DATASHEET

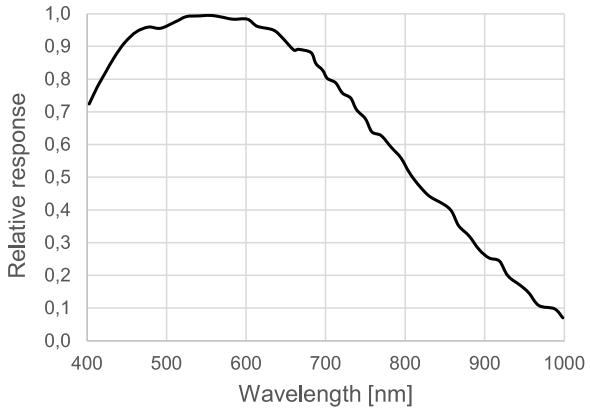
FSM-IMX547x/C01-Bundle

Camera Kit with Sony IMX547 / 5MP Global Shutter

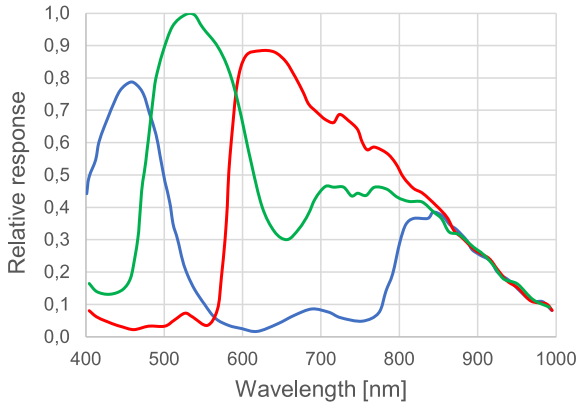
Key Benefits & Features:

- FRAMOS Sensor Module (**FSM**) bundled with Sensor Adapter (**FSA**), lens and accessories
- For use with the SLVS-EC reference implementation on the AMD-Xilinx Kria™ KR260 Robotics Starter Kit
- Part of the "FSM Ecosystem" providing maximum flexibility for rapid prototyping

FSM-IMX547M (Monochrome):



FSM-IMX547C (Color):



Specification	
Model Name	**FSM-IMX547M/C01-Bundle-V1B** (Mono) **FSM-IMX547C/C01-Bundle-V1B** (Color)

Image Sensor Module	
Vendor / Name	Sony IMX547-AAMJ / IMX547-AAQJ
Shutter Type	CMOS Global Shutter
Technology / Grade	Pregius S (Gen4) / Industrial
Chromaticity	Color / Mono
Optical Format	1/1.8"
Pixel Size	2.74 x 2.74 µm
Max. Resolution	5.1 Mpx / 2448 x 2048 px
Framerate (max.)	122 FPS (2-Lane), 65 FPS (1-Lane)
Bit Depth(s)	8 / 10 / 12 bit

Interface	
Type	PixelMateS™
Data Interface	SLVS-EC (1 / 2 Lane)
Communication Interface	I²C (4-wire serial)
Drive Frequency(s)	37.125 / 54 / 74.25 MHz
Input Voltages	3.8V, 1.8V
Interface Connector	Hirose DF40C-60DP-0.4V(51)

Mechanical (Assembly)	
Dimensions (HxWxD)	28 x 28 x 28 mm (no Lens) Ø35 mm x 66 mm (w/ Lens)

Environmental	
Operating Temperature	Function: -30°C to +75°C (case) Perform.: -10°C to +60°C (junction)
Storage Temperature	-40°C to +85°C
Ambient Humidity	20% to 95% RH, non condensing

Software Support
Reference design of AMD-Xilinx Kria™ KR260 Robotics Starter Kit.

Components in the Bundle:	
FSM-IMX547x-000-V1	Sensor Module, Color or Mono
FMA-MNT-CCS/280-IMX547C-V1	C/CS-Mount (Color version) - with IR Cut Filter -
FMA-MNT-CCS/280-V1	C/CS- Mount (Mono version) - no Filter/ Glass -
FPL-300191	C-Mount Lens (8.5mm, F1.4)
FSA-FT18/BC-V1	FRAMOS Sensor Adapter
FMA-FC-150/60-LVDS-V1	Flex Cable PixelMateS™, 150 mm
FMA-MNT-TRP1/4-CS-V1	1/4" Tripod Adapter

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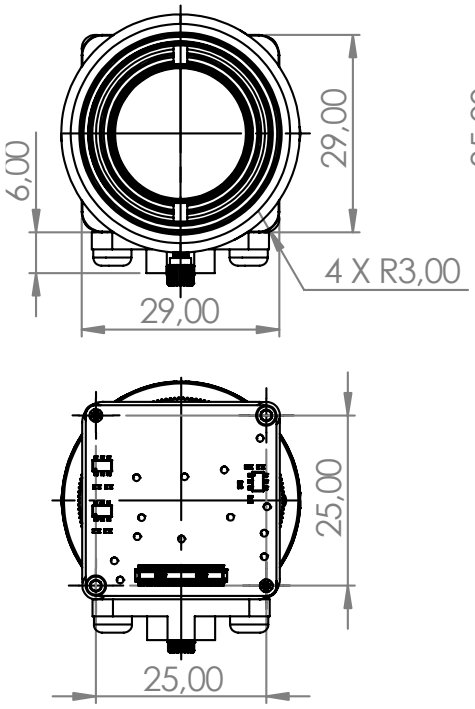
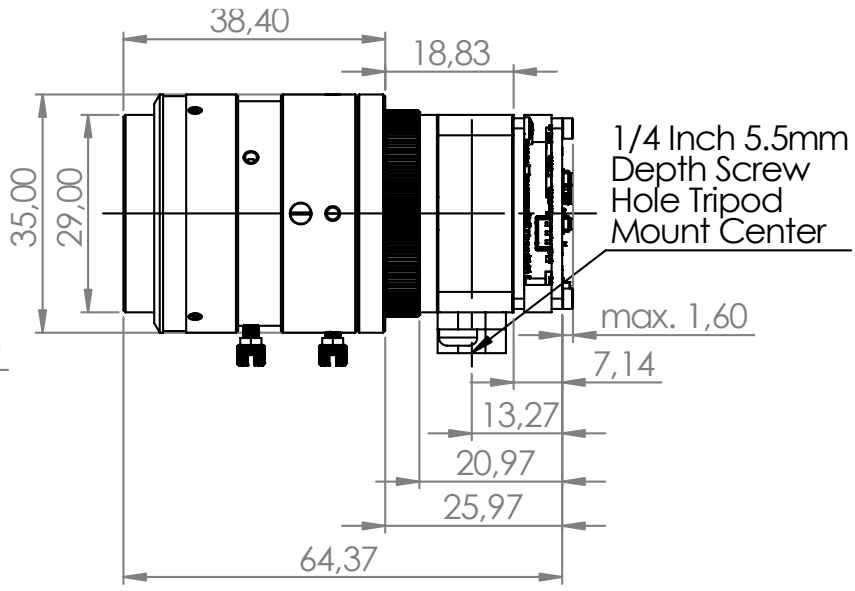
Mechanical Drawing

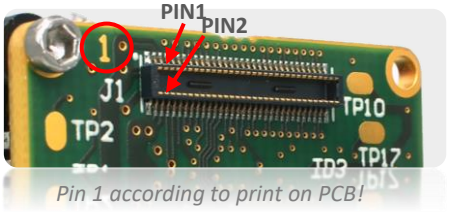




Note: Sensor image optical center is in mechanical board center.

Connector Pinout

Module: FSA-FT18/BC
Type: Hirose DF40C-60DP-0.4V(51)
Label: J1



Pin 1 according to print on PCB!

Note: SLVS-EC and SLVS operation modes share partially the same pins. The numbering of D_DATA_n pins is applied according to SLVS-EC. For SLVS operation, please refer to Chapter 4.1.3.

Pin #	Name	Pin #	Name
1	3V8_VDD	2	1V8_VDD
3	3V8_VDD	4	1V8_VDD
5	NC	6	NC
7	NC	8	NC
9	NC	10	NC
11	GND	12	GND
13	GND	14	GND
15	SDA	16	SCL
17	SDO	18	XCE
19	TOUT0	20	SLAMODE0
21	TOUT1	22	XMASTER
23	TOUT2	24	XTRIG2
25	SLAMODE1	26	XTRIG1
27	SLAMODE2	28	XHS
29	OMODE	30	XVS
31	GND	32	GND
33	RST	34	(Reserved)
35	MCLK	36	(Reserved)
37	GND	38	GND
39	D_DATA_0_P	40	(Reserved)
41	D_DATA_0_N	42	(Reserved)
43	GND	44	GND
45	D_DATA_1_P	46	(Reserved)
47	D_DATA_1_N	48	(Reserved)
49	GND	50	GND
51	(Reserved)	52	(Reserved)
53	(Reserved)	54	(Reserved)
55	GND	56	GND
57	(Reserved)	58	(Reserved)
59	(Reserved)	60	(Reserved)

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Certification and Standards

The equipment described in this document is designed for evaluation and laboratory use, as well as for the integration into electronic devices. The customer is responsible to take all necessary precautions to fulfill regulations and laws of end-customer and target market.

Technical Support

The technical equipment described in this document, be it hardware or software, is delivered as it is and does not include any obligations to the FRAMOS Technologies d.o.o. to provide technical customer support. Technical support is granted on project basis arbitrary by the FRAMOS Technologies d.o.o.

ATTENTION
Electrostatic sensitive devices!
Observe precautions for handling!

Handling ESD Sensitive Components

The electronic components like Printed Circuit Boards (PCB) described in this document are sensitive to Electrostatic Discharge (ESD) and need to be handled with high care in static controlled environments. It is strongly recommended to follow the general handling practices for ESD sensitive parts, that include, but are not limited to, the following points:

- Treat all PCBs and components as ESD sensitive.
- Assume that you will damage the PCB or component if you are not ESD conscious
- Handling areas must be equipped with a grounded table, floor mats and wrist strap
- A relative humidity level must be maintained between 20% and 80% non-condensing
- PCBs should not be removed from their protective package, except in a static controlled location
- PCBs must be handled only after personnel have grounded themselves via wrist straps and mats
- PCBs or components should never come in contact with clothing
- Try to handle all PCBs only by their edges, preventing contact with any components.

FRAMOS Technologies d.o.o. is not responsible for any damages caused by ESD on customer side.

Life support applications

These products are not designed for use in life support systems, appliances or devices where malfunction of the products can reasonably be expected to result in personal injury. Customers, Integrators and End Users using or selling these products for use in such applications do so at their own risk and agree to fully indemnify FRAMOS for any damages resulting from any improper use or sale.

1 FRAMOS Sensor Module Ecosystem

The FSM Ecosystem consists of FRAMOS Sensor Modules, Adapters, Software and Sources, and provides one coherent solution supporting the whole process of integrating image sensors into embedded vision products.

