sanwa

PC5000

DIGITAL MULTIMETER

INSTRUCTION MANUAL CE

CONTENTS

[1] SAFETY PRECAUTIONS

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

This instruction manual explains how to use your new digital multimeter PC5000 safely. Before use, please read this manual thoroughly. After reading it, keep it together with the product for reference to it when necessary. The instruction given under the heading "⚠WARNING" must be followed to prevent accidental burn or electrical shock.

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 damage to the instrument.

⚠: Dangerous voltage (Take care not to get an electric shock in voltage measurement.)

⏚: Ground (Allowable applied voltage range between the input terminal and earth.)

⎓: Direct current (DC)

~: Alternating current (AC)

⊟: Fuse

⧈: Double insulation (Protection Class Ⅱ)

1-2 Warning Instruction for Safe Use

⚠ WARNING

To ensure that the meter is used safely, be sure to observe the instruction when using the instrument.

1. Never use meter on the electric circuit that Exceed 3kVA.
2. Never apply an input signal exceeding the maximum rating input value.
3. Never use meter if the meter or test leads are damaged or broken.
4. Pay special attention when measuring the voltage of AC 30 Vrms (42.4V peak) or DC 60V or more to avoid injury.

5. Never use meter for measuring the line connected with equipment (i.e. motors) that generates induced or surge voltage since it may exceed the maximum allowable voltage.
6. Never use uncased meter.
7. Be sure to use a fuse of the specified rating or type. Never use a substitute of the fuse or never make a short circuit of the fuse.
8. When connecting and disconnecting the test leads, first connecting the ground lead (black one). When disconnecting them, the ground lead must be disconnected last.
9. Always keep your fingers behind the finger guards on the probe when making measurements.
10. Be sure to disconnect the test pins from the circuit when changing the function.
11. Before starting measurement, make sure that the function and range are properly set in accordance with the measurement.
12. Never use meter with wet hands or in a damp environment.
13. Never open tester case except when replacing batteries or fuse. Do not attempt any alteration of original specifications.
14. To ensure safety and maintain accuracy, calibrate and check the tester at least once a year.
15. The multimeter restricts in use in indoor.

1-3 Overload protections

Functions	Input terminals	Maximum rating input value	Maximum overload protection input
mV	mV•V•Ω •))) • →⊢ • ⊣⊢•Hz • COM	DC•AC 500mV	600VDC/VAC rms
V		DC•AC 1000V	1050V rms, 1450Vpeak
Ω • •))) • →⊢ • ⊣⊢		⚠ Voltage and Current input prohibited	600VDC/VAC rms
Hz		Peak max : 300V	600VDC/VAC rms
μA•mA	μA•mA • COM	DC•AC 500mA	0.63A/250V Fuse IR 1.5kA
A	A • COM	DC•AC 10A*	12.5A/500V Fuse IR 20kA

*10A continuous

[2] APPLICATION AND FEATURES

2-1 Applications

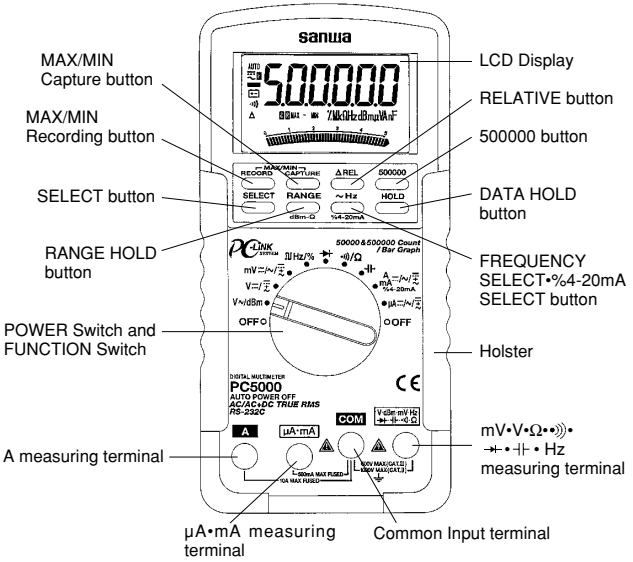
This instrument is portable digital multimeter designed for measurement of weak current circuits. It plays an important role in circuitry analysis by using additional functions as well as measurements of small type communication equipment, electrical home appliance, lighting voltage and batteries of various type.

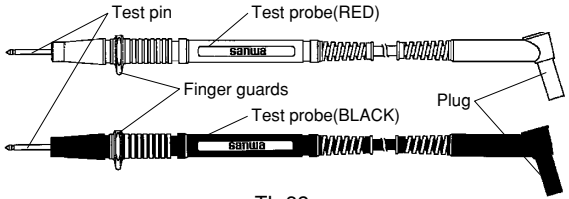
2-2 Features

- The instruments meet the requirements to Safety Standard IEC 1010.
- The main unit case and the circuit board are made of fire retarding materials.
- Fuse protects the current function.
- 500,000 counts in DCV and 999,999 counts in Hz range
- Fast Response Digit: 5 times/sec., Bargraph: 60 times /sec.
- Frequency measurement with 5 selectable sensitivity (Sine RMS)
- Capacitance measurement ranges are 50.00nF to 9999μF.
- dBm, Duty ratio, %4-20mA measurement
- 0.01Ω of resistance and 0.01mV of AC/DC resolution
- AC coupling True RMS / AC+DC coupling True RMS
- MAX/MIN Recording through Auto range
- MAX/MIN Capture (Peak hold 0.8ms in duration) through Auto range
- Relative measurement through Auto range
- RS-232C interface

