Radar Proximity Sensor System (RPSS)

User Manual

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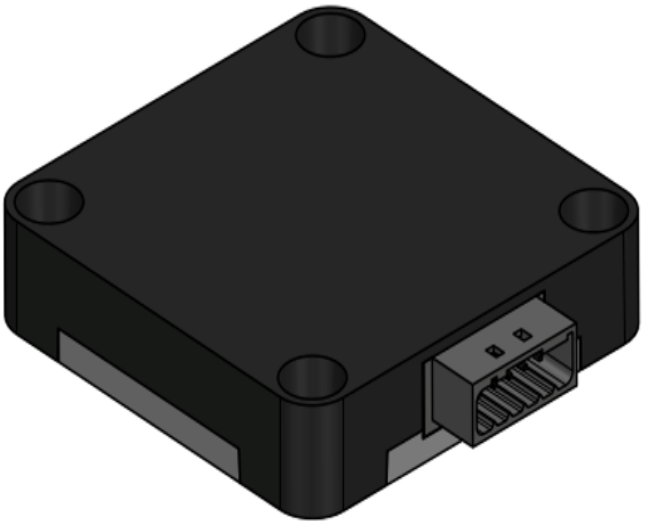
Bootloader:	1.0
Software:	0.5.9.2
Regulatory compliance:	UKCA, CE, FCC

1 Introduction



Radar proximity sensor (RPS) is a hazard monitoring sensor that overcomes the challenges of vision-sensing in Advanced Driver Assistance Systems (ADAS) to realise L2/L3 applications by providing direct measurement of range, velocity and angle of arrival in azimuth and elevation. It offers a safer, efficient, and easier driving experience which is built upon FMCW MIMO technology in the millimeter wave (mmWave) 77-81 GHz band utilising a wide 4GHz bandwidth. It can detect object structure and is generally unaffected by harsh operating conditions such as rain, snow, fog, and ambient lighting.

Key Features:

- Efficient, screw-less enclosure design that incorporates cutting-edge mmWave radar optimised material for the housing, along with an E-coated, cast aluminium alloy back plate which can act as a heatsink to the sensor module. Achieves both IP67 & IPx9k rating. Withstands harsh operating environment, low profile for easy integration and can be hidden behind radome panels.
- CAN-FD enabled, 77 GHz FMCW radar sensor with 3 transmitters and 4 receivers and can be configured to run multiple custom radar modes triggered by CAN commands. Multiple radars can be used on a single bus to create a complete system to support a suite of ADAS features.
- Antenna-on-mezzanine multi-PCBA design enables flexibility on RF design and implementation of antenna array options.
- Software defined simultaneous ultra-short range, medium-range and long-range radar application.

Advanced Driver Assist Systems (ADAS) Applications

- Proximity Warning
- Blind Spot Monitoring
- Cross Traffic Alert
- Parking Assist
- Collision Warning
- VRU detection
- Automated Urban Driving
- Automated Highway Driving

