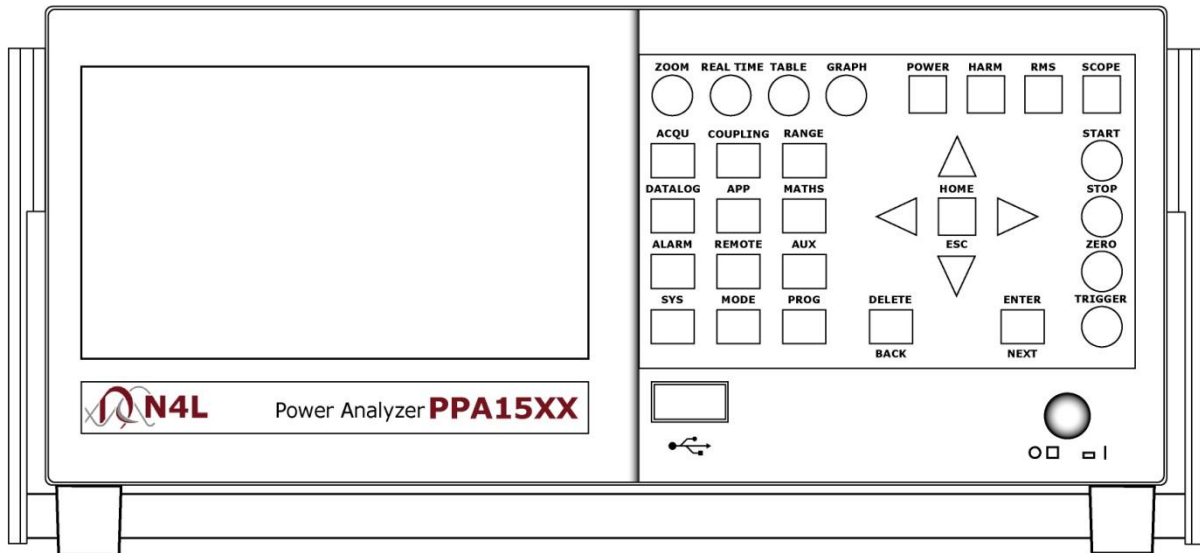




N4L Newtons4th Ltd

PPA5xx/15xx series

Communications Manual



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 slots in the top and sides of the cover free from obstruction.
- Do not operate or store under conditions where condensation may occur or where conducting debris may enter the case.
- 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.

ABOUT THIS MANUAL

This manual gives details of the communication commands recognized by the PSM15xx series of instruments over RS232, USB, or LAN. For more general operating instructions for the instrument refer to the specific user manual.

Each command is listed alphabetically with details of any arguments and reply. Although most of the commands apply to all instruments in the range there are some commands that are specific to one instrument or another.

The information in this manual is believed to be accurate and complete but Newtons4th Ltd cannot accept any liability whatsoever for any consequential damage or losses arising from any errors, inaccuracies, or omissions.

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Appendix A – configurable parameters

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1 Using remote control

The instrument is fitted with an RS232 serial communications port and USB interface as standard, and may have a LAN interface fitted as an option. All the interfaces use the same ASCII protocol:

	Rx expects	Tx sends
RS232 USB, LAN	carriage return (line feed ignored)	carriage return and line feed

All the functions of the instrument can be programmed via any interface, and results read back.

The commands are not case sensitive and white space characters are ignored (e.g. tabs and spaces). Replies from the instrument are always upper case, delimited by commas, without spaces.

Only the first six characters of any command are important – any further characters will be ignored. For example, the command to set the generator frequency is FREQUE but the full word FREQUENCY may be sent as the redundant NCY at the end will be ignored.

Fields within a command are delimited by comma, multiple commands can be sent on one line delimited with a semi-colon. Eg.

FQREF,CURRENT;POWER?

Mandatory commands specified in the IEEE488.2 protocol have been implemented, (e.g. *IDN?, *RST) and all commands that expect a reply are terminated with a question mark (query).

The instrument maintains an error status byte consistent with the requirements of the IEEE488.2 protocol (called

the standard event status register) that can be read by the mandatory command *ESR? (see section 2).

The instrument also maintains a status byte consistent with the requirements of the IEEE488.2 protocol, that can be read either with the IEEE488 serial poll function or by the mandatory command *STB? over RS232 or LAN (see section 2).

RS232 data format is: start bit, 8 data bits (no parity), 1 stop bit. Flow control is RTS/CTS (see section 1.3), baud rate is selectable via the MONITOR menu.

A summary of the available commands is given in the Appendix. Details of each command are given in the communication command section of the manual.

Commands are executed in sequence except for two special characters that are immediately obeyed:

- Control T (20) – reset interface (device clear)
- Control U (21) – warm restart

1.1 Standard event status register

PON		CME	EXE	DDE	QYE		OPC
-----	--	-----	-----	-----	-----	--	-----

- bit 0 OPC (operation complete)
cleared by most commands
set when data available or sweep complete
- bit 2 QYE (unterminated query error)
set if no message ready when data read
- bit 3 DDE (device dependent error)
set when the instrument has an error
- bit 4 EXE (execution error)
set when the command cannot be executed
- bit 5 CME (command interpretation error)
set when a command has not been recognised
- bit 7 PON (power on event)
set when power first applied or unit has reset

The bits in the standard event status register except for OPC are set by the relevant event and cleared by specific command (*ESR?, *CLS, *RST). OPC is also cleared by most commands that change any part of the configuration of the instrument (such as MODE or START).

1.2 Serial Poll status byte

		ESB	MAV	ALA			RDV
--	--	-----	-----	-----	--	--	-----

- bit 0 RDV (result data available)
set when results are available to be read as enabled by DAVER
- bit 3 ALA (alarm active)
set when an alarm is active and enabled by ALARMER
- bit 4 MAV (message available)
set when a message reply is waiting to be read
- bit 5 ESB (standard event summary bit)
set if any bit in the standard event status register is set as well as the corresponding bit in the standard event status enable register (set by *ESE).

1.3 RS232 connections

The RS232 port on the instrument uses the same pinout as a standard 9 pin serial port on a PC or laptop (9-pin male 'D' type).

Pin	Function	Direction
1	DCD	in (+ weak pull up)
2	RX data	in
3	TX data	out
4	DTR	out
5	GND	
6	DSR	not used
7	RTS	out
8	CTS	in
9	RI	not used

The instrument will only transmit when CTS (pin 8) is asserted, and can only receive if DCD (pin 1) is asserted. The instrument constantly asserts (+12V) DTR (pin 4) so this pin can be connected to any unwanted modem control inputs to force operation without handshaking. The instrument has a weak pull up on pin 1 as many null modem cables leave it open circuit. In electrically noisy environments, this pin should be driven or connected to pin 4.

To connect the instrument to a PC, use a 9 pin female to 9 pin female null modem cable:

1 & 6	-	4
2	-	3
3	-	2
4	-	1 & 6
5	-	5
7	-	8

1.4 Data format

Non integer results are sent as ASCII characters in a scientific format consisting of 5 or 6 digit mantissa plus exponent:

```
+1.2345+E00
+1.23456+E00
```

For higher speed transfer a proprietary binary format can be selected which compresses the data into 4 bytes, each of which is sent with the msb set to distinguish them from ASCII control characters. The data is sent as a 7 bit signed exponent, a mantissa sign, and a 20 bit mantissa:

byte	data
1	7 bit signed exponent +63 to -64
2	bit 6 = mantissa sign bit 5:0 = mantissa bit 19:14
3	mantissa bit 13:7
4	mantissa bit 6:0

The value is coded as a binary fraction between 0.5 and 0.9999..., a multiplier of 2^n and a sign ie:

$$\text{Value} = (\text{mantissa} / 2^{20}) \times 2^{\text{exponent}} \times -1^{\text{sign}}$$

value	equivalent	hex data transmitted
3.0	0.75×2^2	0x82,0xB0,0x80,0x80
0.1	0.8×2^{-3}	0xFD,0xB3,0x99,0xCD
-320	-0.625×2^9	0x89,0xE8,0x80,0x80

Any valid number would have the msb of the mantissa set; any number without the msb of the mantissa set is zero.

2 Communication commands

***CLS**

***CLS**

Function: Clear status

Description: Clears the *standard event status register*.

Format: *CLS

Arguments: none

Reply: none

Example: *CLS
*ESR?
0

Notes:

ESE**ESE**

Function: Set standard event status enable register.

Description: Enable which bits of the *standard event status register* set the ESB bit in the serial poll status byte..

Format: *ESE, value

Arguments: decimal equivalent of bits in standard event status enable register

Reply: can be read by *ESE?

Example: *ESE, 60

Notes: The following bits in the standard event status enable register have been implemented:

- bit 0 OPC (operation complete)
- bit 2 QYE (unterminated query error)
- bit 3 DDE (device dependent error)
- bit 4 EXE (execution error)
- bit 5 CME (command interpretation error)
- bit 7 PON (power on event)

For example, *ESE, 60 enables all the error bits so that the ESB bit in the serial poll status byte is set in the event of any error.

