TRIPLETT

Model 2104

4 1/2 Digit DMM with Quad Display & PC Interface

TRIPLETT 21st Century SERIES

Instruction Manual

Familiarization

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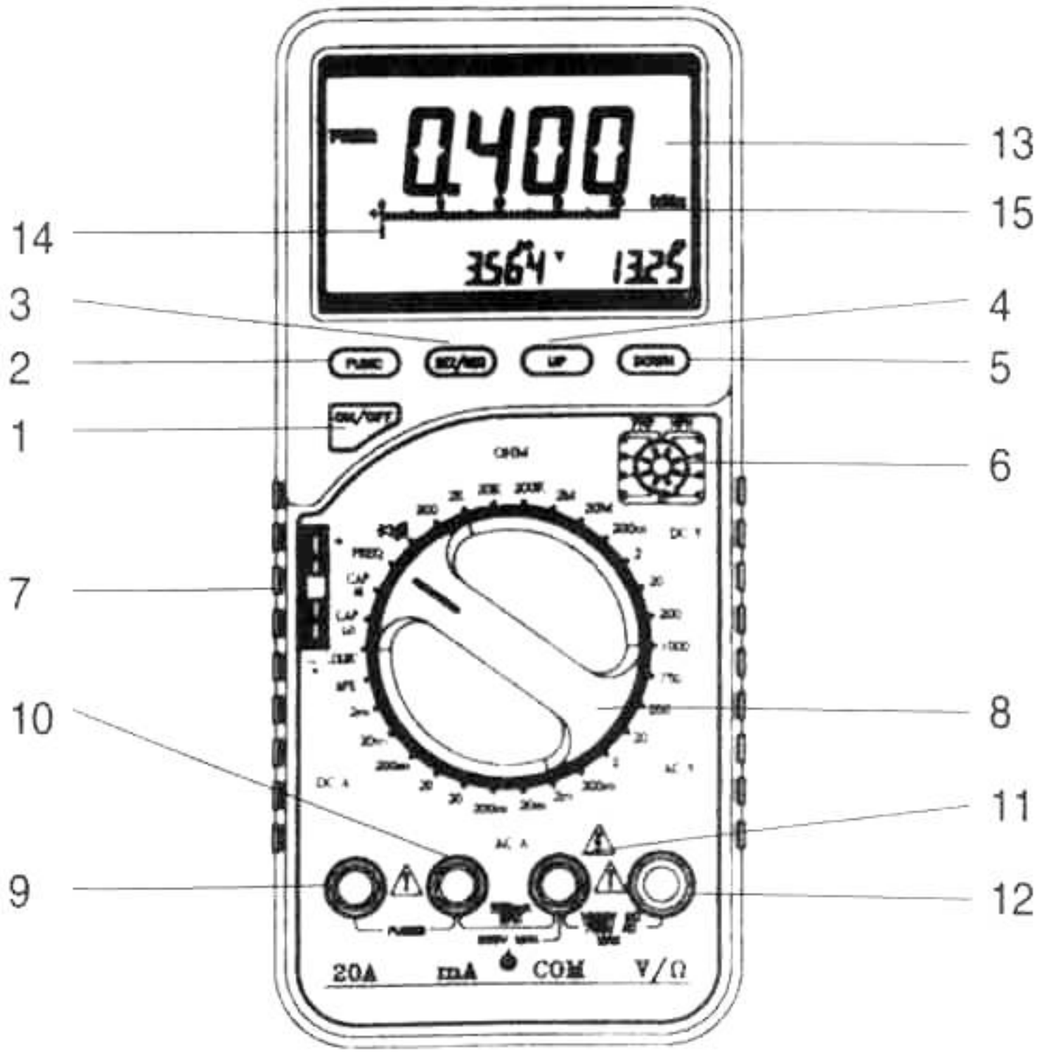

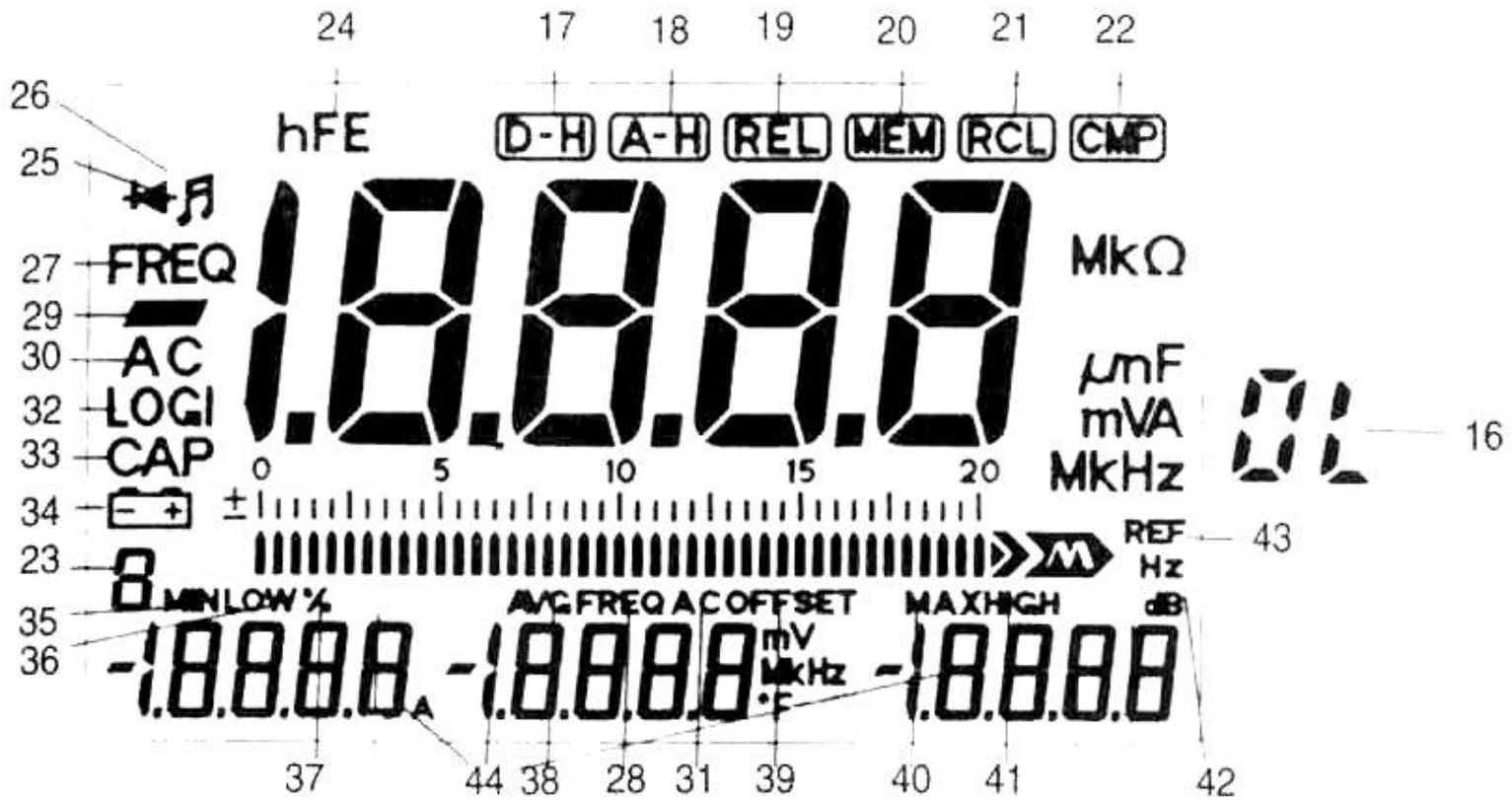

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Due to our policy to refine our products continuously, this manual may contain minor differences in specifications, components, parts, and circuit design from the instrument actually delivered.

1. Introduction

The Triplett 2104 is a hi-tech digital multimeter with a Quad Display LCD and an RS-232 Computer Interface. It combines a number of useful measurement functions into a single, rugged, handheld unit.
Please read these operating instructions very carefully before using this meter.

2. Safety Information

2-1. Safety requirements

This meter has been manufactured and tested in accordance with IEC 1010-1 / EN 61010-1 Part 1: Safety Requirements for Electronic Measuring Apparatus, Safety Class II, Overvoltage category II (CAT II, 1000VDC/750VAC) and category III (CAT III, 600VAC/DC).

This manual contains information and warnings which must be observed to assure safe operation and prevent damage to the meter.

2-2 Safety symbols

The following symbols have been placed on the meter to remind you of the measurement limitations and to promote safety.

20A	The maximum current that you can measure at this terminal is 20 amps DC/AC. This terminal is fuse protected. When using this range to make measurements above 10 amps, limit the duty cycle to 30 seconds on load, and 15 minutes or more off load.
mA	The maximum current that you can measure with this terminal is 200mA DC/AC. This terminal is fuse protected.
MAX ⏚ 500V	To avoid electrical shock or instrument damage, do not connect the Common Input Terminal COM to any source of voltage elevated above earth ground by more than 500 volts.

MAX 1000VDC 750V AC 600V AC/DC — The maximum voltage this meter can measure is 1000V DC or 750V AC (CAT II), and 600V AC/DC (CAT III).

Be exceptionally careful when measuring high voltages. DO NOT TOUCH THE TERMINALS OR PROBE ENDS.

Refer to the complete operating instructions.

Indicates protection class II, double insulation.

2-3. Safety warnings

1. Read all instructions in this manual before using this meter

2. Do not make any measurements with the meter with the case taken apart. Doing so may damage the meter and/or injure the user.

3. Make sure the meter is set to the correct range before applying an input to the meter.

4. Check the condition of the test leads before making a measurement. Do not use the test leads if there is damaged insulation or exposed metal.

5. Make sure test leads are properly inserted and seated in the meter's input jacks. A loose test lead may cause the user to believe that no hazard exists, when in fact, dangerous voltages or currents may be present.

