Application Note

FESTO

IO-Link parameter description

A brief explanation of the contents
- identification
- parameter and commands
- block parameterization
- teach-In
- process data
- using different pressure units
- diagnosis

SFAW-.....
liquid-flow-sensor

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Document no. 100043
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Author ..... Festo

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Table of contents

1 Components/Software used

Type/Name	Version Software/Firmware	Date of manufacture
SFAW-...	general	operative from 2015

Table 1.1: Components/Software used

➔ **Note**

You can find detailed specifications on the product, the instruction manual and the declaration of conformity at:

➔ www.festo.com

Detailed information on the IO-Link specification V1.1 und the Smart Sensor Profile at:

➔ www.io-link.com

The device description file IODD at:

➔ www.festo.com

2 IO-Link operating mode

In the IO-Link operating mode, programmed switching signals and the continuously measured process values (digitally coded analogue values) are transferred.

– Data transmission is serially and digitally coded in the IO-Link protocol
– Usage of unshielded standard cables up to 20 m length is possible
– Process data: 14 bit for the flow measurement value, 14 bit for the temperature value (only for SFAW-..T-..; variant with temperature option) and maximal 4 bit for the binary channels
– Parameters and functions in accordance with Smart Sensor Profile
– There are three binary channels available, which can be individually programmed as threshold value comparator, window comparator. One additional channel is used for volume impulse transmission
– Each binary channel is adjustable as normally closed (NC) or normally open (NO)
– The continuously measured flow and temperature values are always transferred parallel and independent of the binary channels
– Support of optional functions Block Parameterisation and Data Storage
– Display IO-Link operation: “OutA” or “OutC” segment switches off every 2 seconds for the period of 0,1 seconds
– The keys are locked during a parameter access, afterwards the device returns automatically into the RUN mode
– Device description file IODD for all variants.

3 Technical data

3.1 General specification

IO-Link	
Protocol	IO-Link
Protocol version	Device V1.1
Profile	Smart Sensor Profile
Function classes	BinaryDataChannel ProcessDataVariable, Identification, Diagnosis, Teach channel
Communication mode	COM2 (38,4 kBaud)
SIO-Mode support	Yes
Port class	A
Process data length OUT	0 byte
Process data length IN	3 bytes [1] / 5 bytes [2]
Process data content IN	Flow monitoring BDC1 (BinaryDataChannel 1) Temperature monitoring BDC2 [3] (BinaryDataChannel 2) Volume impulse BDC3 (BinaryDataChannel 3) Flow monitoring BDC4 (BinaryDataChannel 4) Flow measured value PDV 14 bit (ProcessDataVariable) Temperature measured value PDV 14 bit [3] (ProcessDataVariable)
Min. cycle time	5 ms
Data storage required	0,5 kByte
Device ID	see chapter *3.3.1 Identification parameters*

1) for SFAW-..-PNLK-PNVBA and SFAW-..-PNLK-PN-VBA; variants without temperature option

2) for SFAW-..**T**-..-PNLK-PNVBA and SFAW-..**T**-..-PNLK-PN-VBA; variants with temperature option

3) only for SFAW-..**T**-..-PNLK-PNVBA and SFAW-..**T**-..-PNLK-PN-VBA; variants with temperature option

Table 3.1: General IO-Link specification

3.2 Communication features

- Preoperate: Frame type 1_V, OD-capability 8 bytes
- Operate: Frame type 2_V, OD-capability 2 bytes
- SIO-Mode: supported
- ISDU: supported
- Data storage: supported
- Block parameterization: supported

3.3 On demand data

The detailed description of these parameters can be found in the IO-Link Interface and System specification, in the IODD and in the IO-Link Smart Sensor Profile. The default values and the respective valid ranges of these parameters are listed in the IODD xml file.

