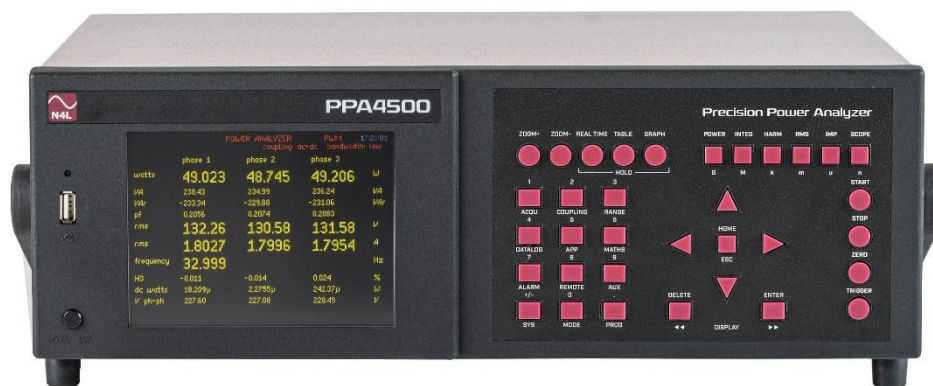




**Newton4th Ltd**

# PPA4500

## COMMUNICATIONS MANUAL



**Firmware v2.180**

**Version v3.01**

**11<sup>th</sup> February 2020**

## **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.
- 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 PPA45xx series of instruments over RS232, USB, LAN or GPIB. 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. A one line summary of each command is given in the appendix. 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.

Version v3.01

Firmware Revision 2.180

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11<sup>th</sup> February 2020

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## 1 Using remote control

The instrument is fitted with an RS232 serial communications port, USB, IEEE488 (GPIB) and LAN interface. All the interfaces use the same ASCII protocol with the exception of the end of line terminators:

	Rx expects	Tx sends
RS232 USB, LAN	carriage return (line feed ignored)	carriage return and line feed
IEEE488	carriage return or line feed or EOI	carriage return with EOI

All the functions of the instrument can be programmed via any interface, and results read back. When the IEEE488 interface is set to 'remote' the other ports are ignored.

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 IEEE or LAN (see section 2).

The IEEE address defaults to 23 and can be changed via the COMMS menu.

The keyboard is disabled when the instrument is set to "remote" using the IEEE. Press HOME to return to "local" operation.

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
8	-	7

## 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	$0.75 \times 2^2$	0x82,0xB0,0x80,0x80
0.1	$0.8 \times 2^{-3}$	0xFD,0xB3,0x99,0xCD
-320	$-0.625 \times 2^9$	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 <i>standard event status register</i> 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:	<p>The following bits in the standard event status enable register have been implemented:</p> <ul style="list-style-type: none"> <li>bit 0 OPC (operation complete)</li> <li>bit 2 QYE (unterminated query error)</li> <li>bit 3 DDE (device dependent error)</li> <li>bit 4 EXE (execution error)</li> <li>bit 5 CME (command interpretation error)</li> <li>bit 7 PON (power on event)</li> </ul> <p>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.</p>

**\*ESR?**

**\*ESR?**

Function:	Standard event status register query
Description:	Returns the contents of the <i>standard event status register</i> 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,PPA4530,165-05582,2.178
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 DSP zero error
- bit 2 – set if DSP run error
- bit 3 – not used
- bit 4 – System error, FPA initialisation
- bit 5 – System error, DSP RAM
- bit 6 – System error, DSP run
- bit 7 – System error, external RAM
- bits 8 – 14 not used
- > 15 – major system error

bit 0 – set

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:

**ADIMAP****ADIMAP**

Function:	Map multilog parameters to outputs
Description:	Applies offset and scaling to a multilog value and maps value to chosen ADI output
Format:	ADIMAP,output,multilog,offset,scale
Arguments:	output: 1-20 multilog: 1-64 offset: Float scale: Float
Reply:	None
Example:	MULTIL,0 MULTIL,2,1,1      (PH1 Frequency) ADIMAP,1,2,0.2,0.5  Output 1 = 0.5 * (PH1 frequency - 0.2)
Notes:	Offset is subtracted from multilog value, then scale is applied within the limits of +/- 10

## **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:	<i>ALARM1,type,data,high,low</i>
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:	ALARM2,LOW,3,0,0.5
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, <i>value</i>
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:



## **ANALOG**

## **ANALOG**

Function: Interface with ADI40

Description: Write to individual ADI40 outputs

Format: *ANALOG,channel,value*

Arguments: Channel:  
                  1-20  
          Value:  
                  -10.00 to +10.00

Reply: None

Example: *ANALOG,5,-3.14*

Notes: Up to 9 outputs can be written to with one CommView transfer, by separating each instance with a ";".

**ANALOG?**

**ANALOG?**

Function: Interface with ADI40

Description: Read from individual ADI40 inputs

Format: ANALOG,channel?

Arguments: Channel:  
1-20

Reply: ASCII characters in scientific format:  
1 - 16 in Volts  
17- 20 in °C

Example: ANALOG,12?

Notes: Up to 9 inputs can be read back at once with this command by separating each instance with a ";".

**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	
PWM	(PWM Motor Drive)
BALLAST	(Lighting ballast)
INRUSH	(Inrush Current)
POWERT	(Transformer mode)
STANDB	(Standby power)
CALIBR	(Calibration)

setting:

filter 0-2 (PWM only)
0: 4kHz
1: 1kHz
2: 250Hz
speed 0-3 (ballast only)
0: fixed time
1: fast
2: medium
3: slow

Reply: none

Example: *APPLIC,POWERT*  
*APPLIC,PWM,1*

Notes:

**BANDWI****BANDWI**

Function: Select bandwidth.

