IO-Link Communication Protocol

Pressure Transmitters with IO-Link Interfacea
KELLER AG für Druckmesstechnik

Version 1.4

1 Introduction

Pressure Transmitters with IO-Link interface are used for acquiring pressure and temperature in liquid or gaseous media. The measurements from the pressure and temperature sensors are digitized and made available for further processing via the IO-Link serial bus protocol.

IO-Link offers process data, parametrization, diagnosis, and status information of the pressure transmitter.

The Smart Sensor Profile of the IO-Link Community has been implemented in order to reduce the diversity in point of view of process data structures and physical units. For simplified data post-processing it's also possible to switch the process data format to a float value and the extended process data format, where the temperature is mapped into the process data as float as well.

An adjustable switching signal channel can be configured with the standard index of the Smart Sensor Profile. The output of the switching signal channel can either be used as Bit in the process-data, or in the IO-Link SIO Mode, where the IO-Link data wire is used as standard IO to signalize the switching state.

1.1 Function Overview

(1) M-Sequence

   a. In the modes PREOPERATE and BOOTLOADER the M-Sequence TYPE_1_2 (with 2 octets OD) is used.

   b. In the mode OPERATE, the M-Sequence TYPE_2_V (with 1 octet OD and 6 octets PD) is used.

(2) Analog signals from the pressure cell and the temperature sensor are digitized and compensated at the factory over pressure and temperature, using mathematic modelling. Field values (compensated pressure and temperature) can be filtered using different low pass filters.

(3) Process data

   a. Resulting process value is available as float or as integer with decimal digits (scale value)

   b. Process data contain the

      i. 32-bit process value (PDI48 or float), 8-Bit scale value and switching signal channel status

      ii. 32-bit pressure value (float), 32-bit temperature value (float) and 8 Bit with the switching signal channel status

   c. The data currency is maximal 1ms (600us time for ADC Sampling post processing of the data and 400us to send the data to the IO-Link Master).

   d. Pressure value can be scaled with gain and offset, which are stored permanently (values are excluded from data storage to calibrate the transmitter outside the machine. The IO-Link Master will not override this calibration values.)

(4) Switching signal channel (SSC)

   a. Available with two different switching modes (single point, window)

   b. Values are stored permanently, to configure the transmitter on the workbench and use it a as pressure switch without IO-Link in the machine

(5) Parameters can be set, and values and status can be requested with ISDU messages

1.2 Factory Settings

The values of the factory settings are available in the IODD File, as well as in the ISDU Object Dictionary.

Most important factory settings:

Process data mapping:	**PDI48** (Smart sensor profile)
Pressure-Value:	Unit is always Pa
Temperature-Value:	Unit is °C as default
Switching Signal Channel:	Disabled

2 Installation / Electrical Connection

An IO-Link device is always connected directly to an IO-Link master (peer to peer connection).

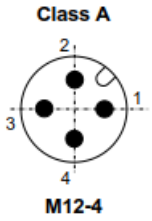
2.1 Connection Cable Restriction

Unshielded cables can be used.

Property	Value
Length	<20m
Overall loop resistance	<3Ω
Effective line capacitance CLeff	<3nF

2.2 Transmitter Connection

2.2.1 M12 Connector, Device Class A



Pin	Signal	Remark
1	L+	Supply Voltage 8-32 V DC
2	NC	Unused
3	L-	GND
4	C/Q	SIO/SDCI (IO-Link Signal or SIO)

2.2.2 Cable Colours

Color	Signal	Remark
Brown	L+	Supply Voltage 8-32 V DC
White	NC	Unused
Blue	L-	GND
Black	C/Q	SIO/SDCI (IO-Link Signal or SIO)

3 Commissioning

The IO-Link device shall be connected to an IO-Link Master.

The IO-Link Master needs to be configured to match the transmitters interface and the demands of the application (i.e. Cycle time and process-data mapping) with an IO-Link Master configuration tool. (i.e. S7-PCT (Siemens), TwinCat-Plugin (Beckhoff)).

All transmitter parameters (see chapter ISDU Object Dictionary) are defined in the IO-Link object dictionary (IODD file) and can be set using standard IO-Link Master configuration software tools (See Chapter Quick Start Guide for an example), or directly by using the IDSU in the PLC application (see chapter Acyclic Parameter Reading / Writing from Application). An appropriate IODD file is available for all device types.

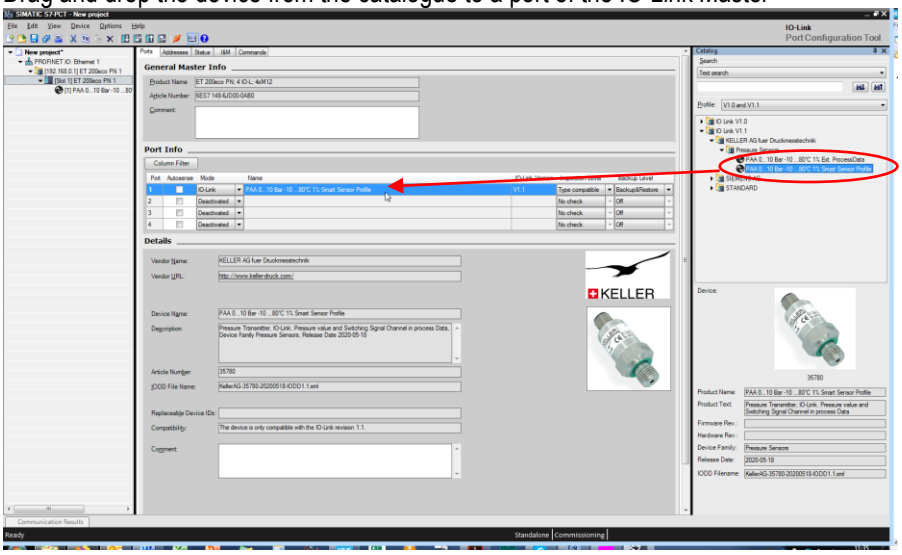
The IODD file is downloadable from the IODDfinder.

