PR-GE 640×512 SWIR Camera
Product Manual

Document Version: V1.5 (August 22, 2024)

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Change History

Version	Release Date	Revision Content
V1.0	April 2022	Create
V1.1	July 2022	Modified ROI setting description.
V1.2	December 2022	Modified the quantum efficiency curve.
V1.3	July 2023	Modified the window opening command.
V1.4	July 2023	Modified instruction set description.
V1.5	August 22, 2024	1. Modified some of the descriptions. 2. Updated 2D drawings and technical illustrations.

1. Product Introduction

1.1. Product Description

PR-GE uncooled infrared thermal core is a compact and universal short-wave infrared imaging module. The movement image sensor adopts high-sensitivity InGaAs focal plane detector, built-in adaptive image processing algorithm, supports high frame rate operation and ROI window opening, supports USB3.0 or CameraLink data interface output, is equipped with CVBS analog interface, and supports active temperature control. The product has the main characteristics of low noise, low power consumption and multifunction, and can be widely used in the fields of visual enhancement, machine vision, photovoltaic detection, plastic sorting, laser detection, etc.

Figure 1-1 PR-GE Schematic Diagram

1.2. Product Features

- Resolution: 640*512
- Provide friendly SDK, support secondary development and product customization.
- Low noise, low power consumption, multi-function.

1.3. Application Scenarios

- Photovoltaic Industry (PV Cell Production, Module Testing, Wafer Sorting)
- Agricultural Byproduct Sorting
- Industrial Sorting - Spectral Imaging
- Laser Detection Analysis
- Fire Safety
- Military Defense

2. Product Selection

2.1. Recommended Product Models

Table 2-1 Recommended Model List of PR-GE Modules

No.	Model	Features
1	PR-GEUN	USB Interface
2	PR-GECN	CameraLink Interface

NOTE: If necessary, you can contact our company to customize the selection combination that is not recommended in the list.

2.2. Recommended Lens

Table 2-2 PR-GE Lens Parameters

Focal Length	F-number	Focusing Mode	FOV(D*V*H)	Weight	PN
50 mm	F1.4-16	Fixed focus	18.18*10.97*14.48	245 g	SW50C
35mm	F1.4-16	Fixed focus	25.75*15.62*20.57	135g	SW35C
25 mm	F1.8-16	Fixed focus	35.49*21.74*28.5	146 g	SW25C
35mm	F1.2-16	Fixed focus	25.75×15.62×20.57	600g	VS35CF01

3. Specifications

Table 3-1 Technical Specifications

Technical Parameters	PR-GE
	Overview
Detector Type	InGaAs Focal Plane Detector
Spectral Band	0.93um~1.7um
Quantum Efficiency	>70% (1.0μm~1.6μm)
Optical Fill Factor	100%
Pixel Pitch	15um
Active Pixels	640×512
Pixel Operability	≥ 99.8%
Integration Type	Snapshot Global Shutter
Max Output Frame Rate	150fps (USB interface)/ 300fps(Cameralink)
Output Data Depth	10bit / 12bit / 14bit(USB)/12bit(Cameralink)
Minimum Integral Time	10us
Read Noise (Typical)	30e@Gain0
Dynamic Range	50dB(Gain0), 62dB(Gain1), 72dB(Gain2)
Average Pixel Dark Current	⩽ 80ke/s@20℃
	Electricity
Power Supply	7 to 24V, typically 12V
Typical Power Consumption @25℃	3.5W (max ≤ 5W)
Communication Interface	UART232
Video Output Format	PAL
Lens Mount	C-Mount
	Physical Characteristics of Module (lens and flange not included)
Camera Core Weight	245±10g
Dimension	53mm×53mm×54.3mm
	Environment
Operating Temperature	-20℃～+55℃
Storage Temperature	-40℃～+70℃
Shock	Final peak sawtooth wave, 40g, 11msec, 3 axes and 6 directions, 3

The spectral response curve is shown in the Figure 3-1.

