

IO-LINK Configuration Guide

Magnetostrictive Sensor

GL_-F-__M-D__-L__1

GA_-M-__M-D__-L__1

GR_-R-__M-D__-L__1

EP_-__M-D__-L__1

T3H_-M-__M-D__-L__1



IO-Link

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1.1 Validity

This guide provides extensive information about the IO-Link configuration of the following products:

GL_-F-__M-D__-L__1
GA_-M-__M-D__-L__1
GR_-R-__M-D__-L__1
EP_-__M-D__-L__1
T3H_-M-__M-D__-L__1

The configuration guide does not replace the user's guide. Read the appropriate user's guide and the other applicable documents completely before installing and operating the product.

This guide was created in Chinese. Other language versions are translations of this guide.

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1.2 Symbols and conventions

Individual action instructions are indicated by a preceding triangle.

► Instruction 1

Action sequences are numbered consecutively:

1. Instruction 1
2. Instruction 2

Numbers unless otherwise indicated are decimals (e.g. 23). Hexadecimal numbers are represented with a preceding 0x (e.g. 0x12AB).



Note, tip

This symbol indicates general notes.

1.3 Technical terms and abbreviations used

AdSS Adjustable Switching Sensor
IODD IO-Device-Description
ISDU IO-Link-Parameter (Index Service Data Unit)
LSB Least Significant Bit
MSB Most Significant Bit
PD Process Data
PDV Process Data Variable
RMS Root Mean Square

2.1 General

IO-Link integrates conventional and intelligent sensors and actuators in automation systems and is intended as a communication standard below classic field buses. Fieldbus-independent transfer uses communication systems that are already available (field buses or Ethernet-based systems).

IO-Link devices, such as sensors and actuators, are connected to the controlling system using a point-to-point connection via a gateway, the IO-Link master. The IO-Link devices are connected using commercially available unshielded standard sensor cables.

Communication is based on a standard UART protocol with a 24-V pulse modulation in half-duplex operation. This allows classic three-conductor physics.

2.2 Protocol

With IO-Link communication, permanently defined frames are cyclically exchanged between the IO-Link master and the IO-Link device. In this protocol, both process and on demand data, such as parameters or diagnostic data, is transferred. The size and the type of the frame and the cycle time used result from the combination of master and device features (see communication properties in section 3.2 on page 9).

2.3 Cycle Time

The cycle time used (master cycle time) results from the minimum possible cycle time of the IO-Link device (min cycle time, see chapter 3.2 on page 9) and the minimum possible cycle time of the IO-Link master. When selecting the IO-Link master, please note that the larger value determines the cycle time used.

2.4 Communication parameters

In order to be able to establish a stable communication connection between master and device, the master requests some important communication parameters from the device at the start of communication. Settings for communication in Preoperate and Operate modes are influenced by the parameters and the device is clearly identified.

Communication parameters are described in chapter 4 on page 26.

2.5 Process Data Flow

The data transfer is based on the general profile specification (IO-Link Common Profile 1.0, see Fig. 2-1 for example).

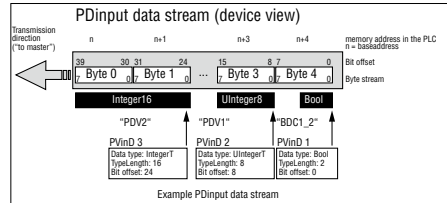


Fig. 2-1: Example of a PDInput data flow

The highest value byte (MSB, designated as Byte 0) is transferred first and can be found in the PLC under the lowest storage address. The lowest value byte (LSB) is transferred last and has the highest byte number (designated in Fig. 2-1 as Byte 4).

For word-based data types (> 8 bit) this means that the byte at the lowest address is the highest value byte, while the highest address contains the lowest value byte.

In the IODD, the description of the data flow is realized using the skew descriptors. This skew starts at the right with the lowest value byte.

Process data variables (in Fig. 2-1: PDV1, PDV2) are aligned to the byte limits in most cases.

Binary information (BDC) is transferred in the lowest value byte in most cases.

2.6 Process data objects

The process data flow is made up of various process data objects, which are not only shown in the process data flow, but are also used for the internal exchange of information between functions. For example, PdObjects can be used to offset random binary information in the function Logic Blocks or to display certain information at the digital output. Therefore, a unique object ID is assigned to this individual information, which can be used at different places.

Process data objects are described in the function chapters under Process Data.

2.7 Device Status

The Device Status indicates the current status of the device or of the directly connected peripherals. This functionality is part of the IO-Link specification.

The following states are output by the device:

- Device is operating properly (device is functioning error-free)
This status indicates that no serious error has occurred in the device and the device can be operated without restrictions.
- Maintenance-Required
Although the process data is valid, internal diagnosis functions show that the device or the operational environment of the device should be serviced.
- Out-of-Specification
Although the process data is valid, internal diagnosis functions show that the device is operating outside of the specified specification. This can affect both the measurement application itself as well as the environmental conditions.
- Functional-Check
Process data is temporarily invalid while a deliberate intervention is performed on the device. For example, parameterization processes or teach-in.
- Failure
The device or the connected peripherals have a severe error. The device cannot perform its intended function!

For further information, see section 7.1 on page 62.

The creation of the Device Status is always based on the output of diagnosis messages. A Device Status is output for every diagnosis message (event). Each of these can be found in the event overview list (see section 3.6 on page 24) or in the description of the functions.

2.8 Block Parameterization

Block parameterization refers to a special process in which multiple parameters are parameterized in one process. It is started with a start command and concluded with an end command.

Because the check of the data is not performed until the parameterization is concluded, pieces of data that are dependent on one another can also be set without problem.

2.9 Data Storage

Data Storage refers to a special process for being able to store the parameterization data of a device on the master. The master controls the process between uploads (if data is intentionally changed) or downloads (if, e.g., an incorrectly parameterized device is connected). The system comprising master and device thereby ensures that a device can be exchanged without the need for an active re-parameterization.



The settings regarding Data Storage are to be performed on the IO-Link master gateway (refer to the information in the corresponding documentation).

Operation is dependent on the used IO-Link master and is explained in the corresponding description.



All parameters that are stored for parameter management in the IO-Link master are marked appropriately in Tab. 3-17 (see ISDU – Identification Data on page 15).

2.10 Variant Handling

A device can consist of a combination of several different IO-Link devices. These device variants differ in the basic functionality, the IO-Link communication settings (length of the process data, communication speed) or in the IO-Link communication model or data model (e.g., support of other ISDU parameters or IO-Link profiles).

A variant can be selected via an ISDU access (see function Variant Configuration on page 67). Note here, that changes do not take effect until after a communication restart (e.g., through Device Reset (see Reset Commands on page 66)).

All device variants can also be selected via the so-called Compatibility Mode. In this case, the port configuration on the master is used to switch the device to the target variant, which is then used permanently by the device.

2.11 Reset Commands

The device offers various reset functions. A corresponding command is executed via a system command.

The behavior and the values that are reset in a given case can be found in the ISDU overview (see section 3.4 on page 15) and in the individual function descriptions.

The Reset Commands are described on page 66.

2.11 Reset Commands

The functions of the device are described in detail in the subsequent sections. Refer to the guide of the IO-Link master for information on the implementation of the process, parameter and diagnostic data via the master gateway.

3.1 Overview of the included Functions

3.1.1 Primary functions

- Identification see page 27
- Device Discovery see page 28
- Magnet Mode see page 29
- Process Data Variable Mapping (QYW-compatible) see page 31
- Output Characteristic and Zero Point Offset (QYW- compatible variants) see page 33
- Measurement Profiles see page 34

3.1.2 Secondary functions

- Signal Delay see page 39
- Basic Statistics see page 42
- Logic Blocks see page 48
- Operating Hours Counter see page 52
- Boot Cycle Counter see page 54
- Extreme Environment Status see page 55
- Internal Temperature see page 57
- Humidity see page 59
(rod versions QYW GA/T/GL... only)
- Storage Usage Monitoring see page 61

3.1.3 System functions

- Device Status and Detailed Device Status see page 62
- Diagnosis Suppression see page 64
- Reset Commands see page 66
- Variant Configuration see page 67
- LED Meaning and Configuration see page 69
- Process Data Info and Configuration see page 72
- Profile Characteristic see page 75
- Parameter Manager see page 76

3 Overview of IO-Link Data and Functions (continued)

3.2 Device Variants

3.2.1 Pure IO-Link variants

QYW-compatible variants (rods), Smart Sensor Profile Legacy

Device ID	Baud rate	PDInput	PDOutput	IO-Link protocol version	Minimum cycle time
0x183002	COM3	4 bytes	-	V1.1	1 ms
0x183003	COM3	8 bytes	-	V1.1	1 ms
0x183004	COM3	16 bytes	-	V1.1	1.5 ms
0x183005	COM3	32 bytes	-	V1.1	2 ms
0x183006	COM2	4 bytes	-	V1.1	4 ms
0x183007	COM2	8 bytes	-	V1.1	6 ms
0x183008	COM2	16 bytes	-	V1.1	9.2 ms
0x183009	COM2	32 bytes	-	V1.1	14.4 ms

Tab. 3-1: Smart Sensor Profile Legacy variants (rods), QYW-compatible

Smart Sensor Profile Ed. 2 variants (rods)

– QYW TBFA00-_____-L-__
– QYW TBFA00-_____-N-__
– QYW TBFE00-_____-

Device ID	Baud rate	PDInput	PDOutput	IO-Link protocol version	Minimum cycle time
0x183000	COM2	6 bytes	-	V1.1	4 ms
0x183001	COM3	6 bytes	-	V1.1	1 ms

Tab. 3-2: Smart Sensor Profile Ed. 2 variants (rods)

3 Overview of IO-Link Data and Functions (continued)

**QYW-compatible variants (profiles), Smart Sensor
Profile Legacy**

QYW TBF_GL_-F-__M-D__-L__1
 QYW TBF_GA_-M-__M-D__-L__1
 QYW TBF_GR_-R-__M-D__-L__1
 QYW TBF_EP_-__M-D__-L__1
 QYW TBF_T3H_-M-__M-D__-L__1

Device ID	Baud rate	PDInput	PDOutput	IO-Link protocol version	Minimum cycle time
0x181022	COM3	4 bytes	–	V1.1	1 ms
0x181023	COM3	8 bytes	–	V1.1	1 ms
0x181024	COM3	16 bytes	–	V1.1	1.5 ms
0x181025	COM3	32 bytes	–	V1.1	2 ms
0x181026	COM2	4 bytes	–	V1.1	4 ms
0x181027	COM2	8 bytes	–	V1.1	6 ms
0x181028	COM2	16 bytes	–	V1.1	9.2 ms
0x181029	COM2	32 bytes	–	V1.1	14.4 ms

Tab. 3-3: Smart Sensor Profile Legacy variants (profiles), QYW- compatible

Smart Sensor Profile Ed. 2 variants (profiles)

QYW TBF_GL_-F-__M-D__-L__1
 QYW TBF_GA_-M-__M-D__-L__1
 QYW TBF_GR_-R-__M-D__-L__1
 QYW TBF_EP_-__M-D__-L__1
 QYW TBF_T3H_-M-__M-D__-L__1

Device ID	Baud rate	PDInput	PDOutput	IO-Link protocol version	Minimum cycle time
0x181020	COM2	6 bytes	–	V1.1	4 ms
0x181021	COM3	6 bytes	–	V1.1	1 ms

Tab. 3-4: Smart Sensor Profile Ed. 2 variants (profiles)

3 Overview of IO-Link Data and Functions (continued)

3.2.2 Mixed signal variants (IO-Link and analog)

QYW-compatible variants (rods), Smart Sensor

Profile Legacy

- QYW TBF _ _ _ _ _ L1_3_-0Q01
- QYW TBF _ _ _ _ _ L1_2_-0Q01

Device ID	Baud rate	PDInput	PDOutput	IO-Link protocol version	Minimum cycle time
0x182010	COM3	4 bytes	–	V1.1	1 ms
0x182011	COM3	8 bytes	–	V1.1	1 ms
0x182012	COM3	16 bytes	–	V1.1	1.5 ms
0x182013	COM3	32 bytes	–	V1.1	2 ms
0x182014	COM2	4 bytes	–	V1.1	4 ms
0x182015	COM2	8 bytes	–	V1.1	6 ms
0x182016	COM2	16 bytes	–	V1.1	9.2 ms
0x182017	COM2	32 bytes	–	V1.1	14.4 ms

Tab. 3-5: Smart Sensor Profile Legacy variants (rods), QYW- compatible

Smart Sensor Profile Ed. 2 variants (rods)

- QYW TBF _ _ _ _ _ L1_3S_-0Q02
- QYW TBF _ _ _ _ _ L1_3S_-0Q01

Device ID	Baud rate	PDInput	PDOutput	IO-Link protocol version	Minimum cycle time
0x182018	COM2	6 bytes	–	V1.1	4 ms
0x182019	COM3	6 bytes	–	V1.1	1 ms

Tab. 3-6: Smart Sensor Profile Ed. 2 variants (rods)

3 Overview of IO-Link Data and Functions (continued)

3.2.3 Analog variants (IO-Link only for the configuration)

QYW (rods) with 1 analog channel

QYW TBF_GL_-F-__M-D__-L__A01
QYW TBF_GA_-M-__M-D__-L__A01
QYW TBF_GR_-R-__M-D__-L__A01
QYW TBF_EP_-__M-D__-L__A01
QYW TBF_T3H_-M-__M-D__-L__A01

Device ID	Baud rate	PDInput	PDOOutput	IO-Link protocol version	Minimum cycle time
0x18301A	COM3	—	—	V1.1	1 ms

Tab. 3-7: QYW (rods) with 1 analog channel

QYW (rods) with 2 analog channels

QYW TBF_GL_-F-__M-D__-L__A02
QYW TBF_GA_-M-__M-D__-L__A02
QYW TBF_GR_-R-__M-D__-L__A02
QYW TBF_EP_-__M-D__-L__A02
QYW TBF_T3H_-M-__M-D__-L__A02

Device ID	Baud rate	PDInput	PDOOutput	IO-Link protocol version	Minimum cycle time
0x18301B	COM3	—	—	V1.1	1 ms

Tab. 3-8: QYW (rods) with 2 analog channels

QYW (profiles) with 1 analog channel

QYW TBF_PFO0-____-__A01

Device ID	Baud rate	PDInput	PDOOutput	IO-Link protocol version	Minimum cycle time
0x18401A	COM3	—	—	V1.1	1 ms

Tab. 3-9: QYW (profiles) with 1 analog channel

QYW (profiles) with 2 analog channels

QYW TBF_GL_-F-__M-D__-L__A02
QYW TBF_GA_-M-__M-D__-L__A02
QYW TBF_GR_-R-__M-D__-L__A02
QYW TBF_EP_-__M-D__-L__A02
QYW TBF_T3H_-M-__M-D__-L__A02

Device ID	Baud rate	PDInput	PDOOutput	IO-Link protocol version	Minimum cycle time
0x18401B	COM3	—	—	V1.1	1 ms

Tab. 3-10: QYW (profiles) with 2 analog channels

3 Overview of IO-Link Data and Functions (continued)

3.3 Process Data Profiles

Process Data Info and Configuration see chapter 7.6 on page 72.

