IO-Link accompanying document for

esf+1/CFF/Pro
esf+1/CFF/Exp

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1 Contents of the IO-Link accompanying document

This IO-Link accompanying document guides the user during start-up and parameterisation of the ultrasonic 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 parameterised 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.

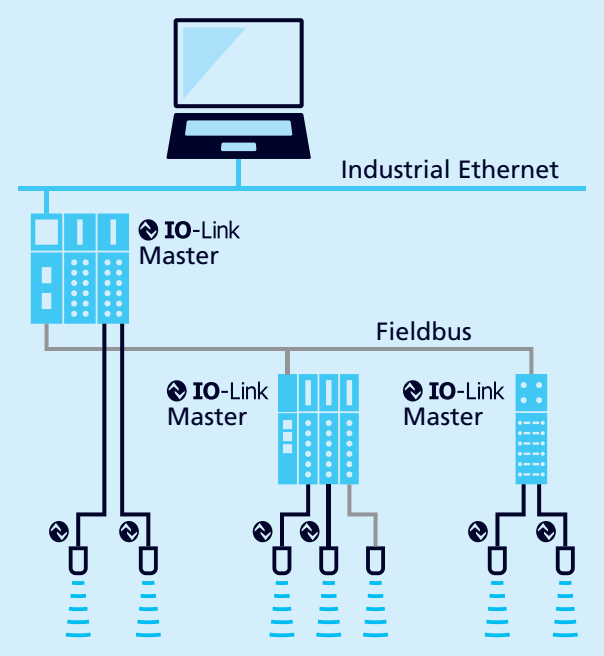


Fig. 1: Structure of an IO-Link system

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 parameterisation can be downloaded here: www.microsonic.de/IODD.

3 Description of the sensor

Ultrasonic label and splice sensor with two switching outputs with IO-Link interface

› esf+1/CFF/Pro
› esf+1/CFF/Exp

The fork houses a transmitter-receiver measuring section. The transmitter is located in the lower leg, and the receiver in the upper leg. The web material to be scanned is guided through the fork. The ultrasonic transmitter in the lower leg emits a fast sequence of pulses that causes the web material to vibrate, resulting in a significantly attenuated sound wave being emitted on the opposite side. The receiver in the upper leg of the fork receives these sound pulses and evaluates them.
The web material can be a carrier material with labels that need to be detected individually, or a continuous material with a splice that needs to be located.
The signal difference between the backing material and the labels, or between the web material and the splice, can be very small. To ensure reliable detection, the esf+1 sensor must therefore initially learn the signal level for the backing or web material.
A simple Teach-in method is available for both label sensor and splice sensor operation. In addition, labels can be programmed statically if necessary.

Fig. 2: esf+1 ultrasonic label and splice sensor

Die esf+1 Sensoren sind IO-Link-fähig gemäß Spezifikation V1.1 und unterstützen das Smart Sensor Profil »**Digital Measuring Sensor**«. Über IO-Link können die Sensoren überwacht und parametrisiert werden.

4 IO-Link data of the sensor

The esf+1 sensors are IO-Link-capable in accordance with specification V1.1. The sensor has an IO-Link communication interface on the black connection cable (see Fig. 3).

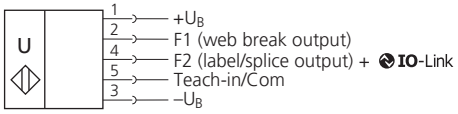


Fig. 3: Connection diagram of the esf+1 sensor

Device Profile

0x0010	Measuring Sensor
0x4000	Identification and Diagnosis
0x800c	Sensor Control
0x8101	Locator
0x8102	ProductURI
0x8103	Teach ReCommanded

Physical layer

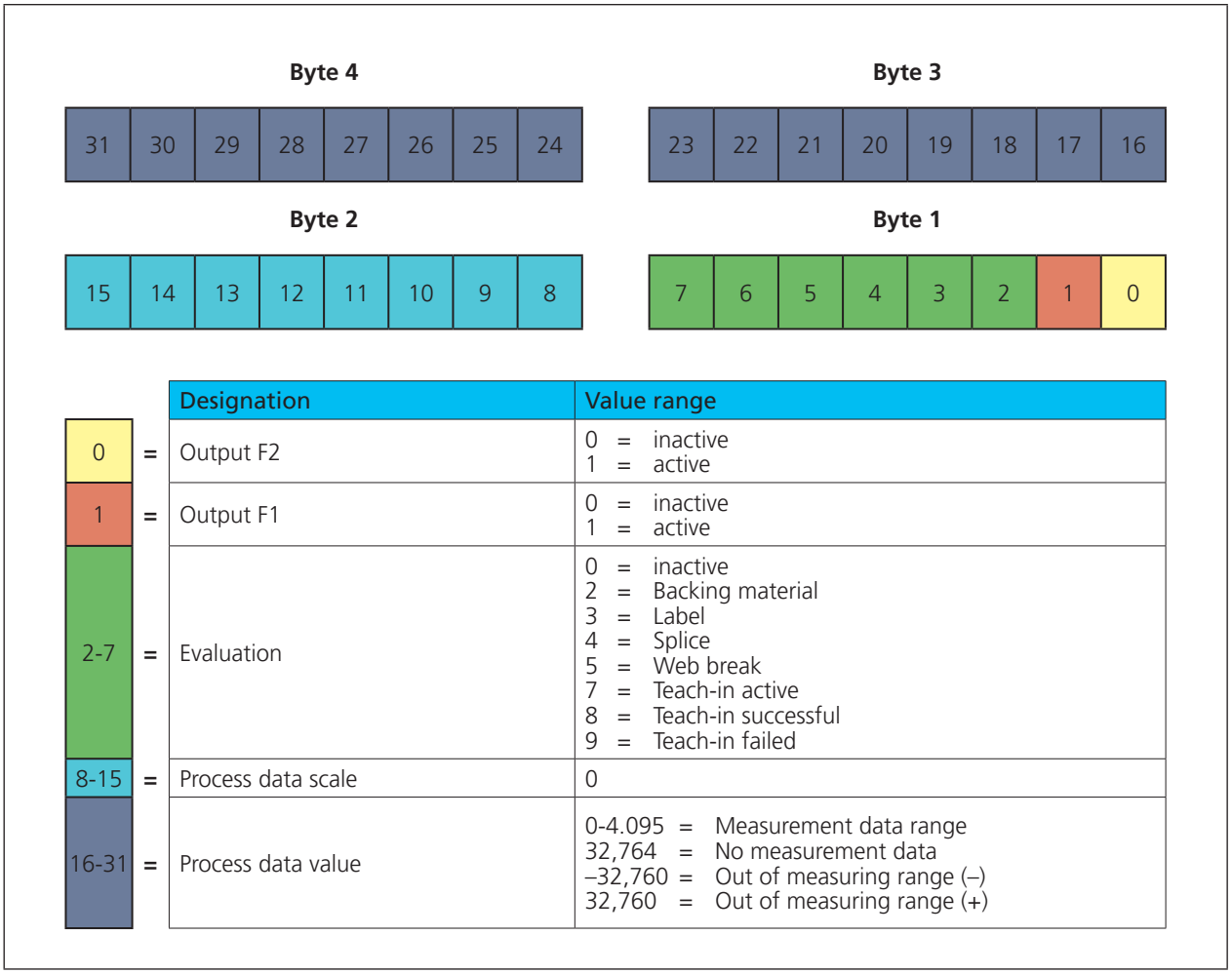
Vendor Name	microsonic GmbH
Vendor ID	419 (0x01a3)
IO-Link Revision	1.1.5
Transmission Rate	230.400 bit/s (COM3)
Process data length	32 Bit PDI + 8 Bit PDO
IO-Link port type	A (<200 mA)
SIO mode	Yes
Smart sensor profile	Yes
Block Parameter	Yes
Data Storage	Yes

