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23.09.2016

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Report

Issue Version 4
Topic **BOSCH: MRR1Crn and MRR1CrnCR technical description**
Description

1 Table of content

2 External Reference Documents

2.1 Environmental Test Specifications

The environmental tests for the MRR1Crn and MRR1CrnCR are preceded according:

Table 2-1

DIN IEC 68-x-x
DIN EN 60068-2-x
ISO 16750-x
DIN EN ISO 9227
DIN 55996-1
DIN 40050, part 9
Bosch N42 AP xxx

2.2 Regulations and Standards

The MRR1Crn and MRR1CrnCR meets the requirements as given in the listed regulation

Table 2-2

Country	Applicable standard / regulation
USA	47 CFR §15.19 47 CFR §2.925 47 CFR §15.21 47CFR §15.53 47CFR §15.253
Canada	RSS-Gen section 7.1.3 RSS-102 section 2.6 RSS-Gen RSS-251
Europe	EN 301 091 part-1 V1.3.3 EN 301 091 part-2 V1.3.2 EN 301 489 part-1 V1.9.2 EN 301 498 part-3 V1.6.1 EN 62479:2010 EN 60950-1:2006/A11:2009/A1:2010/A12:2011
Japan	ARIB STD-48 V2.1
Australia	Radio-Communications(LIPD) Class License 2000
China	Technical Specification for Micropower radio Equipments

2.3 Communications

The MRR1Crn and MRR1CrnCR meets the following specifications for **CAN** communication (High Speed CAN):

Table 2-3

ISO 11898 part 2/ part 5
SAE J 22284
ES-XS4T-12K259-Cx

The MRR1Crn and MRR1CrnCR also meets the following specifications for **FlexRay** communication:

Table 2-4

FlexRay Electrical Physical Specification V3.0 May 2010

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3 General Product Description

3.1 Principle

The radar sensor and control unit (SCU) contains a FMCW radar transceiver operating in the globally harmonized frequency range of 76.0 – 77.0 GHz (Category II, see Appendix A). Targets in front of the sensor are reflecting the radar signal and the relative speed and distance is determined via Doppler-effect and beat frequency. The angular position of the target is determined by use of the normalized antenna diagram.

Figure 3-1 Drawing

Special Properties:

- One of the smallest MRR Sensors with integrated control unit on the market
- Direct measurement of distance and relative velocity
- Extended field of view
- High measurement rate
- Based on newest SiGe-MMIC technology with active mixers, outstanding efficiency due to high transit frequency and very small chip area.
- BIST for high frequency components suitable for monitoring functions.
- Cost efficient and high quality design for high volume market
- Robust weather behavior (snow, fog, rain, dust, illumination)
- Flexible vehicle integration with fast and easy alignment procedures
- HW prepared for implementing functions with ASIL B safety goals

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3.2 MRR1Crn and MRR1CrnCR Block diagram

