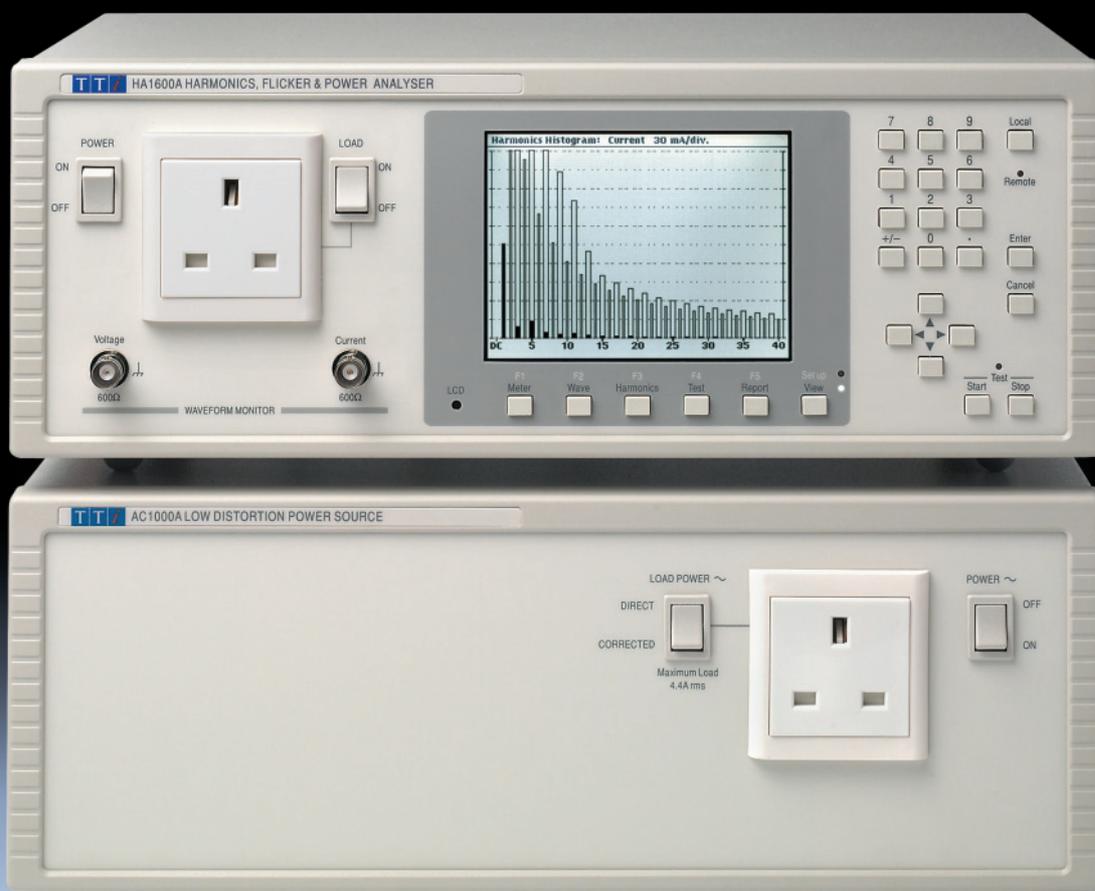




THURLBY THANDAR INSTRUMENTS

HA1600A



Harmonics, Flicker and Power Analyser

*high speed and high accuracy power measurements*

*compliance quality harmonics analysis to EN61000-3-2*

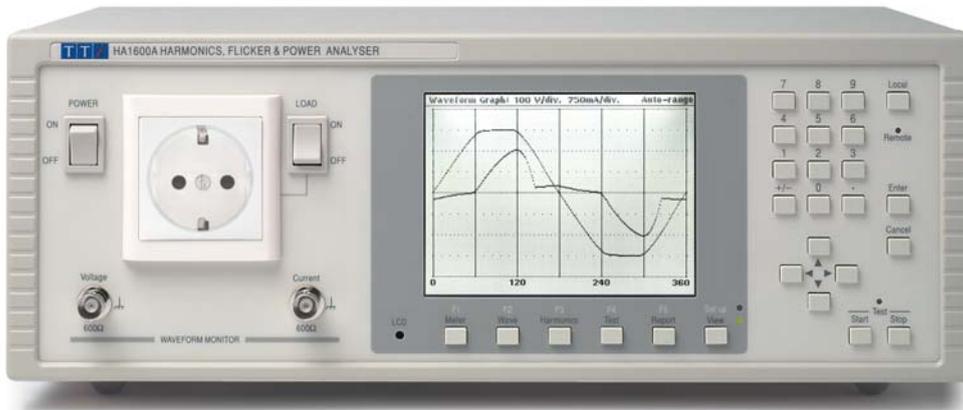
*compliance quality flicker measurement to EN61000-3-3*

*optional low-distortion 1kW AC power source (AC1000A)*



# HA1600A Power and Harmonics Analyser

## High speed compliance quality measurements



### HA1600A

- ▶ Measures power, voltage, current, phase angle etc.
- ▶ Tabular and histogram display of harmonics
- ▶ Voltage and current waveform displays
- ▶ Continuous analysis with real-time graphical update
- ▶ Compliance quality measurements to EN61000-3-2/-3
- ▶ Wide range of national power connectors available
- ▶ Parallel printer and RS232 and USB interfaces
- ▶ PC control and documentation software supplied

### AC1000A

- ▶ Provides an EN61000-3-2 compliant source
- ▶ 1000W power capability at 230V
- ▶ Up to 4.4A rms load current and up to 10A peak currents
- ▶ Comprehensive overload protection
- ▶ Connection via standard national power connector

## Overview

The **HA1600A** is a fast, easy to use mains and harmonics analyser 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 analyser for compliance quality measurements, but it can also be used as a general purpose mains analyser.

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

A printer interface is included for record keeping/archiving, along with RS-232 and USB interfaces for PC connectivity.

The HA1600A is suitable for both the product development environment, and for production line test verification.

**HA-PC Link Plus** is Windows based software supplied with the HA1600A.

It is intended to assist users in taking routine compliance measurements and archiving the results.

