ARS1.31
Millimeter Wave Radar
Specification Sheet

<customer version>

Nanjing Chuhang Technology Co., Ltd.

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1. General description

1.1 Introduction

As an automotive compatible product, the ARS1.31 Millimeter Wave Radar is focused on the Child Presence Detection and Rear Occupant Detection function. It helps to prevent children from being left in the car and to alert the driver when the rear seat belt is not securely fastened during driving.

This document describes the ARS1.31 Millimeter Wave Radar of Nanjing Chuhang Technology Co., Ltd. (hereinafter referred to as Chuhang Tech), including product specification, functional principle, product function, installation, system test, and calibration method.

1.2 Terms and abbreviations

Abbreviation	Full name
AOP	Antenna on package
CAN	Controller Area Network
CPD	Child Presence Detection
SOD	Seat Occupancy Detection
HMI	Human Machine Interface
FMCW	Frequency Modulated Continuous Wave
dB	Decibel
dBm	Decibel milliwatts
dBsm	Decibel square meters
RCS	Radar Cross Section
KL30	Battery is positive, hot at all times
KL15	Ignition switch position #2 (on)
DV	Design Validation

2. Radar system description

2.1 Functional principle

This chapter describes the principle of range, velocity, and angle detection of the frequency modulated continuous wave (FMCW) radar.

2.1.1 FMCW radar principle

Electromagnetic (EM) waves within frequency range between 300 MHz to 300 GHz are defined as microwaves. The propagation velocity of microwaves in the air is almost equal to the speed of light in vacuum, which is $3 \times 10^8 \mathrm{m/s}$. A radar system generally consists of transmitter-receiver module, transmitting and receiving antenna (TX-RX Antenna) and processing unit. Microwaves are radiated by the transmitting antenna, reflected by the target object, and received by the receiving antenna. During this process, the time delay of the microwave between TX and RX antenna can be measured, the distance between the target object and radar is then calculated. The measurement principle of the radial distance between radar antenna and object is shown in Figure 1. Assuming the distance between radar and object is R, the travel time of EM wave between transmitter and receiver is t_d, the travel distance of microwave from radar transmitter to the target object and reflected to radar receiver is thus 2R, the speed of light is c, $c = 3 \times 10^8 m/s$; therefore, R is calculated by equation $R = \frac{1}{2} \cdot c \cdot t_d$.

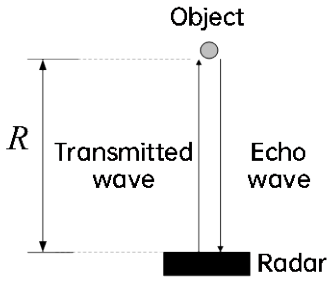


Figure 1 Radar distance detecting principle

FMCW radar generates a saw-tooth wave form, see Figure 2. The radiated EM wave will be reflected/scattered by the target object, part of the EM wave will be captured by the receiving antenna of the radar. The received signal will be down-converted in the mixer with local oscillator (LO). For saw-tooth wave, frequency is linearly changing with time, so is the LO of the radar. Due to the delay t_d, the received signal has the frequency at time $t - t_d$ while the LO has the frequency at time t. In this way, after the mixer an intermediate frequency (IF) is obtained, the IF is equal to the difference between received frequency and LO. After LNA, filter, ADC and baseband processing, the distance of the target object can be extracted.

In addition, to obtain the radial velocity of the target object, the radar has to transmit the single sawtooth signal (Chirp) in a periodical way (frame). The radial velocity is calculated by in-time phase shift of the adjacent chirp signals. By equal interval sampling, the sampled data will be processed with FFT and the outcome is saved in the storage matrix (radar data cube). The processor combines all received chirp signals in one frame and sequentially performs FFT to each single chirp.

The combination of distance FFT and doppler/velocity FFT can be considered as a 2-D (two-dimensional) FFT processing of the digital sampling data in each frame. The 2-D FFT enables the simultaneous measurement of target distance and velocity.

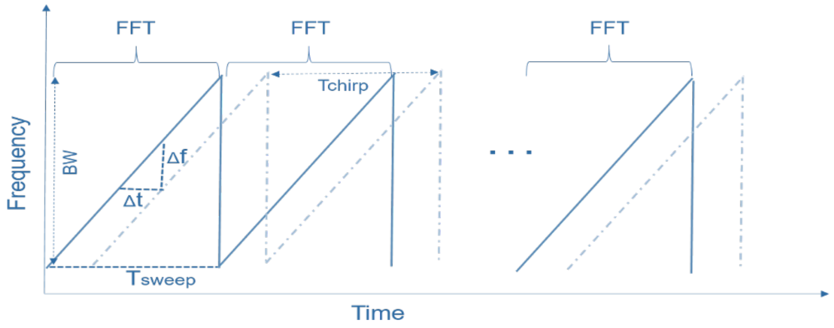


Figure 2 RF sawtooth wave

The correlation between distance and its resolution can be expressed by:

$R = \frac{cT_{sweep}}{2BW} f_{IF}$ $\qquad R_{res} = \frac{c}{2BW}$

where BW is the sweeping bandwidth, T_{sweep} is the sweeping period, f_{IF} is the IF frequency, c is the speed of light.

The correlation between velocity and its resolution can be expressed by:

$V = \frac{c}{2f} f_d$ $\qquad V_{res} = \frac{c}{2f \cdot N \cdot T_{chirp}}$

where c is the speed of light, f_d is the doppler frequency, f is the center frequency of the chirp, N is the number of chirps, T_{chirp} is the period of the chirp.

2.1.2 Angular determination by phase measurement method

The phase measurement method is to use the phase difference among different receiving signals to calculate the angle of the target object. As shown in Figure 3, the angle between the radar and the target object is θ, after reflection and transmission, the receiving wave can be considered as plane wave. Assuming the antenna spacing is d, due to the different transmitting distance ΔR, there must be a phase difference between the two receiving signals at adjacent antenna, the phase difference $\Delta\varphi$ can be expressed by:

$$\Delta\varphi = \frac{2\pi}{\lambda}\Delta R = \frac{2\pi}{\lambda} d \sin\theta$$

where λ is the wavelength. In this way, the angle of the object can be derived as:

$$\theta = \arcsin\left(\frac{\Delta\varphi\lambda}{2\pi d}\right)$$

In digital processing of radar system, the phase difference will be obtained by IQ data. Define φ_1, φ_2 as the phases of the two receiving signals, phase difference can be derived by:

$$\begin{cases} \varphi_1 = \arctan\dfrac{Q_1}{I_1} \\ \varphi_2 = \arctan\dfrac{Q_2}{I_2} \\ \Delta\varphi = \varphi_2 - \varphi_1 \end{cases}$$

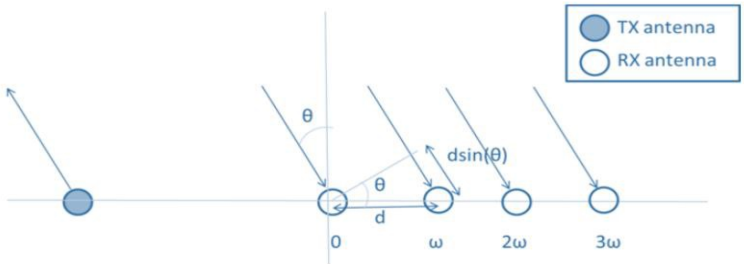


Figure 3 Angular determination by phase measurement method

2.2 System structure

The ARS1.31 Millimeter Wave Radar consists of 10 sub-system modules. The core module A-01 adopts the Antenna on Package (AOP) design, the integrated RF module and MCU perform signal processing and data processing. The signals and data are exchanged between the radar and the vehicle via CAN bus. The alarm signals can also be transmitted via the hardwire. The radar supports KL30 (power-up) supply and wake up mode.

