PA1000

Single Phase AC/DC Power Analyzer Datasheet

The Tektronix PA1000 is a single-phase, single-channel power analysis solution that is optimized for fast, efficient, and accurate power consumption testing to international standards. It's compact size, DMM-like user-interface, graphical display, and powerful software enable users to quickly visualize, analyze, and document the power consumption efficiency of next-generation devices, including standby power measurements and harmonic analysis.

Key specifications

- 1 MHz bandwidth
- 5 mW standby power measurements
- Harmonic analysis to the 50th order (standard)
- +/- 0.04% basic accuracy
- 20 µA to 20 Arms direct current input
- 1 V to 600 Vrms (Cat II) voltage input
- USB, LAN, and GPIB interfaces (standard)
- Three-year warranty

Essential power measurement tool for the R&D bench

- Harmonic analysis to IEC/EN 61000-3-2 / 4-7 (pre-compliance testing to the 50th order)
- Standby power analysis to IEC 62301 / EN 50564 (full compliance testing as low as 5mW)
- Supports additional testing to CE, EnergyStar, CEC, SPEC Power® [1], CQC-3146, NOM-32-ENER-2013, and more
- Transient analysis with 1M sample/sec continuous sampling
- Measure voltage, current, power, VA, WHr, THD, PF, CF, and more
- Convenient front-panel banana jack inputs, color graphical display, and PWRVIEW software to simplify usage and boost productivity
- Optional breakout test box simplifies AC line connections between your device under test and the PA1000

Applications

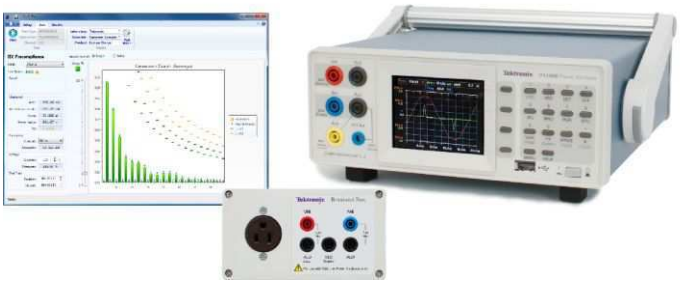
Power, energy, standby power, and harmonics measurements for:

- Power supply and UPS
- LED drivers / lighting
- Wireless charging
- Consumer electronics
- Home appliances
- Computers and IT equipment
- Inverters and converters
- Battery chargers

1 Spec Power® is a registered trademark of the Standard Performance Evaluation Corporation (SPEC)

Complete power consumption analysis

Most of today's AC-powered electronics and electro-mechanical products have government or consumer efficiency regulations they must meet. The PA1000 simplifies the process of proving that designs meet these requirements by offering a complete bench-top solution for single phase power consumption analysis. Use the standard front-panel input jacks and optional breakout box to simplify connections to the device under test, then analyze and document the results with the free PWRVIEW software.

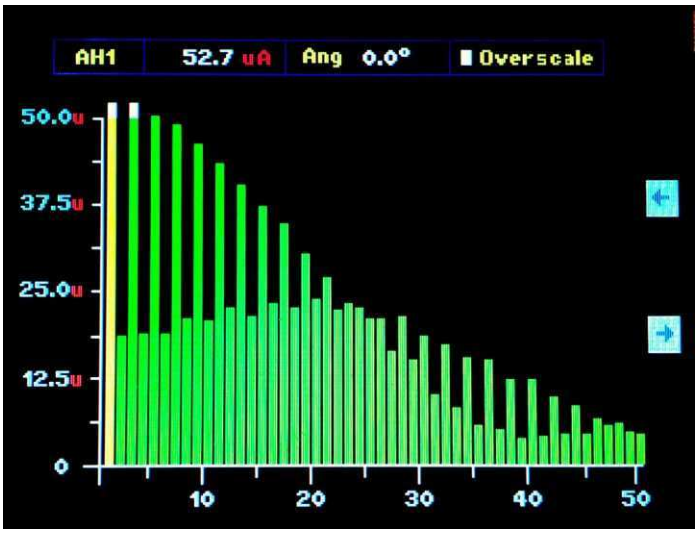


Easily and accurately measure harmonic performance, standby power, and more with the PA1000, optional breakout box, and free PWRVIEW software

Visualize signals

The color graphics display on the PA1000 provides intuitive readout of measured values, harmonic bar charts, waveforms, energy integration plots, and more. Setup is easy using the menu-driven interface and soft keys.