[3] NAME OF FUNCTIONS

3-1 Multimeter and Test Leads





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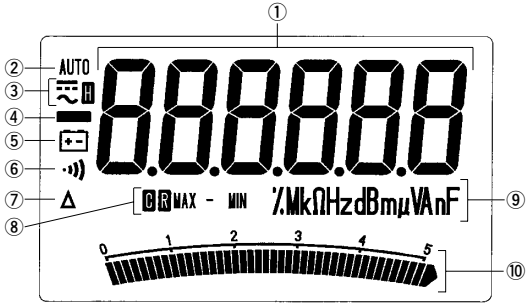
3-2 Display



① Display value in the main display area
② Auto range display
③ **H** : Data hold display
⎓ : DC measurement display
～ : AC measurement display
④ Minus polarity for numeral data
⑤ Battery discharge warning display
⑥ Checking continuity display
⑦ Relative measurement function display
⑧ **C** : Capture mode display
MAX: Maximum value display
MIN : Minimum value display
⑨ Measurement unit display
⑩ Analog bargraph

[4] DESCRIPTION OF FUNCTIONS

4-1 Function Switch

Turn this switch to turn on and off the power and to select the functions of "V⁓ •dBm/V⎓/mV/⎍Hz•%/⊣⊢/Ω••))/→|←/A•mA/μA".

4-2 Auto Power Off

The Auto Power Off mode turns the meter off automatically to extend battery life after approximately 17 minutes of no activities. Activities are specified as:

1) Function switch or push switch operations.
2) Significant measuring data readings of around 10% of range.

To wake up the meter from Auto Power Off, press the SELECT button momentarily or turn the rotary switch to the OFF position and then turn back on again.

To disable the Auto Power Off feature, press the RANGE button while turning the function switch on.

Note:

Always turn the function switch to the OFF position when the meter is not in use.

4-3 Low Battery Indication

If the internal battery has been consumed and the internal battery drops below approx. 7V, Battery mark is shown in the display.

4-4 Measurement Function Select

When the SELECT button is pressed (→), the functions change as follows.

- In the case of V⁓/dBm, the modes change as:
  V⁓ → dBm → V⁓.
- In the case of V⎓/⎓, the modes change as:
  V⎓ → V⎓ → V⎓.
- In the case of mV⎓/⁓/⎓, the modes change as:
  ⎓ → ⁓ → ⎓ → ⎓.
- In the case of ⎍Hz/%, the modes change as:
  ⎍Hz → % → ⎍Hz.

- In the case of Ω/ •)), the modes change as:
  •)) → Ω → •)) .
- In the case of μA, mA and A, the modes change as:
  ⎓ → ∼ → ⎓∼ → ⎓ .

4-5 Range Hold

Press the RANGE button momentary to set the manual range mode then 'AUTO' disappears in the display. In manual range mode, press the button again to step through the ranges. To return to the auto mode, press the button for 1 sec. or more then AUTO is shown.

Note:

Manual mode is not available in Hz measurement.

4-6 Data Hold

When the HOLD button is pressed, the data display at that time is hold ('H' is shown on the display). The display will not changed while the function is active. Press the button again to cancel the function. ('H' on the display disappears.)

4-7 Set Beeper Off

Press the Hz button while turning the function switch on to disable the Beeper feature.

4-8 RS232C Interface

The instrument equips with an optical isolated interface port at the meter back for data communication. Optional purchase KB-RS2 (RS232 cable) and PC Link or PC Link Plus (software) are required for Data logging system. Refer to an instruction manual in the PC Link or PC Link Plus for further details.

Note:

While data communication to PC, Capacitance readout can be sent to PC correctly up to 500.0μF range because of low response speed for large capacitance measurement.

4-9 Max/Min Recording Mode

Press the RECORD button momentarily to activate MAX/MIN recording mode then ' R ' and 'MAX MIN' are shown. The instrument beeps when new maximum or minimum reading is updated. Press the button momentarily to read throughout the Maximum ('MAX'), Minimum ('MIN'), and Maximum minus Minimum ('MAX-MIN') readings. Press the RECORD button for 1 second or more to exit the Recording mode. Auto Power Off feature will be disabled automatically in this mode.

4-10 Max/Min Capture Mode (Peak hold)

Press the CAPTURE button momentarily to activate Capture (Instantaneous peak hold) mode to capture voltage or current signal duration as short as 5ms. ' C ' and 'MAX' are shown on the display. This mode is available in DCV, ACV, DCA and ACA functions. The instrument beeps when new maximum or minimum reading is updated. Press the button momentarily to read throughout the Maximum (MAX), Minimum (MIN), and Maximum minus Minimum (MAX-MIN) readings. Press the CAPTURE button for 1 second or more to exit the Capture Mode. Auto Power Off feature will be disabled automatically in this mode.

4-11 500000 count

In DCV, DCmV and Hz function, press "500000" button momentarily to toggle between 50000 count and 500000 readings.
In 50000 counts sampling rate is 5 times per sec. In 500000 counts sampling rate is 1.25 times per sec.

4-12 Relative Mode

Relative Mode allows the user to offset the meter consecutive measurements with the displaying reading as the reference value. Practically all-displaying readings can be set as relative reference value including MAX/MIN Recording Mode. Press the ΔREL button momentarily to activate and to exit Relative Mode.

4-13 Words

Analog Bargraph

The analog bargraph provides a visual indication of measurement like a traditional analog meter needle.

AC coupling True RMS

When measurement is taken by true r.m.s., the measurement value of input signal becomes the scales of the signal power and therefore provide more effective values than those obtained by average value detection. This multimeter imploys this true RMS circuit, which enables measurement of sine wave and non-sinusoidal waves like square wave and triangular wave in r.m.s.

AC+DC coupling True RMS

DC+AC True RMS calculates both of the AC and DC components given by the expression $\sqrt{DC^2+(AC\ rms)^2}$ when making measurement, and can responds accurately to the total effective RMS value regardless of the waveform.

Crest Factor

The crest factor (CF) is expressed by a value obtained by dividing the peak value of the signal by its RMS value. Most common waveforms such as sine wave and triangular wave have a relatively cycle have a high crest factor. The voltages and crest factors of typical waveforms are shown in the table.