Description: The analogue bandwidth of the instrument can be selected as "wide" (to 3MHz). For low noise measurements at low frequency the bandwidth can be restricted to "low" (to 40kHz). For measurements of dc in the presence of large ac signal, the bandwidth can be further restricted to "dc only" (to 10Hz).

Format: `BANDWI,phase,type`

Arguments: phase:  
                   PHASE1  
                   PHASE2  
                   PHASE3  
 type:  
                   WIDE  
                   LOW  
                   DCONLY

Reply: none

Example: `BANDWI,WIDE`

Notes: Only use DCONLY to improve accuracy of measurement of small dc in the presence of a large ac signal. For normal dc measurements use bandwidth = LOW.

**BANDWI?**

**BANDWI?**

Function: Read bandwidth setting.

Description: Returns a numerical value for the bandwidth setting.

Format: BANDWI,*phase?*

Arguments: phase:  
            PHASE1  
            PHASE2  
            PHASE3

Reply: 0 = WIDE  
       1 = LOW  
       2 = DCONLY

Example: BANDWI,PHASE3,LOW  
          BANDWI,PHASE3?  
          1

Notes: If independent input control has not been enabled then the setting for phase 1 is used for all phases.

**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:

**CALVER****CALVER**

Function:	Load a calibration verification 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:	CALVER, <i>string</i>
Arguments:	<i>string</i> is any sequence of printable alpha numeric characters. Use the underscore character to add a space between words. CALVER without a string argument clears the previously stored string.
Reply:	none
Example:	CALVER,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.



**CALVER?**

**CALVER?**

Function:	Read back the calibration verification 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:	CALVER?
Arguments:	none.
Reply:	alphanumeric string
Example:	CALVER? 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:	<i>CONFIG,index,data</i>
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, <i>index</i> ?
or:	CONFIG? <i>index</i>
Arguments:	<i>index</i> 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, <i>phase,coupling</i>
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, <i>phase,coupling</i>
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 or accesses datalog non-volatile store.
Format:	<i>DATALO,function,interval,speed</i>
Arguments:	function: DISABLE RAM NONVOL RECALL DELETE interval: datalog interval in seconds speed: HIGH
Reply:	none
Example:	DATALOG, NONVOL, 10 DATALOG, 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, <i>start,records?</i> 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:	DATALOG,NONVOL,10 START wait for datalog STOP DATALOG,LINES? 30 DATALOG,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 DATALOG? 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, <i>value</i>
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, <i>page</i>
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, <i>formula</i>
Arguments:	formula: <ul style="list-style-type: none"><li>0 – disabled</li><li>1 – phase 1 / phase 2</li><li>2 – phase 2 / phase 1</li><li>3 – slave / master</li><li>4 – master /slave</li><li>5 – mechanical sum</li><li>6 – sum / mechanical</li><li>7 – phase 3 / sum</li><li>8 – sum /phase</li></ul>
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

Example: EFFICI?  
data returned

Notes:

## 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:	Set the technique for determining the frequency for analysis.
Format:	<i>FQLOCK,value,frequency</i>
Arguments:	value: ON OFF NORMAL CONSTANT DYNAMIC  frequency (optional) CONSTANT -enter frequency DYNAMIC -enter minimum frequency
Reply:	none
Example:	FQLOCK,ON FQLOCK,Dynamic,100
Notes:	FQLOCK,CONSTANT Without an argument locks the frequency to the present value.  ON is the same as CONSTANT OFF is the same as NORMAL  When Dynamic is selected the minimum frequency can be set between 0.010Hz (10mHz) and 500Hz.



**FQREF****FQREF**

Function:	Set frequency reference.
Description:	Select the channel to be used for measuring the frequency.
Format:	<i>FQREF,phase</i> <i>FQREF,channel</i> <i>FQREF,phase,channel</i>
Arguments:	channel: voltage current Speed Ac Line  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).

**FREQFI****FREQFI**

Function:	Set the frequency filter
Description:	Selects a filter to be applied to the data used for frequency measurement to help synchronise in noisy environments.
Format:	FREQFI, <i>value</i>
Arguments:	value: ON OFF
Reply:	none
Example:	FREQFI,ON
Notes:	The filter is applied only to the data used for frequency measurement and does not change the data used for the measurements.

**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, 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:	<i>HARMON,para,harmonic,max,stepsize</i>																				
Arguments:	<p>para:</p> <table> <tr><td>THDD</td><td>difference formula THD</td></tr> <tr><td>THDS</td><td>harmonic series THD</td></tr> <tr><td>TIF</td><td>Telephone Influence Factor</td></tr> <tr><td>THF</td><td>Telephone Harmonic Factor</td></tr> <tr><td>TDD</td><td>Total Demand Distortion</td></tr> <tr><td>TRD</td><td>Total Rated Distortion</td></tr> <tr><td>HPHASE</td><td>harmonic phase</td></tr> <tr><td>INTERH</td><td>Interharmonic sweep</td></tr> <tr><td>HRMS</td><td>Harmonic RMS</td></tr> <tr><td>PH-PH</td><td>Phase to Phase harmonics</td></tr> </table> <p>harmonic: individual harmonic for display</p> <p>max: length of harmonic series</p> <p>stepsize: frequency step size (0.5Hz – 100Hz)</p>	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	INTERH	Interharmonic sweep	HRMS	Harmonic RMS	PH-PH	Phase to Phase harmonics
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																				
INTERH	Interharmonic sweep																				
HRMS	Harmonic RMS																				
PH-PH	Phase to Phase harmonics																				
Reply:	none																				
Example:	HARMON,TRD HARMON,THDS,3,50 HARMON,INTERH,3,7500,20																				
Notes:	It is not necessary to send any arguments, but if any are sent they must be in the specified order. PH-PH command is reset by any THD command.																				

