RESTAR FRAMOS TECHNOLOGIES

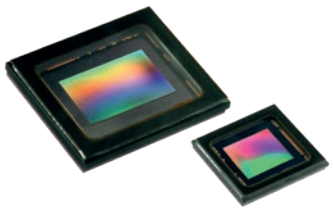



SENSOR INSIGHTS:

Sony's Pregius Technology – CMOS Global Shutter

The State of the Art in Machine Vision Image Sensors

SONY



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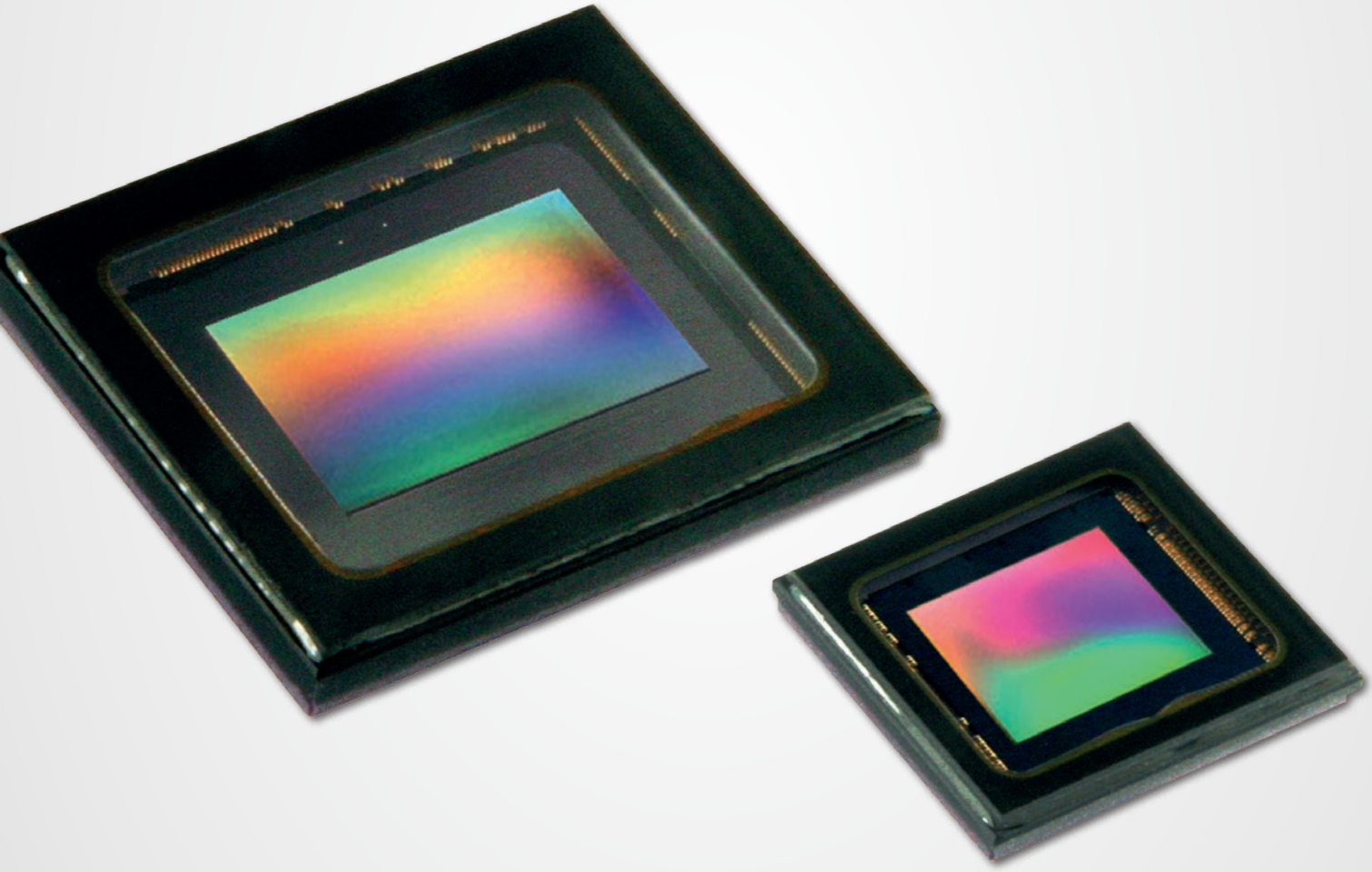
Introduction to the Sony's Pregius Technology Series



THE LAUNCH OF THE SONY'S PREGIUS TECHNOLOGY SERIES IN LATE 2013 MARKED A MILESTONE IN THE HISTORY OF IMAGE SENSORS.

Its outstanding performance, success, and large consumer capacity were among some of the triggers resulting in Sony's decision to shut down their CCD sensor development and production, despite their technology and market leadership. The Pregius technology series combines the image quality from its technology with high readout speeds, an electronic global shutter.

Thanks to latest advances in wafer production techniques and pixel design, today's professional grade CMOS image sensors outperform CCD's in both speed and image quality. They are now also capable to start and stop the light exposure time for all pixels simultaneously, (known as global shutter). CMOS sensor technology has continued to evolve with unprecedented advances in resolution, frame rate, sensitivity, readout-noise, high dynamic range, and control features that enable new applications in industrial imaging.

This series has evolved a few times since then and is now introducing its fourth-generation sensor technology. Each evolution has a unique basic pixel size and design that is optimized for different resolutions and sensor sizes. Later generations provide a continuously expanding set of control and readout features. Sony has created a family of sensors that are pin compatible, enabling customers to create a full product offering with a single design. Furthermore, each sensor type is available as a fully featured version, or with a reduced feature set and lower speed, resulting in a lower cost sensor. Sony also offers special variants for certain modules which can be used for sensing and video recording applications.

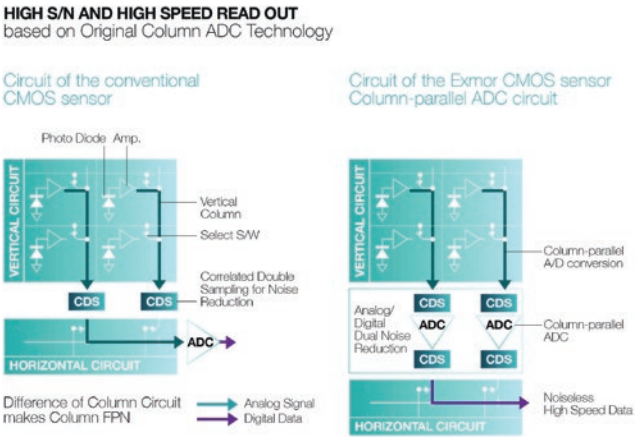
Understanding Sony's Technology

Pregius is a global shutter pixel technology based on Sony's low-noise CCD structure. Active pixel CMOS image sensors used in these products produce high-quality images.

This technology was named Pregius to represent the combination of the low-noise performance of CCD with the high-speed and high-precision performance (Precision GS) of global shutter (GS) required by FA applications.

One of the building blocks of this technology is the digitization of the pixel data early in the transfer process. This minimizes the amount of additional noise that is accumulated as the image data travels around within the sensor, even at high speed. To further improve the noise response of the sensor, correlated double sampling (CDS), a technique borrowed from CCD design, is implemented on either side of the ADC (analog to digital conversion) and cancels out the noise in the signals, ensuring the accuracy of the digitized data.

These sensors now feature a pixel architecture with high quantum efficiency (QE), known as the conversion ratio of arriving photons into electron charges captured within the pixel's photosensitive area. Greater QE leads to a stronger electric signal and thus to better sensitivity.



Pixels within Pregius technology sensors have an increased well depth, enabling them to capture and hold more electrons before saturating. This provides higher dynamic range of achievable pixel values, when combined with ADCs with more digitization bits, while also increasing its sensitivity to longer NIR (near infrared) wavelengths.

Sony has optimized the technology over many years and product generations. It features unrivaled image quality, even at very short exposure times or under diminished lighting conditions.

Sony's Pregius technology Portfolio

High-speed	IMX174	IMX287	IMX273	IMX252	IMX250	IMX250M Polarized#	IMX255	IMX253	IMX253M Polarized#	IMX387	IMX367
Low-speed	IMX249			IMX265	IMX264	IMX264M Polarized#	IMX267	IMX304			
GS-video	IMX302 (color only)						IMX305 (color only)				
Sensing		IMX297	IMX296								
Sony's Generation	1st Generation	2nd Generation	2nd Generation	2nd Generation	2nd Generation	2nd Generation	2nd Generation	2nd Generation	2nd Generation	2nd Generation	2nd Generation
Resolution [MP]	2.35	0.40	1.60	3.19	5.07	5.07	8.95	12.37	12.37	16.88	19.66
Horizontal [px]	1936	728	1456	2064	2464	2464	4112	4112	4112	5472	4432
Vertical [px]	1216	544	1088	1544	2056	2056	2176	3008	3008	3084	4436
Optical format	1/1.2 type	1/2.9 type	1/2.9 type	1/1.8 type	2/3 type	2/3 type	type	type	1.1 type	4/3 type	4/3 type
Pixel pitch [µm]	5.86	6.90	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45
Frame rate [fps]	164.5@10 128.2@12 (IMX174) 30@12 (IMX249) 64.1@12 (IMX302)	523.5@8 436.9@10 319.9@12 (IMX287) 120.8@10 (IMX297)	276@8 226.5@10 165.9@12 (IMX273) 60.3@10 (IMX296)	216.2@8 191.5@10 118.5@12 (IMX252) 55.6@12 (IMX265)	163.4@8 144.7@10 89.5@12 (IMX250) 35.7@12 (IMX264)	163.4@8 144.7@10 89.5@12 (IMX250) 35.7@12 (IMX264)	93.7@8 88.7@10 63.7@12 (IMX255) 32.2@12 (IMX267) 63.7@12 (IMX305)	68.3@8 64.6@10 46.4@12 (IMX253) 23.4@12 (IMX304)	68.3@8 64.6@10 46.4@12	61.3@8 56.5@10 40.4@12	43@8 39.6@10 28.3@12
Aspect ratio	16:10	4:3	4:3	4:3	5:4	5:4	17:9	4:3	4:3	16:9	1:1
Interface	SubLVDS, DDR	SubLVDS MIPI CSI-2 (IMX297)	SubLVDS MIPI CSI-2 (IMX296)	SubLVDS	SubLVDS, DDR	SubLVDS, DDR	SubLVDS, DDR	SubLVDS, DDR	SubLVDS, DDR	SLVS, SLVS-EC	SLVS, SLVS-EC