It can communicate with the instrument through either an RS232 or a USB connection.

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, without the expense of a full AC power source.

## High performance power analyser

The HA1600A is a high speed, high accuracy ac power analyser for single phase loads of up to 16 amps RMS.

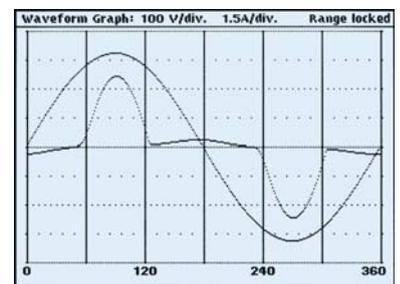
Dual power cables allow the supply to the load to be independent of the supply to the instrument. The output to the load is via a front panel mounted 'standard' mains connector. A wide range of power connectors is available including most national types.

The HA1600A can measure Watts, VA, Volts rms, Volts peak, Amps rms, Amps peak, Crest factors, THD, Power factor, Frequency and Inrush current.

Power Meter			Hold
Supply Voltage			
229.8 V <sub>rms</sub>	0.1% THD	Frequency	50.04 Hz
325.1 V <sub>pk</sub>	at 89.4°	Crest Factor	1.414
Load Power			
47.64 W	64.03 VA	Power Factor	0.744
Load Current			
278.6 mA <sub>rms</sub>	49.9% THD	90.7% under Class D mask	
586.0 mA <sub>pk</sub>	Phase 12.5°	Crest Factor	2.103
Harmonic Summary			
Load detected Class A by waveform.			
Load passes Harmonic levels.			
Supply meets IEC requirements.			

The large display can show multiple parameters simultaneously as well as graphical representations of voltage and current waveforms.

Dual 16 bit Analog to Digital converters continuously sample both voltage and current and give a wide dynamic range. A fast Digital Signal Processor gives the performance needed for continuous real-time analysis of the data. Advanced algorithms yield accurate results, using extended precision or floating point arithmetic wherever necessary.



