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

This manual is copyright © 2006-2020 Newtons4th Ltd. and all rights are reserved. No part may be copied or reproduced in any form without prior written consent.

11th February 2020
PPA45xx communications manual

CONTENTS

1 Using remote control .............................................. 1-1
  1.1 Standard event status register.............................. 1-3
  1.2 Serial Poll status byte...................................... 1-4
  1.3 RS232 connections............................................ 1-5
  1.4 Data format .................................................. 1-6

2 Communication commands........................................... 2-1
  *CLS ........................................................................ 2-1
  *ESE ........................................................................ 2-2
  *ESR?.................................................................... 2-3
  *IDN?..................................................................... 2-4
  *OPC?..................................................................... 2-5
  *RST ..................................................................... 2-6
  *SRE ....................................................................... 2-7
  *SRE?...................................................................... 2-8
  *STB?..................................................................... 2-9
  *TRG .................................................................... 2-10
  *TST?...................................................................... 2-11
  *WAI ..................................................................... 2-12
  ABORT ................................................................... 2-13
  ADIMAP .................................................................. 2-14
  ALARM ................................................................... 2-15
  ALARM?.................................................................. 2-16
  ALARM1 .................................................................. 2-17
  ALARM2 .................................................................. 2-18
  ALARME .................................................................. 2-19
  ALARME?................................................................. 2-20
  ANALOG .................................................................. 2-21
  ANALOG?................................................................. 2-22
  APPLIC ................................................................... 2-23
  BANDWI .................................................................... 2-24
  BANDWI?................................................................. 2-25
  BEEP ....................................................................... 2-26
  BLANKI .................................................................... 2-27
  CALVER .................................................................... 2-28
  CALVER?................................................................. 2-29
  CONFIG .................................................................... 2-30
  CONFIG?................................................................. 2-31
  COUPLI .................................................................... 2-32
  COUPLI?................................................................. 2-33
## PPA45xx communications manual

<table>
<thead>
<tr>
<th>Command</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROGRA?</td>
<td>2-79</td>
</tr>
<tr>
<td>RANGE</td>
<td>2-80</td>
</tr>
<tr>
<td>RESOLU</td>
<td>2-81</td>
</tr>
<tr>
<td>RESULT</td>
<td>2-82</td>
</tr>
<tr>
<td>RESULT?</td>
<td>2-83</td>
</tr>
<tr>
<td>REZERO</td>
<td>2-84</td>
</tr>
<tr>
<td>SCALE</td>
<td>2-85</td>
</tr>
<tr>
<td>SCOPE?</td>
<td>2-86</td>
</tr>
<tr>
<td>SCREEN?</td>
<td>2-87</td>
</tr>
<tr>
<td>SETUP</td>
<td>2-88</td>
</tr>
<tr>
<td>SETUP?</td>
<td>2-89</td>
</tr>
<tr>
<td>SHUNT</td>
<td>2-90</td>
</tr>
<tr>
<td>SMOOTH</td>
<td>2-91</td>
</tr>
<tr>
<td>SPEED</td>
<td>2-92</td>
</tr>
<tr>
<td>START</td>
<td>2-93</td>
</tr>
<tr>
<td>STATUS?</td>
<td>2-94</td>
</tr>
<tr>
<td>STOP</td>
<td>2-95</td>
</tr>
<tr>
<td>SUSPEN</td>
<td>2-96</td>
</tr>
<tr>
<td>TAGREP</td>
<td>2-97</td>
</tr>
<tr>
<td>TEMPER</td>
<td>2-98</td>
</tr>
<tr>
<td>TEMPER?</td>
<td>2-99</td>
</tr>
<tr>
<td>TORQSP</td>
<td>2-100</td>
</tr>
<tr>
<td>TORQSP?</td>
<td>2-101</td>
</tr>
<tr>
<td>USER?</td>
<td>2-102</td>
</tr>
<tr>
<td>VARCON</td>
<td>2-103</td>
</tr>
<tr>
<td>VERSIO?</td>
<td>2-104</td>
</tr>
<tr>
<td>VRMS</td>
<td>2-105</td>
</tr>
<tr>
<td>VRMS?</td>
<td>2-106</td>
</tr>
<tr>
<td>WIRING</td>
<td>2-107</td>
</tr>
<tr>
<td>XSCALE</td>
<td>2-108</td>
</tr>
<tr>
<td>ZERO</td>
<td>2-110</td>
</tr>
<tr>
<td>ZOOM</td>
<td>2-111</td>
</tr>
<tr>
<td>ZOOM?</td>
<td>2-112</td>
</tr>
</tbody>
</table>

Multilog Application Guide .................................................. 2-113

Appendix A – command summary

Appendix B – configurable parameters

Appendix C – MULTILOG parameters
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:

<table>
<thead>
<tr>
<th></th>
<th>Rx expects</th>
<th>Tx sends</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS232</td>
<td>carriage return</td>
<td>carriage return</td>
</tr>
<tr>
<td>USB, LAN</td>
<td>(line feed ignored)</td>
<td>and line feed</td>
</tr>
<tr>
<td>IEEE488</td>
<td>carriage return or line feed or EOI</td>
<td>carriage return with EOI</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>PON</th>
<th>CME</th>
<th>EXE</th>
<th>DDE</th>
<th>QYE</th>
<th>OPC</th>
</tr>
</thead>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>ESB</th>
<th>MAV</th>
<th>ALA</th>
<th></th>
<th>RDV</th>
</tr>
</thead>
</table>

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).

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DCD</td>
<td>in (+ weak pull up)</td>
</tr>
<tr>
<td>2</td>
<td>RX data</td>
<td>in</td>
</tr>
<tr>
<td>3</td>
<td>TX data</td>
<td>out</td>
</tr>
<tr>
<td>4</td>
<td>DTR</td>
<td>out</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>DSR</td>
<td>not used</td>
</tr>
<tr>
<td>7</td>
<td>RTS</td>
<td>out</td>
</tr>
<tr>
<td>8</td>
<td>CTS</td>
<td>in</td>
</tr>
<tr>
<td>9</td>
<td>RI</td>
<td>not used</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>byte</th>
<th>data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7 bit signed exponent +63 to -64</td>
</tr>
<tr>
<td>2</td>
<td>bit 6 = mantissa sign</td>
</tr>
<tr>
<td></td>
<td>bit 5:0 = mantissa bit 19:14</td>
</tr>
<tr>
<td>3</td>
<td>mantissa bit 13:7</td>
</tr>
<tr>
<td>4</td>
<td>mantissa bit 6:0</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>value</th>
<th>equivalent</th>
<th>hex data transmitted</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0</td>
<td>0.75 \times 2^{2}</td>
<td>0x82,0xB0,0x80,0x80</td>
</tr>
<tr>
<td>0.1</td>
<td>0.8 \times 2^{-3}</td>
<td>0xFD,0xB3,0x99,0xCD</td>
</tr>
<tr>
<td>-320</td>
<td>-0.625 \times 2^{9}</td>
<td>0x89,0xE8,0x80,0x80</td>
</tr>
</tbody>
</table>

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

Function: Clear status
Description: Clears the standard event status register.
Format: *CLS
Arguments: none
Reply: none
Example: *CLS
*ESR?
0

Notes:
**ESE**

Function: Set standard event status enable register.

