

DS77 Series ToF Camera Specification



Table of Contents

1	General Information	4
1.1	Terms of Use.....	4
2	Precautions	6
2.1	Safe Usage Instructions.....	6
2.2	Power.....	6
2.3	Usage	7
2.4	Temperature.....	7
3	Specifications and Requirement	8
3.1	General Specifications.....	8
3.2	Electrical Specifications	9
3.2.1	Recommended Operating Conditions	9
3.2.2	Power Consumption	9
3.2.3	Absolute Maximum Ratings.....	9
3.3	DS77 Pro Dimension	10
3.4	DS77 Lite Dimension	11
3.5	DS77C Pro Dimension.....	12
3.6	DS77C Lite Dimension.....	13
3.7	Optical Specifications	14
3.7.1	Field of View	14
3.7.2	Wavelength of the VCSEL	14
3.8	Working Condition Requirements	15
3.8.1	Hardware Requirements.....	15
3.8.2	Software Requirements	15
3.8.3	Environmental Requirements	15
3.8.4	Coordinate of the Camera System	16
4	Interface with Host	17
4.1	DS77 Pro&DS77C Pro Interface.....	17
4.2	DS77&DS77C Lite Interface	20
4.3	LED Indication	24
5	Installation.....	25
5.1	Hardware Installation	25
5.1.1	DS77 Pro&DS77C Pro Installation Steps	25
5.1.2	DS77 Lite&DS77C Lite Installation Steps.....	26
5.1.3	POE Mode Installation (Only For DS77 Pro&DS77C Pro)	26
5.2	Software Installation	27
5.2.1	Nebula SDK.....	27
5.2.2	NebulaGUITool	27
5.2.3	Frameviewer.....	27
5.2.4	Default IP address	28
5.3	Firmware Upgrade	29
5.4	Product State Machine	30
6	Features.....	31

6.1	Slave Trigger Mode.....	31
6.1.1	Hardware Trigger Mode.....	31
6.1.2	Software Slave Trigger Mode	31
6.2	Exposure Time Configuration	31
6.2.1	Auto Exposure	31
6.2.2	Manual Exposure.....	32
6.3	Data Filtering	32
6.4	IR Image	32
7	DS77 Series Accessories and Package.....	34
8	Customization Service	36
Appendix	36
	ROHS Declaration	36
	Laser Specification	36
	Manufacturer	36
	Factory.....	37
	FCC Statement	37
Revision History	38

1 General Information

The purpose of this document is to familiarize the customer with the correct operation of the Vzense ToF DS77 Series products family. This document provides important information about the camera's features, hardware specification, safe use of the camera, and installation procedures.

DS77 series have four configuration, DS77 Pro, DS77 Lite, DS77C Pro and DS77C Lite.

Model	IP67 Housing	PoE+	RGB
DS77 Lite	No	No	No
DS77 Pro	Yes	Yes	No
DS77C Lite	No	No	Yes
DS77C Pro	Yes	Yes	Yes

DS77 Pro and DS77C Pro can be powered either by DC power or Power over Ethernet, and IP67 rating enclosure to resist dust and water.

While DS77 Lite and DS77C Lite can only be powered by DC power and NOT IP67 rating.

1.1 Terms of Use

Vzense offers a 1-year-warranty for this ToF product.

Warranty Information

Please do follow the guidelines below when using the Vzense camera:

Do not remove the product's serial number label

Warranty will be void, if the label is damaged or removed and the serial number can't be read from the camera's registers.

Do not disassemble the product housing

Do not disassemble the housing. Touching any internal components may damage the products.

Prevent any objects or substances from entering the product housing, otherwise the product may fail or damaged.

Avoid electromagnetic areas

Do not use the camera near strong electromagnetic areas. Prevent the product from electrostatic charging.

Transport in original packaging

Transport and store the camera in its original packaging only. Suggest not to discard the packaging.

Clean with care

If you have to clean the housing of the camera, follow the guidelines in the notice as below:

- Use a soft, dry cloth that won't generate static during cleaning;
- To remove tough stains, use a soft cloth dampened with a small amount of neutral detergent(Pure water or alcohol); after that wipe dry;
- Make sure no any residual detergent after cleaning, before reconnecting the camera to power

Read the manual

Do read the manual carefully before using the camera.

2 Precautions

2.1 Safe Usage Instructions

DANGER	
	<p>Electric Shock Risk</p> <p>Non-standard and improper power supplies may result in fire and electric shock. You must confirm the camera power supply used that meets the absolute specification of voltage and current.</p>

CAUTION	
	<p>Invisible Radiation</p> <p>This camera uses laser to work, improper use may damage the eye. Lasers are classified as risk group 1 (low risk) according to EN 60825 which means that the product presents no risk related to exposure limits under normal usage conditions. Eye safety is only guaranteed when the camera is used properly</p>

2.2 Power

The DS77 Pro and DS77C Pro can work with either Power over Ethernet or external DC power; DS77 Lite and DS77C Lite can only work with external DC power.

For PoE power source, the PSE device shall apply the PoE+ standard (802.3at) or above, lower than that may cause the product doesn't work well or even be damaged.

The DC power can accept 12V~24V power source. For higher than 24V or lower than 12V, the device shall not work well or even be damaged.

Vzense doesn't produce PoE injector, but we can purchase it from 3rd party and ship to customer at original cost.

Below is the PoE+ injector available vendor list.

Vendor	Model Number
H3C	EWPAM2NPOE
TP LINK	TL-POE170S

2.3 Usage

Don't try to open the camera housing. Each camera has been calibrated at the factory to achieve precise measurements. Touching internal components may damage the camera and cause calibration data lost.

Incorrect plugging in and unplugging of the camera's power cable can damage the camera. To avoid switch-on surges damaging the camera, please plug in the power cable into the camera's power connector firstly before getting power source on.

Don't try to change the position of the lens, may cause damage to the camera.

Do store the camera carefully when not in use, in original package the best.

2.4 Temperature

To avoid damaging the camera and to achieve best performance, please observe the maximum and minimum housing temperatures in Section 3.1

3 Specifications and Requirement

3.1 General Specifications

Specification	Vzense DS77
Technology	ToF (Time-of-flight) Depth Camera
Depth Sensor Resolution and Frame rate	640 x 480(VGA)@25FPS
Output Formats	Depth & IR Map (RAW12)
Depth Sensor Field of View H-Horizontal, V-Vertical(degree)	Typical: H-70°V-50°
RGB Sensor Resolution and Frame Rate	1600*1200@25fps
RGB Sensor FOV	H-77 °V-55°
Use Range	0.15m~5m(max. 5meters, customizable)
Accuracy	<1%
Power Consumption	Average Max. 7W(Ref)
Illumination	940nm, 2 x 2W VCSEL
Dimension(L*W*H)	DS77 Pro:65mm*65mm*72.65mm DS77 Lite: 65mm*65mm*60mm DS77C Pro:105mm*65mm*72.65mm DS77C Lite: 105mm*65mm*60mm
Weight	DS77 Pro: 342g DS77 Lite: 312g DS77C Pro:581g DS77C Lite: 551g
Power Supply	DS77 Pro: PoE+ or DC power DS77 Lite: DC power DS77C Pro: PoE+ or DC power DS77C Lite: DC power
Interface	Gigabit Ethernet and RS485
Digital I/O (Exposure Control, Synchronization etc.)	1in/1out Passive Sync Signal
Enclosure Rating	DS77 Pro&DS77C Pro: IP67 DS77 Lite&DS77C Lite: IP42
Working/Storage Temperature	-20°C~50°C/-30°C~70°C
Software	C/C++/Python/ROS SDK
Operation System	Windows 7/8/10/11, Linux, Arm Linux/ROS
Cooling	Passive, no fan
Certification	FCC/CE/FDA
Eye safety	Class 1

3.2 Electrical Specifications

3.2.1 Recommended Operating Conditions

Parameter	Symbol	Conditions	Min	Typ.	Max	Units
DC Power	VDD		11		26	V
Digital I/O (Ext_Trigger)	Vin		3.3		20	V
RS485			-12		12	V
Operating Temperature	Ta		-20		50	°C
Operating humidity			20		80	%
Storage humidity			20		80	%
Storage temperature			-30		70	°C

3.2.2 Power Consumption

Parameter	Model	Conditions	Average	Max	Units
Active Mode	DS77 Pro/DS77 Lite	400mm- 5000mm @25fps	612	704	mA
	DS77C Pro/DS77C Lite		642	761	
Broadcast Mode	DS77 Pro/DS77 Lite		141	190	mA
	DS77C Pro/DS77C Lite		159	171	

Note: 12V input voltage

3.2.3 Absolute Maximum Ratings

This is a stress rating only and functional operation of the devices at those or any other conditions above those indicated in the operation listings of this specification is not promised. Exposure to maximum rating conditions for extended periods may affect device reliability

Parameter	Symbol	Conditions	Min	Typ.	Max	Units
DC Power	VDD		10		26	V
Digital I/O (Ext_Trigger)	Vin		3.3		24	V
RS485			-13.2		13.2	V
Operating Temperature	Ta		-20		50	°C

3.3 DS77 Pro Dimension

This drawing contains information about the dimensions and user mounting location of the ToF Camera

