

Horus640-D

Automotive Thermal Imaging Product Manual



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Revision History

The revision history records the changes of each update. The latest version of the document includes updates from all previous versions.

Version	Issue Date	Revised Contents
V1.0	November 18, 2024	Initial version.
V1.1	November 21, 2024	Revised part of the text description and replaced the drawings

1 Introduction

1.1 Description

The Horus640-D is an uncooled long-wave infrared (LWIR) automotive thermal imaging module, featuring low cost, small size, high protection and low power consumption. Built on our proprietary AEC-Q100 certified LWIR thermal imaging MEMS detector and ASIC-ISP image processing chip, the module passively detects the infrared radiation emitted by objects, thereby clearly identifying pedestrians, animals, vehicles, and other targets ahead—regardless of weather and lighting conditions. Infrared thermal imaging technology can provide drivers with accurate and timely image information in nighttime, low light and glare-affected environments, as well as in adverse weather like rain, snow, fog, haze, smoke, or dust.

1.2 Features

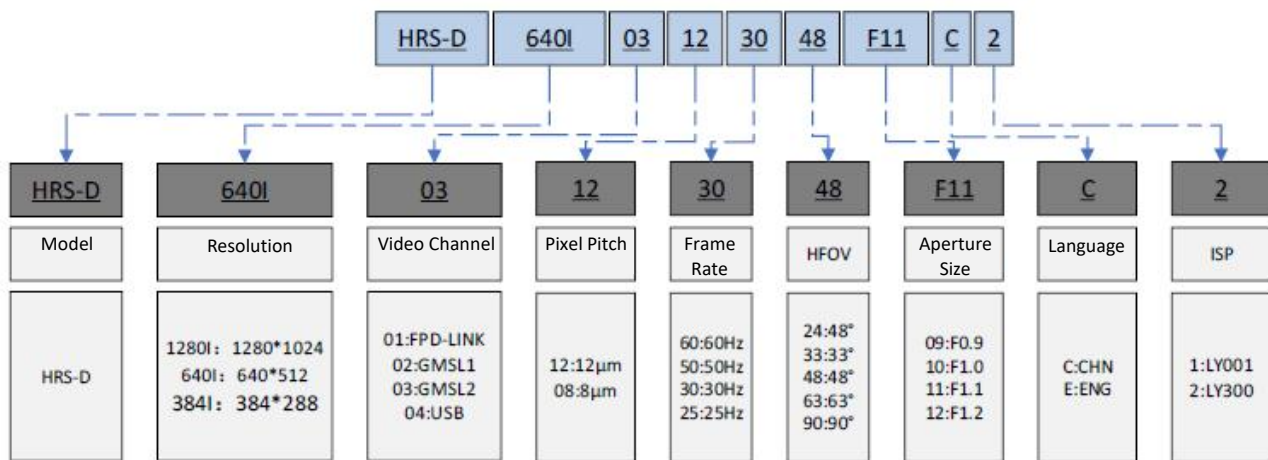
- Integrated with AEC-Q100 Grade2 detector;
- Integrated with the 2nd-generation in-house developed AEC-Q100 Grade2 qualified ASIC-ISP chip LY300;
- Low cost, AEC-Q100 qualified, small size, low power consumption, and lightweight;
- Shutterless correction algorithm based on motion scenario, and no image freezing during motion;
- External synchronization function, capable of setting trigger frequency;
- High-quality image processing algorithm, showing clearer details;
- Front side IP69K and overall product IP67;

1.3 Applications

- Automotive Night Vision System
- Advanced Driving Assistance System/ADAS
- Autonomous Driving

2 Selection Guide

2.1 Model Naming



2.2 Recommended Models

Table 2-1 List of Recommended Models

S/N	Model	Features	Recommended Application
1	HRS-D640I03123048F11C2	Applicable to expressways & urban roads	On-road Scenarios

Note: For selection combinations not given in the above list, you can contact us for customization if needed.

2.3 Lens Selection Reference

Table 2-2 Compatible Lens Specifications

Array Size	Lens Type	Focusing Method	FOV (H×V)	IFOV	Identification Range
640×512	9.1mm F1.1	Athermalized prime lens	48°×37°	1.3mrad	114 m
640×512	13.5mm F1.0	Athermalized prime lens	32°×26°	0.8mrad	169 m

Note: The above identification ranges are estimated based on Johnson’s criteria, taking pedestrians (1.8*0.5*0.3m) as the target.

