DAkkS Deutsche Akkreditierungsstelle D-PL-12053-01-01

Annex acc. to FCC Title 47 CFR Part 15
relating to
Hella KGaA Hueck & Co.
LCA 3.5 - GM

Annex no. 5
User Manual

Title 47 - Telecommunication
Part 15 - Radio Frequency Devices
Subpart C – Intentional Radiators
Measurement Procedure: ANSI C63.4-2009

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Compliance Statements in the User's Manual of the test equipment (EUT)

Brand/Trade name: Hella
Model name: **LCA 3.5 - GM**
FCC Certification Number: **NBG934692A**

Dear Sir / Madam,

On behalf of our customer **Hella KGaA Hueck & Co.** we declare that they ensure that the following will be included in a prominent location of the owner's manual of the car:

The title **"CAUTION TO USERS"** or **"FCC/IC WARNING NOTE"** or relevant title and "**Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment."**

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.

This device complies with Industry Canada licence-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.

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

Yours sincerely,

AJ Phadtare

Mr. Ajit Phadtare
Homologation Deapartment
m. dudde hochfrequenz-technik

<table>
<tr><td rowspan="2">Hella KGaA Hueck & Co.
59552 Lippstadt</td><td rowspan="2">Technical bulletin
– Product development –</td><td>Date: 30 Sep 2013
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<tr><td colspan="2">Subject: Guideline for positioning SBZA/LCA generation 3.5 radar sensors in a vehicle

Reference to:</td><td>Division: E-ED-DAS
Org.-unit/Gr.: DR / DMD
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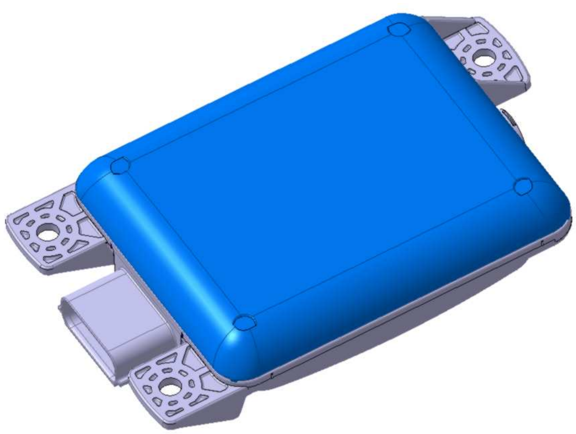
Guideline for positioning SBZA/LCA generation 3.5 radar sensors in a vehicle



SBZA/LCA generation 3.5 rear radar sensor

Editors: Dr. John, Sievers | Review: Dr. Kühnau | Status: released

Revisions:

Revision / Date	Changes
No 1 rev 1 / 10 December 2012	Derivation of SBZA/LCA generation 3.5 guideline from BSD generation 3.0 guideline and implementation of GM specific data
No 1 rev 2 / 25 February 2013	DIS 3D changed; Fascia thickness changed from 3-4mm to 2,8-4mm; text changed for: screwing/facial mounting/Device zero point
No 1 rev 3 / 06 March 2013	Changed definition of device zero point
No 1 rev 4 / 22 March 2013	Changed pictures and clearer definition of other requirements
No 1 rev 5 / 30 September 2013	Changed screw and torque dimensions and clearer definition of other requirements

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1 Introduction

This document describes the radar-technology-based SBZA/LCA generation 3.5 sensor and provides guidelines for its integration in a vehicle.

Due to the fact that radar waves can penetrate plastics, the integration is possible behind the bumper fascia and thus invisible from the exterior. However, the plastic and other materials which surround the sensor may cause bending, refraction and reflection of the radar waves. Distances, clearances, selected radii and other constructive elements in their arrangement can lead to constructive or destructive interference of the radar waves. In case of an unfavorable configuration of all parameters towards each other, the sensor properties can be influenced disadvantageously.

For these reasons, a generally valid positioning guideline which covers the entire configuration and degrees of freedom of all OEMs and guarantees undisturbed sensor properties cannot be given.

This document includes guidelines which describe in general the ideal positioning and which correspond to the accumulated experience.

The final integration position of the SBZA/LCA sensors, the design of the sensor shielding/bracket and guideline violations in any case must be agreed upon with Hella KGaA Hueck & Co. (see Fig. 1).

