

# Operating instructions for pressure transmitter PASCAL CV PROFIBUS PA Type series CV3... with display module



### Features

- Modular pressure transmitter
- Output signal: PROFIBUS PA per IEC 61158-2
- Multifunctional display with 5-segment digital display and bar graph
- Watchdog for electronics modules and measuring cell
- Hygienic housing design, stainless steel, excellent moisture protection
- Accuracy:  $\leq 0.15\%$
- Turndown 5:1
- Explosion protection for gases and dust
- Degree of protection IP 66
- Piezoresistive measuring cell, directly aerated, fully welded, without inside gasket



### Basic modules 4...20 mA



### PROFIBUS PA



### Function modules

#### switching module



#### HART® module



### Display module



Various modules can easily be added to PASCAL CV

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## General

These operating instructions refer to installation, commissioning, servicing and adjustment. Statutory regulations, valid standards, additional technical details in the relevant data sheet, details of the type plate and any additional certificates are to be observed along with these operating instructions.



### Safety instructions

- Installation, operation and maintenance of the instrument may be executed by authorized personnel, only, using suitable equipment.
- Warning: If the instrument is used incorrectly it is possible that serious injuries or damage can occur!
- Prior to the disassembly of the pressure transmitter the impulse ducts between the measuring transmitter and the process have to be locked and relieved from pressure.
- The standard nominal pressure rating and the permissible operating temperature of the gasket should be observed for all process connections. Operation outside the allowed nominal pressure rating, especially with clamp connections, is only possible with suitable clamps. In this case, note DIN 32676 for stipulations on heat resistance.
- Pressure transmitters that are mechanically defective can cause injuries or give rise to process faults. Suitable precautions should be taken to avoid this.



### CE marking

The CE marking on the instruments certifies compliance with valid EU directives for bringing products to market within the European Union. The following directives are met:

EMC directives	EMC	2004/108/EC
Pressure Equipment Directive	PED	97/23/EC
Ex directive	ATEX	94/9/EC



### Ex approval

Electrical equipment in hazardous areas should only be installed and commissioned by competent personnel. Modifications to devices and connections destroy the operating safety, the ex-proofing and the guarantee. The limit values detailed in the EC Type-Examination Certificate of conformity are to be observed.

Certificate no.	TÜV 04 ATEX 2387 X
Ex-protection	
intrinsically safe	 II 1/2 G Ex ia IIC T4/T5/T6 Ga/Gb
Ex-protection dust	 II 2 G Ex ia IIC T4/T5/T6 Gb
	 II 2 D Ex ia IIC T xx °C Db

### Mounting and operating

Details about electrical connection of the device see page 5-7.

General instructions for PROFIBUS PA see page 18.

Mounting instructions for PROFIBUS PA see

[www.profibus.com](http://www.profibus.com) (Downloads).

- Before mounting the instrument ensure that pressure range, overpressure resistance, media compatibility, thermostability and pressure port are suitable for the process at hand.
- Conduct process installation before electrical installation.
- Measuring instruments that should not have any oil or grease residues in the pressure port are marked „Free of oil and grease“.
- Gaskets must be chosen that are suited to the process connection and resistant to the measured medium.
- Check for pressure tightness when commissioning the transmitter.
- Do not insulate the temperature decoupler, as this would reduce the decoupling effect. Follow DIN 32676.
- Wire up the instrument with power switched off.
- The housing in protection class IP66 consists of a two chamber system in which the measuring cell is aerated directly in relation to the environment by means of a PTFE filter system.
- The instrument can only be protected against electromagnetic interference (EMC) when the conditions for screening, earthing, wiring and potential isolation are met during installation.

- The mounting position should be taken into consideration when checking the zero output. Standard transmitters are adjusted at the factory for vertical mounting. Changes to the mounting position can cause zero shifts at pressure ranges  $\leq 2$  bar. These drifts can be corrected by adjustment on site.
- When the instrument is opened any contact with the electrical connections can affect the signals. This situation can be avoided by switching off the supply voltage or by disconnecting the signal circuit.
- The types of protection IP66 are only achieved, when the threaded ring has been screwed tight after electrical connection/parameterization.
- The instrument requires no maintenance.

### Instructions for the operation with diaphragm seal

- To avoid soiling and damage remove protective cap or wrapping in front of the separating diaphragm before mounting.
- Do not touch the flush mounted separating diaphragm, as there is a danger of deformation at measuring ranges to 10 bar / 150 psi. Instrument zero point and measuring characteristics could also be affected.
- Measuring instrument and diaphragm seal are a closed system and should not be separated.
- Avoid overtightening the process screw joints as this can result in zero displacements at the pressure transmitter (fixing error).
- When using systems with capillary for vacuum measurements always mount the pressure transmitter underneath the diaphragm seal. The instruments are set at the factory with pressure transmitter and diaphragm seal at the same height. Correct any differences in height between diaphragm seal and pressure transmitter arising from conditions on site on the pressure transmitter when placing the instrument into operation (see "Setting the measuring range"). When correcting for elevation be aware of the adjustment limits.
- Be sure to install and securely fasten the capillary to avoid vibrations. Roll up overlengths with a minimum radius of 50 cm. Shock and changes in temperature can impact on measurements.
- Process and ambient temperatures can cause zero displacements at the pressure transmitter with some system designs. We can supply you with an error analysis.

## Certificates / Approvals

Interference emission EN 55011  
Noise immunity EN 61326

### Ex-approval

The limit values detailed in the EC-Type Examination Certificate are to be observed!

EG-Type Examination

Certificate TÜV 04 ATEX 2387 X

Type of ex-protection  $\text{Ex}$  II 1/2 G Ex ia IIC T4/T5/T6 Ga/Gb

$\text{Ex}$  II 2 G Ex ia IIC T4/T5/T6 Gb

$\text{Ex}$  II 2 D Ex ia IIIC Txx°C Db

Permissible temperatures for pressure transmitter with category II 1/2 G

Temperature class	Ambient temperature	Medium temperature
T6	-20...+55 °C	-20...+55 °C
T5	-20...+80 °C	-20...+60 °C
T4	-20...+85 °C	-20...+60 °C

Permissible temperatures for pressure transmitter with category II 2G

Temperature class	Ambient temperature	Medium temperature
T6	-20...+55 °C	-20...+55 °C
T5	-20...+80 °C	-20...+80 °C
T4	-20...+85 °C	-20...+85 °C

Permissible temperatures for pressure transmitter with category II 2D

Max. surface temperature	Ambient / Medium temperature
65 °C	40 °C
85 °C	60 °C
105 °C	80 °C
110 °C	85 °C

### Electrical data

Sum of maximum values in the intrinsically safe circuits (acc. to IEC 60079-27;FRISCO)

$U_i = 17,5 \text{ V}$

$L_i = 10 \mu\text{H}$

The effective internal capacitance is negligible small.

### Special conditions for safe use

The pressure port of the pressure transmitter PASCAL CV type CVxx is allowed to be operated in an explosion hazardous atmosphere, which requires apparatus of the category 1, only if atmospheric conditions exist (Temperature from -20°C to 60°C, pressure from 0.8 bar to 1.1 bar).

The maximum surface temperature regarding dust explosion protection was determined without dust layer. Additional information has to be taken from EN 60079-14.

## **Electrical connection**

### **General**

If you make electrical modifications to the device, add/remove a function module or connect electrical device leads, you must de-energize the device first.

If you open up the device you run the risk of interfering with the signals by making contact with the electrical connections. To avoid this, switch off the supply voltage or isolate the signal circuit.

### **EMC interference immunity**

You can only protect against electromagnetic interference (EMC) by fulfilling the requirements for screening, grounding, wiring and potential isolation during installation and assembly.

To improve interference immunity please observe the following:

- lay signal cable so that it is isolated from all cables with voltages > 60 V
- use cable with twisted strands
- if possible, avoid installing the device near large electrical systems or use shielded cable
- use shielded cable to fully comply with the specification
- do not break or interrupt bus cable shielding
- Be sure to ground the shielding at each cable end. The cable between shielding and ground should be as short as possible
- When there are large differences in potential between different ground connection points, connect only one point to the ground reference plane. Connect all other shield ends to reference voltage across an RF capacitor.  
Solid dielectric, e.g. ceramic
  - capacitance  $\leq 10$  nF
  - dielectric strength > 1500 V

Caution!

Please refer to PROFIBUS PA specification EN 50170 for more instructions on network layout and grounding.

### **BUS-CABLE**

We recommend you use a shielded and twisted two-core cable.

