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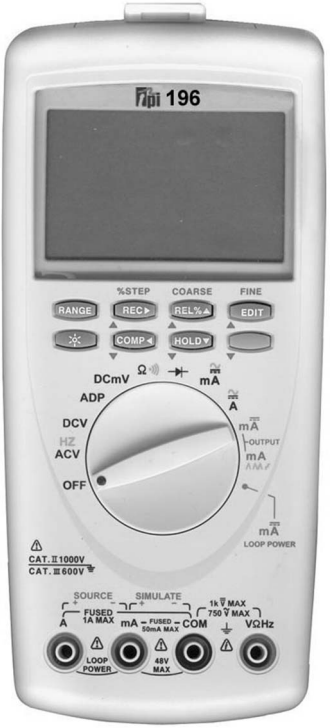
196

Digital Multimeter
Instruction Manual



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A. INTRODUCTION

INTRODUCTION

1. Congratulations!!

Thank you for purchasing a TPI Digital Multimeter. The Triple Display196 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 DMM 196 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, continuity, Capacitance, Frequency, there is the adaptor function. The DMM 196 also has RS232 output and software for recording information into a PC.

The DMM 196 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 DMM 196 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 196 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 DMM 196 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 DMM 196, 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 DMM196 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:
CAT II-1000VDC, 750VAC
CATIII-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	

b. DCmV

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

c. 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		

3. Specifications (cont.)

d. DCA

Range	Resolution	Accuracy	Overload protection
5mA	0.0001mA	+/-0.5% of reading,	Fuse(fast blow)
50mA	0.001mA	+/- 5digits	F600V, 0.5A 31CM
500mA	0.0001A	+/-0.75% of reading,	Fuse(fast blow)
1A	0.01mA	+/- 5digits	F600V, 1A 31CM

e. ACA

Range	Resolution	Accuracy	Overload protection
5mA	0.0001mA	+/-0.75% of reading,	Fuse(fast blow)
50mA	0.001mA	+/- 5digits	F600V, 0.5A 31CM
500mA	0.0001A	+/-1.5% of reading,	Fuse(fast blow)
1A	0.01mA	+/- 5digits	F600V, 1A 31CM

f. OHM(Resistance)

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

g. Diode test

Range	Resolution	Accuracy	Overload protection
3V	Approx. 1mA		600V DC or AC peak

3. Specifications (cont.)

h. Continuity Buzzer

Test voltage	Threshold	Overload protection
3V	30digits	600V DC or AC peak

i. Current Output

Mode	Range	Accuracy
Source	0~24mA	0.1% of reading, +/- 10digits
Smulate	0~24mA	

j. Frequency

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

3. Specifications (cont.)

I. General Specifications	
Max. volt. between any input and Ground	1000V
Fuse protection	**mA :** 0.5A/600VAC; **A :** 10A/600VAC
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 Backlight for the LCD(Automatically turns off after approx. 35 sec.)
COMP	Activates Compare mode.
HOLD	Activates two-hold data hold mode

Rotary Switch

OFF	Turns the instrument off.
DCmV	Selects the DC mV function
DCV	Selects the DCV function
ACV	Selects the ACV function
	Selects the Diode test function
	Selects the Ohm function (Push ORANGE button to activate continuity buzzer.)
HZ	Selects the Frequency function
	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.)
Adp	Can use A254, A256, A296 and A301 (Push ORANGE button to activate AC adaptor, and push RANGE button to choose kind of adaptor)

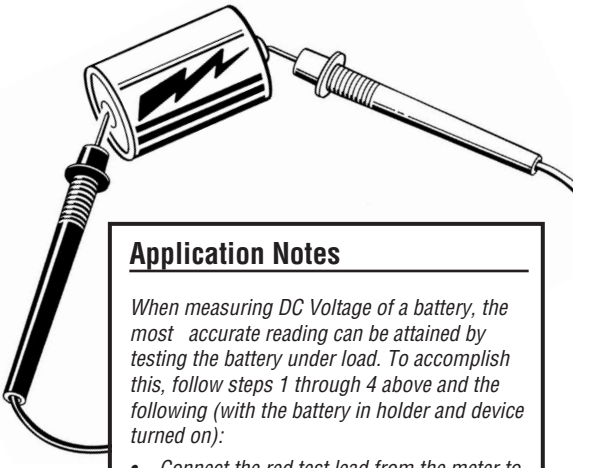
Input Jacks

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.
Current output	Hold down the Range 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!***

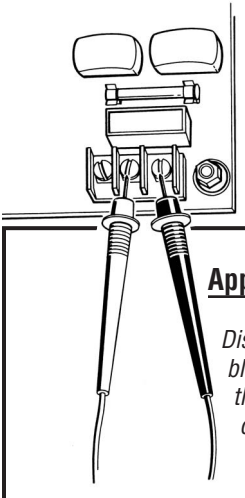
Do not attempt to make a voltage measurement of more than 1000V or of voltage level that is unknown.

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	1000.0V

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 **VΩHz** input jack.
4. Set rotary switch to either the **DCmV** or **DCV** 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 or of a voltage level than is unknown.

Instrument set-up:

FUNCTION	BLACK TEST LEAD	RED TEST LEAD	MINIMUM READING	MAXIMUM READING
$\tilde{V}$Hz	COM	VΩHz	0.0001V	750.0V

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 **VΩHz** input jack.
4. Set the rotary switch to the **ACV** 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!***

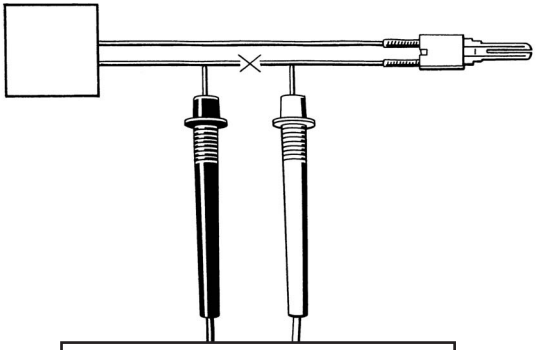
Do not attempt to make a current measurement of circuits with more than 600V present. Instrument damage and/or personal injury may result.

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 present. Instrument damage and/or personal injury may result.

Instrument set-up:

FUNCTION	BLACK TEST LEAD	RED TEST LEAD	MINIMUM READING	MAXIMUM READING
mA̰	COM	mA	0.001mA	500.00mA
A̰	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 **mA** or **A** input jack depending on the value of current to be measured.
4. Set the rotary switch to the **mA̰** or **A̰** function.
5. Press the orange push button.
6. Connect test leads in series to circuit to be measured.
7. Reconnect power to circuit to be measured.
8. 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	**VΩHz**	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 **VΩHz** input jack.
4. Set the rotary switch 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	VΩHz	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 **VΩHz** 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.