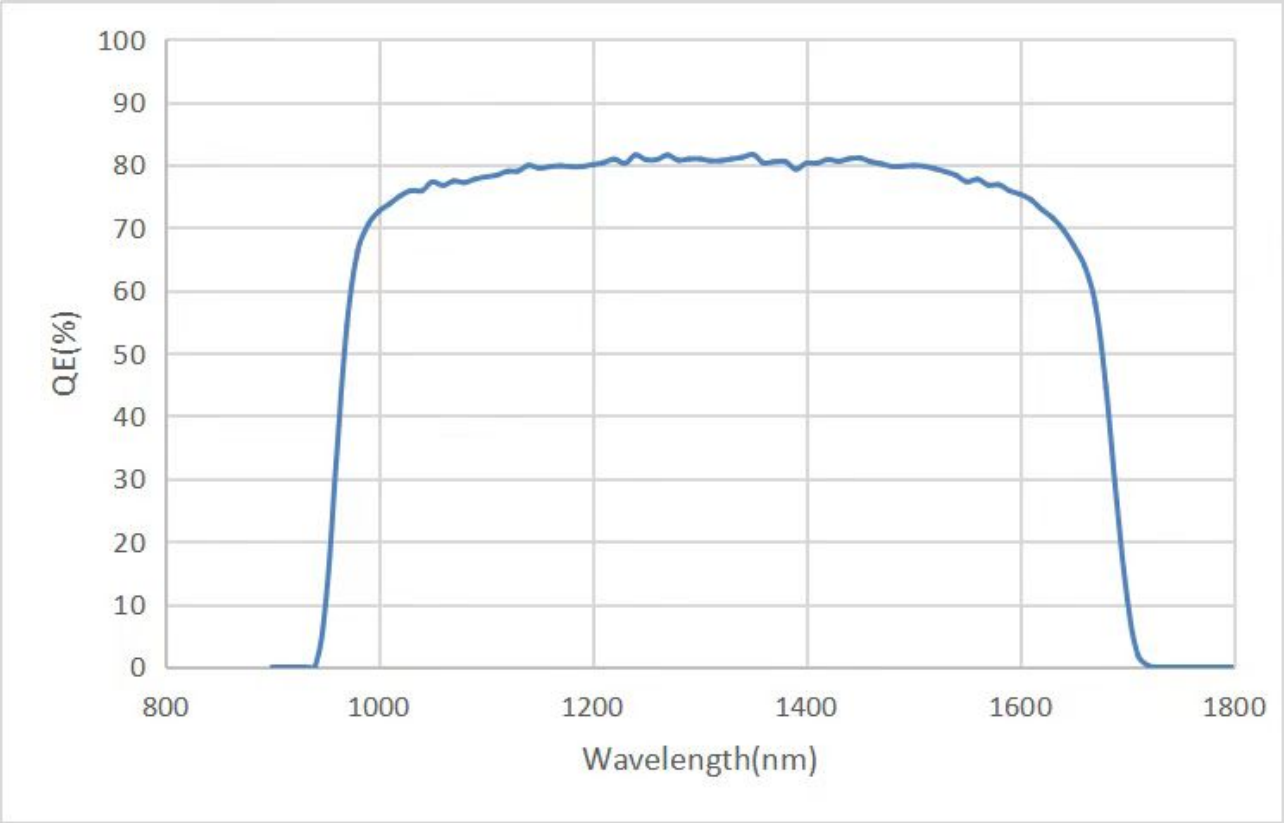


Figure 3-1 Spectral Response Curve

4. Interface Introduction

4.1. Electrical Interface Definition

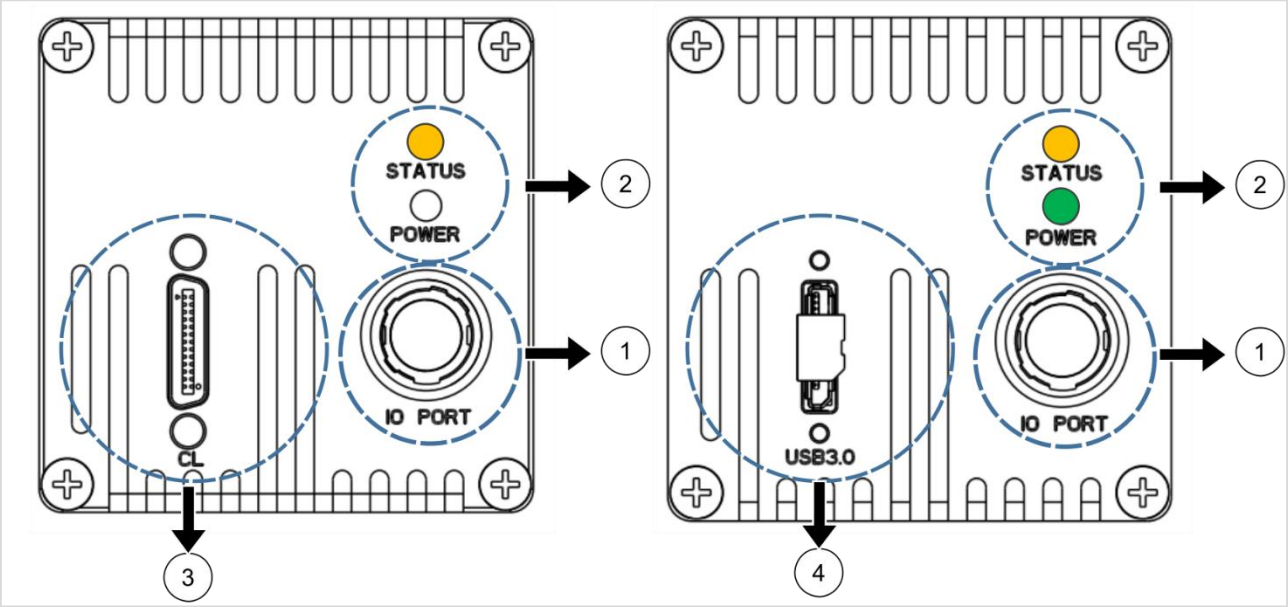


Figure 4-1 PR-GE Interface

① IO PORT

② STATUS&POWER LED

③ Camera Link (SDR)

④ MICRO USB 3.0 TYPE B

4.2. IO PORT Interface

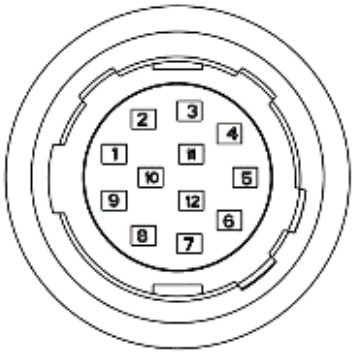


Figure 4-2 IO PORT Interface: HR10A-10R-12SB Connector

The thermal core adopts HR10A-10R-12SB connector, and the matching connector is HR10A-10P-12P. See Table 4-1 for thermal core interface definitions.

Table 4-1 IO PORT Interface Pin Definition

Pin No.	Definition	Revision Content	IO Type
1	GND	GND, connect to Pin10	GROUND
2	RX232_TX	Connect to external TX of RS232	Digital input, DI
3	RX232_RX	Connect to external RX of RS232	Digital output, DO
4	GPIO1	Reserved GPIO1, contains a 5.1K pull down resistor within the core.	Digital IO level, 3.3V
