



OPTISYS TSS X050 SERIES Handbook

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

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1.1 Intended use

**CAUTION!**

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.

**INFORMATION!**

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.

**INFORMATION!**

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.

1.2 Certifications

CE marking



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.

The manufacturer certifies successful testing of the product by applying the CE marking.

1.3 Safety instructions from the manufacturer

1.3.1 Copyright and data protection

The contents of this document have been created with great care. Nevertheless, we provide no guarantee that the contents are correct, complete or up-to-date.

The contents and works in this document are subject to copyright. Contributions from third parties are identified as such. Reproduction, processing, dissemination and any type of use beyond what is permitted under copyright requires written authorisation from the respective author and/or the manufacturer.

The manufacturer tries always to observe the copyrights of others, and to draw on works created in-house or works in the public domain.

The collection of personal data (such as names, street addresses or e-mail addresses) in the manufacturer's documents is always on a voluntary basis whenever possible. Whenever feasible, it is always possible to make use of the offerings and services without providing any personal data.

We draw your attention to the fact that data transmission over the Internet (e.g. when communicating by e-mail) may involve gaps in security. It is not possible to protect such data completely against access by third parties.

We hereby expressly prohibit the use of the contact data published as part of our duty to publish an imprint for the purpose of sending us any advertising or informational materials that we have not expressly requested.

1.3.2 Disclaimer

The manufacturer will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect or incidental and consequential damages.

This disclaimer does not apply in case the manufacturer has acted on purpose or with gross negligence. In the event any applicable law does not allow such limitations on implied warranties or the exclusion of limitation of certain damages, you may, if such law applies to you, not be subject to some or all of the above disclaimer, exclusions or limitations.

Any product purchased from the manufacturer is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.

The manufacturer reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.

1.3.3 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation or operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions" which form the basis for the sales contract shall also apply.

1.3.4 Information concerning the documentation

To prevent any injury to the user or damage to the device it is essential that you read the information in this document and observe applicable national standards, safety requirements and accident prevention regulations.

If this document is not in your native language and if you have any problems understanding the text, we advise you to contact your local office for assistance. The manufacturer can not accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device. Special considerations and precautions are also described in the document, which appear in the form of icons as shown below.

1.3.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.



DANGER!

This warning refers to the immediate danger when working with electricity.



DANGER!

This warning refers to the immediate danger of burns caused by heat or hot surfaces.



DANGER!

This warning refers to the immediate danger when using this device in a hazardous atmosphere.



DANGER!

These warnings must be observed without fail. Even partial disregard of this warning can lead to serious health problems and even death. There is also the risk of seriously damaging the device or parts of the operator's plant.



WARNING!

Disregarding this safety warning, even if only in part, poses the risk of serious health problems. There is also the risk of damaging the device or parts of the operator's plant.



CAUTION!

Disregarding these instructions can result in damage to the device or to parts of the operator's plant.



INFORMATION!

These instructions contain important information for the handling of the device.



LEGAL NOTICE!

This note contains information on statutory directives and standards.



• **HANDLING**

This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.

➡ **RESULT**

This symbol refers to all important consequences of the previous actions.

1.4 Safety instructions for the operator



WARNING!

In general, devices from the manufacturer may only be installed, commissioned, operated and maintained by properly trained and authorized personnel.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device.

2.1 Scope of delivery

**INFORMATION!**

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

**INFORMATION!**

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

**INFORMATION!**

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.

The device is calibrated in the factory and is delivered ready-to-install in a packaging providing ideal protection of the sensor.

