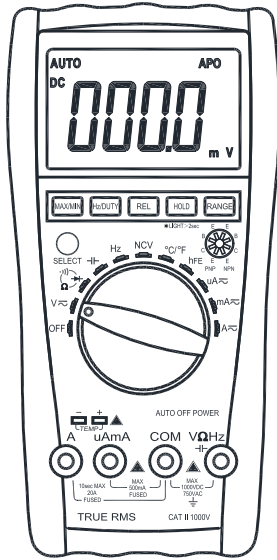


DM-97 DIGITAL MULTIMETER

Operation Manual



1. Overview

This is a 3 3/4 digital multimeter with high stability and performance. It uses a LCD with 20mm high resolution LCD display, which will makes reading more clear. It can be used to measure DCV, ACV, DCA, ACA, resistance, capacitance, frequency, NCV, duty cycle, temperature, diode, and continuity. Meanwhile, This meter has been designed with the functions including unit symbol display, data hold, lighting, auto range, auto power off and alarm function. To assure high accuracy and resolution, it adopts an integrated circuit with the one which can drive 8-bit microprocessor and a dual integral A/D conversion directly for LCD, it also provides high resolution and high accuracy for Digital Display Driver, this meter has complete functions, high accuracy of measurement, easy to use, It is an ideal tool for labs, factories, radio fans and families.

2. Safety Caution

The instrument VC97A is designed in compliance with IEC1010 standard (safety standard issued by International Electrotechnical Committee). Please read the following safety instructions before operation.

2.1 Check the connection of test leads, make sure it is right and reliable, also make sure the insulation is well insulated in order to avoid electric shock before measuring.

2.2 Do not input voltage exceeding rated value in order to avoid electric shock and meter damage when making measurement.

2.3 When measuring voltage is higher than DC 60V or AC 40V, please be careful and prevent electric shock.

2.4 Choose right functions and range, beware of wrong operation.

2.5 Move the test leads away from test points when switching to other function.

2.6 Test lead is not allowed to be put into Current terminal to test Voltage.

2.7 Please do not change the Circuit randomly, It may damage the meter or threaten safety.

2.8 Safety symbols:

“” High voltage, “” GND, “” Dual insulation, “” Refer to manual, “” Low battery indication.

3. Character

3.1 General Characteristics

3.1.1 Display: LCD;

3.1.2 Max display: 4000 (3 3/4 digits, automatic polarity, and unit symbol display);

3.1.3 Measurement method: Analog to digital converter (with micro processor ADC+MCU);

3.1.4 Sampling rate: approx.3 times/sec.

3.1.5 Over-range display: “OL” will be displayed.

3.1.6 Low battery indication: “”

3.1.7 Working environment: (0~40)°C, relative humidity: <80%;

3.1.8 Store condition: (-10~50)°C, relative humidity: <80%

3.1.9 Battery: 2 pieces x1.5V battery (“AAA” 7# battery);

3.1.10 Dimension: 185×93×35mm (length x width x height);

3.1.11 Weight: approx. 290g (including battery);

3.1.12 Accessories: test leads, TP01 thermocouple, user manual, sheath, gift box, and 2*1.5V batteries.

3.2 Technical Character

3.2.1 Accuracy: $\pm (a\% \times \text{reading} + \text{digits})$. To assure accuracy, the ambient temperature should be $(23 \pm 5)^\circ\text{C}$, relative humidity <75%. One year of accuracy is guaranteed since the date of manufacture.

3.2.2 DC Voltage (DCV)

Range	Accuracy	Resolution
400mV	$\pm(0.5\%+5d)$	0.1mV
4V		1mV
40V		10mV
400V		100mV
1000V	$\pm(1.0\%+5d)$	1V

Input impedance: at 400mV range >40MΩ, at other ranges is 10MΩ.

Overload protection: 1000VDC or 750VAC of peak value.

3.2.3. AC Voltage (ACV) (True RMS)

Range	Accuracy	Resolution
400mV	$\pm(1.5\%+10d)$	0.1mV
4V		1mV
40V		10mV
400V		100mV
750V	$\pm(1.0\%+10d)$	1V

Input impedance: at 400mV range >40MΩ, at other ranges is 10MΩ.

Overload protection: 1000VDC or 750VAC of peak value.