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

Format: *ESE, value

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

Reply: can be read by *ESE?*

Example: *ESE, 60

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

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

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

Function: Standard event status register query
Description: Returns the contents of the standard event status register and clears it.
Format: *ESR?
Arguments: none
Reply: decimal equivalent of bits in standard event status register
Example: *ESR?
33
Notes: The following bits in the standard event status register have been implemented:

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

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

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?**

**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.
**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.
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:
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?**

**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)
**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?**

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**

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

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**

**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
Function: Set common controls for alarm1 and alarm2.

Description: Set the alarm latch and sounder control.

Format: \( \text{ALARM}, \text{latch}, \text{sounder} \)

Arguments: latch:
- ON
- OFF
sounder:
- ENABLED
- DISABLED

Reply: none

Example: ALARM,ON,DISABLED

Notes:
**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

Function: Set parameters for alarm1.
Description: Set alarm1 type and thresholds.
Format: ALARM1,type,data,high,low
Arguments: type:
    DISABLED
    HIGH
    LOW
    INSIDE
    OUTSIDE
    LINEAR
data
    1-4
high:
    high threshold
low:
    low threshold

Reply: none
Example: ALARM1,HIGH,1,2,0
Notes: Both thresholds must be sent even if only one is used.
ALARM2

Function: Set parameters for alarm2.

Description: Set alarm2 type and thresholds.

Format: ALARM2,type,data,high,low

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**

Function: Set alarm status enable register

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

Format: ALARME, *value*

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

Reply: none

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

Notes: default value is 0
**ALARME?**

**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

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?

**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 “;”. 
Function: Select application mode.

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

Format: \texttt{APPLIC,type,setting}

Arguments:

- \texttt{type}:
  - \texttt{NORMAL}
  - \texttt{PWM} (PWM Motor Drive)
  - \texttt{BALLAST} (Lighting ballast)
  - \texttt{INRUSH} (Inrush Current)
  - \texttt{POWERT} (Transformer mode)
  - \texttt{STANDB} (Standby power)
  - \texttt{CALIBR} (Calibration)

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

Reply: none

Example: \texttt{APPLIC,POWERT}
\texttt{APPLIC,PWM,1}

Notes:
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,\textit{phase},\textit{type}

Arguments: \begin{itemize}
\item phase: PHASE1, PHASE2, PHASE3
\item type: WIDE, LOW, DCONLY
\end{itemize}

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?**

**Function:** Read bandwidth setting.

**Description:** Returns a numerical value for the bandwidth setting.

**Format:** BANDWI,\textit{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.
Function: Sound the buzzer
Description: Makes a “beep” from the instrument.
Format: BEEP
Arguments: none
Reply: none
Example: BEEP
Notes:
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

**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,string`

**Arguments:** `string` 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?**

**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

Function: Direct access of configuration parameters
Description: Sets configuration parameter for which there may not be a direct command.
Format: CONFIG,index,data
Arguments: index is the number of the parameter
data is the data for that parameter
Reply: none
Example: CONFIG,6,1 (set phase convention)
Notes: The list of configurable parameters is given in the appendix. CONFIG goes through the same limit checking as when entering data from the menus.
## CONFIG?

**Function:** Configurable parameter query  
**Description:** Reads the present value of a single parameter.

**Format:**  
CONFIG,<index>?

or:

CONFIG?<index>

**Arguments:**  
index is the parameter number

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

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

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

**Function:** Set ac or ac+dc coupling.

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

**Format:** COUPLI,phase,coupling

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

**Reply:** none

**Example:** COUPLI,PHASE2,AC+DC

**Notes:** In multi phase applications, the coupling on phase 1 is applied to other phases unless “independent input control” is enabled.
**COUPLI?**

**Function:** Read ac/dc coupling setting.

**Description:** Returns a numerical value for the coupling setting.

**Format:** \texttt{COUPLI,phase,coupling}

**Arguments:**
- phase:
  - PHASE1
  - PHASE2
  - PHASE3

**Reply:**
- 0 = AC+DC
- 1 = ACONLY
- 2 = DCONLY

**Example:**
- \texttt{COUPLI,PHASE2,AC+DC}
- \texttt{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**

Function: Set up datalog

Description: Sets datalog parameters or accesses datalog non-volatile store.

Format: `DATALO,function,interval,speed`

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?**

**Function:** Read back datalog results

**Description:** Return datalog values, one record per line, or the number of lines available

**Format:**
- `DATALO,start,records?`
- `DATALO,0?`
- `DATALO,LINES?`

**Arguments:**
- **start:** first record to return
- **records:** number of records to return
- **0:** return all new records since last read

**Reply:**
3 to 6 data values depending on settings:
- index 1-n
- elapsed time in hours
- data1
- data2 (if stored)
- data3 (if stored)
- data4 (if stored)