Voltage and current waveforms. The mains voltage purity has been restored using an AC1000A. Compare this with the uncorrected mains voltage shown in the instrument illustration.

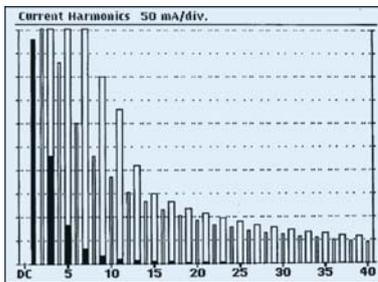
### Compliance-quality harmonics analyser

All electrical equipment sold within the EEC must comply with legislation relating to the harmonics content of the current waveform.

The HA1600A has been designed to make these measurements both quick and simple. It measures harmonics from the 1st to the 40th and updates the display in real time.

Current Harmonics (mA)					
N	Filtered	Limit	Average	% limit	Max. % limit
1:	1005.7	-	1006.3	-	1007.3
3:	173.3	285.0	229.1	80.4	243.8
5:	40.2	100.0	40.2	40.2	40.5
7:	20.8	70.0	20.4	29.2	20.8
9:	61.8	50.0	67.9	135.7	73.3
11:	8.0	30.0	8.2	27.3	8.6
13:	5.7	30.0	5.9	19.5	6.1
15:	44.7	30.0	40.3	134.4	44.7
17:	3.5	30.0	3.5	11.7	3.5
19:	2.6	30.0	2.7	9.1	2.8
21:	33.4	30.0	28.7	95.5	33.4
23:	1.9	30.0	1.9	6.3	1.9
25:	1.4	30.0	1.5	5.1	1.6
27:	24.6	30.0	22.2	74.0	24.8
29:	1.0	30.0	1.1	3.7	1.2
31:	1.0	30.0	1.0	3.4	1.0
33:	18.8	30.0	18.1	60.3	19.7
35:	0.7	30.0	0.8	2.7	0.8
37:	0.7	30.0	0.7	2.4	0.7
39:	16.3	30.0	15.2	50.8	16.7
P:	48.7	94.9	43.4	45.7	48.7

It is suitable for pre-compliance measurements using a normal mains supply and is capable of full compliance measurements to EN61000-3-2 in conjunction with a suitable power source such as the AC1000A.



Support is provided for both the 2006 and 2000 editions of EN61000-3-2. Capabilities include continuous monitoring of the supply voltage, continuous automatic calculation of harmonic limits, and timed test sequences with analysis of fluctuating harmonics.

### Digital interfaces and PC software

The HA1600A incorporates both RS232, and USB interfaces for use with a PC, and a Centronics parallel interface for direct connection to a printer.

The firmware of the instrument is stored in flash memory and can be updated via RS232 or USB as the requirements of the standards evolve.

### Compliance-quality fluctuations & flicker meter

The HA1600A can operate as a compliance quality flicker and fluctuations meter in conformance with EN61000-3-3 and EN61000-4-15.

Test Control	
Operating Mode: IEC 61000-3-3 Flicker	
Sensing method: Current	
Reference Impedance: 0.400 + j 0.250 ohms	
Observation Time for $F_{ST}$ :	10 minutes
Observation Time for $F_{IT}$ :	12 $F_{ST}$ Values
$d(\max)$ limit: 4.00%	
$d(t)$ limit: < 200 ms above 3.00%	
$d(c)$ limit: 3.00%	
'Steady State' definition: >1000 ms below 0.15%	
Nominal Voltage: 230.0 Volts	
Nominal Frequency: 50.0 Hz	
Test type:	Timed Duration: 7200 seconds
Load Power:	During Test
Test status:	Running Elapsed time: 00:00:26
Press STOP to end measurement.	

A current measurement method can be used, as an alternative to voltage measurement, thus eliminating the need for a reference impedance.

Flicker severity is measured in terms of  $P_{st}$  and  $P_{it}$  using analysis periods as defined within the standard.

