

PPA3500 Series 3~6(7) Phase Power Analyzer



Up to 6(7) Phase Power Analysis within a 2U single Chassis



Product Overview	
3 to 7 Phase Configuration	Up to 7 Phase Analysis within 1 chassis (App Note 36)
Dual Core Power Processing	Enable dual analysis modes with maximum performance
PWM Motor Drive Measurements	High Performance PWM Motor Drive Analysis
Leading Wideband Accuracy in 2U form factor	0.04% Accuracy with class leading high frequency performance
Wide Screen Display for 6 Phase Analysis	Unique wide aspect ratio for 6 Phase Analysis
Market Leading Phase Accuracy	0.005 Degrees Phase Accuracy
Built in High Precision Shunt	30Arms or 20Arms (LC) Internal Current Shunt
Versatile interfaces	RS232, USB, LAN, GPIB, Torque, Speed and Extension for ADI40 Option
Compact Size	Unique 6(7) Phase Power Analysis in 2U form factor
Fast Sample Rate and No-Gap	1M sample/s
Wide Frequency Range	DC & 10mHz to 1MHz

PPA3500 Precision Power Analyzer

FRONT VIEW



① POWER BUTTON

② FRONT USB PORT

USB memory port allows data or screendumps to be saved directly to a USB pen drive

③ WIDE ANGLE VIEW DISPLAY SCREEN

Double white LED backlit colour TFT display with high contrast and wide viewing angle

④ SCREEN DISPLAY OPTIONS

Zoom, Real time, Table and Graph options

⑤ MEASUREMENT FUNCTION SELECTION BUTTONS

- POWER ANALYZER
- HARMONIC ANALYZER
- TRUE RMS VOLTMETER and AMMETER
- OSCILLOSCOPE



Measurement Mode Control

⑥ MEASUREMENT SETTINGS BUTTONS

Acquisition settings - Sets wiring configuration, Smoothing and data logging

Coupling - Set coupling to AC, DC or AC+DC, also set bandwidth

Range - Internal or external attenuator, autoranging settings, scale factors

Application mode - PWM, ballast, inrush current, power transformer, standby power,

Plus direct configuration of - Alarm, Auxiliary, Remote, System and Program functions

⑦ MENU SELECTION AND CURSOR CONTROL

⑧ START, STOP, ZERO AND TRIGGER

Trigger button refreshes measurement, Zero resets datalog or allows an offset trim

Start and Stop buttons provide manual control of a measurement period

REAR VIEW



PPA3560 - 6 Phase

⑨ PHASE INPUTS

Direct voltage Input: 2.5kVpk (1kVrms) in 10 ranges

Direct current Input: 1000Apk (30Arms) Standard Model, 300Apk (20Arms) Low Current Model in 10 ranges

External voltage and current sensor inputs to 3Vpk in 8 ranges - BNC Connector

⑩ SYNC CONNECTOR

Can be utilised for external triggering

⑪ EXTERNAL SENSOR INPUTS

+/-10V or pulsed input from torque and speed sensors provides direct measurement of mechanical power + analogue output

Extension Port: Connection of auxiliary devices such as the ADI40 40 Channel Analogue Input/Output Interface for Multi-Channel Sensor and Direct Thermocouple Measurement

⑫ PC INTERFACE CONNECTIONS

Standard interfaces : RS232 + USB + LAN + GPIB

⑬ Safety Earth Connection

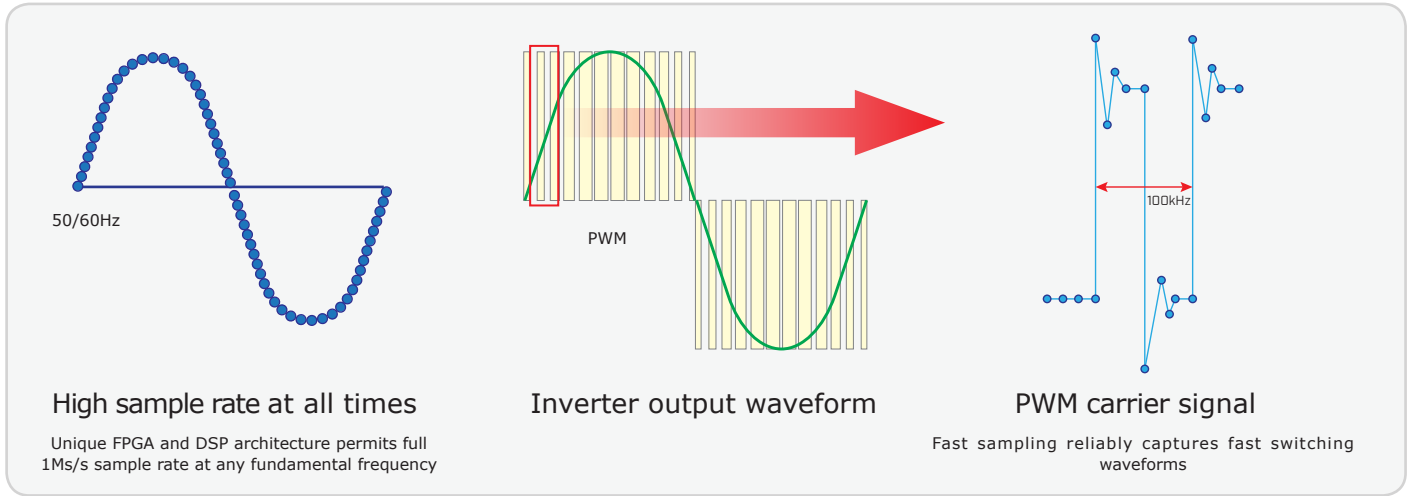
Screw type safety earth connection



FEATURES

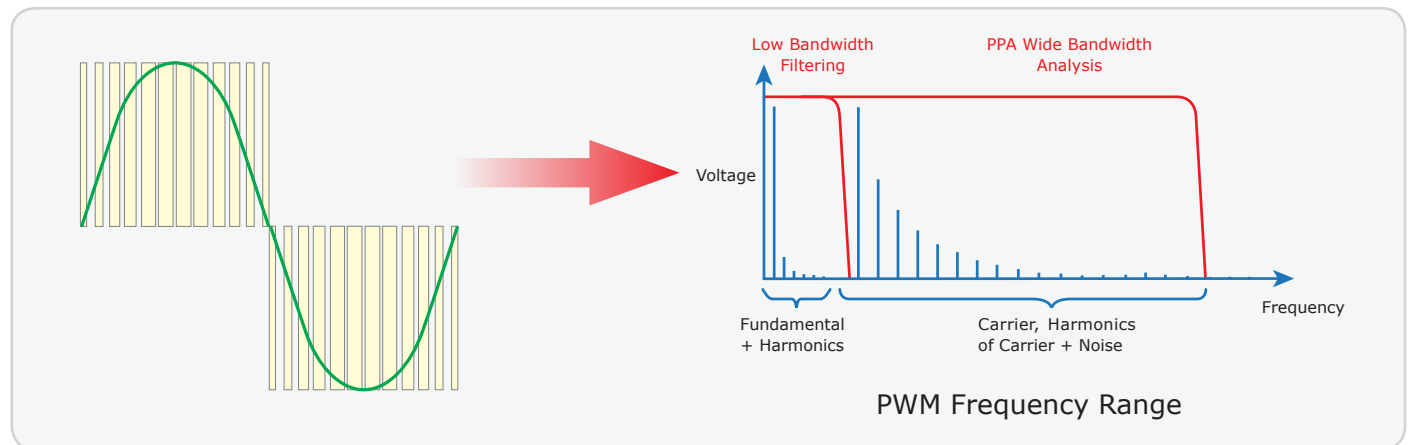
High Speed Power Measurement - 5ms Datalog Interval PPA3500

Measurements include all frequency components in power waveforms for example, fundamental, harmonics of the fundamental and the carrier of a PWM inverter output by maintaining 1Ms/s sampling at any drive frequency



1MHz Wideband Frequency Response PPA3500

With 1MHz bandwidth and exceptionally flat response, the PPA3500 provides precision analysis of total power in applications such as lighting ballasts or PWM drives that involve a wide range of frequency components. Proprietary to N4L, a digital process called Expanded Nyquist Sampling ensures no alias components.

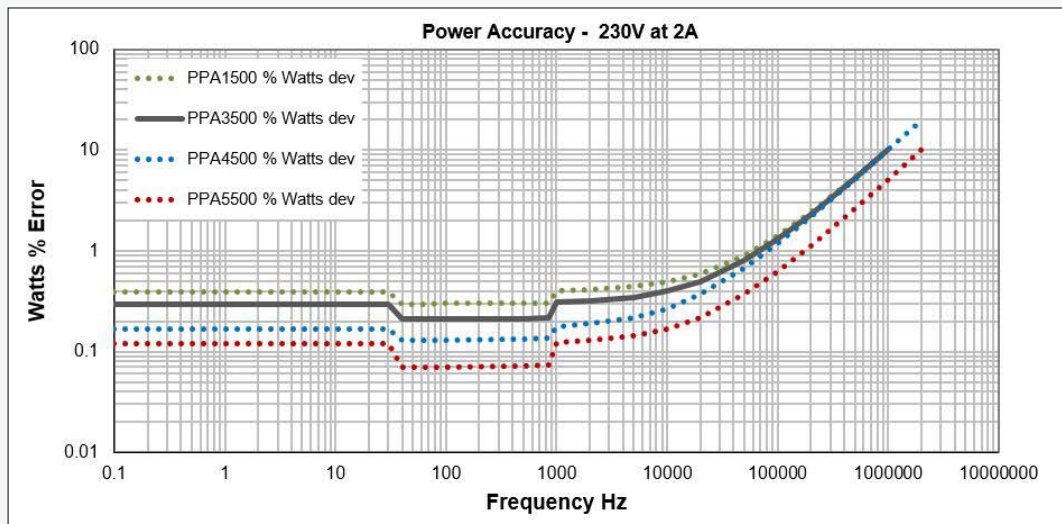


High Accuracy PPA3500

Unique voltage and current analogue card design ensures high accuracy for both power and harmonic analysis

