Digital transmitter for temperature IO-Link

Type series PA2530

Operating Instructions

1 General Information

This document contains necessary information for the proper installation and use of this device. In addition to this instruction, be sure to observe all statutory requirements, applicable standards, the additional technical specifications on the accompanying data sheet (see www.labom.com) as well as the specifications indicated on the type plate.

1.1 General Safety Notes

The installation, set up, service or disassembly of this device must only be done by trained, qualified personnel using suitable equipment and authorized to do so.

Warning

Media can escape if unsuitable devices are used or if the installation is not correct.

Danger of severe injury or damage

- Ensure that the device is suitable for the process and undamaged.

1.2 Intended Use

The device is intended to measure temperature in technical processes as specified in the data sheet.

1.3 Conformity with EU Regulations

The CE-marking on the device certifies its compliance with the applicable EU Directives for placing products on the market within the European Union.

You find the complete EU Declaration of Conformity (document no. KE_051) at www.labom.com.

2 Transportation and Storage

Store and transport the device only under clean and dry conditions preferably in the original packaging. Avoid exposure to shocks and excessive vibrations.

Permissible storage temperature: -40…85 °C

3 Installation and Commissioning

Ensure that the device is suitable for the intended application with respect to temperature range, pressure range, medium compatibility and process connection.

3.1 Mechanical Installation

Before starting operation, check the process connection carefully for leaks under pressure.

Use gaskets, if required, that are suitable for the process connection and resistant to the media.

Please note that the permissible operating pressure is specified by the process connection. An operation outside the standard nominal pressure level, e.g. with Clamp connections, is only permitted with specially approved mounting elements.

The installation position of the temperature measuring system is freely selectable.

3.2 Electrical Connection

Complete the mechanical installation before you connect the device electrically.

Set up all electrical connections while the voltage supply is switched off.

Functional area IO-Link	= 18...32 VDC
Functional area if two switch outputs	= 9,6...32 VDC
Nominal voltage	= 24 VDC

The auxiliary energy of the temperature transmitter must meet SELV requirements, or optionally an energy-limited power circuit can be used in accordance with Chapter 9.3 of DIN EN 61010-1 or UL 61010-1.

Circular connector M12

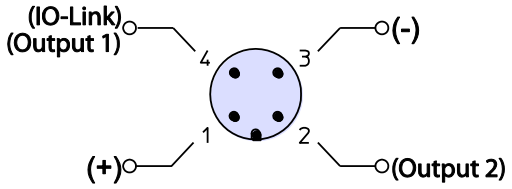


Figure 1: Electrical connection

The transmitter is intended for operation on class A IO-Link ports. Since the “Switch output 2” signal is located at Pin 2, it is not applicable for operation on class B ports.

During installation please take max. cable length of 20 m into consideration.

The temperature transmitter must be connected to the plant's potential equalisation system via the process connection.

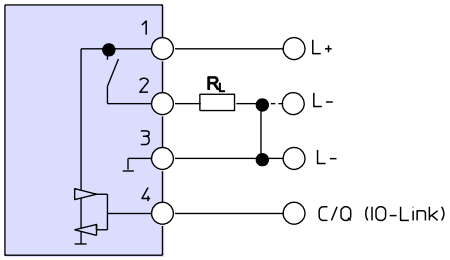
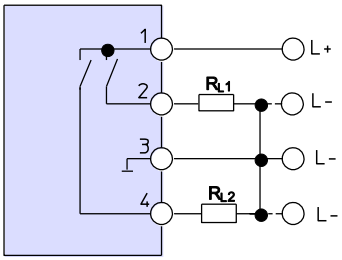
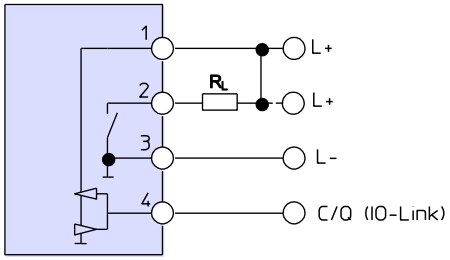
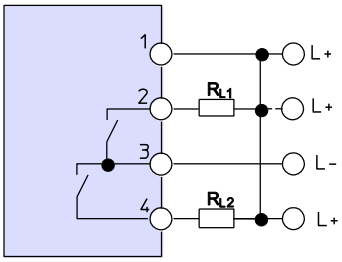
IO-Link operation with 1 switching output	Switch operation with 2 switching outputs
PNP/High-side	
	
NPN/Low-side	
	

Table 1: Connection examples

4 Operation

During device operation, take care that the device remains within its intended temperature range. No other monitoring is necessary.

Permissible ambient temperature:	-40…85 °C
Permissible media temperature:	-50…260 °C*

* Depends on used resistance thermometer.

4.1 Maintenance / Service

When properly installed in accordance with applicable specifications, this device is maintenance-free. However, we recommend an annual recalibration of the device.

In the event of any damage or defect the customer cannot replace or repair any components or assemblies.

5 Disassembly

When measuring hot media, make sure that the device has cooled down prior to any dismounting or wear appropriate protective clothing to avoid burns.

Switch off the power supply to the device before disconnecting the electrical connections. Once this is done, the device may be mechanically removed.

Warning

Opening pressurized lines might cause severe injuries.

Danger of severe injuries or damage

- Relieve the process pressure before attempting to remove the device. Shut off the pressure supply for all feed lines to the device and relieve the pressure in them.

Warning

Hazardous deposits and residues might remain on opened process connections and removed devices.

Danger of injury

- After the device has been removed, seal off the measuring point and mark the open process connection accordingly. Consider a possible danger due to residues when handling the removed device.

6 User Manual

You can download the technical description file (IODD) required for using the pressure transmitter in the download area of the LABOM website (www.labom.com).

6.1 View in configuration tool

Different entries in the menue structure are possible depending on the configuration tool. The four areas below are standardised across tools and contain all important parameter and setting functions:

- Identification, see 6.2
- Parameter, see 6.3
- Observation, see 6.4
- Diagnosis, see 6.5

Outlined below are the detailed menue contents as structured in PACTware 4.1. Other IO-Link tools have a different parameter structure or display them differently, although the functionality is identical.

6.2 Menue "Identification"

The parameters displayed here identify the product and manufacturer.

