Project Documentation | UMRR Automotive Type 146 Data Sheet

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Automotive Radar Sensor

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Blind Spot Detection Radar
Collision Warning Radar

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Contents

1 User Safety Warning Information

Read the instructions carefully before you start to work.

Installation

Please observe the following advices when installing and connecting the sensors:

- Only use provided or approved equipment for installation. Use stainless screws with metric thread M3x8. Screw length must be adapted if the customer uses own brackets.
- Only skilled and instructed persons shall install and connect the devices. Proper experience in working with mains voltage, electrical and electronic devices is required.
- Don't connect the devices directly to mains voltage, instead use the voltage given in the manual.
- Don't wire any connections while power is applied to the device.
- Ground the devices carefully to prevent electrical shock.
- All connectors are pin-coded and fit in only one position. Also note the arrows indicating the top side of the sensor.
- Only use fully functional equipment (ladders, aerial work platform, ...) when working above ground. Staff shall be capable of working at heights.
- Use caution when installing the devices on or around active roadways. Pay attention to moving traffic.
- Mount the devices carefully to prevent them from shifting or dropping.
- The devices must be mounted to a stiff and solid support. Vibration, oscillation or any kind of movement will reduce the sensor performance.
- Make sure that your installation methods are in accordance with local safety policy and procedures and company practices.

Technical service

Only use provided or approved equipment for operation.
Persons other than authorized and approved electrical technicians shall NOT attempt to connect this unit to a power supply, Traffic Management Interface Board and/or other controllers, as there is a risk of electrical shock by unsafe handling of the power source.
Do not attempt to service or repair this unit.

- No user-maintainable parts are contained within the device.
- To avoid electrical shock, do not remove or open the cover.
- Unauthorized opening will void all warranties.
- Smartmicro is not liable for any damages or harms caused by unauthorized attempts to open or repair the device.

Radiation

This product has been tested and found to comply with Part 15 Subpart C of the Federal Communications Commission (FCC) or the European RED directive, or other national rules, depending on the country where it may be in use.

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.

This device generates radio frequency energy.
There are strict limits on continuous emission power levels. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

- Human exposure to transmitted waves from this device is generally considered as safe.
- Nevertheless, it is considered good practice that humans are not subject to higher radiation levels than necessary.
- This device may interfere with other devices using the same frequency band.

Operation

Transmission of radio frequency waves starts after the sensor is powered up and stops when disconnecting it from power.

Using a JBOX or SRO does not influence sensor performance.

For testing purposes, the sensor may be laid on its face when it is powered up, given that the surface or connectors will not be damaged by doing so. Please note that this position is not intended for permanent use.

It is recommended that only one connection interface is used at a time.

Do not operate the device if the device itself or any cables are damaged.

The sensors may become hot during operation, so proper hand protection is recommended for maintenance work.

2 Sensor Data Sheet

Smartmicro offers a family of automotive Radar sensors called UMRR – Universal Medium Range Radar.

A number of different antennas are available - so the permanent fixed field of view and max. range can be selected by the customer.

This data sheet describes the type 146 **4D/HD** High Definition antenna model.

Type 146 Antenna aims at short and medium range with very wide horizontal angular coverage, and features 3TX, 4RX, CMOS RFIC with Quad Core MCU.

Figure 1: Automotive Sensor Type 146 – front and rear view.

Also available on request:

- Other versions of the housing for OEM integration.
- Other connector options.
- Other physical interface options.

For more details please contact us.

