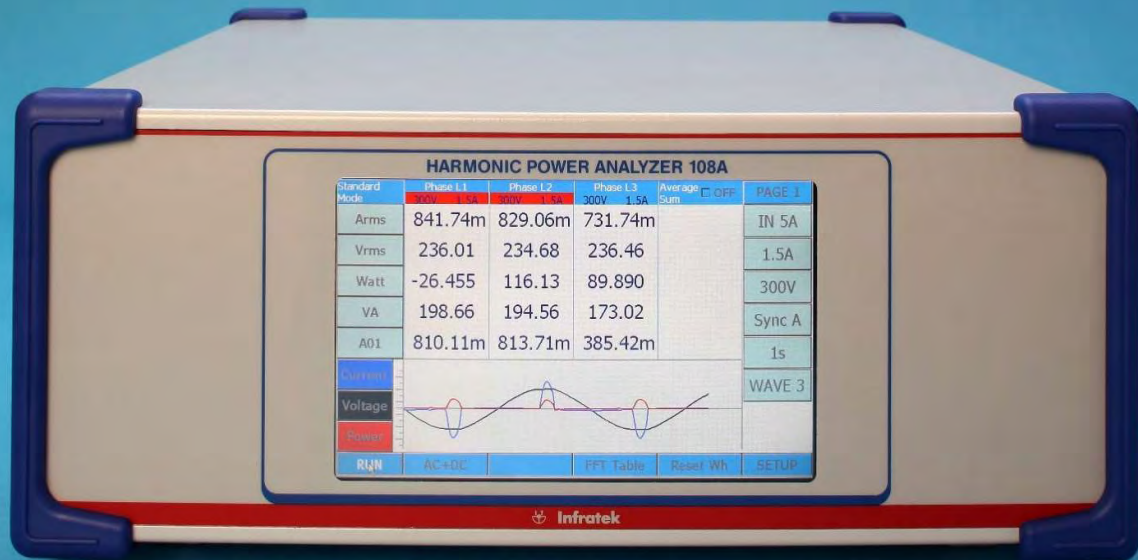


# 108A Harmonic Power Analyzer

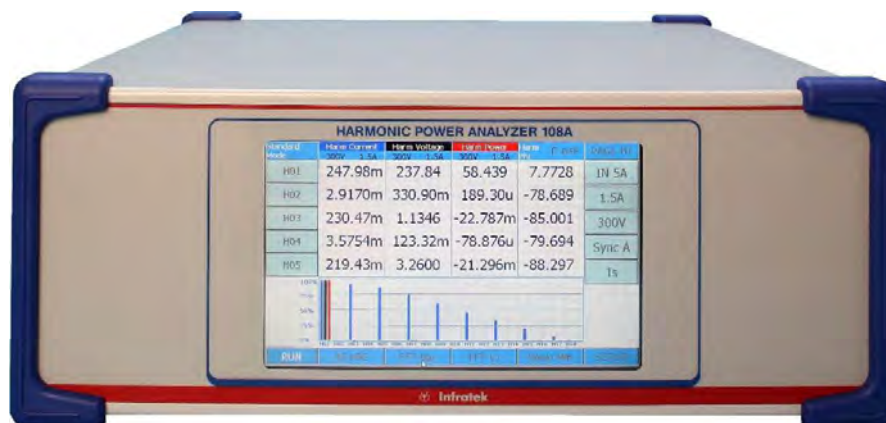


The Swiss Way of Measuring Power

The 108A High Precision Power Analyzer is a state-of-the-art instrument and an ideal tool for many measurement applications and offers engineers and technicians innumerable opportunities.

## Single- to Six Phase Precision Power Analyzer with Touch Screen Operation

<b>Basic Accuracy V, A, W:</b>	<b>±0.02%, 0.02%, 0.04%</b>
<b>Bandwidth:</b>	<b>DC to 2MHz</b>
<b>V-, A- Measurement:</b>	<b>0.3V - 1000V, 50µA - 40A</b>
<b>Hi Current Sensors:</b>	<b>10A - 700A, 0.005%</b>
<b>Measurement Resolution:</b>	<b>18Bit</b>
<b>Customized Display:</b>	<b>4 pages, 32 values per page</b>
<b>Individual Settings:</b>	<b>every phase, all phases</b>
<b>4 Measure Modes:</b>	<b>Standard, Logging, Transient, Power-Speed</b>



**Upgrading the instrument is feasible due to modular concept at any time.**

**Reliable, simple and intuitive to use; highly accurate measurements for test and development of modern, efficient power electronics.**

**The MODEL 108A UNIVERSAL HIGH PRECISION POWER ANALYZER measures 280 electrical quantities on every phase. Energies, harmonics, motor- and transformer values, power sums, power ratios, analog- and frequency inputs can be displayed, or read via interface at any time**

