microsonic

IO-Link accompanying document for

esf-1/CF/A
esf-1/CDF/A
esf-1/7/CDF/A
esf-1/15/CDF/A

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MV-DO-198513-788128

1 Contents of the IO-Link accompanying document

This IO-Link accompanying document guides the user during start-up and parametrisation of the ultrasonic label and splice sensor. It does **not** replace the operating manual enclosed with the ultrasonic sensor. The safety notes and descriptions of installation and start-up contained in the operating manual require compliance.

2 IO-Link in detail

IO-Link is a fieldbus-independent, manufacturer-independent and neutral communication standard which enables seamless communication through all levels of the system architecture down to the sensor.
The IO-Link interface provides direct access to process, service and diagnostic data. The sensor can be parametrised during operation.

Structure of an IO-Link system
An IO-Link system consists of IO-Link devices – usually sensors, actuators or combinations thereof – and a standard 3-wire sensor/actuator cable and an IO-Link master.

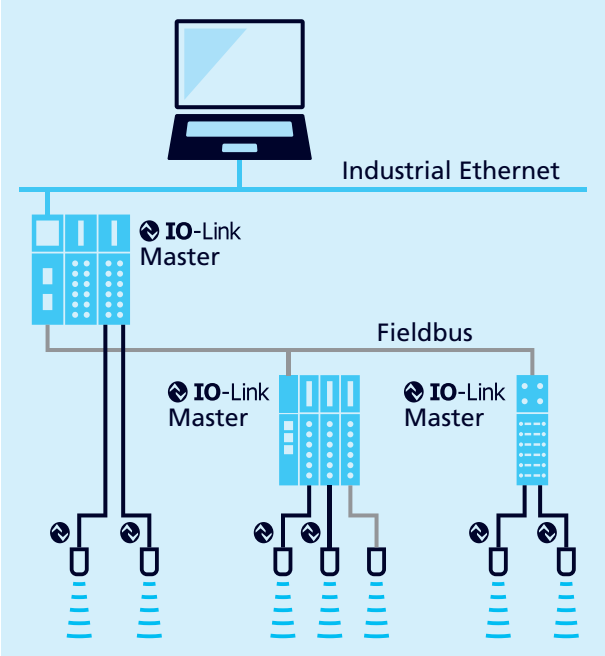


Fig. 1: Structure of an IO-Link system

IODD description file
Each IO-Link-capable sensor has a device-specific description file, the IODD (IO Device Description). The IODD contains parameters in a standardised form and can describe several sensor versions. The parameters included are:

- Communication properties
- Device parameters with permissible and pre-set values
- Identification, process and diagnostic data
- Device data
- Text description
- Product image
- Manufacturer's logo

The current IODD library and information on start-up and parametrisation can be downloaded here: microsonic. de/Service/IO-Link IODD Library.

3 Description of the sensor

Ultrasonic label and splice sensor
A label sensor has the task to detect labels glued to a backing material. For this purpose, the label sensor evaluates the signal level difference between the backing material and the backing material with labels.
A splice sensor has the task to detect a splice in a web material. The end and beginning of the web material can be joined together as a splice and glued with an adhesive tape, or can be glued overlappingly. For this purpose, the splice sensor evaluates the signal level difference between the web material and the splice.

Teach-in
The signal differences between backing material and backing material with labels or web material and splice can be very slight. To ensure a reliable distinction, the label as well as the splice sensor has to learn each respective material: During the Teach-in procedure, the ultrasonic transmitter output and ampflification factor of the internal analog amplifier will be adjusted to the backing material of the labels or the web material. The determined parameters are then stored in the parameter material adjustment. The thresholds to detect labels and splices are then calculated and stored in SP1 and SP2. The parameters are newly determined with each Teach-in procedure.
The Teach-in procedure can be carried out manually with the button on the label and splice sensor or with pin 5 via the controls.

Parametrisation via IO-Link
Many parameters of the sensor are accessible via IO-Link. The parameter can be read or even partly written. The parameters can be read out to set up a recipe management. Optionally, Teach-in procedures via button or pin 5 can be started with IO-Link.
The label and splice sensor has to be calibrated to every material via the Teach-in procedures. For data storage or recipe management, the material-specific parameters can be read out and written back. It is not recommendable to change the determined parameters via IO-Link afterwards.

Fig. 2: Ultrasonic label and splice sensor esf-1

esf-1/CF/A
› 1x push-pull switching output
› IO-Link interface
› fork depth: 70 mm

esf-1/CDF/A
› 1x pnp switching output
› 1x push-pull switching output
› IO-Link interface
› fork depth: 70 mm

esf-1/7/CDF/A
› 1x pnp switching output
› 1x push-pull switching output
› IO-Link interface
› fork depth: 86 mm

esf-1/15/CDF/A
› 1x pnp switching output
› 1x push-pull switching output
› IO-Link interface
› fork depth: 165 mm

The esf-1 sensors are IO-Link-capable in accordance with IO-Link specification V1.1 and have an IO-Link communication interface on pin 4 (see Fig. 3 and Fig. 4).

