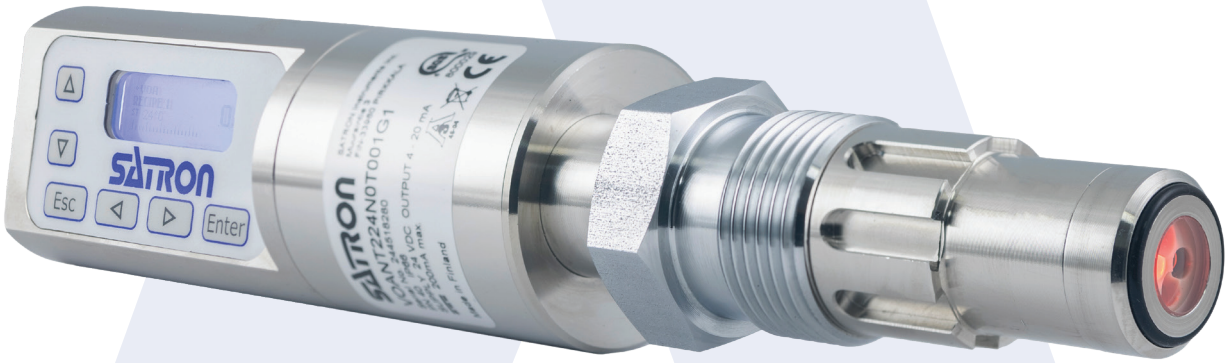
SATRON®

LUMINA™ TURBIDITY

VOA, VOM, VOD, VOF



INSTALLATION AND OPERATION INSTRUCTIONS MANUAL

TABLE OF CONTENTS

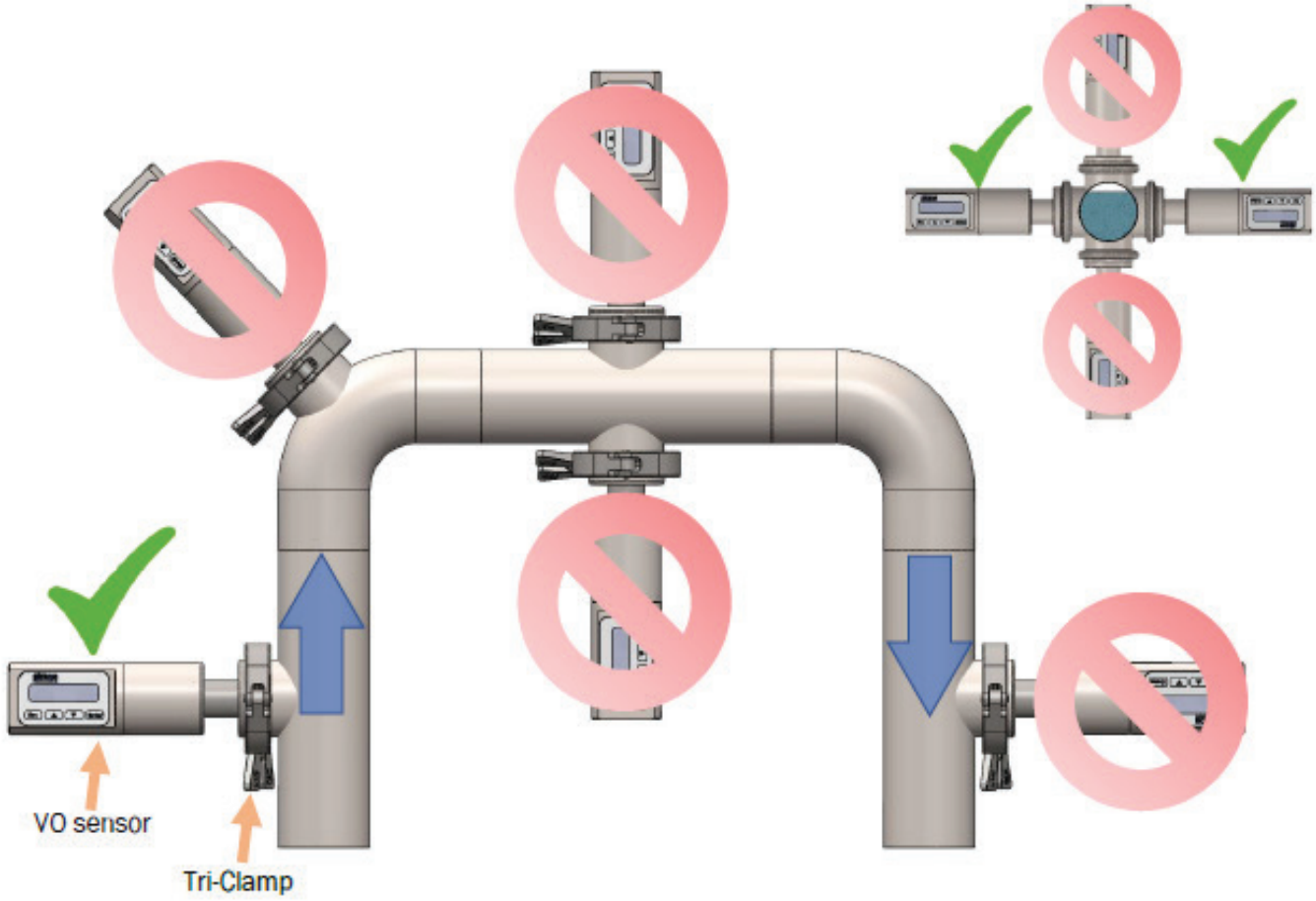
1 INTRODUCTION

LUMINA™ Turbidity sensors are a product family for measuring turbidity in different liquids like white water applications in the dairy industry, effluent monitoring, and outlet of reverse osmosis.
Products: VOA, VOM, VOD, VOF.
LUMINA™ VO products are an accurate real time measurement looking closer into the process and connected to the automation systems. Robust transmitters with no need of regular maintenance.

2 MECHANICAL INSTALLATION

Mounting recommendations: Fig. 1-1
Process connection direction: horizontal
• Cable entry direction: from below
• Connector coupling direction, calibration direction: horizontal
• Process flow: Upwards
• Pressure class: PN40

Figure 1-1 Recommended mounting positions.



2.1 INSTALLING WELDED PROCESS COUPLINGS

For 3A installations please go to page 5

Mounting hole for coupling
• Make a Ø 45.5 mm (+0.5/-0.2 mm) hole in the tank wall or pipe, as shown in Figure 1-3.

Welding the coupling
These instructions apply to all welded couplings; welding the G1 standard coupling is described here as an example.
• Place the coupling in the mounting hole as shown in Fig. 1-6. Then weld with several runs so as to prevent the coupling's oval distortion and tightness problems.
• The sensor must be out of the coupling while the coupling is welded. You can use the shut-off plug shown in Fig. 1-7 to shut the coupling. The plug protects the coupling's sealing face and permits the starting of the process without the sensor.
• It is always recommendable to use the welding assistant (M1050450) while welding the coupling to prevent any distortions due to heat.
• Do not make weld grounding via any sensor's body!

2.2 MOUNTING THE TRANSMITTER ON THE COUPLING

Procedure
• Make sure that the coupling's sealing face is clean.
• Remove the orange protective plug from the transmitter's head.

• Insert the transmitter **aligned with** the coupling (Fig. 1-8), so that the guide groove on the transmitter aligns with the stop pin on the coupling. The transmitter settles into position when the groove and pin are aligned, and will be prevented from rotating in the coupling.

When inserting the sensor, be careful not to damage the edge of the lens on the edges of the coupling or on the end of the stop pin!

• Lock the sensor in position by screwing the hex nut. Apply 60±20 Nm torque to tight to eliminate the effect of vibration and other such factors.

Do not use sealing tape etc. on threaded connection!

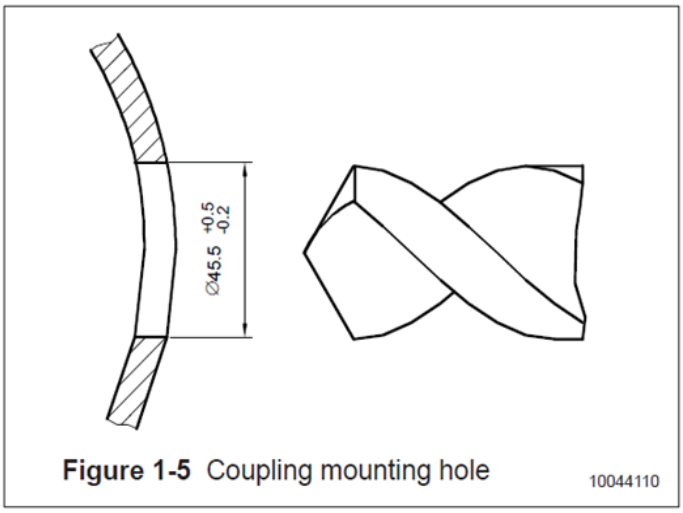


Figure 1-5 Coupling mounting hole 10044110

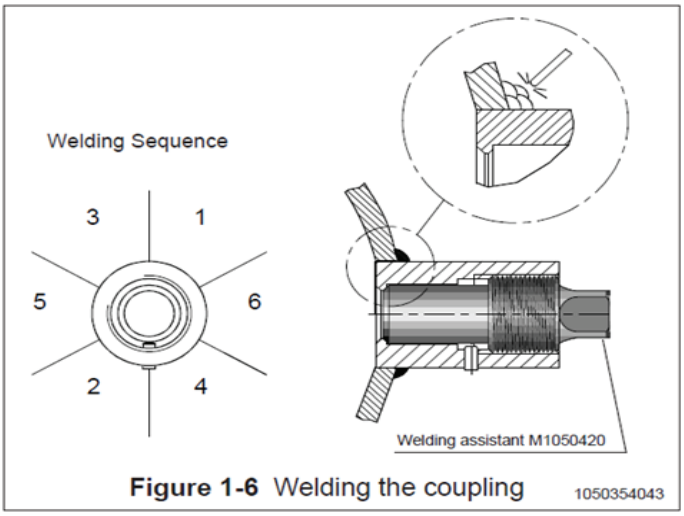
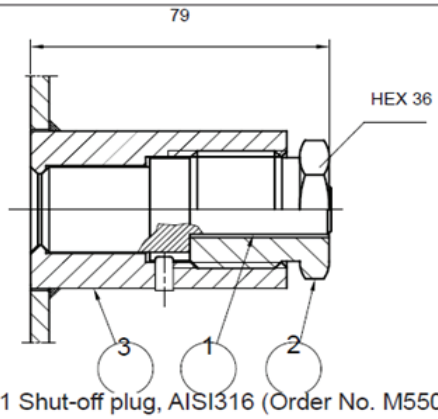


Figure 1-6 Welding the coupling 1050354043



1 Shut-off plug, AISI316 (Order No. M550405)
2 Shut-off screw G1
3 G1 welded process coupling

Figure 1-7 Coupling shut-off plug 10044108

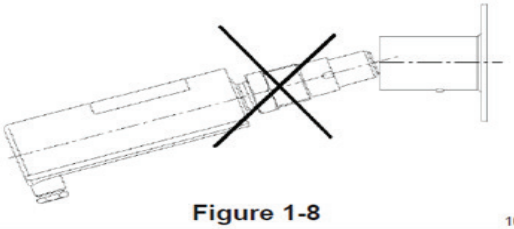


Figure 1-8 10044006

2.3 INSTRUCTIONS THAT ARE ACCORDING AND WITHIN THE 3-A APPLIANCE

46-04

All couplings that are according the 3-A appliance listed in the bottom of this page.
These instructions apply to hygienic welded couplings; welding the G1 M548101 coupling is described here as an example.

• Place the coupling in the mounting hole as shown in Fig. 1-2.1. Make sure the leakage detection port is down. Then weld with several runs so to prevent the coupling's oval distortion and tightness problems. The inside welding must be cleaned, and polished with an end result of Ra <0,8.

• The sensor must be out of the coupling while the coupling is welded. You can use the shut-off plug shown in to shut the coupling. The plug protects the coupling's sealing face and permits the starting of the process without the transmitter.

• It is always recommendable to use the welding assistant (M1050450) while welding the coupling to prevent any distortions due to heat.

• Do not make weld grounding via the sensor's body!

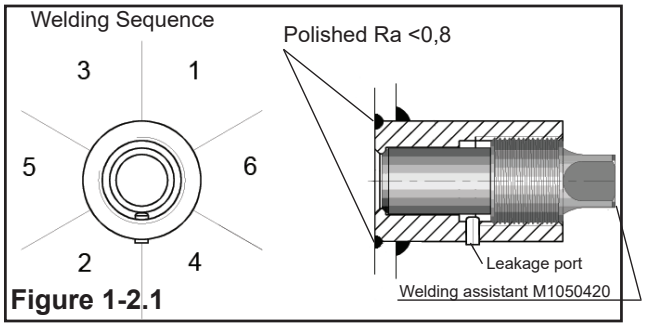


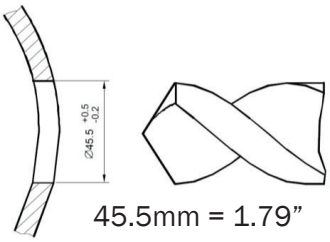
Figure 1-2.1

Couplings in combination with 3A:

38/G1" Welding adapter	M1050577
45/G1" Welding adapter	M548101
Tuchenhagen / Varivent DN25	M1050090
Tuchenhagen / Varivent DN50	M1050091
Tuchenhagen / Varivent DN65,5	M1050092
Tri-clover 25/38 ISO2852	M1050206
Tri-clover 40/51 ISO2852	M1050222
Tri-clover 63.5 ISO2852	M1050224

2.4 INSTALLATION REQUIREMENTS VOMXXXXXXXXXXG1

Mounting recommendations:
- Minimum pipe diameter: 38mm (1.5")
- Process connection direction:
  Vertical: upwards flow with leak detection port facing down.
  Horizontal: on the bottom or side with leak detection port facing down.
- Cable entry direction: from below



Installing 45/G1" Hygienic Welding adapter M548101.
- Tightening torque: 60 +/- 20 Nm
- Replacement O-ring 17x20mm EPDM/FPM/FFPM
- Do not put sealing tape or paste on the threaded connection.

