Image sensors for scientific measurements and industrial equipment

CCD/CMOS image sensors

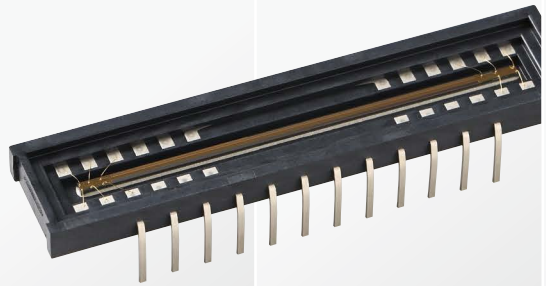
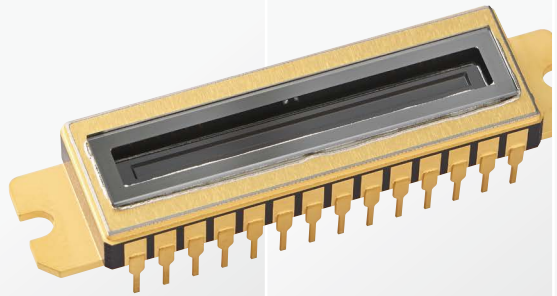
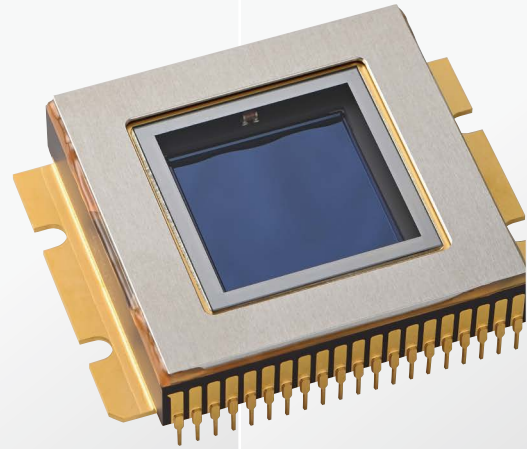
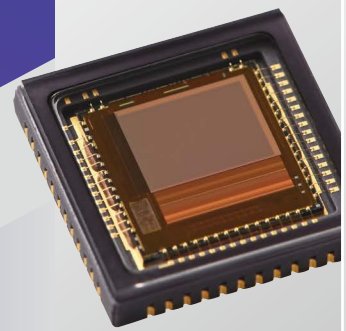
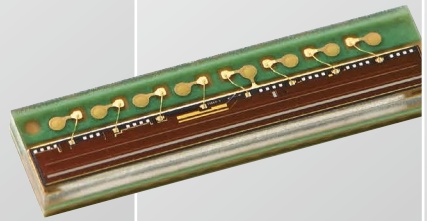







Image sensors
for scientific measurements and industrial equipment

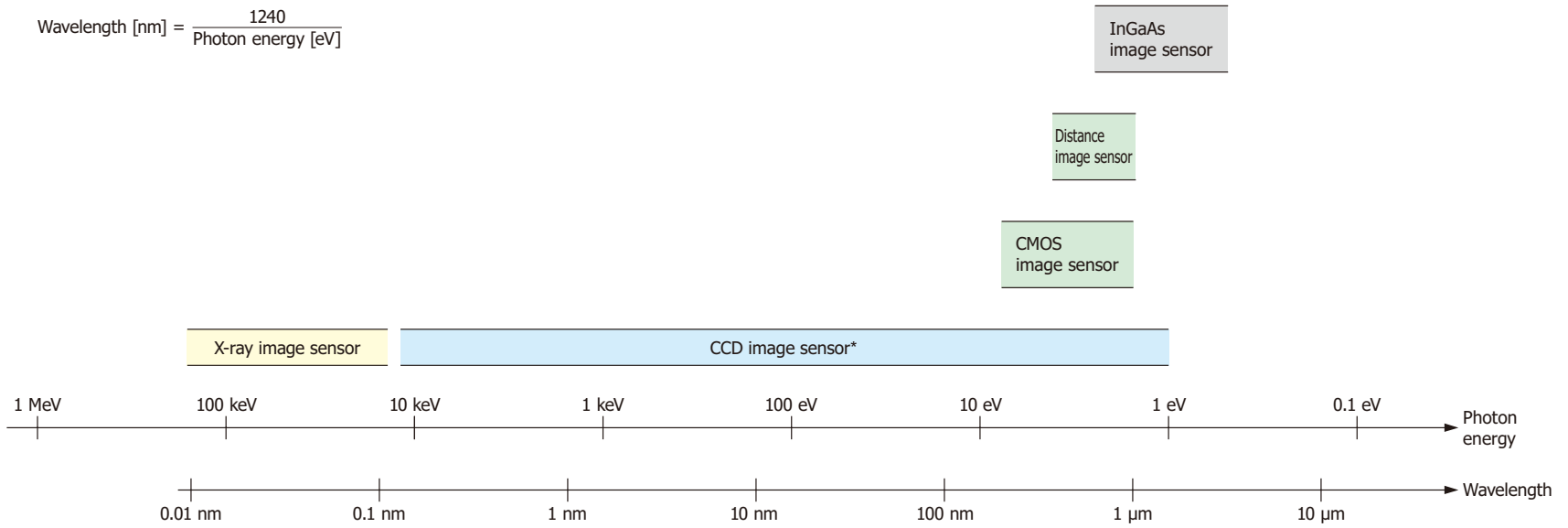
Hamamatsu Photonics offers a wide lineup of image sensors for different wavelengths and applications.
The CCD image sensors realize high quantum efficiency in the ultraviolet, visible, and near infrared regions.
The CMOS image sensors realize low price, low power consumption, and compact size.