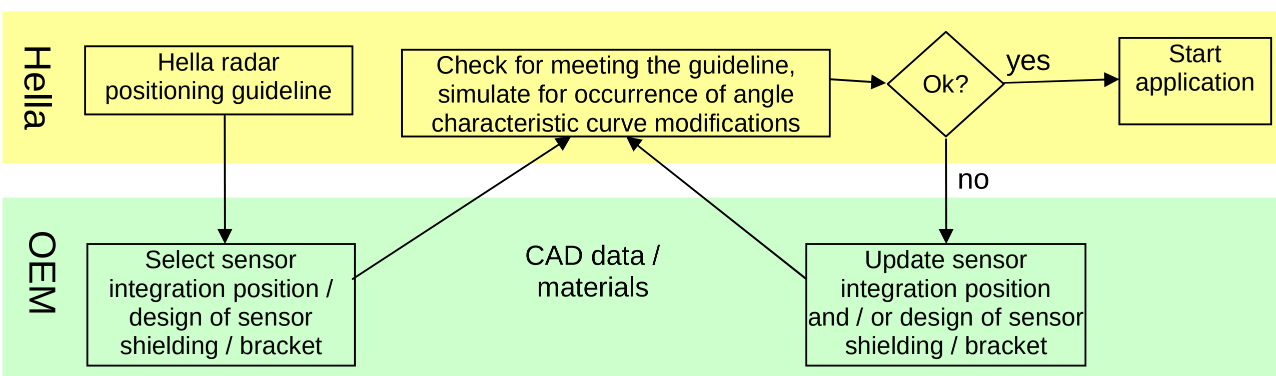


Fig. 1: Typical flow of the coordination process for the SBZA/LCA positioning.

2 Guidelines for sensor integration in a vehicle

2.1 Sensor data

- Dimension: 98 x 77 x 26 mm³ (see also 3D data and drawings)
- Weight: < 170 g
- Car connector: meets 064-S-008-I-Z02 USCAR 0,64mm SEALED MALE
- Cone of rays: XZ plane: 180° (min. required: 140°) / XY plane: 40°
- CAD data: Sensor (3D incl. cone of rays) — DIS **10000928533** (Body.Master); DIS **10000928533** (Body.Slave)

2.2 Sensor positioning / mounting

- Position: Two sensors (one Master on the left and one Slave on the right) behind the rear fascia.
- Positioning:
  - Azimuth angle: 38 - 42°
  - Elevation angle: +3°
  - Tolerances: Azimuth: ± 3°; Elevation: + 0.75° / - 1.25°
  - Distance radome to fascia: > 6 mm
  - Height above road: 400 - 650 mm
- Connector orientation: Either both pointing outwards or both pointing towards rear vehicle center (see also chapter 3)
- Fascia:
  - Thickness: 2.8 - 4 mm
  - Thickness variations: no sudden variations
  - Base material permittivity: 2 - 3
  - Paint permittivity: < 100 (paint thickness 15 µm; metallic content approx. 7 weight-%); < 50 (paint thickness 45 µm; metallic content approx. 5 weight-%)
- Space between sensor and fascia:
  - metallic parts (like trim strip or ultrasonic sensors): not allowed
  - cables or bearing structures: not allowed, exceptions possible after positive radar simulation
- Mounting:
  - on one side catching, as free from play as possible
  - on the other side screwing
  - Diameter of screw: 17mm (flat washer also possible)
  - screw locking: shall be provided by GM
  - plastic relaxation of mounting plate: shall be considered by GM
  - contact surfaces: the design of the contact surfaces between the bracket side and screw side must be flat and not allowed to be positioned in the deformation areas of the bracket or screw.

NOTICE: Screw used to fix the sensor to the fascia is M4.2 x1.41 Hex Washer Head Tapping Screw Assembly with Flat Washer BR (metric) (Point Material acc to ISO 2702 and Surface treatment acc to GMW 4205).
Recommended fastening torque for M4.2 screw is 2.5 ± 0.5 Nm.
Connection has to be tested and approved by Hella

- Sensor vibration: < 0.2 g up to approx. 2000 Hz

2.3 Shielding / bracket design

- Purpose: The shielding / bracket protects the sensor against unwanted reflections (road surface, tires, other objects behind fascia) and reduces multipath effects, which have disadvantageous influence on sensor performance
- Bracket material: - radar absorbing plastic, for example:
  - Witcom PA6-2004/39 (PA6 with GF20 / conductive)
  - Witcom PP-2008/003 (PP with GF30 / conductive)

  - For mechanical reasons of fascia mounting, the same bracket material as the fascia could be required. Additional absorbing material could be necessary.

