User Manual

# ICAM-540 Series

## Integrated Industrial AI Camera

ADVANTECH

*Enabling an Intelligent Planet*

# Copyright



# Acknowledgments

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# Product Warranty (2 years)

Advantech warrants the original purchaser that each of its products will be free from defects in materials and workmanship for two years from the date of purchase.

This warranty does not apply to any products that have been repaired or altered by persons other than repair personnel authorized by Advantech, or products that have been subject to misuse, abuse, accident, or improper installation. Advantech assumes no liability under the terms of this warranty as a consequence of such events.

Because of Advantech's high quality-control standards and rigorous testing, most customers never need to use our repair service. If an Advantech product is defective, it will be repaired or replaced free of charge during the warranty period. For out-of-warranty repairs, customers will be billed according to the cost of replacement materials, service time, and freight. Please consult your dealer for more details.

If you believe your product to be defective, follow the steps outlined below.

1. Collect all the information about the problem encountered. (For example, CPU speed, Advantech products used, other hardware and software used, etc.) Note anything abnormal and list any onscreen messages displayed when the problem occurs.
2. Call your dealer and describe the problem. Please have your manual, product, and any helpful information readily available.
3. If your product is diagnosed as defective, obtain a return merchandise authorization (RMA) number from your dealer. This allows us to process your return more quickly.
4. Carefully pack the defective product, a completed Repair and Replacement Order Card, and a proof of purchase date (such as a photocopy of your sales receipt) into a shippable container. Products returned without a proof of purchase date are not eligible for warranty service.
5. Write the RMA number clearly on the outside of the package and ship the package prepaid to your dealer.

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# Declaration of Conformity

## CE

This product has passed the CE test for environmental specifications when shielded cables are used for external wiring. We recommend the use of shielded cables. This type of cable is available from Advantech. Please contact your local supplier for ordering information.

Test conditions for passing also include the equipment being operated within an industrial enclosure. In order to protect the product from damage caused by electrostatic discharge (ESD) and EMI leakage, we strongly recommend the use of CE-compliant industrial enclosure products.

## FCC Class A

Note: 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 their own expense.

## FM

This equipment has passed the FM certification. According to the National Fire Protection Association, work sites are classified into different classes, divisions and groups, based on hazard considerations. This equipment is compliant with the specifications of Class I, Division 2, Groups A, B, C and D indoor hazards.

# Technical Support and Assistance

1. Visit the Advantech website at www.advantech.com/support to obtain the latest product information.
2. Contact your distributor, sales representative, or Advantech's customer service center for technical support if you need additional assistance. Please have the following information ready before calling:
   - Product name and serial number
   - Description of your peripheral attachments
   - Description of your software (operating system, version, application software, etc.)
   - A complete description of the problem
   - The exact wording of any error messages

# Warnings, Cautions and Notes

***Warning!*** *Warnings indicate conditions, which if not observed, can cause personal injury!*

***Caution!*** *Cautions are included to help prevent hardware damage and data losses. For example,*

*"Batteries are at risk of exploding if incorrectly installed. Do not attempt to recharge, force open, or heat the battery. Replace the battery only with the same or equivalent type as recommended by the manufacturer. Discard used batteries according to the manufacturer's instructions."*

***Note!*** *Notes provide optional additional information.*

# Document Feedback

To assist us with improving this manual, we welcome all comments and constructive criticism. Please send all such feedback in writing to support@advantech.com.

# Safety Precaution - Static Electricity

Follow these simple precautions to protect yourself from harm and the products from damage.

- To avoid electrical shock, always disconnect the power from the PC chassis before manual handling. Do not touch any components on the CPU card or other cards while the PC is powered on.
- Disconnect the power before making any configuration changes. A sudden rush of power after connecting a jumper or installing a card may damage sensitive electronic components.

# Safety Instructions

1. Read these safety instructions carefully.
2. Retain this user manual for future reference.
3. Disconnect the equipment from all power outlets before cleaning. Use only a damp cloth for cleaning. Do not use liquid or spray detergents.
4. For pluggable equipment, the power outlet socket must be located near the equipment and easily accessible.
5. Protect the equipment from humidity.
6. Place the equipment on a reliable surface during installation. Dropping or letting the equipment fall may cause damage.
7. The openings on the enclosure are for air convection. Protect the equipment from overheating. Do not cover the openings.
8. Ensure that the voltage of the power source is correct before connecting the equipment to a power outlet.
9. Position the power cord away from high-traffic areas. Do not place anything over the power cord.
10. All cautions and warnings on the equipment should be noted.
11. If the equipment is not used for a long time, disconnect it from the power source to avoid damage from transient overvoltage.
12. Never pour liquid into an opening. This may cause fire or electrical shock.
13. Never open the equipment. For safety reasons, the equipment should be opened only by qualified service personnel.
14. If any of the following occurs, have the equipment checked by service personnel:
    - The power cord or plug is damaged.
    - Liquid has penetrated the equipment.
    - The equipment has been exposed to moisture.
    - The equipment is malfunctioning, or does not operate according to the user manual.
    - The equipment has been dropped and damaged.
    - The equipment shows obvious signs of breakage.
15. Do not leave the equipment in an environment with a storage temperature of below -20 °C (-4 °F) or above 60 °C (140 °F) as this may damage the components. The equipment should be kept in a controlled environment.
16. CAUTION: Batteries are at risk of exploding if incorrectly replaced. Replace only with the same or equivalent type as recommended by the manufacturer. Discard used batteries according to the manufacturer's instructions.
17. In accordance with IEC 704-1:1982 specifications, the sound pressure level at the operator's position does not exceed 70 dB (A).

DISCLAIMER: These instructions are provided according to IEC 704-1 standards. Advantech disclaims all responsibility for the accuracy of any statements contained herein.

# Wichtige Sicherheishinweise

1. Bitte lesen sie Sich diese Hinweise sorgfältig durch.
2. Heben Sie diese Anleitung für den späteren Gebrauch auf.
3. Vor jedem Reinigen ist das Gerät vom Stromnetz zu trennen. Verwenden Sie Keine Flüssig-oder Aerosolreiniger. Am besten dient ein angefeuchtetes Tuch zur Reinigung.
4. Die NetzanschluBsteckdose soll nahe dem Gerät angebracht und leicht zugänglich sein.
5. Das Gerät ist vor Feuchtigkeit zu schützen.
6. Bei der Aufstellung des Gerätes ist auf sicheren Stand zu achten. Ein Kippen oder Fallen könnte Verletzungen hervorrufen.
7. Die Belüftungsöffnungen dienen zur Luftzirkulation die das Gerät vor überhitzung schützt. Sorgen Sie dafür, daB diese Öffnungen nicht abgedeckt werden.
8. Beachten Sie beim. AnschluB an das Stromnetz die AnschluBwerte.
9. Verlegen Sie die NetzanschluBleitung so, daB niemand darüber fallen kann. Es sollte auch nichts auf der Leitung abgestellt werden.
10. Alle Hinweise und Warnungen die sich am Geräten befinden sind zu beachten.
11. Wird das Gerät über einen längeren Zeitraum nicht benutzt, sollten Sie es vom Stromnetz trennen. Somit wird im Falle einer Überspannung eine Beschädigung vermieden.
12. Durch die Lüftungsöffnungen dürfen niemals Gegenstände oder Flüssigkeiten in das Gerät gelangen. Dies könnte einen Brand bzw. elektrischen Schlag auslösen.
13. Öffnen Sie niemals das Gerät. Das Gerät darf aus Gründen der elektrischen Sicherheit nur von authorisiertem Servicepersonal geöffnet werden.
14. Wenn folgende Situationen auftreten ist das Gerät vom Stromnetz zu trennen und von einer qualifizierten Servicestelle zu überprüfen:
15. Netzkabel oder Netzstecker sind beschädigt.
16. Flüssigkeit ist in das Gerät eingedrungen.
17. Das Gerät war Feuchtigkeit ausgesetzt.
18. Wenn das Gerät nicht der Bedienungsanleitung entsprechend funktioniert oder Sie mit Hilfe dieser Anleitung keine Verbesserung erzielen.
19. Das Gerät ist gefallen und/oder das Gehäuse ist beschädigt.
20. Wenn das Gerät deutliche Anzeichen eines Defektes aufweist.
21. VOSICHT: Explisionsgefahr bei unsachgemaben Austausch der Batterie.Ersatz nur durch densellben order einem vom Hersteller empfohlene-mahnlichen Typ. Entsorgung gebrauchter Batterien navh Angaben des Herstellers.
22. ACHTUNG: Es besteht die Explosionsgefahr, falls die Batterie auf nicht fachmännische Weise gewechselt wird. Verfangen Sie die Batterie nur gleicher oder entsprechender Type, wie vom Hersteller empfohlen. Entsorgen Sie Batterien nach Anweisung des Herstellers.
23. Der arbeitsplatzbezogene Schalldruckpegel nach DIN 45 635 Teil 1000 beträgt 70dB(A) oder weiger.

Haftungsausschluss: Die Bedienungsanleitungen wurden entsprechend der IEC-704-1 erstellt. Advantech lehnt jegliche Verantwortung für die Richtigkeit der in diesem Zusammenhang getätigten Aussagen ab.

# Contents

# Chapter 1

## Product Overview

## 1.1 Introduction

The Advantech ICAM-540 series is an advanced industrial AI camera featuring programmable variable focus lenses, LED illumination, a high-quality SONY 4K industrial-grade image sensor, multi-core ARM processors, and an NVIDIA Orin NX system on module. Its varifocal lens and integrated LED illumination simplify both installation and maintenance.

With support for the CAMNavi SDK, which is Python-based, and the NVIDIA DeepStream SDK, the ICAM-540 series streamlines the development and deployment of cloud-to-edge vision AI solutions. The CAMNavi SDK is optimized for image acquisition and AI algorithm integration, while the HTML5 web utility facilitates easy camera setup and network configuration, reducing installation complexity.

Additionally, the camera comes with a preloaded and optimized Jetpack board support package, featuring V4L2 and RTSP interfaces for seamless AI cloud service connectivity. Compact, rugged, and versatile, the Advantech ICAM-540 is an all-in-one solution ideal for various edge AI vision applications.

