NEXUS-640-1080

Single-Board EO/IR AI Tracking Module

640 × 512 uncooled LWIR thermal imaging · 1080p visible imaging · embedded AI tracking · H.265 Ethernet video output



Representative product appearance. Final appearance may vary according to project configuration.

THERMAL CHANNEL	VISIBLE CHANNEL	AI PROCESSING	SYSTEM INTERFACE
640 × 512 **12 μm LWIR**	**1920 × 1080** **RGB 24-bit**	**>50 Hz tracking** **>15 fps recognition**	**100M Ethernet** **RS422 / SPI**

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1 Product Overview

The NEXUS-640-1080 is a compact single-board integrated EO/IR module combining uncooled long-wave infrared imaging, visible-light imaging, onboard video processing and embedded AI tracking functions. It is intended for electro-optical payloads and compact imaging systems that require dual-spectrum video acquisition, target tracking and system-level integration within a limited size, weight and power envelope.

The module provides H.265 compressed video over a 100 Mbps Ethernet interface, supports UDP and RTSP streaming, and includes configurable image processing functions for both thermal and visible-light channels. AI functions include deep-learning-based target tracking and recognition support, with software and algorithm model upgrade paths through the specified interfaces.

2 Key Features

Single-board integrated architecture	Thermal imaging, visible-light imaging, processing board and interface board are integrated for compact payload design.
Dual-spectrum imaging	Supports a 640 × 512 uncooled LWIR thermal channel and a 1920 × 1080 visible-light channel.
Embedded AI functions	Deep-learning-based target tracking with >50 Hz tracking frame rate and adaptive target boundary support.
Network video output	H.265 compressed video output through 100 Mbps Ethernet, supporting UDP and RTSP protocols.
Configurable image processing	Thermal NUC, polarity switching, brightness/contrast adjustment, DDE enhancement, visible dehazing and sharpening.
Integration-oriented interfaces	Provides Ethernet, RS422 serial communication, SPI synchronous data interface and dedicated power input connectors.

3 System Architecture

Subsystem	Description
Thermal imaging channel	640 × 512 uncooled VOx infrared microbolometer, 12 μm pixel pitch, 8–14 μm spectral response.
Visible-light imaging channel	1920 × 1080 CMOS visible-light sensor, 3.45 μm pixel size, RGB 24-bit color output.
Lens options	Thermal: 25 mm fixed-focus athermalized lens. Visible: 10.44 mm fixed-focus lens. Lens options are project-dependent.
Processing unit	Integrated image processing board with FPGA/RK3588-related upgrade paths and embedded AI model support.
Video processing	H.265 encoding, selectable output resolution, JPEG capture, OSD overlay/blanking and local recording support.
Tracking and recognition	Deep-learning-based tracking algorithm; recognition support for high-resolution images on NPU processing.
Communication and control	100 Mbps Ethernet, RS422 serial communication and SPI synchronous data interface.
Power architecture	DC 5.5 V input; power consumption ≤10 W @ 25°C with tracking excluded, according to the source specification.

4 Imaging Sensor and Lens Specifications

Category	Parameter	Specification
Thermal Sensor	**Resolution**	640 × 512
	Pixel pitch	12 μm
	Detector type	Uncooled VOx infrared microbolometer
	Spectral response	8–14 μm
	MRTD	≤0.5 K (@ 3.125 cy/mrad, F# 1.0), tested with 75 mm standard lens
	NETD	≤40 mK @ 300 K
Thermal Lens (optional)	**Lens type**	Fixed-focus athermalized lens
	Focal length	25 mm

Category	Parameter	Specification
	Field of view	17.4° × 14.0° (±5%)
	F-number	F# 1.0
	Front-element coating	DLC coating
Visible-Light Sensor	Resolution	1920 × 1080
	Pixel size	3.45 μm
	Sensor type	CMOS
	Spectral response	0.4–0.7 μm
	Color mode	Color, RGB 24-bit
Visible-Light Lens (optional)	Lens type	Fixed-focus lens
	Focal length	10.44 mm
	Field of view	35.2° × 20.2° (±5%)
	F-number	F# 1.0

