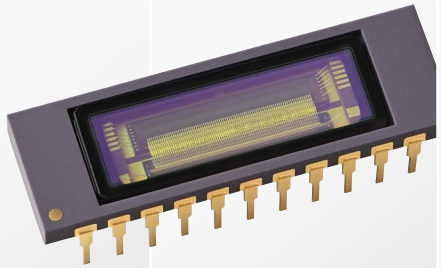
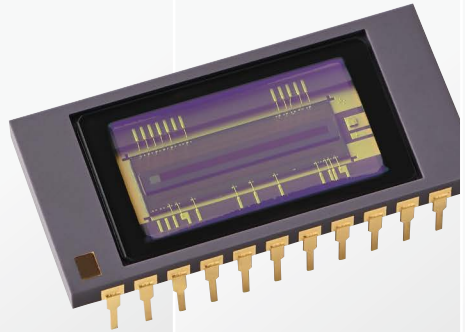
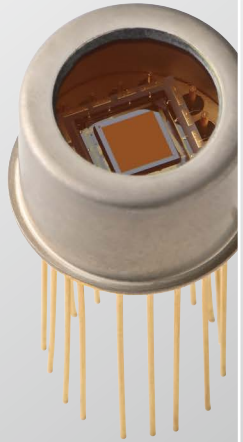
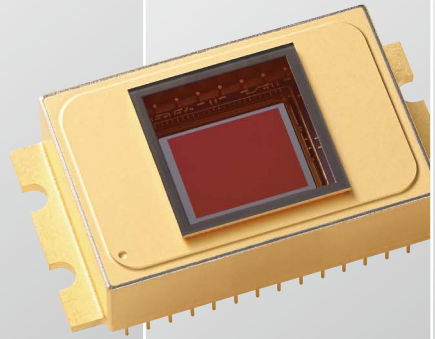
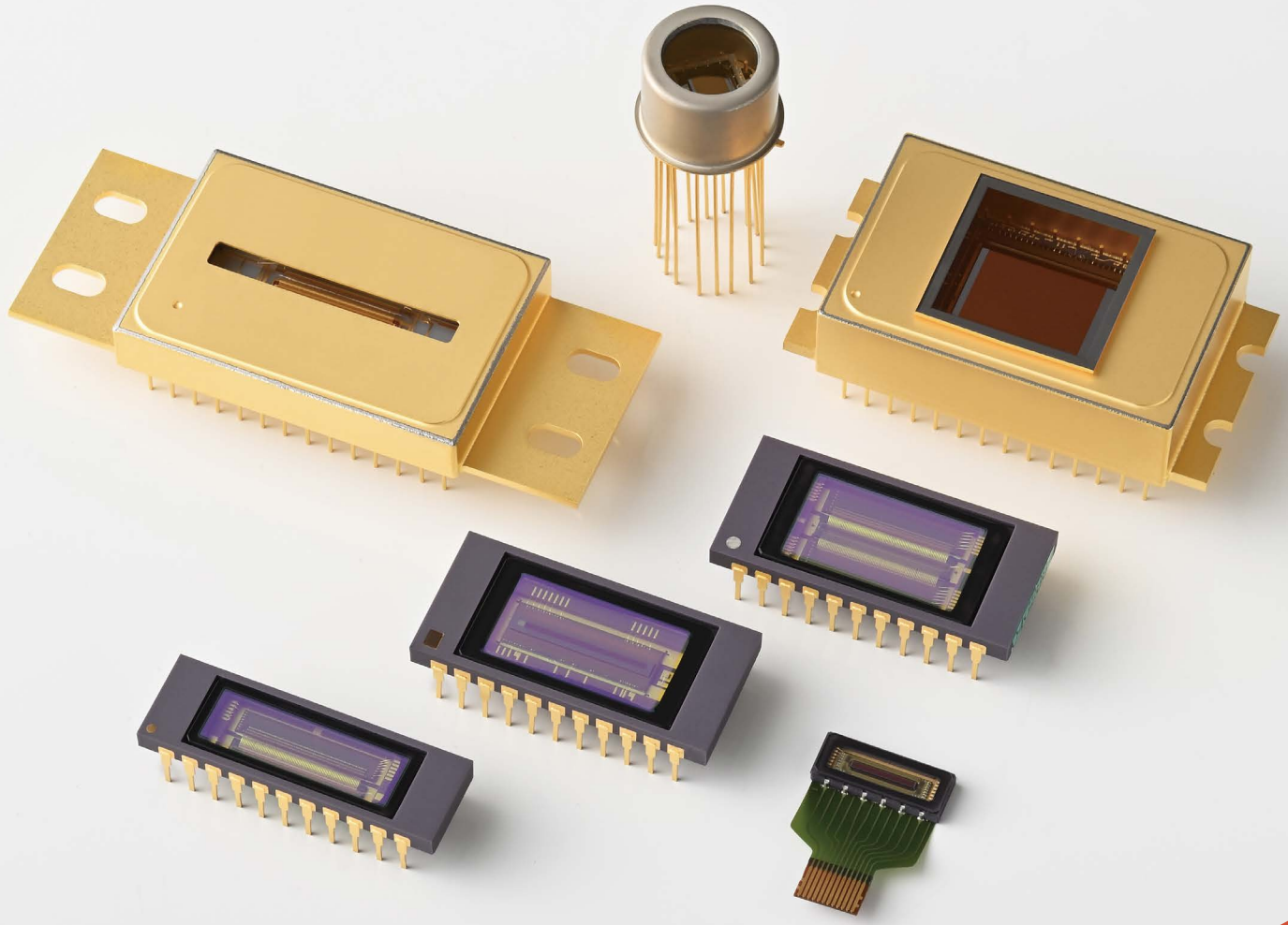
Image sensors for near infrared region