one record per line

**Example:**

```
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?**

**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**

**Function:** Set data available enable register

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

**Format:** DAVER, value

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

**Reply:** none

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

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

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**

**Function:** Set the display page

**Description:** Selects the page on the display so that the zoom data can be used for alarms.

**Format:** DISPLAY,page

**Arguments:**
- page:
  - PHASE1
  - PHASE2
  - PHASE3
  - SUM
  - NEUTRAL
  - TOTAL
  - FUNDAMENTAL
  - VOLTAGE
  - CURRENT

**Reply:** None

**Example:** DISPLAY,FUNDAMENTAL

**Notes:** VOLTAGE is the same as TOTAL; CURRENT is the same as FUNDAMENTAL. They refer to the multiphase display modes.
**DISPLAY?**

**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

Function: Set efficiency calculation
Description: Selects the data to be used for the efficiency calculation.
Format: EFFICI,formula
Arguments: formula:
   0 – disabled
   1 – phase 1 / phase 2
   2 – phase 2 / phase 1
   3 – slave / master
   4 – master /slave
   5 – mechanical sum
   6 – sum / mechanical
   7 – phase 3 / sum
   8 – sum /phase
Reply: none
Example: EFFICIENCY,2
Notes:
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:
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.
Function: Lock frequency.

Description: Set the technique for determining the frequency for analysis.

Format: FQLOCK,value,frequency

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**

**Function:**
Set frequency reference.

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

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

**Arguments:**
- channel:
  - voltage
  - current
  - 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 (e.g., phase 2 only mode).
**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,value

**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

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

Description: Set harmonic analyser mode and parameters.

Format: HARMON,para,harmonic,max,stepsize

Arguments: para:

- THDD difference formula THD
- THDS harmonic series THD
- TIF Telephone Influence Factor
- THF Telephone Harmonic Factor
- TDD Total Demand Distortion
- TRD Total Rated Distortion
- HPHASE harmonic phase
- INTERH Interharmonic sweep
- HRMS Harmonic RMS
- PH-PH Phase to Phase harmonics

harmonic: individual harmonic for display
max: length of harmonic series

stepsize: frequency step size (0.5Hz – 100Hz)

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.
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?**

**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?
- HARMON,\(phase\)?
- HARMON,SERIES?
- HARMON,\(phase\),SERIES?

**Arguments:**
- phase:
  - PHASE1
  - PHASE2
  - PHASE3
  - NEUTRAL
  - PHASES

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

**Example:**
- HARMON,PHASE2?
  - data returned

**Notes:**
- HARMON? waits for next unread data.
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

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

Function: Set integrated power mode.

Description: Set integrated power mode, whether the integration for Watts and current use signed or unsigned values, and whether accumulated or averaged values are computed. Also sets up run time for integration over a specific interval.

Format: INTEGR,type,display
        INTEGR,RUNTIM,hours,minutes

Arguments: type:
            SIGNED
            MAGNITUDE

display:
            TOTAL
            AVERAGE

hours:
    integer

minutes:
    integer

Reply: none

Example: INTEGR,MAGNITUDE,TOTAL

Notes:
INTEGR?

Function: Read integrated power mode.
Description: Read integrated power mode for the selected phase.
Format: INTEGR, phase?
Arguments: phase:
  PHASE1
  PHASE2
  PHASE3
  PHASES
  SUM

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

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

Notes: INTEGR? without specifying the phase returns the appropriate single phase data.
Function: Disable front panel keyboard.
Description: The front panel keyboard can be disabled to prevent accidental operation.
Format: KEYBOARD,value
Arguments: value:
ENABLE
DISABLE
Reply: none
Example: KEYBOARD,DISABLE
Notes: The keyboard can be re-enabled from the front panel only by pressing the HOME key.
**LCR**

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?**

<table>
<thead>
<tr>
<th>Function:</th>
<th>LCR meter query</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>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?</td>
</tr>
<tr>
<td>Format:</td>
<td>LCR, <em>phase</em>?</td>
</tr>
<tr>
<td>Arguments:</td>
<td>phase:</td>
</tr>
<tr>
<td></td>
<td>PHASE1</td>
</tr>
<tr>
<td></td>
<td>PHASE2</td>
</tr>
<tr>
<td></td>
<td>PHASE3</td>
</tr>
<tr>
<td></td>
<td>PHASES</td>
</tr>
<tr>
<td>Reply:</td>
<td>11 data values separated by commas: freq, Vmag, Amag, impedance, phase, R, C, L, tanδ, Qf, reactance</td>
</tr>
<tr>
<td>Example:</td>
<td>LCR, IMPEDA</td>
</tr>
<tr>
<td></td>
<td>LCR, PHASES?</td>
</tr>
<tr>
<td></td>
<td>data returned</td>
</tr>
<tr>
<td>Notes:</td>
<td>LCR? waits for next unread data. LCR? without specifying the phase returns the appropriate single phase data.</td>
</tr>
</tbody>
</table>
LOWFRE

Function: Set low frequency mode
Description: Sets the low frequency option for extending the measurement window.
Format: LOWFRE,value
Arguments: value:
ON
OFF
Reply: none
Example: LOWFRE,ON
Notes: LOWFRE is mainly used for measuring low frequencies (<5 Hz). However, as it applies digital filtering, it may also be useful when analysing any signals below a few hundred Hertz.
MODE

Function: Set mode
Description: Sets the basic operating mode of the instrument.
Format: MODE,type
Arguments: type:
- POWER (power meter)
- INTEGR (integrator)
- HARMON (harmonic analyser)
- RMS (rms voltmeter)
- LCR (LCR meter)
- SCOPE (oscilloscope)
- PHASEM (phase meter)
Reply: none
Example: MODE,LCR
Notes:
Function: Set master/slave mode
Description: Enables the instrument to synchronise with a second instrument to simultaneously measure up to 6 phases.
Format: MSLAVE,type
Arguments: type:
   DISABLE
   MASTER
   SLAVE
Reply: none
Example: MSLAVE,MASTER
Notes:
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?**

<table>
<thead>
<tr>
<th>Function:</th>
<th>Reads multi string reply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Waits for data to be available (if required) then returns selected results. Either a single string or multiple string replies can be selected.</td>
</tr>
<tr>
<td>Format:</td>
<td>MULTIL? MULTIL,number?</td>
</tr>
<tr>
<td>Arguments:</td>
<td>number: The required number of data string replies</td>
</tr>
<tr>
<td>Reply:</td>
<td>A single reply string containing up to 64 data values as selected by the MULTIL command. Multiple reply strings each containing the same number of data values (maximum of 64) as selected by the MULTIL command.</td>
</tr>
</tbody>
</table>

**Example:**

MULTIL,0  
