Power Analyzer

PA1000 Datasheet

The Tektronix PA1000 is your best choice for making precision power measurements on single-phase power supplies and all types of products connected to the AC line. Whether you need to test for compliance with energy-usage regulations such as Energy Star™, or simply need to characterize your product's overall power-conversion performance and efficiency, you will find the PA1000 offers the most modern and complete test solution with performance and features unmatched by other single-phase analyzers.

Key performance specifications

- High measurement accuracy of 0.05% (basic voltage/current accuracy)
- 1 MHz bandwidth / 1 MS/s sample rate for demanding test requirements
- Up to 600 V_{RMS} voltage input
- Up to 20 A_{RMS} current input

Key features

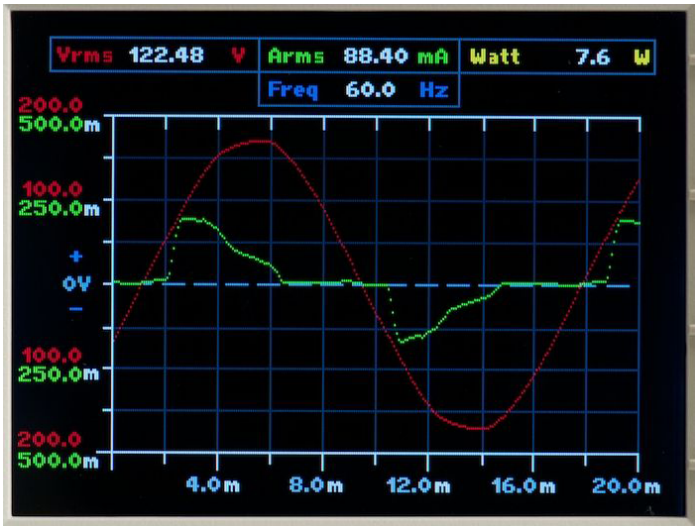
- Bright color graphics display makes instrument setup and data readout easy
- Dual internal current shunts maximize accuracy for high- and low-current measurements
- Application-specific test modes simplify instrument setup and reduce the likelihood of user error
- Easy data export to USB flash drive or remote PC software, for reporting and analysis
- PWRVIEW PC software provides fully automated compliance testing to IEC 62301 requirements
- Many standard features such as GPIB, USB, Ethernet and harmonic analysis eliminate costly upgrade options

Applications

- Standby power and Energy Star™ compliance testing
- Lighting ballasts
- Consumer electronics and appliances
- Power supply testing
- Energy efficiency of any single-phase product

Bright graphics display

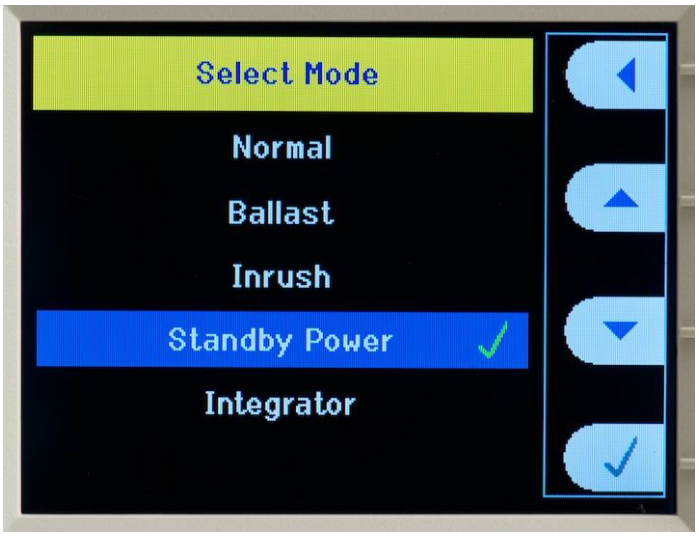
The color graphics display on the PA1000 is unmatched among single-phase power analyzers. It provides intuitive readout of not only measurement values, but also harmonic bar charts, waveform display, energy integration plots and more. Setup of the PA1000 for your particular application is also easy and flexible, using the menu-driven interface and soft keys.



Full color display

Application-specific test modes

Some applications require special instrument settings to ensure proper measurements. The PA1000 simplifies setup for these applications by automatically choosing instrument settings and parameters that are optimized for each type of measurement application, resulting in more reliable measurement results with less opportunity for user setup error.



