



**Newton4th Ltd**

# PPA3500

## Communications Manual



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Document Title: PPA35xx Communications Manual v6.0  
Document Release Date: 11<sup>th</sup> December 2024  
PPA35xx Firmware version on release date: v2.53

**Document Ref: D000222 issue 06**

## **IMPORTANT SAFETY INSTRUCTIONS**

This equipment is designed to comply with BSEN 61010-1 (2010) (Safety requirements for electrical equipment for measurement, control, and laboratory use) – observe the following precautions:

- Ensure that the supply voltage agrees with the rating of the instrument printed on the back panel **before** connecting the mains cord to the supply.
- This appliance **must** be earthed. Ensure that the instrument is powered from a properly grounded supply.
- The inputs are rated at 1kV rms or dc cat II; 600V rms or dc cat III. **Do not exceed the rated input.**
- Keep the ventilation slots in the top and sides of the cover free from obstruction.
- Do not operate or store under conditions where condensation may occur or where conducting debris may enter the case.
- There are no user serviceable parts inside the instrument – do not attempt to open the instrument, refer service to the manufacturer or his appointed agent.

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## **ABOUT THIS MANUAL**

This manual gives details of the communication commands recognized by the PPA35xx series of instruments over RS232, USB, or LAN. For more general operating instructions for the instrument refer to the specific user manual.

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

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

### **Notes:**

**The information in this manual is based on the 30A version of the PPA3560. There will be some minor differences to the Command options when using other PPA35xx models and current versions.**

**Unless otherwise stated Commands and Configs that control Group1 (PH1-PH3) will also control Group2 (PH4-PH6) when Group2 is the active group on the instrument.**

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Appendix A – configurable parameters

Appendix B – MULTIL parameters

## 1 Using remote control

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

|                   | Rx expects                             | Tx sends                         |
|-------------------|----------------------------------------|----------------------------------|
| RS232<br>USB, LAN | carriage return<br>(line feed ignored) | carriage return<br>and line feed |

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

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

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

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

FQREF,CURRENT;POWER?

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

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

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

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

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

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

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

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

## 1.1 Standard event status register

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

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

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

## 1.2 Serial Poll status byte

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

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

### 1.3 RS232 connections

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

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

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

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

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

## 1.4 Data format

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

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

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

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

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

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

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

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

## 2 Communication commands

### **\*CLS**

### **\*CLS**

Function: Clear status

Description: Clears the *standard event status register*.

Format: \*CLS

Arguments: none

Reply: none

Example: \*CLS  
\*ESR?  
0

Notes:

**\*ESE****\*ESE**

Function: Set standard event status enable register.

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

Format: \*ESE, value

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

Reply: can be read by \*ESE?

Example: \*ESE, 60

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

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

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

**\*ESR?****\*ESR?**

Function: Standard event status register query

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

Format: \*ESR?

Arguments: none

Reply: decimal equivalent of bits in standard event status register

Example: \*ESR?  
33

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

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

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

**\*IDN?****\*IDN?**

Function: Identify query

Description: Returns a standard format identification string.

Format: \*IDN?

Arguments: none

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

Example: \*IDN?  
NEWTONS4TH,PPA3530 KinetiQ,  
196-01234,1.00

Notes:

**\*OPC?****\*OPC?**

Function: Test for operation complete

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

Format: \*OPC?

Arguments: none

Reply: 0 or 1

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

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

**\*RST****\*RST**

Function: Reset

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

Format: \*RST

Arguments: none

Reply: none

Example: \*RST

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

Any preceding setup commands will be overwritten.

**\*SRE****\*SRE**

Function: Set service request enable register.

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

Format: \*SRE, value

Arguments: decimal equivalent of bits in status byte register

Reply: can be read by \*SRE?

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

Notes:

**\*SRE?****\*SRE?**

Function: Read service request enable register.

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

Format: \*SRE?

Arguments:

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

Example: \*SRE?  
1

Notes:

**\*STB?****\*STB?**

Function: Read serial poll status byte

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

Format: \*STB?

Arguments: none

Reply: decimal value of the serial poll status byte

Example: \*STB?  
1

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

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

**\*TRG****\*TRG**

Function: Trigger

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

Format: \*TRG

Arguments: none

Reply: none

Example: MODE,VRMS  
\*TRG  
VRMS,SURG?

Notes:

**\*TST?****\*TST?**

Function: Self test query

Description: Returns the results of self test

Format: \*TST?

Arguments: none

Reply: single integer  
bit 0 – set if uncalibrated  
bit 1 – set if DSP zero error  
bit 2 – set if DSP run error  
bit 3 – not used  
bit 4 – System error, FPGA  
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

Example: \*TST?  
0

Notes:

**\*WAI****\*WAI**

Function: Wait for operation complete

Description: Suspends communication until the previous operation has completed

Format: \*WAI

Arguments: none

Reply: none

Example: \*TRG  
\*WAI  
POWER,PHASE1?

Notes:

**ABORT****ABORT**

Function: Abort datalog  
Description: Abort datalog data acquisition.  
Format: ABORT  
Arguments: none  
Reply: none  
Example: DATALOG, RAM, 0.02  
START  
*wait for data values*  
ABORT

Notes:

**ADIMAP****ADIMAP**

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

**ALARM****ALARM**

Function: Set common controls for alarm1 and alarm2.

Description: Set the alarm latch and sounder control.

Format: *ALARM,latch,sounder*

Arguments: latch:  
            ON  
            OFF  
          sounder:  
            ENABLED  
            DISABLED

Reply: none

Example: ALARM,ON,DISABLED

Notes:

**ALARM?****ALARM?**

Function: Read alarm status.

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

Format: ALARM?

Arguments: none

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

Example: ALARM?  
1

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

**ALARM1****ALARM1**

Function: Set parameters for alarm1.

Description: Set alarm1 type and thresholds.

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

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

Reply: none

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

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

**ALARM2****ALARM2**

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

**ALARME****ALARME**

|              |                                                                                                                                                  |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Set alarm status enable register                                                                                                                 |
| Description: | Sets bits in the alarm status enable register to control which alarm bit if any set the alarm active bits in the status byte.                    |
| Format:      | ALARME, <i>value</i>                                                                                                                             |
| Arguments:   | decimal equivalent of alarm bits<br>bit2 set bit 3 of status byte when alarm 1 is active<br>bit3 set bit 3 of status byte when alarm 2 is active |
| Reply:       | none                                                                                                                                             |
| Example:     | ALARME, 12<br>*SRE,8<br>set bit 3 in status byte when either alarm 1 or alarm 2 is active and generate a service request                         |
| Notes:       | default value is 0                                                                                                                               |

**ALARME?****ALARME?**

Function: Read alarm status enable register

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

Format: ALARME?

Arguments: none

Reply: decimal equivalent of alarm bits

Example: ALARME?  
12

Notes:

**ANALOG****ANALOG**

Function: Interface with ADI40

Description: Write to individual ADI40 outputs

Format: ANALOG,channel,value

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

Reply: None

Example: ANALOG,5,-3.14

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

**ANALOG?****ANALOG?**

Function: Interface with ADI40

Description: Read from individual ADI40 inputs.

Format: ANALOG,channel?

Arguments: Channel:  
1-20

Reply: ASCII characters in scientific format:  
1 - 16 in Volts  
17- 20 in °C None

Example: ANALOG,12?

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

**APPLIC****APPLIC**

Function: Select application mode.

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

Format: *APPLIC,type,setting*

Arguments: type:  
              NORMAL  
              PWM  
              BALLAST  
              INRUSH  
              POWERT  
              STANDB  
              setting:  
                  filter 0-6 (PWM only)  
                      0: 4KHz  
                      1: 1KHz  
                      2: 250Hz  
                      3: 64Hz  
                      4: 250KHz  
                      5: 64KHz  
                      6: 16KHz  
                  speed 0-3 (ballast only)  
                      0: fixed time  
                      1: fast  
                      2: medium  
                      3: slow

Reply: none

Example: *APPLIC,POWERT*  
*APPLIC,BALLAST,1*

Notes:

**BANDWI?****BANDWI?**

Function: Selects the hardware bandwidth filter

Description: The bandwidth may be set to “wide” or “low” to minimise high frequency noise in noisy environments.

Format: *BANDWI,setting*

Arguments: Setting:  
                  LOW  
                  WIDE

Reply: None

Example: BANDWI,LOW

Notes:

**BEEP****BEEP**

Function: Sound the buzzer

Description: Makes a “beep” from the instrument.

Format: BEEP

Arguments: none

Reply: none

Example: BEEP

Notes:

**BLANKI****BLANKI**

Function: Select blanking

Description: Enable or disable low value blanking.

