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296

Digital Clamp-on Meter *Amp Plus*

Instruction Manual

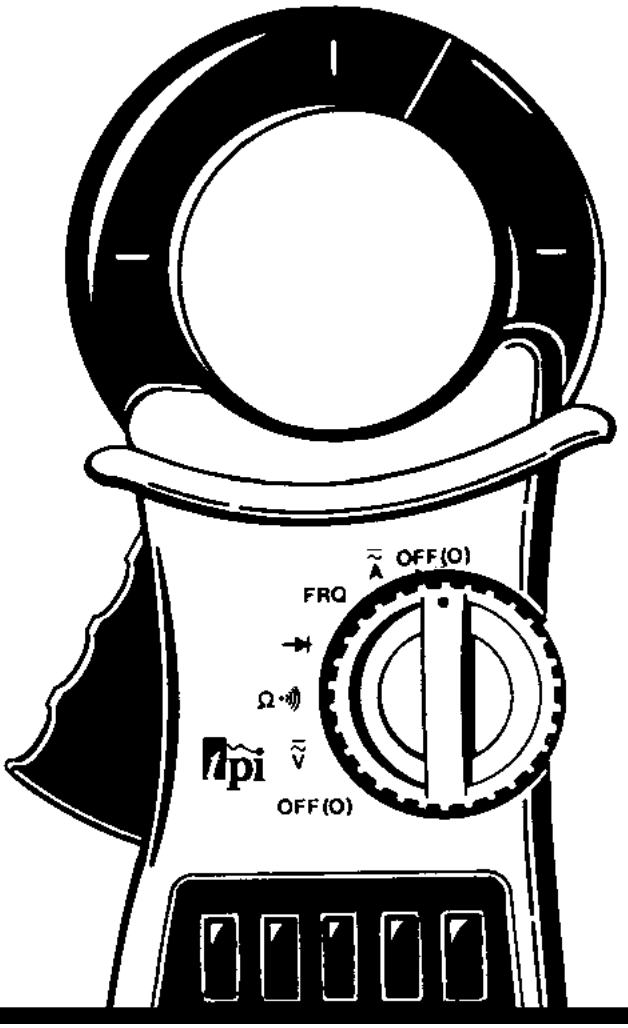


TABLE OF CONTENTS

A. INTRODUCTION

1. Congratulations!!

Thank you for purchasing TPI products. The *Amp Plus* is easy to use and is built to last. It is backed by a 3 year limited warranty. Please remember to complete and return your product warranty registration card.

2. Product Description

The 296 is a clamp-on plus DMM with True RMS and Harmonics capabilities. The 296 offers measurements in all basic electrical functions, plus:

- **True RMS** Provides accurate and dependable readings of non-linear loads.
- **HDR Mode** Determines if a signal is clean or distorted.
- **Bar Graph** When measuring frequency, bar graph indicates current level.
- **TRIM Mode** Smooths out unstable readings.
- **Peak Mode** For start-up and inrush currents.
- **Sleep Mode** Preserves battery life.
- **Data Hold** Holds the reading on the display for easy viewing.

The 296 comes complete with the following accessories:

Carrying Pouch	**Instruction Manual**
Test Lead Set	**Battery**

3. EC Declaration of Conformity

This is to certify that TPI Model 296 conforms to the protection requirements 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**
EN 61010-2-032	**1995 Safety Standard**

To ensure conformity with these standard, this instrument must be operated in accordance with the instructions and specifications given in this manual.

CAUTION: Even though this instrument complies with the immunity standards, it's 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 this instrument. Care should be taken to avoid such situations or alternatively, check to make sure that the instrument is not being influence by these emissions.

CAUTION: 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.

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 296 before using it to make sure it is operating properly.
- 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 being measured.
- Disconnect power to circuit, then connect test leads to the 296, then to circuit being measured.