The scope of delivery is:

- Device as ordered
- Protective sleeve for measuring lens (only for 1050/3050)
- Cabling (if ordered)
- Operating instructions (if ordered)

2.2 Device description

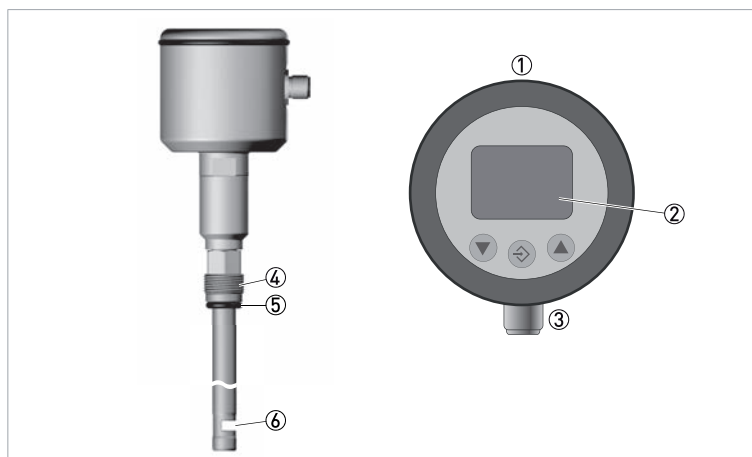


Figure 2-1: Construction of the device

- ① Housing cover
- ② Display and control display (optionally removable)
- ③ M12 connector for electrical connection
- ④ G 1/2 or PG13.5 screw connection
- ⑤ O-Ring (2050/4050) or metal sealing (1050/3050)
- ⑥ Measuring windows

The TSS 1050/3050 is installed into pipelines or tanks by means of its hygienic modular G1/2 process connection directly using a welding sleeve or inserted into existing process connections using the corresponding process adapters.

The TSS 2050/4050 with sensor element in 12 mm / 0.47" / PG 13.5 design is installed into a retractable assembly that in turn is connected to the process lines or to the tank.

The current measured value is shown on the display in each case. With the help of the function keys, the device can be configured. The display can be removed allowing for the efficient prevention of any accidental changes to the settings.

2.3 Nameplate



INFORMATION!

Look at the device nameplate to ensure that the device is delivered according to your order.

The device type is specified on the label of the package and on the device itself.



Figure 2-2: Example for a nameplate

- ① Manufacturer
- ② Observe the installation and operating instructions
- ③ CE marking
- ④ Marking according to WEEE directive
- ⑤ Website
- ⑥ Maximum pressure and temperature
- ⑦ Manufacturer date / Article number / Serial number
- ⑧ Order code
- ⑨ Device name

3.1 General notes on installation

**INFORMATION!**

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

**INFORMATION!**

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

**INFORMATION!**

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 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.

3.3 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.

**CAUTION!**

- *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.*

3.4 Mechanical connection



DANGER!

- 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.

3.5 Electrical connection



DANGER!

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



DANGER!

Observe the national regulations for electrical installations!



WARNING!

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.

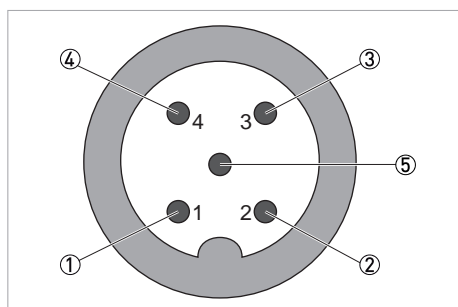


Figure 3-1: Pin designation

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 Parameterisation with display

The device is equipped with a removable display for parameterisation. Optionally for parameterisation the PC can be used.

Even without the display, the device works as previously parameterised.

"Dsp" defines the display value. The display can show the turbidity/absorption, the temperature in °C, or both values in an alternating way.

4.1.1 User menu



CAUTION!

Make sure that only authorised and trained personnel perform changes to the parameterisation.



INFORMATION!

Incorrect settings in the parameters may result in the output of incorrect measured values and switching points.

The device is parameterised using the function keys on the display.

The function keys are accessible after removing the housing cover.

The user menu can be opened by pressing the "Enter" button. The individual parameters can be accessed by pressing the arrow buttons.

To configure a parameter, press the "Enter" button again, use the arrow button to select the desired setting and confirm the selection finally using the "Enter" button.

To return back to the display after configuration, use the arrow key to move to "ESc" and press "Enter".

Description of the user menu

The "rst" function resets all user parameters to the factory settings.