Input waveform	0 to PEAK P	Vrms	Vavg	P/Vrms	Vrms/Vavg
Sine wave 	1.414	1.000	0.900	1.414	1.111
Square wave 	1.000	1.000	1.000	1	1.000
Triangular wave 	1.732	1.000	0.866	1.732	1.155
Puls $D=\frac{T_2}{T_1}$ 	2.000	$2\sqrt{D}$	2•D	$\frac{1}{\sqrt{D}}$	$\frac{1}{\sqrt{D}}$

Note:

that measurement should be taken with the crest factor below 5.

NMRR (Normal Mode Rejection Ratio)

NMRR is the DMM's ability to reject unwanted AC noise effect, which can cause inaccurate DC measurements. NMRR is typically specified in terms of dB (decibel). This series has a NMRR specification of >60dB at 50 and 60Hz, which means a good ability to reject the effect of AC noise in DC measurements.

CMRR (Common Mode Rejection Ratio)

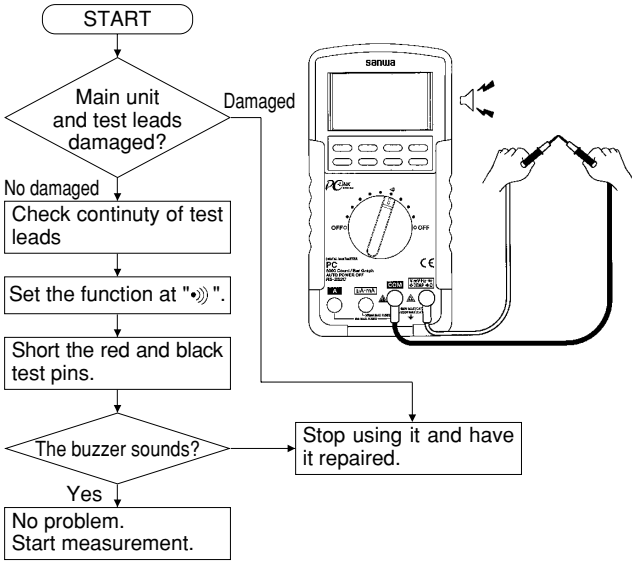
Common mode voltage is voltage present on both the COM and VOLTAGE input terminals of a DMM, with respect to ground. CMRR is the DMM's ability to reject common mode voltage effect, which can cause digit rattle or offset in voltage measurements. This series has a CMRR specifications of >90dB at DC to 60Hz in ACV function; and >120dB at DC, 50 and 60Hz in DCV function.

[5] MEASUREMENT PROCEDURE

5-1 Start-Up Inspection

⚠ WARNING

1. Never use meter if the meter or test leads are damaged or broken.
2. Make sure that the test leads are not cut or otherwise damaged.



5-2 Voltage Measurement

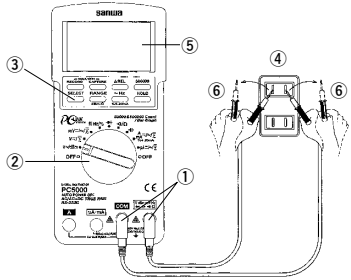
⚠ WARNING

1. Never apply an input signal exceeding the maximum rating input value.
2. Be sure to disconnect the test pins from the circuit when changing the function.
3. Always keep your fingers behind the finger guards on the probe when making measurements.

DCmV: Maximum rating input value 500mVDC
DCV: Maximum rating input value 1000VDC
ACmV: Maximum rating input value 500mVAC
ACV: Maximum rating input value 1000VAC
(AC+DC)mV: Maximum rating input value 500mVAC/DC
(AC+DC)V: Maximum rating input value 1000VAC/DC

5-2-1 ACV / dBm measurement

1) Applications
   ACV: Sine wave AC voltage such as lighting voltage is measured.
   dBm: The decibel is measured.
2) Measuring ranges
   4 ranges from 5.0000V to 1000V
   -11.76dBm to 54.25dBm at 600Ω
3) Measurement procedure
   ① Connect the plug of black test lead to COM terminal and plug of red test lead to V or dBm terminal.
   ② Set the function switch at 'V～ /dBm'.
   ③ Press "**SELECT**" button to toggle 'V～' and 'dBm' measurement.
   ④ Apply the red and black test pins to the circuit to measure.
   ● For measurement of ACV, apply the red and black test pins to the circuit to measure.
   ⑤ The reading of Voltage is shown on the display.
   ⑥ After measurement, release the red and black test pins from the object measured.



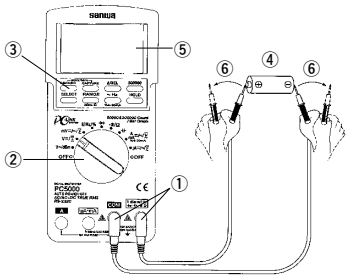
Note:

Power up default reference impedance will be displayed for 1 second before displaying the dBm readings. Press dBm-Ω(RANGE) button momentary to select different reference impedance of 4, 8, 16, 32, 50, 75, 93, 110, 125, 135, 150, 200, 250, 300, 500, 600, 800, 900, 1000, up to 1200Ω. The new impedance value will be saved automatically to the non-volatile memory as power up default.

5-2-2 DCV / (AC+DC) V measurement

1) Applications
   DCV: Voltage of the battery and DC circuit are measured.
   (AC+DC)V: Voltage of the AC component+DC component is measured.
2) Measuring ranges
   4 ranges from 5.0000V to 1000V
3) Measurement procedure
   ① Connect the plug of black test lead to COM terminal and plug of red test lead to V terminal.
   ② Set the function switch at ' V⎓/ ⏦ '
   ③ Press "**SELECT**" button to toggle '⎓' or '⏦' measurement.
   ④ Apply the red and black test pins to the circuit to measure.
   - For measurement of DCV, apply the black test pin to the negative potential side of the circuit to measure and the red test pin to the positive potential side.
   - For measurement of (AC+DC)V, apply the red and black test pins to the circuit to measure.

