



## OPTISYS TSS X050 SERIES Technical Datasheet

Hygienic absorption measurement system  
TSS 1050, TSS 2050, TSS 3050, TSS 4050

- Compact, hygienic design with integrated electronics and parameterisation display
- Elastomer-free sealing with an ingress protection of IP69K in a robust housing
- Fast reacting and comprehensive process monitoring



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## 1.1 Hygienic total suspended solids / turbidity meter

The OPTISYS TSS X050 series are 180° absorption measurement systems for fluids operating in the near infrared range (880 nm wavelength). The systems are installed in and/or on tanks or pipelines. The optical part of the systems is submerged in the process medium in order to measure the physical properties of the medium by absorption of light.

The TSS 1050 and TSS 2050 are simply designed, competitive NIR measuring systems with a scale between 0 to 100% absorption characteristics of the fluids. There are 2 OPL (Optical Path Length) available: 5 mm / 0.2" and 10 mm / 0.4" each for a different range. For the TSS 1050 a version with 20 mm / 0.8" OPL is also available. The TSS 2050 is used in manually (RET) or automatically (RAM) operated retractable assemblies of the SENSOFIT family.

The NIR measuring systems TSS 3050 and TSS 4050 are used for monitoring the optical density (extinction) or absorption in fluids in order to monitor the process results continuously or to securely indicate changes. A logarithmic amplifier guarantees a very wide measuring range, which is about 4 times the size of the TSS 1050 / 2050. The TSS 4050 is used in manually (RET) or automatically (RAM) operated retractable assemblies of the SENSOFIT family.



- ① TSS 1050 / TSS 3050
- ② TSS 2050 / TSS 4050

### Highlights

- 180° transmitted light method according to ISO 7027
- Measuring range (TSS 1050 / TSS 2050): TSS / turbidity scale between 0 to 100% with 3 OPL
- Measuring range (TSS 3050 / TSS 4050): 0...6 OD, 0...3 AU, 0...3250 EBC, 0...13000 FAU, 0...13000 TEF or 0...26.65 g/l
- Analogue output to provide measuring results
- Digital output for setable switching points for enabling / disabling pumps, valves, etc.
- Hygienic design due to bordered sapphire-glass, elastomer-free sealing system and electropolished stainless steel (1.4435 / AISI 316L)
- Robust housing with ingress protection of IP69K
- Compact design with integrated electronics (no external transmitter necessary)
- Parametrisation via display or PC / Laptop

### Industries

- Food & Beverages
- Breweries
- Dairies
- Process industry
- Water

### Applications

- Monitoring of water qualities
- Detection of leakages
- Optimizing of cleaning processes (CIP / SIP)
- Filter monitoring (back washing, status, etc.)
- Optimising of separating processes (inlet / outlet)
- Phase separation
- Concentration measurement

## 1.2 Options and variants

There are altogether 4 TSS / turbidity meter variants available.

### TSS 1050



Connection: G1/2 thread

Measuring range OPL 5 mm / 0.2":  
0...500 EBC / 0...2000 FAU / 5.0 g/l ~ 0.4% TSS\*

Measuring range OPL 10 mm / 0.4":  
0...250 EBC / 0...1000 FAU / 2.5 g/l ~ 0.2% TSS\*

Measuring range OPL 20 mm / 0.8":  
0...100 EBC / 0...400 FAU / 1.0 g/l ~ 0.1% TSS\*

### TSS 2050



Connection: PG 13.5 for retractable assemblies

Measuring range OPL 5 mm / 0.2":  
0...500 EBC / 0...2000 FAU / 5.0 g/l ~ 0.4% TSS\*

Measuring range OPL 10 mm / 0.4":  
0...250 EBC / 0...1000 FAU / 2.5 g/l ~ 0.2% TSS\*

\* the values represent about 80% of the display scale

### TSS 3050



Connection: G1/2 thread

Measuring range OPL 5 mm / 0.2":  
0...3 AU, 0...6 OD, 0...13000 FAU, 0...13000 FTU, 0...3250 EBC, 0...26.65 g/l

### TSS 4050



Connection: PG 13.5 for retractable assemblies

Measuring range OPL 5 mm / 0.2":  
0...3 AU, 0...6 OD, 0...13000 FAU, 0...13000 FTU, 0...3250 EBC, 0...26.65 g/l

### 1.3 Measuring principle

Transmitted light absorption principle; pulsed NIR 880 nm; one emitter and one detector to measure the absorption of light on suspended solids and particles. The light passes the measured particles between the emitter and the detector. Depending on industry and application the absorption measurement principle is used for the parameters extinction (optical density); total suspended solids or turbidity.