InGaAs Image sensors

InGaAs Image sensors



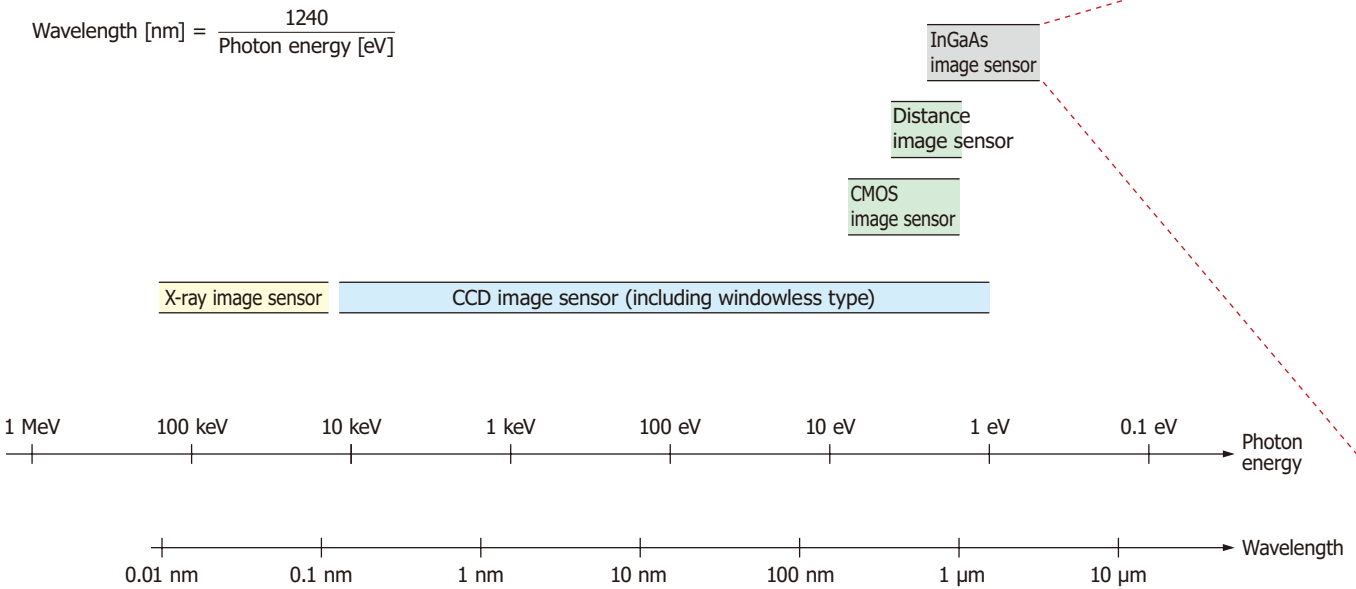
Various InGaAs linear/area image sensors for near infrared region

We offer a wide range of products that adopt a hybrid structure of an InGaAs array with different wavelength ranges, pixel sizes, and numbers of pixels, together with high-performance CMOS readout circuit (ROIC).

Hamamatsu image sensors

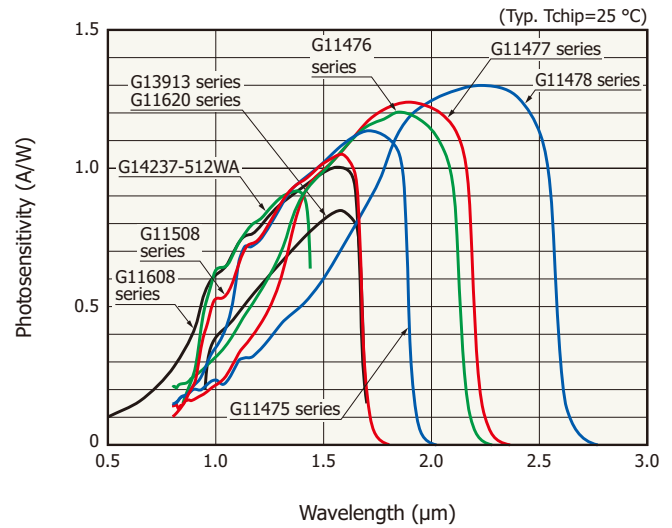
Hamamatsu has developed and produced image sensors supporting broad wavelength regions such as near infrared, visible light, ultraviolet, vacuum ultraviolet (VUV), soft X-rays, and hard X-rays.

● Example of detectable energy and spectral response range



● Spectral response

[InGaAs linear image sensors]



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InGaAs image sensors achieve high sensitivity at wavelengths from 0.5 to 2.55 µm.

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CMOS technology, Hybrid technology

CMOS technology

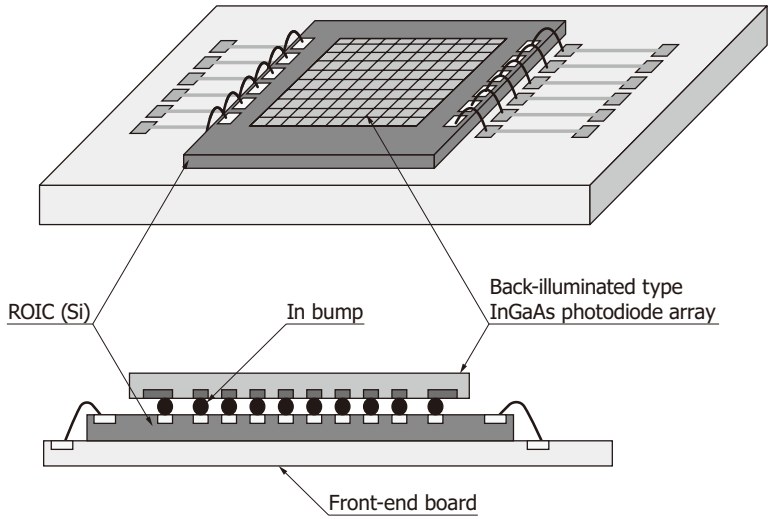
Hamamatsu has made CMOS signal processing circuits with various analog and digital functions using our unique process technology, and realized high-performance, multi-functional image sensors.