## 1.2 Product Features

- 8MP @30FPS, SONY industrial grade sensor
- S-mount programmable variable focus lens or C-mount lens
- NVIDIA Jetson Orin system on module
- Advanced LEDs illumination
- Supports software, including NVIDIA DeepStream, QV4L2, and VLC utility

## 1.3 Specifications

- **Sensor:** SONY IMX334 with full size resolution 3840(H) x 2160(V), 8MP @30FPS, 1/1.8", pixel size (2.0 x 2.0 um) Rolling Shutter, Color

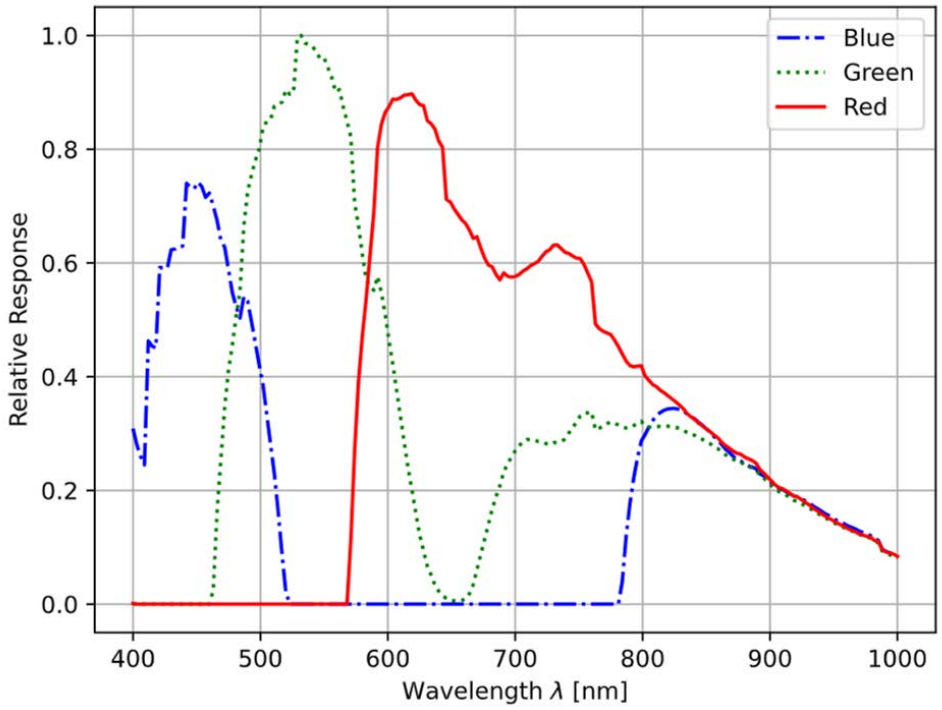


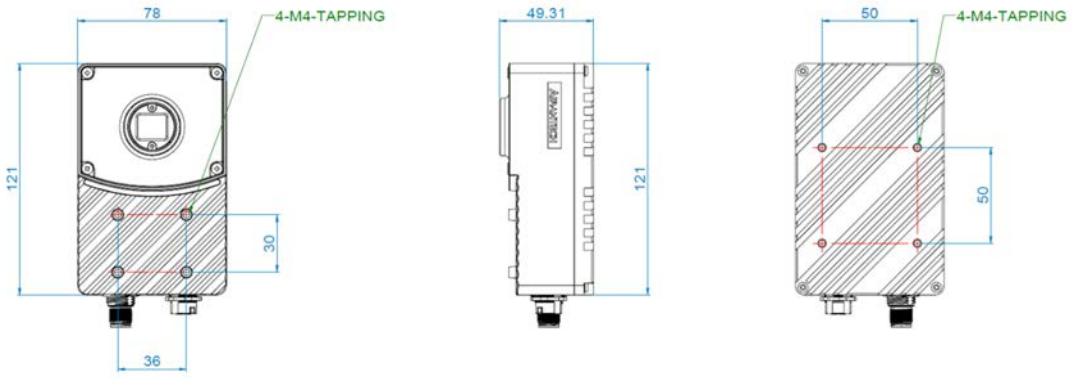

**Figure 1.1 Spectrum response (nm)**

- **Processor system**
  - NVIDIA Orin NX
  - CPU: 6-core Cortex® A78AE ARM® (64-bit) | 2x clusters (4x 256KB L2 +2MB L3) + 4MB LLC | L3 Cache: 4 MB | Max. 2 GHz
  - GPU: 1024 cores | 32 Tensor
- **Memory, Storage**
  - 8 GB 128-bit LPDDR5 / 256GB NVMe
- **Optical**
  - C-mount lens model (based on different user scenarios, the user can adopt a suitable lens.): The following are common lens specifications.
    - 6 mm variable focal length:
      FOV 157 x 88 mm @ 100 mm working distance
      FOV 1,308 x 736 mm @ 1,000 mm working distance
    - 12 mm variable focal length:
      FOV 141 x 79 mm @ 200 mm working distance
      FOV 639 x 360 mm @ 1,000 mm working distance
    - 25 mm variable focal length:
      FOV 64 x 36 mm @ 200 mm working distance
      FOV 309 x 174 mm @ 1,000 mm working distance
  - S-mount lens model:
    - 4.4 mm variable focal length:
      FOV 202 x 114 mm @ 100 mm working distance
      FOV 1,855 x 1,044 mm @ 1,000 mm working distance
    - 12 mm variable focal length:
      FOV 141 x 79 mm @ 200 mm working distance
      FOV 665 x 374 mm @ 1,000 mm working distance
    - 25 mm variable focal length:
      FOV 62.3 x 35.3 mm @ 200 mm working distance
      FOV 272 x 153 mm @ 1,000 mm working distance
  - LED illumination (S-mount model only) 8 x PWM white LEDs, programmable
- **Synchronization**
  - Hardware Trigger / software Trigger / free-run
- **HW ISP**
  - Color debayering, sharpness, white balance, CCM correction (S-mount only), dark noise correction (Default enable), Sharpness and brightness (S-mount only)
- **I/O**
  - 1x USB 3.0, Type-C connector (Only works for Keyboard & mouse. Connect to USB storage will increase power consumption and heat the system)
  - 1 x USB 3.0 Type A connector
  - 1x Micro USB for OTG (Only works in engineering mode)
  - 2 x Digital Input
  - 1 x Digital Output
  - 1 x Hardware trigger in
  - 1 x Trigger Output (S-mount only)
- **LAN**
  - 1x 10/100/1000 Base-T
- **Display**
  - 1x HDMI 2.0

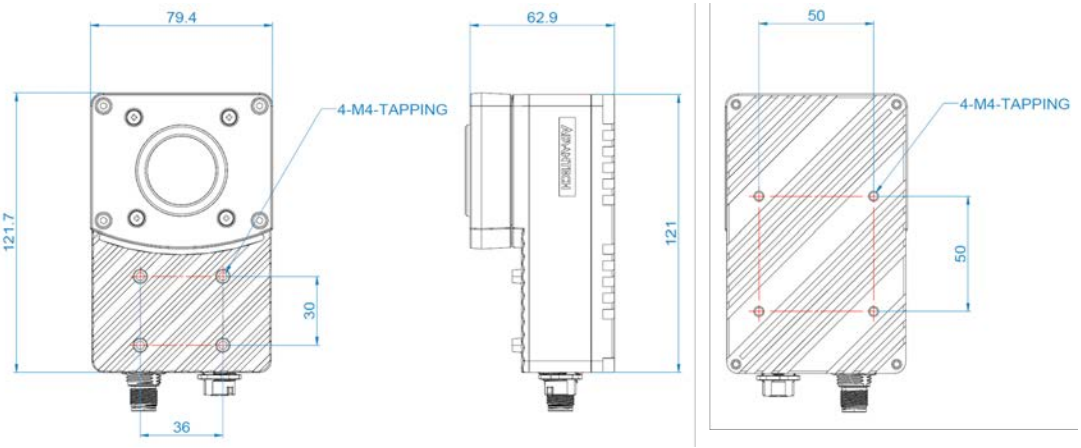
- **Power Requirements**
  - 19~24$V_{DC}$ Max 18W (3W for camera module), typical 15W.

***Note!*** *The power design of the ICAM-540 supports power mode 2 (15W, 4-core CPU). Using other power modes (mode 0 or mode 3) may cause throttling on the Jetson platform. For more details, please visit the NVIDIA website.*

- **Dimension:**
  - C-mount: 78 mm (W) x 121 mm (H) x 49.31 mm (D).

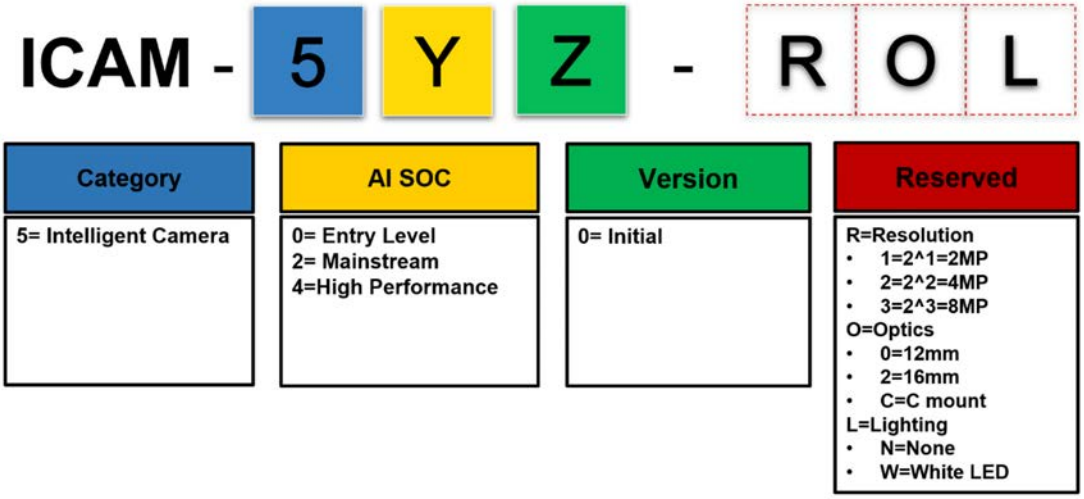


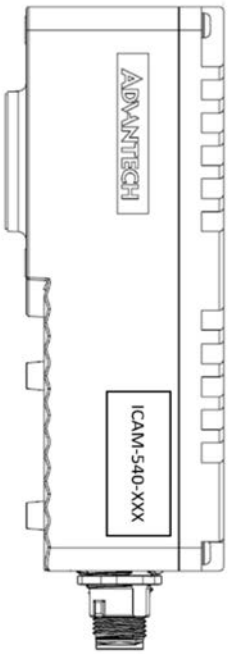

  - S-mount: 79.4 mm (W) x 121 mm(H) x 62.9 mm(D)




- **Software package**
  - OS: Linux Ubuntu 20.04, Jetpack 5.1.1 (or above).
  - SDK/Utility: CAMNavi SDK, Web based camera utility, IP configure tool, NVIDIA DeepStream SDK & examples.

- **Type Key of ICAM-540**




## 1.4 Environment Specifications

- **Operating temperature:** 0 ~ 45°C
- **Vibration during operation:** 5 Grms
- **EMC:** CE, FCC

# Chapter 2

## Optical Functions

## 2.1 Overview of Optical Functions

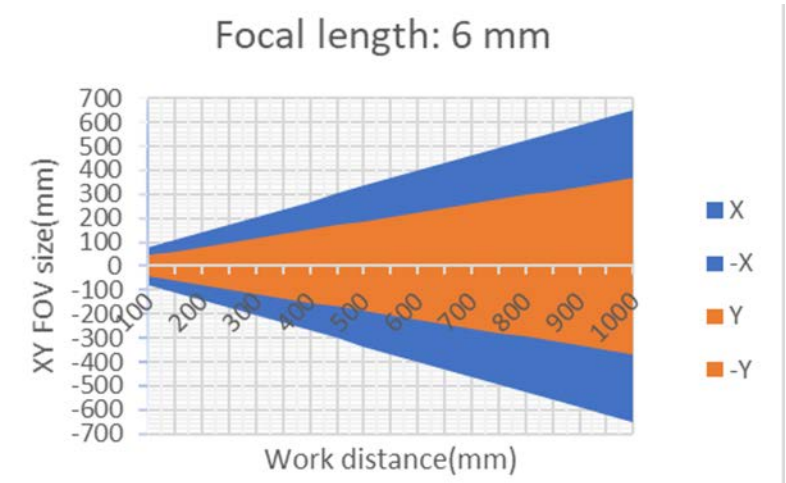
Advantech The ICAM-540 series is equipped with a highly integrated optical module, which includes built-in programmable variable focus lenses or the option to externally connect a C-mount lens. The HTML 5 web based utility can be used to setup the optical parameters for application to lower the installation effort. This section shows optical functions of camera. This section shows the specification of optical function that included the field of view of lens, lens motor movement behavior, spectral distribution of LEDs and LEDs uniformity.