## FEATURES

- Available as 1-, 3-, 4- or 6-phase instrument
- 18 bit resolution. High accuracy at 10% full scale
- Simple to operate, most settings in 2 steps (2 touches)
- Extremely fast data transfer; up to 3400 values per seconds
- 4 current inputs: 1mA–1A, 15mA–5A, 1A–50A, Shunt
- Optional interfaces: Ethernet, RS-232 / USB, IEEE-488
- Interface commands for fast data transmission
- Optional high precision, broadband, current sensors 0.004%
- 6 analog inputs and 2 frequency inputs, 12 analog outputs
- Highest precision available: 0.02% + 0.02% range
- Wide angle, touch-screen TFT display (800 x 480 pixels)
- Standard-, Logging-, Transient-, Power-Speed measure modes
- High DC precision for solar applications
- Voltage Ranges: 0.3V to 1000V
- Two Optional operating software's under Windows
- Software to read data from four 108A-6
- Simple servicing, modular concept, pre-calibrated inputs
- 4GB Memory for storing measurement data
- Reasonably priced by virtue of smart design
- Individual settings for every phase and all phases



### High Performance, Simple to Use

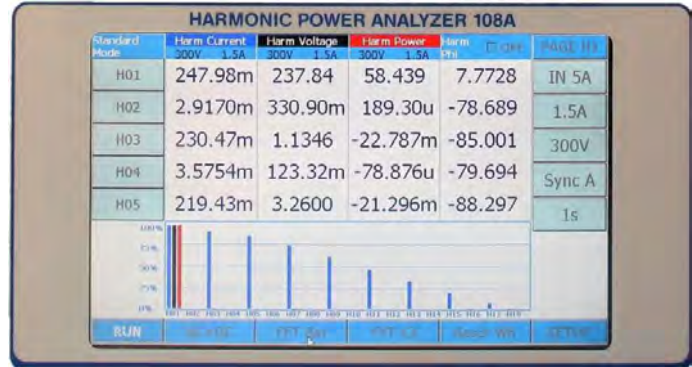
The Infratek 108A High Precision Power Analyzer is available in 1-, 3-, 4- or 6- phase versions. All voltage inputs 0.3V up to 1500Vpeak and all current inputs (1.5mA up to 1A; 15mA up to 5A; 1A up to 40A; and shunt inputs 60mV up to 6V) are potential free and exhibit low noise, high common mode suppression, excellent DC-stability, Wide frequency range (DC-2MHz) and very low self-heating on current inputs. There is no need to fiddle with dc-compensation, or changing current plug-ins. All is built into the input sections of the Power Analyzer, ready for measurements. It is simple to use; your intuition will guide you to operate the Power Analyzer touch screen correctly. Almost all setting changes are accomplished with two touches on the display screen or two clicks with the wireless mouse.

# 4 MEASUREMENT FUNCTIONS

Four different measure functions enhance the 108A Power Analyzer capabilities.

## Standard Measure Mode:

In the Standard Measure Mode 280 quantities per phase are measured without gap and are continuously updated. Values can be displayed on four display pages, can be saved in internal memory, or can be transferred via Interface to a computer. The display shows voltage, current, and power wave forms. Harmonics and bar graphs can be viewed on 5 pages. Two electric motors can be tested simultaneously. External Speed and torque inputs are optionally available. Transformer values are implemented too.

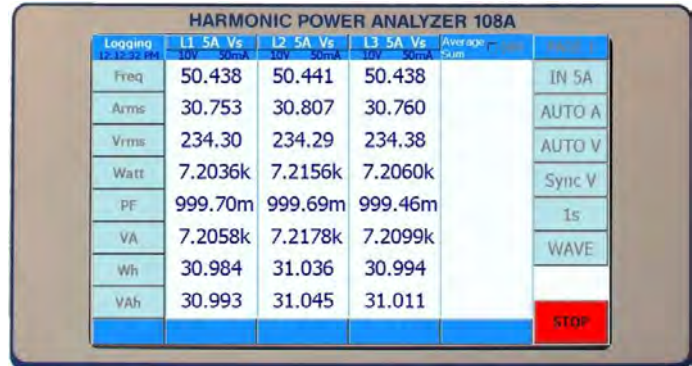


## Logging Measure Mode:

This measure mode is suitable for very fast measurements or for long time averaging of data. It is possible obtaining 6 datasets of a 6-phase instrument within 20ms or 6 datasets per 10 minutes.

From every phase you obtain 8 values: frequency, rms current, rms voltage, power, power factor, apparent power, energy Wh, and apparent energy VAh.

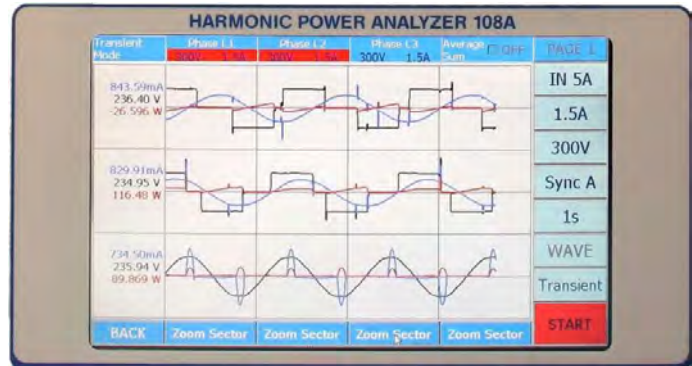
**Cycles:** For Logging Measure Mode set Cycles 1 to 32000. Defines the measurement duration per measurement set. Use pop-up number pad. Format 160.