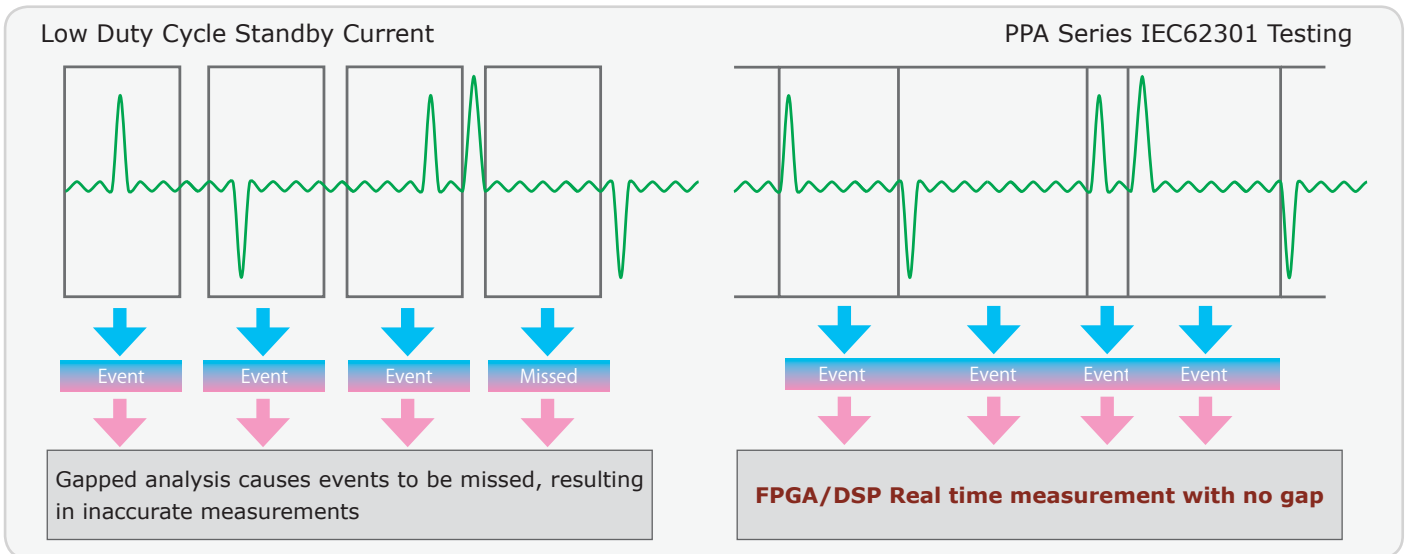
Class Leading Power Accuracy

PPA3500 Power Accuracy: $[0.06\% + 0.1\%/pf + (0.01\% \times pf)/pf]$ Rdg + 0.03%VA Rng
240V (300V Range), 2A (3A Range), Power Factor : 1 (40-400Hz 0.01%VA Rng)



■ DFT Real Time No Gap Analysis PPA3500

Many power applications have fast changing asynchronous current pulses which are not suited to fixed data length FFT analysis. The PPA series combine a real time DFT (Discrete Fourier Transform) technique with variable window no gap analysis to ensure the optimum speed and accuracy at all times

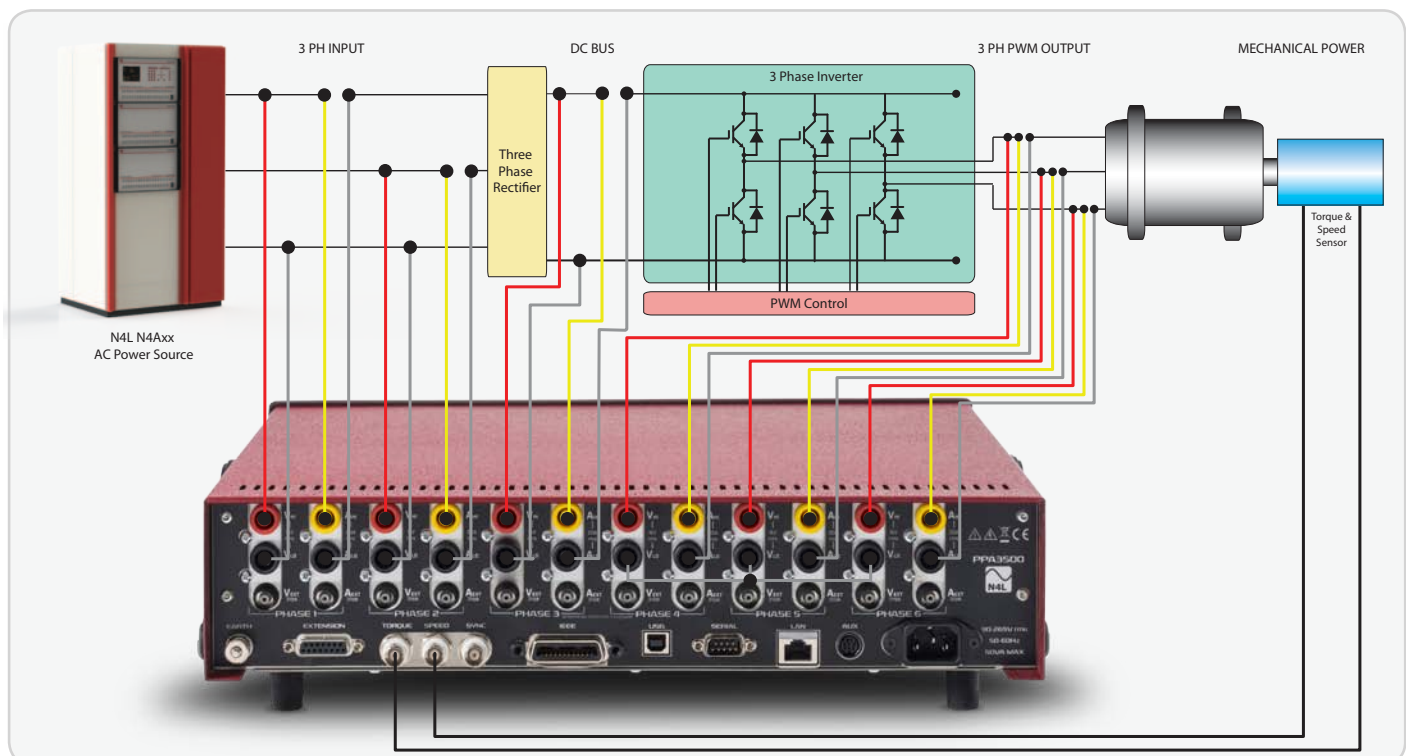


- Missing data compromises power accuracy
- Long term measurement integration achieves approximately correct average power

- Real Time No Gap analysis ensures correct power measurement
- Simultaneous fundamental and pulse frequency synchronization quickly obtains the correct power

■ Up to 6 Phase (8 Wire) Analysis PPA3500

The PPA3560 offers 12 channel, 6 Wattmeter measurements from a single chassis. All measurements are time synchronised utilising a central FPGA core which acquires the sample points from all 12 channels simultaneously, avoiding serialised data acquisition. This enables the PPA3560 to achieve unrivalled channel to channel phase angle accuracy and is one of the key contributors to the market leading 0.005deg phase accuracy.



FPGA Core

- Simultaneous data acquisition, time synchronising phases
- High speed harmonic analysis
- True "Real Time" power computation with no gap

Measurement parameter examples

- Input/Output power measurement
- Efficiency of the inverter
- Inverter output voltage harmonics
- Motor drive characteristics

FUNCTIONS

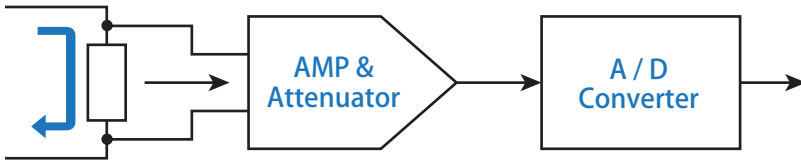
Input Torque and Speed Sensor PPA3500

Direct measurement of torque and speed from dedicated inputs that are fully synchronized with the voltage and current channels permits true real time power conversion efficiency to be evaluated



- ① TORQUE Isolated Bipolar $\pm 10V$ / pulsed
- ② SPEED Isolated Bipolar $\pm 10V$ / pulsed
- ③ SYNC Isolated Bipolar $\pm 10V$ / pulsed

Built in Amplifier and Unique Shunt Resistor PPA3500



The PPA series use a single shunt resistor unique to N4L that combines exceptional linearity and no need for relay switching which can cause measurement errors

Model	Low Current Model	Standard Model
PPA3500	10 ranges: 10mA _{pk} - 30A _{pk} (20Arms) 10mΩ Shunt	10 ranges: 30mA _{pk} - 1000A _{pk} (30Arms) 3mΩ Shunt

External shunt options

(DC ~ 1MHz, 0.1% Accuracy, Inductance < 1nH)

Model	Maximum Current		Bandwidth
	Rated A	Peak	
HF500	500Arms	5000A _{pk}	DC ~ 1MHz
HF200	200Arms	2000A _{pk}	
HF100	100Arms	1000A _{pk}	
HF020	20Arms	200A _{pk}	
HF006	6Arms	60A _{pk}	
HF003	3Arms	30A _{pk}	



HF003



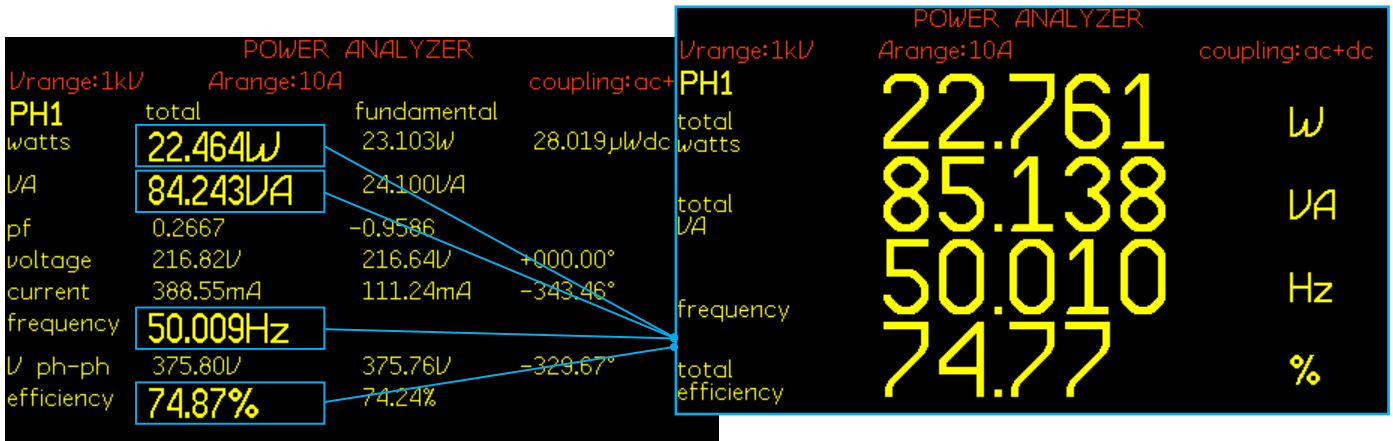
HF500



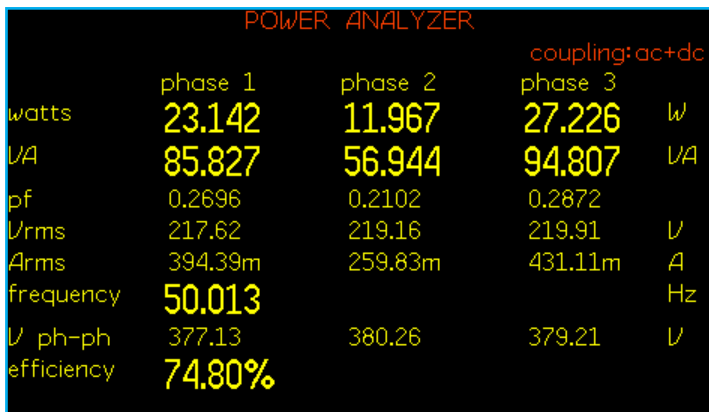
MEASUREMENT DISPLAY

Power Analysis PPA3500

Wide Angle display for convenient viewing of 6 Phase Power Analysis



Zoom function enabled on total watts, total VA, frequency and total efficiency



3 Phase analysis display

All power measurement and RMS values are computed simultaneously across 6 phases, allowing measured values to be selected and viewed during analysis.

