FLUKE®

116
True-rms Multimeter

Users Manual

July 2006 Rev. 2, 5/21

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Introduction

The Fluke Model 116, is a battery-powered, true-rms multimeter (the Meter or Product) with a 6000-count display and a bar graph.

Contact Fluke

Fluke Corporation operates worldwide. For local contact information, go to our website: www.fluke.com

To register your product, view, print, or download the latest manual or manual supplement, go to our website.

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Safety Information

General Safety Information is in the printed Safety Information document that ships with the Product and at www.fluke.com. More specific safety information is listed where applicable.

A **Warning** identifies hazardous conditions and procedures that are dangerous to the user. A **Caution** identifies conditions and procedures that can cause damage to the Product or the equipment under test.

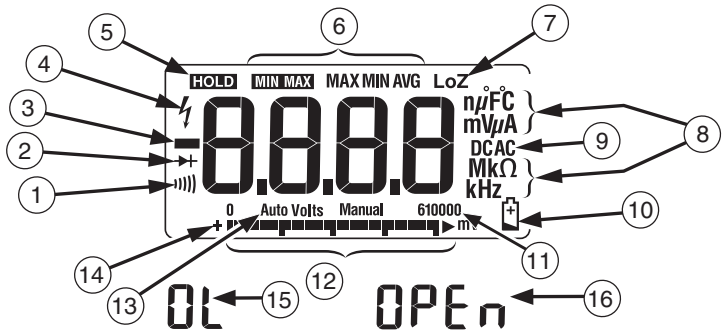
Unsafe Voltage

To alert you to the presence of a potentially hazardous voltage, the ϟ symbol shows when the Meter measures a voltage ≥30 V or a voltage overload (**OL**) condition. When making frequency measurements >1 kHz, the ϟ symbol is unspecified.

Display

Table 1 shows the areas of the display.

Table 1. Display

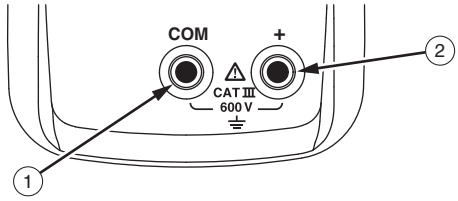


Item	Symbol	Description
①	)))))	The Meter function is set to Continuity.
②	⊣◀	The Meter function is set to Diode Test
③	−	Input is a negative value.
④	ϟ	⚠ Unsafe voltage. Measured input voltage ≥30 V, or voltage overload condition (OL).
⑤	**HOLD**	Display hold enabled. Display freezes present reading.
⑥	**MIN MAX** **MAX MIN** **AVG**	MIN MAX AVG mode enabled. Maximum, minimum, average or present reading displays
⑦	**LoZ**	The Meter is measuring voltage or capacitance with a low input impedance.
⑧	**nµF mV µA** **MkΩ kHz**	Measurement units.
⑨	**DC AC**	Direct current or alternating current
⑩		Battery low warning.
⑪	**610000 mV**	Indicates the Meter's range selection.
⑫	(Bar graph)	Analog display.
⑬	**Auto Volts**	The Meter is in the Auto Volts function.
	Auto	Autoranging. The Meter selects the range for best resolution.
	Manual	Manual ranging. User sets the Meter's range.
⑭	**+**	Bar graph polarity
⑮	OL	⚠ The input is too large for the selected range.
⑯	OPEn	Thermocouple missing or defective when Temperature function is selected.

Terminals

Table 2 is a list of terminals on the Meter.

Table 2. Terminals



No.	Description
①	Common (return) terminal for all measurements.
②	Input terminal for all measurements.

Error Messages

Table 3 is a list of error messages for the Meter.

Table 3. Error Messages

Error Messages	
bAtt	Battery must be replaced before the Meter will operate.
CAL Err	Calibration required. Meter calibration is required before the Meter will operate.
EEPr Err	Internal error. The Meter must be repaired before it will operate.
F11 Err	Internal error. The Meter must be repaired before it will operate.

Rotary Switch Positions

Table 4 is a list of the rotary switch positions and features.