## Transient Measure Mode:

You can catch current-, voltage-, and power wave forms in a start-up on transient mode up to 6 phases simultaneously or you can view all the wave forms at a critical operating point. Sections of the wave forms can be expanded by simply touching one of the 4 "Zoom Sectors".

**Transient ID:** Set it to 1, 2, 3, 4, 5, 6, or 7. The transient ID determines the measurement duration after start.  
 Transient ID Measurement duration: 1 {0.25s}  
 2 {0.5s} default, 3 {1s}, 4 {2s}, 5 {4s}, 6 {8s}, 7 {16s}.



## Power-Speed Measure Mode:

This measure mode analyzes the performance of devices such as electric cars. In 20ms intervals the following data are stored in internal memory: rms current, rms voltage, power, apparent power, energy, apparent energy, and rpm of a shaft.

At the end of the measurement, (maximum 11 seconds) data versus time are displayed, can be expanded to view details, or can be stored.



# APPLICATIONS

## Electric Motors (Railroad systems)

The 108A-6 equipped with (Option03) 6 analog inputs, 2 digital inputs and 12 outputs perform all required measurements for motor testing. The analog inputs can be used for torque-, temperature and vibration measurements. The TTL inputs for speed or torque, and the external synchronization input per phase from an encoder to synchronize to the pole position.

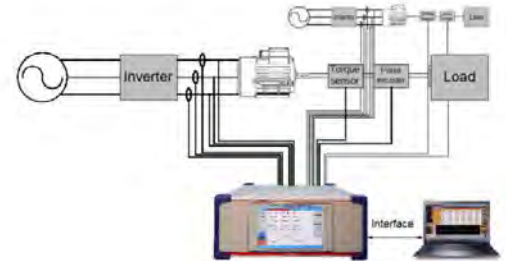
The 108A-6 can measure 2 motors simultaneously: input power, output power, torque, slip, speed, and efficiency of every motor, as well as all harmonics of current, voltage, power, impedance, and phase angle. For none sinusoidal signals (trapezoidal wave-forms or frequency inverters), we recommend to use the fundamental of impedance and fundamental of phase. From these values the motor inductances  $L$ ,  $L_d$ ,  $L_q$  and the motor resistances  $R = R_m + R_{dc}$  can be determined.

The motor DC-resistance is obtained by applying a DC-current:  $R_{dc} = P_{dc} / I^2_{dc}$ .  $R_m$  is a magnetization dependent loss.

## Simultaneous Measurement of 2 Synchronous Motors (PMSM, BLDC)

A wide range of synchronous motors are on the market (PMSM, IPMSM, BLDC). The power consumption ranges from mW to 500kW. Many different constructions are in use. They all have in common that the magnetic field rotation (2 phase or 3 phase) is electronically generated. A wide range of speeds (rpm) are available.

See also the Infratek documentation: [Electric Motor Testing \(PDF\)](#).



## Inverter drive systems

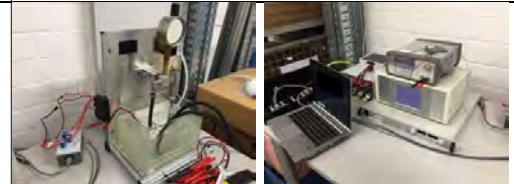
Using the 108A-6 to test the efficiency of an inverter drive, simultaneous measurement of all electrical parameters is essential. By visually inspecting the current waveform, we should see three individual currents all producing an alternating positive/negative pattern waveform. All three phases should be symmetrical. The 108A-6 measures very precisely total input power, total output power and inverter efficiency!



108A switched to transient mode to view inverter U, I, and P wave forms; expand to view details.

## Automotive

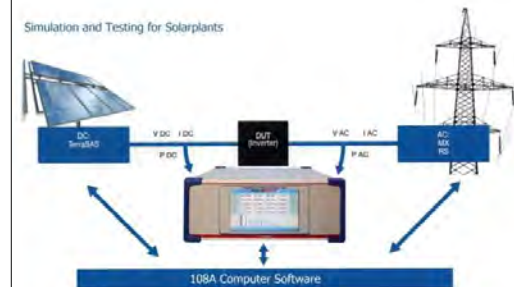
Testing fuel pumps is crucial for proper and reliable vehicle operation and long lasting product quality. Individual fuel pump tests like Start-Stop, Low-Speed/Full-Speed are used; the 108A delivers all important electrical parameters. The 108A in the power-speed measure mode measures the start performance of an electric car. In 20ms intervals current, voltage, power, energy, and speed of the vehicle are measured. Data are plotted versus speed.



## Solar/Wind energy

Decisive for an effective technical implementation of solar plants and wind farms are various simulations and correlations for each location. In these tests, exactly defined levels are simulated. All relevant electrical parameters like frequency, voltage, current, power, efficiency, power factor and energies are measured by the 108A and can be read via computer software.

