

EM420 SERIES

DIGITAL MULTIMETER

USERS MANUAL



Read this manual thoroughly before use

WARRANTY

This instrument is warranted to be free from defects in material and workmanship for a period of one year. Any instrument found defective within one year from the delivery date and returned to the factory with transportation charges prepaid, will be repaired, adjusted, or replaced at no charge to the original purchaser. This warranty does not cover expandable items such as battery or fuse. If the defect has been caused by a misuse or abnormal operating conditions, the repair will be billed at a nominal cost.

SAFETY INFORMATION

This series digital multimeters have been designed according to IEC-61010 concerning electronic measuring instruments with a measurement category (CAT II 250V) and pollution degree 2.

Warning

To avoid possible electric shock or personal injury, follow these guidelines:

- a. Do not use the meter if it is damaged. Before you use the meter, inspect the case. Pay particular attention to the insulation surrounding the connectors.
- b. Inspect the test leads for damaged insulation or exposed metal. Check the test leads for continuity. Replace damaged test leads before you use the meter.
Do not use the test leads with other equipment.

- c. Do not use the meter if it operates abnormally. Protection may be impaired. When in doubt, have the meter serviced.
- d. Do not operate the meter around explosive gas, vapor, or dust.
- e. Do not apply more than the rated voltage, as marked on the meter, between terminals or between any terminal and earth ground.
- f. Before use, verify the meter's operation by measuring a known voltage.
- g. When measuring current, turn off circuit power before connecting the meter in the circuit. Remember to place the meter in series with the circuit.
- h. When servicing the meter, use only specified replacement parts.
- i. Use caution when working with voltage above 30V ac rms, 42V peak, or 60V dc. Such voltages pose a shock hazard.
- j. When using the probes, keep your fingers behind the finger guards on the probes.
- k. When making connections, connect the common test lead before you connect the live test lead. When you disconnect test leads, disconnect the live test lead first.
- l. Remove the test leads from the meter before you open the battery cover or the case.
- m. Do not operate the meter with the battery cover or portions of the case removed or loosened.
- n. To avoid false readings, which could lead to possible electric shock or personal injury, replace the batteries as soon as the low battery indicator () appears.

- o. To avoid electric shock, don't touch any naked conductor with hand or skin.
- p. Remaining endangerment:
When an input terminal is connected to dangerous live potential, it is to be noted that this potential at all other terminals can occur!
- q. **CAT II** - Measurement Category II is for measurements performed on circuits directly connected to low voltage installation. (Examples are measurements on household appliances, portable tools and similar equipments .) Do not use the meter for measurements within Measurement Categories III and IV.

Caution

To avoid possible damage to the meter or to the equipment under test, follow these guidelines:

- a. Disconnect circuit power and discharge all capacitors before testing resistance, diode, continuity, temperature or capacitor.
- b. Use the proper terminals, function, and range for your measurements.
- c. Before measuring current, check the meter's fuse and turn off the power to the circuit before connecting the meter to the circuit.
- d. Before rotating the range switch to change functions, remove the test leads or the clamp from the circuit under test.
- e. Before inserting transistor to the adapter, always be sure all test leads have been removed from the meter.
- f. Remove test leads from the meter before opening the battery cover or the case.

Symbols

-  AC (alternating current)
-  DC (direct current)
-  Both direct and alternating current
-  Important safety information. Refer to the manual.
-  Dangerous voltage may be present. Be cautious.
-  Earth ground
-  Fuse
-  Conforms to European Union directives
-  The equipment is protected throughout by double insulation or reinforced insulation.
-  Low battery
-  Diode
-  The maximum value is being held.
-  The display data is being held.
-  Fahrenheit
-  Centigrade
-  Continuity test
-  Measurement with clamp (optional), widening the field of applications of the meter
- AUTO** Autorange
-  This product has been tested to the requirements of CAN/CSA-C22.2 NO. 61010-1, second edition, including Amendment 1, or a later version of the same standard incorporating the same level of testing requirements.

Maintenance

To continue protection against fire, replace blown fuse only with a new one of the same rating.

To clean the meter, use a damp cloth and mild detergent only, do not use abrasives or solvents on it.