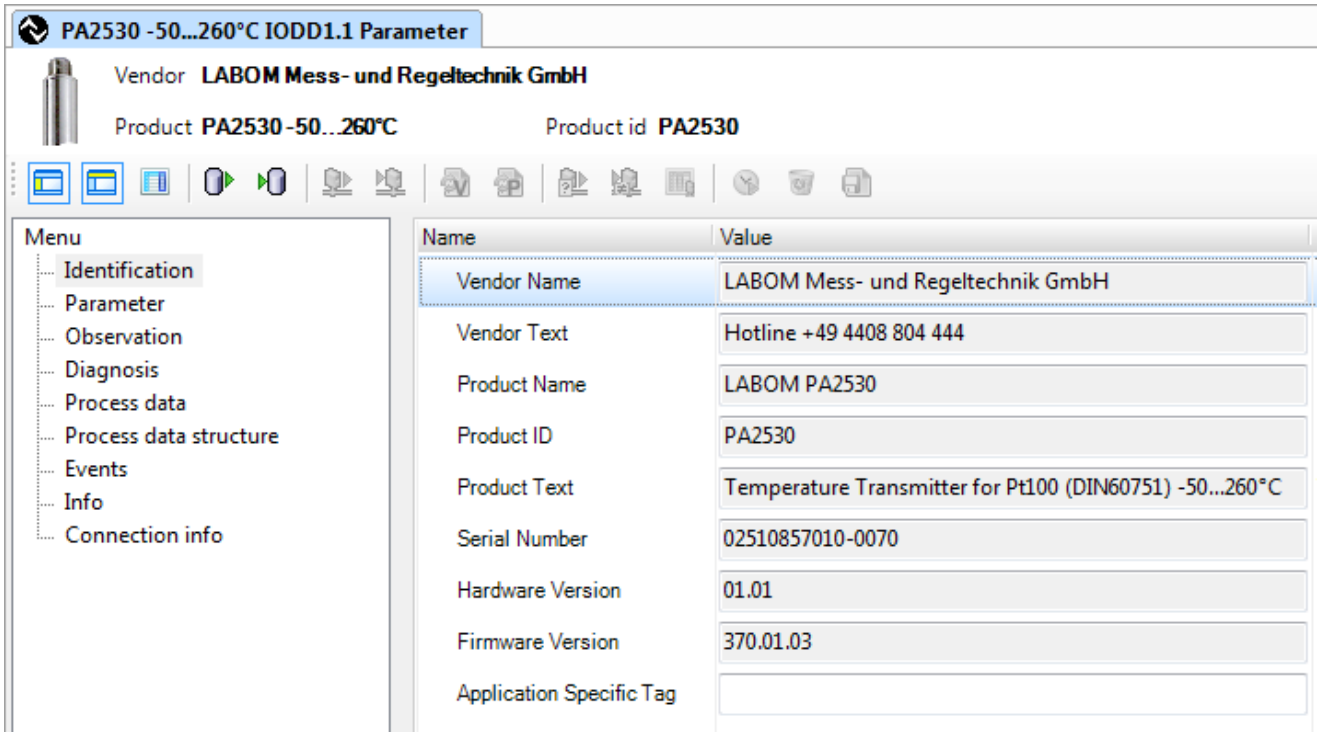


Figure 2: "Identification" menue in PACTware 4.1

6.3 Menue "Parameter"

In this area, the device is parametrised. The individual parametrisation options are outlined below.

6.3.1 Section "Measurement / Output"

In this section, the process data format, pressure unit and damping are parametrised.

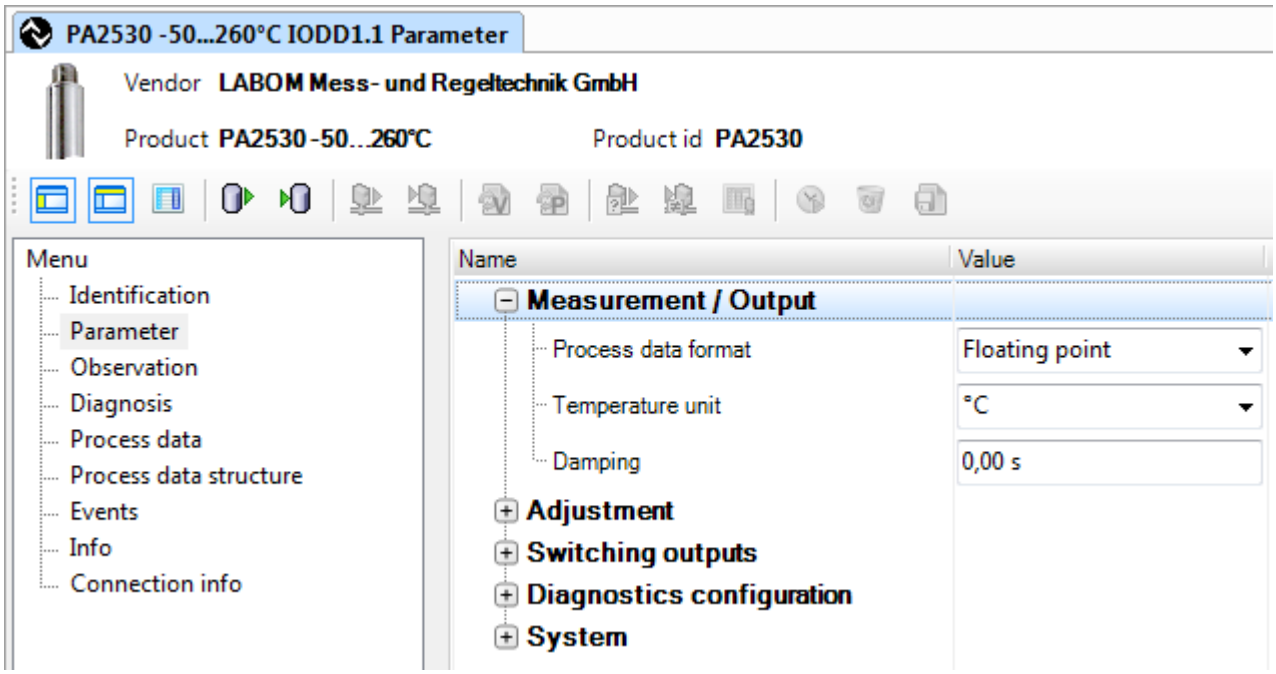


Figure 3: Section „Parameter – Measurement / Output“ in PACTware 4.1

6.3.1.1 Process data format

The process data format is used to set the number format in which the measuring value is transmitted.

In the format “floating point”, the measuring value is transmitted as a floating point number.

In the format “integer”, the measuring value is transmitted as an integer number. The two lowest digits represent two decimal places. E.g. the integer number 199 represents the measuring value 1.99 (in terms of the current unit).

6.3.1.2 Unit temperature

This is where the temperature measuring unit can be set. This is used as basis when transmitting the temperature value as part of the process values. Additionally, all parameters with a temperature reference refer to this unit.

Please note that parameters with a temperature reference are not converted automatically when the unit settings are changed. Example: The zero point offset of 0.1 is saved in the unit ‘°C’. If the unit is changed to °F, the zero point offset is now at 0.1 °F.

This affects the parameters for adjustment (see 6.3.2) and the switching points (see 6.3.3) as well as the min/max values (see 6.5.2).

That is why the temperature unit should be parameterised first. After changing the temperature unit, please check the parameters with a temperature reference and reset the min/max values.

The following units are available:

Unit	Description
°C	Degree Celsius
°F	Degree Fahrenheit ($T_{Fahrenheit} = T_{Celsius}*1,8 + 32$)

Table 2: available temperature units

6.3.1.3 Damping

Adjusting the damping function within the range of 0.00 to 100.00 s, avoids that rapid measured value fluctuations or spikes (input values) are visible in the output signal.

Damping is achieved by a 2nd order digital filter for which the time is set in seconds.

After that set time, 26% of the change in the input value is visible in the output signal. After the set time has elapsed 4 times, approximately 90% of the change is visible in the output signal.

