

Manual Supplement

Manual Title:	287/289 Getting Started	Supplement Issue:	1
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This supplement contains information necessary to ensure the accuracy of the above manual.



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Change #1, 43175, 44790, 45029, 45031, 45190, 45542, 45723, 44620, 47326, 48297, 49879 and 49900.

Replace all the Specifications starting from page 5 through 16.

General Specifications

Maximum voltage between any Terminal and Earth Ground: 1000 V

⚠ **Fuse Protection for mA or μ A inputs** 0.44 A (44/100 A, 440 mA), 1000 V FAST Fuse, Fluke specified part only

⚠ **Fuse Protection for A input** 11 A, 1000 V FAST Fuse, Fluke specified part only

Battery Type 6 AA Alkaline batteries, NEDA 15A IEC LR6

Battery Life 100 hours minimum. 200 hours in Logging mode

Temperature

Operating -20 °C to 55 °C

Storage -40 °C to 60 °C

Relative Humidity 0 % to 90 % (0 °C to 37 °C), 0 % to 65 % (37 °C to 45 °C), 0 % to 45 % (45 °C to 55 °C)

Altitude

Operating 3,000 m

Storage 10,000 m

Temperature Coefficient 0.05 X (specified accuracy) /°C (<18 °C or >28 °C)

Vibration Random Vibration per MIL-PRF-28800F Class 2

Shock 1 meter drop per IEC/EN 61010-1 2nd Edition

Size (HxWxL) 8.75 in x 4.03 in x 2.38 in (22.2 cm x 10.2 cm x 6.0 cm)



Weight 28.0 oz (871 g)

Safety Standards

- US ANSI Complies with ANSI/ISA 82.02.01 (61010-1) 2004
- CSA CAN/CSA-C22.2 No 61010-1-04 to 1000 V Measurement Category III and 600 V Measurement Category IV, Pollution Degree 2
- UL UL 61010 (2003)
- CE European IEC/EN 61010-1 2nd Edition Pollution Degree 2

Electromagnetic Compatibility Standards (EMC)

- European EMC EN61326-1
- Australian EMC.....  N10140
- US FCC FCC CFR47: Part 15 CLASS A

Certifications..... UL, CE, CSA, , (N10140), 

Detailed Specifications

Accuracy:

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: $\pm([\% \text{ of reading}] + [\text{number of least significant digits}])$. Accuracy specification assumes ambient temperature stable at ± 1 °C. For ambient temperature changes of ± 5 °C, rated accuracy applies after 2 hours. To obtain full accuracy in DC mV, Temperature, Ohms and Lo (50) Ohms, let the meter stabilize 20 minutes after using LoZ.

True-rms:

AC mV, AC V, AC μ A, AC mA, and AC A specifications are ac-coupled, true rms, and are specified from 2 % of range to 100 % of range, except 10 A range is specified from 10 % to 100 % of range.

Crest Factor:

Accuracy is specified with AC crest factor ≤ 3.0 at full-scale, increasing linearly to 5.0 at half-scale, except the 1000 V range, where it is 1.5 at full scale, increasing linearly to 3.0 at half-scale and 500 mV and 5000 μ A, where it is ≤ 3.0 at 80 % of full scale, increasing linearly to 5.0 at half-scale. For non-sinusoidal waveforms add $\pm(0.3$ % of range and 0.1 % of reading).

AC Floor:

When the input leads are shorted together in the ac functions, the Meter may display a residual reading up to 200 counts. A 200 count residual reading will cause only a 20 count change for readings at 2 % of range. Using REL to offset this reading may produce a much larger constant error in later measurements.

AC+DC:

