PCE Instruments

Output and control options

DIGITAL PANEL METERS

PANEL METERS . OUTPUT AND CONTROL OPTIONS

Modular output and control options for panel meters from series PCE-DPD (except PCE-DPD-U). Relay outputs, transistor outputs, SSR control outputs, analog outputs, Modbus RTU communications, RS-485 and RS-232 communications.

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1.1 Read this first

All modules mentioned in this document are compatible with digital panel meters PCE-DPD series (except multiinput panel meter PCE-DPD-U). Different series differ in the number of digits, the digit height and the number of output and control options they can accept.

The output and control modules mentioned in this document, are covered by the warranty of the instrument where they are installed. Check the user's manual of the instrument for more information related to warranty.

⚠ The user's manual of the instrument where the module is installed, has important information related to installation that applies also to the output and control modules mentioned in this document. Check the user's manual of the instrument for more information related to installation precautions.

CE The output and control modules mentioned in this document are covered by the 'CE declaration of conformity' of the instrument where they are installed. Check the user's manual of the instrument for more information related to the CE declaration of conformity.

1.2 Modular architecture

Digital panel meters from series M, K and S are designed following a modular architecture that allows the operator to install any od the output and control modules mentioned in this document.

1.3 Installation and start-up

To install an optional output and control module into a digital panel meter from series PCE-DPD:

1. open the housing of the instrument *(see section 1.4)*

2. install the module at slot Opt.1', 'Opt.2' or 'Opt.3' as preferred and close the instrument

3. close the housing of the instrument *(see section 1.4)*

4. if needed, configure the appropriate jumpers at the module

5. connect the signal output terminals

6. configure the parameters at the 'Configuration menu'.

   • modules ALr1, T1 and SSR are configured from the alarms menu of the instrument where the module has been installed

   • other modules are configured from its own configuration menu, accessible from menu entries 'Opt.1', 'Opt.2' or 'Opt.3', depending on the slot where the module has been installed.

1.4 To open the housing

To open the housing and access the internal circuits, use a flat screwdriver to unlock clips 'D', 'C', 'B' and 'A', in this order. Remove the front filter. Let the inside of the instrument slide out of the housing.

To reinsert the instrument make sure that all modules are correctly connected to the pins on the display module. Place all the set into the housing, assuring that the modules correctly fit into the internal guiding slides of the housing. Once introduced, place again the front filter at cover 'X', and then insert clips 'A', 'B', 'C' and 'D', in this order.
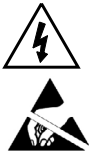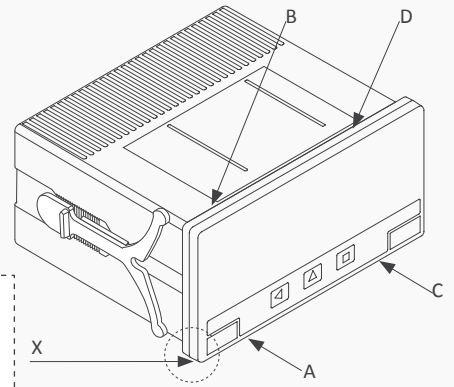
Risk of electric shock. Removing the front cover will grant access to the internal circuits. Disconnect the power and the input signal to prevent electric shock to the operator. Operation must be performed by qualified personnel only.
Observe precautions for handling ESD (electrostatic dis-charge) sensitive devices

1.5 Internal modules

Output and control modules

Opt.1

Opt.2

Opt.3

Power module

Signal module

Opt.1

Opt.2

A B C   A B C

Opt.3

A B C

Signal   Power
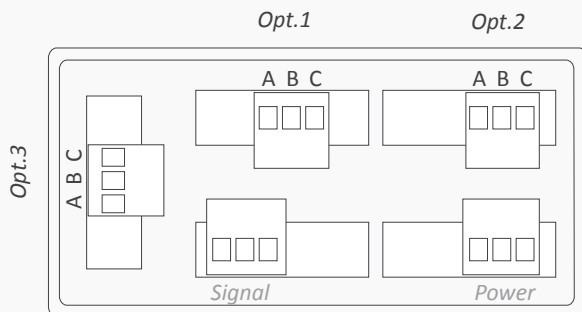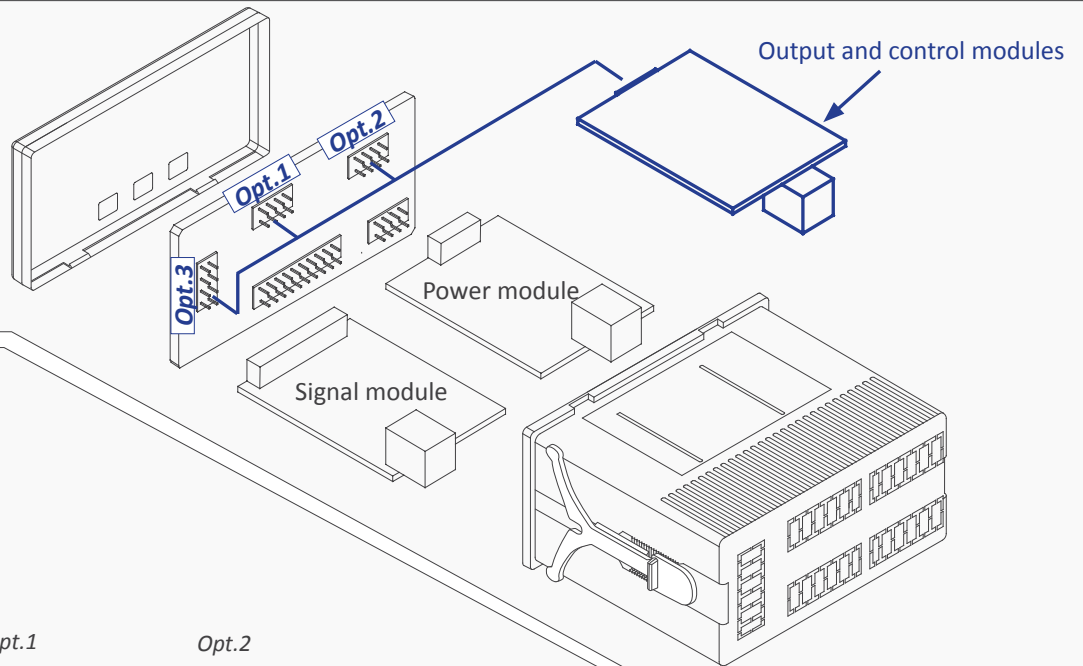
rear view

