MAYSER®
Polymer Electric

Operating Instructions

Ultrasonic Industrial Sensor USi

Version 03

	Master	Slave
USi-PP	1005632 *	1005633 *
USi-IP	1005899 *	100900 *
USi-UP	1005901 *	1005902 *

* plus Sensor 1005264

Original instructions

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Inhaltsverzeichnis

About these operating instructions

These operating instructions are part of the product.
Mayser Polymer Electric accepts no responsibility or warranty claims for damage and consequential damage due to failure to observe the operating instructions.

➔ Read operating instructions carefully before use.

➔ Keep operating instructions for the complete service life of the product.

➔ Pass operating instructions on to every subsequent owner or user of the product.

➔ Add any supplement received from the manufacturer to the operating instructions.

Validity These operating instructions are only valid for the products specified on the title page.

Target group The target group of these operating instructions are operators and trained specialist personnel who are familiar with installation and commissioning.

Other applicable documents

➔ In addition to the Operating Instructions, observe the following documents:
- Manual on Parameter Assignment Software for USi (optional)

Glossary Technical terminology is alphabetically listed and explained at the end of the Operating Instructions.

Symbols used

Symbol	Meaning
➔ ...	Action with one step or with more than one step where the order is not relevant.
1. ... 2. ... 3. ...	Action with more than one step where the order is relevant.
• ... - ...	Bullets first level Bullets second level
(see *Installation*)	Cross-reference

Danger symbols and information

Symbol	Meaning
DANGER 	Immediate danger leading to death or serious injury.
WARNING 	Imminent danger which may lead to death or serious injury
CAUTION 	Possible danger which may lead to slight injury or damage to property.
	Information on easier and safer working practices.

Intended use

The ultrasonic industrial sensor USi is designed for industrial use in the medium air. It is comprised of the Evaluation Unit and up to 2 sensors (ultrasonic transducers). It can be used to achieve the following functions:

- Reflex switch
- Reflex barrier
- Sonic barrier
- Analog distance detection
- Multisensor

Reflex switches and reflex barriers and Analog distance detection are possible using stand-alone (i.e. without parameter assignment software) master or slave units. 2 sensors (ultrasonic transducers) are required for the sonic barriers; several synchronised USi (1 master + several slaves) are required to be multisensory.

Limits

- Safety-related tasks are not possible with the product.
- The use of the product in potentially explosive environments (ATEX) is not possible. The product is not authorised for use in these areas.
- Objects with a highly sound-absorbing surface such as open-pore foam, corduroy, etc., cannot be reliably detected.
- Objects with an extreme sound-dividing shape such as cone tip, or similar cannot be reliably detected.
- Strong fluctuations in temperature within very short periods of time cannot counter balance the integrated temperature compensation.

Safety instructions

➔ **Do not open sensors (ultrasonic transducer)**
Never open, manipulate or alter the sensors.

➔ **Do not squeeze the sensors**
Avoid applying increased mechanical loads to the enclosure and the active surface of the sensor (ultrasonic transducer).

➔ **Check supply voltage**
Check supply voltage. It must correspond with the connecting voltage U_S specified on the type plate.

➔ **Observe protection class**
The Evaluation Unit only has protection class IP65 with carefully screwed on screw plug and carefully fitted lid.

➔ **Protect from sunlight**
In the case of surface installation, ensure that the Evaluation Unit is protected from direct sunlight.

➔ **Do not alter special cable**
The special cable on the sensor (ultrasonic transducer) has a fixed length. Never shorten, lengthen or alter the special cable.

➔ **Observe PIN assignment**
Observe the PIN assignment when connecting the supply voltage.

➔ **Do not overload Evaluation Unit**
Ensure that the specified switching current is not exceeded.

➔ **In the event of a fault, take out of operation**
In the event of malfunctions and visible damage, take the Control Unit out of operation.

Applicable Standards

The type model of the product conforms to the EMC Directive 2004/108/EC. Applicable standards:

- IEC 60947-5-2 „IEC?60947-5-2 “Low-Voltage Switchgear and Controlgear – Part 5-2: Control Circuit Devices and Switching Elements – Proximity Switches”
- IEC 60204-1 “Safety of Machinery – Electrical Equipment of Machinery; Part 1:General Requirements”

These Operating Instructions were drawn up in compliance with IEC 62079 “Preparation of Instructions – Structuring, Content and Presentation”.

Parts supplied

1× Evaluation Unit
Enclosure with electronics module.
1× Sensor (ultrasonic transducer)
1× Operating Instructions
1× Declaration of conformity
Check the scope of supply for completeness and the perfect condition of the product immediately after receipt.

Required accessories:
1× Unit cable M12x8 / USi (optional)

You can find recommended accessories in chapter *Accessories.*

Transport and storage

Packaging and transport

The Evaluation Units are individually packaged in cartons. Several Evaluation Units are stacked in one large carton.
The sensors (ultrasonic transducers) are packaged in a protective pressure lock bag.
The documents are enclosed separately.

Storage

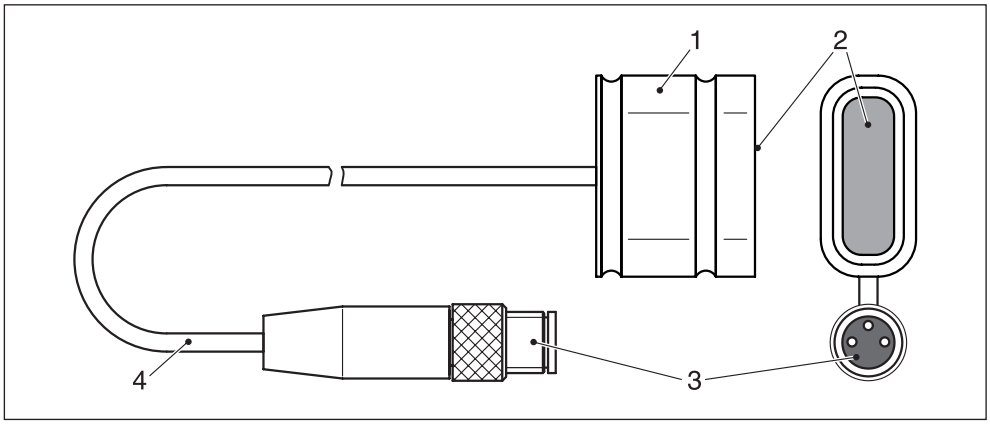
➔ Store the parts of the USi in the original packaging in a dry place.

➔ Observe the storage temperatures given in the technical specifications.

Product overview

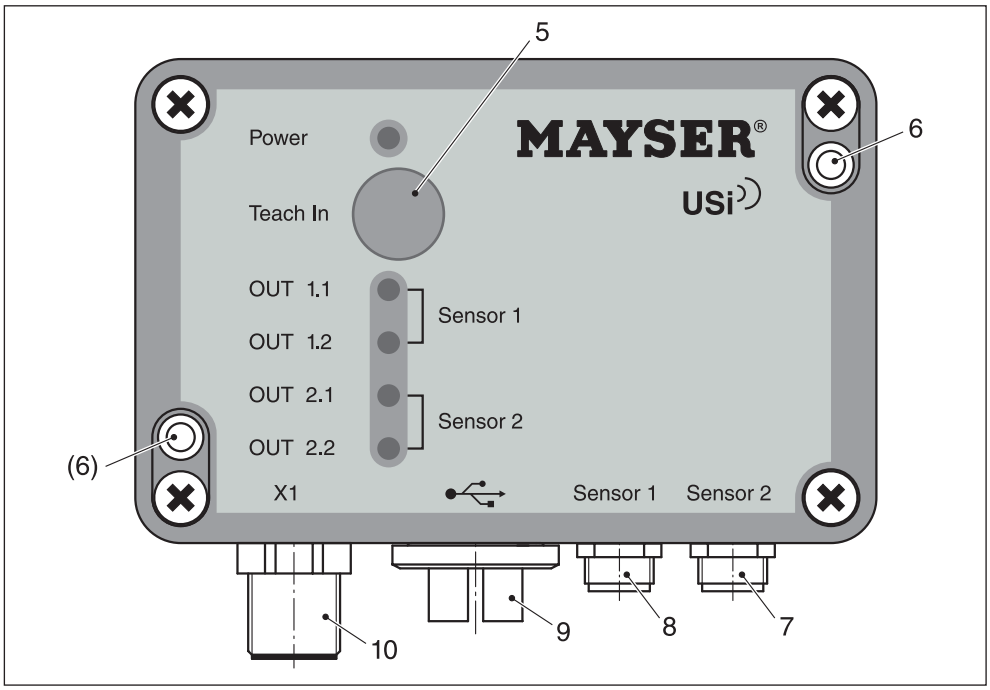
Sensor (Ultrasonic Transducer)

The special cable between the ultrasonic transducer and the M8 plug has a fixed length of 1.5 m and may not be lengthened or shortened.
Should the 1.5 m not be sufficient, the cable length can be doubled using the optional extension cable (1005903).



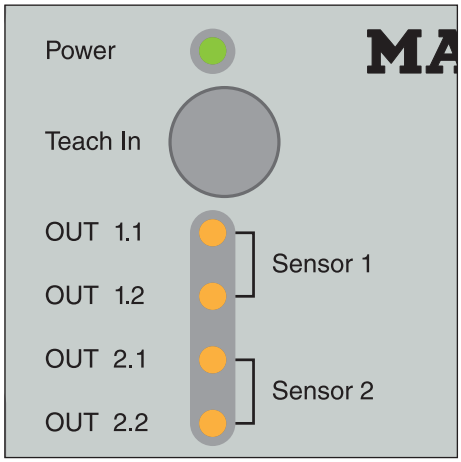
1	Ultrasonic transducer	3	M8 plug
2	Active surface	4	Shielded cable (1.5 m)

Evaluation Unit



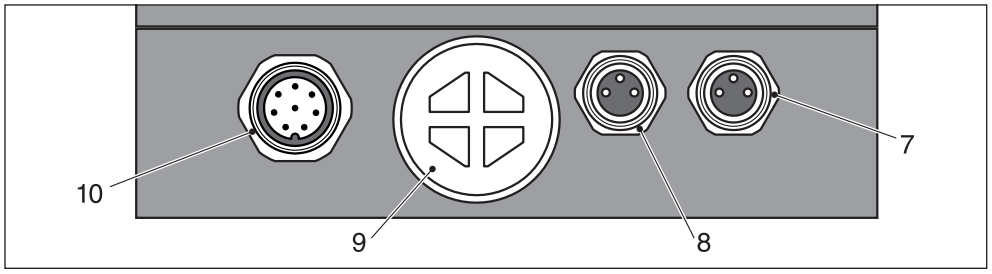
5	“Teach In” button	8	M8 socket: Sensor 1
6	Fastening point (M4)	9	Screw plug: Mini USB
7	M8 socket: Sensor 2	10	M12 plug X1: Unit cable

