Voltech

IEEE488 Interface for the PM100 and PM300 Power Analysers.

User Manual

Version 1.1

Contents

1. INTRODUCTION

1.1. Welcome

Welcome to the Voltech range of interface cards for the PM100 and PM300 Power analysers.

The power analysers can only be operated manually using the keyboard and display with out an interface card. Voltech has produced a variety of interface cards for the PM100 and PM300 power analysers to enhance their flexibility and use. Each carries its own processor to handle all communications

The range of interface cards include :

- The IEEE488.2 Interface
  This allows full remote control of the power analyser with a Personal Computer with daisychain possibilities. It uses the IEE488.2 bus communication standard using up to date National Instruments circuitry.

- The printer (parallel) and RS232 (serial) Interface.
  The parallel interface connects to most printers : matrix, jet, and lasers. It is a 25 way D-type connector.
  The RS232 interface may be used to connect a serial printer, or to allow full remote control of the analyser using the IEEE488.2 protocol. It is a 9 way D-type connector.

- Chart Recorder and Alarms interface.
  12 measurements may be output via a 15 way D type connector to a chart recorder or data logger. Each measurement is scaled for Max. and Min. level from the front panel.
  2 isolated alarm relay contacts are also provided for plant control. The relays may be programmed to operate on receiving a Max. or Min. signal.

1.2. Overview of the Interface card

The IEEE488 interface card allows the power analyser to be controllable by a remote P.C. over a standard GPIB bus. Instruments from a wide variety of suppliers may be integrated allowing all to run together. The interface is configurable to IEEE488.1 and IEEE488.2 protocol standards.

The instrumentation bus uses 8 bit parallel data transfer with hardware handshaking on a multi-drop bus. Devices on the bus are assigned a unique address from 2 to 30 and may receive or transmit data using a single bus controller. Although only one controller may be active at any one time, any number of connected controllers may request control of the bus at the same time. Each device receives and transmits data asynchronously using dedicated handshaking lines so that communication occurs at the fastest rate that each instrument can manage.

2. INSTALLATION

2.1. Hardware Installation

1. Turn off the power analyser. Disconnect all test and power and power leads.

2. Undo the two screws on the protection panel on the rear face of the power analyser.

3. Carefully insert the interface card making sure it is sliding between the guides. It will insert into a connector at the back of the front panel. This is best achieved with the analyser placed front face down.

4. Screw in the two screws to keep the card firmly in place

2.2. Analyser Set Up

The power analyser software will recognise the inserted card once it is connected. As a result, the user will be able to view a new menu : menu 0.

The only user selectable parameter is the IEEE address

IEEE Address
>10<

If this menu is not available, turn off the power, disconnect all peripheral connections and make sure the plug in card is in the connector socket. On continued failure, contact your local distributor.

3. Command Structure

Commands and replies are passed as a sequence of ASCII letters and numbers terminated by either a line feed or an EOI (hardware signal for 'end of instruction').

Upper and lower case letters are treated equally and all white-space characters are ignored. Thus to set manual voltage range 6:

```
output 09; :RNG:VLT:FIX 6
output 09; :RNG:VLT:FIX6
output 09; :RNG :VLT :FIX 6
```

all have exactly the same effect (although it takes longer to transmit strings with more characters).

Commands may be of one of three types - common, device, or system.

Common commands (and common queries) apply universally to all instruments and are preceded by an '*' character eg.

```
output 09; *TRG
```

Device commands are defined by the manufacturer of each instrument,
and Voltech instruments' device commands are preceded by a ':' character eg.

```
output 09; :RNG:VLT:FIX 6
```

Commands may be cascaded if separated by ';' eg.

```
output 09; :FNC:VLT? ; :FNC:AMP? ; :FNC:WAT?
enter 09
1.111E02
enter 09
2.222E-02
enter 09
3.333E01
```

Data replies may only be sent in response to a query message which ends with a question mark. The data is returned either as an integer (NR1 numeric response type) or in scientific format with 4½digit signed mantissa and 2 digit signed exponent (NR3 numeric response type). Data may be entered as integer, integer with decimals, or scientific. The following commands have the same effect:

```
output 09; :CFG 2, 1
output 09; :CFG 2, 1.00
output 09; :CFG 2, 1.0000E+00
```

A query message generates a single reply string terminated with a line-feed character.