During the evaluation and proof-of-concept phase, off-the-shelf sensor modules with a versatile adapter framework allow the connection of latest image sensor technology to open processing platforms, like the AMD-Xilinx Kria™ KR260 Robotics Starter Kit. Reference implementations and sample applications deliver images immediately after installation, supporting V4L2 providing comfortable integration. Within the development phase, electrical design references and driver sources guide with a solid and proven baseline to quickly port into individual system designs and extend scope, while decreasing risk and efforts.

Off-the-Shelf Hardware

- FRAMOS Sensor Modules (FSM) from stock, ready for evaluation and prototyping
- Versatile adapter framework, allowing flexible testing of different modules, on different processing boards.
- FRAMOS Sensor Adapter (FSA): Everything needed for specific sensor operation
- FRAMOS Processor Adapter (FPA): Connect one or multiple FSM + FSA to a specific processor board
- From lenses, mechanics and cables, all needed imaging accessories from one hand

Kickstart Software Package by AMD-Xilinx

- 10GigE Vision Accelerated Application for Kria™ KR260
- Linux V4L2 drivers with basic sensor node control
- FRAMOS SLVS-EC IP Core Reference Implementation

Further to the off-the-shelf hard- and software, the Ecosystem supports you on project basis with:

- Driver sources allowing the focus on application specific scope and sensor features
- Electrical references for FSA and FPA, supporting quick and optimized embedding of FSMs
- Engineering services via FRAMOS and its partners, allowing you to focus on your product’s unique value

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1.1 Materials and Services

Below you can find a list of materials and services as part of the FRAMOS Sensor Module Ecosystem.

Hardware

- FRAMOS Sensor Module Development Kits
- Individual Parts:
  - **FRAMOS Sensor Modules** - Sensors on PCB, with filtering and versatile connector
  - **FRAMOS Sensor Adapters** - Sensor Periphery and PixelMate™ interface, optional data conversion
  - **FRAMOS Functional Adapters** – Sensor independent data and interface adaption, pre-processing
  - **FRAMOS Processor Adapters** – Specific for various processor-/ development boards
  - **FRAMOS Module Accessories** – Cables, mounts, mechanical adapters, etc.

Software (part of the Development Kit)

- AMD-Xilinx 10GigE Vision Accelerated Application for Kria™ KR260 (Sony IMX547)
- AMD-Xilinx FPGA Reference Implementation for SLVS-EC (Sony IMX421, IMX530)
- Software Packages for various other platforms.

Design Sources (on Project Basis)

- Software Driver Sources
- Electrical References for FSA, FFA and FPA (Schematics)

Design Services

- Off-the-shelf hardware customization including size, shape, connector and extended functionality
- Software customization and extension
- Processor board integration support
- Sensor and features support, image (pre-)processing
- Sensor characterization and ISP tuning
- Tailored production and quality assurance processes
- Optimization for volume production
- Lens assembly and alignment
- Standard conformity and certification

1.2 Compliances

1.2.1 CE-Declaration

This equipment is in compliance with the essential requirements and other relevant provisions of the following RoHS Directives: Directive 2011/65/EU and (EU) 2015/863.

1.2.2 RoHS

The RoHS Directive (RoHS = Restriction of Hazardous Substances) complements the WEEE Directive by severely restricting the presence of specific toxic substances in electronic equipment at the design phase, thereby reducing the environmental impact of discarding such products at the end of their useful life. FRAMOS Technologies d.o.o. is committed to complying with this Directive and has worked in collaboration with its suppliers to evaluate the new restrictions, to identify relevant exemptions, and to substitute environmentally benign, compliant alternative materials in its product components and manufacturing processes. Subject to the available exemptions, FRAMOS Technologies d.o.o. products were compliant with the RoHS Directive for its products.

Materials declarations comply with EN 63000:2018 requirements for RoHS Technical Documentation.

EU Declaration of conformity according to RoHS are issued on customer demand.

1.2.3 REACH

FRAMOS Technologies d.o.o. does neither manufacture nor import chemical substances. FRAMOS Technologies d.o.o. is well aware of:

- the requirements of REACH regulation of the European Council (EC) No. 1907/2006.,
- the SVHC Candidate List,
- our obligations concerning safety data sheets as well as informing customers.

1.2.4 WEEE

The WEEE Directive obliges manufacturers, importers, and/or distributors of electronic equipment to label the equipment for recycling and to provide for recycling of the electronic equipment at the end of its useful life. FRAMOS Technologies d.o.o. is committed to complying with the WEEE Directive (as implemented in each EU member state). In accordance with the requirements of the WEEE Directive, FRAMOS Technologies d.o.o. has labelled its electronic products that are shipped. The WEEE label and instructions for disposal are as follows:

Instructions for disposal of waste equipment by users in the European Union

This symbol on the product or its packaging indicates that this product must not be disposed of with other waste. Instead, it is your responsibility to dispose of your waste equipment by handing it over to a designated collection point for the recycling of electrical waste and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where

you can drop off your consumer waste equipment for recycling, please contact your local city recycling office or the dealer from whom you originally purchased the product.

1.2.5 Electro Magnetic Compliance (EMC)

The FRAMOS Sensor Module Ecosystem are OEM components / devices and provided board level. Electrical components with no or open housings do not comply with standards for electromagnetic compatibility (EMC), as the unshielded circuitry enables electromagnetic interference with other electronic devices.

Users who integrate components of the FRAMOS Sensor Module Ecosystem into their systems are obliged to perform appropriate testing regarding electromagnetic interference and apply CE conformity.

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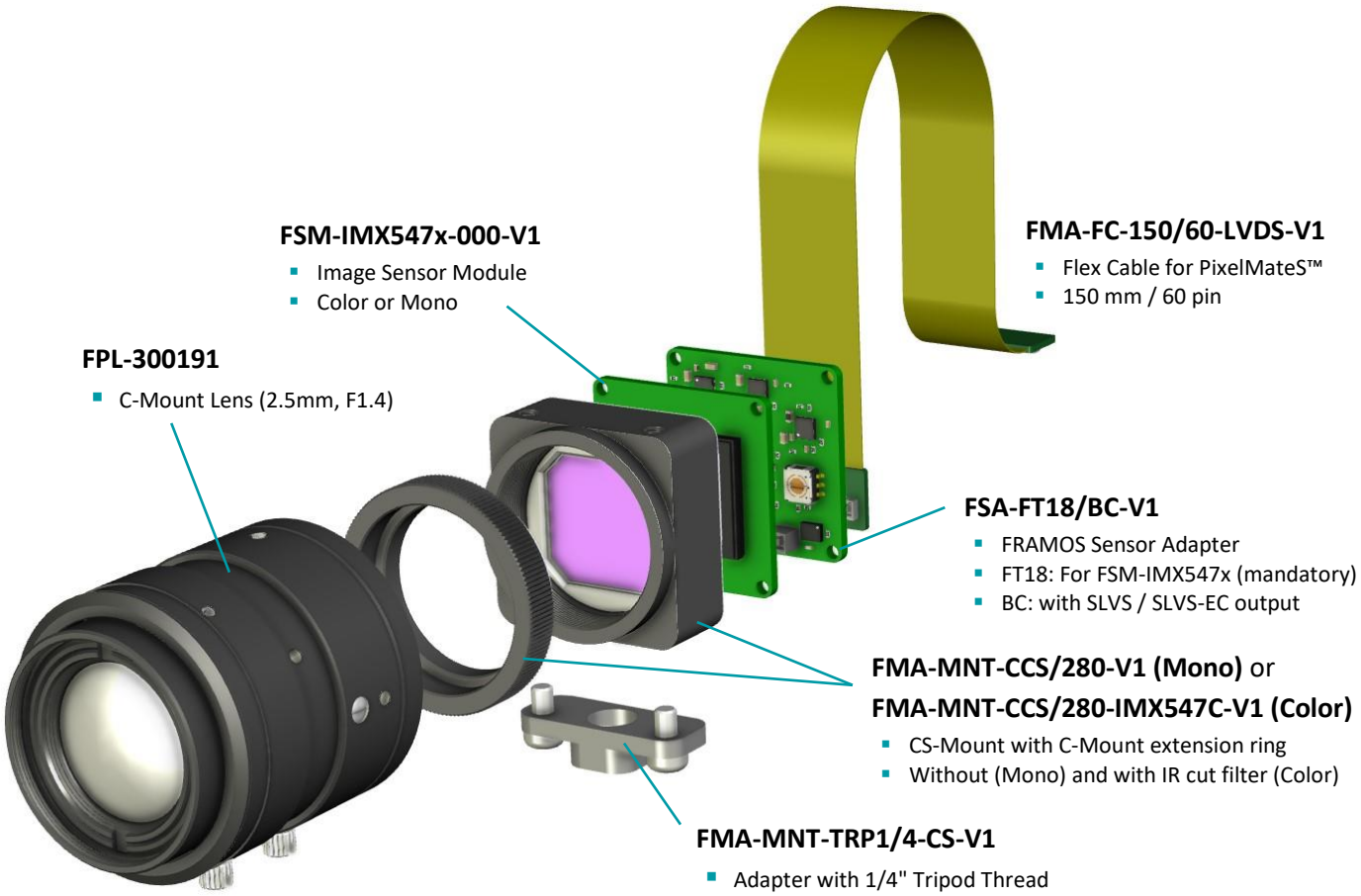
2 Start-Up Instructions

The following chapter describes the hardware assembly procedure according to the AMD-Xilinx Kria™ AI Starter Kit. The software support package, including the SLVS-EC IP Core and IMX547 reference design, is part of the AMD-Xilinx Starter Kit and described in the corresponding documentation.

Components and Assembly

The bundle consists of various components that are part of the FRAMOS Sensor Module Ecosystem. They are supplied fully assembled and can be directly attached to an FPA with PixelMateS™ interface, like the FPA-ABC/XX1, or a carrier board like the **AMD-Xilinx Kria™ KR260 Robotics Starter Kit**.



Compatibility:

- AMD-Xilinx Kria™ KR260 Robotics Starter Kit
- FPA-ABC/XX1-V1 (SLVS, SLVS-EC Port)

By default, all boards and mechanicals are fixed by screwing. The attributes and specifications of the individual components can be found in the following chapters.

