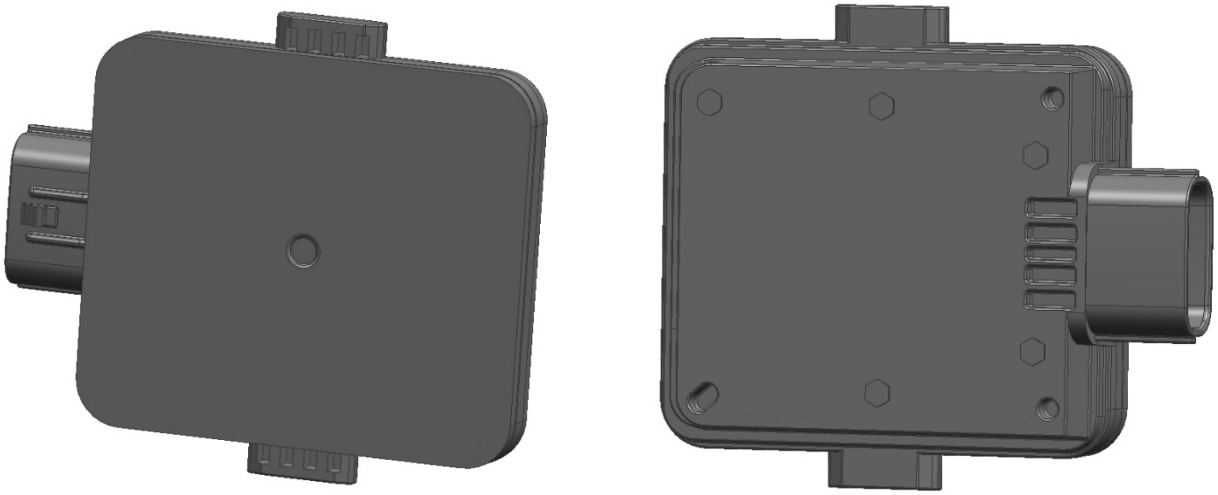
SRR3.0
CornerRadar Product Manual



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1 Overview

1.1 Document Overview

This document mainly introduces the specifications, system architecture, product functions, software and hardware interfaces, and other contents of the SRR3.0 (Short Range Radar) product.

1.2 Product Overview

The SRR3.0 corner radar will complete the following main functions:

- Output point cloud (raw detection) level output for objects within the detection range;
- Output object level tracking for objects within the detection range;
- Alignment of radar installation position;
- Diagnosisof software and hardware faults in radar systems, including blockage detection;
- Output alarm and brake functions according to customer needs.

2 system architecture

2.1 System Overview

The architecture of the SRR3.0 corner radar system is shown in Figure 1.