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The maximum value for length of harmonic series is as follows:

100 for harmonic factor, harmonic RMS, TIF, THF, TDD and TRD.

125 for Harmonic Series and Series Harmonic Phase.

9999 for Interharmonic sweep.

The stepsize argument only applies to Interharmonic Sweep.

**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, <i>phase</i> ?
or:	HARMON,SERIES?
or:	HARMON, <i>phase</i> ,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**

Function: Set input mode

Description: Selects the input type of the instrument

Format: *INPUT,channel,type*

Arguments: channel:  
              CH1  
              CH2  
          type:  
              INTERN  
              EXTATT  
              EXTSHU

Reply: none

Example: INPUT,CH1,EXTSHU

Notes: CH1 applies to all voltage channels  
       CH2 applies to all current channels

**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:	<i>INTEGR,type,display</i> <i>INTEGR,RUNTIM,hours,minutes</i>
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, <i>phase?</i>
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, <i>value</i>
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,*phase?*

Arguments: phase:  
              PHASE1  
              PHASE2  
              PHASE3  
              PHASES

Reply: 11 data values separated by commas:  
          freq, Vmag, Amag, impedance,  
          phase, R, C, L,  $\tan\delta$ , 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, <i>value</i>
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, <i>type</i>
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:	



## MSLAVE

## MSLAVE

Function:	Set master/slave mode
Description:	Enables the instrument to synchronise with a second instrument to simultaneously measure up to 6 phases.
Format:	MSLAVE, <i>type</i>
Arguments:	type: DISABLE MASTER SLAVE
Reply:	none
Example:	MSLAVE,MASTER
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 using the MULTIL? command.

Format: *MULTILOG,index,phase,function*

Arguments:

index:		
0	clear all	
1-64	select data 1-64	
phase:		
1-3	phase 1-3	
4	sum	
5	neutral	
6	ADI40	
function:		
1-99	see appendix C	

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:

For further information and assistance with the Multilog application please go to page 2-113 where you will find an application guide to assist with this function.

## MULTIL?

## MULTIL?

Function:	Reads multi string reply	
Description:	<p>Waits for data to be available (if required) then returns selected results.</p> <p>Either a single string or multiple string replies can be selected.</p>	
Format:	<p>MULTIL?</p> <p>MULTIL,number?</p>	
Arguments:	<p>number: The required number of data string replies</p>	
Reply:	<p>A single reply string containing up to 64 data values as selected by the MULTIL command.</p> <p>Multiple reply strings each containing the same number of data values (maximum of 64) as selected by the MULTIL command.</p>	
Example:	<p>MULTIL,0</p> <p>MULTIL,1,1,2 (phase 1 Watts)</p> <p>MULTIL,2,2,2 (phase 2 Watts)</p> <p>MULTIL,3,4,3 (sum VA)</p> <p>MULTIL?</p> <p>In the above example a single string reply containing 3 data values is returned.</p> <p>MULTIL,10?</p> <p>In the above example 10 data strings are returned, each string containing 3 data values.</p>	

Notes:           The MULTILOG,*number?* command will  
reply each time a new data point is  
available.

For further information and assistance with the Multilog  
application please go to page 2-113 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

## **NOISEF**

## **NOISEF**

Function:	Sets the noise filter.
Description:	Sets noise filter to value sent in string between 1KHz and 250KHz.
Format:	NOISEF,[PHASEx],value,frequency
Arguments:	<p>[PHASEx]:</p> <p>Phase1</p> <p>Phase2</p> <p>Phase3</p> <p>Value:</p> <p>ON</p> <p>OFF</p> <p>frequency:</p> <p>Between: 1000 – 250000</p>
Reply:	none
Example:	NOISEF,PHASE1,ON,1500
Notes:	Applies a digital filter for use in high noise environments. When in independent mode use [PHASEx] command to set noise filter on individual phases. [PHASESx] command is not required in any other wiring mode.

**NOOVER****NOOVER**

Function:	Disable overranging
Description:	Prevents an overrange error from blanking out results in manual ranging.
Format:	NOOVER, <i>value</i>
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.

## **NORMAL**

## **NORMAL**

Function:	Sets the Normalise reference to Current or Voltage.
Description:	Sets the Reference for the NORMALISE function. Press ZERO on the instrument to action the function.
Format:	NORMAL,reference
Arguments:	Reference: CURRENT VOLTAGE
Reply:	none
Example:	NORMAL,VOLTAGE NORMAL,CURRENT NORMALISE,VOLTAGE NORMALISE,CURRENT
Notes:	The "normalise" function adjusts the scale factors on each current channel so that they read the same as phase 1. The reference can be either the current measured on phase 1 or if there is a reference CT it can be connected to the external input of phase 1 voltage and used as a reference.



## **PFCNV**

## **PFCNV**

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: PFCNV,*type*

Arguments: type:  
                   NEGLAG  
                   NEGLEA

Reply: none

Example: PFCNV,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

## **PHANGREF**

## **PHANGREF**

Function: Set phase angle reference.

Description: Select phase angle reference to current or voltage.

Format: PHANGREF,*reference*

Arguments: reference:  
              Current  
              Voltage

Reply: none

Example: PHANGREF,current  
          PHANGREF,voltage

Notes:

## 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,*phase*?

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 and the harmonic angle.

Description: Set phase convention and optionally the harmonic angle.