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2.1 Hardware Assembly

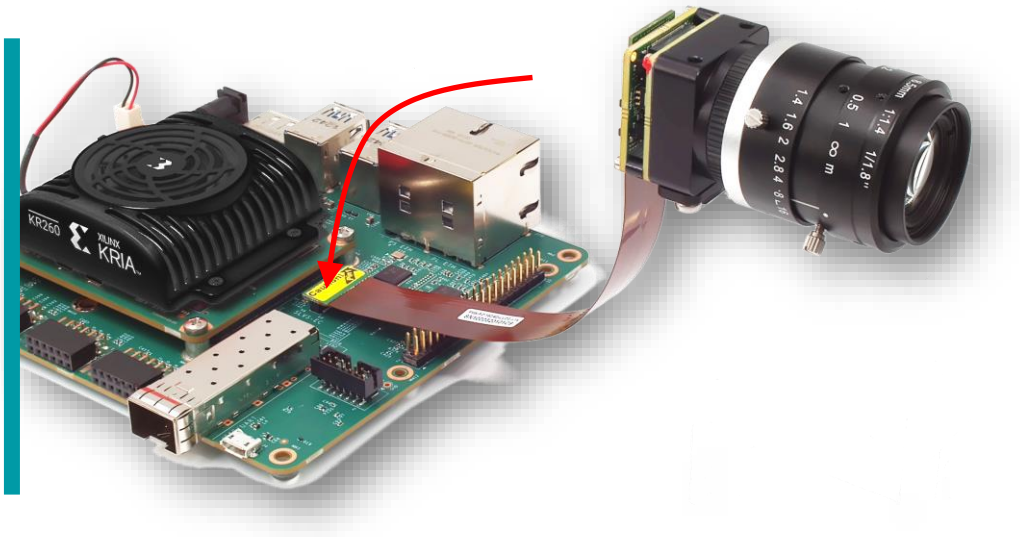
All FRAMOS development kits come pre-assembled and can be plugged directly to the Processor Board or FPA using the supplied flex cable.

Please follow the steps below:

1. Ensure the processor board is not running and is disconnected from power supply.
2. Connect the Flex Cable to the backend of the sensor module assembly.

Ensure that the Pin 1 markings are matching!

3. Connect the other end of the Flex Cable to the processor board or a proper FRAMOS Processor Adapter (FPA). **Ensure that the Pin 1 markings are matching.**



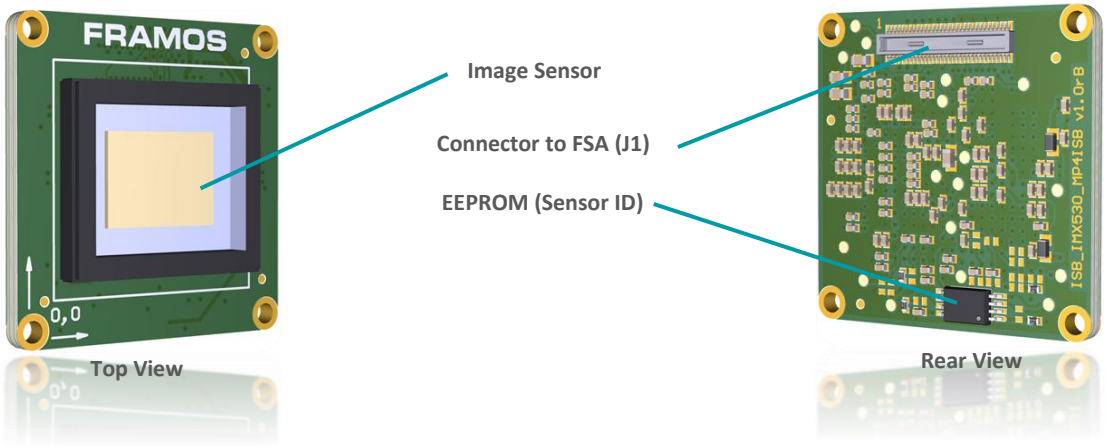
4. Start-up the processor board according to the instructions by its manufacturer.

Warning:

- Misorientation of the connector can lead to bad performance or even permanent damage!
- Never connect an FSM directly (without FSA) to an FPA, or a carrier that was not designed explicitly for this purpose.
- The FSM Ecosystem consists of a large set of components using standardized connectors. The compatibility among these components is not ensured by the connector itself – mixing components that are not compatible may lead to permanent damage. A list of compatible hardware can be found in the “Ecosystem Compatibility Matrix” at the end of this document.

3 FSM-IMX547x-000-V1

The FRAMOS Sensor Module places Sony's IMX547 image sensor on a Generic **28 x 28 mm PCB** adding proper filtering and a connector interface according to the **PixelMateS**™ specification to establish simple accessibility.



For operation with standard FPAs and carrier boards like the AMD-Xilinx Kria KR260, an FSA-FT18/BC is required for proper operation. Detailed specification on image sensor and registers can be found in the image sensor datasheet.

Sensor Module Specification

Image Sensor Module	
Vendor / Name	Sony IMX547-AAMJ / IMX547-AAQJ
Shutter Type	CMOS Global Shutter
Technology / Grade	Pregius S (Gen4) / Industrial
Chromaticity	Color / Mono
Optical Format	1/1.8"
Pixel Size	2.74 x 2.74 µm
Max. Resolution	5.1 Mpx / 2448 x 2048 px
Framerate (max.)[1]	SLVS-EC: 122 FPS (2-Lane), 65 FPS (1-Lane) SLVS: 122 FPS (8-Lane), 72 FPS (4-Lane)
Bit Depth(s)	8 / 10 / 12 bit

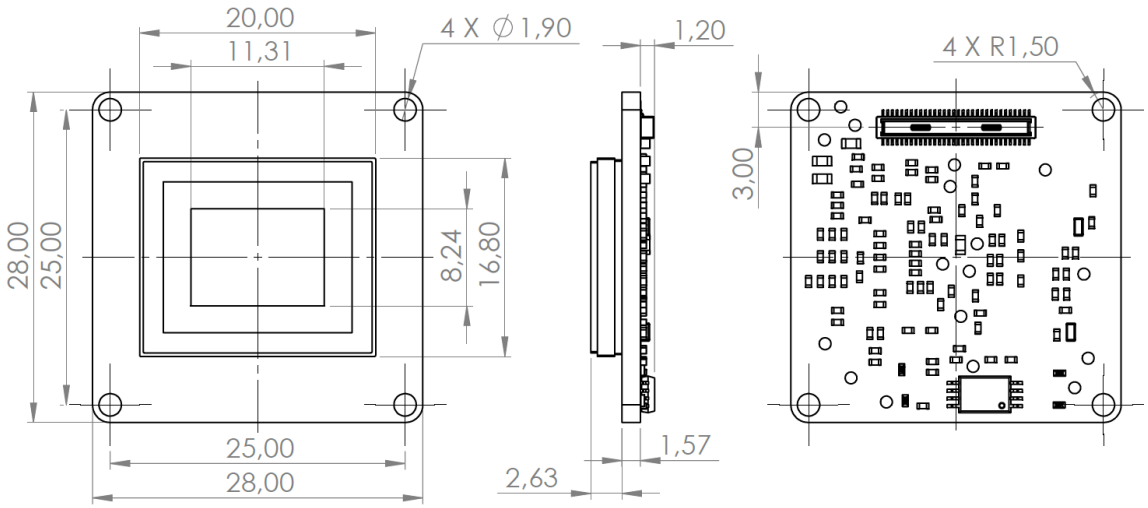
Interface	
Data Interface	SLVS: 2 / 4 / 8 Lane (á 891 Mbps) SLVS-EC: 1 / 2 Lane (á 5 Gbps)
Communication Interface	I²C (4-wire serial)
Drive Frequency(s)	37.125 / 54 / 74.25 MHz
Input Voltages	1.1V, 1.8V, 2.9V, 3.3V
Interface Connector	Hirose DF40C-60DP-0.4V(51)
EEPROM (Sensor ID)	Yes

Variants and Lens Mount

- FSM-IMX547M-000-V1 Sony IMX547-AAMJ, Monochrome
- FSM-IMX547C-000-V1 Sony IMX547-AAQJ, Color

[1] FSM and FSA can output also SLVS modes that might not be supported by SLVS-EC based receivers.

3.1 Mechanical Drawing



Sensor image optical center is in mechanical board center.

3.2 Connector to FSA

Label: J1

Type: Hirose DF40C-60DP-0.4V

Pin #	Name	Pin #	Name
1	NC	2	1V8
3	NC	4	1V8
5	3V3	6	1V1
7	3V3	8	1V1
9	1V8	10	2V9
11	GND	12	GND
13	GND	14	GND
15	SDA	16	SCL
17	SDO	18	XCE
19	TOUT0	20	SLAMODE0
21	TOUT1	22	XMASTER
23	TOUT2	24	XTRIG2
25	SLAMODE1	26	XTRIG1
27	SLAMODE2	28	XHS
29	OMODE	30	XVS
31	GND	32	GND
33	RST	34	(D_DATA_7_P)
35	MCLK	36	(D_DATA_7_N)
37	GND	38	GND
39	D_DATA_0_P (6_P)	40	(D_DATA_5_P)
41	D_DATA_0_N (6_N)	42	(D_DATA_5_N)
43	GND	44	GND
45	D_DATA_1_P (4_P)	46	(D_DATA_3_P)
47	D_DATA_1_N (4_N)	48	(D_DATA_3_N)
49	GND	50	GND
51	(D_DATA_2_P)	52	(D_DATA_1_P)
53	(D_DATA_2_N)	54	(D_DATA_1_N)
55	GND	56	GND
57	(D_DATA_0_P)	58	(D_CLK_0_P)
59	(D_DATA_0_N)	60	(D_CLK_0_N)

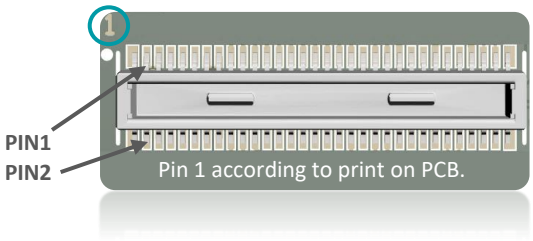
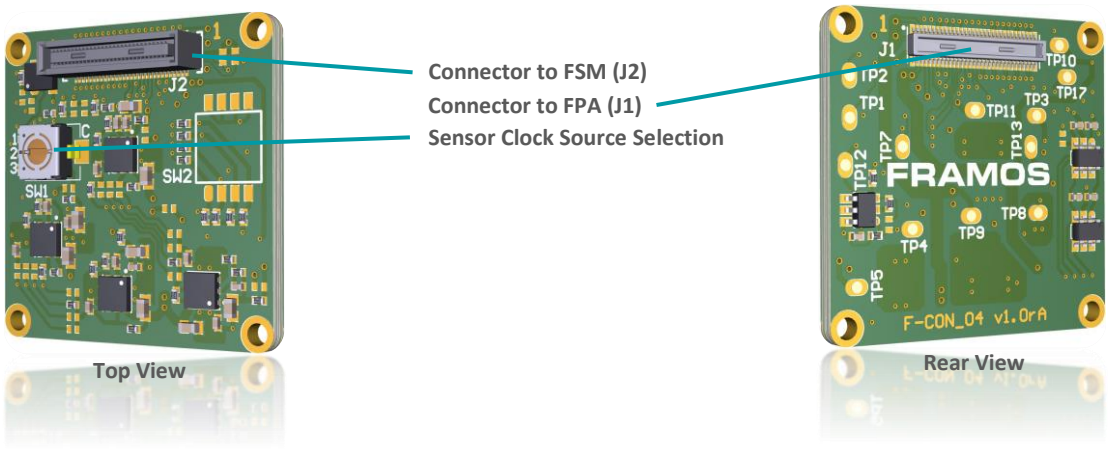


Table 1: Pinout of FSM-IMX547x-000-V1A, connector to FRAMOS Sensor Adapter (FSA) with SLVS-EC output

Note: SLVS-EC and SLVS operation modes share partially the same pins. The numbering of **D_DATA_n** pins is applied according to SLVS-EC. The grayed (D_DATA_n) pins describe the SLVS operation scheme. Please refer to Chapter 4.1.3. for further details.

