



MANUAL

SDM -

SLURRY DENSITY METER

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Table 1-1: Version history

Previous document history

Rev.	Description / Revision	Date	Author	Approved
1	Concept	11-11-2015	RvP	
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While efforts were made to verify the accuracy of the information contained in this document, faults in general are, however, never ruled out. If in doubt of the written information directly contact Rhosonics.

Rhosonics will publish updates and revisions of this document as needed. The document supersedes all previous ones.

All versions of this manual in a language other than English, are translations of the English original. In case of discrepancy, the English original will prevail.

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1. PREFACE

This user manual covers the following: the Slurry Density Meter, or 'SDM' for short.

Please read this manual carefully for important information and instructions before using the Slurry Density Meter. Save this manual for future reference.

The best results will be obtained when the SDM is:

- Installed with reasonable care and caution;
- Regularly maintained by carrying out preventive maintenance instructions;
- Configured and calibrated according to this manual;
- Operated with reasonable care and caution;
- Maintained with Rhosonics-supplied parts.

When this manual refers to “the manufacturer”, this means: Rhosonics.

1.1 Purpose of this manual

The purpose of this user manual is to ensure that the above product is installed, configured, calibrated and used safely and correctly.

Adherence to the instructions herein will help to avoid personal injury, equipment damage and/or property damage. It will also increase the reliability and service life of all components.

This manual must be available at the site of operation. Operators and maintenance personnel are required to read this manual before working with/near the SDM.

This user manual contains information and instructions regarding:

- General description of the product and its components;
- Safety of all personnel working with the product;
- Installation;
- Operation;
- Calibration;
- Troubleshooting;
- Maintenance;
- Disposal of the system.

For any questions or requests for information, please contact Rhosonics.

1.2 Target audience

This manual must be read and understood by:

- Distributors;
- Operators;
- Engineers installing the SDM;
- Maintenance personnel.

The manual is primarily meant for the operators and engineers installing the SDM.

1.3 Operators

Only operators that are properly trained and instructed by Rhosonics are allowed to work with the SDM.

Operators should take the following into account.

1. Work on the electrical parts may only be performed by:
 - A competent and qualified electrician;
 - Trained personnel under the direct supervision of a qualified electrician.

All applicable local regulations should be observed.

2. Local disassembly and assembly may only be carried out by:
 - A competent and qualified engineer;
 - Trained personnel under the direct supervision of a qualified engineer.

Personnel that have not yet been fully educated or instructed in the use of the SDM, may only work with the SDM when under permanent supervision of a qualified and trained engineer (or a person authorized by Rhosonics).

1.4 Reading guide



READ THIS MANUAL CAREFULLY.

PAY CLOSE ATTENTION TO ALL SPECIAL SYMBOLS.

WHEN IN DOUBT, CONSULT YOUR SUPERVISOR ON HOW TO PROCEED.

Reading the instructions in this manual helps to avoid dangerous situations, repair costs and downtime. It also increases the reliability and service life of the SDM.

This manual uses the following symbols to bring important safety information to the reader's attention:




DANGER

INDICATES AN IMMINENTLY HAZARDOUS SITUATION THAT, IF NOT AVOIDED, WILL RESULT IN DEATH OR SERIOUS INJURY.




WARNING

INDICATES A POTENTIALLY HAZARDOUS SITUATION THAT, IF NOT AVOIDED, COULD RESULT IN DEATH OR SERIOUS INJURY. THIS WARNING INCLUDES HAZARDS THAT ARE EXPOSED WHEN GUARDS ARE REMOVED.



CAUTION

INDICATES A POTENTIALLY HAZARDOUS SITUATION THAT, IF NOT AVOIDED, MAY RESULT IN MINOR TO MODERATE INJURY AND/OR PRODUCT OR PROPERTY DAMAGE AND/OR LOSS OF INFORMATION.



NOTE

THIS SHOWS EXTRA INFORMATION THAT MAY HELP THE USER.

Other reading instructions:

- Text represented as **[Bold]** indicates a button to be pressed;
- Text in *ITALIC* refers to visible text on the screen display;
- Illustrations shown in this manual might differ from (parts of) the actual display.

1.5 Abbreviations

In this manual, the following abbreviations are used:

ABBREVIATION	MEANING
c	Velocity
CS	Carbon steel
FDSC	Fluid Dynamic Spool Cell
FS	Full scale
HART	Highway Addressable Remote Transducer
HDPE	High density polyethylene
mA	Milliamp
OD	Outside diameter
PCB	Printed Circuit Board
RHO	Density
SDM	Slurry Density Meter
T	Temperature
UFTP	Ultrasonic Flow Through Cell
UHPE	Ultra-high polyethylene
UWC	Ultrasonic wafer cell
VDC	Volts Direct Current
WT	Wall thickness

Table 1-1: Abbreviations

1.6 Identification

The identification plate contains information about the SDM. When contacting Rhosonics, please state the information supplied on the identification plate. The identification plate is mounted on the side or on the bottom of the SDM, see Figure 1-1, pos. 1.

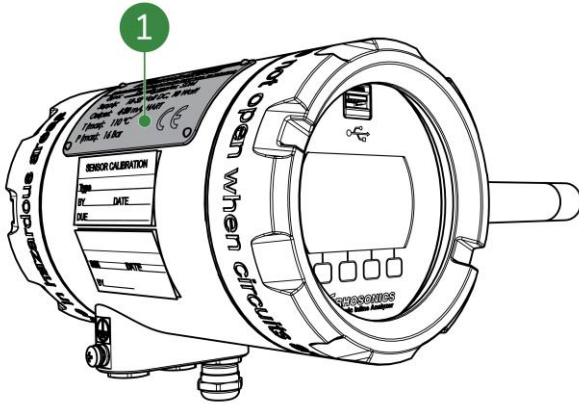


Figure 1-1: Identification plate

Write down the identification plate information in this manual. Rhosonics needs this number when ordering parts and / or when help is needed from Rhosonics.

Serial number information can be found on the sensor calibration and factory calibration stickers.

2. INTRODUCTION

In this introduction, you can find general information on:

- Intended and non-intended use of the slurry density meter (SDM);
- Lifespan of the product;
- Product specifications of the product.

2.1 Intended use

This product can only be used for measuring the density of slurry that flows through pipe systems.

2.2 Non-intended use

Under no circumstance should the product be used:

- as a tool other than its intended use;
- as a step for a person;
- as a temporary storage space to hang or lay items on.



CAUTION

USING THE SDM AS A TOOL, STEP OR STORAGE SPACE CAN LEAD TO SERIOUS INJURIES OF THE PERSONS INVOLVED. IT CAN ALSO LEAD TO DAMAGE OF THE PRODUCT OR THE ENVIRONMENT.



NOTE

NON-INTENDED USE OF THE PRODUCT WILL VOID THE WARRANTY.

2.3 Lifespan

If properly maintained, the lifespan of the system can in principle be indefinite.



CAUTION

TO ENSURE PROPER AND SAFE OPERATION THROUGHOUT THE LIFESPAN OF THE SDM, FOLLOW THE MAINTENANCE INSTRUCTIONS FOR CORRECT MAINTENANCE.

To ensure that the lifespan of the product will be as long as possible, never make any modifications or additions to the system other than described within this manual. Modifications and additions could also affect safety. Modifications and/or additions include:

- Adding or removing parts other than described within this manual;
- Carrying out welding work on the SDM;
- Making changes to the electrical system;
- Changing (re-programming) the software.



DANGER

NEVER MAKE MODIFICATIONS TO THE SDM WITHOUT CONSULTATION AND WRITTEN PERMISSION FROM RHOSONICS. MODIFICATIONS WITHOUT CONSULTATION CAN LEAD TO LIFE THREATENING SITUATIONS.

Spare parts must always meet the technical specifications as laid down in the SDM spare parts list. If in doubt, consult Rhosonics.

2.4 Product specifications

The product specifications of the SDM can be found below.

2.4.1 Operation characteristics - Density

PROPERTY	SG	WT (in %)
Resolution	0.2 SGx1000	0.02 %
Accuracy	Up to +/- 0.5% of reading	Up to +/- 0.5% of reading
Reproducibility	0.2 SGx1000	0.1 % of reading
Range	700 - 3000 SGx1000	0-80 %

Table 2-1: Operation characteristics – density

2.4.2 Operation characteristics - HART 4-20mA Output (1x)

PROPERTY	VALUE / CHARACTERISTIC
Type	Active sourcing
Resolution	± 0.002 % of FS
Repeatability	± 0.02 % of FS
Output current	± 4-20 mA into 250 Ω load

Table 2-2: Operation characteristics - HART output

2.4.3 Operation characteristics - Interfaces

INTERFACE
Serial interface HART
USB

Table 2-3: Operation characteristics - Interfaces

2.4.4 SDM housing

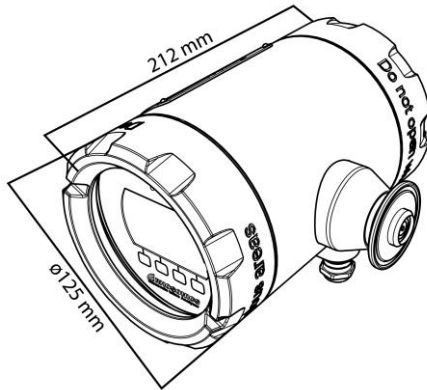


Figure 2-1: SDM housing dimensions

PROPERTY	VALUE
Dimensions SDM housing	Ø125x212 mm (ØxL)
Display, effective area	65x35 mm (WxH)
IP rating with covers	IP 68
IP rating without covers	IP 54
Ambient Temperature	-5°C to +50°C
Relative humidity	< 95% at 40°C (noncondensing)
Display resolution and color	240x128 dots (WxH), 5 colors
Control push-buttons	Pillow embossed metal dome, 4 pieces
Cable entries	3x cable entry M16x1.5
Weight	6.4-6.8 kg
Power consumption	maximum 8 W
Fuse (24 VDC)	Anti Surge T LBC Fuse, 250 mA, 5 x20 mm
Storage conditions	-5°C to + 50°C

Table 2-4: SDM housing properties

2.4.5 SDM sensor – wetted parts

PROPERTY	COMPOSITION / NORM
(Alloyed) Silicon nitride	Si3N4
Duplex Steel	ASTM/ASME: A240 UNS S32205/S31803 EURONORM: 1.4462 X2CrNiMoN 22.5.3 AFNOR: Z3 CrNi 22.05 AZ DIN: W.Nr 1.4462 ISO: 4462-318-03-1 BS: 318S13 SS: 2377 JIS: SUS 329J3L
Length	183,5 mm (146 mm + 37,5 mm)

Table 2-5: SDM sensor properties

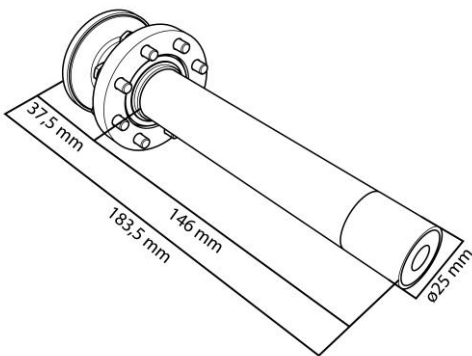


Figure 2-2: Sensor dimensions

3. GENERAL DESCRIPTION

The slurry density meter (SDM) is a product that is used to measure the density of slurry that flows through pipe systems. Its main components are:

- a transmitter;
- a sensor for measuring slurry.

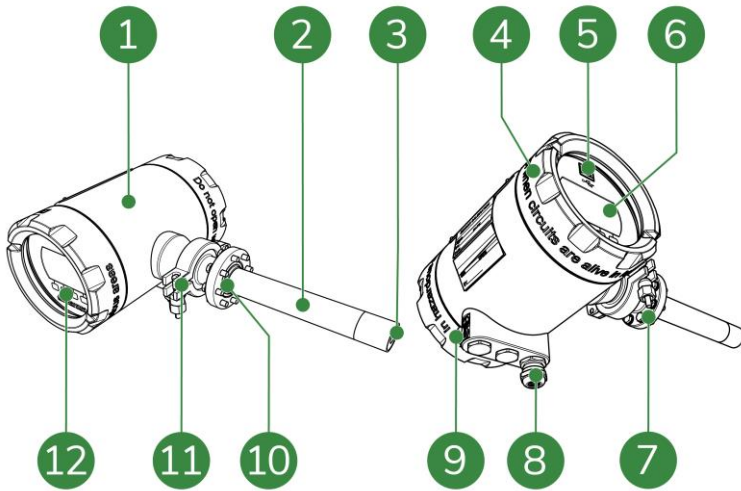


Figure 3-1: Slurry Density Meter

Legend

- | | |
|----|---|
| 1 | Transmitter |
| 2 | Sensor |
| 3 | Sensor surface |
| 4 | SDM frontal lid |
| 5 | USB-port |
| 6 | Display |
| 7 | Mounting flange |
| 8 | Cable gland |
| 9 | Earth connection |
| 10 | O-ring sealing flange (for O-rings, see Figure 3-2) |
| 11 | Tri clamp |
| 12 | Buttons |

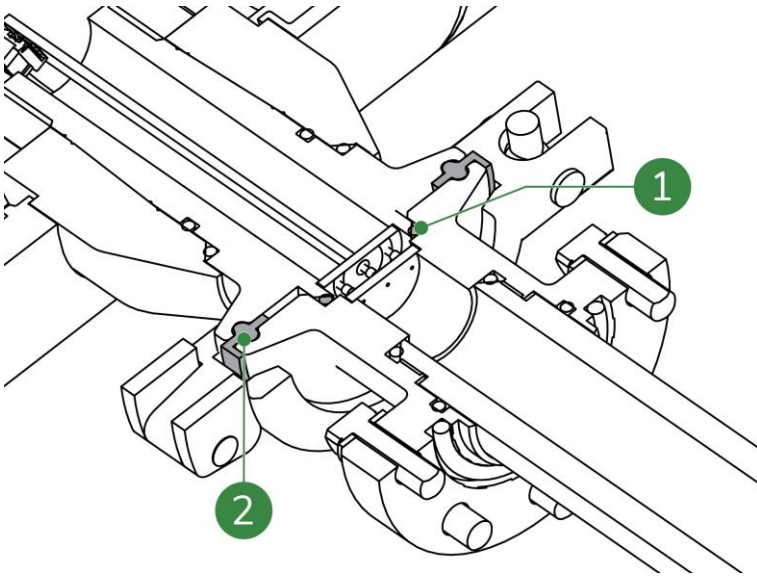


Figure 3-2: O-rings

Legend

- 1 O-ring for sensor contact
- 2 O-ring for sensor flange


3.1 Components functionality

The sensor surface (Figure 3-3, pos. 3) connects to components within the transmitter (Figure 3-3, pos. 1) for processing measurements.

The tri clamp (Figure 3-3, pos. 7) is pre-assembled and connects the sensor (Figure 3-3, pos. 2) to the transmitter (Figure 3-3, pos. 1).


The sensor (Figure 3-3, pos. 2) has a mounting flange (Figure 3-3, pos. 5) for mounting the SDM onto a pipe integration system (not shown).

The transmitter (Figure 3-3, pos. 1) houses cable connections and sensitive components on the inside. On the outside, the transmitter has a display (Figure 3-3, pos. 4) for presenting measurements.



CAUTION

MAKE SURE THE CABLE GLAND COMPLETELY SEALS THE CABLE ENTRY TO PREVENT DAMAGE TO THE SDM FROM MOISTURE AND DUST.



CAUTION

NEVER COVER THE SDM WITH ISOLATION MATERIAL.

The SDM is powered through an external power cable (not shown). The power cable connects to the SDM with a screw connector on the inside on the back of the transmitter (Figure 3-3, pos. 1). A cable gland (Figure 3-3, pos. 6) at the cable entry protects the inside of the transmitter (Figure 3-3, pos. 1) from moisture and dust.

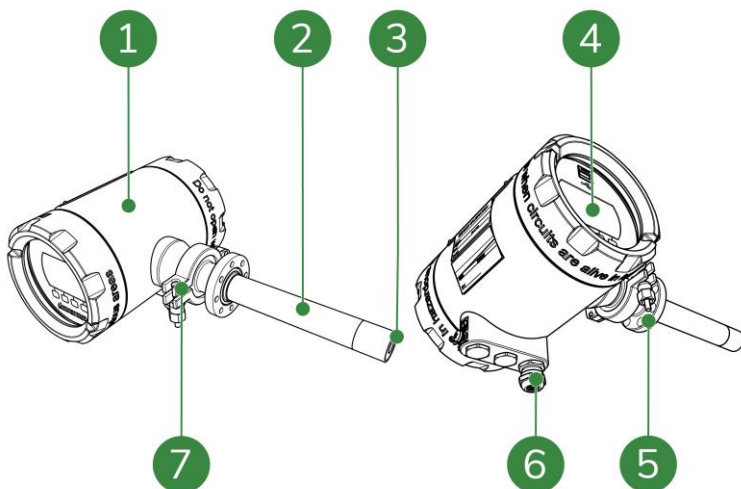


Figure 3-3: Components

3.2 Pipe integration systems

To use the SDM, it needs to be integrated within a pipe system. Several pipe integration systems are available. To get information on the best suited pipe integration system, contact Rhosonics.



NOTE

CONTACT RHOSONICS FOR MORE INFORMATION ON PIPE INTEGRATION SYSTEMS SUITABLE FOR YOUR PIPE INSTALLATION.

All pipe integration systems have an adapter with a receiving flange. To mount the SDM, the sensor (Figure 3-3, pos. 2) slides into the adapter (Figure 3-4, pos. 3) after which the mounting flange is mounted onto the receiving flange of the adapter.

See chapter 5 for a complete instruction on the installation of the SDM.

When the SDM (Figure 3-4, pos. 4) is correctly mounted onto the receiving adapter, the sensor surface will lay flush with the inner diameter of the connected pipes. This ensures reliable and consistent measurements.

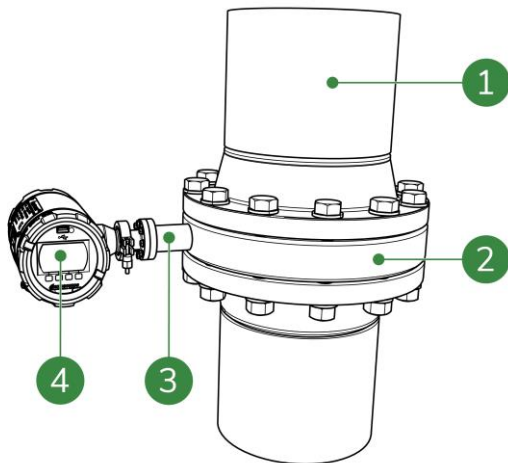



Figure 3-4: Example of a SDM integrated within a vertical pipe system

Legend

- 1 Pipe
- 2 Pipe integration system
- 3 Adapter with receiving flange
- 4 Slurry density meter

4. SAFETY



WARNING

FAILURE TO COMPLY WITH STANDING SAFETY RULES OR THE SAFETY RULES IN THIS MANUAL COULD RESULT IN POTENTIALLY LETHAL INJURY, EQUIPMENT DAMAGE AND/OR PROPERTY DAMAGE.

4.1 General safety rules

General safety rules for everyone working with the SDM are:

- Always visually inspect the SDM for damage before using. Do not use the SDM if it has been damaged. In case of damage, arrange for an inspection by a qualified expert.
- Always wear personal protective equipment (PPE), see chapter 4.3 below for a list of PPE.
- Do not use the SDM as a step, storage space or tool other than its intended use.
- If you suspect the SDM has previously been misused, arrange for an inspection by a qualified expert.





4.2 Local safety rules

Users of the SDM should make sure they are in compliance with all other relevant safety rules in force at the site of operation. These include:

- Safety rules following from local legislation;
- Safety protocols following from the installation or working site in which the SDM has been integrated;
- Safety protocols coming from the user itself;
- Safety instructions found in other manuals that have a reference in this document.

4.3 Mandatory PPE

Ensure that the applicable safety regulations are observed and that everybody working with/on/near the SDM wears the mandatory Personal Protection Equipment (PPE):

SYMBOL	DEFINITION	SYMBOL	DEFINITION
	Safety goggles		Coverall
	Safety shoes		Safety helmet





SYMBOL	DEFINITION	SYMBOL	DEFINITION
	Safety gloves		High visibility vest
	Hearing protection		Safety harness (when working more than 1.1 meters above ground level)

Table 4-1: Mandatory PPE

4.4 Warning symbols on/near the system




WARNING

MAKE SURE THAT STICKERS REMAIN LEGIBLE. REPLACE DAMAGED AND ILLEGIBLE STICKERS.