Parameter	Designation	Value range	Standard value	Description
ESc	Start/end of menu	-	-	Menu input and output
-0- (TSS 1050/ 2050 only)	Reset	-	-	Resets to zero the measured or the taught value. Same function as the teach input.
MPr (TSS 3050/ 4050 only)	Measuring principle	tur: turbidity AbS: absorption	-	-
cdud (TSS 3050/ 4050 only)	Decimal place of the user unit	0...0.000	-	Defines the decimal places of the user unit (cdu).
cdu (TSS 3050/ 4050 only)	User unit	0...19999	-	Defines the value range of the user unit (cdu).

Parameter	Designation	Value range	Standard value	Description
dsp	Display switchover	turB, temp, ALT	turB	Definition of which measured value is to be displayed: turB: turbidity/absorption temp: temperature Alt: turbidity/absorpt. and temperature alternating Regardless of the display switchover, the analogue output always delivers a signal depending on the turbidity.
MrB	Start of measuring range	-100...100	0	Defines the 4 mA point.
MrE	End of measuring range	-100...100	100	Defines the 20 mA point.
dAM	Damping	0.0...200.0	0.0	Damps the measured value for turbidity in the range of 0.0...200.0 seconds, both for the output current and for the display.
r-0-	Zero point range	0...100	0	Defines a range in display digits around the zero point where the measured value is set to 0.
don	Switching on point	-100.0...0...100%	100%	Defines the switching on point of the switching output.
doF	Switching off point	-100.0...0...100%	0%	Defines the switching off point of the switching output.
dtyp	Switching function	0 or 1	0	0 = normally open 1 = normally closed
ddly	Switching delay	0.0...200.0 s	0.0s	Delays the switching point by up to 200 seconds.
Aoll	Lower output limit	3.5...22.5 mA	3.8 mA	Defines the minimum output current.
Aoul	Upper output limit	3.5...22.5 mA	22.5 mA	Defines the maximum output current.
Mout	Error signal	3.5...22.5 mA	3.5 mA	If the transmitter detects an internal error, an error code is shown on the display and the defined current signal is output.
AuLo	Keylock	0...100 min	0 min	Upon corresponding operating time, the keyboard is locked in order to prevent unauthorised operation. The setting 0 will deactivate the keylock.
rst	Reset	0 or 1	0	Resetting the user parameters to the default settings (0 = no; 1 = yes); the calibration values are maintained.
ESC	Start/end of menu	-	-	Menu input and output (saving the entered parameters)

4.1.2 Configuration of output current

The device is equipped with a 4...20 mA output in order to output the absorption measured values. The output current is configured by means of the following parameters:

- **MrB** defines the start of the measuring range and thus the 4 mA point.
- **MrE** defines the end of the measuring range and thus the 20 mA point.
- **dAM** defines the damping effecting the display and the output current.
- **AoI** defines the minimum output current that can be output.
- **AoU** defines the maximum output current that can be output.
- **Mout** defines the error current that is output in the event of an internal error.

4.1.3 Switching points

The device is equipped with a PNP switching output configured by four parameters.

"Don" defines the switching on point and "doF" defines the switching off point. Together, both parameters determine the function of the switching output.

"Don" < "doF"

If "don" is lower than "doF", the output is switched on once the measured value is between the switching points (window function).

"Don" > "doF"

If "don" is higher than "doF", the output is switched on once the measured value exceeds "don". The product is switched off only when the measured value falls below "doF" (hysteresis function).

"Don" = "doF"

If "don" equals "doF", the output is switched on once the measured value exceeds the switching value and is switched off once the measured value falls below the switching value again.

Both parameters can be set independently.

"dtyp" inverts the function of the switching output. If the value is 0, the switching output will work as normally open (NO) contact; if the value is 1, the switching output will work as normally closed (NC) contact.

"ddly" delays the reaction of the switching output by up to 200.0 seconds. This value holds true for switching on and switching off.

4.1.4 Keylock

The keyboard can be protected against unauthorised access.

"AuLo" activates the keylock by setting a value of more than "0". The set value corresponds to the time in minutes, in which the keyboard will be locked after the last entry was made. If another entry is made, the time will start again. If "0" is entered, the keylock will be deactivated.

