



# FSM-AR1335 Datasheet

ON Semiconductor AR1335CSSC11SMKA0-CP Sensor Module

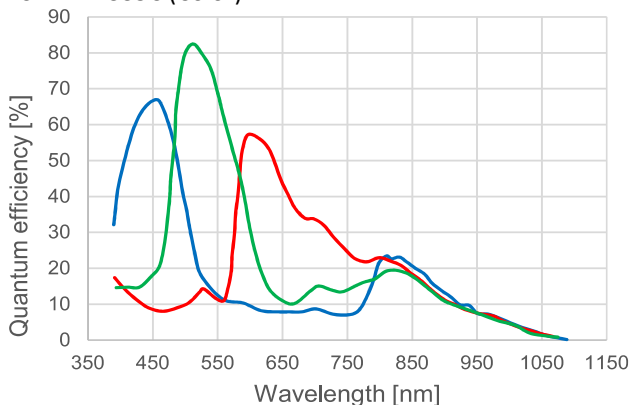
## FRAMOS Sensor Module



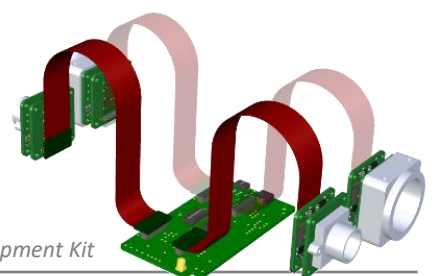
### Key Benefits & Features:

- 13.1 Mpx ON Semiconductor 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-AR1335C (Color):

