

FLUKE®

Model 187 & 189

True RMS Multimeter

Getting Started

PN 1547486
August 2000

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True RMS Multimeter

Introduction

This *Getting Started Manual* provides basic information on Models 187 and 189. Refer to the *Users Manual* on the accompanying CD-ROM for complete operating instructions.

Contacting Fluke

To order accessories, receive assistance, or locate the nearest Fluke distributor or Service Center, call:

USA: 1-888-993-5853 Canada: 1-800-363-5853
Europe: +31 402-678-200 Japan: +81-3-3434-0181
Singapore: +65-738-5655
Anywhere in the world: +1-425-446-5500

Address correspondence to:

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Visit us on the World Wide Web at: www.fluke.com

Safety Information

The Fluke Model 187 and Model 189 True RMS Multimeters (hereafter referred to as the “meter”) comply with:

- EN61010.1:1993
- ANSI/ISA S82.01-1994
- CAN/CSA C22.2 No. 1010.1-92
- 1000V Overvoltage Category III, Pollution Degree 2
- UL 3111-1

Use the meter only as specified in the *Users Manual*. Otherwise, the protection provided by the meter may be impaired.

A **Warning** identifies conditions and actions that pose hazards to the user. A **Caution** identifies conditions and actions that may damage the meter or the equipment under test.

Safety Information

⚠ Warning

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

- **Do not use the meter if it is damaged. Before you use the meter, inspect the case. Look for cracks or missing plastic. Pay particular attention to the insulation surrounding the connectors.**
- **Inspect the test leads for damaged insulation or exposed metal. Check the test leads for continuity. Replace damaged test leads before you use the meter.**
- **If this product is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.**
- **Do not use the meter if it operates abnormally. Protection may be impaired. When in doubt, have the meter serviced.**
- **Do not operate the meter around explosive gas, vapor, or dust.**
- **Do not apply more than the rated voltage, as marked on the meter, between terminals or between any terminal and earth ground.**
- **Before use, verify the meter's operation by measuring a known voltage.**
- **When measuring current, turn off circuit power before connecting the meter in the circuit. Remember to place the meter in series with the circuit.**
- **When servicing the meter, use only specified replacement parts.**
- **Use caution when working above 30 V ac rms, 42 V peak, or 60 V dc. Such voltages pose a shock hazard.**
- **Avoid working alone.**

Safety Information (cont.)

⚠ Warning

- When using the probes, keep your fingers behind the finger guards on the probes.
- Connect the common test lead before you connect the live test lead. When you disconnect test leads, disconnect the live test lead first.
- Remove test leads from the meter before you open the battery door.
- Do not operate the meter with the battery door or portions of the cover removed or loosened.
- To avoid false readings, which could lead to possible electric shock or personal injury, replace the batteries as soon as the low battery indicator (+) appears.
- Use only type AA batteries, properly installed in the meter case, to power the meter.
- To avoid the potential for fire or electrical shock, do not connect the thermocouples to electrically live circuits.

Caution

To avoid possible damage to the meter or to the equipment under test, follow these guidelines:

- Disconnect circuit power and discharge all high-voltage capacitors before testing resistance, continuity, diodes, or capacitance.
- Use the proper terminals, function, and range for your measurements.
- Before measuring current, check the meter's fuses and turn power OFF to the circuit before connecting the meter to the circuit.

Rotary Switch

Turn the meter on by selecting any measurement function (identified with white letters around the rotary switch). The meter presents a standard display for that function (range, measurement units, modifiers, etc.) The display may also be influenced by some of the choices made in Setup.

Use the blue button to select any rotary switch alternate function (labeled in blue letters). You can also use other buttons to choose modifiers for the selected function.


When you turn the rotary switch from one function to another, a display for the new function appears. Button choices made in one function do not carry over into another function.




With Model 189, a VIEW MEM switch position is available.

Each position is described in Table 1.

Pushbuttons

The buttons activate features that augment the function selected with the rotary switch. The buttons are described in Table 2.

Use the blue button () to access functions labeled in blue for some of the rotary switch positions. Table 1 defines all blue button functions.

Use the yellow button () followed by other buttons to access additional features. These features appear in yellow above the appropriate keys. Table 2 defines yellow button features. This manual identifies the yellow button feature in parentheses following the button sequence . For example, activating the FAST MN MX mode appears as   (FAST MN MX).

The following yellow button features are not available on Model 187: (YES), (NO), (LOGGING), and (SAVE).

