RADSENZ

USERGUIDE

RDZ2201

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Described products

RDZ2201RS

RDZ2201M

RDZ2201RL

RDZ2201CS

RDZ2201M

RDZ2201CL

Manufacturer

Raytelligence AB
Olofsdalsvägen
40
30241 Halmstad
Sweden

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1 Safety information

1.1 Intended use

RDZ2201 is a sensor utilizing radar technology for industrial applications such as distance measurements, silo monitoring, collision warnings, or other distance measuring use case where the sensor connects to an end system, such as a PLC. A 4-wire cable connects the sensor to a control or back-end system. The RDZ2201 datasheet describes the connectivity in detail.

1.2 Improper use

RDZ2201 is not intended for safety-critical applications in vehicles where personal injury can occur. In case of collision warning, the user shall be aware that the sensor shall not be used in applications with a risk of human injury. According to RF exposure regulations, under normal operations the end-user shall refrain from being closer than 20 cm from the device.

1.3 Cyber security

Under any operation the sensor is not connected to any network. The user configures the sensor over a wireless LAN connection to a mobile device such as a laptop or tablet. The sensor is protected from unauthorized configurations by means of a password.

2 Product description

2.1 Device variants

The RDZ2201 sensor family has the following sensors:

Part number	Range (m)	Accuracy (mm)	Update frequency (Hz)
RDZ2201RS (Relay short range)	0.3 - 10	< 1	25
RDZ2201RM (Relay medium range)	0.3 - 25	< 20	45
RDZ2201RL (Relay long range)	0.3 - 50	< 25	47
RDZ2201CS (Current Loop short range)	0.3 - 10	< 1	25
RDZ2201CM (Current Loop medium range)	0.3 - 25	< 20	45
RDZ2201CL (Current Loop long range)	0.3 - 50	< 25	47

2.2 Connection and LEDs

The sensor's electrical connection is made using a 4-wire cable described in the datasheet. The sensor is connected with a M12 4pin female connector. The RDZ2201CS, RDZ2201CM, and RDZ2201CL have Current Loop functionality. The RDZ2201RS, RDZ2201RM, and RDZ2201RL have a Relay output signal.

The RDZ2201 has an indicating LED with the following indication:

Green: Power on, upstart in progress. 3.4mA in current loop

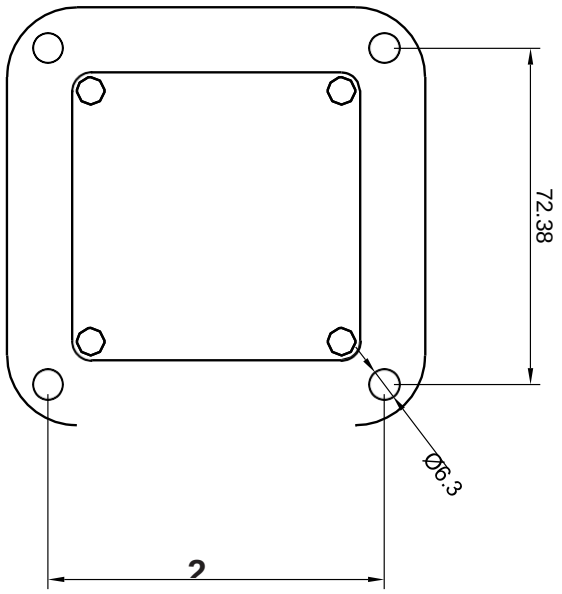
Blue: Normal operation

Red: Error. This is also indicated in the GUI.

3 Mounting

3.1 Mounting instructions

The sensor is mounted with 4 screws to a plane surface.



The sensor has a metal back facing the plane surface. It is recommended to mount the sensor on a metallic surface for best heat dissipation in hot environments.

The sensor front shall be mounted at a distance of at least 0.3 m from the closest target.

Raytelligence assumes no responsibility or liability for any personal injuries or otherwise property-related damage due to incorrect installation or in the event of the device dropping from the mounted position.

All dimensions are in millimeters.

4 Electrical installation

4.1 Connecting the device electrically

The sensor is available with two different interfaces, one with Relay output and the other with Current Loop.

Using a device with Relay output:

When interfacing the Relay, see figure below, the output, Pin 4, on the device connector should be used. When the Relay output is enabled, Pin 4 will be connected to GND. Observe maximum ratings for the Relay output.

