

TENMA®



600A True RMS Digital Clamp Meter

Model: 72-3097 & 72-3099

CONTENTS

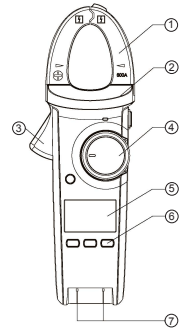
Page Number	Details
3	Important Safety Information
4	Product overview
4	Key Functions
5	General Specification
5	Electrical Specification
5	AC (\bar{A})
6	AC (\bar{A}) (72-3099 only)
6	AC Voltage (\bar{V})
6	DC Voltage (\bar{V})
6	Resistance (Ω)
6	Continuity Test
7	Diode Test
7	Capacitance
7	Temperature ($^{\circ}\text{C}$) (72-3099 only)
8	Frequency (Hz) (72-3099 only)
8	NCV
8	Operation - AC Measurement
9	DC Current Measurement (72-3099 only)
9	AC Voltage Measurement
10	DC Voltage Measurement
10	Resistance Measurement
11	Continuity Test
11	Diode Measurement
12	Capacitance Measurement
13	Frequency
13	Temperature Measurement (72-3099 only)
13	Non-contact AC Voltage Sensing NCV
14	Power Gear (off) & Automatic Shutdown
14	Battery Replacement
14	Cleaning & Maintenance

IMPORTANT SAFETY INFORMATION

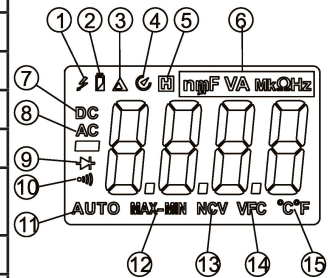
- When using electrical appliances basic safety precautions should always be followed.
- Check the clamp ammeter and test pen before use. If there is any damage or any abnormalities, do not use it.
- Do not use the clamp ammeter if the battery cover and rear cap is not in place, as there is a risk of electric shocking.
- Keep fingers within the scope of the test pen finger protection. Do not contact the bare wire and connector, the unused input terminal or the circuit being measured when the clamp ammeter is in operation.
- Ensure that function switches are set at the correct position prior to measurement. Do not perform gear conversion in measurement to guard against damage to the meter.
- Do not apply over 1000VDC or 750VAC between the clamp ammeter terminals and ground, to guard against damage to the meter.
- Be careful in measuring RMS voltage higher than 30V DC or AC, as there will be electric shocking.
- Do not measure voltage or current higher than the allowable input value. Set the function range switch at the maximum range position if the scope of the measured value cannot be defined.
- Before measurement of online resistance and diode or circuit on-off measurement, the power to the circuits being measured must be switched off and all capacitors should be completely discharged to assure measurement accuracy.
- When the LCD displays the low battery symbol, replace the battery immediately in order to ensure measurement accuracy.
- Remove the battery when the clamp meter is not in use for a long period of time.
- Do not change the internal wiring in the clamp ammeter, in order to guard against damage to the meter.
- Do not store or use the clamp ammeter in an explosive or flammable environment with high temperature, high humidity or a strong electromagnetic field.
- Clean the clamp meter case with a soft cloth and a neutral detergent.
- Do not use any chemicals, abrasives or solvents to avoid causing damage to the instrument.

PRODUCT OVERVIEW

- Clamp head:** a device used to measure AC/DC current and convert current into voltage.
- Clamp body:** designed for safe use and to protect the operator from touching dangerous areas.
- Clamp head pulling handle:** press the trigger to open the clamp head.
- Dial switch:** select the measurement function gear.
- Function key:** select basic functions.
- LCD display area:** displays the measured data and functional symbols.
- Measure input terminal:** measure the signal input.