1. Options PCE-DPD/ALr1, PCE-DPD/T and PCE-DPD/SSR

Modules PCE-DPD/ALr1, PCE-DPD/T and PCE-DPD/SSR provide 1 digital 'on/off' output. The output is configured from the alarms configuration menu ('ALr.1', 'ALr.2' or 'ALr.3') of the instrument where the module is installed.

The menu allows to configure the setpoint, hysteresis, independent activation and deactivation delays, and a second setpoint to create alarm windows.

Modules R1, T1 and SSR are isolated against all other instrument circuits, and isolated between them.

Note : for more than three relays per instrument or higher relay density per module, see special modules R2, R4 and R6.

Option	PCE-DPD/ALr1
Output type	relay
Relay type	3 contact relay (NC, NO, common)
Maximum current	8 A (resistive load)
Maximum voltage	250 Vac continuous
Isolation	3500 Veff
Type of terminal	plug-in screw terminal pitch 5.08 mm
Installation allowed at	'Opt.1', 'Opt.2', ' Opt.3'
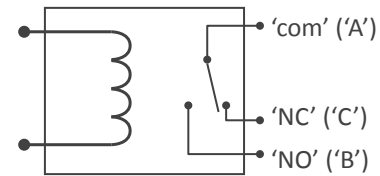
Module output schematics

Option	PCE-DPD/T
Output type	transistor
Maximum voltage	35 Vdc
Maximum current	50 mA
Isolation	3500 Veff
Type of terminal	plug-in screw terminal pitch 5.08 mm
Installation allowed at	'Opt.1', 'Opt.2', ' Opt.3'
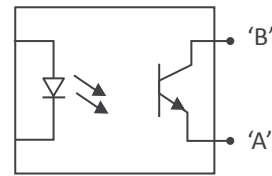
Module output schematics

Option	PCE-DPD/SSR
Output type	to control a SSR relay
Output voltage	+15 Vdc
Maximum current	45 mA
Isolation	1000 Vdc
Type of terminal	plug-in screw terminal pitch 5.08 mm
Installation allowed at	'Opt.1', 'Opt.2', ' Opt.3'
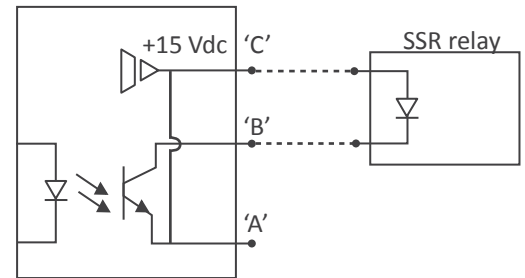
Module output schematics
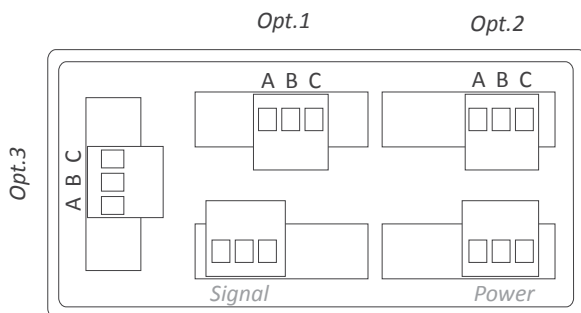
Rear view

2. Option PCE-DPD/AO

Module PCE-DPD/AO provides 1 analog output configurable as 4/20 mA or 0/10 Vdc. The output is configured from the options configuration menu ('Opt.1', 'Opt.2' or 'Opt.3') of the instrument where the module is installed.

The output signal is proportional to the reading and it can be configured for direct (positive) and inverted (negative) slopes. It accepts connection for active and passive current loops.

Modules AO are isolated against all other instrument circuits.

Option	PCE-DPP/AO
Output type	analog output
Output signals	4/20 mA active 4/20 mA passive 0/10 Vdc
Max. signal output Min. signal output	22 mA, 10.5 Vdc 0 mA, -50 mVdc
Scaling	related to the instruments reading direct or inverse slope
Vexc (terminal A)	+13.8 Vdc ± 0.4 Vdc (max. 25 mA) protected against short circuit
Load impedances	≤350 Ohms (in 4/20 mA active) ≤800 Ohms (in 4/20 mA passive) *(with a 24 Vdc external Vexc) (maximum 27 Vdc between terminals 'B' and 'C')* ≥10 KOhms (in 0/10 Vdc)
Accuracy (at 25 ºC)	<0.1 % FS
Thermal stability	60 ppm/ºC in mA mode 50 ppm/ºC in Vdc mode
Step response	<75 mSeconds + meter step response (0% to 99% signal)
Isolation	1000 Vdc
Warm-up	15 minutes
Type of terminal	plug-in screw terminal pitch 5.08 mm
Factory configuration	'Mode mA' 'Scaling 0/9999 = 4/20 mA' 'On error to high level('to_h')'
Installation allowed at	'Opt.1', 'Opt.2', 'Opt.3'

• Mode 4/20 mA active

The current loop is powered from the 'AO' module

Jumper 'M' closed
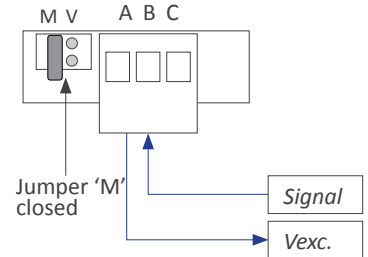
Signal

Vexc.