Basically, nothing needs to be configured; the sensor is ready to run with the default values.

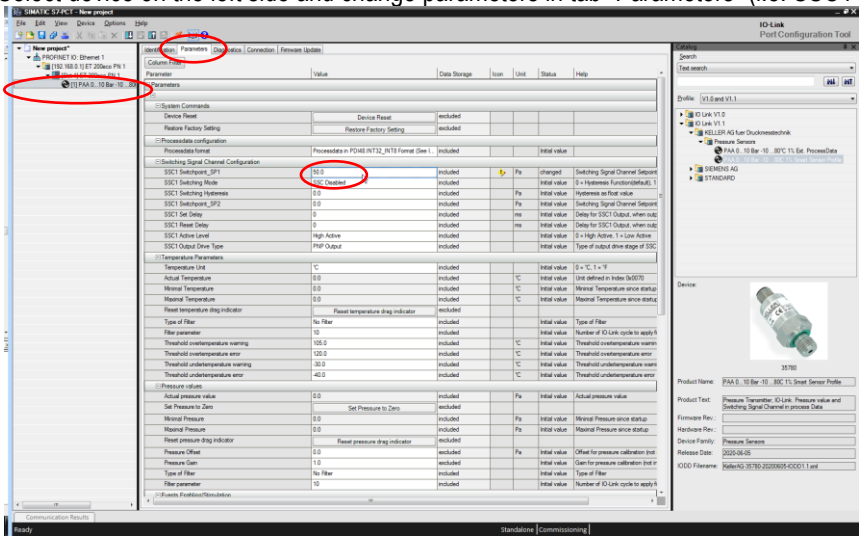
4 Quick Start Guide

4.1 Siemens, S7-PCT

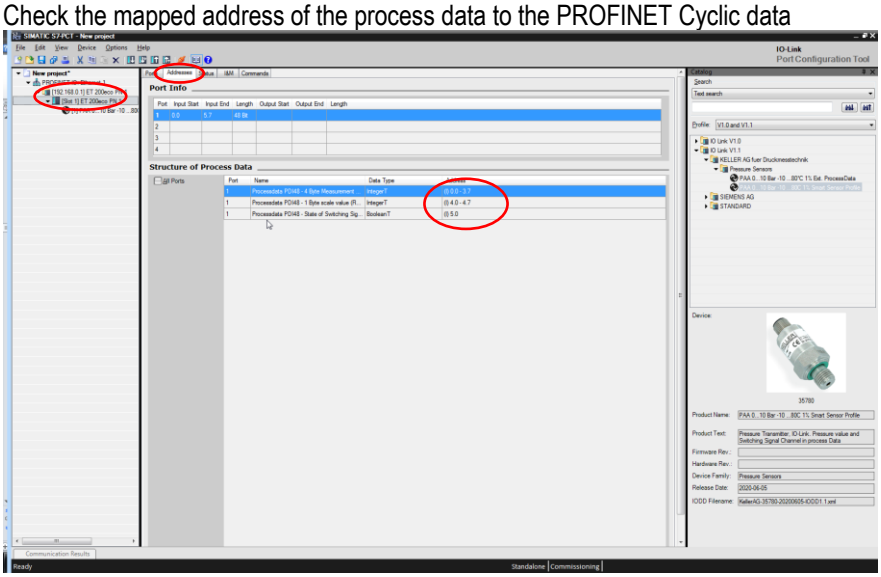
1. Import the IODD File
    a. Options -> Import IODD
    b. Select Path to “KellerAG-ZLine-20190621-IODD1.1.xml” File
        i. (File can be downloaded prior via the IODDfinder)
    c. Click Import (left bottom)
2. Drag and drop the device from the catalogue to a port of the IO-Link Master



3. Select device on the left side and change parameters in tab “Parameters” (i.e. SSC1 Switchpoint)



4. Check the mapped address of the process data to the PROFINET Cyclic data



   a. Select “Slot” on the left side
   b. Check Tab “Addresses”
   c. Use the same Address-Range in the S7/TIA Process data of the IO-Link Master to assign variables to this range.

5 Process Data

There are three different process data formats

1. Smart Sensor Profile process data length (DeviceID with Bit18 Reset)
   a. Pressure value in PDI48 format + Scale + Switching Signal State
   b. Pressure value in Float format + Scale + Switching Signal State
2. Extended process data length (DeviceID with Bit18 Set)
   a. Pressure and temperature value in float format, Switching Signal State

The pressure value will be checked against the measuring range (see chapter Range check)

5.1 Smart Sensor Profile Format (48-Bit Process Data)

This process data format can be configured by writing a value of "0" to ISDU Index 272 (this is the default setting)

The DeviceID can be changed, because another IODD file is used (other process data length). An IODD-File with Bit18 Set (**0**xxxxh) shall be used.

