FLUKE

The Fluke 6100A
Electrical Power Standard

The most accurate, comprehensive and flexible source of electrical power signals

Measurement validation and calibration for electrical power applications

The importance of accurate measurement of power and energy has increased dramatically over a relatively short period of time. De-regulation, competition and the increasingly distributed nature of the power supply network mean that measurements are made more frequently, and a higher degree of accuracy is required as previously acceptable levels of error begin to compound.

At the same time, the environment in which these measurements are being made is becoming increasingly hostile to good measurement practice. Harmonic distortion, voltage fluctuations, phase imbalances and other extraneous, re-injected signal components provide an alien environment for measurement devices designed to operate primarily on sinusoidal signals.

Additionally, many new measurement and instrument types have arisen in an attempt to fully characterize network performance, and the nature of the product delivered – electricity, flicker and harmonic measurements are becoming as commonplace as power factor measurements were a few years ago, and even more complex measurements such as inter-harmonics are now becoming relatively routine. This has resulted in many more instruments, and many more instrument types being used. All of these, of course, require measurement verification and calibration throughout their life, from initial prototype through to mass deployment in the field.

Many national and international standards are in place or are still in development to support and to bring order to this situation. These set out to ensure measurements have traceability and are comprehensive and consistent. Many also address the issue of ensuring that measurements are still valid under real world conditions, and require the simulation of such conditions for full instrument verification.

Against this turbulent change, little progress has been made in the verification of these measurements or the support of these standards. Instruments used to measure and report precise parameters on power lines carrying significantly distorted, noisy and fluctuating voltages are still verified and calibrated under laboratory conditions. Pure, noise free, levelled sinusoidal voltages and currents are still routinely applied as reference signals. Custom built systems are still used to ensure and demonstrate compliance to standards and to verify some of the newer measurements.

Against this background, Fluke has developed the 6100A Electrical Power Standard.

Accuracy and functionality

Who needs a 6100A?

Validation of electrical power measurements and the equipment that make them is required in many disciplines:

- In design engineering to guarantee that measurements are being made correctly and accurately
- In manufacturing test to make certain that measurements are correct and repeatable on every unit manufactured
- In service and calibration to ensure that instruments continue to perform to specification throughout their lifetime
- In standards laboratories to ensure measurement techniques and equipment meet appropriate standards.

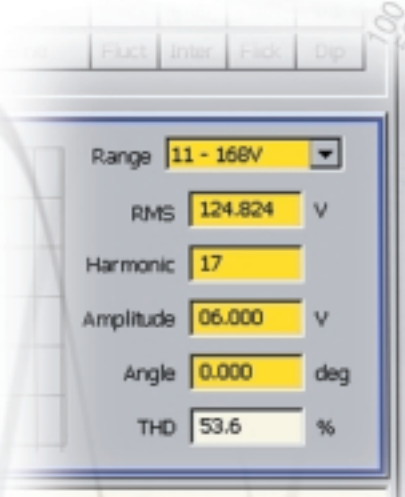
The Fluke 6100A provides the tools, the functions and the performance to fulfill these requirements comprehensively, accurately and reliably.

Phantom power

The 6100A will supply pure sinusoidal voltage to 1000 V and current to 21 Amps (optionally to 80 A). Up to 50 VA's of power is available from the voltage terminals to support instruments which draw power from the line on which they are measuring.

Up to 14 V of compliance is available from the current output to ensure current is delivered in setups involving long cable runs, connectors and switches, or where multiple instruments are connected in series. The current output can also produce an auxiliary voltage of up to 10 V in order to simulate signals that may be produced by transducers or current probes. Phase angle between voltage and current, and between multiple phases, is fully adjustable by the user from -180 degrees to +180 degrees.

In addition to the values of V, I and phase angle set by the user, the on screen display shows calculated values of real power (W), apparent power (VA), various representations of reactive power and power factor (PF).



Outstanding resolution and accuracy

The Fluke 6100A sets a new benchmark for accuracy in power standards. Voltage and current are generated with up to 6 digits resolution and accuracys approaching 100 ppm (0.01 %). Phase adjustment provides for 1 milli-degree or 10 micro-Radian resolution. Phase performance is exceptional, with accuracy to 3 milli-degrees and short term stability to 200 micro-degrees. In multi-phase systems phase accuracy between phases is 5 milli-degrees, again with short term stability to 200 micro-degrees. This outstanding level of phase performance equals or exceeds a number of commercially available phase standards.

Phase accuracy is imperative in achieving power accuracy. The 3 milli-degrees phase accuracy of the Fluke 6100A ensures power accuracy approaching 200 ppm (0.02 %) can be achieved. Simple trigonometry applied to the equation Power = VIcosø demonstrates that compromising phase performance can only severely degrade power uncertainty.

Accuracy and functionality

Multi-phase operation

The 6100A Master unit offers self-contained single phase operation, with one voltage and one current output. For multi-phase applications, the addition of one or more 6101A Auxiliary units provides additional phases, with identical performance but without the overhead and additional complexity of an additional set of controls and display. Additional phases can be added individually until a maximum of four phases is reached. In multiphase systems, each phase remains totally independent and completely electrically isolated, yet synchronized with, and under the control of the master unit.