   ⑤ The reading of Voltage is shown on the display.
   ⑥ After measurement, release the red and black test pins from the object measured.



Note:

Press "500000" button to toggle 50000 count and 500000 count at DCV.

5-2-3 ACmV / DCmV / (AC+DC) mV measurement

1) Applications
   ACmV: Voltage of the battery and DC circuit are measured.
   DCmV: Voltage of the DC circuit is measured.
   (AC+DC) mV: Voltage of the AC component+DC component is measured.
2) Measuring ranges
   1 ranges 500.00mV
3) Measurement procedure
   ① Connect the plug of black test lead to COM terminal and plug of red test lead to V terminal.
   ② Set the function switch at 'mV'.
   ③ Press "**SELECT**" button to toggle '⎓' or '∼' or '⎓∼' measurement.
   ④ Apply the red and black test pins to the circuit to measure.
   - For measurement of DCmV, apply the black test pin to the negative potential side of the circuit to measure and the red test pin to the positive potential side.
   - For measurement of ACmV, apply the red and black test pins to the circuit to measure.
   - For measurement of (AC+DC)mV, apply the red and black test pins to the circuit to measure.

   ⑤ The reading of Voltage is shown on the display.
   ⑥ After measurement, release the red and black test pins from the object measured.

Note:

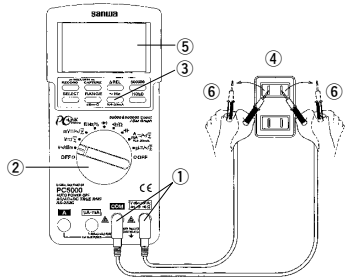
Press "500000" button to toggle 50000 count and 500000 count at DCmV.

5-3 Line Frequency Measurement

⚠ WARNING

1. Never apply an input signal exceeding the maximum rating input value.
2. Be sure to disconnect the test pins from the circuit when changing the function.
3. Always keep your fingers behind the finger guards on the probe when making measurements.

1) Application
   Frequency of an AC circuit is measured.
2) Measuring ranges
   5.0000Hz to 200.000kHz (Auto range)
3) Measurement procedure
   ① Connect the plug of black test lead to COM measuring input terminal and plug of red test lead to Hz measuring terminal.
   ② Set the function switch at 'mV' or 'V' or 'μA' or 'mA' or 'A'.
   ③ Press the "～**Hz**" button momentarily to activate or to exit Hz.
   ④ Apply the red and black test pins to an object to measure.
   ⑤ Read the value on the display.
   ⑥ After measurement, release the red and black test pins from the object measured.



Note:

Press "500000" button to toggle 50000 count and 500000 count.

Frequency measurement is available at 'mV' or 'V' or 'μA' or 'mA' or 'A' functions.

Range	Sensitivity (Sine Wave)
500mV	0.1V
5V	1V
50V	10V
500V	100V
1000V	900V

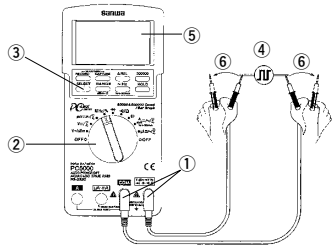
Input sensitivity varies automatically with function range selected before activating the Hz function. mV function has the highest (100mV) and the 1000V range has the lowest (900V). It is recommended to first measure the signal voltage (or current) level then activates the Hz function in that voltage (or current) range to automatically set the most appropriate trigger level. You can also press the RANGE button momentarily to select another trigger level manually. If the Hz reading becomes unstable, select lower sensitivity to avoid electrical noise. If the reading shows zero, select higher sensitivity.

5-4 Logic Frequency / Duty Ratio measurement

⚠ WARNING

1. Never apply an input signal exceeding the maximum rating input value.
2. Be sure to disconnect the test pins from the circuit when changing the function.
3. Always keep your fingers behind the finger guards on the probe when making measurements.

1) Application
   Logic Frequency: Logic frequency is measured.
   Duty ratio: Duty ratio is measured.
2) Measuring ranges
   Logic Frequency: 5.0000Hz to 2.00000MHz (Auto range)
   Duty ratio: 0.1% to 99% (Auto range)
3) Measurement procedure
   ① Connect the plug of black test lead to COM measuring input terminal and plug of red test lead to Hz measuring terminal.
   ② Set the function switch at ' ⎍ Hz/%'.
   ③ Press "**SELECT**" button to toggle between Hz and % (duty ratio).
   ④ Apply the red and black test pins to an object to measure.
   ⑤ Read the value on the display.
   ⑥ After measurement, release the red and black test pins from the object measured.



Note:
No bargraph when Hz and duty cycle function.
Press "500000" button to toggle 50000 count and 500000 count at Hz.
Input sensitivity is set only at the highest.

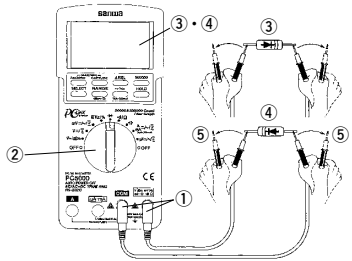
5-5 Testing Diode/ Resistance Measurement and Checking Continuity / Capacitance Measurement

⚠ WARNING

Never apply voltage to the input terminals.

5-5-1 Testing Diode

1) Application
   The quality of diodes is tested.
2) How to use
   ① Connect the plug of black test lead to COM measuring input terminal and plug of red test lead to ⊣⊢ measuring terminal.
   ② Set the function switch at ' ⊣⊢'.
   ③ Apply the black test pins to the cathode of the diode and the red test pin to the anode.
   √ Check reading for judgment of good or defective.
   ● A zero reading indicates a shorted diode (defective).
   ● An OL indicates an open diode (defective).
   ④ Apply the red test pins to the cathode of the diode and the black test pin to the anode
   √ Check reading for judgment of good or defective.
   ● The display shows OL, if diode is good. Any other readings indicated the diode is resistive or shorted (defective).
   ⑤ After measurement, release the red and black test pins from the object measured.

