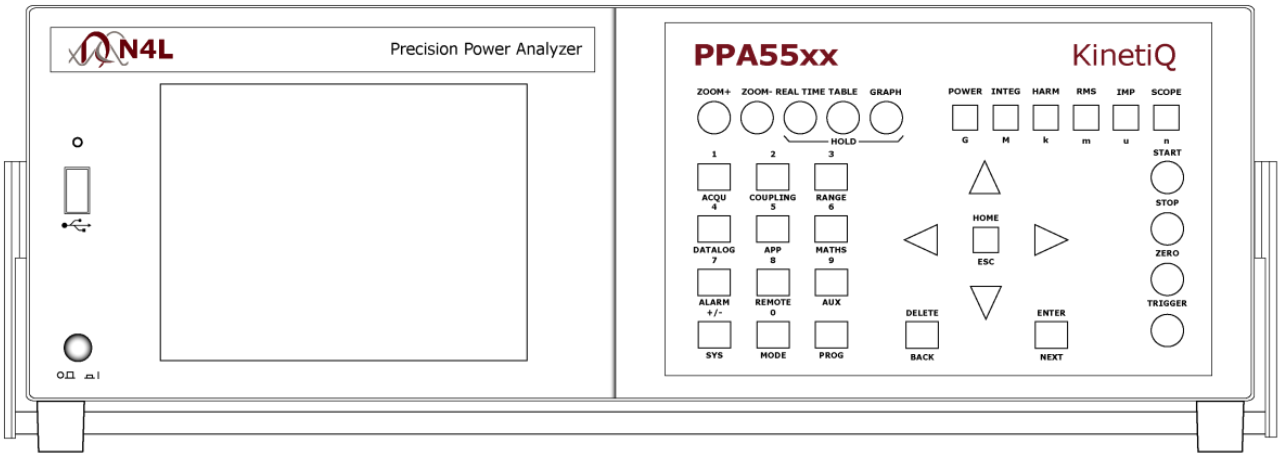
Newtons4th Ltd

PPA55xx series

START UP GUIDE



Firmware v2_169

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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
PPA5510	1	1	2	1	1	2	1	1	1	1
PPA5520	1	2	4	2	2	4	2	1	1	1
PPA5530	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
GPIB	IEEE extender cable 1m long

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.

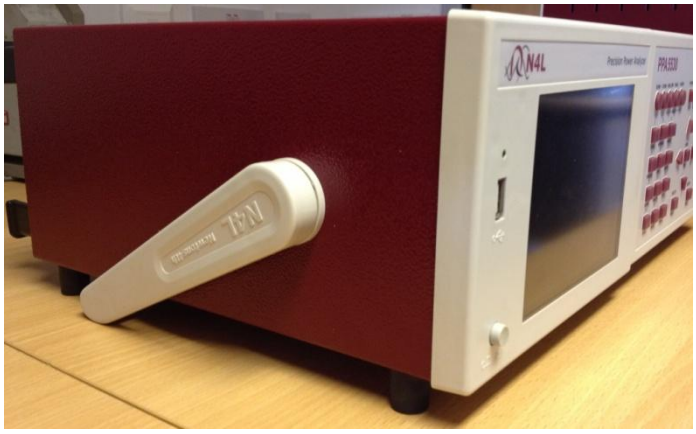
The following pictures illustrate correct and incorrect handle fitment:

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"

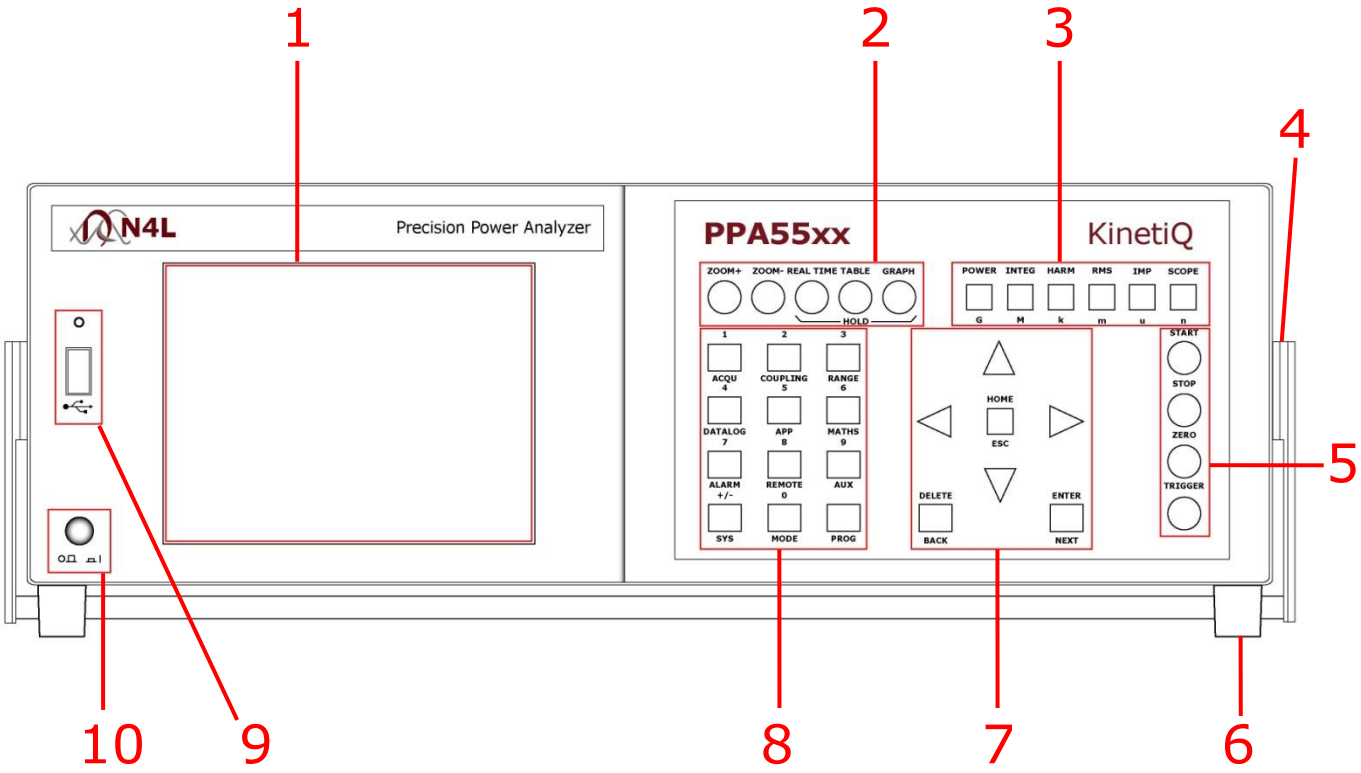
If the problem cannot be resolved directly then you will be given an RMA number and asked to return the unit. The instrument will be repaired or replaced at the sole discretion of Newtons4th Ltd

This guarantee is limited to the cost of the PPA55xx 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 PPA55xx 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
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 phase's 2 & 3 to measure a 3 phase inverter output. PH3 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 PH3
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 Phase 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
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. This option should not be used when DC only coupling is selected in the Coupling menu.

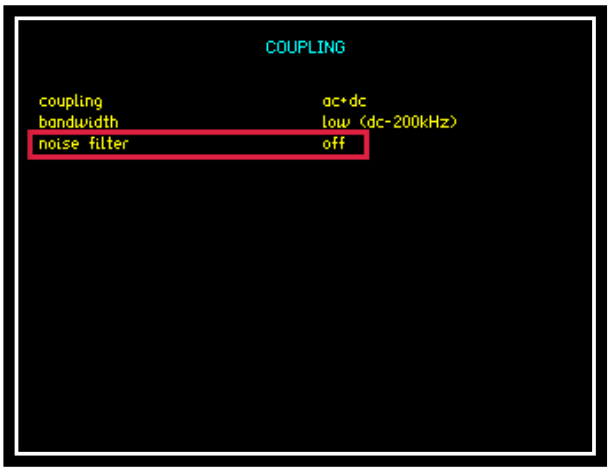
High Speed	High speed mode can be selected for data log speeds less than 100ms
Disabled	Disable high speed function
Enabled	Activate high speed data log function

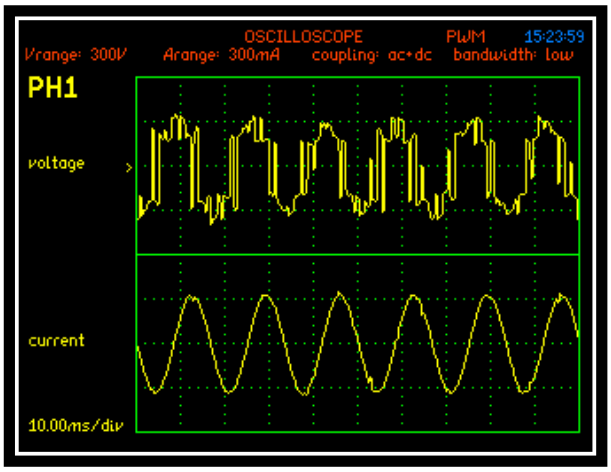
COUPLING	
Coupling	There are three coupling options - AC only, AC+DC, or DC only. AC+DC coupling is the default option and should be used where possible. AC coupling should be used for measuring signals that are biased on a dc level (such as an amplifier operating on a single supply or the output of 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. When DC coupling is selected "Dynamic" Frequency lock has no meaning and so should not be used.

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

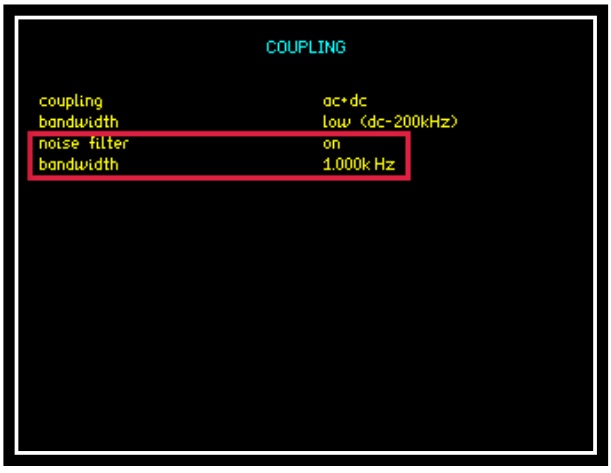
Noise Filter	In signal processing, a "FILTER" is a device or process that removes from a signal some unwanted component or feature. The noise filter is a digitally selectable in line filter which will alter the bandwidth of the processed signal
Off	Select to switch this mode off
On	Select to switch this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

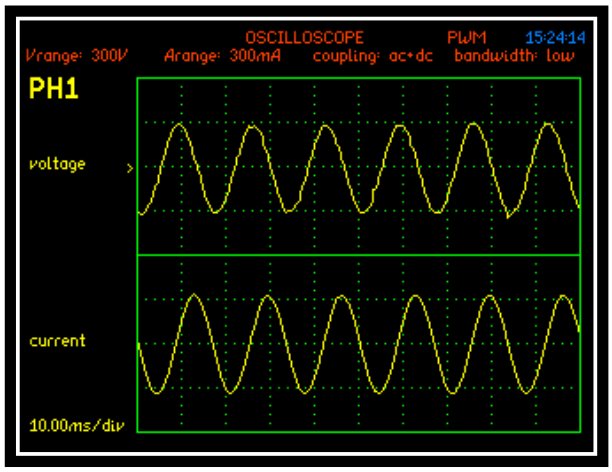
The following screenshots are taken from the "Scope" display with the PPA set in PWM application mode





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
300mV	Minimum Input Voltage range will not be below 300mv
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
3mA LC Version Only	Minimum Input Current range will not be below 3mA
10mA LC Version Only	Minimum Input Current range will not be below 10mA
30mA LC, SC Versions	Minimum Input Current range will not be below 30mA
100mA LC, SC, HC	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 1GB 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 PPA5510) 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 PPA5510) 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

Harmonics / Flicker	This mode is used for IEC61000 testing. Results can be obtained directly from the instrument or preferably via IECSoft software
Harmonics / Flicker	Select between IEC61000-3-2 Harmonics or IEC61000-3-3 Flicker test to be carried out
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
Autoranging	Select which autoranging application is to be used to detect the correct Current measurement from the drop down menu
Class	A, B, C, D as required
Aircraft TVF 105	Use with PPALoG, guidance in TVF 105 section 6.5.8

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)
(term1 + term2 + term3) / term4	Sum of (term1 + term2 + term3) divided by 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
GPIB	GPIB Comms interface

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 PPA55xx units are to be used as a PPA5540/50/60
Disabled	Master / Slave configuration disabled
Master	Select to set PPA55xx as master unit within 4 -6 phase configuration
Slave	Select to set PPA55xx as slave unit within 4 - 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:
-180^0 to $+180^0$	Commonly used in circuit analysis
0^0 to -360^0	Commonly used in power applications
0^0 to $+360^0$	Select as required

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

Autozero	
Autozero	Periodically re-zero'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 125 harmonics

Oscilloscope	The PPA provides a storage oscilloscope function in order to view the waveforms being measured
Fluctuating Harmonics	IEC61000-3-2 Harmonics – For use with IECSoft software
Flickermeter	IEC61000-3-3 Flicker test – For use with IECSoft software

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

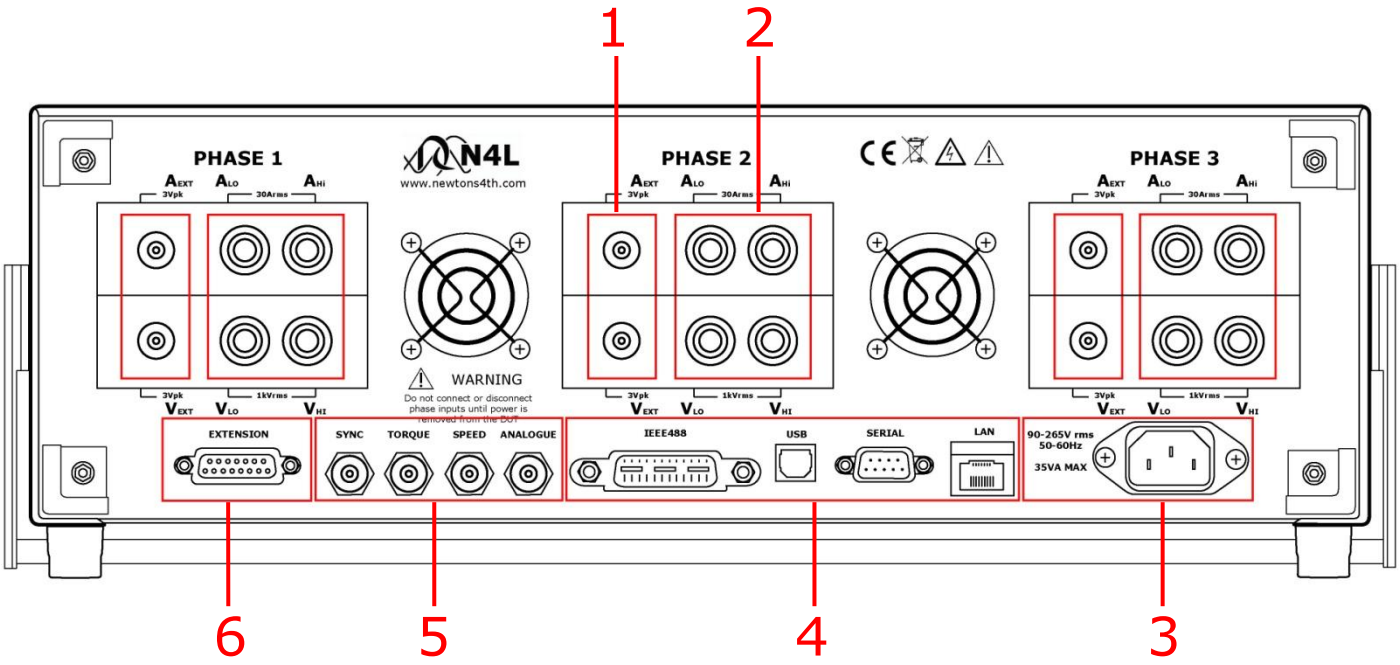
ENTER / NEXT (Dual use button)	Enter / Next will enable the user to confirm any configurations they have set within the menu's and will scroll through the display screen to view all individual phase screens or all phases together

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 PPA55xx 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

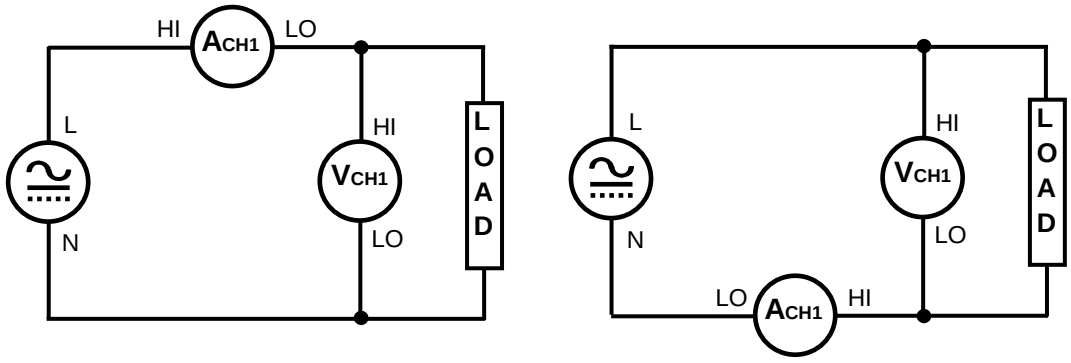
Care must be taken when connecting up the instrument.

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

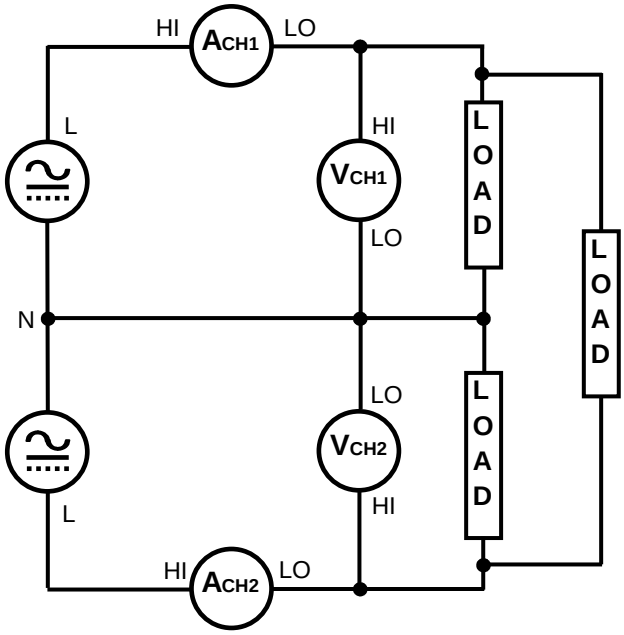
Current in Series – (Hi in, Low out)

Voltage in Parallel

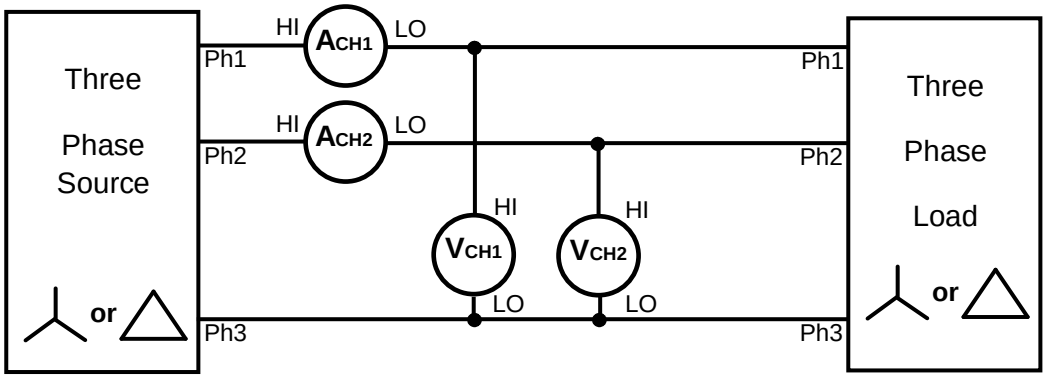
Single Phase Configuration



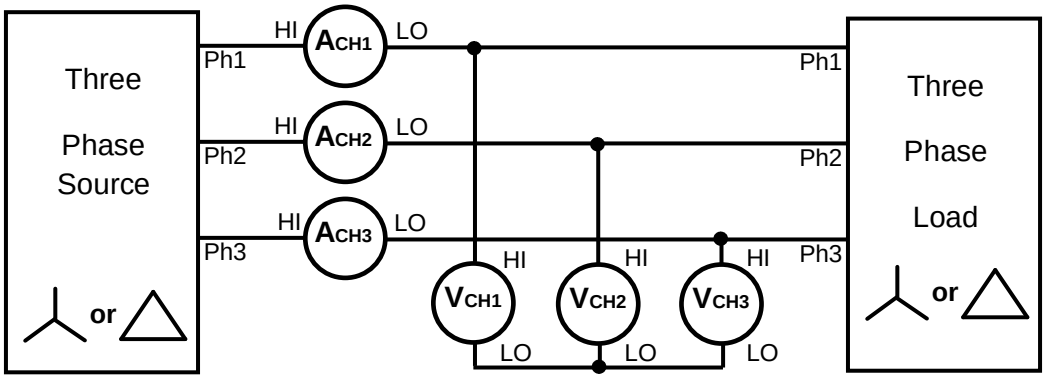
Two Phase Two Wattmeter Configuration



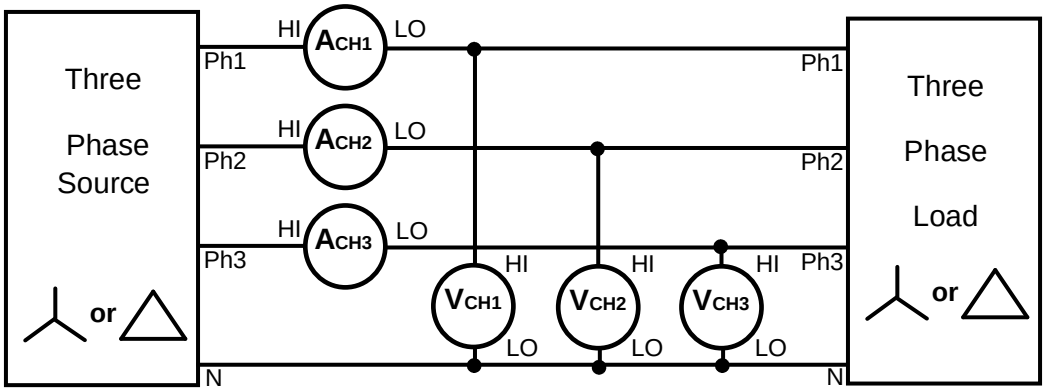
Three Phase Two Wattmeter Configuration



Three Phase Three Wattmeter - simulated neutral configuration

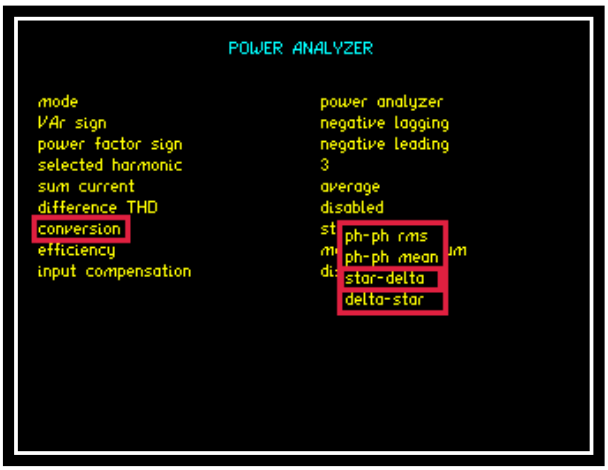


Three Phase Three Wattmeter – Star Connections



To configure PPA55xx 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



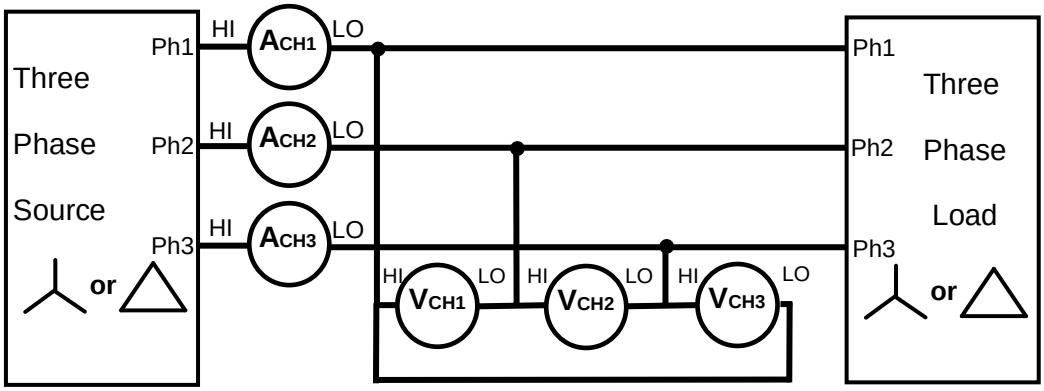
Press ▼ 7 times until red box surrounds "conversion"

Press ▶ to open up dropdown menu selections

Press ▼ until red box surrounds "star-delta"

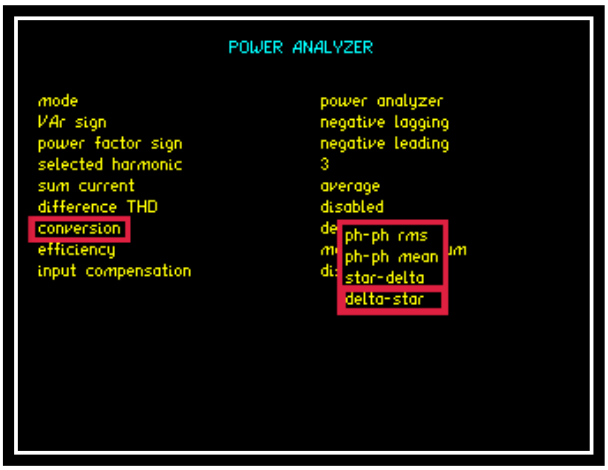
Press "ENTER" to confirm selection

Three Phase Three Wattmeter– Delta Connections



To configure PPA55xx 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"

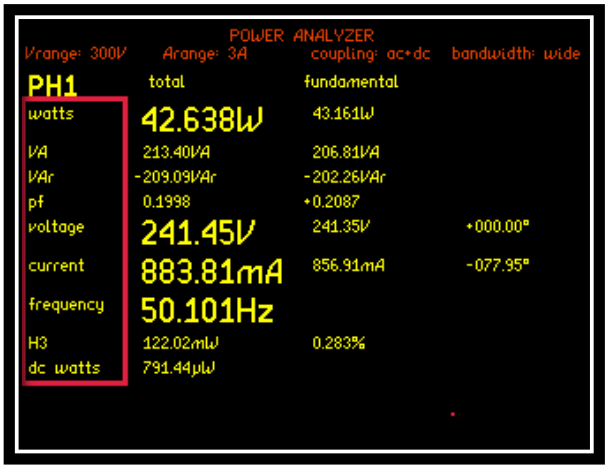
Press ▶ to open up dropdown menu selections

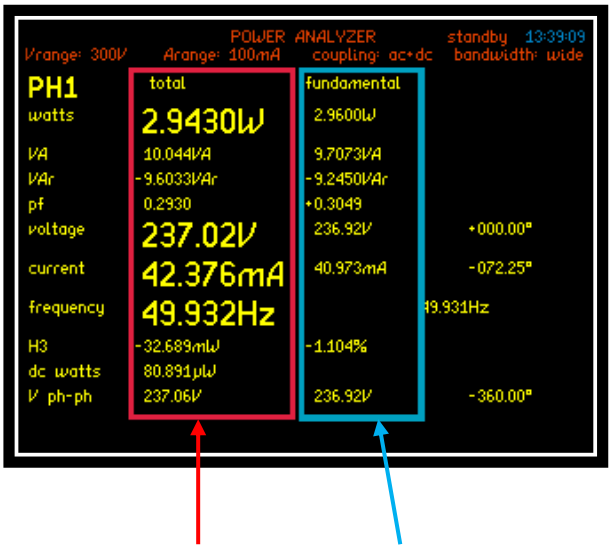
Press ▼ until red box surrounds "delta – star"

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 shown, 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)





Within the Power screen you will notice 2 sets of measurements "Total" and "Fundamental"

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

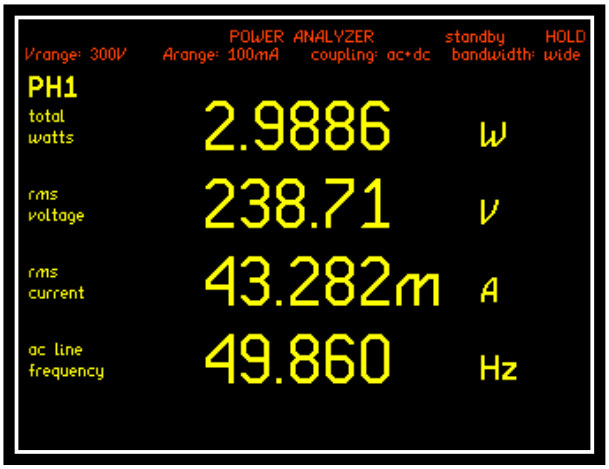
Within the Power screen you are able to select up to 4 measurements that can be made more prominent from the rest, these can be selected and changed by the user as required

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

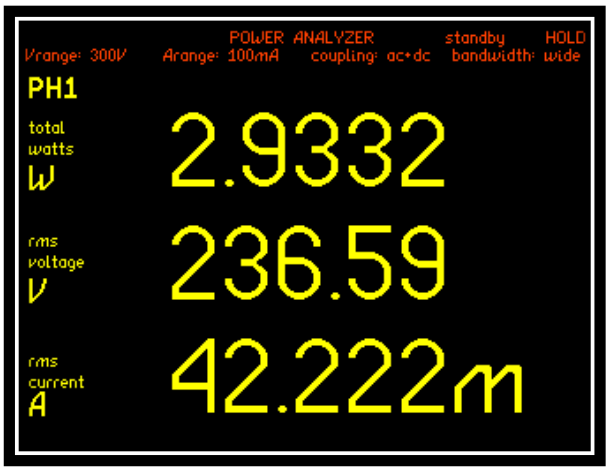


Zoom +

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



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

6.3.1 ANALOGUE (ANALOG) OUTPUT

The Analogue Output BNC connector is located on the rear of the instrument. The output voltage (max ±10V) can be controlled using the ALARM functions to generate a voltage representative of Zoom 1-4 measurements or a manual level.

The Voltage present at the Analogue Output can be calculated using this formula:

Analogue Output = 10V x (measured – zero) / (full scale – zero)

"Measured" is the value measured on the instrument.

"Zero" and "Full Scale" are user defined values.

In the following example a 2V Peak 50Hz signal will be monitored by the Power Analyzer. The frequency will be adjustable by +/-2Hz. Therefore in the above formula Zero will be 50 and Full Scale will be 52.

With a Full scale value of +/-2Hz, the Analogue Output will vary between -10V at 48Hz up to +10V at 52Hz. The Analogue Output Voltage will be 0V when the frequency is 50Hz.

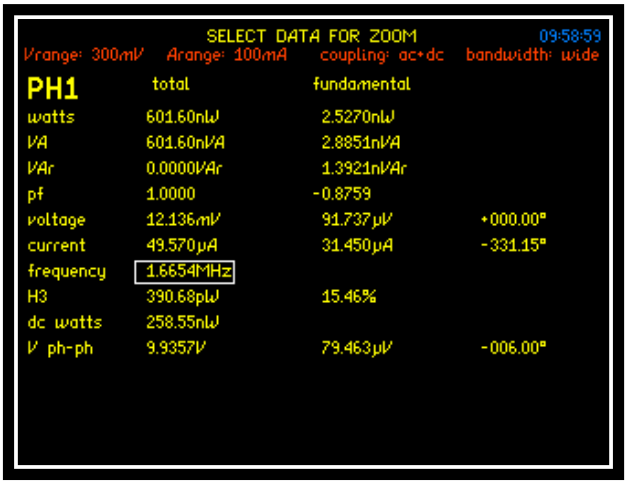
Zoom 1 in the Alarm menus will be used to control the voltage levels on the Analogue Output.

