

TENMA®



LCR METER

Model: 72-10465

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WHAT'S INCLUDED

- One LCR meter
- One user manual
- One USB adaptor
- Short circuit test piece
- Short circuit adaptor
- One software disc
- One tweezer probe

Please read these instructions carefully before use and retain for future reference.

IMPORTANT SAFETY INFORMATION

- When using electrical appliances basic safety precautions should always be followed.
- Do not use the meter in environments exposed to explosive gas, vapour or dust, in direct sunlight or high radiation.
- There are no user serviceable parts in this product. Refer all servicing to qualified personnel.
- Turn off all the circuit power and discharge completely all capacitors before measuring in-line components.
- Measurement terminals, capacitors and other live components must be discharged before being measured.
- There are two power supplies available for the meter: 9V battery and USB powered.
- If the USB port is connected to the PC, the meter is USB-powered and will communicate with the PC for data collection.

MEASUREMENT RANGE & ACCURACY

L: 20mH - 2000H best accuracy: (0.5% + 5)

C: 200pF - 20μF best accuracy: (0.5% + 5)

R: 20Ω - 200MΩ best accuracy: (0.3% + 5)

Impedance/ Frequency	DCR	100/120Hz	1kHz	10kHz	100kHz
0.1-1	1.0%	1.0%	1.0%	1.0%	1.0%
1-10	0.5%	0.5%	0.5%	0.5%	0.5%
10-100k	0.3%	0.3%	0.3%	0.5%	0.3%
100k-1M	0.5%	0.5%	0.5%	1.0%	
1M-20M	1.0%	1.0%	1.0%		
20M-200M	2.0%	2.0%	5.0%		
Remark	D ≤ 0.1				

Note: Multiply by $\sqrt{1+D^2}$ if D exceeds 0.1

Formula to convert capacitance to impedance: $Z^c = 1/2\pi fC$

Formula to convert inductance to impedance: $Z^l = 2\pi fL$

AMBIENT CONDITIONS

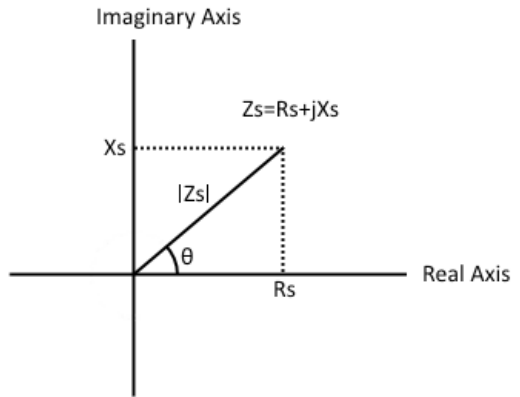
- Altitude: <2000 metres
- Storage humidity: ≤ 75% RH
- Operating environment: 0°C~40°C
- Storage environment: -20°C~50°C

FEATURES

- Main display: 19999 count. Secondary display: 1999 count.
- Measurement frequency: 100Hz/120Hz/1kHz/10kHz/100kHz.
- Measurement voltage: 0.6Vrms.
- Output impedance: 120Ω.
- Basic accuracy: 0.5%.
- LCR automatic identification/manual measurement.
- DC resistance (DCR) measurement.
- Auto calibration.
- Auto power off.
- Relative measurement and sorting function.
- Communicates with PC using mini-USB interface to acquire, analyse and collect data.

IMPEDANCE EXPLANATION

- Impedance is comprised of two base components – Resistance and Reactance.
- This LCR meter is capable of measuring both Resistance and Reactance.
- Reactance varies in proportion to the frequency of the AC circuit.
- Impedance forms an imaginary vector comprised of Resistance R (real) and Reactance X (imaginary) with Impedance $Z=R+jX$, which can also be represented by amplitude $|Z|$ and phase angle θ , which can be seen in the diagram.



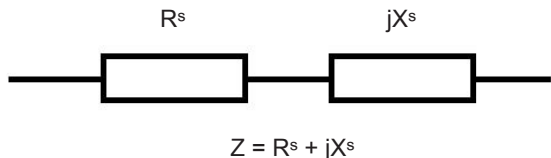
- If the phase angle $\theta > 0$, the reactance is inductive in nature, if $\theta < 0$ the reactance is capacitive in nature.

MEASUREMENT MODE

Impedance can be measured in serial or parallel mode. Under parallel mode, impedance Z can be expressed in relation with the admittance Y and $Y=G+jB$. G is conductance and is B admittance.