4. IEEE Command Set

4.1. Implemented Common Commands

function	command	reply (if any)
identify	*IDN?	VOLTECH,PM300,1234,v120 VOLTECH,PM100,1234,v131
operation control	*OPC	
	*OPC?	1
	*WAI	
reset	*RST	
self test	*TST?	1
status reporting	*CLS	
	*ESE	
	*ESE?	NR1
	*ESR?	NR1
	*SRE	
	*SRE?	NR1
	*STB?	NR1
trigger	*TRG	

Voltech defined commands

function	command	reply (if any)
averaging	:AVG:FIX X :AUT	
ballast mode	:BAL:50H :60H	
calibration	:CAL:VLT X, Y :AMP :EXT	
	:CAL?	PM100 : Vflag, Aflag, Xflag PM300 : V_{ch1}flag, A_{ch1}flag, X_{ch1}flag V_{ch2}flag, A_{ch2}flag, X_{ch2}flag V_{ch3}flag, A_{ch3}flag, X_{ch3}flag
	:CAL:VLT?X :AMP :EXT	NR3
	:CAL:END X	
configure	:CFG? X	NR1 OR NR3
	:CFG X, Y	
data status	:DSE?	NR1
	:DSE X	
	:DSR?	NR1
device clear	:DVC	
read data	:FNC:WAT?	NR3

:VAS	:VAR
:VLT	:AMP
:PWF	:VPK
:APK	:VCF
:ACF	:WHR
:VAH	:VRH
:AHR	:APF
:VHM	:AHM
:VDF	:ADF
:FRQ	:VDC
:ADC	:VHA
:AHA	

:FND :WAT? NR3

:VAS	:VAR
:VLT	:AMP
:PWF	:WHR
:VAH	:VRH
:AHR	:APF

read data selection	:FRD?	NR3, NR3, NR3....
frequency source	:FSR:VLT :AMP	
single harmonic	:HRM X	
series harmonic	:HMX:ODD X :ALL	
integrator	:INT:ENB :DIS	
range selection	:RNG:VLT:AUT X	

	:AMP:FIX X	
reset averaging	:RAV	
scaling	:SCL:VLT X	
	:AMP	
select data	:SEL:CLR	:CH1
	:CH2	:CH3
	:CHN	:SUM
	:FND	:SER
	:WAT	:VAS
	:VAR	:VLT
	:AMP	:PWF
	:VPK	:APK
	:VCF	:ACF
	:WHR	:VAH
	:VRH	:AHR
	:APF	:VHM
	:AHM	:VDF
	:ADF	:FRQ
	:VDC	:ADC
	:VHA	:AHA
	:WHM	
current shunt	:SHU:INT	
	:EXT	
wiring	:WRG:1P2	
	:1P3	
	:3P3	
	:3P4	
	:CH3	
	:CH2	
	:CH1	

:AVG set averaging

Class device command

Return type none

Valid PM300, PM100

Format :AVG:FIX depth
AUT

Options

:FIX	set fixed averaging
:AUT	set auto averaging
depth	1-16

Example CMD> output 10; :AVG:FIX 16

:BAL set ballast mode

Class device command

Return type none

Valid PM300, PM100

Format :BAL:H50
H60

Options :H50 set ballast mode for lock to 50Hz
:H60 set ballast mode for lock to 60Hz

Return format none

Example CMD> output 10; :BAL:H50

:CAL calibrate

Class device command

Return type none

Valid PM300, PM100

Format :CAL:VLT range, value
:AMP
:EXT

:CAL:END password

Options :VLTcalibrate voltage
:AMP calibrate current
:EXTcalibrate external shunt
:END end calibration and save values in EEPROM
pass calibration password 0-9999
range to be calibrated 1-8
valuemeasured value

Return format none

Examples CMD> output 10; :CAL:VLT 3, 1.2345
CMD> output 10; :CAL:END 1234

:CAL? read calibration values

Class device query

Return type NR1 or NR3 numerical response data

Valid PM300, PM100

Format :CAL?

:CAL:VLT? range
:AMP
:EXT

Options :VLTread voltage calibration
:AMP read current calibration
:EXTread external shunt calibration
range 1-8

Return format 4½digit signed mantissa with 2 digit exponent

Example CMD> output 10; :CAL:VLT? 3
CMD> enter 10
1.0673E0, 9.987E-1, 1.0298E0

Notes This represents the calibration correction for the given channel. The calibrated value of an input is given by:

actual value = measured value x calibration

In the case of PM100, 1 value is returned

Example 2 CMD> output 10; :CAL?
CMD> enter 10
0,0,0,0,0,0,0,0,0

Notes The returned data is the flags for each range for each channel,

voltage, current and external. In the case of PM100, 1 value is returned

:CFG configure

Class device command

Return type none

Valid PM300, PM100

Format :CFG prog, data

Options prog integer program location 0-49
data appropriate integer or floating point data