3 Parameters

Table 3-1 Product Performance Parameters

Module Parameters	Horus640-D
Detector Type	VOx uncooled microbolometer
Resolution	640×512
Pixel Pitch	12 μm
Package Type	WLP
Frame Rate	30 Hz
Response Band	8 - 14 μm
Thermal Response Time	≤ 12 ms
NETD	≤ 35mK@25°C, F#1.0
Solar Burn Protection	Supported
External Synchronization	Supported
Automotive Chip	Detector/AECQ100 Grade2 qualified ASIC-ISP chip
Physical Properties	
Weight	< 80 g (f9.1mm F1.1 lens)
Dimensions	32.5 mm×60.5 mm×43 mm (53.4 mm with FAKRA connector) (f9.1mm F#1.1 lens)
IP Grade	Front side IP69K; rear side IP67
Defrosting Function	Supported
Operating Case Temperature	-40°C - 85°C
Storage Case Temperature	-40°C - 105°C
ISP Algorithm	
Shutterless Algorithm	Supported
Tecless Algorithm	Supported
3D Noise Reduction (3DNR)	Supported
2D Noise Reduction (DNS)	Supported
Wide Dynamic Range	Supported

Compression (DRC)	
Digital Detail Enhancement (DDE)	Supported
Performance & Reliability	
Performance Test	Refer to the performance test items in Section 7.1 below.
Reliability Test	It has passed OEM mass production test, and we can make these test items available to key customers.
Electrical Properties	
Power Supply Voltage	DC 12V
Typical Power Consumption @25°C	Average 1.2W (imaging mode only); MAX 6W (imaging + heater ON + shutter operation)
Data Format	YUV422
Transport Protocol	MIPI (GMSL2/MAX96717F)
Physical Interface	FAKRA
Communication Interface	I2C
Optical Properties (Athermalized Prime Lens)	
Focal Length/F#	9.1 mm/F#1.1
Focusing Method	Athermalized fixed focus
Field of View	48° (±2°) × 37° (±2°)
Space Resolution	1.32mrad
Distortion	TV-D ≤ 10%
Image Definition	(Center) >300 LW/PH (Edge 0.7) >280 LW/PH
Uniformity of Luminance	≥ 80%

Note: All parameters listed above were measured under laboratory conditions, and the final specifications are based on the test report.

4 Hardware

Note: The hardware description in this manual is for model selection reference only. For specific development, please contact our FAE to obtain hardware development materials.