• Mode 4/20 mA passive

The current loop is powered from an external equipment

Jumper 'M' closed

Signal-

Signal+

• Mode 0/10 Vdc

Jumper 'V' closed

Com.
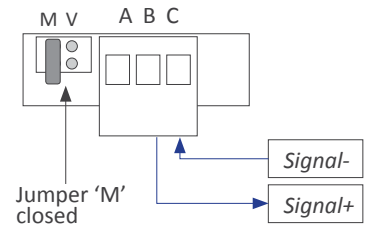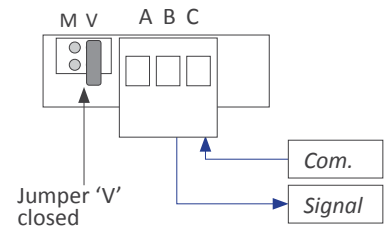
Signal

Terminal A	Vexc
Terminal B	Signal (mA or Vdc)
Terminal C	GND
Jumper M	closed for 'mA'
Jumper V	closed for 'Vdc'

Rear view
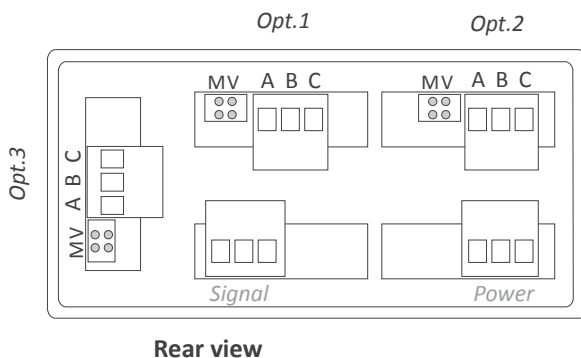
2.1 Configuration menu

Configure at menu '**Mode**' ('**ModE**') the output signal range to '**4/20 mA**' ('**mA**') or '**0/10 Vdc**' ('**Vdc**'). Position for jumpers 'V' and 'M' must be according to the range selected.

At menu '**Scaling**' ('**ScAL**') configure the values that define the two points ('high' and 'low') of the 'signal-reading' slope:

• the lower slope point, defined by '**Display low**' ('**d.Lo**') and '**Output low**' ('**Ao.Lo**')

• the higher slope point, defined by '**Display high**' ('**d.hI**') and '**Output high**' ('**Ao.hI**')

Analog output values are shown with 'XX.XX' format, acceptable values are '0.00' to '10.00' Vdc for voltage, and '0.00' to '20.00' mA for current.

Reading

Example - analog output in 4/20 mA, associated to a reading of -50.0 to 100.0

100.0 ----------------------- 'd.hI'='100.0'

'Ao.hI'='20.00'

4 mA

Analog output

20 mA

-50.0 'Ao.Lo'='4.00'

'd.Lo'='-50.0'

| `oPt 1` → `ModE` | → | `mA` | Mode 4/20 mA |
| | Mode | `Udc` | Mode 0/10 Vdc |

`ScAL` Scaling → `d.Lo` Display low → `888888`

`Ao.Lo` Output low → `888888`

`d.hI` Display high → `888888`

`Ao.hI` Output high → `888888`

`- - - -`

`on.Er` 'On error' → `to h` / `to L` *in case of error, 'to_h' to drive output to high level, 'to_L' to drive output to low level*

`FAct` Factory configuration → `no` / `YES` *select 'yES' to reload the default factory configuration*

`UEr` Version → `HHHH`

`- - - -`

2.2 Error codes

'Er.34' output signal configured to value lower than 0 Vdc or 0 mA

'Er.35' output signal configured to a value higher than 10 Vdc or 20 mA

'Er.36' configured slope points are not acceptable, such as :

    'd.Hi'='d.Lo'

    'Ao.Hi'='Ao.Lo'

    ('Ao.Hi'-'Ao.Lo')>('d.Hi'-'d.Lo')

3. Option PCE-DPD/RTU

Module PCE-DPD/RTU provides 1 Modbus RTU communications port. Using protocol function '4' ('Read Input Registers') the instrument registers are accessible (reading value, alarm status, memory of maximum and minimum, setpoint values, ...)

The protocol parameters are configured from the options configura-

tion menu ('Opt.1', 'Opt.2' or 'Opt.3') of the instrument where the module is installed.

Modules are isolated against all other instrument circuits.

Option	PCE-DPD/RTU
Output type	Modbus RTU communication port
Function implemented	4 (Read_Input_Registers)
Addresses	01 to 247
Exception codes	see section *3.3*
Registers*	see section *3.1*

available registers can vary for different models

|	
Bus	RS-485
speed	57.6 Kbps to 600 bps
Data format	8n1 (standard), 8o1, 8n2, 8e1
bus terminator	not included
Isolation	1000 Vdc
Configuration	3 button front keypad
Temperature	operation from 0 to 50 ºC
	storage from -20 to +70 ºC
Factory configuration	'Address 1'
	'Speed 19.2 Kbps'
	'Format 8n1'
	'Decimal point Auto'
Installation allowed at	'Opt.1', 'Opt.2', 'Opt.3'

Terminal B   RS-485 bus 'B' signal
Terminal A   RS-485 bus 'A' signal
Terminal G   GND