Table 4. Features

Switch Position	Measurement Function
OFF	The Meter is turned off.
AUTO-V LoZ	Automatically selects ac or dc volts based on the sensed input with a low impedance input.
V Hz	AC voltage from 0.06 V to 600 V. Frequency from 5 Hz to 100 kHz.
V	DC voltage from 0.001 V to 600 V.
mV	AC voltage from 6.0 to 600 mV, dc-coupled. DC voltage from 0.1 to 600 mV.
Ω	Ohms from 0.1 Ω to 40 MΩ.
	Temperature from -40 °C to 400 °C (-40 °F to 752 °F) with K-type thermocouple
	Continuity beeper turns on at <20 Ω and turns off at >250 Ω.
	Diode Test. Displays **OL** above 2.0 V.
	Farads from 1 nF to 9999 µF.
µA	DC current from 0.1 to 600 µA. AC current from 6.0 to 600 µA. DC-coupled.
Note: All ac functions and Auto-V LoZ are true-rms. AC voltage is ac-coupled. Auto-V LoZ, AC mV and AC amps are dc-coupled.	

Battery Saver™ (Sleep Mode)

If the Meter is ON, but inactive and not connected to voltage for more than 20 minutes, the display goes blank to save battery life. To use the Meter, press any button or turn the rotary switch. To disable the Sleep mode, see *Power-Up Options*. The Sleep mode is always disabled in the MIN MAX AVG mode.

MIN MAX AVG Recording Mode

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

Note

Autoranging and Battery Saver™ are disabled in MIN MAX AVG mode.

To set up:

1. Select the measurement function and range.
2. Push MIN MAX to enter MIN MAX AVG mode.
3. **MIN MAX** and MAX show on the display. The highest reading detected since entering MIN MAX AVG shows on the display.
4. Push MIN MAX to step through the low (MIN), average (AVG), and present readings.
5. To pause MIN MAX AVG recording without erasing stored values, push HOLD. (**HOLD** shows on the display.)
6. To resume MIN MAX AVG recording, push HOLD again.
7. To exit and erase stored readings, push 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.

1. Push HOLD to activate Display HOLD. (**HOLD** shows on the display.)
2. To exit and return to normal operation, push HOLD or turn the rotary switch.

Backlight

Push ☼ to toggle the backlight on and off.

The backlight automatically turns off after 40 seconds. To disable backlight auto-off, see *Power-Up Options*.

Manual and Autoranging

The Meter has both Manual and Autorange modes. The Meter defaults to Autorange. To toggle between Manual and Autorange, push RANGE for 1 second.

- In the Autorange mode, the Meter selects the range with the best resolution.
- In the Manual Range mode, you override Autorange and select the range yourself. Push RANGE for 1 second to enter Manual range. (**Manual** shows on the display.) Push 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 push RANGE while in MIN MAX AVG or Display Hold, the Meter beeps twice, indicating an invalid operation and the range does not change.

Power-Up Options

To select a Power-Up Option, hold down the button indicated in Table 5 while turning the Meter from OFF to any other function. Power-Up Options are canceled when you turn off the Meter and when sleep mode is activated.

Table 5. Power-Up Options

Button	Power-Up Options
HOLD	Turns on all display segments until button is released.
MIN MAX	Disables beeper. bEEP shows when enabled.
RANGE	Enables low impedance capacitance measurements. LCAP shows when enabled.
▭	Disables Battery Saver™ (Sleep mode). PoFF shows when enabled.
☼	Disables auto backlight off. LoFF is displayed when enabled.