Frequency response: at 750V range: (40~1000)Hz, at other ranges: (40~2000)Hz

Display: True RMS response (calibration based on wave RMS)

3.2.4 DC Current (DCA)

Range	Accuracy	Resolution
400uA	$\pm(1.0\%+5)$	0.1μA
4000uA		1μA
40mA		10μA
400mA		100μA
4A		1mA
20A	$\pm(2.0\%+5)$	10mA

Maximum voltage drop: 400 mV for full mA range, 200 mV for full A range.

Maximum input current: 20A (within 10 seconds).

Overload protection: 0.5/250V fuse and 13A/250V fuse.

3.2.5 AC Current (ACA)

Range	Accuracy	Resolution
400uA	$\pm(1.5\%+10)$	0.1μA
4000uA		1μA
40mA		10μA
400mA		100μA
4A	$\pm(2.0\%+10)$	1mA
20A		10mA

Maximum voltage drop: 400 mV for full mA range, 200 mV for full A range.

Maximum input current: 20A (within 10 seconds).

Overload protection: 0.5/250V fuse and 13A/250V fuse.

Frequency response: at 20A range: (40~100)Hz, at other ranges: (40~400)Hz.

3.2.6 Resistance (Ω)

Range	Accuracy	Resolution
400Ω	±(0.8%+2)	0.1Ω
4kΩ		1Ω
40kΩ		10Ω
400kΩ		100Ω
4MΩ		1kΩ
40MΩ	±(1.2%+5)	10kΩ

Open circuit voltage: > 500mV.

Overload protection: 250V DC/AC of peak value

NOTE: When using a range with 400Ω range, should make test leads to be short circuit firstly to have measuring the wire resistance and then deduct it from the real measurement.

Or press “REL” button to have reading the value directly.

3.2.7 Capacitance (C)

Range	Accuracy	Resolution
40nF	±(2.5%+6)	10pF
400nF		100pF
4uF		1nF
40uF	±(2.5%+5)	10nF
400uF		100nF
4mF		1uF
40mF		10uF
	±(5.0%+8)	

Overload protection: 250V DC/AC peak value.

3.2.8 Frequency (F)

Range	Accuracy	Resolution
10Hz	±(0.5%+4)	0.001Hz
100Hz		0.01Hz
1000Hz		0.1Hz
10kHz		1Hz
100kHz		10Hz
1MHz		100Hz
30MHz		1kHz

Input sensitivity: 0.7V rms.

Overload protection: 250V DC/AC peak value.

3.2.9 Transistor (hFE)

Measurement	Display Range	Test conditions
hFE NPN or PNP	0~1000	Base current is approx 15uA, Vce is about 4.5V

3.2.10 Diode and Continuity Test

Range	Description	Test Conditions
→))	Diode forward direction to voltage drop	Forward DC current is approx 0.8mA, reverse voltage is approx 2.2V.
	When the resistance under test is less than 50Ω, buzzer sounds continuously.	Open circuit voltage: 2V

Overload protection: 250V DC/AC peak value

WARNING: Any voltage at this range is prohibited.

3.2.11 Temperature (°C)

Range	Accuracy	Resolution
-40°C~1000°C	<400°C ±(1.0%+5) ≥400°C ±(1.5%+15)	1°C
0F~1832°F	<750°F ±(1.0%+5) ≥750°F ±(1.5%+15)	°F

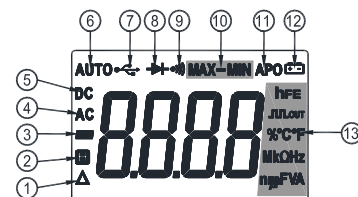
Thermocouple: K type

WARNING: Any voltage at this range is prohibited.

4. OPERATION

4.1 Panel Description

1). LCD: Data and unit symbol display



Sequence	Function symbol	Description
1	Δ	Relative (REL) mode is activated.
2	H	Data Hold is activated.
3	-	Indicates negative readings.
4	DC	DC voltage or current measurement.
5	AC	AC voltage or current measurement.