· Supports photosensitive areas of various specifications (compound semiconductor, one- and two-dimensional array, large area)
· High function (high-speed, partial readout, built-in A/D converter, global shutter, etc.)
· Flexible customization

Hybrid technology (three-dimensional mounting)

InGaAs image sensors employ a hybrid structure, in which the photodiode array used as the photosensitive area and CMOS signal processing circuit are implemented in separate chips and three-dimensionally mounted by using bumps. This construction is advantageous in that the shape of the photosensitive area, spectral response, and the like can easily be modified.

● Schematic of InGaAs area image sensor using fine-pitch bumps



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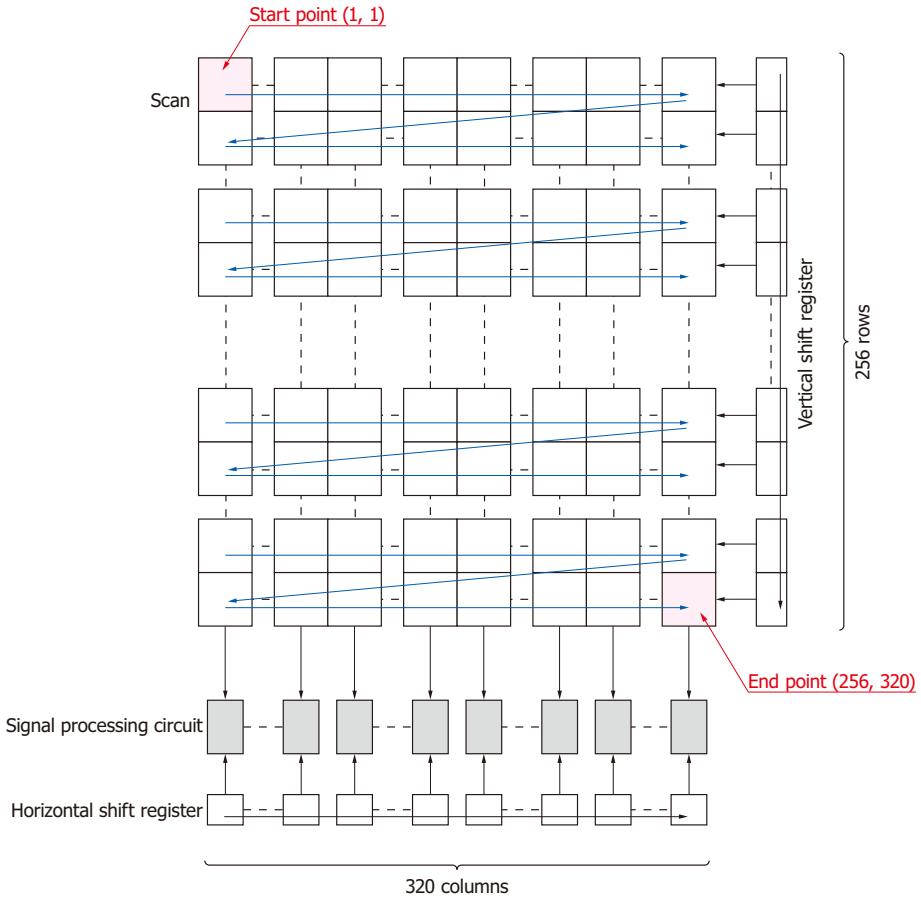
Partial readout function

The InGaAs area image sensors (G14671 to G14674-0808W) can partially read out pixels by specifying the start point coordinates and end point coordinates of the readout region. The partial readout function (for only one region) can be used for one-port readout.

All-pixel readout

Readout region: All pixels [320 (H) × 256 (V)]



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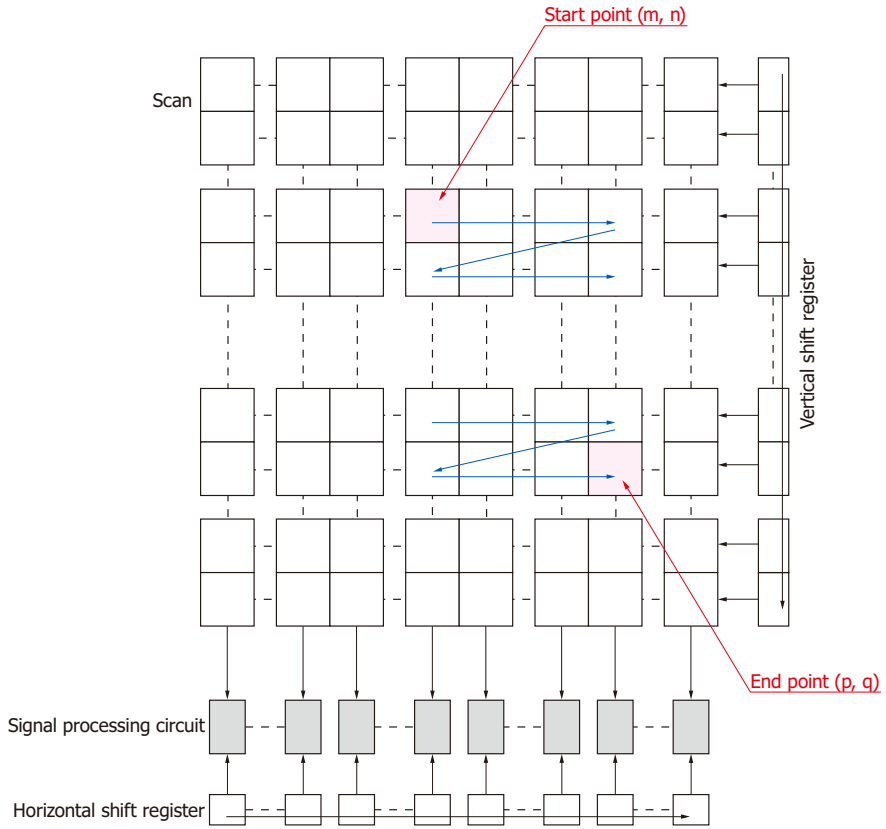
Partial readout