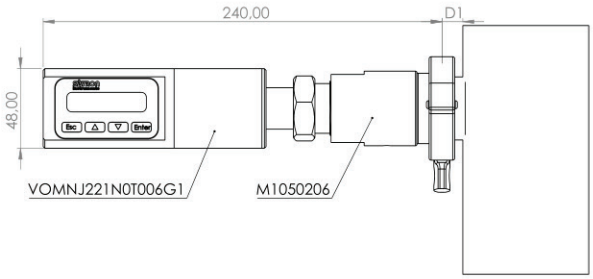
Non hygienic installations can be equipped with the **flushing coupling (M1050021)**, and optional **flushing cabinet (M1370192).**

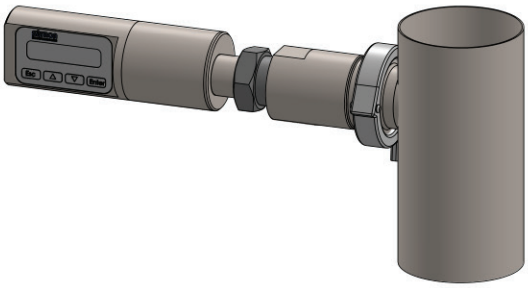
2.5 INSTALLATION REQUIREMENTS FOR CLAMP CONNECTION: VOMXXXXXXXXXXG1 + COUPLING

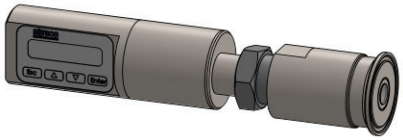
Mounting recommendations:

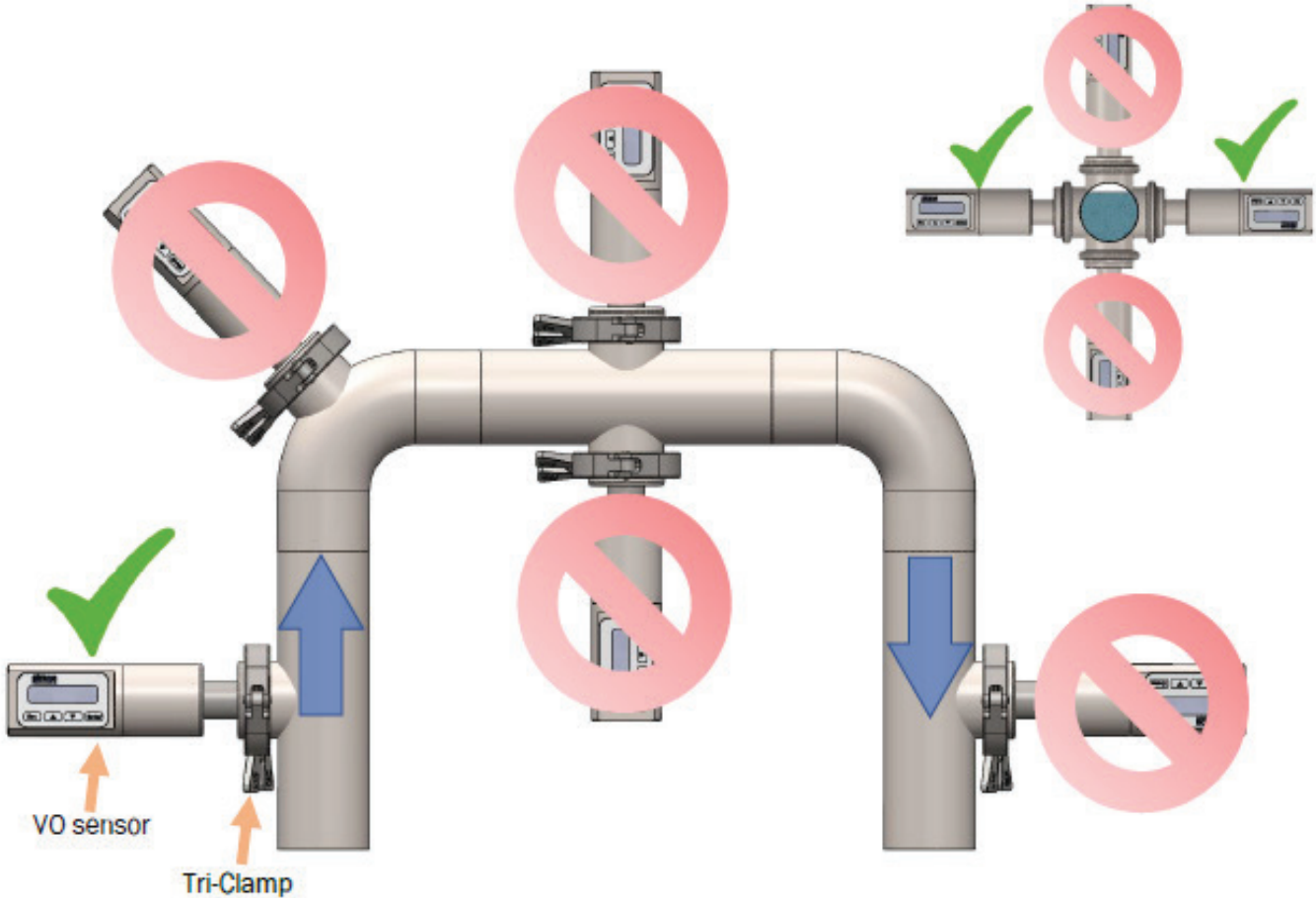
Tri-Clamp connections are hygienic and easy to install but they may trap air that can cause a malfunction.

- The depth of the dead leg shall be kept as shallow as possible; ≤ d1.
- Minimum pipe diameter: 38mm (1.5")
- Process connection direction:
  - Vertical: upwards flow
  - Horizontal: on the side
- Cable entry direction: from below









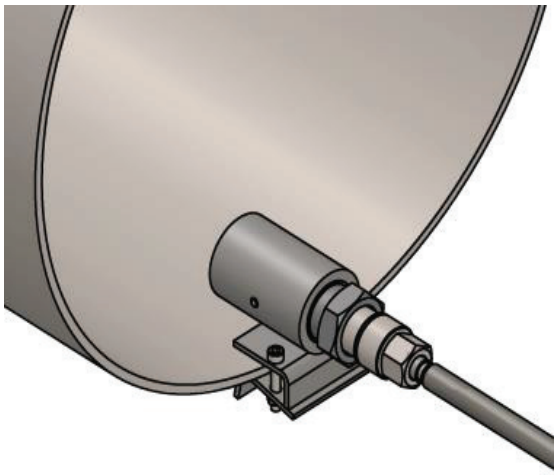
For optimal results, mount the sensor in an upwards flow.
Do not install the sensor on top or on the bottom of the pipe. There can be air or dirt in front of the measuring lens and give false results. Minimum distance from lens to pipe wall is 50 mm.

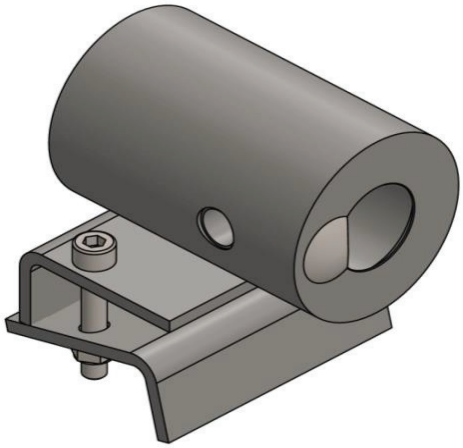
2.6 INSTALLATION EXAMPLES VOM NRT

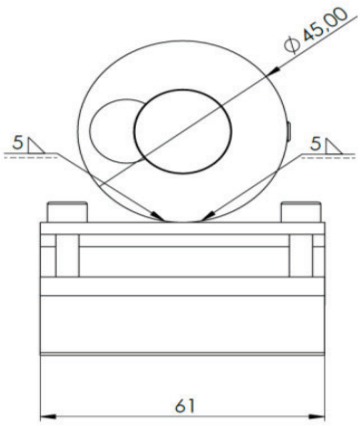
Installation example Clamp coupling for **VOMxxxxNRT2xxG1**

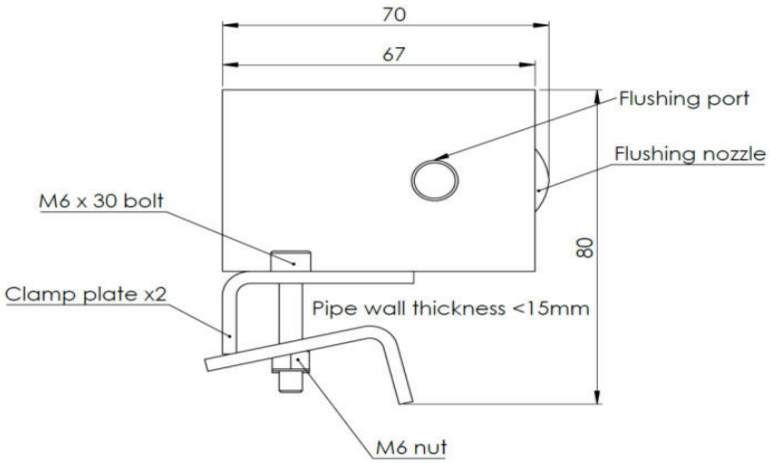
This coupling is intended to be installed on the outlet of a pipe,
Clamped on the pipe wall, the sensor will be facing the flow.

Item code: M1050186-FLUSH





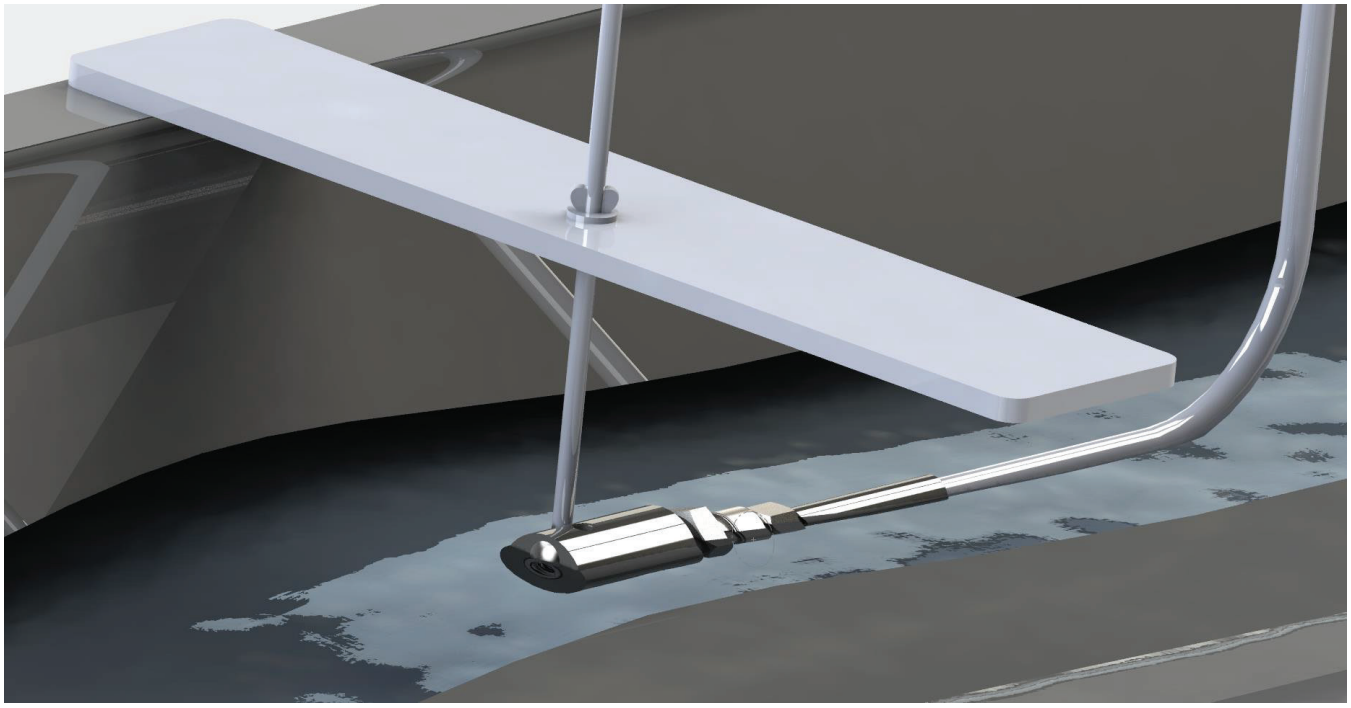


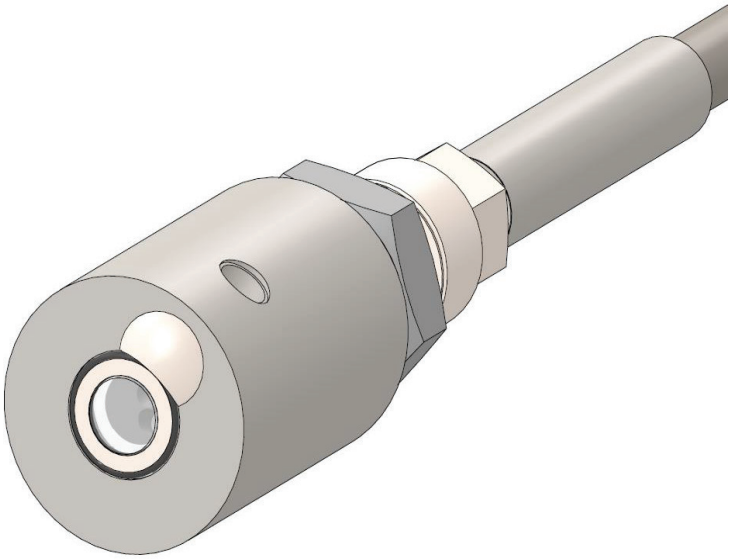


Installation example **VOMxxxxNRT2xxG1**

For drains, floor drains, wells, pits with submersible IP68 measuring head.
The optional flushing coupling can be easily welded to a thread bar and held in place.