In multi-phase work, current and voltage on each phase is independently programmable, allowing the user to simulate unbalance conditions.

Energy calibration and verification

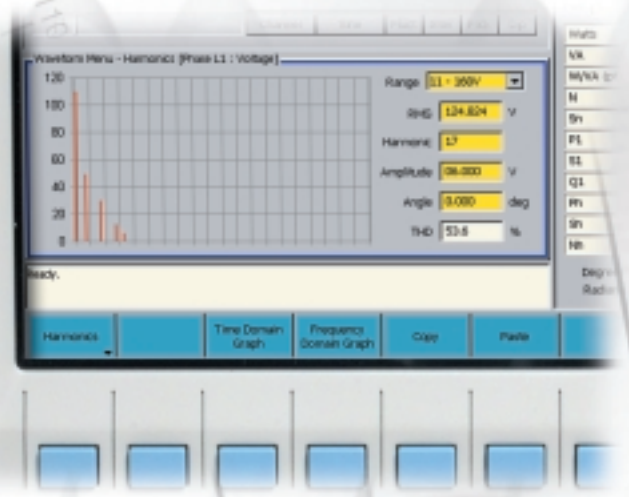
The Fluke 6100A's energy option provides full functionality for work with energy (watthour) meters, and supports a number of methods of working, depending on the users preference and the availability of external references and other equipment.

For full functionality, the 6100A is equipped with inputs to receive calibration pulses from the meter or meters under test (single or multi-phase). The 6100A is then able to calculate energy recorded by the meter (according to the meter constant entered by the user), compare this against energy it has delivered, then calculate and display errors.

If the user prefers to use an external comparator, the 6100A is equipped with pulse outputs. These provide pulses proportional to energy delivered, again according to the meter constant entered by the user. These pulse streams can then be compared against equivalent pulses from the meter under test by the external comparator.

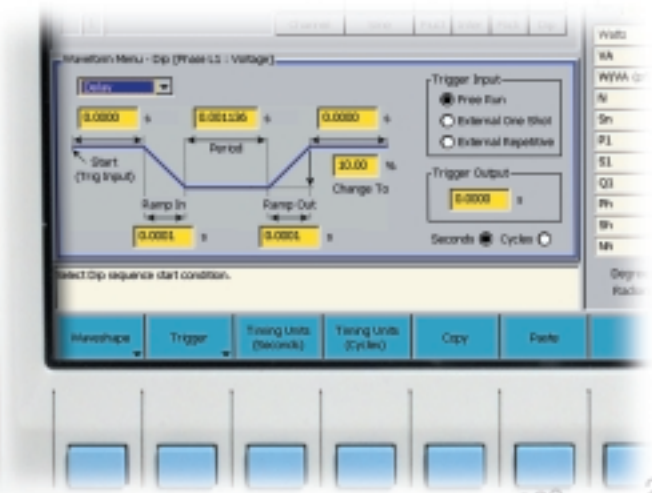
Complex signals

In addition to sinusoidal voltages and currents, the 6100A can supply accurate amounts of harmonic distortion independently on the voltage and current outputs. All of the first 100 harmonics can be set individually by the user, with levels of up to 30 % of the fundamental value, the amplitude and phase of each harmonic are independently controllable by the user. A dc level is also programmable. Addition of harmonics does not significantly impair accuracy or compromise traceability of the measurement. This unique capability means that test protocols using specific waveshapes such as those defined by IEC 61036 for energy meters can now be implemented with ease, and with high levels of confidence and accuracy.



Accuracy and functionality

For more complex work, the 6100A will also generate flicker (compliant to IEC 61000-4-15), interharmonics (compliant to IEC 61000-4-7), and fluctuating harmonics. Dips and swells from 0 % to 140 % can be individually programmed on voltage or current, or both. Dips and swells can be sub-cycle (from around 1 millisecond) out to 1 minute in length. Most of these signal types are available simultaneously, so that very complex scenarios are possible. This not only simulates "real world" conditions, but is also a requirement of new standards defining power quality measurement methods such as IEC61000-4-30. The Fluke 6100A enables full compliance to this international standard.



User interface

The user interface of the 6100A is critical to allow users to exploit its extensive capabilities. To ensure simplicity of operation, a Microsoft Windows® user interface has been adopted. The interface can be accessed through a combination of front panel knobs and buttons, an optional mouse and keyboard and a high resolution, 9-inch TFT display. Status information of all four phases is displayed, alongside more detailed information on current parameters being set or adjusted. Frequency domain and time domain representation of current signal types can be displayed on the screen so that the user is able evaluate the effect of control settings before applying the signal to the output terminals of the 6100A. At the bottom of the screen a context sensitive help window further guides the operator through instrument setup by providing additional control information and error messages.