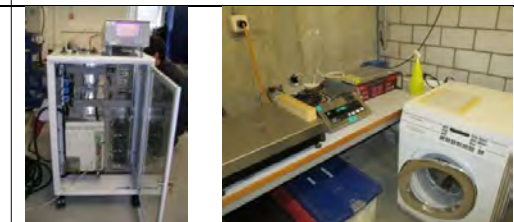
A dedicated high speed data acquisition software is available to read data from several 108A. Data are combined in a single file for simple analysis.



## Power electronics / Appliance

Wide bandwidth guarantees precise power measurement of switching power supplies or other electronically switched devices.

Some electronic devices consume power when they appear to be turned off. This power consumption is known as standby power and can be a significant contribution to product energy use. The 108A Power Analyzer precisely measure standby power on all kind of appliances like ovens, ceramic hobs, washers, dryers etc. This can be done using the 1.5mA/5mA/15mA current ranges.



## 108A Computer Software for Production Testing

For efficient production testing of 12 (or more) single phase apparatus, a dedicated high speed data acquisition software is available. It reads the data of 12 apparatus (or more) in less than 100ms and combines data in a single file for storage or analysis.



# Specifications

Voltage Measurement				
<b>% reading + % range</b>	8 measuring ranges: 0.3V – 1V – 3V – 10V – 30V – 100V – 300V – 1000V		Bandwidth DC-2MHz	
	Coupling: AC or AC + DC		Common mode rejection: 100dB at 100kHz	
	Input impedance: 1MΩ / 15pF. Floating input		max. 1000Vrms	
	Crest Factor 15:1 at 10% fs. Typical accuracy at 10% is 0.1%		fs = full scale	
	Temperature coefficient: 0.004% / °C			
	Standard accuracy 23°C ±1°C. 3V to 600V		<b>High precision 10V to 600V</b>	
	45 to 65Hz	0.08 + 0.08		0.02 + 0.02
	3 to 1000Hz	0.1 + 0.1		0.03 + 0.03
1 to 10kHz	0.2 + 0.2	0.1 + 0.1		
10 to 100kHz	(0.2 + 0.2) + (0.2 + 0.2)*log(f/10kHz)	(0.2 + 0.2) + (0.2 + 0.2)*log(f/10kHz)		
DC <sup>1)</sup> //100-500kHz <sup>1)</sup>		0.1 + 0.1// 0.012*f(kHz)		
Linearity 100V range:		130 % 100 % 50 % 10 % 5 %	Typical linearity at 50/60Hz	
		130.01V 100.00V 49.988V 10.000V 5.0014V		
Voltage Scaling U1-U6		Individual voltage scaling factors of every phase. Use pop-up number pad. Format 2000.8.		

Measured & Computed Voltage Values			
RMS voltage	$V_{rms} = (1/T \int_0^T V^2 dt)^{1/2}$ , includes all harmonics	Voltage crest factor	$V_{cf} = V_{max} / V_{rms}$
Mean voltage	$V_{mean} = 1/T \int_0^T V dt$ , dc component of voltage	Voltage form factor	$V_{ff} = V_{rms} / V_{rect}$ , is 1.1107 for sine wave
Rectified mean voltage	$V_{rect} = 1/T \int_0^T  V  dt$ , rectified mean voltage	Voltage fundamental	$V_{01} = \text{fundamental voltage of FFT}$
Peak voltage	$V_{max} = \text{maximum voltage in time interval}$	V1 line to line	$V1 \text{ ltl} = (V_{1rms} + V_{2rms}) \cdot 0.86603$
Lowest voltage	$V_{min} = \text{lowest voltage in time interval}$	V2 line to line	$V2 \text{ ltl} = (V_{2rms} + V_{3rms}) \cdot 0.86603$
Peak to peak voltage	$V_{ptp} = V_{max} - V_{min}$	V3 line to line	$V3 \text{ ltl} = (V_{3rms} + V_{1rms}) \cdot 0.86603$
Voltage distortion	$V_{thd1} = (V_{rms}^2 - V_{01}^2)^{1/2} / V_{rms}$ , <sup>2)</sup>	V4 line to line	$V4 \text{ ltl} = (V_{4rms} + V_{5rms}) \cdot 0.86603$
Harmonic voltage distortion	$V_{thd2} = (\sum V_n^2)^{1/2} / V_{rms}$ , n = 2,3, ..., 40	V5 line to line	$V5 \text{ ltl} = (V_{5rms} + V_{6rms}) \cdot 0.86603$
		V6 line to line	$V6 \text{ ltl} = (V_{6rms} + V_{4rms}) \cdot 0.86603$