Using a device with Current Loop:

When interfacing the Current Loop, it's important to use separate power supply units (PSU) for the loop circuit; see the figure below. The "Current Loop +" Pin 4 on the device connector, should be connected to +V on the PSU. The "Current Loop -" Pin 2, should be connected to GND via a resistor, for example, a 200 Ohm. The voltage over the resistor will then be proportional to the current in the loop. You could also connect an Ampere meter instead of the resistor to GND for direct measuring the loop current.

IMPORTANT: Do not connect Sensor +24V to Current Loop +, use separate PSUs. Never connect the GND for the two PSUs. The Current Loop must have its own GND for proper operation.

The sensor gives a current signal of 4-20 mA, indicating the distance to the first target within the Range of Interest (RoI) set by the user in the GUI described below. 4 mA refers to the lower limit of the RoI, and 20 mA to the highest limit.

The user sets a threshold in the GUI. If the target peak exceeds the threshold, the output current will be given by the RoI boundaries and scaled.

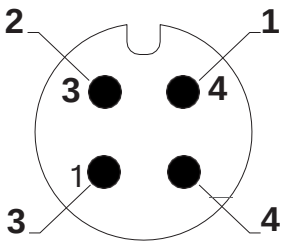
If no peak exceeds the threshold, the output current will be 3 mA indicating no target.

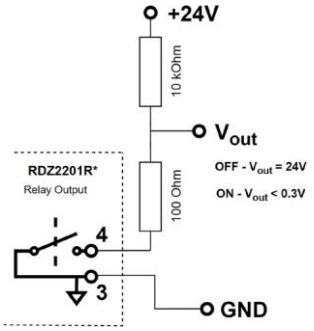
If the sensor enters into an error state, the current output will be 2 mA, and the sensor will attempt to recover from the error state automatically.

The relay will close when a target peak in the RoI exceeds the threshold; in other ways, it is open.

The time delay from when a peak exceeds the threshold in the RoI to when the relay is closed is maximum: 123 µs

4.2 Relay (RDZ2201R∗)



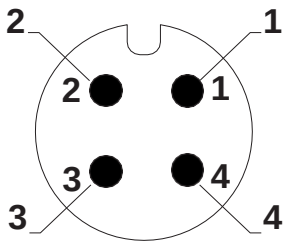


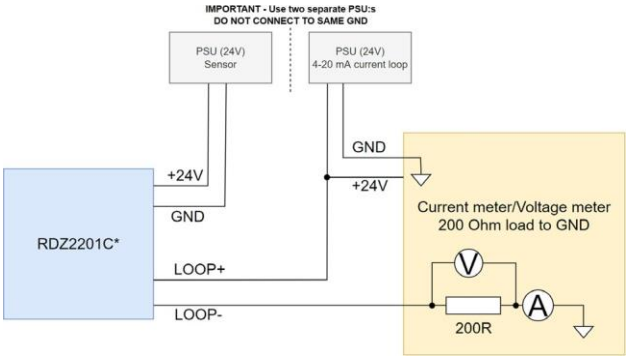
1.	Vin
2.	NC (not connected)
3.	GND
4.	Relay

	Max	Typical
V_{relay}	40 V_{DC} (max 0.4 W)	
I	0.2 A $_{DC}$ (max 0.4 W)	
R_{relay}	10 Ohm	1 Ohm

Solid state relay - UL1577 Approved

4.3 Current Loop (RDZ2201C*)





1.	Vin
2.	Current Loop-
3.	GND
4.	Current Loop+

	Max	Typical
V_{loop+}	24 V	24 V

IMPORTANT -
Use two separate PSU:s. DO NOT CONNECT TO SAME GND

5 Current Loop

5.1 Distance conversion

Distance as a function of current: $d = \frac{I-4}{16} \times (RoI_{max} - RoI_{min}) + RoI_{min}$

d:Calculated distance between the sensor and the target

l: Current received by your system from the sensor

RoI_{min}=Minimum range of RoI

RoI_{max}=Maximum range of RoI

5.2 Example

In the previous section, we provided an example of configuring the device. Here, we will extend that scenario

and explain how to convert a provided current to a distance on your end system. To recap,

RoI is 2 to 8 meters, and your end-system receives a current of 12 mA. Plug in the values

in the formula above to compute the distance between the grain level and the sensor.

$$d = \frac{I-4}{16} \times (RoI_{max} - RoI_{min}) + RoI_{min}$$

Providing the given values, we have the following equation:

$$d = \frac{12-4}{16} \times (8-2) + 2 = 5$$

We're almost finished; all we must do is subtract the distance between the grain level and sensor from the

total height of the silo. This will give us the height of the grain in the silo.

