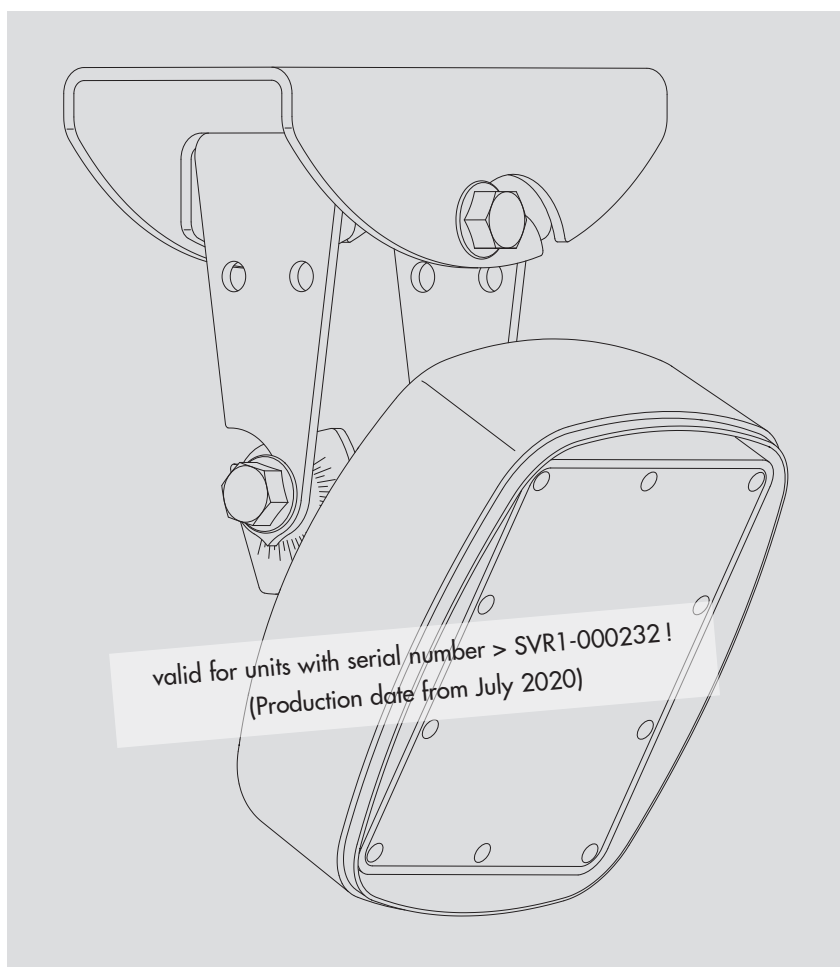


Operating Instructions

Surface Velocity Radar

OTT SVR 100



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1 Scope of supply

- ▶ **OTT SVR 100**
 - Radar sensor for contactless measurement of the surface velocity of a flowing waterway; with SDI-12-, RS-232- and RS-485-interface (SDI-12- or Modbus protocol)
 - Installation accessory kit (two-piece swivel mount, consisting of device and wall brackets, and four M8 hexagon bolts)
 - Connecting cable, 10 m; with 12-pin angled connector
 - Quick guide
 - Acceptance test certificate (FAT)

2 Order numbers

- ▶ **OTT SVR 100** **OTT SVR 100 radar sensor**
 - RS-485-interface with SDI-12-protocol*
 - Version EU (CE marking) 63.151.003.9.0
 - Version USA/Canada (FCC/IC certification) 63.151.004.9.0
- ▶ **Accessories** **OTT USB/SDI-12 interface** 65.050.001.9.2
 - for temporary connection of OTT sensors to a PC using an SDI-12 or RS-485-interface
 - including USB connecting lead; USB A to USB B connector; 3 m
- RS-232 connecting lead** 97.120.371.4.2
 - 1.5 metres, 9-pin Sub-D socket/ open cable end (5 wires)
- RS-232/USB interface adapter** 97.961.168.9.5
- OTT SVR 100 Operating Program**
 - PC Software for
 - Setting the OTT SVR 100 operating parameters (protocol on RS-485 interface)
 - Updating the OTT SVR 100 firmware
 - Continuous measurement and representation of graphs
 - User interface language: English
 - Download setup file from "www.ott.com/resources"
- Operating instructions**
 - Format DIN A4, 32 pages; supplementary information to quick guide (included in scope of supply)
 - German 63.151.001.B.D
 - English 63.151.001.B.E
 - French 63.151.001.B.F
 - Spanish 63.151.001.B.S

* preset

3 Basic safety instructions

3.1 Explanation of safety information used

The safety information used in these operating instructions is classified according to the nature and severity of a particular hazard. The hazard levels defined are indicated by the signal words **Warning/Caution** and associated pictograms **orange/yellow warning triangle** in these operating instructions:

WARNING



Warning of a hazardous situation with a medium level of risk

The safety information specifies the nature and source of the hazard. If you fail to carry out the specified actions, the hazardous situation can result in **death** or **serious injuries**.

- ▶ Action to prevent the hazardous situation!
- ▶ Action to prevent the hazardous situation!

CAUTION



Warning of a hazardous situation with a lower level of risk

The safety information specifies the nature and source of the hazard. If you fail to carry out the specified actions, the hazardous situation can result in **minor** or **moderately severe injuries**.

- ▶ Action to prevent the hazardous situation!
- ▶ Action to prevent the hazardous situation!

3.2 Note the following for safe and trouble-free operation

- ▶ Before commissioning the OTT SVR 100, read these operating instructions and the quick guide enclosed with the device. Ensure you are very familiar with how to install and operate the OTT SVR 100. Retain these operating instructions for subsequent reference
- ▶ The OTT SVR 100 is used for contactless measurement of the surface velocity of a flowing waterway. Only use the OTT SVR 100 as described in these operating instructions. For further information → see Chapter 4, *Introduction*.
- ▶ Observe all detailed safety instructions provided for the individual work steps.
- ▶ Never use the OTT SVR 100 in potentially explosive areas.
For further information → see Chapter 5, *Installing the OTT SVR 100*
- ▶ Note that the OTT SVR 100 may only be installed by specialist personnel (e.g. qualified electrician).
For further information → see Chapter 5, *Installing the OTT SVR 100*
- ▶ Make sure that the electrical, mechanical and climatic specifications set out in the technical data are complied with!
For further information → see Chapter 11, *Technical Data*.
- ▶ Do not make any changes or modifications to the OTT SVR 100. Changes or modifications void all warranty entitlements. In addition, the radio approval necessary for operation is invalidated!
- ▶ Only have a defective OTT SVR 100 inspected and repaired by our repair centre. Never repair it yourself!
For further information → see Chapter 8, *Repair*.
- ▶ After decommissioning, dispose of the OTT SVR 100 properly. Never dispose of the OTT SVR 100 with normal household waste.
For further information → see Chapter 10, *Instructions for disposal of used devices*.



Special note on the use of the OTT SVR 100 within the US State of California:
WARNING: This product can expose you to chemicals including lead, which is known to the State of California to cause cancer or birth defects or other reproductive harm. For more information, go to www.P65Warnings.ca.gov.

Federal Communications Commission (FCC) Approval

This equipment has been tested and found to comply with the limits for a class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- ▶ Reorient or relocate the receiving antenna
- ▶ Increase the separation between the equipment and receiver
- ▶ Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- ▶ Consult the dealer or an experienced radio/TV technician for help

This equipment has been verified to comply with the limits for a class B computing device, pursuant to FCC Rules. In order to maintain compliance with FCC regulations, shielded cables must be used with this equipment. Operation with non-approved equipment or unshielded cables is likely to result in interference to radio and TV reception. The user is cautioned that changes and modifications made to the equipment without the approval of manufacturer could void the user's authority to operate this equipment.

ISED/Canada Statement

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

- ▶ This device may not cause interference.
- ▶ This device must accept any interference, including interference that may cause undesired operation of the device.

RADIATION EXPOSURE STATEMENT

The device meets the exemption from the routine evaluation limits in section 2.5 of RSS 102. This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and users.

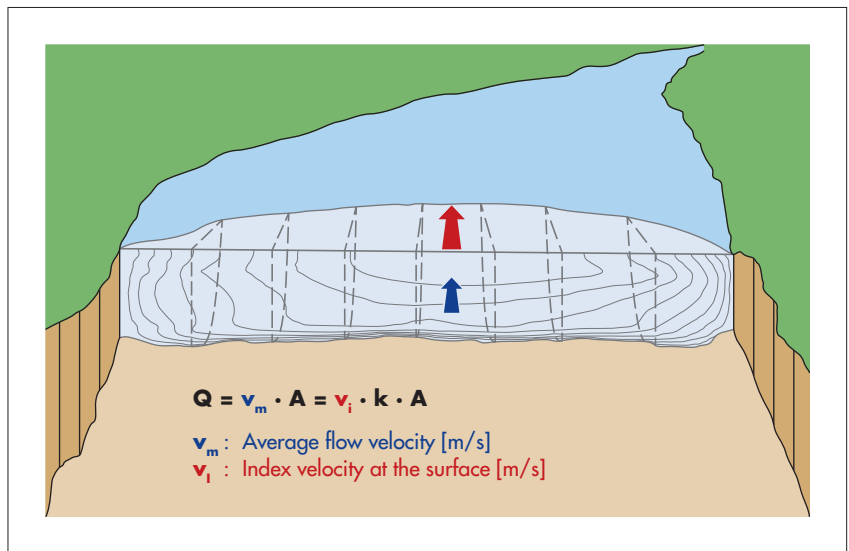
4 Introduction

The OTT SVR 100 radar sensor is used for continuous contactless measurement of the surface velocity of a flowing waterway (= index velocity).

A connected data logger can use this index velocity (preferably measured in the area of the maximum velocity) to calculate the flow using the "velocity index method". The water level that is also required for this calculation can be determined using any water level sensor (e.g. pressure probe or OTT RLS radar level sensor). To obtain accurate flow values, the entire measuring system must be calibrated during commissioning, e.g. using the "OTT Prodis 2" software.

Fig. 1: Schematic representation of the velocity index method.

