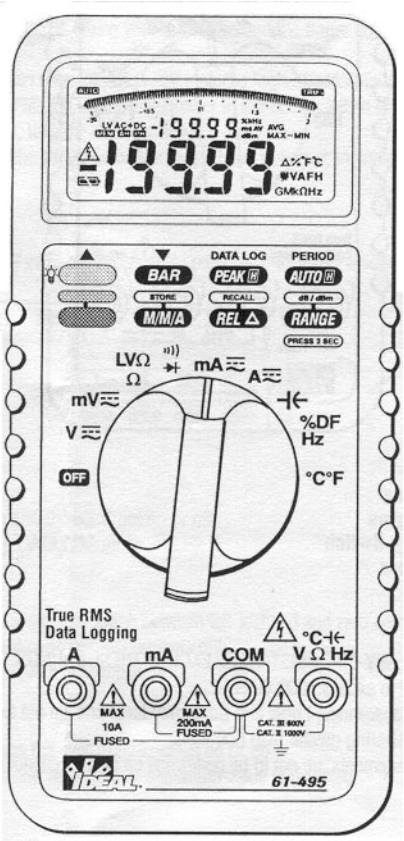
IDEAL INDUSTRIES, INC.
TECHNICAL MANUAL
MODEL: 61-494
MODEL: 61-495

The Service Information provides the following information:

- Precautions and safety information
- Specifications
- Basic maintenance (cleaning, replacing the battery and fuses)
- Performance test procedures
- Calibration and calibration adjustment procedures



Form number: TM61494-5
Revision: 2. Date: Feb 2002

TABLE OF CONTENTS

Introduction

⚠Warning
To avoid shock or injury, do not perform the verification tests or calibration procedures described in this manual unless you are qualified to do so.
The information provided in this document is for the use of qualified personnel only.

⚠Caution
The 61-490 serials contain parts that can be damaged by static discharge.
Follow the standard practices for handling static sensitive devices.

For additional information about IDEAL INDUSTRIES, INC. and its products, and services, visit IDEAL INDUSTRIES, INC. web site at:
www.idealindustries.com

Precautions and Safety Information

Use the Meter only as described in the *Users Manual*. If you do not do so, the protection provided by the Meter may be impaired. Read the "Safety Information" page before servicing this product. In this manual, a **Warning** identifies conditions and actions that pose hazard (s) to the user; a **Caution** identifies conditions and actions that may damage the Meter or the test instruments.

The Symbols

The symbols used on the Meter and in this manual are explained in Table A.

Table A. The Symbols

Symbol	Meaning	Symbol	Meaning
~	Alternating signal		Battery
⎓	Direct signal		Earth ground
CAT III	IEC overvoltage Category III		Fuse
	Refer to the manual. Important information.		Double insulated
	Take appropriate precautions. Hazardous voltage may be present		

SAFETY

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use the product only as specified.

CAUTION. These statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING. These statements identify conditions or practices that could result in personal injury or loss of life.

Specific precautions

Use proper Fuse. To avoid fire hazard, use only the fuse type and rating specified for this product.

Do not operate without covers. To avoid personal injury, do not apply any voltage or current to the product without the covers in place.

Electric overload. Never apply a voltage to a connector on the product that is outside the range specified for that connector.

Avoid electric shock. To avoid injury or loss of life, do not connect or disconnect probes or test leads while they are connected to a voltage source.

Do not operate in wet/damp conditions. To avoid electric shock, do not operate this product in wet or damp conditions.

SPECIFICATIONS
All specifications are warranted unless noted typical and apply to the 61-494 and 61-495.
Stated accuracies are at 23°C ±5°C at less than 80% relative humidity.
If Low Battery indicator is active then specification could be effective.

General specifications:

Characteristics	Description
LCD display digits	4 ½ or 3 ¾
Bargraph segments	42 Segment Graph
Display count	20,000 or 4,000
Numeric update rate	2 times / sec (20,000 count)
Bargraph	20 times/sec
Polarity display	Automatic
Overrange display	"OL" is displayed
Low voltage indicator	"⊏⊐" is indicated
Automatic power-off time	Automatic backlit off =15minutes
Power source	One 9V dry cell battery
Maximum input voltage	1000V (750V AC) CAT II between V and COM
Maximum floating voltage	1000V (750V AC) CAT II between any terminal and earth ground
Maximum input current	200mA between mA and COM 10A continuous between A and COM (20A for 30 seconds)
Maximum open circuit Voltage (current inputs)	600V between A and COM and between mA and COM
Overload protection mA connector	1A (600V) fast blow fuse
A connector	15A (600V) fast blow fuse
V connector	1100 Vp V~ V⎓ AC+DC 850 Vp mV~ mV⎓ AC+DC LVΩ Ω •)) ⊣⊢ ⊣(Hz% DF °C °F
Temperature Coefficient	0.1 x (Spec. Accuracy) / °C, < 18°C or > 28°C
Battery Life	100 hours typical (alkaline)

Measurement Characteristics
(All at 23°C ±5°C, < 80% R.H.) ± ([% of reading] + [number of least digits]).