Simultaneously full analysis of voltage variations is performed, including the calculation of the maximum value  $d_{max}$ , the difference between steady states  $d_c$ , and the change characteristic  $d_{(t)}$ .

Flicker Meter		Range locked	
Duration	Flicker	$F_{IT}$ calculation interval	$F_{ST}$
0.1%	43	> 1:	1.60
0.7%	39	2:	0.00
1.0%	38	3:	0.00
1.5%	37	4:	0.00
2.2%	35	5:	0.00
3%	33	6:	0.00
4%	30	7:	0.00
6%	25	8:	0.00
8%	21	9:	0.00
10%	17	10:	0.00
13%	12	11:	0.00
17%	8	12:	0.00
30%	2		
50%	0		
80%	0		
$F_{ST} =$	1.60	$F_{IT} =$	0.70

HA-PC Link Plus software is supplied with the instrument to assist users in taking routine compliance measurements and archiving the results.

Data updating is continuous, permitting real-time viewing on the PC.

Harmonics can be displayed on the PC as tabular reports or as graphical histograms.

### Optional low distortion 1kW power source

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

The AC supply available at a standard wall socket is usually distorted. This comes about because of nonlinear loads (non-resistive loads) on the AC supply such as transformers, fluorescent lights, switched-mode power supplies etc. The effect of this is to flatten off the top of the sine wave causing significant distortion.

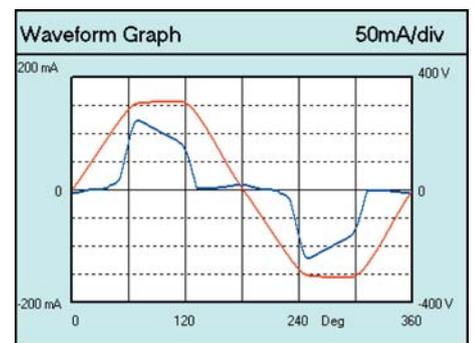
In a typical factory environment this distortion is so significant that it is easily visible using the HA1600A waveform display.

EN61000-3-2 requires that the source supply provides a pure voltage waveform to the equipment under test. The harmonic currents can differ significantly when a pure source is used, so for true compliance measurements it is important that any testing is performed with a device such as the AC1000A.

Because of the large increase in the peak currents that can result from having a pure sinewave mains voltage supply, the AC1000A is also very useful for stress testing a wide variety of power supplies types within electronic equipment.

Compact and portable, the AC1000A is rated at 1000 V-A for 230 V operation at up to 35°C ambient.

Maximum continuous rms current is 4.4A with a peak current capability of 10A.



SUPPLY VOLTAGE			
231.00 V <sub>rms</sub>	Frequency	49.99 Hz	
313.50 V <sub>pk</sub>	103.8 Deg.	Crest Factor	1.357
LOAD POWER			
12.250 W	Power Factor	0.856	
12.70 W <sub>max</sub>	14.318 VA		
LOAD CURRENT			
61.98 mA <sub>rms</sub>	Total Harmonics	31.59 mA	
123.24 mA <sub>pk</sub>	97.5 Deg.	Crest Factor	1.988

Sections of the HA-PC Link Plus screen

# Technical Specifications

## MAINS ANALYSER

Measurement Circuit:	Single Phase with standard mains connector.
Current Rating:	16A rms continuous, or national connector rating if lower.
Voltage Ranges:	115V ( $\pm 200V$ pk) 230V ( $\pm 400V$ pk).
Current Ranges:	$\pm 24mA$ pk to $\pm 400A$ pk in fifteen 2:1 ranges.
Frequency Range:	43 - 67 Hz.
Shunt Resistance:	3m $\Omega$ .
Sampling Rate:	300 points per cycle.
Basic Accuracy:	Better than 0.2% $\pm 1mA$ , up to 16A.
Measured Parameters:	Vrms, Vpk, Arms, Apk, Crest factors, THD, W, VA, Power factor, Frequency, Inrush current.
Display Modes:	Tabular display of all parameters including latest and highest inrush current. Waveform graph display of voltage and current with normal, max hold, accumulate and multiple cycle display.
Monitor Outputs:	Re-constructed Voltage and Current Signals.