4 FSA-FT18/BC: FRAMOS Sensor Adapter for SLVS-EC and SLVS

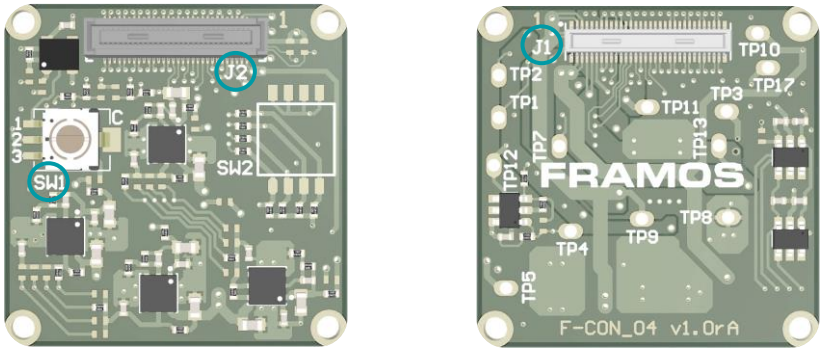
- Connects FSM with SLVS-EC output to Kria™ KR260
- SLVS-EC and SLVS output available to FPA
- Each FSA variant (“x”) might be FSM specific



Functional Blocks:

- Signal routing
- Voltage generation for image sensor
- Power up sequence for image sensor

4.1 Interface Description



4.1.1 SW1: Sensor Clock Source Selection

Pos.	Description
1	Clock Provided from FSA **(Default)**
2	External Clock 1 (MCLK0)
3	External Clock 2 (MCLK1)

Table 2: Selection of Sensor Clock Source on FSA-FTx/A-V1

4.1.2 J2: Connector to FSM

Label: J2
Type: DF40HC(4.0)-60DS-0.4V
Pinout: According to FSM

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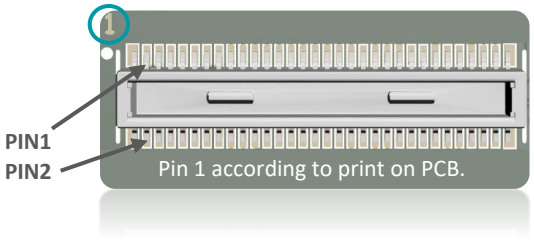
4.1.3 J1: Connector to KR260 (or FPA)

Label: J1

Type: Hirose DF40C-60DP-0.4V

Pinout:



Pin #	Name	Pin #	Name
1	3V8_VDD	2	1V8_VDD
3	3V8_VDD	4	1V8_VDD
5	NC	6	NC
7	NC	8	NC
9	NC	10	NC
11	GND	12	GND
13	GND	14	GND
15	SDA	16	SCL
17	SDO	18	XCE
19	TOUT0	20	SLAMODE0
21	TOUT1	22	XMASTER
23	TOUT2	24	XTRIG2
25	SLAMODE1	26	XTRIG1
27	SLAMODE2	28	XHS
29	OMODE	30	XVS
31	GND	32	GND
33	RST	34	(D_DATA_7_P)
35	MCLK	36	(D_DATA_7_N)
37	GND	38	GND
39	D_DATA_0_P (6_P)	40	(D_DATA_5_P)
41	D_DATA_0_N (6_N)	42	(D_DATA_5_N)
43	GND	44	GND
45	D_DATA_1_P (4_P)	46	(D_DATA_3_P)
47	D_DATA_1_N (4_N)	48	(D_DATA_3_N)
49	GND	50	GND
51	(D_DATA_2_P)	52	(D_DATA_1_P)
53	(D_DATA_2_N)	54	(D_DATA_1_N)
55	GND	56	GND
57	(D_DATA_0_P)	58	(D_CLK_0_P)
59	(D_DATA_0_N)	60	(D_CLK_0_N)

Table 3: Pinout of FSA-FTx/BC-V1, connector to FRAMOS Processor Adapter (FPA) with Sub-LVDS, SLVS or SLVS-EC input

J1: Signal Description (Part 1/2)

Pin	Net name	I/O	Primary function description	Connected to	I/O Standard	
1	3V8_VDD	Power	3.8V Power Supply (Triggers FSA/FSM power-up)	LDO_ICs, FSM		
2	1V8_VDD	Power	1.8V Power Supply	LDO_ICs, FSM		
3	3V8_VDD	Power	3.8V Power Supply (Triggers FSA/FSM power-up)	LDO_ICs, FSM		
4	1V8_VDD	Power	1.8V Power Supply	LDO_ICs, FSM		
5	AUX_ANA	Power	Not Connected	(FSM)		
6	AUX_DIG	Power	Not Connected	(FSM)		
7	AUX_ANA	Power	Not Connected	(FSM)		
8	AUX_DIG	Power	Not Connected	(FSM)		
9	AUX_IF	Power	Not Connected	(FSM)		
10	AUX_V	Power	Not Connected	(FSM)		
11	GND	GND	Common Ground			
12	GND	GND	Common Ground			
13	GND	GND	Common Ground			
14	GND	GND	Common Ground			
15	SDA	IN/OUT	I2C SDA for FSM. Connected to Test Point (TP1)	Test point, FSM	LVCMOS18 (1.8V)	
16	SCL	IN	I2C SCL for FSM. Connected to Test Point (TP2)	Test point, FSM	LVCMOS18 (1.8V)	
17	SDO	OUT		FSM	LVCMOS18 (1.8V)	
18	XCE	IN		FSM	LVCMOS18 (1.8V)	I 4-
19	TOUT0	OUT	TOUT0 from FSM	FSM	LVCMOS18 (1.8V)	
20	SLAMODE0	IN	Slave address select for FSM (SLAMODE0)	FSM	LVCMOS18 (1.8V)	1A: H
21	TOUT1	OUT	TOUT1 from FSM	FSM	LVCMOS18 (1.8V)	
22	XMASTER	IN	XMASTER for FSM. Connected to Test Point (TP7)	Test point, FSM	LVCMOS18 (1.8V)	SI M
23	TOUT2	OUT	TOUT2 from FSM	FSM	LVCMOS18 (1.8V)	
24	XTRIG2	IN	XTRIG2 for FSM	FSM	LVCMOS18 (1.8V)	
25	SLAMODE1	IN	Slave address select for FSM (SLAMODE1)	FSM	LVCMOS18 (1.8V)	
26	XTRIG1	IN	XTRIG1 for FSM	FSM	LVCMOS18 (1.8V)	
27	SLAMODE2	IN	Slave address select for FSM (SLAMODE2)	FSM	LVCMOS18 (1.8V)	
28	XHS	IN/OUT	XHS for FSM	FSM	LVCMOS18 (1.8V)	
29	OMODE	IN	OMODE for FSM	FSM, (Power Sequencer)	LVCMOS18 (1.8V)	SLV S
30	XVS	IN/OUT	Multiple FSM synchronization	FSM	LVCMOS18 (1.8V)	

J1: Signal Description (Part 2/2)

Pin	Net name	I/O	Primary function description	Connected to	I/O Standard
31	GND	GND	Common Ground		
32	GND	GND	Common Ground		
33	RST	IN	General reset for FSM	Reset_IC	LVCMOS18 (1.8V)
34	(D_DATA_7_P)	OUT	SLVS/LVDS output data (7, P)	FSM	LVDS/SLVS
35	MCLK	IN CLK	Master clock 0 (SW1 in pos 2 or 3)	Rotary switch	LVCMOS18 (1.8V)
36	(D_DATA_7_N)	OUT	SLVS/LVDS output data (7, N)	FSM	LVDS/SLVS
37	GND	GND	Common Ground		
38	GND	GND	Common Ground		
39	D_DATA_0_P (D_DATA_6_P)	OUT	SLVS-EC output data (0, P) SLVS/LVDS output data (6, P)	FSM	SLVS-EC LVDS/SLVS
40	(D_DATA_5_P)	OUT	SLVS/LVDS output data (5, P)	FSM	LVDS/SLVS
41	D_DATA_0_N (D_DATA_6_N)	OUT	SLVS-EC output data (0, N) SLVS/LVDS output data (6, N)	FSM	SLVS-EC LVDS/SLVS
42	(D_DATA_5_N)	OUT	SLVS/LVDS output data (5, N)	FSM	LVDS/SLVS
43	GND	GND	Common Ground		
44	GND	GND	Common Ground		
45	D_DATA_1_P (D_DATA_4_P)	OUT	SLVS-EC output data (1, P) SLVS/LVDS output data (4, P)	FSM	SLVS-EC LVDS/SLVS
46	(D_DATA_3_P)	OUT	SLVS/LVDS output data (3, P)	FSM	
47	D_DATA_1_N (D_DATA_4_N)	OUT	SLVS-EC output data (1, N) SLVS/LVDS output data (4, N)	FSM	SLVS-EC LVDS/SLVS
48	(D_DATA_3_N)	OUT	SLVS/LVDS output data (3, N)	FSM	LVDS/SLVS
49	GND	GND	Common Ground		
50	GND	GND	Common Ground		
51	(D_DATA_2_P)	OUT	SLVS/LVDS output data (2, P)	FSM	LVDS/SLVS
52	(D_DATA_1_P)	OUT	SLVS/LVDS output data (1, P)	FSM	LVDS/SLVS
53	(D_DATA_2_N)	OUT	SLVS/LVDS output data (2, N)	FSM	LVDS/SLVS
54	(D_DATA_1_N)	OUT	SLVS/LVDS output data (1, N)	FSM	LVDS/SLVS
55	GND	GND	Common Ground		
56	GND	GND	Common Ground		
57	(D_DATA_0_P)	OUT	SLVS/LVDS output data (0, P)	FSM	LVDS/SLVS
58	(D_CLK_0_P)	OUT	SLVS/LVDS output clock (0, P)	FSM	LVDS/SLVS
59	(D_DATA_0_N)	OUT	SLVS/LVDS output data (0, N)	FSM	LVDS/SLVS
60	(D_CLK_0_N)	OUT	SLVS/LVDS output clock (0, N)	FSM	LVDS/SLVS

Note: "Greyed" signals describe the alternative **SLVS/LVDS** output supported by FSM, FSA and FPA. Hardware like the Kria™ KR260 operates in **SLVS-EC mode only**.