TSS (Total Suspended Solids) is a key measurement for water, wastewater and certain industrial processes. Typically, TSS is monitored through periodic grab samples and a filter test performed by a skilled technician. TSS is the gravimetric dry-weight of particles trapped by a filter. TSS is typically expressed in mg/l, g/l, ppm and %. Total Suspended Solids (mg/l) = (filter weight after filtering – filter weight before filtering) / sample volume in litres. Quantitative online TSS measurement is often done with absorption sensors. The TSS sensors also provide immediate results for process control and reduce the need for the time-consuming suspended solids lab analysis. Online sensors are best used after calibration or correlation to the gravimetric TSS procedure.

Turbidity is an optical property of water based on the amount of light scattered or absorbed (>40 NTU) by colloidal and suspended particles compared against a formazine standard. As an alternative to formazine, a polymer calibration standard is often used to calibrate the turbidity, as used in the corresponding white light method according to EPA 180.1. The turbidity value measured in FNU, FTU, NTU, EBC, FAU is the quantitative statement of this qualitative phenomenon.

The Transmitted light absorption principle delivers total suspended solids or turbidity values and does as such deliver proportional data for particle concentration. Therefore it is suitable for phase separation (indication) as well as process control and similar applications.

The advantage of the using NIR as light source is that this sensor is not affected by colour of the medium measured.

## 2.1 Technical data

- *The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local sales office.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Downloadcenter).*

### Measuring system

Measuring principle	180° transmitted light absorption method pulsed NIR 880 nm. Absorption of light on suspended solids and colloidal particles. The light passes the measured particles between one emitter and one detector.
Application	Total suspended solids, turbidity or optical density (extinction) in fluids in the near infrared range (880 nm wavelength)

### Design

Variants	4 different types
	<b>TSS 1050</b> Simply designed, competitive NIR system with a scale between 0 to 100% absorption characteristics of fluids. G1/2 process connection.
	<b>TSS 2050</b> Simply designed, competitive NIR system with a scale between 0 to 100% absorption characteristics of fluids. This system is used in a manually (RET) or automatically (RAM) operated retractable assembly of the SENSOFIT family. PG13.5 process connection.
	<b>TSS 3050</b> Measuring system for monitoring the optical density (extinction) or absorption of fluids in order to monitor continuous process results or to securely indicate changes. This device has the possibility to be calibrated to improve accuracy. G1/2 process connection.
	<b>TSS 4050</b> Measuring system for monitoring the optical density (extinction) or absorption of fluids in order to monitor continuous process results or to securely indicate changes. This device has the possibility to be calibrated to improve accuracy. This system is used in a manually (RET) or automatically (RAM) operated retractable assembly of the SENSOFIT family. PG13.5 process connection.
Display (option)	Device can be parameterised using the function keys on the display.
Light method specifications	Wavelength: 880 nm
	Light source: LED
<b>Measuring range</b>	
TSS 1050/2050	Scale: 0...100%
	OPL 5 mm / 0.2": 0...500 EBC / 0...2000 FAU / 5.0 g/l ~ 0.4% TSS*
	OPL 10 mm / 0.4": 0...250 EBC / 0...1000 FAU / 2.5 g/l ~ 0.2% TSS*
	OPL 20 mm / 0.8": 0...100 EBC / 0...400 FAU / 1.0 g/l ~ 0.1% TSS* (only TSS 1050)
	* the values represent about 80% of the display scale
TSS 3050/4050	0...3 AU (Absorption Units)
	0...6 OD (Optical Density)
	0...13000 FAU (Formazine Absorption Unit)
	0...13000 FTU (Formazine Turbidity Unit)
	0...3250 EBC (European Brewery Convention)
	0...26.65 g/l (grams per litre)

**Measuring accuracy**

Accuracy	< ± 5% of the maximum value range
Repeatability	< ± 0.5% of the maximum value range
Response time	1.5 seconds