2.1 General Performance Data

Parameter		Specification		
		Long Range Mode	Medium Range Mode	Short Range Mode
Operating Frequency [GHz]		79 (77...81)	79 (77...81)	79 (77...81)
Range[I]	Min/Max [m][I]	Min: 0.6 Max: 85	Min: 0.4 Max: 55	Min: 0.15 Max: 20
	Discrimination[m]	< 0.9	< 0.6	< 0.3
	Accuracy [m]	< 0.5 or 1% (bigger of)	< 0.3 or 1% (bigger of)	< 0.15 or 1% (bigger of)
Velocity	Min/Max [km/h][V]	-340/+140	-340/+140	-400/+140
	Discrimination[m/s]	< 0.3	< 0.3	< 0.3
	Accuracy [m/s]	< 0.15	< 0.15	< 0.15
Angle [II]	FoV of Azimuth [°]	≥100 (squint beam)	≥130	≥130
	FoV of Elevation [°]	15	15	15
	Discrimination [°]	~30 (optional)	~30 (optional)	~30 (optional)
	Accuracy of Azimuth [°][III]	≤ 1 (@<50deg from boresight)		
	Accuracy of Elevation [°][III]	≤ 2 (@above 50deg)		
Initialization Time [s]		< 2		
Update Cycle Time [ms]		≤ 50		
Processing Latency [ms]		2-4 Cycles		
Operating Voltage [V][IV]		7 ~ 32		
Power Consumption [w]		< 5		
Max. Transmit Power (EIRP) [dBm]		<25		
Operating Temperature [°C]		-40 ~ +85		
Storage Temperature [°C]		-45 ~ +125		
Sensor Weight [g]		≤ 110		
Dimension (H/W/D) [mm]		69x57x17 plus connector 69x81.3x21.9 incl. connector		
Interfaces		Primary CAN V2.0b (passive) (CAN FD 2Mbit/s sleep mode capable optional by software) Secondary CAN FD 5Mbit/s (optional by software) Broad-R-Reach Ethernet 100Mbit (optional by software)		
Connector		8 Pin plug ACES / TE Connectivity		
Model No.		UMRR-8Fxxxx		
Shock [g_{rms}]		100		
Vibration [g_{rms}]		14		
IP		67		
Pressure / Transport altitude [m]		0...10.000		

Table 1: Performance Parameters

[I] Typical values; may vary to higher or lower values depending on clutter environment. All values given for bore sight. Please note that the Radar system – like any other sensor system – although being well optimized and providing excellent performance, will not achieve a 100% detection probability and will not achieve a false alarm rate equal to zero. Presence detection below is available. Minimum range may be reduced customer specific depending on local frequency regulations.
[II] Total field of view is angle interval where reflectors can be detected; 3dB field of view is narrower. Accuracy specified at bore sight. Angular accuracy specified at bore sight, falls off towards larger angles.
[III] Measured for point reflector at bore sight with >23dB S/N. Falls off toward larger absolute angles.

[IV] Measured at connector.

2.2 Applications

The sensor is very versatile and can be used for all kind of 360 degree short- and medium range applications.

The sensor is especially well suited for all kind of blind spot detection (**BSD**) and lane change assist (**LCA**) applications. It can be applied for short- and medium range collision warning (**CW**) applications for **autonomous driving**.

One or multiple sensors are specifically integrated into vehicle models of automotive OEMs. Usually there is a certain OEM-specific engineering effort required for the adaptation to specific vehicle models and the test and qualification procedures to be applied. Customer specific connectors, CAN(FD)/Ethernet interfaces, tracking algorithms, warning algorithms or other custom software packages can be included.

Examples:
- Blind Spot Detection (**BSD**).
- Lane Change Assist (**LCA**)
- Rear and front Cross Traffic Alert (**RCTA/FCTA**).
- Warning to open door if object approaches from behind.
- Rear and side **Pre-Crash**/**Pre-Safe** applications.
- **Parking** assistance
- Front, rear and side Collision Warning (**CW**), 360degree collision warning
- **Autonomous driving**

Functional Safety:
This sensor can optionally be compliant to ASIL Level B in customer specific projects (requirements and safety concept to be agreed between OEM and smartmicro).

AUTOSAR:
This sensor can optionally be offered with AUTOSAR compliant software in customer specific projects (specification to be agreed between OEM and smartmicro).

2.3 Function Description

The sensor is a small, lightweight, very robust low cost 79-GHz Radar for automotive applications. It is intended for multiple applications and can be used almost worldwide in this frequency band.

It works in adverse conditions, almost unaffected by weather, and independent of sunlight, in a wide temperature interval. The radar withstands high shock and vibration levels, is maintenance free and made for a long lifetime.

Using a patented transmit signal waveform, each individual sensor measures range, radial speed, azimuth and elevation angle, reflectivity and other parameters of multiple stationary and moving reflectors (**targets**) simultaneously. Having multi target capability, the sensor will report many reflectors at a time being within the field of view (**target list**):

- Range
- Az. and El. Angle
- Radial Speed
- Reflectivity
- Other...

Additional (optional) filter algorithms are implemented (for certain applications) for the tracking of all detected reflectors over time, those tracking algorithms are integrated in the sensor. Multiple **objects** are tracked simultaneously; the individual reflectors are separated in the detection algorithms by having a different radial speed value and/or different range value and/or by different az. angles, as well as by the tracking algorithms and data base. The result of the tracking is an **object list** with the following parameters:

- x position
- y position
- x component of the velocity
- y component of the velocity
- other...