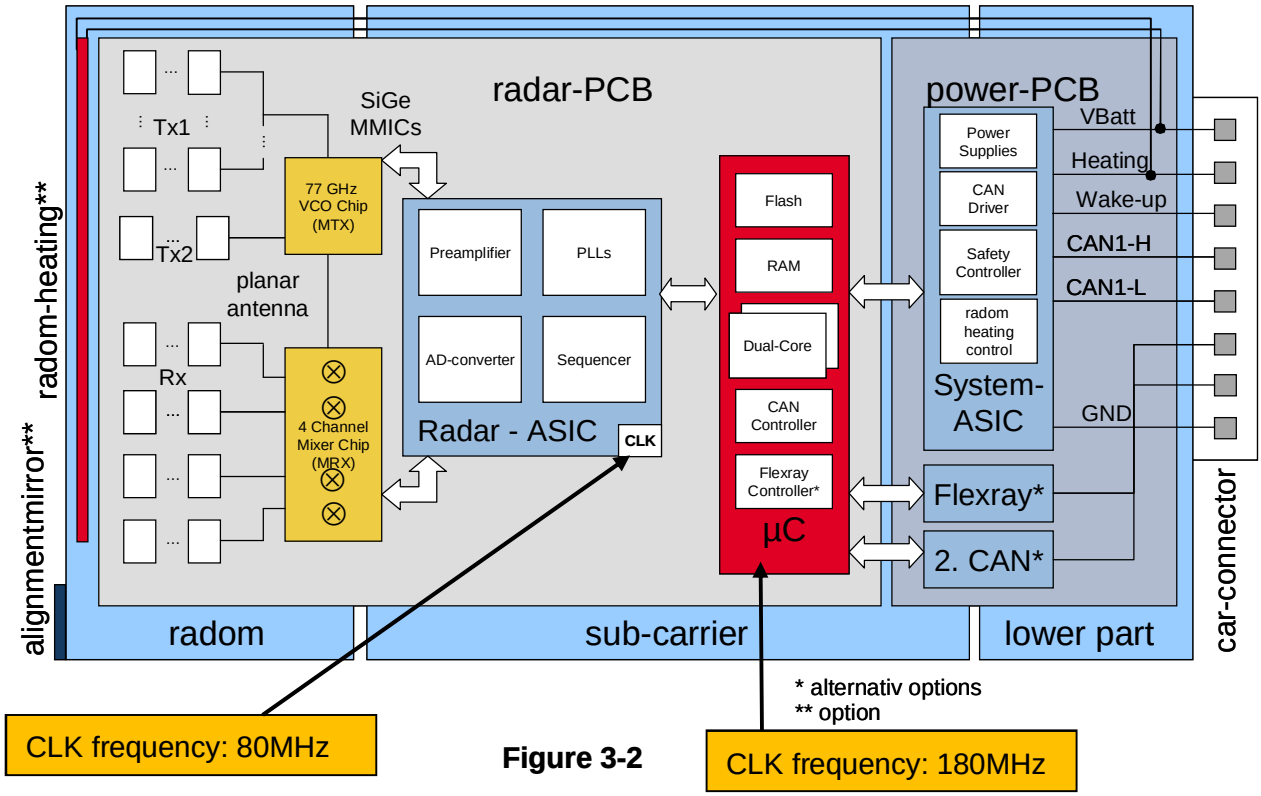

Figure 3-2

The MRR1Crn and MRR1CrnCR Sensor is a highly integrated ECU consisting of 2 printed circuit boards with a small set of electronic parts.

Power - PCB:

- A System-ASIC with power supplies for all internal used voltages, a safety controller (SCON) with watchdog functionality and electrical vehicle interface (CAN - transceiver).

Radar - PCB:

- Floating-Point Microcontroller with double-core
- Radar-ASIC with separate preamplifiers for each channel, a control and self-diagnosis unit and a PLL-unit for generating highly linear frequency ramps with the SiGe MMIC's
- SiGe ASIC (MTX) for frequency generation (77GHz (Category I, see Appendix A)) via integrated VCO
- SiGe ASIC (MRX) with four mixers for receiving signals