ESR?**ESR?**

Function: Standard event status register query

Description: Returns the contents of the *standard event status register* and clears it.

Format: *ESR?

Arguments: none

Reply: decimal equivalent of bits in standard event status register

Example: *ESR?
33

Notes: The following bits in the standard event status register have been implemented:

- bit 0 OPC (operation complete)
- bit 2 QYE (unterminated query error)
- bit 3 DDE (device dependent error)
- bit 4 EXE (execution error)
- bit 5 CME (command interpretation error)
- bit 7 PON (power on event)

For example, if a command is sent incorrectly and is not recognised, the CME bit will be set and the value of 33 will be returned.

***IDN?**

***IDN?**

Function: Identify query

Description: Returns a standard format identification string.

Format: *IDN?

Arguments: none

Reply: An ASCII string in the IEEE488.2 format:
manufacturer,model,serial no,version

Example: *IDN?
NEWTONS4TH,PPA2530 KinetiQ,
01234,1.00

Notes:

***OPC?**

***OPC?**

Function: Test for operation complete

Description: Returns 1 if previous operation is completed, 0 if not.

Format: *OPC?

Arguments: none

Reply: 0 or 1

Example: START
*OPC?
0
*OPC?
0
*OPC?
1

Notes: *OPC? can be used to indicate when data is available or when a frequency sweep has completed.

***RST**

***RST**

Function: Reset

Description: Resets the instrument to the default state and clears the *standard event status register*.

Format: *RST

Arguments: none

Reply: none

Example: *RST

Notes: The *RST command loads the default configuration. This is the same as loading the default configuration via the PROGRAM menu.

Any preceding setup commands will be overwritten.

SRE**SRE**

Function: Set service request enable register.

Description: Enable which bits of the *status byte register* initiate a service request.

Format: *SRE, value

Arguments: decimal equivalent of bits in status byte register

Reply: can be read by *SRE?

Example: *SRE, 1
generate a service request when data available.

Notes:

***SRE?**

***SRE?**

Function: Read service request enable register.

Description: Read back the present setting of the service request enable register.

Format: *SRE?

Arguments:

Reply: decimal equivalent of bits in status byte register that would generate a service request.

Example: *SRE?
1

Notes:

STB?**STB?**

Function: Read serial poll status byte

Description: Returns the decimal value of the serial poll status byte.

Format: *STB?

Arguments: none

Reply: decimal value of the serial poll status byte

Example: *STB?
1

Notes: The following bits in the serial poll status register have been implemented:

- bit 0 RDV (results data available)
- bit 3 ALA (alarm active)
- bit 4 MAV (message available)
- bit 5 ESB (standard event summary bit)

***TRG**

***TRG**

Function: Trigger

Description: Initiates a new measurement, resets the range and smoothing.

Format: *TRG

Arguments: none

Reply: none

Example: MODE,VRMS
*TRG
VRMS,SURG?

Notes:

***TST?**

***TST?**

Function: Self test query

Description: Returns the results of self test

Format: *TST?

Arguments: none

Reply: single integer
bit 0 – set if uncalibrated
bit 1 – set if error with analogue zero
> 15 – major system error

Example: *TST?
0

Notes:

***WAI**

***WAI**

Function: Wait for operation complete

Description: Suspends communication until the previous operation has completed

Format: *WAI

Arguments: none

Reply: none

Example: *TRG
*WAI
POWER,PHASE1?

Notes:

ABORT

ABORT

Function: Abort datalog

Description: Abort datalog data acquisition.

Format: ABORT

Arguments: none

Reply: none

Example: DATALOG, RAM, 0.02
START
wait for data values
ABORT

Notes:

ALARM

ALARM

Function: Set common controls for alarm1 and alarm2.

Description: Set the alarm latch and sounder control.

Format: *ALARM,latch,sounder*

Arguments: latch:
 ON
 OFF
 sounder:
 ENABLED
 DISABLED

Reply: none

Example: ALARM,ON,DISABLED

Notes:

ALARM?

ALARM?

Function: Read alarm status.

Description: Reads the status of the measurements and 2 alarms.

Format: ALARM?

Arguments: none

Reply: single integer
bit 0 data available
bit 1 data error
bit 2 alarm 1
bit 3 alarm 2

Example: ALARM?
1

Notes: An alarm is present if bit 0 is high (data is available) and either alarm 1 or alarm 2 bits are high.

ALARM1**ALARM1**

Function: Set parameters for alarm1.

Description: Set alarm1 type and thresholds.

Format: *ALARM1,type,data,high,low*

Arguments: type:
 DISABLED
 HIGH
 LOW
 INSIDE
 OUTSIDE
 LINEAR
data
 1-4
high:
 high threshold
low:
 low threshold

Reply: none

Example: *ALARM1,HIGH,1,2,0*

Notes: Both thresholds must be sent even if only one is used.

ALARM2**ALARM2**

Function:	Set parameters for alarm2.
Description:	Set alarm2 type and thresholds.
Format:	<i>ALARM2,type,data,high,low</i>
Arguments:	type: DISABLED HIGH LOW INSIDE OUTSIDE data 1-4 for zoom data high: high threshold low: low threshold
Reply:	None
Example:	<i>ALARM2,LOW,3,0,0.5</i>
Notes:	Both thresholds must be sent even if only one is used. There is no LINEAR option for alarm 2.

ALARME**ALARME**

Function: Set alarm status enable register

Description: Sets bits in the alarm status enable register to control which alarm bit if any set the alarm active bits in the status byte.

Format: *ALARME,value*

Arguments: decimal equivalent of alarm bits
bit2 set bit 3 of status byte when alarm 1 is active
bit3 set bit 3 of status byte when alarm 2 is active

Reply: none

Example: *ALARME, 12*
**SRE,8*
set bit 3 in status byte when either alarm 1 or alarm 2 is active and generate a service request

Notes: default value is 0

ALARME?

ALARME?

Function: Read alarm status enable register

Description: Read back present bits in the alarm status enable register which controls the alarm active bit in the status byte.

Format: ALARME?

Arguments: none

Reply: decimal equivalent of alarm bits

Example: ALARME?
12

Notes:

APPLIC**APPLIC**

Function: Select application mode.

Description: Some applications require special settings within the instrument for optimum measurement

Format: *APPLIC,type,setting*

Arguments: type:
 NORMAL
 BALLAST
 INRUSH
 STANDB
 setting:
 speed 0-3 (ballast only)
 0: fixed time
 1: fast
 2: medium
 3: slow

Reply: none

Example: APPLIC,POWERT
 APPLIC,BALLAST,1

Notes:

BEEP

BEEP

Function: Sound the buzzer

Description: Makes a "beep" from the instrument.

Format: BEEP

Arguments: none

Reply: none

Example: BEEP

Notes:

BLANKI

BLANKI

Function: Select blanking

Description: Enable or disable low value blanking.

Format: BLANKI,*value*

Arguments: value:
 ON
 OFF

Reply: none

Example: BLANKI,OFF

Notes:

CALSNO?

CALSNO?

Function: Read back the serial numbers string.

Description: An alphanumeric string comprising the instrument serial number followed by the serial number of the complete input channel for each phase. Also displayed on the front panel by pressing SYS then LEFT.

Format: CALSNO?

Arguments: none.

Reply: alphanumeric string

Example: CALSNO?
201,27,28,29

Notes:

CALSTR**CALSTR**

- Function: Load a calibration string.
- Description: When calibrated, the instrument stores a text string which can be read on the front panel (press SYS and LEFT). This shows the date of calibration. Users who subsequently verify the accuracy in their own calibration facilities can enter an alternative string with the new date. The original string is not overwritten but the alternative string is displayed instead.
- Format: *CALSTR,string*
- Arguments: *string* is any sequence of printable alpha numeric characters. Use the underscore character to add a space between words. CALSTR without a string argument clears the previously stored string.
- Reply: none
- Example: CALSTR,12_DEC_2008_AMW
- Notes: As all white space is stripped from any communications string, the underscore character (ASCII 95 or 0x5F) must be used to space out the words. Underscore is shown as a space on the screen.

CALSTR?

CALSTR?

Function: Read back the calibration string.

Description: When calibrated, the instrument stores a text string which can be read on the front panel (press SYS and LEFT). This shows the date of calibration. Users who subsequently verify the accuracy in their own calibration facilities can enter an alternative string with the new date. The original string is not overwritten but the alternative string is displayed instead.

Format: CALSTR?

Arguments: none.

Reply: alphanumeric string

Example: CALSTR?
12_DEC_2008_AMW

Notes:

CONFIG**CONFIG**

Function: Direct access of configuration parameters

Description: Sets configuration parameter for which there may not be a direct command.

Format: *CONFIG,index,data*

Arguments: index is the number of the parameter
data is the data for that parameter

Reply: none

Example: CONFIG,6,1 (set phase convention)

Notes: The list of configurable parameters is given in the appendix.
CONFIG goes through the same limit checking as when entering data from the menus.