The PDI48.INT32_INT8 format is being used for the process data format. Please consider the specification of the IO-Link community (https://io-link.com - Smart Sensor Profile) for details which are not described in this section.

This format is basically a fix point value. The range (decimal) is set by the scale-value. The scale value is fixed and does not change during operation.

IntegerT(32)	IntegerT(8)	8 bit
Measurement value	Reserved	Vendor specific

Bit offset

SDCI

Transmision direction

Byte	Description	Detail	Value Range
0… 3	Measurement_value	Process Data	-2147483648 to 2147483647
4	Scale	Range shifting (10^{Scale}) Fix-Value for a device (For most KELLER Devices, a Scale Value of "-1" is used	-128 to 127
5	Vendor specific (SSSC1 state)	Bit0: SSC1 State	0/1

ProcessData[Pa] = Measurement_value * 10^{Scale}

Please see chapter Range check for special process values.

5.2 Float Format (48-Bit Process Data)

This process data format can be configured by writing a value of “1” to ISDU Index 272.

The DeviceID can be changed, because another IODD file is used (other process data length). An IODD-File with Bit18 Set (**0**xxxxh) shall be used.

The Float (IEE754) format is being used for the process data format.

Float32T(32)	IntegerT(8)	8 bit
Measurement value	Reserved	Vendor specific

Byte	Description	Detail	Value Range
0… 3	Measurement_value	Process Data	±3.402823466*10^{38}
4	Reserve	(same process data length as PDI48– Format is required)	-
5	Vendor specific (SSSC1 state)	Bit0: SSC1 State	0/1

ProcessData[Pa] = Measurement_value

Please see chapter Range check for special process values.

5.3 Extended Process Data Float Format (72-Bit Process Data)

This process data format can be configured by writing a value of “2” to ISDU Index 272.

The DeviceID can be changed, because another IODD file is used (other process data length). An IODD-File with Bit18 Set (4xxxxh) shall be used.

The Float (IEE754) format is being used for the process data format.

Float32T(32)	Float32T(32)	8 bit
Pressure-Value	Temperature-Value	Vendor specific

Byte	Description	Detail	Value Range
0… 3	**Pressure-Value**	Process Data [Pa]	±3.402823466*10^{38}
4 … 7	Temperature-Value	Process Data [°C / °F]	±3.402823466*10^{38}
5	Vendor specific (SSSC1 state)	Bit0: SSC1 State	0/1

Please see chapter Range check for special process values.

6 Device Function

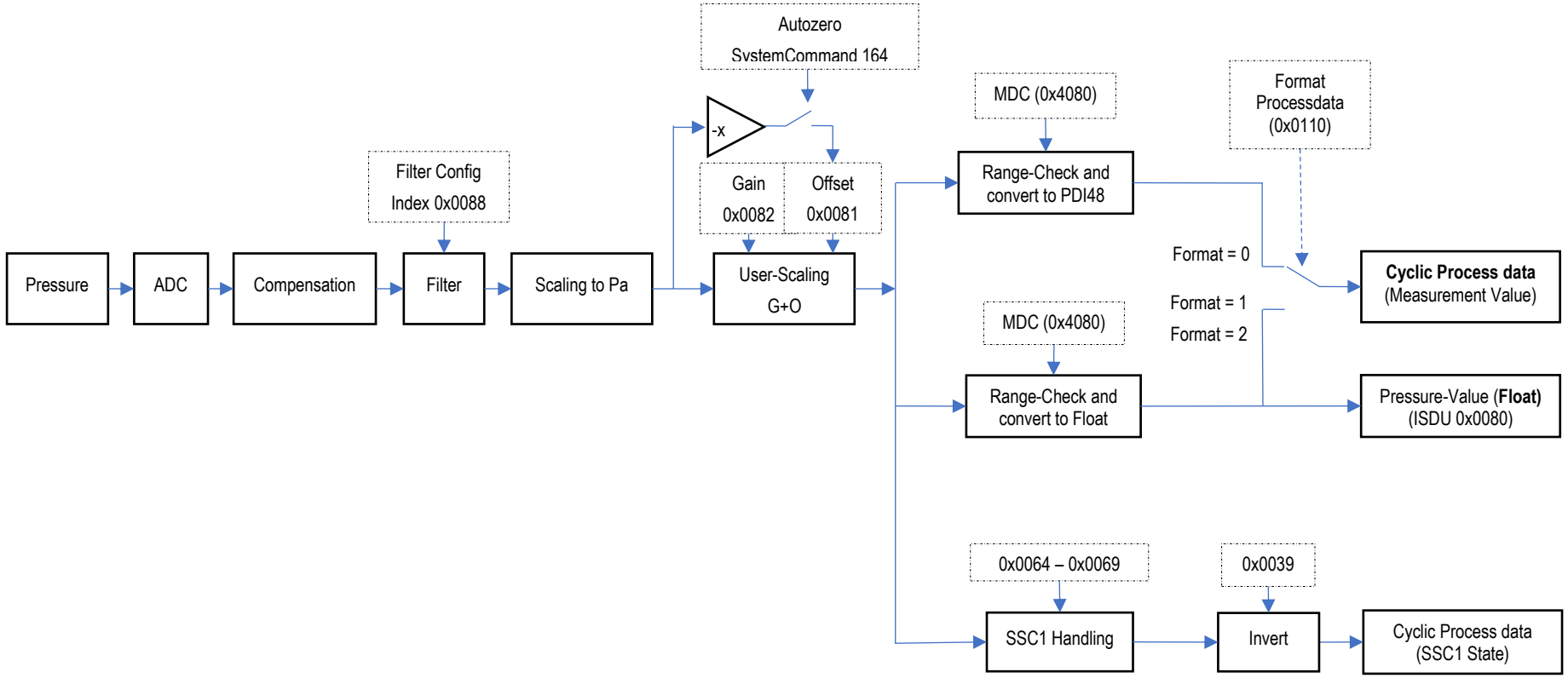
6.1 Introduction

Pressure transmitters with IO-Link interface operate according to the IO-Link specification V1.1 and support the device profile Smart Sensor Profile. The graphics in the following chapters show the signal flow of the measurement through the transmitter.

