

User Manual

ICAM-500 Series

Integrated Industrial AI Camera

ADVANTECH

Enabling an Intelligent Planet

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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.

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 his own expense.

FCC Class B

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

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.

Packing List

Before system installation, check that the items listed below are included and in good condition. If any item does not accord with the list, contact your dealer immediately.

- Item XXXXXXXXX
- Box XXXXXXXXX

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 Sicherheitshinweise

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 Netzanschlussteckdose 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, daß diese Öffnungen nicht abgedeckt werden.
8. Beachten Sie beim. Anschluß an das Stromnetz die Anschlußwerte.
9. Verlegen Sie die Netzanschlusbleitung so, daß 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 autorisiertem 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. **VORSICHT:** Explosionsgefahr bei unsachgemäßen Austausch der Batterie.Ersatz nur durch denselben oder einem vom Hersteller empfohlene-männlichen Typ. Entsorgung gebrauchter Batterien nach 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.

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.

Contents

Chapter 1	Product Overview	1
1.1	Introduction	2
1.2	Product Features.....	2
1.3	Product Features.....	2
	Figure 1.1 Spectrum response (nm).....	2
1.4	Environment Specification.....	4
Chapter 2	Intended Use	5
2.1	Overview of Optical functions.....	6
2.1.1	Field of View	6
	Figure 2.1 Field of view.....	6
2.1.2	Lens Movement	6
2.1.3	Spectral Distribution of LEDs	6
	Figure 2.2 Spectral distribution of LEDs	6
2.1.4	LED Uniformity.....	7
	Figure 2.3 LEDs Uniformity.....	7
2.1.5	LEDs Control Model.....	7
Chapter 3	Hardware Installation	9
3.1	Introduction	10
3.2	External Connector	10
3.2.1	ICAM-500 Series External I/O Connector	10
	Figure 3.1 ICAM-500 series External I/O Connector	10
3.2.2	Power/I/O	11
3.2.3	Ethernet/LAN	13
3.2.4	Micro USB.....	14
3.2.5	USB 3.1.....	14
Chapter 4	Getting Started.....	15
4.1	Connection an Ethernet Cable	16
4.2	Connect a Power and D I/O Cable.....	16
4.3	Discover the ICAM-500	16
	Figure 4.1 ICAM-500 discover utility.....	18
	Figure 4.2 Access ICAM-500 via web browser	18
4.4	Start Acquisition	19
	Figure 4.3 Add new project.....	19
	Figure 4.4 Content of new project.....	19
	Figure 4.5 Content of new project.....	20
	Figure 4.6 Start acquisition	20
4.5	Configure ICAM-500 Camera.....	21
	Figure 4.7 1 Camera function overview	21
4.5.1	Camera Acquisition Setting.....	22
	Figure 4.8 Camera Acquisition Setting	22
4.5.2	ISP Settings	23
	Figure 4.9 ISP Setting.....	23
	Figure 4.10 ISP Setting of Color Version.....	25
4.5.3	ROI Setting & Output	26
	Figure 4.11ROI Setting & Output.....	26
4.5.4	Platform Settings.....	26

	Figure 4.12 Platform Settings	26
4.5.5	Hardware Trigger Mode	27
4.5.6	Software Trigger Mode	27
4.5.7	Continuous Mode.....	27
4.5.8	Set up the Digital I/O control.....	27
4.5.9	Trigger delay (Pin 16)	29
4.6	ICAM-500 camera parameters and SDK	29
	Table 4.1: Camera parameters	29
4.7	Project management.....	30
4.7.1	Auto-run	30
	Figure 4.13 Auto run	30
4.7.2	Project import & export	31
	Figure 4.14 Project import	31
4.7.3	Project export.....	31
	Figure 4.15 Project export	31

Chapter 5 Troubleshooting..... 33

5.1	Connection for Keyboard, Mouse and Display.....	34
5.2	Reconnect a Power and D I/O cable.....	34
5.3	Operate the Camera Function	34
5.4	BSP image flashing.....	34
5.5	Expand storage space with SD card	36

Chapter 1

Product Overview

1.1 Introduction

Advantech ICAM-500 series is a highly integrated Industrial AI Camera equipped with programmable variable focus lenses, LED illumination, SONY industrial grade image sensor, multiple core ARM processors and NVIDIA AI system on module. Equipped with varifocal lens and LED illumination, Advantech ICAM-500 reduces installation and maintenance effort significantly. Featuring CAMNavi SDK, Google Chromium web browser utility and NVIDIA Deepstream SDK, ICAM-500 series accelerates the development and deployment of cloud-to-edge vision AI applications. The CAMNavi SDK uses Python language by default and is better adapted to image acquisition and AI algorithm integration. Meanwhile the HTML 5 web based utility can be used to setup the cameras and network configuration to lower the installation effort. The preloaded, optimized Jetpack board support package seamlessly connect to AI cloud services.. Advantech ICAM-500 series is an all-in-one, compact and rugged industrial AI camera, and is ideal for a variety of Edge AI vision applications.

1.2 Product Features

- 1.6MP 60 FPS, SONY industrial grade sensor
- Programmable Variable focus lens
- Advanced LEDs illumination
- NVIDIA Jetson AI system on module
- HW ISP no GPU/CPU workload

1.3 Product Features

- **Sensor:** SONY IMX296, 1.6MP@60fps, 1/2.9", pixel size (3.45 x 3.45 μm) global shutter, monochrome / color

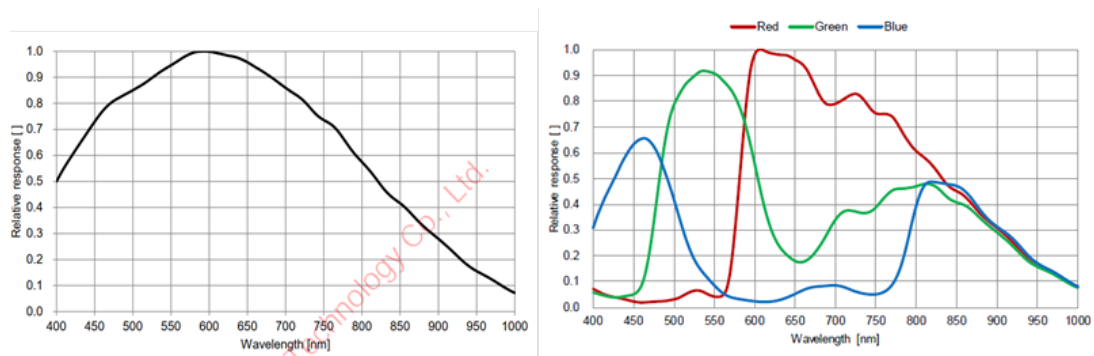
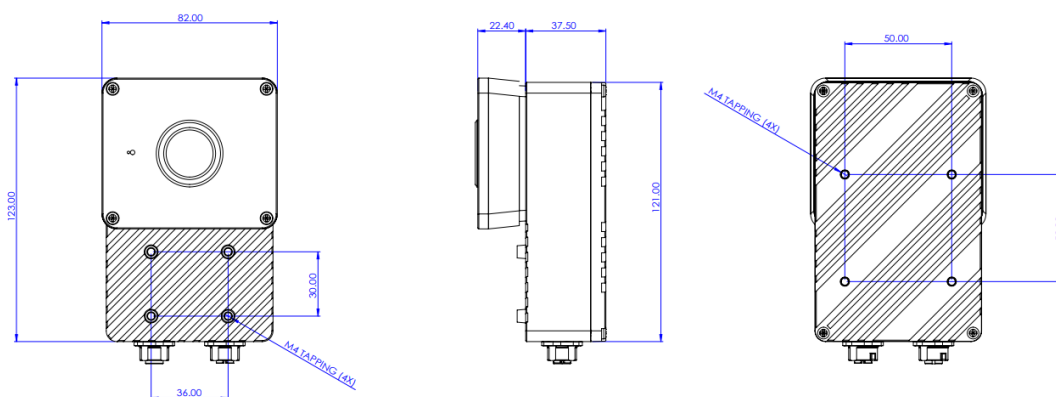


Figure 1.1 Spectrum response (nm)

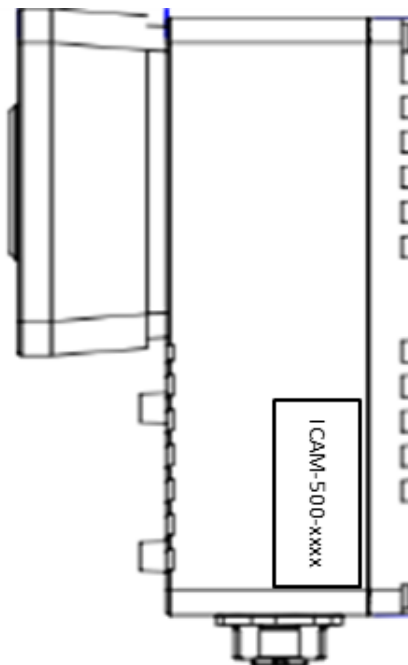
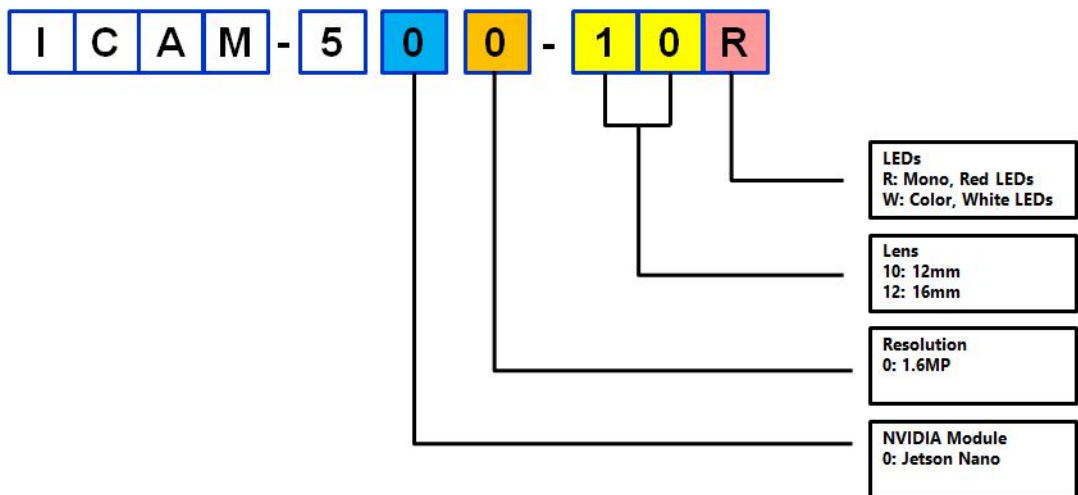
- **Processor system**
 - NVIDIA System on Module Jetson Nano
 - CPU: Quad Core ARM Cortex A57 (Max. operating frequency: 1.43GHz)
 - GPU: Maxwell GPU, 128 CUDA core, performance up to 512 GFLOPS (FP16)
- **Memory, Storage**
 - 4GB LPDDR4 /16G eMMC
- **Optical**