Table 1: IO-Link sensor data

	esf+1/CFF/Pro	esf+1/CFF/Exp
Device ID	107	106
Product Name	esf+1/CFF/Pro	esf+1/CFF/Exp
Product ID	16955	16956
MinCycle Time	0.6 ms	0.6 ms

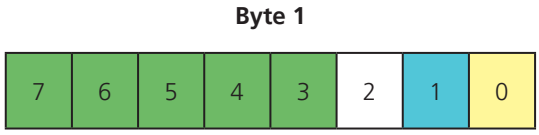
4.1 Process data

The process data is cyclically transmitted data. The PDI process data length of the sensors is 4 bytes, the PDO process data length is 1 Byte.



		Designation	Value range
0	=	Output F2	0 = inactive 1 = active
1	=	Output F1	0 = inactive 1 = active
2-7	=	Evaluation	0 = inactive 2 = Backing material 3 = Label 4 = Splice 5 = Web break 7 = Teach-in active 8 = Teach-in successful 9 = Teach-in failed
8-15	=	Process data scale	0
16-31	=	Process data value	0-4.095 = Measurement data range 32,764 = No measurement data –32,760 = Out of measuring range (–) 32,760 = Out of measuring range (+)

Fig. 4: Structure of the process data input



		Designation	Value range
0	=	Disable sensor (CSC)	0 = inactive 1 = active
1	=	Tracking	0 = inactive 1 = active
2	=	nicht belegt	
3-7	=	Recipe	0 = Recipe 1 1 = Recipe 2 2 = Recipe 3 … 17 = Recipe 18 18 = Recipe 19 19 = Recipe 20

Fig. 5: Structure of the process data output

Note
The sensor adopts the recipe transmitted by the master via the process data and operates according to this setting.
If communication is interrupted, the sensor retains the last valid recipe it received and continues operation with this configuration.
Once communication is restored, the process data must be marked as valid by the master again. The sensor will process the newly transmitted process data only after this validity marking has been performed.

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: 1013 = [mm]

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 parameters – Measurement data channel description

Index	Subindex	Designation	Format	Access	Factory setting	Value range	Resolution
16512	0	Measurement data channel description	Record				
	1	Lower limit	Int32	RO	0	0	1
	2	Upper limit	Int32	RO	4,095	4,095	1
	3	Unit code	UInt16	RO	1,997		
	4	Scale	Int8	RO	0		

5 Teach-in

System Command
System Commands are used to execute application Commands, Teach-in Commands, and IO-Link-specific Commands.

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

Teach-in configuration
The following Teach-in methods are available for operation as a label sensor or a splice sensor:
2 = Label dynamic
The backing material and the backing material with labels must be pulled through the fork at a constant speed. During this dynamic Teach-in, the parameters for the backing material and the backing material with labels are determined and stored in the selected recipe storage.

3 = 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 the selected recipe storage.

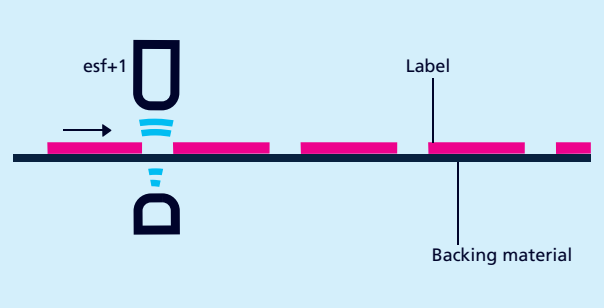


Fig. 6: esf+1 as label sensor

1 = Splice
The backing material is guided through the fork at a constant speed. The parameters for the backing material are determined and stored in the selected recipe storage.

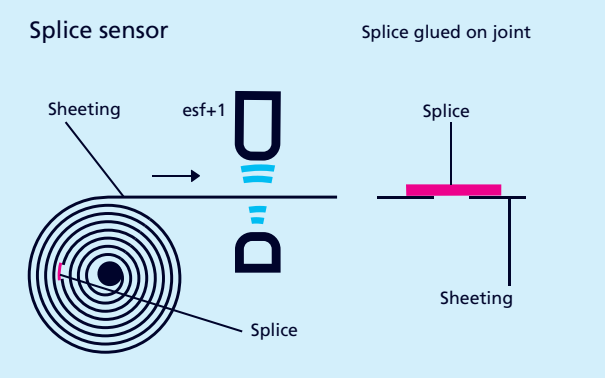


Fig. 7: esf+1 as splice sensor

Recipe storage
The esf+1 label sensor features integrated recipe management via IO-Link. Up to 20 programmed material parameters can be stored in the recipe storage and retrieved as needed. This eliminates the need to repeat the Teach-in process for the same material (see chapter 6).

Table 3: IO-Link parameter – Teach-in

Index	Subindex	Designation	Format	Access	Factory setting	Value range
400	0	Teach-in configuration	Record			
	1	Type	UInt8	RW	2	0 = disable 1 = Splice 2 = Label dynamic 3 = Label static 5 = Label Carrier static
	2	Offset	UInt8	RW	20	5...80 %
	3	Teach lower splice threshold	UInt8	RW	1	0 = inactice 1 = active
	4	Teach upper splice threshold	UInt8	RW	1	0 = inactice 1 = active
401		Teach-in Result	UInt4	RW	0	0 = Idle 1 = Successful 4 = Wait for Command 5 = Busy 7 = Error

5.1 Teach-in Type Label dynamic

Initialisation

➔ Optionally, first select the recipe storage location under the »Recipe storage configuration« parameter (Index 500/Subindex 1); by default, data is written to storage location Recipe 1, see chapter 6.

1. Write the value 2 for »Label dynamic« in parameter »Teach-in configuration/Type« (Index 400/Subindex 1).
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 161 for »Teach SP Start« in parameter »System Command« (Index 2).
3. Read out the parameter »Teach-in Result« (Index 401).

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

➔ If the parameter »Teach-in Result« contains the value 1, the procedure is successfully completed.

◆ Ready, ignore subsequent steps.

➔ If the parameter »Teach-in Result« contains the value 7, the Teach-in procedure was not successful.

◆ Abort, start again at step 1.

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

4. Write the value 169 for »Teach Cancel« in parameter »System Command« (Index 2) .
   The sensor aborts the adjustment.

◆ Abort, start again at step 1.

5.2 Teach-in Type Label static

Initialisation

➔ Optionally, first select the recipe storage location under the »Recipe storage configuration« parameter (Index 500/Subindex 1); by default, data is written to storage location Recipe 1, see chapter 6.

1. Write the value 5 for »Label Carrier static« in parameter »Teach-in configuration/Type« (Index 400/Subindex 1).
2. Place 5 to 30 cm of backing material without labels in the fork.