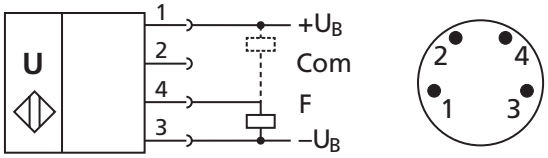


Fig. 3: Connection diagram esf-1/CF/A

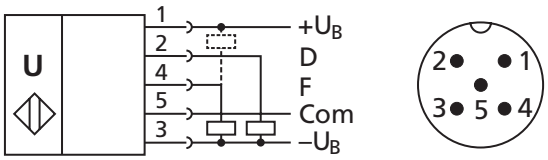


Fig. 4: Connection diagram esf-1/CDF/A; esf-1/7/CDF/A; esf-1/15/CDF/A

4 IO-Link data of the sensor

Device profile

0x0001	Smart Sensor
0x000A	Digital messender Sensor

Function Class

0x8000	Device Identifikation
0x8001	Binary Data Channel (SSC)
0x8003	Device Diagnosis
0x8004	Teach-in Commands
0x800A	Measurement Data Channel, (standard resolution)

Physical layer

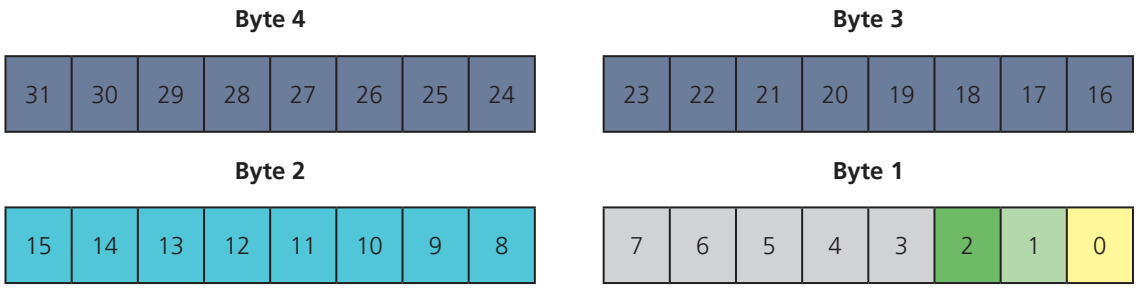
Vendor Name	microsonic GmbH
Vendor ID	419 (0x01a3)
IO-Link Revision	1.1.2
Transmission Rate	38400 bit/s (COM2)
Process data length	32 Bit PDI
IO-Link port type	A (<200 mA)
SIO mode	Yes
Smart sensor profile	Yes
Block-Parameter	Yes
Data Storage	Yes

Table 1: IO-Link sensor data

	esf-1/CF/A	esf-1/CDF/A	esf-1/7/CDF/A	esf-1/15/CDF/A
Device ID	73 (0x000049)	72 (0x000048)	72 (0x000048)	72 (0x000048)
Product ID	16951	16950	16953	16952
Minimum Cycle Time	4 ms	4 ms	4 ms	4 ms

4.1 Process data

The process data is cyclically transmitted data. The process data length of the esf-1 sensors is 4 bytes.



		Designation	Value range
0	=	Switch signal channel 1 (SSC1) state	0 = False 1 = True
1	=	Switch signal channel 2 (SSC2) state	0 = False 1 = True
2	=	Web break	0 = False 1 = True
8-15	=	Process data scale	–1
16-31	=	Process data value	0-32,000 = Measurement value 32,764 = No measurement data –32,760 = Out of measuring range (–) 32,760 = Out of measuring range (+)

Fig. 5: Process data structure

4.2 Measurement data channel description

Lower limit
The »lower limit« is the smallest measured value that the sensor can output.

Upper limit
The »upper limit« is the largest measured value that the sensor can output.

Unit code
The measured value has no dimension. The unit code is based on the official IO-Link unit code: esf-1 = 0. No unit is transferred with this.

Scale
The scaling of the process data. The specified measured value of the sensor is calculated from

Process data value x $10^{(scale)}$ x [unit code]
= measuring value in mm
Example: 642 x $10^{(-1)}$ x [mm] = 64.2 mm

Table 2: IO-Link parameter – Measurement data channel description

Index	Subindex	Designation	Format	Access	Factory setting
16512	0	Measurement data channel description	Record		
	1	Lower limit	Int32	RO	0
	2	Upper limit	Int32	RO	1,023
	3	Unit code	Int16	RO	0
	4	scale	Int8	RO	–1

5 Teach-in

Standard command
The Standard command is used to execute application commands, Teach-in commands and IO-Link specific commands.

Teach-in channel
The target channel of the Teach-in can be selected via this index. SSC1 can be parameterised.

Teach-in status
The Teach-in status indicates the state of the current adjustment.

Splice threshold
The threshold value for the splice is the percentage reduction on SP1, see description Switch Signal Channel (SSC), and the percentage surcharge on SP2, see description SSC. To detect a splice, the measuring value has to be below or above the value of the splice threshold. After changing the splice threshold, the Teach-in procedure for the splice sensor has to be started again.

Teach-in type
0 = Label dynamic
The backing material with labels must be guided through the fork at a constant speed. With this Teach-in type, the parameters for backing material and backing material with labels are determined and stored in SSC1 and in material adjustment. In addition, the threshold values are determined and stored in SSC2 for optional splice evaluation.

1 = Label static
With this static Teach-in for labels, the sensor first learns the backing material, then the backing material with label. The calculated parameters are stored in SSC1. In addition, the threshold values are determind and stored in SSC2 for optional splice evaluation.

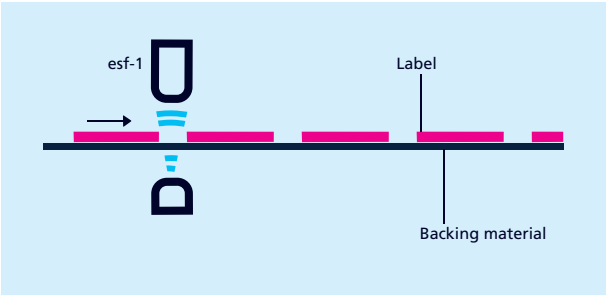


Fig. 6: esf-1 as label sensor

2 = Splice
The web material is guided through the fork at a constant speed. The parameters for the backing material are determined and stored in the parameter material adjustment as well as in SSC1 and SSC2.

