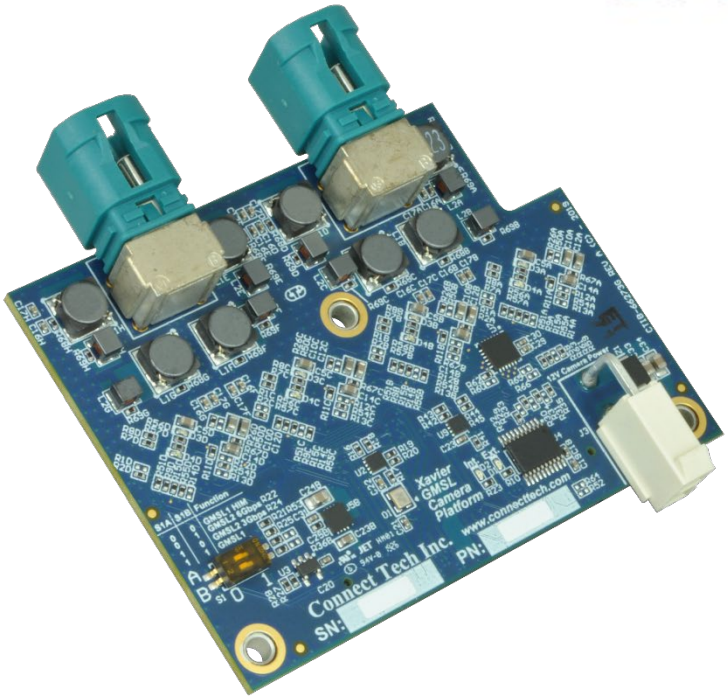
Connect Tech Inc.

Embedded Computing Experts

USERS GUIDE



NVIDIA Jetson® AGX Xavier™ GMSL Camera Platform

CTIM-00077 Revision 0.04 2021-06-18

NVIDIA ELITE PARTNER

CONNECT TECH

www.connecttech.com

support@connecttech.com

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PREFACE

Disclaimer

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 Rd. W. 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.

The above warranty is the only warranty authorized by Connect Tech Inc. Under no circumstances will Connect Tech Inc. be liable in any way for any damages, including any lost profits, lost savings or other incidental or consequential damages arising out of the use of, or inability to use, such product.

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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	2019-07-11	Preliminary Release
0.01	2019-10-17	Added connector pinout
0.02	2019-12-11	Added verified cameras and updated cable description
0.03	2020-03-02	Added Rogue assembly part numbers Added power/thermals information Updated pinout section Updated I2C table for software development Added Power information
0.04	2021-06-18	Updated manual template, updated ordering information

INTRODUCTION

Connect Tech's GMSL camera platform is an expansion board that allows up to 8 cameras to be connected to the Jetson® AGX Xavier module. It was designed for the Connect Tech Rogue carrier but is also compatible with the Nvidia Xavier development kit. Since many different types of GMSL cameras are available, the JCB002 has user selectable options to interface with either GMSL1 or GMSL2 protocols at different operating frequencies. Power to the cameras is provided by PoC (Power over Coax) so all the data, control signals, and power are sent through a single 50 Ohm Coaxial cable. This allows for flexibility in cable routing and ease of installation in automotive applications.

The main power for the board comes from the Camera Expansion Header. The 12V power for the cameras is also available from the same header on the Rogue carrier. Nvidia's development kit does not provide voltage here, so a hot pluggable external 12V connector is available on the JCB002. The circuit will always take the external voltage if both are connected.

Product Features and Specifications

Specifications	
Size	75mm x 57mm
Weight	50g
NVIDIA Xavier Connection (Uplink)	1x High Density Connector Camera Board will mate to the NVIDIA Jetson "Camera Expansion Header"
(GMSL) Camera Inputs	8x Total (GMSL2/GMSL1)
Deserializer	Maxim MAX9296A
MIPI Output	A single 4-lane MIPI CSI-2 v1.3 output from each Deserializer (16-lanes total)
Camera Input Connectors	2x MATE-AX Quad Coax Connectors Breakout cables to FAKRA available
PoC (Power-Over-COAX)	All 8 cameras will be sourced 12V Power-Over-COAX from JCB002
Power	Can be directly powered from Camera Expansion Header or External +12V Input
Operating Temperature	-40°C to +85°C
Warranty and Support	1 Year Warranty and Free Technical Support