Q : Flow [m^3/s]
 A : Cross-sectional area [m^2]
 k : Correction factor [1]



The functional principle of the OTT SVR 100 is based on the physical Doppler effect. A transmission aerial emits radar pulses with a typical frequency of 24.2 GHz (Version USA/Canada: 24.125 GHz) at a nominal angle of 45 degrees to the horizontal. The alignment must be parallel, and ideally against the main flow direction of the waterway. If the water surface is moving and has a minimum roughness, the radar pulses are reflected with a slight frequency shift and are received by a reception aerial on the OTT SVR 100. From the frequency shift, the radar sensor uses a trigonometric function to calculate the average flow velocity within the radar footprint projected onto the water surface. The exact tilt angle necessary for the calculation is provided by an integrated tilt sensor.

In addition, a vibration sensor transmits a specific vibration index for every measured velocity value. This index indicates whether measured values have potentially been impaired by vibration of the device. For example, vibrations can be caused by traffic on bridges or the influence of wind on the cantilever arms.

To connect the OTT SVR 100 data loggers or peripherals, one physical SDI-12 and one RS-485 interface each is available. With the RS-485-interface, communication with the radar sensor is via the SDI-12 or Modbus transmission protocol¹⁾. In addition, the OTT SVR 100 has an RS-232 interface for service purposes (e.g. firmware updates).

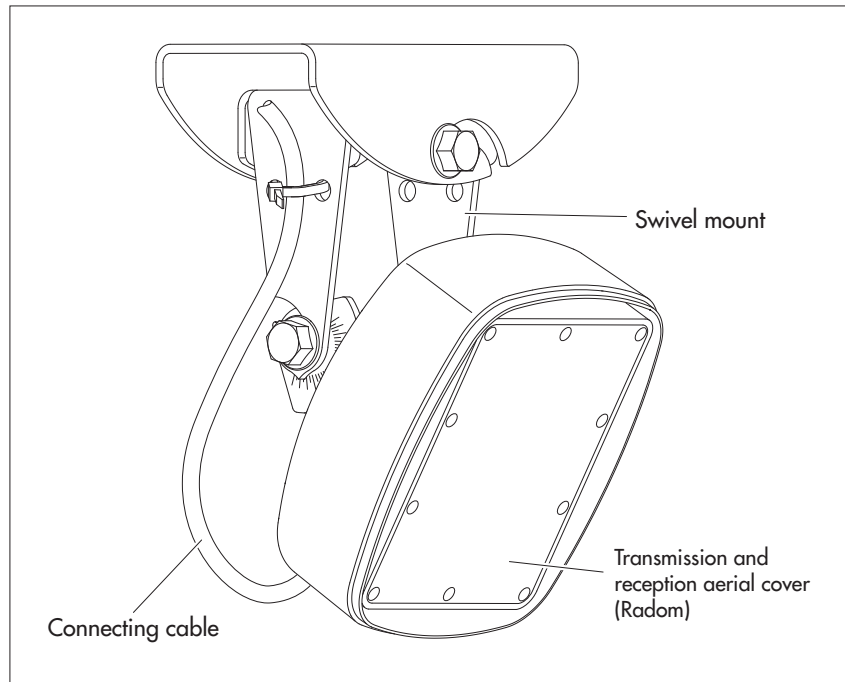
The radar sensor can be configured using SDI-12 transparent mode on a data logger or via the OTT USB/SDI-12 interface (accessory), or alternatively via the RS-232 interface using special service software.

¹⁾ set using the "OTT SVR 100 Operating Program"; see Appendix D

The transmission aerial has a horizontal opening angle of 12° and the vertical opening angle is 24° . The resulting sensor radar footprint can be found in the example applications in Figures 3 and 4 and the table in Chapter 5.1.

A swivel mount allows easy, problem-free installation, even on unsuitable surfaces. The electrical connection is via a factory-assembled 12-pin angled connector and a mounting socket.

Fig. 2: OTT SVR radar sensor overview.



The cable length between the radar sensor and the data logger can be up to 500 metres (depending on the wire cross-section used).

The entire radar sensor – provided it is installed as described in these operating instructions – has a flood-proof design.

Fig. 3: Example application 1: OTT SVR 100 installed on a bridge.

The projection of the radar footprint on the water surface is elliptical.

In the example shown, the water level is determined using a pressure probe.

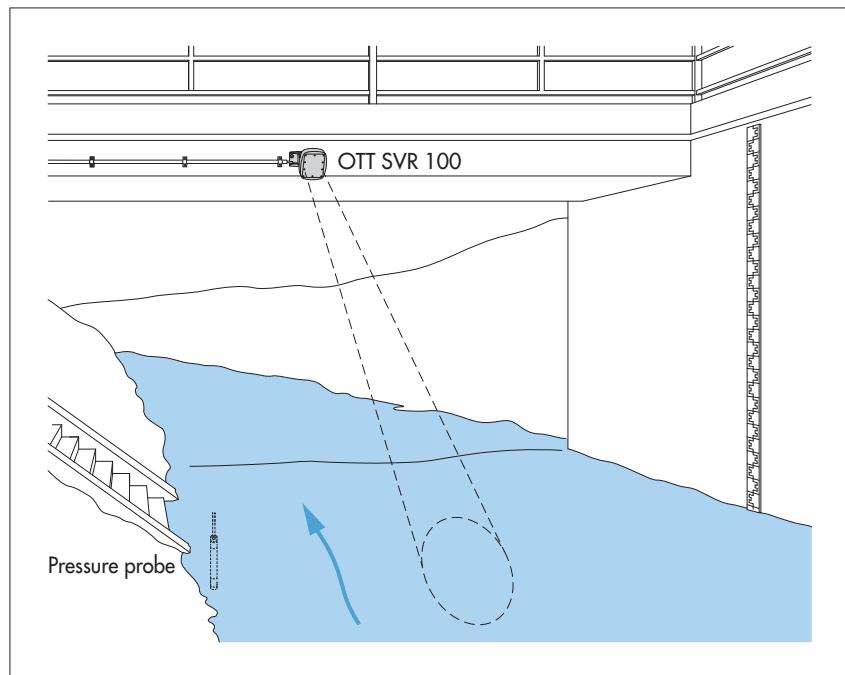
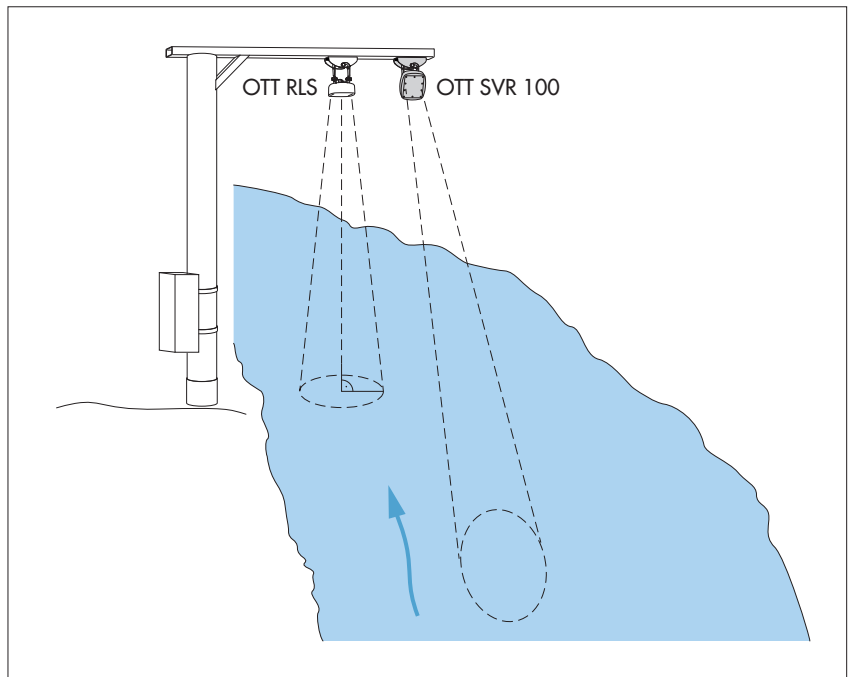


Fig. 4: Example application 2:
OTT SVR 100 installed on an auxiliary
structure, e.g. a cantilever arm.

The projection of the OTT SVR 100 radar
footprint on the water surface is elliptical.

In the example shown here, the water level
is determined using a contactless OTT RLS
radar sensor.



5 Installing the OTT SVR 100

WARNING



Risk of explosion due to spark formation and electrostatic charge

If the OTT SVR 100 is operated in an explosive atmosphere, there is a risk of the atmosphere igniting. This can cause an explosion involving a risk of very severe injury and damage.

- ▶ **Never** operate the OTT SVR 100 in potentially explosive areas (e.g. waste water channels). The OTT SVR 100 does not have EX protection (explosion protection)!

Please note:

- ▶ The electrical installation of the OTT SVR 100 may only be carried out by specialist personnel (e.g. qualified electrician)!

