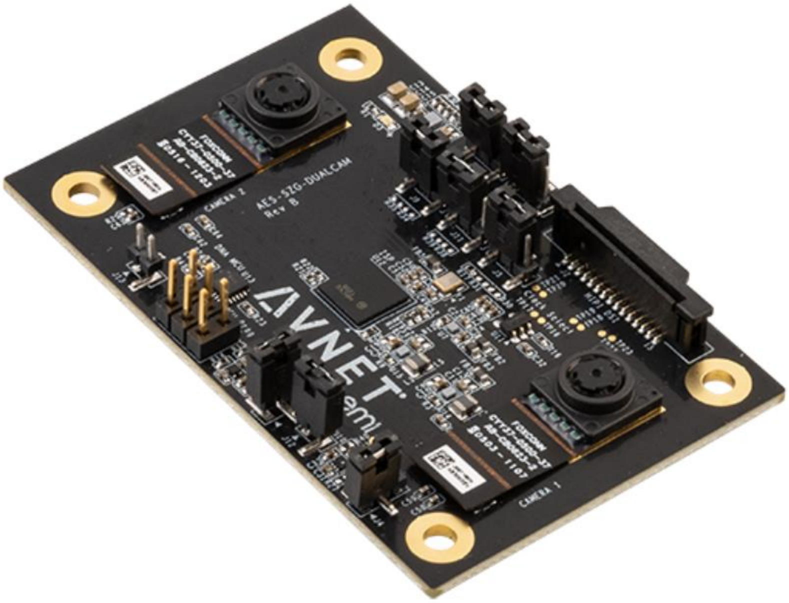

Dual Camera High Speed IO Module Hardware User Guide

Version 1.0

LIT# ACC-DUAL-CAM-UG-V1P0

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1 Document Control

Document Version: 1.0

Document Date: 12 November 2024

2 Version History

Version	Date	Comment
1.0	11/12/2024	Initial Release

3 Introduction

The Dual Camera HSIO module is an accessory that targets Standard 40-pin Board-to-Board HSIO connector types. This type of connector exists on Tria Technologies ZUBoard-1CG, a Zynq UltraScale+ platform. The Dual Camera HSIO module ships with two IAS camera modules pre-installed. This accessory module is intended to be paired with any Tria Technologies AMD platforms containing the Standard 40-pin High Speed IO (HSIO) connectors.

- Features two Rayprus IAS-compatible imaging modules based on imaging sensors from OnSemi.
- These MIPI sensor modules interface to an AP1302 imaging coprocessor. This kit simplifies the complex process of developing with imaging sensors.
- Target many applications for development, including:
    - Machine Vision
    - Factory Automation
    - Embedded vision
    - Computer imaging
    - Industrial IoT and Smart Sensors
    - Smart Home Appliances
    - Prototyping and Experimentation

4 Architecture and Features

The Dual Camera HSIO module integrates two Rayprus IAS-compatible imaging modules, based on imaging sensors from OnSemi, which connect to an OnSemi AP1302 imaging coprocessor. This setup simplifies the typically complex process of developing with imaging sensors.

While MIPI-CSI2 is widely used in consumer electronics to enable high-speed communication between host processors and image sensors, many sensor modules use different connector formats, making it challenging to experiment with various camera modules. The Imager Access System (IAS) module format from OnSemi addresses this issue by offering a standardized approach that simplifies integration. OEMs no longer need to source lenses or work with multiple module vendors, and development times are shortened thanks to the low-touch design. Additionally, IAS is a plug-and-play solution, meaning that prior expertise in imaging systems is not required. The IAS standard ultimately enables product and board designers to easily access any image sensor module that complies with the IAS format.

The details for the Dual Camera High Speed IO Module features are described in the Functional Description sections that follow.

4.1 List of Features

The Dual Camera High Speed IO Modules supports the following features:

- High-Speed IO Board-to-Board Connector
    - Samtec Q-Strip High Performance 40-Pin 0.5mm Differential Pair Array
        - Part Number: **QTE-020-01-F-D-A-K-TR**
- Programmable MCU for information sharing between Dual Camera HSIO Module and the Host Platform
    - Microchip AVR ATTiny Microcontroller 8-Bit
        - Part Number: **ATTINY44A-MMH**
- FFC & FPC Connectors 15P 1.0 FPC
    - TE Connectivity Female DSI MIPI Connector
        - Part Number: **1-1734248-5**
- Image Sensors 13 MP Co-Processor
    - OnSemi AP1302 CMOS Image Sensor Solution
        - Part Number: **AP1302CSSL00SMGA0-DR**
- Board-to-Board/Board-to-FPC Connector
    - Hirose Electric Co Ltd Conn RCPT 34Pos SMD Gold
        - Part Number: **DSC557-054444KI1**