Finally based on all detected targets and tracked objects in the field of view a function/application algorithm can optionally be implemented, like a **blind spot warning** or **collision warning** signal.

Hence the sensor optionally reports such a list of all tracked objects, including stationary objects, inside its field of view in every measurement cycle of typ. 50ms length.

In addition to that, status and diagnose data from the sensor are reported.

2.4 Multi-Mode Operation and Adaptive Beams

Note that UMRR-8F type 146 also **allows to switch between short, medium and long range mode**.

Moreover, UMRR-8F type 146 allows **adaptive beams**, it can be switched between straight beam and a ~30 degree off bore sight squinting beam.

Any mode can be selected for any beam.

Figure 2: 4D/HD graphical illustration for short range mode straight beam and long range mode with straight beam.

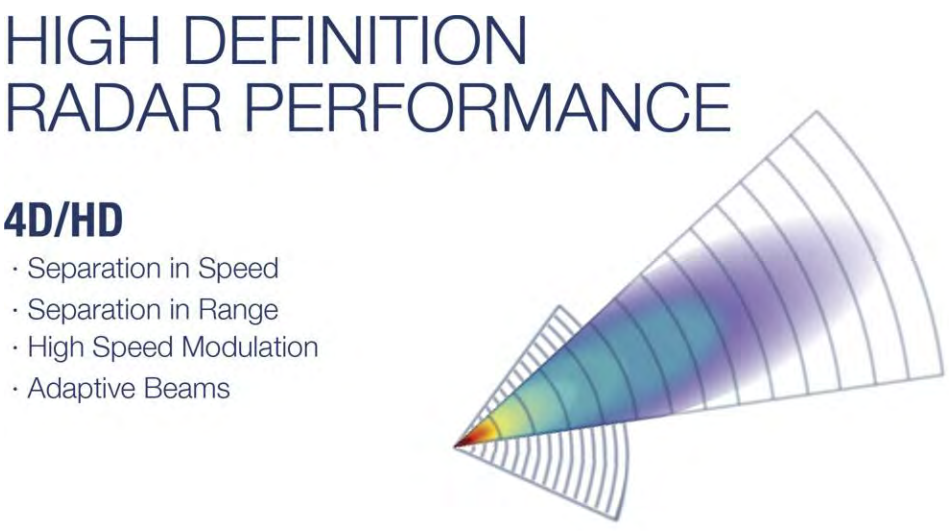


Figure 3: 4D/HD graphical illustration for short range mode straight beam and long range mode with squinting beam.

2.5 Object Separation Performance

UMRR-8F features the latest technology automotive radar sensors: **4D/HD**. For each reflector, there is a true **4D** measurement of range, Doppler, azimuth and elevation angle.

UMRR-8F can accomplish range gate specific and even angular gate specific detection of moving and even stationary vehicles. In each of these gates a separate Doppler detection is possible, including stationary detectors.

The sensor provides excellent target separation (HD). Individual reflectors are separated in the detection algorithms by:

a) having a different radial speed value **OR**
b) having a different range value **OR**
c) having a different azimuth angular position (optional).

Optionally tracking algorithms and data base further support the separation of objects.

2.6 Field of View

The sensor features squinting and straight antennas. Squinting antennas can be used for applications like RCTA/FCTA, where the max. range is required off boresight, i.e. at ~30 degree offset to the mechanical mount axis.

Straight antennas have their max. range at bore sight. A typical configuration is shown below.

The figures below show typical multiple sensors configuration with 360° field of view and for rear collision warning as well as blind spot detection.