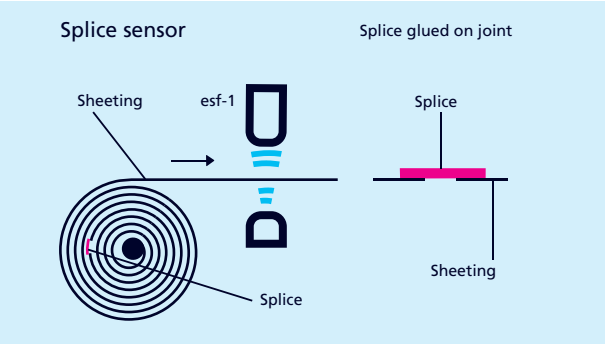


Fig. 7: esf-1 as splice sensor

Material adjustment
The parameter material adjustment is the hardware-specific adjustment from a previous Teach-in procedure. The material adjustment is sensor-specific and should not be transmitted from one sensor to another.
The parameter material adjustment can be used together with the settings of SSC1, SP1 and SP2 as well as SSC2, SP1 and SP2 to create a material management for this sensor. If the material adjustment does not match the sensor or was not generated by the sensor, a warning event (36003) is set by the sensor. This event will not be cancelled until the parameter material adjustment matches the sensor again.

Table 3: IO-Link parameter – Teach-in

Index	Subindex	Designation	Format	Access	Factory setting	Value range
2		Standard Command	UInt8	WO		75 = Teach-in start 76 = Teach-in next step/end 79 = Teach-in cancel
58		Teach-in channel	UInt8	RW	0	0 = SSC1: Default: pin 4 (Push-Pull) 1 = SSC1: pin 4 (Push-Pull)
59		Teach-in status	UInt4	RO	0	Bit 0...3: 0 = Idle 1 = SP1 success 2 = SP2 success 3 = SP12 success 4 = Wait for command 5 = Busy 7 = Error
400	0	Teach-in configuration	Record			
	1	Splice threshold	UInt8	RW	20	5...50, resolution in %
	2	Teach-in type	UInt8	RW	0	0 = Label dynamic 1 = Label static 2 = Splice
500		Material adjustment	UInt32	RW		

5.1 Teach-in – procedure for Teach-in initiated by the master

5.1.1 Teach-in type label dynamic

Initialisation

1. In parameter »Teach-in type« (Index 400.2) write the value 0 for „Label dynamic".
2. Insert backing material with labels into the fork.

Teach-in procedure

1. Move the backing material with labels through the fork at approx. 100 to 200 mm/sec.
2. Write the value 75 for „Teach-in start" in parameter »Standard command« (index 2).
3. Read out the parameter »Teach-in status« (index 59).

➔ If the parameter »Teach-in status« (index 59) contains the value 5, repeat step 3 after a waiting time of e.g. 3 s.

➔ If the parameter »Teach-in status« (index 59) contains the value 1, the procedure is successfully completed.

◆ Ready, ignore subsequent steps.

➔ If the parameter »Teach-in status« (index 59) contains the value 7, the Teach-in procedure was not successful.

◆ Abort, start again at step 1.

➔ If the parameter »Teach-in status« (index 59) still contains the value 5 after a time to be defined (e.g. 10 seconds), continue with step 4.

4. Write the value 79 for „Teach-in abort" in parameter »Standard command« (index 2).
   The sensor aborts the adjustment.

◆ Abort, start again at step 1.

5.1.2 Teach-in type label static

Initialisation

1. In parameter »Teach-in type« (index 400.2) write the value 1 for „static label".
2. Place 5 to 30 cm of backing material without labels in the fork.

Teach-in procedure

1. Write the value 75 for „Teach-in start" in parameter »Standard command« (index 2).
2. Move the backing material in the fork slowly back and forth over the length at least 3 times (this makes it easier to compensate for the inhomogeneity of the material). This procedure must take at least 3 seconds.
3. Write the value 76 for „Teach-in next step/end" in parameter »Standard command« (index 2).
4. Place the backing material with labels in the fork. Make sure that the fork now measures a label in the middle.
5. Write the value 76 for „Teach-in next step/end" in parameter »Standard command« (index 2).
6. Move the label in the fork slowly back and forth over the label length at least 3 times (this makes it easier to compensate for the inhomogeneity of the material). Make sure that only the label and not the edge of the label is measured.
7. Write the value 76 for „Teach-in next step/end" in parameter »Standard command« (index 2).
8. Read the parameter »Teach-in status« (index 59).

➔ If the parameter »Teach-in status« (index 59) contains the value 1, the Teach-in procedure is successfully completed.

◆ Ready, ignore subsequent steps.

➔ If the parameter »Teach-in status« (index 59) contains the value 7, the Teach-in procedure was not successful.

◆ Abort, start again at step 1.

5.1.3 Teach-in type splice

Initialisation

1. In parameter »Teach-in type« (index 400.2) write the value 2 for „splice".
2. Select the value for the splice threshold in parameter »splice threshold« (index 400.1). The recommended default value is 20 %.
3. Insert web material without splice into the sensor.

Teach-in procedure

1. Write the value 75 for „Teach-in start" in parameter »Standard command« (index 2).
2. Move the web material slowly through the fork, depending on the material, 20 cm (plastic foils) to 2 m (recycled paper); this makes it easier to compensate for the inhomogeneity of the material. The procedure must take at least 3 seconds.
3. Write the value 76 for „Teach-in next step/end" in parameter »Standard command« (index 2).
4. Read out the parameter »Teach-in status« (Index 59).