The locked keyboard can be unlocked by de-energising the device for a short period of time. For this, disconnect the connector for a short period of time and reconnect it afterwards.

4.2 Teach function – Calibration (only for TSS 1050/2050)

To adjust the measurement to different media, a teach function is implemented in the device.

Use the function "-0-" in the menu to teach the measuring value. Alternatively you can give a +24 V signal on to the input "Teach". Then the device is adjusted to the current turbidity value.

4.3 Calibration (only for TSS 3050/4050)

4.3.1 Calibration menu



CAUTION!

Make sure that only authorised and trained personnel perform changes to the calibration.



INFORMATION!

Incorrect settings in the parameters may result in the output of incorrect measured values and switching points.

The device is parameterised using the function keys on the display.

Pressing the arrow button (▲) for 4 to 5 seconds will open the calibration menu. If the arrow keys are pressed repeatedly, it is possible to go to the individual parameters.

To configure a parameter, press the "Enter" button, use the arrow key to select the required setting, and confirm the selection by using the "Enter" button.

At the end of each parameter it is possible to return to the Display. Use the arrow key to move to "Esc" and press "Enter". The "rst" function resets the calibration to the factory calibration.

Parameter	Designation	Value range	Description
ESc	Start/end of menu	-	Menu input and output
cdef	Number of calibration points	2...6	Defines the number of calibration points.
cj1...cj6	Calibration points: target values	0...19999 and/or 0.000...19.999	Defines the target values of the calibration points.
cal1...cal6	Calibration points: actual values	0...19999 and/or 0.000...19.999	Defines the actual values of the calibration points. The display alternates with the target values.

Parameter	Designation	Value range	Description
SAVE	Saving the calibration	no or yes	Saves and/or accepts the user calibration values and overwrites the most recent calibration this way.
rst	Reset	no or yes	Reset to factory calibration, the user parameters are maintained.
ESC	Start/end of menu	-	Menu input and output (saving the entered parameters)

4.3.2 Calibration using reference solutions



CAUTION!

Make sure that only authorised and trained personnel perform changes to the calibration.



INFORMATION!

Incorrect settings in the parameters may result in the output of incorrect measured values and switching points.

The device is parameterised using the function keys on the display. The operating steps can be found in the chapter "Calibration menu".



Please proceed as follows to perform a calibration using reference solutions:

- ① Check that the device is set to the required measuring principle (absorption / turbidity).
- ② Reset the calibration to the factory calibration ("rst") (refer to *Reset to factory calibration* on page 20) and save the reset by selecting "SAVE = Yes".
- ③ Prepare a table (see below the example) for 4 different reference solutions.
- ④ Enter the known values of the reference solutions in the target values of the table. The device must show these values upon calibration.
- ⑤ Use the device to consecutively measure the reference solutions and enter the actual values displayed by the device in the table. Avoid incorrect measurements by carrying over the solutions, by flushing and thoroughly drying the instrument between the respective measurements.
- ⑥ Transfer the values from the table into the device as follows:
 - define the number of calibration points "cdef"
 - enter the known target values of the calibration solutions "cj1...cj6"
 - enter the determined actual values of the calibration solutions "cal1...cal6"
- ⑦ Confirm the entries by selecting "SAVE = Yes".

To check the calibration, re-submerge the sensor into the reference solutions. If the device shows the target values, the calibration was successful.

Example table for reference solutions

Reference solutions	Known target value of the reference solution	Determined actual value of the reference solution
1	e.g. 250 EBC	e.g. 234 EBC
2		
3		

**INFORMATION!**

Make sure that the used reference solutions cover the required measuring range as far as possible.

4.3.3 Calibration using set of optical reference filters



Please proceed as follows to perform a calibration using set of optical reference filters:

- Check that the device is set to the required measuring principle (absorption / turbidity).
- Reset the calibration to the factory calibration ("rst") (refer to *Reset to factory calibration* on page 20) and save the reset by selecting "SAVE = Yes".
- Prepare a table (see below the example) for 2 different optical reference filters.
- Enter the known values of the optical reference filters in the target values of the table. The device must show these values upon calibration.
- Use the device to consecutively measure the optical reference filters and enter the actual values displayed by the device in the table.
- Transfer the values from the table into the device as follows:
define the number of calibration points "cdef"
enter the known target values of the optical reference filters "cj1...cj6"
enter the determined actual values with the optical reference filters "cal1...cal6"
- Confirm the entries by selecting "SAVE = Yes".