Current Measurement				
<b>% reading + % range</b>	4 inputs: In30A, In5A, In1A, shunt. Floating inputs. 1 sec averaging.		max. 1000Vrms to earth	
	In1A: 6 ranges 1.5mA <sup>1)</sup> - 5mA - 15mA - 50mA - 150mA - 500mA - 1500mA. DC-100kHz		max. 2A continuous	
	In5A: 6 ranges: 15mA <sup>1)</sup> - 50mA - 150mA - 500mA - 1.5A - 5A - 15A. DC-100kHz		max. 7A continuous	
	In30A: 4 ranges: 1A <sup>1)</sup> - 3A - 10A - 30A - 100A. DC-100kHz		max. 40A/30A cont., 1-3phase /4-6phase	
	Shunt: 60mV - 200mV - 600mV - 2V - 6V. DC-100kHz		max. 30V continuous	
	Coupling: AC or AC + DC		Common mode rejection: 115dB at 100kHz	
	Crest factor 15:1 at 10% fs. Typical accuracy at 10% fs is 0.1%		fs = full scale	
	Temperature coefficient: 0.004% / °C			
	Standard accuracy 23°C ± 1°C		<b>High precision In1A/In5A</b>	
	<b>Input</b>	<b>In1A, In5A, Shunt</b> <b>In30A</b>		15,50,150,500mA,1A/150,500mA,1.5,5A
	45 to 65Hz	0.08 + 0.08      0.08 + 0.08		0.02 + 0.02
	3 to 1000Hz	0.1 + 0.1      0.2 + 0.2		0.03 + 0.03
	1 to 10kHz	0.15 + 0.15		0.15 + 0.15
	10 to 100kHz	(0.15+0.15)+ (0.5+0.5)*log(f/10kHz)		(0.15+0.15)+ (0.5+0.5)*log(f/10kHz)
DC <sup>1)</sup> //100-500kHz <sup>1)</sup>	0.1 + 0.1// 0.023*f(kHz)			
<b>Current Sensors</b>	<b>0-150Apeak</b> <b>0-400Apeak</b> <b>0-600Apeak</b> <b>0-700Apeak</b>	Exposure of current inputs to their max. value will result in additional errors <sup>1)</sup>		
45 to 65Hz	0.004 + 0.004    0.004 + 0.004    0.002 + 0.002    0.01 + 0.01	In1A: 0.03% * I <sup>2</sup>		
3 to 1000Hz	0.01 + 0.01    0.01 + 0.01    0.01 + 0.01    0.02 + 0.02	In5A: 0.003% * I <sup>2</sup>		
<b>Input</b>	<b>0-100A</b> precision current sensor (Option 04) connected to In1A input		In30A: 0.0001% * I <sup>2</sup>	
3 to 100Hz	0.05 + 0.05		Coax: 0.0001% * I <sup>2</sup>	
100 to 1000Hz	0.1 + 0.1			
Linearity 500mA range:		130 % 100 % 50 % 10 % 5 %	Typical linearity at 50/60Hz	
		650.02mA 500.02mA 250.02mA 49.979mA 24.997mA		
Shunt Sensitivity:		60mV/A. For an external shunt with 1mV/A scale by 60.0		
Current Scaling I1-I6		Individual current scaling factors of every phase. Use pop-up number pad. Format 2000.8.		

Measured & Computed Current Values			
RMS current	$I_{rms} = (1/T \int_0^T A^2 dt)^{1/2}$ includes all harmonics	Current distortion	$A_{thd1} = (I_{rms}^2 - A_{01}^2)^{1/2} / I_{rms}$ , <sup>2)</sup>
Mean current	$I_{mean} = 1/T \int_0^T A dt$ , dc-component of current	Harmonic current distortion	$A_{thd2} = (\sum A_n^2)^{1/2} / I_{rms}$ , n = 2,3, ... 40
Rectified mean current	$I_{rect} = 1/T \int_0^T  A  dt$ , rectified mean current	Current crest factor	$A_{cf} = I_{max} / I_{rms}$
Peak current	$I_{max} = \text{maximum current in time interval}$	Current form factor	$A_{ff} = I_{rms} / I_{rect}$ , is 1.1107 for sine wave
		Current fundamental	$A_{01} = \text{fundamental current of FFT}$

1) Typical max. Error

2) Used for frequency inverter

## Power Measurement

<b>% reading + % range</b>	W range = voltage range times current range		112 power ranges	
	Standard accuracy 23°C ± 1°C		<b>High precision</b>	
	<b>Input</b>	<b>PF</b>	<b>In1A, In5A, Shunt</b>	
	45 to 65Hz	0-1	0.16 + 0.16	
	45 to 65Hz	0-0.05		
	3 to 1000Hz	0-1	0.2 + 0.2	
	1 to 20kHz	0-1	0.2+(0.2 + 0.2*log (f/100Hz) + 0.08*k1*log (f/100Hz))	
	20 to 100kHz	1	%error (A+V) %error (A+V)	
DC <sup>1)</sup> //100-500kHz <sup>1)</sup>	1	0.2 + 0.2// add %error (V+A)		
<b>Input</b>	<b>PF</b>	<b>In30A</b>	<b>Current Sensor 0-100A</b>	
45 to 65Hz	0-1	0.16 + 0.16	0.1 + 0.1	
3 to 1000Hz	0-1	0.2+(0.2+0.2 * log(f/3Hz) + 0.1 *k1 * log(f/3Hz)		
DC <sup>1)</sup>		0.2 + 0.2	0.1 + 0.1	
PF 1	0.9 0.8 0.7 0.6 0.5 0.4	0.3 0.2 0.1 0	k1 = (2 - PF <sup>4</sup> ) / (1+PF <sup>2</sup> )	
k1 0.5	0.74 0.97 1.18 1.38 1.55 1.70	1.83 1.92 1.98 2.00	<sup>1)</sup> Typical max. error	
W Linearity	130% 100% 100%	50% 10% 5%	Typical linearity of voltage, current and power	
Volt	130.00 100.00	49.985 9.9992 4.9990		
Ampere	6.5004 5.0014	2.5020 500.82m 250.40m		
Watt PF=1	844.74 500.07	125.05 5.0056 1.2522		