CONFIG?**CONFIG?**

Function: Configurable parameter query

Description: Reads the present value of a single parameter.

Format: *CONFIG,index?*
or: *CONFIG?index*

Arguments: index is the parameter number

Reply: Value of parameter, real or integer as appropriate.

Example: *CONFIG,6?* (read phase convention)
0
CONFIG,6,1 (set phase convention)
CONFIG,6?
1

Notes: The list of configurable parameters is given in the appendix.

COUPLI**COUPLI**

Function: Set ac or ac+dc coupling.

Description: Selects the input coupling for a given input channel.

Format: *COUPLI,phase,coupling*

Arguments: phase:
 PHASE1
 PHASE2
 PHASE3
 coupling:
 AC+DC
 ACONLY
 DCONLY

Reply: none

Example: COUPLI,PHASE2,AC+DC

Notes: In multi phase applications, the coupling on phase 1 is applied to other phases unless "independent input control" is enabled.

COUPLI?**COUPLI?**

Function: Read ac/dc coupling setting.

Description: Returns a numerical value for the coupling setting.

Format: *COUPLI,phase,coupling?*
or: *COUPLI?phase,coupling*

Arguments: phase:
 PHASE1
 PHASE2
 PHASE3

Reply: 0 = AC+DC
 1 = AONLY
 2 = DONLY

Example: COUPLI,PHASE2,AC+DC
 COUPLI,PHASE2?
 0

Notes: In multi phase applications, the coupling on phase 1 is applied to other phases unless "independent input control" is enabled.

DATALO**DATALO**

Function: Set up datalog

Description: Sets datalog parameters.

Format: *DATALO,function,interval,speed*

Arguments: function:
 DISABLE
 RAM
 RECALL
 DELETE
 interval:
 datalog interval in seconds
 speed:
 HIGH

Reply: none

Example: DATALO,RAM,10
 DATALO,RAM,0,HIGH

Notes: set interval to 0 to record every measurement as fast as possible. Set HIGH to select high speed mode for any combination of W, VA, VAr, pf, Vrms, Arms, and frequency. If HIGH is not sent then high speed mode is reset.

DATALO?**DATALO?**

- Function: Read back datalog results
- Description: Return datalog values, one record per line, or the number of lines available
- Format: *DATALO,start,records?*
DATALO,0?
DATALO,LINES?
- Arguments: start:
 first record to return
 records:
 number of records to return
 0:
 return all new records since last read
- Reply: 3 to 6 data values depending on settings:
 index 1-n
 elapsed time in hours
 data1
 data2 (if stored)
 data3 (if stored)
 data4 (if stored)
 one record per line
- Example: *DATALO,RAM,10*
START
 wait for datalog
STOP
DATALO,LINES?
 30
DATALO,21,3?
 21,2.0000E-1,1.2345E0
 22,2.1000E-1,5.6789E3
 23,2.2000E-1,1.2345E0
- Notes: if no arguments are sent then *DATALO?* returns all the available lines of data

DAV?**DAV?**

Function: Data available query

Description: Returns data availability status.

Format: DAV?

Arguments: none

Reply: Decimal equivalent of data available bits:
 bit0 new data available
 bit1 data available
 bit2 harmonic series data available
 bit6 integration data available
 bit7 datalog data available

Example: SPEED,SLOW
 *TRG
 DAV?
 0
 DAV?
 0
 DAV?
 0
 DAV?
 3 (data available)

Notes: DAV? does not modify the status bits.

DAVER**DAVER**

Function: Set data available enable register

Description: Sets bits in the data available enable register to control which status bits set the data available bits in the status byte.

Format: *DAVER,value*

Arguments: decimal equivalent of data available bits
bit0 set bit 0 of status byte when new data available
bit1 set bit 0 of status byte when data available

Reply: none

Example: *DAVER, 1*
set bit 0 in status byte when new data is available

Notes: default value is 2:
bit 0 of status byte is set whenever data is available.

DAVER?

DAVER?

Function: Read data available enable register

Description: Read back present setting of the data available enable register, which controls the status bits that set the data available bits in the status byte.

Format: DAVER?

Arguments: none

Reply: decimal equivalent of bits

Example: DAVER?
4

Notes:

DISPLAY**DISPLAY**

- Function: Set the display page
- Description: Selects the page on the display so that the zoom data can be used for alarms.
- Format: `DISPLAY,page`
- Arguments: page:
PHASE1
PHASE2
PHASE3
SUM
NEUTRAL
TOTAL
FUNDAMENTAL
VOLTAGE
CURRENT
- Reply: None
- Example: `DISPLAY,FUNDAMENTAL`
- Notes: VOLTAGE is the same as TOTAL;
CURRENT is the same as FUNDAMENTAL.
They refer to the multiphase display modes.

DISPLAY?

DISPLAY?

Function: Read the displayed data

Description: Returns all the values presently on the screen.

Format: DISPLAY?

Arguments: none

Reply: Multiple floating point values separated by commas

Example: DISPLAY?

Notes:

EFFICI**EFFICI**

Function: Set efficiency calculation

Description: Selects the data to be used for the efficiency calculation.

Format: *EFFICI,formula*

Arguments: formula:
0 – disabled
1 – phase 1 / phase 2
2 – phase 2 / phase 1
7 – phase 3 / sum
8 – sum /phase

Reply: none

Example: EFFICIENCY,2

Notes:

EFFICI?

EFFICI?

Function: Read efficiency result

Description: Reads back the total and fundamental efficiency results.

Format: EFFICI?

Arguments: none

Reply: 2 data values separated by commas:
total, fundamental
or 6 data values

Example: EFFICI?
data returned

Notes: 6 data values returned if efficiency option is phase / next phase and 3 phase wiring is configured

FAST**FAST**

Function: Set fast communications mode.

Description: Disables the screen drawing for high speed operation.

Format: FAST,*value*

Arguments: value:
ON
OFF

Reply: none

Example: FAST,ON

Notes: FAST mode does not suppress the data acquisition which continues in the background. See SUSPEND to disable all non-communication functions.

FQLOCK**FQLOCK**

Function: Lock frequency.

Description: Fix the frequency for analysis to the present value.

Format: FQLOCK,*value*

Arguments: value:
 ON
 OFF

Reply: none

Example: FQLOCK,ON

Notes: To fix the analysis to a specified frequency, first lock the frequency with FQLOCK,ON then send the desired frequency with the FREQUE command.

FQREF**FQREF**

Function: Set frequency reference.

Description: Select the channel to be used for measuring the frequency.

Format: *FQREF,phase*
FQREF,channel
FQREF,phase,channel

Arguments: channel:
 voltage
 current

 phase:
 PHASE1
 PHASE2
 PHASE3

Reply: none

Example: FQREF,CURRENT

Notes: Measured phase is always referred to phase 1 voltage no matter what channel is selected to measure the frequency, unless phase 1 is not active (eg phase 2 only mode).

FREQUE**FREQUE**

Function:	Set the analysis frequency
Description:	Sets the analysis frequency in Hz for frequency lock mode.
Format:	FREQUE, <i>frequency</i>
Arguments:	frequency in Hz
Reply:	none
Example:	FQLOCK,ON FREQUE,5e4 (set frequency to 50kHz)
Notes:	Lock the frequency with FQLOCK,ON before sending the desired frequency with the FREQUE command.

FSD?**FSD?**

Function: Read the full scale of all input channels at once or that of an individually selected input channel.

Description: Returns the full scale value for all channels or that of a single selected channel.

Format: FSD?
FSD,CH?

Arguments: None
CH1, CH2, CH3, CH4, CH5, CH6

Reply: Up to six data values separated by commas

Example 1: FSD?
Data returned, data returned, data returned, data returned, data returned

Example 2: FSD,CH1?
Data returned

Notes: Number of channels that can be read and the number of data values returned is dependent on the number of phases selected in the instruments settings.
CH1 = PH1: Voltage Input
CH2 = PH1: Current Input
CH3 = PH2: Voltage Input
CH4 = PH2: Current Input
CH5 = PH3: Voltage Input
CH6 = PH3: Current Input

HARMON**HARMON**

Function: Set harmonic analyser mode.

Description: Set harmonic analyser mode and parameters.

Format: HARMON,*para,harmonic,max*

Arguments: para:
 THDD difference formula THD
 THDS harmonic series THD
 TIF Telephone Influence Factor
 THF Telephone Harmonic Factor
 TDD Total Demand Distortion
 TRD Total Rated Distortion
 HPHASE harmonic phase
 harmonic:
 individual harmonic for display
max:
 length of harmonic series (to 50)

Reply: none

Example: HARMON,THDS,3,50

Notes: It is not necessary to send any arguments, but if any are sent they must be in the specified order.