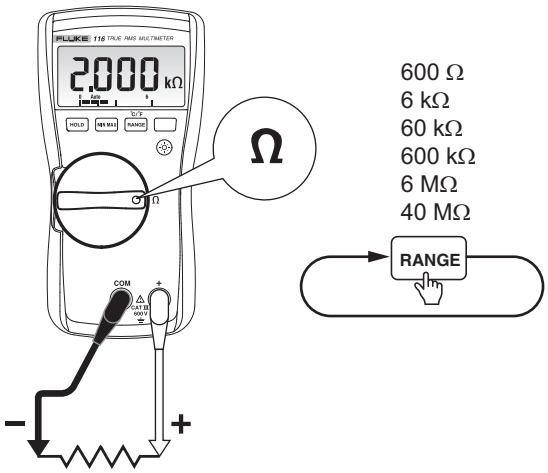
Making Basic Measurements

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

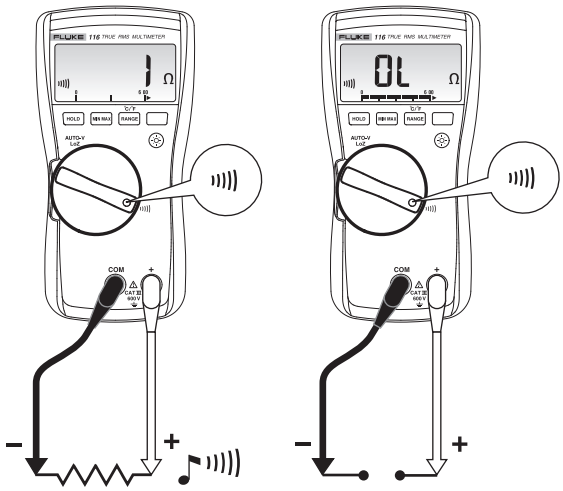
Measuring Resistance



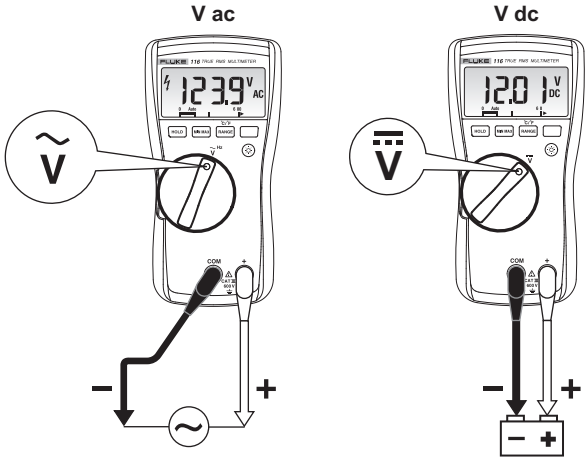
Testing for Continuity

Note

Use the continuity function as a fast, convenient method to check for opens and shorts. For maximum accuracy in making resistance measurements, use the Meter's resistance (Ω) *function.*



Measuring AC and DC Voltage



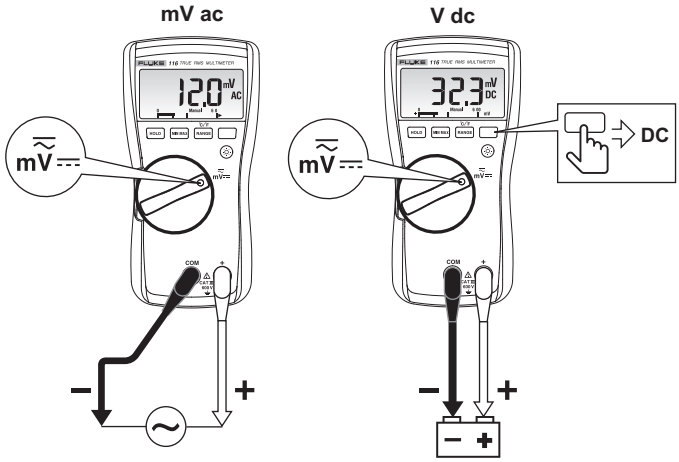
Using Auto Volts Selection

With the function switch in the AUTO-V LoZ position, the Meter automatically selects a dc or ac voltage measurement based on the input applied between the **V** or **+** and **COM** jacks.

This function also sets the Meter's input impedance to approximately 3 kΩ to reduce the possibility of false readings due to ghost voltages.

Measuring AC and DC Millivolts

With the function switch in the mV position, the Meter measures ac plus dc millivolts. Press ▭ to set the Meter to dc millivolts.