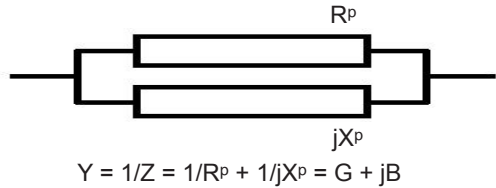
Serial Measurement

- R^s : Serial mode of resistance
- X^s : Serial mode of reactance
- C^s : Serial mode of capacitance
- L^s : Serial mode of inductance



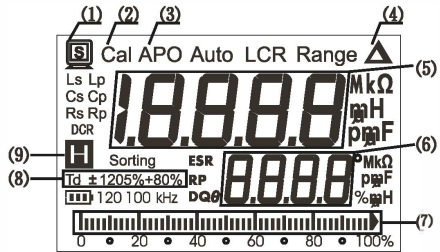
Parallel Measurement

RP: Parallel mode of resistance
 XP: Parallel mode of reactance
 CP: Parallel mode of capacitance
 LP: Parallel mode of inductance



LCD DESCRIPTION

1. USB communication
2. Open/short calibration
3. Auto power off
4. Relative measurement
5. Main display
6. Secondary display
7. Analogue bar
8. Sorting tolerance mode
9. Data hold

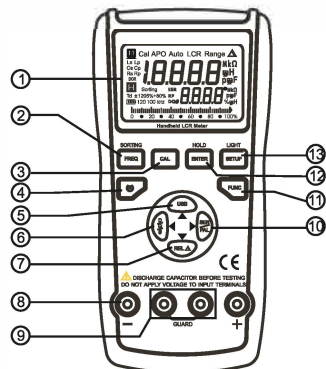


ACRONYM DEFINITIONS

1. LCR: Automatic identification mode
2. LP: Parallel measurement mode for inductance
3. LS: Serial measurement mode for inductance
4. CP: Parallel measurement mode for capacitance
5. CS: Serial measurement mode for capacitance
6. RP: Parallel measurement mode for resistance
7. RS: Serial measurement mode for resistance
8. DCR: DC resistance measurement mode
9. D: Dissipation factor
10. Q: Quality factor
11. θ : Phase angle
12. ESR: Equivalent serial resistance
13. EPR: Equivalent parallel resistance
14. DUT: Device under test
15. Short press (<1 second), long press (>2 seconds): indicating the time to press a button.

PRODUCT OVERVIEW

1. LCD
2. Frequency/sorting button
3. Open/short calibration button
4. Power on/off button
5. USB communication button
6. D/Q/ θ selection button
7. Relative button
8. Input terminals
9. Guard terminals
10. Serial/parallel selection button
11. L/C/R function button
12. Enter/hold button
13. Sorting setup button



OPERATION - AUTOMATIC MEASUREMENT

- Once the meter is switched on, it defaults to AUTO LCR mode, at the frequency of 1kHz.
- In auto mode, the meter can automatically check the impedance characteristics of a tested object and then select L, C or R main parameter, its associated secondary parameter and the correct serial/parallel mode accordingly.
- Correspondence between the main and secondary parameter under auto mode:
 - Capacitance (C) - Dissipation (D)
 - Inductance (L) - Quality Factor (Q)
 - Resistance (R) - Phase Angle (θ)
- Under auto measurement mode, serial/parallel mode is determined based on the impedance of the tested object.
- The parallel mode is selected if the impedance is greater than 10k Ω .
- The serial mode is selected if the impedance is less than 10k Ω .

DATA HOLD

- Press and hold the **HOLD** button to freeze the data during measurement.
- Press again to exit and return to normal measurement.

MEASUREMENT PARAMETER UNDER L/C/R MODE

- Select the corresponding parameters under manual L/C/R mode.

Selection of main parameter:

- Default status is AUTO LCR once powered on.
- Select "FUNC" to select parameters of:
"AUTO LCR → AUTO L → AUTO C → AUTO R → DCR → AUTO LCR".

Selection of secondary parameter:

- After a main parameter has been selected, press **SER/PAL** to switch between serial and parallel mode,
- Press **D/Q/ θ** to select "D", "Q", " θ ", "ESR" ("ESR" will show if under serial mode and likewise "Rp" if parallel mode is selected).
- Under "AUTO R" or "AUTO DCR", the secondary parameter will be negligible.