Always comply with safety instructions and hazard warnings. Always ensure that safety instructions and hazard warnings are well looked after and legible.

When working with the SDM, a number of warning and prohibition symbols might present themselves on pipes and/or equipment surrounding or near the SDM.

4.5 In case of any emergency



DANGER


NEVER USE WATER TO EXTINGUISH FIRE. WATER CONDUCTS ELECTRICITY AND ITS USE COULD LEAD TO ELECTROCUTION.

How to act in an emergency is determined by the regulations that are in force on site.

The minimum actions required are as follows:


- Report the emergency to the company emergency aid officer.
- The company emergency aid officer will alert the emergency services.
- When reporting an emergency, you must identify yourself, indicate where you are and describe the emergency.
- Extinguish small fires at an early stage using the extinguishing equipment on hand.
- If possible, turn off the power supply.
- Warn your colleagues.
- Leave the scene of the emergency and report to the meeting point.

4.6 Temperature ranges



WARNING

DO NOT WORK OUTSIDE THE TEMPERATURE RANGES AS GIVEN IN TABLE 4-2! DOING SO CAN CREATE A POTENTIALLY HAZARDOUS SITUATION, CAUSING DEATH OR SERIOUS INJURY.



WARNING

WHEN WORKING IN LOW TEMPERATURES, PREVENT HYPOTHERMIA AND INJURIES FROM FROSTBITE BY WEARING SUITABLE CLOTHES, SHOES, GLOVES AND HEAD PROTECTION.

The SDM can operate safely with the following temperature ranges:

PROPERTY	TEMPERATURE RANGE IN °C	TEMPERATURE RANGE IN °F
Environmental temperature when in use	-5 °C to +50 °C	23 °F to 122 °F
Environmental temperature when not in use	-5 °C to +50 °C	23 °F to 122 °F
Slurry temperature	0 °C to +110 °C	32 °F tot 230 °F

Table 4-2: Temperature restrictions

When working outside these temperature ranges, the following hazards can occur:

High temperatures:

- Risk of burns on parts of the body;
- Expansion and deformation of materials;
- Accelerated combustion of flammable substances;
- Increase of pressure as a result of expansion in gases and fluids.

Low temperatures:

- Risk of burns on parts of the body;
- Hypothermia or frostbite in parts of the body;
- Materials becoming brittle, with the danger of breaking;
- Freezing of the skin to cold surfaces;
- Freezing of fluids, leading to blockages.

4.7 Preparations working area

**WARNING**

KEEP THE WORKSPACE AS CLEAN AND SAFE AS POSSIBLE TO PREVENT ACCIDENTS AND DANGEROUS SITUATIONS.

To prevent accidents and dangerous situations, it is very important that the working area is very well looked after:

- Keep the working area clean;
- Remove any obstacle that might be present.

5. INSTALLATION

5.1 Supplies and items for installation



CAUTION

IF ANY OF THE BASIC SUPPLIES DELIVERED BY RHOSONICS ARE DAMAGED OR COMPROMISED, CONTACT RHOSONICS FOR REPLACEMENTS OR FURTHER INSTRUCTIONS. NEVER USE DAMAGED SUPPLIES.



NOTE

IF AN OLDER INSTALLATION OF A SDM IS BEING (PARTLY) REPLACED, OTHER INSTALLATION INSTRUCTIONS MIGHT APPLY. CONTACT RHOSONICS FOR FURTHER INSTRUCTIONS AND APPLICABLE MANUALS.

Before starting the installation, make sure that all the basic supplies needed are available, undamaged and clean:

- SDM;
- Pipe integration system;
- Manual.

The SDM-packaging contains these items:

- Transmitter (Figure 5-1, pos. 1);
- Sensor (Figure 5-1, pos. 2);
- 2x Cable glands for \varnothing 2-6 mm cable (Figure 5-1, pos. 4);
- 2x Blind plug (Figure 5-1, pos. 5);
- 1x O-ring for sensor contact (Figure 5-1, pos. 11);
- 1x O-ring for sensor flange (Figure 5-1, pos. 10);
- 1x PT100 connector (Figure 5-1, pos. 9);
- 10x Bolts and 10x washers for sensor flange (Figure 5-1, pos. 6 and 7);
- 1x Yellow protection cover (Figure 5-1, pos. 8).

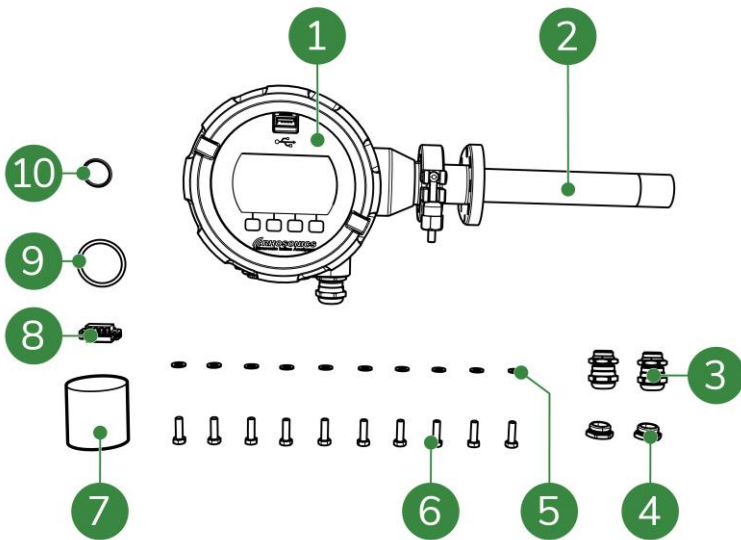


Figure 5-1: SDM packaging contents

The contents of the chosen pipe integration system are mentioned in its accompanying manual.



NOTE

DEPENDING ON THE AGREED UPON PIPE INTEGRATION SYSTEM, RHOSONICS MIGHT ADD COMPONENTS OF THAT PIPE INTEGRATION SYSTEM TO THE ORIGINAL SDM-PACKAGING. IF THIS IS THE CASE, YOU WILL BE NOTIFIED BY RHOSONICS.

These items need to be available on site:


- Gasket mounting hardware: bolts, nuts, washers, gasket sealing;
- One of these power connection options:
 - 2-core power cable - 24 VDC;
 - 2-core analog data cable - HART/4-20mA;
- Tools for mounting gasket hardware;
- Tools for connecting electrical wiring.

5.2 Guidelines for vertical pipe mountings

When selecting the SDM location within a vertical pipe:

- Select a location that allows for an easy access for daily use or maintenance of the SDM;
- Avoid installing in a pipe section where the sensor surface can wear quickly;
- Avoid installing near a dosing valve, flange or other 'interruption' of the straight pipe;
- For reliable measurements, make sure there is:
 - A straight pipe upstream with a uninterrupted length of at least 5 times the diameter of the pipe;
 - A straight pipe downstream with an uninterrupted length of at least 3 times the diameter of the pipe;
- SDM must be placed in a verticale pipe at an straight (90°) angle in relation to the connected horizontal pipe (Figure 5-2).

Vertical pipe mounting only results in reliable measurements if the flow goes in upstream direction.

	<p>CAUTION</p> <p>ALWAYS POINT THE CABLE GLANDS DOWNWARDS TO PREVENT INTRUDING LIQUIDS.</p>
---	--

Make sure to mount the SDM with the display in the correct position and the cable glands pointing downwards to prevent intruding liquids.

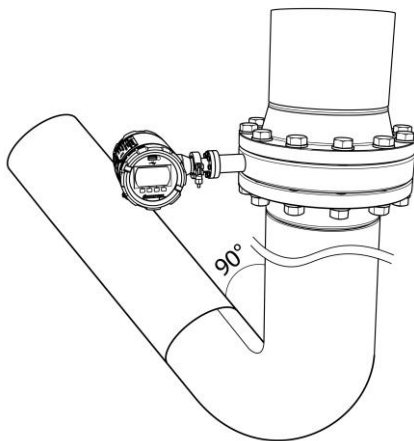



Figure 5-2: Vertical pipe mounting example

5.3 Guidelines for horizontal pipe mountings

When selecting the SDM location within a horizontal pipe:

- Select a location that allows for an easy access for daily use or maintenance of the SDM;
- Avoid installing in a pipe section where the sensor surface can wear quickly;
- Avoid installing near a dosing valve, flange or other ‘interruption’ of the straight pipe;
- For reliable measurements, make sure there is:
 - A straight pipe upstream with a uninterrupted length of at least 5 times the diameter of the pipe;
 - A straight pipe downstream with an uninterrupted length of at least 3 times the diameter of the pipe;
- For the most reliable measurements, an installation sidewise in a 45° angle, as seen/measured from the bottom of the pipe is recommended (Figure 5-3);
- The SDM must be installed either on the left or the right side of the pipe.

	<p>CAUTION</p> <p>ALWAYS POINT THE CABLE GLANDS DOWNWARDS TO PREVENT INTRUDING LIQUIDS.</p>
---	--

Make sure you mount the SDM with the display in the correct position and the cable glands pointing downwards to prevent intruding liquids.

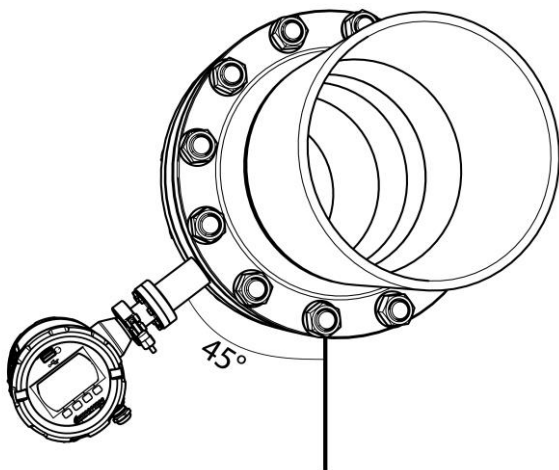




Figure 5-3: Horizontal pipe mounting example

5.4 Mounting the pipe integration system



CAUTION

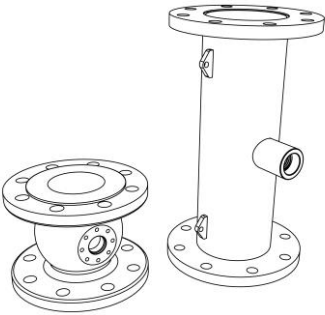
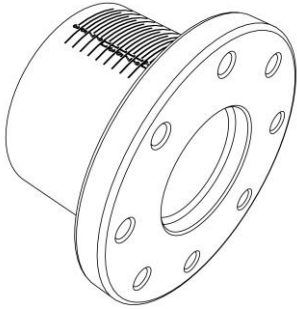
SEALING METAL FLANGES REQUIRES SKILLS, KNOWLEDGE AND EXPERIENCE. SPECIAL REQUIREMENTS MAY APPLY, DEPENDING ON THE PIPE SYSTEM IN WHICH THE PIPE INTEGRATION SYSTEM IS INSTALLED. WHEN YOU ARE NOT FAMILIAR WITH THE NECESSARY PROCEDURES, PLEASE CONSULT THE RESPONSIBLE PERSON BEFORE INSTALLATION.

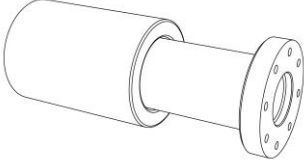
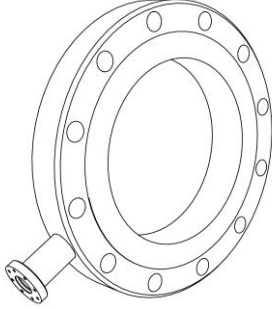
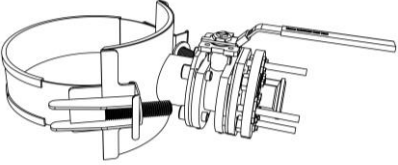


CAUTION

MATING COMPONENTS SHOULD BE CHECKED TO ENSURE TOLERANCES AND COUPLINGS ARE COMPATIBLE. DO NOT USE PARTS THAT LOOK IRREGULAR OR DO NOT FIT PROPERLY. CONTACT THE APPROPRIATE MANUFACTURER OF THE PRODUCT IN QUESTION TO DETERMINE USABILITY.

There are five pipe integration systems:

PIPE INTEGRATION SYSTEM		SUITABLE PIPE TYPE
UFTP and FDSC spools	 <p style="text-align: center;">Figure 5-4: UFTP and FDSC spool</p>	<ul style="list-style-type: none"> - Pipes 1" – 20" - HDPE - 316 - CS
Weldolet	 <p style="text-align: center;">Figure 5-5: Weldolet</p>	<ul style="list-style-type: none"> - Steel pipes without liner - OD > 3" - For pipe with wall thickness 5-22 mm

PIPE INTEGRATION SYSTEM		SUITABLE PIPE TYPE
Do it yourself (DIY) adapter	 <p>Figure 5-6: DIY Adapter</p>	- Pipes with a liner
UWC wafer	 <p>Figure 5-7: UWC Wafer</p>	<ul style="list-style-type: none"> - Pipes 4" - 60" - UHPE - 316 - 304 - 904
Clamp-in	 <p>Figure 5-8: Clamp-in</p>	<ul style="list-style-type: none"> - For every pipe material - OD pipe Ø88-365 mm - For pipe with wall thickness 3-23 mm

Each pipe integration system has a manual that contains instructions for a safe and proper installation. Always consult the manual before installing the pipe integration system.

5.5 Installation of the SDM

5.5.1 Preparing the SDM installation



CAUTION

SEALING METAL FLANGES REQUIRES SKILLS, KNOWLEDGE AND EXPERIENCE. SPECIAL REQUIREMENTS MAY APPLY, DEPENDING ON THE PIPE SYSTEM INTO WHICH THE PIPE INTEGRATION SYSTEM IS INSTALLED. WHEN YOU ARE NOT FAMILIAR WITH THE NECESSARY PROCEDURES, PLEASE CONSULT THE RESPONSIBLE PERSON BEFORE INSTALLATION.

1. Install the chosen pipe integration system properly and completely, following the steps in its included manual.
2. Every pipe integration system has a receiving flange (Figure 5-9, pos. 1) with eight (8) threaded holes. Make sure that all eight (8) threaded holes of the receiving flange are clean and undamaged.

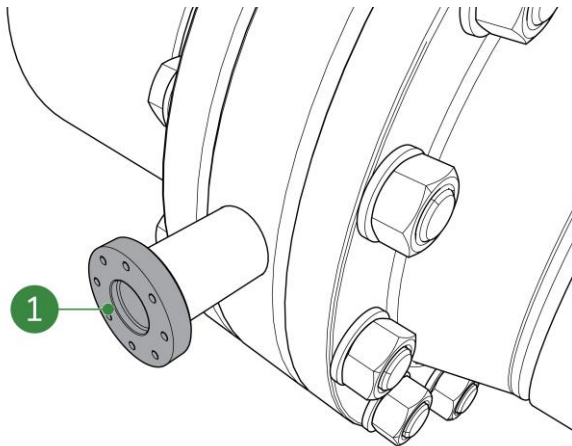


Figure 5-9: Receiving flange of pipe integration system

3. Make sure that the SDM and its installation materials are complete, clean and undamaged.

5.5.2 Installing the SDM



CAUTION

THE 3 GOLDEN SPRING-LOADED CONTACTS OF THE SENSOR ARE SENSITIVE AND MUST ALWAYS BE PROTECTED AGAINST DAMAGE, MOISTURE AND DIRT. MAKE SURE TO ALWAYS PLACE THE PROTECTIVE YELLOW CAP ONTO THE 3 GOLDEN SPRING-LOADED CONTACTS OF THE SENSOR DURING INSTALLATION OR MAINTENANCE PROCEDURES.



CAUTION

MAKE SURE TO NEVER COVER THE SDM WITH INSULATION MATERIALS.

Only use these materials to install the SDM:

- Bolts (six-sided): M5x20mm, AISI 316L, 8 pieces;
 - Washers: M5, AISI 316L, 8 pieces;
 - O-ring: Viton, 29.82x2.62 mm, 1 piece.
1. Ensure that no power is applied to the transmitter when installing the SDM.
 2. Place the washers onto the bolts and keep them within reach.
 3. Remove the black protective cap (Figure 5-10, pos. 1) from the sensor.

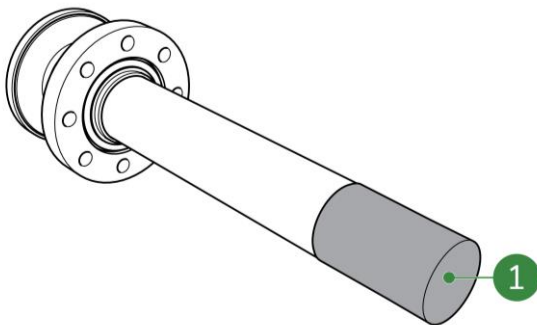


Figure 5-10: Black protective cap



CAUTION

NEVER REUSE OLD O-RINGS OR USE OTHER O-RINGS THAN THE ONES SUPPLIED WITH THE SDM. ONLY NEW O-RINGS SUPPLIED BY RHOSONICS ARE SUITABLE FOR THE USED CHEMICALS AND LOCAL TEMPERATURES.

4. Slide the supplied O-ring (Figure 5-11, pos. 1) onto the sensor. Place it against the sensor flange, within the O-ring groove.

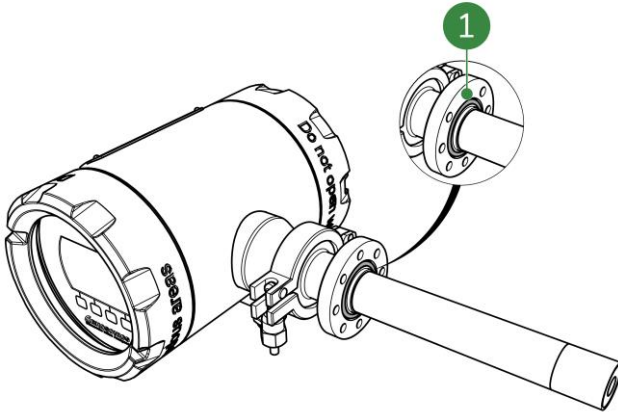


Figure 5-11: O-ring placement

5. Gently slide (as straight as possible) the SDM into the pipe integration system and align the screw holes of both flanges (Figure 5-12). Choose the position in such a way that the display is easy to be read.

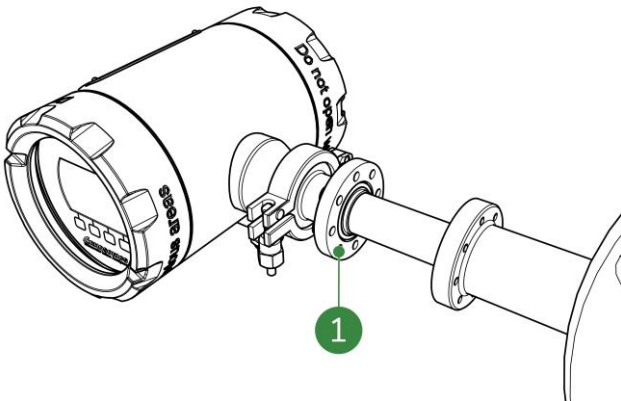


Figure 5-12: Aligning screw holes

6. Safely hold the SDM in place while mounting the screws in the next step.
7. Place the eight bolts (with their washers) through the holes of the SDM's flange, into the threaded holes of the receiving flange (Figure 5-13).

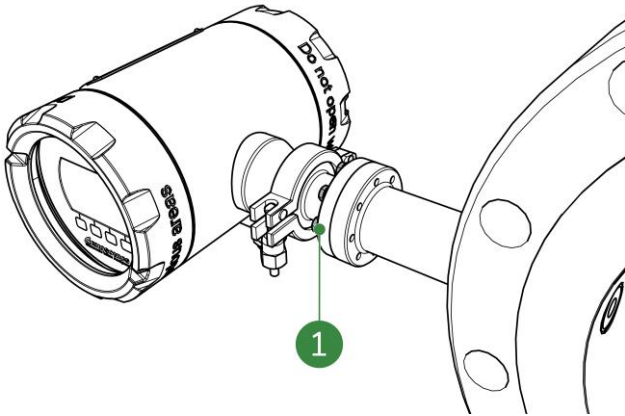


Figure 5-13: Placing the screws

8. Tighten the bolts and washers crosswise (Figure 5-14) until 4.2 Nm is reached for each bolt.

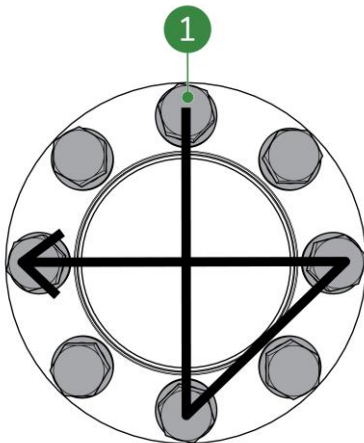


Figure 5-14: Crosswise tightening

5.6 Connecting the SDM

Before connecting the SDM, make sure all supplies match the requirements from the tables in chapter 5.6.1.

