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INTERIOR RADAR CONTROLLER

Product Guide

CubTEK Inc.

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<http://xxxxxxxxxx>

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Revision History

Version	Change Description	Date	Modified by	Approved by
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1 Purpose

This guide, published by CubTEK INC., outlines the product specifications for our INTERIOR RADAR CONTROLLER. It also provides handy tips for users on how to install and fine-tune the product.

2 Scope

Our INTERIOR RADAR CONTROLLER is designed for passenger vehicles. Its capability to detect sleeping infant movements effectively helps to identify sleeping children and pets, thus mitigating the risk of leaving children unattended in vehicles.

3 Terminology & Abbreviations

FOV	Field of View
CAN	Controller Area Network
OMS	Occupant Monitoring System
CPD	Child Presence Detection

4 Standards and Regulations

Standard	Regulation Name	Applicable Vehicles	Date of publication
EURO NCAP	ASSESSMENT PROTOCOL – CHILD OCCUPANT PROTECTION V8.0	All	2023/1/1
EURO NCAP	TEST AND ASSESSMENT PROTOCOL – CHILD PRESENCE DETECTION V 1.2	All	2023/12/5

5 Product Overview

5.1 Related Regulations and Future Trends

As laws and regulations evolve, new cars with in-vehicle life presence detection systems will gradually increase around 2022.

In particular, radar technology, which can sense light breathing and heartbeat to detect sleeping babies and pets has become the leading technology in this field.

- ◆ **Euro NCAP** starts rating the ability to detect in-car children's presence
- ◆ **USA** is implementing the **HOT CARS Act**, which mandates an alarm system if a child is left in the car.
- ◆ **China** following EU regulations, major automakers have paid close attention to developing related technologies.

5.2 Understanding the Concept of CubTEK's INTERIOR RADAR CONTROLLER

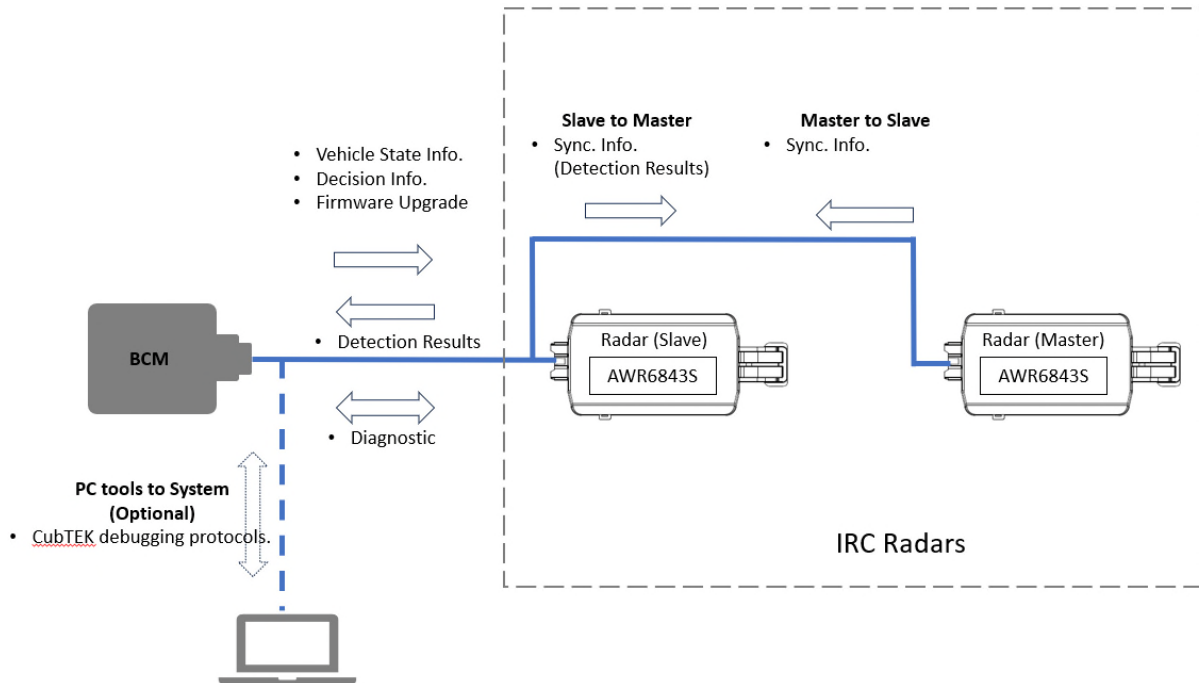
Traditionally, millimeter-wave radar has been used to observe micro-movements of the human body, such as breathing and heartbeat. The restrictions on installation in a car make it difficult to observe the heartbeat signal. When using a ceiling-mounted radar, only the head and neck of the front seat passengers can be observed, and the chest cannot be seen, therefore it is impossible to obtain a heartbeat signal. However, biological bodies can still be identified through the micro-movements caused by breathing. Traditional applications require detection after the engine is turned off to avoid misjudgment due to vehicle vibration. CubTEK proposes a 3D cloud map structure, which displays all micro-movement parts and uses object judgment algorithms for three-dimensional judgment, improving accuracy. This is the feature of its INTERIOR RADAR CONTROLLER.