INTRODUCTION

This series multimeters are compact 3 1/2 digits digital multimeters for measuring DC and AC voltage, DC and AC current, resistance, temperature, diode, transistor, continuity, capacitance (only EM420B) and battery (only EM420A and EM420C). For EM420C, AC voltage detection and AC live line detection are also provided.

They feature polarity indication, data hold, MAX mode (only EM420A and EM420B), overrange indication and automatic power-off. They are easy to operate and are ideal instrument tools.

Except where noted, the instructions in this manual apply to all models of this series multimeters.

STRUCTURE

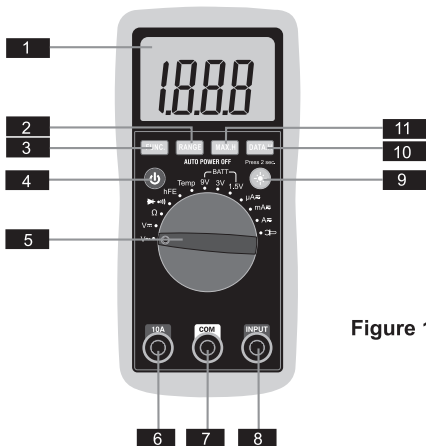


Figure 1

1. Display

3 1/2 digit LCD, with a max. reading of 1999

2. "RANGE" Button

Used to switch between autorange mode and manual range mode as well as to select desired manual range.

3. "FUNC." Button

Used to switch the meter between:

- DC current and AC current measurements.

- b. Celsius and Fahrenheit measurements.
- c. Diode and continuity test functions.
- d. DC voltage and AC voltage measurements. (only EM420C)

4. Power Switch

Used to turn on/off the meter.

5. Function/Range Switch

Used to select desired function and range.

6. "10A" Jack

Plug-in connector for the red test lead for current (200mA~10A) measurements.

7. "COM" Jack

Plug-in connector for the black test lead.

8. "INPUT" Jack

Plug-in connector for the red test lead for all measurements except current ($\geq 200\text{mA}$) measurements.

9. "☼" Button

To turn on or off the backlight, press and hold this button for about 2 seconds.

The backlight will turn off automatically about 15 seconds later after you turn on it.

10. "DATA" Button

Used to enter/exit Data hold mode.

11.a. "MAX" Button (only EM420A and EM420B)

Used for MAX recording.

b. AC Detection Indicator (only EM420C)

An indicator for ac detection.

GENERAL SPECIFICATION

Display: LCD, 1999 counts, updates 2-3 times/sec

Overrange Indication: "OL" shown on the display

Battery: 1.5V, AAA or equivalent, 3 pieces

Negative Polarity Indication: negative sign "-" shown on the display automatically

Low Battery Indication: "  " shown on the display

Operating Temperature: 0°C to 40°C, < 75%RH

Storage Temperature: -10°C to 50°C, < 85%RH

Dimensions: 158 X 75 X 35 mm

Weight: about 200g (including batteries)

SPECIFICATIONS

Accuracy is specified for a period of one year after calibration and at 18°C to 28°C, with relative humidity < 75%.

Accuracy specifications take the form of:

$\pm([\% \text{ of Reading}] + [\text{number of Least Significant Digits}])$

DC Voltage

Range	Resolution	Accuracy
200mV	0.1mV	$\pm (0.8\% + 5)$
2V	0.001V	
20V	0.01V	
200V	0.1V	
250V	1V	$\pm (1\% + 5)$

Input Impedance: 10M Ω

Overload Protection: 250V DC/AC rms

Max. Input Voltage: 250V DC

AC Voltage

Range	Resolution	Accuracy
2V	0.001V	$\pm (1.0\% + 5)$
20V	0.01V	
200V	0.1V	
250V	1V	$\pm (1.2\% + 5)$

Input Impedance: 10M Ω

Frequency Range: 40Hz ~ 400Hz

Overload Protection: 250V DC/AC rms

Response: Average, calibrated in rms of sine wave

Max. Input Voltage: 250V AC rms

DC Current

Range	Resolution	Accuracy
200 μ A	0.1 μ A	$\pm (1.2\%+5)$
2000 μ A	1 μ A	
20mA	0.01mA	
200mA	0.1mA	
2A	0.001A	$\pm (2.0\%+10)$
10A	0.01A	

Overload Protection:

μ A $\approx$ and mA $\approx$ ranges: F 250mA/250V fuse

A $\approx$ ranges: F 10A/250V fuse

Max. Input Current:

"INPUT" jack : 200mA

"10A" jack: 10A

(For measurements > 2A : duration < 15 seconds,
interval > 15 minutes)

Voltage Drop: 200 μ A, 20mA and 2A ranges : 20mV

2000 μ A, 200mA and 10A ranges: 200mV

AC Current

Range	Resolution	Accuracy
200 μ A	0.1 μ A	$\pm(1.5\%+5)$
2000 μ A	1 μ A	
20mA	0.01mA	
200mA	0.1mA	
2A	0.001A	$\pm(3.0\%+10)$
10A	0.01A	

Overload Protection:

μ A $\approx$ and mA $\approx$ ranges: F 250mA/250V fuse
A $\approx$ ranges: F 10A/250V fuse

Max. Input Current:

"INPUT" jack : 200mA

"10A" jack: 10A

(For measurements > 2A: duration < 15 seconds,
interval > 15 minutes)

Voltage Drop: 200 μ A, 20mA and 2A ranges: 20mV
2000 μ A, 200mA and 10A ranges: 200mV

Frequency Range: 40Hz ~ 400Hz

Response: Average, calibrated in rms of sine wave

DC Current (with clamp, only EM420A and EM420B)

	Range	Resolution	Accuracy
meter	 200A	0.1mV/0.1A	$\pm(1.2\%+5)$
meter	 1000A	1mV/1A	$\pm(1.2\%+5)$

Max. Input Voltage: 200mV

AC Current (with clamp, only EM420A and EM420B)

	Range	Resolution	Accuracy
meter	 200A	0.1mV/0.1A	$\pm(1.5\%+5)$
meter	 1000A	1mV/1A	$\pm(1.5\%+5)$

Max. Input Voltage: 200mV

Frequency Range: 40Hz ~ 400Hz

Response: Average, calibrated in rms of sine wave

Resistance

Range	Resolution	Accuracy
200 Ω	0.1 Ω	$\pm(1.2\%+5)$
2k Ω	0.001k Ω	$\pm(1\%+5)$
20k Ω	0.01k Ω	
200k Ω	0.1k Ω	
2M Ω	0.001M Ω	$\pm(1.2\%+5)$
20M Ω	0.01M Ω	$\pm(1.5\%+5)$

Open Circuit Voltage: about 0.25V

Overload Protection: 250V DC/AC rms

Temperature (°C, °F)

Range	Resolution	Accuracy
-20°C ~ 1000°C	1°C	-20°C~0°C: $\pm(5\%+4)$
		0°C~400°C: $\pm(1\%+3)$
		400°C~1000°C: $\pm(2\%+3)$
0°F~ 1800°F	1°F	0°F~50°F: $\pm(5\%+8)$
		50°F~750°F: $\pm(1\%+6)$
		750°F~1800°F: $\pm(2\%+6)$

Note:

1. Accuracy does not include error of the thermocouple probe.
2. Accuracy specification assumes ambient temperature is stable to $\pm 1^\circ\text{C}$. For ambient temperature changes of $\pm 5^\circ\text{C}$, rated accuracy applies after 1 hour.

Battery (only EM420A and EM420C)

Range	Resolution	Function
1. 5V	0. 01V	The approx. voltage of the battery is shown on the LCD.
3V	0. 01V	
9V	0. 01V	
12V	0. 01V	

Overload Protection:

1.5V and 3V ranges: F 250mA/250V fuse

Test Current : 1.5V range: about 50mA

3V range: about 30mA

9V range: about 12mA

12V range: about 120mA

NOTE: Only EM420C has the 12V range.