Here, three phase input and 3 phase output power can be selected with all primary power functions in each phase plus frequency, a selected harmonic, dc watts and phase to phase voltage

Mechanical power, Maths and Efficiency functions can also be added to this screen giving real time analysis of electrical or electrical to mechanical systems

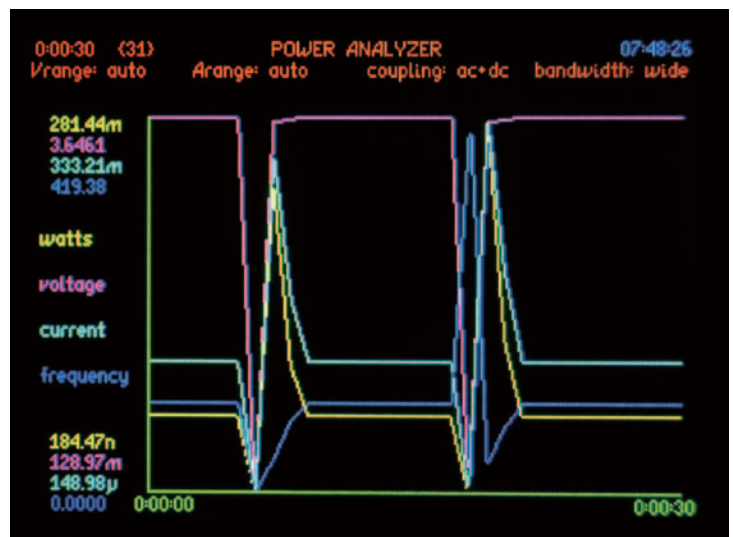
MEMORY

Large 500MB internal memory, data logging from 5ms intervals with synchronization to the fundamental frequency and no gap between measurements

Datapoint storage up to 5M

Alternatively the data can be stored in an external USB pen drive or directly to PPA LoG PC software

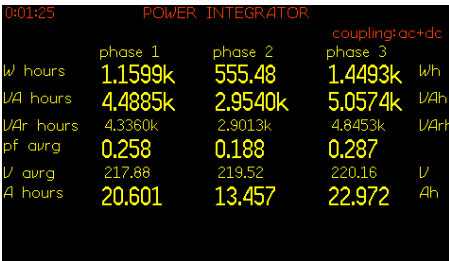
Voltage, Current, Frequency and Power - Examples of graph mode



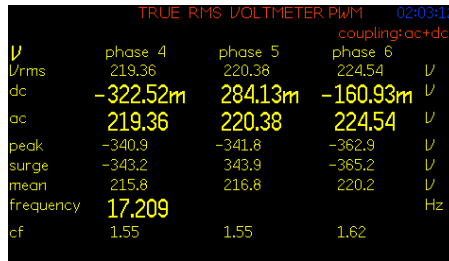
Trend analysis

MEASUREMENT MODES

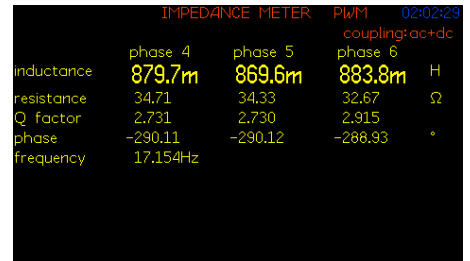
Power Integrator (power consumption) Mode, RMS Meter Mode and Impedance Meter Mode PPA3500



Power Integrator mode



RMS Voltmeter mode



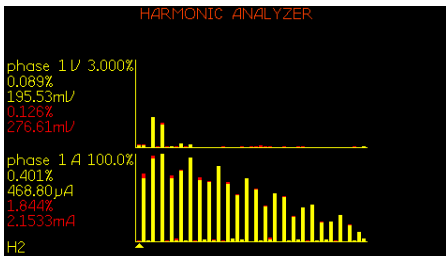
Impedance meter mode

Note

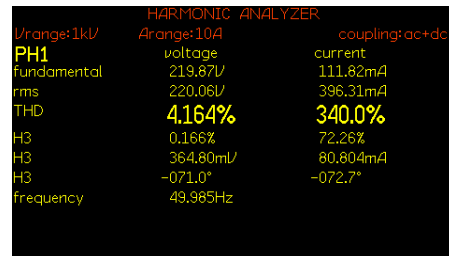
In addition to detailed measurements of the phase power parameters, you can check the balance of power between the phases and observe computed neutral current when 3 phase 4 wire connection is selected, this can be performed over 6 phases with 3 Phase 3 Wattmeter + 3 Phase 3 Wattmeter wiring configuration.

Harmonic Analyzer and Oscilloscope PPA3500

In Harmonic Analyzer Mode, the PPA3500 provides up to 100 Harmonics with real time, table or bar graph presentation. Measurements are in absolute magnitude and percentage of fundamental with harmonic phase also available. The Discrete Fourier Transform (DFT) is utilised, resulting in highly accurate harmonic analysis. With accuracy figures matching the headline Voltage and Current specification the PPA3500 is a highly capable harmonic analyzer. The use of the DFT is made possible via high speed parallel FPGA signal processing as well as proprietary low level DSP algorithms. The DFT was selected for signal decomposition due to the fact that sample by sample window resolution is possible, instead of the restrictive 2^n sample window size of the FFT, the DFT is capable of minimal leakage without the need of error prone window filtering functions.



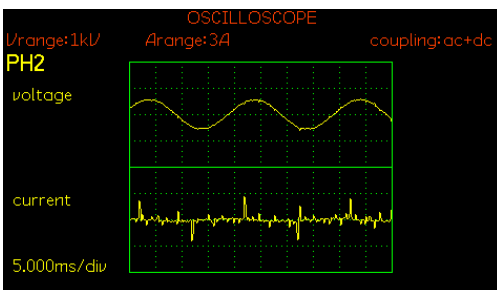
Harmonic analyzer (Bar graph)



Harmonic analyzer summary page

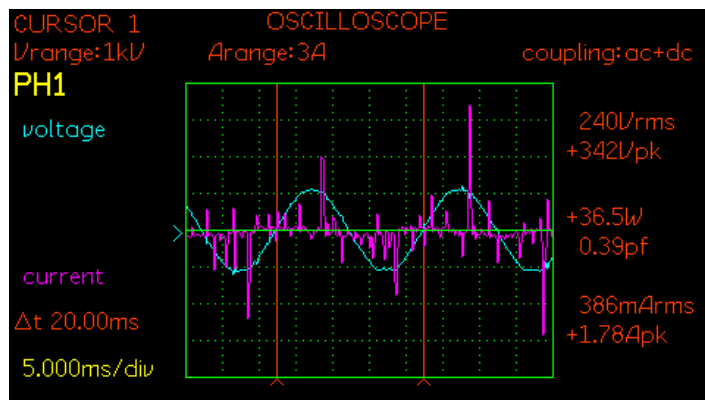
PH1	frequency	voltage	current
1	50.02Hz	219.67V	100.0%
2	100.0Hz	99.944mV	0.046%
3	150.1Hz	258.91mV	0.116%
4	200.1Hz	134.08mV	0.061%
5	250.1Hz	23.495V	1.068%
6	300.1Hz	68.830mV	0.031%
7	350.1Hz	1.7606V	0.802%
8	400.2Hz	57.017mV	0.026%
9	450.2Hz	178.12mV	0.081%
10	500.2Hz	83.405mV	0.038%
11	550.2Hz	426.49mV	0.194%
12	600.2Hz	35.484mV	0.016%
13	650.3Hz	151.85mV	0.069%

Harmonic analyzer table

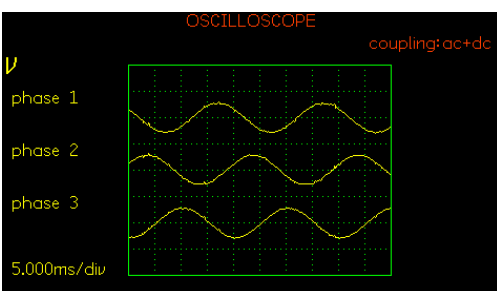


Oscilloscope - Voltage and Current display

Harmonic Accuracy	
Voltage	0.04% Rdg+0.1% Rng+(0.005%×kHz)+5mV
Current	PPA3500-LC 0.04% Rdg+0.1% Rng+(0.005%×kHz Rdg)+300uA PPA3500 0.04% Rdg+0.1% Rng+(0.005%×kHz Rdg)+900uA



Oscilloscope Cursors - Enable cursors and display Vrms, Vpk, Watts, Power Factor, Arms and Apk



Three phase display of voltage

ACQUISITION SETTINGS

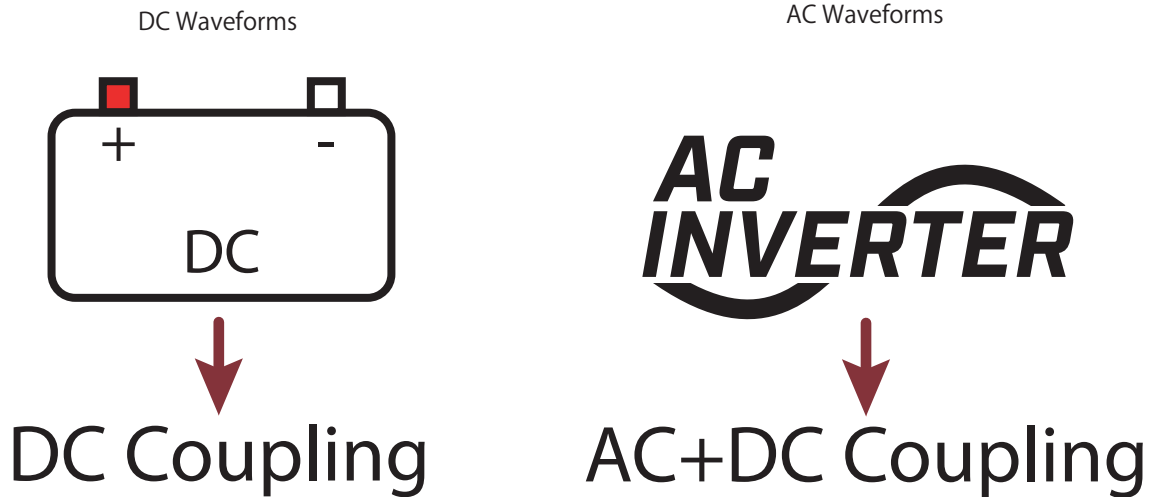
■ Auto-Ranging, Range Up Only or Manual PPA3500

Range modes are selectable

- ① Auto-Ranging Performs automatic switching of voltage and current ranges up and down depending on the level of the measured value with all inputs linked or ranged independently to ensure optimum accuracy
- ② Range up only Performs automatic ranging when the input is 120% of range, ranging up only
- ③ Manual No automatic ranging, user specifies the range in which to operate
(used when input voltages and currents are known) or during inrush current testing

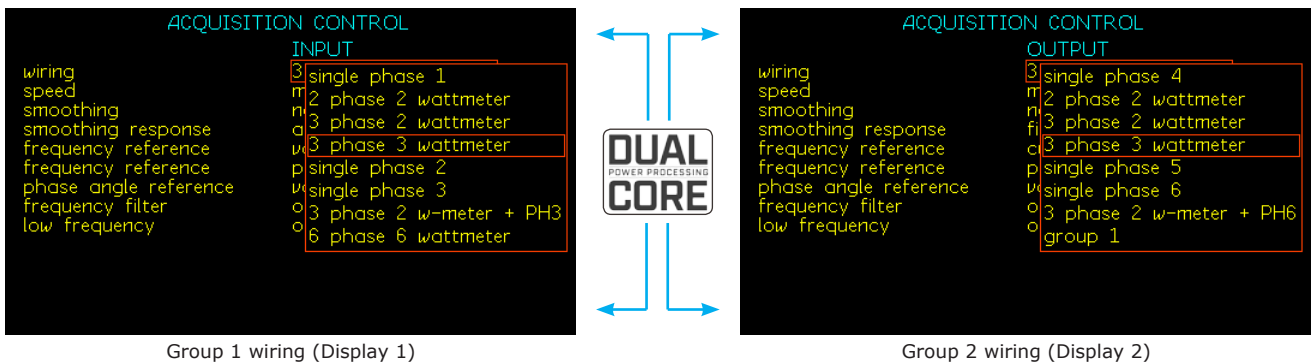
■ Independently Set Input Coupling PPA3500

Independently set input coupling so different methods of sensing can be implemented. Such as CT's on phase 1+2, resistive shunt sensing on phase 3 and Rogowski coils on phase 4~6.