4.1 Hardware Partitioning

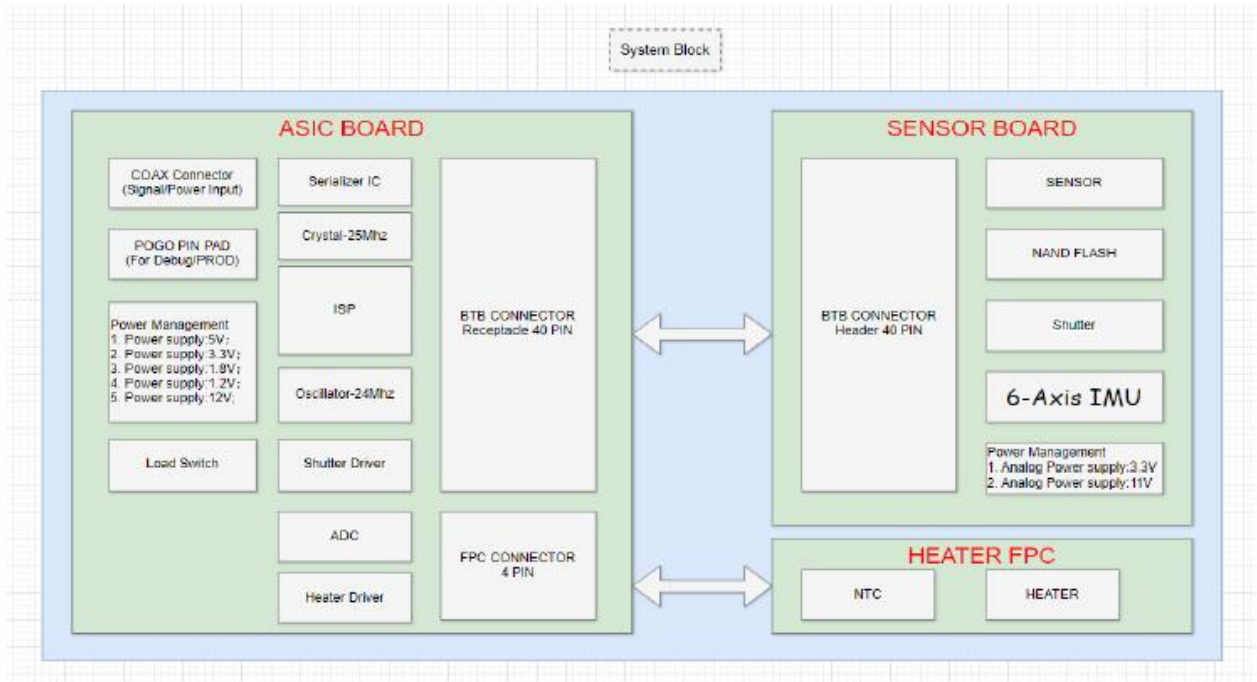


Figure 4-1 Horus640-D Module Hardware Partitioning

4.2 Signal Path

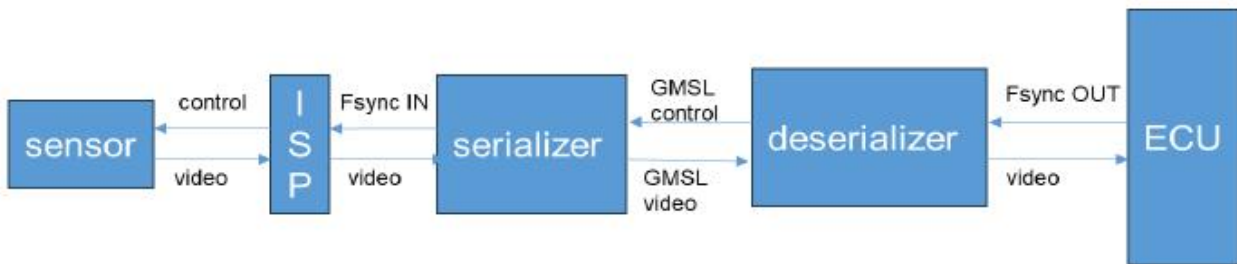


Figure 4-2 Horus640-D Signal Path

4.3 External Interface - FAKRA Connector

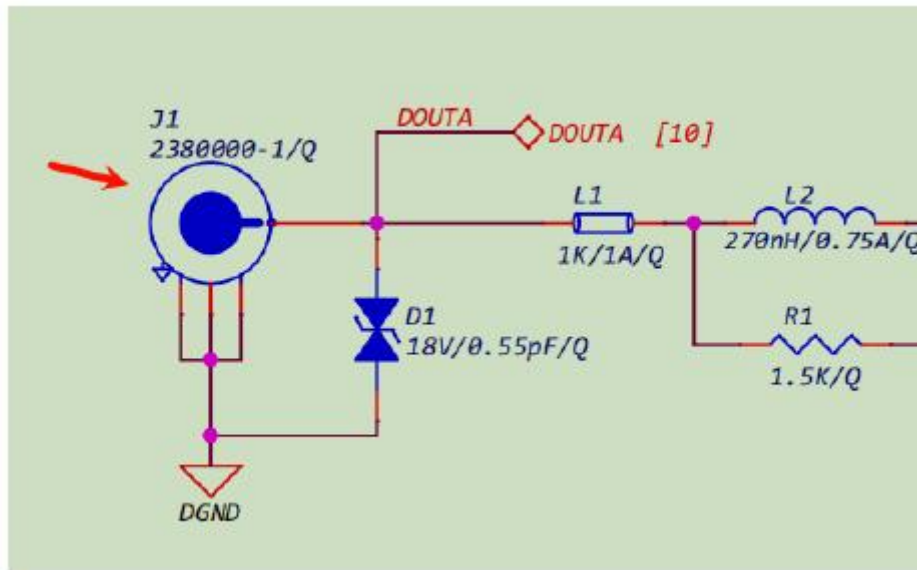


Table 4-1 Connector Specifications

Parameters	Value
Connector Type	SMB: 2380000-1 Adapter: 2390730-4
Connector Model of Connected Part (Straight)	2307198-1
Connector Model of Connected Part (Bent)	2392990
Connector Manufacturer	TE
Frequency Range	DC-6GHz
Characteristic Impedance	50 Ω
Operating Current	≤ 1 A DC
Waterproofness	IPX7