6	AUTO	Auto range mode.
7	↔	Null
8	→	Diode test mode.
9	→))	The continuity beeper is activated
10	MAX-MIN	it can be measured the difference value between MAX. and MIN..
11	APO	Auto Power Off
12	⊖	Low battery indication. Warning: Please replace the battery in time in order to avoid error readings, electric shock or personal injury.
13	hFE uA MΩ, kΩ, Ω Hz, kHz, MHz mV, V uA, mA, A	hFE (Triode magnification measurement); Null; Duty cycle, Degrees Celsius, Degrees Fahrenheit; Megohm, Kilohm, Ohm; Hertz, Kilohertz, Megahertz; Millivolts, Volts; Microamp, Milliamp, Amperes (A).

②. Rotary switch: it is used to change the range and choose functions.

Symbol	Description
V↔	AC/DC voltage measurement. Press SELECT key to switch between frequency and duty cycle.
Ω→))	Resistance / Diode / continuity measurement. Press SELECT key to choose diode, continuity or resistance range.
⊖	Capacitance measurement.
Hz	Frequency measurement, Press SELECT key to switch between frequency and duty cycle.
NCV	Non-contact voltage detecting.
°C/°F	Temperature measurement, press SELECT key to choose °C or °F.
uA↔	DC current measurement (from 0uA to 6000uA). Press SELECT key to switch to AC current measurement (from 0uA to 6000uA).
mA↔	DC current measurement (from 0mA to 600mA). Press SELECT key to switch to AC current measurement (from 0mA to 600mA).
A↔	DC current measurement (from 0A to 10A). Press SELECT key to switch to AC current measurement (from 0A to 10A).

③Input Terminal

Terminal	Description
TEMP	Input terminal for temperature measurement.
uAmA	Measurement for AC and DC current from 0uA to 400mA (Max 18 hours for less than 400mA).
A	Measurement for AC and DC current from 0A to 20.00A (Overload for max 10 seconds).
VΩHz⊖	Input terminal for voltage, resistance, frequency, capacitance, diode, and continuity, and temperature's positive (+) terminal.
COM	Common terminal for all measurements, and temperature's negative (-) terminal.

④ Function Keys

SELECT Key:

- It is a Select Function base on trigger-action, press this key can be chosen for the measurement mode you need: choose DC or AC measurement when switch to “↔”; Choose resistance test or Diode, Continuity range when switch to “Ω→|))”, and their corresponding symbol are: Ω (for resistance test), →| (for diode test) or →|)) (for continuity test); Choose Degrees Celsius or Degrees Fahrenheit to have Temperature

measurement when switch to “°C/°F”; Press SELECT key to switch the measurement between Frequency or Duty Cycle when it is under ACV measurement status;

- 2) When the Operation is discontinued after 15 minutes, the meter will automatically be power off and being sleeping mode. The buzzer will makes a sound with 5 times to remind user within 1 minute before being sleeping mode. Press this SELECT key to restart power supply if needed.
- 3) Hold the SELECT key and put the power on to cancel auto power off function.

RANGE Key:

Choose Auto range or Manual Range,the original showing is Auto range with “AUTO” symbol, Press RANGE to start Manual range mode. Press RANGE again for a higher level, which one time of pressing for one time of level increasing, i.e. from low-to-high as a circle. Hold the RANGE button for more than 2 seconds to return to Auto range.

REL Key: relative value test or Reset button.

- 1) It is for Relative value measurement of Voltage,current and resistance , press REL key, LCD shows symbol “△”, the meter enters into manual range mode and treat the present reading as a reference, then LCD displays the difference value between the measurement value and reference value. Press REL key again to exit relative value test mode.
- 2) Under lower range of capacitance measurement, REL key is as a reset function key, press REL key, the display is zero.

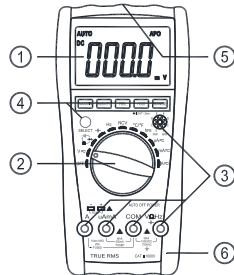
HOLD/☀ Light Key

- 1) HOLD Key : Press HOLD key for few seconds to enter into HOLD mode. The current value will be hold, and symbol “H” will be displayed. Press HOLD again to exit the HOLD mode.
- 2) ☀ Light Key: Press HOLD key for more than 2 seconds to turn on the backlight. The backlight can last for 15 seconds. Press light key “☀” for 2 seconds again to turn off the backlight. If no any actions with this key after 30 seconds the backlight will be off automatically.

⑤ Non-contact voltage detector area.

⑥ Sheath, Battery door.

See picture.



