INFRATEK AG
electronic products

PC11 Spectral Power Converter

The Swiss way of measuring power

CE

The PC11 High Precision Power Converter is the state-of-the-art instrument and an ideal tool for many measurement applications and offers engineers and technicians innumberable opportunities.

Precision Power Converter with Computer Operation

Basic Accuracy V, A, W:	**±0.02%, 0.02%, 0.04%**
Bandwidth:	**DC to 2MHz**
V-, A- Measurement:	**0.3V - 1000V, 50µA - 40A**
Hi Current Sensors:	**10A - 700A, 0.005%**
Measurement Resolution:	**18Bit**
Individual Settings:	**every phase, all phases**
4 Measure Modes:	**Standard, Logging, Transient, Power-Speed**

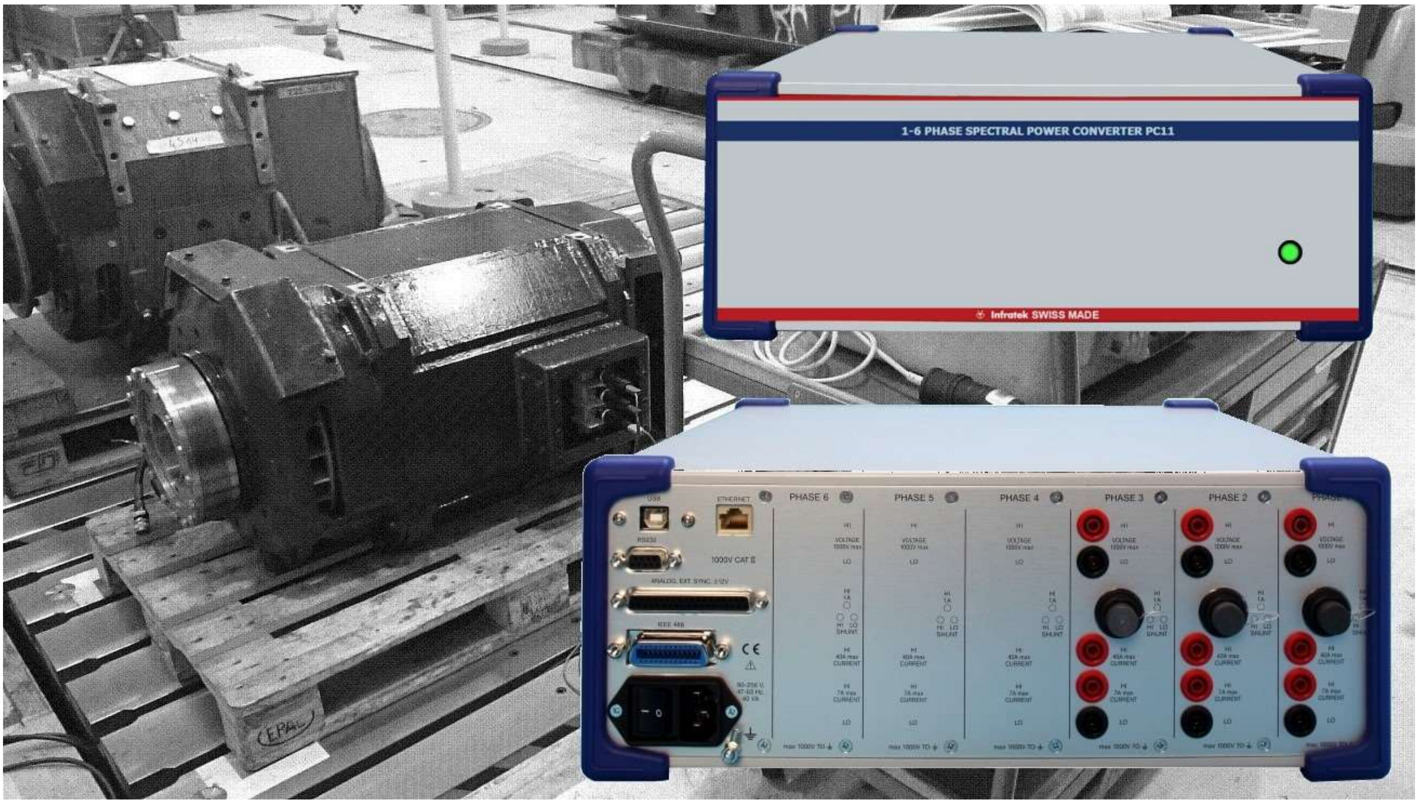
Upgrading the instrument is feasible due to modular concept at any time.