Full color waveform display



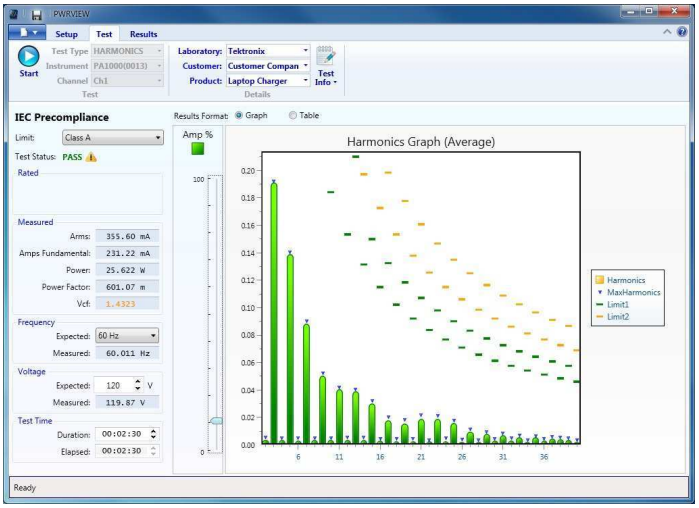
Harmonic bar chart display mode

Analyze data

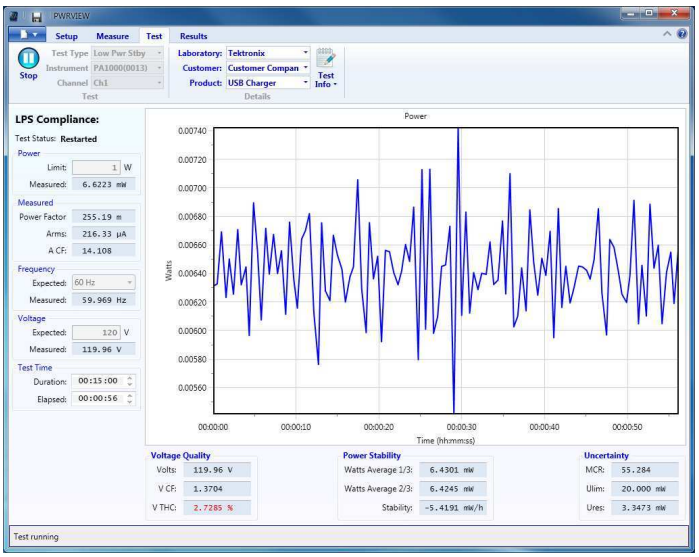
The PA1000 features harmonics analysis to the 50th order as a standard feature. Harmonics, THD, and related measurements can all be analyzed simultaneously with other power parameters.

The PA1000's free PWRVIEW software enables:

- Viewing measurement data and system uncertainty in real-time, including waveforms, trend plots, and more.
- Creating and applying limits you define for simplified pass/fail testing of any parameter, including those based on user-defined math functions.
- Automating instrument setup, data collection, and report generation for key applications with just a few clicks using wizard-driven interfaces.
- Communicating with multiple PA1000 instruments for calculation of power efficiency and other parameters.
- IEC 61000-3-2 / 4-7 Current harmonics, pre-compliance testing.
- IEC 62301 / EN 50564 Standby power, full-compliance testing.



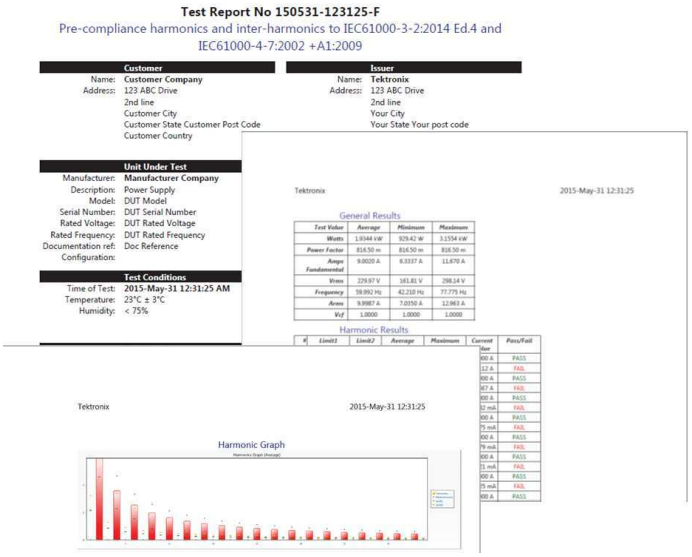
IEC 61000-3-2 current harmonic testing



IEC 62301 Standby power test with real time uncertainty and stability measurements

Document results

PWRVIEW software can automatically generate formatted test reports for IEC 61000-3-2 and 4-7 harmonics (pre-compliance) or IEC 62301 standby power (full compliance). These test reports include pass/fail results, data tables, graphs, and more… everything necessary to prove design performance and ensure a successful result in the compliance test lab.