MULTIL,1,1,2  (phase 1 Watts)  
MULTIL,2,2,2  (phase 2 Watts)  
MULTIL,3,4,3  (sum VA)

MULTIL?  
In the above example a single string reply containing 3 data values is returned.

MULTIL,10?  
In the above example 10 data strings are returned, each string containing 3 data values.
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.
<table>
<thead>
<tr>
<th>Function:</th>
<th>Waits for new data then holds so that multiple commands can be used on the same data set.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Reads multiple sets of data</td>
</tr>
<tr>
<td>Format:</td>
<td>NEWLOC</td>
</tr>
<tr>
<td>Arguments:</td>
<td>None</td>
</tr>
<tr>
<td>Reply:</td>
<td>Data as per returned parameter query. ie from power, harmonics etc.</td>
</tr>
</tbody>
</table>
| 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

Function: Sets the noise filter.

Description: Sets noise filter to value sent in string between 1KHz and 250KHz.

Format: NOISEF,[PHASEx],value,frequency

Arguments:

[PHASEx]:
Phase1
Phase2
Phase3

Value:
ON
OFF

frequency:
Between: 1000 – 250000

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

Function: Disable overranging
Description: Prevents an overrange error from blanking out results in manual ranging.
Format: NOOVER,value
Arguments: value:
  ON
  OFF
Reply: none
Example: NOOVER,ON
Notes: This can be useful when testing devices in a noisy environment. The range can be set to the correct range for the signal to be measured even if sporadic noise spikes would push it up on to the next range.
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.
**PFCONV**

Function: Set power factor sign convention.

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

Format: **PFCONV,** type

Arguments: type:
- NEGLAG
- NEGLEA

Reply: none

Example: PFCONV,NEGLAG

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

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

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

**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:**

---

2-74
**POWER?**

Function: Read power analyser results

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

Format: POWER,phase,results?

Arguments:

- phase:
  - PHASE1
  - PHASE2
  - PHASE3
  - PHASES
  - SUM
  - NEUTRAL (current only)

- results:
  - WATTS
  - VOLTAGE
  - CURRENT
  - VECTORS
  - RMS
  - WVA
  - PH-PH

Reply:

- WATTS:
  - freq,W,W.f,VA,VA.f,VAr,VAr.f,pf,pf.f,
  - Wdc,W.h

- VOLTAGE or CURRENT:
  - freq,rms,mag,dc,phase,pk,cf,mean,
  - form factor,harm

- VECTORS:
  - freq,vmag1,vlag1,amag1,alag1.....

- RMS:
  - freq,vrms1,vdc1,arms1,adc1.....

- WVA:
  - freq,w1,vrms1,arms1,w2.....
PH-PH:
    freq,rms1,mag1,lag1,rms2...

Example:  POWER,VECTORS?
data returned

Notes:  POWER? without specifying the phase returns the appropriate single phase data. PHASES returns the data for all valid phases 1-3.
**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: \texttt{PRIMAR,value}

Arguments: \texttt{value:}
  - \texttt{ON}
  - \texttt{OFF}

Reply: none

Example: \texttt{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:

\texttt{PRIMAR, ON = HIGH SPEED > ENABLED}
\texttt{PRIMAR, OFF = HIGH SPEED > DISABLED}
<table>
<thead>
<tr>
<th><strong>PROGRA</strong></th>
<th><strong>PROGRA</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Function:</strong></td>
<td>Access non volatile program stores.</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td>Recall, store or delete non-volatile program store.</td>
</tr>
<tr>
<td><strong>Format:</strong></td>
<td>PROGRA,&lt;em&gt;function&lt;/em&gt;,&lt;em&gt;number&lt;/em&gt;</td>
</tr>
<tr>
<td><strong>Arguments:</strong></td>
<td>function: RECALL STORE DELETE number 0-100</td>
</tr>
<tr>
<td><strong>Reply:</strong></td>
<td>none</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>PROGRA,RECALL,13</td>
</tr>
<tr>
<td><strong>Notes:</strong></td>
<td>Number 0 represents factory default, which can only be recalled.</td>
</tr>
</tbody>
</table>
### PROGRA?

<table>
<thead>
<tr>
<th>Function:</th>
<th>Identify current program or list all stored programs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>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.</td>
</tr>
<tr>
<td>Format:</td>
<td>PROGRA</td>
</tr>
<tr>
<td>Arguments:</td>
<td>FILES?</td>
</tr>
<tr>
<td></td>
<td>NAME?</td>
</tr>
<tr>
<td>Reply:</td>
<td>text string</td>
</tr>
<tr>
<td>Example:</td>
<td>PROGRA,FILES?</td>
</tr>
<tr>
<td></td>
<td>2,PCIS,21/11/2017</td>
</tr>
<tr>
<td></td>
<td>3,,21/11/2017</td>
</tr>
<tr>
<td></td>
<td>10,remote program,11/01/18</td>
</tr>
<tr>
<td>PROGRA,NAME?</td>
<td>factory default</td>
</tr>
<tr>
<td>PROGRAM,NAME?</td>
<td>Remote program</td>
</tr>
<tr>
<td>Notes:</td>
<td>If a program is stored but not given a name the return string will display no data for the name. See example above.</td>
</tr>
<tr>
<td></td>
<td>Only the first six digits of the command are required so PROGRA and PROGRAM are both valid, both return the same data.</td>
</tr>
</tbody>
</table>
**RANGE**

<table>
<thead>
<tr>
<th>Function:</th>
<th>Set channel ranging.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Select minimum range and range control for a given input channel.</td>
</tr>
<tr>
<td>Format:</td>
<td>RANGE, channel, ranging, range</td>
</tr>
<tr>
<td>Arguments:</td>
<td>channel: CH1 CH2 ranging: AUTO UPAUTO MANUAL range: range number 1-9</td>
</tr>
<tr>
<td>Reply:</td>
<td>none</td>
</tr>
<tr>
<td>Example:</td>
<td>RANGE, CH2, MANUAL, 4</td>
</tr>
<tr>
<td>Notes:</td>
<td>CH1 sets the voltage range CH2 sets the current range Refer to the user manual for the range corresponding to each range number</td>
</tr>
</tbody>
</table>
RESOLU

Function: Set the data resolution

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

Format: RESOLU,format

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

Reply: none

Example: RESOLU,HIGH

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

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

Function: Access non volatile results stores.
Description: Recall, store or delete non-volatile results.
Format: \texttt{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,-1,0,0,0,0,0,0,0,0,0,0,0 |  
**Notes:**  
0 = empty  
1 = normal result  
2 = harmonic result  
3 = scope result  
-1 = continuation of previous
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**

**Function:** Set channel scale factor.

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

**Format:** `SCALE,channel,factor`

**Arguments:**
- channel:
  - CH1
  - CH2
- factor: multiplying scale factor

**Reply:** none

**Example:** `SCALE,CH2,10`

**Notes:**
- CH1 sets the scale for all voltage channels
- CH2 sets the scale for all current channels
**SCOPE?**

**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
```
<table>
<thead>
<tr>
<th>Function:</th>
<th>Read the screen data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Returns a bit map of screen pixel display in ascii and hex format</td>
</tr>
<tr>
<td>Format:</td>
<td>SCREEN?</td>
</tr>
<tr>
<td>Arguments:</td>
<td>none</td>
</tr>
<tr>
<td>Reply:</td>
<td>Multiple data bit values</td>
</tr>
</tbody>
</table>
| 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**

