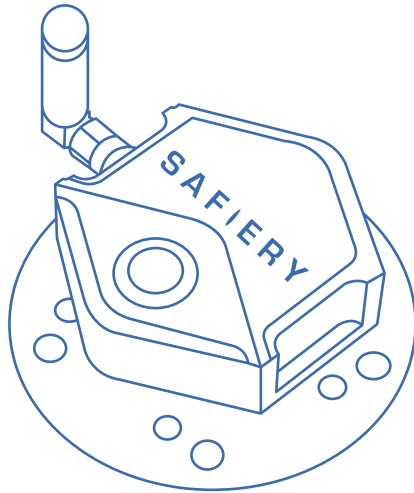


# STAR-TANK

## USER MANUAL Software Version Update 3 User Setting of Tank Depth Major Use of AI in Auto-calibration



Version Release November 20th 2024:

Version 3 which eliminates the need for multiple SKU's for different tank depths and includes an auto-calibration process after the tank depth is set. Over the Air Update process included in this release.

**Tomorrow's Technology, Today**

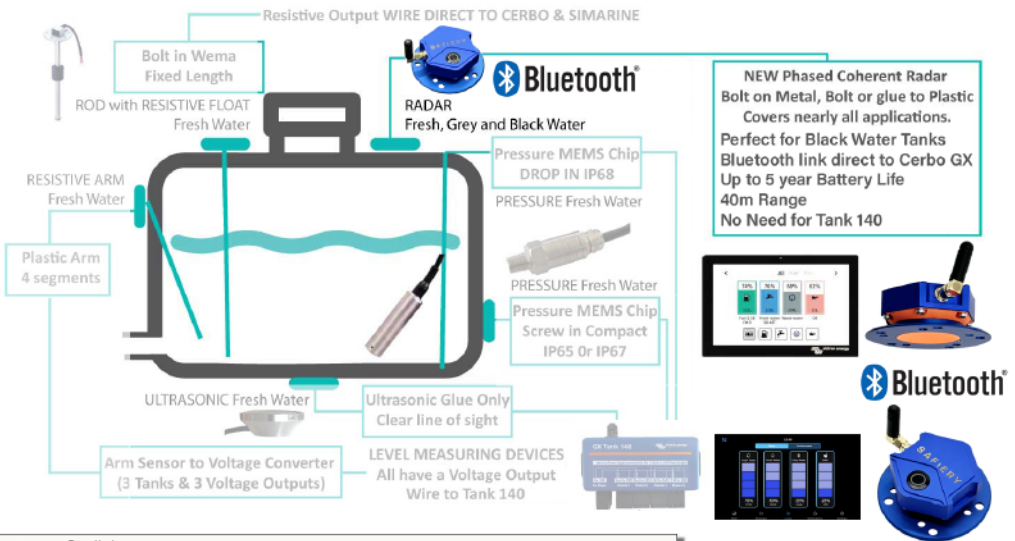


# STAR - TANK

is a radar based tank level sensor that mounts at the top of the tank

- Operates directly through non-metallic tanks - top mounted
- In metal tanks a hole is cut and an SAE 5 holt bolt pattern used (industry standard)
- Operates in Black and Grey Water. It is not affected by foam or gasses
- This model is battery operatedo operated with a target 5 year life.
- Unit has "Long Range Bluetooth" that we have tested to 100m line of sight and 40m through metal layers in a typical van build.

## Fresh, Grey, Black Water and Fuel



Starlink Tank [29]	Last seen 10 minutes ago
Product	Safiery STAR-tank sensor
Last connection	10 minutes ago
VRM instance	29



World's First Battery Operated Radar tank Level Sensor - Bluetooth to Victron Cerbo GX

## SPECIFICATIONS

This battery powered sensor:

- Bluetooth Connection to Victron GX models ONLY
- Battery Life 3-5 years (longer range and lower level tank, battery life 3 years. Shorter range and tank level typically 50% then 5 year)
- Battery 2744
- Bluetooth 5.3 Adv Output ONLY
- Deadband 30mm but this increases with the nominated tank depth below.
- Max Depth 200mm pre-set. User settings now set tank level at:
  - 1) 0-500mm
  - 2) 500-1000mm
  - 3) 1000mm to 2000mm
- Repeatability 1mm
  - Press button on top and reporting changes to 10 sec intervals for 10mins
- (during commissioning)
  - After 10 mins at 10 sec reporting, interval changes to 60 second intervals

## MOUNTING

The base of the Sensor has 2 sets of holes:

SAE 5 bolt hole

For Plastic Tanks:

- Glue Sensor to top of tank. The SAE bolt holes form the basis for the bonding.