Specifications

Available measurements

V_{rms} - Volts RMS	VTHD - Volts Total Harmonic Distortion
	V_{DF} - Voltage distortion factor
A_{rms} - Amps RMS	ATHD - Amps Total Harmonic Distortion
	A_{DF} - Current distortion factor
WATT - True power	Z - Impedance
VA - Apparent power	R - Resistance
VAR - Reactive power	X - Reactance
FREQ - Frequency	HR - Integrator time
PF - Power factor	WHr - Watt Hours
VPK+ - Volts peak (positive)	VAHr - VA Hours
VPK- - Volts peak (negative)	VARHr - VAR Hours
APK+ - Amps peak (positive)	AHr - Amp Hours
APK- - Amps peak (negative)	Vh - Volts harmonics
VDC - Volts DC	Ah - Amps harmonics
ADC - Amps DC	
VCF - Voltage crest factor	
ACF - Current crest factor	

Voltage and current ranges

Voltage ranges	1000 V_{peak}, 500 V_{peak}, 200 V_{peak}, 100 V_{peak}, 50 V_{peak}, 20 V_{peak}, 10 V_{peak}
Current ranges (20 A shunt)	100 A_{peak}, 50 A_{peak}, 20 A_{peak}, 10 A_{peak}, 5 A_{peak}, 2 A_{peak}, 1 A_{peak}, 0.5 A_{peak}, 0.2 A_{peak}, 0.1 A_{peak}
Current ranges (1 A shunt)	2.0 A_{peak}, 1.0 A_{peak}, 0.4 A_{peak}, 0.2 A_{peak}, 0.1 A_{peak}, 0.04 A_{peak}, 0.02 A_{peak}, 0.01 A_{peak}, 0.004 A_{peak}, 0.002 A_{peak}

Measurement accuracy - voltage

Voltage accuracy, V_{RMS} (45 Hz to 850 Hz)	± 0.04% of Reading ± 0.04% of Range ± 0.005 V
Voltage accuracy, V_{RMS} (10 Hz to 45 Hz, 850 Hz to 1 MHz, typical)	± 0.1% of Reading ± 0.1% of Range ± (0.02*F)% of Reading ± 0.05 V
Voltage accuracy, DC (typical)	± 0.1% of Reading ± 0.1% of Range ± 0.05 V
Effect of common mode (typical)	100 V, 100 kHz < 500 mV

Measurement accuracy - current

Current accuracy, A_{RMS} (45 Hz to 850 Hz) [2]	± 0.04% of Reading ± 0.04% of Range ± (1.8 µV/Z_{ext})
Current accuracy, A_{RMS} (10 Hz to 45 Hz, 850 Hz to 1 MHz, typical)	± 0.1% of Reading ± 0.1% of Range ± (0.02*F)% of Reading ± (50 µV/Z_{ext})
Current accuracy, DC (typical)	± 0.1% of Reading ± 0.1% of Range ± (100 µV/Z_{ext})

2 Offset is valid in low bandwidth, with internal shunts, and after a manual zero has been performed. Offset is 10 µV/Z_{ext} in high bandwidth, and with external shunt.

Current - peak inrush accuracy (100 A_{peak} range)	2% of Range ± 20 mA
Effect of common mode (typical)	100 V, 100 kHz, 20 A shunt < 15 mA 100 V, 100 kHz, 1 A shunt < 500 µA 100 V, 100 kHz, external shunt < 40 mV

Measurement accuracy - frequency

Frequency (10 Hz to 20 kHz)	0.1% of Reading, with the peak of the signal extending 10% above and 10% below the DC level
Frequency (20 kHz to 1 MHz)	0.1% of Reading, with the peak of the signal extending 25% above and 25% below the DC level

Measurement accuracy - power

Watts accuracy	± 0.075% of Reading ± 0.075% of Range (PF=1, 45 - 850 Hz)
VA accuracy	$(Vrms^{acc} \times Arms) + (Arms^{acc} \times Vrms)$
VAR accuracy (typical)	$\sqrt{[VA \pm VA_{error}]^2 - [W \pm W_{error}]^2} - \sqrt{VA^2 - W^2}$
PF Accuracy	$\cos\theta - \cos[\theta \pm (Vh1_{ph.err} \pm Ah1_{ph.err})] \pm 0.002$

Measurement accuracy - harmonic magnitude and phase (typical)