Format: PHCONV,*convention,angle*

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

Angle:  
           Cosine  
           Sine

Reply: none

Example: PHCONV, -360  
           PHCONV,180  
           PHCONV,180,cosine

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

The Harmonic Angle argument is optional so does not have to be specified. However, to update the Harmonic phase angle argument the phase convention must be included in the command. See examples above. The default setting in the SYS menu is Cosine.

**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, <i>phase,results?</i>
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.....

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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.



## PRIMAR

## PRIMAR

Function:	Select only primary functions.
Description:	Sets the instrument to only compute total functions not fundamentals, in order to allow shorter measurement windows.
Format:	PRIMAR, <i>value</i>
Arguments:	value: ON OFF
Reply:	none
Example:	PRIMAR,ON
Notes:	When primary is on, fundamental values will be displayed as zero.

On the Instrument this command adjusts the HIGH SPEED mode option that can be found in the ACQU > Advanced menu options:

PRIMAR, ON = HIGH SPEED > ENABLED  
PRIMAR, OFF = HIGH SPEED > DISABLED

**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 or list all stored programs.

**Description:** Sending the argument FILES? – Lists all stored programs. The reply includes the location, file name and date saved for each program.

Sending the argument NAME? - Displays the name of the last program to be loaded or recalled.

**Format:** PROGRA

**Arguments:** FILES?  
NAME?

**Reply:** text string

**Example:** PROGRA,FILES?  
2,PCIS,21/11/2017  
3,,21/11/2017  
10,remote program,11/01/18

PROGRA,NAME?  
factory default

PROGRAM,NAME?  
Remote program

**Notes:** If a program is stored but not given a name the return string will display no data for the name. See example above.

Only the first six digits of the command are required so PROGRA and PROGRAM are both valid, both return the same data.

**RANGE****RANGE**

Function:	Set channel ranging.
Description:	Select minimum range and range control for a given input channel.
Format:	<i>RANGE,channel,ranging,range</i>
Arguments:	channel: CH1 CH2 ranging: AUTO UPAUTO MANUAL range: range number 1-9
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, <i>format</i>	
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 non volatile results stores.

Description: Recall, store or delete non-volatile 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 20 non-volatile 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:	<i>SCALE,channel,factor</i>
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)  
240 lines of 40 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 <sup>th</sup> 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:	<i>SMOOTH,type,dynamics</i>
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:	<i>SPEED,value&gt;window</i>
Arguments:	value: VFAST FAST MEDIUM SLOW VSLOW WINDOW
Reply:	none
Example:	SPEED,SLOW SPEED,WINDOW,0.1
Notes:	The window size argument is only needed for the WINDOW 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, <i>channel</i> ? STATUS? <i>channel</i>
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:

## **TAGREP**

## **TAGREP**

Function:	Set up a reply tag
Description:	Select a reply tag to identify the instrument in a multi-instrument environment
Format:	TAGREP, <i>on/off</i>
Arguments:	on/off: ON OFF
Reply:	none
Example:	TAGREP,ON *ESR? PPA5530:00635:1
Notes:	When "tag reply" is turned on every reply string has a prefix of an identification string comprising the model and serial number

## TEMPER

## TEMPER

Function: Set up temperature measurement

Description: Set scaling and offset for a temperature sensor connected to the torque input (power transformer application mode)

Format: *TEMPER,type,scalefactor,offset*

Arguments: type:  
                   DISABLED  
                   CENTIG  
                   FARHEN  
           scale:  
                   multiplying factor in degrees/Volt  
           offset:  
                   additive zero in Volts

Reply: none

Example: TEMPER,CENTIG,5,-2  
           sensor scaling = 5°C/V  
           0V = 10°C

Notes:

**TEMPER?**

**TEMPER?**

Function: Read the temperature

Description: Returns the measured temperature from a sensor connected to the torque input

Format: TEMPER?

Arguments: none

Reply: single data value

Example: TEMPER?  
data returned

Notes:

**TORQSP****TORQSP**

Function:	Set up torque and speed measurement
Description:	Set scaling and offset for torque and speed measurements. Pulsed input has a value for the number of pulses per revolution.
Format:	TORQSP, <i>type,scale1,scale2</i> TORQSP,OFFSET, <i>offset1,offset2</i>
Arguments:	type: DISABLED ANALOG PULSED (SPEED) OFFSET scale1 and scale 2 multiplying factor in Nm/V or rpm/V pulses/rev offset1 and offset2 zero level in V
Reply:	none
Examples:	TORQSP,PULSED,10,50 speed measured by pulse torque scaling = 10Nm/V 50 pulses/revolution  TORQSP,ANALOG,10,1
Notes:	If type = ANALOG then speed scaling is in rpm/V, if type = PULSED then speed scaling is pulses/rev Torque scaling is always Nm/V



**TORQSP?**

**TORQSP?**

Function:	Read the mechanical power, torque and speed
Description:	Returns measured mechanical power value along with the torque and speed values
Format:	TORQSP?
Arguments:	none
Reply:	3 data values separated by commas: power, torque, speed
Example:	TORQSP? data returned
Notes:	Mechanical power displayed in Watts Torque displayed in Nm Speed displayed in rpm

**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  
          PPA4530 #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, <i>type</i>
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 (30A) 2 – low current version (10A) 4 – high current version (50A)
Examples:	VERSION? 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, Vsurge1,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) INDEP (independent) 3PH3WA,DELTAS (Delta – Star) 3PH3WA,PPRMS (PH-PH RMS) 3PH3WA,PPMEAN (Rectified mean) 3PH3WA,STARDE (Star – Delta)
Reply:	none
Examples:	WIRING,PHASE2
Notes:	WIRING,SINGLE is the same as WIRING,PHASE1

**XSCALE****XSCALE**

Function:	Enables extended system calibration mode
Description:	Enable External system scaling in the AUX menu. Select the required range (1 to 4) for each channel.
Format:	Xscale,function, Xscale,channel,range
Arguments:	Function Enable Disable  Channel: CH1 CH2 CH3 CH4 CH5 CH6  Range: 1 (1 ohm) 2 (2.5 ohm) 3 (5 ohm) 4 (10 ohm)
Reply:	none
Examples:	Xscale,enable  This example enables the mode.  Xscale,CH4,2  This example loads the 2.5ohm range (range 2) for phase 2 current.



