EMBEDDED IMAGE SENSOR ECOSYSTEM

Fast and Easy Vision Development from Concept to Production

Embedded Vision applications have specific vision requirements. Image sensors (IMS) are not only part of stand-alone camera systems anymore. Today, IMS are very tightly integrated with processors into heterogenous „Embedded Systems". The Framos Ecosystem of Sensor Modules and Adapters provides vision engineers and developers with ready-to-use compositions of hardware, software and reference designs to accelerate time-to-market and optimize resources.

THE FRAMOS ECOSYSTEM OF SENSOR MODULES AND ADAPTERS

Every Embedded Vision system has specific requirements that in most cases only a custom solution can solve. The integrated imaging application is realized by connecting image sensors directly to SoCs (System-on-Chip) providing outstanding efficiency, by integrating powerful micro-processors with dedicated ISP, GPU, and AI engines into one device. With the FRAMOS Embedded Vision Ecosystem of interchangeable components, vision engineers and developers can quickly and easily connect those components and develop their products from concept to market.

THIS SYSTEM IS MORE THAN SIMPLY AN OFF-THE-SHELF PRODUCT

- Large lineup of Sony, ON Semiconductor, and Pyxalis image sensors on modules based on one connection standard
- Sophisticated adapter concept allows connections to every sensors and processors in the Ecosystem
- Ready-to-use demo drivers for selected lead platforms providing images immediately
- Electrical and software sources allow the design by well-known and reliable references
- Standard or customized sensor boards and assemblies, which simplify your production
- Strong partner network supporting your implementation from brick to complete solution - it's up to you to decide, which support you need.

PROMPTLY GET TO A WORKING PROOF OF CONCEPT

FRAMOS provides you with the glue and logic needed to put your vision-based building blocks together and accompanies your entire development process from concept to mass production and beyond.