Readout region: Column n to q (H), rows m to p (V)



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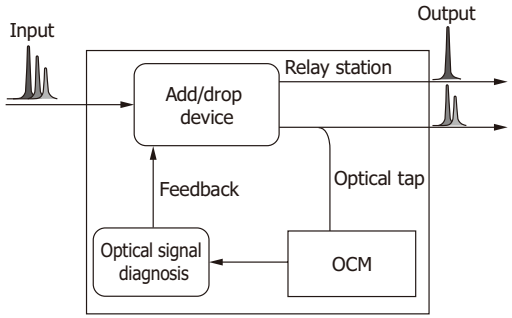
Application examples

Optical channel monitors



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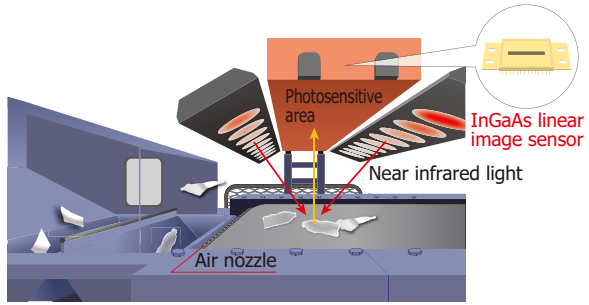
The InGaAs linear image sensor is used for the optical channel monitor in optical communication.

Plastic screening



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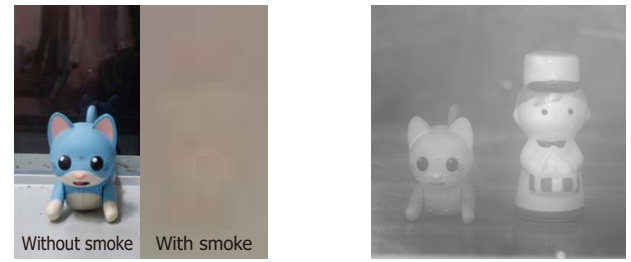
Plastic screening is performed by using the fact that when near infrared light is directed at plastic, the wavelengths that are absorbed varies depending on the material.

Security

[Visible]

[Near IR (LED's peak emission wavelength: 1.55 µm)]

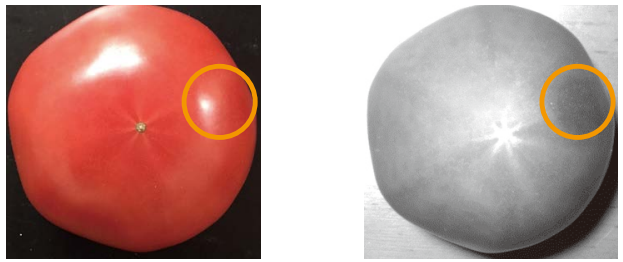


InGaAs area image sensors are used in monitoring cameras, etc. because they can easily capture near infrared images even when there is fog or smoke.

Farm product inspection

[Visible]

[Near infrared (LED's peak emission wavelength: 1.45 µm)]

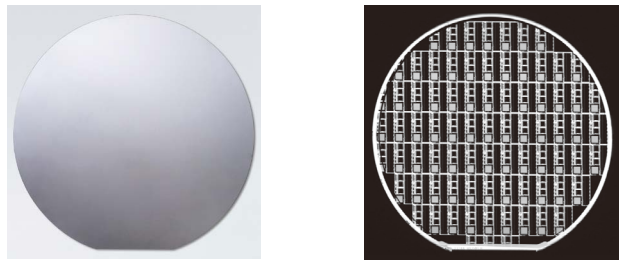


The InGaAs area image sensor is used to detect damaged areas (high moisture content) caused by pushing the tomato.

Semiconductor inspection

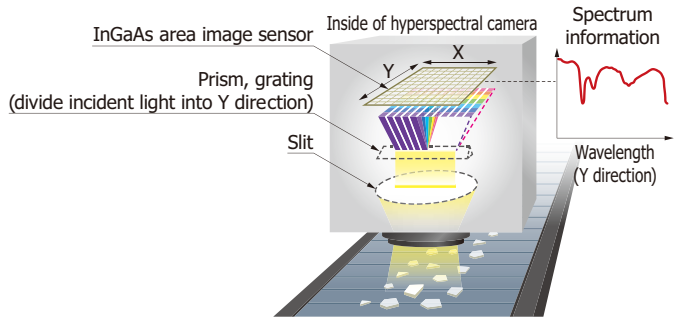
[Visible]

[Near infrared (LED's peak emission wavelength: 1.2 µm)]



The InGaAs area image sensor is used to detect the patterns of silicon wafers.

Hyperspectral imaging



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It can do high accuracy identification by acquiring spectral information using the InGaAs area image sensor.