Connections

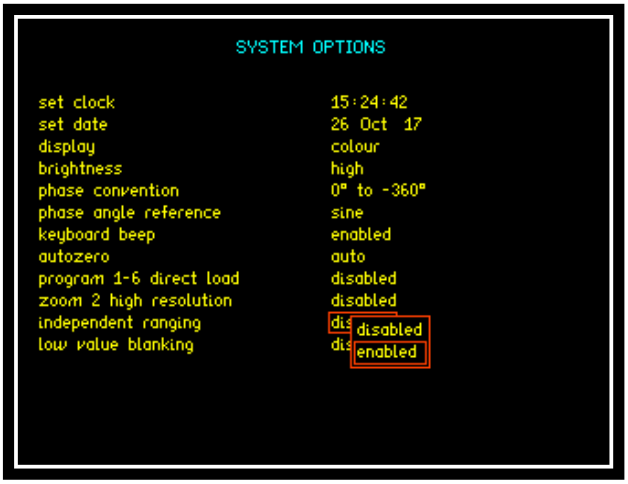
Connect the input signal to Phase 1 on the PPA and connect the Analogue output to Phase 2. In this example a 2.00V Peak 50Hz input signal was used.

PPA Settings

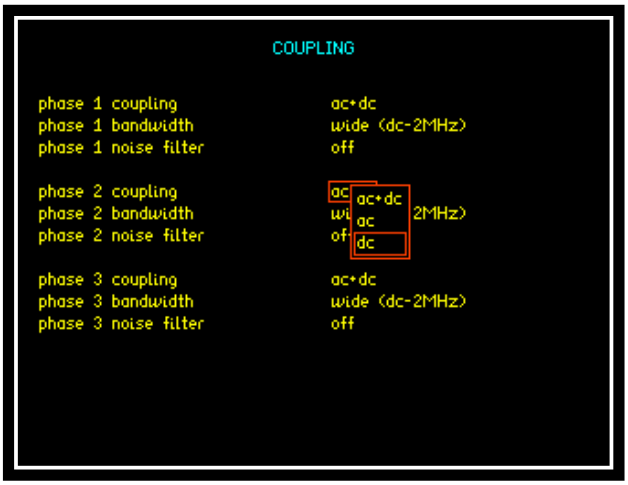
Using the ZOOM buttons select frequency for Zoom 1. Other parameters can also be selected but for this example Zoom 1 must be set to frequency.



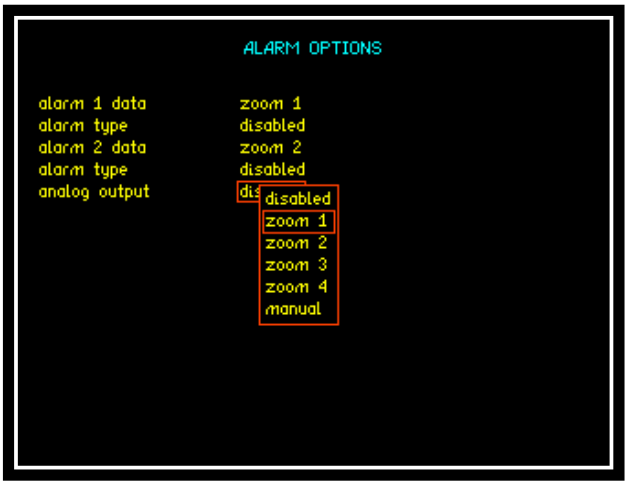
Press the SYS button and enable Independent Ranging.



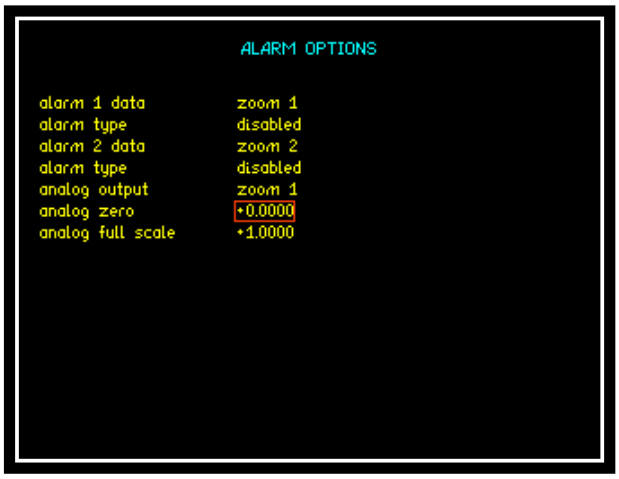
Press the COUPLING button and set Phase 2 coupling to DC.



Press the ALARM button and set the “Analog output” option to ZOOM 1.



This will display the Analogue Output settings.

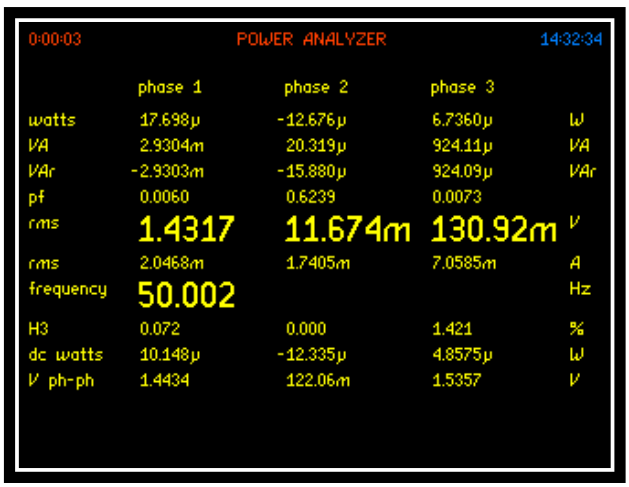


Enter a value of 50 for Analogue Zero.

Enter a value of 52 for Analogue Full Scale.

Press the HOME/ESC button to return to the Power Analyzer display.

Press the ENTER / NEXT button 4 times to display all phases at the same time.



Results

Phase 1 on the PPA display indicates the Frequency and RMS voltage levels of the signal being monitored.

Phase 2 indicates the voltage present on the Analogue Output connector on the rear of the PPA.

Phase 3 is not used.

Example 1.

The Input signal frequency was set to 50.5Hz.

The frequency displayed on the PPA was 50.512Hz.

Analogue Output = 10V x (measured-– zero) / (full scale – zero)

Analogue Output = 10V x (50.512 – 50) / (52-50) = 2.56V

Example 2.

The Input signal frequency was set to 51.5Hz.

The frequency displayed on the PPA was 51.508Hz.

Analogue Output = 10V x (measured – zero) / (full scale – zero)

Analogue Output = 10V x (51.508 – 50) / (52-50) = 7.54V

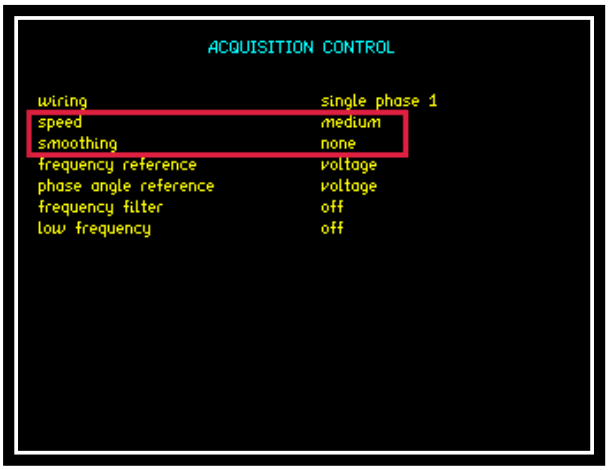
6.4 SPEED AND SMOOTHING

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

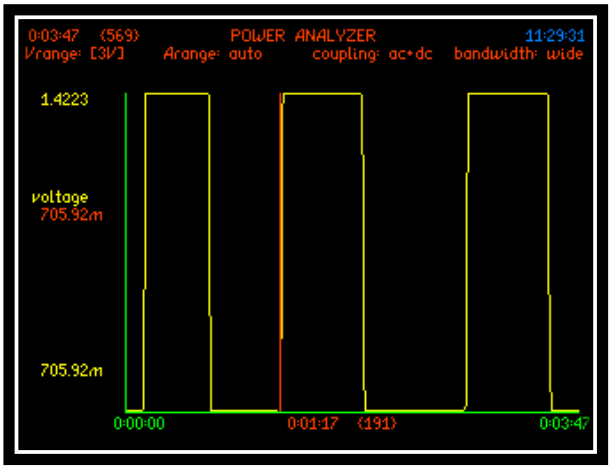
Amplitude = 1Vpk & 2Vpk range



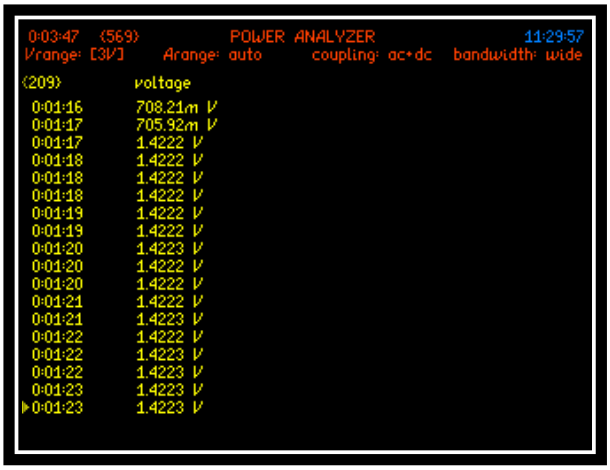
The first sets of results are from a Datalog conducted with NO smoothing selected thus the data update will be dictated by the speed parameter only

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



Displayed left 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

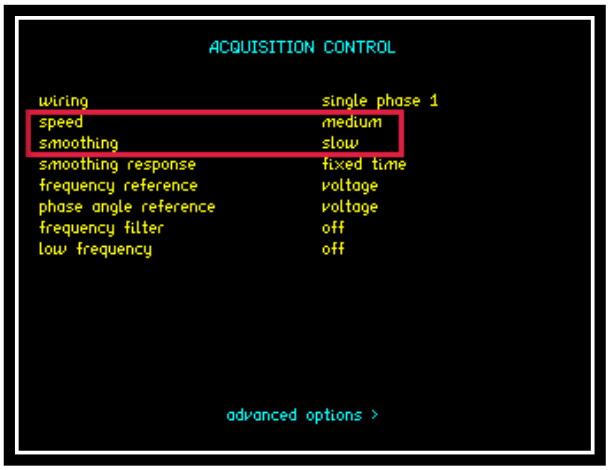


The table of results displayed are in relation to the previous graph; and we can see that the voltage step is immediately recorded after 0:01:17

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

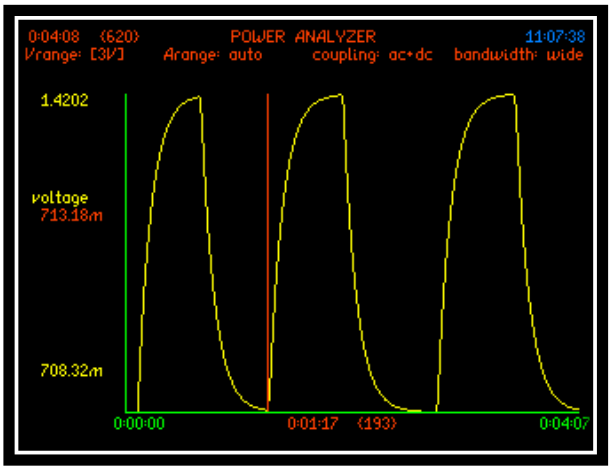
We have selected "SLOW" smoothing with a medium speed giving us a sliding window of 48 seconds

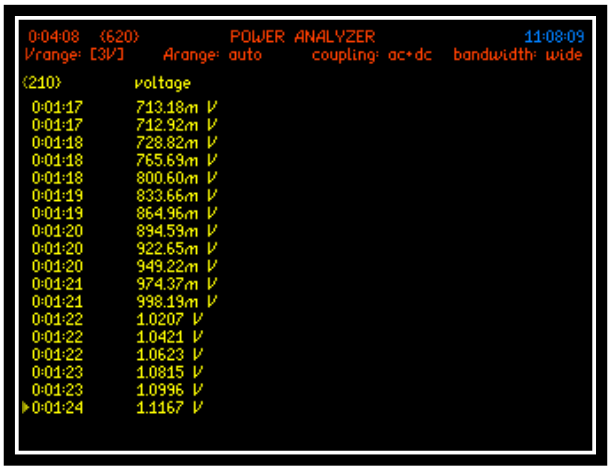


Smoothing response can be set to "Auto Reset" where the instrument will reset the filtering in response to any significant change in data

"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 below;





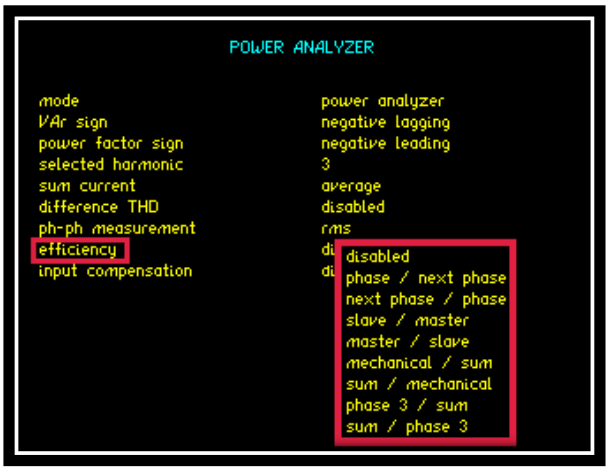
The displays above show how with smoothing applied, the data is smoothed out over the resultant timescale and displaying an intermediate value for every update window during the step between the two peak voltage values

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 the screenshot below



To select the "Efficiency" parameter from any application mode.

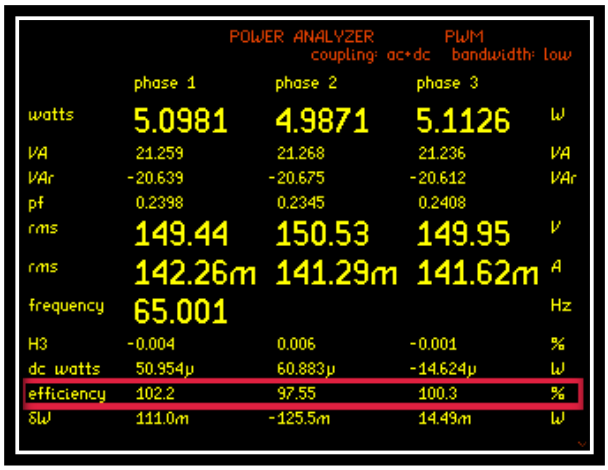
Access the Power Analyzer home screen and press "POWER" this will take you into a sub menu.

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

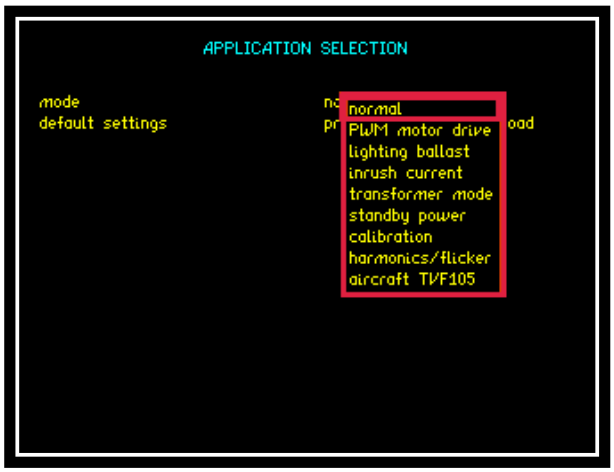
Press "HOME" to return to the Power Analyzer display screen

The results will then be displayed at the end of the Power Analyzer home screen as shown



6.5 APPLICATION MODES

Within this section we will look at all the different application modes selectable from within the PPA55xx 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



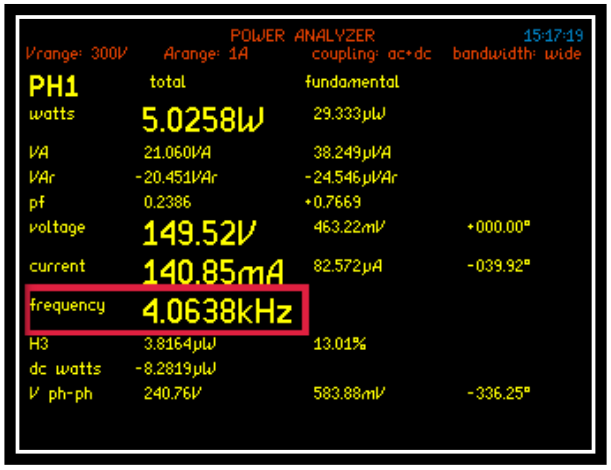
In the following sub sections we will look into and describe how each application mode is set up and configured to enable the user to get the maximum benefit from the PPA55xx

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)

Leaving the PPA55xx in "normal" app mode take note of the frequency measurement



In "normal" app mode the PPA55xx is locking onto a switching frequency / high frequency noise of 4 KHz 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:

Press “APP” button

Press ▼ Key

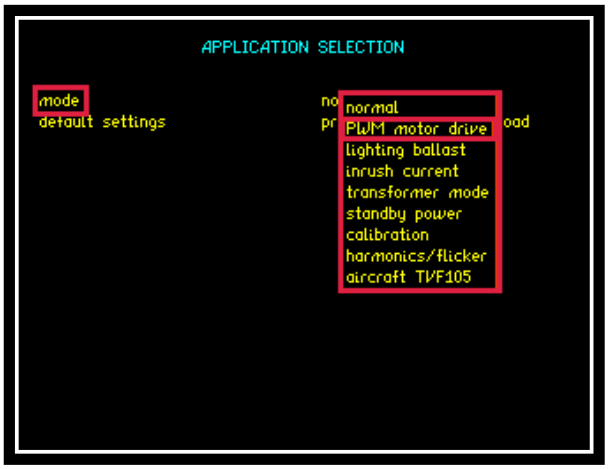
Red Box will surround “Mode”

Press ▶ Key. This will open

the drop down menu selections

Press ▼ Key until red box

surrounds PWM motor drive



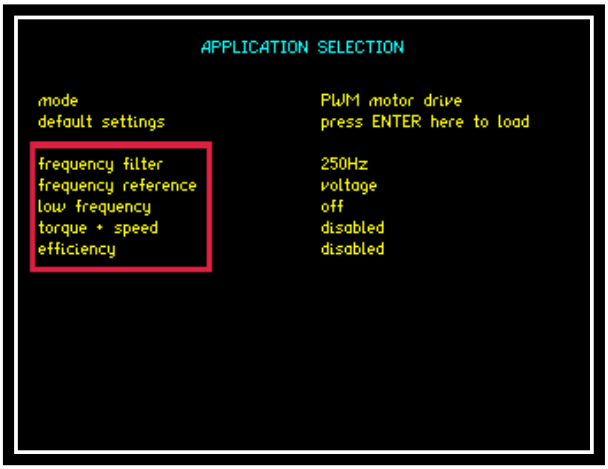
Press “ENTER” this will now set the mode

Press ▼ Key

Red Box will now surround “Default Settings”

Press “ENTER”

When default settings have been activated it will allow 5 further parameters to be configured as shown

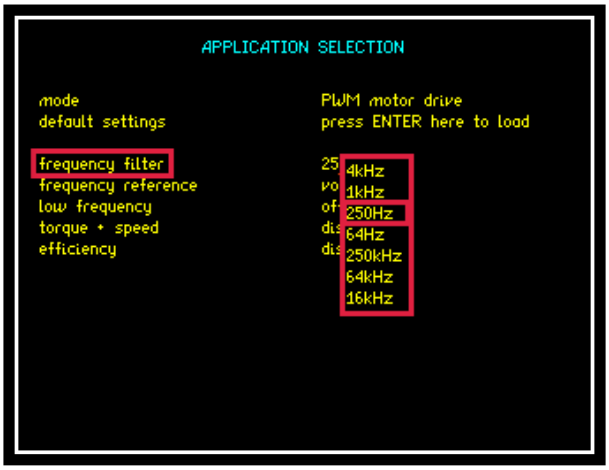


Frequency filter:

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:



Press ▼ 2 times

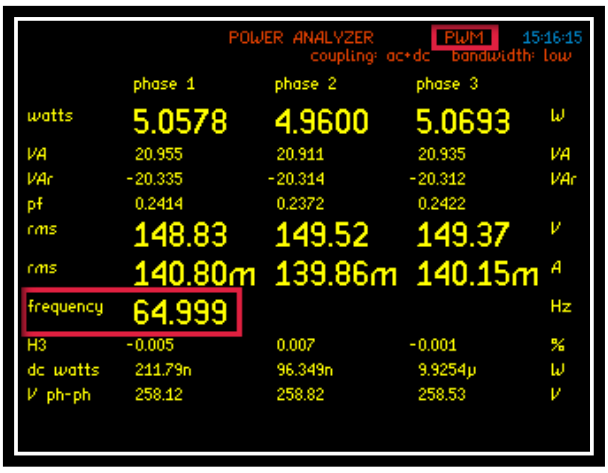
Frequency filter parameter will be selected

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

Press ▼ ▲ arrows to select frequency filter parameter required

Press "ENTER" to confirm selection

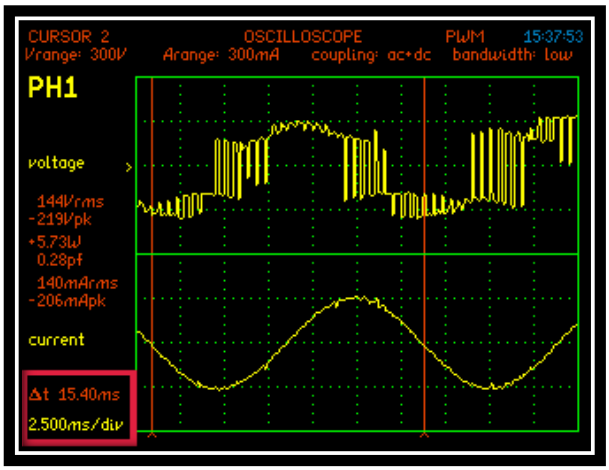
By applying a 250Hz filter within PWM mode we can now see that the instrument is locking onto the fundamental frequency this is required for correct signal processing of the waveform



By viewing the waveforms in the Oscilloscope mode 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



Frequency reference:

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

Low Frequency:

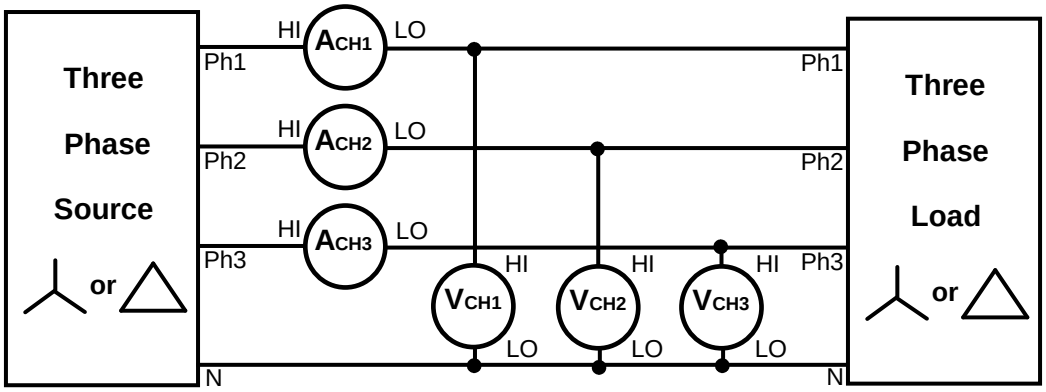
Set this parameter to ON, switching on will open up the minimum frequency parameter

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

Using the PPA5530 to measure 3 phase power with PWM drives

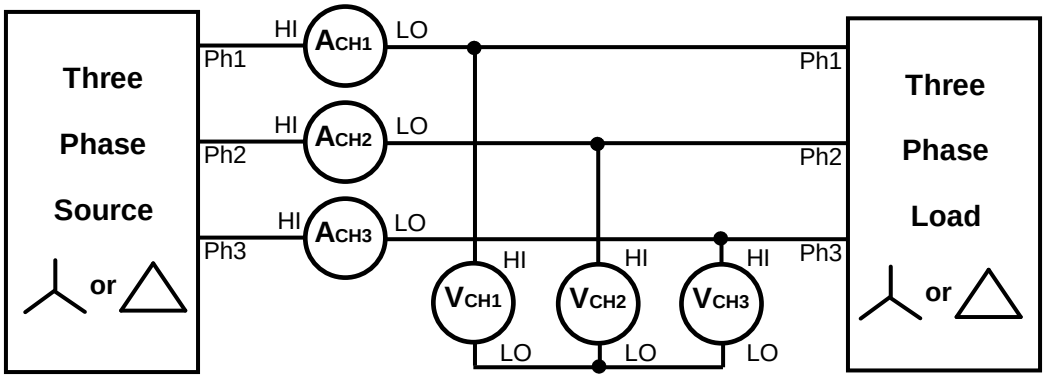
If there is access to the neutral point (star point) of a star wired load, then accurate measurements can easily be made by connecting the measurement channels in star configuration:



In this configuration, the data including rms voltage will be correct for each phase, and the phase to phase voltage rms can be derived (set conversion to "phase to phase rms").

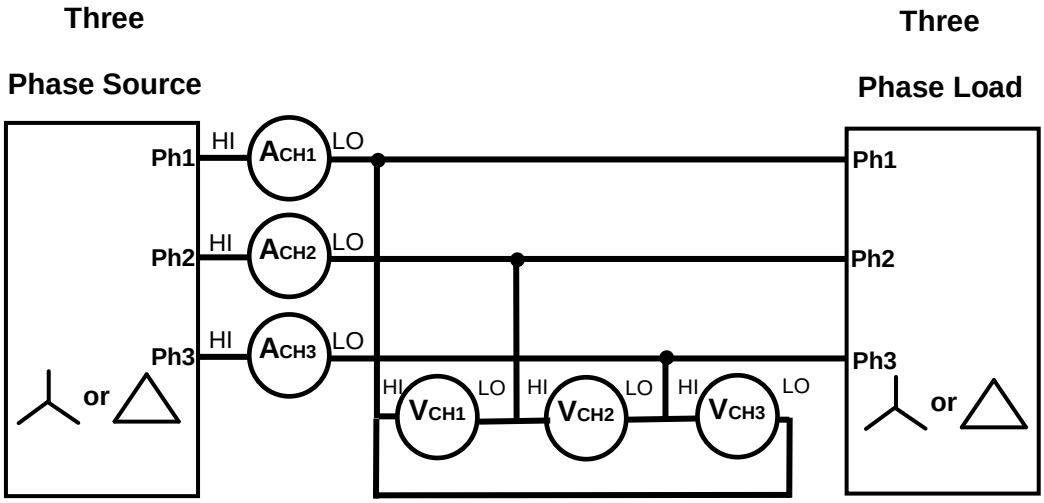
If, however, the neutral point is not available, then the measurement of the voltage rms is more difficult. The options are to use a synthesised neutral or to connect in delta configuration and derive the phase measurements.

Consider the synthesised neutral configuration:



When using synthesised neutral, the elementary measurement of the voltage rms will usually be higher than that measured with a true neutral. For this case, there is a conversion option "star to delta" which accurately computes the phase to phase voltages, then derives a phase to neutral value from the computed phase to phase values. This gives a phase to neutral value which is much closer to that measured with a real neutral. The phase to phase (or "delta") value, Vd(t) is derived from the instantaneous "star" voltage values, Vs(t) (eg. Vd1(t) = Vs1(t) – Vs3(t)) so the voltage present on the synthesised neutral has no effect.

Consider the delta wired configuration:

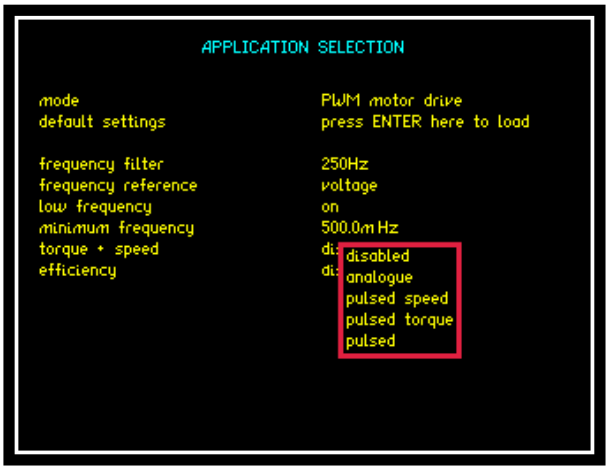


In this case the phase to phase voltages are measured directly and the phase to neutral values are derived (set conversion to "delta to star"). The power measurements are also adjusted to show the individual "star" phase powers. The delta/star conversion assumes that the impedance of the load is equal on all three phases.

Wiring	conversion	Phase rms voltage	Phase power
Star with neutral	Phase to phase rms	Measured	Measured
Star without neutral	Phase to phase rms	Slightly high	Measured
	Star to delta	Derived	Measured
Delta	Delta to star	Derived	Derived

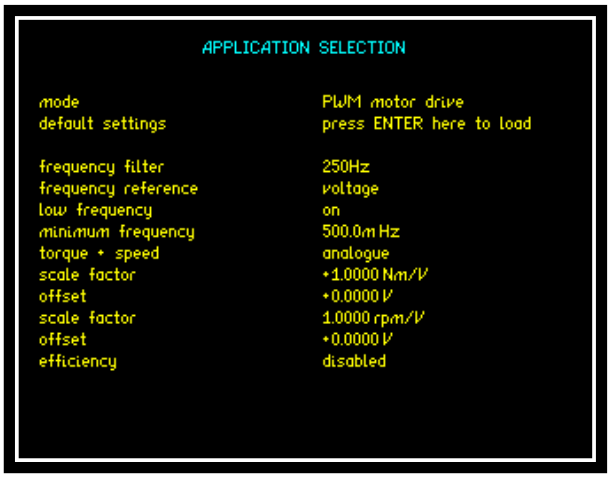
Torque & Speed:

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

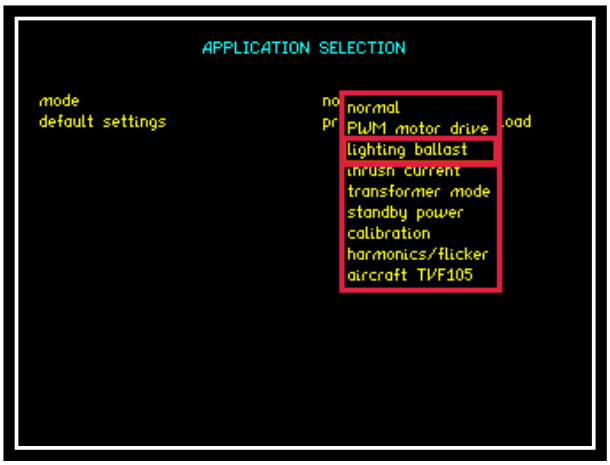


Open up the torque and speed drop down box to select which type of test is to be configured

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



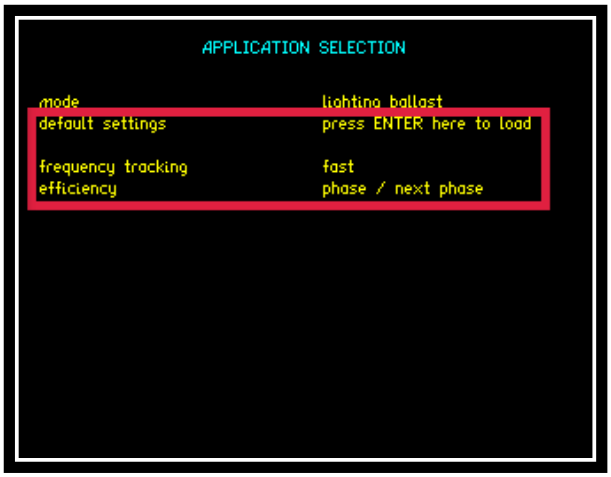
6.5.2 LIGHTING BALLAST MODE



Select Lighting Ballast mode from the Application Menu as in previous applications

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



6.5.3 Inrush Current Mode

Measurement of 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. In inrush mode the PPA55xx samples and analyses every sample at the full sample rate in excess of 2Msamples/s to catch even very fast peaks.