3.3.1 Identification parameters

Vendor ID 333 d / 01 4D h
Device ID see the following table

Device ID [dec]	Device ID [hex]	Order Code
64	00 00 40	SFAW-15T-PNLK-PN-VBA
65	00 00 41	SFAW-32T-PNLK-PN-VBA
66	00 00 42	SFAW-50T-PNLK-PN-VBA
67	00 00 43	SFAW-100T-PNLK-PN-VBA
68	00 00 44	SFAW-15-PNLK-PN-VBA
69	00 00 45	SFAW-32-PNLK-PN-VBA
70	00 00 46	SFAW-50-PNLK-PN-VBA
71	00 00 47	SFAW-100-PNLK-PN-VBA
72	00 00 48	SFAW-15T-PNLK-PNVBA
73	00 00 49	SFAW-32T-PNLK-PNVBA
74	00 00 4A	SFAW-50T-PNLK-PNVBA
75	00 00 4B	SFAW-100T-PNLK-PNVBA
76	00 00 4C	SFAW-15-PNLK-PNVBA
77	00 00 4D	SFAW-32-PNLK-PNVBA
78	00 00 4E	SFAW-50-PNLK-PNVBA
79	00 00 4F	SFAW-100-PNLK-PNVBA

Table 3.2: Device IDs

Index	Subin-dex	Name	Value (example)	Access[1]			Length	Format
				U	M	S		
0x0010	0	Vendor Name	Festo AG & Co. KG	R	R	R	17 bytes	String
0x0011	0	Vendor Text	http://www.festo.com	R	R	R	20 bytes	
0x0012	0	Product Name	Order code, e.g. SFAW-32T-X-E-PNLK-PN-VBA-M12	R	R	R	max 64 bytes	
0x0013	0	Product ID	SFAW-32T-PNLK-PN-VBA	R	R	R	max 21 bytes	
0x0014	0	Product Text	Flow sensor for liquid media	R	R	R	28 bytes	
0x0015	0	Serial Number	Product Key, e.g. 3S7PL9V6HHM	R	R	R	11 bytes	
0x0016	0	Hardware Revision	REV01	R	R	R	5 bytes	
0x0017	0	Firmware Revision	V00.27.06.13	R	R	R	12 bytes	
0x0018	0	Application Specific Tag[2]	***	R	R/W	R/W	32 bytes	

1) Authorisation group: U = user, M = maintenance, S = specialist; access: R = read, R/W = read and write, – = no access
2) Value defined by user

Table 3.3: Identification parameters

3.3.2 Standard IO-Link parameters und commands

Index	SubIndex	Name	Value	Access[1]			Length	Format
				U	M	S		
0x0002	0	SystemCommand	➔ *Table 3.5:*				1 byte	UInterger8
0x000C	0	Device Access Locks[2]	bitwise: 0 = unlocked 1 = locked	R	R/W	R/W	2 bytes	Record
0x0020	0	Error Count	0	R	R	R	2 bytes	UInterger16
0x0024	0	Device Status	0	R	R	R	1 byte	UInterger8
0x0025	0	Detailed Device Status	➔ *Table 3.19:* [3]	R	R	R	36 bytes [4] 30 bytes [5]	Array of 3 byte records
0x0028	0	ProcessDataInput	➔ *Table 3.14:* ➔ *Table 3.15:*	R	R	R	5 bytes [4] 3 bytes [5]	Record

1) Authorisation group: U = user, M = maintenance, S = specialist; access: R = read, R/W = read and write, – = no access
2) Bit 0: lock Parameter Write Access; Bit1: lock data storage; Bit2: lock local parameterization (EDIT- and TEACH-Mode); Bit3: lock local user interface (not used)
3) maximal 7 different Device status are available
4) for SFAW-..**T**-..-PNLK-PNVBA and SFAW-..**T**-..-PNLK-PN-VBA; variants with temperature option
5) for SFAW-..-PNLK-PNVBA and SFAW-..-PNLK-PN-VBA; variants without temperature option

