

**FLUKE®**

# **Models 110, 111 & 112**

True RMS Multimeters

**Users Manual**

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**⚠ Read Before Using the Meter: Warnings and Precautions**

To avoid possible electric shock or personal injury, follow these guidelines:

- Use the Meter only as specified in this manual or the protection provided by the Meter might be impaired.
- Do not use the Meter or test leads if they appear damaged, or if the Meter is not operating properly.
- Always use proper terminals, switch position, and range for measurements.
- Verify the Meter's operation by measuring a known voltage. If in doubt, have the Meter serviced.
- Do not apply more than the rated voltage, as marked on Meter, between terminals or between any terminal and earth ground.
- Use caution with voltages above 30 V ac rms, 42 V ac peak, or 60 V dc. These voltages pose a shock hazard.
- To avoid false readings that can lead to electric shock and injury, replace the battery as soon as the low battery indicator (🔋) appears.
- Disconnect circuit power and discharge all high-voltage capacitors before testing resistance, continuity, diodes, or capacitance.
- Do not use the Meter around explosive gas or vapor.
- When using test leads or probes, keep your fingers behind the finger guards.
- Remove test leads from Meter before opening the battery door or Meter case.

**Symbols**

	AC (Alternating Current)		Fuse
	DC (Direct Current)		Conforms to European Union directives
	AC or DC		Canadian Standards Association
	Earth ground		Double insulated
	Important information; Refer to manual	 950 Z Listed	Underwriters Laboratories, Inc.
	Battery (Low battery when shown on display)	 N10140	Conforms to relevant Australian standards
	Inspected and licensed by TÜV Product Services		VDE (Verband Deutscher Electroniker)

# Models 110, 111 & 112

## True RMS Multimeters

The Fluke **Model 110**, **Model 111**, and **Model 112** are battery-powered, true-RMS multimeters (hereafter "the Meter") with a 6000-count display and a bar graph. This manual applies to all three models. All figures show the Model 112.

The Meter measures or tests the following:

- AC / DC voltage and current
- Resistance
- Continuity
- Diodes
- Voltage and current frequency
- Capacitance

These meters meet CAT III IEC 61010-1-95 standards. The IEC 61010-1-95 safety standard defines four overvoltage categories (CAT I to IV) based on the magnitude of danger from transient impulses. CAT III meters are designed to protect against transients in fixed-equipment installations at the distribution level.

### Contacting Fluke

To contact Fluke, call:

USA: 1-888-99-FLUKE (1-888-993-5853)  
Canada: 1-800-36-FLUKE (1-800-363-5853)  
Europe: +31 402-675-200  
Japan: +81-3-3434-0181  
Singapore +65-738-5655  
Anywhere in the world: +1-425-446-5500

Visit Fluke's web site at: [www.fluke.com](http://www.fluke.com).

Register your Meter at: [register.fluke.com](http://register.fluke.com).

### "Warning" and "Caution" Statements

A "**⚠Warning**" statement identifies hazardous conditions and actions that could cause bodily harm or death.

A "**⚠Caution**" statement identifies conditions and actions that could damage the Meter or the equipment under test.

### Unsafe Voltage

To alert you to the presence of a potentially hazardous voltage, the ⚡ symbol is displayed when the Meter detects a voltage  $\geq 30$  V or a voltage overload (**OL**) condition.

### Test Lead Alert

#### **⚠Warning**

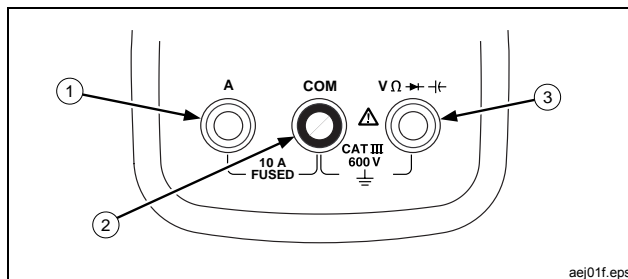
**Personal injury or damage to the Meter can occur if you attempt to make a measurement with a lead in an incorrect terminal.**

To remind you to check that the test leads are in the correct terminals, **LEAD** is displayed briefly when you move the rotary switch to or from any **A** position.