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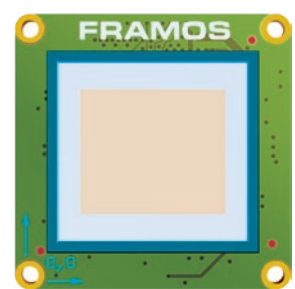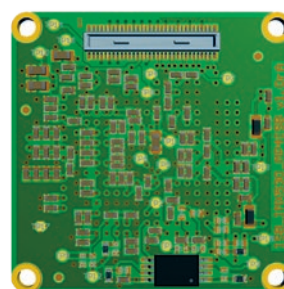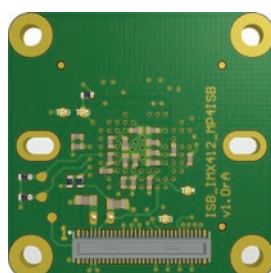| Sensor Module	Sensor Module Adapter		Processor Board Adapter	Processing Board
FSM	FSA		FPA	
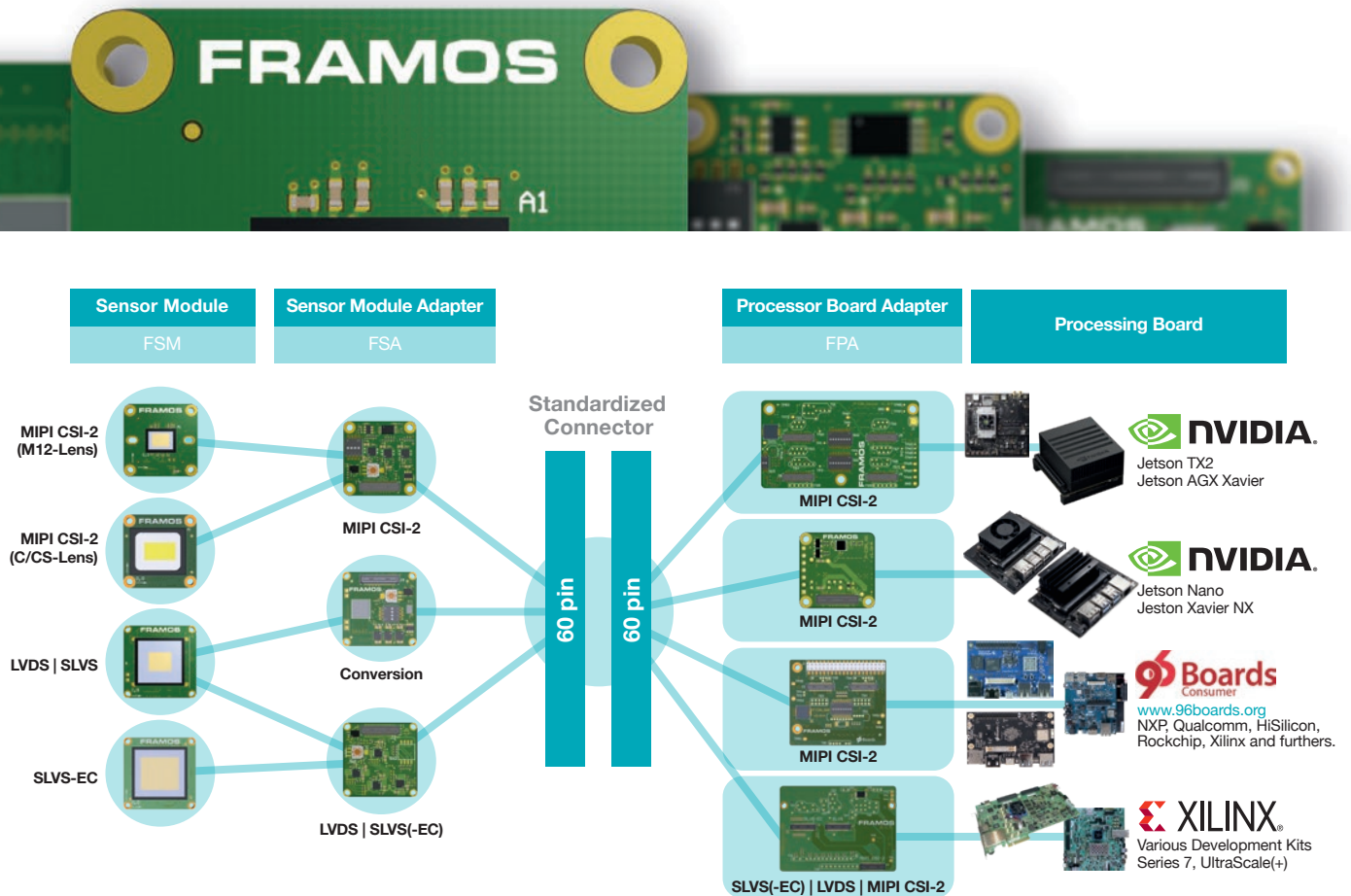
FRAMOS SENSOR MODULES (FSM)

Electrical engineers design hardware, but most of them underestimate the difficulties of integrating image sensors as they require specific digital and analog design know-how. The speed of their design process depends on their experience with imagers especially in the analog domain, as it defines the robustness and grade of the image quality. Respins of new sensor designs, which means producing hardware each time, are unpredictable in that process. Each loop takes a couple of weeks or months to localize the source of an unwanted behavior, redesign hardware, produce it, and repeat testing.