3.3.1 Smart Sensor Profile Ed. 2

Device variants with Device ID of 0x030308, 0x030309, 0x030318, 0x030319, 0x030408, or 0x030409 support the process data after the Smart Sensor Profile Ed. 2.

PDInput

Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
Measurement Value				Measurement Scale	Status Bits

Tab. 3-11: Process Data Profile PD Input

Status Bits

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
System error	Measurement Error	Measurement Warning	n/a				

Tab. 3-12: Process Data Profile PD Input – Status Bits

3 Overview of IO-Link Data and Functions (continued)

3.3.2 Smart Sensor Profile Legacy

Device variants with a Device ID 0x18201[0...7], 0x18301[0...7], or 0x18401[0...7] support the process data after the Smart Sensor Profile (legacy).

PDInput

The process data of these variants contain mappable process data variables, each PDV is 4 bytes long. The number of available process data variables is the number of PDInput bytes divided by 4.

Byte 3	Byte 2	Byte 1	Byte 0
PDV1			

Tab. 3-13: PD Input process data profile – 1 PDV

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
PDV2				PDV1			

Tab. 3-14: PD Input process data profile – 2 PDV

Byte 15	Byte 14	Byte 13	Byte 12	Byte 11	Byte 10	Byte 9	Byte 8	Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
PDV4				PDV3				PDV2				PDV1			

Tab. 3-15: PD Input process data profile – 4 PDV

Byte 31	Byte 30	Byte 29	Byte 28	Byte 27	Byte 26	Byte 25	Byte 24	Byte 23	Byte 22	Byte 21	Byte 20	Byte 19	Byte 18	Byte 17	Byte 16
PDV8				PDV7				PDV6				PDV5			
Byte 15	Byte 14	Byte 13	Byte 12	Byte 11	Byte 10	Byte 9	Byte 8	Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
PDV4				PDV3				PDV2				PDV1			

Tab. 3-16: PD Input process data profile – 8 PDV

3 Overview of IO-Link Data and Functions (continued)

3.4 ISDU Identification Data

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Identification							
Vendor Name	0x0010 (16)	0	R	7 bytes	STRING	n/a	"TBF"
Vendor Text	0x0011 (17)	0	R	15 bytes	STRING	n/a	"www.tbfsensor.com"
Product Name	0x0012 (18)	0	R	≤ 64 bytes	STRING	n/a	"QYW TBF _ GL _ _ _ M - D _ _ -L _ 1"
Product ID	0x0013 (19)	0	R	≤ 64 bytes	STRING	n/a	"QYW TBFG L _ _ _ M - D _ _ -L _ 1"
Product Text	0x0014 (20)	0	R	≤ 64 bytes	STRING	n/a	TBF Position Transducer
Serial Number	0x0015 (21)	0	R	16 bytes	STRING	n/a	
Hardware Revision	0x0016 (22)	0	R	2 bytes	STRING	n/a	
Firmware Revision	0x0017 (23)	0	R	≤ 10 bytes	STRING	n/a	
Application Specific Tag	0x0018 (24)	0	R/W	≤ 32 bytes	STRING	Yes	" * * * "
Function Tag	0x0019 (25)	0	R/W	≤ 32 bytes	STRING	Yes	" * * * "
Location Tag	0x001A (26)	0	R/W	≤ 32 bytes	STRING	Yes	" * * * "
Product Type Code	0x0700 (1792)	0	R	≤ 64 bytes	STRING	n/a	e.g. "QYW TBF _ GL _ _ _ M -D _ _ -L _ 1"
Product Order Code	0x0701 (1793)	0	R	7 bytes	STRING	n/a	e.g. "TBF3F8W"
Device Identification							
Device Discovery Timeout	0x00FE (254)	0	R/W	2 bytes	UINT16	Yes	1
Magnet mode							
Magnet Mode Parameters	0x00C9 (201)	0	R/W	2		Yes	—
Magnet Mode		1	R/W	1	ENUM (UINT8)	No	—
Diagnostic Time		2	R/W	1	ENUM (UINT8)	No	—

3 Overview of IO-Link Data and Functions (continued)

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Mapping of process data variables							
QYW U100/U104-compatible variants:							
PDV Mapping	0x00CA (202)	0	R/W	1	UINT8	Yes	
QYW U101/U105-compatible variants:							
PDV Mapping	0x00CA (202)	0	R/W	2		Yes	—
PDV1		1	R/W	1	ENUM (UINT8)	No	—
PDV2		2	R/W	1	ENUM (UINT8)	No	—
QYW U102/U106-compatible variants:							
PDV Mapping	0x00CA (202)	0	R/W	4		Yes	—
PDV1		1	R/W	1	ENUM (UINT8)	No	—
PDV2		2	R/W	1	ENUM (UINT8)	No	—
PDV3		3	R/W	1	ENUM (UINT8)	No	—
PDV4		4	R/W	1	ENUM (UINT8)	No	—
QYW U103/U107-compatible variants:							
PDV Mapping	0x00CA (202)	0	R/W	8		Yes	—
PDV1		1	R/W	1	ENUM (UINT8)	No	—
PDV2		2	R/W	1	ENUM (UINT8)	No	—
PDV3		3	R/W	1	ENUM (UINT8)	No	—
PDV4		4	R/W	1	ENUM (UINT8)	No	—
PDV5		5	R/W	1	ENUM (UINT8)	No	—
PDV6		6	R/W	1	ENUM (UINT8)	No	—
PDV7		7	R/W	1	ENUM (UINT8)	No	—
PDV8		8	R/W	1	ENUM (UINT8)	No	—
Output Characteristic and Zero Point Offset							
Output Characteristic	0x00C3 (195)	0	R/W	1	BOOL	Yes	—
Zero Point Offset	0x00C1 (193)	1	R/W	4	INT32	Yes	0

3 Overview of IO-Link Data and Functions (continued)

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Measurement Profiles							
MDC Descriptor	0x4080 (16512)	0	R	11 bytes		n/a	
Lower Limit		1	R	4 bytes	INT32	n/a	0
Upper Limit		2	R	4 bytes	INT32	n/a	Max length
Unit Code		3	R	2 bytes	UINT16(ENUM)	n/a	1010 (m)
Scale		4	R	1 byte	INT8	n/a	-6 (µm)
Hide Limited Accuracy Areas	0x00C0 (192)	0	R/W	1 byte	UINT8(ENUM)	Yes	0
Measurement Offset	0x00C1 (193)	0	R/W	4 bytes	INT32	Yes	0
Measurement Preset	0x00C2 (194)	0	R/W	4 bytes	INT32	Yes	0
Measurement Output Characteristics	0x00C3 (195)	0	R/W	1 byte	BOOL	Yes	0
Measurement Hysteresis	0x00C4 (196)	0	R/W	4 bytes	UINT32	Yes	0
Measurement Range	0x0202 (514)	0	R/W	8 bytes		Yes	
Lower Limit		1	R/W	4 bytes	INT32	Yes	0x7FFFFFFC (2147483644)
Upper Limit		2	R/W	4 bytes	INT32	Yes	0x7FFFFFFC (2147483644)

3 Overview of IO-Link Data and Functions (continued)

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Signal Delay							
Signal Delay Input	0x0096 (150)	0	R/W	8 bytes		Yes	
Channel 1		1	R/W	2 bytes	UINT16(ENUM)	No	0
Channel 2		2	R/W	2 bytes	UINT16(ENUM)	No	0
Channel 3		3	R/W	2 bytes	UINT16(ENUM)	No	0
Channel 4		4	R/W	2 bytes	UINT16(ENUM)	No	0
Signal Delay Mode	0x0097 (151)	0	R/W	4 bytes		Yes	
Channel 1		1	R/W	1 byte	UINT8(ENUM)	No	0
Channel 2		2	R/W	1 byte	UINT8(ENUM)	No	0
Channel 3		3	R/W	1 byte	UINT8(ENUM)	No	0
Channel 4		4	R/W	1 byte	UINT8(ENUM)	No	0
Signal Delay On-Delay	0x0098 (152)	0	R/W	8 bytes		Yes	
Channel 1		1	R/W	2 bytes	UINT16	No	0
Channel 2		2	R/W	2 bytes	UINT16	No	0
Channel 3		3	R/W	2 bytes	UINT16	No	0
Channel 4		4	R/W	2 bytes	UINT16	No	0
Signal Delay Off-Delay / One-Shot	0x0099 (153)	0	R/W	8 bytes		Yes	
Channel 1		1	R/W	2 bytes	UINT16	No	0
Channel 2		2	R/W	2 bytes	UINT16	No	0
Channel 3		3	R/W	2 bytes	UINT16	No	0
Channel 4		4	R/W	2 bytes	UINT16	No	0
Signal Delay Status	0x009A (154)	0	R	4 bytes		n/a	
Channel 1		1	R	1 byte	UINT8(ENUM)	n/a	–
Channel 2		2	R	1 byte	UINT8(ENUM)	n/a	–
Channel 3		3	R	1 byte	UINT8(ENUM)	n/a	–
Channel 4		4	R	1 byte	UINT8(ENUM)	n/a	–
Basic Statistics							
Statistics Data Configuration	0x0426 (1062)	0	R/W	8 bytes		Yes	
Input Signal		1	R/W	2 bytes	UINT16(ENUM)	No	0
Time Period Unit		2	R/W	1 byte	UINT8(ENUM)	No	Seconds
Time Period Value		3	R/W	2 bytes	UINT16	No	1
Moving Average Window Unit		4	R/W	1 byte	UINT8(ENUM)	No	Measurement values
Moving Average Window Value	5	R/W	2 bytes	UINT16	No	100	
Statistics Data Output	0x0427 (1063)	0	R	21 bytes		n/a	
Minimum		1	R	4 bytes	FLOAT32	n/a	–
Maximum		2	R	4 bytes	FLOAT32	n/a	–
Average		3	R	4 bytes	FLOAT32	n/a	–
Moving Average		4	R	4 bytes	FLOAT32	n/a	–
Number Of Samples		5	R	4 bytes	UINT32	n/a	–
Status	6	R	1 byte	UINT8	n/a	–	

3 Overview of IO-Link Data and Functions (continued)

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Logic Blocks							
Logic Block Mode	0x0075 (117)	0	R/W	4 bytes		Yes	
Logic Block 1 Mode		1	R/W	1 byte	UINT8	No	0
Logic Block 2 Mode		2	R/W	1 byte	UINT8	No	0
Logic Block 3 Mode		3	R/W	1 byte	UINT8	No	0
Logic Block 4 Mode		4	R/W	1 byte	UINT8	No	0
Logic Block Input 1	0x0076 (118)	0	R/W	8 bytes		Yes	
Logic Block 1 Input 1		1	R/W	2 bytes	UINT16	No	0
Logic Block 2 Input 1		2	R/W	2 bytes	UINT16	No	0
Logic Block 3 Input 1		3	R/W	2 bytes	UINT16	No	0
Logic Block 4 Input 1		4	R/W	2 bytes	UINT16	No	0
Logic Block Input 2	0x0077 (119)	0	R/W	8 bytes		Yes	
Logic Block 1 Input 2		1	R/W	2 bytes	UINT16	No	0
Logic Block 2 Input 2		2	R/W	2 bytes	UINT16	No	0
Logic Block 3 Input 2		3	R/W	2 bytes	UINT16	No	0
Logic Block 4 Input 2		4	R/W	2 bytes	UINT16	No	0
Logic Block Input 3	0x0078 (120)	0	R/W	8 bytes		Yes	
Logic Block 1 Input 3		1	R/W	2 bytes	UINT16	No	0
Logic Block 2 Input 3		2	R/W	2 bytes	UINT16	No	0
Logic Block 3 Input 3		3	R/W	2 bytes	UINT16	No	0
Logic Block 4 Input 3		4	R/W	2 bytes	UINT16	No	0
Logic Block Input 4	0x0079 (121)	0	R/W	8 bytes		Yes	
Logic Block 1 Input 4		1	R/W	2 bytes	UINT16	No	0
Logic Block 2 Input 4		2	R/W	2 bytes	UINT16	No	0
Logic Block 3 Input 4		3	R/W	2 bytes	UINT16	No	0
Logic Block 3 Input 4		4	R/W	2 bytes	UINT16	No	0
Logic Block Result	0x007A (122)	0	R	4 bytes		n/a	
Logic Block 1 Result		1	R	1 byte	BOOL	n/a	0
Logic Block 2 Result		2	R	1 byte	BOOL	n/a	0
Logic Block 3 Result		3	R	1 byte	BOOL	n/a	0
Logic Block 4 Result		4	R	1 byte	BOOL	n/a	0
Operating Hours Counters							
Operating Hours Counter	0x0057 (87)	0	R	12 bytes		n/a	
Current Operating Hours		1	R	4 bytes	UINT32	n/a	—
Total Operating Hours		2	R	4 bytes	UINT32	n/a	—
Custom Operating Hours		3	R	4 bytes	UINT32	n/a	—
Operating Hours Saving Mode		4	R/W	1 byte	UINT8(ENUM)	No	Measurement values
Moving Average Window Value	0x0074 (116)	0	R/W	1 byte	UINT8(ENUM)	Yes	0