4.2 Block Diagram

The following figure is a high-level block diagram of the Dual Camera HSIO Module:

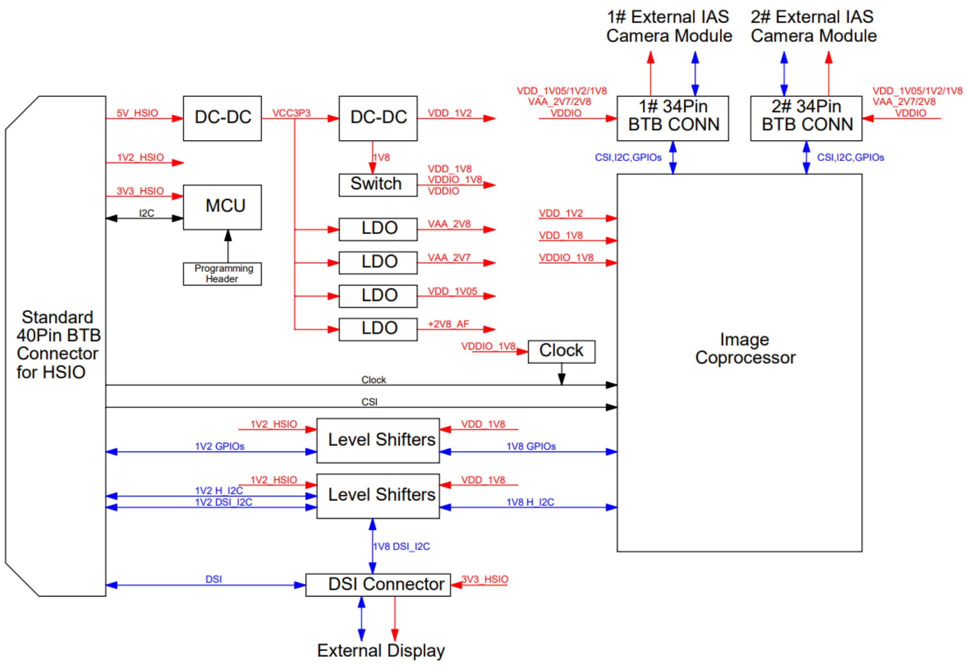

Figure 1 – Dual Camera HSIO Block Diagram

4.3 What's In The Box

The Dual Camera HSIO Module box includes the Dual Camera HSIO Module and a Quick Start Card. This accessory kit is meant for Standard HSIO expansion connector evaluation on Tria Technologies AMD platforms. The Development Kit includes the following in the box:

- Dual Camera HSIO Module
- Polight 1 MP Monochrome Camera Module (**CAV10-000A**) x 2
- Samtec Jumper Shunt (**SNT-100-BK-T**) x 9
- Quick Start Card

Customers need to acquire an appropriate Tria Technologies platform that includes the Standard HSIO connector.

- Tria Technologies ZUBoard-1CG: **http://avnet.me/zuboard-1cg**

5 Functional Description

The following sections provide brief descriptions of each feature provided on the Dual Camera HSIO Module.

5.1 Interfaces and Connectors

The following figure provides an overview of the physical connections, their designators, and relative position on the Dual Camera HSIO Module.