All components of the product passed the automotive-compatible test. See Figure 4 for system hardware structure.

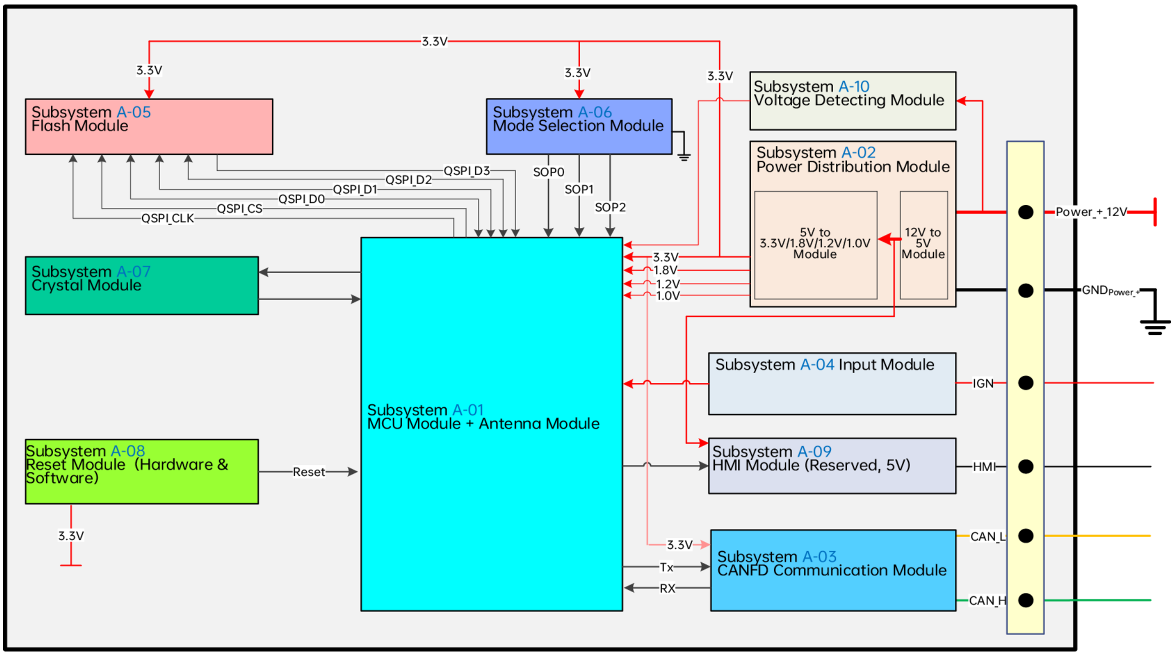


Figure 4 System hardware structure

Main module type:

SOC	AWR6843AOP
CAN	TI TCAN1043
PMIC	MAX20430/TPS7A8101

2.3 Mechanical structure

2.3.1 Radar exploded view

The ARS1.31 offers a compact and assembling-friendly solution, with all components integrated in one PCBA and packaged in an automotive standard conformed radar housing. See Figure 5.

Considering the integration and layout of the radar in the cabin, the following two installation options are offered for the radar: 1) Fixing the radar from its back with screws; 2) Attaching the radar on a slot-type bracket.

Chuhang Tech also provides radar bracket design and sample making.

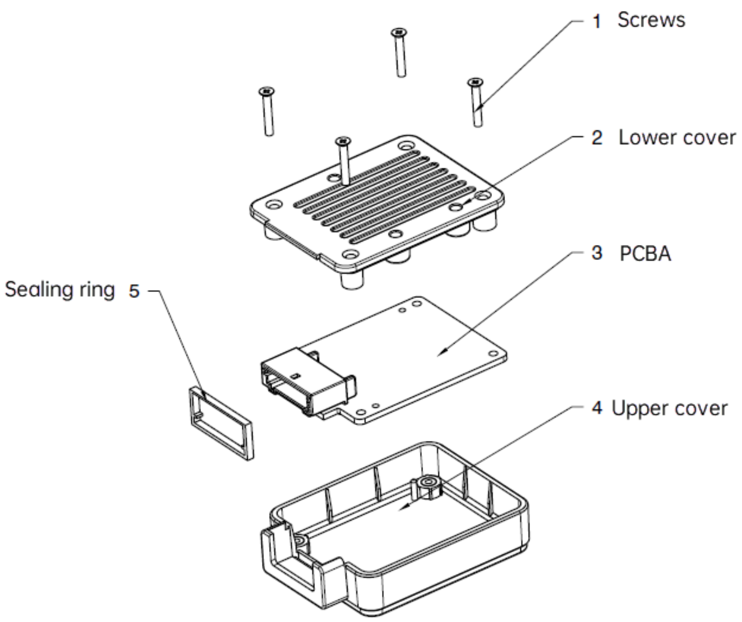


Figure 5 Radar structure

2.3.2 Radar dimension

The product is highly integrated with a compact design, which is easy to install and fit in the cabin. See Figure 6 for the dimension of radar housing.

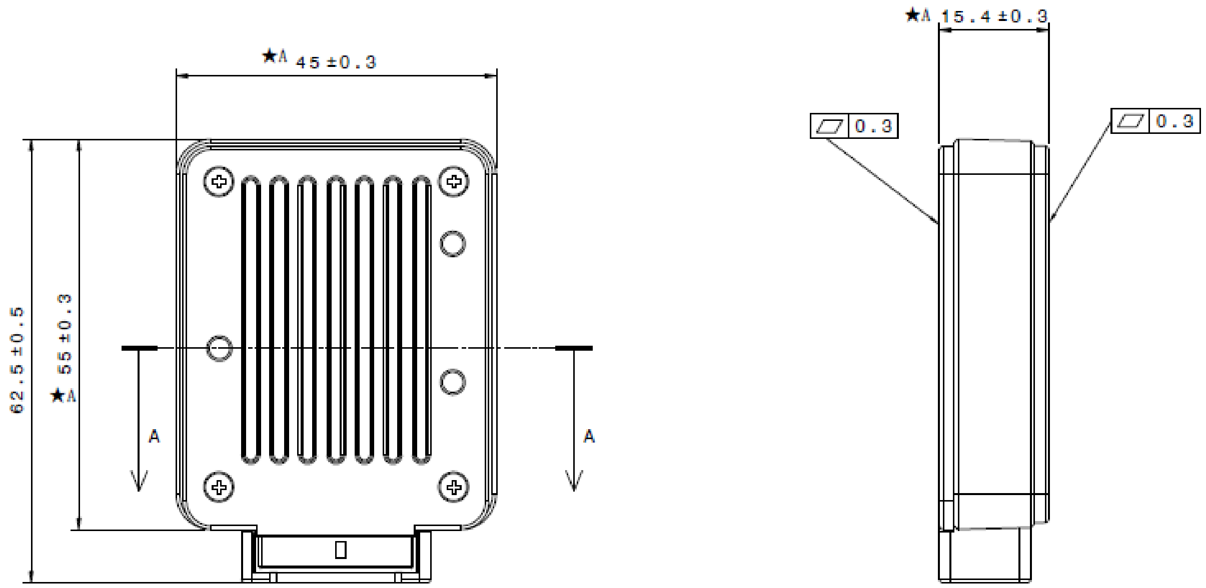
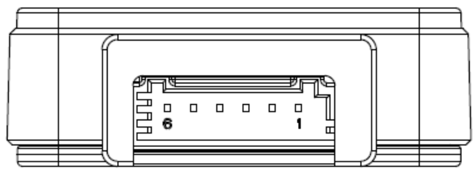


