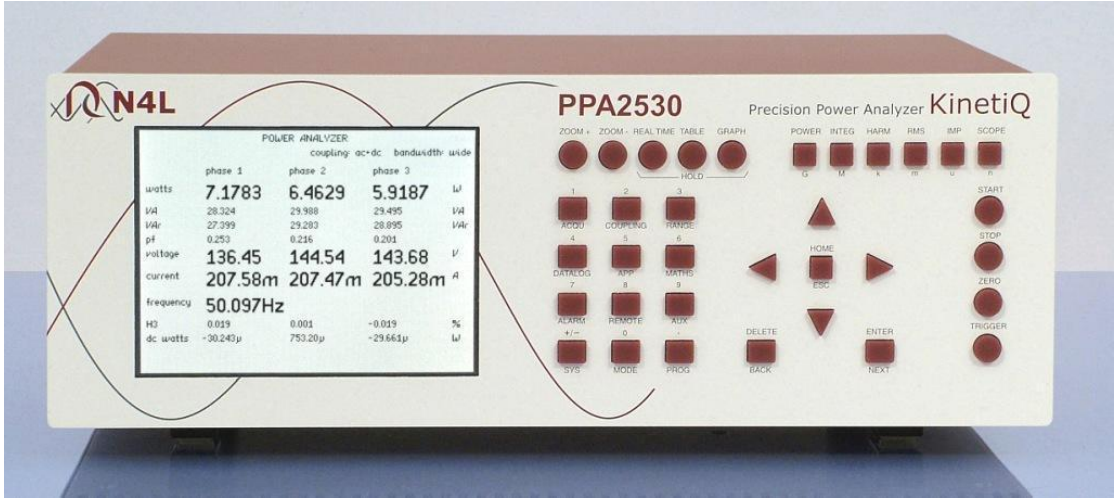
Newtons4th Ltd

PPA2500
PPA2600

KinetiQ

Communications manual



Firmware v1.100

10th April 2017

IMPORTANT SAFETY INSTRUCTIONS

This equipment is designed to comply with BSEN 61010-1 (2001) (Safety requirements for electrical equipment for measurement, control, and laboratory use) – observe the following precautions:

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

Note: Newtons4th Ltd. shall not be liable for any consequential damages, losses, costs or expenses arising from the use or misuse of this product however caused.

ABOUT THIS MANUAL

This manual gives details of the communication commands recognized by the PSM25/26xx series of instruments over RS232, USB, LAN or GPIB. For more general operating instructions for the instrument refer to the specific user manual.

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

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

Revision 1.100

10th April 2017

CONTENTS

1 Using remote control

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

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

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

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

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

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

FQREF,CURRENT;POWER?

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

The instrument maintains an error status byte consistent with the requirements of the IEEE488.2 protocol (called the standard event status register) that can be read by the mandatory command *ESR? (see section 5.1).

The instrument also maintains a status byte consistent with the requirements of the IEEE488.2 protocol, that can be read either with the IEEE488 serial poll function or by the mandatory command *STB? over RS232 or IEEE or LAN (see section 5.2).

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

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

RS232 data format is: start bit, 8 data bits (no parity), 1 stop bit. Flow control is RTS/CTS (see section 5.2), baud rate is selectable via the MONITOR menu.

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

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

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

1.1 Standard event status register

PON		CME	EXE	DDE	QYE		OPC

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

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

1.2 Serial Poll status byte

		ESB	MAV	ALA			RDV

bit 0 RDV (result data available)
set when results are available to be read as enabled by DAVER

bit 3 ALA (alarm active)
set when an alarm is active and enabled by ALARMER

bit 4 MAV (message available)
set when a message reply is waiting to be read

bit 5 ESB (standard event summary bit)
set if any bit in the standard event status register is set as well as the corresponding bit in the standard event status enable register (set by *ESE).

1.3 RS232 connections

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

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

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

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

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

1.4 Data format

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

+1.2345+E00
+1.23456+E00

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

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

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

Value = (mantissa / 2^20) x 2^exponent x -1^sign

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

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

2 Communication commands

*CLS *CLS

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

***ESE** ***ESE**

Function: Set standard event status enable register.

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

Format: *ESE, value

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

Reply: can be read by *ESE?

Example: *ESE, 60

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

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

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

***ESR?** ***ESR?**

Function:	Standard event status register query
Description:	Returns the contents of the *standard event status register* and clears it.
Format:	*ESR?
Arguments:	none
Reply:	decimal equivalent of bits in standard event status register
Example:	*ESR? 33
Notes:	The following bits in the standard event status register have been implemented: bit 0 OPC (operation complete) bit 2 QYE (unterminated query error) bit 3 DDE (device dependent error) bit 4 EXE (execution error) bit 5 CME (command interpretation error) bit 7 PON (power on event) For example, if a command is sent incorrectly and is not recognised, the CME bit will be set and the value of 33 will be returned.

***IDN?** ***IDN?**

Function:	Identify query
Description:	Returns a standard format identification string.
Format:	*IDN?
Arguments:	none
Reply:	An ASCII string in the IEEE488.2 format: manufacturer,model,serial no,version
Example:	*IDN? NEWTONS4TH,PPA2530 KinetiQ, 01234,1.00
Notes:	

***OPC?** ***OPC?**

Function:	Test for operation complete
Description:	Returns 1 if previous operation is completed, 0 if not.
Format:	*OPC?
Arguments:	none
Reply:	0 or 1
Example:	START *OPC? 0 *OPC? 0 *OPC? 1
Notes:	*OPC? can be used to indicate when data is available or when a frequency sweep has completed.

***RST** ***RST**

Function:	Reset
Description:	Resets the instrument to the default state and clears the *standard event status register*.
Format:	*RST
Arguments:	none
Reply:	none
Example:	*RST
Notes:	The *RST command loads the default configuration. This is the same as loading the default configuration via the PROGRAM menu. Any preceding setup commands will be overwritten.