NEVER

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

INTERNATIONAL SYMBOLS

 CAUTION: RISK OF ELECTRIC SHOCK

 AC (ALTERNATION CURRENT)

 DC (DIRECT CURRENT)

 REFER TO INSTRUCTION MANUAL

 GROUND

 DOUBLE INSULATION

 EITHER DC OR AC

C. TECHNICAL DATA

1. Features and Benefits

Agency	UL Listed to U.S. and Canadian Safety Standards. Meets CE and IEC 1010.
True RMS	Needed to accurately measure non-sinusoidal AC voltage and current waveforms found on many controls and circuits.
HDR Mode	Determines if a signal is clean or distorted. Displays the harmonic distortion ratio on ACV and ACA at line voltage and 60 Hz.
4000 Count	Improves the resolution on all functions and ranges.
Data Hold	Maintains the reading on the display for hard to reads areas.
Peak Mode	Measure the inrush current of motors, relays and solenoids.
Trim Mode	Averages the readings for more stable output on LCD.
Record Mode	Records Min/Max and Average value of the function being measured.
Sleep Mode	Automatically powers down after 10 minutes of inactivity.
Frequency	Measures the frequency of the current being measured.
Dual Display	When measuring frequency, the bar graph indicates the current level.
Bar Graph	Shows rapidly changing input signals that the normal display will not.

2. Product Applications

Perform the following tests and/or measurements with the 296 and the appropriate function:

HVAC/R

ACA	• Heat anticipator current in thermostats.
ACV	• Line voltage.
ACV or DCV	• Control circuit voltage.
OHMS	• Heating element resistance (continuity).
OHMS	• Compressor winding resistance.
OHMS	• Contactor and relay coil resistance.
ACA	• Motor and compressor start up current.
OHMS	• Continuity of wiring.
Hz/FREQ	• Frequency on control and line voltages.
REC	• Record min/max voltage of controls and line voltages.
ALL	• Bar graph to indicate rapid fluctuations.

ELECTRICAL

ACV	• Measure line voltage.
ACA	• Measure line current.
OHMS	• Continuity of circuit breakers.
DCV	• Voltage of direct drive DC motors.
DCA	• Current of direct drive DC motors.
ACA	• Start up current of motors, relays, contactors and transformers.
ALL	• Harmonics detection on line voltages.

ELECTRONIC

ACV	• Measure power supply voltage.
ACA	• Measure power supply current.
OHMS	• Continuity of circuit breakers and fuses.

3. Specifications

IEC 1010 Over Voltage:
CAT II - 1000V
CAT III - 600V
Pollution Degree 2

c UL us
LISTED
UL 3111-1

a. DCV

Range	Resolution	Accuracy	Impedance
40V	0.01V	±0.75% of reading,	10Mohm
400V	0.1V	±3 digits	
600V	1V		

b1. ACV (45Hz to 60Hz)

Range	Resolution	Accuracy	Impedance
40V	0.01V	±1.0% of reading,	10Mohm
400V	0.1V	±3 digits	
600V	1V		

b2. ACV (20Hz to 45Hz, 60Hz to 1KHz)

Range	Resolution	Accuracy	Impedance
40V	0.01V	±2.5% of reading,	10Mohm
400V	0.1V	±3 digits	
600V	1V		

c. ACA

Range	Res.	Accuracy	Freq. Response
40A	0.01A	±2% of reading, ±20 digits	45Hz to 60Hz
		±4% of reading, ±20 digits	30Hz to 45Hz
		±4% of reading, ±20 digits	60Hz to 1KHz
400A	0.1A	±2% of reading, ±10 digits	45Hz to 60Hz
700A	1A	±5% of reading, ±10 digits	30Hz to 45Hz
		±5% of reading, ±10 digits	60Hz to 1KHz

d. DCA

Range	Resolution	Accuracy
400A	0.1A	±2% of reading, ±10 digits
700A	1A	±2% of reading, ±15 digits

e. OHM (Resistance,)

Range	Res.	Accuracy	Overload Protection
400	0.1	±1% of reading, ±10 digits	600V DC or
4k	0.001k	±1% of reading, ±3 digits	AC Peak
40k	0.01k		

f. Continuity Buzzer

Test Voltage	Threshold	Over Load Protection
3V	< 100 ohm(100 digits)	600 V DC or Peak AC

⚠ ***Warning:** Test Leads. Use only correct type and overvoltage category rating.

g. Diode Test

Test Voltage	Max Test Current	Over Load Protection
3V	Approx. 2.5mA	600 V DC or Peak AC

h. Frequency

Range	Res.	Accuracy	Overload Protection
1KHz	0.1Hz	±0.2% of reading, ±3 digits	600V DC or AC Peak
10KHz	0.001KHz		

h. General Specifications

Max. Volt. between any Input and Ground	600V
Display Type	4,000 Count, 4 times per second update
Operating Temp.	-10° to 45°C (14° to 113°F)
Storage Temp.	-20° to 55°C (-4° to 131°F)
Relative Humidity	0% to 80% (0° - 35°C/32° - 95°F) 0% to 70% (35° - 50°C/95° - 122°F)
Power Supply	9 Volt Battery
Battery Life	80 hrs. Alkaline
Size (H x L x W)	40mm x 190mm x 65mm (1.5in x 7.25in x 2.5in)
Weight	315g (11.1oz)

D. MEASUREMENT TECHNIQUES

1. Controls and Functions:

Push Buttons

TRIM Activates TRIM, PEAK and HDR functions (Except on Frequency Range).