Figure 6 Radar 2D drawing

2.3.3 Connector specification

The connector model is shown as follows:

Connector	Model
Connector on the device	TE-936287-2
Imperviousness	IP52



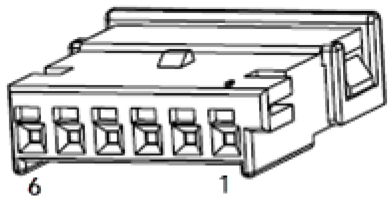
Radar pin definition:

No.	Radar pin	Function description
1	CAN_H	CAN communication interface
2	CAN_L	CAN communication interface
3	HMI	HMI hardwire output
4	IGN	Ignition switch status input
5	PWR	KL30 power supply
6	GND	Ground

2.3.4 Connector specification

The connector model is shown as follows:

Connector	Model
Connector on the device	TE-936289-2
Terminal	TE-928999-1
Imperviousness	IP52



2.3.5 CAN communication terminal circuit design

To match the CAN communication, the terminal circuit is designed as follows:

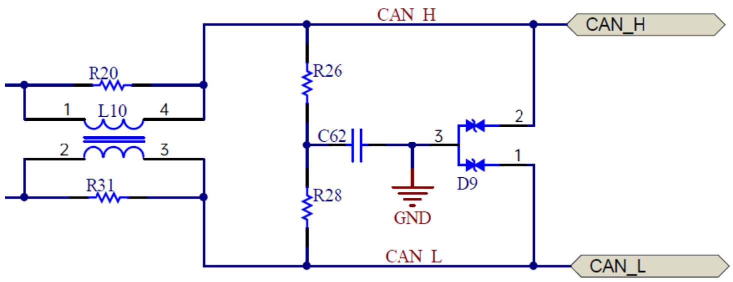


Figure 7 CAN communication terminal circuit

2.4 Software architecture

The software development of ARS1.31 created a complete set of process documents from customer requirements, system requirements, software & algorithm requirements, to software & hardware realization, and system tests, as well as a variety of test cases and test scenarios. The radar software is developed according to ASPICE Level2 requirements. By adopting the AutoSAR architecture, see Figure 8, the modular design realizes an agile development and facilities further maintenance and upgrade.

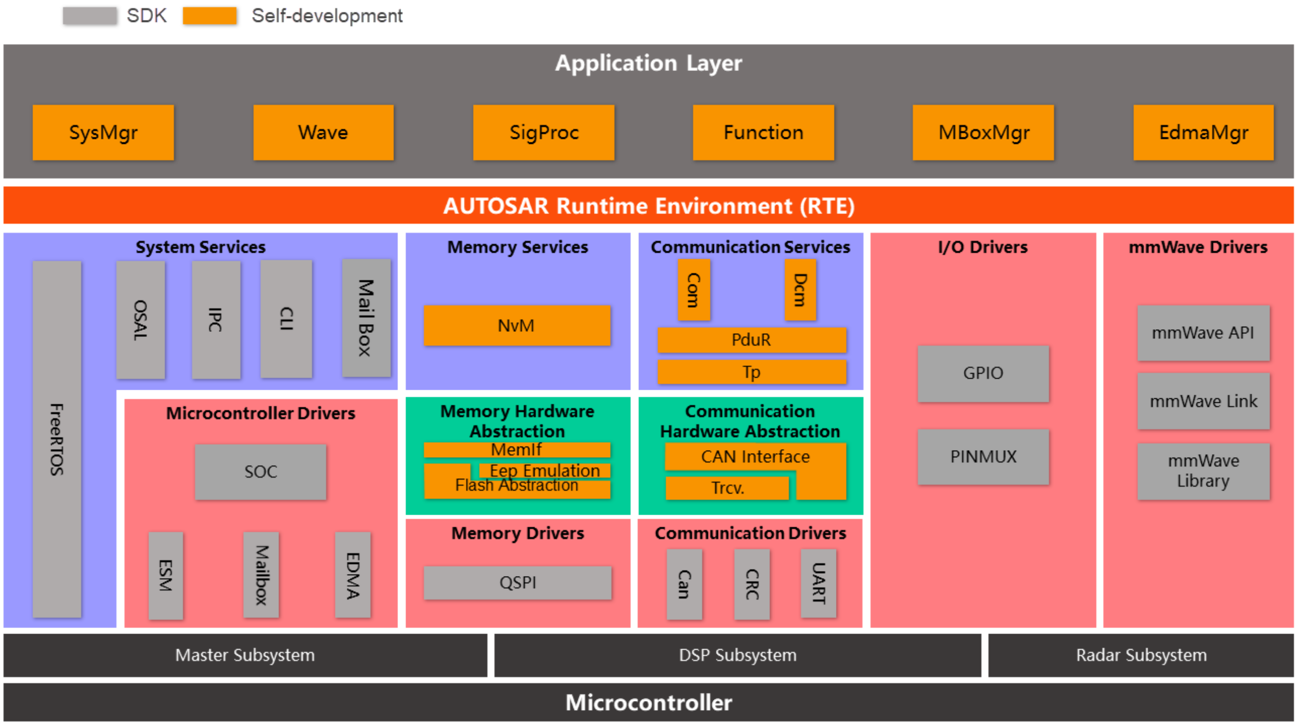


Figure 8 Software architecture

2.5 Algorithm structure

The software module in application layer mainly includes signal processing, data processing and function application. See Figure 9 for algorithm flow chart.