5	GPIO2	Reserved GPIO2, contains a 5.1K pull down resistor within the core.	Digital IO level, 3.3V
6	PAL	Analog video output	Analog Output
7	GND_PAL	Analog Video Ground	GROUND
8	TRG_IN	Sync signal input pin; contains a 5.1K pull down resistor within the core.	Digital input, DI
9	TRG_OUT	Sync signal output pin	Digital output, DO
10	GND	GND, connect to pin1	GROUND
11	VDD	Supported voltage range: 7~24V, typical: 12V	Analog input, POWER
12	VDD		

NOTE: The hardware description here is only for product selection reference. Please contact our technicians for detailed hardware development information during specific development.

4.3. STATUS&POWER Status Display LED

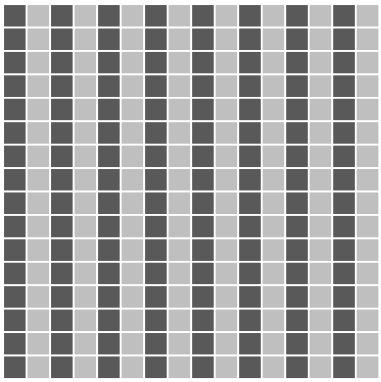
The operating status of the core is displayed by two LEDs, and the corresponding display statuses are described in Table 4-2.