5.1 Criteria for selecting a suitable installation location

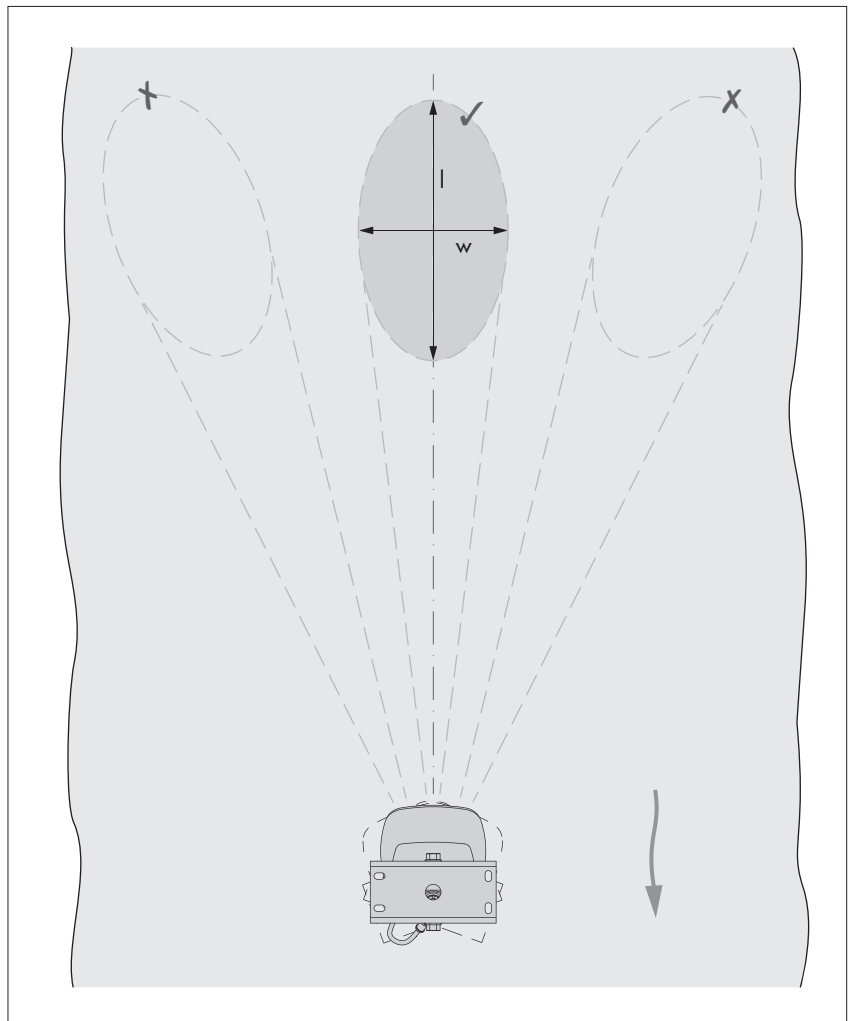
- ▶ Possible installation locations include bridge structures, pontoons or auxiliary constructions that are located directly above the section of waterway to be measured.
- ▶ The minimum distance between the lower edge of the sensor and the water surface must be 0.5 m (dead zone within which no usable measurement can be obtained).
- ▶ Select an installation point that is sufficiently high to allow measurement even at high water.
- ▶ The installation point must be stable and free of vibration; vibrations and movement of the installation point are to be avoided (traffic on bridge structures or influence of wind on cantilever arms impair the measured result). Bridges are subject to movements of up to several centimetres due to changes of load and temperature fluctuations. Installation on or in the immediate vicinity of bridge piers is not recommended. Bridge piers influence the flow velocity and normally cause back-water zones and turbulence.
- ▶ Around the sensor radar footprint, the water surface should have a minimum roughness of 1 mm. Avoid macro turbulences, locations with foam, swells and sections of waterway where obstructions or bridge piers cause changes in the water level.
- ▶ Wind influence on the water surface impairs the measured result.
- ▶ Select an installation location that does not dry out at low water.
- ▶ The sensor radar footprint (see Figures 3 and 4) must be completely free of obstructions.
- ▶ There may not be any inflows, outlets, weirs, ground sills or other obstructions in front of the measuring point; optimum minimum distance: $10 \times \text{waterway width at measuring point}$!
- ▶ As far as possible, the flow direction should be straight, parallel to the bank and free of irregular speed distributions.
 - Rule of thumb: the flow direction is considered **parallel** to the bank if the water runs straight over a length of $5 \dots 10 \times W^*$.
 - Recommended: **straight** waterway for $2 \times W^*$ upstream of the measuring point and $1 \times W^*$ downstream of the measuring point.
- * W = width of watercourse at the measuring point
- ▶ The bottom of the waterway and the measuring point cross-section must be as stable as possible. Large stones in the measuring cross-section should be avoided, as should vegetation in the waterway. Vegetation on the bank can lead to incorrect measurements, particularly if it is close to the sensor radar footprint.

- An optimum measuring point has a uniformly shaped cross-section with an even velocity distribution and a stable position of the maximum surface velocity.
- Avoid large metallic surfaces close to the sensor radar footprint (reflections from these surfaces can falsify the measured result).
- Table for determining the approximate size of the sensor radar footprint:

Height "h" [m]	Distance "a" [m]	Tilt angle 30° l x w [m]	Distance "a" [m]	Tilt angle 45° l x w [m]
1.0	1.7	2.0 x 0.4	1.0	0.9 x 0.3
2.0	3.5	3.9 x 0.8	2.0	1.8 x 0.6
3.0	5.2	5.9 x 1.3	3.0	2.7 x 0.9
4.0	6.9	7.9 x 1.7	4.0	3.6 x 1.2
5.0	8.7	9.8 x 2.1	5.0	4.5 x 1.5
7.5	13.0	14.8 x 3.2	7.5	6.7 x 2.2
10.0	17.3	19.7 x 4.2	10.0	8.9 x 3.0
12.5	21.7	24.6 x 5.3	12.5	11.1 x 3.7
15.0	26.0	29.5 x 6.3	15.0	13.4 x 4.5
17.5	30.3	34.4 x 7.4	17.5	15.6 x 5.2
20.0	34.6	39.3 x 8.4	20.0	17.8 x 5.9
22.5	39.0	44.3 x 9.5	22.5	20.0 x 6.7
25.0	43.3	49.2 x 10.5	25.0	22.3 x 7.4

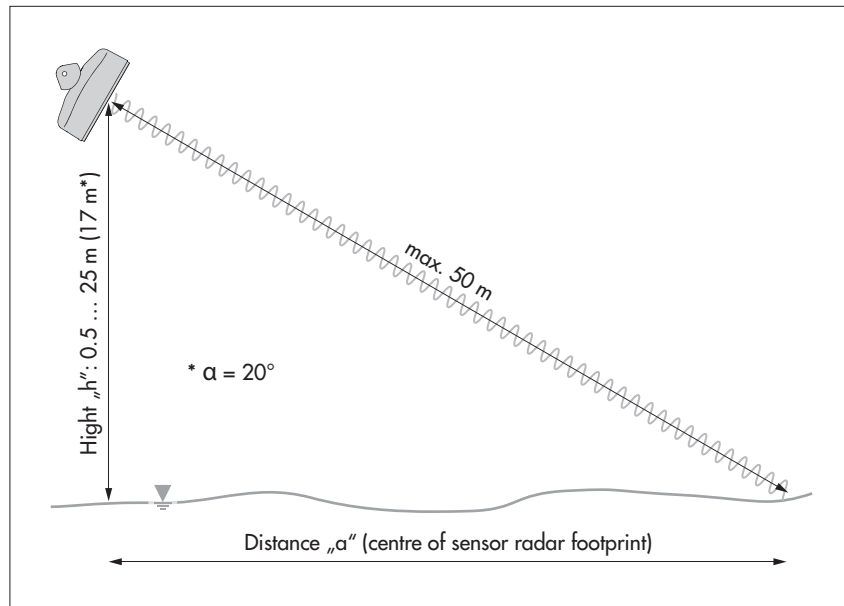
For definitions of height "h" distance "a", "l" and "w", see Figures 6 and 7.
The specified figures are minimum dimensions. Where possible, select a significantly larger obstruction-free area.

Fig. 6: Optimum alignment of sensor radar footprint with waterway flow direction and dimensions of radar footprint.



- Wave height measurement using the OTT SVR 100 is not possible.
- The OTT SVR 100 and OTT RLS can be combined at a single measuring point with no problems as they do not influence one another. Likewise, multiple OTT SVR 100s can be used in parallel on very wide flowing waterways.

Fig. 7: Maximum distances of OTT SVR 100 to water surface.



5.2 Information on supply voltage

The OTT SVR 100 requires a supply voltage of 9 ... 27 V DC, typically 12/24 V_{DC} (e.g. from battery or mains connection with electrically isolated safety extra low voltage).

The OTT SVR 100 is ready to use as soon as the supply voltage is connected. The first valid measured values are available around 30 seconds later.

Please note:

- When using solar panels, we recommend using a surge protector.

5.3 Compatible cable types

RS-485

The connecting cable with angled connector supplied (length: 10 metres) can be extended to a maximum of 500 m. Recommended cable type: Twisted pair cable, unshielded design. However, the wires intended for the supply voltage do not have to be a twisted pair.

The maximum cable length depends on the wire cross-section used:

Connecting cable	for typical. 12 V _{DC}	for typical. 24 V _{DC}
– 2 x 2 x 0.50 mm ²	≤ 150 metres	≤ 250 metres
– 2 x 2 x 0.75 mm ²	≤ 250 metres	≤ 500 metres

SDI-12

The factory supplied connection cable with angled connector (length: 10 metres) can be extended to a maximum of 65 metres! Recommended cable type: any low-voltage cable; wire cross-section: 4 x 0.50 mm².

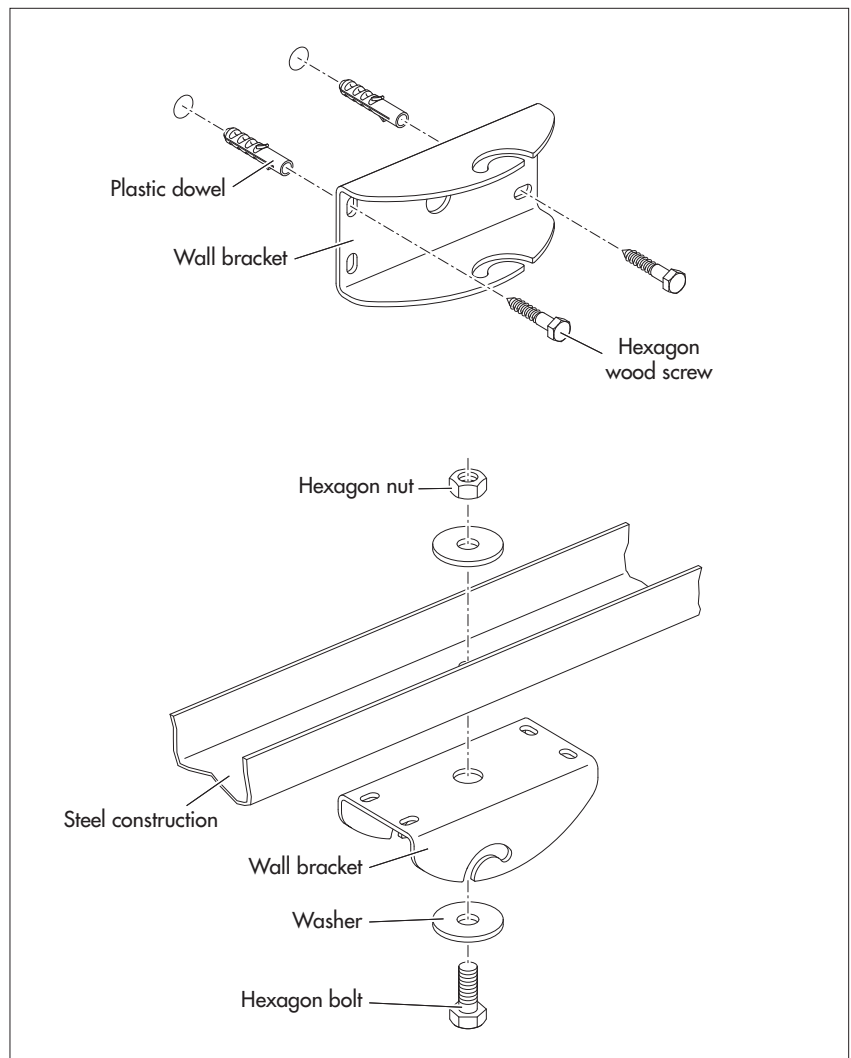
5.4 Installing the OTT SVR 100

Attaching the swivel mount (see also Appendix B)