Automation

Instrument setups can be saved and recalled within the instrument or on floppy disk. This provides one route for automating complex tasks. A series of complete instrument setups can be stored, and recalled under user or computer control, thus producing a sequence of steps, or test program. Additionally, the 6100A is compatible with Fluke's MET/CAL® metrology software package, allowing full automation in addition to a wide range of other functions such as inventory control.

6100A and 6101A specifications

Primary specifications

Voltage/Current amplitude setting resolution	6 digits
Range of fundamental frequency	16 Hz to 850 Hz
Frequency accuracy	50 ppm
Frequency setting resolution	0.1 Hz
Warm up time to full accuracy	1 hour or twice the time since last warm up
Settling time	< 1.4 second
Nominal angle between Voltage phases	120 °
Nominal angle between Voltage and Current of a phase	0 °
Phase angle setting	± 180 °, ± π radians
Phase angle setting resolution	0.001 °, 0.00001 radians

Sinusoidal Voltage output

Range	Frequency	Voltage	1 year accuracy, TCal ± 5 °C ± (ppm of output + mV)		'Closed loop' Stability ± (ppm of output + mV) per hour		'Open loop' Stability ± (ppm of output + mV) per hour	
1.0 V to 16 V	16 Hz – 450 Hz	1.0 V – 6.4 V	122	1.0	40	0.8	200	0.8
		6.4 V – 16 V	112	1.0	40	0.4	200	0.8
	450 Hz – 850 Hz	1.0 V – 6.4 V	164	1.0	40	0.8	200	0.8
		6.4 V – 16 V	150	1.0	40	0.4	200	0.8
2.3 V to 33 V	16 Hz – 450 Hz	2.3 V – 13.2 V	122	2.0	40	0.8	200	0.8
		13.2 V – 33 V	112	1.5	40	0.6	200	0.8
	450 Hz – 850 Hz	2.3 V – 13.2 V	164	2.0	40	0.8	200	0.8
		13.2 V – 33 V	150	1.5	40	0.6	200	0.8
5.6 V to 78 V	16 Hz – 450 Hz	5.6 V – 31 V	122	2.0	40	0.8	200	0.8
		31 V – 78 V	112	2.0	40	0.6	200	0.8
	450 Hz – 850 Hz	5.6 V – 31 V	164	2.0	40	0.8	200	0.8
		31 V – 78 V	150	2.0	40	0.6	200	0.8
11 V to 168 V	16 Hz – 450 Hz	11 V – 67 V	122	4.4	40	1.5	200	1.5
		67 V – 168 V	112	4.4	40	1.5	200	1.5
	450 Hz – 850 Hz	11 V – 67 V	164	4.4	40	1.5	200	0.8
		67 V – 168 V	150	4.4	40	1.5	200	0.8
23 V to 336 V	16 Hz – 450 Hz	23 V – 134 V	122	8.8	40	3.0	200	3.0
		134 V – 336 V	112	8.8	40	3.0	200	3.0
	450 Hz – 850 Hz	23 V – 134 V	164	8.8	40	3.0	200	0.8
		134 V – 336 V	150	8.8	40	3.0	200	0.8
70 V to 1008 V	16 Hz – 450 Hz	70 V – 330 V	166	26	100	10	200	10
		330 V – 1008 V	158	26	100	10	200	10
	450 Hz – 850 Hz	70 V – 330 V	190	26	100	10	200	10
		330 V – 1008 V	175	26	100	10	200	10

6100A and 6101A specifications

Voltage dc and harmonic amplitude specifications

Range	Frequency	Voltage	1 year accuracy, TCal ± 5 °C ± (ppm of output + mV)		'Closed loop' Stability ± (ppm of output + mV) per hour		'Open loop' Stability ± (ppm of output + mV) per hour	
1.0 V to 16 V	0 V – 8 V	dc	122	5.0	40	1.8	200	1.8
	0 V – 4.8 V	16 Hz – 450 Hz	122	1.0	40	0.8	200	0.8
		450 Hz – 850 Hz	164	1.0	40	0.8	200	0.8
		850 Hz – 6 kHz	512	1.0	60	0.8	400	0.8
2.3 V to 33 V	0 V – 16.5 V	dc	122	10	40	3.3	200	3.3
	0 V - 9.9 V	16 Hz – 450 Hz	122	2.0	40	0.8	200	0.8
		450 Hz – 850 Hz	164	2.0	40	0.8	200	0.8
		850 Hz – 6 kHz	512	2.0	60	0.8	400	0.8
5.6 V to 78 V	0 V – 39 V	dc	122	24	40	8.0	200	8.0
	0 V - 23 V	16 Hz – 450 Hz	122	2.0	40	0.8	200	0.8
		450 Hz – 850 Hz	164	2.0	40	0.8	200	0.8
		850 Hz – 6 kHz	512	2.0	60	0.8	400	0.8
11 V to 168 V	0 V – 84 V	dc	122	50	40	15	200	15
	0 V - 50 V	16 Hz – 450 Hz	122	4.4	40	1.5	200	1.5
		450 Hz – 850 Hz	164	4.4	40	1.5	200	1.5
		850 Hz – 6 kHz	512	4.4	60	1.5	400	1.5
23 V to 336 V	0 V – 168 V	dc	122	100	40	30	200	30
	0 V - 100 V	16 Hz – 450 Hz	122	12.0	40	3.0	200	3.0
		450 Hz – 850 Hz	164	12.0	40	3.0	200	3.0
		850 Hz – 6 kHz	512	12.0	60	3.0	400	3.0
70 V to 1008 V	0 V – 504 V	dc	166	300	100	100	200	100
	0 V - 302 V	16 Hz – 450 Hz	166	33	100	10	200	10
		450 Hz – 850 Hz	190	33	100	10	200	10
		850 Hz – 6 kHz	524	33	150	10	450	10