FRAMOS provides sensors on modules with standardized connectors and mechanical design. The design is based on almost 20 years of camera design experience. Each module has been fully tested and is verified by several customers. It contains all components required at the imager. Power generation, clock generation, and trigger logic are separated. This allows the customer to decide where this part is positioned within the system, and to protect the sensor from heat and disturbances.
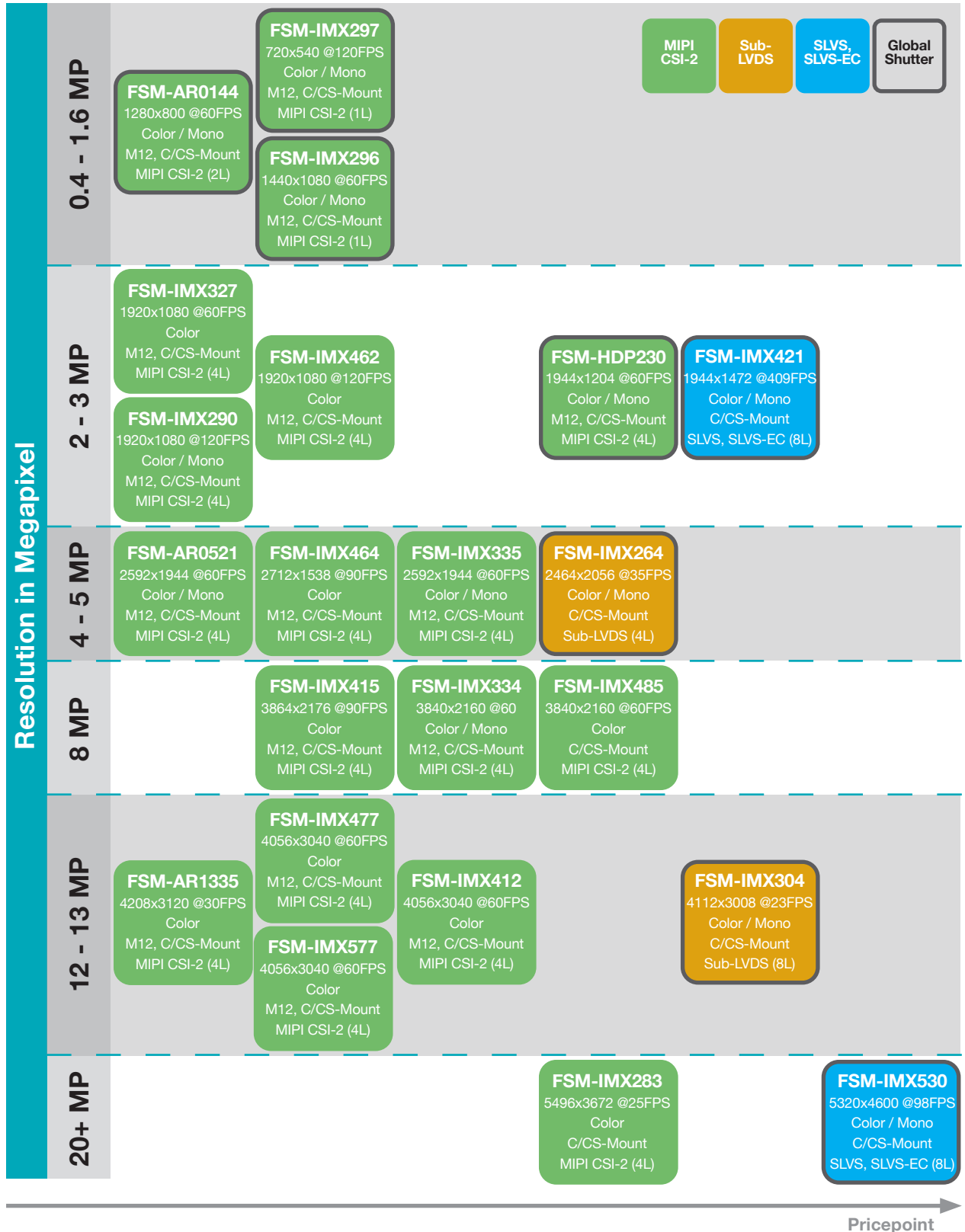
KEY BENEFITS

- **Image sensors on PCB** with connector, off-the-shelf
- **Large lineup** with resolutions from 0.4 to 24 MP rolling shutter and global shutter imagers
- **All sensors available with MIPI CSI-2** (D-PHY) output
- **Converter boards for SubLVDS and SLVS** imagers
- Standardized mechanics featuring **small footprints** of 26.5 x 26.5 mm² and 28 x 28 mm²