- Surface: Concrete or brickwork
- Attachment material: e.g. hexagonal wood screws M6 x 40 + plastic dowels
- Make two holes (Ø 8 mm) using a hammer drill (use the wall bracket for marking the holes).
- Insert the plastic dowels into the drill holes.
- Attach the wall bracket with hexagonal wood screws.
- Mount the housing bracket (without sensor) in the wall bracket and slightly tighten the hexagon bolts **A** (see Fig.10).
- Surface: any steel construction, e.g. cantilever arm
- Attachment material: e.g. hexagon bolt M12 x 25 + hexagon nut M12 + washers
- Make a hole (Ø 13 mm) in the steel construction.
- Attach the wall bracket using a hexagon bolt, washers and hexagon nut.
- Mount the housing bracket (without sensor) in the wall bracket and slightly tighten the hexagon bolts **A** (see Fig.10).

Fig. 8: Attaching the swivel mount (wall bracket).

Both attachment types are intended as examples and are possible for either wall or ceiling installation.

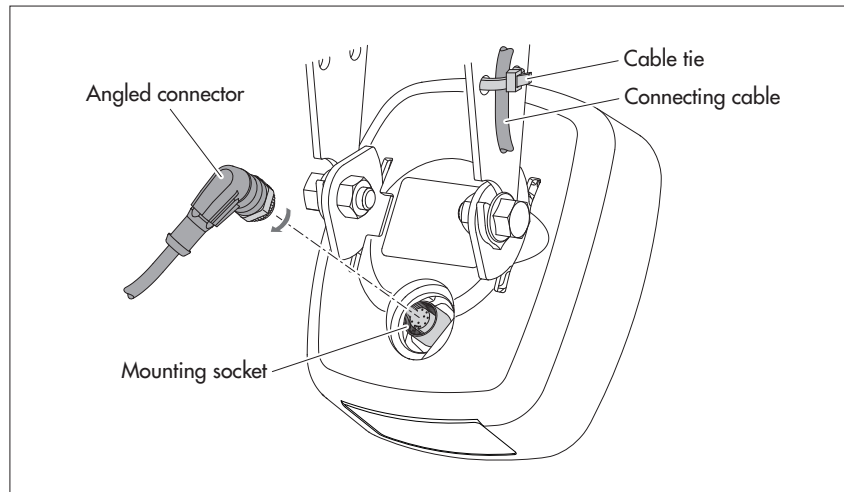


Connecting the cable with angled connector

Please note: No moisture may get into the angled connector/the mounting socket. Protect the OTT SVR 100 from precipitation during installation. Ingress of moisture can lead to malfunctions and corrosion.

- Align the angled connector in the correct position (observe keying nose) and fit on the mounting socket.
- Where possible, tighten the union nut by hand if using a fork wrench. Tightening torque max. 2 Nm. The union nut engages when tightened.
- Run the connecting cable upwards in a loop and secure on the housing bracket with a cable tie (strain relief).

Fig. 9: Connecting the angled connector of the connecting cable on the OTT SVR 100.



Attaching the radar sensor

- Mount the sensor in the housing bracket and slightly tighten the hexagon bolts B (see Fig. 10).
- Adjust the sensor tilt angle to the horizontal:
 - Recommended: 45°
 - Minimum/maximum: 20°/60°
- Carefully tighten the hexagon bolts B (housing shell) (see Figure 10).
- Align the sensor axis with the flow direction (see Figure 6).
- Carefully tighten the hexagon bolts A (wall/housing bracket) (see Figure 10).
- Check the alignment of the OTT SVR 100 again!

Fig. 10: OTT SVR 100 – Installation
of swivel mount.

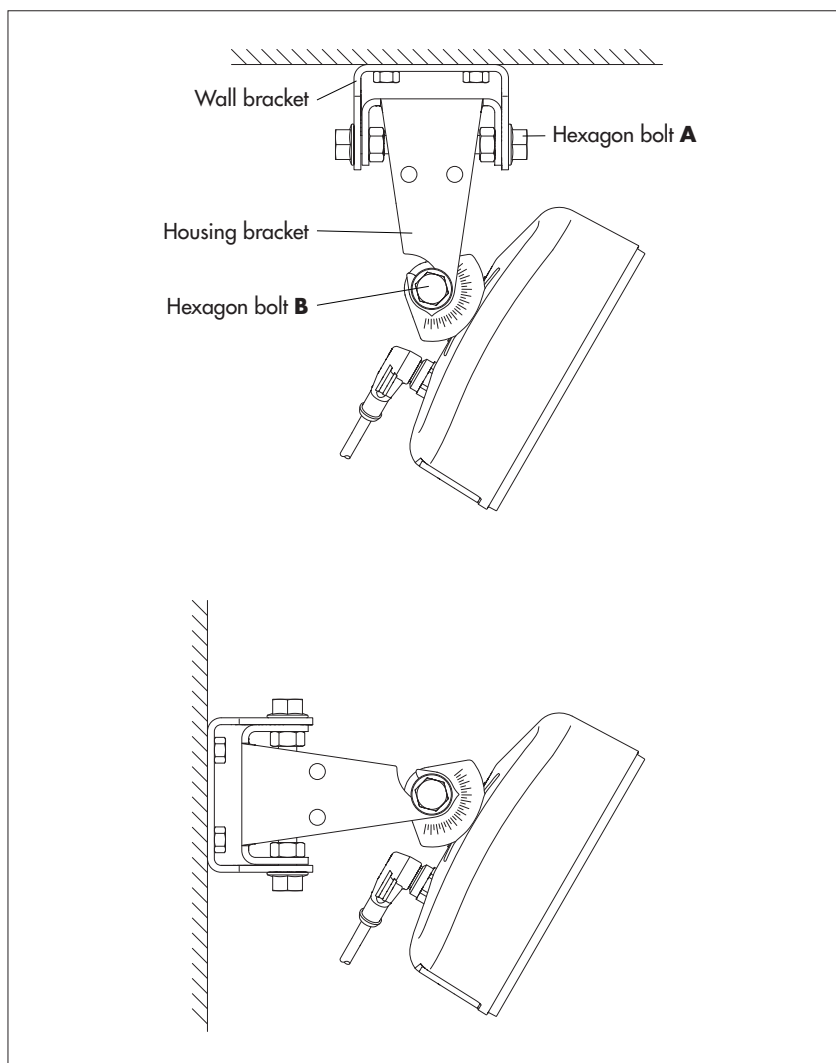
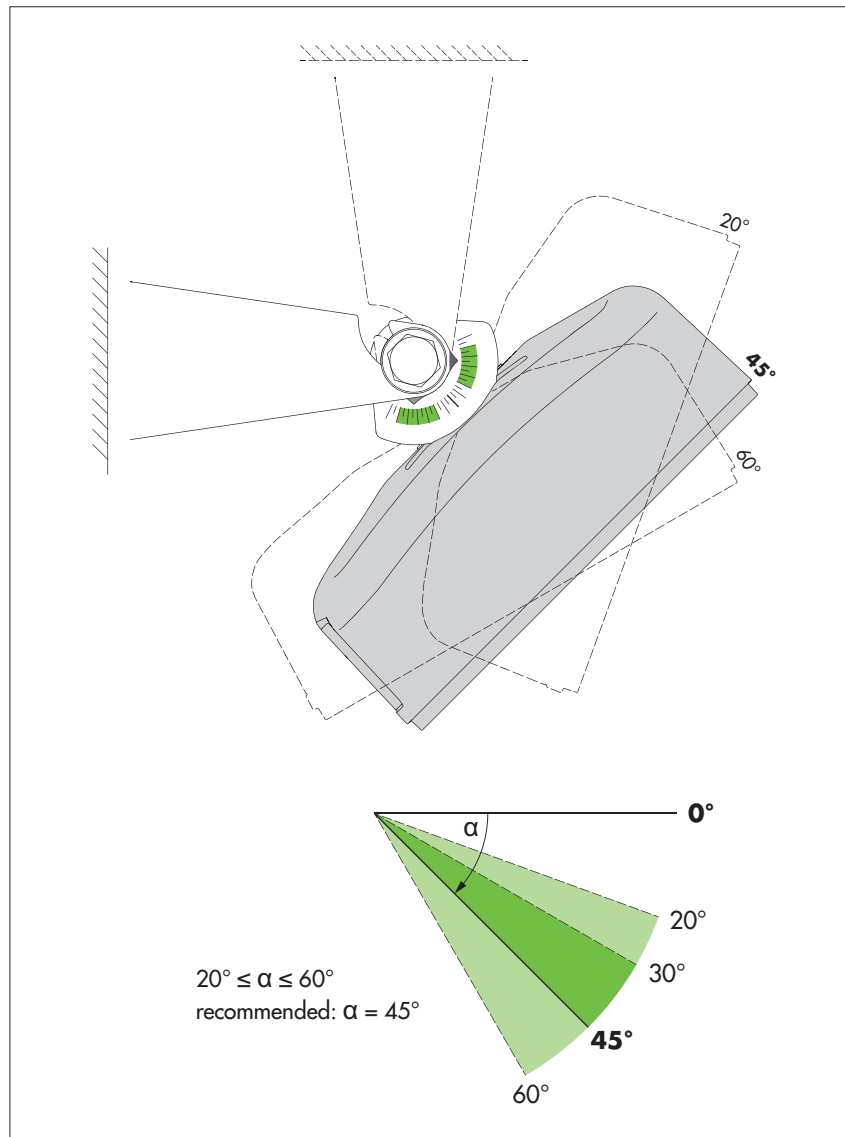


Fig. 11: Adjusting the sensor tilt angle (α) on the OTT SVR 100.