#available with on-chip polarization

Sony's Pregius technology Portfolio

High-speed	IMX342	IMX392	IMX426	IMX425	IMX422	IMX421	IMX420
Low-speed			IMX433	IMX432	IMX430	IMX429	IMX428
GS-video						IMX437 (color only)	
Sensing							
Sony's Generation	2nd Generation	2nd Generation	3rd Generation	3rd Generation	3rd Generation	3rd Generation	3rd Generation
Resolution [MP]	31.49	2.35	0.51	1.78	2.03	2.86	7.10
Horizontal [px]	6480	1936	816	1608	1632	1944	3216
Vertical [px]	4860	1216	624	1104	1248	1472	2208
Optical format	APS-C	1/2.3 type	1/1.7 type	1.1 type	1/1.7 type	2/3 type	1.1 type
Pixel pitch [µm]	3.45	3.45	9.00	9.00	4.50	4.50	4.50
Frame rate [fps]	35.4@8;10 25.8@12	201.4@8 167.0@10 134.6@12	1594.7@8 1449.7@10 941.4@12 (IMX426) 243.0@12 (IMX433)	662.1@8 565.1@10 481.4@12 (IMX425) 98.6@12 (IMX432)	477.6@8 434.1@10 270.4@12 (IMX422) 132.0@12 (IMX430)	409.2@8 371.8@10 231.2@12 (IMX421) 96.0@12 (IMX429) 231.2@12 (IMX437)	207.1@8 172.0@10 134.5@12 (IMX420) 51.4@12 (IMX428)
Aspect ratio	4:3	16:10	4:3	16:11	4:3	5:4	16:11
Interface	SLVS, SLVS-EC	SubLVDS, DDR	SLVS, SLVS-EC	SLVS, SLVS-EC	SLVS, SLVS-EC	SLVS, SLVS-EC	SLVS, SLVS-EC

Sony's Pregius technology Portfolio

High-speed	IMX536	IMX537			IMX535	IMX532	IMX531	IMX530				IMX661
Normal-speed	IMX546	IMX547	IMX548	IMX566	IMX545	IMX542	IMX541	IMX540	IMX567	IMX568	IMX565	
GS-video												
Sensing												
Sony's Generation	4th Generation	4th Generation	4th Generation	4th Generation	4th Generation	4th Generation	4th Generation	4th Generation	4th Generation	4th Generation	4th Generation	2nd Generation
Resolution [MP]	8.1	5.1	5.1	8.1	12.4	16.19	20.35	24.55	5.1	5.1	12.4	127
Horizontal [px]	2856	2472	2472	2856	4128	5328	4512	5328	2472	2472	4128	13472
Vertical [px]	2848	2472	2064	2848	3008	3040	4512	4608	2064	2064	3008	9568
Optical format	2/3 type	1/1.8 type	1/1.8 type	2/3 type	1/1.1 type	1.1 type	1.1 type	1.2 type	1/1.8 type	1/1.8 type	1/1.1 type	3.6 type
Pixel pitch [µm]	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.74	3.45
Frame rate [fps]	194@8 193.6@10 127.2@12 (IMX536) 91@8 81@10 60@12 (IMX546)	259@8;10 171@12 (IMX537) 122.9@8 122.2@10 82.4@12 (IMX547	114.8@8 93.4@10 84@12	62@8 51@10 43@12	184.6@8 184.1@10 120.9@12 (IMX535) 68@8 64@10 46@12 (IMX545)	159@8 152.5@10 111@12 (IMX532) 52.6@8 42.9@10 36@12 (IMX542)	106@8 102@10 74@12 (IMX531) 42@8 34@10 28@12 (IMX541)	106.9@8 102.6@10 74.5@12 (IMX530) 35.1@8 28.6@10 24@12 (IMX540)	96@8 79@10 67@12	96@8 79@10 67@12	42@8 34@10 29@12	12.9fp@14 19.6ps@12 2.8ps@10
Aspect ratio	1:1	5:4	5:4	1:1	4:3	7:4	1:1	15:13	5:4	5:4	4:3	4:3
Interface	SLVS, SLVS-EC	SLVS, SLVS-EC	SLVS	MIPI CSI-2	SLVS, SLVS-EC	SLVS, SLVS-EC	SLVS, SLVS-EC	SLVS, SLVS-EC	MIPI CSI-2	MIPI CSI-2	MIPI CSI-2	SLVS, SLVS-EC

Sony's global shutter CMOS generation

High-speed	IMX900	IMX901	IMX902	IMX925	IMX926	IMX927	IMX928	IMX929	IMX947	IMX949
Normal-speed				IMX935	IMX936	IMX937	IMX938	IMX939		
GS-video										
Sensing										
Sony's Generation	2.2 series	4th Generation	4th Generation	4th Generation	4th Generation	4th Generation	4th Generation	4th Generation	4th Generation	4th Generation
Resolution [MP]	3.2	16	12	24	12	105	68	50	26.3	12.6
Horizontal [px]	2064	8016	6048	5328	4128	10248	8256	8224	5136	4112
Vertical [px]	1552	2048	2048	4608	3008	10248	8256	6176	5136	3088
Optical format	1/3.1 type	1.4 type	1.1 type	1.2 type	1/1.1 type	2.5 type	2.0 type	1.8 type	2.5 type	1.8 type
Pixel pitch [µm]	2.25	2.74	2.74	2.74	2.74	2.74	2.74	2.74	5.48	5.48
Frame rate [fps]	120.9fps@8 13.2fps@10 70.6fps@12	134fps@10 91fps@12	134fps@10 91fps@12	442@8 394@10 212@12 (IMX925) 225@8 200@10 107@12 (IMX935)	660@8 588@10 318@12 (IMX926) 339@8 302@10 162@12 (IMX936)	112@8 102@10 73@12 (IMX927) 56@8 51@10 36@12 (IMX937)	138@8 126@10 90@12 (IMX928) 70@8 64@10 45@12 (IMX938)	225@8 201@10 136@12 (IMX929) 115@8 102@10 69@12 (IMX939)	423@8 383@10 277@12	811@8 722@10 502@12
Aspect ratio	4:3	4:1	3:1	4:3	4:3	1:1	1:1	4:3	1:1	4:3
Interface	MIPI CSI-2, SLVS	MIPI CSI-2, SLVS, SLVS-EC	MIPI CSI-2, SLVS, SLVS-EC	SLVS-EC	SLVS-EC	SLVS-EC	SLVS-EC	SLVS-EC	SLVS-EC	SLVS-EC

Sony's Pregius technology Portfolio

Sony's Pregius technology series of Global Shutter CMOS sensors has evolved over several product generations. Each one features similar pixel architectures and readout circuits. Individual improvements were introduced with each new generation, but so did some trade-offs between pixel size, saturation capacity, and sensor size. Therefore, specific application requirements will determine the best generation to use.

1st Generation

Starting with the IMX174, this first-generation sensor provides 2.35 MP images through an 1/1.2" optical format and set the benchmark for CMOS sensors while being praised by the industrial imaging market. Thanks to a pixel size of 5.86 µm and a very high saturation level, the 73.6 dB dynamic range provided was large for CMOS sensors, even with its high readout noise of 5e-. Features like multiple Regions of Interest (multi-ROI) addressed the requirements of modern machine vision systems. With these sensors, it was possible to implement applications with an image quality and speed that rivaled CCD technology but at a much lower cost.

2nd Generation

With its second generation, Sony responded to the requests from the machine vision market. These sensors provide an 8-bit ADC option, in addition to the 10 and 12-bit ADC options previously offered, reducing the minimum output bit depth while increasing output framerates. To further increase image outputs, Sony doubled the number of data channels offered by the first-generation sensors to 16 lanes, increasing their overall output bitrates to 9.5 Gbps. Extended functionalities, like additional trigger and operating modes, enable and simplify many imaging solutions. The smaller 3.45 µm pixel size does limit the saturation but, with its lower readout noise of 1e-, still enables an impressively high 73.6 dB of dynamic range.

Furthermore, thanks to this pixel size, the first sensor of this generation, the IMX250 with 5.07 MP and 2/3" optical format, is a direct replacement for Sony's ICX625 and ICX655, its CCD antecessors. Thus, a large variety of optics are immediately available for cameras with the new Pregius technology sensors which can serve as drop-in replacement for previous CCD-based systems.

3rd Generation

Some of the innovations that the third generation demonstrate great improvements, mainly in terms of image quality, speed, and features. Applications looking at moving objects or cameras that are subjected to movement or shaking, such as those running production lines, robotics applications, or ITS, and automotive sectors benefit from these advancements.

The larger 4.5 µm pixel size creates a much higher full well capacity which is complemented by a low 1e- readout noise, giving a maximum dynamic range of 76 dB* (Dual ADC mode). These characteristics allow for detection of objects in difficult lighting conditions with only one captured image.

Similar to the second-generation sensors, there are variants that combine 2x2 pixels providing 9 µm pixel sized sensors.

These large pixel sizes enable a high full well capacity giving a 76 dB* (Dual ADC mode) dynamic range that is ideal for detailed snapshots of high-contrast scenes. The increased bandwidth of these sensors requires an interface faster than existing LVDS and MIPI standards can support.

As such, Sony has developed the SLVS-EC standard to overcome these limitations, streaming data at 19 Gbps across 8 channels, doubling the maximum throughput of second-generation devices. These sensors are perfectly suited for cameras leveraging high speed data interfaces like USB 3.2 Gen 2 and 2x2, 10-50 GigE, or CoaXPress.

Besides improved imaging performance, the third-generation sensors come with a host of helpful new functions designed to enable more simple and powerful vision systems.

Sony's Pregius technology Portfolio

4th Generation

The latest, fourth generation, Sony's technology continues to further demonstrate technical advancements. The pixel architecture of these sensors has been shrunk and completely redesigned. The new Pregius S technology series now offers high resolutions, up to 25 megapixels, with a 1.2" optical format, making them suitable for standard C-mount lenses in small camera body sizes.

These new sensors, supporting different resolutions, are included in the introduction of this generation. Thanks to their backside illuminated pixel architecture and global shutter, Sony managed to reduce the pixel size to 2.74 µm while maintaining or improving the previous series' performance features.