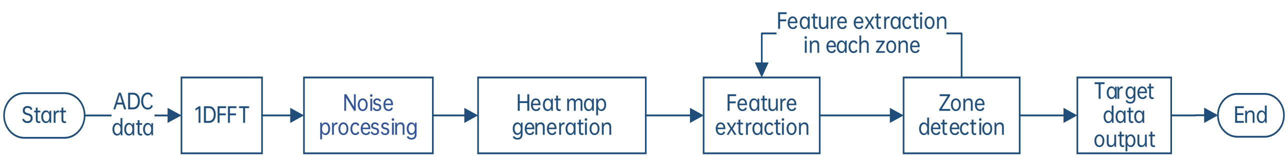
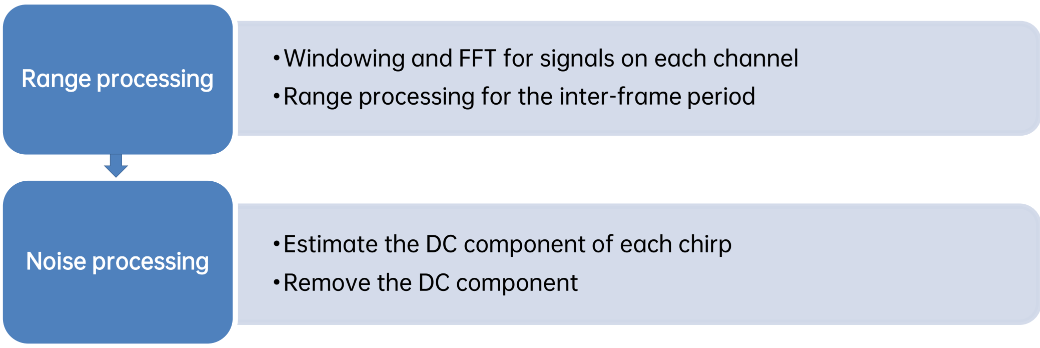


Figure 9 Algorithm flow chart

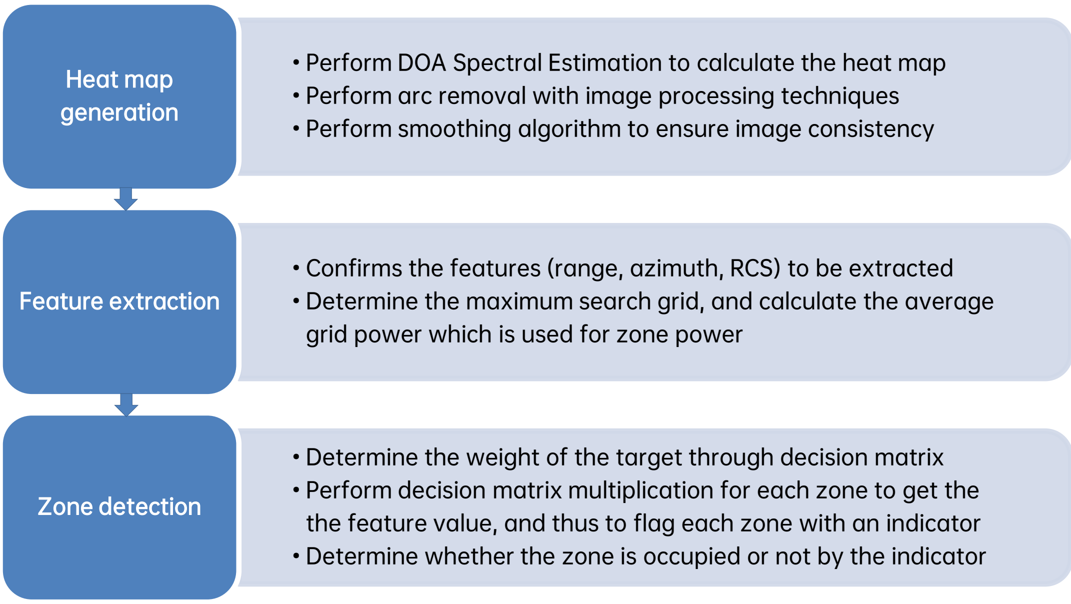
2.5.1 Signal Processing Module

The Signal Processing Module performs windowing and 1DFFT for the signals of each channel, and performs noise processing for the signals after FFT, and to remove the noise signals that generates stationary clutter wave.



2.5.2 Data Processing Module

The Data Processing Module uses the Direction of Arrival (DOA) spectral estimation algorithm to transform the noised processed data into the Range-Azimuth heat map. Then the module performs feature extraction (range, azimuth, RCS) for the target, .and searches the power intensity within each defined zone. By decision matrix and feature extraction, a feature vector is computed to obtain an indicator value, which indicates whether the zone is occupied or not.



2.5.3 Function Application Module

The Function Application Module processes the target object data and zone detection range. Corresponding functions can be developed based on the required feature from customer.

2.6 Radar characteristics

2.6.1 General characteristics

Operating frequency	59.3 GHz to 64 GHz
Data cycle	1 s
Initialization time	<5s
Distance	0 m~5 m
Angle	-75° ~ +75° (horizontal); -75° ~ +75° (vertical)
Antenna channels	1Tx 1Rx
Transmit power	14 dBm
Rated voltage	12 V
Operating voltage	9 V ~ 16 V
Power consumption	≤2 W
Static current	＜100 uA
Operating temperature	-40℃ ~ +85℃
Cummunication interface	CAN/UART
Detection accuracy	≥99%
Degree of protection	IP52

2.7 Supplementary information

2.7.1 Manufacturer's name and address

Nanjing Chuhang Technology Co., Ltd.

12th Floor, Inter-Space, No. 9, Yunzheng Street,

Jiangbei New Area, Nanjing,

P.R. China

2.7.2 Importer's name and address

Importer: xxxx

Address: xxxx

3. System functions

The system outputs the detection result of CPD and SOD function.

The CPD function identifies the living lives by detecting vital signs such as micromotions and breathing rate, and outputs corresponding alarm signals.

The SOD function uses more algorithms to calculate the number and relative position of the living objects. See Figure 10 for function strategy.

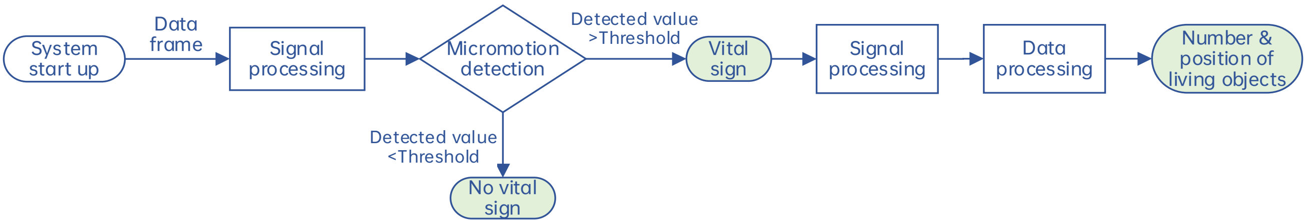
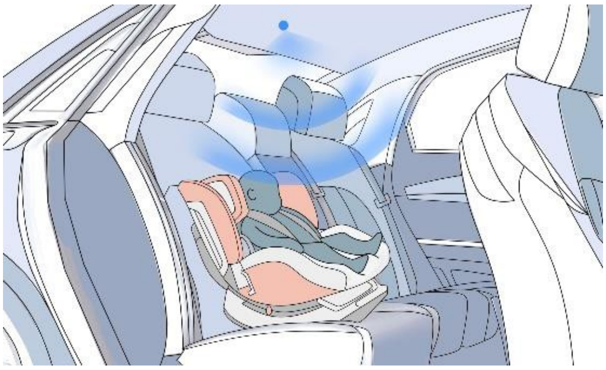


Figure 10 function strategy

1) Child Presence Detection (CPD)

This function detects whether there are infants, children, or other living lives such as adult or pet on the rear seats to avoid the risk of children or pets being left unattended in the car.

