NS-615A-GE
SWIR Area Scan Camera
Product Manual

Document Version: V1.4 (October 16, 2024)

Contents

Change History

Changes between document issues are cumulative. The latest document issue contains all the changes in previous issues.

Version	Release Date	Description
V1.0	May 20, 2024	Created
V1.1	July 13, 2024	1. Modified product performance parameters. 2. Added interface descriptions. 3. Updated description of frame rate in multi-ROI mode.
V1.2	August 08, 2024	1. The encoder and frequency division/multiplication functions have been removed. 2. Fixed errors in the names of some function descriptions. 3. Added IO electrical descriptions.
V1.3	September 03, 2024	1. Updated the document style.
V1.4	October 16, 2024	1. Adjusted some language to enhance accuracy. 2. Added encoder and multiple product functions.

1. Product Introduction

1.1. Product Overview

NS-615A-GE SWIR area scan camera adopts high-resolution InGaAs detector. With built-in image correction and smart processing algorithm. Supports GigE imaging interface. Provide friendly SDK, support secondary development and product customization. Features low noise, digital output, and low power consumption. Suitable for broad application in semiconductor and sorting fields.

1.2. Product Features

- Focus on hyperspectral sorting.
- 640*512@15um InGaAs sensor.
- 180 Hz full resolution.
- GigE interface for easy industrial integration.
- Compact size: 46mm × 46mm × 61mm (dimensions based on the drawing), easy for integration.
- Supports 4900 Hz for 16 freelines from 512 lines.

1.3. Application Scenarios

- Plastic Sorting
- Food Sorting
- Semiconductor Detection
- Security Monitoring

2. Product Selection

2.1. Model Introduction

Table 2-1 NS Product Model Number Explanation

NS	6	15	A	GE
Model	Resolution	Pixel Pitch	Imaging Mode	Interface
NS	6: 640	15: 15um	A: Array	GE: GigE

2.2. Recommended Models

Table 2-2 List of Recommended Models for NS

No.	Model	Features
1	NS-615A-GE	Standard Model

NOTE 1. If necessary, you can contact our company to customize the selection combination that is not recommended in the list.

3. Specifications

Table 3-1 NS-615A Module Parameters

Technical Parameters	NS-615A
Sensor	InGaAs
Spectral Band	0.9μm~1.7μm
Quantum Efficiency	>70% (1.0μm~1.6μm)
Optical Fill Factor	100%
Pixel Pitch	15um
Active Pixels	640*512
Pixel Operability	≥ 99.8%
Maximum Frame Rate (Full Resolution)	180 Hz
Output Data Depth	14/12/10/8bit
Integration Type	Snapshot Global Shutter
Minimum Integral Time	100us
Dynamic Range (Typ.)	67dB(HG)
Optional Gain	3 Level
Average Pixel Dark Current	≤100ke/s@20°C
Power Supply	Typical 12V
Power Consumption	<2.5W (Tec Off)
Digital Video Interface	GigE
Lens Mount	C-Mount
Camera Core Weight	150±5g
Camera Core Size	46x46x61mm
Operating Case Temperature	-40℃～+60℃
Storage Temperature	-40°C～+85°C
Temperature Control	TEC1

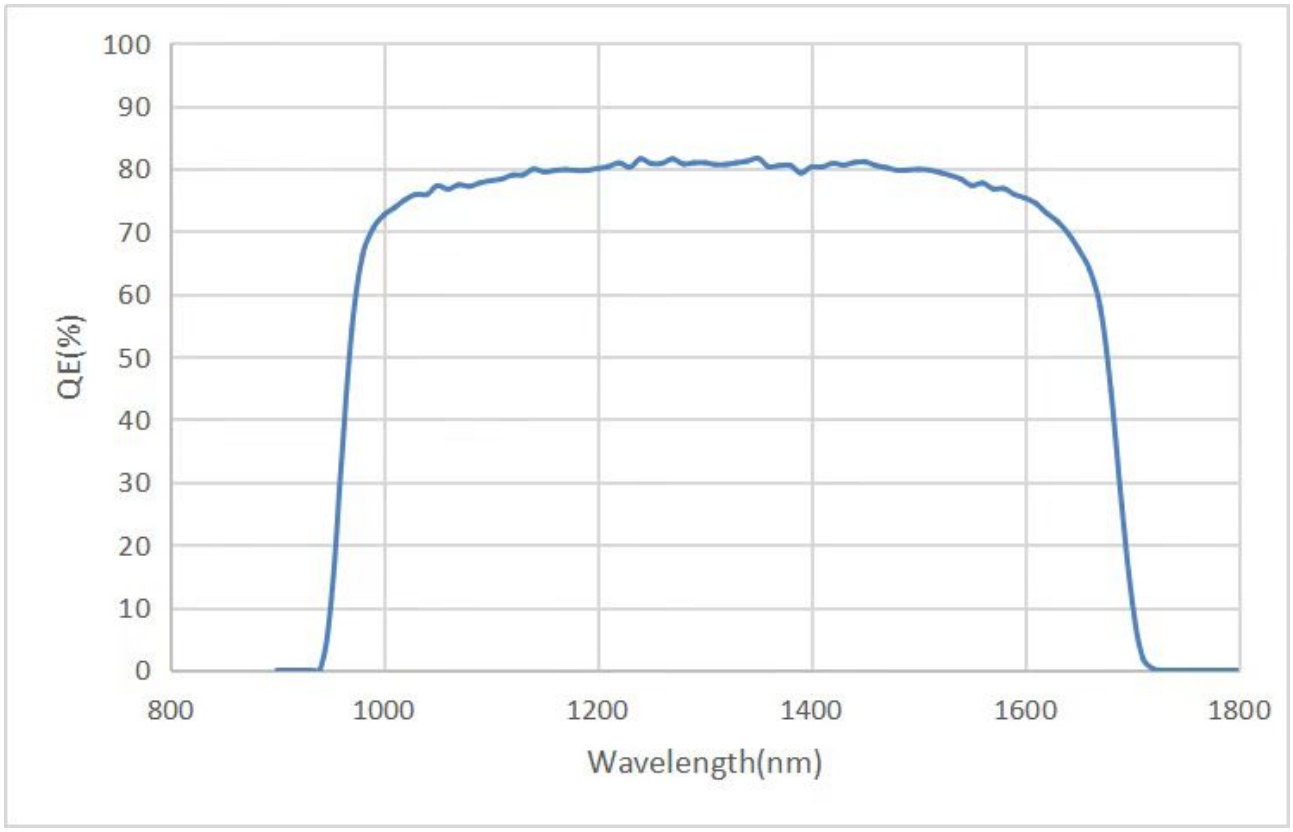

Figure 3-1 Spectral Response Curve

4. Interface Introduction

4.1. Electrical Interface Definition

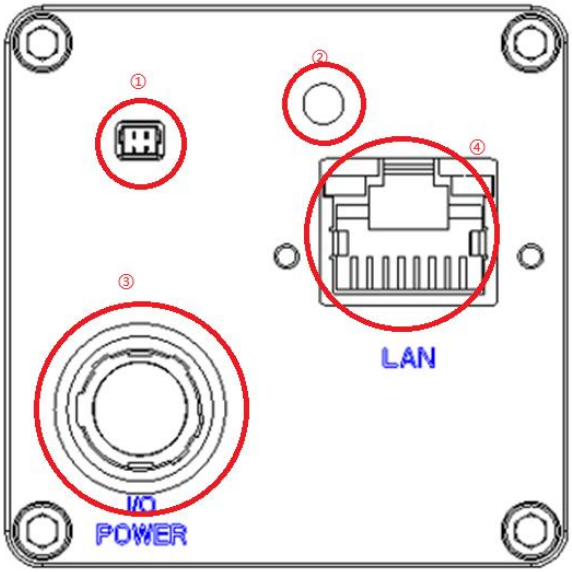

Figure 4-1 NS-615A-GE Interface Diagram

Table 4-1 NS-615A-GE Interface Description

No.	Name
1	Fan Power
2	Power Indicator
3	I/O Power
4	RJ45

4.2. IO Interface

For the definition of the 12pin IO PORT interface, see the Table 4-2.