***SRE** ***SRE**

Function:	Set service request enable register.
Description:	Enable which bits of the *status byte register* initiate a service request.
Format:	*SRE, value
Arguments:	decimal equivalent of bits in status byte register
Reply:	can be read by *SRE?
Example:	*SRE, 1 generate a service request when data available.
Notes:	

***SRE?** ***SRE?**

Function:	Read service request enable register.
Description:	Read back the present setting of the service request enable register.
Format:	*SRE?
Arguments:	
Reply:	decimal equivalent of bits in status byte register that would generate a service request.
Example:	*SRE? 1
Notes:	

***STB?** ***STB?**

Function:	Read serial poll status byte
Description:	Returns the decimal value of the serial poll status byte.
Format:	*STB?
Arguments:	none
Reply:	decimal value of the serial poll status byte
Example:	*STB? 1
Notes:	The following bits in the serial poll status register have been implemented: bit 0 RDV (results data available) bit 3 ALA (alarm active) bit 4 MAV (message available) bit 5 ESB (standard event summary bit)

***TRG** ***TRG**

Function:	Trigger
Description:	Initiates a new measurement, resets the range and smoothing.
Format:	*TRG
Arguments:	none
Reply:	none
Example:	MODE,VRMS *TRG VRMS,SURG?
Notes:	

***TST?** ***TST?**

Function:	Self test query
Description:	Returns the results of self test
Format:	*TST?
Arguments:	none
Reply:	single integer bit 0 – set if uncalibrated bit 1 – set if error with analogue zero > 15 – major system error
Example:	*TST? 0
Notes:	

***WAI** ***WAI**

Function:	Wait for operation complete
Description:	Suspends communication until the previous operation has completed
Format:	*WAI
Arguments:	none
Reply:	none
Example:	*TRG *WAI POWER,PHASE1?
Notes:	

ABORT **ABORT**

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

Notes:

ALARM **ALARM**

Function: Set common controls for alarm1 and alarm2.

Description: Set the alarm latch and sounder control.

Format: ALARM,*latch,sounder*

Arguments: latch:
ON
OFF
sounder:
ENABLED
DISABLED

Reply: none

Example: ALARM,ON,DISABLED

Notes:

ALARM? **ALARM?**

Function: Read alarm status.

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

Format: ALARM?

Arguments: none

Reply: single integer

bit 0 data available
bit 1 data error
bit 2 alarm 1
bit 3 alarm 2

Example: ALARM?

1

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

ALARM1 **ALARM1**

Function: Set parameters for alarm1.

Description: Set alarm1 type and thresholds.

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

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

Reply: none

Example: ALARM1,HIGH,1,2,0

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

ALARM2 **ALARM2**

Function: Set parameters for alarm2.

Description: Set alarm2 type and thresholds.

Format: ALARM2,*type,data,high,low*

Arguments: type:
- DISABLED
- HIGH
- LOW
- INSIDE
- OUTSIDE

data
- 1-4 for zoom data

high:
- high threshold

low:
- low threshold

Reply: None

Example: ALARM2,LOW,3,0,0.5

Notes: Both thresholds must be sent even if only one is used.
There is no LINEAR option for alarm 2.

ALARME **ALARME**

Function: Set alarm status enable register

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

Format: ALARME,*value*

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

Reply: none

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

Notes: default value is 0

ALARME? **ALARME?**

Function:	Read alarm status enable register
Description:	Read back present bits in the alarm status enable register which controls the alarm active bit in the status byte.
Format:	ALARME?
Arguments:	none
Reply:	decimal equivalent of alarm bits
Example:	ALARME? 12
Notes:	

APPLIC **APPLIC**

Function: Select application mode.

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

Format: APPLIC*,type,setting*

Arguments: type:

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

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

Reply: none

Example: APPLIC,POWERT
APPLIC,PWM,1

Notes:

BANDWI **BANDWI**

Function: Select bandwidth.

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

Format: BANDWI,*phase,type*

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

Reply: none

Example: BANDWI,WIDE

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

BANDWI? **BANDWI?**

Function: Read bandwidth setting.

Description: Returns a numerical value for the bandwidth setting.

Format: BANDWI,*phase?*

Arguments: phase:
PHASE1
PHASE2
PHASE3

Reply: 0 = WIDE
1 = LOW
2 = DCONLY

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

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

BEEP **BEEP**

Function:	Sound the buzzer
Description:	Makes a “beep” from the instrument.
Format:	BEEP
Arguments:	none
Reply:	none
Example:	BEEP
Notes:	

BLANKI **BLANKI**

Function: Select blanking

Description: Enable or disable low value blanking.

Format: BLANKI,*value*

Arguments: value:
ON
OFF

Reply: none

Example: BLANKI,OFF

Notes:

CALVER **CALVER**

Function: Load a calibration verification string.

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

Format: CALVER,*string*

Arguments: *string* is any sequence of printable alpha numeric characters. Use the underscore character to add a space between words. CALVER without a string argument clears the previously stored string.

Reply: none

Example: CALVER,12_DEC_2008_AMW

Notes: As all white space is stripped from any communications string, the underscore character (ASCII 95 or 0x5F) must be used to space out the words. Underscore is shown as a space on the screen.

CALVER? **CALVER?**

Function: Read back the calibration verification string.

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

Format: CALVER?

Arguments: none.

Reply: alphanumeric string

Example: CALVER?
12_DEC_2008_AMW

Notes:

CONFIG **CONFIG**

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

CONFIG? **CONFIG?**

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

COUPLI **COUPLI**

Function: Set ac or ac+dc coupling.

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

Format: COUPLI,*phase*,*coupling*

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

Reply: none

Example: COUPLI,PHASE2,AC+DC

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

COUPLI? **COUPLI?**

Function: Read ac/dc coupling setting.

Description: Returns a numerical value for the coupling setting.

Format: COUPLI,*phase*,*coupling*

Arguments: phase:
PHASE1
PHASE2
PHASE3

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

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

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

DATALO **DATALO**

Function: Set up datalog

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

Format: DATALO,*function,interval,speed*

Arguments:
function:
- DISABLE
- RAM
- NONVOL
- RECALL
- DELETE

interval:
- datalog interval in seconds

speed:
- HIGH

Reply: none

Example:
DATALOG,NONVOL,10
DATALOG,RAM,0,HIGH

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

DATALO? **DATALO?**

Function: Read back datalog results

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

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

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

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

Example:
```
DATALOG,NONVOL,10
START
wait for datalog
STOP
DATALOG,LINES?
30
DATALOG,21,3?
21,2.0000E-1,1.2345E0
22,2.1000E-1,5.6789E3
23,2.2000E-1,1.2345E0
```

Notes: if no arguments are sent then DATALOG? returns all the available lines of data

DAV? **DAV?**

Function: Data available query

Description: Returns data availability status.