1. High Voltage	9. Diode
2. Low Battery	10. Circuit on-off measurement
3. Relative value	11. Auto range
4. Auto shutdown	12. Max/min measurement
5. Data hold	13. Non-contact AC voltage sensing
6. Unit	14. Frequency conversion measurement
7. DC Signal	15. Temperature unit
8. AC Signal	



KEY FUNCTIONS

SELECT	Press in order to choose. Press and hold the key and the LCD will display “VFC” to enable frequency conversion signal measurement. It is only valid for AC voltage 600V and AC measurement. Press and hold to block frequency conversion signal measurement.
HOLD	Press this button once to enter data hold measurement mode and press again to exit the mode. Press and hold the button to turn the backlight on. If the button is not held down within 15 seconds the backlight will turn off automatically.
MAX/ MIN	Press once and the LCD will display “MAX” and enter maximum measurement mode. Press again and the LCD will display “MIN” indicating minimum measurement mode. Press and hold the button to exit maximum/minimum value measurement. It is only valid for AC voltage, AC current, resistance and temperature measurement.
REL	With the exception of DC current gear, under the non-read back stored record data mode, it is able to enter the relative measurement mode with by pressing REL . The main display will show: measured value - basic value. It is only valid for AC voltage, AC current, resistance and capacitance measurement.

REL (cont)	Press again to exit relative value measurement mode. Under DC current gear measurement mode, press to enter clearing mode and the LCD will display “Δ”. Press again to exit clearing mode.
FLIGHT	Press and hold this button to turn the torch function on. Press the button once and the torch function will turn off.

GENERAL SPECIFICATION

LCD	Maximum display 6000.
Polarity display	Auto positive and negative polarity display. Overload display: “OL” or “-OL”.
Low voltage display	“Figure 1” indicates that the battery voltage is lower than the working voltage.
Sampling rate	About 3/s.
Sensor type	Coil induction (72-3097)/Hall effect sensor (72-3099).
Text position error	An additional reading error of $\pm 1.0\%$ may result when the power to be measured is not clamped at the centre of the clamp head.
Impact resistance strength	1m fall impact.
Max. openness of clamp head	30mm diameter, max. dimension of current conductor to be measured: 30mm diameter.
Electromagnetic field impact	The application of device near electromagnetic field may result in unstable display or inaccurate readings.
Power	3 AAA 1.5V zinc manganese batteries.
Dimensions	228mm x 77mm x 41mm.
Weight	About 265g (inc. batteries).
Operating temperature	0°C to 30°C (no higher than 80% RH). 30°C to 40°C (no higher than 75% RH). 40°C to 50°C (no higher than 45% RH).
Storage temperature	-20°C to 60°C (no higher than 80% RH).

ELECTRICAL SPECIFICATION

- Accuracy: \pm (% + word number), one year calibration time.
- Ambient temperature: 23°C \pm 5°C.
- Ambient humidity: $\leq 80\%$ RH.
- Temperature coefficient: 0.1 x (accuracy)/°C.

AC (Å)

Range	Resolution	Accuracy	Overload protection
6.000A	0.001A	$\pm(2.5\% + 30)$	600A
60.00A	0.01A	$\pm(2.5\% + 5)$	
600.0A	0.1A		

- Display: current true value: applicable for range from 10% to 100%.
- Frequency response: 50Hz~60Hz.

- The measurement accuracy of non-sinusoidal wave various frequency current should be 5% higher than the former.

AC (A) (72-3099 only)

Range	Resolution	Accuracy	Overload protection
60.00A	0.01A	± (2.5% + 5)	600A
600.0A	0.1A		

- DCI base number should be deleted by the **ZERO** key.

AC VOLTAGE (V)

Range	Resolution	Accuracy	Overload protection
6.000V	0.001V	± (1.2% + 5)	1000V DC 750V AC
60.00V	0.01V		
600.0V	0.1V		
750V	1V	± (1.5% + 5)	

- Display: voltage true value; applicable for range from 10% to 100%.
- Voltage: input impedance ≥10MΩ.
- Frequency response: 40~400Hz.