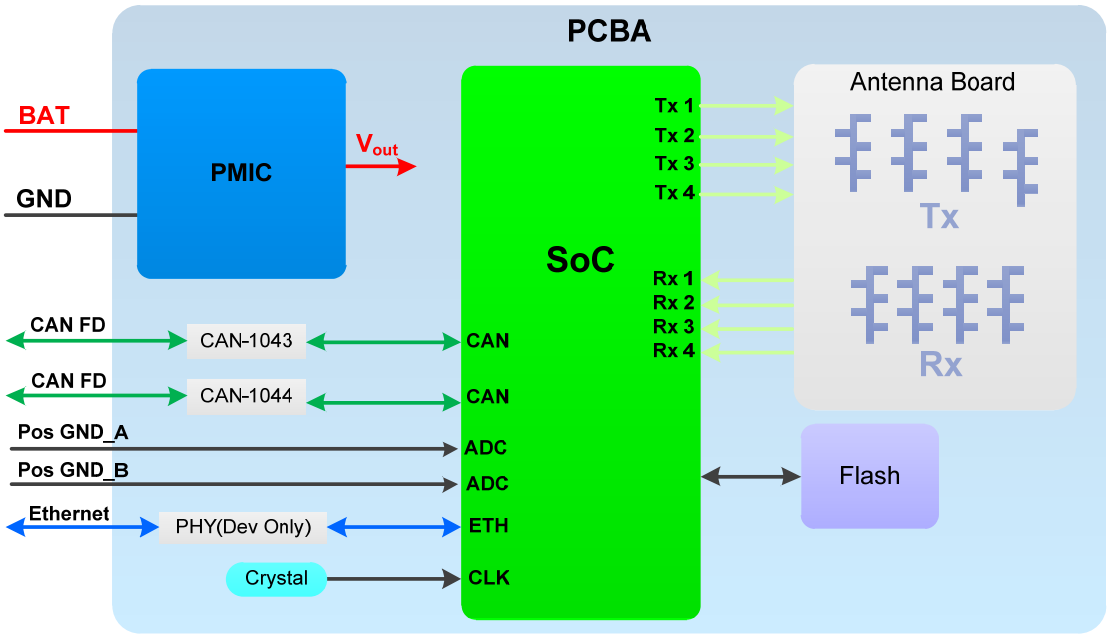


Figure 1- SRR3.0 System Architecture Diagram

SRR3.0 integrates two functional components in its SoC chip: the radar RF front-end control (MMIC) and radar computing processing (MCU), achieving higher integration. The radar RF section consists of a 4-transmit, 4-receive antenna array. The SoC can configure multiple transmission waveforms and control transmission timing. SRR3.0 radar adopts a front-end design where four transmit antennas simultaneously emit, effectively enhancing target point cloud signal-to-noise ratio and angular resolution.

SRR3.0 utilizes an external Flash chip for backup and firmware update functionalities. It identifies the actual installation position of the radar on all four corners of the vehicle through two-position recognition.

SRR3.0 supports power supply from either KL30 (battery power) or KL15 (ignition power). When powered by KL30, it supports CAN wake-up functionality.

2.2 performance parameter

The RF scanning range of SRR3.0 is 76-77GHz. The specific performance parameters of SRR3.0 are shown in the table below.

Type	Units	SRR3.0
Antenna		4T4R

Chips		-	AWR2944
Coverage	Range	m	160
	Range Rate	m/s	LOOKTYPEA:-20~17.3224 LOOKTYPEB:-20~12.3872 LOOKTYPEC:-20~16.2857 LOOKTYPED:-20~11.3508
	Azimuth FOV	degree	±75
	Elevation FOV	degree	±15
Accuracy	Range	m	≤±0.15
	Range Rate	m/s	≤±0.075
	Azimuth Angle	degree	≤±1
	Elevation Angle	degree	≤±6
Multi-Target Discrimination	Range	m	≤0.4
	Range Rate	m/s	≤0.17
	Azimuth Angle	degree	≤3.5
	Elevation Angle	degree	NA
Detection Output	DetectionNumber	-	200
	Cycle	ms	66
Object Output	Object Number	-	16
	Cycle	ms	66

2.3 communication interface

2.3.1 Network topology

The commonly used topology diagram of SRR3.0 corner radar in the vehicle network is shown in Figure 2.