4.2 DCV measurement

4.2.1 Put the black test lead into “COM” terminal, and the red one into “VΩHz” terminal;

4.2.2 Turn the “switch button” to “V” ranges. Press “SELECT” key to choose DC measure mode;

4.2.3 Auto range is the original states, it will displays symbol “AUTO”. Press “RANGE” key

to change to manual range mode, the range of 400mV, 4V, 40V, 400V, 1000V are available;

4.2.4 Connect test leads to the test point; LCD will displays polarity and voltage with the connecting.

NOTE:

- 1) If LCD displays “OL” with manual range, it means it is already exceeds normal range, you need to select a higher range.
- 2) Do not input voltage more than 1000V, if exceeded it might incurred damage of meter circuit, and the buzzer will makes a sound alarm.
- 3) Be careful while measuring a high voltage circuit. DO NOT touch the high voltage circuit.

4.3 ACV measurement

4.3.1 Put the black test lead into “COM” terminal, and the red one into “VΩHz” terminal;

4.3.2 Rotate “ switch button” to “V” range. Press “SELECT” key to choose AC measuring mode;

4.3.3 Auto range is the original states, it will displays symbol “AUTO”, Press “RANGE” key

to change to manual range mode, the range of 400mV, 4V, 40V, 400V, 750V are available;

4.3.4 Connect test leads to the test point; LCD will displays the voltage with the connecting.

NOTE:

- 1) It's only manual range available under 400mV range measurement, press RANGE key to select 400mV range if you need 400mV range measurement;
- 2) If LCD display “OL” at manual range page, it means it is already exceeding normal range, you need to select a higher range.
- 3) Do not input a voltage over than 1000V. If exceeded it might incurred a damage to the meter circuit, and the built-in buzzer will makes a sound alarm.
- 4) Be careful while measuring a high voltage circuit. DO NOT touch the high voltage circuit.

4.4 DCA measurement

4.4.1 Put the black test lead into “COM” terminal and the red one into “mA” terminal (Max. 400mA) or into “A” terminal (Max.20A);

4.4.2 Turn the “switch button” to a proper current range, and then connect the test leads to the electric circuit. Polarity and the current of test point (which connected by the red test lead) will be shown on LCD.

NOTE:

- 1) New users should select the highest range at first, then select the proper range according to displaying value, if users not sure about the range of current which to be tested.
- 2) If the LCD displays “OL”, it means the current is exceeding normal range,you need to select a higher range.
- 3) When tested current $\geq 10A$ at 20A range level, buzzer will makes several sounds to remind user for beware of using.
- 4) When Maximum input current is 400mA or 20A (Depends on where the red test lead to be put into) and Current is exceeding the rated level, it will burn the fuse, and may

cause damage to the circuit of meter.

4.5 ACA measurement

4.5.1 Put the black test lead into “COM” terminal and the red one into “mA” terminal (Max. 600mA) or into “A” terminal (Max.20A);

4.5.2 Rotate “Switch button” to a proper current range, press “SELECT” key to select the AC mode, and then connect the test leads to the electric circuit. LCD will display current value.

NOTE:

- 1) New users should select the highest range at first, then select the proper range according to displaying value, if users not sure about the range of current which to be tested.
- 2) If the LCD displays “OL”, it means the current is exceeding normal range,you need to select a higher range.
- 3) When tested current $\geq 10A$ at 20A range level, buzzer will makes several sounds to remind user for beware of using.
- 4) When Maximum input current is 400mA or 20A (Depends on where the red test lead to be put into) and Current is exceeding the rated level, it will burn the fuse, and may cause damage to the circuit of meter.

4.6 Resistance measurement

4.6.1 Put the black lest lead into “COM” terminal and the red one into “V/Ω/Hz” terminal.

4.6.2 Rotate “ switch button” to “Ω” range, and connect the test leads and target resistor

4.6.3 Press “RANGE” key to choose auto or manual range.

4.6.4 Before measuring low resistance, you should make the test leads to be short-circuit at first,then press “REL” for once.You can get the actual value of the resistance through this way

NOTE:

- 1) When using a measurement at Manual range, please select the highest range if you are not sure about the range of target resistance.
- 2) If LCD displays “OL”, it means it has been exceeded normal range,you need to select a higher range. When measuring value is on &above $1M\Omega$, the reading needs to take a few seconds to be stable. It's normal when having high resistance measurement;
- 3) When input terminal is in an open circuit, LCD will display “OL”;
- 4) Make sure that all of the power is off and all capacitors are discharged completely Before measuring on-line resistor;
- 5) When there is a big error, it may be affected by other online component or there is voltage on the resistor;
- 6) Do not input any voltage at resistance range.

