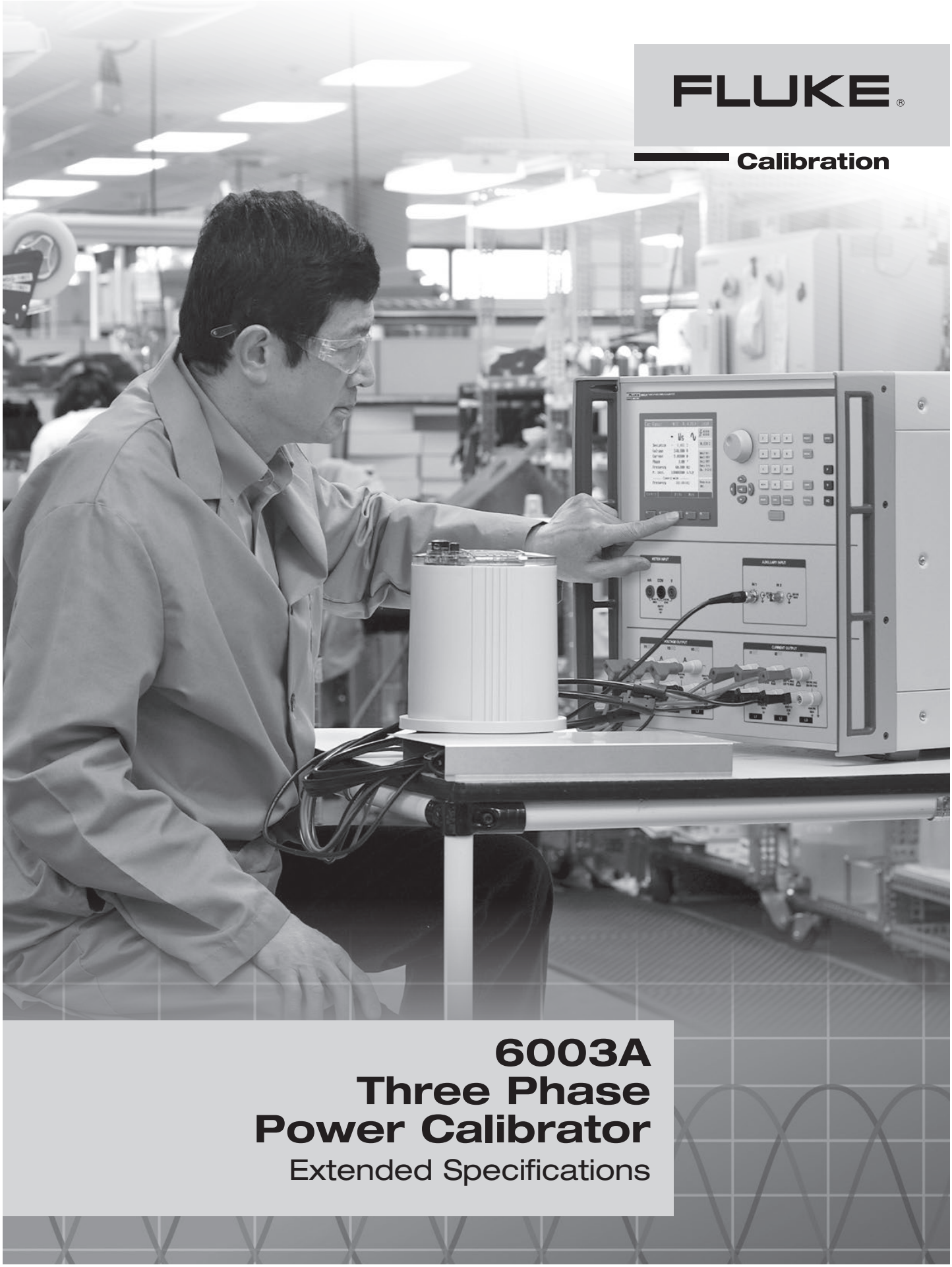

6003A Three Phase Power Calibrator

Extended Specifications

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Specifications

This section gives the general and detailed specifications of the Product.