Set Up

Instrument Used: PPA5530-Std (30Arms)

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

Accessories: 1 x Break Out Box

To access Inrush Current:

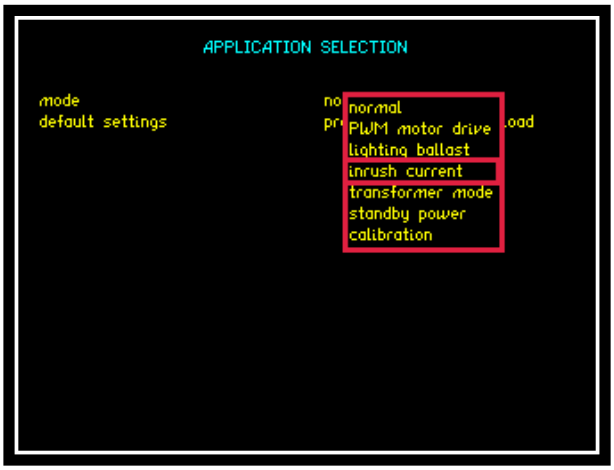
Press "APP" button

Press ▼ button

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

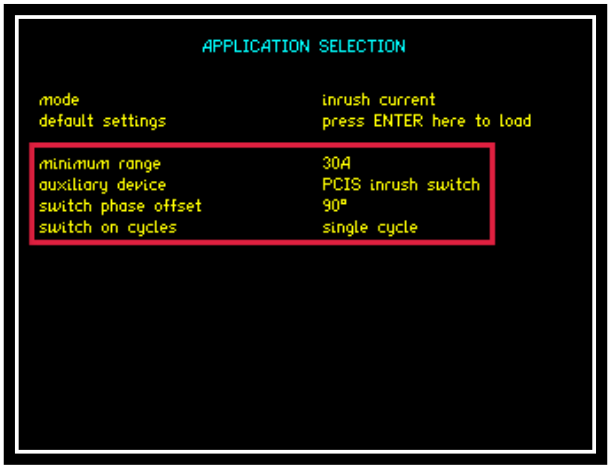
Press ▼ 3 times until red box surrounds inrush current

Press "ENTER" this will now set the mode



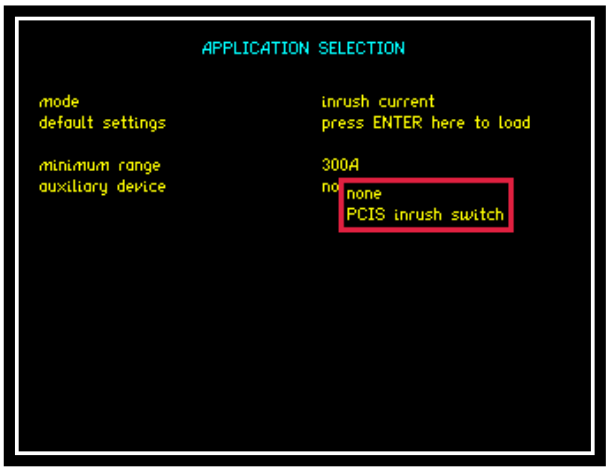
Press ▼ button.

Press "ENTER" this will now set the default settings mode for inrush current and allow further parameters to be configured



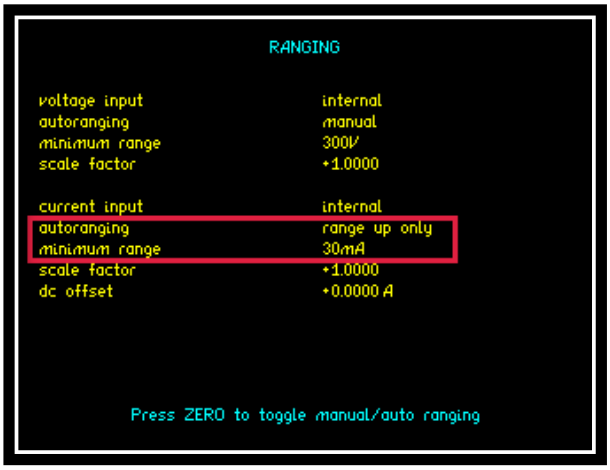
Press ▼ 2 times until the red box surrounds "auxiliary device" parameter

Press ▶ select the auxiliary device to be "none" and press "ENTER"



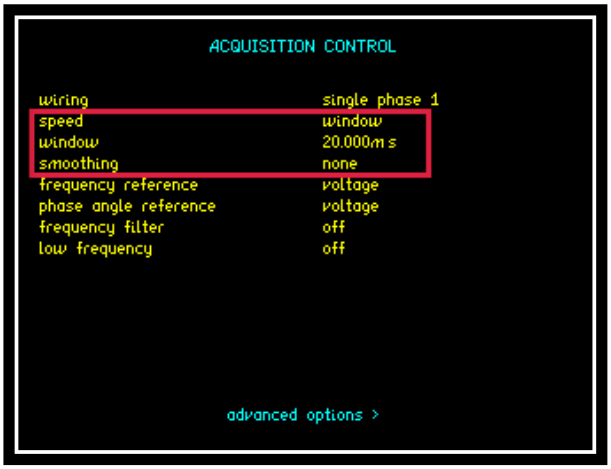
Setting the range parameter

This is best configured if the user has prior knowledge of the peak current measurement expected from the DUT. If this is not available then the user should set the current settings as follows.

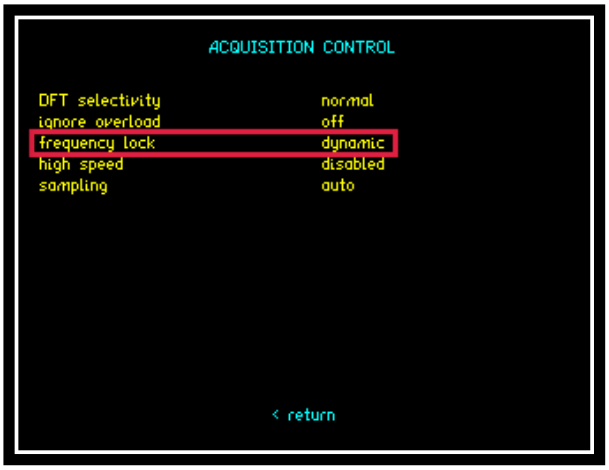


Set the autoranging parameter to "range up only" and the minimum range to the 30mA range this will allow the test being carried out to find the highest range via peak detection and hold on this range

Setting the Speed and Smoothing



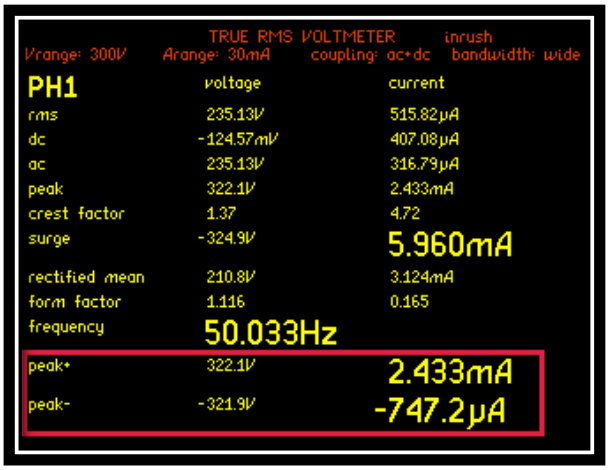
For this application a mains input signal of 50Hz was used, therefore we are able to set the speed to window and 20.00ms this will enable us to capture cycle by cycle data over the whole waveform, to get the instantaneous cycle by cycle power the smoothing parameter is best set to none as shown



Upon completion of the speed and smoothing settings press the ▶ arrow to take you to the advanced settings screen. If undertaking cycle by cycle measurements on the input signal then set the frequency lock to "Dynamic"

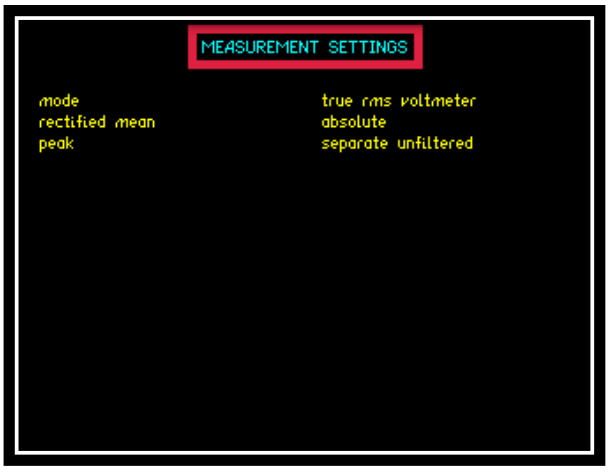
Setting Peak Measurement Parameters

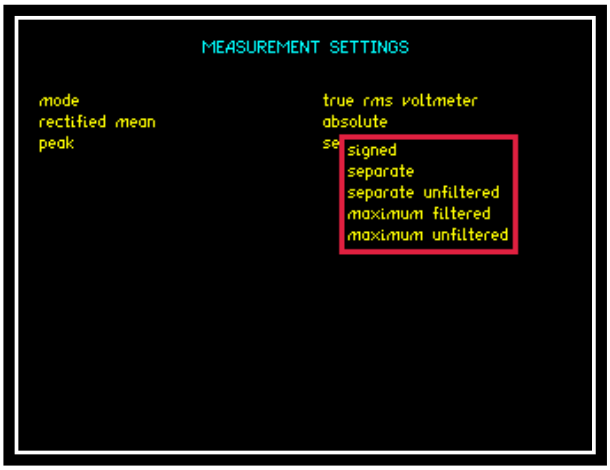
If required you can display the Peak+ and Peak- measurements within the RMS Voltmeter mode screen



These parameters can be configured within the True RMS Voltmeter mode button

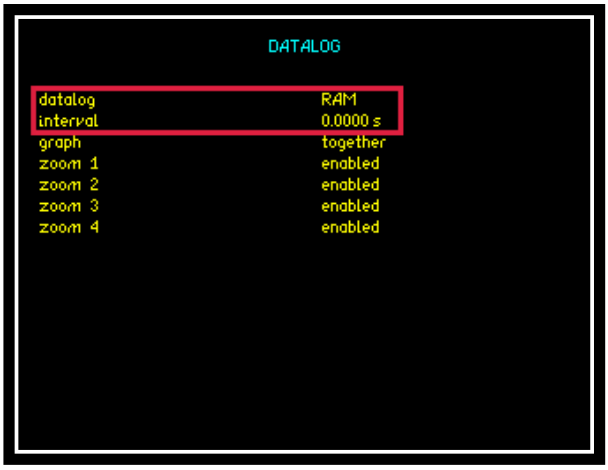
Press the "RMS" mode button until the measurement settings screen is displayed





For this demonstration we selected "separate unfiltered" this then gave us the unfiltered Peak + and Peak – measurement parameters as displayed earlier for both Voltage and Current

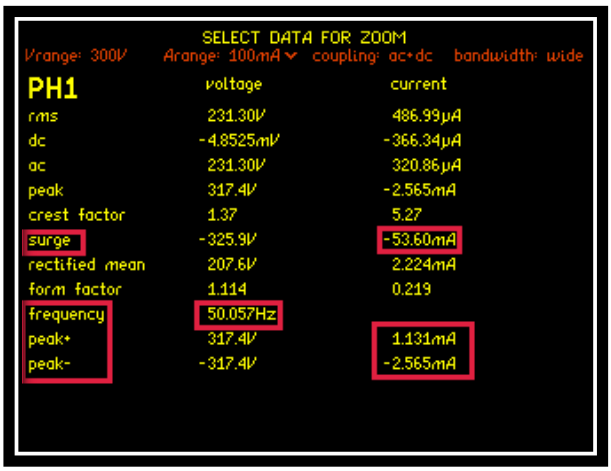
Data logging to Internal Memory

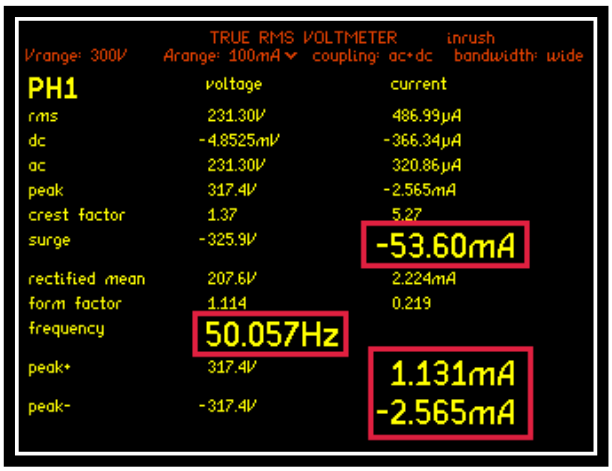


Set the Datalog to be performed to the internal RAM memory this will offer the user the fastest performance

Set the interval time to 0.00s to enable the Datalog to capture every cycle of the fundamental frequency

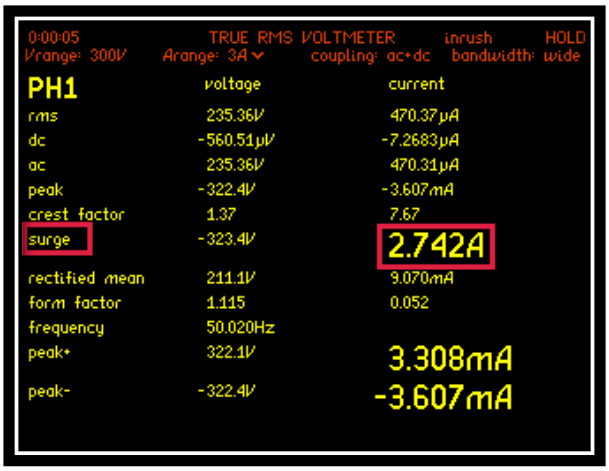
Reconfigure zoom parameters within real time display as described within section 6.3



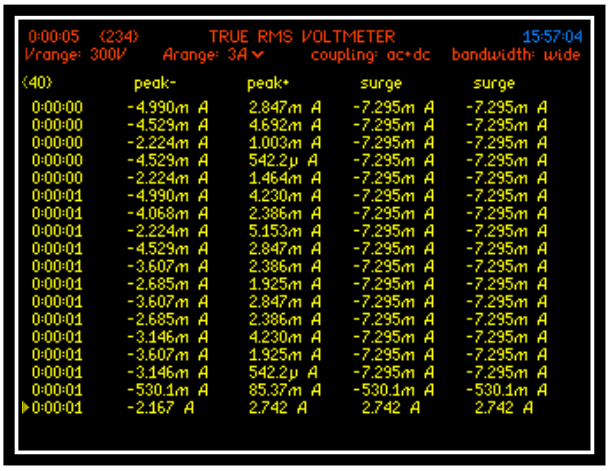


Zoomed parameters can now be used to capture the Inrush Current (Surge) data within a Datalog

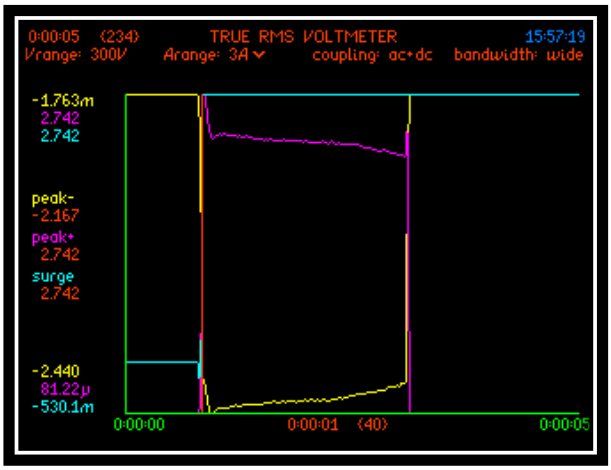
DataLog Results



From the Real Time display the surge measurement at the moment the DUT was switched on is recorded as 2.742A

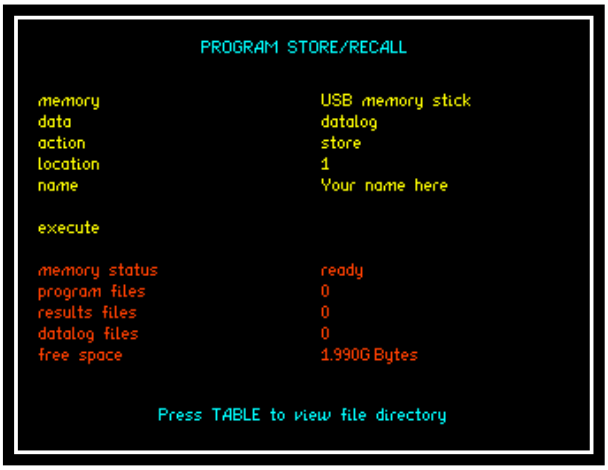


Pressing the "TABLE" button will now display all the data points taken from the associated DataLog and you will notice that the Inrush Current (Surge) is displayed as being 2.742A



Pressing the "GRAPH" button will display in a graphical format all the data points from the associated DataLog displayed within the previous screenshot it is clear that the surge displayed within the tabular display corresponds with the graphical display

Upon completion you are now able to save / recall or delete your test results taken from your DataLog within the " PROG" mode button

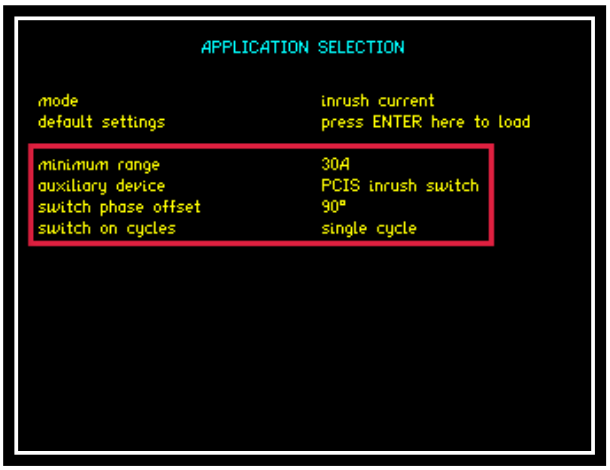


Transferring the Datalog from the RAM memory onto a USB memory stick will allow the user to export the .txt file into an .xls file if desired, more details can be found relating to the transfer of data within section 7.1

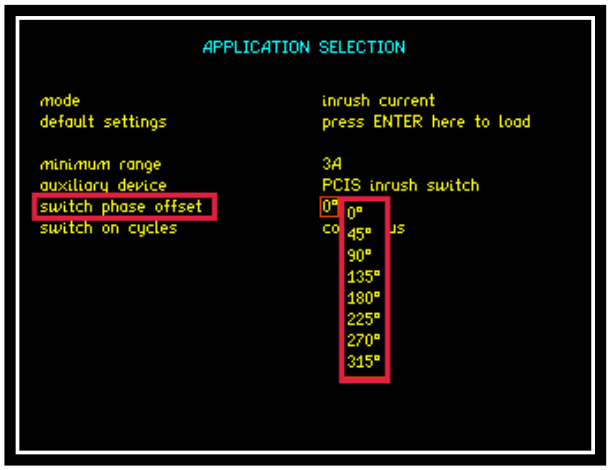
Inrush Current Mode using the N4L PCIS Switch

For the worst case inrush current the input to the device under test must be switched on at the worst point in the cycle (90° or 270° for a capacitive load, 0° or 180° for an inductive load). The Phase Controlled Inrush Switch, or PCIS, available as an accessory for the PPA55xx, controls the switch on of the power to the DUT from 0°to 315° in steps of 45° from the Instruments front panel.

Set up is the same as before but you will need to enter the PCIS switch as the auxiliary device and then set the switch phase offset and switch on cycles parameters as described below



Switch Phase Offset:



Press ▼ Key

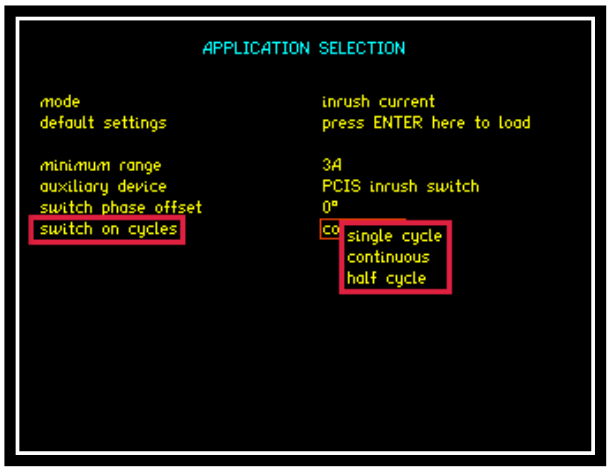
Switch Phase Offset parameter will be selected (controls the switch on of the power to the DUT from 0^{0} to 315^{0} in steps of 45^{0})

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:



Press ▼ Key

Switch on Cycles parameter will be selected

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

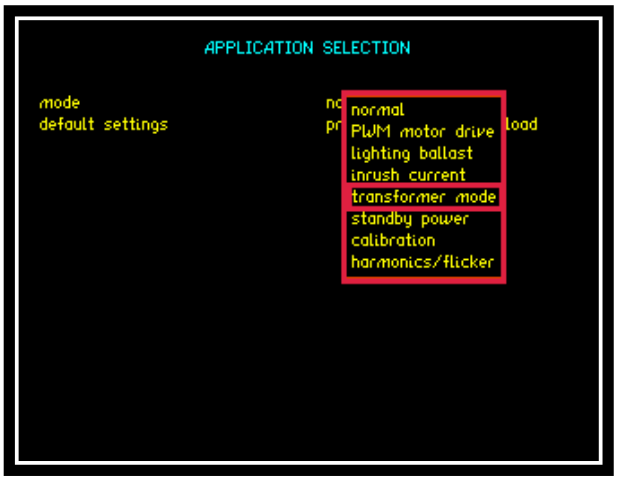
Press ▼ ▲ arrows to select waveform cycle parameter required

Press "ENTER" to confirm selection

6.5.4 Transformer Mode (Single Phase)

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. For both single and three phase tests the Corrected power (Pcorr) and K-factor values are displayed in the results window.

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

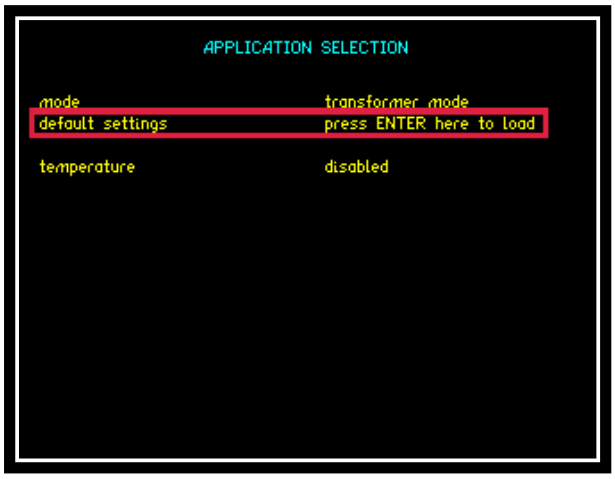


Accessories: 1 x Break out Box

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 displayed, transformer mode will now be selected

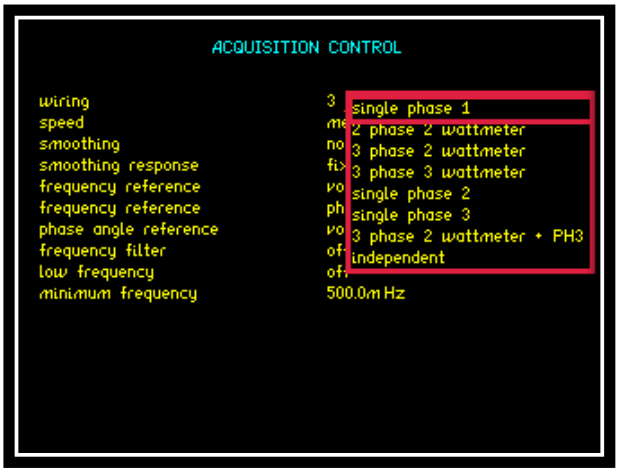
Press the down arrow 1 more time to highlight default settings mode and press "ENTER" this will set the instrument into its default settings for transformer mode



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.

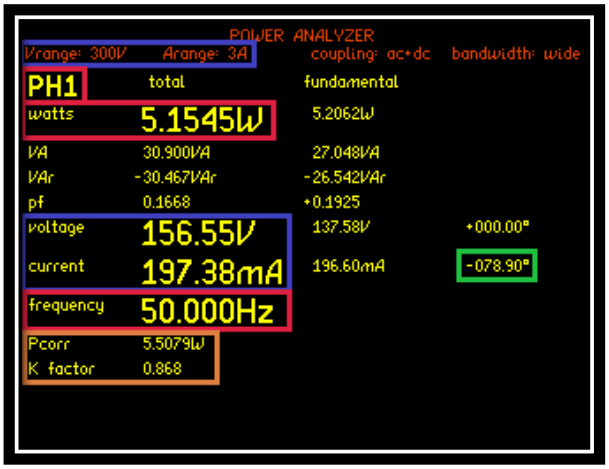
Press "ACQU" button which will bring up the "ACQUISITION CONTROL" screen. Press the down arrow once so the red box flashes around the wiring selection; press the right arrow to open up the drop down menu as seen within the screenshot below



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. 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



The Voltage and Current measurements displayed within the Blue Box above reflect the auto ranging configured by selecting the default settings within the instruments application home set up screen

Viewing the data (Green Box) the phase angle of the fundamental is shown as 78.90^0 . A perfect transformer would display a phase angle of 90^0 . 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

The Pcorr (Corrected Power) and K factor values displayed within the Orange Box (see previous page) are computed in transformer mode. In transformer mode there is usually very little distortion. The equations used to calculate these values are:

The K factor equation is the lower one in the left hand column.

The Corrected power (P_0) equation is the top one in the right hand column.

IEC76-1(1976), ANSI/IEEE C57.12.90-1993	IEC76-1(1993)
$P = \frac{P_m}{P_1 + k \cdot P_2}$	$P_0 = P_m(1+d)$
$k = \left(\frac{U}{U'}\right)^2$	$d = \frac{U' - U}{U'}$

Where

P or P_0 = corrected power

P_m = measured power

P_1 = ratio of hysteresis loss to total iron losses

P_2 = ratio of eddy current losses to total iron losses.

U' = Normalised mean value of voltage

U = rms value of voltage

Within the measurement screen the display shows that with "NO" load connected the transformer is consuming 5.15W 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)

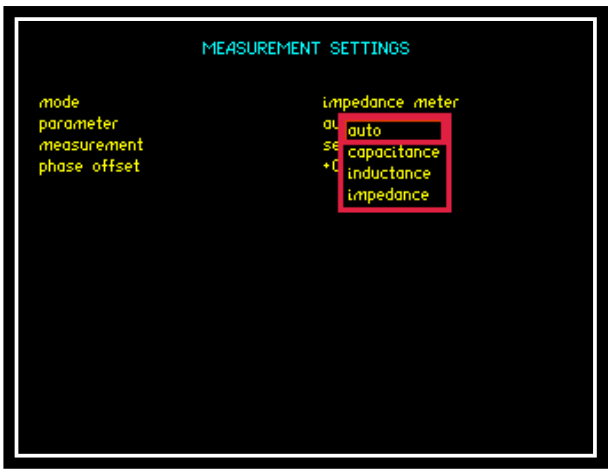
In the next set of screen shots we will be able to view this data

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



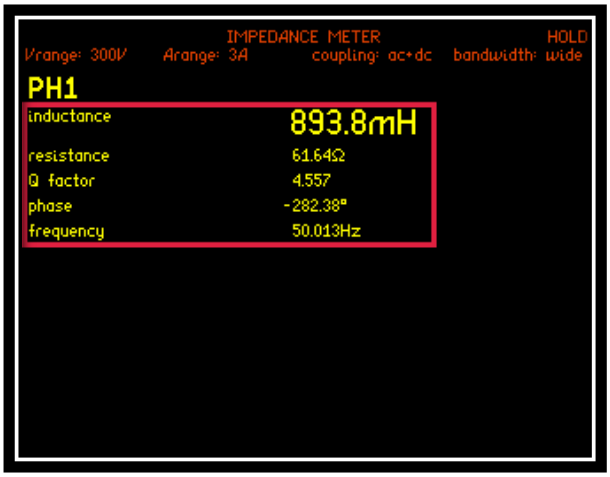
From the drop down menu you will now be able to view all parameters as shown or alternatively by selecting "auto" the display will show the appropriate parameters values attributed to the DUT

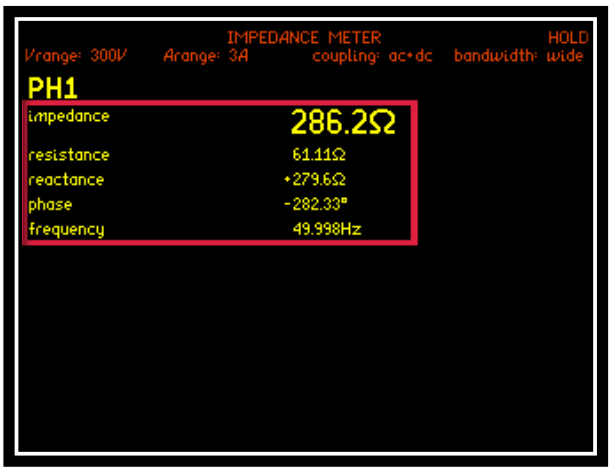
Press "ENTER" to confirm selection

Press "ENTER" to return to home screen and view measurements

From the "auto" screen 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 at the selected frequency

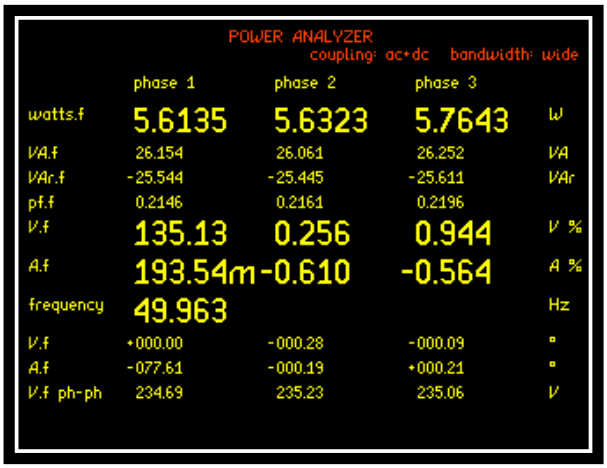




To view the total Impedance calculated you will need to change the display screen back from "Auto" to "Impedance" as shown

Transformer Mode (Three Phase)

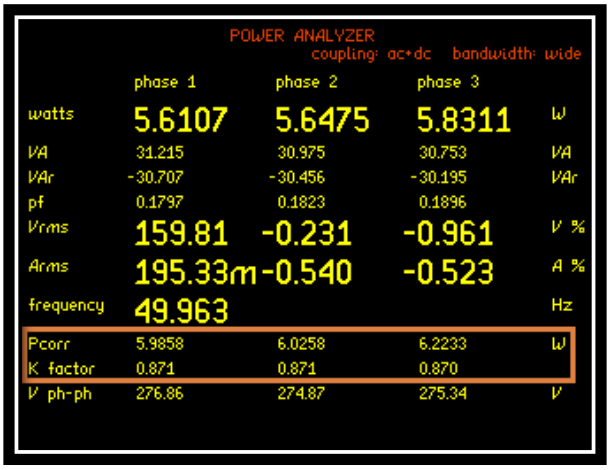
When performing analysis of a 3 Phase load, transformer mode is extremely useful. The PPA will display phase balance information in an intuitive manner without the requirement for a vector display, this has the advantage of maintaining 5 digit resolution which is not possible whilst attempting to visually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



As illustrated, the PPA is able to display 3 phase power simultaneously, along with this the Voltage % and Current % deviation from the phase 1 readings displayed. The phase reference is taken from phase 1 Voltage and we can see that phase 2 and 3 are (120-0.28) deg and (240-0.09) deg respectively.

