

TENMA®



LCR METER

Model: 72-3520

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WHAT'S INCLUDED

- One LCR meter
- One user manual
- Short circuit test piece
- Short circuit adaptor
- 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 all capacitors completely before measuring in-line components.
- Measurement terminals, capacitors and other live components must be discharged before being measured.
- Before measuring, the measurement port and electrical components should be completely discharged.
- The meter is powered by a 9V battery (not included).

AMBIENT CONDITIONS

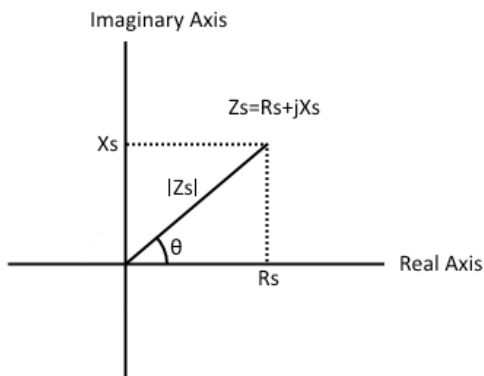
- Altitude: 2000m
- Storage humidity: $\leq 75\%$ RH
- Work environment: $0^{\circ}\text{C}\sim 40^{\circ}\text{C}$
- Storage environment: $-20^{\circ}\text{C}\sim 50^{\circ}\text{C}$

FEATURES

- Main display: 6000 counts. Secondary display: 6000 counts.
- Measuring frequency: 10Hz/120Hz/1kHz/10kHz. Measuring voltage: 0.6Vrms.
- Output impedance: 120Ω .
- LCR automatic identification/manual measurement.
- DC resistance (DCR) measurement.
- Open circuit/short circuit.
- Auto power off.
- Relative measurement and comparison feature.

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.

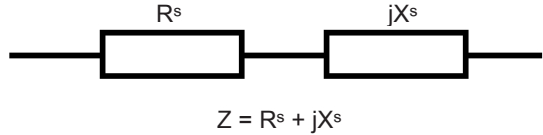
- If the phase angle $\theta > 0$, the reactance is inductive in nature, if $\theta < 0$ the reactance is capacitive in nature.

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 B admittance.

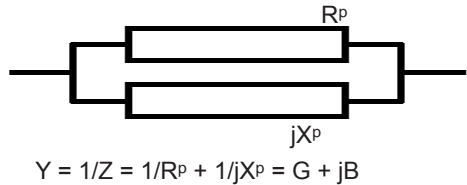
Serial Measurement

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



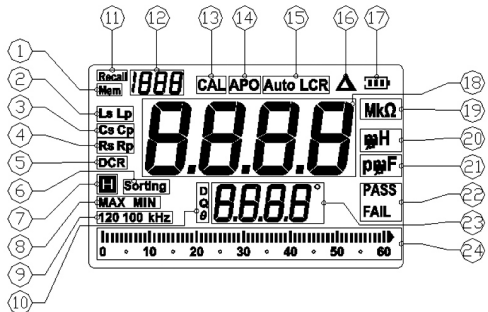
Parallel Measurement

R^p : Parallel mode of resistance
 X^p : Parallel mode of reactance
 C^p : Parallel mode of capacitance
 L^p : Parallel mode of inductance



LCD DESCRIPTION

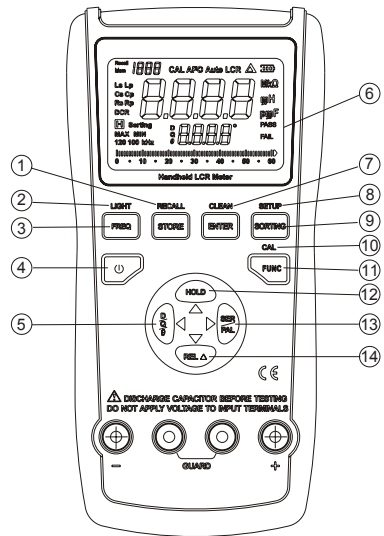
- MEM**: data storage indicator.
- Ls, Lp**: selection of inductance measurement mode. L^s = inductance in series connection measurement mode. L^p = inductance in parallel connection measurement mode.
- S, Cp**: selection of capacitance measurement mode. C^s = capacitance in series connection measurement mode. C^p = capacitance in parallel connection measurement mode.
- Rs, Rp**: selection of resistance measurement mode. R^s = resistance in series connection measurement mode. R^p = resistance in parallel connection measurement mode.
- DCR**: resistance under DC measurement mode.
- SORTING**: comparison function mode.
- H**: data hold.
- MAX, MIN**: upper and lower limitation for comparative model.
- Frequency**: Indicating the measured frequency.
- D, Q, θ** : represented by the secondary parameter.