Notes: To use this command it is necessary to first enable the mode and then resend the command to individually set up each channel.

This command provides a multiple scaling option for the system calibration of the PPA35xx with a LEM6.

Sending this command automatically enables independent ranging.

## **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:	<i>ZOOM,level,data1,data2,data3,data4</i>
Arguments:	<p>level:</p> <ul style="list-style-type: none"> <li>0 – normal</li> <li>1 – 2 line display (zoom level 1)</li> <li>2 – single line display (zoom level 2)</li> <li>3 – single line display (zoom level 3)</li> </ul> <p>data1:</p> <ul style="list-style-type: none"> <li>first data (zoom level 1)</li> <li>or data for single line (zoom level 2)</li> </ul> <p>data2-4:</p> <ul style="list-style-type: none"> <li>other data (zoom level 1)</li> </ul> <p>data consists of line number for channel 1 or line number + 64 for channel 2</p>
Reply:	None
Example:	<p>VRMS</p> <p>ZOOM,1,1,65 (level 1, ch1 rms, ch2 rms)</p>
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 – 2-4 value display (zoom level 1)

2 – single line display (zoom level 2)

3 – single line display (zoom level 3)

data1-4:

zoom data

data consists of line number for channel 1  
or line number + 64 for channel 2

Example: ZOOM?  
1,1,65,0,0 (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.

## PPA45xx communications manual

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 PPA4500 has 93 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 – command summary

COMMAND SUMMARY

## PPA45xx communications manual

command format	reply format
*CLS	
*ESE,value	
*ESE?	single integer data value
*ESR?	single integer data value
*IDN?	company,product,serial no,version
*OPC?	0 or 1
*RST	
*SRE,value	single integer data value
*SRE?	
*STB?	single integer data value
*TRG	
*TST?	single integer data value
*WAI	
ABORT	
ADIMAP	
ALARM,latch,sounder	
ALARM?	single integer data value
ALARME,value	
ALARME?	single integer data value
ALARM1,type,data,high,low	
ALARM2,type,data,high,low	
ANALOG	
ANALOG?	
APPLIC,type,setting	
BANDWI,phase,type	
BEEP	
BLANKI,on/off,threshold	
CALVER,string	
CALVER?	string
CONFIG,parameter,data	
CONFIG,parameter?	single integer or real data value
COUPLI,phase,coupling	
DATALO,func,interval,speed	
DATALO,LINES?	single integer
DATALO,0?	index,time,data... one record per line
DATALO,start,records?	index,time,data... one record per line
DAV?	single integer data value
DAVER,value	
DAVER?	single integer data value
DISPLAY,page	
DISPLAY?	multiple real data values

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EFFICI,type	
EFFICI?	total efficiency, fundamental efficiency
FAST,on/off	
FQLOCK,on/off	
FQREF,phase,channel	
FREQFI,on/off,filter	
FREQUE,frequency	
FSD?	Single or multiple real data values
HARMON,para,h,hmax	
HARMON,phase?	freq,mag1,mag2,hmag1,hmag2,h1,h2, thd1,thd2,hphase1,hphase2
Or	
HARMON,phase,SERIES?	mag,%, x n harmonics
Or	mag,phase, x n harmonics
HOLD,on/off	
INPUT,channel,type	
INTEGR,type,display	
INTEGR,RUNTIM,hours,mins	
INTEGR,phase?	Time,Wh,Wh.f, Varh,Varh.f,Vah,Vah.f, pf,pf.f,Vav,Vav.fAh,Ah.f
KEYBOA,value	
LCR,conditions,param,head	
LCR,phase?	Freq,mag1,mag2,impedance,phase,R, L,C (series),R,L,C (parallel),tan $\delta$ ,Q
LOWFRE,on/off	
MODE,type	
MSLAVE,type	
MULTILOG,index,phase,func	
MULTILOG?	1-30 floats as selected
PFCNV,convention	
PHASEM,ratio	
PHASEM,phase?	Freq,mag1,mag2,dB,phase
PHCONV,convention	
PRIMAR	
POWER,sum A	
POWER,PHASE,WATTS?	Freq,W,W.f, VA,VA.f,Var,Var.f,pf,pf.f, Wdc,W.h
POWER,PHASE,VOLTAGE?	Freq,rms,mag,dc, $\phi$ ,peak,cf,mean,ff, harmonic
POWER,PHASE,CURRENT?	Freq,rms,mag,dc, $\phi$ ,peak,cf,mean,ff, harmonic
POWER,PH-PH?	Freq,rms1,mag1, $\phi$ 1,rms2,mag2, $\phi$ 2, rms3,mag3, $\phi$ 3