The specifications below apply to installations in hazardous areas (EN 60079-27, FISCO):

- loop resistance (DC): 15 - 150  $\Omega$ /km
- inductance per unit length: 0.4 - 1 mH/km
- capacitance per unit length: 45...200 nF/km (including shield)

suitable cables (non-hazardous area):

- Siemens 6XV1830-5EH10 (violet)
- Belden 3076F (orange)

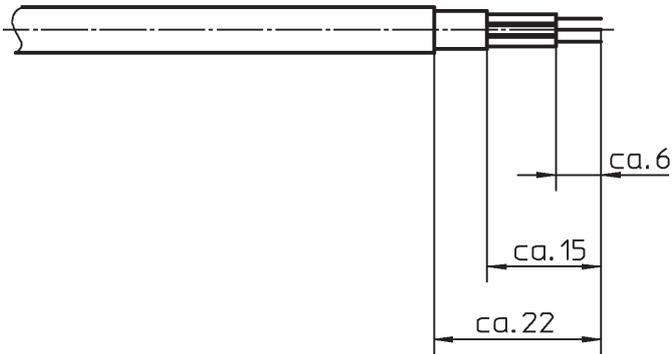
suitable cables (hazardous area):

- Siemens 6XV1831-2A (blue)

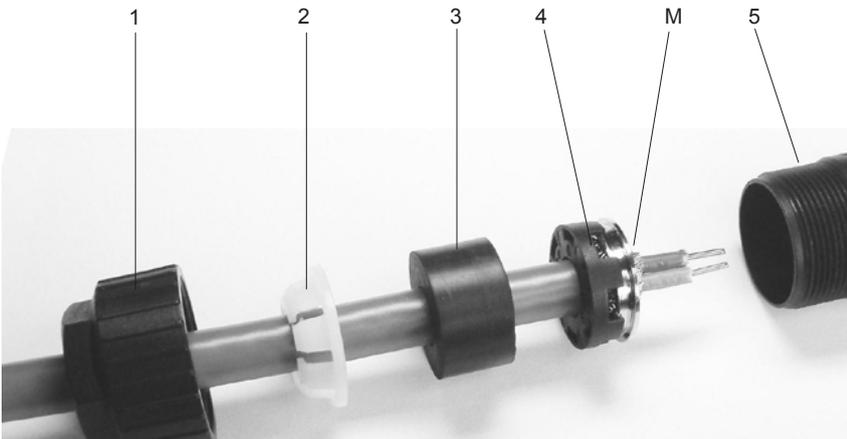
## Connection the 4-pole M12x1 connector

The PASCAL CV PROFIBUS PA version with M12 connector is supplied pre-wired. You can connect the device to the bus with a prefabricated cable or a self-fabricated connector.

### Preparing the cable:



### Design of M12 x 1 circular connector

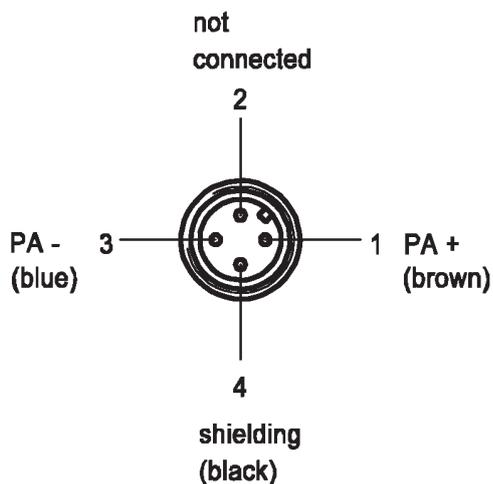


- 1 Nut
- 2 Strain relief
- 3 Gasket
- 4 Shielding contact element  
Caution: the metal side (M) of the shielding contact element must point in the direction of the housing.
- 5 Housing

### Connection diagram

circular plug connector M12x1

View of pins and connector at device



## Connection cable gland M 16 x 1.5



- Preparing cable
- strip cable
  - expose wire braid



- Inserting the cable
- thread cable through union nut
  - slip cable into clamping insert
- 
- stretch and spread wire braid over clamping insert  
the wire braid must stretch approximately 2 mm beyond the O-ring



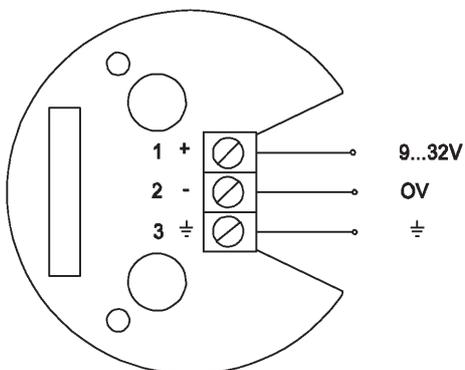
- Fit thread adapter
- slip clamping insert into connecting piece



- tighten thread adapter

## Connection diagram

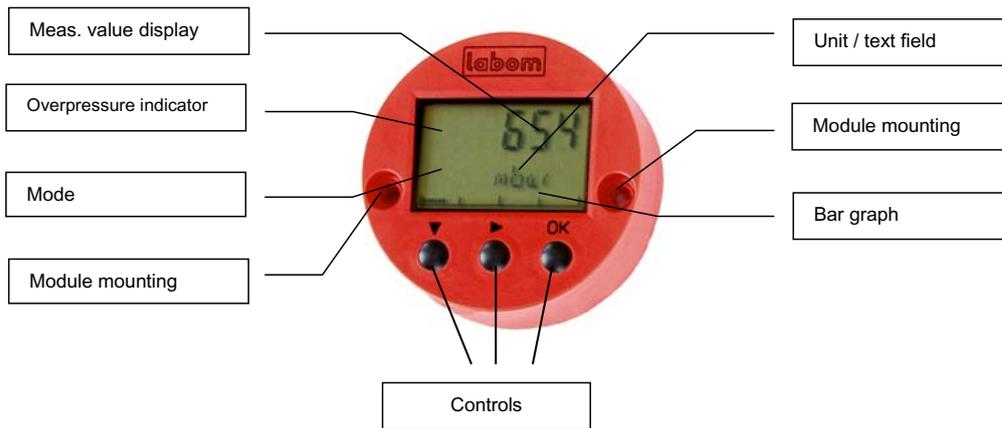
PROFIBUS PA-Module



Modules may only be exchanged/added when the power supply has been switched off!

# Operation of pressure transmitter PASCAL CV with display module SW Rev. 1.1.4

The standard factory setting for the display module can be found in the table on page 9.



## Meas. value display

Display of the current measuring value (see page 9)

## Overpressure display

If the pressure applying to the pressure transmitter exceeds the sensor limits, then the measuring value display begins to flash and an upward-pointing arrow ↑ appears on the display.

## Mode

C = Change (input mode when changing a parameter)  
I = Info (the ACTUAL value specified by the user)  
W = Warnings (Warning of critical states)  
E = Error (error messages)

## Module mounting

When mounting the modules, the screws should not be over-tightened.  
Modules may only be exchanged/added when the power supply has been switched off!

## Unit / text field

Shows the physical unit or displays a text field

## Bar graph

The bar graph shows the current pressure in all menus, based on the set measuring range.  
If the level drops below the set measuring range, the zero point of the bar graph shifts to the right end of the scale and the progression of numbers moves to the left.  
After the set measuring range is exceeded, no further changes are made.

## Controls

The button function depends on the length of time the button is pressed

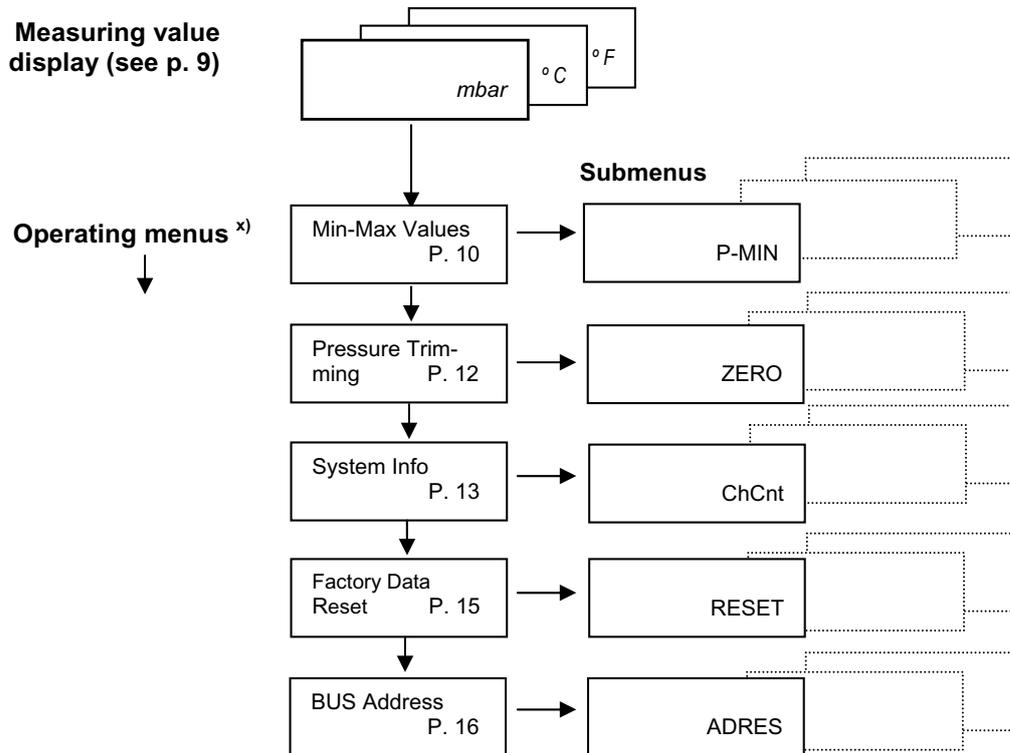
“Short” function : approx. 1 sec.  
“Long” function : approx. 10 sec.

