190 Specifications ±0.05% Basic DCV Accuracy

Function	Range	Resolution
DCV	50mV	0.001mV
	500mV	0.01mV
	5V	0.0001V
	50V	0.001V
	500V	0.01V
	1000V	0.1V
ACV	5V	0.0001V
	50V	0.001V
	500V	0.01V
	750V	0.1V
DCA/ACA	500µA	0.01µA
	5000µA	0.1µA
	50mA	0.001mA
	500mA	0.01mA
	5A	0.0001mA
	10A	0.001A
OHM	500Ω	0.1Ω
	5kΩ	0.0001kΩ
	50kΩ	0.001kΩ
	500kΩ	0.01kΩ
	5MΩ	0.0001MΩ
	50MΩ	0.001MΩ
CAPACITANCE (190,194)	5µF	0.001µF
	50µF	0.01µF
	500µF	0.1µF
	5000µF	1µF
	20mF	0.01mF
CAPACITANCE (192)	100nF	0.1nF
	1µF	0.001µF
	10µF	0.01µF
	100µF	0.1µF
Inductance (Only192)	100mH	0.01mH
Frequency	50Hz	0.001Hz
	500Hz	0.01Hz
	5KHz	0.0001KHz
	50KHz	0.001KHz
	500KHz	0.01KHz

	Test Voltage	Test Current
Diode	Approx. 3V	Approx. 1mA

	Test Voltage	Threshold
Continuity	Approx. 3V	300 Digits

See pages 10~13 for detail specifications.

Test Products International, Inc.

190 Series

Digital Multimeter
Instruction Manual

TABLE OF CONTENTS

A. INTRODUCTION

INTRODUCTION

1. Congratulations!!

Thank you for purchasing a TPI Digital Multimeter. The Triple Display is an innovative new concept in DMM design. The unique display enables you to view more than one event at a time. This eliminates the hassle of switching back and forth to review minimum, maximum or preset comparative values. The meter is also easy to use and built to last.

2. Production Description

The meter is a hand-held autoranging DMM. The backlit LCD can display three readings at one time. In addition to basic function of AC/DC V, AC/DC A, Ohm, Diode test, Inductance(Only192), continuity, Capacitance, Frequency, there is the adaptor function. The meter also has RS232 output and software for recording information into a PC.

The meter also features:

- **REC** Records Min/Max and Average readings during specified measurement intervals.
- **COMP** Compare actual reading to preset HI and LOW value for Pass/Fail testing of component.
- **HOLD** Tow hold system automatically holds the previous stable reading when a new one is obtained.

The meter comes complete with the following accessories:

Battery
Rubber Boot
Test Lead Set
Instruction Manual

3. EC Declaration of Conformity

This is to certify that model DMM 190 conforms to the protection requirement of the council directive 89/336/EEC, in the approximation of laws of the member states relating to Electromagnetic compatibility and 73/23/EEC, the low voltage Directive by application of the following standards:

EN 50081-1	**1992 Emissions standard**
EN 50082-1	**1992 Immunity standard**
EN 61010-1	**1993 Safety standard**
EN 61010-2-031	**1995 Safety standard**

To ensure conformity with these standards, this instruction must be operated in accordance with the instruction and specifications given in this manual.

CAUTION:

Even though this instrument complies with the immunity standards, the accuracy can be affected by strong radio emissions not covered in the above standards. Sources such as hand held radio transceivers, radio and TV transmitters, vehicle radios and cellular phones generate electromagnetic radiation that could be induced into the test leads of the instrument. Care should be taken to avoid such situations or alternatively, check to make sure that the instrument is not being influenced by these emissions.

B. SAFETY CONSIDERATIONS

⚠ ***WARNING!**: Please follow manufacturers test procedures whenever possible. Do not attempt to measure unknown voltages or components until a complete understanding of the circuit is obtained.*

GENERAL GUIDELINES

ALWAYS

- Test the meter before using to make sure it is operating property.
- Inspect the test leads before using to make sure there are no breaks or shorts.
- Double-check all connections before testing.
- Have someone check on you periodically if working alone.
- Have a complete understanding of the circuit under test.
- Disconnect power to circuit, and then connect test leads to the meter, and then to circuit being measured.

NEVER

- Attempt to measure unknown high voltage.
- Attempt to measure current with the meter in parallel to the circuit.
- Connect to the test leads to a live circuit before setting up the instrument.
- Touch any exposed metal part of the test lead assembly.