- Planar antenna array

3.3 Assembly Concept

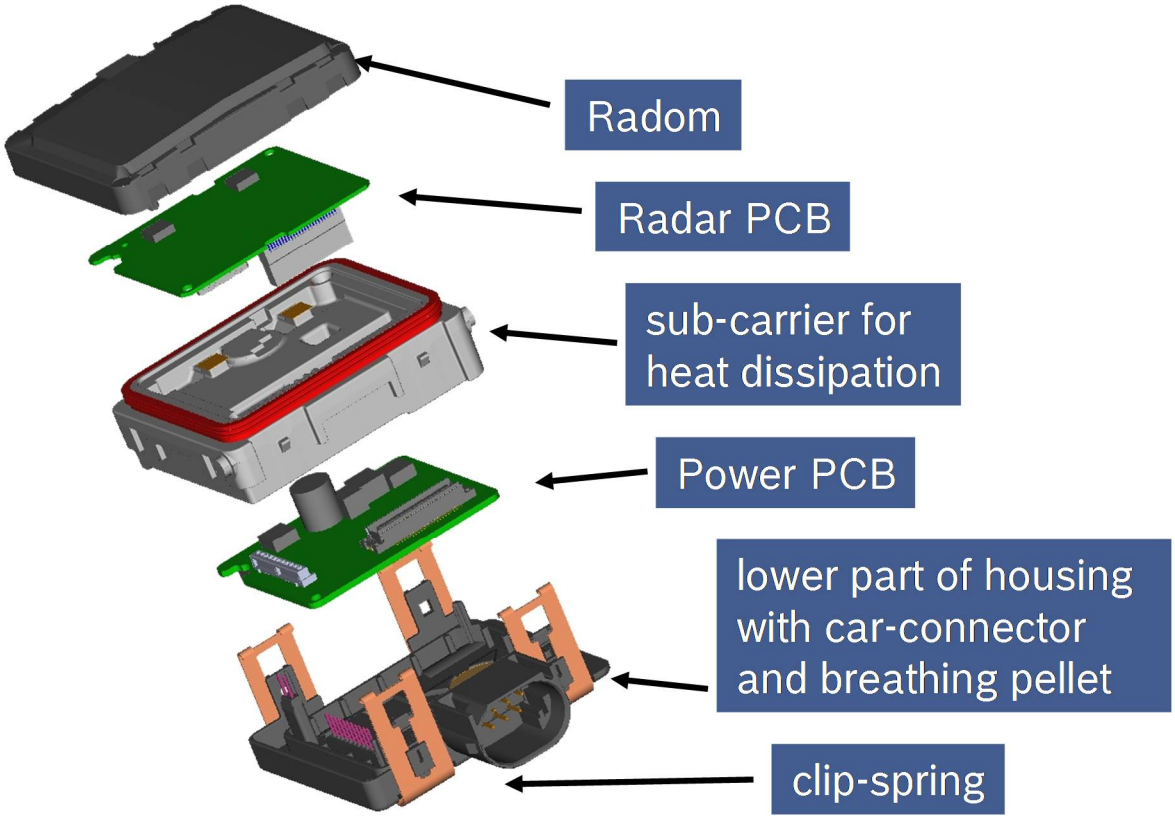

Figure 3-3 Assembly concept

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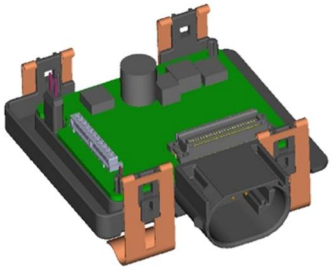
With only 5 main components, the assembly of the MRR1Crn and MRR1CrnCR is quite simple and is focusing to robust and cost effective mass production.



Lower part of housing with Power-PCB

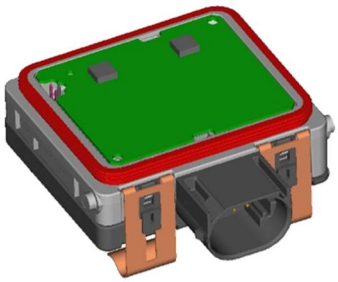


Figure 3-4
Lower part with subcarrier and Radar-PCB

Complete SCU

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4 Electrical Vehicle Interface

4.1 Pinning of the Connector

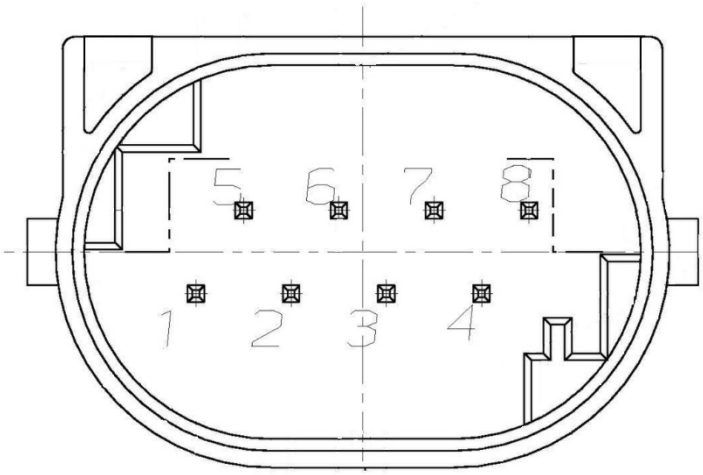

Figure 4-1 Connector

Further details for the whole set of possible configurations:

Table 4-1

Pin No.	Designation	Description
1	GND	Sensor ground: connected to terminal 31
2	CAN1-H / FR-BP-B	CAN1 High/ resp. Flexray BP-B (daisy chain)
3	CAN1-L / FR- BM-B	CAN1 Low/ resp. Flexray BM-B (daisy chain)
4	WAU / GND daisy chain / Radome heating / n.c.	HW-Wakeup / resp. GND daisy chain / radome heating (same potential like Pin 7)
5	CAN2-H / FR-BP-A	CAN2 High resp. Flexray BP-A
6	CAN2-L / FR-BM-A	CAN2 Low resp. Flexray BM-A
7	Radome heating / V + SCU daisy chain / n.c.	Low-Side-Switch Output for