6. Check the general condition of the meter before use. Do not use the meter if there is evidence of internal damage. For example, functions that don't seem to operate properly, loose input jacks, cracks in the case, a burnt smell, etc.

7. Insert the test leads in the jacks specified in the instructions for performing particular tests. Inserting the test leads in incorrect jacks can damage the meter and/or injure the user

8. Do not exceed the maximum voltage or current limitations of the meter (see Table 1 and product specifications). Doing so may damage the meter and/or injure the user.

9. Do not apply voltage or current to the input of the meter when it is set to any of the Ohms [Ω] ranges. Doing so may damage the meter and/or injure the user.

10. Do not apply voltage or current to the input of the meter when it is set to the Diode Test ⊣◀ or Continuity Beeper ♫ modes. Doing so may damage the meter and/or injure the user.

11. Do not rotate the meter's main rotary selector switch with a voltage or current applied to the meter's input. Doing so may damage the meter and/or injure the user.

12. Replace fuses only with exact or equivalent fuses. Do not "bridge" fuses out of circuit. Doing so may damage the meter and/or injure the user.

13. Do not apply voltages to the input of the meter which are elevated above the earth ground potential by more than **500VDC / AC** rms. Doing so may damage the meter and/or injure the user.

14. Do not continue to use meter when the "low power" symbol [− +] is displayed. The displayed reading may be in error and lead the user to believe that no hazard exists, when in fact, dangerous voltages or currents may be present.

15. Use caution when measuring voltage above 35V DC and 25V AC.

16. Do not use this meter to make measurements in adverse environments such as rain, snow, fog, or locations with explosive gases. Doing so may damage the meter and/or injure the user.

17. Do not use meter in condensing atmospheres. That is, do not use meter in conditions where ambient temperature and humidity could cause condensation of water inside of meter. Doing so may cause injury to the user.

18. Do not use the meter if the case of the meter is wet, such as after cleaning the meter. Doing so may cause injury to the user.

19. Do not modify the meter. Changing the design may make the meter unsafe and may result in injury to the user.

20. Do not measure capacitors which may hold a charge of dangerous or lethal potential. Such capacitors could source enough energy to damage the meter and/or injure the user.

21. To avoid damage to the meter or user injury, use the meter only in circuits limited by fuse or circuit-breaker to 20A or 4000**VA**.

22. Do not use the meter to measure currents in circuitry whose open circuit voltages exceeds 250**V AC/DC**.

23. When using the meter to check a high-voltage circuit, do not try to connect both test leads at once. Instead, clamp one probe to the neutral or ground lead of the circuit (usually a bare, green, or white wire in **AC** wiring circuits) using insulated screw-on alligator clips. Then probe for voltages with the other test lead. This helps prevent you from accidentally touching a hot wire, since you need to concentrate on only one test lead.

24. Always connect one of the meter's alligator clips to the low side of a power circuit first. Never clamp onto a hot wire first, (usually red, black, or blue in **AC** wiring circuits.) If you clamp onto a hot wire first, and touch the other probe, you could receive a shock.

25. Use an appropriate method to discharge a capacitor before attempting to measure its value. Use caution when handing some capacitors as they can hold a considerable charge.

26. To avoid damage to the meter or user injury, disconnect test leads from test points before changing the function/range.

27. Do not apply **voltage** between **20A** or **mA** and **COM** terminals. These terminals are intended to measure current, not voltage. Applying voltage to these terminals may result in damage to the meter or user injury.

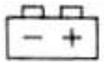
28. Sources like small hand-held radio transceivers, fixed station radio and television transmitters, vehicle radio transmitters and cellular phones generate electromagnetic radiation that may induce voltages in the test leads of the meter. In such cases the accuracy of the meter cannot be guaranteed.

Table 1. INPUT LIMITS

FUNCTION	TERMINAL	INPUT LIMIT
V DC	V/Ω+COM	CAT Ⅱ 1000V DC CAT Ⅲ 600V DC
VAC	V/Ω+COM	CAT Ⅱ 750V AC CAT Ⅲ 600V AC
Ω	V/Ω+COM	250V DC/AC
mA DC/AC	mA+COM	200mA DC/AC
20A DC/AC	20A+COM	20A DC/AC
⊣◀ ♫	V/Ω+COM	250V DC V/AC
Freq.	V/Ω+COM	250V DC V/AC
Logic	V/Ω+COM	250V DC V/AC

3. Preparing for Operation

3-1. Installing the Battery

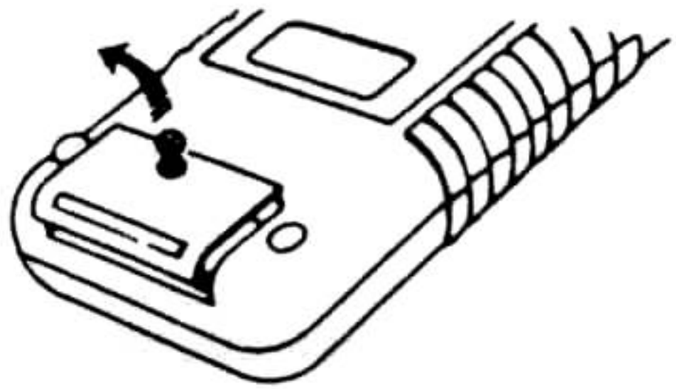
Your meter requires a 9V battery for power. The  symbol appears when the battery voltage is low.
For correct operation, replace the battery as soon as possible. Continued use with a low battery will lead to errors in readings, which could result in user injury.

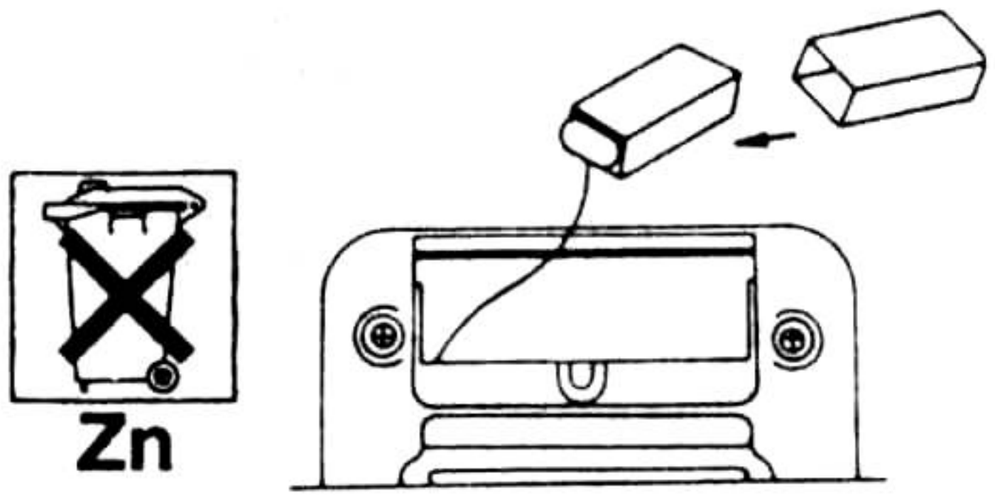
WARNING:
TO AVOID ELECTRIC SHOCK, DISCONNECT BOTH LEADS FROM ANY EQUIPMENT BEFORE YOU REMOVE OR INSTALL THE BATTERY.

Follow these steps to install the battery.

1. Turn off the meter and disconnect the two test leads.

2. Remove the screw to open the battery compartment.





3. Place the battery inside the insulation sleeve and snap the connector to the battery.

WARNING: DO NOT DISCARD THE PROVIDED BATTERY INSULATION SLEEVE. IF YOU DO NOT USE THIS INSULATION SLEEVE PROPERLY, IT CAN RESULT IN DAMAGE TO THE METER OR USER INJURY.

4. Replace the battery compartment cover and tighten screw.

WARNING: DO NOT OPERATE THE METER UNTIL YOU REPLACE THE BATTERY AND CLOSE THE BATTERY COMPARTMENT COVER.

WARNING: CHEMICAL LEAKAGE FROM THE BATTERY CAN DAMAGE THE METER AND MAY RESULT IN USER INJURY. REMOVE THE BATTERY IF THE METER IS UNUSED FOR A WEEK OR MORE. DO NOT USE METER IF LEAKAGE OCCURS.

- Dispose of depleted battery in accordance with prevailing environmental regulations.

3-2. Using the Test Leads

Use only the type of test leads supplied with you meter.

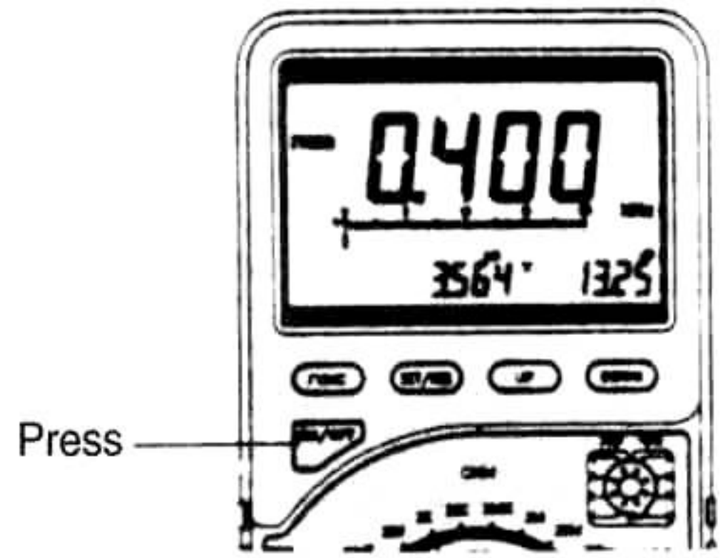
Warning:

- Although the test probes are rated for 1200 volts, the maximum rating of your meter is 1000 volts **DC** and 750 volts **AC, CAT II**, and **600V AC/DC CAT III**. If you try to measure **DC** voltages above 1000 volts or **AC** voltages above 750 volts **RMS CAT II**, or above **600V AC/DC CAT III**, you might damage your meter and expose yourself to a serious shock hazard. Use extreme care when measuring high voltages.