Table 1. Rotary Switch Selections

Position	Rotary Switch Function	○ Blue Key Function
\tilde{V} dB	AC voltage measurement from 0 V to 1000.0 V	dB over AC, AC over dB
$\overset{\sim}{mV}$ dB	AC millivolt measurement from 0 mV to 1500.0 mV	dB over AC, AC over dB
\overline{V} ac+dc	DC voltage measurement from 0 V to 1000.0 V	AC over DC (AC in primary display, DC in secondary display), DC over AC, ac+dc
\overline{mV} ac+dc	DC millivolt measurement from 0 mV to 3000.0 mV	AC over DC (AC in primary display, DC in secondary display), DC over AC, ac+dc
Ω nS	Resistance measurement from 0 Ω to 500.0 M Ω	Continuity test Conductance measurement from 0 nS to 50.00 nS
$\rightarrow +$ $- ←$	Capacitance measurement from 0.001 nF to 50 mF	Diode test
$^{\circ}F$ $^{\circ}C$	Temperature measurement	Toggles between $^{\circ}C$ and $^{\circ}F$.

Table 1. Rotary Switch Selections (cont.)

Position	Rotary Switch Function	○ Blue Key Function
A mA ~	AC current measurements from 0 mA to 20.000 A	none
~ μA ~	AC current measurements from 0 μA to 5000.0 μA	none
A mA ac+dc	DC current measurements from 0 mA to 20.000 A	AC over DC (AC in primary display, DC in secondary display), DC over AC, ac+dc
~ μA ac+dc	DC current measurements from 0 μA to 5000.0 μA	AC over DC (AC in primary display, DC in secondary display), DC over AC, ac+dc
VIEW MEM	(Model 189 only.) Access data held in the meter's memory.	CLEAR MEM.

Table 2. Pushbuttons














Button	Description	Yellow Button Function	Description
<i>Note</i>			
<i>Press <input type="text"/> to access "Yellow Button Functions." The <input type="text"/> box and the 24-hour clock appear in the lower corners of the display and the primary display freezes, allowing time to press a second button.</i>			
	Press to turn backlight on or off. Also, in Setup, use the arrow function (◀) to select the previous digit or item in a list.	SETUP <input type="text"/> 	Press to access Setup selections. Press to store a Setup selection and proceed to the next selection.
<input type="text"/> HOLD	Press to freeze the displayed value. Press again to release the display.	AutoHOLD <input type="text"/> <input type="text"/> HOLD	Press to begin AutoHOLD; the last stable reading is displayed.
<input type="text"/> MIN MAX	Press to start retaining min, max, and average values. Press successively to display max, min, and average values. Press <input type="text"/> Hz % ms (CANCEL) to stop.	FAST MN MX <input type="text"/> <input type="text"/> MIN MAX	Press to start FAST MN MX mode, where min and max values for short duration events are stored.
<input type="text"/> REL Δ	Press to store the present reading as an offset reference; subsequent readings show only the relative difference from this value. Press again to show the difference as a percentage of the reference.	LOGGING <input type="text"/> <input type="text"/> REL Δ	Press to start and stop Logging (Model 189). Press <input type="text"/> + <input type="text"/> Hz % ms (CANCEL) to stop.

Table 2. Pushbuttons (cont.)

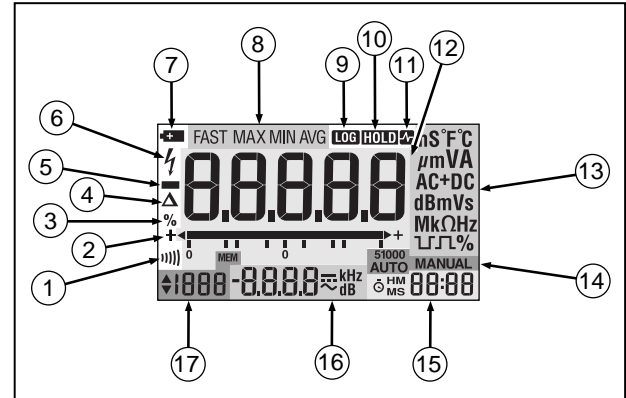
Button	Description	Yellow Button Function	Description
	<ul style="list-style-type: none"> In Setup, increment a digit . In counter functions, select positive pulse slope. In ohms continuity, select beep on open. For VIEW MEM (Model 189), refer to Chapter 4 of the Users Manual. 	(none)	
	<ul style="list-style-type: none"> In Setup, decrement a digit . In counter functions, select negative pulse slope. In ohms continuity, select beep on short. For VIEW MEM (Model 189), refer to Chapter 4 of the Users Manual. 	(none)	
	Exit AUTO and enter MANUAL ranging. In MANUAL, select next input range. Press  Hz % ms (CANCEL) to return to AUTO.	SAVE  	Press to save present reading (Model 189)
	Successively press for frequency, duty cycle, and pulse width.	CANCEL  	CANCEL any ○ (blue key) function and all other button features.
 	The blue button. Press to access blue functions on the rotary switch. In Setup, use arrow function (▷) to select the next digit or item in a list.	(none)	