Notes:

- When measuring capacitance <5pF under AUTO LCR mode, "Rp" will show on the secondary display instead of Dissipation factor (D).
- Some secondary parameters will not show on the LCD even if you have accessed "AUTO R", "AUTO DCR" or "AUTO LCR" mode.

MEASUREMENT FREQUENCY

- This model can provide five frequency testing points:
100Hz/120Hz/1kHz/10kHz/100kHz.
- Default frequency is 1kHz, although the user can press **FREQ** to select:
"1kHz → 10kHz → 100kHz → 100Hz → 120Hz → 1kHz".

Note: DC impedance is measured under "AUTO DCR" mode and measurement frequency can be neglected.

REL% MEASUREMENT

- REL% mode measures % deviation between two components.
- The measured value of the tested object shows on the main display, with the % value on the secondary display.
- Set the main display value as the nominal reference.
- % display range: -99%~99.9%.
- % calculation: $REL\% = (D_{cur} - D_{ref}) / D_{ref} * 100\%$.
 D_{cur} : main display value of tested object.
 D_{ref} : the reference value that has been set.
- If $D_{cur} > 2D_{ref}$ or $2D_{cur} < D_{ref}$, "OL%" will display on the secondary display and the main display will show the measured value of the tested object.

Access REL mode

- Press **FUNC** to select the desired "AUTO L", "AUTO C", "AUTO R" or "AUTO DCR" mode.
- Connect the tested object to the input terminals and press **REL** to access REL% mode.
- Δ appears on the LCD with the main display showing the measured component value and the secondary display showing % of deviation.
- Press **REL** again and the reference value will show on the main display and the Δ icon flashes, while the % value will still be visible on the secondary display.
- Press **REL** again to return to normal REL% measurement mode.
- Press and hold **REL** to exit REL% measurement and return to normal mode.

SORTING MEASUREMENT

- Sorting mode is used to quickly select components' value within a specified tolerance.
- Press **FUNC** to select the desired "AUTO L", "AUTO C", "AUTO R" or "AUTO DCR" mode.
- Connect the tested object to the input terminals and press and hold **FREQ** to access sorting mode. "Sorting" will appear on the LCD. This sets the limit value.
- "PASS" shows on the main display and the measured component value on the secondary display is set to a nominal value.
- Connect another component and "PASS" will show if the component falls within the set limit and the measured value shows on the secondary display.
- The buzzer will sound once. If it is out of scope, "FAIL" shows and the measured component value.
- Press and hold **FREQ** to exit.

Set up sorting tolerance

- The sorting limit can be set at the following values:
 $\pm 0.25\%$, $\pm 0.5\%$, $\pm 1\%$, $\pm 2\%$, $\pm 5\%$, $\pm 10\%$, $\pm 20\%$, $+80\%$ ~-20%.
- The meter defaults to $\pm 1\%$. To set up sorting, put the meter under sorting mode first and then press **SETUP** and the "Range" icon will flash on the LCD.
- Press **ENTER** to confirm and set the main display parameter, of which the last digit flashes.
- Press ∇/\blacktriangle to decrease/increase the digit or $\blacktriangleleft/\blacktriangleright$ to select another flashing digit for adjustment.

- Then press **ENTER** to go into the tolerance setup and the “TOL±1%” icon will flash on the LCD.
- Press **◀/▶** to adjust the tolerance and then press **ENTER** to confirm, to allow you to begin the sorting measurement.
- Press **SORTING** to exit sorting measurement and return to normal mode.

CALIBRATION FUNCTION

- Calibration function can effectively reduce stray impedance caused by test wires.
- The meter offers short and open calibration. Short calibration is to remove the impact of contact resistance and test wire resistance that interferes with low impedance measurement.
- Open calibration is to remove stray capacitance and resistance of test wires that interfere with high impedance measurement.

Access Calibration Function

- Power on the meter and press and hold **CAL** to access open calibration.
 - “OPEN” will show on the secondary display (Fig. 1), then press **CAL** again to begin the calibration and the meter will count down from 30 seconds on the LCD.
 - When it reaches zero “PASS” appears (Fig. 2), which indicates open calibration has finished.
 - Press the **CAL** button and “Srt” appears on the secondary display (see Fig. 3).
 - Insert short-circuit device into input terminals, press **CAL** to begin and the meter will count down from 30 seconds to 0 seconds.
 - “PASS” appears indicating that short calibration is complete (Fig. 4).
 - Press **CAL** again to return to normal measurement mode.
- Note: if the the LCD shows “FAIL” under open calibration mode, it indicates that the calibration has failed. Check whether the input terminals are open or not. Make sure the circuit is open and do the calibration again.
- Similarly, under short calibration mode if the LCD shows “FAIL” it indicates that the calibration has failed. Check the short circuit device has been inserted into the input terminals.
 - Make sure the terminals are shorted and calibrate again.