Table 4-2 LED Status Indication

Status	ON	Flashing	Slow Flashing	OFF
STATUS (orange)	Stable temperature control	Is controlling the temperature	Temperature control exceeds the threshold	Stop temperature control
POWER (green)	Normal mode	Is loading data	Is loading data	Power off

4.4. Camera Link (SDR) Interface

Table 4-3 Cameralink Interface Description

Tap Mode	Output	Data Byte Distribution
	10bit	PortA[7-0] = DataA[7-0] PortB[1-0] = DataA[9-8] PortB[5-4] = DataB[9-8] PortC[7-0] = DataB[7-0]
	12bit	PortA[7-0] = DataA[7-0] PortB[3-0] = DataA[11-8] PortB[7-4] = DataB[11-8] PortC[7-0] = DataB[7-0]

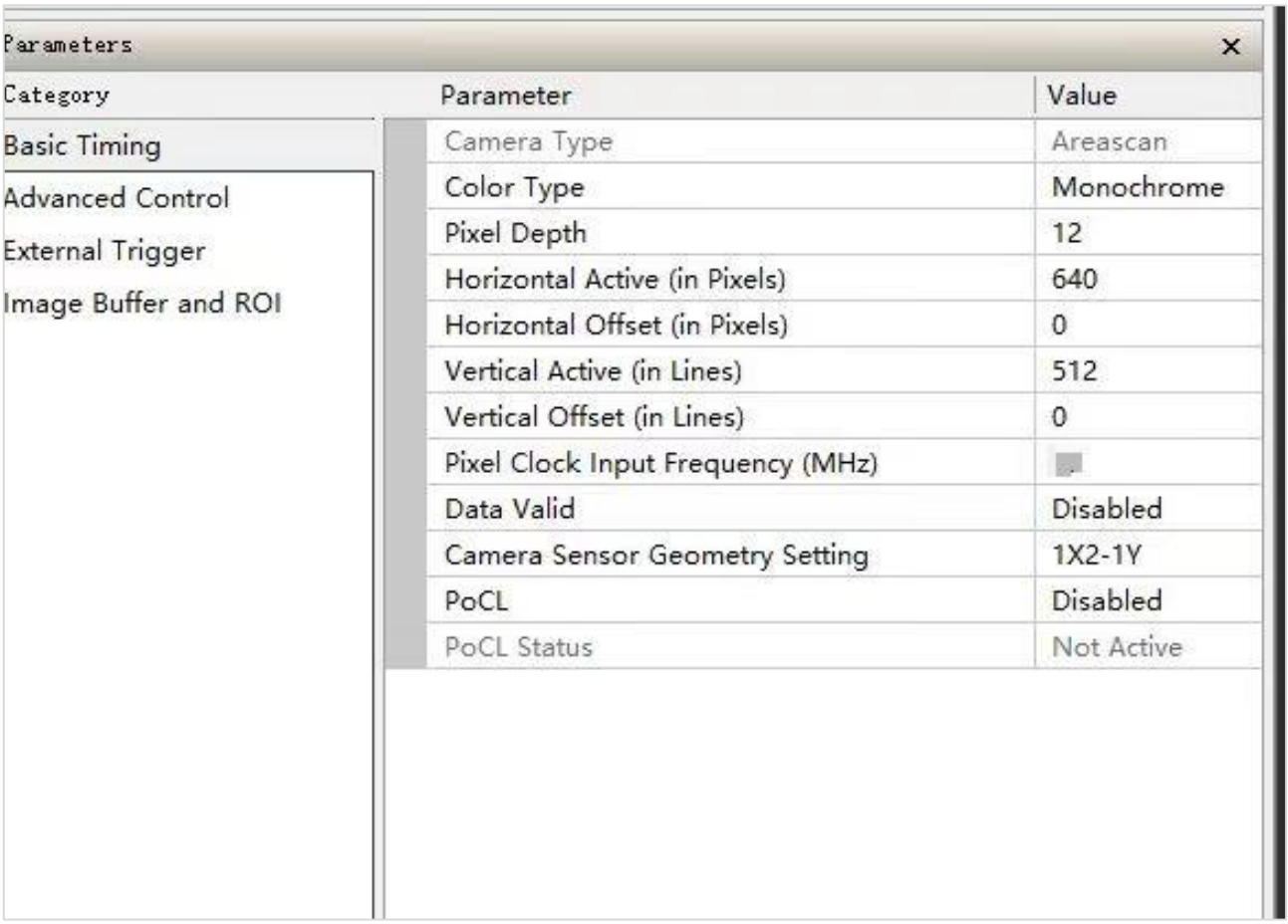


Figure 4-3 Dalsa Capture Card Configuration Reference

5. Functions

5.1. ROI Window Mode

In ROI window output mode, the working frame rate can be further improved to meet the application with special requirements.

“offset_h , offset_v , row , col” are the four configuration parameters of ROI, the configuration is shown in Table 5-1.