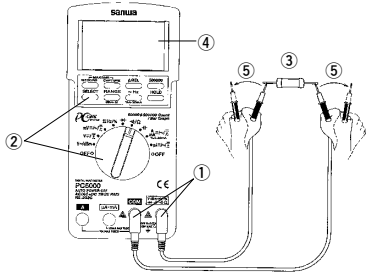


Note:

The input terminals release voltage is about <3.5V.

5-5-2 Resistance Measurement

1) Applications
   Resistance of resistors and circuits are measured.
2) Measuring ranges
   6 ranges from 500.0Ω to 50.00MΩ.
3) Measurement procedure
   ① Connect the plug of black test lead to COM input terminal and plug of red test lead to Ω input terminal.
   ② Set the function switch at 'Ω/•)))' and select 'Ω' with the "**SELECT**" button.
   ③ Apply the red and black test pins to an object to measure.
   ④ The reading is shown in the display.
   ⑤ After measurement, release the red and black test pins from the object measured.



Note:

To compensate internal and lead resistance for low ohm measurement, use Relative function.

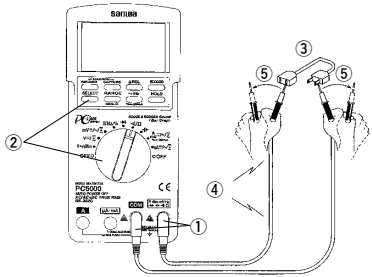
If measurement is likely to be influenced by noise, shield the object to measure with negative potential (COM).

If a finger touches a test pin during measurement, measurement will be influenced by the resistance in the human body to result in measurement error.

The input terminals release voltage is about <1.3VDC.
(<3VDC for 50Ω & 500Ω ranges)

5-5-3 Checking Continuity

1) Application
   Checking the continuity of wiring and selecting wires.
2) How to use
   ① Connect the plug of black test lead to COM measuring input terminal and plug of red test lead to •))) measuring terminal.
   ② Set the function switch at 'Ω/•)))' and select '•)))' with the "**SELECT**" button.
   ③ Apply the red and black test pins to a circuit or conductor to measure.
   ④ The continuity can be judged by whether the buzzer sounds or not.
   ⑤ After measurement, release the red and black test pins from the object measured.



Note:

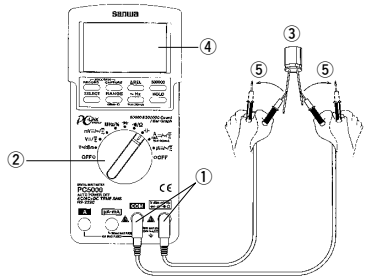
Threshold: between 20Ω and 120Ω.
Response time: <100μs

5-5-4 Capacitance Measurement

⚠ CAUTION

Discharge the capacitance before measurement.

1) Application
   Measures capacitance of capacitance.
2) Measuring ranges
   6 ranges from 50.00nF to 9999μF
3) Measurement procedure
   ① Connect the plug of black test lead to COM measuring input terminal and plug of red test lead to ⊣⊢ measuring terminal.
   ② Set the function switch at ' ⊣⊢ '.
   ③ Apply the red and black test pins to an object to measure.
   ④ Read the value on the display.
   ⑤ After measurement, release the red and black test pins from the object measured.



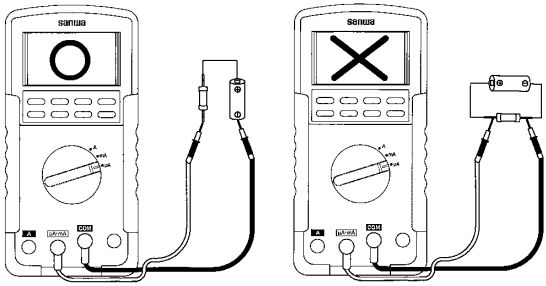
Note:

While data communication to PC, Capacitance can be measured up to 500.0μF range because of low response speed for large capacitance measurement.

5-6 Current / %4-20mA Measurement

⚠ WARNING

1. Never apply voltage to the input terminals.
2. Be sure to make a series connection via load.
3. When measurement a 3-phase system, special attention should be taken to the phase-to-phase voltage which is significantly higher than the phase to earth voltage.
4. Do not apply an input exceeding the maximum rated current to the input terminals.
5. Before starting measurement, turn OFF the power switch of the circuit to separate the measuring part and connect the test leads firmly.



5-6-1 Current Measurement: 10A

DCA: Maximum rating input value 10ADC
ACA: Maximum rating input value 10AAC
(AC+DC)A: Maximum rating input value 10A AC/DC

1) Applications
   DCA: Current in batteries and DC circuits is measured.
   ACA: Current in AC circuits is measured.
2) Measuring ranges
   2 ranges for 5.000A, 10.00A

3) Measurement procedure

① Connect the plug of black test lead to COM measuring input terminal and plug of red test lead to A measuring terminal.

② Set the function switch at 'A' and select either '⎓' or '～' or '⎓～' with the "**SELECT**" switch.

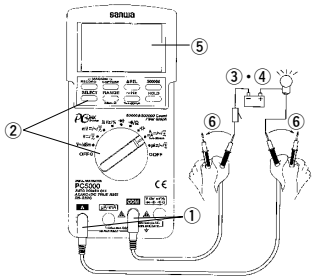
③ In the circuit to measure and apply the red and black test pins in series with load.

- For measurement of DCA, apply the black test pin to the negative potential side of the circuit to measure and the red test pin to the positive potential side in series with load.
- For measurement of ACA, apply the red and black test pins to the circuit to measure in series with load.
- For measurement of (AC+DC)A, apply the red and black test pins to the circuit to measure in series with load.