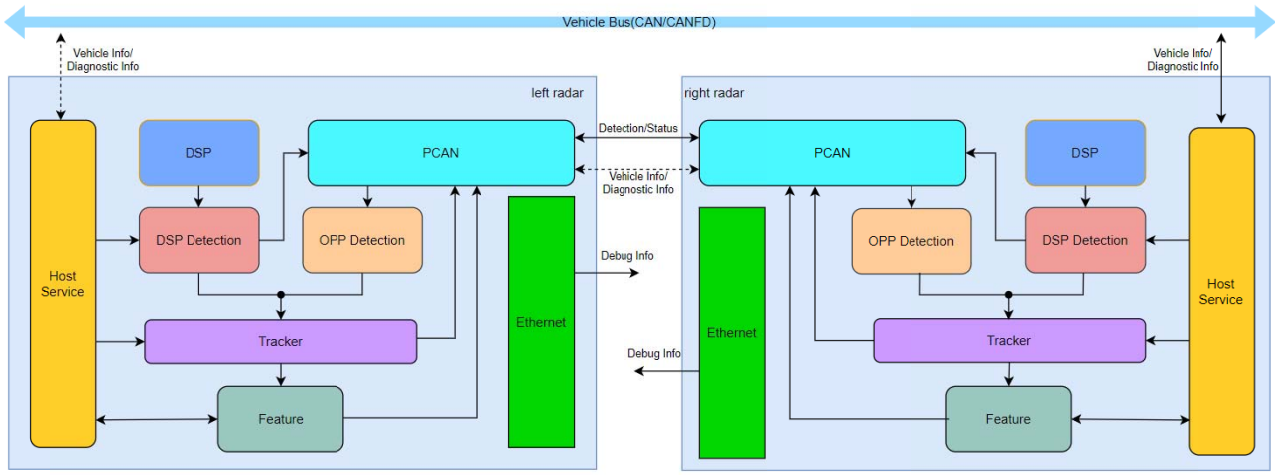


Figure 2- SRR3.0 Network Topology Diagram

2.3.2 Vehicle CAN interface (VCAN)

VCAN (Vehicle CAN) is a CAN interface for communication between SRR3.0 corner radar and vehicle, for the exchange of vehicle status information and UDS diagnostic communication.

VCAN can support two modes: standard CAN and CANFD, and can be configured according to customer needs.

The VCAN Database definition is provided by the customer.

2.3.3 Private CAN Interface (PCAN)

PCAN (Private CAN) is a CAN interface used internally by SRR3.0 corner radar, mainly used for transmitting information including detection, object, status , timestamp, etc.

The type of PCAN is CANFD, with a baud rate of 500Kbit/s and a data rate of 2Mbit/s. The PCAN Database is defined by BCS and can be discussed if customers have special needs to add signals. According to customer needs, vehicle status information exchange and UDS diagnostic communication exchange can also be carried out through PCAN.

2.3.4 Ethernet interface

Ethernet is an internal development interface for radar before SRR3.0, which transmits radar front-end data for simulation analysis. It is only used during product development and is not open to the public. The mass production phase will not include Ethernet related parts.

2.4 Signal interface

2.4.1 Input signal

The static signal input of the vehicle body mainly includes:

- Vehicle installation position and angle
- Radar installation polarity

The dynamic signal input of the vehicle body mainly includes:

- Vehicle speed
- Vehicle acceleration
- Vehicle gears
- Yaw angle
- steering wheel angle
- Time information
- Function switch information
- Door locking status
- Judgment signals related to other functional logic

2.4.2 output signal

The coordinate system of the radar output point cloud (detection) is a polar coordinate system with the radar itself as the origin, mainly containing the following information:

- The radial distance value of the point cloud;
- The radial relative velocity value of the point cloud;
- The intensity value (effective cross-sectional area) of the point cloud;
- The horizontal angle value of the point cloud;
- The vertical angle value of the point cloud;
- The confidence state of the point cloud.

The coordinate system of the radar output trajectory (Object) is a Cartesian coordinate system with the center point of the front bumper of the vehicle as the origin, which mainly includes the following information:

- The ID value of the trajectory;
- The status of the trajectory: newly built, mature, and taxiing;
- The horizontal and vertical coordinate values of the trajectory;
- The lateral and longitudinal relative velocity values of the trajectory;
- The lateral and longitudinal relative acceleration of the trajectory;
- The length and width values of the trajectory;
- The confidence state of the trajectory.

2.5 Diagnosis and alignment

2.5.1 Internal diagnosis

The SRR3.0 corner radar system will monitor internal software and hardware faults during power on and normal operation. If a fault occurs, it will notify and record the fault information, and promptly notify the driver of relevant information.

2.5.2 External diagnosis

The SRR3.0 corner radar system will continuously monitor external information such as voltage, temperature, external communication messages, and signal status during normal operation. If a fault occurs, it will notify and record the fault information, and promptly notify the driver of relevant information.

2.5.3 Offline alignment

Due to errors in the size chain of the vehicle body during the manufacturing process, there will inevitably be errors in the installation position of the SRR3.0 corner radar. Each radar needs to compensate for these installation errors separately. Therefore, the customer's production line needs to have an offline alignment station.
For detailed offline alignment methods and processes, please refer to the offline alignment document.

2.5.4 Automatic alignment

The SRR3.0 corner radar product has an automatic alignment function. When the vehicle speed and yaw angle meet the conditions during driving on public roads after offline, the radar will automatically calibrate the installation angle to prevent deformation caused by long-term use or collision.

2.5.5 Service alignment

After the SRR3.0 corner radar is reinstalled or replaced in a 4S store or repair center, a service alignment process must be initiated. After the technical personnel activate the service alignment, the driver should try to keep the vehicle driving in a straight line at a certain speed on public roads until the service alignment progress reaches 100%. Please refer to the service alignment document for detailed service alignment methods and processes.