		Radome heating / V + SCU daisy chain
8	V + SCU	Supply voltage for sensor (terminal 15/30)

4.2 Supply Voltage

Following values belong to Category II (see Appendix A):

Table 4-2

Supply voltage range on V_BATT An external fuse has to be provided (rec. 10A). **External overvoltage protection is required** (internal overvoltage protection up to 35V)	6,5 V - 18V

The supply voltage pin V_BATT can withstand a load dump impulse (ISO Pulse 5) of for a period of Maximum number of pulses:	35 V t ≤ 400ms 10

The SCU (Pin V_BATT and Radome) can withstand a supply voltage of for a period of at room temperature (23°C ± 5°C)	24 V t ≤ 5 min

Reverse polarity voltage protection (Pin V_BATT) is only guaranteed at a voltage of for a period of	-14 V max. t ≤ 60 sec

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5 Ambient Conditions

5.1 Temperature range

Following values belong to Category IV (see Appendix A):

Table 5-1

Storage temperature	- 20…+ 95 °C max. 5 years
Operating temperature range (ambient)	- 40…+ 85 °C
Temperature after painting	+ 125 °C max. 1h, non-powered
Temperature range for alignment	- 40..+ 85 °C

5.2 Mechanical and climate conditions

Following values are belonging to Category IV (see Appendix A):

Table 5-2

Mounting area		Vehicle front or rear area (bumper, grille)
Kind of protection	complete MRR1Crn and MRR1CrnCR	IP 6K6K (DIN 40 050) IP 6K7 (DIN 40 050)
	frontal area (Radome)	IP 6K9K (DIN 40 050) (no direct jet at breathing element and single-wire sealing's)
Stone impact	frontal area (Radome)	Resistance to stone impact according DIN 55996-1
Vibration		Randome vibration a_{eff} = 30,8 m/s^2, 3x8 h (according ISO/DIS 16750-3), chapter 4.1.3.1.5.2

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6 Mechanical dimensions

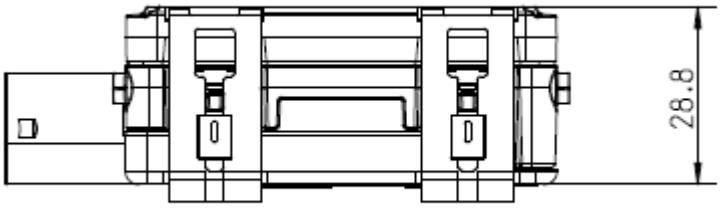
6.1 Weight of the component

Weight of the component without mounting bracket		< 200g (Class II) w/ heating and alignment mirror <190g (Class II) w/o options

6.2 Dimension diagram

All dimensions in the drawings are given in millimetres

6.2.1 Side view



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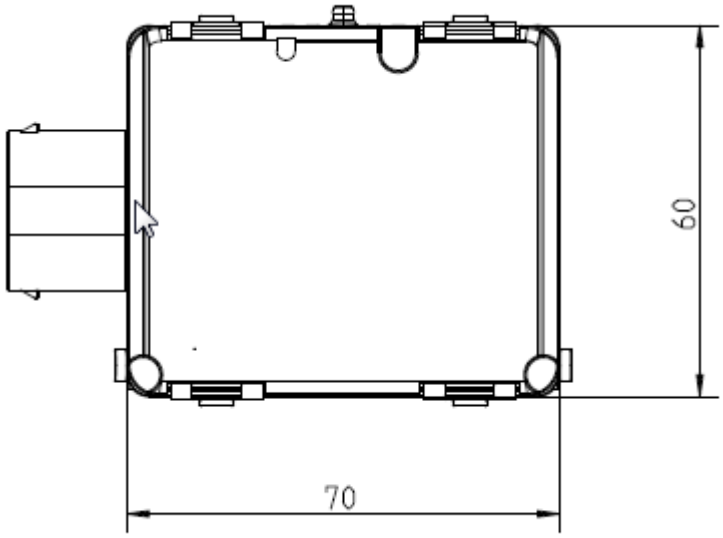
6.2.2 Top view