**Battery Saver ("Sleep Mode")**

The Meter automatically enters "Sleep mode" and blanks the display if there is no function change or button press for 20 minutes. To disable the Sleep mode, hold down the **Hz** button while turning the Meter on. The Sleep mode is always disabled in the MIN MAX AVG mode.

**Terminals**



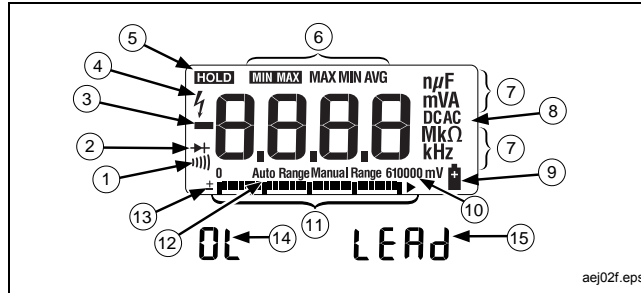
Item	Description
1	Input terminal for AC and DC current measurements to 10 A, or to 20 A overload for 30 seconds maximum (Models 111 and 112 only), and for frequency of current.
2	Common (return) terminal for all measurements.
3	Input terminal for voltage, continuity, resistance, diode test, capacitance, and voltage frequency measurements.

**Rotary Switch Positions**

Switch Position	Measurement Function
$\tilde{V}$ <b>Hz (button)</b>	AC voltage from 300 mV to 600 V. Frequency from 5 Hz to 50 kHz.
$\bar{V}$ <b>Hz (button)</b>	DC voltage from 1 mV to 600 V. Frequency from 5 Hz to 50 kHz.
$\text{     }$	Beeper turns on at < 20 $\Omega$ and turns off at > 250 $\Omega$ .
$\Omega$	Ohms from 0.1 $\Omega$ to 40 M $\Omega$ .
$\rightarrow $	Diode test. Displays OL above 2.4 V.
$  \leftarrow$	Farads from 1 nF to 9999 $\mu$ F.
(Models 111 & 112) $\tilde{A}$ <b>Hz (button)</b>	AC current from 3 A to 10 A. (20 A overload for 30 seconds maximum.) >10.00 display flashes. >20 A, <b>OL</b> is displayed. Frequency from 50 Hz to 5 kHz.
(Models 111 & 112) $\bar{A}$ <b>Hz (button)</b>	DC current from 0.001 A to 10 A. (20 A overload for 30 seconds maximum.) >10.00 display flashes. >20 A, <b>OL</b> is displayed. Frequency from 50 Hz to 5 kHz.

Notes: AC voltage and current AC-coupled, True RMS, up to 500 Hz.

Display



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No.	Symbol	Meaning
1	)	Meter is set to continuity function.
2	→	Diode test.
3	-	Negative readings.
4	⚡	Unsafe voltage. Voltage $\geq 30$ V, or voltage overload condition (OL).
5	<b>HOLD</b>	Display HOLD is enabled. Display freezes present reading. In MIN MAX AVG mode, MIN MAX AVG recording is paused.
6	<b>MIN MAX</b> <b>MAX MIN AVG</b>	MIN MAX AVG mode enabled. Maximum, minimum, or average reading displayed.

No.	Symbol	Meaning
7	nμF mVA MkΩ kHz	Measurement units.
8	DC AC	Direct current, alternating current.
9	🔋	Replace battery immediately.
10	610000 mV	All possible segments of the range annunciator.
11	(Bar graph)	Analog display.
12	Auto Range Manual Range	The Meter selects the range with the best resolution. The user selects the range.
13	±	Bar graph polarity.
14	OL	The input is too large for the range.
15	LEAd	⚠️ Test lead alert. Displayed briefly when rotary switch is moved <u>to</u> or <u>from</u> any <b>A</b> position.

Error Messages	
diSC	Displayed while the capacitor discharges. In Capacitance function only.
EEPr	Cannot read data from EEPROM. Turn power off, then on. If message remains, service Meter.
EEPr Err	Invalid EEPROM data. Have Meter serviced.
CAL Err	Invalid calibration data. Calibrate Meter.

### **MIN MAX AVG Recording Mode**

The MIN MAX AVG recording mode captures the minimum and maximum input values, and calculates a running average of all readings. When a new high or low is detected, the Meter beeps.