**Operating conditions**

Process temperature	0...+90°C / +32...+194°F
Ambient temperature	-20...+70°C / -4...+158°F
Max. admissible temperature	+90°C / +194°F
Max. admissible sterilisation temperature	+140°C / +284°F, max. 2 hours
Max. pressure	10 bar / 145 psi at 60°C / 140°F
Ingress protection	IP69K

**Installation conditions**

Installation position	Installed on tanks or in pipelines.
	Device can be operated in any position but it is recommended with a product flow from bottom to top.
	Optical window of the device is submerged in the process medium
	For flushing or removing device during running process, for types TSS 2050/4050 retractable assemblies are optionally available.
Process connection	G1/2 (1050/3050) or PG 13.5 (2050/4050)
Weight	TSS 1050/3050: 700 g / 1.5 lb
	TSS 2050/4050: 850 g / 1.9 lb

**Materials**

Sensor body	Stainless steel 1.4435 (316L)
	Surface quality: electro-polished < Ra 0.37 µm
Measuring window	Sapphire

**Electrical connection**

Power supply	12...30 VDC
Load	≤ (U <sub>b</sub> - 4 V)/20 mA (max. 400 Ω at 12 V, 1000 Ω at 24 V, 1300 Ω at 30 V)
Analogue output	4...20 mA
Current demand	Approx. 80 mA (30 VDC and analogue output = 22.5 mA)
Power input	2.4 W max.
Current limit	3.5 mA min.; 22.5 mA max.; adjustable
Switching output	All devices: NO or NC adjustable; PNP- switching; 200 mA max., thermally protected
Teach input (only for TSS 1050/2050)	Digital input; +12...30 VDC max. 1.6 mA input current
Cable connection	5-pin M12 connector
Cable length	Standard: 5 m / 16.4 ft
	Option: 10 m / 32.8 ft, 20 m / 65.6 ft or 30 m / 98 ft



## Approvals and certifications

CE	The device meets the essential requirements of the EU directives. The CE marking indicates the conformity of the product with the union legislation applying to the product and providing for CE marking. For full information of the EU directives and standards and the approved certifications, please refer to the EU declaration on the KROHNE website
Hygienic	Regulation (EC) No 1935:2004
Electromagnetic compatibility	EMC Directive 2014/30/EU

