

Millimeter wave radar specifications

Corner Radar MCRI_Rev01

Version history

version number	date	content	editor	Review
V1.0	2024.02.06		Tan Le Ruan Jiangyi Zhou Yang Xu Jianwei Guo Hao Zuo Shanshan	Zhang Yubo Qin Xinghua Yang Ming
V1.1	2024.12.27	Update 6.3 regulatory requirement	Fangyue Wu	Fangyue Wu

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1. Overview

The applicable period of this document is from the delivery of Sample A to the end of SOP. During this period, this document will be continuously revised based on the opinions of both parties. Please refer to the latest version.

1.1. Product description

Corner radar is a 77 GHz mid-range radar sensor with three transmitting and four receiving antennas, which can be applied to passenger cars and commercial vehicles.

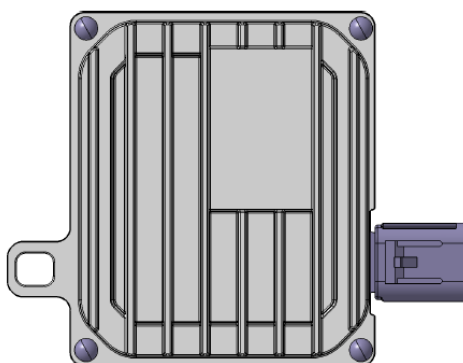
Corner radar sensors can provide the following functions:

- 1.) By using the 76 GHz to 77 GHz frequency band, the corner radar sensor complies with global regulatory standards:
- 2.) Complies with electromagnetic compatibility regulations - EN 301489 (if sold to the European market)
- 3.) Has HS-CAN or CAN-FD interface for vehicle integration
- 4.) Azimuth alignment
- 5.) Sensor occlusion detection
- 6.) The normal operating voltage range is 9V~16V