## HARMONICS ANALYSER

Measurements:	1st harmonic to 40th harmonic. Measurement processing for both 2006 and 2000 editions of EN61000-3-2. Continuous calculation, analysis and assessment of unfiltered, filtered, average, minimum and maximum current harmonic levels and limits. Continuous measurement and assessment of supply waveform and harmonics.
Current Rating:	16A rms continuous, or national connector rating if lower.
Voltage Ranges:	115V ( $\pm 200V$ pk) 230V ( $\pm 400V$ pk).
Current Ranges:	$\pm 24mA$ pk to $\pm 400A$ pk in fifteen 2:1 ranges.
Frequency Range:	43 - 67 Hz.
Shunt Resistance:	3m $\Omega$ .
Transform Windows:	Continuous 4, 10, 12 or 16 cycle Discrete Fourier Transforms.
Basic Accuracy:	Better than 5% of limit or 0.2% of selected range (whichever is the greater) $\pm 1mA$ .
Display Modes:	Display of load supply assessment for voltage, harmonics, crest limits and frequency against requirements of EN61000-3-2. Histogram or tabular display of supply voltage harmonics. Histogram display of current harmonics with limits, Min. hold, Max. hold and percentage of limit display options. Tabular display of current harmonics showing present values, limits, average values, average as percent of limit, maximum values, maximum as percent of limit and pass or fail assessment for each harmonic.
Test Control:	Untimed, manually timed or automatically timed tests; user-defined test time. Limits automatically determined from EN61000-3-2 for appropriate class; Class C and Class D limits can be automatically calculated from power measurements or from ratings declared by the user. Minimum and maximum power thresholds for limits can be changed by the user. Facility for declaring supply voltages other than 230V and deriving appropriate limits. Facility for inseting test limits.
Report Printing:	Direct printer connection for hard-copy report with user-entered narrative, supply voltage assessment and current harmonic analysis and assessment.

## VOLTAGE FLUCTUATIONS & FLICKER METER

Measurements:	Voltage fluctuations $d_{max}$ , $d_c$ , $d(t)$ and flicker $P_{st}$ and $P_{it}$ to EN61000-3-3 and EN61000-4-15.
Current Rating:	16A rms continuous, or national connector rating if lower.
Voltage Ranges:	115V ( $\pm 200V$ pk) 230V ( $\pm 400V$ pk).
Fluctuation Range:	25% max. (relative to nominal voltage)
Flickermeter Range:	Voltage change up to 20% (sinewave change) or 10% (low repetition rate rectangular change) relative to AGC level. Equivalent to 6400 pu on 8.8 Hz sinewave.

Flickermeter AGC:	Up to $\pm 5\%$ .
Flickermeter Accuracy:	Better than 5% for $P_{st}$ range 0.7 to 10.0.
Frequency Range:	50 Hz (operates over 43 - 67 Hz).
Report Printing:	Tabular listing of voltage variations, $P_{st}$ classifier and $P_{st}$ in each $P_{it}$ interval.

## GENERAL

Display:	320 x 240 pixel backlit LCD.
Clock:	Realtime clock for time/date stamping of Report data.
Interfaces:	Parallel Printer, RS-232, USB.
Instrument Supply:	230V or 115V $\pm 14\%$ , 48 to 65Hz.
Operating Range:	+5°C to 40°C, 20-80% RH.
Storage Range:	-10°C to +60°C.
Dimensions:	357 x 132 x 235mm (WxHxD)
Weight:	4.4 kg
Safety:	Complies with EN61010-1
EMC Compliance:	Complies with EN61326-1

## FREE FIRMWARE UPDATES

Changes to measurement methods required by occasional updates to the EN61000-3-2 & EN61000-3-3 standards will generally require just an instrument firmware update. So far, it has been possible to upgrade all HA1600A and HA1600 models ever built to meet the latest requirements. To upgrade firmware and to check what revisions of the standard are now supported, follow links from the Support page of the TTI web site.