- Never connect the probe you plug into the **COM** terminal to a source of voltage greater than 500 volts with respect to earth ground. This creates a serious shock hazard.

4. Pre-Operation Check

To ensure correct operation and to familiarize yourself with the meter, follow these steps before using the meter.



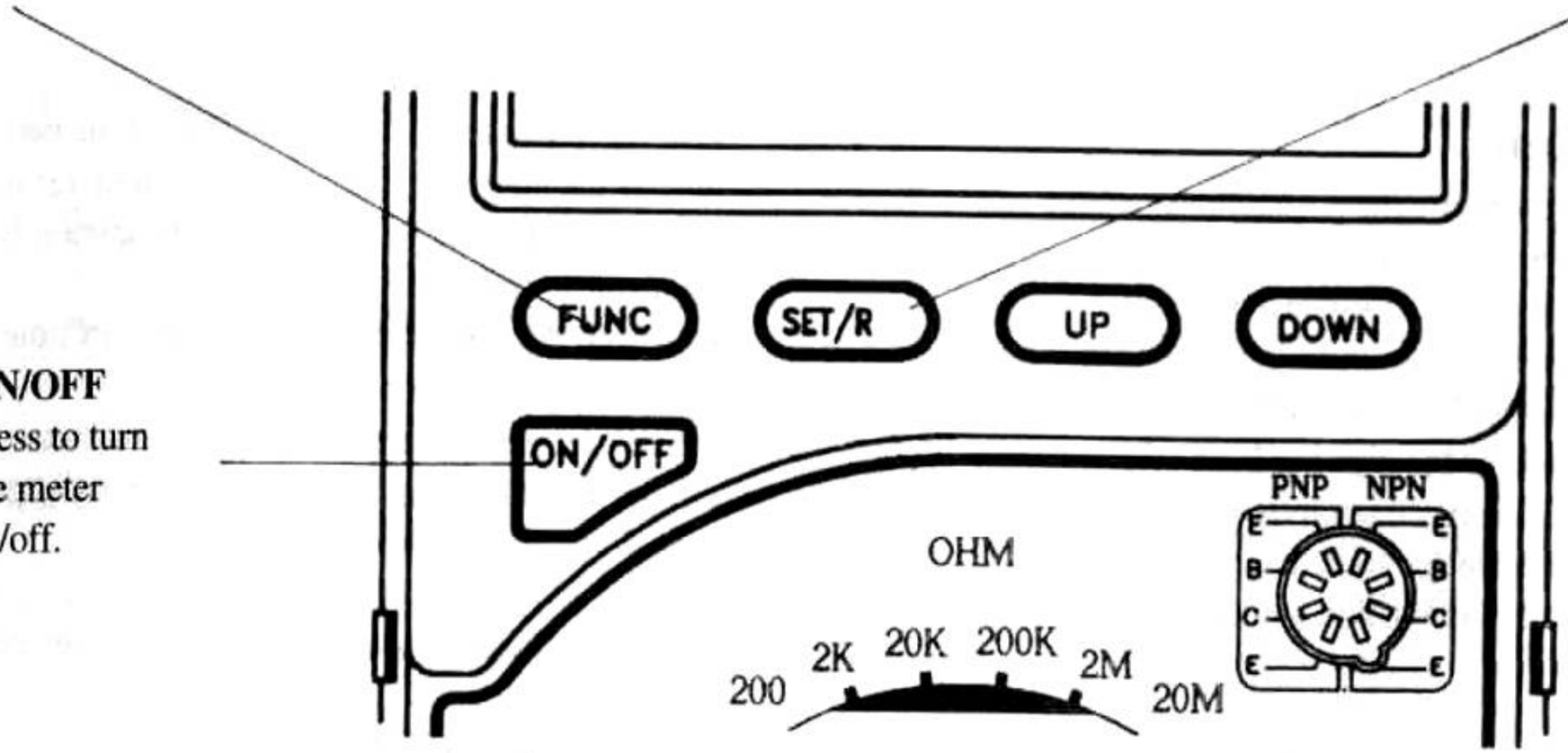
1. Press [ON/OFF] to turn ON.

2. To select a function, turn the rotary selector switch to the desired position.

3. To select an additional operation, press the appropriate push buttons above the rotary selector switch (See Table 2).

FUNCTION · Press to enter the Function modes.
· Press again to scroll.

SET/R
Press to enter.
Press to exit from the functions.



ON/OFF
Press to turn the meter on/off.

Table 2. Summary of Push Button Operations

To operate [FUNC], press to select the function mode and press again to scroll.
To operate [SET/R], press to enter and press again to exit.
[UP] [DOWN] buttons are used for addressing memory numbers in [MEM] and [RCL] modes, and determining polarity and reference value in [REL] and [CMP] modes.

5. How to use the Meter

FOR EASY REFERENCE, EACH DESCRIPTION IS NUMBERED AND KEYED TO THE ILLUSTRATION INSIDE THE FRONT COVER.

5-1. Pushbuttons

Items 1 to 5 describe how to use the pushbuttons. These buttons are used in conjunction with the rotary selector switch to select operating modes. When a button is pushed, the beeper sounds. A summary of pushbutton operation is shown in Table 2. An annunciator is displayed to indicate that a mode or function has been selected. A quick way to reset all the pushbuttons to their default state is to turn the rotary selector switch to an adjacent function and then back to the function you are using.

CAUTION:
DO NOT ROTATE THE SELECTOR SWITCH IF AN INPUT IS APPLIED TO THE METER. DOING SO MAY DAMAGE THE METER OR RESULT IN USER INJURY.

1. [ON/OFF] POWER ON/OFF

Press [ON/OFF] to turn the meter on. Press the button again to turn the meter off.

Automatic Power-off
Automatic Power-off extends the life of the battery by turning the meter off if no significant signal is measured, and neither the rotary switch nor a pushbutton is operated for about 10 minutes.
However, during communication with a PC, the power will not be turned off automatically.
When Automatic Power-off turns off the meter, the **ON/OFF** button must be operated to re-apply power to the meter.

When the meter turns off, all user settings are erased.

2. [FUNC] FUNCTION

Press [FUNC] to select the programmed function modes. The following symbols appear in the upper area of the display.

[D-H] [A-H] [REL] [MEM] [RCL] [CMP]

3. SET/R SET/RESET

You can select or release a function by pressing SET/R

4. and 5.
UP DOWN UP & DOWN

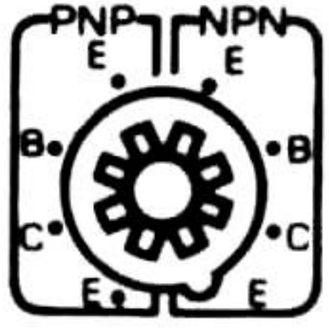
Press UP or DOWN to determine the polarity and reference value in REL & CMP modes, and to address memory numbers in MEM & RCL modes.

5-2. Sockets.

Items 6 and 7 describe the sockets.

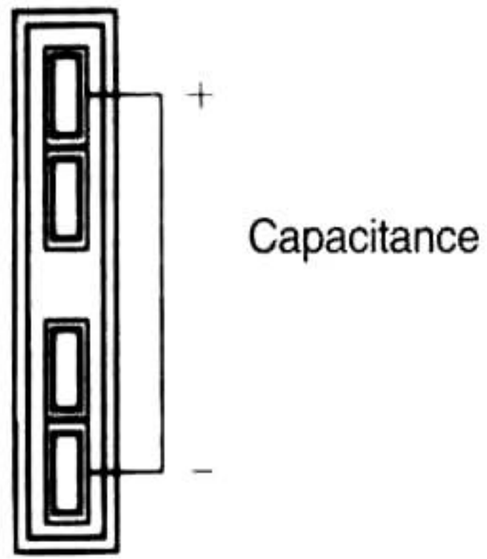
6. Transistor hFE

Insert the base, collector, and emitter pins into the correct sockets as marked.



7. Capacitor Socket

Insert a discharged capacitor, observing the correct polarity.



8. Rotary Selector Switch

The following functions are selected by setting the rotary selector switch.

mV	Millivolts dc/ac
V	Volts dc/ac
mA	Milliamperes dc/ac
A	Amperes dc/ac
hFE	Transistor test
LOGIC	Logic test
CAP(LO)	Capacitance (20-200nF)
CAP(HI)	Capacitance (20-200uF)
FREQ	Frequency measurement up to 2MHz
→◀— ♫	Diode test / Audible Continuity Test
OHM	Resistance measurement

5-3. Input Terminals

Items 9 to 12 describe the input terminals (See Table 1 for Input Limits)

9. 20A Amperes Input Terminal

For current measurements (**AC** or **DC**) up to **20A** when the rotary selector switch is in **20A** position.

10. mA Milliamperes Input Terminal

This input terminal is used for measuring currents up to **200mA** when the rotary selector switch is in the **2m, 20m** or **200m** position.

11. COM Common Terminal

Return terminal for all measurements

12. V/Ω Input Terminal

Volts, Ohms, Continuity, Diode, Frequency and Logic Test Terminal.

5-4. Digital and Bar Graph Displays

Items 13 to 16 describe the digital and bar graph displays.

13. Digital Display

Digital readings are displayed on a 19,999 count LCD display with automatic polarity indication and decimal point placement.

14. Analog Bar Graph

The bar graph consists of forty-two (42) segments that illuminate from left to right as the input increases. It functions in much the same manner as the needle on an analog meter. If the input equals or exceeds 20,000 counts on the range selected, **OL** is displayed, the bar graph flashes, and the beeper sounds (except in Ohms, Diode Test, and Continuity modes).

15. Bar Graph Scale

16. OL Overload Indication

OL is displayed, the bar graph flashes, and the beeper sounds when input value is too high to display.

Note:
The beeper does not sound when **OL** is displayed in the Ohms, Diode Test, and Continuity modes.

5-5. Using the Advanced Functions

Items 17 to 22 describe the advanced functions.