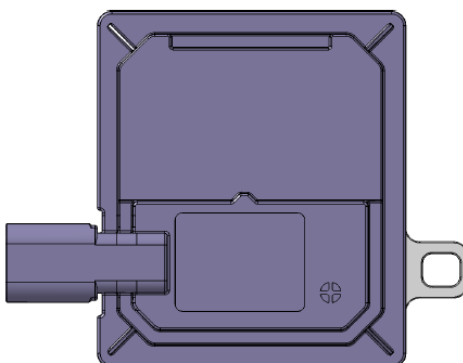
2. External structure

2.1. Overall appearance

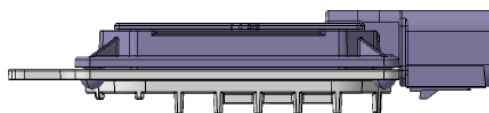
2.1.1. Front appearance



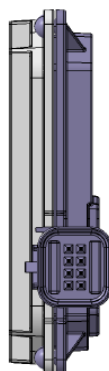
2.1.2. Back appearance



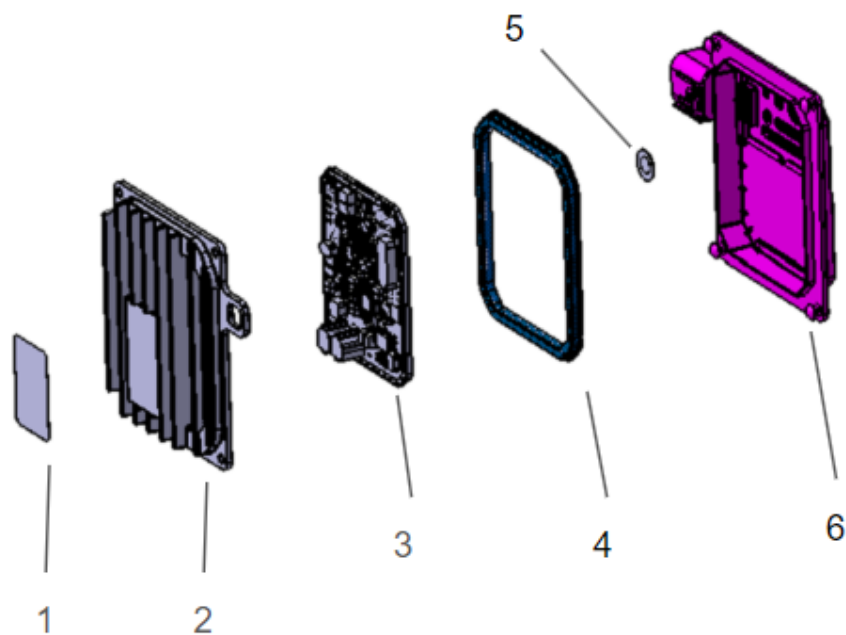
2.1.3. Top view



2.1.4. Side View



2.2. Exploded view

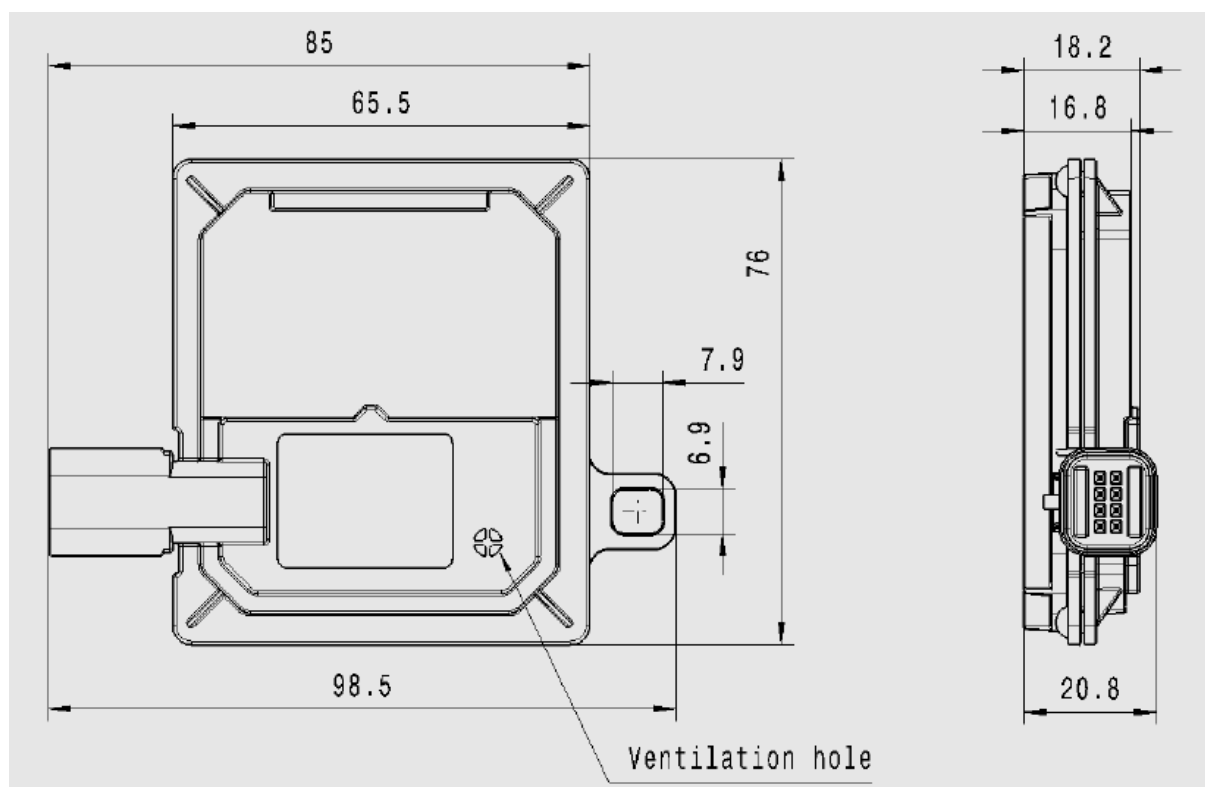


Serial number	Module Name	Material	The main purpose	Remark
1	Label	3M 7815EB TT5 MW PET50-310E-65WG	Marking	
2	Frame	ALS112Cu1(Fe)	Housing	
3	PCBA	/	/	

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4	Sealing Liquid	Silane-modified polymer	sealing	
5	Membrane	PTFE	Breathable membrane	
6	Radome	>PBT+30GF<	Housing	

2.3. Dimension and weight



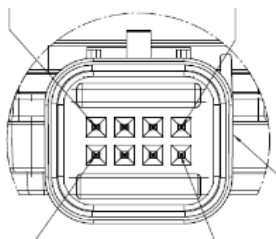
Parameter	Numeric
Length*Width*Height	98.5*76*20.8 mm
weight	88±7g