## 2.2 Dimensions and weight

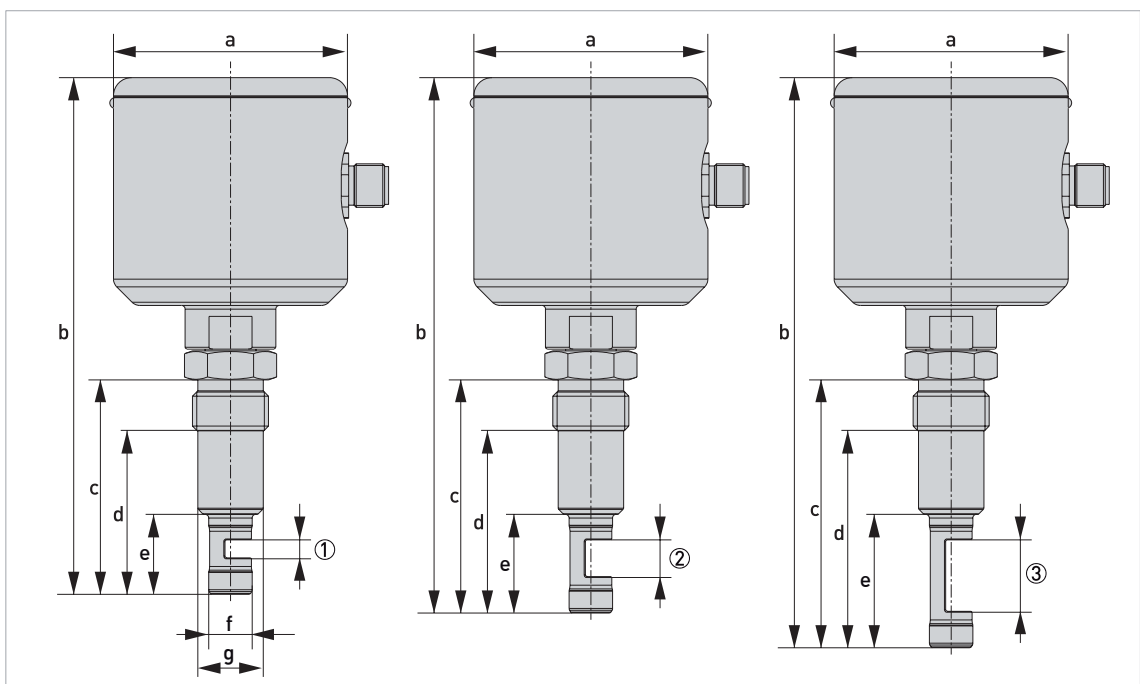


Figure 2-1: Dimensions of TSS 1050

- ① Optical path length 5 mm / 0.2"
- ② Optical path length 10 mm / 0.4"
- ③ Optical path length 20 mm / 0.8"

### Dimensions in mm

Type	a	b	c	d	e	f	g
①	Ø68	142	59	45	22	Ø12	Ø18
②	Ø68	147	64	50	27	Ø12	Ø18
③	Ø68	157	74	60	37	Ø12	Ø18

### Dimensions in inch

Type	a	b	c	d	e	f	g
①	Ø2.7	6.6	2.3	1.8	0.9	Ø0.5	Ø0.7
②	Ø2.7	5.8	2.5	2.0	1.1	Ø0.5	Ø0.7
③	Ø2.7	6.2	2.9	2.4	1.5	Ø0.5	Ø0.7

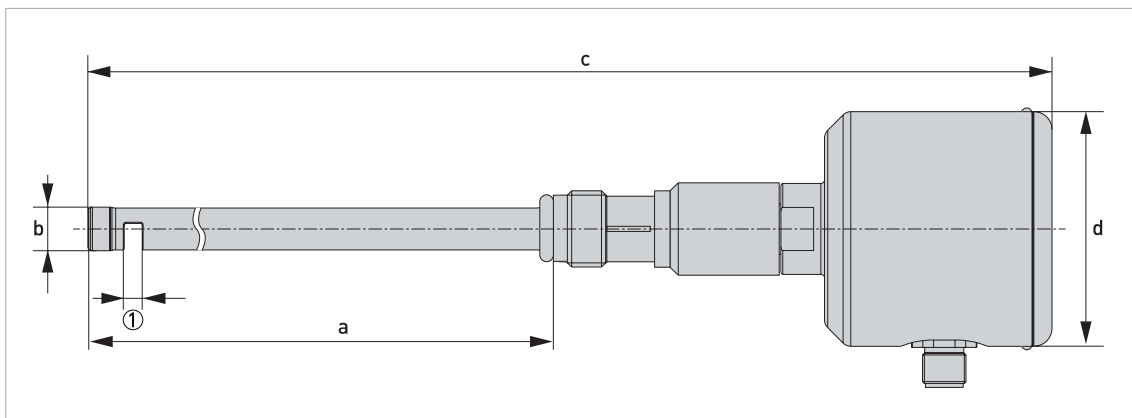


Figure 2-2: Dimensions of TSS 2050

① Optical path length 5 mm / 0.2" or 10 mm / 0.4"

a	b	c	d
<b>Dimensions in mm</b>			
225	Ø12	363	Ø68
<b>Dimensions in inch</b>			
8.9	Ø0.5	14.3	Ø2.7

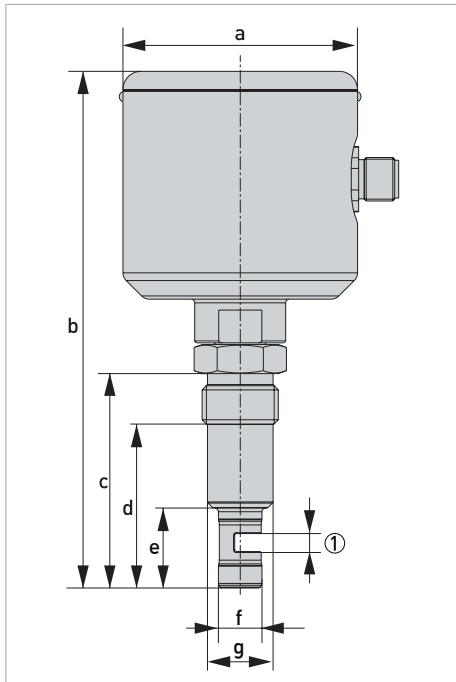


Figure 2-3: Dimensions of TSS 3050

① Optical path length 5 mm / 0.2"

a	b	c	d	e	f	g
<b>Dimensions in mm</b>						
Ø68	142	59	45	22	Ø12	Ø18
<b>Dimensions in inch</b>						
Ø2.7	6.6	2.3	1.8	0.9	Ø0.5	Ø0.7

