Operating instructions

Radar Level Sensor
OTT RLS
We reserve the right to make technical changes and improvements without notice.
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1 Scope of supply

- 1 Radar sensor OTT RLS, two part swivel mount (consisting of device and wall brackets)
- 1 Installation kit (4 x wood screws 6 x 40 mm; 4 x plastic plugs S8)
- 2 Double open-ended wrenches size 10 x 13
- 1 Operating instructions
- 1 Factory acceptance test certificate (FAT)

2 Order numbers

- OTT RLS Radar sensor OTT RLS
  - Version 4: RS-485 + 4 ... 20 mA interface
  - Version S: SDI-12 + 4 ... 20 mA interface

- Accessories Connection cable
  - twisted-pair design
  - PVC, black
  - 2 x 2 x 0,5 mm²
    approx. AWG 22 (7 x AWG 30)

  Connection cable
  - twisted-pair design
  - PVC, black
  - 2 x 2 x 0,75 mm²
    AWG 20 (7 x AWG 28)
3 Basic safety information

- Read these operating instructions before using the OTT RLS for the first time! Make yourself completely familiar with the installation and operation of the OTT RLS! Retain these operating instructions for later reference.

- The OTT RLS is used for contactless level measurement of surface waters. Only use the OTT RLS in the manner described in these operating instructions! For further information see Chapter 4, Introduction.

- Note all the detailed safety information given within the individual work steps. All safety information in these operating instructions are identified with the warning symbol shown here.

- Never use the OTT RLS in areas where there is a danger of explosion. For further information see Chapter 5, Installing the OTT RLS.

- Note that the electric installation of the OTT RLS may only be done by a professional. For further information see Chapter 5, Installing the OTT RLS.

- Protect the power supply connection with a fuse (5 ampere, blowing speed: fast). For further information see Chapter 5, Installing the OTT RLS.

- It is essential to comply with the electrical, mechanical and climatic specifications given in the Technical Data section. For further information see Chapter 12, Technical data.

- Do not make any changes or retrofits to the OTT RLS. If changes or retrofits are made, all guarantee claims are voided. Furthermore, the radio approval required for its operation is void!

- Have a faulty OTT RLS inspected and repaired by our repair center. Never make any repairs yourself under any circumstances. For further information see Chapter 8, Repair.

- Dispose of the OTT RLS properly after taking it out of service. Never put the OTT RLS into the normal household waste. For further information see Chapter 10, Note about the disposal of old units.

Federal Communications Commission (FCC) Approval
Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Industry Canada Approval
This Class A digital apparatus complies with Canadian ICES-003. Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.
4 Introduction

The OTT RLS radar sensor is used for contactless measurement of the levels of surface water.

The OTT RLS is based on impulse radar technology. The transmitting antenna transmits short radar pulses in the 24 GHz ISM band. The separate receiver antenna receives the pulses reflected from the water and uses them to determine the distance between sensor and water surface: the time taken by the radar pulses from transmission to reception is proportional to the distance between sensor and water surface. The actual water level of the waterway is then calculated using a scaling function by a datalogger attached to the radar sensor. For this a reference level has to be input when starting.

The transmission antenna has a beam width of approx. 12 °. The resulting sensor beam can be seen in the depiction in Figures 2 and 3.

Three standardized electrical interfaces are available for connecting the OTT RLS to a datalogger or peripheral devices: 4 … 20 mA, SDI-12 and RS-485 (SDI-12 protocol).

The OTT RLS includes a swivel mount that allows the sensor housing to be mounted parallel (longitudinal and lateral axis) with the water surface, even when the sensor is mounted on a slanted surface. A waterproof terminal area can be found under a removable screw cover for attaching the sensor cable.

If the RS-485 interface is used, the length of cable between radar sensor and datalogger can amount up to 1000 meters · 3,300 ft. Using the SDI-12 interface, the maximum length of cable is 70 m · 230 ft.

Provided that the unit has been mounted correctly according to the operating instructions, the complete radar sensor is flooding proof with IP 67 rating (diving bell principle).

Fig. 1: Overview of radar sensor OTT RLS.
Fig. 2: Application example 1: Mounting the OTT RLS on a bridge. The projection of the sensor beam onto the water surface is virtually round.

Fig. 3: Application example 2: Mounting the OTT RLS on an auxiliary construction, e.g. metal stand with mounting plate.
5 Installing the OTT RLS

**Caution:** The electric installation of the OTT RLS may only be undertaken by qualified persons (e.g. skilled labour for electric installation).

### 5.1 Criteria for selecting a suitable mounting location

- Possible mounting locations are, for example, bridges and auxiliary constructions directly above the waterway section to be measured.
- The minimum distance between lower edge of the sensor and water surface must be 0.8 m · 2.6 ft (dead area in which no usable measurement is possible).
- Select a mounting point high enough so that measurement is possible even with high water levels.
- The mounting point must be steady. Vibrations and movement of the mounting point must be avoided. Bridges are affected by movements of several centimeters as a result of load changes and temperature movements. If pillars are available, the sensor can be mounted to a stable positioned pillar with a suitable spacer.
- The water surface must be as smooth as possible in the area of the sensor beam. Avoid turbulent areas and areas where obstructions in the waterway or bridge piers cause changes in the water level.
- The area within the sensor beam (see Figures 2 and 3) must be completely free of obstructions. Table for approximating the size of the sensor beam:

<table>
<thead>
<tr>
<th>Distance OTT RLS – water surface</th>
<th>Diameter sensor beam</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 m 16.5 ft</td>
<td>1.06 m 3.5 ft</td>
</tr>
<tr>
<td>10 m 33.0 ft</td>
<td>2.12 m 7.0 ft</td>
</tr>
<tr>
<td>15 m 49.0 ft</td>
<td>3.19 m 10.5 ft</td>
</tr>
<tr>
<td>20 m 66.0 ft</td>
<td>4.25 m 14.0 ft</td>
</tr>
<tr>
<td>25 m 82.0 ft</td>
<td>5.31 m 17.5 ft</td>
</tr>
<tr>
<td>30 m 98.0 ft</td>
<td>6.38 m 21.0 ft</td>
</tr>
<tr>
<td>35 m 115.0 ft</td>
<td>7.44 m 24.5 ft</td>
</tr>
</tbody>
</table>

The diameters given are minimum sizes. Where possible, select an area free of obstruction that is clearly larger.

- Avoid large metal surfaces near the sensor beam (reflections from these surfaces can distort the measurement result).
- The climate specifications in the technical data must be kept to at the mounting location.
- Stilling wells are unsuitable as a mounting location.

---

**WARNING** Danger of explosion due to spark formation and electrostatic discharge

The use of the OTT RLS in explosive atmospheres can lead to the danger of ignition of this atmosphere. An explosion resulting from this involves the risk of very severe material and personal damage.

- **Never** operate the OTT RLS in explosive areas (e.g. in sewers). The OTT RLS is not equipped with EX-protection (EXplosion protection)!
5.2 Notes on power supply

The OTT RLS requires a power supply of 9.6 … 28 V direct current of type 12/24 V DC (e.g. a battery or mains connection with galvanically isolated low safety voltage).

The OTT RLS is immediately ready for operation after connecting the power supply.

Warning:

- The power supply must be protected by a fuse (5 ampere, blowing speed: fast) on the input side.
- When using solar panels, we recommend the use of an overvoltage protection device.

5.3 Suitable cable types when using the RS-485 interface

The maximum length of the connecting cable is 1,000 m · 3,300 ft. Recommended cable type: Twisted-pair cable; unshielded (alternatively: shielded). The wires intended for the power supply can be twisted pair, but do not have to be.

Types of OTT cable which can be used (see accessories)

- up to 500 m · 1,650 ft length of connecting cable: 2 x 2 x 0,5 mm²; approx. AWG 22 (flexible wires; 7 x AWG 30)
- 500 to 1000 m · 1,650 to 3,300 ft length of connecting cable: 2 x 2 x 0,75 mm²; AWG 20 (flexible wires; 7 x AWG 28)

5.4 Mounting the OTT RLS

Warning: Ensure no moisture enters the connection area when the screw cover is open! If the connection area gets moist there is increased danger of corrosion of the electric contacts.

Assembling the swivel mount (see also Annex A)

Mounting surface: concrete or masonry

- Make four holes (Ø 8 mm · 5/16" / 43 mm · 1.7 ft deep) using a hammer drill (use wall bracket as a template).
- Insert the four plastic plugs supplied into the holes.
- Attach the wall bracket using the four wood screws supplied.
- Insert housing bracket (without sensor) into wall bracket and lightly tighten the hex bolts A (see fig. 5).

Mounting surface: auxiliary construction, e. g. metal stand with mounting plate

- Drill four holes (Ø 7 mm · 9/32") in the mounting plate (use wall bracket as a template).
- Attach the wall bracket e. g. using four hex bolts (M6) and nuts.
- Insert housing bracket (without sensor) into wall bracket and lightly tighten the hex bolts A (see fig. 5).

Preparing the cable gland

- Remove Globemarker (hexagon with size indication of cable diameters that can be used).
- With a cable diameter of 7.0 … 11.0 mm · 0.28 … 0.43", remove inlet: insert screwdriver vertically into the seam. See Figure 4. Minimum cable diameter with inlet: 4.0 mm · 0.16".
- Remove inlet with screwdriver.
- Insert the connecting cable.
Mounting the radar sensor

- Remove screw cover.
- Insert connecting cable from OTT RLS to datalogger through cable gland.
- Remove insulation from connecting cable.
- With flexible wires: put end caps on the wires.
- Connect the connecting cable to the terminal block. Take note for this of Chapter 5.5 to 5.9! If required, the terminal strip can be pulled out for connecting.
- Retighten connecting cable as necessary.
- Tighten the tightening nut of the cable gland (torque for tightening nut: 6 Nm).
- Screw on the screw cover and tighten firmly by hand.
- Insert sensor into housing bracket and lightly tighten the hex bolts B (see fig. 5).
- Align the housing parallel (longitudinal and lateral axis) with the water surface using a bubble level.
- Tighten the hex bolts B (housing shell) carefully (see fig. 5).
- Tighten the hex bolts A (wall/housing brackets) carefully (see fig. 5).
- Check alignment of the OTT RLS once more.

Fig. 4: OTT RLS – connection area.

![Diagram of OTT RLS connection area with labels for various components and connections, including screw terminal strip, sensor, tightening nut, cable gland, removable screw cover, connecting cable, Globemarker, and inlet. Diagram also includes a section showing connections like +9.6...28 V, RS-485 B, RS-485 A, 4...20 mA, SDI-12 DATA, and GND, with a note that SDI-12 protocol via physical RS-485 interface (for connecting to OTT DuoSens and OTT Logosens 2).]
**Warning:** The alignment of the sensor parallel to the water surface must be carried out as accurately as possible!