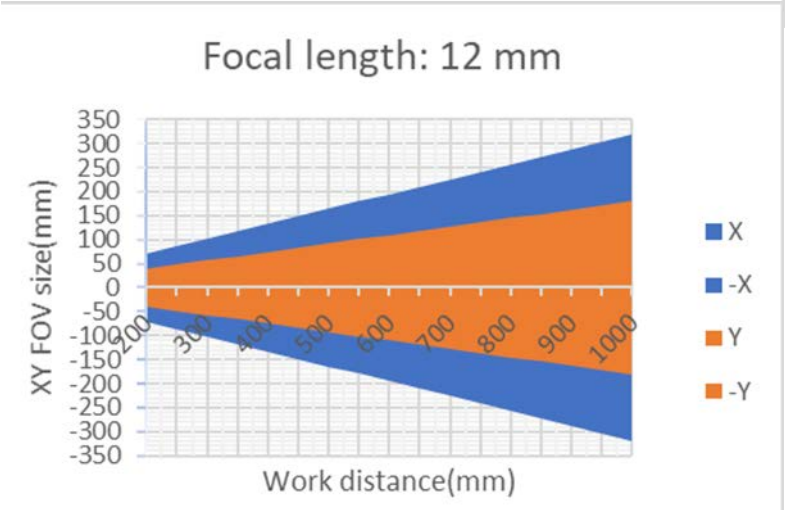
## 2.2 Field of View

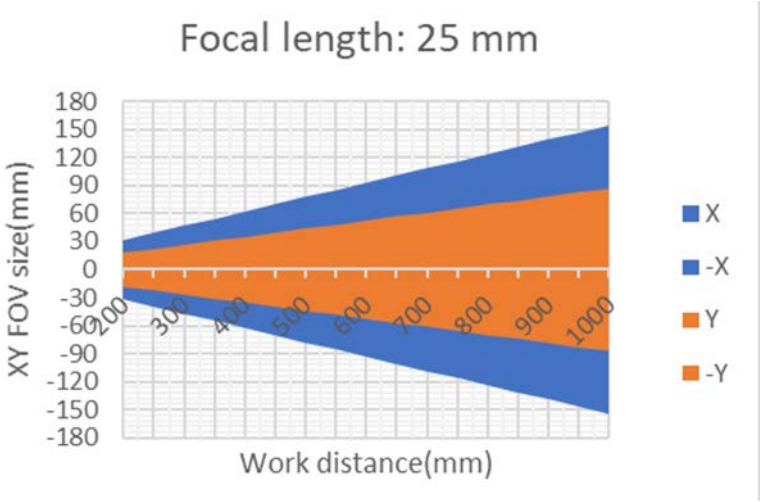
C-mount model: for example, with Advantech optional lens.

| Focal length (mm) | FOV DxHxV @Near(degrees) | Max Object Size @Near(mm) | FOV DxHxV @Far(degrees) | Max Object Size @Far(mm) |
|---|---|---|---|---|
| 6 | 84 x 76 x 48 | 180 x 157 x 88 | 74 x 66 x 40 | 1501 x 1308 x 736 |
| | WD@100 mm | WD@100 mm | WD@1 m | WD@1 m |
| 12 | 44 x39 x 22 | 162 x 141 x 79 | 40 x 35 x 20 | 734 x 639 x 360 |
| | WD @200 mm | WD @200 mm | WD@1 m | WD@1 m |
| 25 | 21 x18 x 10 | 73 x 64 x 36 | 20 x 18 x 10 | 355 x 309 x 174 |
| | WD @200 mm | WD @200 mm | WD@1 m | WD@1 m |

WD: working distances; D x H x V: Diagonal x Horizontal x Vertical



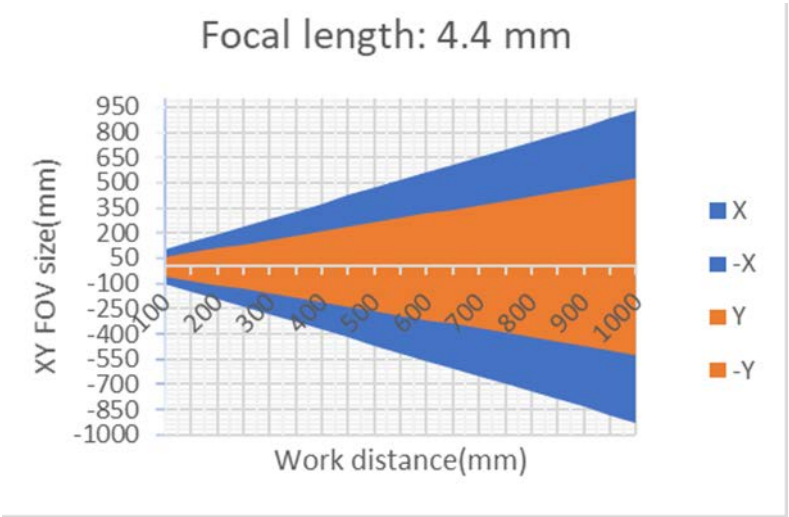



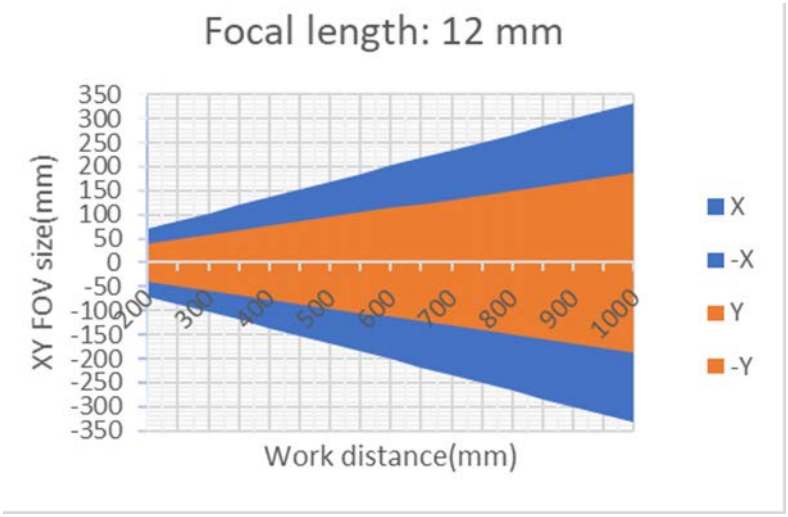


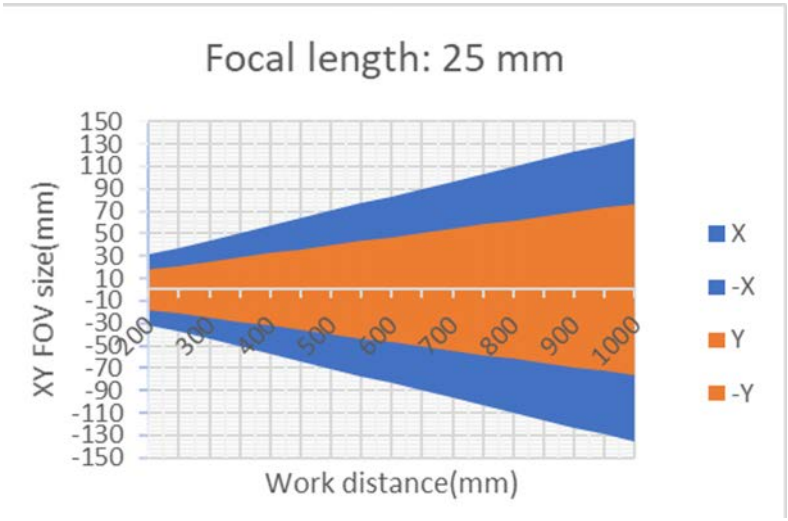

S-mount model

| Focal length (mm) | FOV DxHxV @Near(degrees) | Max Object Size @Near(mm) | FOV DxHxV @Far(degrees) | Max Object Size @Far(mm) |
|---|---|---|---|---|
| 4.4 | 98 x 91 x 59 | 232 x 202 x 114 | 94 x 86 x 55 | 2128 x 1855 x 1044 |
| | WD@100 mm | WD@100 mm | WD@1 m | WD@1 m |
| 12 | 44 x 39 x 22 | 162 x 141 x 79 | 42 x 37 x 21 | 763 x 665 x 374 |
| | WD @200 mm | WD @200 mm | WD@1 m | WD@1 m |
| 25 | 20 x 18 x 10 | 71.6 x 62.3 x 35.3 | 18 x 15 x 9 | 312 x 272 x 153 |
| | WD @200 mm | WD @200 mm | WD@1 m | WD@1 m |

WD: working distances; D x H x V: Diagonal x Horizontal x Vertical

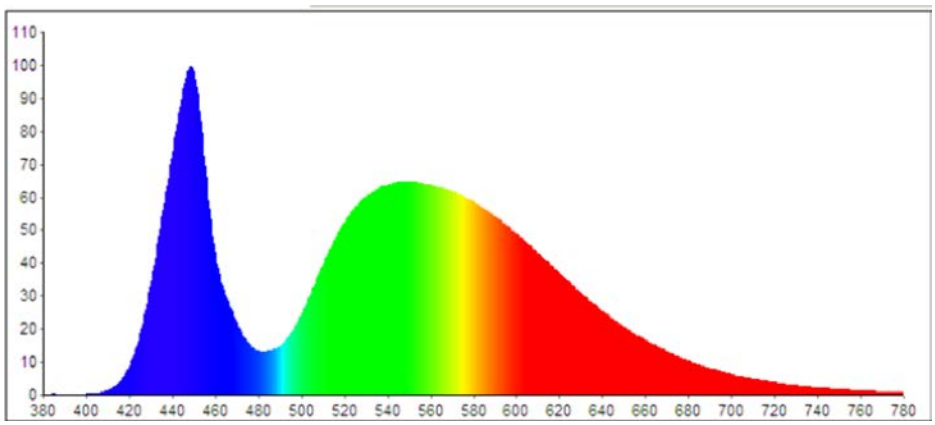





## 2.3 Flash Specification

- LED brightness > 384 lux @1000 mm working distance with all LEDs on in mode 3. The color temperature range: 5500 ~ 6500 K. LED spectrum graph shown below.



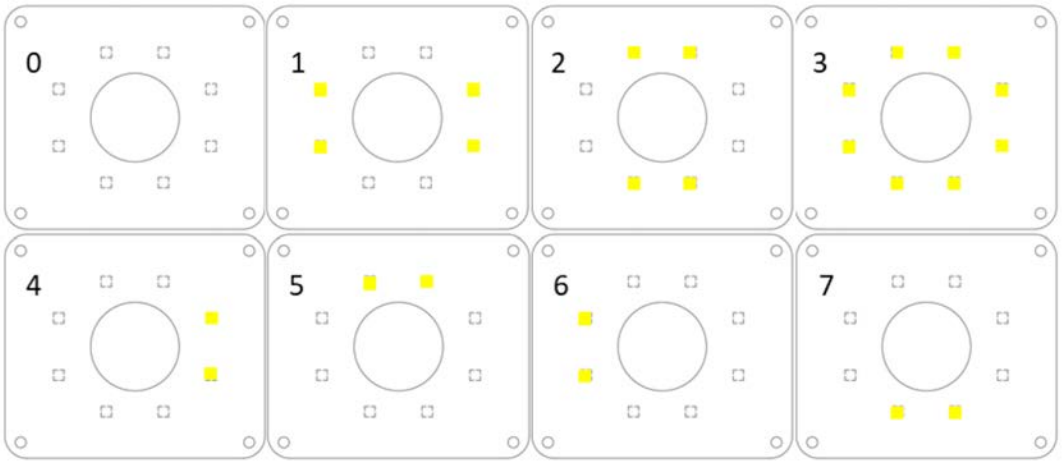
## 2.4 Lens Movement (S-mount model only)

ICAM-540 series equipped electronic lens motor. The following are lens motor specifications and behaviors.