LEDs information

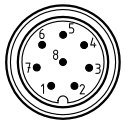


- Green LED “Power”: supply voltage connected
- Yellow LED “OUT 1.1”: Output 1.1 activated
- Yellow LED “OUT 1.2”: Output 1.2 activated
- Yellow LED “OUT 2.1”: Output 2.1 activated
- Yellow LED “OUT 2.2”: Output 2.2 activated

Connections



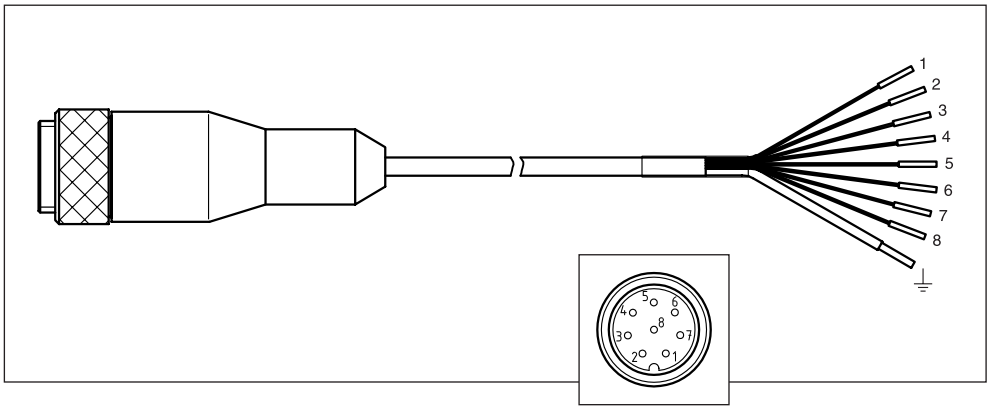
7	M8 socket: Sensor 2	9	Screw plug: Mini USB
8	M8 socket: Sensor 1	10	M12 plug X1: Unit cable

Plug X1	Signal	PIN	Circular connector
Supply voltage	$+U_S$ $-U_S$	2 7	 M12
Output 1.1	OUT 1.1	1	
Output 1.2	OUT 1.2	3	
Output 2.1	OUT 2.1	4	
Output 2.2	OUT 2.2	5	
– (not assigned)	–	6	
Synchronisation	SYNC	8	

Connection	Type	Explanation
X1	M12, 8-poled	for Unit Cable
	Mini USB 2.0	for parameter assignment via software
Sensor 1	M8, 3-poled	Sensor 1 (ultrasonic transducer 1)
Sensor 2	M8, 3-poled	Sensor 2 (ultrasonic transducer 2)

Unit Cable with M12 Socket (optional)

Cable for connection to downstream control system.
The Type LifYCY unit cable must be 8-poled (each lead min. 0.25 mm²), shielded and equipped with an M12 socket.
Maximum length of the unit cable: 30 m.

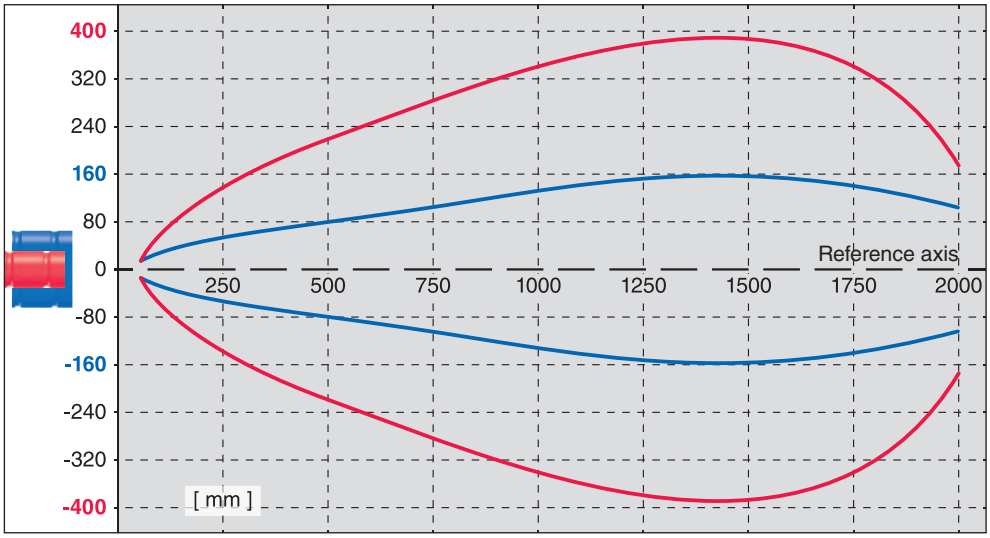


Signal		PIN	Lead colour	
Supply voltage	$+U_S$ $-U_S$	2 7	BN BU	Brown Blue
Output 1.1	OUT 1.1	1	WH	White
Output 1.2	OUT 1.2	3	GN	Green
Output 2.1	OUT 2.1	4	YW	Yellow
Output 2.2	OUT 2.2	5	GY	Grey
– (not assigned)	–	6	PK	Pink
Synchronisation	SYNC	8	RD	Red
Earth	⏚	–	Transparent	

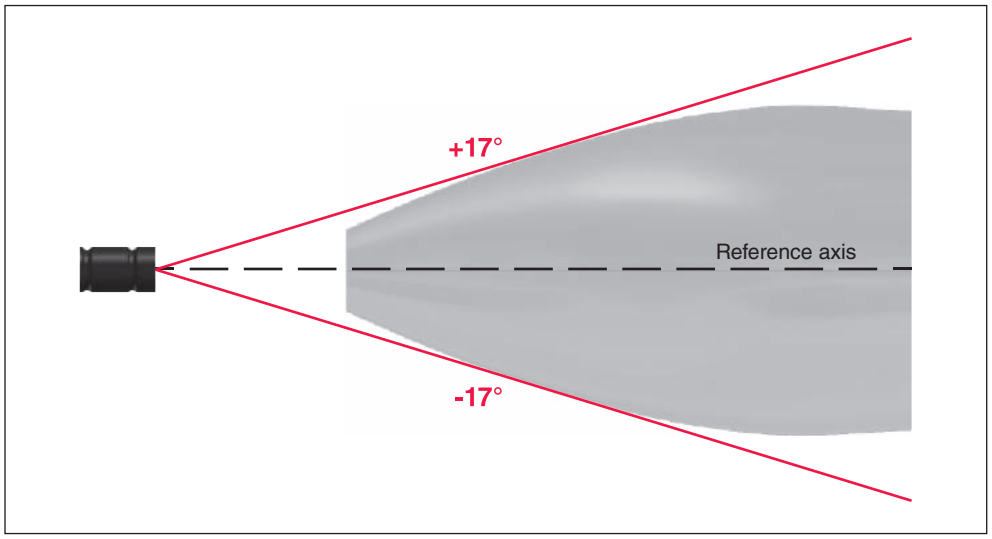
Sonic Lobe

The following representations refer to the USi in delivery condition. Measurement object: steel rod with Ø 10 mm. If parameters have been changed or if a different measurement object is used, the representations will change accordingly.

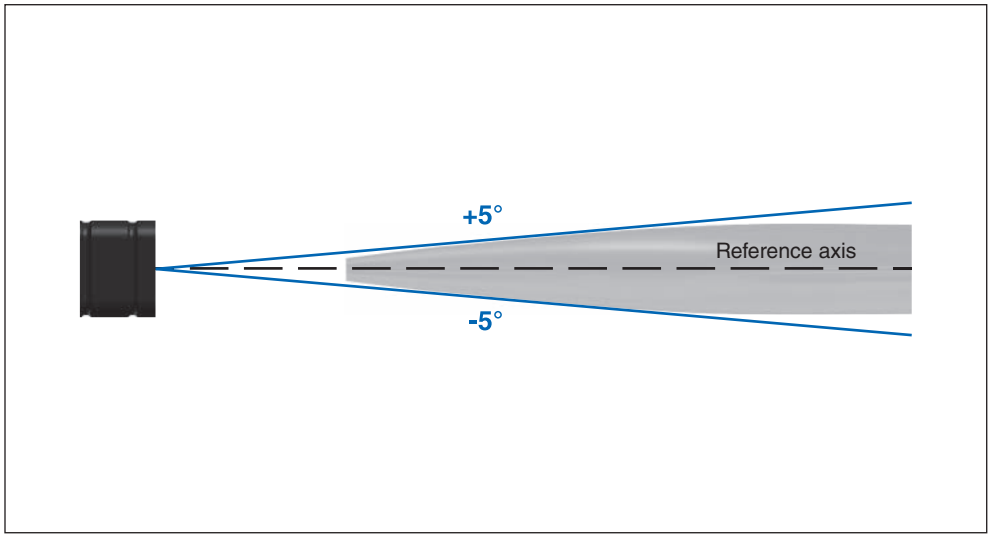
Sonic lobe from the narrow side and the broad side