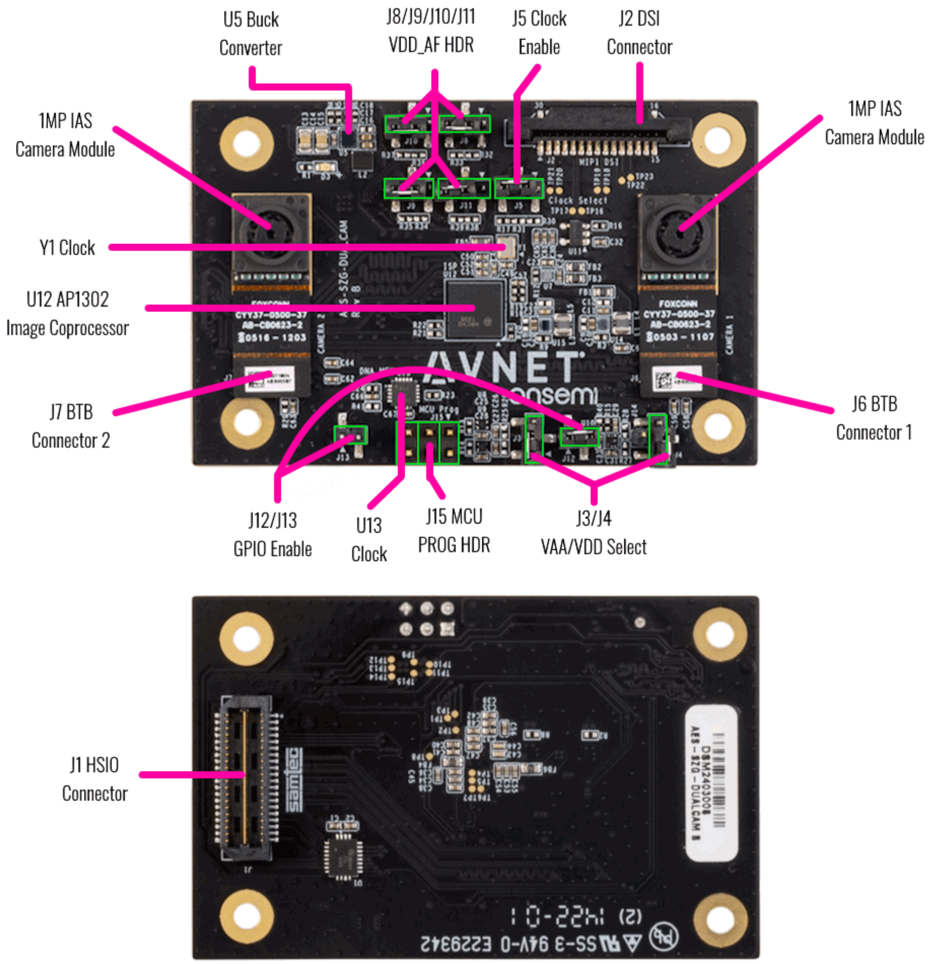

Figure 2 – Interfaces and Connectors

5.2 Setting up the Dual Camera HSIO Module

The Dual Camera HSIO Module has several headers that allows the user to setup the board depending on what type of interface they would like to operate. What follows are descriptions of the various headers that exist on the board and the functionality they represent.

The first headers we will review are the **J8** / **J9** and the **J10 / J11** VDD_AF headers. The **J8** / **J9** headers allow a user to control the behaviour of the Sensor 1. The **J10 / J11** headers do the same for Sensor 2.

Jumpers **J12** and **J13** permit the disabling of the sensors by shunting the appropriate jumper to GND.

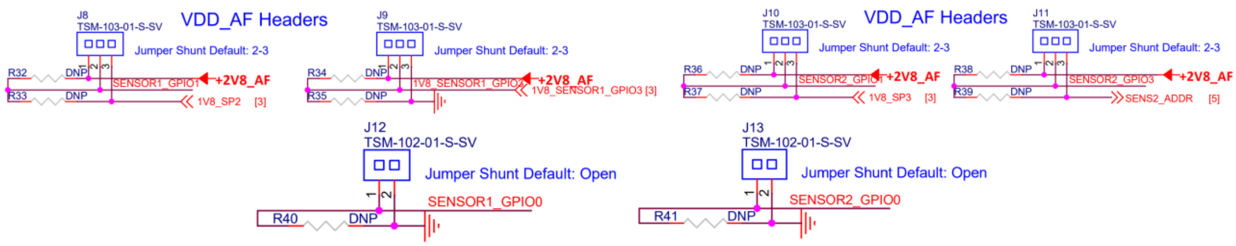

Figure 3 – Sensors Headers J8 - J13

The supply voltage of the Board-to-Board Connectors can be set by shunting **J3 / J4** (and **J14**) headers to configure the voltage needed.

- Jumper Shunt **J3**
  - (1-2): VAA is 2.8V
  - (2-3): VAA is 2.7V
- Jumper Shunt **J4** (and **J14**)
  - (1-2): VDD is 1.2V
  - (2-3): VDD is 1.05V
  - (J4.2-J14): VDD is 1.8V

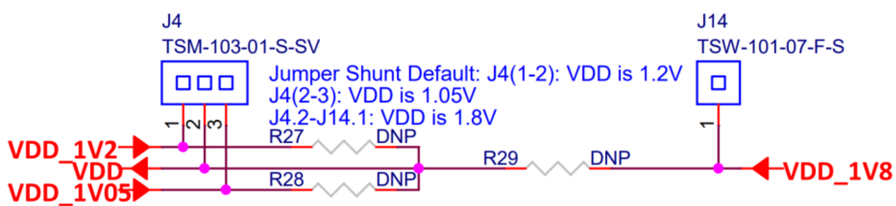

Figure 4 – BTB Connectors Headers J4 / J14

The **J5** header is used to choose which clock signal gets passed to the Image Co-Processor. If the jumper is shunted between 2 and 3 this passes the 48 MHz oscillator to the Image Co-Processor. A jumper shunted between 1 and 2 forwards a clock signal generated by the Host Platform.

The **J15** header is a the MCU programming header. It allows a user to program the on-board MCU via SPI / I2C which can provide the Host Platform with details regarding the accessory module.