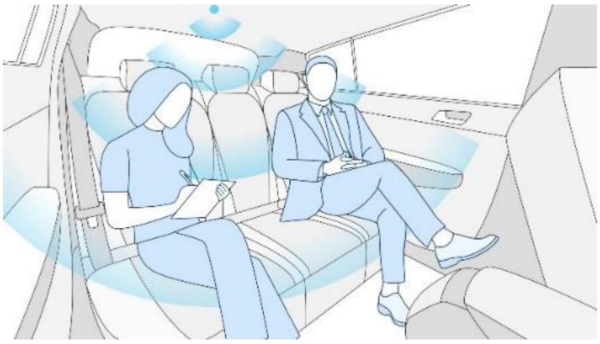
Function description:



The engine is switched off and the doors are closed. Nobody is in the cockpit (and the defined starting conditions are met). When living lives are detected on the rear seats, the radar sends alarm signal to the vehicle via CAN communication and sends warning message to the mobile phone of the defined contact person via the vehicle computer. It can also initiate the vehicle warning system to the get the attention of passersby.

2) Seat Occupancy Detection (SOD)

Based on the CPD, the SOD function detects the number and position of living objects and during driving.



Function description:

When the car is running, the system outputs the number and location of living objects on rear seats via CAN interface. The driver can see the occupancy of the seats from the human-machine interface. The vehicle also alerts if the seat is occupied without seat belt being fastened.

4. Mounting specification

4.1 Mounting position

The product supports a flexible mounting position and is suitable for different types of vehicles, as shown in Figure 11. To achieve optimum performance, and to ensure the function of CPD and SOD, the radar is recommended to be installed in the middle or rear of the roof. Considering some vehicle is equipped with panoramic sunroof or has limited space on the roof, the radar can also be installed on the left or right B-pillar, or nearby the interior rear-view mirror.

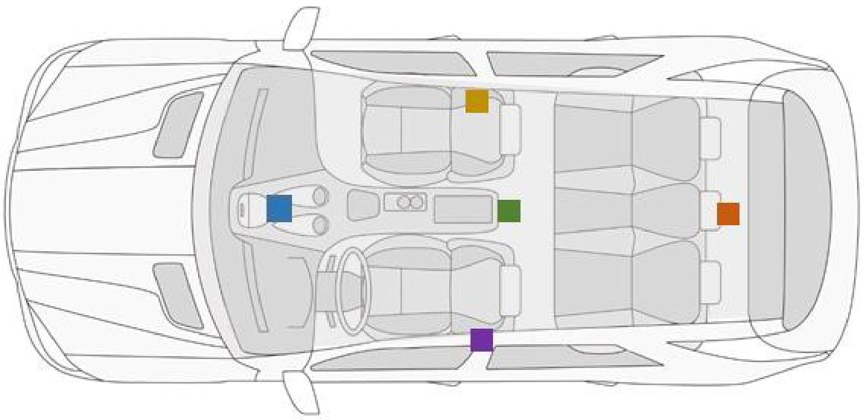


Figure 11 Installation position

- Front of the roof/top control panel
- Upper side of the right B-pillar
- Upper side of the left B-pillar
- Middle of the roof

- Rear of the roof

4.2 Mounting requirements

1) The radar is rigidly fastened to the vehicle, micro relative movements might cause false alarms.
2) It's recommended to fasten the radar to the frame.

4.3 Mounting tolerance

Parameter	Tolerance
Position tolerance	±10mm
Yaw angle	±2°
Pitch angle	±2°
Roll angle	±2°
Connector direction	Facing towards the driving direction (recommended)
Note: The mounting tolerances above are based on the designed position. Within the range of the tolerance, the radar can be calibrated with software.	

See Figure 12 for the definitions of different directions.

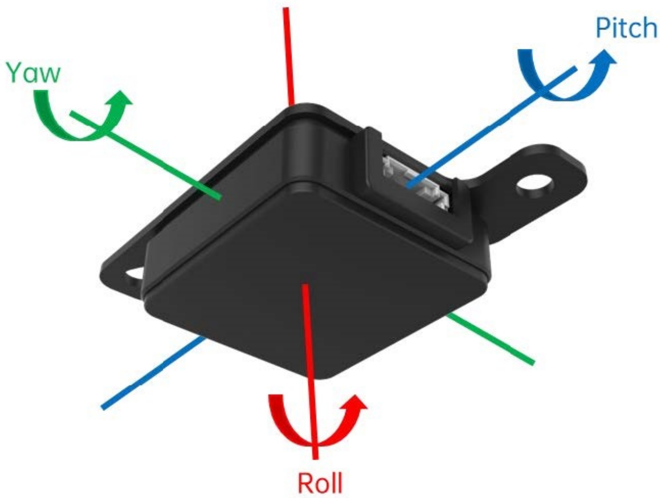


Figure 12 Azimuth angle

4.4 Requirements for the covering

4.4.1 Requirements for single material

For covering made of single material, the thickness is related to the dielectric constant of the material and the tilt angle. When the tilt angle between the radar and the cover pate is α (see Figure 13), the optimal thickness for the cover can calculated according to on the formula below:

$$d = n\frac{\lambda_{diel}}{2} \quad n \in Z_+$$

$$\lambda_{diel} = \frac{c_0}{f\sqrt{\varepsilon_r - sin^2(\alpha)}}$$

where

d is the thickness;

λ_{diel} is the wavelength;

ε_r is the effective dielectric constant;

c_0 is the speed of light;

f is the frequency of radar transmitting center;

According to the calculation, the optimal thickness of the covering should be a multiple of half wavelength within the material.

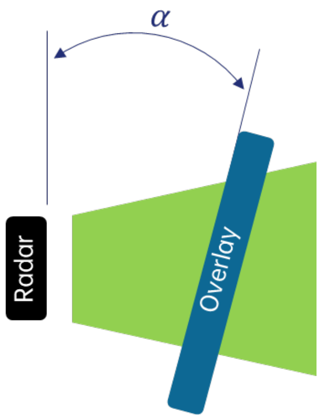


Figure 13 Installation angle

4.4.2 Requirements for composite material

For cover made of composite materials, the thickness is related to the dielectric constant of the material. The optimal thickness for the covering made of composite material or with coating can be calculated according to the formula below:

$$d = n\frac{\lambda_{diel,eff}}{2} \quad n \in Z_+$$

$$\lambda_{diel,eff} = \frac{c_0}{f\sqrt{\varepsilon_{r,eff} - sin^2(\alpha)}}$$

where

d is the thickness;

$\lambda_{diel,eff}$ is the effective wavelength;

$\varepsilon_{r,eff}$ is the effective dielectric constant of the composite material;

c_0 is the speed of light;

f is the frequency of radar transmitting center;

α is the tilt angle, see Figure 13.

