• Digital Multimeters • Component Meters •
• Current Measurement • Power Source Testing •
• Frequency Measurement • RF Spectrum Analysis •
• RF Signal Generation • Power & EMC Harmonics Analysis •

tti-test.com
1. Precision Measurement

Product Range

Digital Multimeters - page 1
Bench-top multimeters with from 4½ to 5½ digit resolution, all with true rms ac and digital control interfaces.

Component Measurement - page 3
Precision LCR bridge, micro-ohm meter.

I-Prober Current Probe - page 4
Innovative probe for applications that include non-contact measurement of currents in PCB tracks.

Power Source Testing - page 5
Electronic DC Load for power supply and battery testing. Proving unit for volt-sticks.

Frequency Measurement - page 6
Bench-top universal counter and handheld frequency meter.

RF and EMC Test Equipment page 7 onwards

Precision measurement instruments
TTi has been designing and manufacturing precision measurement instruments for nearly thirty years. Expertise in precision analog design has enabled the company to offer high performance products with advanced features at attractive prices.

TTi offers instruments for the precision measurement of all of the fundamental electronic parameters including voltage, current, resistance, capacitance, inductance, power and frequency.

The new I-Prober open field current probe will enable the measurement of current in situations where it was previously not possible.

Digital Multimeters

Bench-top DMMs versus hand-held
Low cost hand-held DMMs have replaced bench-top DMMs in many applications. Although the performance of these meters may be sufficient for some tasks, it is likely that most engineers will regularly encounter measurement problems that are beyond the capability of a hand-held unit.

An instrument intended for serious use
A TTi bench-top DMM is a substantial instrument. It stays where you put it even with heavy test leads connected. The tilt stand ensures that the large display is always readable. The functions buttons are large and the front panel is clearly marked.

Sensitivity, Resolution and Accuracy
Compare the performance of any TTi bench-top DMM with a good quality 4000 count hand-held DMM of 0.3% basic dcV accuracy.

Longer scale length, greater sensitivity and higher accuracy ensure that measurement uncertainty is a full order of magnitude better.

TTi bench-top DMMs maintain good accuracy on all functions including ac voltage, resistance and current. For most hand-helds, the accuracies for functions other than dc voltage are dramatically poorer.

Wideband ac measurement and true RMS
Most hand-held DMMs have an ac frequency response specified to below 1kHz. All TTi bench-top DMMs provide excellent accuracy on all ranges throughout the audio band (40Hz to 20kHz) with a 3dB bandwidth extending well above this.

Most ac signals are not sinusoidal. However, most hand-held DMMs incorporate a mean sensing ac converter which only gives useful results on sinusoids, those that do have a True RMS converter often have insufficient bandwidth to cope with complex waveshapes. All TTi bench-top DMMs combine True RMS ac with sufficient bandwidth to ensure accurate results.

Digital Multimeters - Comparison Table

<table>
<thead>
<tr>
<th>Display Type</th>
<th>DC Voltage: Ranges</th>
<th>AC Voltage: Ranges</th>
<th>Frequency Response</th>
<th>Capacitance</th>
<th>Smart Functions</th>
<th>Interfaces</th>
<th>GPB (IEEE-488)</th>
<th>Power Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1604</td>
<td>(5) 400mV to 1000V</td>
<td>(5) 400mV to 750V</td>
<td>0.08%</td>
<td>No</td>
<td>Yes</td>
<td>RS-232</td>
<td>No</td>
<td>AC Line</td>
</tr>
<tr>
<td>1705 &amp; 1705-GP</td>
<td>(5) 120mV to 1000V</td>
<td>(5) 120mV to 750V</td>
<td>0.04%</td>
<td>No</td>
<td>Yes</td>
<td></td>
<td>Yes (GP version)</td>
<td>AC Line or Battery</td>
</tr>
<tr>
<td>1906 &amp; 1906-GP</td>
<td>(5) 200mV to 1000V</td>
<td>(5) 200mV to 750V</td>
<td>0.012%</td>
<td>No</td>
<td>Yes</td>
<td></td>
<td>Yes (GP version)</td>
<td>AC Line</td>
</tr>
</tbody>
</table>

PC and System connectivity
At some point most engineers are going to want to connect their DMM to their personal computer to provide automatic measurement control or importing of data into a computer programme. Unlike a hand-held DMM, all TTi bench-top DMMs include a fully isolated RS-222 interface.