2.4. Connector

category	Figure	Product	Harness	supplier	quantity
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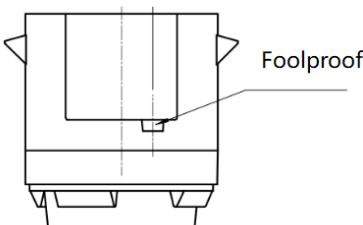
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	No.	end model	end model		
Low speed signal connector	1	1488342	1411001	TYCO	1



Product end diagram

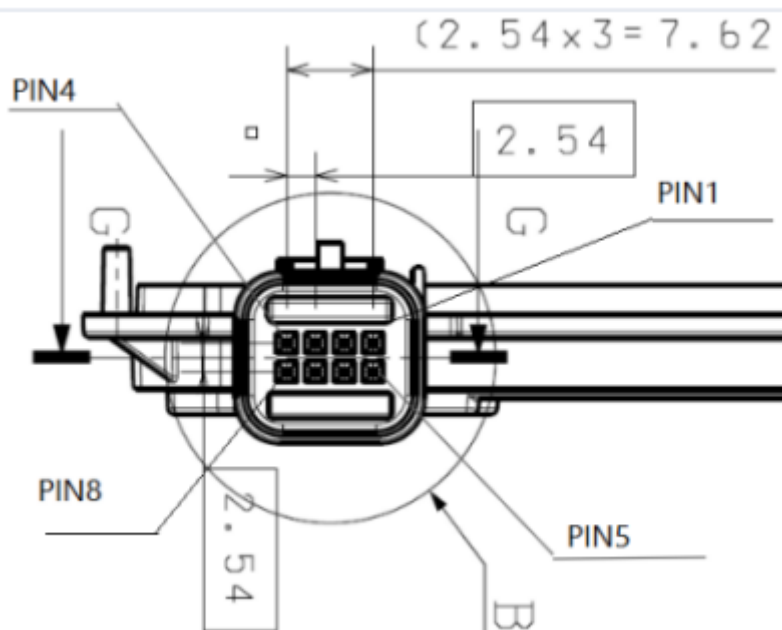
2.5. Fool-proof Instructions

Foolproof module	Graphics	Remark
Foolproof Connector	NA	No foolproof connector
Foolproof flnallation		foolproof connector is installed , aluminum shell positioning holes are oval

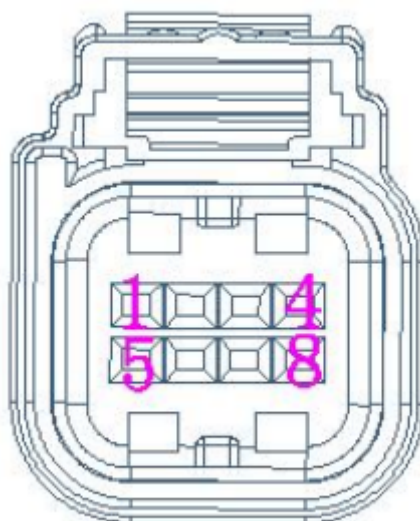
2.6. Pin definition

2.6.1. Projection diagram of product end sheath

Product side:



Harness end:



Corner Radar Pin Definition -MCR							
Pin Number	Port Name	Interface Characteristics	Port Definition	Wiring harness connection	Static operating current	Required power properties	Remark
1	ADD1	Collection Input	Address recognition	See Schedule	-	-	
2	ADD0	Collection Input	Address recognition	See Schedule	-	-	

3	PCAN_H	CANFD	Private CAN+	MPC private CAN+	-	-	With terminating resistor
4	PCAN_L	CANFD	Private CAN-	MPC Private CAN-	-	-	With terminating resistor
5	VBAT	Power	KL30 electric	KL30 electric	100uA	Normal electricity	
6	VCAN_H	CANFD	Public CAN+	ADAS Net +	-	-	No terminal resistor
7	VCAN_L	CAN FD	Male CAN-	ADAS Network	-	-	No terminal resistor
8	GND	GND	Power Ground	Power Ground	100uA		

2.7. Environmental parameters

project	data
Range of working temperature	-40 degC / +85 degC
Storage temperature range	-40 degC / +85 degC
Relative operating humidity	45% / 65%
working pressure	101.325kPa±5%