HARMON?**HARMON?**

Function: Harmonic analyser query

Description: Read harmonic results.
Sets harmonic analyser mode if not already set.
Waits for next unread data if necessary.
Clears new data available bit read by DAV?

Format: HARMON?
or: HARMON,*phase*?
or: HARMON,SERIES?
or: HARMON,*phase*,SERIES?

Arguments: phase:
 PHASE1
 PHASE2
 PHASE3
 NEUTRAL
 PHASES

Reply: 11 data values separated by commas:
freq,mag1,mag2,hmag1,hmag2,h%1,
h%2,thd%1,thd%2,hphase1,hphase2
or: magnitude and percentage for each
harmonic, one channel per line
or: magnitude and phase for each harmonic,
one channel per line

Example: HARMON,PHASE2?
data returned

Notes: HARMON? waits for next unread data.

HOLD

HOLD

Function: Set data hold

Description: Turns data hold on or off. Useful for reading data from different phases without it being changed between reads.

Format: HOLD,state

Arguments: state:
ON
OFF

Reply: none

Example: HOLD,ON
POWER,PHASE1,WATTS?
POWER,PHASE2,WATTS?
POWER,PHASE3,WATTS?
HOLD,OFF

Notes:

INPUT

INPUT

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Function: Set input mode

Description: Selects the input type of the instrument

Format: `INPUT,channel,type`

Arguments: channel:
CH1
CH2
CH3
CH4
CH5
CH6
type:
INTERN
EXTATT
EXTSHU
INTX10

Reply: None

Example: `INPUT,CH1,EXTSHU`

Notes: CH1 applies to all voltage channels
(unless in single phase 2 or 3 wiring)
CH2 applies to all current channels
(unless in single phase 2 or 3 wiring)
CH3 and 4 apply to phase 2 voltage and
current when in single phase 2 wiring
CH5 and 6 apply to phase 3 voltage and
current when in single phase 3 wiring

INTEGR**INTEGR**

- Function: Set integrated power mode.
- Description: Set integrated power mode, whether the integration for Watts and current use signed or unsigned values, and whether accumulated or averaged values are computed.
Also sets up run time for integration over a specific interval.
- Format: *INTEGR,type,display*
INTEGR,RUNTIM,hours,minutes
- Arguments: type:
 SIGNED
 MAGNITUDE
display:
 TOTAL
 AVERAGE
hours:
 integer
minutes:
 integer
- Reply: none
- Example: *INTEGR,MAGNITUDE,TOTAL*
- Notes:

INTEGR?**INTEGR?**

Function: Read integrated power mode.

Description: Read integrated power mode for the selected phase.

Format: `INTEGR,phase?`

Arguments: phase:
 PHASE1
 PHASE2
 PHASE3
 PHASES
 SUM

Reply: 13 values separated by commas
 time,Wh,WH.f,VAh,VAh.f,VArh,Varh.f
 pf,pf.f,V,V.f,Ah,Ah.f

Example: START
 wait for integration time
 INTEGR,PHASE1?
 data returned

Notes: INTEGR? without specifying the phase returns the appropriate single phase data.

KEYBOA**KEYBOA**

Function: Disable front panel keyboard.

Description: The front panel keyboard can be disabled to prevent accidental operation.

Format: KEYBOARD,*value*

Arguments: value:
 ENABLE
 DISABLE

Reply: none

Example: KEYBOARD,DISABLE

Notes: The keyboard can be re-enabled from the front panel only by pressing the HOME key.

LCR**LCR**

Function: Set LCR meter mode.

Description: Set LCR mode and conditions.

Format: LCR,*parameter*

Arguments: parameter:
 AUTO
 CAPACITANCE
 INDUCTANCE
 IMPEDANCE

Reply: none

Example: LCR,IMPEDA

Notes:

LCR?**LCR?**

Function:	LCR meter query
Description:	Read LCR meter results. Sets LCR meter mode if not already set. Waits for next unread data if necessary. Clears new data available bit read by DAV?
Format:	LCR, <i>phase?</i>
Arguments:	phase: PHASE1 PHASE2 PHASE3 PHASES
Reply:	11 data values separated by commas: freq, Vmag, Amag, impedance, phase, R, C, L, tan δ , Qf, reactance
Example:	LCR,IMPEDA LCR,PHASES? data returned
Notes:	LCR? waits for next unread data. LCR? without specifying the phase returns the appropriate single phase data.

LOWFRE**LOWFRE**

Function: Set low frequency mode

Description: Sets the low frequency option for extending the measurement window.

Format: LOWFRE,*value*

Arguments: value:
ON
OFF

Reply: none

Example: LOWFRE,ON

Notes: LOWFRE is mainly used for measuring low frequencies (<5 Hz). However, as it applies digital filtering, it may also be useful when analysing any signals below a few hundred Hertz.

MODE**MODE**

Function: Set mode

Description: Sets the basic operating mode of the instrument.

Format: MODE,*type*

Arguments: type:
POWER (power meter)
INTEGR (integrator)
HARMON (harmonic analyser)
RMS (rms voltmeter)
LCR (LCR meter)
SCOPE (oscilloscope)
PHASEM (phase meter)

Reply: none

Example: MODE,LCR

Notes:

MULTIL**MULTIL**

Function: Selects data for multi string reply

Description: Selects data values across phases and functions that can be read in a single string.

Format: *MULTIL,index,phase,function*

Arguments: index:
 0 clear all
 1-30 select data 1-30
 phase:
 1-3 phase 1-3
 4 sum
 5 neutral
 function:
 1-99 see appendix

Reply: none

Example: MULTIL,0
 MULTIL,1,1,2 (phase 1 Watts)
 MULTIL,2,2,2 (phase 2 watts)
 MULTIL,3,4,3 (sum VA)
 MULTIL?
 3 data values returned

Notes:

MULTIL?**MULTIL?**

Function: Reads multi string reply

Description: Waits for data to be available then returns selected results.

Format: MULTIL?

Arguments: none:

Reply: Up to 30 data values as selected by the MULTIL command in a single reply string

Example: MULTIL,0
MULTIL,1,1,2 (phase 1 Watts)
MULTIL,2,2,2 (phase 2 watts)
MULTIL,3,4,3 (sum VA)
MULTIL?
3 data values returned

Notes:

For further information and assistance with the Multilog application please go to page 2-93 where you will find an application guide to assist with this function

NEWLOC

NEWLOC

Function: Waits for new data then holds so that multiple commands can be used on the same data set.

Description: Reads multiple sets of data

Format: NEWLOC

Arguments: None

Reply: Data as per returned parameter query. ie from power, harmonics etc.

Example: NEWLOC;HARMON?SERIES;HPOWER?
Harmonic series and Power data returned

Notes: After the command the data will still be held so to release the lock send SUSPEND,OFF

NOOVER**NOOVER**

Function: Disable overranging

Description: Prevents an overrange error from blanking out results in manual ranging.

Format: NOOVER,*value*

Arguments: value:
ON
OFF

Reply: none

Example: NOOVER,ON

Notes: This can be useful when testing devices in a noisy environment. The range can be set to the correct range for the signal to be measured even if sporadic noise spikes would push it up on to the next range.

PFCONV**PFCONV**

Function: Set power factor sign convention.

Description: Fundamental power factor is given a sign depending convention either:
negative if lagging current
negative if leading current

Format: PFCONV,*type*

Arguments: type:
NEGLAG
NEGLEA

Reply: none

Example: PFCONV,NEGLAG

Notes: An inductive load would have a lagging current, a capacitive load would have a leading current.
The sign given to VAr can be independently set: see VARCON

PHASEM**PHASEM**

Function: Set phase meter mode.

Description: Select phase meter mode and reference.

Format: PHASE,*reference*

Arguments: reference:
 CH1 ratio = ch2/ch1
 CH2 ratio = ch1/ch2

Reply: none

Example: PHASEM,CH2

Notes:

PHASEM?**PHASEM?**

Function:	Phase meter query
Description:	Reads phase meter results. Sets phase meter mode if not already set. Waits for next unread data if available. Clears new data available bit read by DAV?
Format:	PHASEM? PHASEM, <i>phase?</i>
Arguments:	phase: PHASE1 PHASE2 PHASE3 PHASES?
Reply:	5 data values separated by commas freq,mag1,mag2,dB,phase
Example:	PHASEM,CH1 PHASEM,PHASE1? data returned
Notes:	The phase convention can be set to 0° to -360°, 0° to +360°, or +180° to -180° in the SYSTEM menu or using PHCONV command. PHASEM? without specifying the phase returns the appropriate single phase data.

PHCONV**PHCONV**

Function: Set phase convention

Description: Set phase convention

Format: PHCONV,*convention*

Arguments: convention:
180: -180 to +180
-360: 0 to -360
+360: 0 to +360

Reply: none

Example: PHCONV, -360

Notes: 0 to -360 degrees is usually used for power analysis applications

POWER**POWER**

Function: Set up power analyser mode.