Format: DAV?

Arguments: none

Reply: Decimal equivalent of data available bits:

bit0	new data available
bit1	data available
bit2	harmonic series data available
bit3	efficiency data available
bit6	integration data available
bit7	datalog data available

Example:

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

Notes: DAV? does not modify the status bits.

DAVER **DAVER**

Function: Set data available enable register

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

Format: DAVER,*value*

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

Reply: none

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

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

DAVER? **DAVER?**

Function:	Read data available enable register
Description:	Read back present setting of the data available enable register, which controls the status bits that set the data available bits in the status byte.
Format:	DAVER?
Arguments:	none
Reply:	decimal equivalent of bits
Example:	DAVER? 4
Notes:	

DISPLAY **DISPLAY**

Function: Set the display page

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

Format: DISPLAY,*page*

Arguments: page:

- PHASE1
- PHASE2
- PHASE3
- SUM
- NEUTRAL
- TOTAL
- FUNDAMENTAL
- VOLTAGE
- CURRENT

Reply: None

Example: DISPLAY,FUNDAMENTAL

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

DISPLAY? **DISPLAY?**

Function:	Read the displayed data
Description:	Returns all the values presently on the screen.
Format:	DISPLAY?
Arguments:	none
Reply:	Multiple floating point values separated by commas
Example:	DISPLAY?
Notes:	

EFFICI **EFFICI**

Function: Set efficiency calculation

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

Format: EFFICI,*formula*

Arguments: formula:

0 – disabled
1 – phase 1 / phase 2
2 – phase 2 / phase 1
3 – slave / master
4 – master /slave
5 – mechanical sum
6 – sum / mechanical
7 – phase 3 / sum
8 – sum /phase

Reply: none

Example: EFFICIENCY,2

Notes:

EFFICI? **EFFICI?**

Function:	Read efficiency result
Description:	Reads back the total and fundamental efficiency results.
Format:	EFFICI?
Arguments:	none
Reply:	2 data values separated by commas: total, fundamental
Example:	EFFICI? data returned
Notes:	

FAST **FAST**

Function: Set fast communications mode.

Description: Disables the screen drawing for high speed operation.

Format: FAST,*value*

Arguments: value:
ON
OFF

Reply: none

Example: FAST,ON

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

FQLOCK **FQLOCK**

Function: Lock frequency.

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

Format: FQLOCK,*value*

Arguments: value:
ON
OFF
Normal
Constant
Dynamic

Reply: none

Example: FQLOCK,ON
FQLOCK,Dynamic
FQLOCK,Normal

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

ON is the same as CONSTANT
OFF is the same as NORMAL

FQREF **FQREF**

Function: Set frequency reference.

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

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

Arguments: channel:
- voltage
- current
- speed

phase:
- PHASE1
- PHASE2
- PHASE3

Reply: none

Example: FQREF,CURRENT

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

FREQUE **FREQUE**

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

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	Series harmonic phase

harmonic:
individual harmonic for display
max:
length of harmonic series (to 100)

Reply: none

Example: HARMON,THDS,3,50

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

HARMON? **HARMON?**

Function: Harmonic analyser query

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

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

Arguments: phase:
PHASE1
PHASE2
PHASE3
NEUTRAL
PHASES

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

Example: HARMON,PHASE2?
data returned

Notes: HARMON? waits for next unread data.

HOLD **HOLD**

Function: Set data hold

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

Format: HOLD,state

Arguments: state:
ON
OFF

Reply: none

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

Notes:

INPUT **INPUT**

Function:	Set input mode
Description:	Selects the input type of the instrument
Format:	INPUT,*channel*,*type*
Arguments:	channel: CH1 CH2 type: INTERN EXTATT EXTSHU
Reply:	none
Example:	INPUT,CH1,EXTSHU
Notes:	CH1 applies to all voltage channels CH2 applies to all current channels

INTEGR **INTEGR**

Function: Set integrated power mode.

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

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

Arguments:
type:
SIGNED
MAGNITUDE
display:
TOTAL
AVERAGE
hours:
integer
minutes:
integer

Reply: none

Example: INTEGR,MAGNITUDE,TOTAL

Notes:

INTEGR? **INTEGR?**

Function: Read integrated power mode.

Description: Read integrated power mode for the selected phase.

Format: INTEGR,*phase?*

Arguments: phase:
PHASE1
PHASE2
PHASE3
PHASES
SUM

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

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

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

KEYBOA **KEYBOA**

Function: Disable front panel keyboard.

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

Format: KEYBOARD*,value*

Arguments: value:
ENABLE
DISABLE

Reply: none

Example: KEYBOARD,DISABLE

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

LCR **LCR**

Function: Set LCR meter mode.

Description: Set LCR mode and conditions.

Format: LCR,*parameter*

Arguments: parameter:
AUTO
CAPACITANCE
INDUCTANCE
IMPEDANCE

Reply: none

Example: LCR,IMPEDA

Notes:

LCR? **LCR?**

Function: LCR meter query

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

Format: LCR,*phase*?

Arguments: phase:
PHASE1
PHASE2
PHASE3
PHASES

Reply: 11 data values separated by commas:
freq, Vmag, Amag, impedance,
phase, R, C, L, tanδ, Qf, reactance

Example: LCR,IMPEDA
LCR,PHASES?
data returned

Notes: LCR? waits for next unread data.
LCR? without specifying the phase returns the appropriate single phase data.

LOWFRE **LOWFRE**

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

MODE **MODE**

Function: Set mode

Description: Sets the basic operating mode of the instrument.

Format: MODE,*type*

Arguments: type:

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

Reply: none

Example: MODE,LCR

Notes:

MSLAVE **MSLAVE**

Function: Set master/slave mode

Description: Enables the instrument to synchronise with a second instrument to simultaneously measure up to 6 phases.

Format: MSLAVE,*type*

Arguments: type:
DISABLE
MASTER
SLAVE
SSLAVE

Reply: none

Example: MSLAVE,MASTER

Notes:

MULTIL **MULTIL**

Function: Selects data for multi string reply

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

Format: MULTILOG,*index,phase,function*

Arguments:
index:
- 0 clear all
- 1-64 select data 1-64

phase:
- 1-3 phase 1-3
- 4 sum
- 5 neutral

function:
- 1-99 see appendix C

Reply: none

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

Notes:

For further information and assistance with the Multilog application please go to page 2-98 where you will find an application guide to assist with this function.

