Freetech FVR40 High-Performance Automobile 4D Image Radar User Manual

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Overview

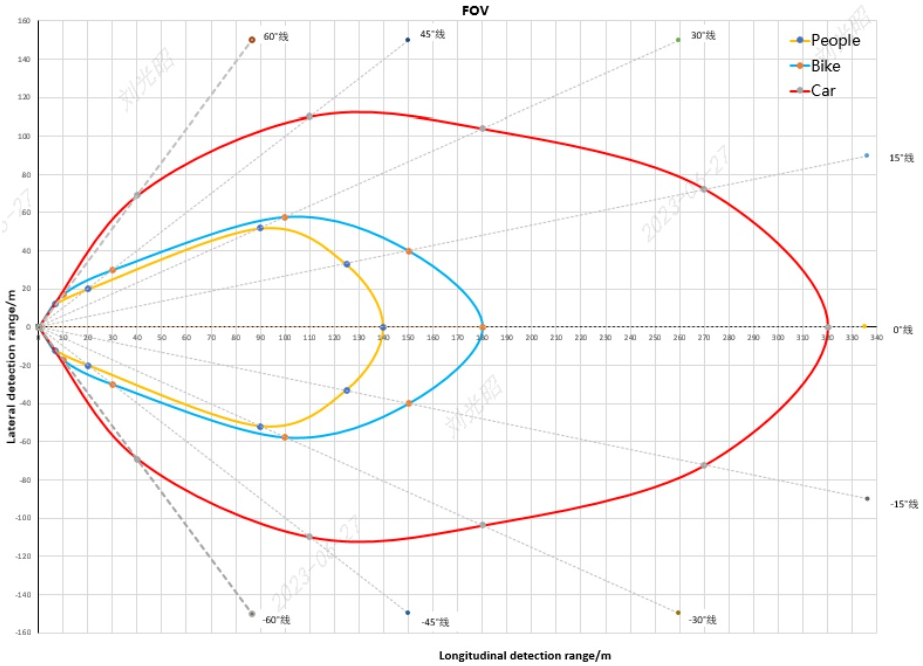
FVR40 is a low-cost, high-performance automobile 4D image radar, which uses unique wave forming design and creative perception algorithm, being capable of detecting four dimensions including Elevation. It is capable of transferring 30, 000 points per second, and has high azimuth and elevation angle accuracy, low false alarm and missing alarm. It has good anti-interference performance. FVR40 radar is equipped with CAN-FD and 100BASE-T1 Ethernet communication, supporting transferring huge amounts of data, and transfer point cloud and objects data in real time manner.

Perception Performance

FVR40 radar can detect objects with RCS between -10 ~ +40 dBsm.

FOV

FVR40 FOV is shown as the picture below.



FT will provide radar mechanical 3D data along with accurate radar FOV cone. If FOV cone is interfered while installing radar on vehicle, Freetech's review and agreement shall be needed.

1.1 Performance Index

FVR40 is working in 77.5 – 78.5 GHz frequency band, with 1 GHz bandwidth. The detection performance parameters are as below:

parameter		Index
Range	Max distance	320m
	Accuracy	0.1m
	Resolution	0.2m
Velocity	Relative velocity	-110~70 m/s
	Accuracy	0.1 m/s
	Resolution	0.2 m/s
Azimuth	FOV Azimuth FOV	-60°~60°
	Accuracy	0.5°
	Resolution	1.0°
Elevation	FOV Elevation FOV	-15°~15°
	Accuracy	0.5°
	Resolution	1.0°
Point cloud transferring rate		30000 points/second
Point cloud quantity (points quantity/cycle time)		1000~2000
Cycle Time		66 ms

Radar Function

FVR40 will output radar perception signals, and outputs detection raw data and objection signals simultaneously. These perception signals can be sent to camera or domain controller to realize related ADAS function.
FVR40 provides attributes for point cloud as below:

Type	Attribute
General information	Frame ID
	Time stamp
	Latency
Range	Range
Velocity	Velocity
Azimuth & Elevation	Azimuth
	Elevation
SNR	SNR

FVR40 provides attributes for object as below:

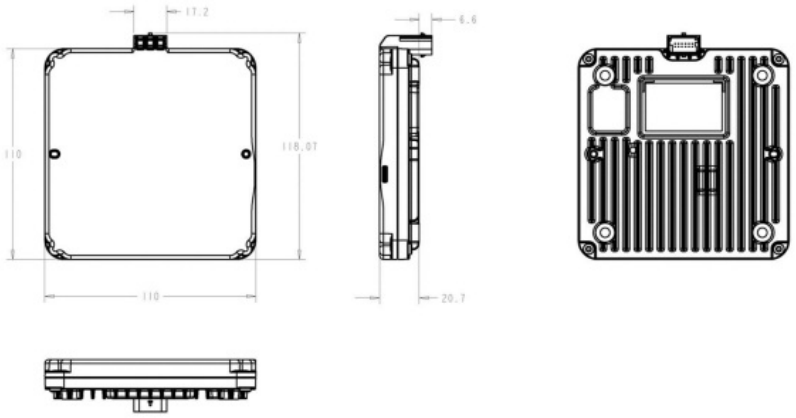
Type	Attribute
General information	Object ID
	Track Status
	Validity
	Magnitude
	Alive counter
	CRC
Range	Longitudinal position
	Standard deviation longitudinal position
	Lateral position

	Standard deviation lateral position
Velocity	Longitudinal velocity
	Standard deviation longitudinal velocity
	Lateral velocity
	Standard deviation lateral velocity
	Longitudinal acceleration
	Lateral acceleration
Height	Vertical position
	Standard deviation vertical position
Classification	Motion classification of the object
	Stationary count
Objects information	Heading angle
	Object extension – box length
	Object extension – box width

Hardware Solution

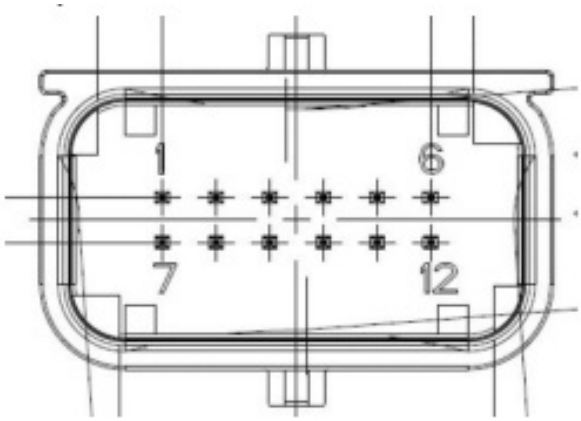
Structure

FVR40 satisfied IP69K water and dust protection level. Weight is about 300g. Dimensions are shown as the figures below (Unit: mm).



Interface

FVR40 radar interface uses 12-pin connector, shown as below:



Detailed pin definition for radar connector is as below:

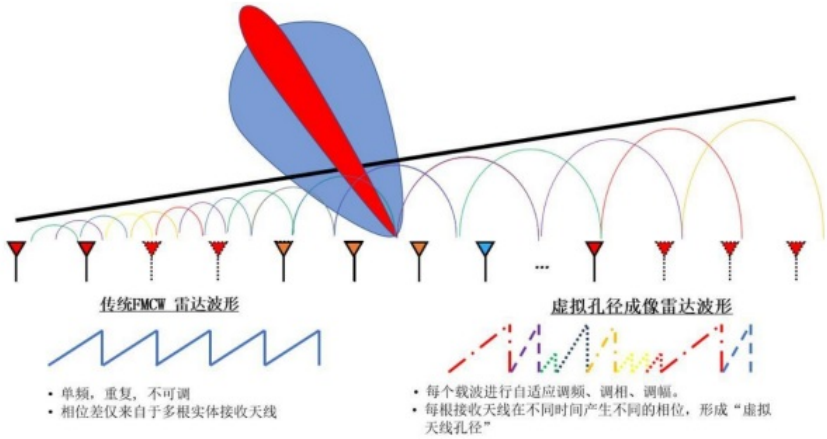
PIN No.	PIN definition	Function Description	Remark
1	BATT	KL30	
2	VCAN_H	COM1	Support specific frame wakeup.
3	MP2 Reserved	Position ID2	Multipurpose Pin2
4	PCAN_H Reserved	CAN	
5			
6	ETH_TRX_M	Ethernet	
7	MP1	Position ID1	Multipurpose Pin1
8	VCAN_L	CAN	
9	GND	Ground	
10	PCAN_L Reserved	CAN	
11			
12	ETH_TRX_P	Ethernet	

Antenna

FVR40 uses micro-strip array antenna, with 6 transmitting channels and 8 receiving channels.

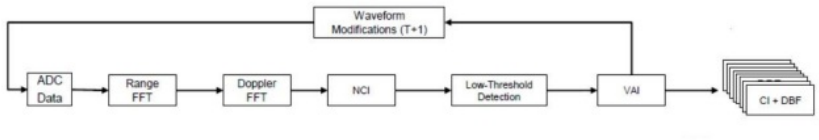
Virtual Aperture Imagine (VAI)

FVR40 uses virtual aperture imaging (VAI) technology, which can significantly increase virtual antenna quantity. The specific implementation principle is shown as below picture. Via unique waveform design, every carrier can change their frequency modulation, phase modulation and amplitude modulation adaptively, to make every reception antenna generate different phases at different time, to get ‘virtual antenna aperture’.



Signal Processing Procedure

FVR40 signal processing procedure is shown as below. NCI means Non-Coherent Integration, and VAI means Virtual Aperture Imaging.



Working Manner

Power Dissipation

Under 12V voltage, FVR40 radar current and power dissipation is shown in the table below:

	Sleep	Normal	Maximum
Current	<100uA	410mA	620 mA
Power	–	5W	<7W

Working state under different voltages

Under different voltages, FVR40 radar working states are shown in the table below:

Voltage	Communication state	Hardware monitor	Over-voltage protection
6.5V	Unable to communicate	Unable to monitor	Inactive
6.5V~9V	Normal	Normal (DTC 'undervoltage'being stored)	Inactive
9V~16V	Normal	Normal	Inactive
16V~32V	Normal	Normal DTC 'overvoltage' being stored	Inactive
32V	Unable to communicate	Unable to monitor	Active

Wake up

FVR40 radar support two kinds of wake up: Network CAN frame wake up, and Reserved KL15 wake up.

Environment parameters

FVR40 radar related environment parameters are as below:

- Storage temperature: -40℃ ~ 105℃
- Operating temperature: -40℃ ~ 85℃
- Function limited operating temperature: 85℃ ~ 95℃

Radar Alignment

FVR40 radar can support three methods for azimuth and elevation alignment: static alignment, dynamic alignment and self-alignment.

- Static alignment uses specific alignment equipment during vehicle
- Dynamic alignment is usually used for vehicle EOL, or after-sale repair provide by 4S Alignment angle can be calculated after driving on a specific road.
- Self-alignment is occurring during normal When the road condition and driving condition are satisfied, the alignment is performing automatically.

Mounting Guideline

FVR40 radar uses bracket to fix on the vehicle body, as the below pictures shown:

Functional Safety

FVR40 can meet functional safety ASIL-B system requirements.

Caution notice of certification

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 device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference, and
- This device must accept any interference received, including interference that may cause undesired

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

- This device may not cause
- This device must accept any interference, including interference that may cause undesired operation of the

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