Associated Part Number Ordering Information

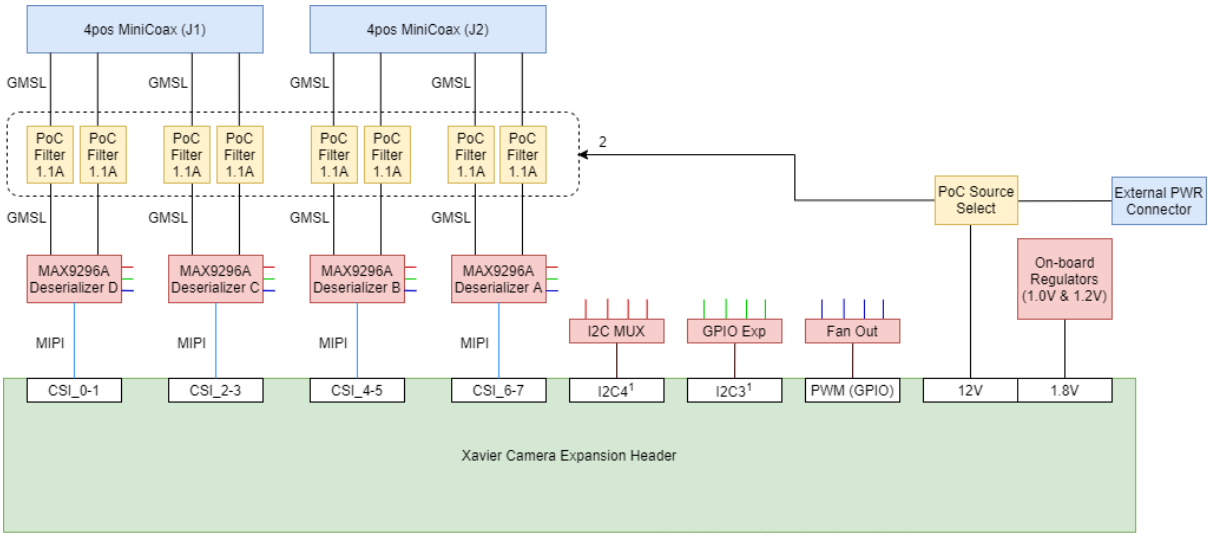
Part Number	Description
JCB002	Xavier GMSL Camera Platform
CBG341	Mate-AX to 4x FAKRA cable
AGX101-50	Xavier Rogue + JCB002 + 1x CBG341 + 4x NileCAM30
AGX101-51	Xavier Rogue + JCB002 + 2x CBG341 + 8x NileCAM30

The following SKUs all include JCB002 boards. CBG341 and cameras are not included.

Sku	AGX Xavier™ Module Included	Heat Sink Options	WiFi Bluetooth Options	SSD Options
AGX101-61	Yes	None	None	None
AGX101-62	Yes	None	None	1x 1TB SSD Installed
AGX101-63	Yes	None	None	2x 1TB SSDs Installed
AGX101-64	Yes	None	WiFi/BT Module Installed	None
AGX101-65	Yes	None	WiFi/BT Module Installed	1x 1TB SSD Installed
AGX101-66	Yes	None	WiFi/BT Module Installed	2x 1TB SSDs Installed
AGX101-67	Yes	CTI Active Thermal Installed	None	None
AGX101-68	Yes	CTI Active Thermal Installed	None	1x 1TB SSD Installed
AGX101-69	Yes	CTI Active Thermal Installed	None	2x 1TB SSDs Installed
AGX101-70	Yes	CTI Active Thermal Installed	WiFi/BT Module Installed	None
AGX101-71	Yes	CTI Active Thermal Installed	WiFi/BT Module Installed	1x 1TB SSD Installed
AGX101-72	Yes	CTI Active Thermal Installed	WiFi/BT Module Installed	2x 1TB SSDs Installed
AGX101-73	Yes	CTI Passive Thermal Installed	None	None
AGX101-74	Yes	CTI Passive Thermal Installed	None	1x 1TB SSD Installed
AGX101-75	Yes	CTI Passive Thermal Installed	None	2x 1TB SSDs Installed
AGX101-76	Yes	CTI Passive Thermal Installed	WiFi/BT Module Installed	None
AGX101-77	Yes	CTI Passive Thermal Installed	WiFi/BT Module Installed	1x 1TB SSD Installed
AGX101-78	Yes	CTI Passive Thermal Installed	WiFi/BT Module Installed	2x 1TB SSDs Installed