Teach-in procedure

1. Write the value 161 for »Teach SP Start« in parameter »System 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 162 for »Teach SP Stop« in parameter »System Command« (Index 2).
4. Read out the parameter »Teach-in Result« (Index 401).

➔ If the parameter »Teach-in Result« contains the value 1, the procedure is successfully completed. Continue to Step 5.

➔ If the parameter »Teach-in Result« contains the value 7, the Teach-in procedure was not successful.

◆ Abort, start again at step 1.

5. Write the value 3 for »Label static« in parameter »Teach-in configuration/Type« (Index 400/Subindex 1).
6. Place the backing material with labels in the fork. Make sure that the fork now measures a label in the middle.
7. Write the value 161 for »Teach SP Start« in parameter »System Command« (Index 2).
8. 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.
9. Write the value 162 for »Teach SP Stop« in parameter »System Command« (Index 2).
10. Read out the parameter »Teach-in Result« (Index 401).

➔ If the parameter »Teach-in Result« contains the value 1, the procedure is successfully completed.

◆ Ready, ignore subsequent steps.

➔ If the parameter »Teach-in Result« contains the value 7, the Teach-in procedure was not successful.

◆ Abort, start again at step 1.

5.3 Teach-in Type Splice

Initialisation

➔ Optionally, first select the recipe storage location under the »Recipe storage configuration« parameter (Index 500/Subindex 1); by default, data is written to storage location Recipe 1, see chapter 6.

1. Write the value 1 for »Splice« in parameter »Teach-in configuration/Type« (Index 400/Subindex 1).
2. In the »Offset« parameter (Index 400/Subindex 2), select the value for the splice threshold. The recommended default value is 20 %.
3. Insert backing material without splice into the sensor.

Teach-in procedure

1. Write the value 161 f or »Teach SP Start« in parameter »System Command« (Index 2).
2. Move the backing 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 162 for »Teach SP Stop« in parameter »System Command« (Index 2).
4. Read out the parameter »Teach-in Result« (Index 401).

➔ If the parameter »Teach-in Result« contains the value 1, the procedure is successfully completed.

◆ Ready, ignore subsequent steps.

➔ If the parameter »Teach-in Result« contains the value 7, the Teach-in procedure was not successful.

◆ Abort, start again at step 1.

5.4 Teach-in methods and controls

Der Sensor esf+1 hat folgende Bedienelemente:

› Teach-in push-button
› Teach-in input on pin 5

Control/Mode

The »Control/Mode« parameter can be used to disable specific input options.

› 0 = Teach-in via button and input pin inactive
› 1 = Teach-in via button inactive and via input pin active
› 2 = Teach-in via button active and via input-pin inactive
› 3 = Teach-in via button and input-pin active

Teach-in Type

A simple Teach-in method is available for both label sensor and splice sensor operation. In addition, labels can be programmed statically if necessary.
The appropriate Teach-in type is selected under Index 400/Subindex 1:

› 0 = disable
› 1 = Splice
› 2 = Label dynamic
› 3 = Label static
› 5 = Label Carrier static

LED

The esf+1 sensor has the following display elements:

› LED red, LED green, LED yellow

Die LEDs können im Normalbetrieb ausgeschaltet und nur für einen Teach-in temporär aktiviert werden. Im Modus »Find me!« blinken alle LEDs des Sensors. Dies kann dazu genutzt werden, den Sensor in einer Maschine bzw. Anlage aufzufinden.

The LEDs can be turned off during normal operation and activated only temporarily for a Teach-in. In »Find me!« mode, all of the sensor's LEDs flash. This can be used to locate the sensor within a machine or system.

› 0 = inactive
› 1 = active
› 4 = »Find me!«

Table 4: IO-Link parameter – Control/LED

Index	Subindex	Designation	Format	Access	Factory setting	Value range
370	0	Control	Record			
	1	Mode	UInt8	RW	3	0 = Teach-in via button and input pin inactive 1 = Teach-in via button inactive and via input pin active 2 = Teach-in via button active and via input-pin inactive 3 = Teach-in via button and input-pin active
371	0	LED	Record			
	1	Mode	UInt8	RW	1	0 = inactive 1 = active 4 = »Find me!«

6 Recipe storage

The esf+1 label sensor features integrated recipe management via IO-Link. Up to 20 learned material parameters can be stored in the recipe storage and retrieved as needed. This eliminates the need to repeat the Teach-in process for the same material. The corresponding storage location is selected under Index 500/Subindex 1 for the currently learned material.
The system writes to storage location 1 by default. This storage location is overwritten during each subsequent Teach-in unless a different storage location is selected beforehand.

Notes

› If the currently selected recipe does not match the sensor or was not generated by the sensor, the sensor triggers warning event 36004 (see Section 9.7). This event is not cleared until the recipe matches the sensor again, for example, following a successful Teach-in procedure, or until a valid recipe is selected.

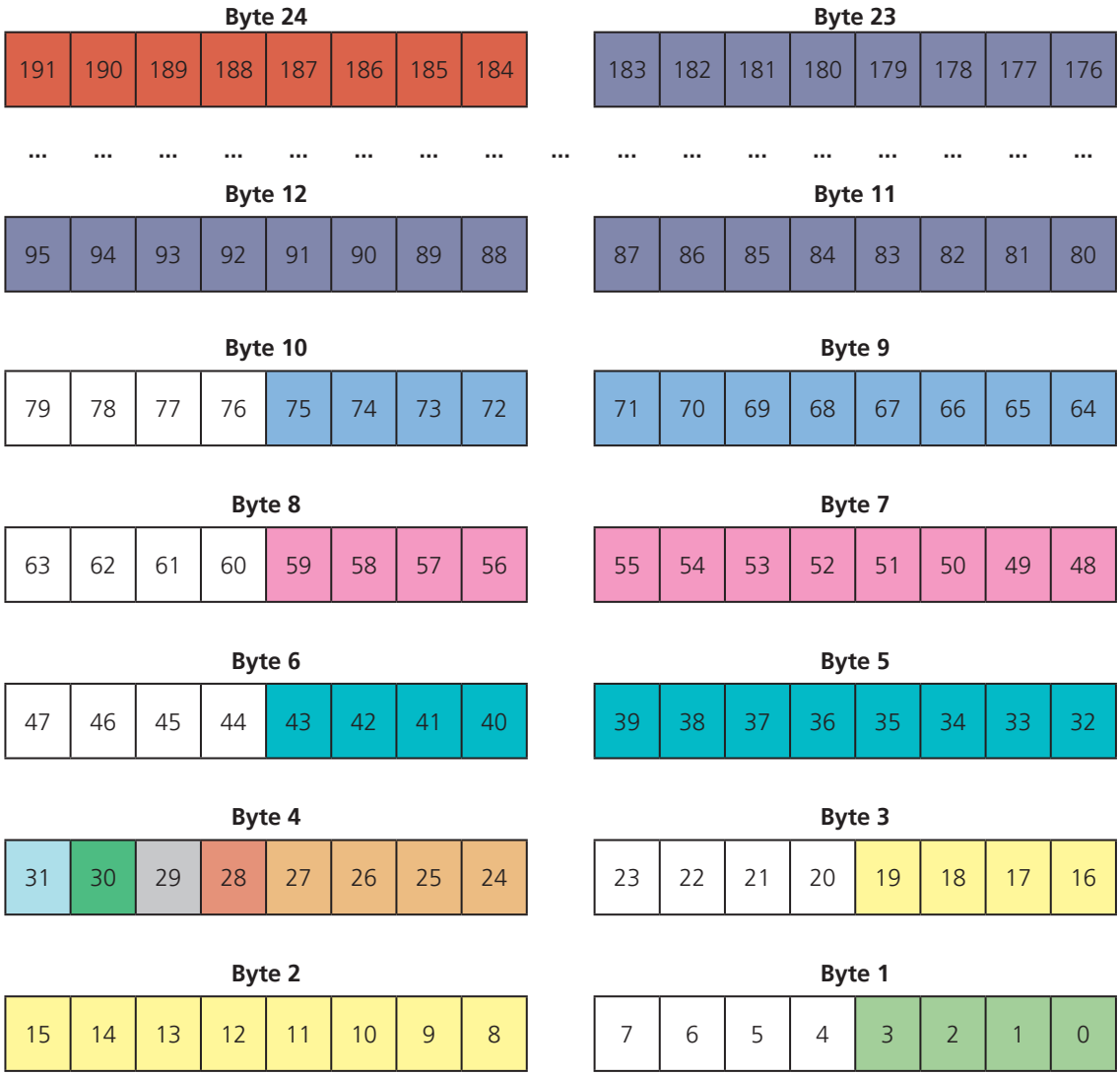
› If the value 22 is selected in the »Teach-in recipe storage« parameter (Index 500/Subindex 1, see Table 5), the sensor adopts the recipe transmitted by the master via process data in IO-Link mode and operates according to this setting.