- If alignment is out by 1.0°, this leads to a linearity error of approx. 0.15 mm per meter change in the distance.
- If alignment is out by 2.5°, this leads to a linearity error of approx. 1 mm per meter change in the distance.
- If alignment is out by 5°, this leads to a linearity error of approx. 4 mm per meter change in the distance.

![Diagram of OTT RLS rotation range of swivel mount](img)

**Please note:** The 4 … 20 mA interface cannot be used parallel to the SDI-12 or RS-485 interfaces.
5.5 Connecting the OTT RLS to any datalogger using an SDI-12 interface

Connect the OTT RLS to an SDI-12 input of the datalogger. Follow the datalogger handbook as you do this. Refer to Figure 6 for the connection assignments of the OTT RLS. The maximum length of the connecting cable is 70 m · 230 ft. Recommended wire cross-section: 0.5 mm² · AWG 21. With separate voltage supply and point-to-point connection (no SDI-12 bus operation) a cable length of up to 300 m · 985 ft is possible.

![Fig. 6: Connecting the OTT RLS to any datalogger using an SDI-12 interface. (Standard SDI-12 wiring via three-wire connecting cable).](image_url)

You will find the SDI-12 commands and responses for the OTT RLS in Chapter 6, SDI-12 commands and responses.

Example for measurement in feet:
Command start measurement: 0M! (sensor address = 0) → response: 00254<CR><LF> (measurement result: 4 values in 25 seconds) → command send data: 0D2! → response 0+010.50><CR><LF> (measured distance value: +10.50 feet)

5.6 Connecting the OTT RLS to any datalogger using a 4 ... 20 mA interface

Connect the OTT RLS to a 4 ... 20 mA input of the datalogger. Follow the datalogger handbook as you do this as well as Chapter 12 of these instructions. Refer to Figure 4 for the connection assignments of the OTT RLS. Contacts used: 1, 4, 5 and 7. The maximum connecting cable length/recommended wire cross-section: depending on the amount of voltage supply and the size of the burden (load resistor). Please note that the ohmic resistance of the connecting cable together with the eventually existing burden do not exceed the max. allowed load resistance (see Chapter 11)!

Please note: the 4 ... 20 mA interface of the OTT RLS is passive. If needed the supply for the current loop must be injected by wire-linking the supply voltage.

5.7 Note on using the RS-485 interface

The RS-485 interface can only be used with an OTT datalogger. In this case, the transmission protocol via the physical RS-485 interface is the SDI-12 protocol. Connect OTT RLS via the RS-485 interface to the OTT LogoSens/DuoSens → see Chapter 5.8, Method B.
5.8 Connecting the OTT RLS via SDI-12 or RS-485 interface to LogoSens 2 or DuoSens

**Method A:** Connecting the OTT RLS via the SDI-12 interface (protocol and physical interface: SDI-12). The maximum length of the connecting cable is 70 m · 230 ft. Recommended wire cross-section: 0.50 mm² · AWG 21:

- Connect the OTT RLS to the LogoSens 2 Station Manager or to the DuoSens Compact Datalogger as shown in Figure 7. Take note of the operating instructions for the LogoSens 2/DuoSens.

**Method B:** Connect OTT RLS using the physical RS-485 interface (SDI-12 protocol via physical RS-485 interface). Refer to Chapter 5.3 for the maximum connecting cable length and the recommended wire cross-section:

- Connect the OTT RLS to the LogoSens 2 Station Manager or to the DuoSens Compact Datalogger as shown in Figure 8. Take note of the operating instructions for the LogoSens 2/DuoSens.

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**Fig. 7:** Connecting the OTT RLS to LogoSens 2 or DuoSens using an SDI-12 interface.

The letters above the screw terminal strip identify the possible connections on the LogoSens 2/DuoSens.

**Fig. 8:** Connecting the OTT RLS to LogoSens 2 or DuoSens using an RS-485 interface (SDI-12 protocol).

The letters above the screw terminal strip identify the possible connections on the LogoSens 2/DuoSens.
Configuring the LogoSens 2/DuoSens for the OTT RLS with SDI-12 interface

- Create a LogoSens 2/DuoSens channel with SDI-12 Master or OTT SDI RS485 function block (serial sensors tab).
- Apply the following settings:

![Table](image)

- **Terminal block**
  - LogoSens 2: A ... R
  - DuoSens SDI-12 Master: A 3-4 (specified)
  - DuoSens OTT SDI RS485: A 1-2 (specified)
- **Slave address**
  - SDI-12 bus address. Each slave address may only be allocated once to an SDI-12 bus line. (checking/setting: see operating instructions LogoSens 2/DuoSens, Chapter SDI-12 transparent mode.) Typical setting: 0 (only one OTT RLS is connected to the terminal block; no bus operation).
- **Value no.**
  - identifies which value (the xth of n values + status information) of the OTT RLS is recorded in this channel. Typical setting: 1 (first of three values: distance in [m]).
- **Measurement mode**
  - M! (for the maximum 3 values + status information of the OTT RLS).
- **Value no. / Virtual terminal ID**
  - Allocation of the other two measured values + status information of the OTT RLS to virtual terminals (distance in [cm]; distance in [ft]; status information; see Chapter 6.1 for further information; command aM!1).