Table 4-2 IO PORT Interface Pin Definition

Pin No.	Definition	Description	IO Type
1	GND	GND, pin1 and pin11 are connected together.	GROUND
2	Line1+	Differential/single-ended input (default differential mode)	Digital input, DI
3	Line1-	Input voltage range supported: 5V to 25V; supports	
4	Line2+	NPN/PNP/no pull switching; threshold voltage: 1.6V/4.5V	

Pin No.	Definition	Description	IO Type
5	Line2-		
6	Line3+	Differential input/output Input voltage range supported: 5V to 25V; output voltage: 3V	Digital input/output, I/O
7	Line3-		Digital input, DI
8	Line4+	Optocoupler input; Low-level threshold: 0-1V; High-level threshold: 5-24V; Maximum frequency: 1k Hz	Digital input, DI
9	Line4-		
10	Line5	Single-ended output, threshold voltage 5V	Digital output, DO
11	GND	GND, pin1 and pin11 are connected together.	GROUND
12	VDD	Supported voltage range: 10~24V, typical: 12V	Analog input, POWER

NOTE 1. It is recommended to ground unused signal pins and not connect them to power to prevent damage to the camera.

5. Installation

Read and follow the safety precautions in this manual before installing, operating, or maintaining the product.

5.1. Camera and Accessories Introduction

For proper operation of the camera, please have the camera and accessories in the Table 5-1 available before installation.

Table 5-1 List of Camera and Accessories

No.	Name	Qty.	Description	Optional/Standard
1	Camera	1	The NS-615A-GE camera mentioned in this manual.	Standard
2	Fan Accessories	1	The heat sink fan for the camera mentioned in this manual.	Standard
3	Lens	1	Select the lens with the suitable mount according to your requirements.	Optional, to be purchased separately
4	Adapter Ring	1	If the lens used has a different mount to the camera lens, configure a suitable adapter ring.	Optional, to be purchased separately
5	Power I/O Cable	1	12-pin cable or extension cable.	Optional, to be purchased separately
6	Power adapter or switching power supply.	1	Select a power adapter or switching power supply to suit your requirements, refer to the relevant specifications.	Optional, to be purchased separately
7	Network Cable	1	Select the suitable length of CAT5e or CAT6e cable to meet your requirements.	Optional, to be purchased separately

5.2. Camera Installation

- Fasten the camera to the mounting location, select the suitable adapter ring and lens to mount to the camera.
- Connect the camera to the tooling cable.
- Connect the serial port of the tooling cable to the power supply, and connect it to the suitable power adapter flowing the correct connection steps.

6. Functions

6.1. Device Control

6.1.1. Device Control Module Parameters

Users can view device information and control the detector temperature.

Table 6-1 Device Control - Parameter Explanation

Parameter	Description
DeviceType	The type of the device
DeviceScanType	The scan type of the sensor
DeviceVendorName	Device supplier
DeviceModelName	Device model
DeviceManufactureInfo	Device manufacture information
DeviceVersion	Device version
DeviceSerialNumber	Device serial number
DeviceUserID	User-defined device name
DeviceUptime(s)	Device running time, the unit is s
DeviceTemperatureSelector	Choose to view the temperature of the component
DeviceTemperature	The actual temperature value of the component
SensorTemperatureControl Mode	Temperature control mode for the sensor
Semi-AutoTemperature	Control temperature to specified points
ManualTemperature	Temperature control to any point within the range
FindMe	Click **Execute** to make the camera indicator light flash once.

6.1.2. Temperature Control Introduction

The detector integrates a TEC module to control temperature, but the temperature difference between the detector and the ambient environment should not exceed 30°C. Detector dark current decreases with lower temperatures.

Table 6-2 Temperature Control Descrdescription

Temperature Control Mode	Description
Auto	The camera adapts its temperature control point based on ambient

Temperature Control Mode	Description
	temperature. (-20,10,25,55)
Semi-Auto	Manually select pre-set temperature points. (-20,10,25,55)
Manual	Manually select any temperature point without built-in NUC data. Manual flat-field correction required.
OFF	No temperature control.

6.2. Image Format Control

6.2.1. Image Format Control Module Parameters

Table 6-3 Image Format Control - Parameter Explanation

Parameter	Description
HighSpeedMode	High speed mode enable
MulLineROIEnable	Enable multiple ROI configuration
ROINumber	Number of ROIs (1-16) x
LineAmountofSingleROI	Number of Lines Supported per ROI (1-4) yl
Region1StratLine	Start line y1 for the 1st ROI
Region2StratLine	Start line y2 for the 2nd ROI
Region3StratLine	Start line y3 for the 3rd ROI
Region4StratLine	Start line y4 for the 4th ROI
Region5StratLine	Start line y5 for the 5th ROI
Region6StratLine	Start line y6 for the 6th ROI
Region7StratLine	Start line y7 for the 7th ROI
Region8StratLine	Start line y8 for the 8th ROI
Region9StratLine	Start line y9 for the 9th ROI
Region10StratLine	Start line y10 for the 10th ROI
Region11StratLine	Start line y11 for the 11th ROI
Region12StratLine	Start line y12 for the 12th ROI
Region13StratLine	Start line y13 for the 13th ROI

Parameter	Description
Region14StratLine	Start line y14 for the 14th ROI
Region15StratLine	Start line y15 for the 15th ROI
Region16StratLine	Start line y16 for the 16th ROI
WidthMax	Maximum lateral resolution of the detector
HeightMax	Maximum longitudinal resolution of the detector
Width	Output image width
Height	Output image height
PixelFormat	Image Output Formats
PixelSize	Bits per pixel for different image formats
TestPattern	Standard test pattern or image
binning_en	Binning enable
binning_type	Binning type
binning_mode	Binning mode: average / sum

6.2.2. Multiple ROI Configuration Introduction

Designed for hyperspectral applications, the camera allows configuring ROIs at vertical intervals to enhance the frame rate. Supports up to 16 spectral ROIs, with 4 lines of pxels per ROI.

Table 6-4 Frame Rate Dependence on ROI Configuration

ROIs Number	Number of Lines per ROI	Output Resolution	Max Frame Rate
/	/	640*512	180 Hz
8	1	640*8	8519 Hz
8	2	640*16	4940 Hz
16	1	640*16	4940 Hz
16	2	640*32	2684 Hz
16	4	640*64	1402 Hz

6.2.3. High Speed Mode

Table 6-5 High Speed Mode vs. Normal Mode

Modes	Max Frame Rate	Optional Gain
High Speed Mode	180	MiddleGain, HighGain
Normal Mode	120	LowGain, MiddleGain, HighGain

6.2.4. Image Output Formats

Supports image output formats: mono8, mono10, mono10p, mono12, mono12p, and mono14. In high-speed mode, the bandwidth limitations of Gigabit Ethernet restrict achieving the maximum frame rate when using mono10, mono12, and mono14.