Coupling order code: M1050021

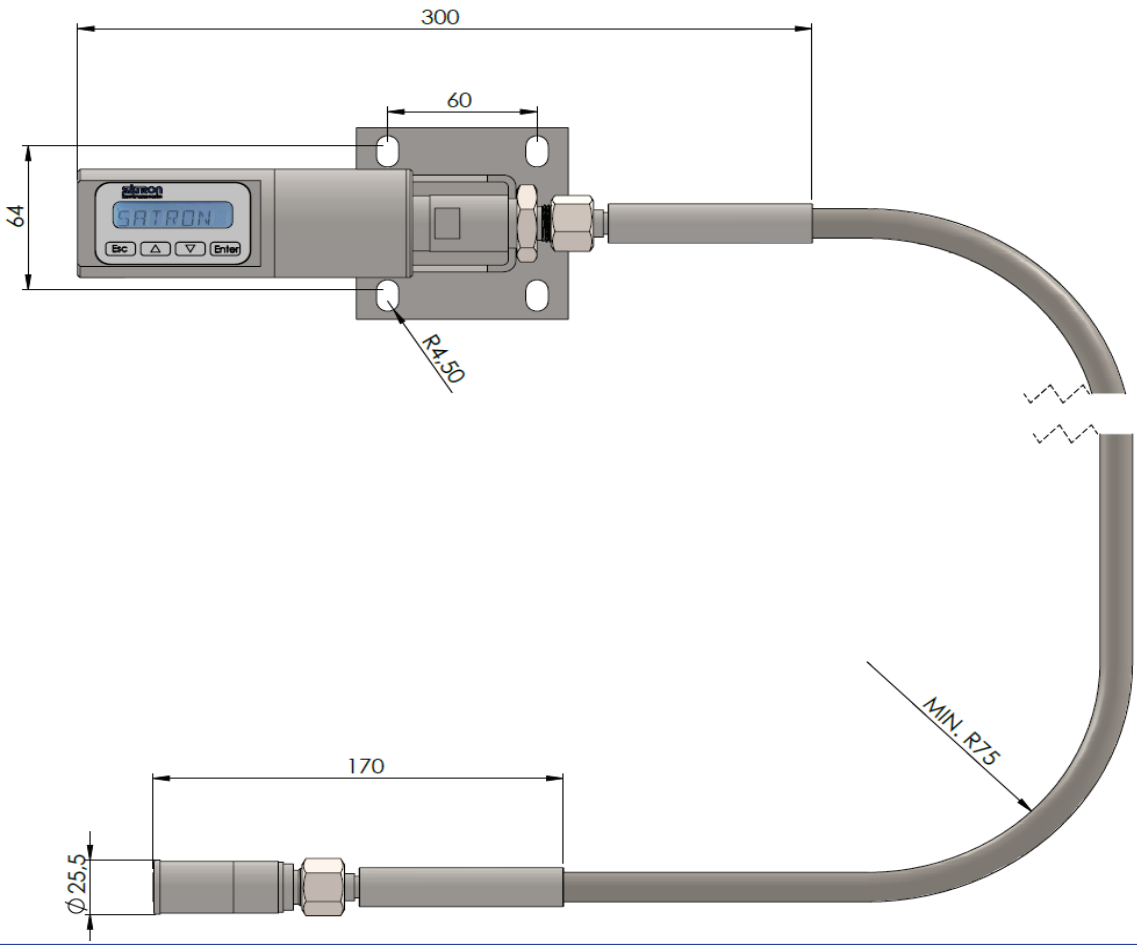




Installation example **VOMxxxxNRT2xxH1**

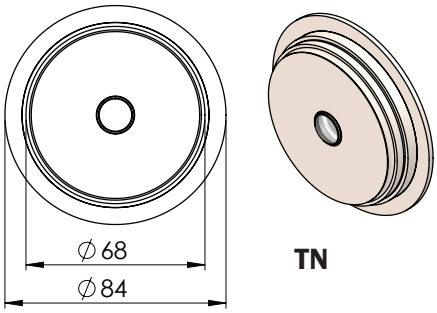
For small drains, floor drains and open tube collectors.
The sensor is dropped in the drain.

No flushing possible, so its important that lens is kept clean.



2.7 VOD INSTALLATION

The Satron VOD is equiped with a VARINLINE process connection TYPE N. Ensure that the O-rings are properly fitted into the sealing grooves of the process flange.
Change of pipe diameter will require a recalibration of the sensor.

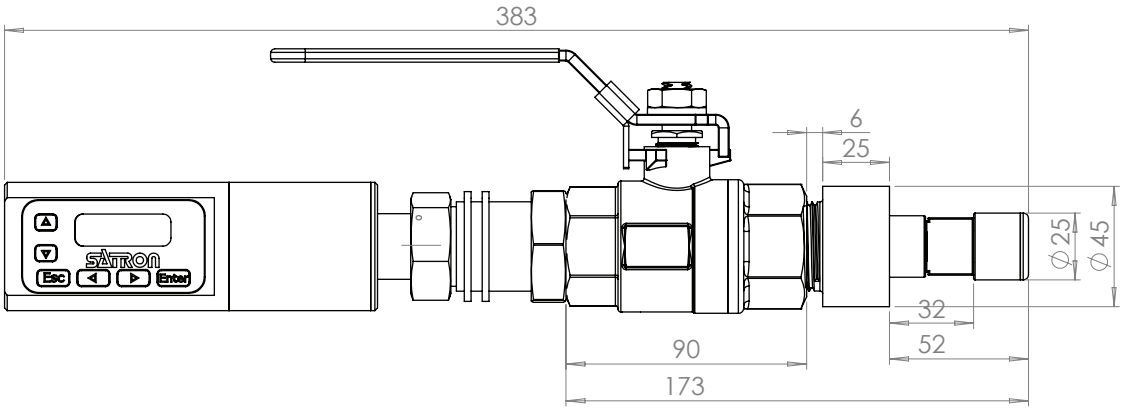


Several pipe diameters are commercially available.

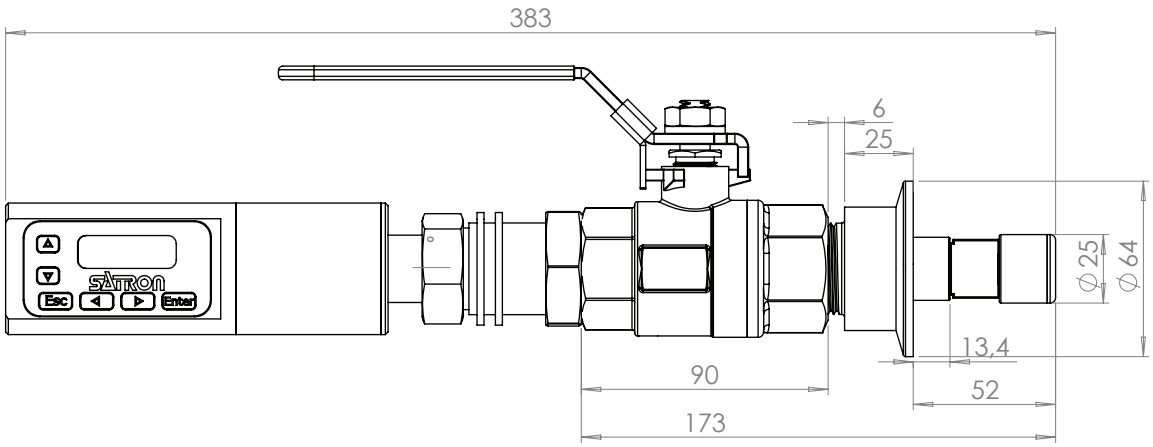
Pipe size	Satron code
Tuchenhagen pipe 2”	82026875
Tuchenhagen pipe 2.5”	82026876
Tuchenhagen pipe 3”	82026877
Tuchenhagen pipe 4”	82026878

2.8 VOF INSTALLATION

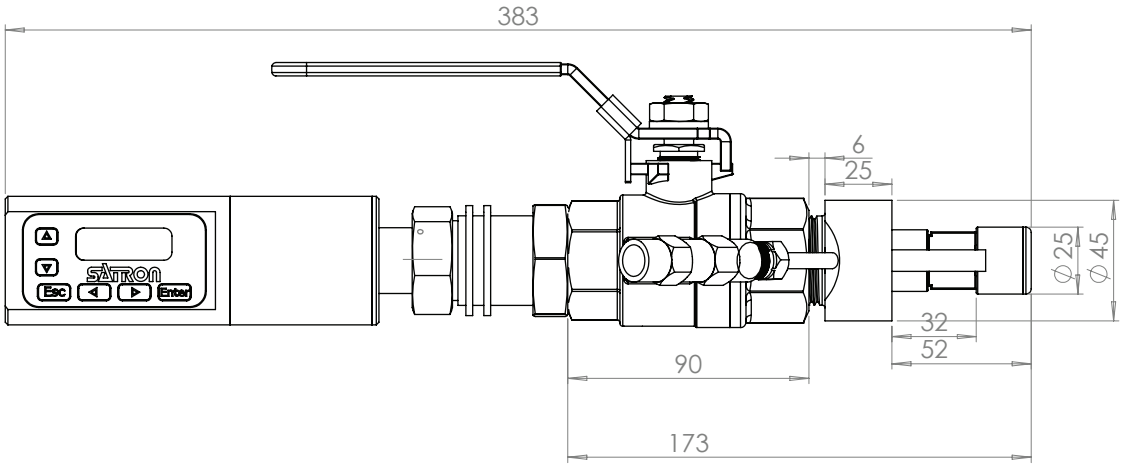
The Satron VOF comes with a G1” retractable process connection type B1.
Different process couplings allow for welding, flanged or clamped connection.



VOF with standard welding adapter M1050598



VOF with tri-clamp adapter M1051276



VOF with flushing adapter M1050102-VOF

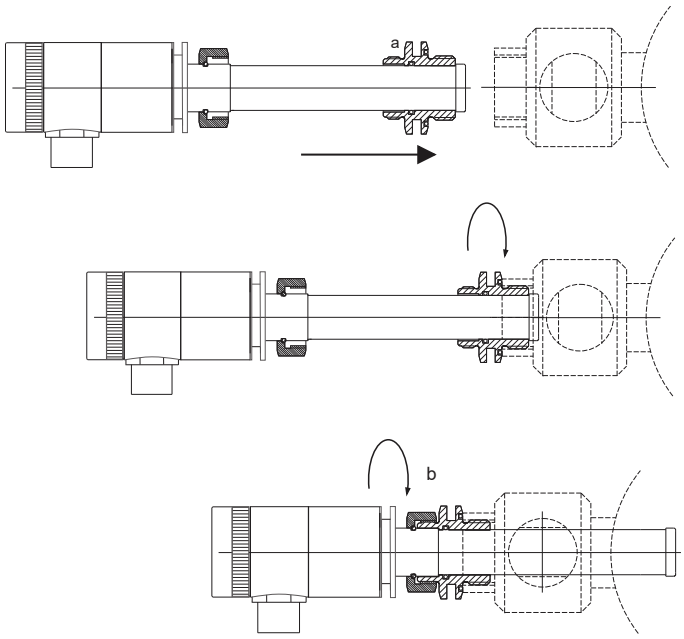
2.8.1 MOUNTING THE TRANSMITTER

To mount the transmitter, ensure O-ring seal is between the screw fitting and ball valve. Insert the screw fitting on the end of the transmitter into the ball valve and tighten the screw fitting (a).

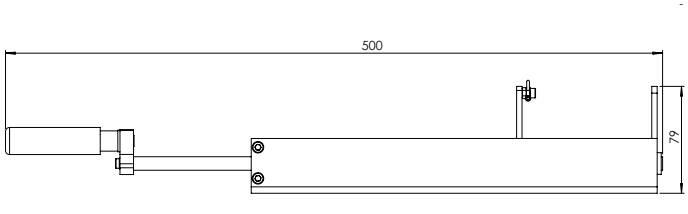
Open the ball valve and push the transmitter through the valve and lock in place with the locking nut (b). In some cases, under higher pressure applications, the insertion tool may be required.

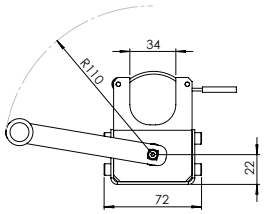
To remove the transmitter, reverse the above steps.

Warning: When removing the transmitter, do not loosen screw fitting (a) unless the ball valve is closed!



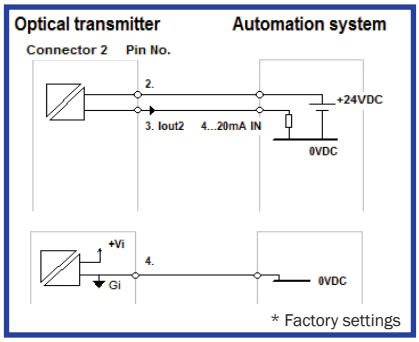
Insertion and removal tool is optional and is not included with the purchase of the transmitter (code: M1050140).