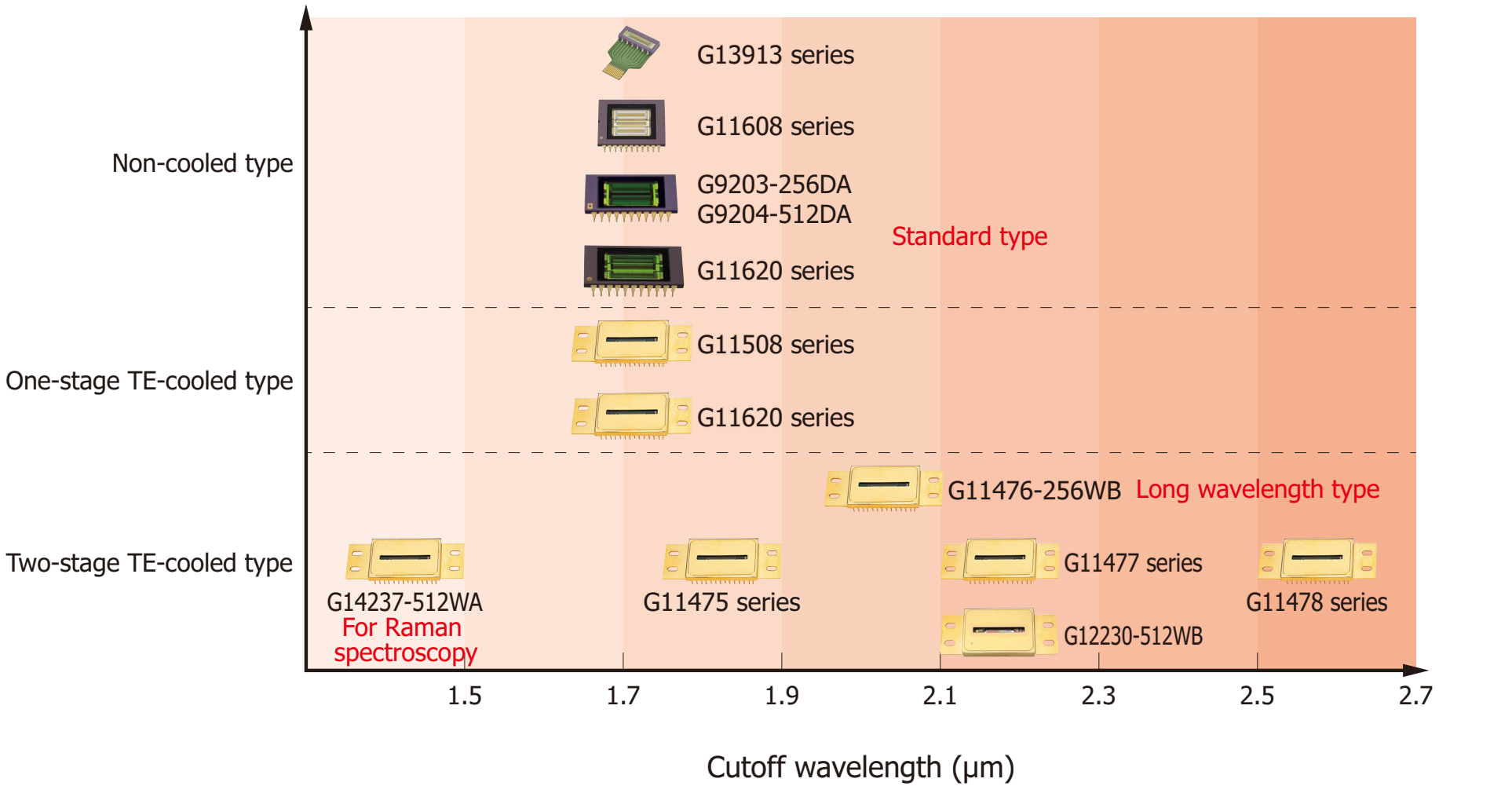
Lineup

InGaAs image sensors are used in a wide variety of applications in the near infrared region. Built-in CMOS signal processing circuit allows easy handling. They use a charge amplifier method, which can integrate electric charge to increase output signal, making it suitable for very low-level light detection.

Product name	Type	Overview
InGaAs linear image sensor	For near infrared spectrophotometry	One-dimensional image sensors for visible (VIS), near infrared (NIR), and short wavelength infrared (SWIR). They feature low dark current, low readout noise, and high scan rate. They are used for spectrophotometry, sorting machines, medical imaging, etc.
	For Raman spectroscopy	
	High-speed type (for line scan camera)	
InGaAs area image sensor	For near infrared imaging, etc.	Two-dimensional image sensors for near infrared and short wavelength infrared. They are used for hyperspectral imaging, sorting machines, process inspections, and night-vision cameras, etc.

InGaAs linear image sensors

For near infrared spectrophotometry



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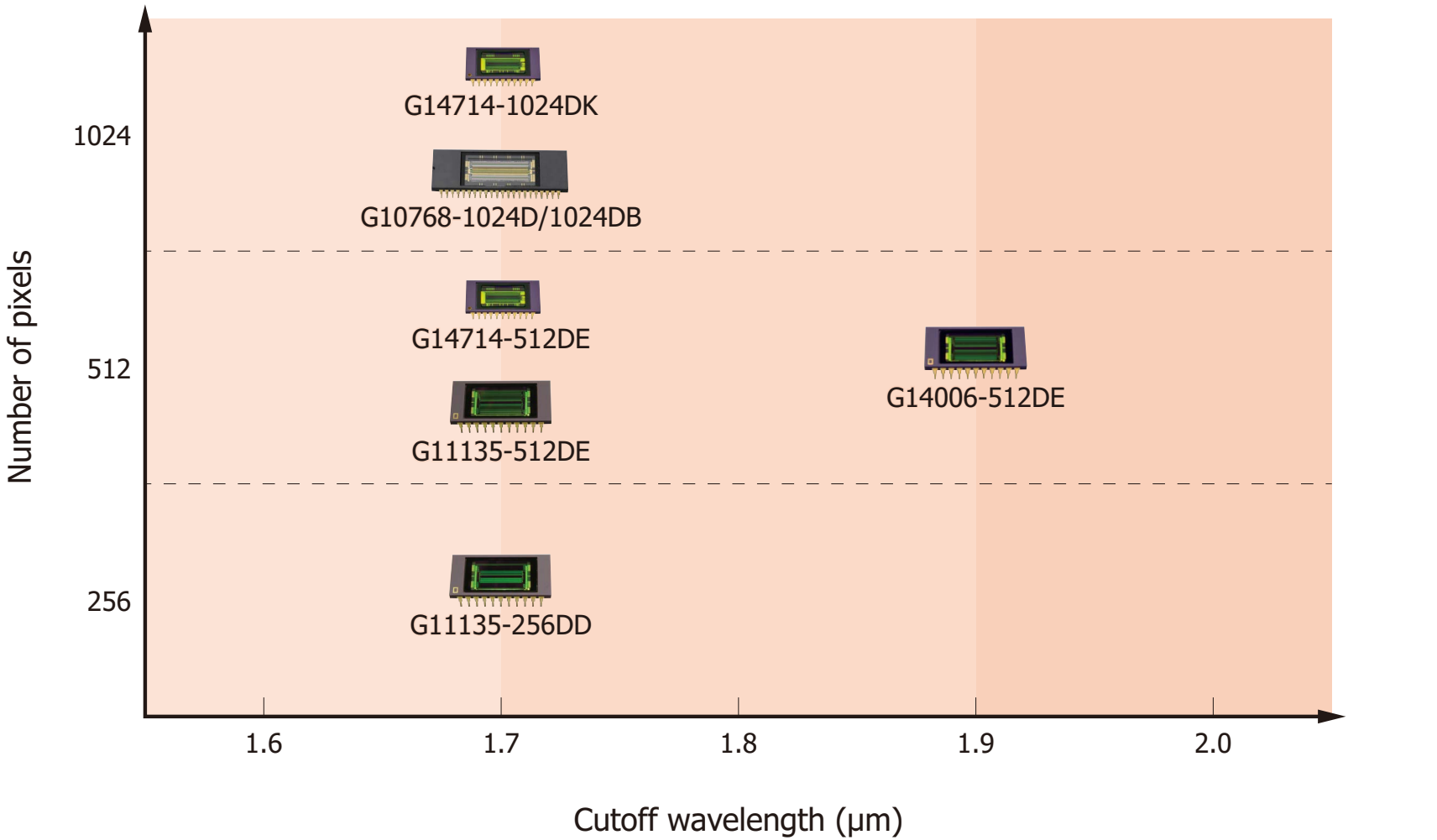
InGaAs linear image sensors

