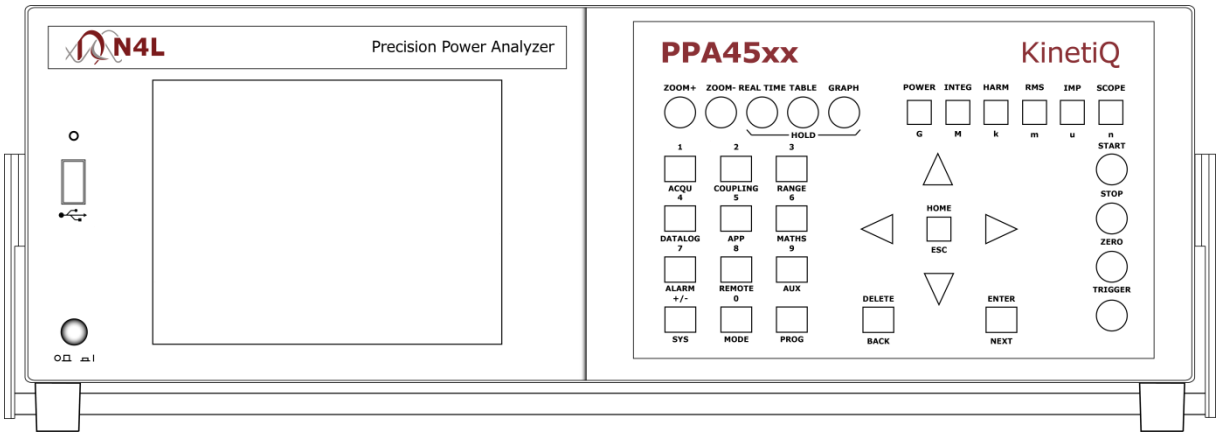
Newtons4th Ltd

PPA45xx series

START UP GUIDE



Firmware v2_105

DECLARATION OF CONFORMITY

CE

Manufacturer: Newtons4th Ltd.
Address: 30 Loughborough Rd.
Mountsorrel
Loughborough
Leics.
LE12 7AT

We declare that the product:

Description: Power Analyser
Product name: KinetiQ
Model: PPA45xx Family

Conforms to the requirements of Council Directives:

89/336/EEC relating to electromagnetic compatibility:
EN 61326:1997 Class A

73/23/EEC relating to safety of laboratory equipment:
EN 61010-1

April 2013

Eur Ing Allan Winsor BSc CEng MIEE
(Director Newtons4th Ltd.)

CONTENTS

1 Getting Started

1.1 Unpacking

When you receive your product, check that the following items are included for the appropriate PPA. Refer to the contents list below for each model. If any item is missing or damaged during transportation, immediately contact your local sales distributor or N4L office

	CONTENTS									
MODEL	Mains Lead	4mm Yellow Lead	4mm Black Lead	4mm Red Lead	Yellow Croc Clip	Black Croc Clip	Red Croc Clip	N4L 2GB Memory Stick	Start Up Guide Manual	Comms Manual
PPA4510	1	1	2	1	1	2	1	1	1	1
PPA4520	1	2	4	2	2	4	2	1	1	1
PPA4530	1	3	6	3	3	6	3	1	1	1

Communication Cables	
USB	Filtered USB 2.0 A male to B male 2m lead
RS232	9 pin to 9 pin null modem cable

1.2 Fitment of the PPA series Carry/Tilt handle

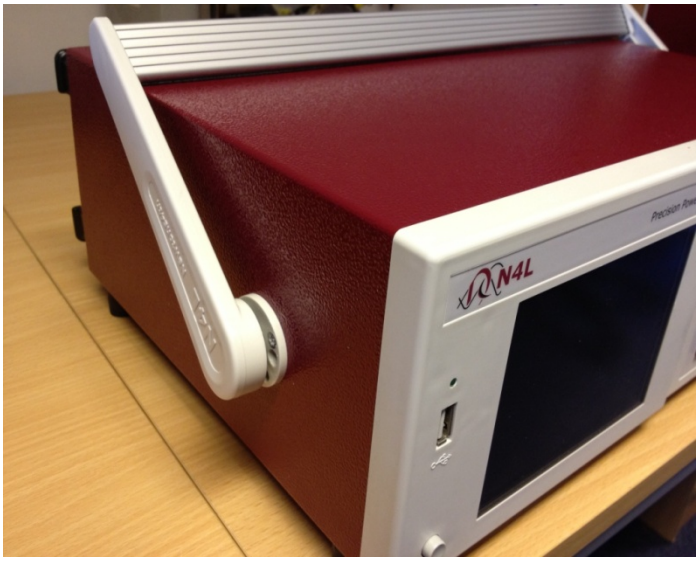
PPA5/15/45/55 series power analyzers are supplied with a Carry/Tilt Handle that is located within the accessory pack.

The handle allows a user to position the instrument upwards at one of two angles for easier viewing when the instrument is positioned below the line of sight. The design also allows storage under the unit without obstruction of the rubber feet so that instruments can be stacked and is easily removed to allow the connection of rack mounting brackets without the need to remove instrument covers.

Correct installation of the handle is important to ensure the correct operation and long life the handle.

The following pictures illustrate correct and incorrect handle fitment:

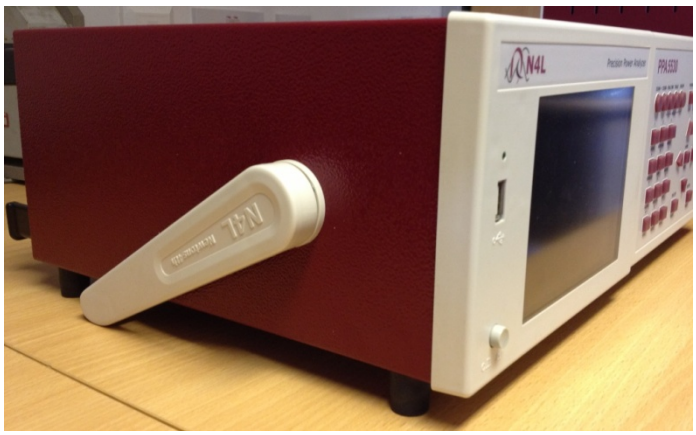
Correct 1



Correct 2

Correct 1/2 – Correct fitting is from the top of the unit as shown here

Correct 3



Correct 4

A correctly fitted handle will have the ‘N4L Newtons4th’ wording in the correct reading plane when the handle is to the front of the instrument (Pic. 3)

Also, a correctly fitted handle will allow storage under the unit (Pic. 4)

Incorrect 1

Incorrect 2

Fitting the handle from the bottom of the unit as shown here is wrong (Incorrect 1)

Incorrect fitting can be seen because the handle does not fit correctly under the unit and handle sides do not fit flush with the registration washer (Incorrect 2)

2 Safety

2.1 IMPORTANT SAFETY INSTRUCTIONS

This equipment is designed to comply with BSEN 61010-1 (2001) (Safety requirements for electrical equipment for measurement, control, and laboratory use) – observe the following precautions:

- Ensure that the supply voltage agrees with the rating of the instrument printed on the back panel ***before*** connecting the mains cord to the supply
- This appliance ***must*** be earthed. Ensure that the instrument is powered from a properly grounded supply
- The inputs are rated at 1kV rms or dc cat II; 600V rms or dc cat III. **Do not exceed the rated input**
- Keep the ventilation holes on the underneath and rear free from obstruction
- There are no user serviceable parts inside the instrument – do not attempt to open the instrument, refer service to the manufacturer or his appointed agent

Note: Newtons4th Ltd shall not be liable for any consequential damages, losses, costs or expenses arising from the use or misuse of this product however caused

2.2 CAUTIONS

- **Do not use a damaged power cord or cables**

  Doing so may cause an electric shock or a fire

- **Do not place any object on this instrument**

- **Do not use this instrument if faulty**

  If you suspect the instrument to be faulty, contact your local N4L office or representative for repair (see section 8)

2.3 Warranty

This product is guaranteed to be free from defects in materials and workmanship for a period of 36 months from the date of purchase

In the unlikely event of a problem within this guarantee period, first contact Newtons4th Ltd or your local representative to give a description of the problem. Please have as much relative information to hand as possible – particularly the serial number and release number these can be found by pressing the SYSTEM button then the “Left Arrow”

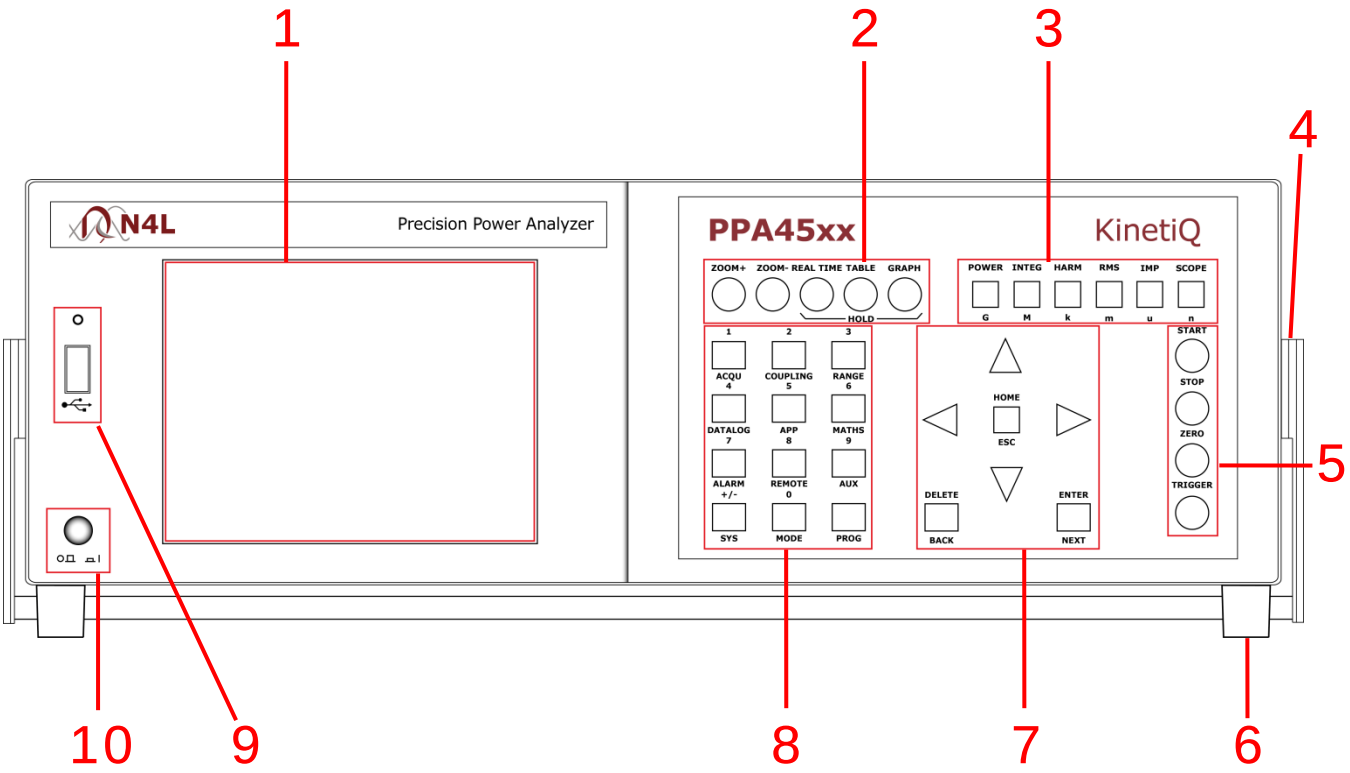
If the problem cannot be resolved directly then you will be given an RMA number and asked to return the unit. The instrument will be repaired or replaced at the sole discretion of Newtons4th Ltd

This guarantee is limited to the cost of the PPA45xx itself and does not extend to any consequential damage or losses whatsoever including, but not limited to, any loss of earnings arising from a failure of the product or software

In the event of any problem with the instrument outside of the guarantee period, Newtons4th Ltd offers a full repair and re-calibration service. Contact your local representative. It is recommended that the PPA45xx be re-calibrated annually

3 Front Panel Layout

1. Display Screen
2. Screen Display Function Buttons
3. Power Analyzer Mode Buttons
4. Handle
5. Measurement Control Function Keys
6. Rubber Feet
7. Menu Selection and Cursor Controls
8. Measurement Settings Buttons
9. Front USB Port
10. Power On / Off Button



3.1 PPA55xx Display Key Functions

Key & Sub Categories	Description
ACQU Wiring:	Acquisition Control: Used for configuring inputs appropriate to source and nature of signals being analyzed
Single Phase 1	In single phase 1 configuration, (phase 2 & phase 3) inputs are disabled and the selected phase acts as a completely independent single phase power analyzer
2 Phase 2 Wattmeter	In the 2 phase 2 wattmeter configuration, the voltages are measured relative to each individual phase input, with a single frequency reference selected within the frequency reference parameter (see page 8)
3 Phase 2 Wattmeter	In the 3 phase 2 wattmeter configurations, the voltages are measured relative to phase 3. Typically the phase 1 voltage input is connected across phase 1 and phase 3, and phase 2 voltage input is connected across phase 2 and phase 3, thus measuring phase to phase voltage directly. Phase 1 and 2 current inputs are connected normally. There is no need to measure the current in phase 3 as phase 3 has no voltage relative to itself so the power contribution is zero. In this mode, the neutral channel displays the synthesized phase 3 current. The advantage of this connection method is that 3 phase power can be measured with only 2 wattmeters
3 Phase 3 Wattmeter	With the 3 phase 3 wattmeter configuration, each measurement phase is connected to a phase of the load with the voltage low inputs measuring to neutral. In this mode, phase to neutral voltages are measured directly and phase to phase voltages are also computed
Single Phase 2	In single phase 2 mode, (phase 1 & phase 3) inputs are disabled and the selected phase acts as a completely independent single phase power analyzer
Single Phase 3	In single phase 3 mode, (phase 1 & phase 2) inputs are disabled and the selected phase acts as a completely independent single phase power analyzer
3 Phase 2 Wattmeter + PH3	As above(3 phase, 2 wattmeter) but with the option to use PH3 as an independent meter ie, use PH3 to measure a DC bus plus channels 2 & 3 to measure a 3 phase inverter output. CH3 can be set as an additional connection for Torque & Speed to supplement the existing "EXT" BNC connections on the rear panel. This mode essentially facilitates independent frequency synchronisation of CH3
Independent	In independent wiring mode each phase can be selected as an individual analyzer enabling the ability to select its own frequency, coupling ranging etc

Speed	In normal acquisition mode the window over which the measurements are computed is adjusted to give an integral number of cycles of the input waveform. The results from each window are passed through a smoothing filter. There are 5 pre set speed options that adjust the nominal size of the window, and therefore the update rate and time constant of the filter. Greater stability is achieved at a slower speed at the expense of a slower update rate
Very Slow	Update rate = 10s. Results window size will update every 10 seconds
Slow	Update rate = 2.5s. Results window size will update every 2.5 seconds
Medium	Update rate = 1/3s. Results window size will update 3 times per second
Fast	Update rate = 1/20s. Results window size will update 20 times per second
Very Fast	Update rate = 1/80s. Results window size will update 80 times per second
Window	The window application will allow the user to input their own speed settings different to any of the 5 pre set settings above

Smoothing	Smoothing filter will gather the data and average out over a sliding window time scale. This is very useful when gathering data which could be affected by noise. Each speed above has its own time constant for filtering and data updates
Normal	With Normal smoothing applied the following update windows will apply to the relevant speed selected. V.Fast =0.05s, Fast = 0.2s, Medium = 1.5s, Slow = 12s, V.Slow = 48s
Slow	With Slow smoothing selected all results are X4 greater than in normal smoothing mode
None	With no smoothing to computed results the data update will be dictated by the speed only

Smoothing Response	
Auto Reset	The smoothing response is by default set to “auto reset” where the filtering described in “smoothing” is reset in response to a significant change in data such as frequency, voltage and current levels. This speeds up the response of the instrument to changing conditions
Fixed Time	Auto reset can be disabled so that the filtering has a fixed time constant, which would have an exponential response to a step change, this is useful for PWM inverter drive evaluation where variable frequency tracking is required

Frequency Reference	The frequency may be measured from any of the following inputs:
Voltage	Select Voltage to detect frequency from the input voltage
Current	Select Current to detect frequency from the input current
Speed Input	Select speed input to frequency detection to set frequency via “speed input” BNC
AC line	Select ac line to read frequency from the ac line input, measured from power inlet to PPA

Frequency Reference	On a multi-phase instrument, any channel may be selected for the frequency measurement
Phase 1	Select this option to detect frequency from phase 1
Phase 2	Select this option to detect frequency from phase 2
Phase 3	Select this option to detect frequency from phase 3

Phase Angle Reference	Phase angle measurements must be made with reference to a specific input
Voltage	Phase 1 voltage is by default set as the input reference channel
Current	The phase angle reference can be set to current which is useful if operating the instrument with only current inputs, or with low level voltage inputs

Frequency Filter	A parallel digital frequency filter of low-pass may be selected to filter out the HF carrier component of a PWM waveform ensuring measurements are carried out on the fundamental frequency, further filter settings for PWM waveforms can be found within the APP/PWM section (page 15)
Off	No frequency filter selected
On	Switches On frequency filter (4kHz)

Low Frequency	Normal frequency measurement is from 5Hz upwards so that there is not a very long delay if measuring dc. There is a low frequency option that extends the frequency measurement down to 20mHz. This low frequency option also applies a digital filter, which can be useful when measuring in a low frequency, noisy environment
Off	Select to switch this mode Off
On	Select to switch this mode On

ADVANCED OPTIONS	
DFT Selectivity	Analysis of the **fundamental** component uses a DFT (Discrete Fourier Transform) algorithm. The selectivity of the DFT analysis is a compromise between noise rejection of frequencies close to the frequency of the fundamental component and the required stability of the frequency component
Normal	Default settings for the fundamental calculations
Narrow	Selecting “narrow” increases the selectivity of the DFT analysis (reducing the effective bandwidth at each component) which has the effect of improving the noise rejection. It does however require that the frequency of the fundamental component is more stable

Ignore Overload	In a noisy application any spikes present on the signal may push the instrument onto a higher range than is necessary for the signal being measured. If the nature of the spurious spikes are such that they do not contribute to the measurement and can safely be ignored then the range can be manually set to the appropriate range for the signal to be measured and the instrument can be told to ignore any overload. If using this mode it is wise to check the signal on the oscilloscope to be sure that the signal being measured is not genuinely over range
Off	Select to switch this mode Off
On	Select to switch this mode On

Frequency Lock	In a very noisy application, where the frequency of the signal is known but the instrument is unable to measure the frequency even with PWM filters or low frequency mode filters applied, it is possible to manually enter the frequency to be used for analysis
Normal	Utilises N4L unique signal processing techniques for fundamental frequency synchronisation including hysteresis to increase frequency noise immunity
Constant	Constant selection will allow the user to overwrite the present measured frequency with the known frequency. This entered frequency is then used for all the analysis and the frequency of the input signal is not measured
Dynamic	As per “Normal” without hysteresis

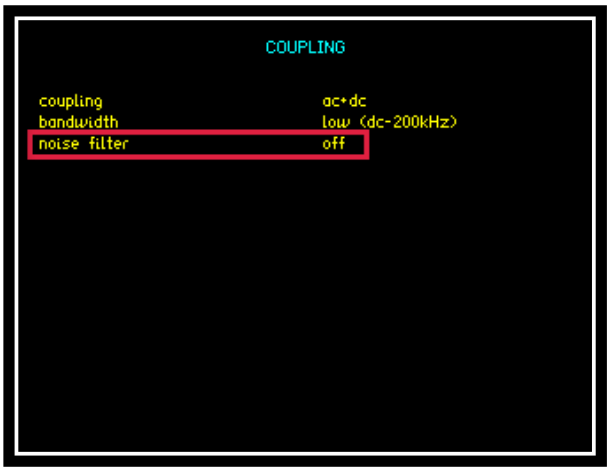
High Speed	High speed mode can be selected for data log speeds less than 100ms
Disabled	Disable high speed function
Enabled	Activate high speed data log function

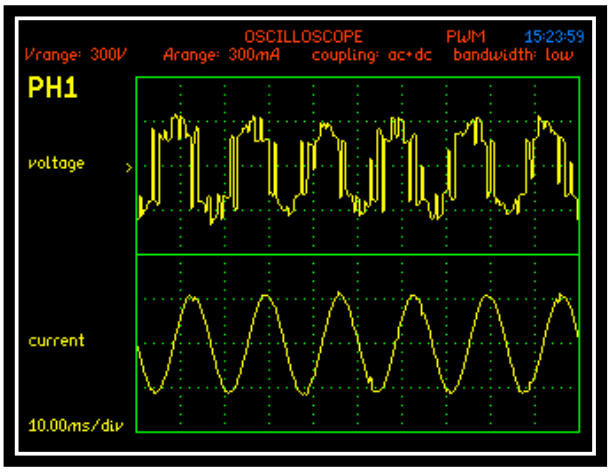
COUPLING	
Coupling	There are three coupling options - AC only, AC+DC, or DC only. AC+DC coupling is the default option and should be used where possible. AC coupling should be used for measuring signals that are biased on a dc level (such as an amplifier operating on a single supply or the output of a dc PSU). DC coupling should be selected when making DC measurements as it prevents noise from resetting the frequency measurement algorithm. The coupling option does not affect the bandwidth of the instrument only the frequency detection
ac + dc	Will allow both ac and dc signals to be calculated in all measurements
ac	AC Coupling only allows ac signals to be measured and will filter out all dc components
dc	DC coupling should be selected when making DC measurements as it prevents noise from resetting the frequency measurement algorithm, the bandwidth of the instrument is not affected

Bandwidth	The bandwidth setting dictates the frequency range of the instrument. This selection sets an inline analogue filter as per the selection
Wide (dc - 2MHz)	Wide bandwidth will offer the full range of frequency components available for analysis
Low (dc - 200KHz)	Low bandwidth may be useful in noisy applications for example where there are switching spikes superimposed on the waveform of interest. The switching spikes may push the input channels onto a higher range than is necessary for the measurement. Selecting low bandwidth puts a hardware filter in the analogue input path to eliminate unwanted high frequency components
dc (dc - 5hz)	The DC only bandwidth option applies a dc-accurate low pass filter of around 10Hz to reduce the ac signal. This is particularly useful when accurately measuring the dc content of an ac waveform such as the output of a UPS (uninterruptible Power Supply). A 50Hz or 60Hz ac signal would not be removed entirely so that the measurement may still be synchronised to the waveform, but the amplitude would be greatly reduced so that the instrument would be on a more appropriate range for the dc component

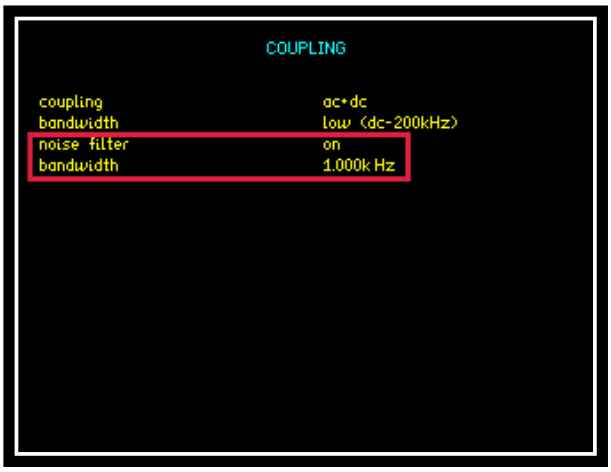
Noise Filter	In signal processing, a “FILTER” is a device or process that removes from a signal some unwanted component or feature. The noise filter is a digitally selectable in line filter which will alter the bandwidth of the processed signal
Off	Select to switch this mode off
On	Select to switch this mode on

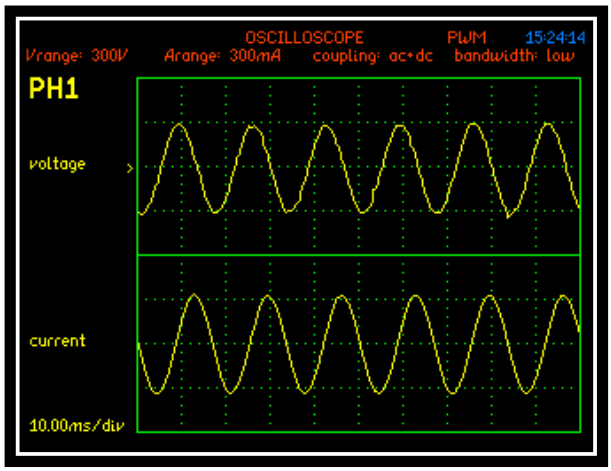
The following screenshots are taken from the “Scope” display with the PPA set in PWM application mode





Noise filter set to OFF the scope display shows a PWM switching Voltage waveform with noise distortion





Noise filter activated and bandwidth set to 1KHz the Voltage waveform is now displayed and is smoother and more sinusoidal

RANGE	Input channel options

Voltage Input	
Internal	The internal voltage attenuator selects the 4mm connections on the rear of the instrument and has a max input of 3000Vpk
External Attenuator (for connection to a HF shunt).....etc	An External Sensor / Shunt can be connected to the instrument which will give the operator more versatility in selecting the Input range required. Note: if this option is selected then the resulting data is scaled by the appropriate value within the attenuator and scale factor sub section. Max input of 3Vpk

Autoranging	
Full Autorange	Default setting. Full autoranging will be selected and implemented within the instrument
Range up only	Selecting this option will allow the test being carried out to find the highest range via peak detection and hold on this range. Once this value has been found another test can be carried out by pressing the "Trigger" button which will restart from the minimum value set parameter use for "Low" Frequency measurements
Manual	Selecting this option will allow the user to set up the range from the configured measurements available, this is useful for inrush testing when a mid-analysis range change is not desirable

Minimum Range	Pre set Input Voltage minimum range
1V	Minimum Input Voltage range will not be below 1v
3V	Minimum Input Voltage range will not be below 3v
10V	Minimum Input Voltage range will not be below 10v
30V	Minimum Input Voltage range will not be below 30v
100V	Minimum Input Voltage range will not be below 100v
300V	Minimum Input Voltage range will not be below 300v
1Kv	Minimum Input Voltage range will not be below 1Kv
3Kv	Minimum Input Voltage range will not be below 3Kv

Scale Factor	Manually set the scale factor required, normally used in conjunction with current transformers

Current Input	
Internal	The internal current shunt selects the 4mm connections on the rear of the instrument. Max Apk is dependent upon model type; LC (10A rms), Standard (30A rms) or HC (50Arms)
External Shunt	An External Shunt can be connected to the instrument which will give the operator more versatility in selecting the Input range required. Note: if this option is selected then the resulting data is scaled by the appropriate value within the scale factor and shunt value sub section

Autoranging	
Full Autorange	Default setting. Full autoranging will be selected and implemented within the instrument
Range up only	Selecting this option will allow the test being carried out to find the highest range via peak detection and hold on this range. Once this value has been found another test can be carried out by pressing the "Trigger" button which will restart from the minimum value set parameter
Manual	Selecting this option will allow the user to set up the minimum range from the configured measurements available