Voltage Specifications:

DCV	61-494	61-495
20mV	± (0.06% + 60)	± (0.06% + 60)
200mV	± (0.06% + 20)	± (0.06% + 20)
2V, 20V, 200V, 1000V	± (0.06% + 10)	± (0.06% + 10)

ACV	61-494	61-495
20mV, 200mV		
40Hz ~ 100Hz	± (0.70% + 80)	± (0.70% + 80)
100Hz ~ 1KHz	± (1.00% + 80)	± (1.00% + 80)
2V		
40Hz ~ 100Hz	± (0.70% + 50)	± (0.70% + 50)
100Hz ~ 1KHz	± (1.00% + 50)	± (1.00% + 50)
1KHz ~ 10KHz	± (2.00% + 60)	± (2.00% + 60)
10KHz ~ 20KHz	± (3.00% + 70)	± (3.00% + 70)
20KHz ~ 50KHz	± (5.00% + 80)	± (5.00% + 80)
50KHz ~ 100KHz	± (10.00% + 100)	± (10.00% + 100)
20V		
40Hz ~ 100Hz	± (0.70% + 50)	± (0.70% + 50)
100Hz ~ 1KHz	± (1.00% + 50)	± (1.00% + 50)
1KHz ~ 10KHz	± (2.00% + 60)	± (2.00% + 60)
10KHz ~ 20KHz	± (3.00% + 70)	± (3.00% + 70)
20KHz ~ 50KHz	± (5.00% + 80)	± (5.00% + 80)
50KHz ~ 100KHz	± (10.00% + 100)	± (10.00% +100)
200V		
40Hz ~ 100Hz	± (0.70% + 50)	± (0.70% + 50)
100Hz ~ 1KHz	± (1.00% + 50)	± (1.00% + 50)
1KHz ~ 10KHz	± (2.00% + 60)	± (2.00% + 60)
10KHz ~ 20KHz	± (3.00% + 70)	± (3.00% + 70)
20KHz ~ 50KHz	± (5.00% + 80)	± (5.00% + 80)
750V		
40Hz ~ 100Hz	± (0.70% + 50)	± (0.70% + 50)
100Hz ~ 1KHz	± (1.00% + 50)	± (1.00% + 50)
Bandwidth	40Hz ~ 100KHz	40Hz ~ 100KHz

AC Conversion Type: AC Coupled True RMS responding.
AC + DC Volts: Same as AC (RMS) + 1.00% + 80.
Crest Factor: +1.5% addition error for C.F. 1.4 to 3
+3.0% addition error for C.F. from 3 to 4
Resolution: 1µV in the 20mV range.
Input Impedance: 10MΩ, <100pF.
Overload Protection: 1000VDC, 750V rms.

dBm / dBv Specifications:
dBm (typical): -15 dBm to +55 dBm (0 dBm = 1mW into 600Ω).
dBv (typical): -80 dBv to + 50 dBv (0 dBv = 1 Vrms).
Note: (ACV and AC + DCV)
Add additional 20 counts for reading under 0.5 time of range for 5K ~ 50KHz. Specifications exclude under 0.4 time of range for 50KHz ~ 100KHz.

Current Specifications:

DCA	61-494	61-495
20mA, 200mA	± (0.20% + 40)	± (0.20% + 40)
2A, 10A	± (0.20% + 40)	± (0.20% + 40)

ACA	61-494	61-495
20mA, 200mA, 2A,10A 40Hz ~ 500Hz	± (0.80% + 50)	± (0.80% + 50)
20mA, 200mA, 2A,10A 500Hz ~ 1KHz	± (1.20% + 80)	± (1.20% + 80)
200mA, 10A1KHz ~ 3KHz	± (2.00% + 80)	± (2.00% + 80)

Range: 20mA, 200mA, 2A, 10A.
Resolution: 1μA in the 20mA range.
Burden Voltage: 800mV max. for mA input, 1V max. for A input.
AC Conversion Type: AC Coupled True RMS responding.
Input Protection: Equipped with High Energy Fuse.
1A, 600V, IR 10KV fuse (Bussmann BBS-1 or equivalent) for mA input.
15A, 600V, IR 100KV fuse (Bussmann KTK 15 or equivalent) for A input.
AC + DC Current: Same as AC (RMS) + 1.00% + 80
C.F.: Same as ACV.

Resistance Specifications:

Ohm	61-494	61-495
200Ω, 2KΩ	± (0.30% + 30)	± (0.30% + 30)
20KΩ, 200KΩ	± (0.30% + 30)	± (0.30% + 30)
2MΩ	± (0.30% + 50)	± (0.30% + 50)
20MΩ	± (5.00% + 50)	± (5.00% + 50)
200MΩ	± (5.00% + 20)	± (5.00% + 20)
2GΩ	± (5.00% + 8)	± (5.00% + 8)

LV Ohm	61-494	61-495
2KΩ, 20KΩ, 200KΩ	± (0.60% + 20)	± (0.60% + 30)
2MΩ	± (0.60% + 50)	± (0.60% + 50)
20MΩ	± (7.00% + 50)	± (7.00% + 50)
200MΩ	± (7.00% + 20)	± (7.00% + 20)

Resolution: 0.01Ω in the 200Ω range.
Open Circuit Voltage: 3.3V
Open Circuit Low Voltage: 0.6V
Input Protection: 600V rms.