MULTIL? **MULTIL?**

Function: Reads multi string reply

Description: Waits for data to be available (if required) then returns selected results.
Either a single string or multiple string replies can be selected.

Format: MULTIL?
MULTIL,*number?*

Arguments: number: The required number of data string replies

Reply: A single reply string containing up to 64 data values as selected by the MULTIL command.

Multiple reply strings each containing the same number of data values (maximum of 64) as selected by the MULTIL command.

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

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

MULTIL,10?
In the above example 10 data strings are returned, each string containing 3 data values.

Notes:
For further information and assistance with the Multilog application please go to page 2-98 where you will find an application guide to assist with this function.

NOOVER **NOOVER**

Function: Disable overranging

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

Format: NOOVER,*value*

Arguments: value:
ON
OFF

Reply: none

Example: NOOVER,ON

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

PFCONV **PFCONV**

Function: Set power factor sign convention.

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

Format: PFCONV,*type*

Arguments: type:
NEGLAG
NEGLEA

Reply: none

Example: PFCONV,NEGLAG

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

PHASEM **PHASEM**

Function: Set phase meter mode.

Description: Select phase meter mode and reference.

Format: PHASE,*reference*

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

Reply: none

Example: PHASEM,CH2

Notes:

PHASEM? **PHASEM?**

Function: Phase meter query

Description: Reads phase meter results.
Sets phase meter mode if not already set.
Waits for next unread data if available.
Clears new data available bit read by DAV?

Format: PHASEM?
PHASEM,*phase*?

Arguments: phase:
PHASE1
PHASE2
PHASE3
PHASES?

Reply: 5 data values separated by commas
freq,mag1,mag2,dB,phase

Example: PHASEM,CH1
PHASEM,PHASE1?
data returned

Notes: The phase convention can be set to 0° to -360°, 0° to +360°, or +180° to -180° in the SYSTEM menu or using PHCONV command.
PHASEM? without specifying the phase returns the appropriate single phase data.

PHCONV **PHCONV**

Function:	Set phase convention
Description:	Set phase convention
Format:	PHCONV,*convention*
Arguments:	convention: 180: -180 to +180 -360: 0 to -360 +360: 0 to +360
Reply:	none
Example:	PHCONV, -360
Notes:	0 to -360 degrees is usually used for power analysis applications

POWER **POWER**

Function:	Set up power analyser mode.
Description:	Configure power analyser with sum current display type
Format:	POWER,*sum type*
Arguments:	sum type: TOTAL AVERAGE
Reply:	none
Examples:	POWER,TOTAL
Notes:	

POWER? **POWER?**

Function: Read power analyser results

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

Format: POWER,*phase*,*results*?

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

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

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

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

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

RMS:
- freq,vrms1,vdc1,arms1,adc1…..

WVA:
- freq,w1,vrms1,arms1,w2…..

PH-PH:
freq,rms1,mag1,lag1,rms2...

Example: POWER,VECTORS?
data returned

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

PROGRA **PROGRA**

Function: Access non volatile program stores.

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

Format: PROGRA,*function,number*

Arguments: function:
RECALL
STORE
DELETE
number
0-100

Reply: none

Example: PROGRA,RECALL,13

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

PROGRA? **PROGRA?**

Function:	Identify current program.
Description:	Reads the name of the last program to be loaded or recalled.
Format:	PROGRA?
Arguments:	none
Reply:	text string
Example:	PROGRA? factory default
Notes:	

RANGE **RANGE**

Function: Set channel ranging.

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

Format: RANGE,*channel*,*ranging*,*range*

Arguments:
channel:
- CH1
- CH2

ranging:
- AUTO
- UPAUTO
- MANUAL

range:
- range number 1-8

Reply: none

Example: RANGE,CH2,MANUAL,4

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

RESOLU **RESOLU**

Function: Set the data resolution

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

Format: RESOLU,*format*

Arguments: format:

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

Reply: none

Example: RESOLU,HIGH

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

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

RESULT **RESULT**

Function: Access non volatile results stores.

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

Format: RESULT,*function,number*

Arguments: function:
RECALL
STORE
DELETE
number
1-20

Reply: none

Example: RESULT,RECALL,13

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

RESULT? **RESULT?**

Function:	Identify used result stores.
Description:	Reads a directory of the 20 non-volatile result locations.
Format:	RESULT?
Arguments:	none
Reply:	20 integers separated by commas
Example:	RESULT? 0,0,1,3,-1,-1,0,2,-1,-1,0,0,0,0,0,0,0,0,0,0
Notes:	0 = empty 1 = normal result 2 = harmonic result 3 = scope result -1 = continuation of previous

REZERO **REZERO**

Function:	Rezero front end
Description:	Request the DSP to re-compensate for dc offset and compute a new autozero
Format:	REZERO
Arguments:	none
Reply:	none
Example:	REZERO
Notes:	

SCALE **SCALE**

Function:	Set channel scale factor.
Description:	Set a multiplying scale factor for a given input channel.
Format:	SCALE,*channel*,*factor*
Arguments:	channel: CH1 CH2 factor: multiplying scale factor
Reply:	none
Example:	SCALE,CH2,10
Notes:	CH1 sets the scale for all voltage channels CH2 sets the scale for all current channels

SCOPE? **SCOPE?**

Function: Fetch raw scope data.

Description: Read back raw oscilloscope data.

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

Arguments: phase:
- PHASE1
- PHASE2
- PHASE3
- NEUTRA

channel:
- VOLTAGE
- CURRENT

Reply: 252 signed integers:
- range
- trigger
- 250 x data

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

Notes:

SCREEN? **SCREEN?**

Function:	Read the screen data
Description:	Returns a bit map of screen pixel display in ascii and hex format
Format:	SCREEN?
Arguments:	none
Reply:	Multiple data bit values
Example:	SCREEN? data returned
Notes:	SCREEN? response: ASCII coded Hex (2 characters for each byte) 240 lines of 40 bytes (each line represents one line of the display) preceded by #H Each byte represents 8 dots where the lsb is the leftmost dot of the display The bit is set for on and cleared for off

SETUP **SETUP**

Function: Upload instrument set up

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

Format: SETUP,index,data

Arguments: index:
0-15
data:
ASCII hex as returned by SETUP?