In the relevant Channel function blocks, adjust the required units and number of digits after the decimal place (m: 3; cm: 0; ft: 2; status information: 0).

**Note:**
- To record all three values + status information of an OTT RLS, four channels in the LogoSens 2/DuoSens are thus necessary. The first channel contains the function block SDI-12 Master or OTT SDI RS485 as the input signal. The other channels each contain a function block Virtual Sensor (V02 to V04) as the input signal. Naturally, just individual channels can be recorded. In this case, there are fewer entries required in the Value no./Virtual terminal ID field.
- You will find further information on the used SDI-12 commands and responses in Chapter 6, SDI-12 commands and responses.

**Please note:** OTT RLS provides the measured values 25 seconds after the SDI-12 command aM!1.
5.9 Connecting the OTT RLS to LogoSens 2 or DuoSens using a 4 … 20 mA interface

Connect the OTT RLS to the LogoSens 2 Station Manager or to the DuoSens Compact Datalogger as shown in Figure 10 and 11. Take note of the operating instructions for the LogoSens 2/DuoSens. Maximum connecting cable length/recommended wire cross-section: depending on the amount of voltage supply and the size of the burden (load resistor). Please note that the ohmic resistance of the connecting cable together with the eventually existing burden do not exceed the max. allowed load resistance (see Chapter 11)!

Fig. 10: Connecting the OTT RLS to LogoSens 2 using a 4 … 20 mA interface

Use the 100 Ohm OTT resistor (order number: 5555080095). The letters above the screw terminal strip identify the possible connections on the LogoSens 2. The supply to the current loop in the application case shown is via the OTT LogoSens 2.

Fig. 11: Connecting the OTT RLS to DuoSens using a 4 … 20 mA interface.

The letters above the screw terminal strip identify the possible connections on the DuoSens. The supply to the current loop in the application case shown on the left is via the OTT DuoSens.

* only with a DuoSens with analog extension
Configuring the LogoSens 2/DuoSens for OTT RLS with 4 ... 20 mA interface

- Create a LogoSens 2/DuoSens channel with function block I 4-20 mA (LogoSens 2) or U/I/Pt100/... (DuoSens) (Analog sensors tab).

- Apply the following settings:

  - **Terminal block**
    - LogoSens 2: A ... R
    - DuoSens: C ... F
    - terminal block used (screw terminal strip)

  - **Measurement mode**
    - (only with DuoSens)
    - Set to I 4-20 mA ext.

  - **Sensor lag time (s)**
    - switches on the LogoSens 2/DuoSens input
    - 1 second before the actual measurement process

  - **Error code if range overflow**
    - if required: record error codes on range overflow

  - **Auxiliary sensor supply via relay contact at terminal block**
    - (only for LogoSens 2)
    - not required with an OTT RLS

- Insert a 2-point scaling function block into this channel and adjust the relating distance values for the outputed current values (e.g. Point 1: 4 → 0; Point 2: 20 → 35 m · 115 ft). This function also enables the referencing to a level zero.

- In the Channel function block, set the unit and number of digits after the decimal place (m: 3; cm: 0; ft: 2).

**Note on points 5.5 to 5.9**

- To reference OTT RLS measured distance values to a level zero: Input the contact gauge/staff gauge measurement, for example using the scaling function of the datalogger, connected to the OTT RLS (e.g. LogoSens 2/DuoSens).
## 6 SDI-12 commands and responses

### 6.1 Standard commands

All SDI-12 standard commands are implemented in the OTT RLS: The following SDI-12 standard commands are relevant for the operation of the OTT RLS:

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
<th>Description</th>
</tr>
</thead>
</table>
| a!      | a<CR><LF> | confirmation active  
a – sensor address; factory setting = 0 |
| aI!     | a13cccccccccmmmmmmm…  
          …vvvxxxx<CR><LF> | send identification  
a – Sensor address  
13 – SDI-12 protocol version  
cccccccc – manufacturer’s identification (company name)  
mmmmmm – sensor identification  
vvv – sensor version  
xxxxxx – serial number  
OTT RLS reply= 013OTT HACH...RLS100xxxxxx |
| aAb!    | b<CR><LF> | change address  
a – old sensor address  
b – new sensor address |
| ?!      | a<CR><LF> | query address  
a – sensor address |
| aM!     | attn<CR><LF> | start measurement  
a – sensor address  
ttt – Time in seconds until the sensor has determined the measurement result  
OTT RLS reply = 025 seconds  
n – number of measured values  
OTT RLS reply = 4 |
| aD0! ... aD3! | a<value><CR><LF> | send data  
a – sensor address  
D0: distance [m]  
<value> = pbb.aaa  
D1: distance [cm]  
<value> = pbbbb  
D2: distance [ft]  
<value> = pbbb.aa  
D3: status  
<value> = b  
0 = measured value OK  
1 = no target recognized  
2 = internal error → device defect; see Chapter 8, Repair  
3 = variance of individual measurements too large  
4 = SDI-12 interface break (infringement of SDI-12 interface protocol, e.g. communication via SDI-12 interface between the commands aM! and aD0!)  
5 = value below or above measuring range  
6 = internal error → device defect; see Chapter 8, Repair  
<value> = p – sign (+,-)  
b – digit (before the decimal point)  
a – digit after the decimal point |

---

1) do not use this command if OTT RLS is connected to a datalogger via the 4 … 20 mA interface! OTT RLS would consequently interrupt the continuous measuring operation which is needed for the 4 … 20 mA interface.