Description: Configure power analyser with sum current display type

Format: POWER,*sum type*

Arguments: sum type:
TOTAL
AVERAGE

Reply: none

Examples: POWER,TOTAL

Notes:

POWER?

POWER?

Function: Read power analyser results

Description: Reads back latest power analyser results.
Sets power analyser mode.
Waits for next unread data if necessary.
Clears new data available status bit.

Format: *POWER,phase,results?*

Arguments: phase:
 PHASE1
 PHASE2
 PHASE3
 PHASES
 SUM
 NEUTRAL (current only)
results:
 WATTS
 VOLTAGE
 CURRENT
 VECTORS
 RMS
 WVA
 PH-PH

Reply: WATTS:
 freq,W,W.f,VA,VA.f,VAR,VAR.f,pf,pf.f,
 Wdc,W.h
 VOLTAGE or CURRENT:
 freq,rms,mag,dc,phase,pk,cf,mean,
 form factor,harm
 VECTORS:
 freq,vmag1,vlag1,amag1,alag1.....
 RMS:
 freq,vrms1,vdc1,arms1,adc1.....
 WVA:
 freq,w1,vrms1,arms1,w2.....
 PH-PH:
 freq,rms1,mag1,lag1,rms2...

Example: POWER,VECTORS?
 data returned

Notes: POWER? without specifying the phase
 returns the appropriate single phase data.
 PHASES returns the data for all valid
 phases 1-3.

PROGRA

PROGRA

Function: Access non volatile program stores.

Description: Recall, store or delete non-volatile program store.

Format: *PROGRA,function,number*

Arguments: function:
 RECALL
 STORE
 DELETE
 number
 0-100

Reply: none

Example: *PROGRA,RECALL,13*

Notes: Number 0 represents factory default, which can only be recalled.

PROGRA?

PROGRA?

Function: Identify current program.

Description: Reads the name of the last program to be loaded or recalled.

Format: PROGRA?

Arguments: none

Reply: text string

Example: PROGRA?
factory default

Notes:

RANGE**RANGE**

Function: Set channel ranging.

Description: Select minimum range and range control for a given input channel.

Format: RANGE,*channel,ranging,range*

Arguments: channel:
 CH1
 CH2
 ranging:
 AUTO
 UPAUTO
 MANUAL
 range:
 range number 1-8

Reply: none

Example: RANGE,CH2,MANUAL,4

Notes: CH1 sets the voltage range
 CH2 sets the current range
 Refer to the user manual for the range
 corresponding to each range number

RESOLU**RESOLU**

Function: Set the data resolution

Description: Data is returned in scientific format with exponent and mantissa. The resolution of the mantissa may be selected to be 5 digit (NORMAL) or 6 digit (HIGH) or 20 bit (BINARY).

Format: RESOLU,*format*

Arguments: format:
 NORMAL (5 digit mantissa)
 HIGH (6 digit mantissa)
 BINARY (compressed format)

Reply: none

Example: RESOLU,HIGH

Notes: Data format for NORMAL is:
 [-]1.2345E[-]00
 Data format for HIGH is:
 [-]1.23456E[-]00
 The sign of the mantissa and exponent are only sent if negative shown as [-] in the above examples
 BINARY format encodes each non-integer value in a proprietary 4 byte format for higher speed data transfer.

[Further notes on data format are included in section 1.4]

RESULT**RESULT**

Function: Access results stores.

Description: Recall, store or delete results.

Format: *RESULT,function,number*

Arguments: function:
 RECALL
 STORE
 DELETE
 number
 1-20

Reply: none

Example: RESULT,RECALL,13

Notes: There are 3 types of result: normal, harmonic and scope. Harmonic and scope results occupy 3 locations each.

RESULT?

RESULT?

Function: Identify used result stores.

Description: Reads a directory of the result locations.

Format: RESULT?

Arguments: none

Reply: 20 integers separated by commas

Example: RESULT?
0,0,1,3,-1,-1,0,2,-1,-1,0,0,0,0,0,0,0,0,0,0

Notes:
0 = empty
1 = normal result
2 = harmonic result
3 = scope result
-1 = continuation of previous

REZERO

REZERO

Function: Rezero front end

Description: Request the DSP to re-compensate for dc offset and compute a new autozero

Format: REZERO

Arguments: none

Reply: none

Example: REZERO

Notes:

SCALE**SCALE**

Function: Set channel scale factor.

Description: Set a multiplying scale factor for a given input channel.

Format: *SCALE,channel,factor*

Arguments: channel:
 CH1
 CH2
 factor:
 multiplying scale factor

Reply: none

Example: SCALE,CH2,10

Notes: CH1 sets the scale for all voltage channels
 CH2 sets the scale for all current channels

SCOPE?**SCOPE?**

Function: Fetch raw scope data.

Description: Read back raw oscilloscope data.

Format: *SCOPE,channel?*
SCOPE,phase,channel?

Arguments: phase:
 PHASE1
 PHASE2
 PHASE3
 NEUTRA
 channel:
 VOLTAGE
 CURRENT

Reply: 252 signed integers:
 range
 trigger
 250 x data

Example: HOLD,ON
 SCOPE,PHASE1,VOLTAGE?
 read data
 SCOPE,PHASE2,VOLTAGE?
 read data
 SCOPE,PHASE3,VOLTAGE?
 read data
 HOLD,OFF

Notes:

SCREEN?

SCREEN?

Function: Read the screen data

Description: Returns a bit map of screen pixel display in ascii and hex format

Format: SCREEN?

Arguments: none

Reply: Multiple data bit values

Example: SCREEN?
data returned

Notes: SCREEN? response:

ASCII coded Hex
(2 characters for each byte)
272 lines of 60 bytes (each line represents one line of the display) preceded by #H
Each byte represents 8 dots where the lsb is the leftmost dot of the display
The bit is set for on and cleared for off

SETUP**SETUP**

Function:	Upload instrument set up
Description:	All the settings within the instrument may be read by SETUP? The same settings may then be stored by ending the same data back to the instrument. As it sends all settings in a compressed format it is quicker than setting individual parameters.
Format:	SETUP,index,data
Arguments:	index: 0-15 data: ASCII hex as returned by SETUP?
Reply:	none
Example:	SETUP? Read 16 lines of data SETUP,00,data00 SETUP,01,data01 . . SETUP,15,data15
Notes:	The settings are only updated when the 16 th line has been received and the checksum has been verified.

SETUP?**SETUP?**

Function: Read instrument set up

Description: All the settings within the instrument may be read by SETUP?. The same settings may then be stored by ending the same data back to the instrument. As it sends all settings in a compressed format it is quicker than setting individual parameters.

Format: SETUP?

Arguments: none

Reply: 16 lines of ASCII data

Example: SETUP?
Read 16 lines of data

Notes:

SHUNT**SHUNT**

Function: Set channel shunt value

Description: Set the resistance factor of an external current shunt to be divided into the measured voltage for a given input channel.

Format: SHUNT,*channel,resistance*

Arguments: channel:
 CH1
 CH2
 resistance:
 shunt resistance in Ohms

Reply: none

Example: SHUNT,CH1,10

Notes: The shunt value is set for all current channels

SMOOTH**SMOOTH**

Function: Select the smoothing

Description: Sets the filter time constant and dynamic response.

Format: *SMOOTH,type,dynamics*

Arguments: type:
 NONE
 NORMAL
 SLOW
 dynamics:
 AUTO
 FIXED

Reply: none

Example: SMOOTH,NORMAL,FIXED
 SMOOTH,NONE

Notes: It is not necessary to send both parameters if it is only required to set the type. Both arguments must be sent to set the dynamics.
 FILTER is an alias for SMOOTH

SPEED**SPEED**

Function: Sets the measurement speed

Description: Sets the minimum window size for the measurement.

Format: *SPEED,value,window*

Arguments: value:
VERY FAST
FAST
MEDIUM
SLOW
VSLOW
WINDOW

Reply: none

Example: *SPEED,SLOW*
SPEED,WINDOW,0.1

Notes: The window size argument is only needed for the SINDOW option

START

START

Function: Start datalog
Description: Initiate datalog data acquisition.
Format: START
Arguments: none
Reply: none
Example: DATALOG, RAM, 0.02
START
Notes:

STATUS?**STATUS?**

Function: Read back channel ranging status.

Description: Read back condition of selected channel:
range number (1-16)
range text
overflow/underflow status

Format: STATUS?
or: STATUS,*channel?*
STATUS?*channel*

Arguments: channel:
CH1
.
.
CH6

Reply: range number,range text,over/under/ok
1-16
range as per RANGE command
OVER if overflow
LOW if underflow
OK if in range

Example: STATUS,CH1?
6,300V,OK
STATUS?
OK

Notes:

STOP**STOP**

Function: Stop datalog
Description: Stop datalog data acquisition.
Format: STOP
Arguments: none
Reply: none
Example: DATALOG, RAM, 0.02
START
wait for data values
STOP
read data values

Notes:

SUSPEN**SUSPEN**

Function: Suspend data acquisition.