5 Software Services

5.1 Development Support

The product comes with quick start application for Windows and an SDK for Linux. Customers can contact our FAE to obtain the latest software development materials.

Available interface: FAKRA.

It supports pseudo-color output (SDK required) in YUV422 8 bit format, including white hot (default) and black hot. Data output format: YUV422 8 bit, default UYVY.



Figure 5-1 White Hot Image (Default)



Figure 5-2 Black Hot Image

5.2 Control and Data Transmission

The module is configured with standard I2C control interface with a maximum clock frequency of 400KHz and 7bit I2C address of 0111100b (0x3C).

The module transmission mode is imaging mode, which can be switched to raw data according to command for customized image algorithm processing or image recognition.

Table 5-1 Data Format Description

Transmission Mode	Data Format	Data Resolution
Imaging	YUV422	640*512

Format of data sent via I2C:

Write mode:		
SLAVE ADDR	VDCMD BUF ADDR	VDCMD DATA STURCTURE
0x78	0x1d00	

PS: BIT[15] of the VDCMD BUF ADDR address space indicates whether the completion of data transmission triggers the LY300 interrupt. When bit[15]=0 and the I2C receives Stop signal, the LY300 interrupt is triggered.

For example, I2C HOST sends 8 bytes of data to LY300 BUF in the following two modes:

1. Single-time data transmission: Set VDCMD BUF ADDR to 0x1d00 and transmit 8 bytes of data at once.
2. Multi-time data transmission: If only 1 byte is transmitted each time, set VDCMD BUF ADDR starting from 0x9d00, and increment the BUF ADDR sequentially (0x9d01, 0x9d02...). For the final communication, set VDCMD BUF ADDR to 0x1d07.

Read command processing status:			
SLAVE ADDR	CMD STS ADDR	SLAVE ADDR	DATA
0x78	0x0200	0x79	CMD_Status

After I2C sends a write command, the command status needs to be obtained. CMD_Status is an 8-bit register

CMD_Status[0]: Current command status, 0 IDLE, 1 BUSY

CMD_Status[1]: Command run result, 0 PASS, 1 FAIL

CMD_Status[2:7]: CMD error code

Read mode:			
SLAVE ADDR	VDCMD BUF ADDR	VDCMD DATA STURCTURE	
0x78	0x1d00		
SLAVE ADDR	CMD STS ADDR	SLAVE ADDR	DATA
0x78	0x0200	0x79	CMD_Status
Confirm command processing completion			
SLAVE ADDR	VDCMD BUF ADDR	SLAVE ADDR	DATA
0x78	0x1d00	0x79	

1. In the read mode process, the VDCMD command must be sent first, with the same timing sequence as the write mode;

2. After the command is sent, two subsequent processes must be continuously sent to finally read the data.

5.3 Software Functions

Note: Due to limited module resources, some basic functions are implemented internally in the firmware, while some extended functions are implemented using the SDK. It is recommended to prioritize functions encapsulated by the SDK.

Table 5-2 Software Functions of Horus640-D Module

Image-related	Adjustable Effect	Remarks
Pseudo-color	Switch different pseudo-color modes via the SDK	
Digital Noise Reduction	Temporal noise reduction and spatial noise reduction	Currently, the same noise reduction interface is used at the base layer with no distinction between temporal and spatial noise reduction
Automatic Image Adjustment	Automatically adjust the image stretching ratio based on the scenario to keep the brightness and contrast within the appropriate range	
Digital Detail Enhancement	Make image edges and details clearer	
Cover Calibration	Eliminate the inherent lid effect of the optical system	
Dead Pixel Calibration	Eliminate blind pixels caused by shocks and other problems	
Temperature Range Switching	Adjust to different ambient temperatures for optimal detector performance	
Automatic Gain Control	Adjust the grayscale range of the image	
Basic Image Information Acquisition	Read the imaging frame rate, resolution, and data source type of the core	
Basic Image Information Setting	Set the imaging frame rate and data source type of the core	
Manual Shutter Correction	Make the image more uniform	
Product Information	Read module name, SN, PN, and firmware version for product identification and	