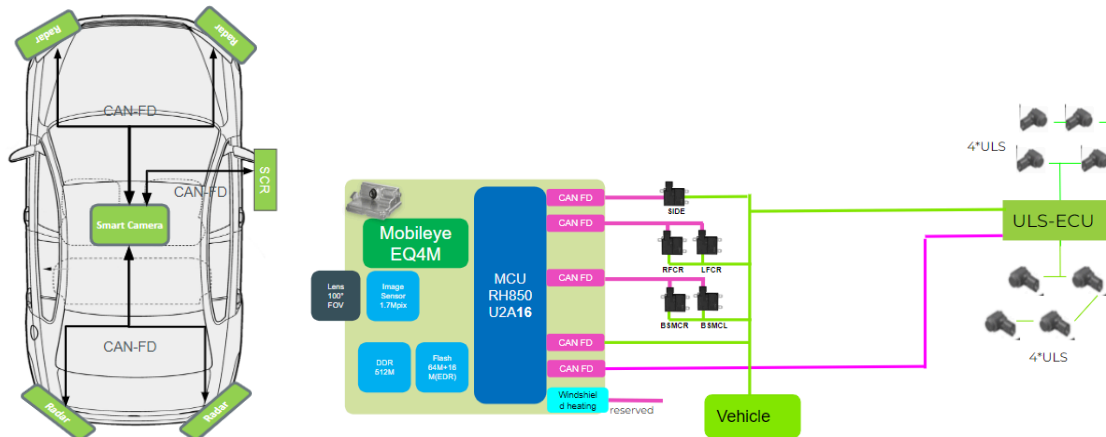
2.8. Other

Project	Describe
Cooling method	(Natural cooling) Metal shell and heat dissipation silicone grease
PCB (material, number of layers,	6 layers,MCL-LW-990(RFD)

through holes or blind holes of several levels, FPC)	
--	--

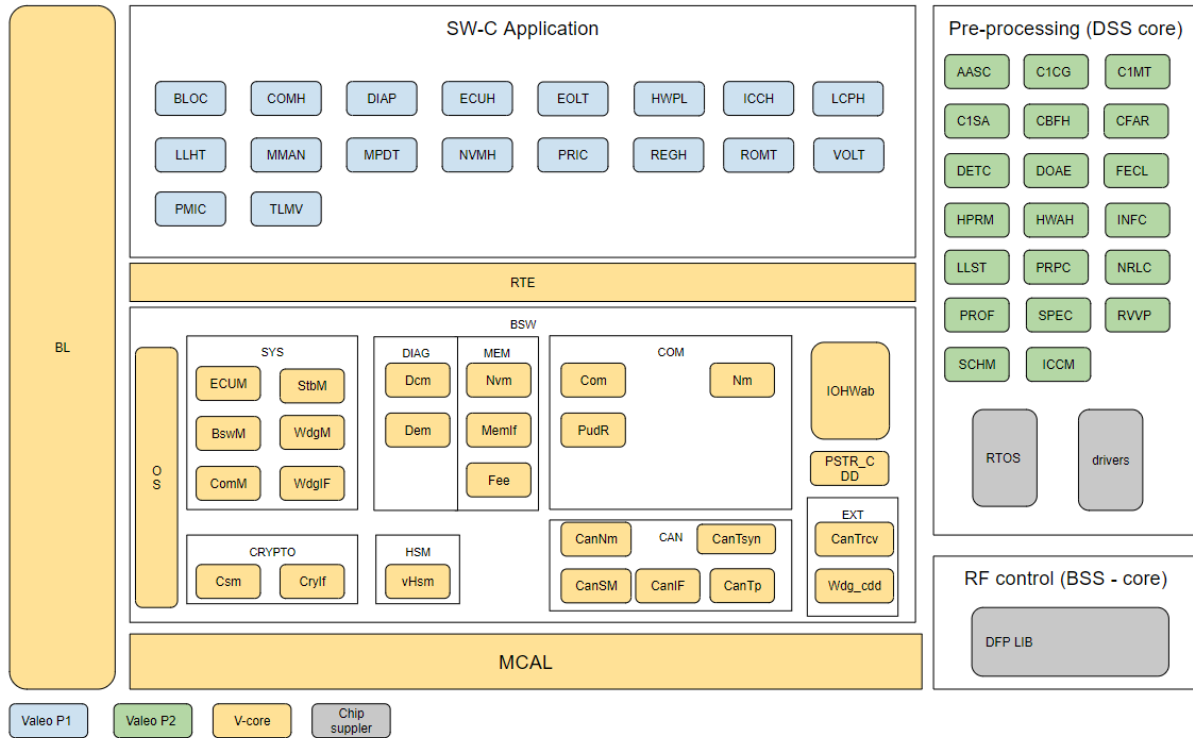
3. Electrical connections

3.1. System architecture



1. The entire ADAS system architecture consists of 1 domain control MPC (integrated front camera), 4 corner radars, 1 side radar, and 8 ultrasonic radars;
2. The 4 corner radars and 1 side radar each have two CANFD channels, one connected to the MPC is called PCAN, and the other connected to the vehicle CANFD network is called VCAN;
3. The side radar is installed according to the left and right steering configuration of the vehicle. For example, for a left-hand steering vehicle, the side radar is installed on the right side of the vehicle.