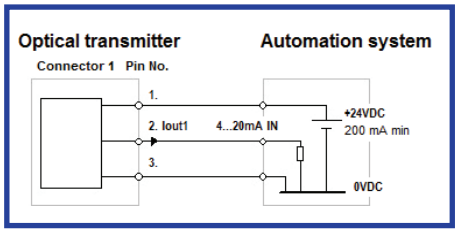


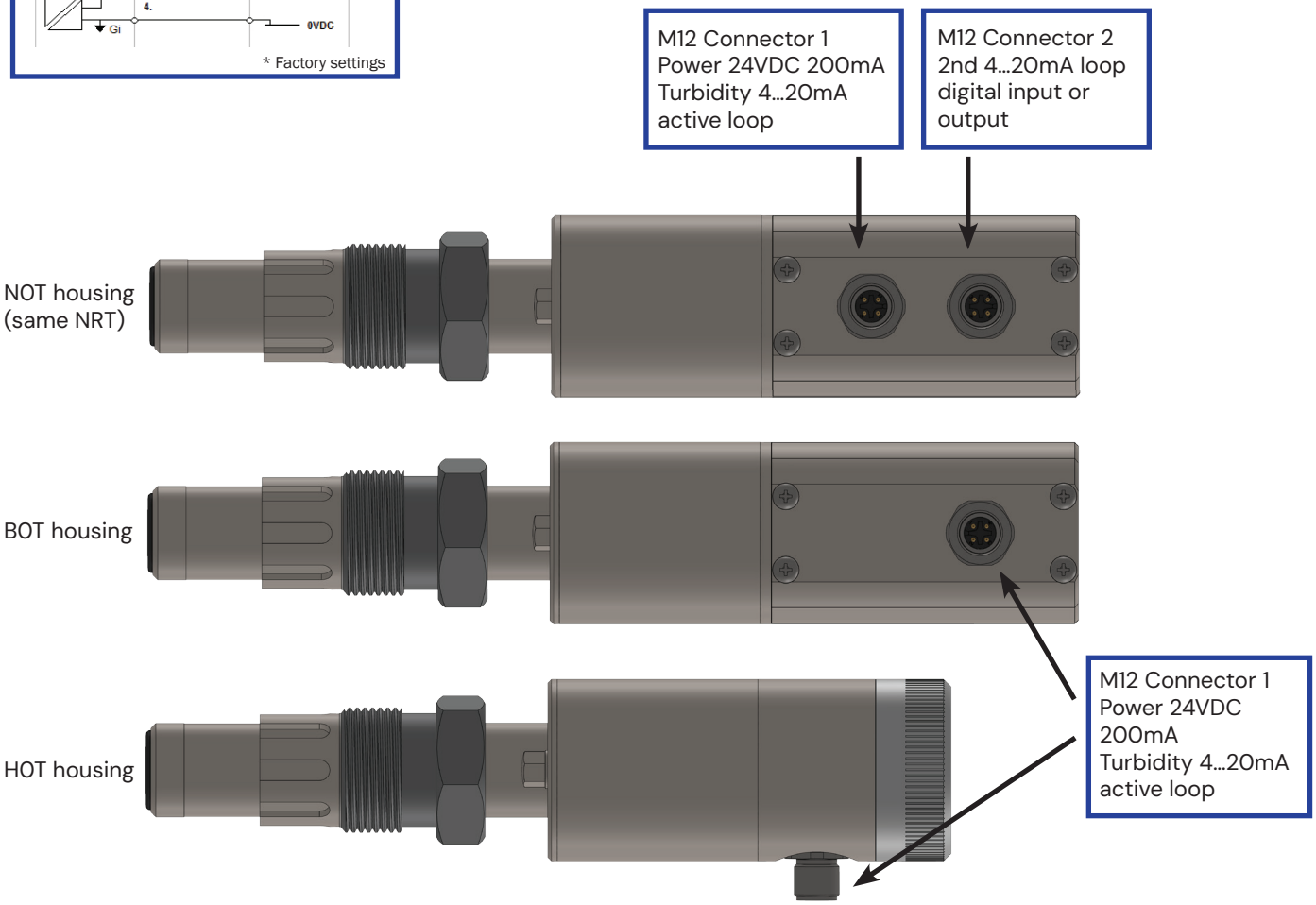


3 ELECTRICAL CONNECTIONS

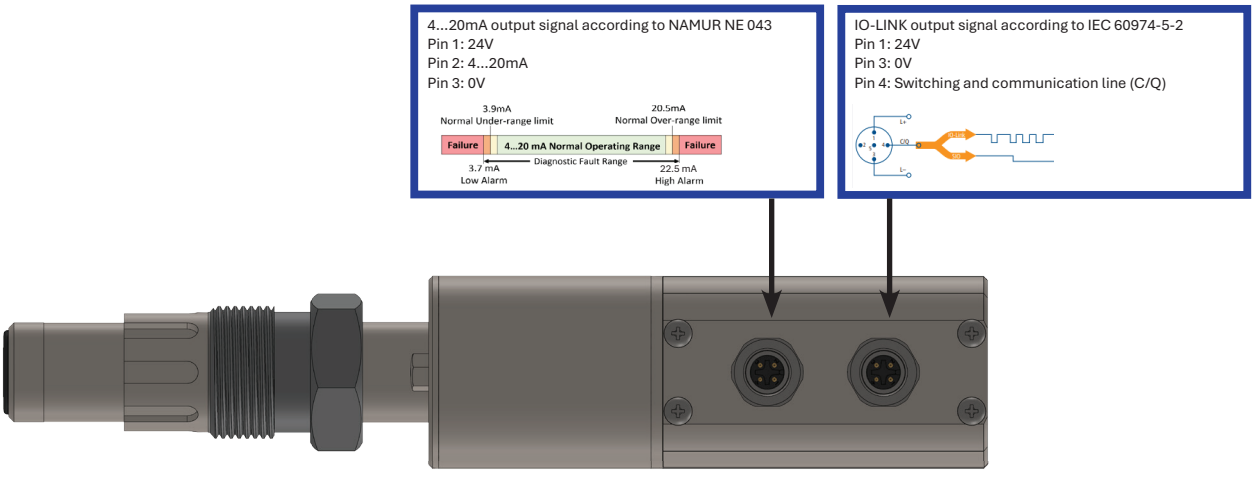
3.1 VOM / VOA ELECTRICAL CONNECTIONS







IO-LINK option signal for output selections T or K, only available with N housing. See VO datasheet for selection chart.



3.2 RDU ELECTRICAL CONNECTIONS

Supply voltage to the transmitter is 24 Vdc and requires up to 200 mA current. It is recommended that a shielded twisted-pair cable is used as a signal cable. The signal cable should not be installed near high voltage cables, large motors or frequency converters.

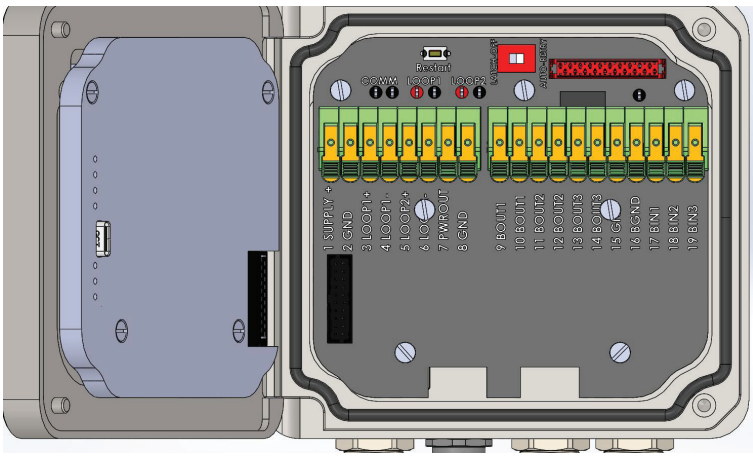
The shield of the cable should be grounded at the end of the power supply or in accordance with the recommendations of the manufacturer of the control system used and the regional electrical code. At the RDU end there's a dedicated screw for connecting the cable shield (1).

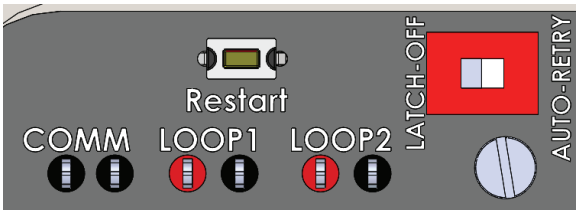
The Satron VO transmitter remote display unit (RDU) can be provided with a wall box which can have a 10/15 meters cable between the transmitter and the sensor unit. Inside the RDU, there is a terminal for up to 3 binary Inputs (BIN1,BIN2,BIN3), 3 relay outputs (BOUT1, BOUT2, BOUT3) and 2 analog 4-20 mA output signals (LOOP1, LOOP2).

The wiring connections to the RDU are shown below.

⚠ Do not connect or disconnect signal cable of the RDU while the device is powered up.

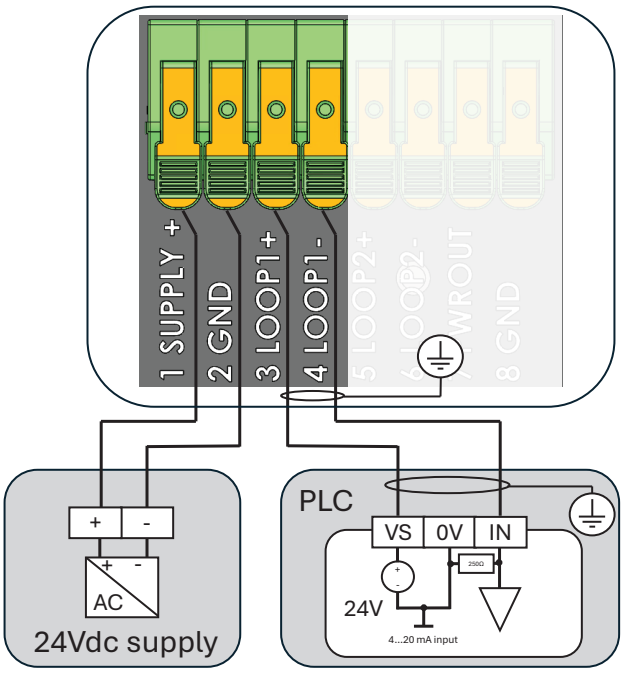
⚠ Do not connect older generation M1/M2 sensors or RDU to new M3 generation devices.



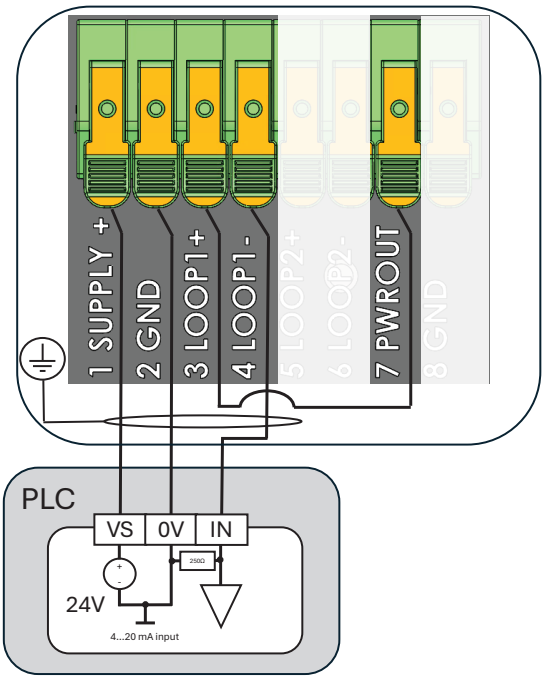


Protection fuse function selection:
LATCH-OFF after the fuse has triggered, device will be kept off until Restart is pressed
AUTO-RETRY device will try to automatically reset the fuse after it has been triggered
COMM Hart® communication terminals
LOOP1 mA loop 1 test terminals
LOOP2 mA loop 2 test terminals

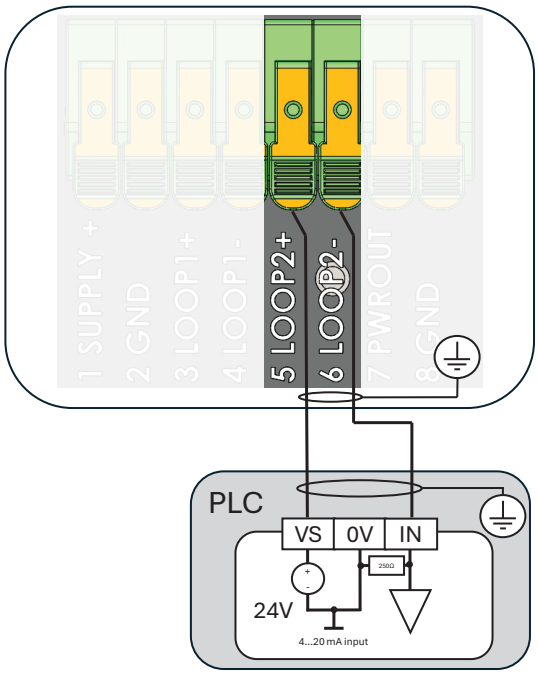
First mA loop (LOOP1) connection with external power supply, isolated mA loop. Preferred mode.



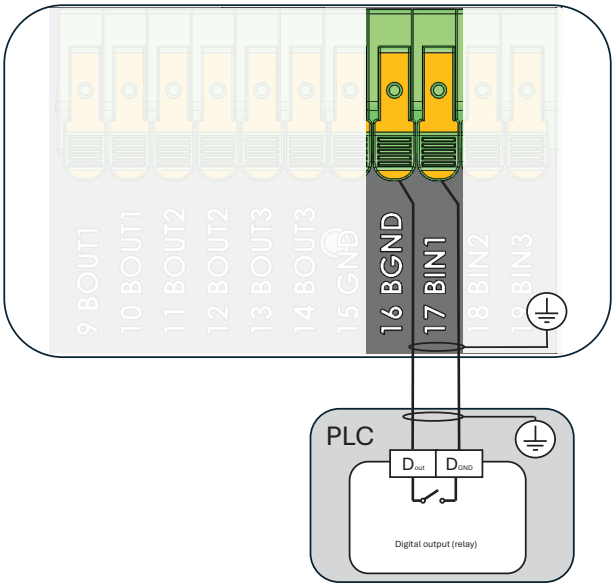
First mA loop (LOOP1) connection (3-wire), non isolated mA loop.