## HA-PC LINK PLUS SOFTWARE

HA-PC LINK PLUS is PC (Windows) software supplied with the HA1600A. It can communicate with the instrument through either an RS232 or a USB connection. It is intended to assist users in taking routine compliance measurements and archiving the results. The PC is used for configuration, display and data archiving only; all real time data handling and measurement processing continues to be performed by the Digital Signal Processor in the instrument. The performance of the PC does not affect the accuracy of the measurement results, and so there is no need for the either the PC or its software to be covered by a calibration certificate.

## AC1000A LOW DISTORTION POWER SOURCE

Input Voltage:	Factory built to 220V to 240V, 110V to 115V or 100V. Factory configure to 50Hz or 60Hz. Installation Category II.
Supply Tolerances:	Voltage $\pm 10\%$ . Frequency $\pm 1\%$
Output Voltage:	Tracks the amplitude of the fundamental of the input voltage. A variable voltage input may be used to adjust the output voltage to within the limits specified by EN61000-3-2.
Output Distortion:	Will meet the requirements of EN61000-3-2 for all normal levels of input voltage distortion.
Output Current:	Maximum continuous output current is 4.4A (10A peak).
Output Power:	Maximum output power is input voltage x 4.4 VA
Input Connection:	IEC connector; front panel switch.
Output Connection:	U.K., Schuko, or other national outlet sockets. Load power switch can be set to DIRECT or CORRECTED for 'A-B' comparisons.
Protection:	Thermal trip automatically diverts load to a DIRECT connection in the event of thermal overload.
Operating Range:	+5°C to +35°C at full rated output; 20% to 80% RH (non-condensing).
Storage Range:	-40°C to +70°C
Environmental:	Indoor use at altitudes to 2000m, Pollution Degree 2.
Safety:	Complies with EN61010-1
EMC:	Complies with EN31326-1
Size and Weight:	357 x 132 x 235mm mm (W x H x D); 5.5kg.

Thurlby Thandar Instruments Ltd. operates a policy of continuous development and reserves the right to alter specifications without prior notice.

Designed and built in Europe by:



**Thurlby Thandar Instruments Ltd.**  
Glebe Road, Huntingdon. Cambs. PE29 7DR United Kingdom  
**Tel: +44 (0)1480 412451** Fax: +44 (0)1480 450409  
Email: info@aimtti.com Web: www.aimtti.com

## Product Summary

### Laboratory Power Supplies

Bench and system power supplies from 30 watts up to 1200 watts using linear, mixed-mode and PowerFlex regulation technologies.



### Waveform Generators

Analog and digital (DDS) function generators, true arbitrary generators, arbitrary/function generators and pulse generators.



### Precision Measurement Instruments

Benchtop DMMs, frequency counters, component measurement instruments (LCR), electronic dc loads, current probes.



### RF and EMC Test Equipment

Spectrum analyzers, signal generators, frequency counters, power meters, emc measurement instruments.



## Company name and product brands

Thurlby Thandar Instruments Ltd. (TTi) is one of Europe's leading manufacturers of test and measurement instruments.

Products have been sold under two brand names: TTi and Aim.



In the future, however, the full product range will be branded Aim-TTi.



This changeover will be gradual and many products will continue to carry the TTi or Aim brands for some time to come.

## Web Addresses (URLs)

The preferred URL for obtaining information concerning Aim-TTi products is:

[www.aimtti.com](http://www.aimtti.com) (international customers)

Customers in the UK should use the URL:  
[www.aimtti.co.uk](http://www.aimtti.co.uk)

Customers in the USA should use the URL:  
[www.aimtti.us](http://www.aimtti.us)

Note that previous URLs such as [www.tti-test.com](http://www.tti-test.com) will continue to operate for the time being.

Designed and built in Europe by:



**Thurlby Thandar Instruments Ltd.**

Glebe Road, Huntingdon, Cambridgeshire PE29 7DR England (United Kingdom)

Tel: +44 (0)1480 412451 Fax: +44 (0)1480 450409

Email: [info@aimtti.com](mailto:info@aimtti.com) Web: [www.aimtti.com](http://www.aimtti.com)