Capacitance (only EM420B)

Range	Resolution	Accuracy
20nF	0.01nF	$\pm(8\%+10)$
200nF	0.1nF	$\pm(5\%+5)$
2 μ F	0.001 μ F	
20 μ F	0.01 μ F	
200 μ F	0.1 μ F	
1000 μ F	1 μ F	$\pm(8\%+10)$

Overload Protection:

200 μ F and 1000 μ F ranges: no overload protection

the other ranges: F 250mA/250V fuse

Open Circuit Voltage: about 0.5V

Transistor hFE Test

Range	hFE	Test Current	Test Voltage
PNP & NPN	0~1000	$I_b \approx 2\mu A$	$V_{ce} \approx 1V$

Diode and Continuity

Range	Description	Remark
	The approximate forward voltage drop will be displayed.	Open Circuit Voltage: about 1.5V
	The built-in buzzer will sound if the resistance is less than about 30Ω.	Open Circuit Voltage: about 0.5V

Overload Protection: 250V DC/AC rms

For Continuity Test:

If the resistance is between 30Ω and 100Ω, the buzzer may sound or may not sound. If the resistance is more than 100Ω, the buzzer won't sound.

OPERATION INSTRUCTION

Data Hold Mode

Press the "**DATA**" button to hold the present reading on the display, the symbol "**DATA**" will appear on the display as an indicator.

To exit the Data Hold mode, just press this button again. "**DATA**" disappears.

Manual Ranging and Autoranging

The meter defaults to autorange mode in measurement functions which have both autorange mode and manual range mode. When the meter is in the autorange mode, "AUTO" is displayed.

1. Press the "**RANGE**" button to enter the manual range mode. "AUTO" disappears.
Each press of the "RANGE" button increments the range. When the highest range is reached, the meter wraps to the lowest range.
2. To exit the manual range mode, press and hold down the "**RANGE**" button for about 2 seconds. The meter returns to the autorange mode and the symbol "AUTO" is displayed.

MAX Mode (only EM420A and EM420B)

Press the "**MAX**  " button to enter the MAX mode, the symbol "**MAX**  " will appear on the display as an indicator. In this mode, the display shows the maximum reading of all readings taken since this mode is activated. To exit the mode, just press the "**MAX**  " button again, "**MAX**  " will disappear.

Note:

In some functions, the MAX mode is not available.

Measuring DC or AC Voltage

1. Connect the black test lead to the "COM" jack and the red test lead to the "INPUT" jack.
2. a. For models EM420A and EM420B, set the range switch to the $\underline{V}$ position for dc voltage measurements or to the $\underline{V}$ position for ac voltage measurements.
b. For model EM420C, set the range switch to the $V \approx$ position and then press the "**FUNC.**" button to select ac or dc voltage measurement, the display will show the corresponding symbol.
3. Select auto range or manual range mode with the "**RANGE**" button.
In manual range mode, if the magnitude of the voltage to be measured is not known beforehand, select the highest range first and then reduce it range by range until satisfactory resolution is obtained.
4. Connect the test leads across the source or circuit to be measured.
5. Read the reading on the display. For DC voltage measurements, the polarity of the red test lead connection will be indicated as well.

Note:

1. In a small range, the meter may display an unstable reading when the test leads have not been connected to the circuit to be measured. It is normal and will not affect measurement.
2. In manual range mode, when the meter shows the overrange indicator "OL", a higher range should be selected.
3. To avoid damage to the meter, don't measure a voltage higher than 250V DC/AC.

Measuring DC or AC Current

1. Connect the black test lead to the "COM" jack. If the current to be measured is less than 200mA, connect the red test lead to the "INPUT" jack. If the current is between 200mA and 10A , connect the red test lead to the "10A" jack instead.
2. Set the range switch to $\mu A \approx$, $mA \approx$ or $A \approx$ range.
3. Press the "**FUNC.**" button to select DC current or AC current measurement, the display will show the corresponding symbol.
4. Select autorange or manual range mode with the "**RANGE**" button.
5. Turn off power to the circuit which you want to measure.
Discharge all high voltage capacitors.
6. Break the circuit path to be measured, connect the test leads in series with the circuit.
7. Turn on power to the circuit and then read the display. For DC current measurements, the polarity of red lead connection will be indicated as well.

Note:

1. If the magnitude of the current to be measured is not known beforehand, select the highest range and then reduce it range by range until satisfactory resolution is obtained.
2. When the display shows the overrange indicator "OL", a higher range has to be selected.