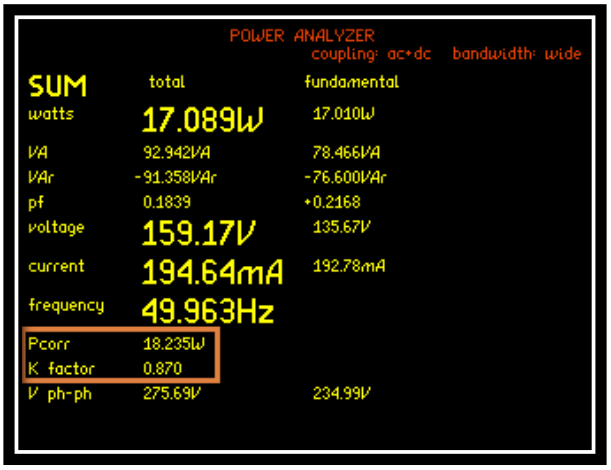
Pcorr (Corrected Power) and K factor values are also displayed in Three Phase Transformer mode.

The calculated values for Pcorr and K factor are displayed for each phase, this can be seen in the Orange box below:



On the SUM screen the displayed Pcorr value is the sum of the Pcorr values for each of the three phases.

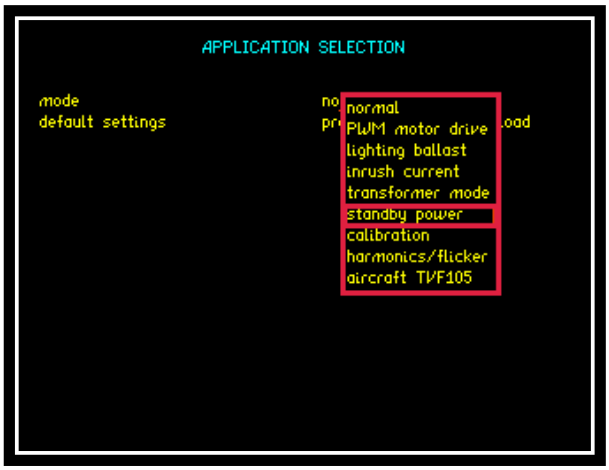
The K factor displayed on the Sum screen is the average of the K factor values for each of the three phases.



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:



Press "APP" button

Press ▼ button

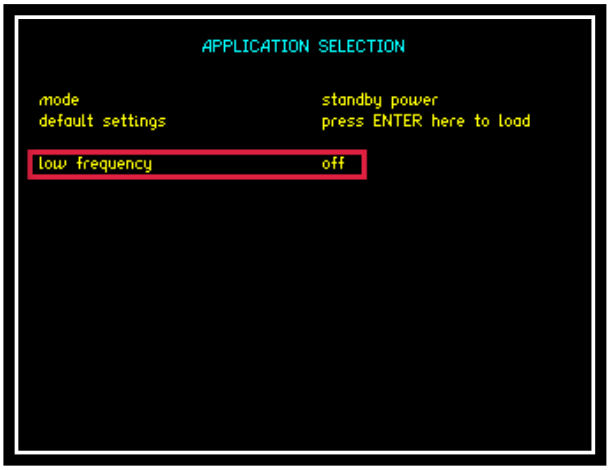
Press ▶ button. This will open the drop down menu selections

Press ▼ 5 times until red box surrounds standby power

Press "ENTER" this will now set the mode

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

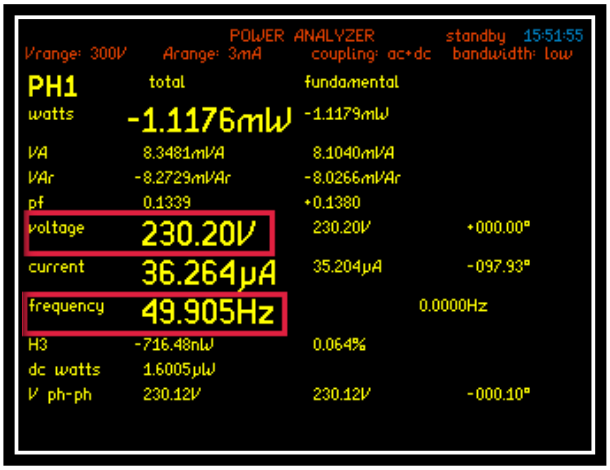


Pressing "ENTER" to load the applications default settings will automatically set the low frequency parameter to "OFF"

You can now return to the Power Analyzer screen

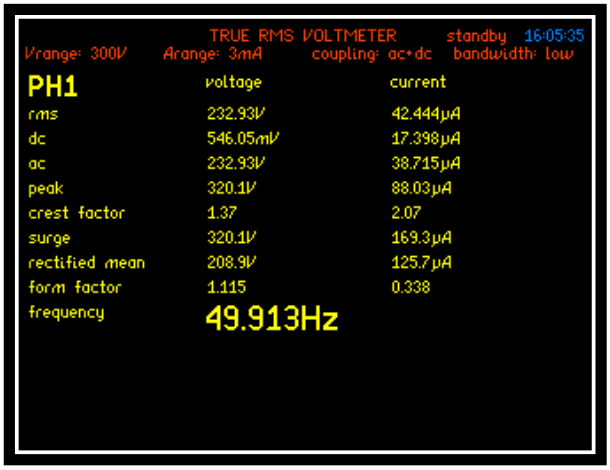
Test device: 1 x Stand alone Heater

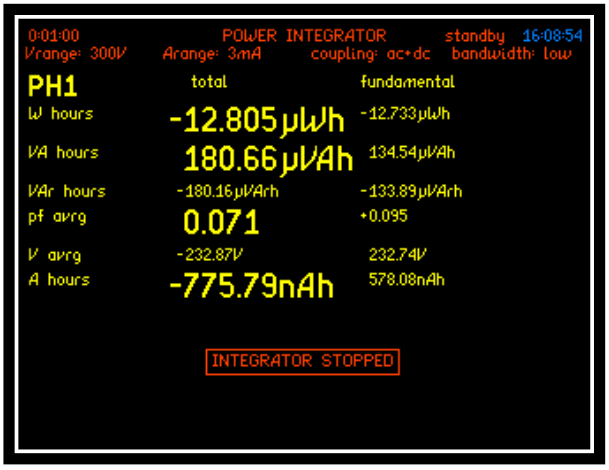
Accessories: 1 x Break Out Box



The real time display shows a screenshot from the Power Analyzer home screen with the test device in standby mode

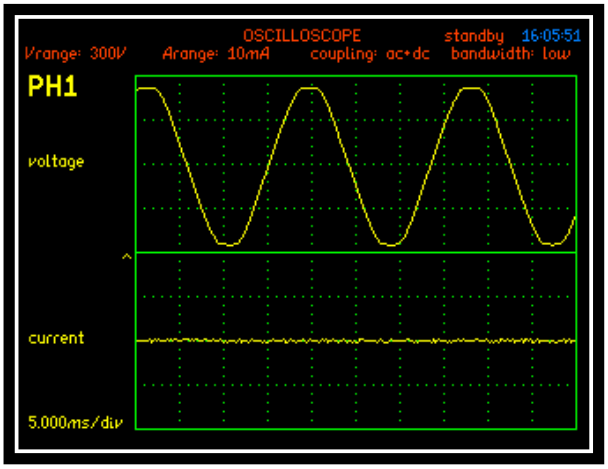
Reverting to the "RMS" screen you can see all the subsequent voltage measurements from each phase associated with the test unit in Standby Mode





Left is a display taken from the power integrator screen "INTEG", 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.



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;

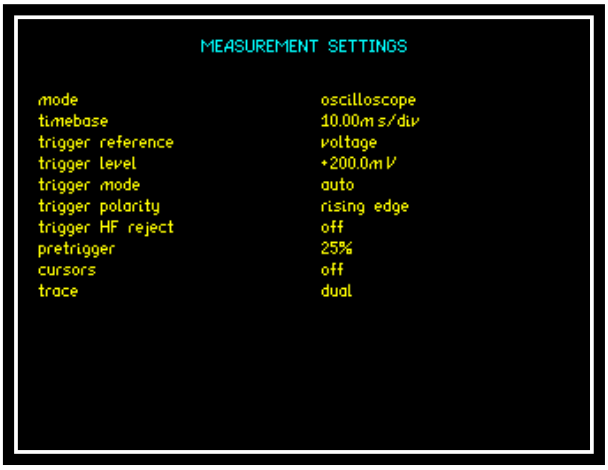
support@newtons4th.com

6.5.7 OSCILLOSCOPE MODE

The PPA55xx 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)

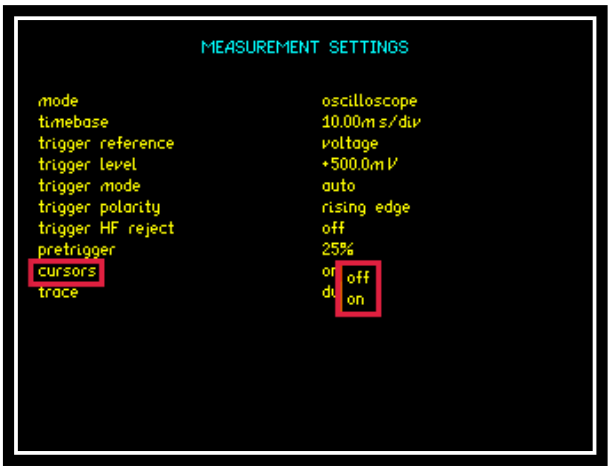
The single shot option is reset using the "TRIGGER" key

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



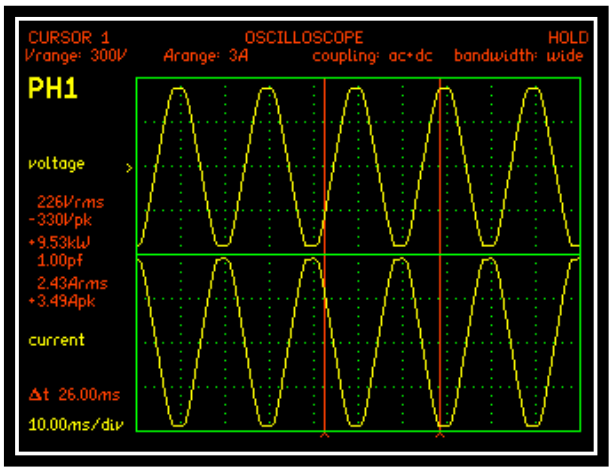
When enabled use the ▲▼ keys to enable and switch between Cursor 1 and Cursor 2.

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

NOTE:

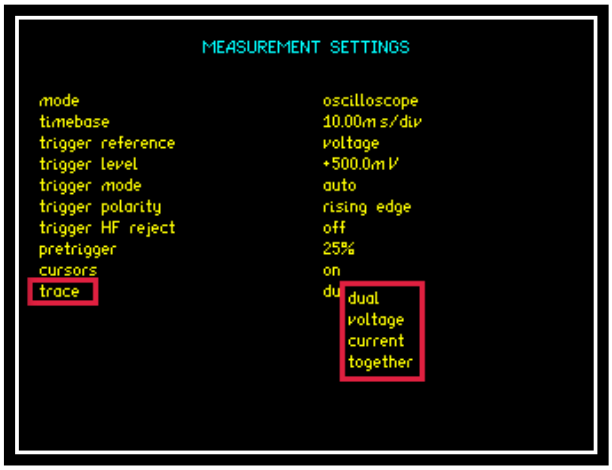
When the cursors are enabled then the "LEFT" and "RIGHT" arrows no longer adjust the timebase

Screenshot from Scope display with "Dual" cursors configured

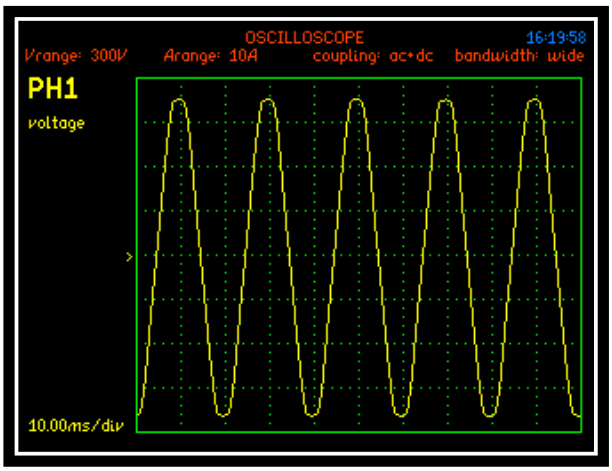


From the screenshot above the display shows all fundamental measurements from the position of cursor 1. Also displayed is the time difference between the 2 cursors, "delta t" = 26.00ms with the timebase set to 10ms/div

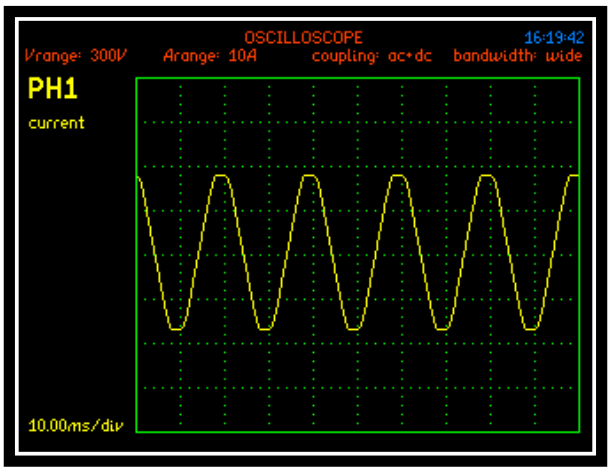
Trace: Set which waveform the user wishes to be displayed at any one time from the 4 options within the drop down menu



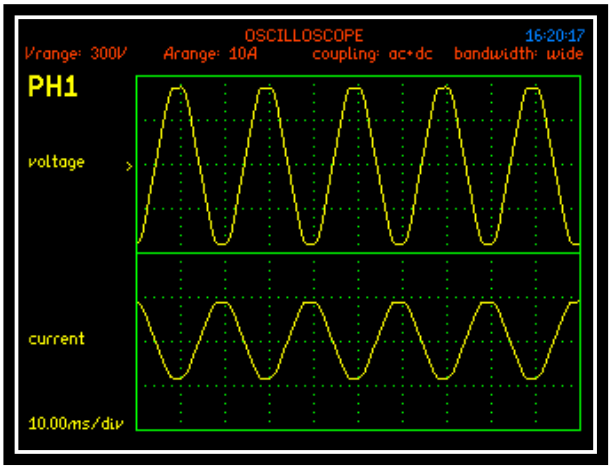
Trace set to Voltage:



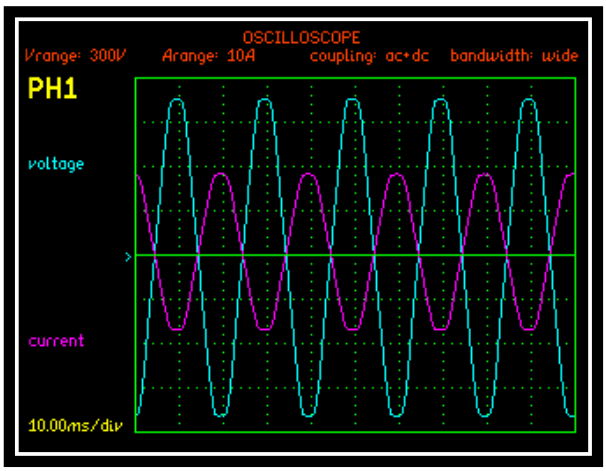
Trace set to Current:



Trace set to Dual:



Trace set to Together:



PPA CAPTURE MODE

To perform capture mode tests it is necessary to use a PPA5510 or a PPA5530 and upgrade the Firmware within the instrument to either PPA5512 (Single Phase) or PPA5532 (Three Phase)

Capture mode operates as a sub function of the normal oscilloscope mode – enable “capture mode” in the application menu. Data is then stored in a 50000 byte circular buffer per channel. Set the trigger mode to single shot and trigger as normal. Extracting the sample data is performed using the CAPTUR? command. Data is returned in 200 lines per channel of 250 values.

The sample capture data reply is consistent with multiple lines of IEEE488.2 “definite length arbitrary block response data”. So each line of data should return as follows:

[#3503] [h1][h2] [d1.1][d1.2][d2.1][2.2]……[d250.1][d250.2] [error] [CR] [LF]

Each line consists of:

5 bytes that represent #3503 (ASCII)
2 bytes that represent the Header bits including channel number [h1][h2]
500 bytes that represent the actual data. 250 pieces of data each made up of 2 bytes. d1.1 is data 1 bit 1, d1.2 is data 1 bit 2, d2.1 is data 2 bit 1, d2.2 is data 2 bit 2 etc
1 byte that represents the error checking bit [error]
1 byte that represents Carriage return [CR]
1 byte that represents Line Feed [LF]

Each 8 bit byte has the msb set in order to prevent any misinterpretation of data within drivers and software which otherwise could mistake data for carriage return etc. so 14 bit data values are returned.

The meaning of the 2 header bytes is as follows:

(header h1)	(header h2)
[1][c2][c1][c0][0][0][0][a7]	*[1][a6][a5][a4][a3][a2][a1[a0]*
^ first bit	^ first bit

And as for the meaning of each of the bits:

[0][0][0] these 3 bits are not used and can be ignored.

[c2][c1][c0] are the channel number
4 2 1 so the channel number can be a number between 0 and 7

[a7][a6][a5][a4][a3][a2][a1][a0] are the line number.
128 64 32 16 8 4 2 1 so the line number can be a number between 0 and 255.

The meaning of each pair of data bytes is as follows:

(data d1.1)	(data 1.2)
[1][d13][d12][d11][d10][d9][d8][d7]	*[1][d6][d5][d4][d3][d2][d1][d0]*
^ first bit	^ first bit

[d13] [d12] [d11] [d10] [d9] [d8] [d7] [d6] [d5] [d4] [d3] [d2] [d1] [d0] contain the data [a number]
8192 4096 2048 1024 512 256 128 64 32 16 8 4 2 1

So the data can be a number between 8191 and -8192.

RETURNED DATA (BINARY FORMAT)

The returned data starts by indicating the date / time and setup mode.

The first line of data is then displayed. The format is as stated above. The first 5 bytes with an MSB of “0” represent #3503 (ASCII). The first 2 bytes with an MSB of “1” represent the header followed by the 500 bytes of data. The final byte with an MSB of “1” is the error check. The line is completed with 2 bytes starting with an MSB of “0”, these are [CR] and [LF].

This is then repeated for each of the remaining lines.

RETURNED DATA EXAMPLE

 # 3 5 0 3 h1

03/06/2014 13:57:24 [RX] 00100011 00110011 00110101 00110000 00110011 10010000

h2 d1.1 d1.2 d2.1 d2.2 d3.1 d3.2 d4.1 d4.2

10000000 10010001 11000101 10011110 11000101 10011010 11000101 11110101 11000110

etc until

d248.1 d248.2 d249.1 d249.2 d250.1 d250.2 [ERROR] [CR] [LF]

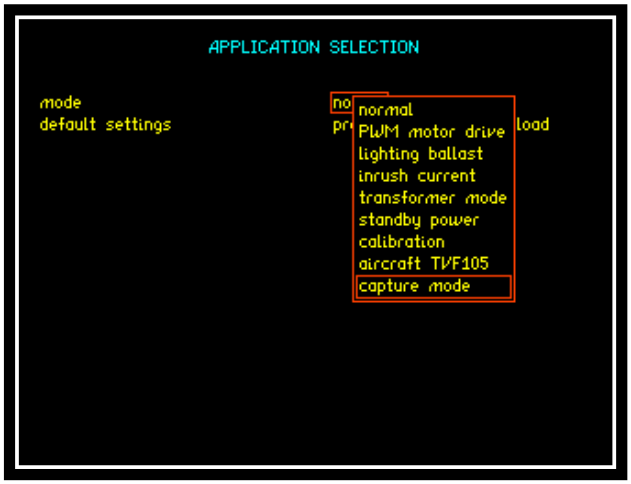
10111011 11001111 10111101 11001010 11000101 11000110 11101101 00001101 00001010

This example is from the start of the returned data. The date, time and mode etc are displayed first. The data for the first line starts from the byte of data labelled # and finishes with the data byte labelled [LF]. Only the early and later pairs of data bytes are shown in this example.

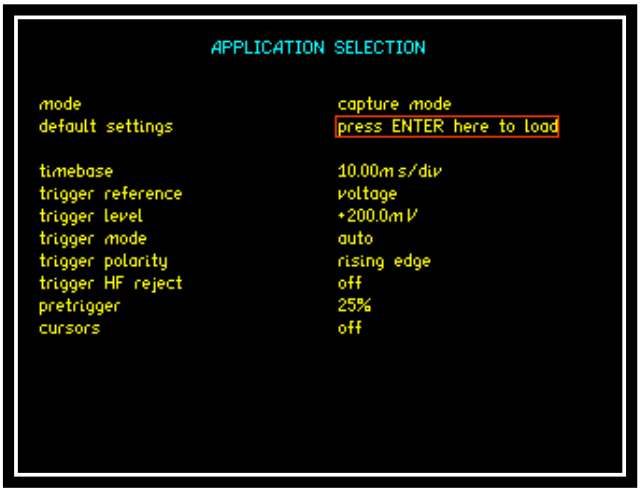
PPA Settings for Capture Mode

To run capture mode it is necessary to set the PPA up as follows:

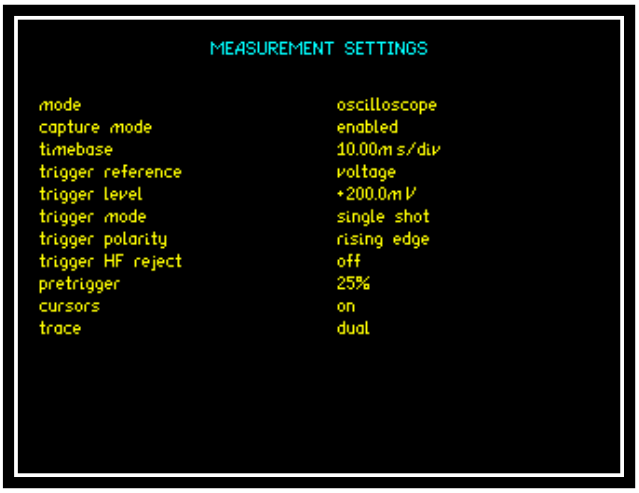
Press the APP button and select capture mode on the drop down menu. Press enter.



The Capture mode settings are then displayed. Select the Default settings and press enter



Press the mode button and confirm that the settings are as shown in the screenshot below.

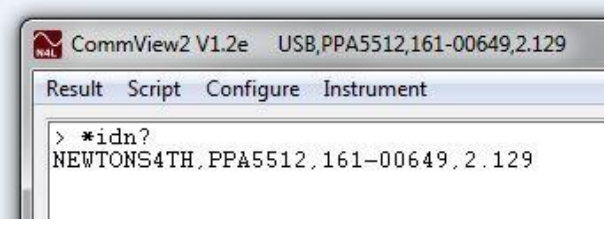


Press the enter button, the PPA display shown will now be in Oscilloscope mode.

CommView2 Software

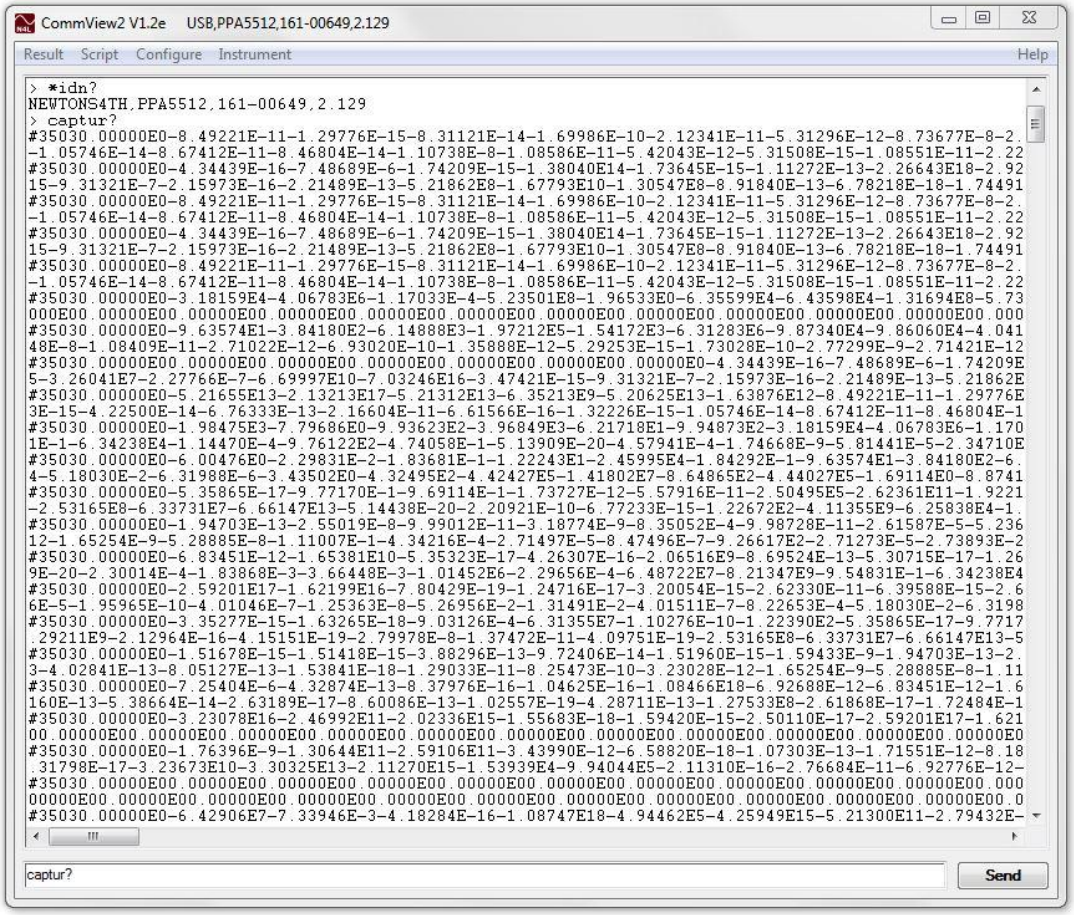
Open the N4L CommView2 software.

Enter the *idn? command and press send, check the reply to confirm that the software is connected to the correct instrument model (either PPA5512 or PPA5532), serial number and Firmware Level.



Enter the Captur? Command and press send.

The capture data should now start to be displayed in the CommView2 window. The data download should take around 25 seconds to complete.



The above screenshot shows the CommView2 window with the capture data being downloaded.

If there is a problem getting the CAPTUR? Command to start returning data it may be necessary to adjust the trigger level on the PPA in the mode menu.

6.5.8 HARMONICS / FLICKER MODE

IEC61000-3-2 Harmonics – For use with IECSoft software

IEC61000-3-3 Flicker test – For use with IECSoft software

IECSoft software is intuitive software that guides the user through the Harmonics and Flicker test applications. More information can be found by downloading the IECSoft guide from the N4L website www.newtons4th.com

6.5.9 AIRCRAFT TVF105 MODE

The Aircraft TVF 105 application must be configured and run in conjunction with N4L PPA Datalogger software.

Connect the PPA5500 to PPA Datalogger version v3.1b or above.

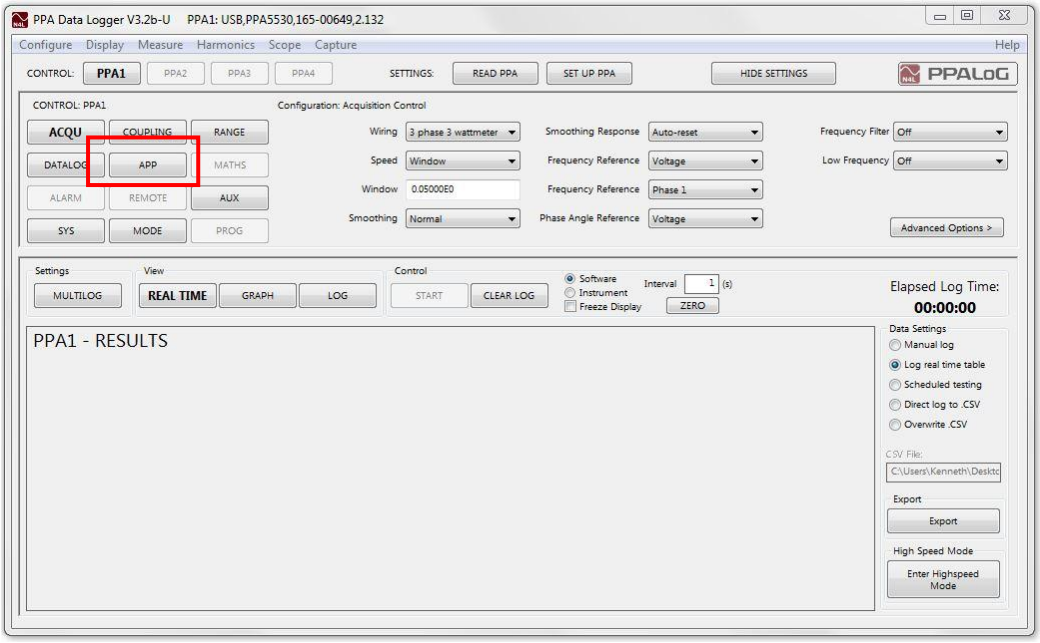
Set up the software according to the following steps:

Step 1.

Click on ACQU.

Set Speed to Window.

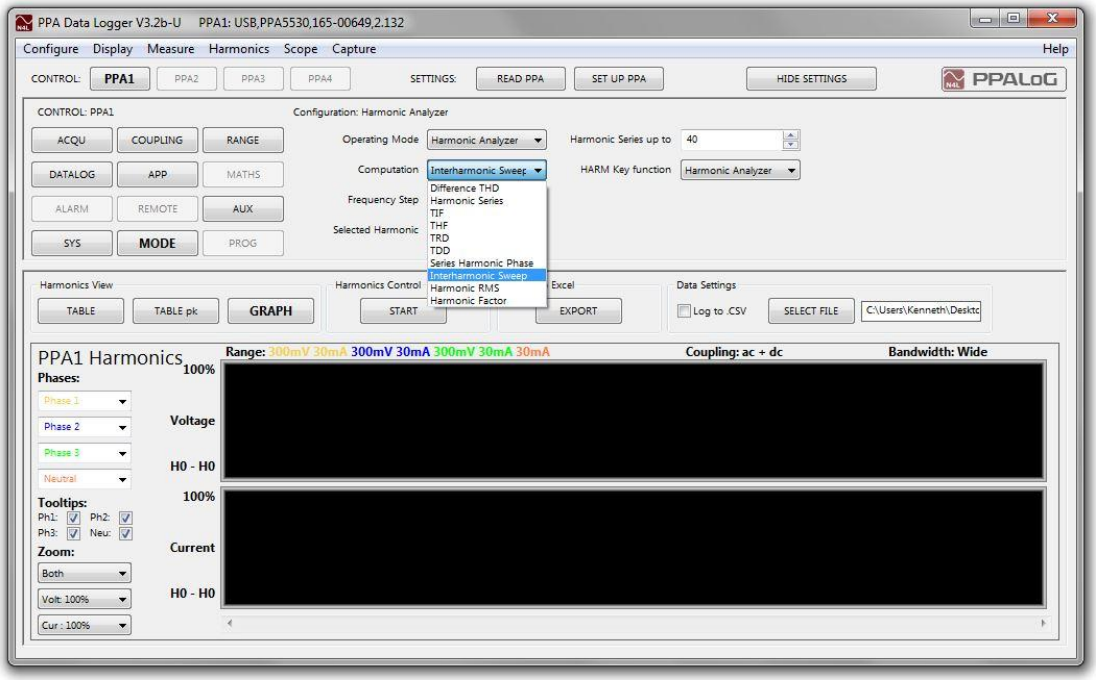
Set Window to 50mS (0.050 or 5.0000E-2)



Step 2.