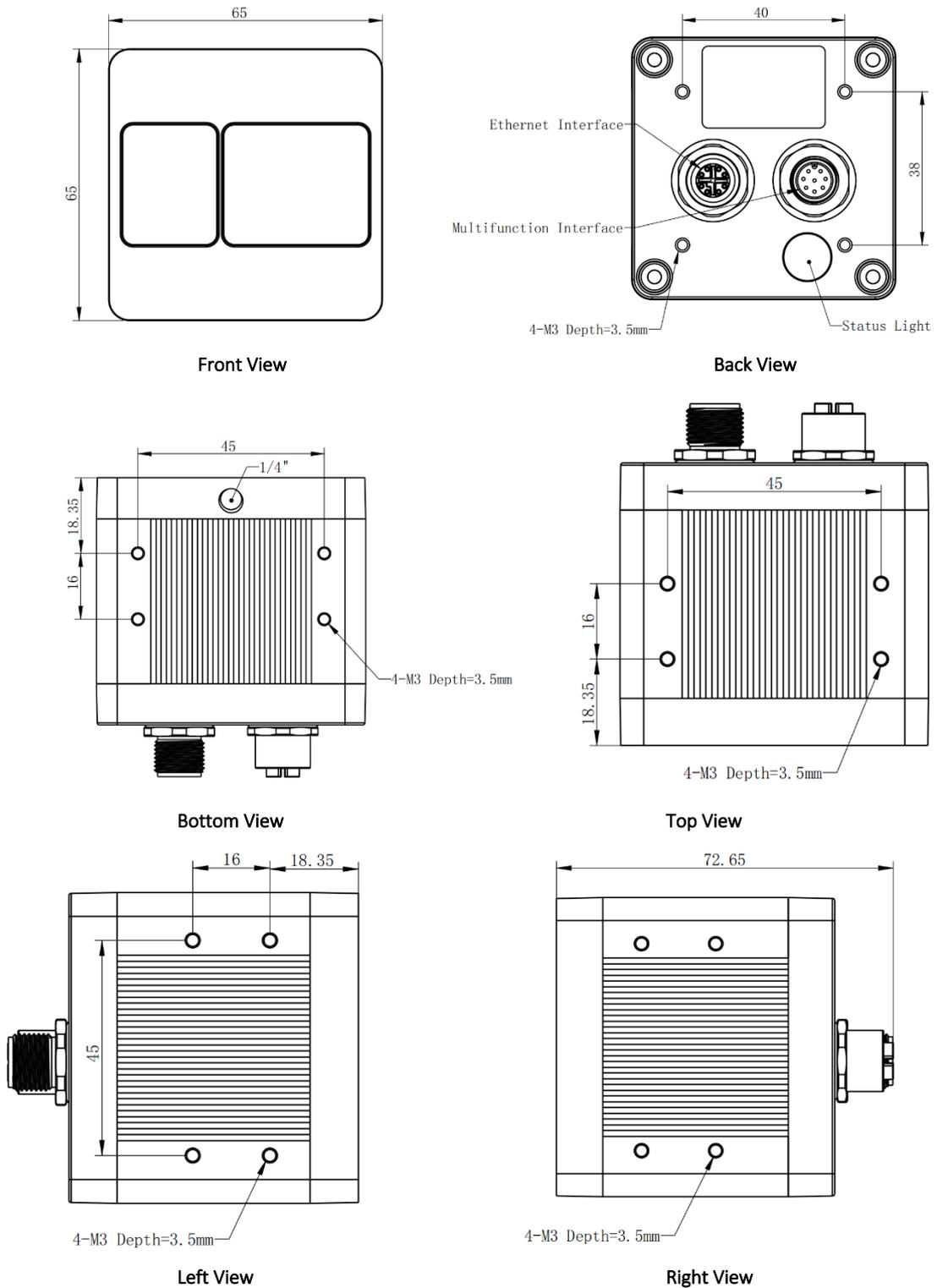


Fig. 3.1: ToF Camera Dimensions: (Unit:mm)

3.4 DS77 Lite Dimension

This drawing contains information about the dimensions and user mounting location of the ToF Camera.

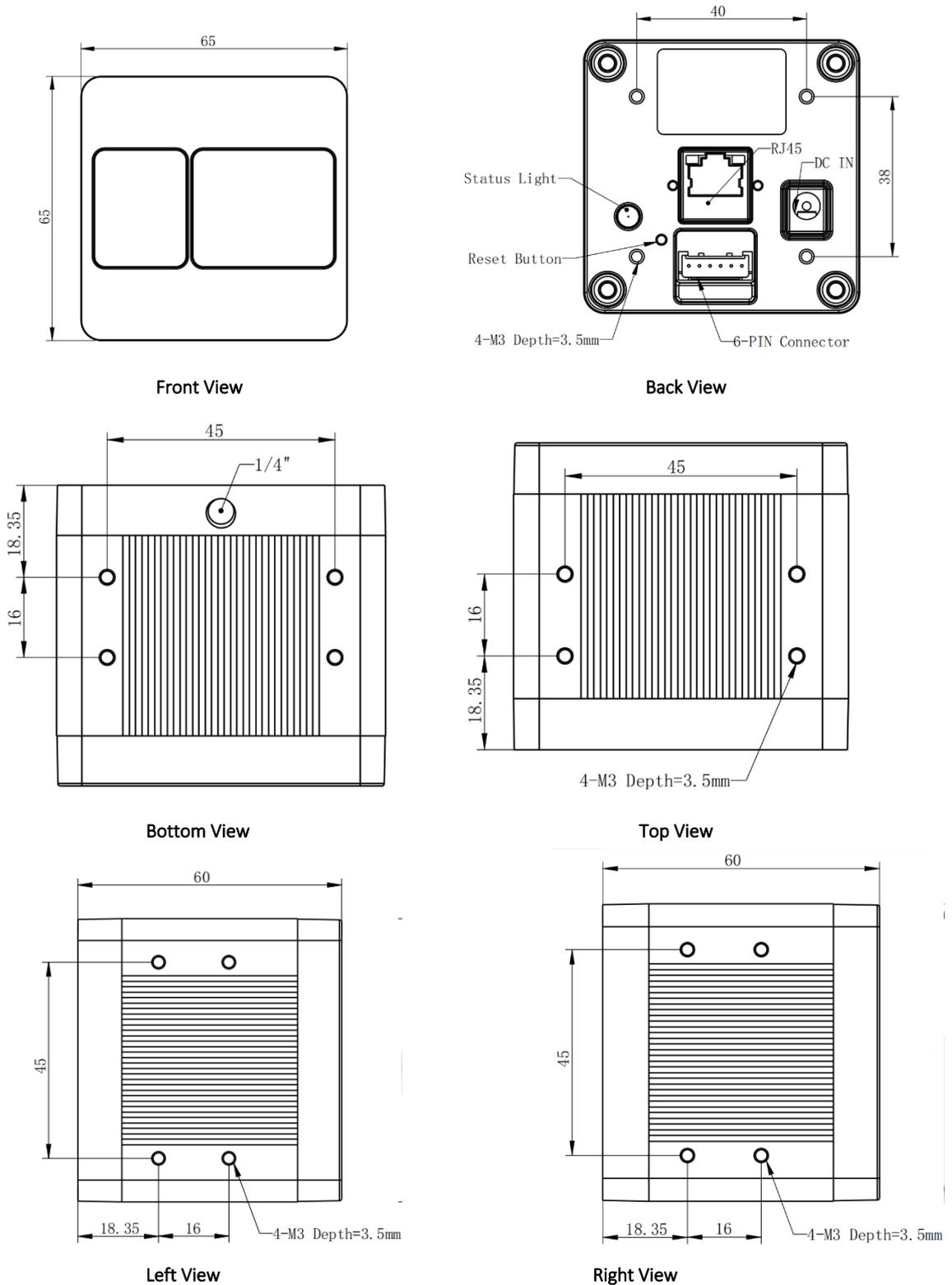


Fig. 3.2: ToF Camera Dimensions:(Unit:mm)

3.5 DS77C Pro Dimension

This drawing contains information about the dimensions and user mounting location of the ToF Camera