According to the calculation, the optimal thickness of the covering should be a multiple of the half wavelength within the composite material.

Avoid to use composite materials. If it cannot be avoided, ensure that no air gap will be generated between the materials at varying temperatures or humidity.

Avoid to use metallic coatings. If it cannot be avoided, the number of layers of metallic coatings should be ≤2.

The material should have uniform properties. It's not recommended to use composites containing glass fiber, carbon fiber, or metallic particles.

4.4.3 Requirements for the shape and the position

1) The curvature radius of the covering within the radar radiation region shall be larger than 350mm;
2) The covering within the radar radiation region shall not contain ribbed profiles, sharp edges or abrupt thickness changes.
3) The covering within the radar radiation region shall not contain stepped zone of two different materials
4) The clearance distance between the radar and the covering shall be more than 10mm, to avoid possible physical collision caused by vibration.

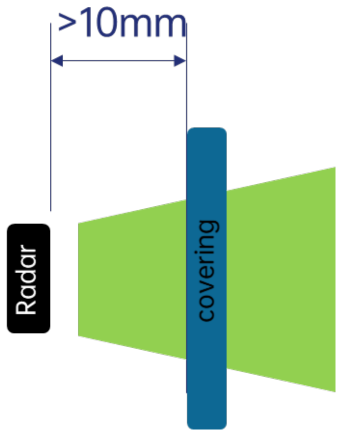


Figure 14 The clearance distance between the radar and the covering

5. Design verification

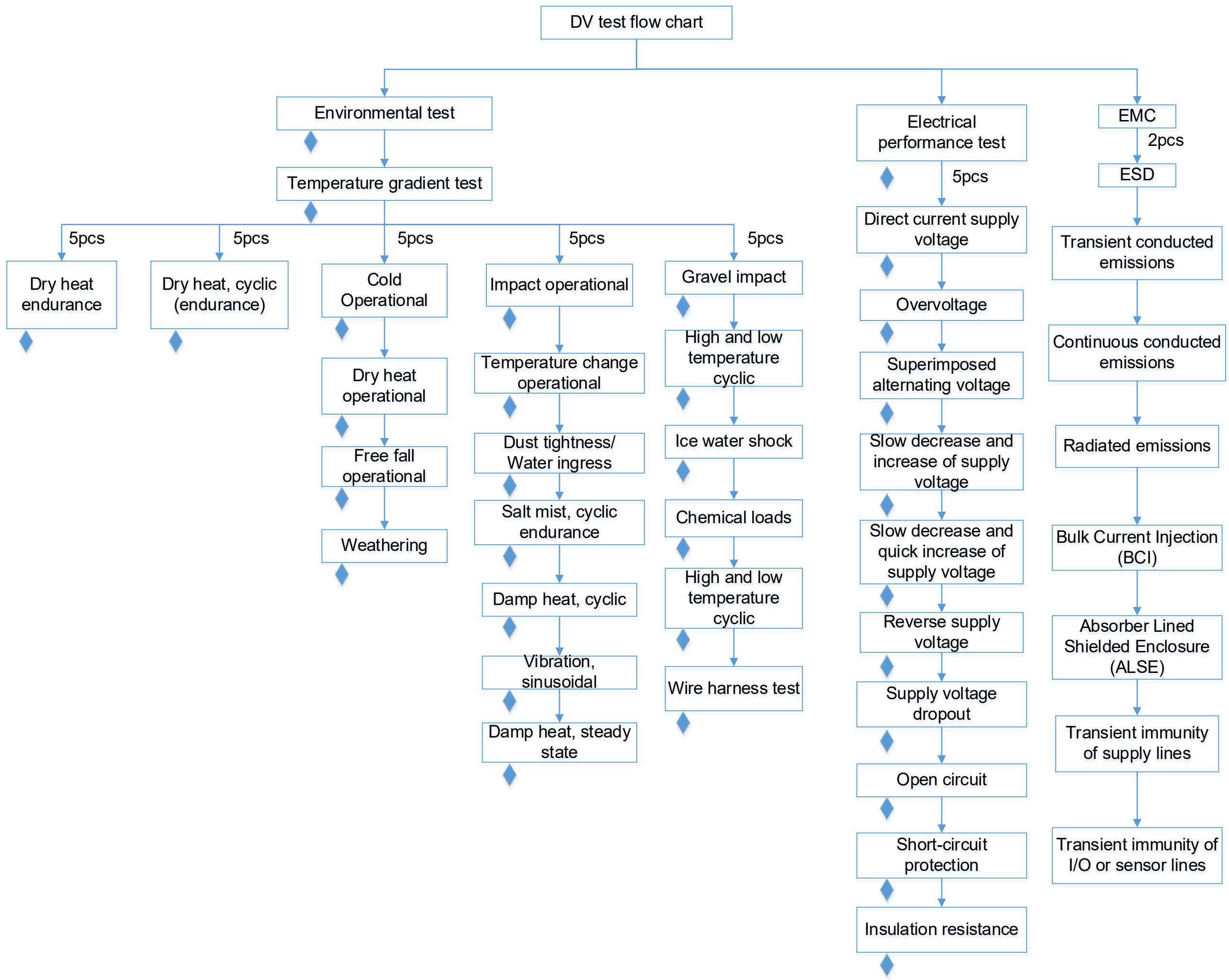
5.1 Design standards

Standard number	Title of standard
GB/T 28046.1-2011	Road vehicles - Environmental conditions and testing for electrical and electric equipment - Part 1: General
GB/T 28046.2-2011	Road vehicles - Environmental conditions and testing for electrical and electric equipment - Part 2: Electrical loads
GB/T 28046.3-2011	Road vehicles - Environmental conditions and testing for electrical and electric equipment - Part 3: Mechanical loads
GB/T 28046.4-2011	Road vehicles - Environmental conditions and testing for electrical and electric equipment - Part 4: Climatic loads
GB/T 28046.5-2013	Road vehicles - Environmental conditions and testing for electrical and electric equipment - Part 5: Chemical loads
GB/T 1865-2009	Paints and varnishes - Artificial weathering and exposure to artificial radiation - Exposure to filtered xenon-arc radiation
GB/T 2423.1-2008	Environmental testing for electric and electronic products - Part 2: Test methods - Tests A: Cold
GB/T 2423.2-2008	Environmental testing for electric and electronic products - Part 2: Test methods - Tests B: Dry heat
GB/T 2423.4-2008	Environmental testing for electric and electronic products - Part 2: Test methods - Test Db: Damp heat, Cyclic (12h+12h cycle)
GB/T 2423.18-2012	Environmental testing for electric and electronic products - Part 2: Test methods - Test Kb: Salt mist, Cyclic (sodium chloride solution)