**Table 2.1: Lens Motor Specification and Behavior**

| Scenario | Behavior and specification |
|---|---|
| Action after Power lost | Lens motor will stay in the last position before power lost. |
| Minimum shift steps | 1 steps, total steps is 2294 steps |
| Shift range | 0.0013075mm |

## 2.5 LEDs Control Model (S-mount model only)



# Chapter 3

## Hardware Installation

# 3.1 Hardware Installation

The electrical installation of the ICAM-540 must be carried out by a qualified electrician. Disconnect all electrical components from the power supply when installing the ICAM-540. The following sections show the external connectors and pin assignments for applications.

# 3.2 External Connector

## 3.2.1 External I/O Connector

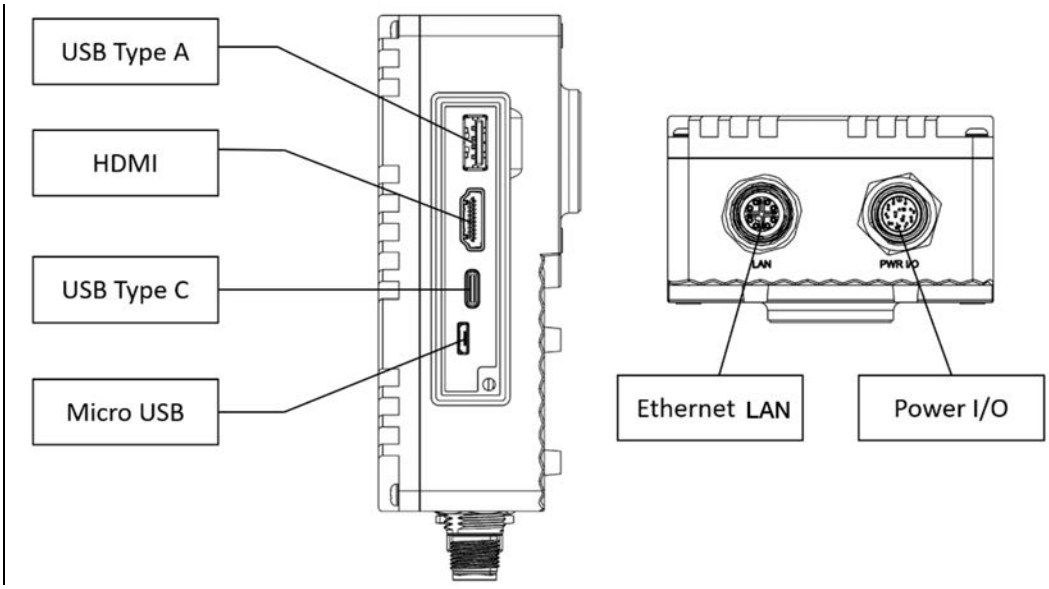
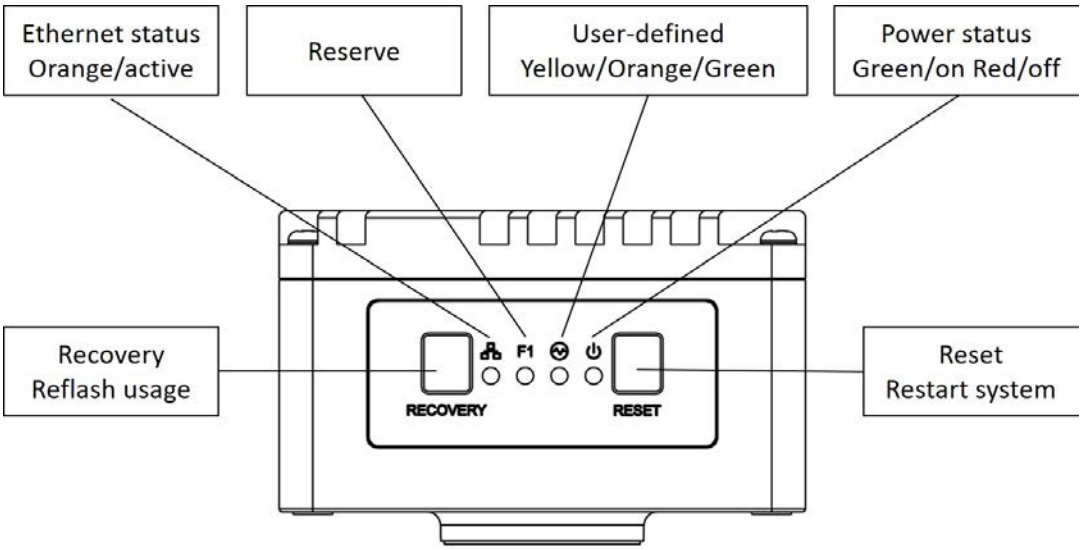



**Figure 3.1 External I/O Connector**



### 3.2.2 Power I/O

Power, Digital I/O, and RS232 Connector

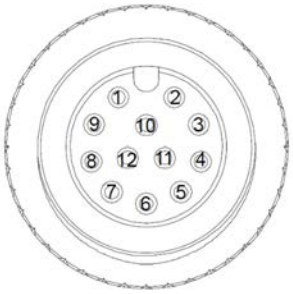



**Table 3.1: Power I/O**

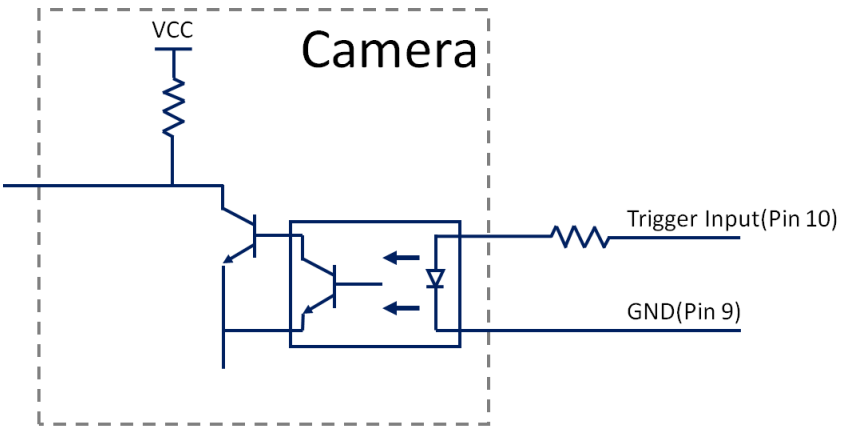
| Pin | Description |
|---|---|
| 1 | Digital Input 1 |
| 2 | Reserve |
| 3 | Reserve |
| 4 | Reset System BTN |
| 5 | Digital Input 0 |
| 6 | Common In |
| 7 | System power in Vin(+) 24V |
| 8 | System power in GND Vin(-) |
| 9 | DI/DO GND |
| 10 | Hardware Trigger Input |
| 11 | Digital Output 0 |
| 12 | Strobe Out (for S-mount model) / Digital Output 1 (for C-mount model) |

**Signal Connections:**

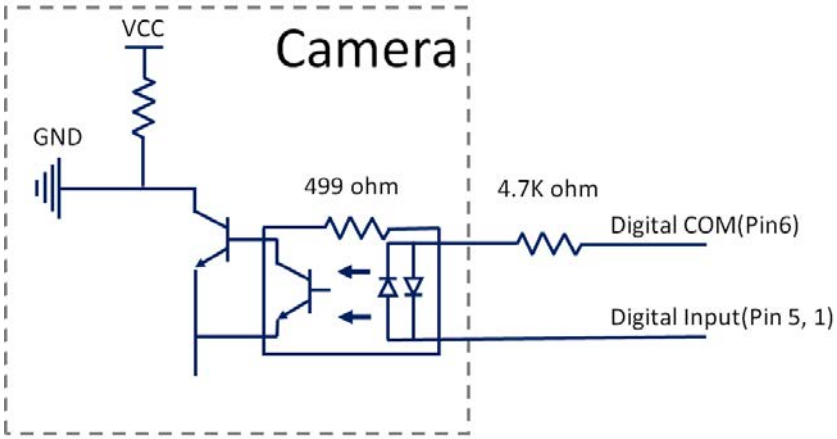
ICAM-540 series supports versatile digital I/O. Please read the following instructions to wire the DI/O.

**Table 3.2: Hardware Trigger Input**

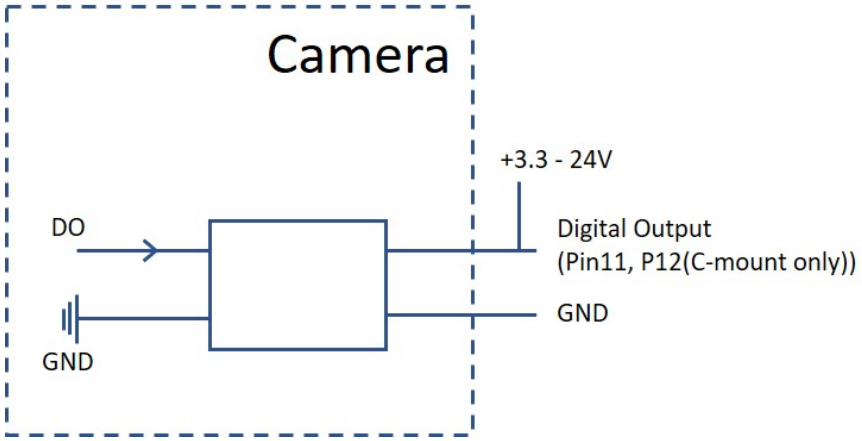
| Pin No. | Input Voltage | Input Current | Duration | S/W Interrupt |
|---|---|---|---|---|
| 10 | 3.3~24$V_{DC}$ | Typical: 24mA | 0-8192 us | No |



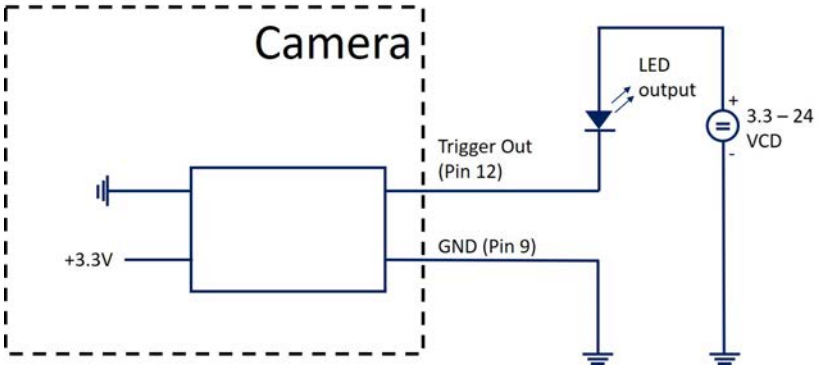
| Table 3.3: Digital Input | | | | | |
|---|---|---|---|---|---|
| **Pin No.** | **Input Voltage** | **Input Current** | **Frequency** | **Response Time** | **S/W Interrupt** |
| 5, 1 | 3.3-24 $V_{DC}$ | Typical: 24mA | Max. 60 Hz | Fall: 0.1us;<br>Rise: 4.35us | Yes |




| Table 3.4: Digital Output | | | | | |
|---|---|---|---|---|---|
| **Pin No.** | **Output Voltage** | **Output Current** | **Frequency** | **Response Time** | **S/W Interrupt** |
| 11 | 3.3-24 $V_{DC}$ | Typical: 0.2A | Max. 60 Hz | Fall: 1.2us;<br>Rise: 1.92us | No |



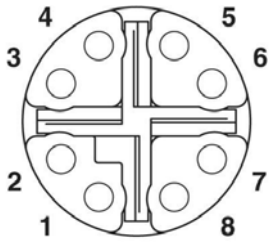
| Table 3.5: Strobe Out (S-mount model only) | | | | | |
|---|---|---|---|---|---|
| **Pin** | **Output Voltage** | **Output Current** | **Frequency** | **Response Time** | **S/W Interrupt** |
| 12 | 3.3-24 $V_{DC}$ | Typical: 0.2A | Max. 60 Hz | Fall: 1.2us;<br>Rise: 1.92us | No |




### 3.2.3 Ethernet/LAN

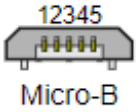
**Ethernet Connector (LAN)**

ICAM-540 series is equipped with one Ethernet controllers that are fully compliant with IEEE 802.3u 10/100/1000 Mbps CSMA/CD standards. The Ethernet port provides a M12 connector.




| Pin | Signal |
|---|---|
| 1 | MDI_0_P |
| 2 | MDI_0_N |
| 3 | MDI_1_P |
| 4 | MDI_1_N |
| 5 | MDI_3_P |
| 6 | MDI_3_N |
| 7 | MDI_2_N |
| 8 | MDI_2_P |

### 3.2.4 Micro USB




| Pin | Signal |
|---|---|
| 1 | Vbus (4.4-5.25V) |
| 2 | D- |
| 3 | D+ |
| 4 | ID |
| 5 | GND |

### 3.2.5 USB 3

**USB type C connector**

ICAM-540 provides one USB type C interface connector which is only for keyboard and mouse usage. Connecting to USB storage will increase the power consumption and will heat up the system. Please refer to the table below for pin assignments.