Format: BLANKI,*value*

Arguments: value:  
            ON  
            OFF

Reply: none

Example: BLANKI,OFF

Notes:

**CALSTR?****CALSTR?**

|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Read back the N4L last calibration string.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Description: | When calibrated at N4L, the instrument stores a text string which can be read on the front panel (press SYS and LEFT to display the System menu and refer to N4L Last Calibration). This shows the date of calibration. Users who subsequently verify the accuracy using a local calibration facility can choose have details of the local calibration displayed instead. The original N4L string is not overwritten but the alternative local calibration string is displayed instead. |
| Format:      | CALSTR?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Arguments:   | none                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Reply:       | alphanumeric string                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Example:     | CALSTR?<br>12_AUG_2020_1055_AMW                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Notes:       | CALSTR? Will read back the most recent N4L last calibration string including on instruments that are displaying details of a more recent local calibration.                                                                                                                                                                                                                                                                                                                             |

**CALVER?****CALVER?**

|              |                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Read back the Local calibration string.                                                                                                                                                                                                                                                                                                                                                                        |
| Description: | When calibrated using an external calibration facility details of the calibration can be stored on the instrument. This text string can be read on the front panel (press SYS and LEFT to display the System menu and refer to Local Calibration). This shows the date of the local calibration. The original N4L string is not overwritten but the alternative local calibration string is displayed instead. |
| Format:      | CALVER?                                                                                                                                                                                                                                                                                                                                                                                                        |
| Arguments:   | none.                                                                                                                                                                                                                                                                                                                                                                                                          |
| Reply:       | alphanumeric string                                                                                                                                                                                                                                                                                                                                                                                            |
| Example:     | CALVER?<br>12_AUG_2020_1055_AMW                                                                                                                                                                                                                                                                                                                                                                                |
| Notes:       | CALVER? Will read back the most recent local calibration string. The string will be blank if no local calibration has been performed or no information was entered when the local calibration was performed.                                                                                                                                                                                                   |

**CONFIG****CONFIG**

|              |                                                                                                                                                    |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Direct access of configuration parameters                                                                                                          |
| Description: | Sets configuration parameter for which there may not be a direct command.                                                                          |
| Format:      | <i>CONFIG,index,data</i>                                                                                                                           |
| Arguments:   | index is the number of the parameter<br>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.<br>CONFIG goes through the same limit checking as when entering data from the menus. |

**CONFIG?****CONFIG?**

|              |                                                                                               |
|--------------|-----------------------------------------------------------------------------------------------|
| Function:    | Configurable parameter query                                                                  |
| Description: | Reads the present value of a single parameter.                                                |
| Format:      | CONFIG, <i>index</i> ?                                                                        |
| or:          | CONFIG? <i>index</i>                                                                          |
| Arguments:   | <i>index</i> is the parameter number                                                          |
| Reply:       | Value of parameter, real or integer as appropriate.                                           |
| Example:     | CONFIG,6? (read phase convention)<br>0<br>CONFIG,6,1 (set phase convention)<br>CONFIG,6?<br>1 |
| Notes:       | The list of configurable parameters is given in the appendix.                                 |

**COUPLI****COUPLI**

|              |                                                                                                                                                                                                                                                                                    |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Set ac, dc or ac+dc coupling.                                                                                                                                                                                                                                                      |
| Description: | Selects the input coupling for a given input channel.                                                                                                                                                                                                                              |
| Format:      | COUPLI, <i>phase,coupling</i>                                                                                                                                                                                                                                                      |
| Arguments:   | phase:<br>PHASE1<br>PHASE2<br>PHASE3<br>PHASE4<br>PHASE5<br>PHASE6<br>coupling:<br>AC+DC<br>ACONLY<br>DCONLY                                                                                                                                                                       |
| Reply:       | none                                                                                                                                                                                                                                                                               |
| Example:     | COUPLI,PHASE2,AC+DC                                                                                                                                                                                                                                                                |
| Notes:       | <p>In multi phase applications, the coupling on phase 1 is applied to other phases unless "independent input control" is enabled. For example when WIRING &gt; SINGLE PHASE 2 is selected.</p> <p>PHASE4-6 may also be set by using PHASE1-3 when group 2 is the active group.</p> |

**COUPLI?****COUPLI?**

|              |                                                                                                                                                                                      |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Read ac/dc/ac+dc coupling setting.                                                                                                                                                   |
| Description: | Returns a numerical value for the coupling setting.                                                                                                                                  |
| Format:      | COUPLI, <i>phase,coupling?</i>                                                                                                                                                       |
| or:          | COUPLI? <i>phase,coupling</i>                                                                                                                                                        |
| Arguments:   | phase:<br>PHASE1<br>PHASE2<br>PHASE3<br>PHASE4<br>PHASE5<br>PHASE6                                                                                                                   |
| Reply:       | 0 = AC+DC<br>1 = AONLY<br>2 = DONLY                                                                                                                                                  |
| Example:     | COUPLI,PHASE2,AC+DC<br>COUPLI,PHASE2?<br>0                                                                                                                                           |
| Notes:       | In multi phase applications, the coupling on phase 1 is applied to other phases unless "independent input control" is enabled. For example when WIRING > SINGLE PHASE 2 is selected. |

**DATALO****DATALO**

|              |                                                                                                                                                                                                                               |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Set up datalog                                                                                                                                                                                                                |
| Description: | Sets datalog parameters.                                                                                                                                                                                                      |
| Format:      | <i>DATALO,function,interval,speed</i>                                                                                                                                                                                         |
| Arguments:   | function:<br>DISABLE<br>RAM<br>NONVOL<br>RECALL<br>DELETE<br>interval:<br>datalog interval in seconds<br>speed:<br>HIGH                                                                                                       |
| Reply:       | none                                                                                                                                                                                                                          |
| Example:     | DATALO,RAM,10<br>DATALO,RAM,0,HIGH                                                                                                                                                                                            |
| Notes:       | set interval to 0 to record every measurement as fast as possible.<br>Set HIGH to select high speed mode for any combination of W, VA, VAr, pf, Vrms, Arms, and frequency. If HIGH is not sent then high speed mode is reset. |

**DATALO?****DATALO?**

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

**DAV?****DAV?**

|              |                                                                                                                                                                                                       |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Data available query                                                                                                                                                                                  |
| Description: | Returns data availability status.                                                                                                                                                                     |
| Format:      | DAV?                                                                                                                                                                                                  |
| Arguments:   | none                                                                                                                                                                                                  |
| Reply:       | Decimal equivalent of data available bits:<br>bit0 new data available<br>bit1 data available<br>bit2 harmonic series data available<br>bit6 integration data available<br>bit7 datalog data available |
| Example:     | SPEED,SLOW<br>*TRG<br>DAV?<br>0<br>DAV?<br>0<br>DAV?<br>0<br>DAV?<br>3                   (data available)                                                                                             |
| Notes:       | DAV? does not modify the status bits.                                                                                                                                                                 |

**DAVER****DAVER**

|              |                                                                                                                                                         |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Set data available enable register                                                                                                                      |
| Description: | Sets bits in the data available enable register to control which status bits set the data available bits in the status byte.                            |
| Format:      | DAVER, <i>value</i>                                                                                                                                     |
| Arguments:   | decimal equivalent of data available bits<br>bit0 set bit 0 of status byte when new data available<br>bit1 set bit 0 of status byte when data available |
| Reply:       | none                                                                                                                                                    |
| Example:     | DAVER, 1<br>set bit 0 in status byte when new data is available                                                                                         |
| Notes:       | default value is 2:<br>bit 0 of status byte is set whenever data is available.                                                                          |

**DAVER?****DAVER?**

Function: Read data available enable register

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

Format: DAVER?

Arguments: none

Reply: decimal equivalent of bits

Example: DAVER?  
4

Notes:

**DISPLAY****DISPLAY**

|              |                                                                                                                                                                                                        |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Set the display page                                                                                                                                                                                   |
| Description: | Selects the page on the display for the active group.                                                                                                                                                  |
| Format:      | DISPLAY, <i>page</i>                                                                                                                                                                                   |
| Arguments:   | page:<br>PHASE1<br>PHASE2<br>PHASE3<br>SUM1<br>NEUTRAL1<br>TOTAL<br>FUNDAMENTAL<br>VOLTAGE<br>CURRENT                                                                                                  |
| Reply:       | None                                                                                                                                                                                                   |
| Example:     | DISPLAY,FUNDAMENTAL                                                                                                                                                                                    |
| Notes:       | VOLTAGE is the same as TOTAL;<br>CURRENT is the same as FUNDAMENTAL.<br>They refer to the multiphase display modes.<br><br>If Group 2 is the active group then the above applied to Group 2 (PH4-PH6). |

**DISPLAY?****DISPLAY?**

Function: Read the displayed data

Description: Returns all the values presently on the screen for the active group.

Format: DISPLAY?

Arguments: none

Reply: Multiple floating point values separated by commas

Example: DISPLAY?

Notes:

**EFFICI****EFFICI**

|              |                                                                                                                                                                                                                                                                                                              |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Set efficiency calculation                                                                                                                                                                                                                                                                                   |
| Description: | Selects the data to be used for the efficiency calculation for the active group.                                                                                                                                                                                                                             |
| Format:      | EFFICI, <i>formula</i>                                                                                                                                                                                                                                                                                       |
| Arguments:   | formula: <ul style="list-style-type: none"><li>0 – disabled</li><li>1 – next phase / phase</li><li>2 – phase / next phase</li><li>3 – group 2 / group 1</li><li>4 – group 1 / group 2</li><li>5 – mechanical / sum</li><li>6 – sum / mechanical</li><li>7 – phase 3 / sum</li><li>8 – sum /phase 3</li></ul> |
| Reply:       | none                                                                                                                                                                                                                                                                                                         |
| Example:     | EFFICIENCY,3                                                                                                                                                                                                                                                                                                 |
| Notes:       |                                                                                                                                                                                                                                                                                                              |

**EFFICI?****EFFICI?**

|              |                                                                                                    |
|--------------|----------------------------------------------------------------------------------------------------|
| Function:    | Read efficiency result                                                                             |
| Description: | Reads back the total and fundamental efficiency results.                                           |
| Format:      | EFFICI?                                                                                            |
| Arguments:   | none                                                                                               |
| Reply:       | 2 data values separated by commas:<br>total, fundamental<br>or 6 data values                       |
| Example:     | EFFICI?<br>data returned                                                                           |
| Notes:       | 6 data values returned if efficiency option is phase / next phase and 3 phase wiring is configured |

**FAST****FAST**

Function: Set fast communications mode.

Description: Disables the screen drawing for high speed operation.

Format: FAST,*value*

Arguments: value:  
            ON  
            OFF

Reply: none

Example: FAST,ON

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

**FQLOCK****FQLOCK**

Function: Lock frequency.

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

Format: FQLOCK,*mode,frequency*

Arguments: value:  
ON  
OFF  
NORMAL  
CONSTANT [,frequency]  
DYNAMIC

Reply: none

Example: FQLOCK,ON

Notes: OFF is the same as NORMAL  
To fix the analysis to a specified frequency, either first lock the frequency with FQLOCK,ON and send the desired frequency with the FREQUE command or send CONSTANT followed by the frequency.