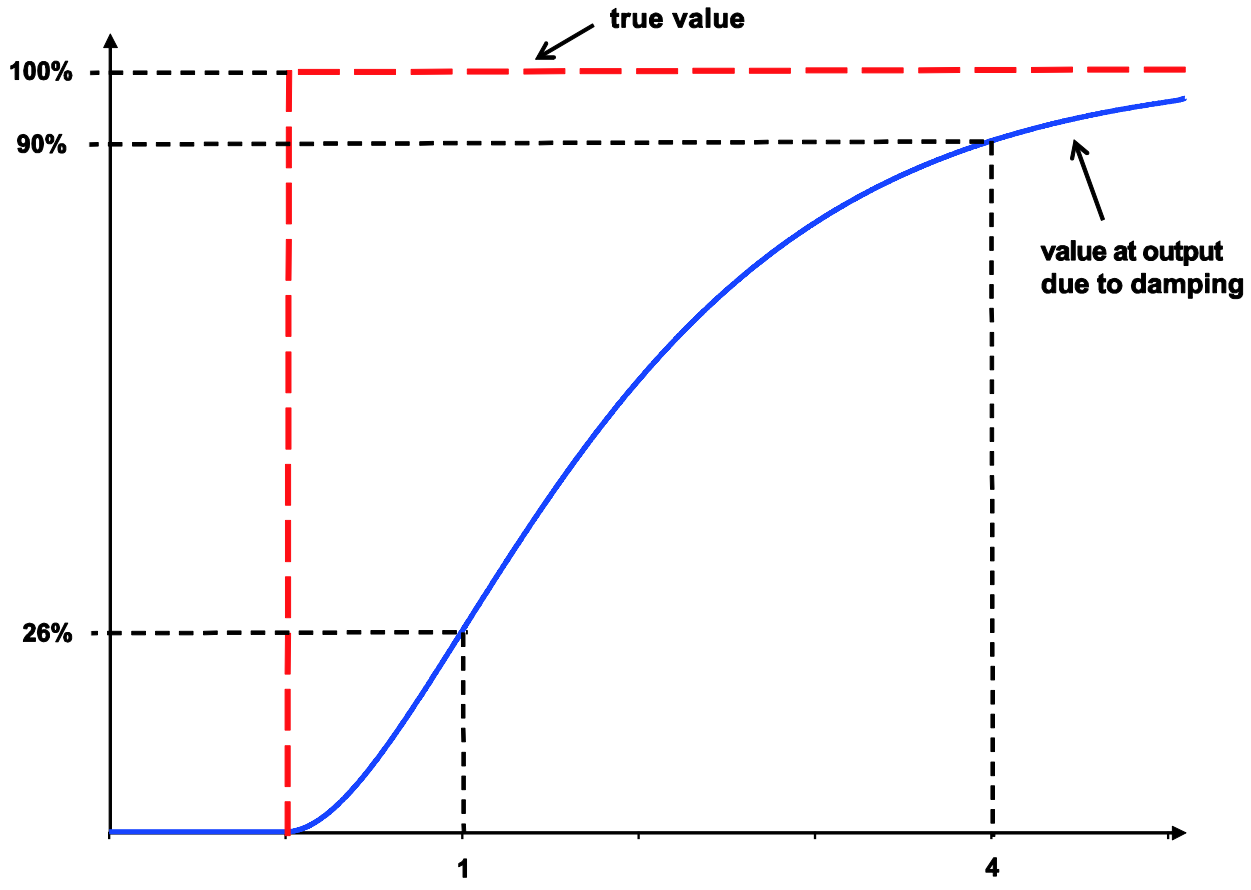


Figure 4: Damping effect

6.3.2 "Adjustment" section

In this section, the measuring device can be calibrated and thus optimises measuring accuracy.

6.3.2.1 Sub-section "Temperature correction"

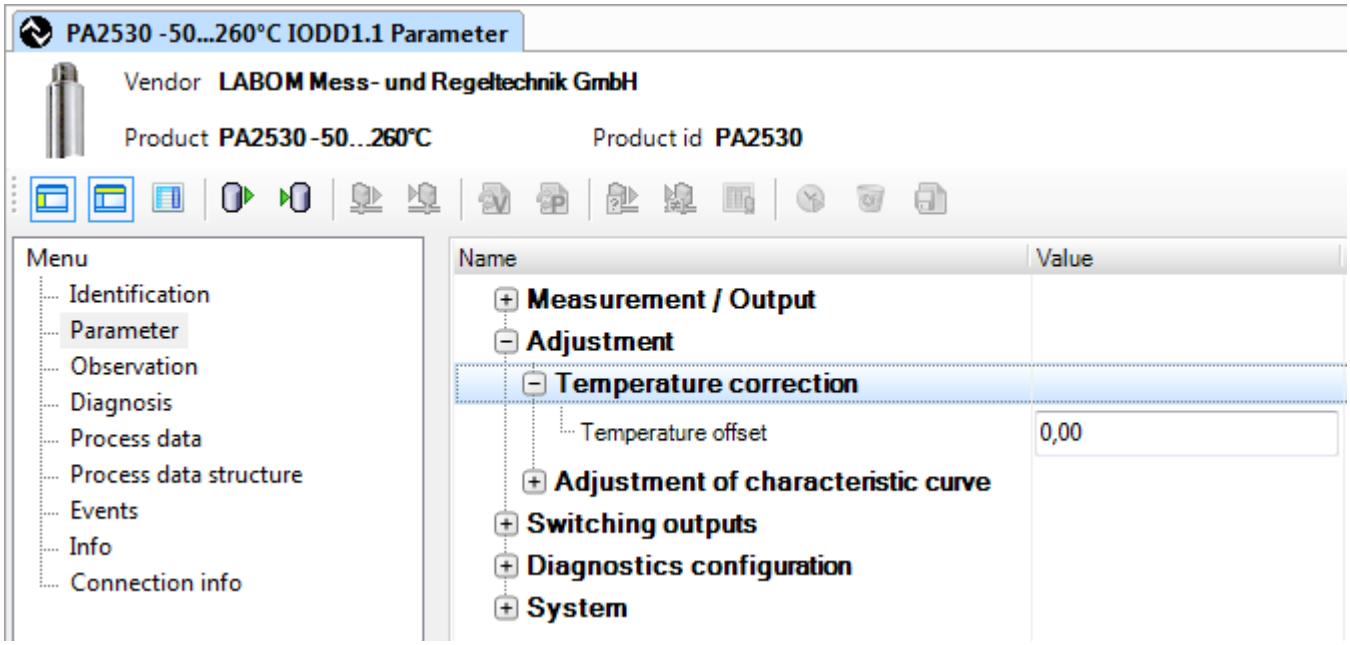


Figure 5: Section „Parameter – Temperature correction“ in PACTware 4.1

In terms of temperature correction, a temperature offset is entered, which acts as the offset across the entire measuring span. You can therefore enter it at any reference temperature you wish.

Expose the instrument to the required reference temperature and read out the temperature value measured by the instrument (see also 6.4). Now enter the difference using the reversed algebraic sign as temperature offset and transfer the value to the instrument.

Please note that the temperature offset value is not displayed in the tool immediately, only after the device parameter is retrieved again.