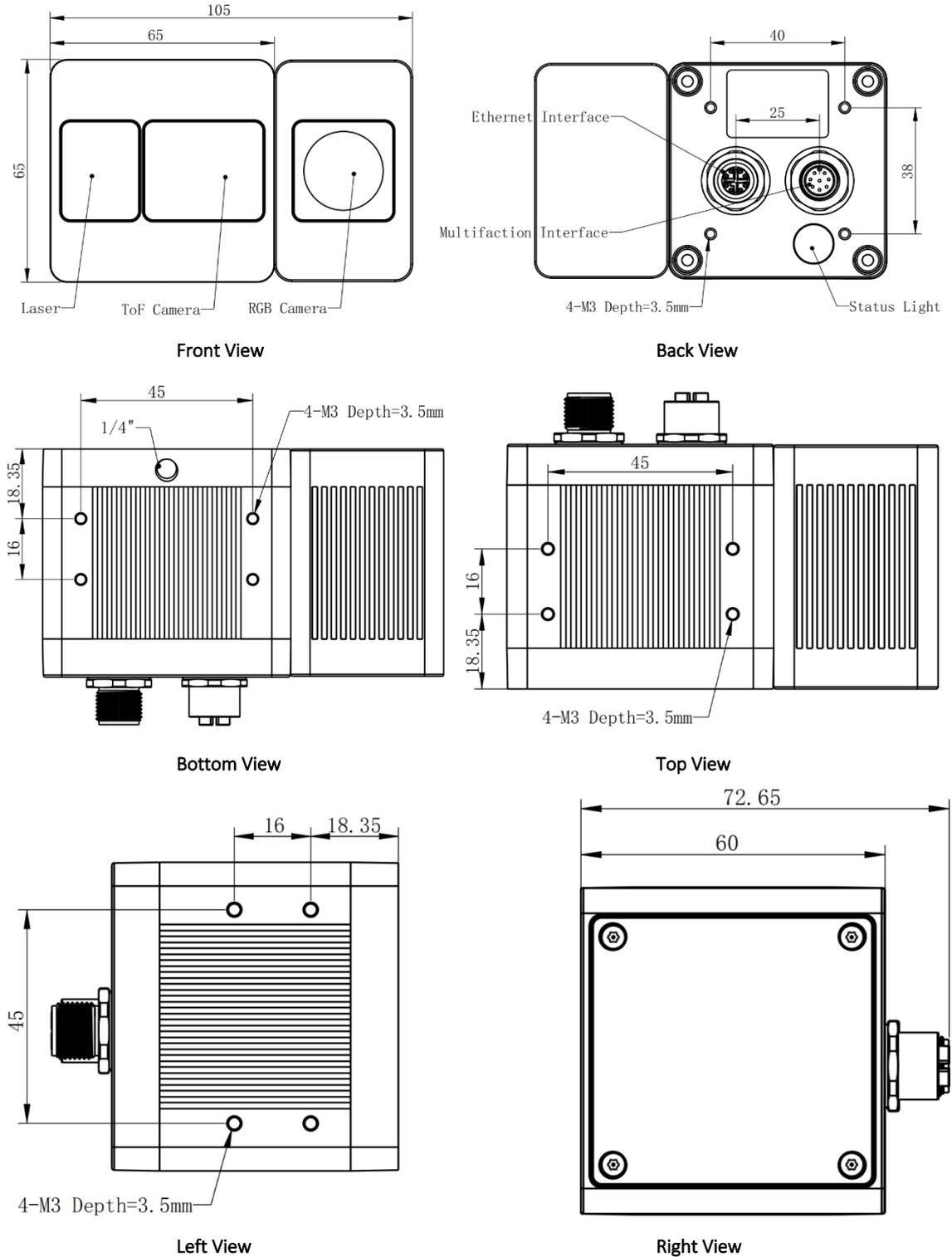


Fig. 3.3: ToF Camera Dimensions: (Unit:mm)

3.6 DS77C Lite Dimension

This drawing contains information about the dimensions and user mounting location of the ToF Camera.

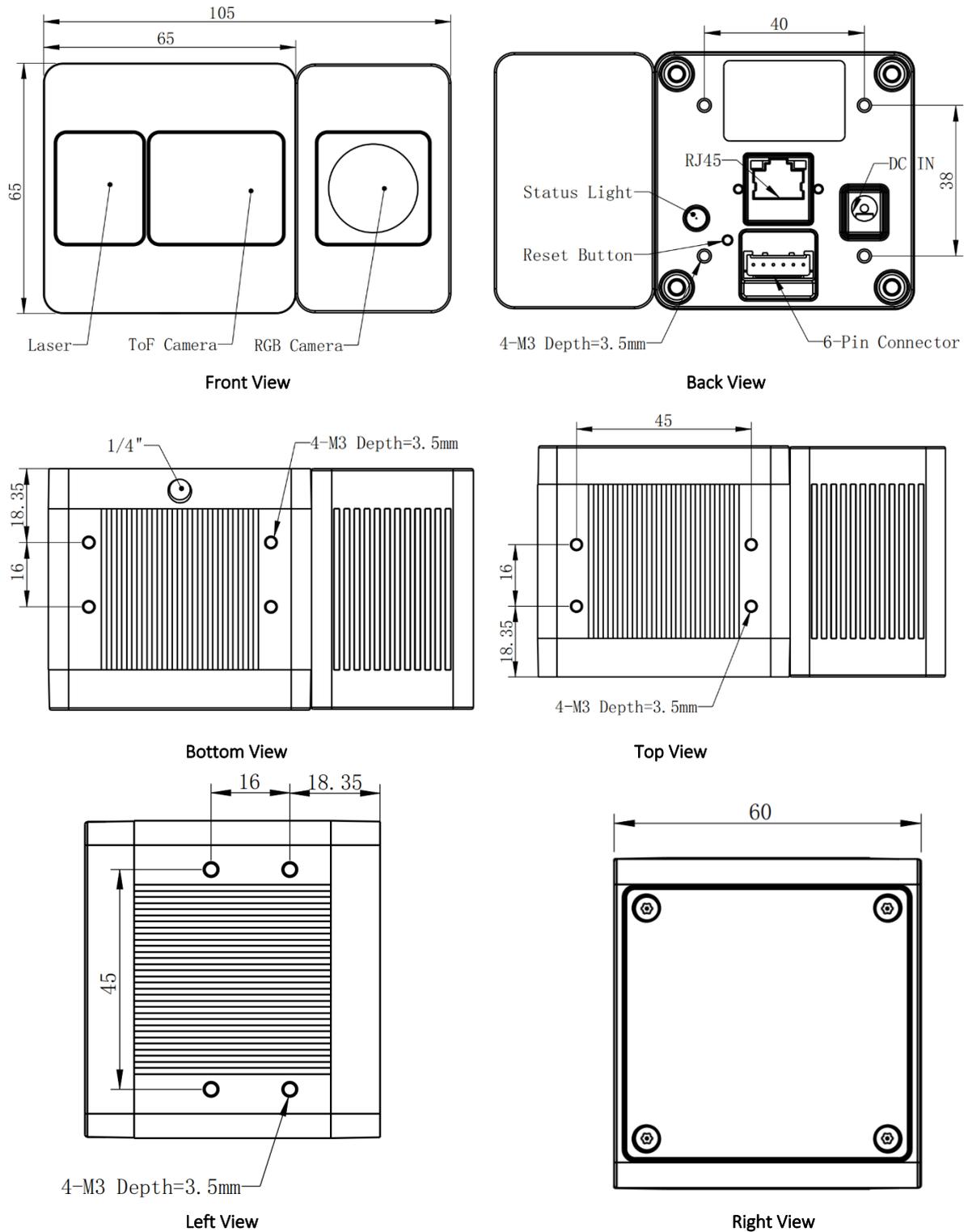
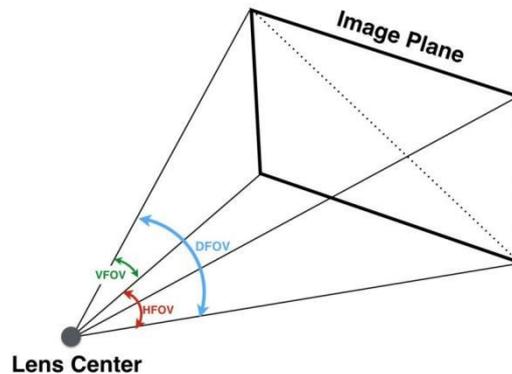


Fig. 3.4: ToF Camera Dimensions:(Unit:mm)

3.7 Optical Specifications

3.7.1 Field of View



The field of view refers to the view angle of the ToF products. The TOF sensor's aspect ratio is 4:3, typically the horizontal field of view is larger than the vertical field of view. The DFOV (see figure below) is the angle subtended by the diagonal of the camera sensor onto the center of the lens.

The definition of HFOV and VFOV can be exchanged, i. e. we can rotate the camera sensor to have larger FOV at vertical direction.

Typical FOV of DS77 Series is $70^{\circ} \times 50^{\circ}$, we can do FOV customization if the customer requires, and reasonable NRE fee shall be charged.

3.7.2 Wavelength of the VCSEL

All our product are based on VCSEL laser. We have variety choices according to the lens FOV and wavelength. The laser FOV must match to the lens FOV, and the wider FOV products need stronger power, therefore higher power consumption. Even with higher power supplied, the laser power per angle of the wider FOV product may be reduced, so normally the maximum distance of wider FOV products is shorter than narrower FOV products.

As for the wavelength, we have 850nm and 940nm laser selection. Because of the silicon process based ToF sensor, the ToF sensor's QE of 850nm is much better than it of 940nm. That means normally 850nm product can reach longer distance or the same distance with lower power consumption;

But the 940nm wavelength has better performance under strong sunlight, especially when the ambient light is stronger than 20K LUX.

Below are the laser choices we can provide, if you have other needs, please let us know.

H70°, V55°--- 2W, 940nm

H110°, V85°--- 2W, 850nm

3.8 Working Condition Requirements

3.8.1 Hardware Requirements

DS77 Pro&DS77C Pro:

- CAT6A Ethernet cable (Included in package)
- 8 PIN A CODE Multiple Functional cable. (Included in package)

Or

- PoE+ Power Supplier. (Not included in package)

DS77 Lite&DS77C Lite:

- CAT5 Ethernet cable (Included in package)
- 6 PIN cable which provide interface with host. (Included in package)
- DC Power cable. (Included in package)

3.8.2 Software Requirements

Operating system

- 32-bit Windows 7/10/11
- 64-bit Windows 7/10 (recommended)/11
- Linux (x86, x64)

Vzense ToF Driver

The Vzense ToF Driver software is available for Windows, Linux, ARM Linux operating systems and includes the following:

- SDK code
- Sample code
- Software user manual

3.8.3 Environmental Requirements

Temperature and Humidity

Housing temperature during operation:	-20–50 °C
Humidity during operation:	20–80 %, relative
Storage temperature:	-30–70 °C
Storage humidity:	20–80 %, relative

Heat Dissipation

Users can provide sufficient heat dissipation, like mounting the camera on a substantial, thermally conductive component that can act as a heat sink. Or a fan can be used to provide

an air flow over the camera.

3.8.4 Coordinate of the Camera System

There are two coordinate system need to be understood, one is camera coordinate system (CCS), one is world coordinate system (WCS).

CCS: CCS describe the two-dimensional data, the origin of coordinates is the optic center.

WCS: WCS describe the three-dimensional information.

The CCS data can switch to the WCS data using the camera internal parameters.