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

The MODEL PC11 HIGH PRECISION POWER Converter measures 280 electrical quantities on every phase. Energies, harmonics, motor- and transformer values, power sums, power ratios, analog- and frequency inputs can be read via interface at any time

FEATURES

- Available as 3-, 4-, 6-phase instrument
- 18 bit resolution. High accuracy at 10% full scale
- Simple to operate using computer software
- 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
- 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
- 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 PC11-6
- Simple servicing, modular concept, pre-calibrated inputs
- Reasonably priced by virtue of smart design
- Individual settings for every phase and all phases
- Interface commands for fast data transmission



High Performance, Simple to Use

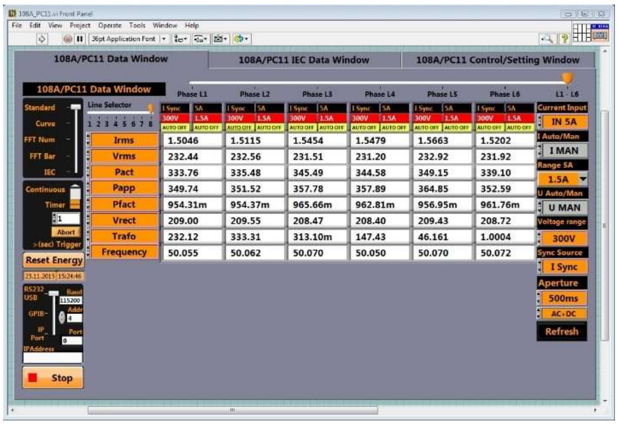
The Infratek PC11 High Precision Power Converter is available in 3-, 4-, or 6- phase versions. All voltage inputs 0.3V up to 1500Vpeak and all current inputs (1.5mA up to 1A; 15mA up to 5A; 1A up to 40A; and shunt inputs 60mV up to 6V) are potential free and exhibit low noise, high common mode suppression, 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. Everything 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 Converter using the available software.

MEASUREMENT FUNCTIONS

Four different measure functions enhance the PC11 Power Converter capabilities.

Standard Measure Mode:

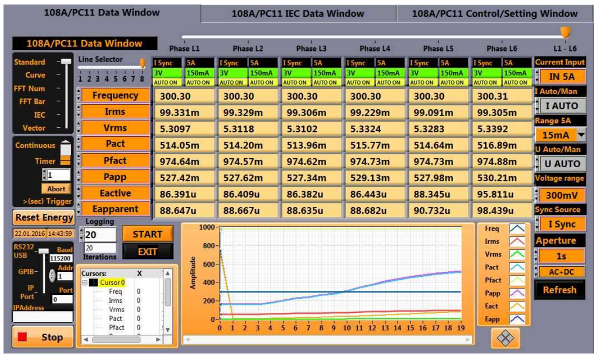
In the Standard Measure Mode 280 quantities per phase are measured without gap and are continuously updated using the computer software. Two electric motors can be tested simultaneously. External Speed and torque inputs are optionally available. Transformer values are implemented too.



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.

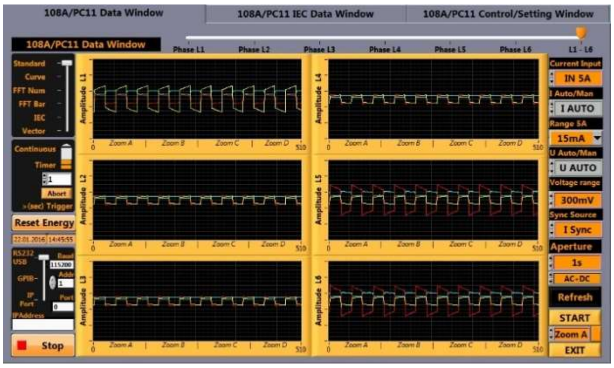
Cycles: For Logging Measure Mode set Cycles 1 to 32000. Defines the measurement duration per measurement set. Format 160.



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 using the Zoom A, B, C and D buttons of the program.