More information on the SDI-12 standard commands can be found in the document SDI-12; A Serial-Digital Interface Standard for Microprocessor-Based Sensors; Version 1.3 (see Internet page www.sdi-12.org).
### 6.2 Advanced SDI-12 commands

All advanced SDI-12 commands begin with an O for OTT. With these commands, it is possible to configure the OTT RLS using the transparent mode of a datalogger.

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>/H17075</td>
<td></td>
<td>4 … 20 mA interface – adjusting/reading unit of the measured values*</td>
</tr>
<tr>
<td>aOPF&lt;value&gt;!</td>
<td>aOPF&lt;value&gt;&lt;CR&gt;&lt;LF&gt;</td>
<td>adjust unit for the commands adjusting/reading the lower/upper limit.</td>
</tr>
<tr>
<td>aOPF!</td>
<td></td>
<td>read unit for the commands adjusting/reading the lower/upper limit.</td>
</tr>
<tr>
<td>a – sensor address</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;value&gt; – 0 = m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 = cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 = ft</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|                   |                   | 4 … 20 mA interface – adjusting/reading the lower limit                                                                                       |
| aOPA<value>!      | aOPA<value><CR><LF> | adjust lower limit                                                                                                                           |
| aOPA!             |                   | read lower limit                                                                                                                             |
| a – sensor address|                   |                                                                                                                                             |
| <value> – pb.a; factory setting = 0 |                   |                                                                                                                                             |
| p – sign (+,−)    |                   |                                                                                                                                             |
| b – digits before the decimal point |                   |                                                                                                                                             |
| b – digits after the decimal point |                   |                                                                                                                                             |
| Number of positions: max. 6 (5 digits + decimal point) |                   |                                                                                                                                             |
| m → pbb.aaa input in m (+0.000 … +35.000) |                   |                                                                                                                                             |
| cm → pbbbb input in cm (+0 … +3500) |                   |                                                                                                                                             |
| ft → pbbb.aa input in feet (+0.00 … +115.00) |                   |                                                                                                                                             |
| Note: When switching between m → ft → m, rounding errors of ±0.001 are possible.                                                                                           |

|                   |                   | 4 … 20 mA interface – adjusting/reading the upper limit                                                                                       |
| aOPB<value>!      | aOPB<value><CR><LF> | adjust upper limit                                                                                                                           |
| aOPB!             |                   | read upper limit                                                                                                                             |
| a – sensor address|                   |                                                                                                                                             |
| <value> – pb.a; factory setting = 0 |                   |                                                                                                                                             |
| p – sign (+,−)    |                   |                                                                                                                                             |
| b – digits before the decimal point |                   |                                                                                                                                             |
| b – digits after the decimal point |                   |                                                                                                                                             |
| Number of positions: max. 6 (5 digits + decimal point) |                   |                                                                                                                                             |
| m → pbb.aaa input in m (+0.000 … +35.000) |                   |                                                                                                                                             |
| cm → pbbbb input in cm (+0 … +3500) |                   |                                                                                                                                             |
| ft → pbbb.aa input in feet (+0.00 … +115.00) |                   |                                                                                                                                             |
| Note: When switching between m → ft → m, rounding errors of ±0.001 are possible.                                                                                           |

With the commands adjusting/reading the lower/upper limit you can scale the available measuring range of an OTT RLS to a smaller range. Where you do not require the whole measuring range, this has the advantage that a higher resolution for the 4 … 20 mA interface can be achieved. Example: 16 mA measurement span stands for 5 m · 16 ft of water level change available (e.g. lower limit = +10,000 m · +33,00 ft; upper limit = +15,000 m · +49.00 ft; see Fig. 13).
Fig. 13: scale the measured value output of the 4 … 20 mA interface down to a smaller range.

Adjust/read 4 … 20 mA interface – operating status (activated/deactivated)

- aOPC<value>! -> adjust operating status
- aOPC! -> read operating status

aOPC<value><CR><LF>

- a – sensor address
- p – sign (+)
- b – digit
  +0 = interface deactivated
  +1 = interface activated

Use: the command aOPC+1! is helpful, if e.g. an aM! command unintended has interrupted the continuous operation which is needed for the 4 … 20 mA interface.
7 Carrying out maintenance work

The OTT RLS radar sensor is almost maintenance free. No setting or calibration work is necessary. There are likewise no parts that need replacing regularly.

Carry out the following maintenance work at regular frequencies based on the local circumstances:

- Check the OTT RLS for dirt (e.g. thick, dewy spider’s webs or insect nests can lead to impairment of the measured results). In this case, carefully clean the sensor (if necessary use commercial, gentle and non-erasing cleaners and a soft sponge). At the same time, ensure that the setting of the swivel mount does not change.
- Check for obstructions in the measurement beam (for example, for flotsam or branches of trees and bushes growing into this area). In this case, remove all obstructions.
- Check the plausibility of the measured values by comparing with a second sensor or with a staff gauge.

**Warning:** Never open the housing of the OTT RLS (exception: connection area)! There are no adjustment or operating elements inside the housing.