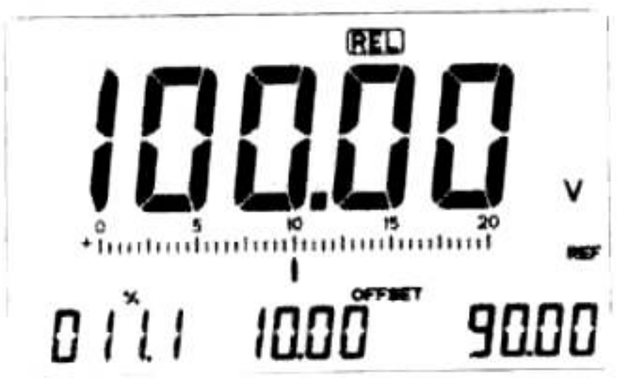
17. D-H Data Hold

The Data Hold feature lets you hold a reading on the middle secondary display. To turn on the Data Hold feature, press [FUNC] until [D-H] flashes at the top of the display. The main display will display the current reading. To hold a reading on the middle secondary display, press [SET/R] . The main display continues to track the current measurement. To release this function mode, press [FUNC] button.

18. [A-H] Auto Hold

The Auto Hold feature lets you rapidly measure the Minimum (**MIN**), average (**AVG**) and maximum (**MAX**) values, respectively, on the secondary displays. The average value (**AVG**) represents an average value of all of the measured values displayed during the period of time that the Auto Hold feature is turned on. To turn on the Auto Hold feature, press [FUNC] until [A-H] flashes at the top of the display. Press [SET/R] to start this function. To release this function mode, press [SET/R] again or press [FUNC] .

19. [REL] Relative measurement



The Relative measurement feature lets you measure values relative to a reference value and then display the difference between the actual value and the reference value.

Follow these steps to set a reference value.

1. Press [FUNC] until [REL] flashes at the top of the display.

2. Press [SET/R] to enter the Relative mode. The reference value to be set will appear in the right hand secondary display.

3. Press [UP] or [DOWN] to set the reference value's polarity (- appears for negative value). Press [SET/R] .

4. Press [UP] or [DOWN] to set the reference value's first digit. The first digit can be either 1 or nothing. 0 does not appear on the display for the first digit. Press [SET/R]

5. Repeat step 4 for the other four digits. The digit being set will flash.

6. After you enter the last digit, the meter begins making relative measurements. The main display shows the actual measurement. The left secondary display shows % [% = (offset/ REF) X 100], the middle secondary display shows the difference between the measured value and reference value, and the right secondary display shows the reference value.

20. [MEM] Memory

Follow these steps to store up to ten measured values in memory for later recall.

1. Set the rotary selector switch to the desired position.

2. Repeatedly press [FUNC] until [MEM] flashes at the top of the display.

3. Press [SET/R] to enter the Memory mode.

4. A memory number will flash above the left hand secondary display. Press [UP] or [DOWN] to select the memory number you want to save the data into. 0 to 9 can be selected.

5. While making a measurement, press [SET/R] to store the current measurement. The stored value appears in the middle secondary display.

6. To release this function mode, press SET/R or press FUNC .

NOTE:
If you store a reading into a memory location which already has stored data, the old data will be updated with the new.
Only the value in the main display is stored. Secondary display values are not stored.

21. RCL Memory Recall

Follow these steps to recall a measured value from one of the ten memories.

1. Repeatedly press FUNC until RCL flashes at the top of the display. Press SET/R .

2. The memory number flashes. Repeatedly press UP or DOWN to select the desired memory number.

3. Press SET/R to recall a stored memory.

NOTE:

When you recall a stored memory in the RCL mode, all three secondary displays will show values sequentially, according to their memory numbers, from left to right. For example, if memory number 3 is recalled, the value of memory number 3 will show on the left display, the value of memory number 4 will show on the middle display, and the value of memory number 5 will show on the right display.

22. CMP Comparison

The comparison function lets you easily compare a measurement to high and low stored reference values. If the measured value is between the reference values, the middle secondary display shows "**PASS**" and the beeper sounds. If the measured value is above the high reference value or below the low reference value, the middle secondary display will show "**HI**" or "**LO**" respectively.

Follow these steps to set the reference values and begin comparison measurements.

1. Repeatedly press [FUNC] until [CMP] flashes at the to of the display. Press [SET/R] .

2. Press [UP] or [DOWN] to set the low reference value's (left hand secondary display) polarity (- appears for negative values). Press [SET/R] .

3. Press [UP] or [DOWN] to set the low reference value's first digit. The first digit can be either 1 or nothing. 0 does not appear on the display for the first digit.

   Press [SET/R] . Repeat this step for the rest of the low reference value's digits. The digit being set will flash.

4. Repeat step 2 and 3 to set the high reference value.

5. After you set both reference values, the meter displays the current measurement in the main display, the low reference value in the left secondary display, comparison results (**LO, PASS, or HI**) in the middle secondary display, and high reference value in the right secondary display.

6. Press [SET/R] to release the measurement.

23. Designating Memory Number (0 thru 9)

[MEM] and [RCL] modes let you designate a memory number by pressing [UP] or [DOWN] and then pressing [SET/R] .

5-6. Annunciators

Items 24 to 34 describe annunciators that indicate the modes or states in which the meter is operating.

24. hFE Transistor hFE

The value displayed is the hFE (gain) of the transistor being tested.

25, 26. ⊣◀ ♬ Diode and Continuity Test

The Diode Test and the Continuity Test share the same rotary selector switch position, and both annunciators appear simultaneously. When testing diodes, the value displayed is the forward voltage of the diode being tested (at approximately **1mA** test current). The Diode Test range is 0 to 2000mV.

When checking Continuity, resistance below approximately 30 ohms will cause the beeper to sound and the middle secondary display to show "Shrt" (Short).

27, 28. FREQ Frequency count mode

Measures frequency up to 2MHz.

29. ▬ Negative Polarity

Indicates negative inputs.

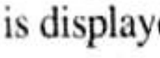
30, 31. AC Alternating Current or Voltage

32. LOGI Logic Test

Enables you to check logic levels. This function displays **HI, LO,** or "**----**" to indicate logic high, logic low, or indeterminate levels, respectively.

33. CAP Capacitance

Measure capacitance from 1pF to 200uF.

34.  Low Battery

This meter is powered by a single **9V** battery. When this symbol is displayed, replace the battery to avoid errors in measurement or user injury.

35. MIN Minimum

The **MIN** annunciator appears above the left hand secondary display when the meter is in the **A-H** mode. This indicates that the left hand secondary display is displaying the minimum value captured by the **A-H** mode.

36. LOW Low Limit Value

The **LOW** annunciator appears above the left hand secondary display when the meter is in the **CMP** mode. This indicates that the left hand secondary display is displaying the user programmed low limit value.

37. % Percentage

The % annunciator appears above the left hand secondary display when the meter is in the **REL** mode. In the **REL** mode, the left hand secondary display reads the percentage of difference between the user programmed reference value and the value in the main display.

38. AVG Average

The **AVG** annunciator appears above the middle secondary display when the meter is in the **A-H** mode. In the **A-H** mode, the middle secondary display reads the average of the **MIN** and **MAX** displays.

39. OFFSET Offset Value

The **OFFSET** annunciator appears above the middle secondary display when the meter is in the **REL** mode. In the **REL** mode, the middle secondary display shows the difference between the user programmed reference value and the main display.

40. MAX Maximum

The **MAX** annunciator appears above the right hand secondary display when the meter is in the **A-H** mode. This indicates that the right hand secondary display is displaying the maximum value captured by the **A-H** mode.

41. HIGH High Limit Value

The **HIGH** annunciator appears above the right hand secondary display when the meter is in the **CMP** mode. This indicates that the right hand secondary display is displaying the user programmed high limit value.

42. dB Decibel

*The **dB** annunciator is displayed above the right hand* secondary display when the meter is in the **AC V** or **FREQ** measurement modes. This indicates that the right hand secondary display is displaying the input level in **dB**.

43. REF Reference Value

The **REF** annunciator is displayed above the right hand secondary display when the meter is in the **REL** mode. This indicates that the right hand secondary display is displaying the user programmed reference value.

44. Secondary Displays

The secondary displays are found below the bar graph in the **LCD** window. These displays usually readout some value which adds to the information presented by the main display.

Notes:

The following symbols indicate the units of the value displayed.

AC	AC Current or Voltage
DC	Direct Current or Voltage
mV	Millivolts (1 X 10^{-3} volts)
V	Volts
KHz	Kilohertz (1 X 10^{3} cycles). Frequency
MHz	Megahertz (1 X 10^{6} cycles). Frequency
uF	Microfarads (1 X 10^{-6} Farads)
nF	Nanofarads (1 X 10^{-9} Farads)
A	Amperes (Amps). Current
mA	Milliampere (1 X 10^{-3} amps). Current
Ω	Ohm
KΩ	Kilo Ohm (1 X 10^{3} ohm)
MΩ	Megaohm (1 X 10^{6} ohm)
dB(m)	Decibels

6. How to make Measurements

6-1. Measuring DC Voltage

WARNING: DO NOT TRY TO MEASURE CAT II DC VOLTAGES GREATER THAN 1000 VOLTS OR CAT III DC VOLTAGES GREATER THAN 600V. YOU MIGHT DAMAGE YOUR METER AND EXPOSE YOURSELF TO USER INJURY.

Follow these steps to measure DC Voltage.

1. Set the rotary selector switch to the desired **DC V** range, as determined by voltage level to be measured. If you do not know the voltage level, start with the rotary selector switch set to the highest voltage position and reduce the setting as needed to get a reading.

CAUTION:
DO NOT ROTATE THE SELECTOR SWITCH IF AN INPUT IS APPLIED TO THE METER. DOING SO MAY DAMAGE THE METER OR RESULT IN USER INJURY.