Voltage from current terminals (Range limits and impedances)

Full Range (FR)	0.25 V	1.5 V	10 V
Max peak	0.353 V	2.121 V	14.14 V
Minimum amplitude	0.05 V	0.15 V	1 V
Source impedance	1 Ω	6.67 Ω	40.02 Ω
Minimum load impedance to maintain specification	25 kΩ	170 kΩ	1 MΩ

Voltage from current terminals (Sine specifications)

Range	Frequency	Output component	1 year accuracy, TCal ± 5 °C ± (ppm of output + µV)		'Closed loop' Stability ± (ppm of output + µV) per hour		'Open loop' Stability ± (ppm of output + µV) per hour	
0.05 V - 0.25 V	16 Hz – 450 Hz	0.05 V – 0.1 V	200	30	50	15	240	15
		0.1 V – 0.25 V	200	30	50	15	240	15
	450 Hz – 850 Hz	0.05 V – 0.25 V	231	30	50	15	240	15
0.15 V - 1.5 V	16 Hz – 450 Hz	0.15 V – 0.6 V	200	50	50	25	240	25
		0.6 V – 1.5 V	200	40	50	20	240	25
	450 Hz – 850 Hz	0.15 V – 1.5 V	231	50	50	25	240	25
1 V – 10 V	16 Hz – 450 Hz	1 V – 4 V	200	300	50	150	240	150
		4 V – 10 V	200	240	50	120	240	150
	450 Hz – 850 Hz	1 V – 10 V	231	300	50	150	240	150

6100A and 6101A specifications

Current range limits

Full Range (FR)	0.25 A	0.5 A	1 A	2 A	5 A	10 A	21 A	80 A
Max peak	0.353 A	0.707 A	1.414 A	2.828 A	7.07 A	14.14 A	28.28 A	113 A
Maximum compliance voltage at FR (Vpk)	14 V	14 V	14 V	14 V	14 V	14 V	13 V	2 V

Sinusoidal Current output

Range	Frequency	Current	1 year accuracy, TCal ± 5 °C ± (ppm of output + µA)		'Closed loop' Stability ± (ppm of output + µA) per hour		'Open loop' Stability ± (ppm of output + µA) per hour	
0.01 A - 0.25 A	16 Hz – 450 Hz	0.01 A – 0.1 A	139	6	50	3	240	3
		0.1 A – 0.25 A	130	6	50	3	240	3
	450 Hz – 850 Hz	0.01 A – 0.1 A	182	6	50	3	360	3
		0.1 A – 0.25 A	170	6	50	3	360	3
0.05 A - 0.5 A	16 Hz – 450 Hz	0.05 A – 0.2 A	139	12	50	5	240	5
		0.2 A – 0.5 A	130	12	50	5	240	5
	450 Hz – 850 Hz	0.05 A – 0.2 A	182	12	50	5	360	5
		0.2 A – 0.5 A	170	12	50	5	360	5
0.1 A -1 A	16 Hz – 450 Hz	0.1 A – 0.4 A	139	24	50	10	240	10
		0.4 A – 1 A	130	24	50	10	240	10
	450 Hz – 850 Hz	0.1 A – 0.4 A	182	24	50	10	360	10
		0.4 A – 1 A	170	24	50	10	360	10
0.2 A - 2 A	16 Hz – 450 Hz	0.2 A – 0.8 A	139	48	50	20	240	20
		0.8 A – 2 A	130	48	50	20	240	20
	450 Hz – 850 Hz	0.2 A – 0.8 A	182	48	50	20	360	20
		0.8 A – 2 A	170	48	50	20	360	20
0.5 A - 5 A	16 Hz – 450 Hz	0.5 A – 2 A	139	120	50	50	240	50
		2 A – 5 A	130	120	50	50	240	50
	450 Hz – 850 Hz	0.5 A – 2 A	182	120	50	50	360	50
		2 A – 5 A	170	120	50	50	360	50
1 A - 10 A	16 Hz – 450 Hz	1 A – 4 A	191	240	70	100	280	100
		4 A – 10 A	164	240	70	100	280	100
	450 Hz – 850 Hz	1 A – 4 A	267	240	70	100	420	100
		4 A – 10 A	250	240	70	100	420	100
2 A - 21 A	16 Hz – 450 Hz	2 A – 8 A	213	720	90	300	320	300
		8 A – 21 A	189	720	90	300	320	300
	450 Hz – 850 Hz	2 A – 8 A	267	720	90	300	480	300
		8 A – 21 A	250	720	90	300	480	300
8 A – 80 A	40 Hz – 450 Hz	8A – 32 A	265	2800	120	1200	1000	1200
		32 A – 80 A	250	2800	120	1200	1000	1200
	450 Hz – 850 Hz	8 A – 32 A	300	2800	120	1200	1000	1200
		32 A – 80 A	280	2800	120	1200	1000	1200