Put the Meter in the desired measurement function and range.

⇒ Press **MIN MAX** to enter MIN MAX AVG mode.

**MIN MAX** and **MAX** are displayed and the highest reading detected since entering MIN MAX AVG is displayed.

⇒ Press **MIN MAX** to step through the low (**MIN**), average (**AVG**), and present readings.

⇒ To pause MIN MAX AVG recording without erasing stored values, press **HOLD**. **HOLD** is displayed.

⇒ To resume MIN MAX AVG recording, press **HOLD** again.

⇒ To exit and erase stored readings, press **MIN MAX** for at least one second or turn the rotary switch.

### **Display HOLD**

#### **⚠ Warning**


**To avoid electric shock, when Display HOLD is activated, be aware that the display will not change when you apply a different voltage.**

In the Display HOLD mode, the Meter freezes the display.

⇒ Press **HOLD** to activate Display HOLD. (**HOLD** is displayed.)

⇒ To exit and return to normal operation, press **HOLD** or turn the rotary switch.

### **Backlight (Model 112 Only)**

Press  to toggle the backlight on and off. The backlight automatically turns off after 2 minutes.

To disable the automatic 2-minute backlight timeout, hold down the  button while turning the Meter on.



### **Manual Ranging and Auto Ranging**

The Meter has both Manual Range and Auto Range modes.

- ⇒ In the Auto Range mode, the Meter selects the range with the best resolution.
- ⇒ In the Manual Range mode, you override Auto Range and select the range yourself.

When you turn the Meter on, it defaults to Auto Range and **Auto Range** is displayed.

1. To enter the Manual Range mode, press **RANGE**. **Manual Range** is displayed.
2. In the Manual Range mode, press **RANGE** to increment the range. After the highest range, the Meter wraps to the lowest range.

*Note*

*You cannot manually change the range in the MIN MAX AVG or Display HOLD modes.*

*If you press **RANGE** while in MIN MAX AVG or Display Hold, the Meter beeps, indicating an invalid operation, and the range does not change.*


3. To exit Manual Range, press **RANGE** for at least 1 second or turn the rotary switch.

The Meter returns to Auto Range and **Auto Range** is displayed.

### **Power-Up Options**

To select a Power-Up Option, hold down the button indicated for at least 1 second while turning the Meter on.

Power-Up Options are canceled when you turn the Meter off and when sleep mode is activated.

<b>Button</b>	<b>Power-Up Options</b>
<b>HOLD</b>	Turns on all display segments. Release <b>HOLD</b> to continue; the software version number is displayed briefly and the Meter resumes normal operation.
<b>MIN MAX</b>	Disables beeper.
<b>Hz</b>	Disables automatic power-down ("Sleep mode").
	Disables automatic 2-minute backlight timeout. <b>(Model 112 Only)</b>

## Making Basic Measurements

The figures on the following pages show how to make basic measurements.

When connecting the test leads to the circuit or device, connect the common (**COM**) test lead before connecting the live lead; when removing the test leads, remove the live lead before removing the common test lead.

### **⚠ Warning**

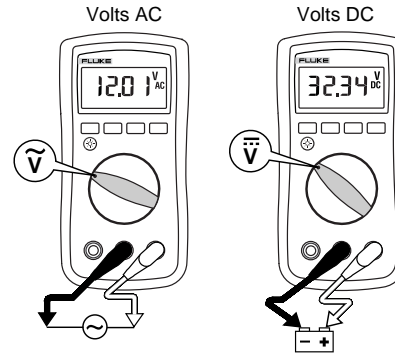
**To avoid electric shock, injury, or damage to the Meter, disconnect circuit power and discharge all high-voltage capacitors before testing resistance, continuity, diodes, or capacitance.**

### *Note*

*In reading AC voltage or current, for the integrated RMS converter to correctly measure distorted waveforms, reading settling time increases to several seconds at the low end of AC voltage and current ranges.*

*Because inputs below 5% of range are not specified, it is normal for this meter to display non-zero readings when the test leads are disconnected from a circuit or are shorted together.*

## Measuring AC and DC Voltage



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### Understanding AC Zero Input Behavior of True RMS Meters

Unlike averaging meters, which can accurately measure only pure sinewaves, True RMS meters accurately measure distorted waveforms. Calculating True RMS converters require a certain level of input voltage to make a measurement. This is why AC voltage and current ranges are specified from 5% of range to 100% of range. Non-zero digits that are displayed on a True RMS meter when the test leads are open or are shorted are normal. They do not affect the specified AC accuracy above 5% of range.