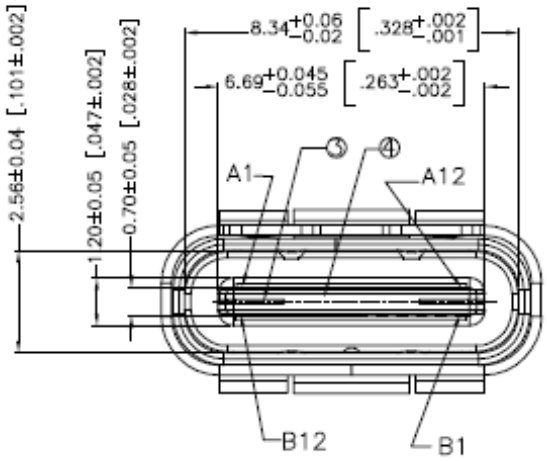



**Table 3.6: USB type C connector**

| Pin No. | Signal | Pin No. | Signal |
|---|---|---|---|
| A1 | GND | B1 | GND |
| A2 | SSTXp1 | B2 | SSTXp1 |
| A3 | SSTXn1 | B3 | SSTXn1 |
| A4 | VBUS | B4 | VBUS |
| A5 | CC1 | B5 | SBU2 |
| A6 | Dp1 | B6 | Dn2 |
| A7 | Dn1 | B7 | Dp2 |
| A8 | SBU1 | B8 | CC2 |
| A9 | VBUS | B9 | VBUS |
| A10 | SSRXn2 | B10 | SSTXn2 |
| A11 | SSRXp2 | B11 | SSTXp2 |
| A12 | GND | B12 | GND |

### USB type A connector

**Table 3.7: USB type A connector**

| Pin | Signal |
|---|---|
| 1 | VBUS |
| 2 | D- |
| 3 | D+ |
| 4 | GND |
| 5 | StdA_SSRX- |
| 6 | StdA_SSRX+ |
| 7 | GND_DRAIN |
| 8 | StdA_SSRTX- |
| 9 | StdA_SSRTX+ |
| H1 | PTH_1 |
| H2 | PTH_2 |

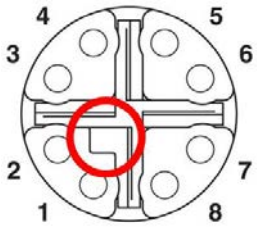
# Chapter 4

## Getting Started

## 4.1 Getting Started

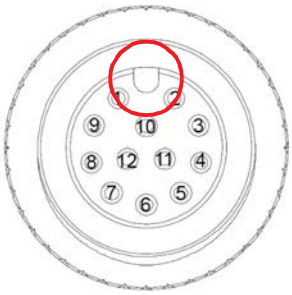
This chapter describes connection, configuration and start acquisition from ICAM-540 via host PC.

## 4.2 Connection an Ethernet Cable




- Align the alignment pin (Cable side) with the alignment channel (Device side)
- Inset the cable connector and tighten the threaded collar to fix the connection.

## 4.3 Connect a Power and D I/O Cable




- Align the alignment pin (Cable side) with the alignment channel (Device side)
- Inset the cable connector and tighten the threaded collar to fix the connection.
- Plug in the power source after the M12 connector feast on the ICAM-540 otherwise that will damage the ICAM-540.

## 4.4 Access the ICAM-540

The default root account and password is iCAM-540/iCAM-540.

Here are two ways to access the ICAM-540 for starting camera preview and configuration:

1. Use browser to activate Web utility on the ICAM locally.
2. Use browser to activate Web utility on the Windows 10 OS host PC.

For local users, please follow these steps to access the camera:

1. Open web browser.
2. Enter the IP address of the ICAM-540: localhost:5000.
3. The ICAM-540 web server interface will be displayed in the web browser.

To configure and set up the ICAM-540 on the Windows 10 OS host PC, first ensure that the connection between your host PC and the ICAM-540 in your local network via Ethernet cable is correct.

1. The default IP address of the ICAM-540 is 192.168.0.100. Please manually specify the TCP/IPv4 settings as follows:
   IP address: 192.168.0.X (where X is any number between 0-255, but IP conflicts should be avoided.)
   Subnet mask: 255.255.255.0
2. Open web browser.
3. Enter the IP address of the ICAM-540: 192.168.0.100:5000.
4. The ICAM-540 web server interface will be displayed in the web browser.

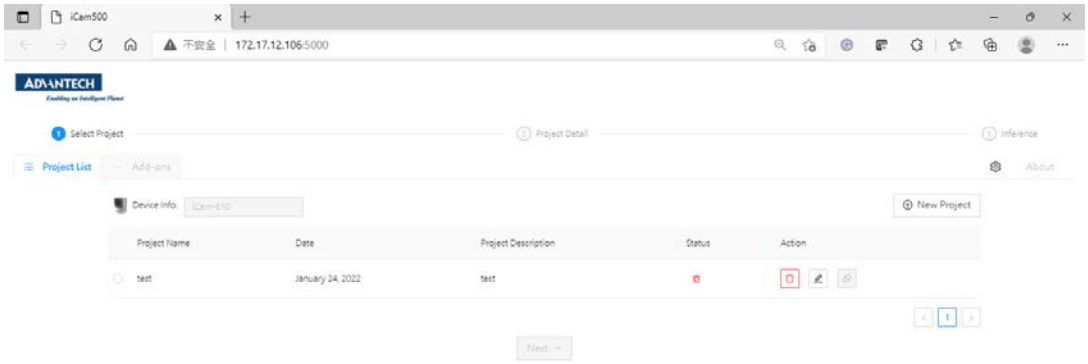



**Figure 4.1 Access ICAM-540 via web browser**

## 4.5 Start Acquisition

1. Follow the instructions of web UI to click the **New Project** button to create a new project for ICAM-540 configuration.

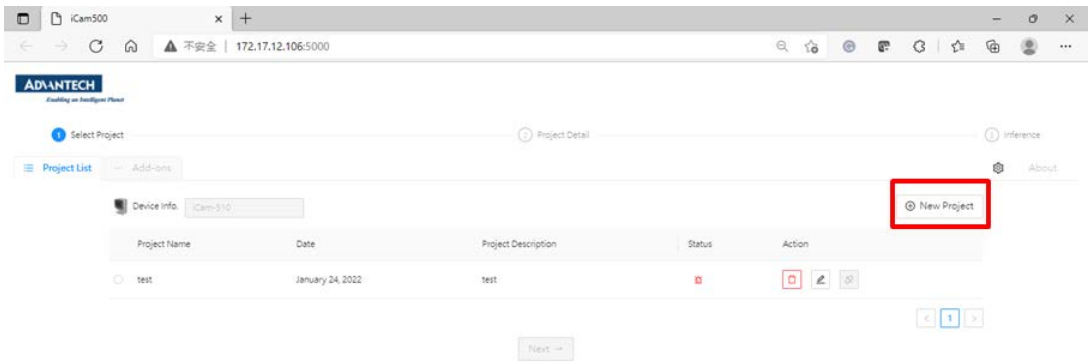



**Figure 4.2 Add new project**

2. Fill in the content of new project, output resolution and select the trigger mode then confirm to save the project. Select the project you just created, click the **Next** button and click the **Play** button to start the acquisition.

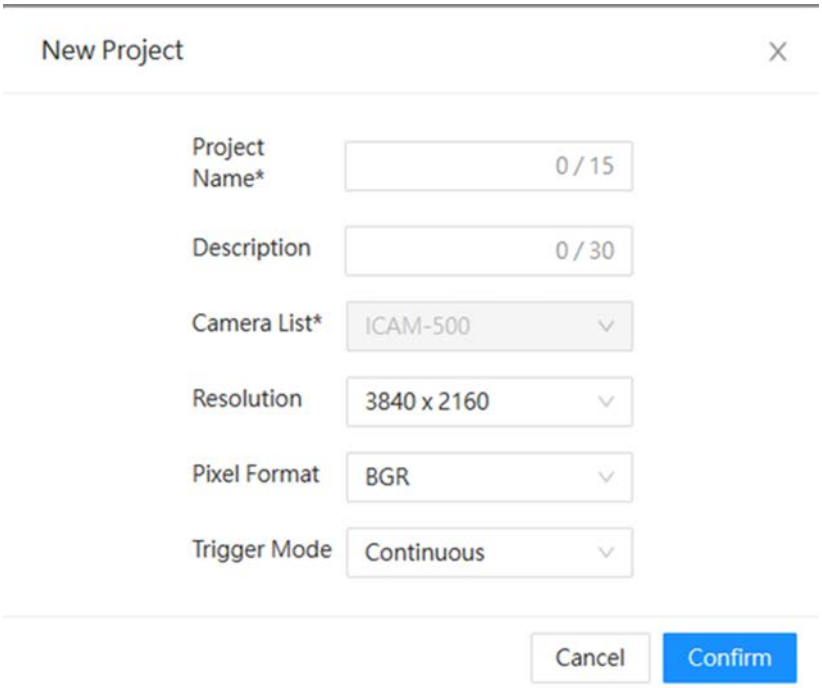



**Figure 4.3 Content of a new project**

3. Image save function only works in continuous mode and can only save the image in ICAM-540. The image will be saved in /opt/advantech/web/temp_-folder/project/{projectName}/images.