5.3 Product Features & Benefits

- Meet NCAP Child Presence Detection Standards
- Offers occupancy information detection (Optimized Airbag deployment /Seat-belt reminder)
- Living object detection, classification, and localization (Adult / Child / Non-living)
- A single radar can simultaneously oversee two rows or five seats
- Extended to 3 rows and up to 7 seats under two-sensor configuration
- Automotive safety integrity level according to ISO 26262: up to ASIL-B

6 Product Introduction

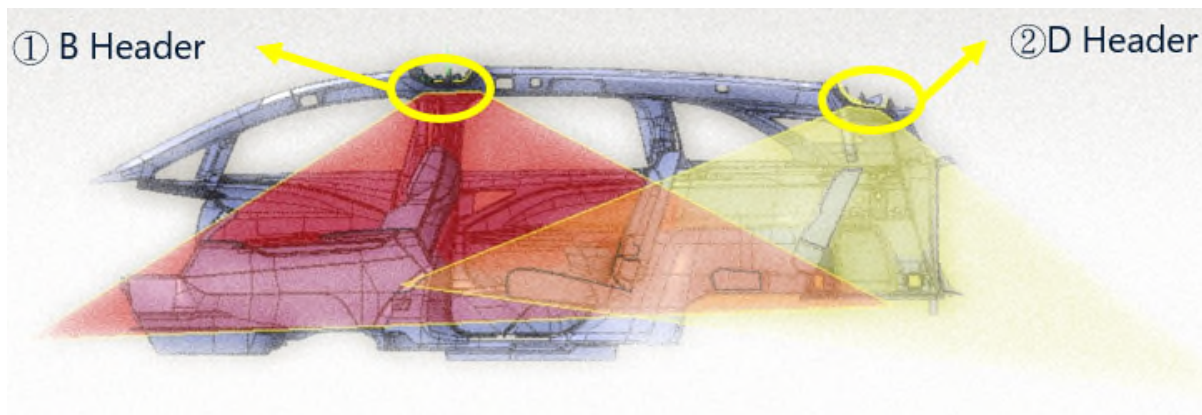
6.1 System Architecture

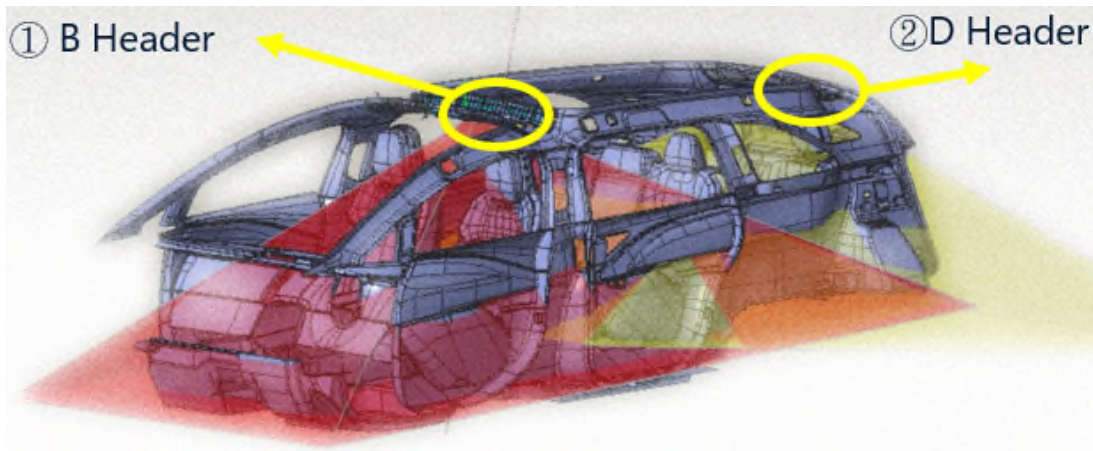


6.2 FOV Diagram

Horizontal Angular $\pm 70^\circ$

Vertical Angular $\pm 60^\circ$





6.3 Feature Introduction

I. Child Presence Detection

Not only can it detect children trapped in the car, it can also provide intelligent safety warning and monitoring for drivers and passengers

II. Protect Personal Privacy

Not like a camera, the Vital sign detector radar only detects vital signs without violating personal privacy.

III. Environment Safety

Enable to monitor and safely use the in-vehicle environment, material standards, and 5G-based interconnection of vehicles.

IV. No environmental effect

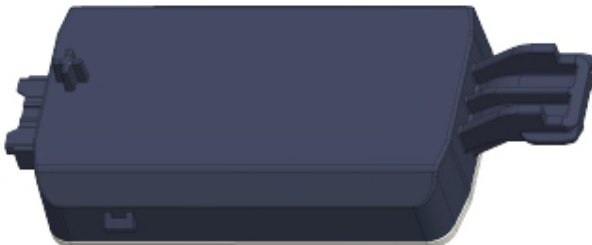
Relatively unaffected by common environmental conditions, such as dust, smoke, light etc.

V. 3D Cloud Structure

No need to distinguish between breathing and heartbeat signals, any micro-vibration is detectable.