Measuring AC or DC Current

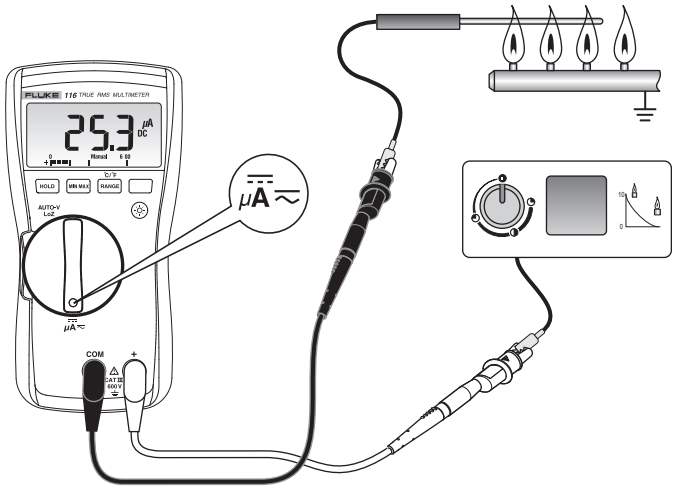
⚠⚠ Warning

To avoid personal injury or damage to the Meter:

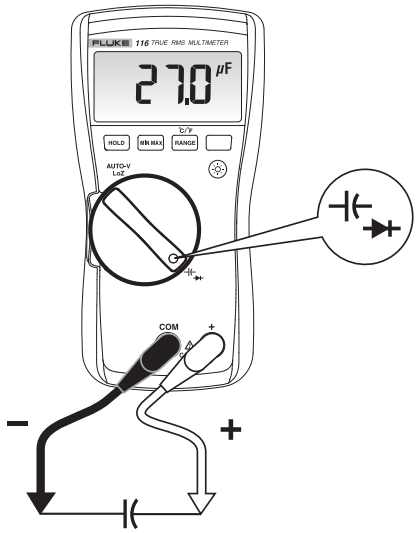
- **Never attempt to make an in-circuit current measurement when the open-circuit potential to earth is >600 V.**
- **Use the proper terminals, switch position, and range for your measurement.**

To measure flame rectification circuits:

1. Turn the function switch to $\mu\overline{\overline{A}}\sim$.
2. Connect the Meter between the flame sensor probe and the control module.
3. Turn heating unit on and record µA measurement.



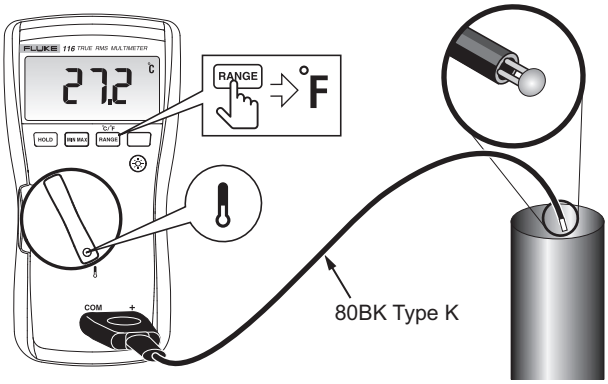
Measuring Capacitance



Measuring Temperature

⚠⚠ Warning

To prevent risk of electric shock, do NOT connect 80BK to live circuits.



Measuring Frequency

⚠⚠ Warning

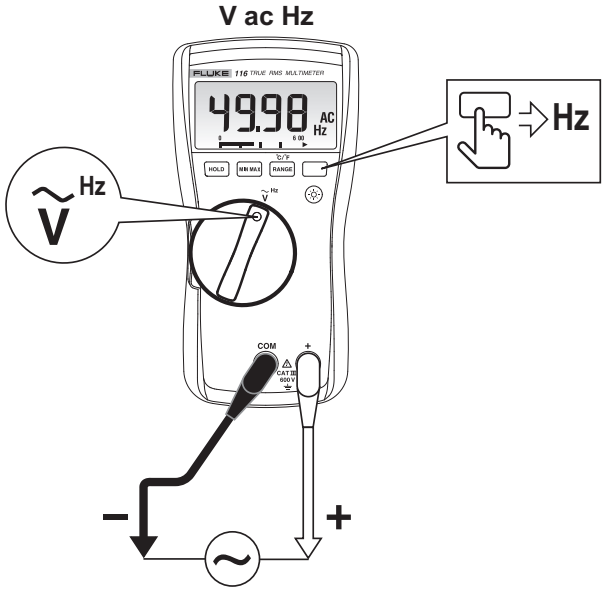
To prevent electrical shock, disregard the bar graph for frequencies >1 kHz. If the frequency of the measured signal is >1 kHz, the bar graph and ϟ are unspecified.