These improvements result in better color reproduction, especially in the blue spectrum band. The new pixels allow for smaller chief ray angles, thus making them more robust against unwanted lens shading effects. The pixel output data rate was doubled from its predecessor which aligns well with the newer, high speed, data interfaces common in machine vision like 10-50 GigE or CoaXPress. The cost-effective, slower variants fit well in cameras using USB3, 5 GigE, single-lane CoaXPress or Camera Link. Once again, a square sensor is included in this portfolio making it perfect for high-resolution microscopy and inspection tasks.

2.2 Series

Sony has recently introduced a new global shutter sensor based on its Pregius S™ technology and a uniquely new pixel architecture. Theses sensors take this technology one step further by utilizing a new, revolutionary 2.25µm pixel architecture where the individual memory units for each pixel are relocated to the signal processing circuit area, below the photodiode. This technology allows for more pixels within the same optical formats while still improving the incident light angle dependency, allowing for the use of higher aperture lenses without any shading effects. This imager leverages its deeper pixel wells to provide higher saturation levels with about10ke-full well capacity and better near IR light performance thanks to thicker photodiode. When this is combined with the changes to the pixel architecture, dramatic improvements can be seen in the quantum efficiency and parasitic light sensitivity in cameras build with this device.

	1st Generation	2nd Generation	3rd Generation	4th Generation	2.2 Series
Pixel size (µm)	5.86	3.45 / 6.9	4.5 / 9	2.74	2.25
Frame Rate	2.4M 10 bit 164 fps	5.1M 10 bit 164 fps	7.1M 10 bit 170 fps	8.1M 10 bit 193 fps	3.2M 10 bit 113.2 fps
Interface	Sub-LVDS	Sub-LVDS SLVS-EC (2.5G9 MIPI	SLVS SLVS-EC (2.5G)	SLVS SLVS-EC (5G) MIPI	MIPI CSI-2 SLVS
Bit depth	10/12	8/10/12	8/10/12	8/10/12	8/10/12
Max. output (Gbps)	4.7	9.5	19.0	38	3.6

Unique Requirements Call for Unique Sensors

All Sony Sensors in a Pregius technology generation share similar pixel architectures, so they supply comparable image quality. As some applications are less dependent on speed and control features, the Sony's Pregius technology Series offers sensor variants with reduced frame rates and feature sets. Leading-edge machine vision applications require high speed, fully featured sensors with ITS and traffic, and standard machine vision can settle for a lower cost, low-speed variant with reduced feature set. Some global shutter modules are designed specifically for video recording that have unique features needed for high-end video captures in areas of research, monitoring, or broadcasting.

High-Speed Applications

These flagship sensors combine outstanding image quality, innovative pixel architectures, and advanced readout circuitry with leading edge data interface protocol and cutting-edge features.

- Analog-digital conversion with 8, 10, or 12 bit
- Various trigger modes:
  - Exposure time control: external trigger pulses can define light accumulation times
  - Trigger output: signals indicating sensor status during shutter operation for synchronization with peripheral circuitry
  - Fast trigger mode: reduced delay between trigger and exposure
  - Multi-exposure mode: single trigger pulses initiate a sequence of image captures
- Sequencer: Series of 2/4 frames can be captured after single trigger, with user selectable exposure time, gain, and ROIs for each frame in the sequence.
- Regions of Interest: Field of view of the sensors can be cropped into 16 / 64 overlapping regions of interest.

CURRENTLY AVAILABLE MODELS:

MX287	0.4 MP
IMX426	0.51 MP
IMX273	1.6 MP
IMX425	1.78 MP
IMX422	2.03 MP
IMX174	2.32 MP
IMX392	2.35 MP
IMX421	2.86 MP
IMX252	3.19 MP
IMX900	3.2 MP
IMX250	5.07 MP
IMX537	5.1 MP
IMX420	7.1 MP
IMX536	8.1 MP
IMX255	8.95 MP
IMX902	12 MP
IMX926	12 MP
IMX253	12.37 MP
IMX535	12.4 MP
IMX901	16 MP
IMX925	16 MP
IMX532	16.19 MP
IMX387	16.88 MP
IMX367	19.66 MP
IMX531	20.35 MP
IMX530	24.55 MP
IMX342	31.49 MP
IMX661	127 MP

Low-Speed Applications

Applications looking for reduced speed and features sets can benefit from these cost-effective models, without sacrificing image quality.

Features:

- Analog-digital conversion at 12 bit
- Regions of Interest: 1
- Sequencer with 2 / 4 frames with different exposure times and gains
- Trigger modes: fast, self, dual

CURRENTLY AVAILABLE MODELS:

IMX433	0.51 MP
IMX432	1.78 MP
IMX430	2.03 MP
IMX249	2.35 MP
IMX429	2.86 MP
IMX265	3.19 MP
IMX264	5.07 MP
IMX548	5.1 MP
IMX547	5.1 MP
IMX428	7.01 MP
IMX546	8.1 MP
IMX267	8.95 MP
IMX936	12 MP
IMX304	12.37 MP
IMX545	12.1 MP
IMX935	16 MP
IMX542	16.19 MP
IMX541	20.35 MP
IMX540	24.55 MP

Global Shutter Visualization and Video Recording Applications

To simply record or visualize moving objects, the following sensor models offer their global shutter functionality to obtain blur-free, color only, image captures. Their frame rates match common video standards.

Features:

- 2-frame set output mode: Recording of two consecutive frames at different exposure times, externally merged into one picture, for wide dynamic range imaging.
- Regions of Interest: All-pixel scan or Full-HD mode

CURRENTLY AVAILABLE MODELS:

IMX302	2.4 MP
IMX437	2.86 MP
IMX305	8.9 MP

Sensing

Inspection tasks that require only monochromatic images with fixed bit depth per pixel can benefit from the low data rates provided by these sensors, and lower cost, smaller processors. These sensors are key for keeping costs low for small, embedded vision systems.

CURRENTLY AVAILABLE MODELS:

IMX297	0.4 MP
IMX296	1.6 MP

Unique Requirements Call for Unique Sensors

High Resolution Embedded Vision

More IoT and embedded vision-based applications are looking for compact sensor sizes at higher resolutions. These devices need to be connected to embedded processors directly through common interfaces. System designers have standardized MIPI CSI-2 for their vision data interface. These sensors can be directly connected and controlled by advanced embedded processors for simpler designs and integrations.

CURRENTLY AVAILABLE MODELS:

IMX568	5.1 MP
IMX567	5.1 MP
IMX566	8.1 MP
IMX565	12.4 MP

Fast Frame Rate at High Resolution Images

As monitor refresh rates and resolutions increase, there is a growing need for vision applications to follow suit. This series of sensors meets the needs of this high horsepower, demanding products. Their very fast and large SLVS-EC data interfaces provide the necessary data in a timely manner while not requiring hundreds of tracks on a PCB. This keeps their board designs compact and easier to design.

CURRENTLY AVAILABLE MODELS:

IMX929	50 MP
IMX939	50 MP
IMX928	68 MP
IMX938	68 MP
IMX928	105 MP
IMX938	105 MP

Features:

- All the features described in previous in the High-Speed applications
- 50-105MP resolutions
- Frames rates from 36-219 fps
- High speed and low speed options available

The Masterpiece

While the IMX174 was introduced in 2013, it is still a class leading sensor in performance while marking a milestone in Machine Vision history. The IMX174 captures full frame images at 1936 x 1216 resolution, running at 164.5 fps with 10 bits/pixels. In Full-HD, the sensor delivers 180 fps, perfect for slow motion playback. The very large 5.86 µm pixel pitch and 1/1.2" format provides crisp images. This sensor and its low-speed companion, the IMX249, fulfill the requirements of a large variety of machine vision applications that once used slow megapixel CCD-based sensors.

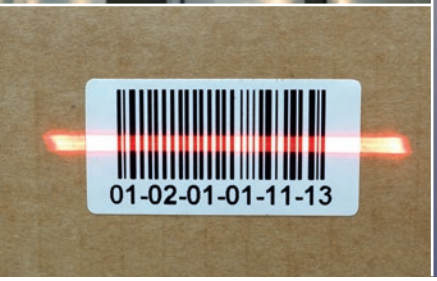
Its large pixel size and per pixel micro-lenses ensure high quantum efficiency and a full well capacity of electrons.

The maximum data rate of the IMX174 is at 4,752 Gbps, pairing well with the USB 3.2 data bandwidth. By reducing this sensor's frame rates by half or a quarter, it can also be targeted for various machine vision applications looking to integrate GigE or dual-GigE interfaces. Short bursts at full speed can be buffered internally to the camera, which can then be slowly transferred across these slower data interfaces. Running the IMX249 at its maximum frame rate of 30 fps at 12 bit delivers 1,188 Mbps aligns well for continuous recording with Gigabit Ethernet based platforms.

The high sensitivity and large full well capacity combine well to ensure that both light and dark areas are accurately captured within one image. This wide dynamic range is beneficial for applications such as fast and precise localization of laser lines in 3D profilometry or for the inspection of shiny surfaces with glare and/or specular surfaces. Traffic applications need to also deal with challenging lighting conditions caused by headlights at night or sun reflections. These sensors deliver high contrasted images needed by the applications for vehicle number plate recognition in automatic tolling, car access control or traffic law enforcement.

Short spec

High-speed	IMX174
Low speed	IMX249
GS-Video	IMX302 (only color)
Generation	1st
Resolution [MP]	2.35
Horizontal [px]	1936
Vertical [px]	1216
Optical format	1/1.2 type
Pixel pitch [µm]	5.86
Frame rate [fps at Bits per Pixel]	164.5@10 128.2@12 (IMX174) 30@12 (IMX249) 64.1@12 (IMX302)
Aspect ratio	16:10
Interface	SubLVDS, DDR



CCD Replacements

These second generation Pregius sensors have the standard 3.45 µm pitch, but they offer small sensor formats and the option of a MIPI interface.

The low-speed model IMX297 already features at least twice the speed of its CCD predecessors, while the high-speed machine vision version IMX287 outperforms competing models from other brands in speed and resolution, alongside its outstanding image quality.