2. Plug the black test lead into the meter's **COM** terminal and the red test lead into the **V/Ω** terminal.

3. Connect the test leads to the **DC** voltage source you wish to measure.

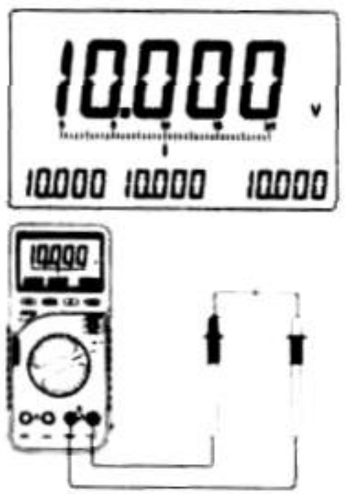
Notes:

If polarity is negative, " − " appears on the left of display.

For the most accurate measurement, select the lowest possible voltage range without getting an overload reading.

Input Impedance : 10Mohm on all **DC V** ranges

If you set the meter for **DC** Voltage, it displays the presently measured value in the main display, the measured value taken 1 second earlier in the left secondary display, the measured value taken 2 seconds earlier in the middle secondary display, and the measured value taken 3 seconds earlier in the right secondary display.



DC Voltage measurement

6-2. Measuring AC Voltage

WARNING: DO NOT TRY TO MEASURE CAT II AC VOLTAGES GREATER THAN 750 VOLTS OR CAT III AC VOLTAGES GREATER THAN 600V. YOU MIGHT DAMAGE YOUR METER AND EXPOSE YOURSELF TO USER INJURY.

Follow these steps to measure AC Voltage.

1. Set the rotary selector switch to the desired **AC V** range. The **AC** annunciator appears for **AC** measurements. Select the range as required for the voltage level to be measured. If you do not know the voltage level, start with the rotary selector switch set to the highest voltage position and reduce the setting as needed to get a reading.

CAUTION:
DO NOT ROTATE THE SELECTOR SWITCH IF AN INPUT IS APPLIED TO THE METER. DOING SO MAY DAMAGE THE METER OR RESULT IN USER INJURY.

2. Plug the black test lead into the meter's **COM** terminal and the red test lead into the **V/Ω** terminal.

3. Connect the test leads to the **AC** Voltage source you wish to measure.

Notes:
Your meter will show the frequency of the input in the middle secondary display, and **dB**(m) in the right secondary display.

- **dB**(m) in the right secondary display indicates the logarithmic ratio of input voltage to 0.775V AC (0 dB(m) = 1 mW/600Ω).

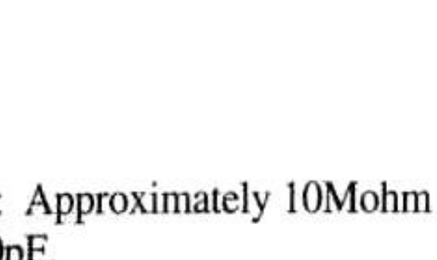
TABLE FOR LOGARITHMIC RATIO

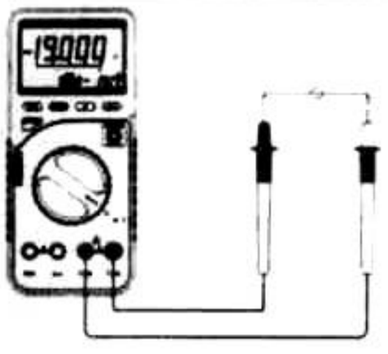
INPUT VOLTAGE	dB
0.775mV	-60dB
109mV	-17dB
1.94V	8dB
19.40V	28dB

- Input impedance : Approximately 10Mohm in parallel with less than 100pF.

- Frequency response : 40Hz to 400Hz.

The meter's high input sensitivity produces a drifting reading on the **LCD** when the test leads are not connected to a circuit. This is normal, and an accurate reading will appear when you connect the test leads to a circuit.





AC Voltage measurement

6-3. Measuring DC/AC Current

WARNING: NEVER MEASURE CURRENTS IN CIRCUITS WITH VOLTAGES OVER 250V DC/AC. IT MAY DAMAGE THE METER AND RESULT IN USER INJURY. A SEVERE FIRE HAZARD AND SHORT CIRCUIT DANGER EXIST IF YOU APPLY A VOLTAGE WITH HIGH CURRENT CAPABILITY (POWER EXCEEDING 4000VA) TO THE 20A OR mA TERMINAL. THE 20A TERMINAL IS FUSE PROTECTED. NEVER MEASURE CURRENTS EXCEEDING 20A. WHEN USING THIS RANGE WITH CURRENTS OVER 10A, LIMIT THE DUTY CYCLE TO 30 SECONDS ON LOAD AND 15 MINUTES OFF LOAD.

Follow these steps to measure Current.

1. Set the rotary selector switch to the desired **DC A** or **AC A** position.

2. Plug the black test lead into the meter's **COM** terminal and the red test lead into the **mA** or **20A** terminal, depending upon the range selected.

3. With power removed from the circuit to be tested, *connect the test leads in series with the load or* circuit. Apply power to the circuit. Observe reading on meter. Reverse procedure to disconnect meter.

Notes:

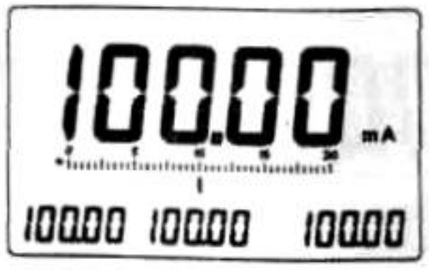
- If you do not know what the current is, connect the circuit to the **20A** input terminal first to see if you have a safe level for the **mA** input terminal. Use the **mA** input terminal for current up to 200mA.

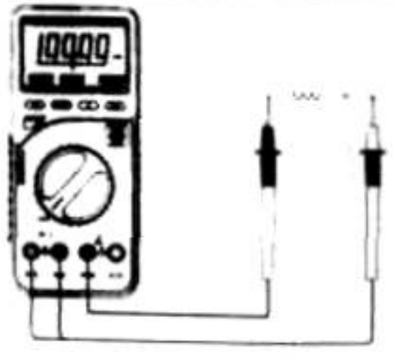
- When measuring current, the meter's internal shunt resistors develop a voltage across the meter's terminals called "burden voltage". This voltage is very low but it may affect precision circuits and measurements.

- If you set the meter for **DC A**, the minus symbol "-" appears or disappears to indicate the polarity of the *measured current.*

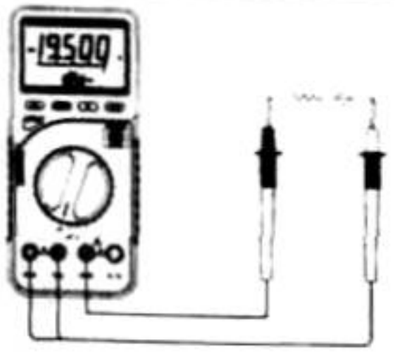
- If the test leads are inserted into the **20A** or **mA** terminals, and the rotary selector switch is not set to a **DC A** or **AC A** range, the beeper will sound.

- If you set the meter for **DC A**, it displays the presently measured value in the main display, the *measured value taken 1 second earlier in the left* secondary display, the measured value taken 2 seconds earlier in the middle secondary display, and the measured value taken 3 seconds earlier in the right secondary display.





DC Current
measurement



AC Current
measurement

- If you set the meter for **AC A**, the main display shows the presently measured value and the middle secondary display shows the frequency (40Hz to 400HZ) of the **AC** current.

6-4. Transistor hFE Test

WARNING: THE TRANSISTOR SOCKET IS NOT PROTECTED AGAINST OVERLOAD. YOU CAN DAMAGE THE METER AND VOID YOUR WARRANTY IF YOU BUILD AND USE YOUR OWN EXTERNAL TRANSISTOR LEADS.

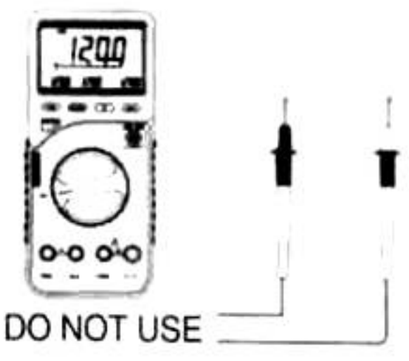
Follow these steps to measure a transistor's hFE value.

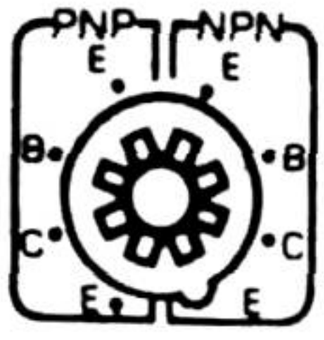
1. Set the rotary selector switch to the **hFE** position.

2. Insert the transistor's base, collector, and emitter pins into the appropriate transistor sockets. Your meter displays the transistor's **hFE**.

Notes:

- Darlington transistors containing internal resistors may give incorrect readings.
- Do not take the **hFE** reading as an absolute measurement. The true gain of a transistor depends on its operating current. This meter applies approximately 1uA to the base, and measures the collector current, to calculate the **hFE**.
- You can not measure the **hFE** of a transistor that is connected in a circuit.
- You can not measure the **hFE** of a **FET** or other non-bipolar transistor.
- High-voltage junctions in power transistors prevent correct readings. Also, the larger leads of the power transistor can damage the test socket.





- During an **hFE** measurement, the presently measured value appears in the main display, the measured value taken 1 second earlier appears in the left secondary display, the measured value taken 2 seconds earlier appears in the middle secondary display, and the measured value taken 3 seconds earlier appears in the right secondary display.

6 - 5. Logic Test

The Logic function allows the user to easily test digital circuits to determine their logic state. Digital circuits typically have logic levels of 3 volts, 5 volts, or 15 volts. The 2104 is programmed to work at the correct logic level by referencing itself to the voltage of the logic power supply.