Return format none

Example CMD> output 10; :CFG 21, 1

:CFG? read configuration

Class	device query
Return type	NR1 numerical response data or NR3 numerical response data
Valid	PM300, PM100
Format	:CFG? prog
Options	prog integer program location 0-49
Return format	integer or floating point data as appropriate

Example
```
CMD> output 10; :CFG? 21
CMD> enter 10
1
```

*CLS clear standard status register & data status register

Class common command

Return type none

Valid PM300, PM100

Format *CLS

Options none

Return format none

Example CMD> output 10; *CLS

:DSE set data status enable register

Class device command

Return type none

Valid PM300, PM100

Format :DSE data

Options none

Data format 0-255

			OVA	OVV	AVF	NDV	DVL

DVL - data available enable
NDV - new data available enable
AVF - averaging full enable
OVV - voltage overflow enable
OVA - current overflow enable

Example CMD> output 10; :DSE 2

Notes The DAS bit in the status byte is set according to the logical bitwise AND of the data status register and the data status enable register.

:DSE? read data status enable register

Class device query

Return type NR1 numerical response data

Valid PM300, PM100

Format :DSE?

Options none

Return format 0-255

			OVA	OVV	AVF	NDV	DVL

DVL - data available enable
NDV - new data available enable
AVF - averaging full enable
OVV - voltage overflow enable
OVA - current overflow enable

Example
```
CMD> output 10; :DSE?
CMD> enter 10
2
```

Notes to the The DAS bit in the serial poll status byte is set according to the logical bitwise AND of data status register and the data status enable register.

:DSR? read data status register

Class device query

Return type NR1 numerical response data

Valid PM300, PM100

Format :DSR?

Options none

Return format 0-255

			OVA	OVV	AVF	NDV	DVL

DVL - data available
NDV - new data available
AVF - averaging full
OVV - voltage overflow has occurred
OVA - current overflow has occurred

Example
```
CMD> output 10; :DSR?
CMD> enter 10
7
```

Notes This command clears the data status register
The DAS bit in the status byte is set according to the logical bitwise AND of the data status register and the data status enable register.

*ESE set standard event status enable register

Class common command

Return type none

Valid PM300, PM100

Format *ESE flags

Data format 0-255

		CME	EXE		QRE		OPC

OPC - operation complete
QRE - unterminated query error
EXE - execution error
CME - command error

Example CMD> output 10; *ESE 32

Notes The ESB bit in the serial poll status byte is set according to the logical bitwise AND of the standard event status register and the standard event status enable register.

*ESE? read standard event status enable register

Class common query

Return type NR1 numeric response data

Valid PM300, PM100

Format *ESE?

Options none

Return format 0-255

		CME	EXE		QRE		OPC

OPC - operation complete
QRE - unterminated query error
EXE - execution error
CME - command error

Example
```
CMD> output 10; *ESE?
CMD> enter 10
32
```

Notes The ESB bit in the status byte is set according to the logical bitwise AND of the standard event status register and the standard event status enable register.

*ESR? read standard event status register

Class common query

Return type NR1 numeric response data

Valid PM300, PM100

Format *ESR?

Options none

Return format 0-255

		CME	EXE		QRE		OPC

OPC - operation complete
QRE - unterminated query error
EXE - execution error
CME - command error

Example
```
CMD> output 10; *ESR?
CMD> enter 10
1
```

Notes The ESB bit in the status byte is set according to the logical bitwise AND of the standard event status register and the standard event status enable register.

:FNC? read function data

Class device query

Return type NR3 numerical response data

Valid PM300, PM100

Format :FNC:WAT?

VAS	VAR
VLT	AMP
PWF	VPK
APK	VCF
ACF	WHR
VAH	VRH
AHR	APF
VHM	AHM
VDF	ADF
FRQ	ADC
VDC	AHA
VHA	WHM

Return format 4½digit mantissa with 2 digit exponent
±x.xxxE±xx
±1.xxxxE±xx

Example CMD> output 10; :FNC:VLT?
CMD> enter 10
+2.395E+02

Notes Data read can be synchronised to new data values by using the

NDV bit in the data status register (see: DSR?), or via the status byte register if the appropriate enable register is set (see :DSE)

:FND? read fundamental data

Class device query

Return type NR3 numerical response data

Valid PM300, PM100

Format :FND: WAT?
VAS
VAR
VLT
AMP
PWF
WHR
VAH
VRH
AHR
APF

Return format 4½digit mantissa with 2 digit exponent
±x.xxxE±xx
±1.xxxxE±xx

Example CMD> output 10; :FND: VLT?
CMD> enter 10
+2.395E+02

Notes Data read can be synchronised to new data values by using the NDV bit in the data status register (see :DSR?), or via the status byte register if the appropriate enable register is set (see :DSE)

:FRD? read foreground data

Class device query

Return type multiple NR3 numerical response data separated by commas.