Image-related	Adjustable Effect	Remarks
Acquisition	subsequent maintenance	
Firmware Upgrade	Push a new firmware version to the module	
External Synchronization	Trigger frame synchronization output using external signals	
Logging Function	Output logs through the serial port in real time and save them to Flash for reading, with time stamps and modules	
Backup and Recovery	Restore the secondary calibration data of the user	
Module Anomaly Status Acquisition	Detect whether the module is abnormal	
Heater Strip Status Acquisition	Enable/disable; manually enable/disable the heater strip function (non-heating)	
Automatic Enable Threshold Setting for Heater Strip	Automatically manage the heater strip status	
RTC	Get the current time	
Interactive Information	Get the module status information	
Core Device Protection	Detector protection	
System Security	System recoverable from anomalies to ensure secure startup	

6 Dimensions

Note: This picture is for reference only. For specific 2D and 3D drawings, please contact our FAE.

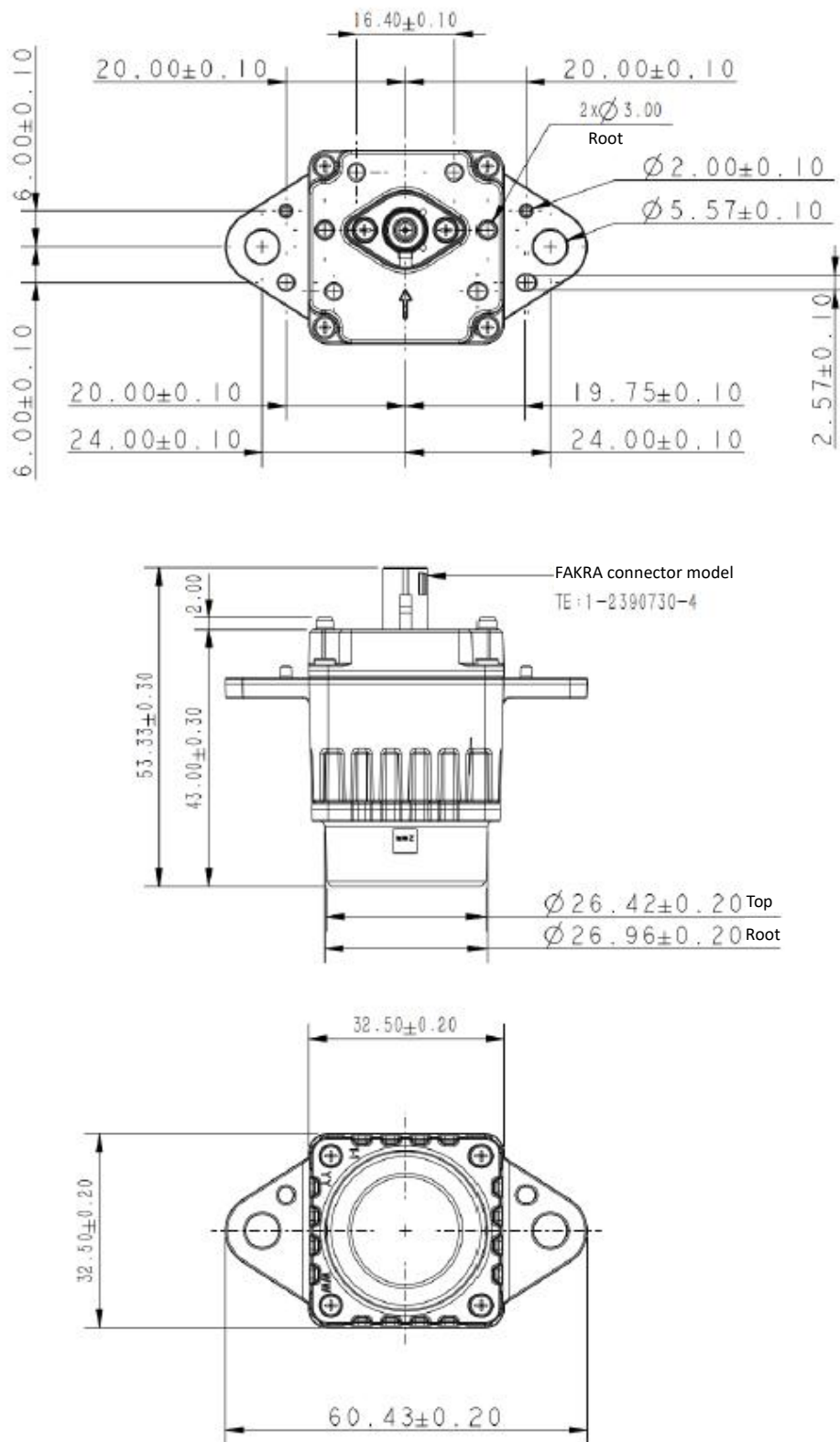


Figure 6-1 Dimensions of Horus640-D Module

7 Tests

Horus640-D modules are AEC-Q100 qualified mass-produced products. To ensure performance, all performance and reliability tests have been completed, following the development lifecycle of before-market specific products. Details are as follows.

7.1 Performance Test Items

Test Items	Acceptance Level
Dimension Check	The outline and installation dimensions of the samples shall meet the requirements of product drawings
Appearance	The appearance of the samples shall meet the relevant requirements
Field of View Accuracy	HFOV: $\geq 48^\circ (\pm 2^\circ)$, VFOV: $\geq 37^\circ (\pm 2^\circ)$
Average Brightness	Corner output uniformity $> 80\%$ of central output
MTF	Central FOV > 300 LW/PH; 0.7 FOV > 280 LW/PH (MTF > 0.5 at 15.2 lp/mm; MTF > 0.5 at 14.2 lp/mm)
Distortion	FOV distortion $< 10\% $
Resolution	Horizontal*Vertical: 640*512
NETD	$\leq 35\text{mK}@25^\circ\text{C}$, F#1.0
Frame Rate	≥ 30 fps
Defective Pixel	No defective pixels within the field of view