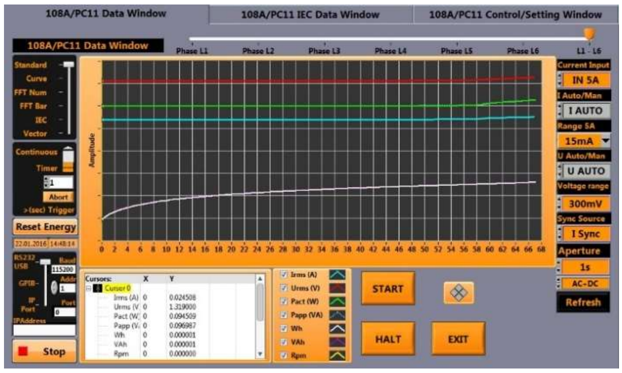
Transient ID: Set it to 1, 2, 3, 4, 5, 6, or 7. The transient ID determines the measurement duration after start. Transient ID Measurement duration: 1 {0.25s} 2 {0.5s} default, 3 {1s}, 4 {2s}, 5 {4s}, 6 {8s}, 7 {16s}.



Power-Speed Measure Mode:

This measure mode analyzes the performance of devices such as electric cars.
In 20ms intervals the following data are transferred: 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.

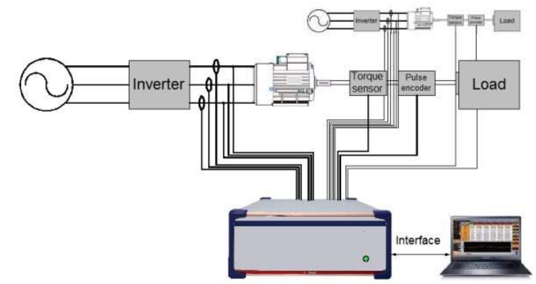


APPLICATIONS

Electric Motors (Railroad systems)

The PC11-6 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 PC11-6 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, Ld, Lq and the motor resistances R = Rm + Rdc can be determined.
The motor DC-resistance is obtained by applying a DC-current: Rdc = Pdc / I^2dc. Rm is a magnetization dependent loss.

Simultaneous Measurement of 2 Synchronous Motors (PMSM, BLDC)

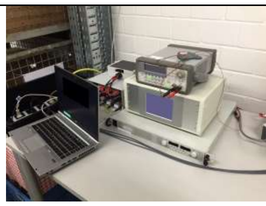


A wide range of synchronous motors are on the market (PMSM, IPMSM, BLDC). The power consumption ranges from mW to 500kW. Many different constructions are in use. They all have in common that the magnetic field rotation (2 phase or 3 phase) is electronically generated. A wide range of speeds (rpm) are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

Inverter drive systems

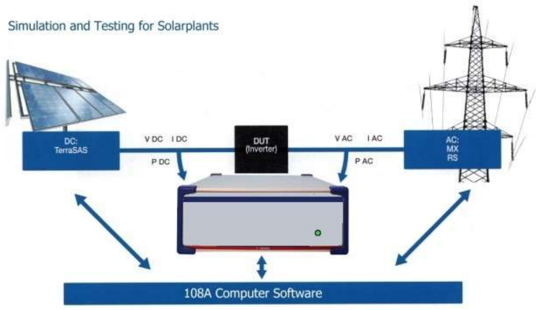
Using the PC11-6 to test the efficiency of an inverter drive, simultaneous measurement of all electrical parameters is essential. By visually inspecting the current waveform, we should see three individual currents all producing an alternating positive/negative pattern waveform. All three phases should be symmetrical. The PC11-6 measures very precisely total input power, total output power and inverter efficiency!

Automotive



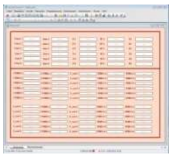
Testing fuel pumps is crucial for proper and reliable vehicle operation and long lasting product quality. Individual fuel pump tests like Start-Stop, Low-Speed/Full-Speed are used; the PC11 delivers all important electrical parameters. The PC11 in the power-speed measure mode measures the start performance 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 PC11 and can be read via computer software.

A dedicated high speed data acquisition software is available to read data from several PC11. 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 PC11 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.