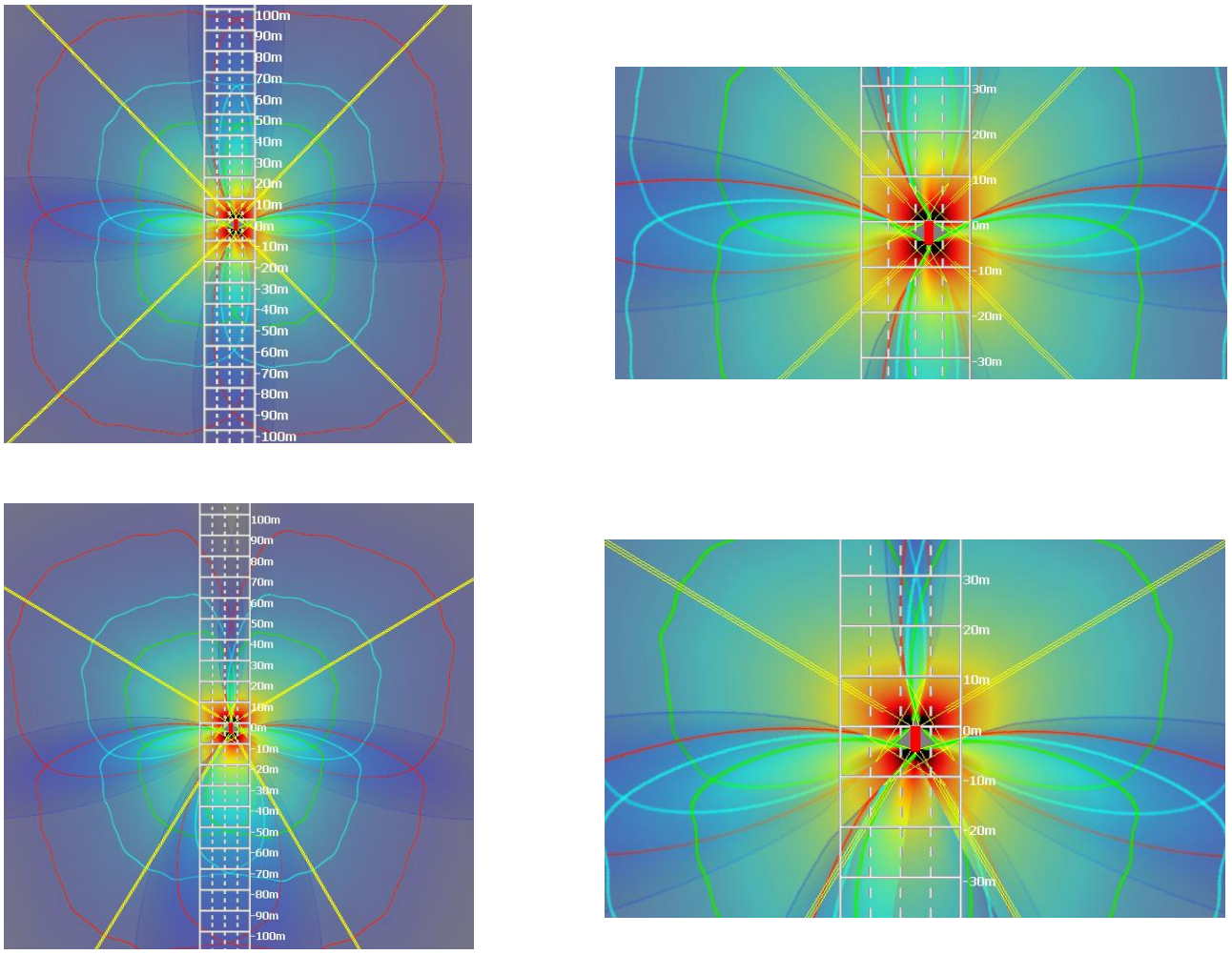


Figure 4: Four sensors configuration and 360° field of view by using straight antennas.

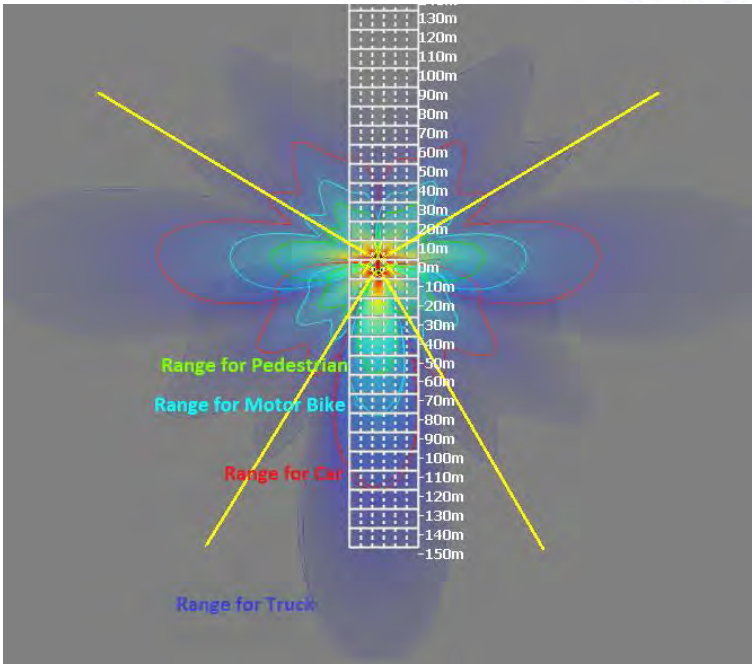


Figure 5: Four sensors configuration and 360° field of view 4x squinting antennas active.