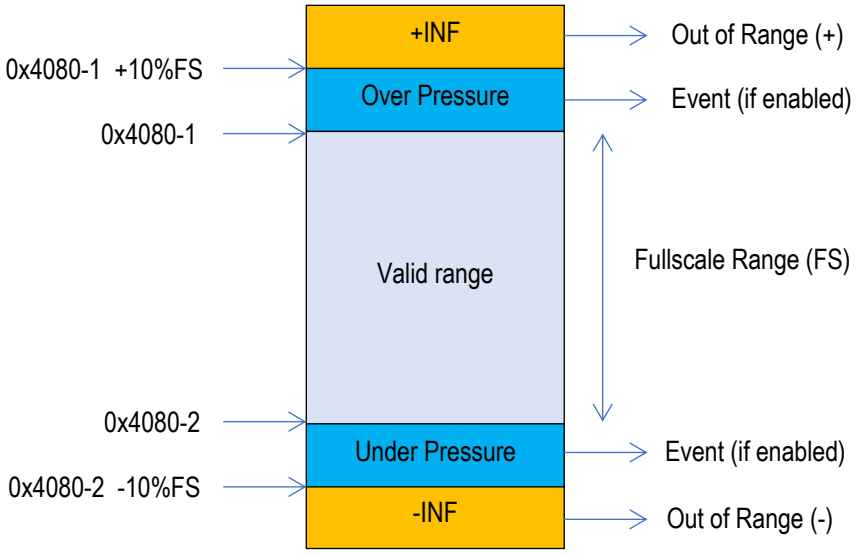
The detailed configuration options are described in chapter ISDU Object Dictionary.

6.2 Data Flow of Pressure Channel

The calculations of the pressure channel are processed once in a communication cycle (cycle time of IO-Link Master)



6.3 Range Check



The process value of the transmitter is still correct, if under pressure or over pressure is detected; only an event and the sensor status index (0x010F) are set accordingly.

If there occurred a “real” under/over pressure (typically more than 10% of the compensated pressure range) the process value will change to +INF/-INF for float and Out of Range (-)/Out of Range (+) for PDI48 format (see table A.6 of the Smart Sensor Profile).

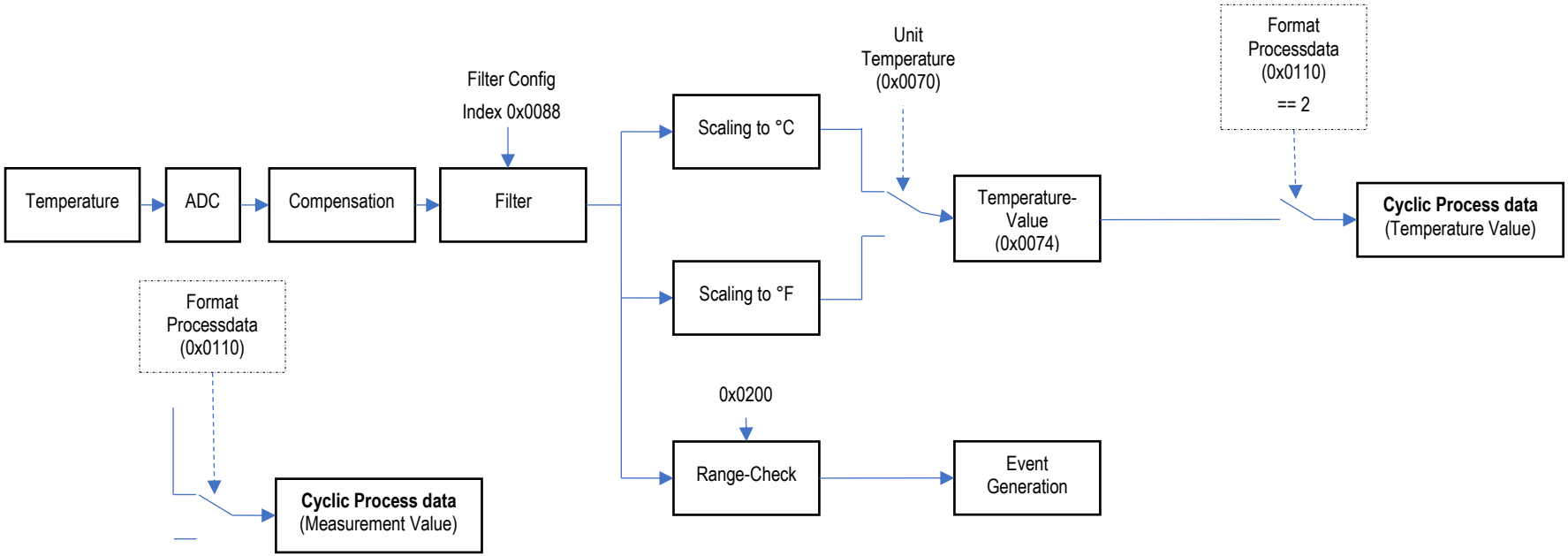
If no measurement value can be provided (i.e. HW-Failure), a NaN will be set in the process measurement value.