Table 5-1 ROI Configuration Guide

Parameter	Scope	Description
offset_h	0~624	Must be a multiple of 8.
offset_v	0~508	Must be a multiple of 4.
row	4~512	row+ offset_v≤512
col	2~80	Col *8 + offset_h* ≤ *640; the effective array width is Col* 8

5.2. Integral Time and Frame Rate Adjustment

PR-GE adopts the integration mode of integrating first and then reading out (ITR), and the frame period time is expressed by the following formula.

$T_{frame} = T_{int} + T_{read} + T_{wait}$ (1)

T_{int} is the integration time, T_{read} is the reading time, and T_{wait} is the reading waiting time. T_{read} is calculated by the following formula:

T_{read} = ((row *col/8)+32*(row -1))*100ns (2)

At a fixed working frame rate, the maximum integration time is calculated by the following formula:

$T_{int\_max} = T_{frame} - T_{read} - T_{wait}$ (3)

The read waiting time of T_{wait} is 9.3μs.

The above applies only to USB interface core.

5.3. Operating Modes

The core provides five imaging modes, including automatic exposure, manual exposure, debugging, external synchronization, and low illumination imaging. The mode descriptions and configurations are shown in Table 5-2 andTable 5-3 below.

Table 5-2 Explanation of Different Operating Modes

Modes	Description
Automatic Exposure	According to the scene and ambient temperature, the integration time, gain, temperature control and corresponding algorithm are adaptively selected.
Manual Exposure	Adjust the control temperature adaptively according to the ambient

Modes	Description
	temperature, and manually adjust the integration time and gain.
Debugging	Manually control temperature, integration time and gain.
External Synchronization	According to the ambient temperature, the control temperature is adjusted adaptively, the gain is adjusted manually, and the integration time is controlled externally.
Low Illumination Imaging	Low illumination will use a fixed gain and integration time and a specific low illumination algorithm.

Table 5-3 Configuration of Different Operating Modes

Modes	Temperature Control	Integration Time Gain	NUC	Low Illumination Algorithm
Automatic Exposure	Auto	Auto	√	√
Manual Exposure	Auto	Manual	√	×
Debugging	Manual	Manual	×	×
External Synchronization	Auto	Manual	√	×
Low Illumination Imaging	Auto	Auto	√	√

5.4. Dead Pixel Correction

PR-GE provides on-site dead pixel correction, which can compensate and correct dead pixels according to the information of 5×5 neighboring pixels around the target pixel and supports updating the dead pixel table through instructions.

5.5. Temperature Control

The core has built-in TEC temperature control module. In debugging mode, the temperature control supports manual setting; In other modes, the temperature can be controlled adaptively according to the ambient temperature.

In the debugging mode, it is suggested that the refrigeration temperature difference (the difference between the ambient temperature and the set temperature) should not exceed 20℃, otherwise, the working power consumption of the core may increase sharply.

Table 5-4 Auto Temperature Control Logic

Core Board Temperature	Detector Temperature Control Target Temperature
＜0°	-20°
＜20°	10°
＜45°	20°
Other Temperature	55°

6. Command and Control Interface

6.1. External Synchronization Control

To adapt to the application of collaborative system, the thermal core supports external synchronization function. The external synchronization signal includes TRG_IN and TRG_OUT. TRG_IN is the external synchronization signal input interface, and TRG_OUT is the integrated signal output interface.

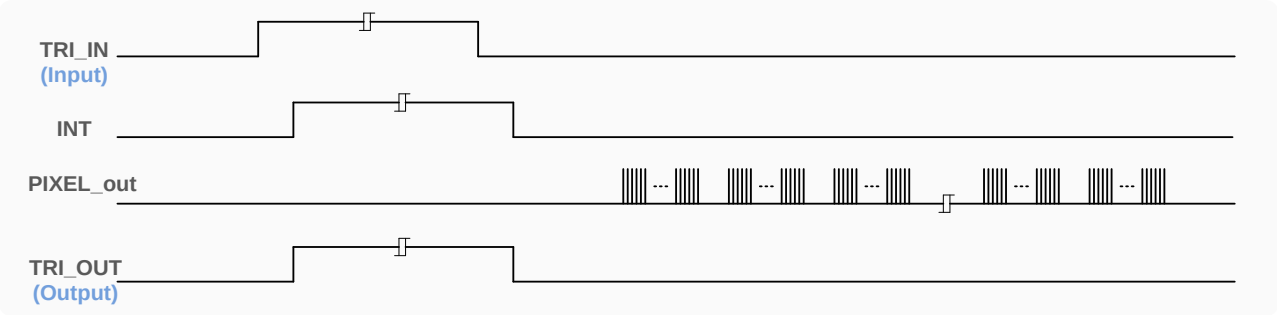


Figure 6-1 External Synchronization Sequence

The high-level time of TRI_IN determines the integration time, and the delay between TRI_OUT and TRI_IN is 400 ~ 500ns. A guaranteed frame readout time is required between two adjacent TRI_IN signals (please refer to 5.2Integral Time and Frame Rate Adjustment for calculation).