6.3.2.2 Sub-section "Adjustment of characteristic curve"

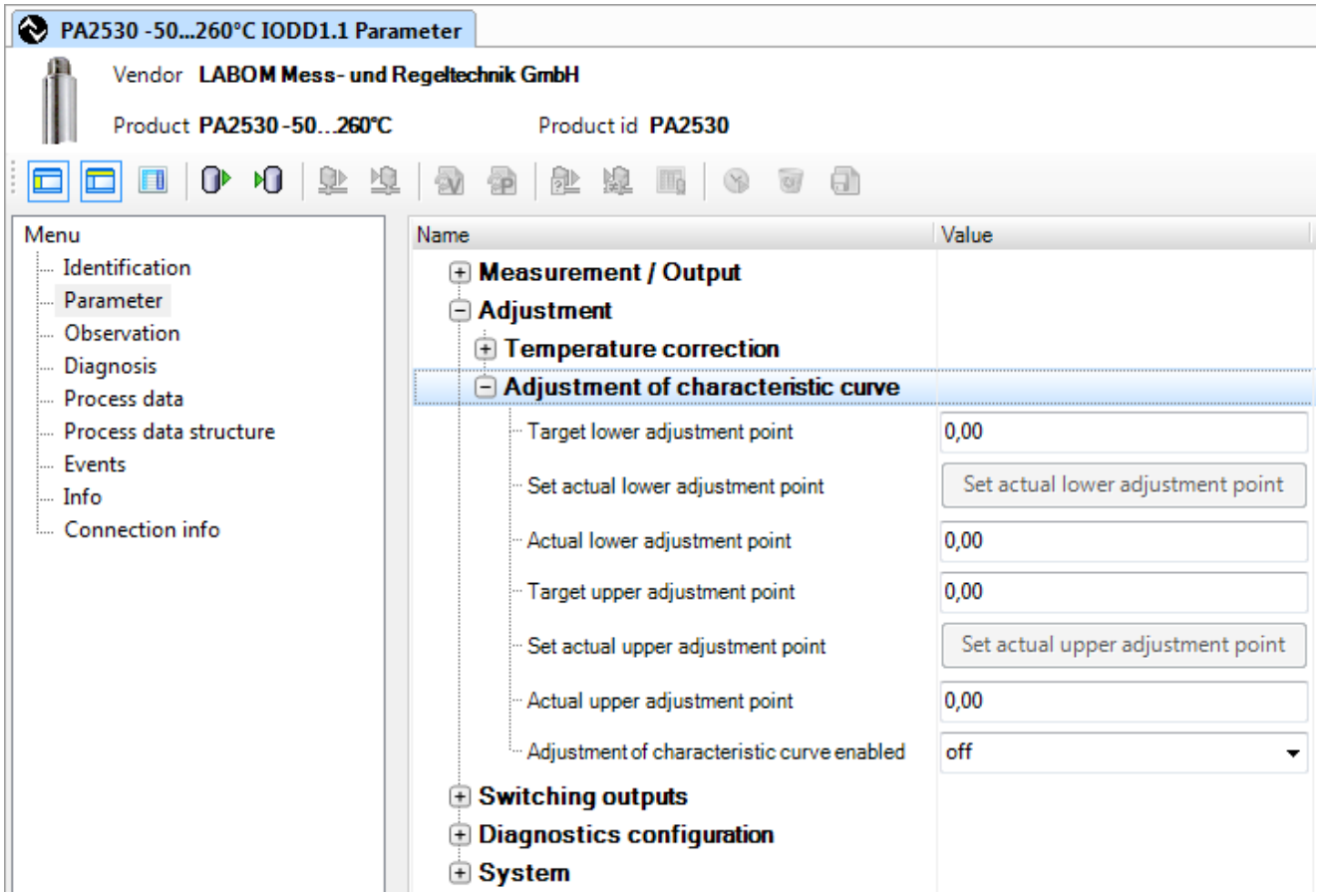


Figure 6: Section "Parameter - Adjustment of characteristic curve" in PACTware 4.1

This feature allows to correct the characteristic curve of the temperature transmitter. In contrast to temperature correction, the adjustment of the characteristic curve allows to change the offset and the gradient.

Follow the process below to perform the adjustment of characteristic curve:

1. Apply the lower (as low as possible) reference pressure level to the measuring device
2. Enter the lower target value in the field “Target value lower adjustment point” and transfer it to the device.
3. Press the button “Set actual value to lower adjustment point”. This sets the current actual value as “actual value lower adjustment point”.
4. Apply the upper (as low as possible) reference pressure level to the measuring device
5. Enter the upper target value in the field “Target value upper adjustment point” and transfer it to the device.
6. Press the button “Set actual value to upper adjustment point”. This sets the current actual value as “actual value upper adjustment point”.
7. Activate the adjustment by setting the parameter “Enable adjustment of characteristic curve” to “on”.

The adjustment of characteristic curve can be performed with any reference temperatures. For instance, the lower adjustment point of a -40…150 °C device at 0 °C. You can also choose any reference temperature for the upper adjustment point. However, to achieve a precise adjustment, the reference values should be as close as possible to the lower and upper range value.

Please note that the actual values for the lower and upper adjustment points are not displayed immediately after the corresponding buttons are pressed in the tool, but only after the device parameters are retrieved again.

Please note that the values for the adjustment of characteristic curve refer to the set unit and that this unit is not converted automatically when changes are made (also see 6.3.1.2).

To deactivate the adjustment, set the parameter “Enable adjustment of characteristic curve” to “off”.

The values for the “Actual/Target lower adjustment point” and “Actual/Target upper adjustment point” are kept, but ignored.

6.3.3 Section "Switching outputs"

This section describes how to parametrise switching outputs.

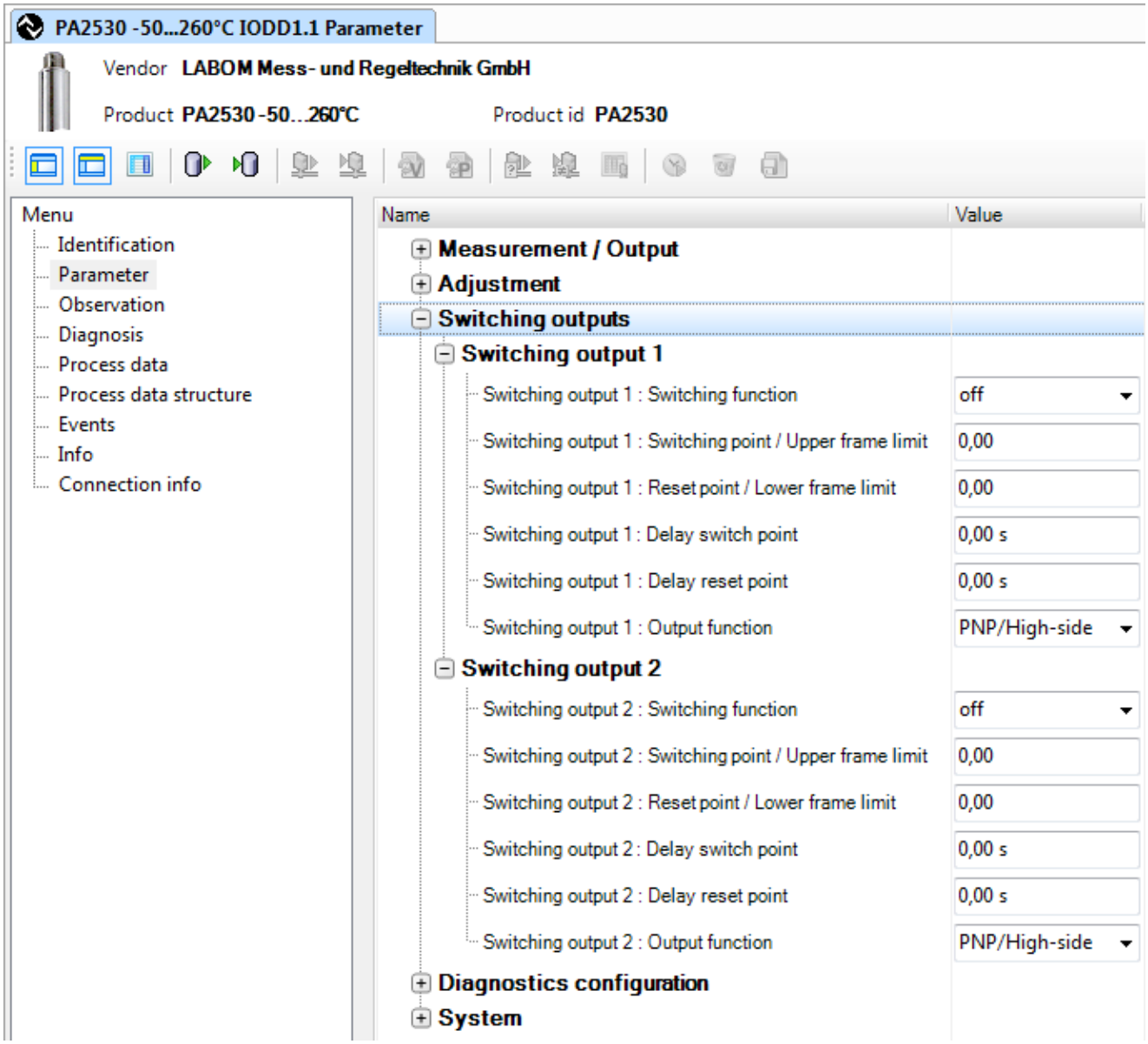


Figure 7: Section „Parameter – Switching outputs“ in PACTware 4.1

The IO-Link signal can also be used as switching output 1, whereas the switching output 2 signal is available at all times. If switching output 1 is activated, an IO-Link master can be connected although. The pressure transmitter identifies the master automatically after start-up and disables switching output 1 in order to respond to the master IO-Link communication. As a result, parameterising is possible at all times without the need to disable switching output 1 first.