Understanding the Display

Display features are shown in Figure 1 and described in Table 3. Major display features are described in the *Users Manual*.

Note

You can show all display segments (as shown in Figure 1) by pressing **HOLD** while turning the meter on. Release **HOLD** to turn off the full display.



tc011f.eps

Figure 1. Display Features

Table 3. Display Features

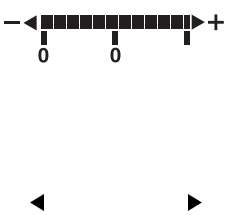


Number	Feature	Description
①))	Continuity test function is selected.
②		<p>Bar Graph.</p> <p>In normal operation 0 (zero) is on the left. In Relative %, 0 is in the center, negative values are to the left and positive to the right.</p> <p>The polarity indicator left of the bar graph shows the polarity of the input. Both polarity indicators appear in REL% mode.</p> <p>The arrow right of the bar graph indicates an overload condition.</p> <p>Both arrows appear (without bar graph) when you can use  (<) and  (>) to select settings in the setup mode.</p>
③	%	Percent difference in Relative mode is being displayed in the primary display. The reference value is shown in the secondary display
④	△	Relative (REL Δ) mode is active. The primary display has been modified by the reference value shown in the secondary display.
⑤	■	Indicates negative readings. In Relative mode, this sign indicates that the present input is less than the stored reference.
⑥	⚡	>30 V ac and/or dc may be present at the input terminals.
⑦	+■	<p>Low battery. If flashing, battery failure is imminent, and logging and backlight are disabled.</p> <p style="text-align: center;">⚠ Warning</p> <p>To avoid false readings, which could lead to possible electric shock or personal injury, replace the battery as soon as the low battery indicator appears.</p>

Table 3. Display Features (cont.)








Number	Feature	Description
⑧	FAST MIN MAX AVG	FAST MN MX mode is enabled. (<input type="checkbox"/> MIN MAX) Minimum reading displayed. Maximum reading displayed. Average reading displayed.
⑨	LOG	Readings are being recorded in memory (Model 189 only.) (<input type="checkbox"/> + REL Δ)
⑩	HOLD	The meter is in Hold mode. (<input type="checkbox"/> HOLD)
⑪	HOLD 	AutoHOLD is active. (<input type="checkbox"/> + <input type="checkbox"/> HOLD)
⑫	0.0.0.0.0 OL	Primary Display (4-1/2 digit)
		Overload input.
⑬	V, mV dBm, dBV	Measurement Units
		V: Volts. The unit of voltage. mV: Millivolt. 1×10^{-3} or 0.001 volts.
		For ac volts functions, reading is shown in decibels of power above or below 1 mW (dBm) or decibels of voltage above or below 1 V (dBV).

Table 3. Display Features (cont.)





Number	Feature	Description
<p>⑬</p>	<p>AC+DC</p>	<p>For dc volts and dc amps functions, reading represents the rms total of ac and dc measurements.</p>
	<p>Ω, kΩ MΩ,</p>	<p>Ω: Ohm. The unit of resistance. kΩ: Kilohm. 1×10^3 or 1000 ohms. MΩ: Megohm. 1×10^6 or 1,000,000 ohms.</p>
	<p>nS</p>	<p>S: Siemens. The unit of conductance. nS: Nanosiemens. 1×10^{-9} or 0.000000001 Siemens.</p>
	<p>nF, μF, mF</p>	<p>F: Farad. The unit of capacitance. nF: Nanofarad. 1×10^{-9} or 0.000000001 farads. μF: Microfarad. 1×10^{-6} or 0.000001 farads. mF: Millifarad. 1×10^{-3} or 0.001 farads.</p>
	<p>°C , °F</p>	<p>Degrees Celsius (default) or Fahrenheit</p>
	<p>A, mA, μA</p>	<p>A: Amperes (amps). The unit of current. mA: Milliamp. 1×10^{-3} or 0.001 amperes. μA: Microamp. 1×10^{-6} or 0.000001 amperes.</p>
	<p>Hz, kHz, MHz</p>	<p>Hz: Hertz. The unit of frequency. kHz: Kilohertz. 1×10^3 or 1000 hertz. MHz: Megahertz. 1×10^6 or 1,000,000 hertz.</p>

Table 3. Display Features (cont.)