High-speed type (for line scan camera)



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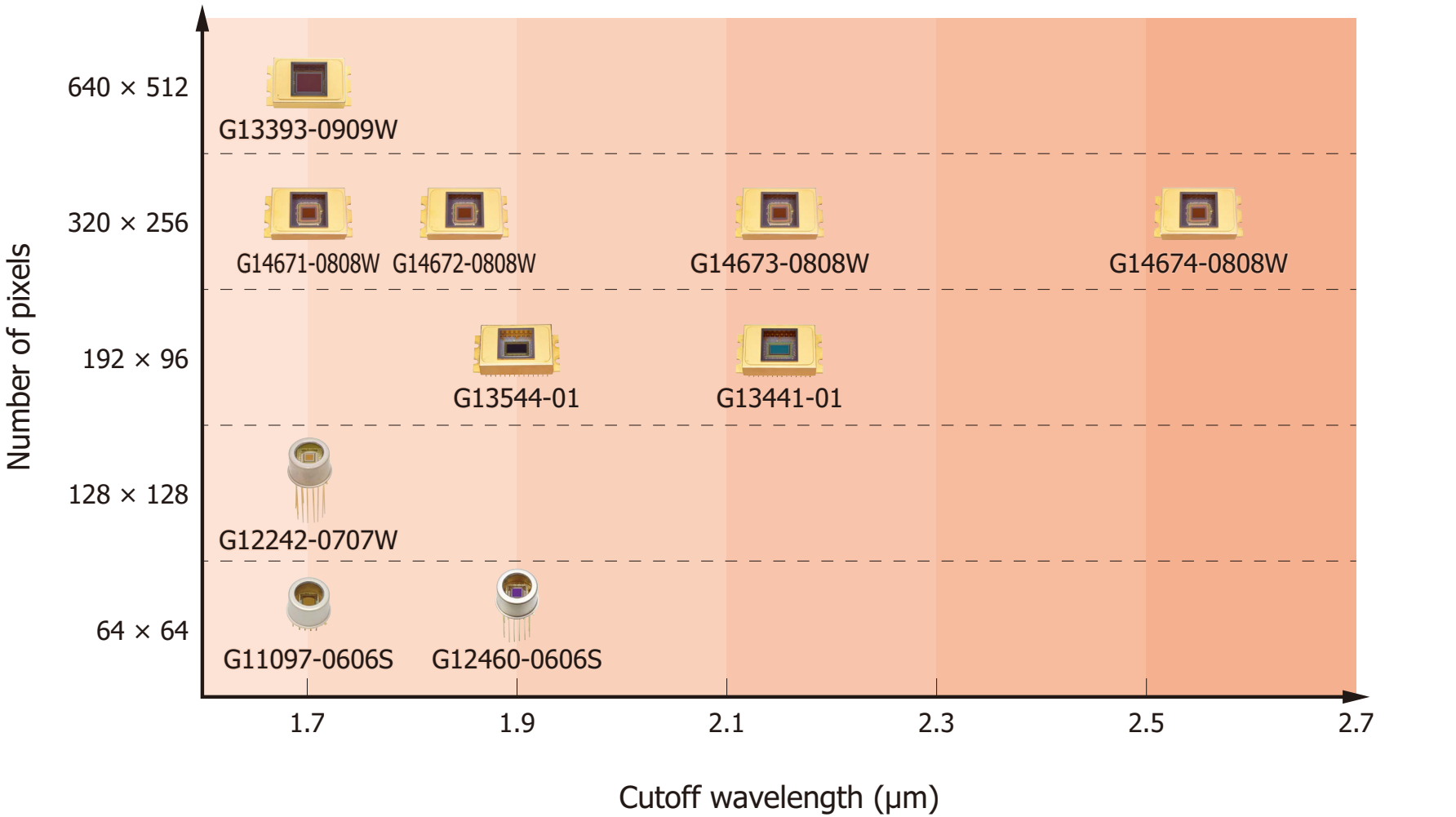
InGaAs area image sensors



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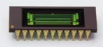
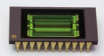
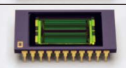
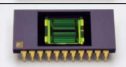
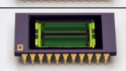
For near infrared spectrophotometry