Once programmed, the 2104 will indicate, on its main display, whether the measured logic state is Low (**Lo**), High (**Hi**), or indeterminate (- - - -). "Indeterminate" means that the level is between the Low and High levels, and that logic circuitry may not correctly interpret its state.

A "**Hi**" state is one which exceeds 70% of the programmed reference value. A "**Lo**" state is one which is less than 30% of the programmed reference value. A " - - - -" state is one which falls between 30% and 70% of the programmed reference value.

While the main display is indicating the logic state, the middle secondary display indicates the frequency of the logic signal, and the right hand secondary display indicates the actual voltage applied to the meter's input.

1. Set the rotary switch to the **LOGIC** position. The main display will display "**rdY**" (ready). This means that the meter is waiting for the user to program its logic reference voltage.

2. Connect the test leads to the meter (black lead to **COM** and red lead to V/Ω), connect the black test probe to the logic circuit's ground, and the red test probe to the logic circuit's power supply. The power supply voltage will be displayed on the right hand secondary display.

Note: The maximum voltage that can be tested in the Logic Test mode is 19.99V. If the voltage exceeds 19.99 volts, the bar graph will flash and the right hand secondary display will indicate **OL**. The minimum voltage that can be tested is 3 volts. The Logic Test will not allow the user to program a reference value of less than 3 volts.

3. While keeping the probes firmly attached to the points specified in step 2, program the reference value by pressing the **SET/R** button. The main display will now indicate "**Hi**", and the right hand secondary display will contiue to indicate th actual input voltage, The middle seccondary display will indicate "**0.000 KHz**".

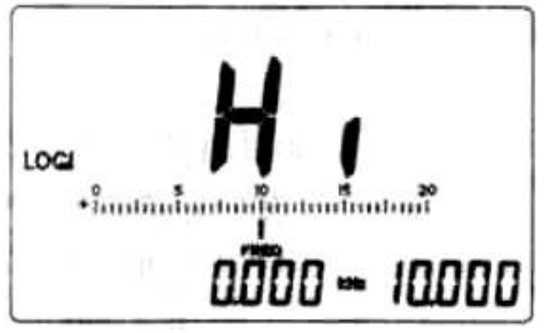
4. Disconnect the red test probe from the power supply voltage. The main display will change to "**Lo**". Probe various test points in the circuit and note that the main display now indicates the logic state, the right hand secondary display indicates the actual voltage, and the middle secondary display indicates the frequency.

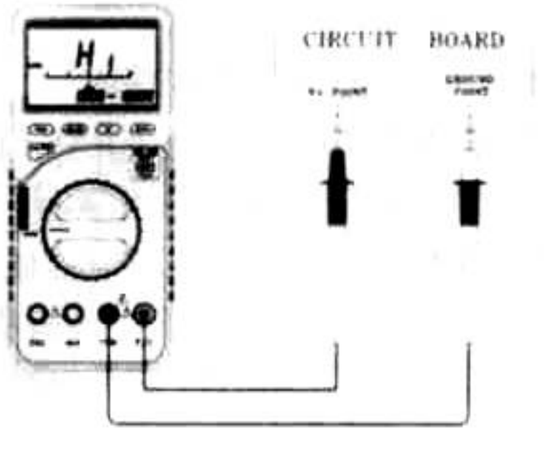
Notes:

- In the Logic Test mode, **FUNC** does not work.

- To change the logic reference level, press the **SET/R** button. "**rdY**" will appear in the main display. Set the reference level as previously described.

- When the logic level changes rapidly, the main display cannot display **Hi** and **Lo** quickly enough, and displays " ---- " instead.





6-6. Measuring Capacitance

WARNING:
WHEN SHORTING CAPACITORS, HIGH ENERGY DISCHARGE MAY TAKE PLACE. USE CAUTION! DO NOT TOUCH THE TERMINALS OF CAPACITORS CHARGED TO VOLTAGES OVER 35V DC. USE SPECIAL CAUTION IN LOCATIONS WITH ADVERSE ENVIRONMENTAL CONDITIONS, WHERE FLAMMABLE GASES, STEAM, OR DUST MAY EXIST.

Follow these steps to measure capacitance.

1. Using an approved method, discharge each capacitor before testing. Use caution when handling capacitors, as they can sometimes hold a dangerous charge.

WARNING:
NEVER ATTEMPT TO MEASURE THE CAPACITANCE OF A CHARGED CAPACITOR. YOU MIGHT DAMAGE THE METER AND EXPOSE YOURSELF TO USER INJURY.

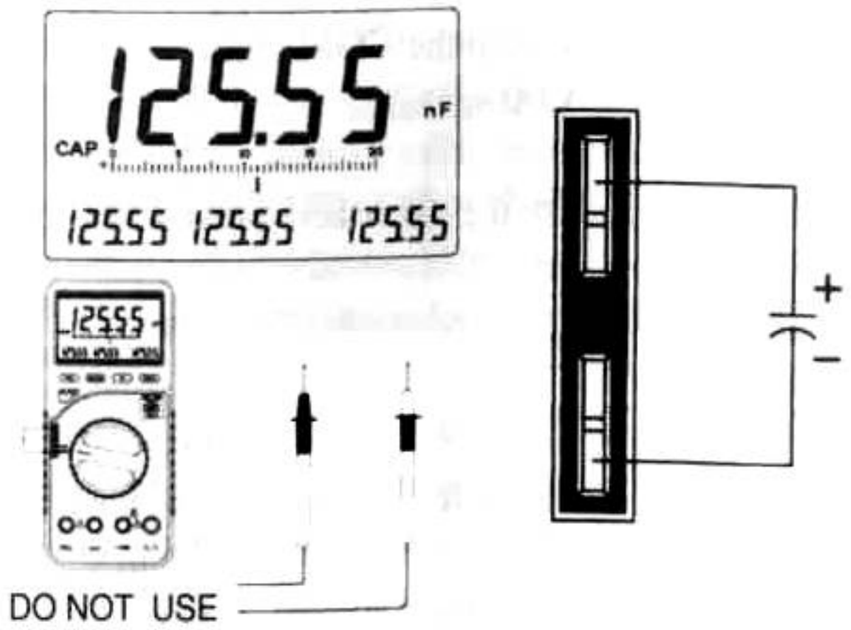
2. Set the rotary selector switch to the **CAP (LO)** or **CAP (HI)** position.

   CAP LO : 20-200 nF (Automatically selects range between 20nF or 200nF)
   CAP HI : 20-200 uF (Automatically selects range between 20uF or 200uF)

3. Insert the discharged capacitor into the CAP socket. The meter will display the capacitance value. For polarized capacitors, be sure to insert the negative lead into the (minus) socket, and the positive lead into the + (plus) socket.

Notes:

- Before reading, allow the unit about 2 to 3 seconds to stabilize.
- During capacitance measurement, the presently measured value is in the main display, the measured value taken 1 second earlier appears in the left secondary display, the measured value taken 2 seconds earlier appears in the middle secondary display, and the measured value taken 3 seconds earlier appears in the right secondary display.
- Use capacitance extension lead to measure capacitors whose leads will not fit into **CAP** socket.



Capacitance measurement

6-7. Measuring Frequency

WARNING: When making a measurement on the FREQ range, do not try to measure the frequency of a signal that exceeds 250 volts AC. You may damage your meter and expose yourself to user injury.

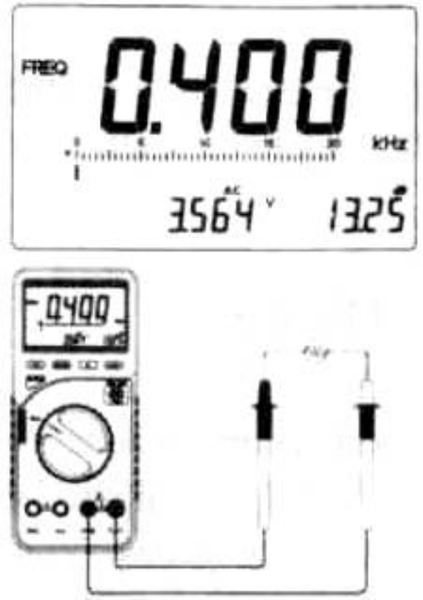
To measure the frequency (up to 400Hz) of a voltage between 250V AC and 600V AC (CAT III), or up to 750V AC (CAT II), use the **750 AC V** range.

Follow these steps to measure the frequency of a signal.

1. Set the rotary selector switch to **FREQ** position.

2. Plug the black test lead into the meter's **COM** terminal and the red test lead into the V/Ω terminal.

3. Connect the test leads to the frequency source. The meter will automatically select and display appropriate frequency ranges up to 2MHz.



Frequency measurement

WARNING: WHEN THE TEST LEADS ARE CONNECTED TO AN AC OUTLET, DO NOT TURN THE ROTARY SELECTOR SWITCH TO ANOTHER RANGE. IT MIGHT DAMAGE THE INTERNAL COMPONENTS OF THE METER OR CAUSE USER INJURY.

Notes:

- For the most accurate measurements, use of a BNC cable with a ferrite core suppressor is recommended.

- During frequency measurements, the middle secondary display will show **AC** Voltage (maximum 19.999V) and the right secondary display will show **dB**(m).

- The middle secondary display (ACV) and the right secondary display (db) will indicate **OL** if the input level exceeds 20VAC.

6-8. Checking Diodes

This function lets you check diodes and other semiconductors for opens and shorts. It also lets you determine the forward voltage for diodes. You can use this function to match diodes.

Follow these steps to check diodes.

1. Set the rotary selector switch to ⊣◀— ♫ position.

2. Plug the black test lead into the **COM** terminal and the red test lead into the **V/Ω** terminal.

3. Connect the test leads to the diode being tested and read the display.

Notes:

- If you check a good diode's forward voltage, you will usually measure a voltage of approximately 250mV (Germanium) or 700mV (Silicon).

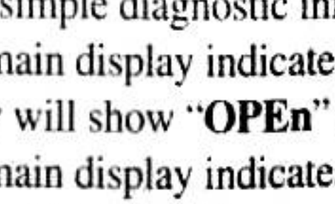
- If you reverse the test leads (red to cathode and black to anode) you are checking the "reverse direction".