The input levels that are unspecified are:

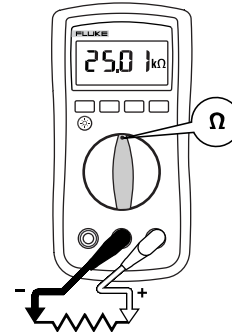
- AC voltage: below 5% of 6000 mV AC, or 300 mV AC
- AC current: below 5% of 60 A AC, or 3.00 A AC

**Note**

The 3.00 A AC minimum specified reading is calculated by the Meter as 5% of 60 A. However for safety and compactness, the current shunt in the Meter is specified for 10 A continuous, 20 A overload for up to 30 seconds. Exceeding these levels will open the user-replaceable internal fuse.

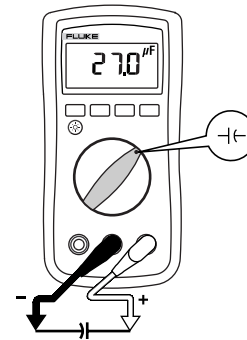
The 10 A AC current in the 111 and 112 is designed for accurate, in-line measurement of loads on line-powered devices and circuits. Because the lowest specified AC readings are 3.00 A AC and 300 mV AC, the Meter is not specified for use with AC current clamp accessories.

**Measuring Resistance**



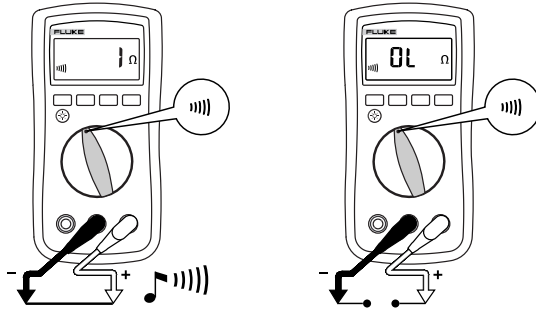
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**Measuring Capacitance**



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### Testing for Continuity

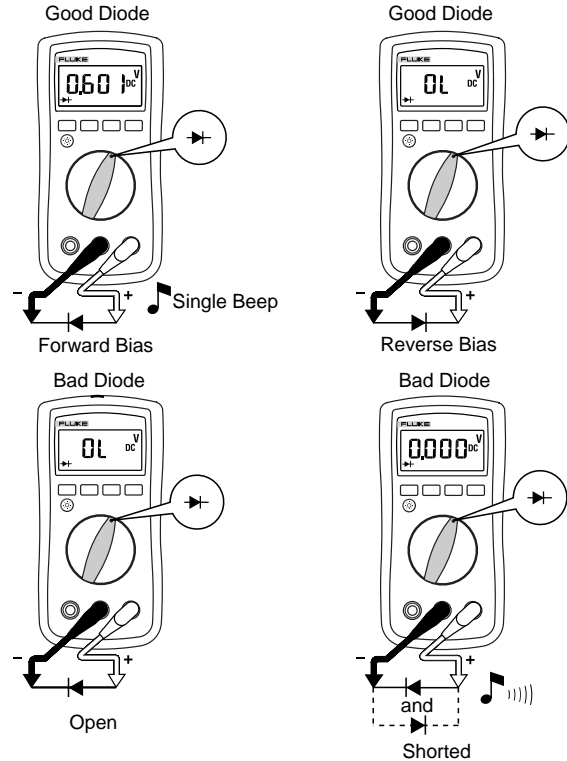


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#### Note

The continuity function works best as a fast, convenient method to check for opens and shorts. For maximum accuracy in making resistance measurements, use the Meter's resistance ( $\Omega$ ) function.

