INSTALLATION GUIDE – MOVING PLATFORM

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CONTENT

1 MOUNTING POSITIONS

There are almost no restrictions on the type of car to be used, except that it should allow for the sensor to be mounted at a height of 0.5m to 0.8m (1.6ft to 26.3ft) above the ground for best performance. However, it is possible to install the sensor on a maximum height of 2m (6.6ft), like in a "bar" on the roof of the vehicle.

The sensor can be mounted on a vehicle as follows:

- On the front
- Behind the bumper
- On the hood
- On the top with up to 2m (6.6ft) mounting height
- Behind the windshield

Please make sure to mount the sensor the right way around. The label on the back of the sensor indicates which side of the sensor is the top side.

1.1 FRONT OR REAR MOUNTING

The sensor should be mounted in the front on the centerline of the car as illustrated below. The azimuth (horizontal) mounting angle should be 0° and the elevation (vertical) mounting angle should be 1.5° (facing up), if the sensor height is below 0.5m (1.6ft). If the sensor height is above 0.5m (1.6ft), the elevation (horizontal) angle should be 0°.

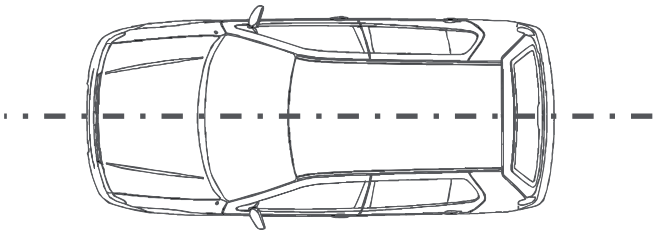


Figure 1: Centre line of the vehicle

Sensor mounting examples:

Figure 2: Behind the bumper

Figure 3: In front of air intake

Figure 4: On top of the roof

1.2 CORNER MOUNTING

The sensors can be mounted close to the corners of the vehicle.

The azimuth angle of the sensor for a corner-based application (e.g. BSD/RCTA) is usually set to 40° from the vehicle's longitudinal centreline.

Based on experience, smaller installation tolerances can be achieved, if the sensor is mounted to the bumper rather than to the chassis.

The mounting position (x-position, y-position, azimuth and elevation angle) is selected in the corner of the bumper in a way that the required warning area of the corner-based applications and other functions are covered.

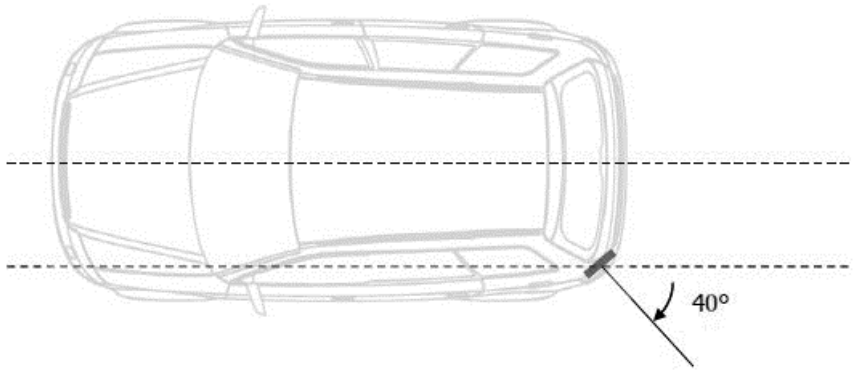


Figure 5: Typical mounting position - azimuth angle

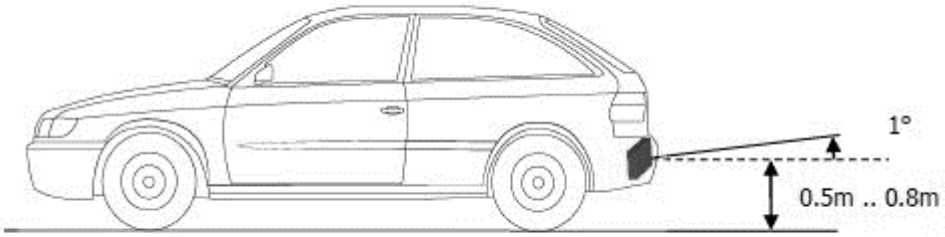


Figure 6: Typical mounting position - elevation angle

1.3 COORDINATE SYSTEM

Below, the coordinate system of the radar sensor is illustrated. The data are reported in polar coordinates. The origin of the coordinate system is the middle of the RX antenna array of each sensor (zero axis). The azimuth angle refers to the horizontal axis, whereas the elevation angle refers to the vertical axis as indicated below. All the values are provided relative to the mounting position.

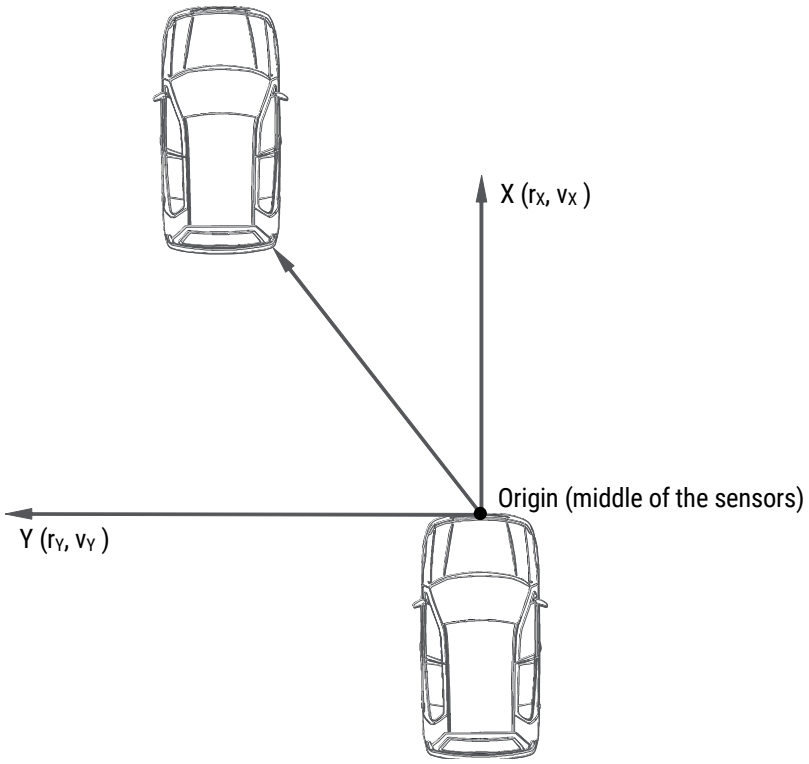


Figure 7: Sensor coordinate system

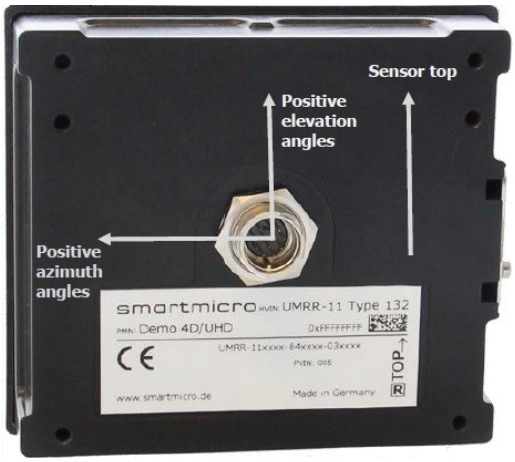


Figure 8: UMRR-11 Type 132 coordinate system (view from the rear side in the positive x-axis direction)

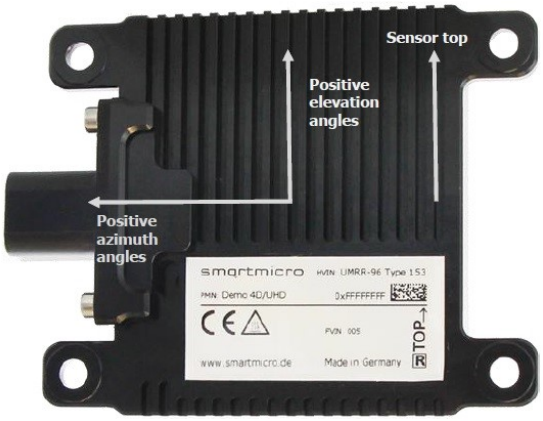


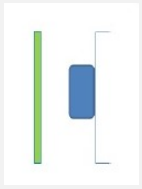
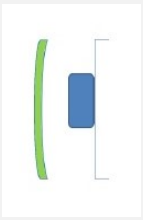
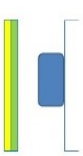
Figure 9: UMRR-96 Type 153 coordinate system (view from the rear side in the positive x-axis direction)

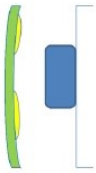
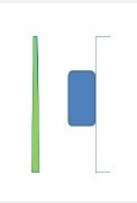
2 GENERAL INSTALLATION GUIDELINES

Some of the general guidelines for the sensor positions are given below:

- The bumper in front of the sensor should be as straight as possible, since each curve has an influence on the performance of the sensor.
- There should be only one layer of plastic (i.e. the bumper skin) in front of the sensor, but no second plastic part (inlay or the like).
- The bumper should consist of standard plastic material to avoid influences on the performance. The thickness of the material itself has an influence on the performance as well, so it should be as constant as possible. The material thickness of the bumper should not exceed the current state-of-art single layer bumper designs.
- The azimuth installation angle of the sensor should be as close as possible to the defined value to avoid influences on the performance.
- The elevation angle of the sensor should be as close as possible to the defined value to avoid influences on the performance and unnecessary ground reflections.

For a better overview, please note the following installation instructions:

Situation	Valuation	Description
	Ideal	A flat bumper parallel to the radome
	Good	A flat bumper and small angle between bumper and radome
	Fair	Bumper shape with large radius
	Not recommended	A double layer bumper should be avoided

	Not recommended	Decoration elements should be avoided
	Not recommended	The bumper surface facing the sensor should be smooth (e. g. rack fastening elements should be avoided)
	Not recommended	Bumper material with changing thickness should be avoided
	Not recommended	The part of the bumper facing the sensor should not be composed of two or more different materials. Also, a junction of different bumper parts should not be in front of the sensor (even if the material is the same)
	Not recommended	The part of the bumper facing the sensor should not overlap with one or more additional layers (even if the material is the same)
	Not recommended	The part of the bumper facing the sensor should have a smooth shape. It should not be shaped with bent lines

2.1 MATERIAL RECOMMENDATION

Since the material in front of the sensor can have an influence on the sensor performance, a few recommendations can be useful:

- Please make sure that no metal resides in front of the plastic radome surface
- Tested materials are:
    - Clear makrolon material of 10mm (0.4in) thickness can be placed in front of the sensor radome
    - PP materials can be placed in front of the sensor, but they are not as protective as other materials
- It is possible to paint the sensor radome but the paint needs to be chosen carefully depending on the ingredients
    - Red color, for example, may contain iron which deteriorated the sensor performance

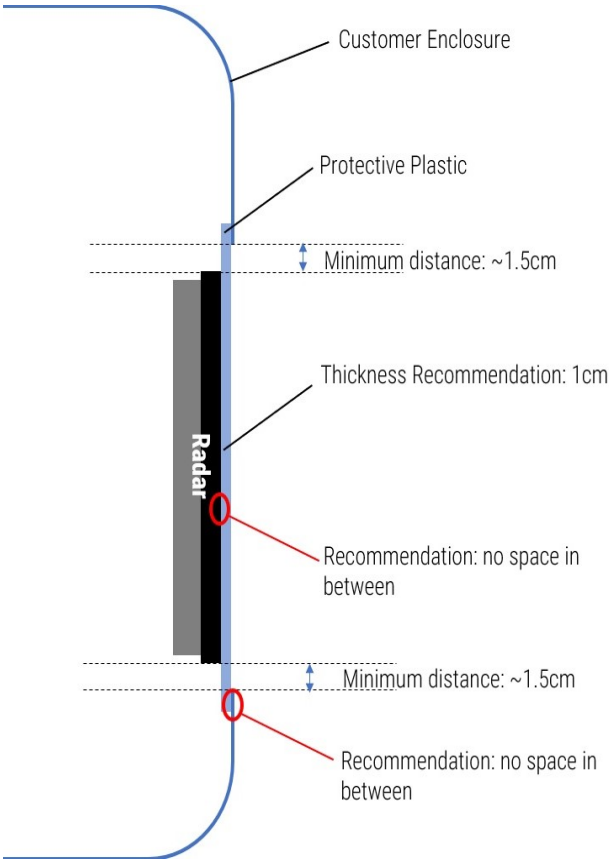


Figure 10: Material recommendation and placement overview

2.2 CLEARANCES

The space between the sensor and the bumper should be empty. Please make sure that no additional parts of the vehicle like other sensors or cables are placed in front of the sensor. The space directly around the sensor should be left empty for at least 10cm (3.9in).

Additionally, the sensor requires a free field of view of -70° to +70° in azimuth (horizontal) and at least - 45° to +45°in elevation (vertical) direction.

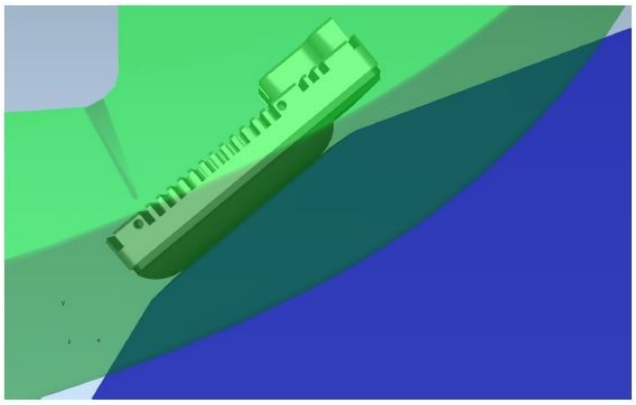


Figure 11: Example mounting position behind a bumper showing azimuth clearance (connector pointing to the center of the vehicle)

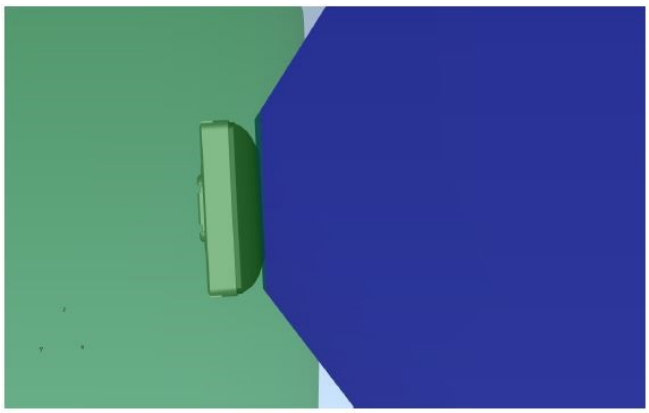


Figure 12: Example mounting position behind a bumper showing elevation clearance

2.3 UNWANTED EFFECTS

While the position of the sensor is crucial for the field of view, the sensor performance may also strongly depend upon the surroundings of the sensor. Unwanted effects due to the surroundings of the sensor and the bumper itself need to be minimized. Various influences can be distinguished as described in the following.

2.3.1 ELECTROMAGNETIC RF CONSIDERATIONS

Using EM (Electromagnetic) simulations, smartmicro can analyse the effects of:

- Bumper material
- Bumper shape
- Bumper decoration

and minimize their influence by selecting the ideal mounting position.

The paint coating of the bumper usually has a smaller influence on the sensor performance than the mounting position. As a rule, it can be said that:

- The paint should have only one layer (or one set of layers), considered a standard for vehicles.
- A second layer (or second set of layers) of paint should be avoided, as it increases attenuation and, therefore, decreases the sensor performance.
- The paint should not include an excessive amount of metal particles to avoid an influence on the sensor performance.

2.3.2 INDIRECT REFLECTION PATHS OR VIBRATIONS

The radar waves may be reflected inside the bumper multiple times like in a waveguide. Due to such reflections, moving parts inside the bumper could have an influence on the radar performance or may cause false alarms. These reflections can be blocked using “blinds” with or without RAM (Radar Absorbing Materials) attached. Changing the sensor position can be an alternative solution.

2.3.3 ELECTRICAL CONSIDERATIONS

The customer system should be designed in a way that an incorrect installation, for example accidentally swapping sensors meant for different locations, is not possible.

Beside the necessary electrical connections (system harness) for the sensors, no other electrical components like communication bus systems, other antenna systems, live wires, etc. should be placed close to the sensor to avoid electrical crosstalk.

2.3.4 OTHER CONSIDERATIONS

Please make sure to avoid excessive temperatures, for example, the installation position of the sensor should not be close to the exhaust system of the vehicle.

Any conductive layer inside or outside of the bumper surface will reduce the sensor range and performance. Usually, conductive layers on the outside cannot be avoided, but mechanical design measures should be taken to avoid such layers on the inner surface. Modern bumper designs are (almost) closed in such a way that water, ice, snow, or other layers are not building up inside.

3 END PRODUCT LABELING REQUIREMENTS

For a product using DRVEGRD 152, a label as shown below has to be used on the end system.

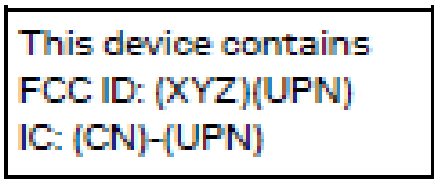


Figure 13: Label

It must contain at least the following information:

1. The FCC ID of the product with Grantee Code (XYZ) and Product ID (UPN)
2. The IC/ISED ID with the Company Number (CN) and Product ID (UPN)

For smartmicro, the FCC Grantee Code is **W34**.

And the Company Number with ISED is **10652A**.

UPN is the Unique Product Number which smartmicro assign to the sensor.

Example for DRVEGRD 152:

FCC ID: W34UMRR9D98

ISED ID: 10652A-UMRR9D98

4 REGULATORY COMPLIANCE STATEMENT

4.1 DECLARATION OF COMPLIANCE FOR USA / FCC

All device has been tested and found to comply with the requirements set forth in 47 CFR Part 95, Subpart M for both fundamental emissions and unwanted emissions. These limits are designed to provide reasonable protection against any harmful interference when the device is operated in a commercial environment.

Modifying the device without smartmicro's authorization may result in the device being no longer compliant with FCC requirements. In that event, your right to use the device may be limited by FCC regulations, and you may be required to correct any interference to radio or television communications at your own expense.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the device.

This device complies with the requirements set forth in 47 CFR Section 95.3385 addressing RF exposure from radio frequency devices. To maintain compliance, the minimum separation distance from the antenna to general bystander is 20 cm.

4.2 COMPLIANCE STATEMENT FOR CANADA / ISED

4.2.1 COMPLIANCE STATEMENT IN ENGLISH

This device complies with Industry Canada license-exempt RSS standard(s).

Operation is subject to the following two conditions:

(1) this device may not cause interference, and

(2) this device must accept any interference, including interference that may cause undesired operation of the device.

IC Radiation Exposure Statement:

This equipment complies with IC RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with the minimum distance 20cm between the radiator & your body.

4.2.2 DÉCLARATION DE CONFORMITÉ EN FRANCAIS

Le present appareil est conforme aux CNR d'Industrie Canada applicables aus appareils radio exempts de licence. Léxploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisaeur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

DÉCLARATION D'EXPOSITION AUX RADIATIONS

Cet equipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cetéquipement doit être installé et utilisé avec un minimum de 20cm de distance entre la source de rayonnement et votre corps.

4.3 GENERAL REQUIREMENTS

These radar sensors are designed to comply with the regulatory demands of Federal Communications Commission (FCC), Innovation, Science and Economic Development Canada (ISED)11 and the CE mark. This chapter contains instructions on the process needed for an integrator when including this module into an end-product.

- Any deviation from the process described may cause the module or radar sensors not to comply with the regulatory authorizations of the module and thus void the user's authority to operate the equipment.
- Any changes to hardware, hosts or co-location configuration may require new radiated emission and SAR evaluation and/or testing.
- The regulatory compliance of our radar sensors do not exempt the end-product from being evaluated against applicable regulatory demands; for example, FCC Part 15B criteria for unintentional radiators [9].
- The end-product manufacturer must follow all the engineering and operating guidelines as specified by the grantee.
- This module is for OEM integrators only.
- Any notification to the end user about how to install or remove the integrated radio module is NOT allowed.

⚠ If these conditions cannot be met or any of the operating instructions are violated, the regulatory authorization will be considered invalid. Under these circumstances, the integrator is responsible to re-evaluate the end-product including the radar sensor module and obtain their own regulatory authorization.

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