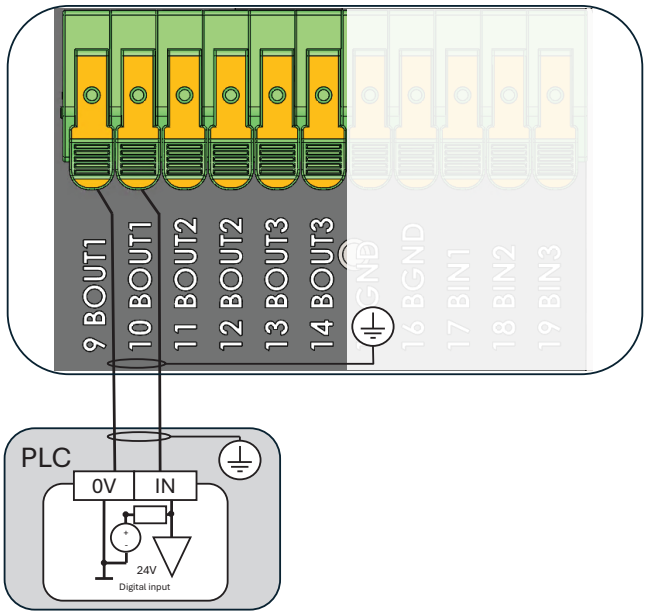
Second mA loop (LOOP2) loop connection (2-wire)



Digital input

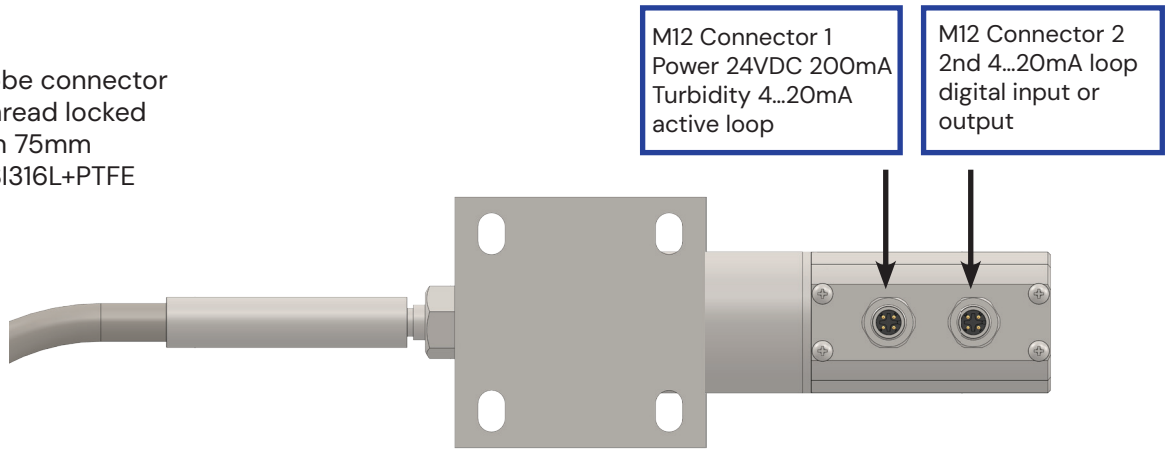


Digital output

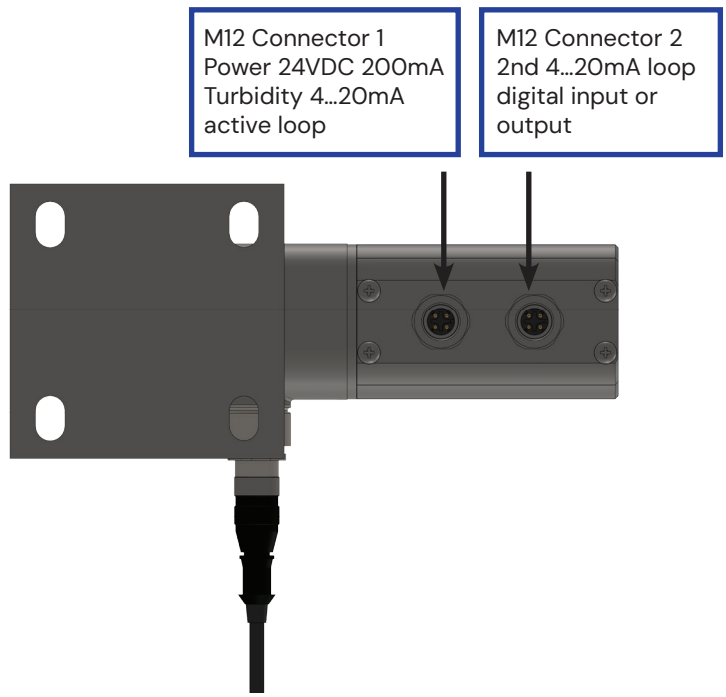


3.3 VOM NRT ELECTRICAL CONNECTIONS

VOxxxxxNRT2xxxx
Sensor remote probe connector
Non-removable, thread locked
Bending radius min 75mm
Cable material: AISI316L+PTFE



VOxxxxxNRT4xxxx
Sensor remote probe connector
Removable M12, 8 pin
Bending radius min 30mm
Cable material: PVC



VOMNS221NRT427G1

VOMNS221NRT217G1

VOMNS221NRT217H1

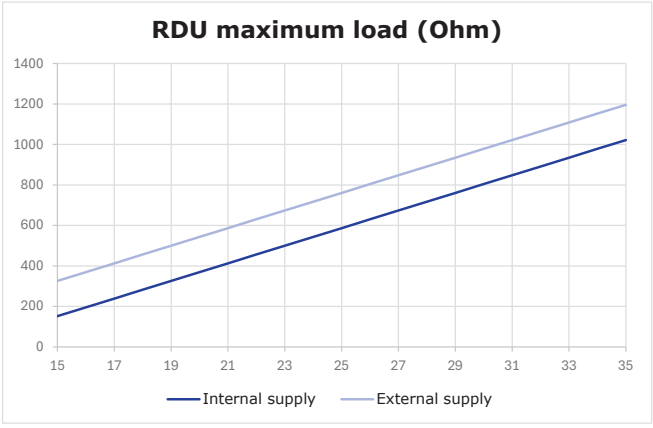
3.4 BACK COVER CONNECTIONS

Supply voltage and load of the transmitter according to the figure 1-16.

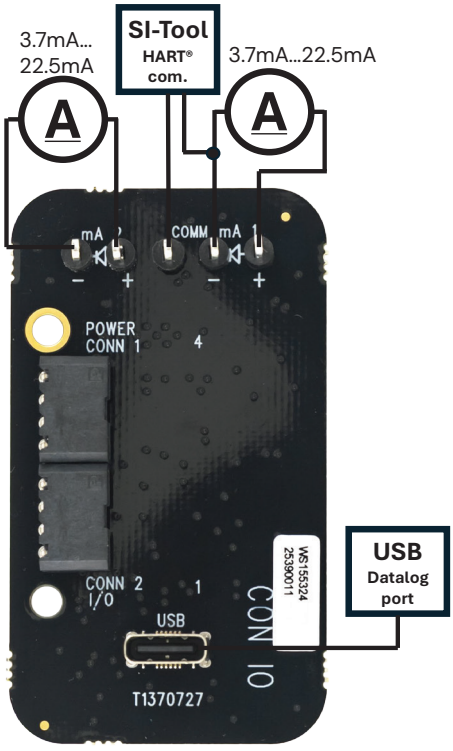
We recommend shielded twisted-pair cable as signal cable. The signal cable should not be installed near high-voltage cables, large motors or frequency converters.

The shield of the cable is grounded at the power supply end or according to the recommendations of the manufacturer of the used control system.

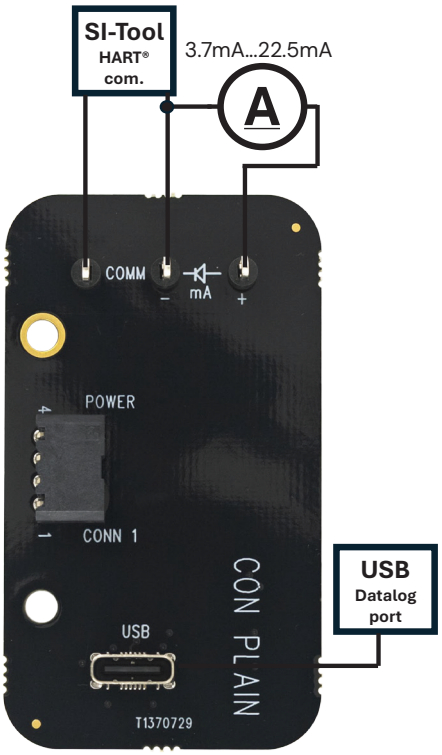
In the unlikely event of failure the sensor will go in alarm mode. See **5.2.3. OUTPCONF/ALARM SAT.**



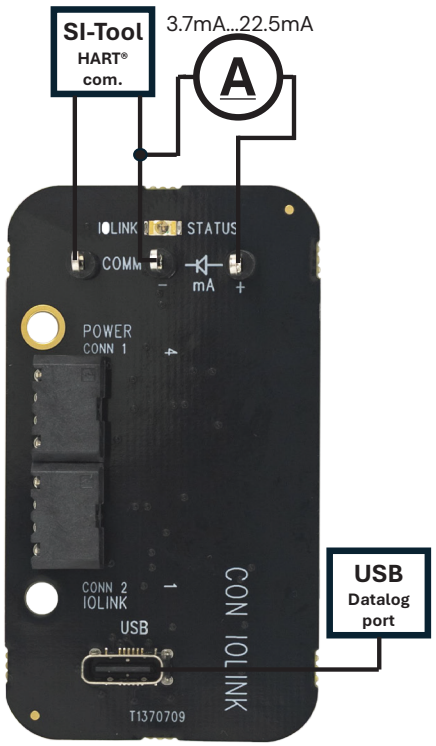
Remove the four screws from the back cover. When reinstalling the back cover onto the transmitter, ensure that the O-ring is in good condition and correctly seated in its groove.



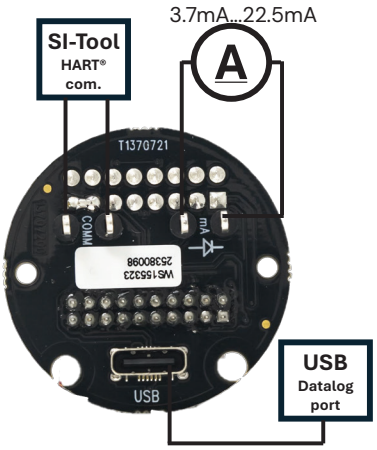
N-housing



B-housing



N-housing with IO-LINK

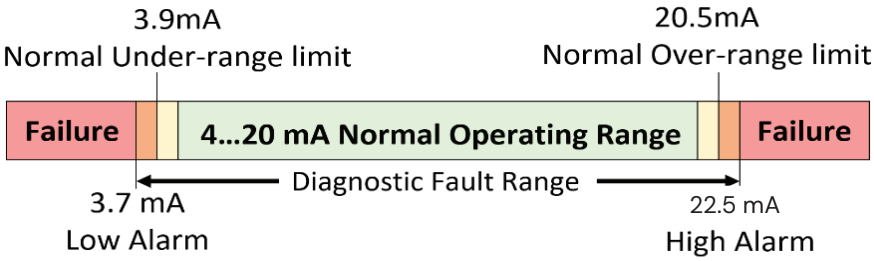


H-housing / L-housing

3.5 ELECTRICAL REQUIREMENTS

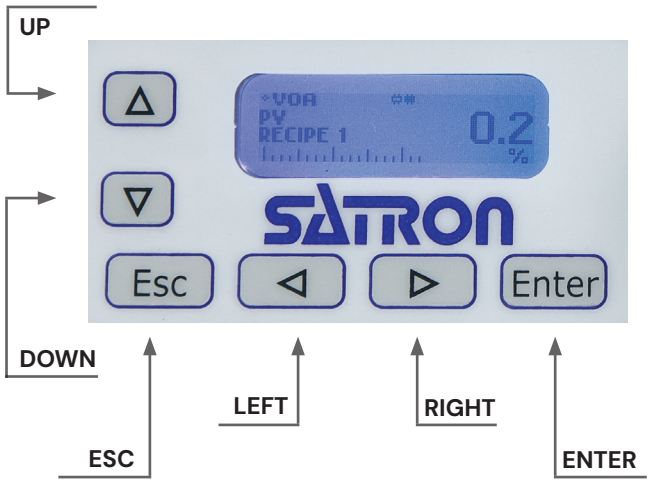
I/O-connections	
Current output1	Turbidity active
Range (Namur NE 043)	3.5...23 mA
Maximum load	600 Ω
Factory setting	4...20 mA
Switch outputs (up to 3 available)	
solid state relay,	grounding contact
Maximum voltage	35 V
Maximum current	50 mA
Maximum leakage current	10 µA
Switch inputs (up to 3 available)	
NC (no connection)	OFF
0...2 V	ON
Minimum values for switch in use	
Voltage	16 V
Current	4 mA
Leakage current	1 mA
Current output2	
Internal power supply	
Current output 2 has same ground as binary IO	
Maximum load	400 Ω
Range	3.5...23 mA
Factory setting	4...20 mA
External power supply	
Current output 2 is galvanically isolated	
Maximum supply voltage	35 VDC
Range	3.5...23 mA
Factory setting	4...20 mA
Maximum isolation voltage	100 VDC

Analog output signal according to NAMUR NE 043:



4. USER GUIDE FOR MENUS

The user interface for the VO-series transmitters, housing option **N or B**, consists of display and six operating keys. User interface allows you to configure, calibrate and diagnose the transmitter.



OPERATING KEYS:
With the **LEFT/RIGHT[←→]** and **UP/DOWN [↑↓]** arrow keys and **ENTER** and **ESC** you can move in the menus.
The functions of the keys:

LEFT [←]:
Use the **LEFT** arrow key to move left on the current menu level.

RIGHT [→]:
Use the **RIGHT** arrow key to move right on the current menu level.

UP [↑]:
Use the **UP** arrow key to increase the selected parameter value.

DOWN [↓]:
Use the **DOWN** arrow key to decrease the selected parameter value.

ENTER:
Press **ENTER** to accept a command or parameter value and to enter the current menu.

ESC:
Press **ESC** to go to the submenus and to move back towards the previous level and to the top of the main menu.

4.1 MEASURE:

When the transmitter is powered up, it immediately shows the MEASURE menu's main display.
The menu does not have any variables adjustable by the user.