MRTD	≤ 500 mK
Detection Range and Recognition Range	Detection range ≥ 300 m; pedestrian detection range: 10 m - 90 m Based on Johnson's criteria, the detection range is defined as the target image pixels ≥ 1.5 pixels, and the identification (recognition) range is defined as the target pixels ≥ 12 pixels.
Startup Time Test	Time ≤ 5 s
Observation Range Test	No inverse white anomaly in white hot mode, and no inverse black anomaly in high-temperature blackbody image area
Thermal Response Time	< 12 ms
Unit Freezing Time	< 600 ms
Image Adjustment Test	Stable brightness and contrast
Solar Protection	Coincident with the shutter protection logic, i.e., close the shutter for 10 s when the sun is detected, then if the sun is no longer detected, normally open the shutter, but if the sun is still detected, keep the shutter closed.

8 Precautions

To protect you and others from injury and your equipment from damage, please read all the following safety instructions before using your device.

- 1 Do not point the device directly at high-intensity radiation sources such as the sun.
- 2 The ideal operating ambient temperature is -10°C - 50°C.
- 3 Do not touch the device and cables with wet hands.
- 4 Do not bend or damage connecting cables.
- 5 Do not scrub the device with thinners.
- 6 Do not plug or unplug other cables when the power is not turned off.
- 7 Do not incorrectly connect the attached cables to avoid damaging the device.
- 8 Please take care to prevent electrostatic discharge.
- 9 Do not disassemble the device. If a fault occurs, please contact us to have it serviced by our professional staff.

9 Support And Services

9.1 Technical Support

- 1 We can customize the designs of extended components to meet users' diverse application requirements;
- 2 We can provide system training for users' technical staff and operators.

9.2 After-Sales Services

The HRS640-D uncooled infrared module is independently developed by our company, with prompt and reliable after-sales service guarantees for maintenance and repair. Please feel free to contact us if you have any needs.