6.3. Acquisition Control

6.3.1. Acquisition Control Module Parameters

Table 6-6 Acquisition Control - Parameter Explanation

Parameter	Description
AcquisitionMode	SingleFrame: Streams one frame and then stops streaming MultiFrame: Streams the number of frames specified by AcquisitionBurstFrameCount and then stops streaming Continuous: Streams continuously until a stop streaming command is issued
AcquisitionStart	SDK starts streaming
AcquisitionStop	SDK stops streaming
AcquisitionBurstFrameCount	Number of images captured in MultiFrame mode
AcquisitionFrameRate	Output frame rate configuration
AcquisitionFrameRateControlEnable	Enable frame rate control, or output the maximum frame rate based on the current exposure time
ResultingFrameRate	Theoretical frame rate of the current camera
TriggerSelector	Trigger options: frame triggering is the only supported mode
TriggerMode	External trigger on/off
TriggerFramesCount	Number of images captured per trigger

Parameter	Description
TriggerSource	Trigger Source
TriggerActivation	Response to trigger
TriggerDelay	Trigger delay
ExposureTime	Exposure time

6.3.2. Frame Rate and Exposure Time Introduction

When AcquisitionFrameRateControlEnable is disabled, exposure time takes precedence, and the frame rate is the maximum frame rate for the current exposure time.

When AcquisitionFrameRateControlEnable is enabled, frame rate takes precedence, and the maximum exposure time is the inverse of the frame rate. The maximum achievable frame rate is determined by factors including resolution and image output format.

6.3.3. Trigger Modes Introduction

The trigger modes support only external and internal triggering. In external triggering mode, images are captured based on signals provided from an external source. The external trigger source consists of the following signals.

Table 6-7 Trigger Modes Explanation

Trigger Source	Working Principle
Software Trigger	The trigger signal is provided to the camera via API for acquisition.
Line1/line2/line3/line4 (Hardware IO)	The trigger signal is provided to the camera via hardware IO for acquisition.
EncoderModuleOut	The trigger signal is provided to the camera via encoder for acquisition.
FrequencyConverter	The trigger signal is provided to the camera via frequency converter for acquisition.

6.4. Analog Control

6.4.1. Analog Control Parameters

Table 6-8 Analog Control - Parameter Explanation

Parameter	Description
Gain	Analog gain, detector properties. Includes three different gain levels: LowGain, MiddleGain, and HighGain
BlackLevel	Black level
DigitalGain	Digital gain

6.4.2. Gain Introduction

LowGain, MiddleGain, and HighGain stand for low gain, medium gain, and high gain modes, with gain ratios approximately x1:x30:x150. High gain mode features lower noise electron counts, facilitating high-sensitivity detection, but results in higher noise output amplitude and a reduced dynamic range. Low gain is appropriate for high SNR scenarios, and medium gain can satisfy most application requirements.

6.4.3. Digital Gain and Black Level

Final image output: Dataout_af = (Dataout_bf – BlackLevel)*DigitalGain

6.5. Digital IO Control

6.5.1. Digital IO Parameters

Table 6-9 Digital IO - Parameter Explanation

Parameter	Description
Line Selector	Select signal source
Line Mode	Indicate the current state of the selected line input or output.Configure the selected line as input or output
Line Format	Set the selected line type as differential or single-ended
Line Status	Indicate the current state of the selected line input or output
Line Status All	Indicate the current state of all available line signals
LineDebouncingPeriod	Set the value of the debounce time
LineDetectionLevel	Set the threshold voltage value
LineEncoderType	Line signal type
StrobeEnable	Strobe output enable
LineInverter	Strobe output inversion
StrobeSourceSelector	Strobe source selection: ExposureActive or FrameStart
StrobeLineDuration	Strobe line duration
StrobeLineDelay	Strobe line delay

6.5.2. Signal Source Configuration

Table 6-10 Optional Signal Source Configuration

Signal Source	Single-ended Input	Single-ended Output	Differential Input	Differential Output	Optocoupler Input
Line1	√	×	√	×	×
Line2	√	×	√	×	×
Line3	×	×	√	√	×
Line4	×	×	×	×	√
Line5	×	√	×	×	×

6.5.3. Signal Debouncing

Line Debouncing Period: Signal debouncing (filtering) is supported only in input mode. It filters out signal levels below the set value, effectively reducing signal noise.

6.6. Encoder Control

6.6.1. Encoder Control Parameters

Table 6-11 Encoder Control - Parameter Explanation

Parameter	Description
Encoder Selector	Select encoder
Encoder Source A	Select external signal source
Encoder Source B	Select external signal source
Encoder Trigger Mode	Source signal trigger mode
Encoder Counter Mode	Encoder counting mode
Encoder Counter	Encoder counting
Encoder Counter Max	Counting upper limit
Encoder Counter Reset	Reset counting
Encoder Max Reverse Counter	Maximum number of reverse movements allowed without outputting an image
Encoder Reverse Counter Reset	Reset the reverse movement counter to zero

6.7. Counter and Timer Control

6.7.1. Counter and Timer Control Parameters

Table 6-12 Counter and Timer Control - Parameter Explanation

Parameter	Description
Counter Selector	Select counter: Counter0 or Counter1
Counter Event Source	Specify which event sources will trigger an increment in the counter, such as FrameTrigger and FrameStart.
Counter Reset Source	Select the signal source for resetting the counter, only software reset is available, default is disabled
Counter Reset	Reset the selected counter via software
Counter Current Value	Display the current count

6.8. Frequency Converter Control

6.8.1. Frequency Converter Control Parameters

Table 6-13 Frequency Converter Control - Parameter Explanation

Parameter	Description
FrequencyConverterSelector	Select the frequency converter
InputSource	Select the signal source for frequency converter
Divider	Set the division factor
Multiplier	Set the multiplication factor

6.9. Shading Correction

6.9.1. Shading Correction Parameters

Table 6-14 Shading Correction - Parameter Explanation

Parameter	Description
Calibrate Enable	Enable calibration data
Calibrate FPN	Calibrate fixed pattern noise(FPN)
Calibrate PRNU	Calibrate photo response non-uniformity(PRNU)
Calibrate Calculate	Shading correction calculation

6.9.2. Shading Correction Method

STEPS:

STEP 1. Disable **Calibrate Enable**.

STEP 2. Point the camera at a uniform dark field, then perform **Calibrate FPN**.

STEP 3. Point the camera at a uniformly half-saturated field, then perform **Calibrate PRNU**.

STEP 4. Perform **Calibrate Calculate**.

STEP 5. Enable **Calibrate Enable**

7. IO PORT Electrical Specifications

7.1. Differential Input

Table 7-1 Differential Input

Input Voltage		Description
Vcm	±25.0V	Input common mode voltage range.
VID（Line1/2)	+200 mV	For the input differential voltage (A-B), a value above this threshold indicates a logic 1.
	-200mV ~+200mV	The input state inverts at this voltage level, and the logic state is indeterminate within this voltage range.
	-200 mV	For the input differential voltage (A-B), a value below this threshold indicates a logic 0.
VID（Line3)	+350 mV	For the input differential voltage (A-B), a value above this threshold indicates a logic 1.
	-350mV ~+350mV	The input state inverts at this voltage level, and the logic state is indeterminate within this voltage range.
	-350 mV	For the input differential voltage (A-B), a value below this threshold indicates a logic 0.

The differential inputs include three sets: Line1/Line2/Line3. These can be individually configured through software as either phase A or phase B of a differential encoder. Specifically, Line1/Line2 can only function as trigger inputs, while Line3 can be configured as both an input and an output.