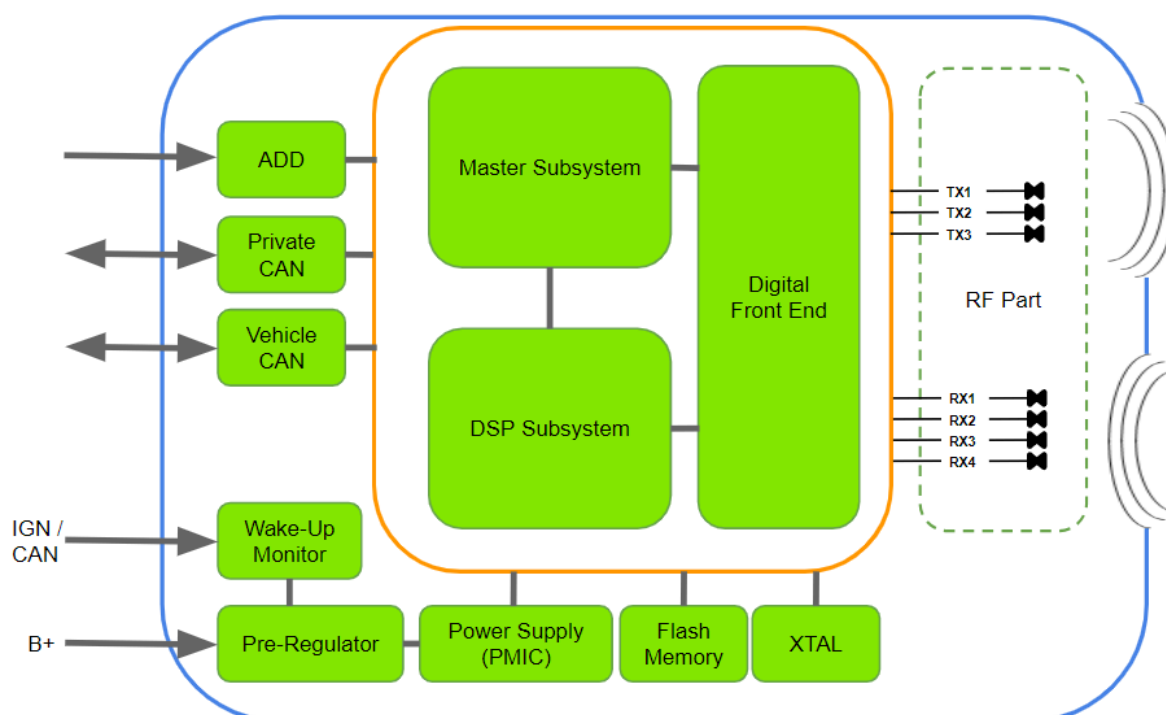
3.2. Software architecture block diagram



3.3. Software

project	describe	Remark
operating system	AutoSAR	
OTA Time	~ 3 min	
OTA package size	~ 9 Mbytes	According to customer format
OTA Channel	CAN or CAN FD	

3.4. Hardware Block Diagram



PS: Green: Sensor has this function; Gray: Sensor does not have this function;

The Radar Sensor uses a two-stage power supply to power the entire system and has a wake-up function;

Radar Sensor exchanges information with the vehicle through VCAN and with MPC through PCAN;

Radar Sensor uses ADD circuit to determine the sensor position;

Radar Sensor has external Flash;

3.5. Key components

chip	model	parameter	Function	supplier	grade
MCU	AWR29 4x	ASIC FMCW Radar Sensor AWR2943	Radar Chip	TI	AEC-Q100
PMIC	LP877 4	PMU Three Buck and 5V Boost CONV LP8774	Power chip	TI	AEC-Q100

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Regulator	LM63625	VREG ADJ 2.5A LM63625	Power chip	TI	AEC-Q100
CAN	TJA1145	TRSV CANHS TJA1145	CAN communication	NXP	AEC-Q100
CAN	TJA1051	TRSV HS-CAN TJA1051	CAN communication	NXP	AEC-Q100
Flash	IS25LP032D	FLASH SPI 32Mb IS25LP032D	memory chip	ISSI	AEC-Q100