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FRAMOS SENSOR MODULE LINEUP

Resolution in Megapixel

Legend
MIPI CSI-2
Sub-LVDS
SLVS, SLVS-EC
Global Shutter

0.4 - 1.6 MP

FSM-AR0144
1280x800 @60FPS
Color / Mono
M12, C/CS-Mount
MIPI CSI-2 (2L)

FSM-IMX297
720x540 @120FPS
Color / Mono
M12, C/CS-Mount
MIPI CSI-2 (1L)

FSM-IMX296
1440x1080 @60FPS
Color / Mono
M12, C/CS-Mount
MIPI CSI-2 (1L)

2 - 3 MP

FSM-IMX327
1920x1080 @60FPS
Color
M12, C/CS-Mount
MIPI CSI-2 (4L)

FSM-IMX290
1920x1080 @120FPS
Color / Mono
M12, C/CS-Mount
MIPI CSI-2 (4L)

FSM-IMX462
1920x1080 @120FPS
Color
M12, C/CS-Mount
MIPI CSI-2 (4L)

FSM-HDP230
1944x1204 @60FPS
Color / Mono
M12, C/CS-Mount
MIPI CSI-2 (4L)

FSM-IMX421
1944x1472 @409FPS
Color / Mono
C/CS-Mount
SLVS, SLVS-EC (8L)

4 - 5 MP

FSM-AR0521
2592x1944 @60FPS
Color / Mono
M12, C/CS-Mount
MIPI CSI-2 (4L)

FSM-IMX464
2712x1538 @90FPS
Color
M12, C/CS-Mount
MIPI CSI-2 (4L)

FSM-IMX335
2592x1944 @60FPS
Color / Mono
M12, C/CS-Mount
MIPI CSI-2 (4L)

FSM-IMX264
2464x2056 @35FPS
Color / Mono
C/CS-Mount
Sub-LVDS (4L)

8 MP

FSM-IMX415
3864x2176 @90FPS
Color
M12, C/CS-Mount
MIPI CSI-2 (4L)

FSM-IMX334
3840x2160 @60
Color / Mono
M12, C/CS-Mount
MIPI CSI-2 (4L)

FSM-IMX485
3840x2160 @60FPS
Color
C/CS-Mount
MIPI CSI-2 (4L)

12 - 13 MP

FSM-AR1335
4208x3120 @30FPS
Color
M12, C/CS-Mount
MIPI CSI-2 (4L)

FSM-IMX477
4056x3040 @60FPS
Color
M12, C/CS-Mount
MIPI CSI-2 (4L)

FSM-IMX577
4056x3040 @60FPS
Color
M12, C/CS-Mount
MIPI CSI-2 (4L)

FSM-IMX412
4056x3040 @60FPS
Color
M12, C/CS-Mount
MIPI CSI-2 (4L)

FSM-IMX304
4112x3008 @23FPS
Color / Mono
C/CS-Mount
Sub-LVDS (8L)

20+ MP

FSM-IMX283
5496x3672 @25FPS
Color
C/CS-Mount
MIPI CSI-2 (4L)

FSM-IMX530
5320x4600 @98FPS
Color / Mono
C/CS-Mount
SLVS, SLVS-EC (8L)

Pricepoint →

EMBEDDED IMAGE SENSOR ECOSYSTEM

ADAPTERS IN THE FRAMOS ECOSYSTEM

It is key for a project's success to start verification of the individual software application as early as possible using actual hardware. In any vision system, this hardware is primarily the image sensing part, combined with a processing part which is able to run the customer's implementation. However, different applications have different requirements for these components and need easy scoping and quick adjustment of the components where needed.