Cable Length:

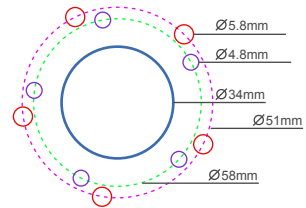
- No Cable. It is Battery powered and Bluetooth.

Connections:

- No Connections

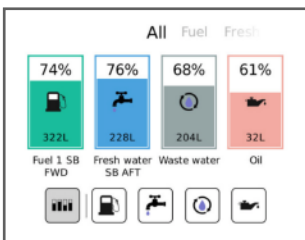
Simple Calibrations:

- Calibration needed from Display



## ETSI

Safiery declares that this sensor is compliant with the European commission radio equipment directive 2014/53/EU article 3.1 and 3.2.



## Safiery STAR-Tank Radar Bluetooth Sensors

STAR-Tank sensor support is added to Venus OS. These radar tank level sensors use Bluetooth Low Energy. This wireless technology allows devices to be networked within a range of about 40 meters (with Bluetooth Adapter added to Cerbo GX, see below), while consuming significantly less power than ordinary Bluetooth technology.

The expected battery life is 5 years with tank measurement averaging 50%. Battery life is less at around 3 years if tanks average 10% level for example. The liquid level, temperature and sensor battery voltage are streamed wirelessly to the GX device.

STAR-Tank sensors feature phased coherent radar sensing for non-pressurized tanks. The tank level range is 2m as standard. This can be extended, consult Safiery. The top 30mm from the base of the sensor is a dead band. If the tank is 12mm thick fiberglass, then the deadband is 18mm below the top of the tank.

The sensors are attached directly on top of any non-metal tank including thick fibreglass tanks. For metal tanks, the sensor needs a clear view of the liquid. To achieve that, a 5 hole SAE pattern adapter is included into the base. To achieve an air tight seal, use “gas sealing tape” (generally pink) and wrap on the thread and screw into the base plate. This prevents gas from the tank passing through STAR-Tank.

For non-metal tanks, adhere the base plate. Then, screw the STAR-Tank module onto the base. STAR-Tank suits black water tanks, even with foam above the liquid line.

STAR-Tank has several machine learning functions for caibration using AI.

1. There are hundreds of reflected radar signals from the bottom and side of the tank. Our program selects the dominant value during the first 10 seconds of “setup” mode. It then retains the profile for your tank at the tank depth selected. Every time a different tank depth is selected using the setup mode, a different filtering profile is stored in memory.
2. The shape of these reflected signals changes with tank depth. By going through the setup process and nominating the tank depth changes the way we filter the reflected signals and select a dominant value.
3. The “Setup Mode” process described on the next page combines 1 and 2 above into a single process.

## Safiery STAR-Tank Radar Operating Modes and Calibration

There are 4 Operating Modes for STAR-Tank:

1. Hibernation Mode (commonly called "off")
2. Setup Mode (used to calibrate/setup and reports at 10 sec intervals for 10 mins)
3. Normal Mode with 60 second scan time automatically occurs 10minutes after being in setup mode.
4. Over the Air Update Mode (commonly call OTA) is a separate user initiated mode.

Before moving from Hibernation mode to Setup mode, there are two allowable positions for STAR-Tank in SETUP Mode. Either:

- Start with an empty tank or one containing a minimal amount of liquid and have STAR-Tank in its recording position.

OR

- If the tank is not empty, point the STAR-Tank sensor into open air, ensuring there are no obstructions within at least 5 meters and follow the Setup mode with STAR-Tank pointing into open space. **Do not proceed with the calibration on a partially full tank with STAR-Tank on top of the tank.** After following Setup Mode below, then place STAR-Tank on a partially full tank.