**FQREF****FQREF**

|              |                                                                                                                                                                        |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Set frequency reference.                                                                                                                                               |
| Description: | Select the channel to be used for measuring the frequency on the active group.                                                                                         |
| Format:      | <i>FQREF,phase</i><br><i>FQREF,channel</i><br><i>FQREF,phase,channel</i>                                                                                               |
| Arguments:   | channel:<br>voltage<br>current<br><br>phase:<br>PHASE1<br>PHASE2<br>PHASE3                                                                                             |
| Reply:       | none                                                                                                                                                                   |
| Example:     | FQREF,CURRENT                                                                                                                                                          |
| Notes:       | Measured phase is always referred to phase 1 voltage no matter what channel is selected to measure the frequency, unless phase 1 is not active (eg phase 2 only mode). |

**FREQUE****FREQUE**

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

**FSD?****FSD?**

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

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

Format: FSD?  
FSD,*channel*

Arguments: Channel:  
CH1  
CH2  
CH3  
CH4  
CH5  
CH6

Reply: Up to six data values separated by commas

Example: 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

**GROUP****GROUP**

Function: Set the active group.

Description: Select the group to which all future commands will be directed.

Format: GROUP,*group*

Arguments: group:  
            1 or 2

Reply: none

Example: GROUP,2

Notes:

**GROUP1****GROUP1**

|              |                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Set the number of phases in group 1.                                                                                                                                                                                                                                                                                                                                                                                            |
| Description: | If there are more than three phases in group 1 then the instrument will operate in single group mode, otherwise the instrument will operate with two independent groups. A six phase unit always has at least three phases in group 1; a four phase unit could have one to four phases in group1                                                                                                                                |
| Format:      | GROUP1, <i>phases</i>                                                                                                                                                                                                                                                                                                                                                                                                           |
| Arguments:   | phases:<br>1 to 6                                                                                                                                                                                                                                                                                                                                                                                                               |
| Reply:       | none                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Example:     | GROUP1,6                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Notes:       | <p>For a four phase unit, set group 1 to</p> <ul style="list-style-type: none"> <li>1 for 1 : 2+3+4</li> <li>2 for 1+2 : 3+4</li> <li>3 for 1+2+3 : 4</li> <li>4 for 1+2+3+4 (single group)</li> </ul> <p>For a six phase unit set group 1 to</p> <ul style="list-style-type: none"> <li>1 for 1+2+3 : 1+2+3</li> <li>3 for 1+2+3 : 4+5+6</li> <li>4 for 1+2+3+4</li> <li>5 for 1+2+3+4+5</li> <li>6 for 1+2+3+4+5+6</li> </ul> |

**HARMON****HARMON**

Function: Set harmonic analyser mode.

Description: Set harmonic analyser mode and parameters.

Format: HARMON,*para,harmonic,max*

Arguments: para:

|        |                            |
|--------|----------------------------|
| THDD   | difference formula THD     |
| THDS   | harmonic series THD        |
| TIF    | Telephone Influence Factor |
| THF    | Telephone Harmonic Factor  |
| TDD    | Total Demand Distortion    |
| TRD    | Total Rated Distortion     |
| HPHASE | harmonic phase             |
| HRMS   | harmonic rms               |
| HFACTO | harmonic factor            |
| PH-PH  | phase to phase             |

harmonic:

individual harmonic for display

max:

length of harmonic series (to 50)

Reply: none

Example: HARMON,THDS,3,50

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

PH-PH sets the conversion from normal to PH-PH measurement (Harmonic menu options).

**HARMON?****HARMON?**

|              |                                                                                                                                                                     |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Harmonic analyser query                                                                                                                                             |
| Description: | Read harmonic results.<br>Sets harmonic analyser mode if not already set.<br>Waits for next unread data if necessary.<br>Clears new data available bit read by DAV? |
| Format:      | HARMON?                                                                                                                                                             |
| or:          | HARMON, <i>phase</i> ?                                                                                                                                              |
| or:          | HARMON,SERIES?                                                                                                                                                      |
| or:          | HARMON, <i>phase</i> ,SERIES?                                                                                                                                       |
| Arguments:   | phase:<br>PHASE1<br>PHASE2<br>PHASE3<br>PHASE4<br>PHASE5<br>PHASE6<br>NEUTRAL<br>PHASES                                                                             |
| Reply:       | 11 data values separated by commas:<br>freq,mag1,mag2,hmag1,hmag2,h%1,<br>h%2,thd%1,thd%2,hphase1,hphase2                                                           |
| or:          | magnitude and percentage for each harmonic, one channel per line                                                                                                    |
| or:          | magnitude and phase for each harmonic, one channel per line                                                                                                         |
| Example:     | HARMON,PHASE2?<br>data returned                                                                                                                                     |
| Notes:       | HARMON? waits for next unread data.                                                                                                                                 |

**HOLD****HOLD**

Function: Set data hold

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

Format: HOLD,state

Arguments: state:  
ON  
OFF

Reply: none

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

Notes: Turns data hold on or off for group 1 and group 2 at the same time.

**HPOWER****HPOWER**

Function: Set harmonic power parameters

Description: Sets power parameters but does not change to power mode so that power can be measured in harmonic series mode.

Format: See POWER

Arguments: See POWER

Reply: none

Example: See POWER

Notes:

**HPOWER?****HPOWER?**

Function: Read harmonic power results

Description: Reads power results but does not change to power mode so that power can be read in harmonic series mode.

Format: See POWER?

Arguments: See POWER?

Reply: None

Example: See POWER?

Notes:

**INPUT****INPUT**

|              |                                                                                                                                                                                                                                                                                                                                      |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Set input mode                                                                                                                                                                                                                                                                                                                       |
| Description: | Selects the input type of the instrument                                                                                                                                                                                                                                                                                             |
| Format:      | INPUT, <i>channel,type</i>                                                                                                                                                                                                                                                                                                           |
| Arguments:   | channel:<br>CH1<br>CH2<br>CH3<br>CH4<br>CH5<br>CH6<br>type:<br>INTERN<br>EXTATT<br>EXTSHU                                                                                                                                                                                                                                            |
| Reply:       | None                                                                                                                                                                                                                                                                                                                                 |
| Example:     | INPUT,CH1,EXTSHU                                                                                                                                                                                                                                                                                                                     |
| Notes:       | CH1 applies to all voltage channels<br>(unless in single phase 2 or 3 wiring)<br>CH2 applies to all current channels<br>(unless in single phase 2 or 3 wiring)<br>CH3 and 4 apply to phase 2 voltage and<br>current when in single phase 2 wiring<br>CH5 and 6 apply to phase 3 voltage and<br>current when in single phase 3 wiring |

**INTEGR****INTEGR**

- Function: Set integrated power mode.
- Description: Set integrated power mode, whether the integration for Watts and current use signed or unsigned values, and whether accumulated or averaged values are computed.  
Also sets up run time for integration over a specific interval.
- Format: *INTEGR,type,display*  
See notes 1&2 *INTEGR,RUNTIM,hours,minutes*
- Arguments: type:  
                  SIGNED  
                  MAGNITUDE  
display:  
                  TOTAL  
                  AVERAGE  
hours:  
                  integer  
minutes:  
                  integer
- Reply: none
- Example: *INTEGR,MAGNITUDE,TOTAL*
- Notes:
1. The *display* parameter can only be used with the *type* parameter  
       *INTEGR,SIGNED,TOTAL* ✓  
       *INTEGR,SIGNED* ✓  
       *INTEGR,TOTAL* ✗
  2. *INTEGR,RUNTIME* cannot be combined with *INTEGR,type,display*

**INTEGR?****INTEGR?**

|                                   |                                                                                                                                                                                                        |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:                         | Read integrated power mode.                                                                                                                                                                            |
| Description:                      | Read integrated power mode for the selected phase.                                                                                                                                                     |
| Format:                           | INTEGR, <i>phase?</i>                                                                                                                                                                                  |
| Arguments:<br>See note 1          | phase:<br>PHASE1<br>PHASE2<br>PHASE3<br>PHASE4<br>PHASE5<br>PHASE6<br>PHASES<br>SUM                                                                                                                    |
| Reply:<br>(Total)                 | 13 values separated by commas<br>time,Wh,WH.f,VAh,VAh.f,VARh,Varh.f<br>pf,pf.f,V,V.f,Ah,Ah.f                                                                                                           |
| Reply:<br>(Average)<br>See Note 2 | 13 values separated by commas<br>time,W avrg,W avrg.f,VAh,VAh.f,<br>VARh,Varh.f pf,pf.f,V,V.f,Ah,Ah.f                                                                                                  |
| Example:                          | START<br>wait for integration time<br>INTEGR,PHASE1?<br>data returned                                                                                                                                  |
| Notes:                            | 1.INTEGR? without specifying the phase returns the appropriate single phase data.<br><br>2.The format of the reply string changes with the value of the DISPLAY parameter set with the INTEGR command. |

**KEYBOA****KEYBOA**

|              |                                                                                    |
|--------------|------------------------------------------------------------------------------------|
| Function:    | Disable front panel keyboard.                                                      |
| Description: | The front panel keyboard can be disabled to prevent accidental operation.          |
| Format:      | KEYBOARD, <i>value</i>                                                             |
| Arguments:   | value:<br>ENABLE<br>DISABLE                                                        |
| Reply:       | none                                                                               |
| Example:     | KEYBOARD,DISABLE                                                                   |
| Notes:       | The keyboard can be re-enabled from the front panel only by pressing the HOME key. |

**LCR****LCR**

Function: Set Impedance meter (LCR) mode.

Description: Set Impedance meter (LCR) mode and conditions.