Input Power

Voltage	115 V, 230 V ±10 %
Frequency	47 Hz to 63 Hz
Maximum consumption	1875 VA max

Dimensions

Height	415 mm (16.3 inches)
Height (without feet)	402 mm (15.8 inches)
Width	430 mm (16.9 inches)
Depth	640 mm (25.2 inches)
Weight	62 kg (136 lb)

Environment

Operating temperature	5 °C to 40 °C
Calibration temperature (Tcal) range	21 °C to 25 °C
Storage temperature	-10 °C to 55 °C
Transit temperature	-15 °C to 60 °C
Warm up time	1 hour
Safe operating max. relative humidity (non-condensing)	<80 %, 5 °C to 31 °C ramping linearly down to 50 % at 35 °C
Storage max. relative humidity (non-condensing)	<90 %, -10 °C to 55 °C
Operating altitude	2,000 m maximum
Storage altitude	12,000 m maximum
Shock	MIL-PRF-28800F class 3
Vibration	MIL-PRF-28800F class 3
Enclosure	MIL-PRF-28800F class 3

Safety

IEC61010-1, IEC 61010-2-030, Overvoltage category II, Pollution Degree 2

EMC

IEC 61326-1, Controlled

General Electrical

Voltage/Current amplitude setting resolution	5.5 digits
Range of fundamental frequencies	15 Hz to 1 kHz
Line frequency locking	45 Hz to 65.9 Hz at user discretion
Frequency accuracy	±50 ppm
Frequency setting resolution	0.001 Hz for 15 Hz to <500 Hz, 0.01 Hz 500 Hz to 1 kHz
Warm up time to full accuracy	The shorter of 1 hour or twice the time since last warmed up
Settling time following change to the output	3 seconds maximum
Nominal angle between voltage phases	120 °
Nominal angle between voltage and current of a phase	0 °
Phase angle setting	0 ° **to** 359.99 °
Phase angle setting resolution	0.01 °

Electrical Specifications

The product specifications describe the Absolute Instrumental Uncertainty of the Product. The product specifications include stability, temperature, and humidity; within specified limits, linearity, line and load regulation, and the reference standard measurement uncertainty. The product specifications are stated at a confidence limit of 99 %, k=2.58, normally distributed.

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Temperature Coefficient

Add 0.1x spec /°C for temperature ranges outside of Tcal ±2 °C. For example, for Tcal = 23 °C, the specification at 11 °C and 35 °C is 2 times the nominal specification.

Voltage

Voltage Channel Maximum Capacitive Loading for Output Stability

The voltage output remains stable up to a 100 nF load but may not be able to drive that capacitance at all voltage/frequency/harmonic combinations due to burden current limitations.

Voltage Range Limits and Burden

Range	1.0000 V to 10 V	10.0001 V to 30 V	30.001 V to 70 V	70.001 V to 140 V	140.001 V to 280 V	280.001 V to 600 V [1]
Maximum Burden Current (peak) 40 Hz - 70 Hz [2] [4]	141 mA	283 mA	424 mA	424 mA	283 mA	85 mA
Maximum Burden Current (RMS) 40 Hz - 70 Hz [2] [4]	100 mA	200 mA	300 mA	300 mA	200 mA	60 mA
Maximum Burden Current (RMS) dc, 15 Hz to 40 Hz, 70 Hz to 1000 Hz [2] [4]	100 mA	200 mA	200 mA	200 mA	150 mA	50 mA[3] [4]

[1] 600 V range is ac only, and limited to the fundamental frequency, i.e. no additional harmonics can be generated

[2] Sum of all currents from three phases is limited to 400 mA RMS

[3] 600 V range cannot output dc.

[4] Maximum burden current is reduced in Power Harmonic, Power Interharmonics and Dip/Swell modes by a factor of 0.707 times the values shown. For example, the maximum burden current for a 10 V, 50 Hz harmonic output is 70.7 mA.