With 226 fps in 10-bit mode, the IMX273 allows for high-speed imaging at a resolution of 1.6 megapixels. The low readout-noise, typical for the 2nd Pregius generation, ensures crisp greyscale images as well as accurate color reproduction. Even the low-speed and low-cost IMX296 delivers more than double the framerate of the widely adopted SONY ICX445 1.25MP CCD, which uses the same optical format. Most lenses designed for this old CCD sensor will be suitable as well for IMX273/IMX296-based cameras.

The IMX297's maximum bandwidth matches that of a typical GigE interface making it ideal for cameras based on this interface. The IMX296 slightly exceeds the effective bandwidth of GigE and calls for dual-GigE or NBaseT at 2.5 Gbps data interface; as does the IMX287. With 3.58 Gbps, IMX273 will likely not reach its full speed on standard USB 3.0 platforms without some data compression. Camera Link, CoaXPress, or NBaseT at 5 Gpbs would be the likely interface candidates to best leverage the throughput of this sensor.

Despite the trend towards higher resolutions, for many applications, as with logistics and factory automation, these 0.4 or 1.6 megapixel sensors are still an excellent choice. In presence detection, code reading, geometric measurement and quality inspection of small areas with close-up captures, these sensors fulfill the requirements at an attractive price.

Thanks to the high frame rates and great image quality at short exposure times, the IMX287 and IMX273 opens up opportunities in new applications as well as in more traditional ones such as production line throughout and imaging of fast-moving objects.

Short spec

High-speed	IMX287	IMX273
Sensing	**IMX297**	**IMX296**
Generation	2nd	2nd
Resolution [MP]	0.4	1.6
Horizontal [px]	728	1456
Vertical [px]	544	1088
Optical format	1/2.9 type	1/2.9 type
Pixel pitch [µm]	6.90	3.45
Frame rate [fps at Bits per Pixel]	523.5@8 436.9@10 319.9@12 (IMX287) 120.8@10 (IMX297)	276@8 226.5@10 165.9@12 (IMX273) 60.3@10 (IMX296)
Aspect ratio	4:3	4:3
Interface	SubLVDS, MIPI CSI-2 (IMX297)	SubLVDS, MIPI CSI-2 (IMX296)

Making a Great Thing better

Sony's first-generation sensors offered a great masterpiece of technology, the IMX174, with its incredible pixel performance.

One of the drawbacks for some customers was its large optical format that prevented its use in small cameras and/or with small lenses. It required 1" format optics so lower cost 2/3" lenses could not be used as they would cause vignetting (a.k.a. shading in the corners).

Along came the new IMX392, with its similar resolution and smaller pixel pitch, offering almost identical pixel performance to the IMX174 in a compact package. Smaller cameras can now be built which also benefit from the additional features included in the second generation Pregius technology designs, like the new trigger options and faster readout modes. Its ~8mm optical format couples well with common and less expensive 1/2" lenses.

Short spec

High-speed	IMX392
Generation	2nd
Resolution [MP]	2.35
Horizontal [px]	1936
Vertical [px]	1216
Optical format	1/2.3 type
Pixel pitch [µm]	3.45
Frame rate [fps at Bits per Pixel]	201.4@8 167.0@10 134.6@12
Aspect ratio	16:10
Interface	SubLVDS, DDR

The Workhouse Resolutions

The first sensors of the second generation were replacements to popular CCDs, the most common ones being the 5-megapixel IMX250 and IMX264. They feature the same optical format, resolution, and pixel size as the widely used ICX625 and ICX655 CCD sensors. This allows them to leverage the large portfolio of lenses from various manufacturers that were already designed for their equivalent CCD models, leading to lower costs imaging systems. Not only that, but they also offer a whole host of improvements, most notably a huge increase in frame rates. Where the 2-tapped ICX625 barely delivered 15 fps, the IMX250 flies by it, offering up 163 fps with ease. Furthermore, the non-linear and temperature-dependent CCD tap balancing has been eliminated, making it very simple to integrate the CMOS sensors into new designs and to get great looking images.

Using the same pixel architecture as the IMX250 and IMX264, the 3.19 MP sensors IMX252 and IMX265 address high-speed imaging systems at a lower resolution. With a maximum data rate of 9.504 Gbps (IMX252) and 9.504 Gbps (IMX250), these sensors command high-speed camera interfaces like Camera Link Full, CoaXPress x2, or 10 GigE to maximize their full speed outputs. Not every application needs this output speed, so the IMX265 and IMX264 deliver maximum data rates of below 1.8 Gbps, in Full HD-Mode, which fits nicely with cameras using dual-GigE interfaces.

While the full-well capacity is just slightly above 1/3 of its predecessor's first generation Pregius technology sensors, the readout noise has been greatly improved, coming in just 1 electron. This low readout noise delivers very clear monochrome pictures and outstanding color reproduction. This amazing image quality is welcomed in applications that analyze color prints, or inspect fruit, vegetables, and pastries in automated food production facilities. Furthermore, demanding applications like panel inspection and surface inspection benefit significantly from higher throughput and accuracy thanks to the speed and resolution of these image sensors.

Want to see more? On-pixel Polarization Filters!

Polarization is an underutilized property of light, and its effect on surfaces and materials was typically managed through external filters in front of the camera. Inspection of objects with transparent packaging or highly reflective surfaces has been managed primarily by placing polarizing filters externally to the camera, thus limiting the incoming light to one polarization angle. This method does not allow the camera to capture light with different angles or under changing conditions.

A variant of the IMX250 and IMX264 are available with additional polarization filters on each of its pixel. These filters transmit light in only one polarization direction. Four different directions are arranged in a 2x2 block of pixels, 45^0 polarization angle between each one. Hence, each captured image includes 4 different images. With external processing, the degree and direction of polarization of the incoming light can be calculated or defects on complexly shaped and/or reflecting surfaces can be recognized irrespective of the speckles appearing in just one or two polarization angles.

Short spec

High-speed	IMX252	IMX250	IMX250M Polarized
Sensing	**IMX265**	**IMX264**	**IMX264M Polarized**
Generation	2nd	2nd	2nd
Resolution [MP]	3.19	5.07	5.07
Horizontal [px]	2064	2464	2464
Vertical [px]	1544	2056	2056
Optical format	1/1.8 type	2/3 type	2/3 type
Pixel pitch [µm]	3.45	3.45	3.45
Frame rate [fps at Bits per Pixel]	216.2@8 191.5@10 118.5@12 (IMX252) 55.6@12 (IMX265)	163.4@8 144.7@10 89.5@12 (IMX250) 35.7@12 (IMX264)	163.4@8 144.7@10 89.5@12 (IMX250M) 35.7@12 (IMX264M)
Aspect ratio	4:3	4:3	4:3
Interface	SubLVDS	SubLVDS DDR	SubLVDS DDR

Ready for the Show

Like all members of the second Pregius technology generation, the IMX253 and its little brother IMX255 are based on small 3.45 µm pixels. They offer 1.1" and 1" optical format, and 12.37 and 8.95-megapixel options, respectively. Their large image format and resolution are still compatible with most C-mount lenses.

With a maximum data rate exceeding 9.5 Gbps, interfaces like 10 GigE or USB 3.1 Gen2 are ideally partnered. But higher bandwidth solutions such as Camera Link Deca, CoaXPress v1 x2, CoaXPress v2 x1 or other data interfaces capable of higher bandwidth are also commonly selected during camera designs.

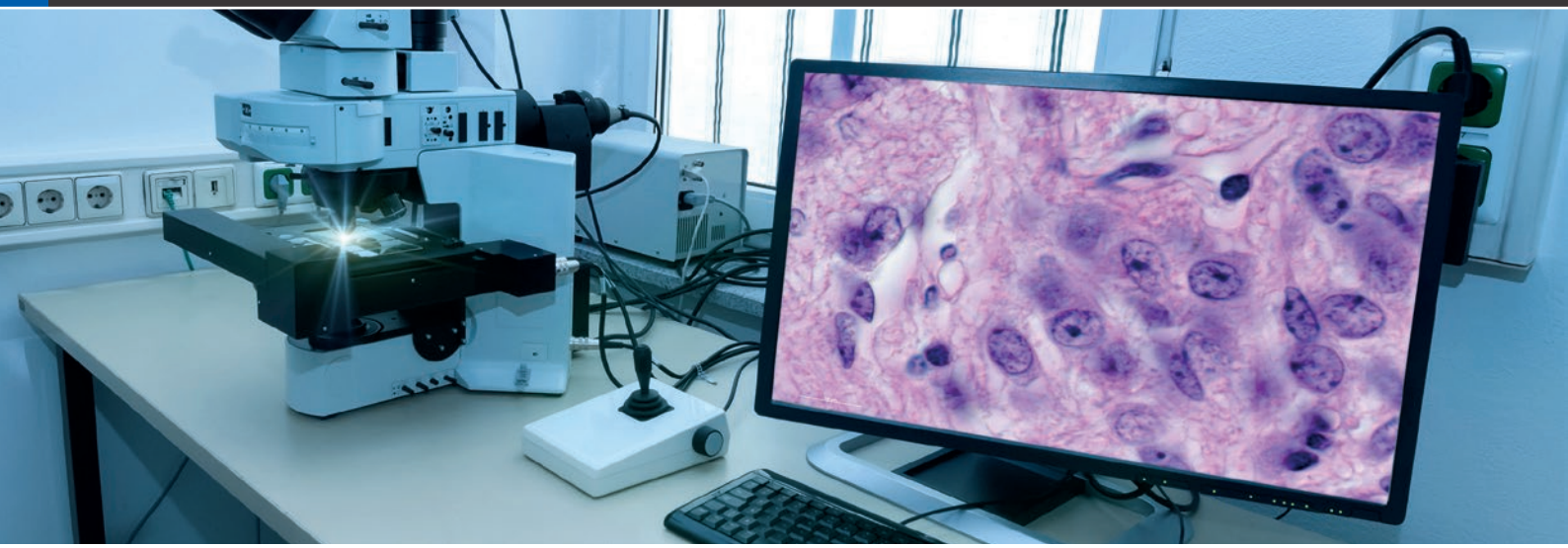
The 1.1" IMX253, with a traditional 4:3 aspect ratio, is designed for high-resolution analysis of displays or solar panels or built into multi-camera 3D model creation systems for Virtual Reality. This sensor is also available with on-chip polarized pixels. The combination of high resolution and 4 angle polarization images enable highly complex imaging tasks. With corresponding processing, a camera can offer color information, angle and degree of polarization, and light intensity all at once. More information about Sony's on-pixel polarization filters can be found on the previous page.