Applicable only to the 6100A/80A and 6100A/E/80A

6100A and 6101A specifications

Current dc and Harmonic amplitude specifications

Range	Output	Frequency	1 year accuracy, TCal ± 5 °C ± (ppm of output + µA)		'Closed loop' Stability ± (ppm of output + µA) per hour		'Open loop' Stability ± (ppm of output + µA) per hour	
0.01 A - 0.25 A	0 A – 0.125 A	dc	139	75	50	11	240	11
	0 A – 0. 75 A	16 Hz – 450 Hz	139	6	50	3	240	3
		450 Hz – 850 Hz	182	6	50	3	360	3
		850 Hz – 6 kHz	505	6	100	3	1000	3
0.05 A - 0.5 A	0 A – 0.25 A	dc	139	150	50	22	240	22
	0 A – 0.15 A	16 Hz – 450 Hz	139	12	50	5	240	5
		450 Hz – 850 Hz	182	12	50	5	360	5
		850 Hz – 6 kHz	505	12	100	5	1000	5
0.1 A -1 A	0 A – 0.5 A	dc	139	300	50	45	240	45
	0 A – 0.3 A	16 Hz – 450 Hz	139	24	50	10	240	10
		450 Hz – 850 Hz	182	24	50	10	360	10
		850 Hz – 6 kHz	505	24	100	10	1000	10
0.2 A - 2 A	0 A – 1 A	dc	139	600	50	90	240	90
	0 A – 0.6 A	16 Hz – 450 Hz	139	48	50	20	240	20
		450 Hz – 850 Hz	182	48	50	20	360	20
		850 Hz – 6 kHz	505	48	100	20	1000	20
0.5 A - 5 A	0 A – 2.5 A	dc	139	1500	50	225	240	225
	0 A – 1.5 A	16 Hz – 450 Hz	139	120	50	50	240	50
		450 Hz – 850 Hz	182	120	50	50	360	50
		850 Hz – 6 kHz	505	120	100	50	1000	50
1 A - 10 A	0 A – 5 A	dc	191	3000	70	450	280	450
	0 A – 3 A	16 Hz – 450 Hz	191	240	70	100	280	100
		450 Hz – 850 Hz	267	240	70	100	420	100
		850 Hz – 6 kHz	519	240	110	100	1100	100
2 A - 21 A	0 A – 10 A	dc	213	6000	90	900	320	900
	0 A - 6 A	16 Hz – 450 Hz	213	720	90	300	320	300
		450 Hz – 850 Hz	267	720	90	300	480	300
		850 Hz – 6 kHz	665	720	120	300	1300	300
8 A – 80 A	0 A – 24 A	40 Hz – 450 Hz	265	2800	120	1200	1000	1200
		450 Hz – 850 Hz	300	2800	120	1200	1000	1200
		850 Hz – 3 kHz	690	2800	150	1200	2000	1200

Maximum inductive loading for output stability

Full range (FR)	0.25 A	0.5 A	1 A	2 A	5 A	10 A	21 A	80 A
Maximum inductive load, hi bandwidth	300 µH	300 µH	300 µH	300 µH	300 µH	45 µH	100 µH	30 µH
Maximum inductive load, lo bandwidth	2 mH	2 mH	1 mH	1 mH	500 µH	360 µH	500 µH	250 µH

Applicable only to the 6100A/80A and 6100A/E/80A

6100A and 6101A specifications

Phase angle – Current to Voltage

For all voltage ranges (16 V to 1008 V)		Voltage and current components >40 % of range		Voltage and current components 0.5 % to 40 % of range	
Current Range	**Frequency**	**1 year accuracy TCal ± 5 °C**	**Stability per hour**	**1 year accuracy TCal ± 5 °C**	**Stability per hour**
0.25 A to 5 A	16 Hz – 69 Hz	0.003 °	0.0002 °	0.010 °	0.001 °
	69 Hz – 180 Hz	0.005 °	0.0002 °	0.017 °	0.002 °
	180 Hz – 450 Hz	0.015 °	0.0005 °	0.050 °	0.005 °
	450Hz – 850 Hz	0.030 °	0.0008 °	0.070 °	0.018 °
	850 Hz – 3 kHz	0.150 °	0.0010 °	0.200 °	0.100 °
	3 kHz – 6 kHz	0.300 °	0.0010 °	0.450 °	0.100 °
5 A to 21 A	16 Hz – 69 Hz	0.004 °	0.0003 °	0.013 °	0.002 °
	69 Hz – 180 Hz	0.007 °	0.0003 °	0.023 °	0.004 °
	180 Hz – 450 Hz	0.020 °	0.0005 °	0.065 °	0.010 °
	450Hz – 850 Hz	0.040 °	0.0008 °	0.080 °	0.020 °
	850 Hz – 3 kHz	0.200 °	0.0015 °	0.250 °	0.100 °
	3 kHz – 6 kHz	0.400 °	0.0020 °	0.600 °	0.150 °
21 A to 80 A	16 Hz – 69 Hz	0.004 °	0.0005 °	0.016 °	0.003 °
	69 Hz – 180 Hz	0.008 °	0.0005 °	0.028 °	0.005 °
	180 Hz – 450 Hz	0.025 °	0.0010 °	0.080 °	0.015 °
	450Hz – 850 Hz	0.050 °	0.0015 °	0.100 °	0.030 °
	850 Hz – 3 kHz	0.250 °	0.0020 °	0.300 °	0.150 °