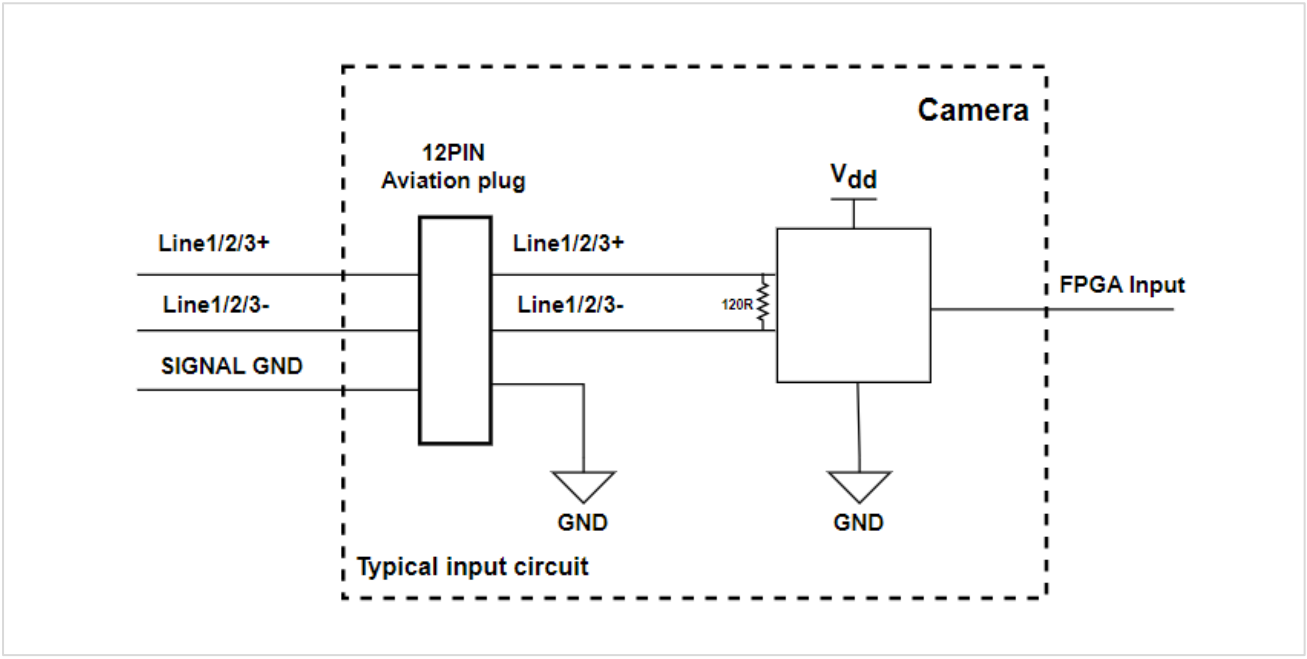

Figure 7-1 Differential Input Wiring Diagram

7.2. Single-ended Input

Table 7-2 Single-ended Input

Positive Terminal Input Voltage	Negative Terminal Reference Voltage	Description
0–24V	-	Input safe operating voltage range.
<2V	1.6V	Does not meet the minimum voltage level required by the trigger logic.
3.3V	1.6V	Threshold levels for High-to-Low and Low-to-High transitions.
5V	1.6V	
12V	4.3V	
24V	4.3V	
＞25V	-	Limit voltage: Input must not exceed this limit value, otherwise it may cause damage to the device.

Only Line1 and Line2 can be configured as single-ended inputs; Line3 must be configured as differential input or output.

For single-ended input, the trigger level must be at least 2V and the shortest trigger pulse must be at least 1us, or else it will not trigger.

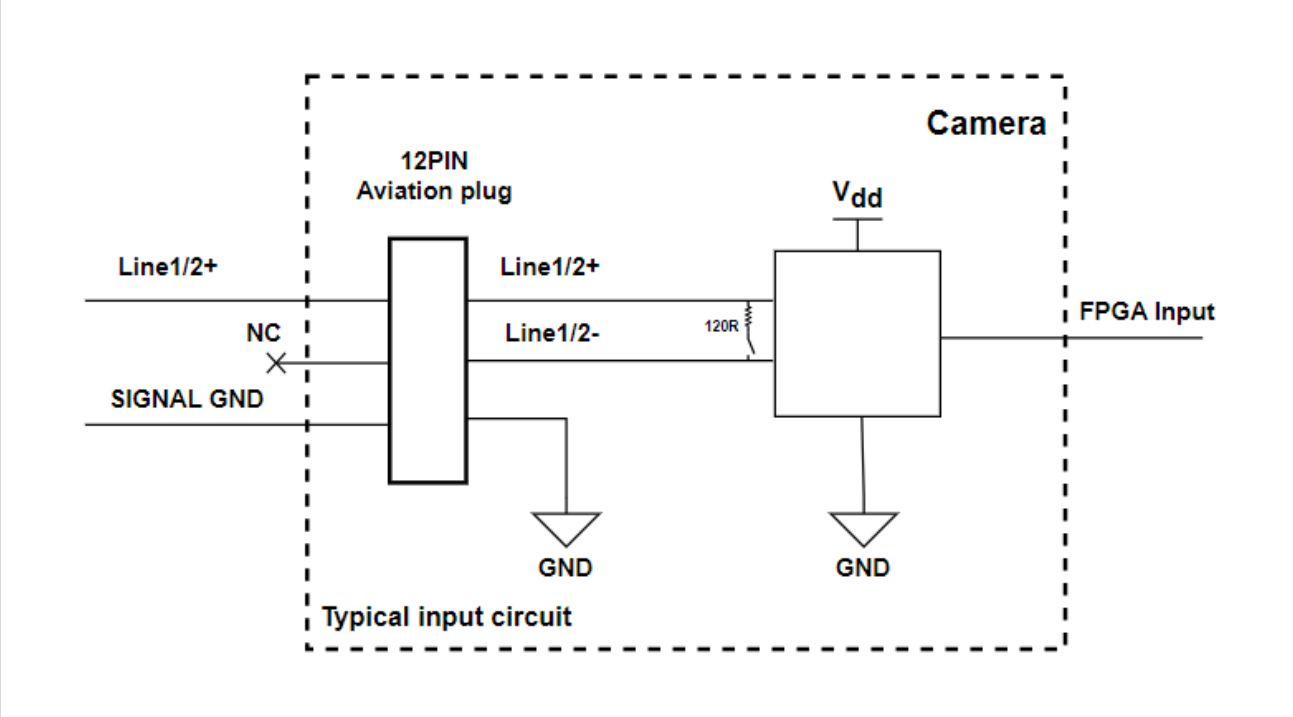

Figure 7-2 Single-ended Input Circuit

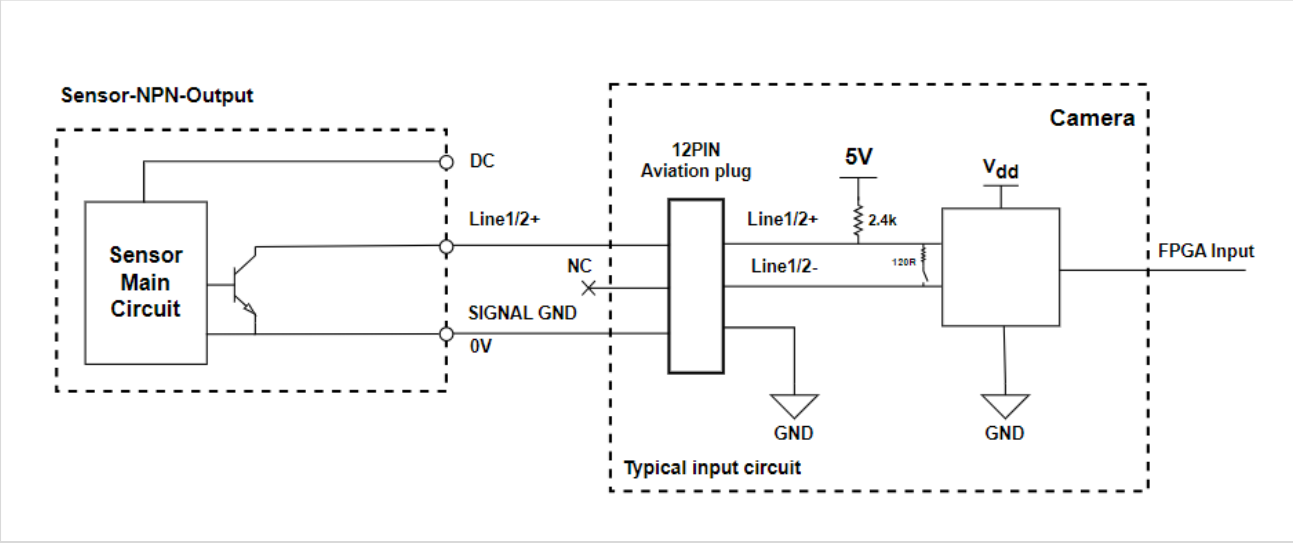

Figure 7-3 Differential Configuration as Single-ended Input — Typical Circuit Diagram 1