Table 3.4: Standard IO-Link parameters

Value dec	Value hex	Access[1]			Command	Note	Format
		U	M	S			
65	0x41	–	W	W	SP1 Single Value Teach	Determines Teachpoint for Setpoint SP1	UInterger8
66	0x42	–	W	W	SP2 Single Value Teach	Determines Teachpoint for Setpoint SP2	
67	0x43	–	W	W	SP1 Two Value Teach TP1	Determines Teachpoint 1 for Setpoint SP1	
68	0x44	–	W	W	SP1 Two Value Teach TP2	Determines Teachpoint 2 for Setpoint SP1	
75	0x4B	–	W	W	One Action Teach	Device specific Teach-In	
79	0x4F	–	W	W	Teach Cancel	Cancels the Teach-In sequence	
128	0x80	–	W	W	Device reset	Device warm start	
130	0x82	–	W	W	Restore factory settings	Sets the factory settings operative again	
160	0xA0	W	W	W	Reset Min PDV (InA)	Minimal measured flow value reset	
161	0xA1	W	W	W	Reset Max PDV (InA)	Maximal measured flow value reset	
162	0xA2	W	W	W	Reset Min PDV (InB)	Minimal measured temperature value reset	
163	0xA3	W	W	W	Reset Max PDV (InB)	Maximal measured temperature value reset	
176	0xB0	-	W	W	Reset volume recorder	Reset volume recorder in RECORDER mode	
177	0xB1	-	W	W	Run volume recorder	Run/resume volume recorder in RECORDER mode	
178	0xB2	-	W	W	Pause volume recorder	Pause volume recorder in RECORDER mode	

1) Authorisation group: U = user, M = maintenance, S = specialist; access: R = read, R/W = read and write, – = no access

Table 3.5: Standard IO-Link commands

3.3.3 Smart Sensor Profile parameters

Index	Sub-index	Name	Value	Access [1]			Length (byte)	Format
				U	M	S		
0x000D	0	Profile Characteristics		R	R	R	12	Array of UInteger16
	1	Device Profile ID	0x0001: Smart Sensor Profile	R	R	R	2	UInteger16
	2	Function Class ID	0x8000: Device Identification	R	R	R	2	
	3	Function Class ID	0x8001: BinaryDataChannel	R	R	R	2	
	4	Function Class ID	0x8002: ProcessDataVariable	R	R	R	2	
	5	Function Class ID	0x8003: Device Diagnosis	R	R	R	2	
	6	Function Class ID	0x8004: Teach Channel	R	R	R	2	
0x000E	0	PDInput Descriptor		R	R	R	6	Array of OctetString3
	1	BDC1, BDC2	0x01, 0x03, 0x00	R	R	R	3	OctetString3
	2	ProcessDataVariable	0x02, 0x0E, 0x08	R	R	R	3	OctetString3
0x000E [2]	0	PDInput Descriptor		R	R	R	9	Array of OctetString3
	1	BDC1, BDC2	0x01, 0x04, 0x00	R	R	R	3	OctetString3
	2	ProcessDataVariable	0x02, 0x0E, 0x08	R	R	R	3	OctetString3
	3	ProcessDataVariable	0x02, 0x0E, 0x18	R	R	R	3	OctetString3
0x003A	0	Teach-In Channel	0: BDC1 (OutA), default	-	R/W	R/W	1	UInteger8
			1: BDC1 (OutA)					
			4: BDC4 (OutD)					
0x003B	0	Teach-In Status	0	-	R	R	1	Record
	1	Teach Flag TP2 for SP2	0: not taught, 1 - taught	-	R	R	1	BooleanT
	2	Teach Flag TP1 for SP2	0: not taught, 1 - taught	-	R	R	1	
	3	Teach Flag TP2 for SP1	0: not taught, 1 - taught	-	R	R	1	
	4	Teach Flag TP1 for SP1	0: not taught, 1 - taught	-	R	R	1	
	5	Teach State	0	-	R	R	1	UInteger4
BDC1, Flow monitoring OutA								
0x003C	1	Setpoint SP1	737 ... 16382, default 9830	R	R/W	R/W	2	UInteger16
	2	Setpoint SP2	819 ... 16382, default 11468				2	
0x003D	1	Switchpoint logic	0: normally open, default 1: normally closed				1	UInteger8
	2	Switchpoint mode	1: Single Point Mode, default 2: Window Mode				1	
	3	Switchpoint hysteresis	0 ... 14745, default 82				2	UInteger16
BDC2, Temperature monitoring OutB [2]								
0x003E	1	Setpoint SP1	164 ... 14745, default 6553	R	R/W	R/W	2	UInteger16
	2	Setpoint SP2	246 ... 14745, default 9830				2	
0x003F	1	Switchpoint logic	0: normally open, default 1: normally closed				1	UInteger8
	2	Switchpoint mode	1: Single Point Mode, default 2: Window Mode				1	
	3	Switchpoint hysteresis	0 ... 13107, default 82				2	UInteger16