Capacitance Specifications (4000 counts):

Capacitance	61-494	61-495
4nF, 40nF *	± (1.50% + 10d)	± (1.50% + 10d)
400nF, 4µF	± (0.90% + 5d)	± (0.90% + 5d)
40µF, 400µF	± (1.20% + 5d)	± (1.20% + 5d)
4mF, 40mF	± (1.50% + 5d)	± (1.50% + 5d)

Note: For best measurements, with Δ mode on nF ranges.
* With Δ mode.
Range: 4nF, 40nF, 400nF, 4µF, 400µF, 4mF, 40mF
Resolution: 1pF in the 4nF range.
Input Protection: 600V rms.

Continuity Check Specifications:
Continuity Threshold: Approx. 50 Ω.
Continuity Indicator: 2KHz Tone Buzzer.
Input Protection: 600V rms.

Diode Test Specifications:
Test Current: 1.1mA (Typical)
Open Circuit Voltage: 3.3V DC (max).
Input Protection: 600V rms.

Peak Hold Specifications:
+[±(0.7% + 20)] additional error for >20% of full scale
and pulse width greater than 0.5mS; ±(10) more for
50% of full scale on 2V range (2000 counts)

Frequency Counter Specifications:
Range: 20Hz, 200Hz, 2KHz, 20KHz, 200KHz, 1MHz.
Resolution: 0.001Hz in the 20Hz range.
Accuracy: ±(0.01% + 10), ±(0.01% + 50) for 20Hz Range.
Sensitivity: 0.5Vp-p, for 5Hz ~ 1MHz.
Min. Frequency: 5Hz.
Input Protection: 600V rms.

Duty Factor Specifications:
Range: 20% ~ 80%
Resolution: 0.1%.
Accuracy: ± 1% (20Hz ~ 10KHz, 5Vp-p), ± 2% for 50% ~ 80%

Temperature Specifications:

Temperature	61-494	61-495
-100°C ~ 1200°C	± (0.1% + 3°C)	± (0.1% + 3°C)
-200°C ~ -100°C	± (0.1% + 6°C)	± (0.1% + 6°C)

Note: The readings < 360°C on 1°C resolution range when settled as manual range, display reads "Er" to change to lower range for best measurements.
Multiply the digit accuracy by 2 for °F.
Range: -200°C ~ 1200°C.
Resolution: 0.1°C for –200°C ~ 400°C, 1°C for 400°C ~ 1200°C
Input protection: 600V rms.

Physical and Environmental Characteristics:

Physical Characteristics:	**Description**
Dimensions (H x W x D)	183mm x 85mm x 33mm 202mm x 95mm x 46mm (with holster)
Weight (with battery)	0.4Kg
With holster	0.6Kg
Environmental Characteristics:	**Description**
Temperature operating	0 to + 50°C
Non-Operating	-20 to + 60°C
Humidity (operating)	< 80% Relative Humidity
Altitude Operating	2,222 m (7290 ft.)
Non-Operating	12,300 m (40354 ft.)
Vibration & shock Operating	MIL-T-28800E TYPE II Class 5 2.66gRMS, 5 to 500 Hz, 3axes (10 minutes each)
Dust / Water Protection IP Rating	IP 64.
Indoor Use	

Page 8

Certifications and compliances

Safety	Designed to IEC 1010-1, UL3111-1 and CSA specifications
Input rating	1000V DC Category II
	600V DC Category III
	750V AC Category II
	600V AC Category III
Over voltage category	CAT III: Distribution level mains, fixed installation.
	CAT II: Local level mains, appliances, portable equipment.
	CAT I: Signal level, special equipment or parts of equipment, telecommunication, electronics.
Pollution Degree 2	Do not operate in environments where conductive Pollutants may be present.
EC Declaration of Conformity	Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility and Low Voltage Directive 73/23/EEC for Product Safety. Compliance was demonstrated to the following specifications as listed in the official Journal of the European Communities: En 55011 Class A: Radiated and Conducted Emissions. EN 50082-1 Immunity: IEC 801-2 Electrostatic Discharge IEC 801-3 RF Radiated EN 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use.

Required Equipment

Required equipment is listed in Table B. If the recommended models are not available, equipment with equivalent specifications may be used. Repairs or servicing should be performed only by qualified personnel.

Table B. Required Equipment

Equipment	Required Characteristics	Recommended Model
Calibrator	**AC Voltage Range:** 0-750V ac **Accuracy:** ±0.07% (Basic) **Frequency Range:** 40 ~ 100KHz **Accuracy:** ± 2% **DC Voltage Range:** 0-1000V dc **Accuracy:** ±0.006% (Basic) **Current Range:** 0 ~ 10A **Accuracy:** AC (40Hz to 1KHz): ±0.08% (Basic) DC: ± 0.02% (Basic) **Frequency Source:** 5.00Hz ~ 1.0000MHz **Accuracy:** ±0.001% **Amplitude:** 0.5V p-p ~ 1.0V p-p (square wave) **Accuracy:** ± 5% **Resistance Range:** 1Ω ~ 2GΩ **Accuracy:** ±0.03% (Basic) **Capacitance Range:** 1pF ~ 40mF **Accuracy:** ±0.10% (Basic) **Temperature Range:** -200°C ~ 1200°C **Accuracy:** ±0.3°C (Basic)	Fluke 5500 or Wavetek 9100 Calibrator or equivalent

Basic Maintenance

⚠ Warning

To avoid shock, remove the test leads and any input signals before opening the case or replacing the battery or fuses.