3 Overview of IO-Link Data and Functions (continued)

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Boot Cycle Counter							
Boot Cycle Counter	0x0058 (88)	0	R	8 bytes		n/a	
Boot Cycle Counter		1	R	4 bytes	UINT32	n/a	–
Custom Boot Cycle Counter		2	R	4 bytes	UINT32	n/a	–
Extreme Environment Status							
Lifetime Extreme Thresholds	0x00D0 (208)	0	R/W	8 bytes		Yes	
Upper Threshold Temperature		2	R/W	2 bytes	INT16	No	85
Lower Threshold Temperature		3	R/W	2 bytes	INT16	No	–25
Lifetime Extreme Status	0x00D1 (209)	0	R	5 bytes		n/a	
State		1	R	1 byte	UINT8(ENUM)	n/a	–
Time		2	R	4 bytes	UINT32	n/a	–
Internal Temperature							
Device Temperature	0x0052 (82)	0	R	10 bytes		n/a	
Device Temperature		1	R	2 bytes	INT16	n/a	–
Minimum Device Temperature Since Reset		2	R	2 bytes	INT16	n/a	–
Maximum Device Temperature Since Reset		3	R	2 bytes	INT16	n/a	–
Lifetime Minimum Device Temperature		4	R	2 bytes	INT16	n/a	–
Lifetime Maximum Device Temperature		5	R	2 bytes	INT16	n/a	–
Device Temperature Alarm Configuration	0x0053 (83)	0	R/W	4 bytes		Yes	
Lower Alarm Level Device Temperature		1	R/W	2 bytes	INT16	No	–40
Upper Alarm Level Device Temperature		2	R/W	2 bytes	INT16	No	115
Humidity Detection							
Humidity	0x005C (92)	0	R	9 bytes		n/a	
Humidity Bad		1	R	1 byte	BOOL	n/a	–
Operating Hours At Exceedance		2	R	4 bytes	UINT32	n/a	–
Temperature At Exceedance		3	R	4 bytes	INT32	n/a	–

3 Overview of IO-Link Data and Functions (continued)

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Device Status and Detailed Device Status							
Device Status	0x0024 (36)	0	R	1 byte	UINT8	n/a	–
Detailed Device Status	0x0025 (37)	0	R	30 bytes	UINT8[]	n/a	0x00 0x00 0x00
Diagnosis Suppression							
Diagnosis Level Configuration	0x0070 (112)	0	R/W	1 byte	UINT8(ENUM)	Yes	0
Event Code Suppression	0x0071 (113)	0	R/W	10 bytes		Yes	
Event Code Suppression		1...5	R/W	2 bytes	UINT16	No	0
Event Code Suppression Teach-in	0x0072 (114)	0	W	2 bytes	UINT16	n/a	–
Event Code Suppression Delete	0x0073 (115)	0	W	2 bytes	UINT16	n/a	–
Reset Commands							
System Commands	0x0002 (2)	0	W	1 byte	UINT8	n/a	–
Variant Configuration							
Device Variant	0x0055 (85)	0	R/W	2 bytes	UINT16(ENUM)	No	Default value depends on the typecode
LED Meaning and Configuration							
LED Standard Selection	0x00FD (253)	0	R/W	1 byte	UINT8(ENUM)	Yes	0
Process Data Information and Configuration							
Process Data Input Descriptor	0x000E (14)	0	R	9 (Smart Sensor Profile Ed. 2), N x 3 (Smart Sensor Profile Legacy, N = Number of PDV objects)	UINT8[]	n/a	–
Process Data Output Descriptor	0x000F (15)	0	R	3	UINT8[]	n/a	–
Last Valid Process Data Inputs	0x0028 (40)	0	R	Variant-dependent	–	n/a	–
Last Valid Process Data Outputs	0x0029 (41)	0	R	0	–	n/a	–

3

Overview of IO-Link Data and Functions (continued)

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Profile Characteristic							
Profile Characteristic	0x000D (13)	0	R	6 bytes (Smart Sensor Profile Ed. 2), 8 bytes (Smart Sensor Profile Legacy), 6 bytes (Smart Sensor Profile Legacy, without PDI _n)	UINT16[]	n/a	—

Tab. 3-17: ISDU – Identification Data

3 Overview of IO-Link Data and Functions (continued)

3.5 System Commands

Command Value	Device Action
0x80 (128)	Device Reset – Device Reset means a warm start of the device. During this process, the microcontrollers are restarted and all initializations performed again without any change made to the parameter values (see chapter 7.3 on page 66).
0x81 (129)	Application Reset (see chapter 7.3 on page 66)
0x82 (130)	Restore Factory Settings (see chapter 7.3 on page 66)
0xA5 (165)	Maintenance Reset (see chapter 7.3 on page 66)
0xA6 (166)	Switching Counter Reset – Resets counter value and flags.
0xA7 (167)	Statistics Reset – Resets all output parameters to 0 and all user settings to the default values.
0xA8 (168)	Statistics Start Min/Max/Avg – Starts the statistics of the minimum value/maximum value/average calculation.
0xA9 (169)	Statistics Stop – Stops statistics operation completely.
0xAA (170)	Signal Speed Monitoring Reset – Resets the speed value and flags.
0xAC (172)	Statistics Start Moving Average – Starts the statistics of the moving average calculation.
0xAF (175)	Start Device Discovery
0xC0 (192)	Set Reference Orientation – Sets the reference orientation of the actual position of the device. Responses: ACK: command successful, reference stored.
0xE0 (224)	Teach Preset – Sets the current measurement value to the value of Measurement Preset.
0xE1 (225)	Teach Lower Limit – Sets the lower end of the measuring range.
0xE2 (226)	Teach Upper Limit – Sets the upper end of the measuring range.
0xE7 (231)	Set Offset Value – Applies the actual position of the first magnet so that 0 is displayed straight away for this position. ¹⁾

¹⁾ This function is only available in Smart Sensor Profile Legacy variants (with PDIn)

Tab. 3-18: System Commands – Overview

3 Overview of IO-Link Data and Functions (continued)

3.6 Events

Event Code	Event Type	Event - Description - Remedy	Device Status
0x1850 (6224)	Notification	Process data profile selection cannot be used – default value is used.	0 – Device is operating properly.
0x1851 (6225)	Notification	Process Data Update Timeout – For information purposes only.	0 – Device is operating properly.
0x1852 (6226)	Warning	Multiple Process Data Update Timeout – For information purposes only.	0 – Device is operating properly.
0x4000 (16384)	Error	Temperature Fault – Overload – The device is operated outside of the device-specific temperature limits. Risk of device damage.	4 – Failure
0x4210 (16912)	Warning	Device Temperature Overrun – Clear Heat Of Source – Risk of device damage. The device is too hot. ► Remove heat source, provide the device with heat insulation if necessary.	2 – Out-of-Specification
0x4220 (16928)	Warning	Device Temperature Underrun – Insulate Device – Risk of device damage. The device is too cold. ► Insulate the device.	2 – Out-of-Specification
0x5111 (20753)	Warning	Primary supply voltage below minimum value ☒ Check for deviations in the supply.	2 – Out-of-Specification
0x8C10 (35856)	Warning	Measurement Range Overrun – The process data are inaccurate.	2 – Out-of-Specification
0x8C20 (35872)	Error	Measurement Range Overrun ► Check application.	4 – Failure
0x8C30 (35888)	Warning	Process Variable Range Underrun – The process data are inaccurate.	2 – Out-of-Specification
0x8CA0 (36000)	Warning	Magnet Number Change – Temporary error status	0 – Device is operating properly.
0x8D00 (36096)	Warning	The measurement value is below the measurement range. Accuracy cannot be guaranteed.	2 – Out of Specification
0x8D01 (36097)	Warning	The measurement value is above the measurement range. Accuracy cannot be guaranteed.	2 – Out of Specification
0x8D02 (36098)	Warning	The measurement value is below the detection range; no measurement value can be determined. ► Check application.	2 – Out of Specification
0x8D03 (36099)	Warning	The measurement value is above the detection range; no measurement value can be determined. ► Check application.	2 – Out of Specification
0x8D04 (36100)	Warning	No measurement value can be determined. ► Check application.	2 – Out of Specification
0x8D05 (36101)	Warning	Measurement error/redundancy check failed. ► Check application.	2 – Out of Specification
0x8D07 (36103)	Warning	The calculation of the basic statistics was stopped automatically to avoid a buffer overflow.	0 – Device is operating properly.
0x8D0E (36110)	Notification	The time has elapsed. This event reports the timeout of the minimum value/maximum value/average calculation. It does not report a timeout for the calculation of the moving average because the timer repeats and it does not indicate the end of the calculation.	0 – Device is operating properly.

3 Overview of IO-Link Data and Functions (continued)

Event Code	Event Type	Event - Description - Remedy	Device Status
0x8D10 (36112)	Warning	Device Temperature Upper Warning – The set upper temperature warning threshold has been exceeded.	0 – Device is operating properly.
0x8D12 (36114)	Warning	The defined threshold of the device-internal humidity was exceeded. ► Check installation and ambient conditions.	1 – Maintenance-Required
0x8D13 (36115)	Warning	One or more extreme conditions present.	0 – Device is operating properly.
0x8D20 (36128)	Warning	Device Temperature Lower Warning – The device temperature has fallen below the set lower temperature warning threshold.	0 – Device is operating properly.
0x8D22 (36130)	Warning	Warning limit for write cycles reached – maintenance monitoring no longer guaranteed – for information purposes only.	0 – Device is operating properly.
0x8D23 (36131)	Error	Write cycle limit reached – saving no longer ensured – replacement recommended.	1 – Maintenance-Required
0x8D24 (36132)	Warning	Parameter write error – for information purposes only.	0 – Device is operating properly.
0x8D25 (36133)	Error	Parameters not consistent – basic settings are used, service required. Parameterization processes and resets can no longer be performed.	4 – Failure

The most important communication parameters of the different device variants can be found in section 3.2 on page 9.

Further information, such as the frame specification, can be read out using the IODD and the TBF Engineering Tool and interpreted using the general IO-Link specification.

5 Primary Device Functions

5.1 Identification

5.1.1 Description

The identification data is used for the identification and management of the IO-Link devices.

5.1.2 ISDU

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Vendor Name	0x0010 (16)	0	R	7 bytes	STRING	n/a	"TBF"
Vendor Text	0x0011 (17)	0	R	15 bytes	STRING	n/a	"www.tbfsensor.com"
Product Name	0x0012 (18)	0	R	≤ 64 bytes	STRING	n/a	"QYW TBF _ - GL _ - _ - _ M - D _ - _ - L _ - _ 1"
Product ID	0x0013 (19)	0	R	≤ 64 bytes	STRING	n/a	"QYW TBF _ - GL _ - _ - _ M - D _ - _ - L _ - _ 1"
Product Text	0x0014 (20)	0	R	≤ 64 bytes	STRING	n/a	TBF Position Transducer
Serial Number	0x0015 (21)	0	R	16 bytes	STRING	n/a	
Hardware Revision	0x0016 (22)	0	R	2 bytes	STRING	n/a	
Firmware Revision	0x0017 (23)	0	R	≤ 10 bytes	STRING	n/a	
Application Specific Tag	0x0018 (24)	0	R/W	≤ 32 bytes	STRING	Yes	" * * * "
Function Tag	0x0019 (25)	0	R/W	≤ 32 bytes	STRING	Yes	" * * * "
Location Tag	0x001A (26)	0	R/W	≤ 32 bytes	STRING	Yes	" * * * "
Product Type Code	0x0700 (1792)	0	R	≤ 64 bytes	STRING	n/a	e.g. "QYW TBF _ - GL _ - _ - _ M - D _ _ - _ - L _ - _ 1"
Product Order Code	0x0701 (1793)	0	R	7 bytes	STRING	n/a	e.g. "TBF3F8W"

Tab. 5-1: Identification – ISDU

Application Specific Tag

With the Application Specific Tag parameter, a string (maximum 32 bytes) can be written to the device. This value typically describes the application in which the product is used.

Function Tag

With the Function Tag parameter, a string (maximum 32 bytes) can be written to the device. This value typically describes the function of the product in the application area.

Location Tag

With the Location Tag parameter, a string (maximum 32 bytes) can be written to the device. This value typically describes the location of the product in the application area.

Product Type Code

The TBF type code is stored permanently in the device.

Product Order Code

The TBF order code is stored permanently in the device.

5.1.3 System Commands

For an overview of all System Commands, see section 3.5 on page 23.

5.1.4 Variant Dependence

The functionality is available in all variants.

5 Primary Device Functions (continued)

5.2 Device Discovery

5.2.1 Description

With the Device Discovery function, an IO-Link device can be found again by starting signaling on the LED of the device by means of a system command.

5.2.2 ISDU

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Device Discovery Timeout	0x00FE (254)	0	R/W	2 bytes	UINT16	Yes	1

Tab. 5-2: Device detection – ISDU

Device Discovery Timeout

The Device Discovery Timeout parameter sets the duration of the Device Discovery signal that is displayed via LEDs. The value is specified minutes. The value range from 0 to 30 minutes is allowed. If the parameter is set to 0, the Device Discovery signal is deactivated. The parameter is reset by Application Reset and Factory Reset (also see section Reset Commands on page 66).

5.2.3 System Commands

Command Value	Device Action
0xAF (175)	Start Device Discovery

Tab. 5-3: Device detection – System Commands

5.2.4 Variant Dependence

This function is not available for analog variants (see Analog variants (IO-Link only for the configuration) on page 12).

5 Primary Device Functions (continued)

5.3 Magnet Mode

The number of magnets can be fixed or flexible. This parameter is only available for QYW-compatible variants.

Set a fixed number of magnets

If a fixed number of one or two magnets is set, the QYW continuously checks the number of detected magnets. If this number does not correspond to the set number, the application goes to error mode: All process data values are replaced with the error value.

Flexible Magnet Mode (FMM)

In Flexible Magnet Mode the number of magnets is flexible and can also be changed during operation. The time at which a magnet is added or removed is critical as the recording can be adapted if necessary and the process data values can be shifted. In this situation a diagnostic time can be configured in the QYW during which an error value is displayed for all process data variables via IO-Link and a corresponding diagnosis (warning) is displayed. The new application status is displayed after the diagnostic time has lapsed.