Rear vie
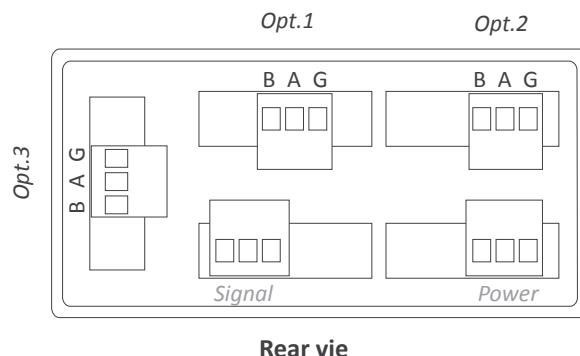
3.1 Accessible registers

Register	Name	Description	Size	Refresh	Value : Series M	Value : Series K and S
0	DISPLAY1_L	Display value	16 bits	same as display	999999 to -199999	9999 to -1999
1	DISPLAY1_H		16 bits			
2	DECIMALS1	Decimals on display	16 bits		0 to 6	0 to 4
3	MAXMEM_L	Memory of maximum	16 bits	every 30 seconds	999999 to -199999	9999 to -1999
4	MAXMEM_H		16 bits			
5	MINMEM_L	Memory of minimum	16 bits		999999 to -199999	9999 to -1999
6	MINMEM_H		16 bits			
7	SETPOINT1_L	Setpoint 1 value	16 bits	every 2 seconds	999999 to -199999	9999 to -1999
8	SETPOINT1_H		16 bits			
9	SETPOINT2_L	Setpoint 2 value	16 bits		999999 to -199999	9999 to -1999
10	SETPOINT2_H		16 bits			
11	SETPOINT3_L	Setpoint 3 value	16 bits		999999 to -199999	9999 to -1999*
12	SETPOINT3_H		16 bits			
13	STATUS	Alarm status Instrument status	16 bits	same as display	bit 0...7 alarm status bit 8...16 instrument status	
14 a 16	Reserved	Reserved	16 x 3 bits		Not accessible	Not accessible

Table 1 - Registers accessible via MODBUS-RTU
All registers codified as binary numbers. Negative values are codified in two's complement. Available registers can vary for different models. Register 11 is not accessible to instruments from series S (limited to 2 output and control option modules)

3.2 Configuration menu
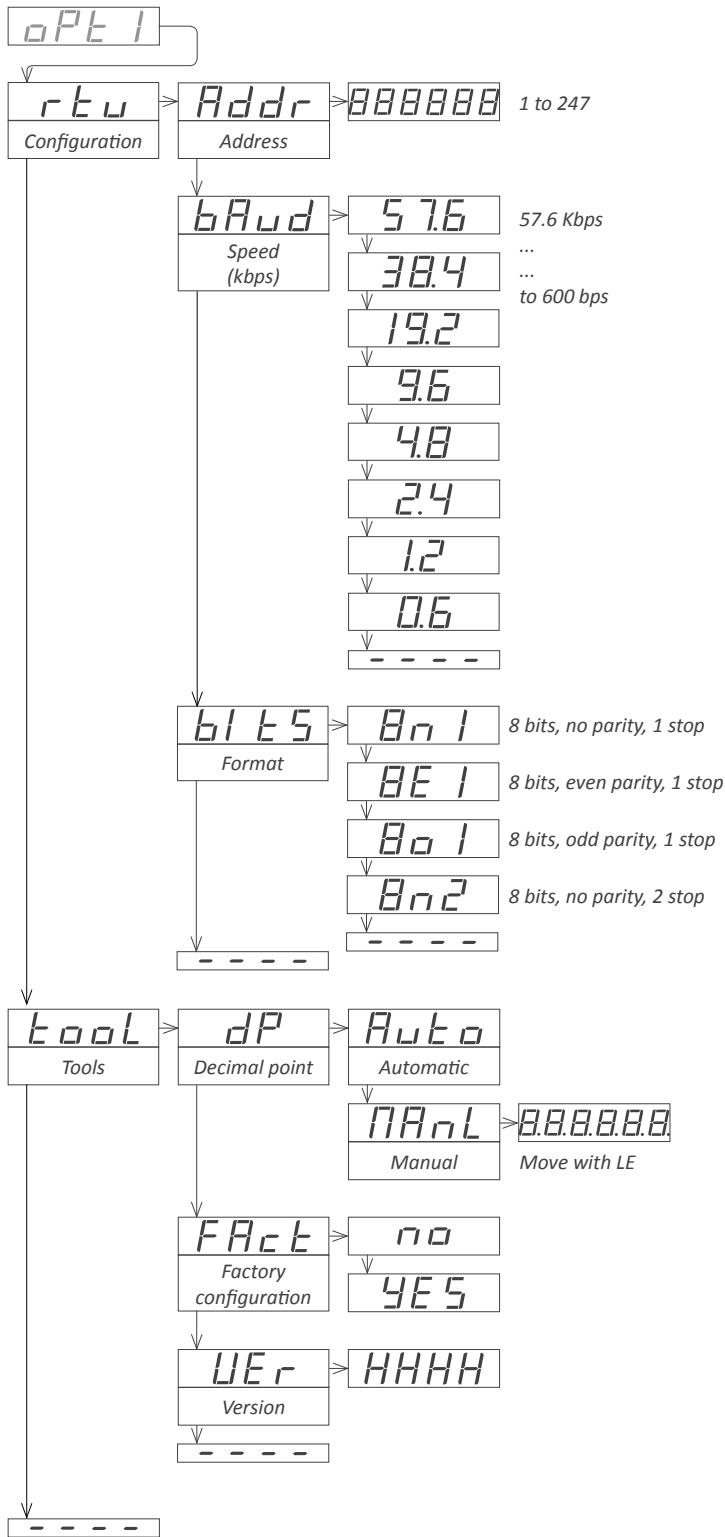
Configure at menu '**Configuration**' ('**rtu**'), the address value between '1' and '247' at parameter '**Address**' ('**Addr**'), bus speed in kbps at parameter '**Speed**' ('**bAud**') and data format at parameter '**Format**' ('**bItS**').