- **12 mm variable focal length:**
FOV 40 x 29.3 mm @ 100 mm working distance
FOV 364.5 x 263.7 @ 900 mm working distance
- **16mm variable focal length:**
FOV 33.9 x 25.3 mm @ 100 mm working distance
FOV 305.4 x 228.2 @ 900 mm working distance
- **LED illumination**
8 x PWM white/red LEDs, programmable
- **Synchronization:**
 - Hardware Trigger / software Trigger / free-run
- **HW ISP**
 - Color debayering, sharpness, white balance, CCM correction, dark noise correction (Default enable), Sharpness and brightness
- **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)
 - 1x Micro USB for OTG (Only works in engineering mode)
 - 1 x Micro SD card slot
 - 1x RS485
 - 2 x digital Input
 - 2 x digital Output
- **LAN**
 - 1x 10/100/1000 Base-T
- **Display**
 - 1x HDMI 2.0
- **Power Requirements**
 - 24V_{DC}+ 10% Max: 17W, typical 15W
- **Dimension**
 - 82mm (W) x 123mm (H) x 59.9mm (D)



- **Software package**
 - O.S: Linux Ubuntu 18.04, Jetpack 4.4, Jetpack 4.4 (Mono), Jetpack 4.5.1(Color)
 - SDK/Utility: CAMNavi SDK, Web based camera utility, IP configure tool, NVIDIA DeepStream SDK & example

■ Type Key of ICAM-500



1.4 Environment Specification

- **Operating temperature:** 0 ~ 40 °C
- **Vibration during operation:** 5 Grms
- **EMC:** CE, FCC

Chapter 2

Intended Use

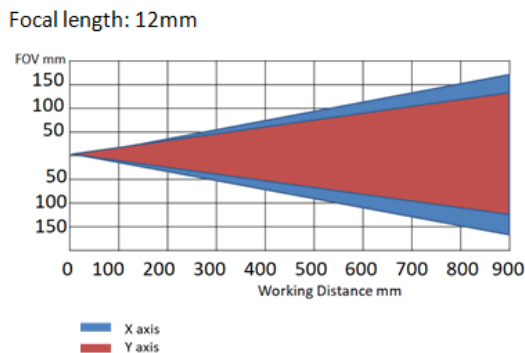
2.1 Overview of Optical functions

Advantech ICAM-500 series equipped with highly integrated optical module which include programmable variable focus lenses and LED illumination. 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.

2.1.1 Field of View

Focal length: 12mm



Focal length: 16mm

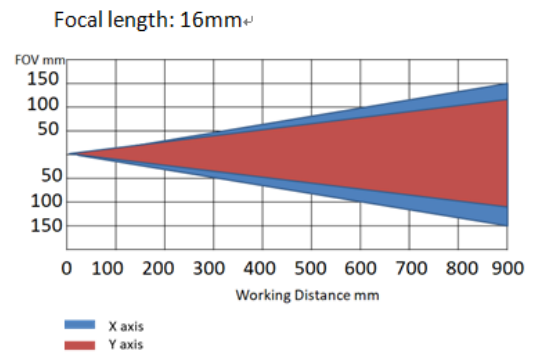


Figure 2.1 Field of view

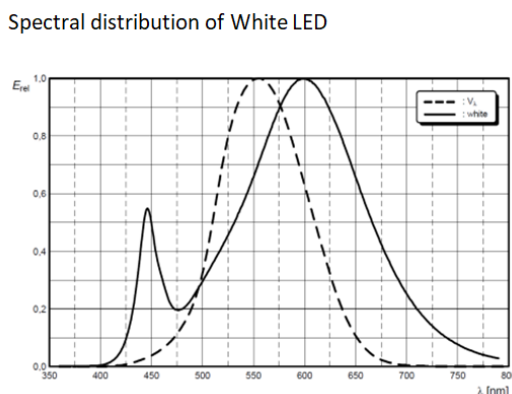
2.1.2 Lens Movement

ICAM-500 series equipped electronic lens motor and the followings are 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 1600 steps
Shift range	0.0136 mm
Reset motor behavior	Allow user to define enable or disable reset lens motor to 0 while camera boot up. Default stay in last position of project setting

2.1.3 Spectral Distribution of LEDs

Spectral distribution of White LED



Spectral distribution of Red LED

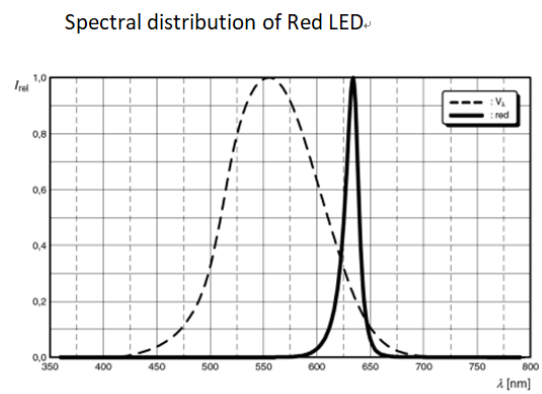


Figure 2.2 Spectral distribution of LEDs

2.1.4 LED Uniformity

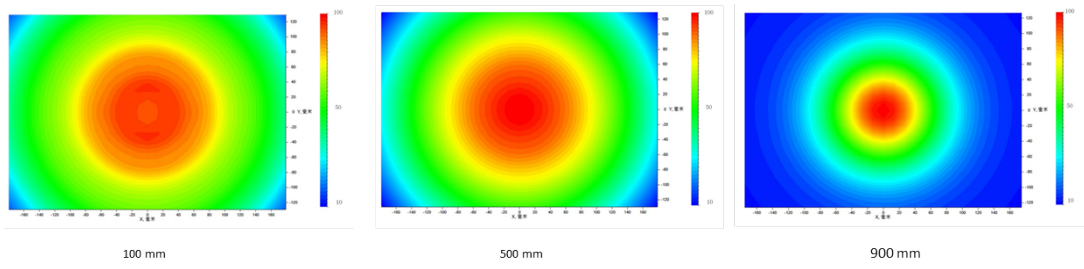
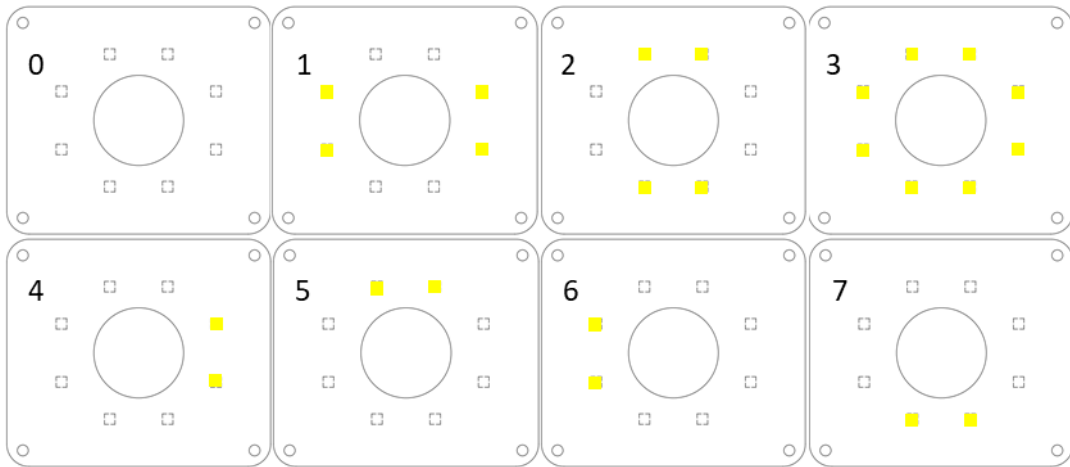


Figure 2.3 LEDs Uniformity

2.1.5 LEDs Control Model



Chapter 3

Hardware Installation

3.1 Introduction

The electrical installation of the ICAM-500 must be carried out by a qualified electrician. Disconnect all electrical components from the power supply when installing the ICAM-500.

The following sections show the external connectors and pins assignment for applications.