11. **RECALL**: recall stored data.
12. Number of stored data: displayed from 001 to 1000.
13. **CAL**: open circuit/short circuit correction indicator.
14. **APO**: auto power-off indicator
15. **AUTO LCR**: auto recognition mode.
16. Relative value identifier.
17. Battery capacity indicator.
18. Main parameter value display.
19. **Resistance unit**
20. **Inductance unit**
21. **Capacitance unit**
22. **PASS, FAIL**: comparative result indicator. PASS: measured value within range of upper and lower limitation. FAIL: measured value beyond the range of upper and lower limitation.
23. **Secondary parameter display.**
24. **Simulation bar.**

PRODUCT OVERVIEW

1. **STORE/RECALL**: data storage and recall. Press once for “Store” and hold down the button for “Recall”.
2. **Backlight**: press and hold for backlight to switch on.
3. **Frequency selection**
4. **ON/OFF**
5. **Secondary parameter selection**
6. **LCD**
7. **ENTER/CLEAN**: press once for “Enter” and hold down the button for “Clean”.
8. **SETUP**: press and hold button for upper and lower limit value setting.
9. **SORTING**: comparative measurement mode.
10. **CAL**: open circuit/short circuit correction key.
11. **FUNC**: toggle between LCR, L, C, R, DCR and LCR main parameters.
12. **HOLD**: data hold button.
13. **SER/PAL**: serial/parallel connection conversion.
14. **REL**: relative value.



OPERATION - AUTO MEASUREMENT

- When the instrument starts, it enters the default status of automatic recognition mode and frequency 1K.
- Under auto mode, the instrument will automatically recognise the impedance characteristic of the measured object.
- Select the main and secondary parameters of L, C or R as well as its proper serial and parallel connection mode.
- Correspondence between major and secondary parameters 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.
- Press **FUNC** to select parameters:
"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 change from: "1kHz → 10kHz → 100kHz → 100Hz → 120Hz → 1kHz".

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

COMPARATIVE VALUE MEASUREMENT MODE

- Designed to rapidly sort the component with the main parameter within a certain range.
- After pressing **FUNC** to enter manual mode, select the mode: "AUTO L", "AUTO C", "AUTO R" or "AUTO DCR".
- Ensure the testing terminal is connected the to the component being measured.
- Press **SORTING** to enter "sorting mode". The LCD will display "Sorting".
- The main display shows "PASS" while the secondary display shows the principal

value of the measured component and inputs the nominal value.

- When the measured component is defined within the limit range, the main display shows “PASS” and the secondary display shows its principal value, accompanied by a buzzing sound.
- When exceeding the range, the main display shows “FAIL” and the secondary display shows its principal value.

Set Comparison Range

- Press and hold **SORTING** to start setting the upper and lower limit.
- When setting the maximum value it will display “MAX” (default maximum value is 5999).
- Press ▼ to display values in descending order and press ▲ to display values in ascending order.
- Flashing position of main parameter will shift right when pressing ► and shift left when pressing ◀ and the value will be regulated accordingly.
- After setting the maximum value, press **SORTING** to proceed with the setting of the lower limit, using the same method as maximum value setting. Ensure it is set correctly and press **ENTER** to quit.

Note: It is not necessary to input the point when setting the upper and lower limit value as the point will be automatically added according to the range of value.

