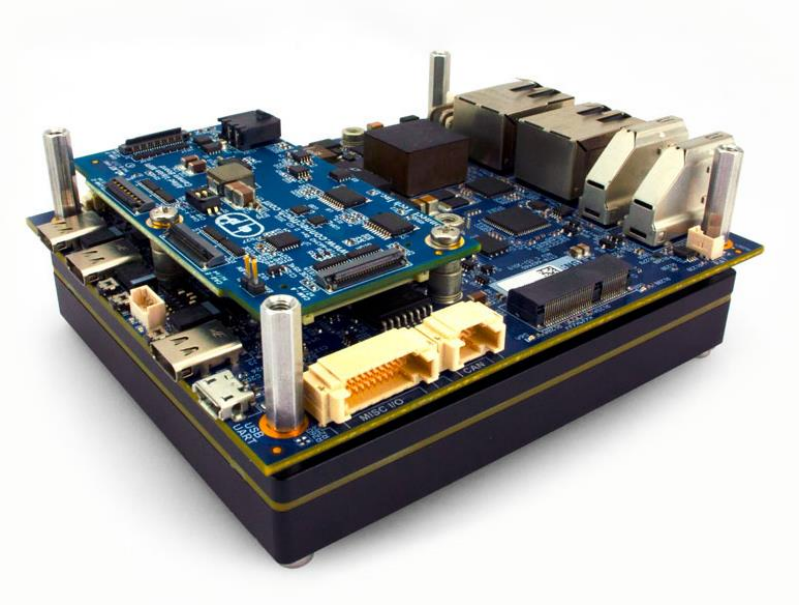
Connect Tech Inc.

Embedded Computing Experts

USERS GUIDE



Allied Vision MIPI Camera Board

CTIM-00065 Revision 0.02 2021-06-17

NVIDIA ELITE PARTNER

CONNECT TECH

www.connecttech.com

support@connecttech.com

TABLE OF CONTENTS

PREFACE

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The information contained within this user's guide, including but not limited to any product specification, is subject to change without notice.

Connect Tech assumes no liability for any damages incurred directly or indirectly from any technical or typographical errors or omissions contained herein or for discrepancies between the product and the user's guide.

Customer Support Overview

If you experience difficulties after reading the manual and/or using the product, contact the Connect Tech reseller from which you purchased the product. In most cases the reseller can help you with product installation and difficulties.

In the event that the reseller is unable to resolve your problem, our highly qualified support staff can assist you at: http://connecttech.com/support/resource-center/. See the contact information section below for more information on how to contact us directly. Our technical support is always free.

Contact Information

Contact Information	
Mail/Courier	Connect Tech Inc. Technical Support 489 Clair Road West Guelph, Ontario Canada N1L 0H7
Contact Information	sales@connecttech.com support@connecttech.com www.connecttech.com Toll Free: 800-426-8979 (North America only) Telephone: +1-519-836-1291 Facsimile: 519-836-4878 (on-line 24 hours)
Support	Please go to the Connect Tech Resource Center for product manuals, installation guides, device drivers, BSPs and technical tips. Submit your technical support questions to our support engineers. Technical Support representatives are available Monday through Friday, from 8:30 a.m. to 5:00 p.m. Eastern Standard Time.

Limited Product Warranty

Connect Tech Inc. provides a one year warranty for this product. Should this product, in Connect Tech Inc.'s opinion, fail to be in good working order during the warranty period, Connect Tech Inc. will, at its option, repair or replace this product at no charge, provided that the product has not been subjected to abuse, misuse, accident, disaster or non-Connect Tech Inc. authorized modification or repair.

You may obtain warranty service by delivering this product to an authorized Connect Tech Inc. business partner or to Connect Tech Inc. along with proof of purchase. Product returned to Connect Tech Inc. must be pre-authorized by Connect Tech Inc. with an RMA (Return Material Authorization) number marked on the outside of the package and sent prepaid, insured and packaged for safe shipment. Connect Tech Inc. will return this product by prepaid ground shipment service.

The Connect Tech Inc. Limited Warranty is only valid over the serviceable life of the product. This is defined as the period during which all components are available. Should the product prove to be irreparable, Connect Tech Inc. reserves the right to substitute an equivalent product if available or to retract the Warranty if no replacement is available.

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ESD Warning

Electronic components and circuits are sensitive to ElectroStatic Discharge (ESD). When handling any circuit board assemblies including Connect Tech COM Express carrier assemblies, it is recommended that ESD safety precautions be observed. ESD safe best practices include, but are not limited to:

- Leaving circuit boards in their antistatic packaging until they are ready to be installed.
- Using a grounded wrist strap when handling circuit boards, at a minimum you should touch a grounded metal object to dissipate any static charge that may be present on you.
- Only handling circuit boards in ESD safe areas, which may include ESD floor and table mats, wrist strap stations and ESD safe lab coats.
- Avoiding handling circuit boards in carpeted areas.
- Try to handle the board by the edges, avoiding contact with components.