DC VOLTAGE (V)

Range	Resolution	Accuracy	Overload protection
600.0mV	0.1mV	± (1.0% + 8)	1000V DC 750V AC
6.000V	0.001V	± (0.8% + 1)	
60.00V	0.01V	± (0.8% + 3)	
600.0V	0.1V		
1000V	1V	± (1.0% + 3)	

- Input impedance ≥10MΩ.

RESISTANCE (Ω)

Range	Resolution	Accuracy	Overload protection
600.0Ω	0.1Ω	± (1.2% + 2)	1000V DC 750V AC
6.000kΩ	0.001kΩ	± (1.0% + 2)	
60.00kΩ	0.01kΩ		
600.0kΩ	0.1kΩ	± (1.2% + 2)	
6.000MΩ	0.001MΩ		
60.00MΩ	0.01MΩ	± (1.5% + 5)	

CONTINUITY TEST

Range	Resolution	Accuracy	Overload protection
600.0Ω	0.1Ω	Buzzer beeps when <30Ω	1000V DC 750V AC
		Open circuit voltage is about 1.2V	

DIODE TEST (▶)

Range	Resolution	Accuracy	Overload protection
6.000V	0.001V	Open circuit voltage is about 3.3V, measurable PN knot $\leq 3V$ positive pressure drop value. Silicon PN normal voltage value is about 0.5~0.8V.	100V DC 750V AC

CAPACITANCE

72-3097

Range	Resolution	Accuracy	Overload protection
99.99nF	0.01nF	$\pm (4.0\% + 25)$	1000V DC 750V AC
999.9nF	0.1nF	$\pm (4.0\% + 5)$	
9.999 μ F	0.001 μ F		
99.99 μ F	0.01 μ F		
999.9 μ F	0.1 μ F	$\pm (10\%)$	
9.999mF	0.001mF		
59.99mF	0.01mF	For reference only	

72-3099

Range	Resolution	Accuracy	Overload protection
60.00nF	0.01nF	$\pm (4.0\% + 25)$	1000V DC 750V AC
600.0nF	0.1nF	$\pm (4.0\% + 5)$	
6.000 μ F	0.001 μ F		
60.00 μ F	0.01 μ F		
600.0 μ F	0.1 μ F	$\pm (10\%)$	
6.000mF	0.001mF		
60.00mF	0.01mF	For reference only	

TEMPERATURE (°C) (72-3099 ONLY)

Range	Resolution	Accuracy	Overload protection
-40°C~40°C	1°C	$\pm (3.0\% + 5)$	1000V DC 750V AC
40°C~400°C			
400°C~1000°C		$\pm (2.0\% + 5)$	
-40°F~104	1°F	$\pm (3.0\% + 10)$	
104°F~752°F			
752°F~1832°F		$\pm (2.0\% + 10)$	

FREQUENCY Hz (72-3099 ONLY)

Range	Resolution	Accuracy	Overload protection
10Hz 1 MHz	0.01Hz 1kHz	$\pm (0.1\% + 4)$	1000V DC 750V AC

Requirement on input range:

- $\leq 100\text{kHz}$: $100\text{mVrms} \leq \text{input range} \leq 20\text{Vrms}$ > $100\text{kHz} \sim 1\text{MHz}$: $200\text{mVrms} \leq \text{input range} \leq 20\text{Vrms}$.