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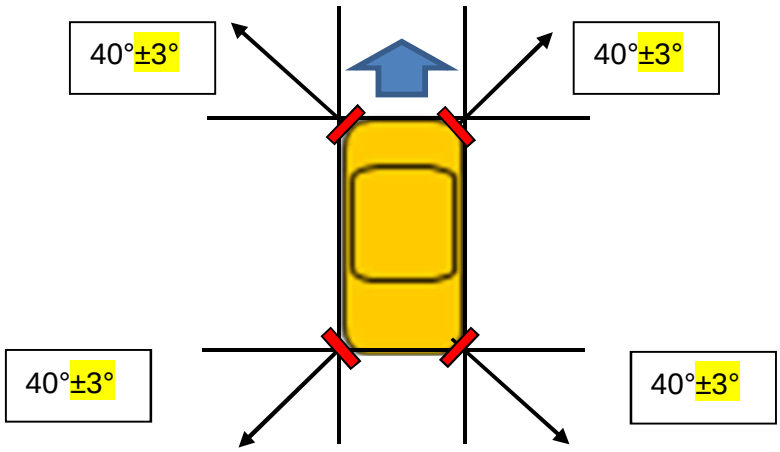
7 Mounting conditions

The MRR1Crn and MRR1CrnCR is installed in the front or rear area of the vehicle in the bumper or grille region. The sensor Radome points under an angle of approx. 40° relative to the vehicle driving direction, the connector points downwards. The outline dimensions of the sensor (without connector) are approx. 70x60x30mm^3 (l×w×h, Category II):



During the application of the sensor behind a bumper, special care must be taken in selecting the cover-material, cover shape, painting and position of the cover relative to the sensor. Water droplets, water film and snow sticking onto the bumper surface might cause additional attenuation that leads to a restricted performance or availability of the implemented functions and further systems.

8 Sensor technical Parameters

	Parameter	
	Nominal operating voltage	12V
	Nominal current consumption	0.35A rms
	Frequency band	76-77GHz
	Type of Modulation	FMCW
	Number of channels	1
	Antenna	Integrated patch
	Antenna gain Of the integrated patch antennas	TX1 and TX2: 15,7dBi RX: 13dBi
	Nominal occupied Bandwidth (99%)	760MHz
	Nominal radiated power: e.i.r.p. (peak detector)	30dBm
	Nominal radiated power: e.i.r.p. (RMS detector)	20.5dBm

9 Antenna characteristics

9.1 Antenna gain simulations

Antennas	Simulated gain
TX1 / TX2	15,7dBi
RX	13dBi

9.2 Antenna patterns

The antenna patterns are provided both in absolute and normed scaling

9.2.1 TX Antenna azimuth and elevation pattern

The main lobe of the antenna is 20degrees off axis with reference to sensor 0degrees axis.
The antenna patterns for both TX antennas (TX1 and TX2) are identical