Minimum Range	Pre set current input minimum range
10mA LC Version Only	Minimum Input Current range will not be below 10mA
30mA LC Version Only	Minimum Input Current range will not be below 30mA
100mA LC, SC, Versions	Minimum Input Current range will not be below 100mA
300mA LC, SC, HC	Minimum Input Current range will not be below 300mA
1A LC, SC, HC	Minimum Input Current range will not be below 1A
3A LC, SC, HC	Minimum Input Current range will not be below 3A
10A LC, SC, HC	Minimum Input Current range will not be below 10A
30A LC, SC, HC	Minimum Input Current range will not be below 30A
100A SC, HC Versions	Minimum Input Current range will not be below 100A
300A SC, HC Versions	Minimum Input Current range will not be below 300A
1000A HC Version Only	Minimum Input Current range will not be below 1000A

Scale Factor	Manually set the scale factor required

DC offset	Used to trim out DC offset commonly found on external current transducers

DATALOG	
Datalog	Interrogation and extraction of information resulting from a test log in a specified time scale and at a set speed
Disabled	No memory selected
RAM	Instruments internal memory selected for data storage, this offers the fastest performance
Internal Flash	Utilises 200MB internal memory
USB memory stick	External USB memory stick selected for data storage

APP	
Mode	Application function to be selected
Normal	Using the Normal Application the default settings within the instrument will be applied to all measurements, useful for general measurements
Default Settings	All default parameters will be selected when “ENTER” is pressed
PWM Motor Drive	The nature of the waveforms in a PWM motor drive application makes measurement of the fundamental frequency difficult. The application mode for PWM motor drives applies a selectable filter which is a parallel digital filter and will not affect the bandwidth of the instrument; it is only used for frequency detection. The best filter to use for a given application should be selected by experiment. The filter does not change the measured data at all. PWM application mode also allows torque and speed to be simultaneously measured so that efficiency can be computed
Default Settings	All default parameters will be selected when “ENTER” is pressed
Frequency Filter	Pre selectable filter options 64Hz, 250Hz, 1KHz, 4KHz, 16KHz, 64KHz, 250KHz
Frequency Reference	Select which parameter frequency reference will be detected from input signal
Low Frequency	Can be selected as On or Off if “On” is selected manually enter the minimum frequency required
Torque + Speed	Power Measurement function can be set to disabled or enable to measure the desired function from analogue, pulsed speed, pulsed torque, or pulsed. Once enabled a scale factor / offset will require setting in relation to either Voltage or Frequency
Efficiency	(Not applicable to the PPA4510) Efficiency can be measured between selected channels from the drop down menu

Lighting Ballast	Electronic lighting ballast waveforms consist of a high frequency carrier signal modulated by the line frequency. The instrument measures the line frequency independently of the input waveform frequency and synchronises the measurement period to the line frequency. The carrier frequency measurement ignores any "dead band" around the zero crossing of the ac line to compute the actual switching frequency of the ballast. Both the frequency measured on the input waveform and the frequency of the line input is displayed, the output of the ballast should always be connected to Phase 1
Default Settings	All default parameters will be selected when “ENTER” is pressed
Frequency Tracking	Selectable tracking speed from drop down menu
Efficiency	(Not applicable to the PPA4510) Efficiency can be measured between selected channels from the drop down menu
Inrush Current	Inrush current (surge) requires very fast sampling to catch the highest instantaneous value. Measurements must be made under conditions of manual ranging and with the voltage applied to the instrument. Then when the load is switched on the highest peak value can be detected. If the peak current is unknown then a minimum of two tests should be performed, one to set the range and a second test to capture the inrush current
Default Settings	All default parameters will be selected when “ENTER” is pressed
Minimum Range	Select the minimum current range applicable from the drop down menu
Auxiliary Device	Allows PCIS inrush switch to be used for measurement of Inrush Current. If selected phase offset and waveform cycle for results will require setting

Transformer Mode	Large power transformers operate at very low power factor (<0.01) and the phase accuracy is critical to measure the losses. Power transformer application mode sets the configuration options to the optimum for phase accuracy e.g. AC+DC coupling range lock across phases. The temperature can be monitored at the same time by connecting a suitable temperature sensor to the “torque” BNC input
Default Settings	All default parameters will be selected when “ENTER” is pressed
Temperature	Temperature mode can be disabled or selected to measure ^{0}C or ^{0}F via a suitable temperature sensor connected to the “Torque” BNC input
Standby Power	In order to minimise standby power, some devices operate in a “dormant” mode whereby power is only drawn from the supply when needed. These devices draw very little current for most of the time and then draw a larger current for a single cycle to charge a reservoir capacitor. This pattern is repeated on an irregular basis. Most of the power consumed by devices in this mode is taken in the periodic higher current cycles so to accurately measure the power drawn by these devices; the instrument synchronises to the power frequency for the analysis but extends the measurement window to the irregular period of higher energy pulses. Because the instrument samples in true real time without any gaps, no data is missed and every power cycle is captured. It is important that ranging is set to manual or up only autoranging so that the power cycles are not missed while ranging
Default Settings	All default parameters will be selected when “ENTER” is pressed
Low Frequency	Select “On” or “Off” if low frequency filter is required
Calibration	This mode is used when calibrating the instrument with N4L software
Default AC Settings	Select to calibrate AC
Default DC Settings	Select to calibrate DC
Frequency Filter	Frequency synchronisation for calibration gives more accuracy at low levels, applies to AC only

Maths	
Formula	
Disabled	No maths formula is selected
(term1 + term2) / (term3 + term4)	Sum of (term1 + term2) divided by sum of (term3 + term4)
(term1 + term2) x (term3 / term4)	Sum of (term1 + term2) multiplied by sum of (term3 ÷ term4)
(term1 x term2) / (term3 + term4)	Sum of (term1 x term2) divided by sum of (term3 + term4)
	Note: Selection of "TERMS" is via the zoom order selections (see section 6.3)

Alarm	
Alarm 1 Data	Alarm on selected parameter and thresholds
Zoom 1	Zoom 1 parameter selected for alarm threshold
Zoom 2	Zoom 2 parameter selected for alarm threshold
Zoom 3	Zoom 3 parameter selected for alarm threshold
Zoom 4	Zoom 4 parameter selected for alarm threshold

Alarm Type (Alarm 1)	
Disabled	No alarm
Linear	Frequency of beep increases linearly as value reaches its limit
Alarm if high	Alarm will sound if values exceed a threshold
Alarm if low	Alarm will sound if values fall below a threshold
Outside window	Alarm will sound if values are outside a permitted window setting
Inside window	Alarm will sound if values are within a permitted window setting

Alarm 2 Data	Alarm on selected parameter and thresholds
Zoom 1	Zoom 1 parameter selected for alarm threshold
Zoom 2	Zoom 2 parameter selected for alarm threshold
Zoom 3	Zoom 3 parameter selected for alarm threshold
Zoom 4	Zoom 4 parameter selected for alarm threshold

Alarm Type (Alarm 2)	
Disabled	No alarm
Alarm if high	Alarm will sound if values exceed a threshold
Alarm if low	Alarm will sound if values fall below a threshold
Outside window	Alarm will sound if values are outside a permitted window setting
Inside window	Alarm will sound if values are within a permitted window setting

Analogue Output	
Disabled	No analogue output
Zoom 1	Set an analogue output voltage representative of zoom 1
Zoom 2	Set an analogue output voltage representative of zoom 2
Zoom 3	Set an analogue output voltage representative of zoom 3
Zoom 4	Set an analogue output voltage representative of zoom 4
Manual	Set a constant analogue output voltage

REMOTE	
Resolution	Press to set the data resolution and change the format to which the instrument responds to future commands, via Comms interface
Normal	Data Resolution set to 5 decimal points
High	Data Resolution set to 6 decimal points
Binary	Data transmitted in Binary Format

Interface	Communications type between instrument and pc
RS232	RS232 Comms interface
USB	USB Comms interface
LAN	LAN Comms interface – optional on the PPA45
GPIB	GPIB Comms interface – optional on the PPA45

Recall with Program	When enabled recalls communication port settings from any stored memory location
Off	Turn OFF this option
On	Turn ON this option

Screen Print	
Disabled	No Screen print option selected
RS232	Print screen via RS232 Cable i.e. to printer
USB Memory Stick	Print screen directly onto USB memory stick

AUX	
Master / Slave	Select if 2 x PPA units are to be used as a PPA4540/50/60
Disabled	Master / Slave configuration disabled
Master	Select to set the PPA45xx to be the master unit within 4 to 6 phase configuration
Slave	Select to set the PPA45xx to be the slave unit within 4 to 6 phase configuration
Simple Slave	In simple slave mode the results window is not synchronised between the 2 units, the master unit will only ask the slave unit for the results from the Watts measurement
Auxiliary Device	
None	No Auxiliary device connected
PCIS Inrush Switch	Phase Controlled Inrush Switch – is an active device which is controlled over the extension port within the instrument. It accurately synchronises to the line input, measures the frequency and switches on the output at a precise phase angle selected from the instruments front panel. Useful for testing inrush current of ballasts

SYS	
Set Clock	Manual Setting Required. Use Numerical Keys
Set Date	Manual Setting of Date and Year, Month settings are preset

Display	
Colour	Display data will be in colour
White on Black	Display data will be displayed as white font on black background
Black on White	Display data will be displayed as black font on white background

Brightness	
Low	Screen brightness set to Low
High	Screen brightness set to High

Phase Convention	Measurements of Phase can be expressed in one of three formats:
-180º to +180º	Commonly used in circuit analysis
0º to -360º	Commonly used in power applications
0º to +360º	Select as required

Keyboard Beep	Audible sound when keys are pressed
Disabled	Audible sound disabled
Enabled	Audible sound activated

Autozero	
Autozero	Periodically rezero's input to prevent drift, useful for long periods of DC analysis
Manual	Unit will only zero inputs if "Zero" is pressed by user

Program 1-6 Direct Load	Program 1-6 may be recalled with a direct press of the function keys (POWER, INTEG etc)
Disabled	Function will be disabled
Enabled	Function will be enabled

Zoom 2 High Resolution	The data displayed in zoom 2 may be displayed to one digit greater resolution than normal, this is particularly useful when measuring phase at power line frequencies
Disabled	Function will be disabled
Enabled	Function will be enabled

Independent Ranging	This allows the user to set different scale factors and select independently internal / external shunts separately on each phase
Disabled	Function will be disabled
Enabled	Function will be enabled

Low Value Blanking	Low value blanking will zero to display values under the following conditions Input Signal Peak < 45% of RNG 1 < 25% of RNG 2 < 15% of all other ranges
Disabled	Function will be disabled
Enabled	Function will be enabled

← System Information	**The information given in this section cannot be changed by the user**
Serial Number	Instruments unique serial number
Manufacturing Code	Code attributed to build date of instrument
Main Release	Current firmware release installed in instrument
DSP Release	Digital Signal Processing release version
FPGA Release	Field Programmable Gate Array release version
Boot Release	Release version of Instruments boot up firmware
Last Calibration	Instruments last calibration date

→ **User Data**	
Supervisor Access	Enable or Disable
User Data	Manually enter company name
User Data	Manually enter individual or company
User Data	Manually enter unique ID for instrument
Save	Save all above settings

MODE	
True RMS Voltmeter	The RMS voltmeter displays the additional secondary parameters of ac, crest factor, surge, mean and form factor
Phase meter	The phase meter mode is a secondary function which does not have a separate button. The phase meter uses the terminology of channel 1 for voltage and channel 2 for current as it is normal to use a phase meter to compare voltages directly. The phase meter measures the phase and gain of channel 2 relative to channel 1 using a Discrete Fourier Transform (DFT) algorithm at the fundamental frequency
Power Analyzer	In the POWER mode, the analyzer measures power values for each phase
Impedance Meter	The IMP mode on the PPA uses the real and imaginary components at the fundamental frequency using DFT analysis to compute the impedance of the load and associated parameters
Power Integrator	In the INTEG mode, the PPA will compute additional power values within a Datalog and display them relative to time (total power)
Harmonic Analyzer	The HARM mode of the PPA computes multiple DFTs on the input waveforms in real time. There are two modes of operation: difference THD, and series harmonics. Series harmonic mode includes options for THD, TIF, THF, TRD, TDD and phase. There is also an option of a series harmonic bargraph display which shows both the voltage and current harmonics simultaneously. In difference THD mode, the THD (Total Harmonic Distortion) is computed from the rms and fundamental: In series THD mode, the THD is computed from a series of up to 100 harmonics
Oscilloscope	The PPA provides a storage oscilloscope function in order to view the waveforms being measured

PROG	
Memory	Program Store / Recall Options
Internal Flash	Instruments internal memory utilised to store or recall data to/from
USB Memory Stick	External USB memory stick utilised to store or recall data to/from

Data	
Program	Upload or download a program
Results	Upload or download results
Datalog	Upload or download Datalog

Action	
Recall	Recall any **Data** selections from above
Store	Store any **Data** selections from above
Delete	Delete any **Data** selections from above

Location	999 selectable locations for data to be; stored, recalled or deleted from

Name	Allows user to name data within location

Execute	Press to execute any change made to any parameter within “PROG” mode

Memory Status	Status of memory in either Internal or USB configuration

ZOOM +	Increase font size on selected parameters on display screen

ZOOM -	Decrease font size on selected parameters on display screen

REAL TIME	Press Real Time to return to the display screen and see all data in real time. Pressing the real time button will also put the display screen into hold mode

TABLE	Press Table to view results either during or at the completion of a Datalog in tabular format, this is also the default screen whilst Datalog is running

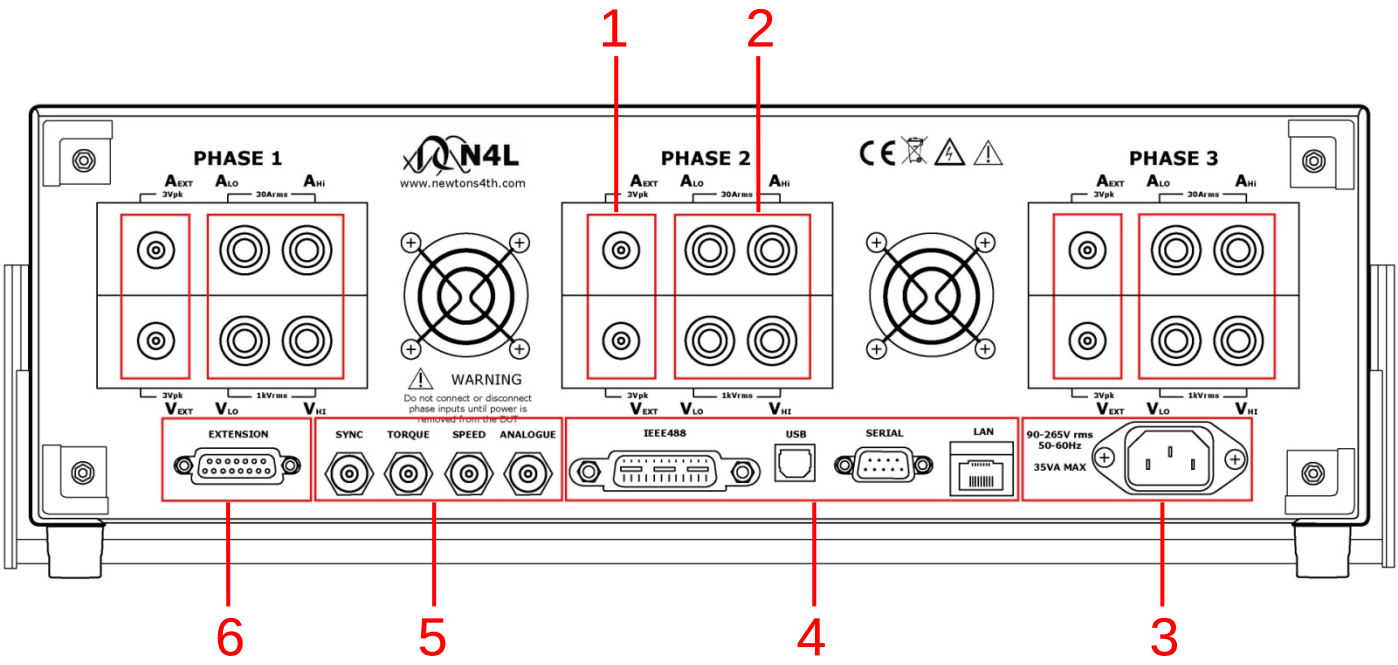
GRAPH	Press Graph during Datalog to view plotted data points whilst log is in process, or view graph plots once Datalog is complete. Press “GRAPH” to move through screen display options
POWER	Direct button to Power Analyzer mode functions
INTEG	Direct button to Power Integrator mode functions
HARM	Direct button to Harmonic Analyzer mode functions
RMS	Direct button to True RMS Voltmeter mode functions
IMP	Direct button to Impedance Analyzer mode functions
SCOPE	Direct button to Scope mode where waveforms can be viewed from measurements being taken. The left and right directional arrows will allow the time base to be changed and the up and down arrows will allow the trigger level to be set
START	Start button will start any Datalog. Is also the button used to initialise a screen dump of any data displayed onto a USB memory stick
STOP	Stop button will stop any Datalog
ZERO	Zero button will reset the inputs to zero
TRIGGER	Trigger returns display screen back to real time from a hold command. Also triggers a single shot in SCOPE mode, all trigger settings can be found by pressing the “scope” button whilst in SCOPE mode
ENTER / NEXT (Dual use button)	Enter / Next will enable the user to confirm any configurations they have set within the menu's and will scroll through the display screen to view all individual phase screens or all phases together

DELETE / BACK (Dual use button)	Delete / Back will enable the user to delete any inputted data or scroll back through any results screens

HOME / ESC (Dual use button)	Home / Esc will enable the user to return to the home page once data within parameters have been adjusted and entered, or will escape from any screen view and return to the selected mode's home screen

4 Rear Panel Layout

1. Voltage & Current External Analogue Inputs
2. Voltage & Current Internal Inputs
3. Mains Supply Inlet
4. Communication Ports
5. Auxiliary Ports
6. Master / Slave Connection Port



5 Basic Key Operations

This chapter is designed to help the user familiarise themselves with the instrument by setting up some basic functions

5.1 SET UP FOR POWER ON

Install Equipment	⇨	Installation of Equipment
Plug in and turn on power	⇨	Power Supply Connection

5.2 SETTING THE TIME

Power Analyzer Default Screen Appears

Press “SYS” Key	⇨	System Option Screen Opens
Press ▼ Key	⇨	Flashing Red Cursor will surround Hrs
Use Numerical Keys	⇨	Set Hours within cursor
Press Enter Key	⇨	Hours in clock now set
Press ▼ Key	⇨	Flashing Red Cursor moves to Minutes
Use Numerical Keys	⇨	Set Minutes within cursor
Press Enter Key	⇨	Minutes in clock now set
Press ▼ Key	⇨	Flashing Red Cursor moves to Seconds
Use Numerical Keys	⇨	Set Seconds within cursor
Press Enter Key	⇨	Clock settings will now be complete

5.3 SET THE DATE

Press ▼ Key	⇨	Flashing Red Cursor moves to Date
Use Numerical keys	⇨	Set Date within Flashing Box
Press Enter Key	⇨	Numerical Day of Month is set
Press ▼ Key	⇨	Flashing Red Cursor moves to Month
Press ▶ Key	⇨	Month Calendar Opens
Press ▼ Key	⇨	Select Month to be entered
Press Enter Key	⇨	Month will be set
Press ▼ Key	⇨	Flashing Red Cursor moves to Year
Use Numerical Keys	⇨	Set Year within Cursor
Press Enter Key	⇨	Date will now be Set

5.4 ADJUSTING THE BRIGHTNESS

Press ▼ Key	⇨	Flashing Red Cursor moves to Brightness
Press ◀ Key	⇨	Changes between High or Low option
Press Enter Key	⇨	Screen Brightness will now be set

5.5 ADJUST KEYBOARD BEEP

Press ▼ Key Twice	⇨	Red cursor moves to Keyboard beep
Press ◀ Key	⇨	Changes between Enable / Disable option
Press Enter Key	⇨	Keyboard beep now set

Now that you have familiarised yourself with the instruments keypad we can complete this section by filling in the User Data Information

5.6 USER DATA

Press “SYS” Key	⇨	System option screen opens
Press ▶ Key	⇨	User settings screen appears
Press ▼ Key	⇨	Red cursor moves to supervisor access
Press ◀ Key	⇨	Changes between Enable / Disable option
Press Enter Key	⇨	Supervisor access selected
Press ▼ Key	⇨	Red cursor moves to User Data
Use Numerical Keys	⇨	On this line we can enter a Company Name
Press Enter Key	⇨	Company Name now set
Press ▼ Key	⇨	Red Cursor moves to User Data
Use Numerical Keys	⇨	Enter an Individual Name or Department
Press Enter Key	⇨	Name / Department now set
Press ▼ Key	⇨	Red cursor moves to User Data
Use Numerical Keys	⇨	Enter a Unique ID for the instrument
Press Enter Key	⇨	User Data now set
Press ▼ Key	⇨	Red cursor moves to Save
Press Enter Key	⇨	All User Data details will be saved

6 PPA45xx Quick User Guide

N4L Power Analyzers cover 1 to 3 phase applications in one instrument depending upon the model and up to 12 phases via N4L's PPALoG software application in both low and high current models. Each phase input has wide ranging voltage and current channels which are fully isolated from each other and from ground.

The voltage and current inputs are simultaneously sampled and the data is analyzed in real time by a high speed DSP (digital signal processor). A separate CPU (central processing unit) takes the DSP results for display and communications. At the heart of the system is an FPGA (field programmable gate array) that interfaces the various elements.

This powerful, versatile structure allows the measurement of a wide range of power related parameters.

6.1 WIRING

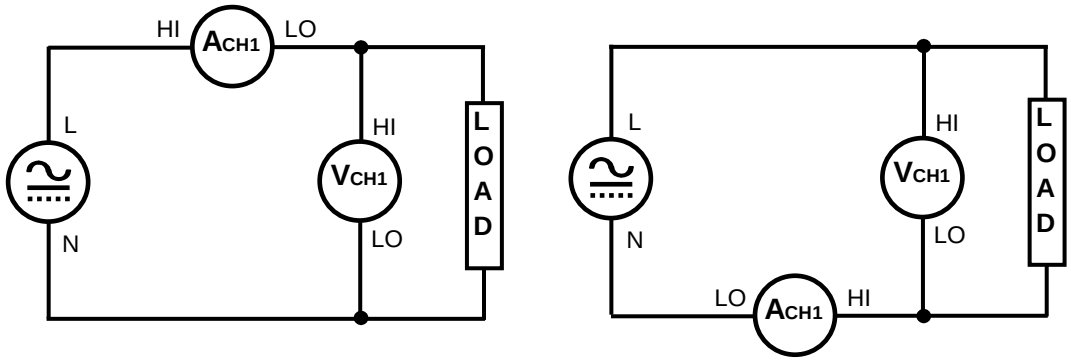
Care must be taken when connecting up the instrument.