For full system applications, the 1705-GP and 1906-GP also have a GPB (IEEE-488) interface.

Functions & features of real value
Hand-held DMMs may offer a few “smart” features but these are rarely well enough implemented to be of real use.

TTi bench-top DMMs offer features which are of real use and not just “gimmicks”. Features such as dual Measurement & display, precision frequency measurement, dBm, data logging, power and VA, to mention just a few.

* RS232 interface on 1604 is only for use with the optional PC-1604 control and data logging software.

Full technical details for all three multimeters is available on the web site.

For more complete information on any product, please visit our web site: www.tti-test.com
The 1604 is a high quality 40,000 count bench-top multimeter with a wide range of features. It offers automatic or manual ranging, high resolution (10µV, 10mΩ) together with current measurement up to 10A.

### 1604 DMM
- 4¾ digit bench-top multimeter
- 0.08% basic dc-v accuracy
- True RMS ac functions
- Isolated RS-232 interface

<table>
<thead>
<tr>
<th>Function</th>
<th>Ranges</th>
<th>Best Resolution</th>
<th>Best Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC V</td>
<td>(5) 400mV - 1000V</td>
<td>1µV</td>
<td>0.08% ± 4 digits</td>
</tr>
<tr>
<td>AC V</td>
<td>(5) 400mV - 750V</td>
<td>10µV</td>
<td>0.16% ± 4 digits</td>
</tr>
<tr>
<td>Resistance</td>
<td>(6) 40mΩ - 40MΩ</td>
<td>100µΩ</td>
<td>0.1% ± 6 digits</td>
</tr>
<tr>
<td>DC I</td>
<td>(3) 4mA - 10A</td>
<td>1µA</td>
<td>0.1% ± 6 digits</td>
</tr>
<tr>
<td>AC I</td>
<td>(3) 1mA - 10A</td>
<td>1µA</td>
<td>0.2% ± 6 digits</td>
</tr>
<tr>
<td>Frequency</td>
<td>(2) 4kHz to 40kHz</td>
<td>0.1Hz</td>
<td>0.01% ± 1 digit</td>
</tr>
</tbody>
</table>

Further measurement functions: Continuity, Diode Test, Smart functions: Null (Relative), Hold, T-Hold, Min/Max. Interface: opto-isolated bi-directional RS-232 interface. 9600 baud.

- 40,000 counts, auto or manual ranging
- Accuracy and resolution, 0.08%, 10µV, 10mΩ
- Large and bright LED display (14mm/0.56")
- True RMS ac functions, wide ac bandwidth
- Relative, T-Hold and Min-Max functions included
- Optional PC control and logging software

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The 1705 is a precision 4¼ digit bench multimeter incorporating dual displays and dual measurement technology. The dual displays can be used either to display one measurement in two units (e.g. mV and dB) or to measure two parameters simultaneously (e.g. dc-V and ac-V).

### 1705 DMM
- Dual measurement multimeter
- 0.04% basic dc-v accuracy
- Built-in data logger
- Isolated RS-232 or GPIB
- AC line or battery operation

<table>
<thead>
<tr>
<th>Function</th>
<th>Ranges</th>
<th>Best Resolution</th>
<th>Best Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC V</td>
<td>(5) 120mV - 1000V</td>
<td>10µV</td>
<td>0.04% ± 2 digits</td>
</tr>
<tr>
<td>AC V</td>
<td>(5) 120mV - 750V</td>
<td>100µV</td>
<td>0.2% ± 20 digits</td>
</tr>
<tr>
<td>Resistance</td>
<td>(6) 120Ω - 20MΩ</td>
<td>10Ω</td>
<td>0.08% ± 2 digits</td>
</tr>
<tr>
<td>DC I</td>
<td>(3) 1mA - 10A</td>
<td>0.1µA</td>
<td>0.1% ± 3 digits</td>
</tr>
<tr>
<td>AC I</td>
<td>(3) 1mA - 10A</td>
<td>0.1µA</td>
<td>0.3% ± 20 digits</td>
</tr>
<tr>
<td>Capacitance</td>
<td>(5) 10µF to 200µF</td>
<td>100pF</td>
<td>2% ± 5 digit</td>
</tr>
</tbody>
</table>

