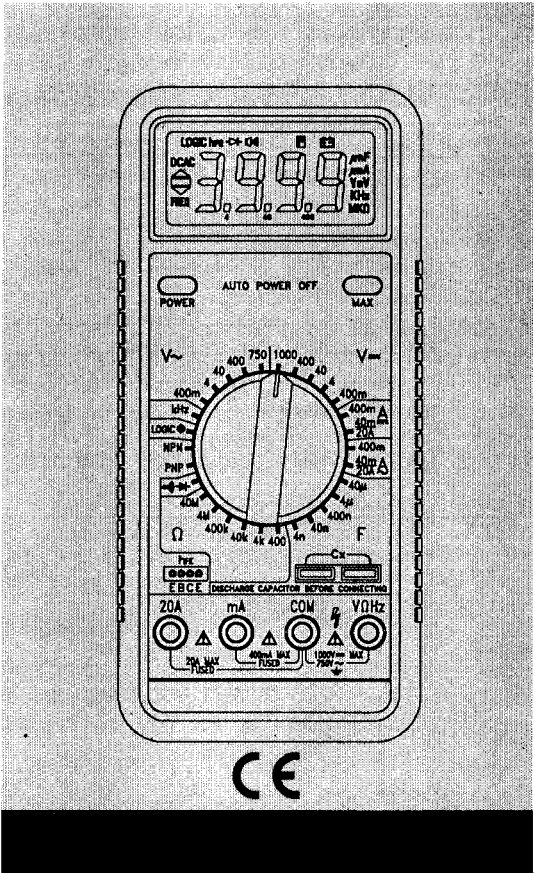
OPERATING INSTRUCTIONS
Model 8020
DIGITAL MULTIMETER



CONTENTS

INTRODUCTION

This manual contains information and warnings which must be followed to ensure safe operation and retain the meter in safe condition.

WARNING

READ "SAFETY INFORMATION" BEFORE USING THE METER.

This multimeter is a handheld, 4000-count instrument that is designed for use in the laboratory, field servicing, and at home. This meter features compact design with rounded corners for easy handling and has a rugged case in shock resistant and fire-retardant. Electronic overload protection for all functions and ranges. The Protective Holster (optional accessory) combined with rugged case make it a durable and reliable instrument.

UNPACKING AND INSPECTION

Upon removing your new Digital Multimeter (DMM) from its packing, you should have the following items:

1. Digital Multimeter
2. Test Lead Set (one black, one red)
3. 9-Volt Battery (installed in meter)
4. Instruction Manual
5. One Spare Fuse (500mA/600V, 6.3mm x 25mm, fast acting)

If any of the above items are missing or are received in a damaged condition, please contact the distributor from whom you purchased the unit.

SAFETY INFORMATION

Injury or death can occur even with low voltages and low currents. It is extremely important that you read these safety information before using your multimeter. Follow all safety practices and proper operating procedures for equipment being tested.

1. Exercise extreme caution when:
   Measuring voltage above 20 volts, measuring current greater than 10mA, measuring AC power line with inductive loads, measuring AC power line during electrical storms.

2. Always inspect your DMM, test leads and accessories for any sign of damage or abnormality before every use. If any abnormal conditions exist (i.e., broken or damaged test leads, cracked case, display not reading, etc.), do not attempt to take any measurements.

3. Never ground yourself when taking electrical measurements. Do not touch exposed metal pipes, outlets, fixtures, etc., which might be at ground potential. Keep your body isolated from ground by using dry clothing, rubber shoes, rubber mats, or any approved insulating material.

4. Never touch exposed wiring, connections, test probe tips, or any live circuit conductors when attempting to make measurements.

5. Never replace the protective fuse inside the DMM with a fuse other than the specified or approved equal fuse.

6. Do not operate this instrument in an explosive atmosphere (i.e., in the presence of flammable gases or fumes, vapor or dust.)

7. Measuring voltage which exceeds the limits of the multimeter may damage the meter and expose the operator to a shock hazard. Always recognize the meter voltage limits as stated on the front of the meter.