3.2 External Connector

3.2.1 ICAM-500 Series External I/O Connector

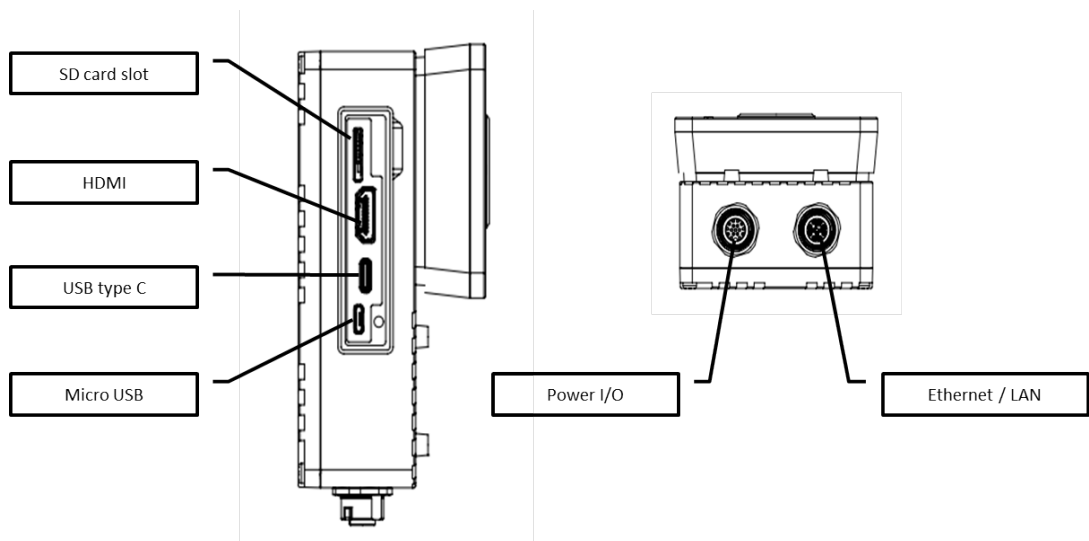
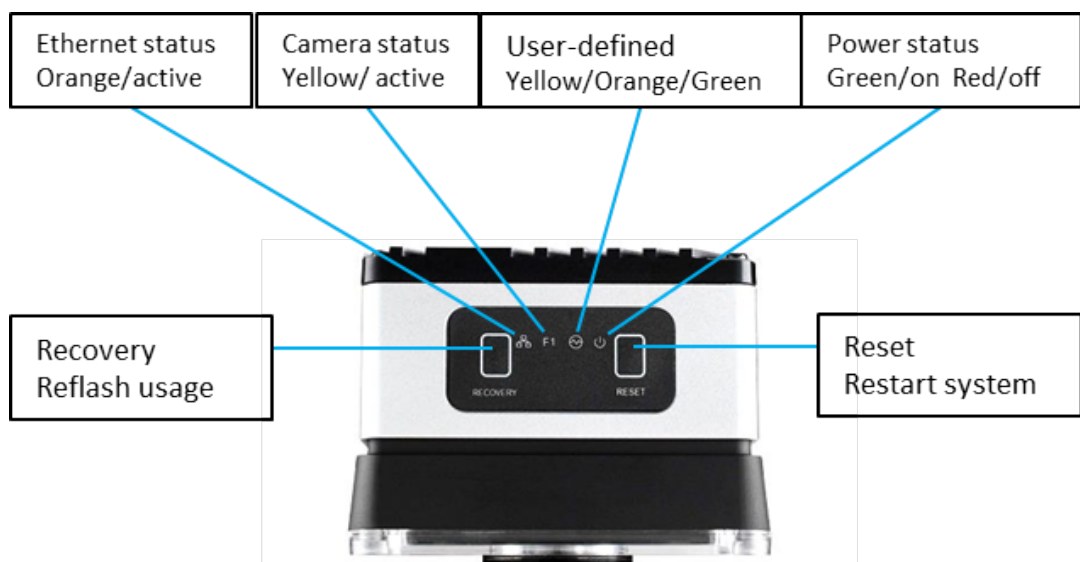
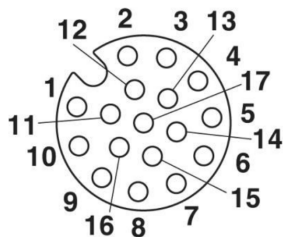


Figure 3.1 ICAM-500 series External I/O Connector



3.2.2 Power/I/O

Power, Digital I/O, and RS485 Connector



Pin	Pigtail	Description	Remark
1	Brown	COM, RS232 TX	No use
2	Blue	COM, RS232 RX	No use
3	White	COM, RS485 D+	
4	Green	COM, RS485 D-	
5	Pink	System power in GND Vin(-)	
6	Yellow	System power in GND Vin(-)	No use
7	Black	DI/DO GND	
8	Gray	Digital input 0	
9	Red	Digital input 1	
10	Violet	Digital output 0	
11	Gray/Pink	Digital output 1	
12	Red/Blue	No use	
13	White/Green	System power in Vin(+)24V	
14	Brown/Green	System power in Vin(+)24V	No use
15	White/Yellow	Rest system BTN	To reset the system via closed to GND(Pin 17)
16	Yellow/Brown	Hardware trigger in	
17	White/Gray	GND	

Signal Connections:

ICAM-500 series support sink type Digital I/O. Please follow the following instruction to wire the DI/O.

I/O	Channel Num.	Pin Num.	Characteristics	Voltage	Current
DI	2	8,9	Dry contact		
Trigger Input	1	16	Dry contact		
DO	2	10, 11	Sink type	High: 28V	Max. 100 mA

I/O	Frequency	Response Time	Delay	Duration	Interrupt
DI	255 Hz/60 Hz	Fall: 0.1us; Rise: 4.35us	No	No	Yes
Trigger Input	16ms /60Hz		0-8192us Step:16us	0-8192 us	No
Step 16 us	No				
DO	255Hz/60Hz	Fall: 1.2us; Rise: 1.92us	No	No	No

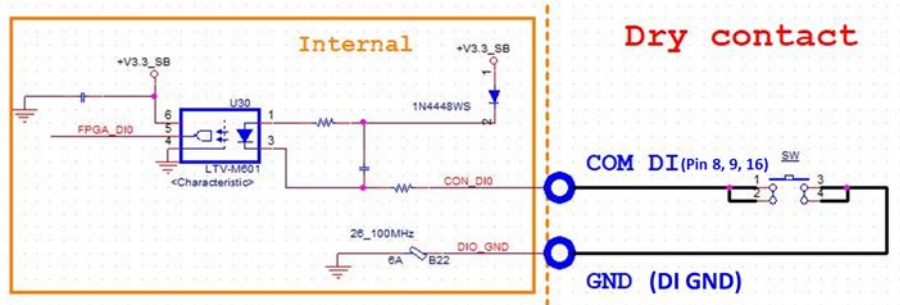
Digital Input & hardware trigger in:

Input channel: 3

Input voltage, 3.3V

Logic 1: close to ground

Logic 0: Open



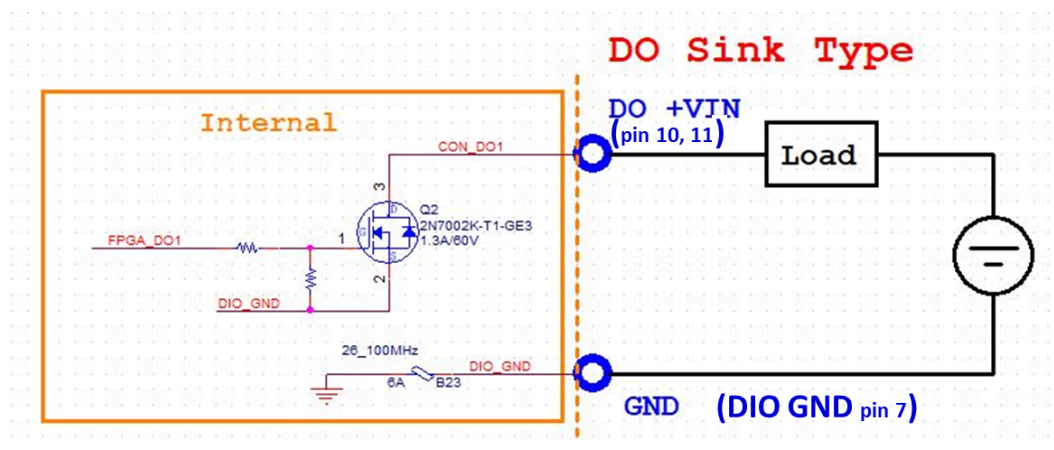
Digital Output:

Output channel: 2

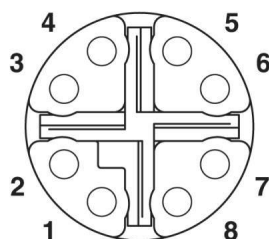
Output voltage,

Supply voltage: 40Vdc

Sink current: 0.2A max /Chanel

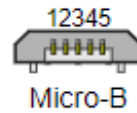
**3.2.3 Ethernet/LAN****Ethernet Connector (LAN)**

ICAM-500 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

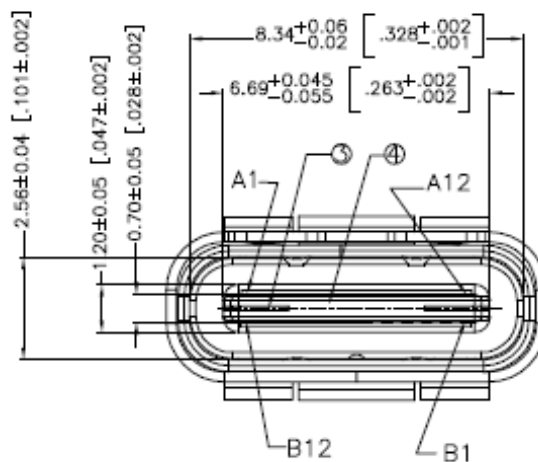


Pin	Signal
1	Vbus (4.4-5.25V)
2	D-
3	D+
4	ID
5	GND

3.2.5 USB 3.1

USB type C connector

ICAM-500 provides 1 USB type C interface connector which only for keyboard and mouse usage. Connect to USB storage will increase the power consumption and will heat the system. Please refer to the table below for pin assignments.



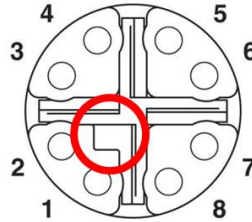
Pin No.	Signal	Pin No.	Signal
A1	GND	B1	GND
A2	SSTXp1	B2	SSTXp1
A3	SSTXn1	B3	SSTXn1
A4	VBUS	B4	VBUS
A5	CC1	B5	SBU2
A6	Dp1	B6	Dn2
A7	Dn1	B7	Dp2
A8	SBU1	B8	CC2
A9	VBUS	B9	VBUS
A10	SSRXn2	B10	SSTXn2
A11	SSRXp2	B11	SSTXp2
A12	GND	B12	GND

Chapter 4

Getting Started

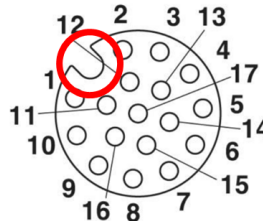
This chapter describes connection, configuration and start acquisition from ICAM-500 via host PC.