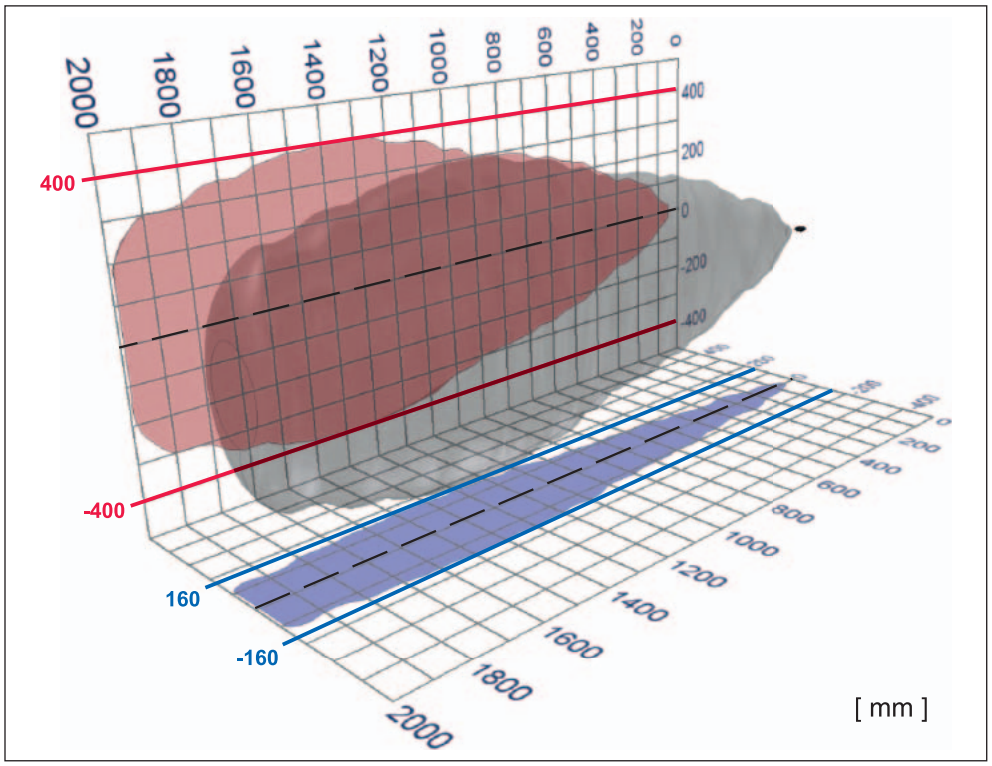
Opening angle (-6 dB) narrow side



Opening angle (-6 dB) broad side



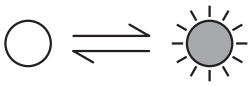
Sonic lobe spatially



Operation

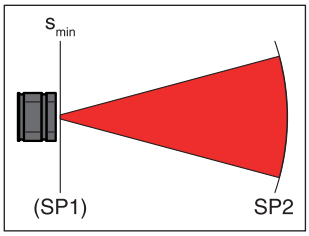
The ultrasonic industrial sensor USi uses the connected sensors (ultrasonic transducers) to both transmit and receive sound in the medium air. With a complex measurement procedure, consisting of echo transit time measurement and echo amplitude measurement, it is possible to reliably **detect** objects and also successfully **measure** distances accurately.

	Outputs		
Type	**Digital**	**Analog**	**Total**
USi-PP	PNP	–	4× PNP
USi-IP	PNP	4 to 20 mA	3× PNP 1× I [A]
ISi-UP	PNP	0 to 10 V	3× PNP 1× U [V]
	Detect	**Measure**	



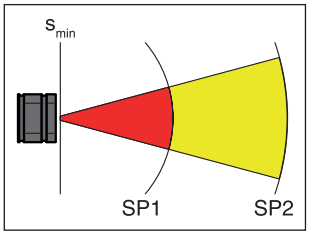
Detection – the USi as a Switch (digital)

If switch point SP1 and switch point SP2 are defined, the USi begins detection in the predetermined operating mode. The 3 possible operating modes are:



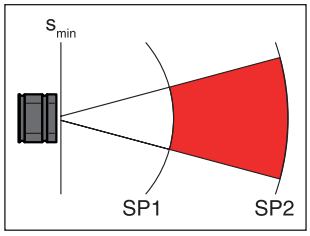
Operating Mode 1 Range

Operating mode 1 Range is the preset standard operating mode.
SP1: 1 cm SP2: 200 cm
Since switch point SP1 complies with the minimum switching distance of only 1 cm, detection is effectively from the active surface to the switch point SP2. If an object penetrates the detection field, the outputs (preset as normally open contacts) “OUT X.1” and “OUT X.2” are closed.



Operating Mode 2 Ranges

If switch point SP1 selection is larger than 1 cm, the USi-PP automatically changes to operating mode 2 ranges.
SP1: > 1 cm SP2: > (SP1 + 1 cm)
The detection field is divided into 2 zones. The detection field (red) that is sensor-proximal extends effectively from the active surface to the switch point SP1. The sensor-distant detection field (yellow) extends from the switch point SP1 to the switch point SP2. Each zone is assigned a separate output (preset as normally open contact). If an object penetrates the detection field (yellow), which is sensor-distant, output “OUT X.2” will be closed. If an object penetrates the detection field (red), which is sensor-proximal, output “OUT X.2” will remain closed and output “OUT X.1” will also be closed.

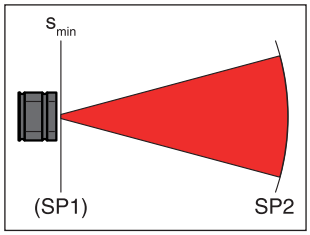


Operating Mode Window

The operating mode Window can be exclusively selected via the parameter assignment software (optional).
SP1: > 1 cm SP2: > (SP1 + 1 cm)
In contrast to **operating mode 2 ranges,** here the detection field that is sensor-proximal will not be visible. The detection field that is sensor-distant still remains. It extends from switch point SP1 to switch point SP2. If an object penetrates the detection field far that is sensor-distant, the outputs (preset as normally open contacts) “OUT X.1” and “OUT X.2” will be closed. If the object enters into the sensor-proximal detection field, the outputs “OUT X.1” and “OUT X.2” will be opened.
If the object laterally penetrates the sensor-proximal detection field, the outputs “OUT X.1” and “OUT X.2” will remain open.

Measuring – the USi as a Sensor (analog)

The measuring function is only available for USi with analog output. The 2 possible operating modes are:



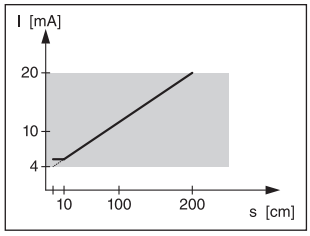
Operating Mode 1 Range

Operating mode 1 Range is the preset standard operating mode.
SP1: 1 cm SP2: 200 cm
Since switch point SP1 complies with the minimum switching distance of only 1 cm, detection is effectively from the active surface to the switch point SP2. If an object penetrates the detection field, the outputs (preset as normally open contacts) “OUT X.2” are closed. The distance from the detected object is converted to an analog value and made available at the analog output “OUT1.1”:

OUT 1.1		**Object at**	
Type	**no object**	**SP1 (1 cm)**	**SP2 (200 cm)**
USi-IP	4 mA	4.8 mA	20 mA
USi-UP	0 V	0.5 V	10 V

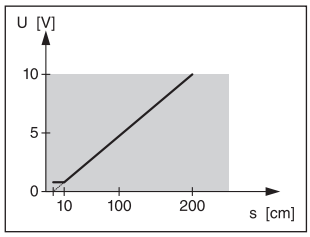
The characteristic curve can also be inverted via the parameter assignment software (optional).

Information: Upper limit in the blind zone. The USi has a blind zone of 10 cm as a sensor. However, the switch point SP1 is preset to 1 cm, so that the full coverage range is simultaneously available to the USi as a scanner. Therefore, the **analog value for 10 cm** is indicated on the analog output “OUT 1.1” for the **range up to 10 cm.**



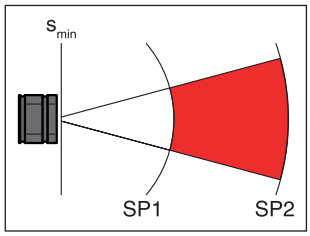
USi-IP

The distances determined by the sensor are indicated as analog current values between 4.8 and 20 mA on output “OUT°1.1”. The linear progression results from the even sub-division of the total measurement distance up to SP2. In the default setting, this is 0.08 mA per centimetre.



USi-UP

The distances measured by the sensor are indicated as analog voltage values between DC 0.5 and 10°V on output “OUT°1.1”. The linear progression results from the even sub-division of the total measurement distance up to SP2. In the default setting, this is 0.05 V per centimetre.

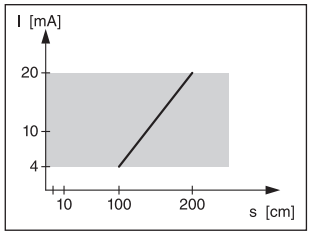


Operating Mode Window

If switch point SP1 is selected larger than 1 cm, the USi-IP automatically changes to operating mode “Window”.
SP1: > 1 cm SP2: > (SP1 + 1 cm)
The sensor-proximal detection field is not visible. The sensor-distant detection field extends from the switch point SP1 to the switch point°SP2. If an object penetrates the detection field further away from the sensor, the outputs (preset as normally open contacts) “OUT X.2” are closed. The distance from the detected object is converted to an analog value and made available at the analog output “OUT1.1”:

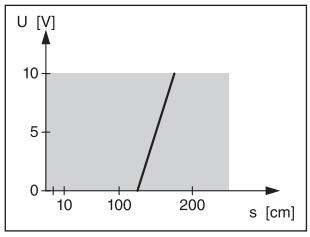
OUT 1.1		**Objekt bei**	
Typ	**kein Objekt**	**SP1**	**SP2**
USi-IP	4 mA	4 mA	20 mA
USi-UP	0 V	0 V	10 V

The characteristic curve can also be inverted via the parameter assignment software (optional).



USi-IP

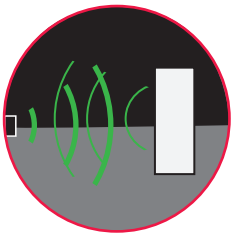
The distances determined by the sensor are indicated as analog power values between 4 and 20 mA at “OUT 1.1”. The linear progression results from the even distribution of the distance (SP2 - SP1).
Example: SP1 = 100 cm, SP2 = 200 cm. This results in 0.16 mA per centimetre

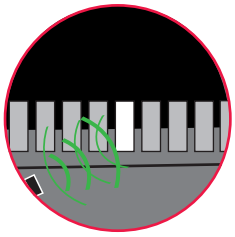


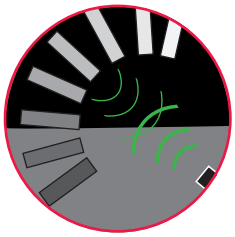
USi-UP

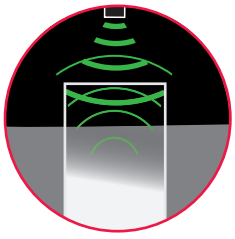
The distances determined by the sensor are be indicated as analog voltage values between DC 0 and 10 V at “OUT 1.1”. The linear progression results from the even distribution of the distance (SP2 - SP1).
Example: SP1 = 125 cm, SP2 = 175 cm. DThis results in 0.2 V per centimetre

Examples of Use

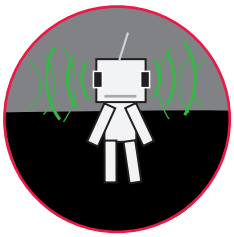


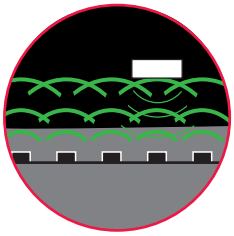






Object detection	
1. Simplest function: Is an object located in the free detection field?	1. Operating mode 1 range.
2. Presence / absence monitoring: Does the taught-in environment change?	2. Operating mode 1 range and teach in.
Conveying check	
3. Flow check: Is the material to be conveyed present?	3. Operating mode 1 range.
4. Quantity check: How many pieces of material to be conveyed have gone through?	4. Operating mode 1 range and downstream counter.
5. Position check: Is the material to be conveyed correctly positioned?	5. Operating mode 1 range and teach in.
Position detection	
6. Position check: Is a defined position reached?	6. Operating mode 1 range and teach in.
Distance detection	
7. Distance check: When is a defined distance not reached?	7. Operating mode 1 range and specification of the switch point SP2.
8. 2-zone observation: Has an object penetrated Zone 1 (from SP2 to SP1)? For continued approach: Has an object penetrated Zone 2 (from SP2 to USi)?	8. Operating mode 2 ranges and specification of the switch points SP1 and SP2.
Fill level monitoring	
9. Fill level check: When is a defined fill level not reached or exceeded?	9. Operating mode 1 range and specification of switch point SP2.
10. Fill procedure check: If a certain fill level (SP2) has been reached, then continue to fill with lower flow volume. If the final fill level (SP1) is reached, conclude the fill procedure.	10. Operating mode 2 ranges and specification of the switch points SP1 and SP2.