Remember to configure the Voltage and Current inputs as per the diagrams shown

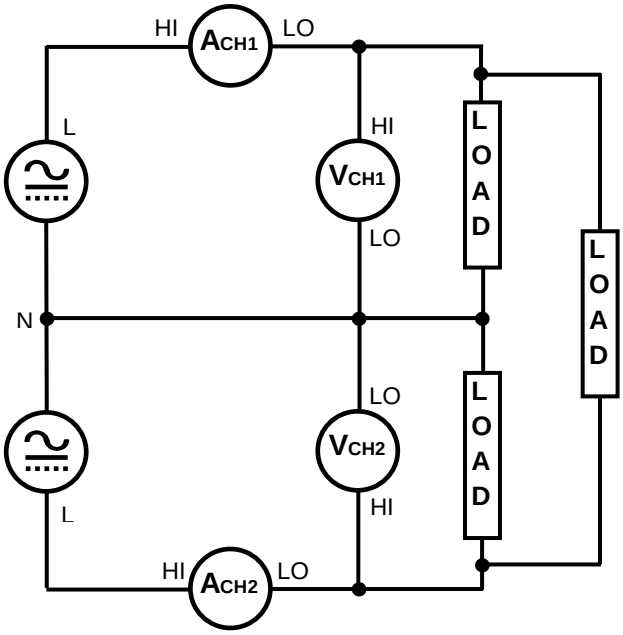
Current in Series – (Hi in, Low out)

Voltage in Parallel

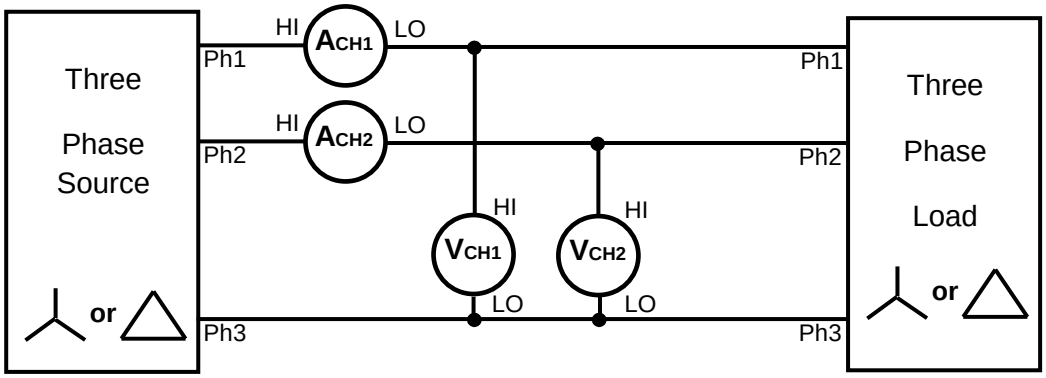
Single Phase Configuration



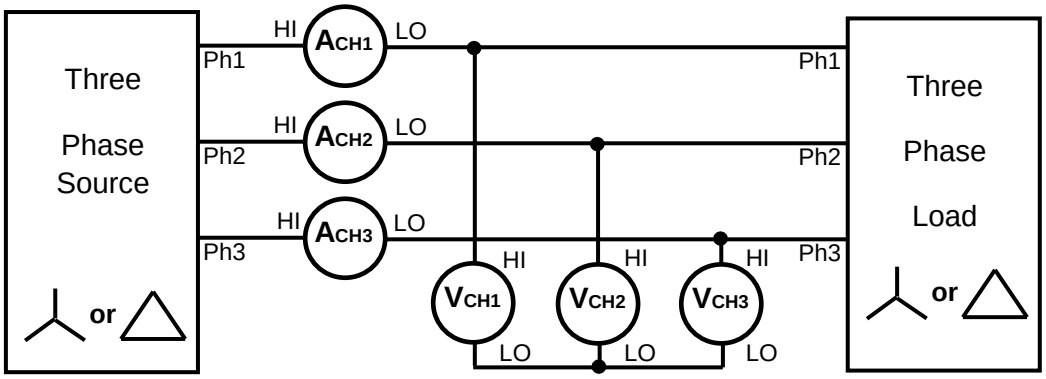
Two Phase Two Wattmeter Configuration



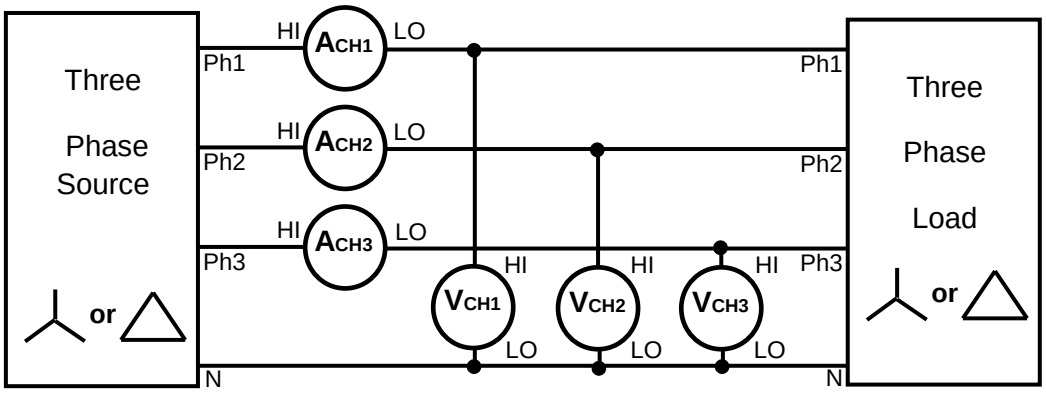
Three Phase Two Wattmeter Configuration



Three Phase Three Wattmeter - simulated neutral configuration

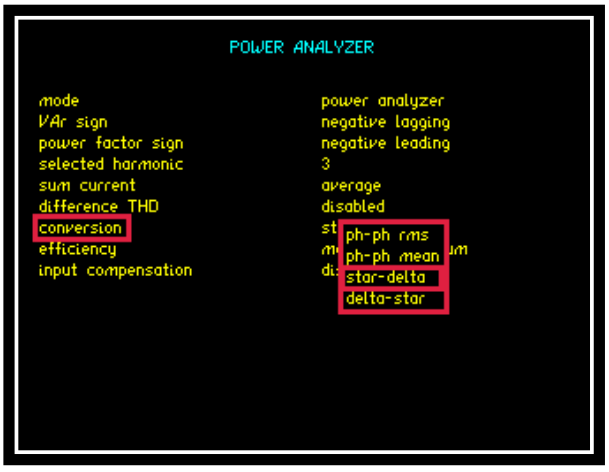


Three Phase Three Wattmeter Star Connections



To configure PPA45xx to calculate the correct phase power when the Load topology is in a Star Configuration;

Access “Power Analyzer” mode either through the “Mode” or the “POWER” button as per the screenshot below



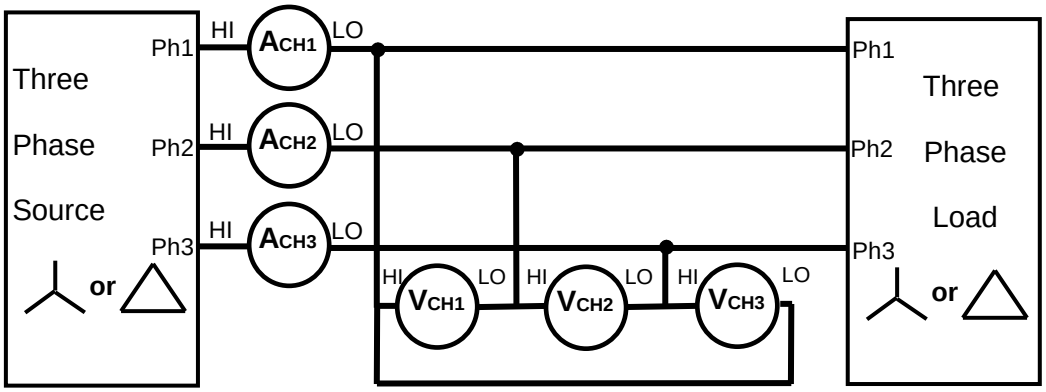
Press ▼ 7 times until red box surrounds “conversion”

Press ▶ to open up dropdown menu selections

Press ▼ until red box surrounds “star-delta”

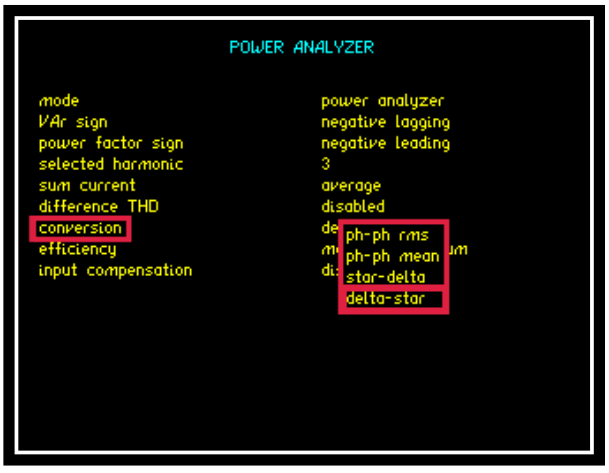
Press “ENTER” to confirm selection

Three Phase Three Wattmeter– Delta Connections



To configure PPA45xx to calculate the correct phase power when the Load topology is in a Delta Configuration;

Access “Power Analyzer” mode either through the “Mode” or the “POWER” button as per the screenshot below



Press ▼ 7 times until red box surrounds “conversion”

Press ▶ to open up dropdown menu selections

Press ▼ until red box surrounds “delta – star”

Press “ENTER” to confirm selection

6.2 START UP

Once connected, power on the instrument and the analyzers factory default settings from memory location 0 will be displayed as per Fig 1, Note these can be altered to your own desired settings (see the User Data section under System Options, section 6 of the main user guide, downloadable from the N4L website)

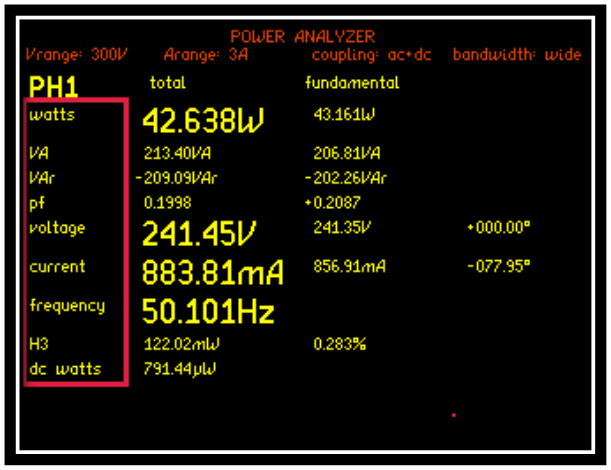


Fig 1

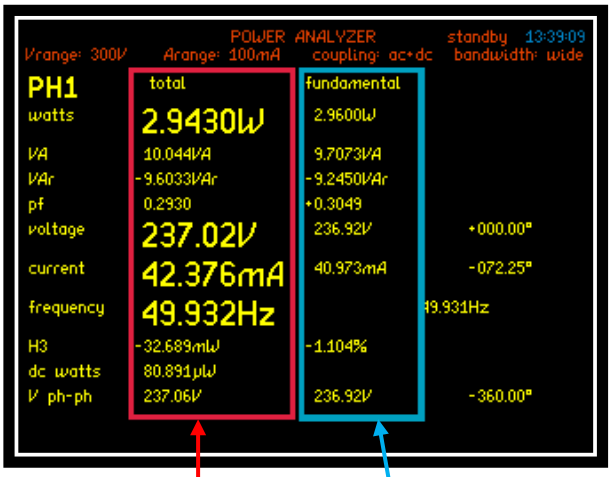


Fig 2

Within the Power screen you will notice 2 sets of measurements “Total” and “Fundamental” as seen in Fig 2

Total Measurements Fundamental Measurements

Total Measurements = Fundamental + Harmonics + Noise

Fundamental = Fundamental Power Measurements (All Distortion Removed)

Each measurement mode is pre-configured to display relevant parameters. Up to 4 functions can be selected and zoomed in. These can be viewed within 3 zoom screens, the Zoom function is described in the next section of this manual

6.3 ZOOM FUNCTION

Within the Power screen you are able to select up to 4 measurements that can be made more prominent from the rest, these can be selected and changed by the user as required

To select or change any zoom measurement

Action	**Result**
Press “ZOOM-”	All measurement parameters revert to same size
Press “ZOOM+”	Red boxes will flash around currently selected zoom parameters
Press “DELETE”	Red Boxes will disappear replaced by 1 white flashing box
Press ▲▼◀▶ Keys	Move Box to desired measurement parameter to be zoomed
Press “ENTER”	Measurement will be selected
Press ▲▼◀▶ Keys	Move Box to next desired measurement parameter to be zoomed
Press “ENTER”	Measurement will be selected

Continue until all measurements you require are selected, up to a maximum of 4

By pressing the ZOOM+ or ZOOM- button you can now alter the on screen display to show a different configuration of the selected measurements

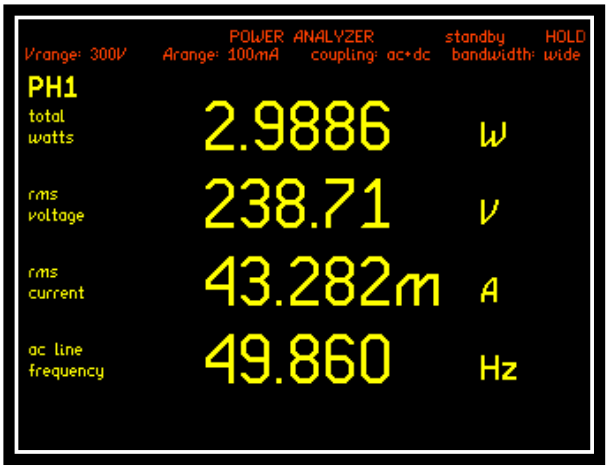


Fig 3

Zoom +

Press Zoom+ to display the 4 selected zoomed measurements as shown

Note: These will be displayed in the order they were selected

Pressing Zoom+ again will display only the first 3 selected zoomed measurements as shown in (Fig 4)

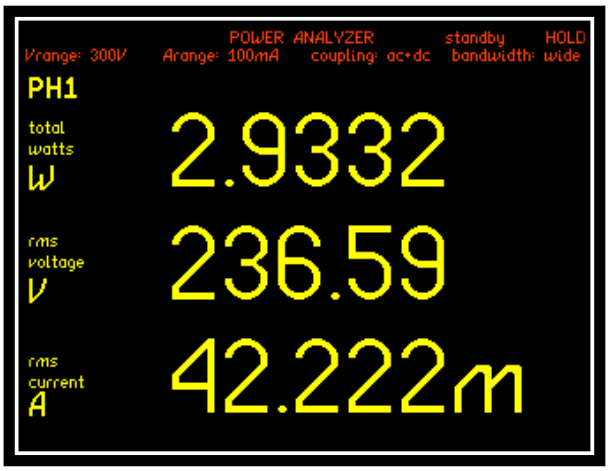


Fig 4

Press ZOOM- button to revert real time display back to all measurement parameters

6.4 SPEED AND SMOOTHING

Within this section we will look at how the speed and smoothing parameters set within the Acquisition menu affect the measurement results

NOTE: All measurement windows must have an integral number of cycles within it to calculate correct RMS and Harmonics

Input = 50Hz Sine Wave

Amplitude = 1Vpk & 2Vpk range

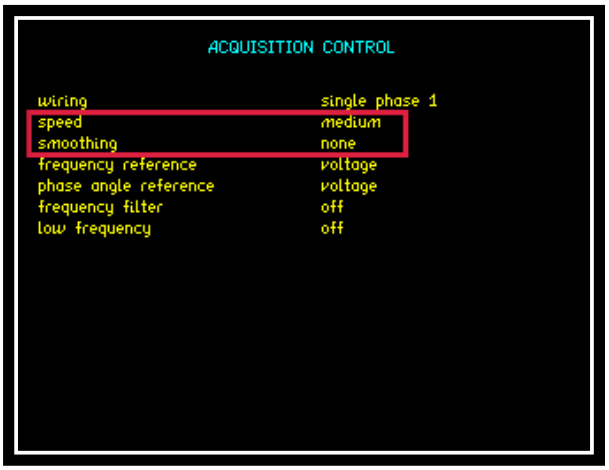


Fig 5

The first sets of results are from a Datalog conducted with NO smoothing selected thus the data update will be dictated by the speed parameter only

Speed set to medium = 3 updates per second

50Hz input signal = 50 cycles worth of data points per second recorded, analyzed, adjusted and displayed within 3 update windows

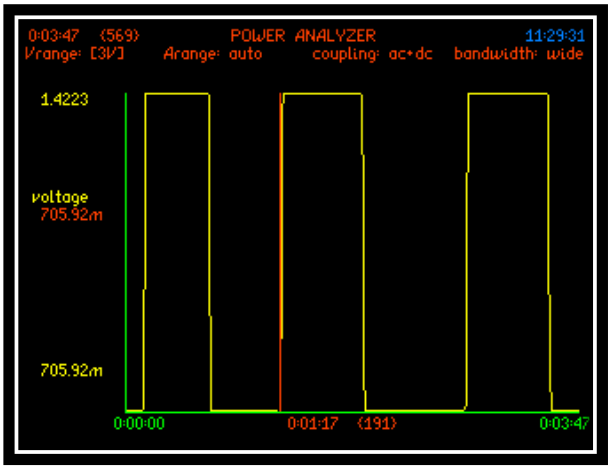


Fig 6

Displayed in (Fig 6) is the graph showing the Datalog results with no smoothing present and the input amplitude switching between 1Vpk and 2Vpk from this graph it is clear that as soon as the amplitude is increased or decreased then the next available update will show this change

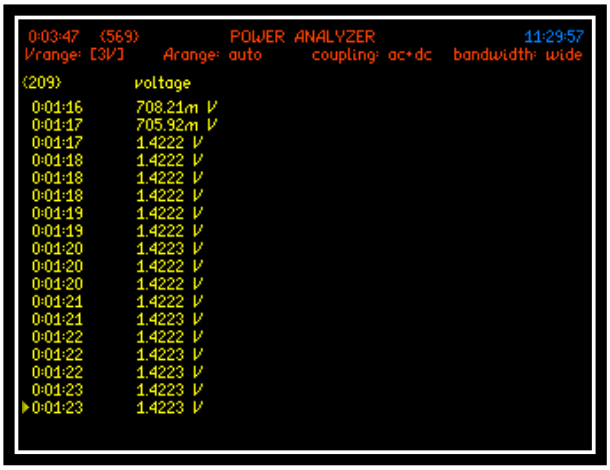


Fig 7

(Fig 7) displays the table of results from the graph in (Fig 6); we can see that the voltage step is immediately recorded after 0:01:17

The next sets of screenshots are for the same set up but with smoothing activated

Selecting smoothing will take the data and apply the equivalent of a single pole low pass filter with an RC time constant relative to the selection mode dependent upon the speed selected

In (Fig 8) we have selected “SLOW” smoothing with a medium speed giving us a sliding window of 48 seconds

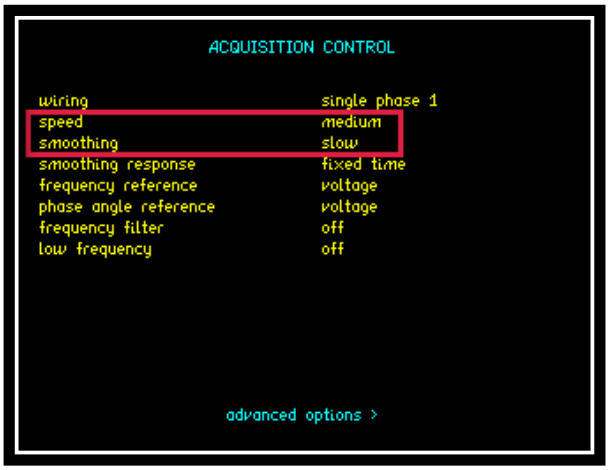


Fig 8

Smoothing response can be set to “Auto Reset” where the instrument will reset the filtering in response to any significant change in data

“Fixed Time” can be selected to correspond with the speed and smoothing parameters and will override auto-reset so that the smoothing is not reset when the frequency changes etc

The resulting graph and results table with smoothing applied are displayed within (Fig's 9 and 10)

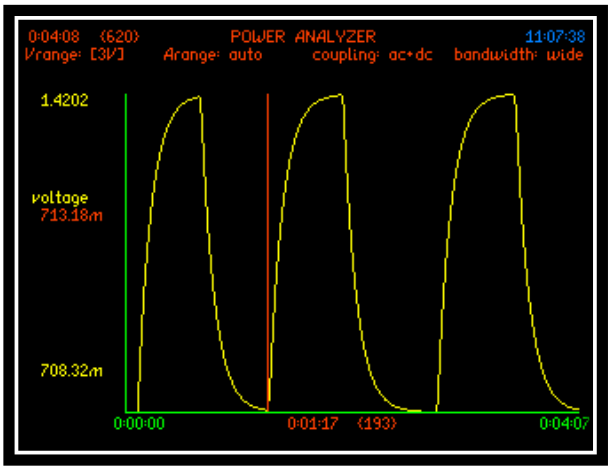


Fig 9

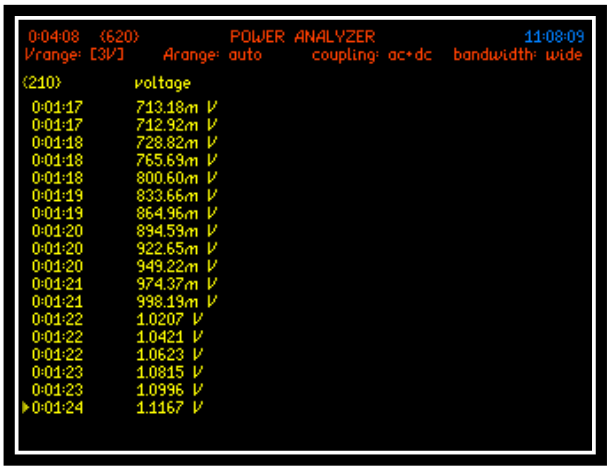


Fig 10

The displays above show how with smoothing applied, the data is smoothed out over the resultant timescale and displaying an intermediate value for every update window during the step between the two peak voltage values

Note: each speed parameter has its own time constant for smoothing and data updates as shown in the table below

Speed	Update Rate: (speed only)	Normal Smoothing: applicable to relevant speed	Slow Smoothing: applicable to relevant speed
Very Slow	10s	48s	196s
Slow	2.5s	12s	48s
Medium	0.333s	1.5s	6s
Fast	0.05s	0.2s	0.8s
Very Fast	0.0125s	0.05s	0.2s
Window	Manually Input speed setting different to 5 pre selected one's above		

6.4.1 EFFICIENCY

The “Efficiency” mode will compute and compare the data results from any of the configurations shown within (Fig 11)

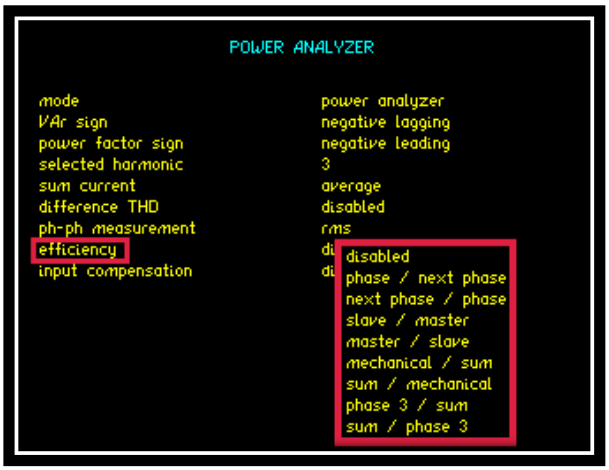


Fig 11

To select the “Efficiency” parameter from any application mode.

Access the Power Analyzer home screen and press “POWER” this will take you into a sub menu (Fig 11). Scroll down to the efficiency parameter and press ▶ this will open up all available configurations as shown

Use the ▲▼ buttons to move through the configurations and press “ENTER” to select and confirm

Press “HOME” to return to the Power Analyzer display screen

The results will then be displayed at the end of the Power Analyzer home screen as shown in (Fig 12)

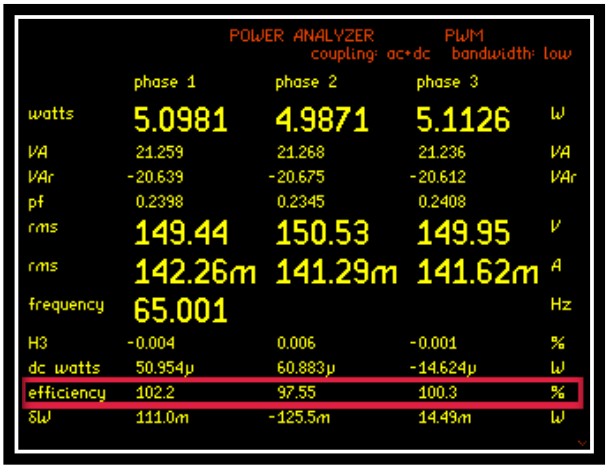


Fig 12

6.5 APPLICATION MODES

Within this section we will look at all the different application modes selectable from within the PPA45xx APP MENU, with the aid of screenshots and instructions. To select your measurement application you will need to activate the “APP” button. Use the down arrow to select mode / function then press the right arrow to open up the drop down menu as seen in (Fig 13)

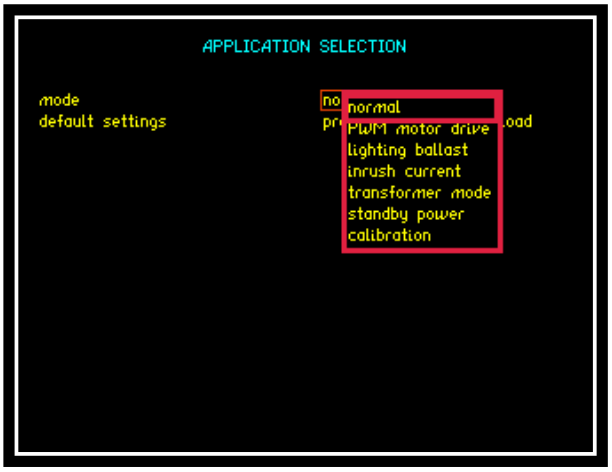


Fig 13

In the following sub sections we will look into and describe how each application mode is set up and configured to enable the user to get the maximum benefit from the PPA45xx

6.5.1 PWM MOTOR DRIVE MODE

The nature of the waveforms produced in a PWM motor drive application makes measurement of the fundamental frequency difficult. In this section we will look at the switching and fundamental frequencies and how frequency lock and filters will allow the correct measurements to be displayed on such a complex waveform

Test device: 1 x Inverter/Motor test unit (set at 65Hz)

Within (Fig 14) we will leave the PPA45xx in “normal” app mode and notice the frequency measurement

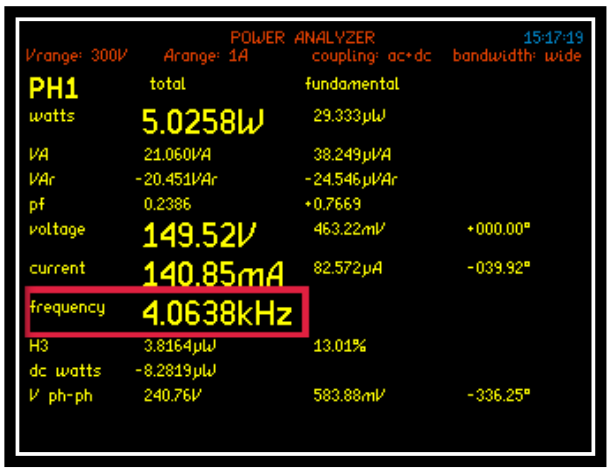


Fig 14

In “normal” app mode the PPA45xx is locking onto a switching frequency / high frequency noise of 4KHz with no filtering applied. This can be used as a guide when selecting a frequency filter from within the PWM motor drive application

To access PWM motor drive mode: (Fig 15)

Press “APP” button

Press ▼ Key

Red Box will surround “Mode”

Press ▶ Key. This will open

the drop down menu selections

Press ▼ Key until red box

surrounds PWM motor drive

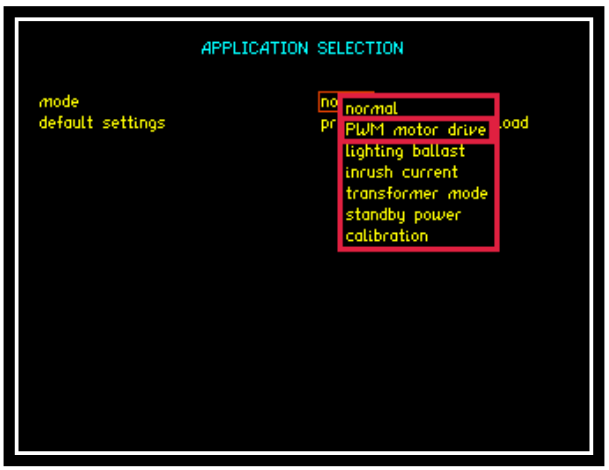


Fig 15

Press “ENTER” this will now set the mode

Press ▼ Key

Red Box will now surround “Default Settings”

Press “ENTER”

When default settings has been selected it will allow 5 further parameters to be configured as shown in (Fig 16)

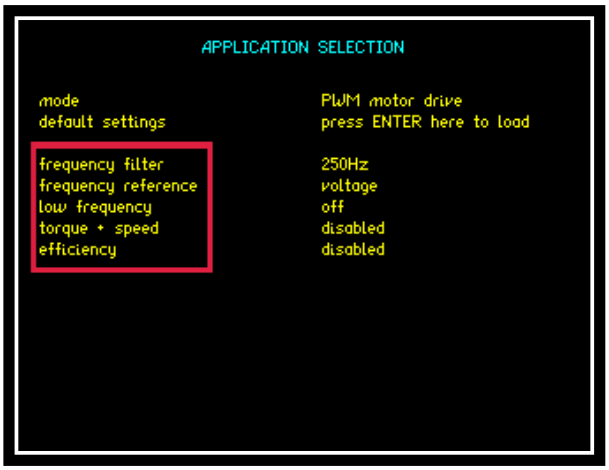


Fig 16

Frequency filter:

Selectable filter from drop down menu. Select a frequency whose range is between the Fundamental Frequency and the Switching Frequency but closer to the fundamental. In this test we have set the inverter to a fundamental frequency of 65Hz so we will select a frequency filter of 250Hz

Note: Do not select a filter too close to the fundamental frequency this may result in the frequency measurement reading 0Hz

Setting the frequency filter:

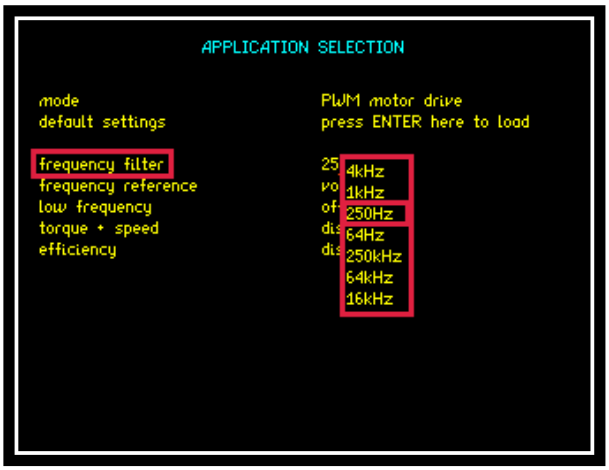


Fig 17

Press ▼ 2 times

Frequency filter parameter will be selected

Press ▶ Drop down box will open with all available frequency ranges

Press ▼ ▲ arrows to select frequency filter parameter required

Press “ENTER” to confirm selection

By applying a 250Hz filter within PWM mode (Fig 17) we can now see that the instrument is locking onto the fundamental frequency this is required for correct signal processing of the waveform

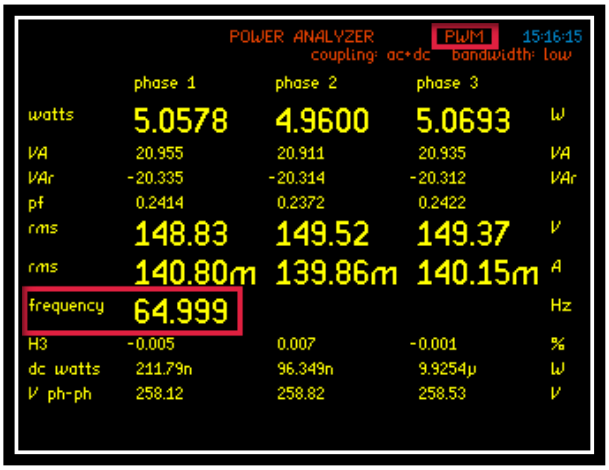


Fig 18

By viewing the waveforms in the Oscilloscope mode (Fig 19) we can see the switching frequency of the Voltage and a smoother sine wave Current waveform

The Current waveform shows the time for 1 cycle approximately 15.40ms

Therefore 1s ÷ ($15.40x10^{-3}$) = 64.9Hz Fundamental Frequency

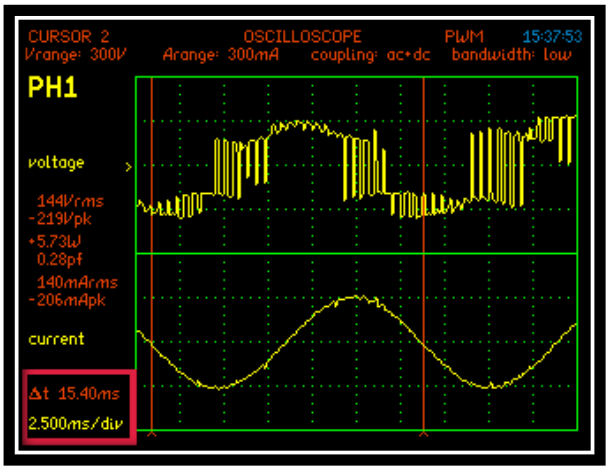


Fig 19

Frequency reference:

Select from the drop down menu which waveform the fundamental frequency is to be synchronised with Voltage or Current

Low Frequency:

Set this parameter to ON, (Fig 15) switching on will open up the minimum frequency parameter

Minimum Frequency:

Manually input a value to allow the results window to extend automatically if the fundamental frequency time period is longer than the time period of the data window. This is recommended

Torque & Speed:

Set the Torque and Speed parameters to measure the Mechanical Power (Nm) and Speed (RPM) via the Torque and Speed BNC connectors on the rear of the instrument

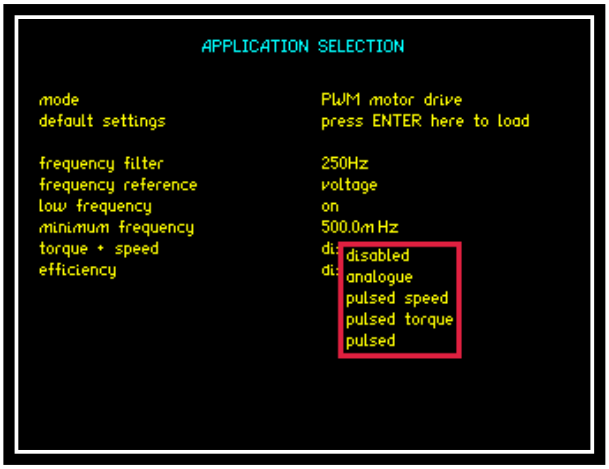


Fig 20

Open up the torque and speed drop down box to select which type of test is to be configured

Once a configuration has been selected you will be required to input a scale factor relating to both the Mechanical Power (Nm) and Speed (RPM), both parameters will then be calculated against the selected source

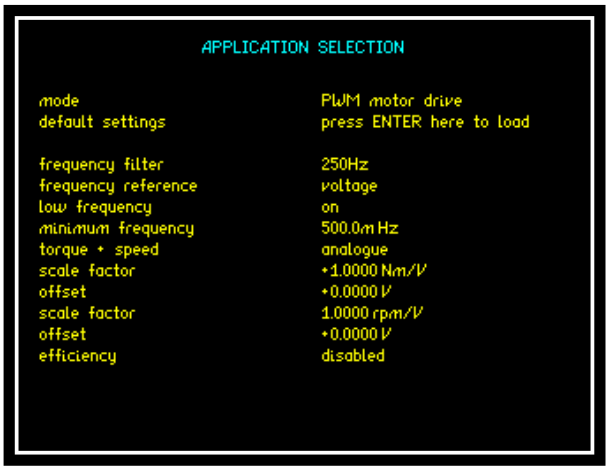


Fig 21

6.5.2 LIGHTING BALLAST MODE

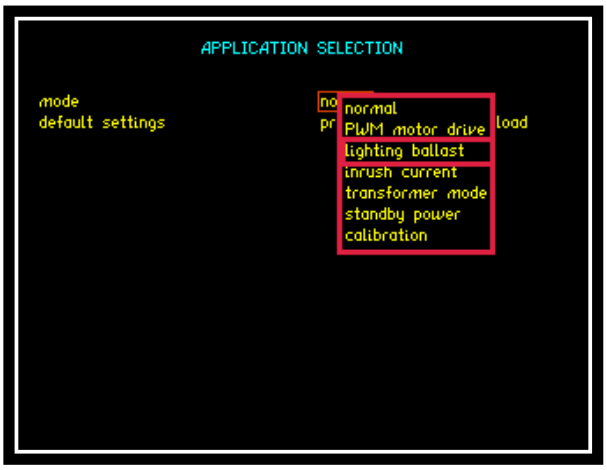


Fig 22

Select Lighting Ballast mode from the Application Menu as in previous applications (Fig 22)

Press ▼ to default settings. Press “ENTER” to load

Once selected you now have the option to select the frequency tracking speed and the efficiency calculation

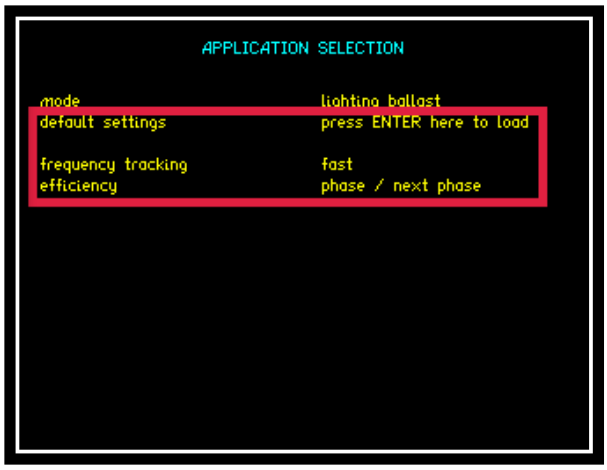


Fig 23

6.5.3 Inrush Current Mode

Test Device: 230v, 50Hz Ventilation Fan (Imax 0.8A)

Accessories: 1 x PCIS Inrush Switch

1 x Break Out Box

Inrush Current Mode (Surge) will allow the user to capture the highest peak value of Current as soon as any load is switched on.

To access Inrush Current: (Fig 24)

Press “APP” button

Press ▼ button

Press ▶ button. This will open the drop down menu selections

Press ▼ 3 times until red box surrounds inrush current

Press “ENTER” this will now set the mode

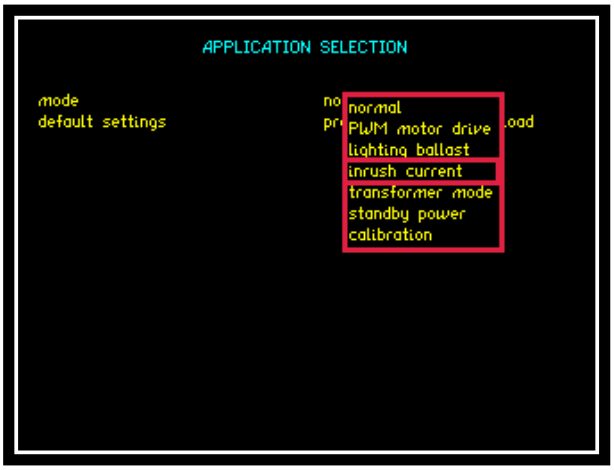


Fig 24

Press ▼ button.

Press “ENTER” this will now set the default settings mode for inrush current and allow further parameters to be configured (Fig.25)

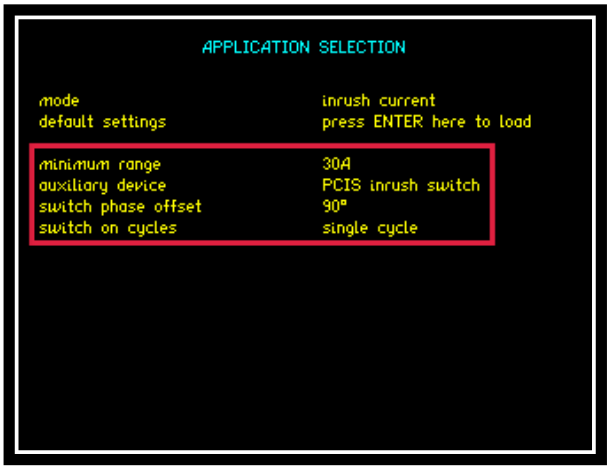


Fig 25

Minimum Range:

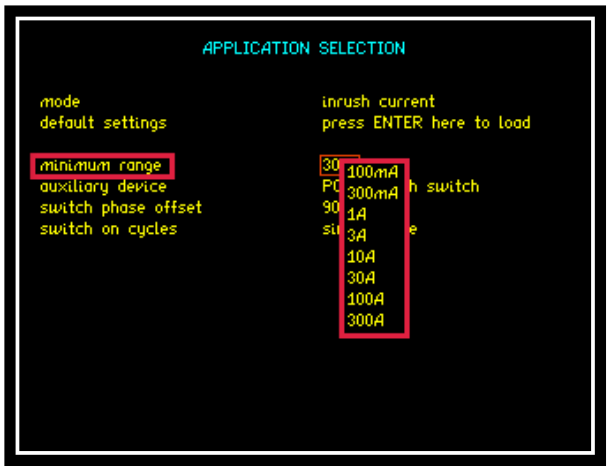


Fig 26

Press ▼ Key

Minimum Range parameter will be selected (Instrument will not range below this value irrespective of input signal)

Press ▶ Drop down box will open with all available Current ranges

Press ▼ ▲ arrows to select minimum range parameter required

Press "ENTER" to confirm selection

Switch Phase Offset:

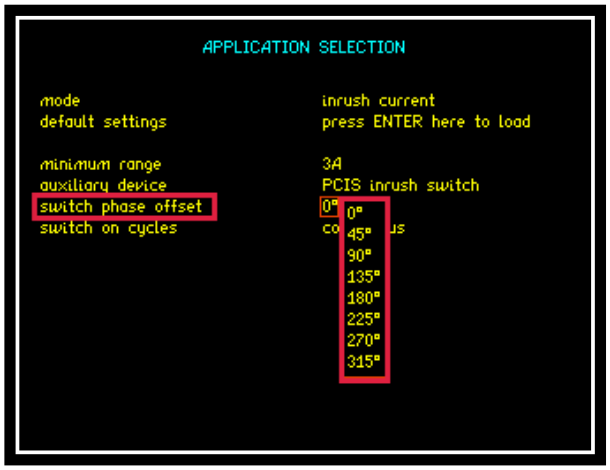


Fig 27

Press ▼ Key

Switch Phase Offset parameter will be selected (controls the switch on of the power to the DUT from 0 ^{0} to 315^{0} in steps of 45^{0})

Press ▶ Drop down box will open with all available angular ranges

Press ▼ ▲ arrows to select angular parameter required

Press "ENTER" to confirm selection

Switch on Cycles:

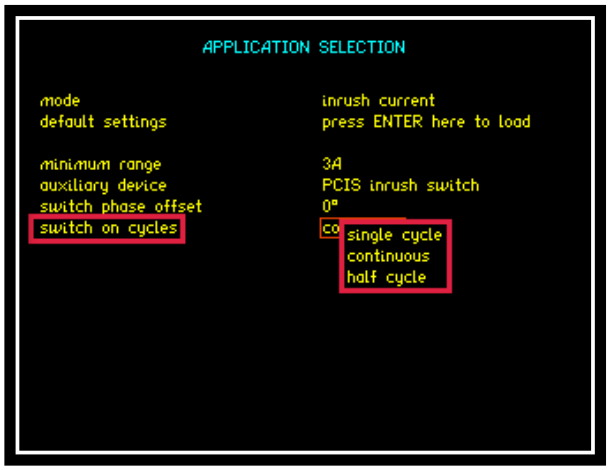


Fig 28

Press ▼ Key

Switch on Cycles parameter will be selected

Press ▶ Drop down box will open with all available waveform cycle ranges

Press ▼ ▲ arrows to select waveform cycle parameter required

Press "ENTER" to confirm selection

Once all settings are configured return to the “MODE” app where the +ve peak and –ve peak parameters can be set to appear within the real time display screen

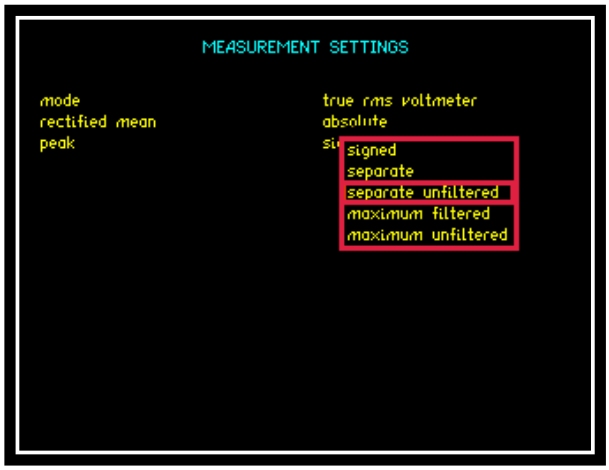


Fig 29

Press “MODE” Key

Press ▼ Key until red box surrounds peak

Press ▶ Drop down box will open with all available peak options

Press ▼ ▲ arrows to select peak parameter required

Press “ENTER” to confirm selection

Returning to the real time display (Fig 30) peak+ and peak- are now available at the bottom of the RMS measurement display

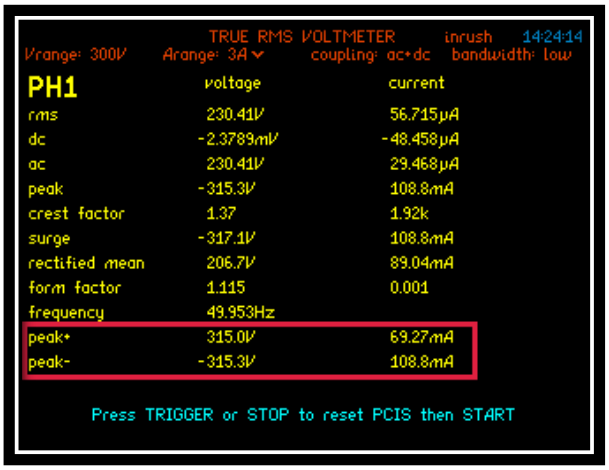


Fig 30

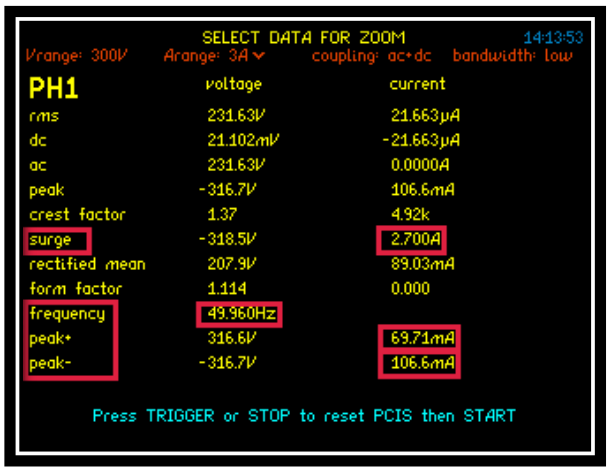


Fig 31

Reconfigure zoom parameters within real time display as described within section 6.3

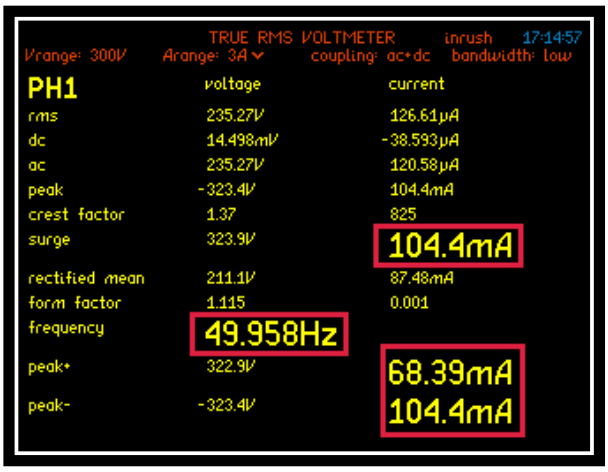


Fig 32

Zoomed parameters as in (Fig 32) can now be used to capture the Inrush Current (Surge) data within a Datalog

Configure Datalog application settings to allow all data to be captured on enabled parameters (Remember these will be displayed in the order they were selected)

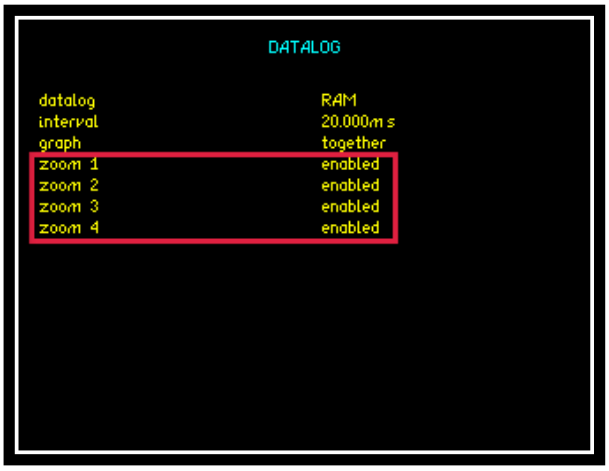


Fig 33

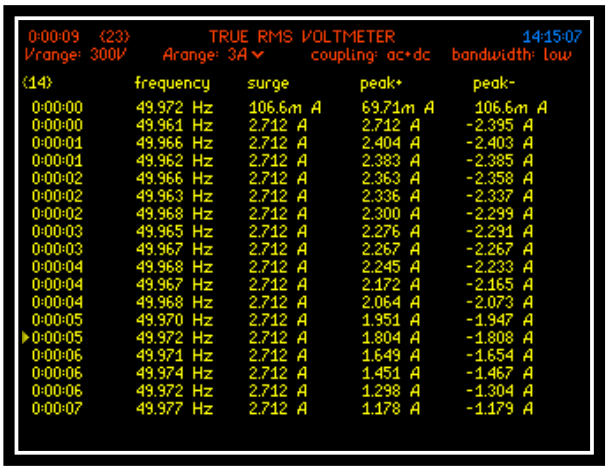


Fig 34

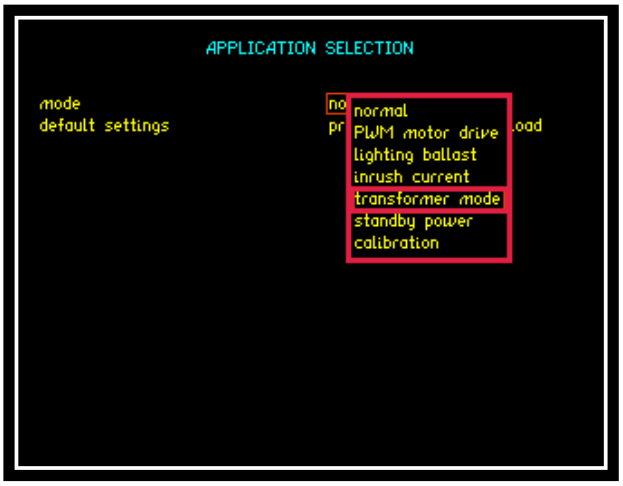
Datalog results from inrush test (Fig 34) show a peak inrush current of 2.712A immediately the PCIS is switched on

6.5.4 Transformer Mode

The Transformer mode in the PPA is ideal for both single phase and three phase transformer analysis, we will first describe general operation with a single phase device and then move on to describe three phase measurements.

Test device: 1 x Single Phase Transformer, ratio (1:1)

Accessories: 1 x Break out Box



Transformer Mode will allow the user to assess and view characteristics applicable to the transformer field under test conditions

To access transformer mode from the drop down menu, press the down arrow 4 times and press “ENTER” as seen in (Fig 35), transformer mode will now be selected

Fig 35

Press the down arrow 1 more time to highlight default settings mode and press “ENTER” this will set the instrument into its default settings for transformer mode (Fig 36)

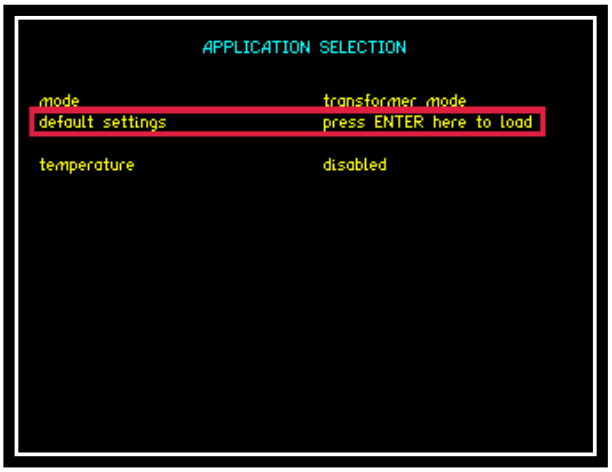


Fig 36

Pressing the “HOME” button twice will take you back to power analyzer home screen

You are now required to set the wiring configuration for the transformer.

Press “ACQU” button which will bring up the “ACQUISITION CONTROL” screen. Press the down arrow once so the red box flashes around the wiring selection; press the right arrow to open up the drop down menu as seen in (Fig 37)

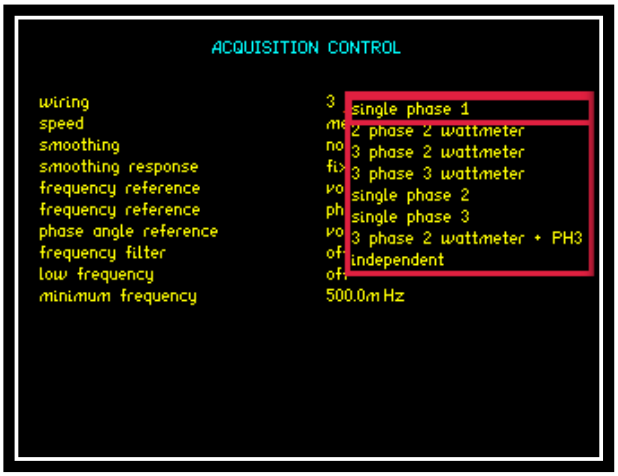


Fig 37

Use the up and down arrows to select which wiring configuration you require. For this manual, single phase 1 was selected to reflect the transformer being used as shown in (Fig 37). Press “ENTER” to confirm selection then “HOME” twice to return to the power analyzer home screen

The “Power Analyzer” home screen will now display the data measurements collected from your transformer under test

With the transformer plugged into a Break Out Box and no load attached, the following measurements are displayed (Fig 38)

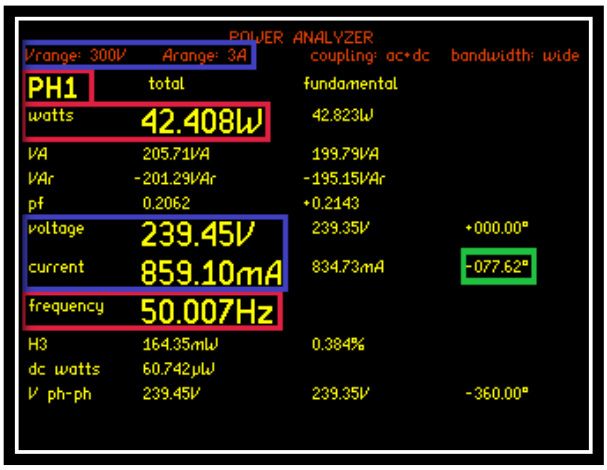


Fig 38

The Voltage and Current measurements displayed within the Blue Box in (Fig 38) reflect the auto ranging configured by selecting the default settings within the instruments application home set up screen (Fig 36)

Viewing the data (Fig 38) the phase angle of the fundamental is shown as 77.62º. A perfect transformer would display a phase angle of 90º. From this data we can confirm that there must be parasitic elements within the makeup of the transformer causing these results, such as a series resistance

Within the measurement screen the display shows that with “NO” load connected the transformer is consuming 42.4W of power at a Frequency of 50Hz. If you now press the “IMP” button you will enter the Impedance Meter screen, within this application mode you will be able to view all the individual data values collected that make up the total Impedance measurement attributed to the DUT. (Both real and imaginary)

In the next set of screen shots we will be able to view this data

Press “IMP” button to enter the Impedance Meter screen

Press “IMP” button again to enter Measurement Settings screen

Press ▼ button 2 times, red box surrounds parameter settings

Press ▶ button to open up the drop down menu (Fig 39)

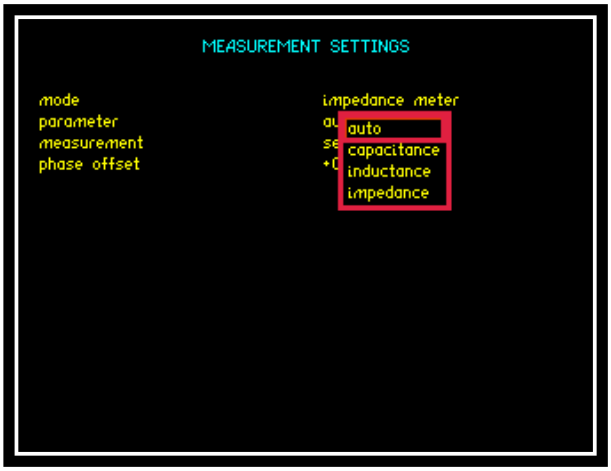


Fig 39

From the drop down menu you will now be able to view any parameters as shown in (Fig 39) or alternatively by selecting “auto” the display will show the appropriate parameters values attributed to the DUT

Press “ENTER” to confirm selection

Press “ENTER” to return to home screen and view measurements

From the “auto” screen (Fig 39) you can now see that we have a Resistive component affecting the purity of the transformer

From the Inductance and Resistance readings the instrument will calculate the total impedance of the transformer winding (Fig 40) at the selected frequency

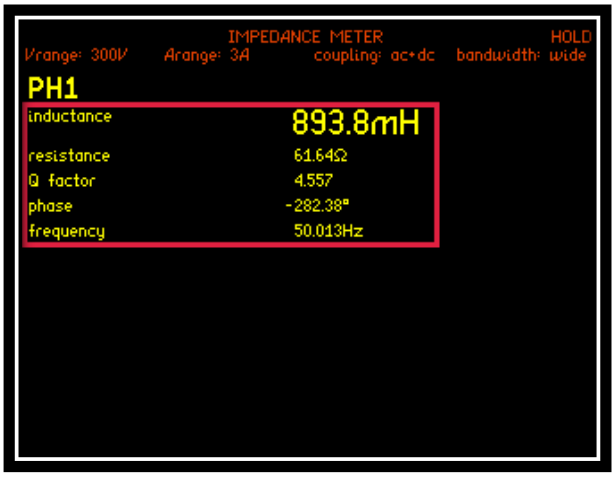


Fig 40

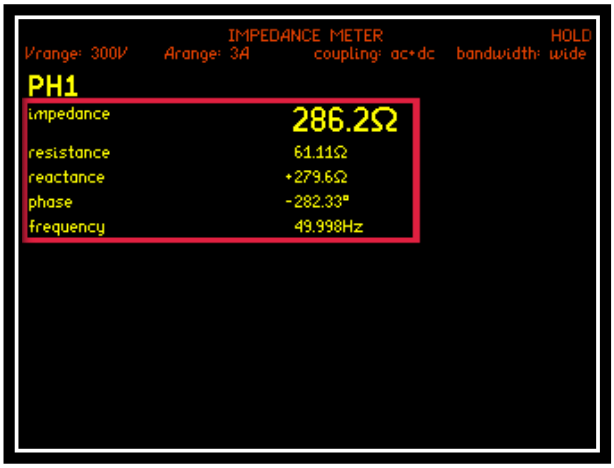


Fig 41

To view the total Impedance calculated you will need to change the display screen back from “Auto” to “Impedance” as shown in (Fig 41)

Transformer Mode (Three Phase)

When performing analysis of a 3 Phase load, transformer mode is extremely useful. The PPA will display phase balance information in an intuitive manner without the requirement for a vector display, this has the advantage of maintaining 5 digit resolution which is not possible whilst attempting to visually interpret phase balance on a conventional vector display.