Fig. 1



Fig. 2

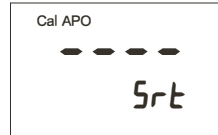


Fig. 3



Fig. 4



Fig. 5

PC COMMUNICATION

- Insert the disc supplied and install software from auto run.
- Press the **USB** button to access communication function.
- Connect the meter to the PC using the USB wire and run the meter software on the PC to start data transfer.
- Press **USB** again to exit and stop the data transfer.

BACKLIGHT

- Press and hold the **LIGHT** button to turn on or off the LCD backlight.
- The backlight will automatically switch off after 60 seconds.

AUTO POWER OFF

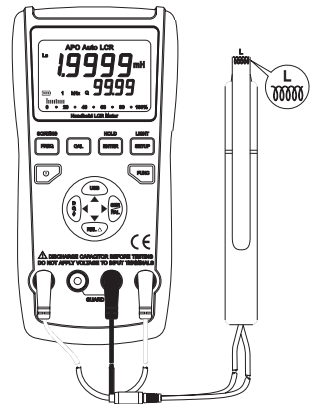
- Power will turn off after 5 minutes of idle time.

SELECTION OF SERIAL/PARALLEL MODE

- A suitable equivalent mode can be selected to gain more precise measurement data.
- In general, it is suggested to select serial equivalent mode for low impedance element, such as less than 100 Ω .
- Select parallel equivalent mode for high impedance element, such as more than 10k Ω .

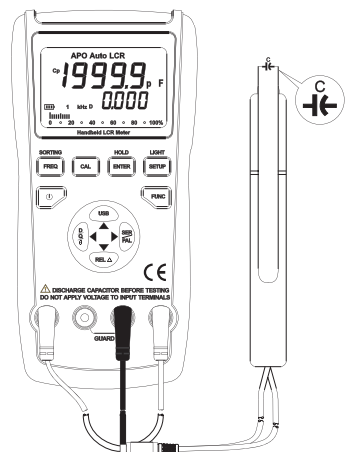
INDUCTANCE MEASUREMENT

- Press the power button and then press **FUNC** to display “Lp” on the LCD.
- Select inductance measurement range.
- Insert the inductor into input terminals or connect the inductor to the meter using the test clamp.
- Press **FREQ** to select suitable testing frequency.
- Press “**D/Q/θ**” to select the auxiliary parameter to measure.



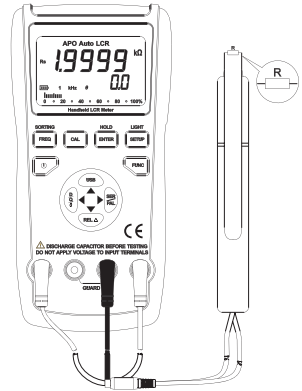
CAPACITANCE MEASUREMENT

- Capacitors must be completely discharged before measurement.
- Press the power button, then press **FUNC** to display “Cp” on the LCD and select capacitance measurement range.
- Insert the capacitor into input terminals or connect the capacitor to the meter using the test clamp.
- Press **FREQ** to select a suitable testing frequency.
- Then press “**D/Q/θ**” to select the auxiliary parameter to measure.



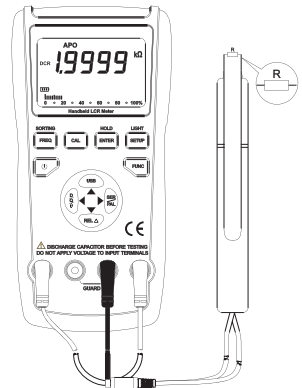
RESISTANCE MEASUREMENT

- Press the power button.
- Press **FUNC** to display “Rp” on the LCD and select resistance measurement range.
- Insert the resistor into the input terminals or connect the resistor to the meter using the test clamp.
- Press **FREQ** to select a suitable testing frequency.
Note: When measuring resistance under auto mode, the secondary parameter θ will be activated. If under manual mode, the secondary parameter of resistance will be neglected.