5.3.1 ISDU

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Magnet Mode Parameters	0x00C9 (201)	0	R/W	2		Yes	—
Magnet Mode		1	R/W	1	ENUM (UINT8)	No	—
Diagnostic Time		2	R/W	1	ENUM (UINT8)	No	—

Tab. 5-4: Magnet Mode – ISDU

5.3.2 Magnet Mode

Command Value	Device Action
0x00 (0)	Flexible Magnet Mode
0x01 (1)	1 Magnet
0x02 (2)	2 Magnet

Tab. 5-5: Magnet Mode – Values

5

Primary Device Functions (continued)

5.3.3 Diagnostic Time

The diagnostic time can be set in 4 ms increments:

Value	Meaning
0x00 (0)	Diagnostic time switched off / not available
0x01 (1)	4 ms
0x02 (2)	8 ms
...	
0xFF (255)	1,02 ms

Tab. 5-6: Magnet Mode – Diagnostic Time

5.3.4 Events

Event Code	Event Type	Event - Description - Remedy	Device Status
0x8CA0 (36000)	Warning	Magnet Number Change – Temporary error status	0 – Device is operating properly.

Tab. 5-7: Magnet Mode – Events

5 Primary Device Functions (continued)

5.4 Process Data Variable Mapping (QYW-compatible)

In QYW-compatible variants the process data contain assignable slots (per 4 bytes), the Process Data Variables (PDVs). Depending on the actual variant the process data length can be 4, 8, 16, or 32 bytes long. Therefore, the number of PDVs varies accordingly between 1, 2, 4, and 8.

5.4.1 ISDU

For QYW U100/U104-compatible variants:

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
PDV Mapping	0x00CA	0	R/W	1	UINT8	Yes	

Tab. 5-8: Process Data Variable Mapping – ISDU (QYW U100/U104)

For QYW U101/U105-compatible variants:

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
PDV Mapping	0x00CA (202)	0	R/W	2		Yes	–
PDV1		1	R/W	1	ENUM (UINT8)	No	–
PDV2		2	R/W	1	ENUM (UINT8)	No	–

Tab. 5-9: Process Data Variable Mapping – ISDU (QYW U101/U105)

For QYW U102/U106-compatible variants:

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
PDV Mapping	0x00CA (202)	0	R/W	4		Yes	–
PDV1		1	R/W	1	ENUM (UINT8)	No	–
PDV2		2	R/W	1	ENUM (UINT8)	No	–
PDV3		3	R/W	1	ENUM (UINT8)	No	–
PDV4		4	R/W	1	ENUM (UINT8)	No	–

Tab. 5-10: Process Data Variable Mapping – ISDU (QYW U102/U106)

For QYW U103/U107-compatible variants:

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
PDV Mapping	0x00CA (202)	0	R/W	8		Yes	–
PDV1		1	R/W	1	ENUM (UINT8)	No	–
PDV2		2	R/W	1	ENUM (UINT8)	No	–
PDV3		3	R/W	1	ENUM (UINT8)	No	–
PDV4		4	R/W	1	ENUM (UINT8)	No	–
PDV5		5	R/W	1	ENUM (UINT8)	No	–
PDV6		6	R/W	1	ENUM (UINT8)	No	–
PDV7		7	R/W	1	ENUM (UINT8)	No	–
PDV8		8	R/W	1	ENUM (UINT8)	No	–

Tab. 5-11: Process Data Variable Mapping – ISDU (QYW U103/U107)

5 Primary Device Functions (continued)

5.4.2 PDV Mapping (for PDV1...PDV8)

Each process data variable can be mapped as follows (A value can be set for several PDV objects):

Value	Meaning
0x00 (0)	Position of magnet 1
0x01 (1)	Position of magnet 2
0x10 (16)	Speed of magnet 1
0x11 (17)	Speed of magnet 2
0x30 (48)	Current internal device temperature
0x40 (64)	Position difference between magnets 1 and 2
0xFD (253)	Empty module (is displayed with 0)

Tab. 5-12: Process Data Variable Mapping – PDV Mapping (for PDV1...PDV8)

5.4.3 Events

Event Code	Event Type	Event - Description - Remedy	Device Status
0x8C10 (35856)	Warning	Measurement Range Overrun – The process data are inaccurate.	2 – Out-of-Specification
0x8C20 (35872)	Error	Measurement Range Overrun ► Check application.	4 – Failure
0x8C30 (35888)	Warning	Process Variable Range Underrun – The process data are inaccurate.	2 – Out-of-Specification

Tab. 5-13: Process Data Variable Mapping – Events

5 Primary Device Functions (continued)

5.5 Output Characteristic and Zero Point

Offset (QYW-compatible variants)

For QYW-compatible variants the output characteristic (rising, falling) and the zero point offset can be configured to the same ISDU indices as for the existing QYW variants.

5.5.1 ISDU

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Output Characteristic	0x00C3 (195)	0	R/W	1	BOOL	Yes	–
Zero Point Offset	0x00C1 (193)	1	R/W	4	INT32	Yes	0

Tab. 5-14: Output characteristic and zero point offset – ISDU



These parameters only influence the IO-Link output. If the devices also have analog outputs, these outputs are not affected thereby.

5.5.2 Output Characteristic

This parameter defines the output function of the QYW for a rising or falling characteristic.

Value	Meaning
0x00 (0)	Falling (FALSE)
0xFF (255)	Rising (TRUE)

Tab. 5-15: Output characteristic and zero point offset – Output Characteristic

5.5.3 Zero Point Offset

This value is deducted from the actual output value (position) as a simple offset.

Command Value	Device Action
0xE7 (231)	Set Offset Value – Applies the actual position of the first magnet so that 0 is displayed straight away for this position.

Tab. 5-16: Output characteristic and zero point offset – System Commands

5 Primary Device Functions (continued)

5.6 Measurement Profiles

5.6.1 Description

The sensor realizes the measuring Smart Sensor Profile Ed. 2 according to profile SSP 3.2. The profile defines four different ranges in which a measurement value can be output:

- The measuring range (Measurement Range)
- Detection range (Detection Range)
- Outside of the detection range (Out of Range)
- No measurement value (No Measurement Data)

The evaluation is realized based on the Transducer Value (PdObjectID 0x0025), which represents the position of the first magnet in micrometers.

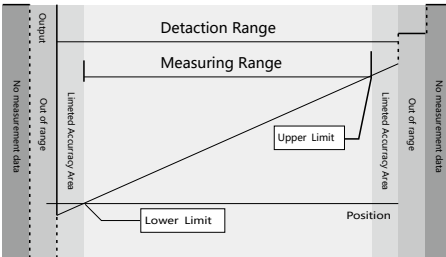


Fig. 5-1: Ranges for which a measurement value is output

Measurement Range

Within the measuring range, all values specified in the data sheet related to measurement accuracy are satisfied. Information on the size of the measuring range can be found in parameter MDC Descriptor, which contains the lower measurement limit (Lower Limit) and upper measurement limit (Upper Limit).

Detection range (Detection Range)

Outside of the measurement range, a measurement value output in the non-linear areas (Limited Accuracy Areas) is still possible, though the accuracy cannot be ensured for these areas. Limited accuracy is indicated via the Measurement Warning bit in the process data.

Outside of the detection range (Out of Range)

Outside of the detection range, the sensor can determine whether the measurement value is below or above the detection range. A meaningful measurement value is not possible in these areas. Instead, a replacement value is output:

Status	Value
Out of Range Minus	-2,147,483,640 (0x80000008)
Out of Range Plus	2,147,483,640 (0x7FFFFFF8)

Tab. 5-17: Measurement Profiles – Out of Range

In addition to the replacement value, the Measurement Error bit is set.

No measurement value (No Measurement Data)

If no measurement value can be determined, the replacement value No Measurement Data is output:

Status	Value
No Measurement Data	2,147,483,644 (0x7FFFFFFC)

Tab. 5-17: Measurement Profiles – Out of Range

In addition to the replacement value, the Measurement Error bit is set.

5 Primary Device Functions (continued)

5.6.2 Process Data

Object ID	Name	Description	Direction
0x0028 (40)	Measurement Value	Measurement Value contains the measurement value.	Input
0x002A (42)	Measurement Value Scale	The scaling as the exponent of a power of ten	Input
0x002B (43)	Measurement Error	Measurement value outside of the detection range or no measurement value	Input
0x002C (44)	Measurement Warning	Measurement value outside of the measurement range	Input

Tab. 5-19: Measurement profiles – process data

Measurement Value

The current measurement value as signed, 32-bit number. In case of an error, a substitute value is output (see Outside of the detection range (Out of Range) and No measurement value (No Measurement Data)).

Measurement Scale

The scaling value is a signed, 8-bit number. The scaling indicates the exponents of a power of ten of the measurement value relative to the base unit (meters). This value is used to interpret the unit of the output value.

Measurement value [μm] of output value
= SI unit × 10^{Measurement Scale}

Measurement Error

Indicates if the measurement value is outside of the detection range or if no measurement value can be determined.

Measurement Warning

Indicates if the measurement value is outside of the measurement range.

5 Primary Device Functions (continued)

5.6.3 Process Data Profiles

PdInput

Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
Measurement Value				Measurement Scale	Status Bits

Tab. 5-20: Measurement profiles – PdInput

Status Bits

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
System Error	Measurement Error	Measurement Warning	0	0	0	0	0

Tab. 5-21: Measurement Profiles – Status Bits

5.6.3 Process Data Profiles

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
MDC Descriptor	0x4080 (16512)	0	R	11 bytes		n/a	
Lower Limit		1	R	4 bytes	INT32	n/a	0
Upper Limit		2	R	4 bytes	INT32	n/a	Max length
Unit Code		3	R	2 bytes	UINT16(ENUM)	n/a	1010 (m)
Scale		4	R	1 byte	INT8	n/a	-6 (µm)
Hide Limited Accuracy Areas	0x00C0 (192)	0	R/W	1 byte	UINT8(ENUM)	Yes	0
Measurement Offset	0x00C1 (193)	0	R/W	4 bytes	INT32	Yes	0
Measurement Preset	0x00C2 (194)	0	R/W	4 bytes	INT32	Yes	0
Measurement Output Characteristics	0x00C3 (195)	0	R/W	1 byte	BOOL	Yes	0
Measurement Hysteresis	0x00C4 (196)	0	R/W	4 bytes	UINT32	Yes	0
Measurement Range	0x0202 (514)	0	R/W	8 bytes		Yes	
Lower Limit		1	R/W	4 bytes	INT32	Yes	0x7FFFFFFC (2147483644)
Upper Limit		2	R/W	4 bytes	INT32	Yes	0x7FFFFFFC (2147483644)

Tab. 5-22: Measurement profiles – ISDU

5 Primary Device Functions (continued)

MDC Descriptor

The MDC Descriptor contains information about the current value range of the measurement value (Measurement Value) within the limits of the measurement range (Measurement Range), about the unit and the scaling of the measurement value. The values for the lower measurement limit (Lower Limit) and upper measurement limit (Upper Limit) specify the value range.

The Scale parameter in the MDC Descriptor is a signed 8 bit number. The scaling indicates the exponents of a power of ten of the measurement value relative to the base unit. The basic unit is coded by the parameter Unit Code in the MDC Descriptor. The possible unit values of the sensor include:

Unit	Value
Meter	1010

Tab. 5-23: Possible unit values of sensor

On delivery, the lower measurement value limit has its origin at value 0. If an offset is set, the value of the lower measurement value limit changes according to the Measurement Offset.

Hide Limited Accuracy Areas

Outside of the measurement range, measurement values are still output. These do not conform to the limits specified in the data sheet.

The output of the non-linear areas (Limited Accuracy Areas) can be configured. If the output is deactivated, the sensor outputs either Out Of Range Plus or Out Of Range Minus if the measurement range is exited.

Value	Meaning
0x00 (0)	Visible
0xFF (255)	Hidden

Tab. 5-24: Measurement profiles – Hide Limited Accuracy Areas

Measurement Offset

The Measurement Offset is subtracted from the current measurement value. This parameter can be reset using Application Reset and Factory Reset.

Measurement Preset

Measurement Preset can be used to calculate a Measurement Offset. Measurement Preset specifies a target value that should be achieved after a Teach Preset by the current measurement value. Following a successful Teach Preset, the current measurement value has the same value as Measurement Preset.

This parameter can be reset using Application Reset and Factory Reset.

Measurement Output Characteristics

The Measurement Output Characteristics parameter defines the output characteristic, which can be rising or falling. This setting affects the offset setting. It is possible that the offset setting needs to be performed again after this setting is changed.

This parameter can be reset using Application Reset and Factory Reset.

Value	Meaning
0x00 (0)	Falling
0xFF (255)	Rising

Tab. 5-25: Measurement profiles – Measurement Output Characteristics

Measurement Hysteresis

The hysteresis of the measurement value can be set with parameter Measurement Hysteresis. This parameter is used to dampen unstable measurement values.

This parameter can be reset using Application Reset and Factory Reset.

Measurement Range

With Measurement Range, the measuring range can be changed by teaching with the Teach Lower Limit and Teach Upper Limit System Commands or by overwriting the parameter.

This parameter Measurement Range can be reset using Application Reset and Factory Reset.

5.6.5 System Commands

Command Value	Device Action
0xE0 (224)	Teach Preset – Sets the current measurement value to the value of Measurement Preset.
0xE1 (225)	Teach Lower Limit – Sets the lower end of the measuring range.
0xE2 (226)	Teach Upper Limit – Sets the upper end of the measuring range.

Tab. 5-26: Measurement profiles – System Commands

For an overview of all System Commands, see section 3.5 on page 23.

5

Primary Device Functions (continued)

5.4.3 Events

Event Code	Event Type	Event - Description - Remedy	Device Status
0x8D00 (36096)	Warning	The measurement value is below the measurement range. Accuracy cannot be guaranteed.	2 – Out of Specification
0x8D01 (36097)	Warning	The measurement value is above the measurement range. Accuracy cannot be guaranteed.	2 – Out of Specification
0x8D02 (36098)	Warning	The measurement value is below the detection range; no measurement value can be determined. ► Check application.	2 – Out of Specification
0x8D03 (36099)	Warning	The measurement value is above the detection range; no measurement value can be determined. ► Check application.	2 – Out of Specification
0x8D04 (36100)	Warning	No measurement value can be determined. ► Check application.	2 – Out of Specification
0x8D05 (36101)	Warning	Measurement error/redundancy check failed. ► Check application.	2 – Out of Specification

Tab. 5-27: Measurement profiles – Eventsts

5.6.7 Variant Dependence

Only available for variants with the Smart Sensor Protocol
Ed. 2:

QYW TBF_GL_-F-__M-D__-L__
QYW TBF_GA_-M-__M-D__-L__
QYW TBF_GR_-R-__M-D__-L__
QYW TBF_EP_-__M-D__-L__
QYW TBF_T3H_-M-__M-D__-L__

6 Secondary Device Functions

6.1 Signal Delay

6.1.1 Description

This is a function that is applied to an internal binary signal. This function allows the user to apply time delay functions to the internal binary signal of the device (On-Delay, Off-Delay, One-Shot or On/Off-Delay).