2.5.6 Blockage detection

During the operation of the entire vehicle on public roads, the barrier in front of the radar may be covered by mud, ice, water, snow, etc., resulting in partial or complete obstruction of the radar. The Blockage detection algorithm will run in real-time to detect the detection environment of the radar. When Blockage is detected, the radar system will promptly report and notify the driver.

Due to the Blockage algorithm being based on radar detection of targets, when the radar is in an open and no reflective environment, the radar system will also report Blockage issues.

3 Electrical specifications

3.1 working voltage

The working voltage of SRR3.0 is shown in the table below.

Electrical characteristics	minimum value	Classic value	Maximum value	单位
Radar operating voltage	6.0	13.5	22.0	V
Radaroperating voltage (full performance)	9.0	13.5	16.0	V
High voltage fault setting voltage	15.1	16.5	18.0	V
High voltage fault clearing voltage	14.6	16.0	17.5	V
Low voltage fault setting voltage	7.7	8.5	9.3	V
Low voltage fault clearing voltage	8.2	9.0	9.9	V
High voltage - radar CAN communication stopped	18.2	20.0	21.9	V
High voltage - radar CAN communication recovery	18.1	19.8	21.7	V
Low voltage - radar CAN communication stopped	5	5.5	6.1	V
Low voltage - radar CAN communication recovery	5.1	5.7	6.3	V
High voltage - radar transmission stopped	15	16.5	18.1	V
High voltage - radar transmission recovery	14.6	16.0	17.5	V
Low voltage - radar transmission stopped	5.2	5.8	6.4	V
Low voltage - radar transmission recovery	6.1	6.8	7.5	V

3.2 Power

The maximum power of SRR3.0 is 4W. Under the minimum working voltage of 9V, the effective current value is 450mA.

3.3 Static current

The static current of SRR3.0 is less than 100uA.

3.4 Temperature

The temperature characteristics of SRR3.0 are shown in the table below.

temperature characteristic	minimum value	Classic value	Maximum value	unit
working temperature	-40	23	85	°C
Storage temperature	-40	23	95	°C

3.5 Working current

characteristic	Current value
Battery current	<1A

3.6 Ground Connection

The SRR3.0 product needs to be connected to the vehicle ground, but the radar should not be damaged when not connected to the vehicle ground.

Requirement	Detailed description
Input signal	Ground signal (SRR signal ground)
Functional level	C
Input current range	Min=0, Max at 16V=0.362A, Max at 6V=1.0A
Shared Signal	yes

Note: The nominal and maximum values of the grounding current load are calculated by the supplier

3.7 Reverse voltage

SRR3.0 can withstand a 16V reverse voltage for 1 minute without any damage.

3.8 Overvoltage

SRR3.0 can withstand a high voltage of 26.5V for 1 minute without damage.

4 Mechanical specifications

4.1 Radar explosion diagram

The explosion diagram of the SRR3.0 corner radar structure is shown in Figure 3. SRR3.0 integrates SoC and antenna on the same PCB board, which has the advantages of high integration and small size.