Description: Disable the data acquisition to maximise the communication speed.

Format: SUSPEN,*value*

Arguments: value:
ON
OFF

Reply: none

Example: FAST,ON
SUSPEN,ON
MULTILOG?
SUSPEN,OFF
FAST,OFF

Notes:

USER?

USER?

Function: Read the user data
Description: Returns up to 3 lines of user data
Format: USER?
Arguments: none
Reply: 3 lines of ASCII terminated by CR
Example: USER?
 Newtons4th Ltd
 R&D department
 KinetiQ #4

Notes:

VARCON**VARCON**

Function: Set VAr sign convention.

Description: Fundamental VAr measurement is given a sign depending convention either:
negative if lagging current
negative if leading current

Format: VARCON,*type*

Arguments: type:
NEGLAG
NEGLEA

Reply: none

Example: VARCON,NEGLAG

Notes: An inductive load would have a lagging current, a capacitive load would have a leading current.
The sign given to power factor can be independently set: see PFCONV

VERSIO?

VERSIO?

Function: Read the instrument code versions.

Description: Returns an ASCII string with the details of the various parts of the instrument firmware.

Format: VERSIO?

Arguments: none

Reply: date code, type, cpu, dsp, fpga, boot type:
0 – normal (20A)
2 – low current version (10A)

Examples: VERSIO?
KQ1306,0,1.10,1.10,1.10,1.01

Notes: This data can be displayed on the screen by pressing SYSTEM then BACK

VRMS**VRMS**

Function: Set up rms voltmeter.

Description: Set mode to rms voltmeter.

Format: VRMS

Arguments: none

Reply: none

Examples: VRMS

Notes: This has the same effect as MODE,VRMS

VRMS?**VRMS?**

Function:	Read true rms voltmeter results
Description:	Reads back latest voltmeter results. Waits for next unread data if necessary. Clears new data available status bit.
Format:	VRMS, <i>phase,results?</i>
Arguments:	results: RMS MEAN SURGE phase: PHASE1 PHASE2 PHASE3 PHASES
Reply:	RMS: 6 data values separated by commas Vrms,Arms,Vdc,Adc,Vac,Aac MEAN: 6 data values separated by commas Vrms,Arms,Vmean,Amean,Vff,Aff SURGE: 8 data values separated by commas Vrms,Arms,Vpk,Apk,Vcf,Acf, Vsurge,Asurge
Example:	VRMS,PHASE1,RMS?
Notes:	VRMS? without specifying the phase returns the appropriate single phase data.

WIRING**WIRING**

Function:	Select wiring mode.
Description:	Set wiring mode for computation of SUM and neutral data.
Format:	WIRING, <i>type</i>
Arguments:	type: SINGLE (single ph 1) 2PHASE (2 ph 2 wattmeter) 3PH2WA (3 ph 2 wattmeter) 3PH3WA (3 ph 3 wattmeter) INDPH3 (3 ph 2 wattmeter + ph3) PHASE1 (single ph 1) PHASE2 (single ph 2) PHASE3 (single ph 3)
Reply:	none
Examples:	WIRING,PHASE2
Notes:	WIRING,SINGLE is the same as WIRING,PHASE1

ZERO**ZERO**

Function: Apply or remove the zero

Description: Applies or removes a zero function depending on the measurement mode (same as pressing ZERO key). Resets the integration data and timer if in power integration mode.

Format: ZERO
ZERO,DELETE

Arguments: none

Reply: none

Example: ZERO

Notes:

ZOOM**ZOOM**

Function: Sets the display zoom parameters.

Description: Sets the zoom level and data.

Format: *ZOOM,level,data1,data2,data3,data4*

Arguments: level:
 0 – normal
 1 – zoom data larger font (zoom level 1)
 2 – zoom data only (zoom level 2)
 3 – first three zoom data only (zoom level 3)
 data1-4:
 zoom data

 data consists of line number for channel 1
 or line number + 128 for channel 2

Reply: None

Example: VRMS
 ZOOM,1,1,12 (level 1, ch1 rms, ch2 rms)

Notes: It is not necessary to send all the parameters, but whatever parameters are sent must be in the correct order.

ZOOM?**ZOOM?**

Function: Read the display zoom parameters.

Description: Reads the zoom level and data.

Format: ZOOM?

Arguments:

Reply: 5 integers separated by commas:

level:

0 – normal

1 – zoom data larger font (zoom level 1)

2 – zoom data only (zoom level 2)

3 – first three zoom data only (zoom level 3)

data1-4:

zoom data

data consists of line number for channel 1
or line number + 128 for channel 2

Example:

ZOOM?

1,1,129,0,0 (level 1, ch1 rms, ch2 rms)

Notes:

Multilog Application Guide **Configuring the N4L PPA Power Analyzer for** **Data logging**

The Multilog (MULTIL) command provides an excellent method for data logging up to 64 parameters of information via one query command - MULTIL?

The instrument will return a comma-separated string which relates to the MULTIL,X,X,X setup commands previously entered by the relevant communication method. This enables the system to send one query and return up to 64 different parameters, from different phases in one response.

Step 1.

Reset "MULTILOG" using the **MULTIL,0** command

This will clear any previously entered Multilog parameters and ensure the instrument does not return unwanted results.

Step 2.

Set up the Multilog parameters

The format of the Multilog command is as follows

MULTILOG, Index, Phase, function

Index is the order in which the value is returned (Effectively allocating a "slot" for the parameter in the returned string)

Phase is the phase (PH1,PH2,PH3 etc) from which the result should be acquired.

Function is the parameter type (eg. Watts, VAr, Frequency etc) of the return.

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The Function ID is chosen from Appendix C which is a continually growing list due to firmware upgrades of the power analyzers at N4L, at present the PPA5500 has 87 possible functions:

Function	Measurement	Notes
1	frequency	
2	watts	
3	VA	
4	VAr	
5	power factor	
6	fundamental watts	
7	fundamental VA	
8	fundamental VAr	
9	fundamental PF	
10	harmonic watts	
11	harmonic watts %	
12	impedance	
13	resistance	

Example extract from the Multilog function list

Required Parameters

Order parameter to be returned within string	Phase (channel) of data returned	Parameter required
1	1	Frequency
2	1	Watts Phase 1
3	2	Watts Phase 2
4	3	Watts Phase 3
5	1	RMS Voltage Phase 1
6	2	RMS Voltage Phase 1
7	3	RMS Voltage Phase 1

MULTILOG Pattern

Command	Index	Phase	Function
MULTIL,	1	1	1
MULTIL,	2	1	2
MULTIL,	3	2	2
MULTIL,	4	3	2
MULTIL,	5	1	50
MULTIL,	6	2	50
MULTIL,	7	3	50

Command strings to sent, reference the above Multilog pattern;

MULTIL,0 // clears Multilog

MULTIL,1,1,1 // set Frequency as parameter 1

MULTIL,2,1,2 // set Phase 1 Watts as parameter 2

MULTIL,3,2,2 // set Phase 2 Watts as parameter 3

MULTIL,4,3,2 // set Phase 3 Watts as parameter 4

MULTIL,5,1,50 // set Phase 1 RMS Voltage as parameter 5

MULTIL,6,2,50 // set Phase 2 RMS Voltage as parameter 6

MULTIL,7,3,50 // set Phase 3 RMS Voltage as parameter 7

Step 3.

Send Multil query and read return string.

MULTIL? // returns a comma separated string as

Example return string:

5.0000E1, 2.4500E2, 2.4320E2, 2.5421E2, 1.0232E3, 1.0152E3, 1.0546E3
↑ ↑ ↑ ↑ ↑ ↑ ↑
Frequency PH1 Watts PH2 Watts PH3 Watts PH1 RMS Volt PH2 RMS Volt PH3 RMS Volt

Appendix A – Configurable parameters

All parameters can be accessed using the CONFIG command:

CONFIG,*number,parameter*

<i>number</i>	Function	<i>parameter</i>
1	Operating mode,	(sets Main Mode) 0=RMS Voltmeter 1=Phase Meter 2=Power Analyser 3=Impedance Analyser 4=Power Integrator 5=Harmonic Analyser 7=Oscilloscope
2	Resolution,	(remote options – digit resolution) 0=Normal 1=High 2=Binary
4	Autozero manual or auto,	(System options) 0=Auto 1=Manual
6	Phase convention,	(System options) 0=-180° to +180° 1=0° to -360° 3=0° to +360°
7	Frequency lock on/off,	(Acquisition advance options) 0=Off 1=On
8	Graph,	(System options) 0=Dots 1=Lines