Special Integer / float Values

	32bit signed Integer	float	Reason
NaN	2147483644 (0x7FFFFFFC)	(0xFFFFFFFF)	No measurement (i.e. HW-Failure)
+INF	2147483640 (0x7FFFFFF8)	(0x7F800000)	More than 10%FS over the measuring range (0x4080-1)
-INF	-2147483640 (0x80000008)	(0xFF800000)	More than 10%FS under the measuring range (0x4080-2)

6.4 Data Flow of Temperature Channel

The calculations of the temperature channel are processed once in a communication cycle (cycle time of IO-Link Master)



6.5 Events and Diagnosis

When an event occurs, the event-flag in the process data will be set. The IO-Link Master will automatically read the event information from the device (over the Event Handler) and signal the event to the PLC.

Overview

Event	Type	Event-Code	IO-Link Standard/ Manufacturer specific
Over temperature	Warning	0x4210	Standard
Over temperature	Error	0x4000	Standard
Under temperature	Warning	0x4220	Standard
Under temperature	Error	0x4000	Standard
HW failure	Error	0x5000	Standard
Over pressure	Error	0x1800	Manufacturer specific
Under pressure	Error	0x1801	Manufacturer specific
Test event1	Warning	0x1802	Manufacturer specific
Test event2	Error	0x1803	Manufacturer specific

The generation of the single events can be enabled/disabled, for cases where an entry into the error log of the PLC is unwanted, i.e. when small overpressure events occurred due to a switching valve. The index for Event Enabling is described in the chapter 0x0100– 0x0106 Events Enable of the object dictionary.

6.6 Firmware Update

The Firmware (Application) of the device can be updated via IO-Link.

The procedure is described in the IO-Link specification.

To ensure, that only compatible Firmware versions are downloaded to the device, a Hardware-ID is implemented in the device, as well as in the IO-Link Firmware package. The Firmware package can be downloaded on the KELLER website, on the corresponding product-page.

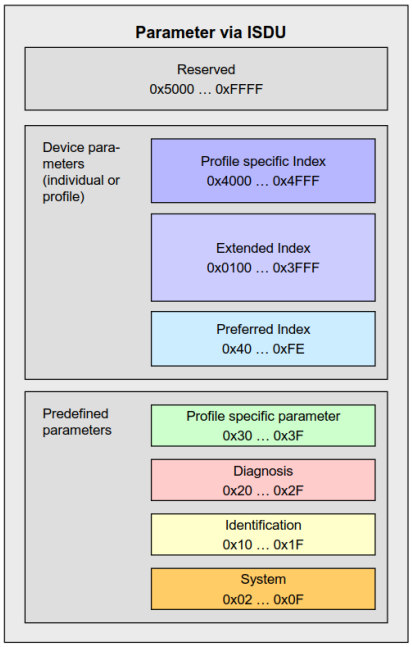
6.6.1 Bootloader Password

To release the Bootloader, a password is needed. The password is “Mockingbird”.

7 ISDU Object Dictionary

All acyclic parameters can be accessed with the ISDU service.

The parameter indices are divided into several spaces/categories:



The entire object dictionary is available with the IODD file.

7.1 IO-Link Specific Parameters (System / Identification / Diagnosis)

Index	Sub-Index	Format	Access	Name	Description	Range	Default
0x02			RW	System Commands			
0x0C	0			Device Access Locks			
	2	Bool	RW	Access lock DataStorage	Datastorage mechanism can be locked (not recommended)		
0x10		String	RO	Vendor name	KELLER AG fuer Druckmesstechnik		
0x11		String	RO	Vendor text	Your swiss sensor specialist		
0x12		String	RO	Product name			
0x13		String	RO	Product ID	ID of the Product		depends on product variant
0x14		String	RO	Product text	Pressure Transmitter		
0x15		String	RO	Serial number			
0x16		String	RO	Hardware revision	i.e. “28”		
0x17		String	RO	Firmware revision	i.e. “5.23-19.40”		
0x18		String	RW	Application specific tag	This is a free user specific tag	Max. 32 chars	
0x19		String	RW	Function tag	Free use for user application	Max. 32 chars	
0x1A		String	RW	Location tag	Free use for user application	Max. 32 chars	
0x24		Uint8	RO	Device Status			
0x25	1…9	String	RO	Detailed Device Status			
0x28	Last valid Process data input (Depending on the configured process data						
	“Short” Process-Data:						
	1	Uint32/ Float	RO	Measurement value	Can either be Uint32 or Float (depending on selected process data format)		
	2	Uint8	RO	Scale / Not used	(depending on selected process data format)		
	3	Uint8	RO	Bit0: SSC1 state			
	Extended Process-Data:						
	1	Float	RO	Pressure value			
	2	Float	RO	Temperature value			
	3	Uint8	RO	Bit0: SSC1 state			

7.1.1 System Commands

By writing a value to the system command index, a routine will be started on the device.