Selection of application-specific test modes

Ballast mode - Synchronizes measurements for highly modulated electronic ballast waveforms. In modern electronic lighting ballasts, it is often difficult to make accurate measurements because the output signals are high frequency waveforms that are heavily modulated by the power frequency. Ballast mode provides a way of locking the measurement period to the power frequency.

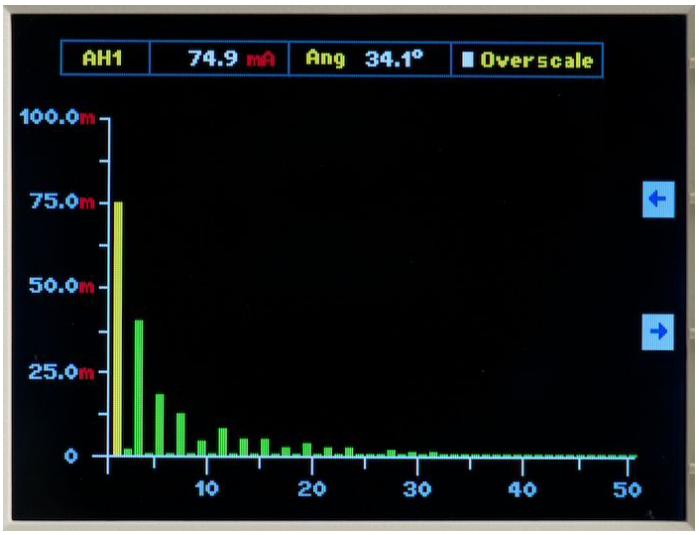
Standby power mode - Driven by consumer demand and energy efficiency regulations (such as ENERGY STAR), there is an ever-increasing need to measure power consumption of products while they are in standby mode. One of the most widely used standards for measurement is IEC 62301. Part of this standard requires the measurement of power over a prolonged period of time without missing any short duration power events. The PA1000 standby power mode provides continuous sampling of voltage and current to produce an accurate Watts measurement over the user specified period.

Inrush mode - For measuring the peak current during any event. Typically this is used to measure the peak current when a product is first switched on.

Integrator mode - Used to provide measurements for determining energy consumption (Watt-hours, Ampere-hours, etc.).

Standard harmonics analysis

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



Harmonics bar chart display mode

Standard communication ports

The PA1000 comes standard with USB, Ethernet and GPIB communication ports, plus a front-mounted USB port for data logging to a flash drive.

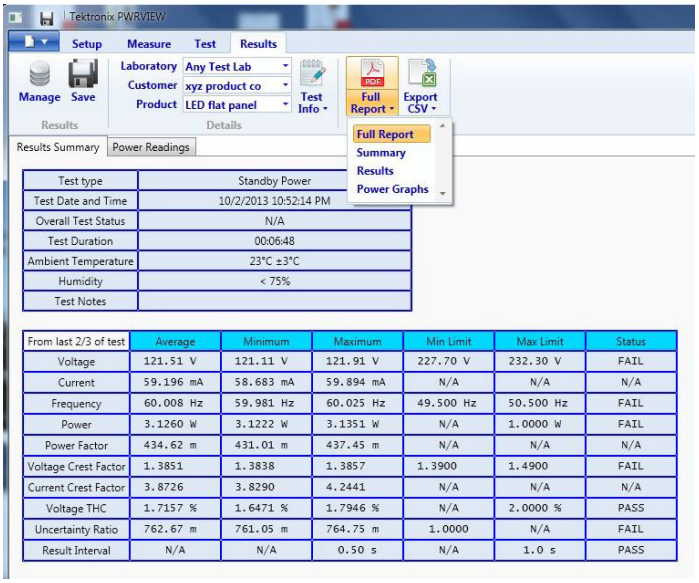
PA1000 rear panel communication ports

PWRVIEW PC software for the PA1000 Power Analyzer

PWRVIEW is a supporting software application for Windows PCs that compliments and extends the functionality of the PA1000. PWRVIEW enables you to do the following:

- Communicate with the PA1000 over any of the instrument comm ports
- Change instrument settings remotely
- Transfer, view, and save measurement data in real-time from the instrument, including waveforms, harmonic bar charts, and plots
- Log measurement data over a period of time
- Communicate with and download data from multiple PA1000 instruments
- Create formulae for the calculation of power conversion efficiency and other values
- Export measurement data to .csv format for import into other applications
- Automate instrument setup, data collection, and report generation for key applications with just a few clicks, using wizard-driven interfaces
- Perform automated full compliance testing for Low Power Standby per IEC 62301, Edition 2
- Additional test automation will be added with future releases

PWRVIEW full compliance test screen



Full test results report

Specifications

All specifications apply to all models unless noted otherwise.