Further measurement functions: Continuity, Diode Test, Frequency Smart functions: Null (Relative), Hold, T-Hold, Min/Max, dB, % deviation, VA, Logger: 100 readings. Interfaces: RS-232 standard, GPIB (IEEE-488) optional. Power: 230V or 115V AC 50/60Hz, or 6 x C cells disposable or rechargeable. Size & weight: 260 x 88 x 235 mm (WxHxD). 2.0 kg (4.4 lb)

- Dual 12,000 count LCD, auto/manual ranging
- Accuracy and resolution: 0.04%, 10µV, 10mΩ
- Dual displays & 'dual measurement' technology
- True RMS ac functions, Frequency, Capacitance
- Wide range of computing functions e.g. Ax + B
- Model with GPIB (IEEE-488) interface available
- Mains and battery operation as standard

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The 1906 is a precision bench-top multimeter offering both high resolution and high accuracy. The precision is matched by a four terminal ohms measurement.

### 1906 DMM
- 5½ digit bench-top multimeter
- 0.012% basic dc-v accuracy
- 1µV, 1nA, 1mΩ resolution
- True RMS ac functions
- Isolated RS-232 or GPIB

<table>
<thead>
<tr>
<th>Function</th>
<th>Ranges</th>
<th>Best Resolution</th>
<th>Best Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC V</td>
<td>(6) 210mV - 1000V</td>
<td>1µV</td>
<td>0.012% ± 3 digits</td>
</tr>
<tr>
<td>AC V</td>
<td>(6) 400mV - 750V</td>
<td>10µV</td>
<td>0.2% ± 25 digits</td>
</tr>
<tr>
<td>Resistance</td>
<td>(6) 40mΩ - 40MΩ</td>
<td>100µΩ</td>
<td>0.19% ± 3 digits</td>
</tr>
<tr>
<td>DC I</td>
<td>(3) 4mA - 10A</td>
<td>1nA</td>
<td>0.08% ± 12 digits</td>
</tr>
<tr>
<td>AC I</td>
<td>(3) 1mA - 10A</td>
<td>1nA</td>
<td>0.37% ± 25 digits</td>
</tr>
</tbody>
</table>

Further measurement functions: Continuity, Diode Test, Smart functions: Null (Relative), Hold, T-Hold, Min/Max, Ax + B, % deviation, VA, Logger: 100 readings. Interfaces: RS-232 standard, GPIB (IEEE-488) optional. Power: 230V or 115V AC 50/60Hz, or 6 x C cells disposable or rechargeable. Size & weight: 260 x 88 x 235 mm (WxHxD). 2.2 kg (4.8 lb)

- 210,000 counts, auto or manual ranging
- Accuracy and resolution: 0.012%, 1µV, 1mΩ
- Four terminal resistance measurement
- True RMS ac functions, wide ac bandwidth
- Wide range of computing functions included
- Automatic data logging functions include
- Digital filtering for improved noise rejection
- Model with GPIB (IEEE-488) interface available
3. Component Measurement - precision measurement

**LCR400 LCR bridge**

- 0.1% basic accuracy
- Built-in component fixture
- Built-in limits comparator
- RS-232 interface

**BS407 low Ohmmeter**

- 0.1% basic accuracy
- 1µΩ to 20kΩ range
- Kelvin clip connection leads
- Rechargeable battery operation

The LCR400 is a high performance LCR meter that offers an alternative to low-cost handheld units or expensive system units. Dual displays, automatic component recognition and auto-ranging make it easy to use, while its built-in test fixture and limits comparator make it suitable for applications within the laboratory, production or inspection areas.