NCV

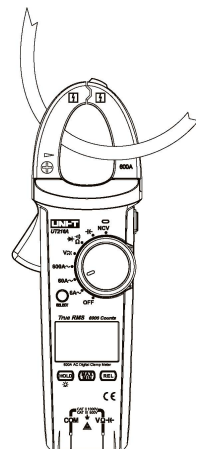
Range	Accuracy
NCV	$\geq 100\text{Vrms}$; $\leq 10\text{mm}$ (LED/buzzer indication)

OPERATION - AC MEASUREMENT

- Push the switch to AC current gear. Then press the trigger to open the clamp head to take the conductor to be measured, then slowly loosen the trigger until the clamp head is completely closed.
- Make sure that the conductor to be measured is clamped at the centre of the clamp head, otherwise it may result in an additional error.
Note: The clamp ammeter can only measure one current conductor. Measuring two or more current conductors concurrently may result in wrong measurement readings.
- Read the true value of AC directly from the display.
- Press and hold the **SELECT** key in AC gear to select VFC measurements and measure frequency converter current (72-3099 only).

Note:

- Current measurement must be operated within $0^{\circ} \sim 40^{\circ}\text{C}$. If a positive reading is achieved after measuring DC current, the current direction will go from up to down. Do not loosen the trigger abruptly as the Hall component is sometimes sensitive to magnets, heat, mechanical stress and also to impact, which may cause short-time reading variation.
- Ensure the conductor to be measured is clamped at the centre of the clamp head. If it isn't, an additional reading error of $\pm 1\%$ may result.
- AC conversion adopts the AC coupling true RMS response mode, sinusoidal input correction. The accuracy of non-sinusoidal waves shall be adjusted as follows:
 - Crest factor 1.4~2.0, accuracy should be increased 1.0%.
 - Crest factor 2.0~2.5, accuracy should be increased 2.5%.
 - Crest factor 2.5~3.0, accuracy should be increased 4.0%.

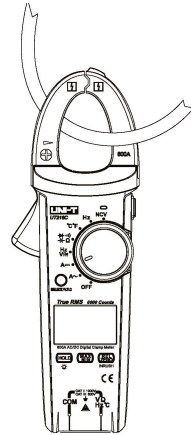


DC CURRENT MEASUREMENT (72-3099 ONLY)

- Push the switch to DC current gear. If the LCD display is not set to zero, press **REL** to clear.
- After measuring the big current gear, the clamp head will be left with remanence and the LCD will have base values.
- Press the trigger to open the clamp head and take the conductor to be measured, then slowly loosen the trigger until the clamp head is completely closed.
- Ensure the conductor to be measured is clamped at the centre of the clamp head, otherwise an error may occur.
- The clamp ammeter can only measure one current conductor. Measuring two or more current conductors concurrently may result in incorrect measurement readings.
- Directly read out the measured DC current value from the display.

Note:

- Current measurement must be operated within $0^{\circ}\sim 40^{\circ}\text{C}$. If a positive reading is achieved after measuring DC current, the current direction will go from up to down. Do not loosen the trigger abruptly as the Hall component is sometimes sensitive to magnetization, heat, mechanical stress and also to impact, which may cause short-time reading variation.
- Ensure the conductor to be measured is clamped at the centre of the clamp head. If it isn't, an additional reading error of $\pm 1\%$ may result.

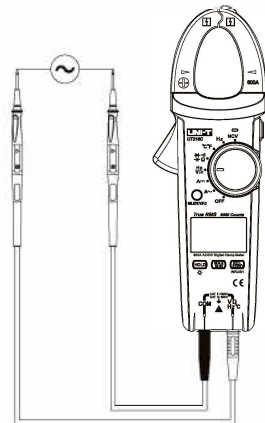


AC VOLTAGE MEASUREMENT

- Insert the red test pen into the “V” jack and the black test pen into the “COM” jack.
- Push the function range switch to the AC voltage measurement gear and connect the test pen in parallel with the power or load to be measured.
- Read the true value of the AC voltage from the display.
- Press and hold the **SELECT** key in AC voltage gear to select VFC measurement and measure the frequency converted voltage (72-3099 only).
- For 72-3099, pressing and holding the **SELECT** key can select frequency measurements of AC voltage. Note: the following conditions must be met when reading frequency value:
input range \geq range $\times 10\%$. (Testing range of frequency gear at voltage gear is 40Hz-400Hz).