Measuring Current (with clamp, only EM420A and EM420B)

1. If you want to measure DC current, you must use the DC clamp.
If you want to measure AC current, you must use the AC clamp.
2. Connect the negative (–) output lead of the selected clamp to the "COM" jack, connect the positive (+) output lead of the clamp to the "INPUT" jack,
3. Set the range switch to  position.
4. Select DC current or AC current measurement with the "**FUNC.**" button.
5. Select autorange or manual range mode with the "**RANGE**" button.
In manual range mode, if the magnitude of the current to be measured is not known beforehand, select the highest range.
6. Clamp the circuit to be measured with the clamp.
Note: Each time only one cable should be clamped and the cable should be in the center of the clamp jaws.
7. Read the reading on the display. For DC current measurements, the polarity of the positive (+) output lead of the clamp will be indicated as well.

Note:

1. In manual range mode, when the display shows the overrange indicator "OL", a higher range should be selected.
2. Don't touch the circuit under test with hand or skin.
3. Matching problem about the meter and the sensitivity of the clamp :
 - a. The sensitivity of the matching clamp is 0.1A/0.1mV. If you use a matching clamp, the present indicated value is same to the measured value.

- b. If you use a clamp whose sensitivity does not equal 0.1A/0.1mV, you should multiply the present reading by a factor which is determined by the used clamp, the result is the measured value.
- To determine the factor, please refer to the instruction of the clamp which you use.

Measuring Resistance

1. Connect the black test lead to the "COM" jack and the red test lead to the "INPUT" jack.
2. Set the range switch to Ω range.
3. Select auto range or manual range mode with the **"RANGE"** button.
4. Connect the test leads across the load to be measured. Read the reading on the display.

Note:

1. For resistance measurements $> 1\text{M}\Omega$, the meter may take a few seconds to stabilize reading. This is normal for high-resistance measurements.
2. When the input is not connected, i.e. at open circuit, the symbol "OL" will be displayed as an overrange indicator.
3. Before measuring in-circuit resistance, be sure that the circuit under test has all power removed and all capacitors have been fully discharged.
4. In manual range mode, when the display shows the overrange indicator "OL", a higher range has to be selected.

Measuring Capacitance (only EM420B)

1. Connect the black test lead to the "COM" jack and the red test lead to the "INPUT" jack.
2. Set the range switch to desired "**1000 μ F**", "**20 μ F**" or "**nF**" position.
3. Select autorange or manual range mode with the "**RANGE**" button.
4. Connect test leads across the capacitor to be measured. Make sure that the polarity of the capacitor is observed. (The red test lead should be connected to the anode of the capacitor, and the black one should be connected to the cathode of the capacitor.)
5. Read the reading on the display.

Note:

In small range, before the test leads are connected to the capacitor, the display may show a reading. This is normal because of the stray capacitance of the test leads and input circuit of the meter and will not affect the measurement accuracy.

Continuity Test

1. Connect the black test lead to the "COM" jack and the red test lead to the "INPUT" jack.
2. Set the range switch to $\bullet \gg$ range.
3. Press the "**FUNC.**" button until the symbol " $\bullet \gg$ " appears on the display.
4. Connect the test leads across the circuit to be measured.
5. If the resistance is lower than about 30Ω , the built-in buzzer will sound.

Note:

Before test, disconnect all power to the circuit to be tested and discharged all capacitors fully.

Diode Test

1. Connect the black test lead to the "COM" jack and the red test lead to the "INPUT" jack (Note: The polarity of the red test lead is positive "+").
2. Set the range switch to  range.
3. Press the "FUNC." button until the symbol "" appears on the display.
4. Connect the red test lead to the anode of the diode to be tested and the black test lead to the cathode of the diode.
5. The display will show the approximate forward voltage drop of the diode. If the connections are reversed, "OL" will be shown on the display.

Transistor Test

1. Set the range switch to **hFE** position.
2. Refer to the Figure 2, connect the adapter to the "COM" jack and the "INPUT" jack. Don't reverse the connection.
3. Identify whether the transistor is NPN or PNP type and locate emitter, base and collector leads. Insert the leads of the transistor to be tested into the proper holes of the transistor test socket of the adapter .
4. The display will show the approximate hFE value.



Figure 2

Transistor Test Socket

Measuring Temperature

Note

To avoid possible damage to the meter or other equipment, remember that while the meter is rated for -20°C to $+1000^{\circ}\text{C}$ and 0°F to 1800°F , the K Type Thermocouple provided with the meter is rated to 250°C . For temperatures out of that range, use a higher rated thermocouple.