PRODUCT OVERVIEW

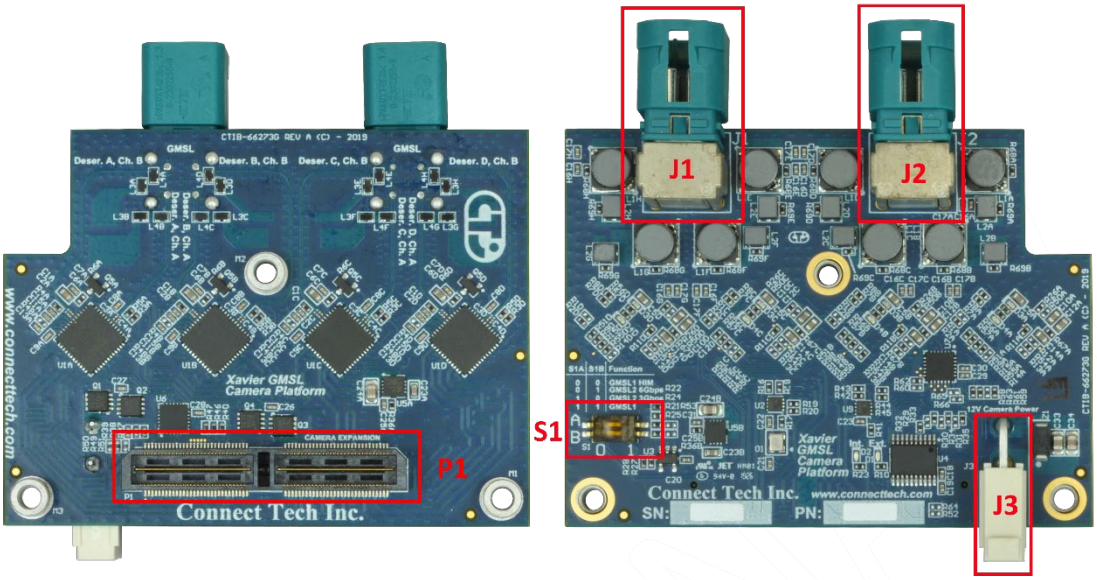
Block Diagram



Notes:

1. I2C bus numbers refer to hardware locations (matching connector P1 pinout). These bus numbers do not necessarily correspond to what is listed in software.
2. The Power over Coax source is shared, but each GMSL line has its own filter which can handle up to 1.1A.

Connector Summary & Locations

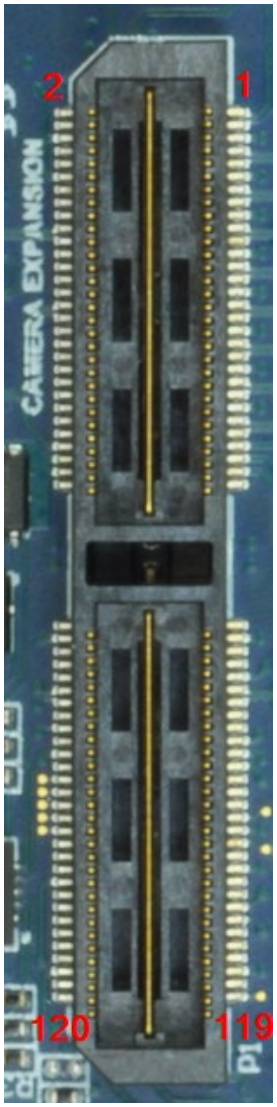


Designator	Connector Description
J1, J2	TE – Mate-AX 4pos miniCoax
J3	External power input
P1	MIPI Camera Expansion Connector
S1	GMSL Mode switch

[P1] MIPI Camera Expansion Connector Pinout

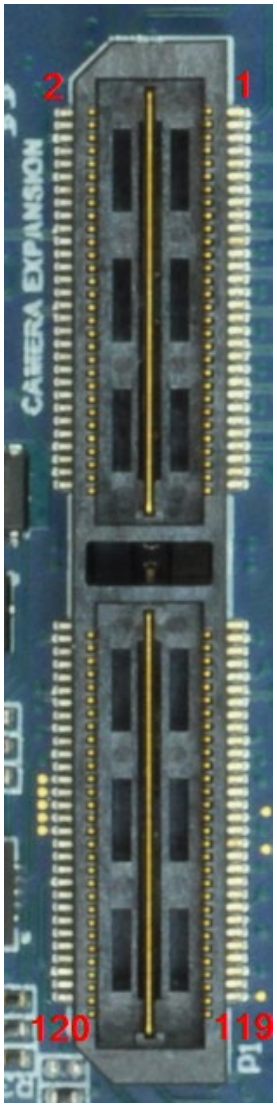
Function	8 MIPI CSI-2 Camera Interface		
Location	P1		
Pin	**Description**	**Pin**	**Description**
1	CSI0_D0_P	2	CSI1_D0_P
3	CSI0_D0_N	4	CSI1_D0_N
5	GND	6	GND
7	CSI0_CLK_P	8	CSI1_CLK_P
9	CSI0_CLK_N	10	CSI1_CLK_N
11	GND	12	GND
13	CSI0_D1_P	14	CSI1_D1_P
15	CSI0_D1_N	16	CSI1_D1_N
17	GND	18	GND
19	CSI2_D0_P	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, and not available on the NVIDIA development kit. To use the JCB002 with these carriers, you must provide power to the external camera power connector.