Hardware re-designs consume a lot of resources and time and can put the whole project at risk. Thus, one significant part of the FRAMOS Embedded Ecosystem is the accessibility of adapters for a large variety of sensor-processor combinations. They act as a glue and are at one time off-the-shelf connectivity and proven reference design for later phases. Therefore, main function groups are split into two separate boards:

- FRAMOS Sensor Adapters (FSA)
- FRAMOS Processor Adapters (FPA)
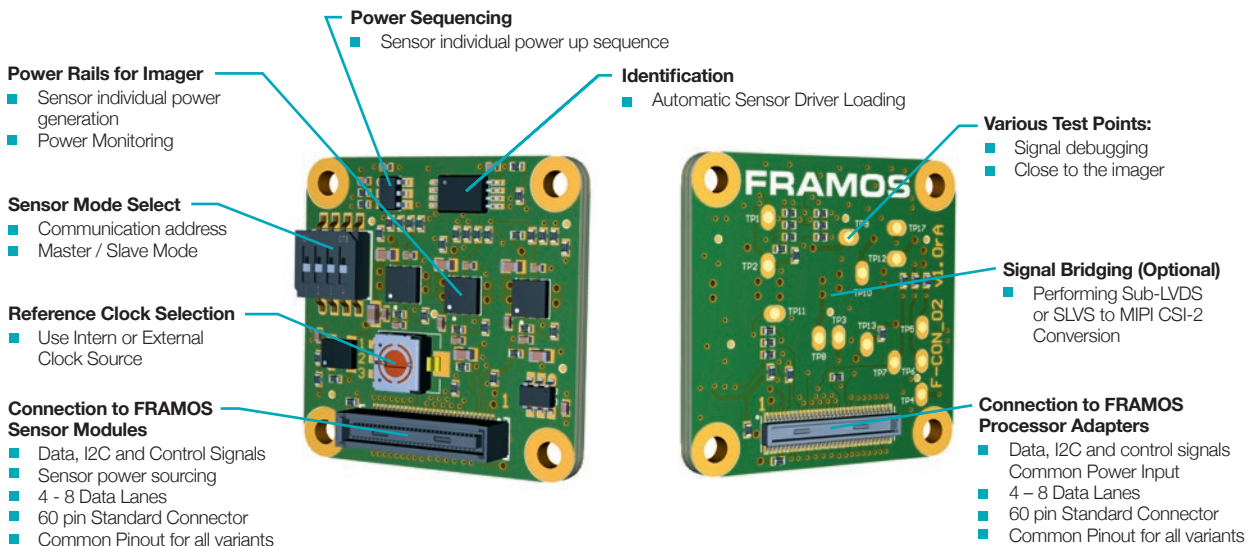
SENSOR RELATED FUNCTIONS BY FSA

FRAMOS Sensor Adapters (FSA) feature individual voltages, reference clocks, and processing functions like data conversion and signal processing. Therefore, they can be implemented by the customer at any point in the final system; individually, close to the sensor, on the processor board, or mixed in different ways.

- Contain periphery required to operate imagers
- Stacked piggyback to FRAMOS Sensor Module (FSM)
- Multiple sensors share the same FSA type
- Options with SubLVDS and SLVS to MIPI CSI-2 (D-PHY) conversion

KEY BENEFITS

- **Better results** - less impact on image quality by neighboring components
- **Less redundancy** - customer can place the module on their mainboard and use existing resources; proofed electrical references are provided
- **Flexibility** - customer can add further functionality without touching the sensor implementation
- **"All-on-one-board customization"** - is possible as soon as the design concept has been fixed by the customer

FRAMOS SENSOR ADAPTERS (FSA)

Power Sequencing
- Sensor individual power up sequence

Power Rails for Imager
- Sensor individual power generation
- Power Monitoring

Identification
- Automatic Sensor Driver Loading

Various Test Points:
- Signal debugging
- Close to the imager

Sensor Mode Select
- Communication address
- Master / Slave Mode

Reference Clock Selection
- Use Intern or External Clock Source

Signal Bridging (Optional)
- Performing Sub-LVDS or SLVS to MIPI CSI-2 Conversion

Connection to FRAMOS Sensor Modules
- Data, I2C and Control Signals
- Sensor power sourcing
- 4 - 8 Data Lanes
- 60 pin Standard Connector
- Common Pinout for all variants

Connection to FRAMOS Processor Adapters
- Data, I2C and control signals Common Power Input
- 4 – 8 Data Lanes
- 60 pin Standard Connector
- Common Pinout for all variants

EMBEDDED IMAGE SENSOR ECOSYSTEM

PROCESSOR BOARD CONNECTIVITY BY FPA

FRAMOS Processor Adapters (FPA) cover individual connectors, signals, voltages, and communication channels to 3rd-party processor boards. This adapter (an individual part) is the reference to implement the image sensing front-end into the customer central processing system. The FPA boards make it plug and play to use the sensor module portfolio to work with a large number of processor boards, providing ecosystem standard interface on various processor boards.