Number	Feature	Description
⑭	51000 AUTO MANUAL	Range. Digits display range in use.
⑮		<p>Time Display. Used with HOLD, AutoHOLD, MIN MAX, FAST MN MX, (SAVE, and LOGGING Model 189).</p> <p>Elapsed Time Display (🕒 on): shown in minutes:seconds to maximum of 59:59 - used if time since Min, Max, or Logging started is less than 60 minutes. Always used for Min, Max, Avg. Displays hours:minutes after 1 hour.</p> <p>24-hour Display (🕒 off): shown in hours:minutes to maximum of 23:59.</p>
⑯	0.0.0.0	Secondary Display
⑰	 10000 MEM	<p>Memory Index Display (Model 189). Also used for dBm reference resistance.</p> <p>◆ appears when you can use   and   to increment or decrement settings.</p>

Setup Selections

The meter allows you to change the default operating configuration of the meter by changing setup options made at the factory. Many of these setup options affect general meter operations and are active in all functions. Others are limited to one function or group of functions.

To enter the Setup mode, turn the meter on and press   (SETUP). In the Setup mode, each press of   (SETUP) saves changes to the last selection and steps to the next option.

Each setup option appears in the primary display in the sequence shown in Tables 4 and 5.

The options in Table 4 are available only when the preconditions are met. The options in Table 5 are available for all functions. (When measuring dc volts, none of the preconditions in Table 4 are required, and only the selections shown in Table 5 will appear.)





To exit the Setup mode, Press   (CANCEL). Be sure to save your last selection by pressing   first.

Table 4. Function Specific Setup Selections






Selection	Precondition	Option	Choices (◀ ▶)	Factory Default
000.0 °C or 000.0 °F	Temperature (°C ^F) selected.	Temperature offset adjust	000.0 ° to ±999.9 ° - Use  to increment or decrement digit. Use ◀ ▶ to select digit. Selected digit flashes.	000.0 °C (or °F)
l Int	Model 189 only.	Log interval	MM:SS - Use  to increment or decrement minute or second values. Use ◀ ▶ to select minute or seconds. Selected values flash.	15:00
dB r E F	AC volts (dB  or dBmV) selected.	dB type	dBm or dBV (m or V flashing) - Use ◀ ▶ to select.	dBV
dB r E F	AC volts (dB  or dBmV) and dBm selected.	dBm reference	0001 Ω to 1999 Ω - Use  to increment or decrement digit. Use ◀ ▶ to select digit.	0600 Ω

Table 5. Common Setup Selections

Selection	Option	Choices	Factory Default
bEEP	Beeper	YES or NO (flashing) Use ◀ ▶ to select.	YES
BBBB	Display digits	BBBB (4) or BBBBBB (5) Use ◀ ▶ to select.	BBBBBB
BL OFF	Backlight time out	MM:SS - Use ⬆ to increment or decrement minute or second values. Use ◀ ▶ to select minutes or seconds. Selected values flash. Setting value to 00:00 disables timeout.	15:00
Pr OFF	Power off time out	HH:MM - Use ⬆ to increment or decrement hour or minute values. Use ◀ ▶ to select hours or minutes. Selected values flash.	00:15
Hour	24-hour clock	HH:MM - Use ⬆ to increment or decrement hour or minute values. Use ◀ ▶ to select hours or minutes. Selected values flash.	00:00
50-60	Line/Main frequency	60 or 50 (flashing) - Use ◀ ▶ to select.	60
Fc tY	Restore factory defaults	YES or NO (flashing) - Use ◀ ▶ to select.	NO


Parts

Replacement parts are listed in Table 6. These parts can be ordered by contacting Fluke. Refer to the Users Manual for a complete list of user-replaceable parts.