5.6.1 Supply requirements

- Power supply requirements

ITEM	VALUE
Input voltage	18 - 30 V DC
Maximum input power	8 W
Admissible ripple voltage	USS < 1V [$<100\text{Hz}$] USS < 10mV [$100\text{Hz} - 10\text{kHz}$]

- Protective earth connection requirements

ITEM	VALUE
Safety ground cable diameter	$\geq 4 \text{ mm}^2$

- HART cable connection requirements

ITEM	VALUE / INSTRUCTION
Cable gland outer diameter	2-6 mm
Load resistance	50 - 1000 Ω
Minimum conductor size	0.51 mm / 24AWG (cabling $\leq 1500 \text{ m}$) 0.81 mm / 20AWG (cabling $> 1500 \text{ m}$)
Maximum cable length	2700 m (Cap $< 70 \text{ pF/m}$)
Cable type	Twisted single pair shielded, or multiple pair with overall shield (Cap $\leq 65 \text{ pF/m}$)
Shield connection	Use grounding at one point only, at the host or DCS system

5.6.2 Connecting the protective earth

Connect a safety ground $\geq 4 \text{ mm}^2$ to the protective earth connection (Figure 5-15, pos. 1).

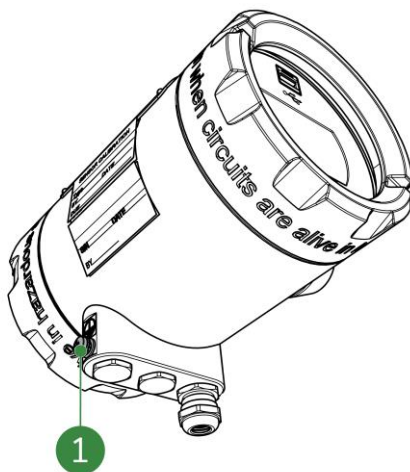


Figure 5-15: Protective earth connection

5.6.3 Connecting the power cable



DANGER

ALWAYS MAKE SURE THAT POWER CABLES ARE NOT CONNECTED TO A POWER SUPPLY WHILE CREATING NEW CONNECTIONS. ONLY (RE)CONNECT THE POWER SUPPLY AFTER CONNECTIONS HAVE BEEN SAFELY MADE AND THE CABLE COMPARTMENTS ARE SAFELY CLOSED AND SEALED.



CAUTION

MAKE SURE TO TIGHTEN THE CABLE GLANDS TO AVOID INTERNAL MOISTURE DAMAGE TO THE SDM.



NOTE

THE CABLE GLANDS CAN ALSO BE REPLACED BY A BLIND PLUG (STANDARD: M16X1.5) IF THE ENTRY IS NOT USED.

1. Open the back lid (Figure 5-16, pos. 1).

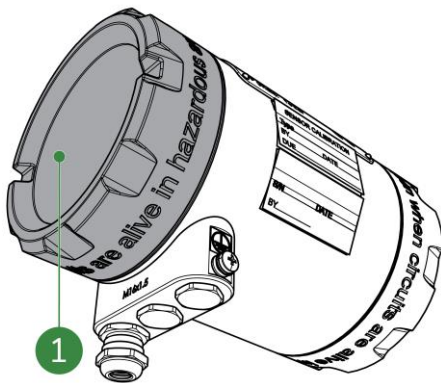


Figure 5-16: Back lid

2. Guide the power cable through the cable gland (standard supplied cable glands suitable for cables \varnothing 2-6 mm).

3. Connect the power cable to the power connection (Figure 5-17, pos. 1) using the screw connectors.

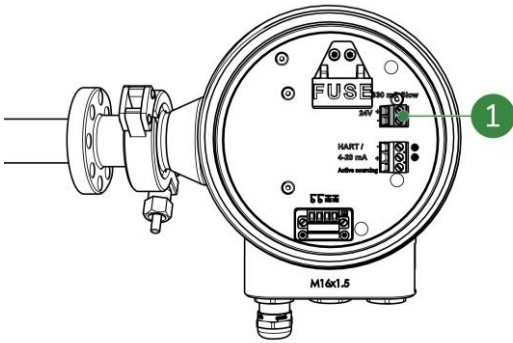


Figure 5-17: Power connection

4. Tighten the cable gland (Figure 5-18, pos. 1) to prevent moisture and dirt entering the SDM.

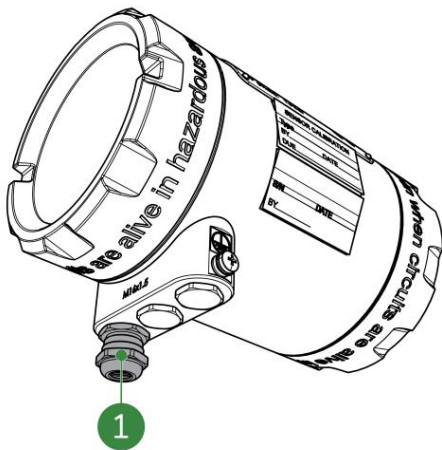


Figure 5-18: Cable gland

5. Connect other cables if necessary, use the spare cable gland(s).
6. Close the back lid (Figure 5-16, pos. 1).

5.6.4 Connecting the HART data cable



DANGER

ALWAYS MAKE SURE THAT POWER CABLES ARE NOT CONNECTED TO A POWER SUPPLY WHILE CREATING NEW CONNECTIONS. ONLY RECONNECT THE POWER SUPPLY AFTER CONNECTIONS HAVE BEEN SAFELY MADE AND THE CABLE COMPARTMENTS ARE SAFELY CLOSED AND SEALED.



CAUTION

MAKE SURE TO TIGHTEN THE CABLE GLANDS TO AVOID INTERNAL MOISTURE DAMAGE TO THE SDM.



CAUTION

BE AWARE THAT THE 4MA TO 20MA IS ACTIVELY SOURCING.



NOTE

THE CABLE GLANDS CAN ALSO BE REPLACED BY A BLIND PLUG (STANDARD: M16X1.5) IF THE ENTRY IS NOT USED.

1. Open the back lid (Figure 5-19, pos. 1).

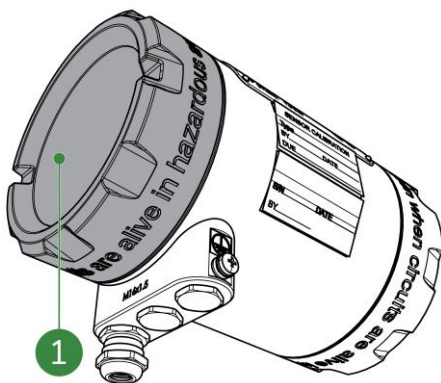


Figure 5-19: Back lid

2. Remove a blind plug (Figure 5-20, pos. 1).

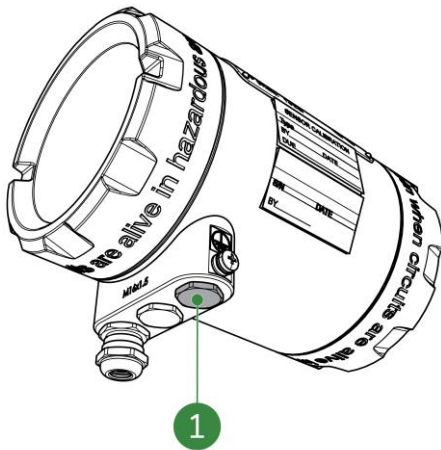


Figure 5-20: Blind plugs

3. Install spare cable gland (not shown) into cable entrance.
4. Guide the 4-20 mA cable (HART) through the newly placed cable gland.
5. Connect the 4-20 mA cable (HART) to the HART connection (Figure 5-21, pos. 1) using the screw connectors.

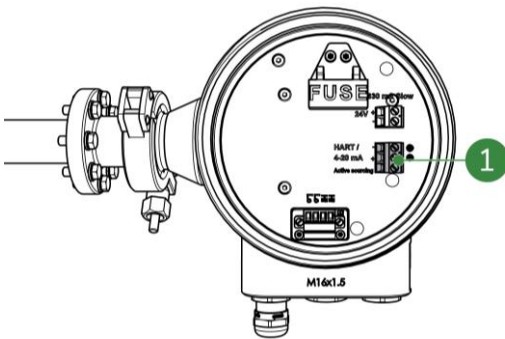


Figure 5-21: HART connection

6. Tighten the newly placed cable gland to prevent moisture and dirt entering the SDM.
7. Connect a PT100 cable if necessary, using a spare cable gland for the cable entry (Figure 5-22, pos. 1).

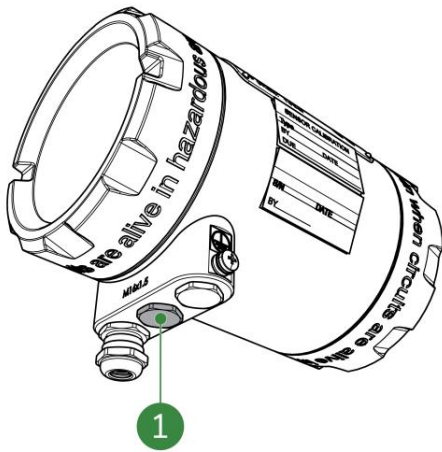


Figure 5-22: PT100 cable entry

8. Close the back lid.

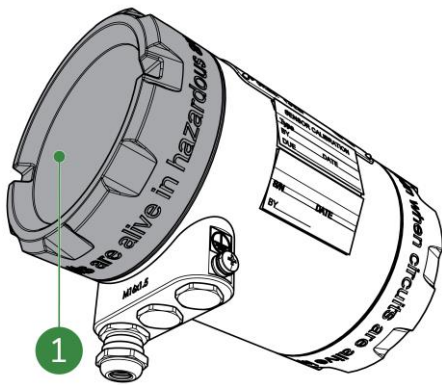


Figure 5-23: Back lid

5.6.5 Connecting the PT100



DANGER

ALWAYS MAKE SURE THAT POWER CABLES ARE NOT CONNECTED TO A POWER SUPPLY WHILE CREATING NEW CONNECTIONS. ONLY (RE)CONNECT THE POWER SUPPLY AFTER CONNECTIONS HAVE BEEN SAFELY MADE AND THE CABLE COMPARTMENTS ARE SAFELY CLOSED AND SEALED.



CAUTION

MAKE SURE TO TIGHTEN THE CABLE GLANDS TO AVOID INTERNAL MOISTURE DAMAGE TO THE SDM.



CAUTION

THE TEMPERATURE SENSOR MAY BE DISCONNECTED FROM THE SDM ONLY IF THE TEMPERATURE MEASUREMENT WAS PREVIOUSLY DISABLED.



NOTE

THE PT100 CABLE IS OPTIONAL AND ONLY NECESSARY IN EXTREME TEMPERATURE CONDITIONS.

The PT100 connection is used for temperature measurements. It consists of a block-form connector that can be connected to the PT100 connector on the back plate of the SDM.

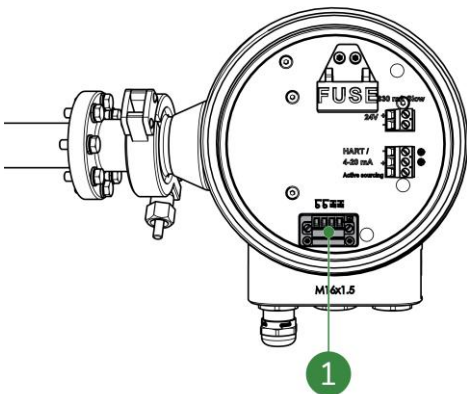


Figure 5-24: PT100 connector

1. Open the back lid.
2. Remove the blind plug (Figure 5-25, pos. 1) at the centre cable entry.
3. Install a spare cable gland into the cable entry.
4. Guide the PT100 cable through the cable gland.

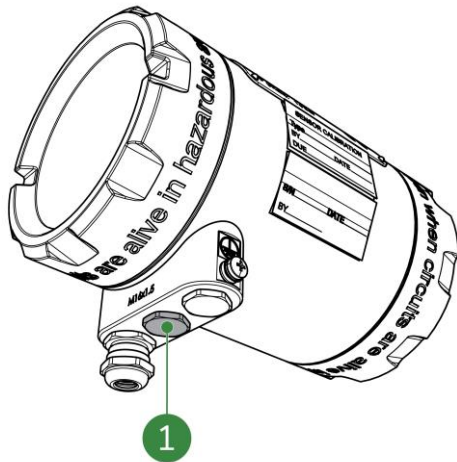


Figure 5-25: Blind plug at PT100 cable entry

NOTE



THE PT100 WIRING CONSISTS OF 4 WIRES:

- 2 SENSE HIGH WIRES (THESE ARE RED IN MOST CASES);
- 2 SENSE LOW WIRES (THESE ARE WHITE IN MOST CASES).

5. Connect the 4 threads of PT100 wiring to the block-form connector:
 - a. Have the row of 4 screws facing you.
 - b. Put the 2 sense high wires (Figure 5-26, pos. 1) into the 2 right cable entries.
 - c. Put the 2 sense low wires (Figure 5-26, pos. 2) into the 2 left cable entries.

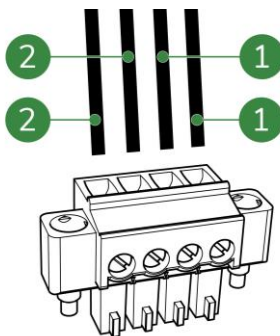


Figure 5-26: PT100 wiring for block-form connector

6. Tighten the 4 screws on the block-form connector to secure the wiring ends.
7. Click the block-form connector onto the PT100 connector (Figure 5-27, pos. 1) on the back plate.

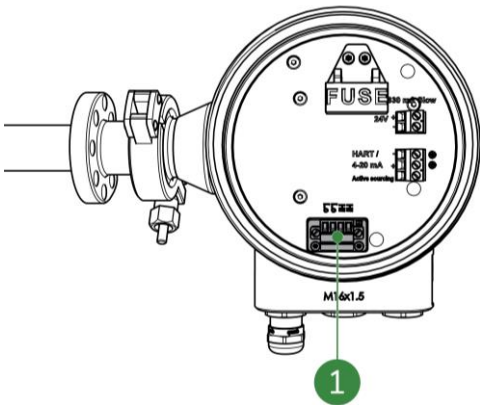


Figure 5-27: PT100 connector

8. Tighten the 2 screws on the far left and far right of the block-form connector.
9. Tighten the cable gland (Figure 5-28, pos. 1) to prevent moisture and dirt entering the SDM.

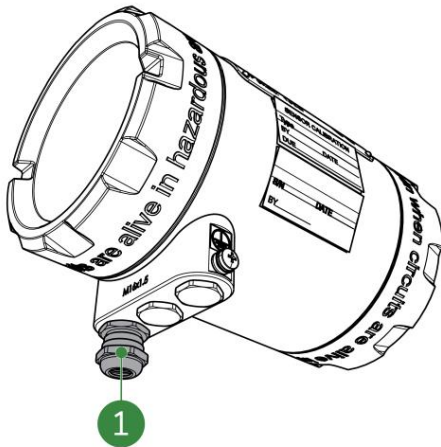


Figure 5-28: Cable gland

10. Close the back lid (Figure 5-29, pos. 1).

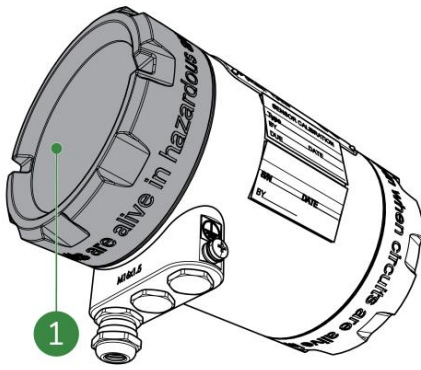


Figure 5-29: Back lid

11. Erase the log from the SDM, see chapter 6.3.11, and wait for 60 seconds.
12. The temperature measurement can be enabled and disabled:
Main Menu -> Advanced functions -> PT100 connected.
13. Select On/Off using ▼ button.
14. Press the ✓ button to accept.

6. OPERATION

6.1 Introduction and user levels

The SDM is operated via the buttons and display for day-to-day use.

Local supervisors, service engineers or distributors have access to more advanced options for operation via HART and/or the USB-port.

These are the levels of operation dependent on the type of user:

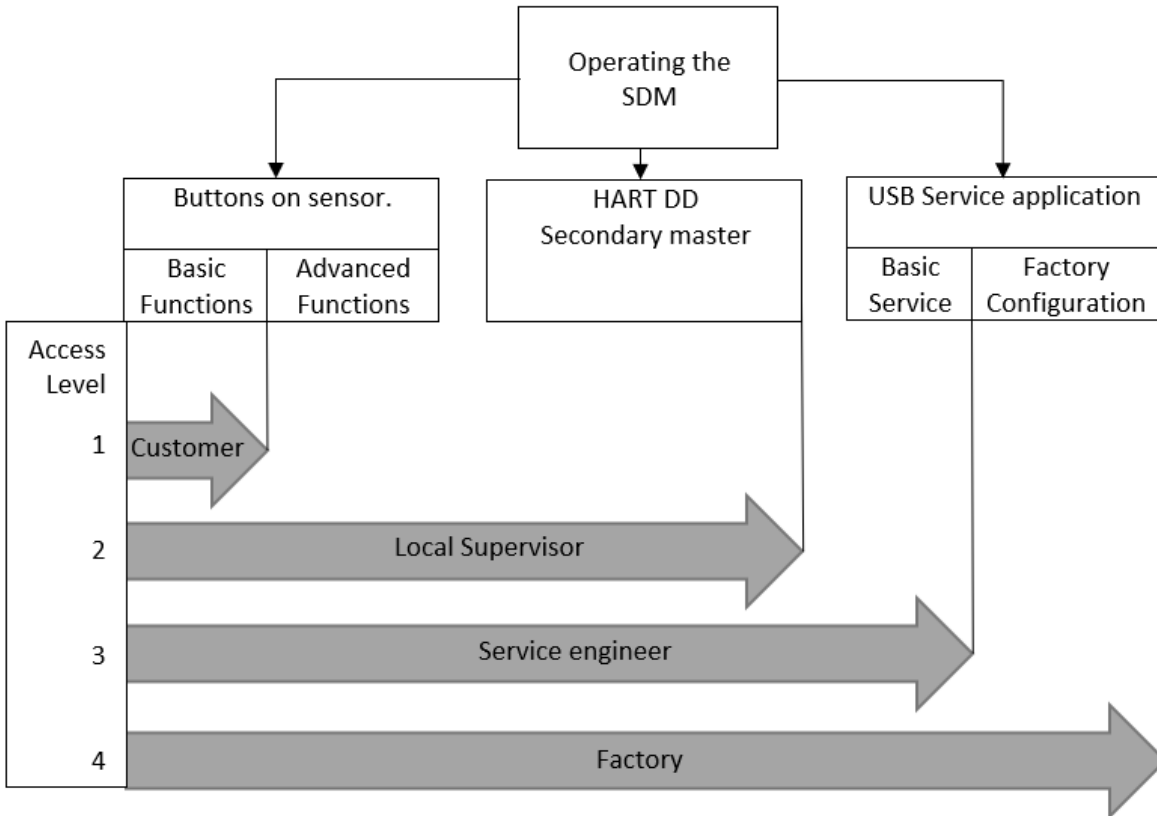


Figure 6-1: Chart for operation level per type of user

Each user interface has a different set of functions:

- An overview of available functionalities per user interface can be found in chapter 13.4 on page 101;
- An overview of the menu tree can be found in chapter 13.3 on page 100.

6.2 SDM display and buttons

6.2.1 Accessibility and functionality

The SDM display and its buttons support several access level functionalities. Setting time and date, setting the log interval and a minor system status icon displays the most relevant error in case of measurement problems.