The IMX255 features the same horizontal pixel count but has fewer vertical lines when compared to the IMX253. Providing a 17:9 aspect ratio, the IMX255 is suitable for broadcast applications targeting the popular 4K HD (a.k.a. Ultra HD) resolution.

The low readout noise of both sensors contributes to crisp and clear images for reliable 3D captures, color rendition and accuracy, and inspection tasks.

Short spec

High-speed	IMX255	IMX253	IMX253M Polarized
Low speed	IMX267	IMX304	
GS-Video	IMX305		
Generation	2nd	2nd	2nd
Resolution [MP]	8.95	12.37	12.37
Horizontal [px]	4112	4112	4112
Vertical [px]	2176	3008	3008
Optical format	1 type	1.1 type	1.1 type
Pixel pitch [µm]	3.45	3.45	3.45
Frame rate [fps at Bits per Pixel]	93.7@8 88.7@10 63.7@12 (IMX255) 32.2@12 (IMX267) 63.7@12 (IMX305)	68.3@8 64.6@10 46.4@12 (IMX253) 23.4@12 (IMX304)	68.3@8 64.6@10 63.7@12
Aspect ratio	4:3	4:3	4:3
Interface	SubLVDS DDR	SubLVDS DDR	SubLVDS DDR



See it All

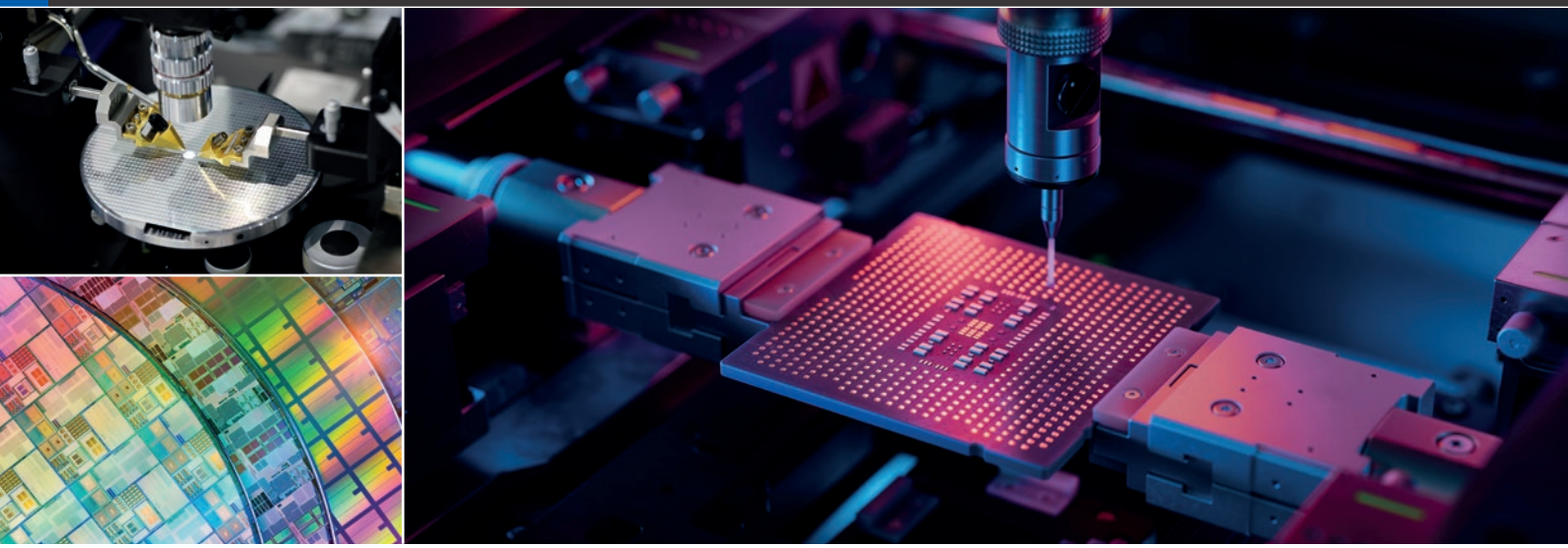
Rounding out the list of second-generation sensors is a few large resolution ones with larger optical formats. The IMX342, at nearly 32 megapixels, is designed for applications where high resolution is key, such as electronics and semiconductor panel inspection, where the goal is to recognize fine details over large areas with speed and with fewest images as possible. The large number of pixels enable digital pan or zoom on demand. Cameras with the IMX367 can run up to 43 fps while those with the IMX342 can do 35.4 fps. Both are perfectly suited to replace existing implementations based on slower 29-megapixel CCD sensors.

The smaller IMX387 and IMX367, with their 16.88 and 19.66 megapixels, respectively, have a 4/3" format that fits into C-mount camera designs. They are ideal when more than 5 megapixels is required for a given task. The 19-megapixel array is capable of standard video frame rates allowing for continuous visual inspection with no jittering. The IMX367 has an aspect ratio of 1:1 which makes it attractive for utilization in microscopes and telescopes where the optics can be more efficiently used. The IMX387 offers a 16:9 aspect ratio which is perfect for visualization, broadcast, or high-end surveillance applications.

All three sensors are available in high-speed versions only and have both monochrome and color variants.

Short spec

High-speed	IMX387	IMX367	IMX342
Resolution [MP]	16.88	19.66	31.49
Horizontal [px]	5472	4432	6480
Vertical [px]	3048	4436	4860
Optical format	4/3 type	4/3 type	APS-C
Pixel pitch [µm]	3.45	3.45	3.45
Frame rate [fps at Bits per Pixel]	61.3@8 56.5@10 40.4@12	43@8 39.6@10 28.3@12	35.4@8;10 25.8@12
Aspect ratio	16:9	1:1	4:3
Interface	SLVS, SLVS-EC	SLVS, SLVS-EC	SLVS, SLVS-EC



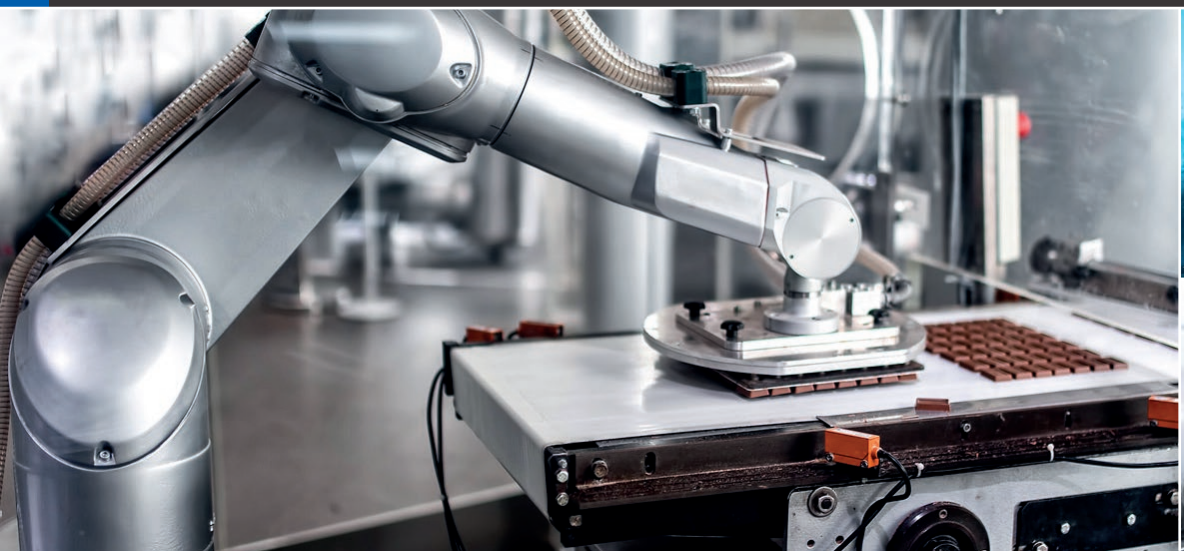
Need to See More All At Once

The IMX661 is unique in this generation of sensors as it provides a very large image resolution. Leveraging all same features as other second generation sensors, it provides a 127MP image that is four times larger than other sensors in this family.

Applications that need to see more in each image or need to cover more detail will be naturally drawn to this sensor. Vision systems become less complex without the need to synchronize multiple cameras to cover the same field of view that this sensor can see. The extra bits per pixel improve the achievable dynamic range that works well in challenging lighting situations or to improve image analytics.

Short spec

High-speed	IMX661
Generation	2nd
Resolution [MP]	127
Horizontal [px]	13472
Vertical [px]	9568
Optical format	3.6 type
Pixel pitch [µm]	3.45
Frame rate [fps at Bits per Pixel]	12.9fps@14 19.6ps@12 21.8ps@10
Aspect ratio	4:3
Interface	SubLVDS, SLVS-EC



Large Pixel and Rich Feature Sets

The IMX420 and IMX428 were the first introduced sensors in third generation line of products. The new 4.5 µm pixel size nicely balances high quantum efficiency, saturation capacity, and compactness. Thanks to its low 1 electron readout noise and high full well capacity, these sensors are able to provide up to 72.3 dB dynamic range.

These sensors come with a variety of new and highly innovative features including High Conversion Gain for better image quality under low light conditions, and the Standard Conversion Gain for bright scenes. With the Dual ADC, each pixel can be read out twice, each one with different gains applied. By combining these two captures, high dynamic range images can be achieved. As with the previous generation sensors, the high-speed models allow captures with multiple ROIs. The new Dual Triggering enables different exposure times and gains in different regions of interest, while the Self-Triggering feature detects changes a predefined “sensing area” and when the threshold is surpassed, the sensor acquires an image automatically. The new SLVS-EC interface introduced in this generation outputs data at a maximum of 19 Gbps over 8 lanes.

The IMX420 produces frames at 172 fps at 10 bit and is best matched with high speed interfaces like 3x CoaXPress or Camera Link HS. The lower speed IMX428 offers 51.4 fps which makes it a perfect fit for use with USB 3.1 based platforms.

High resolution, high frame rate, effective global shutter, and a host of new features, all qualify the IMX420 for demanding system setups in quality assurance with fast moving objects, and precision control for robots. The IMX428 is optimized for ITS and delivers 12-bit images in one ROI at a reduced frame rate. These applications will still benefit from the high resolution, image quality this model provides at a lower cost.