Format: LCR,*parameter*

Arguments: parameter:  
              AUTO  
              CAPACITANCE  
              INDUCTANCE  
              IMPEDANCE

Reply: none

Example: LCR,CAPACI  
          LCR,INDUCT  
          LCR,IMPEDA

Notes:

**LCR?****LCR?**

|              |                                                                                                                                                                              |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Impedance meter (LCR) query                                                                                                                                                  |
| Description: | Read Impedance meter (LC meter results.<br>Sets LCR meter mode if not already set.<br>Waits for next unread data if necessary.<br>Clears new data available bit read by DAV? |
| Format:      | LCR, <i>phase?</i>                                                                                                                                                           |
| Arguments:   | phase:<br>PHASE1<br>PHASE2<br>PHASE3<br>PHASE4<br>PHASE5<br>PHASE6<br>PHASES                                                                                                 |
| Reply:       | 11 data values separated by commas:<br>freq, Vmag, Amag, impedance,<br>phase, R, C, L, tan $\delta$ , Qf, reactance<br>Phases? returns 11 data values for each phase.        |
| Example:     | LCR,IMPEDA<br>LCR,PHASES?<br>data returned                                                                                                                                   |
| Notes:       | LCR? waits for next unread data.<br>LCR? without specifying the phase returns the appropriate single phase data.                                                             |

**LOWFRE****LOWFRE**

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

**MODE****MODE**

Function: Set mode

Description: Sets the basic operating mode of the instrument.

Format: MODE,*type*

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

Reply: none

Example: MODE,LCR

Notes:

**MULTIL****MULTIL**

Function: Selects data for multi string reply

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

Format: *MULTIL,index,phase,function*

Arguments:

|           |                  |
|-----------|------------------|
| index:    |                  |
| 0         | clear all        |
| 1-30      | select data 1-30 |
| phase:    |                  |
| 1-3       | phase 1-3        |
| 4         | sum              |
| 5         | neutral          |
| 6         | ADI40            |
| 7-9       | phase 4-6        |
| 10        | sum 2            |
| 11        | neutral 2        |
| function: |                  |
| 1-99      | see appendix     |

Reply: none

Example:

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

Notes:

**MULTIL?****MULTIL?**

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

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 3-1 where you will find an application guide to assist with this function

**NEWLOC****NEWLOC**

|              |                                                                                                    |
|--------------|----------------------------------------------------------------------------------------------------|
| Function:    | Waits for new data then holds so that multiple commands can be used on the same data set.          |
| Description: | Reads multiple sets of data                                                                        |
| Format:      | NEWLOC                                                                                             |
| Arguments:   | None                                                                                               |
| Reply:       | Data as per returned parameter query. ie from power, harmonics etc.                                |
| Example:     | NEWLOC<br>HARMON,SERIES?<br>HPOWER?<br>Harmonic series and Power data returned from the same data. |
| Notes:       | After the command the data will still be held so to release the lock send SUSPEND,OFF              |

**NOISEF****NOISEF**

|              |                                                                                                                                            |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Set the digital noise filter                                                                                                               |
| Description: | Select the noise filter and set the filter frequency to reduce the presence of high frequency noise.                                       |
| Format:      | NOISEF, <i>setting,frequency</i>                                                                                                           |
| Arguments:   | setting:<br>ON<br>OFF<br>Frequency:<br>Frequency in Hz                                                                                     |
| Reply:       | none                                                                                                                                       |
| Example:     | NOISEF,ON,150E3                                                                                                                            |
| Notes:       | Minimum filter frequency is 1kHz.<br>Because the same digital filter is applied to voltage and current there is no introduced phase error. |

**NOOVER****NOOVER**

|              |                                                                                                                                                                                                                                                                                                                                            |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Disable overranging                                                                                                                                                                                                                                                                                                                        |
| Description: | Prevents an overrange error from blanking out results in manual ranging.                                                                                                                                                                                                                                                                   |
| Format:      | NOOVER, <i>value</i>                                                                                                                                                                                                                                                                                                                       |
| Arguments:   | value:<br>ON<br>OFF                                                                                                                                                                                                                                                                                                                        |
| Reply:       | none                                                                                                                                                                                                                                                                                                                                       |
| Example:     | NOOVER,ON                                                                                                                                                                                                                                                                                                                                  |
| Notes:       | <p>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.</p> <p>On the instrument this command adjusts Ignore Overload and can be found in the ACQU &gt; Advanced Options menu.</p> |

**NORMAL****NORMAL**

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

**PFCNV****PFCNV**

Function: Set power factor sign convention.

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

Format: PFCNV,*type*

Arguments: type:  
NEGLAG  
NEGLEA

Reply: none

Example: PFCNV,NEGLAG

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

**PHANGREF****PHANGREF**

|              |                                                                                                                                                  |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Set phase angle reference                                                                                                                        |
| Description: | Fourier transform analysis can be phase referred to current or voltage fundamental                                                               |
| Format:      | PHANGREF, <i>reference</i><br>PHANGR, <i>reference</i>                                                                                           |
| Arguments:   | reference:<br>VOLTAGE<br>CURRENT                                                                                                                 |
| Reply:       | none                                                                                                                                             |
| Example:     | PHANGR,CURRENT<br>PHANGREF, CURRENT                                                                                                              |
| Notes:       | If measuring current without any voltage present it is important to set the phase angle reference to CURRENT for the fundamental to be accurate. |

**PHASEM****PHASEM**

Function: Set phase meter mode.

Description: Select phase meter mode and reference.

Format: PHASEM,*reference*

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

Reply: none

Example: PHASEM,CH2

Notes:

On the instrument this is referred to as Computation in the Phase Meter menu.

**PHASEM?****PHASEM?**

|              |                                                                                                                                                                                                               |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Phase meter query                                                                                                                                                                                             |
| Description: | Reads phase meter results.<br>Sets phase meter mode if not already set.<br>Waits for next unread data if available.<br>Clears new data available bit read by DAV?                                             |
| Format:      | PHASEM?<br>PHASEM, <i>phase</i> ?                                                                                                                                                                             |
| Arguments:   | phase:<br>PHASE1<br>PHASE2<br>PHASE3<br>PHASE4<br>PHASE5<br>PHASE6<br>PHASES?                                                                                                                                 |
| Reply:       | 5 data values separated by commas<br>freq,mag1,mag2,dB,phase                                                                                                                                                  |
| Example:     | PHASEM,CH1<br>PHASEM,PHASE1?<br>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.<br>PHASEM? without specifying the phase returns the appropriate single phase data. |

**PHCONV****PHCONV**

Function: Set phase convention

Description: Set phase convention

Format: PHCONV,*convention*

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

Reply: none

Example: PHCONV, -360

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

**POWER****POWER**

Function: Set up power analyser mode.

Description: Configure power analyser with sum  
current display type

Format: POWER,*sum type*

Arguments: sum type:  
TOTAL  
AVERAGE

Reply: none

Examples: POWER,TOTAL

Notes:

**POWER?****POWER?**

Function: Read power analyser results

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

Format: *POWER,phase,results?*

Arguments: phase:  
    PHASE1  
    PHASE2  
    PHASE3  
    PHASE4  
    PHASE5  
    PHASE6  
    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****PRIMAR**

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

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

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

**PROGRA****PROGRA**

Function: Access non volatile program stores.

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

Format: *PROGRA,function,number*

Arguments: function:  
              RECALL  
              STORE  
              DELETE  
              number  
              0-99

Reply: none

Example: *PROGRA,RECALL,13*

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

**PROGRA?****PROGRA?**

**Function:** Identify current program or list all stored programs.

**Description:** Sending the argument FILES? – Lists all stored programs. The reply includes the location, file name and date saved for each program.  
Sending the argument NAME? - Displays the name of the last program to be loaded or recalled.

**Format:** PROGRA

**Arguments:** FILES?  
NAME?

**Reply:** text string

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

PROGRA,NAME?  
factory default

PROGRAM,NAME?  
Remote program

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

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

**RANGE****RANGE**

|              |                                                                                                                                                                                                                                    |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Set channel ranging.                                                                                                                                                                                                               |
| Description: | Select minimum range and range control for a given input channel.                                                                                                                                                                  |
| Format:      | <i>RANGE,channel,ranging,range</i>                                                                                                                                                                                                 |
| Arguments:   | channel:<br>CH1<br>CH2<br>CH3<br>CH4<br>CH5<br>CH6<br>ranging:<br>AUTO<br>UPAUTO<br>MANUAL<br>range:<br>range number 1-10                                                                                                          |
| Reply:       | none                                                                                                                                                                                                                               |
| Example:     | RANGE,CH2,MANUAL,4                                                                                                                                                                                                                 |
| Notes:       | CH1, CH3 & CH5 set the voltage ranges.<br>CH2, CH4, & CH6 set the current ranges.<br>Refer to the user manual for the range corresponding to each range number<br><br>Independent Ranging needs to be enabled to adjust CH3 – CH6. |

**RESOLU****RESOLU**

|              |                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Function:    | Set the data resolution                                                                                                                                                                                                                                                                                                                                                                                                         |                     |
| Description: | Data is returned in scientific format with exponent and mantissa. The resolution of the mantissa may be selected to be 5 digit (NORMAL) or 6 digit (HIGH) or 20 bit (BINARY).                                                                                                                                                                                                                                                   |                     |
| Format:      | RESOLU, <i>format</i>                                                                                                                                                                                                                                                                                                                                                                                                           |                     |
| Arguments:   | format:                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |
|              | NORMAL                                                                                                                                                                                                                                                                                                                                                                                                                          | (5 digit mantissa)  |
|              | HIGH                                                                                                                                                                                                                                                                                                                                                                                                                            | (6 digit mantissa)  |
|              | BINARY                                                                                                                                                                                                                                                                                                                                                                                                                          | (compressed format) |
| Reply:       | none                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |
| Example:     | RESOLU,HIGH                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |
| Notes:       | <p>Data format for NORMAL is:<br/>           [-]1.2345E[-]00</p> <p>Data format for HIGH is:<br/>           [-]1.23456E[-]00</p> <p>The sign of the mantissa and exponent are only sent if negative shown as [-] in the above examples</p> <p>BINARY format encodes each non-integer value in a proprietary 4 byte format for higher speed data transfer.</p> <p>[Further notes on data format are included in section 1.4]</p> |                     |

**RESULT****RESULT**

Function: Access results stores.