The “Switching outputs” section contains the entries for the first and second switching output in consecutive order. The parameter function partly depends on whether a hysteresis or frame function is selected. The delay switch point and delay reset point can be parametrised for both functions.

The following parameters are available:

Parameter	Setting	Description
Switching function	see 6.3.3.1	Hysteresis/frame, normally closed/normally open see 6.3.3.1
Switch point / Upper frame limit	-999 to 999	Switch point in set temperature unit
Reset point / Lower frame limit	-999 to 999	Reset point in set temperature unit
Delay switch point	0 to 100 s	Delay time at switch point
Delay reset point	0 to 100 s	Delay time at reset point
Output function	PNP/High-side or NPN/Low-side	Setting of output driver see table 1

Table 3: Switch output parameters

Please note that the switch point refers to the set unit and that this unit is not converted automatically when changes are made (see 6.3.1.2).

The switch point must be selected between the end of the nominal range and the reset point. In turn, the reset point must be selected between the start of the nominal range and the switch point.

You can define delays for the switch point as well as the reset point, e.g. to avoid that short temperature peaks trigger the switch.

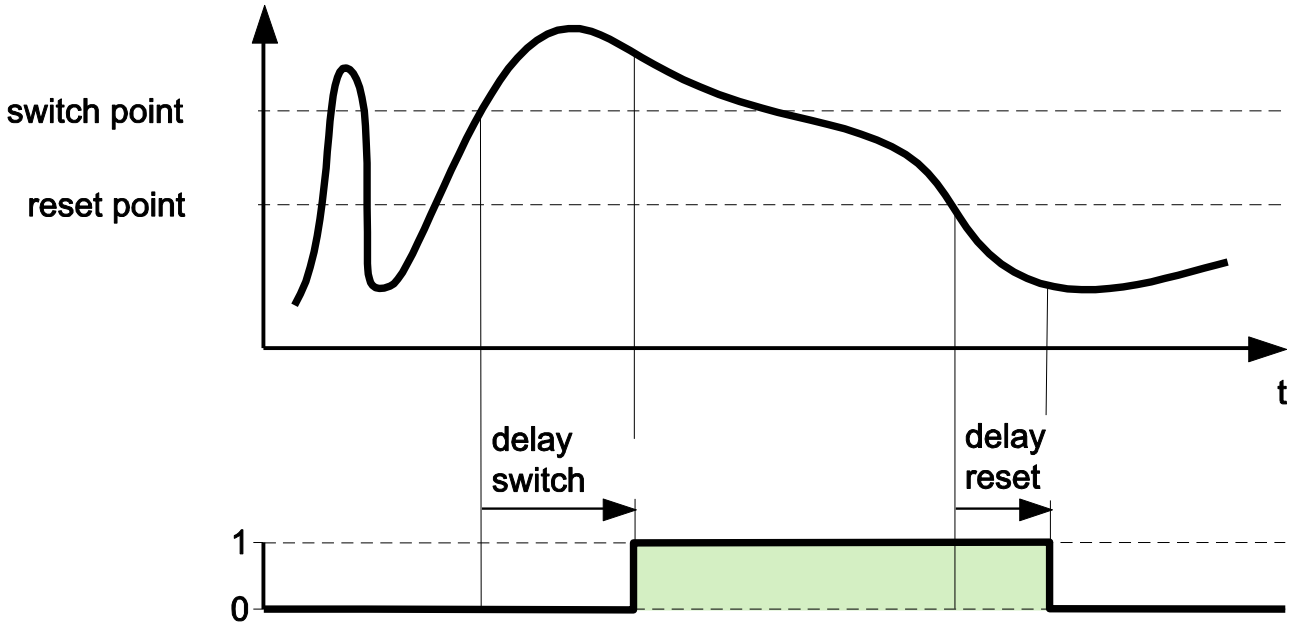


Figure 8: Output delays for the switching function "hysteresis/normally open"

6.3.3.1 Configuring the output function

You can choose a hysteresis or frame function as the output function. Furthermore you can define whether the output is normally open or normally closed.

Parameter	Designation	Description
Switching function	Hysteresis, normally open	If the measured value is above the switch point the switch is closed. At the lower range limit the switch is open.
	Hysteresis, normally closed	If the measured value is above the switch point the switch is open. At the lower range limit the switch is closed.
	Frame, normally open	Inside of the frame the switch is closed. At the lower range limit the switch is open.
	Frame, normally closed	Inside of the frame the switch is open. At the lower range limit the switch is closed.

Table 4: Parameter list for output function

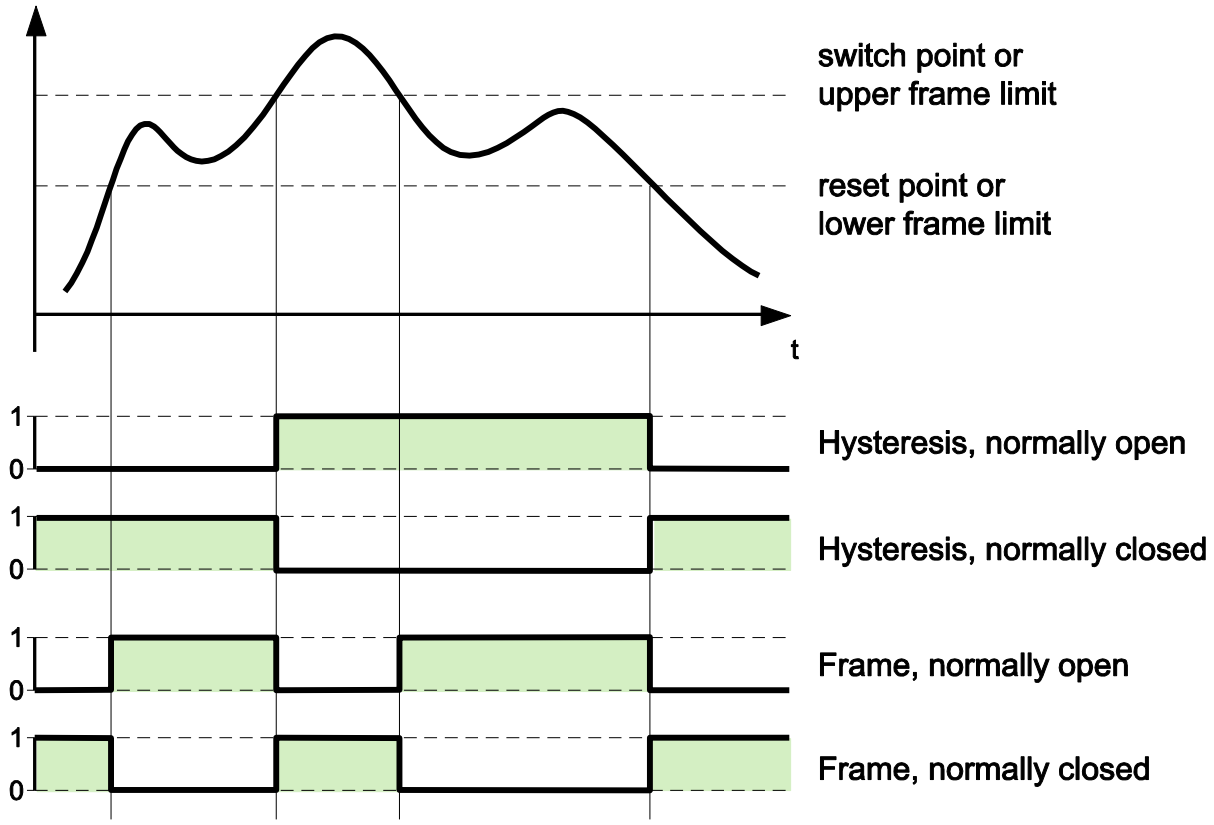


Figure 9: The switching functions

6.3.4 Section "Diagnostics configuration"

This section describes how to configure the device's diagnostic events.