Short spec

High-speed	IMX425	IMX420
Low speed	IMX432	IMX428
Generation	3rd	3rd
Resolution [MP]	1.78	7.10
Horizontal [px]	1608	3216
Vertical [px]	1104	2208
Optical format	1.1 type	1.1 type
Pixel pitch [µm]	9.00	4.50
Frame rate [fps at Bits per Pixel]	662.1@8 565.1@10 481.4@12 (IMX425) 98.6@12 (IMX432)	207.1@8 172.0@10 134.5@12 (IMX420) 51.4@12 (IMX428)
Aspect ratio	16:11	3:2
Interface	SLVS, SLVS-EC	SLVS, SLVS-EC

Addressing the Need for Speed

These third-generation sensors are similar and were designed to replace their CCD sensor equivalents. The IMX422 and IMX430 offer the classical 4:3 aspect ratio in the 1600 by 1200 resolution format. With many camera models based on the classic ICX274, 15fps, CCD sensor, they have become too slow for many modern inspection tasks. Running at 477 fps in the 8-bit mode, the IMX422 plays in a completely different speed class than its predecessor.

The IMX426 and IMX433 offer the widely used 800 x 600 resolution, aligning closely to the SD video format, while providing more than 1,500 fps, making it ideal for very high-speed image captures.

The IMX421 and its slower versions offer a very flexible solution. By using the ROI feature, the sensor can act as a Full-HD capture device with 1920 by 1080pixel widescreen format, be altered to provide 1600 by 1200 to match the classic 4:3 TV aspect ratio or be cropped to 1440 by 1440 pixels for microscopes.

All these fast sensors offer multi-ROI that use multiple trigger options, ADC and/or gain modes. Additionally, these sensors come with the Sony's third generation sequencer feature that allows for different image settings for each frame enabling quick image captures at different settings, repeatedly, which is key for inspection applications that have difficult lighting or reflective surfaces, as an example.

Short spec

High-speed	IMX426	IMX422	IMX421
Low speed	IMX433	IMX430	IMX429
GS-Video			IMX437 (only color)
Generation	3rd	3rd	3rd
Resolution [MP]	0.51	2.03	2.86
Horizontal [px]	816	1632	1944
Vertical [px]	624	1248	1472
Optical format	1/1.7 type	1/1.7 type	2/3 type
Pixel pitch [µm]	9.00	4.50	4.50
Frame rate [fps at Bits per Pixel]	1594.7@8 1449.7@10 941.4@12 (IMX426) 243.0@12 (IMX433)	477.6@8 434.1@10 270.4@12 (IMX422) 132.0@12 (IMX430)	409.2@8 371.8@10 231.2@12 (IMX421) 96.0@12 (IMX429) 231.2@12 (IMX437)
Aspect ratio	4:3	4:3	4:3
Interface	SLVS, SLVS-EC	SLVS, SLVS-EC	SLVS, SLVS-EC

Sweet Spot for Resolution and Speed

Taking full advantage of the smaller, improved pixel that was introduced as part of Sony's fourth-generation line, these sensors target applications that require mid to high resolution with a fully featured sensor. The high frame rates provided take full advantage of the SLVS-EC v2.0 interface that is included in these products.

With compact camera designs in mind, Sony separated the surrounding electronics from the pixel array and created a second chip layer underneath. The new generation technology is called Pregius S, where "S" stands for Stacked. This groundbreaking technology allows a small sensor package, perfect for a 29x29mm industrial camera enclosure and using cost-effective C-mount lenses.

Shrinking the CMOS pixel and maintaining the imaging performance has been one of the great technological challenges over the last decades. The all-new pixel architecture of these sensors puts the light sensitive photodiode on top of the readout electronics. This BSI approach increases light sensitivity, improves blue light response, and allows for larger chief ray angle acceptance for each pixel. This leads to more accurate blue color in images while minimizing the need to increase blue gains, producing more homogeneous images, especially with wide-angle lenses.

The IMX537 streams 259 frames at 5.1 MP each second while the IMX535 can do 184 frames at 12.4 MP, both in either 8 or 10 bits per pixel. When combined with the high dynamic range that is offered and the electronic global shutter, these sensors can freeze all movement in crisp, blur free images. Applications working on high-speed assembly inspection lines can benefit from all the features provided by these sensors without compromising image quality or product outputs.

The IMX547 and IMX545 sensors are built on the same architecture as the other sensors but with a reduced feature set and at slower frame rates. These lower cost sensors are perfect for applications that require the pixel performance and resolution offered by these fourth generation but do not need to process images at high speeds. This makes them ideal for applications needing real-time video like traffic monitoring or broadcasting. The IMX548 is a 5.1 MP sensor in the same family as the others listed but only supports SLVS interface in a smaller package.

Both the IMX901 and IMX902 have been created with wide field of views which make them uniquely designed for applications looking at a small band across multiple lanes or columns, like conveyor belts in factory automation or lanes on a highway in traffic applications. Their high-resolution images combined with very high speed data interfaces provide fast frame rates for high speed capture and analysis. They are great in challenging lighting conditions with their greater than 70dB dynamic range image captures with more evenly illuminated images for both the dark and bright areas in the same image. Implementing these sensors into camera designs are made easier and flexible with the availability to use either MIPI or SLVC-EC interfaces to transmit the data from the sensors. And it is not just bar code reading, in-line inspection and traffic applications that benefit from the sensors, but also other applications such as PCB inspection, droplet inspection, bottle inspection and grocery store shelf POS and inventory systems.

Short spec

High-speed	IMX537		IMX535	IMX901	IMX902
Traffic	IMX547	IMX548	IMX545		
Generation	4th Generation	4th Generation	4th Generation	4th Generation	4th Generation
Resolution [MP]	5.1	5.1	12.4	16	12
Horizontal [px]	2472	2472	4128	8016	6048
Vertical [px]	2472	2064	3008	2048	2048
Optical format	1/1.8 type	1/1.8 type	1/1.1 type	1.4 type	1.1 type
Pixel pitch [µm]	2.74	2.74	2.74	2.74	2.74
Frame rate [fps at Bits per Pixel]	259@8;10 171@12 (IMX537) 122.9@8 122.2@10 82.4@12 (IMX547)	114.8@8 93.4@10 84@12	184.6@8 184.1@10 120.9@12 (IMX535) 68@8 64@10 46@12 (IMX545)	134fps@10 91fps@12	134fps@10 91fps@12
Aspect ratio	5:4	5:4	4:3	4:1	3:1
Interface	SLVS, SLVS-EC	SLVS	SLVS, SLVS-EC	MIPI, CSI-2, SLVS, SLVS-EC	MIPI, CSI-2, SLVS, SLVS-EC

Small Pixels, High Resolution, Great Sensitivity

The fourth-generation Pregius S technology image sensors stand out with their small pixel size of 2.74 µm, global shutter functionality and high sensitivity performance thanks to their back-side illumination (BSI) architecture.

The first sensor in this series is the IMX530 and offers a 24-megapixel resolution with more than 100 fps. The newer IMX925 uses the latest SLVC-EC technology to provide 442 fps in 8-bit mode at the same resolution.

All features of the third generation are implemented and, in some cases, improved. They provide additional trigger and exposure modes as well as multi-ROI and capture modes. Short and long exposure features are included as well as a high dynamic range (HDR) mode with 2 different conversion gains.

The IMX532 offers 16 megapixels in a widescreen format with 5.3k by 3.0k resolution. The sensor output interface transmits at a data rate of 38 Gbps while the new IMX926 uses two additional lanes to output at almost 100 Gbps. This requires mating to 25 Gigabit Ethernet or multiple CoaXPress v2.0 lanes data interfaces to take advantage of these speeds.

The IMX540, IMX542, IMX935 and IMX936 are slower; cost-effective versions offering 2.5 to 3 times slower framerates. The output of these sensors matches well with camera platforms using USB 3.1 Gen 1, 5 / 10 Gigabit Ethernet, CoaXPress v1.0, or Camera Link interfaces.

Short spec

High-speed	IMX532	IMX926	IMX530	IMX925
Low speed	IMX542	IMX936	IMX540	IMX935
Resolution [MP]	16.9	12	24.55	24
Horizontal [px]	5328	4128	5328	5328
Vertical [px]	3040	3008	4608	4608
Optical format [inch/mm]	1/1 type	1/1.1 type	1.2 type	1.2 type
Pixel pitch [µm]	2.74	2.74	2.74	2.74
Frame rate [fps at Bits per Pixel]	159@8 152.5@10 111@12 (IMX532) 52.6@8 42.9@10 36@12 (IMX542)	660@8 588@10 318@12 (IMX926) 339@8 302@10 162@12 (IMX936	106.9@8 102.6@10 74.5@12 (IMX530) 35.1@8 28.6@10 24@12 (IMX540)	442@8 394@10 212@12 (IMX925) 225@8 200@10 107@12 (IMX935)
Aspect ratio	7:4	4:3	15:13	4:3
Interface	SLVS, SLVS-EC	SLVS-EC	SLVS, SLVS-EC	SLVS-EC

Square is the New Circle

These sensors feature a square aspect ratio and 20 megapixels. They make optimal use of the field of view of the camera lens and provide maximal resolution of square or round objects. This is especially relevant for imaging applications where a high spatial resolution is required.

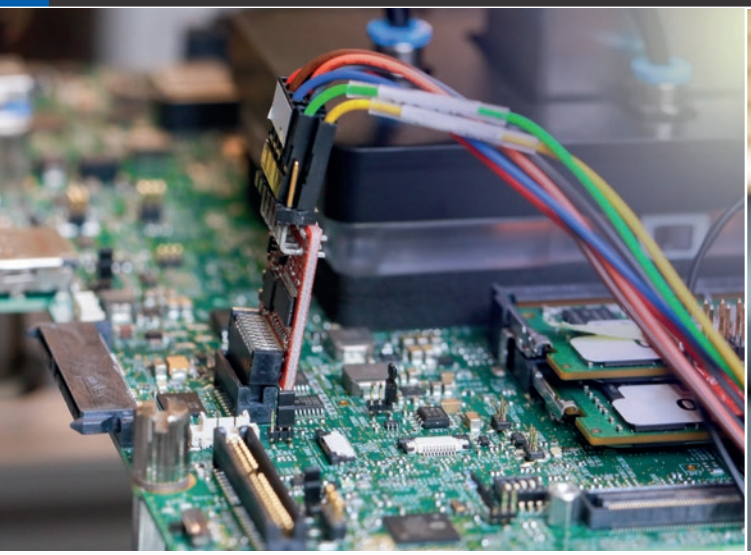
Like all fourth-generation Pregius technology imagers, these sensors maintain a small optical format of 1.1" despite their high resolution with their smaller, 2.74 µm, stacked pixels. This makes them compatible with high-resolution C-mount lenses and compact camera designs. Microscopy and high-end quality inspection benefit from these sensors by replacing multi-camera setups providing similar overall area of inspection. The high resolution allows for the detection of smallest defects in surfaces, displays, PCBs, solar panels, and other products with challenging quality requirements.