To assure settings can only be changed by authorized personal most menus are hidden behind an access code. Except for the *Start page*, *Measured Value* and *Decay Time* pages.



NOTE

AN OVERVIEW OF THE COMPLETE MENU TREE IS AVAILABLE IN CHAPTER 13.3 ON PAGE 100.

6.2.2 Symbols, buttons and icons

During operation, several items can be visible on the display (Figure 6-2).

ITEM / ICON	EXPLANATION	LOCATION ON SCREEN
	Current access level	Top right corner
	Unlocked (local access)	Top right corner
	Locked (Remote access)	Top right corner
	Warning (value out of range)	Central / Top right corner
	Device is in maintenance / Check function is on	Central / Top right corner
	Maintenance required	Central / Top right corner
	Failure Functions	Central / Top right corner
	Go right	First button at bottom left*
	Go up	First button at bottom left*
	Go down	Second button at bottom*
	Accept or Main menu	Third button at bottom
	Back / Page level higher	Fourth button at bottom right

Table 6-1: LCD screen icons and explanations

* The color of the first and second button might be reversed (black to white / white to black). This is to indicate that this button was used last.

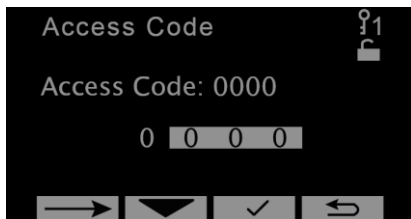


Figure 6-2: Display with icon positions

6.2.3 Status SDM and display colors

The status of the SDM is shown through different icons and backlight colors. Unless the black and white backlight mode is enabled, see chapter 6.3.5.

The screen has two modes: active and time-out. The active mode is activated by pressing a button. If a button isn't pressed for 10 minutes the screen will return to the time-out mode.

**NOTE**

THE DEVICE STATUS IS DISPLAYED ACCORDING NAMUR RECOMMENDATION NE107. ONCE THE BLACK AND WHITE BACKLIGHT MODE IS ENABLED, THE COLORED DISPLAYS WILL NO LONGER WORK AND THE SDM WILL NO LONGER DISPLAY ITS STATUS IN A COLORED DISPLAY.

The various states and modes are shown in Table 6-2, Table 6-3 and Table 6-4.

**NOTE**

INDICATED VALUES MIGHT DIFFER FROM VALUES VISIBLE ON YOUR DEVICE.

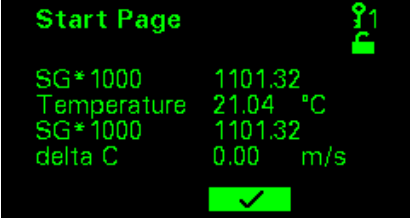

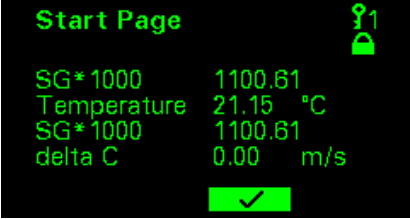



ACTIVE	TIME-OUT
<p>Color: Green Accessibility: Unlocked (local access) Status: Normal operation Output: Valid</p> <p>Info: Device is operating within specified range.</p> 	<p>Color: Green Accessibility: Unlocked (local access) Status: Normal operation Output: Valid</p> <p>Info: Device is operating within specified range.</p> 
<p>Color: Green Accessibility: Locked (remote access) Status: Normal operation Output: Valid</p> <p>Info: Device is operating within specified range.</p> 	<p>Color: Green Accessibility: Locked (remote access) Status: Normal operation Output: Valid</p> <p>Info: Device is operating within specified range.</p> 
<p>Color: Green Accessibility: Unlocked (local access) Status: Normal operation Output: Valid</p> <p>Info: Device is operating within specified range.</p> 	<p>Info: In time Out Access level will be reset to level 1.</p> 

Table 6-2: SDM states and modes - Green colored

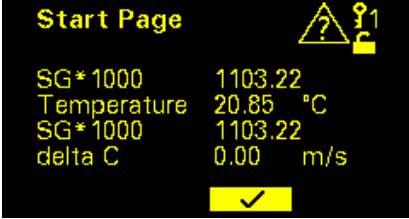

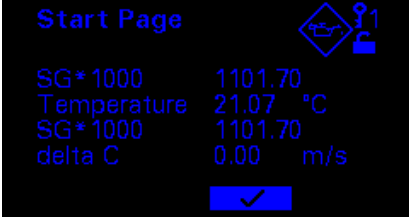

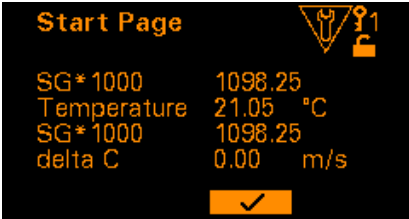

ACTIVE	TIME-OUT
<p>Color: Yellow Accessibility: Unlocked (local access) Status: Value out of range Output: Valid</p> <p>Info: Device is operating outside specified range. Internal diagnoses indicate deviations from measured or set values.</p> 	<p>Color: Yellow Accessibility: Unlocked (local access) Status: Value out of range Output: Valid / Icon and measurement values are alternating.</p> <p>Info: Device is operating outside specified range. Internal diagnoses indicate deviations from measured or set values.</p> 
<p>Color: Blue Accessibility: Unlocked (local access) Status: Maintenance required Output: Valid</p> <p>Info: Maintenance is required.</p> 	<p>Color: Blue Accessibility: Unlocked (local access) Status: Maintenance required Output: Valid / Icon and measurement values are alternating.</p> <p>Info: Maintenance is required.</p> 
<p>Color: Orange Accessibility: Unlocked (local access) Status: Device is in maintenance Output: Valid</p> <p>Info: Device is in maintenance.</p> 	<p>Color: Orange Accessibility: Unlocked (local access) Status: Device is in maintenance Output: Valid / Icon and measurement values are alternating.</p> <p>Info: Device is in maintenance.</p> 

Table 6-3: SDM states and modes – Yellow, blue and orange colored

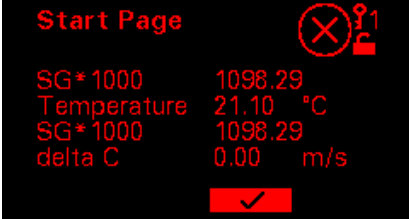

ACTIVE	TIME-OUT
<p>Color: Red Accessibility: Unlocked (local access) Status: Failure Output: Invalid</p> <p>Info: Replace device.</p> 	<p>Color: Red Accessibility: Unlocked (local access) Status: Failure Output: Invalid / Icon and measurement values are alternating.</p> <p>Info: Replace device.</p> 

Table 6-4: SDM states and modes – Red colored

6.3 Operation via SDM display and buttons



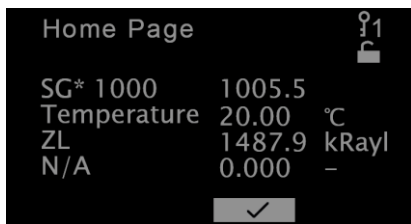
NOTE

AN OVERVIEW OF THE COMPLETE MENU TREE IS AVAILABLE IN CHAPTER 13.3 ON PAGE 100.

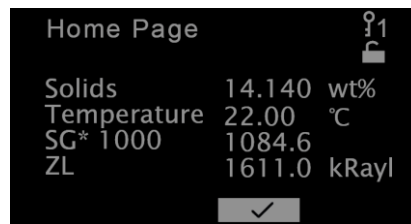
6.3.1 Home page

The first page seen when the SDM is starting up is the *Software Page*, see Figure 6-5 on page 63. When a key is pressed in time-out mode, the *Home Page* will be shown. The *Home Page* contains four values: the HART communication values.

SDM SG:



SDM WT%:

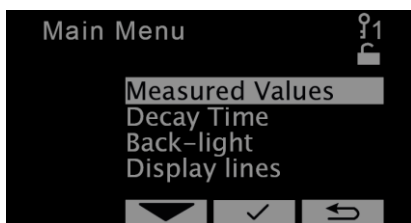


6.3.2 Main menu

On the *Home Page* press  to go to the *Main Menu*.

In the *Main Menu* you can choose from 5 options:

- Measured Values
- Decay Time
- Back-light
- Display lines
- Advanced Function (Access Code required)

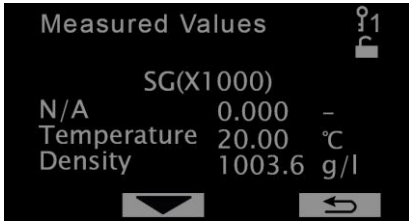


6.3.3 Measured values

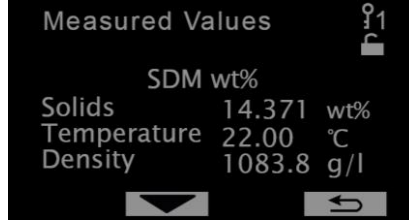
Main Menu -> Measured Values.

To view all the values that are measured go to the *Measured Values* page. Use the up and down arrows to go through the values.

SDM SG:



SDM WT%:



6.3.4 Decay time

Main Menu -> Decay Time.

A *Decay Time* of 15 seconds is the default setting. This setting is sufficient for most applications. For a faster response time the *Decay Time* should be set lower, resulting in higher noise. For lower noise the *Decay Time* should be set higher, resulting in a slower response time.

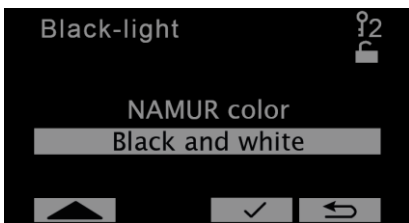


6.3.5 Back-light

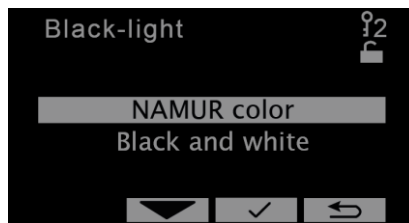
Main Menu -> Back-light.

On the SDM you can choose different *Back-light* modes. The default setting is *NAMUR color* mode. The *Black and white* mode can be used in sunny locations to get a better view of the display. Once the *Black and white* mode is enabled, the SDM will no longer display its status in a colored display. Select *NAMUR color* to reset the color display.

Black and white mode:



NAMUR color mode:



6.3.6 Display lines

Main Menu -> Display lines.

On the SDM you can choose how much information is shown while in time-out mode. The time-out mode is activated after 10 minutes if no actions are performed on the SDM.

The default setting is zero (0) display lines and there are 3 options:

- Zero (0) display lines. Based on the chosen model only SGx1000 or WT% values are displayed.
- One (1) display lines. Based on the chosen model 2 values will be displayed.
- Two (2) display lines. Based on the chosen model 3 values will be displayed.

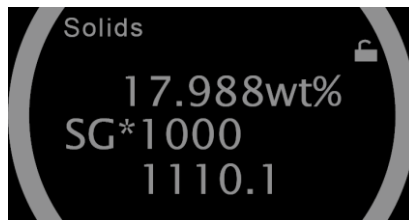
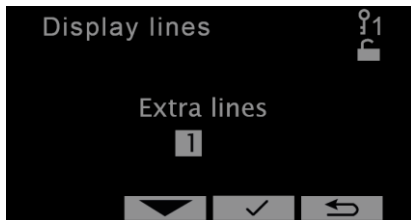


Zero (0) display lines.



NOTE

IF THE SG*1000 VALUE FOR THE SDM MODEL WT% IS VISIBLE ON THE DISPLAY, THEN IT IS AN INCORRECT VALUE.

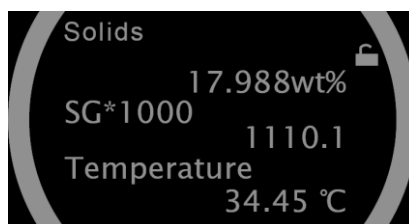
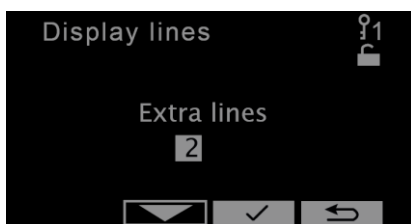


One (1) display lines.



NOTE

WITHIN THE TWO (2) DISPLAY LINE OPTION, THE TEMPERATURE VALUE IS A SET VALUE. THE SHOWN TEMPERATURE VALUE IS NOT BASED ON TEMPERATURE MEASUREMENTS.

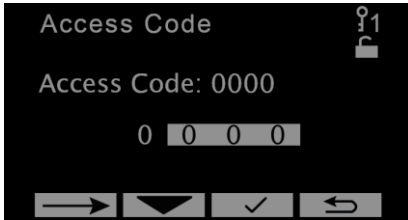


Two (2) display lines.




6.3.7 Access code

Main Menu -> Advanced Function.

A higher Access Code is required to access the *Advanced Function* menu and all related functions. Access code for level 2 is 1802.



Entering the *Advanced Function* menu, the *Access Code* page will appear if you are not already in level 2.

- Enter the code using the  and  buttons.
- Submit the code using the  button.
- The *Advanced Function* menu appears on the display.

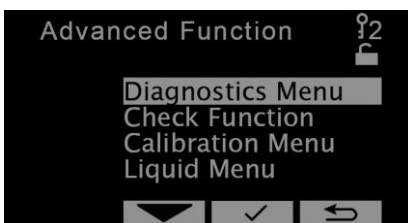
6.3.8 Advanced function

Main Menu -> Advanced Function

A higher Access Code is required to access the *Advanced Function* menu and all related functions.

In the *Advanced Function* menu you can choose from 6 options:

- Diagnostics Menu
- Check Function
- Calibration Menu
- Liquid Menu
- Write protect
- Output mA Range
- PT100



6.3.9 Diagnostics menu

Main Menu -> Advanced Function -> Diagnostics Menu.

In the Diagnostics Menu you can choose from 6 options:

- Logging Menu
- Erase log
- System status
- Set Clock
- Restore Calibration
- Load sensor settings

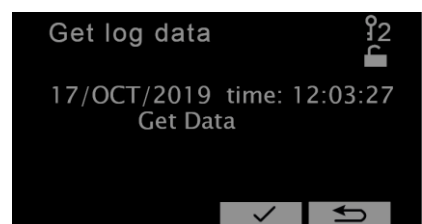
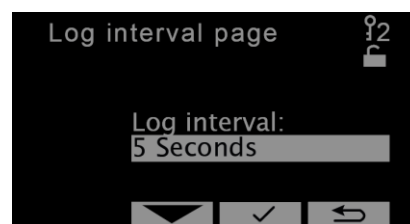
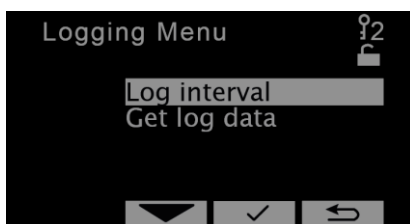


6.3.10 Logging menu

Main Menu -> Advanced Function -> Diagnostics Menu -> Logging Menu.

In the Logging Menu you can choose from 2 functions:

- *Log interval:* This function is used to set the interval in which log data is saved. Keep in mind that the log file has room for 65535 entries. You can choose from the following intervals:
 - 1, 2, 5, 10 or 30 Seconds
 - 1, 2, 5 or 10 Minutes.
- *Get log data:* This function is used to write the log-data to the USB-stick, see chapter 6.5. In case of issues with writing the log-data, see chapter 9.2.2.

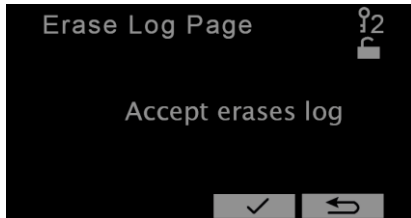


6.3.11 Erase log

Main Menu -> Advanced Function -> Diagnostics Menu -> Erase Log.

The device is constantly logging. This has the advantage that the log can be accessed after an incidental measurement error. When starting a test, it may be necessary to clear the log data. To make sure the time settings are correct, check the date and time, see chapter 6.3.13.

Press the  button to erase the log.



6.3.12 System status

Main Menu -> Advanced Function -> Diagnostics Menu -> System Status.


On this page you will find information on the SDM.

- Software version
- Status
 - If the status is OK, Normal Operation is shown.
 - If the status not OK, the error and additional information is shown.

SYSTEM STATUS	ERROR CODE
Normal operation	0
Out of range	74
Failure	79



6.3.13 Set clock and date

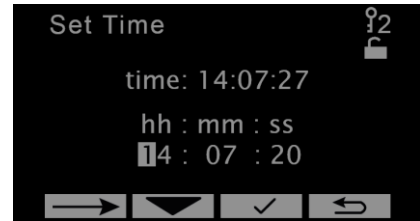
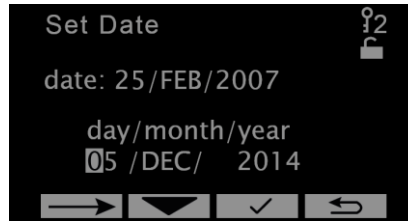
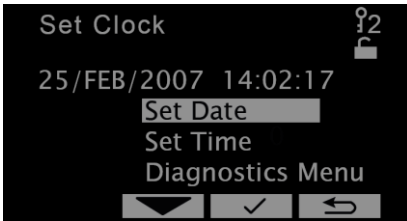


CAUTION

IF THE TIME OR DATE IS SET, MAKE SURE TO ERASE THE LOG AFTERWARDS. TO ERASE THE LOG, CONSULT CHAPTER 6.3.13.

Main Menu -> Advanced Function -> Diagnostics Menu -> Set Clock.

The time and date must be set on these pages. Please set to the local date and time. The timestamps are used in calibration, troubleshooting and to interpret the log files.




6.3.14 Factory settings

SDM-SGx1000 FACTORY SETTINGS		SDM-WT% FACTORY SETTINGS	
ITEM	VALUE	ITEM	VALUE
(Customer) Temperature offset	00.0	(Customer) Temperature offset	00.0
SGx1000 offset	0000	SGx1000 offset	0000
SGx1000 span	1.000	SGx1000 span	1.000
Field span	1.000	Field span	1.000
Output mA range:		Output mA range:	
- Output lower range	500	- Output lower range	-2%
- Output upper range	2500	- Output upper range	100%
Decay time	15 sec	Decay time	15 sec

6.3.15 Restore calibration



CAUTION

READ THIS SECTION CAREFULLY BEFORE STARTING. PAY ATTENTION BEFORE PRESSING  , IF ACCEPTED, ALL CALIBRATIONS (TEMPERATURE, OFFSET AND (FIELD)SPAN) WILL BE LOST AND RESET TO FACTORY SETTINGS.

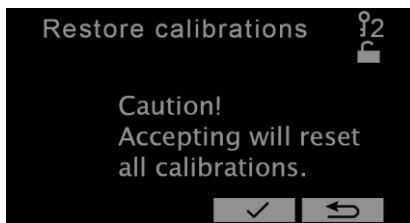


CAUTION

OUTPUT MA RANGE AND DECAY TIME WILL NOT GO TO FACTORY SETTINGS WHEN YOU RESTORE TO FACTORY SETTINGS.

Main Menu -> Advanced Function -> Diagnostics Menu -> Restore Calibrations.

On this page all calibrations can be restored to factory settings. This will reset the calibrated temperature offset, water offset, span to slurry.



6.3.16 Load sensor settings

See chapter 6.5.4.

6.3.17 Calibration menu

Main Menu -> Advanced Function -> Calibration Menu.

In the Calibration Menu you can choose from 3 options:

- Temperature
- SGx 1000
- FIELD (for SDM WT% only)

For instructions on the calibration of the SDM, see chapter 7 on page 64.

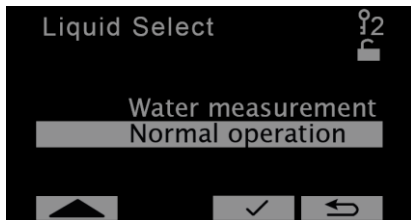
6.3.18 Liquid menu

Main Menu -> Advanced Function -> Liquid Menu.

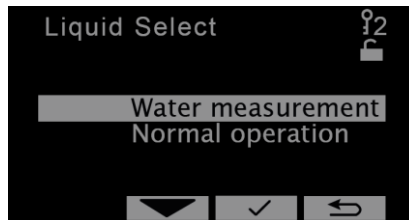
The default setting is *Normal operation*.