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, and not available on the NVIDIA development kit. To use the JCB002 with these carriers, you must provide power to the external camera power connector.



[S1] GMSL Switch Summary & Locations

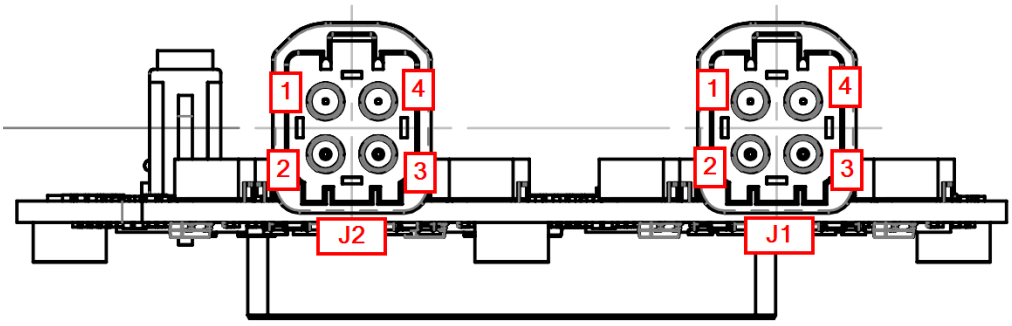
This must be set correctly at power up! This signal is sampled once at boot up and cannot be changed on-the-fly. The GMSL mode cannot be changed in software. The setting applies to all 8 channels, so you cannot mix GMSL1 and GMSL2 cameras on the same board.

A	B	Mode
0	0	GMSL1 High Immunity mode on
0	1	GMSL2 6Gbps
1	0	GMSL2 3Gbps
1	1	GMSL1 High Immunity mode off

[J3] External Power Connector

Pin	Connector Description
1 (Bottom)	GND
2 (Top)	+12V IN

[J1/J2] GMSL and Software Development



	FAKRA PIN	Deserializer	Deserializer Channel	Jetson MIPI Source	Jetson I2C MUX Source	Jetson I2C GPIO Source	Deserializer MFP8 (RST)	Deserializer MFP9 (BOOT)
J2	1	U1A	B	CSI 6/7	I2C4-0	I2C3	TCA9539-0	TCA9539-1
J2	2	U1A	A	CSI 6/7	I2C4-0	I2C3	TCA9539-0	TCA9539-1
J2	3	U1B	B	CSI 4/5	I2C4-1	I2C3	TCA9539-2	TCA9539-3
J2	4	U1B	A	CSI 4/5	I2C4-1	I2C3	TCA9539-2	TCA9539-3
J1	1	U1C	B	CSI 2/3	I2C4-2	I2C3	TCA9539-4	TCA9539-5
J1	2	U1C	A	CSI 2/3	I2C4-2	I2C3	TCA9539-4	TCA9539-5
J1	3	U1D	B	CSI 0/1	I2C4-3	I2C3	TCA9539-6	TCA9539-7
J1	4	U1D	A	CSI 0/1	I2C4-3	I2C3	TCA9539-6	TCA9539-7

TYPICAL INSTALLATION AND USAGE

Software setup

Prior to hardware installation, make sure you have the correct software installed on the Xavier Module. CTI supports ECON NileCam30 and Leopard IMX390 with our BSP. Installation instructions can be found at https://connecttech.com/resource-center/kdb373/. All other GMSL and GMSL2 (MIPI) cameras should work with proper software and firmware configuration as long as the power requirements match what JCB002 provides. Power to the cameras can be disabled by setting CAM0_PWDN (UART4_CTS) low. There is a 100k external pull up resistor on this pin, so it is not necessary to configure the pin for always on operation. If using the NVIDIA Development Kit carrier, GPIO 36 MUST be set as an output and driven high. This enables the 2.8V power rail which powers the logic levels on the deserializers