- When the Dual Camera HSIO module is connected to the Host Platform, the processor can access the MCU and the programming header, **J15,** should not be utilized.
- When the Dual Camera HSIO Module is disconnected from the Host Platform, the programming header, **J15**, can be utilized to program the MCU.

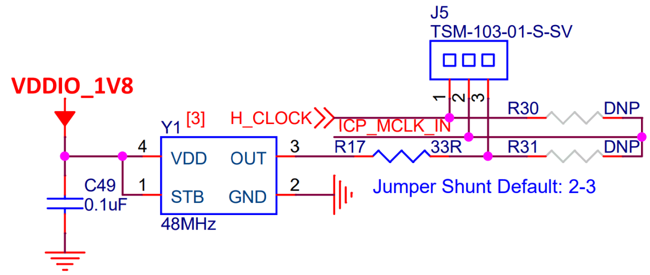

Figure 5 – Clock Enable Header J5

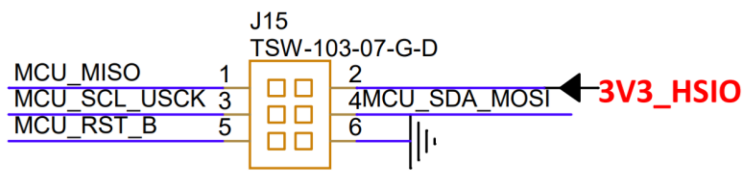

Figure 6 – MCU Programming Header J15

5.3 Standard HSIO Expansion Interface

The Dual Camera HSIO Module offers a Samtec connector for the Standard HSIO (high-speed I/O) expansion interfaces as the main board-to-board connector, **J1**. This board-to-board interface contains two Rayprus IAS-compatible imaging modules based on imaging sensors from OnSemi and a DSI Connector to add Display functionality to the Host Platform.

A Samtec **QTH-020-01-F-D-DP-A-K-TR** connector is used to provide the Standard HSIO expansion interface which is also known as a GPIO only expansion interface. Figure 7 and Table 1 shows the pinout of the Standard HSIO expansion interface and the peripherals that are mapped to the connector.

- Manufacturer: Samtec
- Part Number: **QTH-020-01-F-D-DP-A-K-TR**
- 0.50mm / 40-position differential array connector

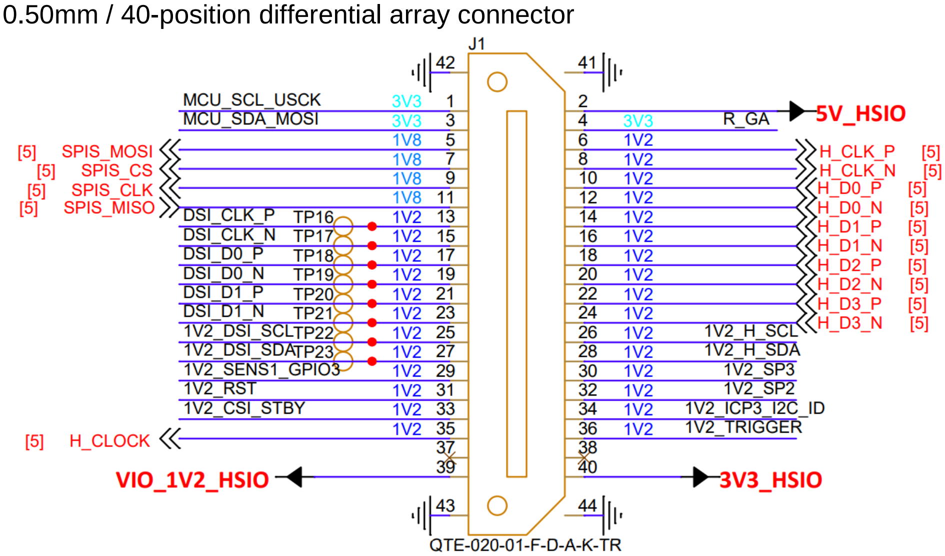

Figure 7 – Standard HSIO Expansion Interface

HSIO Interface (J1) Pin Numbers	Schematic Net Name	Connection on Dual Camera Module
1	MCU_SCL_USCK	MCU I2C Clock Pin
3	MCU_SDA_MOSI	MCU I2C Data Pin
5	SPIS_MOSI	SPI Master To Slave
7	SPIS_CS	SPI Chip Select
9	SPIS_CLK	SPI Serial Clock
11	SPIS_MISO	SPI Slave To Master
6/8	H_CLK_P/N	AP1302 Clock
10/12	H_D0_P/N	AP1302 Data 0
14/16	H_D1_P/N	AP1302 Data 1
18/20	H_D2_P/N	AP1302 Data 2
22/24	H_D3_P/N	AP1302 Data 3
26	1V2_H_SCL	AP1302 I2C Clock
28	1V2_H_SDA	AP1302 I2C Data
13/15	DSI_CLK_P/N	DSI Clock
17/19	DSI_D0_P/N	DSI Data 0
21/23	DSI_D1_P/N	DSI Data 1
25	1V2_DSI_SCL	DSI I2C Clock
27	1V2_DSI_SDA	DSI I2C Data
29	1V2_SENS1_GPIO3	GPIO3 Sensor1
30	1V2_SP3	Jumper 10
31	1V2_RST	AP1302 Reset
32	1V2_SP2	Jumper 8
33	1V2_CSI_STBY	AP1302 Standby
34	1V2_ICP3_I2C_ID	AP1302 I2C ID GPIO11
35	H_CLOCK	Clock Signal from Host
36	1V2_TRIGGER	AP1302 Trigger Input GPIO8