1 DEVICE TYPE:
For example, VOA.

2 PV:
Process Value.

3 RECIPE:
Recipe number.

4 MEASUREMENT GRAPHIC:
Graphic mA scale that goes up and down according to the measurement changes.

5 PROCESS UNIT:
The active recipe unit (e.g. %).

6 PROCESS VALUE:
This shows the PV (process value/primary variable) e.g 0.2.

The top row of the graphic display shows information and can include icons. Their meanings are explained below.

7 ICONS:

Blinking dot: indicates that CPU and display are fine.
VOA: informs the device type.
i Depends on the status information:
- A static **i** indicates a warning or noncritical error, with the measurement value blinking. It can also signal an unacknowledged inactive error bit.
- Exclamation mark '**!**' and '**mA**' indicate a critical error (alarm current is active).
- Otherwise, device status is empty.

When data or event is being logged into memory.
When EEPROM is being written.
USB communication active.
HART communication active.
IO-Link communication active.
Upload symbol: when log is being read.
Download symbol: when firmware is being updated.
12:00 RTC HH:MM (if Real Time Clock is activated).

Use the **LEFT/RIGHT[←→]** keys to move in the menu. Moving RIGHT you will find the following variables.

1. **PV (Process Value)**
2. **IOUT1**
3. **ST (Sensor Temperature)**
4. **ET (Electronics Temperature)**
5. **BINARY OUTPUT/INPUT state (if activated)**
6. **IOUT2**
7. **RECIPE**
8. **Serial number**
9. **FU value**

4.2 MEASUREMENTS VALUES MENU:

VO transmitters menu is split into "BASIC" or "FULL" structures. BASIC menu is suitable in quick 2 point calibrations and is sufficient for 90% of application scenarios. For more advanced settings like language, I/O configuration, change of recipe, the "**FULL**" structure needs to be used.

5. DISPLAY SETUP

5.1 SETTING UP WITH "BASIC"

To enter the "**BASIC**" structure menu:
Press **ESC** shortly and 3 submenus are accessible

CALIB

This is the basic calibration mode. Here the 4mA and 20mA points can be changed. The result is always a linear 2 point calibration. You can change both 4mA and 20 mA, or only one of them. The sensor needs to be taught to the new calibration, by means of having the corresponding liquid in front of the lens. The sensor will inform that the calibration on current recipe will be erased. Confirm by pressing Enter.

 # 4 MA ?

Now the sensor is asking for the 4mA value. Insert the sensor in the corresponding liquid, wait 5 seconds and press Enter.

 # 20 MA ?

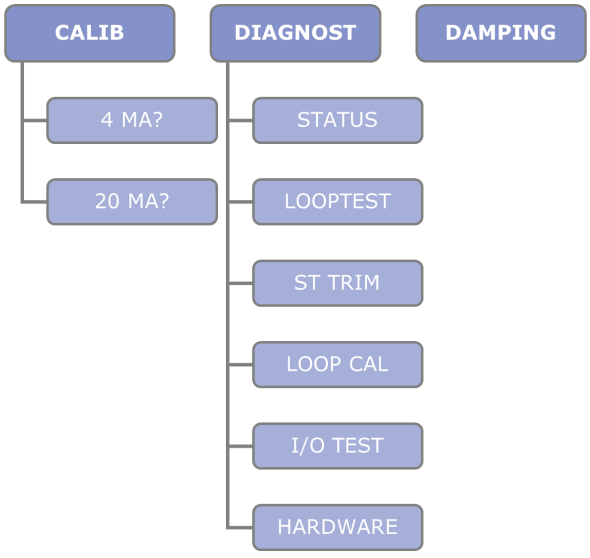
Now the sensor is asking for the 20 mA value. Insert the sensor in the corresponding liquid, wait 5 seconds and press **Enter**.
By pressing **ESC** the value will be left the same, allowing to for example only change the 4 mA or only the 20mA. By pressing **ESC** for each value the calibration procedure will be cancelled totally.

DIAGNOST

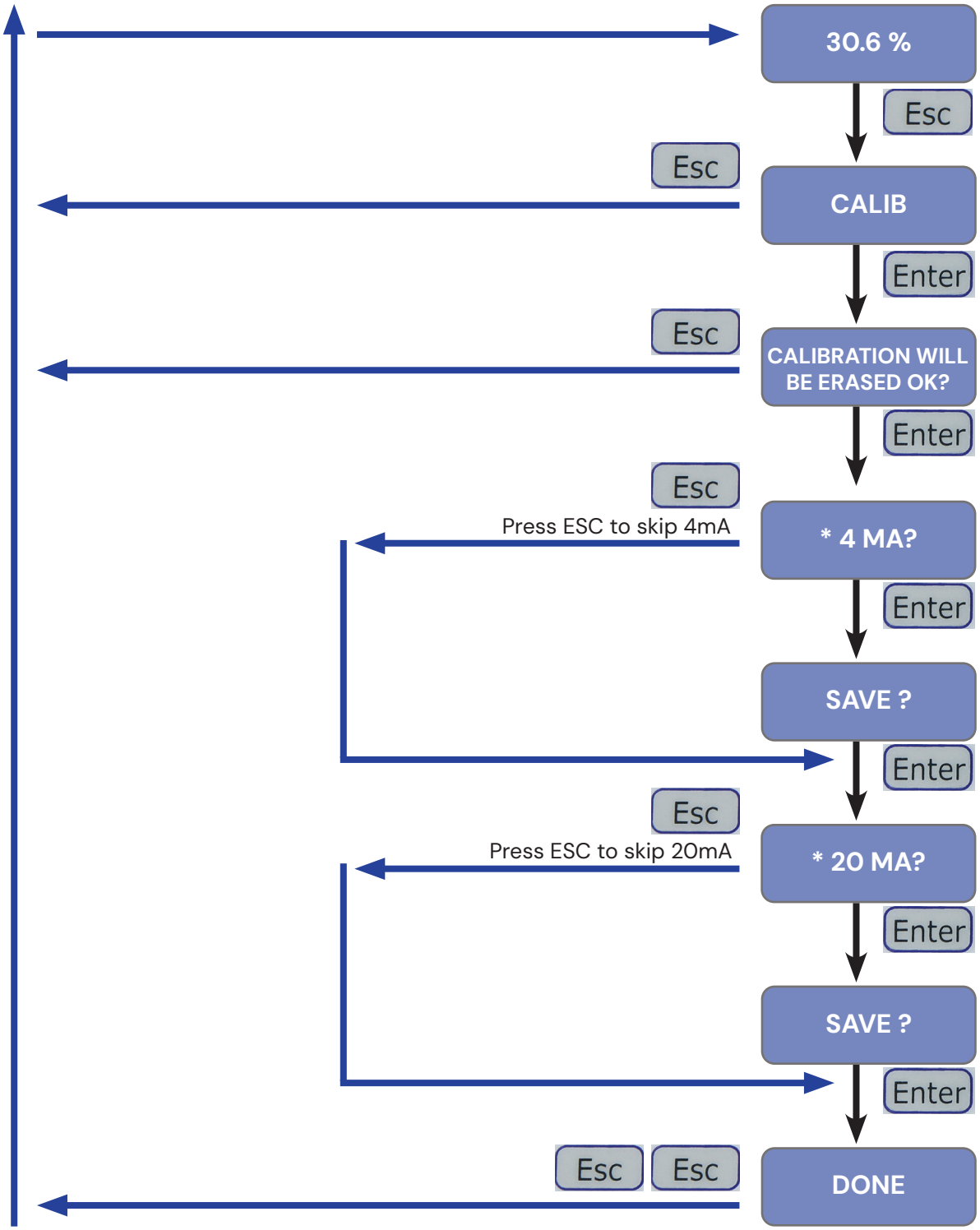
(*See 4.2.5 for more information*)
STATUS
LOOPTEST
ST TRIM
LOOP CAL
I/O TEST
HARDWARE
FUVALUES

DAMPING

Time constant, in seconds for output damping. The range is 0.000s to 60s. Set the value with the **UP/DOWN** keys and accept it with **ENTER** or press **ESC** if you do not want to change the value.
Default damping is 0.5s. For Satron VOA PRIME is 10s.

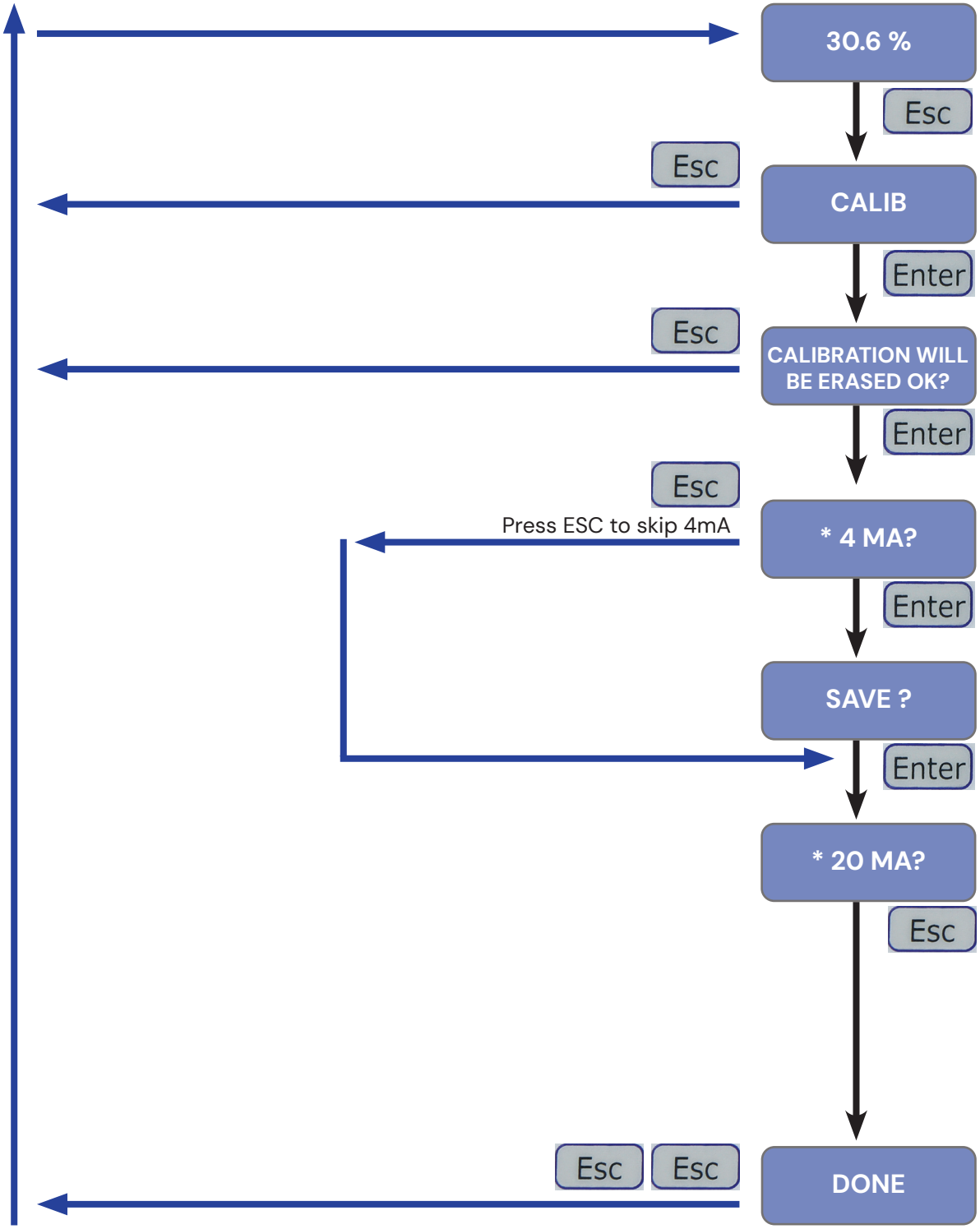


5.1.1 BASIC 2 POINT CALIBRATION



5.1.2 BASIC CALIBRATION, ZEROING VOD/VOF

Typical procedure after VOD/VOF installation:
Ensure the process is at the Lower Range Value (LRV) condition.
Additional calibration points can be added later using multipoint calibration.



5.2 SETTING UP WITH "FULL"

Under the full menu there are 6 submenus: **System configuration, Measurement configuration, Output configuration, I/O configuration, Info,** and **Diagnostics**. To enter these submenus press **ESC** for 3 seconds when in Measurement Values menu. See full menu tree on page 26.

5.2.1. SYSTEM CONFIGURATION

SYSTCONF

Configure parameters that have an effect on the system like e.g. language and date.

TAG

Tag code. You can enter free-format text one character at a time. When you select this option with **ENTER** the cursor will be at the left. Select characters with **ENTER** (to the right) and **ESC** (to the left). You can view the selectable characters one character at a time with the **UP/DOWN** keys until the desired character is found. When the cursor is at the right edge you can go back to the **SYSTCONF** menu either by accepting the new tag code with **ENTER** or by pressing exiting without changing the tag code by pressing the **ESC** key when asked to accept your entry. Apostrophe indicates the cursor position; at point, however, the cursor will disappear. A great deal of special characters are available besides letters and numbers.

CONFDATE

From this menu you can set the date **DD.MM.YYYY.** You enter the **CONFDATE** in the same way as **TAG**. The calendar year can be selected from between 1900 and 2155. This date can be for example the date of the last calibration done.

RTC

Set Real Time Clock.

HART

Select this function with the **LEFT/RIGHT** keys. In menus 1-3 you select the content of the burst message. You can view the available selections with the **LEFT/RIGHT** keys.
Available options:
In menu 1 (PV): Transmitter sends process value PV to system.
In menu 2 (PERCEN%): Transmitter sends process variable's value in per cent of specified measuring range to master.
In menu 3 (PVS/CURR): Transmitter sends all process variables and current signal's value.
In menu 5 (POLL ADR): Select the transmitter's Hart® address. The address can be set between 0 and 15. The transmitter enters Multidrop mode when the polling address is set between 1 and 15. When the address is set to 0 (Default) the unit resumes in the normal live mA loop.
In menu 6 (BURST ON/OFF): Select the Burst mode. First define the process variable sent by the transmitter from menus 1-3. The procedure is the same as described above.