### Testing Diodes



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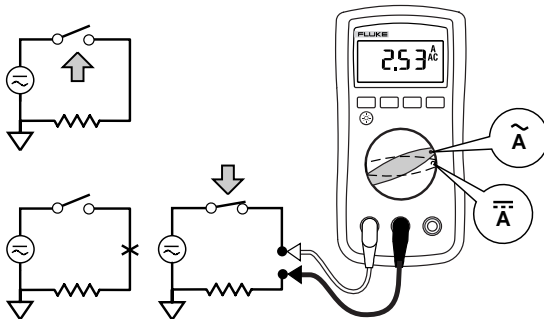
### Measuring AC or DC Current (Models 111 and 112)

#### ⚠ Warning

To avoid personal injury or damage to the Meter:

- Never attempt to make an in-circuit current measurement when the open-circuit potential to earth is > 600 V.
- Check the Meter's fuse before testing. (See "Testing the Fuse")
- Use the proper terminals, switch position, and range for your measurement.
- Never place the probes in parallel with a circuit or component when the leads are plugged into the current terminals.

Turn power OFF, break circuit, insert Meter in series, turn power on.



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### Measuring Frequency

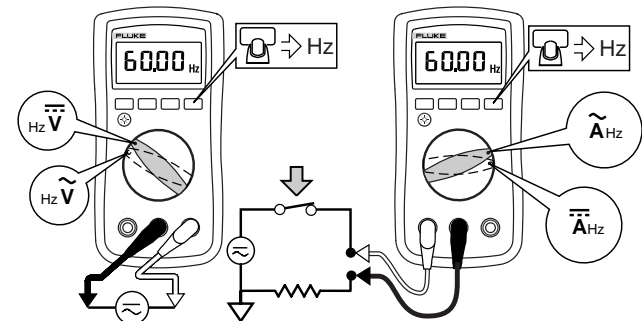
#### ⚠ Warning

To avoid electrical shock, disregard the bar graph for frequencies > 500 Hz. If the frequency of the measured signal is > 500 Hz, the bar graph is unspecified.

The Meter measures the frequency of a signal by counting the number of times the signal crosses a trigger level each second. The trigger level is 0 V, 0 A for all ranges.

AC/DC Voltage Frequency

AC/DC Current Frequency



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- ⇒ Press **Hz** to turn the frequency measurement function on and off.
- ⇒ In frequency, the bar graph and range annunciator indicate the AC or DC voltage or current present.
- ⇒ Select progressively lower ranges using manual ranging for a stable reading.

### Using the Bar Graph

The bar graph is like the needle on an analog meter. It has an overload indicator (▶) to the right and a polarity indicator (±) to the left.

Because the bar graph updates about 40 times per second, which is ten times faster than the digital display, the bar graph is useful for making peak and null adjustments.

The bar graph is disabled when measuring capacitance. In frequency, the bar graph and range annunciator indicate the underlying voltage or current.

*The number of segments indicates the measured value and is relative to the full-scale value of the selected range, except on the 10 A ranges.*

In the 60 V range, for example (see below), the major divisions on the scale represent 0, 30, and 60 V. An input of -30 V turns on the negative sign and the segments up to the middle of the scale.



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### Cleaning

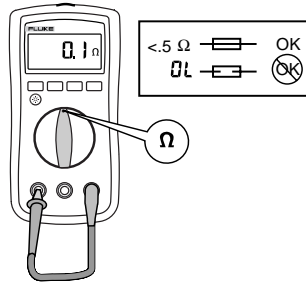
Wipe the case with a damp cloth and mild detergent. Do not use abrasives or solvents. Dirt or moisture in the terminals can affect readings.

### Testing the Fuse (Models 111 and 112)

**⚠ Warning**

To avoid electrical shock or injury, remove the test leads and any input signals before replacing the fuse.

Test fuse as shown below.