INTERNATION SYMBOLS

 CAUTION: RISK OF ELECTRIC SHOCK

 AC (ALTERNATING CURRENT)

 DC (DIRECT CURRENT)

 REFER TO INSTRUCTION MANUAL

 GROUND

 FUSE

 DOUBLE INSULATION

C. TECHNICAL DATA

1. Features and benefits

Safety	Meets CE and IEC 1010 requirements. UL Listed to U.S. and Canadian Safety Standards.
True RMS	Needed to accurately measure non-sinusoidal AC voltage and current waveforms found on many controls and circuits.
Triple Display	Shows more than one reading simultaneously.
Two-Hold System	Holds two readings on the display at thesame time.
Auto Power Off	Automatically powers instrument down after 15 minutes of inactivity, yet will continue acquiring data in its various modes.
Record	Records Min/Max and Average values
Compare	Compares stored value with measured value for matching components.
Relative Percentage	Displays measured value as a % of stored value for checking component tolerances.
RS232 Output	Transfers data directly to a PC while measuring.
Back Light	Allows viewing in any light condition.
Auto range	Automatically selects the best range for the measurement.

2. Product Applications

Perform the following tests and/or measurements with the meter and the appropriate function:

HVAC/R

DC mV	• Gas application.
ACA	• Heat anticipator current in thermostats.
ACV	• Line voltage.
ACV or DCV	• Control circuit voltage.
DcuA	• Flame safeguard control current.
OHMS	• Heating element resistance (continuity).
OHMS	• Compressor winding resistance.
OHMS	• Contactor and relay coil resistance.
OHMS	• Continuity of wiring.
Hz/FREQ	• Frequency of line and control voltage.
CAP	• Motor start and run capacitance.
REC	• Record min/max voltage of controls and line voltages.

ELECTRICAL

ACV	• Measure line voltage.
OHMS	• Continuity of circuit breakers.
Hz/FREQ	• Frequency of line and control voltage.
DCV	• Voltage of direct drive DC motors.

ELECTRONIC

ACV	• Measure power supply voltage.
OHMS	• Continuity of circuit breakers.
REL%	• Match components
COMP	• Compare readings in circuit or components
Hz/FREQ	• Frequency of line and control voltage.

3. Specifications

IEC 1010 Over Voltage: (190, 192)
CAT II-1000VDC, 750VAC
CATIII-600V
Pollution Degree 2

c UL us LISTED
UL 3111-1

EC 1010 Over Voltage: (194)
CAT III-1000V
CAT IV-600V
Pollution Degree 2

c UL us LISTED
UL 3111-1

※ **INSTALLATION** I • II • III

INSTALLATION CATEGORY(OVERVOLTAGE CATEGORY) I :
Signal level, special equipment or parts of equipment, telecommunication, electronic etc., with smaller transient overvoltages than INSTALLATION CATEGORY **II**.

INSTALLATION CATEGORY(OVERVOLTAGE CATEGORY) II :
Local level, appliances, PORTABLE EQUIPMENT etc., with smaller transient overvoltages than INSTALLATION CATEGORY **III**.

INSTALLATION CATEGORY(OVERVOLTAGE CATEGORY) III :
Distribution level, fixed installation, with smaller transient overvoltages than INSTALLTION CATEGORY **IV**.

3. Specifications (cont.)

General Specifications

a. DCV

Range	Resolution	Accuracy	Impedance
5V	0.0001V	+/-0.05% of reading, +/- 4digits	10MΩ
50V	0.001V		
500V	0.01V		
1000V	0.1V	+/-0.1% of reading, +/- 10digits	

a1. DCmV

Range	Resolution	Accuracy	Impedance
50mV	0.001mV	+/-0.1% of reading, +/- 10digits	
500mV	0.01mV		

b1. ACV(45Hz to 450Hz)

Range	Resolution	Accuracy	Impedance
5V	0.0001V	+/-0.4% of reading, +/- 40digits	10MΩ
50V	0.001V		
500V	0.01V		
1000V	0.1V		

b2. ACV(450Hz to 5KHz)

Range	Resolution	Accuracy	Impedance
5V	0.0001V	Unspecified	10MΩ
50V	0.001V	+/-1.5% of reading, +/- 40digits	
500V	0.01V		
1000V	0.1V		

b3. ACV(5KHz to 20KHz)