Special button functions (irrespective of the position in the menu) :

Left button => allows you to switch from the current operating menu to the next operating menu  
Left **and** middle button “short” => Return to measuring value display (also takes place if the buttons are not pressed after 5 minutes)  
Left **and** right button “long” => Activate / deactivate write protection (input locked / input active)

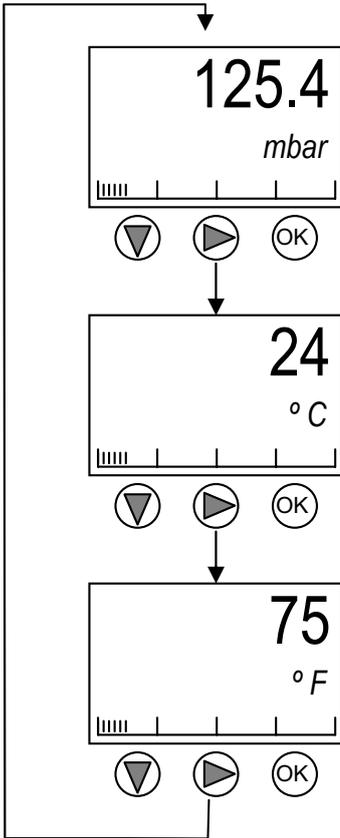
## Menu structure

The transmitter is configured by means of an input menu with the following structure:



x) the left button allows you to switch from the current operating menu to the next operating menu.

## 1. Measuring value display



### Pressure display

Numerical display : Current pressure  
 Text field : mbar (selected physical unit)  
 Bar graph : Pressure (display in the set range)

### Temperature display (°C)

Numerical display : Temperature at the pressure sensor  
 Text field : °C (degrees Celsius)  
 Bar graph : Pressure (display in the set range)  
 Note : The temperature indicator shows the temperature at the sensor; the process temperature can vary from this.

### Temperature display (°F)

Numerical display : Temperature at the pressure sensor  
 Text field : °F (degrees Fahrenheit)  
 Bar graph : Pressure (display in the set range)  
 Note : The temperature indicator shows the temperature at the sensor; the process temperature can vary from this..

### Selecting Measuring value display as standard display

1. Select with the middle button
2. Confirm with the right button

Note: The left button takes you to the operating menu level (see following pages).

## 2. Operating menus

### Operating menus and parameterizing Description of further function modules

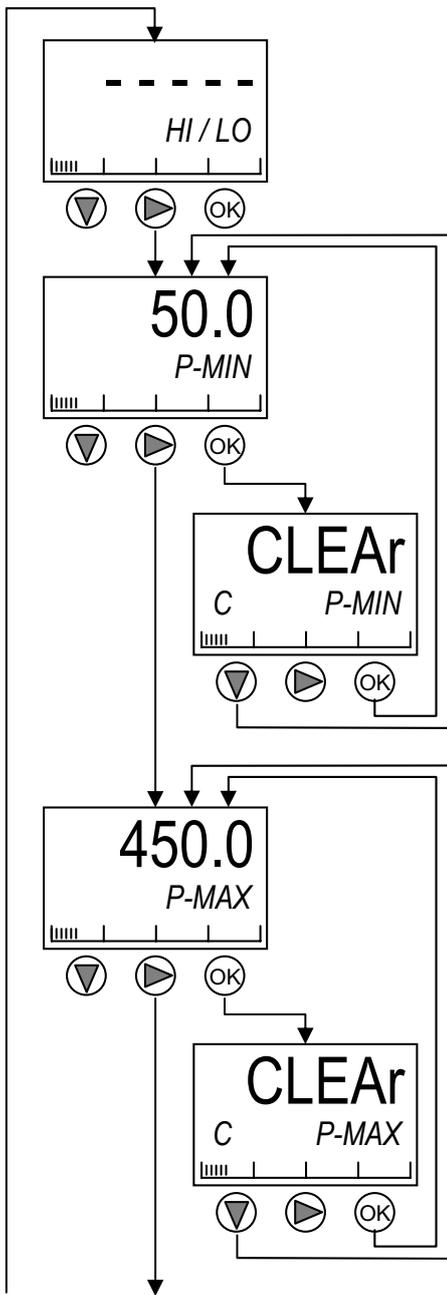
Please check the following table for further information concerning the operating menu of the display module (grey marked).

operating menus	display of display module	parameter		baisc module PROFIBUS PA		
		variability	standard	basic module	display module	PDM
min-max-values	HI / LO	pressure and temperature resettable	—	—	x	x
pressure trimming	P-CAL	zero point -50...+50 % o.n. range -10...+10 % o.n.	—	x	x	x
system info	INFO	software, serial number revision level	—	—	x	x
factory data reset	RESET	—	—	—	x	x
BUS address	BUS	0...126	126	w	x	x
write protection	—	ON, OFF	OFF	x	x	x

x = configurable w = factory setting

## 2.1 Reading out / resetting Min-Max values (operating menu: Min-Max Values)

The minimum and maximum pressure values (in the set unit, in this case *mbar*) and sensor temperature (in °C) can be read out and/or reset at this point.



### Operating menu Min-Max values

Numerical display : None  
 Bar graph : Pressure ( display in measuring range )  
 Text field : HI/LO  
 (the next operating menu is reached with left button )  
 Next: : to display of minimum pressure value with the middle button 

### Display of min-value (P-MIN submenu)

The minimum-value measured after last reset is displayed.  
 Numerical display : Minimum value pressure in set unit, in this case *mbar*  
 Text field : Switches between *P-MIN* and *mbar*  
 Bar graph : Pressure ( display in set measuring range )  
 Next : to display of maximum pressure value with the middle button 

### Delete the stored minimum value

Display : flashing writing *CLEAR*  
 Text field : *P-MIN*  
 Modus display : *C*  
 Deleting : Delete value with right button  and return to P- MIN submenu.  
 Back : Go to P-MIN submenu without deleting the value with the left button .

When saved value is deleted each current pressure value is registered in the memory.

### Display maximum value (P-MAX submenu)

The maximum-value measured after last reset is displayed.  
 Numerical display : Maximum value pressure in set unit, in this case *mbar*  
 Text field : Switches between *P-MAX* and *mbar*  
 Bar graph : Pressure ( display in set measuring range )  
 Next : to display of minimum temperature value with the middle button 

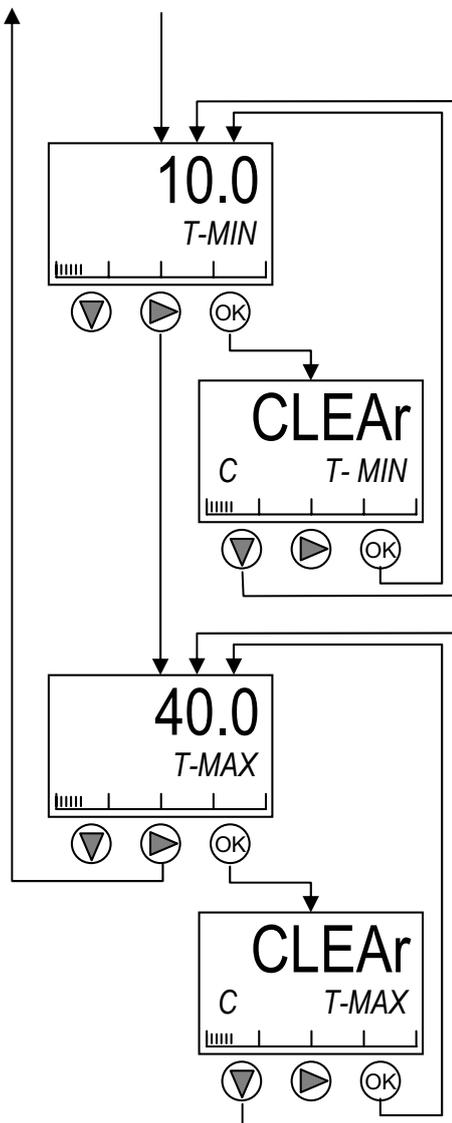
### Delete the stored maximum value

Display : flashing writing *CLEAR*  
 Text field : *P-MAX*  
 Modus display : *C*  
 Delete : Delete value with right button  and return to P-MAX submenu.  
 Back : Go to P-MAX submenu without deleting the value with the left button .