REVISION HISTORY

Revision	Date	Changes
0.00	2021-03-30	Initial Release
0.01	2021-04-05	Preliminary Production Release
0.02	2021-06-17	Production Release

INTRODUCTION

The Allied Vision MIPI Camera Board connects up to six MIPI CSI-2 cameras directly to this tiny footprint adapter. The Camera Board easily attaches to the Rogue/Rogue-X Carrier Boards through the camera expansion header connector.

Product Features and Specifications

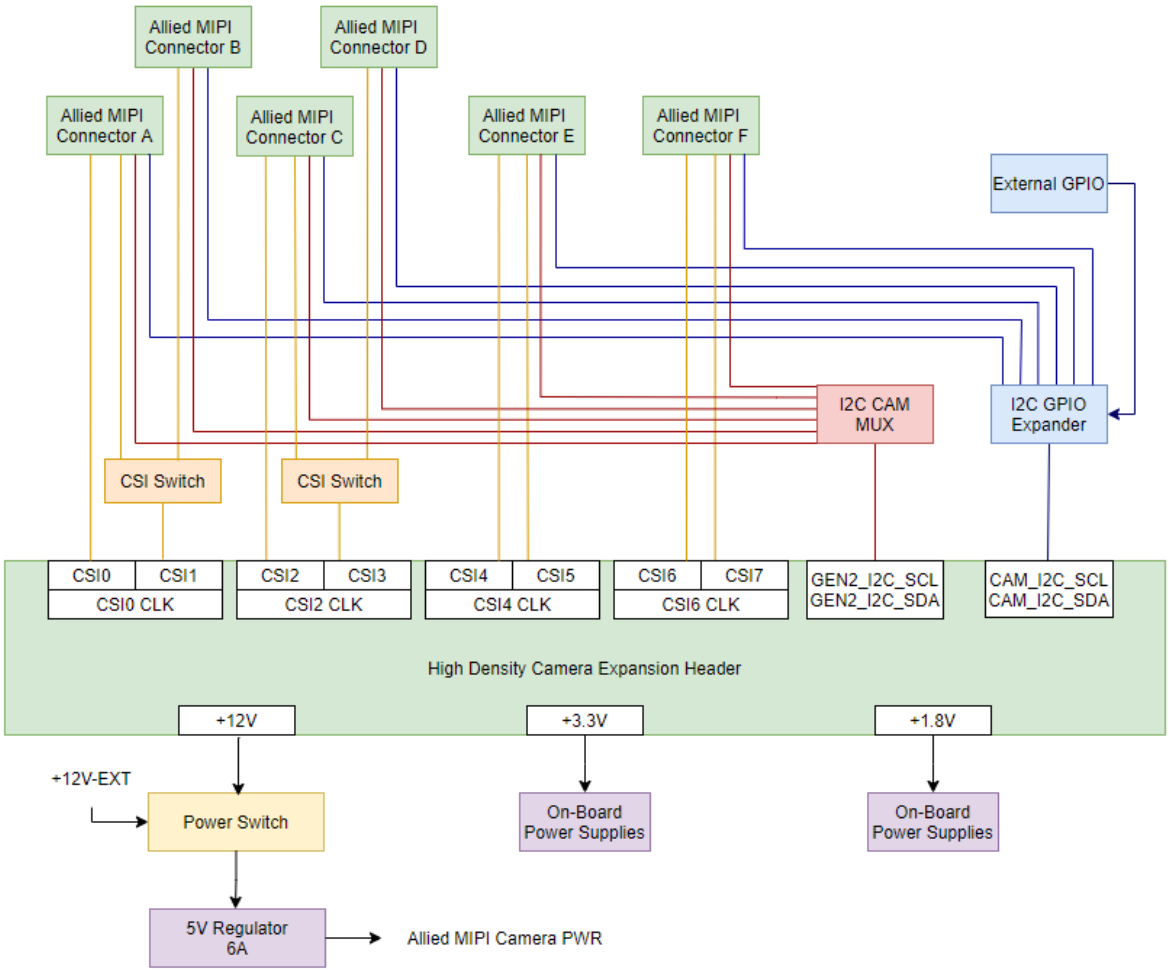
Specifications	
Size	75mm x 40.2 mm (2.95” x 1.58”)
Camera Expansion Connector	QSH-060-01-L-D Samtec Connector
Camera Inputs	Up to 6x MIPI CSI-2
Allied Vision Sensor Support	1500 C and 1800 C Series Alvium MIPI CSI sensors
Camera Input Connectors	FH55-22S-0.5SH Hirose Connectors
External GPIO Connectors	DF14-15P-1.25H Hirose Connector
Input Power	Input Power Supply uses 12V on MIPI Camera Expansion Header Rogue/Rogue-X Carrier must be powered from 12V to 19V
Operating Temperature	-40°C to +85°C (-40°F to +185°F)
Warranty	1 Year
Integrated Rogue/Rogue-X Storage Option	NVMe 970 EVO M.2 1TB SSD
Integrated Rogue/Rogue-X Wireless Option	Intel 7265 WIFI AC+BT M.2 2230