④ Apply the red and black test pins to the circuit to measure.

⑤ Read the value on the display.

⑥ After measurement, remove the red and black test pins from the circuit measured.



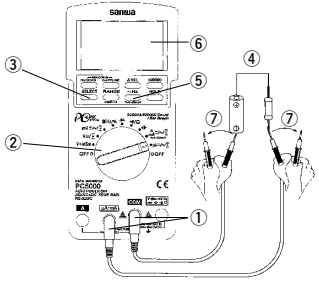
Note:

10A continuous.

5-6-2 Current Measurement: μA, mA

DCμA, mA: Maximum rating input value 500mADC
ACμA, mA: Maximum rating input value 500mAAC
(AC+DC) μA, mA: Maximum rating input value 500mA AC/DC

1) Applications
   DCA: Current in batteries and DC circuits is measured.
   ACA: Current in AC circuits is measured.
   (AC+DC)A: Current in AC component + DC component is measured.
2) Measuring ranges
   4 ranges for 5000.0μA/500.00μA and 50.000mA/500.00mA
3) Measurement procedure
   ① Connect the plug of black test lead to COM measuring input terminal and plug of red test lead to μA/mA measuring
   ② terminal.
   Set the function switch at 'μA' or 'mA' and select either ' ⎓ ', ' ⎓ ' and ' ⎓ ' with the "**SELECT**" button.
   ③ In the circuit to measure and apply the red and black test pins in series with load.
   For measurement of μA and mA, apply the black test pin to the negative potential side of the circuit to measure and the red test pin to the positive potential side in series with load.
   For measurement of μA and mA, apply the red and black test pins to the circuit to measure in series with load.
   For measurement of (AC+DC) μA and mA, apply the red and black test pins to the circuit to measure in series with
   ④ load.
   ⑤ Apply the red and black test pins to the circuit to measure.
   In DcmA function, press and hold "**%4-20mA**" button for 1 second or more to display the current digital data in terms of
   ⑥ loop current percentage (%) value.
   ⑦ Read the value on the display.
   After measurement, remove the red and black test pins from the circuit measured.



Note:

In %4-20mA function, it is set at 4mA = 0% and 20mA + 100%.

5-7 How to use Optional Products

⚠ WARNING

1. Never apply an input signal exceeding the maximum rating input value of optional products.
2. Be sure to disconnect the test pins from the circuit when changing the function.

5-7-1 Clamp probe: CL-20D

1) Applications
   It is suitable for measurement of alternating current in electric equipment and power supplies.
2) Measuring ranges
   2 ranges for 20A, 200A
3) Measurement procedure
   ① Connect the black plug to COM measuring terminal and the red plug to V measuring terminal.
   ② Set the function at 'V' and select AC with the "**SELECT**" button.
   ③ Press the "**RANGE**" button to hold the 5V range.
   ④ Select either 20A or 200A with selector knob of clamp meter.
   ⑤ Open the clamp part, have electric wire (one line) clamped, and close the clamp part perfectly.
   ⑥ Read the value on the display. *1
   ⑦ After measurement, open the clamp part and release clamp probe from the electric wire.

*1: Read the value on the display as follows

Measuring range	Multiplier	Unit
20A	x10	A
200A	x100	A

5-7-2 Clamp probe: CL-22AD

1) Applications
   ACA: It is suitable for measurement of alternating current in electric equipment and power supplies.
   DCA: An electric current of electric circuit of a car and a consumption electric current of direct current apparatus are measured.
2) Measuring ranges
   ACA: 2 ranges for 20A, 200A
   DCA: 2 ranges for 20A, 200A
3) Measurement procedure
   ① Connect the black plug to COM measuring terminal and the red plug to mV measuring terminal.
   ② Set the function at 'mV' and select either '⎓' or '∼' with the "**SELECT**" button.
   ③ Press the "**RANGE**" button to hold the 500mV range.
   ④ Select either 20A or 200A with selector knob of clamp meter.
   ● The zero point varies when the DCA is measured, so be sure to check that the multimeter indicates zero. If not zero, adjust the indication to the zero point by turning the Zero Adjusting Knob (0ADJ).
   ⑤ Open the clamp part, have electric wire (one line) clamped, and close the clamp part perfectly.
   ⑥ Read the value on the display. *2
   ⑦ After measurement, open the clamp part and release clamp probe from the electric wire.

*2: Read the value on the display as follows

Measuring range	Multiplier	Unit
20A	x1/10	A
200A	x1	A

5-7-3 Clamp probe: CL33DC

1) Applications
   An electric current of electric circuit of a car and a consumption electric current of direct current apparatus are measured.
2) Measuring ranges
   2 ranges for 30A, 300A
3) Measurement procedure
   ① Connect the black plug to COM measuring terminal and the red plug to mV measuring terminal.
   ② Set the function at 'mV' and select either '⎓' or '∼' with the "**SELECT**" button.
   ③ Press the "**RANGE**" button to hold the 500mV range.
   ④ Select either 30A or 300A with selector knob of clamp meter.
   ● The zero point varies when the DCA is measured, so be sure to check that the multimeter indicates zero. If not zero, adjust the indication to the zero point by turning the Zero Adjusting Knob (0ADJ).
   ⑤ Open the clamp part, have electric wire (one line) clamped, and close the clamp part perfectly.
   ⑥ Read the value on the display. *3
   ⑦ After measurement, open the clamp part and release clamp probe from the electric wire.