Phase Angle – Voltage to Voltage (Multiphase systems)

For all voltage ranges (16 V to 1008 V)	Voltage and current components >40 % of range		Voltage and current components 0.5 % to 40 % of range	
Frequency	**1 year accuracy TCal ± 5 °C**	**Stability per hour**	**1 year accuracy TCal ± 5 °C**	**Stability per hour**
16 Hz – 69 Hz	0.005 °	0.0002 °	0.010 °	0.001 °
69 Hz – 180 Hz	0.007 °	0.0002 °	0.018 °	0.002 °
180 Hz – 450 Hz	0.025 °	0.0005 °	0.052 °	0.005 °
450 Hz to 850 Hz	0.050 °	0.0008 °	0.075 °	0.018 °
850 Hz to 3 kHz	0.170 °	0.0010 °	0.220 °	0.100 °
3 kHz to 6 kHz	0.350 °	0.0015 °	0.400 °	0.150 °

Applicable only to the 6100A/80A and 6100A/E/80A

6100A and 6101A specifications

Power

The following tables show in parts per million the minimum to maximum power accuracy for specific voltage and current bands under sinusoidal conditions.

Sinusoidal VA

Current range	V Range					
	16 V (6.4 V to 16 V)	33 V (13.2 V to 33 V)	78 V (31 V to 78 V)	168 V (67 V to 168 V)	336 V (134 V to 336 V)	1008 V (330 V to 1008 V)
0.1 A to 5 A	233 to 329	220 to 295	206 to 259	207 to 260	207 to 260	240 to 304
5.1 A to 10 A	256 to 341	245 to 309	233 to 275	233 to 276	233 to 276	263 to 317
10.1 A to 21 A	284 to 373	274 to 344	263 to 314	264 to 315	264 to 315	290 to 352
21.1 A to 80 A	347 to 485	339 to 463	330 to 441	330 to 442	330 to 442	352 to 469

Sinusoidal Power 16 Hz to 69 Hz, 1.0 > Power Factor > 0.75

Current range	V Range					
	16 V (6.4 V to 16 V)	33 V (13.2 V to 33 V)	78 V (31 V to 78 V)	168 V (67 V to 168 V)	336 V (134 V to 336 V)	1008 V (330 V to 1008 V)
0.1 A to 2 A	237 to 323	225 to 288	212 to 252	212 to 253	212 to 253	244 to 297
2.1 A to 5 A	241 to 333	229 to 299	215 to 264	216 to 265	216 to 265	248 to 308
5.1 A to 10 A	264 to 347	253 to 315	241 to 282	241 to 283	241 to 283	270 to 323
10.1 A to 21 A	291 to 378	281 to 350	270 to 320	271 to 321	271 to 321	297 to 357
21.1 A to 80 A	398 to 489	391 to 467	383 to 445	384 to 446	384 to 446	402 to 473

(Valid for RMS values > 40 % of range for Voltage and Current, not valid when Flicker, Fluctuating Harmonics, Dips/Swells or Interharmonics are applied)

Sinusoidal Power 16 Hz to 69 Hz, 0.75 > Power Factor > 0.5

Current range	V Range					
	16 V (6.4 V to 16 V)	33 V (13.2 V to 33 V)	78 V (31 V to 78 V)	168 V (67 V to 168 V)	336 V (134 V to 336 V)	1008 V (330 V to 1008 V)
0.1 A to 2 A	250 to 332	238 to 299	225 to 264	226 to 264	226 to 264	257 to 307
2.1 A to 5 A	262 to 349	251 to 317	239 to 284	240 to 285	240 to 285	269 to 325
5.1 A to 10 A	283 to 362	273 to 332	262 to 300	263 to 301	263 to 301	290 to 340
10.1 A to 21 A	309 to 393	300 to 365	290 to 337	290 to 337	290 to 337	315 to 372
21.1 A to 80 A	411 to 500	404 to 478	397 to 457	397 to 458	397 to 458	416 to 484

(Valid for RMS values > 40 % of range for Voltage and Current, not valid when Flicker, Fluctuating Harmonics, Dips/Swells or Interharmonics are applied)