Part Numbers/ Ordering Information

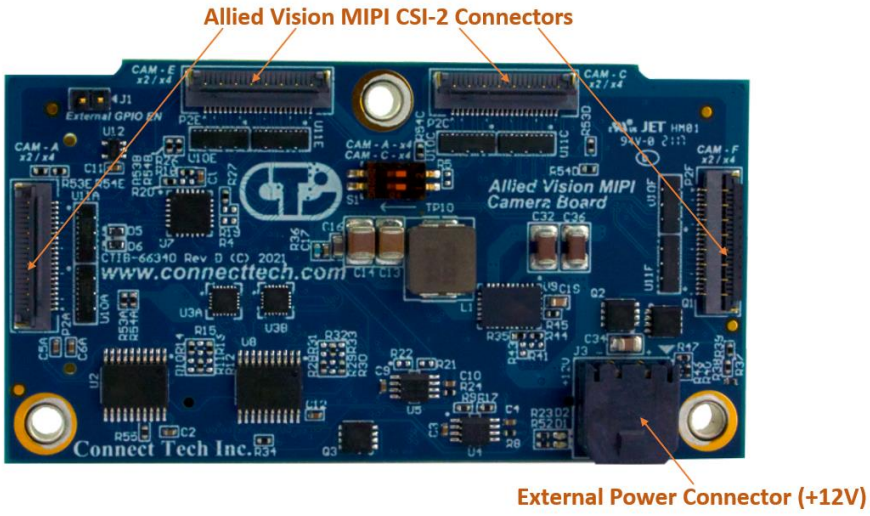
Part Number				
JCB005	Allied Vision MIPI Camera Board			
Integrated Assemblies				
Part Number	Carrier Board	Thermal Option	Wireless Option	Storage Option
AGX101-58	Rogue Carrier	Stock Heatspreader	No Wireless Installed	No SSDs Installed
AGX101-59	Rogue Carrier	Stock Heatspreader	No Wireless Installed	1x 1TB SSD Installed
AGX101-60	Rogue Carrier	Stock Heatspreader	No Wireless Installed	2x 1TB SSD Installed
AGX101-79	Rogue Carrier	Stock Heatspreader	Wireless Installed	No SSDs Installed
AGX101-80	Rogue Carrier	Stock Heatspreader	Wireless Installed	1x 1TB SSD Installed
AGX101-81	Rogue Carrier	Stock Heatspreader	Wireless Installed	2x 1TB SSD Installed
AGX101-82	Rogue Carrier	CTI Active Thermal	No Wireless Installed	No SSDs Installed
AGX101-83	Rogue Carrier	CTI Active Thermal	No Wireless Installed	1x 1TB SSD Installed
AGX101-84	Rogue Carrier	CTI Active Thermal	No Wireless Installed	2x 1TB SSD Installed
AGX101-85	Rogue Carrier	CTI Active Thermal	Wireless Installed	No SSDs Installed
AGX101-86	Rogue Carrier	CTI Active Thermal	Wireless Installed	1x 1TB SSD Installed
AGX101-87	Rogue Carrier	CTI Active Thermal	Wireless Installed	2x 1TB SSD Installed
AGX101-88	Rogue Carrier	CTI Passive Thermal	No Wireless Installed	No SSDs Installed
AGX101-89	Rogue Carrier	CTI Passive Thermal	No Wireless Installed	1x 1TB SSD Installed
AGX101-A1	Rogue Carrier	CTI Passive Thermal	No Wireless Installed	2x 1TB SSD Installed
AGX101-A2	Rogue Carrier	CTI Passive Thermal	Wireless Installed	No SSDs Installed
AGX101-A3	Rogue Carrier	CTI Passive Thermal	Wireless Installed	1x 1TB SSD Installed
AGX101-A4	Rogue Carrier	CTI Passive Thermal	Wireless Installed	2x 1TB SSD Installed
AGX103-22	Rogue-X Carrier	Stock Heatspreader	No Wireless Installed	No SSDs Installed
AGX103-23	Rogue-X Carrier	Stock Heatspreader	No Wireless Installed	1x 1TB SSD Installed
AGX103-24	Rogue-X Carrier	Stock Heatspreader	Wireless Installed	No SSDs Installed
AGX103-25	Rogue-X Carrier	Stock Heatspreader	Wireless Installed	1x 1TB SSD Installed
AGX103-26	Rogue-X Carrier	CTI Active Thermal	No Wireless Installed	No SSDs Installed
AGX103-27	Rogue-X Carrier	CTI Active Thermal	No Wireless Installed	1x 1TB SSD Installed
AGX103-28	Rogue-X Carrier	CTI Active Thermal	Wireless Installed	No SSDs Installed
AGX103-29	Rogue-X Carrier	CTI Active Thermal	Wireless Installed	1x 1TB SSD Installed
AGX103-30	Rogue-X Carrier	CTI Passive Thermal	No Wireless Installed	No SSDs Installed
AGX103-31	Rogue-X Carrier	CTI Passive Thermal	No Wireless Installed	1x 1TB SSD Installed
AGX103-32	Rogue-X Carrier	CTI Passive Thermal	Wireless Installed	No SSDs Installed
AGX103-33	Rogue-X Carrier	CTI Passive Thermal	Wireless Installed	1x 1TB SSD Installed