› If communication is lost, the sensor retains the last valid recipe it received and continues operation using that configuration.

› Once communication has been restored, the master must re-validate the process data. The sensor will process the newly transmitted process data only after this validation has taken place.

Table 5: IO-Link parameter – Recipe storage configuration

Index	Subindex	Designation	Format	Access	Factory setting	Value range
500	0	Recipe storage configuration	Record			
	1	Teach-in recipe storage	UInt8	RW	1	1 = Recipe 1 2 = Recipe 2 3 = Recipe 3 4 = Recipe 4 5 = Recipe 5 6 = Recipe 6 7 = Recipe 7 8 = Recipe 8 9 = Recipe 9 10 = Recipe 10 11 = Recipe 11 12 = Recipe 12 13 = Recipe 13 14 = Recipe 14 15 = Recipe 15 16 = Recipe 16 17 = Recipe 17 18 = Recipe 18 19 = Recipe 19 20 = Recipe 20 22 = Recipe selection via IO-Link PDO



		Designation	Value range
0-3	=	Transmission length	1...15
8-19	=	Amplification	0...4095
24-27	=	Evaluation Type	0 = Label 1 = Splice
28	=	invert Label	0 = inactive 1 = active
29	=	min. Splice threshold evaluation	0 = inactive 1 = active
30	=	max. Splice threshold evaluation	0 = inactive 1 = active
31	=	Switch-on/-off delay	0 = inactive 1 = active
32-43	=	Label threshold	0...4095
48-59	=	min. Splice threshold	0...4095
64-75	=	max. Splice threshold	0...4095
80-183	=	Splice advanced	
184-191	=	CRC	

Fig. 8: Encoding of the recipe storage

7 Outputs

The esf+1 sensor has outputs F1 and F2. The following settings can be configured for F1 and F2:

› Output function
› Signalart
› Output logic
› Dynamic Teach-in feedback

Output function

The following output functions are available for F1 and F2:

› 0 = deactivated
› 2 = Splice
› 3 = Label
› 4 = Web material
› 5 = Web break
› 7 = Teach-in Feedback
› 8 = Label missing
› 9 = Label faulty
› 10 = Label/Splice

Output logic

The output logic is set to 0 or 1 as follows:

› 0 = High active
Output status set = $+U_B$
› 1 = Low active
Output status set = $–U_B$

Dynamic Teach-in feedback (see Fig. 9)

When a teach-in is started, the selected switching outputs are set to Low (0).
As soon as the teach-in is completed (either by the user or by the calibration process itself), the selected switching outputs are set to High (1) for 200 ms.
Nach den 200 ms signalisiert der Sensor, ob das Teach-in erfolgreich war oder nicht: wenn das Teach-in erfolgreich war, bleibt der Pegel des Ausgangs für 300 ms auf High. Wenn das Teach-in nicht erfolgreich war, geht der Ausgang für 300 ms auf Low.
Nach Ablauf dieser Zeit gibt der Sensor wieder die parametrisierte Schaltinformation aus.

Table 6: IO-Link parameter – Output configuration

Index	Subindex	Designation	Format	Access	Factory setting	Value range
300	0	Output configuration	Record			
	1	Output function F1	UInt8	RW	5	0 = deactivated 2 = Splice 3 = Label 4 = Web material 5 = Web break 7 = Teach-in Feedback 8 = Label missing 9 = Label faulty 10 = Label/Splice
	2	Output function F2	UInt8	RW	10	0 = deactivated 2 = Splice 3 = Label 4 = Web material 5 = Web break 7 = Teach-in Feedback 8 = Label missing 9 = Label faulty 10 = Label/Splice
	3	Signal type	UInt2	RO	3	1 = pnp-switching 2 = npn-switching 3 = pnp- and npn-switching
	4	Output logic F1	UInt2	RW	0	0 = High active 1 = Low active
	5	Output logic F2	UInt2	RW	0	0 = High active 1 = Low active
	6	Dynamic Teach-in feedback F1	UInt2	RW	0	0 = inactive 1 = active
	7	Dynamic Teach-in feedback F2	UInt2	RW	0	0 = inactive 1 = active

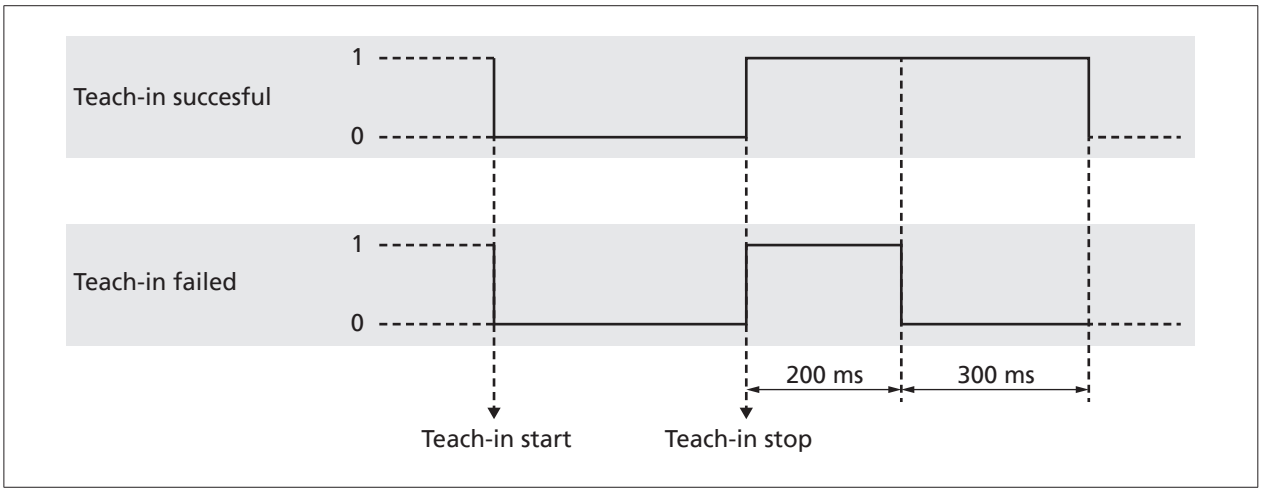


Fig. 9: Signal waveform for dynamic Teach-in feedback (Index 300, Subindex 6/7)

7.1 Switch-on/-off delay

Switch-on/-off delay
The switch-on or switch-off delay, specified in milliseconds, extends the »Output set« state. The value is rounded internally to the nearest multiple of the measurement cycle time. This is adjusted depending on the material being scanned.