➔ If the parameter »Teach-in status« (Index 59) contains the value 1, the Teach-in procedure is successfully completed.

◆ Ready, ignore subsequent steps.

➔ If the parameter »Teach-in status« (Index 59) contains the value 7, the Teach-in procedure was not successful.

◆ Abort, start again at step 1.

5.2 Teach-in method and controls

The esf-1 sensor has the following controls:
› Button
› Control input Com on pin 2 for esf-1/CF/A
› Control input Com on pin 5 for esf-1/CDF/A; esf-1/7/CDF/A; esf-1/15/CDF/A

Teach-in input
Specific input options can be switched off via the «Teach-in input» parameter.

esf-1/CF/A:
› 0 = Inactive/manual setting deactivated
› 1 = Button and pin 2 active
› 2 = Only pin 2 active
› 3 = Only button activev

esf-1/CDF/A, esf-1/7/CDF/A, esf-1/15/CDF/A:
› 0 = Inactive/manual setting deactivated
› 1 = Button and pin 5 active
› 2 = Only pin 5 active
› 3 = Only button activev

Manual Teach-in method and QuickTeach
The selection of the Teach-in mode facilitates the manual Teach-in of the sensor. If the sensor is only used for one operating mode (label or splice) you can use QuickTeach to set a simplified Teach-in, which you must activate and define once.
The QuickTeach label sensor corresponds to the Teach-in type Label dynamic (Index 400.2 = 0).
The QuickTeach splice sensor corresponds to the Teach-in type splice (Index 400.2 = 2).
› 0 = Standard Teach-in methods
› 1 = QuickTeach label sensor
› 2 = QuickTeach splice sensor

LED mode
The esf-1 sensor has the following display elements:
› LED red, LED green, LED yellow
The LEDs can be switched off in normal operation and only temporarily activated for a Teach-in. In Find me! operation, all LEDs of the sensor flash simultaneously. This helps to locate the sensor in a machine.
› 0 = Inactive
› 1 = Active
› 4 = Find me!

5.3 Teach-in feedback mode

Teach-in feedback is intended for QuickTeach in SIO mode.

esf-1/CF/A:
If the controller initiates a QuickTeach in SIO mode via pin 2 (or if the button is pressed), the controller can query at pin 4 whether this Teach-in was successful (see Fig. 8, marking A).
If QuickTeach is successfully performed via pin 2 (or button), output pin 4 will be set for 300 ms 200 ms after the end of this process (see Fig. 8, marking B).
› 0 = Inactive
› 3 = Feedback on pin 4

esf-1/CDF/A, esf-1/7/CDF/A, esf-1/15/CDF/A:
If the controller initiates a QuickTeach in SIO mode via pin 5 (or if the button is pressed), the controller can query at pin 2 and/or pin 4 whether this Teach-in was successful (see Fig. 8, marking A).
If QuickTeach is successfully performed via pin 5 (or the key), output pin 2, pin 4 or both will be set for 300 ms 200 ms after the end of this process (see Fig. 8, marking B).
› 0 = Inactive
› 1 = Feedback on pin 2 and pin 4
› 2 = Feedback on pin 2
› 3 = Feedback on pin 4

This function is activated with the parameter Teach-in feedback mode (Index 372.1).

QuickTeach label sensor
Simplified Teach-in procedure in SIO mode. The sensor carries out the Teach-in procedure until the material has been successfully taught. The Teach-in feedback is available afterwards.

QuickTeach splice sensor
Simplified Teach-in procedure in SIO mode. The sensor performs the Teach-in procedure while the button is pressed or Com is connected to $+U_B$. The Teach-in feedback is available as soon as the button is released or Com is disconnected from $+U_B$.