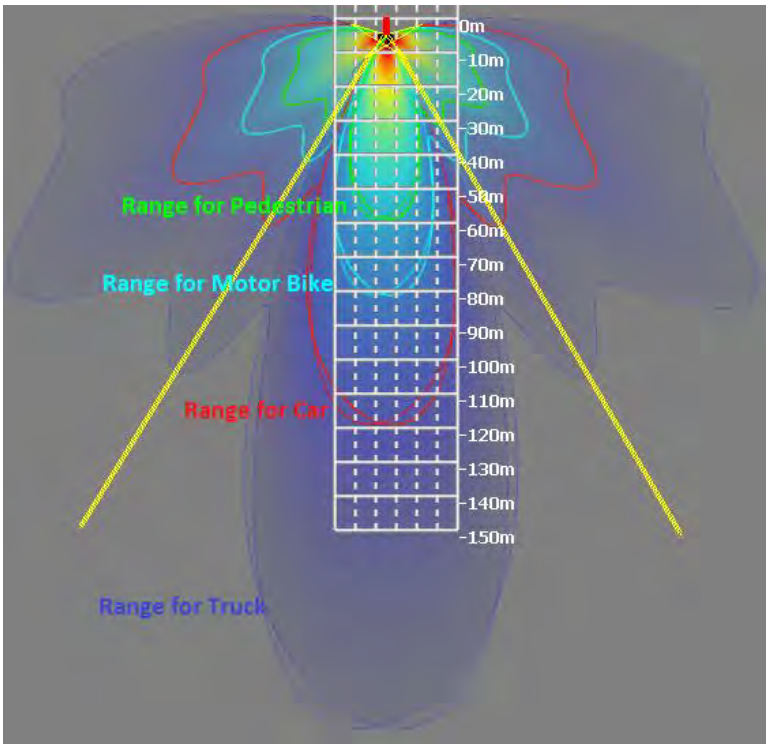


Figure 6: Two sensors configuration for BSD plus rear collision warning – 2x squint antenna active.

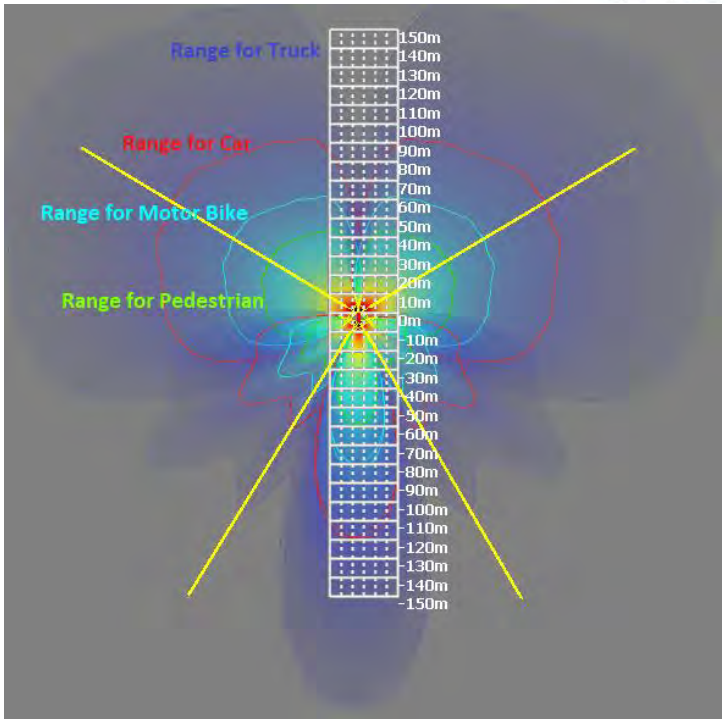


Figure 7: Four sensors configuration and 360° field of view by using 2xstraight (front) and 2xsquinting antennas (rear).