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.

Press [ ] to turn on or turn off the frequency measurement function on and off. Frequency works with ac functions only.

In frequency, the bar graph and range annunciator indicate the ac voltage or current present.

Select progressively lower ranges using manual ranging for a stable reading.



Making Low Impedance Capacitance Measurements

For making capacitance measurements on cables with ghost voltage:

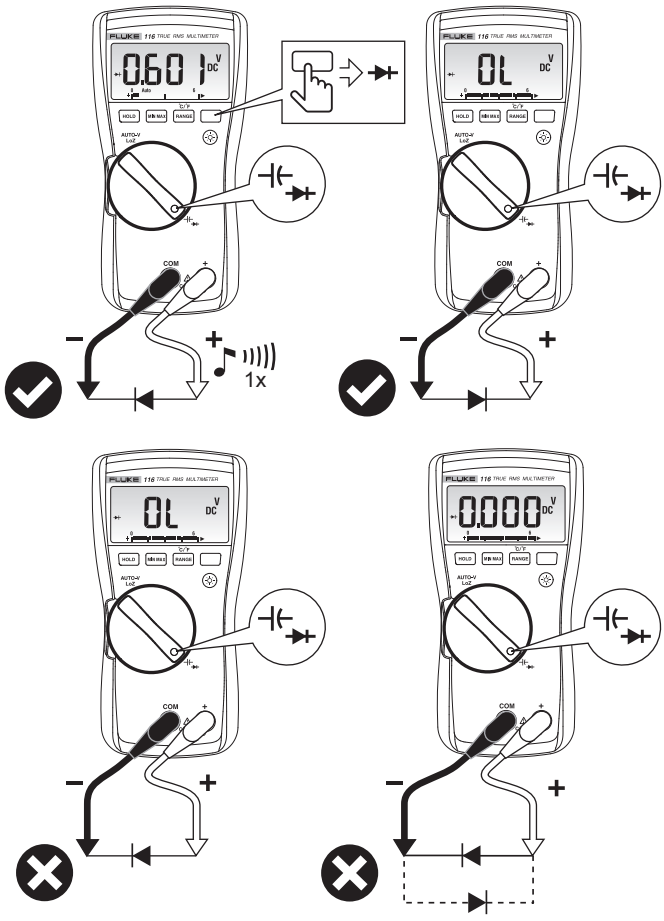
1. Hold [RANGE] as you turn on the Meter to enable the low-input impedance Capacitance mode.
2. Wait until LCAP shows on the display.

   In this mode, capacitance measurements will have a lower accuracy and lower dynamic range.

Note

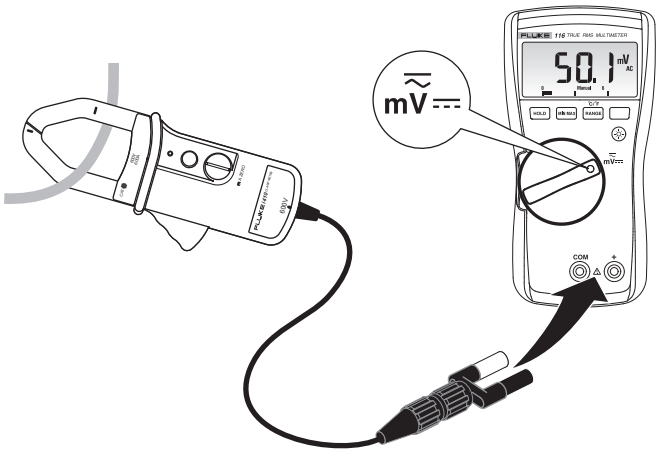
This setting is not saved when the Meter is turned off or goes into sleep mode.

Testing Diodes



Measuring Current above 600 µA

The millivolt and voltage function of the Meter can be used with an optional mV/A output Current Probe to measure currents that exceed the rating of the Meter. Make sure the Meter has the correct function, AC or DC, selected for your current probe. Refer to a Fluke catalog or contact your local Fluke representative for compatible current clamps.



Using the Bargraph

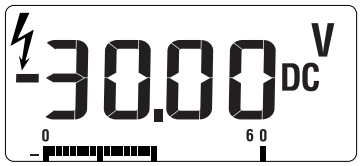
The bar graph is like the needle on an analog meter. It has an overload indicator (▶) to the right and a polarity indicator (÷) to the left.