- Correct setting SDM model SGx1000 = water measurement in liquid menu.
- Correct setting SDM model WT% = normal operation in liquid menu.

Default setting:



Incorrect setting:



6.3.19 Write protect

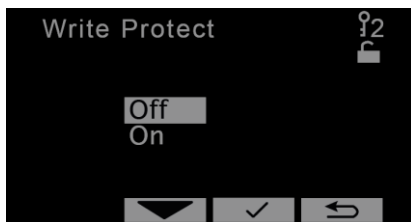
Main Menu -> Advanced Function -> Write Protect.

Write protect mode is used when the HART communication for the SDM is used. If the HART communication is not used, this menu is not used and write protect mode should be set to *Off*.

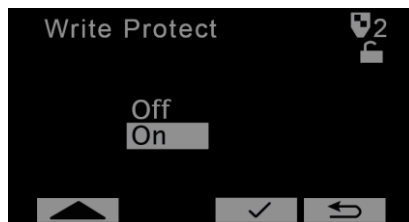
When the write protect mode is enabled, a shield icon is visible in the top right corner.

The write protect mode prevents data to be written onto the device from external devices.

Default setting:



Write protect mode enabled:

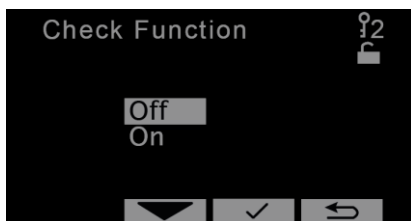


6.3.20 Check function

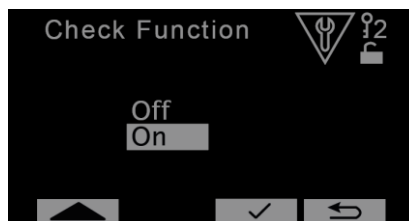
Main Menu -> Advanced Function -> Check Function.

The *Check Function* mode is only used when a service engineer needs to make expert adjustments to the system. This function is not used during standard operations and setup. Once this mode is enabled, no log will be created. Once the check function mode is enabled, the screen will turn orange and a wrench will appear in the top right corner. Returning to normal operation can be done by selecting *Off*.

Default setting:



Check function mode enabled:



The *Check Function* can be used for 2 things:

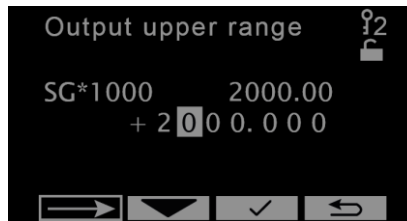
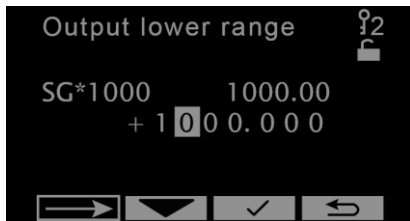
- When HART is used the DCS is warned that the SDM is in maintenance. The values sent to the DCS may be invalid.
- Another function is that a COM-port is configured for a service PC to be used by a Rhosonics service engineer.

6.3.21 Output mA range

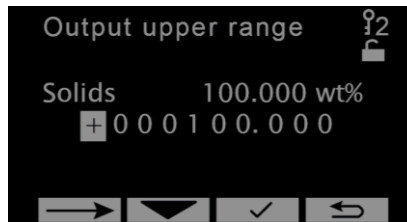
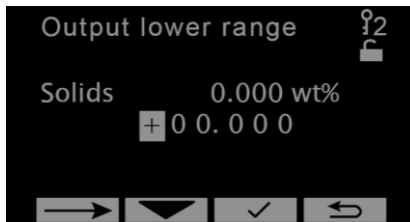
Main Menu -> Advanced Function -> Output mA Range.

On this page the upper and lower range value can be set. Setting *Output mA range* is used to assign which value is corresponding to the 4mA and 20mA range of the analog output. As a consequence the transmitter (and mA out) will go into the out of range modus, when the measured value will go out of this range.

SDM SG



SDM WT%



6.4 Operation via HART

Operating the SDM via HART is only available for people with access level 2 or above.



NOTE

FOR INSTRUCTIONS ON OPERATING THE SDM VIA HART, SEE THE RHOSONICS 9D HART FIELD DEVICE MANUAL BY RHOSONICS.

6.5 Operation via USB

The USB-port (Figure 6-3, pos. 1) is located top center on the SDM.

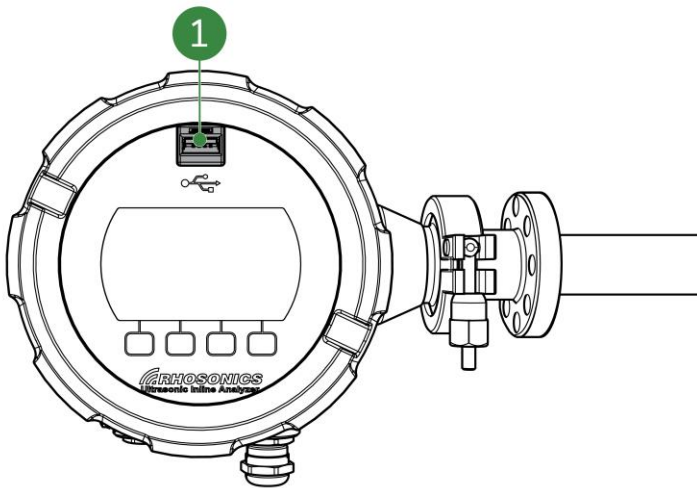


Figure 6-3: USB-port

The USB-port is used for:

- software updates;
- saving settings and log data;
- connecting the SDM to a laptop from a Rhosonics service engineer;
- load sensor settings.

6.5.1 Updating the software via USB

To update the software on the SDM:

1. Power off the SDM by interrupting the power supply.
2. Insert an USB-stick with the latest software and the file bootscrip.img.
3. Power on the SDM by restoring the power supply.
4. Wait until the SDM has booted and the software version is shown in the screen.
5. Disconnect the USB-stick.



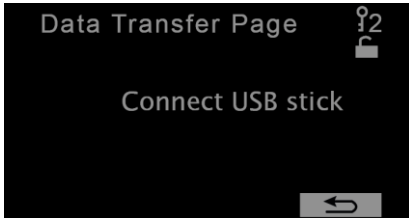
NOTE

IF IT IS IMPOSSIBLE TO INTERRUPT THE POWER SUPPLY, THE SDM CAN ALSO BE RESTARTED BY A REBOOT. SEE CHAPTER 6.6 FOR REBOOTING INSTRUCTIONS.

6.5.2 Saving settings and log data via USB

Saving settings and log can be done for diagnostics evaluation and for troubleshooting. When a log-file is stored to the USB stick the settings from the SDM will be stored as well. The settings from the SDM can then be interpreted by the factory.

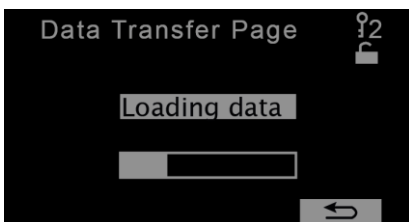
1. Go to *Logging Menu* -> *Get log data*. A request will open automatically to connect the USB.



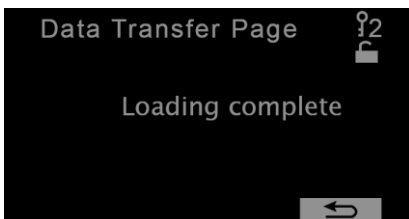
2. Insert the supplied empty Rhosonics USB stick for collecting log files.
3. The USB stick is checked. Then the echoes, settings and measured values are saved. Within 20 seconds this should be finished. If failed, the display shows so.



4. The log is retrieved from the log memory. This will take a few minutes. The blinking of *Loading data* as well as the updating of the progress bar indicate that the data is being saved.



5. When data saving is finished, the message *Loading complete* appears. It is now possible to leave this page and remove the USB-stick.



The table below shows the files that are saved:

Filename	Description
L"YYMMDD".txt	Log
I"YYMMDD".txt	Interface echo
M"YYMMDD".txt	All measured values at time of "Get Log"
RLS-FILE.csv	Liquid calibration in transmitter (Loadable for service engineers)
S"YYMMDD".txt	Settings (Not loadable)
SETTING.csv	Settings (Loadable for service engineers)
3ASENSOR.csv	Settings and calibration of sensor (Loadable)

Send all the files to service@rhosonics.com when you need any service of the SDM.



NOTE

IF THE TRANSFER IS FAILED, IT WILL SHOW "PROBLEM WITH TRANSFER". SEE CHAPTER 9.2.2 FOR TROUBLESHOOTING.

6.5.3 Connecting the SDM via the USB to a laptop or PC

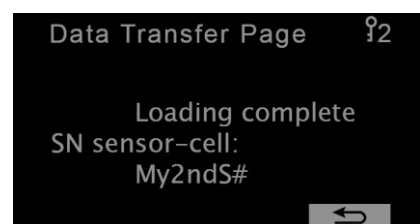
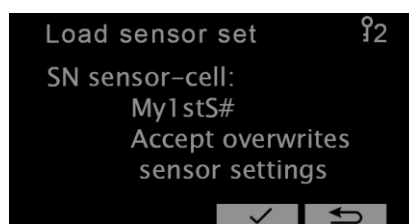
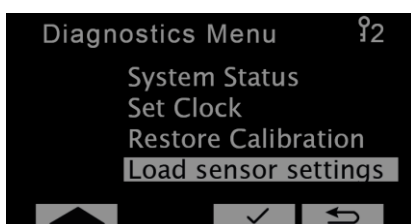
For instructions on connecting the SDM via the USB-port to a laptop or PC, contact Rhosonics at service@rhosonics.com.

6.5.4 Load sensor settings

Before uploading the sensor file, you need to make sure:

- To restore the calibrations, see chapter 6.3.14.
- To erase the log data, see chapter 6.3.11.
- The 3ASENSOR.CSV file has the same software version as the SDM transmitter:
 - To check the current software version of the SDM transmitter, see chapter 6.7 (see chapter 6.6 for rebooting);
 - To check the software version of the file, open the 3Asensor.CSV file from the supplied USB stick on a computer in excel and compare column B1 with the software version of the transmitter.

1. Select in *Advanced Function -> Diagnostics menu -> Load sensor settings*.
2. Place the USB stick with 3ASENSOR.CSV file.
3. Accept overwrites sensor settings.
4. Wait until the process finishes and press back. Then you can pull out USB stick.



6.6 Rebooting the SDM

To reboot the SDM:

1. Press the two outer buttons (Figure 6-4, pos. 1 and pos. 2) simultaneously for two seconds.
2. The display will show a message that the SDM will be rebooted within 30 seconds.

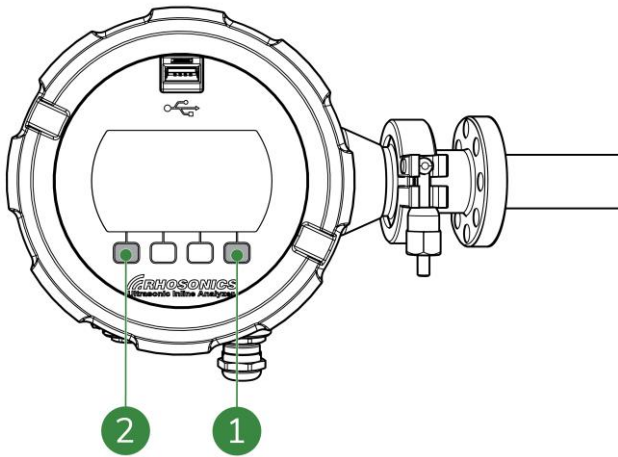


Figure 6-4: SDM reboot

6.7 Checking the software version



NOTE

A SOFTWARE VERSION CHECK IS ONLY NECESSARY IF REQUESTED BY RHOSONICS.

To check the software version:

1. Reboot the SDM, see chapter 6.6.
2. When the display is powered up, the software version displays in the top left corner (Figure 6-5, pos. 1).

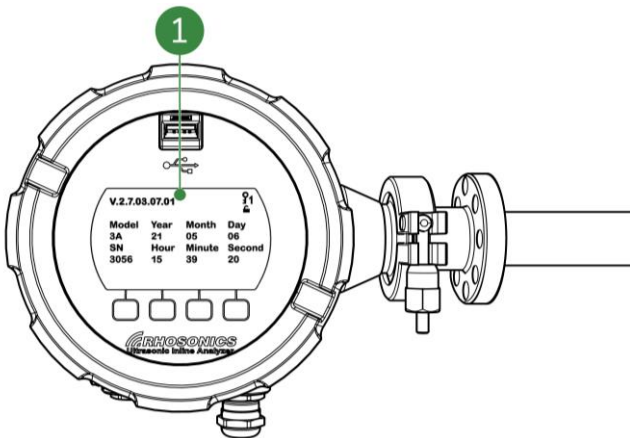




Figure 6-5: Software version

7. CALIBRATION



CAUTION

THE SDM-SG MUST BE CALIBRATED FOLLOWING THE SDM-SG CALIBRATION METHOD.
THE SDM-WT% MUST BE CALIBRATED FOLLOWING THE SDM-WT% CALIBRATION METHOD.
MIXING UP CALIBRATION METHODS WILL RESULTS IN INCORRECT READINGS.



NOTE

BEFORE YOU START CALIBRATING, MAKE SURE THAT THE SDM HAS BEEN CONNECTED TO A POWER SUPPLY FOR AT LEAST 4 HOURS AND THAT WATER HAS BEEN RUNNING FOR AT LEAST 30 MINUTES.

7.1 How ultrasonic sound is transformed into density values

The density of slurry is measured through acoustic impedance, see Figure 7-1.

“The measurement is based on the physical law of Acoustic Impedance, established by Sir Rayleigh”

$$Z_L = \rho_L \times c_L$$

Z_L = Acoustic impedance
 ρ_L = Density of the liquid
 c_L = Speed of sound

Density range: 700 to 3000 g/l ... 0.7 to 3 t/m³
 %solids range: 0 to 80 wt%

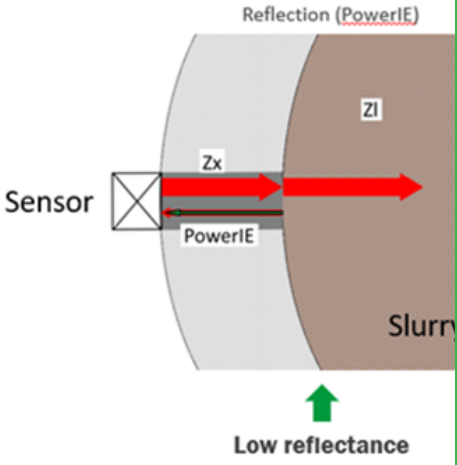


Figure 7-1: Basics of acoustic impedance

7.2 Calibration basics

To calibrate the SDM, take notice of the calibration basics in chapter 7.2.1, chapter 7.2.2 and chapter 7.2.3 to make sure measurement values are reliable.

7.2.1 Off-set calibration basics

After installation, we need to check if the density value of clear liquid is right. In customer processes the density may deviate from the real value due to slightly different circumstances in the process pipe.

If the value of the clear liquid is incorrect, i.e. for water 1020, you will need to enter the right density value of the water to 1000. We use the off-set to adjust this, see Figure 7-2.

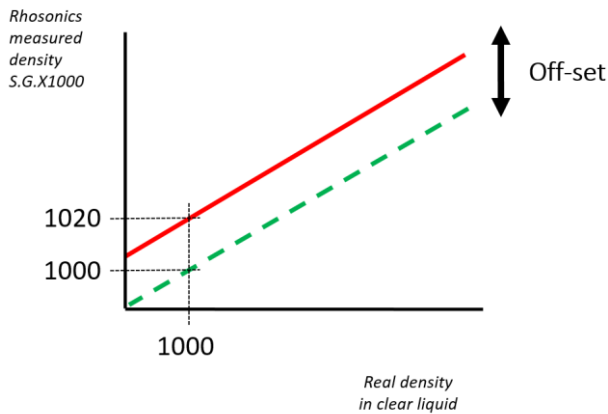


Figure 7-2: Off-set calibration basics

7.2.2 Span-factor calibration basics

When pumping slurry you will need to have a reference value to verify the accuracy.

If the shown density on the density meter is too high, i.e. 1350 instead of 1320, we use the span-factor to adjust this. Simply change the shown value until it reaches the reference value, see Figure 7-3.

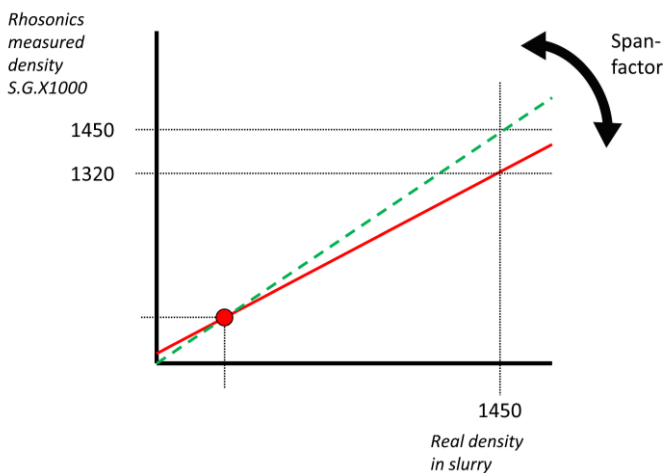


Figure 7-3: Span-factor calibration basics

7.2.3 Correct density values basics

Since Rhosonics uses the acoustic impedance to measure the density, which is a linear function, the density meter will now read the correct density value in between this range (1000 – 1320), see Figure 7-4.

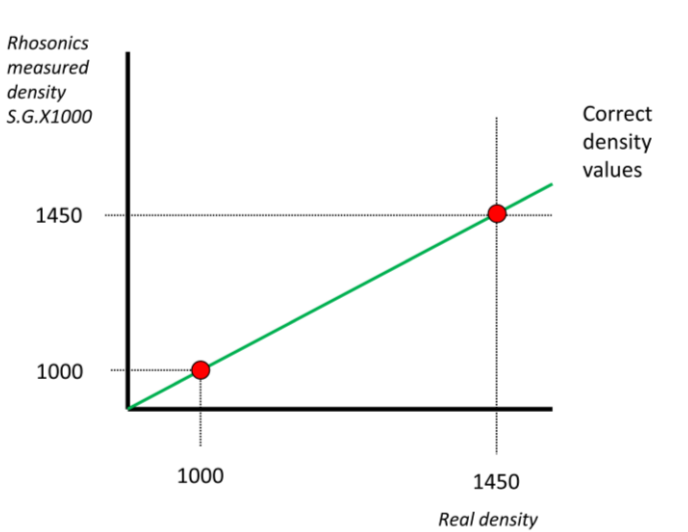


Figure 7-4: Density value basics

7.3 Calibration SDM SG

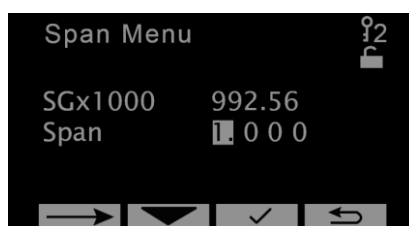
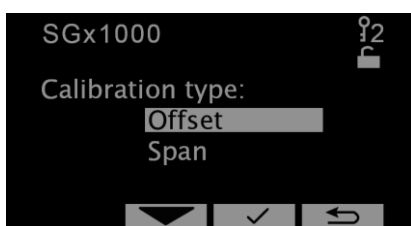
1. Make sure the SDM is powered on for 4 hours.
2. Check if the date and time are set correctly on the SDM, see chapter 6.3.13.
Main menu -> Advanced Function -> Diagnostics Menu -> Set Clock.



NOTE

RESETTING THE CALIBRATION TO THE FACTORY SETTINGS IS ONLY NEEDED WHEN THE SDM HAS BEEN USED BEFORE.