Enter the Harmonics mode and select;

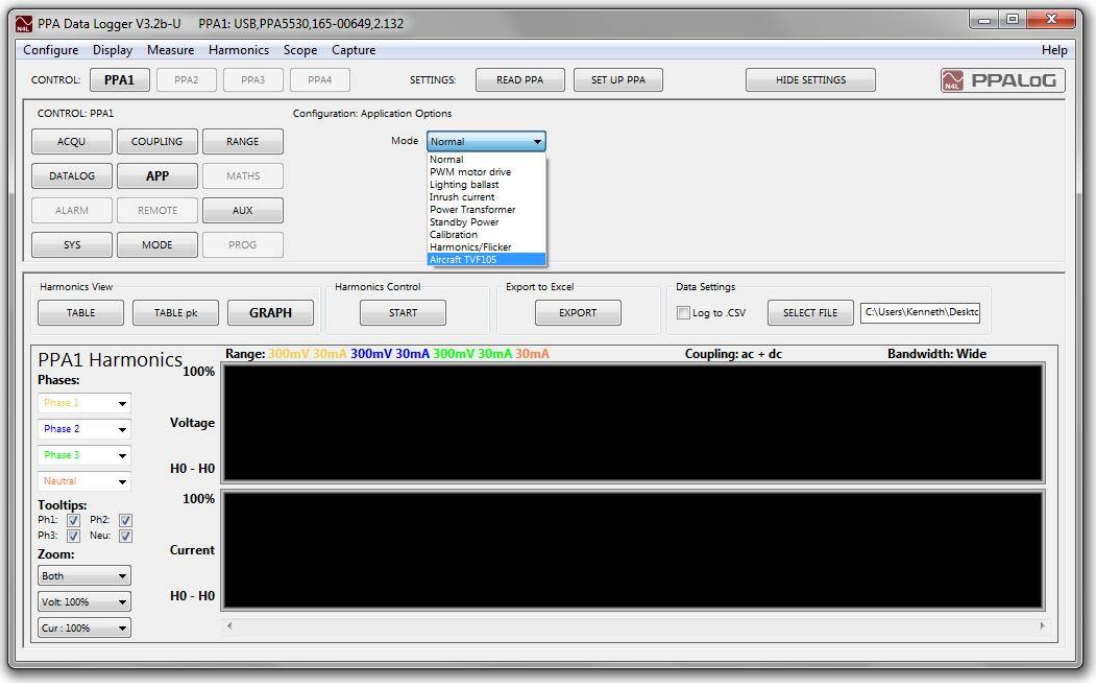
Computation: Interharmonic Sweep



Step 3.

Enter APP Mode and select;

Mode: Aircraft TVF105



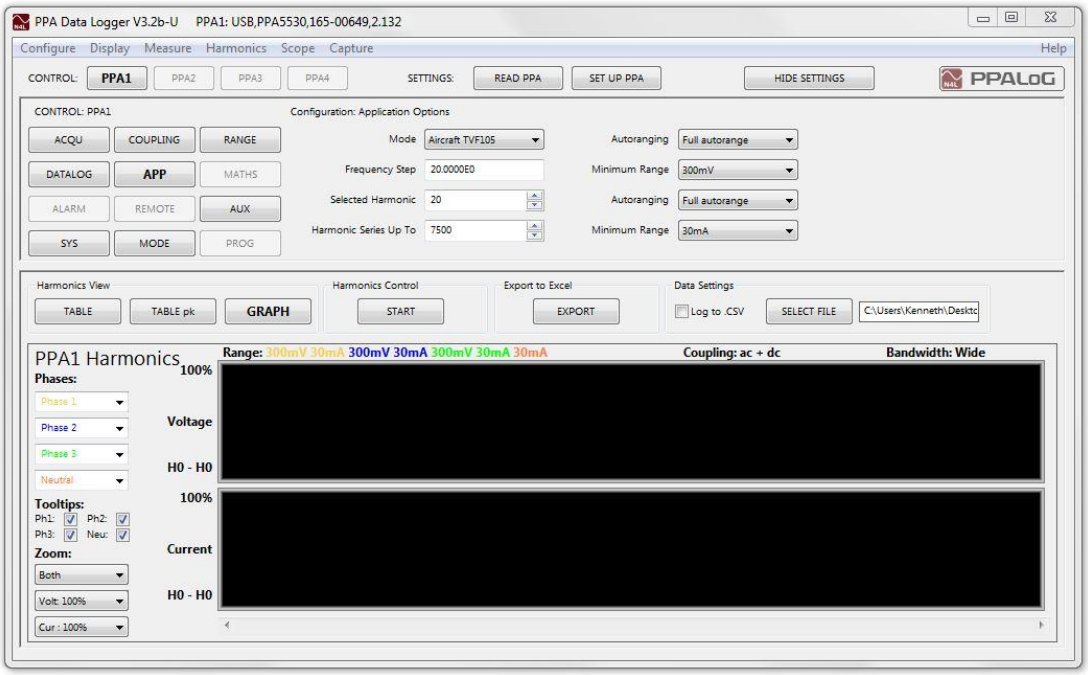
Step 4.

Select;

Frequency Step: 20 Hz. (20, 20.0000E0 or 2.0000E1)

Selected Harmonic: 20

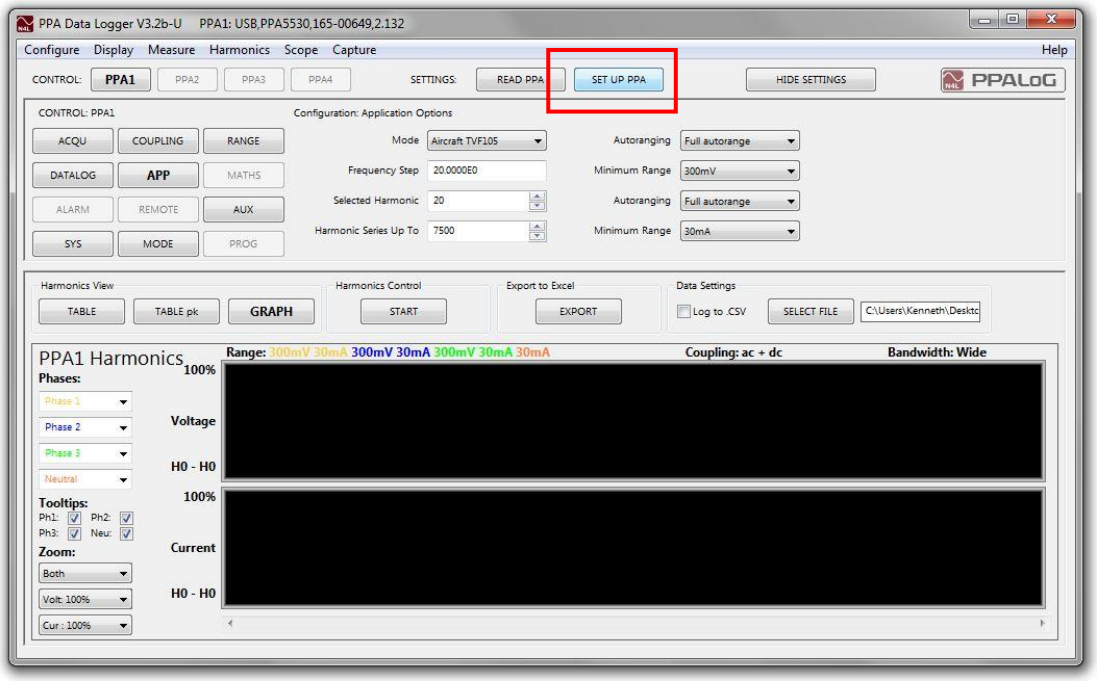
Harmonic Series Up To: 7500



Step 5.

Select;

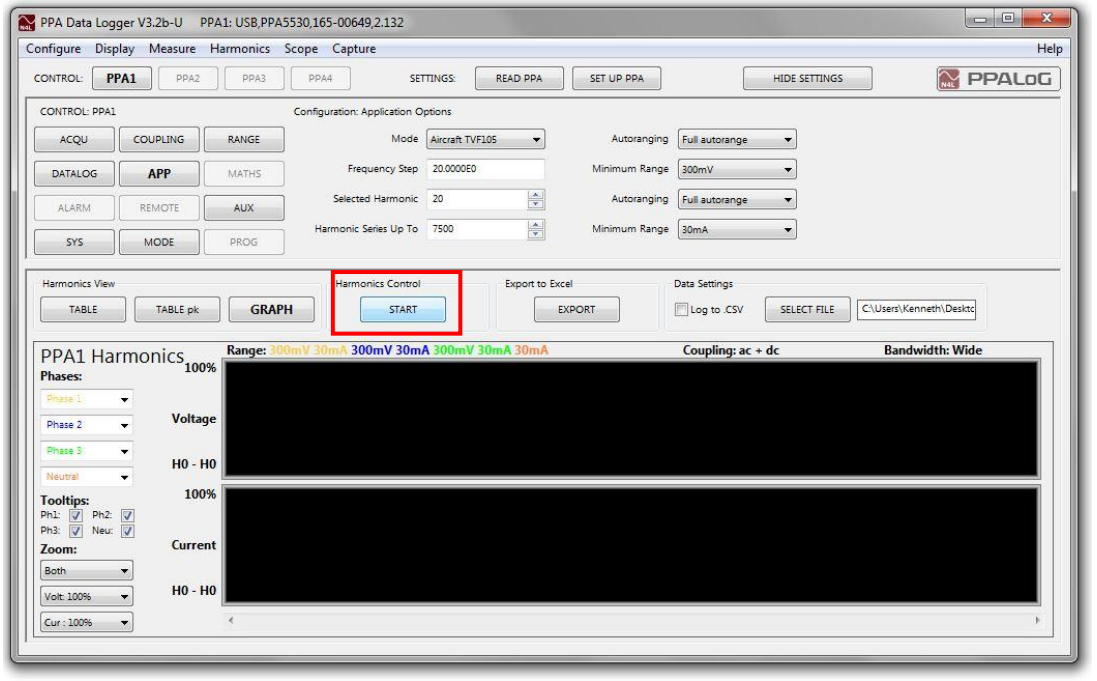
Click the “Set up PPA” button



Step 6.

Select;

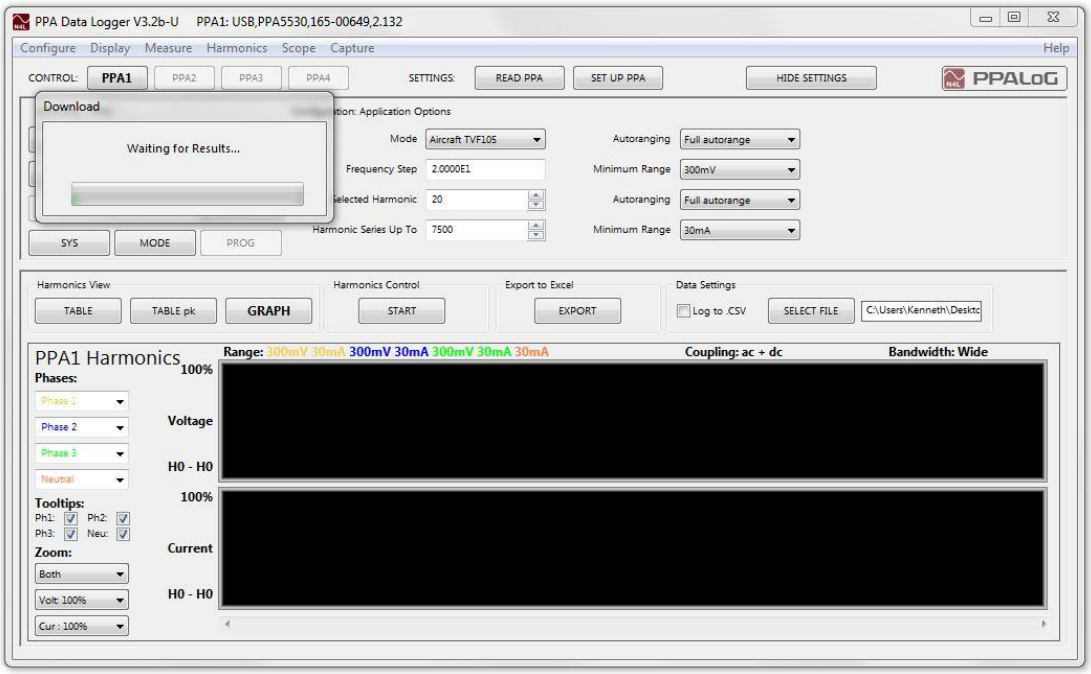
Click the “Start” button



Step 7.

Wait for test to complete (approx 30 mins)

The software will display a message: “Waiting for Results”

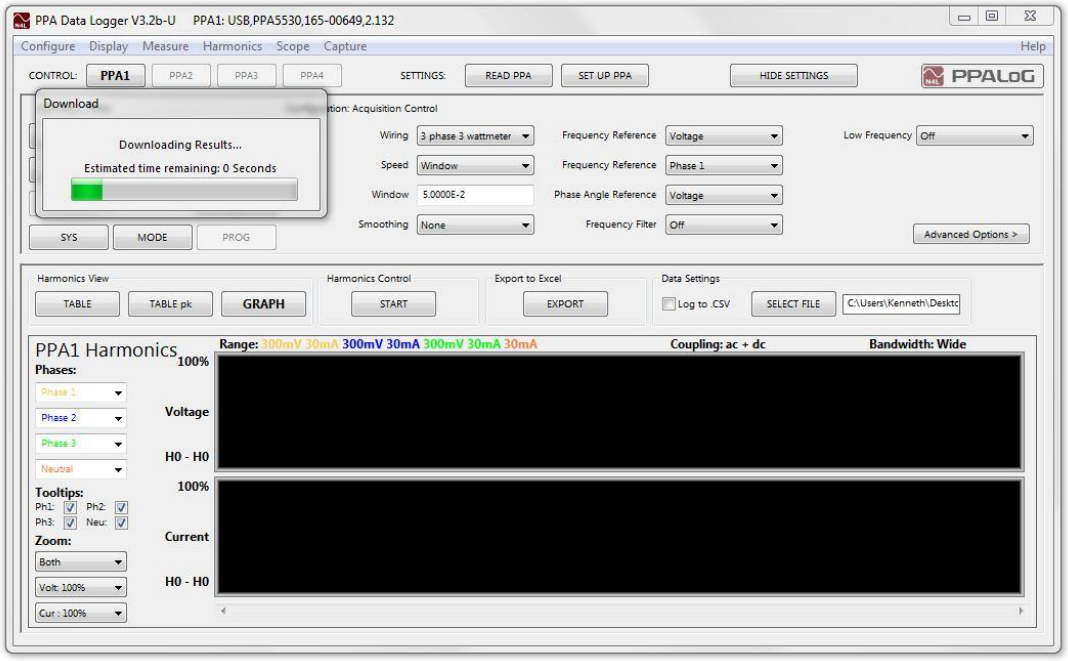


On the PPA display, a flashing message is displayed: “Sweep Running”

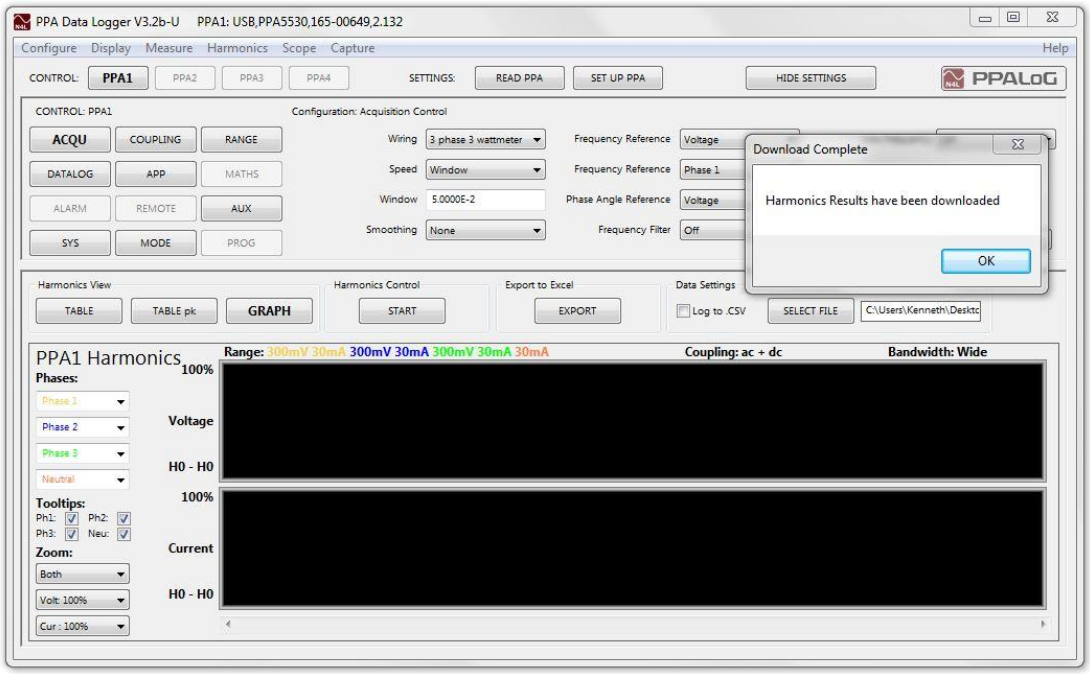
The test number will be incrementing in the top left hand corner of the display.

Step 8.

On completion of the tests the software will start to download the results from the instrument.

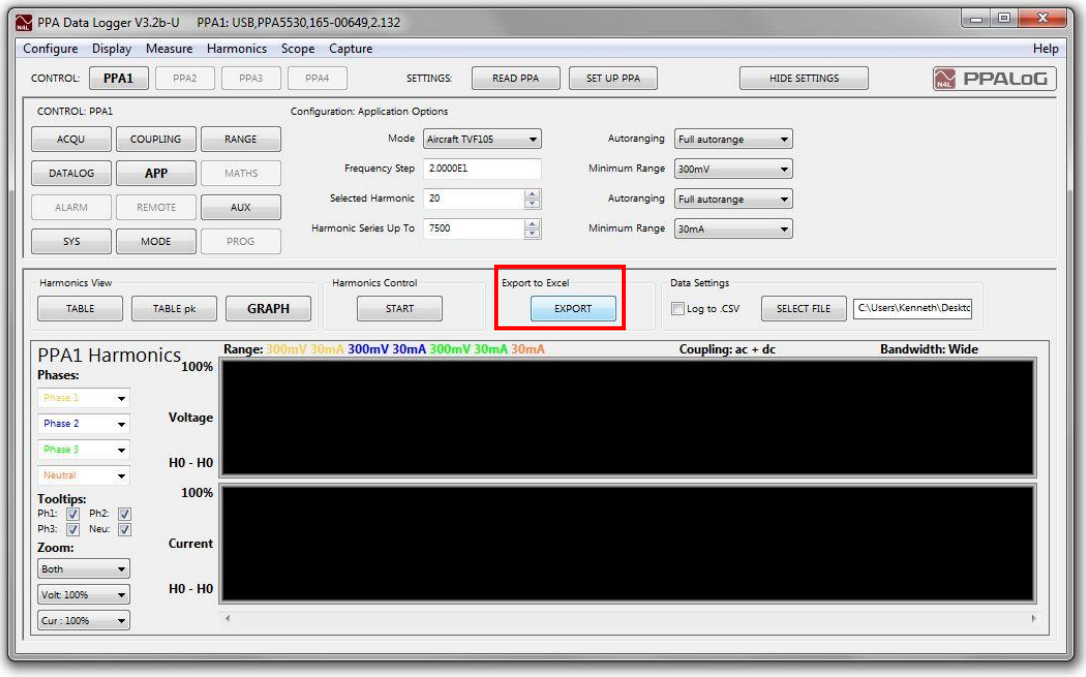


The message is updated once the results have been downloaded.



Step 9.

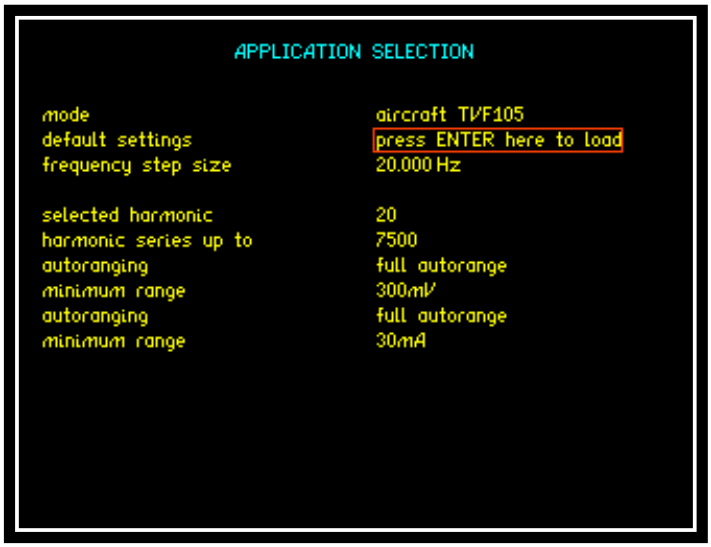
An Excel results document can be created by clicking on the Export button in the software.



Note:

Rather than performing steps 1-5 above the settings can instead be entered on the PPA. Press the APP button and set the mode to "Aircraft TVF105"

Use the arrow keys to move the cursor to the default settings. Press the enter key on the PPA to enter the default settings. Finally click on the "Read PPA" button in the software to transfer the settings from the PPA into the software. Ensure the software is displaying the Harmonic test window and then proceed from step 6 above.



6.5.10 Interharmonic Sweeps

Interharmonic voltages and currents can be measured and displayed in an Excel report using PPA Datalogger software.

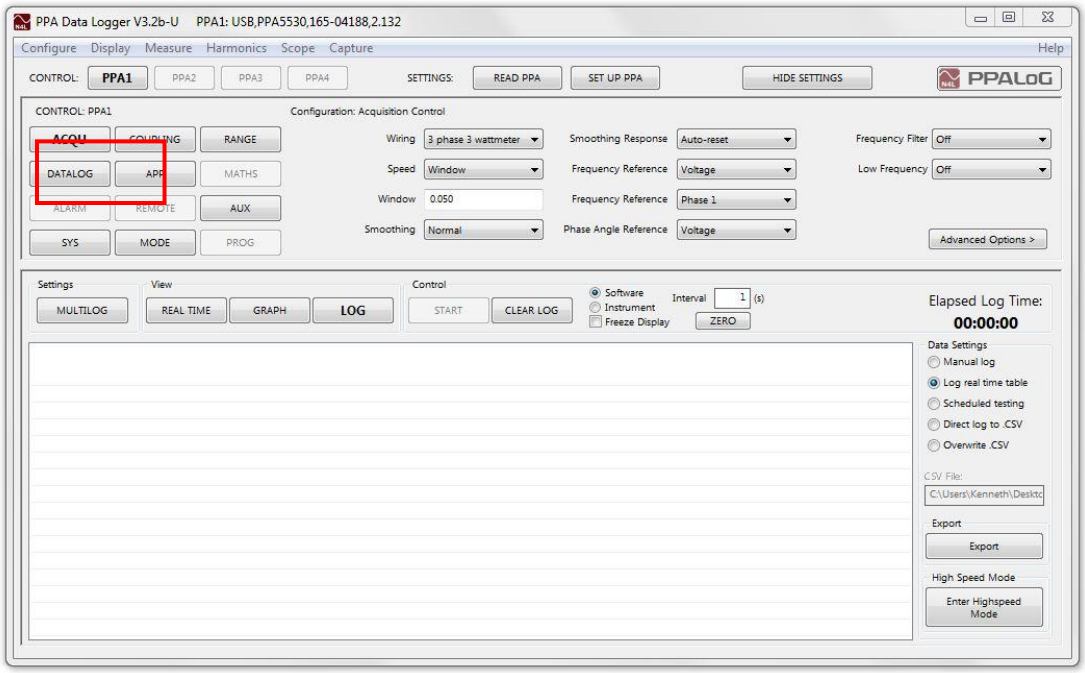
Connect the PPA5500 to PPA Datalogger version v3.1b or above.

Set up the software according to the following steps:

Step 1. (Optional)

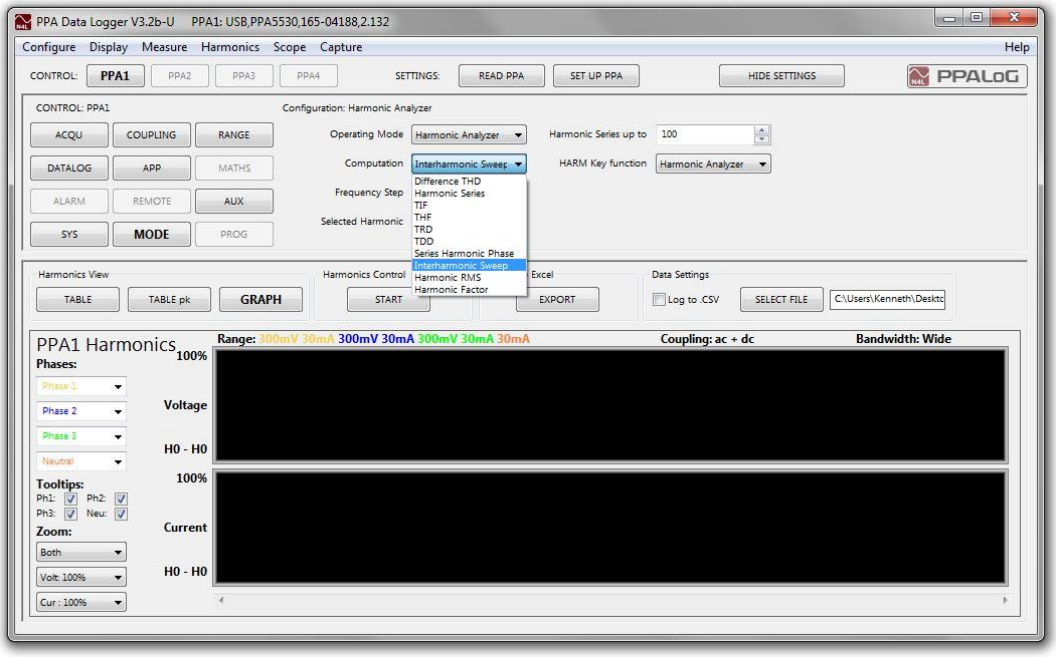
Click on ACQU.

Set Speed to the required setting. If "Window" is selected enter the speed.



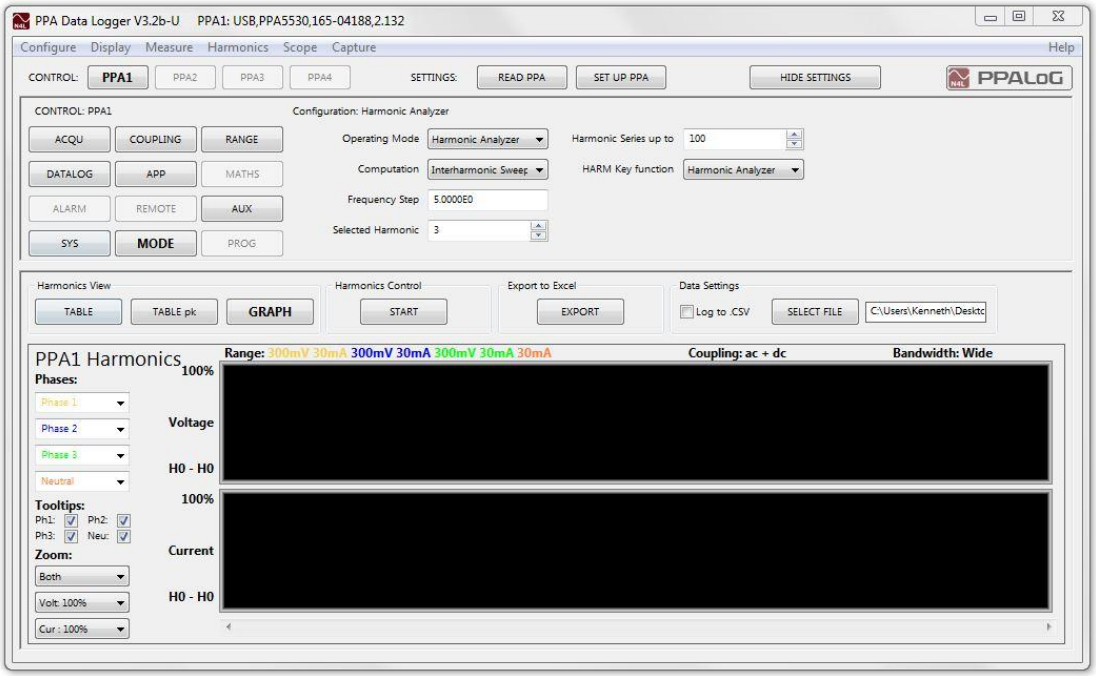
Step 2.

Enter the Harmonics mode and select;
Computation: Interharmonic Sweep



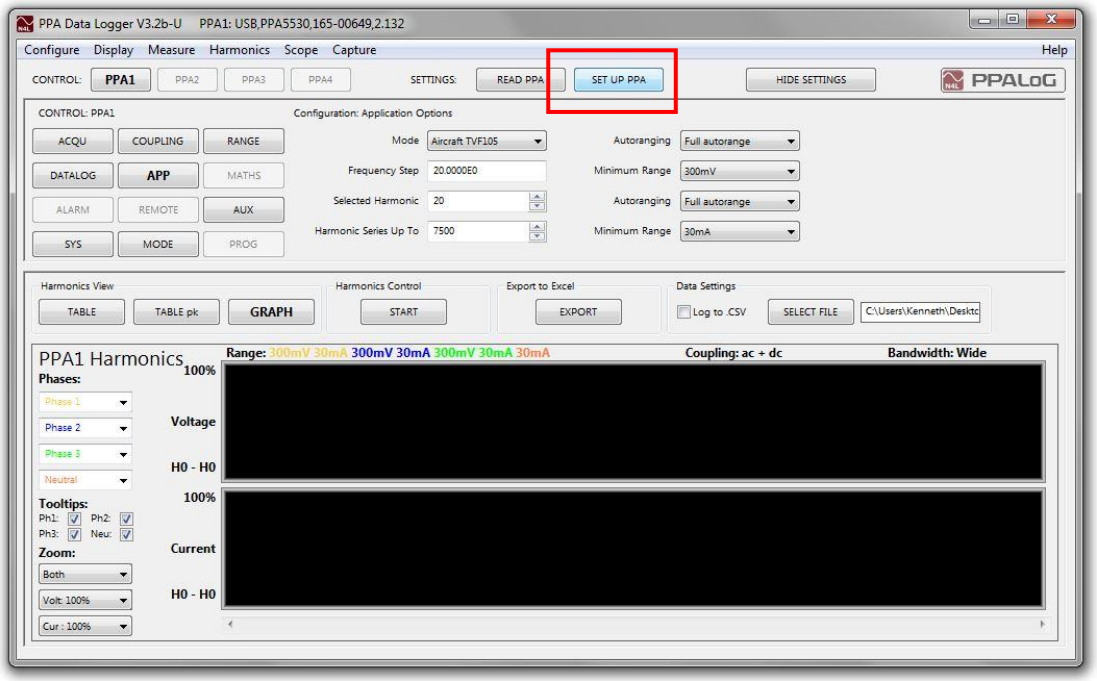
Step 3.

Frequency Step: Enter the required frequency
Selected Harmonic: Enter the harmonic
Harmonic Series Up To: Enter the number of harmonics to be included in the sweep.