When stored value is deleted each current pressure value is registered in the memory.

*Continued on next page*

## Reading out / resetting Min-Max values (operating menu: Min-Max Values) continued from page 11



### Display min-value (T-MIN submenu)

The minimum-value measured after last reset is displayed.

Numerical display : Minimum value temperature in °C  
Text field : Switches between *T-MIN* and °C  
Bar graph : Pressure ( Display in set measuring range )  
Next : to display of maximum temperature value with the middle button (▶)

### Delete the stored minimum value

Display : Flashing writing *CLEAR*  
Text field : *T-MIN*  
Mode display : *C*  
Delete : Delete value with the right button (OK) and return to *T-MIN* submenu.  
Back : Go to *T-MIN* submenu without deleting the value with the left button (◀).

When stored value is deleted each current temperature value is registered in the memory.

### Display of maximum value (T-MAX submenu)

The maximum-value measured after last reset is displayed.

Numerical display : Maximum value temperature in °C  
Text field : Switches between *T-MAX* and °C  
Bar graph : Pressure ( display in set measuring range )  
Back : Go to the operating menu Min-Max Values with the middle button (▶)

### Delete the stored maximum value

Display : Flashing writing *CLEAR*  
Text field : *T-MAX*  
Mode display : *C*  
Delete : Delete value with right button (OK) and return to *T-MAX* submenu.  
Back : Go to *T-MAX* submenu without deleting the value with the left button (◀).

When stored value is deleted each current temperature value is registered in the memory.

Skip back to the measuring value display: Press the left and middle buttons briefly

## 2.2 Adjusting the measuring range limits (operating menu: Pressure Trimming)

### Notes:

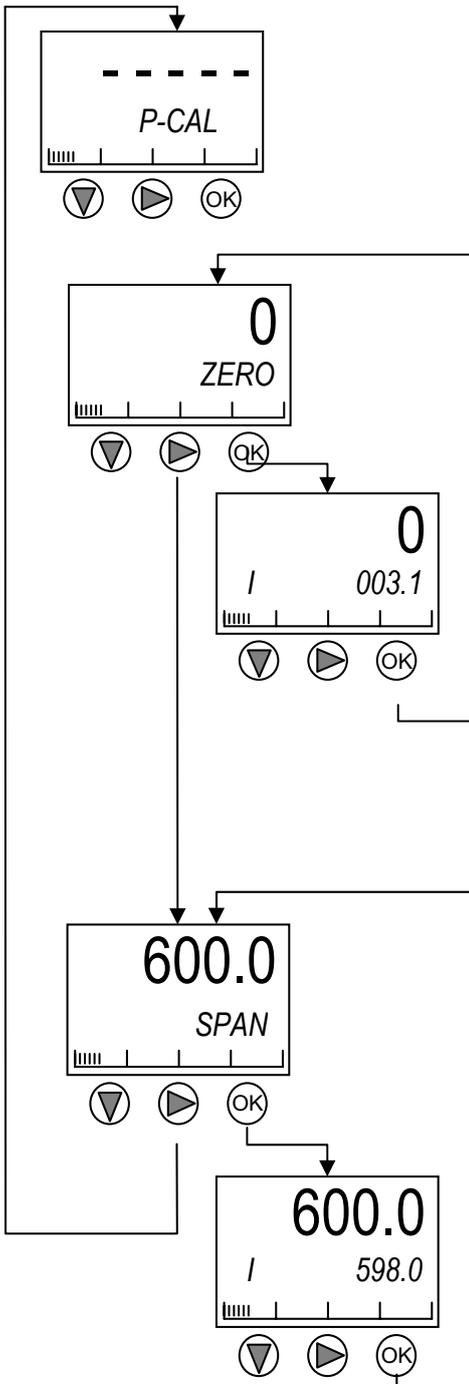
The lower range limit and the upper range limit can be adjusted in this operating menu. In addition, it is also possible to correct errors caused by the installation position.

The beginning and end of measurement do not have to be adjusted at the lower range value or upper range value. Pressure specifications near these points can be approached and adjusted (example: containers that cannot be completely emptied). The suggested values for ZERO and SPAN are range limits; these can be changed to the actual pressure applied.

### Notes:

Negative values are entered by setting the minus character at the point indicated by 

Return to measuring value display:  +  Press both buttons briefly at the same time



### Operating menu pressure trimming

Numerical display : None  
 Text field : P-CAL  
 Bar graph : Pressure specification ( display in set measuring range )  
 Next : Pressure specification (ZERO submenu) with the middle button   
 (the next operating menu is reached with left button 

### Adjusting the lower range limit (ZERO submenu)

Numerical display : lower range limit of instrument ( see notes above)  
 Text field : Switches between ZERO and selected unit   
 Next : Go to SPAN submenu with the middle button   
 Next : Go to Change of adjusting with the right button 

### Change of adjusting the lower range limit

Numerical display : Entering section, given value is the lower range limit ( see notes above )  
 Text field : Switches between current pressure value display and selected unit  
 Mode display : /  
 Change : Select point to be changed with middle button   
 Application and back : Go to ZERO submenu with the right button , so that the value from the entering section is applied (display of the current pressure value).

### Adjusting the upper range limit (SPAN submenu)

Numerical display : upper range limit of instrument (see notes above)  
 Text field : Switches between SPAN and selected unit  
 Back : Go to operating menu Pressure Trimming with the middle button   
 Next : Go to Change of adjusting with the right button 

### Change of adjusting the upper range limit

Numerical display : Entering section, given value is the upper range limit  
 Text field : Switches between current pressure value display and selected unit  
 Mode display : /  
 Change : Select point to be changed with the middle button   
 Confirm and back : To SPAN submenu with the right button , so that the value from the entering section is applied (display of the current pressure value).

Skip back to the measuring value display: Press the left and middle buttons briefly

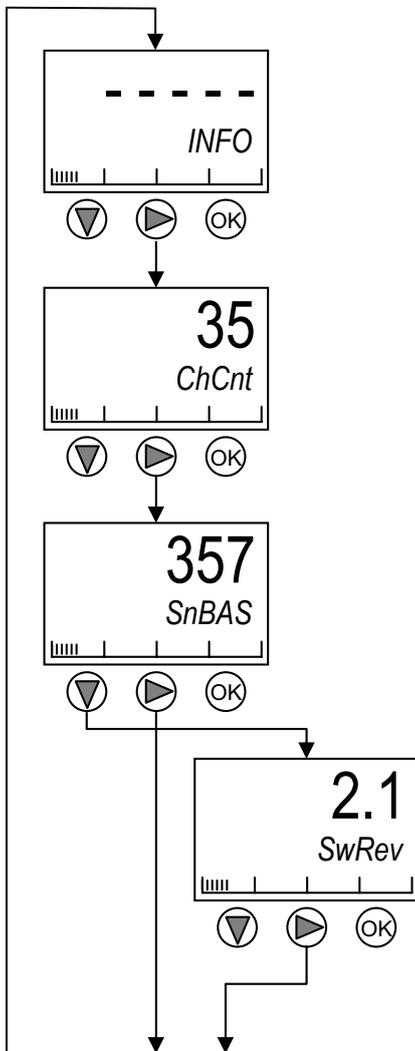
## 2.3 Testing module compatibility (operating menu: System Info)

### Notes :

This menu can be used to test the hardware and software compatibility of the modules used.

In addition, it entails an option for checking whether changes have been made on the basis of the parameter change number. Submenus are only displayed if the relevant module has been found.