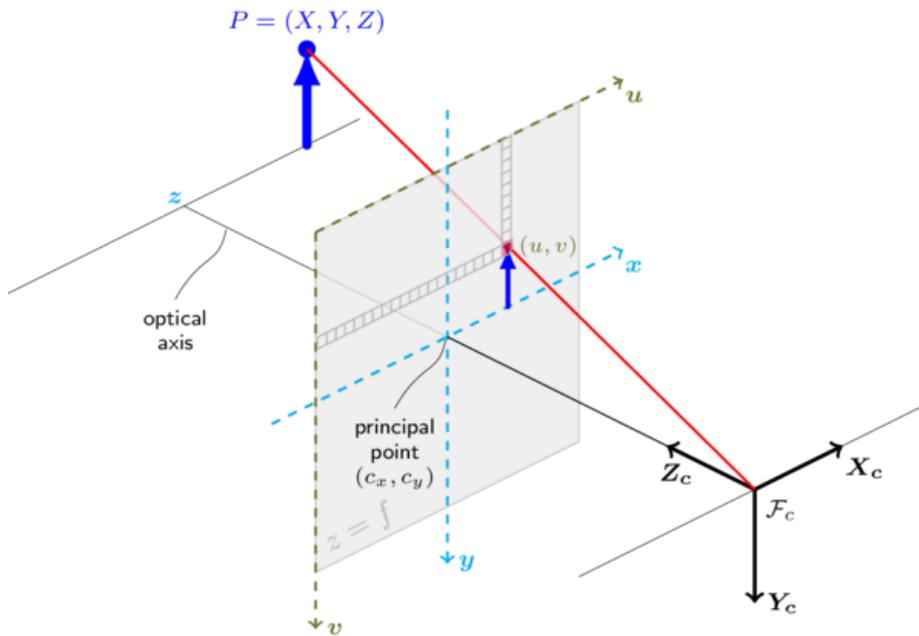
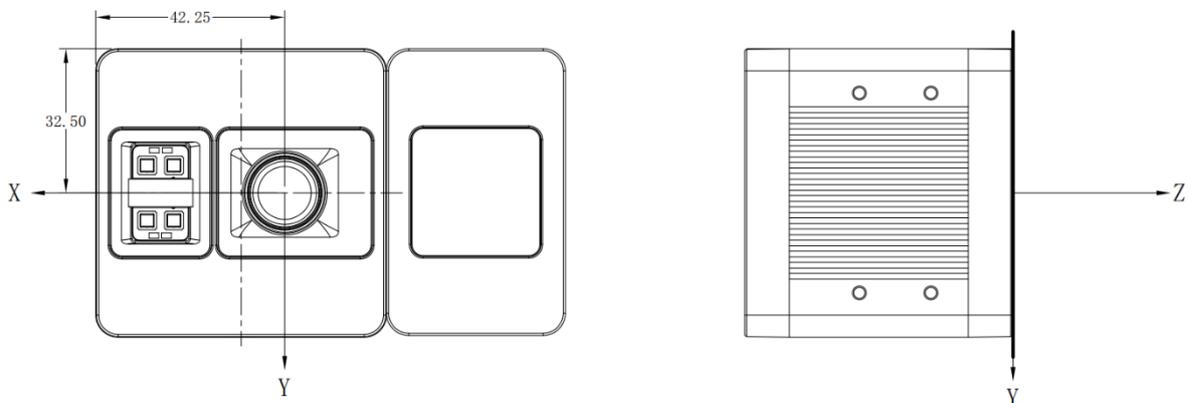


Fig. 3.5: Origin of the Coordinate System

The origin of the coordinate system is defined as the below figure shows:

1. X coordinate locates 32.5mm from the top edge of the camera;
2. Y coordinate locates 42.25mm from the left edge of the camera;
3. Z coordinate is zero offset at the front of the camera housing;



MeshLab and CloudCompare tools are recommended to analyze the point cloud data saved by Vzense software or SDK method.

4 Interface with Host

4.1 DS77 Pro&DS77C Pro Interface

DS77 Pro&DS77C Pro is equipped with two M12 aviation connectors at the back of its housing as shown in below figure.

For more information about pin assignments and connector types, see the following sections.

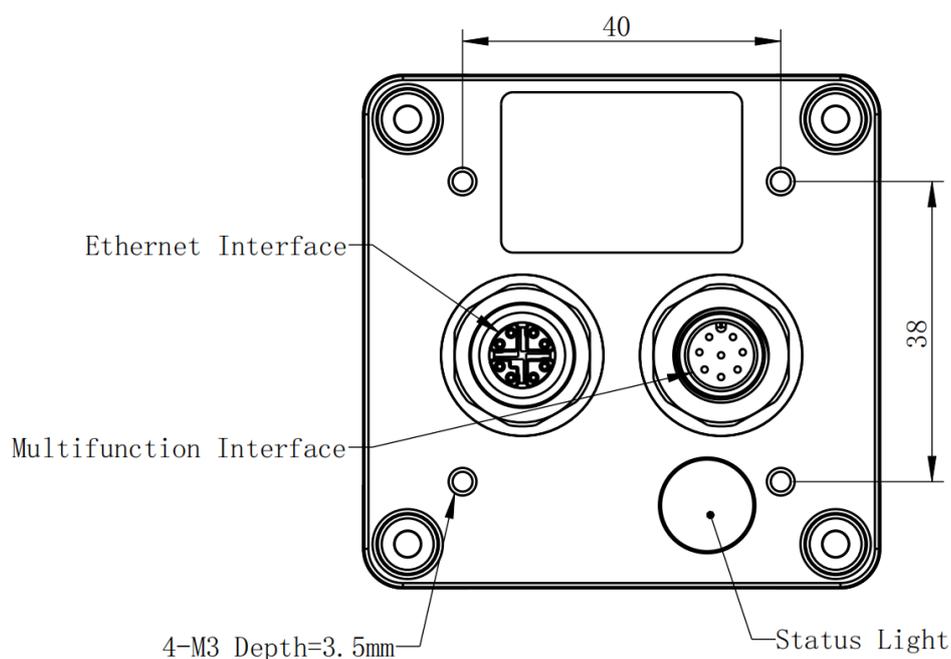


Figure 4.1 DS77 Pro Interface

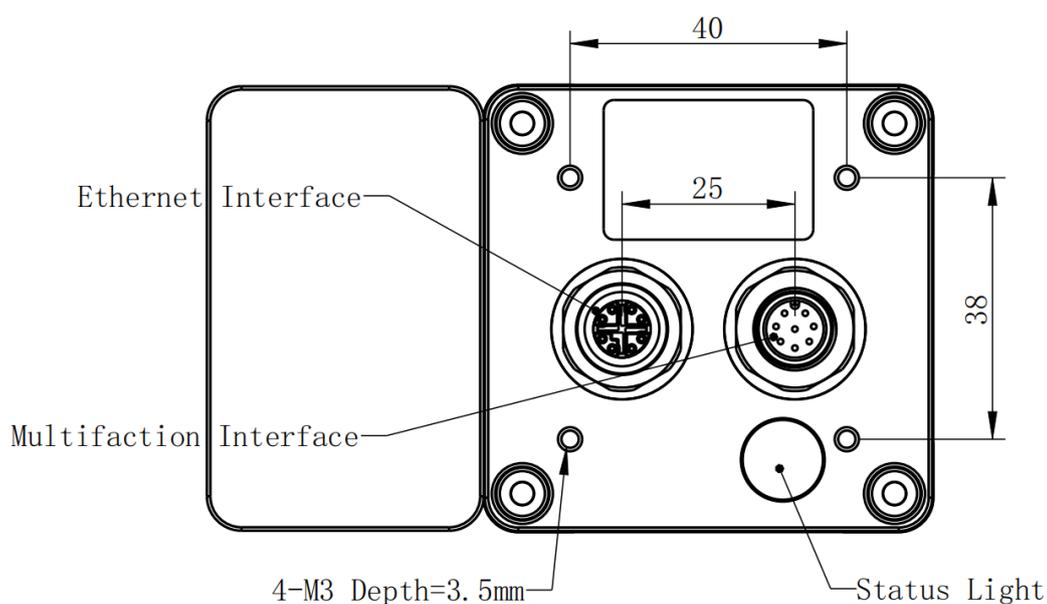
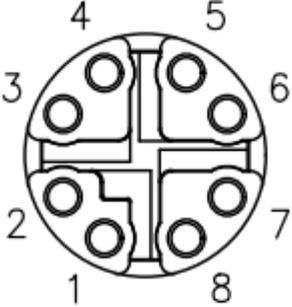
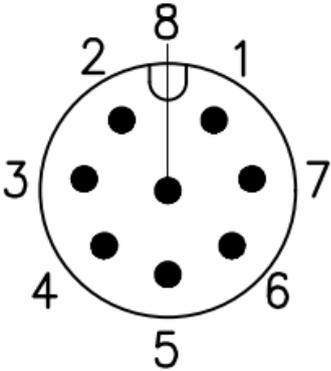


Figure 4.2 DS77C Pro Interface

8PIN-X CODE Ethernet Interface

	Pin	Designation	Description
	1	TX_D1+	Tranceive Data+
	2	TX_D1-	Tranceive Data-
	3	RX_D2+	Receive Data+
	4	RX_D2-	Receive Data-
	5	BI_D4+	Bi-directional Data+
	6	BI_D4-	Bi-directional Data-
	7	BI_D3-	Bi-directional Data-
8	BI_D3+	Bi-directional Data+	

8PIN-A CODE Multiple Functional Interface

	Pin	Line Color	Designation
	1	BLACK	GND
	2	RED	VCC
	3	BROWN	RS485-A
	4	GREEN	RS485-B
	5	WHITE	Ext_Trigger
	6	YELLOW	NC
	7	BLACK	GND
8	BLUE	IP RESET	

Pin	Designation	Direction	Description
1.7	GND	GND	GND
2	VCC	Power	DC 12-24V
3	RS485-A	I/O	RS485-A
4	RS485-B	I/O	RS485-B
5	Ext_Trigger	INPUT	External trigger input (3.3V-20V)
8	IP RESET	INPUT	Pull high (3.3V-20V) for 10 seconds then the IP is reset as 192.168.1.101.