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### Replacing the Battery and Fuse

**⚠ Warning**

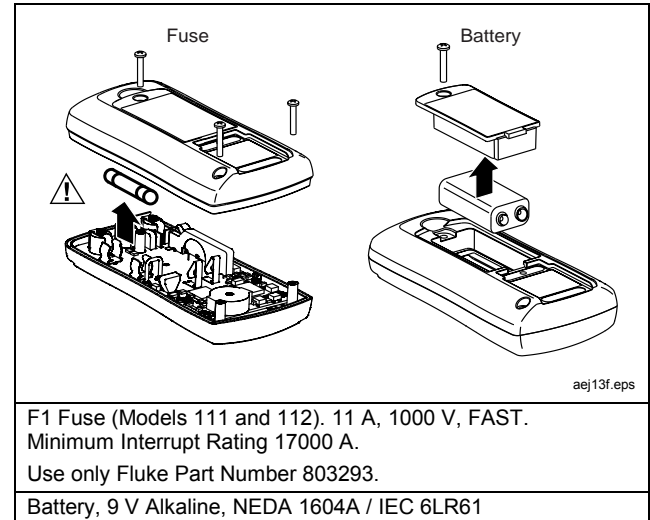
To avoid shock, injury, or damage to the Meter:

- Remove test leads from the Meter before opening the case or battery door.
- Use **ONLY** a fuse with the amperage, interrupt, voltage, and speed ratings specified.
- Replace the battery as soon as the low battery indicator (  ) appears to avoid false readings.

To remove the battery door:

1. Remove screw from battery door.
2. Use the finger recess to lift door slightly.
3. Pull door toward bottom of Meter to release the latch.
4. Lift the door straight up to separate from case.


The battery fits inside the battery door, which is then inserted straight into the case until it clicks into place. Do not attempt to install the battery directly into the case.



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**Specifications**

Accuracy is specified for 1 year after calibration, at operating temperatures of 18 °C to 28 °C, with relative humidity at 0 % to 95 %.  
The accuracy specifications take the form of:  $\pm ( [ \% \text{ of Reading } ] + [ \text{ Counts } ] )$

<b>Maximum voltage between any terminal and earth ground:</b>	600 V
<b>Surge Protection</b>	6 kV peak per IEC 61010-1-95
<b>⚠ Fuse for A input:</b>	11 A, 1000 V FAST Fuse
<b>Display:</b>	Digital: 6,000 counts, updates 4/sec Bar Graph: 33 segments, updates 40/sec Frequency: 9,999 counts Capacitance: 9,999 counts
<b>Temperature:</b>	Operating: -10 °C to +50 °C Storage: -30 °C to +60 °C
<b>Temperature Coefficient:</b>	0.1 x (specified accuracy) / °C for < 18 °C or > 28 °C
<b>Electromagnetic Compatibility:</b>	Performance $\geq 3$ V/m is not specified.
<b>Relative Humidity:</b>	Noncondensing < 10 °C 0 % to 95 % @ 10 °C to 30 °C 0 % to 75 % @ 30 °C to 40 °C 0 % to 45 % @ 40 °C to 50 °C
<b>Battery Life:</b>	Alkaline: 300 hours typical, without backlight
<b>Size, with Holster (H x W x L):</b>	4.6 cm x 9.6 cm x 16.0 cm
<b>Weight:</b>	350 g
<b>Safety Compliances:</b>	ANSI/ISA-S82.01-1988, CSA C22.2 No 231 and IEC 61010-1-95 Overvoltage Category III (CAT III), 600 V
<b>Certifications:</b>	UL (3111), CÉ, CSA, TÜV,  (N10140), VDE