Sinusoidal Power 16 Hz to 69 Hz, 0.5 > Power Factor > 0.25

Current range	V Range					
	16 V (6.4 V to 16 V)	33 V (13.2 V to 33 V)	78 V (31 V to 78 V)	168 V (67 V to 168 V)	336 V (134 V to 336 V)	1008 V (330 V to 1008 V)
0.1 A to 2.1 A	309 to 378	299 to 349	289 to 320	290 to 321	290 to 321	314 to 357
2.1 A to 5 A	357 to 424	349 to 399	340 to 373	340 to 374	340 to 374	362 to 405
5.1 A to 10 A	373 to 435	365 to 410	357 to 386	357 to 386	357 to 386	377 to 417
10.1 A to 21 A	392 to 461	385 to 438	377 to 414	378 to 415	378 to 415	397 to 444
21.1 A to 80 A	477 to 555	471 to 536	465 to 517	465 to 518	465 to 518	481 to 541

(Valid for RMS values > 40 % of range for Voltage and Current, not valid when Flicker, Fluctuating Harmonics, Dips/Swells or Interharmonics are applied)

Applicable only to the 6100A/80A and 6100A/E/80A

6100A and 6101A specifications

Harmonics

Number of Harmonics available	100 (simultaneously if required)
Maximum Harmonic frequency available	6 kHz (100th Harmonic of 60 Hz)
Maximum level of individual Harmonic	30 % of full range
Setting method (user selectable)	% RMS, % fundamental, dB down from fundamental, absolute value

Flicker

Setting range	±30 % of set voltage or current within range values (60% ΔV/V)
Flicker modulation depth accuracy	0.025 %
Modulation depth setting resolution	0.001 %
Shape	Rectangular or sinusoidal
Duty cycle (shape = rectangular)	0.01 % to 99.99 %
Modulating frequency range	0.0008 Hz to 40 Hz
Pst indication accuracy	0.25 % Valid for voltage only between 220 V and 240 V

Although Flicker is Voltage phenomena the 6100A will provide Flicker on its Current output. Flicker is not available if Fluctuating Harmonics are already enabled on that channel.

Fluctuating Harmonics

Number of Harmonics to fluctuate	Any number from 0 to all set Harmonics can fluctuate
Modulation depth setting range	0 % to 100 % of nominal Harmonic voltage
Fluctuation accuracy (0 % to ± 30 % modulation)	0.025 %
Modulation depth setting resolution	0.001 %
Shape	Rectangular or sinusoidal
Duty cycle (shape = rectangular)	0.1 % to 99.99 %
Modulating frequency range	0.008 Hz to 30 Hz

Not available on Voltage or Current channels if Flicker is already enabled on that channel

Interharmonics

Frequency accuracy	500 ppm
Amplitude accuracy 16 Hz to < 6 kHz	1 %
Amplitude accuracy > 6 kHz	4 %
Maximum value of a single Interharmonic	The maximum value for an Interharmonic < 2850 Hz is 30 % of range.
Frequency range of Interharmonic	16 Hz to 9 kHz

Dips and Swells

Dip/Swell Minimum duration	1 µs
Dip/Swell Maximum duration	1 minute
Dip Minimum amplitude	0 % of the nominal output
Swell Maximum amplitude	The least of full range value and 140 % of the nominal output
Ramp up/down period	Settable 100 µs to 30 seconds
Optional repeat with delay	0 to 60 seconds ± 31 µs
Starting level amplitude accuracy	±0.025 % of level
Dip/Swell level amplitude accuracy	±0.25 % of level
Trigger out	TTL falling edge co-incident with end of trigger out delay, remaining low for 10 µs to 31 µs

6100A/E specifications

Pulse Inputs

Maximum frequency	5 MHz
Minimum pulse width	60 ns
Maximum counts per channel	2^{32}-1 (4,294,967,295)

Pulse and Gate Inputs

Input Low level maximum	1 V
Input High level minimum	3 V
Internal pull-up values	135 Ω and 940 Ω to 4.5 V nominal (Approximately equivalent to 150 Ω/1k Ω to 5V nominal)
Maximum input voltage	28 V (clamped @ 30 V approximately)
Minimum input voltage	0 V (clamped @ -0.5 V approximately)

Pulse Output

Drive	Open-collector with optional 470 Ω pull-up
Frequency range	0.011 Hz - 5 MHz
Frequency accuracy	± (50 ppm + 107 nHz)
External pull-up voltage	30 V maximum (clamped)
Sink current	150 mA maximum

Gate Output

Drive	Open-drain
Internal pull-up	As Gate-Input
External pull-up voltage	30 V maximum (clamped)
Sink current	1 A maximum

Accuracy

Counted/Timed timing accuracy	± (50 ppm + 60 ns)
Packet mode accuracy (ppm)	± (output power (ppm) + 50 ppm + 101,000/Test Duration (secs))

When very low pulse input rates are used (<1 Hz) the instantaneous power and frequency displays may be unstable and/or have poor resolution. However, the accumulated energy or counts are always accurate.