**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 16th line has been received and the checksum has been verified.
**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

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

Function: Select the smoothing
Description: Sets the filter time constant and dynamic response.
Format: SMOOTH,type,dynamics
Arguments: type:
   NONE
   NORMAL
   SLOW
dynamics:
   AUTO
   FIXED
Reply: none
Example: SMOOTH,NORMAL,FIXED
         SMOOTH,NONE
Notes: It is not necessary to send both parameters if it is only required to set the type. Both arguments must be sent to set the dynamics.
FILTER is an alias for SMOOTH
**SPEED**

**Function:** Sets the measurement speed

**Description:** Sets the minimum window size for the measurement.

**Format:** SPEED, value, window

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

**Function:**
Read back channel ranging status.

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

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

**Arguments:**
channel:
- CH1
- CH6

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

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

**Notes:**
STOP

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**

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

Function: Set up a reply tag
Description: Select a reply tag to identify the instrument in a multi-instrument environment
Format: TAGREP, on/off
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**

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?

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**

**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, type, scale1, scale2
TORQSP, OFFSET, offset1, offset2

**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?

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?

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

Function: Set VAr sign convention.
Description: Fundamental VAr measurement is given a sign depending convention either:
  negative if lagging current
  negative if leading current
Format: VARCON,type
Arguments: type:
  NEGLAG
  NEGLEA
Reply: none
Example: VARCON,NEGLAG
Notes: An inductive load would have a lagging current, a capacitive load would have a leading current.
The sign given to power factor can be independently set: see PFCONV
VERSIO?

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**

**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?

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,phase,results?

