

DIGITAL MULTIMETER

USER'S MANUAL

CONTENTS

1. GENERAL INSTRUCTIONS.....	1
1.1 Precaution safety measures.....	1
1.2 Safety mechanisms.....	3
2. DESCRIPTION.....	4
2.1 Instrument Familiarization.....	4
2.2 LCD Display.....	5
2.3 Key pad.....	5
2.4 Rotary switch.....	6
2.5 Terminals.....	6
3. TECHNICAL SPECIFICATIONS.....	6
3.1 General specifications.....	6
3.2 Measurement specifications.....	7
4. OPERATING INSTRUCTION.....	11
4.1 Data hold.....	11
4.2 Relative measurement.....	11
4.3 Voltage measurement.....	11
4.4 Resistance measurement.....	12
4.5 Continuity measurement.....	13
4.6 Diode measurement.....	13
4.7 Capacitance measurement.....	13
4.8 Frequency measurement.....	14
4.9 Current measurement.....	15
4.10 Duty cycle measurement.....	15
5. MAINTENANCE.....	16
5.1 General maintenance.....	16
5.2 Testing the fuse.....	16
5.3 Fuse replacement.....	17
5.4 Battery replacement.....	17

1. GENERAL INSTRUCTIONS

This instrument has been designed according to IEC1010 concerning electronic measuring instruments with an overvoltage category (CAT II) and pollution 2.

To get the best service from this instrument, read carefully this user's manual and respect the detailed safety precautions.


1.1 Precautions safety measures

1.1.1 Preliminary

- * When using this Multimeter, the user must observe all normal safety rules concerning:
 - protection against the dangers of electric current.
 - protection of the Multimeter against misuse.
- * For your own safety, only use the test probes supplied with the instrument. Before use, check that they are in good condition.

1.1.2 During use

- * If the meter is used near noise generating equipment, be aware that display may become unstable or indicate large errors.
- * Do not use the meter or test leads if they look damaged.
- * Use the meter only as specified in this manual; otherwise, the protection provided by the meter may be impaired.
- * Use extreme caution when working around bare conductors or bus bars.
- * Do not operate the meter around explosive gas, vapor, or dust.
- * Check the main function dial and make sure it is at the correct position before each measurement.
- * When the range of the value to be measured is unknown, check that the range initially set on the multimeter is the highest possible or, wherever possible, choose the autoranging mode.
- * To avoid damages to the instrument, do not exceed the maximum limits of the input values shown in the technical specification tables.
- * Caution when working with voltages above 60Vdc or 30Vac rms. Such voltages pose a shock hazard.
- * When using the probes, keep your fingers behind the finger guards.

- * When making connections, connect the common test lead before connecting the live test lead; when disconnecting, disconnect the live test lead before disconnecting the common test lead.
- * Before changing functions, disconnect the test leads from the circuit under test.
- * Disconnect circuits power and discharge all high-voltage capacitors before testing resistance, continuity, diodes, or capacitance.
- * Before measuring current, check the meter's fuse (see "Testing the fuse".) and turn off power to the circuit before connecting the meter to the circuit.
- * Change the battery when the  symbol appears to avoid incorrect data.

1.1.3 Symbols:

Symbols used in this manual and on the instrument:



Caution: refer to the instruction manual. Incorrect use may result in damage to the device or its components.



Earth



This instrument has double insulation.



Fuse



Conforms to European Union directives

1.1.4 Instructions

- * Before opening up the instrument, always disconnect from all sources of electric current and make sure you are not charged with static electricity, which may destroy internal components.
- * Any adjustment, maintenance or repair work carried out on the meter while it is live should be carried out only by appropriately qualified personnel, after having taken into account the instructions in this present manual.
- * A "qualified person" is someone who is familiar with the installation, construction and operation of the equipment and the hazards involved.

He is trained and authorized to energize and de-energize circuits and equipment in accordance with established practices.

- * When the instrument is opened up, remember that some internal capacitors can retain a dangerous potential even after the instrument is switched off.
- * If any faults or abnormalities are observed, take the instrument out of service and ensure that it cannot be used until it has been checked out.
- * If the meter is not going to be used for a long time, take out the battery and do not store the meter in high temperature or high humidity environment.