JCB002

1. Ensure all external system power supplies are off.
2. Install Xavier GMSL Camera Platform on the Rogue Carrier's MIPI CSI Camera Expansion Connector.
3. Install 3x 8mm M2.5 screws (provided).
4. Make sure S1 is set to the correct GMSL mode for the cameras connected.
5. Connect camera(s) to miniCoax connector(s).
    a. Optionally connect an external 12V DC power supply to J3.
    b. The external power connector provides unregulated power to the cameras. Do not exceed 14V on this input.
6. Switch ON the Power Supply. DO NOT power up your system by plugging in live power.

Note: 10mm M3 extension standoffs are recommended to be added to the 18mm standoffs provided with the Rogue carrier for clearance.

SOFTWARE CONFIGURATION

BSP Requirements	JCB002 + Rogue
LI-IMX390 – GMSL2	Jetpack 4.3+
NileCAM30 – GMSL1	Jetpack 4.3+

JetPack files can be found here:
http://www.connecttech.com/resource-center/l4t-board-support-packages/

POWER & THERMALS

External Power Connector

Although +12V is available on the Rogue Carrier (Rev. C and higher), the JCB002 allows for external power to be provided to the cameras. The voltage is unregulated and could potentially damage cameras if they cannot handle the input voltage.

Test setup:

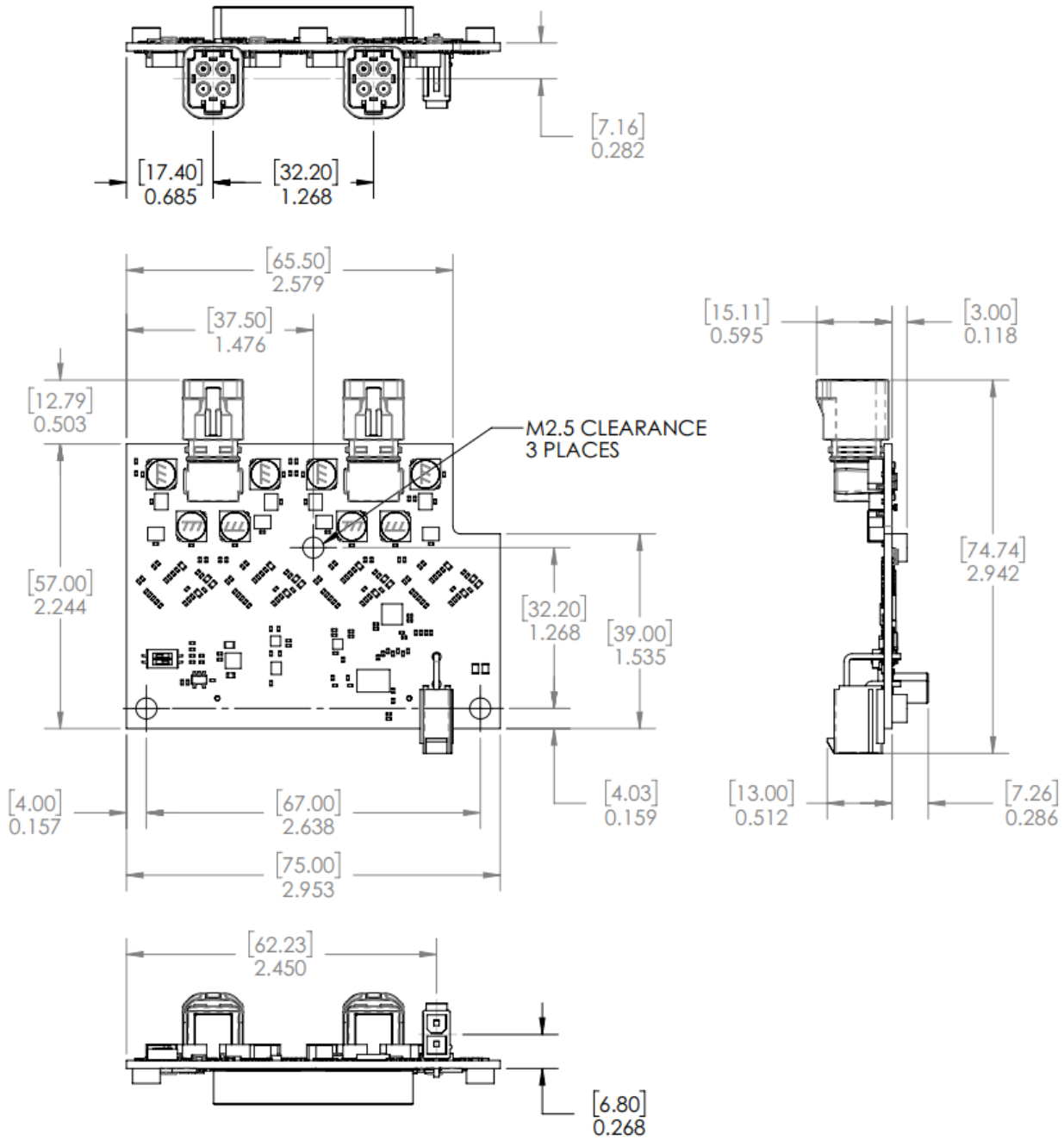
- Rogue AGX minimal setup carrier powered at +13V/XXXA
- Up to 8 ECON NileCAM30 connected.