Enter Comparative Mode

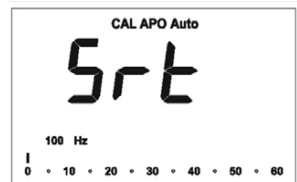
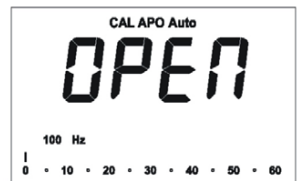
- Press **SORTING** to enter comparative measurement mode.
- When the measured value is between the rated maximum and the rated minimum value, the display will show “PASS”, or otherwise “FAIL”.
- Press **SORTING** again to quit the mode and return to normal measurement mode.

CALIBRATION FUNCTION

- The calibration function, including short circuit calibration and open circuit calibration can effectively reduce the distributed parameter interference caused by testing line.
- Short circuit calibration can reduce the impact on low impedance component measurement caused by contact resistance and testing line.
- Open circuit calibration can reduce the impact on high impedance component measurement caused by the distributed capacitance and resistance of testing line.

Enter Calibration Function

- After turning on the meter, press and hold the **FUNC** button to access open circuit calibration, the “OPEN” icon shows on the second display.
- Press **ENTER** to start and the progress bar and CAL icon will blink simultaneously on the LCD.
- When open circuit calibration finishes, the “PASS” icon appears and the meter is ready to enter into short circuit calibration.
- Then plug the short circuit device into test terminals,



and press the **ENTER** button to start calibration.

- The LCD will display the blinking progress bar and the “CAL” icon.
- When “PASS” is displayed, short circuit calibration finishes and the meter automatically returns to normal measuring mode.
- If the progress bar does not work, check if the short circuit device is inserted into the test terminals to ensure the circuit is shorted and begin the calibration again.

BACKLIGHT

- After pressing and holding the **LIGHT** button, the LCD backlight will be illuminated and the automatically turn off after 60 seconds.
- When the backlight is on you can switch it off by pressing and holding the **LIGHT** button again.

DATA STORAGE & RECALL

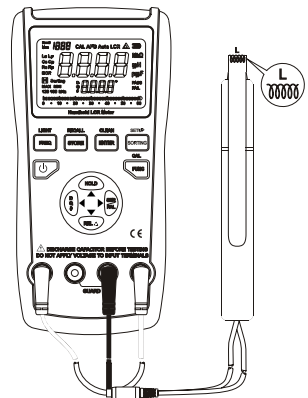
- The current displayed value will be saved after pressing **STORE**, saving one value after pressing once and the stored number will automatically increase in sequence.
- When you need to recall data it is able to check the value stored in the machine by pressing and holding **STORE**.
- The value will reduce when pressing ◀ and gradually increase when pressing ▶.

SELECTION OF SERIAL/PARALLEL CONNECTION MODE

- More accurately measured data can be achieved by selecting the equivalent mode.
- Generally, serial connection equivalent mode should be selected when measuring low impedance components (lower than 100Ω).
- Parallel connection equivalent mode should be selected when measuring high impedance components (higher than 10kΩ).
- Serial/parallel connection mode may have little impact on the measured result when impedance is between the two values mentioned above.

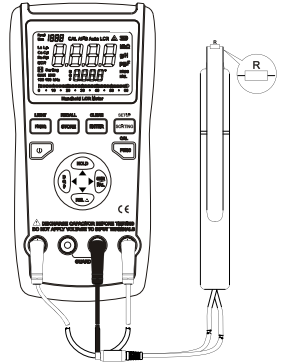
INDUCTANCE MEASUREMENT

- Press the power button to turn on the instrument.
- Press **FUNC** and the LCD will display “Lp”. Select inductance measurement.
- Connect inductance to the testing terminal or connect the corresponding accessory to the measured inductance (see right).
- Press **FREQ** to select the appropriate testing frequency.
- Press **D/Q/θ** to select the secondary parameter to be measured.



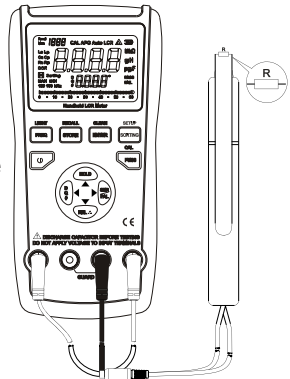
CAPACITANCE MEASUREMENT

- **WARNING:** Capacitors must be completely discharged prior to measurement.
- Press the power button to turn on the instrument.
- Press **FUNC** and the LCD will display “Cp”, then select capacitance measurement.
- Connect capacitance to the testing terminal or connect the corresponding accessory to the measured capacitance (see right).
- Press **FREQ** to select the appropriate testing frequency.
- Press **D/Q/θ** to select the secondary parameter to be measured.