1.2 Safety mechanisms

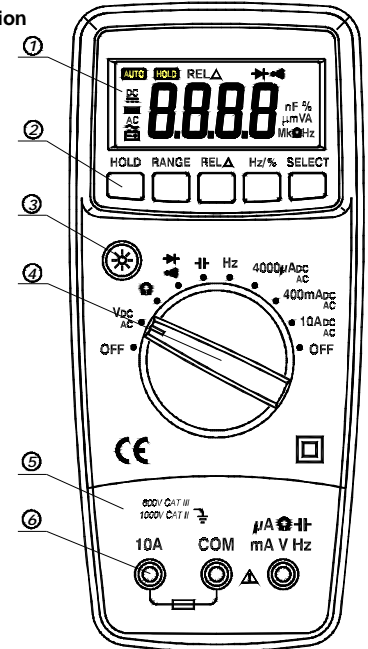
- * The battery unit cannot be accessed without first disconnecting the measuring leads.
- * If the maximum range is repeatedly exceeded, a continuous audible signal warns the user in DCV, ACV, DC μ A, AC μ A, DC mA, AC mA, DC 10A and AC 10A functions.

FUNCTION	MAXIMUM INPUT
DCV	1000V dc
ACV	750V ac rms
DC μ A	4000 μ A dc
AC μ A	4000 μ A ac rms
DC mA	400mA dc
AC mA	400mA ac rms
DC10A	10A dc
AC10A	10A ac rms

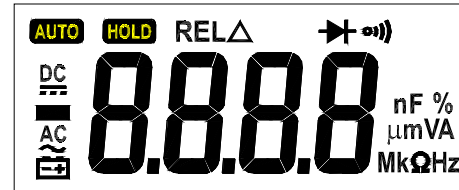
2. DESCRIPTION









2.1 Instrument Familiarization

- (1) LCD display
- (2) Keypad
- (3) Back light key
- (4) Rotary switch
- (5) Battery cover
- (6) Terminals



2.2 LCD Display



	Low battery indication
	Auto range indication
	Hold data indication
RELD	Relative measurement indication
	Diode test indication
	Continuity function indication
	DC input indication
	AC input indication
m V	Voltage measurement indication
mm A	Current measurement indication
kM W	Ohm measurement indication
k Hz	Frequency measurement indication
nm F	Capacitance measurement indication
	Polarity indication
%	Duty cycle measurement indication

2.3 Keypad

CHOLD key:

¥ Fixes the display on the current value and memories it (short press).

¥ A second short press returns the meter to normal mode.

CRANGE key:

¥ Selection of the automatic (default) or manual mode:
short press < 1 sec. on the key, the beep sounds briefly.

¥ Switch from manual to autoranging mode:

long press > 1 sec. on the key, the beep sounds briefly.

¥ In manual mode, ranges selection:

press successively < 1 sec. on the key.

¥ This key is operative in V and Ω ranges.

CRELD key:

¥ Selection of the Relative measurement mode, press on the key, the beep sounds briefly.

¥ This key is operative in V, A, Ω and CAP ranges.

CHz/% key:

¥ Selection of the Frequency or Duty cycle measurement mode: press on the key, the beep sounds briefly.



¥ Press to start the frequency counter.



¥ Press again to enter duty cycle (duty factor) mode.

¥ Press again to exit the frequency counter mode.

¥ This key is operative in V, A and Hz ranges.

CSELECT key:

¥ Selection of the dc (default) or ac mode and the  (default) or  mode: press on the key, the beep sounds briefly.

¥ This key is operative in V, A and  () ranges.

CBACK LIGHT key:

¥ This key is used to turn the backlight on. After about 5 seconds, the backlight is auto-off. To turn the backlight on again, just press this key once more.

2.4 Rotary switch



A ten-position rotary selector switch gives access to the following quantities:

¥ Voltage ¥ Resistance ¥ Diode and Continuity (with beep)

¥ Capacitance ¥ Frequency ¥ 4000 μ A ¥ 400mA

¥ 10A ¥ OFF: off position (2 positions)

2.5 Terminals

Terminal	Description
μ A   mA V Hz	Terminal receiving the red lead for voltage, resistance, mA, μ A, capacitance, frequency, duty cycle, diode and continuity measurements.
COM	Terminal receiving the black lead as a common reference.
10A	Terminal receiving the red lead for 10A measurement.