Standard number	Title of standard
GB/T 2423.22-2012	Environmental testing for electric and electronic products - Part 2: Test methods - Test N: Change of temperature
GB/T 30038-2013	Road vehicles - Degrees of electrical equipment protection (IP-Code)
Q-JLY-J7110195D-2017	Technical specification for harness connector of vehicle
GB/T 21437.2-2008	Road vehicles - Electrical disturbances from conduction and coupling - Part 2: Electrical transient conduction along supply lines only
GB/T 19951-2017	Road vehicles - Test methods for electrical disturbances from electrostatic discharge
GB/T 18655-2010	Vehicles boats and internal combustion engines - Radio disturbance characteristics - Limits and methods of measurement for the protection of on-board receivers
SMTC 3800006-2015	General test specification for electrical/electronic components and subsystems, electromagnetic compatibility (Electrical transient conduction along supply lines)
GB/T 21437.3-2012	Road vehicles - Electrical disturbances from conduction and coupling - Part 3: Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines
CEVT	EMC Specification (BCI and RI)

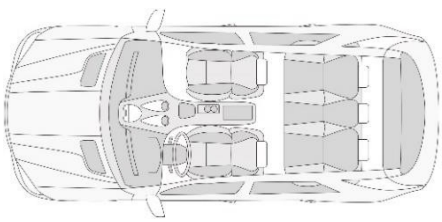
5.2 DV test verification

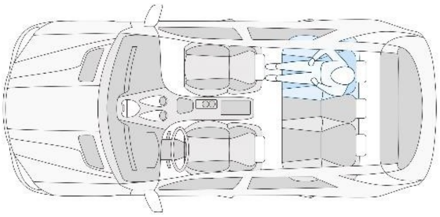
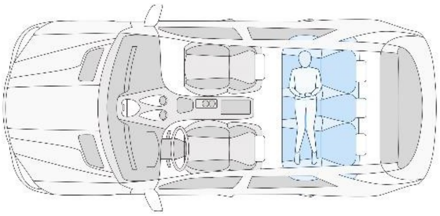
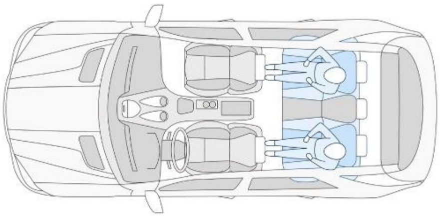
The ARS1.31 products passed the DV tests according to the above standards.

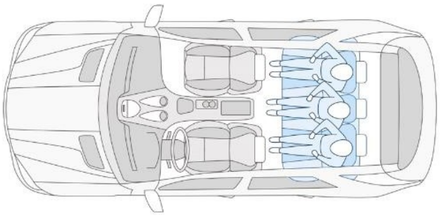
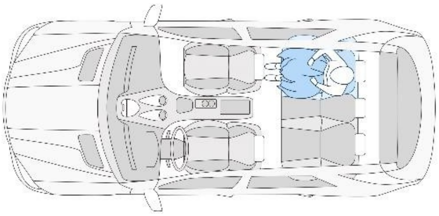
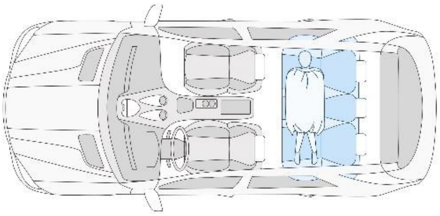


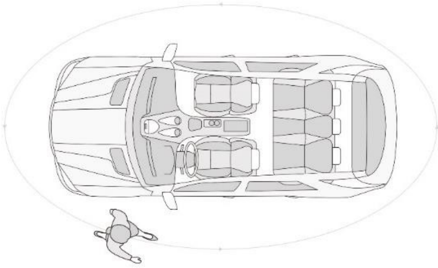
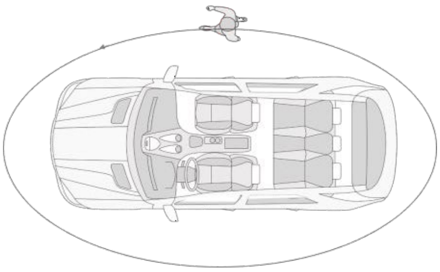
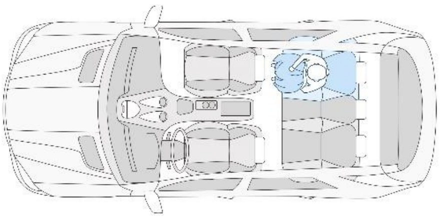
5.3 Performance test verification

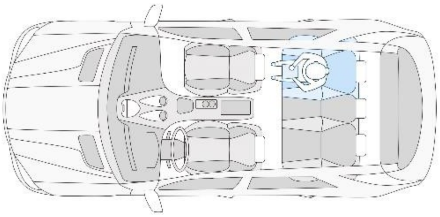
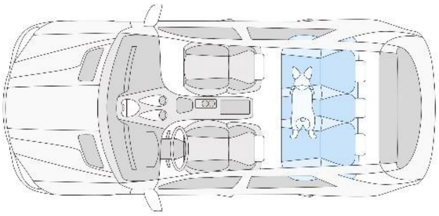
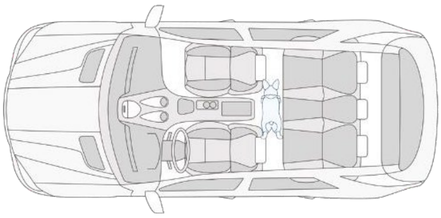
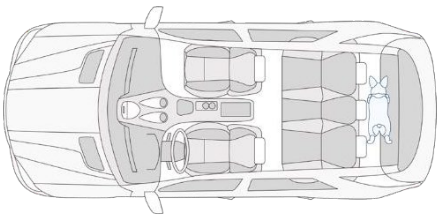
Based on the installation position shown in Figure 12, the performance of the radar is tested in the following scenarios. See below for details of test scenarios and test results.

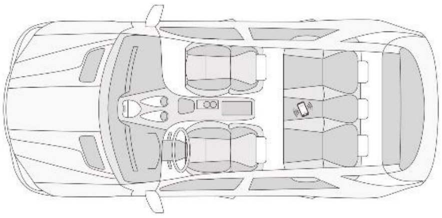
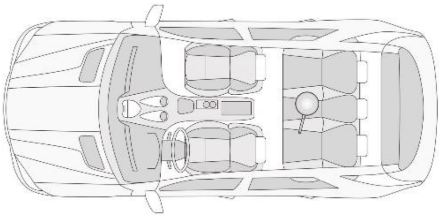
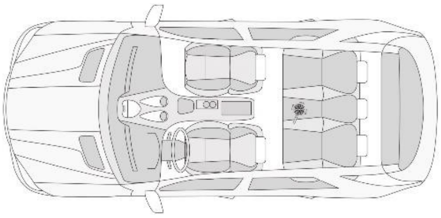
No.	Test scenario	Description	Illustration	Expected result	Test result
1	Nobody is in the car (with the engine off/on)	The car is parked, no living objects in the cabin, car doors and windows are closed, no source of external vibration, no pedestrians, pets or other living objects) within 50cm away from the car.		Alarm not triggered	Passed