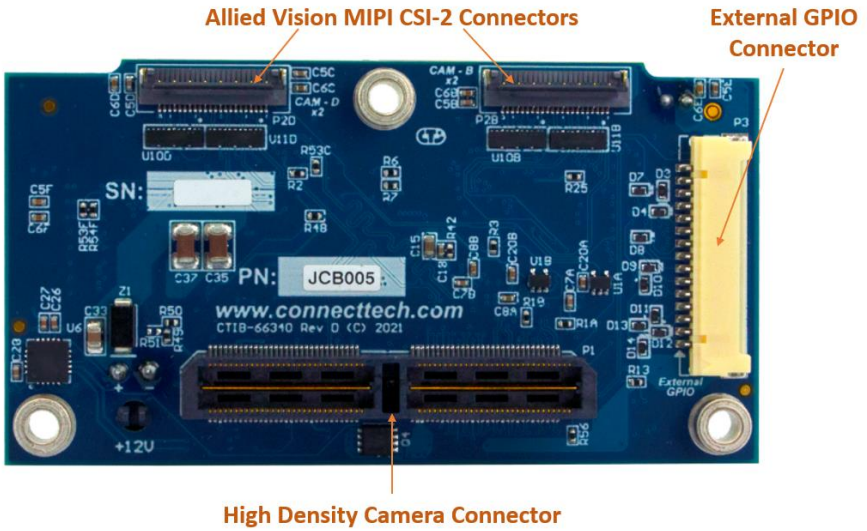
PRODUCT OVERVIEW

Block Diagram



Connector Summary & Locations





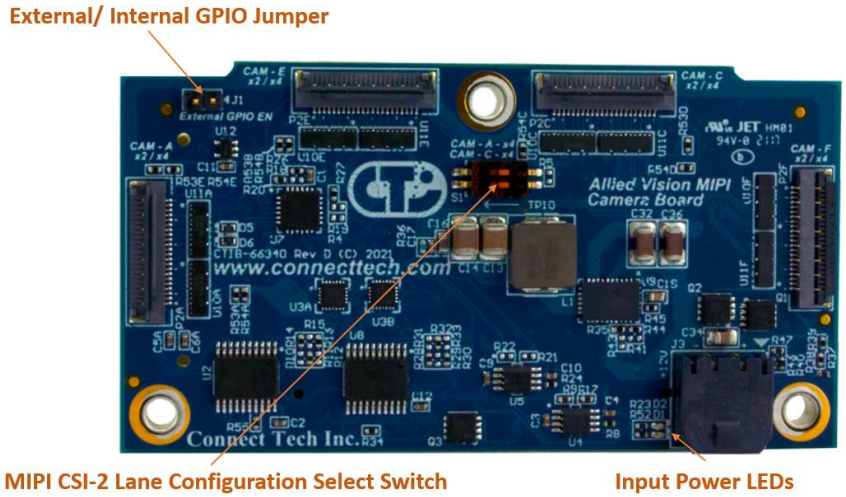
Designator	Connector Description
P1	High Density Camera Connector
P2A-P2F	Allied Vision MIPI-2 CSI Connectors
J3	External Power Connector (+12V)
P3	External GPIO Connector

Notes:

Rogue/Rogue-X Carrier Carrier integrations do not require camera expansion board external power to be used. Connect Tech AGX Xavier Carrier provides 12V input voltage for Allied Vision MIPI Camera Board.

LED, Jumper & Switch Summary

The Switch and Jumper should be set correctly before power up. Ensure the correct software configuration is used for appropriate MIPI CSI Lane and GPIO configuration.