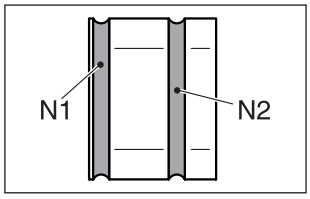
Obstacle detection	
11. Path check: Is the path taken unobstructed? 12. Distance check: When is a defined distance to the obstacle fall so far short (SP1) that action must be taken?	11. Operating mode 1 range. 12. Operating mode 2 ranges and specification of the switch points SP1 and SP2.
Area monitoring	
13. Width of continuous surface: Is an object located in the defined area?	13. Multisensory consisting of multiple intersynchronised USi, thereof one master.

Installation

The installation includes three individual installation steps:
1. Mounting the sensor (ultrasonic transducer)
2. Mounting the Evaluation Unit
3. Wiring the unit cable

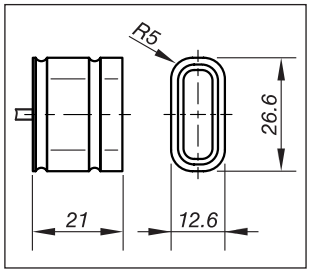
Mounting the Sensor (Ultrasonic Transducer)

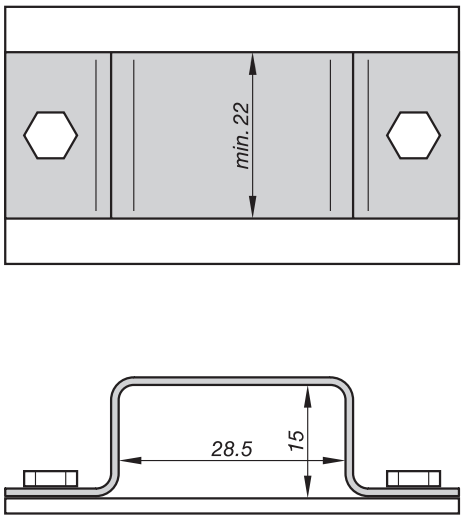
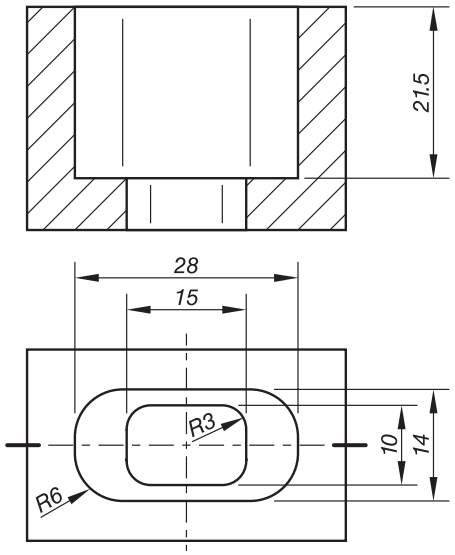
The sensors can be mounted in any position.
If the sensors are supposed to be mounted in quiet workplaces or in areas where there are hearing-sensitive animals, the interfering sonification must be considered. Ultrasound is not audible for human beings. The “hard” transmission burst, however, is perceived as a clearly audible crackle. At a measurement frequency of 20 Hz (typical), 20 crackles per second are audible. This can be stressful when continuous. Here, it is recommended to not align the sensor directly to the ears, but at an angle of at least 20°. The same applies for indirect sonification reflected from hard reflectors like e.g. walls.
Alternatively, the transmission intensity can be altered via the parameter assignment software (optional).



1. Place one O-Ring in each of the grooves N1 and N2 of the sensor. To do so, select the corresponding O-rings for the specified mounting fixture (see below).

Sensor: Dimensions



Standard mounting fixture – clamping version –	**Optimised mounting fixture – integrated version –**
	
Tolerances: ISO 2768-1 c	Tolerances: ISO 2768-1 m
with O-rings 18.0 × 2.5 mm Part number 7502819 (optional)	with O-rings 17.5 × 2.0 mm Part number 7502820 (optional)

2. Mount the sensor (ultrasonic transducer) in any position in the mounting brackets.

3. Lay the cable of the sensor at sufficient distance to sources of electromagnetic interference, like e.g. direct current motors.

CAUTION

Malfunction due to incorrect mounting

Squeezing the sensor – particularly in the front area near the active surface – can cause malfunctions and mechanical damage.

➔ Only attach the sensor with the recommended O-rings.

➔ Do not use the cable as a pulling aid. The cable can tear off.

➔ Avoid high mechanical loads on the active surface (heavy pressure, impact, etc.) when mounting.

➔ Immediately replace damaged sensor (torn off cable, damaged active surface). Repairs are not possible.

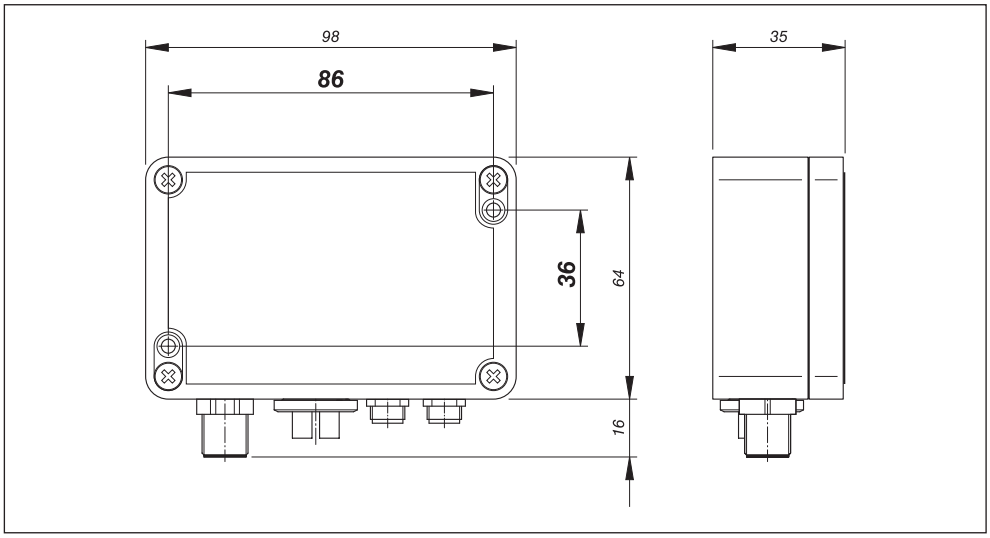
Alternative: Enclosure set (optional)

Instead of using your own brackets you can also use one of the Mayser enclosure sets. See Chapter *Accessories* for a small selection. The installation steps are the same as described above.

Mounting the Evaluation Unit

The Evaluation Unit can be mounted in any position. If the Evaluation Unit is to be mounted in a splash water environment, the parameter assignment situation via USB connection must be considered. If the screw plug is removed, the protection class drops to IP20. The opening for the USB connection should therefore be configured in such a way that it preferably faces down and not in the direction of the source of the splash water. We recommend the installation of an additional splash water protection during parameter assignment (guard plate, foil, or similar).

➔ Fix the Evaluation Unit in any position with two screws Ø 3 mm.



Screws with Ø 4 mm are also an option. For this, the lid of the Evaluation Unit must be removed, the two screws inserted and the lid carefully replaced on the Evaluation Unit. The screws are now captive.

➔ When performing these actions, avoid touching and soiling the electronics.

➔ Ensure the correct seat of the seal in the lid.

Alternative: Mounting rail adapter (optional)

1. Mount the mounting rail adapter with the enclosed **self-cutting screws SK M5x10** on the rear side of the Evaluation Unit.

2. Fix the Evaluation Unit in any position on a 35 mm mounting rail IEC 60715.

Wiring the Unit Cable

WARNING

Danger of injury due to electrocution!

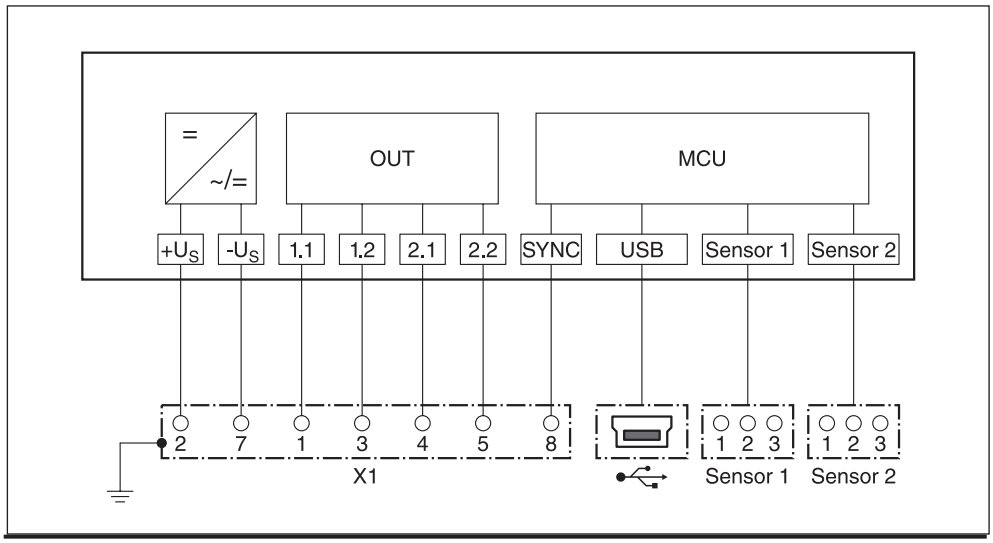
➔ Disconnect all devices and live parts in the immediate environment of the power supply and protect them against being switched on again (see relevant Operating Instructions).