Table 7: IO-Link parameter – Switch-on/-off delay

Index	Subindex	Designation	Format	Access	Factory setting	Value range
221	0	Switch-on/-off delay	Record			
	1	Splice/Label switch-off delay	UInt8	RW	20 ms	0...100 ms
	2	Web break switch-on delay	UInt8	RW	0 ms	0...15 ms
	3	Splice/Label switch-on delay	UInt8	RW	4 ms	0...15 ms

8 Measurement configuration

Depending on the attenuation of the sound in the track material, the esf+1 automatically adjusts its transmission power and thus its measurement cycle time. If the transmission power needs to be increased, the measurement time increases accordingly. This can vary from 150 µs to 2 ms (esf+1/CFF/Pro) or 300 µs to 3.9 ms (esf+1/CFF/Exp), see Subindex 4.

Table 8: IO-Link parameter – Measurement configuration

Index	Subindex	Designation	Format	Access	Factory setting	Value range
200	0	Measurement configuration	Record			
	3	Transmission power	UInt8	RO	0	0 = Standard power 1 = Low power
	4	Measurement cycle time	UInt8	RW	0	esf+1...**Pro** / esf+1...**Exp** 0 = autom. / autom. 1 = 150 µs / 300 µs 2 = 300 µs / 600 µs 3 = 450 µs / 900 µs 4 = 600 µs / 1200 µs 5 = 750 µs / 1500 µs 6 = 900 µs / 1800 µs 7 = 1050 µs / 2100 µs 8 = 1200 µs / 2400 µs 9 = 1350 µs / 2700 µs 10 = 1500 µs / 3000 µs 11 = 1650 µs / 3300 µs 12 = 1800 µs / 3600 µs 15 = 1950 µs / 3900 µs

9 Further settings via IO-Link

9.1 Trigger and Synchronisation

If multiple esf+1 sensors are operated in a confined space, they may interfere with one another. To prevent this, the esf+1 sensors can be synchronised with one another. To do this, connect pin 5 (Teach-in/Com) on all sensors and set the value to 1 in parameter Index 350/Subindex 1.

If the value 3 is entered in Subindex 1 (IO-Link communication), measurement starts synchronously with each IO-Link communication (depending on the IO-Link master used):

Table 9: IO-Link parameter – Synchronisation

Index	Subindex	Designation	Format	Access	Factory setting	Value range
350	0	Trigger and Synchronisation	Record			
	1	Trigger Channel	UInt8	RW	0	0 = Free-Run 1 = Synchronisation 3 = IO-Link communication

9.2 Temperature

The Index 2000 parameter can be used to retrieve the currently measured sensor temperature as well as the minimum and maximum sensor temperature values recorded over the entire operating period. The System Command »228« can be used to reset the values for »Sensor temperature since last reset« (see Subindexes 4 and 5).

Table 10: IO-Link parameter – Temperature

Index	Subindex	Designation	Format	Access	Factory setting	Value range
2000	0	Temperature	Record			
	1	Current temperature	Int16	RO		–40...+105 °C, resolution 0.1 °C
	2	Max. temperature all time	Int16	RO		–40...+105 °C, resolution 0.1 °C
	3	Min. temperature all time	Int16	RO		–40...+105 °C, resolution 0.1 °C
	4	Max. temperature since last reset	Int16	RO		–40...+105 °C, resolution 0.1 °C
	5	Min. temperature since last reset	Int16	RO		–40...+105 °C, resolution 0.1 °C

9.3 Diagnosis

The following diagnostic data is collected and stored throughout the sensor's entire lifecycle:

- Operating time counter
- Bootcycles
- EEPROM write cycles
- Total number of error

Table 11: IO-Link parameter – Diagnosis runtime

Index	Subindex	Designation	Format	Access	Note
2003	0	Diagnosis runtime	Record		
	1	Operating time counter	UInt32	RO	Counting value in 1-minute intervals
	2	Operating time counter since reset	UInt32	RO	Counting value in 1-minute intervals
	3	Bootcycles	UInt32	RO	
	4	EEPROM write cycles	UInt32	RO	
	5	Error count	UInt16	RO	

9.4 Counter

The esf+1 features a temporary counter for monitoring status changes (Backing material, label/splice, and web break) that have occurred since the power was turned on. The counter values can be reset using System Command 172, »Reset counter«.

Table 12: IO-Link parameter – Counter

Index	Subindex	Designation	Format	Access	Factory setting	Value range
2006	0	Counter	Record			
	1	Backing material	UInt32	RO		List of the number (volatile)
	2	Splice/label	UInt32	RO		List of the number (volatile)
	4	Web break	UInt32	RO		List of the number (volatile)

9.5 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 Revision
The firmware revision shows the firmware version of the application used by the manufacturer.

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

Table 13: IO-Link parameter – Identification

Index	Designation	Format	Access	Factory setting
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 Revision	String	RO	
24	Application-specific Tag	String	RW	***

9.6 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 14: IO-Link parameter – System Command - Werkseinstellung setzen

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

9.7 Events

Events are sent from the sensor to the master. This is performed asynchronously via the ISDU channel. The master acknowledges these events in the sensor and stores them in the master memory. There, a PLC can read the events. Several events can be pending in the sensor at the same time. Events are divided into three types:

› **Notifications** are displays of general information or non-critical states of the sensor. They are issued upon every re-occurrence of the sensor state.

› **Warnings** indicate a possible functional restriction of the sensor. These events remain until the reason for the functional restriction has been rectified.

› **Error** events indicate an inoperative sensor. These displays remain pending until the reason for the functional restriction has been rectified.

Table 15: IO-Link Events

Code		Type	Name	Meaning/measure
decimal	hex			
16384	0x4000	Error	Temperature fault	Overload
16912	0x4210	Warning	Device temperature over-run	The maximum permissible sensor temperature was exceeded.
16928	0x4220	Warning	Device temperature under-run	The minimum permissible sensor temperature was undercut.
30480	0x7710	Error	Short circuit	Check the installation
20736	0x5100	Error	General power supply fault	Check the supply voltage.
36000	0x8CA0	Notification	Teach-in error	A Teach-in procedure was not successful.
36001	0x8CA1	Notification	Teach-in success	A Teach-in procedure was successful.
36003	0x8CA3	Warning	Manual Teach-in is executed	The sensor cannot be configured at this time because a Teach-in process is currently active via the button or pin 5.
36004	0x8CA4	Warning	Material adjustment data record does not match the sensor	The material adjustment dataset does not match the sensor. Please execute a Teach-in.
36005	0x8ca5	Warning	Invalid parameter set for secondary splice evaluation	No active splice thresholds were found in the current material data set. Please activate the required splice thresholds (top/bottom) and execute a label-Teach-in.
36010	0x8CAA	Notification	History event triggered	The history event has been triggered. The ring buffer is ready.