Voltage harmonics magnitude (10 Hz to 480 kHz)	± 0.02% of Reading ± 0.1% of Range ± (0.04*F)% of Reading ± 0.05 V
Voltage harmonics phase	$\pm 0.04 \pm [0.01 * (V_{range} / V_{reading})] \pm (0.1 / V_{range}) \pm (0.005 * F)$
Current harmonics magnitude (10 Hz to 480 kHz)	± 0.2% of Reading ± 0.1% of Range ± (0.04*F)% of Reading ± (50 µV / Z_{ext})
Current harmonics phase	$\pm 0.04 \pm [0.01 * (A_{range} / A_{reading})] \pm (0.001 / A_{range} * Z_{ext}) \pm (0.005 * F)$

Physical characteristics

Dimensions	**mm**	**in**
Height	102	4.0
Width	223	8.7
Depth	285	11.2
Weight	**Kg**	**lb**
Net (without lead set)	3.2	7.0
Temperature	**C**	**F**
Operating	0 °C to +40 °C	+32 °F to +102 °F
Nonoperating	-20 °C to +60 °C	-4 °F to +140 °F

Notes:

All stated accuracies are based upon a minimum of a 30-minute warm-up period.

Z_{ext} is the external shunt impedance used and must be less than or equal to 10 Ohms.

If no frequency is measured, then the signal is considered DC for the purpose of accuracy.

F is the frequency measured in kHz. In the case of harmonics, F is the harmonic frequency.

Specifications are valid from 1 to 100% of range in low bandwidth and after a manual zero has been performed. Values below 1% are typical.

In high bandwidth, specifications are valid when the signal is greater than 10% of the range.

Harmonic specifications are always valid when the harmonic is greater than 2% of the range.

Measurement conditions during calibration: Instrument default settings unless otherwise stated, sine waves applied to V and I inputs, 30 min warm up, ambient temperature 23 °C ±5 °C.

Ordering information

Models

PA1000	Single-phase power analyzer

Standard accessories

Voltage lead set	
Country-specific power cord	
USB host-to-device interface cable	
Documentation CD	Includes user manual in English, French, German, Spanish, Japanese, Portuguese, Simplified Chinese, Traditional Chinese, Korean, and Russian languages.
Certificate of calibration	Documents the traceability to National Metrology Institute(s) and ISO9001 Quality System Registration
Three year product warranty	

Recommended accessories

BB1000-NA	Breakout box (North America plug configuration)
BB1000-EU	Breakout box (Europe plug configuration)
BB1000-UK	Breakout box (United Kingdom plug configuration)
BALLAST-CT	Specialty current transducer for lamp ballast testing
CL200	Current clamp, 1 A - 200 A, for Tektronix Power Analyzers
CL1200	Current clamp, 0.1 A - 1200 A, for Tektronix Power Analyzers
PA-LEADSET	Replacement lead set for Tektronix Power Analyzers (one channel lead set)

BB1000-NA breakout box

The Tektronix breakout box provides an easy way to make wiring connections between your device under test and the Tektronix power analyzer. Your device power cord plugs directly into the outlet on the breakout box (choose the version that best matches the connector style for your geography).

Connection to the power analyzer is then simple, using the standard input lead set with 4 mm safety banana connectors that are provided as a standard accessory with the power analyzer.

Power plug options

Opt. A0	North America power plug (115 V, 60 Hz)
Opt. A1	Universal Euro power plug (220 V, 50 Hz)
Opt. A2	United Kingdom power plug (240 V, 50 Hz)
Opt. A3	Australia power plug (240 V, 50 Hz)
Opt. A4	North America power plug (240 V, 50 Hz)
Opt. A5	Switzerland power plug (220 V, 50 Hz)
Opt. A6	Japan power plug (100 V, 50/60 Hz)
Opt. A10	China power plug (50 Hz)
Opt. A11	India power plug (50 Hz)
Opt. A12	Brazil power plug (60 Hz)
Opt. A99	No power cord

Service options

Opt. C3	Calibration Service 3 Years
Opt. C5	Calibration Service 5 Years
Opt. D1	Calibration Data Report
Opt. D3	Calibration Data Report 3 Years (with Opt. C3)
Opt. D5	Calibration Data Report 5 Years (with Opt. C5)
Opt. R5	Repair Service 5 Years (including warranty)
Opt. R5DW	Repair Service Coverage 5 Years (includes product warranty period). 5-year period starts at time of instrument purchase

CE

Tektronix is registered to ISO 9001 and ISO 14001 by SRI Quality System Registrar.

GPIB IEEE-488

Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

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For Further Information. Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit www.tektronix.com.

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