BDC3, Volume impulse OutC								
0x4000	1	Setpoint	51 ... 4294967295, default 16383	R	R/W	R/W	4	UInteger32
	2	Not used	0				4	
0x4001	1	Switchpoint logic	0: normally open, default 1: normally closed				1	UInteger8
	2	Switchpoint mode	128: volume impulse				1	
	3	Not used	0				2	UInteger16
BDC4, Flow monitoring OutD								
0x4002	1	Setpoint SP1	737 ... 16382, default 9830	R	R/W	R/W	2	UInteger16
	2	Setpoint SP2	819 ... 16382, default 11468				2	
0x4003	1	Switchpoint logic	0: normally open, default 1: normally closed				1	UInteger8
	2	Switchpoint mode	1: Single Point Mode, default 2: Window Mode				1	
	3	Switchpoint hysteresis	0 ... 14745, default 82				2	UInteger16

1) Authorisation group: U = user, M = maintenance, S = specialist; access: R = read, R/W = read and write, – = no access

2) only for SFAW-..**T**-..-PNLK-PNVBA and SFAW-..**T**-..-PNLK-PN-VBA; variants with temperature option

Table 3.6: Smart Sensor Profile parameters

3.3.4 IO-Link Teach-In

The remote Teach-In procedure via IO-Link is the same as the manual one. Instead of key pressing the teaching points will be taught by the corresponding commands from IO-Link Smart Sensor Profile. The chronological order of determining teaching points does not matter too.

IO-Link Teach-In just as local Teach-In is only available for flow monitoring channels BDC1 (OutA) and BDC4 (OutD). All switching functions require two applied Teach-In flow values.

In case of an overflow event every teach command causes ISDU error “function temporarily unavailable” 0x8036 and the Teach-In procedure is cancelled. If the Teach-In mode was not yet started, then the device will remain in the run mode.

A survey on the Teach-In commands ➔ *Table 3.5:*

The sensor starts the Teach-In procedure as soon as a successful Teach-In command is sent. It sets the corresponding teach point, the teach state, the status “successfully taught“ and waits for the second command. The keys A, B and EDIT are locked and the display flashes alternately “ t-IN / IO.link “ until either the Teach-In procedure is successfully completed or aborted. The display shows the currently measured process value.

In contrast to the manual Teach-In procedure a teach point can be repeatedly set with the commands 0x41, 0x42, 0x43 and 0x44. This procedure is regardless of the chronological order of applying the teach flow TP1 or TP2.

In case an invalid command, respective to the current switching / Teach-In mode, is sent, the device will signal the ISDU error “function temporarily unavailable” 0x8036.

If the first teach command comes once more before the second one, then the currently measured process value will be used again for the first teach point. After sending of second teach command all successfully calculated switching points will be immediately taken over and the remote Teach-In procedure will end. The Teach Apply command 0x40 is not used during Teach-In process.

All Teach-In commands are in format UInterger8. They should be sent with the index 0x0002 (system command) sub-index 0.