Because the bar graph is much 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 indicates the underlying voltage or current up to 1 kHz.

The number of segments indicates the measured value and is relative to the full-scale value of the selected range.

In the 60 V range, for example (see below), the major divisions on the scale represent 0, 15, 30, 45, and 60 V. An input of -30 V turns on the negative sign and the segments up to the middle of the scale.



Maintenance

Maintenance of the Meter consists of battery replacement and case cleaning.

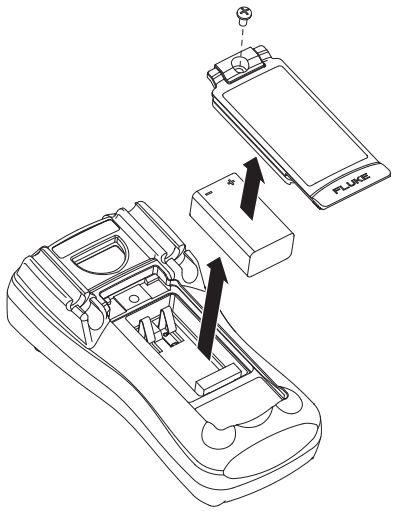
Replacing the Battery

⚠⚠ Warning

To prevent shock, injury, or damage to the Meter, remove test leads from the Meter before opening the case or battery door.

See Figure 1 for disassembly.

Figure 1. Disassembly



To remove the battery door for battery replacement:

1. Remove the test leads from the Meter.
2. Remove the battery door screw.
3. Use the finger recess to lift the door slightly.
4. Lift the door straight up to separate it from the case.
5. The battery fits inside the battery door, which is then inserted into the case, bottom edge first, until it is fully seated. Do not attempt to install the battery directly into the case.
6. Install and tighten battery door screw.

Cleaning

Wipe the case with a damp cloth and mild detergent. Dirt or moisture in the terminals can affect readings.

Specifications

Accuracy is specified for 1 year after calibration, at operating temperatures of 18 °C to 28 °C, with relative humidity at 0 % to 90 %.

Extended specifications are available at www.fluke.com.

Maximum voltage between any terminal and earth ground	600 V
Display	
Digital	6000 counts, updates 4/s
Bar Graph	33 segments, updates 32/s
Temperature	
Operating	-10 °C to 50 °C
Storage	-40 °C to 60 °C
Temperature Coefficient	0.1 x (specified accuracy)/°C (<18 °C or >28 °C)
Altitude	
Operating	2000 meters
Storage	10 000 meters
Relative Humidity	95 % to 30 °C, 75 % to 40 °C, 45 % to 50 °C
Battery	IEC 6LR61
Battery Life	400 hours typical, without backlight
Safety	IEC 61010-1: Pollution Degree 2 IEC 61010-2-033 Measurement CAT III 600 V
Ingress Protection	IEC 60529: IP42 (non-operating)
Electromagnetic Compatibility (EMC)	
International	IEC 61326-1: Portable Electromagnetic Environment CISPR 11: Group 1, Class A

Group 1: Equipment has intentionally generated and/or uses conductively-coupled radio frequency energy that is necessary for the internal function of the equipment itself.

Class A: Equipment is suitable for use in all establishments other than domestic and those directly connected to a low-voltage power supply network that supplies buildings used for domestic purposes. There may be potential difficulties in ensuring electromagnetic compatibility in other environments due to conducted and radiated disturbances.

Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

Emissions that exceed the levels required by CISPR 11 can occur when the equipment is connected to a test object.

Korea (KCC)	Class A Equipment (Industrial Broadcasting & Communication Equipment)

Class A: Equipment meets requirements for industrial electromagnetic wave equipment and the seller or user should take notice of it. This equipment is intended for use in business environments and not to be used in homes.

USA (FCC)	47 CFR 15 subpart B. This product is considered an exempt device per clause 15.103.