Opening Meter Case

⚠ Caution

To avoid unintentional short circuit, always place the uncovered Meter assembly on a protective surface. When the case of the Meter is open, circuit connections are exposed.

To open the Meter case, refer to Figure 1.1 and do the following:

1. Disconnect test leads from any live source, turn the rotary switch to OFF, and remove the test leads from the front terminals.
2. Remove the battery door by using a flat-blade screwdriver to turn the battery door screws 1/4 turn counterclockwise.
3. The case bottom is secured to the case top by three screws and two internal snaps (at the LCD end). Using a Phillips-head screwdriver, remove the three screws.
4. Hold the Meter display side up.
5. Lifting up on the input terminal end, disengage the case top from the gasket.
6. Gently unsnap the case top at the display end.

Note

The gasket between the two case halves is sealed to, and must remain with, the case bottom. The case top lifts away from the gasket easily. Do not damage the gasket or attempt to separate the case bottom from the gasket.

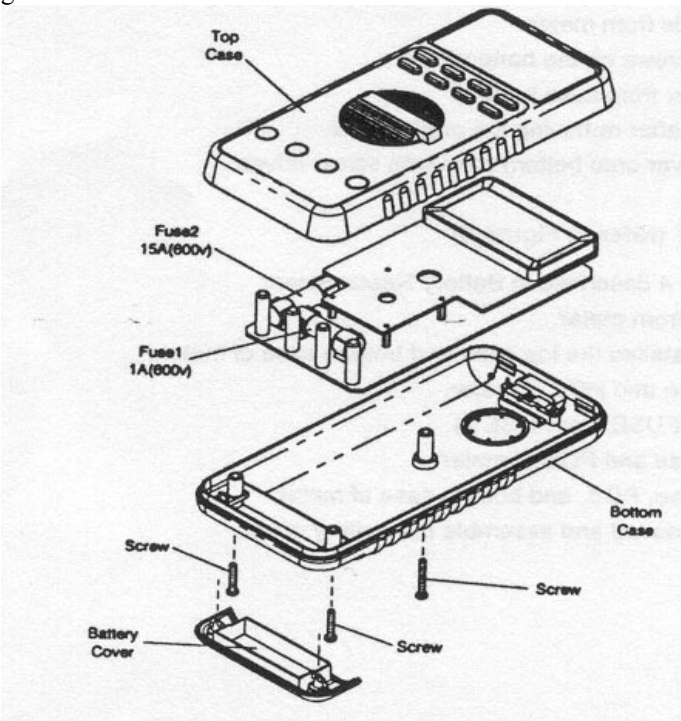


Figure 1.1

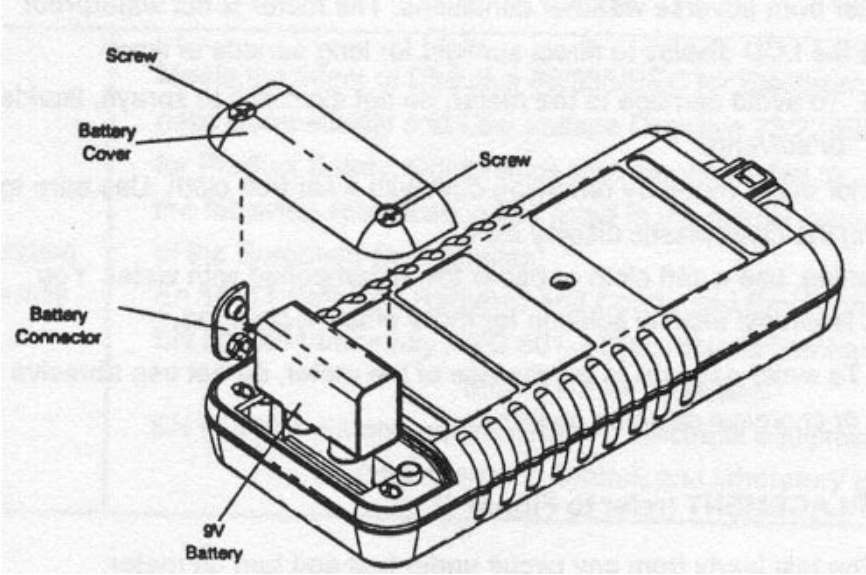


Figure 1.2

Replacing the Battery

The Meter is powered by a single 9V battery (NEDA 1604, 6F22, or 006P).
To replace the battery, refer to Figure 1.2 and do the following:

1. Turn the rotary switch to OFF and remove the test leads from the terminals.
2. Remove the battery door by using a flat-blade screwdriver to the turn the battery door screws 1/4-turn counterclockwise.
3. Remove the battery and replace it with a new one. Dress the battery leads so that they will not be pinched between the battery door and case bottom.
4. Replace the battery door and secure the door by turning the screws 1/4-turn clockwise.

Testing Fuses (FS1 and FS2)

To test the internal fuses of the Meter, refer to Figure 1 and do the following:

1. Turn the rotary selector switch to the mA position for 1A fuse test FS2 or A position for 15A fuse test FS1.
2. To test FS2, plug a test lead into mA input terminal, and turn the rotary selector to the mA position.
   2.1 Fuse is OK if the Display shows normal functional graphics.
   2.2 Fuse is defective if "Prob" is displayed and the built-in beeper alarm is on.
3. To test FS1, plug a test lead into A input terminal, and turn the rotary selector to the A position.
   3.1 Fuse is OK if the Display shows normal functional graphics.
   3.2 Fuse is Defective if "Prob" is displayed and the built-in beeper alarm is on.