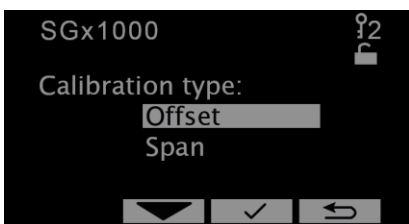
3. Reset the calibration to the factory settings and accept the warning. See chapter 6.3.14.
Main Menu -> Advanced Function -> Diagnostics Menu -> Restore Calibrations.
4. Clear the log from the SDM, see chapter 6.3.11. Wait for 60 seconds. Reboot the SDM, see chapter 6.6. Or disconnect and reconnect the power supply. (Only necessary if step 3 has been performed)
Main Menu -> Advanced Function -> Diagnostics Menu -> Erase Log.
5. Before the water calibration, check that the span is 1.
Main Menu -> Advanced Function -> Calibration Menu -> SGx 1000 -> Span Menu



6. Pump water for 30 minutes to monitor the SDM and verify that you have a stable SGx1000 reading.
7. Check the temperature of the water. Adjust the temperature to the correct value if needed.
Main Menu -> Advanced Function -> Calibration menu -> Temperature.



8. Adjust the SGx1000 reading (only when there is water in front of the sensor) with an offset calibration to the water density when you have a stable reading.
Main Menu -> Advanced Function -> Calibration menu -> SGx 1000 -> Offset.



9. Pump slurry for 30 minutes to monitor the SDM and verify that you have a stable SGx1000 reading.
10. Check the temperature of the slurry and calibrate this with an offset calibration. The temperature setting should be equal to the average process temperature when pumping slurry.
Main Menu -> Advanced Function -> Calibration menu -> Temperature.
11. Take samples of the process. For the correct sampling method, consult the manual 'Rhosonics sampling procedure'.

12. Calibrate the span factor on the S.G. x 1000 pages. Only do this if there is slurry in the pipe, this will change the accuracy of the SDM.

Main Menu -> Advanced Function -> Calibration Menu -> SGx 1000 -> Span.

There are two ways to do it:

- The simple method: Take a sample and adjust the value in the span menu to the value of the reference sample.
- The difficult method: setting a span factor by using the formula below (Figure 7-5):

$$\text{Span}_{SG} = \frac{SG_{\text{Certified}} - SG_{\text{Offset}}}{SG_{\text{Uncorrected}} - SG_{\text{Offset}}}$$

Figure 7-5: Calibration span factor formula

- $SG_{\text{Certified}}$ is the value of the sample.
- $SG_{\text{Uncorrected}}$ is the value read on the SDM at the time of sampling (on screen or in log file).
- SG_{Offset} is the number 1000 (represents water).
- Example: $SG_{\text{Certified}}$ is 1600SG-1000SG. $SG_{\text{Uncorrected}}$ is 1205SG-1000SG makes 600:205 and gives a span factor of 2.92.



For unstable processes repeat the step above 5 times and calculate the average span factor.

13. Validate the SDM reading by taking more samples and compare them to the displayed values on the SDM. Adjust the value if not satisfied.

7.4 Calibration SDM WT%

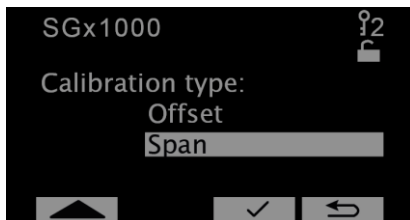
1. Make sure the SDM is powered on for 4 hours.
2. Check if the date and time are set correctly on the SDM, see chapter 6.3.13.
Main menu -> Advanced Function -> Diagnostics Menu -> Set Clock.



NOTE

RESETTING THE CALIBRATION TO THE FACTORY SETTINGS IS ONLY NEEDED WHEN THE SDM HAS BEEN USED BEFORE.

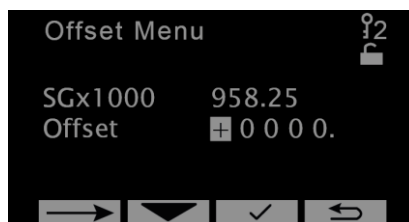
3. Reset the calibration to the factory settings and accept the warning. See chapter 6.3.14.
Main Menu -> Advanced Function -> Diagnostics Menu -> Restore Calibrations.
4. Clear the log from the SDM, see chapter 6.3.11. Wait for 60 seconds. Reboot the SDM, see chapter 6.5.3. Or disconnect the power for a short time. (Only necessary if step 3 has been performed)
Main Menu -> Advanced Function -> Diagnostics Menu -> Erase Log.
5. Before the water calibration, check that the span is 1.
Main Menu -> Advanced Function -> Calibration Menu -> S.G. x 1000 -> Span Menu



6. Pump water for 30 minutes to monitor the SDM and verify that you have a stable SGx1000 reading.
7. Check the temperature of the water. Adjust the temperature to the correct value if needed.
Main Menu -> Advanced Function -> Calibration menu -> Temperature.



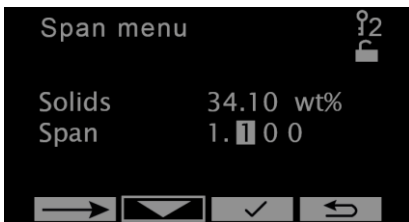
8. Adjust the SGx1000 reading (only when there is water in front of the sensor) with an offset calibration to the water density when you have a stable reading.
Main Menu -> Advanced Function -> Calibration menu -> SGx1000 -> Offset.



9. Pump slurry for 30 minutes to monitor the SDM and verify that you have a stable SGx1000 reading.
10. Check the temperature of the slurry and calibrate this with an offset calibration. The temperature should be equal to the average process temperature when pumping slurry.
Main Menu -> Advanced Function -> Calibration menu -> Temperature.
11. Take samples of the process. For the correct sampling method, consult the manual 'Rhosonics sampling procedure'.
12. Calibrate the span factor only when there is slurry in the pipe. Do not perform the Field offset calibration.
Main Menu -> Advanced Function -> Calibration menu -> Field -> Span.



13. The solids will be displayed and will hold for 18hours. Take a sample, submit this sample to the lab and with the results adjust the Span until the displayed value matches the lab result.



14. Validate the SDM reading by taking more samples and compare them to the displayed values on the SDM. Adjust the value if not satisfied.

8. MAINTENANCE

8.1 General maintenance tasks

The SDM needs general maintenance every 3 – 6 months. Follow the general maintenance tasks below:

1. Check if the earth connection (Figure 8-1, pos. 1) is:
 - free from rust, dust, dirt and moisture;
 - tightened to the SDM;
 - low on internal resistance of the cable (must be very low);
 - damage free.

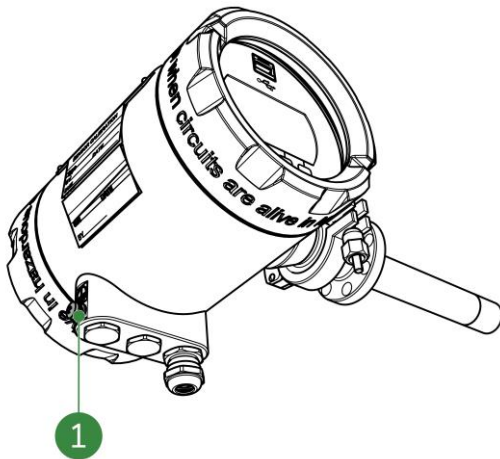


Figure 8-1: SDM earth connection

2. Check if the cable gland (Figure 8-2, pos. 2) is tightened.

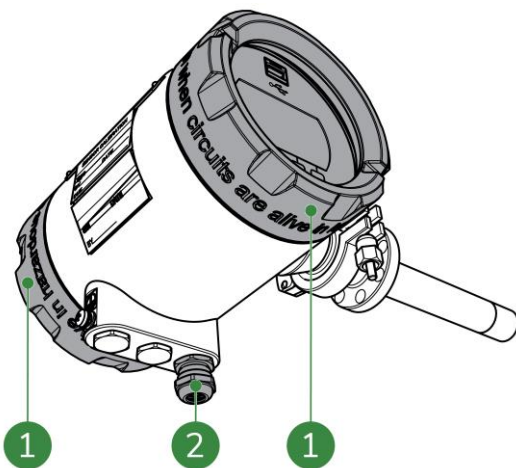


Figure 8-2: SDM lids and cable gland

3. Check if the front and back lids (Figure 8-2, pos. 1) are tightened.



NOTE

FOR INFORMATION AND INSTRUCTIONS CONSIDERING SAMPLING METHODS, CONSULT THE MANUAL 'RHOSONICS SAMPLING PROCEDURE'.

4. Check the SDM values. Take reference samples during a stable process / reading. Consult the manual 'Rhosonics sampling procedure'. In case of a deviation, take the following actions:
 - Check the process temperature. Validate the set temperature of the SDM;
 - pump water and perform a water calibration;
 - pump slurry and perform a slurry calibration;
 - remove the sensor and check for scaling and fouling, see chapter 8.2.3.

8.2 Detailed maintenance tasks

The SDM needs detailed maintenance every 3 – 6 months for the:

- tri clamp, see chapter 8.2.1;
- transmitter and sensor connections, see chapter 8.2.2;
- sensor, see chapter 8.2.3;
- sensor settings, see chapter 8.2.4.

8.2.1 Tri-clamp

Check if the tri-clamp (Figure 8-3, pos. 1) is:

- free of damage;
- free of moisture;
- free of dirt;
- free of dust;
- tightened at 10 Nm.

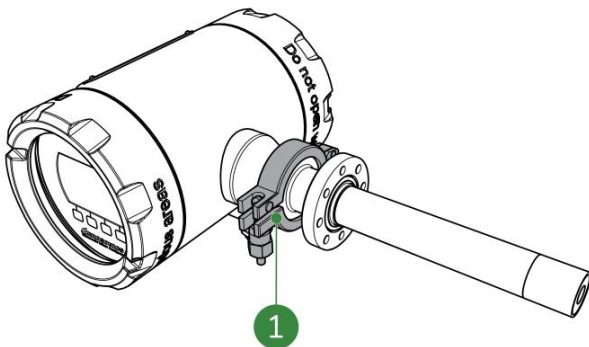


Figure 8-3: Tri-clamp

8.2.2 Transmitter and sensor connections



CAUTION

BE AWARE THAT THE TRANSMITTER AND SENSOR (CONNECTIONS) ARE FRAGILE.



CAUTION

WHEN DISCONNECTING THE CABLES, NO TENSION WHATSOEVER IS ALLOWED ON THE CABLES. WHEN TENSION ON ANY CABLE IS PRESENT, IMMEDIATELY DISCONNECT ALL CABLES TO PREVENT DAMAGE.

To check and maintain the transmitter and sensor connections:

1. Disconnect the transmitter from the power supply.
2. Remove the 4 to 20 mA cable (Figure 8-4, pos. 1).

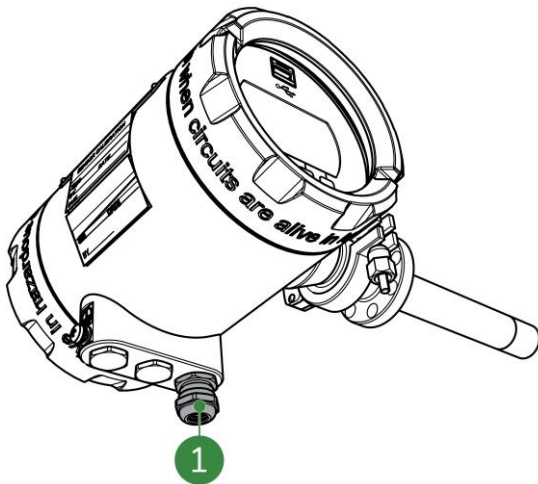


Figure 8-4: 4 – 20 mA cable

3. Support the transmitter by hand.



NOTE

BE AWARE THAT THE TRANSMITTER WEIGHS APPROXIMATELY 6 KG. THE TRANSMITTER WILL DETACH FROM THE SENSOR WHEN THE TRI CLAMP IS LOOSENED.

4. Loosen the nut (Figure 8-5, pos. 2) of the tri clamp (Figure 8-5, pos. 1).

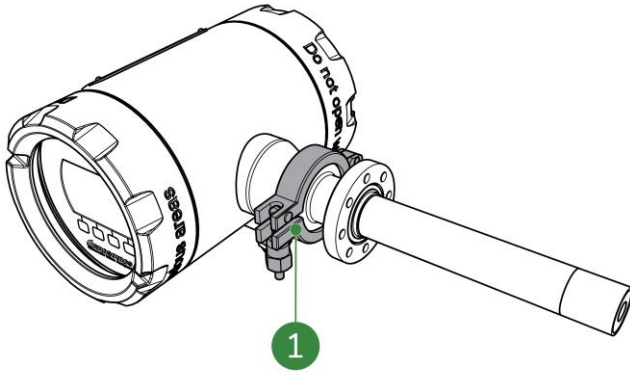


Figure 8-5: Tri-clamp nut loosening

5. Remove the transmitter and the tri clamp.
6. If needed, clean the:
 - tri clamp;
 - transmitter connections (Figure 8-6, pos. 1);
 - sensor connections (Figure 8-6, pos. 2).

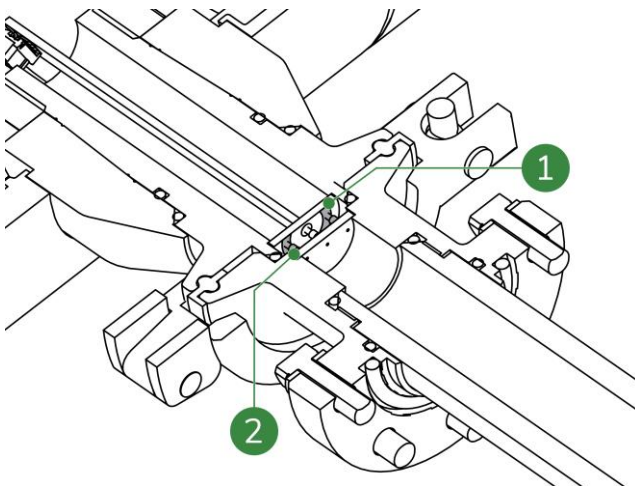


Figure 8-6: Sensor and transmitter connections



CAUTION

IF AT STEP 7 THE CONTACT PIN DOESN'T SPRING BACK, THERE IS AN INTERNAL CONTACT FAILURE. CONTACT RHOSONICS IF THIS OCCURS.

7. Check the springs of the sensor connections:

- gently press on each connection pin (Figure 8-7, pos. 1);
- the contact pin will return due to the spring.

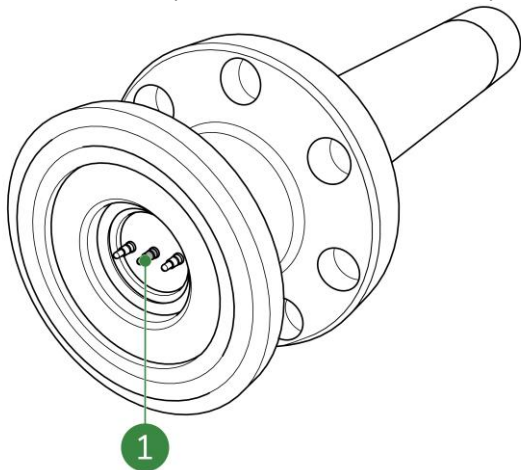


Figure 8-7: Sensor contact pins

8. If the SDM remains disassembled; protect the sensor or/and transmitter:

- place the yellow protection cap on the transmitter, see Figure 8-8, pos. 1;
- or place the yellow protection cap on the sensor, see Figure 8-9, pos. 1.

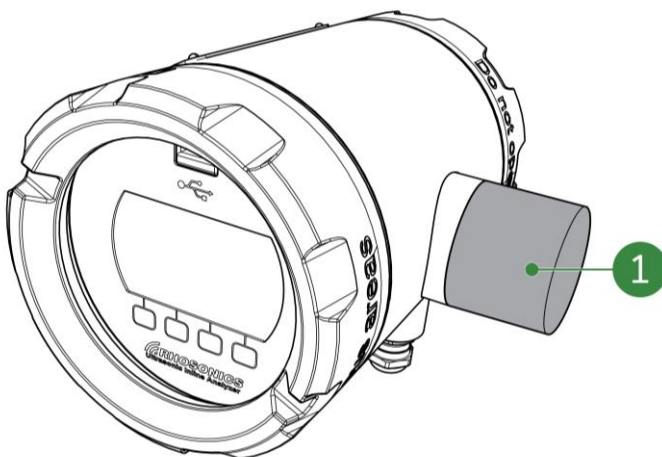


Figure 8-8: Yellow protection cap on transmitter

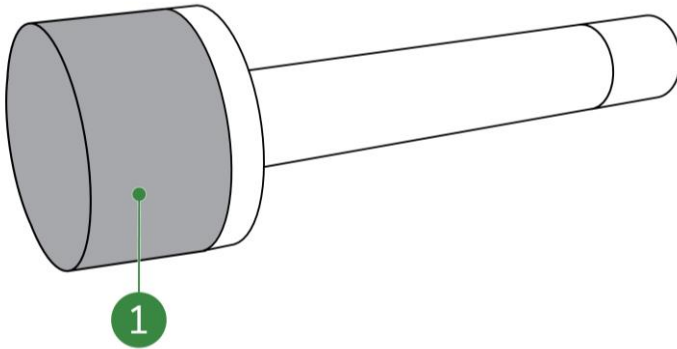


Figure 8-9: Yellow protection cap on sensor

9. If the SDM needs to be re-assembled, make sure that the 2 O-rings are present in the transmitter and sensor, see Figure 8-10, pos. 1 and 2.

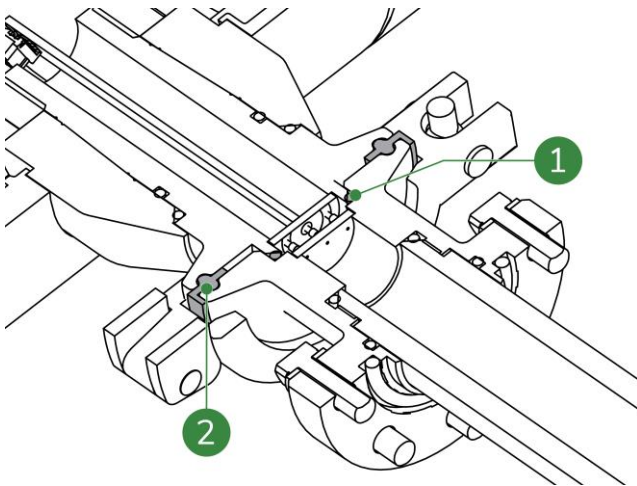


Figure 8-10: O-rings

10. Assemble the SDM in reversed order.

8.2.3 Sensor



CAUTION

WHEN DISCONNECTING THE CABLES, NO TENSION WHATSOEVER IS ALLOWED ON THE CABLES. WHEN TENSION ON ANY CABLE IS PRESENT, IMMEDIATELY DISCONNECT ALL CABLES TO PREVENT DAMAGE.



NOTE

BEFORE REMOVING THE SDM FROM THE INSTALLATION (FIGURE 8-11, POS. 2), MARK THE POSITION OF THE SENSOR ON THE FLANGES (FIGURE 8-11, POS. 1). THE SENSOR MUST BE PLACED IN THE EXACT SAME POSITION (FIGURE 8-11, POS. 3) DUE TO WEAR.

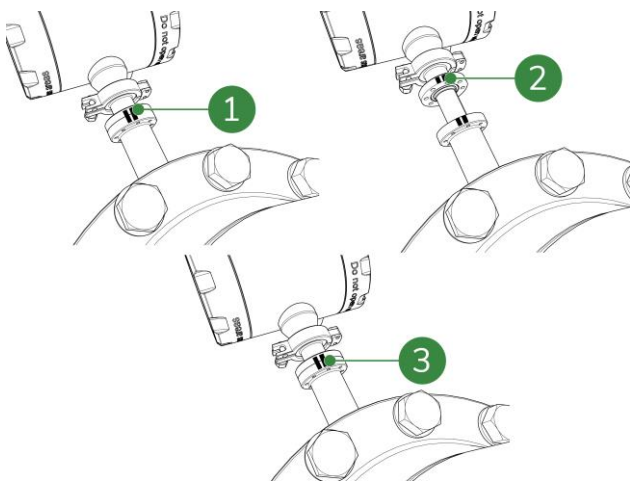


Figure 8-11: Sensor position markings

1. Disconnect the transmitter from the power supply.

2. Remove the 4–20 mA cable or the combined cable (Figure 8-12, pos. 1).

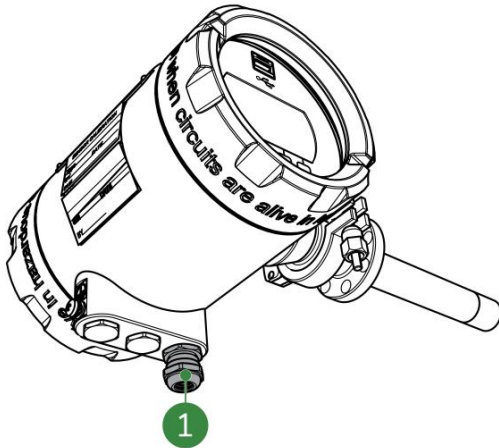


Figure 8-12: 4–20 mA cable

3. Support the transmitter by hand.



NOTE

BE AWARE THAT THE TRANSMITTER WEIGHS APPROXIMATELY 6 KG. THE TRANSMITTER WILL DETACH FROM THE SENSOR WHEN THE TRI CLAMP IS LOOSENED.