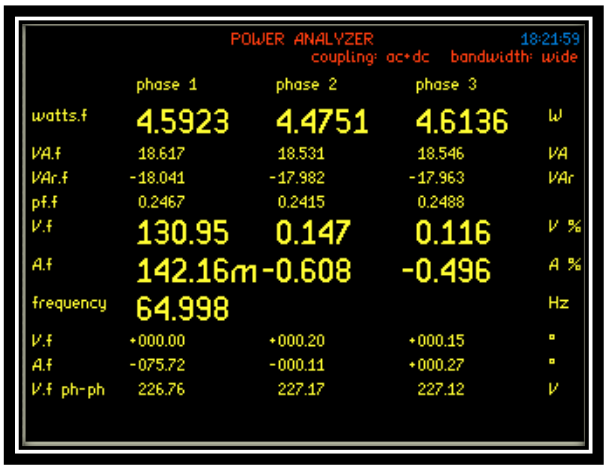


Fig 42

As illustrated in (Fig.42), the PPA is display 3 phase power simultaneously, along with this the Voltage % and Current % deviation from the phase 1 readings is displayed. The phase reference is taken from phase 1 Voltage and we can see that phase 2 and 3 are (120+0.2) deg and (240+0.15) deg respectively.

6.5.5 STANDBY POWER MODE

Power Standby mode will show all power measurements from a device which is in standby mode

To access standby mode: (Fig 43)

Press “APP” button

Press ▼ button

Press ▶ button. This will open the drop down menu selections

Press ▼ 5 times until red box surrounds standby power

Press “ENTER” this will now set the mode

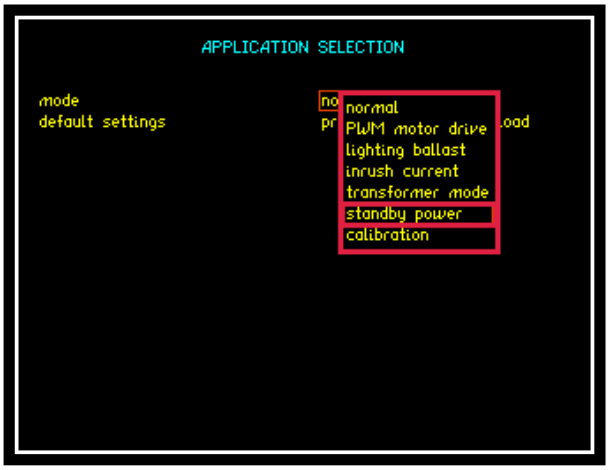


Fig 43

Press ▼ to move to default settings and press “ENTER”. The instrument will now set the voltage and current measurement parameters

Press ▼ to move the cursor to low frequency mode

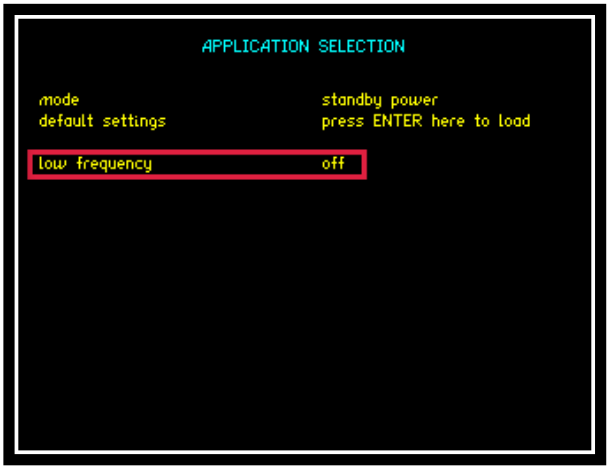


Fig 44

Pressing “ENTER” to load the applications default settings will automatically set the low frequency parameter to “OFF”

You can now return to the Power Analyzer screen

Test device: 1 x Stand alone Heater

Accessories: 1 x Break Out Box

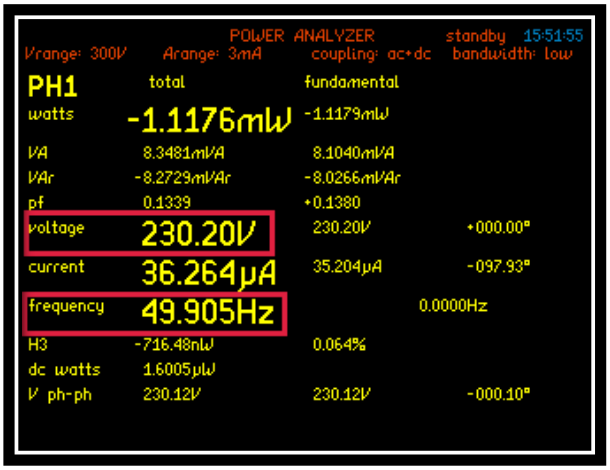


Fig 45

(Fig 45) shows a screenshot from the Power Analyzer home screen with the test device in standby mode

(Fig 46) screenshot is taken from the “RMS” screen here you can see all the subsequent voltage measurements from each phase associated with the test unit in Standby Mode

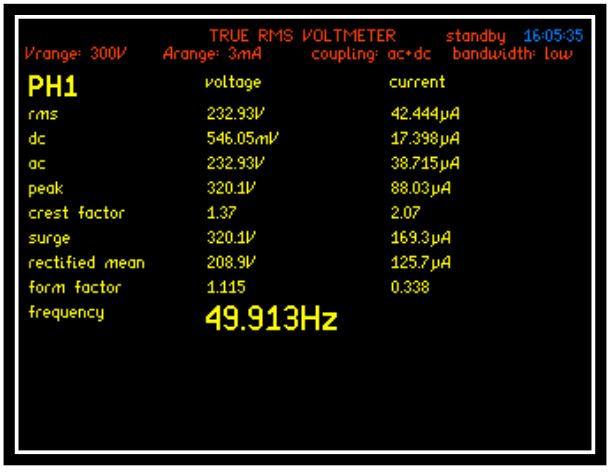


Fig 46

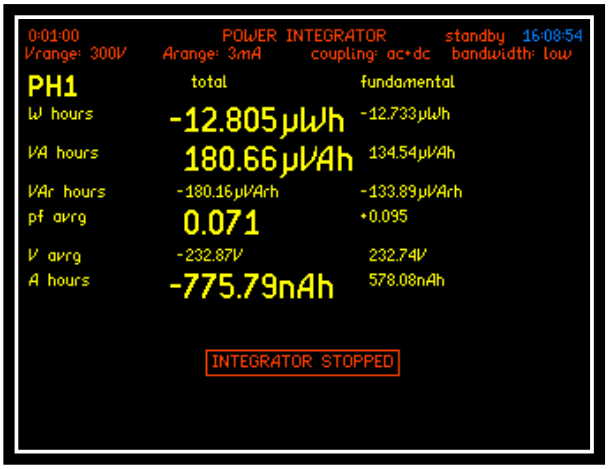


Fig 47

(Fig 47) is taken from the power integrator screen, displaying a 1 minute integration of the power being consumed

Press “SCOPE” button to view the Voltage and Current waveforms being produced by the device under test. (Fig 48)

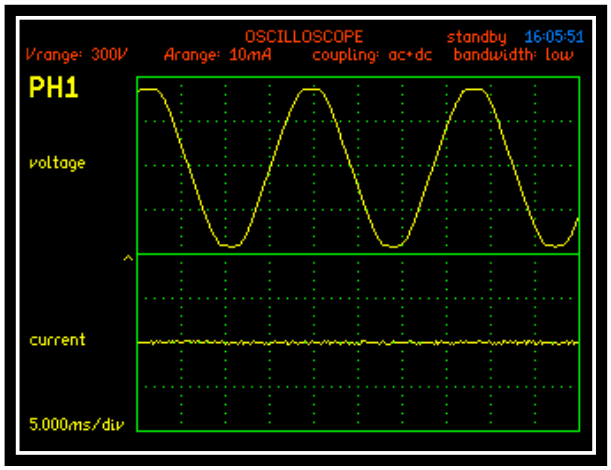


Fig 48

6.5.6 CALIBRATION MODE

Calibration Mode is to be used in combination with N4LCal (N4L Calibration software) which facilitates performing manual calibration with an external source. This software is supplied with a detailed manual describing the calibration process, for more information contact N4L on the following email;

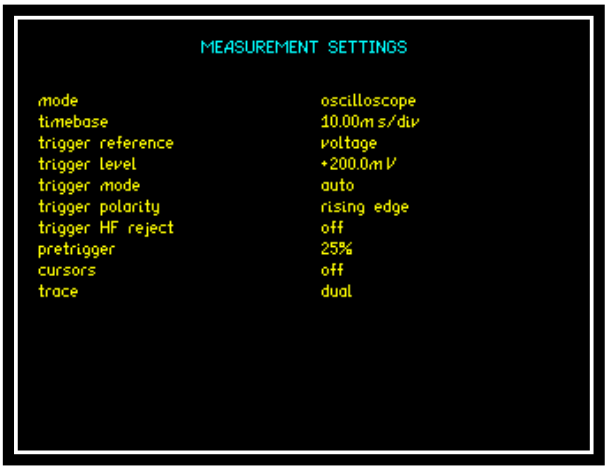
support@newtons4th.com

6.5.7 OSCILLOSCOPE MODE

The PPA45xx provides a digital storage oscilloscope function in order to view the waveforms being measured.

The settings for the oscilloscope are configured by pressing the “SCOPE” button twice

Upon entering the “SCOPE” menu, the following screenshot will be displayed



Timebase: The display for the oscilloscope is divided into 10 divisions along the time axis with the selected timebase displayed in the bottom left hand corner of the display. The timebase may be set to any real value between 15µs/div to 5s/div. Pressing the ◀ ▶ arrows on the main panel will adjust the timebase by a factor of 2

Trigger Reference: The data source for the trigger can be selected to be either Voltage or Current. On a multiphase instrument, any of the phases may be selected for the trigger source.

Trigger Level: The trigger level is set directly in Volts or Amps in relation to the trigger reference settings and does not change if the range is changed. The trigger level is displayed by a small > on the extreme left hand edge of the display. If the trigger is set to a value above or below the range of the input channel then a small carat ^ is shown at the top or inverted at the bottom of the display as appropriate

Trigger Mode: The trigger mode may be set to be;

Auto (trigger if possible but do not wait)

Normal (wait indefinitely for trigger)

Single shot (wait for trigger then hold)

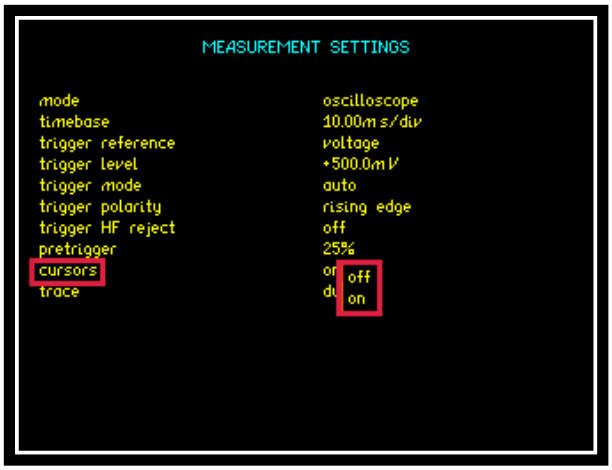
The single shot option is reset using the “TRIGGER” key

Trigger Polarity: The trigger polarity may be set to rising edge or falling edge

Trigger HF Reject: Select to be either “ON” or “OFF”. When set to “ON” a low pass filter is applied to the trigger data to stabilise the trace with noisy signals. The filter only influences the trigger detection and does not change the data displayed.

Pretrigger: The pretrigger may be set to none, 25%, 50% or 75**%** using the drop down menu

Cursors: Two cursors can be enabled on the display as per the screenshot below



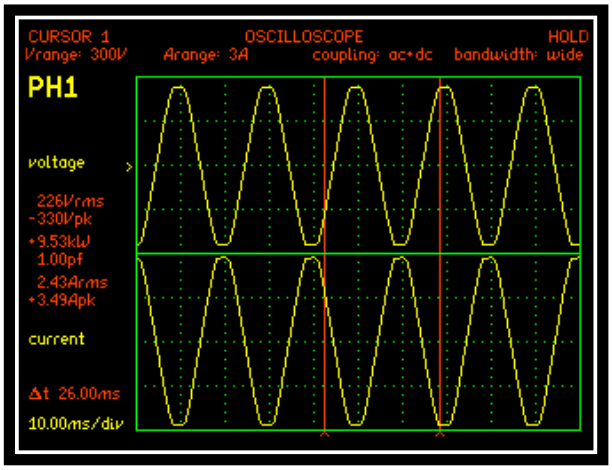
When enabled use the ▲▼ keys to enable and switch between Cursor 1 and Cursor 2.

Use the ▶◀ keys to move the selected cursor along the timescale

NOTE:

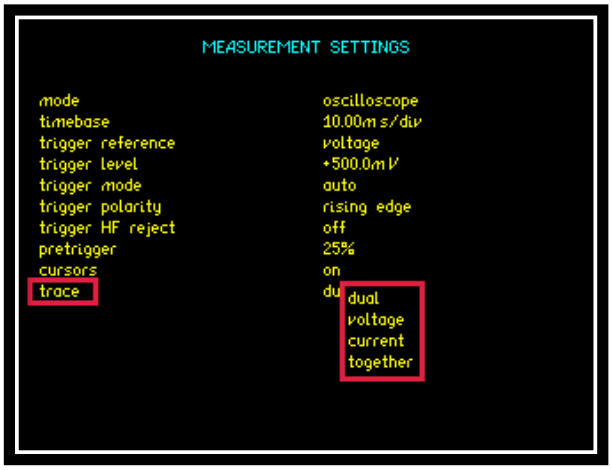
When the cursors are enabled then the “LEFT” and “RIGHT” arrows no longer adjust the timebase

Screenshot from Scope display with “Dual” cursors configured

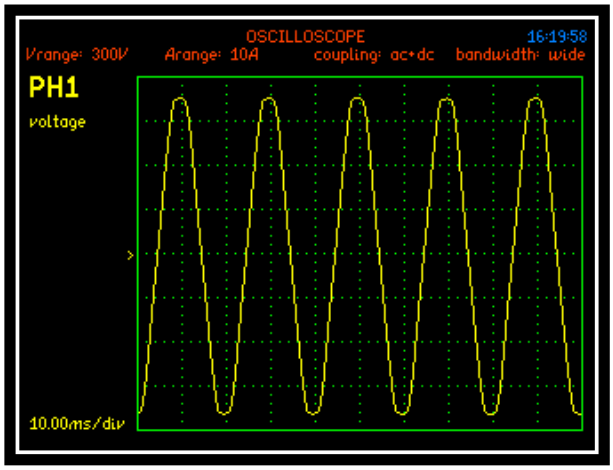


From the screenshot above the display shows all fundamental measurements from the position of cursor 1. Also displayed is the time difference between the 2 cursors, “delta t” = 26.00ms with the timebase set to 10ms/div

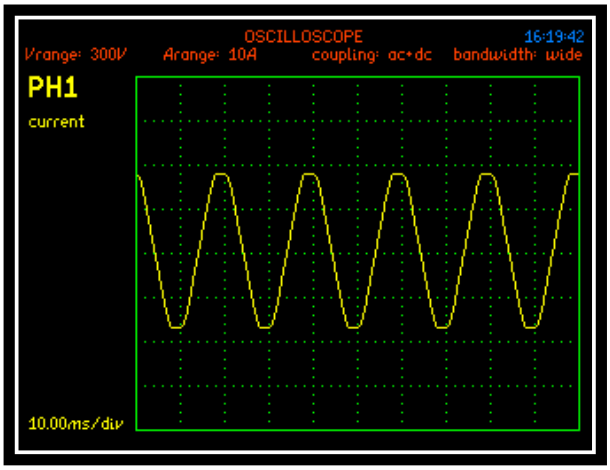
Trace: Set which waveform the user wishes to be displayed at any one time from the 4 options within the drop down menu



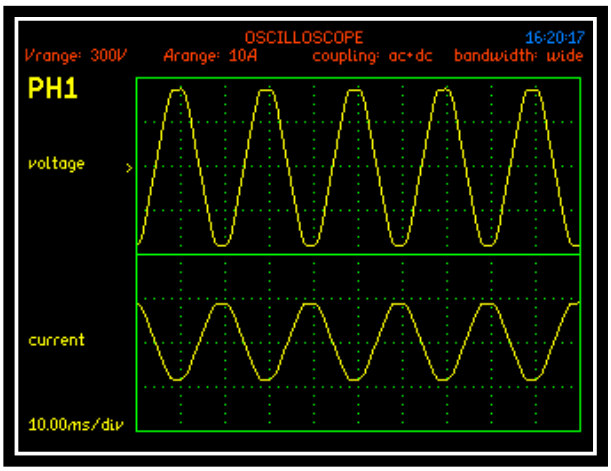
Trace set to Voltage:



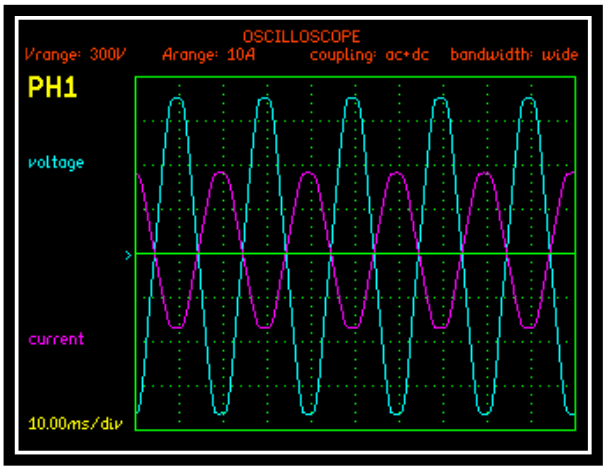
Trace set to Current:



Trace set to Dual:



Trace set to Together:



6.5.8 HF Current Shunts

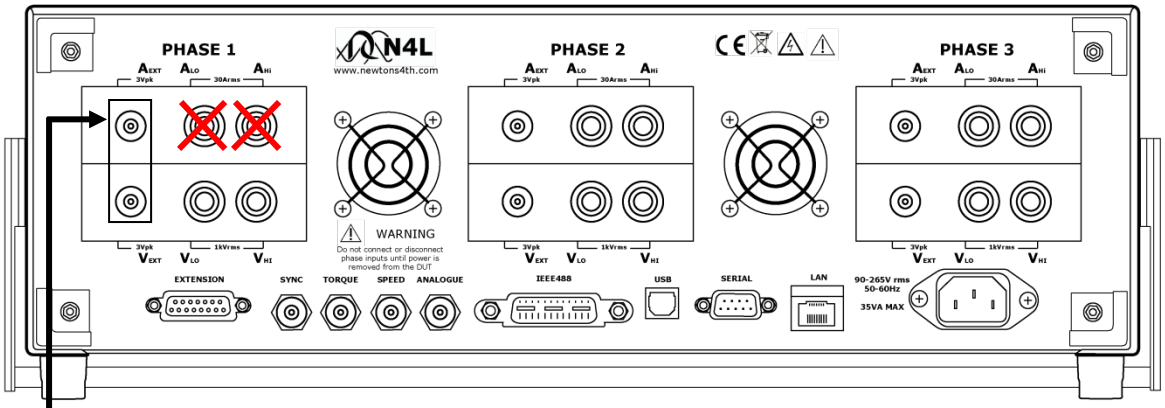
External current shunts can be used as an alternative to the instruments internal shunt as a fixed value Impedance circuit. **Note** do not use both shunts together

Test equipment for demonstration:

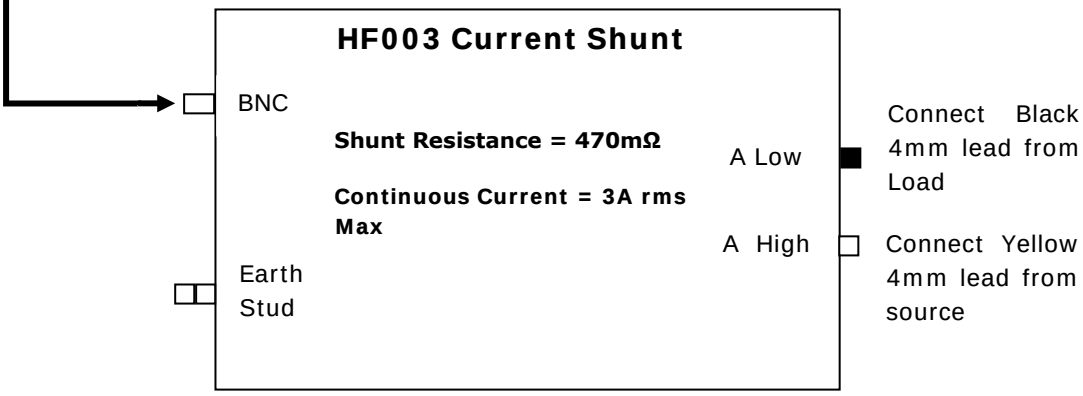
1 x Inverter/Motor test unit (single phase)

1 x HF 003 Current Shunt (shunt resistance = 470mΩ)

Wiring Configuration:



Connect BNC safety lead between the “A EXT” BNC on the rear of the PPA45xx and the BNC connector on the HF shunt



Remember disconnect all leads to appropriate channels internal current shunt

Set up PPA to read the external current shunt: (Fig 49)

Press “RANGE” button

Press ▼ arrow until black box surrounds the current input parameter

Press ▶ arrow and select “external shunt”

Press “ENTER”, external shunt will now be selected

Press ▼ arrow until black box surrounds the shunt parameter

Manually input the shunt resistance value

Press “ENTER”, external shunt value will now be selected

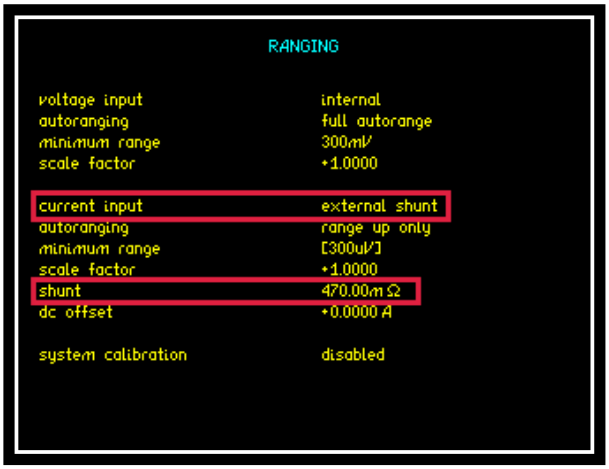


Fig 49

If connecting the external shunt to a different channel then use the ▶ arrow to select the correct channel configurations screen as prompted at the bottom of the “RANGE” home screen

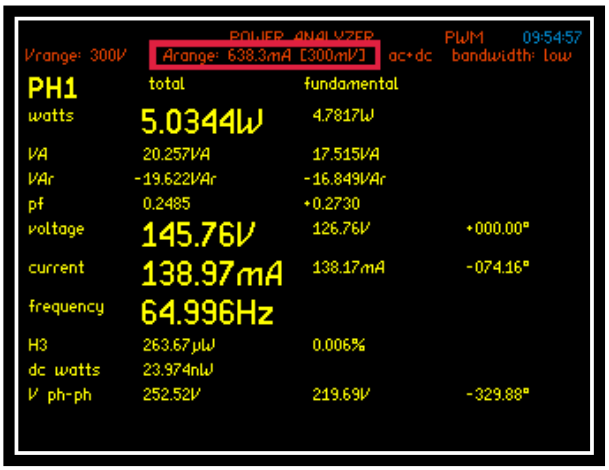


Fig 50

Now going back to the real time display screen (Fig 50) the range selected by the analyzer is the (300mV) range. This range is a peak range and the analyzer will convert this voltage to the equivalent current range, dependent upon the shunt value entered in the “RANGE” menu. In this case the shunt value is 470mΩ; therefore the analyzer will display 638.3mA for the 300mV range

$$I = \frac{300mV}{470m\Omega}$$

As the instrument ranges up and down the Arange value will change respectively

Rogowski Coil

Set the range value of the PPA45xx to the selected channel the Rogowski Coil is connected to, input the correct shunt value corresponding to the switch value on the Rogowski Transducer, within (Fig 51) the shunt value is set to 2mΩ to reflect the switch position being set to 1KA (2mV per A) and a scale factor of 1:1