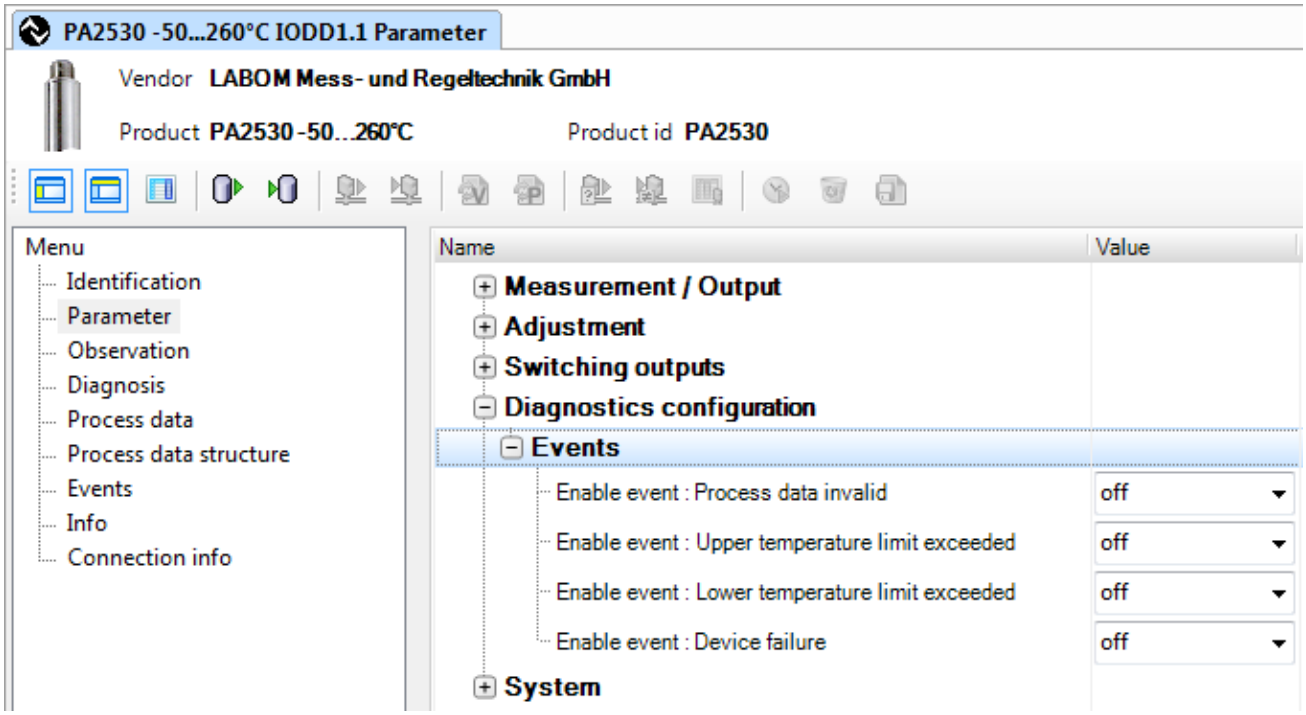


Figure 10: Section „Parameter – Diagnostics configuration“ in PACTware 4.1

6.3.4.1 Sub-Section "Events"

Up to four specific IO-Link events can be activated for pressure transmitter diagnostics:

- Process data invalid: The process data are invalid. The measuring value contains an error code which describes the cause in more detail. Also see 6.5.1.1.
- Upper temperature limit exceeded: The value exceeded the upper range value
- Lower temperature limit exceeded: The value has fallen below the lower range value
- Device failure: Defect in the adjustment data and/or hardware defective (sensor broken, sensor shorted)

Also see Chapter 7.2 Error detection.

6.3.5 Section "System"

In this section, you can reset all parameters to factory settings and reset the min/max values.

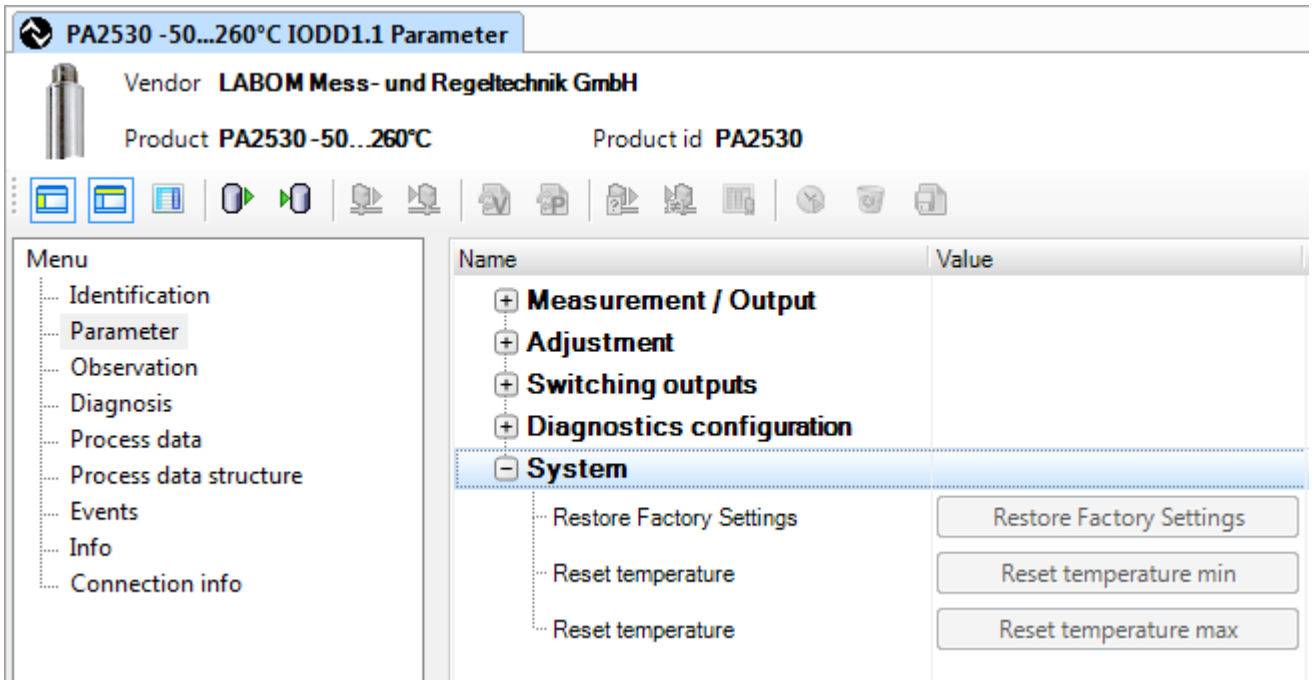


Figure 11: Section „Parameter – System“ in PACTware 4.1

Pressing the button “Restore Factory Settings” resets all parameters in the sections “Measurement / Output”, “Adjustment”, “Switching outputs” and “Diagnostics configuration” to their factory settings.