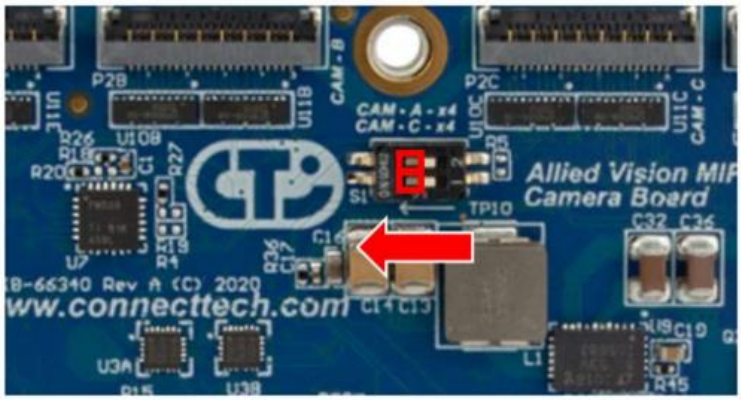
Designator	LED Description
D1	External Input Power
D2	AGX Carrier Input Power

Designator	Jumper Description
J1	OFF = Internal GPIO Usage ON = External GPIO Usage

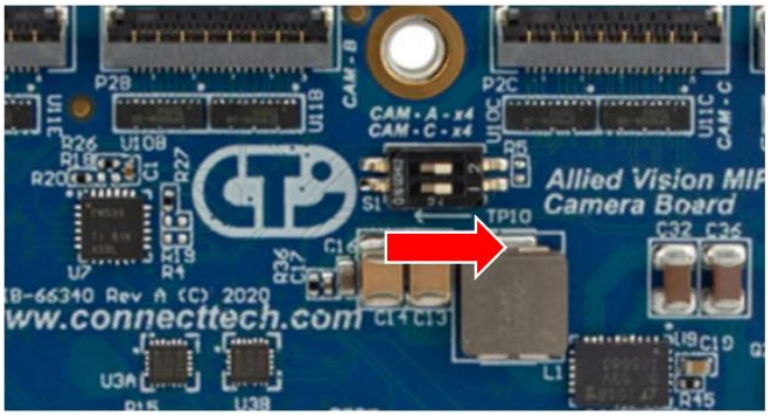
Ensure when using your system, you are set to the correct hardware and software configuration. The DIP Switch controls the hardware configuration. Our Connect Tech Board Support controls the software configuration. Please ensure you have the correct software configuration profile flashed onto the AGX Xavier Module.

Designator	Switch Description
S1	ON = 4 CAM mode OFF = 6 CAM mode

In 4 CAM mode, the system supports 4 quad lane cameras. In this mode, customers may connect cameras for the top four camera connectors on the board (P2A, P2C, P2E, P2F).



In 6 CAM mode, the system supports 2 quad lane cameras and 4 dual lane cameras. In this mode, customers may connect cameras for all camera connectors on the board (P2A, P2B, P2C, P2D, P2E, P2F).

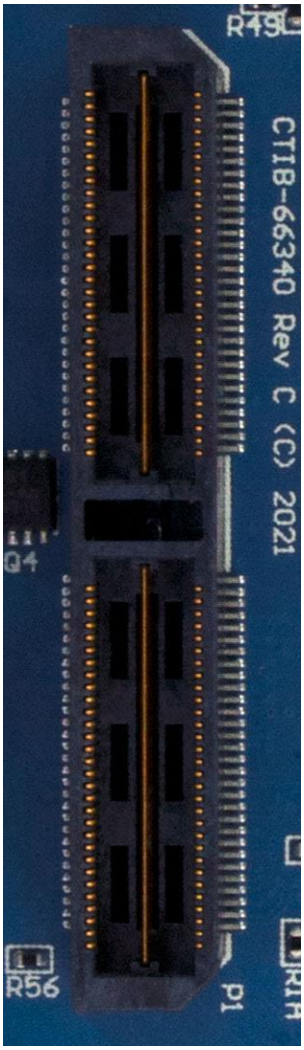


MIPI Camera Expansion Connector Pinout

Function	8 MIPI CSI-2 Camera Interface		
Location	P1		
Type	120 Pin QSH with M2.5 Standoffs		
Pin	**Description**	**Pin**	**Description**
1	CSI0_D0_P	2	CSI1_D0_P
3	CSI0_D0_N	4	CSI1_D0_N
5	GND	6	GND
7	CSI0_CLK_P	8	CSI1_CLK_P
9	CSI0_CLK_N	10	CSI1_CLK_N
11	GND	12	GND
13	CSI0_D1_P	14	CSI1_D1_P
15	CSI0_D1_N	16	CSI1_D1_N
17	GND	18	GND
19	CSI2_D0_P	20	CSI3_D0_P
21	CSI2_D0_N	22	CSI3_D0_N
23	GND	24	GND
25	CSI2_CLK_P	26	CSI3_CLK_P
27	CSI2_CLK_N	28	CSI3_CLK_N
29	GND	30	GND
31	CSI2_D1_P	32	CSI3_D1_P
33	CSI2_D1_N	33	CSI3_D1_N
35	GND	36	GND
37	CSI4_D0_P	38	CSI6_D0_P
39	CSI4_D0_N	40	CSI6_D0_N
41	GND	42	GND
43	CSI4_CLK_P	44	CSI6_CLK_P
45	CSI4_CLK_N	46	CSI6_CLK_N
47	GND	48	GND
49	CSI4_D1_P	50	CSI6_D1_P
51	CSI4_D1_N	52	CSI6_D1_N
53	GND	54	GND
55	+12V	56	+12V