Example table for optical reference filter

Optical reference filter	Known target value of the reference filter	Determined actual value of the reference filter
1	0,35AU/290EBC	0,34AU/276EBC
2	2,0AU/2200 EBC	1,9AU/2100EBC
3		
4		

4.3.4 Calibration using a reference instrument with process samples


CAUTION!

Make sure that only authorised and trained personnel perform changes to the calibration.


INFORMATION!

Incorrect settings in the parameters may result in the output of incorrect measured values and switching points.

The device is parameterised using the function keys on the display. The operating steps can be found in the chapter "Calibration menu".



Please proceed as follows to perform a calibration using a reference instrument with process samples:

- ① Check that the device is set to the required measuring principle (absorption / turbidity).
- ② Reset the calibration to the factory calibration ("rst") (refer to *Reset to factory calibration* on page 20) and save the reset by selecting "SAVE = Yes".
- ③ Prepare a table (see below the example) for e.g. 4 different process samples.
- ④ Enter the values of the process samples measured by the reference instrument in the target values of the table. The device must show these values after successful calibration.
- ⑤ Use the device to consecutively measure the process samples and enter the actual values displayed by the device in the table. Avoid incorrect measurements by carrying over the solutions, by flushing and thoroughly drying the instrument between the respective measurements.
- ⑥ Transfer the values from the table into the device as follows:
 - define the number of calibration points "cdef"
 - enter the known target values of the process samples "cj1...cj6"
 - enter the determined actual values of the process samples "cal1...cal6"
- ⑦ Confirm the entries by selecting "SAVE = Yes".

To check the calibration, re-submerge the sensor into the process samples. If the device shows the target values, the calibration was successful.

Example table for process samples

Process samples	Known target value of the process samples	Determined actual value of the process samples
1	e.g. 250 EBC	e.g. 234 EBC
2		
3		
4		


INFORMATION!

Make sure that the used process samples cover the required measuring range as far as possible.

4.3.5 Reset to factory calibration


CAUTION!

Make sure that only authorised and trained personnel perform changes to the calibration.


INFORMATION!

Incorrect settings in the parameters may result in the output of incorrect measured values and switching points.

The device is parameterised using the function keys on the display. The operating steps can be found in the previous chapter "Calibration menu".

Proceed as follows to reset the device to the factory calibration and delete possible user calibrations:



- ① Press the arrow button (▲) for 4 to 5 seconds to get access to the calibration menu.
- ② Press the arrow button (▲) until the display shows "rst".
- ③ Press the "Enter" button and use the arrow button (▲) to select the option "Yes".
- ④ Press again the "Enter" button in order to confirm the resetting process.
- ⑤ Press the arrow button (▼) in order to open the "SAVE" function.
- ⑥ Confirm the selection using "SAVE = Yes" in order to save the reset to the factory calibration.

4.4 Troubleshooting

Possible cause	Action
----------------	--------

No or erroneous measured value

No voltage at the sensor	Check electrical connection (for details refer to <i>Electrical connection</i> on page 12).
Measuring windows are coated	Clean the measuring windows (for details refer to <i>Cleaning the measuring windows</i> on page 22). If the measuring windows get dirty frequently, it is better to use a TSS 2050 / TSS 4050 within a retractable assembly.

Strongly fluctuating measured value

Air bubbles in the system	Dampen display and output current (for details refer to <i>Configuration of output current</i> on page 15).
Sensor is not completely submerged in the process fluid	Change the installation location.

Output current does not match the measured value

Current output parameterised incorrectly	Check and, if required, change the parameterisation of the current output (for details refer to <i>Configuration of output current</i> on page 15).
Electrical connection incorrect	Check electrical connection (for details refer to <i>Electrical connection</i> on page 12).