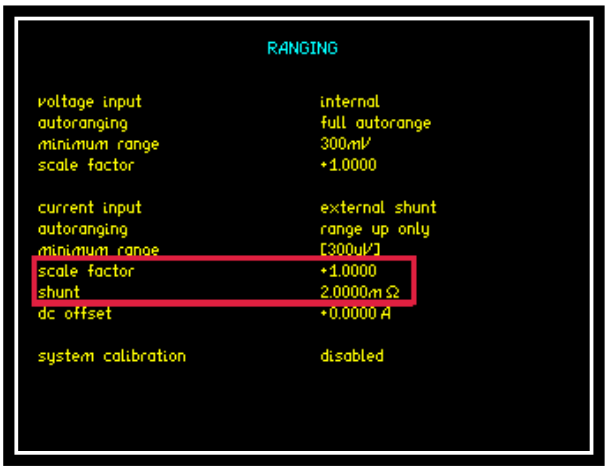
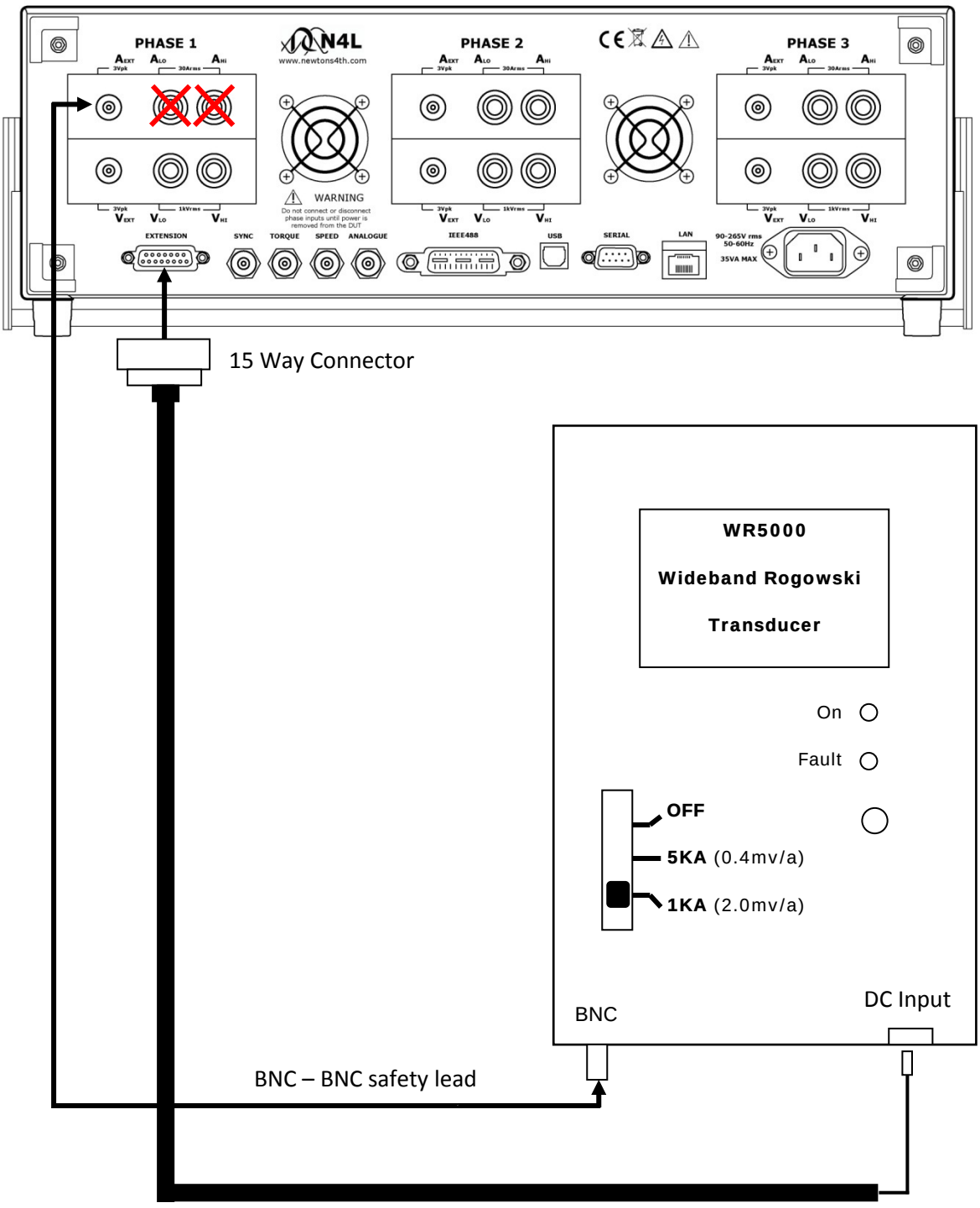


Fig 51

We set 2mΩ as a 2mΩ shunt would also produce the same 2mV/A

Connection should be made as per the following diagrams

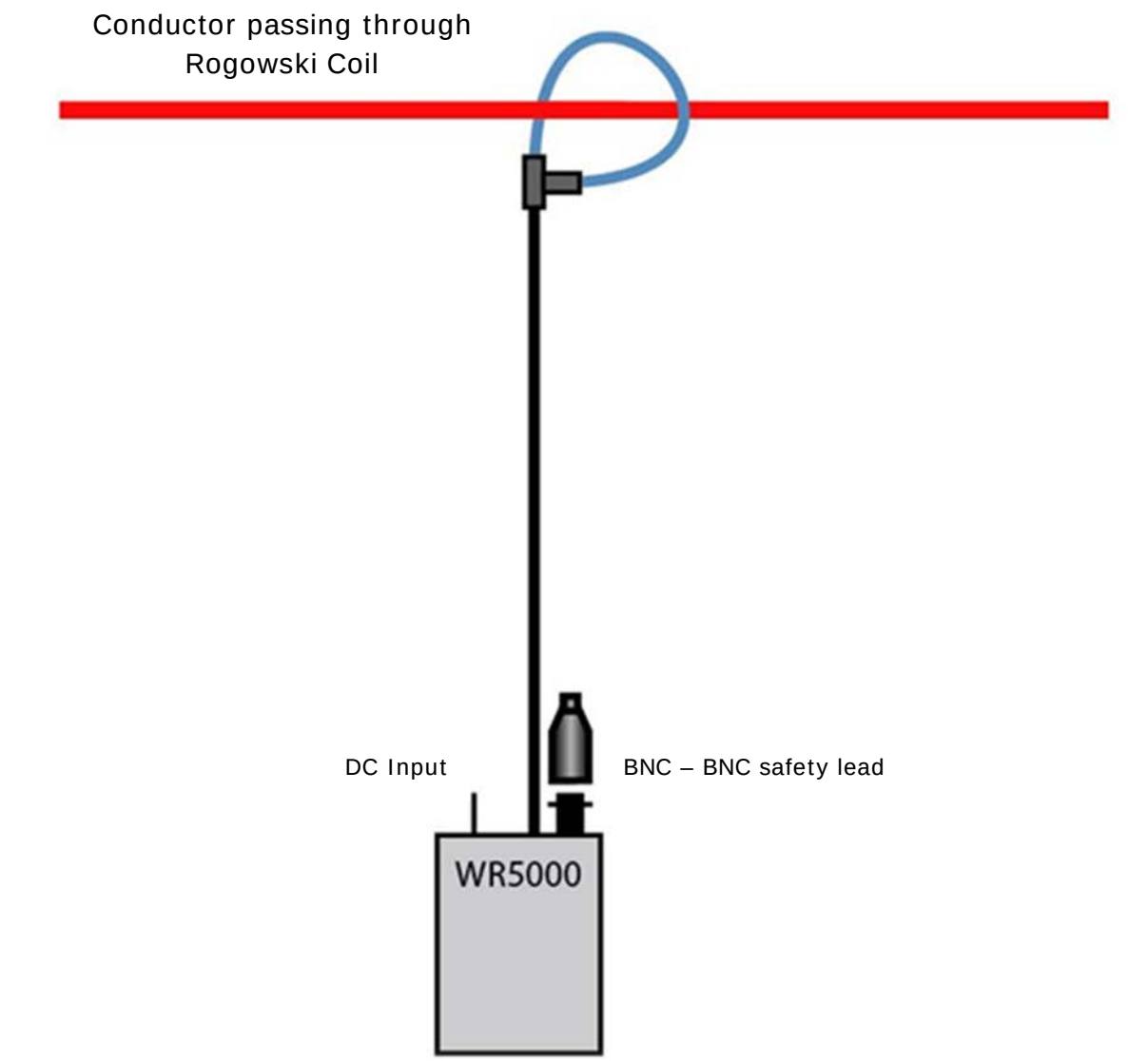


WARNING: Remember to connect either the Internal or External shunt only to the PPA45xx

Connect up the Rogowski Coil as shown, wrap the clear plastic tube around the conductor and slot into the “T”piece connector, tighten the connector nut to secure the lead into position

A single coil wrapped around the conductor will result in voltage measurement equal to the 2mV/A detail on the WR5000 as set on previous page

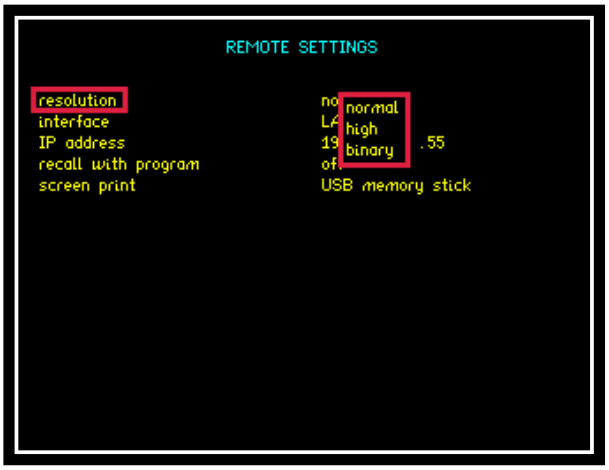
If the coil is double wrapped around the conductor then the voltage value will double accordingly



7 Remote Settings

The Remote Settings menu provides an interface for the user to set the method of connection and the ability to configure the ports as required

Resolution



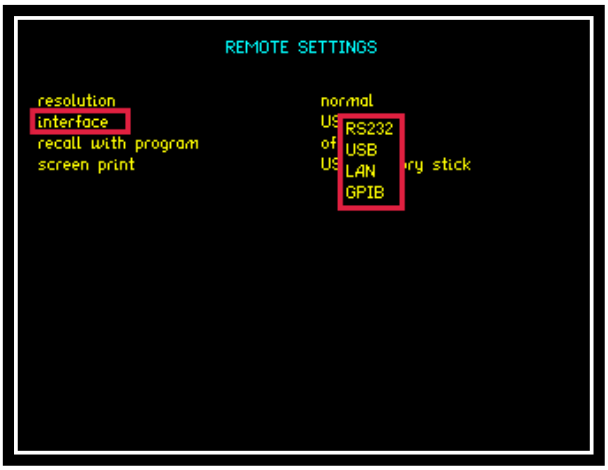
The default resolution setting for the PPA45xx is “Normal” this will set the Data Resolution to 5 decimal points plus any exponent eg: +1.2345+E00

Selecting “High” will set the Data Resolution to 6 decimal points plus any exponent eg: +1.23456+E00

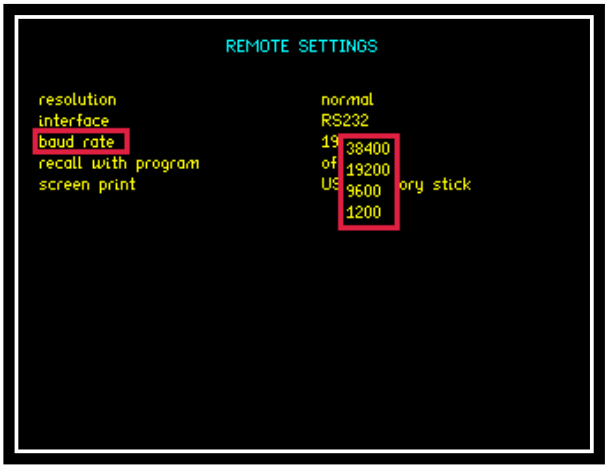
For higher speed transfer a proprietary binary format can be selected which compresses the data into 4 bytes

Interface

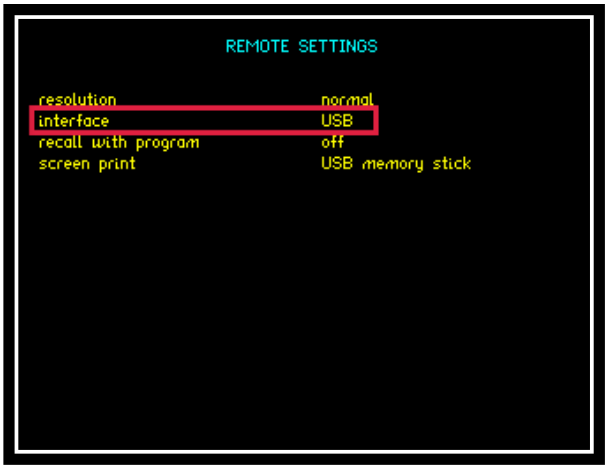
The PPA45xx is fitted as standard with an RS232 serial communications port and USB interface for communication purposes between the instrument and PC. (LAN and IEEE488 (GPIB) Interfaces are optional extras on the PPA45xx)



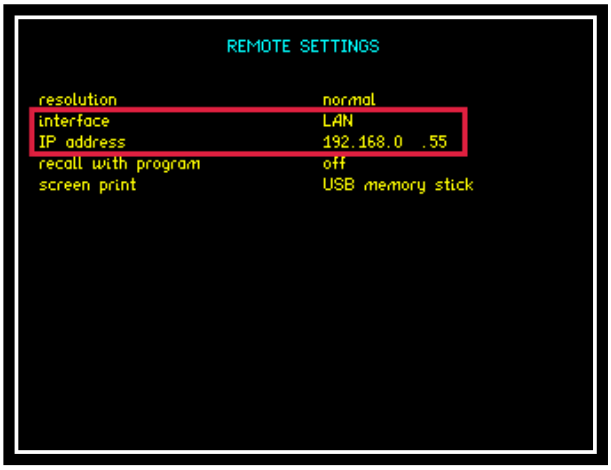
Selection is made via the interface parameter within the remote settings



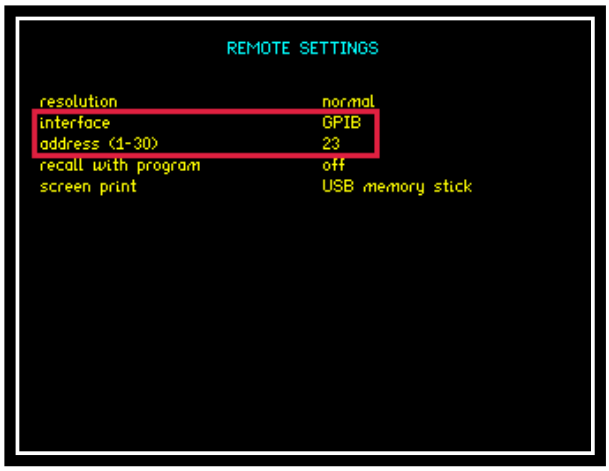
Selecting RS232 will then open up the "Baud Rate" option. Select an applicable data speed rate from the 4 options given in the drop down menu (Default Setting is 19200)



To use a USB lead to connect, set the interface parameter to read "USB"

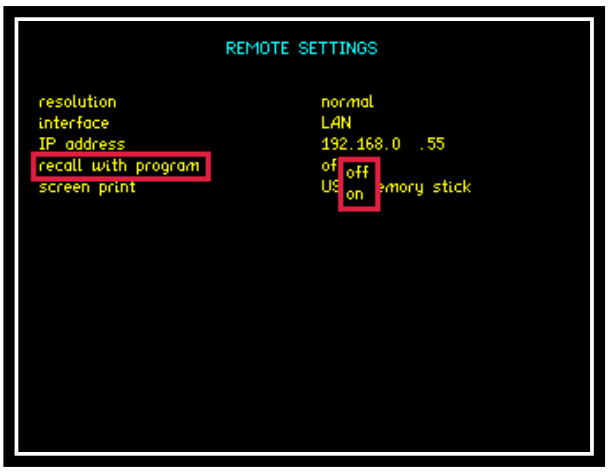


Configuring the interface to LAN will then display the IP address applicable to your instrument. This address will be required upon connection to any software to enable correct connection to the instrument; this is changed using the numerical keypad



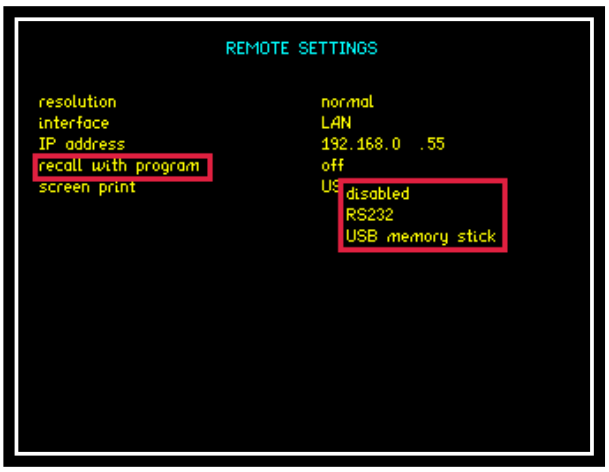
Configuring the instruments interface to GPIB will automatically set the IEEE address to 23 this can be changed within the address parameter in the range 0 to 30 (31 total possible addresses available)

Recall with Program



The recall with program parameter will allow any pre set Comms configuration to be recalled if saved along with a nominated program within the “PROG” settings. To recall a Comms configuration set the recall option to “ON” then recall the appropriate program (Remember to set this first before recalling your saved program)

Screen Print

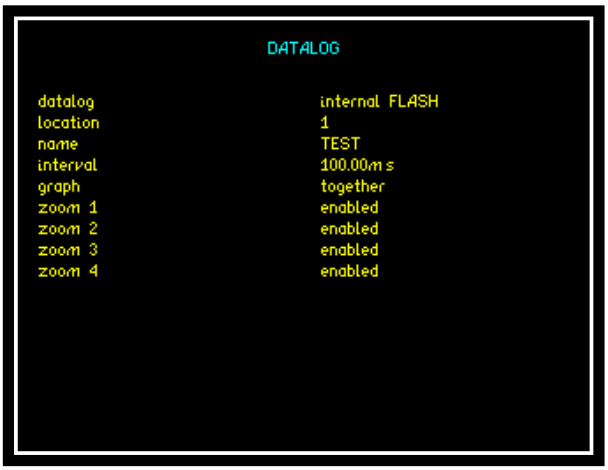


The Screen Print option will allow any screen display on the PPA45xx to be copied either to an RS232 printer or USB memory stick. Select the appropriate transfer method required or alternatively this parameter can be disabled

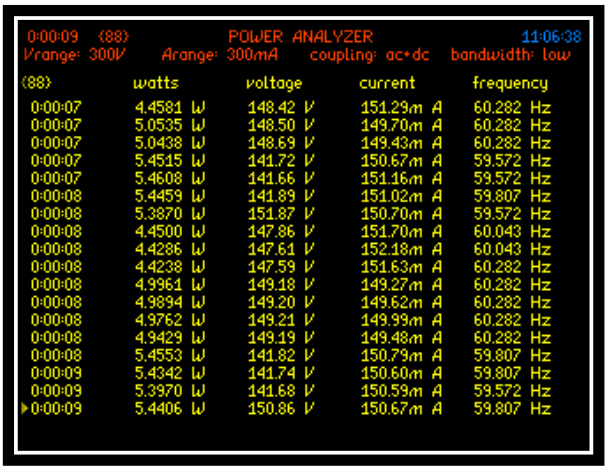
7.1 Transferring Internal Datalogs to USB memory stick

The following section explains the procedure for storing a datalog to internal memory and exporting the data to a USB memory Stick

1. Setup Datalog (DATALOG MENU)



2. Press START to commence Datalog



3. Store Datalog to Internal memory

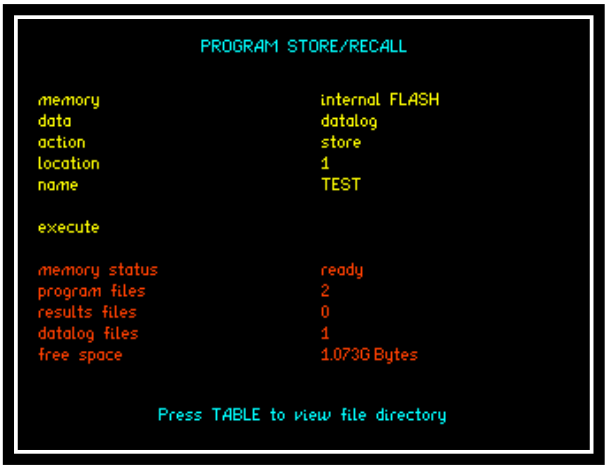
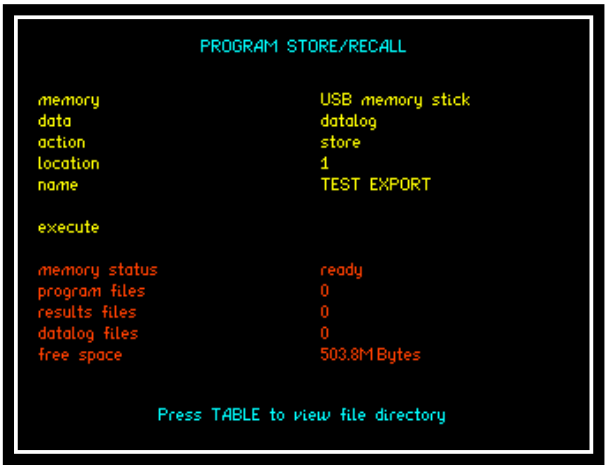
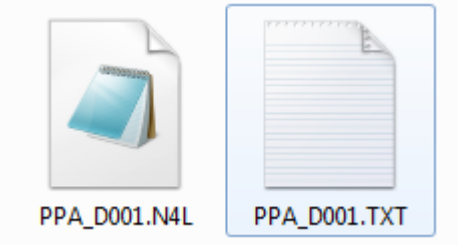


Fig 52

4. Store Datalog to External USB Memory Stick



5. Locate file on memory stick, the file format will have a .txt extension



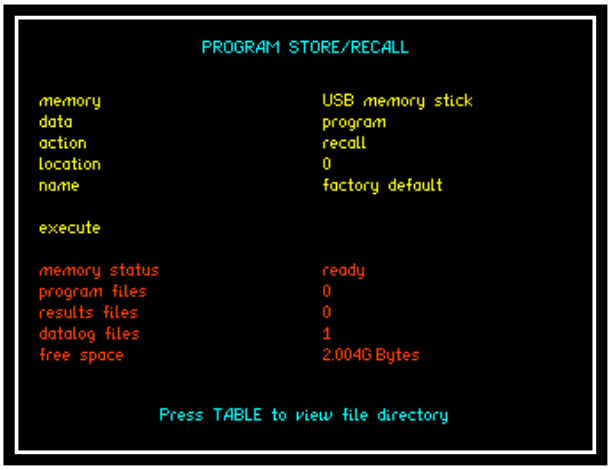
D001 represents “location 1” as specified in (Fig 52) above.