4. Technical and performance parameters

4.1. Parameters Table

Parameter classification	Parameter	Specification	Remark
Electrical Interface	Power supply	9V-16V DC	
	Typical power consumption	0.35A	
	Peak power consumption	0.5A	
	Quiescent Current	100uA	
	Operating Voltage	9V-16V DC	
	Arousal mechanism	CAN Bus Wake up	
	Power supply type	KL30	
	Power on time	NA	
interface	CAN	CANFD	
	100M Ethernet	NA	
RF characteristics	Working frequency	76-77GHz	
	working bandwidth	225MHz/450MHz	
	Maximum port power	6W	
	Output Power	Peak: 36.5 ± 2 dbm	

	(e.r.i.p)	Mean: 26.48± 2 dbm	
	Transceiver channel	3Tx4Rx	
	Receive sensitivity	MAX160m@10dBsm	
	signal-to-noise ratio	NA	
Communi cation indicators	Communicatio n delay	56ms	
	Coverage	150°	
	Packet collection rate within coverage	NA	
/	Functional safety level	QM	

Key Parameters	Index
Working frequency Frequency(HZ)	76G~77GHz
System Format (working format)	FMCW(3Tx 4Rx)
Detection distance Range Measurement (m) (5dbsm)	170m/85m
Range Accuracy (m)	0.1@wide beam 0.3@far beam
Range Resolution (m)	0.33@wide beam 0.7 @far beam
Detection speedVelocity Measurement(m/s)	-70~70
Velocity Accuracy / Resolution(m/s)	0.05/ < 0.5
Azimuth angle Range / Accuracy (°)	150 @wide beam/

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	40 @far beam
Azimuth angle Accuracy(°)	±0.6
Elevation Angle Range (°)	12
Cycle time (ms)	56
Weight(g)	89g

4.2. Antenna Performance

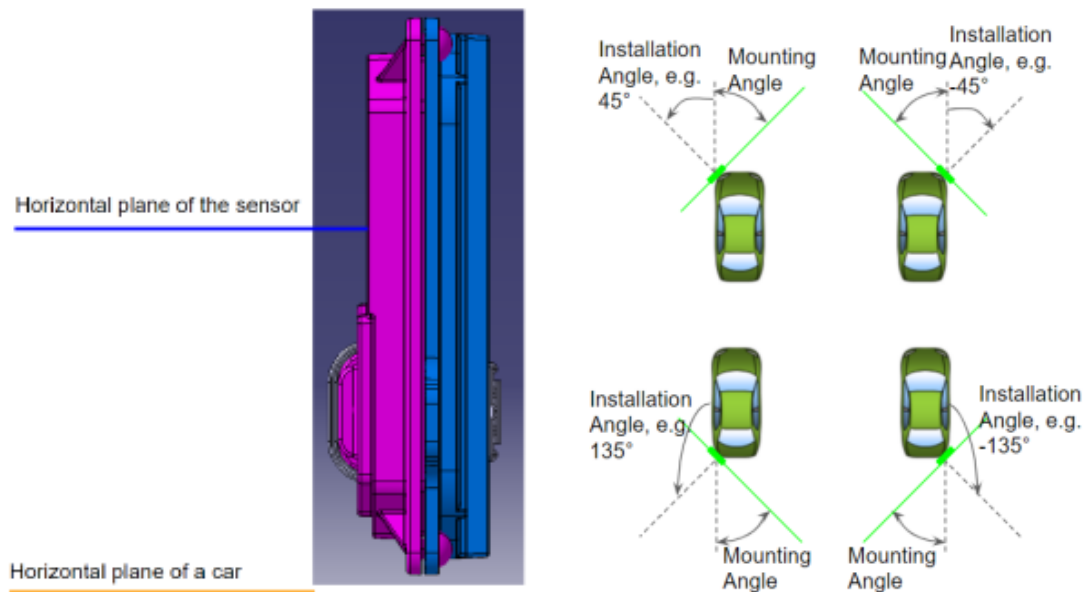
S11<-10dB	74.85GHz~77.78GHz
Center frequency	76GHz
Transmit and receive isolation	<-31.5dB
Transmit antenna horizontal 3dB beamwidth	±7°
Transmit antenna vertical 3dB beamwidth	±4°
Receive antenna horizontal 3dB beamwidth	±50°
Receive antenna vertical 3dB beamwidth	±4°
Transmitting antenna horizontal plane side lobe level	-11dB
Transmitting antenna vertical plane side lobe level	-11dB
Receive antenna horizontal plane side lobe level	-14dB
Side lobe level in the vertical plane of the receiving antenna	-11dB
Transmitting antenna gain	Beam 1: 18.8dBi Beam 2: 14.5 dBi
Receive antenna gain	14dBi