Table 6. Parts

Description	Reference Designators	Part Number	Qty
Access Door, Battery / Fuse	MP14	666446	1
Tilt-Stand	MP8	659026	1
Accessory Mount	MP9	658424	1
⚠ Fuse, 0.44 A (44/100 A, 440 mA), 1000 V, FAST	F1	943121	1
⚠ Fuse, 11 A, 1000 V FAST	F2	803293	1
Battery, 1.5 V, 0-15 mA, AA Alkaline	H8, H9, H10, H11	376756	4
Fasteners, Battery / Fuse Access Door	H12, H13	948609	2
Screws, Phillip-Head	H4, H5, H6, H7	832246	4
AC70A Alligator Clip (Black)	MP38	738047	1
AC70A Alligator Clip (Red)	MP39	738120	1
TL71 Right-Angle Test Lead Set	MP34	802980	1
Getting Started Manual	(TM1-TM5)	(see footnote)	5
CD-ROM (Contains Users Manual)	(TM6)	1576992	1
Getting Started Manual PNs: English=1577028; French, German, Italian, Dutch=1577037; Danish, Finnish, Norwegian, Swedish=1577055; French, Spanish, Portuguese=1577043; Simplified Chinese, Traditional Chinese, Korean, Japanese, Thai=1577062			

Safety and Compliances

Maximum voltage between any terminal and earth ground.	1000 V dc or rms ac
Compliances	Complies with ANSI/ISA-S82.01-94, CSA C22.2 No 1010.1-92 to 1000 V Overvoltage Category III, Pollution Degree 2 *
Certifications (listed and pending)	CSA per standard CSA/CAN C22.2 No. 1010.1-92 UL per standard UL 3111 TÜV per standard EN 61010 Part 1-1993
Surge Protection	8 kV peak per IEC 1010.1-92
⚠ Fuse Protection for mA or μA inputs	0.44 A (44/100 A, 440 mA), 1000 V FAST Fuse
⚠ Fuse Protection for A input	11 A, 1000 V FAST Fuse
Markings	CE,  , UL, and TÜV
* CAT III: OVERVOLTAGE (Installation) Category III, Pollution Degree 2 per IEC1010-1 refers to the level of Impulse Withstand Voltage protection provided. Equipment of OVERVOLTAGE CATEGORY III is equipment in fixed installations. Examples include electricity meter and primary over-current protection equipment.	

Feature Summary

Feature	Description
Dual Digital Displays	Primary: 50,000 counts Secondary: 5,000 count
Analog Bar Graph	Bar graph: 51 segments, updates 40 times/second
Backlight with 2 brightness levels	Bright white backlight for clear readings in poorly lighted areas
Fast Autorange	Meter automatically selects best range - instantly
AC+DC true rms, ac rms specified to 100 kHz	Choices for AC only, AC and DC dual display, or AC+DC readings
dBm, dBV	User selectable impedance references for dBm
AutoHOLD	Holds readings on display
Continuity / Open test	Beeper sounds for resistance readings below threshold, or to indicate a momentary open circuit
Fast Bar Graph	51 segments for peaking and nulling
Duty cycle / Pulse width	Measure signed on or off time in % or milliseconds.
MIN MAX Mode	Record maximum, minimum, and average values. 24-hour clock for MAX or MIN, elapsed time for AVG.
FAST MN MX with 24-hour time stamp	FAST MN MX captures peaks to 250 μ sec.
Closed-Case Calibration	No internal adjustments needed
Battery / Fuse Access Door	Battery or fuse replaceable without voiding calibration
Hi-Impact Overmolded Case	Protective holster features

Physical Specifications

Display (LCD)	Digital: 50000/5000 counts primary display, 5000 counts secondary display; updates 4/second. Analog: 51 segments, updates 40/second.
Operating Temperature	- 20 °C to + 55 °C
Storage Temperature	- 40 °C to + 60 °C
Temperature Coefficient	0.05 x (specified accuracy) / °C (<18 °C or >28 °C)
Relative Humidity	0 % to 90 % (0 °C to 35 °C) 0 % to 70 % (35 °C to 55 °C)
Altitude	Operating: 0-2000 meters per EN61010 CAT III, 1000 V; CAT IV, 600 V 0-3000 meters per EN61010 CAT II, 1000 V; EN61010 CAT III, 600 V; CAT IV, 300 V Storage: 10000 meters
Battery Type	4 AA Alkaline, NEDA 15A or LR6
Battery Life	72 Hours typical (with backlight off)
Shock Vibration	Per MIL-T-PRF 28800 for Class II instruments
Electromagnetic Compatibility (EMC)	Susceptibility and Emissions: Commercial Limits per EN61326-1
Size	10.0 cm x 20.3 cm x 5.0 cm (3.94 in x 8.00 in x 1.97 in) (Not Including Accessory Mount)
Weight	545 grams (1.2 lbs.)
Case Sealing	IP-42 per IEC 529, Section 3
Warranty	Lifetime
Calibration Interval	1 year