9.8 Error history

The error history stores the last 32 events of type »Error« (see Table 15), including the time they occurred, in an error storage (parameter Index 2005; see Appendix, Section 10). This error storage consists of a circular buffer with 32 elements.

9.9 Parameter access and error codes

The master issues cyclical requests for the sensor to communicate. The measured value is sent from the sensor to the master with each communication. Part of this communication is the Indexed Service Data Unit channel (ISDU channel). This is used to write data or read data of the sensor acyclically.
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 first processes a transferred parameter when it has been transferred completely. Parameters, diagnostic data, events and Commands are sent via this ISDU channel.
If the sensor detects errors during parameter access, it reports these with corresponding error codes.

Table 16: IO-Link Error codes

Error code		Meaning/measure
decimal	hex	
0	0x0000	No error
32816	0x8030	Parameter value outside the valid range
32817	0x8031	Parameter value above the permissible limit
32818	0x8032	Parameter value below the permissible limit
32822	0x8036	Function currently not available
33024	0x8100	General manufacturer-specific error
33025	0x8101 … 0x81FF	Manufacturer-specific error

9.10 Measurement recording

The sensor has a ring buffer that contains 1,000 storage locations, each with a capacity of 12 bits. The ring buffer is continuously filled with measurement data and evaluation statuses. The coding of the storage locations is illustrated in Fig. 10.

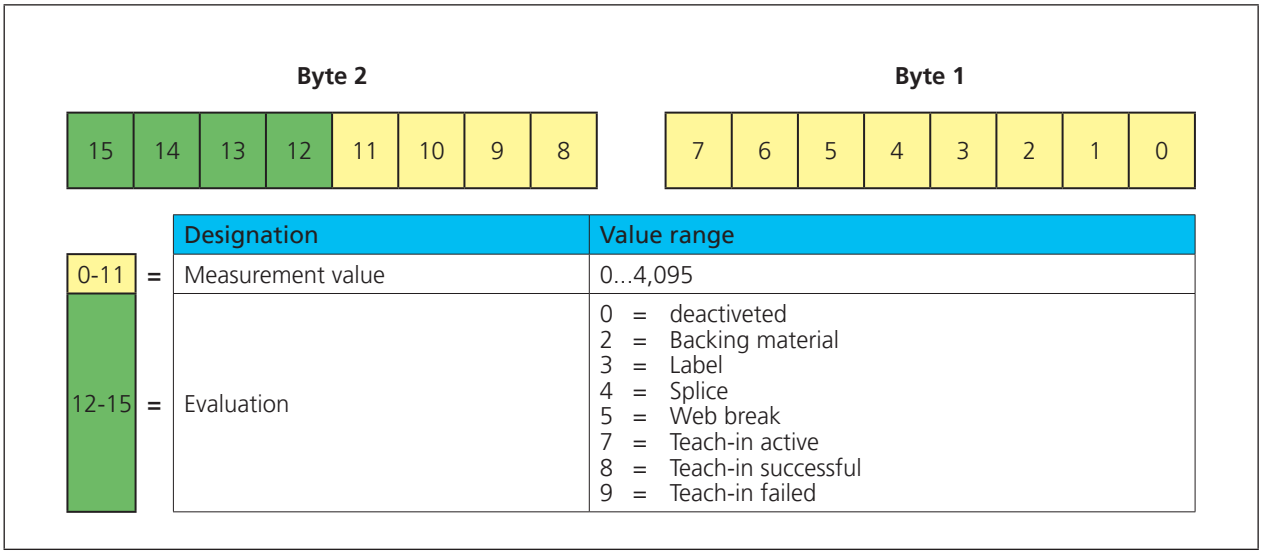


Fig. 10: Structure of the history buffer (little-endian format)

To configure Measurement recording, follow these steps:

Setting via Parameter Index 2020

1. Write the desired value to Subindex 1 (Mode).
2. Write the corresponding value to Subindex 2 (Trigger).
3. In Subindex 3 (Send event), enter the value 1 if an IO-Link event message is desired (see Section 9.7).
4. In Subindex 4 (Post-Trigger), enter the value for the Post-trigger. This corresponds to the number of measurement data points to be recorded after the event.

Note

After selecting a mode, the ring buffer is continuously filled with the corresponding data. When the configured trigger event occurs, recording continues for the set post-trigger time. The ring buffer, which is then frozen, forms the snapshot and thus contains data from both before and after the trigger.

➔ If the value 2 »IO-Link System Command trigger« has been selected as the trigger, the value 170 »Trigger measurement recording manually« must be written to parameter Index 2, »System Command« to create a snapshot.

➔ The metadata for the recorded snapshot can be read from parameter Index 2021. Subindex 1 (Index) specifies the Index in the ring buffer at which the recording began. Subindex 2 (Status) indicates the current status of the measurement data recording.

➔ All data can be retrieved from parameters Index 2022 through Index 2031 (see Appendix, Section 10).

Table 17: IO-Link parameter – Measurement recording configuration

Index	Subindex	Designation	Format	Access	Factory setting	Value range
2020	0	Measurement recording configuration	Record			
	1	Mode	UInt8	RW	0	0 = inactive 1 = Record measurement data from a trigger 2 = Gap and label width alternating 3 = Lowest gap and highest label amplitude alternating
	2	Trigger	UInt8	RW	0	0 = inactive 1 = Splice or label 2 = IO-Link System Command trigger
	3	Send event	UInt8	RW	0	0 = inactive 1 = active
	4	Post-Trigger	UInt16	RW	100	1...999

10 Appendix: Overview IO-Link data

Index	Sub-index	Designation	Format	Access	Factory setting	Value range
2		System Command	UInt8	WO		1 = ParamUploadStart 2 = ParamUploadEnd 3 = ParamDownloadStart 4 = ParamDownloadEnd 5 = ParamDownloadStore 6 = ParamBreak 126 = Locator Start 127 = Locator Stop 128 = Device Reset 129 = Application Reset 130 = Restore Factory Settings 131 = Back-to-box 161 = Teach SP Start 162 = Teach SP Stop 169 = Teach Cancel 170 = Trigger measurement recording manually 171 = Clear measurement recording 172 = Reset counter 228 = Reset Diagnosis
12		Device Access Locks	Record	RW		
		Bit 0: Parameter Write Access	Boolean	RW	0	0 = unlocked 1 = locked
		Bit 2: Local Parameterization	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	esf+1/CFF/Pro esf+1/CFF/Exp	
19		Product ID	String	RO	16955 16956	
20		Product Text	String	RO	Ultrasonic sensor	
21		Serial Number	String	RO		
22		Hardware Revision	String	RO		
23		Firmware Revision	String	RO		
24		Application-specific Tag	String	RW	***	
25		Function Tag	String	RW	***	
26		Location Tag	String	RW	***	
27		Product URI	String	RO	pid.microsonic.de/...	
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	0	Prozess data input	Record	RO		
	5	Output F2	Boolean			
	4	Output F1	Boolean			
	3	Process data	UInt6			
	2	Process data scale	Int8			
	1	Process data value	Int16			