FUNC Toggles between AC and DC volts, amps and or functions.

RNG Activates manual ranging. Hold in for 2 seconds to return to autorange.

HOLD Holds the reading on the display until the button is pushed a second time.

REC Activates the Min/Max/Record mode. (Except on Frequency Range).

1. Controls and Functions (cont.):

Rotary Switch

OFF Turns the 296 completely off.

V Used to measure AC and DC volts.

Ω Used to measure resistance and use the continuity buzzer.

Used to measure diodes.

FRQ Used to measure the frequency of the current through the jaws.

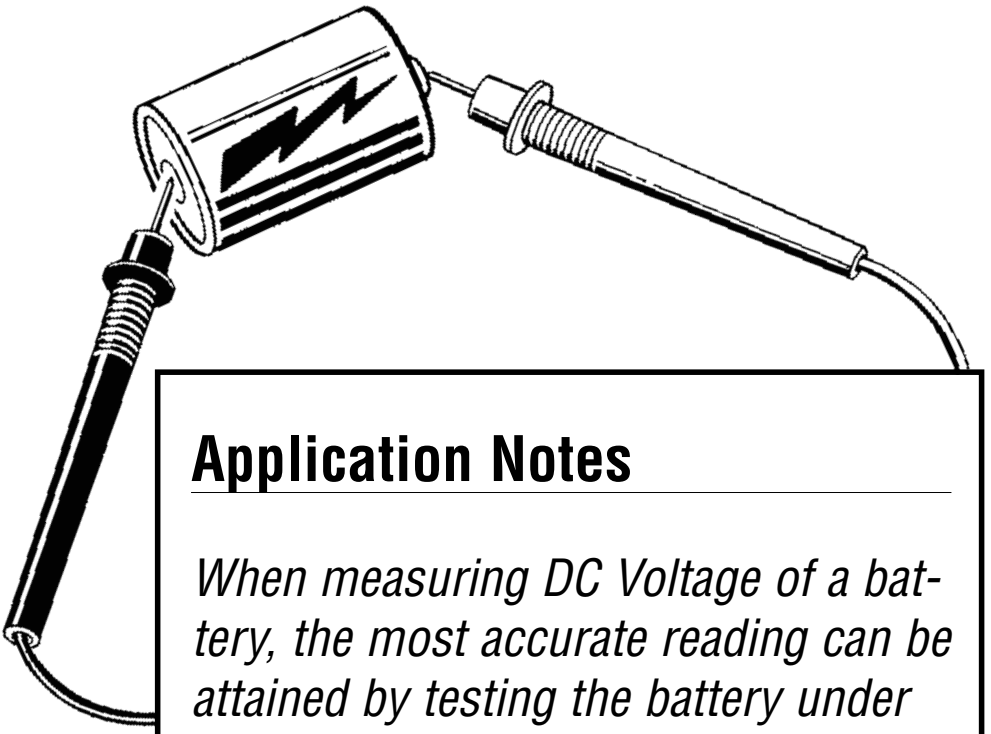
A Used to measure AC amps.

OFF Turns the 296 completely off.

Input Jacks

COM Black test lead connection for ACV, DCV, , Continuity Buzzer and Diode Test functions.

V/Ω Red test lead connection for all ACV, DCV, , Continuity Buzzer and Diode Test functions.



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 shown on page 15 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 296.*

2. Step by Step Procedures:

a. Measuring DC Volts

⚠ ***WARNING!***

Do not attempt to make a voltage measurement of more than 600V or of a voltage level that is unknown.