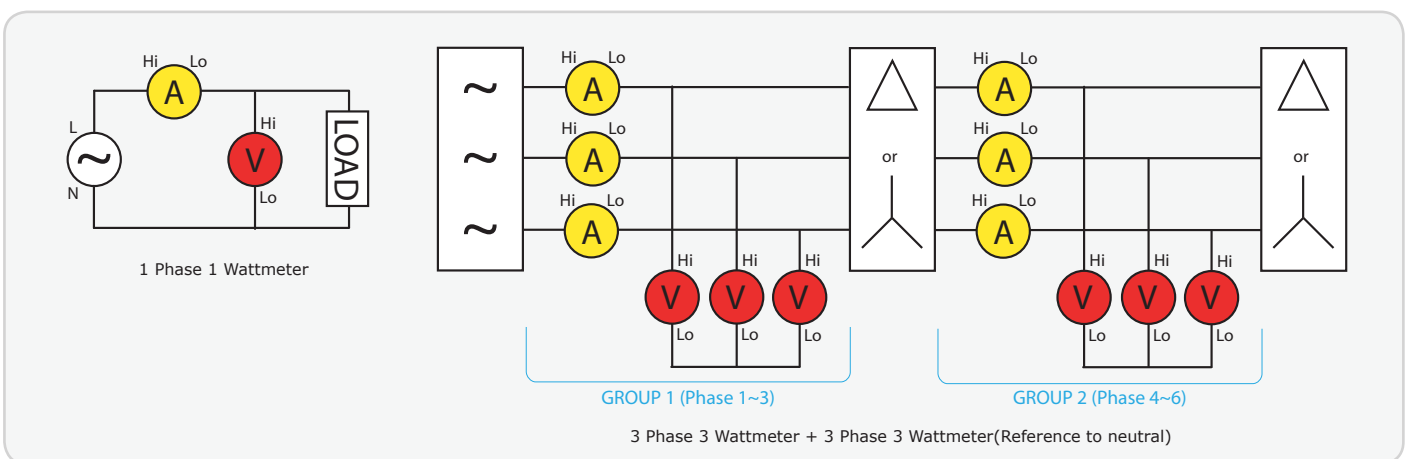


AC+DC and DC coupling both provide 1MHz bandwidth measurements, the coupling setting ensures the instrument is synchronised to the largest power component of the measured waveform. DC coupling should be used for DC bus measurements and AC+DC coupling used for Inverter Output and AC input power measurements.

■ Wiring Settings PPA3500



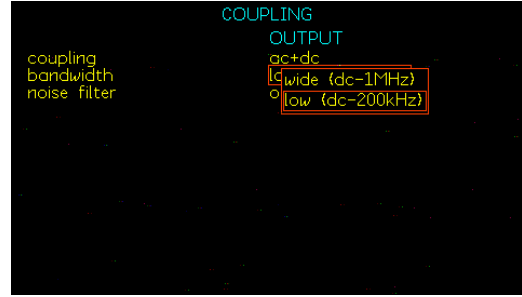
The PPA3500 utilises a dual control menu system, the instrument is divided into 2 distinct groups. Group 1 is controlled via display 1(left hand) and group 2 is controlled via display 2(right hand).



ACQUISITION SETTINGS

■ Bandwidth Settings PPA3500

- Low(DC-200kHz) Basic power (50/60Hz) including harmonics of the fundamental while rejecting high frequency noise
- Wide(DC-1MHz) Wideband applications such as PWM inverter drives including all power components for true total power



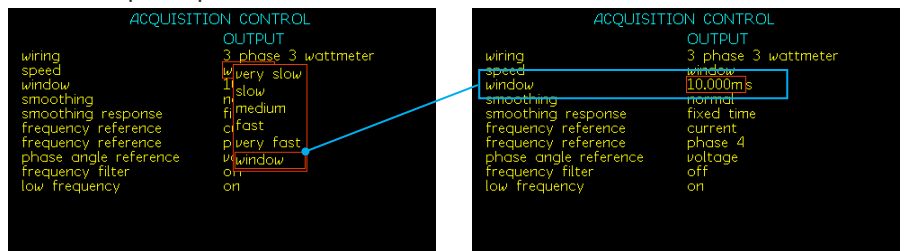
Example of wiring configuration showing 1 phase, individual coupling settings also available.

Note
The PPA3500 series includes a programmable digital filter that allows users to set a preferred bandwidth

■ Display Settings, Smoothing Response and Frequency Reference PPA3500

① Display update rate

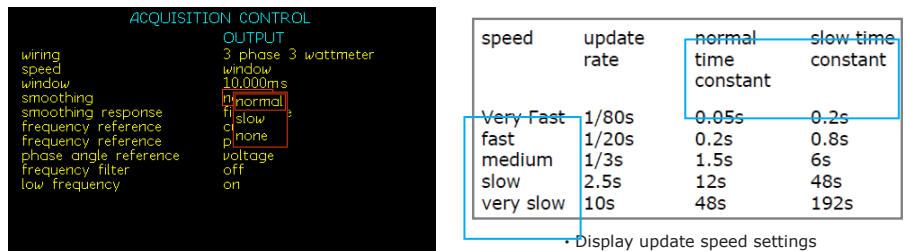
Various settings for the display update rate (5ms ~ 100s) which also increases the smoothing when used together with the smoothing option. A 'window' option permits direct control of the measurement window size



Example of setting the window, eg (100Hz set to 10ms)

② Smoothing settings

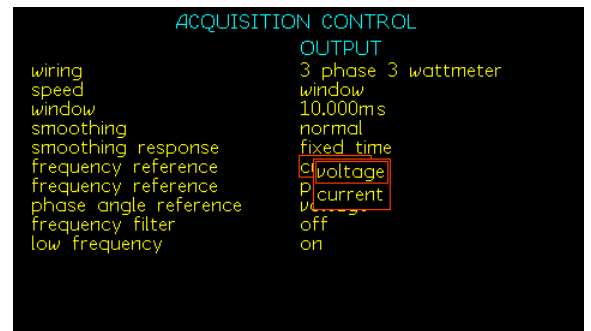
Working in conjunction with the speed setting, a smoothing filter can then be applied to the measurements. Normal and slow options are available which apply an increasing time constant to the output of the measurement window



• Display update speed settings
• Setting the filter (normal/slow)

■ Frequency Reference PPA3500

When making a precision measurement of ac power, correct synchronization with the fundamental frequency is essential. The PPA series provides a solution to frequency synchronization in a wide range of applications including Standby Power, Variable Speed Drives, Electronic Ballasts and DC to AC Inverters with the option to select voltage, current, speed or ac line input as the frequency reference.



Frequency Reference

■ Simultaneous Dual Mode Capability DUAL CORE

The PPA3500 has the capability to output two modes simultaneously utilising N4L's proprietary "Dual Core Power Processing" Architecture, providing great flexibility to the user. Of particular interest is the ability to display both Power Analysis and Oscilloscope data at the same time, while maintaining full sample rate on all power measurements. Traditionally, it is common for instruments to decrease raw sample rate within the power analyzer function when another mode is enabled. The PPA3500's "Dual Core" architecture allows for maximum performance of both modes.

