

# 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. Its 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 50<sup>th</sup> order (standard)
- +/- 0.04% basic accuracy
- 20  $\mu$ A 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 50<sup>th</sup> 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<sup>®</sup> 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

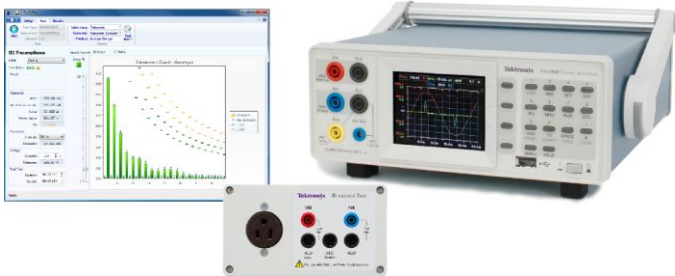
Power, energy, standby power, and harmonics measurements for:

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

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

## Complete power consumption analysis

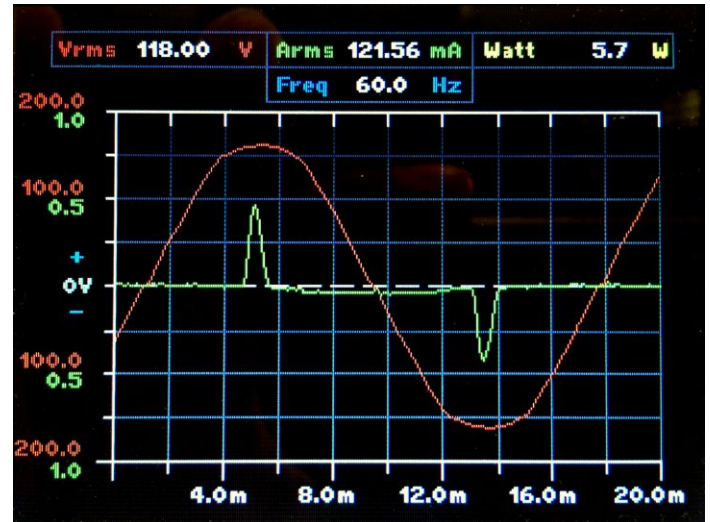
Most of today's AC-powered electronics and electro-mechanical products have government or consumer efficiency regulations they must meet. The PA1000 simplifies the process of proving that designs meet these requirements by offering a complete bench-top solution for single phase power consumption analysis. 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.



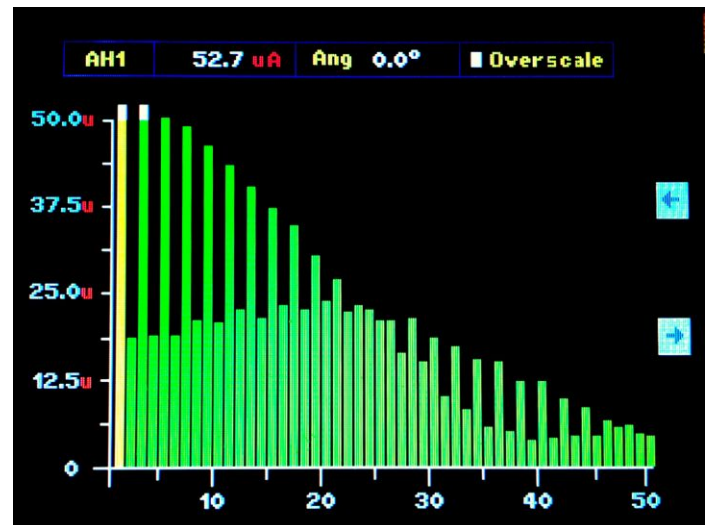
Easily and accurately measure harmonic performance, standby power, and more with the PA1000, optional breakout box, and free PWRVIEW software