Value	Name	Description	Link to specification
80	Bootloader command, UNLOCK_S	Start unlocking sequence	https://io-link.com Firmware Update, Chapter 7.6.8
81	Bootloader command, UNLOCK_F	Unlocking command 1	
82	Bootloader command, UNLOCK_T	Unlocking command 2	
83	Bootloader command, ACTIVATE	Stop communication and start new FW	
128	Device Reset	Device performs a complete reset	IOL-Interface-Spec_10002_dV113_Sep18.pdf Chapter 10.7.2
130	Restore Factory settings	Device preforms a factory reset (If the IO-Link Master has a stored parameter set, the data will automatically be downloaded to the device after communication restart.	https://io-link.com Interface Spec V113 Chapter 10.7.4
160	Reset -Pressure drag Indicator	The pressure drag indicators (Index 0x85, 0x86) will be cleared	
161	Reset -Temperature drag Indicator	The temperature drag indicators (Index 0x72, 0x73) will be cleared	
162	Reset Overpressure counter	Overpressure counter (Index 0x87) will be cleared	
163	Reset operating hours	The operating hours (index 0x90) will be cleared	
164	Pressure Auto Zero	An offset will be calculated to get a pressure output of 0kPa .The Offset is written to Index 0x81 and stored to EEPROM	

7.1.2 Device Access Locks

No device lock mechanism is implemented. The data storage access lock has been implemented because the IO-Link Masters are reading this Index and expecting the data storage access lock to be available. Please consider IO-Link spec, chapter B.2.4 DeviceAccessLocks. **It is not recommended to lock the data storage**.

7.1.3 Device Status

This index represents the status of the device.

The following values are implemented:

Value	Description	Reason/Measure
0	Device is operating properly	-
2	Out of specification	In case of over- / under temperature warning -> the user must take care lower/increase the device ambient/medium temperature
4	Failure	In case of a HW failure or over-/under pressure error, this value will be set.

7.1.4 Detailed Device Status

In the device status, the status of every event can be read. Every event has its own sub-index. With the Mode-Bits (Bit7,6) from the CKS Byte, the application can read, if the event is present (0x3), or not present (0x0 / 0x2). The EventCode is set to 0x0000, when the event disappeared or was never present. The Sub index are reserved for every single EventCode, which is set, as soon as the event appears (**static event list**)

Because the generation of an entry in this list can be disabled, an additional Index (0x010F– Sensor Status) has been created, which is showing the status of every single event independent of the event generation.

The following sub-indices are implemented, while a Sub-Index has always 3 Octets:

Sub-Index	Object name	Type	Event-Qualifier (without Mode) Octet 0	Event Code Octet 1/2
1	Over temperature	Warning	0x24	0x4210
2	Over temperature	Error	0x34	0x4000
3	Under temperature	Warning	0x24	0x4220
4	Under temperature	Error	0x34	0x4000
5	HW failure	Error	0x34	0x5000
6	Over pressure	Error	0x34	0x1800
7	Under pressure	Error	0x34	0x1801
8	Test event1	Warning	0x24	0x1802
9	Test event2	Error	0x34	0x1803

The structure of the Event qualifier is as follow (See chapter A.6.4 of the https://io-link.com Interface Spec V113):

Mode		**Type**		**Source**	**Instance**		
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

The Mode bits do vary during operation, while the other values are fixed for each sub-index

Values for Mode:

Value	Description
0	Reserved
1	Event single shot
2	Event disappears
3	Event appears

Values for Type:

Value	Description
0	Reserved
1	Notification
2	Warning
3	Error

Values for Source (Always “0”):

Value	Description
0	**Device (remote)**
1	Master/Port

Values for Instance (Always “4”):

Value	Description
0	Unknown
1 to 3	Reserved
4	Application
5 to 7	Reserved

7.2 Smart Sensor Profile Parameters

Index	Sub-Index	Format	Access	Name	Range	Default	Stored presistant
0x39		Bool	RW	Active Level SSC1	**Value** / **Description** **0** / **Active High** 1 (True) / Active Low	0	x