4.1.4 TPx: Test Points

Name	Signal	Name	Signal	Name	Signal
TP1	I2C_0_SDA (SPI_MOSI)	**TP7**	IS_GPIO0 (XMASTER0)	**TP12**	V_IF
TP2	I2C_0_SCL (SPI_SCK)	**TP8**	GND	**TP13**	V_DIG
TP3	IS_MCLK_0	**TP9**	3V8_VDD	**TP17**	GND
TP4	IS_RST_0	**TP10**	1V8_VDD		
TP5	V_ANA-1	**TP11**	V_ANA		

Table 4: Test Points on FSA-FTx/BC-V1

4.2 Technical Drawing

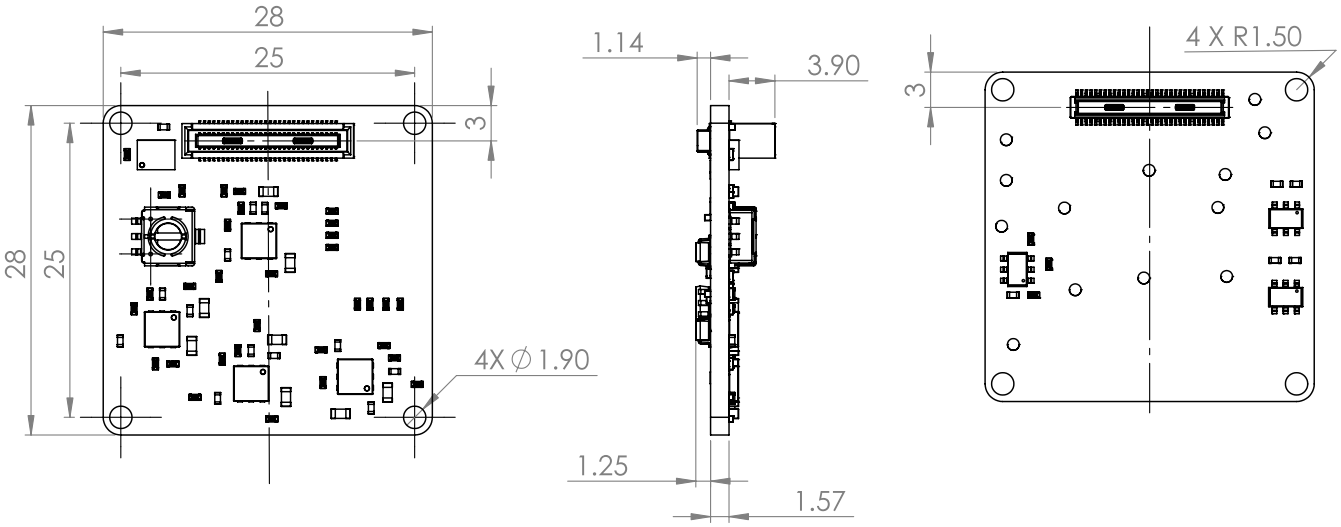


Figure 1: Technical Drawing of FSA-FTx/BC-V1

5 FRAMOS Processor Adapter (FPA)

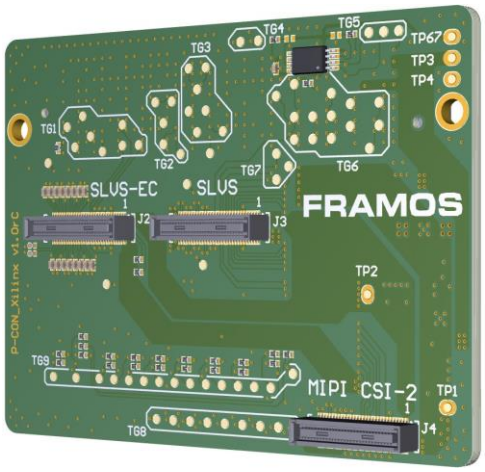
FPAs connect one or multiple FSAs to a processor board and are separately available. They are processor board or family specific and differentiate into the following PixelMate™ input interface types:

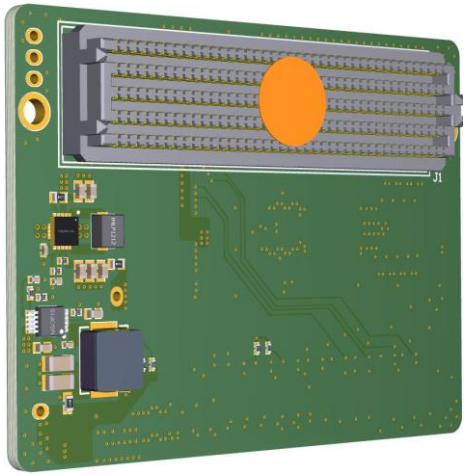
- A: MIPI CSI-2
- B: Sub-LVDS / SLVS
- C: SLVS-EC

5.1 FPA-ABC/XX1: Multi-Format FPA to AMD-Xilinx Development Boards

This FPA type connects the FSM Ecosystem via the standardized PixelMate™ interfaces to AMD-Xilinx Development Board deployed with the FPGA Mezzanine Card (FMC) connector. *It is not part of the bundle and separately available*.

- Three inputs, one for each interface:
  - SLVS-EC
  - Sub-LVDS / SLVS
  - MIPI CSI-2 (D-PHY)
- EEPROM for dynamic device tree management
- Testpoints to important sensor signals
- Configurable trigger routing
- Compatible to various AMD-Xilinx Development Boards; verified types can be found in the compatibility matrix in this chapter.





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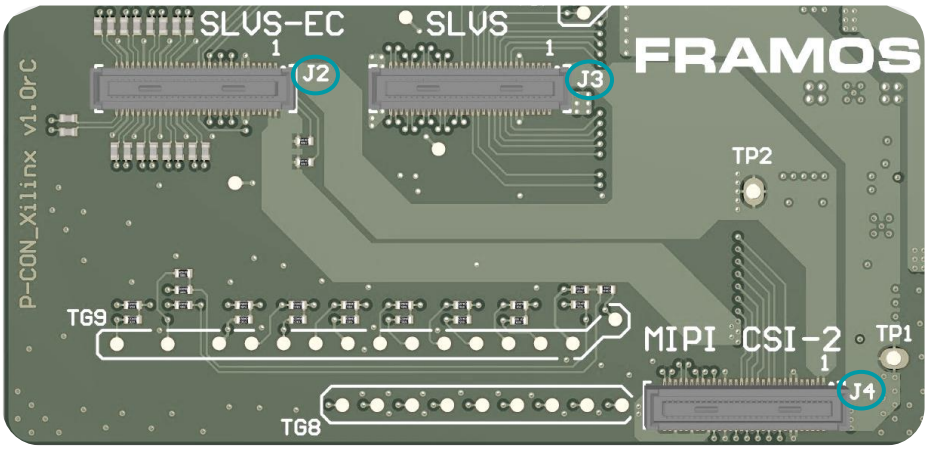
5.1.1 Image Sensor Connectors



Label	Name	Description	Connector Type	FPGA Routing
J2	SLVS-EC	Port 2, 8-Lanes SLVS-EC, to FSA	Hirose DF40HC(4.0)-60DS-0.4V	8-Lanes to Transceivers
J3	SLVS	Port 1, 8-Lanes SLVS / Sub-LVDS, to FSA		8-Lanes to differential IOs
J4	MIPI CSI-2	Port 3, 4-Lanes MIPI CSI-2, to FSA		4-Lanes to CSI-2 D-PHY

Table 5: Image Sensor Connectors on FPA-ABC/XX1-V1

All ports provide the same pinout. The pin assignment is according to the corresponding FSA.

Caution: Direct connection of FSM to FPA (without FSA) or wrong cable orientation will lead to permanent damage of FSM, Adapters or the Processor Board. Using flex cable (FMA-FC-150/60-v1) between FSA and FPA is mandatory.

Processor Board Compatibility Matrix

The FPA has been designed to comply to the following Xilinx Development Boards.

Xilinx Development Board	SLVS-EC	SLVS	MIPI CSI-2
AC701-G (Artix-7)	Yes	TBD	TBD
KC705-G (Kintex-7)	Yes	TBD	TBD
ZC706-G (Zynq-7000)	Yes	TBD	TBD
KCU105-G (Kintex UltraScale)	Yes	Yes	TBD
KCU116-G (Kintex UltraScale+)	Yes	TBD	TBD
ZCU102-G (Zynq UltraScale+)	Yes	Yes	Yes

Important Notes:

- **Kria KR260:** Boards like the Kria KR260 Robotics Starter Kit integrate the PixelMateS™ SLVS-EC connector (2-Lane) directly into the carrier board. FSM+FSA are directly connected, an FPA is not needed.
- **SLVS-EC:** The different AMD-Xilinx Development Boards provide access to a different count of Gigabit Transceivers (GTx). This might limit the utilization of the 8-Lanes available from the FPA. Please refer to the datasheet of the AMD-Xilinx Development Board for more information.
- **MIPI CSI-2 (D-PHY):** The AMD-Xilinx XCU102-G provides hard D-PHY lanes on the appropriate pins of the FPA connector. The usage of the MIPI CSI-2 port is routed but has not been verified. Operation is in the responsibility of the user. Further AMD-Xilinx Development Kits might be compatible but have not been validated for correct electrical connectivity.

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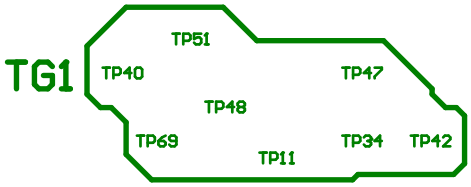
5.1.2 TGx, TPx: Test Groups and Test Points

Ungrouped (according to silk print)

Label	Signal	Label	Signal
TP1	1V8_VDD	**TP67**	UTIL_3V3_10A
TP2	3V8_VDD	**TP75**	GND
TP3	UTIL_3V3	**TP76**	GND
TP4	GND	**TP77**	GND
TP12	CAM1_GPIO0(XMASTER0)	**TP78**	GND

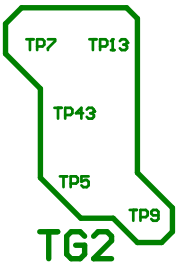
TG1: Clocks and various GPIOs

Label	Signal	Label	Signal
TP11	CAM1_GPIO8(TOUT1)	**TP47**	CAM1_GPIO14
TP34	CAM1_GPIO10	**TP48**	CAM1_MCLK0
TP40	CAM2_GPIO3(XTRIG0)	**TP51**	CAM3_MCLK0
TP42	CAM1_GPIO16	**TP69**	CAM2_MCLK0



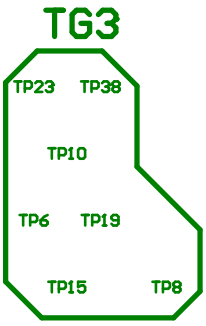
TG2: Various

Label	Signal	Label	Signal
TP5	CAM1_I2C_0_SDA(SPI_MOSI)	**TP13**	CAM1_GPIO9(TOUT2)
TP7	CAM1_GPIO15(SPI_MISO)	**TP43**	CAM1_RST0
TP9	CAM1_GPIO11(TOUT0)		



TG3:

Label	Signal	Label	Signal
TP6	CAM1_I2C_0_SCL(SPI_SCK)	**TP19**	CAM1_GPIO3(XTRIG0)
TP8	CAM1_GPIO17(SPI_CS)	**TP23**	CAM1_GPIO2(XHS0)
TP10	CAM1_GPIO6(SLAMODE)	**TP38**	CAM1_GPIO1(XVS0)
TP15	CAM1_GPIO7(XTRIG2)		