Instrument set-up:

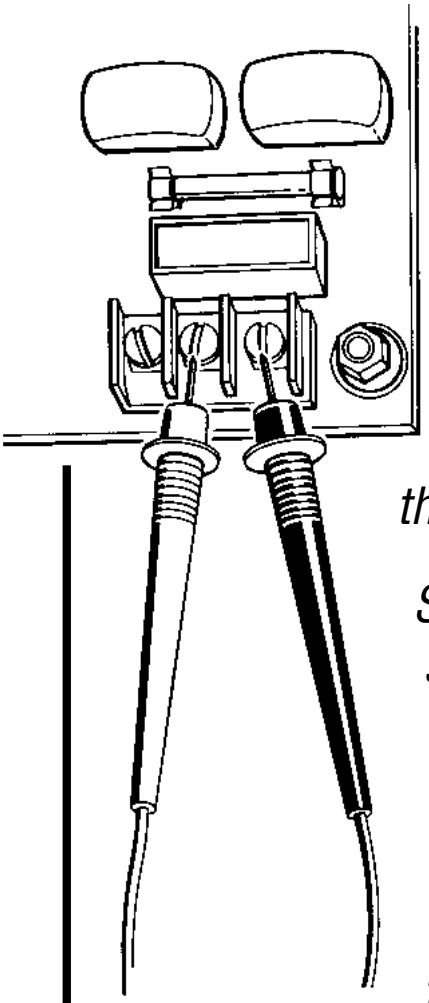
FUNC.	BLACK TEST LEAD	RED TEST LEAD	MIN READING	MAXI READING
$\widetilde{V}$	COM	V/Ω	0.01V	600V

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 **V/Ω** input jack.
4. Set rotary switch to the $\widetilde{\mathbf{V}}$ range.
5. Push **FUNC** button so AC does not show on LCD.
6. Connect test leads to circuit to be measured.
7. Reconnect power to circuit to be measured.
8. Read the voltage on the 296.

Optional Modes

- **TRIM:** Push TRIM button to stabilize reading.
- **HOLD:** Freezes the reading on the LCD.
- **RANGE:** Manually ranges the instrument.
- **REC:** Record minimum, maximum and average values.



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 17. 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

⚠ ***WARNING!***

Do not attempt to make a voltage measurement of more than 600V or of a voltage level that is unknown.

Instrument set-up:

FUNC.	BLACK TEST LEAD	RED TEST LEAD	MIN READING	MAX READING
$\widetilde{V}$	COM	V/Ω	0.01V	600V

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 **V/Ω** input jack.
4. Set the rotary switch to the $\widetilde{V}$ function.
5. Press the **FUNC** button until AC is on LCD.
6. Connect test leads to circuit to be measured.
7. Reconnect power to circuit to be measured.
8. Read the voltage on the 296.

Optional Modes

- **TRIM:** Push **TRIM** button to stabilize reading.
- **HOLD:** Freezes the reading on the LCD.
- **RANGE:** Manually ranges the instrument.
- **PEAK:** Measures the peak voltage.
- **REC:** Record minimum, maximum and average values.
- **HDR:** Check harmonic distortin ratio.

d. Measuring DC Amps

CAUTION!

Do not attempt to make a current measurement with the test leads. The 296 measures the current by clamping the jaw around one conductor (wire). Clamping around more than one wire will result in erroneous readings.

Instrument set-up:

FUNC.	BLACK TEST LEAD	RED TEST LEAD	MIN READING	MAX READING
$\overline{\sim}$ A	NOT USED	NOT USED	0.1A	700A

Measurement Procedure:

1. Disconnect power to circuit to be measured.
2. Set rotary switch to **$\overline{\sim}$ A** function.
3. Press the **FUNC** button to set to measure DCA.
4. Press and hold the **HOLD** button until LCD zero's.
5. Clamp the jaws around one conductor of the circuit to be measured.
6. Reconnect power to circuit to be measured.
7. Read the current on the 296.