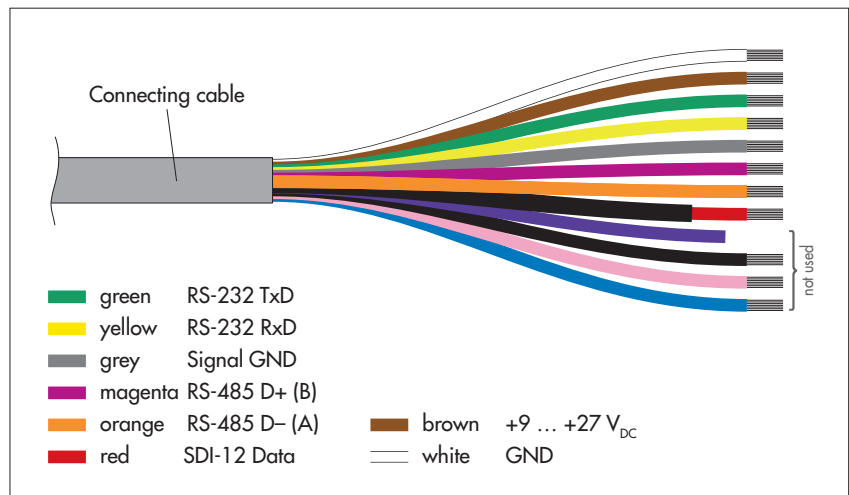


5.5 Connecting the OTT SVR 100 to the data logger

- Connect the OTT SVR 100 to an SDI-12 or RS-485 input on the data logger. Refer to the data logger manual for more details. Refer to Figure 12 for the OTT SVR 100 terminal assignment. The maximum cable length is 65 metres (SDI-12) or 500 metres (RS-485). Recommended wire cross-section: see Chapter 5.3.
- Insulate all unconnected wires from each other (shrink sleeving, insulated terminals)! Otherwise there is a risk of malfunction.

The SDI-12 commands that can be used with the OTT SVR 100 can be found in Chapter 6, SDI-12-commands and responses.

Fig. 12: Wire assignment in connecting cable (12-wire).
The RS-232 interface is provided for service purposes.
The red wire is provided with a black shrink sleeving for easy identification.



5.6 Information on using the RS-485 interface

The RS-485 interface with SDI-12 protocol is designed and tested for use with OTT and Sutron data loggers. For details of connecting the OTT SVR 100 to OTT netDL via the RS-485 interface → see Appendix A.

OTT is unable to guarantee proper functioning if you connect the OTT SVR 100 to a data logger from a third-party manufacturer via the RS-485 interface with SDI-12 protocol!

6 SDI-12-commands and responses

The OTT SVR 100 communicates using the physical SDI-12 interface or the RS-485 interface via the SDI-12 transfer protocol. In this technical documentation, you will find a detailed description of the SDI-12 commands implemented in the SDI-12 transfer protocol.

Further information on the SDI-12 standard can be found in the document "SDI-12; A Serial-Digital Interface Standard for Microprocessor-Based Sensors; Version 1.3" (see website "www.sdi-12.org").

All advanced, manufacturer-specific SDI-12 commands on the OTT SVR 100 begin with "O" for OTT. With these commands it is possible to configure the OTT SVR 100, for example using the "SDI-12 transparent mode" on a data logger or with the OTT USB/SDI-12 interface (accessory).

Conventions for measured value formats

- p – Sign (+,-)
- b – Figure (before the decimal point)
- e – Figure (after the decimal point)
- ! – Ends a command

6.1 Overview of standard SDI-12 commands

- ▶ a! Acknowledgement active
- ▶ aI! Send identification
- ▶ aAb! Change sensor address
- ▶ ?! Query sensor address; factory setting: 0
- ▶ aM! Start measurement
- ▶ aD0! Send data
- ▶ aD1! Send data (SNR-value; signal-to-noise ratio)
- ▶ aR0! Continuous measurement
- ▶ aR1! Continuous measurement (SNR-value; signal-to-noise ratio)
- ▶ aMC! Start measurement and request CRC (Cyclic Redundancy Check)
- ▶ aC! Start concurrent measurement (simultaneous measurement with multiple sensors on one bus line)
- ▶ aCC! Start concurrent measurement and request CRC
- ▶ aV! Start system test

Advanced commands (manufacturer specific)

- ▶ aOAA<value>! Set internal filter type
aOAA! Read internal filter type
 Factory setting: 1 → Floating mean
- ▶ aOAB<value>! Set measuring sensitivity
aOAB! Read measuring sensitivity
 Factory setting: 14
- ▶ aOAC<value>! Set filter length
aOAC! Read filter length
 Factory setting: 1 → internal filter deactivated
- ▶ aOSD<value>! Set flow direction filter
aOSD Read flow direction filter
 Factory setting: 0 → Flow direction filter deactivated; both flow directions are recorded
- ▶ aOSU<value>! Set unit for "flow velocity" measured values
aOSU Read unit for "flow velocity" measured values
 Factory setting: 0 → m/s

6.2 Standard commands

Command	Response	Description
a!	a<CR><LF>	Acknowledgement active a – Sensor address; factory setting = 0
aI!	allccccccmmmmmm... ...vvvxxxxxx<CR><LF>	Send identification a – Sensor address 11 – SDI-12-protocol version ccccccc – Manufacturer identification (company name) mmmmmm – Sensor designation vvv – Sensor version (here firmware version) xxxxxxx – Additional designation (here serial number) OTT SVR 100 response = 013OTT SVR100485xxxxxx
aAb!	b<CR><LF>	Change sensor address a – Old sensor address b – New sensor address
?!	a<CR><LF>	Query sensor address a – Sensor address
aM!	atttn<CR><LF>	Start measurement a – Sensor address ttt – Time in seconds until sensor has determined measured result OTT SVR 100 response = XXX seconds The individual response time depends on the type and filter length of the internal filter; minimum: 015 s n – Number of measured values OTT SVR 100 response = 6
aD!	a<value1><value2><value3> <value4><value5><CR><LF>	Send data (after aM!) a – Sensor address <value1> – Average flow velocity (floating mean over approx. 30 seconds) Measured value format: pb.eeee ... pbb.eee [m/s] ¹⁾ pb.bbbb ... pbbbb.e [cm/s] ¹⁾ pb.bbbb ... pbb.eee [ft/s] ¹⁾ <value2> – Current flow velocity: Measured value format: pb.eeee ... pbb.eee [m/s] ¹⁾ pb.bbbb ... pbbbb.e [cm/s] ¹⁾ pb.bbbb ... pbb.eee [ft/s] ¹⁾ <value3> – Sensor tilt angle to horizontal Measured value format: +bbb [°] <value4> – Signal quality index Measured value format: +00b [1] +000 = Excellent signal quality (SNR > 6) +001 = Good signal quality (3 < SNR ≤ 6) +002 = Poor signal quality (0 < SNR ≤ 3) → impaired measured values +003 = Very poor signal quality (SNR = 0) → unacceptable measured values <value5> – Vibration index Measured value format: +00b [1] +000 = No device vibration +001 = Slight device vibration +002 = Significant device vibration → impaired measured values +003 = Very significant device vibration; → unacceptable measured values

¹⁾ depending on the set unit (advanced command aOSU<value>!)

²⁾ negative sign: flowing away from the sensor; positive sign: flowing towards the sensor

Command	Response	Description
aD1!	a<value6><CR><LF>	Send data (after aM!) a – Sensor address <value6> – SNR (signal-to-noise ratio) Measured value format: +bbb [dBm] The SNR is a measure of the quality of a desired signal that is superimposed by an interfering signal. It is defined as the logarithmic ratio of the average power of the desired signal to the average noise power of the interfering signal. For reliable measurement results, the SNR should be greater than 3 dBm; see also "Signal quality index".
aR0!	a<value1><value2><value3> <value4><value5><CR><LF>	The OTT SVR 100 continuously measures the flow velocity This command enables measured results to be obtained even without the aM! / aD0! command combination; for details see aD0! command.
aR1!	a<value6><CR><LF>	The OTT SVR 100 continuously measures the signal-to-noise ratio. With this command it is possible to retrieve measurement results without the command combination aM! / aD1!; for details see command aD1!.
aMC!	atttn<CR><LF>	Start measurement and request CRC (Cyclic Redundancy Check); for details see aM! command. The response to the subsequent aD0! command is extended with a CRC value: a<value1><value2><value3> <value4><value5><CRC><CR><LF>
aC!	atttnn<CR><LF>	Start measurement and request CRC (Cyclic Redundancy Check); for details see aM! command. The number of measured values in the response to this command has two digits: nn = 06.
aCC!	atttnn<CR><LF>	Start concurrent measurement (simultaneous measurement with multiple sensors on one bus line) and request CRC (Cyclic Redundancy Check); for details see aM!. The number of measured values in the response to this command has two digits: nn = 06. The response to the subsequent aD0! command is extended with a CRC value: a<value1><value2><value3> <value4><value5><CRC><CR><LF>
aV!	atttn<CR><LF>	Perform system test a – Sensor address ttt – Time in seconds until the sensor provides the result of the system test OTT SVR 100 response = 000 n – Number of measured values OTT SVR 100 response = 2
aD0!	a<value1><value2><CR><LF>	Send data (after aV!) a – Sensor address <value1> – Result of system test: Firmware ... +0 = Internal error occurred +1 = Firmware working properly <value2> – Result of system test: Internal sensors ... +0 = are (partially) inactive +1 = are all active