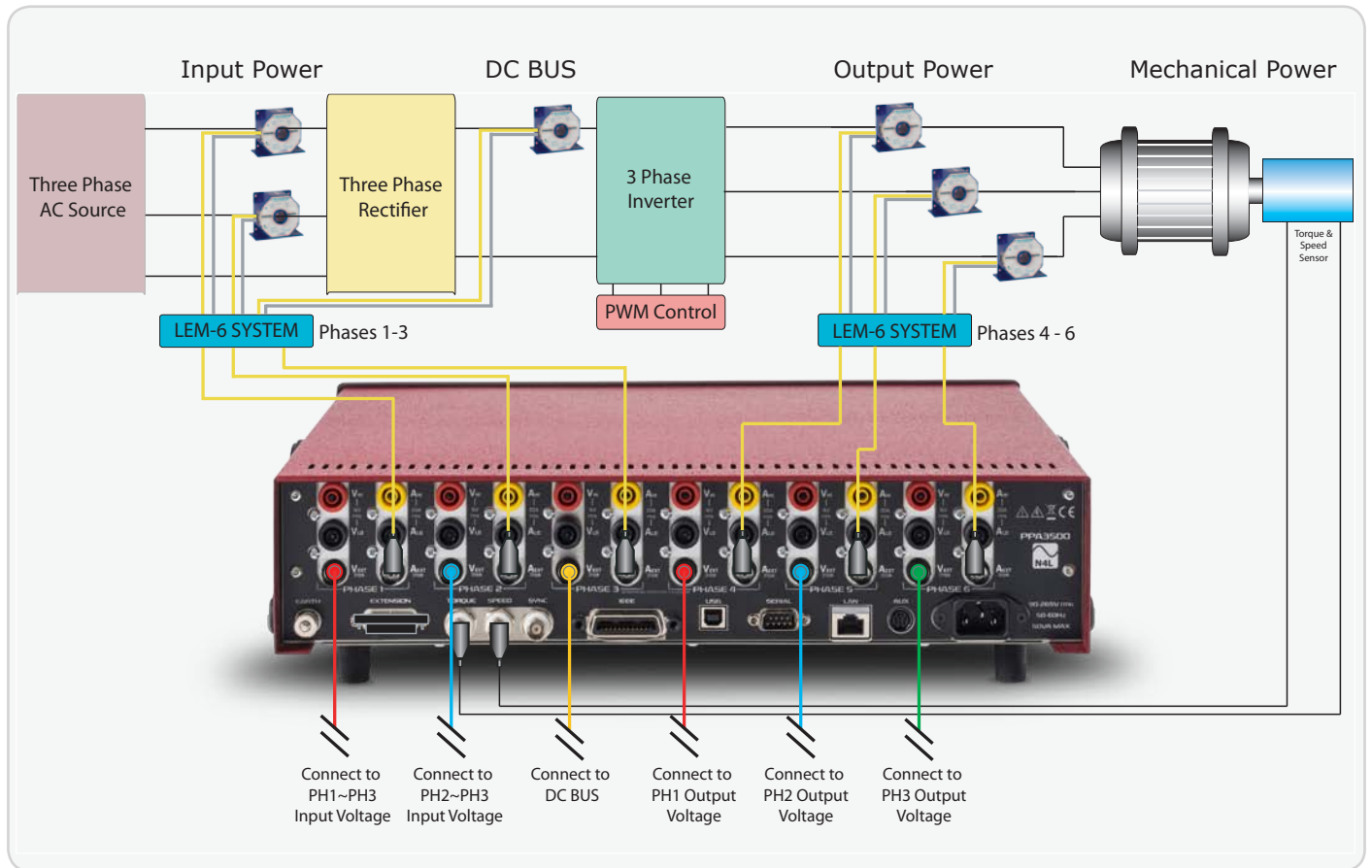
Example Dual Core Operation



APPLICATIONS


■ PWM Motor Drive Evaluation PPA3500

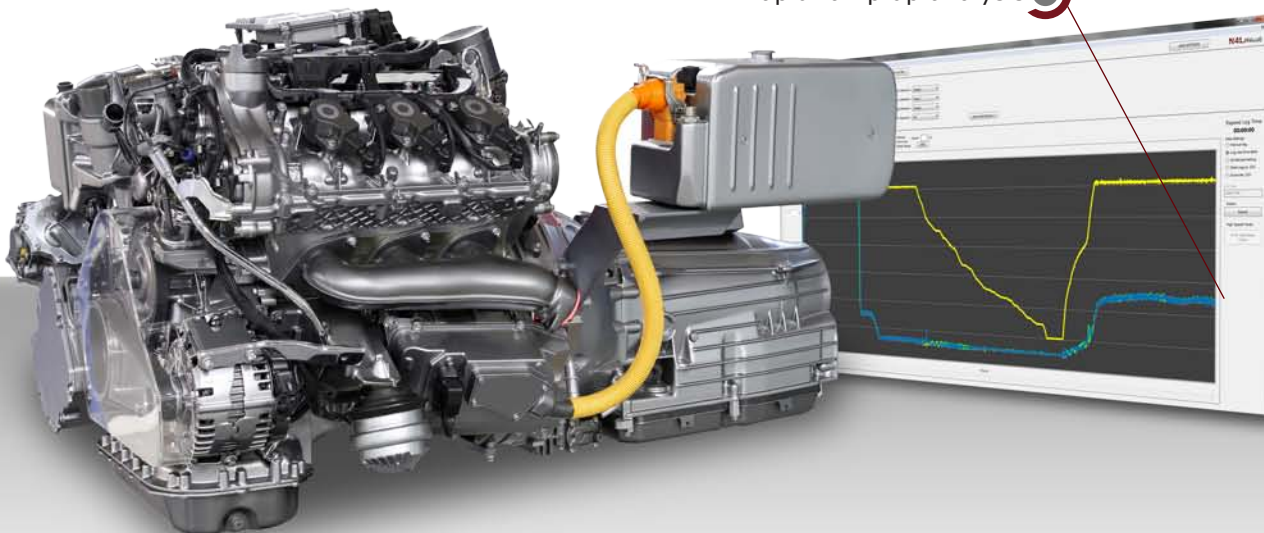
The PPA3500 is the ideal solution for 6 Phase Analysis within a single instrument, a typical application is Variable Speed Inverter Drive analysis. Utilising proprietary digital filtering algorithms, the N4L power analyzer range offers unrivalled performance. The PPA3500 can be used in conjunction with external current sensors such as the WR5000 - a 1MHz 5000A Rogowski Coil in high current applications as well as the LEM range of Zero Flux Current Transducers. Inverter efficiency is available via 3 Phase 2 Wattmeter method + CH3 + 3 Phase 3 Wattmeter, whereby PH1+PH2 are utilised to measure the input power to the three phase rectifier, PH3 is used to monitor DC bus power and PH4~PH6 are used to monitor the output power of the variable speed inverter drive.



■ High Speed Analysis PPA3500

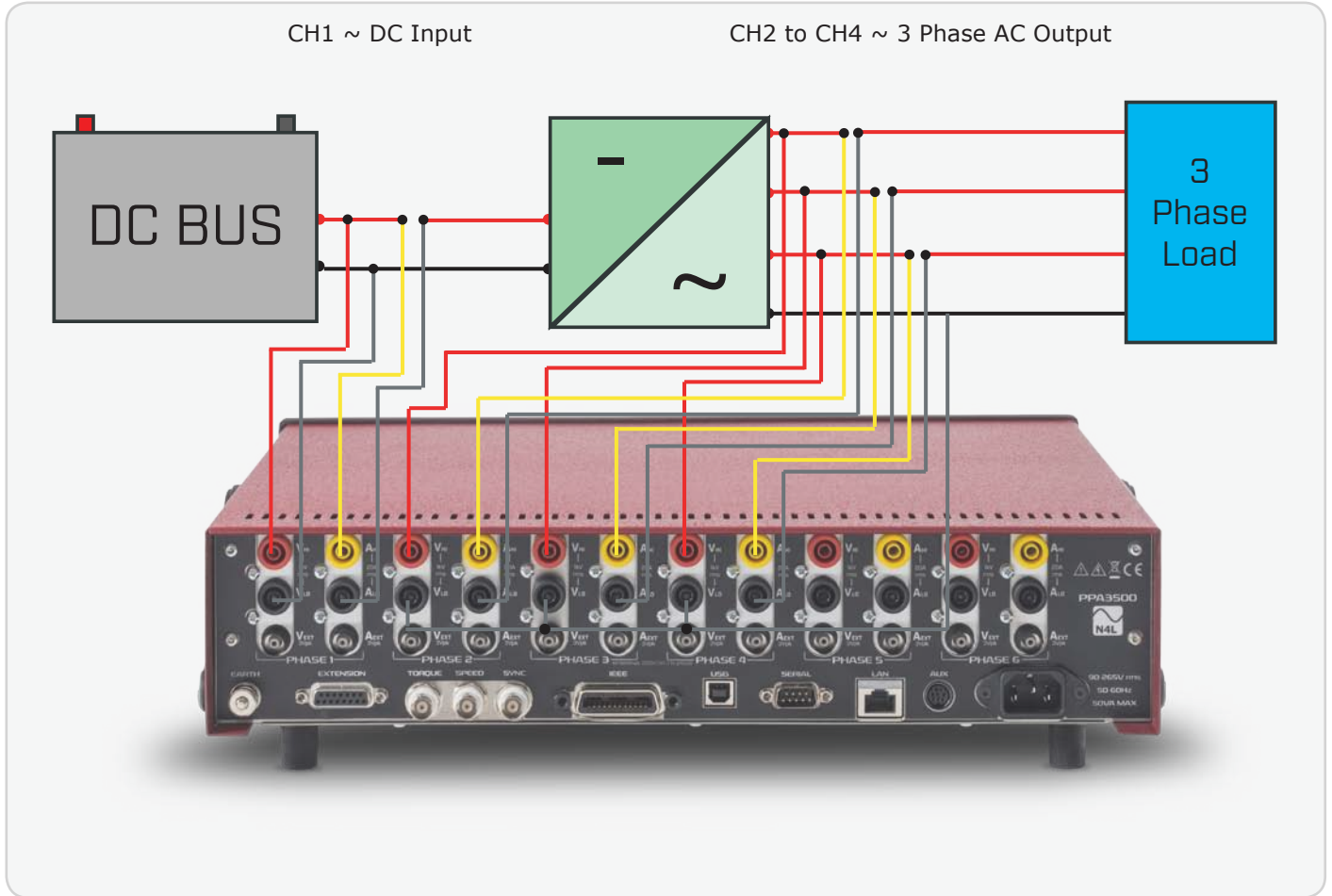
The PPA3500 features high speed parallel digital signal processing, this enables high speed tracking of changing inverter drive frequencies and power parameters during ramp up and ramp down conditions, for example in electric vehicle applications. N4L's free to download software package (PPALoG) offers datalog intervals down to 5ms, providing fast, no-gap real-time data direct to software.

Rapid ramp up analysis 



4 Phase Solar Inverter Performance Analysis PPA3500

The PPA3500 provides a highly accurate solar inverter analysis and evaluation solution from one measurement chassis, featuring independent frequency detection N4L Power Analyzers exhibit the ability to synchronise to the 50/60Hz output signal simultaneously with the DC input signal from the solar array. Both efficiency of the inverter, quality of the AC output and many other performance parameters can be recorded. In the application below, the PPA3500 is configured as a 4-Channel solution which allows the user to display DC Input to 3 Phase output efficiency data along with THD power quality measurements from one measurement chassis.



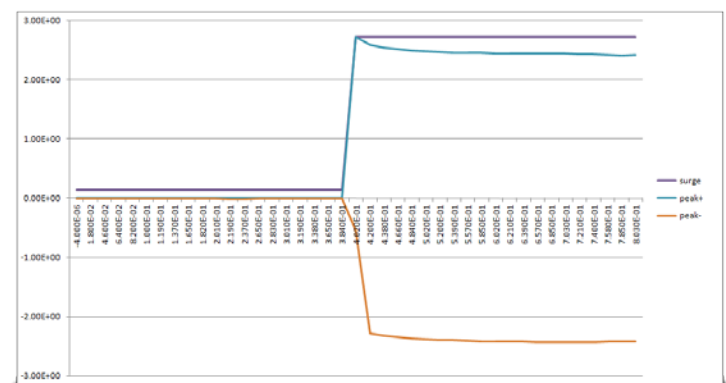
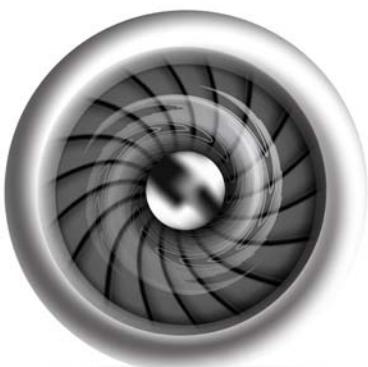
Inrush Current PPA3500

Accurate inrush current measurements rely upon two factors aside from fundamental measurement accuracy, these are gapless measurement and a high sampling rate;

1. Gapless Measurement - Inrush waveforms by their nature are transient; gapless measurement is vitally important in order to ensure that inrush waveform data is not missed.

2. High Sampling Rate - When working with mains frequencies, many power analyzers have low sample rates due to the computation of measured values from a data block of finite size. The PPA3500 utilises a proprietary real time signal processing technique that maintains full 1Ms/s sample rate irrespective of the measured load frequency, ensuring that high frequency events are captured without aliasing.

Example Inrush current data, datalogging at nominally 20ms intervals directly to PPALoG



Calibration and ISO17025 Certification



Newtons4th are an accredited UKAS Calibration laboratory, all PPA3500 Power Analyzers are supplied with an ISO17025 UKAS Calibration Certificate as standard. Calibration of N4L Power Analyzers is an integral and important part of our service to our clients, we offer quick turnaround times at a competitive price. Re-Calibration is also available at our international offices and various distributors throughout the world*.



Schedule of Accreditation

N4L's schedule of accreditation to ISO17025 is wide ranging and an overview of the schedule is detailed below, for more specific information please see the UKAS website to view the full accreditation schedule.