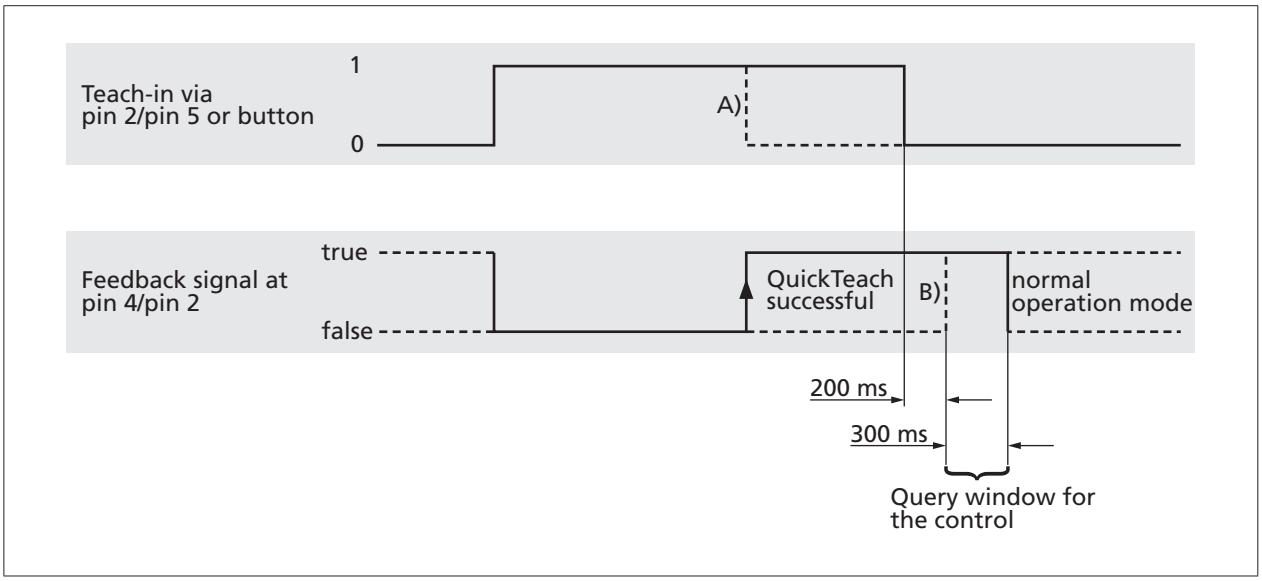


Fig. 8: Signal progression for Teach-in feedback mode

Table 4: IO-Link parameter – Controls

Index	Subindex	Designation	Format	Access	Factory setting	Value range
370	0	**esf-1/CF/A:** Button and pin 2 **esf-1/CDF/A, esf-1/7/CDF/A, esf-1/15/CDF/A:** Button and pin 5	Record			
	1	Teach-in input	UInt8	RW	1	**esf-1/CF/A:** 0 = Inactive 1 = Button and pin 2 active 2 = Only pin 2 active 3 = Only Button active **esf-1/CDF/A, esf-1/7/CDF/A, esf-1/15/CDF/A:** 0 = Inactive 1 = Button and pin 5 active 2 = Only pin 5 active 3 = Only Button active
	2	Manual Teach-in method	UInt8	RW	0	0 = Standard Teach-in methods 1 = QuickTeach label sensor 2 = QuickTeach splice sensor
371	0	LED	Record			
	1	Mode	UInt8	RW	1	0 = Inactive 1 = Active 4 = Find me!
372	0	Teach-in Feedback	Record			
	1	Mode	UInt8	RW	0	**esf-1/CF/A:** 0 = Inactive 3 = Feedback on pin 4 **esf-1/CDF/A, esf-1/7/CDF/A, esf-1/15/CDF/A:** 0 = Inactive 1 = Feedback on pin 2 and pin 4 2 = Feedback on pin 2 3 = Feedback on pin 4

6 Switch Signal Channel

The esf-1 sensor has two switch signal channels, SSC1 and SSC2:

Sensor	SSC1	SSC2
esf-1/CF/A	•	
esf-1/7/CDF/A	•	•
esf-1/CDF/A	•	•
esf-1/15/CDF/A	•	•

The switch signal channels contain the values for the switching points SP1 and SP2, the setting of the switching output logic, the definition of the switching mode and the values for the switch-off delay.

SP1, Setpoint 1 and SP2, Setpoint 2
SP1 and SP2 are the threshold levels to detect label and splice. These threshold values are determined by a Teach-in procedure.

Mode
is selected by the Teach-in type and can optionally be changed later. The special functions „Web break", „Missing label" and „Mismatched label length" are available for SSC2, which can only selected via IO-Link.

0 = Outpt deactivated
The switching output is deactivated and is not set.

1 = Only lower threshold (SP1) (label/splice)
If the measured value of the sensor is below the value of SP1, the output is set. SP2 is not used in this evaluation. This is the default setting for scanning labels.

2 = Both thresholds (SP1 and SP2) (splice)
If the measured value of the sensor is below the value of SP1 and above the value of SP2, the output is set. This is the default setting for detecting a splice.

130 = Only upper threshold (SP2) (splice)
If the measured value of the sensor is above the value of SP2, the output is set.

132 = Web break (nur SSC2)
The output is set as soon as the sensor detects a web break.

134 = Missing label (nur SSC2)
The output is set if the sensor detects a missing label. The prerequisite for this is a constant material flow at a constant speed.

135 = Mismatched label length (nur SSC2)
The output is set if the sensor detects a faulty label (± 50 % of the usual length). The prerequisite for this is a constant material flow at a constant speed.

Logic SSC1
› 0 = High active
State output set = $+U_B$
› 1 = Low active
State output set = $–U_B$

Logic SSC2
› 0 = Normally open
State output set = $+U_B$
› 1 = Normally closed
State output set = $–U_B$

Switch-off delay
The switch-off delay specified as the number of measurement repetition rate extends the status output set. The measurement repetition rate is dependent on scanned material. With the same switch-off delay, but with different materials, the real switch-off delay varies in ms.

6.1 Switch Signal Channel SSC1

Table 5: IO-Link parameter – Switch Signal Channel SSC1

Index	Subindex	Designation	Format	Access	Factory setting	Value range
60	0	SSC1 parameter	Record			
	1	SP1	Int16	RW	300	0...1,023; resolution in 0.1
	2	SP2	Int16	RW	508	0...1,023; resolution in 0.1
61	0	SSC1 configuration	Record			
	1	Logic	UInt8	RW	0	0 = High active 1 = Low active
	2	Mode	UInt8	RW	1	0 = Output deactivated 1 = Only low threshold (SP1) (label/splice) 2 = Both thresholds (SP1 and SP2) (splice) 130 = Only high threshold (SP2) (splice)
100	0	SSC1 advanced configuration	Record			
	2	Switch-off delay	UInt8	RW	0	0…255, resolution in cycletime

6.2 Switch Signal Channel SSC2

Available only at esf-1/CDF/A, esf-1/7/CDF/A, esf-1/15/CDF/A

Table 6: IO-Link parameter – Switch Signal Channel SSC2

Index	Subindex	Designation	Format	Access	Factory setting	Value range
62	0	SSC2 parameter	Record			
	1	SP1	Int16	RW	300	0...1,023; resolution in 0.1
	2	SP2	Int16	RW	508	0...1,023; resolution in 0.1
63	0	SSC2 ponfiguration	Record			
	1	Logic	UInt8	RW	0	0 = Normally open 1 = Normally closed
	2	Mode	UInt8	RW	132	0 = Output deactivated 1 = Only low threshold (SP1) (label/splice) 2 = Both thresholds (SP1 and SP2) (splice) 130 = Only high threshold (SP2) (splice) 132 = Web break 134 = Missing label 135 = Mismatched label length
101	0	SSC2 advanced configuration	Record			
	2	Switch-off delay	UInt8	RW	0	0…255, resolution in cycletime

7 Further settings via IO-Link

7.1 Synchronisation

If several esf-1 sensors are operated in a confined space, they can influence each other. To avoid this, the esf-1 sensors can be synchronised with each other. For this purpose, all Teach-in/Com control inputs must be connected to each other and mode 1 (= on) must be selected.