3. TECHNICAL SPECIFICATIONS

3.1 General specifications

¥ Environment conditions:

600V CAT.III and 1000V CAT. II

Pollution degree: 2

Altitude < 2000 m

Operating temperature: 0~40 °C, (<80% RH, non-condensing)

Storage temperature: -10~60 °C, (<70% RH, battery removed)

¥ Temperature Coefficient:

0.1×(specified accuracy) /°C (<18 °C or >28 °C)

¥ MAX. Voltage between terminals and earth ground:

750V AC rms or 1000V DC

¥ Fuse Protection:

µA and mA: resettable fuse (F2 RXE040)

10A: F 10A/250V Ø6.3×32


¥ Sample Rate: 3 times/sec for digital data.

¥ Display: 3 3/4 digits LCD display with max. reading 3999,

Automatic indication of functions and symbols.

¥ Range selection: automatic and manual.

¥ Over Range indication: LCD will display "OL".

¥ Low battery indication: The "" is displayed when the battery is under the proper operation range.

¥ Polarity indication: "-" displayed automatically.

¥ Auto power off:

If there is no key or dial operation for 15 minutes, the meter will power itself off to save battery consumption.

One minute before power off, the beeper will sound 5 sounds. The beeper will sound again before power off.

¥ Power source: 9V battery, NEDA 1604, 6F22, or 006P.

¥ Dimensions: 185(L)×84(W)×38(H) mm.

¥ Weight: 285g. Approx. (battery included).

¥ Accessories: User's manual. Test leads. Carry case.

3.2 Measurement specifications

* Accuracy:

± (% of reading + number of digits) at 18°C to 28°C (64°F to 82°F) with relative humidity to 80%.

3.2.1 DC Voltage

Range	Resolution	Accuracy
400mV	0.1mV	±(0.7% of rdg +2 digits)
4V	1mV	
40V	10mV	
400V	100mV	
1000V	1V	±(0.8% of rdg +2 digits)

Input impedance: 10MΩ

Maximum input voltage: 1000V dc or 750V ac rms.

3.2.2 AC Voltage

Range	Resolution	Accuracy
4V	1mV	±(0.8% of rdg +3 digits)
40V	10mV	
400V	100mV	
750V	1V	±(1.0% of rdg +3 digits)

Input impedance: 10MΩ

Maximum input voltage: 1000V dc or 750V ac rms.

Frequency Range: 40Hz~1kHz, 40Hz-400Hz for 4V range

Response: Average, calibrated in rms of sine wave


3.2.3 Resistance

Range	Resolution	Accuracy
400Ω	0.1Ω	±(1.2% of rdg+2 digits)
4kΩ	1Ω	
40kΩ	10Ω	
400kΩ	100Ω	
4MΩ	1kΩ	
40MΩ	10kΩ	±(2.0% of rdg+5 digits)

Open circuit voltage: approx. 0.25V

Overload protection: 250V dc or 250V ac rms.


3.2.4 Audible continuity

Range	Continuity beeper
	$\leq 40\Omega$

Open circuit voltage: approximate 0.5V

Overload protection: 250V dc or 250V ac rms.

3.2.5 Diode

Range	Resolution	Function
	1mV	Display read approx. forward voltage of diode

Forward DC Current: approx. 1mA

Reversed DC Voltage: approx. 1.5V

Overload protection: 250V dc or 250V ac rms.

3.2.6 Capacitance

Range	Resolution	Accuracy
4nF	1pF	$\pm (3.0\% \text{ of rdg}+3 \text{ digits})$
40nF	10pF	
400nF	100pF	
4 μ F	1nF	
40 μ F	10nF	
200 μ F	100nF	

Overload protection: 250V dc or 250V ac rms.

3.2.7 Frequency

Range	Resolution	Accuracy
9.999Hz	0.001 Hz	$\pm (2.0\% \text{ of rdg}+5 \text{ digits})$
99.99Hz	0.01 Hz	
999.9Hz	0.1 Hz	
9.999kHz	1Hz	
99.99kHz	10Hz	
199.9kHz	100Hz	
>200kHz	100Hz	Unspecified @ >200kHz

- By Hz range:

Overload protection: 250V dc or 250V ac rms.