## Measured & Computed Power Values

Active power	$W = 1/T \int_0^T u \cdot i \, dt$ , total power in W	Fundamental power	$W01 = A01 \cdot V01 \cdot \cos \varphi01$ , $\varphi01 = \text{phase}$
Apparent power	$VA = \text{Arms} \cdot \text{Vrms}$ , total apparent power VA	Fundamental apparent power	$VA01 = A01 \cdot V01$
Reactive power	$\text{Var} = \pm(\text{Papp}^2 - \text{Pact}^2)^{1/2}$ , reactive power Var	Fundamental reactive power	$\text{Var01} = (\text{VA01}^2 - \text{W01}^2)^{1/2}$ , magnitude only
Power Factor	PF = Pact / Papp, includes all harmonics	Power of distortion	$D = V01(\sum \text{An}^2)^{1/2}$ , n = 2,3, ..., 40; D in Watt
		Power Factor of Fundamental	$\text{PF01} = \text{W01} / \text{VA01}$

## Frequency Measurement

SyncA: 2Hz-5kHz	Accuracy: 0.05 %
SyncV: 2Hz-150kHz	Accuracy: 0.05 %
S_ExtV: 2Hz-150kHz	Accuracy: 0.05 %
S_ExtV is a TTL output for SyncA/V or a TTL input for S_ExtV	Sync for each phase
<b>Measured &amp; Computed Values</b>	
Frequency	Freq = zero crossing of A, V, Ext; SYNC I, SYNC U, Ext; Accuracy 0.05%

## Energy Measurement

Wh, VAh, Varh, Ah, integration time. Add accuracy % of values involved.  
Reset sets all values to zero. Integration runs uninterrupted, also in the background.

## Measured & Computed Values

Energy	$Wh = \int_0^t \text{Pact} \cdot dt$ , active energy in Wh	Battery charge	$Ah = \int_0^t \text{Arect} \cdot dt$ , is positive only
Apparent energy	$\text{VAh} = \int_0^t \text{Papp} \cdot dt$ , use it for long term PF	Elapsed time	$\text{time} = \int_0^t dt$ , time in hours since RESET
Reactive energy	$\text{VAR} = \int_0^t \text{Prea} \cdot dt$ , can be positive / negative	Time	Accuracy: 0.05 %

## Harmonic Measurement

Frequency range of fundamental 3Hz – 15kHz	FFT averaging:
Harmonics: V and A: 1-88; W and phase angle 1-21	Set FFT ID = 0, 1, 2, 3, 4 which corresponds to averaging over 4, 16, 64, 256, or 1024 periods.
Accuracy: Fundamental <sup>1)</sup> , use % figures of V, A, W	
Harmonic Display: Select button <b>'FFT Table'</b> to view current-, voltage-, power-, impedance-, and phase harmonics 1-40. A single harmonic can be displayed by selecting <b>A FFT</b> , <b>V FFT</b> or <b>W FFT</b> . The whole range of harmonics can be read via interface.	

## Measured & Computed Values

Magnitude impedance	$\text{Mag Z} = V01 / A01$ fundamental	Phase of fundamental	$\text{Phi01} = \text{phase V01, A01}$
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## Additional Computed Values

Accuracy: Add % figures of values involved	65 values per phase
Rectified mean, VA, Var, impedance, distortion factor, power factors, motor- and transformer values, sums, ratios, analog inputs and -outputs, speed inputs, and more are continuously updated and ready for display or interface output.	

<sup>1)</sup> Typical max. Error

## Measured & Computed Values

Sum1 of power	Sum1 = Pact1 + Pact2 + Pact3; Power phase 1+2+3	Ratio1 of power	Ratio1 = Pact4 / Pact1 + Pact2 + Pact3
Sum2 of power	Sum2 = Pact1 + Pact2	Ratio2 of power	Ratio2 = Pact3 / Pact1 + Pact2
Sum3 of power	Sum3 = Pact4 + Pact5 + Pact6; Power phase 4+5+6	Ratio3 of power	Ratio3 = Pact2 / Pact1
Sum4 of power	Sum4 = Pact4 + Pact5	Ratio4 of power	Ratio4 = Pact4 + Pact5 + Pact6 / Pact1 + Pact2 + Pact3
Sum5 of power	Sum5 = not used	Ratio5 of power	Ratio5 = Pact6 / Pact4 + Pact5
Sum6 of power	Sum6 = not used	Ratio6 of power	Ratio6 = Pact5 / Pact4