Replacing Fuses

⚠ Warning

To avoid electrical shock, remove the test leads and any input signals before replacing the battery or fuses. To prevent damage or injury, INSTALL ONLY quick acting fuses with the following Amp/Volt current interrupt rating:
FS1 Fuse: 15A, 600V, FAST. Minimum interrupt rating 100,000A
FS2 Fuse: 1A, 600V, FAST. Minimum interrupt rating 10,000A

1. Open the case as described in "**Open Meter Case**" section, steps 1 – 6
2. Gently lift the case top to separate the two halves of the case.
3. Remove the fuse by gently prying one end loose, then sliding the fuse out of its bracket.
4. Replace the fuse only with one specified above.
5. Verify that the rotary switch and the circuit board switch are in the **OFF** position.
6. Place the case top on the case bottom, ensuring that the gasket is properly seated and the case halves snap together (See Figure 1).
7. Reinsert the three case bottom screws and the battery door.

Cleaning

⚠Warning

To avoid electrical shock or damage to the Meter, never allow water inside the case. To avoid damaging the Meter's housing, never apply solvents to the Meter.

Input Terminals

Water, dirt, or other contamination in the **A** or **mA** input terminals may activate the Input Alert beeper even though test leads are not inserted. Such contamination might be dislodged by turning the Meter over and, with all test leads removed, gently tapping on the case.
To clean the input terminals more effectively, do the following:

1. Turn the Meter off and remove all test leads from the terminals.
2. Use a clean swab in each of the four terminals to dislodge and clean out the contamination.
3. Moisten a new swab with a cleaning and oiling agent. Work this swab around in each of the four terminals. The oiling agent insulates the terminals from moisture-related shorting and ensures against false Input Alerts.

Performance Tests

The following performance tests verify the complete operability of the Meter and checks the accuracy of each Meter function against the Meter's specifications.

Accuracy specifications are valid for a period of one year after calibration, when measured at an operating temperature of 18°C to 28°C and at a maximum of 80% relative humidity.

To perform the following tests, it is not necessary to open the case; no adjustments are necessary. Merely make the required connections, apply the designated inputs, and determine if the reading on the Meter display falls within the acceptable range indicated.

If the Meter fails any of these tests, it needs calibration adjustment or repair.

A Basic Operability Test

To check the basic operability, do the following:

1. Turn the rotary switch to **A** and plug a test lead into **A** input terminal, display is of functional graphics if the fuse is good.
2. Then test the **mA** input fuse (1A) by inserting a test lead into **mA** input terminal and turn the rotary switch to **mA**. (**A** input must be open).
   The display is of normal functional graphics if the fuse is good.

If the Meter fails to operate properly:

- Check the battery and fuses and replace as needed.
- Verify that you are operating the Meter correctly by reviewing the operating instructions found in the *Users Manual.*

To complete a comprehensive performance test and verify the accuracy of each Meter function and operation, perform the remainder of the tests under "Performance Tests".

Testing the Display

Press **Bar** key and turn the meter on from the **OFF** position to hold the Meter in Display Test Mode. Compare the display with the appropriate example in Figure 2. Turn off the meter to escape the test mode.

LCD Display of the 61-490 Series

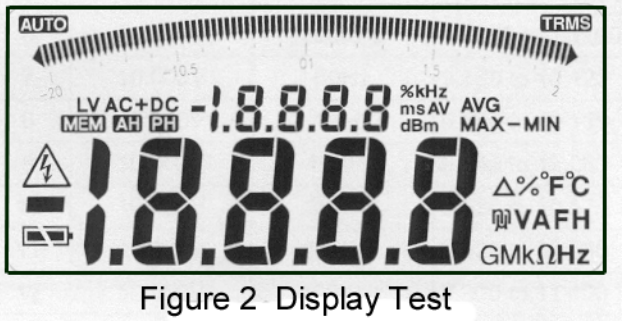


Figure 2 Display Test

Testing the Voltage Function

To verify accuracy in the **AC** and **DC** voltage ranges, do the following:

1. Connect the Calibrator to the **VΩ** and **COM** inputs on the Meter.
2. Set the Calibrator for the voltage and frequency from step 1 to 19 in Table 1.
3. Compare the reading on the Meter display with the display reading shown in Table 1.
4. *If the display reading falls outside of the range shown in Table 1, the Meter does not meet specification.*

Table 1. AC Voltage Test

Input		Reading	
Step	**Voltage**	**Frequency**	
1	1.0000V	60Hz	0.9880 to 1.0120
2	1.0000V	1KHz	0.9850 to 1.0150
3	1.0000V	10KHz	0.9740 to 1.0260
4	1.0000V	20KHz	0.9630 to 1.0370
5	1.0000V	50KHz	0.9420 to 1.0580
6	1.0000V	100KHz	0.8900 to 1.1100
7	10.000V	60Hz	9.880 to 10.120
8	10.000V	1KHz	9.850 to 10.150
9	10.000V	10KHz	9.740 to 10.260
10	10.000V	20KHz	9.630 to 10.370
11	10.000V	50KHz	9.420 to 10.580
12	10.000V	100KHz	8.900 to 11.100
13	100.00V	60Hz	98.80 to 101.20
14	100.00V	1KHz	98.50 to 101.50
15	100.00V	10KHz	97.40 to 102.60
16	100.00V	20KHz	96.30 to 103.70
17	100.00V	50KHz	94.20 to 105.80
18	700.0V	60Hz	690.1 to 709.9
19	700.0V	1KHz	688.0 to 712.0