8 Repair

- With a device defect, use Chapter 9, Troubleshooting to see if you can resolve the problem yourself.
- In case of device defects, please contact the repair center of OTT:
  
  OTT MESSTECHNIK GmbH & Co. KG
  Repaircenter
  Ludwigstrasse 16
  87437 Kempten · Germany
  Telephone +49 (0)831/5617-433
  Fax +49 (0)831/5617-439
  repair@ott.com

**Warning:** Only have a defective OTT RLS checked and repaired by the OTT repair center. Never make any repairs yourself under any circumstances. Any repairs or attempted repairs carried out by the customer will result in the loss of any guarantee rights.
9 Troubleshooting

Sensor does not respond to the SDI-12 interface

► Fuse in the power supply input side defective?
  → Replace fuse.
► Sensor correctly connected to a datalogger with SDI-12 input (master)?
  → Correct connection assignment.
► Polarity of the power supply reversed?
  → Correct connection assignment.
► Power supply < 9.6 V or > 28 V?
  → Correct level of voltage supplied (check the length and cross-section of the
  connection cable).
► Is the power supply direct current?
  → Only operate sensor with direct current.

4 ... 20 mA signal not present

► Sensor correctly connected to a datalogger or peripheral device to 4 ... 20 mA
  input (check polarity)?
  → Correct connection assignment.
► 4 ... 20 mA current loop correctly supplied through datalogger or OTT RLS
  (internal/external supply)?
  → Correct connection assignment.

Measured value varies or is not present

► Sensor (front plate) dirty?
  → Carefully clean the sensor; see Chapter 7, Carrying out maintenance work
► Obstruction in the measurement beam?
  → Remove obstructions.
► Sensor aligned at right angles to the water surface?
  → Correct sensor alignment.
► Mounting location of the sensor steady (e.g. bridge movement)?
  → Optimize mounting location.
► Large metal surfaces near the sensor beam (e.g. piling)?
  → Optimize mounting location.

Status messages/output of interfaces

<table>
<thead>
<tr>
<th>SDI-12 1)</th>
<th>4 ... 20 mA</th>
<th>Status message/output</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>measured value</td>
<td>measured value OK</td>
</tr>
<tr>
<td>1</td>
<td>3.0 mA</td>
<td>no target recognized</td>
</tr>
<tr>
<td>2</td>
<td>3.1 mA</td>
<td>internal error → device defect; see Chapter 8, Repair</td>
</tr>
<tr>
<td>3</td>
<td>3.2 mA</td>
<td>variance of individual measurements too large</td>
</tr>
<tr>
<td>4</td>
<td>3.3 mA</td>
<td>SDI-12 interface break (infringement of SDI-12 interface protocol, e.g. communication via SDI-12 interface between the commands aM! and aD3!)</td>
</tr>
<tr>
<td>5</td>
<td>3.4 mA</td>
<td>value below or above measuring range</td>
</tr>
<tr>
<td>6</td>
<td>3.5 mA</td>
<td>internal error → device defect; see Chapter 8, Repair</td>
</tr>
</tbody>
</table>

1) reply to commands aM! and aD3!

Note: If there is no power supply for more than 60 minutes, the radar sensor
resets and starts again. (It takes this time until the circuit is voltage-free due to the
extremely low power consumption). Settings for the upper and lower value remain
unchanged (see Chapter 6.2, Advanced SDI-12 commands).
10 Note about the disposal of old units

Within the member countries of the European Union
In accordance with the European Union guideline 2002/96/EC, OTT takes back old devices within the member countries of the European Union and disposes of them in an appropriate way. The devices concerned by this are marked with the symbol shown aside.

- For further information on 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 EU guideline 2002/96/EC of your country.

For all other countries
- Dispose of the OTT RLS properly after taking out of service.
- Observe the regulations valid in your country for the disposal of electronic devices.
- Never put the OTT RLS into the normal household waste.

Used materials
see Chapter 12, Technical Data
11 Determining the maximum load resistance at the 4 ... 20 mA interface

The load resistance (burden + ohmic resistance of the connection cable) connected to the OTT RLS must not exceed a specific maximum value. This value depends on the level of the supply voltage of the OTT RLS. If the load resistance is greater, the output current can no longer be evaluated. Smaller load resistances are allowed.

- Read off the maximum load resistance for your power supply from the following diagram.

**Example:** Power supply 18 volt → max. load resistance 450 ohm.

The OTT RLS delivers an output current corresponding to the measured value for a load resistance of up to 450 ohm.

- Dimension the connected electrical circuit accordingly. Check the input resistance of the connected peripheral device for this purpose.

---

**Figure 14. Diagram to determine the maximum load resistance as a function of the power supply.**

- Minimum power supply: 9.6 V
- Maximum power supply: 28 V
- Resistor tolerance: 0.1 %/15 ppm (burden = load resistor).
12 Technical Data

Measuring range
Resolution SDI-12 interface
Accuracy 1)

<table>
<thead>
<tr>
<th>Range</th>
<th>SDI-12 interface</th>
<th>Resolution</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8 ... 35 m</td>
<td>0.001 m</td>
<td>±0.001 m</td>
<td></td>
</tr>
<tr>
<td>80 ... 3500 cm</td>
<td>1 cm</td>
<td>±0.001 m</td>
<td></td>
</tr>
<tr>
<td>2.6 ... 115 ft</td>
<td>0.01 ft</td>
<td>±0.001 m</td>
<td></td>
</tr>
</tbody>
</table>