Range	Resolution	Accuracy	Impedance
5V	0.0001V	Unspecified	10MΩ
50V	0.001V	+/-2.0% of reading, +/- 40digits	
500V	0.01V		
1000V	0.1V	Unspecified	

3. Specifications (cont.)

c. DCA

Range	Resolution	Accuracy	Overload protection
500uA	0.01uA	+/-0.5% of reading, +/- 5digits	Fuse(fast blow) F600V, 0.5A 31CM F1000V, 0.44A (Only 194)
5000uA	0.1uA		
5000uA	0.1uA		
50mA	0.001mA		
500mA	0.01mA		
5A	0.0001A	+/-0.75% of reading, +/- 5digits	Fuse(fast blow) F600V, 10A 31CM F1000V, 11A (Only 194)
10A	0.001A		

d. ACA

Range	Resolution	Accuracy	Overload protection
500uA	0.01uA	+/-0.75% of reading, +/- 5digits	Fuse(fast blow) F600V, 0.5A 31CM F1000V, 0.44A (Only194)
5000uA	0.1uA		
50mA	0.001mA		
500mA	0.01mA		
5A	0.0001A	+/-1.5% of reading, +/- 5digits	Fuse(fast blow) F600V, 10A 31CM F1000V, 11A (Only194)
10A	0.001A		

e. OHM(Resistance)

Range	Resolution	Accuracy	Overload protection
500Ω	0.01Ω	+/-0.05% of reading, +/- 5digits	600V DC or AC peak 1000V DC or AC peak(Only194)
5KΩ	0.0001KΩ		
50KΩ	0.001KΩ		
500KΩ	0.01KΩ		
5MΩ	0.0001MΩ	+/-1.0% of reading, +/- 10digits	
50MΩ	0.001MΩ		

3. Specifications (cont.)

f. Diode test

Range	Resolution	Accuracy	Overload protection
3V	Approx. 1mA		600V DC or AC peak 1000V DC or AC peak (Only 194)

g. Continuity Buzzer

Test voltage	Threshold	Overload protection
3V	30digits	600V DC or AC peak 1000V DC or AC peak (Only 194)

h. Capacitance (190, 194)

Range	Resolution	Accuracy	Overload protection
5uF	0.001uF	+/-2.0% of reading, +/- 10digits	
50uF	0.01uF		
500uF	0.1uF		
5000uF	1uF		
20mF	0.01mF	+/-7.0% of reading, +/- 10digits	

h-1. Capacitance (192)

Range	Resolution	Accuracy
100nF	0.1nF	+/-2.0% of reading, +/- 10digits
1uF	0.001uF	
10uF	0.01uF	
100uF	0.1uF	(Max 120uF)

Capacitance is max. 5000 counts

i. Inductance (Only 192)

Range	Resolution	Accuracy
100mH	0.01mH	+/-5% of reading, 50digits

3. Specifications (cont.)

j. frequency

Range	Resolution	Accuracy	Overload protection
50Hz	0.001Hz	+/-0.05% of reading, +/- 5digits	600V DC or AC peak
500Hz	0.01Hz		
5Khz	0.0001Khz		
50Khz	0.001Khz		
500Khz	0.01Khz		

k. Adaptor

Model		Display
A301(Temp Adaptor C/F)	1mV/C, 1mV/F	0000.0 C/F
A254(Current Adaptor 10/60A)	100mV/A, 10mV/A	00.000A 000.00A
A256(Current Adaptor 40/400A)	1mV/A	0000.0A
A296(Current Adaptor 400/1000A)	1mV/A	0000.0A

l. General Specifications

Max. volt. between any input and Ground	1000V
Fuse protection	**mA :** 0.5A/600VAC; **A :** 10A/600VAC **[mA :** 0.44A/1000VAC; **A :** 11A/1000VAC(Only 194)**]**
Display Type Digital :	50000 count, 4 times/S update Bar graph : 51 segment
Operating temp.	0°C to 40 °C (32°F to 113°F)
Storage Temp.	-20°C to 60°C (-4°F to 140°F)
Relative Humidity	0% to 80% (0° ~ 35 °C/ 32° ~ 95°F) 0% to 70% (35° ~ 55 °C/ 95° ~ 131°F)
Power Supply	9Volt battery
Battery Life	
Size(H x L x W)	
Weight	

D. MEASUREMENT TECHNIQUES

1. Controls and function:

Push Button

RANGE Activates manual range

REC Activates the Min/Max/Avg mode.