## 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



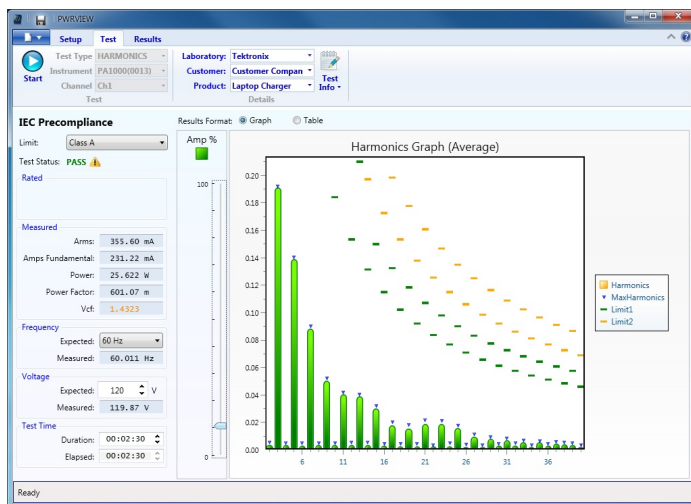
Harmonic bar chart display mode

## Analyze data

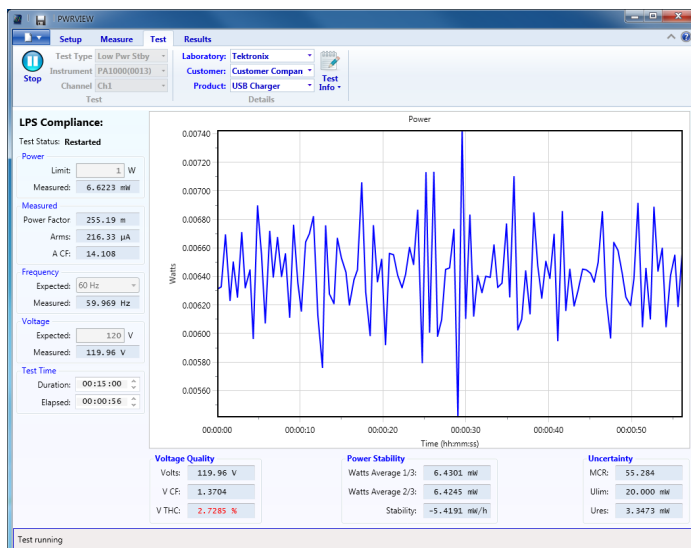
The PA1000 features harmonics analysis to the 50<sup>th</sup> order as a standard feature. Harmonics, THD, and related measurements can all be analyzed simultaneously with other power parameters.

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.



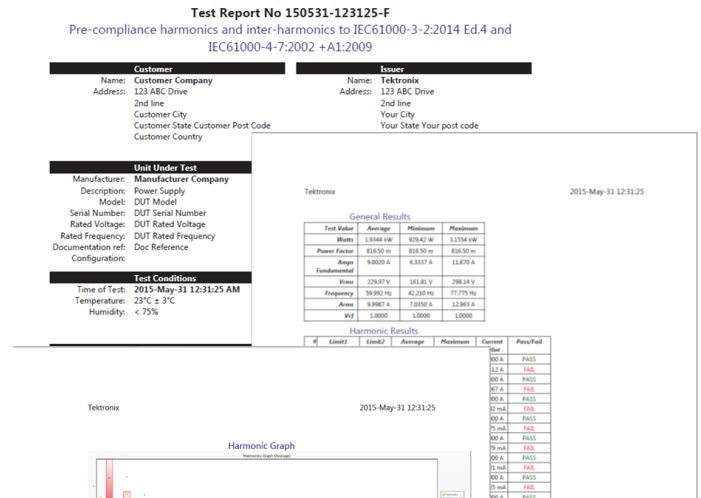
IEC 61000-3-2 current harmonic testing



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 <sub>rms</sub> - Volts RMS | VTHD - Volts Total Harmonic Distortion      |
|                              | V <sub>DF</sub> - Voltage distortion factor |
| A <sub>rms</sub> - Amps RMS  | ATHD - Amps Total Harmonic Distortion       |
|                              | A <sub>DF</sub> - 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