Switching output does not switch properly

Switching output parameterised incorrectly	Check and, if required, change the parameterisation of the switching output (for details refer to <i>Switching points</i> on page 15).
Electrical connection incorrect	Check electrical connection (for details refer to <i>Electrical connection</i> on page 12).

Possible cause	Action
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Keyboard cannot be operated

Keylock is activated	Unlock the keyboard (for details refer to <i>Keylock</i> on page 16).
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Error message on the display

Err0 Factory setting adjustment corrupted	Contact the manufacturer.
Err1 User parameters corrupt	Use the "rst" function in order to reset.
Err2 Temperature measurement failed	Contact the manufacturer.
Err3 Measuring range expansion faulty	Check the parameters "MRB" and "MRE". Maximum expansion 4:1
Err4 ADC error	Contact the manufacturer.

5.1 Maintenance

5.1.1 General instructions

**CAUTION!**

Make sure that only authorised and trained personnel perform maintenance work.

- Always perform the maintenance work wearing suitable protective clothing.
- Before disconnecting the device from the process, the pipelines or tanks must be depressurised, empty and clean.
- Check the process connection for leakages at regular intervals. If required, tighten the pressure screw to a maximum torque of 10 Nm.
- Structural modifications must only be implemented upon consultation with the manufacturer.

5.1.2 Cleaning the measuring windows

The absorption (as well expressed as total suspended solids or in some applications as turbidity) is measured using two measuring windows (sapphire) in the process. Contaminations or coatings on the windows will cause the measured value to drift or be wrong.

To avoid any damage, do not focus high pressure cleaning "jets of water" directly at the optic.

In particular never clean the optic with tools or other mechanical objects. Do not insert hard objects into the optical path.

**Cleaning procedure**

- Remove the device from the process connection.
- Clean the measuring windows from coatings using appropriate cleaning and rinsing solutions in combination with a soft tissue.

5.2 Spare parts availability

The manufacturer adheres to the basic principle that functionally adequate spare parts for each device or each important accessory part will be kept available for a period of 3 years after delivery of the last production run for the device.

This regulation only applies to spare parts which are subject to wear and tear under normal operating conditions.

5.3 Availability of services

The manufacturer offers a range of services to support the customer after expiration of the warranty. These include repair, maintenance, technical support and training.



INFORMATION!

For more precise information, please contact your local sales office.

5.4 Returning the device to the manufacturer

5.4.1 General information

This device has been carefully manufactured and tested. If installed and operated in accordance with these operating instructions, it will rarely present any problems.



WARNING!

Should you nevertheless need to return a device for inspection or repair, please pay strict attention to the following points:

- *Due to statutory regulations on environmental protection and safeguarding the health and safety of the personnel, the manufacturer may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.*
- *This means that the manufacturer can only service this device if it is accompanied by the following certificate (see next section) confirming that the device is safe to handle.*



WARNING!

If the device has been operated with toxic, caustic, radioactive, flammable or water-endangering products, you are kindly requested:

- *to check and ensure, if necessary by rinsing or neutralising, that all cavities are free from such dangerous substances,*
- *to enclose a certificate with the device confirming that it is safe to handle and stating the product used.*

5.4.2 Form (for copying) to accompany a returned device



CAUTION!

To avoid any risk for our service personnel, this form has to be accessible from outside of the packaging with the returned device.

Company:		Address:	
Department:		Name:	
Tel. no.:		Fax no. and/or Email address:	
Manufacturer's order no. or serial no.:			
The device has been operated with the following medium:			
This medium is:	<input type="checkbox"/>	radioactive	
	<input type="checkbox"/>	water-hazardous	
	<input type="checkbox"/>	toxic	
	<input type="checkbox"/>	caustic	
	<input type="checkbox"/>	flammable	
	<input type="checkbox"/>	We checked that all cavities in the device are free from such substances.	
	<input type="checkbox"/>	We have flushed out and neutralized all cavities in the device.	
We hereby confirm that there is no risk to persons or the environment through any residual media contained in the device when it is returned.			
Date:		Signature:	
Stamp:			

5.5 Disposal



LEGAL NOTICE!