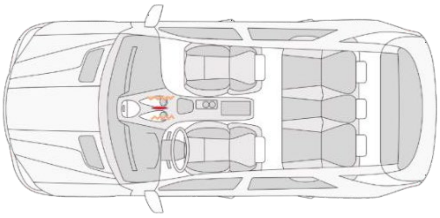
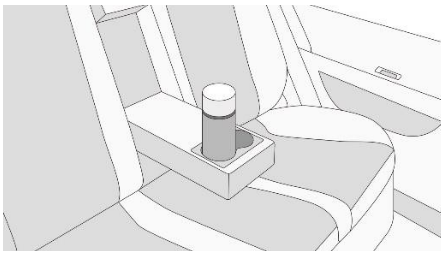
No.	Test scenario	Description	Illustration	Expected result	Test result
2	One adult sitting on the 2nd-row seat	The car is parked with the engine off, no pedestrians, pets or other living objects within 50 cm away from the vehicle. Car doors and windows are closed, no source of external vibration. One adult is sitting on the 2nd-row seat. All three seats at the 2nd row are detected, each detecting for 1 min.		Alarm signals and occupancy status are issued	Passed
3	One adult lying on the 2nd-row seats	The car is parked with the engine off, no pedestrians, pets or other living objects within 50 cm away from the vehicle. Car doors and windows are closed, no source of external vibration. One adult without being covered is lying on the 2nd-row seats. Both lying facing or against the radar positions are detected, each detecting for 1 min.		Alarm signals and occupancy status are issued	Passed
4	Two adults sitting (adjacently/separately) on the 2nd-row seats	The engine is shut down, no pedestrians, pets or other living objects within 50 cm around the vehicle. Car doors and windows are closed, no source of external vibration. Two adults are sitting adjacently on the 2nd-row seats for 1 min. Two adults are sitting separately (one seat away from each other) for1 min.		Alarm signals and occupancy status are issued	Passed

No.	Test scenario	Description	Illustration	Expected result	Test result
5	Three adults sitting on the 2nd-row seats	The engine is shut down, no pedestrians, pets or other living objects within 50 cm around the vehicle. Car doors and windows are closed, no source of external vibration. Three adults are sitting adjacently on the 2nd-row seats for 30s. Two adults are sitting separately (one seat away from each other) for 1 min.		Alarm signals and occupancy status are issued	Passed
6	One adult covered with blanket sitting on the 2nd-row seat	The engine is shut down, no pedestrians, pets or other living objects within 50 cm around the vehicle. Car doors and windows are closed, no source of external vibration. One adult covered with blanket is sitting on the 2nd-row seat. All three seats at the 2nd row are detected, each detecting for 1 min.		Alarm signals and occupancy status are issued	Passed
7	One adult covered with blanket lying on the 2nd-row seats	The car is parked with the engine off, no pedestrians, pets or other living objects within 50 cm around the vehicle. Car doors and windows are closed, no source of external vibration. One adult covered with blanket is lying on the 2nd-row seat. Both lying facing or against the radar positions are detected, each detecting for 30s.		Alarm signals and occupancy status are issued	Passed

No.	Test scenario	Description	Illustration	Expected result	Test result
8	One adult walking slowly around a car with closed windows	The car is parked with the engine off. Car doors and windows are closed, no source of external vibration. One adult walks around the car, with each circle keeping a distance of 5cm, 10cm, 15cm, 20cm, 25cm, 30cm away from the car.		Alarm not triggered	Passed
9	One adult walking slowly around a car with open windows	The car is parked with the engine off and all windows open. No source of external vibration. One adult walks around the car, with each circle keeping a distance of 5cm, 10cm, 15cm, 20cm, 25cm, 30cm away from the car.		Alarm not triggered	Passed
10	A 3-year-old child covered with blanket sitting on the 2nd-row seat	The car is parked with the engine off, doors & windows closed. No pedestrians, pets or other living objects within 50 cm around the car, no source of external vibration. A 3-year-old child covered with blanket sits on the 2nd-row seat. All three seats at the 2nd row are detected, each detecting for1 min.		Alarm signals and occupancy status are issued	Passed

No.	Test scenario	Description	Illustration	Expected result	Test result
11	A 3-year-old child sitting on the 2nd-row seat	The car is parked with the engine off, doors & windows closed. No pedestrians, pets or other living objects within 50 cm around the car, no source of external vibration. A 3-year-old child covered with blanket sits on the 2nd-row seat. All three seats at the 2nd row are detected, each detecting for1 min.		Alarm signals and occupancy status are issued	Passed
12	Pet staying on the 2nd-row seat	The car is parked with the engine off, doors & windows closed. No pedestrians, pets or other living objects within 50 cm around the car, no source of external vibration. A pet stays on the 2nd-row seat for 1 min.		Alarm signals and occupancy status are issued	Passed
13	Pet staying on the floor between the 1st and 2nd-row seats	The car is parked with the engine off, doors & windows closed. No pedestrians, pets or other living objects within 50 cm around the car, no source of external vibration. A pet stays on the floor between the 1st and 2nd-row seats for1 min.		Alarm signals and occupancy status are issued	Passed
14	Pet staying in the trunk	The car is parked with the engine off, doors & windows closed. No pedestrians, pets or other living objects within 50 cm around the car, no source of external vibration. A pet stays in the trunk for 1 min.		Alarm signals and occupancy status are issued	Passed

No.	Test scenario	Description	Illustration	Expected result	Test result
15	A buzzing phone on the 2nd-row seat	The car is parked with the engine off, doors & windows closed. No pedestrians, pets or other living objects) within 50 cm around the car, no source of external vibration. A buzzing phone is placed on the 2nd-row seats. All three seats at the 2nd row are detected, each detecting for 1 min.		Alarm not triggered	Passed
16	A metal pot on the 2nd-row seat	The car is parked with the engine off, doors & windows closed. No pedestrians, pets or other living objects within 50 cm around the car, no living objects in the cabin. A metal pot is placed on the 2nd-row seats for 1 min.		Alarm not triggered	Passed
17	A running fan on the 2nd-row seat	The car is parked with the engine off, doors & windows closed. No pedestrians, pets or other living objects within 50 cm around the car, no living objects in the cabin. A fan running at full speed is placed on the 2nd-row seats. All three seats at the 2nd row are detected, each detecting for 1 min.		Alarm not triggered	Passed

No.	Test scenario	Description	Illustration	Expected result	Test result
18	A hanging decoration on the interior rear-view mirror	The car is parked with the engine off, doors & windows closed. No pedestrians, pets or other living objects within 50 cm around the car, no living objects in the cabin. A hanging decoration is hung on the interior rear-view mirror for 1 min.		Alarm not triggered	Passed
19	A metal cup in the cup holder	The car is parked with the engine off, doors & windows closed. No pedestrians, pets or other living objects within 50 cm around the car, no living objects in the cabin. A metal cup is placed in the cup holder for 1 min.		Alarm not triggered	Passed

6. Compliance information

6.1 CE compliance statement

The radar sensor complies with the Radio Equipment Directive (RED) 2014/53/EU.

6.2 FCC compliance statement

The radar sensor 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 equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Please take attention that changes or modification not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment is prohibited to be used on satellite equipment and this equipment is prohibited to be used on the aircraft.

— End —