## Motor Measurement

Measured & Computed Values from phase 1, phase 2, phase 3		Measured & Computed Values from phase 4, phase 5, phase 6	
Mechanical input power	Pin = electric power applied to motor	Mechanical input power	Pin = electric power applied to motor
Mechanical output power	Pout = Pin - Pin at no load in Watt (Loss)	Mechanical output power	Pout = Pin - Pin at no load in Watt
Torque	Torque = Pout · poles1 / 4 · π · frequency1	Torque	Torque = Pout · poles / 4 · π · frequency2
Slip	Slip = 1 - fout / fin	Slip	Slip = 1 - fout / fin
Rotation per minute	rpm = 120 · frequency1 / poles1	Rotation per minute	rpm = 120 · frequency / poles
Efficiency	efficiency = 1 - Pin at no load / Pin	Efficiency	efficiency = 1 - Pin at no load / Pin

## Transformer Measurement

### Measured & Computed Values from phase 1 and phase 2

Vrect, rms corrected	Vcorrected = 1.1107 · Vrect	Loss resistance	Equivalent loss resistance = Pact1 / Arms <sup>2</sup>
Corrected power	Corr power = Pact 1 / (0.5 + 0.5 · Vrms / Vcorrected)	Loss inductance	Equivalent loss reactance = Prea 1 / Arms <sup>2</sup>
Loss factor Q	Q = tan X/R, where Z=R + jX	Turn ratio	Turn ratio = N2 / N1 = Vrms2 / Vrms1, no load

## Analog Input / Output

Analog Input		Analog Output	
4 Analog inputs (I1-I4) 2 analog inputs (I5-I6) 2 TTL auto ranging speed inputs 20Hz-150kHz	±5V, 100kΩ input impedance, accuracy 0.2% <sup>1)</sup> ±10V, 100kΩ input impedance, accuracy 0.2% <sup>1)</sup> Accuracy 0.1% <sup>1)</sup> . Reading rate in Standard-Mode 0.5sec, reading rate in Power Speed-Mode 20ms Each input can be scaled 0.0001 up to 99999	12 analog outputs (O1-O12)	±5V, 1kΩ output impedance, accuracy 0.2% <sup>1)</sup> Update rate 0.5sec. Arms, Vrms, W, VA, Var, PF, Frequency, and Wh can be sent to the analog outputs. In Logging- and Power Speed-Mode output1 is an actuator to Start/Stop ext. devices.
Scaling An1-An6	Individual analog scaling. Use pop-up number pad. Format 10.0.		
Scaling rpm1-rpm2	TTL freq1/rpm1 and freq2/rpm2 scaling. Use pop-up number pad. Format 2.0. For 180 pulses per turn, scaling = 1.0000		

## Four Measuring Functions

Standard	1 to 6 phase, measures all electrical values at 0.8s updates or 100ms updates.
Logging	Up to 48 values in 20ms, or long time averaging up to 10 minutes.
Transient	Simultaneous V-, A-, W-waves on 6 phases, time 0.25 to 16 seconds.
Power-Speed	Measures in 20ms intervals V, A, W, VA, Wh, VAh, speed of rotating devices.

1) Typical max. Error

## Interface

<p>USB connection to Host Computer for downloading measurement data (Windows Mobile Device Center)</p> <p>10/100 Mbps Ethernet interface (Up to 230.4kbaud)</p> <p>RS232 Interface (Up to 115.2kbaud) or USB Interface (Up to 921.6kbaud)</p> <p>Analog Input / Output connector (37-pole)</p> <p>GPIB, IEEE 488.2 (Set address 1 to 30, store in setting)</p>	
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## Saving and Recalling 108A Setting Configurations

Save your personal setting in **S01**, or **S02**,..., or **S20**. The 108A starts up in setting **S01**. With Load Setup you can change to your personal setting. If start up in your setting is required store it in **S01**.

## Continuous Storing of Measurement Data

Select the storing interval (1s, 2s, 3s,...). Select storing location **D01**, or **D02**,..., or **D20**. All values displayed on page 1 are stored at set time interval in EXCEL compatible format.

## Servicing and Calibration

Servicing: Replacement amplifier boards from the factory are calibrated (no re-calibration is required). All other boards can simply be exchanged.  
 Calibration: Enter calibration code, follow calibration instructions. Apply 60Hz, 1.5mA - 20A, and 0.3V - 1000V. Calibration cycle 2 years.

## General Technical Data

Dimensions	Metal housing H x W x D; 148 x 355 x 335mm
Weight	Maximum 7kg, 6-phase
Display	TFT color display, 155 x 94, 800 x 480 pixels, 262k Colors, Wide viewing angle (X-Y) 170°
Operation	By touch screen, wireless mouse or interface
Mains	90 - 256V, 47 - 63Hz, 40VA
Warm up time	25 minutes
Calibration cycle	2 years
Inputs	4mm safety sockets, 3-pol Amphenol socket
Temperature range	Operation 2 to 32°C, storage -10 to 50°C
Standards	Electrical safety EN61010-1, 1000V CAT II Emission IEC 61326-1, class B Immunity IEC 61326-1
Dielectric Strength	Line input to case: 1500V ac Measuring inputs to case: 2500V ac Measuring inputs to measuring inputs: 2500V ac

## Recommended Accessories

### Ultra Precise Current Transducers

Nominal current measurement	60 - 1000 ADC
Linearity	better than 3 ppm
High resolution	between 40 to 80 ppm
Very low offset drift	between 0.5 to 2.5 ppm/K
Overall accuracy @ IPN (+25°C)	±0.0044 % and ±0.02725 %
Wide frequency bandwidth	up to 800 kHz (±3 dB)
Power supply	±15 V