|                                    |                                                                                                                                                                                                                                                      |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Voltage ranges</b>              | 1000 V <sub>peak</sub> , 500 V <sub>peak</sub> , 200 V <sub>peak</sub> , 100 V <sub>peak</sub> , 50 V <sub>peak</sub> , 20 V <sub>peak</sub> , 10 V <sub>peak</sub>                                                                                  |
| <b>Current ranges (20 A shunt)</b> | 100 A <sub>peak</sub> , 50 A <sub>peak</sub> , 20 A <sub>peak</sub> , 10 A <sub>peak</sub> , 5 A <sub>peak</sub> , 2 A <sub>peak</sub> , 1 A <sub>peak</sub> , 0.5 A <sub>peak</sub> , 0.2 A <sub>peak</sub> , 0.1 A <sub>peak</sub>                 |
| <b>Current ranges (1 A shunt)</b>  | 2.0 A <sub>peak</sub> , 1.0 A <sub>peak</sub> , 0.4 A <sub>peak</sub> , 0.2 A <sub>peak</sub> , 0.1 A <sub>peak</sub> , 0.04 A <sub>peak</sub> , 0.02 A <sub>peak</sub> , 0.01 A <sub>peak</sub> , 0.004 A <sub>peak</sub> , 0.002 A <sub>peak</sub> |

### Measurement accuracy - voltage

|                                                                                           |                                                                   |
|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| <b>Voltage accuracy, V<sub>RMS</sub></b><br>(45 Hz to 850 Hz)                             | ± 0.04% of Reading ± 0.04% of Range ± 0.005 V                     |
| <b>Voltage accuracy, V<sub>RMS</sub></b><br>(10 Hz to 45 Hz,<br>850 Hz to 1 MHz, typical) | ± 0.1% of Reading ± 0.1% of Range ± (0.02°F)% of Reading ± 0.05 V |
| <b>Voltage accuracy, DC (typical)</b>                                                     | ± 0.1% of Reading ± 0.1% of Range ± 0.05 V                        |
| <b>Effect of common mode</b><br>(typical)                                                 | 100 V, 100 kHz < 500 mV                                           |

### Measurement accuracy - current

|                                                                                           |                                                                                      |
|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| <b>Current accuracy, A<sub>RMS</sub></b><br>(45 Hz to 850 Hz) <sup>2</sup>                | ± 0.04% of Reading ± 0.04% of Range ± (1.8 μV/Z <sub>ext</sub> )                     |
| <b>Current accuracy, A<sub>RMS</sub></b><br>(10 Hz to 45 Hz,<br>850 Hz to 1 MHz, typical) | ± 0.1% of Reading ± 0.1% of Range ± (0.02°F)% of Reading ± (50 μV/Z <sub>ext</sub> ) |
| <b>Current accuracy, DC (typical)</b>                                                     | ± 0.1% of Reading ± 0.1% of Range ± (100 μV/Z <sub>ext</sub> )                       |

<sup>2</sup> Offset is valid in low bandwidth, with internal shunts, and after a manual zero has been performed. Offset is 10 μV/Z<sub>ext</sub> in high bandwidth, and with external shunt.

|                                                                    |                                                                                                                    |
|--------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| <b>Current - peak inrush accuracy (100 A<sub>peak</sub> range)</b> | 2% of Range ± 20 mA                                                                                                |
| <b>Effect of common mode (typical)</b>                             | 100 V, 100 kHz, 20 A shunt < 15 mA<br>100 V, 100 kHz, 1 A shunt < 500 µA<br>100 V, 100 kHz, external shunt < 40 mV |

#### Measurement accuracy - frequency

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

#### Measurement accuracy - power

|                               |                                                                                                               |
|-------------------------------|---------------------------------------------------------------------------------------------------------------|
| <b>Watts accuracy</b>         | ± 0.075% of Reading ± 0.075% of Range (PF=1, 45 - 850 Hz)                                                     |
| <b>VA accuracy</b>            | (V <sub>rms</sub> <sup>acc</sup> x A <sub>rms</sub> ) + (A <sub>rms</sub> <sup>acc</sup> x V <sub>rms</sub> ) |
| <b>VAR accuracy (typical)</b> | $\sqrt{[VA \pm VA_{error}]^2 - [W \pm W_{error}]^2} - \sqrt{VA^2 - W^2}$                                      |
| <b>PF Accuracy</b>            | $\cos \theta - \cos [\theta \pm (V_{h1} \pm A_{h1} \pm \theta_{ph.err})] \pm 0.002$                           |