4.1 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.

4.2 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.
- Please plugin the power source after the M12 connector feast on the ICAM-500 otherwise that will damage the ICAM-500.

4.3 Discover the ICAM-500

Start to configure the ICAM-500 via Ethernet after installed the ICAM-500. ICAM-500 set DHCP as default, use the IP discover utility of ICAM-500 and connected it via web browser with the IP address shows on the IP discover in windows 10 OS host PC. The default IP address of ICAM-500 is 192.168.0.100.

There are two way to access ICAM-500 in the same network domain.

1. Use LINUX command line in LINUX OS host PC.
2. Use IP discover utility in Windows 10 OS host PC

Follow the instruction to access ICAM-500 with host Linux OS PC.

ipcfg configure iCam-500 network settings in Linux command line.

Command location:

/opt/advantech/sdk/bin/ipcfg

Command Parameters:

Help

Show command parameters.

ipcfg -help

```

Allowed options:
--help                This help.
-C [ --command ] arg  Discover commands.
--local-device arg    Local network device.
--local-address arg   Local network address.
--remote-mac arg      Remote device MAC address.
--nic-list            List local network device

Commands
GetInfo
ChangeNetwork DHCP
ChangeNetwork STATIC 192.168.0.10 255.255.255.0 192.168.0.1 --remote-mac 001122334455
ChangeDevName name --remote-mac 001122334455

```

Options

`ipcfg --nic-list` List local network interfaces.

`ipcfg -C [cmd]` Run commands (see Commands section)

`ipcfg -C [cmd] --remote-mac [MAC]` Configure remote device with MAC address.

`ipcfg -C [cmd] --local-address [IP address]` Configure specified NIC with the IP address.

`ipcfg -C [cmd] --local-device [dev_name]` Configure device named [dev_name].

ChangeNetwork

Set network parameters.

Config device network to DHCP

`ipcfg -C ChangeNetwork DHCP`

Config device network to static IP ?IP Netmask Gateway)

`ipcfg -C ChangeNetwork STATIC 192.168.0.100 255.255.255.0 192.168.0.1`

ChangeDevName

Change device identify name in discovery utility.

`ipcfg -C ChangeDevName A-0011 --remote-mac 001122334455`

User can configure and set up the ICAM-ICAM-500 via web server. The web server is accessed from a host windows 10 OS PC using Google Chrome as follows. Please connect your host PC and ICAM-500 in your local networking area.

1. Open Google Chrome on the configured PC connected to the ICAM-500.
2. Change the Network segment of Host PC and enter the IP address of the ICAM-500: 192.168.0.100:5000
3. Then ICAM-500 web server interface will be displayed in the Chrome browser.

The IP address of ICAM-500 can be modified via discover utility.

Discover utility is an ipconfig which is an application tool to access network configuration of ICAM-500 in LAN. Please download the IP discover utility from Advantech website (<https://www.advantech.com/search/?q=ICAM-500&st=support>) and decompressed

Decompressed the Discover utility of ICAM-500 in windows 10 OS PC and execute discover.exe. Copy the IP address shows on the discover utility and paste in the web browser to access the ICAM-500.

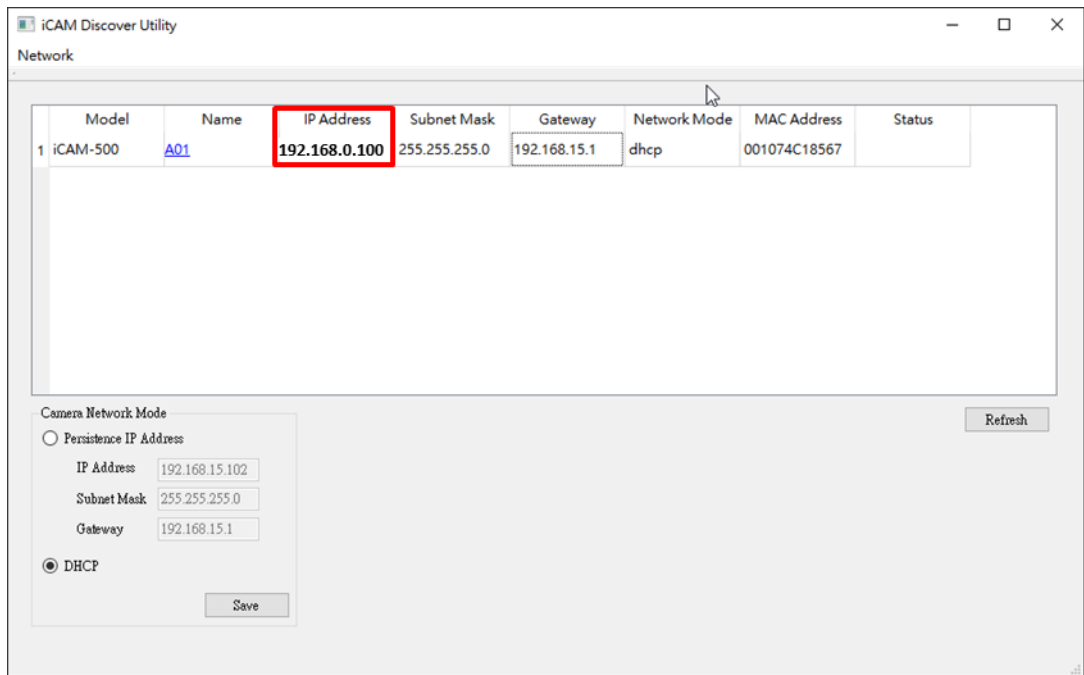


Figure 4.1 ICAM-500 discover utility

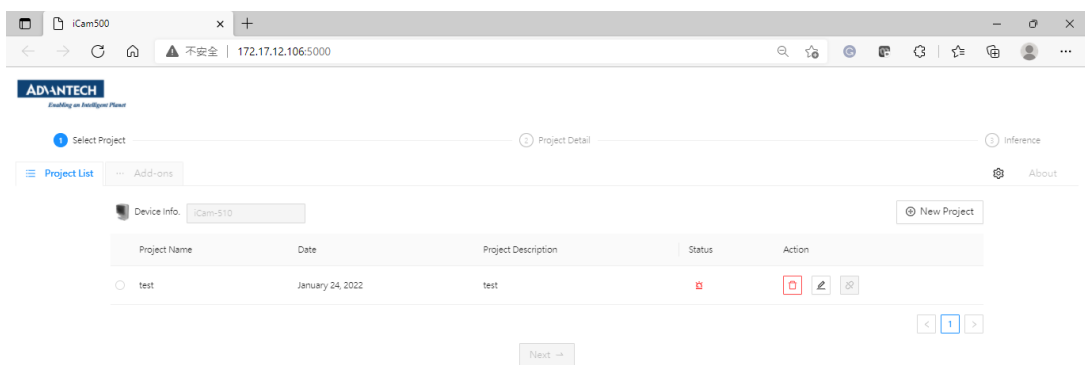


Figure 4.2 Access ICAM-500 via web browser

4.4 Start Acquisition

1. Follow the instruction of web UI to select the “New Project” bottom to create a new project for ICAM-500 configuration.

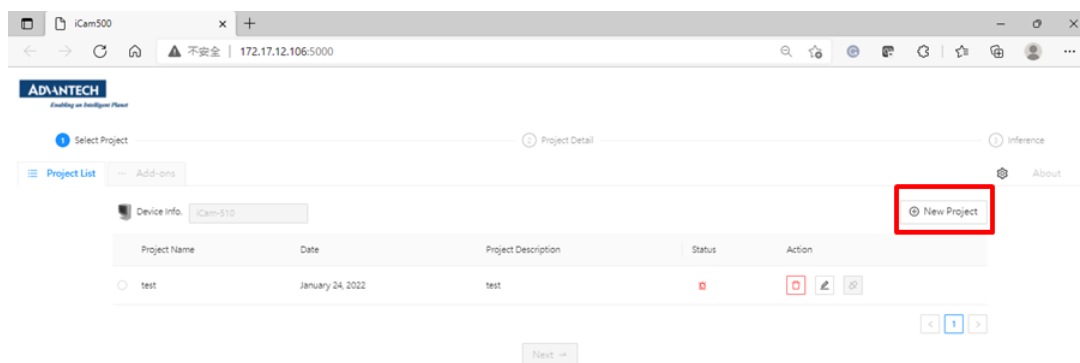


Figure 4.3 Add new project

2. Fill in the content of new project, output resolution and select the trigger mode then confirm to save project, select the project just created, click the “next” button and click the “play” button to start the acquisition.