AC+DC is defined as $\sqrt{ac^2 + dc^2}$

AC Voltage Specifications

Function	Range	Resolution	Accuracy				
			20 to 45 Hz	45 to 65 Hz	65 Hz to 10 kHz	10 to 20 kHz	20 to 100 kHz
AC mV	50 mV ^[1]	0.001 mV	1.5 % + 60	0.3 % + 25	0.4 % + 25	0.7 % + 40	3.5 % + 40 ^[5]
	500 mV	0.01 mV	1.5 % + 60	0.3 % + 25	0.4 % + 25	0.7 % + 40	3.5 % + 40
AC V	5 V ^[1]	0.0001 V	1.5 % + 60	0.3 % + 25	0.6 % + 25	1.5 % + 40	3.5 % + 40 ^[5]
	50 V ^[1]	0.001 V	1.5 % + 60	0.3 % + 25	0.4 % + 25	0.7 % + 40	3.5 % + 40
	500 V ^[1]	0.01 V	1.5 % + 60	0.3 % + 25	0.4 % + 25	Not Spec'd	Not Spec'd
	1000 V	0.1 V	1.5 % + 60	0.3 % + 25	0.4 % + 25	Not Spec'd	Not Spec'd
dBV	-70 to -62 dB ^[3]	0.01 dB	3 dB	1.5 dB	2 dB	2 dB	3 dB
	-62 to -52 dB ^[3]	0.01 dB	1.5 dB	1.0 dB	1 dB	1 dB	2 dB
	-52 to -6 dB ^[3]	0.01 dB	0.2 dB	0.1 dB	0.1 dB	0.2 dB	0.8 dB
	-6 to +34 dB ^[3]	0.01 dB	0.2 dB	0.1 dB	0.1 dB	0.2 dB	0.8 dB
	34 to 60 dB ^[3]	0.01 dB	0.2 dB	0.1 dB	0.1 dB	Not Spec'd	Not Spec'd
Low pass filter ^[4]			2 % + 80	2 % + 40	2 % + 10 -6 % -60 ^[2]	Not Spec'd	Not Spec'd
$\frac{L_{oz}}{V}$ ^[4]	1000 V	0.1 V	2 % + 80	2 % + 40	2 % + 40 ^[6]	Not Spec'd	Not Spec'd

[1] Below 5 % of range, add 20 counts.

[2] Specification increases linearly from -2 % at 200 Hz to -6 % at 440 Hz. Range is limited to 440 Hz.

[3] dBm (600 Ω) is specified by adding +2.2 dB to the dBV range values.

[4] 289 only.

[5] Add 2.5 % above 65 kHz.

[6] Range is limited to 440 Hz.

See Detailed Specifications introduction for additional information.

AC Current Specifications

Function	Range	Resolution	Accuracy			
			20 to 45 Hz	45 to 1 kHz	1 to 20 kHz	20 to 100 kHz ^[4]
AC μ A ^[3]	500 μ A	0.01 μ A	1 % + 20	0.6 % + 20	0.6 % + 20	5 % + 40
	5000 μ A	0.1 μ A	1 % + 5	0.6 % + 5	0.6 % + 10	5 % + 40
AC mA ^[3]	50 mA	0.001 mA	1 % + 20	0.6 % + 20	0.6 % + 20	5 % + 40
	400 mA	0.01 mA	1 % + 5	0.6 % + 5	1.5 % + 10	5 % + 40
AC A ^[2]	5 A	0.0001 A	1.5 % + 20	0.8 % + 20	3 % + 40 ^[4]	Not Spec'd
	10 A ^[1]	0.001 A	1.5 % + 5	0.8 % + 5	3 % + 10 ^[4]	Not Spec'd

[1] 10 A range (10 % to 100 % of range).

[2] 20 A for 30 seconds on, 10 minutes off. >10 A not specified.

[3] 400 mA continuous; 550 mA for 2 minutes on, 1 minute off.

[4] Verified by design and type tests.

See Detailed Specifications introduction for additional information.

DC Voltage Specification

Function	Range	Resolution	Accuracy				
			DC ^[2]	AC over DC, DC over AC, AC + DC ^[2]			
				20 to 45 Hz	45 Hz to 1 kHz	1 to 20 kHz	20 to 35 kHz
DC mV	50 mV ^[3]	0.001 mV	0.05 % + 20 ^[4]	2 % + 80	0.5 % + 80	1.5 % + 40	5 % + 40
	500 mV	0.01 mV	0.025 % + 2 ^[5]			1.5 % + 40	5 % + 40
DC V ^[1]	5 V	0.0001 V	0.025 % + 2			1.5 % + 40	5 % + 40
	50 V	0.001 V	0.025 % + 2			1.5 % + 40	5 % + 40
	500 V	0.01 V	0.03 % + 2			Not Spec'd	Not Spec'd
	1000 V	0.1 V	0.03 % + 2			Not Spec'd	Not Spec'd
LoZ V ^[1]	1000 V	0.1 V	1 % + 20	Not Spec'd	Not Spec'd	Not Spec'd	Not Spec'd

[1] Add 20 counts in dual display ac over dc, dc over ac or ac+dc.
[2] AC+DC ranges are specified from 2 % to 140 % of range, except 1000 V is specified from 2 % to 100 % of range.
[3] When using the relative mode (REL Δ) to compensate for offsets.
[4] Add 4 counts/10 mV AC in dual display ac over dc, dc over ac or ac + dc
[5] Add 10 counts/100 mV AC in dual display ac over dc, dc over ac or ac + dc.