Valid PM300, PM100

Format :FRD?

Options none

Return format NR3,NR3,NR3.....

Example
```
CMD> output 10; :FRD?
CMD> enter 10
2.395E02,6.789E-01,1.2345E01
```

Notes The data to be sent is determined by the previously stored selection (see :SEL).
The data is sent when NDV is set and NDV is then cleared again. In this way, repeated :FRD? commands return subsequent measurements and do not repeat the same data.

:FSR set frequency source

Class device command

Return type none

Valid PM300, PM100

Format :FSR:AUT
FIX AMP
FIX VLT

Options

:AUT	set auto frequecy source
:FIX	set fixed frequency source
:VLT	set voltage frequency source
:AMP	set current frequency source

Return format none

Example CMD> output 10; :FSR:FIX:VLT

:HRM set single harmonic

Class	device command
Return type	none
Valid	PM300, PM100
Format	:HRM harm
Options	harm integer harmonic number 0-50
Return format	none
Example	CMD> output 10; :HRM 3

:HMX set maximum harmonic for series

Class	device command
Return type	none
Valid	PM300, PM100
Format	:HMX:ODD harm ALL
Options	:ODD only odd harmonics :ALLuse both odd and even harmonics harm integer maximum harmonic 1-50
Return format	none
Example	CMD> output 10; :HMX:ODD 39

*IDN? identify

Class	common query
Return type	arbitrary ASCII response data
Valid	PM300, PM100
Format	*IDN?
Options	none
Return format	VOLTECH,PM300,serial,version
Example	CMD> output 10; *IDN? CMD> enter 10 VOLTECH,PM300,1234,v120

:INT set up integrator

Class device command

Return type none

Valid PM300, PM100

Format :INT:ENB
DIS

:INT:RUN time

Options :ENB enable integrator
:DIS disable integrator
:RUN enable integrator and set stop time
time run time in integer minutes

Return format none

Example CMD> output 10; :INT:ENB

*OPC initialise operation complete function

Class	common command
Return type	none
Valid	PM300, PM100
Format	*OPC
Options	none
Return format	none
Example	CMD> output 10; *OPC

*OPC? flag when operation complete

Class	common query
Return type	NR1 numeric response data
Valid	PM300, PM100
Format	*OPC?
Options	none
Return format	1

Example
```
CMD> output 10; *OPC
CMD> output 10; *OPC?
CMD> enter 10
1
```

:RAV reset averaging

Class device command

Return type none

Valid PM300, PM100

Format :RAV

Options none

Return format none

Example CMD> output 10; :RAV

Notes This command can be used to speed up the response of the instrument to step changes especially when in fixed averaging.

:RNG set ranging

Class	device command	
Return type	none	
Valid	PM300, PM100	
Format	:RNG:VLT:FIX range AMP	
	:RNG:VLT:AUT AMP	
Options	:VLT	set voltage ranging
	:AMP	set current ranging
	:FIX	fixed ranging
	:AUT	autoranging
	range	integer range 1-8
Return format	none	
Example	CMD> output 10; :RNG:AMP:FIX 5	

*RST reset device

Class	common command
Return type	none
Valid	PM300, PM100
Format	*RST
Options	none
Return format	none
Example	CMD> output 10; *RST

:SCL set scaling

Class	device command
Return type	none
Valid	PM300, PM100
Format	:SCL:VLT scale AMP
Options	:VLTset voltage scaling :AMP set current scaling
Return format	none
Example	CMD> output 10; :SCL:AMP 99.34

:SEL select function list

Class device command

Return type none

Valid PM300, PM100

Format :SEL:CLR CH1
CH2 CH3
CHN SUM
WAT VAS
VAR VLT
AMP PWF
VPK APK
VCF ACF
WHR VAH
VRH AHR
APF VHM
AHM WHM
VDF ADF
FRQ VDC
ADC VHA
AHA FND
SER (series of harmonics)

Options :CLR clears entire selection
:FND selects return of fundamentals as well
others set selection for that function/channel

Return format none

Example CMD> output 10; :SEL:CLR
CMD> output 10; :SEL:CH1
CMD> output 10; :SEL:VLT; :SEL:WAT;
:SEL:AMP

Notes CH2, CH3, CHN, SUM not valid for PM100. This functions
selects the list of parameters to be returned by the :FRD?

command.