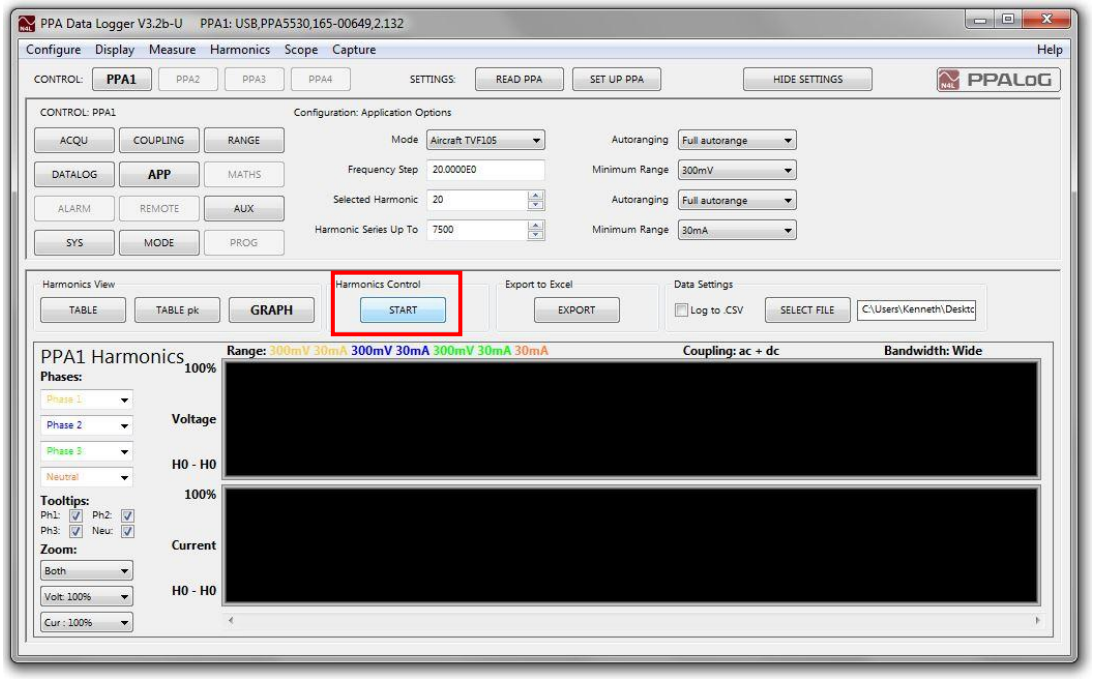
Step 4.

Click the "Set up PPA" button



Step 5.

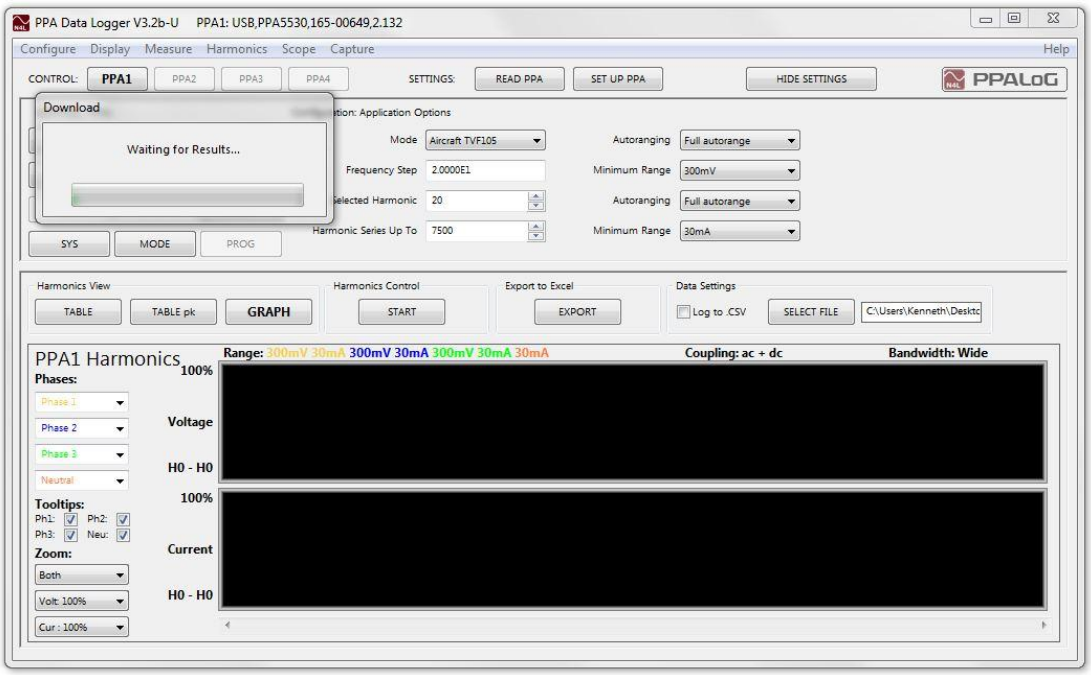
Click the "Start" button



Step 6.

Wait for test to complete (depends on the PPA speed setting and the number of harmonics included in the sweep)

The software will display a message: "Waiting for Results"

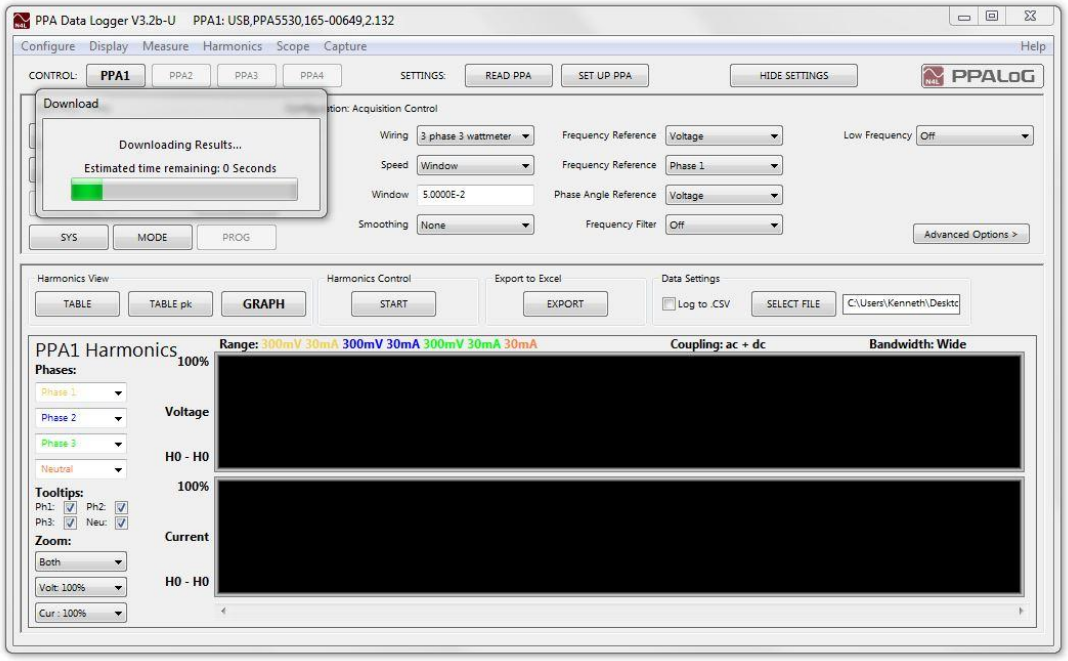


Depending on the settings selected, a flashing message may be displayed on the PPA: "Sweep Running"

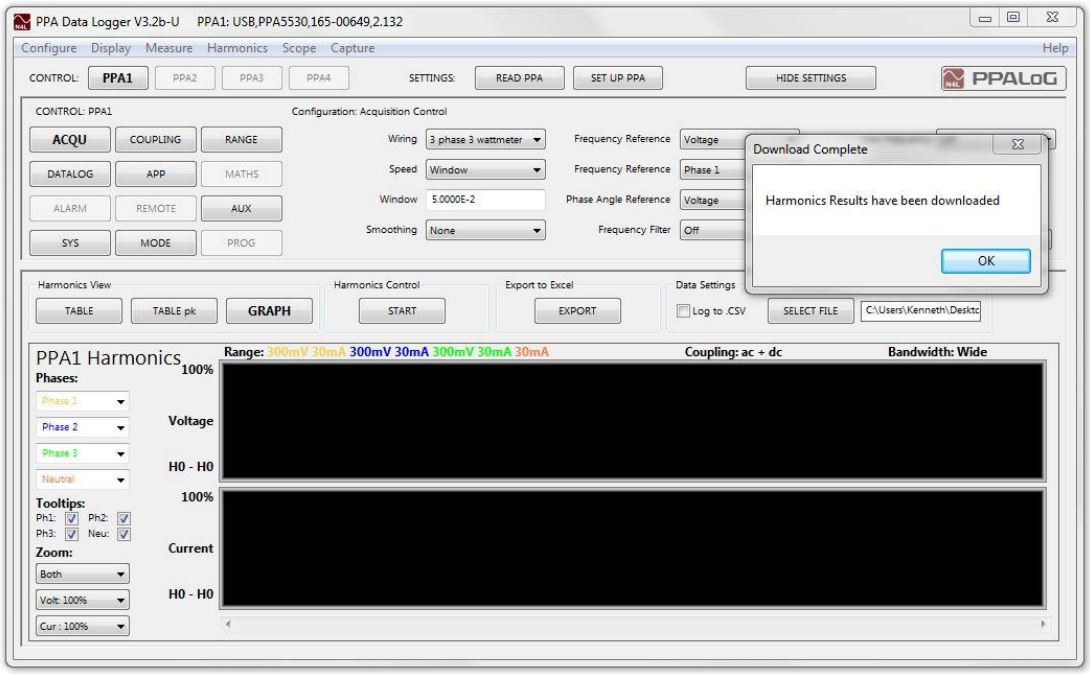
For all settings entered, the test number will be seen to be incrementing in the top left hand corner of the display.

Step 7.

On completion of the tests the software will start to download the results from the instrument.

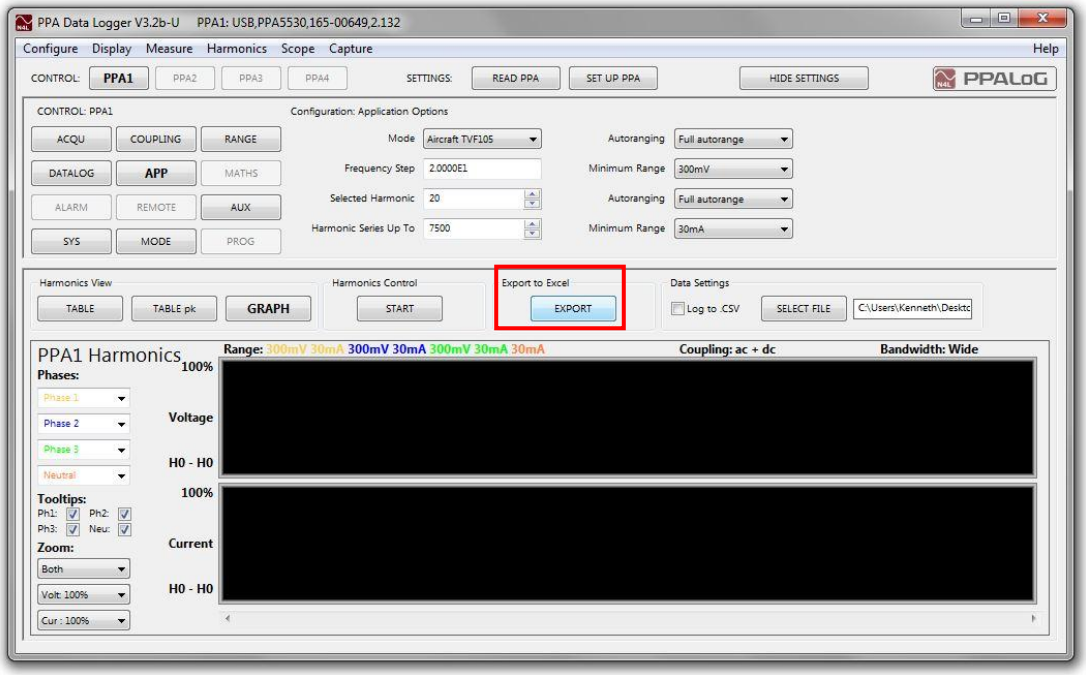


The message is updated once the results have been downloaded.



Step 8.

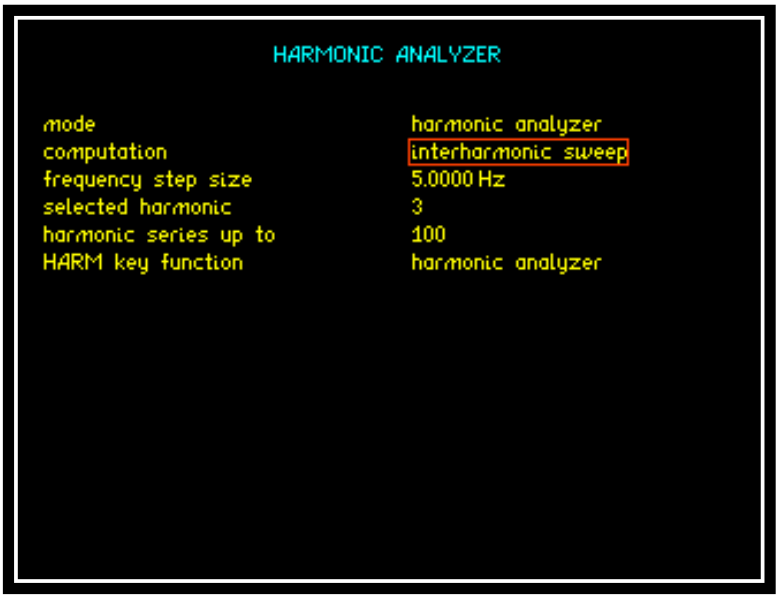
An Excel results document can be created by clicking on the Export button in the software.



Note:

Rather than performing steps 1-4 above the settings can instead be entered on the PPA. Press the ACQU button and entered the required speed setting.

Press the MODE button and select Harmonic Analyzer mode and Interharmonic sweep. Enter the required values for "Frequency step size", "Selected harmonic" and "Harmonic series up to". Finally click on the "Read PPA" button in the software to transfer the settings from the PPA into the software. Ensure the software is displaying the Harmonic test window and then proceed from step 5 above.



6.5.11 HF Current Shunts

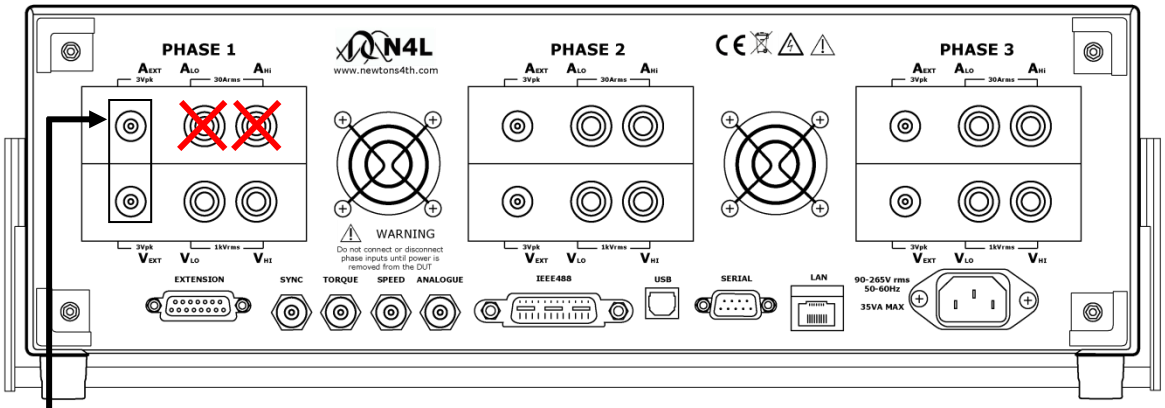
External current shunts can be used as an alternative to the instruments internal shunt as a fixed value Impedance circuit. **Note** do not use both shunts together

Test equipment for demonstration:

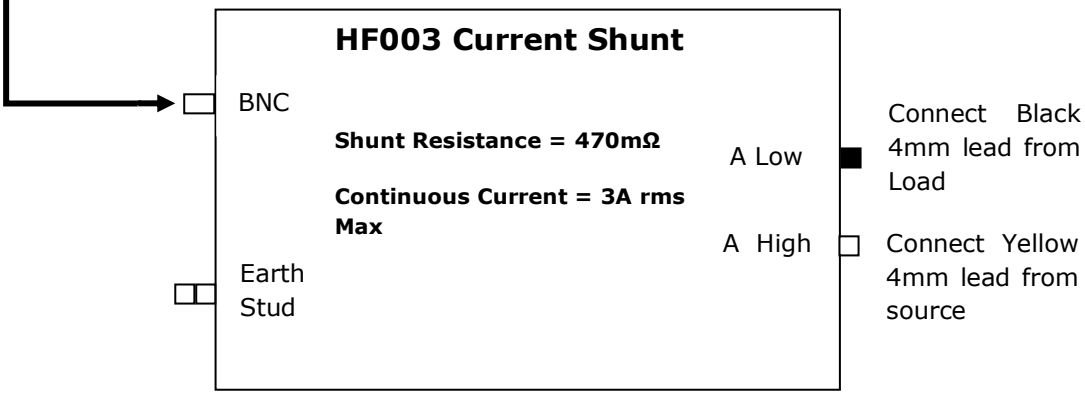
1 x Inverter/Motor test unit (single phase)

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 PPA55xx 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:

Press "RANGE" button

Press ▼ arrow until black box surrounds the current input parameter

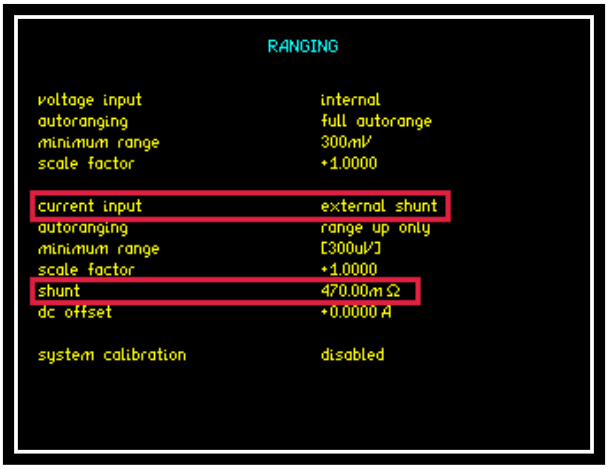
Press ▶ arrow and select "external shunt"

Press "ENTER", external shunt will now be selected

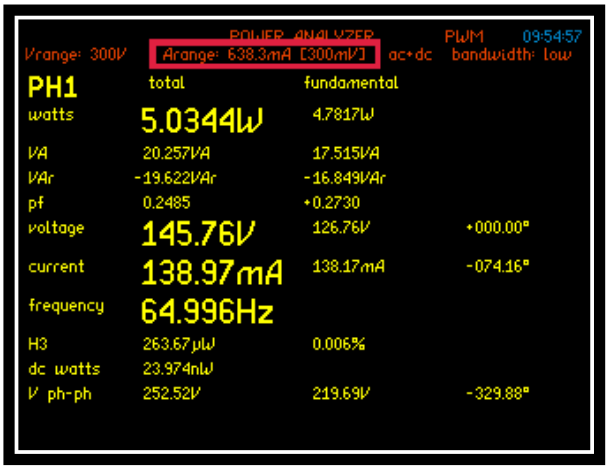
Press ▼ arrow until black box surrounds the shunt parameter

Manually input the shunt resistance value

Press "ENTER", external shunt value will now be selected



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



Now going back to the real time display screen 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

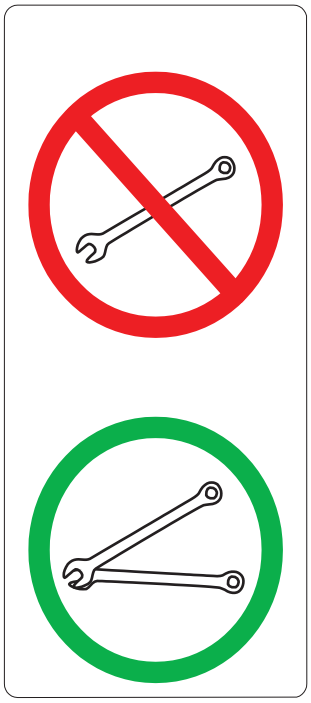
HF100, HF200 and HF500 Current Shunts

Connection to these instruments is made via a stud and bolt and great care must be taken when connecting heavy duty ring terminals to the appropriately sized stud or alternatively, to an "L" bracket on the HF500 shunt.

It is essential that 2 correctly sized spanners are used at all times (see table below) so that adequate torque can be applied to the bolt without transferring excessive turning force to the stud

Any damage caused to the fixing stud will be irreparable

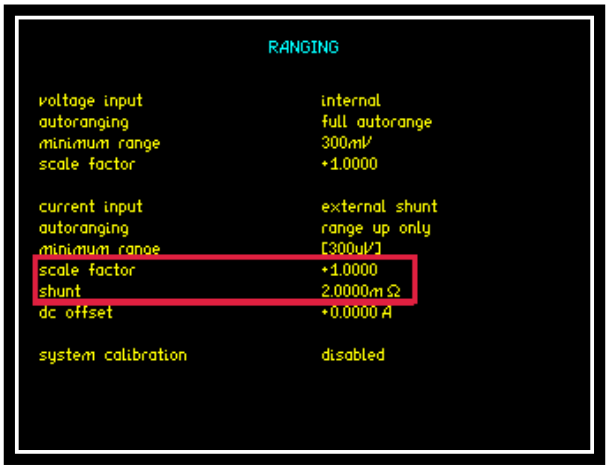
Damage to the shunt will occur when using only 1 spanner



Always use 2 spanners to limit torque stress on the shunt stud

Current Shunt Model	Spanner Size
HF100 + HF200	17mm
HF500	24mm

Rogowski Coil



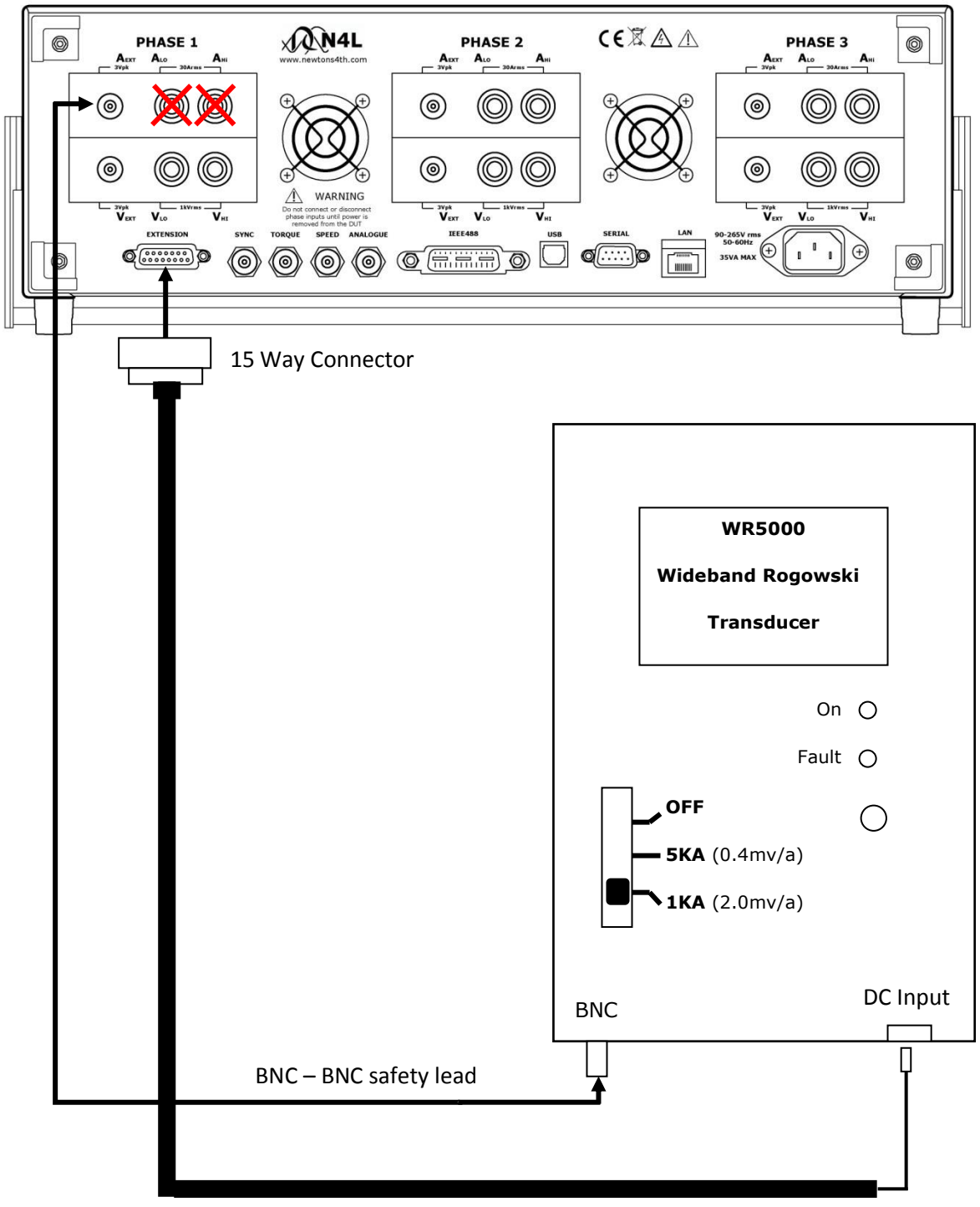
Set the range value of the PPA55xx to the selected channel the Rogowski Coil is connected to,

Input the correct shunt value corresponding to the switch value on the Rogowski Transducer

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

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

Connection should be made as per the following diagrams

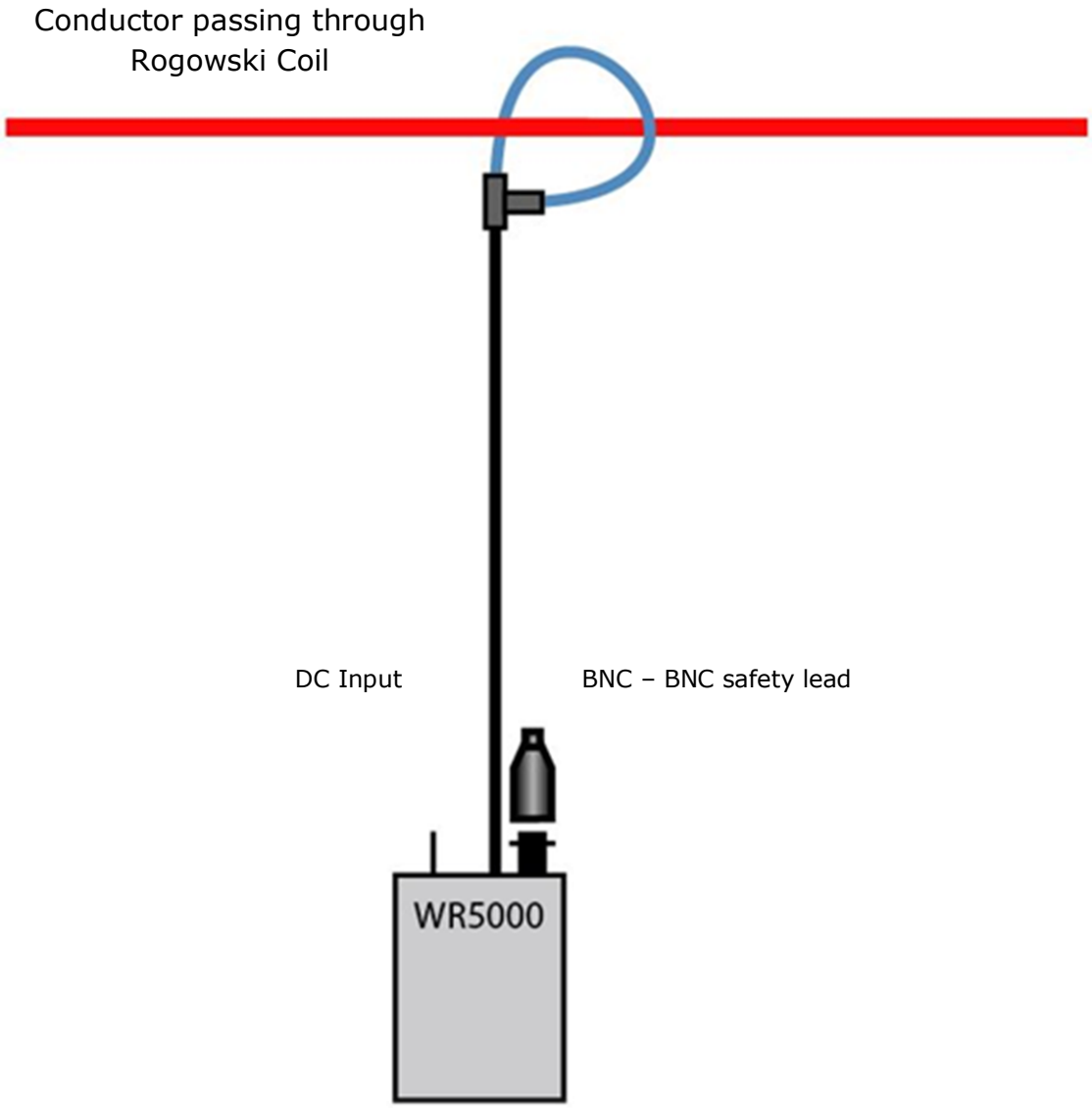


WARNING: Remember to connect either the Internal or External shunt only to the PPA55xx

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

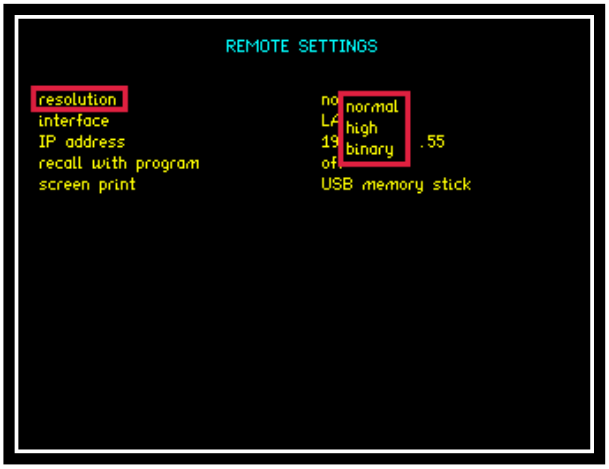
If the coil is double wrapped around the conductor then the voltage value will double accordingly



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



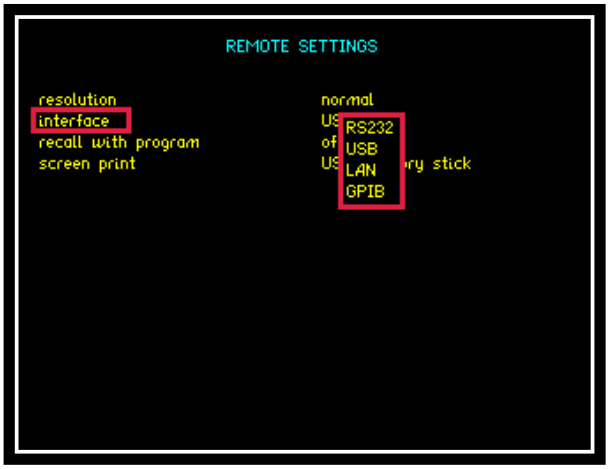
The default resolution setting for the PPA55xx is "Normal" this will set the Data Resolution to 5 decimal points plus any exponent eg: +1.2345+E00

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

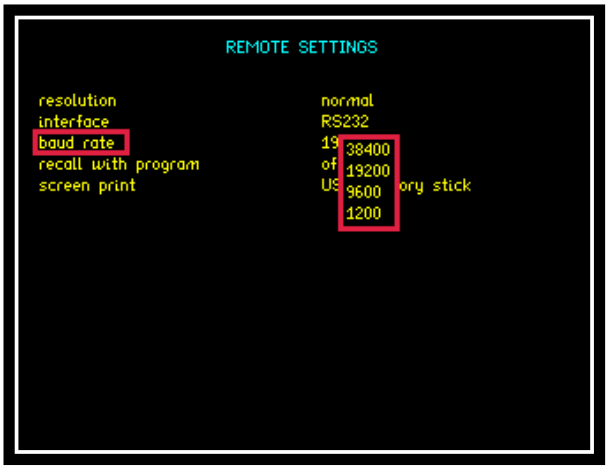
For higher speed transfer a proprietary binary format can be selected which compresses the data into 4 bytes