Note:

- Do not input voltage higher than AC 750V. It may be feasible to measure higher voltage, but damage will be caused to the meter.



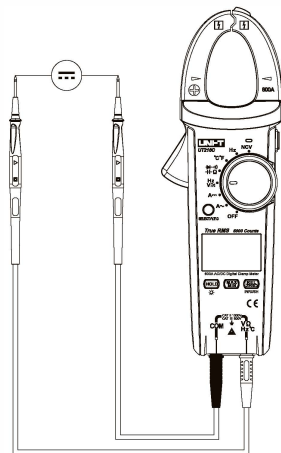
- Pay attention to electric shocks when measuring high voltage.
- After completing all measurement operations, disconnect the test pen from the measured circuit.
- When the measured voltage is higher than the safety voltage of 30V AC, the meter LCD displays the high voltage warning prompt.
- When inputting overvoltage, higher than 750V AC gear range, the meter will automatically sound intermittent buzzing and the high voltage warning prompt will automatically flash.
- AC conversion adopts the AC coupling true RMS response mode, sinusoidal input for correction.
- The accuracy of non-sinusoidal wave shall be adjusted as follows:
 - Crest factor 1.4~2.0, accuracy should be increased 1.0%,
 - Crest factor 2.0~2.5, accuracy should be increased 2.5%,
 - Crest factor 2.5~3.0, accuracy should be increased 4.0%.

DC VOLTAGE MEASUREMENT

- Insert the red test pen into the “V” jack and the black test pen into the “COM” jack.
- Push the function range switch to the DC voltage measurement and connect the test pen in parallel with the power or load to be measured.
- Directly read the measured resistance value from the display.

Note:

- Do not input voltage higher than 1000V. It may be feasible to measure higher voltage, but damage will be caused to the meter.
- In order to obtain a precise reading when measuring at 600mV gear, the relative measurement function can be adopted.
- Firstly, input the test pen under the short-circuit condition, press the **REL** button and read the resistance measurement value. Afterwards, the meter automatically deducts the test pen displayed value under short-circuit condition.
- Watch out for electric shocks when measuring high voltage. After completing all measurement operations, disconnect the test pen from the measured circuit.
- When the measured voltage is higher than the safety voltage of 30V DC, the meter LCD will display the warning prompt.
- When inputting overvoltage higher than 1000V DC gear range, the meter will automatically sound intermittent buzzing and the high voltage warning prompt will automatically flash.



RESISTANCE MEASUREMENT

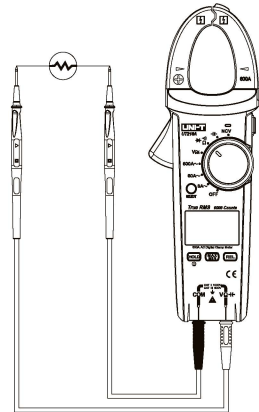
- Insert the red test pen into the “Ω” jack and the black test pen into the “COM” jack.
- Push the function range switch to the measurement gear “Ω”, press **SELECT** to

select resistance measurement Ω and connect the test pen in parallel with the two terminals of measured resistance.

- Directly read the measured resistance value from the display.

Note:

- If the open circuit of resistance being measured exceeds the maximum range of the meter, the display will show “OL”.
- Before measuring resistance on-line, the power of circuits being measured shall be powered off and all capacitors will release residues of electric charges to assure measurement accuracy.