The 12V pins are only available on Rogue-X and Rogue Revision C or higher

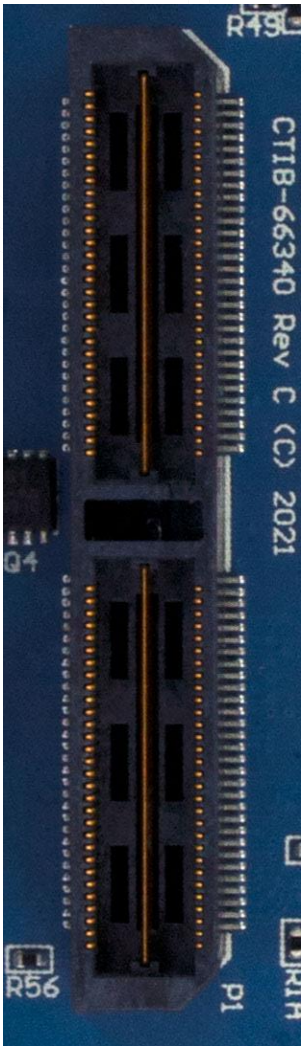
This camera platform is not targeted to be used with the NVIDIA Development kit.



Pin	Description	Pin	Description
57	+12V	58	+12V
59	CSI5_D0_P	60	CSI7_D0_P
61	CSI5_D0_N	62	CSI7_D0_N
63	GND	64	GND
65	CSI5_CLK_P	66	CSI7_CLK_P
67	CSI5_CLK_N	68	CSI7_CLK_N
69	GND	70	GND
71	CSI5_D1_P	72	CSI7_D1_P
73	CSI5_D1_N	74	CSI7_D1_N
5	I2C3_SCL	76	NC
77	I2C3_SDA	78	NC (PWM1)
79	GND	80	GND
81	+2.8V	82	+2.8V
83	+2.8V	84	NC
85	NC	86	PWM2
87	I2C2_SCL	88	CAM_MCLK3
89	I2C2_SDA	90	CAM1_PWDN
91	CAM_MCLK2	92	CAM1_RST#
93	CAM0_PWDN	94	CAM_MCLK4
95	CAM0_RST#	96	NC
97	NC	98	NC
99	GND	100	GND
101	NC	102	1.8V
103	NC	104	NC
105	I2C4_SCL	106	NC
107	I2C4_SDA	108	3.3V
109	NC	110	3.3V
111	NC	112	NC
113	NC	114	NC
115	GND	116	GND
117	NC	118	3.3V
119	CAM_AVDD_EN	120	3.3V

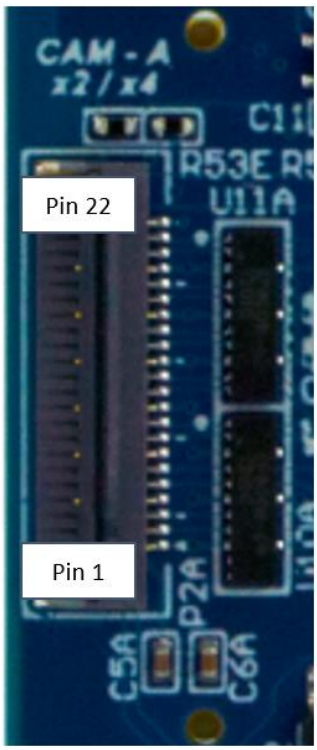
The 12V pins are only available on Rogue-X and Rogue Revision C or higher

This camera platform is not targeted to be used with the NVIDIA Development kit.



Allied Vision MIPI CSI Connector Pinout

Function	Camera Video Input	
Location	P2A – P2F	
Type	Hirose Connector	
Connector	FH55-22S-0.5SH - FP Inverted	
Cable	12316	
Pin #	**Description**	
1	5V	
2	CAM_SCL	
3	CAM_SDA	
4	5V	
5	GPIO2	
6	GPIO3	
7	5V	
8	CSI_DATA3_N	
9	CSI_DATA3_P	
10	GND	
11	CSI_DATA2_N	
12	CSI_DATA2_P	
13	GND	
14	CSI_CLK_N	
15	CSI_CLK_P	
16	GND	
17	CSI_DATA1_N	
18	CSI_DATA1_P	
19	GND	
20	CSI_DATA0_N	
21	CSI_DATA0_P	
22	GND	
23	GND	
24	GND	

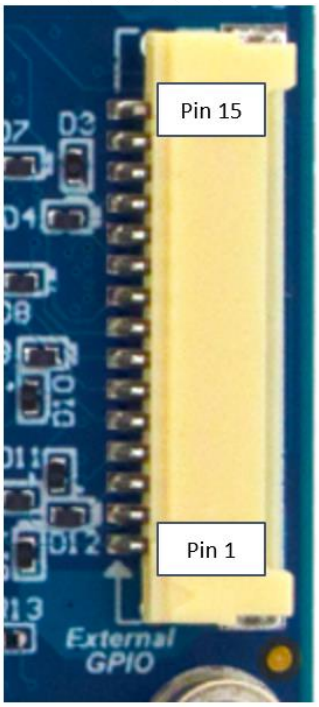


External GPIO Connector Pinout

The J1 jumper must be ON for use of external GPIOs. The jumper overrides the internal GPIOs for use of external GPIOs. Suggested Voltage level for external GPIO is 3.3V.