DCR MEASUREMENT

- Press the power button.
- Press the **FUNC** button to display DCR on the LCD and select DCR measurement range.
- Insert the resistor into the input terminals or connect the resistor to the meter using the test clamp.
Note: The secondary parameter and the frequency is negligible under DCR measurement and doesn't show on the LCD.



PC COMMUNICATION SPECIFICATION

Communication parameters:

- 1) Baud rate: 9600
- 2) Data bit: 8
- 3) Start bit: 1
- 4) Stop bit: 1
- 5) Parity: None

Refer to the connection diagram (right).



TECHNICAL INDICATORS

- 1) Testing ambient temperature: $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$, humidity = 75% RH.
- 2) Warm up for 10 minutes before testing.
- 3) Test on the meter's terminals.
- 4) Perform short/open calibration before testing.

Function: Inductance gear

Measurement Mode: L^S/L^P

Frequency	Range	Min. Resolution	Accuracy: ± (a% of reading + b digits) (18°C to 28°C)
100Hz / 120Hz	20.000mH	1μH	± (1.0% + 5)
	200.00mH	0.01mH	± (0.5% + 5)
	2000.0mH	0.1mH	± (0.5% + 5)
	20.000H	1mH	± (0.5% + 5)
	200.00H	0.01H	± (1.0% + 5)
	2000.0H	0.1H	± (1.0% + 5)
1kHz	2000.0μH	0.1μH	± (1.0% + 5)
	20.000mH	1μH	± (0.5% + 5)
	200.00mH	0.01mH	± (0.5% + 5)
	2000.0mH	0.1mH	± (1.0% + 5)
	20.000H	1mH	± (1.0% + 5)
	200.00H	0.01H	± (2.0% + 5)
10kHz	20.000μH	0.01μH	± (1.0% + 5)
	200.00μH	0.01μH	± (1.0% + 5)
	2000.0μH	0.1μH	± (0.5% + 5)
	20.00mH	1μH	± (0.5% + 5)
100kHz	20.000μH	0.001μH	± (2.0% + 5)
	200.00μH	0.01μH	± (2.0% + 5)
	2000.0μH	0.1μH	± (2.0% + 5)

Note: The precision is evaluated if D is less than 0.1. $Ae = Ae * \sqrt{1 + D^2}$ if D exceeds 0.1. (Ae: Precision).

Function: Capacitance gear

Measurement mode: C^S/C^P

Frequency	Range	Min. Resolution	Accuracy: ± (a% of reading + b digits) (18°C to 28°C)
100Hz / 120Hz	20.000nF	1pF	± (2.0% + 5)
	200.00nF	0.01nF	± (0.5% + 5)
	2000.0nF	0.1nF	± (0.5% + 5)
	20.000μF	1nF	± (0.5% + 5)
	200.00μF	0.01μF	± (1.0% + 5)
	2000.0μF	0.1μF	± (2.0% + 5)
	20.00mF	0.1mF	± (2.0% + 5)

1kHz	2000.0pF	0.1pF	$\pm (1.0\% + 5)$
	20.000nF	1pF	$\pm (1.0\% + 5)$
	200.00nF	0.01nF	$\pm (0.5\% + 5)$
	2000.0nF	0.1nF	$\pm (0.5\% + 5)$
	20.000 μ F	1nF	$\pm (0.5\% + 5)$
	200.00 μ F	0.01 μ F	$\pm (1.0\% + 5)$
	2000.0 μ F	0.1 μ F	$\pm (1.0\% + 5)$
10kHz	2000.0pF	0.1pF	$\pm (1.0\% + 5)$
	20.000nF	1pF	$\pm (1.0\% + 5)$
	200.00nF	0.01nF	$\pm (1.5\% + 5)$
	2000.0nF	0.1nF	$\pm (2.0\% + 5)$
100kHz	2000.0pF	0.1pF	$\pm (2.0\% + 5)$
	20.000nF	1pF	$\pm (2.0\% + 5)$
	200.00nF	0.01nF	$\pm (5.0\% + 5)$

Note: The precision is evaluated if D is less than 0.1. $A_e = A_e * \sqrt{1+D^2}$ if D exceeds 0.1. (Ae: Precision).

