



THURLBY THANDAR INSTRUMENTS

HA1600



## Power and Harmonics Analyser

*high speed and high accuracy power measurements*

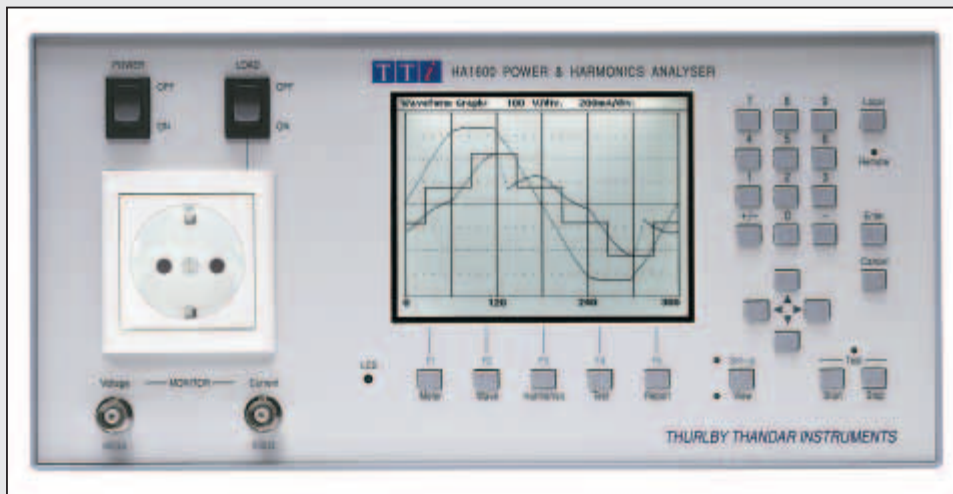
*compliance quality harmonics analysis to EN61000-3-2*

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

*optional low-distortion 1kW AC power source (AC1000)*

# HA1600 Power and Harmonics Analyser

## High speed compliance quality measurements



### High performance power analyser

The HA1600 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 HA1600 can measure Watts, VA, Volts rms, Volts peak, Amps rms, Amps peak, Crest factors, THD, Power factor, Frequency and Inrush current.

### HA1600

- 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 interfaces included
- Optional PC software available

### AC1000

- 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 power connector

### Overview

The HA1600 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 HA1600 can be used as a general purpose mains analyser or as a dedicated harmonics and flicker analyser for compliance quality measurements.

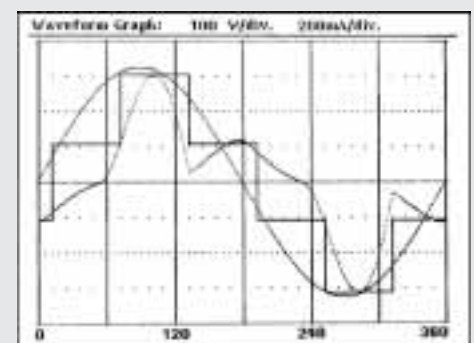
A printer interface is included for record keeping and archiving, along with an RS-232 interface.

The AC1000 is an innovative, low cost, pure power source designed specifically for use with a harmonics analyser such as the TTI HA1600, permitting compliance quality measurements to EN61000-3-2 in situations where the quality of the AC supply is poor or variable.

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 B mask
586.0 mA <sub>pk</sub>	Phase 12.5°	Crest Factor 2.103
Harmonics 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 (plus mask). The mains voltage purity has been restored using an AC1000. Compare this with the uncorrected mains voltage shown in the instrument illustration.

# Harmonics analysis to EN61000-3-2

## Flicker measurement to EN61000-3-3

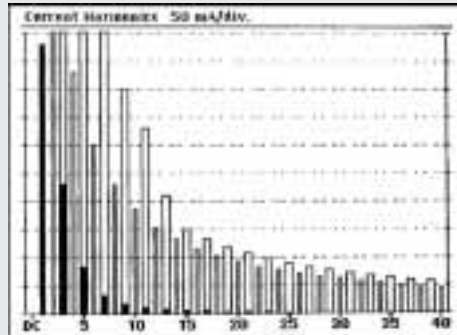
### Compliance-quality harmonics analyser

From January 2001 all electrical equipment sold within the EEC must comply with legislation relating to the harmonics content of the current waveform.

The HA1600 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	Σ limit	Max. Σ limit	
1:	1005.7	-	1006.3	-	1007.3	-
3:	173.3	205.0	223.1	60.4	243.0	85.5
5:	40.2	100.0	40.2	40.2	40.4	40.5
7:	20.8	70.0	20.4	28.2	28.8	28.8
9:	61.8	50.0	67.5	125.7	73.5	146.7
11:	8.0	30.0	8.2	27.3	8.6	28.0
13:	5.7	30.0	5.8	18.5	6.1	20.4
15:	44.7	30.0	46.3	124.4	44.7	145.3
17:	3.5	30.0	3.5	11.7	3.5	12.0
19:	2.6	30.0	2.7	9.1	2.8	9.6
21:	33.8	30.0	28.7	95.5	33.8	111.5
23:	1.8	30.0	1.8	6.3	1.8	6.6
25:	1.8	30.0	1.5	5.1	1.6	5.4
27:	24.6	30.0	22.2	74.0	24.8	82.7
29:	1.0	30.0	1.1	3.7	1.2	4.2
31:	1.0	30.0	1.0	3.4	1.0	3.6
33:	18.8	30.0	18.1	66.3	18.7	65.9
35:	0.7	30.0	0.8	2.7	0.8	2.0
37:	0.7	30.0	0.7	2.4	0.7	2.4
39:	16.3	30.0	15.2	58.0	16.7	58.7
P:	40.7	94.8	43.4	95.7	40.7	51.4

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 AC1000.