Table 1 – HSIO Expansion Interface Connections

5.4 Image Coprocessor

The Dual Camera HSIO Module offers an OnSemi AP1302 Image Signal Co-Processor, **U12**. AP1302 can handle all image processing functions including interlaced High Dynamic Range (iHDR) operations. Figure 8 and Table 2 shows the pinout of the Image Coprocessor interface and how the interface is mapped to the Standard HSIO expansion connector, **J1** and the Board-to-Board connectors (BTB), **J6 / J7**.

NOTE: Every signal named 1V8_xxxxx goes through the Level Shifter, **U1**, to be converted to a 1V2_xxxxx before reaching the Standard HSIO expansion connector, **J1**.

- Manufacturer: OnSemi
- Part Number: **AP1302CSSL00SMGA0-DR**
- Image Signal Processor 13 MP

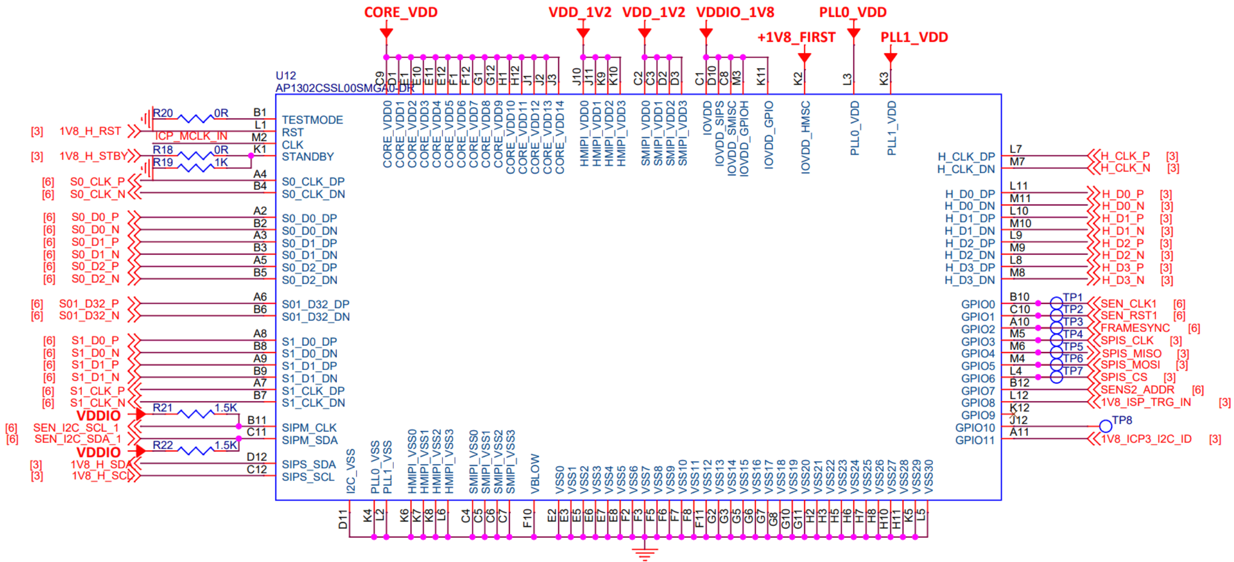

Figure 8 – Image Signal Processor

Image Signal Processor (U12)	Schematic Net Name	Component	Pin Number
L7 / M7	H_CLK_P/N	J1	6/8
L11 / M11	H_D0_P/N	J1	10/12
L10 / M10	H_D1_P/N	J1	14/16
L9 / M9	H_D2_P/N	J1	18/20
L8 / M8	H_D3_P/N	J1	22/24
GPIO0	SEN_CLK1	J6/J7	32
GPIO1	SEN_RST1	J6/J7	21
GPIO2	FRAMESYNC	J6/J7	20
GPIO3	SPIS_CLK	J1	9
GPIO4	SPIS_MISO	J1	11
GPIO5	SPIS_MOSI	J1	5
GPIO6	SPIS_CS	J1	7
GPIO7	SENS2_ADDR	J7 (see J11)	34
GPIO8	1V8_ISP_TRG_IN	J1	36
GPIO11	1V8_ICP3_I2C_ID	J1	34
L1	1V8_H_RST	J1	31
M2	ICP_MCLK_IN	J1/Y1 (see J5)	J1.35/Y1.3
K1	1V8_H_STBY	J1	33
A4 / B4	S0_CLK_P/N	J6	7/8