Input Voltage range: 0.6V-3V ac rms (Input voltage must be enlarged with increasing frequency under measurement)

Frequency Response: 600Hz-200kHz, sine wave.

0.5Hz-200kHz, square wave.

- By V range:

Input Voltage range: 1V-750V ac rms (Input voltage must be enlarged with increasing frequency under measurement)

Frequency Response: 1Hz-10kHz, sine wave.

Maximum input voltage: 1000V dc or 750V ac rms.

Input impedance: 10M Ω

- By A range:

Input current range:

500 μ A -4000 μ A ac rms for 4000 μ A range.

50mA-400mA ac rms for 400mA range.

(Input current must be enlarged with increasing frequency under measurement)

Frequency Response: 1Hz-10kHz, sine wave.

Maximum input current: 400mA dc or 400mA ac rms for μ A and mA ranges.

3.2.8 DC Current

Range	Resolution	Accuracy
4000 μ A	1 μ A	$\pm (1.2\% \text{ of rdg}+3 \text{ digits})$
400mA	0.1mA	
10A	10mA	$\pm (2.0\% \text{ of rdg}+5 \text{ digits})$

Overload protection: F 10A/250V fuse for 10A range.

Resettable fuse for μ A and mA ranges.

Maximum input current: 400mA dc or 400mA ac rms for μ A and mA ranges.

3.2.9 AC Current

Range	Resolution	Accuracy
4000 μ A	1 μ A	\pm (1.5% of rdg+5 digits)
400mA	0.1mA	
10A	10mA	\pm (3.0% of rdg+7 digits)

Overload protection: F 10A/250V fuse for 10A range.

Resettable fuse for μ A and mA ranges.

Maximum input current: 400mA dc or 400mA ac rms for μ A and mA ranges.

Frequency Range: 40Hz-1kHz

Response: Average, calibrated in rms of sine wave

4. OPERATING INSTRUCTION

4.1 Data hold

⌘ During measure, you can press the "HOLD" key to hold the last reading and the "**HOLD**" symbol will appear on the LCD.

⌘ A second short press returns the instrument to normal mode.

4.2 Relative measurement

⌘ Press the "REL Δ " key once to enter the relative measurement mode and the "REL Δ " symbol will appear on the LCD. The reading on the LCD is the relative value.

Relative value equal to real measuring value minus reference value.

The reference value is the last reading before enter the relative measurement mode

⌘ A second short press returns the instrument to normal mode.

⌘ Relative measurement is operative in V, A, Ω and CAP ranges.

4.3 Voltage measurement

⚠ To avoid electrical shock and/or damage to the instrument, do not attempt to take any voltage measurement that might exceeds 1000Vdc or 750Vac rms. Do not apply more than 1000Vdc or 750Vac rms between the common terminal and the earth ground.

⌘ Set rotary switch to the V range.

⌘ Press "SELECT" key to select DCV or ACV measuring mode. (Press "RANGE" key to select manual range.)

⌘ Connect the black and red test leads to the COM and V terminals respectively.

⌘ Connect the test leads to the circuit being measured

⌘ Read the displayed value. The polarity of red test lead connection will be indicated when making a DC measurement.

NOTE:

⌘ Unstable display may occur especially at 400mV dc range, even though you do not put test leads into input terminals, in this case, if an erroneous reading is suspected, short the V terminal and the COM terminal, and make sure the zero display.

⌘ For better accuracy when measuring the dc offset of an ac voltage, measure the ac voltage first. Note the ac voltage range, the manually select a dc voltage range equal to or higher than the ac range. This improves the accuracy of the dc measurement by ensuring that the input protection circuits are not activated.

4.4 Resistance measurement

⚠ To avoid electrical shock and/or damage to the instrument, disconnect circuit power and discharge all high-voltage capacitors before measuring resistance.

⌘ Set the rotary switch to Ω range.

⌘ Connect the black and red test leads to the COM and V Ω terminals respectively.

⌘ Connect the test leads to the circuit being measured and read the displayed value.

⌘ In order to ensure the best accuracy in measurement of low resistance, short the test leads before measurement and memory the test probe resistance in mind. This necessary to subtract for the resistance of the test leads.

NOTE:

⌘ On 40M Ω range, the meter may take a few seconds to stabilize reading. This is normal for high resistance measuring.