Basic Specifications

Function	Ranges/Description
DC Voltage	0 to 1000 V
AC Voltage, true RMS	2.5 mV to 1000 V – 100 kHz bandwidth
Basic Accuracy	DC voltage: 0.025 % AC voltage: 0.4 %
DC Current	0 to 10 A (20 A for 30 seconds)
AC Current, true RMS	25 μ A to 10 A (20 A for 30 seconds)
Resistance	0 to 500 M Ω
Conductance	0 to 500 nS
Capacitance	0.001 nF to 50 mF
Diode Test	3.1 V
Temperature	–200 °C to 1350 °C (–328 °F to 2462 °F)
Frequency	0.5 Hz to 1000 kHz
LOGGING Intervals (Model 189 only)	At least 288 intervals may be stored. Up to 700 unstable event values (see AutoHOLD) are automatically added to LOGGING memory for viewing only through optional PC software. Additional intervals will be logged up to 995 if the signal is stable.
SAVE Readings (Model 189 only)	Up to 100 readings may be saved by the user in a memory separate from LOGGING memory. These readings may be viewed using VIEW MEM.

Detailed Accuracy Specifications

Accuracy is specified for a period of one year after calibration, at 18 °C to 28 °C (64 °F to 82 °F), with relative humidity to 90 %. Accuracy specifications are given as:

$$\pm ([\% \text{ of reading}] + [\text{number of least significant digits}])$$

AC mV, AC V, AC μ A, AC mA, and AC A specifications are ac coupled, true rms and are valid from 5 % of range to 100 % of range. AC crest factor can be up to 3.0 at full-scale, 6.0 at half-scale except the 3000 mV and 1000 V ranges where it is 1.5 at full scale, 3.0 at half-scale.

Function	Range	Resolution	Accuracy				
			45 Hz-1 kHz	20-45 Hz	1 kHz-10 kHz	10 kHz-20 kHz	20 kHz-100 kHz
AC mV ^{1,2}	50.000 mV	0.001 mV	0.4 % + 40	2 % + 80	5 % + 40	5.5 % + 40	15 % + 40
	500.00 mV	0.01 mV	0.4 % + 40	2 % + 80	5 % + 40	5.5 % + 40	8 % + 40
	3000.0 mV	0.1 mV	0.4 % + 40	2 % + 80	0.4 % + 40	1.5 % + 40	8 % + 40
AC V ^{1,2}	5.0000 V	0.0001 V	0.4 % + 40	2 % + 80	0.4 % + 40	1.5 % + 40	8 % + 40
	50.000 V	0.001 V	0.4 % + 40	2 % + 80	0.4 % + 40	1.5 % + 40	8 % + 40
	500.00 V	0.01 V	0.4 % + 40	2 % + 80	0.4 % + 40	Not specified	Not specified
	1000.0 V	0.1 V	0.4 % + 40	2 % + 80	0.4 % + 40	Not specified	Not specified
dBV	-52 to -6	0.01 dB	0.1 dB	0.2 dB	0.5 dB	0.5 dB	1.4 dB
	-6 to +34	0.01 dB	0.1 dB	0.2 dB	0.1 dB	0.2 dB	0.8 dB
	+34 to +60	0.01 dB	0.1 dB	0.2 dB	0.1 dB	Not specified	Not specified

1. For the 5,000 count mode, divide the number of least significant digits (counts) by 10.

2. A residual reading of 8 to 180 digits with leads shorted, will not affect stated accuracy above 5 % of range.

Model 187 & 189*Getting Started*

			Accuracy			
Function	Range	Resolution	45-1 kHz	20-45 Hz	1-20 kHz	20 kHz-100 kHz
AC μ A	500.00 μ A	0.01 μ A	0.75 % + 20	1 % + 20	0.75 % + 20	6 % + 40
	5,000.0 μ A	0.1 μ A	0.75 % + 5	1% + 5	0.75 % + 10	2 % + 40
AC mA	50.000 mA	0.001 mA	0.75 % + 20	1% + 20	0.75 % + 20	9 % + 40
	400.00 mA	0.01 mA	0.75 % + 5	1% + 5	1.5 % + 10	4 % + 40
AC A	5.0000 A	0.0001 A	1.5 % + 20	1.5% + 20	6 % + 40	Not specified
	10.000 A ¹	0.001 A	1.5 % + 5	1.5% + 5	5 % + 10	Not specified
1. 10 A [bw6]continuous up to 35 °C, less than 10 minutes 35[bw7] °C to 55 °C. 20 A overload for 30 seconds maximum.						