4.7Capacitance measurement

4.7.1 Turn “Switch button” to “F” range;

4.7.2 Put the black test lead into “COM” terminal and the red one into “V/Ω/Hz” terminal;

4.7.3 If the LCD didn't show “0”, press “REL” to clear the reading;

4.7.4 Connect the capacitor to “COM” and “VΩHz” terminal by using test leads. (Note: It is positive polarity “+” for the red test lead), Then LCD shows capacitance value.

NOTE:

- 1) It is prohibited to input the signal of voltage or current when having measurement of capacitance ;
- 2) If there's a reading value to be shown before testing, please press “REL” to clear the reading in order to make sure the accuracy;
- 3) There is only auto range mode with the capacitance range;
- 4) The target capacitor must be completely discharged before testing in order to avoid damage of the meter,;
- 5) If the reading value is more than 200uF range then it will takes more than 15 seconds to be stabled.

4.8 FREQUENCY MEASUREMENT

4.8.1 Put the test leads into or shielding cable to be put into “COM” terminal and “V Ω Hz” terminal;

4.8.2 Turn the “switch button” to “Hz” range, cross-connected the test leads or cable to the signal source or to the target load (It must be over than 3Hz).

4.8.3 Press “Hz/DUTY” key to choose frequency or duty cycle measurement, LCD will display the frequency or duty cycle of the target signal source.

NOTE:

- 1) There is only auto range mode with the frequency range;
- 2) The meter can still work if input current is higher than 10V rms, but the accuracy can not be guaranteed;
- 3) It's better to use a shielded cable to measure a lower signal when under a noisy environment,;
- 4) When measuring high voltage circuit, do not touch the high voltage circuit;
- 5) It's prohibited to input voltage which is more than 250V DC or AC peak value, in order to avoid damage of the meter.

4.9 NON-CONTACT VOLTAGE (NCV) DETECT

WARNING:

This function could be affected by different external interference sources, then it might incurred a wrong alarm. The measurement result is for reference only when you were using this function.

Turn the switch button to “NCV” position. When the target circuit is placed above the meter, the meter will displays strong and weak signal, at the meantime the buzzer will makes an alarm with “beep beep”.

NOTE:

- 1) Even if there is no voltage indication, there may be voltage on the circuit. Do not rely on NCV detector as the only way to detect voltage.
- 2) Voltage detecting may be affected by power socket design, type of insulation and its thickness and other factors.

3) Interference sources of the external environment, such as flashing light, motor might cause a wrong signal to activated alarm function.

4.10 Transistor hFE measurement

4.10.1 Turn Switch button to hFE range;

4.10.2 Define the transistor is NPN or PNP type, then put the emitter, base and collector respectively into relative holes, the value will be displayed on LCD.

4.11 Diode and Continuity test:

4.11.1 Put the black test lead into “COM” terminal and the red one to be put into “VΩHz” terminal (Attention to the polarity of red lead should be “+”)

4.11.2 Turn Switch button to $\Omega \rightarrow \rightarrow \rightarrow$ range, and press “SELECT” key to select diode measurement mode, and then connect test leads with the diode.

4.11.3 Forward direction measurement: connect red test lead to the positive polarity of the target diode and the black test lead to the negative polarity of the target diode. LCD will display similar value of forward drop voltage.

4.11.4 Backward measurement: connect red test lead to the negative polarity of the target diode and the black test lead to positive polarity of the target diode. LCD will display “OL”.

4.11.5 The complete diode testing includes forward direction and backward direction measurement, if the result can't meet these two options, it means the diode is broken.

4.11.6 Press “SELECT” key to select the Continuity measurement mode.

4.11.7 Connect test leads to both ends of target circuit, if the resistance is less than $(50 \pm 10) \Omega$, the buzzer will makes an alarm sound.

NOTE:

- 1) Don't input voltage at “ $\Omega \rightarrow \rightarrow \rightarrow$ ” range.
- 2) Please make sure to shut down the power and all capacitors has been discharged when you have an on-line testing of circuits,. Any electric potential or AC signal will makes the buzzer to be activated.