Reply: none

Example: SETUP?
Read 16 lines of data
SETUP,00,data00
SETUP,01,data01
.
.
SETUP,15,data15

Notes: The settings are only updated when the 16th line has been received and the checksum has been verified.

SETUP? **SETUP?**

Function:	Read instrument set up
Description:	All the settings within the instrument may be read by SETUP? The same settings may then be stored by ending the same data back to the instrument. As it sends all settings in a compressed format it is quicker than setting individual parameters.
Format:	SETUP?
Arguments:	none
Reply:	16 lines of ASCII data
Example:	SETUP? Read 16 lines of data
Notes:	

SHUNT **SHUNT**

Function: Set channel shunt value

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

Format: SHUNT,*channel*,*resistance*

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

Reply: none

Example: SHUNT,CH1,10

Notes: The shunt value is set for all current channels

SMOOTH **SMOOTH**

Function: Select the smoothing

Description: Sets the filter time constant and dynamic response.

Format: SMOOTH,*type,dynamics*

Arguments: type:
- NONE
- NORMAL
- SLOW

dynamics:
- AUTO
- FIXED

Reply: none

Example: SMOOTH,NORMAL,FIXED
SMOOTH,NONE

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

SPEED **SPEED**

Function:	Sets the measurement speed
Description:	Sets the minimum window size for the measurement.
Format:	SPEED,*value,window*
Arguments:	value: FAST MEDIUM SLOW VSLOW WINDOW
Reply:	none
Example:	SPEED,SLOW SPEED,WINDOW,0.1
Notes:	The window size argument is only needed for the SINDOW option

START **START**

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

STATUS? **STATUS?**

Function: Read back channel ranging status.

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

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

Arguments: channel:
- CH1
- .
- .
- CH6

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

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

Notes:

STOP **STOP**

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

Notes:

SUSPEN **SUSPEN**

Function: Suspend data acquisition.

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

Format: SUSPEN,*value*

Arguments: value:
ON
OFF

Reply: none

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

Notes:

TEMPER **TEMPER**

Function: Set up temperature measurement

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

Format: TEMPER,*type,scalefactor,offset*

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

Reply: none

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

Notes:

TEMPER? **TEMPER?**

Function:	Read the temperature
Description:	Returns the measured temperature from a sensor connected to the torque input
Format:	TEMPER?
Arguments:	none
Reply:	single data value
Example:	TEMPER? data returned
Notes:	

TORQSP **TORQSP**

Function:	Set up torque and speed measurement
Description:	Set scaling for torque and speed measurements
Format:	TORQSP,*type,torquescaling,speedscaling* TORQSP,OFFSET*,torqueoffset,speedoffset*
Arguments:	type: DISABLED ANALOG PULSED OFFSET
Reply:	none
Example:	TORQSP,PULSED,10,50 speed measured by pulse torque scaling = 10Nm/V 50 pulses/revolution
Notes:	If type = ANALOG then speed scaling is in rpm/V, if type = PULSED then speed scaling is pulses/rev Torque scaling is always Nm/V

TORQSP? **TORQSP?**

Function:	Read the mechanical power
Description:	Returns measured mechanical data values
Format:	TORQSP?
Arguments:	none
Reply:	3 data values separated by commas: power, torque, speed
Example:	TORQSP? data returned
Notes:	

USER? **USER?**

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

VARCON **VARCON**

Function: Set VAr sign convention.

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

Format: VARCON,*type*

Arguments: type:
NEGLAG
NEGLEA

Reply: none

Example: VARCON,NEGLAG

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

VERSIO? **VERSIO?**

Function:	Read the instrument code versions.
Description:	Returns an ASCII string with the details of the various parts of the instrument firmware.
Format:	VERSIO?
Arguments:	none
Reply:	date code, type, cpu, dsp, fpga, boot type: 0 – normal (30A) 2 – low current version (10A) 4 – high current version (50A)
Examples:	VERSION? KQ1306,0,1.10,1.10,1.10,1.01
Notes:	This data can be displayed on the screen by pressing SYSTEM then BACK

VRMS **VRMS**

Function:	Set up rms voltmeter.
Description:	Set mode to rms voltmeter.
Format:	VRMS
Arguments:	none
Reply:	none
Examples:	VRMS
Notes:	This has the same effect as MODE,VRMS

VRMS? **VRMS?**

Function: Read true rms voltmeter results

Description: Reads back latest voltmeter results.
Waits for next unread data if necessary.
Clears new data available status bit.

Format: VRMS,*phase*,*results*?

Arguments: results:
- RMS
- MEAN
- SURGE

phase:
- PHASE1
- PHASE2
- PHASE3
- PHASES

Reply: RMS:
- 6 data values separated by commas
- Vrms,Arms,Vdc,Adc,Vac,Aac

MEAN:
- 6 data values separated by commas
- Vrms,Arms,Vmean,Amean,Vff,Aff

SURGE:
- 8 data values separated by commas
- Vrms,Arms,Vpk,Apk,Vcf,Acf,
- Vsurge1,Asurge

Example: VRMS,PHASE1,RMS?

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

WIRING **WIRING**

Function: Select wiring mode.

Description: Set wiring mode for computation of SUM and neutral data.

Format: WIRING,*type*

Arguments: type:

SINGLE	(single ph 1)
2PHASE	(2 ph 2 wattmeter)
3PH2WA	(3 ph 2 wattmeter)
3PH3WA	(3 ph 3 wattmeter)
INDPH3	(3 ph 2 wattmeter + ph3)
PHASE1	(single ph 1)
PHASE2	(single ph 2)
PHASE3	(single ph 3)

Reply: none

Examples: WIRING,PHASE2

Notes: WIRING,SINGLE is the same as WIRING,PHASE1

ZERO **ZERO**

Function:	Apply or remove the zero
Description:	Applies or removes a zero function depending on the measurement mode (same as pressing ZERO key). Resets the integration data and timer if in power integration mode.
Format:	ZERO ZERO,DELETE
Arguments:	none
Reply:	none
Example:	ZERO
Notes:	

ZOOM **ZOOM**

Function: Sets the display zoom parameters.

Description: Sets the zoom level and data.