5 Video, Imaging and Data Processing Functions

Category	Parameter	Specification
Video Output	Ethernet video	100 Mbps Ethernet interface; H.265 compression; supports UDP and RTSP protocols.
	Default network settings	Default IP address: 192.168.1.79; gateway: 192.168.1.1.
Thermal Imaging	Non-uniformity correction	Automatic correction (default interval: 2 min), manual correction and correction disabled.
	Polarity switching	White-hot (default) and black-hot modes.
	Brightness adjustment	Supported; adjustment range: 0–255.
	Contrast adjustment	Supported; adjustment range: 0–255.
	Image flip	Vertical flip, horizontal flip and diagonal flip.
	DDE image enhancement	DDE enhancement type with enhancement enable/disable control.
Visible-Light Imaging	Brightness adjustment	Supported; adjustment range: 0–255.
	Contrast adjustment	Supported; adjustment range: 0–255.
	Image flip	Vertical flip, horizontal flip and diagonal flip.
	Image enhancement	Sharpening enhancement with enable/disable control.
	Image dehazing	Dark-channel dehazing with three adjustable levels.
Data Processing	OSD overlay / blanking	Customizable character content. OSD information can be added to the video and blanked as required.
	Video encoding	Selectable resolution: 1080p (default) and 960 × 540 center-region output. H.265 encoding; configurable compression bitrate within 8 Mbit/s.
	Image encoding	JPEG format.
	Video storage	Supported. Files are named by system time; MKV/MP4 format; loop recording for 4 hours.
	Log storage	Customizable log format and content.
	Data storage	Customizable data format and content.

6 AI Tracking and Processing Functions

Function Group	Capability	Specification
AI Tracking	Tracking algorithm	Deep-learning-based tracking algorithm model.
	Tracking frame rate	>50 Hz.
	Target boundary	Adaptive target boundary support.
AI Recognition	Recognition performance	Recognition speed above 15 fps for 4K × 3K image frames on a single-core NPU.
Program Upgrade	FPGA program	Supports upgrade through serial interface J3.
	RK3588 program	Supports upgrade through Ethernet interface J2.
	Algorithm model	Supports upgrade through Ethernet interface J2.

Function Group	Capability	Specification

AI performance note
AI detection, recognition and tracking performance should be interpreted together with target size, range, field of view, background condition, illumination condition, frame rate, confidence threshold and project-specific dataset. Avoid quoting stand-alone AI accuracy values without test context.

7 Video, Data and Control Interfaces

Category	Parameter	Specification
Video	**Encoded video output**	H.265 compressed video through 100 Mbps Ethernet; UDP and RTSP protocols supported.
	Selectable resolution	1080p default or 960 × 540 center-region output.
Control	**Communication method**	Serial communication.
External Interface	**SPI interface**	HC-1.0-8PLT. Two differential pairs transmit synchronous clock and synchronous data. Connector: J4 / SPI interface.
	RS422 serial interface	HC-1.0-8PLT. Connector: J4 / RK3588 communication.
	100 Mbps Ethernet	HC-1D0-4PLT, 4-pin. Connector: J2.
	Power input	HX20007-4A, 4-pin. Connector: J5.
Upgrade	**FPGA / processor / AI model upgrade**	FPGA through serial interface J3; RK3588 program and algorithm model through Ethernet interface J2.

8 Performance, Electrical and Environmental Characteristics

Category	Parameter	Specification
Performance	**Output frame rate**	50 Hz
	Start-up time	≤15 s
Electrical	**Power supply**	DC 5.5 V
	Power consumption	≤10 W @ 25°C. Source note: full operating temperature range, tracking excluded.
Physical	**Weight (excluding lenses)**	≤140 g total. Infrared part <50 g; visible-light part <20 g; processing board + interface board <70 g; lenses excluded.
	Thermal component envelope	35 mm × 35 mm × 23 mm
	Visible-light component envelope	27 mm × 38 mm × 5.73 mm
	Processing-board assembly envelope	70 mm × 60 mm × 16.6 mm
Temperature	**Operating temperature**	-40°C to +70°C
	Storage temperature	-45°C to +80°C
Environmental	**Altitude**	20,000 m
Mechanical environment	**Overload resistance**	Axial overload ≥80 g, 300 ms, half-sine wave; radial overload ≥10 g.
EMC	**Electromagnetic interference resistance**	Meets CE102, CS101, CS112, CS114, CS115, CS116, RE102 and RS103 requirements, subject to system-level verification.

9 Product Appearance and Mechanical Reference

The following images are provided as mechanical and integration references. Final mounting, connector orientation, thermal design and optical-axis alignment should be verified against formal project drawings and interface-control documentation.