## PPA45xx communications manual

POWER,RMS?	Freq,vrms1,vdc1,arms1,adc1,vrms2,vdc2,arms2,adc2,vrms3,vdc3, arms3, adc3
POWER,VECTORS?	Freq,mag1, $\phi$ 1,mag2, $\phi$ 2,mag3, $\phi$ 3,mag4, $\phi$ 4,mag5, $\phi$ 5,mag6, $\phi$ 6
POWER,WVA?	Freq,w1,vrms1,arms1,w2,vrms2,arms2,w3,vrms3,arms3
PROGRAM,function,number PROGRAM?	CR terminated text string
RANGE,ch,ranging,range RESOLU.format RESULT,function,number RESULT	multiple integers
REZERO SCALE,channel,factor SCALE,channel?	Single real data value
SCOPE,PHASE,v/a?	Range, trigger, 250 signed integer values
SHUNT,channel,resistance SHUNT,channel?	Single real data value
SMOOTH,type,dynamics SPEED,value>window START	
STATUS,channel?	Range number,range text,over/low/ok
STOP STREAM,enable>window STREAM,disable	
STREAM?	Data, data, data, data, data, .....
SUSPEN,on/off TAGREP,on/off TEMPER,type,scale,offset TEMPER?	single real data value
TORQSP,type,tscale,sscale TORQSP,OFFSET,toff,soff TORQSP?	mechanical power, torque, speed
USER?	3 CR terminated text strings
VARCON,convention VERSION?	datecode,cpu,dsp,fpga,boot
VRMS VRMS,PHASE,RMS?	rms1,rms2,dc1,dc2,ac1,ac2
VRMS,PHASE,MEAN?	rms1,rms2,mean1,mean2,ff1,ff2
VRMS,PHASE,SURGE?	pk1,pk2,cf1,cf2,surge1,surge2
WIRING,configuration XSCALE	

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ZERO	
ZERO,DELETE	
ZOOM,level,d1,d2,d3,d4	
ZOOM?	level,d1,d2,d3,d4

### calibration commands

CALAPP	
CALCOM,freq	
CALFIL,index,value	
CALFIL?	Six real data values
CALFRQ,index,freq	
CALFRQ?	Seven real data values
CALIBR,index,value,inputs	
CALIBR?	Single integer data value
CALIDS,string	
CALIDS?	String
CALJIG,value	
CALMOD,value	
CALPHA,index,inputs	
CALRES	
CALSAV,password	
CALSYS,index,value,inputs	
CALSNO,serial number	
CALSTR,string	
CALSTR?	String
CALTQS,index,value	
CALTQS?	Four real data values
CALVER,string	
CALVER?	String

## PPA45xx communications manual

### Appendix B – Configurable parameters

All parameters can be accessed using the CONFIG command:

CONFIG, <i>number,parameter</i>		
<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
3	Master/slave, (Aux control)	0=Disabled 1=Master 2=Slave
4	Autozero manual or auto, (System options)	0=Auto 1=Manual
6	Phase convention, (System options)	0=-180° to +180° 1=0° to -360° 2=0° to +360°
7	Frequency lock on/off, (Acquisition advance options)	0=Off 1=On 2=Dynamic
8	Graph, (System options)	0=Dots 1=Lines

## PPA45xx communications manual

- 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)
- 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)

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- 22      Independent ranging, (System options)  
         0=Disabled  
         1=Enabled
- 24      Enable channel 1, (Range – voltage input)  
         1=Internal  
         3=External Attenuator
- 25      Enable channel 2, (Range – current input)  
         1=Internal  
         2=External Shunt
- 26      Input range channel 1, (Range – minimum range voltage)  
         0=300mV  
         1=1V  
         2=3V  
         3=10V  
         4=30V  
         5=100V  
         6=300V  
         7=1kV  
         8=3KV
- 27      Input range channel 2, (Range – minimum range current)  
         0=30mA  
         1=100A  
         2=300mA  
         3=1A  
         4=3A  
         5=10A  
         6=30A  
         7=100A  
         8=300A
- 28      Input ranging channel 1, (Range – autoranging voltage)  
         0=Full Autorange  
         1=Range up only  
         2=Manual
- 29      Input ranging channel 2, (Range – autoranging current)  
         0= Full Autorange  
         1=Range up only  
         2=Manual



## PPA45xx communications manual

- 30 Coupling, (Coupling)  
0=ac+dc  
1=ac  
2=dc
- 31 Bandwidth, (Coupling - bandwidth)  
0=Wide (dc-2MHz)  
1=Low (dc-200KHz)  
2=dc (dc-5Hz)
- 32 Scale factor channel 1 voltage, (Ranging - Enter figures as required)
- 33 Scale factor channel 2 current, (Ranging - Enter figures as required)
- 34 External attenuator channel 1, (Ranging - voltage input - attenuator ratio  
- Enter figures as required)
- 35 External shunt channel 2, (Ranging - current input - resistance value- Enter  
figures as required)
- 38 Frequency reference voltage/current, (Acquisition control)  
0=Voltage  
1=Current  
2=Speed  
3=ac line
- 40 Frequency reference phase, (Acquisition control)  
0=Phase 1  
1=Phase 2  
2=Phase 3
- 41 Display page, (Main display)  
0=Phase 1 page  
1=Phase 2 page  
2=Phase 3 page  
3=Sum page  
4=Phase 1,2 & 3 page  
5=Phase 1,2 & 3 fundamentals page  
6=NEU page

- 42      Zoom level, (Main display)  
          0=Zoom –  
          1=Zoom +  
          2=second Zoom +  
          3=Third Zoom +
- 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  $\mu\text{Hz}$   
         1=Frequency in Hz
- 49      DFT selectivity, (Acquisition advance options)  
         0=Normal  
         1=Narrow
- 50      Program 1-6 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  
         2=Internal Flash  
         3=USB Memory stick
- 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