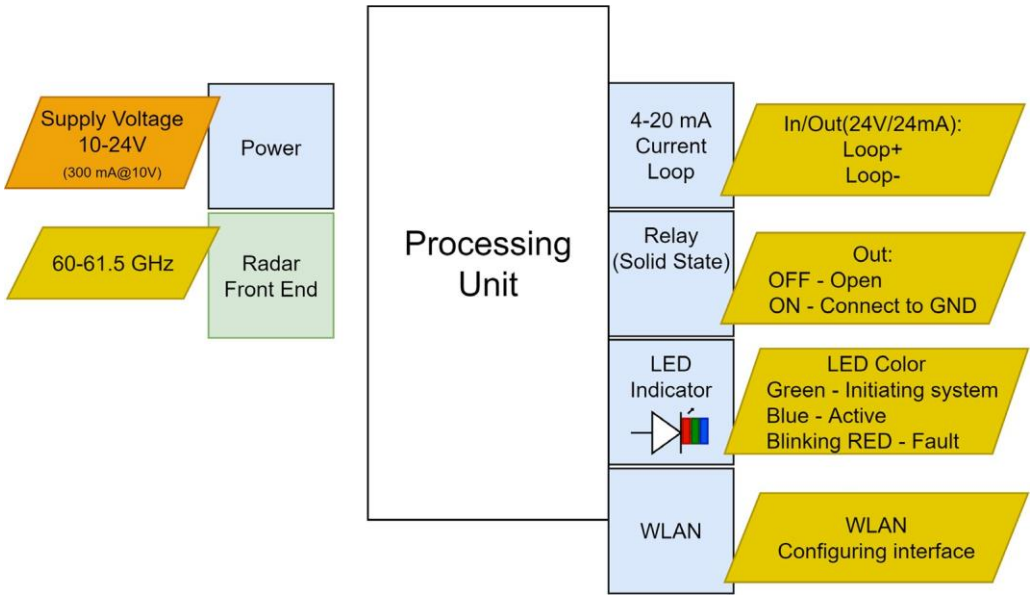
8 - 5 = 3m

And there it is! The silo is filled up 3 meters with grain, given a current provided by the Radsenz device.

6 Operation

6.1 General advice

The sensor is configured over a web interface that the user connects to via wireless LAN. Any WiFi- equipped mobile device, such as a laptop or a tablet, discovers the sensor. The sensor is an access point and not connected to any other network.



The sensor is first set into operation by the following steps:

1. Prepare the wire connection to your control system
2. Mount the sensor
3. Connect the sensor to the control system
4. Log onto the sensor with a WLAN device.
5. Set the RoI and threshold
6. Test the sensor operation with the Dashbord (GUI) running. You will find the sensor output in the GUI as well as over the electric connection.
7. When the sensor is operating to satisfaction logout from the GUI.

6.2 Power On

The sensor is automatically switched on when power is connected. The LED will indicate power-on with GREEN. The sensor boot time is approximately 2 minutes. The sensor is in operation when the LED is BLUE.

6.3 Opening User Interface

After power-on, the LED will turn blue after approximately two minutes. The user then starts his device equipped with WLAN. The user then starts the web browser on the device and types in the following **IP address: 192.168.8.1** to access the graphical user interface, also “GUI” or “Dashboard.”

7 Dashboard

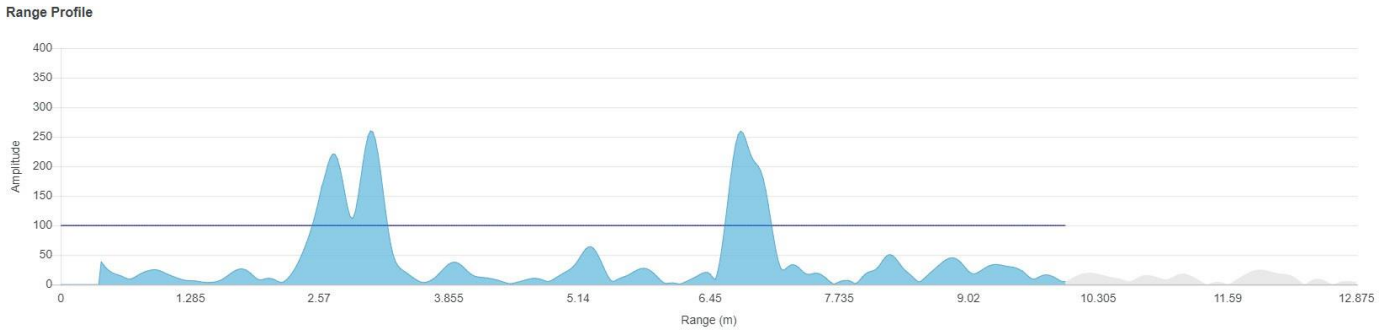
The Dashboard is the sensor's user interface, letting users interact with and configure the device. On the Dashboard, you can get a graphical presentation of the radar's view, set output parameters, or receive additional information about your device. This section will describe the graphical user interface in more detail.