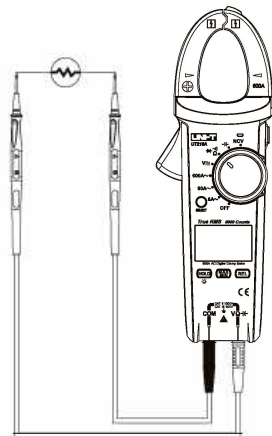


CONTINUITY TEST

- Insert the red test pen into the “ Ω ” jack and the black test pen into the “COM” jack.
- Push the function range switch to the measurement gear “ \rightarrow ”, press **SELECT** to select circuit on-off measurement and connect the test pen in parallel with the two terminals of measured circuit.
- When the measured resistance between the two terminals $<30\Omega$, the circuit should be deemed conductive and the buzzer will sound continuously.
- When resistance is $\geq 30\Omega$ and $\leq 60\Omega$, the buzzer will not sound.
- When resistance is $>60\Omega$, the buzzer will not sound.
- Directly read the measured resistance value loaded by the circuit from the display.

Note:

- When checking on-line circuit on-off conditions, it is required, prior to measurement, to switch off all power in the measured circuit and discharge all residual charges in the capacitor.
- With respect to the circuit on-off measurement, open-circuit voltage is approximately -3.5V and range should be 600 Ω measurement gear.
- Do not input voltage higher than 30V DC or AC, as it may cause personal injury.
- After completing all measurement operations, disconnect the test pen from the measured circuit.



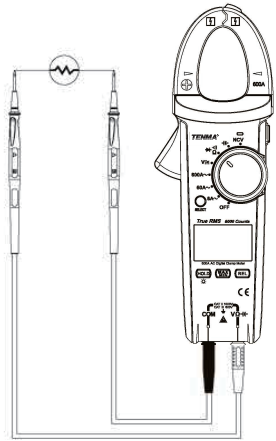
DIODE MEASUREMENT

- Insert the red test pen into the “ Ω ” jack and the black test pen into the “COM” jack. The polarity of the red and black test pen is respectively “+” and “-”.
- Push the function range switch to the measurement gear “ \rightarrow ”, select diode measurement and directly read out the approximate forward direction PN junction voltage.

- For silicon PN junction generally 500~800mV is confirmed to be the normal value.

Note:

- “OL” will be displayed when the measured diode is open-circuit or the polarity is inversely connected.
- Before measuring diode, the power circuits being measured shall be powered off and all capacitors shall release residues of electric charged to assure the measurement accuracy,
- The test open-circuit voltage of diode is approximately 3.5V.
- Do not input voltage higher than 30V DC or AC, as it may cause personal injury.
- After completing all measurement operations, disconnect the test pen from the measured circuit.

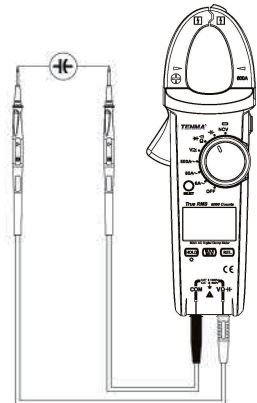


CAPACITANCE MEASUREMENT

- Insert the red test pen into the “V” jack and the black test pen into the “COM” jack. Measure by REL mode.
- Push the range switch to the measurement gear “ \overline{C} ”, press **SELECT** to select “capacitance” and connect the test pen in parallel with the two terminals of measured capacitance.
- Directly read out the capacitance value of the measured circuit from the display.
- It is recommended to carry out the capacitance measurement with test short line input, thus reducing the impact caused by distributed capacitance.

Note:

- If the measured capacitance is short circuited or capacitance exceeds the maximum range of the meter, the display will show “OL”. Under capacitance measurement mode, the simulation bar indicator is forbidden.
- It will take a longer time to achieve the correct reading when measuring capacitance larger than 600 μ F.
- To ensure the measurement accuracy, it is recommended to discharge all residual charges in the capacitor before the test.
- Then, input the meter for measurement, which is particularly important to the capacitor with high voltage.
- It is required to prevent damage to the meter and personal injury.
- After completing the measurement operation, disconnect the test pen from the measured capacitance.