**True RMS Multimeters**  
Specifications

Function	Range	Resolution	Accuracy $\pm$ ( [ % of Reading ] + [ Counts ] )		
			Model 110	Model 111	Model 112
AC Volts <sup>1,2,3</sup> -- True RMS (50 Hz to 500 Hz)	6000 mV <sup>4</sup> 6.000 V 60.00 V 600.0 V	1 mV 0.001 V 0.01 V 0.1 V	1.0 % + 3	1.0 % + 3	1.0 % + 3
DC Volts	6000 mV <sup>4</sup> 6.000 V 60.00 V 600.0 V	1 mV 0.001 V 0.01 V 0.1 V	0.7 % + 2	0.7 % + 2	0.7 % + 2
Continuity	600 $\Omega$	1 $\Omega$	Beeper guaranteed on < 20 $\Omega$ , guaranteed off > 250 $\Omega$ ; detects opens or shorts of 250 $\mu$ s or longer.		
Ohms	600.0 $\Omega$ 6.000 k $\Omega$ 60.00 k $\Omega$ 600.0 k $\Omega$ 6.000 M $\Omega$ 40.00 M $\Omega$	0.1 $\Omega$ 0.001 k $\Omega$ 0.01 k $\Omega$ 0.1 k $\Omega$ 0.001 M $\Omega$ 0.01 M $\Omega$	0.9 % + 2 0.9 % + 1 0.9 % + 1 0.9 % + 1 0.9 % + 1 1.5 % + 3	0.9 % + 2 0.9 % + 1 0.9 % + 1 0.9 % + 1 0.9 % + 1 1.5 % + 3	0.9 % + 2 0.9 % + 1 0.9 % + 1 0.9 % + 1 0.9 % + 1 1.5 % + 3
Diode test	2.200 V	0.001 V	0.9 % + 2		
Capacitance <sup>5</sup>	1000 nF 10.00 $\mu$ F 100.0 $\mu$ F  10000 $\mu$ F	1 nF 0.01 $\mu$ F 0.1 $\mu$ F  1 $\mu$ F	1.9 % + 2 1.9 % + 2 1.9 % + 2	1.9 % + 2 1.9 % + 2 1.9 % + 2	1.9 % + 2 1.9 % + 2 1.9 % + 2
AC Amps <sup>6,8</sup> -- True RMS (50 Hz to 500 Hz) (Models 111 and 112)	10.00 A continuous or 20 A overload for 30 seconds maximum	0.01 A	NA	1.5 % + 3	1.5 % + 3

## Models 110, 111 & 112

### Users Manual

Function	Range	Resolution	Accuracy $\pm$ ( [ % of Reading ] + [ Counts ] )		
			Model 110	Model 111	Model 112
DC Amps <sup>8</sup> (Models 111 and 112)	6.000 A 10.00 A continuous or 20 A overload for 30 seconds maximum	0.001 A 0.01 A	NA	1.0 % + 3	1.0 % + 3
Hz <sup>7</sup> (V or A input )	99.99 Hz 999.9 Hz 9.999 kHz 50.00 kHz	0.01 Hz 0.1 Hz 0.001 kHz 0.01 kHz	0.1 % + 2	0.1 % + 2	0.1 % + 2
MIN MAX AVG Accuracy and Response Time	Accuracy is the specified accuracy of the measurement function $\pm$ 12 digits for changes >275 ms in duration ( $\pm$ 40 digits in AC). Typical response time: 100 ms to 80 % of signal, except V AC and A AC.				
<ol style="list-style-type: none"> <li>All AC voltage ranges are specified from 5% of range to 100% of range. Because inputs below 5% of range are not specified, it is normal for this and other True RMS meters to display non-zero readings when the test leads are disconnected from a circuit or are shorted together.</li> <li>Crest factor of <math>\leq 3</math> at full scale up to 300 V, decreasing linearly to crest factor <math>\leq 1.5</math> at 600 V.</li> <li>For non-sinusoidal waveforms, add -(2% reading + 2% full scale) typical, for crest factors up to 3.</li> <li>The 6000 mV range can only be entered in Manual Range mode.</li> <li>For film capacitors.</li> <li>Crest factor of <math>\leq 3</math>. AC current is not specified below 3A. It is normal for this and other True RMS meters to display non-zero readings when the test leads are disconnected from a circuit or are shorted together.</li> <li>Hz is specified from 5 Hz to 50 kHz in volts, from 50 Hz to 5 kHz in amps.</li> <li>Amps input burden voltage (typical): 400 mA input 2 mV/mA, 10 A input 37 mV/A.</li> </ol>					

Function	Input Impedance (Nominal)	Common Mode Rejection Ratio		Normal Mode Rejection
Volts AC	> 5 M $\Omega$ < 100 pF	> 60 dB at DC, 50 Hz or 60 Hz		
Volts DC	> 10 M $\Omega$ < 100 pF	> 100 dB at DC, 50 Hz or 60 Hz		> 50 dB at 50 Hz or 60 Hz
	<b>Open Circuit Test Voltage</b>	<b>Full Scale Voltage</b>		<b>Short Circuit Current</b>
		<b>To 6 M<math>\Omega</math></b>	<b>40 M<math>\Omega</math></b>	
Ohms	< 1.5 V DC	< 600 mV DC	< 1.5V DC	< 500 $\mu$ A
Diode test	2.4 to 3.0 V DC	2.400 V DC		1.2 mA typical