Description: Recall, store or delete results.

Format: *RESULT,function,number*

Arguments: function:  
              RECALL  
              STORE  
              DELETE  
          number  
              1-99

Reply: none

Example: RESULT,RECALL,13

Notes:

**RESULT?****RESULT?**

Function: Identify used result stores.

Description: Reads a directory of the result locations.

Format: RESULT,NAME?  
RESULT,FILES?

Arguments: none

Reply: Name of last recalled result or program  
List of names of all stored results

Example: RESULT,FILES?  
10,AMW1,18/01/2016  
11,AMW2,21/01/2016  
RESULT,RECALL,11  
RESULT,NAME?  
AMW2

Notes:

**REZERO****REZERO**

Function: Rezero front end

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

Format: REZERO

Arguments: none

Reply: none

Example: REZERO

Notes:

**SCALE****SCALE**

|              |                                                                                                                                                                                                       |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Set channel scale factor.                                                                                                                                                                             |
| Description: | Set a multiplying scale factor for a given input channel.                                                                                                                                             |
| Format:      | <i>SCALE,channel,factor</i>                                                                                                                                                                           |
| Arguments:   | channel:<br>CH1<br>CH2<br>CH3<br>CH4<br>CH5<br>CH6<br>factor:<br>multiplying scale factor                                                                                                             |
| Reply:       | none                                                                                                                                                                                                  |
| Example:     | SCALE,CH2,10                                                                                                                                                                                          |
| Notes:       | CH3 to CH6 only apply when Independent Ranging is enabled.<br><br>When Independent Ranging is disabled:<br>CH1 sets the scale for all voltage channels<br>CH2 sets the scale for all current channels |

**SCOPE?****SCOPE?**

|              |                                                                                                                                       |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Fetch raw scope data.                                                                                                                 |
| Description: | Read back raw oscilloscope data.                                                                                                      |
| Format:      | SCOPE, <i>channel?</i><br>SCOPE, <i>phase,channel?</i>                                                                                |
| Arguments:   | phase:<br>PHASE1<br>PHASE2<br>PHASE3<br>PHASE4<br>PHASE5<br>PHASE6<br>NEUTRA<br>channel:<br>VOLTAGE<br>CURRENT                        |
| Reply:       | 252 signed integers:<br>range<br>trigger<br>250 x data                                                                                |
| Example:     | HOLD,ON<br>SCOPE,PHASE1,VOLTAGE?<br>read data<br>SCOPE,PHASE2,VOLTAGE?<br>read data<br>SCOPE,PHASE3,VOLTAGE?<br>read data<br>HOLD,OFF |
| Notes:       | Group 2 must be the active group to receive data for Phase 4 to Phase 6.                                                              |

**SCREEN?****SCREEN?**

|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Read the screen data                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Description: | Returns a bit map of screen pixel display in ascii and hex format                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Format:      | SCREEN?<br>SCREEN,COLOUR?<br>SCREEN, <i>group</i><br>SCREEN,COLOUR, <i>group</i> ?                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Arguments:   | Group<br>GROUP1<br>GROUP2                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Reply:       | Multiple lines of data bit values                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Example:     | SCREEN?<br>data returned                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Notes:       | <p>SCREEN? response:<br/> 272 lines of 60 bytes in ASCII coded Hex (2 characters for each byte) preceded by #H.<br/> Each byte represents 8 dots where the lsb is the leftmost dot of the display<br/> The bit is set for on and cleared for off</p> <p>SCREEN,COLOUR? response:<br/> 1088 lines of 120 bytes preceded by #C<br/> Each line of the display is sent as four lines of data from left to right<br/> Each byte represents a single RGB dot in binary format: 0 1 r1 r0 g1 g0 b1 b0</p> |

**SHUNT****SHUNT**

|              |                                                                                                                                                                                                                                                                                          |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Set channel attenuator or shunt value                                                                                                                                                                                                                                                    |
| Description: | <p>For voltage channels, sets the attenuator value.</p> <p>For current channels, sets the resistance factor of an external current shunt to be divided into the measured voltage for a given input channel.</p>                                                                          |
| Format:      | SHUNT, <i>channel,resistance</i>                                                                                                                                                                                                                                                         |
| Arguments:   | <p>channel:</p> <p>CH1</p> <p>CH2</p> <p>CH3</p> <p>CH4</p> <p>CH5</p> <p>CH6</p> <p>resistance:</p> <p>CH1: attenuator ratio</p> <p>CH2: shunt resistance in Ohms</p>                                                                                                                   |
| Reply:       | none                                                                                                                                                                                                                                                                                     |
| Example:     | <p>SHUNT,CH1,10</p> <p>SHUNT,CH2,5</p>                                                                                                                                                                                                                                                   |
| Notes:       | <p>CH1 sets the attenuator value for all voltage channels when independent ranging is disabled.</p> <p>CH2 sets the shunt value <del>is set</del> for all current channels when independent ranging is disabled.</p> <p>Independent Ranging needs to be enabled to adjust CH3 – CH6.</p> |

**SMOOTH****SMOOTH**

|              |                                                                                                                                                                       |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Select the smoothing                                                                                                                                                  |
| Description: | Sets the filter time constant and dynamic response.                                                                                                                   |
| Format:      | <i>SMOOTH,type,dynamics</i>                                                                                                                                           |
| Arguments:   | type:<br>NONE<br>NORMAL<br>SLOW<br>dynamics:<br>AUTO<br>FIXED                                                                                                         |
| Reply:       | none                                                                                                                                                                  |
| Example:     | SMOOTH,NORMAL,FIXED<br>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.<br>FILTER is an alias for SMOOTH |

**SPEED****SPEED**

|              |                                                                                                                                                                   |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Sets the measurement speed                                                                                                                                        |
| Description: | Sets the target window size for the measurement.                                                                                                                  |
| Format:      | <i>SPEED,value&gt;window</i>                                                                                                                                      |
| Arguments:   | value:<br>VFAST (very fast)<br>FAST<br>MEDIUM<br>SLOW<br>VSLOW (very slow)<br>WINDOW                                                                              |
| Reply:       | none                                                                                                                                                              |
| Example:     | SPEED,SLOW<br>SPEED,WINDOW,0.1                                                                                                                                    |
| Notes:       | The window size argument is only needed for the WINDOW option. Enter the value is seconds.<br>The actual window size used depends on the frequency of the signal. |

**START****START**

Function: Start datalog

Description: Initiate datalog data acquisition.

Format: START

Arguments: none

Reply: none

Example: DATALOG, RAM, 0.02  
START

Notes:

**STATUS?****STATUS?**

|              |                                                                                                                                      |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Read back channel ranging status.                                                                                                    |
| Description: | Read back condition of selected channel:<br>range number (1-16)<br>range text<br>overflow/underflow status                           |
| Format:      | STATUS?                                                                                                                              |
| or:          | STATUS, <i>channel</i> ?                                                                                                             |
| Arguments:   | channel:<br>CH1<br>.<br>.<br>CH6                                                                                                     |
| Reply:       | range number,range text,over/under/ok<br>1-8<br>range as per RANGE command<br>OVER if overflow<br>LOW if underflow<br>OK if in range |
| Example:     | STATUS,CH1?<br>6,300V,OK<br>STATUS?<br>OK                                                                                            |
| Notes:       | STATUS? gives a summary value<br>reporting OK only if all channels are not<br>overrange or underrange                                |

**STOP****STOP**

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

Notes:

**SUSPEN****SUSPEN**

|              |                                                                                                                           |
|--------------|---------------------------------------------------------------------------------------------------------------------------|
| Function:    | Suspend data acquisition.                                                                                                 |
| Description: | Disable the data acquisition to maximise the communication speed.                                                         |
| Format:      | SUSPEN, <i>value</i>                                                                                                      |
| Arguments:   | value:<br>ON<br>OFF                                                                                                       |
| Reply:       | none                                                                                                                      |
| Example:     | FAST,ON<br>SUSPEN,ON<br>MULTILOG?<br>SUSPEN,OFF<br>FAST,OFF                                                               |
| Notes:       | It should be remembered that the data on the screens for both groups will not be updating with data acquisition disabled. |

**TAGREP****TAGREP**

|              |                                                                                                                                                                                                                |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Set the comms reply tag                                                                                                                                                                                        |
| Description: | When TAGREP is enabled any reply string is preceded by an identifier string in order to identify a message from a given instrument connected to a network.                                                     |
| Format:      | TAGREP, <i>setting</i>                                                                                                                                                                                         |
| Arguments:   | setting:<br>DISABLED or OFF<br>ENABLED or ON                                                                                                                                                                   |
| Reply:       | none                                                                                                                                                                                                           |
| Example:     | *ESR?<br>1<br><br>TAGREP,ON<br>*ESR?<br>PPA3560:04656:1<br><br>TAGREP,ENABLE<br>*ESR?<br>196-05099:1                                                                                                           |
| Notes:       | Using TAGREP, ON will result in a reply string preceded with the instrument type and serial number.<br><br>Using TAGREP, ENABLE will result in a reply string preceded only with the instrument serial number. |

**TORQSP****TORQSP**

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

**TORQSP?****TORQSP?**

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

**USER?****USER?**

Function: Read the user data

Description: Returns up to 3 lines of user data

Format: USER?