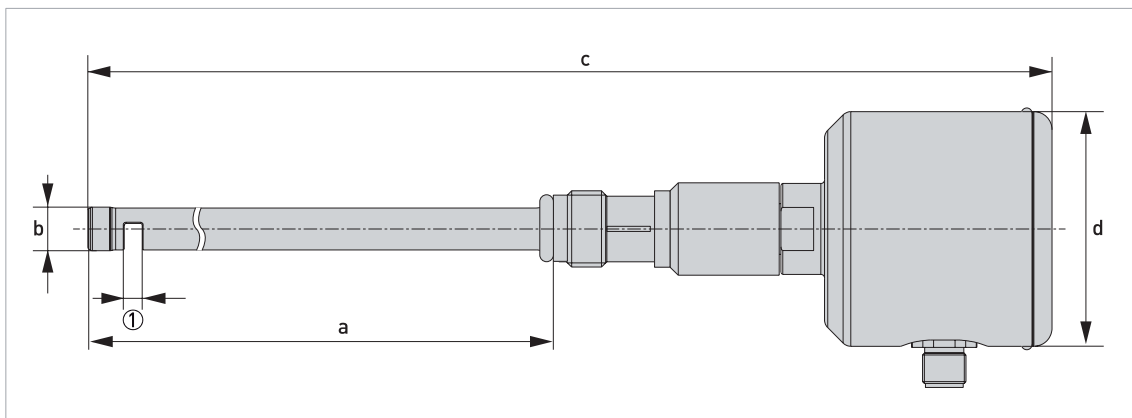


Figure 2-4: Dimensions of TSS 4050

① Optical path length 5 mm / 0.2"

a	b	c	d
<b>Dimensions in mm</b>			
225	Ø12	363	Ø68
<b>Dimensions in inch</b>			
8.9	Ø0.5	14.3	Ø2.7

### 3.1 General notes on installation

*Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.*

*Do a check of the packing list to make sure that you have all the elements given in the order.*

*Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.*

### 3.2 Intended use

*Responsibility for the use of the measuring devices with regard to suitability, intended use and corrosion resistance of the used materials against the measured fluid lies solely with the operator.*

*This device is a Group 1, Class A device as specified within CISPR11:2009. It is intended for use in industrial environment. There may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.*

*The manufacturer is not liable for any damage resulting from improper use or use for other than the intended purpose.*

The OPTISYS TSS X050 series are 180° absorption measuring systems for fluids. They operate in the near infrared range (880 nm wavelength). The systems are installed in and/or on tanks or pipelines. The optical part of the systems is submerged in the process medium in order to measure the physical medium properties by absorption of light.

There are four different types available:

#### **TSS 1050**

is a simply designed, competitive NIR measuring system with a scale between 0 to 100% absorption characteristics of fluids. There are 3 OPL (Optical Path Lengths) available: 5 mm, 10 mm and 20 mm / 0.2", 0.4" and 0.8", each for a different turbidity/suspended solids range.

#### **TSS 2050**

is a simply designed, competitive NIR measuring system with a scale between 0 to 100% absorption characteristics of fluids. There are 2 OPL (Optical Path Lengths) available: 5 mm and 10 mm / 0.2" and 0.4", each for a different turbidity/suspended solids range.

This device is used in manually (RET) or automatically (RAM) operated retractable assemblies of the SENSOFIT family. By using retractable assemblies, the device can be flushed or removed with the process running, efficiently preventing wrong readings caused by coatings on the measuring windows and allowing for long-term monitoring of processes.

#### **TSS 3050**

is a measuring system for monitoring the optical density (extinction) or absorption of fluids in order to monitor continuous process results or to securely indicate changes. A logarithmic amplifier guarantees a very wide measuring range (0...6 OD, 0...3 AU, 0...3250 EBC, 0...13000 FAU, 0...13000 TEF or 0...26.65 g/l).