- ChCnt : Total number of parameter changes
- SnBAS : Serial number of the basic module
- SnLCD : Serial number of the display module
- "-O-K-" : Modules can work with each other
- "ERROR" : Module has been found but is incompatible
- "HwRev" : Hardware version of the corresponding module
- "SwRev" : Software version of the corresponding module
- SnSEN : Serial number of the sensor module



### Operating menu System-Info

Numeric display : None  
 Text field : INFO  
 Bar graph : Pressure ( display in measuring range )  
 Next : Go to number of all parameter changes (ChCnt submenu) with the middle button (▶) (the next operating menu is reached with left button (◀))

### Number of all parameter changes (ChCnt submenu)

Numeric display : 35 (example)  
 Text field : ChCnt  
 Next : Go to display serial number of basic module (SnBAS submenu) display with the middle button (▶)

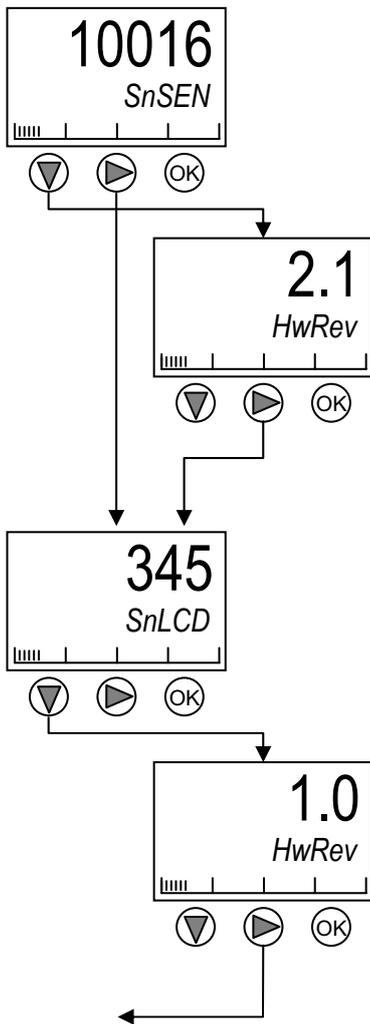
### Serial number of basic module (SnBAS submenu)

Numeric display : e. g. 357 serial number basic module  
 Text field : Switches between SnBAS and -O-K-  
 Next : Go to display serial number of sensor module (Sn SEN submenu) with the middle button (▶)  
 Next : Go to display software version of the basic module with the left button (◀)

### Display of software version of basic module

Display : Version-No. of the software of the basic module  
 Text field : Switches between SwRev and -O-K-  
 Next : Go to display serial number of the sensor module (SnSEN submenu) with the middle button (▶)

Continued next page



**Serial number of sensor module (SnSEN submenu)**

- Numeric display : e. g. 10016 serial number of sensor module
- Text field : Switches between *SnSEN* and *-O-K-*
- Next : Go to display serial number display module (*SnLCD* submenu) with the middle button
- Next : Go to display hardware version with the left button
- Next : Go to display hardware version of sensor module with the left button

**Hardware version of sensor module**

- Display : Version-No. of hardware of sensor module
- Text field : Switches between *HwRev* and *-O-K-*
- Next : Go to display serial number of the display module with the middle button

**Serial number of the display module**

- Numeric display : e. g. 345 serial number display module
- Text field : Switches between *SnLCD* and *-O-K-*
- Back : Go to operating menu System-info with the middle button
- Next : Go to display hardware version with the left button

**Hardware version of the display module**

- Display : Version-No. hardware display module
- Text field : Switches between *HwRev* and *-O-K-*
- Back : Go to operating menu System-info with the middle button

Skip back to the measuring value display: Press the left and middle buttons briefly

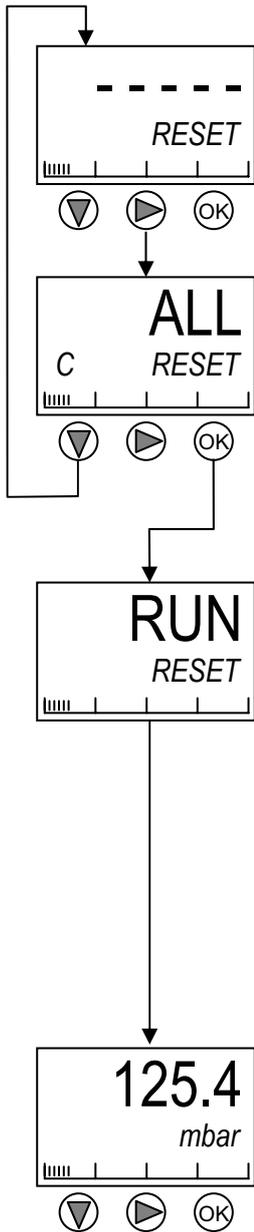
## 2.4 Restoring the settings according to data sheet (operating menu: Factory Data Reset)

### Notes:

In the case of the factory data RESET all entered parameters are reset to the specification data sheet. The adjustment of the transmitter is reset to the factory setting. The transmitter executes a warmstart after the factory data has been restored, i.e. it is in Measuring value display mode.

### Note:

- The IDENT\_NUMBER\_SELECTOR parameter is set to profile\_specific\_ident\_number.
- The bus address is not altered by the RESET.



### Operating menu Factory data RESET

Numeric display : None  
 Text field : RESET  
 Bar graph : Pressure ( display in set measuring range )  
 Next : Got to Safety inquiry (RESET submenu) with the middle button (▶)  
 (the measuring value display can be reached with the left button (▼))

### Safety inquiry (RESET submenu)

Numeric display : ALL  
 Text field : RESET  
 Next : Go to Execution factory data RESET with the right button (OK)  
 Back : Go to Operating menu Factory data RESET with the left button (▼)

### Execution factory data RESET

Numeric display : RUN  
 Text field : RESET  
 Bar graph : Running / reset progress indication (abt. 10 sec.)

All parameters are reset to the specification sheet data. Also the factory setting is reset.

### Measuring value display (see page 10)

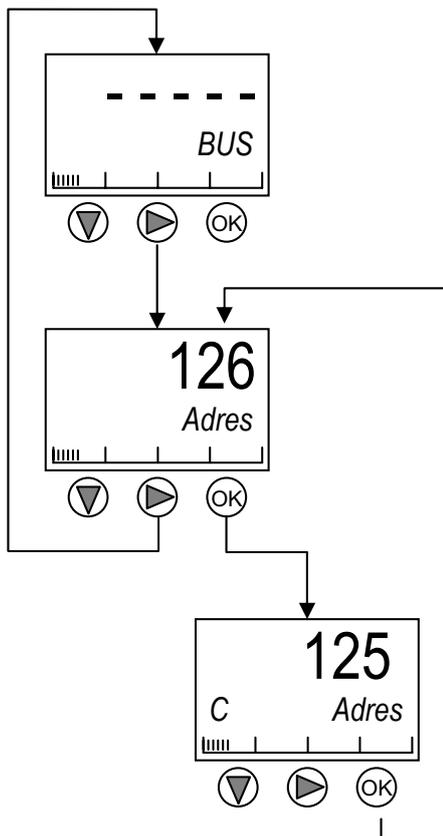
Numeric display : Pressure in mbar  
 Text field : Selected physical unit  
 Bar graph : Pressure ( display in measuring range )

## 2.5 Enter/change the PROFIBUS PA address (operating menu: BUS address)

### Notes:

Each PROFIBUS device must be assigned an address, as only measuring devices with correct addresses will be detected. Valid addresses lie in the range 0-126. Each address may only be assigned once in a PROFIBUS PA network. The devices are supplied ex works with address 126. The address can be used to set up a new device in an operational PROFIBUS PA network. After setup, the address should be changed. If an address greater than 126 is selected, it will be set to 126. There are two ways of changing the address:

1. via software with the help of a class 2 master (e.g. PDM)
2. with the help of the local LCD module (as described below)



### Operating menu BUS-address

Numeric display : none  
 Text field : *BUS*  
 Bar graph : Pressure ( display in measuring range )  
 (go to measuring value display with the left button )  
 Next : Go to display of BUS-address (Adres submenu) with the middle button 

### Display of BUS-address (BUS submenu)

Numeric display : current set address  
 Text field : displays the text Adres  
 Bar graph : Pressure (display in measuring range)  
 Back : Go to operating menu BUS-address with the middle button 

### Change BUS-Adresse (siehe Anmerkung oben)

Numeric display : current set address  
 Text field : displays the text Adres  
 Mode display : C  
 Change : Select point to be changed with middle button .  
 Change the number with left button .  
 Confirm and back : Go to BUS submenu with the right button  so that the set address is applied.

Skip back to the measuring value display: Press the left and middle buttons briefly

## PROFIBUS PA

### General functions and key benefits

Signal conversion is the same for all variants. The pressure sensor converts the pressure to an electrical signal which is then processed by the micro-electronics and a digital PROFIBUS PA signal (complying with European standard IEC 61158) is output.