Function	Range	Resolution	Accuracy	Accuracy Dual Display AC or AC+DC ³		
			DC	20 - 45 Hz	45 Hz - 1 kHz	1 kHz- 20 kHz
DC mV	50.000 mV	0.001 mV	0.1% + 20	2 % + 80	0.5 % + 40	6 % + 40
	500.00 mV	0.01 mV	0.03 % + 2			
	3000.0 mV	0.1 mV	0.025 % + 5			2 % + 40
DC V	5.0000 V	0.0001 V	0.025 % + 10 ²	1 % + 20	1.0 % + 20	Not specified
	50.000 V	0.001 V	0.03 % + 3 ²			
	500.00 V	0.01 V	0.1 % + 2 ²			Not specified
	1000.0 V	0.1 V	0.1 % + 2 ²			Not specified
DC μA	500.00 μA	0.01 μA	0.25 % + 20	1 % + 20	1.0 % + 20	2 % + 40
	5,000 μA	0.1 μA	0.25 % + 2	1 % + 10	0.75 % + 10	2 % + 40
DC mA	50.000 mA	0.001 mA	0.15 % + 10	1 % + 20	0.75 % + 20	2 % + 40
	400.00 mA	0.01 mA	0.15 % + 2	1 % + 10	1 % + 10	3 % + 40
DC A	5.0000 A	0.0001 A	0.5 % + 10	2 % + 20	2 % + 20	6 % + 40
	10.000 A ¹	0.001 A	0.5 % + 2	1.5 % + 10	1.5 % + 10	5 % + 10

1. 10 A continuous up to 35 °C, less than 10 minutes 35 °C to 55 °C. 20 A overload for 30 seconds maximum.
2. 20 counts in dual display DC or AC+DC.
3. See AC conversions notes for AC mV and V.

Function	Range	Resolution	Accuracy
Resistance ¹	500.00 Ω	0.01 Ω	0.05 % + 10 ³
	5.0000 kΩ	0.0001 kΩ	0.05 % + 2
	50.000 kΩ	0.001 kΩ	0.05 % + 2
	500.00 kΩ	0.01 kΩ	0.05 % + 2
	5.0000 MΩ	0.0001 MΩ	0.15 % + 4 ²
	30.000 MΩ	0.001 MΩ	1 % + 4 ²
	100.0 MΩ	0.1 MΩ	3 % + 2 ⁴
	500.0 MΩ	0.1 MΩ	10 % + 2 ⁴
Conductance	50.00 nS	0.01 nS	1 % + 10

1. For the 5,000 count mode, divide the number of least significant digits (counts) by 10.
2. For relative humidity greater than 70 %, resistance accuracy is 0.5 % over 1 MΩ and 2.5 % over 10 MΩ.
3. Using relative mode (**REL Δ**) to zero residual reading.
4. To ensure stated accuracy, switch to conductance mode and verify that the open circuit reading is less than 0.10 nS.

Function	Ranges	Resolution	Accuracy
Capacitance ²	1.000 nF	0.001 nF	2% + 5
	10.00 nF	0.01 nF	1% + 5
	100.0 nF	0.1 nF	
	1.000 μF	0.001 μF	
	10.00 μF	0.01 μF	
	100.0 μF	0.1 μF	
	1,000 μF	1 μF	
	10.0 mF	0.01 mF	
	50.00 mF	0.01 mF ³	3% + 10
Diode Test ¹	3.1000 V	0.0001 V	2% + 20

1. For the 5,000 count mode, divide the number of least significant digits (counts) by 10.
2. For film capacitor or better, using Relative mode (**REL Δ**) to zero residual on 1.000 nF and 10.00 nF range.
3. Least significant digit not active above 10 mF.