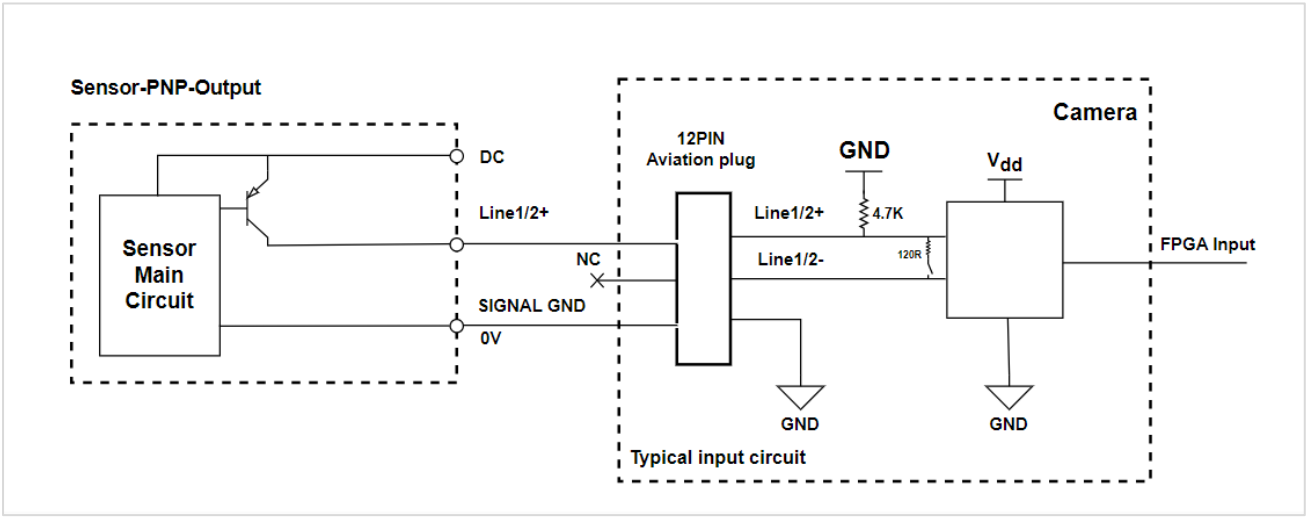

Figure 7-4 Differential Configuration as Single-Ended Input — Typical Circuit Diagram 2

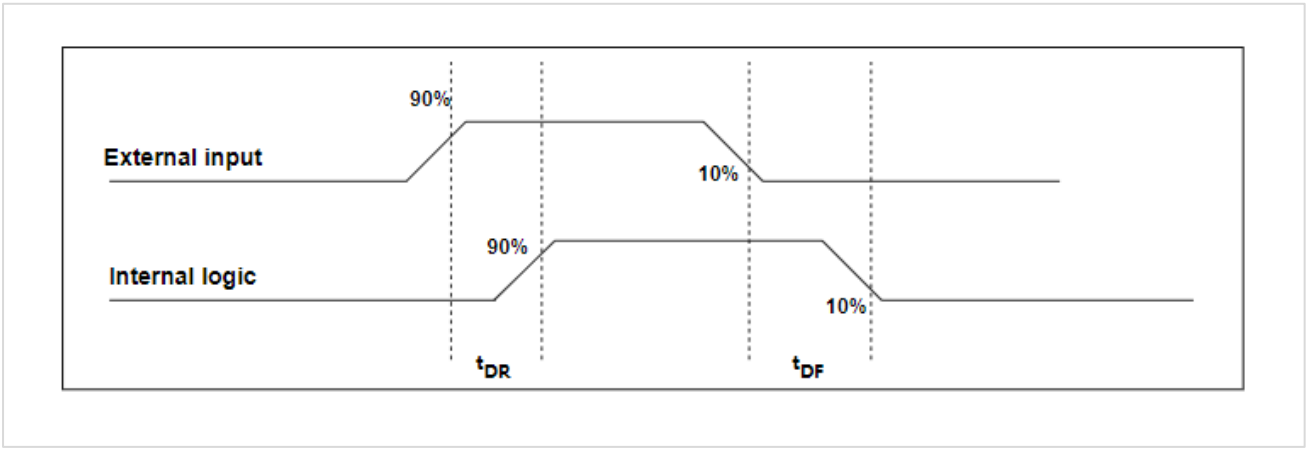

Figure 7-5 Output Delay Time

Table 7-3 FPGA Input and Output Delay Dependence

External Supply Voltage (V)	Rise Time tR (ns)	Fall Time tF (ns)	Rising Edge Trigger Delay tDR (ns)	Falling Edge Trigger Delay tDF (ns)
3.3	<12	<6	<53	<40
5.0				
12			<60	<26

7.3. Differential Output

Differential output includes only one pair of Lines3.

Table 7-4 Differential Output

Input Voltage		Description
Voc	±3.0V	Output maximum current.
VOD	+200 mV	For the output differential voltage (A-B), a value above this threshold indicates a logic 1.
	-200mV~+200mV	The output state inverts at this voltage level, and the logic state is indeterminate within this voltage range.
	-200 mV	For the output differential voltage (A-B), a value below this threshold indicates a logic 0.