THEN Enter Setup Mode:

1. Press and hold the button for 5 to 15 seconds, then release to enter SETUP MODE. The LED will indicate the following statuses:
  - Green: Button held for less than 5 seconds (not in Setup Mode).
  - Fast Flashing Red: Button held for 5 to 15 seconds (Setup Mode activated).
  - **Then Release the button before the 15secs is up.**

The LED will now show the selected maximum tank depth as follows:

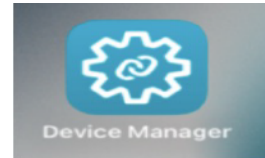
- One Green Flash for 1 sec: Small Depth of 0-50cm.
- Two Red Flashes for 2 secs: Medium Depth of 50-100cm.
- Three Blue Flashes for 3 secs: Large Depth of 100-200cm.

To change the depth, go back to step 1 above and repeat the 5 to 15sec press. Remember to release the button before 15 seconds. The calibrated tank depth will cycle through the three levels.

Once the level is nominated, the AI function is now complete. Every 10 seconds for 10 minutes, the LED flashes tank level status: Flashing purple means tank is absolutely full or some object under sensor is blocking it like a baffle or the tank is empty and DRY. Flashing red means the tank is close to full. Flashing green means tank level is 100cm or more below the sensor. In-between are the colours of orange to yellow.

## Safiery STAR-Tank Radar Over the Air Update Mode

### Entering OTA Mode



1. Download the following app, Device manager.
2. Once the app is installed, press the STAR-Tank button 10 times. The LED will start blinking purple, indicating you are now in OTA mode.
3. Open the app. In the Device Manager, you will see "Startank\_DFU". Select it.
4. You will enter a screen with four options. Select Image, which is the second option from the right.
5. Inside the Image screen, there will be a blue-highlighted option labelled Select File.
6. Select the zip file with the updated version.
7. Once selected, press the blue Start icon to begin the process.
8. A menu will appear. Select Upload Only.
9. Once the upload is complete, a message will display: Upload Complete.
10. Finally, recalibrate the sensor by going into SETUP MODE and complete setup

### To Set to "OFF" or Hibernation Mode

11. Press and hold the LED for more than 15 secs.
12. Looking at the LED, it will indicate the following ( 0 < green <= 5 secs, 5 secs < Fast flash red <= 15 secs, Solid red < 15 secs ) once 15 seconds has elapsed the LED will change to solid red until the button is released.
13. Let go of the button and you are now in Hibernation mode.

### Automatically moving to "NORMAL MODE"

14. From "SETUP MODE" after 10mins, STAR-Tank automatically moves to NORMAL MODE with 60 second reporting.

## Safiery STAR-Tank Sampling Rate and Approvals

To turn STAR-Tank off, press and hold the black button. The sensor will not use any battery capacity when turned off. .

The normal sampling interval for the long battery life is 60 seconds. Pressing the black button for 1-2 seconds will change the sampling time to 10 seconds for up to 10 minutes. Then the sampling reverts to 60 seconds.

Many tank level sensors use averaging to smooth out signal results. We cannot do this with STAR-Tank as it would consume too much battery power. Every reading is a one shot result. The implications of this is that occasionally, you may see a flickering of value for 1 cycle.

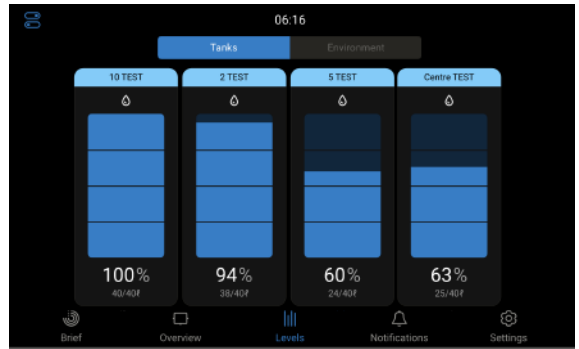
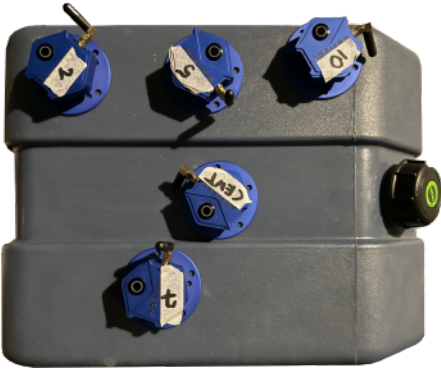
In future developments on the Victron side, the temperature value may be used to trigger the temperature relay function on the GX device with relays to initiate stirrers or heaters in tanks as well as notification of this.