7 Product Specifications

7.1 Detailed Specifications

Specification Introduction	INTERIOR RADAR CONTROLLER
Product drawing	
Application	Occupancy detection Occupant Classification Living object detection Intrusion detection Vital sign (Heart rate 、 Respiration detection)
Power	Sensing $\leq 1.6\text{w}$ Power saving $\leq 0.3\text{w}$ Average Power $\leq 0.95\text{w}$
Operating voltage	Nominal Operating voltage: 13.5V Operating voltage: 9V-16V
Operating temperature / Storage temperature	-40~85°C/ -40~90°C
Waterproof level	IP67
Material	Cover : PBT+GF30% Base: PBT+GF30%
Appearance dimensions	 100.5 (L) x 21 (W) x 47 (D) (mm)
Connector (device end)	6P Connector Molex 505570 series
Connector (harness end)	6P Connector Molex 505570-0601
Other modules (Public version)	Without controller
Automotive safety integrity level	ASIL B

Communication and Interface Specification	INTERIOR RADAR CONTROLLER
CAN communication channel	2 channels
CAN data frame	Standard frame
CAN baud rate (HMI-CAN external interface)	Baud Rate : 1M ; Data Rate : 1M
CAN FD (external interface)	V (Support)
Vehicle signal - Speed	▲ (Optional)
Vehicle signal - Gear	▲ (Optional)
Vehicle signal - Door	V (Mandatory)
Vehicle signal - Turn Indicator	▲ (Optional)
Vehicle signal - Steering Angle	▲ (Optional)
Vehicle signal - Ignition (ON/OFF)	V (Mandatory)
Vehicle signal - Yaw Rate	▲ (Optional)
Max target output number	5
Max cluster output number	X (Not Supported)