REL % Activates REL% mode.

EDIT Activates the EDIT mode for the compare and relative % function.

☼ Activates Back light for the LCD(Automatically turns off after approx. 35 sec.)

COMP Activates Compare mode.

HOLD Activates tow-hold data hold mode

Rotary Switch

OFF Turns the instrument off.

$\overline{\overline{mV}}$ Selects the DC mV function

$\overline{\overline{V}}$ Selects the DCV function

$\tilde{V}$ Selects the ACV function

$\tilde{\overline{\overline{V}}}$ Selects the DCV function (Push ORANGE button to activate ACV) (Only192)

→| Selects the Diode test function

Ω))) Selects the Ohm function (Push ORANGE button to activate continuity buzzer.)

CAP Selects the Capacitance function

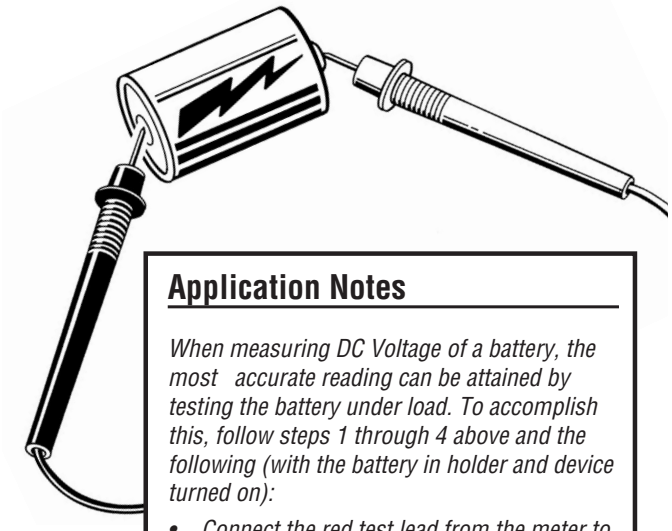
mH	Selects the Inductance function
HZ	Selects the Frequency function
μA	Selects the DC uA function (Push ORANGE button to activate AC uA.
mA	Selects the DC mA function (Push ORANGE button to activate AC mA.)
A	Selects the DC A function (Push ORANGE button to activate AC A.)
Adaptor	Can use A254, A256, A296 and A301 (Push ORANGE button to activate AC adaptor, and push RANGE button to choose kind of adaptor)

Input Jacks

V/Ohm	Red test lead connection for all Volt, Ohm, Diode, and Continuity measurement.
COM	Black test lead connection for all functions.
uA/mA	Red test lead connection for current measurement on the AC/DC uA and AC/DC mA.
A	Red test lead connection for current measurement on the AC/DC A.
RS-232	See section on RS-232C interface

2. Power on Options:

Disable Auto Off	Hold down the REC button while turning on the instrument.



Application Notes

When measuring DC Voltage of a battery, the most accurate reading can be attained by testing the battery under load. To accomplish this, follow steps 1 through 4 above and the following (with the battery in holder and device turned on):

- *Connect the red test lead from the meter to the positive (+) terminal of the battery.*
- *Connect the black test lead to the negative (-) terminal of the battery.*
- *Reconnect power to the circuit and read the voltage on the 190.*

3. Step by step procedure

a. Measuring DC Volts

CAUTION

Do not attempt to make a voltage measurement if a test lead is plugged in the A or mA input jack. Instrument damage and/or personal injury may result.

⚠ ***WARNING!***

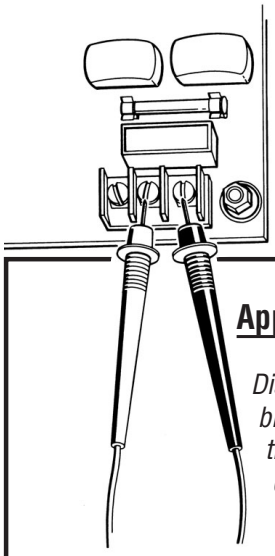
Do not attempt to make a voltage measurement of more than 1000V or of voltage level that is unknown.