DC Current Specifications

Function	Range	Resolution	Accuracy				
			DC ^{[1][3]}	AC over DC, DC over AC, AC + DC ^[1]			
				20 to 45 Hz	45 Hz to 1 kHz	1 to 20 kHz	20 to 100 kHz ^[5]
DC μ A ^[4]	500 μ A	0.01 μ A	0.075 % + 20	1 % + 20	0.6 % + 20	0.6 % + 20	5 % + 40
	5000 μ A	0.1 μ A	0.075 % + 2	1 % + 5	0.6 % + 5	0.6 % + 10	5 % + 40
DC mA ^[4]	50 mA	0.001 mA	0.05 % + 10 ^[6]	1 % + 20	0.6 % + 20	0.6 % + 20	5 % + 40
	400 mA	0.01 mA	0.15 % + 2	1 % + 5	0.6 % + 5	1.5 % + 10	5 % + 40
DC A ^[2]	5 A	0.0001 A	0.3 % + 10	1.5 % + 20	0.8 % + 20	3 % + 40 ^[5]	Not Spec'd
	10 A	0.001 A	0.3 % + 2	1.5 % + 10	0.8 % + 10	3 % + 10 ^[5]	Not Spec'd

[1] AC+DC ranges are specified from 2 % to 140 % of range.
 [2] 20 A for 30 seconds on, 10 minutes off. >10 A not specified.
 [3] Add 20 counts in dual display ac over dc, dc over ac or ac+dc.
 [4] 400 mA continuous; 550 mA for 2 minutes on, 1 minute off.
 [5] Verified by design and type tests.
 [6] Temperature coefficient: 0.1 X (specified accuracy)/ °C (<18 °C or > 28 °C)

Resistance Specifications

Function	Range	Resolution	Accuracy
Resistance	50 Ω ^{[1][3]}	0.001 Ω	0.15 % + 20
	500 Ω ^[1]	0.01 Ω	0.05 % + 10
	5 k Ω ^[1]	0.0001 k Ω	0.05 % + 2
	50 k Ω ^[1]	0.001 k Ω	0.05 % + 2
	500 k Ω	0.01 k Ω	0.05 % + 2
	5 M Ω	0.0001 M Ω	0.15 % + 4
	30 M Ω	0.001 M Ω	1.5 % + 4
	50 M Ω	0.01 M Ω	1.5 % + 4
	50 M Ω up to 100 M Ω	0.1 M Ω	3.0 % + 2
100 M Ω up to 500 M Ω	0.1 M Ω	8 % + 2	
Conductance	50 nS ^[2]	0.01 nS	1 % + 10

[1] When using the relative mode (REL Δ) to compensate for offsets.
 [2] Add 20 counts above 33 nS in 50 nS range.
 [3] 289 only.

Temperature Specifications

Temperature	Resolution	Accuracy ^[1,2]
-200 °C to +1350 °C	0.1 °C	1 % + 10
-328 °F to +2462 °F	0.1 °F	1 % + 18

[1] Does not include error of the thermocouple probe.
 [2] Accuracy specification assumes ambient temperature stable to ± 1 °C. For ambient temperature changes of ± 5 °C, rated accuracy applies after 2 hours.

Capacitance and Diode Test Specifications

Function	Range	Resolution	Accuracy
Capacitance	1 nF ^[1]	0.001 nF	1 % + 5
	10 nF ^[1]	0.01 nF	1 % + 5
	100 nF ^[1]	0.1 nF	1 % + 5
	1 μF	0.001 μF	1 % + 5
	10 μF	0.01 μF	1 % + 5
	100 μF	0.1 μF	1 % + 5
	1000 μF	1 μF	1 % + 5
	10 mF	0.01 mF	1 % + 5
	100 mF	0.1 mF	2 % + 20
Diode Test	3.1 V	0.0001 V	1 % + 20
[1] With a film capacitor or better, using relative mode (REL Δ) to zero residual.			

Frequency Counter Specifications

Function	Range	Resolution	Accuracy
Frequency (0.5 Hz to 999.99 kHz, pulse width >0.5 μs)	99.999 Hz	0.001 Hz	0.02 % + 5
	999.99 Hz	0.01 Hz	0.005 % + 5
	9.9999 kHz	0.0001 kHz	0.005 % + 5
	99.999 kHz	0.001 kHz	0.005 % + 5
	999.99 kHz	0.01 kHz	0.005 % + 5
Duty Cycle ^{[1][2]}	1.00 % to 99.00 %	0.01 %	0.2 % per kHz + 0.1 %
Pulse Width ^{[1][2]}	0.1000 ms	0.0001 ms	0.002 ms + 3 counts
	1.000 ms	0.001 ms	0.002 ms + 3 counts
	10.00 ms	0.01 ms	0.002 ms + 3 counts
	1999.9 ms	0.1 ms	0.002 ms + 3 counts
<p>[1] For rise times <1 μs. Signals centered around trigger levels.</p> <p>[2] 0.5 to 200 kHz, pulse width >2 μs. Pulse width range is determined by the frequency of the signal.</p>			