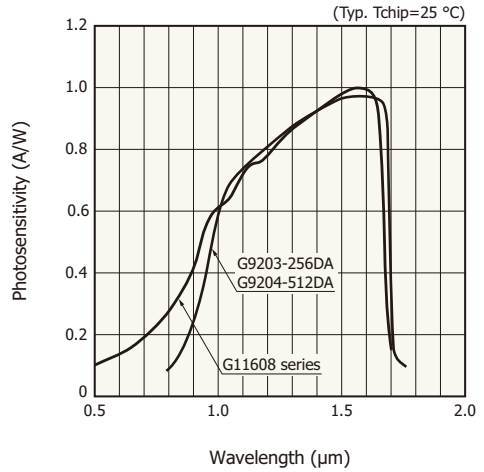
Standard type to 1.7 µm

Type no.	Cooling	Pixel height (µm)	Pixel pitch (µm)	Number of pixels	Line rate max. (lines/s)	Spectral response range (µm)	Defective pixels	Photo	Related products (sold separately)
G9203-256DA	Non-cooled	500	50	256	1910	0.9 to 1.7	0		–
G9204-512DA			25	512	960*				
G11608-256DA			50	256	17200	0.5 to 1.7	1% max.		–
G11608-512DA			25	512	9150*				
G11508-256SA	One-stage TE-cooled (Tchip=-10 °C)	500	50	256	17200	0.9 to 1.67	0		C16091 series
G11508-512SA			25	512	9150*				
G11620-128DA	Non-cooled	500	50	128	30800	0.95 to 1.7	1% max.		C11513
G11620-256DA				256	17200				
G11620-256DF			25	256	17200				
G11620-512DA				512	9150				
G13913-128FB		250	50	128	13600				–
G13913-256FG			25	256	7290				
G11620-256SA	One-stage TE-cooled (Tchip=-10 °C)	500	50	256	17200	0.95 to 1.67			C16091 series
G11620-512SA			25	512	9150				

* When reading with two video lines, the line rate is the same as 256 pixels.

Spectral response

[G9203-256DA, G9204-512DA, G11608 series]



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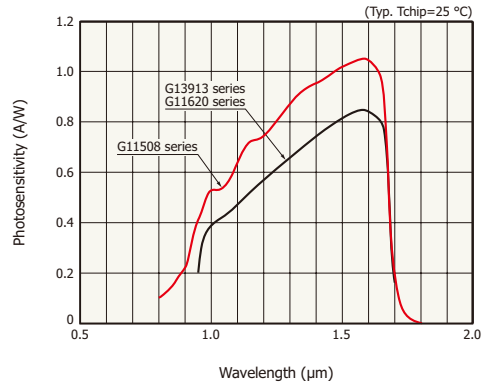
[G11508/G11620/G13913 series]



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For near infrared spectrophotometry

Long wavelength type

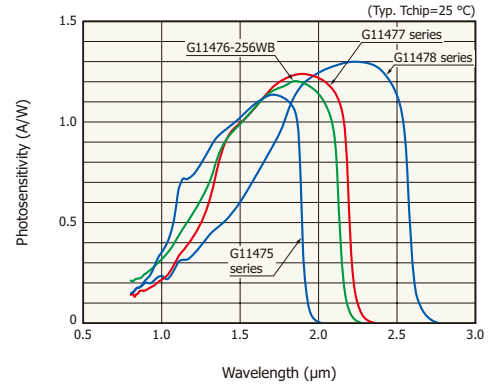
The G11475 to G11478 series are types that extend the spectral response range from 1.85 µm to 2.55 µm. The G12230-512WB has two types of InGaAs chips in a series configuration to achieve high S/N over a wide spectral response range.

Type no.	Cooling	Pixel height (µm)	Pixel pitch (µm)	Number of pixels	Line rate max. (lines/s)	Spectral response range (µm)	Defective pixels	Photo	Related products (sold separately)
G11475-256WB	Two-stage TE-cooled (Tchip=-20 °C)	250	50	256	17200	0.9 to 1.85	5% max.		C16091 series
G11476-256WB						0.9 to 2.05			
G11477-256WB						0.9 to 2.15			
G11478-256WB						0.9 to 2.55			
G11475-512WB			25	512	9150*	0.9 to 1.85	4% max.		
G11477-512WB						0.9 to 2.15			
G11478-512WB						0.9 to 2.55			
G12230-512WB						0.95 to 2.15	2% max.		

* When reading with two video lines, the line rate is the same as 256 pixels.

Spectral response

[G11475/G11477/G11478 series, G11476-256WB]



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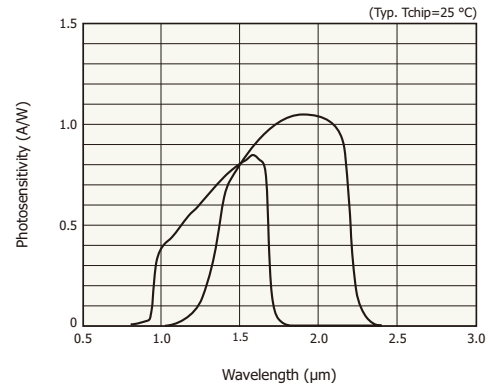
[G12230-512WB]



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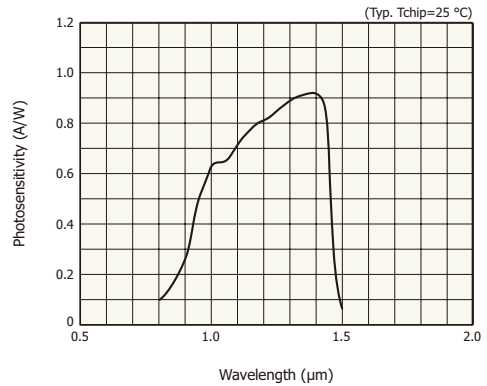
For Raman spectroscopy

This type is designed for Raman spectroscopy using a 1064 nm laser. It achieves lower dark current than the previous product (G11508-512SA).