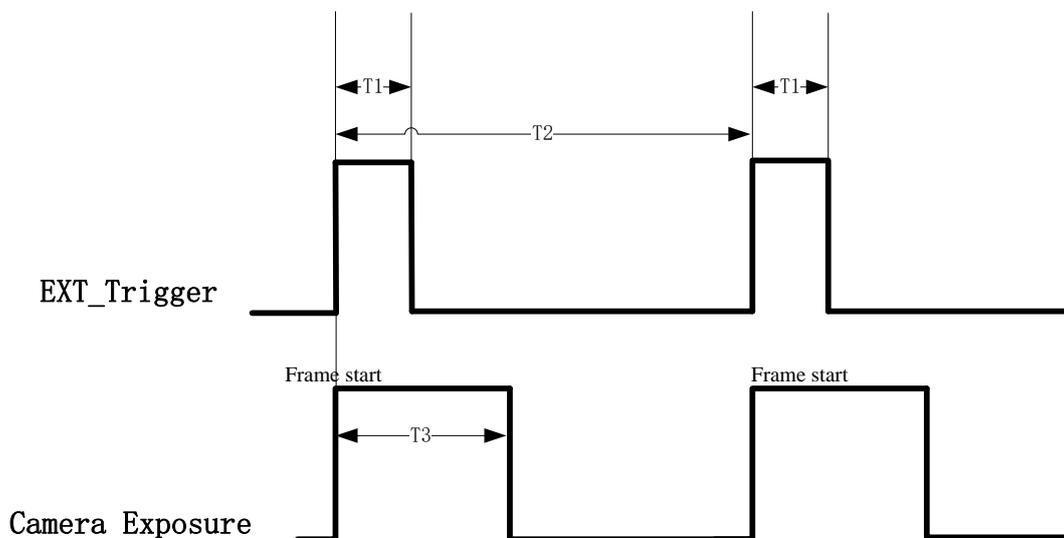
Hardware Trigger Function

Hardware trigger mode is available only when the camera works at slave mode, in slave mode the camera will wait for the hardware trigger signal on Ext_Trigger.

The EXT_Trigger signal is to driver the MOSFET, External input trigger signal voltage should range 3.3V-20V, driving current ability should be more than 5mA;

You can use input pin Ext_Trigger to send a hardware trigger signal to the camera. The hardware trigger can be used to trigger the acquisition start. **A hardware debouncer circuit shall be considered on the EXT_Trigger line.**

By default, the hardware trigger is **rising edge** activated, refer to below exposure timing:



The requirement to T1 should be from 100us to 2ms;

T2 means the interval between two trigger signals, it MUST be more than 33ms;

T3 means the exposure time of the frame, it varies according to the range mode;

4.2 DS77&DS77C Lite Interface

DS77C Lite is equipped with RJ45, LED, 6pin connector, IP reset button at the back of its housing as shown in below figure.

For more information about pin assignments and connector types, see the following sections.

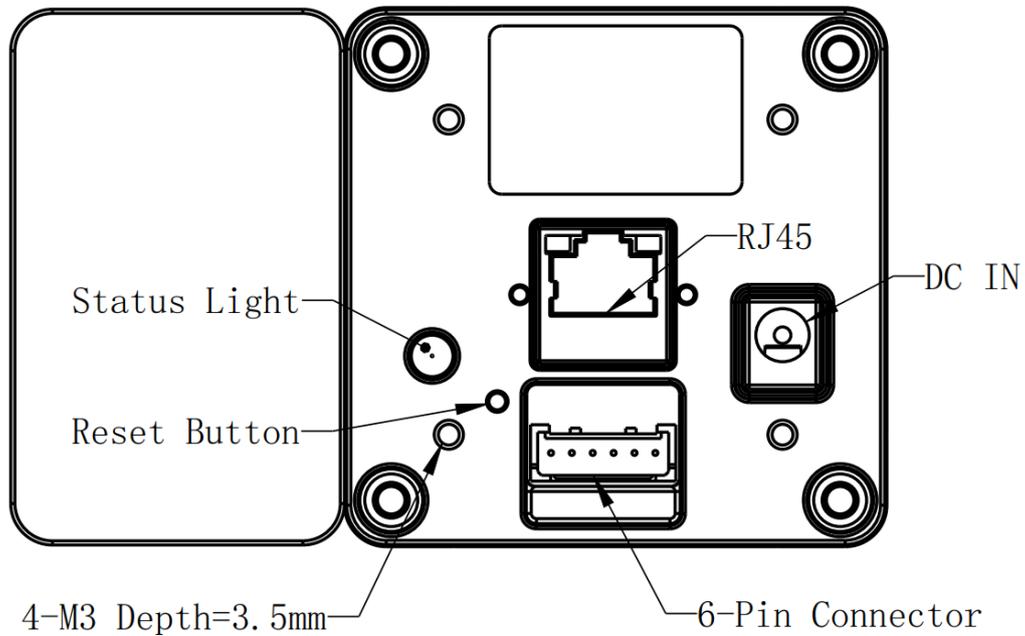


Figure 4.3 DS77C Lite Interface

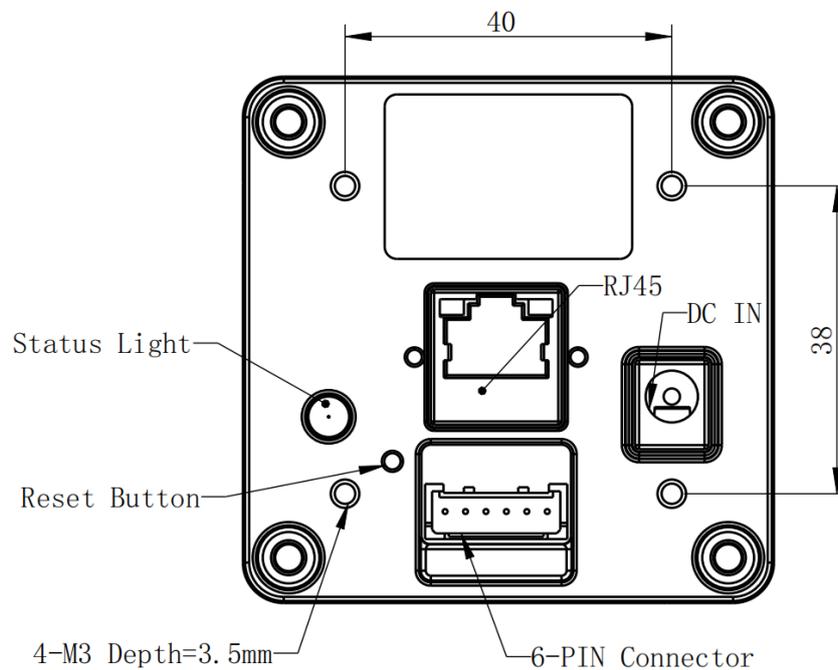


Figure 4.4 DS77 Lite Interface

6PIN Connector for DS77C Lite

The 6pin connector includes the one physical input signals and one physical output signal, RS485 signal.

The pin assignments and pin numbering for the receptacle are as shown in below table. The connector of the camera is a Molex receptacle, part number 535170630. The recommended mating connector is a Molex plug, part number 511030600.

Pin	Line Color	Designation
1	BROWN	RS485-A
2	GREEN	RS485-B
3	WHITE	Ext_Trigger
4	YELLOW	NC
5	BLACK	GND
6	RED	NC

Pin Description

Pin	Designation	Direction	Description
1	RS485-A	I/O	RS485-A
2	RS485-B	I/O	RS485-B
3	Ext_Trigger	INPUT	External trigger input (3.3V-20V)
5	GND	GND	System ground

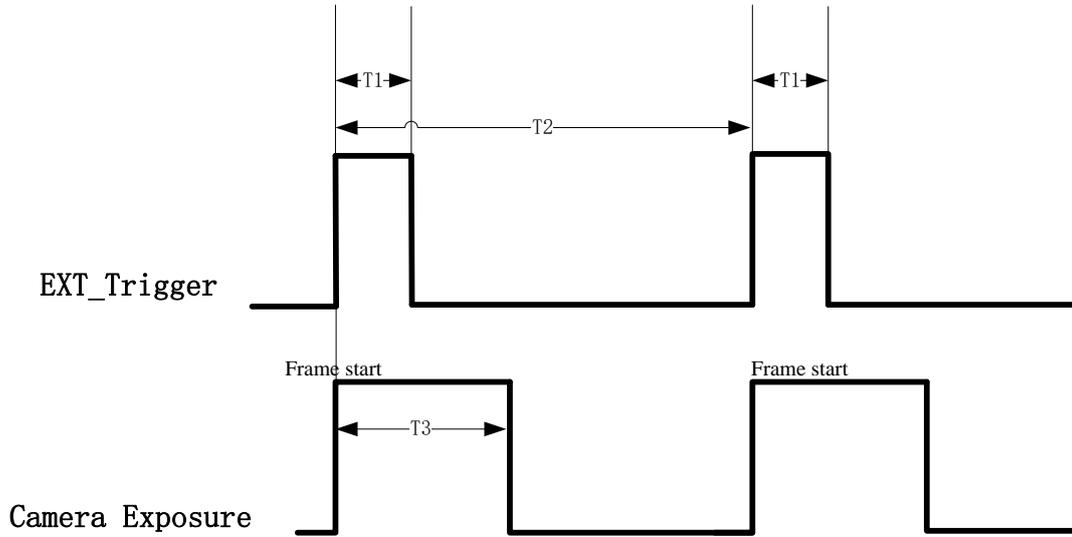
Hardware Trigger Function

Hardware trigger mode is available only when the camera works at slave mode, in slave mode the camera will wait for the hardware trigger signal on Ext_Trigger.