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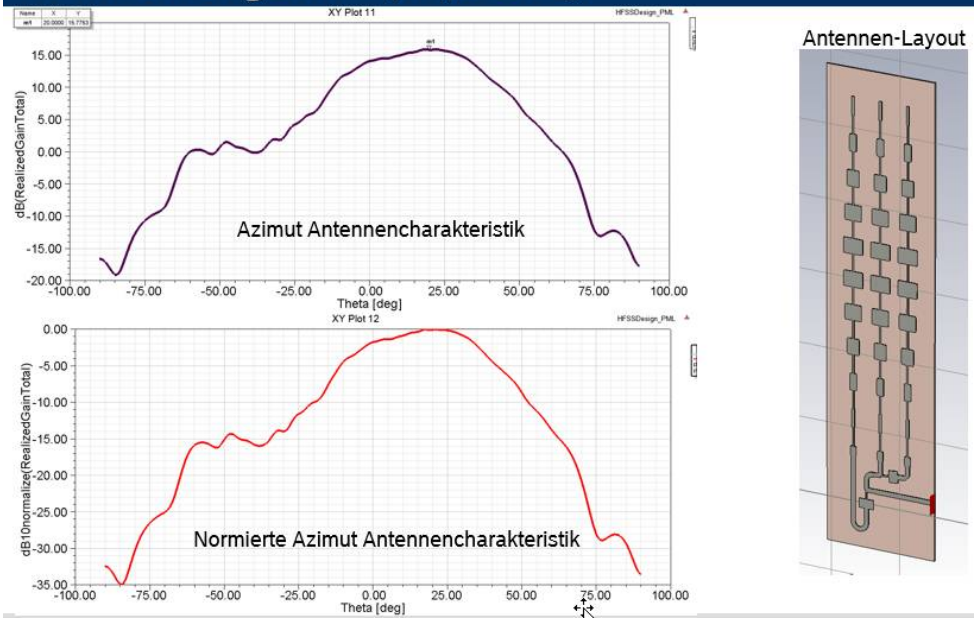
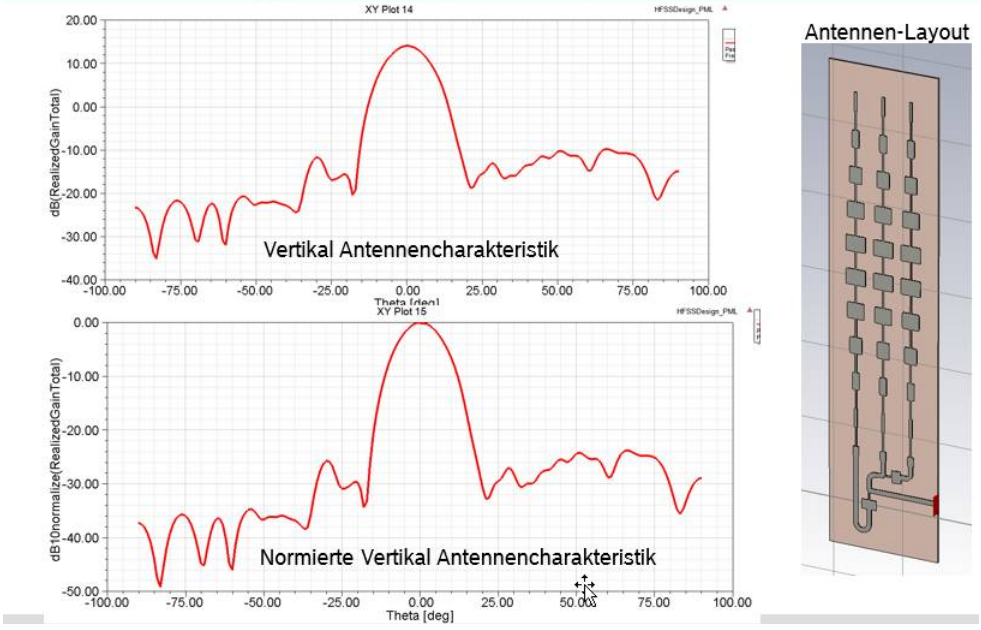
TxAntennengewinn (76,5 GHz)



Tx-Antennengewinn (76,5 GHz)