Instrument set-up:

FUNCTION	BLACK TEST LEAD	RED TEST LEAD	MINIMUM READING	MAXIMUM READING
mV⎓	COM	VΩ	0.001mV	500.00mV
V⎓	COM	VΩ	0.0001V	1000.0mV

Measurement Procedure:

1. Disconnect power to circuit to be measured.
2. Plug black test lead into the **COM** input jack.
3. Plug red test lead into the VΩ⊣((input jack.
4. Set rotary switch to either the mV⎓ or V⎓ range, depending on the voltage to be measured.
5. Connect test leads to circuit to be measured.
6. Reconnect power to circuit to be measured.
7. Read the voltage on the LCD.



Application Notes

Disconnect power from the terminal block, find the fuse or circuit breaker that controls the block and turn it off.

Set up the meter following the steps under "Measurement Procedure" on page 13. Then proceed with the following:

- *Connect the red test lead to the hot side of the block and the black lead to the neutral side of the block. Reconnect power to the block and read the voltage on the meter. The reading should be approximately 110V to 130V.*
- *Disconnect power from the block and move the red wire to ground. Reconnect power to the block and read the voltage on the meter. Typically less than 20V should exist from neutral to ground. If 110V or above exists, the block may be wired incorrectly.*

b. Measuring AC Volts

CAUTION

Do not attempt to make a voltage measurement if a test lead is plugged in the A or umA input jack. Instrument damage and/or personal injury may result.

⚠ ***WARNING!***

Do not attempt to make a voltage measurement of more than 750V(1000V-Only 194) or of a voltage level than is unknown.

Instrument set-up:

FUNCTION	BLACK TEST LEAD	RED TEST LEAD	MINIMUM READING	MAXIMUM READING
$\tilde{V}$	COM	VΩ⊣(	0.0001V	750.0V 1000V(Only 194)

Measurement Procedure:

1. Disconnect power to circuit to be measured.
2. Plug black test lead into **COM** input jack.
3. Plug red test lead into the VΩ⊣(input jack.
4. Set the rotary switch to the $\tilde{V}$ function depending on the voltage to be easured.
5. Connect test leads to circuit to be measured.
6. Reconnect power to circuit to be measured.
7. Read the voltage on the LCD.

c. Measuring DC Amps

CAUTION

Do not attempt to make a current measurement with the test leads connected in parallel with the circuit to be tested. Test leads must be connected in series with the circuit.

⚠ ***WARNING!***

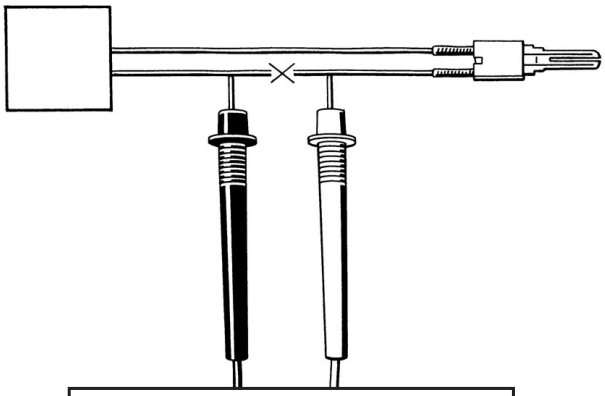
Do not attempt to make a current measurement of circuits with more than 600V(1000V-Only 194) present. Instrument damage and/or personal injury may result.

Instrument set-up:

FUNCTION	BLACK TEST LEAD	RED TEST LEAD	MINIMUM READING	MAXIMUM READING
mA⎓	COM	mA	0.001mA	500.00mA
A⎓	COM	A	0.0001A	10.000A

Measurement Procedure:

1. Disconnect power to circuit to be measured.
2. Plug black test lead into the **COM** input jack.
3. Plug red test lead into the mA⎓ or A⎓ input jack depending on the value of current to be measured.
4. Set the rotary switch to the mA⎓ or A⎓ function.
5. Connect the test leads in series to the circuit to be measured.
6. Reconnect power to circuit to be measured.
7. Read the current on the LCD.



Application Notes

When measuring the DC current of a flame controller, follow the steps under "Measurement Procedure" above and then proceed with the following:

- *Set up the meter for making a µA measurement.*
- *Connect the meter to the flame controller lead by opening the circuit and inserting the leads in series with the circuit as shown in the picture above.*

d. Measuring AC Amps

CAUTION

Do not attempt to make a current measurement with the test leads connected in parallel with the circuit to be tested. Test leads must be connected in series with the circuit.

⚠ ***WARNING!***

Do not attempt to make a current measurement of circuits with more than 600V (1000V-Only 194)present. Instrument damage and/or personal injury may result.