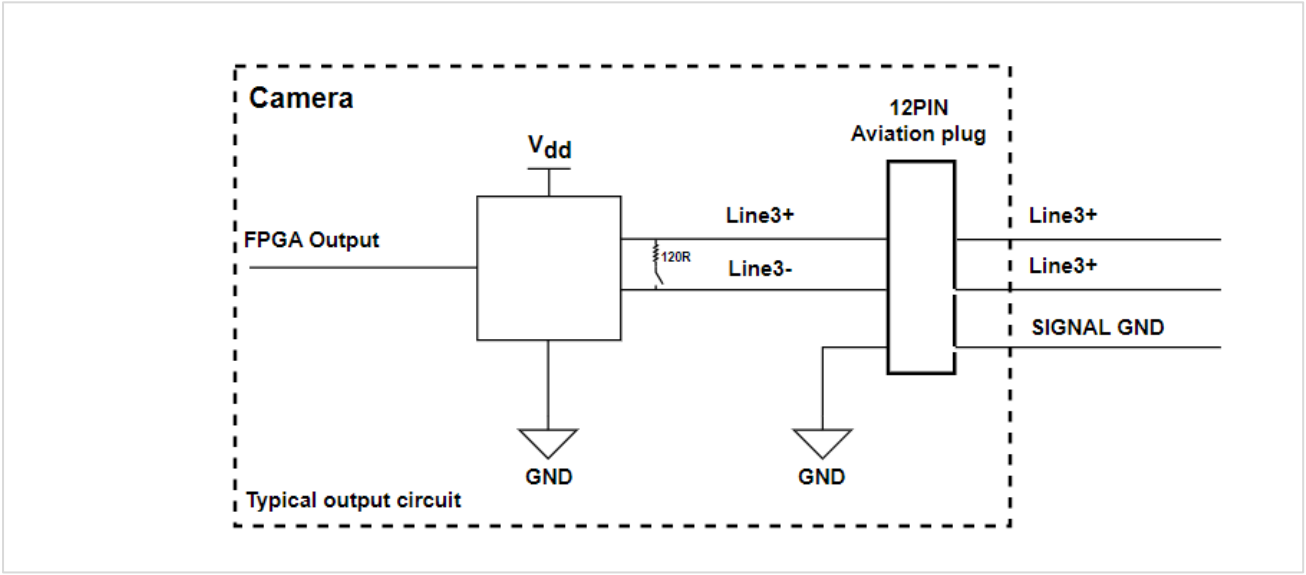

Figure 7-6 Differential Output Typical Circuit

Table 7-5 Output Delay Under No Load

Rise Time tR (ns)	Fall Time tF (ns)	Rising Edge Trigger Delay tDR (ns)	Falling Edge Trigger Delay tDF (ns)
＜2.1	＜2	＜31	＜12

7.4. Optocoupler Isolated Input

Table 7-6 Optocoupler Isolated Input

Input Voltage	Description
+25 VDC	Limit voltage: Input must not exceed this limit value, otherwise it may cause damage to the device.
0-24 VDC	Safe operating voltage range for I/O inputs.
0-1.2 VDC	Logic 0
＞1.2-3.3 VDC	The input state inverts at this voltage level, and the logic state is indeterminate within this voltage range.
＞3.3 VDC	Logic 1

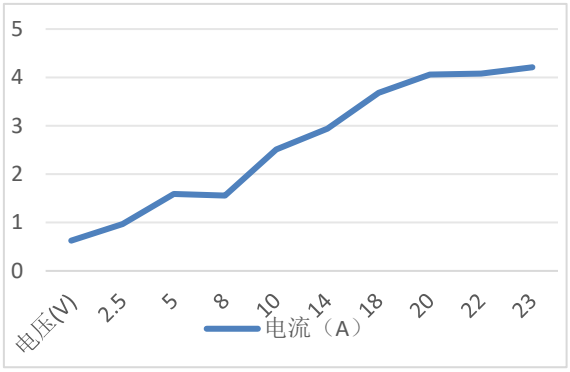

Figure 7-7 Sink Current Dependence on Input Voltage for Optocoupler Isolated Input

Note:

- The maximum sink current for the optocoupler isolated input is 4.8 mA.
- The above value is measured under an ambient temperature of 25°C and may vary between different cameras.

Table 7-7 Trigger Delay Dependence on Input Signal Amplitude

Input Signal Amplitude (Vp-p)	Rising Edge Trigger Delay tDR	Falling Edge Trigger Delay tDF
3.3V	110us	115us
5.0V	120us	25us
9.0V	125us	8.4us
12V	500 ms	7.7 ms

Note:

- The trigger delay measures the latency from the external optocoupler input port to the FPGA input pin, excluding any internal logic delay within the FPGA.
- The values mentioned above are typical measurements taken at an ambient temperature of 25°C.

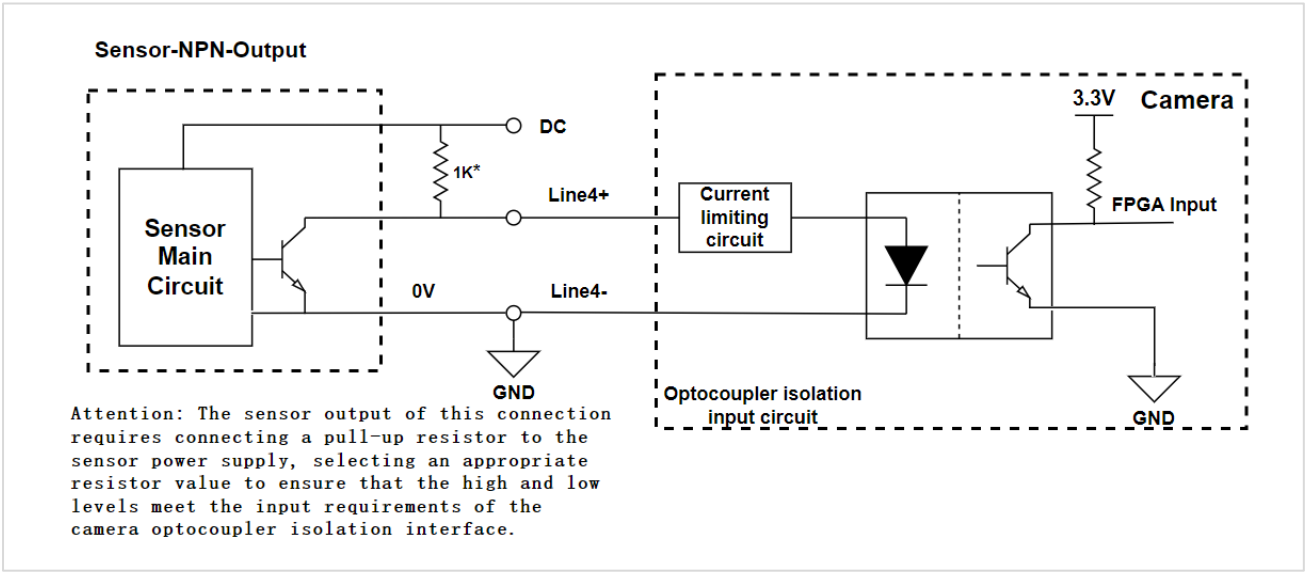

Figure 7-8 Optocoupler Isolated Input Circuit (1)

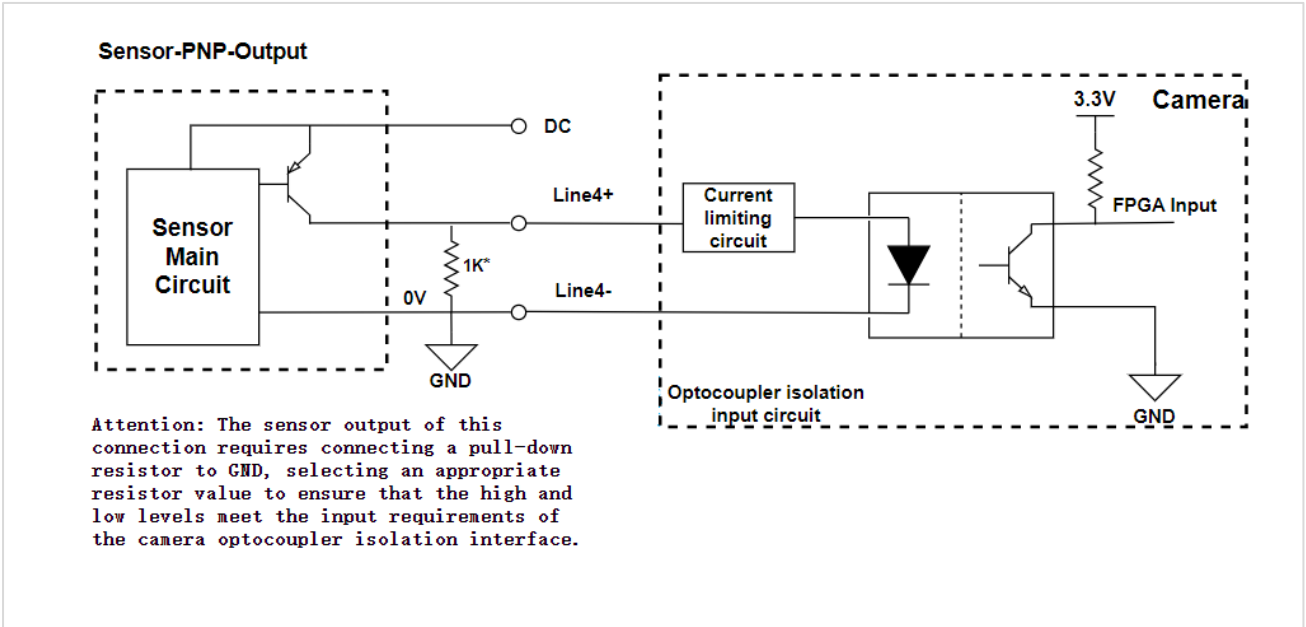

Figure 7-9 Optocoupler Isolated Input Circuit (2)