Disposal must be carried out in accordance with legislation applicable in your country.

Separate collection of WEEE (Waste Electrical and Electronic Equipment) in the European Union:



According to the directive 2012/19/EU, the monitoring and control instruments marked with the WEEE symbol and reaching their end-of-life **must not be disposed of with other waste**.

The user must dispose of the WEEE to a designated collection point for the recycling of WEEE or send them back to our local organisation or authorised representative.

6.1 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 %. $\text{Total Suspended Solids (mg/l)} = (\text{filter weight after filtering} - \text{filter weight before filtering}) / \text{sample volume in litres}$. 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.

6.2 Technical data



INFORMATION!

- 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
	TSS 1050 Simply designed, competitive NIR system with a scale between 0 to 100% absorption characteristics of fluids. G1/2 process connection.
	TSS 2050 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.
	TSS 3050 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.
	TSS 4050 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
Measuring range	
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 _b - 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

6.3 Dimensions and weight

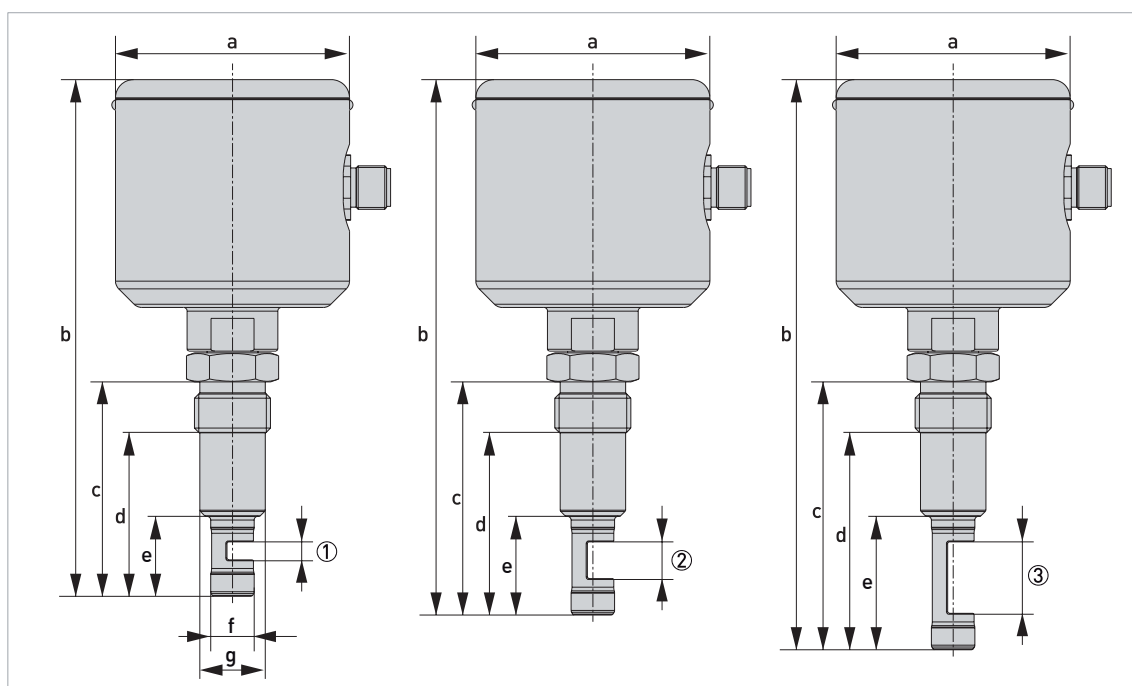


Figure 6-1: Dimensions of TSS 1050

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

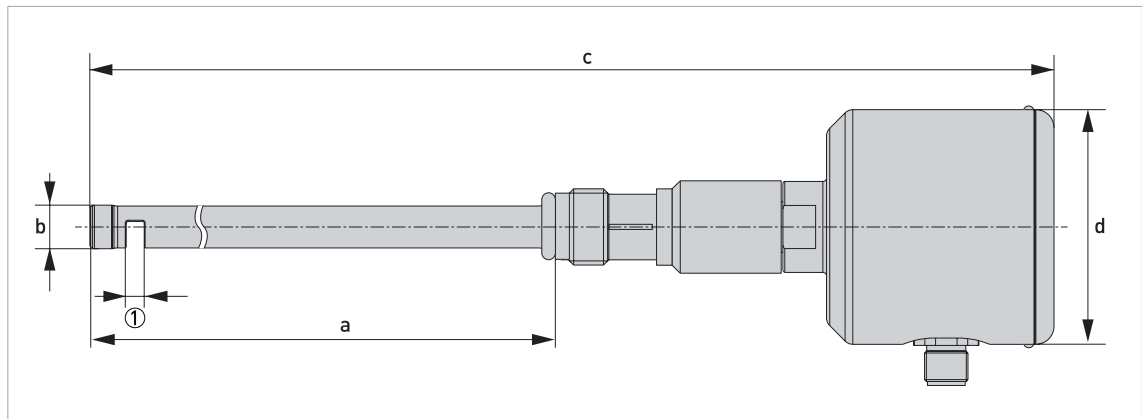


Figure 6-2: Dimensions of TSS 2050

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

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

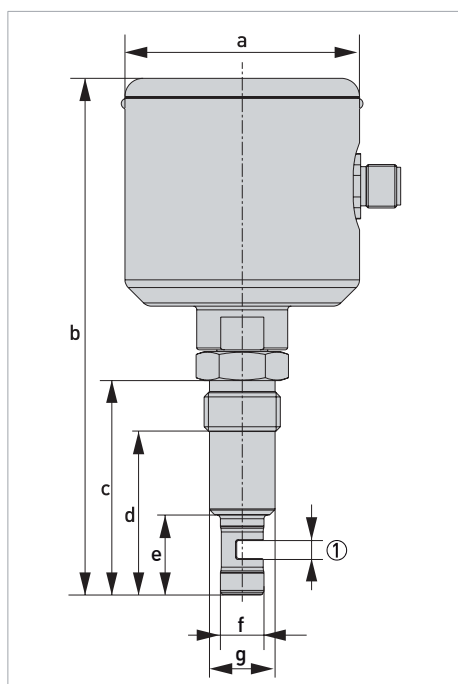


Figure 6-3: Dimensions of TSS 3050

① Optical path length 5 mm / 0.2"

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

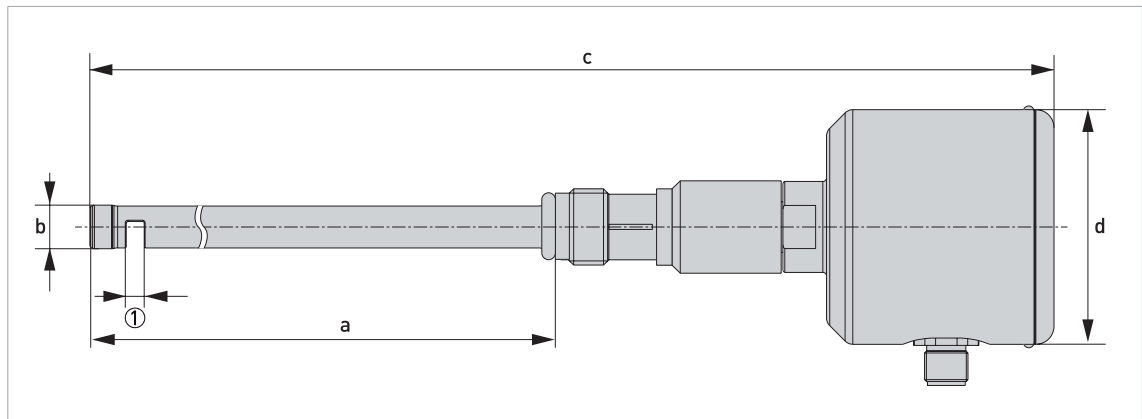


Figure 6-4: Dimensions of TSS 4050

① Optical path length 5 mm / 0.2"

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



KROHNE – Process instrumentation and measurement solutions

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