Parameter	Min	Typ.	Max	Units
Power Over Coax				
External Supply Voltage (unregulated)	10.45	12	14.6	V
External Supply Current (per channel)	-	-	1.1	A
No Cameras Connected				
Internal current consumption (From Rogue)	-	0.395	1.6	A
1 Camera Connected				
Internal current consumption only	0.26	0.46	-	A
Internal current consumption	0.118	0.32	-	A
External current consumption	0.154	0.154	0.3	
Temperature Rise (Above Ambient)	-	-	19	°C
2 Cameras, Same Deserializer				
Internal current consumption only	0.4	0.753	-	A
Internal current consumption	0.115	0.458	-	A
External current consumption	0.303	0.303	0.6	
Temperature Rise (Above Ambient)			20	°C
2 Cameras, Different Deserializers				
Internal current consumption only	0.408	0.765	-	A
Internal current consumption	0.125	0.471	-	A
External current consumption	0.303	0.303	0.6	
Temperature Rise (Above Ambient)	-	-	20.5	°C
8 Cameras				
Internal current consumption only	1.285	1.755	-	A
Internal current consumption	0.155	0.615	-	A
External current consumption	1.172	1.172	2.3	
Temperature Rise (Above Ambient)	-	-	24	°C

Note:

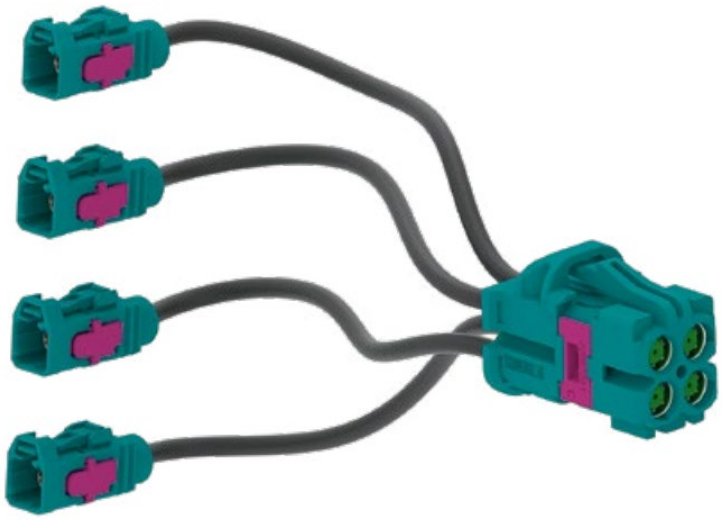
1. Since the Rogue carrier can be populated in many different configurations, the current consumption is listed excluding power needed to run the Rogue (and Xavier Module) itself, i.e. the value in the *No Cameras Connected* section.
2. Minimum current is defined as when the cameras are not streaming, maximum is the peak surge current and typical is current consumption during streaming.

MECHANICAL DRAWINGS & MODELS



CABLES

CBG341 – 4pos. Mate-AX to 4x FAKRA Z-code 50Ω Cable



VERIFIED CAMERAS

Any GMSL camera should work with some software development, however, these are the ones that Connect Tech has tested and verified.

GMSL1 – NileCAM30
https://www.e-consystems.com/gmsl-camera-ar0330-lowlight-cameramodule.asp

GMSL2 – IMX390
https://leopardimaging.com/product/autonomous-camera/maxim-gmsl2-cameras/li-imx390-gmsl2/