Voltage Sine Amplitude

Ranges	Frequency	1-Year Specification, Tcal ±2 °C ± (% of output + V)	
1.0000 V to 10.0000 V	15 Hz to 40 Hz	0.016	1 mV
	40 Hz to 70 Hz	0.012	1 mV
	70 kHz to 1 kHz	0.016	1 mV
10.0001 V to 30.000 V	15 Hz to 40 Hz	0.016	3 mV
	40 Hz to 70 Hz	0.012	3 mV
	70 kHz to 1 kHz	0.016	3 mV
30.001 V to 70.000 V	15 Hz to 40 Hz	0.016	7 mV
	40 Hz to 70 Hz	0.012	7 mV
	70 kHz to 1 kHz	0.016	7 mV
70.001 to 140.000 V	15 Hz to 40 Hz	0.016	14 mV
	40 Hz to 70 Hz	0.012	14 mV
	70 kHz to 1 kHz	0.016	14 mV
140.001 V to 280.000 V	15 Hz to 40 Hz	0.016	28 mV
	40 Hz to 70 Hz	0.012	28 mV
	70 kHz to 1 kHz	0.016	28 mV
280.001 V to 600.000 V	20 Hz to 40 Hz	0.024	60 mV
	40 Hz to 70 Hz	0.016	60 mV
	70 kHz to 1 kHz	0.024	60 mV

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Voltage DC

Range	1-Year Specification, Tcal ±2 °C ± (% of output + V)	
1.0000 V to 10.0000 V	0.015	1 mV
10.0001 V to 30.0000 V	0.015	3 mV
30.001 V to 70.0000 V	0.015	7 mV
70.001 V to 140.000 V	0.015	14 mV
140.001 V to 280.000 V	0.015	28 mV

Voltage Distortion

<0.05 % 15 Hz to 200 kHz bandwidth

Current

Current Range Limits and Compliance

Range	8.000 mA to 300.000 mA	0.30001 A to 1.00000 A	1.00001 A to 2.00000 A	2.00001 A to 5.00000 A	5.0001 A to 10.0000 A	10.0001 A to 30.0000 A	90 mA to 90.0000 A [1]
Maximum Compliance Voltage (dc/peak) [3]	8	8	8	5	5	5	5
Maximum Compliance Voltage (RMS) 15 Hz to 400 Hz [3]	5.5	5.5	5.5	3.5	3.5	3.5	3.5
Maximum Compliance Voltage (RMS) 400 kHz to 1 kHz [3]	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Maximum Inductive Load [2]	1 mH	1 mH	1 mH	1 mH	1 mH	1 mH	1 mH

[1] 90 A range is available in the Current High I mode

[2] Voltage compliance developed across inductive loads may limit the maximum current output being achieved at higher frequencies. The maximum frequency (Fmax) for a given load inductance and current is given by Fmax = Vc/(2* π*I*L), where Vc is the maximum RMS compliance voltage.

[3] Maximum burden voltage is reduced in Power Harmonic, Power Interharmonic and Dip/Swell modes by 0.707 times the values shown above. For example, the maximum burden voltage for a 1 A, 50 Hz harmonic output is 3.89 V.

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Current Sine Amplitude

Range (Amps)	Frequency	1-Year Specification, Tcal ±2 °C ±(% of output + A)	
8.000 mA to 300.000 mA	15 Hz to 40 Hz	0.021	60 µA
	40 Hz to 70 Hz	0.0175	30 µA
	70 Hz to 1 kHz	0.021	60 µA
0.30001 A to 1.00000 A	15 Hz to 40 Hz	0.021	200 µA
	40 Hz to 70 Hz	0.0175	100 µA
	70 Hz to 1 kHz	0.021	200 µA
1.00001 A to 2.00000 A	15 Hz to 40 Hz	0.021	400 µA
	40 Hz to 70 Hz	0.0175	200 µA
	70 Hz to 1 kHz	0.021	400 µA
2.00001 A to 5.00000 A	15 Hz to 40 Hz	0.021	1 mA
	40 Hz to 70 Hz	0.0175	500 µA
	70 Hz to 1 kHz	0.021	1 mA
5.0001 A to 10.0000 A	15 Hz to 40 Hz	0.028	2 mA
	40 Hz to 70 Hz	0.021	1.5 mA
	70 Hz to 1 kHz	0.028	2 mA
10.0001 A to 30.0000 A	15 Hz to 40 Hz	0.035	6 mA
	40 Hz to 70 Hz	0.0245	4.5 mA
	70 Hz to 1 kHz	0.035	6 mA
90 mA to 90.0000 A [1]	15 Hz to 40 Hz	0.035	18 mA
	40 Hz to 70 Hz	0.0245	13.5 mA
	70 Hz to 1 kHz	0.035	18 mA
[1] 90 A range is available in the Current High I mode			

Current DC

Range	1-Year Specification, Tcal ±2 °C ±(% of output + A)	
8.000 mA to 300.000 mA	0.0175	30 µA
0.30001 A to 1.00000 A	0.0175	100 µA
1.00001 A to 2.00000 A	0.0175	200 µA
2.00001 A to 5.00000 A	0.0175	500 µA
5.0001 A to 10.0000 A	0.021	1.5 mA
10.0001 A to 30.0000 A	0.0245	4.5 mA
90 mA to 90.0000 A[1]	0.0245	13.5 mA
[1] 90 A range is available in the Current High I mode		

Current Distortion

<0.1 %, 15 Hz to 200 kHz bandwidth

Current Output Isolation (high or low terminal)

450 V peak maximum above earth ground. The current output terminals must only be energized by the Product Voltage output terminals.