➔ Check whether all devices and parts are disconnected from the power supply.

Lead colour	Signal	USi-PP	USi-IP	USi-UP
Brown Blue	$+U_S$ $-U_S$	DC 15 to 30 V		
White	OUT 1.1	max. 200 mA max. DC 30 V	DC 4 to 20 mA	DC 0 to 10 V
Green	OUT 1.2	max. 200 mA max. DC 30 V		
Yellow	OUT 2.1	max. 200 mA max. DC 30 V		
Grey	OUT 2.2	max. 200 mA max. DC 30 V		
Pink	–	– (nicht belegt)		
Red	SYNC	(intern)		
Shielding	⏚	Earth		

➔ Wire the strands of the unit cable that have been equipped with wire and sleeves.

➔ Connect the shielding to a suitable grounding point



CAUTION

Failure due to incorrect wiring!

➔ Carefully check the wiring.

➔ Inspect the supply voltage.

CAUTION

Impaired operation due to missing grounding!

➔ Carefully check the grounding

Commissioning

The Evaluation Unit expects that at least one sensor (ultrasonic transducer) is connected. If only one sensor (ultrasonic transducer) is used, then this must be connected to “Sensor 1”.

1. Connect the sensor (ultrasonic transducer) and the unit cable with the Evaluation Unit.

2. Make sure that the plug connectors are firmly mounted.

3. Connect the supply voltage.

WARNING

Danger of injury due to electrocution!

➔ Never disconnect terminals with the power on

➔ Never unplug plug connections with the power on.

Initialisation

After the supply voltage has been connected, the USi immediately begins with initialisation. The USi tests inter alia the internal hardware, the stored functional parameters and the connected sensor (ultrasonic transducer). The result of the test is stored internally in the diagnosis memory.
If the diagnosis memory does not contain error reports, the USi starts its function immediately – namely independently of the existing functional parameters.

At the first initialisation following delivery, the USi starts with the functional parameters preset in the factory, the factory settings (see chapter *Factory Settings*): A sensor in operating mode 1 range and a monitoring range of 200 cm (SP2), at medium object size and middle measurement frequency. The outputs are preset as normally open contacts.

Correlation

LEDs					**Meaning**
Power Operation green	OUT 1.1 Output 1.1 yellow	OUT 1.2 Output 1.2 yellow	OUT 2.1 Output 2.1 yellow	OUT 2.2 Output 2.2 yellow	LED off: ○ LED on: ☼
☼	☼	☼	☼	☼	Supply voltage is connected, initialisation in progress, the yellow LEDs go off after 0.1 s
☼	○	○	○	○	Initialisation concluded, diagnosis: no fault; USi ready for operation
☼	☼	☼	☼	☼	Initialisation concluded, diagnosis: fault; all LEDs flash 3x with 1.5 Hz

LEDs					Meaning
Power Operation green	OUT 1.1 Output 1.1 yellow	OUT 1.2 Output 1.2 yellow	OUT 2.1 Output 2.1 yellow	OUT 2.2 Output 2.2 yellow	LED off: ○ LED on: ☀
○	☀	☀	○	○	Display of the specific error: Sensor 1 missing; the yellow LEDs go off after 1 s
○	○	○	☀	☀	Display of the specific error: Sensor 2 missing; the yellow LEDs go off after 1 s
○	☀	☀	☀	☀	Display of the specific error: no sensor connected; the yellow LEDs go off after 1 s

Testing the Function

The following description applies for USi with two sensors.
For USi with only one sensor, the functional test is completed after Step 2.

1. Make sure that the detection fields from sensor 1 and sensor 2 are clear.
   - Green LED “Power” is lit
   - All yellow LEDs are off
   - All outputs are open

2. Place an object in the detection field of sensor 1. Make sure that the detection field of sensor 2 remains clear.
   - Green LED “Power” is lit
   - Yellow LEDs “OUT 1” and “OUT 1.2” are lit
   - USi-PP: Outputs 1.1 and 1.2 are closed
     USi-IP/UP: analog Signal at output 1.1, output 1.2 is closed
   - Yellow LEDs “OUT 2” and “OUT 2.2” are off
   - Outputs 2.1 and 2.2 are open

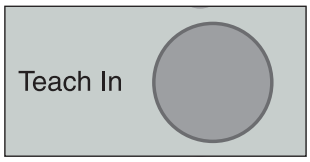
3. Repeat Step 1.

4. Place an object in the detection field of Sensor 2. Make sure that the detection field of Sensor 1 remains clear.
   - Green LED “Power” is lit
   - Yellow LEDs “OSSD 1.1” and “OSSD 1.2” are off
   - Outputs 1.1 and 1.2 are open
   - Yellow LEDs “OSSD 2.1” and “OSSD 2.2” are lit
   - Outputs 2.1 and 2.2 are closed

All tests passed? – If so, your USi is now ready for operation.

TIP: Diagnosis. Lack of earthing may cause malfunctions. With the ***Continuous echo diagnostics*** in the parameter assignment software (optional), you can quickly detect a lack of earthing.

Adjust Settings



The following settings can be changed with the “Teach In” button:
1. Teach in environment
2. Adjusting switch points
3. Logoff/logon sensor
4. Restore factory settings

Teach In: Teach in Environment

The actual function of “Teach In” is to teach in the environment within the detection field. That is always necessary if there are additional objects (e.g. columns, containers, tables, shelves, etc.) in the detection field, which should, however, be regarded as “given”. Due to the teaching in of the environment, accidental activation by such secondary objects is prevented.
The “Teach In” function is always available with a USi that is ready for operation. The USi thereby learns the environment of all logged on sensors.

This is how to teach in the environment:

1. Check if all logged on sensors are attached.

2. Make sure that there is nothing in the detection field, which should usually not be located there (this includes you and your limbs!).

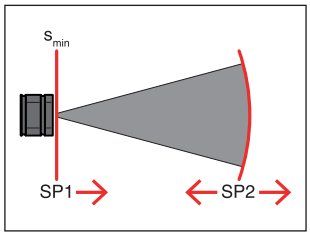
3. Keep the “Teach In” button pressed down until the green LED “Power” starts to flash (1 Hz).

4. Now release the “Teach In” button.
   The green LED “Power” now flashes faster (5 Hz). This means that the USi is in the process of learning the environment. As soon as the green LED “Power” stops flashing, the teach in process is concluded and the USi is ready for operation again.

5. Check the result: Remove one of the secondary objects; the USi then changes the status of the relevant outputs.

TIP: Cancel. If you have already started the “Teach In” function, and the green LED “Power” is flashing slowly (1 Hz), but you do not want to teach in the environment now, **keep the “Teach In” button pressed** until all yellow LEDs "OUT" are lit. When they are, immediately release the button.

Adjusting the Switch Points



With the preset switch points SP1 = 1 cm and SP2 = 200 cm, the USi operates in operating mode 1 range: From minimum switching distance s_{min} up to 200 cm distance, objects will be detected that penetrate the detection field. If the detection field is shorter or longer, the switch points SP1 and SP2 must be changed. Switch point SP1 must always be smaller than switch point SP2.

The switch points can be set between 1 and 250 cm.
The “Set Switch Points” function is always available with a USi that is ready for operation.
The preset standard settings for all sensors are switch points SP1 = **1 cm** and SP2 = **200 cm**.

This is how to set a different switch point:

1. Measure the desired distance, starting at the active surface of the sensor (ultrasonic transducer).

2. Make sure that there is nothing in the detection field, which should usually not be located there (this includes you and your limbs!).

3. Have a suitable reference object (e.g. cardboard carton 10 x 10 cm) ready.

4. Keep the “Teach In” button pressed down: The green LED “Power” starts flashing slowly (1 Hz), turns of for 2 s (while the yellow LEDs “OUT are lit), starts to flash slowly again (1 Hz) and turns off again.

Now the yellow LEDs “OUT 1.X” and “OUT 2.X” are alternately lit. The USi is awaiting your decision: Do you want to set a switch point for Sensor 1 or for Sensor 2?

5. Release the “Teach In” button as soon as all the yellow LEDs “OUT” of the corresponding sensor is lit, for the switch points that you want to set.

Now the yellow LED “OUT X.2” is lit and the green LED “Power” flashes quickly (5 Hz). The USi now expects your confirmation for switch point SP2: Is the reference object at the desired distance in the detection field?

6. Place the reference object at the desired distance in the detection field.

If the USi recognises the reference object, the green LED “Power” changes from quick flashing (5 Hz) to being continuously lit.

7. Press the “Teach In” button (> 0.5 s), and the USi overwrites the previous switch point SP2 with the determined distance to the reference object.

Now the yellow LED “OUT X.1” is lit and the green LED “Power” flashes quickly (5 Hz). The USi now expects your confirmation for switch point SP1: Is the reference object at the desired distance in the detection field?

TIP: Operating Mode 1 Range. If you acknowledge the switch point SP1 on the USi without setting a reference object in the detection field, the USi automatically saves the minimum distance of 1 cm for switch point SP1. An automatic switch to operating mode 1 range occurs.

8. Place the reference object at the desired distance in the detection field.
If the USi recognises the reference object, the green LED “Power” changes from quick flashing (5 Hz) to being continuously lit.

9. Press the “Teach In” button (> 0.5 s), and the USi overwrites the previous switch point SP1 with the determined distance to the reference object.
The USi now operates automatically in the operating mode 2 ranges.

10. Check both switch points: Move the reference object toward the USi and back again. Does a signal change occur at the output when the set switch points are executed (see yellow LEDs “OUT”)? Does the signal change take place at the correct distance?

TIP: Omit reference object. If you set the switch points without the reference object, the USi automatically saves the **maximum distance** of 250 cm for switch point SP2 and the **minimum distance** of 1 cm for switch point SP1.

TIP: Cancel. After Step 5, cancellation is only possible by **disconnection of the supply voltage.**

Logon/logoff Sensor 2

The USi is preset to one sensor (ultrasonic transducer) on Sensor 1 when supplied. If a second sensor (ultrasonic transducer) is required, Sensor 2 must be logged on. Sensor 1 must always remain connected; it may not be logged off.
The “Sensor 2 logon/logoff” function is not available with a USi that is ready for operation.