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

Function: Select wiring mode.
Description: Set wiring mode for computation of SUM and neutral data.
Format: WIRING,type
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
**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.
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

Function:     Sets the display zoom parameters.
Description:  Sets the zoom level and data.
Format:       ZOOM,level,data1,data2,data3,data4
Arguments:
              level:
                0 – normal
                1 – 2 line display (zoom level 1)
                2 – single line display (zoom level 2)
                3 – single line display (zoom level 3)

              data1:
                first data (zoom level 1)
                or data for single line (zoom level 2)

              data2-4:
                other data (zoom level 1)

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

Reply:       None

Example:     VRMS
              ZOOM,1,1,65 (level 1, ch1 rms, ch2 rms)

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

**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.
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:

<table>
<thead>
<tr>
<th>Function</th>
<th>Measurement</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>frequency</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>watts</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>VA</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>VAr</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>power factor</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>fundamental watts</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>fundamental VA</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>fundamental VAr</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>fundamental PF</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>harmonic watts</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>harmonic watts %</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>impedance</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>resistance</td>
<td></td>
</tr>
</tbody>
</table>

Example extract from the Multilog function list
Required Parameters

<table>
<thead>
<tr>
<th>Order parameter to be returned within string</th>
<th>Phase (channel) of data returned</th>
<th>Parameter required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Frequency</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Watts Phase 1</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>Watts Phase 2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>Watts Phase 3</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>RMS Voltage Phase 1</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>RMS Voltage Phase 1</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
<td>RMS Voltage Phase 1</td>
</tr>
</tbody>
</table>

MULTILOG Pattern

<table>
<thead>
<tr>
<th>Command</th>
<th>Index</th>
<th>Phase</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>MULTIL,</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>MULTIL,</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>MULTIL,</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>MULTIL,</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>MULTIL,</td>
<td>5</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>MULTIL,</td>
<td>6</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>MULTIL,</td>
<td>7</td>
<td>3</td>
<td>50</td>
</tr>
</tbody>
</table>

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
```

<table>
<thead>
<tr>
<th>Frequency</th>
<th>PH1 Watts</th>
<th>PH2 Watts</th>
<th>PH3 Watts</th>
<th>PH1 RMS Volt</th>
<th>PH2 RMS Volt</th>
<th>PH3 RMS Volt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix – command summary

COMMAND SUMMARY
command format_reply format

*CLS
*ESE,value
*ESE?
*ESR?
*IDN?
*OPC?
*RST
*SRE,value
*SRE?
*STB?
*TRG
*TST?
*WAI

ABORT
ADIMAP
ALARM,latch,sounder
ALARM?
ALARME,value
ALARME?
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?
CONFIG,parameter,data
CONFIG,parameter?
COUPLI,phase,coupling
DATALO,func,interval,speed
DATALO,LINES?
DATALO,0?
DATALO,start,records?
DAV?
DAVER,value
DAVER?
DISPLAY,page
DISPLAY?
EFFICI, type
EFFICI?
FAST, on/off
FQLOCK, on/off
FQREF, phase, channel
FREQFI, on/off, filter
FREQUE, frequency
FSD?
HARMON, para, h, hmax
HARMON, phase?
  Or
HARMON, phase, SERIES?
  Or
HOLD, on/off
INPUT, channel, type
INTEGR, type, display
INTEGR, RUNTIM, hours, mins
INTEGR, phase?
KEYBOA, value
LCR, conditions, param, head
LCR, phase?
LOWFRE, on/off
MODE, type
MSLAVE, type
MULTILOG, index, phase, func
MULTILOG?
PFCONV, convention
PHASEM, ratio
PHASEM, phase?
PHCONV, convention
PRIMAR
POWER, sum A
POWER, PHASE, WATTS?
POWER, PHASE, VOLTAGE?
POWER, PHASE, CURRENT?
POWER, PH- PH?
total efficiency, fundamental efficiency
Single or multiple real data values
freq, mag1, mag2, hmag1, hmag2, h1, h2,
  thd1, thd2, hphase1, hphase2
mag, %, x n harmonics
mag, phase, x n harmonics
Time, Wh, Wh. f, Varh, Varh. f, Vah, Vah. f,
pf, pf. f, Vav, Vav. fAh, Ah. f
Freq, mag1, mag2, impedance, phase, R,
  L, C (series), R, L, C (parallel), tan δ, Q
1-30 floats as selected
Freq, mag1, mag2, dB, phase
Freq, W, W. f, VA, VA. f, Var, Var. f, pf, pf. f,
  Wdc, W. h
Freq, rms, mag, dc, ϕ, peak, cf, mean, ff,
  harmonic
Freq, rms, mag, dc, ϕ, peak, cf, mean, ff,
  harmonic
Freq, rms1, mag1, ϕ1, rms2, mag2, ϕ2,
  rms3, mag3, ϕ3
<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>POWER,RMS?</td>
<td>Freq, vrms1, vdc1, arms1, adc1, vrms2, vdc2, arms2, adc2, vrms3, vdc3, arms3, adc3</td>
</tr>
<tr>
<td>POWER,VECTORS?</td>
<td>Freq, mag1, φ1, mag2, φ2, mag3, φ3, mag4, φ4, mag5, φ5, mag6, φ6</td>
</tr>
<tr>
<td>POWER,WVA?</td>
<td>Freq, w1, vrms1, arms1, w2, vrms2, arms2, w3, vrms3, arms3</td>
</tr>
<tr>
<td>PROGRAM, function, number</td>
<td>CR terminated text string</td>
</tr>
<tr>
<td>RANGE, ch, ranging, range</td>
<td>multiple integers</td>
</tr>
<tr>
<td>RESOLU, format</td>
<td></td>
</tr>
<tr>
<td>RESULT, function, number</td>
<td></td>
</tr>
<tr>
<td>RESULT</td>
<td></td>
</tr>
<tr>
<td>SCALE, channel, factor</td>
<td>Single real data value</td>
</tr>
<tr>
<td>SCALE, channel?</td>
<td></td>
</tr>
<tr>
<td>SCOPE, PHASE, v/a?</td>
<td>Range, trigger, 250 signed integer values</td>
</tr>
<tr>
<td>SHUNT, channel, resistance</td>
<td>Single real data value</td>
</tr>
<tr>
<td>SHUNT, channel?</td>
<td></td>
</tr>
<tr>
<td>SMOOTH, type, dynamics</td>
<td></td>
</tr>
<tr>
<td>SPEED, value, window</td>
<td></td>
</tr>
<tr>
<td>START</td>
<td></td>
</tr>
<tr>
<td>STATUS, channel?</td>
<td>Range number, range text, over/low/ok</td>
</tr>
<tr>
<td>STOP</td>
<td></td>
</tr>
<tr>
<td>STREAM, enable, window</td>
<td>Data, data, data, data, data, .....</td>
</tr>
<tr>
<td>STREAM, disable</td>
<td></td>
</tr>
<tr>
<td>STREAM?</td>
<td></td>
</tr>
<tr>
<td>SUSPEN, on/off</td>
<td></td>
</tr>
<tr>
<td>TAGREP, on/off</td>
<td></td>
</tr>
<tr>
<td>TEMPER, type, scale, offset</td>
<td>single real data value</td>
</tr>
<tr>
<td>TEMPER?</td>
<td></td>
</tr>
<tr>
<td>TORQSP, type, tscale, sscale</td>
<td>mechanical power, torque, speed</td>
</tr>
<tr>
<td>TORQSP, OFFSET, toff, soff</td>
<td>3 CR terminated text strings</td>
</tr>
<tr>
<td>TORQSP?</td>
<td></td>
</tr>
<tr>
<td>USER?</td>
<td></td>
</tr>
<tr>
<td>VARCON, convention</td>
<td>datecode, cpu, dsp, fpga, boot</td>
</tr>
<tr>
<td>VERSION?</td>
<td></td>
</tr>
<tr>
<td>VRMS</td>
<td></td>
</tr>
<tr>
<td>VRMS, PHASE, RMS?</td>
<td>rms1, rms2, dc1, dc2, ac1, ac2</td>
</tr>
<tr>
<td>VRMS, PHASE, MEAN?</td>
<td>rms1, rms2, mean1, mean2, ff1, ff2</td>
</tr>
<tr>
<td>VRMS, PHASE, SURGE?</td>
<td>pk1, pk2, cf1, cf2, surge1, surge2</td>
</tr>
<tr>
<td>WIRING, configuration</td>
<td></td>
</tr>
<tr>
<td>XSACLE</td>
<td></td>
</tr>
</tbody>
</table>
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
Appendix B – Configurable parameters
All parameters can be accessed using the CONFIG command:

```
CONFIG,number,parameter
number    Function    parameter
```

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
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)
Independent ranging, (System options)
0=Disabled
1=Enabled

Enable channel 1, (Range – voltage input)
1=Internal
3=External Attenuator

Enable channel 2, (Range – current input)
1=Internal
2=External Shunt

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

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

Input ranging channel 1, (Range – autoranging voltage)
0=Full Autorange
1=Range up only
2=Manual

Input ranging channel 2, (Range – autoranging current)
0=Full Autorange
1=Range up only
2=Manual
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>Coupling, (Coupling)</td>
<td>0=ac+dc, 1=ac, 2=dc</td>
</tr>
<tr>
<td>31</td>
<td>Bandwidth, (Coupling - bandwidth)</td>
<td>0=Wide (dc–2MHz), 1=Low (dc-200KHz), 2=dc (dc-5Hz)</td>
</tr>
<tr>
<td>32</td>
<td>Scale factor channel 1 voltage, (Ranging)</td>
<td>Enter figures as required</td>
</tr>
<tr>
<td>33</td>
<td>Scale factor channel 2 current, (Ranging)</td>
<td>Enter figures as required</td>
</tr>
<tr>
<td>34</td>
<td>External attenuator channel 1, (Ranging)</td>
<td>voltage input - attenuator ratio</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Enter figures as required</td>
</tr>
<tr>
<td>35</td>
<td>External shunt channel 2, (Ranging)</td>
<td>current input - resistance value - Enter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>figures as required</td>
</tr>
<tr>
<td>38</td>
<td>Frequency reference voltage/current, (Acquisition)</td>
<td>0=Voltage, 1=Current, 2=Speed, 3=ac line</td>
</tr>
<tr>
<td>40</td>
<td>Frequency reference phase, (Acquisition control)</td>
<td>0=Phase 1, 1=Phase 2, 2=Phase 3</td>
</tr>
<tr>
<td>41</td>
<td>Display page, (Main display)</td>
<td>0=Phase 1 page, 1=Phase 2 page, 2=Phase 3 page</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3=Sum page, 4=Phase 1,2 &amp; 3 page, 5=Phase 1,2 &amp; 3 fundamentals page, 6=NEU page</td>
</tr>
</tbody>
</table>
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
Datalog display type, (Datalog display information mode)
   0=Real Time
   1=Table
   2=Graph

Manual frequency, (Acquisition advance options – frequency lock on)
   0=Frequency in µHz
   1=Frequency in Hz

DFT selectivity, (Acquisition advance options)
   0=Normal
   1=Narrow

Program 1-6 direct load, (System options)
   0=Disabled
   1=Enabled

Language, (System options)
   0=English
   1=Other language if installed

Frequency filter, (Acquisition control)
   0=Disabled
   1=Enabled

Phase reference, (Acquisition control)
   0=Voltage
   1=Current

Datalog Zoom1, (Datalog-RAM)
   0=Enabled
   1=Disabled

Datalog Zoom2, (Datalog-RAM)
   0=Enabled
   1=Disabled

Datalog Zoom3, (Datalog-RAM)
   0=Enabled
   1=Disabled
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
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
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
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

Term 4 coefficient, (Enter value)

Temperature, (Application - Transformer mode)
0=Disabled
1=Enabled °C
2=Enabled °F

Sum watts, (Auxiliary - Master)
0=Master
1=Master + Slave

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

Integration, (Power analyzer - Power integrator)
0=Signed
1=Magnitude

Torque + speed, (Application options – PWM motor drive)
0=Disabled
1=Analogue speed
2=Pulsed speed

Torque scaling Nm/V, (Applications – PWM motor drive) (Also transformer scale factor Deg/v)(Enter Nm/v value)

Speed scaling Hz/V, (Applications – PWM motor drive)(Enter rpm/v value)
Pulses per revolution, (Applications–PWM motor drive) (Enter pulses/rev value)

Integration display, (Mode - Power integrator)
0=Total
1=AVERAGE

Sum current average, (Power analyzer)
0=Total
1=AVERAGE

Input compensation, (Mode)
0=Disabled
1=Enabled

Power factor sign, (Power analyzer)
0=Negative lagging
1=Negative leading

VAr sign, (Power analyzer)
0=Negative lagging
1=Negative leading

Efficiency computation, (Power analyzer)
0=Disabled
1=Phase 1 / Phase 2
2=Phase 2 / Phase 1
3=Slave/Master
4=Master/Slave
5=Mechanical/Sum
6=Sum/Mechanical
7=Phase 3/Sum
8=Sum/Phase 3

Range lock across phases, (Range – when acquisition is using 3 phases)
0=Disabled
1=Enabled

Torque offset, (Applications–PWM motor drive)(Also transformer mode) (Enter Nm offset value)

Speed offset, (Application options mode – PWM motor drive – rpm offset value)
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

Selected harmonic, (Harmonic analyzer - figure = harmonic required)
Harmonic series up to, (Harmonic analyzer - figure = harmonic max)
Voltage bargraph scale, (Harmonic analyzer - figure = % required)
Current rating (TRD), (Harmonic analyzer – TRD mode – enter figure)
Current bargraph scale, (Harmonic analyzer - figure = % required)

Timebase, (Scope - Enter figure/div)
trigger level, (Scope - Enter figure/div)

Pretrigger, (Scope)
   0=None
   1=25%
   2=50%
   3=75%

trigger polarity, (Scope)
   0=Rising edge
   1=Falling edge

trigger Mode, (Scope)
   0=Auto
   1=Normal
   2=Single shot
<table>
<thead>
<tr>
<th></th>
<th>Function</th>
<th>Scope/Control</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>111</td>
<td>Trigger reference</td>
<td>Scope</td>
<td>0=Voltage, 1=Current</td>
</tr>
<tr>
<td>112</td>
<td>Trigger phase</td>
<td>Scope</td>
<td>0=Phase 1, 1=Phase 2, 2=Phase 3</td>
</tr>
<tr>
<td>113</td>
<td>Cursors enable</td>
<td>Scope</td>
<td>0=Off, 1=On</td>
</tr>
<tr>
<td>114</td>
<td>Trigger HF reject</td>
<td>Scope</td>
<td>0=Off, 1=On</td>
</tr>
<tr>
<td>115</td>
<td>Trace</td>
<td>Scope</td>
<td>0=Dual, 1=Voltage, 2=Current</td>
</tr>
<tr>
<td>119</td>
<td>Zoom 2 high resolution</td>
<td>System</td>
<td>0=Disabled, 1=Enabled</td>
</tr>
<tr>
<td>120</td>
<td>Brightness</td>
<td>System</td>
<td>0=Low, 1=High</td>
</tr>
<tr>
<td>121</td>
<td>Display</td>
<td>System</td>
<td>0=Colour, 1=White on black, 2=Black on white</td>
</tr>
<tr>
<td>122</td>
<td>Auxiliary device</td>
<td>Aux control</td>
<td>0=Idle, 1=None, 6=PCIS</td>
</tr>
</tbody>
</table>
Switch phase offset, (Aux control – PCIS device)
0=0°
1=45°
2=90°
3=135°
4=180°
5=225°
6=270°
7=315°

Switch on cycles, (Aux control – PCIS device)
0=Single cycle
1=Continuous
2=Half cycle

Gear ratio, (ACQU – frequency reference – speed input - Enter ratio value)

2 Wattmeter sum computation, (Power Analyser)( select in acquisition wiring-2 phase 2 wattmeter)
0=Low distortion
1=High Distortion

Integrator-run time (Hours), (Mode – Power integrator - enter figure)

Integrator-Run time (mins), (Mode - Power integrator – enter figure)

Ph – Ph Measurement, (Power analyser)
0=ph-ph rms
1=ph-ph Mean
2=Star - Delta
3=Delta - Star

Difference THD, (Power analyser)
0=Disabled
1=Enabled including dc
2=Enabled excluding dc

Parameter, (Impedance analyzer)
0=Auto
1=Capacitance
2=Inductance
3=Impedance
138 Measurement, (Impedance analyzer)
   0=Series
   1=Parallel

139 Phase offset, (Impedance analyzer - Enter figures)

140 Voltage peak, (rms voltmeter)
   0=Signed
   1=Separate
   2=Unfiltered

143 Sampling Rate / compensation (ACQU - sampling)
   0=Auto
   1=Fast
   2=Medium
   3=Slow
   4=19.2uS compensation
   5=3.857uS compensation

144 Rectified mean, (rms voltmeter)
   0=Absolute
   1=Normalised

148 dB offset, (Phase meter - Enter figures)

150 Computation, (Phase meter)
   0=ch2/ch1
   1=ch1/ch2

152 RS232 printer enable, (Remote options)
   0=Disabled
   1=Enabled

153 IEEE address, (Remote options – GPIB mode – enter address figures)

154 Interface, (Remote options)
   0=RS232
   1=USB
   2=LAN
   3=GPIB

155 Recall with program, (Remote options)
   0=Off
   1=On
**Alarm functions**

156 **Alarm 1 data,** (Alarm options)
   0=Zoom 1
   1=Zoom 2
   2=Zoom 3
   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)
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
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)
External shunt channel 4, (Ranging – current input – resistance value Enter figures as required) (Sys independent ranging enabled)

ID tag prepends comms replies
0 = Off
1 = On

High Speed Mode (ACQU – Advanced options)
0 = Off
1 = On

Enable channel 5, (Range – voltage input) (Sys independent ranging enabled)
1 = Internal
3 = External attenuator

Enable channel 6, (Range – current input) (Sys independent ranging enabled)
1 = Internal
2 = External shunt

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

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
Input ranging channel 5, (Range – autoranging voltage) (Sys independent ranging enabled)
0=Full Autorange
1=Range up only
2=Manual

Input ranging channel 6, (Range – autoranging current) (Sys independent ranging enabled)
0= Full Autorange
1=Range up only
2=Manual

Coupling phase 3, (Coupling) (Sys independent ranging enabled)
0=ac +dc
1=ac
2=dc

Bandwidth phase 3, (Coupling - bandwidth) (Sys independent ranging enabled)
0=Wide (dc–2MHz)
1=Low (dc-200KHz)
2=dc (dc-5Hz)

Scale factor channel 5 voltage, (Ranging - Enter figures as required) (Sys independent ranging enabled)

Scale factor channel 6 current, (Ranging - Enter figures as required) (Sys independent ranging enabled)

External attenuator channel 5, (Ranging – voltage input – attenuator ratio as required) (Sys independent ranging enabled)

External shunt channel 6, (Ranging – current input – resistance value as required) (Sys independent ranging enabled)

Memory, (Program)
0=Internal
1=USB Memory stick

Data, (Program)
0=Program
1=Results
2=Datalog
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

<table>
<thead>
<tr>
<th>function</th>
<th>measurement</th>
<th>notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>frequency</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>watts</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>VA</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>VAr</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>power factor</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>fundamental watts</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>fundamental VA</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>fundamental VAr</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>fundamental PF</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>harmonic watts</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>harmonic watts %</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>impedance</td>
<td>Imp meter mode</td>
</tr>
<tr>
<td>13</td>
<td>resistance</td>
<td>Imp meter mode</td>
</tr>
<tr>
<td>14</td>
<td>reactance</td>
<td>Imp meter mode</td>
</tr>
<tr>
<td>15</td>
<td>impedance phase</td>
<td>Imp meter mode</td>
</tr>
<tr>
<td>16</td>
<td>efficiency</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>fundamental efficiency</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>maths</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>integrated watts</td>
<td>integrator mode</td>
</tr>
<tr>
<td>20</td>
<td>integrated VA</td>
<td>integrator mode</td>
</tr>
<tr>
<td>21</td>
<td>integrated VAr</td>
<td>integrator mode</td>
</tr>
<tr>
<td>22</td>
<td>integrated rms current</td>
<td>integrator mode</td>
</tr>
<tr>
<td>23</td>
<td>average power factor</td>
<td>integrator mode</td>
</tr>
<tr>
<td>24</td>
<td>integrated fundamental watts</td>
<td>integrator mode</td>
</tr>
<tr>
<td>25</td>
<td>integrated fundamental VA</td>
<td>integrator mode</td>
</tr>
<tr>
<td>26</td>
<td>integrated fundamental VAr</td>
<td>integrator mode</td>
</tr>
<tr>
<td>27</td>
<td>integrated fundamental current</td>
<td>integrator mode</td>
</tr>
<tr>
<td>28</td>
<td>average fundamental power factor</td>
<td>integrator mode</td>
</tr>
<tr>
<td>29</td>
<td>average integrated watts</td>
<td>integrator mode</td>
</tr>
<tr>
<td>30</td>
<td>average integrated VA</td>
<td>integrator mode</td>
</tr>
<tr>
<td>31</td>
<td>average integrated VAr</td>
<td>integrator mode</td>
</tr>
<tr>
<td>32</td>
<td>average integrated fundamental watts</td>
<td>integrator mode</td>
</tr>
<tr>
<td>33</td>
<td>average integrated fundamental VA</td>
<td>integrator mode</td>
</tr>
<tr>
<td>34</td>
<td>average integrated fundamental VAr</td>
<td>integrator mode</td>
</tr>
<tr>
<td>35</td>
<td>average rms voltage</td>
<td>integrator mode</td>
</tr>
<tr>
<td>36</td>
<td>average fundamental voltage</td>
<td>integrator mode</td>
</tr>
<tr>
<td>37</td>
<td>Standby mode frequency</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>DC watts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Mode</td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>39</td>
<td>average rms current</td>
<td>integrator mode</td>
</tr>
<tr>
<td>40</td>
<td>average fundamental current</td>
<td>integrator mode</td>
</tr>
<tr>
<td>41</td>
<td>delta watts</td>
<td>Imp meter mode</td>
</tr>
<tr>
<td>42</td>
<td>fundamental delta watts</td>
<td>Imp meter mode</td>
</tr>
<tr>
<td>43</td>
<td>elapsed time</td>
<td>integrator mode</td>
</tr>
<tr>
<td>44</td>
<td>resistance</td>
<td>Imp meter mode</td>
</tr>
<tr>
<td>45</td>
<td>inductance</td>
<td>Imp meter mode</td>
</tr>
<tr>
<td>46</td>
<td>capacitance</td>
<td>Imp meter mode</td>
</tr>
<tr>
<td>47</td>
<td>tan delta</td>
<td>Imp meter mode</td>
</tr>
<tr>
<td>48</td>
<td>Q factor – see notes</td>
<td>Imp meter mode</td>
</tr>
<tr>
<td>48</td>
<td>k-factor – see notes</td>
<td>Transformer mode</td>
</tr>
<tr>
<td>49</td>
<td>corrected power</td>
<td>Transformer mode</td>
</tr>
<tr>
<td>50</td>
<td>rms voltage</td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>rms current</td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>fundamental voltage</td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>fundamental current</td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>voltage phase</td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>current phase</td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>harmonic voltage</td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>harmonic current</td>
<td></td>
</tr>
<tr>
<td>58</td>
<td>dc voltage</td>
<td></td>
</tr>
<tr>
<td>59</td>
<td>dc current</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>ac voltage</td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>ac current</td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>peak voltage</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>peak current</td>
<td></td>
</tr>
<tr>
<td>64</td>
<td>voltage crest factor</td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>current crest factor</td>
<td></td>
</tr>
<tr>
<td>66</td>
<td>rectified mean voltage</td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>rectified mean current</td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>voltage form factor</td>
<td></td>
</tr>
<tr>
<td>69</td>
<td>current form factor</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>voltage harmonic</td>
<td>harmonic mode</td>
</tr>
<tr>
<td>71</td>
<td>current harmonic</td>
<td>harmonic mode</td>
</tr>
<tr>
<td>72</td>
<td>voltage harmonic percentage</td>
<td>harmonic mode</td>
</tr>
<tr>
<td>73</td>
<td>current harmonic percentage</td>
<td>harmonic mode</td>
</tr>
<tr>
<td>74</td>
<td>voltage thd</td>
<td>harmonic mode</td>
</tr>
<tr>
<td>75</td>
<td>current thd</td>
<td>harmonic mode</td>
</tr>
<tr>
<td>76</td>
<td>voltage tif</td>
<td>harmonic mode</td>
</tr>
<tr>
<td>77</td>
<td>current tif</td>
<td>harmonic mode</td>
</tr>
<tr>
<td>78</td>
<td>phase to phase rms voltage</td>
<td></td>
</tr>
<tr>
<td>79</td>
<td>phase to phase fundamental voltage</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>phase to phase voltage phase angle</td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>81</td>
<td>phase to phase rms voltage</td>
<td></td>
</tr>
<tr>
<td>82</td>
<td>voltage surge</td>
<td></td>
</tr>
<tr>
<td>83</td>
<td>current surge</td>
<td></td>
</tr>
<tr>
<td>84</td>
<td>voltage rms deviation</td>
<td></td>
</tr>
<tr>
<td>85</td>
<td>voltage fundamental deviation</td>
<td></td>
</tr>
<tr>
<td>86</td>
<td>voltage phase deviation</td>
<td></td>
</tr>
<tr>
<td>87</td>
<td>voltage positive peak</td>
<td></td>
</tr>
<tr>
<td>88</td>
<td>current positive peak</td>
<td></td>
</tr>
<tr>
<td>89</td>
<td>voltage negative peak</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>current negative peak</td>
<td></td>
</tr>
<tr>
<td>91</td>
<td>voltage positive peak unfiltered</td>
<td></td>
</tr>
<tr>
<td>92</td>
<td>current positive peak unfiltered</td>
<td></td>
</tr>
<tr>
<td>93</td>
<td>voltage negative peak unfiltered</td>
<td></td>
</tr>
<tr>
<td>94</td>
<td>current negative peak unfiltered</td>
<td></td>
</tr>
<tr>
<td>95-99</td>
<td>reserved for future expansion</td>
<td></td>
</tr>
</tbody>
</table>

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
There are some special functions:

<table>
<thead>
<tr>
<th>Measurement (function)</th>
<th>phase</th>
<th>Previous function</th>
</tr>
</thead>
<tbody>
<tr>
<td>mechanical speed in Hz</td>
<td>neutral</td>
<td>dc voltage (function 58)</td>
</tr>
<tr>
<td>mechanical speed in rpm</td>
<td>neutral</td>
<td>ac voltage (function 60)</td>
</tr>
<tr>
<td>torque in Nm</td>
<td>neutral</td>
<td>rms voltage (function 50)</td>
</tr>
<tr>
<td>mechanical power</td>
<td>neutral</td>
<td>Watts (function 2)</td>
</tr>
</tbody>
</table>

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
Newtons4th Ltd. contact details

Please direct all queries or comments regarding the PPA45xx instruments or this manual to:

Newtons4th Ltd.
1 Bede Island Road
Leicester
LE2 7EA
United Kingdom

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

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

Web site:     www.newtons4th.com

At Newtons4th Ltd. we have a policy of continuous product improvement and are always keen to hear comments, whether favourable or unfavourable, from users of our products. Please telephone, fax, write or e-mail with your comments.