Support is provided for both the 1995 and 2000 editions of EN61000-3-2. Capabilities include continuous monitoring of the supply voltage, continuous automatic calculation of harmonic limits (with real-time Class D evaluation and visual display to 1995 requirements), and timed test sequences with analysis of fluctuating harmonics.

### Compliance-quality flicker meter

The HA1600 can operate as a compliance quality flicker and fluctuations meter in conformance with EN61000-3-3 and EN60868.

Test Control	
Operating Mode: EC 61000-3-3 Flicker	
Sensing method: Current	
Reference Impedance: 0.400 -j 0.250 Ohms	
Observation Time for P <sub>St</sub> : 10 minutes	
Observation Time for P <sub>It</sub> : 12 P <sub>St</sub> values	
d(max) limit: 4.00%	
d(t) limit: < 200 ms above 3.00%	
d(s) limit: 3.00%	
"Steady State" definition: >1000 ms below 0.15%	
Nominal Voltage: 230.0 Vrms	
Nominal Frequency: 50.0 Hz	
Test type: Fixed	Duration: 7200 seconds
Load Power: Dering 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<sub>St</sub> and P<sub>It</sub> using analysis periods as defined within the standard.

Simultaneously full analysis of voltage variations is performed, including the calculation of the maximum value d<sub>max</sub>, the difference between steady states d<sub>c</sub>, and the change characteristic d(t).

Flicker Meter		Range locked	
P <sub>St</sub> Classifier	Flicker	P <sub>St</sub> calculation Interval	P <sub>St</sub>
0.5%	43	1:	1.00
0.7%	39	2:	0.00
1.0%	28	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
15%	12	11:	0.00
17%	8	12:	0.00
30%	2		
50%	0		
80%	0		
P <sub>St</sub> <sup>2</sup>	1.60	P <sub>It</sub> <sup>2</sup>	0.70

### Digital interfaces and optional PC software

A printer interface is included for record keeping and archiving, together with a high speed RS-232 interface for use with a PC.

The firmware of the instrument is stored in flash memory and can be updated through the serial port as the requirements of the standards evolve.

### Optional low distortion 1kW power source

The AC1000 is a low cost pure power source designed specifically for use with a harmonics analyser such as the HA1600.

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 an oscilloscope.

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 AC1000.

Because of the large increase in the peak currents that can result from having a pure sinewave mains voltage supply, the AC1000 is also very useful for stress testing a wide variety of power supplies types within electronic equipment.

Compact and portable, the AC 1000 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.

Optional HA-PC Link software is also available that enables results to be displayed, recorded and documented using a PC connected via RS-232.

Data can either be in the form of a single report or can be continuous, permitting real-time viewing on the PC. Harmonics can be displayed on the PC as tabular reports or as graphical histograms.

# 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:	<0.2%.
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 1995 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 $\Omega$ .
Sampling Rate:	300 points per cycle. 4 or 16 cycle Discrete Fourier Transforms
Basic Accuracy:	Better than 5% of limit or 0.2% of selected range whichever is the greater.
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. For assessment to EN61000-3-2:2000: 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. For assessment to EN61000-3-2:1995: Automatic fit of the Class D envelope on the Waveform Graph display for Class A / Class D detection. Tabular display for steady-state harmonics with present values, minimums, maximums, limits, % of limits (present values and maximums) and pass or fail assessment for each harmonic. Option of using filtered measurements. Graphical display of a selected harmonic against time, with limits. Graphical display against time of all harmonics exceeding steady-state limits.
Test Control:	Untimed, manually timed or automatically timed tests; user-defined test time. Manual load classification or automatic detection of Class A or Class D. 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. One report format for assessment to EN61000-3-2:2000 and two (steady state and fluctuating) for assessment to EN61000-3-2:1995.

## FLICKER METER

Measurements:	Voltage fluctuations $d_{max}$ , $d_c$ , $d(t)$ and flicker $P_{st}$ and $P_{It}$ to EN61000-3-3 and EN60868.
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.
Frequency Range:	Operates over 43 - 67 Hz. (filter frequencies scale proportionately. Limit values in EN61000-3-3 and Flicker meter parameters in EN60868 only defined for 50Hz.
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.
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:	307 x 148 x 225mm (WxHxD)
Weight:	4.2kg
Safety:	Complies with EN61010-1
EMC Compliance:	Complies with EN61326-1

## OPTIONAL HA-PC LINK SOFTWARE

HA-PC LINK is a PC software option which collects measurement data from the HA1600 via a serial (RS232) port connection. Data can either be in the form of a single report or can be continuous, permitting real-time viewing on the PC. Harmonics can be displayed on the PC as tabular reports or as graphical histograms. Reports are saved as standard text files that can be viewed with any text editor or imported into other documents. HA-PC LINK requires Windows 95 or later.

## AC1000 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:	Dependent on the purity of the input but will generally meet the requirements of EN61000-3-2.
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). -40°C to +70°C
Storage Range:	Indoor use at altitudes to 2000m, Pollution Degree 2.
Environmental:	
Safety:	Complies with EN61010-1
EMC:	Complies with EN31326.
Size:	307 x 105 x 225 mm (W x H x D)
Weight:	5 kg.

*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:



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