The BS407 is fully optimised for the task of accurate measurement of low resistances with a best resolution of 1µΩ. It uses a Direct Current technique to measure true resistance, rather than the resistive component of impedance which is shown by AC excited LCR bridges. The test current for each range has been chosen to minimise heating of the sample under test while being sufficient to minimise the effects of thermal emf and noise. This gives much greater accuracy at low resistances than can be obtained from the very low test currents used by general purpose high resolution multimeters.

For more complete information on any product, please visit our web site: [www.tti-test.com](http://www.tti-test.com)
The I-Prober 520 is a compact hand-held probe which is used with an oscilloscope. By placing the insulated tip of the probe onto a PCB track, the current flowing in the track can be observed and measured.

- Current measurement from non-contact probing of conductor
- Wide dynamic range of 5mA to 20A peak to peak
- Wide bandwidth of DC to 5MHz
- Low noise equivalent to <5mA rms
- Designed to meet safety requirements to 600V Cat II
- Suitable for connection to any oscilloscope
- High accuracy general purpose H-field probe
- Convertible into standard ‘closed magnetic circuit’ current probe

The I-Prober 520 is supplied with a clip-on toroid assembly which converts it into a closed magnetic circuit probe for measuring current in a wire.

The toroid is open until the probe is attached, allowing insertion of the wire without disconnection.

The wide bandwidth, dynamic range and low noise of the probe are retained.

For more complete information on any product, please visit our web site: www.tti-test.com
### LD300 dc load

- 300 watt dc electronic load
- Up to 80 volts or 80 amps
- CI, CR, CV and CP modes
- Built-in transient generator

### P240 proving unit

- Essential equipment for safety compliance
- Long-life battery operation
- Belt-clip mountable

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The LD300 is an inexpensive electronic load which is suitable for testing and characterising a wide variety of dc power sources. It can be used to investigate the behaviour of many different types of power source such as batteries, solar cells, fuel cells or wind generators, as well as electronic power supply units. Its wide voltage/current range, multiple operating modes and built-in transient generator give it the versatility to offer test solutions from the design laboratory through to the component test area.

The P240 is a hand-held battery powered proving unit that provides a nominal 240V dc, 2mA source intended for proving the integrity of neon type test voltage indicators. For safety compliance, voltage indicators should be checked for correct operation from this known voltage source before and after every use. Testing is performed by inserting the test probes of the neon tester into two recessed “touch proof” terminals on the proving unit. Insertion of the probes automatically turns the proving unit on thus eliminating the need for an on-off switch.
For more complete information on any product, please visit our web site: www.tti-test.com

TF830

- 5Hz to 1300MHz range
- Frequency, period, pulse width, ratio and event counter modes
- Battery and AC line operation
- RS-232 interfaced version

The TF830 is a high quality bench/portable universal frequency counter which offers period measurement, frequency ratio, pulse width and event counting. Pulse width measurements can be made from rising to falling or falling to rising edge.

It uses the reciprocal frequency counting technique to achieve high resolution at all frequencies. Reciprocal counting involves synchronized multiple period measurements followed by computation of the reciprocal value.

This results in high resolution measurements regardless of the signal frequency and eliminates the +/-1 input cycle errors of a conventional frequency counter.

The system yields at least 7 digits of resolution per second of measurement time and can measure low frequencies to a resolution of 0.001mHz.

PFM1300

- 5Hz to 1300MHz range
- Frequency & period measurement
- Handheld format
- Long battery life

The PFM1300 is a handheld frequency counter with a wide range of features. It can measure both frequency and period and uses a reciprocal frequency counting technique which involves multiple period measurements followed by computation of the reciprocal.

The system yields at least 7 digits of resolution per second of measurement time and can measure low frequencies to a resolution of 0.001mHz.

Despite its wide frequency range the PFM1300 has a low power consumption enabling it to operate for many hours from a PP3 size battery.

A push-to-measure capability gives a virtually instantaneous reading followed by an automatic power down after 15 seconds.

This provides greatly extended battery life where continuous monitoring of the signal is not required.