PC11 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

	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	
% reading + % range	Standard accuracy 23°C ±1°C. 3V to 600V	**High precision** 10V to 600V
	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[1]//100-500kHz[1]: 0.1 + 0.1// 0.012*f(kHz)	
	Linearity 100V range: 130 % / 100 % / 50 % / 10 % / 5 % 130.01V / 100.00V / 49.988V / 10.000V / 5.0014V	Typical linearity at 50/60Hz
Voltage Scaling U1-U6	Individual voltage scaling factors of every phase. Format 2000.8.	

Measured & Computed Voltage Values

RMS voltage	Vrms = $(1/T \int_0^T V^2 dt)^{1/2}$, includes all harmonics	Voltage crest factor	Vcf = Vmax / Vrms
Mean voltage	Vmean = $1/T \int_0^T$ Vdt, dc component of voltage	Voltage form factor	Vff = Vrms / Vrect, is 1.1107 for sine wave
Rectified mean voltage	Vrect = $1/T \int_0^T$ IVI dt, rectified mean voltage	Voltage fundamental	V01 = fundamental voltage of FFT
Peak voltage	Vmax = maximum voltage in time interval	V1 line to line	V1 ltl = $(V_{1rms} + V_{2rms}) \cdot 0.86603$
Lowest voltage	Vmin = lowest voltage in time interval	V2 line to line	V2 ltl = $(V_{2rms} + V_{3rms}) \cdot 0.86603$
Peak to peak voltage	Vptp = $V_{max} – V_{min}$	V3 line to line	V3 ltl = $(V_{3rms} + V_{1rms}) \cdot 0.86603$
Voltage distortion	Vthd1 = $(Vrms^2 – V01^2)^{1/2}$ / Vrms, [2]	V4 line to line	V4 ltl = $(V_{4rms} + V_{5rms}) \cdot 0.86603$
Harmonic voltage distortion	Vthd2 = $(\Sigma Vn^2)^{1/2}$ / Vrms, n = 2,3, …, 40	V5 line to line	V5 ltl = $(V_{5rms} + V_{6rms}) \cdot 0.86603$
		V6 line to line	V6 ltl = $(V_{6rms} + V_{4rms}) \cdot 0.86603$

Current Measurement

	4 inputs: In30A, In5A, In1A, shunt. Floating inputs. 1 sec averaging.	max. 1000Vrms to earth
	In1A: 6 ranges 1.5mA[1] - 5mA - 15mA - 50mA - 150mA - 500mA - 1500mA. DC-100kHz	max. 2A continuous
	In5A: 6 ranges: 15mA[1] - 50mA - 150mA - 500mA - 1.5A - 5A - 15A. DC-100kHz	max. 7A continuous
	In30A: 4 ranges: 1A[1] - 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	**High precision In1A/In5A**
	Input / **In1A,In5A,Shunt** / **In30A**	15,50,150,500mA,1A/150,500mA,1.5,5A
% reading + % range	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[1]//100-500kHz[1]: 0.1 + 0.1// 0.023*f(kHz)	
	Current Sensors / **0-150Apeak** / **0-400Apeak** / **0-600Apeak** / **0-700Apeak** 45 to 65Hz: 0.004 + 0.004 / 0.004 + 0.004 / 0.002 + 0.002 / 0.01 + 0.01 3 to 1000Hz: 0.01 + 0.01 / 0.01 + 0.01 / 0.01 + 0.01 / 0.02 + 0.02	Exposure of current inputs to their max. value will result in additional errors[1] In1A: 0.03% * I^2 In5A: 0.003% * I^2 In30A: 0.0001% * I^2 Coax: 0.0001% * I^2
	Input / **0-100A** precision current sensor (Option 04) connected to In1A input 3 to 100Hz: 0.05 + 0.05 100 to 1000Hz: 0.1 + 0.1	
	Linearity 500mA range: 130 % / 100 % / 50 % / 10 % / 5 % 650.02mA / 500.02mA / 250.02mA / 49.979mA / 24.997mA	Typical linearity at 50/60Hz
	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. Format 2000.8.	