The IMX531 features a frame rate of up to 109 fps at 8 bit enabling maximum throughput and productivity of machines on manufacturing lines. With their compact size, cameras utilizing this sensor are popular with demanding applications in Vision Guided Robotics. The IMX536 offers faster frame rates at a smaller resolution which can be ideal for monitoring fluids looking for microscopic debris to be filtered.

The slower IMX541 offers a sufficient video rate for recording in medical or industrial microscopy, monitoring, or high-end aerial surveillance. The video stream can be displayed on two 8K or four 4K screens. On the other hand, applications looking to continue to use Full HD displays, the IMX546 provides the necessary resolution at reduced speeds.

Short spec

High-speed	IMX536	IMX531
Low speed	IMX546	IMX541
Resolution [MP]	8.1	20.35
Horizontal [px]	2856	4512
Vertical [px]	2848	4512
Optical format [inch/mm]	2/3 type	1.1 type
Pixel pitch [µm]	2.74	2.74
Frame rate [fps at Bits per Pixel]	194@8 193.6@10 127.2@12 (IMX536) 91@8 81.6@10 60.8@12 (IMX546)	109.1@8 104.7@10 76@12 (IMX531) 42.7@8 34.2@10 28.8@12 (IMX541)
Aspect ratio	1:1	1:1
Interface	SLVS, SLVS-EC	SLVS, SLVS-EC



Big and Fast

Sometimes applications just can't compromise; they need a large image with a fast refresh rate. These fourth-generation sensors were designed to meet these requirements.

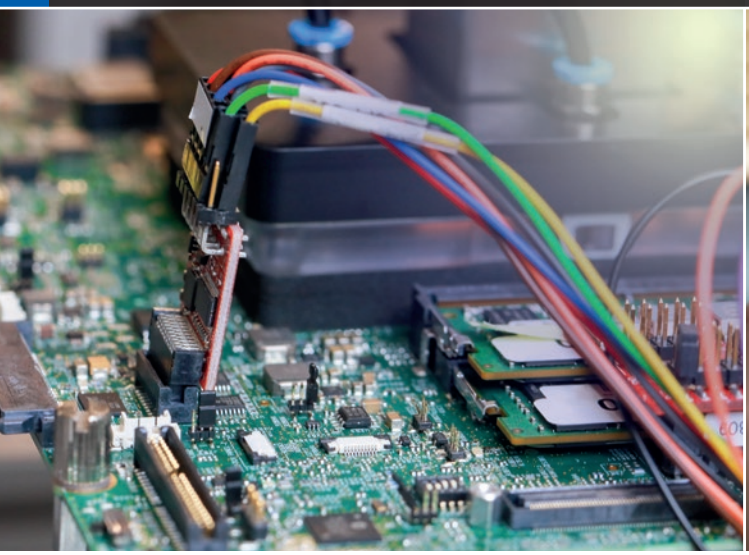
Utilizing the latest version of the SLVS-EC specification and adding additional lanes gives them the power and performance to stream very large FOV images at a relatively high fps. By using this data interface also makes designing in these sensors much easier and more compact.

More areas can be covered with just one camera. No need to have multiple cameras to see the same FOV. Avoid the struggles of synchronizing them and stitching them together. Get the same results or better by using a vision system using one of these imagers.

Still want the resolution but don't need the speed? Leverage the lower speed versions to capture the same image information and quality while reducing the overall bandwidth needed to transfer them.

Short spec

High-speed	IMX927	IMX928	IMX929
Low speed	IMX937	IMX938	IMX939
Resolution [MP]	105	68	50
Horizontal [px]	10248	8256	8200
Vertical [px]	10248	8256	6152
Optical format	2.5 type	2.0 type	1.8 type
Pixel pitch [µm]	2.74	2.74	2.74
Frame rate [fps at Bits per Pixel]	112@8 102@10 73@12 (IMX927) 56@8 51@10 36@12 (IMX937)	138@8 126@10 90@12 (IMX928) 70@8 64@10 45@12 (IMX938)	225@8 201@10 136@12 (IMX929) 115@8 102@10 69@12 (IMX939)
Aspect ratio	4:3	1:1	1:1
Interface	SLVS-EC	SLVS-EC	SLVS-EC



Embedded Vision

Embedded Vision needs a small, lightweight, and low-powered sensor. MIPI CSI-2 is a common interface standard for these image sensors as it is predominant for mobile phones and automotive vision. With such requirements in mind, Sony has expanded the Pregius technology range with low resolution and highly compact image sensors that are targeting embedded vision applications.

These highly integrated systems typically include one or more image sensors and single-board image processing units that include one or many FPGAs, ISPs, DSPs, GPUs, and CPUs. Many of these devices have native MIPI CSI-2 support, making it easy to directly connect these new sensors without the need for interface hardware/software. Onboard processing of the image data can be done with minimal data outputs, reducing the need for expensive and fast data interfaces. Some areas where these smart devices are becoming more common include autonomous conveyors in factories and automation tasks on manufacturing lines, for example.

In many cases, a minimum 60fps and global shutter readout is mandatory with monochrome sensors being more commonly requested and implemented. The IMX297 sensor offers a 0.4 MP (VGA) resolution.

With 1.60 MP, the IMX296 features four times the resolution of the IMX297 in the same 1/2.9" sensor size, enabling the coupling of low cost, readily available M12 lenses. Thanks to its 60 fps, the IMX296 is well suited for compact systems that monitor processes or moving objects.

Short spec

Sensors for EV	IMX297	IMX296
Generation	2nd Generation	2nd Generation
Resolution [MP]	0.40	1.60
Horizontal [px]	728	1456
Vertical [px]	544	1088
Optical format	1/2.9 type	1/2.9 type
Pixel pitch [µm]	6.90	3.45
Frame rate [fps at Bits per Pixel]	120.8@10	60.3@10
Aspect ratio	4:3	4:3
Interface	MIPI CSI-2	MIPI CSI-2

High Resolution Embedded Vision

As more embedded applications are being created, the demand for higher resolutions is increasing. For this reason, more sensors have been introduced to address this need with resolutions starting at 5.1 MP up to 12.4 MP. These sensors, with their MIPI CSI-2 data interface, can be directly connected to many popular embedded processors with additional components or connection logic.

The 12.4 MP IMX565 provides a 4:3 aspect ratio within a 1/1.1" optical format that aligns with many C-Mount lenses already available in the market. It runs at a modest 42 fps over its MIPI CSI-2 data interface. The IMX567 has similar characteristics and boasts a 5.1 MP image that streams up to 96 fps, in 8-bit mode.

The IMX566 has great image response in a square, 1:1, aspect ratio ideal for industrial and scientific microscopy and astrophotography. Running at 62 frames in 8-bit mode, it can be mated with high end custom optics or with off the shelf C-Mount lenses.

All these sensors benefit from the incredible picture quality offered by the Pregius S technology pixel architecture that they are built on. They also benefit from the rich feature set included in the fourth generation series including the short interval shutter, and exposure period output monitoring.

The unique pixel structure of the IMX900 sets it apart from all the other sensors in this category. Its smaller, 2.25µm pixel architecture, permits the use of smaller, less expensive, lenses while still performing as well or better than its older, bigger brothers. It provides brighter images, with wider dynamic ranges, which make it ideal for more light challenged applications. Unique features like On Chip Fast Auto Exposure, Quad Shutter Mode and Quad HDR mode ensure that it will be the sensor of choice for new camera designs in bar code reading, factory automation and other applications needing these features.

Short spec

High Resolution Sensors for EV	IMX567	IMX568	IMX566	IMX565	IMX900
Generation	4th Generation	4th Generation	4th Generation	4th Generation	2.2 series
Resolution [MP]	5.1	5.1	8.1	12.4	3.2
Horizontal [px]	2472	2472	2856	4128	2064
Vertical [px]	2064	2064	2848	3008	1552
Optical format	1/1.8 type	1/1.8 type	2/3 type	1/1.1 type	1/3.1 type
Pixel pitch [µm]	2.74	2.74	2.74	2.74	2.25
Frame rate [fps at Bits per Pixel]	96.2@8 79.1@10 67.2@12	96@8 79@10 67@12	62.6@8 51.3@10 43.4@12	42.6@8 34.6@10 29.2@12	120.9fps@8 113.2fps@10 70.6fps@12
Aspect ratio	5:4	5:4	1:1	4:3	4:3
Interface	MIPI CSI2	MIPI CSI2	MIPI CSI2	MIPI CS	MIPI CSI2, SLVS

Typical Applications

High-end Manufacturing Automation and Logistics

Production managers are under constant pressure to increase the output quality and productivity of their facilities while at the same time reducing the total costs of manufacturing lines. Furthermore, the new Industry 4.0 revolution calls for utmost flexibility in production and logistics. The high speed, resolution, image quality and the rich feature set of SONY Pregius sensors provides unprecedented opportunities to build very flexible machine vision systems with high accuracy and throughput at moderate costs.

Features and Benefits:

- **High resolution** allows for more detailed inspection, especially in the inspection of display panels, solar panels, and wafers, for example, the detection of the smallest imperfections in food and glass production.
- **High frame rates** allow for more throughput/ productivity while the ROI and multi-ROI features minimize excess image data and provide even higher readout speeds. Vision guided robots and 3D cameras, using structured light or laser lines, benefit from these fast frame rates.
- **Sensitivity** enables very short exposure times which minimizes blur of fast-moving objects like on items on a conveyor belt, or if the camera is moving while on a robotic arm.
- **Larger full-well cpacity** leads to higher dynamic range when combined with high bit ADCs that enable image captures that produce detailed pictures of shiny or specular surfaces or can minimize the impact of speckle and/or glare from scenes where external light sources are not controllable, typical of traffic applications.
- **Features** like various trigger modes, sequencing, fast trigger response, trigger-controlled exposure times, and more, reduce the need for external control peripherals while allowing new innovative solutions for the most demanding applications.
- **Lower cost** variants with a minimized feature set target cost-sensitive, large volume applications that do not require these advanced options.
- **Very small package** and **MIPI interface** open embedded vision applications to high end global shutter sensors adding high functionality and features set while reducing sensor and system cost.