The buttons "Reset temperature min/max" can be used to reset the temperature min/max values to the current temperature independently from each other.

6.4 Menue "Observation"

In this section, you can monitor the process values (current values). The values are displayed according to the structure outlined in Chapter 7.1.

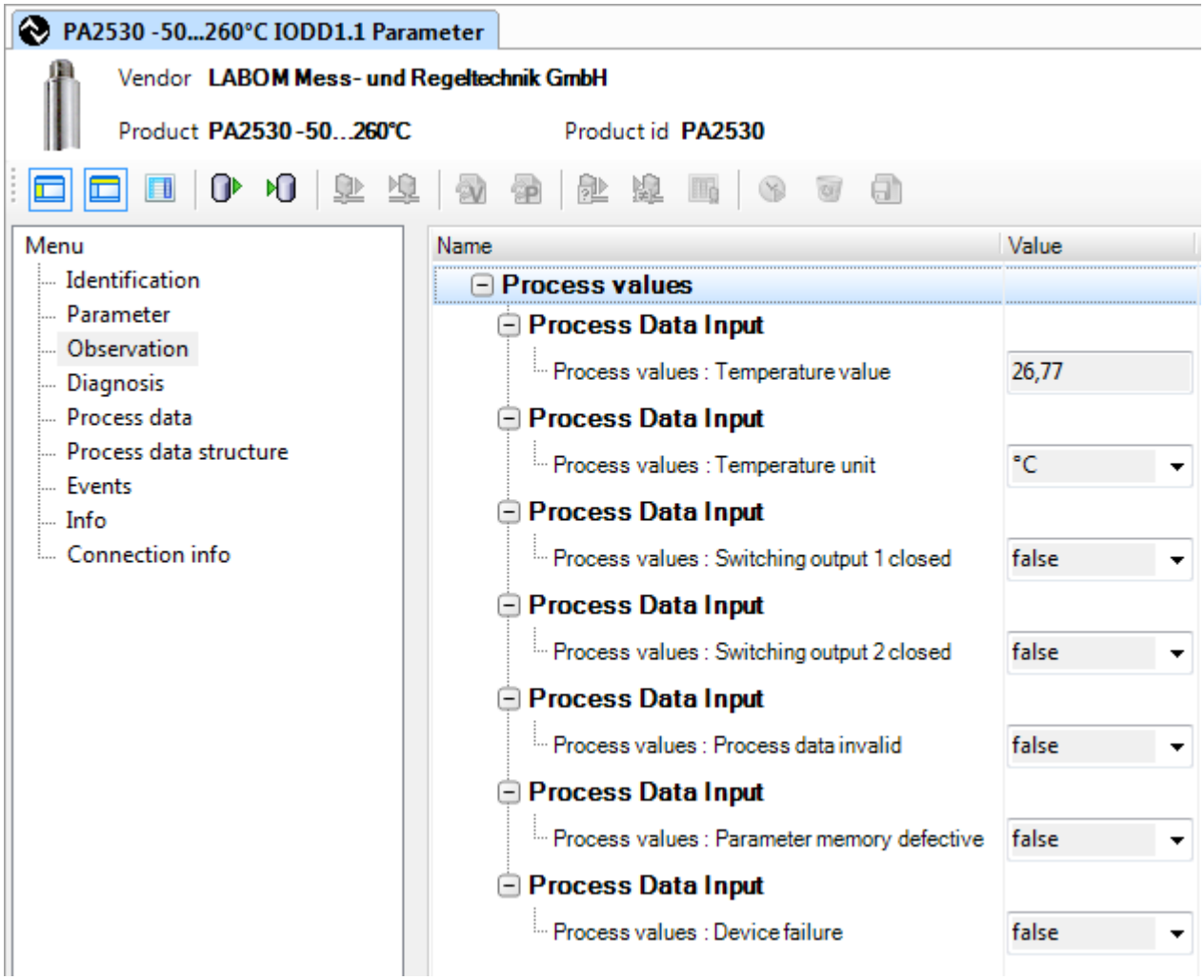


Figure 12: „Monitoring“ menue in PACTware 4.1

6.5 Menue "Diagnosis"

In this section all the diagnose data is summarised. This includes possible errors within the process data, Min/Max values as well as the device status.

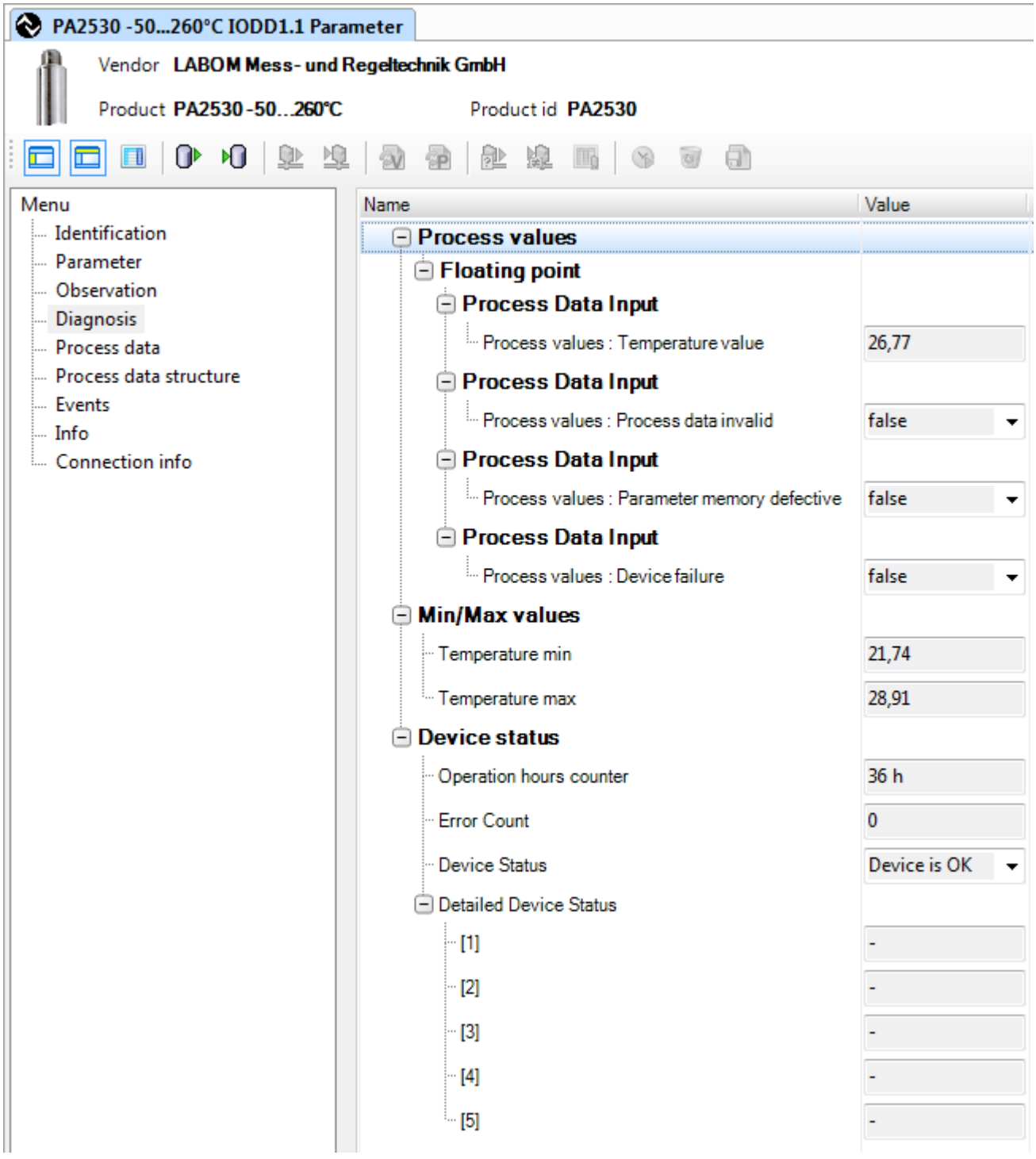


Figure 13: "Diagnosis" menue in PACTware 4.1

6.5.1 Section "Process values"

This is where errors in the measuring value and status byte flags are indicated.