Index	Sub-index	Designation	Format	Access	Factory setting	Value range
41		Process data output	Record	RO		
	1	Deactivate transmitter (CSC)	Boolean			
	2	Deactivatetracking	Boolean			
	4	Recipe selection	UInt5			0 = Recipe 1 1 = Recipe 2 2 = Recipe 3 3 = Recipe 4 4 = Recipe 5 5 = Recipe 6 6 = Recipe 7 7 = Recipe 8 8 = Recipe 9 9 = Recipe 10 10 = Recipe 11 11 = Recipe 12 12 = Recipe 13 13 = Recipe 14 14 = Recipe 15 15 = Recipe 16 16 = Recipe 17 17 = Recipe 18 18 = Recipe 19 19 = Recipe 20
200	0	Measurement configuration	Record			
	3	Transmission power	UInt8	RO	0	0 = Standard power 1 = Low power
	4	Max. Measurement cycle time	UInt8	RW	0	esf+1...**Pro** / esf+1...**Exp** 0 = automatically / automatically 1 = 150 µs / 300 µs 2 = 300 µs / 600 µs 3 = 450 µs / 900 µs 4 = 600 µs / 1200 µs 5 = 750 µs / 1500 µs 6 = 900 µs / 1800 µs 7 = 1050 µs / 2100 µs 8 = 1200 µs / 2400 µs 9 = 1350 µs / 2700 µs 10 = 1500 µs / 3000 µs 11 = 1650 µs / 3300 µs 12 = 1800 µs / 3600 µs 15 = 1950 µs / 3900 µs
211	0	Tracking	Record			
	1	Tracking automatically	UInt8	RW	0	0 = inactive 1 = active
212	0	Additional functions	Record			
	1	Secondary splice	UInt8	RW	0	0 = inactive 1 = active
221	0	Switch-on/-off delay	Record			
	1	Splice/Label switch-off delay	UInt8	RW	20 ms	0...100 ms
	2	Web break switch-on delay	UInt8	RW	0 ms	0...15 ms
	3	Splice/Label switch-on delay	UInt8	RW	4 ms	0...15 ms

Index	Sub-index	Designation	Format	Access	Factory setting	Value range
300	0	Output configuration	Record			
	1	Output function F1	UInt8	RW	5	0 = deactivated 2 = Splice 3 = Label 4 = Backing material 5 = Web break 7 = Teach-in Feedback 8 = Label missing 9 = Label faulty 10 = Label/splice
	2	Output function F2	UInt8	RW	10	0 = deactivated 2 = Splice 3 = Label 4 = Backing material 5 = Web break 7 = Teach-in Feedback 8 = Label missing 9 = Label faulty 10 = Label/splice
	3	Type of signal	UInt2	RO	3	1 = pnp-switching 2 = npn-switching 3 = pnp- and npn-switching
	4	Output logic F1	UInt2	RW	0	0 = High active 1 = Low active
	5	Output logic F2	UInt2	RW	0	0 = High active 1 = Low active
	6	Dynamic Teach-in feedback F1	UInt2	RW	0	0 = inactive 1 = active
	7	Dynamic Teach-in feedback F2	UInt2	RW	0	0 = inactive 1 = active
301	0	Input configuration	Record			
	3	Type of signal	UInt2	RW	1	1 = pnp-controllable 2 = npn-controllable
350	0	Trigger and synchronisation	Record			
	1	Trigger channel	UInt8	RW	0	0 = Free run 1 = Synchronisation 3 = IO-Link communication
370	0	Control	Record			
	1	Mode	UInt8	RW	3	0 = Teach-in via button and input pin-inactive 1 = Teach-in via button inactive and via input pin-active 2 = Teach-in via button active and via input-pin inactive 3 = Teach-in via buttons and input-pin active
371	0	LED	Record			
	1	Mode	UInt8	RW	1	0 = inactive 1 = active 4 = »Find Me!«
400	0	Teach-in configuration	Record			
	1	Type	UInt8	RW	2	0 = disable 1 = Splice 2 = Label dynamic 3 = Label static 5 = Label Carrier static
	2	Offset	UInt8	RW	20	5...80 %
	3	Teach lower splice threshold	UInt8	RW	1	0 = inactive 1 = active
	4	Teach upper splice thres-hold	UInt8	RW	1	0 = inactive 1 = active

Index	Sub-index	Designation	Format	Access	Factory setting	Value range
401		Teach-in Result	UInt4	RW	0	0 = Idle 1 = Successful 4 = Wait for Command 5 = Busy 7 = Error
500	0	Recipe storage configura-tion	Record			
	1	Teach-in Recipe storage	UInt8	RW	1	1 = Recipe 1 2 = Recipe 2 3 = Recipe 3 4 = Recipe 4 5 = Recipe 5 6 = Recipe 6 7 = Recipe 7 8 = Recipe 8 9 = Recipe 9 10 = Recipe 10 11 = Recipe 11 12 = Recipe 12 13 = Recipe 13 14 = Recipe 14 15 = Recipe 15 16 = Recipe 16 17 = Recipe 17 18 = Recipe 18 19 = Recipe 19 20 = Recipe 20 22 = Recipe selection via Process data output
510		Recipe storage 1	OctetString	RW		see Section 6
511		Recipe storage 2	OctetString	RW		see Section 6
512		Recipe storage 3	OctetString	RW		see Section 6
513		Recipe storage 4	OctetString	RW		see Section 6
514		Recipe storage 5	OctetString	RW		see Section 6
515		Recipe storage 6	OctetString	RW		see Section 6
516		Recipe storage 7	OctetString	RW		see Section 6
517		Recipe storage 8	OctetString	RW		see Section 6
518		Recipe storage 9	OctetString	RW		see Section 6
519		Recipe storage 10	OctetString	RW		see Section 6
520		Recipe storage 11	OctetString	RW		see Section 6
521		Recipe storage 12	OctetString	RW		see Section 6
522		Recipe storage 13	OctetString	RW		see Section 6
523		Recipe storage 14	OctetString	RW		see Section 6
524		Recipe storage 15	OctetString	RW		see Section 6
525		Recipe storage 16	OctetString	RW		see Section 6
526		Recipe storage 17	OctetString	RW		see Section 6
527		Recipe storage 18	OctetString	RW		see Section 6
528		Recipe storage 19	OctetString	RW		see Section 6
529		Recipe storage 20	OctetString	RW		see Section 6