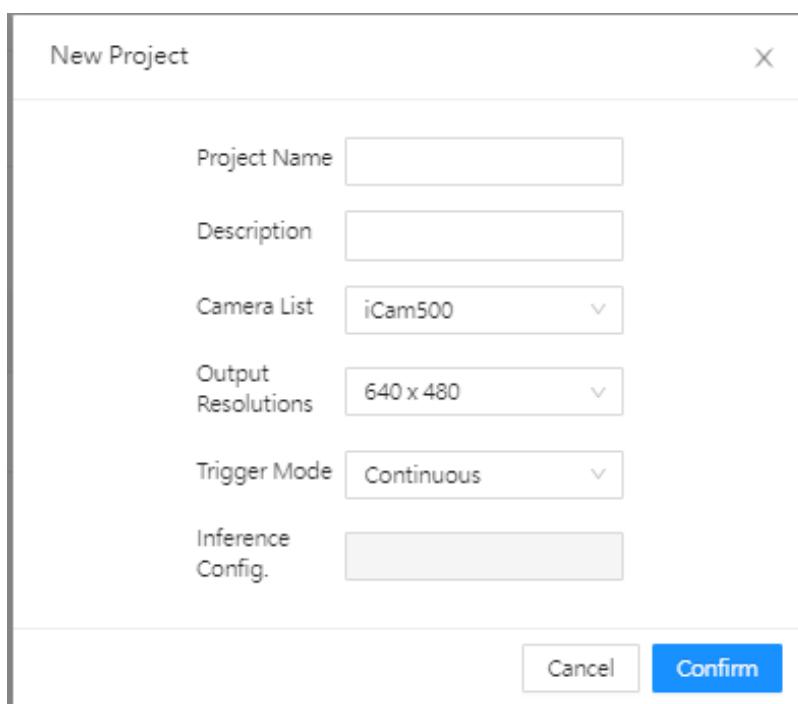
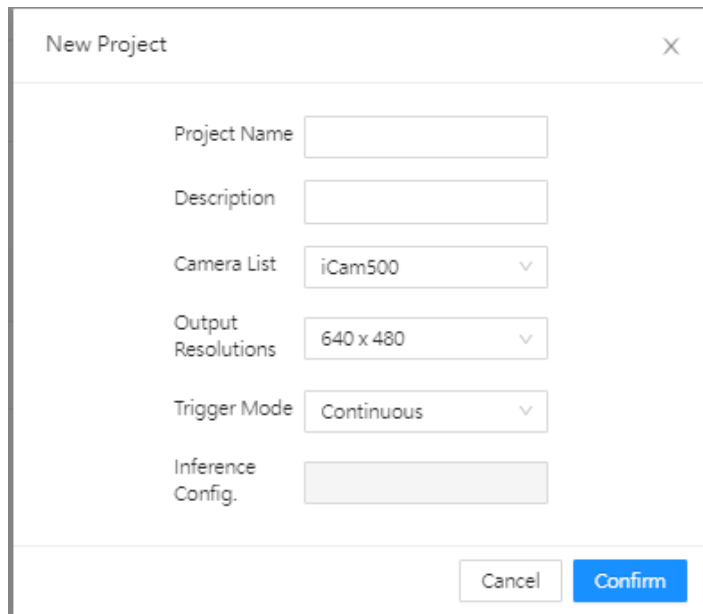
A screenshot of the 'New Project' dialog box. The dialog has a title bar with 'New Project' and a close button. The main area contains several input fields: 'Project Name' (text input), 'Description' (text input), 'Camera List' (dropdown menu with 'iCam500' selected), 'Output Resolutions' (dropdown menu with '640 x 480' selected), 'Trigger Mode' (dropdown menu with 'Continuous' selected), and 'Inference Config.' (text input). At the bottom right, there are two buttons: 'Cancel' and 'Confirm'.

Figure 4.4 Content of new project

- Image save function only works on continuous mode and only can save the image in ICAM-500. The image will be saved in /opt/advantech/web/temp_ - folder/project/{projectName}/images.



The 'New Project' dialog box contains the following fields and controls:

- Project Name:
- Description:
- Camera List:
- Output Resolutions:
- Trigger Mode:
- Inference Config.:
- Buttons: Cancel, Confirm

Figure 4.5 Content of new project

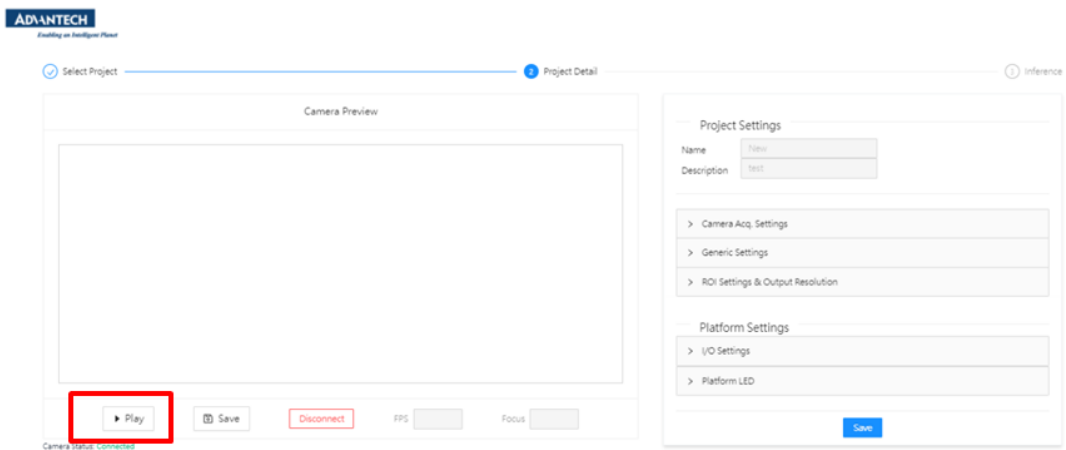


Figure 4.6 Start acquisition

4.5 Configure ICAM-500 Camera

All the camera functions are listed on the right hand side of UI. ICAM-500 provides camera setting, generic setting, ROI setting, I/O setting and LED indicator settings. In addition to using web browser to configure the ICAM-500, Python based example and APIs provide more flexible way to configure and integrate the ICAM-500. All the information of the APIs and example please reference the programming guide.

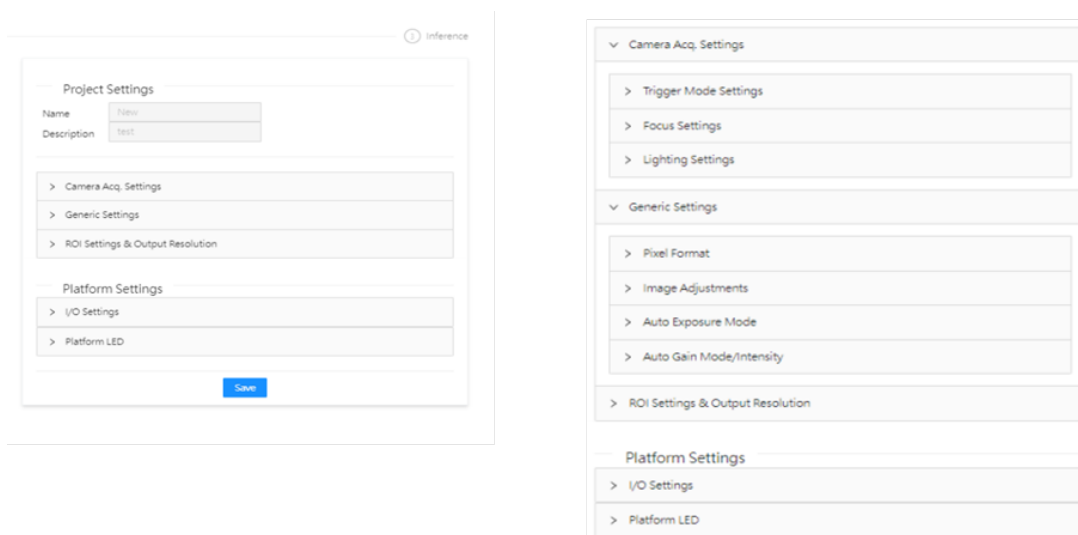


Figure 4.7 1 Camera function overview

4.5.1 Camera Acquisition Setting

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

The exposure time will affect the Continuous mode

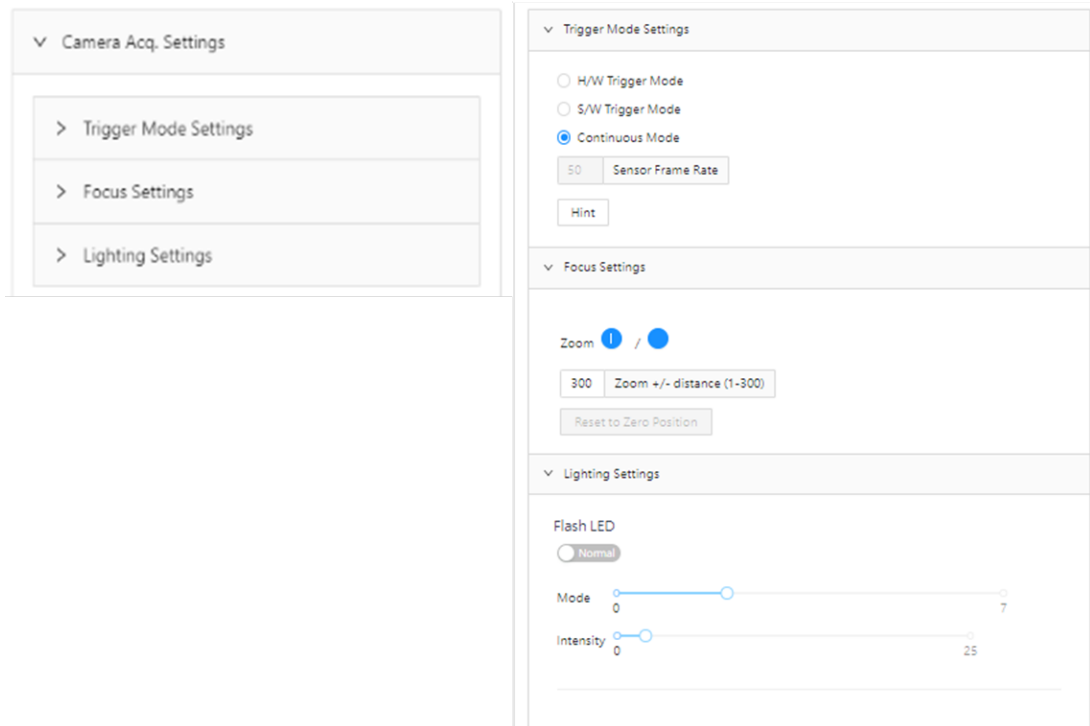


Figure 4.8 Camera Acquisition Setting

4.5.2 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, and its range is from 0 to 255.
- **Sharpness**
To enhance the sharpness level of the image edge via enable sharpness function which only available when the camera is in Mono and YUV pixel format. The range of sharpness is from 0 to 100.
- **Gamma**
Gamma correction provides non-linear adjustment to change image brightness. The range of Gamma is from 0 to 400.
- **Mirror X**
Enable Mirror X function to mirror the images in x axis.