A2 / B2	S0_D0_P/N	J6	4/5
A3 / B3	S0_D1_P/N	J6	30/29
A5 / B5	S0_D2_P/N	J6	27/26
A6 / B6	S01_D32_P/N	J6	10/11
A8 / B8	S1_D0_P/N	J7	4/5
A9 / B9	S1_D1_P/N	J7	30/29
A7 / B7	S1_CLK_P/N	J7	7/8
B11	SEN_I2C_SCL_1	J6/J7	14
C11	SEN_I2C_SDA_1	J6/J7	22
D12	1V8_H_SDA	J1	26
C12	1V8_H_SCL	J1	28

Table 2 – Image Signal Processor Connections

5.5 BTB Connectors for IAS Camera Modules

The Dual Camera HSIO Module features two Hirose Electric BTB connectors, **J6** and **J7**, for IAS Camera Modules. This interface connects to the AP1302 Image Signal Processor, **U12**. The Hirose **BM20B(0.8)-34DS-0.4V(51)** connectors on the Dual Camera HSIO Module allow connection of up to two IAS Camera Modules, such as the 1MP Global Shutter Image Sensor Modules (**CAV10-000A**) included in the kit. Although these cameras use only 2 differential pairs on both connectors, **J6** supports up to 4 differential pairs, making the Dual Camera HSIO Module compatible with other IAS Camera Modules:

- **CAV80-000A** - 8Mpixel RGB Color Image Sensor Module
- **CAVBA-000A** - 4K Imaging Solution with Auto-Focus

Figure 9 and Table 3 shows the pinout of the Dual Camera interface and how the interface is mapped to the standard HSIO expansion connector, **J1**.

- Manufacturer: Hirose Connector
- Part Number: **BM20B(0.8)-34DS-0.4V(51)**
- Female Dual Camera (NGFF) PCIe Dual Camera Gen 3 1Connector B-Key

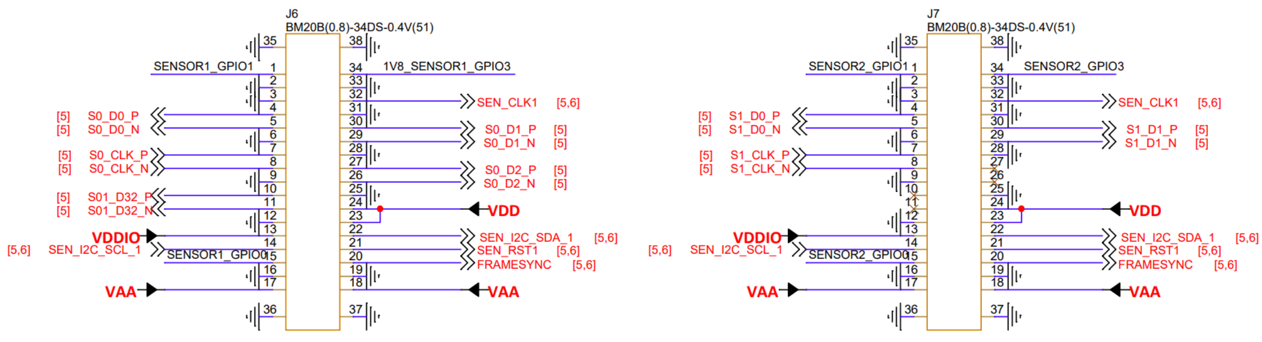

Figure 9 – BTB Connectors Interface

BTB Connector (J6) Pin Number	Schematic Net Name	Connection on Camera Module
1	SENSOR1_GPIO1	Jumper 8
4/5	S0_D0_P/N	AP1302 Lane 0-0 Diff Pair
7/8	S0_CLK_P/N	AP1302 CLock Diff Pair
10/11	S1_D32_P/N	AP1302 Lane 1-32 Diff Pair
14	SEN_I2C_SCL_1	AP1302 SEN I2C Clock
15	SENSOR1_GPIO0	Jumper 12 to Ground
32	SEN_CLK1	AP1302 SEN Clock
30/29	S0_D1_P/N	AP1302 Lane 0-1 Diff Pair
27/26	S0_D2_P/N	AP1302 Lane 0-2 Diff Pair
22	SEN_I2C_SDA_1	AP1302 SEN I2C Data
21	SEN_RST1	AP1302 SEN Reset
20	FRAMESYNC	AP1302 FrameSync
BTB Connector (J7) Pin Number	**Schematic Net Name**	**Connection on Camera Module**
1	SENSOR2_GPIO1	Jumper 10
4/5	S1_D0_P/N	AP1302 Lane 1-0 Diff Pair
7/8	S1_CLK_P/N	AP1302 Clock Diff Pair
14	SEN_I2C_SCL_1	AP1302 SEN I2C Clock
15	SENSOR2_GPIO3	Jumper 11
32	SEN_CLK1	AP1302 SEN Clock
30/29	S1_D1_P/N	AP1302 Lane 1-1 Diff Pair
22	SEN_I2C_SDA_1	AP1302 SEN I2C Data
21	SEN_RST1	AP1302 SEN Reset
20	FRAMESYNC	AP1302 FrameSync