6.3 Advanced SDI-12 commands

Command	Response	Description
► Set/read internal filter type		
aOAA<value>!	a<value><CR><LF>	Set internal filter type
aOAA!	a<value><CR><LF>Calculation	Read internal filter type
		a – Sensor address
		<value> – 0 = IIR filter (Infinite Impulse Response filter)
		1 = Floating mean
		Factory setting: 1
		The OTT SVR 100 determines approx. 10 individual measured values for the flow velocity per second. Depending on factors such as the roughness of the water surface, wind influence, precipitation or turbulence, the individual measured values can be very scattered. The internal filter allows them to be "smoothed". In principle, both filter types lead to very similar results, but the IIR filter responds faster if there are significant changes in flow velocity. When using the floating mean, you can specify the number of individual measured values (aOAC<value>!command). This filter works totally independently of the "average flow velocity" (value 1 in the response to the aD0!command)
		IIR filter calculation:
		$v_{\text{filtered}}(t) = v_{\text{current}}(t) * Q + v_{\text{filtered}}(t - 1) * (1 - Q) \quad Q = 1/3$
► Set/read measuring sensitivity		
aOAB<value>!	a<value><CR><LF>	Set measuring sensitivity
aOAB!	a<value><CR><LF>	Read measuring sensitivity
		a – Sensor address
		<value> – bb
		Input/output without leading zeroes
		Value range: 1 ... 100
		Factory setting: 45
		You can use this command to set the sensitivity of the radar sensor. The advantage of a high sensitivity (low value) is that measurements can be taken on very smooth water surfaces. On the other hand, there is a risk that unwanted effects will also be recorded, for example movement of vegetation on the bank.
		For normal applications, you should not change the factory setting.
► Set/read internal filter length (filter type: floating mean)		
aOAC<value>!	a<value><CR><LF>	Set filter length
aOAC!	a<value><CR><LF>	Read filter length
		a – Sensor address
		<value> – bbb
		Input/output without leading zeroes
		Value range: 1; 16 ... 512
		Recommended: 50 ... 200
		Factory setting: 50
		You can use this command to specify the number of individual measured values from which the internal filter calculates a floating mean (prerequisite: aOAA1!).

Command	Response	Description
		For example, a filter length of "50" leads to an internal measurement time of 5 seconds. Setting of a high filter length leads to more "smoothed" measured values; a low setting to faster visibility of speed changes in the measured value output. Recommended setting for very turbulent waters: > 200 (special case; leads to a very long internal measurement time). The setting "1" deactivates the internal filter.
► Set/read flow direction filter		
aOSD<value>!	a<value><CR><LF>	Set flow direction filter
aOSD!	a<value><CR><LF>	Read flow direction filter
		a – Sensor address <value> – 0 = Filter is deactivated → The OTT SVR 100 determines the flow velocities towards sensor (+) and away from the sensor (-). The signs of the values 1 and 2 in the response to the command aD0! show the corresponding flow direction. Factory setting 1 = Towards sensor only → the OTT SVR 100 only determines flow towards the sensor 2 = Away from sensor only → the OTT SVR 100 only determines flow away from the sensor.
Note If the filter is set to "only towards sensor"/"only away from sensor" the OTT SVR 100 outputs "0" as the current flow velocity if a counter flow occurs!		
► Set/read unit for "average flow velocity" and "current flow velocity" measured values		
aOSU<value>!	a<value><CR><LF>	Set unit
aOSU!	a<value><CR><LF>	Read unit
		a – Sensor address <value> – +0 = m/s; factory setting +1 = cm/s +2 = ft/s

7 Performing maintenance work

The OTT SVR 100 radar sensor is largely maintenance free. No adjustment or calibration work is necessary. Likewise, it has no parts that have to be cyclically replaced.

The following maintenance work should be performed at regular intervals, according to your local conditions:

- Check the OTT SVR 100 for soiling (e.g. dense, dew-covered spiders' webs or insect nests can lead to negative impairment of the measured results). If necessary, clean the sensor carefully (using standard mild and non-abrasive household cleaning agents and a soft sponge). Make sure that the swivel mount setting does not change.
- Check that the measuring section is free of obstructions (for example flotsam or overgrowing branches of trees and shrubs). Remove all obstructions.

Caution: Never open the OTT SVR 100 housing. There are no adjustments or controls inside the housing.

8 Repairs

- In the event of a device malfunction, check whether you can resolve the fault yourself using Chapter 10, Troubleshooting.
- If the device has a defect, please contact the OTT repair centre:

OTT HydroMet GmbH
Repair Centre
Ludwigstraße 16
87437 Kempten · Germany
Phone +49 831 5617-433
Fax +49 831 5617-439
repair@ott.com

Caution: Only have a defective OTT SVR 100 inspected and repaired by the OTT repair centre. Never repair it yourself. Independent repairs or attempted repairs void all warranty entitlements.

9 Information on disposal of old devices



Please note: Never dispose of the OTT SVR 100 with normal household waste!



Within the member states of the European Union

In compliance with the Electrical and Electronic Equipment Act (ElektroG; national implementation of EU Directive 2012/19/EU) OTT will take back and properly dispose of old devices in the member states of the European Union. Affected devices are indicated by the adjacent symbol.

- For further information about the return procedure, please contact your local sales contact. You will find the addresses of all sales partners in the internet on "www.ott.com". Please take into consideration also the national implementation of the EUR guideline 2002/96/EC of your country.

For all other countries

- After decommissioning, dispose of the OTT SVR 100 properly.
- Comply with the applicable regulations for disposal of electronic devices in your country.

Materials used

See Chapter 11, *Technical data*

10 Troubleshooting

Sensor not responding to SDI-12/RS-485 interface

- ▶ Sensor correctly connected to a data logger with SDI-12-input (master)?
→ Correct terminal assignment.
- ▶ Does the sensor address of the OTT SVR 100 match the sensor address used by the data logger?
→ Correct sensor address.
- ▶ Supply voltage polarity reversed?
→ Correct terminal assignment.
- ▶ Supply voltage < 9 V or > 27 V?
→ Correct supply voltage level (check length and cross section of connecting cable).
- ▶ Can the supply voltage used deliver 1 A output current?
→ Use a suitable supply voltage.
- ▶ Is the supply voltage a DC voltage?
→ Only operate the sensor with DC voltage.

Measured values are incorrect or missing

- ▶ Sensor (front panel, Radom) soiled?
→ Carefully clean sensor; see Chapter 7, *Performing maintenance work*.
- ▶ Obstructions inside or in the immediate vicinity of the radar sensor footprint?
→ Remove obstructions.
- ▶ Sensor tilt angle in permitted range (20° ... 60°)?
→ Correct tilt angle.
- ▶ Distance to measuring point in permitted range (1 ... 50 m)?
→ Optimise installation location.
- ▶ Alignment of sensor not parallel to flow direction?
→ Optimise alignment.
- ▶ Installation point of sensor not stable (e.g. continuous significant fluctuations of bridge)?
→ Optimise installation location.
- ▶ Large metallic surfaces close to the radar sensor footprint (e.g. sheet piling)?
→ Optimise installation point.
- ▶ Measuring point is not suitable for measurement of the surface flow velocity; see Chapter 5.1?
→ Change measuring point.
- ▶ Measured values are explicitly incorrect during precipitation events, with "away from sensor" alignment?
→ Change alignment to "towards sensor".
- ▶ In addition for all potential faults:
→ Check "Signal quality index", "Vibration index" and "SNR" (signal-to-noise ratio).

11 Technical Data

Measuring range	0.08 ... 15 m/s
Resolution	0.1 mm/s
Measuring accuracy	
0.08 ... 4 m/s	±2 % of measured value
4 ... 15 m/s · 13.1 ... 49.2 ft/s	±2.5 % of measured value
Measuring time	
SDI-12	depending on type and filter length of the internal filter (min.: 15 s)
Modbus	continuous measurement
Supply voltage	9 ... 27 V _{DC}
Current consumption	
active	< 90 mA at 12 V
Standby	< 7.5 mA at 12 V
maximum	< 175 mA
Transmission frequency (min./typ./max.)	
version EU (CE marking)	24.150 / 24.200 / 24.250 GHz (K-band)
version USA/Canada (FCC/IC certification)	24.075 / 24.125 / 24.175 GHz (K-band)
Transmission power	≤ 20 dBm (100 mW)
Antenna opening angle	
Azimuth (horizontal angle; 3 dB)	12°
Elevation (vertical angle; 3 dB)	24°
Distance to water surface	0.5 ... 25 m
Distance to measuring point	1 ... 50 m
Installation angle to horizontal	
Recommended	45°
Minimum/maximum	20°/60°
Serial interfaces	RS-232 RS-485, two-wire; 1200 ... 115 200 bps (9600 bps preset) SDI-12 SDI-12; SDI-12 (via RS-485); Modbus
Communication protocols	
Maximum cable length	
RS-485 interface	500 m
SDI-12 interface	65 m
Materials	
Housing	Aluminium, ASA (UV-stabilised ABS)
Radom (front panel)	TFM PTFE
Swivel mount	1.4301 (V2A)
Swivel mount swivelling range	
Transverse axis	±90 °
Longitudinal axis	±15 °
Weight	
Without swivel mount	Approx. 0.820 kg
With swivel mount	Approx. 1.530 kg
Dimensions L x W x H	134.5 mm x 114.5 mm x 80 mm (without swivel mount)
Temperature range	
Operation	-40 ... +85 °C
Storage	-40 ... +85 °C
Relative humidity	0 ... 100 %
Degree of protection	IP 68
Connecting cable	
Length	10 m (with 12-pin angled connector)
Number of wires	12

Product certifications

CE (EU)

The equipment meets the essential requirements of Radio Equipment Directive 2014/53/EU.