6. NOTE: Data presented within the .txt file for time will be displayed as a fraction of an hour, to convert this data back into real time the user will need to multiply the data by 3600 (seconds within an hour)

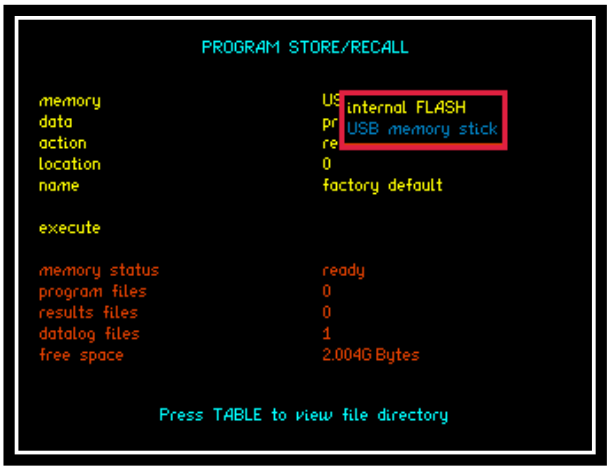
7.2 Program Store / Recall / Delete

The following section explains the procedure for storing / recalling or deleting a program to or from the instruments internal memory or USB memory Stick

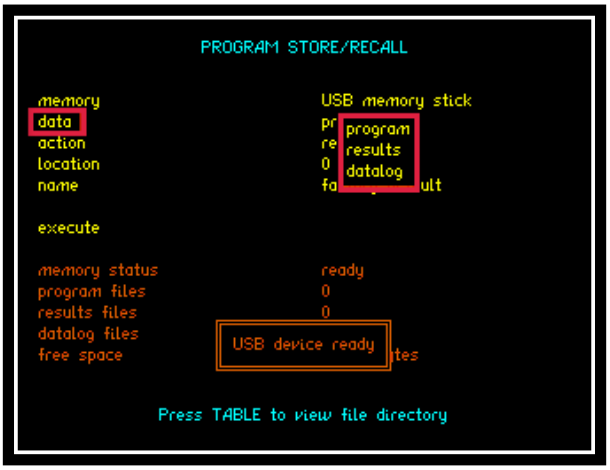
1. Press “PROG” button to open up program store / recall mode



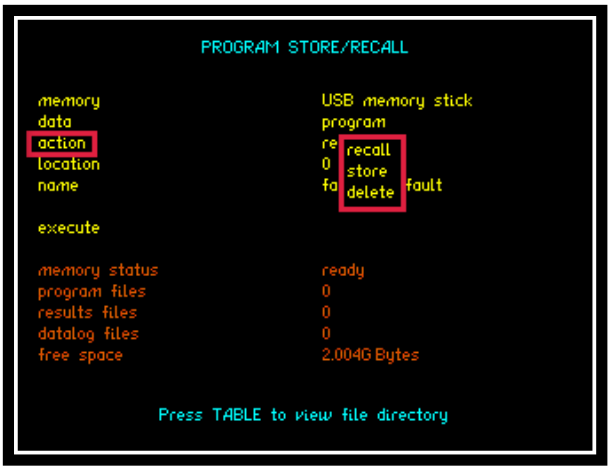
2. Select memory type to be used for action from the dropdown menu



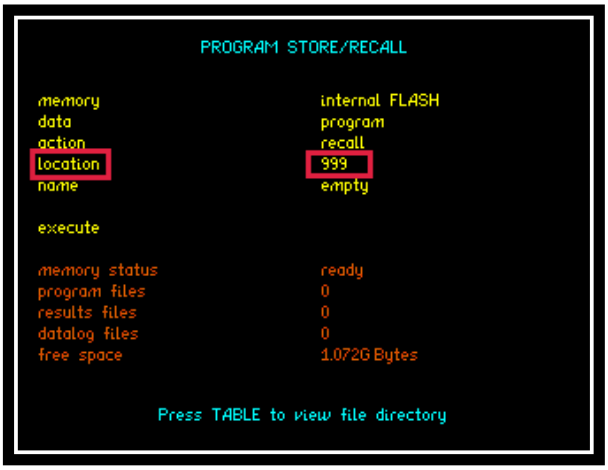
3. Select which data type you require to be actioned from the list shown



4. Select the action to be taken in association with the data selected



5. Select the location that the associated action is to be recalled from, stored to or deleted from, there are 999 locations available

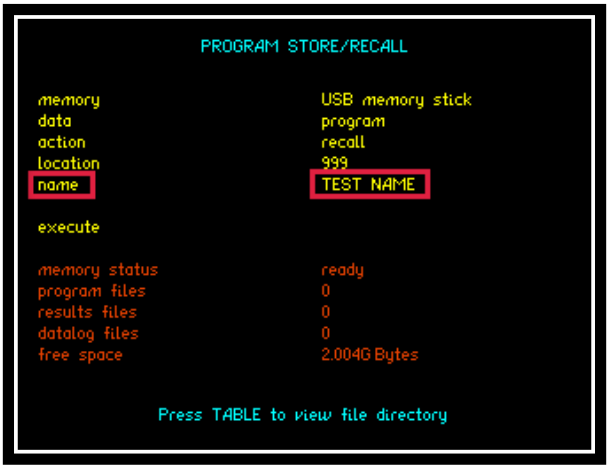


NOTE:

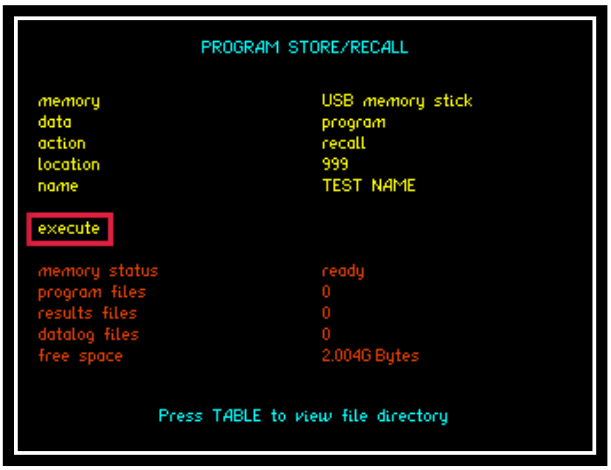
Location 0 = FACTORY DEFAULT and cannot be changed

Location 1 = Upon start up should any program be stored within program 1 then the PPA will automatically recall this program

6. Enter a name within this parameter to aid the user in relation to storing / recalling a program to / from memory for future reference. To enter a name use the Alpha / Numerical keypad on the instruments front panel



7. Upon implementing any of the above actions then remember to scroll down to “EXECUTE” and press “ENTER” to validate your selection / action



8 Repair / Recalibration

In the event of any problem with the instrument, during or outside of the guarantee period, contact your local representative

Newtons4th Ltd offer a full repair and re-calibration service

It is recommended that the instrument be re-calibrated annually

Contact details:

1. Newtons4th Ltd

30 Loughborough Road
Mountsorrel
Loughborough
LE12 7AT
United Kingdom

Tel: (0116) 230 1066 International: +44 116 230 1066
Fax: (0116) 230 1061 International: +44 116 230 1061

E-mail address: sales@newtons4th.com
office@newtons4th.com

Web site: www.newtons4th.com

We have a policy of continuous product improvement and are always keen to hear comments, whether favourable or unfavourable from users of our products. Please telephone, fax, write or e-mail with your comments

8.1

PPA45xx / PPA55xx.

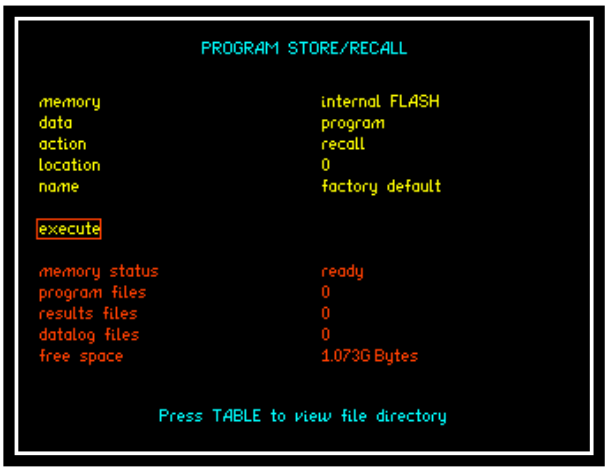
GUIDE FOR TESTING THE BASIC FUNCTIONALITY OF THE INSTRUMENT.

This document provides instructions on how to test the basic functionality of your Precision Power Analyzer in order to ensure it has a basic level of functionality; this should be used as a pre cursor to any further fault investigations. Details are provided of the instrument setup, the required connections between the PPA and other basic test equipment commonly available in a laboratory. Furthermore, screen shots of the expected results are displayed on the PPA.

Testing of the external inputs of the PPA is performed by monitoring the output of a signal generator. To test the internal inputs of the PPA a breakout box with a load connected is used, the PPA monitoring the AC mains supply with the current shunts in series with the load and the voltage attenuators in parallel.

RESETTING THE PPA TO FACTORY DEFAULT MODE.

This will clear any user defined programs that might be stored in the PPA and recalled when the instrument is switched on. Program 1 is recalled when the PPA is restarted.....



To access Program Store / Recall mode:

Press “PROG” button

Press ▼ Key until

Red Box surrounds the number adjacent to “Location”

Enter “0”

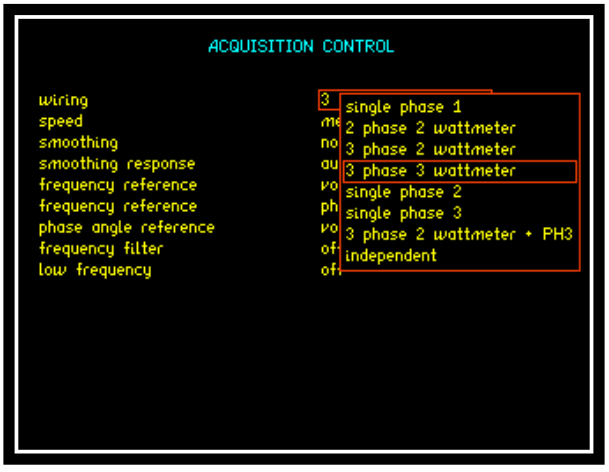
Press ▼ Key until

Red Box surrounds “Execute”

Press “ENTER” - This will now reset the instrument to factory default mode.

Setting up PPA5530 for external BNC functionality Check.

Acquisition control.



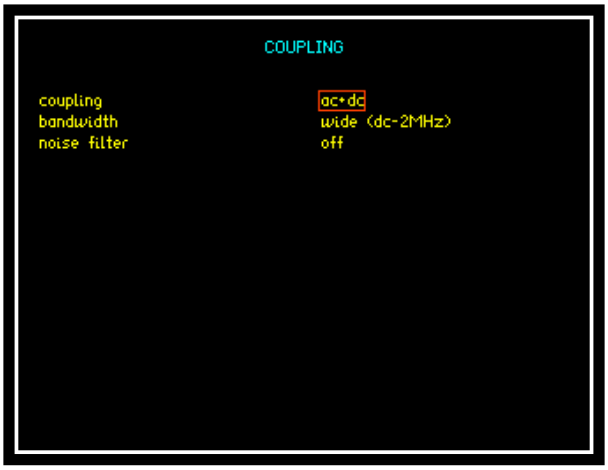
Press “ACQU” button

Press ▼ Key until

Red Box surrounds the “Wiring” options

Use the ▲▼ buttons to select “3 phase 3 wattmeter” from the list.

Coupling.

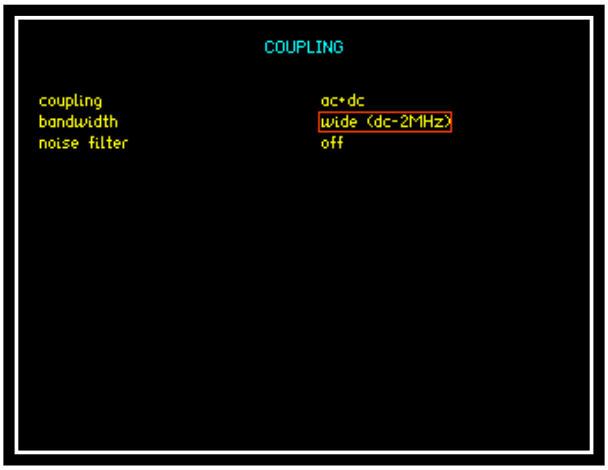


Press “COUPLING” button

Press ▼ Key until

Red Box surrounds the “Coupling” options

Use the ▲▼ buttons to select “ac+dc” from the drop down list.

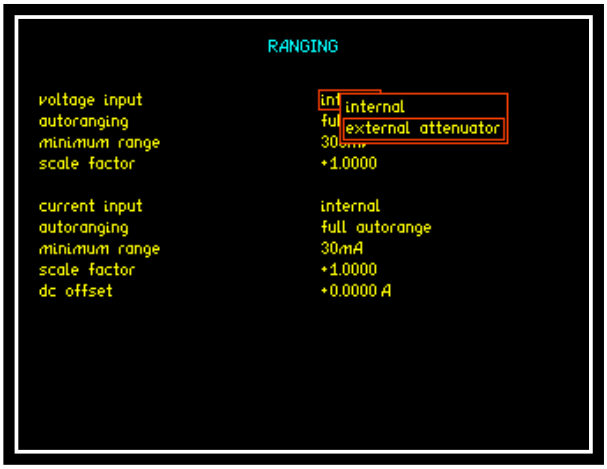


Press ▼ Key until

Red Box surrounds the “Bandwidth” options

Use the ▲▼ buttons to select “wide (dc-2MHz)” from the list.

Ranging.

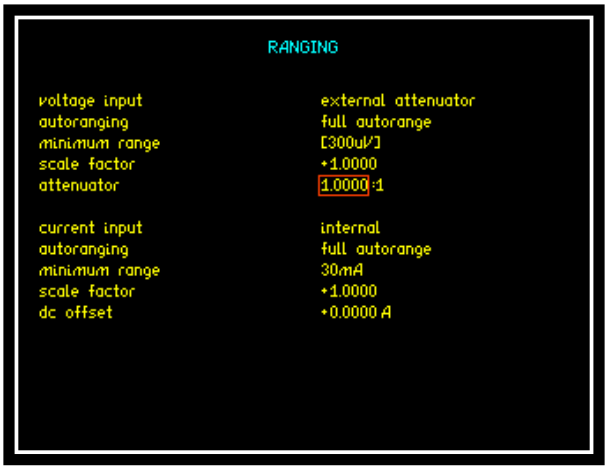


Press “RANGE” button

Press ▼ Key until

Red Box surrounds the “Voltage input” options

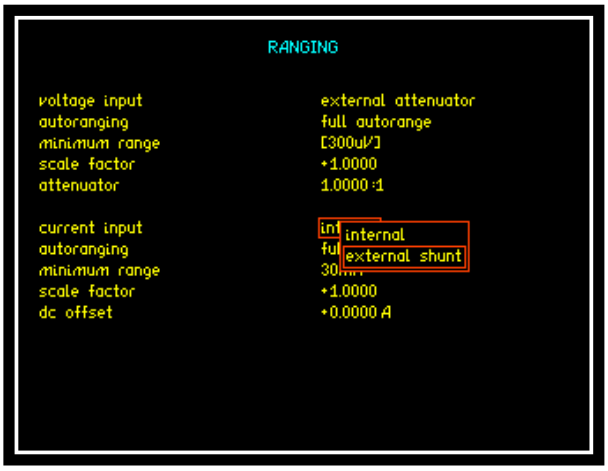
Use the ▲▼ buttons to select “external attenuator” from the list.



Press ▼ Key until

Red Box surrounds the “attenuator” options

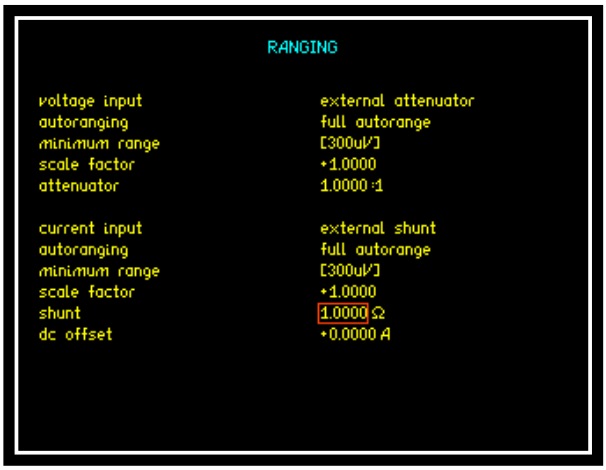
Type in an attenuator setting of 1.0000:1



Press ▼ Key until

Red Box surrounds the “Current input” options

Use the ▲▼ buttons to select “external shunt” from the list.



Press ▼ Key until

Red Box surrounds the “shunt” options

Type in a shunt value of 1.0000Ω.

Connecting up the PPA to a signal Generator

A signal generator is required to provide a 1.41V PK (1.00Vrms) 50Hz sine wave, if the signal generator expects a 50Ohm load impedance then an output voltage of 0.707V (0.5Vrms) should be used. This signal is used for checking the integrity of the external voltage and external current inputs; these are 3Vpk Max Isolated Differential Voltage inputs.

The PPA is connected to the signal as shown in the drawing. The various modes on the instrument can then be selected. The following section provides screenshots of the PPA display for each of these modes.

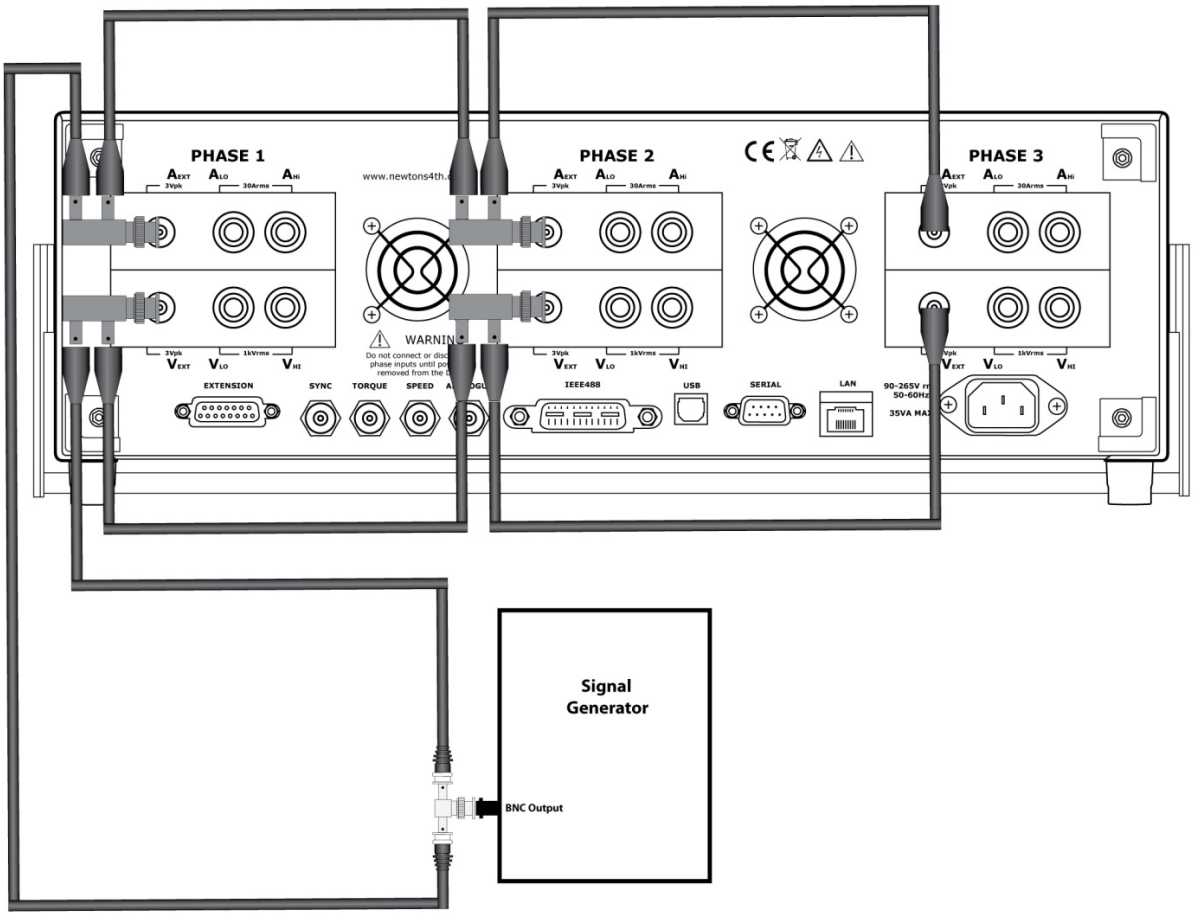
To make the connections shown in the diagram you will need the following accessories that are not supplied with the PPA.

4 x BNC cables for connections on the rear of the PPA.

2 x BNC cables to connect between the PPA and the signal generator.

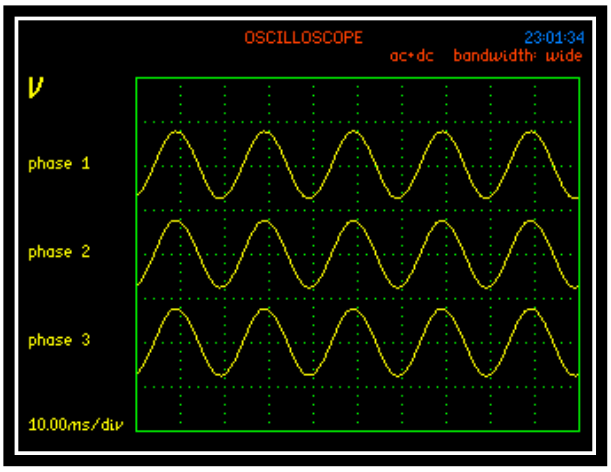
5 x BNC “T” piece connectors.

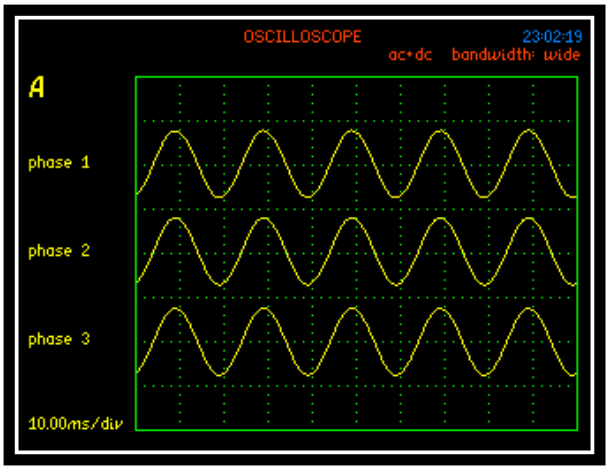
Connection diagram for the functionality checks of the External BNC inputs.



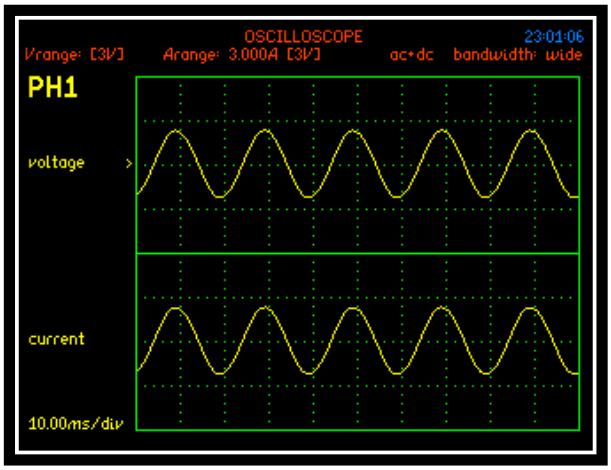
Screenshots of PPA Display when making "external" measurements.

Oscilloscope Mode

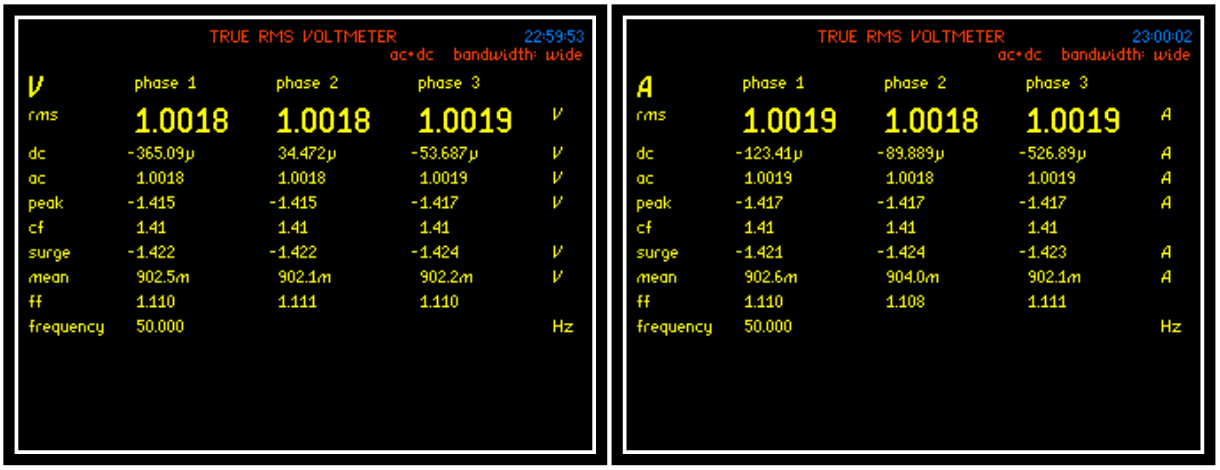




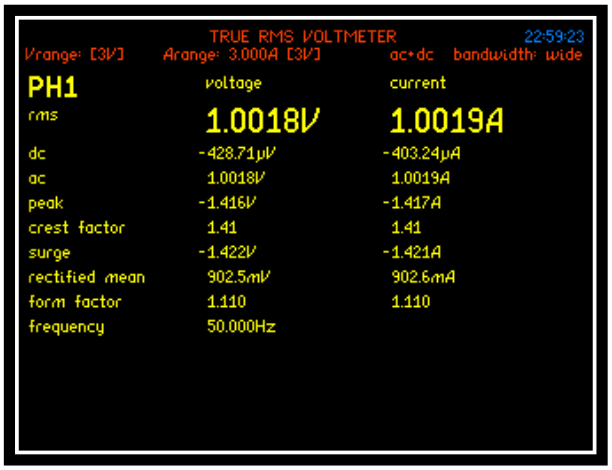
The above screenshots of the scope mode display current and voltage for all 3 phase inputs. Use the ENTER/NEXT button to scroll through the various oscilloscope displays. The screenshot below shows current and voltage for phase 1 only. Comparisons can be made of current and voltage on all 3 phase inputs. We should see zero phase shift and equal magnitude on both traces.



True RMS Voltmeter Mode

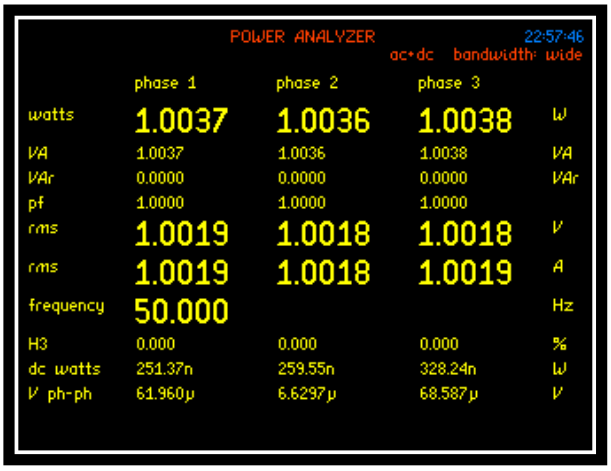


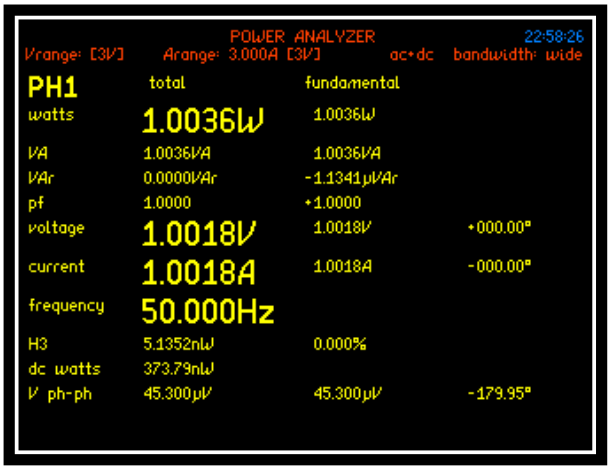
These screenshots are of the instrument in True RMS Voltmeter mode. The one on the left is displaying the voltage results for all 3 phases whilst the one on the right is displaying current for all 3 phase inputs. These allow comparisons of current and voltage readings between the 3 phases. It is also possible to check that the instrument has detected the correct frequency.



In this screenshot we are looking at just one phase, in this example phase 1. The instrument is displaying both the voltage and current readings for the one phase only. It is also possible to scroll through the various true RMS voltmeter displays to view similar results for phases 2 or 3.

Power Analyzer Mode

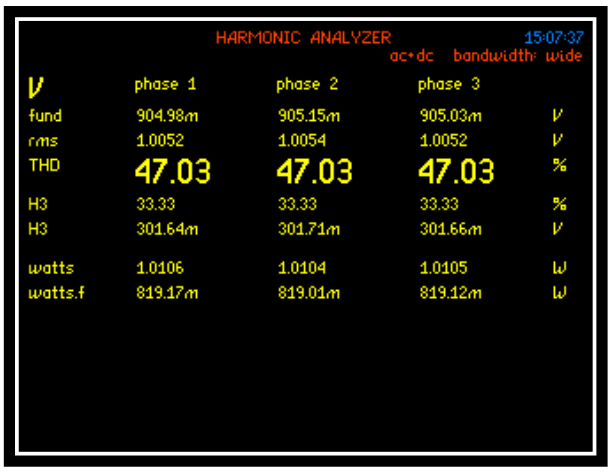




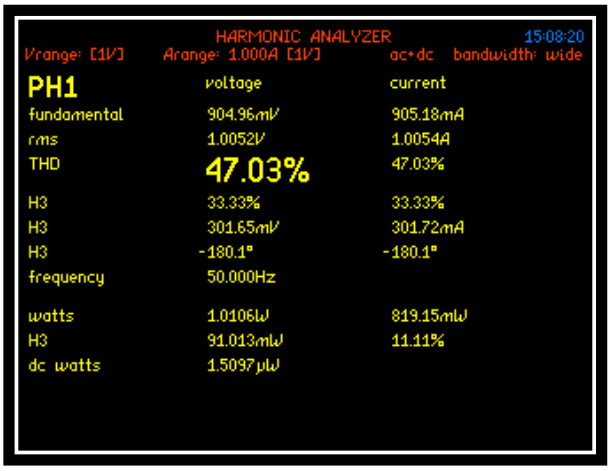
The above screenshots are of the instrument in Power Analyzer mode. The screenshot on the left is displaying the results for all 3 phase inputs. The screenshot on the right is the results for phase 1 only. Comparison of current, power and voltage can be made on all 3 phases and it is also possible to check that the instrument has detected the correct frequency.