6.1.2 Mathematics/Algorithm

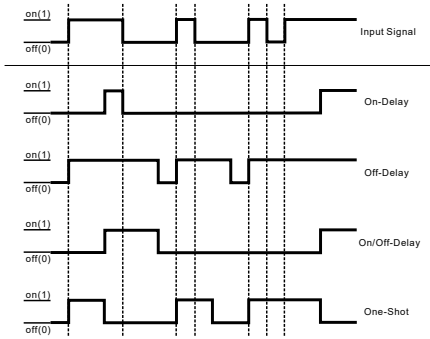


Fig. 6-1: Signal delay – mathematics/algorithm

6.1.3 Process Data

Object ID	Name	Description	Direction
0x0008 (8)	Signal Delay Channel 1	Output signal Signal Delay Channel 1	Input
0x0009 (9)	Signal Delay Channel 2	Output signal Signal Delay Channel 2	Input
0x000A (10)	Signal Delay Channel 3	Output signal Signal Delay Channel 3	Input
0x000B (11)	Signal Delay Channel 4	Output signal Signal Delay Channel 4	Input

Tab. 6-1: Signal delay – process data

6 Secondary Device Functions (continued)

6.1.4 ISDU

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Signal Delay Input	0x0096 (150)	0	R/W	8 bytes		Yes	
Channel 1		1	R/W	2 bytes	UINT16(ENUM)	No	0
Channel 2		2	R/W	2 bytes	UINT16(ENUM)	No	0
Channel 3		3	R/W	2 bytes	UINT16(ENUM)	No	0
Channel 4		4	R/W	2 bytes	UINT16(ENUM)	No	0
Signal Delay Mode	0x0097 (151)	0	R/W	4 bytes		Yes	
Channel 1		1	R/W	1 byte	UINT8(ENUM)	No	0
Channel 2		2	R/W	1 byte	UINT8(ENUM)	No	0
Channel 3		3	R/W	1 byte	UINT8(ENUM)	No	0
Channel 4		4	R/W	1 byte	UINT8(ENUM)	No	0
Signal Delay On-Delay	0x0098 (152)	0	R/W	8 bytes		Yes	
Channel 1		1	R/W	2 bytes	UINT16	No	0
Channel 2		2	R/W	2 bytes	UINT16	No	0
Channel 3		3	R/W	2 bytes	UINT16	No	0
Channel 4		4	R/W	2 bytes	UINT16	No	0
Signal Delay Off-Delay / One-Shot	0x0099 (153)	0	R/W	8 bytes		Yes	
Channel 1		1	R/W	2 bytes	UINT16	No	0
Channel 2		2	R/W	2 bytes	UINT16	No	0
Channel 3		3	R/W	2 bytes	UINT16	No	0
Channel 4		4	R/W	2 bytes	UINT16	No	0
Signal Delay Status	0x009A (154)	0	R	4 bytes		n/a	
Channel 1		1	R	1 byte	UINT8(ENUM)	n/a	–
Channel 2		2	R	1 byte	UINT8(ENUM)	n/a	–
Channel 3		3	R	1 byte	UINT8(ENUM)	n/a	–
Channel 4		4	R	1 byte	UINT8(ENUM)	n/a	–

Tab. 6-2: Signal delay – ISDU

6 Secondary Device Functions (continued)

Signal Delay Input

With Signal Delay Input, the internal binary signal source can be selected. Input contains a list of the internal binary signals.

Signal Delay Mode

With Signal Delay Mode, the current mode of the signal delay function can be selected.

Value	Meaning	Description
0x00 (0)	Deactivated	Deactivated
0x01 (1)	Delay	On, Off and On-/Off delay function
0x02 (2)	One-Shot	One-Shot function

Tab. 6-3: Signal Delay – Signal Delay Mode

Signal Delay On-Delay

With Signal Delay On-Delay, the time for On-Delay can be set. The value represents the time in milliseconds. The value range is between 0x0000 (0) and 0xFFFF (65535). A value of 0x0000 (0) represents no delay. The parameter has no effect in One-Shot-Modus.

Signal Delay Off-Delay / One-Shot

With Signal Delay Off-Delay / One-Shot, the time for Off-Delay and One-Shot can be set. The value represents the time in milliseconds. The value range is between 0x0000 (0) and 0xFFFF (65535). A value of 0x0000 (0) represents no delay.

Signal Delay Status

With Signal Delay Status, the current status of each channel can be read.

Value	Meaning	Description
0x00 (0)	Off	Output signal of Signal Delay = 0/FALSE
0x01 (1)	On	Output signal of Signal Delay = 1/TRUE
0x02 (2)	On-Delay	Output signal of Signal Delay = 0/FALSE and On-Delay currently running.
0x03 (3)	Off-Delay	Output signal of Signal Delay = 1/TRUE and OFF-Delay currently running.
0x07 (7)	One-Shot	Output signal of Signal Delay = 1/TRUE and One-Shot function currently running.
0xFF (255)	Deactivated	Feature is deactivated.

Tab. 6-4: Signal Delay – Signal Delay Status

6.1.5 System Commands

Command Value	Device Action
0x81 (129)	Application Reset – Resets writable parameters to the default value.
0x82 (130)	Restore Factory Settings – Resets writable parameters to the default value.

Tab. 6-5: Signal delay – System Commands

For an overview of all System Commands, see section 3.5 on page 23.

6.1.6 Variant Dependence

This function is not available for the following variants:

QYW TBF_GL_-F-__M-D__-L__
QYW TBF_GA_-M-__M-D__-L__
QYW TBF_GR_-R-__M-D__-L__
QYW TBF_EP_-__M-D__-L__
QYW TBF_T3H_-M-__M-D__-L__

6 Secondary Device Functions (continued)

6.2 Basic Statistics

6.2.1 Description

With the Basic Statistics function, statistics processes can be executed, such as the calculation of minimum, maximum and average. Furthermore, it is possible to calculate the moving average.

With Basic Statistics, trends can be displayed for the selected entry over the specified duration (between 1 second and 1 week or 1 to 1000 sampling points).

6.2.2 Mathematics/Algorithm

Fig. 6-2 displays the realistic view of the calculation of minimum value, maximum value and average.

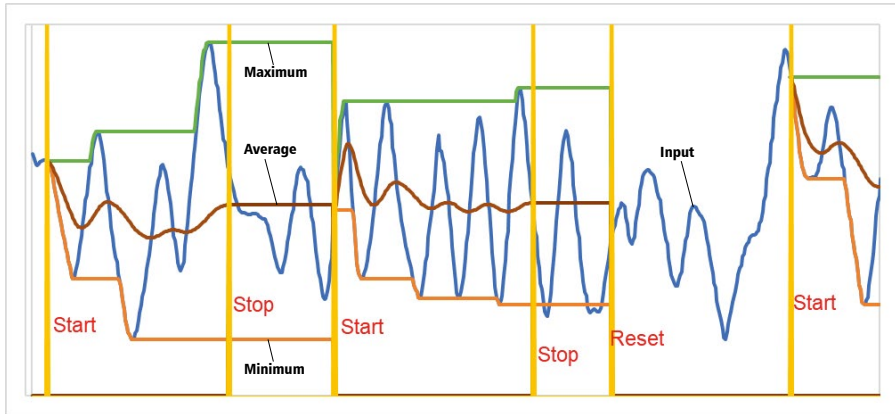


Fig. 6-2: Calculation of minimum, maximum and average

As shown in Fig. 6-2, the calculation is initiated by the start command and stopped by the stop command. The values are kept between start and stop until a reset is performed. If the operating voltage is switched off, the current values are not stored and, as a result, are reset on the next start. Fig. 6-3 shows how the calculation of the moving average functions with the periodic window approach. The average is calculated for each periodic window, whereby the size of the window can be set. As shown, the average is calculated repeatedly for a window size of 5 elements. It must be mentioned that the windows do not overlap.

6 Secondary Device Functions (continued)

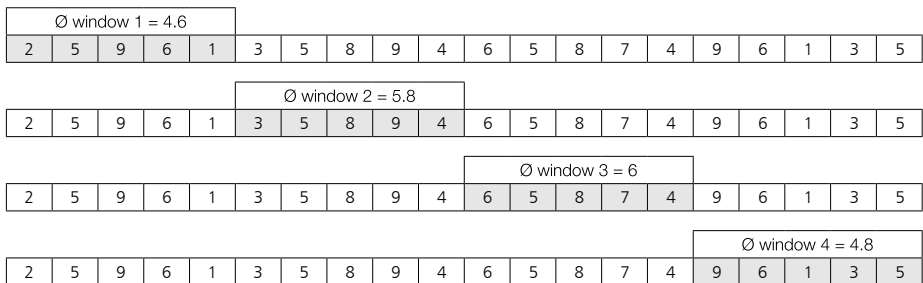


Fig. 6-3: Periodic window approach

Fig. 6-4 shows the moving average using the method of the periodic window.

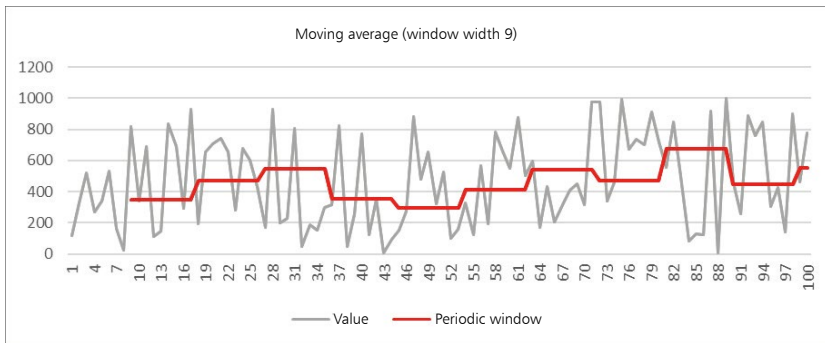


Fig. 6-4: Periodic window approach (example)

6.2.3 Process Data

Object ID	Name	Description	Direction
0x0053 (83)	Minimum	Minimum value	Input
0x0054 (84)	Maximum	Maximum value	Input
0x0055 (85)	Average	Average	Input
0x0056 (86)	Moving Average	Repeatedly calculated average value	Input
0x0057 (87)	Status	Status value	Input
0x0058 (88)	Number Of Samples	Number of measurement values for the calculation of minimum, maximum and average	Input

Tab. 6-6: Basic statistics – process data

6 Secondary Device Functions (continued)

6.2.4 ISDU



Minimum, Maximum, Average and Moving Average outputs are output in FLOAT32 format. Before they are processed further and converted from FLOAT32 to INT32 or UINT32, the output signal must be checked to determine whether it is larger than INT32_Max or UINT32_Max. If it is larger, data type UINT64 or INT64 should be used.

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Statistics Data Configuration	0x0426 (1062)	0	R/W	8 bytes		Yes	
Input Signal		1	R/W	2 bytes	UINT16(ENUM)	No	0
Time Period Unit		2	R/W	1 byte	UINT8(ENUM)	No	Seconds
Time Period Value		3	R/W	2 bytes	UINT16	No	1
Moving Average Window Unit		4	R/W	1 byte	UINT8(ENUM)	No	Measurement values
Moving Average Window Value		5	R/W	2 bytes	UINT16	No	100
Statistics Data Output	0x0427 (1063)	0	R	21 bytes		n/a	
Minimum		1	R	4 bytes	FLOAT32	n/a	–
Maximum		2	R	4 bytes	FLOAT32	n/a	–
Average		3	R	4 bytes	FLOAT32	n/a	–
Moving Average		4	R	4 bytes	FLOAT32	n/a	–
Number Of Samples		5	R	4 bytes	UINT32	n/a	–
Status		6	R	1 byte	UINT8	n/a	–

Tab. 6-7: Basic statistics – ISDU

Statistics Data Configuration: Input Signal

All data types of process data objects can be used for input configuration, with the exception of Boolean. The respective Object IDs can be found in the respective section on the function. Default value is 0, this corresponds to No Object.

6 Secondary Device Functions (continued)

Statistics Data Configuration: Time Period Unit

The time unit Time Period Unit can be set with one of the values from Tab. 6-8 to calculate the minimum, maximum and average. For example, to calculate minimum, maximum and average for all 1-hour values, hours can be selected as the unit for this subindex.

Value	Meaning	Description
0x01 (1)	Seconds	Seconds
0x02 (2)	Minutes	Minutes
0x03 (3)	Hours	Hours
0x04 (4)	Days	Days
0x05 (5)	Samples	Measurement values

Tab. 6-8: Statistics Data Configuration – Time Period Unit

Statistics Data Configuration: Time Period Value

Time Period Value can be set from 1 second to 1 week or 1 to 1000 measurement values, over which minimum, maximum and average are calculated. Other checks are performed internally and, if an unsuitable selection is made for Time Period Value, a standard error is returned.

Time Period Unit	Time Period Value (value range)
Seconds	1... 1000
Minutes	1... 100
Hours	1...24
Days	1...7
Measurement values	1... 1000

Tab. 6-9: Statistics Data Configuration – Time Period Value

Statistics Data Configuration: Moving Average Window Unit

For the moving average, one of the units from Tab. 6-10 should be selected. For example, to calculate the moving average for groups of 100 measurement values, measurement values (samples) can be selected as the unit.

Value	Meaning	Description
0x01 (1)	Seconds	Seconds
0x02 (2)	Minutes	Minutes
0x03 (3)	Hours	Hours
0x04 (4)	Samples	Measurement values

Tab. 6-10: Statistics Data Configuration – Moving Average Window Unit

Statistics Data Configuration: Moving Average Window Value

The value for the moving average (moving average window) must be in the value range (see Tab. 6-11). To calculate the moving average, it is possible to select, for example, 1... 1000 measurement values.

Moving Average Window Unit	Moving Average Window Value (value range)
Seconds	1... 1000
Minutes	1... 100
Hours	1...24
Measurement values	1... 1000

Tab. 6-11: Statistics Data Configuration – Moving Average Window Value

Statistics Data Output: Minimum

Minimum value of the measured values over a certain time period.