8. Never apply more than 500VDC between the COM jack and earth ground.

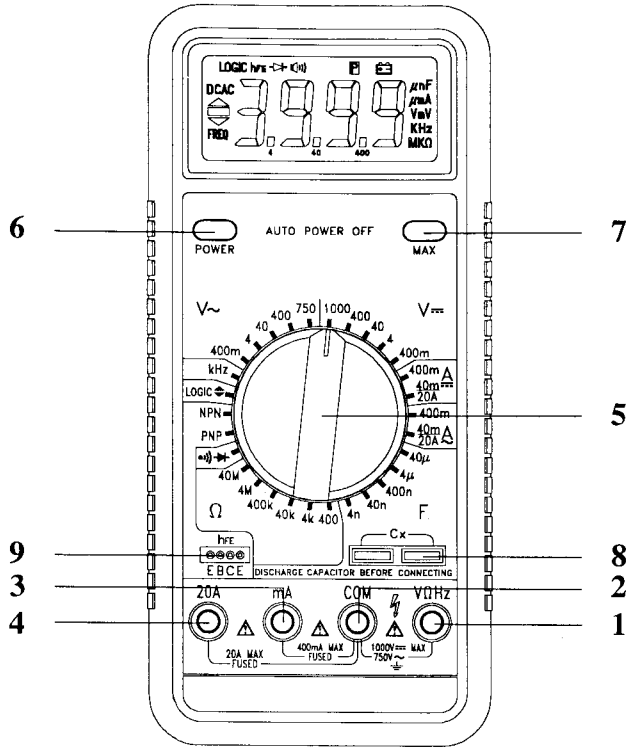
9. Never touch a voltage source when the test leads are plugged into a current jack.

10. When testing for the presence of voltage or current, make sure the voltage or current ranges are functioning correctly. Take a reading of a known voltage or current before assuming a zero reading indicates no current or voltage.

SYMBOL EXPLANATION

	Attention! Refer to the Operating Instructions
	Dangerous Voltage May Be Present at terminals
	Ground
	AC - Alternating Current
	DC - Direct Current
	Audible Continuity / Diode
	Logic Test
	Double Insulation

INSTRUMENT LAYOUT



1 V Ω Hz ⊣⊢ ⇳ Volt, Ohms, Frequency, Diode, Logic Input Terminal

This is the positive input terminal for all functions except current measurements. Connection is made to it using the Red test lead.

2 COM Common Terminal

This is the negative (ground) input terminal for all measurement modes. Connection is made to it using the Black test lead.

3 μA mA Microamp/Milliamp Input Terminal

This is the positive input terminal for current measurement (ac or dc) up to 400 mA. Connection is made to it using the Red test lead.

4 20A 20 Amperes Input Terminal

This is the positive input terminal for current measurement (ac or dc) up to 20A. Connection is made to it using the Red test lead.

5 Function / Range Selector Rotary Switch

This rotary switch selects the function, and selects the desired range.

6 Power Button

This switch is used to turn meter on or off.

7 MAX Maximum Recording Mode

This measurement function is used to measure the maximum value of a signal.

It is usable with AC/DC voltage, AC/DC current, resistance, frequency and temperature measurements.

To use this function, select the function and range and press the MAX button. When this is done, the "MAX" annunciator will appear in the display. Next, by inputting a signal, the MAX function operates. This maximum (MAX) value is held in digital memory for a long period. To exit the MAX mode, press the MAX button once again.

8 Capacitor Test Socket
In the capacitance measurements, insert the capacitance leads into this socket.

9 Transistor Test Socket
In the transistor measurements, insert the transistor leads into this socket.

10 Other Functions

• Auto Power Off
Automatic power-off extends the life of the battery by turning the meter off. After approximately 45 minutes of inactivity.

• Input Warning Beeper
The Input Warning Beeper is a feature to protect the meter and you from unintentional misuse. If the DMM is set to measure a voltage while the test leads are plugged into a current jack, very high current could result when the test lead tips are placed to the voltage test point. This feature warns you that the test lead needs to be changed from a current jack to the voltage jack.
All current ranges are fused with fast acting ceramic fuses as an added protection.

HOW TO MAKE MEASUREMENTS

Before making any measurements always examine the instrument and accessories used with the instrument for damage, contamination (excessive dirt, grease, ect.) and defects. Examine the test leads for cracked or frayed insulation and make sure the lead plugs fit snugly into the instrument jacks. If any abnormal conditions exist do not attempt to make any measurements.

VOLTAGE MEASUREMENTS

1. Insert the black and red test leads into the COM and V-Ω input terminals respectively.
2. Select the desired AC voltage range (V ~), or DC voltage range (V ⎓).

WARNING
To avoid possible electric shock, instrument damage and / or equipment damage, do not attempt to take any voltage measurements if the voltage is above 1000Vdc / 750Vac. 1000Vdc and 750Vac are the maximum voltages that this instrument is designed to measure. The "COM" terminal potential should not exceed 500V measured to ground.

3. Connect the test lead tips in parallel with the circuit to be measured (e.g. across a load or power supply). Be careful not to touch any energised conductors. Note the reading.
4. When all measurements are completed, disconnect the test leads from the circuit under test. Remove test leads from the multimeter.