7.5. GPIO Output

Line5 is a GPIO output that provides 4.4V with a maximum current of 90mA.

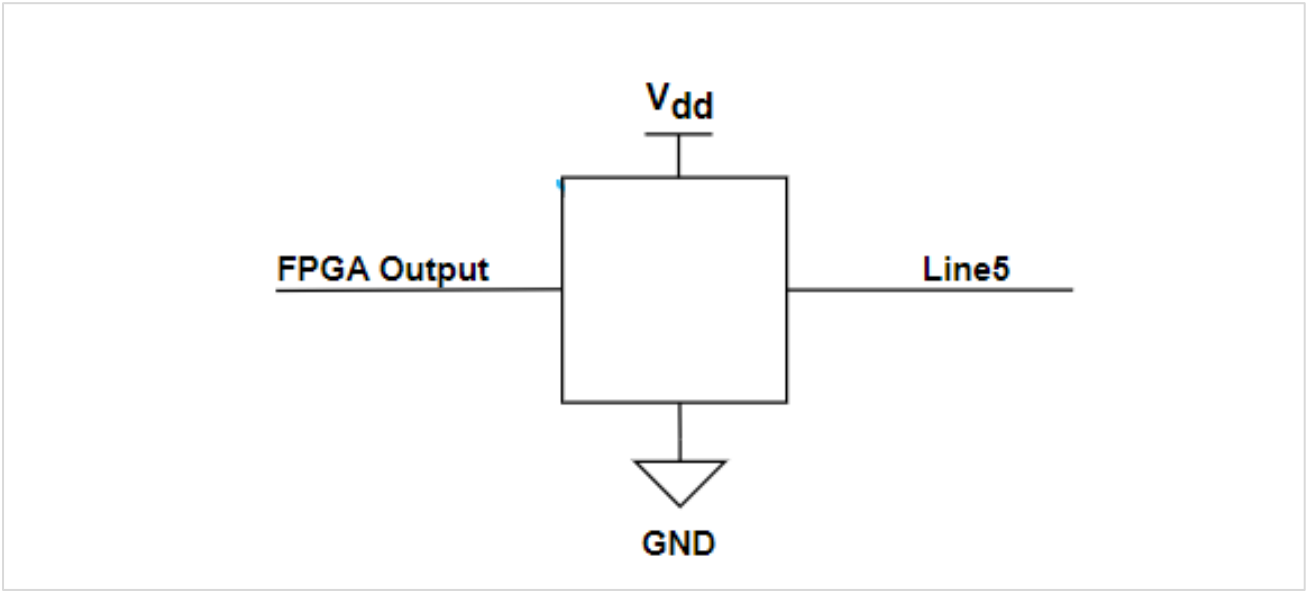

Figure 7-10 GPIO Output Circuit

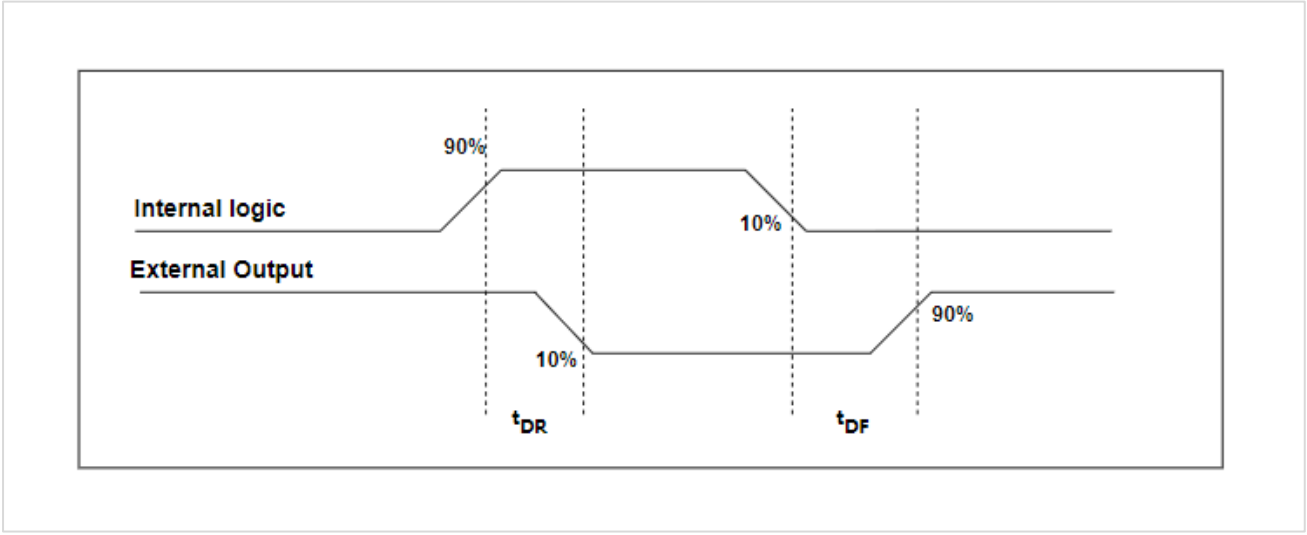

Figure 7-11 GPIO Output Logic Delay

Table 7-8 Output Delay Under No Load

Rise Time tR (ns)	Fall Time tF (ns)	Rising Edge Trigger Delay tDR (ns)	Falling Edge Trigger Delay tDF (ns)
124.1	131.6	242.4	141.35

8. User Set Control

Supports the ability to save or load customized parameter sets and to configure the default parameters upon client startup.

Table 8-1 User Set Control

Parameter	Description
UserSetSelector	Select a configuration
UserSetLoad	Load selected parameters
UserSetSave	Save selected parameters
UserSetDefault	Set default startup parameters

9. Structure and Dimensions

Note: For detailed 2D and 3D drawings, please contact our technical personnel.