5. Press the blue button on the Meter to toggle to **DCV** function.
6. Set the calibration for the voltage from step 1 to 4 in Table 2.
7. Compare the reading on the Meter display with the display reading shown in Table 2.
8. *If the display reading falls outside of the range shown in Table 2, the meter does not meet specification.*

Table 2. DC Voltage Test

Input		Reading
Step	**Voltage**	
1	1.0000V	0.9984 to 1.0016
2	10.000V	9.981 to 10.016
3	100.00V	99.84 to 100.16
4	900.0V	898.5 to 901.5

Testing Millivoltage (mV) Function

To verify accuracy of the **mV** function, do the following.

1. Connect the Calibrator to the **VΩ** and **COM** inputs on the meter.
2. Turn the rotary switch to **mV**
3. Set the calibrator for the voltage and frequency from step 1 to 4 in Table 3.
4. Compare the reading on the Meter display with the display reading in Table 3.
5. *If the display reading falls outside of the range shown in Table 3, the Meter does not meet specification.*

Table 3. AC mV Test

Input			Reading
Step	**Voltage**	**Frequency**	
1	10.000mV	60Hz	9.850 to 10.150
2	10.000mV	1KHz	9.820 to 10.180
3	100.00mV	60Hz	98.50 to 100.15
4	100.00mV	1KHz	98.20 to 100.20

6. Press the blue button on the Meter to toggle to **DC mV** function.
7. Set the calibrator for the voltage from step 1 to 2 in Table 4.
8. Compare the reading on the Meter display with the display reading in Table 4.
9. If the display reading falls outside of the range shown in Table 3, the Meter does not meet specification.

Table 4. DC mV Test

Input		Readings
Step	**Voltage**	
1	10.00mV	9.934 to 10.066
2	100.00mV	99.74 to 100.26

Testing the PEAK HOLD Function

To check **PEAK HOLD** feature, do the following:

1. Connect the Calibrator to the **VΩ** and **COM** inputs on the Meter.
2. Apply 1.0V AC at 60Hz from the Calibrator to the **VΩ** and **COM** inputs on the Meter.
3. Turn the rotary switch to **V**
   Note: The RMS converter is not used in Peak Hold mode. The digital display represents the actual peak value of the input.
4. Press **PEAK H** and then **M/M/A**
5. The reading on sub-display should be within 1.441 (Max) and -1.441 (MIN).
6. Press **PEAK H** to escape.

Testing the Resistance Function

To verify the accuracy of the resistance function, do the following:

1. Connect the Calibrator to **VΩ** and **COM** on the Meter.
2. Turn the rotary switch to **Ω**
3. Apply the inputs for steps 1 - 7 in Table 5.
4. Compare the Meter display readings to the readings in Table 5.
   Note: Press **RANGE** on the Meter to enter the 200MΩ and 2GΩ ranges. Then proceed with steps 8 - 9 in Table 5. Compare the meter display readings to the readings in Table 5.
5. *If the display reading falls outside of the range shown in Table 5, the meter does not meet specification.*

Table 5. Resistance Test

Input		Reading
Step	**Resistance (Ω)**	
1	0.00	0 to 0.30
2	100.00	99.40 to 100.60
3	1.0000K	0.9984 to 1.0016
4	10.000K	9.984 to 10.016
5	100.00K	99.84 to 100.16
6	1.0000M	0.9920 to 1.0080
7	10.000M	9.450 to 10.550
8	100M	75 to 125
9	1.0G	0 to 1.3

6. Press the blue button on the meter to toggle to **LVΩ** function.
7. Apply the inputs for step 1 - 6 in Table 6.
8. Compare the Meter display readings to the readings in Table 6
   Note: Press **RANGE** on the Meter to enter 200MΩ range.
9. *If the display reading falls outside of the reading shown in Table 6, the meter does not meet specification.*

Table 6 LVΩ Test

LVΩ	Input	Reading
Step	**Resistance (Ω)**	
1	0.00	0 to 0.0030
2	1.0000K	0.9910 to 1.0090
3	10.000K	9.910 to 10.090
4	100.00K	99.10 to 100.90
5	1.0000M	0.9890 to 1.0110
6	10.000M	9.250 to 10.750
7	100M	43 to 157

Testing the Capacitance Function

The Meter measures capacitance by charging the capacitor with a known Direct current, measuring the resultant voltage, and calculating the capacitance. If the same capacitance is measured on an impedance bridge, a different reading may result. This variance is likely to be Greater at higher frequencies.