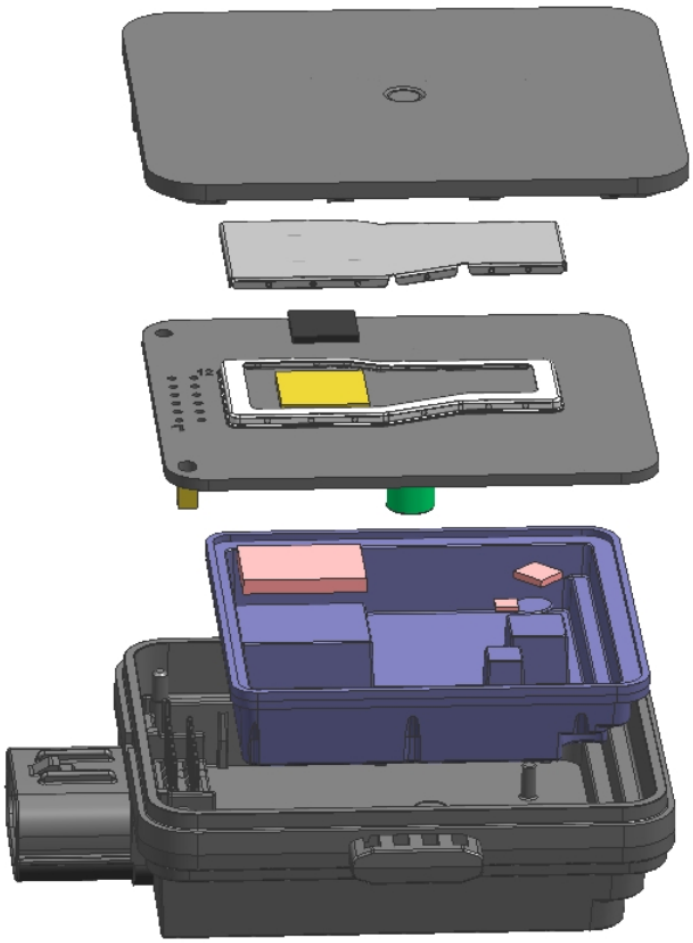


Figure 3- Explosion diagram of SRR3.0 structure

4.2 Size

The size parameters of SRR3.0 are shown in the table below. Please refer to Figure 4 for detailed dimensions.

Size	Company	Size range
Length	mm	73.50 (excluding connectors)

width	mm	63.50
Thickness	mm	20.50

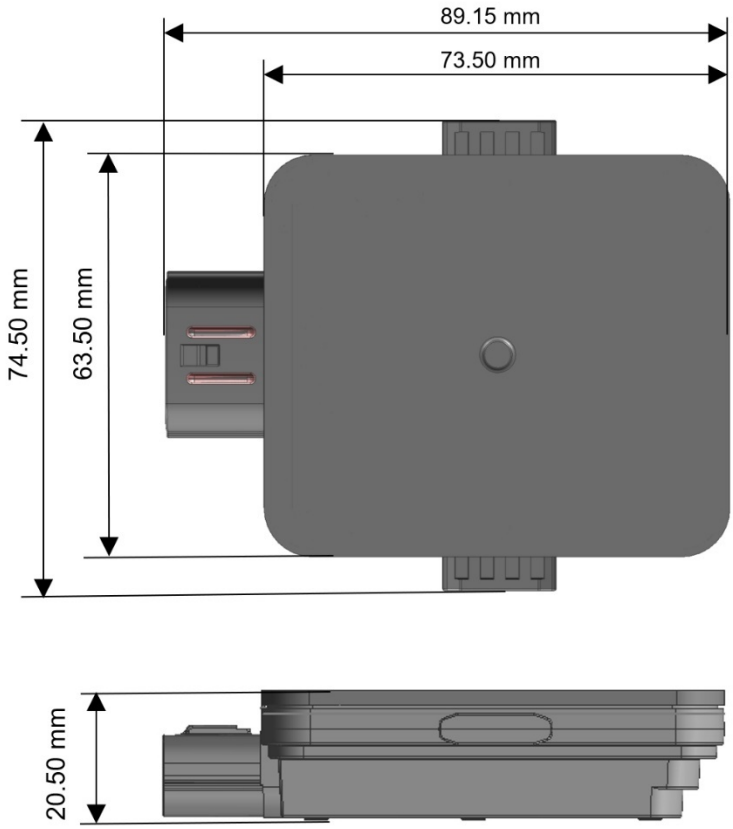


Figure 4 SRR3.0 Detailed Dimensional Drawing

4.3 Connector

Wire harness end connector model:

Female end sheath: 6189-8374

Female end TPA: 6918-3545

Terminal: 8240-0541

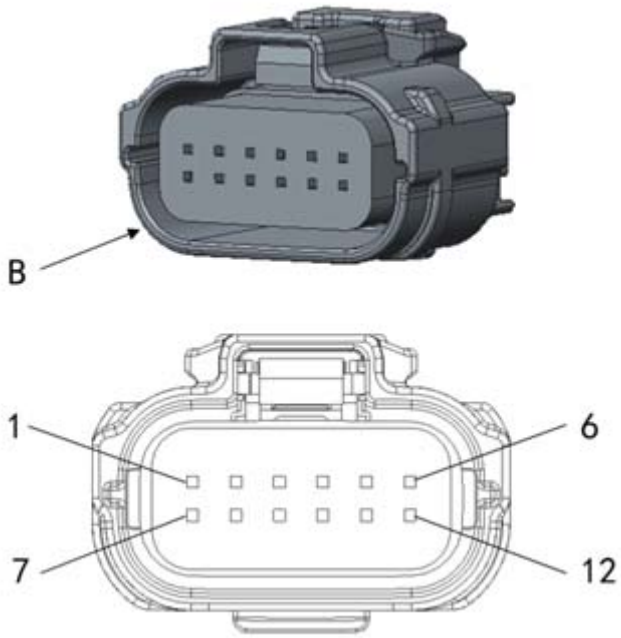


Figure 5 SRR3.0 connector pin numbers

Pin number	Function	Signal Name
1	Car body CAN-H	CAN0_H
2	Car body CAN-L	CAN0_L
3	Radar Private CAN-H	CAN1_H
4	Radar private CAN-L	CAN1_L
5	NA	NA
6	NA	NA
7	GND	GND
8	Power supply	Battery
9	NA	NA
10	NA	NA
11	Location recognition A	Pos GND A
12	Location recognition B	Pos GND B

4.4 Quality

SRR3.0 corner radarQuality: 76g+/-5%.

4.5 Protection level

The SRR3.0 corner radar body has a waterproof and dustproof rating of IP67, Combined with direct shielding, the dustproof and waterproof level can reach IP6K9K.

4.6 Vehicle installation

Refer to the SRR3.0 Vehicle Installation Manual.

5 Software specifications

5.1 Software architecture

The software architecture of SRR3.0 corner radar is shown in Figure 6.

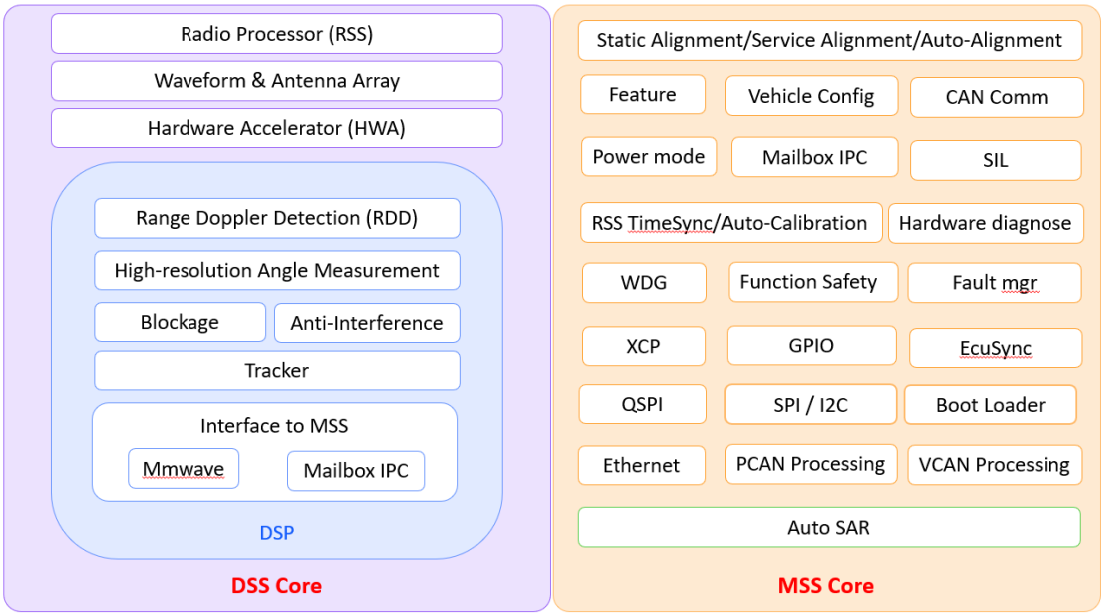


Figure 6 SRR3.0 Software Architecture

SRR3.0 software is mainly divided into two parts: algorithm software and application layer software. According to the computing architecture of SoC chips, algorithm software and application layer software are processed on different cores. Among them, DSS is a DSP core, mainly used for processing point cloud signal processing algorithms, Tracker trajectory algorithms, anti-interference algorithms, Blockage algorithms and other algorithms that require high computing power. MSS is an ARM core, mainly running application layer software and algorithms with low computing power requirements such as automatic alignment and alarm functions.