Figure 1. Demo sample front view



Figure 2. Demo sample rear / interface view



Figure 3. Demo sample side / heat-dissipation view

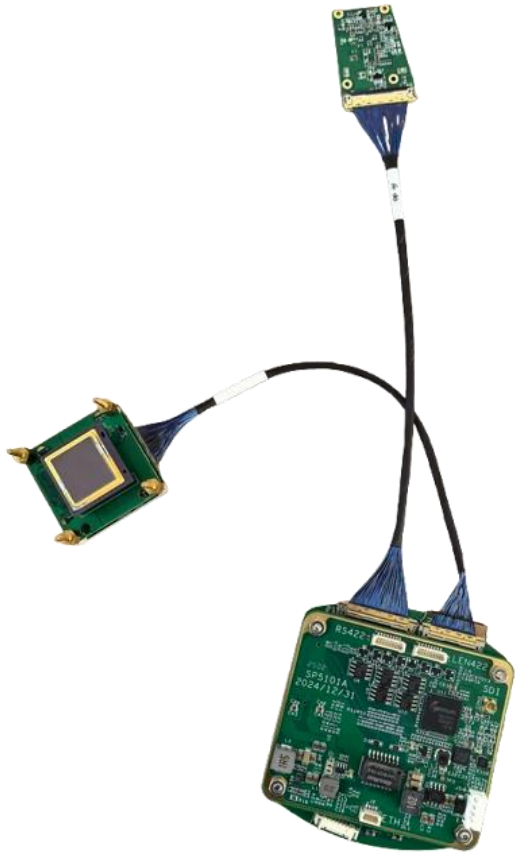


Figure 4. Circuit-board assembly reference

10 Mechanical Interface and Dimensions

Mechanical drawings below summarize the main dimensions for the infrared component, visible-light component and processing-board/interface-board assembly. Dimension tolerance and mounting-hole definitions should be confirmed before mechanical design release.