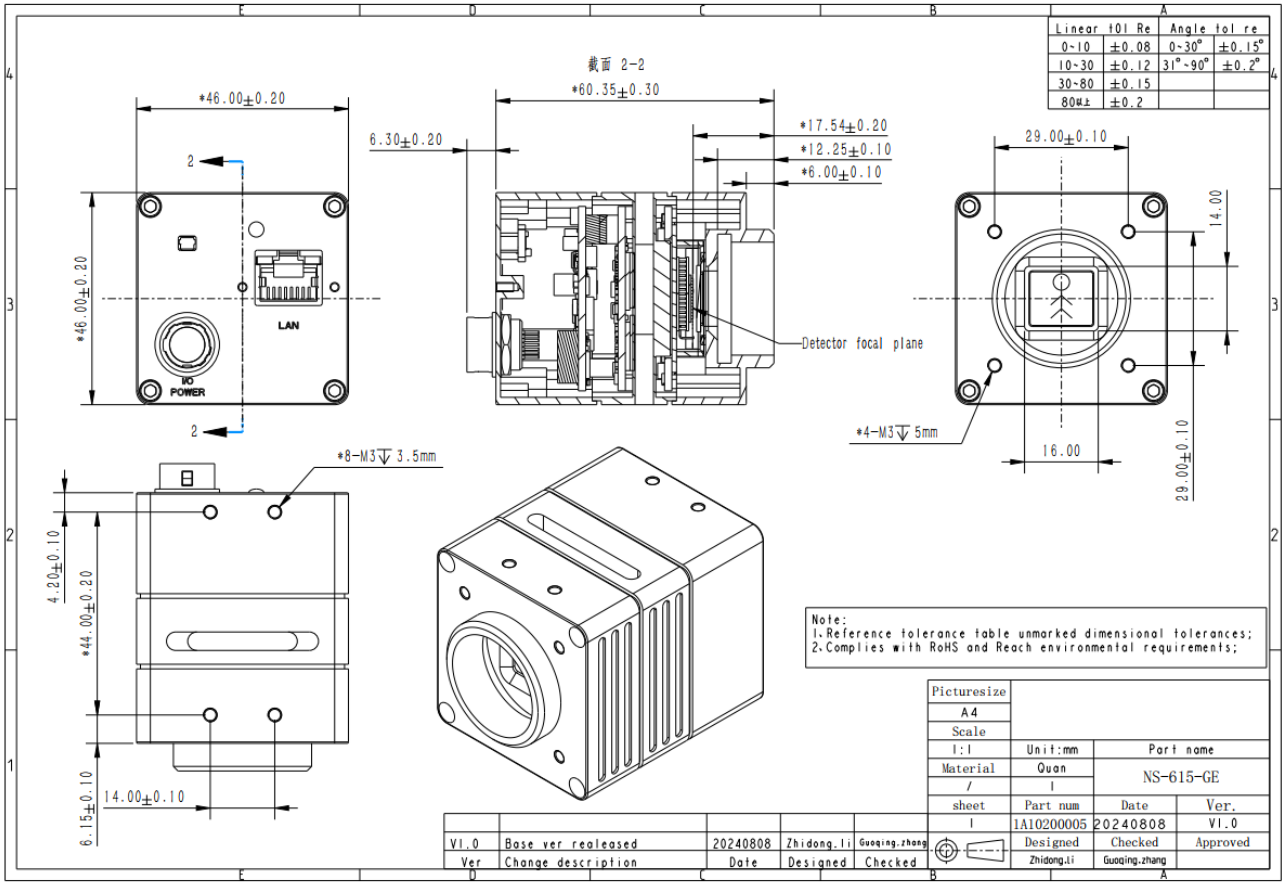

Figure 9-1 2D Structural Drawing

10.Safety Guidelines

Read and follow the safety precautions in this manual before installing, operating, or maintaining the product.

10.1. Safety Notices

- For personal and product safety, follow all safety precautions for use when installing, operating, and maintaining the product as indicated on the product's labeling and in the manual.
- The "CAUTION", "WARNING" and "DANGER" instructions in this manual do not contain all the safety precautions to be observed, but are intended to supplement all safety precautions.
- The product should be used in an environment that complies with the design specifications, otherwise it may cause malfunctions. Abnormal functions or damage to parts, etc. caused by failure to comply with the relevant regulations are not covered by the product warranty.
- We will not assume any legal responsibility for any personal safety accidents or property damage caused by non-compliant operation of the product.

10.2. Precautions for Safe Use

- Do not install the product and accessories if you find any defects, rust, water ingress, model number discrepancy, missing parts, etc. when you open the box!
- Avoid storing and transporting the product in places such as water splash, rain, direct sunlight, strong electric field, strong magnetic field, and violent vibration.
- Avoid dropping the product or accessories that could cause damage or vibrating the product with force when transporting.
- When installing the product indoors, take care to avoid environments where it may be drenched with water or other liquids, otherwise moisture in the product may cause fire and electric shock hazards!
- Put the product in a place free from direct sunlight and ventilated, taking care to keep it away from heat sources such as heaters and radiators.
- During the installation and use of the product, please strictly observe the electrical safety regulations of your country and region.

- Make sure to use the power adapter provided by the regular manufacturer, the power adapter needs to meet the LPS requirements, please refer to the technical specification of the product.
- Do not block the plug or socket of the product for easy plugging and unplugging to disconnect the power supply.
- Make sure to disconnect the power supply before wiring, removing wires, etc. Do not operate with electricity, otherwise there is a risk of electric shock!
- If the product emits smoke, odor, or noise, turn off the power supply and unplug the power cable immediately, and contact the selling dealer or service center in time.
- Do not touch any of the product's terminals in the operating status, otherwise there is a risk of electric shock!

10.3. Precautions for Installation

- Please check the product packaging for completeness, damage, moisture, deformation, etc. before opening the box.
- Please check the surface of the product and accessories for any damage, rust, bruises and so on after opening the box.
- Please check that the product, accessories and documentation are complete after opening the box.
- Please observe the storage and transportation conditions of the product, the storage temperature and humidity should meet the requirements.
- Do not mix this product with items that may affect or damage during transportation.
- Qualification requirements for installation and maintenance personnel:

  Qualifications or relevant experience in the installation and maintenance of weak current systems, as well as the following knowledge and operational skills.

  Basic knowledge and operation skills of low voltage wiring and low voltage electronic wiring.

  Ability to understand and apply the contents of this manual.
- Please read the product manual and safety precautions carefully before installation!
- Please install the product by strictly following to the installation instructions in this manual.

- The outer housing temperature of the product may overheat, please do not touch the product until half an hour after the power is off.
- Do not place the product near an exposed fire source, such as a burning candle.

10.4. Precautions for Prevention of Electromagnetic Interference

- When using shielding cables, ensure that the shielding layer is intact and connected to the metal connector by 360° crimping.
- Do not wire the product with other products (especially servo motors or high-power products, etc.), and the wire spacing should be greater than 10 cm. If this cannot be avoided, take proper measures to shield cables.
- Product control cable and industrial light source voltage supply cable should be routed separately, do not bundle wiring.
- Product power cable and data cable, signal cable, etc. must be routed separately. If wiring is done separately with a metallic wiring trunking, be sure to ground it.
- Evaluate the wiring space and do not pull the cable forcefully to avoid damaging the electrical properties of the cable.
- If the product is frequently powered on or powered off, strengthen the voltage regulator isolation, such as adding a DC/DC isolated power module between the product and the adapter.
- Please use the power adapter to power the product. In the case of a centralized power supply, a DC filter must be used to filter the product power supply individually for use.
- Insulate the unused cables of the product.
- When installing the product, make sure that both the product and the equipment to which the product is connected are properly grounded, otherwise isolate the product with an insulated bracket.
- To avoid static buildup, ensure that other products on site (e.g., machines, internal components, etc.) and metal supports are properly grounded.
- High voltage leakage and other phenomena must be avoided during the installation and use of the product.

- If the product cable is too long, be sure to bundle it in a figure of eight.
- The product needs to be stably connected to metal-based accessories to maintain good electrical conductivity.

Please use a network cable with shielding function to connect with the product. If you use self-manufactured cable, please make sure that the shielding shell of the aviation head and the aluminum foil or metal braid layer of the shielding cable overlap well.

11. 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 cable, 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.).

12. Supports and Services

The company provides services such as pre-sales training, in-sales support, and after-sales maintenance. Please contact our sales-reps for specific information.