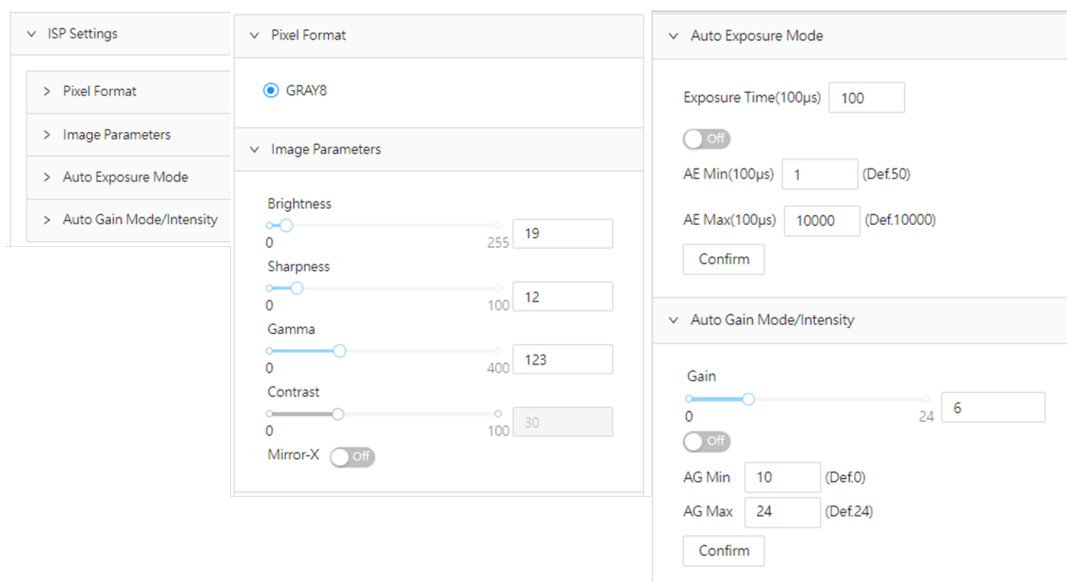


Figure 4.9 ISP Setting

Color HUE

To shifts the color of image color via the color HUE controls. HUE only works on YUV and RGB format. The range of saturation is from 0 to 255.

Color Saturation

To changes the colorfulness of image color via the color saturation controls. Saturation only works on YUV and RGB format. The range of saturation is from 0 to 255.

Color transformation control

The color transformation control is used to restore color and eliminate the overlap in the color channels. RGB to RGB is available for Color Transformation Selector only
Two methods are available to set color transformation control.

Method 1: Disable Color transformation, Select Color Transformation Value Selector, and set Color Transformation Value according to actual demand.

Gain00, Gain10 and Gain20 are group for R channel. Gain01, Gain11 and Gain21 are group for G channel.

Gain02, Gain12 and Gain22 are group for B channel.

Method 2: Click Color Transformation Control, enable Color Transformation Enable, Go to image parameters to set Hue and Saturation to adjust Color Transformation Value.

***Color HUE, Saturation and Color transformation control only works while camera gain setting lower than or equal 6. camera gain setting higher than 7 will cause false behavior of color HUE, saturation and color transformation.

Auto Exposure:

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

The range of exposure is: [1,10000]/*100 us

Auto Gain

Automatically adjusts the gain within specified limits until a target brightness value has been reached
The range of gain: 0-24

White balance

White balance function keep white images under different color temperatures through adjust the Gain Value of the image's R channel and B channel. Ideally, the proportion of R channel, G channel and B channel in the white region is 1:1:1.

It is recommended to correct white balance when there is great difference between the camera's color effect and actual effect. You can correct white balance as shown below.

Steps:

1. Put a white paper in the range of the camera's field of view, and make sure the paper covers the entire field of view.
2. Set exposure and gain. It is recommended to set image brightness value between 120 and 160.
3. Select Once as Balance White Auto, and the camera will automatically adjust white balance for once.

If there is still great difference between correction effect and actual color, it is recommended to correct white balance according to following steps.

Steps:

1. Select Off as Balance White Auto. At this time, Balance Ratio is 1024.

2. Find corresponding R/G/B channel in Balance Ratio Selector. Here we take Green as an example.
3. Find camera's R/G/B value.
4. Take Green as correction standard, and manually adjust other two channels (R channel and B channel) to let these three channels have same value.

**** Here we take Green as an example. For specific Balance Ratio Selector value, please refer to the actual condition. In order to avoid repeated correction after rebooting the camera, it is recommended to save white balance parameter to User Set after white balance correction. You can refer to the Section Save and Load User Set for details. If the light source and color temperature in environment change, you need to correct white balance again.

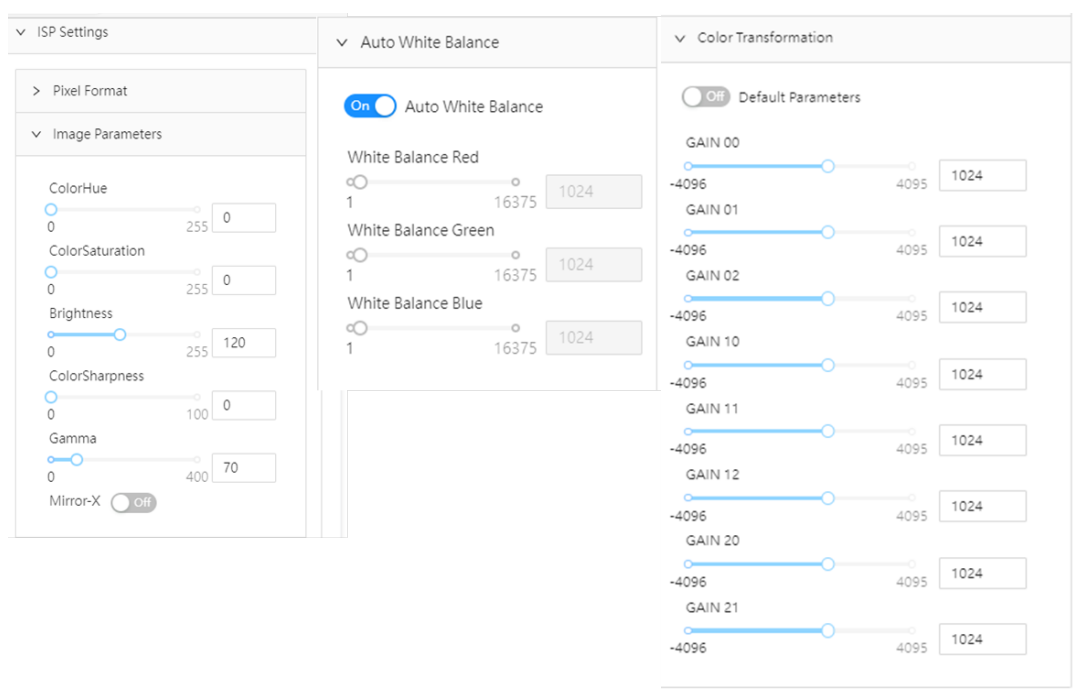


Figure 4.10 ISP Setting of Color Version

4.5.3 ROI Setting & Output

This section shows how to set the image resolution of camera. There are four types resolution for setting.

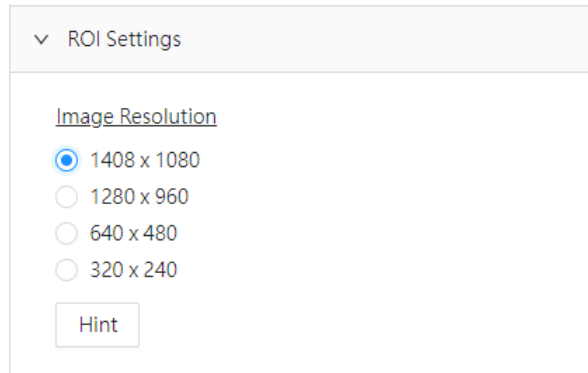


Figure 4.11 ROI Setting & Output

4.5.4 Platform Settings

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

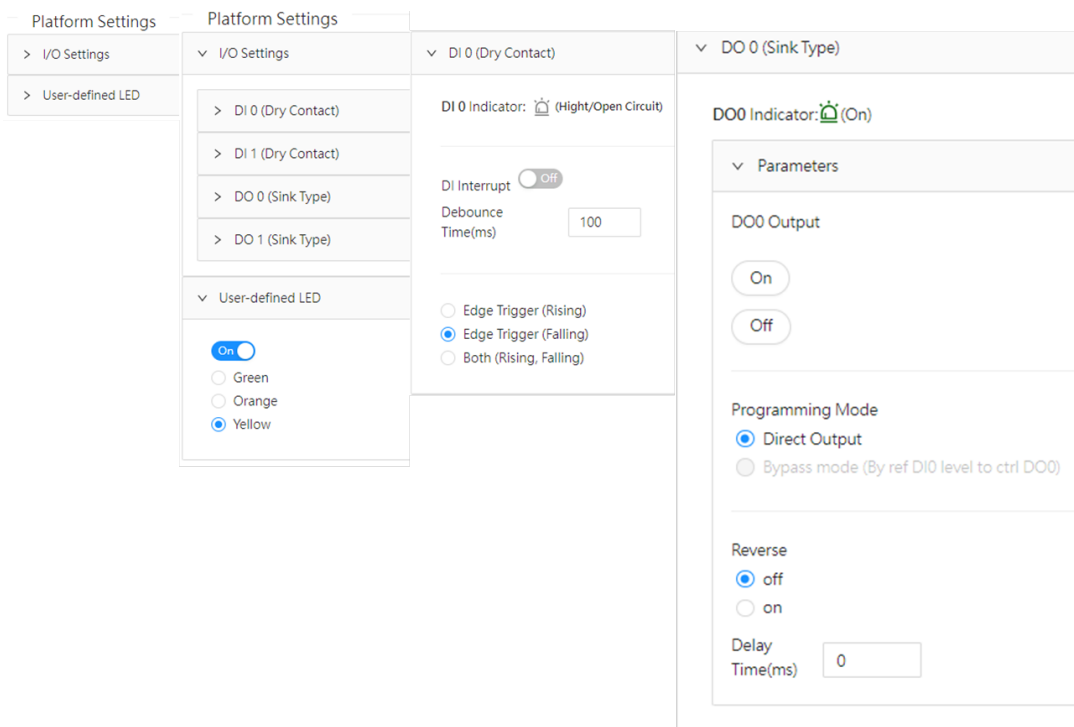


Figure 4.12 Platform Settings

4.5.5 Hardware Trigger Mode

In hardware trigger mode, the digital output pin of ICAM-500 must be connected to the trigger input (pin 16) of the cameras, and the camera will begin the process of exposing and reading out a frame, below are the operation procedures:

1. Wire trigger input (pin 16)
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 shortest duration of trigger input is 16 ms.