This is how to logon Sensor 2:

1. Make sure that there is no supply voltage connected.

2. Connect Sensor 2 to the M8 socket “Sensor 2”.

3. Keep the “Teach In” button pressed down (up until step 5).

4. Connect the supply voltage.
The USi signalises readiness for operation to “Logon Sensor 2” by slowly flashing (1 Hz) the green LED "Power".

5. Now release the “Teach In” button.
Now both yellow LEDs “OUT 2.1” and “OUT 2.2” simultaneously flash slowly (1 Hz). The USi expects your confirmation for the logon to Sensor 2 within 10 s.

Note: If the “Teach In” button is not pressed, the USi will automatically cancel the function “Logon/logoff Sensor 2” after a period of 10 s.

6. Now press the “Teach In” button > 0.5 s.

The USi signalises that Sensor 2 is now logged on by the continuously lit yellow LEDs “OUT” for 1 s.

This is how to logoff Sensor 2:

1. Make sure that there is no supply voltage connected.

2. Keep the “Teach In” button pressed (up until step 4).

3. Connect the supply voltage.

The USi signalises readiness for operation to “Logoff Sensor 2” by slowly flashing (1 Hz) the green LED “Power”.

4. Now release the “Teach In” button.

Now the yellow LEDs “OUT 2.1” and “OUT 2.2” are alternately lit. The USi expects your confirmation for the logoff to Sensor 2 within 10 s.

Note: If the “Teach In” button is not pressed, the USi will automatically cancel the function “Logon/logoff Sensor 2” after a period of 10 s.

5. Now press the “Teach In” button > 0.5 s.

The USi signalises that Sensor 2 is now logged off by the continuously lit yellow LEDs “OUT” for 1 s.

6. Disconnect Sensor 2 from the M8 socket “Sensor 2”.

Restore Factory Settings

Sometimes a RESET is faster, if a USi that has previously been assigned parameters must be reassigned. A RESET writes over all parameters, restoring the factory settings (see chapter *Factory Settings*). The USi subsequently restarts and automatically executes a “Teach In”.
Exception: The settings “Sensor 2 logged on” and “Sensor 2 logged off” are not included in the parameters. These settings remain untouched during RESET.
The “RESET” function is not available with a USi that is ready for operation.

This is how you perform a RESET:

1. Make sure that there is no supply voltage connected.

2. Keep the “Teach In” button pressed down (up until step 4).

3. Connect the supply voltage.

The green LED “Power” flashes for 5 s slowly (1 Hz), then the yellow LEDs “OUT” are lit continuously for 2 s. Subsequently, the green LED “Power” flashes slowly (1 Hz).

4. Now release the “Teach In” button.

Now all the LEDs are lit alternately from the top to the bottom in the manner of a chaser light. The USi expects your confirmation for the RESET within 10 s.

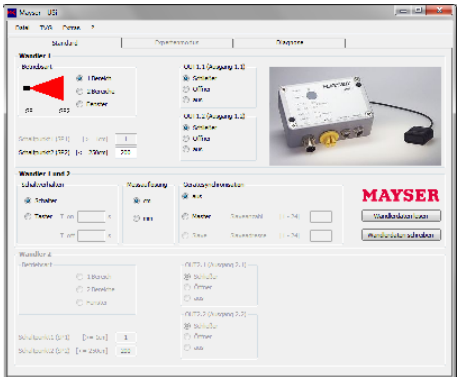
Note: If the “Teach In” button is not pressed, the USi will automatically cancel the function “RESET” after a period of 10 s.

5. Press the “Teach In” button > 0.5 s.

The USi signalises that the RESET is executed by fast flashing (5 Hz) the green LED “Power” for 1 s and then briefly lighting up all LEDs “OUT”.

Adjust Settings with Software (optional)

The settings can be easily changed with the parameter assignment software: Select the option with the mouse, directly enter the switch points with the keyboard and transfer all settings in the USi with one mouse click.



The parameter assignment software (7502768) is supplied on a USB flash.

Troubleshooting and remedies

Prerequisite: The USi is connected to the supply voltage. There is at least one sensor connected to the Evaluation Unit. Only taught-in objects are located in the detection field.
For troubleshooting upon initialisation see Chapter *Commissioning* / *Connections*.

Fault display	Possible cause	Elimination
Green LED “POWER” not lit	No or incorrect supply voltage	1. Check the supply voltage: Does it comply with the type plate? 2. Check the PIN assignment
	If supply voltage is correctly connected: Evaluation Unit faulty	➔ Replace the Evaluation Unit
LEDs lit or flash randomly	Supply voltage too low or incorrect	1. Check the supply voltage: Does it comply with the type plate? 2. Check the PIN assignment
The green LED “Power” flashes at 10 Hz	Interference in the direct vicinity of the sensor (ultrasonic transducer)	1. When possible, eliminate the interference 2. Reconfigure the sensor 3. Move the sensor
	Internal error	➔ Perform a RESET
The green LED “Power” flashes at 20 Hz	Electromagnetic interference	1. Check the cable laying between the sensor and the Evaluation Unit: Too close to the source of interference? 2. Shield the USi from the source of electromagnetic interference 3. Earth the Evaluation Unit
	Acoustic interference	1. When possible, eliminate the interference 2. Reconfigure the sensor 3. Move the sensor
Green LED “Power” flashes at 2 Hz, yellow LEDs “OUT 1.1” and “OUT 1.2” are lit	Sensor 1 not correctly connected	➔ Connect Sensor 1 ➔ Check the cable connections
	If Sensor 1 is correctly connected: Supply line or sensor faulty	➔ Replace Sensor 1
Green LED “Power” flashes at 2 Hz, yellow LEDs “OUT 2.1” and “OUT 2.2” are lit	Sensor 2 not correctly connected	➔ Connect Sensor 2 ➔ Check the cable connections
	If Sensor 2 is correctly connected: Supply line or sensor faulty	➔ Replace Sensor 2
Green LED “Power” flashes at 2 Hz, all yellow LEDs “OUT” are lit	Sensor 1 and Sensor 2 not correctly connected	➔ Connect both sensors ➔ Check the cable connections
	If the sensors are correctly connected: Supply line or sensor faulty	➔ Replace both sensors

Fault display	Possible cause	Elimination
Yellow LED “OUT X.X” (normally open contact) is lit, although there is no variable object in the detection field	Taught-in detection field has changed	➔ Press the “Teach In” button until the green LED “Power” flashes (see chapter *Teach In: Teach In Environment*)
Yellow LED “OUT X.X” (normally open contact) is not lit, although objects in the detection field are apparently changing	The objects are actually outside of the detection field	➔ Observe the maximum measurement distance of 250 cm ➔ Observe the exit angle of the sonic lobe: ±17° and ±5°
	Switch points are incorrectly defined	➔ Reset the switch points
	The fault is displayed exclusively on OUT 2.X: Sensor 2 is logged off	➔ Logon Sensor 2
No signal at output	Output connections have been switched	➔ Check the lead colours on the unit cable M12x8 ➔ Wire the outputs correctly
The object is not detected	The object is outside of the detection field	➔ Check the limits of the detection field with a test object
	Object has sound-absorbing structure	➔ Check the acoustic quality of the object ➔ Rethink the position of the sensor
	Object with sound-dividing shape; sound is deflected	➔ Check the acoustic quality of the object ➔ Rethink the position of the sensor
	Exchange air for a different medium or vacuum	➔ Check the entire sound path to the object: Is there air available along the entire path as transmission medium?
Static object is sometimes detected, sometimes not detected	The object is on the boundary of the detection field	➔ Change the corresponding switch point ➔ Reconfigure the sensor
	Object has sound-absorbing structure	➔ Check the acoustic quality of the object
	Object with sound-dividing shape; sound is deflected	➔ Check the acoustic quality of the object
	Electromagnetic interference	1. Check the cable laying between the sensor and the Evaluation Unit: Too close to the source of interference? 2. Shield the USi from the source of electromagnetic interference 3. Earth the Evaluation Unit

Fault display	Possible cause	Elimination
Accidental activation	Sources of acoustic interference (e.g. escaping compressed air)	1. Remove the source of interference 2. Shield the USi from the source of acoustic interference 3. Reconfigure the sensor
	Acoustic transverse reflections from other ultrasonic sources	1. Reconfigure the sensor 2. Apply multisensors (master + slave + software)
	Reciprocal interference from sensors	➔ Apply multisensors (master + slave + software)
	Direct sunlight on the Evaluation Unit	➔ Shield the Evaluation Unit
	Electromagnetic interference	1. Check the cable laying between the sensor and the Evaluation Unit: Too close to the source of interference? 2. Shield the USi from the source of electromagnetic interference 3. Earth the Evaluation Unit
	Too extreme temperature fluctuations within too short a time period	➔ Give the USi sufficient time (> 10 min) to acclimatise.

Fault can still not be detected?

➔ Contact Mayser-Support: Tel. +49 731 2061-0.

Replacement parts

	Designation	Part number
	Screw plugs for USi Evaluation Unit	1005377
	Sensor ultrasonic transducer ps/mt/18x4/m with 1.5 m cable	1005264

CAUTION

Malfunction due to spare parts from third-party suppliers

Malfunctions can occur if product parts are not replaced with original parts from Mayser.

➔ Only use original parts from Mayser.

Accessories

	Designation	Part number
	O-Ring Set 18×2.5 mm for ultrasonic transducer, to mount in standard mounting brackets (clamping version), consisting of: 2× O-Ring 18.0 × 2.5 mm	7502819
	O-Ring Set 17.5×2 mm for ultrasonic transducer, to mount in optimised mounting brackets (integrated version), consisting of: 2× O-Ring 17.5 × 2.0 mm	7502820
	Enclosure Set M30 for ultrasonic transducer, consisting of: 1× M30 enclosure 2× O-Ring 14.0 × 2.0 mm	7502704

	Designation	Part number
	Enclosure set, horizontal for Ultrasonic transducer, consisting of: 1× Enclosure horizontal 2× O-Ring 17.5 × 2.0 mm	7502905
	Enclosure set vertical for Ultrasonic transducer, consisting of: 1× Enclosure vertical 2× O-Ring 17.5 × 2.0 mm	7502906
	Extension cable for sensor (ultrasonic transducer) cut-to-size incl. M8 socket and M8 connector. Length: 1.5 m	1005903
 	Mounting rail adapter set for USi, consisting of: 1× Aluminium adapter 4× screws SK M5×10 self-cutting	7502767
	Unit cable M12x8 / USi, cut-to-size incl. lead ferrules and ready-to-connect shielding braid Length: 2 m	1005433
	Parameter assignment software for USi 1× on USB flash drive	7502768

CAUTION

Malfunction due to spare parts from third-party suppliers

Malfunctions can occur if third-party replacement parts are installed instead of original parts from Mayser.