High Resolution Rates

The Compactness of the fourth-generation pixel architecture provides up to approx. 25 MP images with high sensitivity to be used with a C-mount sized lens and in typical industrial cameras with 29x29 mm footprint.

Security

Access control, passport validation, and optical inspection of personal identification devices are a few of the various imaging applications in the security sector. The better the images captured, the more reliable is the verification processes of retinas, finger, and palm prints, ID cards, or bank notes..

Features and Benefits:

- **Sensitivity and low noise** are especially important for retina scans. The light intensity that can be used is limited so as not be blinding to the patient, but exposure times must be short to cope with continuous eye movements. For these reasons, the first and third generation sensors are ideally suited for this application.
- **Wide dynamic range** for automatic passport inspection machines as the ambient light cannot always be controlled. Background light sources and reflections from glasses will affect the image quality and the proper recognition of faces being scanned. Similarly, reflective security features, like holograms, require detailed texture resolution in both in bright and dark regions, and so benefit from the industry's leading characteristics of these sensors.

Sports and Entertainment

This broad application field has rapidly evolved over the last few years. Sports like basketball, soccer, baseball, and hockey require continuous tracking of players and equipment for real-time analysis and rule enforcement. High speed, high frame rate video can be slowed to better show fast moving objects or players providing fascinating and insightful views for audiences which can then be further augmented with overlays and virtual reality artifacts that provide more detailed analysis of the scenes or actions.

Features and Benefits:

- **High frame rates** enable accurate analyses of physical processes as well as the fine movements from athletes or animals. Slow motion replays are more intriguing with higher frame rates and global shutters to completely stop motion in each video frame with less blur and distortion. Sony's Pregius technology sensors can reach greater than 1000 frames per second, which is increased with smaller regions of interest.
- **High resolutions** offer more spatial detail in one image without the need for multiple images from one or more cameras to be matched, aligned, and stitched together. With up to 12 megapixels, large sections of a playing field can be viewed in detail with ease.
- **Wide dynamic range** is key for all outdoor applications or in stadiums where sections of the playing field are shadowed while others are in bright sunlight.

Typical Applications (cont'd)

Intelligent Traffic Systems and Transportation

Vision systems play a pivotal role in the management and monitoring of ever-increasing traffic volumes and the growing complexity in transportation and traffic safety. In cities with scarce parking resources or need to monitor public transport, image processing can help.

Features and benefits:

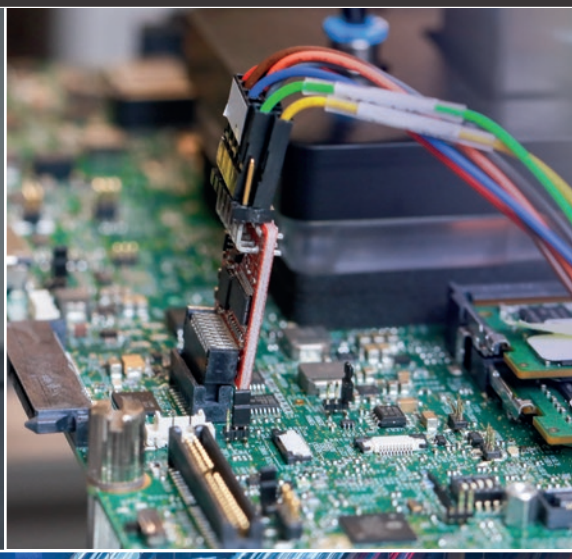
- **High resolution,** 31.5 megapixels sensors built into a single camera can monitor larger areas, such as multiple lanes on a highway. This reduces costs and system complexity.
- **Amazing image quality** can be had with highly sensitive, large capacity pixels that provide wide dynamic range image captures of drivers and license plates for tolling or law enforcement. These ensure reliable, clear images, even under challenging light conditions, that ensure accurate detection and reading of number places even under challenging conditions such as reflections, shadows, and direct sunlight.
- **NIR sensitivity** is increased with the deep pixel wells of the Pregius technology architectures, making them especially interesting for outdoor, nighttime applications, especially if combined with NIR light sources.
- **Compact sensors** of the fourth-generation series enable high, 24.6 MP, camera resolutions that are still compatible with C-mount lenses and compact camera designs.

Surveillance

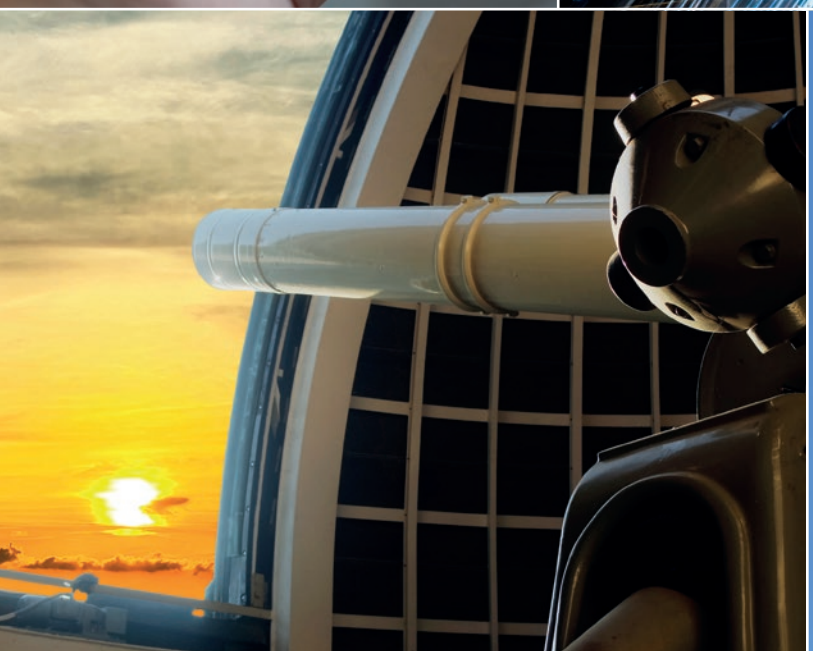
Demands in the growing CCTV market are shifting to higher resolutions and higher frame rates in part thanks to new efficient video compression standards. The need for capturing larger scenes are more dominant now and needs to be captured with greater detail for robust face and license plate recognition.

Features and Benefits

- **High resolution,** 1920 x 1080, full HD resolution is standard today. Newer standards are now looking to 4K formats for their next generation products which is pushing camera designers to match and provide products with this next professional resolution.
- **Improved image quality** with low noise using monochrome sensors to enable cameras to capture images with starlight sensitivity. Details can be seen in both bright and dark scenes and at high amplification.
- **Global** shutter-based vision systems prevent geometrical distortion from motion artifacts on moving objects or when cameras are moving.




SMART HOME



How We Can Support Your Application

RESTAR FRAMOS supports industrial customers, OEMs, system integrators, and researchers overcome imaging challenges. We work with our clients to select the right products meet their application requirements.




We provide:

Requirements Analysis

Product Selection Support

Evaluation Tools

Experienced Design-in Support

Commercial Flexibility

Quality Management

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

Requirements Analysis

At RESTAR FRAMOS, our goal is to enable our customers to leverage imaging and vision technology, to be ahead of the competition, and to create cutting- edge business solutions in their field. This means that working to find the best solution for our customers is our number one priority. As the experts in the industry, we listen to you, understand your requirements, and

find a solution that best fits your needs. Our experts are available to assist in selecting the right components that meet the requirements for your vision system.

Product Selection Support

After a requirements assessment, our vision experts will work together with you to determine how to fulfill your requirements.

Expertienced Design-in Support

To fully understand the specifications of the sensor, we provide you with all necessary data, test measurements and development tools needed to create your vision system. Evaluation boards are available to ensure a full analysis and review can be done fairly to ensure best selection of key components.

Evaluation Tools

Evaluation Boards (EVB) help camera manufacturers and OEMs in the development, selection and integration of sensors into their image processing applications and vision systems. An EVB is an excellent development tool that can be used through all stages of product design. The Sony's EVB kits allow for detailed test and measurement with access to 'truly raw data' from the sensor, as well as its configuration and status information. It serves as a test tool to help you evaluate whether a particular sensor has the required image quality and performance for your application.

The EVB provides direct access to the output data for the image sensors running in any mode. This raw pixel data ensures you are seeing the true performance of the sensor. The purity of this data allows designers to get a head start on the image pipeline and downstream image processing. With the use of an EVB, designers have complete control of the sensor enabling you to evaluate it to see if it will perform exactly as you need it to.

With the use of an evaluation board, the development of the image pipeline can be started at an early stage while providing the ability to test several lenses under your operating conditions. Costs are significantly reduced with the use of an EVB as it allows you to fully analyze and assess the true performance of the sensor under your operating conditions, which will reduce development time.

Commercial Flexibility

To provide you with the flexibility you need, RESTAR FRAMOS offers frame contracts allowing products to be in- stock and available as you need them. This ensures the sensors you need are always available and delivery delays or product discontinuations will not affect their availability. Consignment stock can be set up to help with long production cycles to ensure you get the products when you need them.

Quality Management

On-time delivery, highest quality products, and warehousing are areas where RESTAR FRAMOS is known and makes us a reliable partner in your logistic services. Our cleanroom warehouses are in accordance with DIN EN ISO 14644, Clean Room Class 5. The ESD certification ensures ESD compliant clothing, conductive shelves and floors, and special packaging regulations for conductive packaging reduce electrostatic charging. Moisture and temperature control, as well as ionization fans ensure high quality ambient conditions. Our RESTAR FRAMOS warehouses are monitored and certified by Sony.

RESTAR FRAMOS product and business processes, developments, and logistics are ISO 9001-certified. This certification ensures that everything that leaves our warehouses consistently adheres to the highest quality standards. RESTAR FRAMOS continuously monitors its quality metrics and always strives to improve on the industry's best practices.

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