For DC voltage readings, the RED lead tip should be connected to the positive side of the circuit, the BLACK lead to the negative side.

A minus sign on the left hand side of the LCD will appear if the leads are connected the other way round.

CURRENT MEASUREMENTS

These are made in series with the test circuit. All the current to be measured flows through the multimeter.

WARNING

Do not attempt to measure currents in high energy circuits capable of delivering greater than 600V. Since the fuse is rated at 600V damage or injury could occur. The 20A input terminal is protected by a 20A/600V high energy, fast blow fuse. The mA input terminal is protected by a 500mA/600V fast blow fuse.

Do not exceed the limits of each current input terminal. This is 20A (maximum time limit of 30 seconds for currents greater than 10A) for the 20A terminal and 400mA for the mA terminal.

All current ranges are fused. If a current greater than 20A on the 20A range or greater than 500mA on all other ranges flows, the fuse will blow causing an open circuit between the current measuring terminals.

1. Insert the BLACK test lead in the COM input terminal.
2. For measuring currents less than 400mA, connect the RED test lead to the mA input terminal. For measuring currents between 400mA and 20A connect the RED test lead to the 20A terminal.
3. Select the desired AC current range (A ~) or DC current range (A ⎓).
4. Switch OFF or disconnect the circuit to be measured from all power sources, connect the multimeter in series with the conductor in which the current to be measured flows.
5. Switch ON the circuit. Note the reading.
6. Switch OFF or disconnect the circuit and remove the test leads from multimeter.

CAUTION

A common abuse of multimeters is to attempt to measure a voltage while the test leads are still plugged into the current input terminals. This basically puts a short circuit across the voltage source since current ranges have a low impedance. If the voltage source is typically 240VAC or a 3-phase industrial voltage (415V), very high fault currents can result. This is why all current input terminal are fused. If the fuses blow they must only be replaced by the equivalent ones otherwise the safety of the instrument may be impaired.

7. Never apply a voltage between the COM terminal and current terminals.
8. When switching between current ranges to obtain greater accuracy and better resolution, completely de-energise the circuit to be measured before changing the range.

RESISTANCE MEASUREMENTS

CAUTION

Turn off power on the test circuit and discharge all capacitors before attempting in-circuit resistance measurements. If an external voltage is present across a component, it will be impossible to take an accurate measurement of the resistance of that component.

1. Insert the BLACK and RED test leads into the COM and VΩ input terminals respectively.
2. Select the desired ohms (Ω) range.
3. Connect the BLACK and RED test probe tips to the circuit or device under test, making sure it is de-energised first.
4. Test lead resistance can interfere when measuring low resistance readings and should be subtracted from resistance measurements for accuracy. Select lowest resistance range and make the test leads short together. The display value is the test lead resistance to be subtracted.

CONTINUITY TESTING

1. Select the ( ) position by turning the rotary selector switch.
2. Follow steps 1 and 3 as for resistance measurements.
   An audible tone will sound for resistance less than approximately 150Ω. After all measurements are completed, disconnect the test leads from the circuit and from the multimeter input terminals.

DIODE TESTING

CAUTION
Turn off power to the device under test and discharge all capacitors.

1. Set the rotary selector switch to the ( ) position.
2. Follow steps 1 and 3 as for resistance measurements.
3. The RED lead should be connected to the anode and the BLACK lead to the cathode. The typical forward voltage drop should be about 0.7V for silicon diode or 0.4V for germanium diode.
4. If the diode is reverse biased or there is an open circuit the reading displayed will be between 3150mV and 3450mV.

FREQUENCY MEASUREMENTS

1. Set the rotary selector switch to the (kHz) position.
2. Insert the BLACK and RED test leads into the "COM" and "VΩ" input terminals respectively.
3. Determine that the amplitude level of the signal to be measured is not greater than the input voltage limit. The signal amplitude must also be greater than the sensitivity level.
4. Attach the probe tips to the points across which the frequency is to be measured, and read the result directly from the display.
5. Disconnect the DMM test leads.

LOGIC TESTING

1. Insert the BLACK and RED test leads into the "COM" and "VΩ" input terminals respectively.
2. Select the logic function by rotating the selector dial to the ( ) logic position.
3. Connect the BLACK probe tip to the Common Bus of the logic circuitry to be measured.
4. Connect the RED probe tip to the point to be tested.
5. With a logic high pulse (1), the ▲ indicator will display in the LCD. With a logic low pulse (0), the ▼ indicator will appear in the LCD and a beeping sound will emit.