Function	Range	Resolution	Accuracy
Frequency	500.00 Hz	0.01 Hz ¹	± (0.0050 % + 1)
	5.0000 kHz	0.0001 kHz	
	50.000 kHz	0.001 kHz	
	999.99 kHz	0.01 kHz	
Duty Cycle	10.00% to 90.00 %	0.01 %	± ((voltage range/input voltage) X 300 counts) ^{5,6}
Pulse Width	499.99 ms	0.01 ms	± (3 % X (voltage range/input voltage) + 1 count) ^{5,6}
	999.9 ms	0.1 ms	
Temperature	-200 to +1350 °C	0.1 °C	± (1% of reading + 1 °C) ^{2,3}
	-328 to +2462 °F	0.1 °F	± (1% of reading + 1.8 °F) ^{2,3}
MIN MAX AVG	Response: 100 ms to 80 %		Specified accuracy ± 12 counts for changes > 200 ms in duration. (± 40 counts in AC for changes > 350 ms and inputs > 25 % of range)
FAST MN MX	250 µs ⁴		Specified accuracy ±100 counts up to 5,000 count (full range) reading. For higher peak readings (to 20,000 counts), specified accuracy ± 2% of reading.

1. Reading will be 0.00 for signals below 0.5 Hz.
2. Accuracy specification is relative to the user-adjustable temperature offset, and assumes ambient temperature stable to ± 1 °C.
3. For ambient temperature changes of ± 5 °C, rated accuracy applies after 1 hour.
4. For repetitive peaks; 2.5 ms for single events. Use DC function settings below 20 Hz. 50 mV range not specified.
5. Frequency greater than 5 Hz, except for VDC, 500 mVDC and 3000 mVDC functions; 0.5 Hz to 1 kHz. Signals centered around trigger levels.
6. Range/input ratios also apply to current functions. 500 counts or 5 % for 10 A ranges.

Frequency Counter Sensitivity

Input Range	Approximate VAC Sensitivity (RMS Sine Wave) ¹		VAC Bandwidth ³	Approximate VDC Trigger Levels ¹	VDC Bandwidth ³
	15 Hz to 100 kHz ²	500 kHz ²			
50 mV	5 mV	10 mV	1 MHz	-5 mV & 5 mV	1 MHz
500 mV	20 mV	20 mV	1 MHz	5 mV & 65 mV	1 MHz
3000 mV	500 mV	2000 mV	800 kHz	140 mV & 200 mV	90 kHz
5 V	0.5 V	2.0 V	950 kHz	1.4 V & 2.0 V	14 kHz
50 V	5 V	5.0 V	1 MHz	0.5 V & 6.5 V	> 400 kHz
500 V	20 V	20 V	1 MHz	5 V & 65 V	> 400 kHz
1000 V	100 V	100 V	> 400 kHz	5 V & 65 V	> 400 kHz

1. Maximum input = 10 x Range (1000 V max). Noise at low frequencies and amplitudes may affect accuracy.
2. Useable at reduced sensitivity to 0.5 Hz and 1000 kHz.
3. Typical frequency bandwidth with full scale (or maximum 2×10^7 V-Hz product) RMS sine wave.

Burden Voltage (A, mA, μ A)

Function	Range	Burden Voltage (typical)
mA - μ A	500.00 μ A	102 μ V / μ A
	5,000 μ A	102 μ V / μ A
	50.000 mA	1.8 mV / mA
	400.00 mA	1.8 mV / mA
A	5.0000 A	0.04 V / A
	10.000 A	0.04 V / A

Input Characteristics

Function	Input Impedance (Nominal)					
Volts, mV	10 M Ω , < 100 pF					
	Common Mode Rejection Ratio			Normal Mode Rejection		
DC Volts, mV	>100 dB at dc, 50 Hz or 60 Hz \pm 0.1%			>90 dB at 50 Hz or 60 Hz \pm 0.1%		
AC Volts, mV	> 90 dB dc to 60 Hz					
	Open Circuit Test Voltage			Full-Scale Voltage		
				To 5 MΩ	30 MΩ + nS	
Ohms	< 5 V			500 mV	3.1 V	
Diode Test	< 5 V			3.1000 V		
	Typical Short-Circuit Current					
	500 Ω	5 kΩ	50 kΩ	500 kΩ	5 MΩ	30 MΩ
Ohms	1 mA	100 μ A	10 μ A	1 μ A	0.1 μ A	0.1 μ A
Diode Test	1 mA typical					