➔ Only use original parts from Mayser.

Maintenance and cleaning

Maintenance

The USi is maintenance-free.

➔ Repeat the functional test annually.
For harsh environmental conditions or very high detection frequency, the interval for the functional test is reduced accordingly.

Cleaning

WARNING

Danger of injury due to electrocution!

➔ Disconnect the USi as well as all devices and live parts in the immediate environment from the power supply and protect them against being switched on again (see relevant Operating Instructions).

➔ Check whether all devices and parts are disconnected from the power supply.

➔ Clean the outside of the enclosure with conventional cleaning products.

➔ Allow the enclosure to dry before recommissioning.

CAUTION

Failure due to water penetration

Cleaning with a high-pressure cleaner my result in penetration of water in the Evaluation Unit (IP65) and failure of the electronic system.

➔ Never clean the Evaluation Unit with a high-pressure cleaner.

Decommissioning

WARNING

Danger of injury due to electrocution!

If the wiring is detached while the USi is still connected to the supply voltage, current can flow to 1 A.

➔ It is imperative to follow the sequence of instructions.

1. Remove the supply voltage.

2. Disconnect the wiring.

Disposal

The Control Units produced by Mayser are professional electronic tools exclusively intended for commercial use (so-called B2B devices). Unlike devices mainly used in private households (B2C), they may not be disposed of at the collection centres of public sector disposal organisations (e.g. municipal recycling depots). At the end of their useful life, the devices may be returned to us for disposal.
WEEE reg. no. DE 39141253

Conformity

The design type of the product complies with the basic requirements of the following directives:

- 2004/108/EC (EMC)

The Declaration of Conformity is available in the Downloads section of our website: www.mayser-sicherheitstechnik.de

Factory Settings

The USi is returned to the condition supplied to the customer by performing RESET. The factory settings stored in the USi thereby overwrite all current parameters. The standard values apply respectively for Sensor 1 **and** Sensor 2.

Display tab	Parameter	Standard value
Standard	Operating mode	1 range
	Switch point SP1	1 [cm]
	Switch point SP2	200 [cm]
	OUT 1.1 (output 1.1) *	Normally open contact/ analog
	OUT 1.2 (output 1.2) *	Normally open contact
	OUT 2.1 (output 2.1) *	Normally open contact
	OUT 2.2 (output 2.2) *	Normally open contact
	Switching behaviour*	Switch
	Measurement resolution *	cm
	Device synchronisation *	Off
Expert mode	Echo gain *	5 [–]
	Sensitivity *	5 [–]
	Multiple scan *	3 [–]
	Power-on delay *	10 [–]
	Close range to *	16 [cm]
	Echo distribution from *	50 [cm]
	Hysteresis *	0 [cm]
	Object size *	Medium
	Object detection *	Automatic
	Transducer mode *	Transmitter and receiver
	Transmitting intensity*	max.
	Transducer priority *	Off
	Interference suppression *	High / 1 s
	Measurement frequency * Measurement delay min. * Measurement delay max.*	Middle (ca. 20 Hz) 9 [ms] 13 [ms]
	Temperature compensation *	Constant +18 °C
Diagnosis	TVG *	TVG standard
	Select oscillogram *	Echo digital
	Distance display *	cm

* Parameter can only be changed with parameter assignment software

Technical Data

The “type” information refers to the USi in the condition supplied to the customer. If parameters are changed, these values change. The thereby potential bandwidth will be indicated by “.. to ...”

USi-PP/ USi-IP/ USi-UP	
Testing basis	IEC 60947-5-2, IEC 60204-1
Connecting voltage U_s	
Voltage tolerance	DC 15 to 30 V, reverse polarity protection
Rated current	type 80 mA (40 to 150 mA)
External protection	2 A time-lag
Power consumption	< 2.5 W (without load)
Detection functions	
Measurement method	Ultrasonic pulse-echo procedure
Evaluation	combined echo runtime and Echo amplitude measurement
Ultrasonic frequency	103 kHz
Measurement frequency	typically 20 Hz (2 to 250 Hz)
Measurement distance, max.	
Switch	typically 2000 mm (10 to 2500 mm)
Sensor (USi-IP/-UP)	typically 2000 mm (100 to 2500 mm)
Blind zone	
Switch	10 mm
Sensor (USi-IP/-UP)	100 mm
Opening angle sonic lobe	(see chapter *Sonic Lobe*)
Horizontal	±17°
Vertical	±5°
Resolution	
Switch	1 mm
Sensor (USi-IP/-UP)	1 mm
Object detection	
Size (min.)	typically 10 mm (to 1 mm)
Speed, axial (max.)	typically 2 m/s (to 2.5 m/s)
Repeatability	±2 mm (equals ±0.08%)
Hysteresis	typically 0 mm (0 to 250 mm) max.10% of SP2
Temperature compensation	
without: Temperature drift	0.17% /K
with	automatic/manual
Times	
Reaction time t_a	typically 150 ms (3 to 500 ms)
Re-start time t_w	typically 500 ms (3 to 50000 ms)
Switch frequency	typically 1.5 Hz (0.02 to 111 Hz)

USi-PP/ USi-IP/ USi-UP	
Inputs	
Sensor 1 and 2	Sensor 1 and Sensor 2
Connection	M8, 3-pole
Line length	1.5 m (+1.5 m extension cable)
USB	2.0
Version	USB Mini-B
Type	
Outputs	
Type: short-circuit-proof	NO contact, NC contact, off
Output 1.1 (OUT 1.1)	USi-PP: Power FET PNP
	USi-IP: DC 4 to 20 mA
	USI-UP: DC 0 to 10 V
Output 1.2 (OUT 1.2)	Power FET PNP
Output 2.1 (OUT 2.1)	Power FET PNP
Output 2.2 (OUT 2.2)	Power FET PNP
Switching current (max.)	200 mA per output
Switching voltage (max.)	DC 30 V
Safety classifications	
Electrostatic discharge protection in compliance with	IEC 61000-4-2
interference immunity against high frequency electromagnetic fields in compliance with	IEC 61000-4-3
interference immunity against fast transients in compliance with	IEC 61000-4-4
interference transmission in compliance with	IEC/CISPR 11 Group 1, Class A
Mechanical operating conditions	
Material, enclosure	
Evaluation Unit	Aluminium die casting
Sensor	PA 6.6
IEC 60529: protection class	
Evaluation Unit	IP65
Sensor	IP69K
max. humidity (23 °C)	99%
Operating temperature	-25 to +80 °C
Storage temperature	-40 to +85 °C
Dimensions (W × H × D)	
Evaluation Unit	98 × 80 × 35 mm
Sensor	12.6 × 26.6 × 21 mm
Weight	
Evaluation Unit	250 g
Sensor (incl. cable)	25 g

Glossary

Active surface Surface of a *proximity switch*, from which ultrasound is emitted and enters. [IEC 60947-5-2, 2.2.11.2]

Blind zone Zone between the *active surface* and the *minimum switching distance*, where no object can be detected. [IEC 60947-5-2, 2.3.1.3]

Coverage range Range, where the *switch points* can be set. [IEC 60947-5-2, 2.3.1.2]

Condition as supplied Condition of the *USi* upon leaving Mayser. All parameters conform to the *factory settings*.

Detection Basic function of a *proximity switch*. In contrast to the basic function *measurement,* the objective of the evaluation of the *echo signals* is only to determine the two conditions “object present” and “object not present”. (cf. *Measurement*)

Detection field That area within the s*onic lobe*, which is monitored by the *USi*. The detection field is bounded axially by the switch points and laterally and vertically by the edges of the *sonic lobe*. (cf. *Coverage range*, *sonic lobe*)

Diagnosis memory Internal memory of the *Evaluation Unit* for faults, which are determined during *initialisation*.

Distance The space between two points. First point of the *USi* is the *active surface*, second point is the detected object. (cf. *Measurement distance*)

Echo Returning (ultra)sonic wave.

Echo amplitude measurement Complex *measurement procedure* of the *USi*, where the measurement path itself is evaluated. This *measurement procedure* provides greater safety against disruptive signals. (cf. *Echo runtime measurement*, *measurement procedure*)

Echo envelope curve Interim result of the *USi* internal signal processing. The echo envelope curve serves as a basis for the *USi* internal evaluation of the *echo signals*.

Echo evaluation *USi* internal processing of the incoming *echo signals*.

Echo runtime measurement Ultrasonic *measurement procedure*, where the time span between the transmitting pulse and the input of the *echo signal* is used as the basis for the evaluation of the *distance*. (cf. *Echo amplitude measurement*, *measurement procedure*)

Echo signal Signal, which generates an *echo* on the *active surface*. (cf. *Continuous echo, echo*)

Evaluation Unit The part of the *USi* that controls the *sensor*, processes incoming signals from the *sensors* and supplying them to the *outputs* as evaluated signals.

Factory setting Table of all *USi* parameters, which are permanently saved in the *USi* and replace all changed *USi* parameters when *RESET*. In *the condition as supplied to customer* all *USi* parameters conform to the factory settings.

Initialisation Start sequence of the *USi* as soon as the *supply voltage* is connected. During initialisation testing is conducted for, among others, the internal hardware, the stored functional parameters, the connected sensors and the *outputs*. The result of the test is stored internally in the *diagnosis memory*. If the diagnosis memory does not contain any error reports, the *USi* immediately starts its function.

Logoff sensor Function of the *USi*, to log off and disconnect the connected Sensor 2 from the *USi*.

Logon sensor Function of the *USi*, to connect Sensor 2 and log on to the *USi*.

Master That *USi* of a *multisensor*, which transmits the synchronisation signal *SYNC* to the connected *slaves*.

Measurement Basic function of a *proximity switch*. In contrast to the basic function *detection,* the objective here is the evaluation of the *echo signals* to the *distance* of the detected *objects*. The measurement result is available at the analog output OUT 1.1 as a power signal (USi-IP) or as a voltage signal (USi-UP) (*cf. Output analog, Detection, OUT, Sensor, Switch*)

Measurement distance Distance between *active surface* and detected object. The minimum measurement distance is equal to the *minimum switching distance*, the maximum measurement distance is equal to the *monitoring range*.

Measurement frequency Parameter value in the expert mode in the parametrisation software (optional), that gives the number of measurements undertaken by the USi within one second.. The parameter value measurement frequency is not entered. Instead, there are three standard values “slow”, “medium” and “fast”. The measurement frequency is substantially affected by the number of sensors, the parameter values min. measuring delay and max. measuring delay as well as the switching point SP2 (cf. Sound frequency).