CAPACITANCE MEASUREMENTS

1. Turn off power to the device under test and discharge all capacitors.
2. Discharge all voltage from the capacitor before measuring its capacitance value.
   NOTE: A safe way to discharge a capacitor is to connect a 100kΩ resistor across the two capacitor leads.
3. Set the rotary selector switch to the capacitance range that gives the most accurate measurement reading.
4. Plug the capacitor leads into the capacitor test jacks.
5. Read capacitance value directly from the display.

TRANSISTOR h_{FE} MEASUREMENTS

1. Transistor must be out of circuit. Set the rotary selector switch to the PNP or NPN position, according to the type of transistor to be measured.
2. Plug the emitter, base and collector leads of the transistor into the correct holes in either the NPN or the PNP transistor test socket. Read the h_{FE} beta, (DC current gain) in the display.

SPECIFICATIONS

- **Display:** 3¾ digits, 17mm large LCD maximum reading 3999 with function and units sign annunciators.
- **Polarity Indication:** Automatic, positive implied, negative indicated.
- **Overrange Indication:** (OL) is displayed.
- **Low Battery Indication:** The " ⊟ " is displayed when the battery voltage drops below accurate operating level.
- **Display Update Rate:** 2.5 per second, nominal.
- **Operating Environment:** 0°C to 50°C, 0 to 70% Relative Humidity.
- **Storage Environment:** -20°C to 60°C, 0 to 80% RH with battery removed from meter.
- **Auto Power Off:** After 45 minutes of no function or range change.
- **Power:** Standard 9-volt battery, NEDA 1604, IEC 6F22, JIS 006P.
- **Battery Life:** 300 hours typical with carbon-zinc battery.
- **Size** (H x W x D): 7.5 x 3.4 x 1.5 inches (18.9 x 8.7 x 3.7 cm).
- **Weight:** Approx. 320 grams (including battery).

* Accuracy is given as ±([% of reading]+[number of least significant digits]) at 18°C to 28°C, with relative humidity up to 70%.

DC Volts

Range	Resolution	Accuracy	Input Impedance
400mV	100μV	±(0.5% rdg+1d)	20MΩ
4V	1mV	±(0.5% rdg+1d)	20MΩ
40V	10mV	±(0.5% rdg+1d)	20MΩ
400V	100mV	±(0.5% rdg+1d)	20MΩ
1000V	1V	±(0.5% rdg+1d)	20MΩ

Overload Protection: 500VDC/350VRMS 15sec on 400mV range
1000VDC / 750VRMS on all other ranges

AC Volts (Average sensing RMS indicating)

Range	Resolution	Accuracy (50Hz - 500Hz)	Input Impedance
400mV	100μV	±(1.2% rdg+3d)	20MΩ
4V	1mV	±(1.2% rdg+3d)	20MΩ
40V	10mV	±(1.2% rdg+3d)	20MΩ
400V	100mV	±(1.2% rdg+3d)	20MΩ
750V	1V	±(2.0% rdg+3d)	20MΩ

Overload Protection: 500VDC/350VRMS 15sec on 400mV range
1000VDC / 750VRMS on all other ranges

DC Current

Range	Resolution	Accuracy	Burden Voltage
40mA	10μA	±(1.0% rdg+1d)	400mV
400mA	100μA	±(1.0% rdg+1d)	900mV
20A**	10mA	±(3.0% rdg+3d)	700mV

Overload Protection: 500mA/600V fuse on mA inputs (fast blow ceramic fuse). 20A/600V fuse on 20A inputs(fast blow ceramic fuse).
**10A continuous, 20A for 30 seconds maximum.

AC Current (Average sensing RMS indicating)

Range	Resolution	Accuracy (50Hz to 500Hz)	Burden Voltage
40mA	10μA	±(1.5% rdg+4d)	400mV
400mA	100μA	±(1.5% rdg+4d)	900mV
20A**	10mA	±(3.5% rdg+4d)	700mV

Overload Protection: 500mA/600V fuse on mA inputs (fast blow ceramic fuse). 20A/600V fuse on 20A inputs(fast blow ceramic fuse).
**10A continuous, 20A for 30 seconds maximum.