4. Loosen the nut of the tri clamp.

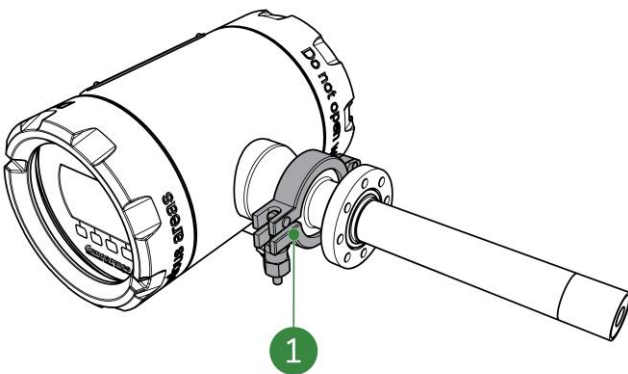


Figure 8-13: Tri-clamp nut loosening

5. Do not rotate the transmitter and sensor when they are connected. This causes damage to the sensor contacts and the transmitter circle contacts (Figure 8-14, pos. 1).
6. Remove the tri clamp and then the transmitter.

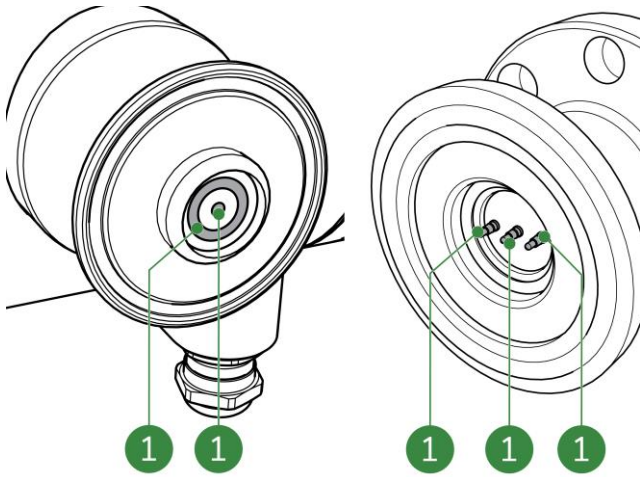


Figure 8-14: Sensor contacts

7. Remove the bolts and washers (Figure 8-15, pos. 1).

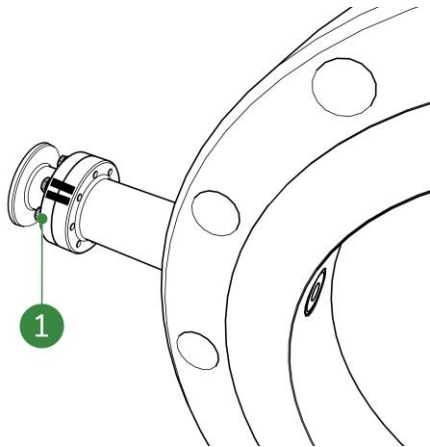


Figure 8-15: M5 bolts and washers

8. Remove the sensor from the pipe integration system.



WARNING

BE AWARE TO ONLY ROTATE THE SENSOR IN CLOCKWISE DIRECTION. COUNTERCLOCKWISE ROTATIONS DAMAGES THE SENSOR BEYOND REPAIR.

9. Check and (if needed) clean the connection pins and rings carefully (Figure 8-16, pos. 1).

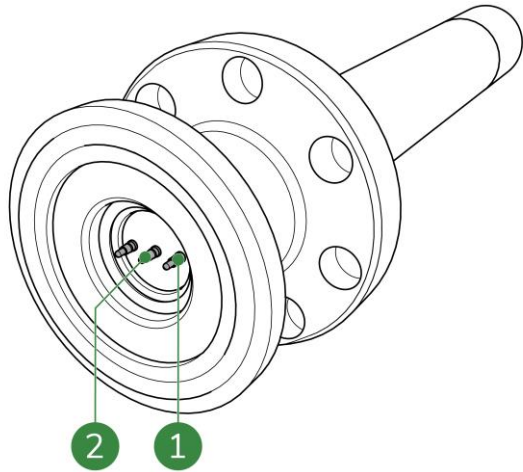


Figure 8-16: Connection pins



NOTE

IN DOUBT OF THE CONDITION, TAKE PICTURES AND CONTACT RHOSONICS.

10. Place back the sensor in the exact same position (Figure 8-17, pos. 3).

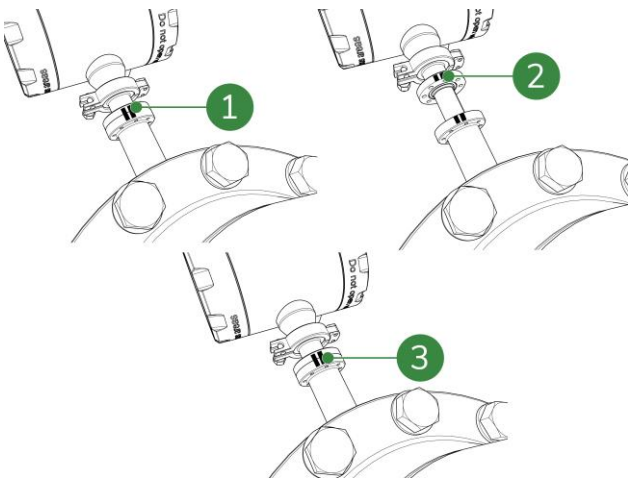


Figure 8-17: Sensor position markings



NOTE

WHEN PLACING BACK THE SENSOR, USE THE MARKINGS FOR THE SENSOR POSITION.

INSERT THE SDM AS STRAIGHT AS POSSIBLE INTO THE PIPE INTEGRATION SYSTEM, WITH RESPECT TO THE AXIAL ORIENTATION OF THE SDM PORT AND DISPLAY POSITION.

11. Clean and inspect the grooves for the 2 O-rings (Figure 8-18, pos. 1 and 2).
12. If needed, apply high vacuum grease to the grooves.
13. Make sure that the 2 O-rings are present at the transmitter and sensor (Figure 8-18, pos. 1 and 2).

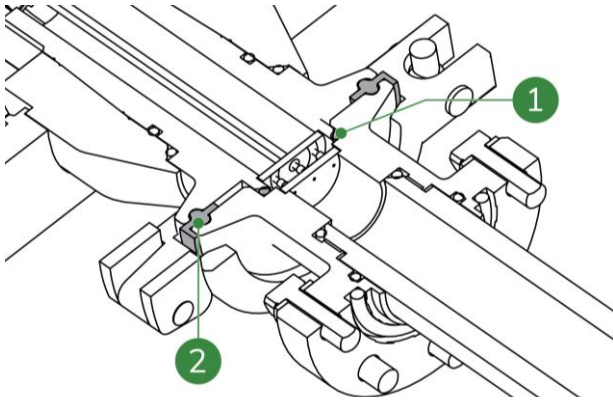


Figure 8-18: O-rings

14. Place and tighten (crosswise) (Figure 8-19, pos. 1) the bolts and washer at 4.2 Nm (8x).

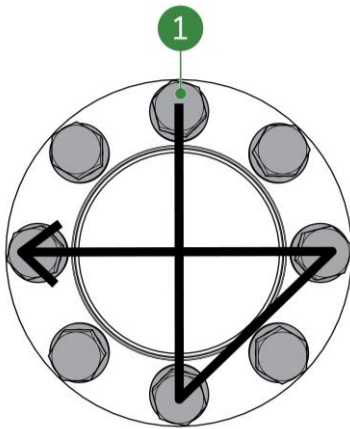


Figure 8-19: Crosswise tightening

15. Place the tri-clamp and transmitter back on the sensor.
16. Tighten the tri-clamp nut (10 Nm).

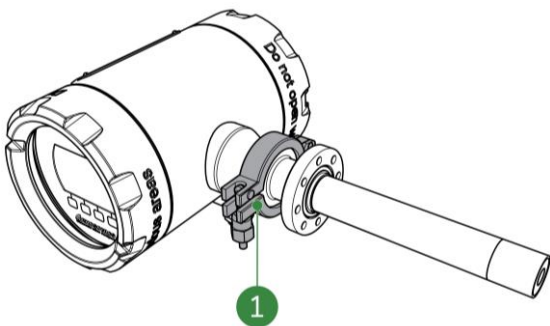


Figure 8-20: Tri-clamp nut

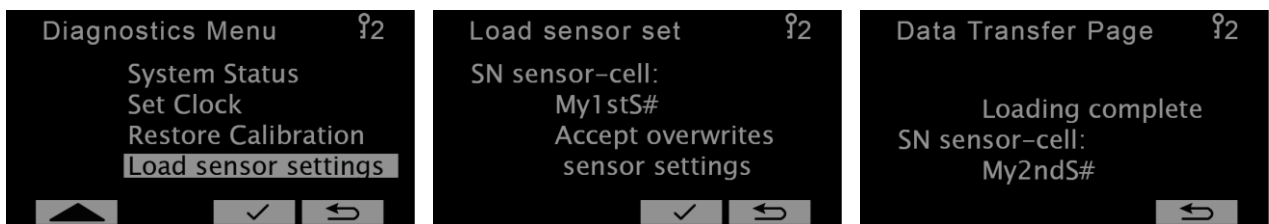
8.2.4 Sensor settings

Before uploading the sensor file, make sure:

- to restore the calibrations, see chapter 6.3.14;
- to erase the log data, see chapter 6.3.11;
- that the 3ASENSOR.CSV file has the same software version as the SDM transmitter:
 - check the current software version of the SDM transmitter, see chapter 6.7. For rebooting see chapter 6.6.
 - Check the software version of the file. Open the 3Asensor.CSV file from the supplied USB stick in excel. Compare column B1 with the software version of transmitter.

To load sensor settings:

1. Go to Load sensor settings.
Advanced Function -> Diagnostics menu -> Load sensor settings.



2. Place the USB stick into the USB-port (Figure 8-21, pos. 1) with the 3ASENSOR.CSV file.

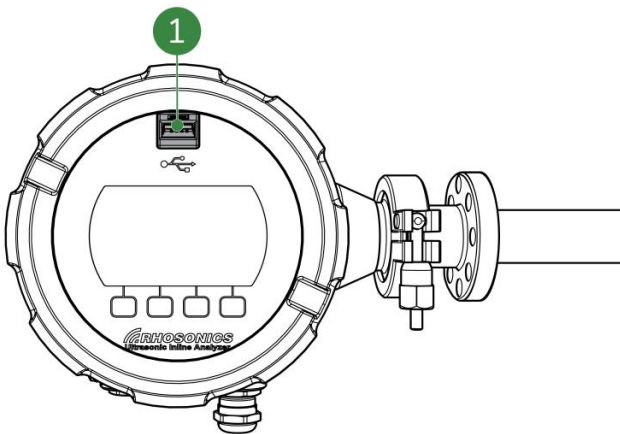


Figure 8-21: USB-port

3. Overwrite sensor settings.
4. Wait until the process finishes and press back.
5. Remove the USB stick.

9. TROUBLESHOOTING

The SDM is designed to work maintenance free for a long time. Of course, as in every technical unit, an issue may occur. Here are some tips on how to find a solution. If this does not solve your problem or if your problem is not listed, contact Rhosonics.

9.1 Gather situation information

The first step is always to gather information from the SDM and the situation. This is needed for the supplier and / or Rhosonics:

- note the problem and situation when the problem occurred.;
- log files from the SDM;
- check the system status and performance;
- note process / application information such as:
 - flow;
 - composition;
 - temperature;
 - etc....
- gather installation information such as;
 - pictures;
 - drawings;
 - etc....

When all the necessary information is gathered, send it to service@rhosonics.com. A Rhosonics service engineer will contact you and help you to solve the issue.

9.2 Issues and solution

The most common SDM issues and their problems are listed below:

Issue	Possible cause	Possible solution
Display is black / off.	No power.	Check power supply, see chapter 5.6.3.
		Check polarization of the power cable.
		Check the voltage on the power cable. The voltage must be 18-36 V.
	Burnt fuse.	Replace the fuse, see chapter 2.4.
No response.	Software is frozen.	Reboot the SDM, see chapter 6.6.
Value on DCS system / PLC is incorrect.	Setting 4-20 mA output of SDM is not equal with DCS /PLC 4-20 mA input.	Change SDM 4-20 mA output to same 4-20 mA range input DCS / PLC, see chapter 6.3.21.
No (4 to 20 mA) value to DCS system / PLC.	No contact between SDM and DCS / PLC.	Check the current on the 4-20 mA connection of the SDM.
Density value on SDM is incorrect.	Calibration is incorrect or not executed.	Do a calibration, see chapter 7.
SDM has a red screen with a cross.	No connection between sensor and transmitter.	Check the Tri clamp, see chapter 8.2.1.
		Disconnect the power. Check the transmitter connection, see chapter 8.2.2.
		Check resistance, see chapter 9.2.1.
		Disconnect the power. Check the golden pins on the sensor, see chapter 8.2.3.

Issue	Possible cause	Possible solution
SDM shows a yellow screen with a question marker.	Value is out of range due to incorrect 4-20 mA setting.	Change SDM 4-20 mA output to same 4-20 mA range input DCS / PLC, see chapter 6.3.21.
	Value is out of range due to air in front of the sensor.	Relocate the SDM to a point without air.
	Value is out of range due to incorrect calibration.	Do a calibration, see chapter 7.
SDM shows an orange screen with wrench.	SDM is in check function mode.	Check the function, see chapter 6.3.20.
SDM shows a shield in the top left corner.	SDM is in write protect.	Put off the write protect, see chapter 6.3.19.
SDM shows correct WT% but incorrect SGx1000.	This is correct. It's a SDM WT%.	No further action is needed.
SDM is leaking at the sensor flange.	O-ring failure.	Install new O-ring , see chapter 5.5.
	Bolts are not correctly tightened.	Place new O-rings and tighten bolts, see chapter 8.2.1.
Date and / or time is incorrect.	Not adjusted to local time.	Set correct date and time, see chapter 6.3.13.
SDM reading / response is slow.	Decay time is set too low or too fast.	Change the decay time, see chapter 6.3.4.
SDM reading is reacting too fast.	Decay time is set too low or too fast.	Change the decay time, see chapter 6.3.4.
SDM is not accurate.	Incorrect calibration.	Do a calibration, see chapter 7.
SDM is not changing color when there is an error message.	Back light is in black and white mode or SDM is in check function mode	Change display setting, see chapter 6.3.5.

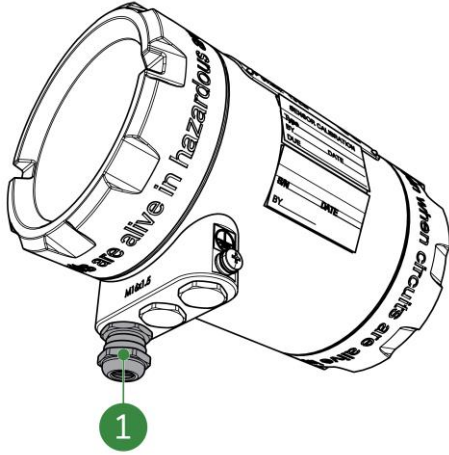
Issue	Possible cause	Possible solution
SDM stopped continuously logging	SDM is in check function mode	Turn off check function mode, see chapter 6.3.20.
SDM shows more than 1 value in screen saver mode	Display lines is set to 1 or 2 (Display line default is 0 extra lines)	Adjust the display lines 6.3.6.
SDM log period is too short or too long	Log interval is not set optimal	Adjust the log interval setting, see chapter 6.3.10.
Problem with transferring data.	Data is corrupt	Format USB stick, see chapter 9.2.2.
USB stick is empty.	Data is corrupt.	Use a different USB stick.
USB port unresponsive	Incorrect USB stick.	Erase log, see chapter 6.3.11 .
	USB port defect.	Contact Rhosonics.
SDM temperature cannot be adjusted.	PT100 setting is on.	Set the PT100 setting to off, see chapter 5.6.5, step 13-15.
Temperature shows around - 248°C.	PT100 defect or PT100 is not connected.	Check or connect PT100, see chapter 5.6.5.
SDM needs multiple calibrations.	Unstable process during calibration.	Calibrate the SDM, see chapter 7.
	Sensor is worn out.	Check the sensor, see chapter 8.2.3.
	Calibration is incorrect.	Calibrate the SDM, see chapter 7.
Sensor has (strange) wear/abrasion.	Sensor was installed intrusive instead of flush with the wall.	Gather information and contact Rhosonics, see chapter 9.1.
The SDM is deviating the first few hours.	SDM electronica is not heated up for 4 hours.	Ensure that the SDM has been on for 4 hours without interruption before performing the calibration.
	The power supply was interrupted	

Issue	Possible cause	Possible solution
SDM is always out of range.	Air in the process.	Gather information and contact Rhosonics, see chapter 9.1.
SDM is measuring water while pumping slurry.	Water in front of the sensor.	Gather information and contact Rhosonics, see chapter 9.1.
SDM value incorrect while pumping water	No water in front of the sensor.	Gather information and contact Rhosonics, see chapter 9.1.
	Calibration is incorrect	Calibrate the SDM, see chapter 7.
	Water not clean	Check if water is clean.
SDM value is always deviating.	It's a chemical slurry (dissolved solids) instead of water-based slurry.	Gather information and contact Rhosonics, see chapter 9.1.
	Sensor is worn out.	Check the sensor, see chapter 8.2.3.
	Process is unstable and SDM is measuring correct.	Gather information and contact Rhosonics, see chapter 9.1.
	Incorrect validation.	Calibrate the SDM, see chapter 7.
SDM value is drifting of over time.	Temperature setting is incorrect due to season changing.	Calibrate the SDM, see chapter 7.
	Incorrect calibration.	Calibrate the SDM, see chapter 7.
	Sensor is worn out.	Remove sensor and check on wear / abrasion, see chapter 8.2.3.

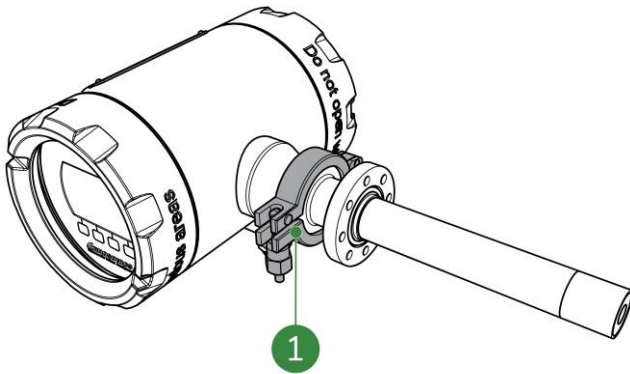
9.2.1 Resistance check

To measure the resistance of the transmitter and sensor:

1. Disconnect the power supply.



2. Remove the 4 to 20 mA cable.
3. Remove the Tri-clamp.



4. Check if the connection points are clean and free of moisture.

5. Measure the resistance of the transmitter connection points. The resistance is around 55 to 57 ohms. Measure between the inner and outer connection point (Figure 9-1, pos. 1 and 2).

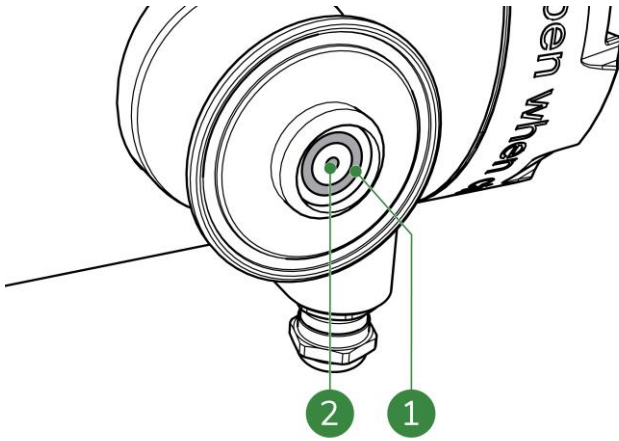


Figure 9-1: Transmitter connection

6. Measure the resistance of the sensor connection pins. The resistance results in overload. Measure between the inner and outer connection pin (Figure 9-2, pos. 1 and 2).