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FLUKE Calibration

Voltage from the Current Terminals (DC and Sine Wave Only)

Range Limits and Impedances

Range	1.000 mV to 20.000 mV	20.001 mV to 330.000 mV	0.33001 V to 5.00000 V
Source Impedance	1 Ω	1 Ω	18 Ω
Minimum load impedance to maintain specification	25 kΩ	25 kΩ	450 kΩ

Voltage from Current Terminals

Range	Frequency	1-Year Specification, Tcal 2°C ±(% of output + V)	
1.000 mV to 20.000 mV	dc	0.05	20 µV
	15 Hz to 400 Hz	0.05	20 µV
20.001 mV to 330.000 mV	dc	0.05	200 µV
	15 Hz to 400 Hz	0.05	200 µV
0.33001 V to 5.00000 V	dc	0.05	1 mV
	15 Hz to 400 Hz	0.05	1 mV

Voltage from Current Terminals, Distortion

<0.1 %, 15 Hz to 200 kHz bandwidth

Phase and Power Factor (Sine Wave Outputs)

Phase range	0.0 ° to 359.99 °
Frequency range	15 Hz to 1 kHz
Phase resolution	0.01 °
Power factor range	-1 to +1 (Lead, Lag)
Power factor resolution	0.001
Power factor accuracy	(1 - cos (φ+dφ)/cos φ) where φ is the phase in degrees and dφ is the phase specification in degrees.

Current to Voltage Phase

For All Voltage Outputs (1 V to 600 V)		
Current Output	Frequency	1-Year Specification, Tcal ±2 °C
0.008 A to 0.099999 A	15 Hz to 70 Hz	0.05 °
	70 Hz to 400 Hz	0.1 °
	400 kHz to 1 kHz	0.4 °
0.1 A to 10 A	15 Hz to 70 Hz	0.01 °
	70 Hz to 400 Hz	0.1 °
	400 kHz to 1 kHz	0.4 °
10.0001 A to 30 A	15 Hz to 70 Hz	0.05 °
	70 Hz to 400 Hz	0.1 °
	400 kHz to 1 kHz	0.4 °
For voltage from the current terminals, use the 0.1 A to 10 A phase specification for > 40 % of range and 0.008 A to 0.099999 A for ≤40 % of range. There are three voltage ranges, 20 mV, 330 mV and 5 V.		

Voltage to Voltage Phase

For All Voltage Ranges (1 V to 600 V)	
Frequency	1-Year Specification, Tcal ±2 °C
15 Hz to 70 Hz	0.01 °
70.001 Hz to 400 Hz	0.1 °
400.001 kHz to 1 kHz	0.4 °

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Power

The power specifications below are valid for sinusoidal outputs for voltage, current, and frequencies shown. They are not valid when any harmonics, modulation (flicker), interharmonics, or dips/swells are applied.

To calculate the power specification for any specific voltage, current, and power factor outputs, use this formula:

$$dP=\sqrt{(dV^2+dI^2+dPF^2+0.01^2)}\ (\%)$$

where dV is the specification of the voltage, dI is the specification of the current, dPF is the specification of the power factor; all expressed as a %.