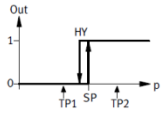
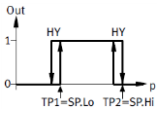
➔ **note**

There is also a specific Teach-In command 0x4B, which is used in IODD to simulate key pressing in IODD device tool. This command reflects the logic of the manual Teach-In and operates analogous to the local Teach-In via display and keys. Additionally this command can ease the use of the Teach-In functions provided by IO-Link for customer applications.

- In mode threshold value comparator the first sending of this command equates to the “SP1 two value teach TP1” command 0x43 and the second sending equates to the “SP1 two value teach TP2” command 0x44
- In mode window comparator the first sending equates to the “SP1 single value teach” command 0x41 and the second equates to the “SP2 single value teach” commands 0x42

For more information see IO-Link Smart Sensor Profile.

Survey of the Teach-In command sequence

					Mode	
					_I¯	_I¯I_
					Single Point Mode	Window Mode
						
					Threshold value comparator	Window-comparator
No.	**Action**	**Out**	**Index**	**Sub-Index**	**Data**	
1	If necessary choose the appropriate switching function[1)]	A	0x003D	0x02	0x01	0x02
		D	0x4003	0x02		
2	Choose BDC	A	0x003A	0x00	0x01	
		D	0x003A	0x00	0x04	
i	Single Value Teach-In					✓
	Two Value Teach-In				✓	
3	Apply the first teach pressure					
4	SP1 Single Value Teach		0x0002	0x00		0x41
	SP1 Two Value Teach TP1		0x0002	0x00	0x43	
5	Apply the second teach pressure					
6	SP2 Single Value Teach		0x0002	0x00		0x42
	SP1 Two Value Teach TP2		0x0002	0x00	0x44	
i	Canceling Teach-In		0x0002	0x4F	always possible during active teach-in process	

1) By changing the switching function an inconsistent set of parameters for switchpoint mode, SP1, SP2, HY could occur which prevents the switching function to be changed. An appropriate error message is shown. In this case it is recommended to restore the factory settings. With the factory settings a free choice of a switching function is always possible.

Table 3.7: Teach-In commands

3.3.5 Device specific parameters

Index	Sub-Index	Name	Value	Access[1]			Length bytes	Format
				U	M	S		
0x0118	0	OutA, backlight color	0: allways blue (default) 1: red if Out = 0 2: red if Out = 1	R	R/W	R/W	2	UInteger16
0x0136	0	OutB, backlight color [2) 3)]	0: allways blue (default) 1: red if Out = 0 2: red if Out = 1	R	R/W	R/W		
0x0149	0	OutC, volume impulse length	10 ... 1000 (ms) default 100 (ms)	R	R/W	R/W		
0x0172	0	OutD, backlight color	0: allways blue (default) 1: red if Out = 0 2: red if Out = 1	R	R/W	R/W		
0x017F	0	InA, unit	0: l/min (default) 1: l/h 2: cfm 3: gal/min	R	R/W	R/W		
0x0181	0	Flow display filter	8: 650 ms (default) 9: 1200 ms 10: 2500 ms	-	-	R/W		
0x0182	0	InA, filter response time (τ=2,5ms x 2n)	5: 100 ms 6: 150 ms (default) 7: 300 ms 8: 650 ms 9: 1200 ms 10: 2500 ms 11: 5000 ms 12: 10000 ms	-	-	R/W		
0x0183	0	Analog output scaling - Input range start value in percent of full scale	0 ... 90, default 0	R	R/W	R/W		
0x0184	0	Analog output scaling - Input range end value in percent of full scale	10 ... 100, default 100	R	R/W	R/W		
0x0185	0	Analog output type	0: 0..10V voltage output (default) 1: 1..5V voltage output 2: 4..20mA current output	R	R/W	R/W		
0x018C	0	Flow instability monitoring - filter response time for smoothing indication of flow instability error	0: off, no flow instability detection 1: on, flow instability detection without smoothing other values: flow instability detection is on with smoothing and following filter response times 2: 100 ms 3: 150 ms 4: 300 ms (default) 5: 650 ms 6: 1200 ms 7: 2500 ms 8: 5000 ms 9: 10000 ms	R	R/W	R/W		
0x0193	0	Unit of temperature process value [2) 3)]	0: °C (default) 1: °F	R	R/W	R/W		
0x01A7	0	Unit of volume process value	0: l (default) 1: m³ 2: ft³ 3: US gal	R	R/W	R/W		