4.5.6 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 receiving image data.
4. The camera will return to the standby mode, and wait for the next acquisition command.

*** The shortest duration of trigger input is 16 ms.

4.5.7 Continuous Mode

Camera performs acquisition continuously until acquisition stop is executed.

Mono

Color

YUV format : max 60fps

RGBA format: max 43 fps

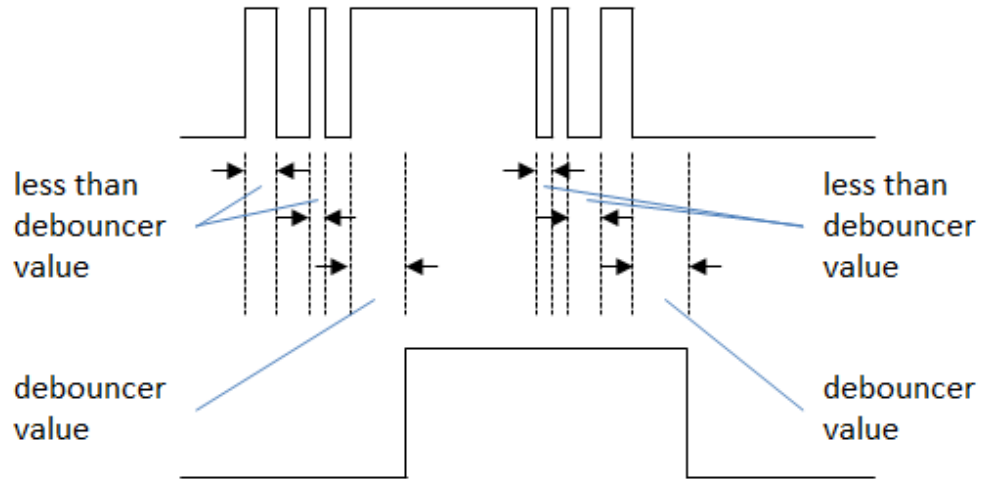
4.5.8 Set up the Digital I/O control

ICAM-500 provides 2 port digital input and 2 ports digital output for external connection.

4.5.8.1 Digital Input and trigger input

There are two digital inputs (Pin 8,9), 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 debouncer value

trigger in: default setting debouncer 50 us.



4.5.8.2 Digital output

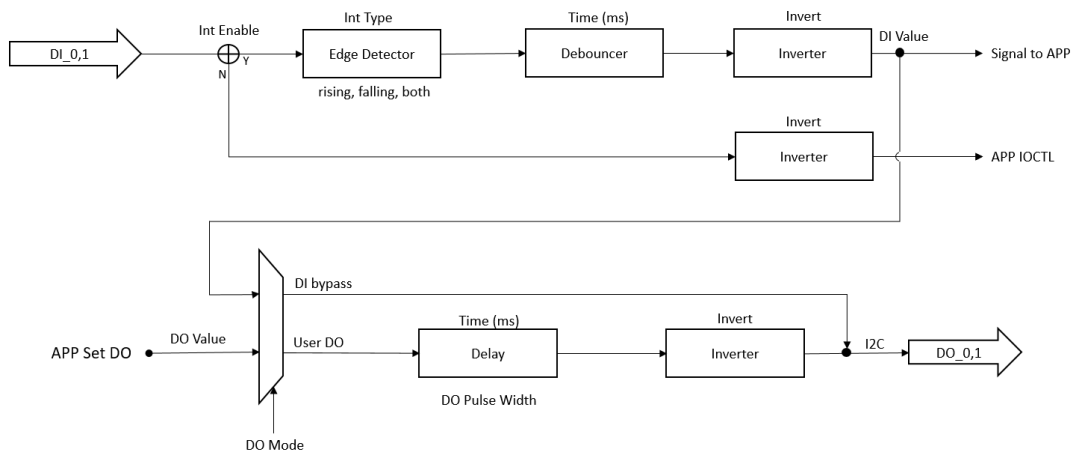
There are two digital outputs (Pin 10,11), each digital output supports inverter and can be configured as two different modes, including direct output.

Direct output:

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

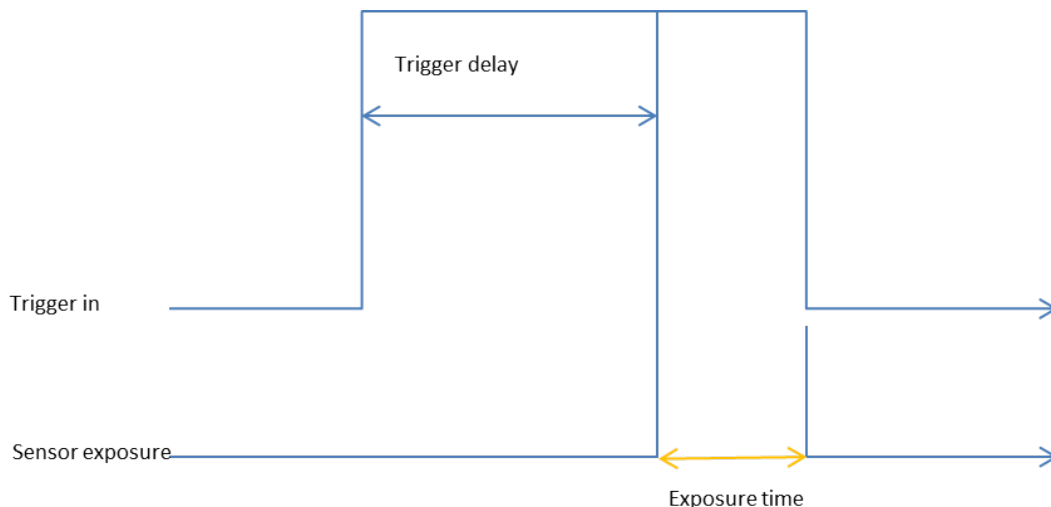
ByPass Mode:

The digital output signal is active when a valid digital input occurs.



4.5.9 Trigger delay (Pin 16)

The Trigger delay allows user to add a delay between the receipt of a hardware trigger signal and the moment the trigger becomes active.



4.6 ICAM-500 camera parameters and SDK

All the information of the APIs and example please refer to the programming guide.

Table 4.1: Camera parameters		
Function Name	Parameters	
	Mono	Color
Camera Acq. Settings		
Trigger Mode Settings	H/W Trigger Mode S/W Trigger Mode Continuous Mode Frame rate	
Focus Settings	Focus Step Distance Zoom + / - Reset to zero position	
Lighting Settings LED Control and the LED mode	Flash LED Mode (0~7) Gain (0~25)	
ISP Settings		
Pixel Format	GRAY 8	YUV RGBA
Image Adjustments	Brightness (0-255) Sharpness (0-100) Gama (0-400) Mirror X	Color HUE (0~255) Color Saturation (0~255) CCM Gain00, Gain10 and Gain20 R channel. (-4096~4096) Gain01, Gain11 and Gain21 G channel. (-4096~4096) Gain02, Gain12 and Gain22 B channel. (-4096~4096) White balance(1~16376)
Auto Exposure Mode	Exposure time Range [1,10000]/*100 us	

Auto Gain Mode/Intensity	Gain Range(0~24)
Platform Settings	
I/O Setting	DI 0/1 Debounce time Edge Trigger (Rising) DO 0/1 Output High Output Low Programming Mode Direct Output Reverse on/off Delay time (ms)
User-defined LED	Green Orange Yellow

4.7 Project management

ICAM-500 allow user to save camera setting as project and provides auto-run, import and export function.

4.7.1 Auto-run

ICAM-500 allow user to set up auto run project function while camera boot up. Select the project and enable auto-run function and ICAM-500 will auto execute the project while camera boot up.

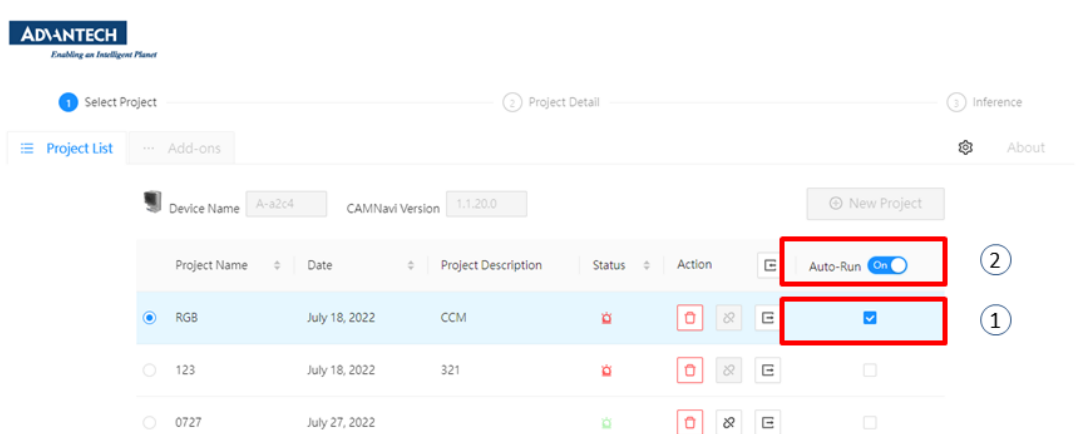


Figure 4.13 Auto run

4.7.2 Project import & export

ICAM-500 provides the project import and export function.