The key benefits are:

- saving on installation costs
- in-depth diagnostics with improvements in the availability of system components
- automatic updating of plant documentation
- system optimization during normal operation

### PROFIBUS PA transmission technologie

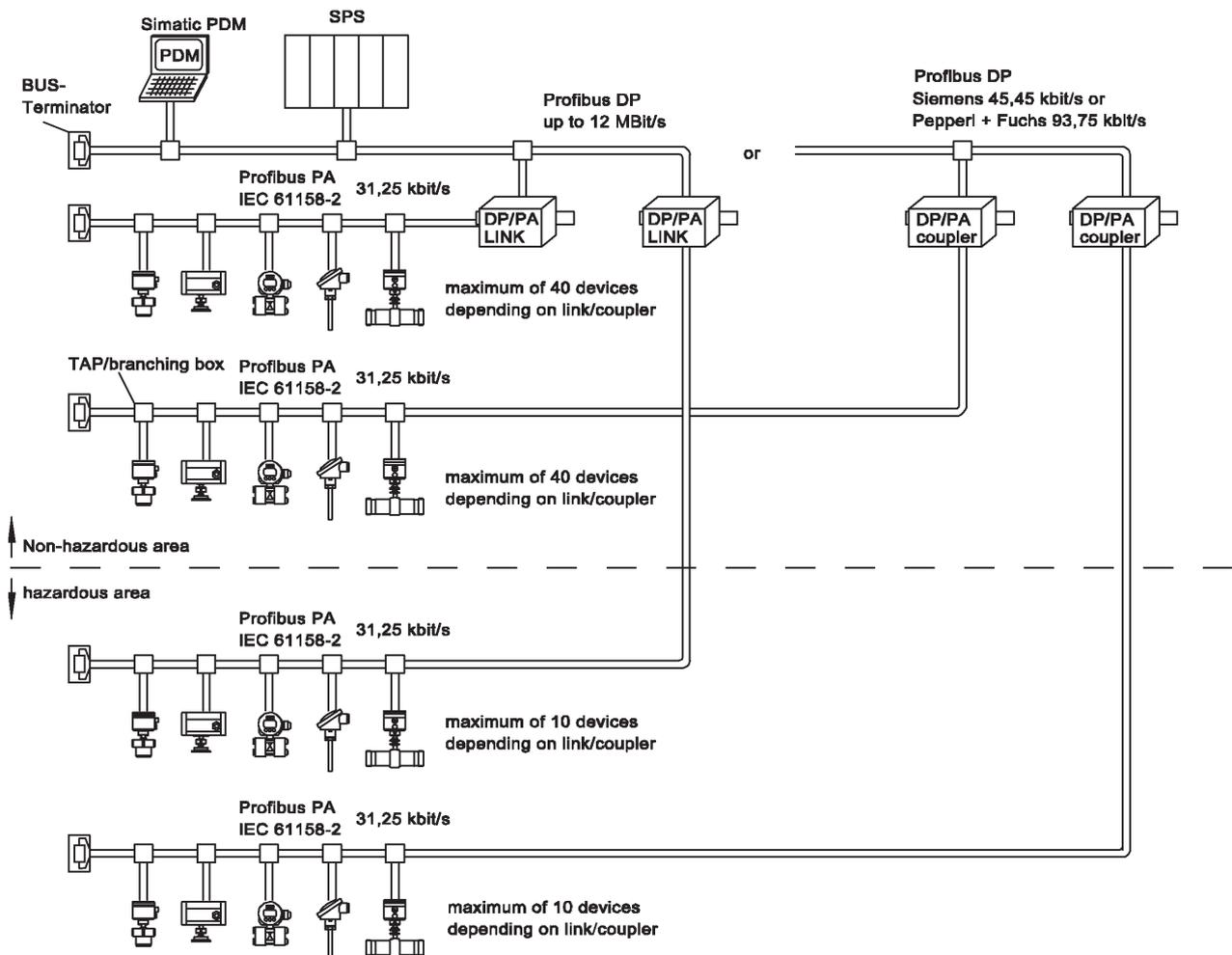
PROFIBUS PA employs special transmission technology in line with the international standard IEC 61158-2 and thus meet the requirements of process automation and process technology. The low baud rate reduces the power loss when compared with PROFIBUS DP. This is an intrinsically safe technology that can be applied in explosion hazardous areas.

A terminating resistor must be fitted at both ends of the PA and DP bus systems.

### Topology

The bus topology can be chosen at will. PROFIBUS uses a line structure. Network components such as couplers and repeaters serve to join together individual lines segments to form star/tree structures.

All types of field devices such as transmitters, actuators, analyzers etc. can be connected to PROFIBUS PA.



## DP/PA-coupler and DP/PA link

Depending on the number of PROFIBUS PA field devices in the automation system and depending on the required time response, a DP/PA coupler, or a more powerful DP/PA link for higher requirements, is deployed.

### DP/PA link

- contains „intelligence.“
- communicates on the DP side at a high baud rate
- communicates on the PA side at a low baud rate
- converts the physics

### DP/PA coupler

- couples DP + PA only
- the baud rate on the DP side is reduced  
example: Siemens coupler 45.45 kBit/s  
P&F coupler 93.75 kBit/s
- converts the physics

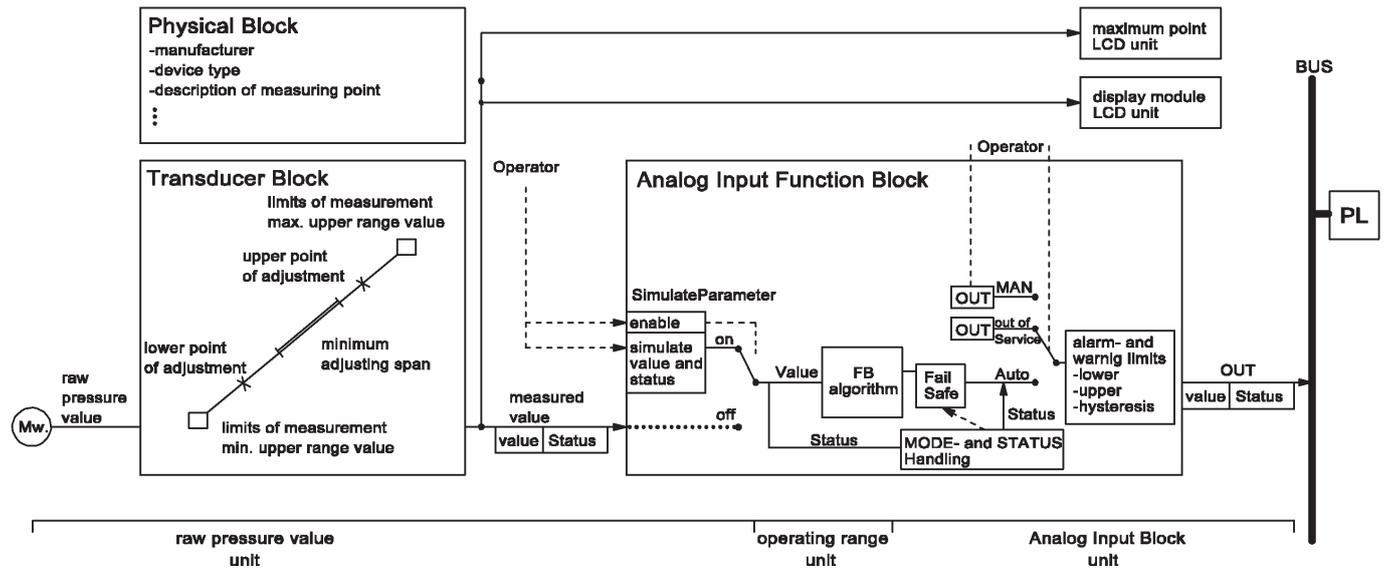
The maximum number of devices that can be connected to a bus daisy-chain is determined by the sum of the maximum power consumption of the connected devices (as per standard - 10 mA per device) and the available current. A current reserve should be designed into the system for safety reasons. This should be done to prevent a defective device with increased power consumption from overloading the bus system and thus the power supply, and to prevent it disrupting communication with all operational slaves. The necessary level of current reserve is based on the current rise ( $I_{FED}$ ) in case of malfunction as specified by the device manufacturer.

Please refer to the following documents for more information on the installation and layout of the PROFIBUS network:

1. Technical Guideline  
PROFIBUS PA  
User and Installation Guideline  
Version 2.2 February 2003  
Order No: 2.092 PNO
2. PROFIBUS Recommended installation  
Version 1.0.6 May 2006  
Order No: 8.021 PNO

Further information: [www.profibus.com](http://www.profibus.com) / Downloads

## Cyclical data exchange (master class 1)



### Physical Block (PB)

The physical block contains the characteristic data for a device (e.g. device name, manufacturer, version and serial numbers etc.). A device may only have one physical block.

### Transducer Block (TB)

The TB contains all data needed to prepare the raw signal output from a sensor for transfer to a function block.

### Funktionsblock (FB)

The FB contains all data needed for final preparation of a measured value before it is transmitted to the control system.

### Analog Input Block (AI)

The AI sends the measured value received from the sensor or a TB after further preparation to the control system („Input“ as in „Input on the bus“).