0x01DD	0	Process value shown on display in run mode	1: InA Flow (default) 2: InB Temperature [2) 3)] 3: InC Volume pulse	R	R/W	R/W	2	UInteger16
0x01E2	0	Pin 2 selection [3)]	0: OutB Temperature [2)] 1: OutD Flow (default) 2: InA Flow (analog) [5)] 3: InB Temperature (analog) [2) 5)]	R	R/W	R/W		
0x01E3	0	Pin 4 selection	0: OutA Flow (default) 1: OutC Volume pulse	R	R/W	R/W		
0x01E4	0	Pin 5 selection [2) 3) 4)]	0: InA Flow (analog) (default) 1: InB Temperature (analog)	R	R/W	R/W		
0x01E8	0	Backlight duration	0: always on (default) 1 … 3600 sec - time-out	R	R/W	R/W		
0x01EA	0	Local parameter lock	0: Off (default) 1…9999 - code	R	R/W	R/W		
0x2001	0	PDV InA, process value of flow measuring	0 … $2^{14} – 1$	R	R	R		
0x2002	0	PDV InB, process value of temperature measuring [2) 3)]	0 … $2^{14} – 1$	R	R	R		
0x2003	0	PDV InC, process value of volume impulse	0 … $2^{32} – 1$	R	R	R	4	UInteger32
0x2004	0	PDV InD, process value of volume recorder	0 … $2^{32} – 1$	R	R	R		
0x2005	0	Min PDV InA, minimal measured flow value	0 … $2^{14} – 1$	R	R	R	2	UInteger16
0x2006	0	Max PDV InA, maximal measured flow value	0 … $2^{14} – 1$	R	R	R		
0x2007	0	Min PDV InB, minimal measured temperature value [2) 3)]	0 … $2^{14} – 1$	R	R	R		
0x2008	0	Max PDV InB, maximal measured temperature value [2) 3)]	0 … $2^{14} – 1$	R	R	R		
0x200D	0	Average PDV InA, flow value filtered additionally by display filter	0 … $2^{14} – 1$	R	R	R		
0x200E	0	Time of volume recording since its last reset/power-on	0 … $2^{32} – 1$ sec	R	R	R	4	UInteger32
0x200F	0	Time of volume recording in error state of flow measurement since last reset/power-on	0 … $2^{32} – 1$ sec	R	R	R		

1) Authorisation group: U = user, M = maintenance, S = specialist; access: R = read, R/W = read and write, – = no access

2) not for SFAW-..-PNLK-PNVBA (variants without temperature option, 2 Outputs)

3) not for SFAW-..-PNLK-PN-VBA (variants without temperature option, 3 Outputs)

4) not for SFAW-..T-..-PNLK-PNVBA (variants with temperature option, 2 Outputs)

5) not for SFAW-..T-..-PNLK-PN-VBA (variants with temperature option, 3 Outputs)

Table 3.8: Device specific parameters

3.3.6 Block parameterization

With this feature the sending of invalid parameters to a device can be prevented. Individually sent parameter values are possibly not compatible to the parameter values already stored in the device. The parameters transmitted as a block will be simultaneously accepted and activated.