FCC (US)

FCC Part 15C – Statement intentional radiator:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- this device may not cause harmful interference;
- this device must accept any interference received, including interference that may cause undesired operation.

Warning: Unauthorized modification or changes to this wireless communication equipment will void the right to use it. Changes or modifications to this unit not expressly approved by the party responsible for compliance will void the user's authority to operate the equipment. Any change to the equipment will void the FCC grant.

FCC ID: 2AN9XRSS2301W

IC (CA)

Canadian Radio Interference-Causing Equipment Regulation, ICES-001:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

- this device may not cause harmful interference;
- this device must accept any interference received, including interference that may cause undesired operation.

Warning: Unauthorized modification or changes to this wireless communication equipment will void the right to use it. Changes or modifications to this unit not expressly approved by the party responsible for compliance will void the user's authority to operate the equipment. Any change to the equipment will void the Industry Canada grant.

IC: 26475-SVR100

Appendix A – Connecting the OTT SVR 100 to OTT netDL IP data logger via the SDI-12 interface or the RS-485 interface

Variant A: Connecting the OTT SVR 100 via the SDI-12 interface (protocol and physical interface: SDI-12). The maximum cable length is 65 metres!

- Connect the OTT SVR 100 to the OTT netDL IP data logger as shown in Figure A1 (left). Also refer to the OTT netDL operating manual.

Variant B: Connect the OTT SVR 100 using the physical, RS-485 interface (SDI-12 protocol via physical RS-485 interface). Refer to Chapter 5.3 for the maximum cable length and recommended wire cross-section.

- Connect the OTT SVR 100 to the OTT netDL IP data logger as shown in Figure A1 (right). Also refer to the OTT netDL operating manual.

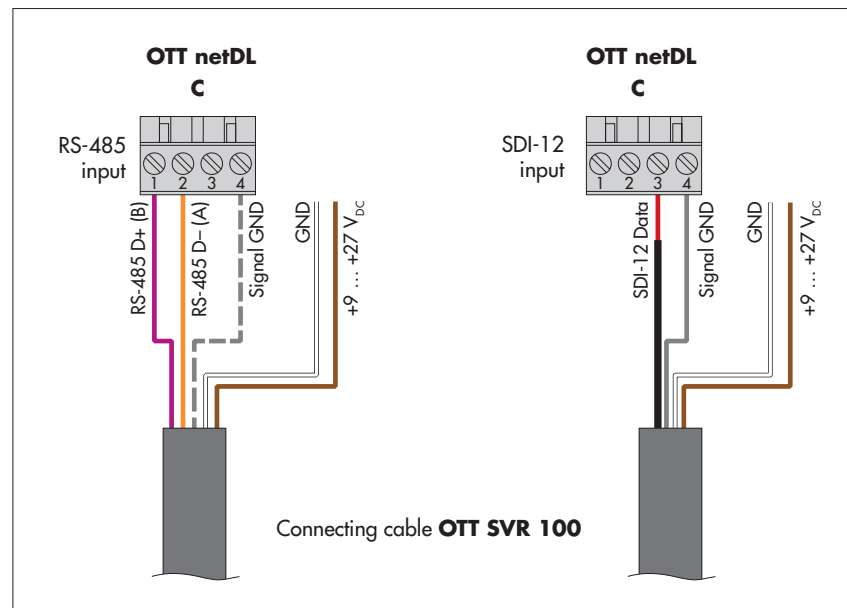
Fig. A1: Connecting OTT SVR 100 to OTT netDL via RS-485-interface (SDI-12-protocol; left) or via SDI-12 interface (right).

The letters above the screw terminal blocks indicate the possible connections on the OTT netDL.

The other (not required) wires of the connecting cable are not shown.

The red wire is provided with a black shrink sleeving for easy identification.

The dotted signal GND connection is only necessary if the OTT SVR 100 and the OTT netDL are supplied from separate power supplies.



Configuring OTT netDL for OTT SVR 100 with SDI-12 or RS-485 interface

- Connect an OTT netDL channel with SDI-12 Master or OTT SDI RS485 function block (register Serial sensors).
- Make the following settings:

Fig. A2: Set the operating parameters for the OTT netDL *SDI-12 Master* function block.

The *OTT SDI RS485* function block is set in the same way.

Value no.	Virtual Terminal ID
2	V02
3	V03
4	V04
5	V05
6	V06

- Terminal block
 - OTT netDL OTT SDI RS485: C 1-2 (preset)
 - OTT netDL SDI-12 Master: C 3-4 (preset)
 Terminal block (screw terminal block) on the OTT netDL, to which the OTT SVR 100 is connected.
- Slave address

SDI-12 bus address. Each address may only be assigned once on an SDI-12 bus line.
(For details of checking/setting, see OTT net DL operating manual, Chapter SDI-12 Transparent mode; alternatively with OTT USB/SDI-12 interface)

Factory setting on OTT SVR 100: 0
- Measured value no.

Indicates which value from the OTT SVR 100 will be recorded on this channel. Average flow velocity = 1, Current flow velocity = 2, Sensor tilt angle = 3, Signal quality index = 4, Vibration index = 5, SNR-value (signal-to-noise ratio) = 6
- Measuring mode

M! (C!); for measured values average flow velocity, current flow velocity, sensor tilt angle, flow direction, signal quality index and vibration index.
- Concurrent Mode

☒: instead of SDI-12 standard measuring mode (M!) uses concurrent measuring mode (C!).

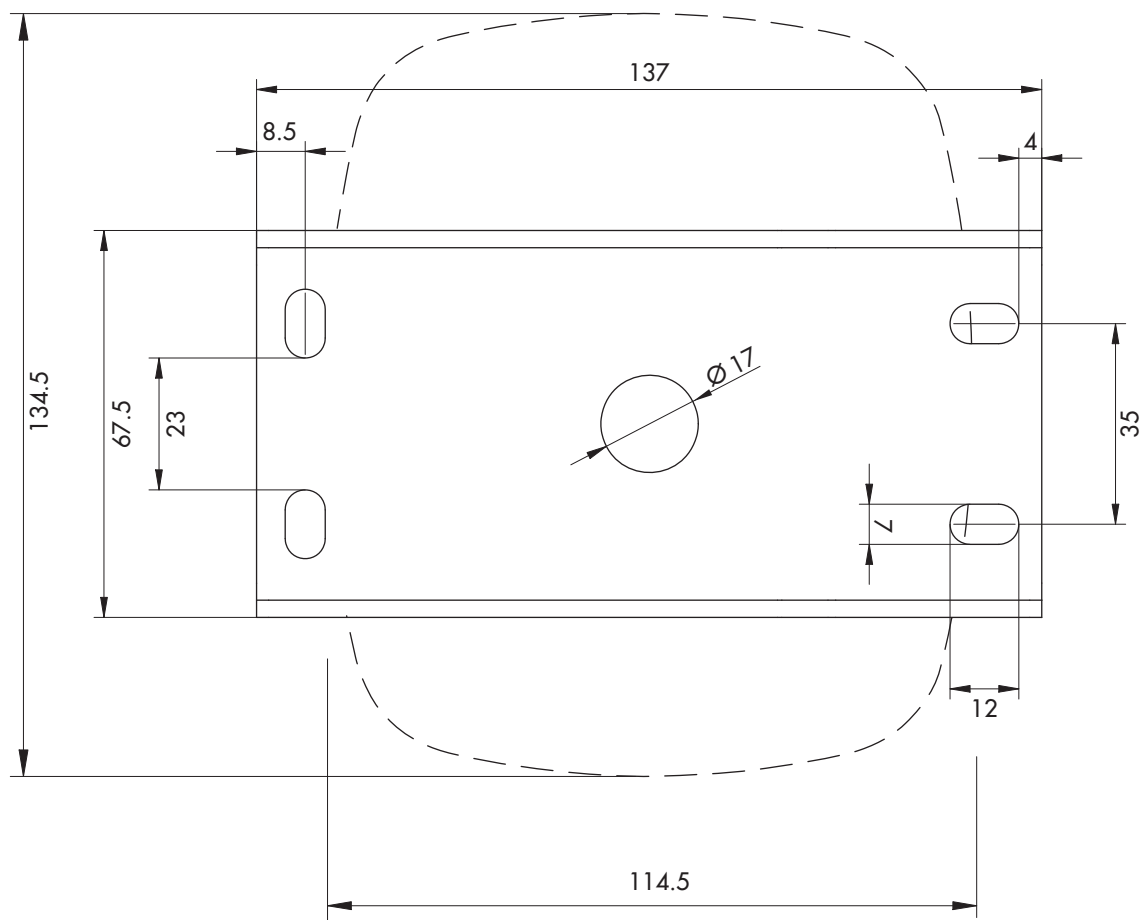
This allows simultaneous measurement with multiple sensors on a bus line (the sensors respond to a measurement command without a service request). The sensors must support version 1.2 or higher of the SDI-12 standard. Further information about Concurrent Mode can be found in the SDI-12 standard; see "www.sdi-12.org". This mode is useful if several sensors with a longer measuring time and identical sample interval are connected to a bus line.

- ▶ Instantaneous value ☒: If the OTT netDL receives an instantaneous value request (using LCD display and jog shuttle), it sends a command to start a current measurement to the OTT SVR 100. Until this measurement is complete, the LCD display uses the last measured value (or the last instantaneous value displayed if this is more recent). This is indicated by an "s" after the channel number (sensor number) in the display. After completion of the measurement, the new measured value appears with no additional indication.
☐: For an instantaneous value request, shows the last measured value from the sensor (measured value from last sample interval). This is indicated by an "s" after the channel number (sensor number) in the display (see also "OTT netDL IP data logger" operating manual, Chapter 9.1). This setting is not required on an OTT SVR 100.
- ▶ Measured value no./ Virtual terminal no. Assignment of further measured values from the OTT SVR 100 – that are not recorded on this channel – to virtual terminals.
- Set the units and the number of decimal places in the relevant Channel function blocks (m/s: 3; cm/s: 1; ft/s: 3; all others: 0).