### Measured-value conditioning

The measured value is prepared in the transducer block and passed to the LCD display module and to the function block. It is scaled in the function block and passed to the analog input block, where it is assigned a status. The PASCAL CV returns a measured value comprising a floating-point number (4 bytes) and associated quality display (1 byte). The status is encoded in accordance with the specification „PROFIBUS PA Profile for Process Control Devices.“ The status „measured value OK“ is encoded as 0x80 (hexadecimal). The measured value is transmitted as a 32 bit floating-point number in IEEE-754 format.

### IEEE-754 Format

Byte n								Byte n*1								Byte n*2								Byte n*3															
Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit	Bit						
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
VZ	2 <sup>7</sup>	2 <sup>6</sup>	2 <sup>5</sup>	2 <sup>4</sup>	2 <sup>3</sup>	2 <sup>2</sup>	2 <sup>1</sup>	2 <sup>0</sup>	2 <sup>-1</sup>	2 <sup>-2</sup>	2 <sup>-3</sup>	2 <sup>-4</sup>	2 <sup>-5</sup>	2 <sup>-6</sup>	2 <sup>-7</sup>	2 <sup>-8</sup>	2 <sup>-9</sup>	2 <sup>-10</sup>	2 <sup>-11</sup>	2 <sup>-12</sup>	2 <sup>-13</sup>	2 <sup>-14</sup>	2 <sup>-15</sup>	2 <sup>-16</sup>	2 <sup>-17</sup>	2 <sup>-18</sup>	2 <sup>-19</sup>	2 <sup>-20</sup>	2 <sup>-21</sup>	2 <sup>-22</sup>	2 <sup>-23</sup>								
Sig. Bit	Exponent							Significant							Significant							Significant																	

$$\text{Value} = (-1)^{VZ} \cdot 2^{(\text{Exponent} - 127)} \cdot (1 + \text{Significant})$$

Not all programmable controllers support the IEEE-754 format. In these cases a conversion block must be used or coded. You may have to re-arrange the byte order depending on the data format (most-significant-byte or least-significant-byte) used in the PLC (master).

Coding the status byte for the OUT parameter

Status-code	Description as per PROFIBUS norm	Possible cause
0x0F	<b>bad</b> - device failure	<ul style="list-style-type: none"> <li>- the basic electronics has been replaced</li> <li>- there is no sensor connected</li> <li>- sensor type is unknown</li> <li>- display module is unknown or faulty</li> <li>- no connection to sensor electronics</li> <li>- configuration data in the sensor is invalid</li> <li>- error in parameter data</li> <li>- error in compensating data</li> <li>- invalid serial number</li> <li>- program execution error has occurred</li> </ul>
0x13	<b>bad</b> - sensor failure	<ul style="list-style-type: none"> <li>- measuring bridge faulty</li> <li>- pressure is higher than data sheet spec.</li> <li>- pressure is lower than data sheet spec.</li> <li>- temperature sensor defective</li> <li>- temperature at sensor higher than data sheet spec.</li> <li>- temperature at sensor lower than data sheet spec.</li> </ul>
0x1F	<b>bad</b> - out of service	- appears when the AI block is not executed e.g.: target mode of AI block is set to „out of service“
0x44	<b>uncertain</b> - last useable value	measured value invalid, latest valid measured value is used. Appears when a sensor or device error has occurred and AI parameter FSAVE_TYPE is set to 1.
0x48	<b>uncertain</b> - substitute-set	measured value faulty, default value is used. Appears when a sensor or device error has occurred and AI parameter FSAVE_TYPE is set to 0. The FSAVE_VALUE value stored in the AI parameter is used as measured value.
0x4C	<b>uncertain</b> - initial value	no valid measured value is available. This situation occurs when the device is switched on during start-up.
0x80	<b>good</b> - ok	measured value is OK
0x84	<b>good</b> - update event	appears when a permanent parameter in the AI block in the device is changed. Is reset after 10 sec.
0x89	<b>good</b> - active advisory alarm low limited	lower warning limit undershoot
0x8A	<b>good</b> - active advisory alarm high limited	upper warning limit overshoot
0x8D	<b>good</b> - active critical alarm low limited	lower alarm limit undershoot
0x8E	<b>good</b> - active critical alarm high limited	upper alarm limit overshoot

## Acyclical data exchange (master class 2)

Device parameters in the physical, transducer and analog input blocks may be accessed with the acyclical service.

A programmable PC with Simatic PDM is a class 2 master.

The following parameters are defined in PASCAL CV PA:

Parameter	Value	Unit	Status
<b>PASCAL CV31xx PA</b>			
<b>» Identification</b>			
<b>» » Operation Unit</b>			
TAG	PASCAL CV		loaded
Descriptor			loaded
Message			loaded
<b>» » Device</b>			
Manufacturer	LABOM		loaded
Product designation	PASCAL CV31xx PA		loaded
Device Serial Number	000000/00/016		loaded
Basis Serial Number	800015		loaded
Software Revision	1.0.0		loaded
Firmware-Version	1.1.4		loaded
Hardware Revision	1.0.0		loaded
Profil Revision	3.0		loaded
Static Revision No.	5		loaded
PROFIBUS Ident Number	Manufacturer specific		loaded
Installation Date	12.07.2005		loaded
Sensor Type	Gage 16 bar		loaded
Sensor Serial Number	10396		loaded
HW Write Protection	not HW write protected		loaded
Write Locking	not write protected		loaded
<b>» Input</b>			
<b>» » Transducer Block 1</b>			
Static Revision No.	5		loaded
Transmitter Type	Pressure		loaded
<b>» » » Measuring Limits</b>			
Unit Pressure Raw Value	bar		loaded
Lower Value Min	-1.05	bar	loaded
Upper Value Max	16.8	bar	loaded
<b>» » » Working Range</b>			
Unit	bar		loaded
<b>» » » Process Value Scale</b>			
Lower Value	-1.000	bar	loaded
Upper Value	16.000	bar	loaded
<b>» » » Characterization</b>			
Characterization Type	Linear		loaded
<b>» » » Sensor Temperature</b>			
Temperature Unit	°C		loaded
<b>» » » Peak values (max values)</b>			
Pressure Value Min	-0.01	bar	loaded
Pressure Value Max	15.80	bar	loaded
Sensor Temperature Min	22.83	°C	loaded
Sensor Temperature Max	25.27	°C	loaded
<b>» Output</b>			
<b>» » Function Block 1 - Analog input</b>			
Static Revision No.	20		loaded
Unit	bar		loaded
Filter Time Const	0	s	loaded
<b>» » » Batch Information</b>			
Batch ID	0		loaded
Batch Unit	0		loaded
Batch Operation	0		loaded
Batch Phase	0		loaded
<b>» » » Output scale</b>			
Lower Value	-1.000	bar	loaded
Upper Value	16.000	bar	loaded
<b>» » » Output Limits</b>			
Lower Limit Alarm	-1.000	bar	loaded
Lower Limit Warning	-0.800	bar	loaded
Upper Limit Warning	14.000	bar	loaded
Upper Limit Alarm	16.000	bar	loaded
Limit Hysteresis	0.010	bar	loaded
<b>» » » Fail Safe Mode</b>			
Fail Safe Mode	Default value is used as output value.		loaded
Fail Safe Default Value	8		loaded
<b>» » » Human Interface</b>			
Decimal Point	3		loaded
<b>» Human Local Interface</b>			
LCD Present	LCD present		loaded
LCD Serial Number	301281		loaded
LCD Unit	bar		loaded
Local Operation	Enabled		loaded
<b>» Operating conditions</b>			
<b>» » Sensor Calibration</b>			
Lower Calibration Point	0	bar	loaded
Upper Calibration Point	16	bar	loaded
Calibration Span Min	3.2	bar	loaded
<b>» Certificates and Approvals</b>			
Device Certification	CE, NE 21, Exmarking: Kein		loaded

The parameters have the following meaning:

## **IDENTIFICATION**

### **TAG**

This is an apparatus marking. The tag can be up to 32 characters long and the characters can be chosen at will. We recommend you use a unique tag for the field device in the system.

### **Descriptor**

You may enter an additional description of the measuring point here. The description can be up to 32 characters long.

### **Message**

You may enter any message you wish in the message field. For example, you may want to enter the date of the next device adjustment.

The message can be up to 32 characters long

### **Manufacturer**

Indicates the manufacturer of the field device. This is typically the name of the company that manufactured the device.

### **Product designation**

The designation of a manufacturer's device type. The product designation comprises up to 16 characters.

### **Device serial number**

It comprises 16 characters and is unique. The device manufacturer can thus be identified. This number describes the whole unit and all its modules.

### **Basis serial number**

Six digit serial number for the basic module integrated in the device..

### **Software Revision**

PROFIBUS communications software version.

### **Firmware-Version**

Version of measured-value conditioning software.

### **Hardware Revision**

Revision level of electronics.

### **Profile Revision**

PROFIBUS PA profile version for process controllers.