ISO17025 UKAS Accreditation Schedule		
	Signal Amplitude	Frequency Range
Voltage Sine Amplitude	1V to 1008V	16Hz to 850Hz
Voltage Harmonic Amplitude	0V to 302V	16Hz to 6kHz
Current Sinewave Amplitude	100mA to 48A	16Hz to 850Hz
Current Harmonic Amplitude	0A to 15A	16Hz to 6kHz
Current to Voltage Phase Angle	-180° to +180°	16Hz to 850Hz
Apparent Power (VA Product)	100mVa to 48.4kVA	16Hz to 850Hz
AC Power	0W to 48.4kW	16Hz to 850Hz
AC Power (Calorimetry)	1W to 5W	45Hz to 2MHz
Current Harmonic Amplitude to IEC61000-4-7	0A to 6A	16Hz to 6kHz
Flicker to IEC61000-4-15	Pinst(Sinusoidal Modulation)	As per IEC61000
	Pinst(Rectangular Modulation)	
	Pst	
	Frequency Changes	
	Distorted Voltage with Multiple Zero Crossings	
	Harmonics with Sidebands	
	Phase Jumps	
	Rectangular Changes with Duty Cycle	



Guaranteed Accuracy up to Crest Factor 20

The Newtons4th Power Analyzers feature a guaranteed accuracy up to a crest factor of 20, meaning the auto-ranging system of the PPA3500 is able to peak detect automatically upon waveforms with a crest factor (peak/rms) of up to 20.



Newtons4th are the only Power Analyzer Manufacturer in the world** to provide ISO17025 calibration certificates on all new Power Analyzers as standard. Our ISO17025 Schedule of Accreditation includes Voltage, Current, Phase, Power, Harmonics and Flicker. With traceable certification of power accuracy down to 0.5W, N4L offer the ideal measurement solution for certified standby power measurement.

Due to the specialist nature of Power Measurement Instrumentation Calibration, N4L utilise both commercially available calibration equipment (such as the Fluke 6105A for UKAS Certification) along with N4L bespoke designed signal generation equipment in order to calibrate our instruments over the full frequency range (up to 2MHz). Calibration over the full frequency range is uncommon given that such signal generation equipment is not commercially available. When supplied with an N4L analyzer, all customers will receive a calibration certificate covering the complete frequency range.

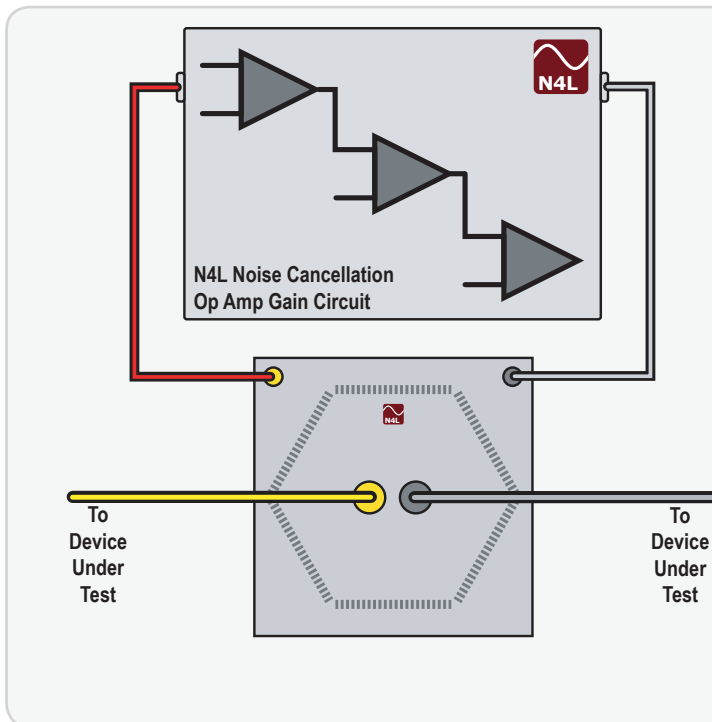


*N4L's UKAS ISO17025 Laboratory is based in the UK, international accreditation is dependent upon local distributor calibration capabilities
 **According to N4L research, 2015

Ranging Principles

■ 10 Stage Solid State Ranging System - PPA3500

Combining highly linear voltage attenuator and current shunt designs with a proprietary 10 stage solid state ranging system on every phase input, the PPA series achieve a uniquely wide dynamic range, with no need to switch between voltage attenuators or current shunts when ranging up or down.



Design features:

- Single attenuator on each voltage input
- High impedance low capacitance
- Single shunt on each current input
- Low impedance low inductance
- Auto peak detect
- High speed solid state ranging
- High Noise rejection
- Auto DC offset trimming

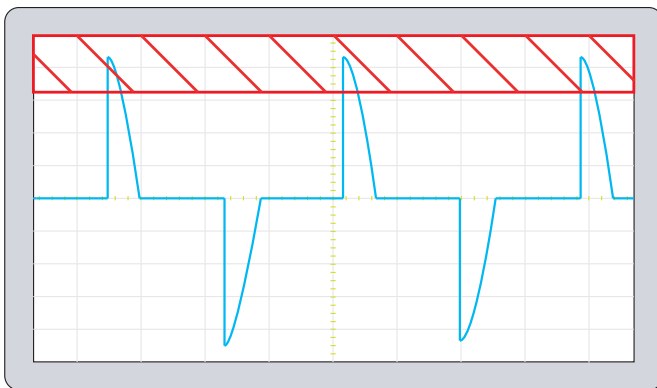
Benefits:

- Overload protected on any range
- Low shunt affect on voltage connections
- Low voltage burden on current connections
- Market leading phase accuracy
- Peak detect ranging ensures no signal clipping
- Low attenuator/shunt operating temperature
- Fast range switching
- Constant frequency response on all ranges
- Signal can be applied with instrument powered off

■ Auto Peak Ranging Ensures Complete Waveform Analysis PPA3500

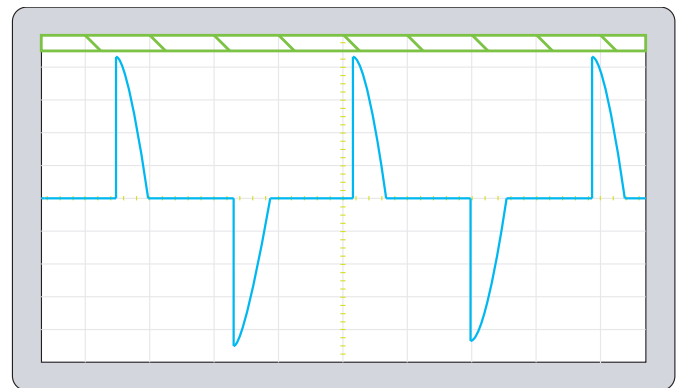
It is often overlooked that for an instrument to correctly calculate power parameters, the entire waveform must be digitised for analysis. The Peak Ranging system employed by all N4L Power Analyzers ensures that the entire waveform is digitised and the correct power parameters are calculated.

Example RMS Ranging system, commonly used in older instrument designs



Waveform within red hashed area is clipped by an RMS ranging system and fixed crest factor setting

Modern Peak Ranging System, implemented on all N4L Power Analyzers



Peak Ranging system auto-detects the peak of the input signal and selects the ideal range

Note

An RMS Ranging system requires the user to have prior knowledge of the crest factor which in many applications is not practical, either because the user cannot reasonably be expected to know this value before a measurement, or because the crest factor is changing during a measurement period. The ideal ranging system is therefore based upon peak detection which does not require the user to be concerned with a crest factor setting. While many RMS ranging systems are only guaranteed to support a Crest Factor of 6, all N4L Power Analyzers guarantee to auto-range with any crest factor and maintain full accuracy with a CF of at least 20. While waveforms with a true CF above 20 are very unusual, 'auto range up' or 'manual' ranging combined with a market leading range sensitivity enables the PPA to achieve a dynamic range equal to a CF >300.

PC CONTROL AND DATA ACQUISITION

PC Software PPA3500

Analysis carried out by the instrument can easily be transferred to a PC via USB, RS232 or LAN

① **PPALoG** Exceptional flexibility and ease of use with all the functions included in the original PPAComm program plus multiple instrument control for 7-24 phase applications and data export to Text file, Excel, Bitmap or Clipboard

a. Measurement parameters are chosen by the user from tick box options
 b. Real time results can be displayed as latest value, table or graph
 c. Datalogging results are then saved in the selected format

Simultaneous display of master and slave units

Real time Datalog

Capture up to 60 measured functions per line

Data Export options

A Bitmap image of any PPA screen image can be copied to clipboard or imported directly into documents

Measurement tables generated by the data logging function can be exported directly to Excel

② **PPA Standby Power** Full compliance testing to EN50564 (IEC62301). Meets or exceeds the requirements and methodology of U.S. EPA (Energy Star), U.S. DOE, California Energy Commission (CEC), among others.



Standby power test screen with real time update of EN50564 (IEC62301) criteria

On completion of the standby test, a full test report can be exported directly to a spreadsheet

N4L - Standby Power Test Report - IEC 62301			
Test Details			
Device Under Test	Company ABC		
Model	123 ABC		
Serial No.	10001		
Rated Voltage (Vrms)	230V		
Rated Current (Arms)	9.80A		
Rated Voltage (VDC)	50VDC		
Rated Current (IDC)	1.00A		
Test Environment	23°C ± 0.5°C, 50% ± 5% RH		
Test Location	Lab 101		
Operator	John Doe		
Date	2023-10-27		
Time	10:00		
Humidity	50%		
Test No.	1001		
Test Notes	Test made with AC source		
Measurement Instruments			
Manufacturer	N4L		
Model	PPA3500		
Serial No.	0001		
Factory Level	1.00		
Nominal Test Conditions			
Voltage (V)	230.17	Lower Limit	225.00
Frequency (Hz)	50.00	Lower Limit	49.50
Test Duration	00:03:00	Lower Limit	2
Test Result	Pass	Upper Limit	Pass
Test Factor	1.41216	Lower Limit	1.40
Test Result	Pass	Upper Limit	Pass
Test Results			
Vrms	230.04	Lower Limit	225.00
Arms	9.7185	Lower Limit	9.50
Total Power Factor	0.9123	Lower Limit	0.90
Apparent Power (VA)	2104.03	Lower Limit	2000.00
Real Power (W)	1912.76	Lower Limit	1800.00
Test Duty Cycle (%)	62.7218	Lower Limit	24
Elapsed Time (min:sec)	05:00	Lower Limit	05:00
Test Result	Pass	Upper Limit	Pass
Summary			
Vrms	230.04	Lower Limit	225.00
Arms	9.7185	Lower Limit	9.50
Total Power Factor	0.9123	Lower Limit	0.90
Apparent Power (VA)	2104.03	Lower Limit	2000.00
Real Power (W)	1912.76	Lower Limit	1800.00
Test Duty Cycle (%)	62.7218	Lower Limit	24
Elapsed Time (min:sec)	05:00	Lower Limit	05:00
Test Result	Pass	Upper Limit	Pass