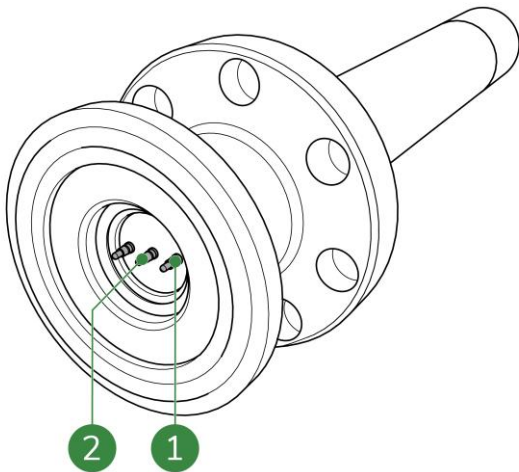


Figure 9-2: Sensor connection

7. Measure the resistance of the sensor. The resistance must be lower than 50 ohms. Measure between the outer connection point and the end of the sensor (Figure 9-3, pos. 1 and 2).

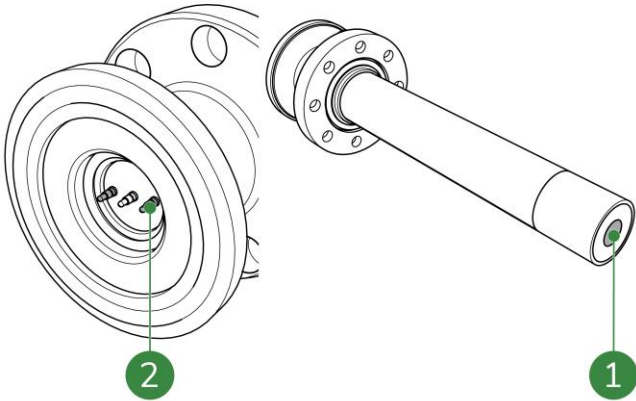


Figure 9-3: O-rings

8. Contact Rhosonics if the resistance is not correct.

9.2.2 Problem with transfer

How to solve the problem with transfer:

1. Make sure to use an empty USB-stick max 16 GB (preferably 8GB USB stick provided with SDM by Rhosonics).
2. If the USB stick has been used before, format USB stick (standard, File system: FAT 32 and Cluster size: 4096 bytes).

If the issue is not solved, go to step 3.

3. Reboot the SDM (chapter 6.6):
 - Press the 2 outer buttons on the display (Figure 9-4, pos. 1 and 2) simultaneously, or;
 - disconnect and reconnect the power supply.

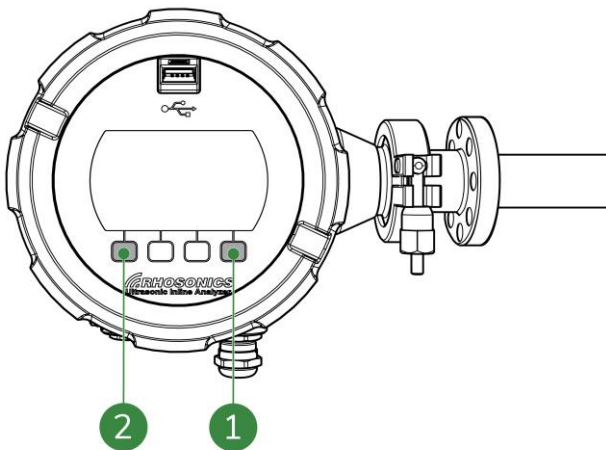


Figure 9-4: Display buttons

If the issue is not solved, go to step 4.

4. Select the option 'erase the log' from the SDM (chapter 6.3.11).
5. Reboot after 1 minute.

After the memory of the SDM has been cleared, the problem is solved. All the history of the SDM is deleted.

To prevent the transfer error:

1. Erase the log after setting the date and time;
2. Erase the log before starting to calibrate the SDM.

9.2.3 Red screen



NOTE

FOR MORE INFORMATION ABOUT THE RED SCREEN, SEE CHAPTER 6.2.3.

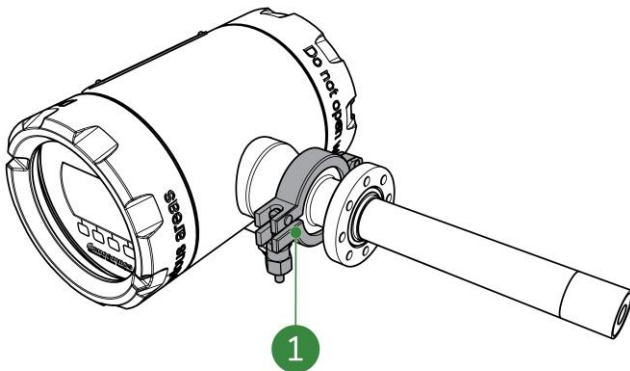
A red screen indicates a problem with the transmitter or the sensor, see Figure 9-5.



Figure 9-5: Red screen

To solve the red screen:

1. Check if the tri clamp is installed properly.



If the issue is not solved, go to step 2.

2. Disconnect and reconnect power supply

If the issue is not solved, go to step 3.

3. Contact Rhosonics.

9.2.4 Yellow screen



NOTE

FOR MORE INFORMATION ABOUT THE YELLOW SCREEN, SEE CHAPTER 6.2.3.

The measured density value is lower or higher than the set 4-20 mA value (Figure 9-6).

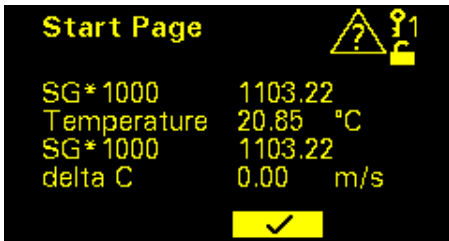


Figure 9-6: Yellow screen

To solve the yellow screen:

1. Check the process conditions.
2. Check the 4-20 mA setting.
3. To set the 4-20 mA setting, see chapter 6.3.21.

If the issue is not solved, contact Rhosonics.

Example:

1. 4-20 mA has been set to 4 mA = 1000 and 20 mA = 2000
2. If the sensor detects air, the SG x 1000 value will drop below 1000 and the yellow screen with the question mark will appear.
3. If scaling occurs, the SG x 1000 value will rise above 2000 and the yellow screen with the question mark will appear.

9.2.5 Orange screen



NOTE

FOR MORE INFORMATION ABOUT THE ORANGE SCREEN, SEE CHAPTER 6.2.3.

An orange screen indicates the check function mode is enabled, see Figure 9-7.

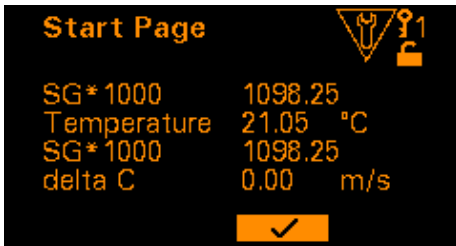


Figure 9-7: Orange screen

To solve the orange screen:

1. Set Check function to off (chapter 6.3.20).

10. FREQUENTLY ASKED QUESTIONS

FAQ	Answer
Where or how can I find the SDM software version?	See chapter 6.7.
Where can I find the serial number of the SDM?	The serial number can be found: <ul style="list-style-type: none"> • on the outside of the SDM (sticker, see chapter 1.6); • in the S-file of the log files.
What type of SDM do I have?	The type can be found on the outside of the SDM (sticker), see chapter 1.6.
How do I perform a software update?	See chapter 6.5.1.
How to get the log file from the SDM?	See chapter 6.5.2.
How much data points can the SDM store in its memory?	65 535 entries.
How to set the time and date?	See chapter 6.3.13.
How to set the decay time?	See chapter 6.3.4.
How to set 4mA to 20 mA output range?	See chapter 6.3.21.
How to adjust the temperature?	See chapter 7.
How to perform the offset / water calibration?	See chapter 7.
How to perform the span / slurry calibration?	See chapter 7.
How many samples do we need for the slurry calibration?	We advise to take at least 3 samples. These are needed to determine if the sample taking is as expected and consistent.
How to restore the calibration?	See chapter 6.3.14 and 6.3.15
How to install the sensor?	See chapter 5.5 or 8.2.3
How to deinstall the sensor?	See chapter 8.2.3.

How do I remove the tri clamp?	See chapter 8.2.1
How accurate is the SDM?	<p>We mention an accuracy of 0.5% of reading. The accuracy is dependent of the:</p> <ul style="list-style-type: none"> • accuracy of the samples that are taken; • process conditions. <p>This means the more accurately you work with the SDM, the better results will be achieved.</p>
What kind of USB stick do I need to use?	<p>USB stick with:</p> <ul style="list-style-type: none"> • a flashing light; • a max capacity of 16GB (preferably use the 8GB USB stick provided with the SDM by Rhosonics).
How do I format the USB stick?	<p>File system: FAT 32 (standard)</p> <p>Cluster size: 4096 bytes</p>
What does error code 0 'normal operation' in the system status menu mean?	There is no problem, the SDM is in normal operation.
What does error code 74 'out of range' in the system status menu mean?	<p>SDM is out of operation range. The SDM is measuring:</p> <ul style="list-style-type: none"> • air or; • very high density. <p>SDM is outside the set 4 to 20 mA, see chapter 6.3.21.</p>
What does error code 79 'failure in system' in the system status menu mean?	There is a problem with the transmitter or sensor, see chapter 8 or 9.2.3.

11. TRANSPORT AND STORAGE

11.1 Transport

When transporting the SDM, the SDM must be safely packed into a strong box – preferably in its original box - that protects it from outside moisture and dust. Make sure to add material inside the box and around the SDM that protects it from damage in case the box bumps or drops.

11.2 Shipment

For shipment of the SDM, follow the transport procedures mentioned in 11.1. Make sure the box is properly sealed to ensure a safe and secure transport of the package.

11.3 Storage

When not in use, store the SDM in an environment that:

- is free from dust and moisture;
- has a temperature that is within the range of -5 °C to +50 °C;
- has features to prevent the SDM from falling.

Preferably store the SDM in its original box when not in use.

12. DISPOSAL

When disposing the SDM after its use, it can be sent to Rhosonics for proper disposal. It is the user's responsibility to safely ship the SDM to Rhosonics. The shipping address of Rhosonics is mentioned on the last page of this manual.

13. APPENDICES

13.1 List of spare parts

DESCRIPTION	PART NUMBER	CONSISTS OF
SDM Sensor only (no transmitter included) - spare part	SDM Sensor	SDM Sensor
SDM transmitter	SDM transmitter	SDM transmitter
Back cover	Back cover	Back cover
Front cover with glass window	SDM front cover	SDM front cover
Tri clamp set for SDM	SDM-TRI-CLAMP-SET-1½"	1 x Stainless Steel tri clamp 1½" 1 x NBR seal 1½"
SDM Mounting Kit	MONTAGE-KIT-SDM	1 x Wartel M16x1.5, Nikkel kabel Ø2-6 mm 10 x Hexagonal head bolt M5 x 16 RVS 1 x O-ring Viton 51414 Ø17x2 1 x O-ring 29.82x2.62 - FKM - FPM - Viton - 80 Shore A – Black 10 x Spacer M5 cilinderschroeven, RVS
Cable gland ½"NPT set	SDM-CABLE-GLAND-½"NPT-SET	3 x SS316L reducing plug M16X1.5 outside; 1/2" NPT inside 2 x cable gland ½"NPT, Nickel coated, for cables Ø5-9 mm 2 x cable gland ½"NPT, Nickel coated, for cables Ø6-12 mm
Cable gland M20 set	SDM-CABLE-GLAND-M20-SET	3 x SS316L reducing plug M16X1.5 outside; M20x1.5 inside 2 x cable gland M20x1.5, Nickel coated, for cables Ø6-12 mm 2 x cable gland M20x1.5, Nickel coated, for cables Ø10-14 mm
Cable gland M16 set	SDM-CABLE-GLAND-M16-SET	2 x cable gland M16x1.5, Nickel coated, for cables Ø2-6 mm 2 x cable gland M16x1.5, Nickel coated, for cables Ø4-8 mm 2 x cable gland M16x1.5, Nickel coated, for cables Ø5-10 mm

Table 13-1: List of spare parts

13.2 List of options

DESCRIPTION	PART NUMBER	CONSISTS OF
SDM sun-shade (stainless steel) (Figure 13-1, pos. 1)	SDM-SHADE-ROOF-SET	Stainless steel sun shade mounted as one part
TAG no. plate (stainless steel)	TAG-NR-SPECIFIC	Stainless steel tagging plate with steel wire and zinc wire sealings
Remote control unit with display (HART/Modbus RTU output)	RCU-1	Housing with HART converter, display and 10 meter power cable to SDM
Power supply/converter, 24VDC out, 90...264 VAC in, Din rail	ZEAS-PS-24VDC-DNR18US24	DIN rail Power supply/converter, 24VDC out, 90...264 VAC in
Blind Plug (for the installation tool)	BP-60T13-HDPE-UNIVERSAL-VITON	HDPE blind plug 16-146 mm with 1 x O-ring Viton® 51414 Ø20,3x2,62 and 1 x O-ring 29.82x2.62 Viton 80S

Table 13-2: List of options

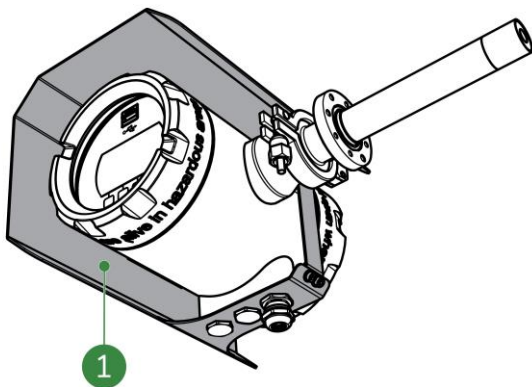


Figure 13-1: SDM Sun shade roof

13.3 Menu tree

MENU*	→ Measured values			
	→ Decay time → 0-99 sec			
	→ Back-light → Namur color → Black and white			
	→ Display lines → 0 to 2			
	→ Advanced function → Diagnostics Menu			
	→ Logging menu → Log interval → 1, 2, 5, 10, 30 sec → Get log data → 1, 2, 5, 10 min → Get data → Connect USB stick			
	→ Erase log			
	→ System status			
	→ Set clock → Set date → Set time			
	→ Restore calibration			
	→ Load sensor settings → Connect USB stick			
	→ Check function → Off → On			
	→ Calibration menu → Temperature → Offset			
	→ SGx1000 → Offset → Offset → Span → Span			
	→ FIELD (only for SDM WT%) → Offset → Offset → Span → Span			
	→ Liquid menu → Liquid select → Water measurement → Normal operation → Add liquid			
	→ Write protect → Off → On			
	→ Output mA range → Output lower range → Output upper range → Ranging set			
	→ PT100 connected → Off → On			

* The menu item 'Advanced function' is password-protected.

13.4 Functionality per user interface

Each user interface has a different set of functions. They are categorized based on access level and accessibility of each type of user interface.

This functionality is available per type of user interface:

Functionality	Available via			
	Button / LCD	HART DD	USB stick	USB * interface
Measurements				
Measured values digital	✓	✓		✓
mA out		✓		✓
Settings				
Manually changing sensor settings		✓		
Averaging outputs (decay time/damping)	✓	✓		✓
Liquid select	✓	✓		
Configuring output values (type and range)	✓	✓		✓
Loading of settings from file				✓
Loading liquid calibration				✓
Setting real time clock	✓	✓		
Backlight setting	✓			
Calibration				
Factory calibrations				✓
Local offset and span calibrations	✓	✓		
mA out calibration		✓		✓
Local calibration reset	✓	✓		✓
Diagnostic				
NAMUR state	✓	✓		
General error code	✓			✓
Diagnostic measured values		✓		✓
Condensed status map (HART)		✓		
Real time echo monitoring				✓
Saving log data			✓	
Loading liquids				✓
Loading firmware			✓	
Save settings			✓	
Error log			✓	
Reading writing device location		✓		
Reading version information		✓		✓
Reading model type		✓		✓

Table 13-3: Available functionalities per user interface

* USB interface is only available for specialists.

13.5 Appendix A: Sound speed of water at 0 to 100 °C

T [°C]	c [m/s]	T [°C]	c [m/s]	T [°C]	c [m/s]	T [°C]	c [m/s]
0	1402.388	25	1496.687	50	1542.551	75	1555.133
1	1407.367	26	1499.323	51	1543.619	76	1555.081
2	1412.232	27	1501.883	52	1544.636	77	1554.991
3	1416.985	28	1504.37	53	1545.601	78	1554.862
4	1421.628	29	1506.784	54	1546.517	79	1554.696
5	1426.162	30	1509.127	55	1547.382	80	1554.492
6	1430.589	31	1511.399	56	1548.199	81	1554.251
7	1434.912	32	1513.603	57	1548.967	82	1553.974
8	1439.132	33	1515.738	58	1549.687	83	1553.66
9	1443.251	34	1517.806	59	1550.36	84	1553.31
10	1447.27	35	1519.81	60	1550.986	85	1552.924
11	1451.191	36	1521.745	61	1551.566	86	1552.504
12	1455.016	37	1523.618	62	1552.101	87	1552.048
13	1458.747	38	1525.428	63	1552.59	88	1551.558
14	1462.384	39	1527.176	64	1553.035	89	1551.034
15	1465.931	40	1528.863	65	1553.437	90	1550.476
16	1469.387	41	1530.489	66	1553.794	91	1549.884
17	1472.755	42	1532.066	67	1554.109	92	1549.259
18	1476.036	43	1533.564	68	1554.381	93	1548.602
19	1479.231	44	1535.015	69	1554.611	94	1547.912
20	1482.343	45	1536.409	70	1554.799	95	1547.19
21	1485.372	46	1537.746	71	1554.947	96	1546.436
22	1488.319	47	1539.028	72	1555.053	97	1545.651
23	1491.187	48	1540.256	73	1555.12	98	1544.834
24	1493.976	49	1541.43	74	1555.146	99	1543.987
						100	1543.109

Table 13-4: Sound speed of water [m/s] at different temperatures [°C]

13.6 Appendix B: Density of water at 0 to 100 °C

T [°C]	RHO [g/l]	T [°C]	RHO [g/l]	T [°C]	RHO [g/l]	T [°C]	RHO [g/l]
0	999.86341	25	997.04784	50	988.00825	75	974.85658
1	999.91390	26	996.78615	51	987.55238	76	974.25961
2	999.94857	27	996.51495	52	987.09017	77	973.65750
3	999.96773	28	996.23442	53	986.62172	78	973.05025
4	999.9717	29	995.94474	54	986.14709	79	972.43790
5	999.96082	30	995.64608	55	985.66636	80	971.82046
6	999.93537	31	995.33859	56	985.17959	81	971.19794
7	999.89566	32	995.02246	57	984.68686	82	970.57037
8	999.84198	33	994.69781	58	984.18822	83	969.93776
9	999.77462	34	994.36483	59	983.68373	84	969.30013
10	999.69386	35	994.02363	60	983.17346	85	968.65748
11	999.59998	36	993.67438	61	982.65745	86	968.00984
12	999.49325	37	993.31720	62	982.13577	87	967.35721
13	999.37393	38	992.95224	63	981.60845	88	966.69961
14	999.24227	39	992.57962	64	981.07555	89	966.03705
15	999.09854	40	992.19946	65	980.53711	90	965.36954
16	998.94297	41	991.81189	66	979.99318	91	964.69708
17	998.77580	42	991.41702	67	979.44379	92	964.01969
18	998.59727	43	991.01497	68	978.88899	93	963.33739
19	998.40761	44	990.60585	69	978.32881	94	962.65017
20	998.20703	45	990.18976	70	977.76328	95	961.95804
21	997.99576	46	989.76681	71	977.19245	96	961.26103
22	997.77400	47	989.33709	72	976.61633	97	960.55912
23	997.54196	48	988.90070	73	976.03496	98	959.85235
24	997.29984	49	988.45772	74	975.44837	99	959.14070
						100	958.42421

 Table 13-5: Density of water [g/l or kg/m³] at different temperatures [°C]



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