  - Realization needs to be agreed on with Hella
- Approximate wall thickness: - same like fascia if using ultrasonic welding technique (2.8mm–4mm). If thickness is chosen smaller than 2.8mm and/or is not a constant value, Hella must be notified before design release.
- Design: - Side walls surround / cut the cone of rays
  - Distance between shielding / bracket and cone of rays revolving 2 mm (nom.)
  - Design if cone of rays is cut (<180°, see Fig . 3 and 4):
    - right angled / no chamfer
    - Base length: > 20 mm
  - Certain mounting positions may lead to special requirements concerning some shielding / bracket surfaces, for example convex instead of planar. In such cases, the practicality will be checked together with GM.

2.3.1 Body shell mounting

- To minimize disturbances due to reflections by one's own rear tires, the road surface below the sensor, other objects behind the fascia, the clearance between shielding and fascia shall be as small as possible. Clearance values larger than 10 mm have to be agreed on with Hella.
- Clearance between shielding and fascia: revolving approx. 10 mm
- For larger clearance values, shielding overhang at upper sensor side (see Fig. 2): min. 10 - 20 mm
- Length of shielding (see Fig. 2): > 140 mm
- Schematic illustration:

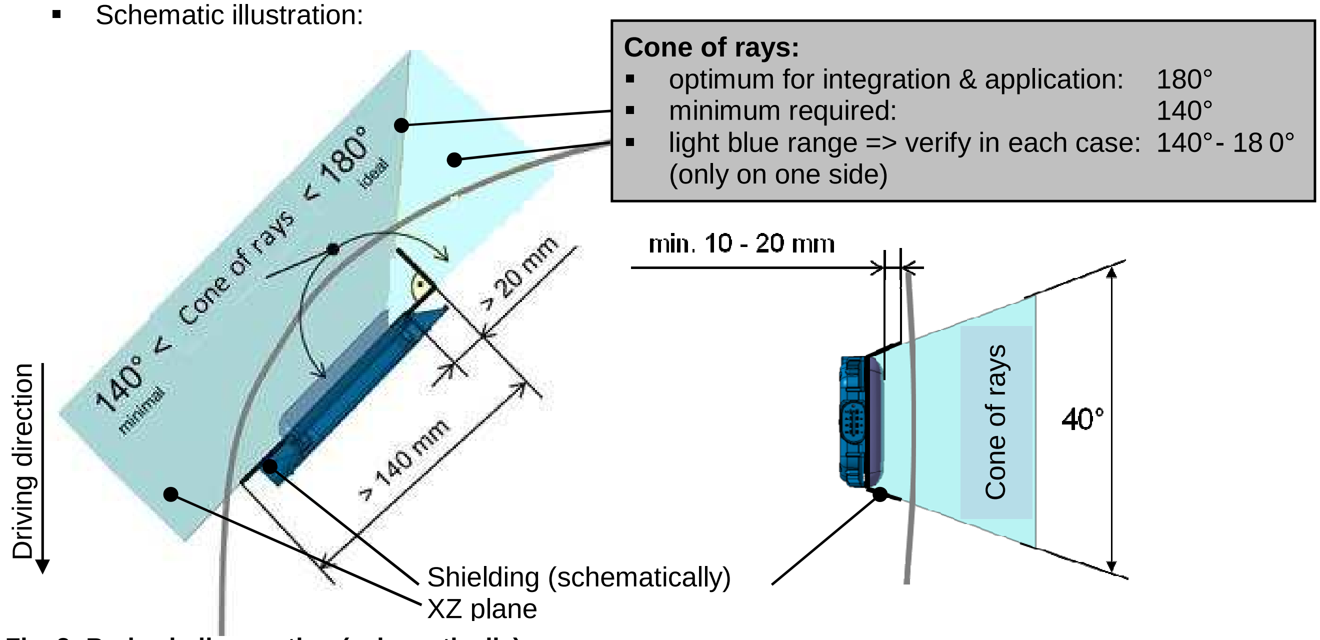


Fig. 2: Body shell mounting (schematically)

2.3.2 Fascia mounting (preferred from Hella point of view)

- Clearance betw. shielding / bracket and fascia: revolving 0 mm (shielding connected to fascia)
- Schematic illustration:

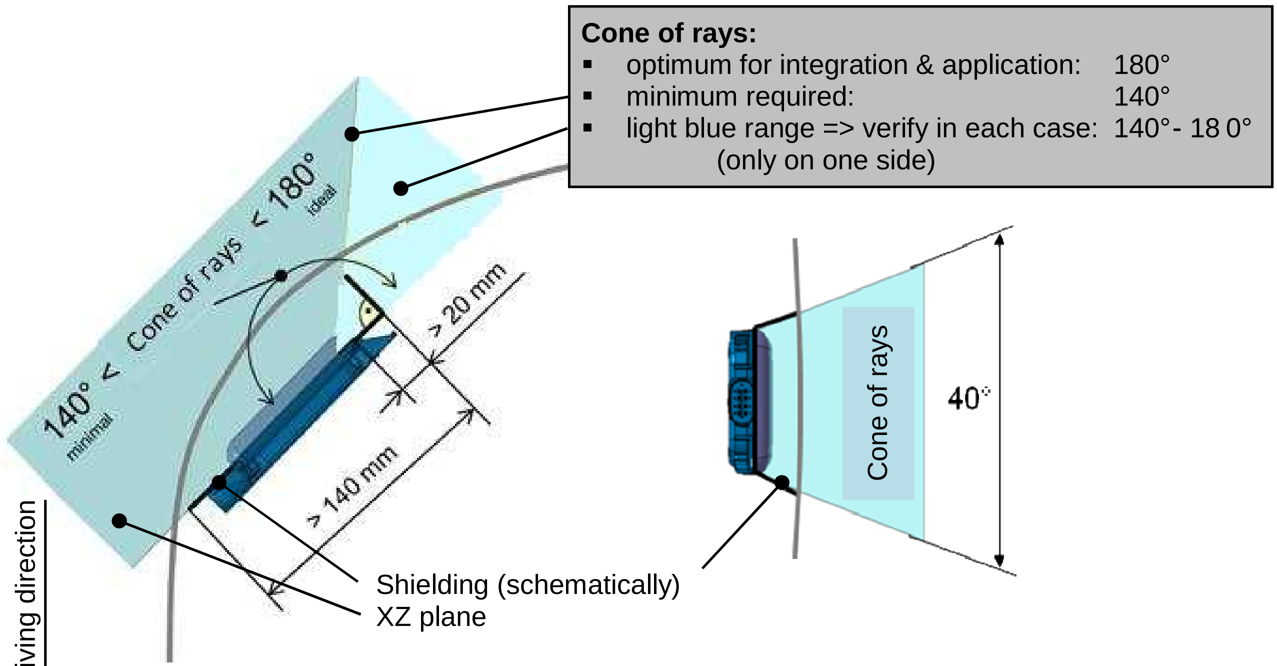
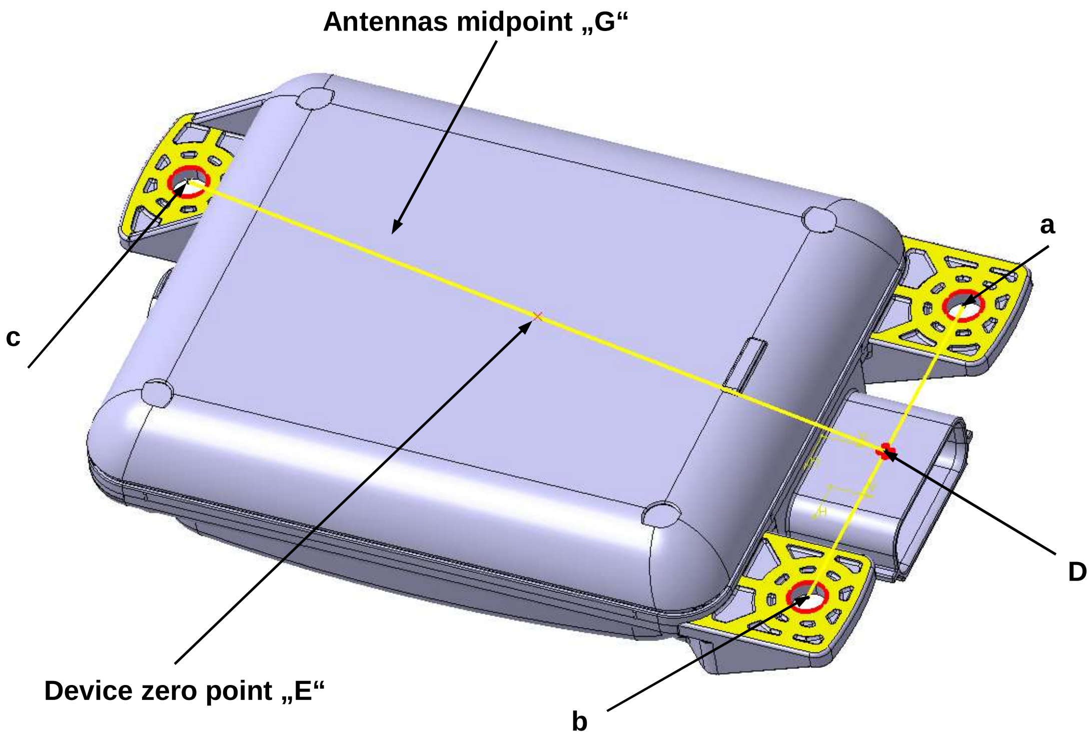