Arguments: none

Reply: 3 lines of ASCII terminated by CR

Example: USER?  
          Newtons4th Ltd  
          R&D department  
          KinetiQ #4

Notes:

**VARCON****VARCON**

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

**VERSIO?****VERSIO?**

|              |                                                                                           |
|--------------|-------------------------------------------------------------------------------------------|
| Function:    | Read the instrument code versions.                                                        |
| Description: | Returns an ASCII string with the details of the various parts of the instrument firmware. |
| Format:      | VERSIO?                                                                                   |
| Arguments:   | none                                                                                      |
| Reply:       | date code, type, cpu, fpga, dsp, boot type:<br>0 – 20A<br>4 – 30A                         |
| Examples:    | VERSIO?<br>KQ4715,4,2.11,2.11,2.02,2.01                                                   |
| Notes:       | This data can be displayed on the screen by pressing SYSTEM then BACK                     |

**VRMS****VRMS**

Function: Set up rms voltmeter.

Description: Set mode to rms voltmeter.

Format: VRMS

Arguments: none

Reply: none

Examples: VRMS

Notes: This has the same effect as MODE,VRMS

**VRMS?****VRMS?**

|              |                                                                                                                                                                                                                                                     |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Read true rms voltmeter results                                                                                                                                                                                                                     |
| Description: | Reads back latest voltmeter results.<br>Waits for next unread data if necessary.<br>Clears new data available status bit.                                                                                                                           |
| Format:      | VRMS, <i>phase,results?</i>                                                                                                                                                                                                                         |
| Arguments:   | results:<br>RMS<br>MEAN<br>SURGE<br>phase:<br>PHASE1<br>PHASE2<br>PHASE3<br>PHASE4<br>PHASE5<br>PHASE6<br>PHASES                                                                                                                                    |
| Reply:       | RMS:<br>6 data values separated by commas<br>Vrms,Arms,Vdc,Adc,Vac,Aac<br>MEAN:<br>6 data values separated by commas<br>Vrms,Arms,Vmean,Amean,Vff,Aff<br>SURGE:<br>8 data values separated by commas<br>Vrms,Arms,Vpk,Apk,Vcf,Acf,<br>Vsurge,Asurge |
| Example:     | VRMS,PHASE1,RMS?                                                                                                                                                                                                                                    |
| Notes:       | VRMS? without specifying the phase returns the appropriate single phase data.                                                                                                                                                                       |

**WIRING****WIRING**

|              |                                                                                                                                                                                                                                 |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Select wiring mode.                                                                                                                                                                                                             |
| Description: | Set wiring mode for computation of SUM and neutral data.                                                                                                                                                                        |
| Format:      | WIRING, <i>type</i>                                                                                                                                                                                                             |
| Arguments:   | type:<br>SINGLE (single ph 1)<br>2PHASE (2 ph 2 wattmeter)<br>3PH2WA (3 ph 2 wattmeter)<br>3PH3WA (3 ph 3 wattmeter)<br>INDPH3 (3 ph 2 wattmeter + ph3)<br>PHASE1 (single ph 1)<br>PHASE2 (single ph 2)<br>PHASE3 (single ph 3) |
| Reply:       | none                                                                                                                                                                                                                            |
| Examples:    | WIRING,PHASE2                                                                                                                                                                                                                   |
| Notes:       | WIRING,SINGLE is the same as<br>WIRING,PHASE1<br>Use GROUP1 command to set a single<br>group with four or more phases.                                                                                                          |

**XSCALE****XSCALE**

Function: Enables extended system calibration mode

Description: Enable External system scaling in the AUX menu. Select the required range (1 to 4) for each channel.

Format: Xscale,function,  
Xscale,channel,range

Arguments: Function  
Enable  
Disable

Channel:

CH1  
CH2  
CH3  
CH4  
CH5  
CH6

Range:

1 (1 ohm)  
2 (2.5 ohm)  
3 (5 ohm)  
4 (10 ohm)none

Reply: none

Example: Xscale,enable

This example enables the mode.

Xscale,CH4,2

This example loads the 2.5ohm range (range 2) for phase 2 current.

Notes:

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

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

Sending this command automatically enables independent ranging.

**ZERO****ZERO**

Function: Apply or remove the zero

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

Format: ZERO  
ZERO,DELETE

Arguments: none

Reply: none

Example: ZERO

Notes:

**ZOOM****ZOOM**

|              |                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:    | Sets the display zoom parameters.                                                                                                                                                                                                                                                                                                                                                                 |
| Description: | Sets the zoom level and data.                                                                                                                                                                                                                                                                                                                                                                     |
| Format:      | <i>ZOOM,level,data1,data2,data3,data4</i>                                                                                                                                                                                                                                                                                                                                                         |
| Arguments:   | <div>level:<ul style="list-style-type: none"><li>0 – normal</li><li>1 – zoom data larger font (zoom level 1)</li><li>2 – zoom data only (zoom level 2)</li><li>3 – first three zoom data only (zoom level 3)</li></ul></div> <div>data1-4:<ul style="list-style-type: none"><li>zoom data</li></ul></div> <div>data consists of line number for channel 1 or line number + 64 for channel 2</div> |
| Reply:       | None                                                                                                                                                                                                                                                                                                                                                                                              |
| Example:     | VRMS<br>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?****ZOOM?**

Function: Read the display zoom parameters.

Description: Reads the zoom level and data.

Format: ZOOM?

Arguments:

Reply: 5 integers separated by commas:

level:

0 – normal

1 – zoom data larger font (zoom level 1)

2 – zoom data only (zoom level 2)

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

data1-4:

zoom data

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

Example: ZOOM?

1,1,65,0,0 (level 1, ch1 rms, ch2 rms)

Notes:

### 3 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.

## PPA35xx communications manual

Phase selection:

|             |             |
|-------------|-------------|
| 1 = Phase 1 | 6 = ADI40   |
| 2 = Phase 2 | 7 = Phase 4 |
| 3 = Phase 3 | 8 = Phase 5 |
| 4 = Sum 1   | 9 = Phase 6 |
| 5 = Neutral | 10 = Sum 2  |

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

The Function ID is chosen from Appendix B which is a continually growing list due to firmware upgrades of the power analyzers at N4L, at present the PPA3500 has 99 functions:

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

Example extract from the Multilog function list

**Required Parameters**

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

**MULTILOG Pattern**

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

Command strings to sent, reference the above Multilog pattern;

MULTIL,0 // clears Multilog

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

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

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

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

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

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

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

**Step 3.**

Send Multil query and read return string.

MULTIL? // returns a comma separated string as

Example return string:

5.0000E1, 2.4500E2, 2.4320E2, 2.5421E2, 1.0232E3, 1.0152E3, 1.0546E3

|                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|  |  |  |  |  |  |  |
| Frequency                                                                         | PH1 Watts                                                                         | PH2 Watts                                                                         | PH3 Watts                                                                         | PH1 RMS Volt                                                                      | PH2 RMS Volt                                                                        | PH3 RMS Volt                                                                        |

## Appendix A – Configurable parameters

All parameters can be accessed using the CONFIG command:

CONFIG,*number,parameter*

Send GROUP,2 to access the parameters for group 2. All subsequent commands will be applied to group 2 until GROUP,1 is sent.

Note that not all parameters have a corresponding value for group 2. For example the selection of COM port is common to both groups.

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

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- 7            Frequency lock on/off, (Acquisition advance options)  
                 0=Normal  
                 1=Constant  
                 2=Dynamic
- 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 - Enter figures in seconds)
- 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

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- 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)
- 22 Independent ranging, (Range options)  
0=Disabled  
1=Enabled
- 23 Grouping (PPA3560), (ACQU options)  
1=1+2+3 : 1+2+3  
2=1+2+3 : 4+5+6  
3=1+2+3+4  
4=1+2+3+4+5  
5=1+2+3+4+5+6
- 24 Enable channel 1, (Range - voltage input)  
1=Internal  
3=External Attenuator
- 25 Enable channel 2, (Range - current input)  
1=Internal  
2=External Shunt
- 26 Input range channel 1, (Range - minimum range voltage)  
0=100mV  
1=300mV  
2=1V  
3=3V  
4=10V  
5=30V  
6=100V  
7=300V  
8=1kV  
9=3kV

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- 27 Input range channel 2, (Range – minimum range current)  
0=30mA  
1=100mA  
2=300mA  
3=1A  
4=3A  
5=10A  
6=30A  
7=100A  
8=300A  
9=1kA

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

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

30 Coupling, (Coupling)  
0=ac+dc  
1=ac  
2=dc

31 Bandwidth, (Coupling)  
0=Wide(dc-1MHz)  
1=Low (dc-200kHz)

32 Scale factor channel 1 voltage, (Ranging - Enter figures as required)

33 Scale factor channel 2 current, (Ranging - Enter figures as required)

34 External attenuator channel 1, (Ranging – voltage input - attenuator ratio  
– Enter figures as required)

35 External shunt channel 2, (Ranging – current input - resistance value  
– Enter figures as required)

36 Phase 1 noise filter, (Coupling)  
0 = Off  
1 = On

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- 37      Phase 1 noise filter frequency, (Coupling, enter frequency in Hertz)
- 38      Frequency reference voltage/current, (Acquisition control)  
         0=Voltage  
         1=Current
- 40      Frequency reference phase, (Acquisition control)  
         0=Phase 1  
         1=Phase 2  
         2=Phase 3
- 41      Display page, (Main display)  
         0=Phase 1 page  
         1=Phase 2 page  
         2=Phase 3 page  
         3=Sum page  
         4=Phase 1,2 & 3 page  
         5=Phase 1,2 & 3 fundamentals page  
         6=NEU page
- 42      Zoom level, (Main display)  
         0=Zoom level 0  
         1=Zoom level 1  
         2=Zoom level 2 – 4 figures  
         3=Zoom level 3 – 3 figures
- 47      Datalog display type, (Datalog display information mode)  
         0=Real Time  
         1=Table  
         2=Graph
- 48      Manual frequency, (Acqu advanced options – frequency in Hertz)
- 49      DFT selectivity, (Acqu advance options)  
         0=Normal  
         1=Narrow
- 50      Program 1-4 direct load, (System options)  
         0=Disabled  
         1=Enabled