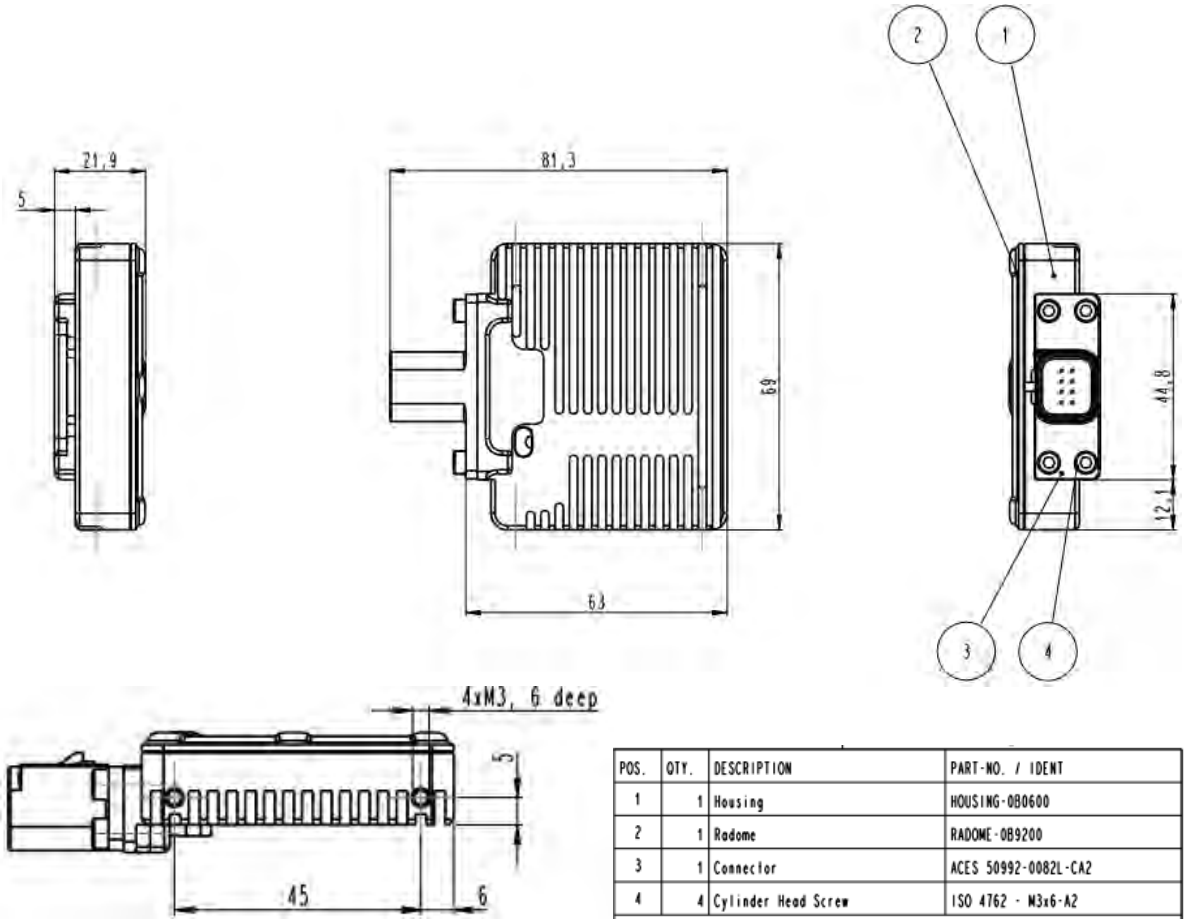
2.7 Compliance

EU RED directive (pending),
ETSI EN 302-264 (pending),
FCC part 15 (pending),
RSS-xxx (pending)

CE
ROHS

2.8 Sensor Dimensions

All values are given in mm.



POS.	QTY.	DESCRIPTION	PART-NO. / IDENT
1	1	Housing	HOUSING-0B0600
2	1	Radome	RADOME-0B9200
3	1	Connector	ACES 50992-0082L-CA2
4	4	Cylinder Head Screw	ISO 4762 - M3x6-A2

Figure 8: Sensor Dimensions

2.9 Connector Pin-Out

The used sensor connector is an 8-pin male circular connector (water proof IP67, manufacturer ACES). A female counterpart has to be used to connect to the sensor. The pin numbering of the female connector is shown in Figure 9 the pin out of the connector is shown below.

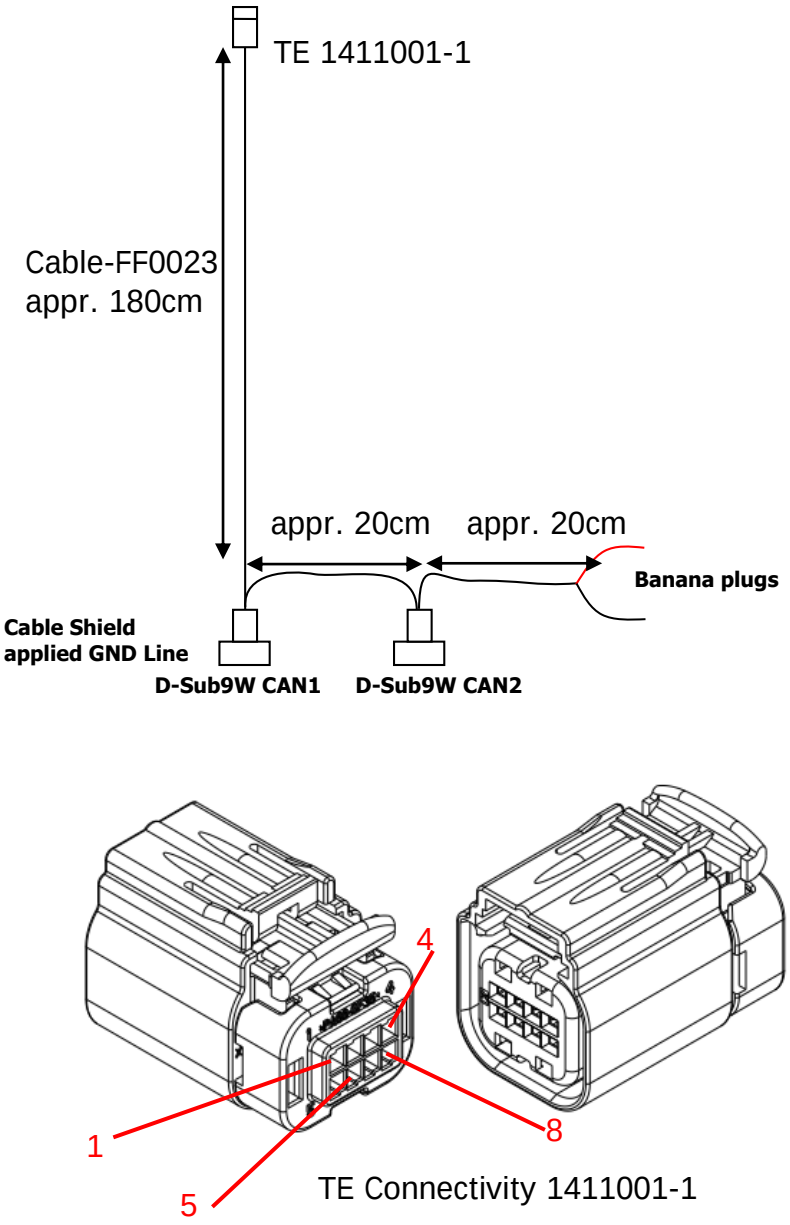


Figure 9: Diagram of cable-FF0023 and rear view of female counterpart to be connected to sensor

Table 1: Sensor connector pin-out

Pin Layout TE	Label	DSUB-9-w CAN1	DSUB-9-w CAN1	Banana Plug
1	GND	3		
2	GND	3	3	Black
3	CAN2_H		7	
4	CAN2_L		2	
5	V^+			Red
6	V^+			
7	CAN1_H	7		
8	CAN1_L	2		
SHIELD	SHIELD	3		

Please note that in the standard configuration the sensor has no 120 Ohms resistor on board (CAN bus termination between CAN_L and CAN_H). The resistor is nevertheless required at either end of a CAN bus and is in most cases integrated in the cable delivered along with the sensor (if cable is manufactured by Smartmicro).

3 Multi Sensor Systems

3.1 Configurations

The sensor may be used standalone or multiple sensors can be connected in a network. Such networks are only possible using CAN(FD) interface. Sensors in the network work plug and play, free of mutual interference.

Customer specific configurations are possible.

3.2 Data Logging and Visualization Tools

Visualization of all data (i.e. **target lists, object lists**, other) is possible using the Drive Recorder software on any PC, as well as data logging, associated video documentation, play back and analysis functions and more.

Instead of the Drive Recorder, other customer specific visualization, logging, or function/application software products may be applied; the radar system's data interface is easy to integrate.