Fig. 3: Fascia mounting (schematically)

3 Further explanations

3.1 Device zero point and antennas midpoint

For the proper function of the sensors in the vehicle it is necessary that the software knows the exact finally determined position of the sensors relative to the vehicle zero point. Now, two special points are relevant for the calculation of the position of the SWA sensors: The device zero point **E** and the antennas midpoint **G**.



The device zero point **E** results from the midpoints of the individual fastening clips (preliminary values):

$$D = \frac{\overline{ab}}{2} = \frac{\overline{57}}{2} \qquad E = \frac{\overline{Dc}}{2} = \frac{\overline{119}}{2}$$

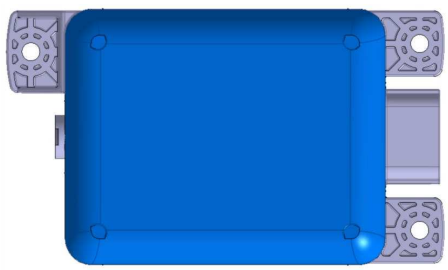
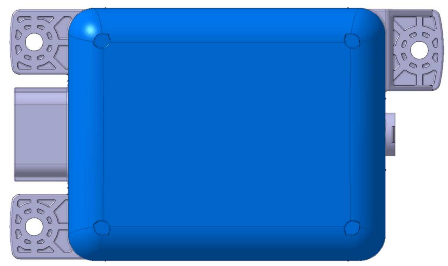
The antennas midpoint **G** amounts from the device zero point **E**:

X: - 24.47 mm (according to coordinate system defined in above figure)
Y: - 13.95 mm
Z: - 6,9 mm

Since the distance from the device zero point to the antennas midpoint is a constant, the software requires only the dimensions of the device zero point related to the vehicle's zero point.

3.2 Master and Slave assignment

The SBZA/LCA system consists of two similar radar sensors. The main differences are in the component placement on the printed circuit board and the position of the fastening clips. The sensor performing communication with the vehicle data network is called “Master“ and the other sensor is called “Slave“ (see Tab. 1).

Master	Slave
	
• Performs communication with vehicle data network • Performs communication with Slave sensor	• Performs only communication to Master sensor • Controls the HMI, if available

Tab. 1: Assignment of Master and Slave sensors.

Both sensors are mounted in the left and right rear corners of a vehicle. The vehicle connectors may either both point outwards or both point towards the rear vehicle center. Hella’s experiences show that for some car lines one orientation is more advantageous than the other orientation to faster reach a sufficient function performance. This aspect will be evaluated during the sensor simulation (see Fig. 1).

Typically the Master sensor should be mounted on the left side of the vehicle. The Slave sensor should be mounted on the right side of the vehicle. If the vehicle data network access for the Master is easier on the right side of the vehicle, Master and Slave positions may also be switched.
The label of the sensor, mounted on the left side, is marked with “LH”, the sensor on the right side “RH”.

After the final sensor position is fixed for a car line, the position and assignment details have to be implemented in the sensor software to achieve the correct system function.

3.3 Angle and plane definition

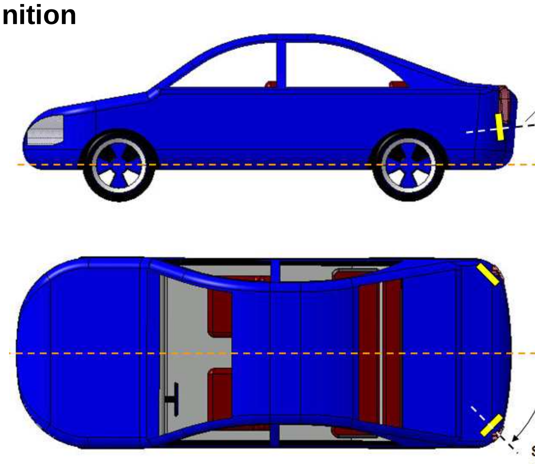


Fig. 4: Angle and plane definition