NOTE: The external synchronization needs to enter the external synchronization mode first.

6.2. Serial Port Command Set

The core is controlled via an RS232 serial port. The command format is shown in Table 6-1.

Table 6-1 Serial Port Command Set

Instruction Description		Module Receives Commands	Remark
Operating Mode Switch	Receive	CC01 A5XX YY	0x00: automatic exposure 0x01: manual exposure 0x02: debugging mode 0x03: external synchronization mode 0x04: low illumination imaging
	Return	5502 A500 A7	
Read Operating Mode	Receive	CC01 B000 B1	
	Return	5502 B0XX YY	
Adjust Integral Time 1	Receive	CC01 A0XX YY	Set the integration time in ms. Threshold: 1~255
	Return	5502 A000 A2	

Instruction Description		Module Receives Commands	Remark
Adjust Integral Time 2	Receive	CC03 A200 XXXX XXXX YY	Set the integration time in us. Threshold: 100~4294967296
	Return	5502 A200 A0	
Read Integral Time	Receive	CC01 B100 B0	Integration time. Unit is μs
	Return	5505 B1XX XXXX XXYY	
Set Frame Rate	Receive	CC02 A600 XXXX YY	Set the frame rate and calculate the range by referring to frame time.
	Return	5502 A600 A4	
Read Frame Rate	Receive	CC01 B200 B3	
	Return	5505 B2XX XXXX XXYY	
Gain Adjustment	Receive	CC01 21XX YY	Gain (0: low; 1: medium; 2: high)
	Return	5502 2100 23	
Read the Current Gain	Receive	CC01 B300 B2	
	Return	5505 B3XX XXXX XXYY	
Adjust Temperature Control	Receive	CC02 A1XX 00ZZ YY	XX: 0 is not for temperature control; 1 is for temperature control ZZ: temperature control [-20-50] Controllable in debug mode only
	Return	5502 A100 A3	
Read Temperature	Receive	CC01 B400 B5	XX: current temperature (I8)
	Return	5502 B4XX YY	
Set ROI	Receive	CC05 A300 XXXX ZZZZ WWWW VVVV YY	ZZZZ:row_length[4:512] WWWW: col_start [0,79],needs to be a multiple of 8. VVVV:row_start[0,508] XXXX:col_length[8,640]
	Return	5502 A300 A1	
Read ROI	Receive	CC01 B500 B4	ZZZZ:row_length[4:512]

Instruction Description		Module Receives Commands	Remark
	Return	5509 B5WW WWVV VVXX XXZZ ZZYY	WWWW:col_start[0,624] , VVVV:row_start[0,508] XXXX:col_length[8,640]
Save Settings	Receive	CC01 1700 16	
	Return	5502 1700 15	
Restore Factory Settings	Receive	CC011600 17	
	Return	5502 1600 14	
Uniform Correction	Receive	CC01 1400 15	
	Return	5502 1400 16	
Read Model PN	Receive	CC015200 53	Assic output display
	Return	5511 52XX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXYY	
Read Model SN	Receive	CC016C00 6D	
	Return	5511 6CXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXYY	
Dead Pixel Correction	Receive	CC01 A8XX YY	00 cancel marking the current pixel as a dead pixel. 01 mark the current pixel as a dead pixel
	Return	5502 A800 AA	
Cursor Callout	Receive	CC01 AAXX YY	00: OFF 01: ON
	Return	5502 AA00 A8	
Cursor Movement	Receive	CC02 A700 XXWW YY	XX: direction 0: down, 1: up, 2: left, 3: right WW: step
	Return	5502 A700 A5	
End Calibration	Receive	CC01 A900 A8	Save the dead pixel table and close the cursor.
	Return	5502 A900 AB	
Read Firmware Version	Receive	CC03 0E00 0000 00FB F6	

Instruction Description		Module Receives Commands	Remark
	Return	5506 0EFB XXXX XXXX YY	XXXX XXXX:Version No. (0007ADD4:503252)

NOTE: The hardware description here is only for product selection reference. Please contact our technicians for detailed hardware development information during specific development.