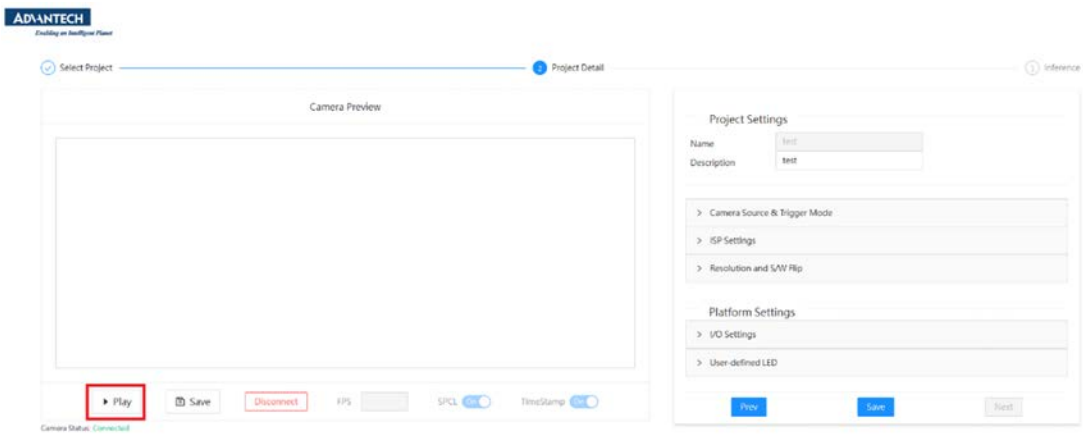



**Figure 4.4 Start acquisition**

## 4.6 Configure ICAM-540 Camera

All the camera functions are listed on the right hand side of the UI. ICAM-540 provides camera setting, generic setting, ROI setting, I/O setting and LED indicator settings. In addition to using a web browser to configure the ICAM-540, a Python based example and APIs provide more flexible ways to configure and integrate the ICAM-540. For information on the APIs and examples, please reference the programming guide.

All illustrations in this section are demonstrated using S-mount models. C-mount models will have some differences.

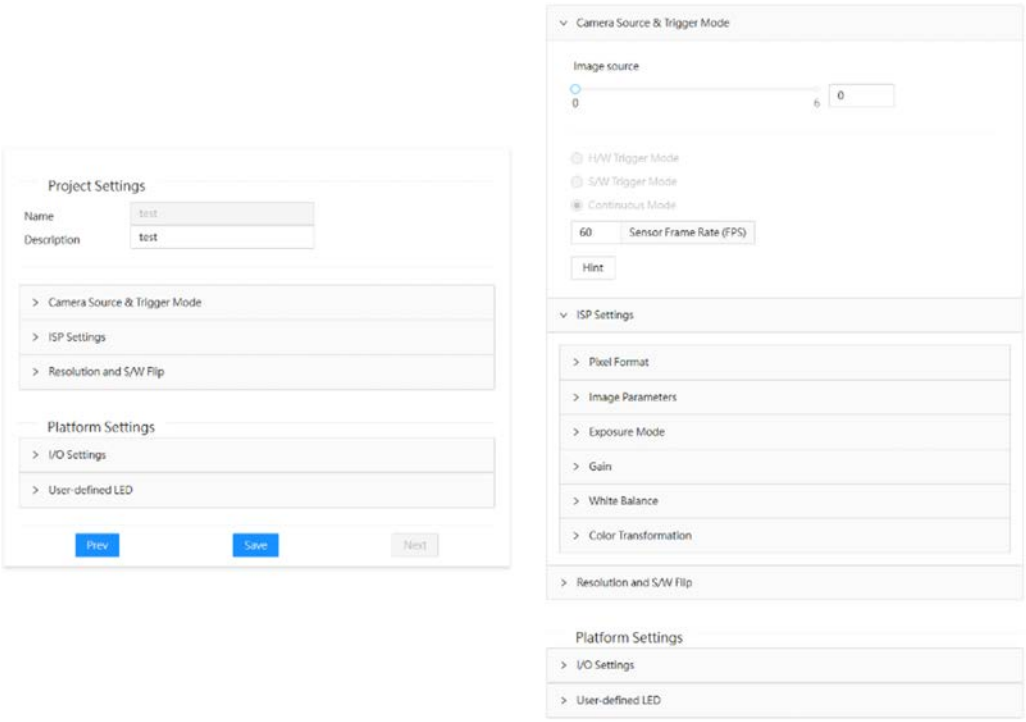



**Figure 4.5 Camera function overview**

### 4.6.1 Camera Acquisition Setting

This section shows camera acquisition settings that include trigger mode, lens focus settings, and PWM LEDs lighting settings.

The exposure time will affect Continuous Mode

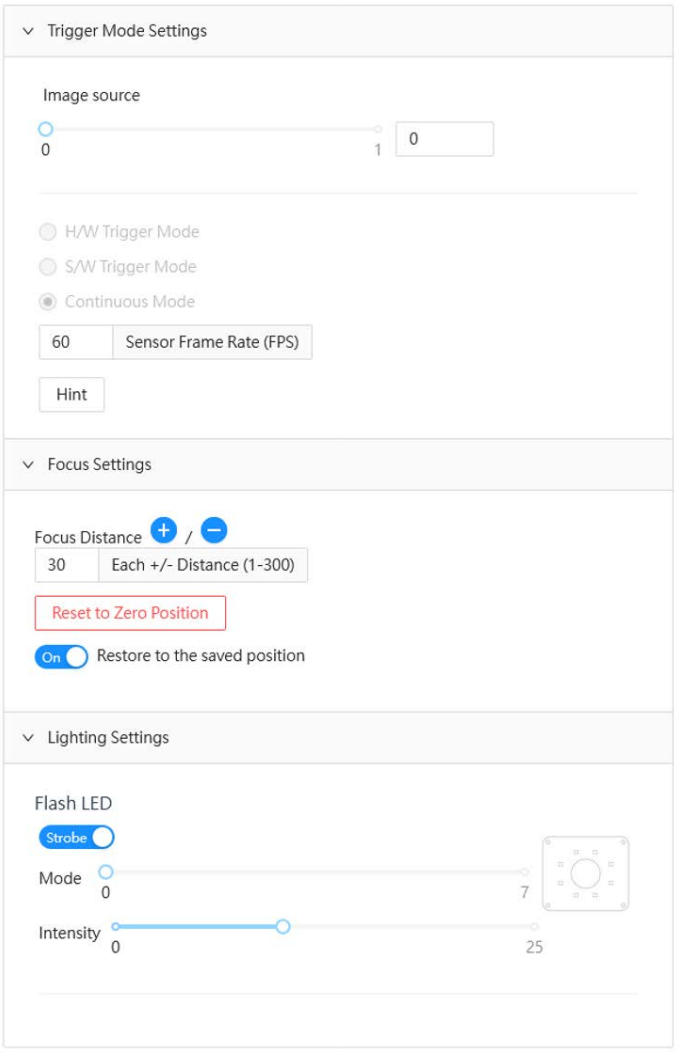



**Figure 4.6 Camera Acquisition Setting**

### 4.6.2 ISP Settings

This section shows ISP settings.

- **Brightness**
  The camera brightness refers to the brightness when the camera adjusts image under Auto exposure mode, or Auto Gain mode. You can set brightness as shown below. Set Brightness according to actual demand.
- **Gamma**
  Gamma correction provides non-linear adjustment to change image brightness.
- **Mirror X**
  Enable Mirror X function to mirror the images in the x axis.
- **Mirror Y(C-mount only)**
  Enable Mirror Y function to mirror the images in the y axis.

**Color HUE**

Shifts the color of image color via the color HUE controls. HUE only works on YUV and RGB formats.

**Color Saturation**

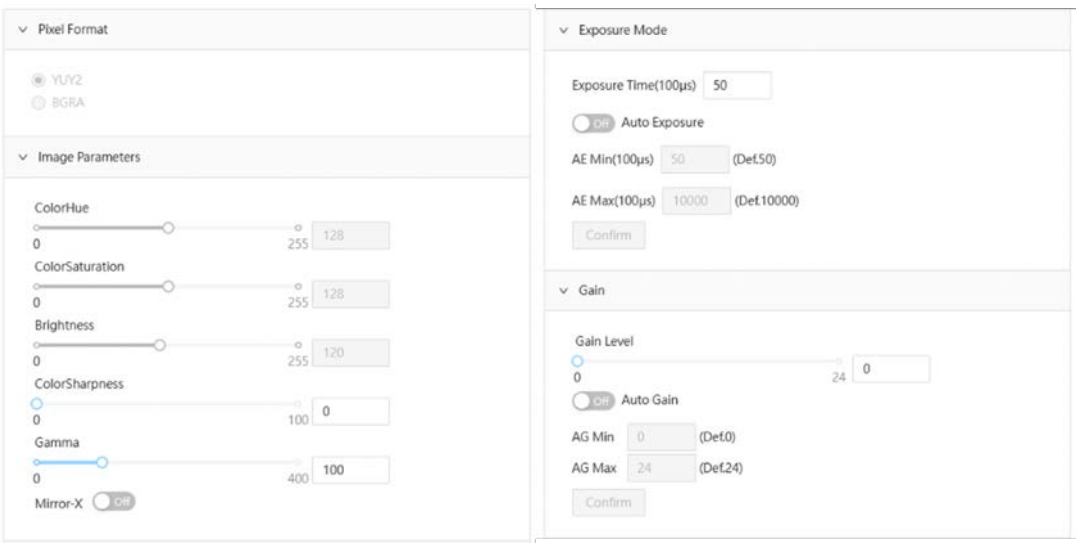
Changes the colorfulness of image color via the color saturation controls. Saturation only works on YUV and RGB format.

**Auto Exposure**

Automatically adjusts the exposure time within specified limits until a default brightness value has been reached.

**Auto Gain**

Automatically adjusts the gain within specified limits until a target brightness value has been reached.



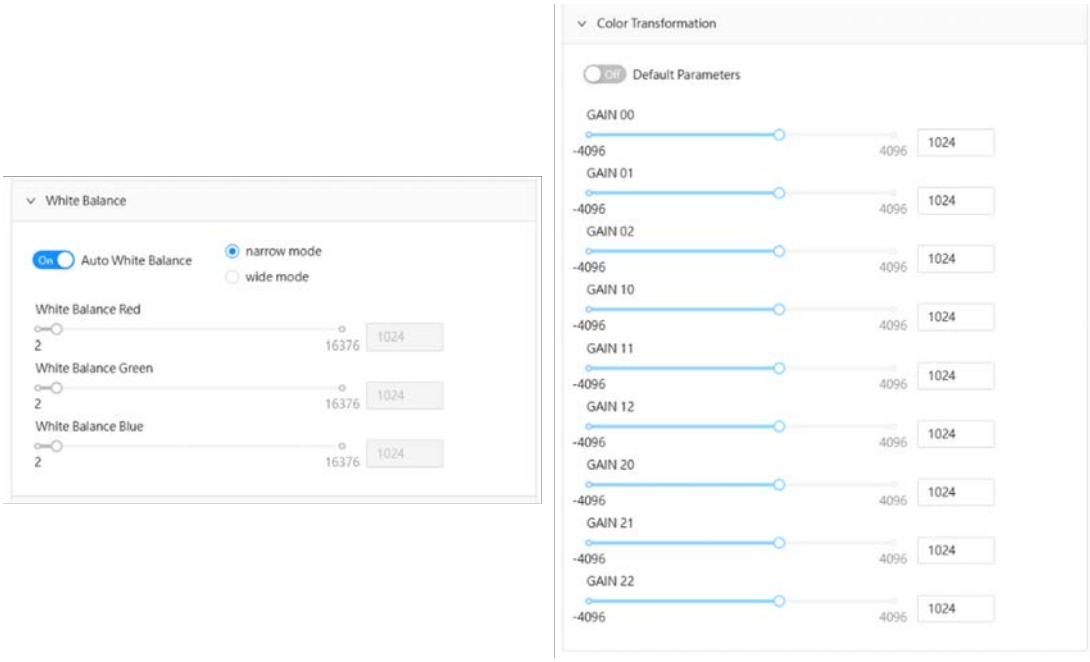



**Figure 4.7 ISP Setting**

### 4.6.3 ROI Setting & Output

This section shows how to set the image resolution of the camera.