Measured & Computed Current Values

RMS current	Arms = $(1/T \int_0^T A^2 dt)^{1/2}$, includes all harmonics	Current distortion	Athd1 = $(Arms^2 – A01^2)^{1/2}$ / Arms, [2]
Mean current	Amean = $1/T \int_0^T$ Adt, dc-component of current	Harmonic current distortion	Athd2 = $(\Sigma An^2)^{1/2}$ / Arms, n = 2,3, … 40
Rectified mean current	Arect = $1/T \int_0^T$ IAI dt, rectified mean current	Current crest factor	Acf = Amax / Arms
Peak current	Amax = maximum current in time interval	Current form factor	Aff = Arms / Arect, is 1.1107 for sine wave
		Current fundamental	A01 = fundamental current of FFT

1) Typical max. Error

2) Used for frequency inverter

Power Measurement

% reading +% range	W range = voltage range times current range	112 power ranges
	Standard accuracy 23°C ± 1°C **Input** / **PF** / **In1A, In5A, Shunt** 45 to 65Hz / 0-1 / 0.16 + 0.16 45 to 65Hz / 0-0.05 / 3 to 1000Hz / 0-1 / 0.2 + 0.2	**High precision** **In1A, In5A, Shunt** 0.04 + 0.04 0.01 + 0.01 0.1 + 0.1
	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[1)]//100-500kHz[1)] / 1 / 0.2 + 0.2// add %error (V+A)	
	Input / **PF** / **In30A** / **Current Sensor 0-100A** 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[1)] / / 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 0.5 / 0.74 / 0.97 / 1.18 / 1.38 / 1.55 / 1.70 / 1.83 / 1.92 / 1.98 / 2.00	$k1 = (2 - PF^4) / (1+PF^2)$ [1)] Typical max. error
	W Linearity / 130% / 100% / 50% / 10% / 5% 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	Typical linearity of voltage, current and power

Measured & Computed Power Values

Active power	W = 1/T $\int_0^T$ u·i dt, total power in W	Fundamental power	W01 = A01 · V01 · cos φ01, φ01 = phase
Apparent power	VA = Arms · Vrms, total apparent power VA	Fundamental apparent power	VA01 = A01 · V01
Reactive power	Var = $\pm(Papp^2 - Pact^2)^{1/2}$, reactive power Var	Fundamental reactive power	Var01 = $(VA01^2 - W01^2)^{1/2}$, magnitude only
Power Factor	PF = Pact / Papp, includes all harmonics	Power of distortion	D = V01$(\Sigma An^2)^{1/2}$, n = 2,3, …, 40; D in Watt
		Power Factor of Fundamental	PF01 = W01 / 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

Measured & Computed Values

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

Harmonic Measurement

Frequency range of fundamental 3Hz – 15kHz Harmonics: V and A: 1-88; W and phase angle 1-21 Accuracy: Fundamental[1)], use % figures of V, A, W	FFT averaging: Set FFT ID = 0, 1, 2, 3, 4 which corresponds to averaging over 4, 16, 64, 256, or 1024 periods.
The whole range of harmonics can be read via interface.	

Measured & Computed Values

Magnitude impedance	Mag Z = V01 / A01 fundamental	Phase of fundamental	Phi01 = phase V01, A01

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 interface output.	

1) 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 / $Arms^2$
Corrected power	Corr power = Pact 1 / (0.5 + 0.5 · Vrms / Vcorrected)	Loss inductance	Equivalent loss reactance = Prea 1 / $Arms^2$
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%[1)] ±10V, 100kΩ input impedance, accuracy 0.2%[1)] Accuracy 0.1%[1)]. 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%[1)] 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. Format 10.0.		
Scaling rpm1-rpm2	TTL freq1/rpm1 and freq2/rpm2 scaling. 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

10/100 Mbps Ethernet interface (Up to 230.4kBaud)

RS232 Interface (Up to 115.2kBaud)
or
USB Interface (Up to 921.6kBaud)

Analog Input / Output connector (37-pole)

GPIB, IEEE 488.2 (Set address 1 to 30)

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: Use computer software, 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
Operation	Computer (Software)
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