Table 6-2 Serial Port Configuration

Baud Rate	Data Bits	Parity Bits	Stop Bits	Flow Control
115200	8Bit	N/A	1Bit	N/A

All commands sent from the computer to the core (reception) and responses returned from the core to the computer (return) undergo XOR checksum verification, with the last two digits representing the checksum value.

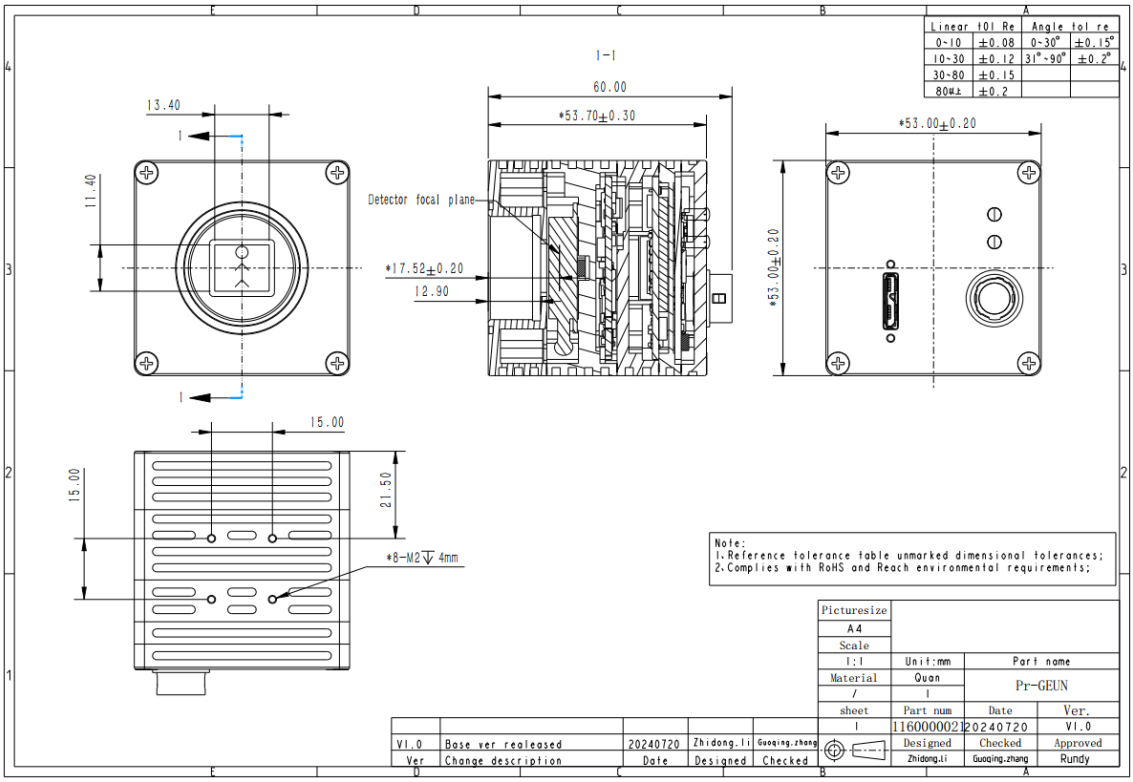
The data after the instruction header is bitwise XOR every 8bit.