2 Product profile

2.1 Description

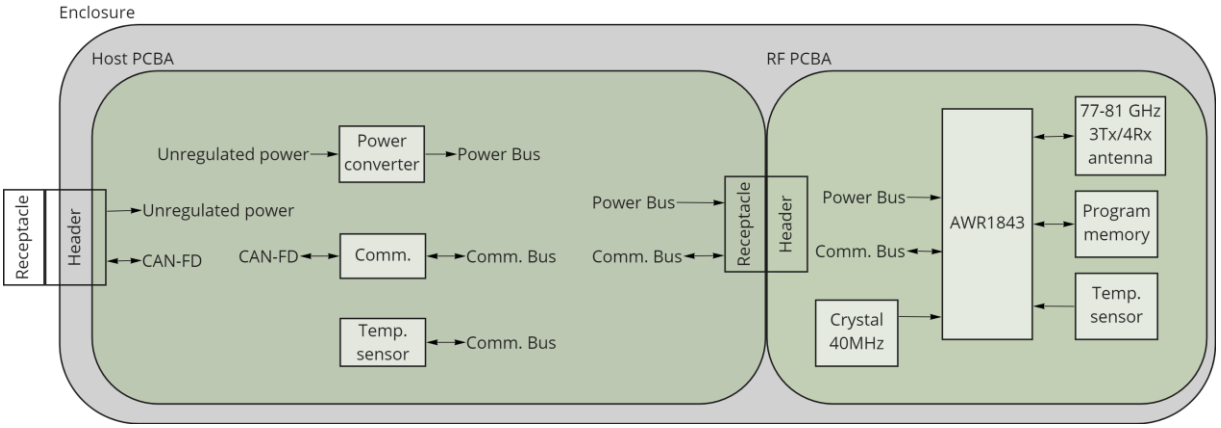


Figure 1: Radar proximity sensor block diagram

As depicted in figure above, the sensor comprises two printed circuit board assemblies (PCBA) namely RF Board and Host Board which are connected internally through a board-to-board connector. The sensor interfaces with rest of the system through an external connector which brings power and system communication bus to the sensor. The sensor can operate from a wide input voltage range, 12 – 36 VDC, and communicates with rest of the system over twisted pair cable using Controller Area Network Flexible Data-Rate (CAN-FD) data-communication protocol.

2.2 Specification

Electrical	
Operating voltage	10VDC ~ 14VDC(Nominal 12VDC) 22VDC ~ 26VDC(Nominal 24VDC)
Power rating	12.5W
Communication Interface	
Physical layer	Twisted pair differential signal
Protocol	Controller Area Network Flexible Data-Rate (CAN-FD)
Data rate	upto 5mbps
Object detection - Azimuth	
Type	Static and Dynamic
Range measurement	0.05 - 225 m
Velocity measurement	0 - 92 kmph
Azimuth beamwidth	+/- 60° (depending upon antenna array implementation)
Elevation beamwidth	+/- 30° (depending upon antenna array implementation)
minimum object to object separation in range	0.039m
minimum object to object separation in velocity	0.32m/s
Environmental	

Ingress protection	IP67, IPx9K
Operating temperature range	-40 to + 75°C
Mechanical	
RPSS Dimensions	80 x 90 x 18 mm OA
Weight	150g / 0.015kg
Radar Properties	
Frequency of operation	77-81GHz band
Antenna array	3x Transmit antenna, +12dBm/antenna 4x Receive antenna
Radio certification	FCC/RED/ETSI
Data Output	
Type	Point cloud, clusters, trackers (depending upon radar mode and customer requirement)
Data rate	Adjustable depending upon use case, radar mode and sensor integration

2.3 Mating Connector and wiring

Mating connector: JAE MX44006SF1
Contacts: JAE MX44006SF1

Pin	Function	Size	Colour	
1	Power	0.5 mm2	Red	
2	Ground	0.5 mm2	Black	
3	CAN_H	For external 120Ω Resistor		
4	CAN_H	0.5 mm2	White/Blue	Twisted pair
5	CAN_L	0.5 mm2	Blue	Twisted pair
6	CAN_L	For external 120Ω Resistor		