Table 7: IO-Link parameter – Synchronisation

Index	Sub-index	Designation	Format	Access	Factory setting	Value range
350	0	Synchronisation	Record			
	1	Mode	UInt8	RW	0	0 = off 1 = on

7.2 Temperature compensation

The sensor is equipped with an internal temperature sensor, which can compensate the temperature dependence of the amplitude loss in the air. Normally it is not necessary to activate temperature compensation. Only when the ambient temperature fluctuates by more than 20 °C in a short time should temperature compensation be switched on as an option.

Table 8: IO-Link parameter – Temperature compensation

Index	Sub-index	Designation	Format	Access	Factory setting	Value range
300	0	Temperature compensation	Record			
	1	Mode	UInt8	RW	1	0 = off 1 = on

7.3 Temperature

The sensor displays the current sensor temperature.

Table 9: IO-Link parameter – Temperature

Index	Sub-index	Designation	Format	Access	Factory setting	Value range
2000	0	Temperature	Record			
	1	Sensor Temperature	Int16	RO	200	–560...1,560, resolution in 0.1 °C

7.4 Measurement

Measurement repetition rate in SIO mode
The value indicates the repetition rate of the sensor when it is operated with the current material adjustment in SIO mode.

Measurement repetition rate in IO-Link mode
The value specifies the repetition rate under IO-Link. This depends on the master, which determines the time.

Quality of the last Teach-in
The quality of the Teach-in is a value to provide a direct comparison between several identical adjustment processes with the same material. The larger it is, the better the adjustment.

Table 10: IO-Link parameter – Measurement

Index	Sub-index	Designation	Format	Access	Factory setting	Value range
2001	0	Measurement	Record			
	1	Cycletime in SIO mode	UInt16	RO	30	30...195, resolution in 0.1 ms
	2	Cycletime in IO-Link mode	UInt16	RO	400	400...13,000, resolution in 0.1 ms
	3	Quality of the last Teach-in	UInt8	RO		0...255: 0 = low quality 255 = high quality

7.5 Identification

Vendor Name
The manufacturer's name contains the name of the manufacturer.

Vendor Text
The manufacturer's text contains the manufacturer's claim.

Product Name
The product name contains the designation of the sensor used.

Product ID
The product ID contains the article number of the sensor used.

Product Text
The product text describes the sensor used.

Serial Number
The serial number is determined by the manufacturer.

Firmware Version
The firmware version shows the firmware version of the application used by the manufacturer.

Application Specific Tag
The application-specific code can be used to store explanatory information about the sensor's application.

Table 11: IO-Link parameter – Identification

Index	Designation	Format	Access	Value range
16	Vendor Name	String	RO	microsonic GmbH
17	Vendor Text	String	RO	Unser Herz schallt ultra.
18	Product Name	String	RO	
19	Product ID	String	RO	
20	Product Text	String	RO	Ultrasonic sensor
21	Serial Number	String	RO	
23	Firmware Version	String	RO	
24	Application Specific Tag	String	RW	***

7.6 Returning to factory setting

If the value 130 is written in index 2, all parameters of the sensor are reset to the factory setting.

Table 12: IO-Link parameter – Standard Command - Restore Factory Settings

Index	Designation	Format	Access	Factory setting	Value range
2	Standard Command	UInt8	WO		130 = Restore Factory Settings

7.7 Parameter access and error codes

The sensor is cyclically requested by the master to communicate. With each communication the measured value is sent from the sensor to the master. Part of this communication is the Indexed Service Data Unit channel (ISDU channel). This channel is used to write or read data acyclically to the sensor. This means that writing or reading a parameter can take several communication cycles.

Each communication of the master via the ISDU channel is answered by the sensor. The sensor only processes a parameter after it has been fully transmitted. Parameters, diagnostic data, events and Standard commands are sent via this ISDU channel.
If the sensor discovers errors during parameter accessing, it reports these with corresponding error codes.

Table 13: IO-Link error codes

Error code		Description
decimal	hex	
0	0x0000	No error
32768	0x8000	Device application error – no details
32785	0x8011	Index not available
32786	0x8012	Subindex not available
32800	0x8020	Service temporarily not available
32801	0x8021	Service temporarily not available – local control
32802	0x8022	Service temporarily not available
32803	0x8023	Access denied
32816	0x8030	Parameter value out of range
32817	0x8031	Parameter value above limit
32818	0x8032	2 Parameter value below limit
32819	0x8033	Parameter length overrun
32820	0x8034	Parameter length underrun
32821	0x8035	Function not available
32822	0x8036	Function temporarily unavailable
32832	0x8040	Invalid parameter set
32833	0x8041	Inconsistent parameter set
32898	0x8082	Application not ready

7.8 Device Access Locks

The Device Access Locks are a specified IO-Link function. The parameter DeviceAccessLocks enables the control of the device behavior. Device functions can be deactivated via defined bits in this parameter.

Parameter write access
If this bit is set, write access to application parameters and some IO-Link specific parameters is disabled.