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- 9 Keyboard beep on/off, (System options)
 0=Off
 1=On
- 10 Ignore overload, (Acquisition advance options)
 0=Off
 1=On
- 11 Low frequency mode, (Acquisition control)
 0=Off
 1=On
- 12 Window size, (Acquisition control, speed-window)
 0=ms
 1=Sec's
- 13 Speed, (Acquisition control or Phase meter)
 0=Very Slow
 1=Slow
 2=Medium
 3=Fast
 4=Very Fast
 5=Window
- 14 Smoothing (Acquisition Control or Phase Meter)
 0=Normal
 1=Slow
 2=None
- 15 Smoothing Response (Acquisition Control or Phase meter)
 0=Auto reset
 1=Fixed time
- 16 Baud rate, (Remote options , RS232)
 0=38400
 1=19200
 2=9600
 3=1200
- 18 LAN IP address nibble 3, (Remote options - LAN - enter figure as required)

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- 19 LAN IP address nibble 2, (Remote options - LAN - enter figure as required)
- 20 LAN IP address nibble 1, (Remote options - LAN - enter figure as required)
- 21 LAN IP address nibble 0, (Remote options - LAN - enter figure as required)
- 22 Independent ranging, (System options)
0=Disabled
1=Enabled
- 24 Enable channel 1, (Range - voltage input)
0=Internal
3=External Attenuator

4=Internal x10
- 25 Enable channel 2, (Range - current input)
0=Internal
2=External Shunt

4=Internal x10
- 26 Input range channel 1, (Range - minimum range voltage)
0=1v
1=3v
2=10v
3=30v
4=100v
5=300v
6=1kV
7=3kV
- 27 Input range channel 2, (Range - minimum range current)
0=300ma
1=1A
2=3A
3=10A
4=30A
5=100
6=300A
7=1kA

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4=Phase 1,2 &3 page
5=Phase 1,2 & 3 fundamentals page
6=NEU page

- 42 Zoom level, (Main display)
 0=Zoom level 0
 1=Zoom level 1
 2=Zoom level 2 – 4 figures
 3=Zoom level 3 – 3 figures
- 43 Function zoomed on 1, (Main display)
 0=Voltage, Current & Frequency
 1=Watts, Current, Voltage & Frequency
 2= VA, Current, Voltage & Frequency
 3= VAr, Current, Voltage & Frequency
 4= pf, Current, Voltage & Frequency
- 44 Function zoomed on 2, (Main display)
 0=Current & Frequency
 1= Watts, Current & Frequency
 2= VA, Current & Frequency
 3= VAr, Current & Frequency
 4= pf, Current & Frequency
 5= Current, Voltage & Frequency
- 45 Function zoomed on 3, (Main display)
 0= Watts & Frequency
 2= Watts, VA & Frequency
 3= Watts, VAr & Frequency
 4= Watts, pf & Frequency
 5= Watts, Voltage & Frequency
 6= Watts, Current & Frequency
- 46 Function zoomed on 4, (Main display)
 0= Watts & VA
 3= Watts, VA & VAr
 4= Watts, VA & pf
 5= Watts, VA & Voltage
 6= Watts, VA & Current
 7= Watts, VA & Frequency
 8= Watts, VA & Harmonic
 9= Watts, VA & dc watts
 10= Watts, VA & V Ph-Ph

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- 47 **Datalog display type,** (Datalog display information mode)
 0=Real Time
 1=Table
 2=Graph
- 48 **Manual frequency,** (Acquisition advance options – frequency lock on)
 0=Frequency in μ hz
 1=Frequency in Hz
- 49 **DFT selectivity,** (Acquisition advance options)
 0=Normal
 1=Narrow
- 50 **Program 1-4 direct load,** (System options)
 0=Disabled
 1=Enabled
- 51 **Language,** (System options)
 0=English
 1=Other language if installed
- 52 **Frequency filter,** (Acquisition control)
 0=Disabled
 1=Enabled
- 53 **Phase reference,** (Acquisition control)
 0=Voltage
 1=Current
- 54 **Datalog Zoom1,** (Datalog-RAM)
 0=Enabled
 1=Disabled
- 55 **Datalog Zoom2,** (Datalog-RAM)
 0=Enabled
 1=Disabled
- 56 **Datalog Zoom3,** (Datalog-RAM)
 0=Enabled
 1=Disabled

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- 57 Datalog Zoom4, (Datalog-RAM)
 0=Enabled
 1=Disabled
- 58 Datalog memory type, (Datalog)
 0=Disabled
 1=RAM
- 59 Datalog Interval, (Datalog) (Enter interval time figure in seconds)
- 60 Datalog graph, (Datalog-RAM)
 0=Together
 1=Seperate
- 61 Formula, (Maths)
 0=Disabled
 1=(term1 + term2/term3 + term4)
 2=(term1 + term2) x term3/term4
 3=term1 x term2/(term3 + term4)
- 62 Argument term 1
 0=Disabled
 1=Constant
 2=Voltage
 3=Current
 4=Torque
 5=Speed
- 63 Sub argument term 1, (For voltage and current arguments only)
 0=rms
 1=dc
 2=ac
 3=Fundamental
 4=Peak
 5=Mean
 6= Ph-Ph rms
 7=Ph-Ph mag
- 64 Term 1 coefficient, (Enter value)

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- 65 Argument term 2,
 0=Disabled
 1=Constant
 2=Voltage
 3=Current
 4=Torque
 5=Speed
- 66 Sub argument term 2, (For voltage and current arguments only)
 0=rms
 1=dc
 2=ac
 3=Fundamental
 4=Peak
 5=Mean
 6= Ph-Ph rms
 7=Ph-Ph mag
- 67 Term 2 coefficient, (Enter value)
- 70 Application mode,
 0=Normal
 2=Lighting ballast
 3=Inrush current
 5=Standby power
- 72 Frequency tracking speed, (Application options mode - Lighting Ballast)
 0=Fixed time
 1=Fast
 2=Medium
 3=Slow
- 73 Low frequency, (Acquisition Menu)
 0=Off
 1=On
- 74 Argument term 3
 0=Disabled
 1=Constant
 2=Voltage
 3=Current
 4=Torque
 5=Speed

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- 75 Sub argument term 3, (For voltage and current arguments only)
0=rms
1=dc
2=ac
3=Fundamental
4=Peak
5=Mean
6= Ph-Ph rms
7=Ph-Ph mag
- 76 Term 3 coefficient, (Enter value)
- 77 Argument term 4
0=Disabled
1=Constant
2=Voltage
3=Current
4=Torque
5=Speed
- 78 Sub argument term 4, (For voltage and current arguments only)
0=rms
1=dc
2=ac
3=Fundamental
4=Peak
5=Mean
6= Ph-Ph rms
7=Ph-Ph mag
- 79 Term 4 coefficient, (Enter value)
- 82 Wiring configuration, (Acquisition control)
0=Single phase 1
1=2 phase 2 wattmeter
2=3 phase 2 wattmeter
3=3 phase 3 wattmeter
4=Single phase 2
5=Single phase 3
6=3 phase 2 wattmeter + PH3

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- 83 **Integration,** (Power analyzer - Power integrator)
 0=Signed
 1=Magnitude
- 88 **Integration display,** (Mode - Power integrator)
 0=Total
 1=Average
- 89 **Sum current average,** (Power analyzer)
 0=Total
 1=Average
- 90 **Phase 3 reference,** (Acquisition control - 3 phase 2 wattmeter + PH3)
 0=Voltage
 1=Current
 2=ac line
 3=Phase 1 & 2
- 91 **Power factor sign,** (Power analyzer)
 0=Negative lagging
 1=Negative leading
- 92 **VAr sign,** (Power analyzer)
 0= Negative lagging
 1=Negative leading
- 94 **Range lock across phases,** (Range - when acquisition is using 3 phases)
 0=Disabled
 1=Enabled
- 99 **Computation mode,** (Harmonic analyzer)
 0=Difference formula
 1=Harmonic series
 2=TIF
 3=THF
 4=TRD
 5=TDD
 6=Series harmonic phase
- 100 **Selected harmonic,** (Harmonic analyzer - figure = harmonic required)
- 101 **Harmonic series up to,** (Harmonic analyzer - figure = harmonic max)
- 102 **Voltage bargraph scale,** (Harmonic analyzer - figure = % required)

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- 103 Current rating (TRD), (Harmonic analyzer – TRD mode – enter figure)
- 104 Current bargraph scale, (Harmonic analyzer - figure = % required)
- 106 Timebase, (Scope - Enter figure/div)
- 107 trigger level, (Scope - Enter figure/div)
- 108 Pretrigger, (Scope)
0=None
1=25%
2=50%
3=75%
- 109 trigger polarity, (Scope)
0=Rising edge
1=Falling edge
- 110 trigger Mode, (Scope)
0=Auto
1=Normal
2=Single shot
- 111 trigger reference, (Scope)
0=Voltage
1=Current
- 112 trigger phase, (Scope)
0=Phase 1
1=Phase 2
2=Phase 3
- 113 cursors enable, (Scope)
0=Off
1=On
- 114 trigger HF reject, (Scope)
0=Off
1=On
- 115 Trace, (Scope)
0=Dual