The EXT_Trigger signal is to driver the MOSFET, External input trigger signal voltage should range 3.3V-20V, driving current ability should be more than 5mA;

You can use input pin Ext_Trigger to send a hardware trigger signal to the camera. The hardware trigger can be used to trigger the acquisition start. **A hardware debouncer circuit shall be considered on the EXT_Trigger line.**

By default, the hardware trigger is **rising edge** activated, refer to below exposure timing:

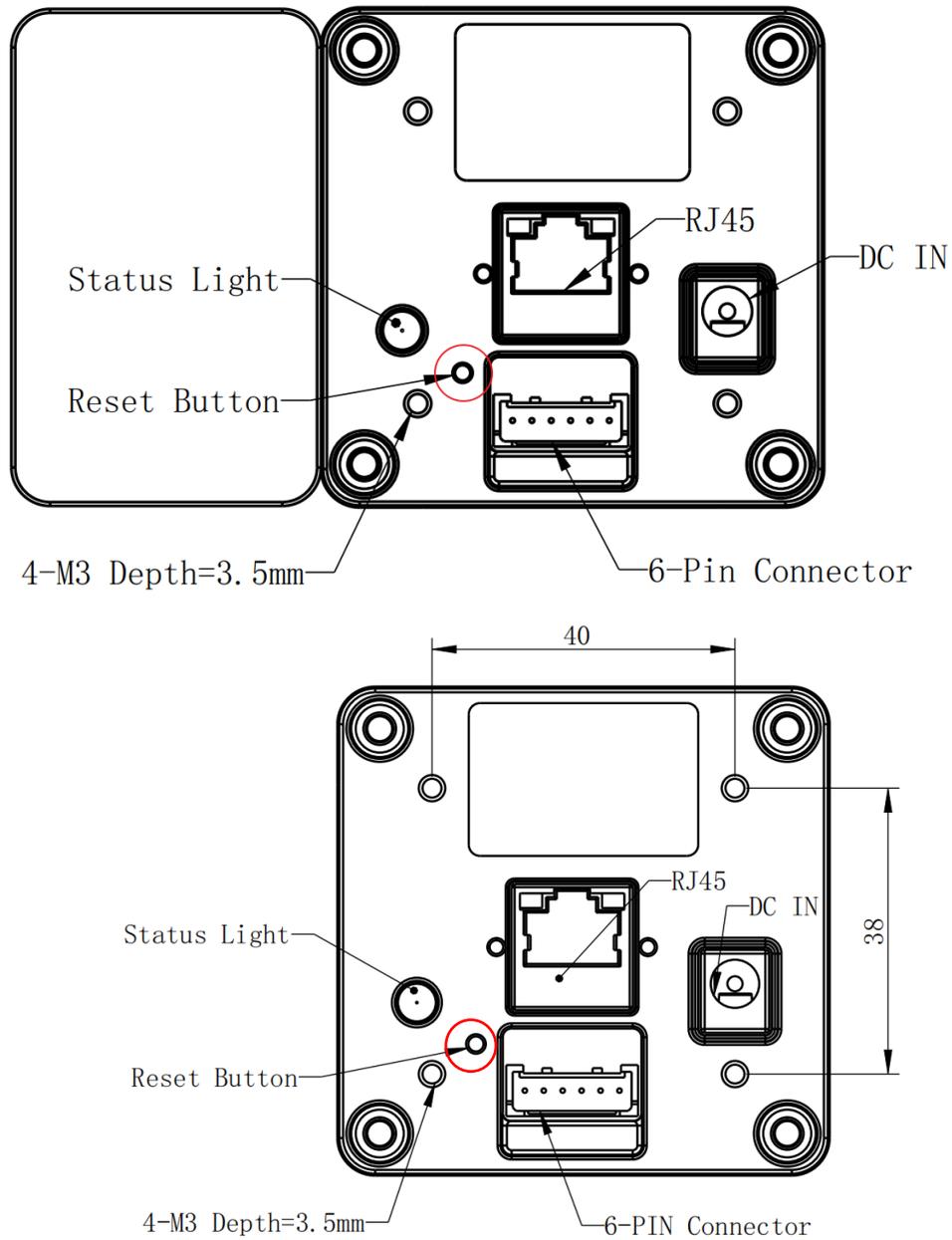


The requirement to T1 should be from 100us to 2ms;

T2 means the interval between two trigger signals, it MUST be more than 33ms;

T3 means the exposure time of the frame, it varies according to the range mode;

IP Reset Button for DS77C Lite



A hidden button hole is for IP reset, a pin shall be used to press the button. While the camera is powered on, long pressing the button for 10 seconds until the LED is off. Then the IP is reset as 192.168.1.101.

4.3 LED Indication

An LED at the back side of the camera indicates the camera status.
The LED animation table is shown as below:

Ethernet Broadcast, no connection established, BLUE LED blinking repeatedly



Ethernet connection established, BLUE LED constantly on



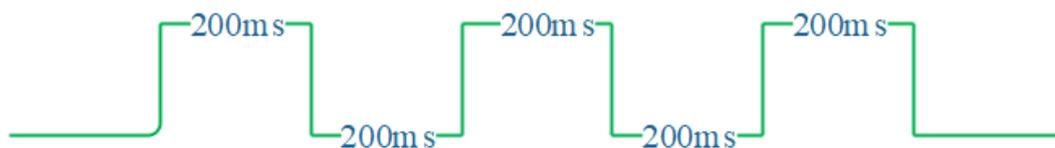
IP RESET, Press the IP RESET button for 5 seconds, PURPLE LED is on for 5 seconds and blink twice then the product reset itself.



Firmware Upgrade, WHITE LED is on until firmware upgrade finished



ToF driver Upgrade, GREEN LED blinking repeatedly



5 Installation

5.1 Hardware Installation

You have read and understood the warnings listed under "Precautions" on Chapter 2;
To achieve reliable distance measurements, please follow below tips:

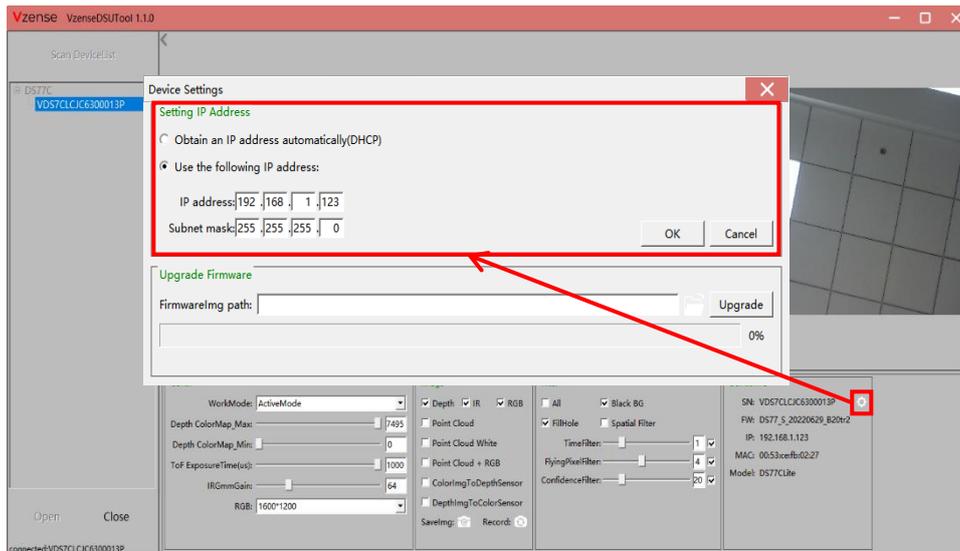
- Better not using the camera in strong sunlight. If have to, keep the ambient light
- below 50k Lux.
- Do NOT place any objects in the scene that are not part of your intended
- target, especially mirrors or other shiny surfaces/objects.
- Maintain a stable housing temperature during operation.
- Take measures to provide cooling to camera
- Mount the camera robustly.
- All accessories are ready

5.1.1 DS77 Pro&DS77C Pro Installation Steps

The steps are as below:

1. Mount the camera in an appropriate fixture, e.g. a camera bracket;
2. Connect the DS77 Pro&DS77C Pro ToF camera to the host processor with the Ethernet cable, the standard RJ45 socket locates at the back of the DS77 Pro&DS77C Pro camera;
3. Insert the DC connector of the power supply adaptor into the 12V DC Jack at the back of the camera;
4. Connect the adaptor to power source;
5. Please do set the IP address of the camera and host PC in the same segment;
6. The default IP address of DS77 Pro&DS77C Pro is 192.168.1.101, you can change the IP address by the NebulaGUITool;

Please do read the document before reconfigure the camera:



5.1.2 DS77 Lite&DS77C Lite Installation Steps

DS77 Lite&DS77C Lite product transmits the required data to host by Ethernet cable, and it doesn't support Power over Ethernet, so the power adaptor shall be used.

The steps are as below:

1. Mount the camera in an appropriate fixture, e.g. a camera bracket;
2. Insert the DC connector of the power supply adaptor into the 12V~24V DC Jack at the back of the camera;
3. Connect the adaptor to power source;
4. Please do set the IP address of the camera and host PC in the same segment;
5. The default IP address of DS77 Lite&DS77C Lite is 192.168.1.101, you can change the IP address by the NebulaGUITool ;

Please do read the document before reconfigure the camera:

5.1.3 POE Mode Installation (Only For DS77 Pro&DS77C Pro)

What is PoE+ (Power Over Ethernet)

Power over Ethernet (PoE+) is a technology that lets network cables carry electrical power. It simplifies the topology of the Ethernet system by reducing the dedicated power cable, a PoE switch or injector shall be in use to support the PoE feature.