Frequency Counter Sensitivity

Input Range	Approximate Voltage Sensitivity (rms sine wave) ^[1]	AC Bandwidth ^[2]	Approximate DC Trigger Levels	DC Bandwidth ^[2]
	15 Hz to 100 kHz			
50 mV	5 mV	1 MHz	5 mV & 20 mV	600 kHz
500 mV	25 mV	1 MHz	20 mV & 60 mV	1 MHz
5 V	0.25 V	700 kHz	1.4 V & 2.0 V	80 kHz
50 V	2.5 V	1 MHz	0.5 V & 6.5 V	1 MHz
500 V	25 V	300 kHz	5 V & 40 V	300 kHz
1000 V	50 V	300 kHz	5 V & 100 V	300 kHz
Input Range	Approximate Current Sensitivity (rms sine wave)	AC Bandwidth	Approximate DC Trigger Levels	DC Bandwidth
	15 Hz to 10 kHz			
500 μ A	25 μ A	100 kHz	NA	NA
5000 μ A	250 μ A	100 kHz		
50 mA	2.5 mA	100 kHz		
400 mA	25 mA	100 kHz		
5 A	0.25 A	100 kHz		
10 A	1.0 A	100 kHz		
<p>[1] Maximum input = 10 x range (1000 V maximum, 2×10^7 V-Hz product maximum). Noise at low frequencies and amplitudes may affect accuracy.</p> <p>[2] Typical frequency bandwidth with full scale (or maximum 2×10^7 V-Hz product) rms sine wave.</p>				

MIN MAX, Recording, and Peak Specifications

Function	Nominal Response	Accuracy
MIN MAX, Recording	200 ms to 80% (dc function)	Specified accuracy ± 12 counts for changes >425 ms in duration in manual range.
	350 ms to 80 % (ac function)	Specified Accuracy ± 40 counts for changes >1.5 s in duration in manual range.
Peak	250 μ S (peak) ^[1]	Specified accuracy ± 100 counts ^[2] up to 5,000 count (full range) reading. For higher peak reading (to 12,000 counts), specified accuracy ± 2 % ^[3] of reading.
Crest Factor	350 ms to 80 %	For periodic waveforms from 50 to 440 Hz $\pm (4 \% + 1 \text{ count})$.
<p>[1] For repetitive peaks; 2.5 ms for single events. Peak not specified for 500 μA DC, 50 mA DC, 5 A DC.</p> <p>[2] 200 counts in 500 mV AC, 500 μA AC, 50 mA AC, 5 A AC.</p> <p>[3] 3 % in 500 mV AC, 500 μA AC, 50 mA AC, 5 A AC.</p>		

Input Characteristics

Function	Overload Protection ^[1]	Input Impedance	Common Mode Rejection Ratio (1 k Ω unbalance)		Normal Mode Rejection						
\bar{V}	1000 V	10 M Ω <100 pF	>120 dB at dc, 50 Hz or 60 Hz		>60 dB at 50 Hz or 60 Hz						
\bar{mV}	1000 V ^[2]	10 M Ω <100 pF	>120 dB at dc, 50 Hz or 60 Hz		>60 dB at 50 Hz or 60 Hz						
\tilde{V}	1000 V	10 M Ω <100 pF (ac-coupled)	>60 dB, dc to 60 Hz								
$\overset{LoZ}{\tilde{V}}$	1000 V	3.2 k Ω <100 pF (ac-coupled)	Not specified		Not specified						
Function	Overload Protection ^[1]	Open Circuit Test Voltage	Full Scale Voltage		Typical Short Circuit Current						
			To 500 k Ω	\geq 5 M Ω or 50 nS	500 Ω	5 k Ω	50 k Ω	500 k Ω	5 M Ω	50 M Ω	500 M Ω
Ω	1000 V ^[2]	5 V dc	550 mV	<5 V	1 mA	100 μ A	10 μ A	1 μ A	0.3 μ A	0.3 μ A	0.3 μ A
50Ω	1000 V ^[2]	20 V decreasing to 2.5 V	500 mV		10 mA						
\rightarrow	1000 V ^[2]	5 V dc	3.1 V dc		1 mA						
<p>[1] Input is limited to the product of a V rms sinewave times frequency of 2×10^7 V-Hz.</p> <p>[2] For circuits <0.5 A short circuit. 660V for high energy circuits.</p>											

Burden Voltage (A, mA, μ A)

Function	Range	Burden Voltage
mA, μ A	500 μ A	102 μ V/ μ A
	5000 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



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