6.5.1.1 Error codes in the measuring value

Severe errors are indicated by very high measuring values. This corresponds to the principle of an alarm current of a 4...20 mA interface.

The error codes depend on whether the measuring value is transmitted as a floating point or as an integer number (see 6.3.1.1).

The following error codes have been defined:

Error	Floating point	Integer number
Lower temperature limit exceeded	$1{,}0 \times 10^{37}$	2147483638 (0x7FFFFFF6)
Upper temperature limit exceeded	$2{,}0 \times 10^{37}$	2147483639 (0x7FFFFFF7)
Process data invalid	$3{,}0 \times 10^{37}$	2147483640 (0x7FFFFFF8)
Internal error (division by zero)	$4{,}0 \times 10^{37}$	2147483641 (0x7FFFFFF9)
Internal error (computation error)	$5{,}0 \times 10^{37}$	2147483642 (0x7FFFFFFA)
Sensor short-circuit	$7{,}0 \times 10^{37}$	2147483644 (0x7FFFFFFC)
Sensor broken	$8{,}0 \times 10^{37}$	2147483645 (0x7FFFFFFD)

Table 5: Error codes in the measuring value

6.5.1.2 Error flags in status byte

The error flags in the status byte can either have the status “true” or “false”. In this context, “true” means that the error specified actually occurred.

The following error flags have been defined:

- “Process data invalid“: This is the same as the event “Process data invalid”. Value has exceeded upper temperature limit or has fallen below lower temperature limit
- “Parameter memory defective”: Check sum error in the parameter section
- “Device failure”: Check sum error in the adjustment data section, sensor broken or short-circuited

6.5.2 Section "Min/Max values"

This is where the min/max measuring values since the last reset are displayed (see 6.3.5).

6.5.3 Section "Device status"

This section is where the diagnose data for the device status are summarised. This includes

- Operation hours counter
- Error counter: Increases whenever an event occurs
- Device status: According to the IO-Link specification
- Detailed device status: According to the IO-Link specification

The device status can have the following values according to the IO-Link specification:

- 0: No error
- 2: Outside the specification (low voltage)
- 4: Downtime

For more details, see Chapter 7.2 on error detection.

7 Information for programmers

This section contains information for programmers who integrate the IO-Link device into the process data landscape.

7.1 Process data

The process data can be read out via Index 40 and Sub-index 0. In addition to the actual measuring value, additional status information is transmitted.

Parameter	Data type	Value range	Bit-Offset	Default	Chapter
Temperature value	TFLOAT or TINT32		24	0	6.3.1.1
Unit temperature	TUINT8	0 = °C 1 = °F	16	°C	6.3.1.2
Status temperature value	TUINT8 (bit field)	Bit 0 = Process data invalid (Upper limit temperature exceeded or lower limit temperature undershot) Bit 1 = Parameter memory defective Bit 2 = Device failure	8	0	6.5.1.2
Switching outputs	TUINT8 (bit field)	Bit 0 = switching output 1 closed Bit 1 = switching output 2 closed	0	0	6.3.3

Table 6: Process data structure

7.2 Error detection

The control system can generally identify two types of pressure transmitter faults: Based on the cyclically transmitted process values (see 7.1) and based on the occurrence of events.

Further information regarding the status of the pressure transmitter can be gained by reading out the parameters “Device status” and “Extended device status”.

The following table summarises the error detection and signaling.

Error	**Indication in the measuring value**	**Status byte (part of the process data)**	**Device status (parameters)**	**Event value (standard event)**	**Event can be configured**
No error	-	-	0 (device is OK)	-	-
Process data invalid	yes	Bit0 (process data invalid)	4 (error)	0x1000	yes
Upper temperature limit exceeded	yes			0x8C20	yes
Lower temperature limit exceeded	yes				yes
Parameter memory defective	no	Bit1 (Parameter memory defective)	4 (error)	0x6320	
Error in the adjustment data	no	Bit2 (Device failure)	4 (error)	0x5000	yes
Hardware defective (sensor broken, sensor shorted)	yes				yes
Low voltage	no	-	2 (outside the specification)	0x5111	no
Temperature error, overload	no	-	4 (error)	0x4000	no

Table 7: Summary of errors

7.3 Device parameters

The parameters can be read and written. Actions are triggered by writing a parameter with a specific value.

Description	Index	Sub-index	Data type	Value range	Default	Access right[a]	Chapter
Standard commands	2	0	Action	130 = Restore delivery status 176 = Correct zero point 160 = Set actual value to lower adjustment point 161 = Set actual value to upper adjustment point	-	WO	
Process data format	64	0	TENUM (1 Byte)	0 = Floating point 1 = Integer number	Floating point	RW	6.3.1.1
Event configuration	111	0	TUINT8 (bit field)	Bit 0 = Process data invalid Bit 1 = Upper temperature limit exceeded Bit 2 = Lower temperature limit exceeded Bit 3 = Device failure 0 = off 1 = on	0	RW	6.3.4.1
Unit temperature	120	0	TENUM (1 Byte)	0 = °C 1 = °F	°C	RW	6.3.1.2
Damping	122	0	TFLOAT	0 to 100 s	0	RW	6.3.1.3
Temperature offset	121	0	TFLOAT	-999 to 999	0	RW	6.3.2.1
Switching function	200 and 201[b]	1	TENUM	0 = off 1 = Hysteresis function, normally open 2 = Hysteresis function, normally closed 3 = Frame function, normally open 4 = Frame function, normally closed	off	RW	6.3.3.1

Description	Index	Sub-index	Data type	Value range	Default	Access right[a]	Chapter
Switching point / Upper frame limit	200 and 201	2	TFLOAT	-999 to 999	0	RW	6.3.3
Reset point / Lower frame limit	200 and 201	3	TFLOAT	-999 to 999	0	RW	6.3.3
Delay switch point	200 and 201	4	TFLOAT	0 to 100 s	0	RW	6.3.3
Delay reset point	200 and 201	5	TFLOAT	0 to 100 s	0	RW	6.3.3
Output function	200 and 201	6	TENUM (1 Byte)	0 = PNP/High-side 1 = NPN/Low-side	PNP/ High-side	RW	6.3.3
Adjustment of characteristic curve activated	220	0	TENUM (1 Byte)	0 = off 1 = on	off	RW	6.3.2.2
Actual value lower adjustment point	221	0	TFLOAT	-999 to 999	0	RW	6.3.2.2
Actual value upper adjustment point	222	0	TFLOAT	-999 to 999	0	RW	6.3.2.2
Target value lower adjustment point	223	0	TFLOAT	-999 to 999	0	RW	6.3.2.2
Target value upper adjustment point	224	0	TFLOAT	-999 to 999	0	RW	6.3.2.2
Reset min/max values	3100	0	Action	3 = Reset min value temperature 4 = Reset max value temperature	-	WO	6.3.5

[a] RW = read/write access

WO = write-only

[b] 200 = Switching point 1

201 = Switching point 2

Table 8: IO-Link parameters