5. Design constraints

5.1. layout requirements

Need reference: MCR1 ISMOP Customer Full Ver.A_11 2024_01 for layout

5.1.1. layout direction



- 1). The horizontal plane of the radar should be parallel to the ground where the vehicle is running, with an error of $\pm 2^\circ$;
- 2). The vertical plane of the radar needs to be perpendicular to the unloaded ground of the vehicle, and the error is $\pm 2^\circ$;
- 3). The angle (Mounting angle) between the radar wave surface and the vehicle's forward direction (X-axis) is $40 \sim 45^\circ$.
- 4). The installation height is within the range of 400mm~1100mm from the ground.

5.2. Installation requirements

5.2.1. Manual plug and unplug space:

Left and right directions: It is convenient to hold the wire harness end connector manually, one finger width is recommended (10mm)

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Wire harness direction: 2 times the length of the wire harness end connector, vehicle Ethernet connector $2 \times 20\text{mm} = 40\text{mm}$, main connector $2 \times 33\text{mm} = 66\text{mm}$, RF connector $2 \times 25\text{mm} = 50\text{mm}$

5.3. Configuration information

Configuration information is subject to actual vehicle configuration.

5.4. Power supply

Corner radar needs to provide KL30 power.

5.5. Power on and off logic requirements

NA

5.6. Related parts requirements

The entire vehicle is required to send speed, corner, and gear signals to the Corner radar for target detection.

6. Function description

6.1. Function

6.1.1. Feature list

serial number	First level function	Secondary function
1	Occlusion detection	Occlusion detection

6.1.2. Function Description

The current platform's millimeter-wave radar only outputs point clouds and does not perform separate functions.

6.2. Feature score

Since the radar output point cloud, the functions are integrated in the MPC, the function score can refer to the Valeo MPC function score

6.3. Regulatory Requirement

6.3.1 EU Regulatory Compliance:

Hereby, We declare that the radio equipment type MCR1_Rev01 is in compliance with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at the following internet address <https://www.valeo-clientportal.com/product-regulatory-compliance/>

6.3.2 Serbia Regulatory Compliance:



N038 24

6.3.3 Israel Regulatory Compliance:

- 1) מספר אישור התאמה מטעם משרד התקשורת: 55-19770
- 2) חל איסור לבצע פעולות במכשיר שיש בהן כדי לשנות את תכונותיו האלחוטיות של המכשיר, ובכלל זה שינויי תוכנה, החלפת אנטנה מקורית או הוספת אפשרות לחיבור לאנטנה חיצונית, בלא קבלת אישור משרד התקשורת, בשל החשש להפרעות אלחוטיות.

6.3.4 Mexico Regulatory Compliance:

La operación de este equipo está sujeta a las siguientes dos condiciones:

- (1) es posible que este equipo o dispositivo no cause interferencia perjudicial y (2) este equipo o dispositivo debe aceptar cualquier interferencia, incluyendo la que pueda causar su operación no deseada

6.3.5 Brazil Regulatory Compliance:

Este equipamento não tem direito à proteção contra interferência prejudicial e não pode causar interferência em sistemas devidamente autorizados. Para maiores informações, consulte o site da ANATEL – (www.anatel.gov.br)



XXXXXX-XX-XXXXXX

6.3.6 Paraguay Regulatory Compliance:



NR:XXXX-XX-X-XXXX

6.3.7 FCC Compliance Statements:

FCC ID: 2AAS2-MCR1

All controls, adjustments and switches that's instructed in the manual or follow-up instruction provided by the manufacturer that may be operated or adjusted without resulting in a violation of FCC rules.

Any adjustment that could result in a violation of FCC rules and it's recommended that could be performed only by or under the immediate supervision and responsibility of a person certified as technically qualified to

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perform transmitter maintenance and repair duties in this radio service by an organization or committee representative of users of that service.

Changes or modifications i.e. replacing any transmitter component (crystal, semiconductor, etc.) not expressly approved by the party responsible for compliance could void the user's authority to operate the product.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This equipment should be installed and operated with minimum distance 25cm between the radiator and your body.