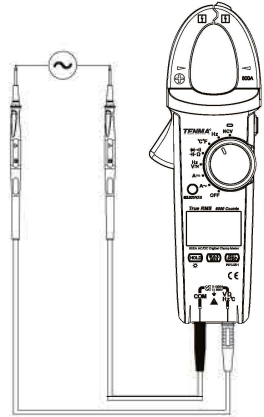


FREQUENCY

- Insert the red test pen into the “Hz” jack and the black test pen into the “COM” jack.
- Push the range switch to the measurement gear “Hz” and connect the test pen in parallel with the signal source to be measured.
- Directly read out the measured frequency value from the display.

Note:

- It is required to meet the input range a when measuring: $\leq 100\text{kHz}$ 100mVrms $\leq a \leq 20\text{Vrms}$.
- Do not input frequency higher than 30Vrms , as it may cause personal injury.
- After completing all measurement operations, disconnect the test pen from the measured circuit.

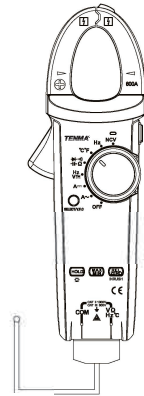


TEMPERATURE MEASUREMENT (72-3099 only)

- Push the range switch to “°C °F” gear and the LCD will display “OL”, the short-circuit test pen displays the room temperature.
- Insert the temperature K type socket into the corresponding hole.
- Place the temperature probe to detect the measured surface and several seconds later, directly read out the measured Celsius temperature value from the LCD.
- Press **SELECT** to select Fahrenheit temperature measurement.

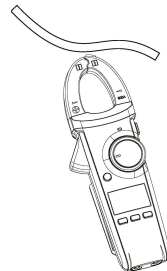
Note:

- The meter should not be operated in a place with ambient temperature beyond the range 18°C to 28°C as results can be affected, particularly evident in a low temperature environment.
- Do not input voltage higher than 30V DC or AC, as it may cause personal injury.
- After completing all measurement operations, remove the temperature probe.



NON-CONTACT AC VOLTAGE SENSING NCV

- In order to sense whether there is AC voltage or electromagnetic field in this space, place the front end of the clamp meter near to the conductor to be tested in order to sense detection (distance $< 10\text{mm}$).
- When the electric field voltage is $\geq 100\text{VAC}$, the LCD will display “-”, which has four levels, “-”, “--”, “---” and “----” subject to sensing voltage.
- The buzzer will continue to beep and the LED will flash a red light.

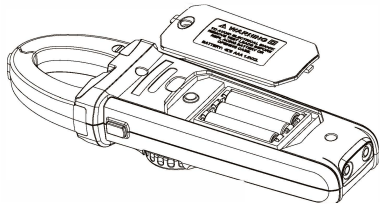


POWER GEAR (OFF) & AUTOMATIC SHUTDOWN

- The instrument should be powered off.
- If you're not turning the knob switch or pressing the key to the clamp ammeter within the user-defined shutdown time (default 15 mins), the display will be blank and enter the low power consumption dormant state.
- Press any key to wake up the meter.
- Press the **SELECT** key to start up the machine and the automatic shutdown function is forbidden.

BATTERY REPLACEMENT

- Shut down the clamp meter and move away the test pen located at the input terminal.
- Place the meter with the panel facing down and unscrew the battery box screws, take off the battery cap and remove the old batteries.
- Place the new batteries into the compartment, observing the polarities.
- After installing the new batteries, replace the battery cap and screw on the screws.



CLEANING & MAINTENANCE

- The clamp meter should be maintained and serviced by qualified personnel.
- Clean the outer case with a clean, dry cloth.
- Do not use any chemicals, abrasives or solvents that could cause damage to the meter.



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

This symbol indicate that separate collection of Waste Electrical and Electronic Equipment (WEEE) or waste batteries is required. Do not dispose of these items with general household waste. Separate for the treatment, recovery and recycling of the materials used. Waste batteries can be returned to any waste battery recycling point which are provided by most battery retailers. Contact your local authority for details of the battery and WEEE recycling schemes available in your area.