Special tools are grouped inside the '**Tools**' ('**TooL**') menu.

• the '**Decimal point**' ('**dP**') menu is provided for compatibility with ancient hardware that does not support decimal point retransmission. By default, select '**Automatic**' ('**Auto**'). If your instrument does nos transmit the decimal point position, select '**Manual**' ('**MAnL**') and fix the position of the decimal point manually.

• at the '**Factory reset**' ('**FAct**') menu, select '**yes**' to load the default factory configuration for the instrument.

the '**Version**' ('**VEr**') menu informs of the current firmware version installed in the module.

3.3 Exception codes

The Modbus RTU protocol defines the following scenarios when a 'Master' is sending a frame to a 'Slave':

• the 'Slave' device receives the frame correctly and replies with the requested data

• the 'Slave' devices detects a CRC error, parity error, or other. and discards the frame without generating a reply frame. The 'Master' will detect a 'TIMEOUT' condition due to the absence of reply.

• the 'Slave' device receives the frame correctly, but replies with an 'EXCEPTION_CODE' as it can not process the function or register requested.

The 'EXCEPTION_CODES' configured in the RTU module are :

Exception code	Name	Description
0	ILLEGAL_FUNCTION	*Requested function is not supported*
1	ILLEGAL_DATA_ADDRESS	*Requested register is not supported*
Table 2 - Exception codes		

3.4 Description and example of registers

Register R0 and R1 (DISPLAY1_L and DISPLAY1_H)

Contains the display value of the instrument, codified in two registers of 16 bits each. Possible values are from 999999 to -199999. Decimal point position is codified on register R2.

> *Example   R0=FBF1 (hex) and R1=0009 (hex)*
>
> *Register value = 0009 FBF1 (hex)*
>
> *Reading value = 654321*

Register R2 (DECIMALS1)

Contains the number of decimals of the display, codified in a single register of 16 bits. Possible values are from 0 to 6.

> *Example   R2=0002 (hex)*
>
> *Number of decimals = 2 = 6543.21*

Register R3 and R4 (MAXMEM_L and MAXMEM_H)

Contains the memory of maximum reading of the instrument, codified in two registers of 16 bits each. Possible values are from 999999 to -199999. Decimal point position is codified on register R2.

> *Example - same example as in R0 and R1 but accessing to R3 and R4.*

Register R5 and R6 (MINMEM_L and MINMEM_H)

Contains the memory of minimum reading of the instrument, codified in two registers of 16 bits each. Possible values are from 999999 to -199999. Decimal point position is codified on register R2.

> *Example - same example as in R0 and R1 but accessing to R5 and R6.*

Register R7 and R8 (SETPOINT1_L and SETPOINT1_H)

Contains the setpoint value of alarm 1, codified in two registers of 16 bits each. Possible values are from 999999 to -199999. Decimal point position is codified on register R2.

> *Example - same example as in R0 and R1 but accessing to R7 and R8.*

Register R9 and R10 (SETPOINT2_L and SETPOINT2_H)

Contains the setpoint value of alarm 2, codified in two registers of 16 bits each. Possible values are from 999999 to -199999. Decimal point position is codified on register R2.

> *Example - same example as in R0 and R1 but accessing to R9 and R10.*

Register R11 and R12 (SETPOINT3_L and SETPOINT3_H)

Contains the setpoint value of alarm 3, codified in two registers of 16 bits each. Possible values are from 999999 to -199999. Decimal point position is codified on register R2.

> *Example - same example as in R0 and R1 but accessing to R11 and R12.*

Register R13 (STATUS)

Information bit-by-bit, for the alarm status (on / off) and instrument status. See below for a description.

> Bit 0   Alarm 1 status (0 = inactive, 1 = active)
> Bit 1   Alarm 2 status (0 = inactive, 1 = active)
> Bit 2   Alarm 3 status (0 = inactive, 1 = active)
> Bit 3 a 7   Reserved
> Bit 8   Display overrange
> Bit 9   Display underrange
> Bit 10   Lost communication with the main processor
> Bit 11 to 15   Reserved

Registers R14, R15 and R16

Reserved

4. Option PCE-DPD/AScI4

Module PCE-DPD/AScI4 provides 1 RS-485 ASCII communications port. Protocol with 'master' - 'slave' architecture, addressable up to 31 modules. Frames codified in representable ASCII characters (codes 32 to 255), which are visible using 'hyperterminal' or similar programs.

Instrument registers are accessible through the RS-485 ASCII port (reading value, alarm status, memory of maximum and minimum, setpoint values, ...)

The protocol parameters are configured from the options configuration menu ('Opt.1', 'Opt.2' or 'Opt.3') of the instrument where the module is installed.