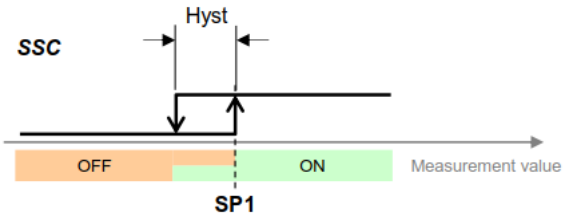
7.3 Manufacturer Specific Parameters

Index	Sub-Index	Format	Access	Name	Unit	Default	Stored persistent	Excluded from data storage
0x0064		Uint8	RW	0x0064 Description of the Switching Modes Switching Mode 0: Hysteresis Function 1: Window Function 2: Disabled		2	x	
0x0065		Float	RW	SSC1 Hysteresis	[Pa]	5%Fullscale	x	
0x0066		Float	RW	SSC1 Switchpoint SP1	[Pa]	Fullscale/2	x	
0x0067		Float	RW	SSC1 Switchpoint SP2	[Pa]	Fullscale/3	x	
0x0068		Uint16	RW	SSC1 Output set delay	[ms]	0	x	
0x0069		Uint16	RW	SSC1 Output reset delay	[ms]	0	x	
0x006A		Uint8	RW	SSC1 Output Driver Mode 0: PNP Output 1: NPN Output 2: Push-Pull Output		0	x	
0x0070		Uint8	RW	Physical unit of temperature value: 0: Unit [°C] 1: Unit [°F]		0		
0x0071		Float	RO	Actual sensor temperature (Physical Unit defined in Index 0x0070)	[°C]/[°F]			
0x0072		Float	RO	Minimal temperature since startup (Physical Unit defined in Index 0x0070)	[°C]/[°F]			
0x0073		Float	RO	Maximal temperature since startup (Physical Unit defined in Index 0x0070)	[°C]/[°F]			
0x0074		Uint8	RW	Type of filter 0: No filter is applied 1: Moving average filter 2: Repeated average filter				
0x0075		Uint8	RW	Filter for temperature measurement				
0x0076		Float	RW	Threshold overtemperature warning	[°C]	105		
0x0077		Float	RW	Threshold overtemperature error	[°C]	120		
0x0078		Float	RW	Threshold undertemperature warning	[°C]	-30		
0x0079		Float	RW	Threshold undertemperature error	[°C]	-40		
0x007A		Uint32	RO	Samples per Second temperature acquisition	SPS	Will be implemented in next FW Version (25ms for Z-Line transmitter)		
0x0080		Float	RO	Actual pressure value	[Pa]			
0x0081		Float	RW	Offset for Pressure value	[Pa]		x	x
0x0082		Float	RW	Gain for Pressure value			x	x
0x0085		Float	RO	Minimal pressure since startup	[Pa]			
0x0086		Float	RO	Maximal pressure since startup	[Pa]			

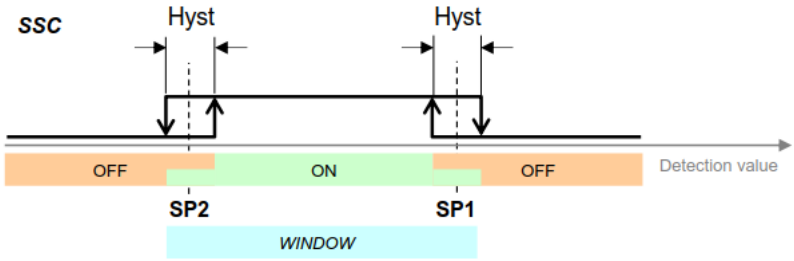
0x0087		**Uint32**	**RO**	**Pressure overload counter (Counts, when exceeding Measuring Range (Index 0x0200), With a Hysteresis of 5kPa)**				
0x0088		Uint8	RW	Type of filter 0: No filter is applied 1: Moving average filter 2: Repeated average filter				
0x0089		Record	RW	Filter for pressure measurement				
0x008A		Uint32	RO	Samples per Second pressure acquisition	SPS	Will be implemented in next FW Version (0.4ms for Z-Line transmitter)		
0x0090		Uint8	RO	Operating time since startup	[s]			
0x0100 – 0x0106		Record	RW	0x0100 – 0x0106 – Events Enable				
0x010E		Uint8	RW	0x010E– Event Stimulation		0		x
0x010F		Record	RO	0x010F– Sensor Status				
0x0110		Uint8	RW	0x0110– Process Data Format Configuration		0		
0x0111		Uint16	RW	Date of Last Calibration			x	x
0x0112		Uint8	RW				x	x
0x0113		Uint8	RW				x	x
0x0114		Uint8	RW	Manufacturer Reserved				x
0x0115		Uint16	RW	Manufacturer Reserved				x
0x02FE		Uint16	RO	Firmware SVN Revision				
0x4080		Record	RO	Measurement device description				
0x43BE		String	RO	Hardware Identification Key				
0x43BF		Uint8	RO	Bootmode Status				

7.3.1 0x0064 Description of the Switching Modes

7.3.1.1 Hysteresis Function



7.3.1.2 Window Function



7.3.2 0x0081 – 0x0082 Pressure Gain and Offset

An application specific Gain and Offset can be set with this index. The values are not part of the datastorage and will be stored permanently in the device itself. Storing of the parameters is done automatically after writing to this index.

ProcessValue = (Filed Value * Gain) + Offset

7.3.3 0x0100 – 0x0106 – Events Enable

Single events can be disabled with this index. The generation of the event flag in the process data will therefore not be set and the corresponding entry in the Detailed device status will not be created.

Index	Object name	Type	Values	Default
0x0100	Device Failure	Bool	0: Event disabled 1: Event enabled	1
0x0101	Over pressure	Bool	0: Event disabled 1: Event enabled	0
0x0102	Under pressure	Bool	0: Event disabled 1: Event enabled	0
0x0103	Overtemperature warning	Bool	0: Event disabled 1: Event enabled	0
0x0104	Overtemperature error	Bool	0: Event disabled 1: Event enabled	1
0x0105	Undertemperature warning	Bool	0: Event disabled 1: Event enabled	0
0x0106	Undertemperature error	Bool	0: Event disabled 1: Event enabled	1

7.3.4 0x010E– Event Stimulation

With this index, a test event can be simulated. This index has especially been implemented for conformity testing purposes, although it can also be used to test the event chain of the application.

Value	Description
1	Test-Event1 appearing
2	Test-Event1 disappearing
3	Test-Event2 appearing
4	Test-Event2 disappearing

7.3.5 0x010F– Sensor Status

The status of the sensor can be read with this index.