Statistics Data Output: Maximum

Maximum value of the measured values over a certain time period.

Statistics Data Output: Average

Average of the measured values over a certain time period.

Statistics Data Output: Moving Average

The moving average is an average that is calculated repeatedly over a certain value of the moving average window.

Statistics Data Configuration: Number of Samples

Total number of read measurement values during start and stop operation of the minimum value/maximum value/average function.

6 Secondary Device Functions (continued)

Statistics Data Output: Status

Bit position	Meaning	Description
0	Configured	1 – all inputs are configured
1	Started Min/Max/Avg	1 – Min/Max/Avg running
2	Started Moving Average	1 – Moving Average running
3	Buffer Overflow Event	1 – buffer overflow
4	Timeout Event	1 – the set time for the minimum value/maximum value/average calculation has elapsed
5	Reserved	–
6	Reserved	–
7	Reserved	–

Tab. 6-12: Statistics Data Output – Status

6.2.5 System Commands

Command Value	Device Action
0xA7 (167)	Statistics Reset – Resets all output parameters to 0 and all user settings to the default values.
0xA8 (168)	Statistics Start Min/Max/Avg – Starts the statistics of the minimum value/maximum value/average calculation.
0xA9 (169)	Statistics Stop – Stops statistics operation completely.
0xAC (172)	Statistics Start Moving Average – Starts the statistics of the moving average calculation.

Tab. 6-13: Basic statistics – System Commands

For an overview of all System Commands, see section 3.5 on page 23.

6.2.6 Events

Event Code	Event Type	Event Description Remedy	Device Status
0x8D07 (36103)	Warning	The calculation of the basic statistics was stopped automatically to avoid a buffer overflow.	0 – Device is operating properly.
0x8D0E (36110)	Notification	The time has elapsed. This event reports the timeout of the minimum value/maximum value/average calculation. It does not report a timeout for the calculation of the moving average because the timer repeats and it does not indicate the end of the calculation.	0 – Device is operating properly.

Tab. 6-14: Basic statistics – Events

6.2.7 Variant Dependence

This function is not available for the following variants:

QYW TBF_GL-F-__M-D__-L__
QYW TBF_GA-M-__M-D__-L__
QYW TBF_GR-R-__M-D__-L__
QYW TBF_EP-__M-D__-L__
QYW TBF_T3H-M-__M-D__-L__

6.3 Logic Blocks

6.3.1 Description

The device offers four digital logic blocks that can be configured as AND/NOR/OR/XOR. Each of these logic blocks has 4 input signals. These input signals are evaluated cyclically according to the cycle time.

The result of a logic block can be used as an input signal for each other logic block. The configuration of Logic Block Mode and the input signals can be set via the ISDU parameter access.

Even though each logic block contains 4 inputs, a block with fewer inputs can be used. The unused inputs are set so that they cannot influence the result.

6.3.2 Signal Inputs

All process data objects of the type Boolean can be used for input configuration. The respective Object IDs can be found in the respective section on the function.

6.3.3 Mode Inputs

The mode of a logic block can be set with the values from Tab. 6-15.

Modes	Value
UNUSED	0x00 (0)
AND	0x01 (1)
OR	0x02 (2)
NOR	0x03 (3)
XOR	0x04 (4)

Tab. 6-15: Logic blocks – Mode inputs

Fig. 6-5 illustrates the logic blocks:

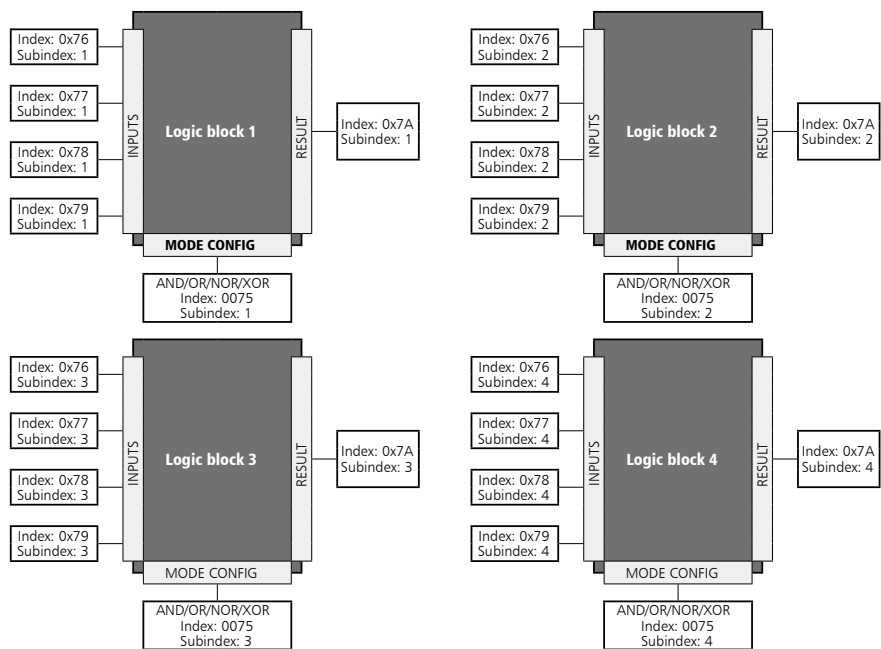


Fig. 6-5: Logic blocks – Mode inputs

6.3.4 Mathematics/Algorithm

Truth tables of the Logic Blocks Modes

XOR		
A	B	X
0	0	0
1	0	1
0	1	1
1	1	0

OR		
A	B	X
0	0	0
1	0	1
0	1	1
1	1	1

AND		
A	B	X
0	0	0
1	0	0
0	1	0
1	1	1

NOR		
A	B	X
0	0	1
1	0	0
0	1	0
1	1	0

Tab. 6-16: Logic blocks – Truth tables

6 Secondary Device Functions (continued)

6.3.5 Process Data

Object ID	Name	Description	Direction
0x0063 (99)	LOGICBLOCK1_RESULT	Result Logic Block 1	Input
0x0064 (100)	LOGICBLOCK2_RESULT	Result Logic Block 2	Input
0x0065 (101)	LOGICBLOCK3_RESULT	Result Logic Block 3	Input
0x0066 (102)	LOGICBLOCK4_RESULT	Result Logic Block 4	Input

Tab. 6-17: Logic blocks – Process data

6.3.6 ISDU

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Logic Block Mode	0x0075 (117)	0	R/W	4 bytes		Yes	
Logic Block 1 Mode		1	R/W	1 byte	UINT8	No	0
Logic Block 2 Mode		2	R/W	1 byte	UINT8	No	0
Logic Block 3 Mode		3	R/W	1 byte	UINT8	No	0
Logic Block 4 Mode		4	R/W	1 byte	UINT8	No	0
Logic Block Input 1	0x0076 (118)	0	R/W	8 bytes		Yes	
Logic Block 1 Input 1		1	R/W	2 bytes	UINT16	No	0
Logic Block 2 Input 1		2	R/W	2 bytes	UINT16	No	0
Logic Block 3 Input 1		3	R/W	2 bytes	UINT16	No	0
Logic Block 4 Input 1		4	R/W	2 bytes	UINT16	No	0
Logic Block Input 2	0x0077 (119)	0	R/W	8 bytes		Yes	
Logic Block 1 Input 2		1	R/W	2 bytes	UINT16	No	0
Logic Block 2 Input 2		2	R/W	2 bytes	UINT16	No	0
Logic Block 3 Input 2		3	R/W	2 bytes	UINT16	No	0
Logic Block 4 Input 2		4	R/W	2 bytes	UINT16	No	0
Logic Block Input 3	0x0078 (120)	0	R/W	8 bytes		Yes	
Logic Block 1 Input 3		1	R/W	2 bytes	UINT16	No	0
Logic Block 2 Input 3		2	R/W	2 bytes	UINT16	No	0
Logic Block 3 Input 3		3	R/W	2 bytes	UINT16	No	0
Logic Block 4 Input 3		4	R/W	2 bytes	UINT16	No	0
Logic Block Input 4	0x0079 (121)	0	R/W	8 bytes		Yes	
Logic Block 1 Input 4		1	R/W	2 bytes	UINT16	No	0
Logic Block 2 Input 4		2	R/W	2 bytes	UINT16	No	0
Logic Block 3 Input 4		3	R/W	2 bytes	UINT16	No	0
Logic Block 3 Input 4		4	R/W	2 bytes	UINT16	No	0
Logic Block Result	0x007A (122)	0	R	4 bytes		n/a	
Logic Block 1 Result		1	R	1 byte	BOOL	n/a	0
Logic Block 2 Result		2	R	1 byte	BOOL	n/a	0
Logic Block 3 Result		3	R	1 byte	BOOL	n/a	0
Logic Block 4 Result		4	R	1 byte	BOOL	n/a	0

Tab. 6-18: Logic blocks – ISDU

6.3.7 Variant Dependence

This function is not available for the following variants:

QYW TBF_GL-F-__M-D__-L__
QYW TBF_GA-M-__M-D__-L__
QYW TBF_GR-R-__M-D__-L__
QYW TBF_EP-__M-D__-L__
QYW TBF_T3H-M-__M-D__-L__

6 Secondary Device Functions (continued)

6.4 Operating Hours Counter

6.4.1 Description

The operating hours counter can record the operating hours of a device accurately to the second. There are a total of three operating hours counters. In addition to an operating hours counter for the operating hours since the start of the device, there is a total operating hours counter and a customer-specific operating hours counter that can be reset. The storage interval is configurable and the operating hours are not stored once one million storage cycles have been reached.

The output of the operating hours can serve as a time control for the service interval as well as for preventative maintenance. Schedules for regular service can be tied to the operating hour values. Moreover, a high value of the total operating hours is indicative of intensive use of a device and possible deterioration of the performance. The risk of failure can be countered preventatively through replacement.

6.4.2 Algorithm

While the counter is incremented every second, the storage interval doubles after each save operation. Starting with a save operation after 1 minute, then after 2 minutes, then after 4 minutes, then after 8 minutes, up to a maximum storage rate of 12 minutes.

6.4.3 Process Data

Object ID	Name	Description	Direction
0x001B (27)	Current Operating Hours	Output of the current operating hours counter	Input
0x001C (28)	Total Operating Hours	Output of the total operating hours counter	Input
0x001D (29)	Custom Operating Hours	Output of a user-defined operating hours counter	Input

Tab. 6-19: Operating hours counter – Process data

Also see section Process Data Profiles on page 13.

6.4.4 ISDU

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Operating Hours Counter	0x0057 (87)	0	R	12 bytes		n/a	
Current Operating Hours		1	R	4 bytes	UINT32	n/a	–
Total Operating Hours		2	R	4 bytes	UINT32	n/a	–
Custom Operating Hours		3	R	4 bytes	UINT32	n/a	–
Operating Hours Saving Mode	0x0074 (116)	0	R/W	1 byte	UINT8(ENUM)	Yes	0

Tab. 6-20: Operating hours counter – ISDU



The maximum counter value that can be saved is 1,000,000 and, with a switch-on and switch-off every 12 minutes (with static counter), this means a service life of over 20 years. If switched on and off more frequently or in the case of dynamic storage, the maximum storage time is reduced depending on the application.

6 Secondary Device Functions (continued)

Current Operating Hours

This parameter saves the value of the operating hours since the last commissioning in seconds.

Total Operating Hours

This parameter saves the value of the operating hours since the first commissioning in seconds.

Custom Operating Hours

This parameter saves the value of the operating hours since the last reset in seconds.

Operating Hours Saving Mode

The current storage behavior can be set.

Value	Meaning	Description
0x00 (0)	Dynamic	The first save operation is performed 1 minute after switching on; the storage interval then doubles after every save operation. This is limited to a storage interval of 12 minutes. The intervals are 1, 2, 4, 8, 12 minutes.
0x01 (1)	Static	Operating hours counters are stored every 12 minutes.

Tab. 6-21: Operating Hours Counter – Operating Hours Saving Mode

6.2.5 System Commands

Command Value	Device Action
0x81 (129)	Application Reset – Resets Custom Operating Hours to the default value.
0x82 (130)	Restore Factory Settings – Resets Custom Operating Hours and Operating Hours Saving Mode to the default value.
0xA5 (165)	Maintenance Reset – Resets Custom Operating Hours to the default value.

Tab. 6-22: Operating hours counter – System Commands

For an overview of all System Commands, see section 3.5 on page 23.

6 Secondary Device Functions (continued)

6.5 Boot Cycle Counter

6.5.1 Description

After each start, the current Boot Cycle Counter is read from the non-volatile memory, incremented by 1 and rewritten. In addition, a second Boot Cycle Counter is implemented that can be reset.

The output of the current boot cycle can serve as a control for the service interval as well as for preventative maintenance. Schedules for regular maintenance can be tied to the values of the Boot Cycle Counter.

6.5.2 Process Data

Object ID	Name	Description	Direction
0x001E (30)	Boot Cycle Counter	Output of the current Boot Cycle Counter	Input
0x001F (31)	Custom Boot Cycle Counter	Output of the resettable Boot Cycle Counter	Input

Tab. 6-23: Boot cycle counters – Process data

Also see section Process Data Profiles on page 13.

6.5.3 ISDU

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Boot Cycle Counter	0x0058 (88)	0	R	8 bytes		n/a	
Boot Cycle Counter		1	R	4 bytes	UINT32	n/a	–
Custom Boot Cycle Counter		2	R	4 bytes	UINT32	n/a	–

Tab. 6-24: Boot cycle counter – ISDU



The maximum counter value that can be saved is 1,000,000 and, with a switch-on and switch-off every 12 minutes (with static counter), this means a service life of over 20 years.

Boot Cycle Counter

This parameter saves the value of the current boot cycle, which is incremented on each start.

Custom Boot Cycle Counter

This parameter saves the value of the current, user-defined counter, which is incremented on each start and can be reset via the Maintenance Reset system command.

6.5.4 System Commands

Command Value	Device Action
0x81 (129)	Application Reset – Resets the Custom Boot Cycle Counter with ISDU-index 0x58 subindex 2 to the default value 0.
0x82 (130)	Restore Factory Settings – Resets the Custom Boot Cycle Counter with ISDU-index 0x58 subindex 2 to the default value 0.
0xA5 (165)	Maintenance Reset – Resets the Custom Boot Cycle Counter with ISDU-index 0x58 subindex 2 to the default value 0.