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

Arguments: level:
0 – normal
1 – 2 line display (zoom level 1)
2 – single line display (zoom level 2)
data1:
first data (zoom level 1)
or data for single line (zoom level 2)
data2-4:
other data (zoom level 1)

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

Reply: None

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

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

ZOOM? **ZOOM?**

Function: Read the display zoom parameters.

Description: Reads the zoom level and data.

Format: ZOOM?

Arguments:

Reply: 5 integers separated by commas:
level:
0 – normal
1 – 2-4 value display (zoom level 1)
2 – single line display (zoom level 2)
data1-4:
zoom data

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

Example: ZOOM?
1,1,129,0,0 (level 1, ch1 rms, ch2 rms)

Notes:

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

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

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

Step 1.

Reset "MULTILOG" using the **MULTIL,0** command
This will clear any previously entered Multilog parameters and ensure the instrument does not return unwanted results.

Step 2.

Set up the Multilog parameters
The format of the Multilog command is as follows

MULTILOG, Index, Phase, function

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

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

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

The Function ID is chosen from Appendix C which is a continually growing list due to firmware upgrades of the power analyzers at N4L, at present the PPA2500 & PPA2600 have 78 possible functions:

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

Example extract from the Multilog function list

Required Parameters **MULTILOG Pattern**

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

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

Command strings to sent, reference the above Multilog pattern;

MULTIL,0 // clears Multilog

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

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

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

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

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

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

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

Step 3.

Send Multil query and read return string.

MULTIL? // returns a comma separated string as

Example return string:

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

Frequency	PH1 Watts	PH2 Watts	PH3 Watts	PH1 RMS Volt	PH2 RMS Volt	PH3 RMS Volt

Appendix – command summary

COMMAND SUMMARY

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

FQLOCK,on/off	
FQREF,phase,channel	
FREQUE,frequency	
HARMON,para,h,hmax	
HARMON,phase?	freq,mag1,mag2,hmag1,hmag2,h1,h2,
or	thd1,thd2,hphase1,hphase2
HARMON,phase,SERIES?	mag,%, x n harmonics
or	mag,phase, x n harmonics
HOLD,on/off	
INPUT,channel,type	
INTEGR,type,display	
INTEGR,RUNTIM,hours,mins	
INTEGR,phase?	time,Wh,Wh.f, VArh,VArh.f,VAh,VAh.f, pf,pf.f,Vav,Vav.fAh,Ah.f
KEYBOA,value	
LCR,conditions,param,head	
LCR,phase?	freq,mag1,mag2,impedance,phase,R, L,C (series),R,L,C (parallel),tanδ,Q
LOWFRE,on/off	
MODE,type	
MSLAVE,type	
MULTILOG,index,phase,func	
MULTILOG?	1-30 floats as selected
PFCONV,convention	
PHASEM,ratio	
PHASEM,phase?	freq,mag1,mag2,dB,phase
PHCONV,convention	
POWER,sum A	
POWER,PHASE,WATTS?	freq,W,W.f, VA,VA.f,VAr,VAr.f,pf,pf.f, Wdc,W.h
POWER,PHASE,VOLTAGE?	freq,rms,mag,dc,ϕ,peak,cf,mean,ff, harmonic
POWER,PHASE,CURRENT?	freq,rms,mag,dc,ϕ,peak,cf,mean,ff, harmonic
POWER,PH-PH?	freq,rms1,mag1,ϕ1,rms2,mag2,ϕ2, rms3,mag3,ϕ3
POWER,RMS?	freq,vrms1,vdc1,arms1,adc1,vrms2, vdc2,arms2,adc2,vrms3,vdc3, arms3, adc3
POWER,VECTORS?	freq,mag1,ϕ1,mag2,ϕ2,mag3,ϕ3, mag4,ϕ4,mag5,ϕ5,mag6,ϕ6
POWER,WVA?	freq,w1,vrms1,arms1,w2,vrms2, arms2,w3,vrms3,arms3

PROGRAM,function,number	
PROGRAM?	CR terminated text string
RANGE,ch,ranging,range	
RESOLU.format	
RESULT,function,number	
RESULT	multiple integers
REZERO	
SCALE,channel,factor	
SCALE,channel?	single real data value
SCOPE,PHASE,v/a?	range, trigger, 250 signed integer values
SHUNT,channel,resistance	
SHUNT,channel?	single real data value
SMOOTH,type,dynamics	
SPEED,value,window	
START	
STATUS,channel?	range number,range text,over/low/ok
STOP	
STREAM,enable,window	
STREAM,disable	
STREAM?	data, data, data, data, data, …..
SUSPEN,on/off	
TEMPER,type,scale,offset	
TEMPER?	single real data value
TORQSP,type,tscale,sscale	
TORQSP,OFFSET,toff,soff	
TORQSP?	mechanical power, torque, speed
USER?	3 CR terminated text strings
VARCON,convention	
VERSION?	datecode,cpu,dsp,fpga,boot
VRMS	
VRMS,PHASE,RMS?	rms1,rms2,dc1,dc2,ac1,ac2
VRMS,PHASE,MEAN?	rms1,rms2,mean1,mean2,ff1,ff2
VRMS,PHASE,SURGE?	pk1,pk2,cf1,cf2,surge1,surge2
WIRING,configuration	
ZERO	
ZERO,DELETE	
ZOOM,level,d1,d2,d3,d4	
ZOOM?	level,d1,d2,d3,d4

calibration commands

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

Appendix B – Configurable parameters

All parameters can be accessed using the CONFIG command:

CONFIG,*number*,*parameter*

number	Function	*parameter*
1	Operating mode, (sets Main Mode)	0=RMS Voltmeter 1=Phase Meter 2=Power Analyser 3=Impedance Analyser 4=Power Integrator 5=Harmonic Analyser 7=Oscilloscope
3	Master/slave, (Aux control)	0=Disabled 1=Master 2=Slave 3=Sslave
4	Autozero manual or auto, (System options)	0=Auto 1=Manual
5	Low blanking, (System options)	0=Off 1=On
6	Phase convention, (System options)	0=-180° to +180° 1=0° to -360° 3=0° to +360°
7	Frequency lock on/off, (Acquisition advance options)	0=Normal 1=Constant 2=Dynamic
8	Graph, (System options)	0=Dots 1=Lines