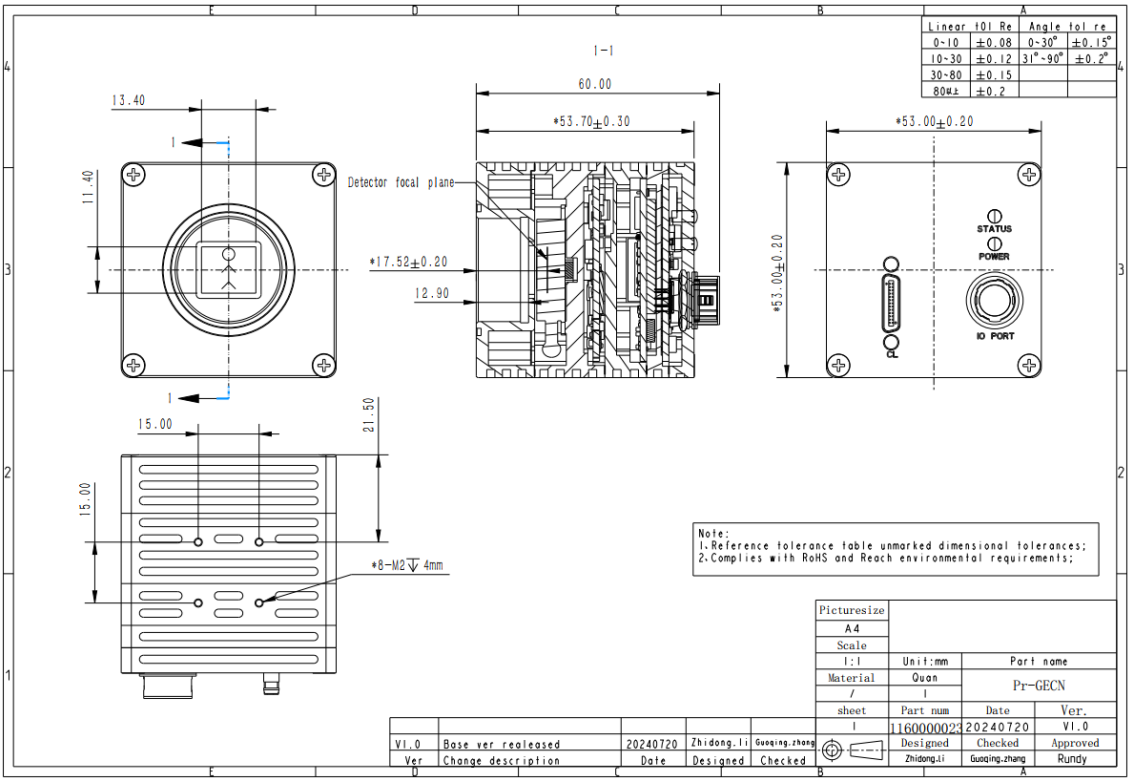
e.g., save configurations: CC01 1700 16, 16=01^17^00

YY in the remarks is the check bit, and other XX, WW, ZZ and VV are all parameters, with 2 letters and 1byte. Different letters indicate different parameters.

7. Structure and Dimensions

Note: Only drawings of some lens models are shown here. For detailed 2D and 3D drawings, please contact our technicians.





8. Precautions

To protect you and others from injury or to protect your equipment from damage, please read all the information below before using the equipment.

1. The ideal operating environment temperature is -20° C~50° C.
2. Do not touch devices and cables with wet hands.
3. Do not bend or damage the cables.
4. Do not scrub your device with diluent.
5. Do not unplug other cables before cutting off the power supply.
6. Do not connect the attached cables in the wrong way to avoid damaging the device.
7. Take measures to prevent static electricity.
8. Do not dismantle the device. If there is any fault, please contact us to have it repaired by professionals.

9. Warranty

Dear User,

Thank you for choosing our products, we will, as always, to provide you with satisfactory service!

1. This product in normal use under the circumstances of failure the company will provide 1-year warranty, life-long maintenance services.
2. Warranty scope:

   Failure under normal circumstances is generally defined as natural damage caused by the user of the product during normal use without human intent or due to negligence factors.
3. The following cases are not in our warranty scope:
   1) Any damage caused by modification or repair not authorized and permitted by the company.
   2) Failure or damage caused by the use of third-party product software, service behavior.
   3) Accidental factors or human behavior caused by product damage. Such as into the liquid, drop damage, input the wrong voltage, excessive extrusion, deformation of the motherboard and so on. Appearance of obvious hard object damage, cracks, broken foot, serious deformation, power cord broken, broken wire, bare core and other phenomena.
   4) Product data loss or damage.
   5) Cannot effectively present the product warranty certificate. (Product nameplates, SN barcodes, and tamper-evident labels are torn off or damaged, blurred and unrecognizable.)
   6) Not in accordance with the instructions for installation, use, maintenance, storage of the product failure or damage.
   7) It has exceeded the warranty period.
   8) Failure or damage due to uncontrollable factors (e.g. fire, earthquake, flood, etc.).

10. Supports and Services

10.1. Technical Support

User extension accessories can be tailored to users' different application requirements.

10.2. After-Sales Services

We provide excellent after-sales services such as device maintenance and repair for its self-developed PR-GE series SWIR accessories. One year warranty service is available, please contact us if you have any questions.