*3: Read the value on the display as follows

Measuring range	Multiplier	Unit
30A	x1/10	A
300A	x1	A

5-7-4 Temperature probe: T300-PC

1) Applications
   It is used this product when temperature is measured to 300℃ from -50℃ .
2) Measuring ranges
   Range of -50℃ to 300℃
3) Measurement procedure
   ① Connect the black plug to COM measuring terminal and the red plug to Ω measuring terminal.
   ② Set the function at 'Ω/•))' and select '•))' with the "**SELECT**" button.
   ③ Press the "**RANGE**" button to hold the 5kΩ range.
   ④ Apply the sensor to an object to measure.
   ⑤ Read the value on the display. *4
   ⑥ After measurement, release the sensor from the object measured.

   *4: The value on the display of DMM has a resistance value indicate, please read the value of measuring window of PC Link.

[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
   - Does falling not damage the appearance?
2) Test leads
   - Is the cord of the test leads not damaged?
   - Is the core wire not exposed at any place of the test leads?

NOTE:

If the built-in fuse is blown, only the current measurement becomes impossible.

Make sure that the test leads are not cut, referring to the section 5-1.

6-2 Calibration

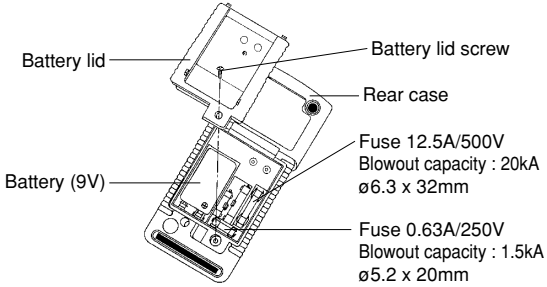
The manufacturer may conduct the calibration and inspection. For more information, please contact the manufacturer.

6-3 Battery and Fuse Replacement

⚠ WARNING

1. If the rear case or the battery lid is removed with input applied to the input terminals, you may get electrical shock. Before starting the work, always make sure that no input is applied.
2. Before starting the work, be sure to turn OFF the main unit power and release the test leads from the circuit.
3. Be sure to use a fuse of the specified rating or type. Never use a substitute of the fuse or never make a short circuit of the fuse.

① Remove the battery lid screw with a screwdriver.
② Removed the battery lid.
③ Take out the battery or fuse and replace it with a new one.
④ Attach the battery lid and fix it with the screw.



⚠ CAUTION

Set a battery with its polarities facing in the correct directions.

6-4 Storage

⚠ CAUTION

1. The panel and the case are not resistant to volatile solvent and must not be cleaned with thinner or alcohol. For cleaning, use dry, soft cloth and wipe it lightly.
2. The panel and the case are not resistant to heat. Do not place the instrument near heat-generating devices (such as a soldering iron).
3. Do not store the instrument, in a place where it may be subjected to vibration 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.

Following the above instructions, store the instrument in good environment. (See 8-1)

[7] AFTER-SALE SERVICE

7-1 Repair

If the multimeter fails during use, check the following items before sending it for repair.

- Is the fuse not blown?
- Is the battery not exhausted?

We repair defective product at cost. When mailing it to us for repair, do not use the same cardboard box in which it was delivered to you because it may receive damage in transit. Please send it in a box at least five times as large as the original box with enough cushioning material stuffed around it.

7-2 For Information or Enquiries

If you need information regarding purchase of repair parts or if you have any other sales related questions, please contact the dealer, selling agent, or maker.

[8] SPECIFICATIONS

8-1 General Specifications

Display:
4-4/5 digits 50000 counts LCD display (selectable 5-4/5 digits 500000 counts for DCV and 999999 counts for Hz)

Update Sampling Rate:
4-4/5 Digital data: 5 times / sec nominal
5-4/5 Digital data: 1.25 times / sec nominal
52 segments bar graph: 60 times / sec nominal

Low Battery Indication:
Below approx. 7V

Operating Temperature:
0℃ to 30℃, 0-80% R.H.; 31℃ to 50℃, 0-50% R.H.

Storage Temperature:
-20℃ to 60℃, 80% R.H. (With battery removed)

Altitude:
Operating below 2000m

Temperature Coefficient:
Nominal 0.15x(specified accuracy)/℃ @(0℃-18℃ or 28℃-50℃), or otherwise specified

Power Supply:

Single alkaline 9V battery; NEDA1604, IEC6LF22 or 6LR61

Sensing:

AC, AC+DC True RMS

Auto Power Off Timing:

Idle for 17 minutes

Safety:

Meets the requirements for double insulation to EN61010-1 (1995), UL3111-1 (6.1944), CSA C22.2 No.1010-1-92, IEC10101-1 to terminals:

V/⊣⊢/Ω•))/⊣⊢/Hz	: CAT Ⅲ for 600V DC & AC, and CAT Ⅱ for 1kV DC & AC
µA•mA	: CAT Ⅱ 250V AC & 150V DC
A	: CAT Ⅱ 500V AC & 300V DC

Transient Protection:

6.5kV (1.2/50µs surge)

E.M.C.:

Meets EN55022 (1994/A1; 1995/Class B) and EN50082-1 (1992)

Power Consumption:

2.6mA Typical

Dimension:

179(H) x 87(W) x 55(D) mm with holster

Weight:

320 mg, 460 mg with holster

Accessories:

Test leads (TL-82), Alligator clip (CL-13), Holster (H-50), Battery (installed), Instruction manual

Optional Accessories:

RS232 cable: KB-RS2

Software: PC Link, PC Link Plus

Temperature Probe: T-300PC (Platinic thin film)

Clamp Probe: CL-20D, CL-22AD, and CL33DC

OVERVOLTAGE CATEGORY

- **Equipment of CAT** Ⅰ is equipment for connection to circuits in which measures are taken to limit the transient overvoltages to an appropriate low level.
  Note: Examples include protected electronic circuits.
- **Equipment of CAT** Ⅱ is energy-consuming equipment to be supplied from the fixed installation.
  Note: Examples include household, office, and laboratory appliances.
- **Equipment of CAT** Ⅲ is equipment in fixed installations.
  Note: Examples include switches in the fixed installation and some equipment for industrial use with permanent connection to the fixed installation.
- **Equipment of CAT** Ⅳ is for use at the origin of the installation.
  Note: Examples include electricity meters and primary over-current protection equipment.