9 Keyboard beep on/off, (System options)
0=Off
1=On

10 Ignore overload,(Acquisition advance options)
0=Off
1=On

11 Low frequency mode, (Acquisition control)
0=Off
1=On

12 Window size, (Acquisition control, speed-window)
0=ms
1=Sec's

13 Speed, (Acquisition control)
0=Very Slow
1=Slow
2=Medium
3=Fast
4=Window

14 Smoothing (Acquisition Control)
0=Normal
1=Slow
2=None

15 Smoothing Response (Acquisition Control)
0=Auto reset
1=Fixed time

16 Baud rate, (Remote options , RS232)
0=19200
1=9600
2=4800
3=2400
4=1200

18 LAN IP address nibble 3, (Remote options - LAN - enter figure as required)
19 LAN IP address nibble 2, (Remote options - LAN - enter figure as required)
20 LAN IP address nibble 1, (Remote options - LAN - enter figure as required)
21 LAN IP address nibble 0, (Remote options - LAN - enter figure as required)

22 Independent input control, (System options)
0=Disabled
1=Enabled

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

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

26 Input range channel 1, (Range – minimum range voltage)
0=1v
1=3v
2=10v
3=30v
4=100v
5=300v
6=1Kv
7=3kV

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

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

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

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

31 Bandwidth, (Coupling - bandwidth)
0=Wide (dc–2MHz)
1=Low (dc-30KHz)
2=dc (dc-5Hz)

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

33 Scale factor channel 1 current, (Ranging - Enter figures as required)

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

35 External shunt channel 1, (Ranging – current input - resistance value as required)

38 Resolution, (remote options – digit resolution)
0=Normal
1=High
2=Binary

39 Frequency reference phase, (Acquisition control)
0=Phase 1
1=Phase 2
2=Phase 3

40 Frequency reference voltage/current, (Acquisition control)
0=Voltage
1=Current
2=Speed

41 Display page, (Main display)
0=Phase 1 page
1=Phase 2 page
2=Phase 3 page
3=Sum page
4=Phase 1,2 &3 page
5=Phase 1,2 & 3 fundamentals page
6=NEU page

42 Zoom level, (Main display)

0=Zoom –
1=Zoom +
2=second Zoom +

43 Function zoomed on 1, (Main display)

0=Voltage, Current & Frequency
1=Watts, Current, Voltage & Frequency
2= VA, Current, Voltage & Frequency
3= VAr, Current, Voltage & Frequency
4= pf, Current, Voltage & Frequency

44 Function zoomed on 2, (Main display)

0=Current & Frequency
1= Watts, Current & Frequency
2= VA, Current & Frequency
3= VAr, Current & Frequency
4= pf, Current & Frequency
5= Current, Voltage & Frequency

45 Function zoomed on 3, (Main display)

0= Watts & Frequency
2= Watts, VA & Frequency
3= Watts, VAr & Frequency
4= Watts, pf & Frequency
5= Watts, Voltage & Frequency
6= Watts, Current & Frequency

46 Function zoomed on 4, (Main display)

0= Watts & VA
3= Watts, VA & VAr
4= Watts, VA & pf
5= Watts, VA & Voltage
6= Watts, VA & Current
7= Watts, VA & Frequency
8= Watts, VA & Harmonic
9= Watts, VA & dc watts
10= Watts, VA & V Ph-Ph

47 Datalog display type, (Datalog display information mode)
0=Real Time
1=Table
2=Graph

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

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

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

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

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

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

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

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

57 Datalog Zoom4, (Datalog-RAM)
0=Enabled
1=Disabled

58 Datalog memory type, (Datalog)
0=Disabled
1=RAM
2=Non Volatile

59 Datalog interval, (Datalog – Enter time required)

61 Formula, (Maths)
0=Disabled
1=(term1 + term2/term3 + term4)
2=(term1 + term2) x term3/term4
3=term1 x term2/(term3 + term4)

62 Argument term 1 (Maths)
0=Disabled
1=Constant
2=Voltage
3=Current
4=Torque
5=Speed

63 Sub argument term 1, (For voltage and current arguments only)
0=rms
1=dc
2=ac
3=Fundamental
4=Peak
5=Mean
6= Ph-Ph rms
7=Ph-Ph mag

64 Term 1 coefficient, (Enter value)

65 Argument term 2,
0=Disabled
1=Constant
2=Voltage
3=Current
4=Torque
5=Speed

66 Sub argument term 2, (For voltage and current arguments only)
0=rms
1=dc
2=ac
3=Fundamental
4=Peak
5=Mean
6= Ph-Ph rms
7=Ph-Ph mag

67 Term 2 coefficient, (Enter value)

70 application mode,
0=Normal
1=PWM motor Drive
2=Lighting ballast
3=Inrush current
4=Power transformer
5=Standby power

71 Frequency filter, (Application options mode - PWM Motor Drive)
0=4KHz
1=1KHz
2=250Hz

72 Frequency tracking speed, (Application options mode - Lighting Ballast)
0=Fixed time
1=Fast
2=Medium
3=Slow

73 Low frequency, (Application options mode - PWM Motor Drive)
0=Off
1=On

74 Argument term 3 (Maths)
0=Disabled
1=Constant
2=Voltage
3=Current
4=Torque
5=Speed

75 Sub argument term 3, (For voltage and current arguments only)
0=rms
1=dc
2=ac
3=Fundamental
4=Peak
5=Mean
6= Ph-Ph rms
7=Ph-Ph mag

76 Term 3 coefficient, (Enter value)

77 Argument term 4 (Maths)
0=Disabled
1=Constant
2=Voltage
3=Current
4=Torque
5=Speed

78 Sub argument term 4, (For voltage and current arguments only)
0=rms
1=dc
2=ac
3=Fundamental
4=Peak
5=Mean
6= Ph-Ph rms
7=Ph-Ph mag

79 Term 4 coefficient, (Enter value)

80 Temperature, (Applications – Power Transformer)
0=Disabled
1=°C
2=°F

81 Master/Slave-Sum watts, (Aux control–Master/Slave-Master)
0=Master
1=Master + Slave

82 Wiring configuration, (Acquisition control)
0=Single phase 1
1=2 phase 2 wattmeter
2=3 phase 2 wattmeter
3=3 phase 3 wattmeter
4=Single phase 2
5=Single phase 3
6=3 phase 2 wattmeter + PH3