Tab. 6-25: Boot cycle counter – System Commands

For an overview of all System Commands, see section 3.5 on page 23.

6 Secondary Device Functions (continued)

6.6 Extreme Environment Status

6.6.1 Description

With the help of the Extreme Environment Status, the time is recorded in which the device was exposed to extreme conditions. In parameter Lifetime Extreme Thresholds, limit values can be configured for the respective conditions. Parameter Lifetime Extreme Status can be used to read out the current status as well as the summed time. The calculation is based on the features Internal Temperature) and Humidity.

6.6.2 Mathematics/Algorithm

If one (or more) extreme conditions are met, the device begins to record the time.



If the power supply is interrupted during this time, the time counter can have an error of maximum 180 seconds.

6.6.3 Process Data

Object ID	Name	Description	Direction
0x0041 (65)	Lifetime Extreme	One or more extreme conditions present.	Input
0x0042 (66)	Lifetime Extreme Time	Combined total time in which the device was exposed to an extreme condition.	Input

Tab. 6-26: Extreme environment status – Process data

6.6.4 ISDU

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Lifetime Extreme Thresholds	0x00D0 (208)	0	R/W	8 bytes		Yes	
Upper Threshold Temperature		2	R/W	2 bytes	INT16	No	85
Lower Threshold Temperature		3	R/W	2 bytes	INT16	No	-25
Lifetime Extreme Status	0x00D1 (209)	0	R	5 bytes		n/a	
State		1	R	1 byte	UINT8(ENUM)	n/a	–
Time		2	R	4 bytes	UINT32	n/a	–

Tab. 6-27: Extreme environment status – ISDU



For the internal humidity, it is not possible to parameterize your own limit values.

Upper Threshold Temperature

Threshold value for the detection of excessive temperature.

Lower Threshold Temperature

Threshold value for the detection of temperature that is too low.

6

Secondary Device Functions (continued)

State

The current status can be read under State.

Bit	Name	Description
1	Upper Temperature	The temperature is above the threshold value.
2	Lower Temperature	The temperature is below the threshold value.
3	Internal Humidity	The humidity is too high.

Tab. 6-28: Extreme environment status – State

Time

Under Time, the summed time in seconds in which the device was exposed to an extreme condition can be read out.

6.6.5 System Commands

Command Value	Device Action
0x81 (129)	Application Reset – Resets writable parameters to the default value.
0x82 (130)	Restore Factory Settings – Resets writable parameters to the default value.
0xA5 (165)	Maintenance Reset – Resets the value for Time and Flags.

Tab. 6-29: Extreme environment status – System Commands

For an overview of all System Commands, see section 3.5 on page 23.

6.6.6 Events

Event Code	Event Type	Event Description	Remedy	Device Status
0x8D13 (36115)	Warning	One or more extreme conditions present.		0 – Device is operating properly.

Tab. 6-30: Extreme environment status – Events

6.6.7 Variant Dependence

The functionality is available in all variants.

6 Secondary Device Functions (continued)

6.7 Internal Temperature

6.7.1 Description

The device has internal temperature monitoring. This records the device temperature as well as the maximum and minimum values since production and since the last time the device was restarted.

An upper and a lower threshold value can be defined for the device temperature module. If the threshold is exceeded or if device limit values are exceeded or undercut, the device triggers IO-Link events.



The internal device temperature is measured in the device and is therefore higher than the ambient temperature. The level of this increased temperature depends on the ambient temperature, the ventilation of the device and the device settings.

6.7.2 Process Data

Object ID	Name	Description	Direction
0x004E (78)	Temperature Status Customer Limits	Temperature status – Warning related to the configured customer limits [Index 0x0053]. Set when out of limits.	Input
0x004F (79)	Temperature Status Device Limits	Temperature status – Warning related to the device limits. Set when out of limits.	Input
0x0050 (80)	Device Temperature	Current device temperature in °C.	Input

Tab. 6-31: Internal temperature – Process data

6.7.3 ISDU

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Device Temperature	0x0052 (82)	0	R	10 bytes		n/a	
Device Temperature		1	R	2 bytes	INT16	n/a	–
Minimum Device Temperature Since Reset		2	R	2 bytes	INT16	n/a	–
Maximum Device Temperature Since Reset		3	R	2 bytes	INT16	n/a	–
Lifetime Minimum Device Temperature		4	R	2 bytes	INT16	n/a	–
Lifetime Maximum Device Temperature		5	R	2 bytes	INT16	n/a	–
Device Temperature Alarm Configuration	0x0053 (83)	0	R/W	4 bytes		Yes	
Lower Alarm Level Device Temperature		1	R/W	2 bytes	INT16	No	–40
Upper Alarm Level Device Temperature		2	R/W	2 bytes	INT16	No	115

Tab. 6-32: Internal temperature – ISDU (overview)

6

Secondary Device Functions (continued)

Device Temperature

Device Temperature contains information about the device temperature (current value in °C), the minimum or maximum device temperature since the last time the device was switched on/reset (in °C) and minimum or maximum device temperature during the lifetime of the device (in °C).

Device Temperature Alarm Configuration

Setting of the lower threshold value (in °C) for the device temperature warning (0x8D20) and of the upper threshold value (in °C) for the device temperature warning (0x8D10).

6.7.4 Events

Event Code	Event Type	Event Description Remedy	Device Status
0x4000 (16384)	Error	Temperature Fault – Overload – The device is operated outside of the device-specific temperature limits. Risk of device damage.	4 – Failure
0x4210 (16912)	Warning	Device Temperature Overrun – Clear Heat Of Source – Risk of device damage. The device is too hot. ► Remove heat source, provide the device with heat insulation if necessary.	2 – Out-of-Specification
0x4220 (16928)	Warning	Device Temperature Underrun – Insulate Device – Risk of device damage. The device is too cold. ► Insulate the device.	2 – Out-of-Specification
0x8D10 (36112)	Warning	Device Temperature Upper Warning – The set upper temperature warning threshold has been exceeded.	0 – Device is operating properly.
0x8D20 (36128)	Warning	Device Temperature Lower Warning – The device temperature has fallen below the set lower temperature warning threshold.	0 – Device is operating properly.

Tab. 6-33: Internal temperature – Events

6 Secondary Device Functions (continued)

6.8 Humidity



This function is only available for the rod variants QYW BN/ZN/FA ...

6.8.1 Description

The function monitors the air humidity in the device and informs of changes through corresponding IO-Link events. The humidity detection returns an immediate reaction in the event of a critical failure. This reaction is triggered if the humidity rises above a fixed threshold value and gives the clear if a satisfactory humidity value is again achieved. The status when the level is exceeded the first time is stored permanently.

6.8.2 Process Data

Object ID	Name	Description	Direction
0x0023 (35)	Humidity Bad	Output of the current humidity evaluation; FALSE means a humidity below the threshold value, TRUE means a humidity value equal to or above the threshold value.	Input

Tab. 6-34: Humidity detection – Process data

Also see section Process Data Profiles on page 13.

6.8.3 ISDU

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Humidity	0x005C (92)	0	R	9 bytes		n/a	
Humidity Bad		1	R	1 byte	BOOL	n/a	–
Operating Hours At Exceedance		2	R	4 bytes	UINT32	n/a	–
Temperature At Exceedance		3	R	4 bytes	INT32	n/a	–

Tab. 6-35: Humidity detection – ISDU

Humidity Bad

The status of the humidity is displayed as a Boolean value. If the value is TRUE, the signal quality is above the threshold value; if the value is FALSE, the signal quality is below the threshold value. The evaluation includes a hysteresis for better signal stability.

Operating Hours At Exceedance

The operating hours value at the first exceedance of the threshold value is stored.

Temperature At Exceedance

The temperature value at the first exceedance of the threshold value is stored.

6.8.4 System Commands

For an overview of all System Commands, see section 3.5 on page 23.

6.8.5 Events

Event Code	Event Type	Event Description Remedy	Device Status
0x8D12 (36114)	Warning	The defined threshold of the device-internal humidity was exceeded. ► Check installation and ambient conditions.	1 – Maintenance-Required

Tab. 6-36: Humidity detection – Events

6 Secondary Device Functions (continued)

6.9 Storage Usage Monitoring

6.9.1 Description

All variable data is stored in a permanent memory on the device. The data is stored in various segments for different access and usage purposes.
Because the number of write cycles in the permanent memory is limited, the number in each segment is monitored by a counter.
All data segments are protected with a CRC32 checksum.

6.9.2 Events

Event Code	Event Type	Event - Description - Remedy	Device Status
0x8D22 (36130)	Warning	Warning limit for write cycles reached – maintenance monitoring no longer guaranteed – for information purposes only.	0 – Device is operating properly.
0x8D23 (36131)	Error	Write cycle limit reached – saving no longer ensured – replacement recommended.	1 – Maintenance-Required

Tab. 6-37: Storage usage monitoring – Events

6.9.3 Variant Dependence

This function is not available for the following variants:

QYW TBF_GL_-F-__M-D__-L__
QYW TBF_GA_-M-__M-D__-L__
QYW TBF_GR_-R-__M-D__-L__
QYW TBF_EP_-__M-D__-L__
QYW TBF_T3H_-M-__M-D__-L__

7 System functions

7.1 Device Status and Detailed Device Status

7.1.1 Description

The Device Status feature provides information about the current device status.

Each Device Status is combined with a corresponding diagnostic message (Events see chapter 3.6 on page 24).

It also gives the user the possibility to actively read out currently pending events of the device.

7.1.2 Process Data

Object ID	Name	Description	Direction
0x002F (47)	System Error	This bit is set (TRUE) if there is an error in the device. This information is linked to the device status (4-Failure), which can be triggered by different device functions or diagnostic messages. The bit is reset as soon as the error status is no longer displayed (FALSE).	Input

Tab. 7-1: Device status and detailed device status – Process Data

Also see section Process Data Profiles on page 13.

7.1.3 ISDU

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Device Status	0x005C (92)	0	R	1 byte	UINT8	n/a	–
Detailed Device Status		0	R	30 bytes	UINT8[]	n/a	0x00 0x00 0x00

Tab. 7-2: Device status and detailed device status – ISDU

7 System functions (continued)

7.1.4 Device Status

The parameters are accessed via subindex 0. The output values are to be interpreted as follows:

Value	Status	Description
0	Device is operating properly	Device working correctly.
1	Maintenance Required	Although the process data is valid, internal diagnoses show that the device will soon lose its ability to function properly. Maintenance is necessary.
2	Out-of-Specification	Although the process data is valid, internal diagnoses show that the device is operating outside of its specified measurement range or environmental conditions. The installation must be checked for unintentional malfunctions.
3	Functional check	Process data is temporarily invalid due to intentional changes to the device, e.g., parameterization or teaching-in.
4	Failure	Process data is invalid due to a malfunction of the device or its peripheral devices. The device is not able to perform its intended function. Re-configuration (resetting to factory settings) can help. Otherwise, TBF service must be contacted or the device replaced.

Tab. 7-3: Device Status

7.1.5 Detailed Device Status

Detailed Device Status indicates the currently pending diagnosis messages (error, warning). For an event overview, see section 3.6 on page 24.

It can be used to perform a more detailed error analysis or to find the corresponding error source in the event of an unexpected device status.

The length of the list varies dynamically depending on the number of entries. Each entry in the list consists of the EventQualifier and the EventCode and has a data length of 3 bytes. The total list can be queried via subindex 0, individual entries with the corresponding subindex. Each of the entries in the lists can only be called while the event is pending.

Subindex	Object name	Data Type	Comment
1	Error_Warning_1	3 bytes	All bytes 0x00 (0): no error/warning Byte 1: EventQualifier Byte 2, 3: EventCode
2	Error_Warning_2	3 bytes	
3	Error_Warning_3	3 bytes	
4	Error_Warning_4	3 bytes	
...			
n	Error_Warning_n	3 bytes	

Tab. 7-4: Detailed Device Status

7 System functions (continued)

7.2 Diagnosis Suppression

7.2.1 Description

Diagnosis suppression is used to suppress diagnosis messages from the device. There are two possibilities here:

- Diagnosis suppression level that permits a general suppression of messages of a certain level (message, warning, error).
- Event-code suppression of up to 5 events as a list or via a teach-in.

7.2.2 ISDU

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Diagnosis Level Configuration	0x0070 (112)	0	R/W	1 byte	UINT8(ENUM)	Yes	0
Event Code Suppression	0x0071 (113)	0	R/W	10 bytes		Yes	
Event Code Suppression		1...5	R/W	2 bytes	UINT16	No	0
Event Code Suppression Teach-in	0x0072 (114)	0	W	2 bytes	UINT16	n/a	–
Event Code Suppression Delete	0x0073 (115)	0	W	2 bytes	UINT16	n/a	–

Tab. 7-5: Diagnosis suppression – ISDU

7.2.3 Diagnosis Level Configuration

This parameter offers the possibility to select an output level for events.

This index is part of the data management and is stored in non-volatile memory.

7.2.2 ISDU

Value	Diagnosis Level	Descriptions
0	All events	All diagnosis messages are reported (default setting).
1	Warnings and errors	All warnings and errors are reported – messages are suppressed.
2	Error	Only events of type error are reported.
3	No events	All diagnosis messages from the device are suppressed.

Tab. 7-6: Diagnosis suppression – Diagnosis level configuration

7.2.4 Events

For an event overview, see section 3.6 on page 24.

Event Code Suppression

This parameter indicates the currently suppressed event messages. The user can access the individual messages via subindex 0 or a specific subindex. This index is part of the data storage and is stored in non-volatile memory.

Value 0x0000 (0) is the default value and is interpreted as FREE.

Each event message is structured as follows:

Byte1 (MSB)	Byte0 (LSB)
Event Code High Byte	Event Code Low Byte

Tab. 7-7: Diagnosis suppression – Event Message Suppression

Event Code Suppression Teach-in/Delete

To add an event to the list of suppressed events, the event code is inserted in subindex 0 in Event Code Suppression Teach-In. It is added to the next free place in the table.

If the event code is deleted with Event Code Suppression Delete, it is removed from the list.

7 System functions (continued)

7.3 Reset Commands

7.3.1 Description

The device supports various reset commands for resetting the set parameters to default values. Each of these commands is accessed by means of System Commands. This function is defined in the IO-Link specification and is implemented according to Version 1.1.3.