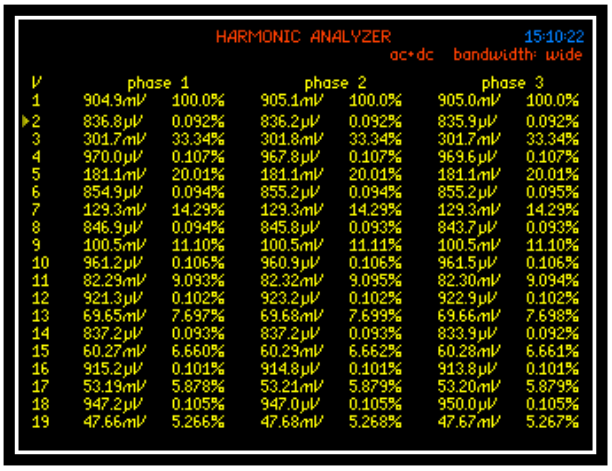
Harmonic Analyzer Mode

The signal generator is adjusted to provide a 1.00V PK, 50Hz square wave to check the frequency detection function of the PPA. Harmonic Analyzer mode is utilised and correct harmonic magnitudes are displayed providing the fundamental frequency of the waveform is correctly detected.



These screenshots show the instrument in Harmonic Analyzer mode with a square wave input. Comparisons can be made of Current, Power, Voltage and Total Harmonic Distortion on all 3 phases. When looking at a single channel it is also possible to check the frequency of the signal. The final screenshot shows that it is also possible to look at the harmonics in table form so that it is possible to look at all of the individual harmonics at once. This example was for the voltage harmonics but it is also possible to get the same table format for current harmonics.





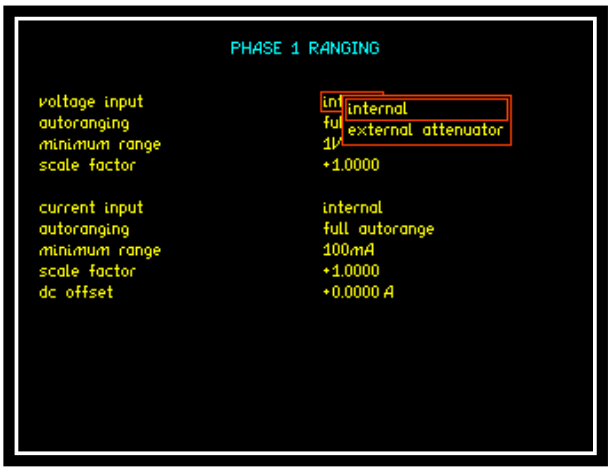
We have used a square wave as the harmonics of this waveform are well known, it is advisable to compare the harmonic values in the displayed table and ensure they are nominally the same as the table below;

Harmonic Content of a Square Wave

Harmonic Number	Frequency	Relative Magnitude
Fundamental	50 Hz	100 %
3rd harmonic	150 Hz	33 %
5th harmonic	250 Hz	20 %
7th harmonic	350 Hz	14 %
9th harmonic	450 Hz	11 %

Setting up PPA for “internal” measurements.

The set up procedure for internal measurements is very similar to that above for external measurements. The only difference is in the configuration of the Ranging settings. Ranging should be set up as follows:

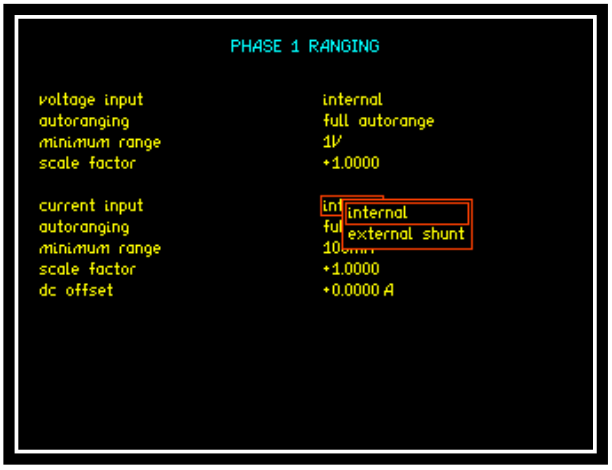


Press “RANGE” button

Press ▼ Key until

Red Box surrounds the “Voltage input” options

Use the ▲▼ buttons to select “internal” from the list.



Press ▼ Key until

Red Box surrounds the “Current input” options

Use the ▲▼ buttons to select “Internal” from the list.

Connecting up the PPA for “internal” measurements.

The breakout box is connected to a mains supply. A load is connected to the breakout box to produce a current for the PPA to monitor. The PPA is used to monitor the voltage and current on the connections of the breakout box. The same voltage and current levels are applied to the 3 phase inputs of the PPA. Therefore the display should indicate the nominally same values for all 3 phases. For the tests in this document a 230V 50Hz mains supply was used, the load used was sinking a current of 3.00A.

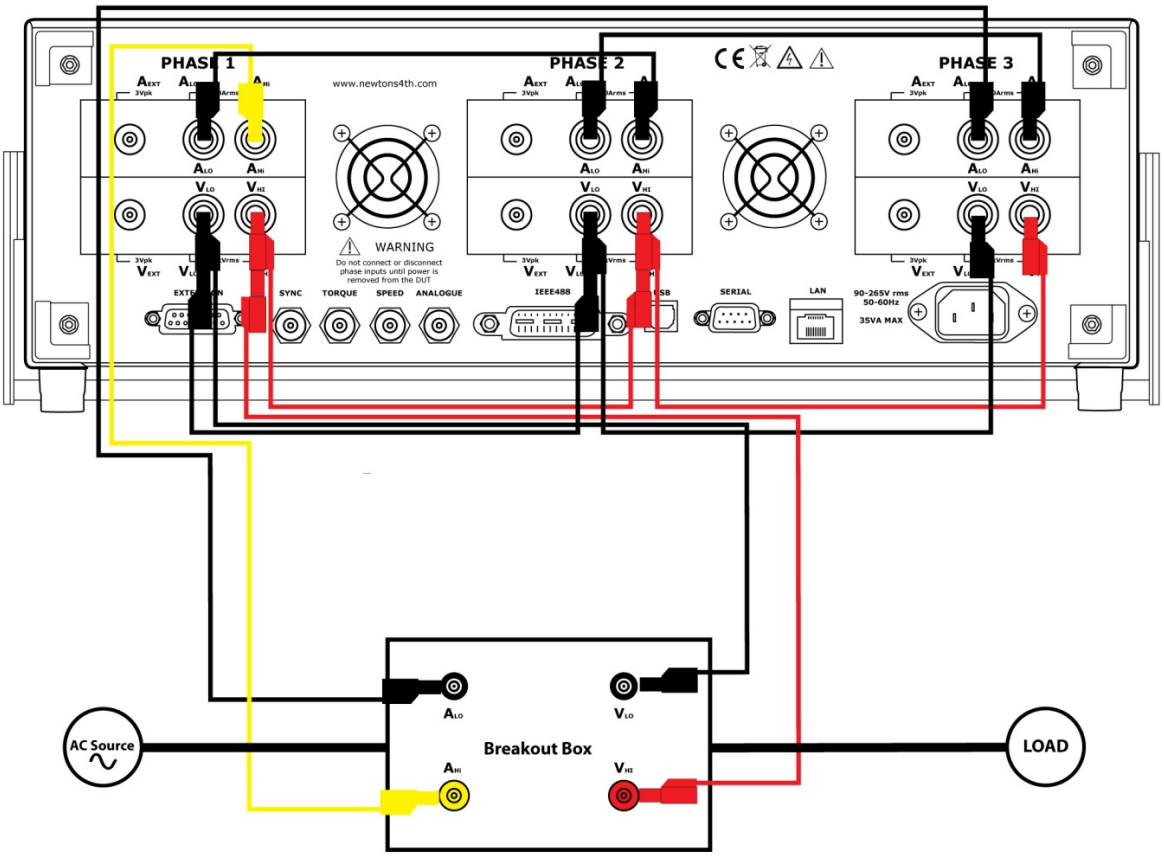
To make the connections shown in the diagram you will need the following accessories that are not supplied with the PPA.

1 x breakout box.

1 x Load that will be connected to the breakout box.

All other connections can be made using the 4m leads supplied with the PPA.

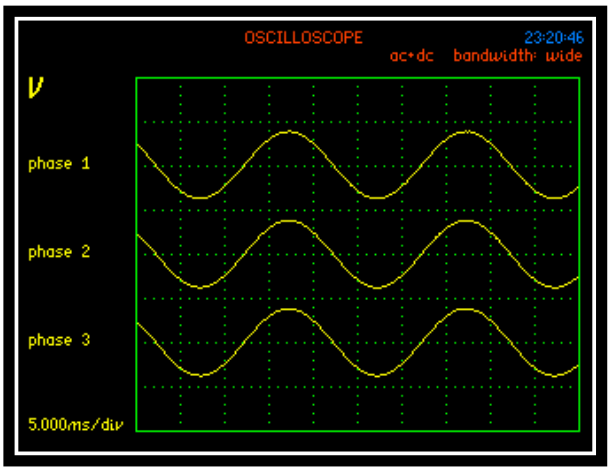
Connection diagram for the functionality checks of the Internal 4mm sockets inputs.

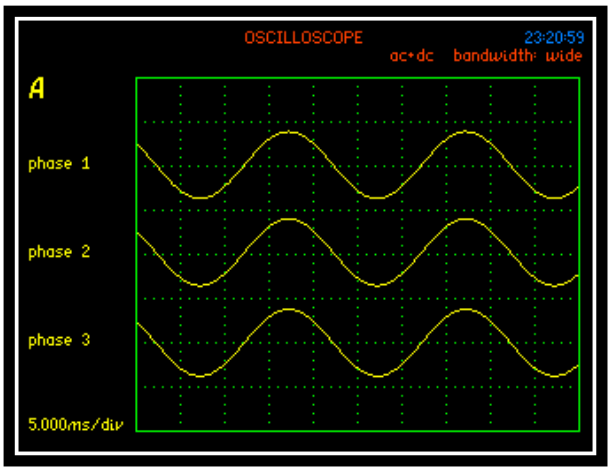


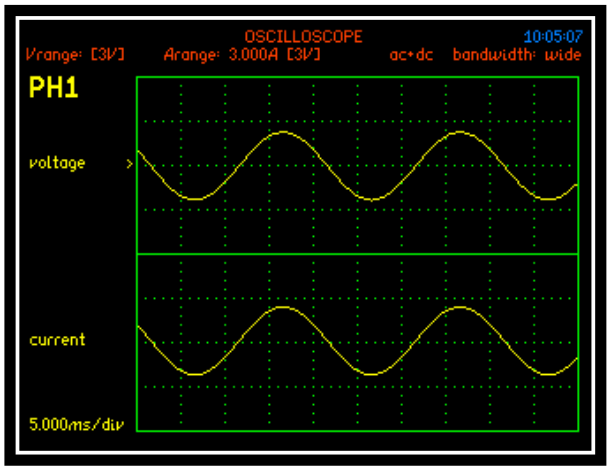
Screenshots of PPA Display when making “internal” measurements.

The following screenshot examples were taken with the PPA set up for internal measurements. For full descriptions for each of the PPA modes please refer to the “external” measurements section.

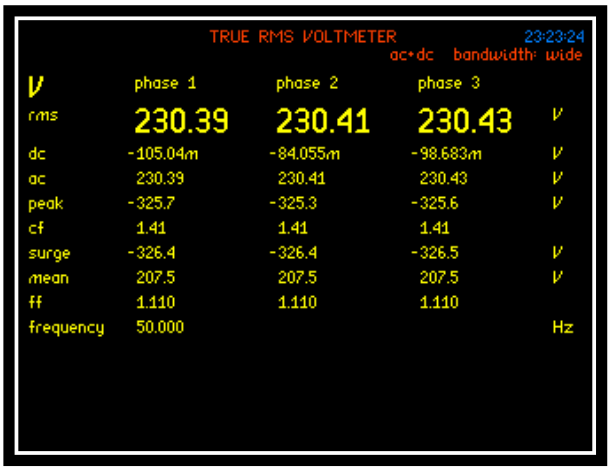
Oscilloscope Mode

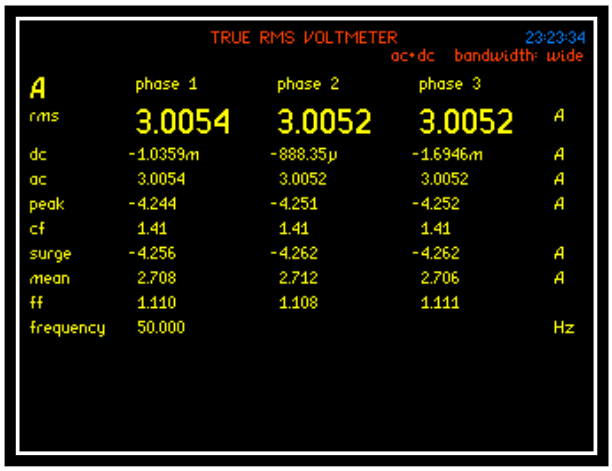


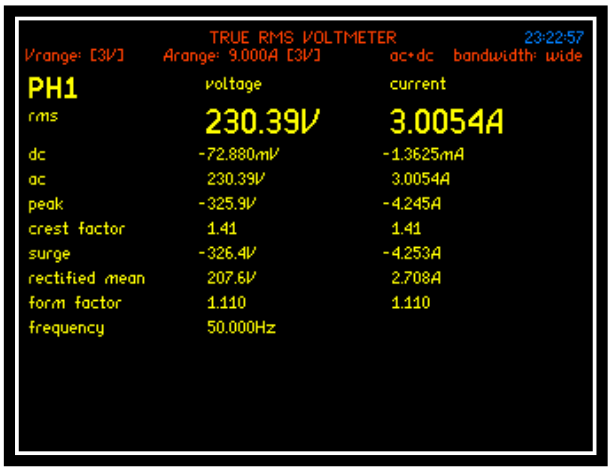




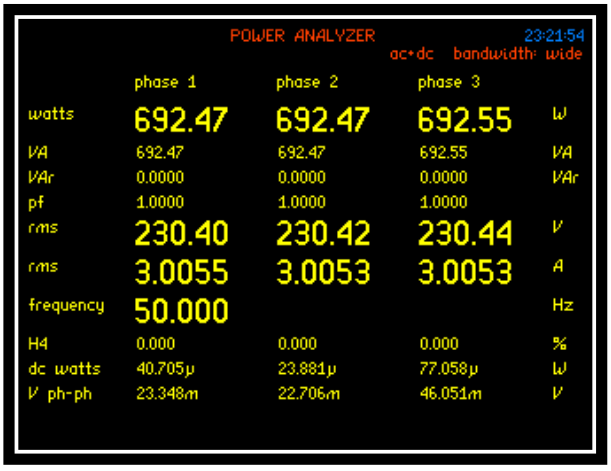
True RMS Voltmeter Mode

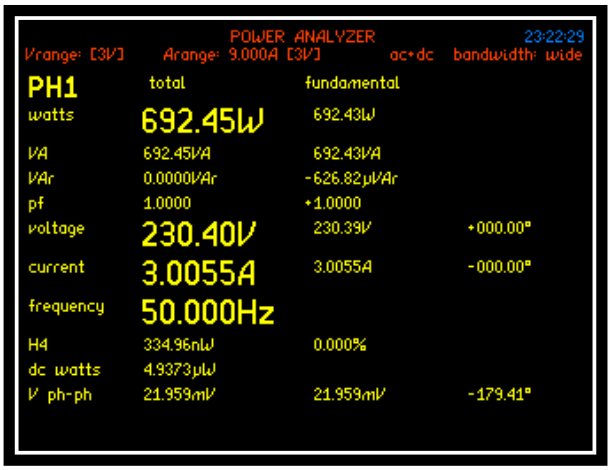




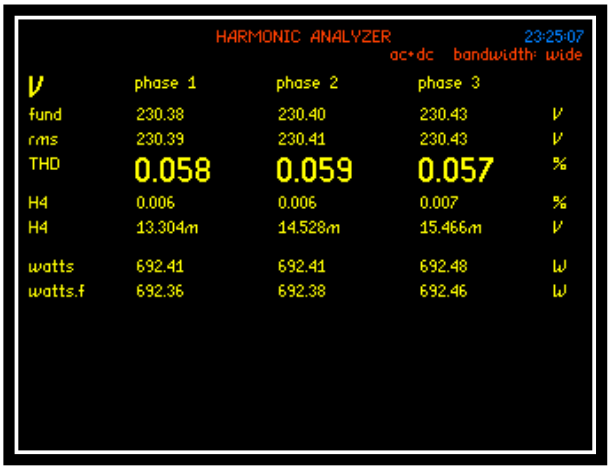


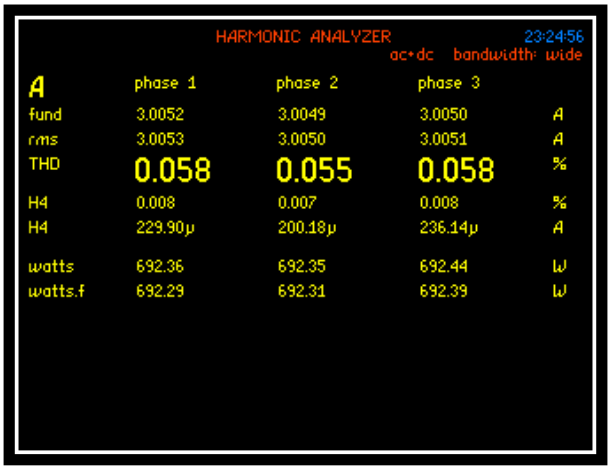
Power Analyzer Mode

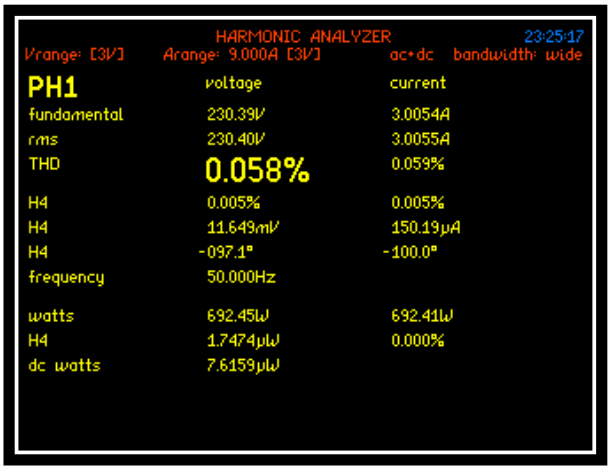




Harmonic Analyzer Mode







Harmonic verification

Verify that Vthd is nominally the same across all phases inputs, as a reference signal (such as a squared wave) is not being used we cannot verify individual harmonic magnitudes. This is not a problem as we have already verified this with the external inputs

Basic Fault Symptoms and Causes

Symptom	Cause
Noisy trace on external voltage input	Possible damage to analogue front end circuitry caused by excessive voltage
Noisy trace on external current input	Possible damage to analogue front end circuitry caused by excessive current
Flat trace on external voltage input	Possible damage to digital circuitry in voltage card
Flat trace on external current input	Possible damage to digital circuitry in voltage card
Incorrect Voltage reading on External Input	Possible damage to input attenuator caused by excessive voltage
Incorrect Current reading on External Input	Possible damage to input attenuator caused by excessive voltage.
Incorrect Voltage reading on Internal Input	Possible damage to input attenuator caused by excessive voltage
Incorrect Current reading on Internal Input	Possible damage to current shunt caused by excessive current
Incorrect Harmonic magnitude on external input	Possible damage to analogue input circuitry / Incorrect frequency detection
Incorrect Harmonic magnitude on internal input	Possible damage to analogue input circuitry / Incorrect frequency detection

If you find any of the faults described above, please contact Newtons4th Ltd or alternatively your local distribution office.

Email: support@newtons4th.com

Telephone: +44(116)2301066

9 Specifications

Frequency Range	
LC & Standard Version	DC and 10mHz to 2MHz
HC Version	DC and 10mHz to 1MHz

Voltage Input	
Internal Input:	
Ranges	1Vpk to 3000Vpk (1000Vrms) in 8 ranges 20% over-range ability maintains 300Vpk range with 240Vrms
Accuracy	0.03% Rdg + 0.04% Rng + (0.004% x kHz) + 5mV *
External Input:	BNC connector – Max Input 3Vpk
Range	1mVpk to 3Vpk in 9 ranges
Accuracy	0.03% Rdg + 0.04% Rng + (0.004% x kHz) + 3µV *

Current Input	
Internal Shunts:	
10A rms Shunt:	4mm Safety Connectors
Ranges	10mApk to 30Apk (10Arms) in 8 ranges
Accuracy	0.03% Rdg + 0.04% Rng + (0.004% x kHz) + 30µA*
30A rms Shunt:	4mm Safety Connectors
Ranges	100mApk to 300Apk (30Arms) in 8 ranges
Accuracy	0.03% Rdg + 0.04% Rng + (0.004% x kHz) + 300µA*
50A rms Shunt:	Touch Proof Screw Terminals
Ranges	300mApk to 1000Apk (50Arms) in 8 ranges
Accuracy	0.03% Rdg + 0.04% Rng + (0.004% x kHz) + 900µA*
External Shunt:	BNC connector – Max Input 3Vpk
Ranges	1mVpk to 3Vpk in 8 ranges
Accuracy	0.03% Rdg + 0.04% Rng + (0.004% x kHz) + 3µV *

Phase Accuracy:	
LC & Standard Version	0.005deg + (0.01deg x kHz)
HC Version	0.01deg + (0.02deg x kHz)

Power Accuracy:	
	[0.04% + 0.05%/pf +(0.01% x kHz)/pf] Rdg + 0.04%VA Rng
40-850Hz	[0.03% + 0.04%/pf +(0.01% x kHz)/pf] Rdg + 0.03%VA Rng

DC Accuracy	
Voltage:	
Voltage Internal	0.06% Rdg + 0.08% Rng + 10mV
Voltage External	0.06% Rdg + 0.08% Rng + 6µV

Current:	
LC Current Internal	0.06% Rdg + 0.08% Rng + 60µA
SC Current Internal	0.06% Rdg + 0.08% Rng + 600µA
HC Current Internal	0.06% Rdg + 0.08% Rng + 1.8mA
Current External	0.06% Rdg + 0.08% Rng + 6µV

Total Harmonic Distortion (THD) Accuracy

$$THD + THD\ Error = \left(\frac{1}{h1 + h1\ error}\right)\sqrt{\sum_{i=2}^{i=n}(hi + hi\ error)^2}$$

Voltage:	
Normal:	
hi error (Voltage) = 0.03% hi rdg + 0.04% rng + 0.004% * KHz +5mV	
External Input:	
hi error (Voltage) = 0.03% hi rdg + 0.04% rng + 0.004% * KHz +3uV	
Current:	
10A:	hi error (Current) = 0.03% hi rdg + 0.04% rng + 0.004% * KHz + 30uA
30A:	hi error (Current) = 0.03% hi rdg + 0.04% rng + 0.004% * KHz + 300uA
50A:	hi error (Current) = 0.03% hi rdg + 0.04% rng + 0.004% * KHz + 900uA
External shunt:	
hi error (Voltage) = 0.03% hi rdg + 0.04% rng + 0.004% * KHz +3uV	

Common Mode Rejection
Total Common Mode and Noise effect on current channels
Applied 250V @ 50Hz – Typical 1mA (150dB)
Applied 100V @ 100kHz – Typical 3mA (130dB)

Torque and Speed Analogue Accuracy	
Range:	+/- 10V Analogue Bipolar
Accuracy:	0.05% Rdg + 0.05% Rng

Torque and Speed Pulse Count Accuracy	
Range:	+/- 1Hz to 1MHz
Accuracy:	0.01% Rdg

Datalog	
Functions:	Up to 4 measured functions user selectable (30 with optional PC software)
Datalog window:	From 10ms with no gap between each log
Memory:	RAM or non-volatile, up to 16,000 records

General	
Crest factor:	Voltage and Current = 20
Sample rate:	Real time no gap - 2.2Ms/s on all channels
IEC modes:	IEC62301 Standby Power
Remote operation:	Full capability, control and data
Application modes:	PWM Motor Drive
	Ballast
	Inrush
	Standby Power
	Power Transformer

Ports	
RS232	Baud rate to 38400 – RTS/CTS flow control
LAN (Optional)	10/100 base-T Ethernet auto sensing RJ45
GPIB (Optional)	IEEE488.2 compatible
USB	USB device – 2.0 and 1.1 compatible
Analogue	Bipolar +/- 10V
Speed	BNC bipolar +/- 10V or pulse count
Torque	BNC bipolar +/- 10V or pulse count
Sync	Measurement synchronization for 4-6 phase mode
Extension	Master slave control and N4L accessory port

Physical	
Display	320 x 240mm Colour TFT Display White LED Backlit
Size	130H x 400W x 315D mm – excl feet
Weight	5.4kg – 1 phase – 6kg 3 phase
Safety isolation	1000Vrms or DC (CATII), 600Vrms or DC (CATIII)
Power supply	90-265Vrms, 50-60Hz, 40VA max

*** measured fundamental value**

10 Comparisons

Model	PPA15xx	PPA45xx	PPA55xx
Item			
USB Port on front	Y	Y	Y
Colour Display	Y	Y	Y
Speed and Torque Standard	N	Y	Y
GPIB, LAN Standard	N	N	Y
IEC61000 Standard	N	N	Y
Current Options	20, 30	10,30,50	10,30,50
Bandwidth	1MHz	2MHz	2MHz
V&I Accuracy	0.05 + 0.1	0.03 + 0.04	0.01 + 0.038
W Accuracy	0.1 + 0.1	0.04 + 0.05	0.03 + 0.02
PWM Mode	N	Y	Y
Transformer Mode	N	Y	Y
Minimum Window Size	2ms	10ms	2ms
Scope	Y	Y	Y
Harm order	50	100	417
PWM Filter options	NA	7	7
Internal Datalog	16000 records	16000 records	10M records
Internal logging parameters	4	16	16
TTV 105	N	N	Y
Harm comp/sec	300	600	1800
Range	8	8	9
Internal Memory	192kB	200MB	1GB