Optional Modes

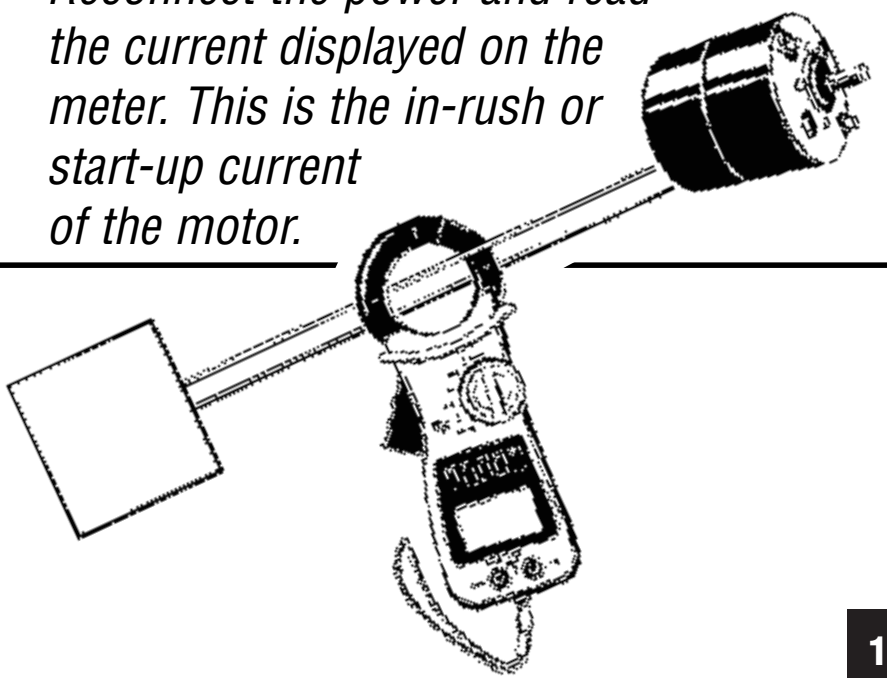
- **HOLD:** Freezes the reading on the LCD.
- **RANGE:** Manually ranges the instrument.
- **REC:** Record minimum, maximum and average values.
- **TRIM:** Push TRIM button to stabilize reading.

Application Notes

When measuring DC Amps of a motor there are two types of measurements that can be made, running current and in-rush or start-up current. Start-up current will usually be much higher than running current.

Set up the meter following the steps under "Measurement Procedure" on page 18, and then proceed with the following:

- *Clamp the meter around a single wire and reconnect power to the device. Read the current displayed on the meter. This is the running current of the motor.*
- *Disconnect power to the motor and put the meter in PEAK HOLD mode. Reconnect the power and read the current displayed on the meter. This is the in-rush or start-up current of the motor.*



c. Measuring AC Amps

CAUTION!

Do not attempt to make a current measurement with the test leads. The 296 measures the current by clamping the jaw around one conductor (wire). Clamping around more than one wire will result in erroneous readings.

Instrument set-up:

FUNC.	BLACK TEST LEAD	RED TEST LEAD	MIN READING	MAX READING
$\overline{\sim}$ A	NOT USED	NOT USED	0.01A	700A

Measurement Procedure:

1. Disconnect power to circuit to be measured.
2. Set rotary switch to **$\overline{\sim}$A** function.
3. Clamp the jaws around one conductor of the circuit to be measured.
4. Reconnect power to circuit to be measured.
5. Read the current on the 296.

Optional Modes

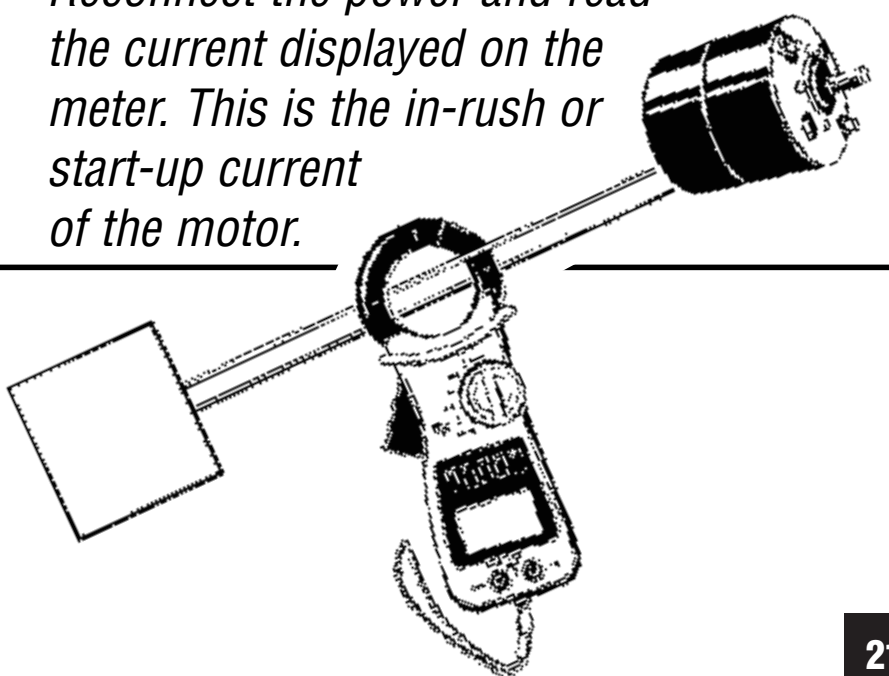
- **TRIM:** Push TRIM button to stabilize reading.
- **HOLD:** Freezes the reading on the LCD.
- **RANGE:** Manually ranges the instrument.
- **PEAK:** Measures the peak amperage.
- **HDR:** Check the harmonic distortion ratio.
- **REC:** Record minimum, maximum and average values.