### **Static Revision No.**

Revision level of static data (stored in the device) associated with this block. The version number is incremented every time data is changed.

### **PROFIBUS Ident Number**

PASCAL CV PA can be addressed via two different GSD files. Typically, the parameter is set to „manufacturer-specific,“ and the GSD file LAB\_0954.GSD is used. If this file is not available, the parameter can be changed to „profile-specific“ and the standard GSD file PA139700.GSD used.

### **Installation Date**

The date on which the device was installed. You may select this date at will; it can have up to 16 characters.

### **Sensor Type**

Describes the type of sensor fitted in the device (relative or absolute sensor including measuring range and sensor element).

### **Sensor Serial Number**

Defines the actual serial number of the sensor in the device.

### **HW Write Protection**

Can only be enabled/disabled with the device buttons. If write protection is enabled, no more parameters (except the bus address) can be changed.

### **Write Locking**

Can be enabled/disabled per software.

## **INPUT**

### **Static Revision No.**

Revision level of static data (stored in the device) associated with this block. The version number is incremented every time data is changed.

**Transmitter Type**

Defines the device type (pressure or absolute pressure).

**Unit Pressure Raw Value**

Engineering unit for measured process pressure

**Lower Value Min**

Defines the lower limit of the measuring range.

**Upper Value Max**

Defines the upper limit of the measuring range

**Unit**

Engineering unit of the lower and upper range values for measured value scaling.

**Lower Value**

The measured value passed from the transducer block to the AI function block can be scaled. This parameter is the minimum value of input scaling.

**Upper Value**

The upper value is the maximum value of input scaling.

**Characterization**

Defines the type of linearization. Linear means that the measured value is processed without any alterations..

**Sensor Temperature**

The sensor temperature unit can be set here. The unit also applies to the maximum pointer temperatures.

**Pressure Value Min**

The minimum measured pressure value.

**Pressure Value Max**

The maximum measured pressure value.

**Sensor Temperature Min**

The minimum temperature measured at the sensor.

**Sensor Temperature Max**

The maximum temperature measured at the sensor.

**Output****Static Revision No.**

Revision level of static data (stored in the device) associated with this block. The version number is incremented every time data is changed.

**Unit**

The unit of pressure value for the analog input block and the variable OUT (see figure on page 20)

**Filter time constant**

Duration of a 63 % rise in output due to a change in voltage at the input.

**Batch ID**

Identifies a particular batch, in order to allow device information (e.g. faults, ...) to be assigned.

**Batch Unit**

Identifies the assigned unit (e.g. dryer, ...) or the current master recipe.

**Batch Operation**

Identifies the current master recipe operation.

**Batch Phase**

Identifies the current master recipe step.

**Lower Value**

Defines the lower value of output scaling in the output unit.

**Upper Value**

Defines the upper value of output scaling in the output unit.

**Lower Limit Alarm**

Output value at which a lower alarm is triggered.

**Lower Limit Warning**

Output value at which a lower warning is triggered.

**Upper Limit Warning**

Output value at which an upper warning is triggered

**Upper Limit Alarm**

Output value at which an upper alarm is triggered.

**Limit Hysteresis**

Hysteresis value that is added/subtracted to the lower/upper alarm and warning limits in order to rescind the alarm/warning.

**Fail Safe Mode**

Defines the response of the device when the actual network value is lost or the desired value status „Go to fail-safe mode“ is returned.

The following responses are available:

- the default value is loaded to the output value
- save the latest valid output value
- the incorrectly calculated measured value is provided at the output

**Fail Safe Default Value**

The default setting for OUT when the actual measured value is lost and fail-safe mode is enabled: „The default value is loaded into the output value.“ The unit is the same as for OUT.

**Decimal Point**

Defines the number of decimal places for the AI block as displayed in the user interface (PDM).

**LCD Present**

Defines whether a display module is integrated in the device

**LCD Serial Number**

Contains the serial number of the built-in display module.

**LCD Unit**

Defines the engineering unit used in the pressure value display.

**Local Operation**

Defines whether the user can make changes on the local display module.

**Operating conditions****Lower Calibration Point**

The lowest point at which the measuring signal was adjusted.

**Upper Calibration Point**

The upper point at which the measuring signal was adjusted.

**Calibration Span Min**

The minimum pressure should lie between the lower and upper adjustment points.

**Certificates and Approvals****Device Certification**

Indicates device certification and operation in explosion hazardous areas.

## Device master and type files (GSD)

PROFIBUS devices have different features. They differ with respect to the available functionality (e.g. number of I/O signals, diagnostic messages) or possible bus parameters such as baud rate and time watchdogs. These parameters are specific for each device type and manufacturer. In order to facilitate a basic plug & play configuration for PROFIBUS, electronic device data sheets (GSD files) have been created for the device communications features.

### GSD file for LABOM PASCAL CV31xx PA

```
#Profibus_DP
GSD_Revision           = 3
Vendor_Name           = „Labom GmbH“
Model_Name            = „PASCAL CV31xx“
Revision              = „3.0 (blue)“
Ident_Number          = 0x0954
Protocol_Ident        = 0
Station_Type          = 0
FMS_supp              = 0
Hardware_Release      = „1.0“
Software_Release     = „1.0.1“
Bitmap_Device         = „Lab0954n“
31.25_supp            = 1
45.45_supp            = 1
93.75_supp            = 1
MaxTsdR_31.25         = 100
MaxTsdR_45.45         = 250
MaxTsdR_93.75         = 1000
Redundancy            = 0
Repeater_Ctrl_Sig    = 0
24V_Pins              = 0
Freeze_Mode_supp     = 0
Sync_Mode_supp       = 0
Set_Slave_Add_supp   = 1
Min_Slave_Intervall  = 250
Modular_Station      = 1
Max_Module            = 1
Max_Input_Len        = 5           ; maximum Input Length
Max_Output_Len       = 0           ; maximum Output Length
Max_Data_Len         = 5           ; maximum In-Output Length
Slave_Family         = 12
Max_Diag_Data_Len    = 20
Max_User_Prm_Data_Len = 3
Ext_User_Prm_Data_Const(0) = 0x00, 0x00, 0x00

;----- Description of extended DP features: -----
;
DPV1_Slave = 1
C2_Read_Write_supp = 1
C2_Max_Data_Len = 128
C2_Read_Write_required = 1
C2_Max_Count_Channels = 1
Max_Initiate_PDU_Length = 52
C2_Response_Timeout = 4000
DPV1_Data_Types = 1

;--- Description of physical interface for async. and sync. transmission: ---
Physical_Interface = 0           ; RS-485 Standard Copper
Transmission_Delay_45.45 = 0
Reaction_Delay_45.45 = 0
Transmission_Delay_93.75 = 0
Reaction_Delay_93.75 = 0
End_Physical_Interface
;
Physical_Interface = 1           ; IEC61158-2
Transmission_Delay_31.25 = 0
Reaction_Delay_31.25 = 0
End_Physical_Interface
```

;----- Description of device related diagnosis: -----

```
;
Unit_Diag_Bit(16) = „Error appears“
Unit_Diag_Bit(17) = „Error disappears“
Unit_Diag_Bit(24) = „Hardware failure electronics“
Unit_Diag_Bit(25) = „Hardware failure mechanics“
Unit_Diag_Bit(26) = „Motor temperature too high“
Unit_Diag_Bit(27) = „Electronic temperature too high“
Unit_Diag_Bit(28) = „Memory error“
Unit_Diag_Bit(29) = „Measurement failure“
Unit_Diag_Bit(30) = „Device not initialized“
Unit_Diag_Bit(31) = „Device initialization failed“
Unit_Diag_Bit(32) = „Zero point error“
Unit_Diag_Bit(33) = „Power supply failed“
Unit_Diag_Bit(34) = „Configuration invalid“
Unit_Diag_Bit(35) = „Restart“
Unit_Diag_Bit(36) = „Coldstart“
Unit_Diag_Bit(37) = „Maintenance required“
Unit_Diag_Bit(38) = „Characteristics invalid“
Unit_Diag_Bit(39) = „Ident_Number violation“
Unit_Diag_Bit(55) = „Extension Available“
```

;-----

```
;
;Modules for Analog Input
Module = „Analog Input (AI)short“ 0x94
1
EndModule
;Modules for Analog Input
Module = „Analog Input (AI)long“ 0x42,0x84,0x08,0x05
2
EndModule
```

;----- Description of the module assignment: -----

```
;
SlotDefinition
Slot(1) = „Analog Input“ 1 1,2
EndSlotDefinition
```

The PNO makes available a standard database file called PA139700.GSD for devices with a profile-specific analog input block (Profile 3.0).

Sources in the Internet:

PNO <http://www.PROFIBUS.com> in the GSD Library link  
LABOM <http://www.labom.com>  
<http://www.pascal-cv.com>