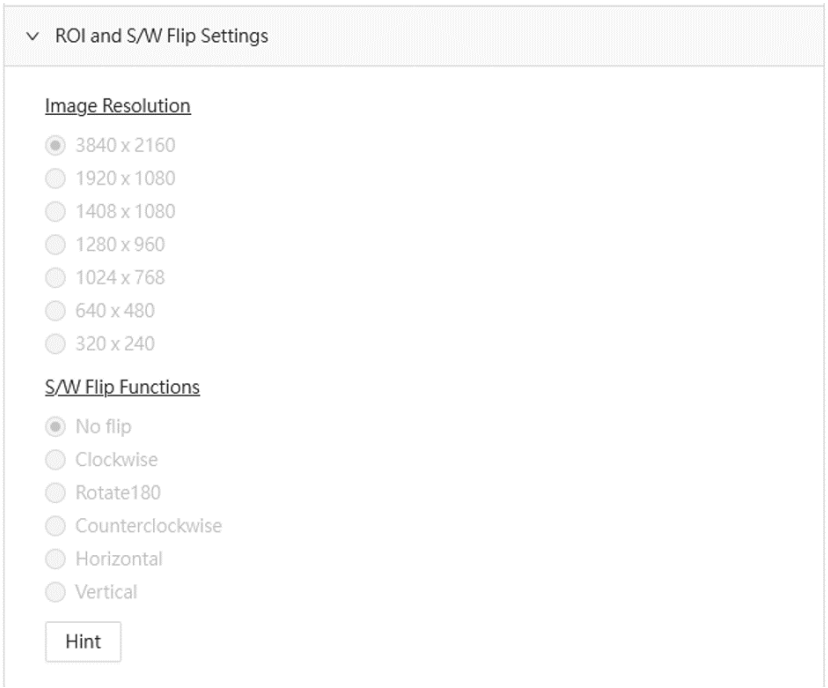



**Figure 4.8 ROI Setting & Output**

### 4.6.4 Platform Settings

This section shows the setting of LED indicators, digital inputs, and digital output.

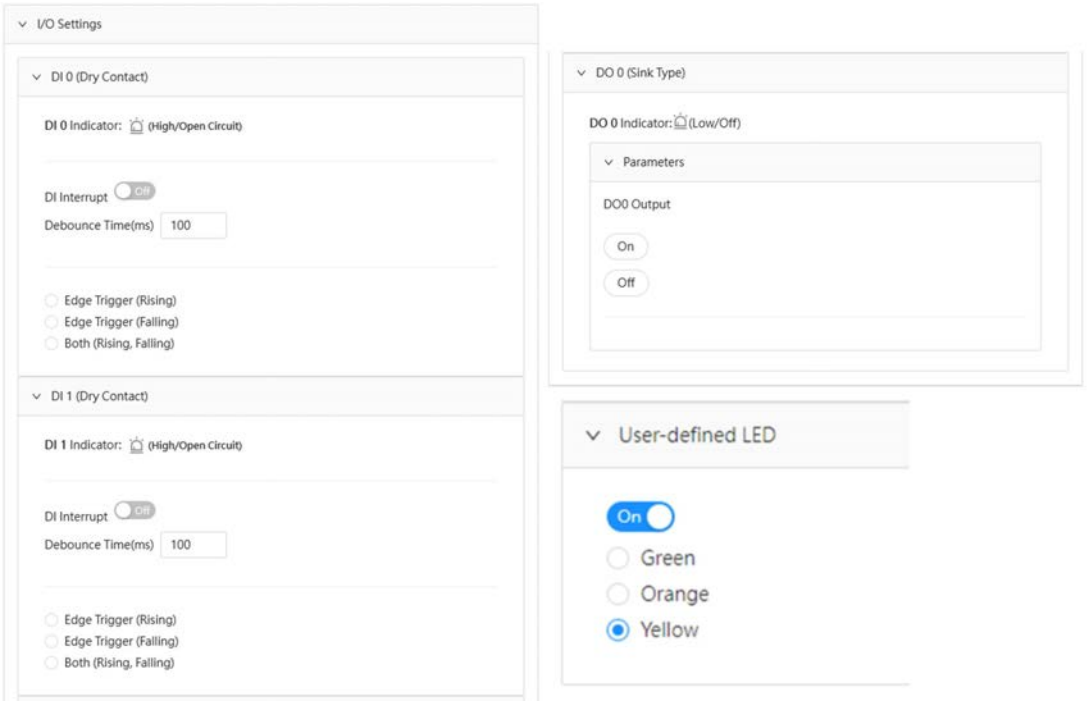



**Figure 4.9 Platform Settings**

### 4.6.5 Hardware Trigger Mode

In hardware trigger mode, the digital output pin of ICAM-540 must be connected to the trigger input (pin 10) of the cameras, and the camera will begin the process of exposing and reading out a frame, below are the operating procedures:

1. Wire trigger input (pin 10)
2. Configure the camera in hardware trigger mode.
3. The camera will acquire the images, and then send out the image data.
4. The camera will return to the standby mode, and wait for the next valid trigger signal.

The ICAM-540 uses a SONY rolling shutter sensor. Due to the characteristics of this sensor, the frame rate in Trigger mode = 1/2 [fps in continuous mode] - 1 fps

For example

| Resolution | YUV2 color format | |
|---|---|---|
| 1920x1080, | Continuous Mode | Trigger mode |
| | 38.66 fps | 18.33 fps. |

***Note!*** The duration of the trigger input can refer to the continuous mode frame rate.

### 4.6.6 Software Trigger Mode

In software trigger mode, users can use the software API to control the image acquisition, and the camera will not acquire frames unless software acquisition command is executed, below are the operation procedures:

1. Configure the camera in software trigger mode.
2. Execute the image acquisition command through software API.
3. The camera will acquire the images and receive image data.
4. The camera will return to standby mode, and wait for the next acquisition command.

### 4.6.7 Continuous Mode

The camera performs acquisition continuously until an acquisition stop is executed.

Below are the fps in different resolutions and color formats in the web browser.

**Table 4.1: C-mount model - fps in different resolution and color format**

| Resolution | BGR Color Format | YUV2 Color Format |
|---|---|---|
| 3860x2178 | 12.9 | 9.3 |
| 1920x1080 | 52.6 | 37 |
| 1408x1080 | 59.8 | 52.6 |
| 640x480 | 59.8 | 59.8 |

**Table 4.2: S-mount model - fps in different resolution and color format**

| Resolution | BGR Color Format | YUV2 Color Format |
|---|---|---|
| 3860x2178 | 7.33 | 12.66 |
| 1920x1080 | 27.99 | 38.66 |
| 1408x1080 | 36.66 | 38.66 |
| 640x480 | 36.66 | 38.66 |

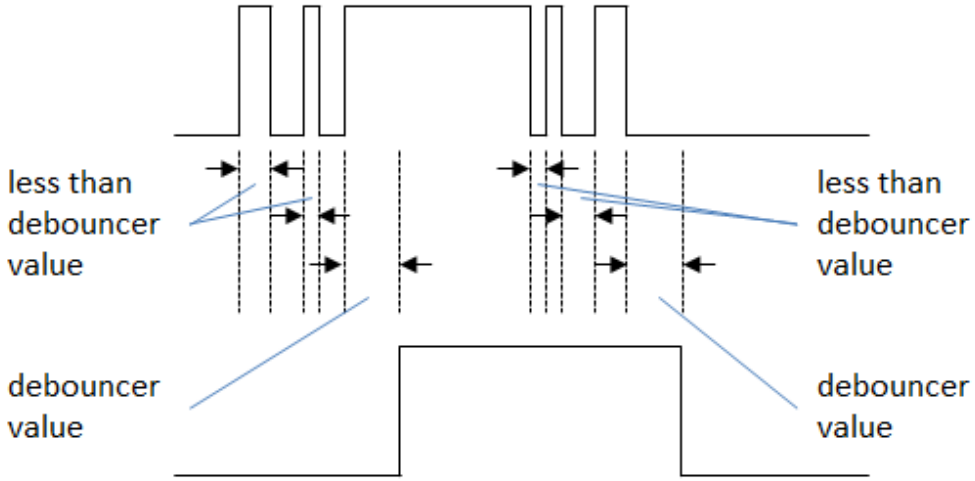
## 4.6.8 Set up the Digital I/O control

ICAM-540 provides 2 port digital input and 1 port digital output for external connection.

### 4.6.8.1 Digital Input

There are two digital inputs (Pin 1, 5) that support debouncer features. The debouncer feature identifies the valid and invalid input signals via setting the debouncer value (the minimum period of time for the valid signal). In this way, the circuit will only respond to the signal that the pulse width is greater than the debouncer value.

Trigger in: default setting debouncer 50 us.




### 4.6.8.2 Digital output

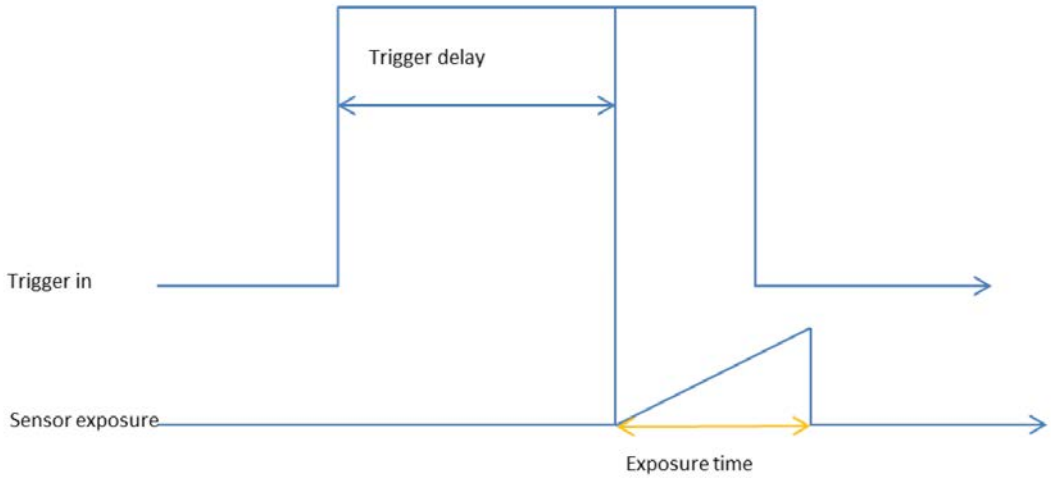
There are two digital outputs (Pin 11, 12) in the C-mount model and one digital output (Pin 11) in the S-mount model, both of which can be configured.

**Direct output:**

The digital output signal is active when a valid command occurs, and the delay time can be set as well.

### 4.6.9 Trigger Delay

The Trigger delay allows users to add a delay between the receipt of a hardware trigger signal and the moment the trigger becomes active. The unit of trigger delay is µm.




## 4.7 ICAM-540 Camera Parameters and SDK

For information on the APIs and examples please refer to the programming guide.