Table 6. Accuracy Specifications

Function	Range	Resolution	Accuracy ± ([% of Reading] + [Counts])	
DC Millivolts	600.0 mV	0.1 mV	0.5 % + 2	
DC Volts	6.000 V	0.001 V	0.5 % + 2	
	60.00 V	0.01 V		
	600.0 V	0.1 V		
			DC, 45 to 500 Hz	**500 Hz to 1 kHz**
Auto-V LoZ[1] True-rms	600.0 V	0.1 V	2.0 % + 3	4.0 % + 3
			45 to 500 Hz	**500 Hz to 1 kHz**
AC millivolts[1] True-rms	600.0 mV	0.1 mV	1.0 % + 3	2.0 % + 3
AC Volts[1] True-rms	6.000 V	0.001 V	1.0 % + 3	2.0 % + 3
	60.00 V	0.01 V		
	600.0 V	0.1 V		
Continuity	600 Ω	1 Ω	Beeper on <20 Ω, off >250 Ω. Detects opens or shorts of 500 µs or longer.	
Ohms	600.0 Ω	0.1 Ω	0.9 % + 2	
	6.000 kΩ	0.001 kΩ	0.9 % + 1	
	60.00 kΩ	0.01 kΩ	0.9 % + 1	
	600.0 kΩ	0.1 kΩ	0.9 % + 1	
	6.000 MΩ	0.001 MΩ	0.9 % + 1	
	40.00 MΩ	0.01 MΩ	5.0 % + 2	
Diode Test	2.000 V	0.001 V	0.9 % + 2	
Capacitance	1000 nF	1 nF	1.9 % + 2	
	10.00 µF	0.01 µF	1.9 % + 2	
	100.0 µF	0.1 µF	1.9 % + 2	
	9999 µF	1 µF	100 µF - 1000 µF: 1.9 % +2 >1000 µF: 5 % + 20	
Lo-Z Capacitance (Power-up option)	1 nF to 500 µF		10 % + 2 typical	
Temperature (Type K Thermocouple)	-40 °C to 400 °C	0.1 °C	1 % + 10[2]	
	-40 °F to 752 °F	0.2 °F	1 % + 18[2]	
AC µAmps True-rms[1] (45 Hz to 500 Hz)	600.0 µA	0.1 µA	1.5 % + 3 (2.5 % + 3 >500 Hz)	
DC µAmps	600.0 µA	0.1 µA	1.0 % + 2	

Table 6. Accuracy Specifications (cont.)

Function	Range	Resolution	Accuracy ± ([% of Reading] + [Counts])
Hz (V or A input)[3]	99.99 Hz	0.01 Hz	0.1 % + 2
	999.9 Hz	0.1 Hz	
	9.999 kHz	0.001 kHz	
	50.00 kHz	0.01 kHz	

Notes:
[1] All ac ranges except Auto-V LoZ are specified from 1 % to 100 % of range. Auto-V LoZ is specified from 0.0 V. Because inputs below 1 % 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. For volts, crest factor of ≤3 at 4000 counts, decreasing linearly to 1.5 at full scale. For amps, crest factor of ≤3. AC volts is ac-coupled. Auto-V LoZ, AC mV, and AC amps are dc-coupled.
[2] AC Volts Hz is ac-coupled and specified from 5 Hz to 99.99 kHz. Minimum input required above 50.00 kHz typically is >1.1 vac sine. Minimum input typical and not specified. AC Amps Hz is dc-coupled and specified from 45 Hz to 5 kHz.
[3] ⚠>10 A unspecified.Duty cycle: >10 A to 20 A, 30 seconds on, 10 minutes off.

Table 7. Input Characteristics

Function	Input Impedance (Nominal)	Common Mode Rejection Ratio (1 kΩ Unbalanced)		Normal Mode Rejection
Volts AC	>5 MΩ <100 pF	>60 dB at dc, 50 or 60 Hz		- - -
Volts DC	>10 MΩ <100 pF	>100 dB at dc, 50 or 60 Hz		>60 dB at dc, 50 or 60 Hz
Auto-V LoZ	~3 kΩ <500 pF	>60 dB at dc, 50 or 60 Hz		- - -
	Open Circuit Test Voltage	**Full Scale Voltage**		**Short Circuit Current**
Ohms	<2.7 V dc	**to 6.0 MΩ**	**40 MΩ**	<350 µA
		<0.7 V dc	<0.9 V dc	
Diode Test	<2.7 V dc	2.000 V dc		<1.2 mA