The K Type Thermocouple provided with the meter is a present, it is not professional and can only be used for non-critical measurements. For accurate measurements, use a professional thermocouple.

1. Set the range switch to **Temp** range.
2. Press the **"FUNC."** button to select celsius or fahrenheit measurement.
3. Insert the black (or **"-**") plug of the K type thermocouple to the "COM" jack and the red (or **"+"**) plug of the thermocouple to the "INPUT" jack.
4. Carefully touch the sensing end of the thermocouple to the object to be measured.
5. Wait a while, then read the reading on the display.

Battery Test (only EM420A and EM420C)

1. Connect the black test lead to the "COM" jack and the red test lead to the "INPUT" jack.
2. According to the rated voltage of the battery to be tested, set the range switch to corresponding **BATT** range position .
3. Connect the test leads to the two terminals of the battery to be tested.
4. Read the reading on the display. The polarity of the red test lead connection will be indicated as well.

AC Detection (only EM420C)

Warning

1. To avoid electric shock, do not touch any naked conductor with hand or skin.
2. Because of the meter's detection limit, a line (or conductor) under test may be live even if the built-in buzzer does not sound and the AC Detection Indicator does not light.
3. Before use, verify the meter's operation by detecting a known ac voltage and a known live line.

1. AC Voltage Detection

1. Set the range switch to the "**TEST**" range position, and turn off the meter.
2. Move the top of the meter to the object to be detected. When

the meter detects AC voltage, the built-in buzzer will sound and the AC Detection Indicator will light.

2. To Detect AC Live Line

1. Set the range switch to the **"TEST"** position, and turn off the meter.
2. Connect a test lead to the **"INPUT"** jack, touch the probe of this test lead to the conductor of the line to be tested. If the line is an ac live line, the built-in buzzer will sound and the AC Detection Indicator will light.

Auto Power Off

Except in the **"TEST"** range (only EM420C), if you don't operate the meter for about 15 minutes, it will turn off automatically. To turn on it again, just rotate the range switch or press a button.

If you press the **"DATA"** button to arouse the meter after it turns off automatically, the automatic power-off feature will be disabled.

BATTERY REPLACEMENT

When the symbol "  " appears on the display, the batteries are low and should be replaced. To replace the battery, use an appropriate screwdriver to gently rotate the rotary lock on the battery cover by 90° in the indicated direction (refer to Figure 3). Remove the battery cover and replace the exhausted batteries with new batteries of the same type ("AAA" type). Reinstall the battery cover, and gently rotate the rotary lock by 90° clockwise to lock the battery cover.

Note:

Excess force will cause damage to the rotary lock.
Don't use a screwdriver which is not big enough.

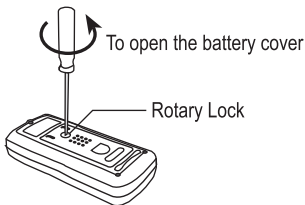


Figure 3

FUSE REPLACEMENT

Fuse rarely needs replacement and is blown almost always as a result of operator's error.

To replace the F 250mA/250V fuse, open the battery cover, replace the blown fuse with a new one of the same rating. Reinstall the battery cover and lock this cover.

To replace the F 10A/250V fuse, remove the screws on the back cover and remove the back cover, replace the blown fuse with a new one of the same rating. Reinstall the back cover and the screws.

This meter uses two fuses:

F1: F 250mA/250V, Ø5×20mm

F2: F 10A/250V, Ø5×20mm

ACCESSORIES

Manual : 1 piece

Test Lead: 1 pair

K Type Thermocouple : 1 piece

Adapter : 1 piece

DC Clamp (optional)

AC Clamp (optional)

NOTE

1. Our company will not take the other responsibilities for any loss.
2. The contents of this manual can not be used as the reason to use the meter for special application.

Zhangzhou Eastern Intelligent Meter Co., Ltd

Address: Zhangzhou High & New Technology Center Building,
Gangqiao, Zhangzhou, Fujian, China

Telephone: (+86-596)2161618

DISPOSAL OF THIS ARTICLE

Dear Customer,

If you at some point intend to dispose of this article, then please keep in mind that many of its components consist of valuable materials, which can be recycled.

Please do not discharge it in the garbage bin, but check with your local council for recycling facilities in your area.