### TSS 4050

is a measuring system for monitoring the optical density (extinction) or absorption of fluids in order to monitor continuous process results or to securely indicate changes. A logarithmic amplifier guarantees a very wide measuring range (0...6 OD, 0...3 AU, 0...3250 EBC, 0...13000 FAU, 0...13000 TEF or 0...26.65 g/l).

This measuring system is used in manual (RET) or automatic (RAM) retractable assemblies of the SENSOFIT family. By using retractable assemblies, the device can be flushed or removed with the process running, efficiently preventing wrong readings caused by coatings on the measuring windows and allowing for long-term monitoring of processes.

## 3.3 Storage and transport

- Store the device in a dry, dust-free location.
- Avoid continuous direct sunlight.
- The original packing is designed to protect the equipment. It has to be used if the device is transported or sent back to the manufacturer.

## 3.4 Pre-installation requirements

### Installation position

As a matter of principle, the device can be operated in any position. However, for installations in vertical pipes, the direction of flow should be from bottom to top. Moreover please observe the good legibility of the indicator and good accessibility and operability.

### Measuring window

The measuring windows must be oriented in such a way that no air bubbles or particles may be caught between them. The measuring windows must be kept clean. This can be achieved by an appropriate CIP / SIP cleaning process or you can alternatively use the type for a retractable assembly.

### Make sure before installation that:

- there is enough working space for operating the device.
- the process is shut down.
- tanks or pipelines are depressurised, empty and clean.
- connection nozzle and process connection of the device are matching.
  
- *If the temperature drops below the dew point, the device may be influenced or damaged by condensation in the housing.*
- *At stress with change of temperatures, e.g. a cold water jet on the hot device could lead to leakages into the device.*
- *At applications with dew point, temperature shock or thermal shock stresses it is recommended to put the desiccant pouch into the housing.*

### 3.5 Mechanical connection

- *Risk of injuries due to escaping process fluid!*
- *Burns or chemical burns depending on the properties of the process fluid.*
- *Wear safety goggles and protective clothing!*
- *Install the device only when the tank or pipeline is depressurised, empty and clean!*

#### Installation procedure

- Insert the sensor into the matching modular process connection.
- Tighten the pressure screw to a torque of maximum 10 Nm.

### 3.6 Electrical connection

*All work on the electrical connections may only be carried out with the power disconnected.*

*Observe the national regulations for electrical installations!*

*Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.*

The electrical connection is made via a M12 plug connection. Assure to use the original IP69K connecting cable with the proper VA connector.

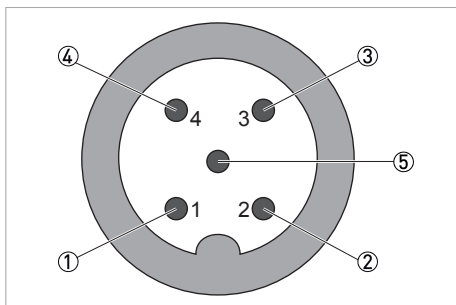


Figure 3-1: Pin designation

Pin	Colour	Designation
①	Brown	(+) supply (24 VDC)
②	White	Switching output
③	Blue	(-) supply
④	Black	4...20 mA analogue output
⑤	Green/yellow or grey	Teach input (+12...30 VDC) [only for TSS 1050/2050]

- Connect the cable to the plug of the device.
- Tighten the retainer nut hand-tight.

4.1 Order code

The characters of the order code highlighted in light grey describe the standard.

VGA 6	4	Sensor type									
		1	OPTISYS TSS 1050								
		2	OPTISYS TSS 2050								
		3	OPTISYS TSS 3050								
		4	OPTISYS TSS 4050								
		<b>Wave length</b>									
		2	880 nm								
		<b>Optical path length</b>									
		1	5 mm (TSS 1050, 2050, 3050, 4050)								
		2	10 mm (TSS 1050, 2050)								
		3	20 mm (TSS 1050)								
		<b>Process conditions</b>									
		1	G 1/2 (TSS 1050, 3050)								
		2	PG 13.5 (TSS 2050, 4050)								
		<b>Sensor insertion length</b>									
		1	45 mm (OPL 5 mm for TSS 1050, 3050)								
		2	50 mm (OPL 10 mm for TSS 1050)								
		3	60 mm (OPL 20 mm for TSS 1050)								
		4	225 mm (TSS 2050, 4050)								
		<b>Hygienic certificates</b>									
		0	None								
		<b>Calibration certificates</b>									
		0	None (TSS 1050, 2050, 3050, 4050)								
		1	Test certificate (TSS 3050, 4050)								
		<b>Approvals</b>									
		0	None								
		<b>Options</b>									
		0	None								
		<b>Documentation</b>									
		0	None								
		1	English								
		2	German								
		3	French								
VGA 6	4										