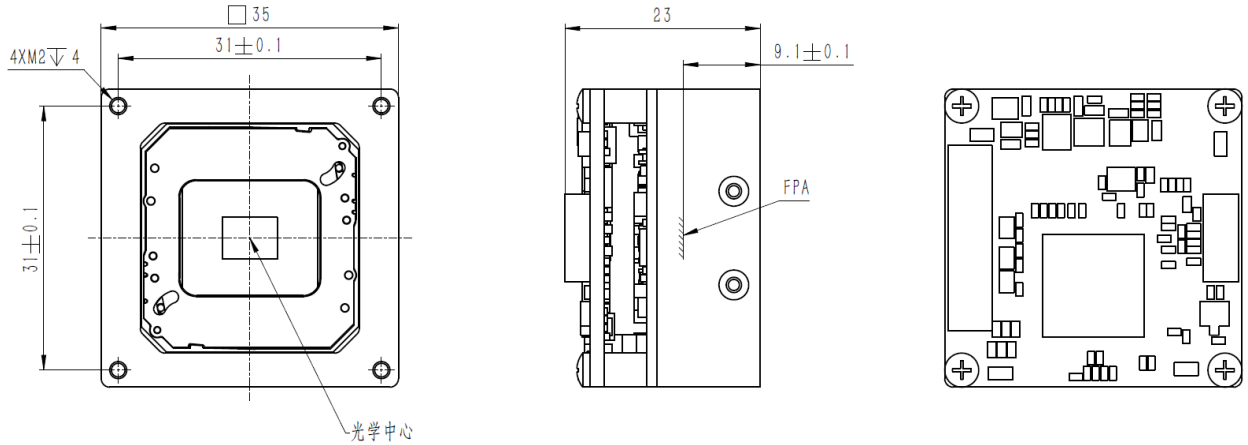


Figure 5. Infrared component mechanical outline and interface dimensions

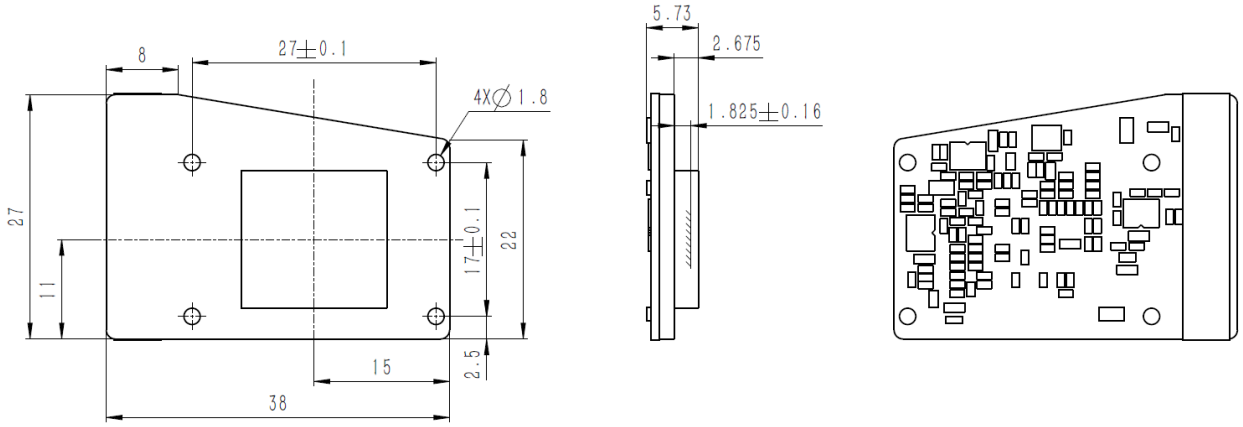


Figure 6. Visible-light component mechanical outline and interface dimensions

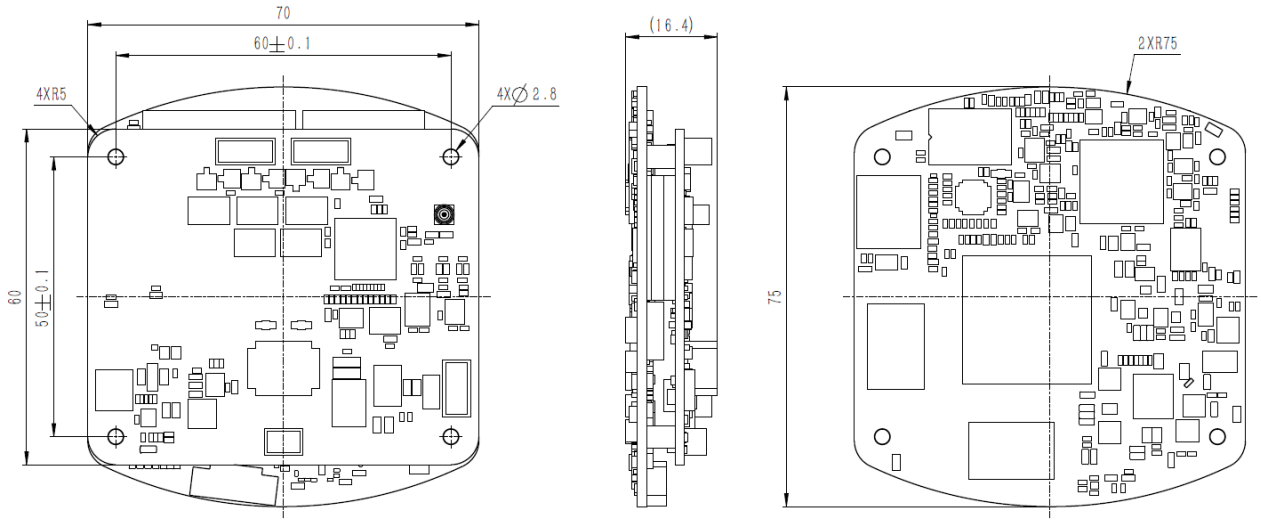


Figure 7. Processing board + interface board mechanical outline and interface dimensions

11 External Connector Definitions

11.1 J2 External Interface — Ethernet

Pin	Signal Name	Function Description
1	ETH1_RX+	Ethernet 1 receive +
2	ETH1_RX-	Ethernet 1 receive -
3	ETH1_TX+	Ethernet 1 transmit +
4	ETH1_TX-	Ethernet 1 transmit -

Connector model / location: HC-1D0-4PLT, power-interface board J2 to system.

11.2 J4 External Interface — SPI and RS422

Pin	Signal Name	Function Description
1	SPI_CLK+	SPI transmit clock +
2	SPI_CLK-	SPI transmit clock -
3	SPI_DOUT+	SPI transmit data +
4	SPI_DOUT-	SPI transmit data -
5	RS422_TX1+	Serial transmit 1 +
6	RS422_TX1-	Serial transmit 1 -
7	RS422_RX1+	Serial receive 1 +
8	RS422_RX1-	Serial receive 1 -

Connector model / location: HC-1.0-8PLT, power-interface board J4 to system.

11.3 J5 External Interface — Power Input

Pin	Signal Name	Function Description
1	5V_IN	5.5 V power input
2	5V_IN	5.5 V power input
3	PGND	Power ground
4	PGND	Power ground

Connector model / location: HX20007-4A, power-interface board J5 to system.

12 Standard Packing List

No.	Item
1	Integrated dual-spectrum module assembly
2	Certificate of conformity
3	Factory inspection report

13 Delivery and Integration Notes

- Final configuration should be confirmed according to selected lens, connector orientation, mechanical mounting and platform integration requirements.
- Joint verification is recommended for power stability, Ethernet/RTSP video streaming, RS422 communication, SPI timing, grounding/shielding, heat dissipation and optical-axis alignment.
- Video-storage, log-storage and data-storage formats can be customized according to project requirements.
- EMC performance should be verified together with the host system and installation environment.
- Unless otherwise stated, all performance values should be interpreted under the test conditions and configuration defined in the corresponding engineering documentation.