7.1 Range Profile

The Range Profile is a graphical representation of radar reflections from targets as a function of distance from the sensor. Targets amplitude depends on many factors, such as range, size, shape, and material properties. Every object illuminated by the radar beam will add to the Range Profile response and may cause obscuring clutter. The user must tune the sensor settings and its surroundings for optimal use. In the Dashboard settings, you can configure the device's sensitivity by changing the threshold bar. The Range Profile in the user interface is updated at a rate of 5Hz.

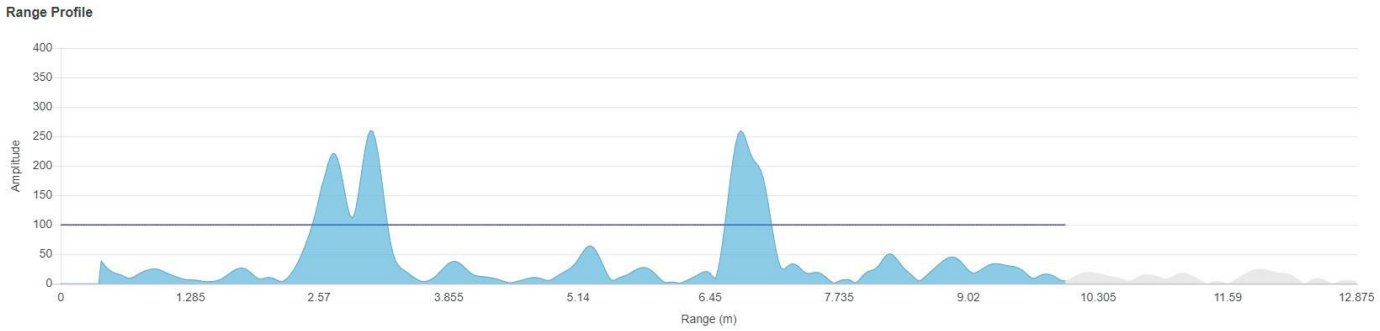
An inherent property of a radar sensor is its maximum unambiguous range. Strong reflections from objects beyond the unambiguous range will appear inside the range profile curve, apparently at a shorter distance, and thus may cause false detections and readouts. The sensor unambiguous range depends on properties of the emitted radar signal, set from the factory. Typically, problems caused by this can be mitigated by rearranging the sensor position, aiming, and by reducing strong reflections beyond the unambiguous range.