5.2 Algorithm software

5.2.1 Point cloud algorithm

The process module of the point cloud algorithm software is shown in Figure 7.

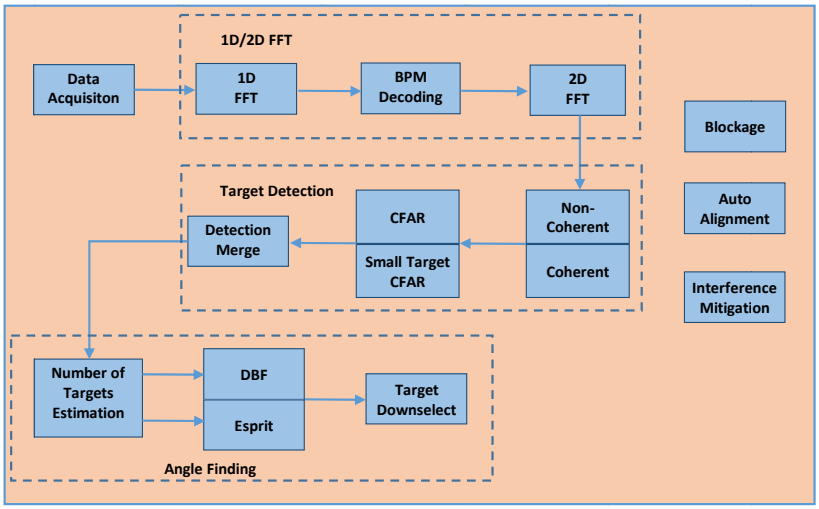


Figure 7 Point Cloud Algorithm Flowchart

The point cloud algorithm software includes the signal processing flow, alignment algorithm, and Blockage algorithm of the point cloud algorithm.

5.2.2 Tracking algorithm

The tracking algorithm software process module is shown in Figure 8.

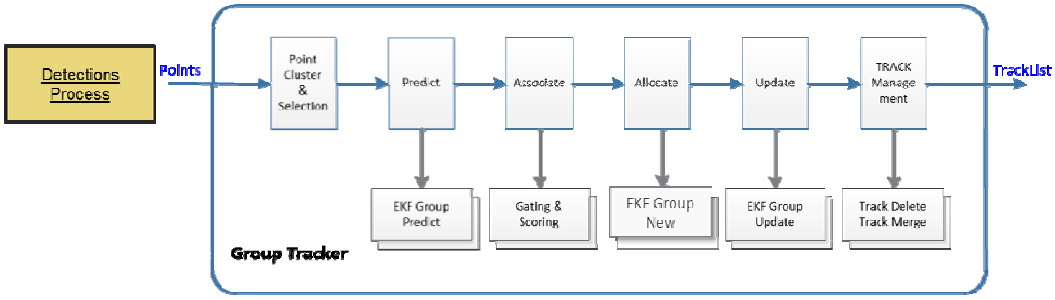
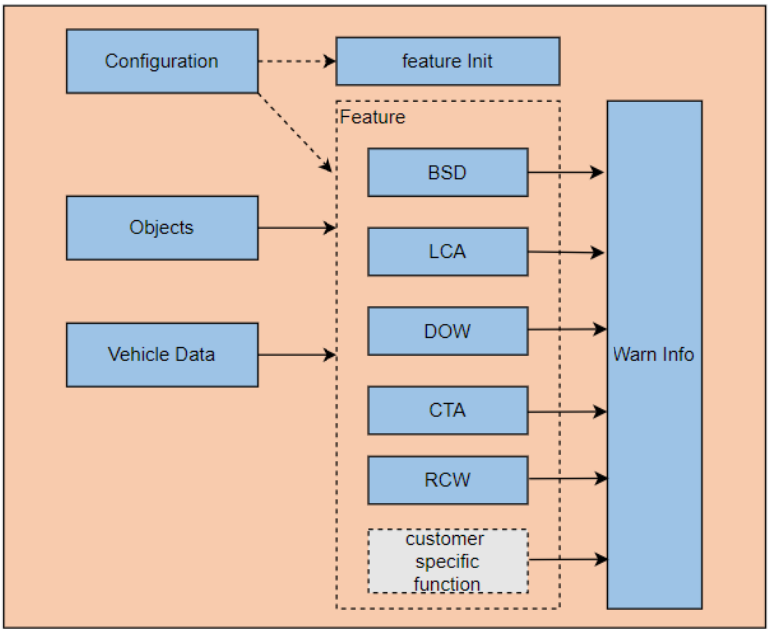


Figure 8 Tracking Algorithm Flowchart

Tracking algorithm software processes point clouds (detections) into target trajectories (Objects).