Instrument set-up:

FUNCTION	BLACK TEST LEAD	RED TEST LEAD	MINIMUM READING	MAXIMUM READING
mÃ	COM	mA	0.001mA	500.00mA
Ã	COM	A	0.0001A	10.000A

Measurement Procedure:

1. Disconnect power to circuit to be measured.
2. Plug black test lead into the **COM** input jack.
3. Plug the red test into the mÃ or Ã input jack depending on the value of current to be measured.
4. Set the rotary switch to the mÃ or Ã function.
5. Connect test leads in series to circuit to be measured.
6. Reconnect power to circuit to be measured.
7. Read the current on the LCD.

e. Measuring Resistance

⚠ ***WARNING!***

Do not attempt to make resistance measurements with circuit energized. For best results, remove the resistor completely from the circuit before attempting to measure it.

NOTE:

To make accurate low ohm measurements, short the ends of test leads together and record the resistance reading. Deduct this value from actual readings.

Instrument set-up:

FUNCTION	BLACK TEST LEAD	RED TEST LEAD	MINIMUM READING	MAXIMUM READING
Ω•)))	COM	VΩ⊣⋲	0.01Ω	50.000MΩ

Measurement Procedure:

1. Disconnect power to circuit to be measured.
2. Plug black test lead into the **COM** input jack.
3. Plug red test lead into VΩ⊣⋲ input jack.
4. Set the rotary switch on the DMM to the Ω•))) function.
5. Connect the test leads to the circuit to be measured.
6. Read the resistance value on the LCD.

f. Measuring Diodes

CAUTION

Do not attempt to make diode measurements with circuit energized. The only way to accurately test a diode is to remove it completely from the circuit before attempting to measure it.

Instrument set-up:

FUNCTION	BLACK TEST LEAD	RED TEST LEAD	MINIMUM READING	MAXIMUM READING
⊣◀	COM	VΩ⊣⋲	0.001V	2.0000V

Measurement Procedure:

1. Disconnect power to circuit to be measured.
2. Plug black test lead into the **COM** input jack.
3. Plug red test lead into VΩ⊣⋲ input jack.
4. Set the rotary switch to the ⊣◀ function.
5. Connect the black test lead to the banded end of the diode and the red test lead to the non-banded end of the diode.
6. Reading on the display should be between 0.5 and 0.8 volts.
7. Reading test lead connections in 5 above.
8. Reading on the display should be OFL(Overflow).

NOTE: If diode reads 0 in both directions, diode is shorted. If diode reads OFL in both directions, diode is open.

g. Continuity Buzzer

⚠ ***WARNING!***

Do not attempt to make continuity measurements with circuit energized.

Instrument set-up:

FUNCTION	BLACK TEST LEAD	RED TEST LEAD
Ω•)))	COM	VΩ⊣(

Measurement Procedure:

1. Disconnect power to circuit to be measured.
2. Plug black test lead into the **COM** input jack.
3. Plug red test lead into the VΩ⊣(input jack.
4. Set the rotary switch to the Ω•))) function.
5. Press the yellow push button to activate the continuity buzzer.
6. Connect test leads to circuit to be measured.
7. Listen for the buzzer to confirm continuity.

h. Measuring Capacitance

⚠ ***WARNING!***

All capacitance measurements are to be made on de-energized circuit with all capacitors Discharged only. Failure to de-energize and discharge capacitors before attempting to measure them could result in instrument damage and/or personal injury.

FUNCTION	BLACK TEST LEAD	RED TEST LEAD	MINIMUM READING	MAXIMUM READING
⊣(	COM	VΩ⊣(	0.001uF	20.00mF
			0.1nF	120.0uF(Only 192)

Measurement Procedure:

1. Disconnect power to circuit to be measured.
2. Remove capacitor from the circuit and discharge it.
3. Plug black test lead into the **COM** input jack.
4. Plug the red test lead into the VΩ⊣(input jack.
5. Set the rotary switch to the ⊣(function.
6. Connect test leads to capacitor to be measured.
7. Read the capacitor value on the LCD.

i. Measuring Inductance (Only 192)

FUNCTION	BLACK TEST LEAD	RED TEST LEAD	MINIMUM READING	MAXIMUM READING
mH	COM	umAmH	0.01mH	120.00mH

Measurement Procedure:

1. Disconnect power to circuit to be measured.
2. Plug black test lead into the **COM** input jack.
3. Plug red test lead into the **μmAmH** input jack.
4. Set the rotary switch to the DMM 192 to the **mH** function.
5. Connect the test leads to the circruit to be measured.
6. Read the Inductance value on the LCD.

j. Measuring Frequency

⚠ ***WARNING!***

Never attempt a frequency measurement with a voltage source greater than 600V. (1000V-Only 194)Determine the voltage of any unknown frequency source before connecting the instrument in frequency source before connecting the instrument in frequency mode.