⌘ When the input is not connected, i.e. at open circuit, the figure "OL" will

be displayed for the overrange condition.

4.5 Continuity measurement

⚠ To avoid electrical shock and/or damage to the instrument, disconnect circuit power and discharge all high-voltage capacitors before testing for Continuity.

- ✎ Set the rotary switch to \rightarrow (\rightarrow) range.
- ✎ Press "SELECT" key to select \rightarrow measuring mode.
- ✎ Connect the black and red test leads to the COM and Ω terminals respectively.
- ✎ Connect the test leads to the resistance in the circuit being measured.
- ✎ When the test lead to the circuit is below 40 Ω , a continuous beeping will indicate it.

Note: continuity test is available to check open/short of the circuit.

4.6 Diode measurement

⚠ To avoid electrical shock and/or damage to the instrument, disconnect circuit power and discharge all high-voltage capacitors before testing diodes.

- ✎ Set the rotary switch to \rightarrow (\rightarrow) range.
- ✎ Press "SELECT" key to select \rightarrow measuring mode.
- ✎ Connect the black and red test leads to the COM and Ω terminals respectively.
- ✎ Connect the red test lead to the anode, black test lead to the cathode of the diode under testing.
- ✎ The meter will show the approx. forward voltage of the diode. If the lead connection is reversed, only figure "OL" displayed.

4.7 Capacitance measurement

⚠ To avoid electrical shock and/or damage to the instrument, disconnect circuit power and discharge all high-voltage capacitors before measuring capacitance. Use the dc voltage function to confirm that the capacitor is discharged.

- ✎ Set the rotary switch to \rightarrow range.
- ✎ Connect the black and red test leads to the COM and \rightarrow terminals respectively.
- ✎ Connect the test leads to the capacitor being measured and read the displayed value.

NOTE:

- ✎ The meter may take a few seconds (200 μ F range, 30 seconds) to stabilize reading. This is normal for high capacitance measuring.
- ✎ To improve the accuracy of measurements less than 4nF, subtract the residual capacitance of the meter and leads.

4.8 Frequency measurement

4.8.1 To measure frequency by Hz range

- ✎ Set the rotary switch to Hz range.
- ✎ Connect the black and red test leads to the COM and Hz terminals respectively.
- ✎ Connect the test leads across the source or load under measurement, and read the displayed value.

Note:

- ✎ Reading is possible at input voltages above 3V rms, but the accuracy is not guaranteed.
- ✎ In noisy environment, it is preferable to use shield cable for measuring small signal.

4.8.2 To measure frequency by V (or A) range

- ✎ Set the rotary switch to the desired range.
- ✎ Connect the black and red test leads to the COM and V (or mA) terminals respectively.
- ✎ Connect the meter to the signal source; then press Hz/% key.
- ✎ For 5V logic signals (TTL), use the 4Vdc range. For 12V switching signals in automobiles, use the 40Vdc range.

Note:

¥ If the reading is 0.000Hz or is unstable, the input signal may be below or near the trigger level.

These problems can frequently be fixed by selecting a lower range, which increases the sensitivity of the meter. In the DCV function, the lower ranges also have lower trigger levels.

¥ If a reading seems to be a multiple of what you expect, the input signal may be distorted.

Distortion can cause multiple triggering of the frequency counter. Selecting a higher voltage range might solve this problem by decreasing the sensitivity of the meter. Also, try selecting a dc range, which raises the trigger level. In general, the lowest frequency displayed is the correct one.

4.9 Current measurement



To avoid damage to the meter, check the meter's fuse before proceeding. (See "Testing the fuse".) Use the proper terminals, function, and range for your measurement.

¥ Set the rotary switch to the 4000 μ A, 400mA or 10A range.

¥ Press "SELECT" key to select DCA or ACA measuring mode.

¥ Connect the black test lead to the COM terminal and the red test leads to the mA terminal for a maximum of 40mA. For a maximum of 10A, move the red test lead to the 10A terminal.

¥ Connect test leads in series with the load in which the current is to be measured.

¥ Read the displayed value. The polarity of red test lead connection will be indicated when making a DC measurement.

¥ When only the figure "OL" displayed (Buzzer will sound continually), it indicates overrange situation and the higher range has to be selected.

4.10 Duty cycle measurement

Duty cycle (duty factor) is the percentage of time a signal is above or below a trigger level during one cycle.