Average temperature coefficient
(range: −10 °C ... +40 °C · 14 ... +104 °F)

<table>
<thead>
<tr>
<th>Range</th>
<th>±0.001 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8 ... 1.5 m</td>
<td>±10 mm</td>
</tr>
<tr>
<td>1.5 ... 30 m</td>
<td>±3 mm</td>
</tr>
<tr>
<td>30 ... 35 m</td>
<td>±10 mm</td>
</tr>
</tbody>
</table>

Measuring time

20 seconds

Power supply

9.6 ... 28 V DC, typ. 12/24 V DC

Power consumption 2)

< 140 mW (< 12 mA at 12 V)
< 1 mW (< 0.05 mA at 12 V)

Interfaces

4 ... 20 mA (measurement update every 20 seconds); SDI-12; RS-485, two-wire (SDI-12 protocol)

Beam angle of antenna

12 ° (±6 °)

Transmission frequency

24 GHz (puls radar)

Transmission power

< 5 mW

Materials

Housing ASA (UV-stabilized ABS)
Radom (front plate) TFM PTFE
Mounting 1.4301 (V2A)

Weight (including mounting)

approx. 2.1 kg · 4.63 lb

Cable gland sealing range

with inlet (min. Ø ... max. Ø) 4.0 ... 7.0 mm · 0.16 ... 0.28"
without inlet (min. Ø ... max. Ø) 7.0 ... 11.0 mm · 0.28 ... 0.43"

Connection capacity of screw terminal strip

Solid conductor 0.25 ... 2.5 mm² · AWG 24 to 12
Wire with end cap and plastic collar 0.25 ... 1.5 mm² · AWG 24 to 16

Terminal assignment screw terminal strip

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal 1</td>
<td>Power supply</td>
</tr>
<tr>
<td>Terminal 2</td>
<td>RS-485 B</td>
</tr>
<tr>
<td>Terminal 3</td>
<td>RS-485 A</td>
</tr>
<tr>
<td>Terminal 4</td>
<td>4 ... 20 mA −</td>
</tr>
<tr>
<td>Terminal 5</td>
<td>4 ... 20 mA +</td>
</tr>
<tr>
<td>Terminal 6</td>
<td>SDI-12 DATA</td>
</tr>
<tr>
<td>Terminal 7</td>
<td>GND</td>
</tr>
</tbody>
</table>

Rotation range of swivel mount

Lateral axis ±90 °
Longitudinal axis ±15 °

Type of protection at horizontal installation

IP 67 (submersion depth max. 1 m · 3.3 ft;
Submersion duration max. 48 h)

Dimensions L x W x H

222 mm x 152 mm x 190 mm · 8.74" x 5.98" x 7.48"

Temperature range

Operation −40 ... +60 °C · −40 ... +140 °F
Storage −40 ... +85 °C · −40 ... +185 °F

Relative humidity

0 ... 100 % 3)

EMC limits and radio approvals

EMV for Short Range Device ETSI EN 301 489-3
Safety of equipment of low voltage device EN 60950-1
Approval for Short Range Device; Europe ETSI EN 300 440
Approval for Short Range Device; USA FCC 47 CFR Part 15
Approval for Short Range Device; Canada RSS 210 Issue 7

1) at 20 °C · 68 °F ambient temperature; 1013 mbar · 29.9 inHg air pressure; 45 % to 65 % relative humidity; ideal reflector; without interfering reflector in the sensor beam
2) Power consumption of OTT RLS with SDI-12, RS-485 or externally supplied 4 ... 20 mA interface
3) Condensation on the front plate of the antenna (Radom) can disturb measuring accuracy
Annex A – Dimensions of wall bracket/position of fixing bores

- 35 mm · 1.38"
- 137 mm · 5.39"
- 67.5 mm · 2.66"
- 152 mm · 5.98"
- 222 mm · 8.74"
- 7 mm · 0.28"
- 8.5 mm · 0.33"
- 23 mm · 0.91"
- 4 mm · 0.16"
- Ø 17 mm · 0.67"
- 17 mm · 0.67"
Annex B – Declaration of Conformity

Konformitätserklärung
Declaration of Conformity
Déclaration de Conformité

Wir/ We/ Nous: OTT Messtechnik GmbH & Co. KG
Anschrift/ Address/ Adresse: Ludwigstraße 16
D-87437 Kempten

erklären, daß das Produkt/ declare, that the product/ declarams, que le produit

Bezeichnung/ Name/ Nom: OTT RLS
Artikel- Nr./ Article No./ No. d’ Article: 63.105.001.9.2

mit den Anforderungen der Normen/ fulfills the requirements of the standard/ satisfait aux exigences
des normes:

EG (2004/108/EG):

Electromagnetic compatibility and Radio Spectrum Matters (ERM)
ElectroMagnetic Compatibility (EMC)
for Short Range Devices (9kHz to 40GHz)
ETSI EN 301 489-3 V1.4.1 (2002-08)
EN 61000-4-5 (4kV); IEC 61000-4-5 (4kV)

Electromagnetic compatibility and Radio Spectrum Matters (ERM)
for Short Range Devices (1GHz to 40GHz)
ETSI EN 300 440-2 V1.1.1 (2001-09)

Safety of Electrical Equipment and Industrial Low-Voltage Devices
EN 60950-1:2001; IEC 60950-1:2001

Radio Standards Specification (RSS)
RSS-210 Issue 7

Radio Frequency Devices
FCC 47 CFR Part 15

und den hinterlegten Prüfberichten übereinstimmt und damit den Bestimmungen entspricht/
and the taken test reports and therefore corresponds to the regulations of the Directive/
et les rapports d'essais notifiés et, ainsi, correspond aux règlement de la Directive.