See also

PFM3000 3GHz frequency counter available from mid 2008 see page 24
RF Test

The rapid growth in the use of wireless communications and the inclusion of RF elements into many electronic designs has increased the need for RF test equipment. The high cost of products from the major producers in this area has led TTi to develop lower cost alternatives for the essential RF tools such as signal generators and spectrum analyzers.

RF products from TTi are designed to offer the essential elements required by engineers at significantly lower costs.

EMC Test

Most countries have now implemented legislation requiring products to comply with standards for radiated and conducted emissions.

TTi has produced equipment capable of compliance quality measurements, enabling users to self-certify for current harmonics and flicker.

Product Range

**Spectrum Analyzers - page 8**
PSA-T series low-cost handheld spectrum analyzers, 1.3GHz and 2.7GHz.

**Signal Generators - page 9**
Synthesised RF signal sources offering exceptional value for money, 1GHz and 2GHz.

**Harmonics & Flicker Measurement - page 10**
Compliance quality power and harmonics analyzer and source for measurements to EN61000-3-2 and EN61000-3-3.

**Frequency Measurement - page 7**
See also Precision Measurement section (page 6).

PFM3000 counter

- 5Hz to 3GHz frequency range
- Frequency or period display
- Continuous reciprocal measurement
- Handheld format
- Long battery life

The PFM3000 is the latest handheld frequency counter from TTi offering measurement up to 3GHz.

It provides high impedance measurement up to 100MHz and 50Ω measurement up to 3000MHz, with excellent sensitivity across all frequencies.

It can measure both frequency and period and uses a continuous reciprocal frequency counting technique which gives high resolution and accuracy at all frequencies.

Despite its wide frequency range the PFM3000 has a low power consumption enabling it to operate for many hours from a disposable battery.

A push-to-measure capability is provided to extend battery life when continuous signal monitoring is not required.

**New Product**

The PFM3000 is available mid 2008 for other frequency counter products see Precision Measurement section - page 23

- 5Hz to 3000MHz frequency range
- Frequency and period measurement
- High sensitivity at all frequencies
- Switchable low pass filter
- Continuous reciprocal counting measurement
- 0.001MHz low frequency resolution
- Push-to-measure function with auto power-down
- Large 8 digit display with full range of annunciators
The PSA1301T and PSA2701T are low-cost, highly portable RF spectrum analyzers. They incorporate the features most needed in a portable spectrum analyzer, together with many additional functions provided within the handheld computer.

### PSA-T series
- True handheld spectrum analyzers
- 1.3 GHz and 2.7 GHz models
- Half VGA colour screen
- Built-in handheld computer

<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSA1301T</td>
<td>150 kHz to 1300 MHz</td>
</tr>
<tr>
<td>PSA2701T</td>
<td>1 MHz to 2700 MHz</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size and weight:</th>
</tr>
</thead>
<tbody>
<tr>
<td>170mm high x 97mm wide x 47mm deep</td>
</tr>
<tr>
<td>495 grams total</td>
</tr>
</tbody>
</table>

- 150kHz to 1300MHz frequency range (PSA1301T)
- 1MHz to 2700MHz frequency range (PSA2701T)
- Resolution bandwidths of 280kHz or 15kHz (PSA1301T) 1MHz, 280kHz or 15kHz (PSA2701T)
- High resolution (480 x 320 pixel) TFT colour screen
- -96dBm typical noise floor at -20dBm reference level
- Measurement in dBm or dBµV
- Fully adjustable centre frequency and span in 1kHz steps
- Choice of centre/span or start/stop setting
- Zero span mode with AM and FM audio demodulation
- Sweep modes of normal, single, peak hold and average
- Reference waveforms displayed in contrasting colour
- Twin markers with readout of absolute & difference values
- Smart marker movement with selectable peak tracking
- Amplitude limit lines with editor and store/recall
- Unlimited storage for waveforms, set-ups and screens
- Data transfer to PC for analysis, documentation & printing
- More than 4 hours continuous operation from a charge
- Smaller and lighter than any other spectrum analyzer (weight less than 0.5kg)

**plus:**
- Handheld computer based facilities including word processing, spreadsheets, appointments, picture/video viewing, MP3, Web and Email via Bluetooth and WiFi
- Large range of third party programs available including many for engineering, science and mathematics

The small size, low weight and long battery life of the PSA-T Series make it the ideal tool for RF field measurements.