7.2 Range of Interest



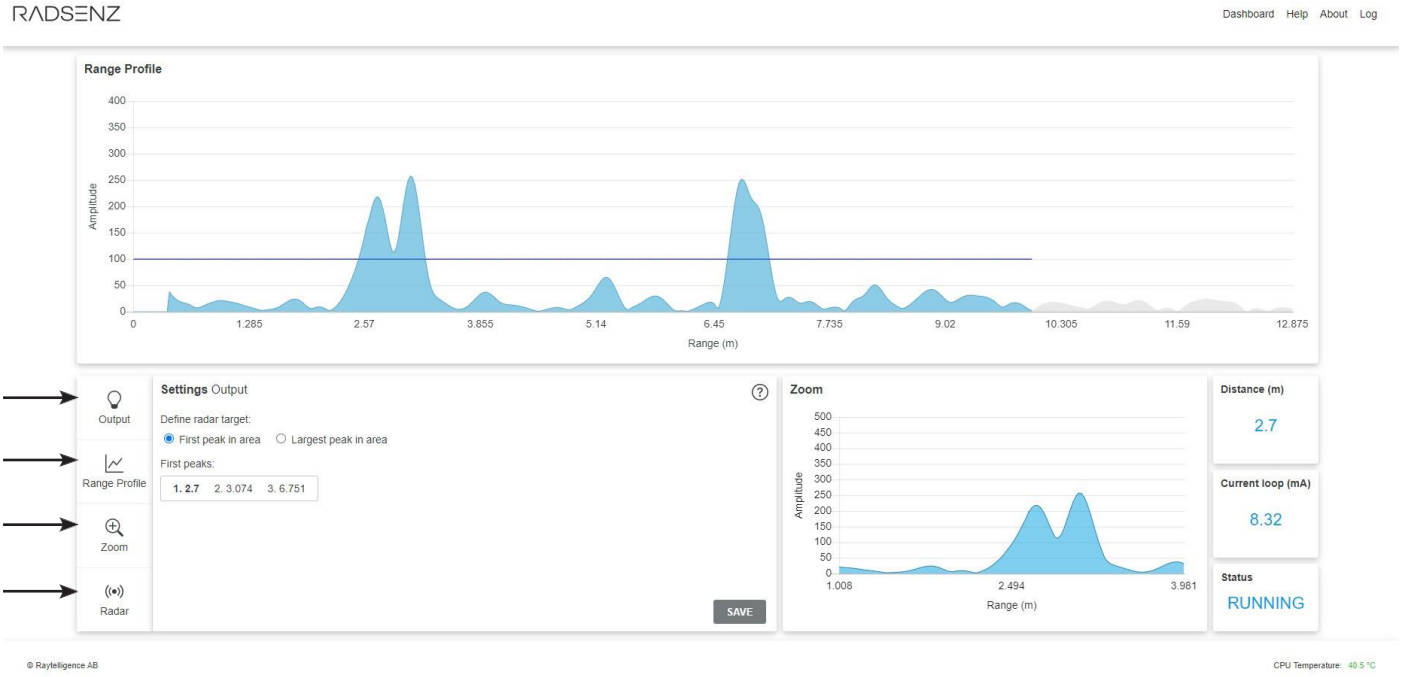
Range of Interest (RoI) is the delimited area within the Range Profile denoted in blue color. Everything outside the Range of Interest will have a faded grey color. Any targets within the RoI will generate an output, either pulling the relay, or sending a corresponding current on the current loop. The Range of Interest will not alter the accuracy or resolution of the radar.

7.3 Peak Selection



Given the previous section regarding radar noise, you can define what the sensor determines as noise and what it determines as a peak. This process of selecting peaks is conducted by tuning the “Target threshold” parameter in the Range Profile setting tab. Any graphical peaks above the target threshold are considered valid targets by the sensor and will trigger a sensor output if the peak is within the Range of Interest. The distinction between noise and peaks is presented in the figure above.

7.4 Settings



There are four different tabs to the left of the Dashboard used to decide the behavior of the radar and configure when the device should communicate to your end system. The four tabs are Output, Range Profile, Zoom, and Radar, described in more detail below.

7.5 Settings : Output

In the Output tab, you choose whether the sensor should send output signals to your end system depending on the first target or the target with the most prominent reflection. Depending on your use case, either one of them could be beneficial. Here are different use cases to clarify the distinction between the two.

First radar target: There is a clear view between the sensor and the radar target. Even if radar reflections occur after the first peak, it is still the first object you wish to monitor. In the Dashboard, you select the First radar target.

Largest radar target: Some irrelevant objects exists between the sensor and the radar target(s) you wish to monitor, but your target will cause the largest radar reflection. Perhaps your radar target is the largest or has a material that facilitates waves reflecting from it, such as metal. In the Dashboard, you select the Largest radar target.

Depending on your choice, this option follows a list of the five first or the largest peaks. The list serves as a tool to distinguish targets in your Range of Interest.

7.6 Settings : Range Profile

The Range of Interest is the horizontal Range interval, in which the sensor will react to targets and further communicate them to your end system. For example, there is an occurrence of objects somewhere between three and five meters from the sensor. You want the sensor to react according to these objects but only something before three or beyond five meters. In the Range Profile tab, setting the minimum Range to 3 and the maximum Range to 5, you isolate your Range of interest in the entire field of view. The Range of Interest is denoted in blue color in the Range Profile. The sensor will ignore all targets outside this zone.

In this tab, you can also configure what the sensor considers targets. Use the Target threshold as a threshold for this determination. All amplitudes below the Target threshold will be ignored, while all amplitudes above the Target threshold are considered peaks. If you want the sensor to be more sensitive and reactive, set the Target threshold to a low value. On the other hand, set the Target threshold to a high value, and you'll filter more reflections.

Min range (m): Range of Interest starting point.

Max range (m): Range of Interest ending point.

Max graph amplitude: Set the maximum value of the graph's vertical axis.