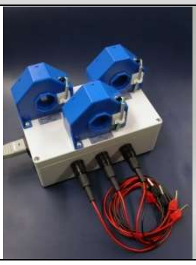
Ultra Precise Current Transducers

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

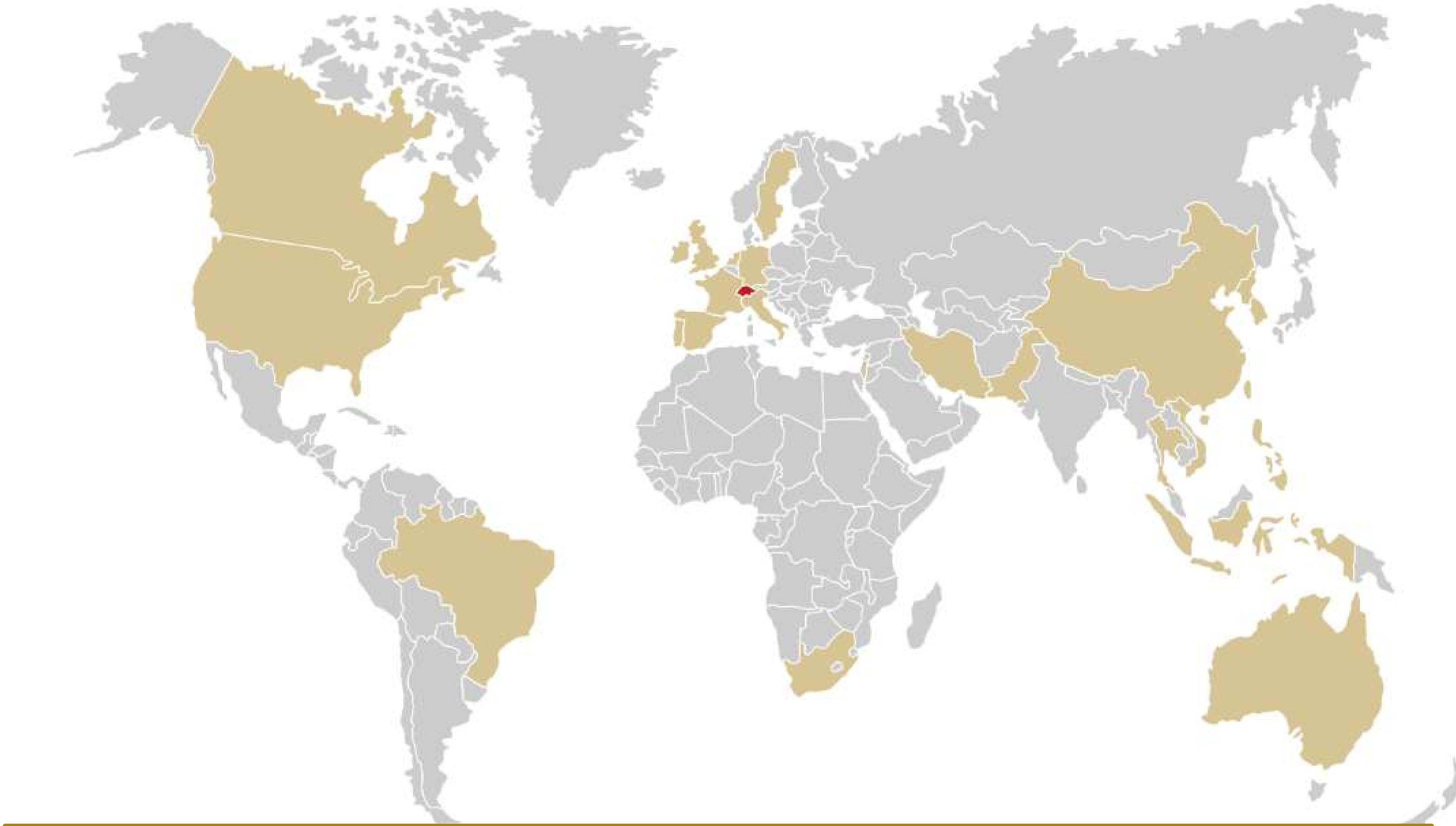
Nominal current measurement	100 - 2000 A
Linearity error	<0.3 %
Basic accuracy @ IPN (+25°C)	±0.2 %
Wide frequency bandwidth	DC to 100 kHz
Power supply	±12 V / ±15 V



Applications: Energy measurement, Power analyzers, Transformer, Motor

Typical performance at low power factor.

		UUT	SYSTEM			ERROR	EXP.
TEST	RANGE	INDICATED	ACTUAL	MODIFIER	ERROR	(%TOL)	UNCERT
CHANNEL 1:	**1A INPUT**						
	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
CHANNEL 1:	**5A INPUT**						
	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
CHANNEL 2:	**1A INPUT**						
	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
CHANNEL 2:	**5A INPUT**						
	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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