For Vzense DS77 Series camera, the POE Switch or POE injector needs to support IEEE 802.3at-2009 standard also known as PoE+, which can provide up to 25.5W, or IEEE 802.3bt-2018 standard also known as PoE++, which can provide up to 60W. Otherwise the product may not work well at long range mode.

We can provide optional PoE switch or PoE injector to our customers, please try to contact the sales for the quotation and more information.

Steps to Setup PoE Mode

As mentioned above, a PoE switch or PoE injector shall be in use to setup the PoE;

The steps are as below:

1. Mount the camera in an appropriate fixture, e.g. a camera bracket;
2. Plug one end of the Ethernet cable into the RJ45 socket at the back of the camera, and plug the RJ45 end into the Ethernet port of your PoE switch or PoE injector;
3. Connect the PoE switch or PoE injector to your host processor by Ethernet cable;
4. Connect the PoE switch or PoE injector to power source;

5.2 Software Installation

5.2.1 Nebula SDK

Nebula SDK is a cross platform software development kit designed by Vzense team. It can support DS77 series products and contains multiple versions on different operation systems, including **Windows, Linux, Arm Linux, ROS, C#, PYTHON** etc...

Download or clone SDK project from our GitHub /Gitee:

China: <https://gitee.com/Vzense/NebulaSDK>

Oversea: <https://github.com/Vzense/NebulaSDK>

5.2.2 NebulaGUITool

NebulaGUITool is a graphic tool on windows for the all Vzense DS77 Series products.

Download or clone NebulaGUITool evaluation tool from our GitHub /Gitee:

China: <https://gitee.com/Vzense/NebulaGUITool>

Oversea: <https://github.com/Vzense/NebulaGUITool>

Please do read the Vzense_DSUTool_User_guide.pdf in the folder before using.

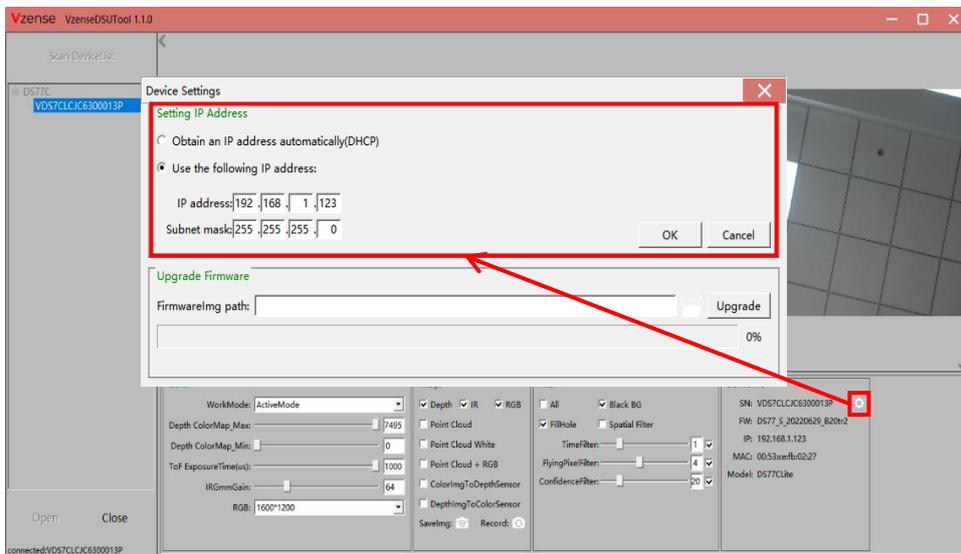
5.2.3 Frameviewer

Frameviewer is an opensource application in SDK project that can guide user how to call the SDK APIs. It has a pre-build version app in Tools folder, the source code is in Samples folder. See the document for the details.

Include	update ver1.0.8
Lib	update ver1.0.8
Samples	update ver1.0.8
Thirdparty/opencv-3.4.1	first version on ubuntu18.04
Tools	update ver1.0.8
ReleaseNotes.txt	update ver1.0.8
install.sh	first version on ubuntu18.04

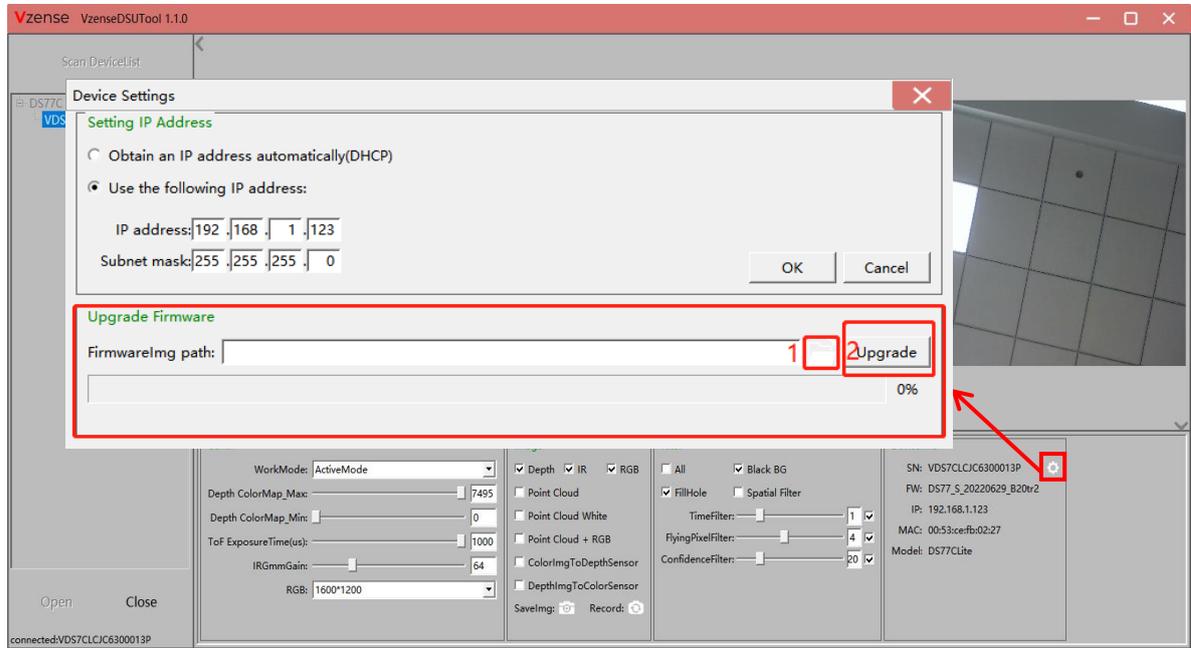
5.2.4 Default IP address

The default IP address of the DS77 Series is 192.168.1.101, if you want to set the IP with others or enable DHCP method, please use Vzense NebulaGUITool to change the default setting:

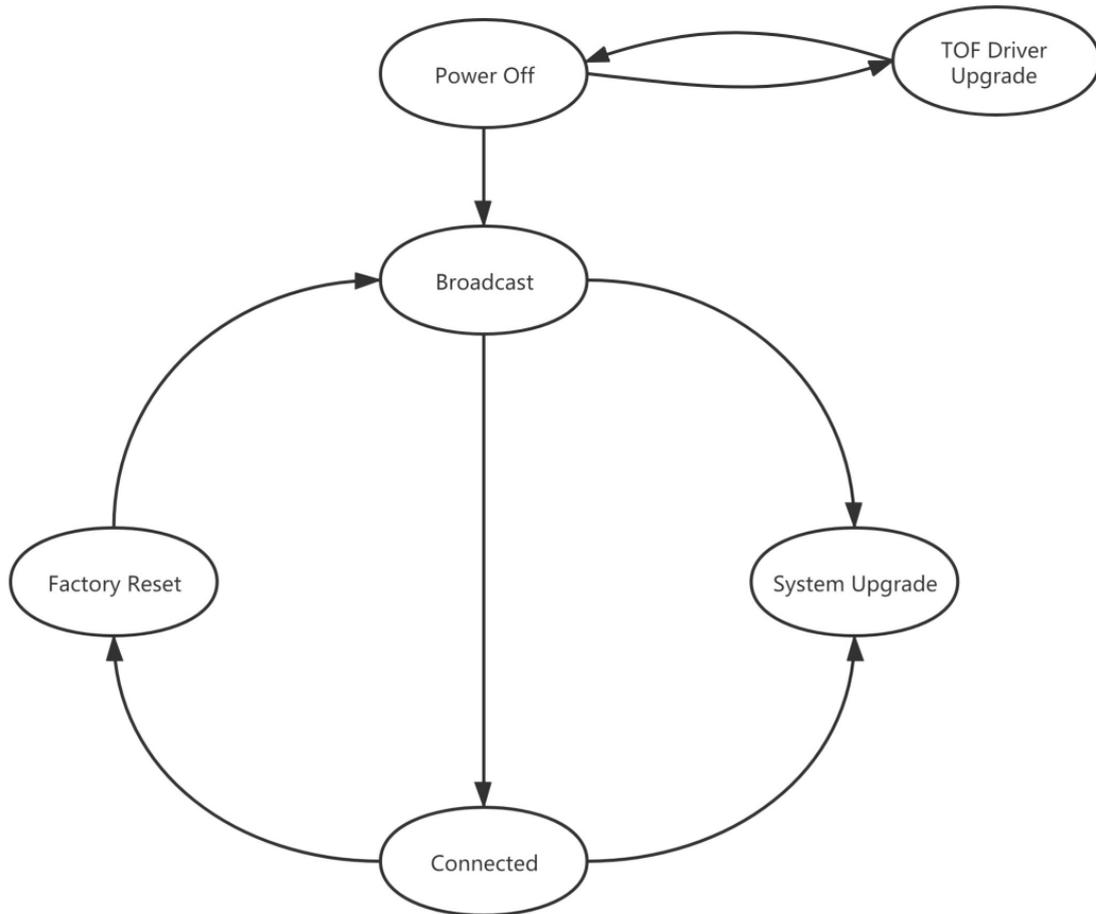


5.3 Firmware Upgrade

The user can use NebulaGUITool to upgrade the firmware of the DS77 products
Please read the Vzense_NebulaGUITool_User_Guide.pdf before upgrading firmware.