4.12 TEMPERATURE MEASUREMENT


4.12.1 Turn the switch button to “ $^{\circ}\text{C}/^{\circ}\text{F}$ ” range. Press “SELECT” key to select $^{\circ}\text{C}$ or $^{\circ}\text{F}$ mode.

4.12.2 Put the cold end (free end) of black plug for thermocouple into “TEMP- (or COM)” terminal, Put red plug of thermocouple into “TEMP+ (or VΩHz)” terminal, and put the working end (which is the end of temperature to be measured) of thermocouple on the surface or inside to the temperature field which is being measured. Then LCD will display the temperature value for the target of temperature field, and the reading is in $^{\circ}\text{C}/^{\circ}\text{F}$ (Please pay attention to the polarity, when it appears opposite the reading will be decreasing while the temperature which is to be tested will be increasing).

NOTE:

- 1) When the input terminal is an open circuit, it will display the current environment temperature.
- 2) Don't change the temperature probe randomly, otherwise the accuracy can not be guaranteed.
- 3) Don't input voltage at temperature range.

4.13 Data hold

Press HOLD will enter into HOLD mode, the current value will be held on LCD and symbol  will be displayed. Press HOLD again can exit the HOLD mode.

4.14 Auto power off


4.14.1 If there is no any measurement actions within 15 minutes, the meter will be power off and enter into sleeping mode, when the power is being off within 1 minute the built-in buzzer will makes 5 times of alarm reminder. Press any key to restart the meter if needed.

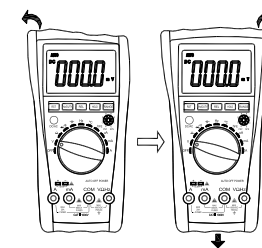
4.14.2 Hold “SELECT” button then turn on the meter, and then “auto power off function” will be canceled.

5. METER MAINTENANCE

The meter is a precise instrument. Random changes to the circuit are not allowed.

NOTE:


- 1) Don't input the voltage value higher than DC 1000V or AC 750V rms.
- 2) Don't measure voltage when the meter is at the range of current, resistance, diode and continuity.
- 3) Don't make any measurements if the battery isn't well installed or the back cover isn't fixed.
- 4) Before replacing fuse, please remove the test leads from the measuring ends and turn off the power.
- 5) Keep the meter away from water, dust and slipping.
- 6) Don't expose or store the meter under high temperature, high humidity, combustible, explosive and strong magnetic place.
- 7) Wipe the case with a damp cloth and a soft detergent. Do not use abrasives and alcohol to clean the meter.
- 8) If the meter is not being used for a long time, you should take out the battery in order to avoid leakage corrosion.
- 9) Attention to battery 9V status, when symbol  is appeared, you should replace the battery according to the following steps:
 - 9-1) Remove the sheath at first and as per picture 2.
 - 9-2) Unscrew the screws on the battery door and remove the cover;
 - 9-3) Take out the old battery and replace with a new one. In order to extend the using life, it's better to use alkaline battery.
 - 9-4) Put on battery door and fix the screws.
 - 9-5) Follow the picture to put on the sheath.
- 10) Fuse replacement: When replacing fuse, please use same type and same specification of fuse.
 - 10-1) Remove the sheath firstly, then unscrew the screws of the battery door and back cover and then open the cover;
 - 10-2) Take off the old fuse and replace with a new one.
 - 10-3) Put on the back cover, then fix the screws of the battery door and back cover. Put on the sheath.



6. Trouble Shooting

If the meter does not work properly, please check the meter as following steps:

(If the problems still cannot be solved, please contact with repairing center or contact the local dealers.)

Fault	Solution
No reading on LCD	<ul style="list-style-type: none">■ Turn on the power;■ Release the HOLD key;■ Replace battery.
 signal appears	<ul style="list-style-type: none">■ Replace battery.
No current to be input	<ul style="list-style-type: none">■ Replace fuse.
Big error Value	<ul style="list-style-type: none">■ Replace battery.

- The specifications are subject to changes without prior notice;
- The content of this manual is regarded as correct. If users find out any mistakes or omissions, please kindly contact the manufacturer;
- The manufacturer will not be responsible for accidents and damage caused by improper operations;
- The functions described in this User Manual shall not be considered as the reason for any special usages;