Measurement object Specified part, which is used for comparative measurements of the *switch points* and the *detection fields*. Synonymous with *Reference object*. (cf. *Object*)

Measurement procedure Procedure to determine a physical size. There are two measurement procedures for *USi*: *Echo runtime measurement* and *echo amplitude measurement*.

Measurement resolution *USi* parameter, which defines the smallest detectable unit of length. The USi differentiates between two measurement resolutions: cm mode and mm mode. The measurement resolution is preset to cm mode in *the condition as supplied to customer*. (cf. *Resolution*)

Minimum switching distance Lower limit of the specified *coverage range* of an ultrasonic proximity switch. [IEC 60947-5-2, 2.3.1.2.1] (cf. s_{min})

Monitoring range Maximum *measurement distance* within a defined *detection field* of an *ultrasonic*

	proximity switch.
Multisensor	System of multiple *USi* to monitor larger surface areas. The *USi* are intersynchronised by the signal *SYNC*. A multisensor system consists of one *master* and up to 24 *slaves*.
Noise interference	General side-effect of ultrasound sensor systems. Ultrasonic waves are not audible to humans. The transmission burst of the ultrasonic transducer, however, is perceived as a clearly audible crackle. At a typical frequency of 20 Hz, this may be perceived as annoying in the long term. Animals may occasionally also hear the ultrasonic waves and be annoyed by them.
Normally open contact	*Output* with NO contact function, which effects the flow of the load current when the *measurement object* is detected and causes the load current to stop flowing when the *measurement object* is not detected. (cf. *Output digital*, *OUT*)
Object	Element, which is detected by the ultrasonic proximity switch in the detection field. (cf. *Secondary object*)
Opening angle	Total angle around the *reference axis* of an *ultrasonic proximity switch*, where the sound level is reduced by 3 dB. [IEC 60947-5-2, 2.3.1.4] (cf. *Reference axis*)
Operating mode 1 Range	*USi* operating mode, where the switch point 1 is identical with the *minimum switching distance*. The detection field extends from 1 Range from *minimum switching distance* on to switch point 2.
Operating mode 2 Ranges	*USi* operating mode, where the *detection field* is divided into 2 ranges. Range 1: The sensor-proximal *detection field* extends from the *minimum switching distance* to switch point 1. Range 2: The sensor-distant *detection field* extends from switch point 1 to switch point 2.
Operating mode Window	*USi* operating mode, where Range 1 is not visible. A (monitoring) window is thereby created between switch point 1 and switch point 2. The operating mode Window can only be selected with the *parameter assignment software* (optional). Range 1: The hidden *detection field* extends from the *minimum switching distance* to switch point 1. Range 2: The detection window extends from switch point 1 to switch point 2.
OUT	Abbreviation for output. The USi has 2 outputs per sensor. For sensor 1, these are OUT 1.1 and OUT 1.2, for sensor 2 OUT 2.1 and OUT 2.2. For USi-IP, OUT 1.1 is an analog current output with DC 4 to 20 mA. For USi-UP, OUT 1.1 is an analog voltage output with DC 0 to 10 V. (cf. Output)
Output	Connection on which the output signal of a *proximity switch* is connected. The USi-PP has 4 digital outputs, 2 each for every *sensor* (Sensor 1, Sensor 2). USi-IP and USi-UP each have 3 digital outputs and one analog output (*cf. Output analog, output digital, OUT*)
Output analog	Output on which a linear current characteristic (USi-IP) or a linear voltage (USi-UP)

	is connected. The analog output OUT°1.1 can also be assigned an inverted output signal via the parameter assignment software (optional). (*cf. Output, OUT)*
Output digital	Semi-conductor of type PNP. Each output can be an NO contact, an NC contact or Off. The digital output is preset as NO contact in delivery condition. A changeover is implemented, e.g., by defining output 1.1 as a normally open contact and output 1.2 as a normally closed contact. The digital outputs are defined via the parameter assignment software (optional) (cf. Output, OUT, PNP)
Parameter assignment software	Optional software, with which all *USi* parameters can be changed via a Windows® interface and transmitted via USB interface to the USi. The parameter assignment software allocates the three modes *Standard*, *Expert mode* and *Diagnosis*.
PNP	Transistor *output* Type PNP.
Proximity switch	Position switch, which is activated without mechanical contact with the moving object. [IEC 60947-5-2, 2.1.1] (cf. *Ultrasonic proximity switch*)
Real switching distance	*Switching distance* of an individual *proximity switch*, which is measured at specific temperature, voltage and installation conditions. [IEC 60947-5-2, 2.3.1.5]
Reference axis	Axis, which runs perpendicularly to the *active surface* and through its centre. [IEC 60947-5-2, 2.2.2.1] (cf. *Opening angle*)
Reference object	Specified part, which is used for comparative measurements of the *switch points* and the *detection fields*. Synonymous with *measurement object*.
Reflex barrier	Extended function of an *ultrasonic proximity switch*. The *USi* monitors the area between *switch point SP1* and a taught-in reflector. Each change results in signal change at the *output*. (cf. *Sonic barrier*)
Reflex switch	Basic function of an *ultrasonic proximity switch*. *Objects* in the *detection field* will be detected, meaning sensed using the *sonic lobe*.
Repeatability	Make a change to the *real switching point* under predetermined conditions. [IEC 60947-5-2, 2.3.4] Indicates the accuracy of measurement results, which have passed through the same *switch point* with predetermined conditions. Synonymous with reproducibility.
RESET	Function with which the *USi* is set back to the *delivery condition.* Subsequently, the *USi* will start with the *factory settings*.
Resolution	Smallest unit of length, which can be differentiated by a *proximity switch*. Resolution of the USi: 1 mm. (cf. *Measurement resolution*)
Secondary object	*Object* in the *detection field*, which is not an *object* to be detected. Examples: machine parts, shelves, columns, etc. In order to prevent malfunctions, the *USi* will be subjected to a *Teach In* of the environment incl. all secondary objects. (cf. *Object*)

Slave
That *USi* of a *multisensor*, which receives the synchronisation signal *SYNC* from the *master*.

s_{min}
Formula for the *minimum switching distance*.

Sensor
Proximity switch, which operates in the basic function *measurement*. Here, the objective of the evaluation of the *echo signals* is to determine the distance of the detected *objects*. The measurement result is available at the analog output OUT 1.1 as a current signal (USi-IP) or voltage signal (USi-UP).
(cf. *Measurement, Switch*)

Sensor
Part of the *USi*, which can transmit the ultrasonic waves via the *active surface* and receive resulting echos. Up to two sensors can be connected to each *USi*. The connection designations on the *Evaluation Unit* are in English. (cf. *Ultrasonic transducer*, *transducer*; BUT: *sensor*)

Sonic barrier
Extended function of an *ultrasonic proximity switch*. Two *sensors* face each other and monitor the taught-in area in between. One *sensor* thereby acts as a *transmitter* and the other as a *receiver*. Each change results in signal change at the *output*. (cf. *Reflex barrier*)

Sonic lobe
Three-dimensional *coverage range* of a *ultrasonic proximity switch*.

Supply voltage
Voltage, which is externally connected to a device, in order to enable its operation. The supply voltage should correspond to the connecting voltage indicated on the type plate of the device.

SYNC
Signal for the synchronisation of a *multisensor*.

Switch
Proximity switch, which operates in the basic function *measurement*. The objective of the evaluation of the *echo signals* is only to determine the two conditions “object present” and “object not present”. (cf. *Detection, Sensor*)

Switching behaviour
USi parameter which defines the switching characteristic at the outputs. The switching characteristic is preset as a switch in delivery condition. In the case of a switching behaviour as a switch, the outputs function as normal switches. In the case of a switching behaviour as a button, the outputs function according to time periods: if an object is detected, the outputs react and remain in this state for the period T_{ON}. The USi then pauses for the time period T_{OFF}. The outputs are reset during this time.

Switching distance
Distance, at which a signal change at the output is caused by the approximation of a *measurement object* to the *active surface* along the *reference axis*.
[IEC 60947-5-2, 2.3.1]

Switching frequency
Number of switching operations of a proximity switch in a specified time interval.
[IEC 60947-5-2, 2.4.3] (cf. *Measurement frequency*)

Switch point	Determined *switching distance*. Two switch point are always determined at the *USi: switch point SP1* and *switch point SP2*.
Switch point SP1	The sensor-proximal *switch point* of the USi. The following applies: SP1 < SP2. Switch point SP1 is preset to 1 [cm] in *delivery condition*.
Switch point SP2	The sensor-distant *switch point* of the USi. The following applies: SP2 > SP1. Switch point SP2 is preset to 200 [cm] in *delivery condition*.
Teach In	Function, which causes the *USi* to teach in the currently prevailing environment in the *detection field* and to consider all *secondary objects* as given. Also available as a button in the *Diagnosis* mode of the *parameter assignment software* (optional).
Temperature compensation	Internal function of *ultrasonic proximity switches*, which balance the typical ultrasonic *temperature drift*. (cf. *Temperature drift*)
Temperature drift	Deviating measurement behaviour of *ultrasonic proximity switches* dependent on temperature. The typical ultrasonic temperature drift is generally balanced by internal *temperature compensation*. (cf. *Temperature compensation*)
Transducer	Abbreviated name for *ultrasonic transducer*. Referred to as *sensor* for USi. (cf. *Sensor*, *Ultrasonic transducer*)
Transmission burst	Start sequence of an ultrasound bundle which is transmitted. May be heard as a crackle.
Transverse reflections	Unwanted echos generated by unfavourable environmental conditions. Transverse reflection can lead to malfunction of the *ultrasonic proximity switch*.
Ultrasonic frequency	Sound frequency, with which an *ultrasonic proximity switch* operates.
Ultrasonic proximity switch	Proximity switch, which transmits ultrasonic waves in an active zone and receives a semiconductor switching element. [IEC 60947-5-2, 2.1.1.3] (cf. *Proximity switch*)
Ultrasonic transducer	Part of an *ultrasonic proximity switch*, which can transmit the ultrasonic waves via the *active surface* and receive resulting echos. Referred to as *sensor* for USi. (cf. *Sensor*, *Transducer*)
USi	Abbreviation for Ultrasonic Industrial Sensor.
USi-IP	Abbreviation for USi with one power output and three PNP outputs.
USi-PP	Abbreviation for *USi* with two PNP outputs per sensor.
USi-UP	Abbreviation for USi with one voltage output and three PNP outputs.