8-2 Measurement Range and Accuracy

ACCURACY IS ±(% READING DIGITS + NUMBER OF DIGITS) OR OTHERWISE SPECIFIED, AT 23℃ ±5℃ & LESS THAN 75% R.H.
TRUE RMS VOLTAGE & CURRENT ACCURACIES ARE SPECIFIED FROM 5 % TO 100 % OF RANGE OR OTHERWISE SPECIFIED.
MAXIMUM CREST FACTOR <5:1 AT FULL SCALE & <10:1 AT HALF SCALE, AND WITH FREQUENCY COMPONENTS WITHIN THE SPECIFIED FREQUENCY BANDWIDTH FOR NON-SINUSOIDAL WAVEFORMS

DC Voltage

RANGE	Accuracy
500.00mV, 5.0000V, 50.000V	0.03%rdg + 2dgt
500.00V	0.05%rdg + 2dgt
1000.0V	0.1%rdg + 2dgt

NMRR: >90dB @ 50/60Hz
CMRR: >120dB @ DC, 50/60Hz, Rs=1kΩ
Input Impedance: 10MΩ, 30pF nominal (80pF nominal for 500mV range)

AC & AC+DC Voltage

RANGE	Accuracy*
45Hz – 300Hz	
500.00mV, 5.0000V, 50.000V, 500.00V, 1000.0V	0.8%rdg + 60dgt
300Hz – 1kHz	
500.00mV	0.8%rdg + 40dgt
5.0000V, 50.000V, 500.00V	2.0%rdg + 60dgt
1000.0V	1.0%rdg + 40dgt
1kHz – 20kHz	
500.00mV	1dB**
5.0000V, 50.000V	2dB**
500.00V	3dB**
1000.0V	Unspec'd

*From 5% to 10% of range: Accuracy % of reading + 80d
**From 5% to 10% of range: Accuracy % of reading + 180d
**From 10% to 15% of range: Accuracy % of reading + 100d
CMRR: >90dB @ DC to 60Hz, Rs=1kΩ
Input Impedance: 10MΩ, 30pF nominal (80pF nominal for 500mV range) Residual reading less than 50 digits with test leads shorted.

dBm

At 600Ω, -11.76dBm to 54.25dBm,
Accuracy: ±0.25dB + 2dgt (@40Hz – 20kHz)
Input Impedance: 10MΩ, 30pF nominal
Selectable reference impedance of 4, 8, 16, 32, 50, 75, 93, 110, 125, 135, 150, 200, 250, 300, 500, 600, 800, 900, 1000, 1200Ω

DC Current

RANGE	Accuracy	Burden Voltage
500.00μA	0.15%rdg + 20dgt	0.15mV/μA
5000.0μA	0.1%rdg + 20dgt	
50.000mA	0.15%rdg + 10dgt	3.3mV/mA
500.00mA	0.1%rdg + 20dgt	
5.0000A	0.5%rdg + 10dgt	0.03V/A
10.000A*	0.5%rdg + 20dgt	

*10A continuous.

AC & AC+DC Current

RANGE	Accuracy	Burden Voltage
50Hz – 60Hz		
500.00μA	1.0%rdg + 4dgt	0.15mV/μA
5000.0μA		
50.000mA		3.3mV/mA
500.00mA		
5.0000A		0.03V/A
10.000A*		
40Hz – 1KHz		
500.00μA	1.0%rdg + 40dgt	0.15mV/μA
5000.0μA		
50.000mA		3.3mV/mA
500.00mA		
5.0000A		0.03V/A
10.000A*		

*10A continuous.

DC Loop Current %4~20mA

Accuracy: ±25dgt

4mA = 0% (zero) 20mA = 100% (span) Resolution: 0.01%

ΩOhms

RANGE	Accuracy
500.00Ω	0.2%rdg + 6dgt
5.0000kΩ	
50.000kΩ	
500.00kΩ	
5.0000MΩ	0.8%rdg + 6dgt
50.000MΩ	2.0%rdg + 6dgt

Open Circuit Voltage: < 1.3VDC (< 3VDC for 500Ω range)

⊣⊢ Capacitance

RANGE	Accuracy*
50.00nF	0.8%rdg + 3dgt
500.0nF	
5.000µF	1.0%rdg + 3dgt
50.00µF	2.0%rdg + 3dgt
500.0µF	3.5%rdg + 5dgt
9999µF	5.0%rdg + 5dgt

*Accuracies with film capacitor or better

~Hz Line Level Frequency

RANGE	Accuracy
5.0000Hz~200.000kHz	0.002%rdg + 4dgt

Sensitivities (Sine RMS):

0.1V min	@500mV range
1V min	@5V range
10V min	@50V range
100V min	@500V range
900V min	@1000V range

⎍ Hz Logic Level Frequency

RANGE	Accuracy
5.0000Hz~2.00000MHz	0.002%rdg + 4dgt

Sensitivity: 2.5Vp square wave

%Duty Ratio

RANGE	Accuracy
0.1% – 99.99%	3dgt/kHz + 2dgt

Input Frequency: 5Hz – 500 kHz, 5V Logic Family

→|← Diode Test

Range	Accuracy	Test Current (Typical)	Open Circuit Voltage
5.0000V	1%rdg + 1dgt	0.8mA	< 3.5 VDC

•))) Audible Continuity Tester

Audible threshold: between 20Ω and 200Ω Response time < 100µs

Crest mode (Instantaneous Peak Hold)

Accuracy: Specified accuracy ±100 digits for changes > 0.8ms in duration

Specifications and external appearance of the product described above may be revised for modification without prior notice.

MEMO

MEMO

MEMO

sanwa

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INSTRUMENT CO.,LTD.
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① 01.02 Ⓜ