Ort und Datum der Ausstellung/ Kempten, den 2007-09-20
Place and Date of Issue/ Lieu et date d’établissement

Name und Unterschrift des Befugten/ Peter Fend
Name and Signature of authorized person/ Nom et signature de la personne autorisée
( Director R&D )
TCB

GRANT OF EQUIPMENT AUTHORIZATION

Issued Under the Authority of the
Federal Communications Commission

By:

PHOENIX TESTLAB GmbH
Koenigswinkel 10
D-32825 Blomberg,
Germany

Date of Grant: 08/29/2007
Application Dated: 08/29/2007

Ott Messtechnik GmbH & Co. KG
Ludwigstrasse 16
PO Box 21 40
Kempten D-87437,
Germany

Attention: Mr. Kay Zircher, Manager

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: OA6OTTRLS

Name of Grantee: Ott Messtechnik GmbH & Co. KG
Equipment Class: Part 15 Low Power Communication Device Transmitter
Notes: Radar Level Sensor

<table>
<thead>
<tr>
<th>FCC Rule Parts</th>
<th>Frequency Range (MHz)</th>
<th>Output Watts</th>
<th>Frequency Tolerance</th>
<th>Emission Designator</th>
</tr>
</thead>
<tbody>
<tr>
<td>15C</td>
<td>24150.0 - 24150.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Grant Notes

This device must be professionally installed.
Annex D – Radio Approval Canada: Technical Approval Certificate

TECHNICAL APPROVAL CERTIFICATE

based on the Agreement on Mutual Recognition between the European Community and Canada

CERTIFICATION NUMBER
NUMÉRO DE CERTIFICATION
7253A-OTTRLS

TYPE OF SERVICE
TYPE DE SERVICE
New Single Certification

CERTIFICATE HOLDER
TITULAIRE DU CERTIFICAT
OTT MESSTECHNIK GmbH & Co. KG
Ludwigstrasse 16
87411 Kempten
Germany

TYPE OF EQUIPMENT
GENRE DE MATERIEL
RADAR LEVEL SENSOR

TRADE NAME AND MODEL
MARQUE ET MODELLE
OTT / RLS

FREQUENCY RANGE
BANDE DE FREQUENCES
24.15 GHz

EMISSION DESIGNATION (TRC-43)
DESIGNATION D’EMISSION (CRT-43)
1G33P0N

CONDUCTED POWER RATING (WATT)
PUISSANCE NOMINALE (WATT)
–

ANTENNA INFORMATION
INFORMATION D’ANTENNE
Integral Radom-Antenna

ACCESSORIES
ACCESSOIRES
–

CONTACT INFORMATION OF TESTING LABORATORY
COORDONNEES DU LABORATOIRE D’ESSAI
PHOENIX TESTLAB GMBH
Koenigswinkel 10
32825 Blomberg
Germany

CERTIFIED TO
CERTIFIÉ SELON LE
RSS-210 Issue 7, RSS-GEN Issue 2
RSS-102 Issue 2

SPECIFICATION / ISSUE
CAHIER DES CHARGES / ÉDITION

Certification of equipment means only that the equipment has met the requirements of the above noted specification. License applications, where applicable to use certified equipment, are acted on accordingly by the issuing office and will depend on the existing radio environment, service and location of operation. This certificate is issued on condition that the holder complies and will continue to comply with the requirements of the radio standards specifications and procedures issued by the Department. La certification du matériel signifie seulement que le matériel a satisfait aux exigences de la spécification indiquée ci-dessus. Les demandes de licences nécessaires pour utiliser du matériel certifié sont traitées en conséquence par le bureau de délivrance et dépendent de l’environnement radio existant, du service et du lieu d’exploitation. Le présent certificat est délivré à la condition que le titulaire satisfasse et continue de satisfaire aux exigences de ces cahiers des charges sur les normes radiotechniques et aux procédures du Ministère. Labeling of Certified Radio Equipment:

Certified radio equipment must be labelled with a unique certification/registration number, which consists of the Company Number (CN), assigned by the Bureau, followed by the Unique Product Number (UPN) assigned by the certificate holder. IC: 7253A-OTTRLS

A radio equipment that is issued a TAC or a Certificate but is not properly labelled is not considered certified.

Étiquetage du matériel radio homologué:

Le matériel radio homologué doit porter une étiquette sur laquelle figure un seul et unique numéro d’homologation/inscription qui est formé du numéro de compagnie (NC), attribué par le Bureau, et du numéro de produit unique (NPU), attribué par le titulaire du certificat. IC: 7253A-OTTRLS

N’est pas considéré homologué tout matériel radio mal étiqueté et pour lequel un CAT ou un certificat a été délivré.

PTL NO.: DE0003

Blomberg, 29 August 2007

Foreign Certification Body (FCB)

PHOENIX TESTLAB GmbH • Königswinkel 10 • D-32825 Blomberg, Germany • Phone: +49 (0) 5235-9500-0 • Fax: +49 (0) 5235-9500-10
http://www.phoenix-testlab.de

Signed by / Signataire Dirk Brandhorst