6.4. Functional safety

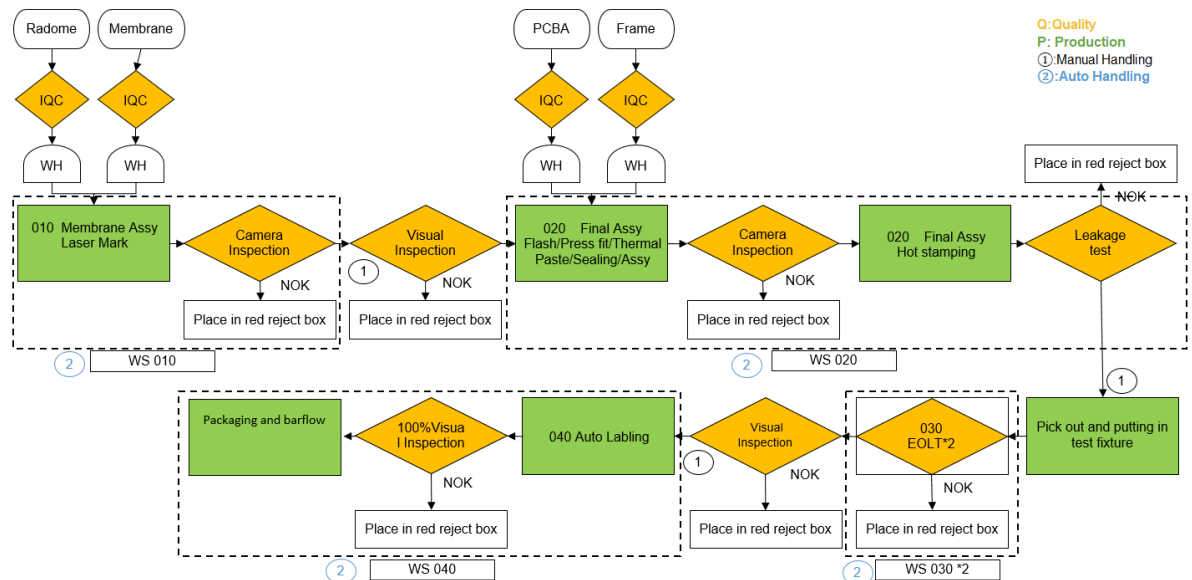
module	ASIL level	Remark
System	QM	

6.5. information security

Security Concept	Key Name	Description	Type	Generated at(Valeo corp HSM,Valeo plant HSM,BYD)corp	Algorithm	Owner(Generated at Valeo/Customer)
Secure Debug	Secure_Debug_Certificate_Debug_Field_Enable	Debug field in secure boot certificate X.509 appended to PBL SW used to unlock JTAG	Asymmetric	Valeo - Corp HSM signing server	RSA	Valeo
Secure Debug	Secure_Debug_Certificate_Debug_UID	Debug UID extension in secure boot certificate X.509 appended to PBL SW used to unlock JTAG	Asymmetric	Valeo - Corp HSM signing server	RSA	Valeo
Secure Debug	Secure_Debug_Certificate_Debug_Type	Debug Type extension in secure boot certificate X.509 appended to PBL SW used to unlock JTAG	Asymmetric	Valeo - Corp HSM signing server	RSA	Valeo
Secure Debug	Secure_Debug_Certificate_Debug_CoreDbgEn	Debug CoreDbgEn extension in secure boot certificate X.509 appended to PBL SW used to unlock JTAG	Asymmetric	Valeo - Corp HSM signing server	RSA	Valeo
Secure Debug	Secure_Debug_Certificate_Debug_CoreDbgSecEn	Debug CoreDbgSecEn extension in secure boot certificate X.509 appended to PBL SW used to unlock JTAG	Asymmetric	Valeo - Corp HSM signing server	RSA	Valeo
Secure Boot	To verify the bootloader	Binary image generated and verified in the certificate	Asymmetric	Corp HSM	RSA	Valeo
Secure Update	To verify the firmware to update	corpHSM sign the FW and ECU verify the signature to validate the downloaded firmware	Asymmetric	Corp HSM	RSA	Valeo

7. Production characteristics (optional)

7.1. Process



8. Precautions

NA

9. Others

Manufacturer info.:

Valeo Interior Controls (Shenzhen) Co,Ltd

No.3 Building 101, No.3 Building, No.3 Building 2#, No.4 Building, Cuigang
Industrial Park Six Huaide, Fuyong Street, Bao'an District, 518103, Shenzhen City,
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