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- 64 Term 1 coefficient, (Enter value)
- 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)
- 69 Frequency lock, minimum freq, (ACQU, advanced options)  
  
Enter value (0.010 to 500)
- 70 application mode,  
0=Normal  
1=PWM motor Drive  
2=Lighting ballast  
3=Inrush current  
4=Transformer mode  
5=Standby power  
6=Calibration  
7=Not used  
8=Not used

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- 71      Frequency filter, (Application options mode - PWM Motor Drive)  
         0=4KHz  
         1=1KHz  
         2=250Hz
- 72      Frequency tracking speed, (Application options mode - Lighting Ballast)  
         0=Fixed time  
         1=Fast  
         2=Medium  
         3=Slow
- 73      Low frequency, (Application options mode - PWM Motor Drive)  
         0=Off  
         1=On
- 74      Argument term 3  
         0=Disabled  
         1=Constant  
         2=Voltage  
         3=Current  
         4=Torque  
         5=Speed
- 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

## PPA45xx communications manual

- 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)
- 80 Temperature, (Application-Transformer mode)  
0=Disabled  
1=Enabled °C  
2=Enabled °F
- 81 Sum watts, (Auxiliary-Master)  
0=Master  
1=Master + Slave
- 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  
7=Independent
- 83 Integration, (Power analyzer - Power integrator)  
0=Signed  
1=Magnitude
- 84 Torque + speed, (Application options – PWM motor drive)  
0=Disabled  
1=Analogue speed  
2=Pulsed speed
- 85 Torque scaling Nm/V, (Applications – PWM motor drive) (Also transformer scale factor Deg/v)(Enter Nm/v value)
- 86 Speed scaling Hz/V,(Applications – PWM motor drive)(Enter rpm/v value)

## PPA45xx communications manual

- |    |  |
|----|--|
| 87 | Pulses per revolution, (Applications-PWM motor drive)(Enter pulses/rev value)  |
| 88 | Integration display, (Mode - Power integrator)<br>0=Total<br>1=Average   |
| 89 | Sum current average, (Power analyzer)<br>0=Total<br>1=Average  |
| 90 | Input compensation, (Mode)<br>0=Disabled<br>1=Enabled  |
| 91 | Power factor sign, (Power analyzer)<br>0=Negative lagging<br>1=Negative leading  |
| 92 | VAR sign, (Power analyzer)<br>0= Negative lagging<br>1=Negative leading  |
| 93 | Efficiency computation, (Power analyzer)<br>0=Disabled<br>1=Phase 1 / Phase 2<br>2=Phase 2 / Phase 1<br>3=Slave/Master<br>4=Master/Slave<br>5=Mechanical/Sum<br>6=Sum/Mechanical<br>7=Phase 3/Sum<br>8=Sum/Phase 3 |
| 94 | Range lock across phases, (Range - when acquisition is using 3 phases)<br>0=Disabled<br>1=Enabled  |
| 95 | Torque offset, (Applications-PWM motor drive)(Also transformer mode)(Enter Nm offset value)  |
| 96 | Speed offset, (Application options mode - PWM motor drive - rpm offset value)  |



- 99 Computation mode, (Harmonic analyzer)  
0=Difference formula  
1=Harmonic series  
2=TIF  
3=THF  
4=TRD  
5=TDD  
6=Series harmonic phase  
7=Interharmonic sweep  
8=Harmonic RMS  
9=Harmonic factor
- 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)
- 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

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- 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  
1=Voltage  
2=Current
- 119 zoom 2 high resolution, (System)  
0=Disabled  
1=Enabled
- 120 Brightness, (System)  
0=Low  
1=High
- 121 Display, (System)  
0=Colour  
1=White on black  
2=Black on white
- 122 Auxiliary device, (Aux control)  
0=None  
6=PCIS

## PPA45xx communications manual

- |     |  |
|-----|--|
| 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   |
| 130 | Gear ratio, (ACQU – frequency reference – speed input - Enter ratio value)                       |
| 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=ph-ph rms  |
|     | 1=ph-ph Mean   |
|     | 2=Star - Delta   |
|     | 3=Delta - Star   |
| 135 | Difference THD, (Power analyser)   |
|     | 0=Disabled   |
|     | 1=Enabled including dc   |
|     | 2=Enabled excluding dc   |
| 137 | Parameter, (Impedance analyzer)  |
|     | 0=Auto   |
|     | 1=Capacitance  |
|     | 2=Inductance   |
|     | 3=Impedance  |

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- |     |   |
|-----|---|
| 138 | Measurement, (Impedance analyzer)<br>0=Series<br>1=Parallel   |
| 139 | Phase offset, (Impedance analyzer - Enter figures)  |
| 140 | Voltage peak, (rms voltmeter)<br>0=Signed<br>1=Separate<br>2=Unfiltered   |
| 143 | Sampling Rate / compensation (ACQU - sampling)<br>0=Auto<br>1=Fast<br>2=Medium<br>3=Slow<br>4=19.2uS compensation<br>5=3.857uS compensation |
| 144 | Rectified mean, (rms voltmeter)<br>0=Absolute<br>1=Normalised   |
| 148 | dB offset, (Phase meter - Enter figures)  |
| 150 | Computation, (Phase meter)<br>0=ch2/ch1<br>1=ch1/ch2  |
| 152 | RS232 printer enable, (Remote options)<br>0=Disabled<br>1=Enabled   |
| 153 | IEEE address, (Remote options - GPIB mode - enter address figures)  |
| 154 | Interface, (Remote options)<br>0=RS232<br>1=USB<br>2=LAN<br>3=GPIB  |
| 155 | Recall with program, (Remote options)<br>0=Off<br>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 window  
                 5=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
- 162      Analog output, (Alarm options – alarm if high)  
                 0=Disabled  
                 1=Zoom 1  
                 2=Zoom 2  
                 3=Zoom 3  
                 4=Zoom 4  
                 5=Manual
- 164      Analog zero, (Alarm options – enter figure)
- 165      Analog full scale, (Alarm options – enter figure)