Table 3 – BTB Connectors Interface Connections

5.6 On-Board Oscillator

The Dual Camera HSIO Module contains an on-board oscillator, **Y1**, to provide a clock for the AP1302 Image Signal Processor. The oscillator, **ECS-2520MV-480-CN-TR,** is a miniature SMD HCMOS Oscillator with MultiVolt capability of 1.6~3.6 V that generates the 48MHz clock required by the processor.

- Manufacturer: ECS
- Part Number: **ECS-2520MV-480-CN-TR**
- SMD HCMOS Oscillator

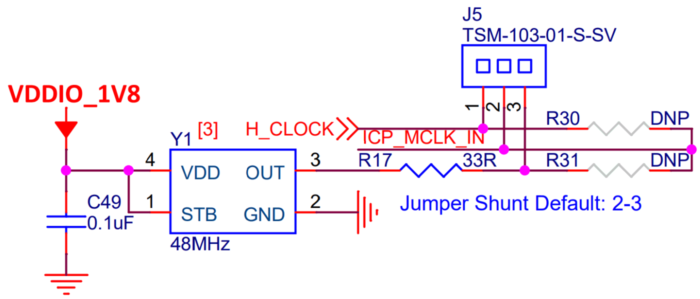

Figure 10 – Clock Generator Implementation

5.7 DSI Connector

The Dual Camera HSIO Module also provide a MIPI Display Serial Interface Connector, **J2**, to give the user the possibility to connect an External Display. The FPC Connector, **1-1734248-5,** is a 3.3V, Zero Insertion Force (ZIF), 1 mm (0.039 in), with 15 positions.

- Manufacturer: TE Connectivity
- Part Number: **1-1734248-5**
- 15P 1.0 FPC Female DSI MIPI Connector

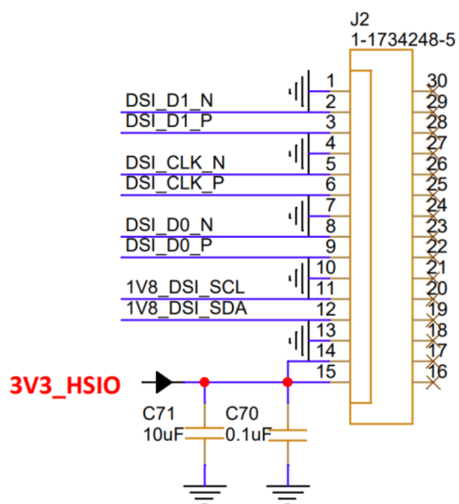

Figure 11 – DSI Connector Implementation

5.8 Recommended Operating Conditions

This section contains the recommended operating conditions when using the Dual Camera HSIO Module. Values listed are those available at the time of publication. Users may want to consult the latest device manufacturer's specifications if their application approaches any of the limits.

It is important that you review the mating board connections to the Standard HSIO expansion connector interface to ensure proper operation. Please check that the voltage provided by the HSIO expansion connectors agrees with the table for recommended input voltages and the Host Platform.

Parameter	Min	Max	Units	Notes
Operating Temperature	-20	85	°C	DSI Connector Range

Table 4 – Recommended Temperature Range

Parameter	Min	Max	Units	Notes
5V Input Voltage	4.85	5.15	V	HSIO Connector 5V +/- 3%
3.3V Input Voltage	3.20	3.40	V	HSIO Connector 3.3V +/- 3%
1.2V Input Voltage	1.164	1.236	V	HSIO Connector 1.2V +/- 3%

Table 5 – Recommended Input Voltages

5.9 Mechanical

The Dual Camera HSIO Module is designed with a form factor intended to mate to a Host Platforms Standard HSIO expansion sites. The board measures 70mm x 45mm (approximately 2.76” x 1.77”).

Several factors can affect the maximum vertical dimension of the board including the height of modules incorporated on the Dual Camera HSIO Module, the flat cable of an external display connected to the DSI Connector. A STEP model / DXF file of the PCB and its components can be made available to end users that may require it.