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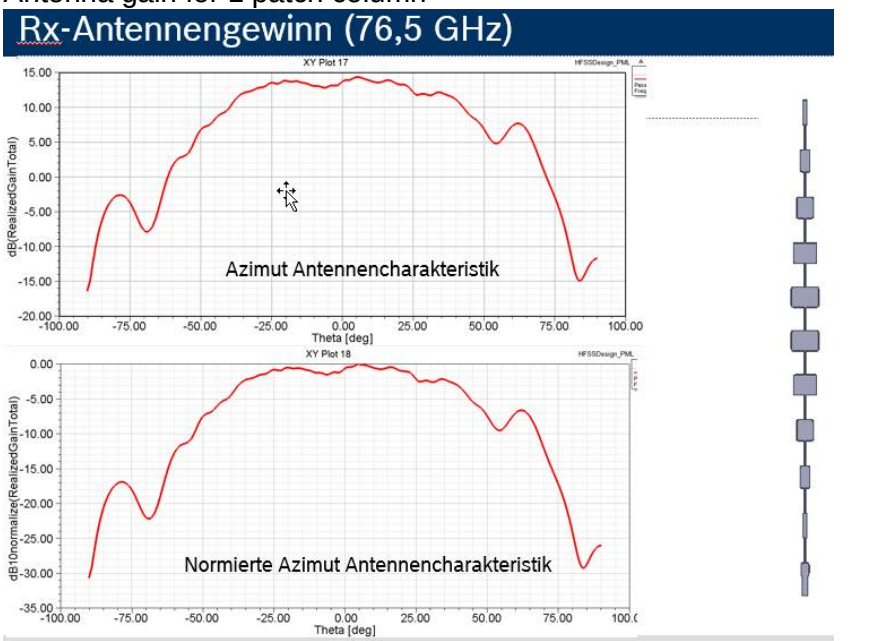
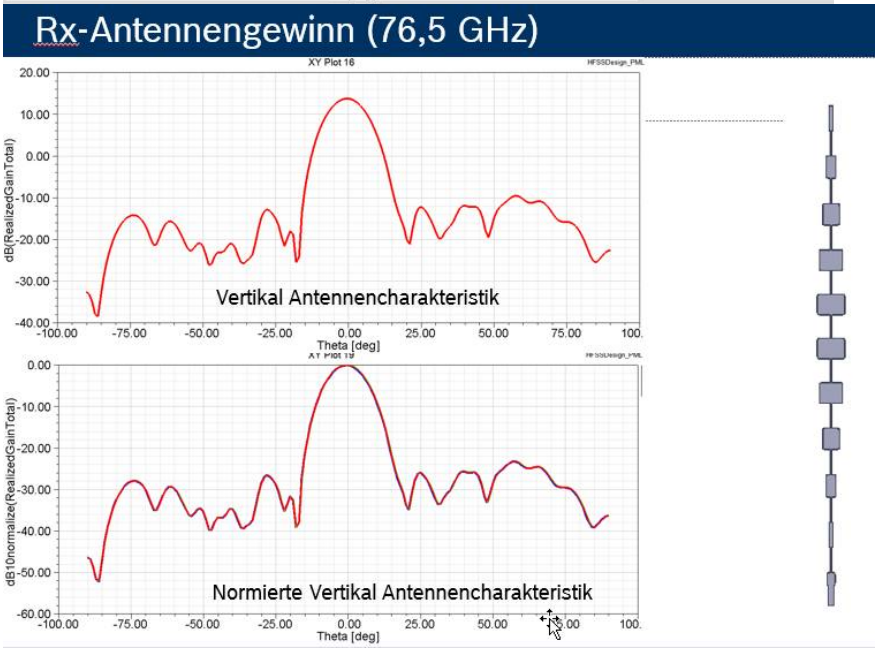
9.2.2 RX antenna azimuth and elevation pattern