Local parametrisation
If this bit is set, the parameterisation is disabled via local operating elements such as button/pin 5 on the device.

Local User Interface
If this bit is set, use of the user interface on the device is disabled and the display is switched off.

Table 14: IO-Link parameter – Device Access Locks

Index	Designation	Format	Access	Factory setting	Value range
12	Device access locks	UInt16	RW	0	
	Bit 0: Parameter write access	Boolean	RW	0	0 = Unlocked 1 = Locked
	Bit 2: Local parametrisation	Boolean	RW	0	0 = Unlocked 1 = Locked
	Bit 3: Local User Interface	Boolean	RW	0	0 = Unlocked 1 = Locked

7.9 Events

Events are sent from the sensor to the master. This is done asynchronously via the ISDU channel of IO-Link. The master acknowledges these events in the sensor and stores them in the master memory. There a PLC can read out the events. Several events can be present simultaneously in the sensor. Events are divided into three types:

- **Notification** are for general information or non-critical states of the sensor and are sent each time the sensor state occurs again.
- **Warnings** indicate a possible functional limitation of the sensor. These events are present until the reason for the function restriction is eliminated or switched off.
- **Error** events indicate a sensor that is not functional. These events are present until the reason for the function restriction is removed or switched off.

Temperature fault
The operating temperature of the sensor has been significantly exceeded, the function cannot be guaranteed. The sensor may be damaged.

Device temperature over-run
The operating temperature of the sensor has be exceeded. A correct functioning of the sensor cannot be ensured.

Device temperature under-run
The operating temperature of the sensor has fallen below the minimum. A correct functioning of the sensor cannot to ensured.

Manual Teach-in is not successful
A Teach-in via button or pin 5 was executed and terminated incorrectly. The parameters have not changed.

Manual Teach-in is successful
A Teach-in via button or pin 5 was executed and successfully completed. The parameters have changed.

Material adjustment data record does not match the sensor
The transfered parameter material adjustment does not match with this sensor. The function of the sensor cannot be guaranteed.

Manual Teach-in is executed
At the sensor, a Teach-in is carried out via button or pin 5 (during a Teach-in procedure, the status of the outputs are frozen).

Table 15: IO-Link parameter – Events

Code		Type	Description
decimal	hex		
16384	0x4000	Error	Temperature fault
16912	0x4210	Warning	Device temperature over-run
16928	0x4220	Warning	Device temperature under-run
36000	0x8ca0	Notification	Manual Teach-in is not successful
36001	0x8ca1	Notification	Manual Teach-in is successful
36003	0x8CA3	Warning	Material adjustment data record does not match the sensor
36004	0x8CA4	Warning	Manual Teach-in is executed

7.10 Device status

Error count
The error count is incremented as soon as an error is detected in the sensor. The counter is set to 0 every time the operating voltage is switched on.

Device status
If no events can be read out or the sensor is switched from SIO mode into IO-Link mode and the sensor is still to be monitored, we recommend querying this variable cyclically. The device status shows the entire status of the sensor depending on the problem that has occurred.

Detailed device status
The detailed device status lists all active error messages and warnings until they are revoked by the sensor as soon as the reason has been rectified.

Table 16: IO-Link parameter – Device status

Index	Designation	Format	Access	Factory setting	Value range
32	UInt16	Error count	RO	0	0...65,535
36	UInt8	Device status	RO	0	0 = Device is OK 1 = Maintenance required 2 = Out of specification 3 = Functional check 4 = Failure
37	Array	Detailed device status	RO	0	

7.11 Data storage

The sensors support data storage according to IO-Link version 1.1. Data storage enables the master to store the entire parameter set of the sensor. If the sensor has to be replaced, the data set is loaded from the master into the replacement device. The data storage is completely controlled by the master and is a function of IO-Link to be configured in the master. Nothing has to be configured in the sensor.
The parameter material adjustment and SP1 as well as SP2 are hardware dependent. After exchanging a sensor it is recommended to carry out the material adjustment again.

Note
The configuration of the IO-Link master is decisive for the handling of the parameter set when storing data.
➔ **Comply with the specifications of the documentation and configuration of the IO-Link maste**

7.12 Block parameterisation

The block parameterisation is a specified IO-Link function. The use of this function is recommended if several parameters have to be changed simultneously. Each individual parameter write access is immediately implemented in the sensor. This also includes a consistency check against other parameters and immediate transfer to the application if the inspection is successful. If parameters are transferred in an unfavourable sequence, the consistency check may fail.

In block parameterisation, on the other hand, all parameters are first written and then the consistency check is performed for all transferred parameters. The parameters are only stored in the sensor if this consistency check was successful. This block parameterisation also applies analogously to reading out parameters.

Table 17: IO-Link parameter – Block parameterisation

Index	Designation	Format	Access	Factory setting	Value range
2	Standard Command	UInt8	WO		1 = ParamUploadStart 2 = ParamUploadEnd 3 = ParamDownloadStart 4 = ParamDownloadEnd 5 = ParamDownloadStore 6 = ParamBreak