SUPPORTED PROCESSOR DEVELOPMENT KITS

FRAMOS Processor Adapters with MIPI CSI-2 routing are provided off-the-shelf for the NVIDIA® Jetson™ TX2, Jetson AGX Xavier™, Jetson Nano™, and Jetson Xavier™ NX developer kits, as well as for the 96Boards Consumer Edition ecosystem with its over 16 single board computers. Further, a Xilinx specific FMC adapter establishes SubLVDS, SLVS, SLVS-EC and MIPI CSI-2 connectivity to a number of Xilinx development boards.

FRAMOS PROCESSOR ADAPTERS (FPA)

Up to four Individual Sensor Ports
All signals are available on each port
- Generic Power Supply
- 4 - 8 Data Lanes
- Reference Clock
- Synchronization Signals
- Communication (I2C / SPI)
- Further GPIOs

Test Points for All Relevant Signals
- Clocks, Synchronization Signals
- Communication
- Further GPIOs

External Trigger Input Line
- Optionally equipped

Configurable EEPROM
- Hardware Identifier
- Enable / Disable / Protect

Synchronize sensors
- Interconnect sync signals of multiple imagers
- Includes: XVS, XHS, MCLK
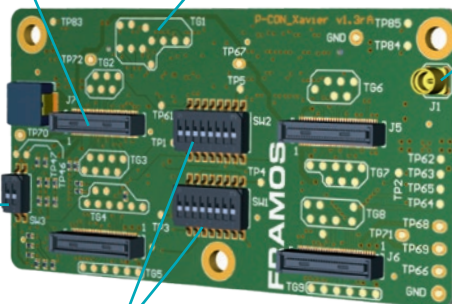
Processor Board Specific Connector
- FPA Lineup for Multiple Platforms
- Routing all relevant signals
- Adjusted for the capabilities of each board

Main Power Rails
- Sourcing FSAs with processor board independent voltages

Master Clock Signaling
- Drive multiple sensors with one or two clock sources
- Ensure highest signal integrity

I2C Multiplexing
- Individual addressing of multiple sensors via one I2C bus
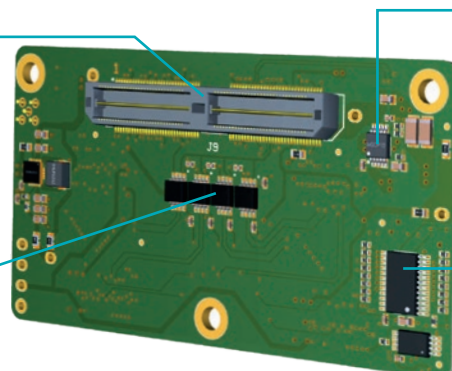
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SOFTWARE SUPPORT

With the hardware in place, there is still one significant, but often underestimated element missing, until one sees the first image on screen, or can even use it with his algorithms; the device driver. Working with proprietary hardware interfaces on both sensor and processor platform side requires solid know-how and time to understand and use the individual underlying architecture. Establishing communication and basic data streams is only the first difficult step, adding up with the complex sensor initialization sequences, and configuration scripts for every single feature. As a result, tuning the sensor settings for an immaculate image can become an issue and require a lot of time.

ECOSYSTEM SOFTWARE PACKAGE

To support a smooth start and unburden developers from starting from scratch, the Software Pack, along with the ecosystem, provides reference drivers for all sensors on selected processor platforms. The focus is to enable a quick start demonstrating the implementation of the fundamental functions that are required to utilize the sensor and receive one or multiple image streams. The application specific finalization of the driver can then happen seamlessly on project base by the customer or FRAMOS, extending or porting the Software Pack utilizing the provided driver sources.