Interface

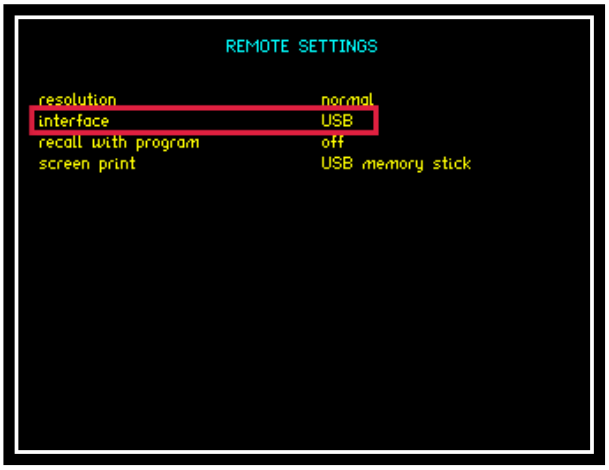
The PPA55xx is fitted as standard with an RS232 serial communications port and USB, LAN and IEEE488 (GPIB) Interfaces for communication purposes between the instrument and PC



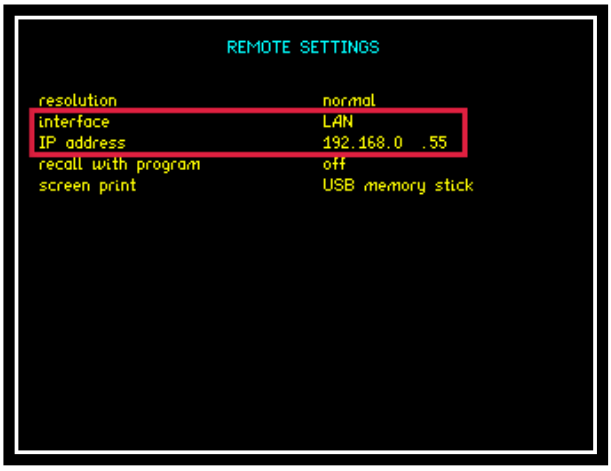
Selection is made via the interface parameter within the remote settings



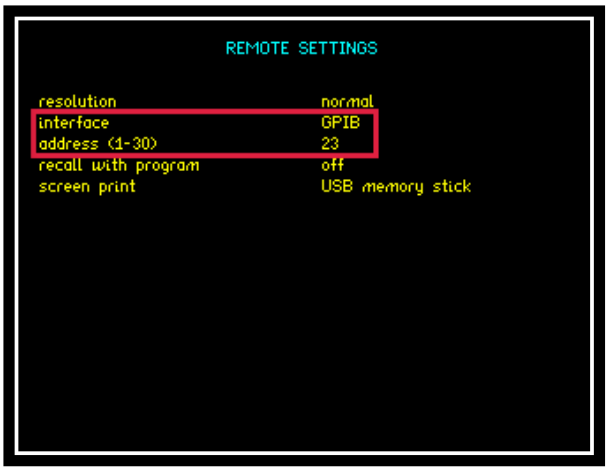
Selecting RS232 will then open up the "Baud Rate" option. Select an applicable data speed rate from the 4 options given in the drop down menu (Default Setting is 19200)



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

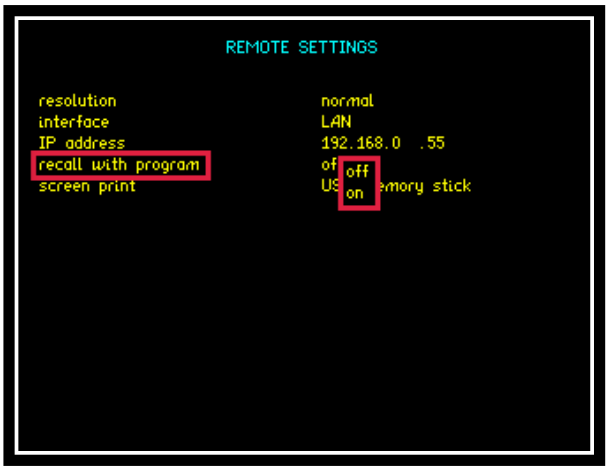


Configuring the interface to LAN will then display the IP address applicable to your instrument. This address will be required upon connection to any software to enable correct connection to the instrument, this is changed using the numerical keypad



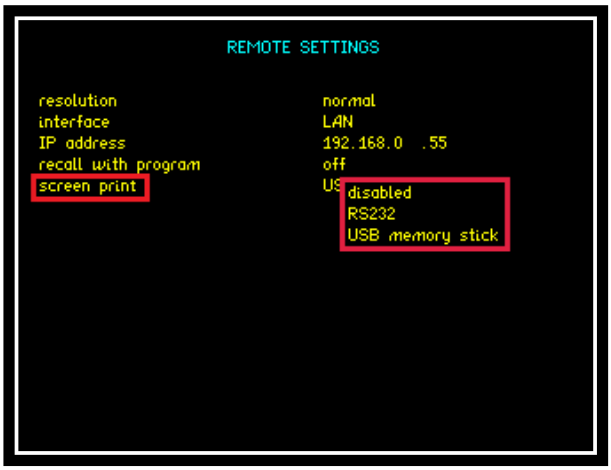
Configuring the instruments interface to GPIB will automatically set the IEEE address to 23 this can be changed within the address parameter in the range 0 to 30 (31 total possible addresses available)

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

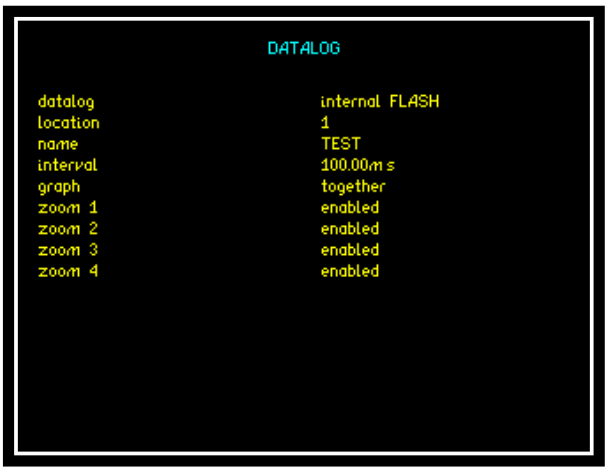


The Screen Print option will allow any screen display on the PPA55xx to be copied either to an RS232 printer or USB memory stick, select the appropriate transfer method required or alternatively this parameter can be disabled. To print the screen display press and hold the "START" button for approx 3 seconds

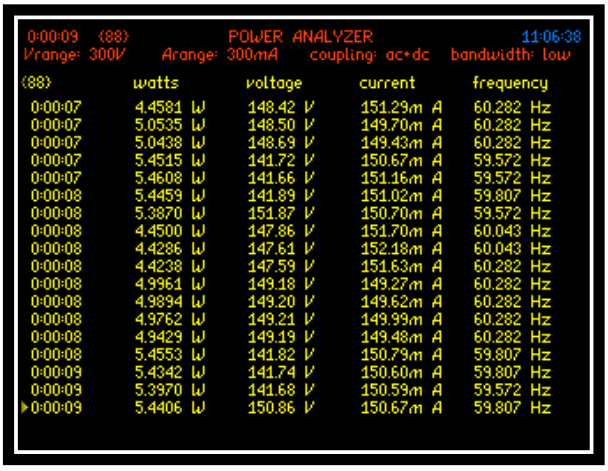
7.1 Transferring Internal Datalogs to USB memory stick

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

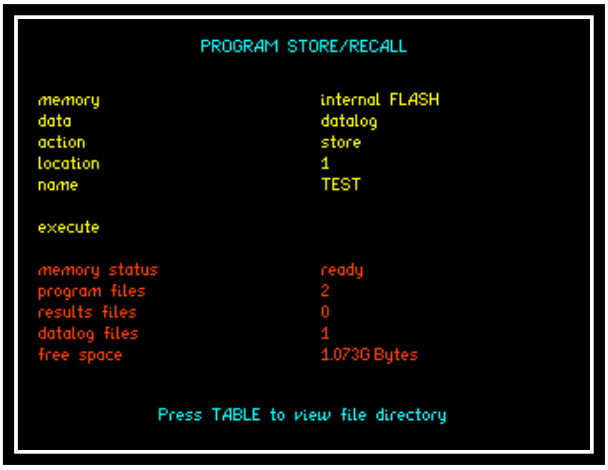
1. Setup Datalog (DATALOG MENU)



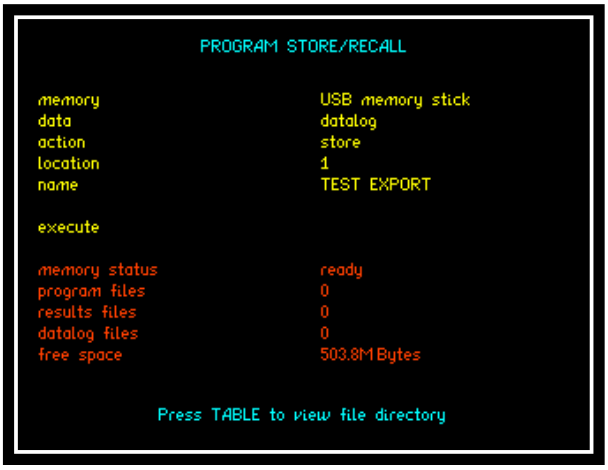
2. Press START to commence Datalog



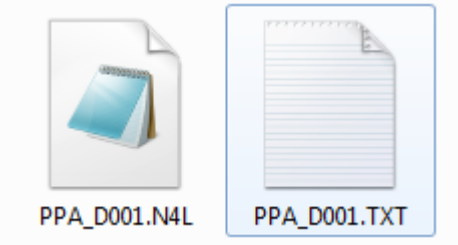
3. Store Datalog to Internal memory



4. Store Datalog to External USB Memory Stick



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

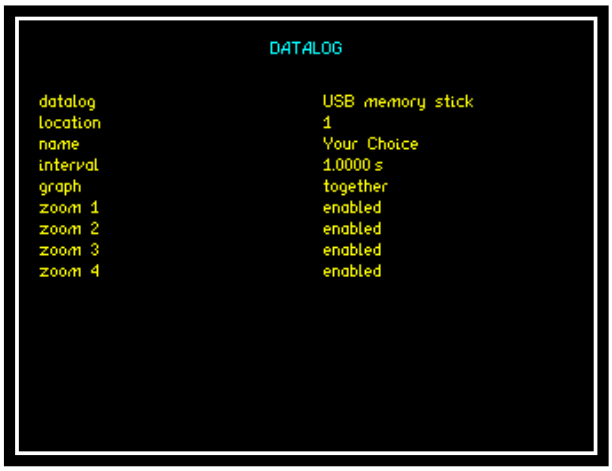


D001 represents "location 1" as specified above.

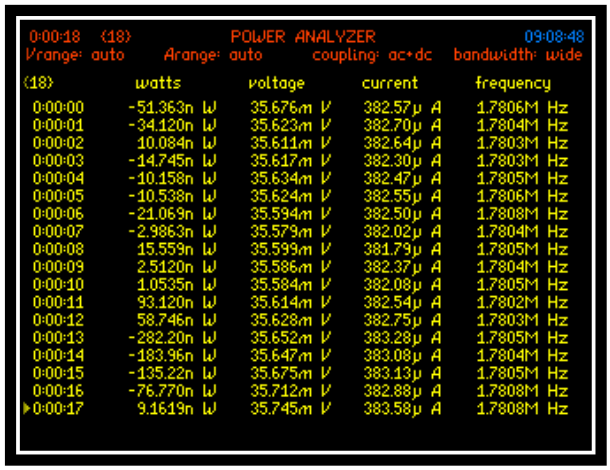
6. NOTE: Data presented within the .txt file for time will be displayed as a fraction of an hour, to convert this data back into real time the user will need to multiply the data by 3600 (seconds within an hour)

7.1.1 Data logging to USB memory stick

1. Setup Datalog (DATALOG MENU)



2. Press START to commence Datalog



3. Press STOP to terminate Datalog, results will now be stored upon USB memory stick

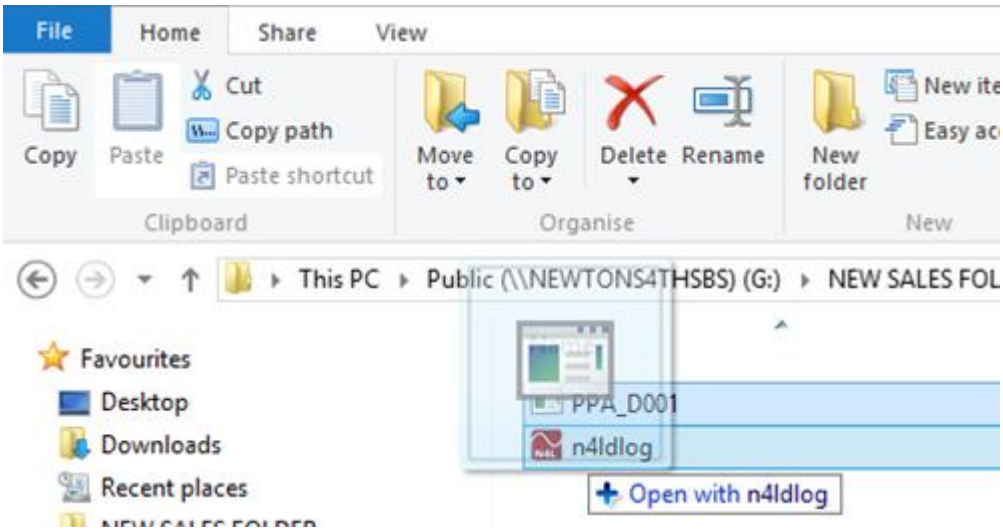
4. Locate file on memory stick, the file format will have a .N4L extension and save to a location on your PC

PPA_D001.N4L

5. Converting the .N4L to a .txt file will require the user to download free of charge from the N4L website; software application "n4ldlog"

n4ldlog.exe

6. Upon downloading the n4ldlog software then drag and drop the .N4L file on top of the n4ldlog.exe as shown below



7. Following this procedure a .txt file will be created as shown

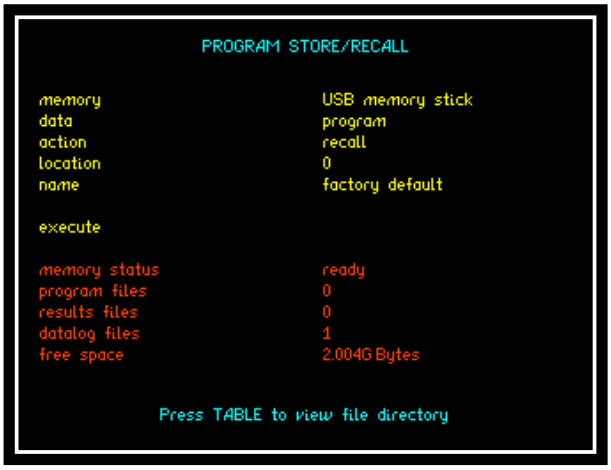
PPA_D001.txt

D001 represents "location 1" as specified within the Datalog home screen

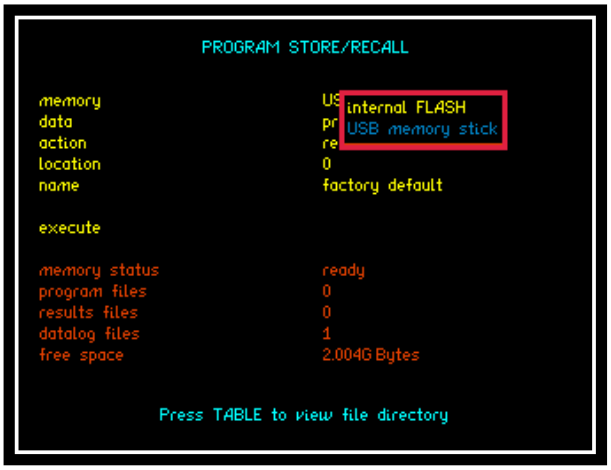
7.2 Program Store / Recall / Delete

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

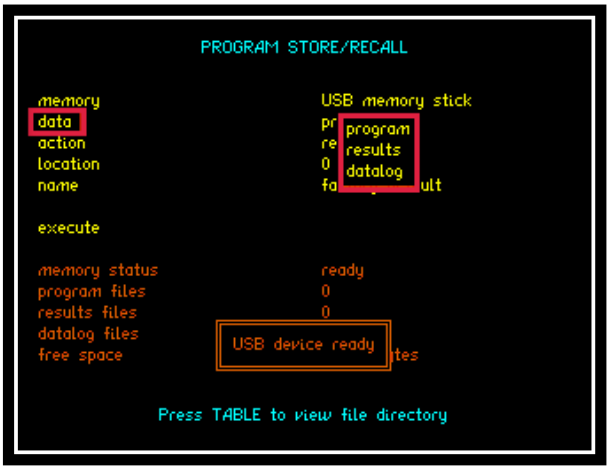
1. Press "PROG" button to open up program store / recall mode



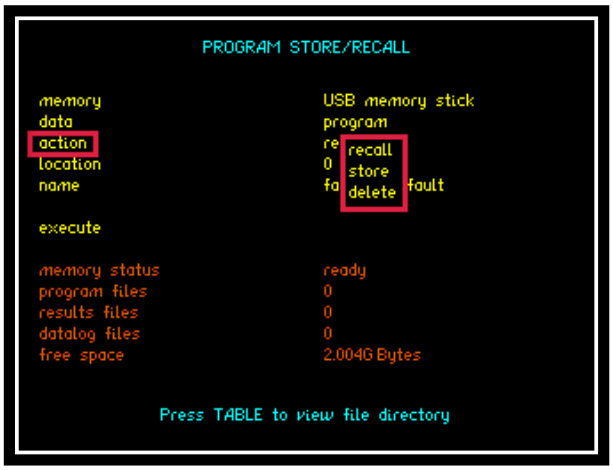
2. Select memory type to be used for action from the dropdown menu



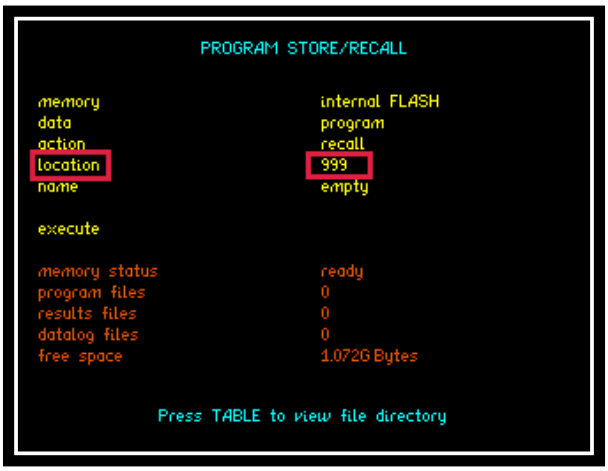
3. Select which data type you require to be actioned from the list shown



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

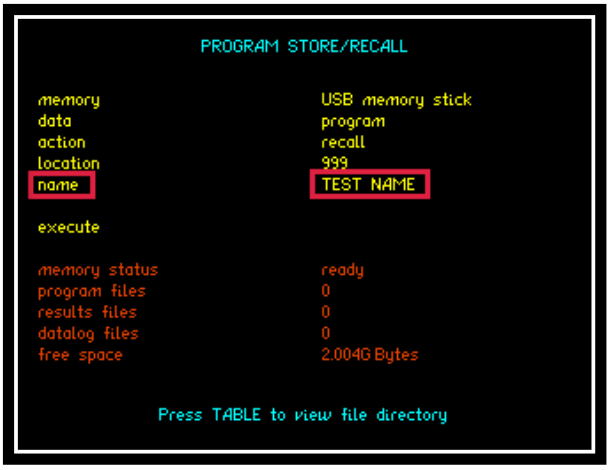


NOTE:

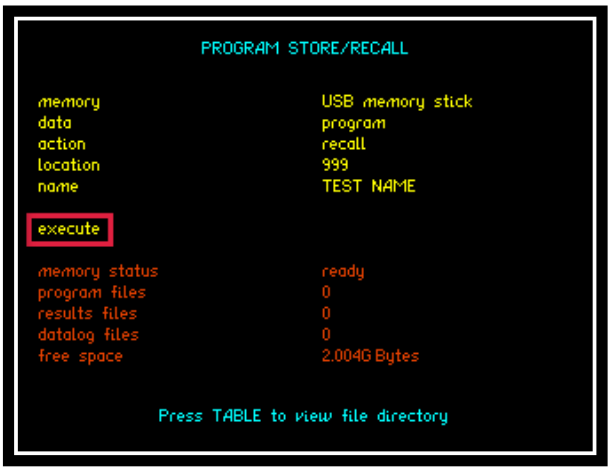
Location 0 = FACTORY DEFAULT and cannot be changed

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
   1 Bede Island Road
   Leicester
   LE2 7EA
   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.

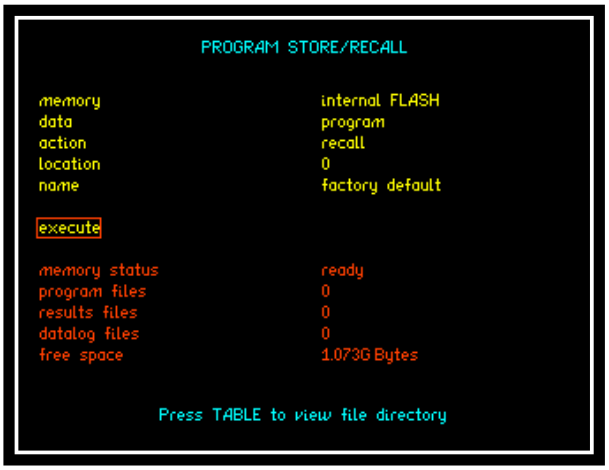
GUIDE FOR TESTING THE BASIC FUNCTIONALITY OF THE INSTRUMENT.

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"

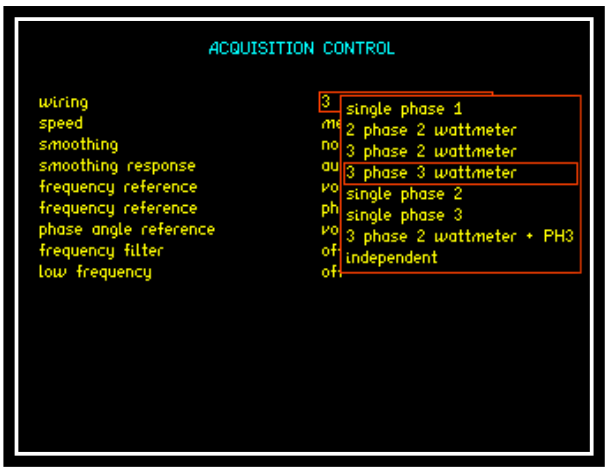
Press ▼ Key until

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.



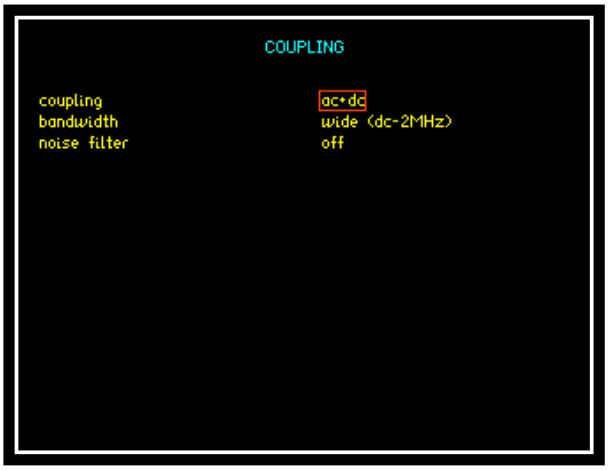
Press "ACQU" button

Press ▼ Key until

Red Box surrounds the "Wiring" options

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

Coupling.

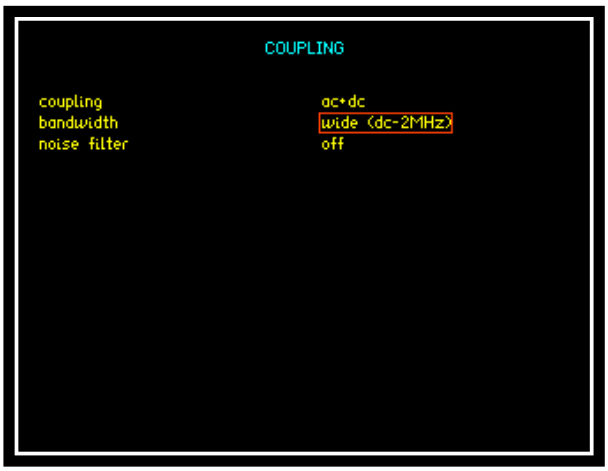


Press "COUPLING" button

Press ▼ Key until

Red Box surrounds the "Coupling" options

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

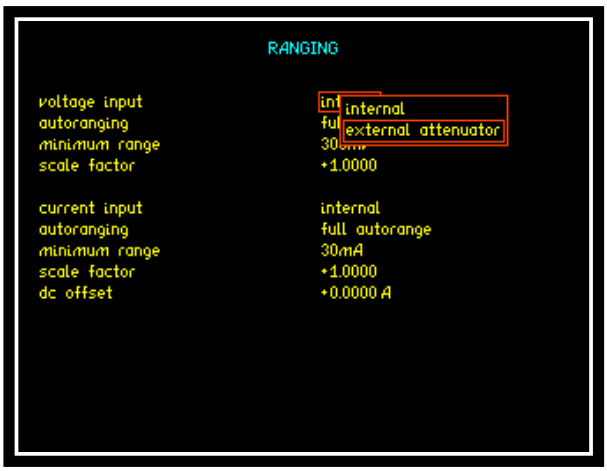


Press ▼ Key until

Red Box surrounds the "Bandwidth" options

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

Ranging.

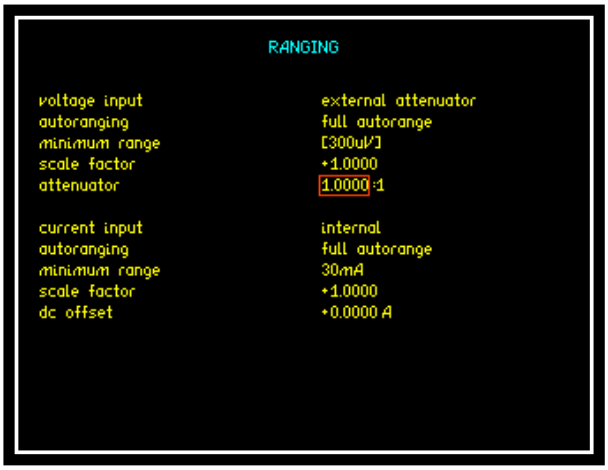


Press "RANGE" button

Press ▼ Key until

Red Box surrounds the "Voltage input" options

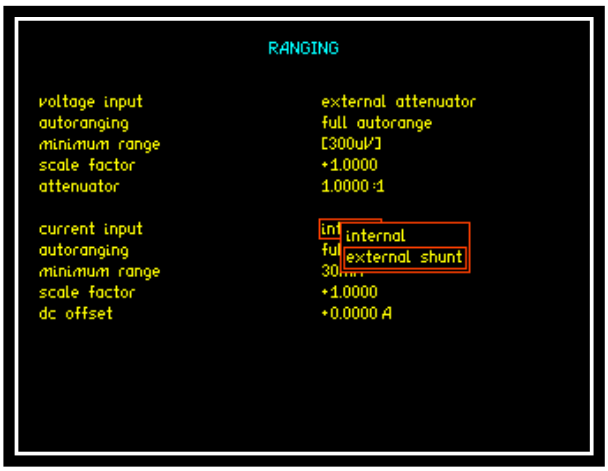
Use the ▲▼ buttons to select "external attenuator" from the list.



Press ▼ Key until

Red Box surrounds the "attenuator" options

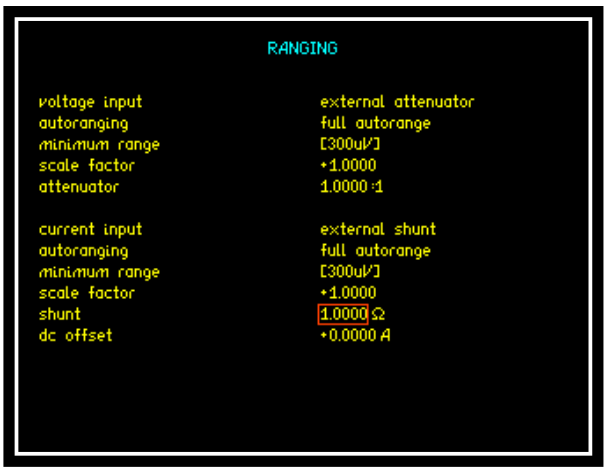
Type in an attenuator setting of 1.0000:1



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.

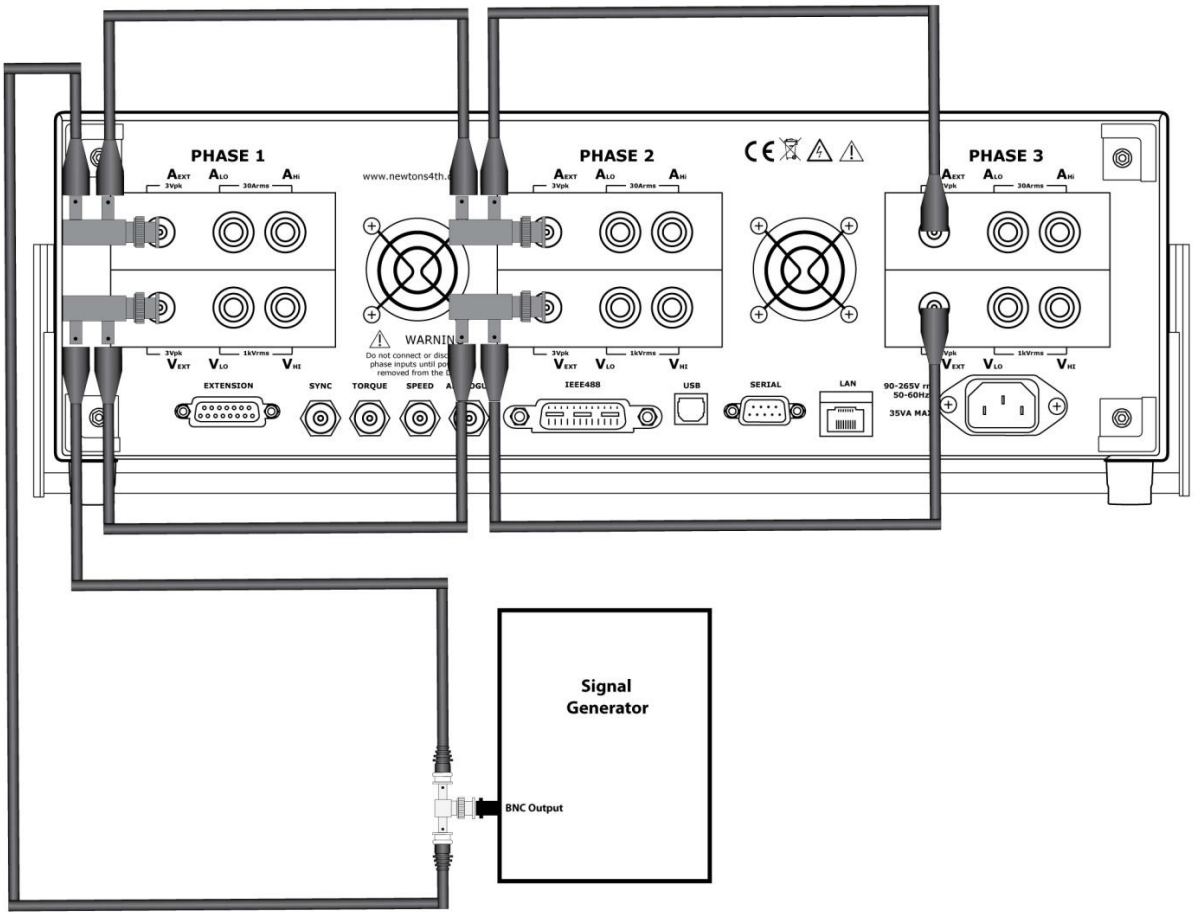
To make the connections shown in the diagram you will need the following accessories that are not supplied with the PPA.