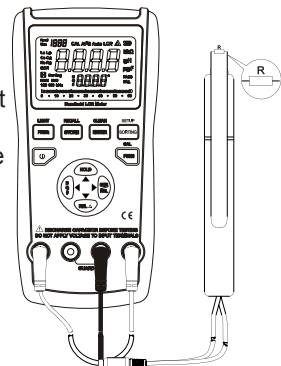
RESISTANCE MEASUREMENT

- Press the power button to turn on the instrument.
 - Press **FUNC** and the LCD will display “Lp”. Select inductance measurement.
 - Insert the resistor into the input terminals or connect the resistor to the meter using the test clamp.
 - Press **D/Q/θ**.
- Note: secondary parameter will be neglected and not displayed on the LCD when measuring resistance.



DC IMPEDANCE MEASUREMENT

- Press the power button to turn on the instrument.
 - Press **FUNC** and the LCD will display “DCR”, then select DC impedance measurement.
 - Connect resistance to the testing terminal or connect the corresponding accessory to the measured resistance (see right).
- Note: Frequency and secondary parameter will be neglected and the secondary parameter will not be displayed by the LCD when measuring DC resistance.



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.
- 5) L, C, R functions are all for tests on passive (fixed) components.

INDUCTANCE SPECIFICATION

Frequency	Equivalent Mode	Range	Input	Accuracy	Minimum Resolution
100Hz / 120Hz	LS	60.00mH	10.00mH	$\pm 2.0\% + 5d$	0.01mH
		600.0mH	100.0mH	$\pm 1.0\% + 5d$	0.1mH
		6.000H	1.000H	$\pm 1.0\% + 5d$	0.001H
		60.00H	10.00H	$\pm 1.0\% + 5d$	0.01H
		200.0H	100.0H	$\pm 1.5\% + 5d$	0.1H
1kHz	LS	6.000mH	1.000mH	$\pm 1.5\% + 5d$	0.001mH
		60.00mH	10.00mH	$\pm 0.7\% + 5d$	0.01mH
		600.0mH	100.0mH	$\pm 0.4\% + 2d$	0.1mH
		6.000H	1.000H	$\pm 1.0\% + 5d$	0.001H
		60.00H	10.00H	$\pm 1.5\% + 5d$	0.01H
10kHz	LS	600.0 μ H	100.0 μ H	$\pm 0.7\% + 5d$	0.01 μ H
	LP	6.000mH	1.000mH	$\pm 0.7\% + 5d$	0.001mH
		60.00mH	10.00mH	$\pm 1.0\% + 5d$	0.01mH
		600.0mH	100.0mH	$\pm 1.0\% + 5d$	0.1mH

Note: Fixed inductance input.

CAPACITANCE SPECIFICATION

Frequency	Equivalent Mode	Range	Input	Accuracy	Minimum Resolution
100Hz / 120Hz	CS/CP	60.00nF	19.00nF	$\pm 2.0\% + 5d$	0.01nF
		600.0nF	190.0nF	$\pm 0.4\% + 2d$	0.1nF
		6.000 μ F	1.90 μ F	$\pm 0.7\% + 3d$	0.001 μ F
		60.00 μ F	10.00 μ F	$\pm 1.0\% + 5d$	0.01 μ F
		600.0 μ F	100.0 μ F	$\pm 1.0\% + 5d$	0.1 μ F
	CS	10.00mF	1.800mF	$\pm 1.5\% + 5d$	0.001mF