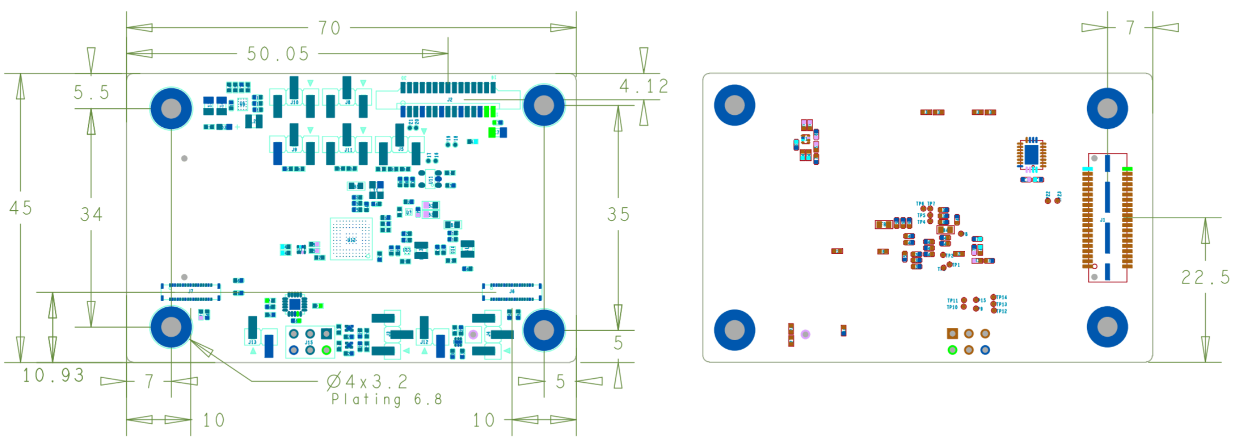

Figure 12 – Mechanical Dimensions

6 Getting Help and Support

If additional support is required, TRIA Technologies has many avenues to search depending on your needs.

For general question regarding Dual Camera HSIO, please visit our website at **http://avnet.me/dualcam-hsio-module**. Here you can find any available documentation, technical specifications, videos and tutorials, reference designs and other support.

Here are some interesting links on some posted references:

ZUBoard – Vitus Platforms: Building the Foundational Designs – 2023.2
Hackster.IO Project: **https://avnet.me/tria-vitis-2023.2-part1**

ZUBoard – Vitus Platforms: Building the Foundational Designs – 2022.2
Hackster.IO Project: **http://avnet.me/zub1cg-sbc-dualcam-2022.2**

ZUBoard – Vitus Platforms: Building the Foundational Designs – 2022.2 Image
Avnet Sharepoint: **http://avnet.me/zub1cg-sbc-dualcam-2022.2-sdimage**

ZUBoard - Petalinux Archive 2022.2 Tools
Avnet Sharepoint: **http://avnet.me/zub1cg_sbc_base_2022_2_bsp**

Detailed questions regarding Dual Camera HSIO Module hardware design, software application development, using AMD tools, training and other topics can be posted on the Avnet Boards Community pages at the Element14 Support Forums. Avnet's technical support team monitors the forum during normal business hours in North America.

Those interested in customer-specific options on K24 Development Kit can send inquiries to **customize@avnet.com**.

7 Certification Disclaimer

CE certification is necessary for system level products in those countries governed by this regulatory bodies.

Because Avnet boards are intended for evaluation kits only and destined for professionals (you) to be used solely at research and development facilities for such purposes, they are considered exempt from the EU product directives and normally are not tested for CE or FCC compliance.

If you choose to use your board to transmit using an antenna, it is your responsibility to make sure that you are in compliance with all laws for the country, frequency, and power levels in which the device is used. Additionally, some countries regulate reception in certain frequency bands. Again, it is the responsibility of the user to maintain compliance with all local laws and regulations.

8 Regulatory Compliance

WEEE Statement: Correct Disposal of this product.

This marking indicates that this product should not be disposed with other household wastes throughout the EU. To prevent possible harm to the environment or human health from uncontrolled waste disposal, recycle it responsibly to promote the sustainable reuse of material resources. To return your used device, please use the return and collection systems or contact the retailer where the product was purchased. They can take this product for environmentally safe recycling.

9 Safety Warnings

This product shall only be connected to a Carrier Card that provides the required current need to operate the HSIO expansion connector. Any external power supply used with the mating Carrier Card shall comply with relevant regulations and standards applicable in the country of intended use.

The connection of incompatible devices may affect compliance or result in damage to the unit and void the warranty.

This product shall be operated in a well-ventilated environment. If an enclosure is used, it shall have adequate ventilation. Use caution when handling the board when powered.