#### Measurement accuracy - harmonic magnitude and phase (typical)

|                                                       |                                                                                                                                 |
|-------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| <b>Voltage harmonics magnitude (10 Hz to 480 kHz)</b> | ± 0.02% of Reading ± 0.1% of Range ± (0.04*F)% of Reading ± 0.05 V                                                              |
| <b>Voltage harmonics phase</b>                        | ± 0.04 ± [0.01 * (V <sub>range</sub> / V <sub>reading</sub> )] ± (0.1 / V <sub>range</sub> ) ± (0.005 * F)                      |
| <b>Current harmonics magnitude (10 Hz to 480 kHz)</b> | ± 0.2% of Reading ± 0.1% of Range ± (0.04*F)% of Reading ± (50 µV / Z <sub>ext</sub> )                                          |
| <b>Current harmonics phase</b>                        | ± 0.04 ± [0.01 * (A <sub>range</sub> / A <sub>reading</sub> )] ± (0.001 / A <sub>range</sub> * Z <sub>ext</sub> ) ± (0.005 * F) |

## Physical characteristics

| Dimensions             | mm               | in                |
|------------------------|------------------|-------------------|
| Height                 | 102              | 4.0               |
| Width                  | 223              | 8.7               |
| Depth                  | 285              | 11.2              |
| <b>Weight</b>          | <b>Kg</b>        | <b>lb</b>         |
| Net (without lead set) | 3.2              | 7.0               |
| <b>Temperature</b>     | <b>C</b>         | <b>F</b>          |
| 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<sub>ext</sub> 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 |



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



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

PA1000 Power Analyzer

|                                                            |                                                      |                                                                              |
|------------------------------------------------------------|------------------------------------------------------|------------------------------------------------------------------------------|
| <b>ASEAN / Australasia</b> (65) 6356 3900                  | <b>Austria</b> 00800 2255 4835*                      | <b>Balkans, Israel, South Africa and other ISE Countries</b> +41 52 675 3777 |
| <b>Belgium</b> 00800 2255 4835*                            | <b>Brazil</b> +55 (11) 3759 7627                     | <b>Canada</b> 1 800 833 9200                                                 |
| <b>Central East Europe and the Baltics</b> +41 52 675 3777 | <b>Central Europe &amp; Greece</b> +41 52 675 3777   | <b>Denmark</b> +45 80 88 1401                                                |
| <b>Finland</b> +41 52 675 3777                             | <b>France</b> 00800 2255 4835*                       | <b>Germany</b> 00800 2255 4835*                                              |
| <b>Hong Kong</b> 400 820 5835                              | <b>India</b> 000 800 650 1835                        | <b>Italy</b> 00800 2255 4835*                                                |
| <b>Japan</b> 81 (3) 6714 3010                              | <b>Luxembourg</b> +41 52 675 3777                    | <b>Mexico, Central/South America &amp; Caribbean</b> 52 (55) 56 04 50 90     |
| <b>Middle East, Asia, and North Africa</b> +41 52 675 3777 | <b>The Netherlands</b> 00800 2255 4835*              | <b>Norway</b> 800 16098                                                      |
| <b>People's Republic of China</b> 400 820 5835             | <b>Poland</b> +41 52 675 3777                        | <b>Portugal</b> 80 08 12370                                                  |
| <b>Republic of Korea</b> +822 6917 5084, 822 6917 5080     | <b>Russia &amp; CIS</b> +7 (495) 6647564             | <b>South Africa</b> +41 52 675 3777                                          |
| <b>Spain</b> 00800 2255 4835*                              | <b>Sweden</b> 00800 2255 4835*                       | <b>Switzerland</b> 00800 2255 4835*                                          |
| <b>Taiwan</b> 886 (2) 2656 6688                            | <b>United Kingdom &amp; Ireland</b> 00800 2255 4835* | <b>USA</b> 1 800 833 9200                                                    |

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

**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](http://www.tektronix.com).

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