External GPIOs are directly routed to GPIO pins on the MIPI CSI connector. Alvium GPIOs use CMOS push-pull output drivers and Schmitt trigger inputs with an internal 3.3V pull-up resistor. The push-pull Alvium GPIOs are able to source or sink current from the Allied Vision Camera board external GPIOs.

Function	External GPIO Connector	
Location	P3	
Type	Hirose Connector	
Connector	DF14-15P-1.25H	
Mating Connector	DF14-15S-1.25C	
Cable	CBG489	
Pin	**Description**	
1	GPIO2A	
2	GPIO3A	
3	GPIO2B	
4	GPIO3B	
5	GPIO2C	
6	GPIO3C	
7	GPIO2D	
8	GPIO3D	
9	GPIO2E	
10	GPIO3E	
11	GPIO2F	
12	GPIO3F	
13	GND	
14	GND	
15	GND	



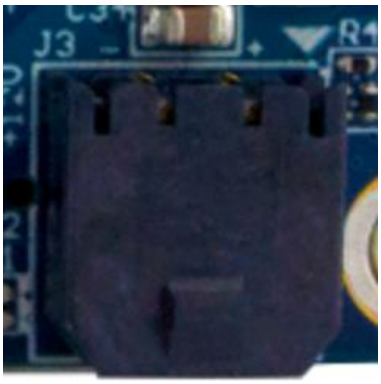
Note:

External GPIOs are available on JCB005 revision D and above with CBG489. Alvium GPIO direction is dependent on camera firmware. When Alvium GPIOs are set to inputs, do not go above maximum value of +5.5V DC. Exceeding maximum input voltage will damage the camera. When Alvium GPIOs are set to output:
Max. current = 12 mA per output
Max. Out VCC = 3.3 VDC

External Power Connector

The Allied Vision Camera Board when integrated with a Rogue/Rogue-X carrier board **does not require an external power source** for the specified Alvium sensor cameras. Our Connect Tech Rogue/Rogue-X carrier boards allow for 12V input voltage through the Samtec MIPI Camera Expansion Connector.

Typical power consumption per specified Alvium sensor is approximately 2W. The external power connector is available for future Allied Vision Alvium sensors that require more power.

Function	External Power (Optional)	
Location	J3	
Type	Molex Connector	
Connector	43650-0201	
Mating Connector	436450-200	
Pin #	**Description**	
1	12V EXT	
2	GND	

MIPI CSI & I2C Camera Mapping

The Allied Vision MIPI Camera board was designed based on the MIPI CSI specifications of the AGX Xavier Jetson module. The system can support 4 quad lane cameras, 4 dual lane cameras with 2 quad lane cameras, and 6 dual lane cameras as per the AGX Xavier Jetson module.

The CSI configurations are in MIPI D-PHY mode. Each data channel has peak bandwidth of up to 2.5Gbps. Please note that maximum data rate specified may be limited by use case and memory bandwidth.

As outlined in the block diagram, the following table below shows the multiplexed I2C signals and CSI signals from the camera expansion connector for each camera.

Camera Connector	Muxed CAM I2C	Jetson MIPI Source 4 CAM Mode	Jetson MIPI Source 6 CAM Mode
P2A	I2C-26	MIPI CSI 0 *[CLK]* MIPI CSI 1	MIPI CSI 0 *[CLK]*
P2B	I2C-27	*Not Available*	MIPI CSI 1 *[CLK]*
P2C	I2C-28	MIPI CSI 2 *[CLK]* MIPI CSI 3	MIPI CSI 2 *[CLK]*
P2D	I2C-29	*Not Available*	MIPI CSI 3 *[CLK]*
P2E	I2C-30	MIPI CSI 4 *[CLK]* MIPI CSI 5	MIPI CSI 4 *[CLK]* MIPI CSI 5
P2F	I2C-31	MIPI CSI 6 *[CLK]* MIPI CSI 7	MIPI CSI 6 *[CLK]* MIPI CSI 5

Note:

For dual lane modes, only a single MIPI CSI CLK and Data is passed through
For quad lane mode, both MIPI CSI Data is passed through but only a single CLK source for a designated MIPI CSI is chosen
For capturing with cameras, please refer to Allied Vision Example GStreamer Sample code:
https://github.com/alliedvision/examples/tree/master/GStreamer

Internal GPIO Properties

Please reference our **GPIO KDB** for how to use the software Linux SYSFS GPIO pins as well as the outlined sample code on the site. The J1 jumper must be OFF for use of internal GPIOs. The jumper overrides the external GPIOs for use of internal GPIOs. Internal and external GPIOs from the Allied Vision MIPI camera board cannot be used simultaneously. The Rogue/ Rogue-X carrier also supports four additional 3.3V GPIOs if more GPIOs are ever needed with the integrated setup.