Available measurements

V_{rms} - Volts RMS	VTHD - Volts Total Harmonic Distortion
A_{rms} - Amps RMS	ATHD - Amps Total Harmonic Distortion
WATT - Watts	Z - Impedance
VA - Volt-Amps	R - Resistance
VAR - Volt-Amps reactive	X - Reactance
FREQ - Frequency	HR - Integrator time
PF - Power factor	WHR - Watt Hours
VPK+ - Volts peak (positive)	VAHrs - VA Hours
VPK- - Volts peak (negative)	VArHr - VAr Hours
APK+ - Amps peak (positive)	AHR - Amp Hours
APK- - Amps peak (negative)	V-harm - Voltage harmonics
VDC - Volts DC	A-harm - Ampere harmonics
ADC - Amps DC	V range
VCF - Voltage crest factor	A range
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) [1]	± 0.05% of Reading ± 0.05% of Range ± 0.05 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 (typical)
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) [1]	± 0.05% of Reading ± 0.05% of Range ± (50 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}) (typical)
Current accuracy, DC (typical)	± 0.1% of Reading ± 0.1% of Range ± (100 µV/Z_{ext})
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 [1]	± 0.075% of Reading ± 0.075% of Range (PF=1)
VA accuracy [1]	± 0.075% of Reading ± 0.075% of Range
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) [1]

Voltage harmonics magnitude (10 Hz to 1 MHz)	± 0.02% of Reading ± 0.1% of Range ± (0.04*F)% of Reading ± 0.05 V
Voltage harmonics phase	$\pm 0.1 \pm [0.01 * V_{range} / V_{reading})] \pm (0.2 / V_{range}) \pm (0.005 * F)$
Current harmonics magnitude (10 Hz to 1 MHz)	± 0.2% of Reading ± 0.1% of Range ± (0.04*F)% of Reading ± (50 µV /Z_{ext})
Current harmonics phase	$\pm 0.1 \pm [0.01 * A_{range} / A_{reading})] \pm (0.002 / A_{range} * Z_{ext})) \pm (0.005 * F)$

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

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

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

Specifications are valid only when applicable voltage and current inputs are >10% of range. The exception is harmonics where the specification is valid when the magnitude of the harmonic is >2% of range.

Measurement conditions during calibration: Instrument default settings unless otherwise stated, Sine waves applied to V and I inputs, 30 minute warm-up, 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
Five 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, 110/120 V, 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)

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.

ASEAN / Australasia (65) 6356 3900
Belgium 00800 2255 4835*
Central East Europe and the Baltics +41 52 675 3777
Finland +41 52 675 3777
Hong Kong 400 820 5835
Japan 81 (3) 6714 3010
Middle East, Asia, and North Africa +41 52 675 3777
People's Republic of China 400 820 5835
Republic of Korea 001 800 8255 2835
Spain 00800 2255 4835*
Taiwan 886 (2) 2722 9622

Austria 00800 2255 4835*
Brazil +55 (11) 3759 7627
Central Europe & Greece +41 52 675 3777
France 00800 2255 4835*
India 000 800 650 1835
Luxembourg +41 52 675 3777
The Netherlands 00800 2255 4835*
Poland +41 52 675 3777
Russia & CIS +7 (495) 6647564
Sweden 00800 2255 4835*
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Balkans, Israel, South Africa and other ISE Countries +41 52 675 3777
Canada 1 800 833 9200
Denmark +45 80 88 1401
Germany 00800 2255 4835*
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Mexico, Central/South America & Caribbean 52 (55) 56 04 50 90
Norway 800 16098
Portugal 80 08 12370
South Africa +41 52 675 3777
Switzerland 00800 2255 4835*
USA 1 800 833 9200

* European toll-free number. If not accessible, call: +41 52 675 3777

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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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