FUNCTION	BLACK TEST LEAD	RED TEST LEAD	MINIMUM READING	MAXIMUM READING
HZ	COM	**VΩ⊣(**	0.01Hz	500.00KHz

Measurement Procedure:

1. Disconnect power to circuit to be measured.
2. Plug black test lead into the **COM** input jack.
3. Plug red test lead into the **VΩ⊣(** input jack.
4. Set the rotary switch to the **HZ** function.
5. Reconnect power to circuit to be measured.
6. Read the frequency on the LCD.

k. Record Mode

The record mode saves minimum (MIN) and maximum (MAX) values measured for a series of readings. The main part of the LCD displays the actual reading, the MAX value is constantly displayed on the lower left hand sub-display while the MIN value is constantly displayed on the lower right hand sub-display. Activate the function as follows:

1. Depress the **REC** button on the meter.
2. The meter will immediately start to record and display MIN/MAX values on the two lower sub-displays.
3. Press **REC** button a second time and the AVG(average) reading will be displayed.
4. Press the **REC** button again to return to normal record mode.

l. Compare Mode

The compare mode takes the actual reading on the main display and compares it to LOW and HIGH values, programmed by the user, on the sub-displays. This is used to compare components or measurements for acceptable readings. Activate the function as follows:

1. To use **Compare Mode** manually select the correct range for the function.
2. Depress the **COMP** button.
3. Depress the **EDIT** button the right hand digit under the HIGH sub-display will start to flash.
4. Depress the **REL**% or **HOLD** buttons until the correct number is selected for the position.
5. Depress the **REC** button. The next digit to the right of 3 above will start to flash.
6. Repeat steps 4 and 5 until the correct values for all eight digits under LOW and HIGH sub-display are entered.
7. After the correct LOW and HIGH values are entered, depress the **EDIT** button.
8. Measure the circuit or component being compared to the programmed values. Results will be displayed as PASS for the acceptable readings, LO for low readings, and HI for high readings.
9. Depress the **COMP** button or turn the rotary switch to exit the function.

m. Relative % Mode

The Relative % mode takes the actual reading on the main display and compares it to a reference value programmed by the user on the right hand sub-display. The left hand sub-display will show the percentage the actual reading varies from the reference value. Activate the function as follows:

1. To use **Relative** % mode manually select the range for the function.
2. Depress the **REL**% button.
3. Depress the **EDIT** button. The right hand digit under the **REF** sub-display will start to flash.
4. Depress **REL**% or **HOLD** buttons until correct number is selected for that display position.
5. Depress the **REC** button. The next digit to the right of 3 above will start to flash.
6. Repeat steps 4 and 5 until correct values for all four digits under **REF** sub-display are entered.
7. After the correct **REF** value is entered, depress the **EDIT** button.
8. Measure the circuit or component being compared to the programmed reference value. Results will be displayed as a percentage in the lower left hand left hand sub-display.
9. Depress the **REL**% button or turn the rotary switch to exit the function.

n. Two-Hold System

The two-hold system is a data hold feature that will automatically store a stable reading under the 1 HOLD sub-display in the lower left hand corner of the LCD. When a new, stable reading is obtained, the reading under 1 HOLD will be moved to 2 HOLD and the new reading will be displayed under 1 HOLD

Depress the **HOLD** button to activate the feature.