Option	PCE-DPD/AScI4
Output type	RS-485 ASCII communication port
Bus	RS-485
Speed	57.6 Kbps to 600 bps
Data format	8n1 (standard), 8o1, 8n2, 8e1
Protocol	ASCII
Architecture	'master - slave'
Addresses	01 to 31
'Broadcast' address	128
Registers*	see section *4.1*

available registers can vary for different models

Isolation	1000 Vdc
Configuration	3 button front keypad
Temperature	operation from 0 to 50 ºC
	storage from -20 to +70 ºC

Factory configuration	'Mode	Slave'
	'Address	1'
	'Speed	19.2 Kbps'
	'Format	8n1'
	'Decimal point	Auto'
configuration 'Master'	'Destination address	31'
	'Frequency	0.5 seconds'
tools	'Decimal point	Auto'
	'Legacy	Off'
	'Answer delay	0 mSeconds'
Installation allowed at	'Opt.1', 'Opt.2', 'Opt.3'	

Terminal B   RS-485 bus 'B' signal
Terminal A   RS-485 bus 'A' signal
Terminal G   GND

Rear view
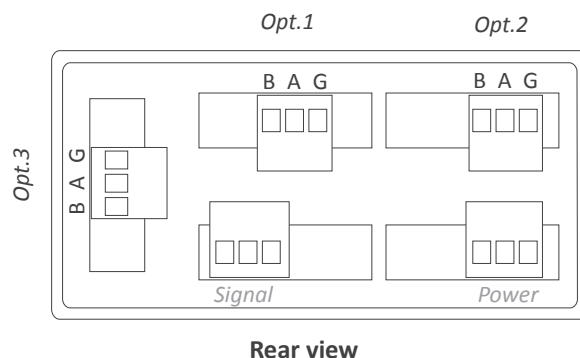
4.1 Accessible registers

Display values (DISPLAY1, MAXMEM, MINMEM, AL1, AL2, AL3) are codified with a minimum of 6 digits (left zeros are added if necessary), polarity and decimal point.

Register	Name	Description
0	DISPLAY1	Display1 value
1	MAXMEM	Memory of maximum
2	MINMEM	Memory of minimum
3	AL1	Setpoint 1 value
4	AL2	Setpoint 2 value
5	AL3	Setpoint 3 value
6	STATUS	Alarm status

Table 3 - Accessible registers for ASCII protocol.

Register 0 - DISPLAY1
Contains the display value of the instrument, in ASCII code, including polarity (positive / negative) and decimal point.

> *Example 1*   R0='+' '0' '6' '5' '4' '3' '.' '2'
> Display value = 6543.2
> *Example 2*   R0='-' '0' '0' '0' '4' '.' '5' '2'
> Display value = -4.52

Register 1 - MAXMEM
Contains the value for memory of maximum, in ASCII code, including polarity (positive / negative) and decimal point.

Register 2 - MINMEM
Contains the value for memory of minimum, in ASCII code, including polarity (positive / negative) and decimal point.

Register 3 - AL1
Contains the value for alarm 1 setpoint, in ASCII code, including polarity (positive / negative) and decimal point.

Register 4 - AL2
Contains the value for alarm 2 setpoint, in ASCII code, including polarity (positive / negative) and decimal point.

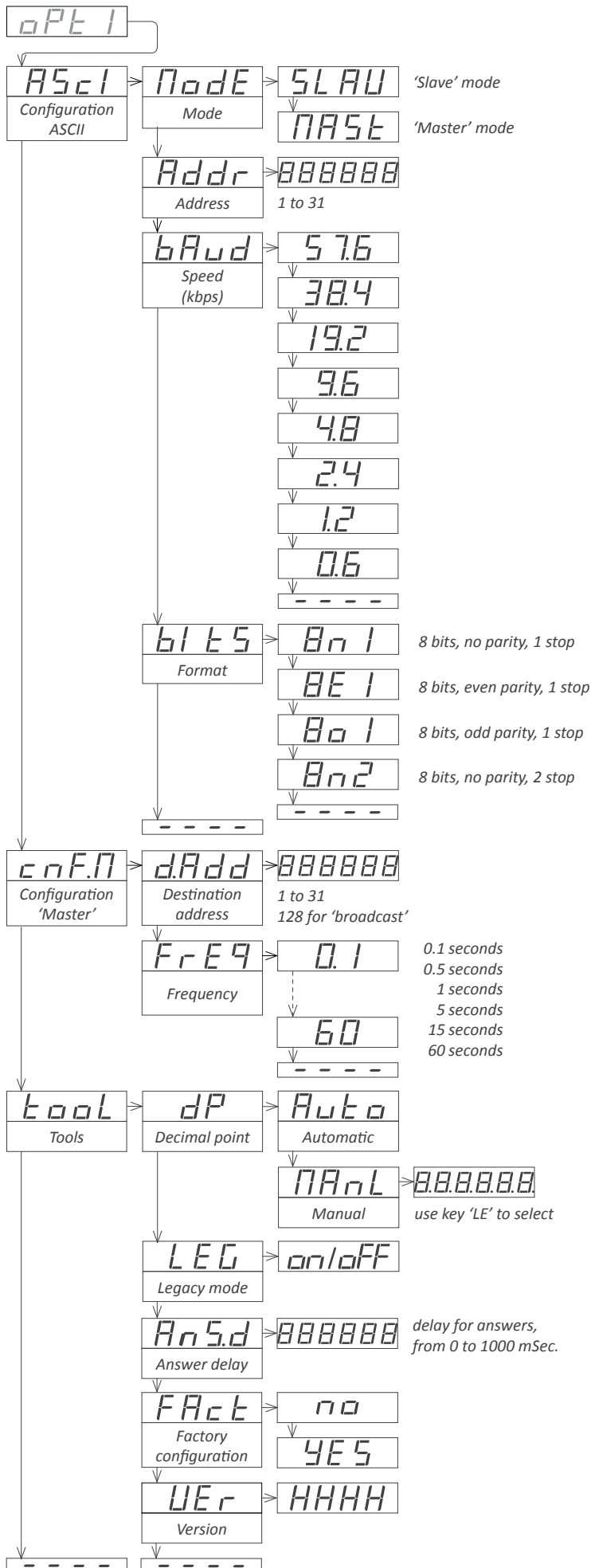**Register 5 - AL3**
Contains the value for alarm 3 setpoint, in ASCII code, including polarity (positive / negative) and decimal point.