7.2 Performance Specification

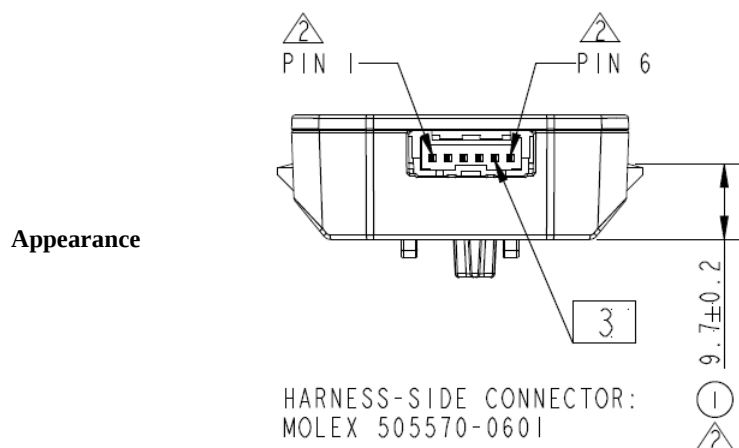
Radar performance Specification		Unit	INTERIOR RADAR CONTROLLER
Radar Frequency		GHz	60-64
Data cycle time		ms	100
Distance	Range	m	0.2 - 4
	Accuracy	m	± 0.005
	Resolution	m	0.04
Velocity	Range	km/h	± 6
	Accuracy	km/h	± 0.07
	Resolution	km/h	NA
Horizontal Angular	Range (FOV)	°	± 70
	Accuracy	°	2
	Resolution	°	28
Vertical Angular	Range	°	± 60
	Accuracy	°	2
	Resolution	°	28

7.3 Function Specification

Function Specification	INTERIOR RADAR CONTROLLER
Installation Calibration Method	To be defined
UDS diagnostic function	V (Support)
UDS Firmware update function	V (Support)
Network management function	X (Not Support)
Rollback and Recovery	V (Support)
Image Size	1M
Update Time	To be defined

8 Connector and Plug-in PIN Definition

INTERIOR RADAR CONTROLLER



Material PBT+GF30%

6P Connector

Connector Model Connector (device end) 6P Connector Molex 50770 series
Connector (harness end) 6P Connector Molex 50770-0601



PIN DEFINITION	
1	VBAT
2	TERMINAL
3	GND
4	WAKE_OUT
5	CAN_L
6	CAN_H

9 Communication Protocol

Proceed with the customer's confirmation and execution.

10 Limitations

Our product provides in-cabin monitoring and alerts, but accuracy may be influenced by installation location, metal shielding, and interference, causing possible false or missed alarms. We don't ensure absolute detection or alert accuracy. We advise drivers to obey traffic laws, stay alert, and not rely entirely on this product for accident prevention.

Drivers need to be cautious in these scenarios:

1. Verify the installation location with CubTEK to control the false alarm rate.
2. Avoid covering the radar surface with metal or heavy clothing.
3. Ensure the radar's view is not blocked by stationary objects like large plastic boxes or metal.
4. Be mindful of items causing disturbances, such as electronic toys, which may trigger false alarms after the engine is turned off.

FCC Statement:

- Please include the following FCC Statement:
- 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.
- NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.
- This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.
- If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
 - —Reorient or relocate the receiving antenna.
 - —Increase the separation between the equipment and receiver.
 - —Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
 - —Consult the dealer or an experienced radio/TV technician for help.
- Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
- This device has been evaluated to meet general FCC RF exposure requirement. The device can be used in portable exposure condition without restriction.

ISED Statement:

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

- (1) this device may not cause interference,
- (2) this device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

- (1) L'appareil ne doit pas produire de brouillage;
- (2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This device has been evaluated to meet general ISED RF exposure requirement. The device can be used in portable exposure condition without restriction.

Cet appareil a été évalué pour répondre à l'exposition générale aux RF ISED exigence. L'appareil peut être utilisé dans des conditions d'exposition portables sans restriction.