To connect STAR-Tank sensors to the GX device via Bluetooth, the GX device needs Bluetooth functionality. Although GX products already have built-in Bluetooth, this internal function may be disabled if the processor gets too hot. Safiery recommends installing a Nano USB Bluetooth adapter from the list below.

USB Bluetooth adapter				
Insignia (NS-PCY5BMA2)	<a href="#">Logilink BT0037</a>	TP-Link UB400(UN)	<a href="#">Kinivo BTD-400</a>	<a href="#">Ideapro USB bluetooth adapter 4.0</a>
<a href="#">Ewent EW1085R4</a>	Laird BT820	Laird BT851	-	-

This radar tank level sensor is approved with FCC for USA. It is compliant with European commission radio equipment directive 2014/53/EU article 3.1 and 3.2. and is CE and UKCA approved.

## Safiery STAR-Tank Radar Sensor Positions and Calibrated Depth



*STAR-Tank uses reflected radio waves at 60GHz. It is therefore important that the sensor is away from the edge of the tank and free from baffles. The test setup above is a nominal 40L tank with 25L of water in it.*

- 1 The Centre Test Sensor is reading correctly as the range for the bottom of the tank is set correctly at 35.6 cm in this example.
- 2 Test Sensor 5 was calibrated at same bottom reading then lifted up to the raised side section of the tank which is 9 mm higher. This meant the distance to the water inside was 9 mm longer. At 40L for 356mm depth, the volume per mm is approx 0.1124 L. So raising 9 mm will reduce the aparent volume by  $9 \times 0.1124 = 1.011$  L.
- 3 Test Sensors 2 and 10 are too close to the edge. The Frenzel lens is set to give a 30 degree cone of trasmission. The side is interfering with this giving a 100% reading for Sensor 10 and 94% for Sensor 2 which is a little further from the edge..

*If the tank is a shallow tank of say 200-250mm depth, the standard STAR-Tank sensor will show fluctuations when full as the top dead band is a percentage of full scale setting. For a nominal 1m calibrated sensor: the top deadband is about 50mm. The sensor is 16mm above the bottom of the housing leaving 34mm below top of tank.*

*Generally, full tank accuracy is not important. But if this irritates you, then set the tank level in the Cerbo to Full at a value greater than 0. Here is a guide.*

### 20~50 cm Depth

Dead band 9-15mm  
When tank is full.  
But won't read past  
500mm

### 50~100 cm Depth

Dead band 30-35mm  
When tank is full.  
But won't read past  
1,000mm

### 100~ 200cm Depth

Dead band 50-70mm  
When tank is full.  
But won't read past  
2,000mm

## Safiery STAR-Tank Radar Sensor Positions

### BLACK Water Tank



This position did NOT work



This position did work

### FRESH Water Tank



This position did work



This position works  
on ALKO ribbed 95L tank

This video Shows how to setup STAR-Tank for different Max Tank Depths

## Safiery STAR-Tank Radar Bluetooth Sensors

Device List		📶 08:29
AC load		61W >
Diesel		53W >
Fresh water tank (34)	23 C	55% >
LPG tank (35)	15 C	65% >
MPPT 75/15 rev2 beta		4W >
MPPT 150/35 rev2 BS		22W >
📄 Pages		⏏ Menu

*The installation of the STAR-Tank sensor is very simple. First, however, the sensor must be installed according to Safiery's installation instructions.*

*Then the installation and configuration is done in the GX device as described*

- 1 Make sure Bluetooth is enabled in the Bluetooth sensors menu (enabled by default).
- 2 Go to Settings → I/O → Bluetooth sensors menu.
- 3 Move the Enable slider to the right to enable Bluetooth sensors.
- 4 To find your STAR-Tank sensor, scroll down until you see them.
- 5 To activate the sensor, move the slider to the right. It should now appear on the Device List.
- 6 Repeat steps 1..5 for more than one sensor.

GO TO VICTRON CERBO OR EKRANO GX MANUAL FOR SETUP PROCESS.