To verify the accuracy of the capacitance measuring function, do the following:

1. Apply the Capacitor to the **VΩ** and **COM** inputs to the Meter. For steps 1 through 8 in Table 7.
2. Turn the rotary switch to ⊣⊢
3. Set the **VΩ** and **COM** inputs un-connected
   Note: Press **REL**Δ for steps 1 and 2 in Table 7, after steps 1 and 2 are completed, then escape **REL** mode, then press **RANGE** until **AUTO** is displayed. {upper left corner of display}

4. Compare the readings on the Meter display to readings in Table. 7
   Note: The meter selects the proper range automatically. Each measurement takes about one second per range, 5mF takes about 15 seconds.
5. *If the display reading falls outside of the range shown in Table 7, the Meter does not meet specification.*

Table 7: Capacitance Test

Input		Reading
Step	**Capacitance**	
I	1 .000nF	0.975 to 1.025
2	10.00nF	9.750 to 10.25
3	100.0nF	98.60 to 101.4
4	1 .000uiF	0.986 to 1.014
5	10.00pF	9.830 to 10.17
6	100.0pF	98.30 to 101.7
7	1.000mF	0.980 to 1.020
8	5.00mF	4.880 to 5.120

Checking the Diode Test Function

To check the diode test function, do the following:

1. Connect the Calibrator to the **VΩ** and **COM** inputs on the Meter.
2. Turn the rotary switch to ⊣⊢.
3. Apply 3.000V.
   The meter display should read approx. 3.000V DC.
4. Press the blue button to test the •))) function.
5. Apply a 50Ω resistor to the meter. The built-in beeper alarms.

Testing the Milliamp (mA) Function

To verify the accuracy of AC and DC current measurement functions, do the following:

1. Connect the Calibrator to the **mA** and **COM** inputs on the Meter.
2. Turn the rotary switch to **mA**
3. Apply the inputs for steps 1 - 5 in Table 8.
4. For each input, compare the readings on the Meter display to the readings in Table 8.
5. *If the display reading falls outside of the range shown in the Tables 8, the meter does not meet specification.*

Table 8: AC mA Test

Input			Reading
Step	**Current**	**Frequency**	
1	10.000mA	60Hz	9.870 to 10.130
2	10.000mA	1KHz	9.800 to 10.200
3	100.00mA	60Hz	98.70 to 101.3
4	100.00mA	1KHz	98.00 to 102.00
5	100.00mA	3KHz	97.20 to 102.80

6. Press the blue button on the Meter to toggle to DC measurement function.
7. Apply the inputs for steps 1 - 2 in Table 9.
8. For each input, compare the readings on the Meter display to the readings in Table 9.
9. *If the display reading falls outside of the range shown in the Tables, the meter does not meet specification.*

Table 9: DC mA Test

Input		Reading
Step	**Current**	
1	10.000mA	9.940 to 10.060
2	100.00mA	99.40 to 100.60

Testing the Amp (A) Function

To verify the accuracy in the ampere (A) measurement function, do the Following:

1. Connect the Calibrator to the **A** and **COM** inputs of the Meter.
2. Turn the rotary switch to **A**
3. Apply the inputs for steps 1 - 6 in Table 10.
4. For each input, compare the readings on the Meter display to the readings in Table 10.
5. *If the display reading falls outside of the range shown in Table 10, the meter does not meet specification.*

Table 10. ACA Test

Input			Reading
Step	**Current**	**Frequency**	
1	1.0000A	60Hz	0.9870 to 1.0130
2	1.0000A	1KHz	0.9800 to 1.0200
3	1.0000A	3KHz	0.9720 to 1.0280
4	9.000A	60Hz	8.878 to 9.122
5	9.000A	1KHz	8.812 to 9.188
6	9.000A	3KHz	8.740 to 9.260

6. Press the blue button on the Meter to toggle to the **DCA** measurement function.
7. Apply the inputs for steps 1 - 2 in Table 11.
8. For each input, compare the reading on the Meter display to the readings for your meter in Table 11.
9. *If the display reading falls outside of the range shown in Table 11, the meter does not meet specification.*

Table 11. DCA Test

Input		Reading
Step	**Current**	
1	1.0000A	0.9940 to 1.0060
2	9.000A	8.942 to 10.058

Testing the Frequency Function

To verify the accuracy of the Meter's frequency function, do the following:

1. Connect the Calibrator to the **VΩ** and **COM** inputs on the Meter.
   Note The accuracy of the Calibrator's frequency function must be appropriate for the specified accuracy of the Meter.
2. Set the rotary switch to **Hz**.
3. Set the Function Generator for the square wave voltage and frequency for steps 1 - 6 of Table 12.

4. Compare the reading on the Meter display with the readings shown in Table 12.
5. *If the display reading falls outside of the range shown in Table 12, the Meter does not meet specification.*

Table 12. Frequency Test

Input			Reading
Step	**Frequency**	**Level**	
1	10.000Hz	0.5Vp-p	9.949 to 10.051
2	100.00Hz	0.5Vp-p	99.89 to 100.11
3	1.0000KHz	0.5Vp-p	0.9989 to 1.0011
4	10.000KHz	0.5Vp-p	9.989 to 10.011
5	100.00KHz	0.5Vp-p	99.89 to 100.11
6	0.9000MHz	0.5Vp-p	0.9989 to 1.0011

Testing the Duty Factor Function

To verify the accuracy of the Meter's Duty Factor function, do the following:

1. Connect the Calibrator to the **VΩ** and **COM** inputs on the Meter.
   Note The accuracy of the Calibrator's Duty function must be appropriate for the specified accuracy of the Meter.
2. Set the rotary switch to **Hz**.
3. Press the blue button on the meter to toggle to **%DF** function.
4. Set the Function Generator for square wave voltage for steps 1 - 3 of Table 13. (Frequency is about 1KHz)
5. Compare the reading on the Meter display with the readings shown in Table 13.
6. *If the display reading falls outside of the range shown in Table 13, the Meter does not meet specification.*

Table 13. Duty Factor Test

Input			Reading
Step	Duty (%)	Level	
1	20.0	5Vp-p	19.0 to 21.0
2	50.0	5Vp-p	48.0 to 52.0
3	77.0	5Vp-p	75.0 to 79.0

Testing the Temperature Function

To verify the accuracy of the Meter's Temperature Function do the following:

1. Connect the calibrator to **VΩ** and **COM** via K-type wire and T-V adaptor (Ideal 61-465 TC adapter)
   Note: The T-V adaptor should be allowed to stabilize to the same room temperature as the meter before beginning test.
2. Set the rotary switch to **°C**
3. Set the Calibrator for inputs in Table 14.
4. Compare the reading on the Meter display with the reading shown in Table 14.
5. *If the display reading falls outside of the range shown in Table 14, the Meter does not meet specification.*

Table 14. Temperature Test

Input		Reading
Step	**Temperature**	
1	-100.0°C	-106.1 to -93.9
2	0.0°C	-3.0 to 3.0
3	100.0°C	96.9 to 103.1
4	1000°C	996 to 1001

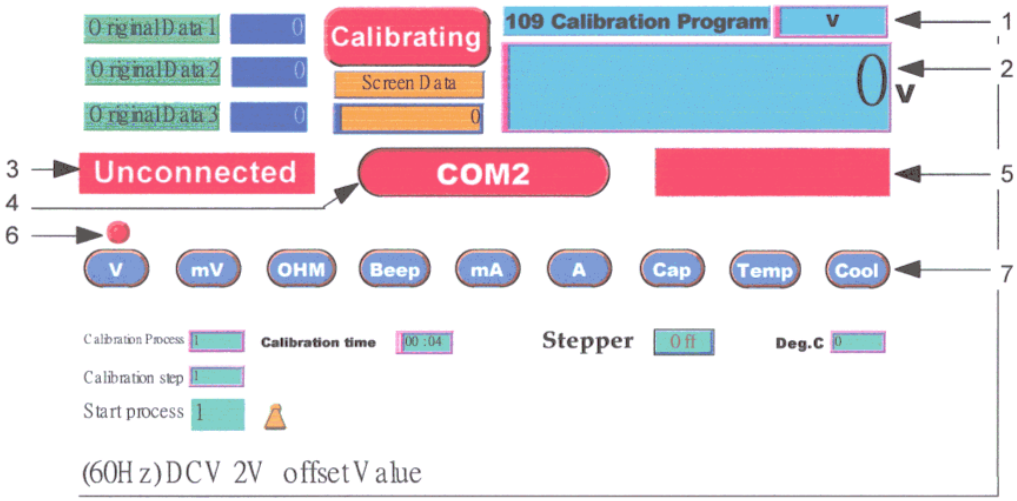


Figure 3. Calibration Tool

Calibration

Calibration of the meter is recommended once a year to ensure performance according to the published specifications.

Calibration is performed with the use of **CalWin 109VPTCM** Software as illustrated above. (This software can be obtained by contacting Customer Service at IDEAL INDUSTRIES, INC.)

Do not perform this step if software is already loaded.

The software consists of three files titled **Setup.exe, Data001, and Data002**. After you execute the **setup.exe** program in the Window (95 or 98) environment, you will have **109CalVPTCM100** option in the PROGRAM set.

Execute **CalWin109VPTCM** choice and you should get the screen shown in Figure 3.

Description of **CalWin109VPTCM** window:

1. **Main Function Indicator:** Displays the function of the Meter.
2. **Main Display:** Displays the main reading of the Meter.
3. **Connection Indicator:** "Connection" shows that the meter is connected to your computer and the meter and computer are communicating
   "Disconnection" shows that the meter and computer are not connected or are not communicating.

4. **Communication Port:** Selects port available to connect to meter.
   Selectable ports are COM 1 or COM 2.
5. **Error Indication:** Displays error message when an error of calibration occurred.
   When an error occurs, press the blinking (RESET) key to display mode.
6. **Calibration Function Indicator:** Indicates the calibration function selected.
   It disappears if the calibration function has not been selected or the calibration is completed.
7. **Calibration Function Selector:** Select the calibration function desired.

Note Before the Calibration Function is selected, the function selected on the Meter has to be confirmed, to prevent Mis-function error from occurring.

Calibrating the ACV Frequency Response

To calibrate the Meter, perform the following procedure:
Turn the rotary switch of the Meter to **V**
Connect the Calibrator to the **VΩ** and **COM** inputs on the Meter.
Output 100V/10KHz from the Calibrator.
Adjust VC3 to obtain a Meter display reading of 100.50 ± 0.20
Output 10V/10KHz from the Calibrator.
Adjust VC2 to obtain a Meter display reading 10.050 ± 0.020
Output 1V/10KHz from the Calibrator.
Adjust VC1 to obtain a Meter display reading of 1.0050 ± 0.0020