Sub-Index	Object name	Type	Values
1	Device Failure	Bool	1: Sensor defect
2	Overpressure	Bool	1: Overpressure applied
3	Underpressure	Bool	1: Underpressure applied
4	Overtemperature_Warn	Bool	1: Over temperature warning threshold exceeded
5	Overtemperature_Err	Bool	1: Over temperature error threshold exceeded
6	Undertemperature_Warn	Bool	1: Under temperature warning threshold exceeded
7	Undertemperature_Err	Bool	1: Under temperature error threshold exceeded

The Sub-Index 1 is a summary of the following detected errors:

- Supply/GND connection to the sensing element is broken (Signal wires are not monitored)
- EEPROM/FLASH corruption (CRC protected)
- Current at C/Q Pin exceeds 300mA
- L+ Supply falls below 6V

7.3.6 0x0110– Process Data Format Configuration

The data format of the process data can be configured with this index. The unit of the process data can't be changed and is fixed to kPa (other units can be achieved by applying a pressure gain and pressure offset). Please consider chapter Process data for details about the process data format.

Value	Description
0	48-Bit Process Data PDI48 format
1	48-Bit Process Data Float format (Only pressure)
2	72-Bit Process Data Float format (pressure and temperature value)

7.3.7 0x0111 … 0x113 – Calibration Date

These indices can be used to store the date of the last calibration. As default, the manufacturing-date is stored.

Index	Format	Access	Name
0x0111	Uint16	RW	Year of last calibration
0x0112	Uint8	RW	Month of last calibration
0x0113	Uint8	RW	Day of last calibration

7.3.8 0x4080 – MDC Descr

Description parameters for measuring device channel

Sub-Index	Format	Access	Name	Default
1	Int32	RO	Upper pressure measuring range	
2	Int32	RO	Lower pressure measuring range	
3	Int16	RO	Physical Unit (SI-Unit)	Pa
4	Int8	RO	Scale (10^{Scale})	-1

7.3.9 Filter for Pressure / Temperature Measurement

With this index, the filter steps can be configured separately for the temperature and pressure measurement. A step means a single measurement of the channel itself.

The pressure channel is sampled with 2700SPS, while the temperature channel is sampled with 21SPS.

I.e.: When using a value of 10 for the pressure channel, the average of 10 measurements is calculated.

The tables below give some example values and the corresponding corner frequencies.

Frequency response depending on the filter steps:

Pressure channel:

Approx. Formula: $fg = 410 * \frac{3}{Steps}$

Filter steps	Corner frequency [Hz]
0	410
10	125
50	25
100	12.5
200	6.2

Temperature channel:

Approx. Formula: $fg = 14 * \frac{61}{Steps}$

Filter steps	Corner frequency [Hz]
0	14
150	5.7
255	3.3

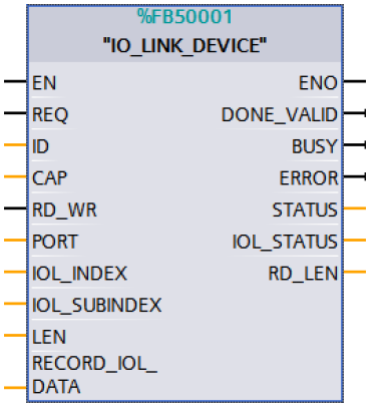
8 Appendix

8.1 Acyclic Parameter Reading / Writing from Application

Acyclic parameters and status can be read by function blocks from the PLC programming software.

8.1.1 Siemens

In TIA, a function block called “IO_LINK_DEVICE”, which can be used directly.



8.1.2 Beckhoff

Acyclic reading can be achieved with the command “ADS”. For reading, AdsSyncReadReq() can be used, or AdsSyncWrite() for writing.

8.2 Firmware Versions

An overview of the released versions:

Revision Number (Index 0x17)	**Release Date**	**Major Changes**	**Sign**
5.23-19.40	04.10.2019	Initial Version	chg
5.24-20.23	22.06.2020	Introduced Bootloader Added extended Process Data Change SI-Unit from “kPa” to “Pa”	chg
5.24-21.35	01.09.2021	Reduced on request data octets in mode PREOPERATE Changed password for unlocking bootloader	chg

8.3 Glossary

OD
On demand Data

PD
Process data

PLC
Programmable logic controller

SSC
Switching Signal Channel

PDI48
48 Bit Process Data In from Smart Sensor Profile

ISDU
Indexed Service Data Unit

8.4 Related Links

- Product page of 21Zio series
  www.keller-druck.com
- Specifications from IO-Link community
  https://io-link.com/
- Single precision float (IEEE 754) converter
  https://www.h-schmidt.net/FloatConverter/IEEE754.html

8.5 Contact Information

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8.6 Document History

Date	Version	Description	Sign
01.07.2019	1.0	Initial Version	Ch. Gysel
07.10.2019	1.1	Added configuration in Index 0x0064 to disable SSC1 Removed ProcessDataInv Entry from EventEnable-Register (0x0100) Added Index 0x006A to configure the SSC1 Output driver type Converted most Sub-Index to Index	Ch. Gysel
22.06.2020	1.2	Process data: • Added the extended process data format, where the temperature value is available as well. • Changed unit to Pa instead of kPa • Change the Shift-Value from “-6” to “-1” Removed the chapters about the synchronization of the analog-digital conversion to IO-Link communication Added chapter about the calibration date	Ch. Gysel
02.11.2020	1.3	Chapter “M12 Connector”: Changed Operating-Voltage from “7 … 36” to “8 … 32V”	Ch. Gysel
13.09.2021	1.4	Document renamed from "Operating Manual" to "Communication Protocol" Changed password for unlocking bootloader to "Mockingbird"	Ch. Gysel