Type no.	Cooling	Pixel height (µm)	Pixel pitch (µm)	Number of pixels	Line rate max. (lines/s)	Spectral response range (µm)	Defective pixels	Photo	Related products (sold separately)
G14237-512WA	Two-stage TE-cooled (Tchip=-20 °C)	500	25	512	9150*	0.85 to 1.4	1% max.		C16091 series

* When reading with two video lines, the line rate is the same as 256 pixels.

● Spectral response



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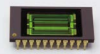
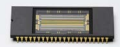
High-speed type

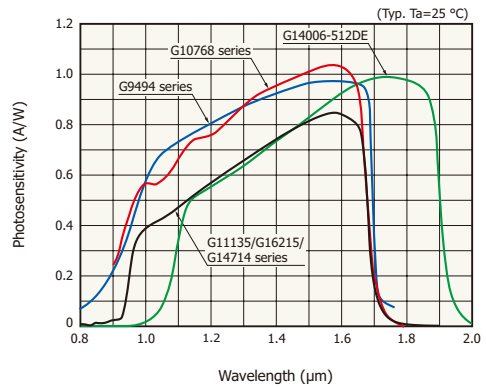
For line scan camera

These are high line rate types suitable for various industrial measurement instruments.

Type no.	Cooling	Pixel height (µm)	Pixel pitch (µm)	Number of pixels	Line rate max. (lines/s)	Spectral response range (µm)	Defective pixels	Photo	Related products (sold separately)
G9494-256D	Non-cooled	50	50	256	7100	0.9 to 1.7	1% max.		–
G9494-512D		25	25	512	3720*				
G10768-1024D		100		1024	39000				C10854
G10768-1024DB		25							
G11135-256DD		50	50	256	14000	0.95 to 1.7			C11514
G11135-512DE		25	25	512	8150	0.95 to 1.7			
G14006-512DE						1.12 to 1.9			
G14714-512DE		25	25	512	40000	0.95 to 1.7			C15853-01
NEW G14714-1024DG		250	12.5	1024	40000				–
G14714-1024DK		12.5							C15853-02

* When reading with two video lines, the line rate is the same as 256 pixels.

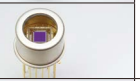
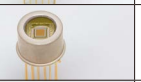
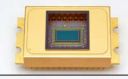
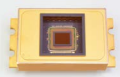
Spectral response



KMIRB0134EA

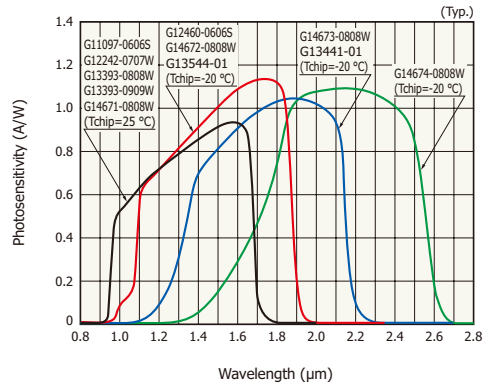
InGaAs area image sensors

These are used for near-infrared image acquisition (hyperspectral imaging, etc.), FSO (free space optics), and laser beam profilers, etc.

Type no.	Cooling	Pixel height (μm)	Pixel pitch (μm)	Number of pixels	Frame rate*1 max. (frames/s)	Spectral response range (μm)	Defective pixels	Photo	Related products (sold separately)
G11097-0606S	One-stage TE-cooled (Tchip=25 °C)	50	50	64 × 64	1025	0.95 to 1.7	1% max.		C11512
G12460-0606S	One-stage TE-cooled (Tchip=0 °C)					1.12 to 1.9			
G12242-0707W	Two-stage TE-cooled (Tchip=15 °C)	20	20	128 × 128	258	0.95 to 1.7	1% max.		C11512-02
G13393-0808W				320 × 256	228		0.37% max.		—
G13393-0909W				640 × 512	62				
G13441-01	Two-stage TE-cooled (Tchip=-20 °C)	50	50	192 × 96	867	1.3 to 2.15	1% max.		*2
G13544-01	Two-stage TE-cooled (Tchip=-10 °C)					1.12 to 1.9			—
G14671-0808W*3	Two-stage TE-cooled (Tchip=15 °C)	20	20	320 × 256	509	0.95 to 1.69	0.37% max.		C16090 series
G14672-0808W*3	Two-stage TE-cooled (Tchip=-20 °C)					1.12 to 1.85	1% max.		
G14673-0808W*3						1.3 to 2.15			
G14674-0808W*3						1.7 to 2.55			

*1: Integration time 1 μm (min.) *2: Dem equipment is available. *3: With partial readout function

Spectral response



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Related products

An InGaAs image sensor offers excellent performance, but it requires more complex drive electronics and signal processing than a single element. Driver circuits, multichannel detector heads, and image sensor modules compatible with our main InGaAs image sensors are available to easily evaluate and test Hamamatsu InGaAs image sensors.

Product name	Type no.	Features	Photo	Applicable sensors	
Driver circuit	C11513	USB 2.0 Interface		InGaAs linear image sensors (sold separately)	G11620-128DA/-256DA/-256DF/-512DA
	C11514	Compatible with CameraLink			G11135-256DD/-512DE, G14006-512DE
Multichannel detector head	C10854	Compatible with CameraLink		InGaAs linear image sensors (sold separately)	G10768-1024D/-1024DB
	C11512			InGaAs area image sensors (sold separately)	G11097-0606S, G12460-0606S
	C11512-02				G12242-0707W
Image sensor module	NEW C16091 series	USB 3.1 Interface		InGaAs linear image sensors (built-in)	G11508-256SA/-512SA, G11620-256SA/-512SA, G11475-G11478 series, G14237-512WA, G12230-512WB
	NEW C15853 series				G14714-512DE/-1024DK
	NEW C16090 series			InGaAs area image sensors (built-in)	G14671/G14672/G14673/G14674-0808W

Technical notes

InGaAs linear image sensors
InGaAs area image sensors

Precautions

Disclaimer
Safety consideration
Image sensors

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