DISPLAY

In this menu you can select the looks in which the display will be read.

BACKLIGHT: Select the intensity of the backlighting from **OFF, LOW, MEDIUM** and **HIGH**.
ANGLE: Let you select the angle of the text.
NORMAL: From left to right. Transmitter mounted horizontally with process connection directed to the right.
ROTATED: Rotates the text 180 degrees from normal.
MODE
COLORS: Status backlight enabled/disabled.
DEFCOLORS: Default backlight color.

PASSWORD

From this menu you can set a password (0...999) for the transmitter. If a password has been specified, you cannot set any parameters or make any other settings on the transmitter unless you enter the correct ID number in this menu. Password is not in use when **PASSWORD** is 000 after reset. You enter the **PASSWORD** in the same way as TAG. **PASSWORD** will be on when you define a value between 1 and 999. If you forget password get in contact with Satron Instruments Inc.

LANGUAGE

Select the Display language. **ENGLISH, FRANÇAIS, POLSKA.**

T UNIT

Select transmitter's universal temperature unit. Available units are **°C** and **°F**

5.2.2. MEASCONF

MEASCONF

Configure parameters that have an effect on the measurement.

DAMPING

Time constant in seconds for output damping. The range is 0.000s to 60s. Set the value with the **UP/DOWN** keys and accept it with **ENTER** or press **ESC** if you do not want to change the value.

AVERAGE

Time constant in Hz for averaging the output. Cannot be changed.

LED CURR

Transmitter's primary LED's current [%]. Cannot be changed.

UNIT

Select transmitter's unit you want to show in the display as active recipe's Process Value. **FNU, FTU, NTU, %, mg/L, ppm etc.**

5.2.3. OUTPCONF

OUTCONF

Configure parameters that have an effect on the output current loops. Change the recipe and perform new calibrations.

RECIPE

Up to 4 different recipes can be stored in the VO. The basic factory calibration is stored standard in Recipe 1. To perform a new calibration it is recomended to use a different recipe.

USERPNTS

With the **LIN FUNC** selected as **USER**, the number of points used for the calibration is selected. **POINT.CNT can have values between 2 to 16 (default is 2).** By selecting **SAMPLE** for the corresponding point, a real time measurement will start and when the user presses "**ENTER**" the unit will average the sample currently being measured and save this for the current point number. The first point corresponds to 4mA output and the last point corresponds to 20mA output. Please refer to the chapter **CALIBRATION** of this manual to find more detailed information on how to perform a full re-calibration.

USERMODE

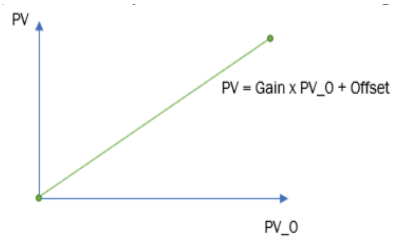
Select the interpolation method between points. **INTERPL** selects linear interpolation. **SPLINE** selects spline interpolation.

OFFSET

Offset value for the active recipe's Process Value trim. (Default 0). Set the new value and accept it with **ENTER** or press **ESC** if you do not want to change the value.

GAIN

Gain value for the active recipe's Process Value trim. (Default 1) Set the new value and accept it with **ENTER** or press **ESC** if you do not want to change the value.



TEXT

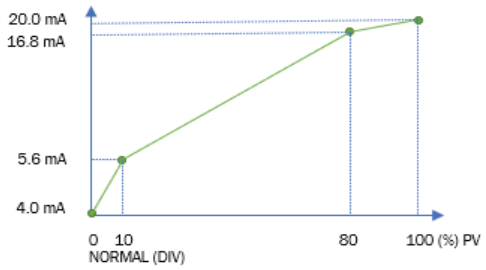
Menu for editing the Recipe name. Edit the name and accept it with **ENTER** or press **ESC** if you do not want to change the value.

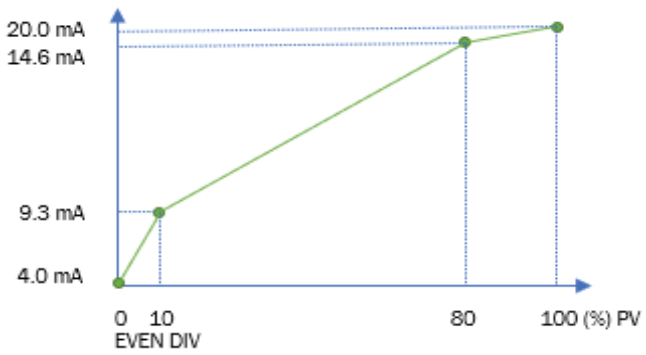
UNIT

Select transmitter's unit you want to show in the display as active recipe's Process Value. **FNU, FTU, NTU, %, mg/L, ppm etc.**

MA MODE

This option is only available with transmitter type **VOA**. Available mA modes are **NORMAL** (Default) and **EVEN DIV. EVEN DIV** mode can be used for magnifying certain areas of the calibrated range if needed. An example comparing **NORMAL** and **EVEN DIV** mA modes:





ALARMSAT

Submenu **ALARMCUR** shows the High and Low Alarm Current levels. Submenu **MODE** allows user to select between three different predetermined alarm current and current saturation configurations:

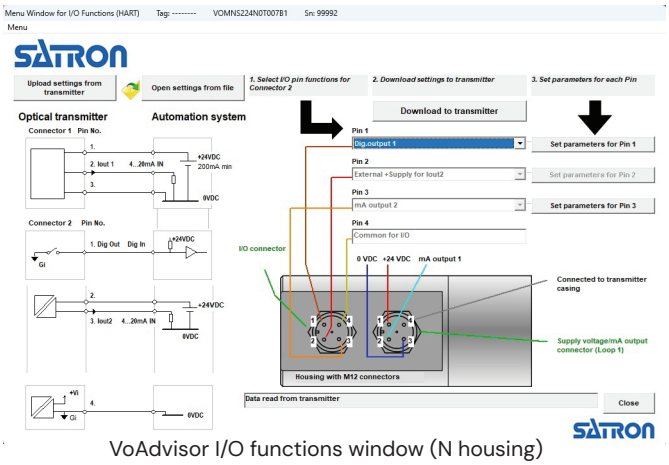
Mode	Low Alarm	Lower Sat	Upper Sat	Upper Alarm
SATRON (default)	3.7 mA	3.9 mA	20.5 mA	22.5 mA
NAMUR (NE 43)	3.6 mA	3.8 mA	20.5 mA	21.0 mA
4-20 mA	3.7 mA	4.0 mA	20.0 mA	20.5 mA

5.2.4. I/O CONF:

5.2.4.1 I/O CONF (HOUSING OPTIONS N OR L AND OUTPUT OPTIONS S OR J)

I/O CONF

Configure parameters that control the INPUT functions, OUTPUT relay(s) functions or the 2nd mA loop. The use of Satron VoAdvisor software is recommended but not mandatory.



VoAdvisor I/O functions window (N housing)

I/O 1

Settings menu for INPUT / OUTPUT PIN #1.
I/O 1 menu applies only to N housing option.

TYPE

Select function type. With "**NONE**" selected, I/O 1 will be off. For digital INPUT with corresponding submenus, select **DI1**. For digital OUTPUT with corresponding submenus, select **DO1**. TYPE menu applies only to N housing option.

IO2 SRC

Select transmitter's 2nd mA loop's control source. Default control source is **ST** (Sensor Temperature). Default for VOA is **FUDIFF** (PRIME).

IO2 LRV

Lower Range Value (4mA) for the selected **IO2 SRC**. Default 0°C. Set the new value and accept it with **ENTER** or press **ESC** if you do not want to change the value.

IO2 URV

Upper Range Value (20mA) for the selected **IO2 SRC**. Default 100°C. Set the new value and accept it with **ENTER** or press **ESC** if you do not want to change the value.

IO2 DAMP

Time constant in seconds for the second output (**IO2**) damping. The range is 0.000s to 60s. Set the value with the **UP/DOWN** keys and accept it with **ENTER** or press **ESC** if you do not want to change the value.

5.2.4.2 I/O CONF (HOUSING OPTIONS N AND OUTPUT OPTIONS T OR K (IO-LINK))

I/O CONF

Configure I/O parameters for IO-LINK transmitter.

IO-LINK

Main menu for IO-LINK settings.

IODD VERSION

Default IODD version: **1.0 / 2022-08-31**
IODD version for SATRON VOA PRIME: **1.2 / 2025-06-09**

PRIME

Configuration menu for SATRON VOA PRIME output function parameters.
Factory settings:

FUDIFF	(Read-only)
LRV.....	(-20.0)
URV.....	(20.0)
DIFFTIME	(20 s)
FUSE.....	(FU)
DIFFMODE	(PLAIN)

PRIME menu available only with SATRON VOA PRIME IO-LINK transmitters.

MODE

Satron diagnostical tool's settings. For normal IO-LINK operation, select **DEFAULT**.

5.2.5. INFO

INFO

MANUFCTR

Manufacturer's name (**SATRON**). Cannot be changed.

DEV TYPE

Product type code. Cannot be changed.

VERSION

Version numbers of the transmitter's electronics and software. Press **ENTER** to select this item. Press **ESC** to exit. With the **LEFT/RIGHT** keys you can select either **CPU HW, CPU FW, ADC HW, or I/O HW** from this submenu.

ASSM NUM

The transmitter's assembly number. Cannot be changed.

SER NUM

Serial number. Cannot be changed.

OP TIME

HH : MM : SS when the value of counter is <100 hours
HHHH : MM when the value of counter is <100000 hours
HHHHHHHH when the value of counter is ≥100000 hours

AC HZ

Local line voltage frequency. Used for optimizing noise cancellation. This parameter is only changeable by Satron.

5.2.6. DIAGNOSTICS

DIAGNOST

This submenu allows you to examine the transmitter's internal errors and faults, to set the transmitter to give out a fixed current, and to calibrate the transmitter's mA loop and sensor temperature.

STATUS

Here you can display and reset accumulated errors one at a time. The text **OK** will be displayed if there are no errors. Possible error messages (alarm means a serious fault/error that also puts the current signal in fault status and makes the display blink).

LOOPTEST

The transmitter can be set to give out a fixed current signal for testing the mA output. The first **ENTER** will switch the transmitter off from normal mode (**AUTO OFF**), the second **ENTER** will set it for 4 mA output, and the third **ENTER** for 20 mA output. The next **ENTER** after that will give default value 12 mA, which can be changed as desired with the **UP/DOWN** keys. The last **ENTER** will switch the transmitter back to normal mode (**AUTO ON**). The purpose of this test is to test the accuracy of the transmitter's current output with a reference meter.

ST TRIM

Sensor Temperature Trim. Here you are able to calibrate the temperature probe which is placed in the head of the analyzer. (Maximum by 10 degrees).

LOOPCAL

Here you can calibrate the current signal given by the transmitter. The first **ENTER** will switch the transmitter off from normal mode (**AUTO OFF**). The next **ENTER** will make the transmitter give out a signal which it assumes to be 4 mA. Use the **UP/DOWN** keys to change this value in accordance with the reading on the reference meter. Then press **ENTER** for 20 mA output, which you must also set in accordance with the reference meter. Press **ENTER** to accept the new reading. Note: Use a sufficiently accurate reference meter.

I/O TEST

Allows user to monitor the functionality of set I/O functions.

HARDWARE

Submenu **VOLTAGES** displays transmitter's inner voltage levels. Submenu **DISPLAY** performs display and button test. Submenu **IOUT1 NC ALARM** chooses if the alarm is displayed when the IOUT1 is not connected. By default this alarm is on.

LOG

Submenu **ADD TEXT** allows user to create and save a notification text to transmitter's data log with time stamp. This can be used later for example to separate different process phases when analyzing the data log. Edit the text and accept it with **ENTER** or press **ESC** if you do not want to change the value. Submenu **DATA LOG** enables user to select between **CYCLIC** data logging (cycle time is determined in submenu **INTERVAL**) or **DIG I/O. DIG I/O** enables user to control data logging via digital input. The factory default setting is **CYCLIC** and its **INTERVAL** setting depends on the transmitter type.