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

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

85 Torque scaling Nm/V, (Enter Nm/v value) or (Temperature °/v value)

86 Speed scaling Hz/V, (Enter rpm/v value)

87 Pulses per revolution, (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 Phase 3 reference, (Acquisition control – 3 phase 2 wattmeter + PH3)
0=Voltage
1=Current
2=ac line
3=Phase 1 & 2

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

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

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

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

95 Torque offset, (Application options mode – PWM motor drive – Nm offset value)
(Application options mode –Power transformer - Temperature– offset value)

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

99 Computation mode, (Harmonic analyzer)
0=Difference formula
1=Harmonic series
2=TIF
3=THF
4=TRD
5=TDD
6=Series harmonic phase

100 Selected harmonic, (Harmonic analyzer - figure = harmonic required)

101 Harmonic series up to, (Harmonic analyzer - figure = harmonic max)

102 Bargraph scale, (Harmonic analyzer - figure = % required)

103 Current rating (TRD), (Harmonic analyzer – TRD mode – enter figure)

106 Timebase, (Scope - Enter figure/div)

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

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

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

110 trigger type, (Scope)
0=Auto
1=Normal
2=Single shot

111 trigger reference, (Scope)
0=Voltage
1=Current

112 trigger phase, (Scope)
0=Phase 1
1=Phase 2
2=Phase 3

113 cursors enable, (Scope)
0=Off
1=On

114 trigger HF reject, (Scope)
0=Off
1=On

119 zoom 2 high resolution, (System)
0=Disabled
1=Enabled

122 Auxiliary device, (Aux control)
0=None
6=PCIS

128 Switch phase offset, (Aux control – PCIS device)
0=0°
1=45°
2=90°
3=135°
4=180°
5=225°
6=270°
7=315°

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

130 Gear ratio, (Aux control – frequency reference – speed - Enter ratio value)

Gear ratio, (Aux control – frequency reference – speed - Enter ratio value)

131 3 Phase 2 Wattmeter VA, VAr Option, (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, (Power analyser)
0=Rms
1=Mean

135 Difference THD, (Power analyser)
0=Disabled
1=Enabled

136 Master/Slave Mechanical, (Aux control – Master/slave-Master)
0=Master
1=Slave

137 Parameter, (Impedance analyzer)
0=Auto
1=Capacitance
2=Inductance
3=Impedance

138 Model, (Impedance analyzer – auto parameter)
0=Series
1=Parallel

139 Phase offset, (Impedance analyzer - Enter figures)

148 dB offset, (Phase meter - Enter figures)

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

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

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

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

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

169 Alarm 2 high threshold, (Alarm options – alarm if high – enter figure)

170 Alarm 2 low threshold, (Alarm options – alarm if low – enter figure)

176 Enable channel 3, (Range – voltage input)
0=Internal
3=External attenuator

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

178 Input range channel 3, (Range – minimum range voltage)
0=1v
1=3v
2=10v
3=30v
4=100v
5=300v
6=1Kv
7=3kV

179 Input range channel 4, (Range – minimum range current)
0=100ma
1=300ma
2=1A
3=3A
4=10A
5=30A
6=100A
7=300A

180 Input ranging channel 3, (Range – autoranging voltage)
0=Full Autorange
1=Autorange up
2=Manual

181 Input ranging channel 4, (Range – autoranging current)
0= Full Autorange
1=Autorange up
2=Manual

182 Coupling phase 2, (Coupling)
0=ac +dc
1=ac
2=dc

183 Bandwidth phase 2, (Coupling - bandwidth)
0=Wide (dc–2MHz)
1=Low (dc-30KHz)
2=dc (dc-5Hz)

184 Scale factor channel 3 voltage, (Ranging - Enter figures as required)

185 Scale factor channel 4 current, (Ranging - Enter figures as required)

186 External attenuator channel 3, (Ranging – voltage input - attenuator ratio as required)

187 External shunt channel 4, (Ranging – current input – resistance value as required)

200 Enable channel 5, (Range – voltage input)
0=Internal
3=External attenuator

201 Enable channel 6, (Range – current input)
0=Internal
2=External shunt

202 Input range channel 5, (Range – minimum range voltage)
0=1v
1=3v
2=10v
3=30v
4=100v
5=300v
6=1Kv
7=3kV

203 Input range channel 6, (Range – minimum range current)
0=100ma
1=300ma
2=1A
3=3A
4=10A
5=30A
6=100A
7=300A

204 Input ranging channel 5, (Range – autoranging voltage)
0=Full Autorange
1=Autorange up
2=Manual

205 Input ranging channel 6, (Range – autoranging current)
0= Full Autorange
1=Autorange up
2=Manual

206 Coupling phase 3, (Coupling)
0=ac +dc
1=ac
2=dc

207 Bandwidth phase 3, (Coupling - bandwidth)
0=Wide (dc–2MHz)
1=Low (dc-30KHz)
2=dc (dc-5Hz)

208 Scale factor channel 5 voltage, (Ranging - Enter figures as required)

209 Scale factor channel 6 current, (Ranging - Enter figures as required)

210 External attenuator channel 5, (Ranging – voltage input - attenuator ratio as required)

211 External shunt channel 6, (Ranging – current input – resistance value as required)

Appendix C – MULTILOG parameters

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

39	average rms current	integrator mode
40	average fundamental current	integrator mode
41	reserved for future expansion	
42	reserved for future expansion	
43	elapsed time	integrator mode
44	reserved for future expansion	
45	reserved for future expansion	
46	reserved for future expansion	
47	reserved for future expansion	
48	reserved for future expansion	
49	reserved for future expansion	
50	rms voltage	
51	rms current	
52	fundamental voltage	
53	fundamental current	
54	voltage phase	
55	current phase	
56	harmonic voltage	
57	harmonic current	
58	dc voltage	
59	dc current	
60	ac voltage	
61	ac current	
62	peak voltage	
63	peak current	
64	voltage crest factor	
65	current crest factor	
66	rectified mean voltage	
67	rectified mean current	
68	voltage form factor	
69	current form factor	
70	voltage harmonic	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	

82	voltage surge	
83	current surge	
84	voltage rms deviation	transformer mode
85	voltage fundamental deviation	transformer mode
86	voltage phase deviation	transformer mode
87-99	reserved for future expansion	

Note: Functions 78 and 81 are the same.

Phase selection:

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

There are some special functions:

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

Notes:

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

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

Examples for setting up 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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