3.3 Front cross traffic alert configuration with tracking controller

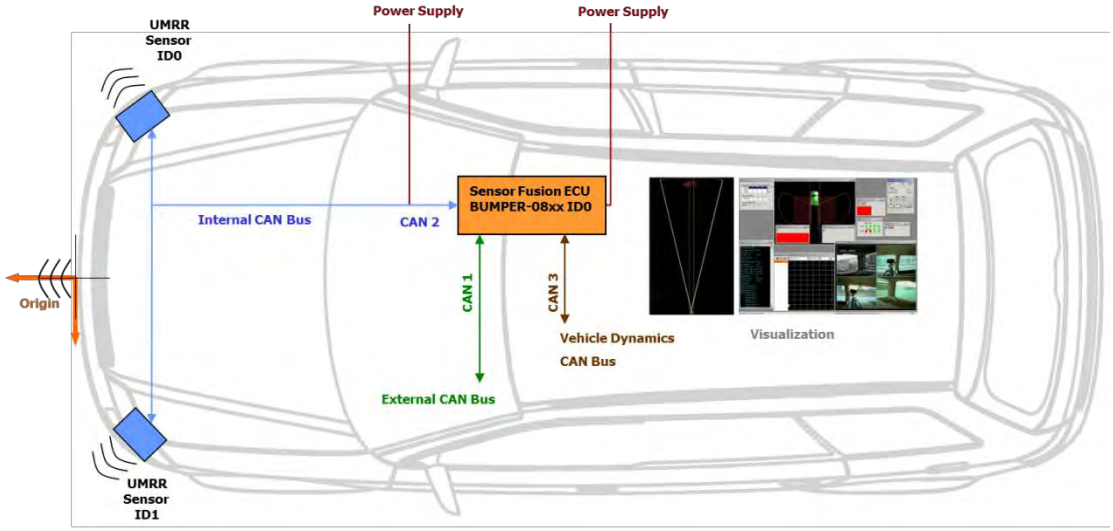


Figure 10: Front cross traffic alert (CTA) configuration with tracking controller.

3.4 Typical sensor setup for blind spot detection and rear cross traffic alert.

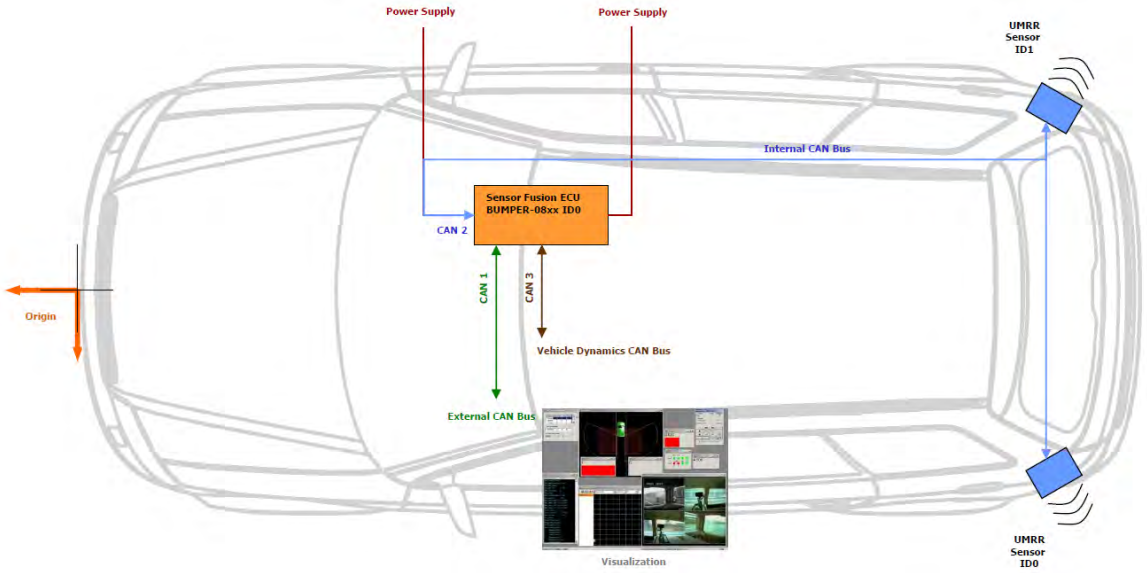


Figure 11: Typical Sensor Setup for blind spot detection (BSD) and rear cross traffic alert (CTA).

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