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- 51      Language, (System options)  
         0=English  
         1=Other language if installed
- 52      Frequency filter, (Acquisition control)  
         0=Disabled  
         1=Enabled, fundamental>1kHz  
         2=Enabled, fundamental<1kHz
- 53      Phase reference, (Acquisition control)  
         0=Voltage  
         1=Current
- 58      Datalog memory type, (Datalog)  
         0=Disabled  
         1=RAM  
         2=Internal  
         3=USB Memory stick
- 59      Datalog Interval, (Datalog) (Enter interval time figure in seconds)
- 60      Datalog graph, (Datalog-RAM)  
         0=Together  
         1=Separate
- 61      Formula, (Maths)  
         0=Disabled  
         1=(term1 + term2/term3 + term4)  
         2=(term1 + term2) x term3/term4  
         3=term1 x term2/(term3 + term4)  
         4=(term1 + term2 + term3)/term4
- 62      Argument term 1  
         0=Disabled  
         1=Constant  
         2=Voltage  
         3=Current  
         6=Frequency  
         7=Power

- 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  
             6=Frequency  
             7=Power
- 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        Low frequency mode minimum frequency, (Enter value)
- 70        Application mode,  
             0=Normal  
             1=PWM  
             2=Lighting ballast  
             3=Inrush current  
             4=Transformer mode  
             5=Standby power  
             6=Calibration mode

- 71        PWM Frequency filter, (Application options mode – PWM motor drive)  
             0=4kHz  
             1=1kHz  
             2=250Hz  
             3=64Hz  
             4=250kHz  
             5=64kHz  
             6=16kHz
- 72        Frequency tracking speed, (Application options mode - Lighting Ballast)  
             0=Fixed time  
             1=Fast  
             2=Medium  
             3=Slow
- 73        PWM low frequency, (Application options mode)  
             0=Off  
             1=On
- 74        Argument term 3  
             0=Disabled  
             1=Constant  
             2=Voltage  
             3=Current  
             6=Frequency  
             7=Power
- 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  
         6=Frequency  
         7=Power
- 78      Sub argument term 4, (For voltage and current arguments only)  
         0=rms  
         1=dc  
         2=ac  
         3=Fundamental  
         4=Peak  
         5=Mean  
         6= Ph-Ph rms  
         7=Ph-Ph mag
- 79      Term 4 coefficient, (Enter value)
- 82      Wiring configuration, (Acquisition control)  
         0=Single phase 1  
         1=2 phase 2 wattmeter  
         2=3 phase 2 wattmeter  
         3=3 phase 3 wattmeter  
         4=Single phase 2  
         5=Single phase 3  
         6=3 phase 2 wattmeter + PH3
- 83      Integration, (Mode - Power integrator)  
         0=Signed  
         1=Magnitude
- 84      Torque + speed, (Application options – PWM motor drive)  
         0=Disabled  
         1=Analogue speed  
         2=Pulsed speed  
         3=Pulsed Torque  
         4=Pulsed
- 85      Torque scaling Nm/V, (Applications – PWM motor drive) (Also transformer  
         scale factor Deg/v)(Enter Nm/v value)

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- 86      Speed scaling RPM/V, (Applications – PWM motor drive)(Enter rpm/v value)
- 87      Pulses per revolution, (Applications–PWM motor drive)(Enter pulses/rev value)
- 88      Integration display, (Mode - Power integrator)  
         0=Total  
         1=Average
- 89      Sum current average, (Power analyzer)  
         0=Total  
         1=Average
- 90      Input compensation, (Mode)  
         0=Disabled  
         1=Enabled
- 91      Power factor sign, (Power analyzer)  
         0=Negative lagging  
         1=Negative leading
- 92      VAr sign, (Power analyzer)  
         0=Negative lagging  
         1=Negative leading
- 93      Efficiency computation, (Power analyzer)  
         0=Disabled  
         1=Phase / next  
         2=Next / Phase  
         3=group2/group  
         4=group1/group2  
         5=mechanical/sum  
         6=sum/mechanical  
         7=Phase 3/Sum  
         8=Sum/Phase 3
- 94      Torque offset, (Mode – value in Volts)
- 95      Speed offset, (Mode – value in Volts)

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- |     |                                                                                                                                                                                                                  |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 97  | Equipment (Voltage) rating for Harmonic Factor,<br>(Harmonic mode – value in Volts)                                                                                                                              |
| 99  | Computation mode, (Harmonic analyzer)<br>0=Difference formula<br>1=Harmonic series<br>2=TIF<br>3=THF<br>4=TRD<br>5=TDD<br>6=Series harmonic phase<br>7=Difference formula<br>8=Harmonic RMS<br>9=Harmonic factor |
| 100 | Selected harmonic, (Harmonic analyzer - figure = harmonic required)                                                                                                                                              |
| 101 | Harmonic series up to, (Harmonic analyzer - figure = harmonic max)                                                                                                                                               |
| 102 | Voltage bargraph scale, (Harmonic analyzer - figure = % required)                                                                                                                                                |
| 103 | Equipment (Current) rating (TRD / Harmonic Factor),<br>(Harmonic analyzer – TRD / Harmonic factor modes – enter figure)                                                                                          |
| 104 | Current bargraph scale, (Harmonic analyzer - figure = % required)                                                                                                                                                |
| 106 | Timebase, (Scope - Enter figure/div)                                                                                                                                                                             |
| 107 | trigger level, (Scope - Enter figure/div)                                                                                                                                                                        |
| 108 | Pretrigger, (Scope)<br>0=None<br>1=25%<br>2=50%<br>3=75%                                                                                                                                                         |
| 109 | trigger polarity, (Scope)<br>0=Rising edge<br>1=Falling edge                                                                                                                                                     |

- 110      trigger Mode, (Scope)
  - 0=Auto
  - 1=Normal
  - 2=Single shot
  
- 111      trigger reference, (Scope)
  - 0=Voltage
  - 1=Current
  
- 113      cursors enable, (Scope)
  - 0=Off
  - 1=On
  
- 114      trigger HF reject, (Scope)
  - 0=Off
  - 1=On
  
- 115      Trace, (Scope)
  - 0=Dual
  - 1=Voltage
  - 2=Current
  - 3=Together
  
- 117      DFT phase angle ref, (System)
  - 0=Cosine
  - 1=Sine
  
- 119      Zoom 2 high resolution, (System)
  - 0=Disabled
  - 1=Enabled
  
- 120      Brightness, (System)
  - 0=Low
  - 1=High
  
- 122      Auxiliary device, (Aux control)
  - 0=None
  - 6=PCIS
  - 10=ADI40-4
  - 11=ADI40-8
  - 12=ADI40-12
  - 13=ADI40-16

- 128      Switch phase offset, (Aux control – PCIS device)  
            0=0°  
            1=45°  
            2=90°  
            3=135°  
            4=180°  
            5=225°  
            6=270°  
            7=315°
- 129      Switch on cycles, (Aux control – PCIS device)  
            0=Single cycle  
            1=Continuous  
            2=Half cycle
- 131      Sum VA & VAR computation, (Power Analyser)  
            0=Low distortion  
            1=High Distortion
- 132      Integrator-run time (Hours), (Mode – Power integrator - enter figure)
- 133      Integrator-Run time (mins), (Mode - Power integrator – enter figure)
- 134      Ph – Ph Measurement (Conversion), (Power analyser)  
            0=rms  
            1=Mean  
            2=star-delta  
            3=delta-star
- 135      Difference THD, (Power analyser – penultimate line - Vthd)  
            0=Disabled  
            1=Enabled including dc  
            2=Enabled excluding dc
- 137      Parameter, (Impedance analyzer)  
            0=Auto  
            1=Capacitance  
            2=Inductance  
            3=Impedance

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- 138      **Measurement,** (Impedance analyzer)  
            0=Series  
            1=Parallel
- 139      **Phase offset,** (Impedance analyzer - Enter figures)
- 140      **Voltage peak,** (rms voltmeter)  
            0=Signed  
            1=Separate  
            2=Unfiltered
- 143      **Last Line,** (rms voltmeter)  
            0=Disabled  
            1=Crest Factor  
            2=Form Factor  
            3=Maths Function
- 144      **Rectified mean,** (rms voltmeter)  
            0=Absolute  
            1=Normalised
- 150      **Computation,** (Phase meter)  
            0=ch2/ch1  
            1=ch1/ch2
- 152      **RS232 printer enable,** (Remote options)  
            0=Disabled  
            1=USB memory stick  
            2=RS232 (DPU-414)  
            3=RS232 (DPU-D2)
- 153      **GPIB IEEE Address(1-30),** (Remote options)
- 154      **Interface,** (Remote options)  
            0=RS232  
            1=USB  
            2=LAN  
            3=GPIB

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

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- 169 Alarm 2 high threshold, (Alarm options – alarm if high – enter figure)
- 170 Alarm 2 low threshold, (Alarm options – alarm if low – enter figure)
- 176 Enable channel 3, (Range–voltage input)(Range - independent ranging enabled)  
1=Internal  
3=External Attenuator
- 177 Enable channel 4, (Range – current input)(Range - independent ranging) enabled)  
1=Internal  
2=External Shunt
- 178 Input range channel 3, (Range – minimum range voltage)  
(Range - independent ranging enabled)  
0=100mV  
1=300mV  
2=1V  
3=3V  
4=10V  
5=30V  
6=100V  
7=300V  
8=1kV  
9=3kV
- 179 Input range channel 4, (Range – minimum range current)  
(Range - independent ranging enabled)  
0=30mA  
1=100mA  
2=300mA  
3=1A  
4=3A  
5=10A  
6=30A  
7=100A  
8=300A  
9=1kAA
- 180 Input ranging channel 3, (Range – autoranging voltage) (Range independent ranging enabled)  
0=Full Autorange  
1=Range up only  
2=Manual