TG4: I2C Clock and Data

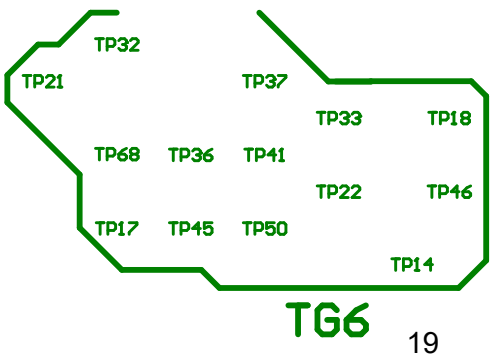
Label	Signal
TP25	SCL
TP26	SDA

TG5: EEPROM Address

Label	Signal
TP27	GA1
TP28	GA0
TP30	GND

TG6:

Label	Signal	Label	Signal
TP14	CAM3_RST0	**TP36**	CAM2_GPIO7(XTRIG2)
TP17	CAM2_GPIO6(SLAMODE)	**TP37**	CAM3_I2C_0_SDA(SPI_MOSI)
TP18	CAM3_GPIO0(XMASTER0)	**TP41**	CAM3_GPIO2(XHS0)
TP21	CAM2_GPIO8(TOUT1)	**TP45**	CAM2_GPIO2(XHS0)
TP22	CAM3_I2C_0_SCL(SPI_SCK)	**TP46**	CAM3_GPIO3(XTRIG0)
TP32	CAM2_GPIO0(XMASTER0)	**TP50**	CAM2_GPIO1(XVS0)
TP33	CAM3_GPIO1(XVS0)	**TP68**	CAM2_RST0



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TG7:

Label	Signal
TP44	CAM2_GPIO9(TOUT2)
TP49	CAM2_GPIO10
TP64	CAM3_GPIO5(MCLK3)

TG8:

Label	Signal
TP52	CAM3_GPIO16(SYS_PW_EN)
TP53	CAM3_GPIO8
TP54	CAM3_GPIO14
TP55	CAM3_RST1
TP60	CAM3_GPIO6
TP61	CAM3_GPIO7

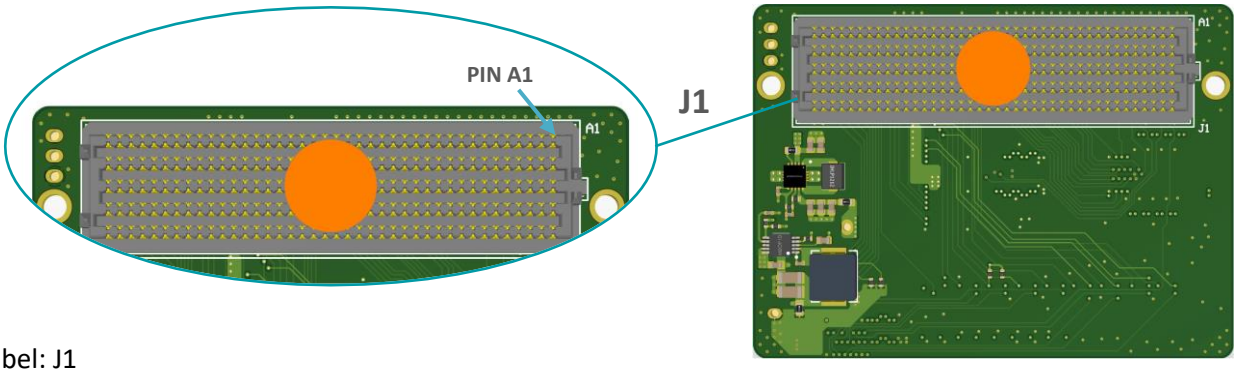
Label	Signal
TP62	CAM3_GPIO4(MCLK2)
TP63	CAM3_MCLK1
TP64	CAM3_GPIO5(MCLK3)

TG9:

Label	Signal
TP16	CAM2_I2C_0_SDA(SPI_MOSI)
TP20	CAM2_I2C_0_SCL(SPI_SCK)
TP24	CAM2_GPIO15(SPI_MISO)
TP35	CAM2_GPIO17(SPI_CS)
TP39	CAM2_GPIO11(TOUT0)
TP56	CAM3_GPIO15(SPI_MISO)
TP57	CAM3_I2C_1_SCL
TP58	CAM3_GPIO17(SPI_CS)

Label	Signal
TP59	CAM3_GPIO9
TP66	CAM2_GPIO14
TP70	CAM3_I2C_1_SDA
TP71	CAM3_GPIO10
TP72	CAM3_GPIO11
TP73	CAM3_PW_EN0
TP74	CAM3_PW_EN1

5.1.3 Processor Board Connector



Label: J1
Type: ASP-134488-01
Pinout (A – J): Table 6 / Table 7
Notes: **CAM1**: J2 (SLVS-EC), **CAM2**: J3 (SLVS), **CAM3**: J4 (MIPI CSI-2)

Table 6: Pinout J1 - Part1 (A-E) of FPA-ABC/XX1-V1 connector to AMD-Xilinx Development Board

PIN #	A	B	C	D	E
1	GND	NC	GND	NC	GND
2	FMC_CAM1_DO1_P	GND	NC	GND	NC
3	FMC_CAM1_DO1_N	GND	NC	GND	NC
4	GND	NC	GND	FMC_CAM1_D_CLK_0_P	GND
5	GND	NC	GND	FMC_CAM1_D_CLK_0_N	GND
6	FMC_CAM1_DO2_P	GND	FMC_CAM1_DO0_P	GND	NC
7	FMC_CAM1_DO2_N	GND	FMC_CAM1_DO0_N	GND	NC
8	GND	NC	GND	CAM2_D_DATA_1_P	GND
9	GND	NC	GND	CAM2_D_DATA_1_N	NC
10	FMC_CAM1_DO3_P	GND	CAM2_D_DATA_5_P	GND	NC
11	FMC_CAM1_DO3_N	GND	CAM2_D_DATA_5_N	CAM2_D_DATA_6_P	GND
12	GND	FMC_CAM1_DO7_P	GND	CAM2_D_DATA_6_N	NC
13	GND	FMC_CAM1_DO7_N	GND	GND	NC
14	FMC_CAM1_DO4_P	GND	CAM2_D_DATA_7_P	CAM1_GPIO15(SPI_MISO)	GND
15	FMC_CAM1_DO4_N	GND	CAM2_D_DATA_7_N	CAM1_GPIO9(TOUT2)	NC
16	GND	FMC_CAM1_DO6_P	GND	GND	NC
17	GND	FMC_CAM1_DO6_N	GND	CAM1_GPIO2(XHS0)	GND
18	FMC_CAM1_DO5_P	GND	CAM1_GPIO1(XVS0)	CAM1_GPIO6(SLAMODE)	NC
19	FMC_CAM1_DO5_N	GND	CAM_GPIO14	GND	NC
20	GND	NC	GND	CAM_GPIO10	GND
21	GND	NC	GND	CAM_GPIO9	NC
22	NC	GND	CAM_GPIO11	GND	NC
23	NC	GND	CAM_GPIO15	CAM3_D_CLK_0_P	GND
24	GND	NC	GND	CAM3_D_CLK_0_N	NC
25	GND	NC	GND	GND	NC
26	NC	GND	CAM_I2C_SDA	CAM3_D_DATA_3_P	GND
27	NC	GND	CAM_GPIO17	CAM3_D_DATA_3_N	NC
28	GND	NC	GND	GND	NC
29	GND	NC	GND	NC	GND
30	NC	GND	SCL	TDI	NC
31	NC	GND	SDA	TDO	NC
32	GND	NC	GND	UTIL_3V3_10A	GND
33	GND	NC	GND	NC	NC
34	NC	GND	GA0	NC	NC
35	NC	GND	NC	GA1	GND
36	GND	NC	NC	UTIL_3V3	NC
37	GND	NC	NC	GND	NC
38	NC	GND	NC	UTIL_3V3	GND
39	NC	GND	UTIL_3V3	GND	VADJ
40	GND	NC	NC	UTIL_3V3	GND

Table 7: Pinout J1 – Part2 (F-J) of FPA-ABC/XX1-V1 connector to AMD-Xilinx Development Board

PIN #	F	G	H	I	J
1	NC	GND	NC	GND	NC
2	GND	CAM2_GPIO3(XTRIG)	PRSNT_M2C_L	NC	GND
3	GND	CAM3_MCLK0	GND	NC	GND
4	NC	GND	CAM2_MCLK_0	GND	NC
5	NC	GND	CAM1_MCLK_0	GND	NC
6	GND	CAM2_D_CLK_0_P	GND	NC	GND
7	NC	CAM2_D_CLK_0_N	CAM1_GPIO8(TOUT1)	NC	NC
8	NC	GND	CAM1_GPIO10	GND	NC
9	GND	CAM2_D_DATA_3_P	GND	NC	GND
10	NC	CAM2_D_DATA_3_N	CAM2_D_DATA_0_P	NC	NC
11	NC	GND	CAM2_D_DATA_0_N	GND	NC
12	GND	CAM2_D_DATA_4_P	GND	NC	GND
13	NC	CAM2_D_DATA_4_N	CAM2_D_DATA_2_P	NC	NC
14	NC	GND	CAM2_D_DATA_2_N	GND	NC
15	GND	CAM1_RST0	GND	NC	GND
16	NC	CAM1_I2C_0_SDA(SPI_MOSI)	CAM1_GPIO11(TOUT0)	NC	NC
17	NC	GND	CAM1_GPIO7(XTRIG2)	GND	NC
18	GND	CAM1_I2C_0_SCL(SPI_SCK)	GND	NC	GND
19	NC	CAM1_GPIO3(XTRIG0)	CAM1_GPIO0(XMASTER0)	NC	NC
20	NC	GND	CAM1_GPIO17(SPI_CS)	GND	NC
21	GND	CAM3_D_CLK_1_P	GND	NC	GND
22	NC	CAM3_D_CLK_1_N	CAM3_D_DATA_2_P	NC	NC
23	NC	GND	CAM3_D_DATA_2_N	GND	NC
24	GND	CAM3_D_DATA_0_P	GND	NC	GND
25	NC	CAM3_D_DATA_0_N	CAM3_D_DATA_1_P	NC	NC
26	NC	GND	CAM3_D_DATA_1_N	GND	NC
27	GND	CAM_I2C_SCL	GND	NC	GND
28	NC	CAM2_GPIO8(TOUT1)	CAM2_RST0	NC	NC
29	NC	GND	CAM2_GPIO6(SLAMODE)	GND	NC
30	GND	CAM2_GPIO0(XMASTER0)	GND	NC	GND
31	NC	CAM2_GPIO7(XTRIG2)	CAM2_GPIO2(XHS0)	NC	NC
32	NC	GND	CAM2_GPIO1(XVS0)	GND	NC
33	GND	CAM3_I2C_0_SDA(SPI_MOSI)	GND	NC	GND
34	NC	CAM3_GPIO2(XHS0)	CAM_GPIO16	NC	NC
35	NC	GND	CAM3_I2C_0_SCL(SPI_SCK)	GND	NC
36	GND	CAM3_GPIO1(XVS0)	GND	NC	GND
37	NC	CAM3_GPIO0(XMASTER0)	CAM3_RST0	NC	NC
38	NC	GND	CAM3_GPIO3(XTRIG0)	GND	NC
39	GND	NC	GND	NC	GND
40	NC	GND	NC	GND	NC

5.1.4 Technical Drawing

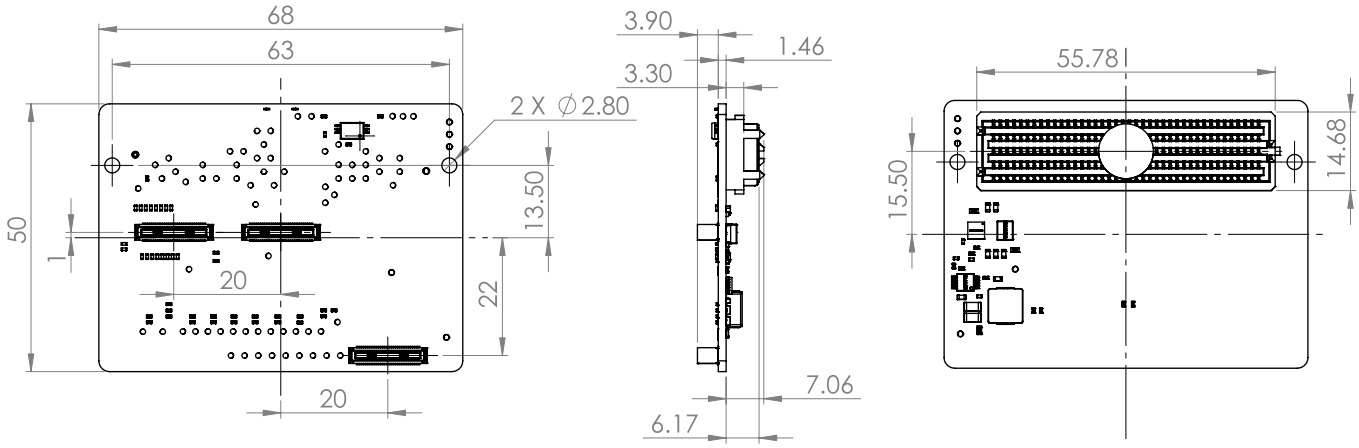


Figure 2: Technical Drawing of FPA-ABC/XX1-V1

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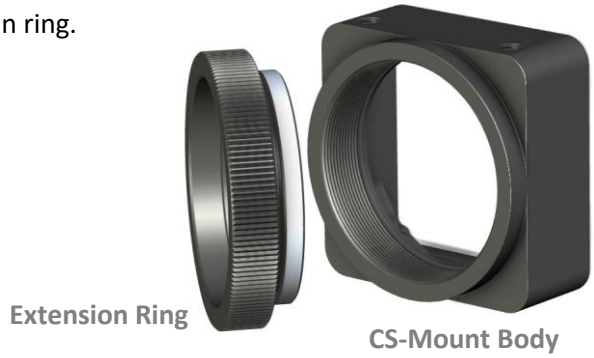
6 FRAMOS Module Accessories (FMA)

6.1 **FMA-MNT-CCS/280-V1:** C/CS-Mount for 28mm FSM Footprint

CS-mount body delivered with 5mm CS- to C-Mount extension ring.

- Lens Thread: 1-32 UN 2A
- Extension Ring: CS- to C-Type, BFD + 5 mm
- Material: AlMgSi0.5
- Finish: Black Anodizing
- Optical Filter: Not applicable



Technical Drawing

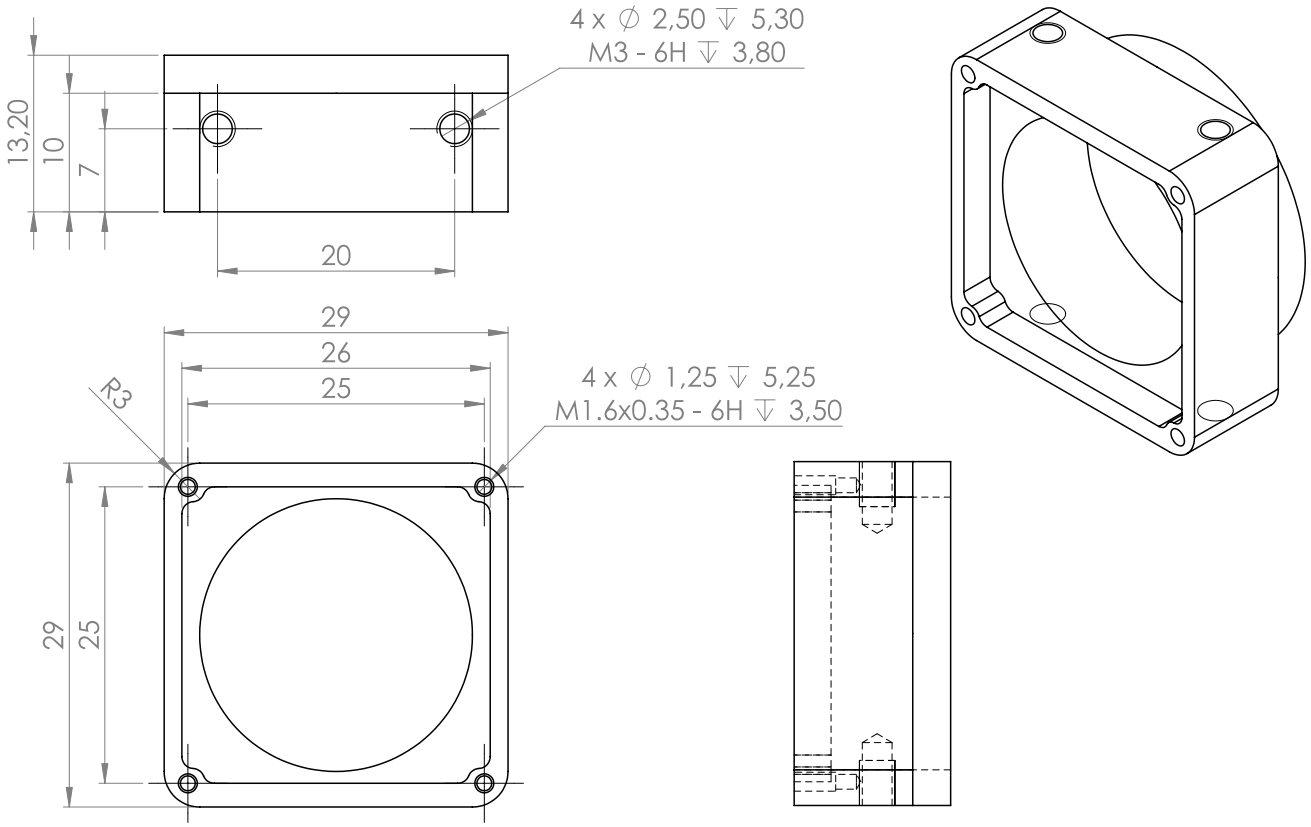


Figure 3: CS-Mount Body for 28 mm FSM

Note: The sensor specific distance of the active pixel layer to PCB and different types of sensor cover glasses might require adding a number of 0.1 mm distance rings to raise the flange height. Appropriate spacers or extension rings are not provided with the lens mount. All FSMs delivered with this mount applied are adjusted accordingly to meet the correct back focal distance by C- and CS-Mount standard using thin foils between mount and PCB.

6.2 FMA-MNT-CCS/280-IMX547C-V1A: C/CS-Mount (with IRC30) for 28mm FSM Footprint

CS-mount body for color sensors, delivered with IR Cut filter and 5 mm CS- to C-Mount extension ring.

- Lens Thread: 1-32 UN 2A
- Extension Ring: CS- to C-Type, BFD + 5 mm
- Material: AlMgSi0.5
- Finish: Black Anodizing
- Optical Filter: IRC30 (applied)

Technical Drawing

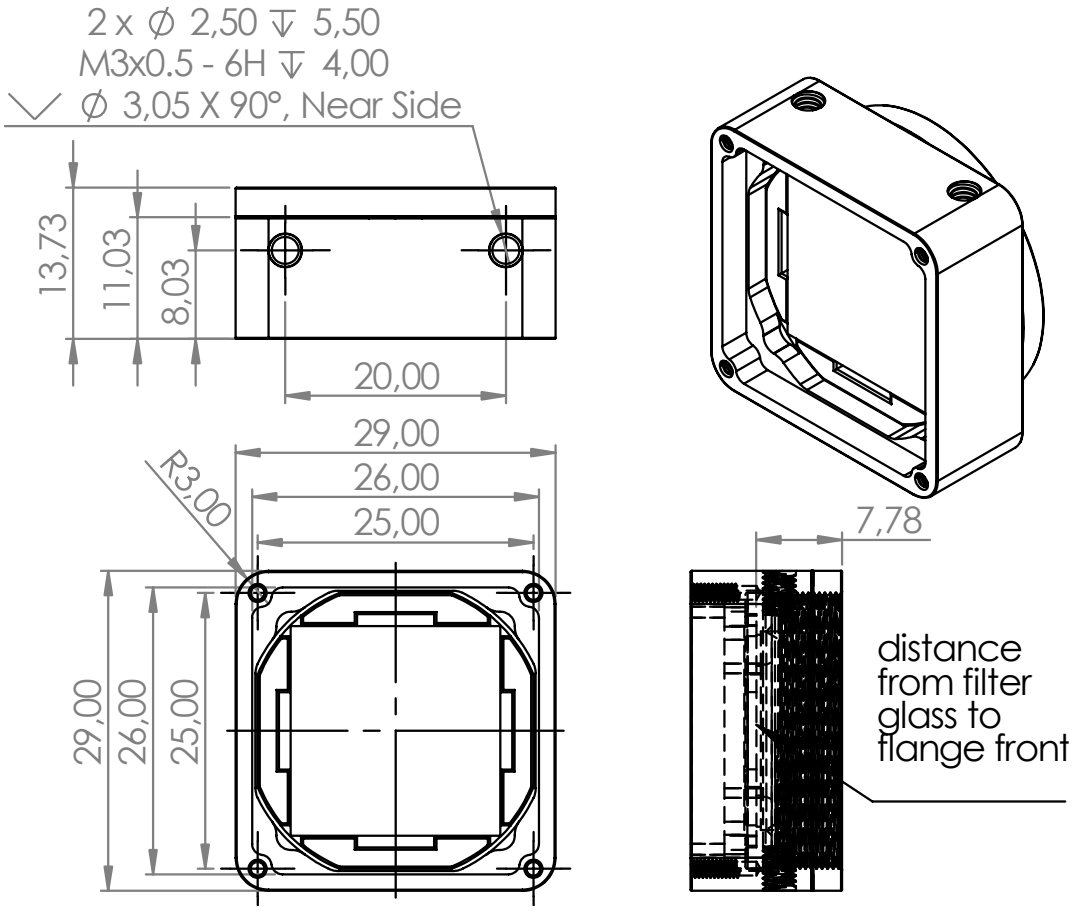
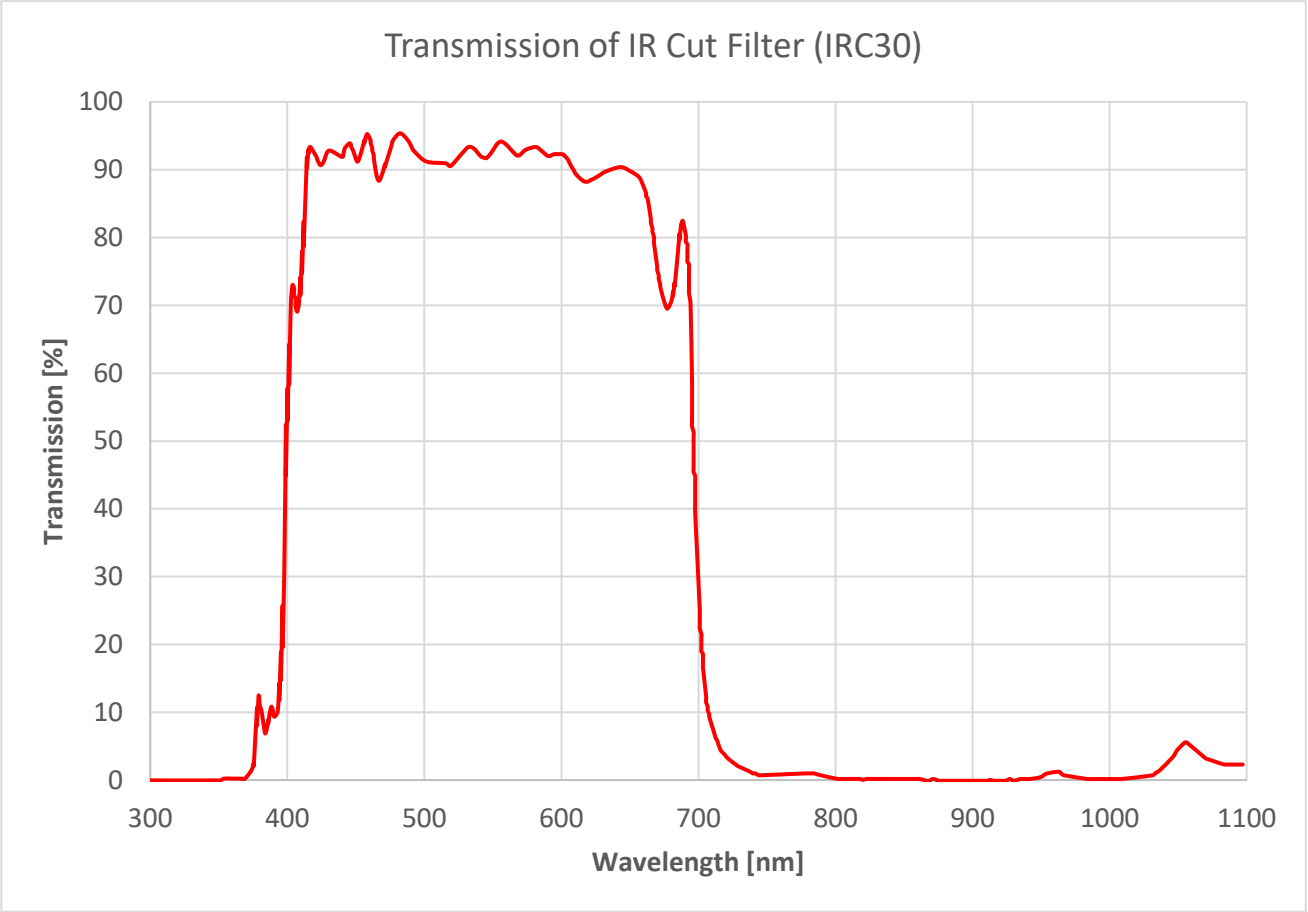


Figure 4: CS-Mount Body for 28 mm FSM

Note: The sensor specific distance of the active pixel layer to PCB and different types of sensor cover glasses might require adding a number of 0.1 mm distance rings to raise the flange height. Appropriate spacers or extension rings are not provided with the lens mount. All FSMs delivered with this mount applied are adjusted accordingly to meet the correct back focal distance by C- and CS-Mount standard using thin foils between mount and PCB.

ICR30 Optical Filter (IR Cut)

The lens mount is equipped by default with an IR cut filter glass removing the (invisible) infrared wavelengths leading to bad color representation when hitting the image sensor.

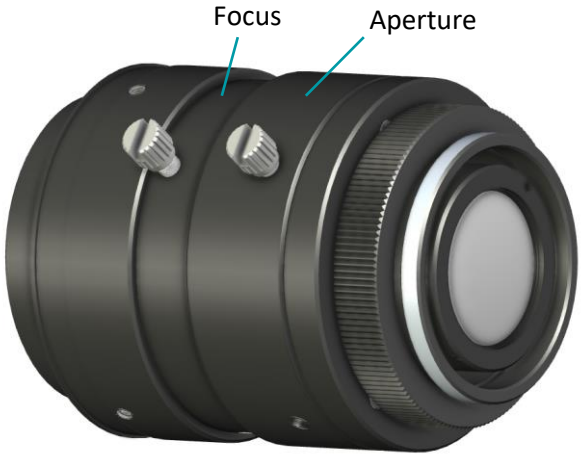


Version v1.0a from 2022-05-19

6.3 FPL-300191: C-Mount Lens (8.5mm, F1.4)

Following low distortion varifocal lens will delivered along with this kit with following properties. The lens is highly suitable for Intelligent Transportation Systems Applications.

- Mounting Standard: C-Mount, 1-32UNF
- Focal length [mm]: 8.5
- Resolution [MP]: 5
- Aperture: 1.4 - 16
- Image Circle [mm]: 9.5
- FOV @ 1/1.8" (DxHxV): 56° x 46° x 35.4°
- IR-cut coating: no IR-cut Filter
- Total Track Length [mm]: 53.68
- Focus Type: Fixed focal
- Backfocal [mm]: 9.75(in air)
- Iris Contol: Manual
- Minimum object distance [mm]: 500
- Distortion [%]: <-1%



- Working distance [mm]: 6000
- CRA [°]: 2

Technical Drawing

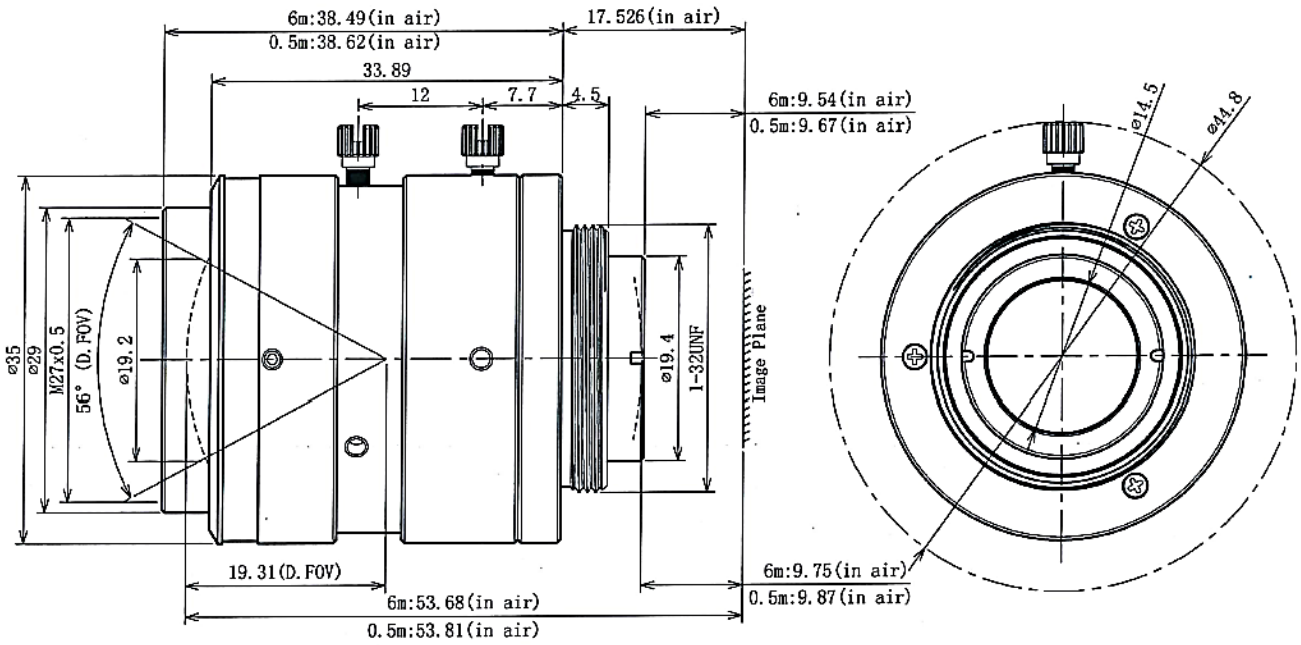


Figure 5: C-Mount Lens Type FPL-300191 for FSM-IMX547

6.4 FMA-FC-150/60-LVDS: Flex Cable for Sub-LVDS, SLVS and SLVS-EC Connections

- FSA to FPA for Sub-LVDS, SLVS and SLVS-EC connections (mandatory)
- Extension through “daisy-chaining” possible (maximum length is sensor and setup depending)
- Rigid-flex design (connectors on rigid PCBs)

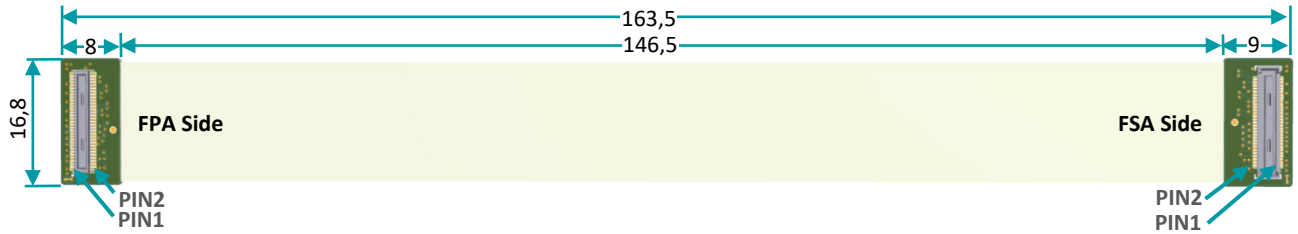
Note: Don’t use for PixelMateC™ (MIPI CSI-2) connections. Might lead to signal degradation or even damage!

Flex Cable Connectors

- FSA Side: Hirose DF40C-60DS-0.4V
- FPA Side: Hirose DF40C-60DP-0.4V
- Pin Assignment: Pin 1 to Pin 1

Technical Drawing

Top Side



Bottom Side

7 Manufacturer and Contact

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Technical Support: support@framos.com
Website: https://www.framos.com

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