PLATFORM SUPPORT

Lead platform for all driver activities are the NVIDIA® Jetson™ TX2, Jetson AGX Xavier™, Jetson Nano™, and Jetson Xavier™ NX developer kits. Drivers for further platforms already exist and are available on request or can be designed on project basis.

Linux for Tegra environment streaming

DEVELOPMENT KIT

The FRAMOS Module Ecosystem consists of a large number of modules, adapters, and accessories. To start right away, we provide several development kits which include everything that is needed for a smooth startup. On request, this basic list can be individually extended by additional components:

- One or multiple FRAMOS Sensor Module(s) with M12 or C/CS lens with mount
- FRAMOS Sensor Adapter for the selected sensor module(s)
- FRAMOS Processor Adapter for up to four modules on a specified platform
- Accessories per sensor module (150 mm Flex Cable, 1/4" Tripod Adapter)
- Download of binary Software Pack

x1 (Single), x2 (Dual) or x4 (Quad)   x1 (Single, Dual and Quad)

+ Software Download
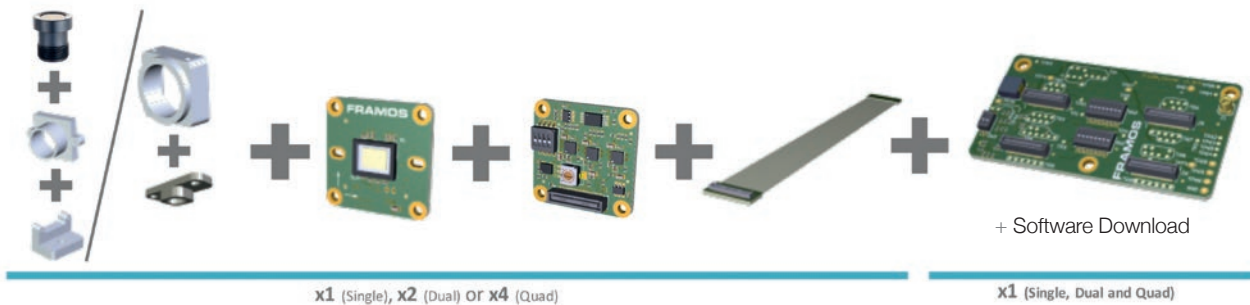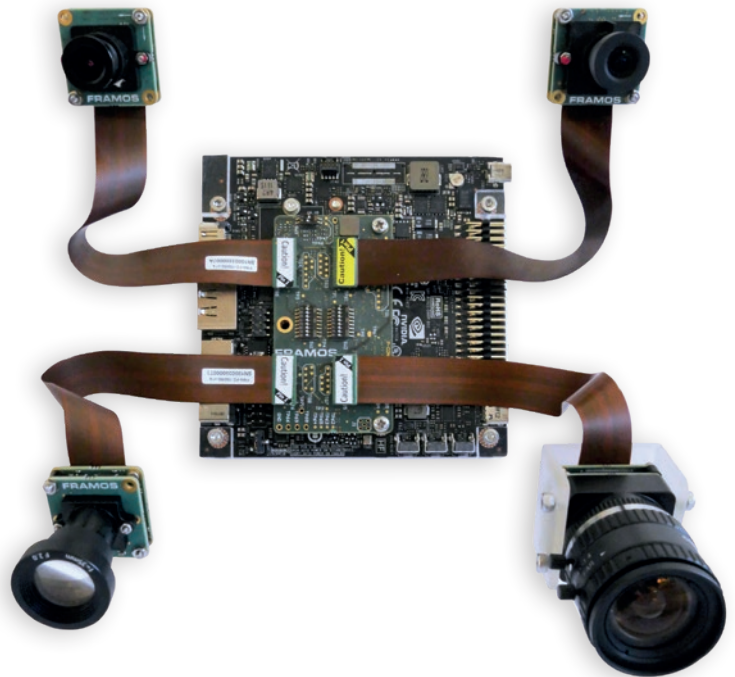
SOFTWARE PACK CONTENTS