Example calculations:

Output 230 V, 20 A, PF = 1. 230 V has a specification of (0.012 % of output + 28 mV) or 0.024 %. 20 A has a specification of (0.0245 % + 4.5 mA), or 0.047 %. The phase specification for this output is 0.05 °. At PF = 1 the power factor specification is 0.0000 %. Applying the power specification formula, this gives

$$\sqrt{(0.024^2+0.047^2+0.00^2+0.01^2)}=0.054\%$$

Output 115 V, 3 A, PF = 0.8. 115 V has a specification of (0.012 % of output + 14 mV) or 0.024 %. 3 A has a specification of (0.0175 % + 500 μA), or 0.034 %. The phase specification for this output is 0.01 °. At PF = 0.8 the power factor specification is 0.0131 %. Applying the power specification formula, this gives

$$\sqrt{(0.024^2+0.034^2+0.0131^2+0.01^2)}=0.045\%$$

Output 280 V, 5 A, PF = 0.5. 280 V has a specification of (0.012 % of output + 28 mV) or 0.022 %. 5 A has a specification of (0.0175 % + 500 μA), or 0.028 %. The phase specification for this output is 0.01 °. At PF = 0.5 the power factor specification is 0.0302 %. Applying the power specification formula, this gives

$$\sqrt{(0.022^2+0.028^2+0.0302^2+0.01^2)}=0.047\%$$

Sinusoidal Power Specification at 40 Hz to 70 Hz, Power Factor 1.0 (%)

Current Output	Voltage Output					
	10 V	30 V	70 V	140 V	280 V	600 V
1.00000 A	0.037	0.037	0.037	0.037	0.037	0.039
5.00000 A	0.037	0.037	0.037	0.037	0.037	0.039
10.0000 A	0.043	0.043	0.043	0.043	0.043	0.046
30.0000 A	0.046	0.046	0.046	0.046	0.046	0.048

Sinusoidal Power Specification at 40 Hz to 70 Hz, Power Factor 0.8 (%)

Current Output	Voltage Output					
	10 V	30 V	70 V	140 V	280 V	600 V
1.00000 A	0.039	0.039	0.039	0.039	0.039	0.041
5.00000 A	0.039	0.039	0.039	0.039	0.039	0.041
10.0000 A	0.045	0.045	0.045	0.045	0.045	0.047
30.0000 A	0.080	0.080	0.080	0.080	0.080	0.081

Sinusoidal Power Specification at 40 Hz to 70 Hz, Power Factor 0.5 (%)

Current Output	Voltage Output					
	10 V	30 V	70 V	140 V	280 V	600 V
1.00000 A	0.047	0.047	0.047	0.047	0.047	0.049
5.00000 A	0.047	0.047	0.047	0.047	0.047	0.049
10.0000 A	0.053	0.053	0.053	0.053	0.053	0.055
30.0000 A	0.158	0.158	0.158	0.158	0.158	0.158

DC Power Specification (%)

DC power is calculated as $dP=\sqrt{(dV^2+dI^2+0.01^2)}\ (\%)$

Current Output	Voltage Output				
	10 V	30 V	70 V	140 V	280 V
5.00000 A	0.038	0.038	0.038	0.038	0.038
10.0000 A	0.045	0.045	0.045	0.045	0.045
30.0000 A	0.048	0.048	0.048	0.048	0.048

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FLUKE ® Calibration

Multimeter

Function	Measuring Range	1-year Specification, Tcal ±2 °C (% of reading + floor)	Resolution
DC Voltage	0 V to ±12 V	0.01 % + 1 mV	100 µV
DC Current	0 mA to ±25 mA	0.01 % + 2.5 µA	100 nA
Frequency	1 Hz to 15 kHz	0.005 %	10 µHz to 0.1 Hz

IN2 Input

Input IN2 (trigger, synchronization)	
Max frequency	10 kHz
Input low level max	0.8 V
Input low level min	3.5 V

Energy (6003A/E Energy Option)

Pulse Inputs (IN1)

Max frequency	1 MHz (400 Hz with Input Filter On)
Min pulse width	500 ns
Max counts	5 000 000 000
Voltage high and low limits	low level max 0.8 V, high-level min. 3.2 V

Energy Pulse Output

Drive	Open collector
Frequency range	0.02 Hz to 1 MHz
Frequency specification	50 ppm of output
External pull-up	150 Ω, selectable on/off
Sink current	100 mA

Energy

Time range	1 to 1 0000 0000 seconds
Time resolution	0.1 seconds
Time interval specification	0.01 % of time interval + 0.1 seconds

Test Duration

Maximum test duration	1000 hours

Power Quality (6003A/PQ Power Quality Option)