Applications: Precise and high stability inverters, Medical equipment, Energy measurement, Power analyzers, Calibration units

### High Performance Current Transducers

Nominal current measurement	100 - 2000 A
Linearity error	<0.3 %
Basic accuracy @ IPN (+25°C)	±0.2 %
Wide frequency bandwidth	DC to 100 kHz
Power supply	±12 V / ±15 V



Applications: Energy measurement, Power analyzers, Transformer, Motor

## Typical performance at low power factor.

TEST	RANGE	UUT INDICATED	SYSTEM ACTUAL	MODIFIER	ERROR	ERROR (%TOL)	EXP. UNCERT
<b>CHANNEL 1:</b>	<b>1A INPUT</b>						
	50W Range (10V/500mA):						
177	50	50.016W	50.0000W	50H Cos=1	0.032%	40	3.3mW
178	50	35.367W	35.3550W	50H Cos=0.707	0.033%	34	3.2mW
179	50	40.013W	40.0000W	50H Cos=0.8	0.033%	37	3.2mW
180	50	4.003W	4.0000W	50H Cos=0.08	0.067%	12	1.7mW
181	50	0.401W	0.4000W	50H Cos=0.008	0.352%	28	1.7mW
	150W Range (300V/500mA):						
182	150	115.0220W	150.0000W	50H Cos=1	0.019%	21	8.4mW
183	150	81.3404W	81.31700W	50H Cos=0.707	0.029%	25	7.5mW
184	150	92.0246W	92.00000W	50H Cos=0.8	0.027%	25	6.1mW
185	150	9.2065W	9.20000W	50H Cos=0.08	0.070%	10	3.7mW
186	150	0.9253W	0.92000W	50H Cos=0.008	0.571%	35	3.7mW
<b>CHANNEL 1:</b>	<b>5A INPUT</b>						
	150W Range (100V/1.5A):						
189	150	150.052W	115.0000W	50H Cos=1	0.035%	43	20mW
190	150	106.098W	106.0660W	50H Cos=0.707	0.030%	31	14mW
191	150	120.030W	120.0000W	50H Cos=0.8	0.025%	28	15mW
192	150	12.000W	12.0000W	50H Cos=0.08	-0.0000167%	0	2.3mW
193	150	1.195W	1.2000W	50H Cos=0.008	-0.380%	30	860uW
	450W Range (230V/1.5A)						
194	450	345.078W	345.0000W	50H Cos=1	0.023%	25	43mW
195	450	243.996W	243.9520W	50H Cos=0.707	0.018%	16	20mW
196	450	276.062W	276.0000W	50H Cos=0.8	0.022%	21	20mW
197	450	27.607W	27.6000W	50H Cos=0.08	0.027%	4	25mW
198	450	2.752W	2.7600W	50H Cos=0.008	-0.306%	19	13mW
<b>CHANNEL 2:</b>	<b>1A INPUT</b>						
	50W Range (100V/500mA):						
233	50	50.012W	50.0000W	50H Cos=1	0.024%	31	3.8mW
234	50	35.365W	35.3550W	50H Cos=0.707	0.028%	29	3.0mW
235	50	40.011W	40.0000W	50H Cos=0.8	0.029%	32	3.4mW
236	50	4.004W	4.0000W	50H Cos=0.08	0.097%	18	1.8mW
237	50	0.403W	0.4000W	50H Cos=0.008	0.836%	66	1.8mW
	150W Range (300V/500mA):						
238	150	115.0100W	115.00000W	50H Cos=1	0.000087%	9	11mW
239	150	81.3302W	81.31700W	50H Cos=0.707	0.016%	14	7.2mW
240	150	92.0192W	92.00000W	50H Cos=0.8	0.021%	20	8.6mW
241	150	9.2100W	9.20000W	50H Cos=0.08	0.109%	16	3.8mW
242	150	0.9272W	0.92000W	50H Cos=0.008	0.778%	47	3.9mW
<b>CHANNEL 2:</b>	<b>5A INPUT</b>						
	150W Range (100V/1.5A):						
245	150	150.042W	150.0000W	50H Cos=1	0.028%	35	18mW
246	150	106.094W	106.0660W	50H Cos=0.707	0.026%	27	15mW
247	150	120.028W	120.0000W	50H Cos=0.8	0.023%	26	16mW
248	150	12.003W	12.0000W	50H Cos=0.08	0.027%	5	2.1mW
249	150	1.200W	1.2000W	50H Cos=0.008	0.020%	2	2.3mW
	450W Range (230V/1.5A)						
250	450	345.040W	345.0000W	50H Cos=1	0.012%	13	43mW
251	450	243.988W	243.9520W	50H Cos=0.707	0.015%	13	17mW
252	450	276.044W	276.0000W	50H Cos=0.8	0.016%	15	21mW
253	450	27.603W	27.6000W	50H Cos=0.08	0.0000942%	1	12mW
254	450	2.764W	2.7600W	50H Cos=0.008	0.135%	8	17mW



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