Register 6 - STATUS
Contains the alarm status (on/off).

> Bit 0   Alarm 1 status (0 = inactive, 1 = active)
> Bit 1   Alarm 2 status (0 = inactive, 1 = active)
> Bit 2   Alarm 3 status (0 = inactive, 1 = active)
> Bit 3 to 15   Reserved

4.2 Configuration menu

oPt 1

AScI Configuration ASCII	**ModE** Mode	**SLAU**	'Slave' mode
		MASt	'Master' mode
	Addr Address	**888888**	1 to 31
	bAud Speed (kbps)	**57.6**	
		38.4	
		19.2	
		9.6	
		4.8	
		2.4	
		1.2	
		0.6	
		– – – –	
	bItS Format	**8n1**	8 bits, no parity, 1 stop
		8E1	8 bits, even parity, 1 stop
		8o1	8 bits, odd parity, 1 stop
		8n2	8 bits, no parity, 2 stop
		– – – –	

cnF.M Configuration 'Master'	**d.Add** Destination address	**888888**	1 to 31 128 for 'broadcast'
	FrEq Frequency	**0.1**	0.1 seconds 0.5 seconds 1 seconds 5 seconds 15 seconds 60 seconds
		60	
		– – – –	

tooL Tools	**dP** Decimal point	**Auto**	Automatic
		MAnL	**8.8.8.8.8.8** use key 'LE' to select
		Manual	
	LEG Legacy mode	**on/oFF**	
	AnS.d Answer delay	**888888**	delay for answers, from 0 to 1000 mSec.
	FAct Factory configuration	**no**	
		YES	
	UEr Version	**HHHH**	

At menu '**Configuration ASCII**' ('**AScI**'), configure the instrument at parameter '**Mode**' ('**ModE**') to work as 'slave' or 'master', at parameter '**Address**' ('**Addr**') set the address value from '1' to '31', set the bus speed in kbps at parameter '**Speed**' ('**bAud**') and set the data format at parameter '**Format**' ('**bItS**').

When working as 'master', the instrument continuously transmits the display value data frame. The local module address is '0'. Configure at menu '**Configuration Master**' ('**cnF.M**') the '**Destination address**' ('**d.Add**') parameter from '1' to '31' or use value '128' for a broadcast message. At parameter '**Frequency**' ('**FrEq**') select the how often the frame with the reading value will be transmitted.

Special tools are grouped inside the '**Tools**' ('**TooL**') menu.

• the '**Decimal point**' ('**dP**') menu is provided for compatibility with ancient hardware that does not support decimal point retransmission. By default, select '**Automatic**' ('**Auto**'). If your instrument does nos transmit the decimal point position, select '**Manual**' ('**MAnL**') and fix the position of the decimal point manually.

•the '**Legacy mode**' ('**LEG**') parameter is provided to maintain compatibility with instruments with older communication protocols. Select '**on**' to activate this mode.

• the '**Answer delay**' ('**AnS.d**') parameter applies only to 'Slave' mode. The local module delays the answer frame. Configure for applications where the 'Master' needs additional time to switch between 'transmit' and 'receive' modes. Enter a numeric value between '0' and '1000' mSeconds.

• at the '**Factory reset**' ('**FAct**') menu, select '**yes**' to load the default factory configuration for the instrument.

the '**Version**' ('**VEr**') menu informs of the current firmware version installed in the module.

4.3 Frame types

The ASCII protocol defines the following frames:

• Frame 'read' ('**RD**'). Id code 36. Request data frame. The requested register is indicated into the 'REG' byte ('Header' section).

• Frame 'answer' ('**ANS**'). Id code 37. Response frame to a request data frame. The requested register is indicated into the 'REG' byte' ('Header' section). Data of the requested register is indicated into data bytes 'D0' to 'Dn' ('Data' section).

• Frame 'error' ('**ERR**'). Id code 38. Response frame to a request data frame. Indicates that an error has occurred. Error code is codified into the 'REG' byte ('Header' section).

• Frame 'ping' ('**PING**'). Id code 32. Used to confirm the existence of the remote instrument.

• Frame 'pong' ('**PONG**'). Id code 33. Response to a 'ping' frame. It confirms the existence of the remote instrument.

4.4 Frame structure

Header								Data				Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	D0	D1	...	Dn	CRC	ETX
2	x	32	x	x	x	32	n+1	[data]				x	3
0	1	2	3	4	5	6	7	8	9	...	n+7	n+8	n+9

Protocol frames have a structure made of 'Header', 'Data' and 'Trail'.

Section 'Header'

Contains the start byte ('STX'), the frame identifier ('ID'), the origin address ('FROM') and the destination address ('TO'), the register id ('REG') and the length ('LONG') of the 'Data' section.

Section 'Data'

Contains data for the requested register ('REG').

Section 'Trail'

Contains the 'CRC' code and the end of frame byte ('ETX').