Voltage and Current Sinusoidal and Rectangular Modulation Flicker Specification

Modulation depth	0 to 30 %
Modulation depth specification	0.2 % of modulation depth
Modulation depth setting resolution	0.001 %
Shape of modulation envelope	Rectangular or Sinusoidal
Duty cycle (shape = rectangular)	1 % to 99 %
Modulating frequency specification	50 ppm of output
Modulation frequency range	0.001 Hz to 50 Hz
RMS amplitude specification	0.2 % of range
Fundamental frequency range	15 Hz to 1 kHz
Harmonic (2 to 63) frequency range	30 Hz to 5 kHz

[1] For a given modulation %, the output signal swings between (output setting + modulation %) and (output setting - modulation %). The Fluke 6100 Series Electrical Power Standard defines modulation as ΔV/V%, where its output signal swings between (output setting + ½ ΔV/V %) and (output setting - ½ ΔV/V%). To get the same modulation as the 6100 series, set the 6003A modulation to ½ the ΔV/V % setting of the 6100.

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Harmonics and Interharmonic

Interharmonics are available on voltage and current outputs.

Fundamental harmonic frequency range	15 Hz to 1 kHz
Fundamental harmonic amplitude specification	±0.2 % of range
Harmonics (2 to 63) frequency range	30 Hz to 5 kHz
Interharmonic frequency range	15 Hz to 1 kHz
Maximum harmonic number	63
Number of interharmonic products	1
Frequency specification	±0.005 % of output
Fundamental harmonic phase specification	15 Hz to 70 Hz: 0.2 °
	70 Hz to 400 Hz: 0.5 °
	400 Hz to 1 kHz: 1 °
Harmonics (2 to 63) phase specification	5 µs [1]
Voltage harmonic and interharmonic amplitude specification (1 V to 280 V)	30 Hz to 3 kHz: 0.1 % of range
	3 kHz to 5 kHz: 0.2 % of range
Current harmonic and interharmonic amplitude specification (8 mA to 2 A)	30 Hz to 3 kHz: 0.1 % of range
	3 kHz to 5 kHz: 0.2 % of range
Current harmonic and interharmonic amplitude specification (2 A to 10 A)	30 Hz to 3 kHz: 0.2 % of range
	3 kHz to 5 kHz: 0.4 % of range
Current harmonic and interharmonic amplitude specification (10 A to 30 A)	30 Hz to 3 kHz: 0.2 % of range
	3 kHz to 5 kHz: 0.8 % of range
Maximum amplitude of harmonic products	30 % of RMS output value
Harmonic resolution of harmonic products	0.001 %
Noise and Distortion	-60 dB

[1] Into resistive loads. For Current outputs, harmonics > 3 kHz and/or > 1.5 V rms compliance on the composite waveform, the specification is 10 µs. The phase accuracy of a given harmonic is given by P = 5 us / (1/f) x 360 where P = phase accuracy in degrees, f = harmonic frequency

Dip/Swell

Although Dips and Swells are primarily voltage phenomena, the Product provides the same facility on its current output.

AC voltage range	0.1 V to 280 V
AC current range	1 mA to 30 A
Amplitude accuracy	0.2 % of range [1]
Frequency range	15 Hz to 1 kHz
Timing [2]	
T1 range	0 s to 60 s
T2 range	0.1 ms to 60 s
T3 range	2 ms to 60 s
T4 range	0.1 ms to 60 s
T5 range	0 s to 60 s

[1] Range is determined by the highest value of the output signal
[2] T1 + T5 >2 ms

Note

Maximum voltage burden and current compliance is reduced in Power Quality functions. See Voltage Range Limits and Burden and Current Range Limits and Compliance above.

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Ordering information

Models

6003A ..... 6003A 3 Phase Power Calibrator

6003A/E..... 6003A 3 Phase Power Calibrator with energy option

6003A/PQ ..... 6003A 3 Phase Power Calibrator with PQ option

6003A/PQ/E ..... 6003A 3Phase Power Calibrator with PQ option and energy option

Options and accessories

6003A-90A ..... 90 A adapter and high current cables

52120A/COIL3KA ..... Coil, 25 turn, 3000 A

52120A/COIL6KA ..... Coil, 50 turn, 6000 A

5500A/COIL ..... Coil, 50 turn, 1000 A

Software

MET/CAL Software ..... Automation solution for DC/LF and RF calibration

MET/TEAM Software..... Calibration asset management software and modules

Software Services..... Installation, customization, and training services

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Electrical | RF | Temperature | Pressure | Flow | Software

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