Test Duration

Maximum test duration	2500 hours

General specifications

Power	
Voltage	100 V to 240 V with up to ± 10 % fluctuations
Transient overvoltages	Impulse withstand (overvoltage) category II of IEC 60364-4-443
Frequency	47 Hz to 63 Hz
Maximum consumption	1000 VA maximum from 100 V to 130 V, 1250 VA maximum from 130 V to 260 V

Dimensions		
	6100A, 6101A and 6100A/E	6100A/80 A, 6101A/80 A and 6101A/E/80 A
Height	233 mm (9.17 inches)	324 mm (12.8 inches)
Height (without feet)	219 mm (8.6 inches)	310 mm (12.2 inches)
Width	432 mm (17 inches)	432 mm (17 inches)
Depth	630 mm (24.8 inches)	630 mm (24.8 inches)
Weight	23 kg (51 lb)	30 kg (66 lb)

Environment	
Operating temperature	5 °C to 35 °C
Calibration temperature (TCal) range	16 °C to 30 °C
Storage temperature	0 °C to 50 °C
Transit temperature	-20 °C to 60 °C < 100 hours
Warm up time	1 hour
Safe operating maximum relative humidity (non-condensing)	< 80 % 5 °C to 31 °C ramping linearly down to 50 % at 35 °C
Storage maximum relative humidity (non-condensing)	<95 % 0 °C to 50 °C
Operating altitude	0 m to 2,000 m
Non operating altitude	0 m to 12,000 m
Shock	MIL-PRF-28800F class 3
Vibration	MIL-PRF-28800F class 3
Enclosure	MIL-PRF-28800F class 3

Safety

Designed to EN61010-1: 2001, CAN/CSA 22.2 No 1010.1-92, UL61010A-1
Indoor use only, pollution degree 2; installation category II
CE marked and ETL listed

EMC

EN61326: 2002, class A[1], FCC rules part 15, sub-part B, class A

[1] (Class A equipment is suitable for use in establishments other than domestic, and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes).

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6100A Electrical Power Standard

Ordering information

Model

6100A Electrical Power Standard Master comprises:
- One phase, (one voltage channel to 1000 V, one current channel to 21 A)
- User controls and display system
- Interfacing via GPIB/RS232
- Interfacing to Auxiliary Unit
- Line cord
- Lead kit
- User manual

6101A Auxiliary Power Standard comprises:
- One phase, (one voltage channel to 1000 V, one current channel to 21 A)
- Cable and interfacing to connect to Master
- Line cord
- Lead kit

6100A/80A Electrical Power Standard Master comprises:
- One phase, (one voltage channel to 1000 V, one current channel to 80 A)
- User controls and display system
- Interfacing via GPIB/RS232
- Interfacing to Auxiliary Unit
- Line cord
- Lead kit
- User manual

6101A/80A Auxiliary Power Standard comprises:
- One phase, (one voltage channel to 1000 V, one current channel to 80 A)
- Cable and interfacing to connect to Master
- Line cord
- Lead kit

6100A/E Electrical Power Standard Master comprises:
- One phase, (one voltage channel to 1000 V, one current channel to 21 A) with energy counting option fitted
- User controls and display system
- Interfacing via GPIB/RS232
- Interfacing to Auxiliary Unit
- Line cord
- Lead kit
- User manual

6100A/E/80A Electrical Power Standard comprises:
- One phase, (one voltage channel to 1000 V, one current channel to 80 A) with energy counting option fitted
- Cable and interfacing to connect to Master
- Line cord
- Lead kit
- User manual

Complete systems

6120A complete 2-phase system comprises:
- One 6100A
- One 6101A

6130A complete 3-phase system comprises:
- One 6100A
- Two 6101As

6140A complete 4-phase system comprises:
- One 6100A
- Three 6101As

Complete 6100A/80A systems

6120A/80A complete 2-phase system comprises:
- One 6100 A/80A
- One 6101 A/80A

6130A/80A complete 3-phase system comprises:
- One 6100A/80A
- Two 6101A/80As

6140A/80A complete 4-phase system comprises:
- One 6100A/80A
- Three 6101A/80As

Complete 6100A/E systems

6120A/E complete 2-phase system comprises:
- One 6100A/E
- One 6101A

6130A/E complete 3-phase system comprises:
- One 6100A/E
- Two 6101As

6140A/E complete 4-phase system comprises:
- One 6100A/E
- Three 6101As

Complete 6100A/E/80A systems

6120A/E/80A complete 2-phase system comprises:
- One 6100A/E/80A
- One 6101A/80A

6130A/E/80A complete 3-phase system comprises:
- One 6100A/E/80A
- Two 6101A/80As

6140A/E/80A complete 4-phase system comprises:
- One 6100A/E/80A
- Three 6101A/80As

Accessories

6100-CASE
6100A/6101A Transit case

Y6100
6100A/6101A Rack Mount Kit

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6100A Electrical Power Standard

6100A Electrical Power Standard

6101A Auxiliary Power Standard

6100A/E Electrical Power Standard

6100A/80A Electrical Power Standard

6100A/E/80A Electrical Power Standard

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