8 Appendix: Overview IO-Link data

Index	Sub-index	Designation	Format	Access	Factory setting	Value range
2		Standard Command	UInt8	WO		1 = ParamUploadStart 2 = ParamUploadEnd 3 = ParamDownloadStart 4 = ParamDownloadEnd 5 = ParamDownloadStore 6 = ParamBreak 75 = Teach-in star 76 = Teach-in next step/end 79 = Teach-in abort 130 = Restore Factory Settings
12		Device access locks	Record	RW	0	
		Bit 0: Parameter write access	Boolean	RW	0	0 = Unlocked 1 = Locked
		Bit 2: Local parametrisa-tion	Boolean	RW	0	0 = Unlocked 1 = Locked
		Bit 2: Local User Interface	Boolean	RW	0	0 = Unlocked 1 = Locked
16		Vendor Name	String	RO	microsonic GmbH	
17		Vendor Text	String	RO	Unser Herz schallt ultra.	
18		Product Name	String	RO		
19		Product ID	String	RO		
20		Product Text	String	RO	Ultrasonic sensor	
21		Serial Number	String	RO		
23		Firmware Version	String	RO		
24		Application Specific Tag	String	RW	***	
32		Error count	UInt16	RO	0	0...65,535
36		Device status	UInt8	RO	0	0 = Device is OK 1 = Maintenance required 2 = Out of specification 3 = Functional check 4 = Failure
37		Detailed device status	Array	RO		
40		Process data input Bit 0: Switch signal channel 1 state Bit 1: Switch signal channel 2 state Bit 2: Web Break Bit 8-15: Process data scale Bit 16-31: Process data value	String Boolean Boolean Boolean Int8 Int16	RO		
58		Teach-in channel	UInt8	RW	0	0 = SSC1: Default: pin 4 (Push-Pull) 1 = SSC1: pin 4 (Push-Pull)
59		Teach-in state	UInt4	RO	0	Bit 0...3: 0 = Idle 1 = SP1 success 2 = SP2 success 3 = SP12 success 4 = Wait for command 5 = Busy 7 = Error

Index	Sub-index	Designation	Format	Access	Factory setting	Value range
60	0	SSC1 parameter	Record			
	1	SP1	Int16	RW	300	0...1,023, resolution in 0.1
	2	SP2	Int16	RW	508	0...1,023, resolution in 0.1
61	0	SSC1 configuration	Record			
	1	Logic	UInt8	RW	0	0 = High active 1 = Low active
	2	Mode	UInt8	RW	1	0 = Output deactivated 1 = Only low threshold (SP1) (label/splice) 2 = Both thresholds (SP1 and SP2) (splice) 130 = Only high threshold (SP2) (splice)
62 [1)]	0	SSC2 parameter	Record			
	1	SP1	Int16	RW	300	0...1,023, resolution in 0.1
	2	SP2	Int16	RW	508	0...1,023, resolution in 0.1
63 [1)]	0	SSC2 configuration	Record			
	1	Logic	UInt8	RW	0	0 = Normally open 1 = Normally closed
	2	Mode	UInt8	RW	132	0 = Output deactivated 1 = Only low threshold (SP1) (label/splice) 2 = Both thresholds (SP1 and SP2) (splice) 130 = Only high threshold (SP2) (splice) 132 = Web break 134 = Missing label 135 = Mismatched label length
100	0	SSC1 advanced configuration	Record			
	2	Switch-off delay	UInt8	RW	0	0...255, resolution in cycletime
101 [1)]	0	SSC2 advanced configuration	Record			
	2	Switch-off delay	UInt8	RW	0	0...255, resolution in cycletime
300	0	Temperature compensation	Record			
	1	Mode	UInt8	RW	0	0 = off 1 = on
350	0	Synchronisation	Record			
	1	Mode	UInt8	RW	0	0 = off 1 = on

[1)] only available with esf-1/CDF/A, esf-1/7/CDF/A, esf-1/15/CDF/A

Index	Sub-index	Designation	Format	Access	Factory setting	Value range
370	0	**esf-1/CF/A:** Button and pin 2 **esf-1/CDF/A, esf-1/7/CDF/A, esf-1/15/CDF/A:** Button and pin 5	Record			
	1	Teach-in input	UInt8	RW	1	**esf-1/CF/A:** 0 = Inactive 1 = Button and pin 2 active 2 = Only pin 2 active 3 = Only Button active **esf-1/CDF/A, esf-1/7/CDF/A, esf-1/15/CDF/A:** 0 = Inactive 1 = Button and pin 5 active 2 = Only pin 5 active 3 = Only Button active
	2	Manual Teach-in method	UInt8	RW	0	0 = Standard Teach-in methods 1 = QuickTeach label sensor 2 = QuickTeach splice sensor
371	0	LED	Record			
	1	Mode	UInt8	RW	1	0 = Inactive 1 = Active 4 = Find me!
372	0	Teach-in Feedback	Record			
	1	Mode	UInt8	RW	0	**esf-1/CF/A:** 0 = Inactive 3 = Feedback on pin 4 **esf-1/CDF/A, esf-1/7/CDF/A, esf-1/15/CDF/A:** 0 = Inactive 1 = Feedback on pin 2 and pin 4 2 = Feedback on pin 2 3 = Feedback on pin 4
400	0	Teach-in configuration	Record			
	1	Splice threshold	UInt8	RW	20	5...50, resolution in %
	2	Teach-in type	UInt8	RW		0 = label dynamic 1 = label static 2 = splice
500		Material adjustment	UInt32	RW		
2000	0	Temperature	Record			
	1	Sensor Temperature	Int16	RO	200	–560...1,560, resolution in 0.1 °C
2001	0	Measurement	Record			
	1	Cycletime in SIO mode	UInt16	RO	30	30...195, resolution in 0.1 ms
	2	Cycletime in IO-Link mode	UInt16	RO	400	400...13,000, resolution in 0.1 ms
	3	Quality of the last Teach-in	UInt8	RO		0...255: 0 = low quality 255 = high quality
16512	0	Measurement data channel description	Record			
	1	Lower limit	Int32	RO	0	
	2	Upper limit	Int32	RO	1,023	
	3	Unit code	Int16	RO	0	
	4	Scale	Int8	RO	–1	