5.4 Product State Machine



- Power Off: product do not have any power
- Broadcast: broadcast IP address, socket have not connected
- Connected: socket is connected, product can transfer image and answer host command
- Factory Reset: resume all data to factory setting
- TOF Driver Upgrade: product is in upgrading of TOF driver
- System Upgrade: product is in upgrading of firmware

6 Features

6.1 Slave Trigger Mode

6.1.1 Hardware Trigger Mode

At Hardware slave trigger mode, the DS77 product outputs image only at every trigger signal happens.

Step 1: set the DS77 product as hardware slave trigger mode by a software API;

Please refer to the sample code of Vzense DS77 hardware slave trigger mode;

Step 2: Feed the DS77 with a correct hardware trigger signal.

Please refer to **Chapter 4.1 or Chapter 4.2** for the requirement to the hardware trigger signal; A hardware trigger source could be generated by a MCU GPIO or any clock source which can meet the requirement.

6.1.2 Software Slave Trigger Mode

At software slave trigger mode, the DS77 product outputs image only at every trigger API call.

Step 1: set the DS77 product as software slave trigger mode by a software API;

Step 2: Call the API of software trigger to issue a frame start;

Please refer to the sample code of Vzense DS77 software slave trigger mode;

6.2 Exposure Time Configuration

6.2.1 Auto Exposure

At auto exposure mode, the DS77 products can automatically set the exposure time, according to the environment around. Basically, the more near object, the lower the exposure time will be, it has maximum exposure time limitation. And the maximum exposure time depends on the frame rate, the lower frame rate, the bigger maximum exposure time.

Frame rate	Maximum exposure time
5fps	4000
10fps	3000
15fps	2000
20fps	1500
25fps	1000

6.2.2 Manual Exposure

The user can set the DS77 product at manual exposure mode, with a fixed exposure time. The value of maximum exposure time depends on the frame rate.

Frame rate	Maximum exposure time(us)
5fps	4000
10fps	3000
15fps	2000
20fps	1500
25fps	1000

6.3 Data Filtering

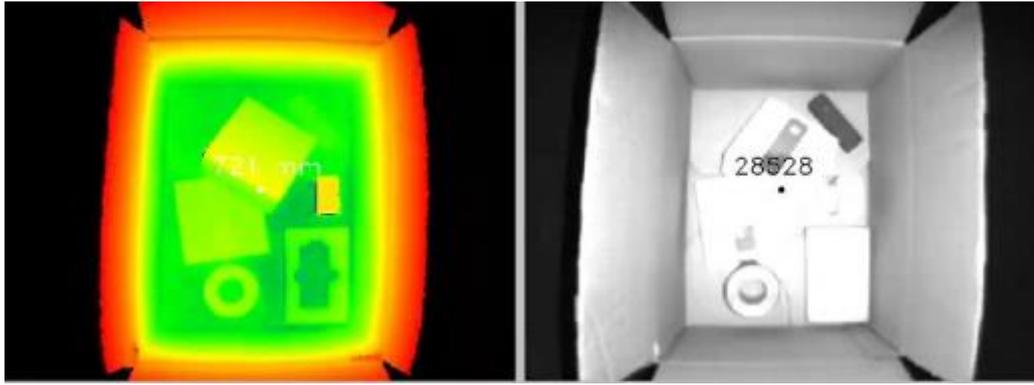
In the software SDK and Frameviewer, we implemented data filtering to improve the depth data performance.

The filtering algorithm includes:

- Median filtering;
- Gaussian filtering;
- Bilateral filtering;
- Timing filtering;
- Confidence filtering;
- Flying pixel removing;

6.4 IR Image

Besides the depth image, Vzense DS77 Series camera can also output a VGA resolution IR image. And the IR image is exactly timing synchronized with the depth image. Pixel to pixel mapping is also exactly aligned.



7 DS77 Series Accessories and Package

In package item list:

DS77 Pro&DS77C Pro

Part No.	Description	Picture																																				
DS77 Pro&DS77C Pro	Vzense DS77 Pro&DS77C Pro Depth Camera Module																																					
814000300025	-CAT6a Ethernet Cable, 26AWG 4 Pair, shielded Twisted Pair; -Aviation Connector to RJ45 -Cord Length: 3m																																					
814000300026	-8PIN A CODE Multiple Functional Cable -Cord Length: 2m <table border="1"> <thead> <tr> <th>No.</th> <th>Color</th> <th>Wire Gauge</th> <th>Signal</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>BLACK</td> <td></td> <td>GND</td> </tr> <tr> <td>2</td> <td>RED</td> <td></td> <td>VCC</td> </tr> <tr> <td>3</td> <td>BROWN</td> <td></td> <td>RS485-A</td> </tr> <tr> <td>4</td> <td>GREEN</td> <td></td> <td>RS485-B</td> </tr> <tr> <td>5</td> <td>WHITE</td> <td></td> <td>Ext_Trigger</td> </tr> <tr> <td>6</td> <td>YELLOW</td> <td></td> <td>NC</td> </tr> <tr> <td>7</td> <td>BLACK</td> <td></td> <td>GND</td> </tr> <tr> <td>8</td> <td>BLUE</td> <td></td> <td>IP RESET</td> </tr> </tbody> </table>	No.	Color	Wire Gauge	Signal	1	BLACK		GND	2	RED		VCC	3	BROWN		RS485-A	4	GREEN		RS485-B	5	WHITE		Ext_Trigger	6	YELLOW		NC	7	BLACK		GND	8	BLUE		IP RESET	
No.	Color	Wire Gauge	Signal																																			
1	BLACK		GND																																			
2	RED		VCC																																			
3	BROWN		RS485-A																																			
4	GREEN		RS485-B																																			
5	WHITE		Ext_Trigger																																			
6	YELLOW		NC																																			
7	BLACK		GND																																			
8	BLUE		IP RESET																																			
VZENSE-UGDS77	User guide																																					

DS77 Lite&DS77C Lite

Part No.	Description	Picture																					
DS77 Lite&DS77C Lite	Vzense DS77 Lite&DS77C Lite Depth Camera Module																						
814000600015	-CAT5e Ethernet Cable, 24AWG 4 Pair, Unshielded Twisted Pair -Cord Length: 3m																						
814000300019	-DC 12V~24V Input -DC Plug: 5.5±0.1mm*2.1+0.1/-0mm*11.5±0.5mm -Cord Length: 2m -RED: DC 12V~24V input, BLACK: GND																						
814000300014	-6pin Multiple Functional Cable(RS485, EXT IO) -Cord Length: 1m <table border="1" data-bbox="454 1131 1061 1433"> <thead> <tr> <th>No.</th> <th>Color</th> <th>Signal</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>BROWN</td> <td>RS485-A</td> </tr> <tr> <td>2</td> <td>GREEN</td> <td>RS485-B</td> </tr> <tr> <td>3</td> <td>WHITE</td> <td>Ext_Trigger</td> </tr> <tr> <td>4</td> <td>YELLOW</td> <td>NC</td> </tr> <tr> <td>5</td> <td>BLACK</td> <td>GND</td> </tr> <tr> <td>6</td> <td>RED</td> <td>NC</td> </tr> </tbody> </table>	No.	Color	Signal	1	BROWN	RS485-A	2	GREEN	RS485-B	3	WHITE	Ext_Trigger	4	YELLOW	NC	5	BLACK	GND	6	RED	NC	
No.	Color	Signal																					
1	BROWN	RS485-A																					
2	GREEN	RS485-B																					
3	WHITE	Ext_Trigger																					
4	YELLOW	NC																					
5	BLACK	GND																					
6	RED	NC																					
VZENSE-UGDS77	User guide																						

You can ask Vzense to do customization to the cable for any reason, for example extending the cable length.

Please do NOT use the accessories from other parts except Vzense Company, otherwise warranty will void.

Optional item list:

Item	Component	Description	Quantity
1	H3C EWPAM2NPOE	802.3at PoE Injector	1

Optional items need customer to pay for.

8 Customization Service

Vzense team has rich experience in ToF product design and delivery, we welcome customer to send customization requirement besides the standard module. Reasonable NRE fee shall be charged depends on the requirement.

Appendix

ROHS Declaration

Laser Specification



CAUTION

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed.3., as described in Laser Notice No. 56, data May 8, 2019.

The following Class1 laser label is located on the bottom of the sensor.



Manufacturer

Name: Qingdao Vzense Technology Co., Ltd.

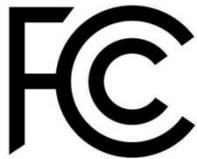
Address: 3 Building, Qingdao Research Institute of Beihang University, No. 393 Songling Road, Laoshan District, Qingdao, Shandong

Factory

Name: Qingdao Vzense Technology Co., Ltd.

Address: 3 Building, Qingdao Research Institute of Beihang University, No. 393 Songling Road, Laoshan District, Qingdao, Shandong

FCC Statement



This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Caution: Any changes or modifications not expressly approved by Vzense Technology for compliance could void the user's authority to operate this equipment.

Revision History

Revised on	Version	Description	Approved by
25-Jul-2022	1.0	Add appendix with laser spec and manufacturer information per requirement by compliance test	