Resistance

Range	Resolution	Accuracy	Open Circuit Volts
400Ω	0.1Ω	±(1.0% rdg+4d)	3.45Vdc
4KΩ	1Ω	±(0.75% rdg+4d)	0.6Vdc
40KΩ	10Ω	±(0.75% rdg+4d)	0.6Vdc
400KΩ	100Ω	±(0.75% rdg+4d)	0.6Vdc
4MΩ	1KΩ	±(0.75% rdg+4d)	0.6Vdc
40MΩ	10KΩ	±(2.0% rdg+5d)	0.6Vdc

Overload Protection: 500V DC or RMS AC

Continuity Test

Range	Audible Threshold	Response Time	Open Circuit Volts
400Ω	Less than 150Ω	Approx. 150ms	3.45Vdc

Overload Protection: 500V DC or RMS AC

Diode Test

Range	Resolution	Accuracy	Test Current	Open Circuit Volts
4V	1mV	±(1.0% rdg+1d)	1.0mA	3.45Vdc typical

Overload Protection: 500V DC or RMS AC

Logic Test

Thresholds		Pulse Rise	Pulse Rep	Pluse Width
Logic 1 (Hi)	Logic 0 (Lo)	(max.)	(max.)	(min.)
2.8V±0.8V	0.8V±0.5V	10μSec	1Mpps	25nS

Test Voltage: 5VDC
Duty Cycle: >20% and <80%
Frequency Response: 20MHz
Indication: 40msec beep at logic 0 (Lo)
Overload Protection: 500VDC or RMS AC

Frequency (Autoranging)

Range	Resolution	Accuracy	Input Protection
4kHz	1Hz	±(0.1% rdg+4d)	500VDC/RMSAC
40kHz	10Hz	±(0.1% rdg+4d)	500VDC/RMSAC
400kHz	100Hz	±(0.1% rdg+4d)	500VDC/RMSAC
4000kHz	1kHz	±(0.1% rdg+4d)	500VDC/RMSAC

Sensitivity: 250mV RMS min. on 10Hz to 1MHz
500mV RMS min. on 1MHz to 4MHz
Duty cycle limits: >30% and <70%
Effect reading: More than 10Hz at pulse width >2μSec

Capacitance

Range	Resolution	Accuracy	Test Frequency
4nF	1pF	±(3.0% rdg+10d)	180Hz
40nF	10pF	±(3.0% rdg+10d)	180Hz
400nF	100pF	±(3.0% rdg+10d)	180Hz
4μF	1nF	±(3.0% rdg+10d)	180Hz
40μF	10nF	±(3.0% rdg+10d)	180Hz

NOTE: Never apply voltage to the test sockets. Discharge capacitor before taking measurements.

Transistor h_{FE}

Range	Base Current	Voltage C-E	Types
0-1000	≈10μADC	≈3.45VDC	NPN, PNP

MAINTENANCE

Repairs or servicing not covered in this manual should only be performed by qualified personnel.

REPLACING THE BATTERY

WARNING

TO AVOID ELECTRICAL SHOCK, DISCONNECT THE TEST LEADS AND ANY INPUT SIGNALS BEFORE REPLACING THE BATTERY. REPLACE ONLY WITH SAME TYPE OF BATTERY.

This meter is powered by a NEDA type 1604 or equivalent 9-volt battery.
When the multimeter displays the " ⊟ " the battery must be replaced to maintain proper operation. Use the following procedure to replacing the battery:

1. Disconnect test leads from any live source, turn the rotary switch to OFF, and remove the test leads from the input terminals.

2. The case bottom is secured to the case top by three screws and two internal snaps (at the LCD end). Using a Phillips-head screwdriver, remove the three screws from the case bottom and turn the case over.

3. Lift the input terminal end of the case bottom until it gently unsnaps from the case top at the end nearest the LCD.

4. Remove battery and replace with a new equivalent 9-volt battery.

5. Replace the case bottom, ensuring that the two snaps on the case top (at the end near the LCD) are engaged. Reinstall the three screws.

REPLACING THE FUSE

WARNING

TO AVOID ELECTRICAL SHOCK, DISCONNECT THE TEST LEADS AND ANY INPUT SIGNALS BEFORE REPLACING THE FUSES. REPLACE ONLY WITH SAME TYPE OF FUSES. THE 20A INPUT TERMINAL IS PROTECTED BY A F20A,600V HIGH ENERGY, FAST ACTING. THE mA INPUT TERMINAL IS PROTECTED BY A F500mA,600V FAST ACTING FUSE.

Use the following procedure to examine or replace the meter's fuses:

1. Disconnect test leads from any live source, turn the rotary switch to OFF, and remove the test leads from the input terminals.

2. The case bottom is secured to the case top by three screws and two internal snaps (at the LCD end). Using a Phillips-head screwdriver, remove the three screws from the case bottom and turn the case over.

3. Lift the input terminal end of the case bottom until it gently unsnaps from the case top at the end nearest the LCD.

4. Remove blown fuse, replace with fuse of the same size and rating. Make sure the new fuse is centered in the fuse holder.

5. Replace the case bottom, ensuring that the two snaps on the case top (at the end near the LCD) are engaged. Reinstall the three screws.