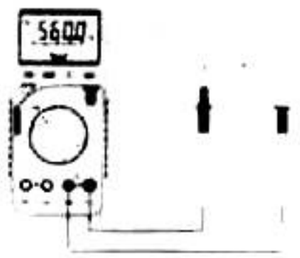
- If **OL** is displayed, it means the diode is open, being tested in the reverse direction, or its forward voltage drop is above 2000mV.

- The meter supplies enough forward voltage to light most LED's. However, if the LED's forward voltage is greater than 2000mV, the meter incorrectly indicates that the device is open.

During Diode test. the middle secondary display shows simple diagnostic information.
If the main display indicates **OL**, the middle secondary display will show "**OPEn**" (for OPEN).
If the main display indicates between 400.0mV and 1999.9mV, the middle secondary display will show "**good**" (for good).
If the main display indicates between 030.0mV and 399.9mV, the middle secondary display will show "**bAd**" (for bad).
If the main display indicates between 000.0mV and 030.0mV, the middle secondary display will show "**shrt**" (for short).

Diodes whose forward voltage drop is between 030.mV and 399.9mV will indicate as "**bad**", even though they are good.





Diode measurement

6-9. Checking Continuity

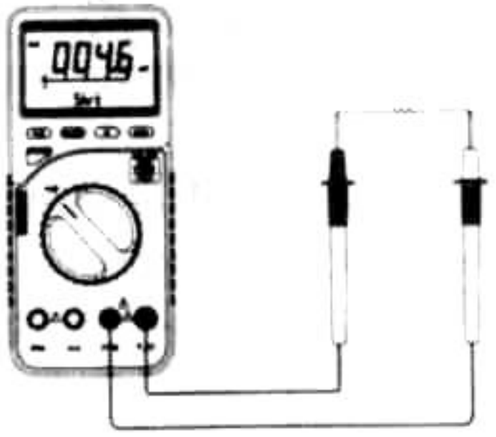
Continuity testing verifies that circuit connections are intact.

WARNING: NEVER PERFORM A CONTINUITY TEST ON A CIRCUIT THAT HAS POWER CONNECTED.

Follow these steps to perform an audible continuity test.

1. Set the rotary selector switch to the ⊣◀ ♫ position.
2. Plug the black test lead into the meter's **COM** terminal and the red test lead into the **V/Ω** terminal.
3. Remove power from the circuit being tested.
4. Connect the test lead tips to the object to be measured.

Notes:
The buzzer will sound if the measured resistance is approximately 30 ohms or below, and the middle secondary display will show "**Shrt**" (for short).



Audible Continuity Test

6-10. Measuring Resistance

WARNING: NEVER CONNECT THE TEST LEADS TO A SOURCE OF VOLTAGE WHEN YOU HAVE SELECTED THE OHMS FUNCTION. BE SURE THAT THE CIRCUIT UNDER TEST HAS ALL POWER REMOVED AND ANY ASSOCIATED CAPACITORS ARE FULLY DISCHARGED BEFORE YOU MAKE A RESISTANCE MEASUREMENT. FAILURE TO HEED THIS WARNING MAY RESULT IN DAMAGE TO THE METER OR USER INJURY.

Follow these steps to measure resistance.

1. Set the rotary selector switch to the appropriate **OHM** position.

2. Plug the black test lead into the meter's **COM** terminal and the red test lead into the **V/Ω** terminal.

3. Connect the test leads to the object to be measured.

Notes:

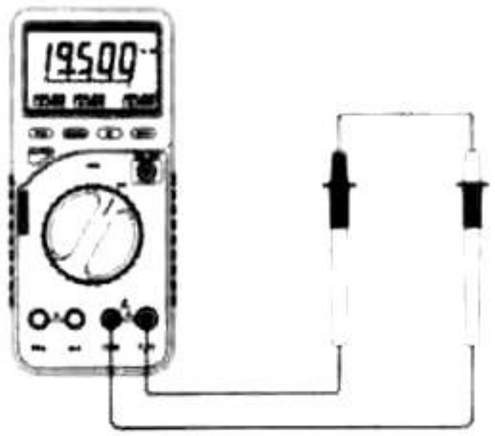
- The resistance in the test leads can diminish the accuracy on the lowest (200 ohm) range. The error is usually 0.1 to 0.2 ohms for a standard pair or test leads. To determine the error, short the test leads together and read the resistance of the test leads. Subtract this error from subsequent readings to obtain an accurate resistance reading.

- When measuring resistance, be sure that good contact is established between the test leads and the object being measured. Dirt, oil, solder flux or other foreign materials can cause incorrect readings.

- If the measured resistance value exceeds the maximum value, **OL** will be displayed (indicating overload) and the bar graph will flash.

- For resistances of approximately 2 megohms and above, the display might take a few seconds to stabilize. This is normal for high resistance readings.

- During resistance measurement, the presently measured value is in the main display, the measured value taken 1 second earlier appears in the left secondary display, the measured value taken 2 seconds earlier appears in the middle secondary display and the measured value taken 3 seconds earlier appears in the right secondary display.



Resistance measurement

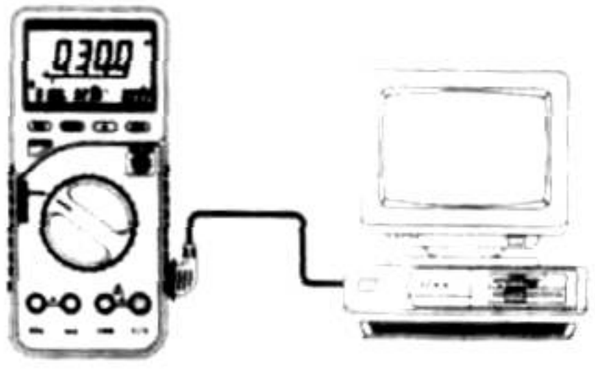
7. How to use the meter with a PC

7-1. Interfacing the Meter with a PC

Follow these steps to interface the meter with a computer.

1. Connect the supplied custom RS-232C cable between the meter's serial port and the computer's serial port.

2. Turn on the meter.



Notes:

- Use only the serial interface cable exclusively designed for your meter.

- Do not extend the length of the cable.

7-2. Technical Information

Communication Parameters

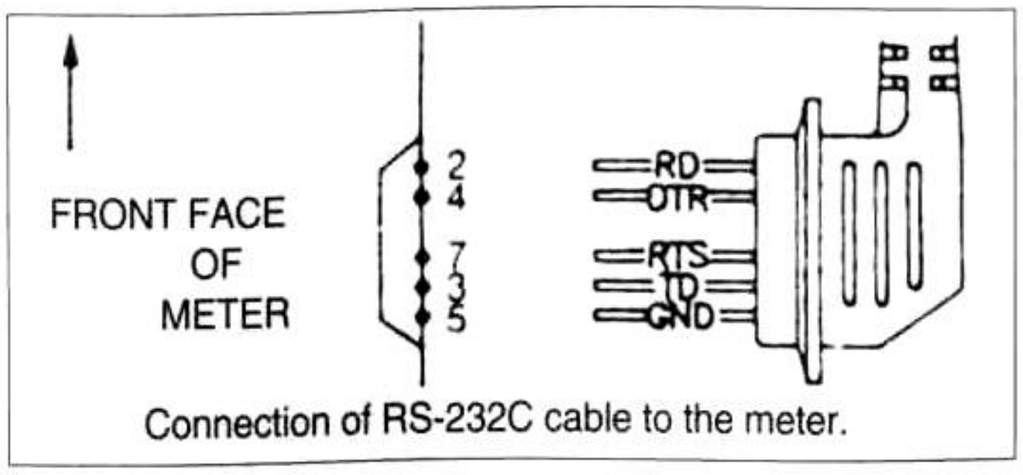
- Transmission rate : 9600 baud
- Character coding : 7 bit
- Parity : None
- Stop bits : 2

Hints for Writing Your Own Software

If you write your own program, the host computer must give the meter the "D" command to activate data transmission.

The following program is an example of a BASIC program that gets a single reading from the meter:

```
10 OPEN "COM1:9600,N,7,2,RS,CS,DS,CD" AS #2
20 PRINT #2,"D"
30 IN$=INPUT$(4*14,#2)
40 PRINT IN$
50 CLOSE #2
```



Connection of RS-232C cable to the meter.

Data Format

The data format consists of four frames of each 14 bytes.
The frames are set as follows.

Byte) 1 2 3 4 5 6 7 8 9 A B C D E
Example D C - 1 . 9 9 9 9 V CR ; 1st frame
- 1 . 9 9 9 9 CR ; 2nd frame
- 1 . 9 9 9 9 CR ; 3rd frame
- 1 . 9 9 9 9 CR ; 4th frame

Byte) 1 2 3 4 5 6 7 8 9 A B C D E
Example A C 0 2 9 . 8 0 m V CR ; 1st frame
CR ; 2nd frame
F R 0 0 . 0 6 0 k B m CR ; 3rd frame
d B 0 0 2 8 . 4 d B m CR ; 4th frame

* CR ; Carriage Return

7-3. Triplett SoftDMM Software
SEE ADDENDUM SHEET

8. Care and Maintenance

Your digital multimeter is a precise electronic device. Do not modify or tamper with its circuit. To prevent electric shock hazard, turn off the meter and disconnect test leads before removing the back cover.