4.7.2.1 Project import

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

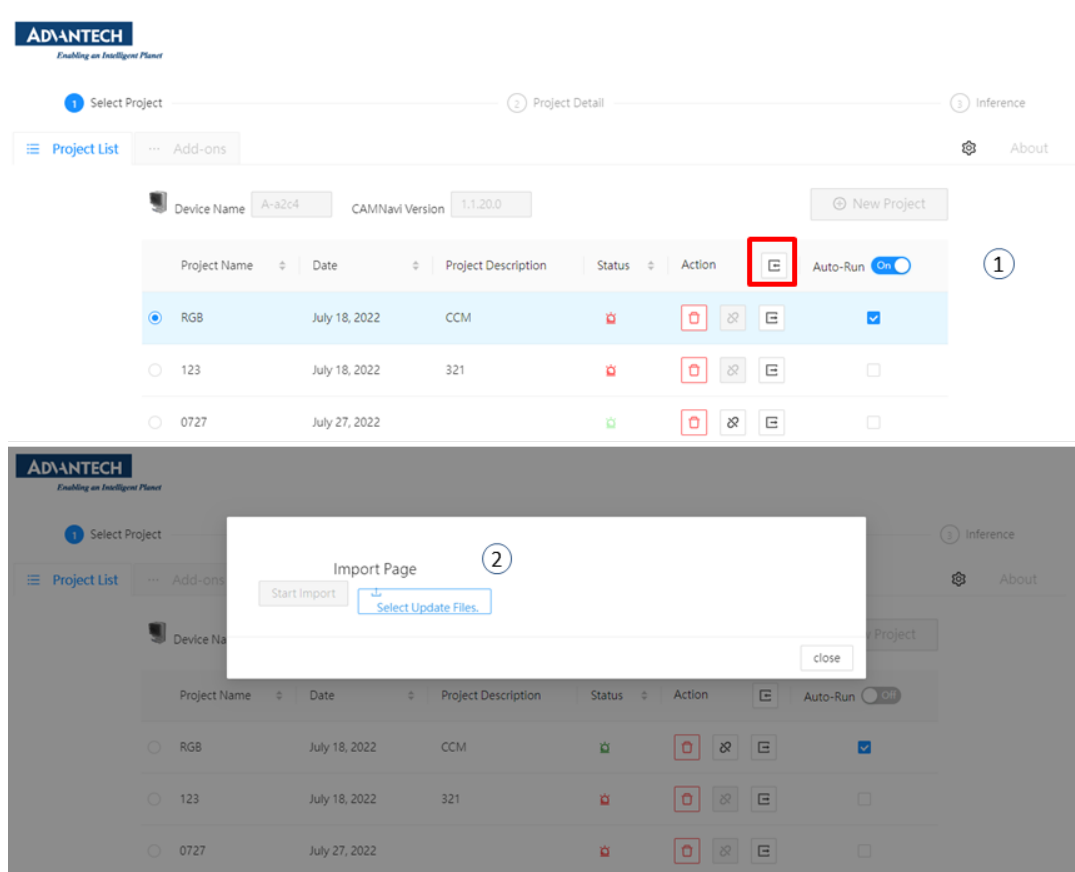


Figure 4.14 Project import

4.7.3 Project export

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

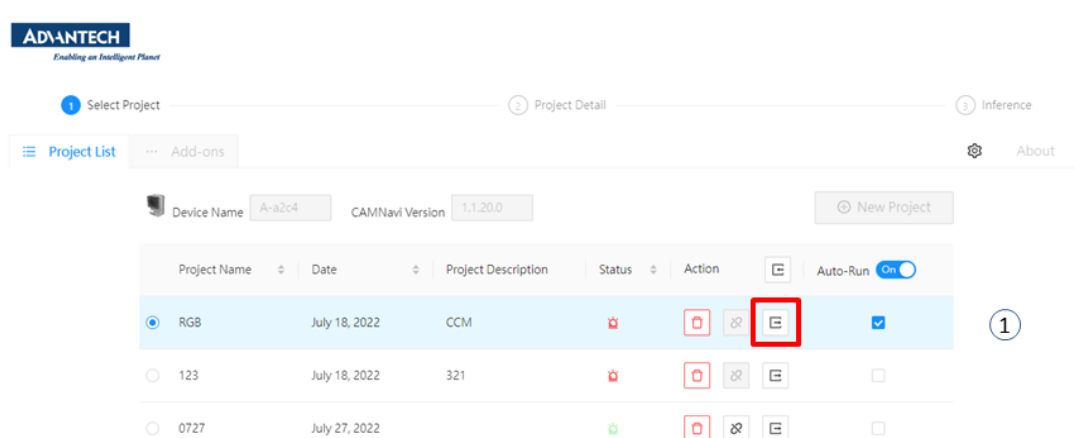


Figure 4.15 Project export

Chapter 5

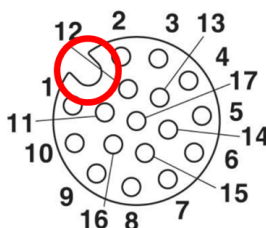
Troubleshooting

Please setup the ICAM-500 with following instruction to operating ICAM-500 in local for troubleshooting, if user have problem to connect the ICAM-500 via host PC. Contact Advantech FAE for technical support If ICAM-500 still can't be boot up and acquisition after reset up the ICAM-500.

5.1 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

5.2 Reconnect a Power and D I/O cable



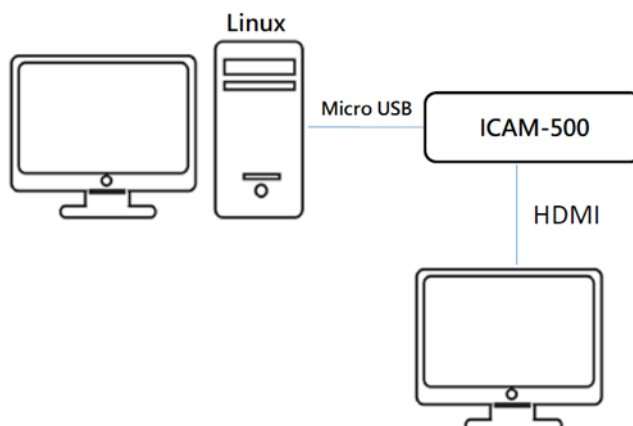
- Align the alignment pin (Cable side) with the alignment channel (Device side)
- Inset the cable connector and tighten the threaded collar to fix the connection.
- Plugin the power source after the M12 connector feast on the ICAM-500.

5.3 Operate the Camera Function

1. Click Google Chrome on desktop of the ICAM-500.
2. Enter the default IP address of the ICAM-500: 192.168.0.100:5000 or Local-host5000
3. Then ICAM-500 web server interface will be displayed in the Chrome browser.

5.4 BSP image flashing

1. Connect ICAM-500 device and Host PC(X 86 with Ubuntu OS) with micro USB cable. And connect the HDMI screen to the ICAM-500 device.



- Copy BSP file (Ex: ICAM-500_Nano_4.5.1_1.1.10.5_MassFlash.tbz2) to Host PC
- Enter following command on Host PC to un-tar BSP image file:
`tar -vxjf ICAM-500_Nano_4.5.1_1.1.10.5_MassFlash.tbz2`
- Press and hold the Reset and Recovery buttons on the ICAM-500 at the same time.
- Release the Reset button first.
- Release the Recovery button after waiting for 3 seconds.
- Enter the “lsusb” command on the Host PC.
- ID 0955:7f21 Nvidia Corp. means device is in recovery mode.

```
docker@ubuntu:~$ lsusb
Bus 001 Device 002: ID 0955:7f21 NVidia Corp.
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
Bus 002 Device 003: ID 0e0f:0002 VMware, Inc. Virtual USB Hub
Bus 002 Device 002: ID 0e0f:0003 VMware, Inc. Virtual Mouse
Bus 002 Device 001: ID 1d6b:0001 Linux Foundation 1.1 root hub
docker@ubuntu:~$
```

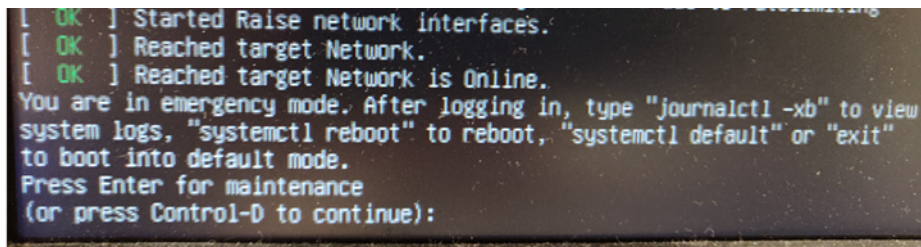
- Enter the “sudo su” command on the Host PC to get the administrator authority.
- Enter the following command on the Host PC to find the BSP image file.
“cd ICAM-500_Nano_4.xxxxxx_MassFlash/ xxxxx folder
- Enter the “./nvmflash.sh” command on the Host PC.
- After 10 to 20 minutes, you can see the success message as shown below on Host PC and the ICAM-500 will automatically restart.

```
Ongoing processes: 13013
Ongoing processes: 13013
Ongoing processes: 13013
Ongoing processes: 13013
Ongoing processes: 13013
Ongoing processes: 13013
Ongoing processes: 13013
Ongoing processes:
Flash complete (SUCCESS)
root@ubuntu:/home/jetson/Desktop/ICAM-500_Nano_4.4_1.0.9.0#
```

5.5 Expand storage space with SD card

If you have insufficient storage space to deal with, please ask your local FAE/AE for an SD card expansion tool.

1. Please prepare an SD card with a capacity of at least 32GB, 64GB is better.
2. Insert the SD card into the ICAM-500 then enter the “sdcard-expansion-tool.sh” command.
3. This script will sync some major file system to the SD card and automatically mount the linked files via fstab at boot time.
4. After you use script to expand the storage space, any operation on the ICAM-500 will be reflected on the SD card, so do not remove the SD card at any time!
5. When the SD card is abnormal, the system will enter emergency mode.



```
[ OK ] Started Raise network interfaces.  
[ OK ] Reached target Network.  
[ OK ] Reached target Network is Online.  
You are in emergency mode. After logging in, type "journalctl -xb" to view  
system logs, "systemctl reboot" to reboot, "systemctl default" or "exit"  
to boot into default mode.  
Press Enter for maintenance  
(or press Control-D to continue):
```

6. Press Enter for maintenance. Replace /etc/fstab.org with /etc/fstab in console.
7. Restart the ICAM-500 device.
8. Please note that the file system at this time is the file system before you use the SD card expansion tool.
9. Then back up the wrong SD card files and prepare a new SD card to re-execute the script.

www.advantech.com

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