:SHU set internal/external shunt

Class	device command
Return type	none
Valid	PM300, PM100
Format	:SHU:INT EXT
Options	:INT use internal shunt :EXTuse external shunt
Return format	none
Example	CMD> output 10; :SHU:EXT

*STB? read status byte

Class common query

Return type NR1 numeric response data

Valid PM300, PM100

Format *STB?

Options none

Return format 0-255

	MSS	ESB	MAV				DAS

DAS - data available summary (see :DSR?)
MAV - message available
ESB - standard event status summary (see *ESR?)
MSS - master summary status

Example
```
CMD> output 10; *STB?
CMD> enter 10
65
```

*TRG trigger

Class	common command
Return type	none
Valid	PM300, PM100
Format	*TRG
Options	none
Return format	none
Example	CMD> output 10; *TRG
Notes	*TRG has the same effect as a Group Execute Trigger.

*WAI wait for operation

Class	common command
Return type	none
Valid	PM300, PM100
Format	*WAI
Options	none
Return format	none
Example	CMD> output 10; *WAI
Notes	The operation complete flag is set when new data is available. *WAI will then effect a delay until data is available.

:WRG set wiring configuration

Class	device command
Return type	none
Valid	PM300
Format	:WRG:1P2 1P3 3P3 3P4 CH3 CH2
Options	:1P2 set 1 phase 2 wire :1P3 set 1 phase 3 wire :3P3 set 3 phase 3 wire :3P4 set 3 phase 4 wire :CH3 set channel 3 only mode :CH2 set channel 2 only mode :CH1 set channel 1 only mode
Return format	none
Example	CMD> output 10; :WRG:3P4

5. Example Program

In this example, the voltage and current readings from channel 1 and channel 2 are being tested. It is set in a Quick Basic environment and uses the PM300 power analyser.

```
output 10;:WRG:3P4      Select 3 phase 4 wire layout
output 10;:SEL:AMP      select to read :    amps,
output 10;:SEL:VLT      volts
output 10;:SEL:CH1      from:channel 1
output 10;:SEL:CH2      channel 2
output 10;*TRG          reset averaging
DO
      output 10;:DSR?
      I = enter 10
      J = I AND 4       Check that Data Set Ready bit is set
LOOP WHILE  J <> 4
output 10;:FRD?         get selected values
enter 10                output them.
```

The address of the IEEE port on the PM300 is 10 in this case.

6. Configuration Commands

The IEEE command set allows you to configure the instrument using the :cfg command. Below is a list of parameters relating to this command and enabling configuration. Those commands whose number is enclosed in {} parenthesis apply only to the PM300.

1.	operating mode	0-7
{2.}	wiring	0-7
3.		
4.	averaging	auto/manual
5.	averaging depth	0-15
6.	current shunt	internal/external
7.	sample pre-filter	0-255
8.	number of samples	100-8000
9.	sample rate	auto/manual
10.	voltage range	auto/manual
11.	current range	auto/manual
12.	voltage range	0-7
13.	current range	0-7
14.	frequency source	auto/manual
15.	frequency source	V/A
16.	jitter generator	auto/manual
17.	jitter generator	on/off
18.	fundamentals	on/off
19.	V harmonic	on/off
20.	A harmonic	on/off
21.	harmonic series	on/off
22.	harmonic number	0-50
23.	maximum harmonic	1-50
24.	harmonic series	odd/odd+even
25.	harmonic reference	h1/rms
26.	harmonic display	percentage/absolute
27.	dc included in series	on/off

28.	integrator enable	on/off
29.	integrator run time	floating point
30.	display function	0-63
31.	top function	0-63
32.	middle function	0-63
33.	display fundamentals	0-63
34.	single display	on/off
35.	low value banking	on/off
36.	peak display	peak/crest factor
37.	power factor sign	normal/reverse
38.	voltage scaling	floating point
39.	current scaling	floating point
40.	thd formula selection	on/off
41.	thd formula	difference/series
{42.}	display option	0-4
43.	language	0/1
44.		
45.	peak current	floating point
46.	waveform	off/on
47.	barchart	off/on
48.	display mode	off/on
49.	display parameter	1-6

7. Status Byte Table

The IEEE488.2 status byte contains the mandatory MSS, ESB and MAV bits with two instrument specific summary bits, BAS and DAS. The enable registers are set by the user, and act as a mask to reflect chosen elements of the appropriate status registers to the Status Byte Register. Transparency is set by setting the appropriate bit of the enable register to 1. If any of the status registers are read, the register is reset to zero.