8-1. Replacing the Fuse

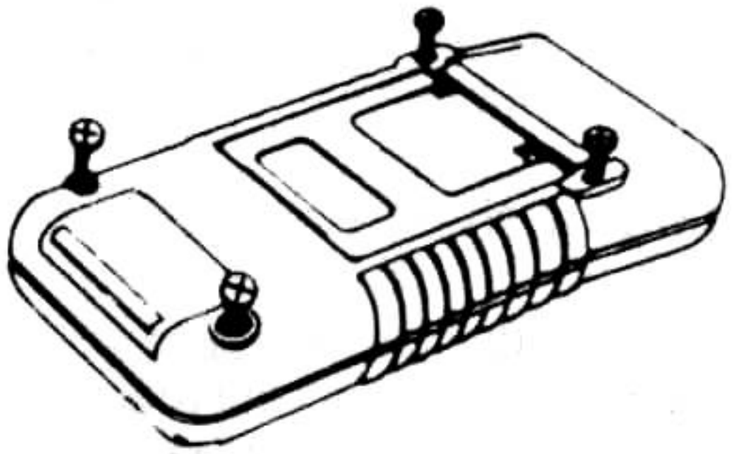
WARNING: TO AVOID ELECTRIC SHOCK, DISCONNECT THE TEST LEADS BEFORE REMOVING THE BATTERY OR THE FUSE. REPLACE ONLY WITH THE SAME TYPE OF BATTERY OR FUSE. SERVICE SHOULD BE PERFORMED ONLY BY QUALIFIED INDIVIDUALS.

WARNING: FOR PROTECTION AGAINST FIRE OR OTHER HAZARDS, REPLACE ONLY WITH A FUSE OF THE SPECIFIED VOLTAGE AND CURRENT RANGES.

Follow these steps to replace the fuse.

1. Turn the meter off. Disconnect the test leads.

2. Remove the back cover by unscrewing four screws and carefully pulling off the meter's back cover.

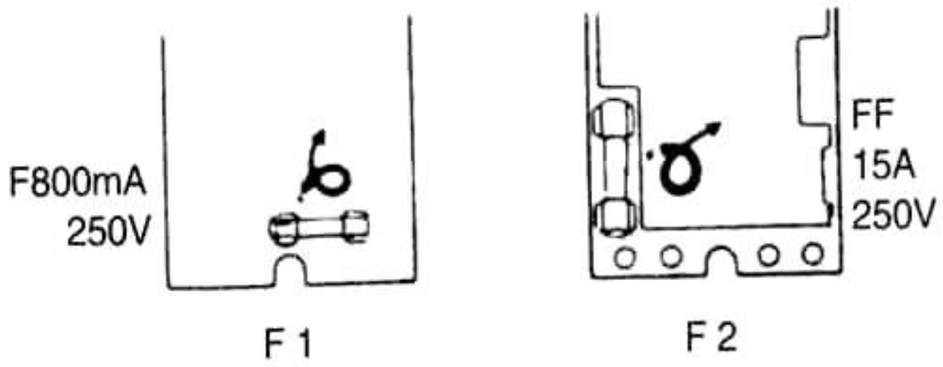


3. Locate and remove the blown fuse.

4. Install a new fuse.

5. Replace the cover and secure it with the screws.

WARNING: DO NOT OPERATE YOUR METER UNTIL THE BACK COVER IS IN PLACE AND FULLY CLOSED.



8-2. General Maintenance

Any adjustments, maintenance or repair of the instrument, should be done by qualified individuals.

1. Keep your meter dry. If it does get wet, wipe it immediately. Liquids might contain chemicals that can corrode the electronic circuits.

2. Use and store your meter only in normal temperature environments. Extreme temperatures can shorten the life of electronic devices, damage the battery, and distort or melt plastic parts.

3. Handle your meter gently and carefully. Dropping it can damage circuit boards and cause the meter to work improperly.

4. Keep your meter away from dust and dirt which can cause premature wear of parts.

5. Occasionally clean the meter with a damp cloth. Do not use harsh chemicals, cleaning solvents, or strong detergents.

6. When replacing the battery, use only a brand new battery of the same size and type. Always remove an old or weak battery. It can leak chemicals that destroy electronic circuits.

WARNING:
MODIFYING OR TAMPERING WITH YOUR METER'S INTERNAL COMPONENTS CAN CAUSE A MALFUNCTION THAT MIGHT INVALIDATE ITS WARRANTY, OR RESULT IN USER INJURY.

9. SPECIFICATIONS: TRIPLETT MODEL 2104

9-1. General Characteristics

Max Display	19,999 counts (4 1/2 digits) with automatic polarity indication
Reading Rate	1 to 2 readings per second
Operating Temperature	0 degrees C to 40 degrees C (32F to 104F)
Storage Temperature	-10 degrees C to 50 degrees C (14F to 122F)
Temperature for Guaranteed Accuracy	23 degrees C +/- 5 degrees C
Memories	10 User Memories, numbered 0 to 9
Battery Type	Standard 9 volt alkaline battery NEDA 1604 or 6F22 Triplett Part Number 37-48
Fuses	800mA / 250V, 5 x 20mm Triplett # 3207-122 Littelfuse # 216.800 Bussman # GDA 800mA 15A / 250V, 1/4" x 1 1/4" Triplett # 3207-126 Littelfuse # 322 015 Bussman # GBB-15

Size (H x W x L)	88 x 194 x 38mm (3.45 x 7.6 x 1.4 inches)
Net Weight	Approx 415g (0.92 lbs) with battery
Approvals	IEC 1010-1 (EN61010-1 Part 1) Safety Class II Overvoltage Category II(on voltage ranges only) 1000VDC 750VAC Overvoltage Category III(on voltage ranges only) 600V AC/DC CE Mark (EMC / LVD) TUV Rheinland
Supplied Accessories	Instruction Manual (Triplett # 84-820) Test Leads (Triplett # 79-773) Spare Fuse (Triplett # 3207-122) Carrying Case (Triplett # 10-4218) Software (Triplett # 158-220) Serial Cable (Triplett # 26-922) Battery Insulation Sleeve (Triplett # 31-666) Holster (Triplett # 10-4221) Capacitance extension lead (Triplett # 26-923)

Optional Accessories ..... Model 10-N AC Current Clamp-On for measuring AC current up to 400A.

Triplett # 60-573

Model 101-G Line Separator for use with the Model 10-N. Allows easy measurement of current in standard AC line cords.

Triplett # 3264

9-2. Special Characteristics

FUNCTION	RANGE	ACCURACY	RESOLUTION
DC Voltage	200 mV	+/- (0.05% of rdg + 3 digits)	10uV
	2 V		100uV
	20 V		1mV
	200 V		10mV
	1000 V	+/- (0.1% of rdg + 5 digits)	100mV
ACVoltage	200 mV	+/- (0.5% of rdg + 10 digits)[1]	10 uV
	2 V		100 uV
	20 V		1 mV
	200 V		10 mV
	750 V	+/- (0.8% of rdg + 10 digits)[1]	100 mV
DC Current	2 mA	+/- (0.3% of rdg + 3 digits)	100 nA
	20 mA	+/- (0.3% of rdg + 3 digits)	1 uA
	200 mA	+/- (0.5% of rdg + 3 digits)	10 uA
	20 A[2]	+/- (0.8% of rdg + 5 digits)	1 mA

Notes:

1. 40Hz to 400Hz
2. Above 10A, limit measuring time to 30 seconds.
   Allow 15 minutes to cool down between measurements.

FUNCTION	RANGE	ACCURACY	RESOLUTION
AC Current	2 mA	+/- (0.8% of rdg + 10 digits)[1]	100nA
	20 mA	+/- (0.8% of rdg + 10 digits)[1]	1 uA
	200 mA	+/- (1.0% of rdg + 10 digits)[1]	10 uA
	20 A[2]	+/- (1.2% of rdg + 15 digits)[1]	1mA
RESISTANCE	200 ohm	+/- (0.2% of rdg + 5 digits)	0.01 ohm
	2 Kohm	+/- (0.15% of rdg +3 digits)	0.1 ohm
	20 Kohm		1 ohm
	200 Kohm		10 ohm
	2 Mohm		100 ohm
	20 Mohm	+/- (0.5% of rdg + 5 digits)	1 Kohm
DIODE / CONTINUITY	Diode: Measures forward voltage drop of semiconductor junction with a test current of approximately 1mA Continuity: The buzzer sounds if the measured resistance is less than approximately 30 ohm.		

Notes:

1. 40Hz to 400Hz
2. Above 10A, limit measuring time to 30 seconds. Allow 15 minutes to cool down between measurements.

FUNCTION	RANGE	ACCURACY	RESOLUTION
hFE	Display reads approximate hFE of transistor under test.		
CAPACITANCE	20 nF	+/- (2.0% of rdg + 5 digits)	1 pF
	200 nF		10 pF
	20 uF	+/- (3.0% of rdg + 8 digits)	1 nF
	200 uF		10 nF
FREQUENCY	20 kHz	+/- (0.1% of rdg + 2 digits)	1 Hz
	200 kHz		10 Hz
	2 MHz		100 Hz
LOGIC	DC 20 V	+/- (0.05% of rdg + 3 digits)	1 mV
	FREQUENCY	+/- (0.1% of rdg + 2 digits)	

TRIPLETT THREE YEAR LIMITED WARRANTY

The Triplett Corporation warrants instruments and test equipment manufactured by it to be free from defective material or workmanship and agrees to repair or replace such products which, under normal use and service, disclose the defect to be the fault of our manufacturing, with no charge within three years (one year on calibration) of the date of original purchase for parts and labor. If we are unable to repair or replace the product, we will make a refund of the purchase price. Consult the Instruction Manual for instructions regarding the proper use and servicing of instruments and test equipment. Our obligation under this warranty is limited to repairing, replacing, or making refund on any instrument or test equipment which proves to be defective within three years from the date of original purchase.

This warranty does not apply to any of our products which have been repaired or altered by unauthorized persons in any way so as, in our sole judgment, to injure their stability or reliability, or which have been subject to misuse, abuse, misapplication, negligence, accident or which have had the serial numbers altered, defaced, or removed. Accessories, including batteries and fuses, not of our manufacture used with this product are not covered by this warranty.

To register a claim under the provisions of this warranty, return the instrument or test equipment to Triplett Corporation, Service Department, One Triplett Drive, Bluffton, Ohio 45817, transportation prepaid. Upon our inspection of the product, we will advise you as to the disposition of your claim.

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