Function: Resistance gear

Measurement mode: R^s/R^p

Frequency	Range	Min. Resolution	Accuracy: $\pm (a\% \text{ of reading} + b \text{ digits})$ (18°C to 28°C)
100Hz / 120Hz	200.00 Ω	0.01 Ω	$\pm (1.0\% + 5)$
	2.0000k Ω	0.1 Ω	$\pm (0.3\% + 5)$
	20.000k Ω	1 Ω	$\pm (0.3\% + 5)$
	200.00k Ω	0.01k Ω	$\pm (0.5\% + 5)$
	2.0000M Ω	0.1k Ω	$\pm (1.0\% + 5)$
	20.000M Ω	1k Ω	$\pm (2.0\% + 5)$
1kHz	20.000 Ω	0.001 Ω	$\pm (1.0\% + 5)$
	200.00 Ω	0.01 Ω	$\pm (1.0\% + 5)$
	2.0000k Ω	0.1 Ω	$\pm (0.3\% + 5)$
	20.000k Ω	1 Ω	$\pm (0.3\% + 5)$
	200.00k Ω	0.01k Ω	$\pm (0.5\% + 5)$
	2.0000M Ω	0.1k Ω	$\pm (1.0\% + 5)$
	20.000M Ω	1k Ω	$\pm (2.0\% + 5)$

10kHz	20.000Ω	0.001Ω	± (1.0% + 5)
	200.00Ω	0.01Ω	± (1.0% + 5)
	2.0000kΩ	0.1Ω	± (0.3% + 5)
	20.000kΩ	1Ω	± (0.5% + 5)
	200.00kΩ	0.01kΩ	± (1.0% + 5)
	2.0000MΩ	0.1kΩ	± (2.0% + 5)
100kHz	20.000Ω	0.001Ω	± (2.0% + 5)
	200.00Ω	0.01Ω	± (2.0% + 5)
	2.0000k	0.1Ω	± (2.0% + 5)
	20.000kΩ	1Ω	

Function: Resistance gear

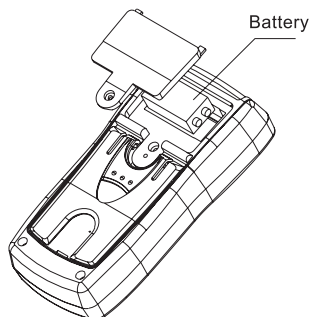
Measurement mode: DCR

Frequency	Range	Min. Resolution	Accuracy: ± (a% of reading + b digits) (18°C to 28°C)
	200.00Ω	0.01Ω	± (1.0% + 5)
	2.0000kΩ	0.1Ω	± (0.3% + 5)
	20.000kΩ	1Ω	± (0.3% + 5)
	200.00kΩ	0.01kΩ	± (0.5% + 5)
	2.0000MΩ	0.1kΩ	± (1.0% + 5)
	20.000MΩ	1kΩ	± (2.0% + 5)
	200.00MΩ	0.1MΩ	± (2.0% + 5)

Note: The precision is evaluated if D is less than 0.1. $Ae = Ae * \sqrt{1+D^2}$ if D exceeds 0.1. (Ae: Precision).

BATTERY REPLACEMENT

- Replace the battery as soon as the low battery symbol appears on the LCD, in order to avoid an impact on measurement accuracy.
- Replace the old battery with a new battery of the same specification (9V).



MAINTENANCE

Cleaning

- Ensure the power is off and remove the battery and external power before cleaning.
- Clean the meter with a soft cloth and mild detergent.
- Do not use any chemicals, abrasives or solvents that could damage the meter.
- Ensure the detergent does not enter the meter.
- Only use the meter if it is completely dry.

Moisture Prevention

- Use and store the meter in a dry environment.
- Switch the power off and remove the battery quickly if the water enters the casing.
- Do not disassemble the meter randomly. Have the meter checked by qualified personnel.

Repair

- If the meter doesn't power on, inspect the battery, external power and power input terminal.
- If the measurement does not work normally, check if the test wires are in good condition and if the component pin has been connected with the input terminals.
- Refer all servicing to qualified personnel.
- Do not disassemble the meter, replace components or change the circuits randomly.



INFORMATION ON WASTE DISPOSAL FOR CONSUMERS OF ELECTRICAL & ELECTRONIC EQUIPMENT.

When this product has reached the end of its life it must be treated as Waste Electrical & Electronic Equipment (WEEE). Any WEEE marked products must not be mixed with general household waste, but kept separate for the treatment, recovery and recycling of the materials used. Contact your local authority for details of recycling schemes in your area.