7.3.2 ISDU

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
System Commands	0x0002 (2)	0	W	1 byte	UINT8	n/a	–

Tab. 7-8: Reset Commands – ISDU

7.3.3 System Commands

Command Value	Device Action
0x80 (128)	Device Reset – Device Reset means a warm start of the device. During this process, the microcontrollers are restarted and all initializations performed again without any change made to the parameter values.
0x81 (129)	Application Reset – This reset is performed using IO-Link specification V1.1.3. – Resets all parameters and device settings to default values (with the exception of the identification and tagging parameters) – No reset of the configuration of the device variant – Set DS-Upload request (accept the data in the memory) – No communication stop or restart
0x82 (130)	Restore Factory Settings – This reset is performed using IO-Link specification V1.1.3. – Reset all parameters and device settings to default settings (including identification and tagging parameters) – Reset the configuration of the device variants to the default variant – No DS-upload-request – No communication stop or restart
0xA5 (165)	Maintenance Reset – Resets all resettable maintenance and service life parameters for the user so that the next maintenance cycle can begin.

Tab. 7-9: Reset Commands – System Commands

For an overview of all System Commands, see section 3.5 on page 23.

7.4 Variant Configuration

7.4.1 Description

This parameter indicates which variant is currently set. The device variant can be changed either with this parameter or by using the IO-Link compatibility mode. If this parameter is written, the device variant is not changed immediately but instead after the device is restarted. If the device variant is changed via the IO-Link compatibility mode, the change in this parameter is visible immediately. This parameter is not changed by a reset.



After a variant changeover, an inconsistent configuration may occur because there is no automatic changeover of parameters.

It is therefore recommended that the setup be done in the following order:

1. Variant setting
2. Activate the variant with a device restart.
3. Check parameters and set valid parameters if necessary or use Data Storage (see section 2.9 on page 7).

Enables the changeover between QYW-compatible variants (Smart Sensor Profile Legacy) and Smart Sensor Profile Ed. 2 variants. Both variants support different COM speeds (COM3 and COM2).

7 System functions (continued)

7.4.2 ISDU

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Device Variant	0x0055 (85)	0	R/W	2 bytes	UINT16(ENUM)	No	Default value depends on the typecode

Tab. 7-10: Variant Configuration – ISDU

Device Variant

This parameter indicates which variant is currently set.

IO-Link variants

The following variants are available in IO-Link QYW:

- QYW TBF _____-C15A__0-_____
- QYW TBFPF _____-C15A__0-_____
- QYW TBFPA _____-C15A__0-_____

Value	Meaning	Description
0x0000 (0)	–	Smart Sensor Profile Legacy, COM3, 4 bytes PDIn (QYW U100-compatible)
0x0001 (1)	–	Smart Sensor Profile Legacy, COM3, 8 bytes PDIn (QYW U101-compatible)
0x0002 (2)	–	Smart Sensor Profile Legacy, COM3, 16 bytes PDIn (QYW U102-compatible)
0x0003 (3)	–	Smart Sensor Profile Legacy, COM3, 32 bytes PDIn (QYW U103-compatible)
0x0004 (4)	–	Smart Sensor Profile Legacy, COM2, 4 bytes PDIn (QYW U104-compatible)
0x0005 (5)	–	Smart Sensor Profile Legacy, COM2, 8 bytes PDIn (QYW U105-compatible)
0x0006 (6)	–	Smart Sensor Profile Legacy, COM2, 16 bytes PDIn (QYW U106-compatible)
0x0007 (7)	–	Smart Sensor Profile Legacy, COM2, 32 bytes PDIn (QYW U107-compatible)
0x0008 (8)	–	Smart Sensor Profile Ed. 2, COM2
0x0009 (9)	–	Smart Sensor Profile Ed. 2, COM3

Tab. 7-11: Variant configuration – IO-Link variants

Mixed signal variants

The following variants are available in QYW with mixed signals (analog and IO-Link):

Value	Meaning	Description
0x000C (12)	–	Smart Sensor Profile Legacy, COM3, 4 bytes PDIn (QYW U100-compatible)
0x000D (13)	–	Smart Sensor Profile Legacy, COM3, 8 bytes PDIn (QYW U101-compatible)
0x000E (14)	–	Smart Sensor Profile Legacy, COM3, 16 bytes PDIn (QYW U102-compatible)
0x000F (15)	–	Smart Sensor Profile Legacy, COM3, 32 bytes PDIn (QYW U103-compatible)
0x0010 (16)	–	Smart Sensor Profile Legacy, COM2, 4 bytes PDIn (QYW U104-compatible)
0x0011 (17)	–	Smart Sensor Profile Legacy, COM2, 8 bytes PDIn (QYW U105-compatible)
0x0012 (18)	–	Smart Sensor Profile Legacy, COM2, 16 bytes PDIn (QYW U106-compatible)
0x0013 (19)	–	Smart Sensor Profile Legacy, COM2, 32 bytes PDIn (QYW U107-compatible)
0x0014 (20)	–	Smart Sensor Profile Ed. 2, COM2
0x0015 (21)	–	Smart Sensor Profile Ed. 2, COM3

Tab. 7-12: Variant configuration – Mixed signal variants

7 System functions (continued)

7.5 LED Meaning and Configuration

7.5.1 Description

Only the signal with the highest priority is displayed. The signals are listed in descending priority.

TBF Standard

Value	Meaning	Description
Device Discovery	Blue flashing, 3 Hz	The Device Discovery can be activated via a system command to find the device again.
Short Circuit Pin 2 / Pin 4	Red flashing, 3 Hz	Short circuit at pin 2 or pin 4
Measurement Error	Red flashing, 1 Hz	This signal occurs if a measurement error occurs. The measurement value is unknown due to an error or outside of the measuring range.
Failure	Static red	General error
Teach-in	Static red	The device is currently in teach-in mode.
Maintenance Required	Blue, static	Maintenance must be performed.
Overload	Orange, flashing, 3 Hz	Overload on pin 2 / pin 4 has been detected.
Out of Specification	Yellow flashing, 3 Hz	The device is operated outside of specifications. Areliable measurement signal can no longer be ensured.
Communication	Green alternating with LED off at ratio of 10:1, 1 s period	IO-Link communication is active. The device is ready.
Ready	Static green	The device is ready.

Tab. 7-13: LED meaning and configuration – TBF Standard

7 System functions (continued)

Namur Standard

Name	Signal	Meaning
Device Discovery	Blue flashing, 3 Hz	The Device Discovery can be activated via a system command to find the device again.
Short Circuit Pin 2 / Pin 4	Red flashing, 3 Hz	Short circuit at pin 2 or pin 4
Measurement Error	Red flashing, 1 Hz	This signal occurs if a measurement error occurs. The measurement value is unknown due to an error or outside of the measuring range.
Failure	Static red	General error
Teach-in	Static red	The device is currently in teach-in mode.
Maintenance Required	Blue, static	Maintenance must be performed.
Overload	Orange, flashing, 3 Hz	Overload on pin 2 / pin 4 has been detected.
Out of Specification	Yellow flashing, 3 Hz	The device is operated outside of specifications. Reliable measurement signal can no longer be ensured.
Communication	Green alternating with LED off at ratio of 10:1, 1 s period	IO-Link communication is active. The device is ready.
Ready Diagnosis On	Static green	The device is ready. Diagnosis functions are on.
Ready Diagnosis Off	Static white	The device is ready. Diagnosis functions are switched off.

Tab. 7-14: LED meaning and configuration – Namur Standard

7.5.2 ISDU

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
LED Standard Selection	0x00FD (253)	0	R/W	1 byte	UINT8(ENUM)	Yes	0

Tab. 7-15: LED meaning and configuration – ISDU

LED Standard Selection

It is possible to select between two different signaling standards with the help of a parameter. The parameter defines which signaling standard is to be used:

Value	Standard
0	TBF
1	NAMUR

Tab. 7-16: LED meaning and configuration – LED Standard Selection

Event Code Suppression Teach-in/Delete

The parameter is reset by the commands Application Reset and Factory Reset (also see section Reset Commands on page 66).

7.5.3 Variant Dependence

This function is not available for the following variants:

QYW TBF_GL-F-__M-D__-L__

QYW TBF_GA-M-__M-D__-L__

QYW TBF_GR-R-__M-D__-L__

QYW TBF_EP-__M-D__-L__

QYW TBF_T3H-M-__M-D__-L__

7 System functions (continued)

7.6 Process Data Info and Configuration

7.6.1 Description

Process data information and configuration offers various possibilities related to process data:

- Selection of a process dataset specified by the device
- Information about the structure of the input and output data
- Information about the last valid value for input and output data

As a diagnosis function, monitoring of the updates of certain process values is available. If these are not updated in the specified time, the device sends corresponding diagnosis messages.

Invalid Process Data

Input data (from the device to the master) is only marked as invalid if the device has the Failure device status.



In the case of individual pieces of faulty data, the data is not marked as invalid but is instead replaced by substitution values or error codes. This is to be taken into account during the evaluation.

7.6.2 ISDU

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Process Data Input Descriptor	0x000E (14)	0	R	9 (Smart Sensor Profile Ed. 2), N x 3 (Smart Sensor Profile Legacy, N = Number of PDV objects)	UINT8[]	n/a	–
Process Data Output Descriptor	0x000F (15)	0	R	3	UINT8[]	n/a	–
Last Valid Process Data Inputs	0x0028 (40)	0	R	Variant-dependent	–	n/a	–
Last Valid Process Data Outputs	0x0029 (41)	0	R	0	–	n/a	–

Tab. 7-17: Process data info and configuration – ISDU

PD Description

This parameter is used to specify the structure of the currently selected process data profile for input and output data. The individual process data variables are described. The total list is accessible via subindex 0, a single entry is possible using a specific subindex. Subindex 1 corresponds to the least significant (or the element most recently transferred in the process data stream). When reading out the entire list, this element is transferred first. The length of the list is dependent on which process data profile is selected. A single element has a length of 3 bytes.

Byte number	Contents	Values
Byte 1	Data type	0: OctetStringT 1: Set of BoolT 2: UIntegerT 4: Float32T 5... 255: reserved
Byte 2	TypeLength	0...255 bits
Byte 3	Bit offset	0...255 bits

Tab. 7-18: Process data info and configuration – PD Description

Last Valid Process Data

This parameter indicates the most recently valid input or output data of the device. The first transferred byte in the process data (MSB) is transferred first. This is an exact representation. Access occurs via subindex 0.

7.6.3 Events

PD Update Timeout

With special process data values, the device automatically checks whether the values are updated in the time period specified by the device. If an update timeout is triggered as a result, this is output via the following diagnosis messages:

Event Code	Event Type	Event - Description-Remedy	Device Status
0x1851 (6225)	Notification	Process Data Update Timeout – for information purposes only	0 – Device is operating properly.
0x1852 (6226)	Warning	Multiple Process Data Update Timeout – for information purposes only	0 – Device is operating properly.

Tab. 7-19: Process data information and configuration – Events

PD Profile Selection after Change of Variant

If the variant of the device is changed, the currently set profile is retained.
In the case that the corresponding PD profile is not valid for this variant, the default profile for the corresponding variant is selected.

Event Code	Event Type	Event - Description-Remedy	Device Status
0x1850 (6224)	Notification	Process data profile selection cannot be used – default value is used.	0 – Device is operating properly.

Tab. 7-20: Process data information and configuration – Events

PD Invalid

PD Inputs Invalid:
Input data (device-to-master) is marked as invalid if the device status (see section 7.1 on page 62) of the device is Failure. In all other states, replacement values for the data are output for which the content cannot be output correctly.

7 System functions (continued)

7.7 Profile Characteristic

7.7.1 Description

Profile Characteristic is a readable parameter that provides information about which IO-Link profiles are supported. It is used mainly to allow profile function modules of the control unit to detect which profile or functions on the device are available.

This parameter is defined in the IO-Link specification.

Name	Index	Sub-index	Access	Length	Data Type	Data Storage	Default
Profile Characteristic	0x000D (13)	0	R	6 bytes (Smart Sensor Profile Ed. 2), 8 bytes (Smart Sensor Profile Legacy), 6 bytes (Smart Sensor Profile Legacy, without PDIn)	UINT16[]	n/a	–

Tab. 7-21: Profile Characteristic – ISDU

The parameter can be read via subindex 0 and consists of multiple profile indices and function classes (each 16-bit values).

If a profile ID is specified, this means that all included function classes are supported. If only sub-functions are supported, these are output explicitly as an individual function class.

This device supports the following profiles:

Profile ID	Name / Description
0x0001	Smart Sensor Profile Legacy
0x000B	Digital Measuring Sensor
0x0030	BLOB
0x0031	Firmware Update
0x4000	Common Profile

Tab. 7-22: Profile Characteristic – supported profiles

The following function classes are supported:

Function Class ID	Name / Description
0x8000	Device Identification
0x8002	Process Data Mapping
0x8003	Device Diagnosis
0x8004	Teach Commands
0x800B	Measurement High Resolution
0x8100	Extended Identification

Tab. 7-23: Profile Characteristic – supported function classes

All individual functions are described in this guide.

For more exact descriptions of the profiles, refer to the corresponding profile specifications (see www.io-link.com).

7.7.3 Variant Dependence

- Smart Sensor Profile Ed. 2: 0x000B, 0x0031, 0x4000
- Smart Sensor Profile Legacy: 0x0001, 0x00031, 0x8000, 0x8002
- Smart Sensor Profile Legacy (without PDIn): 0x0001, 0x0031, 0x4000

7.8 Parameter Manager**7.8.1 Description**

The parameter manager is responsible for the saving of parameters in the permanent memory of the device. On startup, all stored parameters are read from permanent memory; if parameters are changed, the data is stored within the permanent memory by the parameter manager.

All data is protected with a CRC32 checksum. In the event of damaged memory, the parameter manager outputs the Parameters not consistent event.

7.8.2 Events

Event Code	Event Type	Event Description Remedy	Device Status
0x8D24 (36132)	Warning	Parameter write error – for information purposes only.	0 – Device is operating properly.
0x8D25 (36133)	Error	Parameters not consistent – basic settings are used, service required. Parameterization processes and resets can no longer be performed.	4 – Failure

Tab. 7-24: Parameter manager – Events

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