Push the button again to de-activate the feature.

o. RS-232C interface

Demonstration software is provided with the DMM. The program is written for windows using MFC. For you own applications, consult the following;

1. Specification

Baud rate	19200 baud
Parity	none
Data length	8 bit
Stop bit	1 bit

2. Transmitte format(DMM to PC)

Output and Input of all data are ASCII String.
Send Format(DMM to PC)
"fun b sign value b unit b cr lf"

fun	Function(ASCII code)
b	blank(0x20)
Sign	-(0x2E)/ (0x20)
Value	Measured value(ASCII string)
unit	Unit(ASCII string)
cr	Carriage Return
lf	Line Feed

Function code

Function	Function code	Unit
DCmV	DCV	mV
DCV	DCV	V
ACV	ACV	V
Diode	DIO	V
Ohm/Continuity	OHM/BEP	Ohm/ Kohm/ Mohm
Capacitance	CAP	uF/mF
Frequency	FRQ	Hz/ Khz
uA	DCA/ACA	uA
mA	DCA/ACA	mA
A	DCA/ACA	A
Adaptor	AC/DC1,2,3 TMP	A/ tC/ tF
Inductance	IND	mH

Push button code

Push key	Code
RANGE	RANGE AUTO/ RANGE MANUAL
REC	REC ON/ REC AVG/ REC OFF
REL	REL ON ref2/ REL OFF
COMP	COMP ON ref1 ref2/ COMP OFF
HOLD	HOLD ON/ HOLD OFF

★) ref1 is the sub display on the left lower part of the LCD, ref2 is the sub display value on the right lower part of the LCD.

ex)"1 DCV 12.345 mV HIGH 10.000 11.000 crlf"

: "1" indicates the push button is being operated and mean the DCV function. The real value is 12.345mV. The main display shows "HI". The left lower part of the LCD shows 10.000mV and the right lower part of the LCD shows 11.000mV.

"2 DCV -1.2345 mV crlf"

: "2" indicates the push button is being off and Outputs the value being displayed on the Main display.

"3 REL ON crlf"

: Indicates the REL % key is being pressed.

Receive Format(PC to DMM)

REL ON ref2 Activates REL %.(If the value is input on ref2, it sets with value)

REL OFF Deactivates REL %

REC ON Activates the record mode to the normal mode.

REC AVG Activates the record mode to the AVG mode.

REC OFF Deactivates Record mode

COMP ON ref1 ref2 Activates COMP.(If value is input on the meter uses these as high & low limit of compare)

COMP OFF Deactivates COMP mode

HOLD ON Activates HOLD mode

HOLD OFF Deactivates HOLD mode

SKEY f Indicates status of the function f is REL, REC, COMP, HOLD, RANGE.

DMM STOP Set the RS-232C to stop mode.
DMM GO Set the RS-232C to start mode.

DMM SINGLE Output only one single data(one string) on the DMM(you can keep getting data by using this command)

E. ACCESSORIES

Standard Accessories	Part NO.
9 Volt Alkaline Battery	
Fuse 0.5A	Fuse 0.44A(Only194)
Fuse 10A	Fuse 11A(Only194)
Test lead	
Rubber boot	
Optional Accessories	

Accessories	Part NO.
Demonstration Software	
Deluxe Test lead set	
IEC 1010 Deluxe test lead kit	
Temperature Adaptor	A301
Current Adaptor 10/60A	A254
Current Adaptor 40/400A	A256
Current Adaptor 400/1000A	A296
Carrying case	

F. MAINTENANCE

1. **Battery Replacement:** The meter will display AT when the 9 volt battery needs replacement. Battery replaced as following:

   a. Disconnect and remove all test leads from live circuit and from the meter.

   b. Remove the meter from protective boot.

   c. Remove the three screws from battery cover of back

   d. Remove old batteries and replace with new batteries.

   e. Reassemble instrument in reverse order from above.

2. **Fuse Replacement:** Both the A and mA/uA input jacks are fuse protected. Use only Fast blow, 600V fuses with correct current ratings. Failure to do so will void all Warranties. If either do not function, replace as Following:

   a. Disconnect and remove all test leads from live circuit and from the meter.

   b. Remove the meter from protective boot.

   c. Remove the three screws from battery cover of back

   d. Remove old fuse(s) and replace it with new fuse(s).

   e. Reassemble instrument in reverse order from above.

   f. Fuse must be changed by replacement in service center.

3. **Cleaning your Meter**

   Use a mild detergent and a slightly damp cloth to clean the surfaces of the meter.

G. TROUBLE SHOOTING GUIDE

Problem	Probable Causes
Does not power up	• Dead or defective battery • Broken wire from battery snap to PCB
Won't display current readings	• Open fuse • Open test lead • Improperly connected to circuit under test
All functions except ohms read high	• Very weak battery that will not turn on the low battery indicator on the LCD
ACV do not read	• Very weak battery that will not turn on the low battery indicator on the LCD

WARRANTY

Please refer to product warranty card for warranty statement.

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