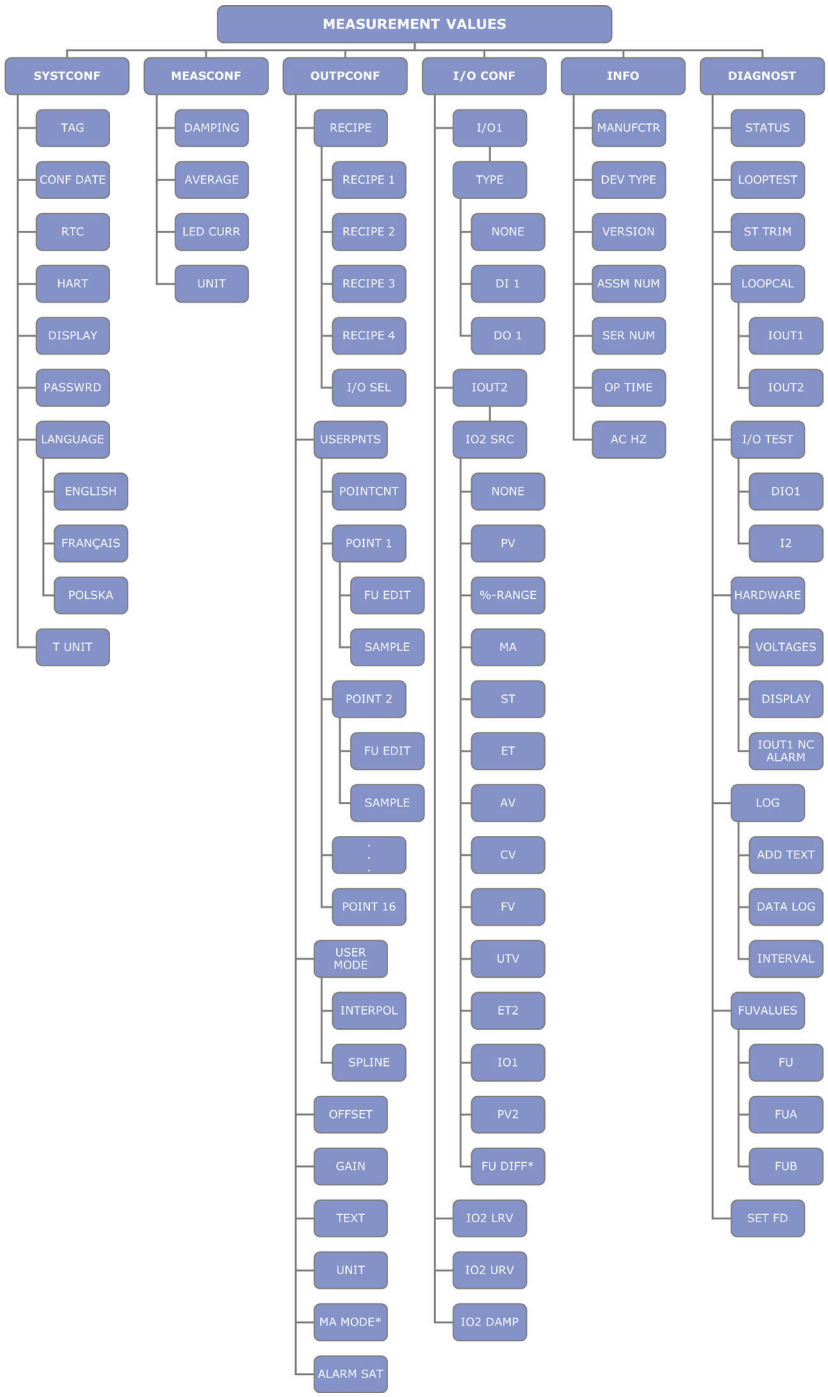
FUVALUES

FU is short for Satron Factory Unit and can be used for diagnosing the primary measurement's status. **FUA** and **FUB** are only available with transmitter type **VOA**.

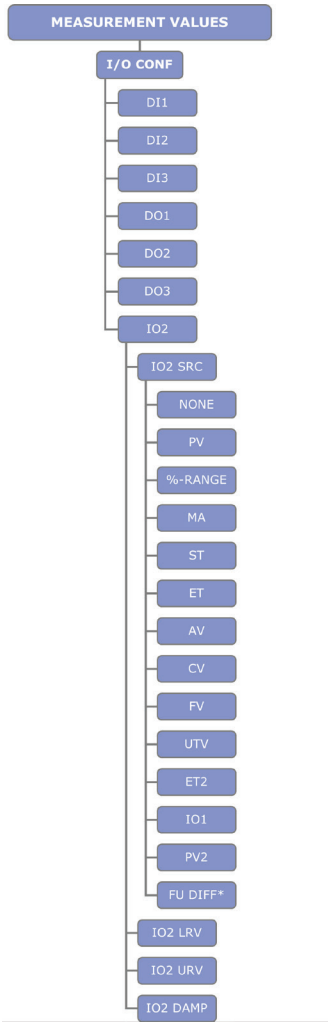
SET FD

SET FD restores the default factory settings. All calibrations will be lost.

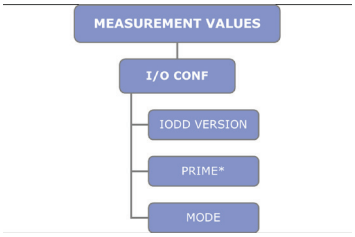
Full menu structure tree (local display housing N)



I/O CONF (Remote Display Unit housing L)



I/O CONF (local display housing N with IO-LINK output option T or K)



*VOA PRIME only. See appendix A for PRIME function

6 CALIBRATION

The VO series sensor comes with a standard factory calibration. There is space for 4 different calibrations, called recipe 1, 2, 3 and 4. As a standard, the factory calibration is stored in recipe 1. The different recipes can be renamed and also be enabled with the binary input(s). Housing option L has 3 binary inputs to change between all 4 recipes; housing option N has 1 binary input to change between 2 recipes.
The current enabled recipe is shown with the down arrow when the normal user value (in measurement values) is shown. To enable a different recipe go to **OUTPCONF>RECIPE.** Here you can choose between 1, 2, 3 and 4. Press enter to save.
To change a calibration Satron recommends to use the VoAdvisor software. It is also possible to change the calibration with the use of the sensors own user interface. The configuration of how the mA signal is divided is set under **OUTPCONF>MA MODE** (only for VOA PRIME). For detailed instructions, see page 23.

6.1 CALIBRATION EXAMPLE: MULTIPOINT CALIBRATION GUIDE

ESC	Press the **ESC** key for 3 seconds, to enter the "**FULL**" menu.
OUTPCONF	Use the **left/right** keys to enter the Output configuration window.
ENTER	
USERPRNTS	Use the **left/right** keys to enter the User points window.
ENTER	
POINT.CNT	Use the **left/right** keys to enter the Point count configuration window.
ENTER	
3	Use the **up/down** keys to select how many points the calibration will have. In this example there are 3 calibration points. Point 1 equals 4mA and Point 2 equals 20mA. Press **enter** to save the settings. Use the **up/down** keys to calibrate Point 1 (4mA).
ENTER	
SAVE ?	
ENTER	
POINT 1	
ENTER	
SAMPLE	Use the **left/right** keys to change between sample mode and edit. Use sample. The sensor will start showing the raw data on the display. Press **enter** when ready. Enter the display value corresponding to 4mA (0.0 NTU in this example).
ENTER	
*	
ENTER	
0.0000000	
ENTER	
SAVE ?	Press **enter** to save the first point of the calibration.
ENTER	
POINT 2	Use the **up/down** keys to calibrate Point 2 (4mA).
ENTER	
SAMPLE	Use the **up/down** keys to change between sample mode and edit. Use sample. The sensor will start showing the raw data on the display. Press **enter** when ready. Enter the display value corresponding to 12mA (2000.0 NTU in this example)
ENTER	
*	
ENTER	
2000.0000	
ENTER	
SAVE ?	Press **enter** to save the second point of the calibration.
ENTER	
POINT 3	
ENTER	
SAMPLE	Use the **up/down** keys to change between sample mode and edit. Use sample. The sensor will start showing the raw data on the display. Press **enter** when ready. Enter the display value corresponding to 20mA (4000.0 NTU in this example)
ENTER	
*	
ENTER	
4000.0000	Press **enter** to save the third point of the calibration.
ENTER	
SAVE ?	
ENTER	
ESC	Press **esc** until the measurements values show. This completes the multipoint calibration procedure.

APPENDIX A

PRIME

PRIME PRINCIPLE AND USAGE

PRIME is a function only available on VOA which is measuring the rate of change of optical properties of a media. Instead of measuring only FU in the process value, it will also measure the rate of change of FU value in FU/s.
PRIME allows to work on the following:

- Very early detection of interface - Picking up early change even before process value changes significantly
- Detection of interfaces between almost similar products. If there are only few hundred of FU difference between 2 products it is tricky to control a switch with process value – but if the change is fast then PRIME can detect it.
- Monitoring of chemical reactions, whose kinetics and optimal reaction time may be measured by a rate of change of optical signal.
- Stability of process, small but fast optical signal changes or instability can be easily detected and tracked (non-homogenous media, bubbles…)

Even if Process value is temporarily out of calibration range, PRIME will remain operational.

PRIME ACTIVATION

PRIME uses the second mA output of the VOA, and it is recommended to retrieve both process value and PRIME value.
Under **I/O CONF** menu, select **IOUT2** and **IO2 SRC = FU DIFF.**

PRIME PARAMETERS AND RECOMMENDED CONFIGURATION

The following parameters can be modified:

- **IO2 LRV** = Value of PRIME corresponding to 4mA signal - either FU/s or (FU/s)^2 depending on **DIFFMODE** below
- **IO2 URV** = Value of PRIME corresponding to 20 mA signal
- **IO2 DAMP** = Secondary damping
- **DIFFTIME** = Seconds between measurement point now and reference point **DIFFTIME** seconds in the past
- **FU SEL** = FU by default, with possibility to deactivate 1 wavelength and measure change only on 1 (FUA red or FUB high IR)
- **DIFFMODE** = Plain or square. Plain is FU/s while Square is (FU/s)^2

PRIME **PLAIN** value at time t = (FUt – FU(t-DIFFTIME))/DIFFTIME
PRIME **PLAIN** is good for detecting the beginning of a change and a direction of a change (going towards higher or lower FU)
PRIME **SQUARE** can be used with much shorter **DIFFTIME** and damping, so it can also accurately detect the end of a change but can't detect a direction of change, only its speed.

APPENDIX B

ERROR WORDS

The content of error words 1...12.

EW number	EW bit	EW name (function)	Description
01	00	**EW1**	Turbidity / Consistency error (TU ER/CS ER)
〃	01	〃	Sensor temperature error (ST ER)
〃	02	〃	Electronics temperature error (ET ER)
〃	03	〃	Output under -10 % or over 110 % (RANGE ER)
〃	04	〃	Output current saturated (OUTSA WA)
〃	05	〃	ADC runtime error (ADCR ER)
〃	08	〃	ADC startup error (ADCS ER)
〃	09	〃	EEPROM read error (EERPR ER)
〃	10	〃	EEPROM write error (EEPRW ER)
〃	11	〃	EEPROM calibration error (EECAL ER)
〃	12	〃	HART error (HART ER)
〃	13	〃	System error (INTRN ER)
02	02	**EW2**	Overfeed timer (OFTMR ER)
〃	04	〃	ADCA error
〃	05	〃	ADCB error
〃	06	〃	DACA error
〃	07	〃	DACB error
〃	08	〃	DISP error
〃	09	〃	EEPR error
〃	10	〃	HARA error
〃	11	〃	HARB error
〃	12	〃	SYSA error
〃	13	〃	SYSB error
03	00	**ADCA** (A/D, LEDs)	ADC not found
〃	01	〃	Comm error
〃	02	〃	Invalid channel
〃	03	〃	Irpt timeout
〃	04	〃	Gain comm error
〃	08	〃	AINM undervoltage
〃	09	〃	AINM overvoltage
〃	10	〃	AINP undervoltage
〃	11	〃	AINP overvoltage
〃	12	〃	ADC saturation
〃	13	〃	ADC conversion error
〃	14	〃	Miscellaneous error
04	08	**ADCB** (〃)	LED comm1 error
〃	09	〃	LED comm2 error
〃	10	〃	LED short error
〃	11	〃	LED open error
05	00	**DACA** (D/A, I/O)	IOUT not connected
〃	01	〃	Comm timeout
〃	02	〃	Frame error
〃	04	〃	VLoop 12V
〃	05	〃	VLoop 6V
〃	06	〃	Temp 100C
〃	07	〃	Temp 140C
〃	08	〃	ILoop under
〃	09	〃	ILoop over

〃	12	〃	Loop error
〃	13	〃	I/O comm error
06	00	**DACB** (〃)	IOUT2 not connected
〃	01	〃	I2 Comm timeout
〃	02	〃	I2 Frame error
〃	04	〃	I2 VLoop 12V
〃	05	〃	I2 VLoop 6V
〃	06	〃	I2 Temp 100C
〃	07	〃	I2 Temp 140C
〃	08	〃	I2 ILoop under
〃	09	〃	I2 ILoop over
〃	12	〃	I2 Loop error
〃	13	〃	I/O comm2 error
07	00	**DISP** (Display, RDU)	Keyb error
〃	01	〃	Disp error
〃	08	〃	No reply
〃	09	〃	Frame error
〃	10	〃	Checksum error
〃	12	〃	Keyb error (R)
〃	13	〃	Timeout error (R)
〃	14	〃	Frame error (R)
〃	15	〃	Checksum error (R)
08	00	**EEPR** (EEPROM, Flash)	Checksum error
〃	01	〃	Calibration error
〃	08	〃	CPU r/w error
〃	09	〃	Log r/w error
〃	10	〃	ADC r/w error
〃	11	〃	I/O r/w error
〃	12	〃	CON r/w error (R)
09	00	**HARA** (HART, USB, IO-Link)	Preamble error
〃	01	〃	Frame error
〃	02	〃	Too few chars
〃	03	〃	Checksum error
〃	08	〃	Timeout error (IOL)
〃	09	〃	Overflow error (IOL)
〃	10	〃	Checksum error (IOL)
10	00	**HARB** (〃)	RC2 Invalid selection
〃	01	〃	RC3 Passed parameter too large
〃	02	〃	RC4 Passed parameter too small
〃	03	〃	RC5 Too few data bytes received
〃	04	〃	RC6 Device specific command error
〃	05	〃	RC7 In write protect mode
〃	06	〃	RC16 Access restricted
〃	07	〃	RC18 Invalid units code
〃	08	〃	RC32 Device is busy
〃	09	〃	RC64 Command not implemented
〃	10	〃	RCxx Other single definition response code
〃	11	〃	RCxx Command-specific response code
11	00	**SYSA** (System)	WD reset
〃	01	〃	Invalid reset
〃	02	〃	Stack error
〃	03	〃	Hard fault

〃	07	〃	Fuse blow error
〃	08	〃	AVDD error
〃	09	〃	IOVDD error
〃	10	〃	ALDO error
〃	11	〃	DLDO error
〃	12	〃	20mV error
〃	14	〃	V6V error
〃	15	〃	V24V error
12	00	**SYSB** (〃)	WD reset (R)
〃	01	〃	Invalid reset (R)
〃	02	〃	Stack error (R)
〃	03	〃	Hard fault (R)
〃	08	〃	V24V error (R)
〃	09	〃	Vana error (R)
〃	10	〃	Vdig error (R)
〃	11	〃	I error (R)
〃	12	〃	Fuse blow error (R)
〃	13	〃	Vcc error (R,IOL)
〃	14	〃	Vdd error (R,IOL)

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