Notes:

- ▶ Therefore, six channels on the OTT netDL are necessary to record all measured values from an OTT SVR 100. The first channel contains the SDI-12 Master or OTT SDI RS485 function block as the input signal. The other channels each contain a "Virtual Sensor" function block (V02 ... V06) as input signal. Of course, it is also possible to record fewer measured values.
- ▶ Further information on the SDI-12 commands and responses used can be found in Chapter 6, SDI-12 commands and responses.

Appendix B – Wall bracket dimensions/mounting hole positions



all measures in mm

Appendix C – RS-485 interface with Modbus protocol (RTU)

C.1 Prerequisites

- ▶ Transmission parameter 1 stop bit, even parity
- ▶ Transmission speed Factory setting: 9 600
- ▶ RS-485 interface protocol Modbus

C.2 "Read Holding Registers" function (0x03)

Register name	Register-number	Type	Value range	Factory setting	Access mode	Unit
▶ Bus address	0000	unsigned word	1 ... 255	1	R	–
▶ Baud rate	0001	unsigned word	0 → 9 600 1 → 38 400 2 → 57 600 2 → 115 200	57 600	R	[Bit/s]
▶ –	0002					
▶ Current flow velocity	0003	unsigned word	0 ... 15000		R	[mm/s]
▶ Average flow velocity	0004	unsigned word	0 ... 15000		R	[mm/s]
▶ Tilt angle	0005	unsigned word	0 ... 360		R	[°]
▶ Internal filter type	0006	unsigned word	0 → IIR filter 1 → Floating mean	1	R	[1]
▶ Filter length	0007	unsigned word	1, 16 ... 512	50	R	[1]
▶ Flow direction	0008	unsigned word	0 → Towards sensor 1 → Away from sensor		R	[1]
▶ Setting Flow direction	0009	unsigned word	0 → both 1 → Towards sensor 2 → Away from sensor	0	R	[1]
▶ Measuring-sensitivity	000A	unsigned word	0 ... 100	45	R	[1]
▶ Signal intensity	000B	unsigned word	0 ... 2048		R	[1]
▶ –	000C					
▶ Firmware version	000D	unsigned word	000 ... 999		R	–
▶ –	000E					
▶ Gain factor	000F	unsigned word	0 → 1 1 → 2 2 → 5 3 → 10 4 → 20 5 → 50 6 → 100 7 → 200		R	[1]
▶ –	0010					

Register name	Register-number	Type	Value range	Factory setting	Access-mode	Unit
▶ RS-232 protocol	0011	unsigned word	1 → NMEA		R	[1]
▶ RS-485 protocol	0012	unsigned word	1 → Modbus 3 → SDI-12	3	R	[1]
▶ –	0013					
▶ SNR-value	0014	unsigned word	SNR-value in dBm multiplied by 256		R	[dBm]

C.3 "Write Single Register" function (0x06)

Register name	Register-number	Type	Value range	Factory setting	Access mode	Unit
▶ Bus address	0000	unsigned word	1 ... 255	1	W	–
▶ Baud rate	0001	unsigned word	0 → 9 600 1 → 38 400 2 → 57 600 3 → 11 5200	9 600	W	[Bit/s]
▶ – ¹⁾	0002					
▶ Internal filter type	0003	unsigned word	0 → IIR filter 1 → Floating mean	1	W	[1]
▶ Filter length	0004	unsigned word	1, 16 ... 512	1	W	[1]
▶ Flow direction setting	0005	unsigned word	0 → Both 1 → Towards sensor 2 → Away from sensor	0	W	[1]
▶ Measuring-sensitivity	0006	unsigned word	0 ... 100		W	[1]
▶ – ¹⁾	0007					
▶ RS-232 protocol	0008	unsigned word	1 → NMEA		W	[1]
▶ RS-485 protocol	0009	unsigned word	1 → Modbus 3 → SDI-12	3	W	[1]
▶ – ¹⁾	000A					
▶ – ¹⁾	000B					

¹⁾ Do not write to this register

Appendix D – OTT SVR 100 Operating Program

The "OTT SVR 100 Operating Program" PC software is available for service purposes. You can use this software to establish a temporary connection to the OTT SVR 100 via the RS-232 interface and

- ▶ set OTT SVR 100 operating parameters
- ▶ perform a firmware update
- ▶ start a continuous measurement and represent flow velocity measured values graphically

If necessary, download the latest version of the operating program (setup file) from "www.ott.com/resources". The user interface language is English.

Required equipment:

- ▶ PC (desktop or laptop; operating system: Microsoft Windows 7 or later) with RS-232- or USB interface
- ▶ for PC with USB interface: RS-232/USB interface adapter ¹⁾
- ▶ RS-232 connecting cable ¹⁾
- ▶ (temporary) power supply for the OTT SVR 100

¹⁾ See Chapter 2, Accessories

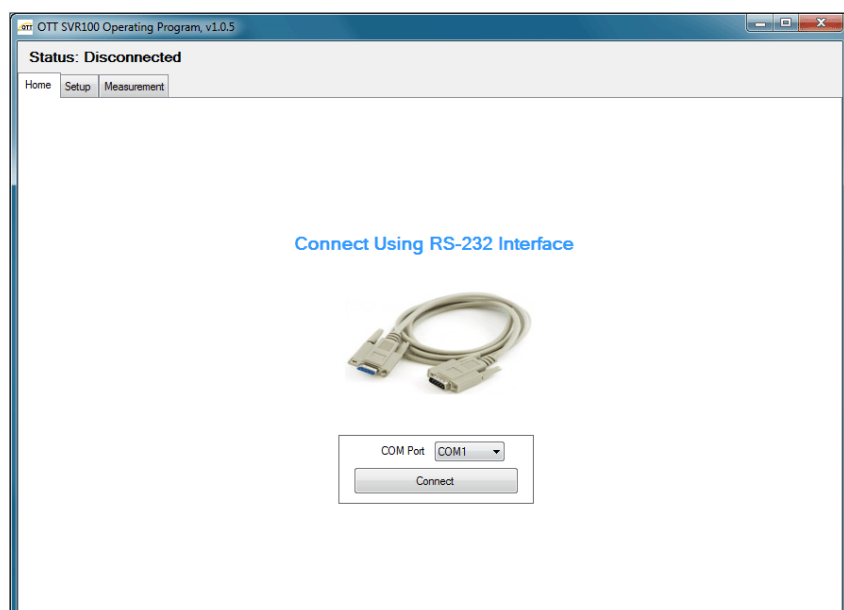
How to install the OTT SVR 100 Operating Program

- Launch "Setup-SVR100-Configurator-x.x.x.exe" → the "OTT SVR100 Configurator Setup Wizard" (installation program) opens.
- Perform the actions displayed on the screen.

How to use the OTT SVR 100 Operating Program

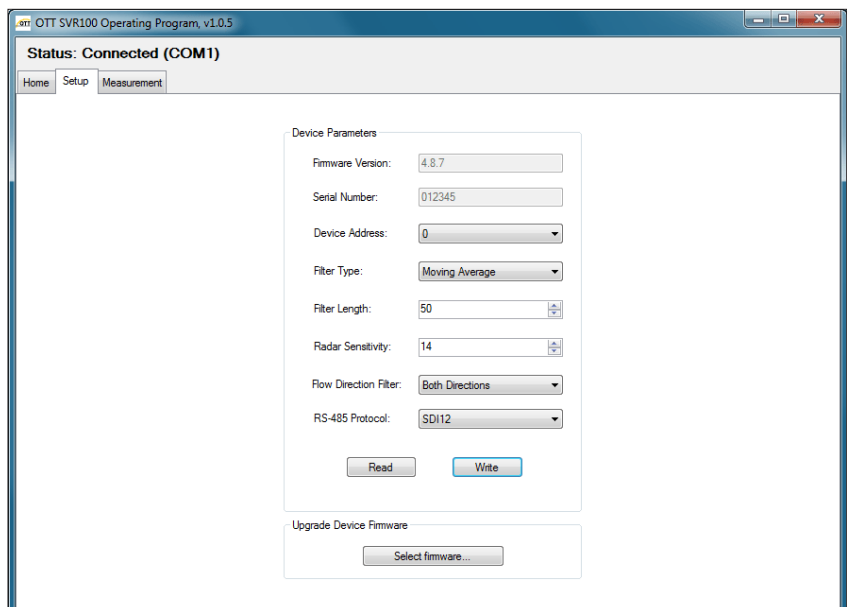
- Connect the OTT SVR 100 to the PC:
OTT SVR 100 connecting cable (TxD: green, RxD: yellow, Signal GND: grey)
↔ RS-232 connecting cable (TxD: brown (2), RxD: red (3), GND: yellow (5))
↔ RS-232 interface (or USB interface with interface adapter) on PC.
- Connect OTT SVR 100 to power supply (+9 ... +27 V_{DC}: brown; GND: white).
- Launch the OTT SVR 100 Operating Program (file "OTT SVR100 Configurator.exe")
- Establish a connection: Select "Home" tab, set "COM Port used" and click on "Connect" → The operating program establishes a connection to the OTT SVR 100.

Fig. E1: Establishing a connection to the OTT SVR 100 via the RS-232 interface.



- Set operating parameters: Select "Setup" tab, set required parameters and click on "Write" → The operating program writes the changed parameters to the OTT SVR 100.
You can find a description of the parameters in Chapter 6 "SDI-12 commands and responses", additional parameters "RS-485 protocol": Protocol on the RS-485 interface, either "SDI-12" or "Modbus RTU".
- Update firmware: Select the "Setup" tab and click on "Select firmware..." → The operating program opens a new window. Select the firmware file (... .fwi) and click on "Open" → The operating program writes the new firmware to the OTT SVR 100.
Please note: The power supply must not be interrupted during an update.
- Continuous measurement: Select the "Measurement" tab → The operating program starts continuous measurement and outputs 8 measured values as instantaneous values every 5 seconds. In addition the operating program plots the instantaneous values "average flow velocity" and "current flow velocity" graphically.

Fig. E2: Setting OTT SVR 100 operating parameters with the "OTT SVR 100 Operating Program".



Appendix E – Note on the declaration of conformity

If required, you can download the current version of the declaration of conformity for the OTT SVR 100 from our website as a PDF file: "www.ott.com/resources".

Document number
63.151.001.B.E 04-1025



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