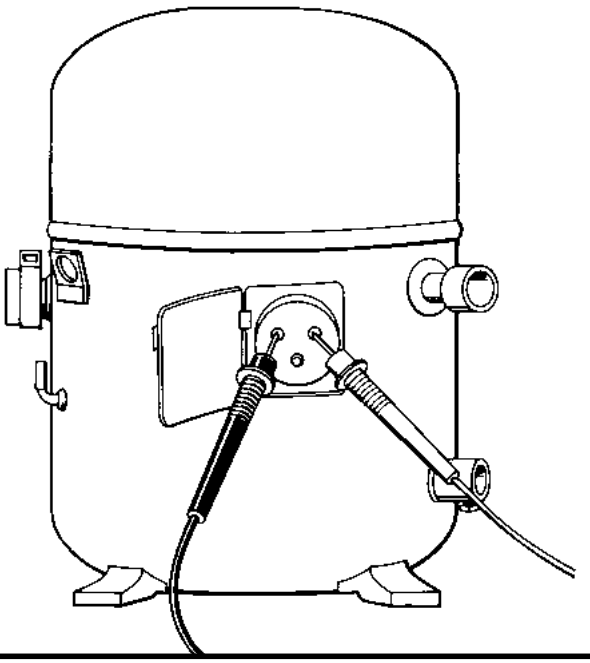
Application Notes

When measuring AC Amps of a motor there are two types of measurements that can be made, running current and in-rush or start-up current. Start-up current will usually be much higher than running current.

Set up the meter following the steps under "Measurement Procedure" on page 20, and then proceed with the following:

- *Clamp the meter around a single wire and reconnect power to the device. Read the current displayed on the meter. This is the running current of the motor.*
- *Disconnect power to the motor and put the meter in PEAK HOLD mode. Reconnect the power and read the current displayed on the meter. This is the in-rush or start-up current of the motor.*





Application Notes (Resistance)

When measuring resistance of a motor, make sure the power is disconnected prior to testing.

Set up meter following steps under "Measurement Procedure" on page 20, and proceed with the following:

- *Connect the red test lead to one power input line of the motor and the black test lead to the other power input line of the motor. In most applications if the reading is OFL, the motor winding is open.*
- *Connect the red test lead to the frame of the motor and the black test lead to the winding. In most applications if a reading of 0 Ohms is displayed, the winding is shorted to the motor frame (ground).*

e. Measuring Resistance

⚠ *WARNING!*

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

NOTE:

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

Instrument set-up:

FUNC.	BLACK TEST LEAD	RED TEST LEAD	MIN READING	MAX READING
Ω •)))	COM	V/Ω	0.1Ω	39.99KΩ

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 V/Ω input jack.
4. Set the rotary switch to the Ω function.
5. Connect test leads to circuit to be measured.
6. Read the resistance value on the 296.

Optional Modes

- **HOLD:** Freezes the reading on the LCD.
- **RANGE:** Manually ranges the instrument.
- **TRIM:** Push TRIM button to stabalize reading.
- **REC:** Record minimum, maximum and average values.

f. Continuity Buzzer

⚠ ***WARNING!***

Do not attempt to make continuity measurements with circuit energized.

Instrument set-up:

FUNC.	BLACK TEST LEAD	RED TEST LEAD	MIN READING	MAX READING
Ω•)))	COM	V/Ω	0.001KΩ	4.000KΩ

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 **V/Ω** input jack.
4. Set the rotary switch to the Ω•))) function.
5. Press the **FUNC** button until •))) is on the LCD.
6. Connect test leads to circuit to be measured.
7. Listen for the buzzer to confirm continuity.

Optional Modes

- **HOLD:** Freezes the reading on the LCD.
- **TRIM:** Push **TRIM** button to stabalize reading.

g. 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:

FUNC.	BLACK TEST LEAD	RED TEST LEAD	MIN READING	MAX READING
→|	COM	V/Ω	0.001V	2.000V

Measurement Procedure:

1. Disconnect power to circuit to be measured.
2. Plug the black test lead into COM input jack.
3. Plug red test lead into the V/ 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. Reverse test lead connections in 5 above.
8. Reading on the display should be OFL (Overload).

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