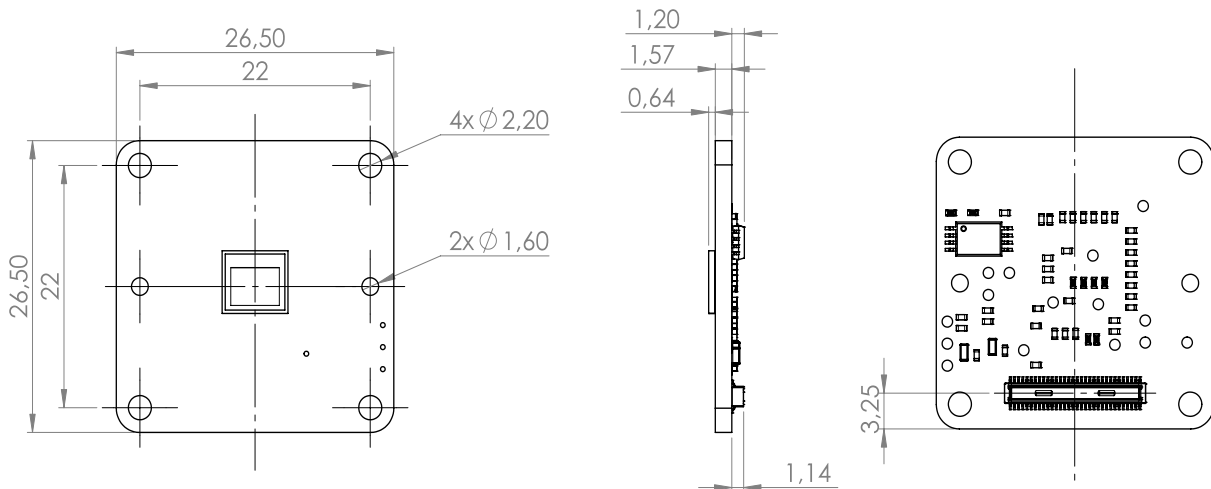


| Specification                                                                                                                                                                            |                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| Model Name                                                                                                                                                                               | FSM-AR1335C (v1a)                     |
| Image Sensor                                                                                                                                                                             |                                       |
| Vendor / Name                                                                                                                                                                            | ON Semiconductor AR1335CSSC11SMKA0-CP |
| Technology                                                                                                                                                                               | CMOS Rolling Shutter                  |
| Chromaticity                                                                                                                                                                             | Color                                 |
| Optical Format                                                                                                                                                                           | 1/3.2"                                |
| Pixel Size                                                                                                                                                                               | 1.1 x 1.1 µm                          |
| Max. Resolution                                                                                                                                                                          | 13.1 Mpx / 4208 x 3120 px             |
| Framerate (max.)                                                                                                                                                                         | 30 FPS (at max. resolution)           |
| Bit Depth(s)                                                                                                                                                                             | 10 bit                                |
| Interface                                                                                                                                                                                |                                       |
| Module Interface                                                                                                                                                                         | MIPI CSI-2 (2 / 4 Lane)               |
| Control Interface                                                                                                                                                                        | I <sup>2</sup> C                      |
| Clock Frequency(s)                                                                                                                                                                       | 6 to 48 MHz                           |
| Voltage Requirements                                                                                                                                                                     | 1.2V / 1.8V / 2.7V                    |
| Interface Connector                                                                                                                                                                      | Hirose DF40C-60DP-0.4V(51)            |
| EEPROM (Sensor ID)                                                                                                                                                                       | Yes                                   |
| Mechanical                                                                                                                                                                               |                                       |
| Dimensions (HxWxD)                                                                                                                                                                       | 26.5 mm x 26.5 mm                     |
| Environmental                                                                                                                                                                            |                                       |
| Operating Temperature                                                                                                                                                                    | -30°C to +70°C                        |
| Storage Temperature                                                                                                                                                                      | -40°C to +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 <i>Sensor Adapters (FSA)</i> and <i>Processor Board Adapters (FPA)</i> for single- and multi-sensor setups can be found separately at the end of this document. |                                       |



Available in Development Kit

## Mechanical Drawing



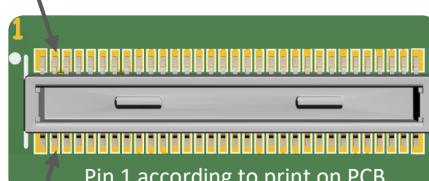
Sensor image optical center is in mechanical board center.

## Connector Pinout

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

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

| Name | NC | NC | 2V7_A | 2V7_A | 1V8_IO | GND | GND | RESETn | NC | NC | SCL | NC | TRIGGER | SDA | NC | NC | NC | SLAMODE | GND | EXTCLK | 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 1 according to print on PCB.

| 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 | 1V8 | 1V8 | 1V2_D | 1V2_D | NC | GND | GND | NC | NC | SHUTTER | NC | NC | NC | NC | NC | FLASH | 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 |

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



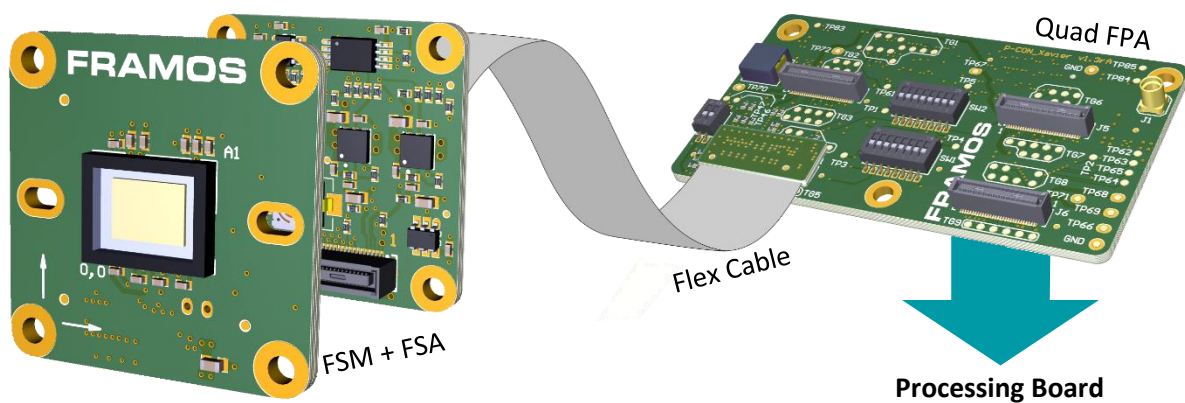
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## 1 FRAMOS Sensor Module Ecosystem

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, with no effort. Exemplary drivers and sample applications deliver images immediately after installation, supporting V4L2 and an own optional API for 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 massively simplify and relieve the whole supply chain, all FRAMOS Sensor Modules and adapters are optimized and ready for delivery in volume, pre-configured with 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
  - *FRAMOS 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 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!