SPECIFICATION

		PPA3500	
Frequency Range			
	Normal	PPA3500-LC(20Arms) DC,10mHz ~ 1MHz, PPA3500(30Arms) DC,10mHz ~ 1MHz	
		Range 1+2* ** : DC, 10mHz ~ 100kHz	
No. of Phases			
		3~6	
Voltage Input			
Internal	Range	Normal : 100mVpk ~ 2500Vpk(1000Vrms) in 10 ranges (240Vrms within 300Vpk range, using 20% overrange)	
	Accuracy	1V ~ 2500Vpk range : 0.04% Rdg+0.1% Rng+(0.005%×kHz Rdg)+5mV Range 1+2* : 0.04% Rdg+0.1% Rng+(0.01%×kHz Rdg)+1mV	
External	Range	1mVpk ~ 3Vpk in 8 ranges [BNC connector 3Vpk max input]	
	Accuracy	0.04%Rdg+0.1%Rng+(0.005%×kHz Rdg)+3µV	
Current Input			
	20Arms Low Current (PPA3500-LC) 4mm safety connectors	Ranges	10mApk ~ 300Apk(20Arms) in 10 ranges
		Accuracy	100mA ~ 300Apk ranges: 0.04% Rdg+0.1% Rng+(0.005%×kHz Rdg)+ 300µA 10mA** ~ 30mA** ranges: 0.04% Rdg+0.1% Rng+ (0.01%×kHz Rdg)+100µA
	30Arms (PPA3500) 4mm safety connectors	Ranges	30mApk ~ 1000Apk(30Arms) in 10 ranges
		Accuracy	300mA ~ 1000Apk ranges: 0.04% Rdg+0.1% Rng+(0.005%×kHz Rdg)+ 900µA 30mA** ~ 100mA** ranges: 0.04% Rdg+0.1% Rng+(0.01%×kHz Rdg)+ 300µA
External input (External shunt Current sensor)	BNC Connector (Max input 3Vpk)	Ranges	1mVpk ~ 3Vpk in 8 ranges
		Accuracy	0.04% Rdg+0.1% Rng+(0.005%×kHz Rdg)+ 3µV
Phase Accuracy			
		Normal : 0.005deg+(0.01deg×kHz) Range 1+2* ** : 0.005deg+(0.02deg×kHz)	
Power Accuracy			
		[0.1% + 0.1%/pf + (0.01%×kHz)/pf] Rdg + 0.05%VA Rng Range 1+2* ** : [0.1% + 0.1%/pf + (0.02%×kHz)/pf] Rdg + 0.05%VA Rng	
40-850Hz		[0.06% + 0.1%/pf + (0.01%×kHz)/pf] Rdg + 0.03%VA Rng	
General			
Crest Factor	20(Voltage and Current)		
Sample Rate	1Ms/s on all channels, No-Gap		
IEC Modes	IEC50564 (Replaced IEC62301) and Energy Star		
Application Modes	PWM Motor Drive, Ballast, Inrush, Power Transformer, Standby Power		
CMRR - Common Mode Rejection Ratio			
		250V @ 50Hz - ≥ 1mA (150dB)	
		100V @ 100kHz - ≥ 3mA (130dB)	
Measurement Parameters			
	W, VA, Var, pf, V & A - rms, rectified mean, AC, DC, Peak, Surge, Crest Factor, Form Factor, Star to Delta Voltage, +ve Pk, -ve Pk		
	Frequency (Hz), Phase (deg), Fundamentals, Impedance		
	Harmonics, THD, TIF, THF, TRD, TDD		
	Integrated Values, Datalog, Sum and Neutral values		
Datalog - Up to 4 user selectable measurement functions across 6 phases, 32 total (60 with optional PC software)			
Datalog Window	No-Gap analysis, Minimum window 5ms		
Memory	500MB, 5M records		
Communication Ports			
RS232	Baud rate up to 38.4kbps,RTS/CTS flow control		
LAN	10/100 Base-T Ethernet auto sensing		
GPIB	IEEE488.2 Compatible		
USB	USB 2.0 and 1.1 Compatible		
Analogue Output	Bipolar ±10V(BNC)		
Speed Input	BNC Bipolar±10V or Pulse count 1Hz to 1MHz 0.01% Rdg		
Torque	BNC Bipolar±10V or Pulse count 1Hz to 1MHz 0.01% Rdg		
Standard Accessories			
Leads	Power, RS232, USB		
Connection Cables	36A 1.5m long 4mm stackable terminals 1x red, 1x yellow and 2x black per phase		
Connection Clips	4mm terminated aligator clips - 1x red, 1x yellow and 2x black per phase		
CD-ROM	CommView2 (RS232/USB/LAN), Command line, Script based communication software		
Documents	Communications manual, Calibration certificate, Quick start guide		
Mechanical/Environmental			
Input Impedance	Voltage Attenuator and External Inputs 3.3MΩ 25pF		
Display	2 x 480x272 dot full colour TFT, White LED Backlit		
Dimensions	92H x 404W x 346D mm excluding feet		
Weight	5.9kg(3 Phase), 8.8kg(6 Phase)		
Safety Isolation	1000Vrms or DC(CATII), 600Vrms or DC(CATIII)		
Power supply	90 ~ 265Vrms, 50 ~ 60Hz, 50VAmax		
Operating Conditions	0 to 50°C Ambient Temperature (or air intake temperature when rack mounted), 20-95% Relative Humidity Non-Condensing, 2,000 Metres Altitude Temperature coefficient ±0.01% per °C of reading at 5-18°C and 28-40°C		
Storage Conditions	Temperature -10 to 60°C, 20-95% Relative Humidity Non-Condensing, 2,000 Metres Altitude		

Note * : Voltage Range[x] 1 + 2 : [1]100mV + [2]300mV

Note ** : Current Range[x] 1 + 2 : PPA3500-LC 20Arms model: [1]10mA + [2]30mA , PPA3500 30Arms model: [1]30mA + [2]100mA

SPECIFICATION

PPA3500	
Harmonic Specification	
Bandwidth	DC,10mHz ~ 1MHz - PPA3500-LC(20Arms), PPA3500(30Arms)
No. of Harmonics	100
Sampling Frequency	1Ms/s
Signal Processing	DFT (Discreet Fourier Transform)
Crest Factor	20
Power Factor	0 to 1
Harmonic Accuracy	
Voltage	0.04% Rdg+0.1% Rng+(0.005%×kHz Rdg)+5mV
Current	PPA3500-LC 0.04% Rdg+0.1% Rng+(0.005%×kHz Rdg)+300uA PPA3500 0.04% Rdg+0.1% Rng+(0.005%×kHz Rdg)+900uA
Harmonic Accuracy (above) still applies with Frequency Filter set	
Cycle by Cycle Analysis direct to PC - 2Ms/s sample rate (Window setting)	
Data Rate	10ms (all channels active)
Cycle by Cycle Analysis direct to Internal RAM - 2Ms/s sample rate	
Data Rate	5ms (all channels active)
Voltage Attenuator Overload Capability	
20ms	4.2kVpk (3kVrms)
5s	3.1kVpk (2.2kVrms)
Continuous	3kVpk (1kVrms)
Voltage Attenuator Input Impedance	
	3.3MΩ 25pF
Current Shunt Impedance	
20Arms	10mΩ
30Arms	3mΩ
Selectable Analogue Filter	
	250kHz
Minimum Current Measurement at Full Accuracy	
PPA3500-LC	220uArms
PPA3500	700uArms

ACCESSORIES SUPPLIED AS STANDARD

Leads and Interfacing	
Type	Specification
36A Connection lead set	1.5 Metre - 36A lead set with 4mm stackable safety terminals 1x Red, 1x Yellow and 2x Black per phase plus alligator clips
RS232 cable	RS232 9pin serial Cable
USB cable	USB 2 Metre A male to B male
LAN Interface	LAN fitted as standard
USB to 9-pin RS232 (Option)	USB ~ 9-pin RS232 Serial Converter
GPiB Interface	GPiB fitted as standard --

Documents (Standard)	
Type	Specification
Calibration/Test & Inspection Certificate	PPA Certificate of Calibration
UKAS ISO17025 Certificate	UKAS ISO17025 Certificate of Calibration
Spare set of manuals	Quick Start Guide Comms manual PPALog user guide available as website download

OPTIONAL ACCESSORIES

PC Software (Optional CD, Free to Download)	
Type	Specification
PPALog	PC control and data acquisition of 1 ~ 24 phases with selectable Real Time data, Graphing, Datalog and versatile export options User Manual for PPALog available as a free download from our website
PPA Standby Power	Standby power measurements and reporting to IEC62301

Carry cases (Optional)	
Type	Specification
Soft carrying case	Black nylon with shoulder strap

Connection and extension port accessories (Optional)	
Type	Specification
Breakout box	Simple analyzer connection between source and DUT
PCIS	10Arms 300Apk rated Phase Controlled Inrush Switch
ADI40	40 Channel Analogue Input/Ouput Interface
GPiB Communication Cable	GPiB Communication Cable Option



Breakout Box

Rack Mount Kit (Optional)	
Type	Specification
Rack Mount brackets	PPA3500 19in rack mount brackets

ACCESSORIES

High Performance Voltage Attenuating Probes			
Model	Voltage Range	Frequency Range	Details
TT-HV250	2500Vpk	300MHz	High Voltage Probe (Passive) 2.5kVpk 100:1
TTV-HVP	1500Vpk	50MHz	High Voltage Probe (Passive) 15kVpk 1000:1
ATT10	30Vpk	30MHz	10:1 Voltage Attenuator Box (For use in conjunction with HV Probes when output voltage of probe is >3Vpk, BNC Input/BNC Output)
ATT20	60Vpk	30MHz	20:1 Voltage Attenuator Box (For use in conjunction with HV Probes when output voltage of probe is >3Vpk, BNC Input/BNC Output)
ULCP	3000Vpk	2MHz	1000:1 Ultra Low Capacitance Probe (Active), For use in applications such as Ballast Testing (<1pF Capacitance)



TT-HV250 2.5kVpk Probes



TTV-HVP 15kVpk Probes



ATT10



ULCP

High Performance External Current Measurement Options					
Model Number	Measuring Range	Frequency Range	Basic Accuracy	Phase Accuracy	Details
HF003	3Arms - 30Apk	DC - 2MHz	470mΩ (±0.1%)	0.0001° / kHz	3Arms External Current Shunt, BNC Output (Use with PPA External Input)
HF006	6Arms - 60Apk	DC - 2MHz	100mΩ (±0.1%)	0.001° / kHz	6Arms External Current Shunt, BNC Output (Use with PPA External Input)
HF020	20Arms - 200Apk	DC - 2MHz	10mΩ (±0.1%)	0.01° / kHz	20Arms External Current Shunt, BNC Output (Use with PPA External Input)
HF100	100Arms - 1000Apk	DC - 2MHz	1mΩ (±0.1%)	0.05° / kHz	100Arms External Current Shunt, BNC Output (Use with PPA External Input)
HF200	200Arms - 2000Apk	DC - 2MHz	0.5mΩ (±0.1%)	0.1° / kHz	200Arms External Current Shunt, BNC Output (Use with PPA External Input)
HF500	500Arms - 5000Apk	DC - 2MHz	0.2mΩ (±0.1%)	0.1° / kHz	500Arms External Current Shunt, BNC Output (Use with PPA External Input)