For SFAW there are five blocks of parameters:

Block parameterization for **BDC1** (OutA)

Index	Sub-Index	Name
0x003C	1	Setpoint SP1
	2	Setpoint SP2
0x003D	2	Switchpoint mode
	3	Hysteresis

Table 3.9: Block of OutA coherent parameters

Block parameterization for **BDC2** (OutB)

Index	Sub-Index	Name
0x003E	1	Setpoint SP1
	2	Setpoint SP2
0x003F	2	Switchpoint mode
	3	Hysteresis

Table 3.10: Block of OutB coherent parameters

Block parameterization for **BDC3** (OutC)

Index	Sub-Index	Name
0x4000	1	Setpoint SP1
0x0149	0	OutC impulse length

Table 3.11: Block of OutC coherent parameters

Block parameterization for **BDC4** (OutD)

Index	Sub-Index	Name
0x4002	1	Setpoint SP1
	2	Setpoint SP2
0x4003	2	Switchpoint mode
	3	Hysteresis

Table 3.12: Block of OutD coherent parameters

Block parameterization for **analog output**

Index	Sub-Index	Name
0x0183	0	Scaling of analog output to input range start value
0x0184	0	Scaling of analog output to input range end value

Table 3.13: Block of analog output coherent parameters

Note

- The following table show the Bits and Bytes based on the IO-Link Standard, with Motorola Byte order! Big-Endian
- If you use PLC controller with other Byte order, the program have to convert the Bytes into the correct order of the particular controller. Respect the MSB and LSB indicator in the table.

3.4 Process Data IN

Process Data IN for variants with temperature option

Bit	**39**	**38**	**37**	**36**	**35**	**34**	**33**	**32**	**31**	**30**	**29**	**28**	**27**	**26**	**25**	**24**
Significance	not used		MSB													LSB
Process data			PDV Flow													
Data content			14-bit measured value (InA)													
Index			0x0028													
Sub-Index			1													
Data type			UInteger14													

Bit	**23**	**22**	**21**	**20**	**19**	**18**	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**
Significance	not used		MSB													LSB
Process data			PDV Temperature													
Data content			14-bit measured value (InB)													
Index			0x0028													
Sub-Index			2													
Data type			UInteger14													

Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Process data	not used				BDC4	BDC3	BDC2	BDC1
Data content					OutD	OutC	OutB	OutA
Index					0x0028			
Sub-Index					3	4	5	6
Data type					Boolean			

Table 3.14: Process data mapping for SFAW-..T-...

Process Data IN for variants without temperature option

Bit	**23**	**22**	**21**	**20**	**19**	**18**	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**
Significance	not used		MSB													LSB
Process data			PDV Flow													
Data content			14-bit measured value (InA)													
Index			0x0028													

Sub-Index		1
Data type		UInteger14

Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Process data	not used					BDC4	BDC3	BDC1
Data content						OutD	OutC	OutA
Index						0x0028		
Sub-Index						2	3	4
Data type						Boolean		

Table 3.15: Process data mapping for SFAW-..-...

Note

- The table in chapter 3.5 show the conversion factors, for the calculation of the desired measuring value.

3.5 Conversion factors for the parameters ProcessDataVariable, ProcessDataVariable Min, ProcessDataVariable Max, and Setpoints SP1, SP2, Hysteresis

The conversion factors, necessary for the correct representation of the measurement values and the switching points in different physical units in the control unit, are:

Range		**Flow Units**			
[l/min]		**l/min**	**l/h**	**ft³/min**	**US gal/min**
0 ... 15	Gradient	0,000915583	0,054934994	0,0000323335	0,000241871
	Offset	0	0	0	0
0 ... 32	Gradient	0,001953244	0,117194653	0,0000689782	0,000515993
	Offset	0	0	0	0
0 ... 15	Gradient	0,003051944	0,183116645	0,000107778	0,000806238
	Offset	0	0	0	0
0 ... 100	Gradient	0,006103888	0,366233291	0,000215557	0,001612477
	Offset	0	0	0	0