5.2.3 Functional algorithm



Functional algorithm software is the implementation of blind spot detection (BSD), lane merging assistance (LCA), door opening warning (DOW), crossing warning (CTA), rear collision warning (RCW) and other functions based on the trajectory output from the tracking algorithm.

5.3 Application layer software

The application layer software architecture is shown in Figure 10.

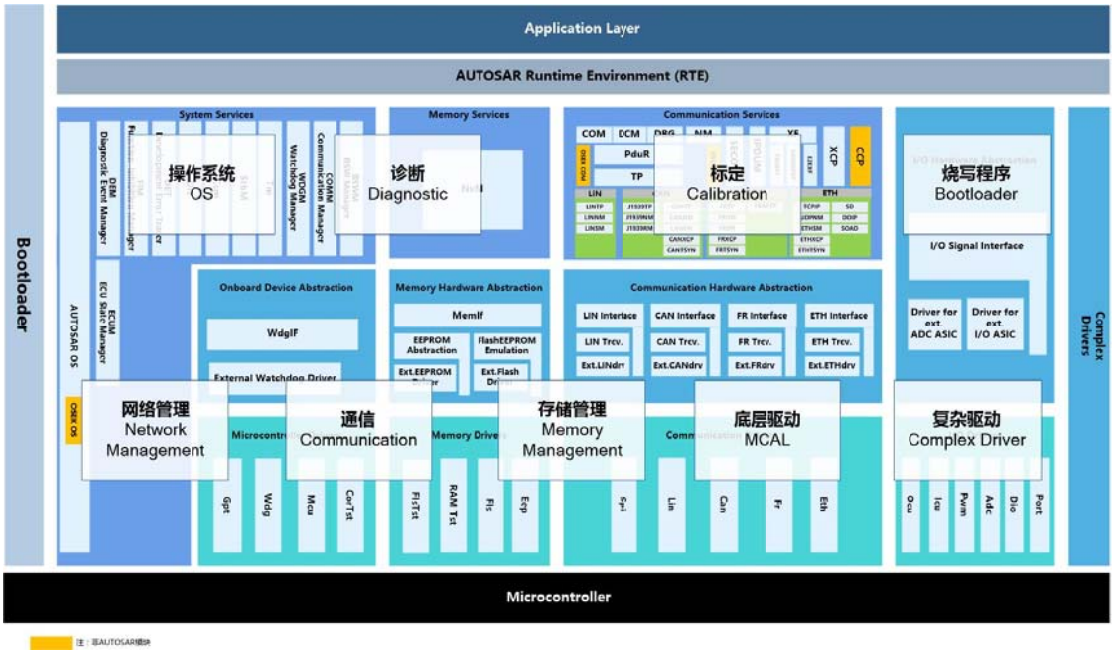


Figure 10 AutoSAR software architecture diagram

The application layer software runs in the MSS core, mainly including the operating system (OS), program flashing (BootLoader), UDS diagnostics (DEM), storage management (NVM), communication (COM), and other parts. Using an independent kernel to run application layer software not only facilitates development and management, but also decouples application layer software from algorithm software, improves software flexibility, and facilitates adaptation to different customer needs.
The application layer software adopts the AutoSAR architecture, using the AutoSAR standard protocol stack and software interface, which not only improves software standardization, shortens the radar software development cycle, but also maintains inter platform reusability, reduces radar software development costs, and can improve product reliability and security.

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.

6 Version records

Draft			
version	Date	author	Description
1.0	2024-05-10	Vincent Liu	Initial Version
1.1	2024-05-16	Zhihao Zhou	Add detailed descriptions of connectors
1.2	2024-05-20	Vincent Liu	Update EE and ME parameter for SRR3.0
1.3	2024-05-30	Zhihao Zhou	Update radar working cycle of 66ms, update radar speed range Update exploded view
1.4	2024-07-08	Zhihao Zhou	Updateperformance parameter
1.5	2024-07-08	Zhihao Zhou	UpdatesizedatainMechanical specifications