External Shunt HF-003



External Shunt HF-100



External Shunt HF-200



External Shunt HF-500

Probe/Current Clamp Transformer: AC							
Model Number	Measuring range	Frequency range	Accuracy	Details	Clamp diameter	Category	
M3 UB 50A-1V	100mA ~ 50A	40Hz ~ 5kHz	1%	100mA to 50A AC Current Clamp	15mm×17mm	600V CATIII	
M3 U 100A-1V	1A ~ 100A	40Hz ~ 5kHz	1%	1A to 100A AC Current Clamp	15mm×17mm	600V CATIII	
S UE 200A-1V	1A ~ 200A	40Hz ~ 5kHz	1%	1 A to 200A AC Current Clamp	50mm ø	600V CATIII	
S UE 250 500 1000-1V	1A ~ 250A/500A/1000A	40Hz ~ 5kHz	1%(250A) 0.5%(500+1000A)	1 A to 250/500/1000A AC Current Clamp	50mm ø	600V CATIII	
US UE 1000A-1V	1A ~ 1000A	40Hz ~ 5kHz	1%	1A to 1000A AC Current Clamp	43mm ø	600V CATIII	
SM UE 1000A-1V	0.5A ~ 1000A(1%>100A)	15Hz ~ 15kHz	1%	0.5A to 1000A AC Current Clamp	54mm ø	600V CATIII	
SM UB 1000A-1V	0.5A ~ 1000A(0.5%>10A)	15Hz ~ 15kHz	0.5%	0.5A to 1000A AC Current Clamp	54mm ø	600V CATIII	
P32 UE 1000A-1V	5A ~ 1000A	40Hz ~ 5kHz	1%	5 A to 1000A AC Current Clamp	83mm ø (125mm×47mm or 100mm×58mm)	600V CATIII	
P32 UE 3000A-1V	5A ~ 3000A	40Hz ~ 5kHz	1%	5 A to 3000A AC Current Clamp	83mm ø	600V CATIII	



Current Clamp M3-UB 50A-1V



Current Clamp S-UE 200A-1V



Current Clamp SM-UB 1000A-1V



Current Clamp P32-UE 1000A-1V

Probe / Current Clamp (Hall effect): AC + DC

Model number	Measuring range	Frequency range	Accuracy	Details	Clamp diameter	Category
SC 2C 100A-1V	1A ~ 100A	DC ~ 5kHz	2%	1A to 100A AC+DC Current Clamp	50mm ø	600V CATIII
SC 3C 1000A-1V	1A ~ 1000A	DC ~ 2kHz	1%	1A to 1000A AC+DC Current Clamp	59mm ø	600V CATIII
P20 3C 2000A-2V	40A ~ 1000/2000A	DC ~ 2kHz	1%	40A to 2000A AC+DC Current Clamp	83mm ø	600V CATIII
P40 3C 4000A-2V	40A ~ 2000/4000A	DC ~ 2kHz	1.5%	40A to 4000A AC+DC Current Clamp	83mm ø	600V CATIII
P50 3C 5000A-2V	50A ~ 2000/5000A	DC ~ 2kHz	1.5%	50A to 5000A AC+DC Current Clamp	83mm ø	600V CATIII



Current Clamp SC 2C 100A-1V



Current Clamp SC 3C 1000A-1V



Current Clamp P20 3C 2000A-2V



Current Clamp P50 3C 5000A-2V

Rogowski Current Transducer: AC / Zero Flux Current Transducer: AC+DC

Model number	Measuring range	Frequency range	Nominal Accuracy	Details	Coil/Through Hole Circumference	Category
WR5000 Rogowski	1A ~ 5000A	1Hz ~ 1MHz	0.05%	1A to 5000A AC Rogowski Coil	600mm	600V CATIII
WR10000 Rogowski	1A ~ 10000A	1Hz ~ 1MHz	0.05%	1A to 10000A AC Rogowski Coil	600mm	600V CATIII
LEM IT 60-S	0A ~ 60A DC/pk (42Arms)	DC ~ 800kHz	0.01%	60A Zero Flux Current Transducer	26mm	600V CATIII
LEM IT 65-S	0A ~ 60A DC / 85A pk (60Arms)	DC ~ 800kHz	0.01%	60A Zero Flux Current Transducer	26mm	600V CATIII
LEM IT 200-S	0A ~ 200A DC/pk (141Arms)	DC ~ 500kHz	0.01%	200A Zero Flux Current Transducer	26mm	600V CATIII
LEM IT 205-S	0A ~ 200A DC/ 283A pk (200Arms)	DC ~ 1MHz	0.01%	200A Zero Flux Current Transducer	26mm	600V CATIII
LEM IT 400-S	0A ~ 400A DC/pk (282Arms)	DC ~ 500kHz	0.01%	400A Zero Flux Current Transducer	26mm	600V CATIII
LEM IT 405-S	0A ~ 400A DC/ 566A pk (400Arms)	DC ~ 300kHz	0.01%	400A Zero Flux Current Transducer	30mm	600V CATIII
LEM IT 700S	0A ~ 700A DC/pk (495Arms)	DC ~ 100kHz	0.01%	700A Zero Flux Current Transducer	30mm	300V CATIII
LEM IT 1000S	0A ~ 1000A DC/pk (707Arms)	DC ~ 500kHz	0.01%	1000A Zero Flux Current Transducer	30mm	300V CATIII
LEM IT 605S	0A ~ 600A DC/ 849A pk (600Arms)	DC ~ 300kHz	0.01%	600A Zero Flux Current Transducer	30mm	300V CATIII
LEM IT 600S	0A ~ 600A DC/pk (425Arms)	DC ~ 300kHz	0.01%	600A Zero Flux Current Transducer	30mm	300V CATIII
LEM ITN 900S	0A ~ 900A DC/pk (636Arms)	DC ~ 300kHz	0.01%	900A Zero Flux Current Transducer	30mm	300V CATIII
LEM ITN 1000S	0A ~ 1000A DC/pk (707Arms)	DC ~ 300kHz	0.01%	1000A Zero Flux Current Transducer	30mm	300V CATIII
LEM IN 1000-S	0A ~ 1000A DC/ 1500Apk (1000Arms)	DC ~ 440kHz	0.01%	1000A Zero Flux Current Transducer	38.2mm	1000V CATII
LEM IN 2000-S	0A ~ 2000A DC/ 3000Apk (2000Arms)	DC ~ 140kHz	0.01%	2000A Zero Flux Current Transducer	70mm	1000V CATIII

LEM Interfaces

Model number	Description	Compatibility	Nominal Accuracy
LEM6/X Interface	Combined PSU + Configurable Load Resistor interface for connecting up to 6 LEM transducers to PPA	All LEM transducers listed above except IT 1000-S, ITN 1000-S, IN 1000-S and IN 2000-S	0.1%
LEM-1 Interface	Combined PSU + Load Resistor interface for connecting LEM transducer to PPA.	All LEM transducers listed above	0.1%



WR5000 Rogowski Coil



LEM-1 Interface



LEM IT 700-S

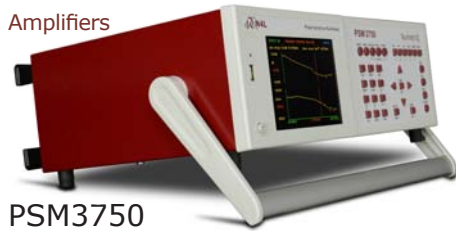
PRODUCT COMPARISON

	PPA500	PPA1500	PPA3500	PPA4500	PPA5500
Basic Accuracy					
V, A rdg error	0.05%	0.05%	0.04%	0.03%	0.01%
Power rdg error	0.10%	0.10%	0.06%	0.04%	0.02%
Phase Options					
Internal	1~3	1~3	1~6	1~3	1~3
Master/Slave operation	—	—	—	4~6	4~6
Bandwidth					
20 & 30A Shunt	DC ~ 500kHz	DC ~ 1MHz	DC ~ 1MHz	—	—
10 & 30A Shunt	—	—	—	DC ~ 2MHz	DC ~ 2MHz
50A Shunt	—	—	—	DC ~ 1MHz	DC ~ 1MHz
Voltage Input					
Max input voltage	2500Vpk (1kVrms)	2500Vpk (1kVrms)	2500Vpk (1kVrms)	3000Vpk (1kVrms)	3000Vpk (1kVrms)
No. of ranges	8	8	10	8	9
Direct Current Input					
10Arms model	—	—	—	○	○
20Arms model	○	○	○	—	—
30Arms model	○	○	○	○	○
50Arms model	—	—	—	○	○
No. of ranges	8	8	10	8	9
Features					
Scope and Graph Modes	—	○	○	○	○
USB Memory port	○	○	○	○	○
LAN Port	○	○	○	○	○
GPiB Port	○	○	○	○	○
RS232 Port	○	○	○	○	○
Real time clock	○	○	○	○	○
19in Rack mount option	○	○	○	○	○
Torque and Speed	—	—	○	○	○
IEC61000 Mode	—	—	—	—	○
PWM Motor Drive Mode	—	Limited Functionality	○	○	○
Oscilloscope	—	○	○	○	○
Transformer Mode	—	—	○	○	○
PWM Filter Options	—	2	7	7	7
Speed/Harmonics/Sec	300/sec	300/sec	300/sec	600/sec	1800/sec
Internal Datalogging	4 Parameters	4 Parameters	32 Parameters	16 Parameters	16 Parameters
Datalog Records	16000	16000	5M	5M	10M
ABD0100.1.8 Mode	—	—	—	—	○
Internal Memory	192kB	192kB	500MB	500MB	1GB
Harmonics	50	50	100	100	417
Minimum Window Size	10ms	5ms	5ms	2ms	2ms
Dimensions - Excl. Feet H x W x D (mm)	92 x 215 x 312	92 x 215 x 312	92 x 404 x 346	130 x 400 x 315	130 x 400 x 315
Weight	3.3 - 4kg	3.3 - 4kg	5 - 8.8kg	5.4 - 6kg	5.4 - 6kg

— Not Applicable ○ Option ● Standard

All specifications at 23°C ± 5°C. These specifications are quoted in good faith but Newtons4th Ltd reserves the right to amend any specification at any time without notice.

The N4L product range also includes Frequency Response and Impedance Analyzers, Selective Level Meters and Laboratory Power Amplifiers



PSM3750
10µHz ~ 50MHz



PSM17xx
10µHz ~ 35MHz

Applications



- Power supply phase margin and gain margin (FRA)
- Inductance, Capacitance and Resistance (LCR)
- Analysis of mechanical vibration (HARM)
- Phase Angle Voltmeter (PAV)

Contact your local N4L Distributor for further details

Newtons4th

Newtons4th Ltd (abbreviated to N4L) was established in 1997 to design, manufacture and support innovative electronic equipment to a world-wide market, specialising in sophisticated test equipment particularly related to phase measurement. The company was founded on the principle of using the latest technology and sophisticated analysis techniques in order to provide our customers with accurate, easy to use instruments at a lower price than has been traditionally associated with these types of measurements. Flexibility in our products and an attitude to providing the solutions that our customers really want has allowed us to develop many innovative functions in our ever increasing product range.



Newtons4th Ltd are ISO9001 registered, the internationally recognised standard for the quality management of businesses



In recognition of the technical innovation and commercial success of the PPA series, N4L received the "Innovation 2010" Queen's award for enterprise

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