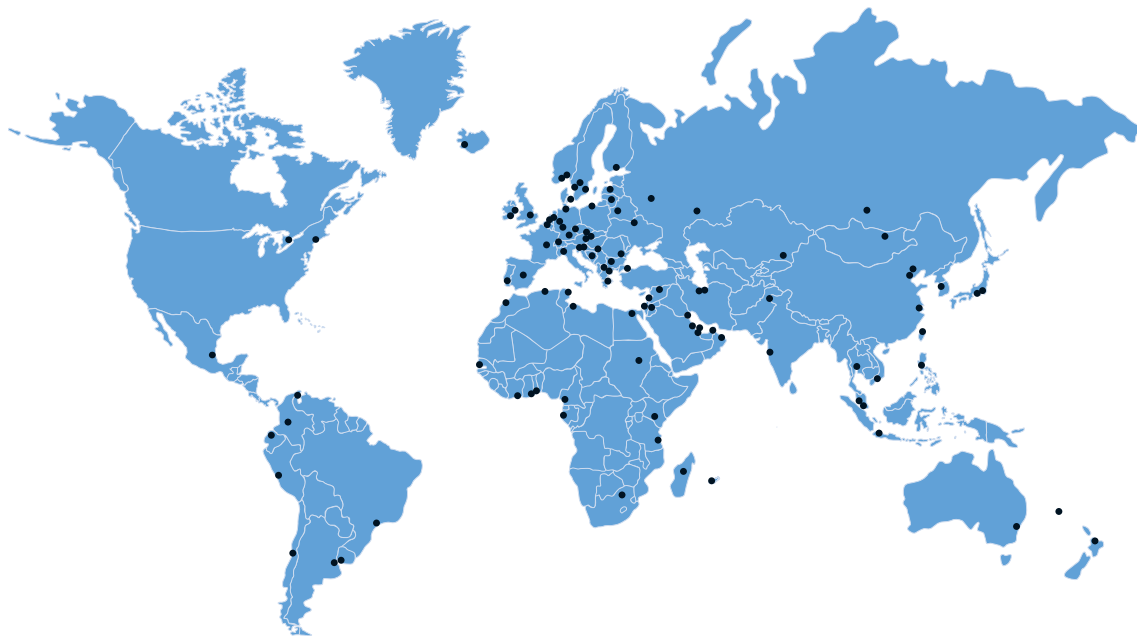


Process adapters for OPTISYS TSS X050	Order code
Weld in socket for tanks, G1/2, cylindrical	XGA6000010
Adapter sleeve, G1 to G1/2	XGA6000020
Varivent N DN 50, G1/2	XGA6000030
Milk cone DN 50, G1/2	XGA6000040
TriClamp DN 50 (2"), G1/2	XGA6000050
TriClamp DN 65 (3"), G1/2	XGA6000060
Blanking plug for G 1/2, SS 316L /1.4404	XGA6000110
Brass weld in pin for G1/2	XGA6000120

Cables for OPTISYS TSS X050	Order code
M12 x 1.5 cable with plug, 5 m, IP69K, 5-pole, stainless steel nut	XGA6000205
M12 x 1.5 cable with plug, 10 m, IP69K, 5-pole, stainless steel nut	XGA6000210
M12 x 1.5 cable with plug, 20 m, IP69K, 5-pole, stainless steel nut	XGA6000220
M12 x 1.5 cable with plug, 30 m, IP69K, 5-pole, stainless steel nut	XGA6000230
USB / M12 programming cable (optional for programming of TSS X050)	XGA6000310
M12 / M8 adapter (optional for programming of TSS X050)	XGA6000320







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