Target threshold: Threshold that determines peaks (above).

Relay threshold: Any peak higher than the Relay threshold, within the Range of Interest, will send a relay output. (Only valid for relay sensors)

7.7 Settings : Zoom

Use the Zoom function to distinguish target amplitudes in the Range Profile. Set the zoom limits directly by clicking on the graph in the Range Profile or manually set the values in this tab. The Zoom will zone in on a specific section of the range profile, which you can use as a tool to determine peaks.

Min range (m) - Zoom's minimum Range and starting point. 0.5 meters before the point you clicked on the Range Profile.

Max range (m) - Zoom's maximum Range and ending point. 0.5 meters beyond the point you clicked on the Range Profile.

Max graph amplitude: Set the maximum value of the graph's vertical axis.

7.8 Settings : Radar

This tab contains technical data about the devices radar configuration.

7.9 Output Indicator

The output indicator on the Dashboard is one of the cards to the right. For the Current Loop version, it is the card that states the current in mA. For the Relay version, the same card only contains a light bulb symbol. A pulled relay will turn the card orange.

7.10 Status

The status card indicates the status of the device and can be one of the following:

ONLINE: The device is turned on and connected, but the radar is not running.

RUNNING: The device is turned on, connected and the radar is running. Operational status.

FAULT: Something is wrong with the device and it will be rebooted. Disconnect the power source and connect it again.

 : Your device has no connection to the device's WLAN.

7.11 Help

The Help page contains useful information on how to operate the device. Note that the latest version of the datasheet and manual is available on our website www.raytelligence.com

7.12 About

The About page contains information about your device, such as version numbers, serial number and how to get in touch with us if you experience any issues

7.13 Example

This section will provide you with a first look at how to work with the Radsenz Dashboard. Below you will find two examples explained in clear 'step-by-step'-tutorials. The results will be a configuration that sends a Current Loop or Relay signal when a target moves within the Range of Interest. Scenario: In this example a Radsenz device is mounted at the top of a silo filled with grain. The silo is 8 meters high, and the maximum capacity of grain corresponds to a height of 6 meters.

Current Loop output:

Configuration:

We will configure the device to emit a current corresponding to the distance from the grain level to the sensor.

1. *Open the Radsenz Dashboard*

Connect to the devices' WLAN, by selecting it in your device's WiFi-settings and enter the password. Once connected, open a web browser on your mobile device and go to URL 192.168.8.1.

2. *Define the Range of Interest*

The silo is 8 meters, and the maximum capacity of grain is 6 meters (2 meters from the sensor), meaning that the RoI should be set to these two distances. In the setting tab Range Profile, set the following parameters, Min range (m): 2 Max range (m): 8 .

3. *Set amplitude levels*

Set Max target amplitude and Target threshold to your preferences depending on the reflections within the silo. See section Range Profile : Peak Selection for more information.

4. *Configure the sensor to react to the first peak*

Knowing that the grain level will be the first object reflected to the radar, toggle the option "First peak in area" in the setting tab "Output".

Now you have configured the mounted device to send a current corresponding to the grain level in your silo with the RoI, 2 to 8 meters from the mounted sensor. See section "Current Loop" for more information.

Relay output:

Configuration:

We will configure the device to send a relay signal when the silo reaches its maximum capacity, somewhere between 5 and 6 meters.

1. *Open the Radsenz Dashboard*

Connect to the devices' WLAN, by selecting it in your device's WiFi-settings and enter the password. Once connected, open a web browser and go to URL 192.168.8.1.

2. *Define the Range of Interest*

The maximum capacity of the silo is known to be somewhere between 5 and 6 meters high. From the sensor's perspective this is equivalent to a range of 2 to 3 meters from the sensor (given that the sensor is mounted on the top of the 8-meter-tall silo). In the setting tab Range Profile, set the following parameters, Min range (m): 2 Max range (m): 3 .

3. *Set amplitude levels*

Set Max graph amplitude and Target threshold to your preferences depending on the reflections within the silo. See section Range Profile : Peak Selection for more information. Set the Relay threshold to a value knowing that the grain level target will be higher than that. The grey area outside the RoI is also active to show the current grain level.

4. *Configure the sensor to react to the first peak*

Knowing that the grain level will be the first object reflected to the radar, toggle the option "First peak in area" in the setting tab "Output". Save your settings by clicking the "SAVE"-button.

Now you have configured the mounted device to react whenever the grain level is between 5 and 6 meters.

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MADE IN SWEDEN

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