Camera Connector	Camera GPIO Pin	Internal GPIO SYSFS	Voltage Level	Default Direction
P2A	CAM2A CAM3A	224 225	3.3V	output/high
P2B	CAM2B CAM3B	226 227		
P2C	CAM2C CAM3C	228 229		
P2D	CAM2D CAM3D	230 231		
P2E	CAM2E CAM3E	232 233		
P2F	CAM2F CAM3F	234 235		

Note:

Internal GPIOs are available on all revisions of JCB005. The total current sourced by these must be limited to 160 mA

For triggering cameras, please refer to Allied Vision Example Hardware Trigger Sample code. Sample code uses camera GPIOs to trigger and can be controlled using either internal and external GPIOs. Default trigger activation is rising edge and can be altered to specification.

https://github.com/alliedvision/examples/tree/master/Trigger

TYPICAL INSTALLATION AND USAGE

Software setup

Prior to hardware installation, ensure the correct software installed on the AGX Xavier Module. Supported Software Board Support Packages can be found on our website:
https://connecttech.com/resource-center/l4t-board-support-packages/

Board Support Package Installation instructions can be found:
http://connecttech.com/resource-center/kdb373/

SDK Component Installation instructions can be found:
http://connecttech.com/resource-center/kdb374/
This includes CUDA, CUDA-X AI, Computer Vision, Multimedia and other Developer Tools

Installation of the Allied Vision MIPI CSI Camera Adapter with AGX Carrier

1. Ensure all external system power supplies are off
2. Install JCB005 onto the AGX Carrier's MIPI CSI Camera Expansion Connector
3. Install 3x 8mm M2.5 screws provided with the hardware kit
4. Ensure S1 is set to the correct MIPI CSI Lane configuration for the cameras connected
5. Optional Step: Connect an external 12V DC power supply to J3
   External power connector provides unregulated power to the cameras
6. Switch ON the Power Supply. DO NOT power up your system by plugging in live power.

Installation of Allied Vision Sensors

For more information regarding cable integration and sensor model documentation from Allied Vision:
https://www.alliedvision.com/en/support/technical-documentation/alvium-csi-2-documentation.html

For more information regarded supported cameras from Connect Tech:
https://connecttech.com/supported-cameras/

Streaming of Allied Vision Sensors

GStreamer is natively part of the JetPack OS. Example of a gst-launch-1.0 command:

```
gst-launch-1.0 v4l2src device=video0 ! video/x-raw, format=BGRx ! ximagesink
```

If you would like to switch between the 4CAM software configuration and the 6CAM software configuration without reflashing your system, run the following command as a root user.

```
sudo cti-agx-fdt.sh
```

POWER CONSUMPTION

The intended use of the Allied Vision MIPI Camera board is to be integrated with a Rogue/ Rogue-X carrier. The required input voltage range of the Rogue/ Rogue-X carrier is 12V to 19V. The carriers are designed for input voltage range 9V to 19V. Due to the increased load requirements from the camera expansion connector, the input voltage of the carrier must compensate.

Parameter	Min	Typical	Max	Units
External Power Source (EPS)				
External Supply Voltage (Unregulated)	10.5	12	14.6	V
External Supply Current limits	2.5	3	3.6	A
x6 Cameras Plugged in w/o Streaming w/o EPS				
Rogue Input Power	-	12	19	V
Internal Current Consumption	-	1.622	1.056	A
x1 Cameras Streaming w/o EPS				
Rogue Input Power	-	12	19	V
Integrated system current consumption	-	1.886	1.412	A
x2 Cameras Streaming w/o EPS				
Rogue Input Power	-	12	19	V
Integrated system current consumption	-	2.016	1.652	A
x3 Cameras Streaming w/o EPS				
Rogue Input Power	-	12	19	V
Integrated system current consumption	-	2.273	1.841	A
x4 Cameras Streaming w/o EPS				
Rogue Input Power	-	12	19	V
Integrated system current consumption	-	2.500	1.947	A
x5 Cameras Streaming w/o EPS				
Rogue Input Power	-	12	19	V
Integrated system current consumption	-	2.7	2.002	A
x6 Cameras Streaming w/o EPS				
Rogue Input Power	-	12	19	V
Integrated system current consumption	-	2.7	2.067	A

Note:

Only camera peripherals were stressed during these tests with HDMI and USB mouse and keyboard connected. Current consumption specifications will be similar with Rogue-X integration.