However, its surprisingly low cost provides every engineer with the potential to own a spectrum analyzer, whether they work in the RF field or not.

The PSA-T Series will find applications within development, servicing and production as well as field use.

For more complete information on any product, please visit our web site: www.tti-test.com
9. Signal Generators - RF & EMC test equipment

**TGR1040**
- 1 GHz signal generator
- -127dBm to +7dBm
- RS-232, optional GPIB
- Low cost

The TGR1040 is the low cost solution for RF engineers who require a basic RF generator of high stability and wide amplitude range. It has good phase noise and low leakage and offers FM modulation, internal or external.

**TGR2050**
- 2 GHz signal generator
- -127dBm to +7dBm
- AM, FM & phase modulation
- RS-232 and GPIB standard

The TGR2050 offers a wide frequency range with a setability of 10Hz. It has 1ppm internal stability and can be locked to an external standard. Modulation facilities of FM, Phase and AM are included. Remote control via RS232 and GPIB is included.
Compliance quality current harmonics measurements to EN61000-3-2 when using compliant source (such as AC1000A)

- Tabular and histogram display of harmonics
- Continuous analysis with real-time graphical update
- Compliance quality fluctuations and flicker measurements to EN61000-3-3
- Full power analyzer measuring Watts, VA, Vrms, Vpk, Arms, Apk, A-inrush, CF, THD, PF, Hz
- Real-time voltage and current waveform displays
- Wide range of national power connectors available
- Parallel printer port plus RS232 and USB interfaces
- Windows PC control and documentation software supplied

Note: Full technical details are available on the web site.

The HA1600A is a fast, easy to use power and harmonics analyzer with a large and high resolution graphical display, capable of continuous real-time analysis.

The HA1600A is intended primarily as a dedicated harmonics and flicker analyzer for compliance quality measurements, but it can also be used as a general purpose power analyzer.

The unit is available with range of power connectors to suit different national standards.

A printer interface is included along with RS-232 and USB interfaces for PC connectivity.

It is suitable for both the product development environment, and for production line test verification.

The AC1000A is a 1 kW low-distortion source suitable for EN61000-3-2

The AC1000A is an innovative, low cost, pure power source designed specifically for use with a harmonics analyser such as the TTI HA1600A.

It permits compliance quality measurements to EN61000–3–2 in situations where the quality of the AC supply is poor or variable.

The AC1000A has a power rating of 1000 watts at 230 volts. Maximum continuous rms current is 4.4A with a peak current capability of 10A.

Note: Full technical details are available on the web site.
About this Short Form Catalogue

Products included
This Precision Measurement & RF Test Equipment catalogue is an extract from the main TTi short form catalogue which covers all TTi product groups and can be downloaded from the web site.

New product introductions and changes
TTi regularly introduces new products and some may have been added since this catalogue was printed. For the latest information please visit our web site.

Products are subject to continuous development and changes to some detailed specifications or to cosmetic appearance may have taken place since the catalogue was printed.

Detailed product information
This catalogue contains only limited product information.

Fully detailed information for each product is available from the web site. Alternatively contact TTi or the local distributor in your country to request detailed information.

Product illustrations
The illustrations within this catalogue are representative of the products at the time of printing. The main illustration for each product is at approximately 42% (linear) of actual size in order to enable size comparisons.

Further illustrations within the product description area are at a variable scaling to fit the available space.

About TTi

Excellence through experience
Thurlby Thandar Instruments is one of Europe’s leading manufacturers of test and measurement instruments.

The company has wide experience in the design and manufacture of advanced test instruments and power supplies built up over nearly thirty years.

TTi is based in the United Kingdom, and all products are built at the company’s facility in Huntingdon, close to the famous university city of Cambridge.

Traceable quality systems
TTi is an ISO9001 registered company operating fully traceable quality systems for all processes from design through to final calibration.

BS EN ISO9001:2000
Certificate number FM 20695