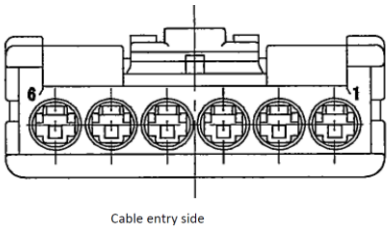


Figure 2: Mating Connector

2.4 Dimensions and part marking

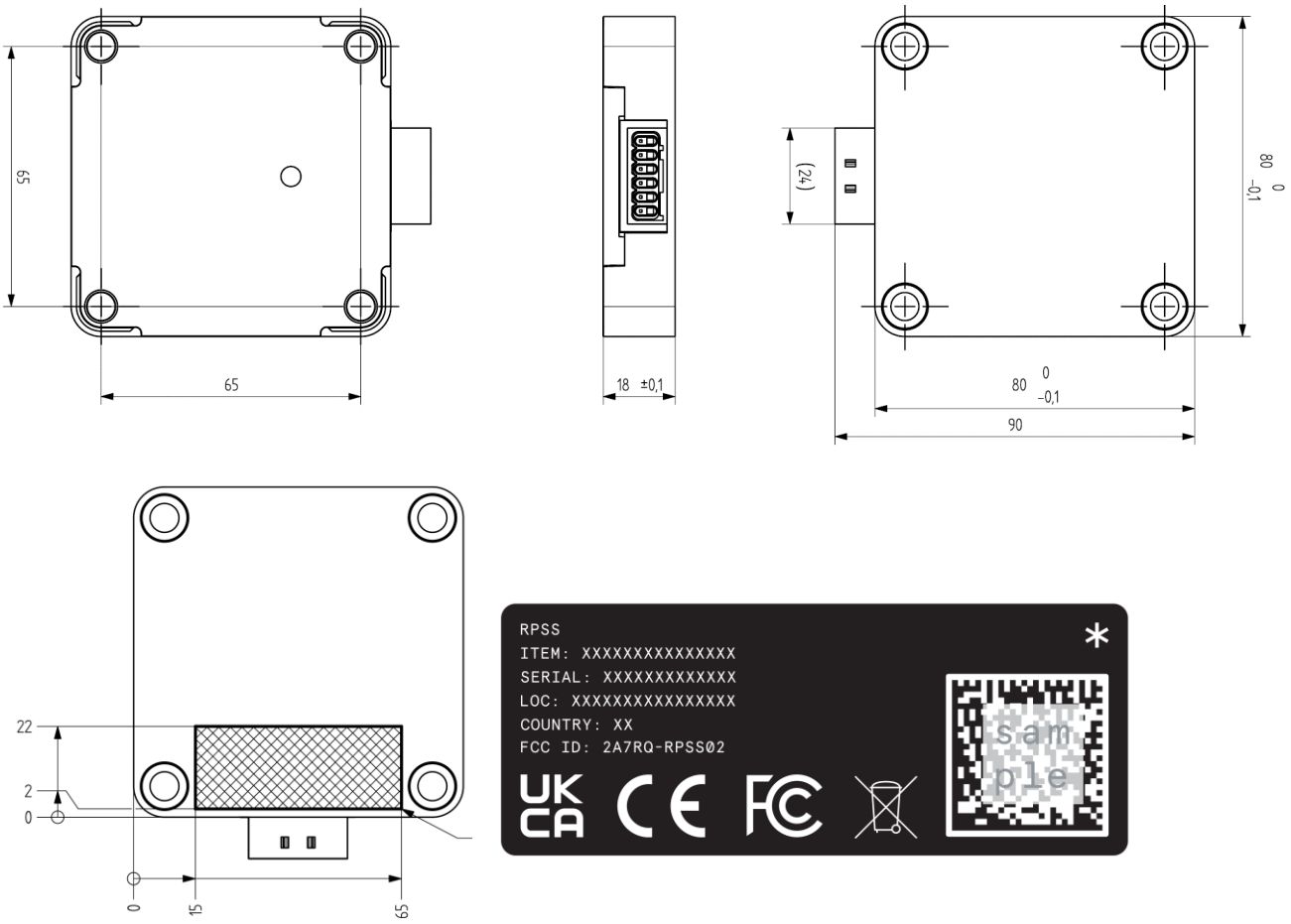


Figure 3: Dimensions and part marking

2.5 Operating the sensor

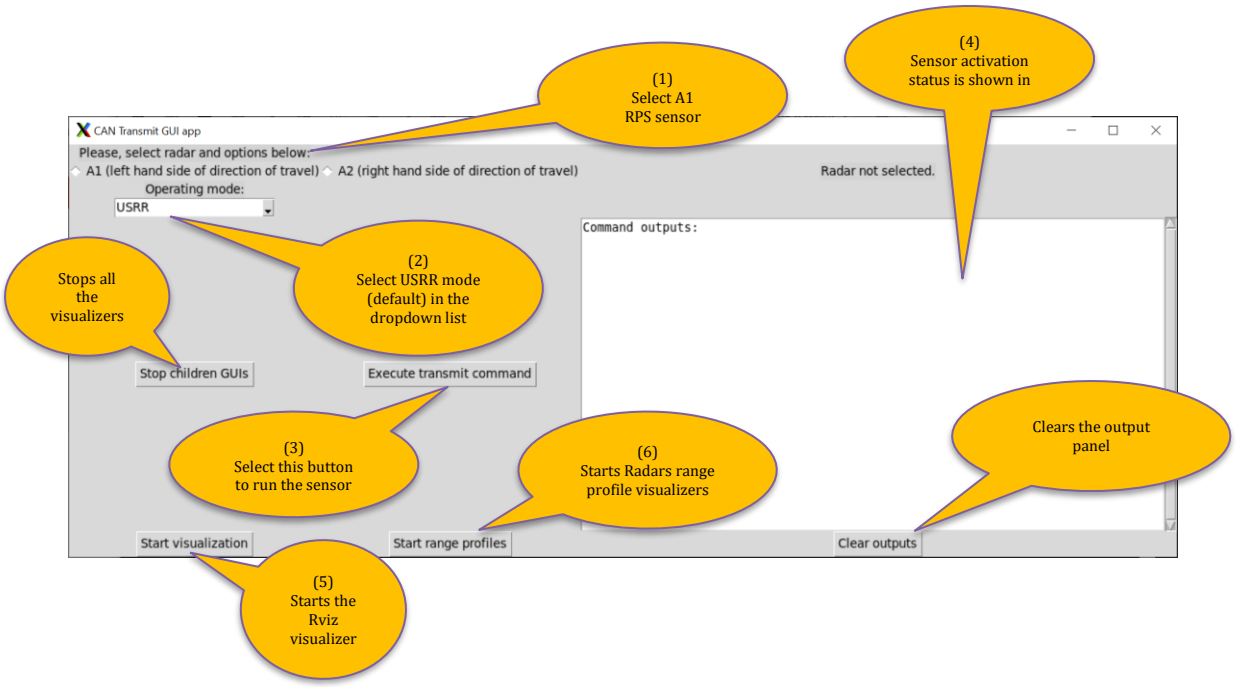
2.5.1 Hardware and software setup

- Connect the RPSS device to the CAN bus
- Connect the other end of the CAN bus to the PEAK PCAN USB adapter and to a power supply (Voltage should be set between 12V and 20V and 2Amp max).
- Connect the PEAK PCAN USB adapter to a free USB port on the laptop.
- Open a Linux Bash terminal and go to the $HOME/Arrival folder
- Run the following script to initialize the Host CAN interface
- sudo ./can_bring_up.sh
- Power the RPSS device and wait for 20 seconds.
- Run the CAN Transmit GUI application
- ./tx_gui.py

2.5.2 Running Graphical User Interface

- Select A1 for the target RPSS sensor using the toggle button.
- Select the USRR sensor operating mode (USRR is the default in the dropdown list).
- Click on the “Execute transmit command” button to run the selected sensor using the selected mode.
- Sensor activation log messages should show up in the white panel status.
- Click on the “Start visualization” button to display the sensors visualization using the ROS/Rviz external tool. You should see point clouds detected by the red 3D box (A1 RPSS device) on the visualization.

- Click on the “Start range profiles” button to display the sensors’ range profile external GUIs. You should see a range profile graph showing on the “Red sensor – Range Profile” window only.



- Two range profile windows are showing one for each sensor.
- The blue curve shows the range detection signal power in dB. Peaks with high power levels shows detections along the x-axis representing the distance.
- The green curve shows the relative noise ratio.

3 Contact Information

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Beaumont House
Kensington Village
Avonmore Road
London W14 8TS
United Kingdom

4 FCC Statements

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 device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

RF Exposure
This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This device and its antenna must not be co-located or operating in conjunction with any other antenna or transmitter.

Not necessary to perform SAR testing
The antennas used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter."