FSM-IMX462 Datasheet

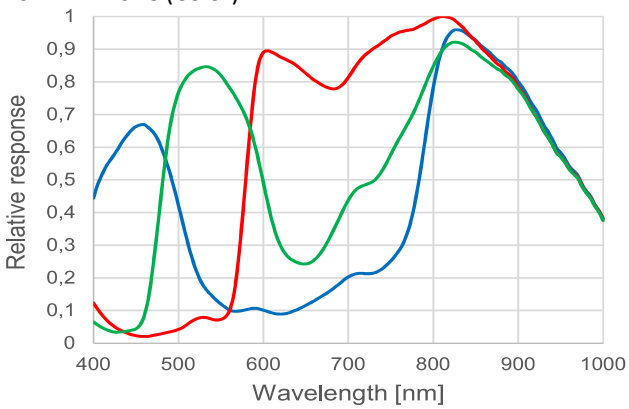
Sony IMX462LQR Sensor Module

FRAMOS Sensor Module

Key Benefits & Features:

- 2.1 Mpx Sony CMOS Rolling Shutter sensor module, ready to embed!
- All FSMs are part of a rapid prototyping ecosystem, consisting of:
  - ✓ Adapters to various processing boards
  - ✓ Design sources for deep embedding
  - ✓ Various accessories and design in services

FSM-IMX462C (Color):



Specification	
Model Name	**FSM-IMX462C** (v1)

Image Sensor	
Vendor / Name	Sony IMX462LQR
Shutter Type	CMOS Rolling Shutter
Chromaticity	Color
Optical Format	1/2.8“
Pixel Size	2.9 x 2.9 µm
Max. Resolution	2.1 Mpx / 1920 x 1080 px
Framerate (max.)	120 FPS (at full resolution)
Bit Depth(s)	10 /12 bit

Interface	
Data Interface	MIPI CSI-2 (2 / 4 Lane)
Communication Interface	I²C
Drive Frequency(s)	37.125 / 74.25 MHz
Input Voltages	1.2V, 1.8V, 2.9V
Interface Connector	Hirose DF40C-60DP-0.4V(51)
EEPROM (Sensor ID)	No

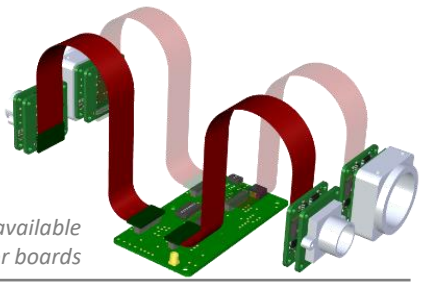
Mechanical	
Dimensions (HxWxD)	26.5 mm x 26.5 mm

Environmental	
Operating Temperature	-30°C - 85°C
Storage Temperature	-30°C - 85°C
Ambient Humidity	20% to 95% RH, non condensing

Software Support	
Driver	V4L2 Based Device Driver
Supported Platform(s)	NVIDIA Jetson TX2 / AGX Xavier
Linux Version(s)	L4T 32.2.1 (JetPack 4.2.2)
API Languages	C / C++

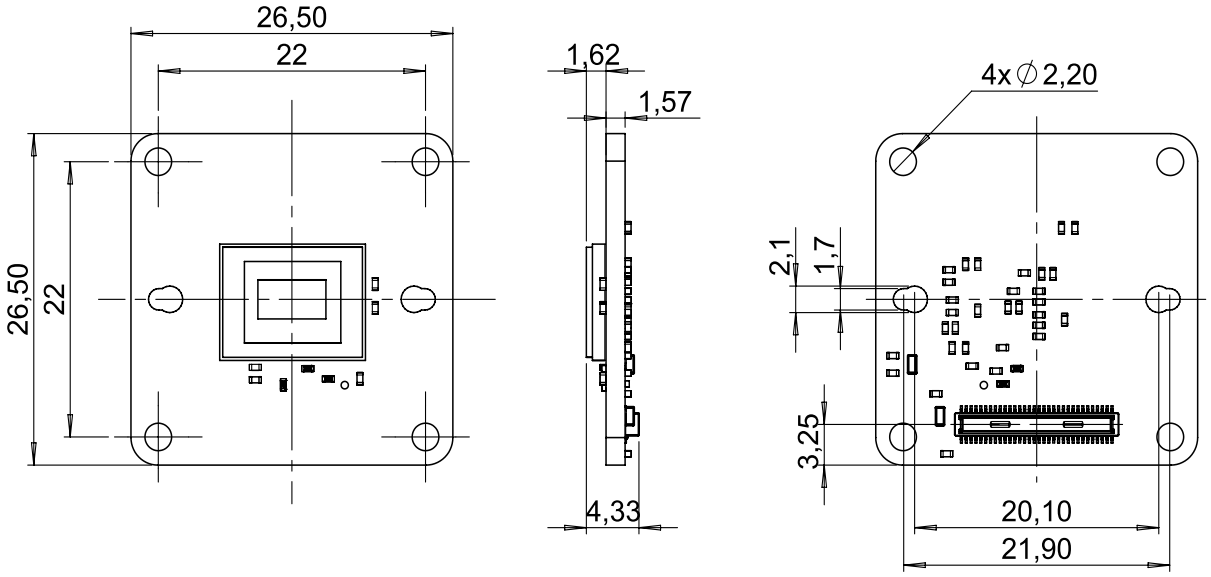
Suggested Accessories	
Flex Cable 150 mm (FSM to FSA)	FMA-FC-150/60
Lens Mounts:	M12 or C/CS-Mount options

A matrix with compatible *Sensor Adapters (FSA)* and *Processor Board Adapters (FPA)* for single- and multi-sensor setups can be found separately at the end of this document.



Development kits available for various processor boards

Mechanical Drawing



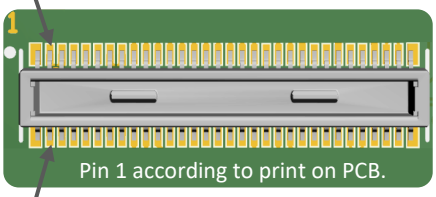
Sensor image optical center is in mechanical board center.

Connector Pinout

Type: Hirose DF40C-60DP-0.4V(51)

Mating Type: Hirose DF40HC(4.0)-60DS-0.4V(51)

Name	NC	NC	2V9	2V9	1V8	GND	GND	XCLR	NC	XMASTER	SCL	XCE	XVS	SDA	XHS	XTRIG	NC	NC	GND	INCK	NC	GND	NC	NC	GND	CSI_D0_N	CSI_D0_P	GND	CSI_D2_P	CSI_D2_N
Pin	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59



Pin	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
Name	NC	NC	1V2	1V2	NC	GND	GND	NC	SDO	NC	NC	NC	NC	NC	TENABLE	TOUT	NC	NC	GND	NC	NC	GND	CSI_D3_P	CSI_D3_N	GND	CSI_D1_N	CSI_D1_P	GND	CSI_CLK_P	CSI_CLK_N

Signals are routed directly from image sensor to connector. Details on specific signals are described in the respective image sensor datasheet.

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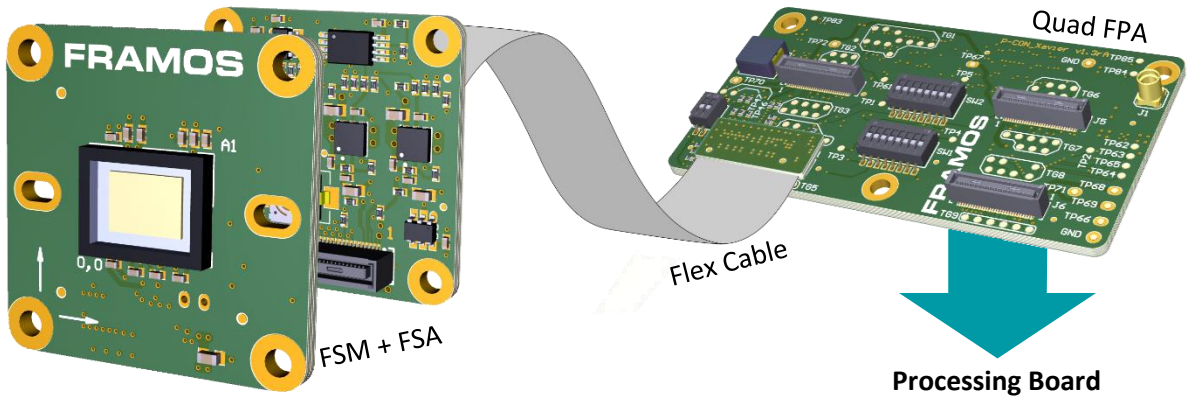
1 FRAMOS Sensor Module Ecosystem

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 NVIDIA Jetson TX2, AGX Xavier or the 96boards.org standard. Reference drivers and sample applications deliver images immediately after installation, supporting V4L2 and an optional derivate API 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.



To simplify and relieve the whole supply chain, all FRAMOS Sensor Modules and adapters are optimized and ready for delivery in volume and customization with pre-configured lens holder, lens and further accessories.

Key Benefits & Features

Hardware Offering:

- Off-the-shelf *FRAMOS Sensor Modules (FSM)*, ready for evaluation and mass production.
- Versatile adapter framework, allowing flexible testing of different modules, on different processing boards:
  - *FRAMOS Sensor Adapter (FSA)* – everything the specific sensor needs for operation
  - *FPAMOS Processor Adapter (FPA)* – connecting up to four FSM + FSA to a specific processor board
- From lenses, mechanics and cables, all needed imaging accessories from one hand

Software Package:

- Drivers providing base level sensor integration:
  - Platform specific device drivers
  - V4L2 subdevice drivers for specific image sensors (low-level C API)
- Streamlined V4L2 library (LibSV) with comfortable and generic C/C++ API
- Example application demonstrating initialization, basic configuration and image stream processing

Further to off-the-shelf hard- and software, the Ecosystem supports you 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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2 Software Package and Drivers

As FRAMOS we know that the getting started with a new technology is the biggest challenge. The idea behind the Software Pack is to enable embedded software engineers to get quickly to a streaming system and provide at the same time all tools that are needed to extend and adapt it according the individual needs of the application.

What the software package and driver are:

- A reference for a custom sensor implementation
- Demonstrating how to use the required interfaces
- Demonstrating how to communicate with the image sensor
- Demonstrating how to generaly initialize and configure the image sensor
- Provide initial image streaming output to the user space
- Demonstrating how to run basic image processing on pixel data

What it is not:

- A fully featured camera implementation (not all sensors features implemented)
- Ready to be use in the field
- A benchmark for the capabilities of the image sensor
- Focused on image processing

Supported Processor Platforms

The table below shows which platforms are supported by the standard driver package, and how many FSMs can at maximum be operated in parallel.

Sensor Module	NVIDIA Jetson TX2	NVIDIA AGX Xavier	DragonBoard 410c	96Boards Consumer Edition	Xilinx Development Boards
FSM-AR0144	4			HW only, driver development on project basis.	HW only, driver development on project basis.
FSM-AR0521	4		2		
FSM-AR1335	4				
FSM-HDP230	2	4			
FSM-IMX264	2	4			
FSM-IMX283	2	4			
FSM-IMX290	4		2		
FSM-IMX296	4		2		
FSM-IMX297	4				
FSM-IMX304	2	4			
FSM-IMX327	4		2		
FSM-IMX334	2	4			
FSM-IMX335	4				
FSM-IMX412	4		2		
FSM-IMX415	4				
FSM-IMX462	4				
FSM-IMX477	4				
FSM-IMX485	4				
FSM-IMX577	4				
FSM-IMX530	2	4			1[1]

Table 1: Ecosystem Software Package - Supported number of FSMs per processing board

[1] SLVS-EC based FPGA reference implementation as part of the SLVS-EC RX IP Core offering.

2.1 Reference Software: NVIDIA Jetson TX2, AGX Xavier

The software package provided with the Development Kits of the FRAMOS Sensor Module Ecosystem provided for NVIDIA Jetson platforms provides a reference implementation of sensor and device drivers for MIPI CSI-2. It contains a minimum feature set demonstrating how to utilize the platform specific data interface and communication implementation, as well as the initialization of the image sensor and implementation of basic features.

Package Content:

- Platform and device drivers with Linux for Tegra Support
- V4L2 based subdevice drivers (low-level C API)
- Streamlined V4L2 library (LibSV) providing generic C/C++ API
- Image Pre-Processing Examples:
    - OpenCV (Software)
    - LibArgus (Hardware)

2.1.1 Platform and Sensor Device Drivers

Image Modes – Image Format and Speeds

Their impact of several major attributes to the main configuration of the image data stream formatting, requires a static pre-configuration within the device tree:

- Image / streaming resolution
- Pixel format / bit depth
- Data rate / lane configuration

Each driver provides access to 3 – 5 pre-built configurations, reflecting the main operation modes of the imager. Beside the full resolution, that is always available, they allow to receive image streams in common video resolutions like VGA, Full HD and UHD as they are supported or make sense by the imagers, and utilize sensor features like ROI and binning.

They act as an example for implementation and usage and are available as source. Due to the size limitation of the device tree, it is not possible to integrate an extensive set of options.

General Features – Sensor Attributes

The drivers as part of the Software Pack support the sensor features as shown in the table below.

Pre-Implemented Features per Model	Gain (Analog / Digital)	Frame Rate	Exposure Time	Flip / Mirror	IS Mode (Master / Slave)	Sensor Mode ID	Test Pattern Output	Black Level	HDR Output	Broadcast	Data Rate	Synchronizing Master
FSM-AR0144												
FSM-AR0521												
FSM-AR1335												
FSM-HDP230												
FSM-IMX264												
FSM-IMX283												
FSM-IMX290												
FSM-IMX296		*										
FSM-IMX297		*										
FSM-IMX304												
FSM-IMX327												
FSM-IMX334												
FSM-IMX335												
FSM-IMX412												
FSM-IMX415												
FSM-IMX462												
FSM-IMX477												
FSM-IMX485												
FSM-IMX530												
FSM-IMX577												

Table 2: Supported sensor features on NVIDIA Jetson TX2 / AGX Xavier

V4L (libsv) and libargus
V4L (libsv)
Not Implemented

*Only supported in all pixel mode

2.1.2 Image Pre-Processing Examples

The provided image processing examples show the general mechanisms of data handling, for an image processing using 3rd-party IP. Both, the OpenCV and the LibArgus examples do not output data that is tuned for best visual experience.

LibArgus Example:

- Closed source ISP implementation
- Using hard ISP in NVIDIA SoC
- Most performant option
- Example Implementation: Full but not tuned image pipeline, Displaying

Color tuning and lens correction needs to be calibrated for every image sensor separately and depends on sensor and lens attributes as well as illumination situation.

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Image Pre-Processing Features per Model	Bad Pixel Correction	Noise Reduction	Black Level Comp.	Auto Exposure, Gain	Auto White Balance	Demosaic	Color Correction	Color Artifact Suppr.	Downscaling	Edge Enhancement
FSM-AR0144										
FSM-AR0521										
FSM-AR1335										
FSM-HDP230										
FSM-IMX264										
FSM-IMX283										
FSM-IMX290										
FSM-IMX296										
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FSM-IMX327										
FSM-IMX334										
FSM-IMX335										
FSM-IMX412										
FSM-IMX415										
FSM-IMX477										
FSM-IMX485										
FSM-IMX530										
FSM-IMX577										

Implemented
Using Default Config
Not Implemented

Table 3: Implemented LibArgus features for NVIDIA Jetson TX2 / AGX Xavier

Default Config

Image streaming is performed through the libargus pipeline, using a common configuration. It demonstrates the usage of libargus but is not optimized for the certain sensor configuration and might not lead to good image representation.

Appropriate tuning can be applied on project basis for the individual sensor and lens combination.

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OpenCV Example:

- Open software library
- Easy to use and large feature set
- Extremely performance hungry (CPU)
- Not recommended for pre-processing
- Example Implementation: Demosaicing, Displaying

Image Pre-Processing Features per Model	Bad Pixel Correction	Noise Reduction	Black Level Comp.	Auto Exposure, Gain	Auto White Balance	Demosaic	Color Correction	Color Artifact Suppr.	Downscaling	Edge Enhancement
FSM-AR0144										
FSM-AR0521										
FSM-AR1335										
FSM-HDP230										
FSM-IMX264										
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FSM-IMX412										
FSM-IMX415										
FSM-IMX477										
FSM-IMX485										
FSM-IMX530										
FSM-IMX577										

Implemented
Not Implemented

Table 4: Implemented features in OpenCV example

Due to limited performance and extreme resource utilization, it is not planned to enhance the image processing support on software side.

3 Ecosystem Compatibility Matrix

3.1 Hardware Support

The following matrix shows the compatibility of FSMs, FSAs and FPAs to each other. The FSAs differentiate to each other by supplied voltages, power up sequence, generated clock (oscillator) and physical attributes.

Sensor Modules with MIPI CSI-2 (D-PHY) Output

Item	FSM-IMX412 FSM-IMX477 FSM-IMX577	FSM-IMX290 FSM-IMX327 FSM-IMX334 FSM-IMX335 FSM-IMX462 FSM-IMX485	FSM-IMX296 FSM-IMX297	FSM-AR0521 FSM-AR1335	FSM-IMX415	FSM-IMX283	FSM-AR0144	FSM-HDP230
FSA-FT1/A	FPA-4.A/TXA FPA-2.A/96B FPA-ABC/XX1[2]							
FSA-FT3/A		FPA-4.A/TXA FPA-2.A/96B FPA-ABC/XX1[2]						
FSA-FT6/A			FPA-4.A/TXA FPA-2.A/96B FPA-ABC/XX1[2]					
FSA-FT7/A				FPA-4.A/TXA FPA-2.A/96B FPA-ABC/XX1[2]				
FSA-FT11/A					FPA-4.A/TXA FPA-2.A/96B FPA-ABC/XX1[2]			
FSA-FT12/A						FPA-4.A/TXA FPA-2.A/96B FPA-ABC/XX1[2]		
FSA-FT13/A							FPA-4.A/TXA FPA-2.A/96B FPA-ABC/XX1[2]	
FSA-FT19/A								FPA-4.A/TXA FPA-2.A/96B FPA-ABC/XX1[2]

Table 5: Ecosystem Compatibility Matrix – Native CSI-2 (D-PHY) FSMs

[2] Not verified, Xilinx Development Board with hard MIPI CSI-2 / D-PHY interface.

Sensor Modules with (Sub-) LVDS and SLVS Output

Item	Data Output (FSA)	FSM-IMX264	FSM-IMX304	FSM-IMX421	FSM-IMX530
FSA-FT14/ A-00G	MIPI CSI-2	FPA-4.A/TXA FPA-2.A/96B FPA-ABC/XX1[2]			
FSA-FT14/BC	Sub-LVDS	FPA-ABC/XX1			
FSA-FT15/A-00G	MIPI CSI-2		FPA-4.A/TXA FPA-2.A/96B FPA-ABC/XX1[2]		
FSA-FT15/BC	Sub-LVDS		FPA-ABC/XX1		
FSA-FT18/A-00G	MIPI CSI-2				FPA-4.A/TXA FPA-2.A/96B FPA-ABC/XX1[2]
FSA-FT18/BC	SLVS, SLVS-EC				FPA-ABC/XX1
FSA-FT20/BC	SLVS, SLVS-EC			FPA-ABC/XX1	

Table 6: Ecosystem Compatibility Matrix – Sub-LVDS, SLVS and SLVS-EC FSMs

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10008753 10008712 10008871 FSM-IMX462C-01S-V1A FSM-IMX462C-04G-V1A FSM-IMX462C-000-V1A