- Device drivers for the MIPI CSI-2 interface (processor board) supporting image streaming and fundamental sensor features
- Sub-device drivers for the image sensor, featuring communication, initialization, streaming, and basic configuration in master mode, multiple presets for resolution and pixel format as well as access to integration time, gain, and sensor mode

- Basic image processing example for color imagers (software and Libargus)
- Source code and built environment

EMBEDDED IMAGE SENSOR ECOSYSTEM

FRAMOS' EMBEDDED VISION SERVICES

- **Unbiased Consulting** - provided by industry experts who listen and understand your requirements and find the right solutions.

- **Analysis of Requirements** - to choose right vision components and provide guidance in selecting the best sensor, optics and interface.

- **Product Selection Support** - for navigating our diverse supplier network to match their products with your requirements.

- **Measurements & Testing** - services that evaluate and compare image sensors

- **Evaluation Boards & RDK's** - assist in understanding how to design sensors into your vision system.

- **Rapid Prototyping** - for assessing and comparing various options and solutions that with parallelizing development.

- **Experienced Design-in Support** - assists during development by answering questions and providing the necessary data, test measurements and development tools needed to create a vision system.

- **Custom Designs** - Our engineering team can be your trusted development partner for an individual approach to sensor modules, IP and SoC solutions. We support you in customizing existing solutions or completely developing new solutions tailor-made for your embedded vision system.

With its practical industry and project experience, Framos serves their clients as a technical consultant, development partner, and external supplier enabling our customers to develop cutting-edge imaging solutions while shortening their times to market.

STANDARD OFF-THE-SHELF CUSTOMIZED OR FULL CUSTOM DESIGN!
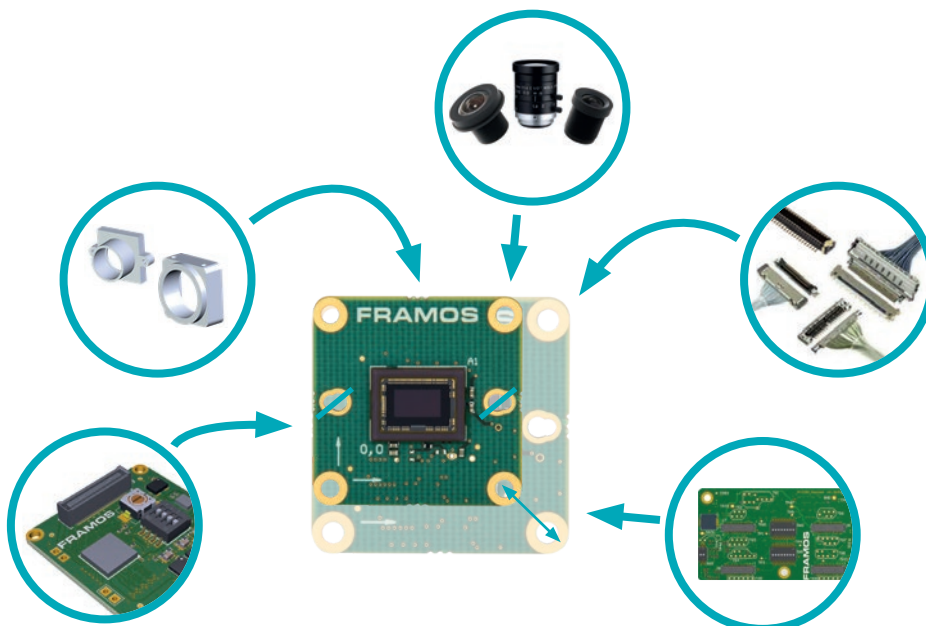
CONTACT

If you have additional questions about this technology or how it would benefit you, our FRAMOS imaging experts are available to answer any questions. We can be reached at: info@framos.com