Antenna gain for 1 patch column





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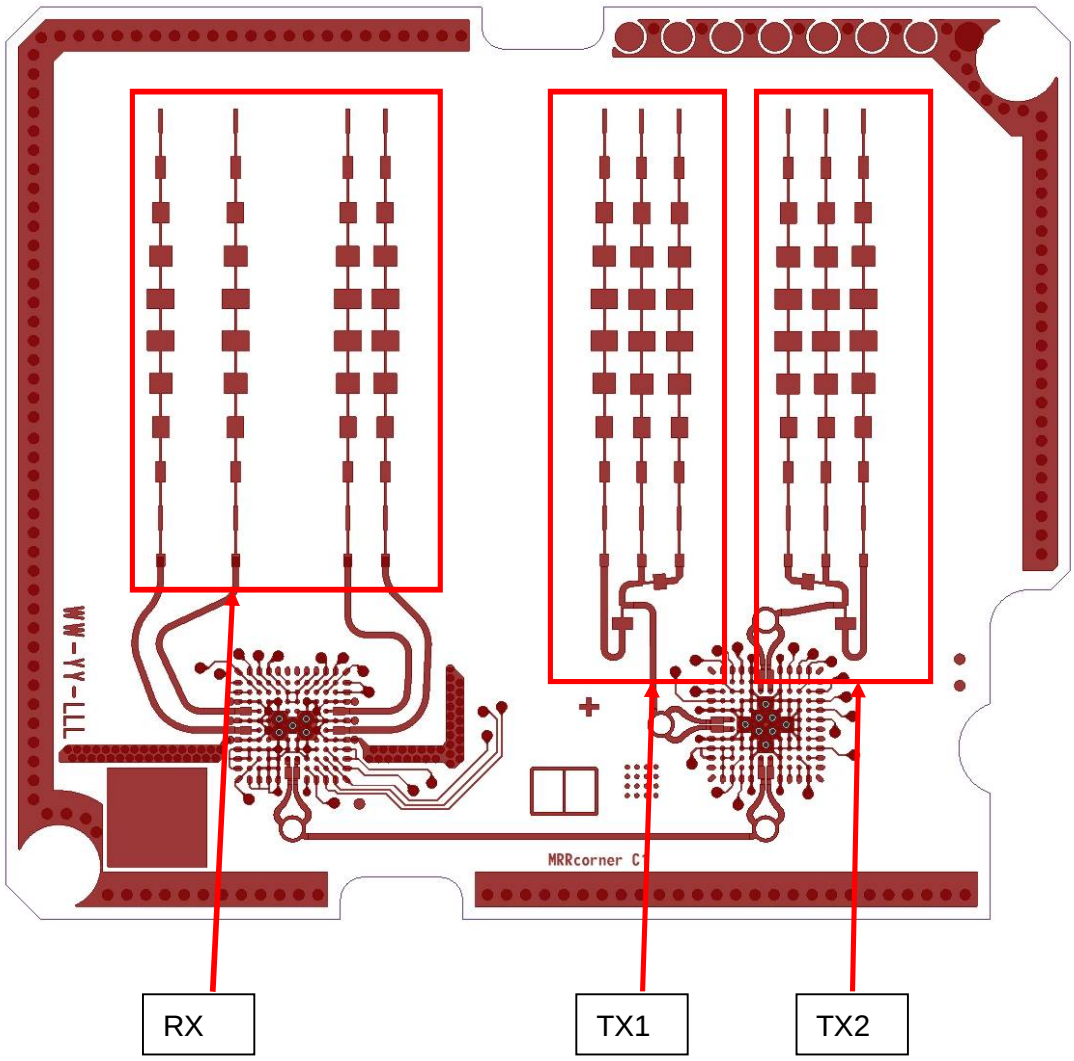
9.3 Antenna layout

The antenna layout of the sensor is shown in the below picture.

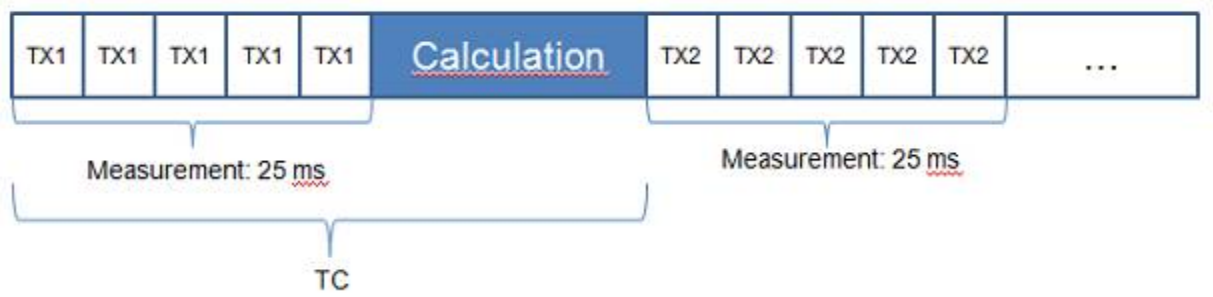


The structure for TX1 and TX2 are identical but placed mirror reversed in the pcb layout.

9.4 Tx antenna configurations TX1 & TX2: operating conditions

9.4.1 Operating principle

The TX antennas used in the MRR1Crn and MRR1CrnCR sensor alternate every second cycle independent of vehicle speed.
The below diagram gives the usage of the TX antennas per measurement cycle:



In the “TX” phases the sensor is transmitting via the TX1 or TX2 antenna, depending on the cycle.
In the “calculation” phase the sensor is receiving signals and processing the received signals.
The value for “TC” is 120ms.

9.4.2 TX antenna configuration

The antenna structure of the sensor contains 2 TX antennas, with a pattern as described in chapter 8.1. In Azimuth, the main lobe of the TX antennas is rotated +/- 20degrees with reference to the center axis of the sensor (0degrees reference).
To generate the required field of view for the sensor performance, both TX antennas are arranged mirror inverted on the radar pcb in the device.
Through this arrangement the total resulting antenna opening angle is appox. 50degrees with a minimum at the center axis (0degrees reference) of the sensor.