Frequency	Equivalent Mode	Range	Input	Accuracy	Minimum Resolution
1kHz	CS/CP	6.000nF	1.000nF	$\pm 1.0\% + 5d$	0.001nF
		60.00nF	19.00nF	$\pm 0.4\% + 2d$	0.01nF
		600.0nF	190.0nF	$\pm 0.4\% + 2d$	0.1nF
		6.000 μ F	1.90nF	$\pm 0.7\% + 3d$	0.001 μ F
		60.00 μ F	10.00 μ F	$\pm 0.7\% + 3d$	0.01 μ F
	CS	600.0 μ F	100.0 μ F	$\pm 1.0\% + 5d$	0.1 μ F
10kHz	CS/CP	600pF	300.0pF	$\pm 3.0\% + 5d$	0.1pF
		6nF	1.000nF	$\pm 1.0\% + 5d$	0.001nF
		60nF	19.00nF	$\pm 1.0\% + 5d$	0.01nF
		600nF	190.0nF	$\pm 1.5\% + 5d$	0.1nF
		6.000 μ F	1.000 μ F	$\pm 1.0\% + 5d$	0.001 μ F

Notes: Fixed capacitance input.
600pF range is for reference only.

RESISTANCE SPECIFICATION

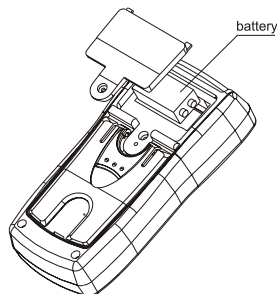
Frequency	Equivalent Mode	Range	Input	Accuracy	Minimum Resolution
100Hz / 120Hz	RS/RP	60.00 Ω	19.00 Ω	$\pm 0.5\% + 5d$	0.01 Ω
		600.0 Ω	190.0 Ω	$\pm 0.4\% + 2d$	0.1 Ω
		6.000k Ω	1.900k Ω	$\pm 0.4\% + 2d$	0.001k Ω
		60.00k Ω	19.00k Ω	$\pm 0.4\% + 2d$	0.01k Ω
		600.0k Ω	190.0k Ω	$\pm 0.7\% + 3d$	0.1k Ω
		6.000M Ω	1.900M Ω	$\pm 1.5\% + 3d$	0.001M Ω
	RP	20.00M Ω	19.00M Ω	$\pm 2.0\% + 5d$	0.01M Ω
1kHz	RS/RP	60.00 Ω	19.00 Ω	$\pm 0.4\% + 2d$	0.01 Ω
		600.0 Ω	190.0 Ω	$\pm 0.4\% + 2d$	0.1 Ω
		6.000k Ω	1.900k Ω	$\pm 0.4\% + 2d$	0.001k Ω
		60.00k Ω	19.00k Ω	$\pm 0.4\% + 2d$	0.01k Ω
		600.0k Ω	190.0k Ω	$\pm 0.7\% + 3d$	0.1k Ω
		6.000M Ω	1.900M Ω	$\pm 1.5\% + 5d$	0.001M Ω
	RP	20.00M Ω	19.00M Ω	$\pm 2.0\% + 5d$	0.01M Ω

Frequency	Equivalent Mode	Range	Input	Accuracy	Minimum Resolution
10kHz	RS/RP	60.00Ω	19.00Ω	± 0.4% + 2d	0.01Ω
		600.0Ω	190.0Ω	± 0.4% + 2d	0.1Ω
		6.000kΩ	1.900kΩ	± 0.4% + 2d	0.001kΩ
		60.00kΩ	19.00kΩ	± 0.4% + 2d	0.01kΩ
		600.0kΩ	190.0kΩ	± 0.7% + 3d	0.1kΩ
		6.000MΩ	1.900MΩ	± 3.0% + 3d	0.001MΩ
DCR		600.0Ω	190.0Ω	± 1.0% + 5d	0.1Ω
		6.000kΩ	1.900kΩ	± 0.4% + 2d	0.001kΩ
		60.00kΩ	19.00kΩ	± 0.4% + 2d	0.01kΩ
		600.0kΩ	190.0kΩ	± 0.4% + 2d	0.1kΩ
		6.000MΩ	1.900MΩ	± 1.5% + 5d	0.001MΩ
		20.00MΩ	19.00MΩ	± 1.5% + 5d	0.01MΩ

Note: 100Hz, 120Hz, 1kHz, 10kHz fixed resistance input.

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).



CLEANING & MAINTENANCE

- 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.



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.