## 2 Ecosystem Compatibility Matrix

### 2.1 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.

#### FSMs with MIPI CSI-2 (D-PHY) Output

| Item                                    | Clock on FSA | FSM-IMX412<br>FSM-IMX477<br>FSM-IMX577 | FSM-IMX290<br>FSM-IMX327<br>FSM-IMX334<br>FSM-IMX335 | FSM-IMX296<br>FSM-IMX297 | FSM-AR0521<br>FSM-AR1335 | FSM-IMX415  | FSM-IMX283  | FSM-AR0144  |
|-----------------------------------------|--------------|----------------------------------------|------------------------------------------------------|--------------------------|--------------------------|-------------|-------------|-------------|
| Single-/Multi-Sensor Setup              |              |                                        |                                                      |                          |                          |             |             |             |
| FSA-FT1/A                               | 27MHz        | FPA-4.A/TXA                            |                                                      |                          |                          |             |             |             |
| FSA-FT3/A                               | 37.125MHz    |                                        | FPA-4.A/TXA                                          |                          |                          |             |             |             |
| FSA-FT6/A                               | 37.125MHz    |                                        |                                                      | FPA-4.A/TXA              |                          |             |             |             |
| FSA-FT7/A                               | 27MHz        |                                        |                                                      |                          | FPA-4.A/TXA              |             |             |             |
| FSA-FT11/A                              | 37.125MHz    |                                        |                                                      |                          |                          | FPA-4.A/TXA |             |             |
| FSA-FT12/A                              | 24MHz        |                                        |                                                      |                          |                          |             | FPA-4.A/TXA |             |
| FSA-FT13/A                              | 27MHz        |                                        |                                                      |                          |                          |             |             | FPA-4.A/TXA |
| Single-Sensor Setup (96boards.org only) |              |                                        |                                                      |                          |                          |             |             |             |
| FSA-FT1                                 | 27MHz        | FPA-96B-FT1                            |                                                      |                          |                          |             |             |             |
| FSA-FT3                                 | 37.125MHz    |                                        | FPA-96B-FT1                                          |                          |                          |             |             |             |
| FSA-FT6                                 | 37.125MHz    |                                        |                                                      | FPA-96B-FT1              |                          |             |             |             |
| FSA-FT7                                 | 27MHz        |                                        |                                                      |                          | FPA-96B-FT1              |             |             |             |
| FSA-FT11                                | 37.125MHz    |                                        |                                                      |                          |                          | FPA-96B-FT1 |             |             |
| FSA-FT12                                | 24MHz        |                                        |                                                      |                          |                          |             | FPA-96B-FT1 |             |

Table 1: Ecosystem Compatibility Matrix – Native CSI-2 (D-PHY) FSMs

## 2.2 Software & Driver Support

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

| Sensor Module | NVIDIA Jetson TX2 <sup>1</sup> | NVIDIA AGX Xavier <sup>1</sup> | DragonBoard 410c      | 96boards.org Consumer Edition                 |
|---------------|--------------------------------|--------------------------------|-----------------------|-----------------------------------------------|
| FSM-AR0144    | 1, 2, 3, 4                     |                                |                       | HW only, driver development on project basis. |
| FSM-AR0521    | 1, 2, 3, 4                     |                                | 1                     |                                               |
| FSM-AR1335    | 1, 2, 3, 4                     |                                |                       |                                               |
| FSM-HDP230    | 1, 2                           | 1, 2, 3, 4                     |                       |                                               |
| FSM-IMX283    | 1, 2                           | 1, 2, 3, 4                     |                       |                                               |
| FSM-IMX290    | 1, 2, 3, 4                     |                                | 1                     |                                               |
| FSM-IMX296    | 1, 2, 3, 4                     |                                | 1                     |                                               |
| FSM-IMX297    | 1, 2, 3, 4                     |                                |                       |                                               |
| FSM-IMX327    | 1, 2, 3, 4                     |                                | 1                     |                                               |
| FSM-IMX334    | 1, 2                           | 1, 2, 3, 4                     |                       |                                               |
| FSM-IMX335    | 1, 2, 3, 4                     |                                |                       |                                               |
| FSM-IMX412    | 1, 2, 3, 4                     |                                | 1                     |                                               |
| FSM-IMX415    | 1, 2, 3, 4                     |                                |                       |                                               |
| FSM-IMX462    | 1, 2, 3, 4                     |                                |                       |                                               |
| FSM-IMX477    | 1, 2, 3, 4                     |                                | 1 (via IMX412 driver) |                                               |
| FSM-IMX577    | 1, 2, 3, 4                     |                                | 1 (via IMX412 driver) |                                               |

Table 2: Ecosystem Software Package - Supported number of FSMs per processing board

<sup>1</sup> The NVIDIA Jetson driver package contains driver binaries for V4L2 (software processing) and the Libargus ISP pipeline.