Table 3.16: Conversion factors for flow range units

Value type		**Temperature Units**	
		°C	**°F**
Process value	Gradient	0,006103888	0,010986999
	Offset	0	32
Hysteresis	Gradient	0,006103888	0,010986999
	Offset	0	0

Table 3.17: Conversion factors for temperature units

Range		**Volume Units**			
[l/min]		**l**	**m³**	**ft³**	**US gal**
0 ... 15	Gradient	0,000915583	0,000000915583	0,0000323335	0,000241871
	Offset	0	0	0	0
0 ... 32	Gradient	0,001953244	0,00000195324	0,0000689782	0,000515993
	Offset	0	0	0	0
0 ... 15	Gradient	0,003051944	0,00000305194	0,000107778	0,000806238
	Offset	0	0	0	0
0 ... 100	Gradient	0,006103888	0,00000610389	0,000215557	0,001612477
	Offset	0	0	0	0

Table 3.18: Conversion factors for volume units

3.6 Diagnosis

Event Codes	Event Type	Mode	Device Status	Local Indication	Possible cause	Remedy
0x1802	Error	(Dis)appear	Failure	Display: Er02 Subdisplay: ASIC	IO-Link driver failure	Device exchange
0x1808	Error	(Dis)appear	Out-of-Specification	Display: "----" Subdisplay: Er08/FLOW	Instability in the flow is detected	Secure laminary flow and flow measuring range
0x1815	Error	(Dis)appear	Out-of-Specification	Display: Measured Value /Pin4 Subdisplay: Er21 / SHRt	Short circuit at the switching output pin 4	Eliminate short circuit
0x1816	Error	(Dis)appear	Out-of-Specification	Display: Measured Value /Pin2 Subdisplay: Er22 / SHRt	Short circuit at the switching output pin 2	Eliminate short circuit
0x180A	Warning	(Dis)appear	Out-of-Specification	Display: Measured Value /OVER Subdisplay: Er10 / FLOW	Flow rate measuring range exceeded	Comply with flow measuring range
0x180B	Error	(Dis)appear	Out-of-Specification	Display: Measured Value /UNDR Subdisplay: Er11 / tEMP	Temperature measuring range of the operating medium fallen below	Comply with temperature measuring range
0x180C	Error	(Dis)appear	Out-of-Specification	Display: Measured Value /OVER Subdisplay: Er12 / tEMP	Temperature measuring range of the operating medium exceeded	Comply with temperature measuring range
0x181F	Warning	Single shot	Device is operating properly	Display: Measured Value /Pin2 Subdisplay: Operate properly	InD, overflow of counter of volume recorder	
0x4000	Error	(Dis)appear	Failure	Display: Measured Value Subdisplay: Er20/ tEMP	Temperature fault in IO-Link driver	Eliminate short circuit or overload
0x5000	Error	(Dis)appear	Failure	Display: Er01 Subdisplay: FAIL	Device hardware fault	Device exchange
0x5100	Error	(Dis)appear	Failure	Display: Measured Value Subdisplay: Er17 / SUPL	Supply voltage under-run	Check power supply availability or tolerance

Table 3.19: Supported errors and warnings

3.7 I-Port

I-Port is an internal technology for automatically identification of Festo devices on I-Port compatible master.

Index	Name	Default Value	Length (byte)
0x40	Device Attributes	0x00	1
0x41	Extended Parameters	0x0000	2
0x42	Diagnosis Parameter	0x0000	2
0x43	Device Specific Parameters	➔ *Table 3.21:*	8
0xFE	I-Port Revision	0x0100	2

Table 3.20: Supported I-Port Indexes

Byteorder	1	2	3	4	5	6	7	8
IO-Link Index	0x003C				0x003D			
Subindex	1		2		1	2	3	
Function	SP1		SP2		logic	mode	HY	
Byte	high	low	high	low	-	-	high	low
Default value	➔ *3.3.3 Smart Sensor Profile parameters*							

Table 3.21: Mapping of Smart Sensor Profile Indexes on I-Port parameter 0x43