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- |     |                                                                                                                                                |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------|
| 181 | Input ranging channel 4, (Range – autoranging current) (Range independent ranging enabled)<br>0= Full Autorange<br>1=Range up only<br>2=Manual |
| 182 | Coupling phase 2, (Coupling) (independent input control enabled)<br>0=ac +dc<br>1=ac<br>2=dc                                                   |
| 184 | Scale factor channel 3 voltage, (Ranging - Enter figures as required)<br>(Range - independent ranging enabled)                                 |
| 185 | Scale factor channel 4 current, (Ranging - Enter figures as required)<br>(Range - independent ranging enabled)                                 |
| 186 | External attenuator channel 3,(Ranging – voltage input - attenuator ratio<br>-Enter figures as required)(Range - independent ranging enabled)  |
| 187 | External shunt channel 4, (Ranging – current input – resistance value<br>Enter figures as required) (Range - independent ranging enabled)      |
| 188 | Phase 2 noise filter, (Coupling)(Independent input control –phase 2 selected)<br>0 = Off<br>1 = On                                             |
| 196 | ID tag prepends comms replies<br>0 = Off<br>1 = On                                                                                             |
| 197 | High speed mode<br>0 = Disabled<br>1 = Enabled                                                                                                 |
| 200 | Enable channel 5, (Range – voltage input) (Range – independent ranging enabled)<br>1=Internal<br>3=External Attenuator<br>5=Torque             |
| 201 | Enable channel 6, (Range – current input) (Range - independent ranging enabled)<br>1=Internal<br>2=External Shunt                              |

- 202**      Input range channel 5, (Range – minimum range voltage) (Range  
                                                                                                 - independent ranging enabled)

  - 0=100mV
  - 1=300mV
  - 2=1V
  - 3=3V
  - 4=10V
  - 5=30V
  - 6=100V
  - 7=300V
  - 8=1kV
  - 9=3kV

**203**      Input range channel 6, (Range – minimum range current) (Range  
                                                                                                 - independent ranging enabled)

  - 0=30mA
  - 1=100mA
  - 2=300mA
  - 3=1A
  - 4=3A
  - 5=10A
  - 6=30A
  - 7=100A
  - 8=300A
  - 9=1kA

**204**      Input ranging channel 5, (Range – autoranging voltage) (Range  
                                                                                                 independent ranging enabled)

  - 0=Full Autorange
  - 1=Range up only
  - 2=Manual

**205**      Input ranging channel 6, (Range – autoranging current) (Range –  
                                                                                                 independent ranging enabled)

  - 0= Full Autorange
  - 1=Range up only
  - 2=Manual

**206**      Coupling phase 3, (Coupling -independent input control enabled)

  - 0=ac +dc
  - 1=ac
  - 2=dc

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- |     |                                                                                                                                  |
|-----|----------------------------------------------------------------------------------------------------------------------------------|
| 208 | Scale factor channel 5 voltage, (Ranging - Enter figures as required)<br>(Range - independent ranging enabled)                   |
| 209 | Scale factor channel 6 current, (Ranging - Enter figures as required)<br>(Range - independent ranging enabled)                   |
| 210 | External attenuator channel 5, (Ranging - voltage input - attenuator ratio<br>as required) (Range - independent ranging enabled) |
| 211 | External shunt channel 6, (Ranging - current input - resistance value<br>as required) (Range - independent ranging enabled)      |
| 212 | Phase 3 noise filter, (Coupling)(Independent input control -phase 3 selected)<br>0 = Off<br>1 = On                               |
| 220 | Reference Group, (Datalog)<br>0 = Group 1<br>1 = Group 2                                                                         |
| 231 | Memory, (Program)<br>0=Internal<br>1=USB Memory stick                                                                            |
| 232 | Data, (Program)<br>0=Program<br>1=Results<br>2=Datalog                                                                           |
| 233 | Action, (Program)<br>0=Recall<br>1=Store<br>2=Delete                                                                             |
| 234 | Location, (Program - Enter figures as required)                                                                                  |
| 240 | set clock (hrs) (System clock)                                                                                                   |
| 241 | set clock (mins) (System clock)                                                                                                  |
| 242 | set clock (secs) (System clock)                                                                                                  |
| 243 | set date (day) (System clock)                                                                                                    |

- 244      set date (month) (System clock)
- 245      set clock (year) (System clock)

**Appendix B – MULTIL parameters**

| function | measurement                          | notes           |
|----------|--------------------------------------|-----------------|
| 1        | frequency                            |                 |
| 2        | watts                                |                 |
| 3        | VA                                   |                 |
| 4        | VAr                                  |                 |
| 5        | power factor                         |                 |
| 6        | fundamental watts                    |                 |
| 7        | fundamental VA                       |                 |
| 8        | fundamental VAr                      |                 |
| 9        | fundamental PF                       |                 |
| 10       | harmonic watts                       |                 |
| 11       | harmonic watts %                     |                 |
| 12       | impedance                            | Imp meter mode  |
| 13       | resistance                           | Imp meter mode  |
| 14       | reactance                            | Imp meter mode  |
| 15       | impedance phase                      | Imp meter mode  |
| 16       | efficiency                           |                 |
| 17       | fundamental efficiency               |                 |
| 18       | maths                                |                 |
| 19       | integrated watts                     | integrator mode |
| 20       | integrated VA                        | integrator mode |
| 21       | integrated VAr                       | integrator mode |
| 22       | integrated rms current               | integrator mode |
| 23       | average power factor                 | integrator mode |
| 24       | integrated fundamental watts         | integrator mode |
| 25       | integrated fundamental VA            | integrator mode |
| 26       | integrated fundamental VAr           | integrator mode |
| 27       | integrated fundamental current       | integrator mode |
| 28       | average fundamental power factor     | integrator mode |
| 29       | average integrated watts             | integrator mode |
| 30       | average integrated VA                | integrator mode |
| 31       | average integrated VAr               | integrator mode |
| 32       | average integrated fundamental watts | integrator mode |
| 33       | average integrated fundamental VA    | integrator mode |
| 34       | average integrated fundamental VAr   | integrator mode |
| 35       | average rms voltage                  | integrator mode |
| 36       | average fundamental voltage          | integrator mode |
| 37       | Standby mode frequency               |                 |
| 38       | DC watts                             |                 |
| 39       | average rms current                  | integrator mode |

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|    |                                    |                  |
|----|------------------------------------|------------------|
| 40 | average fundamental current        | integrator mode  |
| 41 | delta watts                        |                  |
| 42 | fundamental delta watts            |                  |
| 43 | elapsed time                       | integrator mode  |
| 44 | LCR resistance                     | Imp meter mode   |
| 45 | LCR inductance                     | Imp meter mode   |
| 46 | LCR capacitance                    | Imp meter mode   |
| 47 | LCR tan delta                      | Imp meter mode   |
| 48 | Q factor – see notes               | Imp meter mode   |
| 48 | k-factor – see notes               | Transformer mode |
| 49 | Corrected Power                    | Transformer mode |
| 50 | rms voltage                        |                  |
| 51 | rms current                        |                  |
| 52 | fundamental voltage                |                  |
| 53 | fundamental current                |                  |
| 54 | voltage phase                      |                  |
| 55 | current phase                      |                  |
| 56 | harmonic voltage                   |                  |
| 57 | harmonic current                   |                  |
| 58 | dc voltage                         |                  |
| 59 | dc current                         |                  |
| 60 | ac voltage                         |                  |
| 61 | ac current                         |                  |
| 62 | peak voltage                       |                  |
| 63 | peak current                       |                  |
| 64 | voltage crest factor               |                  |
| 65 | current crest factor               |                  |
| 66 | rectified mean voltage             |                  |
| 67 | rectified mean current             |                  |
| 68 | voltage form factor                |                  |
| 69 | current form factor                |                  |
| 70 | voltage harmonic                   | harmonic mode    |
| 71 | current harmonic                   | harmonic mode    |
| 72 | voltage harmonic percentage        | harmonic mode    |
| 73 | current harmonic percentage        | harmonic mode    |
| 74 | voltage thd                        | harmonic mode    |
| 75 | current thd                        | harmonic mode    |
| 76 | voltage tif                        | harmonic mode    |
| 77 | current tif                        | harmonic mode    |
| 78 | phase to phase rms voltage         |                  |
| 79 | phase to phase fundamental voltage |                  |
| 80 | phase to phase voltage phase angle |                  |
| 81 | phase to phase rms voltage         |                  |

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|    |                                  |                  |
|----|----------------------------------|------------------|
| 82 | voltage surge                    |                  |
| 83 | current surge                    |                  |
| 84 | voltage rms deviation            | transformer mode |
| 85 | voltage fundamental deviation    | transformer mode |
| 86 | voltage phase deviation          | transformer mode |
| 87 | voltage positive peak            |                  |
| 88 | current positive peak            |                  |
| 89 | voltage negative peak            |                  |
| 90 | current negative peak            |                  |
| 91 | voltage positive peak unfiltered |                  |
| 92 | current positive peak unfiltered |                  |
| 93 | voltage negative peak unfiltered |                  |
| 94 | current negative peak unfiltered |                  |
| 95 | In-phase component of voltage    |                  |
| 96 | Quadrature component of voltage  |                  |
| 97 | In-phase component of current    |                  |
| 98 | Quadrature component of current  |                  |
| 99 | reserved for future expansion    |                  |

### Notes:

**Functions 78 and 81 are the same.**

Function 48 is used to measure Q-factor in Impedance meter mode  
AND measure Corrected Power in Transformer mode.

Phase selection:

|             |             |
|-------------|-------------|
| 1 = Phase 1 | 6 = ADI40   |
| 2 = Phase 2 | 7 = Phase 4 |
| 3 = Phase 3 | 8 = Phase 5 |
| 4 = Sum 1   | 9 = Phase 6 |
| 5 = Neutral | 10= Sum 2   |

There are some special functions:

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

Notes:

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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 individual special function measurements:

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

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

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

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