The duty cycle mode is optimized for measuring the on or off time of logic and switching power supplies are controlled by pulses of varying width that can be checked by measuring duty cycle.

To measure duty cycle:

¥ Set up the meter on measure frequency.

¥ To select duty cycle, press Hz/% key again (or until the "%" symbol is shown on the right of the display).

¥ For 5V logic signals, use the 4Vdc range. For 12V switching signals in automobiles, use the 40Vdc range.

¥ For sine waves, use the lowest range that does not result in multiple triggering. (Normally, a distortion-free signal can be up to ten times the amplitude of the selected voltage range.)

5. MAINTENANCE

5.1 General Maintenance



To avoid electrical shock or damage to the meter, do not get water inside the case. Remove the test leads and any input signals before opening the case

Periodically wipe the case with a damp cloth and mild detergent. Do not use abrasives or solvents.

Dirt or moisture in the terminals can affect readings.

To clean the terminals:

¥ Turn the meter off and remove all test leads.

¥ Shake out any dirt that may be in the terminals.

¥ Soak a new swab with a cleaning and oiling agent (such as WD-40).

¥ Work the swab around in each terminal. The oiling agent insulates the terminals from moisture-related contamination.

5.2 Testing the fuse

¥ Set the rotary switch to Ω range.

¥ Plug a test lead into the Ω terminal and touch the probe to the 10A

terminal.

- ✘ If the display shows a resistance value lower than 1Ω , the fuse is good.
- ✘ If the display shows "OL", replace the fuse and test again.
- ✘ If the display shows any other value, have the meter serviced.

5.3 Fuse replacement


⚠ Before replacing the fuse, disconnect test leads from any circuit under test. To prevent damage or injury, replace the fuse only with specified ratings.

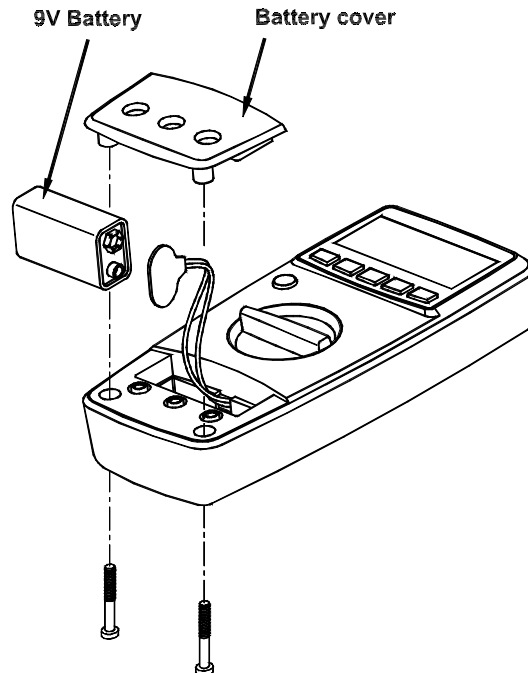
- ✘ Set rotary switch to OFF position.
- ✘ Disconnect test leads from any inputs terminals.
- ✘ Use a screwdriver to unscrew the three screws secured on the back cover and the battery cover.
- ✘ Separate the back cover from the top case.
- ✘ Replace the fuse only with specified ratings:
F 10A/250V $\varnothing 6.3 \times 32$.
- ✘ Replace the back cover and secure by the three screws.

5.4 Battery replacement

⚠ Before replacing the battery, disconnect test leads from any circuit under test, turn the meter off and remove test leads from the input terminals.

Use the following procedure:

- ✘ When the battery voltage drop below proper operation range the  symbol will appear on the LCD display and the battery need to be replaced.
- ✘ Set range switch to OFF position.
- ✘ Disconnect test leads from any inputs terminals.
- ✘ Use a screwdriver to unscrew the two screws secured on the battery cover, and remove the battery cover.
- ✘ Replace the battery with a new 9V battery (NEDA 1604, 6F22, or 006P).
- ✘ Reinstall the battery cover and secure by the two screws.



Battery Replacement

⚠ CAUTION

Using this appliance in an environment with a strong radiated radio-frequency electromagnetic field (approx. 3V/m), may influence its measuring accuracy. The measuring result can be strongly deviating from the actual value.