'Real value' and 'Frame value'

To use representable ASCII values, the real values are codified before being sent into the frame. The following definitions apply :

• 'real value' is the value of the field without codification

• 'frame value' is the value of the field, codified

Field	Description	Size	Position	Real value	Frame value
STX	Start of frame	1 byte	0	does not apply	2
ID	Frame type	1 byte	1	(see section 4.4)	real_value
RSV	Reserved	1 byte	2	0	32
FROM	Origin address	1 byte	3	0 ('Master') / 1 to 31 ('Slave')	32 + real_value
TO	Destination address	1 byte	4	0 ('Master') / 1 to 31 ('Slave') 128 ('broadcast')	32 + real_value
REG	Register identification	1 byte	5	(see section 4.1)	32 + real_value
RSV	Reserved	1 byte	6	0	32
LONG	Length of 'Data' section	1 byte	7	n (between 0 and 32)	32 + real_value
D0 ... Dn	Data	n bytes	8 to n+7	number 0 to 9 decimal point polarity (+/-)	ASCII code of the number (48 to 57) ASCII code of decimal point (46) ASCII code of '+' (43) ASCII code of '-' (45)
CRC	CRC calculation	1 byte	n+8	does not apply	(see section 4.7)
ETX	End of frame	1 byte	n+9	does not apply	3
Table 4 - Description of the bytes for the ASCII frame					

4.5 Error codes

Frames 'ERR' contain within the 'REG' field, the error code. Available error codes are :

error 1	unknown register
error 2	display overrange
error 3	display underrange
error 4	CRC error
error 5	internal error

4.7 Frame examples

4.7.1 Frames 'RD' (36) and 'ANS' (37)

Example - 'Master' (address '0') requests the value of register '0' (display value) to the 'Slave' at address '28' ('RD' frame) and the 'Slave' replies to the 'Master' with a reply frame ('ANS' frame) containing the requested data (765.43).

*Instruments with 4 digits also send reading values formatted with 6 digits : value -321.5 is transmitted as -00321.5

Header								Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	CRC	ETX
2	36	32	32	60	32	32	32	58	3
Start	RD	---	0	28	0	---	0	CRC	Stop

Header								Data								Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	D0	D1	D2	D3	D4	D5	D6	D7	CRC	ETX
2	37	32	60	32	32	32	40	43	48	55	54	53	46	52	51	15	3
Start	ANS	---	28	0	0	---	8	+0765.43								CRC	Stop

4.7.2 Frames 'ERR' (38)

Example - 'Slave' at address '11' replies to the 'Master' (address '0') with an error frame ('ERR' frame) indicating that the requested register number is unknown ('UNKNOWN_REGISTER', error code '1'). The

error code is codified into the 'REG' byte. For a list of error code see section 4.6.

Header								Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	CRC	ETX
2	38	32	43	32	33	32	32	46	3
Start	ERR	---	11	0	1	---	0	CRC	Stop

4.7.3 Frames 'PING' (32) and 'PONG' (33)

Example - 'Master' (address '0') requests confirmation of existence to the 'Slave' at addrress '22' ('PING' frame) and the 'Slave' replies to the 'Master' with a 'PONG' frame.

Header								Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	CRC	ETX
2	32	32	32	54	32	32	32	52	3
Start	Ping	---	0	22	0	---	0	CRC	Stop

Header								Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	CRC	ETX
2	33	32	54	32	32	32	32	53	3
Start	Pong	---	22	0	0	---	0	CRC	Stop

4.6 CRC calculation

The 'frame value' for the CRC byte is calculated applying a XOR function to the 'frame value' *(see section 4.5)* of all bytes in sections 'Header' and 'Data', from byte '0' ('STX') to the last data byte ('Dn').

• if the calculated CRC value is lower than '32', it is normalized by applying the 'one's complement' function .

CRC0=STX ^ ID ^ RSV ^ FROM ^ TO ^ REG ^ RSV ^ LONG ^ D0 ^...^ Dn

- • if (CRC0<32) -> CRC=!CRC0 (one's complement function)
- • if (CRC0>31) -> CRC=CRC0

```
//example of CRC calculation in C language
int8 Calculate_CRC(int8 CRC_Position)
{
 int8 i,CRC=0;
  for(i=0;c<CRC_Position;c++)
  {
     crc=crc ^ frame[i];
  }
 if(crc<32) CRC=~CRC;
 return(CRC);
}
```

5. Option PCE-DPD/AScI2

Module PCE-DPD/AScI2 provides 1 RS-232 ASCII communications port. Protocol specifications are the same sa with module S4 *(see section 4)*, with only difference that the physical bus is RS-232 instead of RS-485.

S2 modules allow for point-to-point communication over RS-232 and also allow for multinode communication over RS-232 using a 'Daisy-Chain' type of connection.

Terminals RX1 and TX1 are for connection to the RS-232 bus. Terminals RX2 and TX2 are for RS-232 multinode connection. Frames received on RX1 with destination address different than the local instrument's address, will be retransmitted over the TX2 terminal. In a similar way, frames received from RX2 with destination address

Option	PCE-DPD/AScI2
Output type	RS-232 ASCII communication port
Bus	RS-232
Speed	57.6 Kbps to 600 bps
Data format	8n1 (standard), 8o1, 8n2, 8e1
Protocol	ASCII
Architecture	'master - slave'
Addresses	01 to 31
'Broadcast' address	128
Registers*	see section *4.1*

available registers can vary for different models

Isolation	1000 Vdc
Configuration	3 button front keypad
Temperature	operation from 0 to 50 ºC
	storage from -20 to +70 ºC
Installation allowed at	'Opt.1', 'Opt.2', 'Opt.3'

Terminal E	*GND*	*Terminal B*	*Rx2*
Terminal D	*Rx1*	*Terminal A*	*Tx2*
Terminal C	*Tx1*		

Rear view
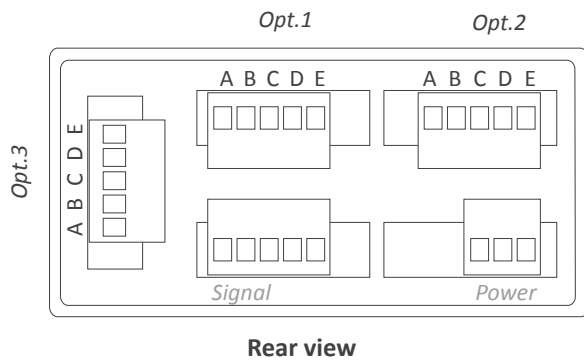
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