Index	Sub-index	Designation	Format	Access	Factory setting	Value range
2000	0	Temperature	Record			
	1	Current temperature	Int16	RO		–40...+105 °C, resolution 0.1 °C
	2	Max. temperature all time	Int16	RO		–40...+105 °C, resolution 0.1 °C
	3	Min. temperature all time	Int16	RO		–40...+105 °C, resolution 0.1 °C
	4	Max. temperature since last reset	Int16	RO		–40...+105 °C, resolution 0.1 °C
	5	Min. temperature since last reset	Int16	RO		–40...+105 °C, resolution 0.1 °C
2001	0	Cycletimes	Record			
	1	SIO-Mode	Int16	RO		resolution 0.01 ms
	2	IO-Link	Int16	RO		resolution 0.01 ms
2002	0	Teach-in				
	1	State	UInt8	RO	0	0 = Standby 1 = Operate 2 = Success 3 = canceled 4 = Error 5 = Error material 6 = Error values 7 = Error web break
	2	Adjustment quality	Int8	RO	0	
2003	0	Diagnosis runtime	Record			
	1	Operating time counter	UInt32	RO		
	2	Operating time counter since reset	UInt32	RO		
	3	Bootcycles	UInt32	RO		
	4	EEPROM write cycles	UInt32	RO		
	5	Error count	UInt16	RO		
2004	0	Diagnosis Measurement	Record			
	1	Material Inhomogeneity	UInt16	RO		0…1,000 %, resolution 0.1 %
2005	0	Error history	UInt48[32]	RO		List of the last 32 errors
	1	Time[0]	UInt32	RO		Operating time in 1-minute increments
	2	Description[0]	UInt16	RO		Temperature overload (16384), Short circuit (30480), General power supply fault (20736), empty (0) **see Table 15, pageSeite 16**
	3	Time[1]	UInt32	RO		see Subindex 1
	4	Description[1]	UInt16	RO		see Subindex 2
	5	Time[2]	UInt32	RO		see Subindex 1
	6	Description[2]	UInt16	RO		see Subindex 2
	7	Time[3]	UInt32	RO		see Subindex 1
	8	Description[3]	UInt16	RO		see Subindex 2
	9	Time[4]	UInt32	RO		see Subindex 1
	10	Description[4]	UInt16	RO		see Subindex 2
	11	Time[5]	UInt32	RO		see Subindex 1
	12	Description[5]	UInt16	RO		see Subindex 2
	13	Time[6]	UInt32	RO		see Subindex 1
	14	Description[6]	UInt16	RO		see Subindex 2

Index	Sub-index	Designation	Format	Access	Factory setting	Value range
	15	Time[7]	UInt32	RO		see Subindex 1
	16	Description[7]	UInt16	RO		see Subindex 2
	17	Time[8]	UInt32	RO		see Subindex 1
	18	Description[8]	UInt16	RO		see Subindex 2
	19	Time[9]	UInt32	RO		see Subindex 1
	20	Description[9]	UInt16	RO		see Subindex 2
	21	Time[10]	UInt32	RO		see Subindex 1
	22	Description[10]	UInt16	RO		see Subindex 2
	23	Time[11]	UInt32	RO		see Subindex 1
	24	Description[11]	UInt16	RO		see Subindex 2
	25	Time[12]	UInt32	RO		see Subindex 1
	26	Description[12]	UInt16	RO		see Subindex 2
	27	Time[13]	UInt32	RO		see Subindex 1
	28	Description[13]	UInt16	RO		see Subindex 2
	29	Time[14]	UInt32	RO		see Subindex 1
	30	Description[14]	UInt16	RO		see Subindex 2
	31	Time[15]	UInt32	RO		see Subindex 1
	32	Description[15]	UInt16	RO		see Subindex 2
	33	Time[16]	UInt32	RO		see Subindex 1
	34	Description[16]	UInt16	RO		see Subindex 2
	35	Time[17]	UInt32	RO		see Subindex 1
	36	Description[17]	UInt16	RO		see Subindex 2
	37	Time[18]	UInt32	RO		see Subindex 1
	38	Description[18]	UInt16	RO		see Subindex 2
	39	Time[19]	UInt32	RO		see Subindex 1
	40	Description[19]	UInt16	RO		see Subindex 2
	41	Time[20]	UInt32	RO		see Subindex 1
	42	Description[20]	UInt16	RO		see Subindex 2
	43	Time[21]	UInt32	RO		see Subindex 1
	44	Description[21]	UInt16	RO		see Subindex 2
	45	Time[22]	UInt32	RO		see Subindex 1
	46	Description[22]	UInt16	RO		see Subindex 2
	47	Time[23]	UInt32	RO		see Subindex 1
	48	Description[23]	UInt16	RO		see Subindex 2
	49	Time[24]	UInt32	RO		see Subindex 1
	50	Description[24]	UInt16	RO		see Subindex 2
	51	Time[25]	UInt32	RO		see Subindex 1
	52	Description[25]	UInt16	RO		see Subindex 2
	53	Time[26]	UInt32	RO		see Subindex 1
	54	Description[26]	UInt16	RO		see Subindex 2
	55	Time[27]	UInt32	RO		see Subindex 1
	56	Description[27]	UInt16	RO		see Subindex 2
	57	Time[28]	UInt32	RO		see Subindex 1
	58	Description[28]	UInt16	RO		see Subindex 2
	59	Time[29]	UInt32	RO		see Subindex 1
	60	Description[29]	UInt16	RO		see Subindex 2
	61	Time[30]	UInt32	RO		see Subindex 1

Index	Sub-index	Designation	Format	Access	Factory setting	Value range
	62	Description[30]	UInt16	RO		see Subindex 2
	63	Time[31]	UInt32	RO		see Subindex 1
	64	Description[31]	UInt16	RO		see Subindex 2
2006	0	Counter	Record			
	1	Backing material	UInt32	RO		List of the number (volatile)
	2	Splice/label	UInt32	RO		List of the number (volatile)
	3	Web break	UInt32	RO		List of the number (volatile)
2007	0	Current State	Record			
	1	Measurement value	UInt16	RO	0	0...4,095
	2	Output F1	Boolean	RO	0	0 = low (0) 1 = high (1)
	3	Output F2	Boolean	RO	0	0 = low (0) 1 = high (1)
2020	0	Measurement recording configuration	Record			
	1	Mode	UInt8	RW	0	0 = inactive 1 = Record measurement data from a trigger 2 = Gap and label width alternating 3 = Lowest gap and highest label amplitude alternating
	2	Trigger	UInt8	RW	0	0 = inactice 1 = Splice or label 2 = IO-Link System Command trigger
	3	Send event	UInt8	RW	0	0 = inactive 1 = active
	4	Post-Trigger	UInt16	RW	100	1...999
2021	0	Snapshot	Record			
	1	Index	Int16	RO	0	0...1,000
	2	State	Int8	RO	0	0 = inactive 1 = Recording in progress (waiting for Trigger) 2 = Recording in progress (Post-Trigger) 3 = Snapshot available
2022		Snapshot ringbuffer 1	OctetString	RO		Elements 0...99 of the ringbuffer
2023		Snapshot ringbuffer 2	OctetString	RO		Elements 100...199 of the ringbuffer
2024		Snapshot ringbuffer 3	OctetString	RO		Elements 200...299 of the ringbuffer
2025		Snapshot ringbuffer 4	OctetString	RO		Elements 300...399 of the ringbuffer
2026		Snapshot ringbuffer 5	OctetString	RO		Elements 400...499 of the ringbuffer
2027		Snapshot ringbuffer 6	OctetString	RO		Elements 500...599 of the ringbuffer
2028		Snapshot ringbuffer 7	OctetString	RO		Elements 600...699 of the ringbuffer
2029		Snapshot ringbuffer 8	OctetString	RO		Elements 700...799 of the ringbuffer
2030		Snapshot ringbuffer 9	OctetString	RO		Elements 800...899 of the ringbuffer
2031		Snapshot ringbuffer 10	OctetString	RO		Elements 900...999 of the ringbuffer
16512	0	Measurement data channel description	Record			
	1	Lower limit	Int32	RO	0	resolution 1
	2	Upper limit	Int32	RO	4,095	resolution 1
	3	Unit code	UInt16	RO	1,997	
	4	Scale	Int8	RO	0	