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- 1=Voltage
2=Current
- 119 Zoom 2 high resolution, (System)
0=Disabled
1=Enabled
- 120 Brightness, (System)
0=Low
1=High
- 122 Auxiliary device, (Aux control)
0=None
6=PCIS
- 128 Switch phase offset, (Aux control – PCIS device)
0=0°
1=45°
2=90°
3=135°
4=180°
5=225°
6=270°
7=315°
- 129 Switch on cycles, (Aux control – PCIS device)
0=Single cycle
1=Continuous
2=Half cycle
- 131 2 Wattmeter sum computation, (Power Analyser)(select in acquisition wiring-2 phase 2 wattmeter)
0=Low distortion
1=High Distortion
- 132 Integrator-run time (Hours), (Mode – Power integrator - enter figure)
- 133 Integrator-Run time (mins), (Mode - Power integrator – enter figure)
- 134 Ph – Ph Measurement, (Power analyser)
0=Rms
1=Mean

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- 135 **Difference THD,** (Power analyser)
 0=Disabled
 1=Enabled
- 137 **Parameter,** (Impedance analyzer)
 0=Auto
 1=Capacitance
 2=Inductance
 3=Impedance
- 138 **Measurement,** (Impedance analyzer)
 0=Series
 1=Parallel
- 139 **Phase offset,** (Impedance analyzer - Enter figures)
- 140 **Voltage peak,** (rms voltmeter)
 0=Signed
 1=Separate
 2=Unfiltered
- 144 **Rectified mean,** (rms voltmeter)
 0=Absolute
 1=Normalised
- 148 **dB offset,** (Phase meter - Enter figures)
- 150 **Computation,** (Phase meter)
 0=ch2/ch1
 1=ch1/ch2
- 152 **RS232 printer enable,** (Remote options)
 0=Disabled
 1=Enabled
- 154 **Interface,** (Remote options)
 0=RS232
 1=USB
 2=LAN
- 155 **Recall with program,** (Remote options)
 0=Off

1=On

Alarm functions

- 156 Alarm 1 data, (Alarm options)
0=Zoom1
1=Zoom 2
2=Zoom3
3=Zoom 4
- 157 Alarm 1 type, (Alarm options)
0=Disabled
1=Linear
2=Alarm if high
3=Alarm if low
4=Outside window5=Inside window
- 158 Alarm 1 high threshold, (Alarm options – alarm if high – enter figure)
- 159 Alarm 1 low threshold, (Alarm options – alarm if low – enter figure)
- 160 Alarm latch, (Alarm options – alarm if high)
0=Off
1=On
- 161 Alarm sounder, (Alarm options – alarm if high)
0=Enabled
1=Disabled
- 167 Alarm 2 data, (Alarm options)
0=Zoom1
1=Zoom 2
2=Zoom 3
3=Zoom 4
- 168 Alarm 2 type, (Alarm options)
0=Disabled
1=Linear

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2=Alarm if high
3=Alarm if low
4=Outside window
5=Inside window

- 169 Alarm 2 high threshold, (Alarm options – alarm if high – enter figure)
- 170 Alarm 2 low threshold, (Alarm options – alarm if low – enter figure)
- 176 Enable channel 3, (Range–voltage input)(Sys - independent ranging enabled)
0=Internal
3=External Attenuator

4=Internal x10
- 177 Enable channel 4, (Range – current input)(Sys independent ranging enabled)
0=Internal
2=External Shunt

4=Internal x10
- 178 Input range channel 3, (Range – minimum range voltage) (Sys independent ranging enabled)
0=1v
1=3v
2=10v
3=30v
4=100v
5=300v
6=1kV
7=3kV
- 179 Input range channel 4, (Range – minimum range current) (Sys independent ranging enabled)
0=300ma
1=1A
2=3A
3=10A
4=30A
5=100
6=300A
7=1kA
- 180 Input ranging channel 3, (Range – autoranging voltage) (Sys independent

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- ranging enabled)
- 0=Full Autorange
1=Range up only
2=Manual
- 181 Input ranging channel 4, (Range – autoranging current) (Sys independent ranging enabled)
0= Full Autorange
1=Range up only
2=Manual
- 182 Coupling phase 2, (Coupling) (Sys independent ranging enabled)
0=ac +dc
1=ac
2=dc
- 184 Scale factor channel 3 voltage, (Ranging - Enter figures as required)(Sys independent ranging enabled)
- 185 Scale factor channel 4 current, (Ranging - Enter figures as required) (Sys independent ranging enabled)
- 186 External attenuator channel 3,(Ranging – voltage input - attenuator ratio Enter figures as required)(Sys independent ranging enabled)
- 187 External shunt channel 4, (Ranging – current input – resistance value Enter figures as required) (Sys independent ranging enabled)
- 200 Enable channel 5, (Range – voltage input) (Sys independent ranging enabled)
0=Internal
3=External Attenuator
4=Internal x10
- 201 Enable channel 6, (Range – current input) (Sys independent ranging enabled)
0=Internal
2=External Shunt
4=Internal x10
- 202 Input range channel 5, (Range – minimum range voltage)
0=1v

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1=3v
2=10v
3=30v
4=100v
5=300v
6=1kV
7=3kV

- 203 Input range channel 6, (Range – minimum range current) (Sys independent ranging enabled)
 0=300ma
 1=1A
 2=3A
 3=10A
 4=30A
 5=100
 6=300A
 7=1kA
- 204 Input ranging channel 5, (Range – autoranging voltage) (Sys independent ranging enabled)
 0=Full Autorange
 1=Range up only
 2=Manual
- 205 Input ranging channel 6, (Range – autoranging current) (Sys independent ranging enabled)
 0= Full Autorange
 1=Range up only
 2=Manual
- 206 Coupling phase 3, (Coupling) (Sys independent ranging enabled)
 0=ac +dc
 1=ac
 2=dc
- 208 Scale factor channel 5 voltage, (Ranging - Enter figures as required) (Sys independent ranging enabled)
- 209 Scale factor channel 6 current, (Ranging - Enter figures as required) (Sys independent ranging enabled)
- 210 External attenuator channel 5, (Ranging – voltage input - attenuator ratio as required) (Sys independent ranging enabled)
- 211 External shunt channel 6, (Ranging – current input – resistance value as

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Appendix B – MULTIL parameters

function	measurement	notes
1	frequency	
2	watts	
3	VA	
4	VAr	
5	power factor	
6	fundamental watts	
7	fundamental VA	
8	fundamental VAr	
9	fundamental PF	
10	harmonic watts	
11	harmonic watts %	
12	impedance	
13	resistance	
14	reactance	
15	impedance phase	
16	efficiency	
17	fundamental efficiency	
18	maths	
19	integrated watts	integrator mode
20	integrated VA	integrator mode
21	integrated VAr	integrator mode
22	integrated rms current	integrator mode
23	average power factor	integrator mode
24	integrated fundamental watts	integrator mode
25	integrated fundamental VA	integrator mode
26	integrated fundamental VAr	integrator mode
27	integrated fundamental current	integrator mode
28	average fundamental power factor	integrator mode
29	average integrated watts	integrator mode
30	average integrated VA	integrator mode
31	average integrated VAr	integrator mode
32	average integrated fundamental watts	integrator mode
33	average integrated fundamental VA	integrator mode
34	average integrated fundamental VAr	integrator mode
35	average rms voltage	integrator mode
36	average fundamental voltage	integrator mode
37	Standby mode frequency	
38	DC watts	

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39	average rms current	integrator mode
40	average fundamental current	integrator mode
41	delta watts	
42	fundamental delta watts	
43	elapsed time	integrator mode
44-49	reserved for future expansion	
50	rms voltage	
51	rms current	
52	fundamental voltage	
53	fundamental current	
54	voltage phase	
55	current phase	
56	harmonic voltage	
57	harmonic current	
58	dc voltage	
59	dc current	
60	ac voltage	
61	ac current	
62	peak voltage	
63	peak current	
64	voltage crest factor	
65	current crest factor	
66	rectified mean voltage	
67	rectified mean current	
68	voltage form factor	
69	current form factor	
70	voltage harmonic	
71	current harmonic	
72	voltage harmonic percentage	
73	current harmonic percentage	
74	voltage thd	harmonic mode
75	current thd	harmonic mode
76	voltage tif	harmonic mode
77	current tif	harmonic mode
78	phase to phase rms voltage	
79	phase to phase fundamental voltage	
80	phase to phase voltage phase angle	
81	phase to phase rms voltage	
82	voltage surge	
83	current surge	
84	voltage rms deviation	transformer mode
85	voltage fundamental deviation	transformer mode
86	voltage phase deviation	transformer mode

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87	voltage positive peak	
88	current positive peak	
89	voltage negative peak	
90	current negative peak	
91	voltage positive peak unfiltered	
92	current positive peak unfiltered	
93	voltage negative peak unfiltered	
94	current negative peak unfiltered	
95-99	reserved for future expansion	

Phase selection:

- 1 = phase 1
- 2 = phase 2
- 3 = phase 3
- 4 = sum
- 5 = neutral

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