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- 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  
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)
- 171 Sync on alarm, (Alarm options – alarm if high)  
0=Disabled  
3=Enabled
- 176 Enable channel 3, (Range–voltage input)(Sys - independent ranging enabled)  
1=Internal  
3=External attenuator
- 177 Enable channel 4, (Range – current input)(Sys independent ranging enabled)  
1=Internal  
2=External shunt
- 178 Input range channel 3, (Range – minimum range voltage) (Sys independent ranging enabled)  
0=300mV  
1=1V  
2=3V  
3=10V  
4=30V  
5=100V  
6=300V  
7=1kV  
8=3KV

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- 179      Input range channel 4, (Range – minimum range current) (Sys independent ranging enabled)  
            0=30mA  
            1=100mA  
            2=300mA  
            3=1A  
            4=3A  
            5=10A  
            6=30A  
            7=100A  
            8=300A
- 180      Input ranging channel 3, (Range – autoranging voltage) (Sys independent 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
- 183      Bandwidth phase 2, (Coupling - bandwidth) (Sys independent ranging enabled)  
            0=Wide (dc-2MHz)  
            1=Low (dc-200KHz)  
            2=dc (dc-5Hz)
- 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)

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- 187      External shunt channel 4, (Ranging – current input – resistance value Enter figures as required) (Sys independent ranging enabled)
- 196      ID tag prepends comms replies  
          0 = Off  
          1 = On
- 197      High Speed Mode (ACQU – Advanced options)  
          0 = Off  
          1 = On
- 200      Enable channel 5, (Range – voltage input) (Sys independent ranging enabled)  
          1=Internal  
          3=External attenuator
- 201      Enable channel 6, (Range – current input) (Sys independent ranging enabled)  
          1=Internal  
          2=External shunt
- 202      Input range channel 5, (Range – minimum range voltage)  
          0=300mV  
          1=1V  
          2=3V  
          3=10V  
          4=30V  
          5=100V  
          6=300V  
          7=1kV  
          8=3KV
- 203      Input range channel 6, (Range – minimum range current) (Sys independent ranging enabled)  
          0=30mA  
          1=100mA  
          2=300mA  
          3=1A  
          4=3A  
          5=10A  
          6=30A  
          7=100A  
          8=300A



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- 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
- 207      Bandwidth phase 3,(Coupling - bandwidth) (Sys independent ranging enabled)  
            0=Wide (dc-2MHz)  
            1=Low (dc-200KHz)  
            2=dc (dc-5Hz)
- 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 required) (Sys independent ranging enabled)
- 217      Memory, (Program)  
            0=Internal  
            1=USB Memory stick
- 218      Data, (Program)  
            0=Program  
            1=Results  
            2=Datalog

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- 219      Action, (Program)  
                 0=Recall  
                 1=Store  
                 2=Delete
- 220      Location, (Program - Enter figures as required)
- 226      Set clock hours, (System - Enter figures as required)
- 227      Set clock minutes, (System - Enter figures as required)
- 228      Set clock Seconds, (System - Enter figures as required)
- 229      Set date day, (System - Enter figures as required)
- 230      Set date month, (System - Enter figures as required)
- 231      Set date year, (System - Enter figures as required)

## Appendix C – MULTILOG 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	Imp meter mode
13	resistance	Imp meter mode
14	reactance	Imp meter mode
15	impedance phase	Imp meter mode
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	resistance	Imp meter mode
45	inductance	Imp meter mode
46	capacitance	Imp meter mode
47	tan delta	Imp meter mode
48	Q factor – see notes	Imp meter mode
48	k-factor – see notes	Transformer mode
49	corrected power	Transformer mode
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	harmonic mode
71	current harmonic	harmonic mode
72	voltage harmonic percentage	harmonic mode
73	current harmonic percentage	harmonic mode
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	

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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
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	

### Notes:

Function 48 is used to measure Q-factor in Imp meter mode AND to measure corrected power in Transformer mode.

Functions 78 and 81 are the same.

### Phase selection:

- 1 = phase 1
- 2 = phase 2
- 3 = phase 3
- 4 = sum
- 5 = neutral
- 6 = ADI40

## PPA45xx communications manual

There are some special functions:

Measurement (function)	phase	Previous function
mechanical speed in Hz	neutral	dc voltage (function 58)
mechanical speed in rpm	neutral	ac voltage (function 60)
torque in Nm	neutral	rms voltage (function 50)
mechanical power	neutral	Watts (function 2)

Notes:

These special functions must use the Neutral Phase (Phase 5)

Due to the limited number of function numbers available these Special functions re-use function numbers that apply to other measurements for Phases 1 to 3.

Examples for setting up each measurement:

- > multil,0                      Setting to clear any previous data
- > multil,1,5,58                Setting for Mechanical speed in Hz
- > multil,1,5,60                Setting for Mechanical speed in rpm
- > multil,1,5,50                Setting for Torque in Nm
- > multil,1,5,2                 Setting for Mechanical Power in nW
- > multil?                      Setting to read back and display data

Example script to return results for Mechanical Power, Torque & Speed (in rpm):

```
>
>
> multil,0
> multil,1,5,2
> multil,2,5,50
> multil,3,5,60
> multil?
-1.8846E-7,-2.0984E-3,8.5765E-4
```

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