**Table 4.3: Table 3.2: Camera parameters**

| **Function Name** | **Parameters** | | |
|---|---|---|---|
| | **ICAM-540 C-Mount** | | **ICAM-540 S-Mount** |
| | Mono | Color | Color |
| Camera Acq. Settings | | | |
| Trigger Mode Settings | H/W Trigger Mode<br>S/W Trigger Mode<br>Continuous Mode<br>Frame rate | | |
| **ISP Settings** | | | |
| Pixel Format | | YUV RGBA | YUV<br>RGB |
| Image Adjustments | | Color Sharpness (-1~1)<br>Color HUE (-180~180)<br>Color Saturation (0~2)<br>Color Gamma (0~3)<br>White balance (1~16) | Color Sharpness (0~100)<br>Color HUE (0~255)<br>Color Saturation (0~255)<br>Color Gamma (0~400)<br>CCM<br>Gain[00,10, 20] R channel. (-4096~4096)<br>Gain[01,11, 21] G channel. (-4096~4096)<br>Gain[02, 12, 22] B channel. (-4096~4096)<br>White balance (1~16376) |
| Auto Exposure Mode | Exposure time | | |
| Auto Gain Mode/Intensity | Gain (0~48) | | Gain (0~24) |
| **Platform Settings** | | | |

| | | |
|---|---|---|
| I/O Setting | DI 0/1<br>Debounce time<br>Edge Trigger<br>(Rising/Falling/Both)<br>DO 0/1<br>Output High<br>Output Low | DI 0/1<br>Debounce time<br>Edge Trigger (Rising/Falling/Both)<br>DO 0<br>Output High<br>Output Low |
| User-defined LED | Green<br>Orange<br>Yellow | |

## 4.8 Project Management

ICAM-540 allows users to save camera setting as a project and provides auto-run, import and export functions.

### 4.8.1 Auto-run

ICAM-540 allow users to set up an auto run project function while camera boots up. Select the project and enable auto-run function and ICAM-540 will auto execute the project while the camera boots up.

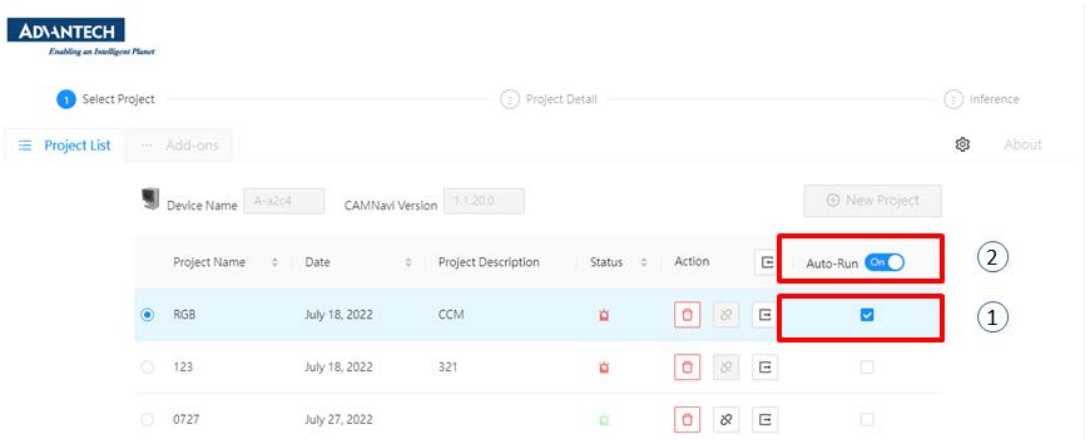



**Figure 4.10 Auto run**

## 4.8.2 Project import & export

ICAM-540 provides a project import and export function.

### 4.8.2.1 Project import

Click the project import icon and upload the selected project to import.

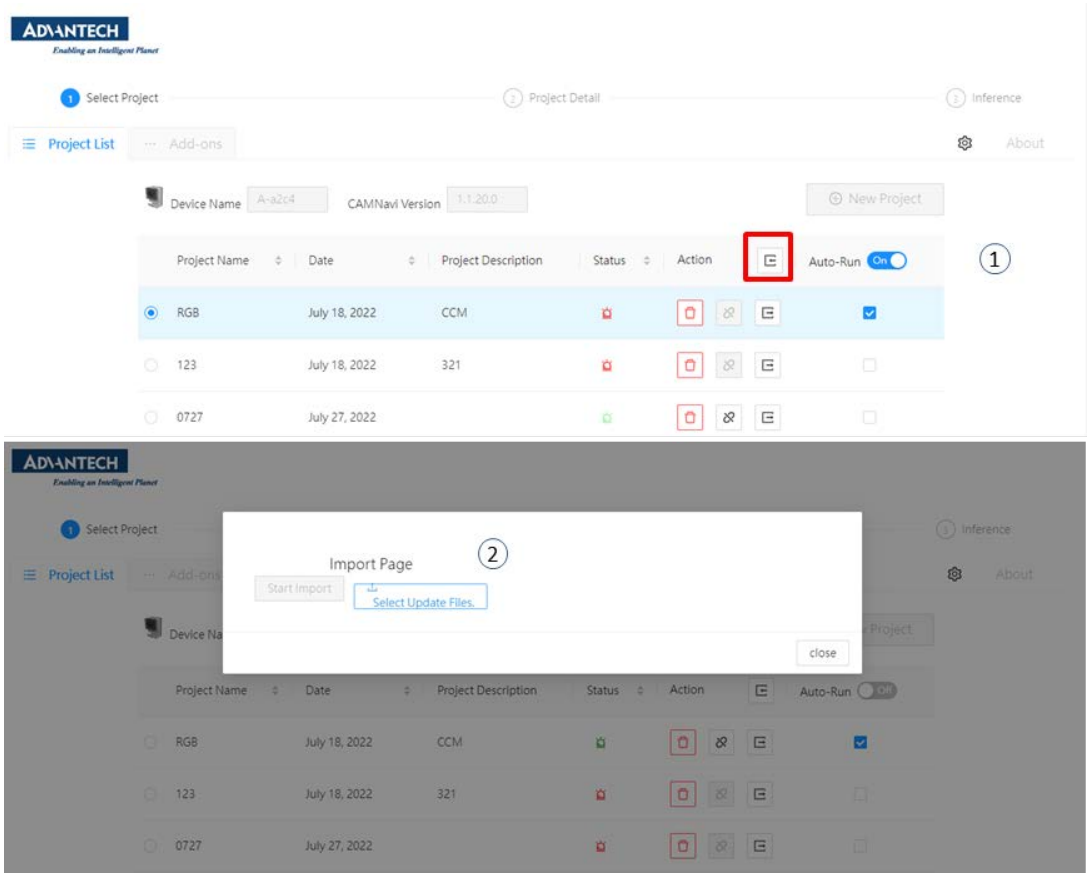



**Figure 4.11 Project import**

## 4.8.3 Project Export

Click the project export icon and export the selected project to a download folder.

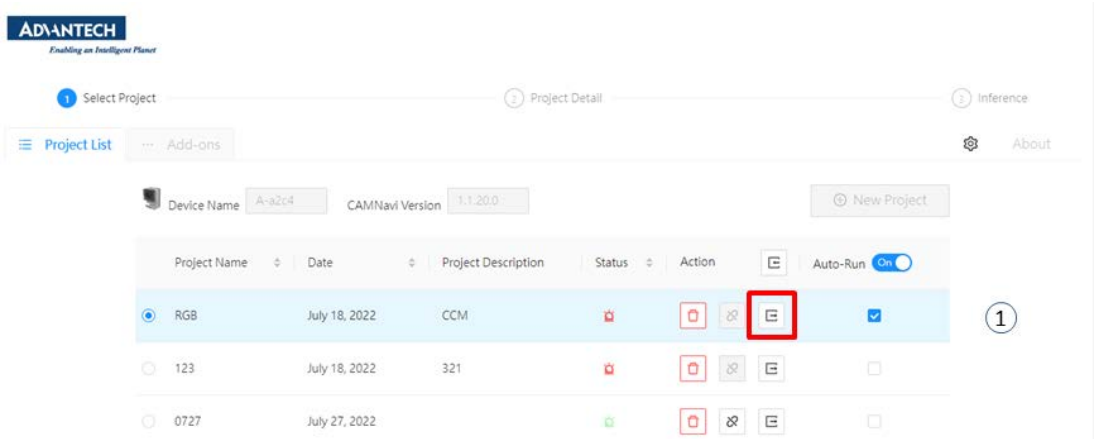



**Figure 4.12 Project export**

# Chapter 5

## Troubleshooting

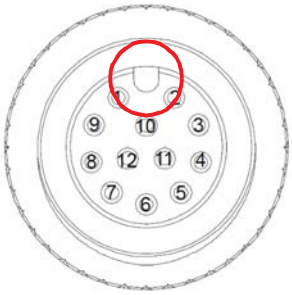
## 5.1 Troubleshooting

Please setup the ICAM-540 with the following instructions to operate ICAM-540 in local mode for troubleshooting. If the user has problems connecting the ICAM-540 via a host PC, or if ICAM-540 still can't boot up and make an acquisition after reset up the ICAM-540, contact Advantech FAE for technical support.

## 5.2 Connection for Keyboard, Mouse and Display

- Insert the USB type C adapter/cable to USB type C connector directly for keyboard & mouse connection.
- Insert the HDMI cable to connector directly for display connection.

## 5.3 Reconnect a Power and D I/O Cable



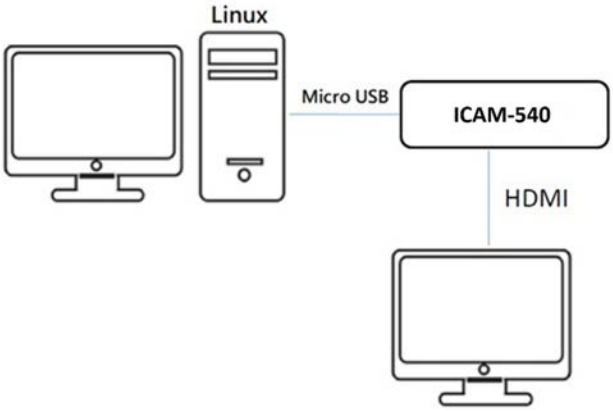

- Align the alignment pin (Cable side) with the alignment channel (Device side).
- Inset the cable connector and tighten the threaded collar to fix the connection.
- Plugin the power source after the M12 connector is fastened on the ICAM-540.

## 5.4 Operate the Camera Function

1. Use Firefox on the desktop to connect with the ICAM-540.
2. Enter the default IP address of the ICAM-540: 192.168.0.100:5000 or localhost:5000
3. ICAM-540 web server interface will be displayed in the browser.

## 5.5 BSP Image Flashing

1. Connect ICAM-540 device and Host PC(X 86 with Ubuntu 20.04 OS with 80GB or above storage) with micro USB cable and connect the HDMI screen to the ICAM-540 device. DO NOT connect USB type-C during flashing.




2. Copy BSP file (Ex: ICAM-540_ORIN-NX_5.1.1_GA_3.1.4.14.tbz) to Host PC
3. Enter the following command on the Host PC to un-tar the BSP image file: sudo tar -jxvf ICAM-540_ORIN-NX_5.1.1_GA_3.1.4.13.tbz2
4. Press and hold Recovery buttons during micro USB connection. Then turn on the power.
5. Release the Recovery button after waiting for 3 seconds.
6. Enter the "lsusb" command on the Host PC.
7. ID 0955:7423 Nvidia Corp. means device is in recovery mode.

```
Bus 001 Device 003: ID 0955:7423 NVIDIA Corp. APX
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
```

8. On the Host PC, enter the decompressed BSP directory and type the following command: sudo ./tools/kernel_flash/l4t_initrd_flash.sh --external-device nvme0n1p1 -c tools/kernel_flash/flash_l4t_external.xml -p "-c bootloader/t186ref/cfg/flash_t234_qspi.xml" --showlogs --network usb0 p3509-a02+p3767-0000 internal
9. After 20 to 30 minutes, you should see a success message as shown below on the Host PC and ICAM-540 will automatically restart.

```
icam-540@tegra-ubuntu:~$ cat /opt/version
ICAM-540_ORIN-NX_5.1.1_GA_3.1.4.14, Build Date: 2023-12-22 15:04:02
icam-540@tegra-ubuntu:~$
icam-540@tegra-ubuntu:~$
icam-540@tegra-ubuntu:~$
icam-540@tegra-ubuntu:~$
```

10. To find BSP version, enter cat /opt/version

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