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.

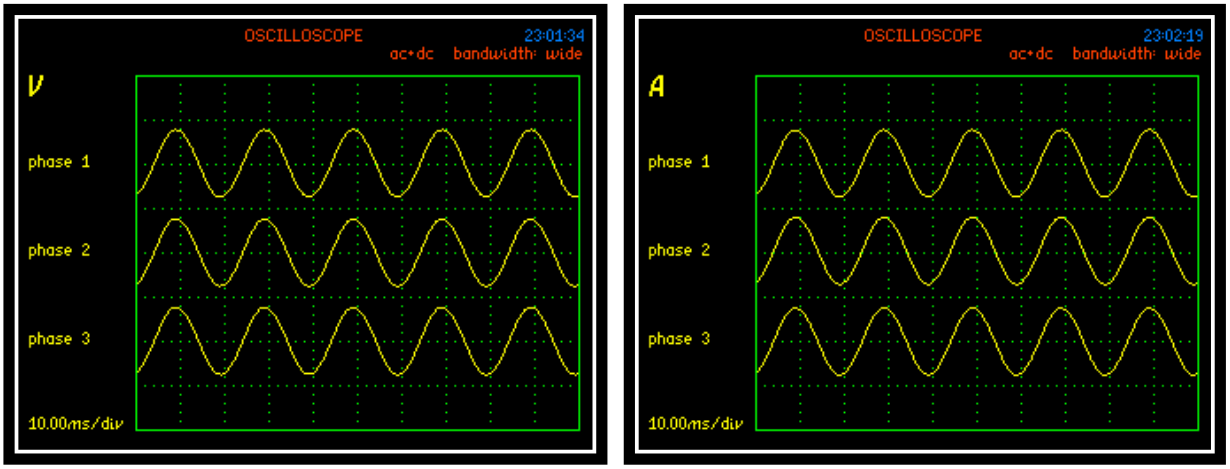
5 x BNC “T” piece connectors.

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

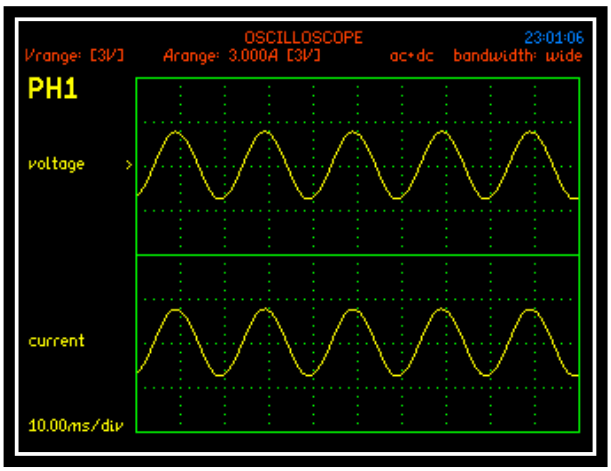


Screenshots of PPA Display when making "external" measurements.

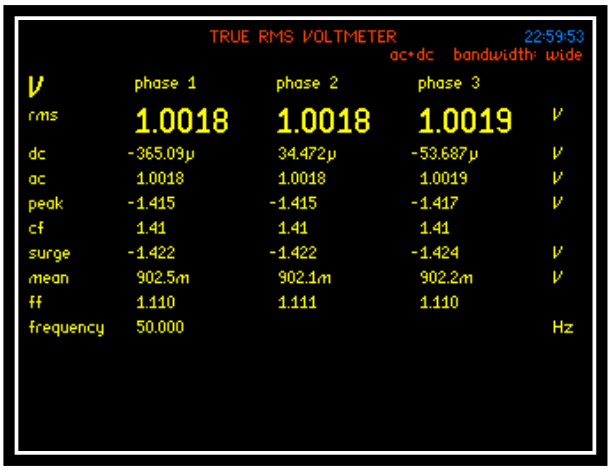
Oscilloscope Mode

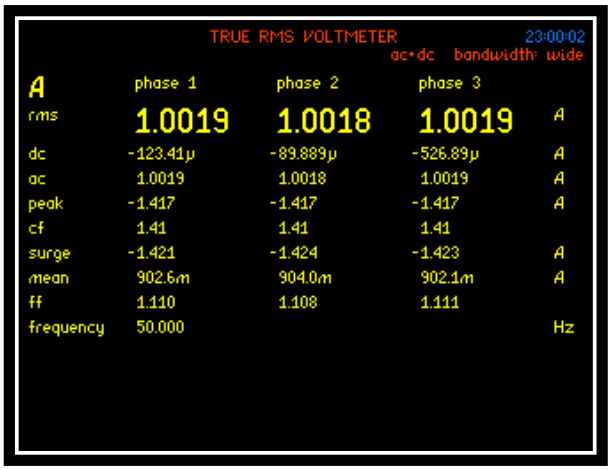


The above screenshots of the scope mode display current and voltage for all 3 phase inputs. Use the ENTER/NEXT button to scroll through the various oscilloscope displays. The screenshot below shows current and voltage for phase 1 only. Comparisons can be made of current and voltage on all 3 phase inputs.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

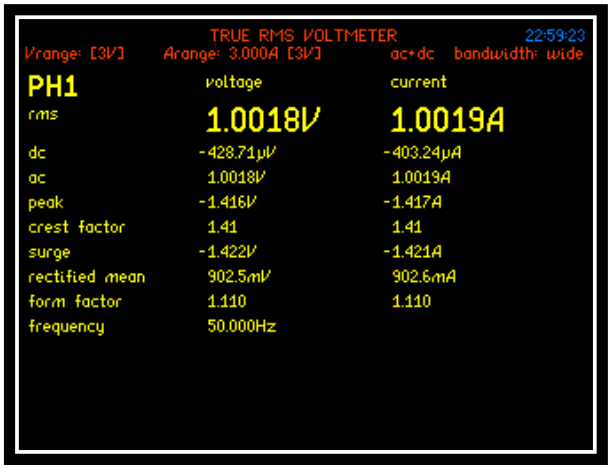


True RMS Voltmeter Mode



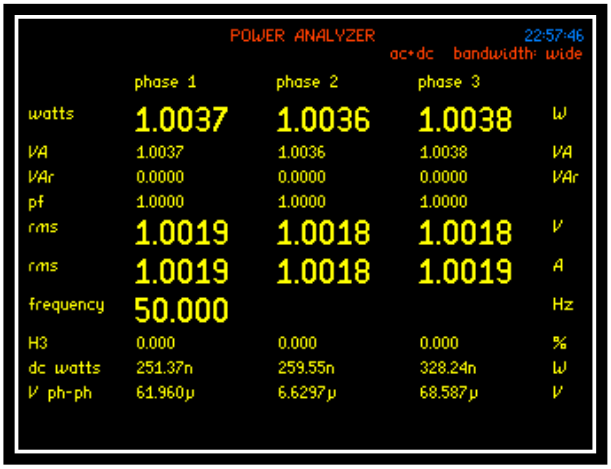


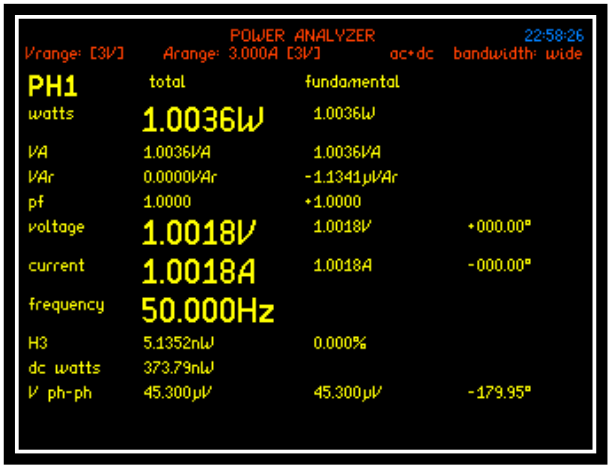
These screenshots are of the instrument in True RMS Voltmeter mode. The one on the left is displaying the voltage results for all 3 phases whilst the one on the right is displaying current for all 3 phase inputs. These allow comparisons of current and voltage readings between the 3 phases. It is also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

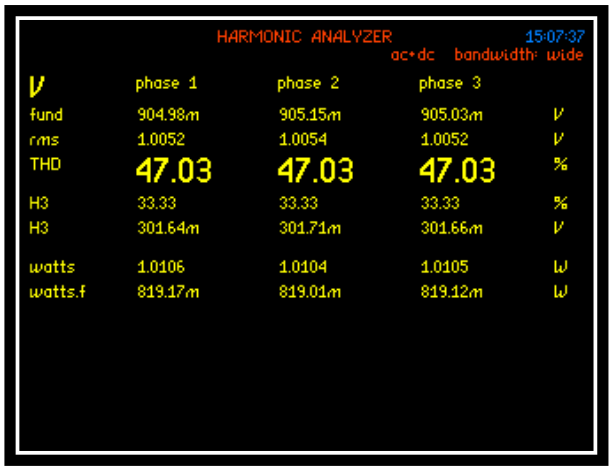


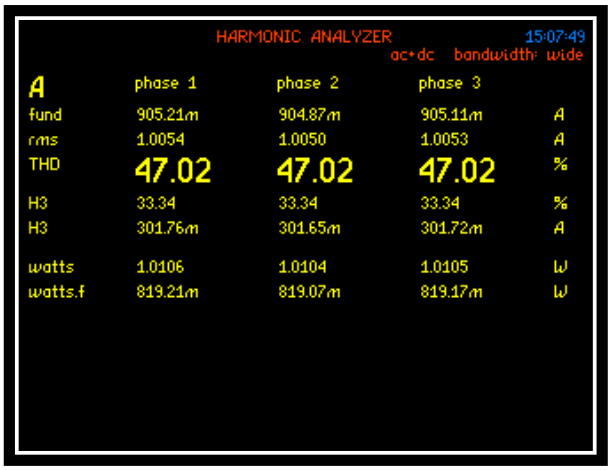


The above screenshots are of the instrument in Power Analyzer mode. The screenshot on the left is displaying the results for all 3 phase inputs. The screenshot on the right is the results for phase 1 only. Comparison of current, power and voltage can be made on all 3 phases and it is also possible to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

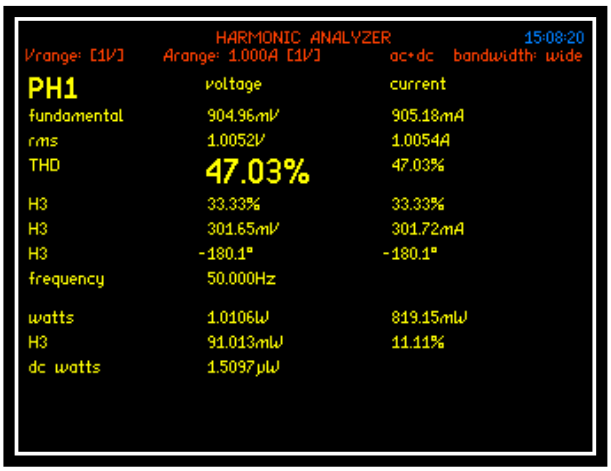
Harmonic Analyzer Mode

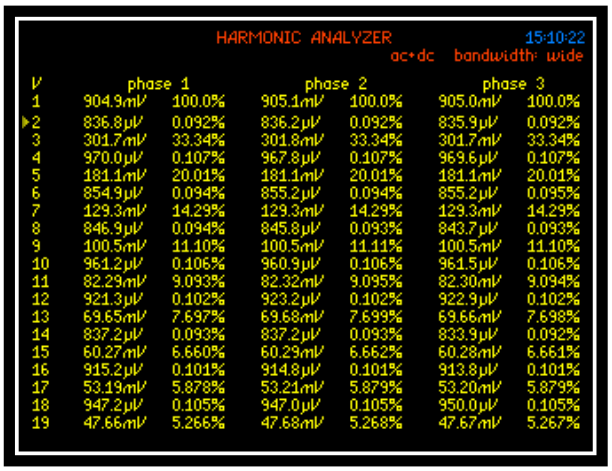
The signal generator is adjusted to provide a 1.00V PK, 50Hz square wave to check the frequency detection function of the PPA. Harmonic Analyzer mode is utilised and correct harmonic magnitudes are displayed providing the fundamental frequency of the waveform is correctly detected.





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.





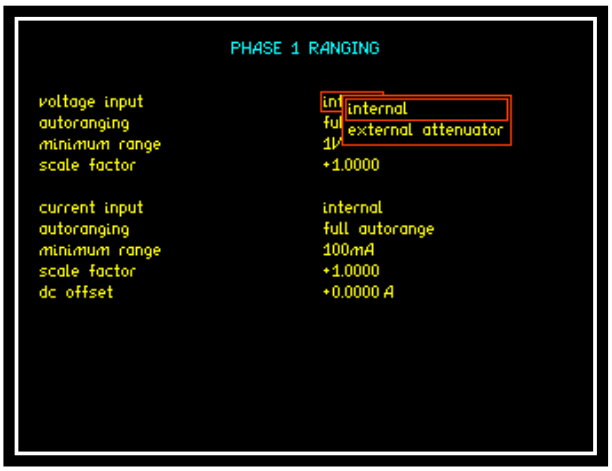
We have used a square wave as the harmonics of this waveform are well known, it is advisable to compare the harmonic values in the displayed table and ensure they are nominally the same as the table below;

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:

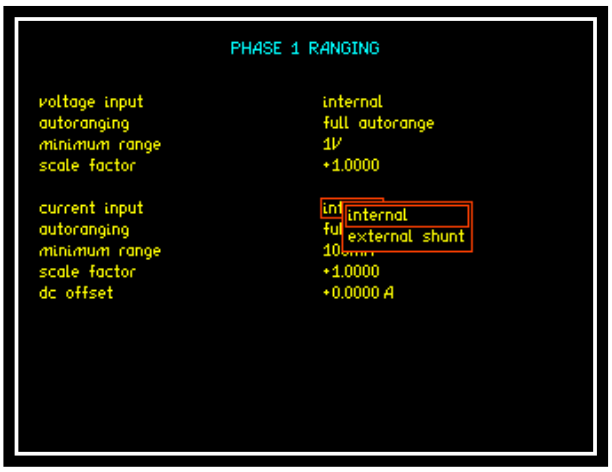


Press "RANGE" button

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.

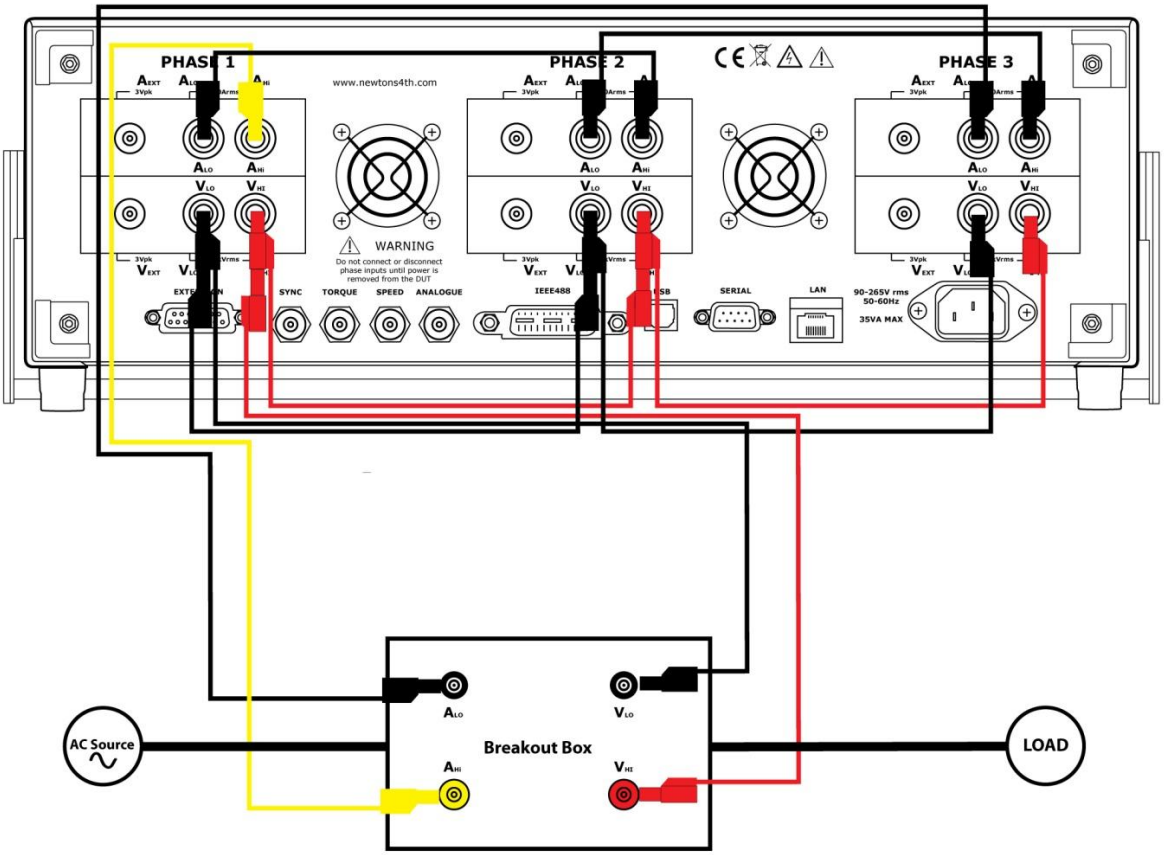
To make the connections shown in the diagram you will need the following accessories that are not supplied with the PPA.

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.

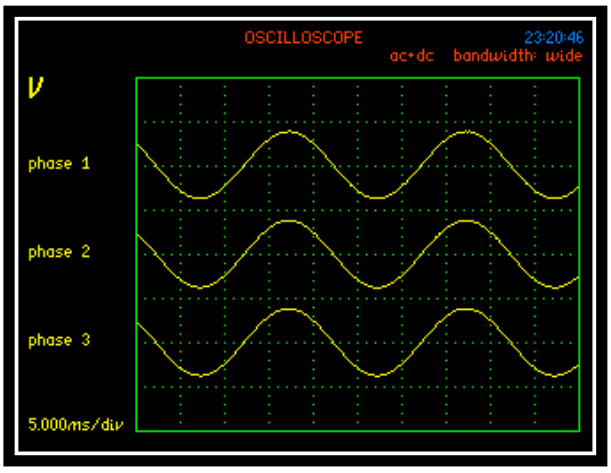
Connection diagram for the functionality checks of the Internal 4mm sockets inputs.

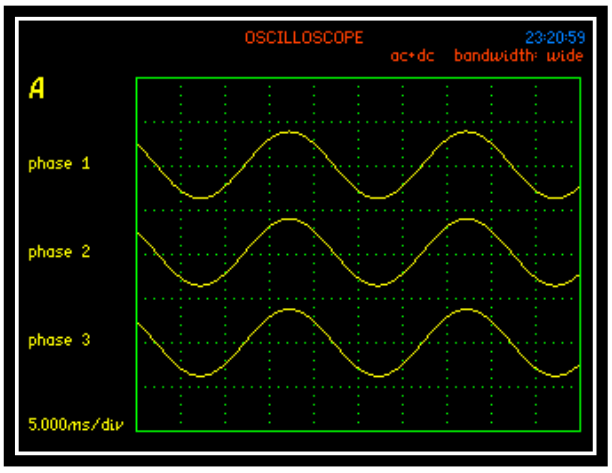


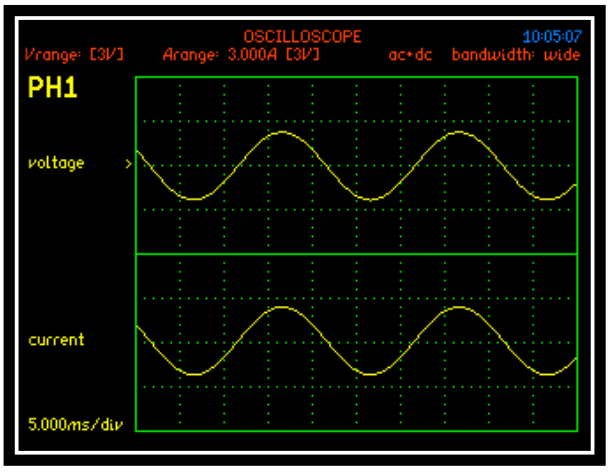
Screenshots of PPA Display when making "internal" measurements.

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.

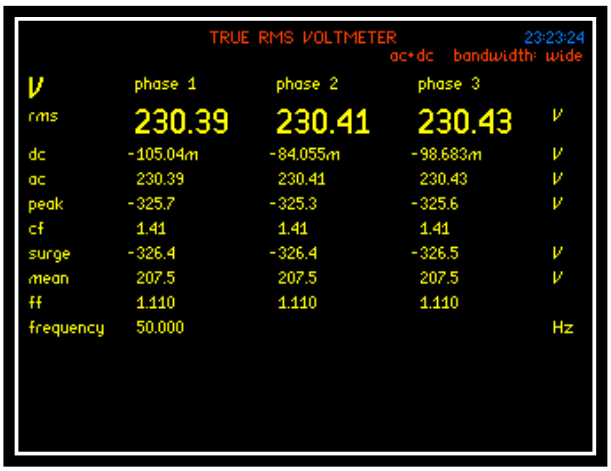
Oscilloscope Mode

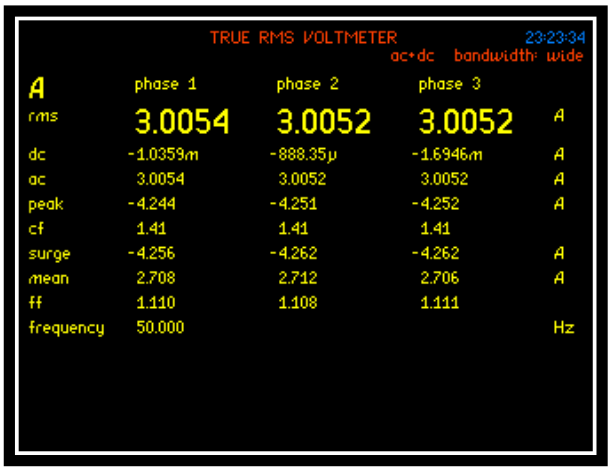


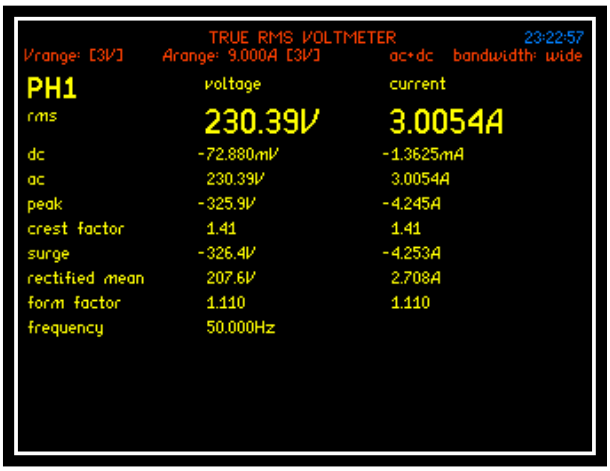




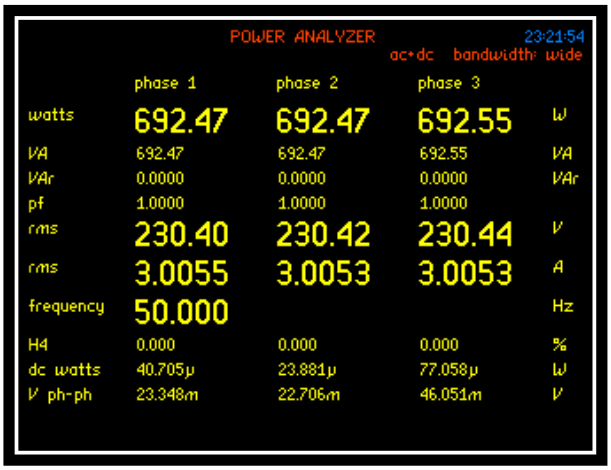
True RMS Voltmeter Mode

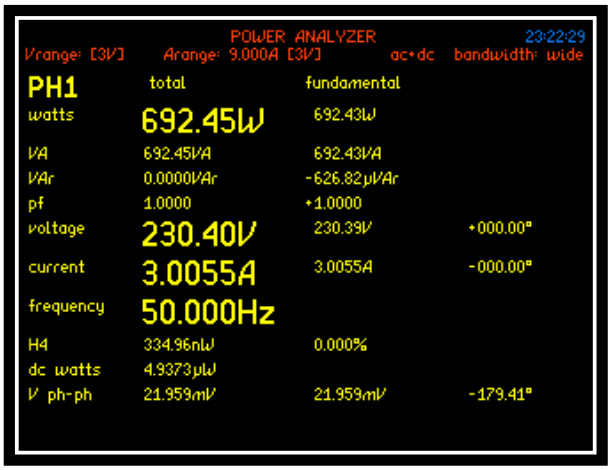




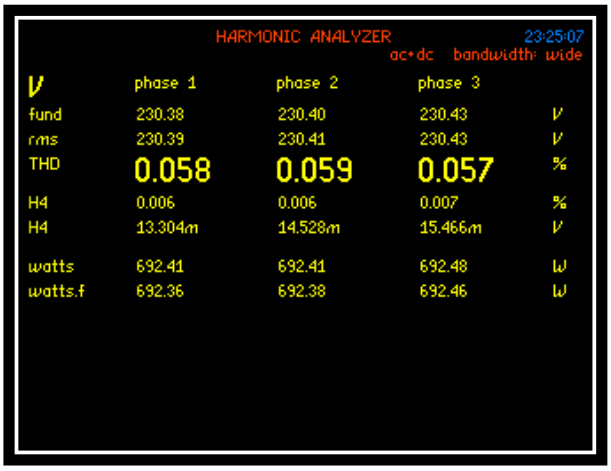


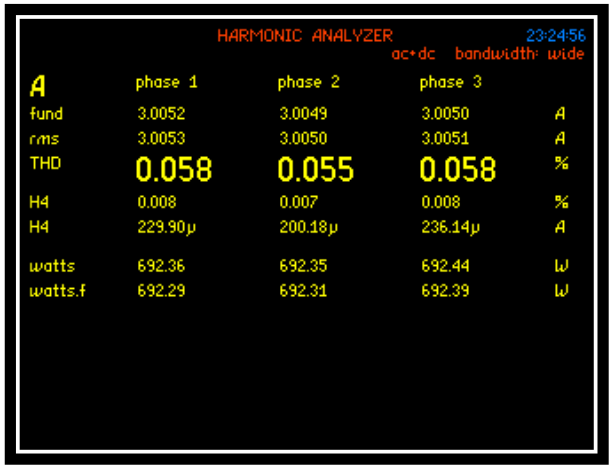
Power Analyzer Mode

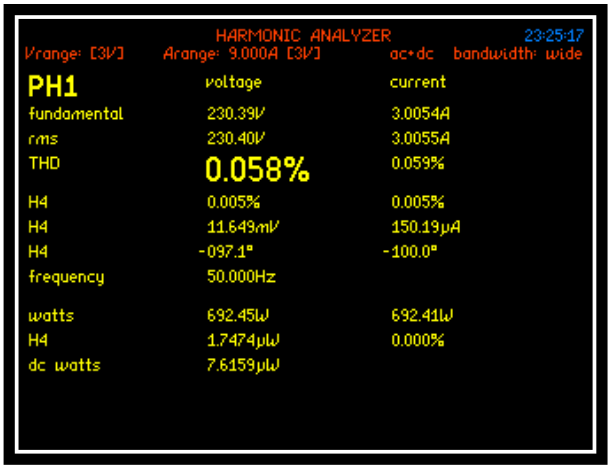




Harmonic Analyzer Mode







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

9 Specifications

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

Frequency	
Accuracy	0.001%

Voltage Input	
Internal Input:	
Ranges	300mVpk to 3000Vpk (1000Vrms) in 9 ranges 20% over-range ability maintains 300Vpk range with 240Vrms
Accuracy	0.01% Rdg + 0.038% Rng + (0.004% x kHz) + 5mV *
External Input:	BNC connector – Max Input 3Vpk
Range	300µVpk to 3Vpk in 9 ranges
Accuracy	0.01% Rdg + 0.038% Rng + (0.004% x kHz) + 3µV *

Current Input	
Internal Shunts:	
30A rms Shunt:	4mm Safety Connectors
Ranges	30mApk to 300Apk (30Arms) in 9 ranges
Accuracy	0.01% Rdg + 0.038% Rng + (0.004% x kHz) + 300µA*
10A rms Shunt:	4mm Safety Connectors
Ranges	3mApk to 30Apk (10Arms) in 9 ranges
Accuracy	0.01% Rdg + 0.038% Rng + (0.004% x kHz) + 30µA*
50A rms Shunt:	Touch Proof Screw Terminals
Ranges	100mApk to 1000Apk (50Arms) in 9 ranges
Accuracy	0.01% Rdg + 0.038% Rng + (0.004% x kHz) + 900µA*
External Shunt:	BNC connector – Max Input 3Vpk
Ranges	300µVpk to 3Vpk in 9 ranges
Accuracy	0.01% Rdg + 0.038% 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:	
	[0.03% + 0.03%/pf +(0.01% x kHz)/pf] Rdg + 0.03%VA Rng
40-850Hz	[0.02% + 0.03%/pf +(0.01% x kHz)/pf] Rdg + 0.02%VA Rng

DC Accuracy	
Voltage:	
Voltage Internal	0.02% Rdg + 0.076% Rng + 10mV
Voltage External	0.02% Rdg + 0.076% Rng + 6µV

Current:	
LC Current Internal	0.02% Rdg + 0.076% Rng + 60µA
SC Current Internal	0.02% Rdg + 0.076% Rng + 600µA
HC Current Internal	0.02% Rdg + 0.076% Rng + 1.8mA
Current External	0.02% Rdg + 0.076% 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) = 0.01% hi rdg + 0.038% rng + 0.004% * KHz +5mV	
External Input:	
hi error (Voltage) = 0.01% hi rdg + 0.038% rng + 0.004% * KHz +3uV	
Current:	
10A:	hi error (Current) = 0.01% hi rdg + 0.038% rng + 0.004% * KHz + 30uA
30A:	hi error (Current) = 0.01% hi rdg + 0.038% rng + 0.004% * KHz + 300uA
50A:	hi error (Current) = 0.01% hi rdg + 0.038% rng + 0.004% * KHz + 900uA
External shunt:	
hi error (Voltage) = 0.01% hi rdg + 0.038% 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:	No-Gap analysis, Minimum window 2ms
Memory:	RAM or non-volatile, up to 10,000,000 records

General	
Crest factor:	Voltage and Current = 20
Sample rate:	Real time no gap - 2.2Ms/s on all channels
IEC modes:	IEC61000 Harmonics and Flicker IEC62301 Standby Power
Remote operation:	Full capability, control and data
Application modes:	PWM Motor Drive
	Lighting Ballast
	Inrush Current
	Transformer Mode
	Standby Power
	Calibration
	Harmonics / Flicker
	Aircraft TVF 105 Interharmonics

Ports	
RS232	Baud rate to 38400 – RTS/CTS flow control
LAN	10/100 base-T Ethernet auto sensing RJ45
GPIB	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
USB, LAN Standard	Y	Y	Y
GPIB - 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
TVF 105	N	N	Y
Harm comp/sec	300	600	1800
Range	8	8	9
Internal Memory	192kB	200MB	1GB