Hamamatsu image sensors

Hamamatsu Photonics develops and manufactures image sensors compatible with various spectral ranges such as near infrared, visible light, ultraviolet, vacuum ultraviolet (VUV), soft X-rays, and hard X-rays.

Detectable energy and spectral response range

$$\text{Wavelength [nm]} = \frac{1240}{\text{Photon energy [eV]}}$$

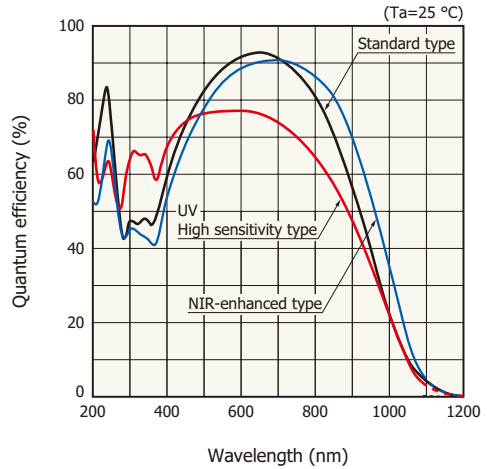


* No window for soft X-ray and hard X-ray

KMPDC1014EA

Spectral response (typical example, without window)

[CCD image sensors]



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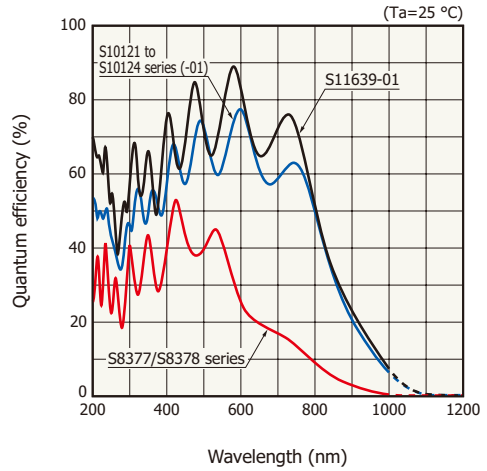
[CMOS image sensors]



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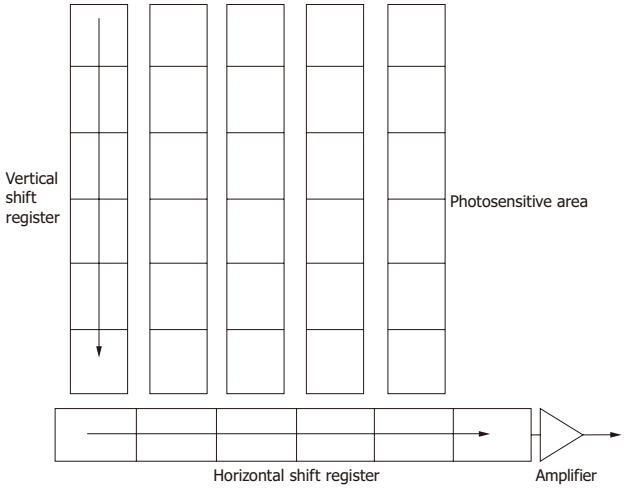
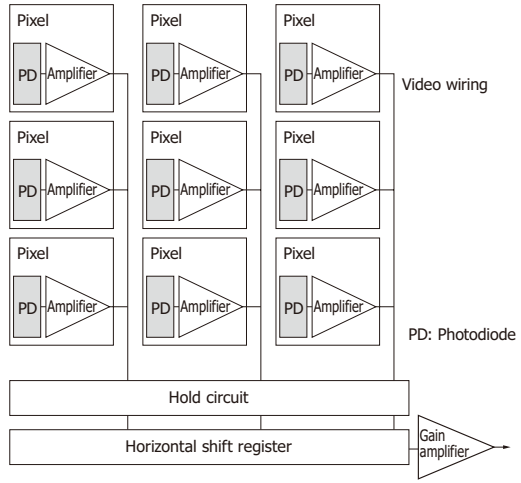
Features of CCD/CMOS image sensors

	CCD image sensors	CMOS image sensors
Structure (typical example)		
Amplifier	One amplifier for all pixels (in case of one-port readout)	One amplifier per pixel
Output	Analog	Digital or analog
Drive voltage	Multiple, High	Low
On-chip signal processing	Not possible	Possible
External circuit	Complex	Simple
Readout noise	Small	Small
Binning operation	Possible	Possible
Partial readout	Impossible	Possible
Dynamic range	Large	Small

Back-thinned type

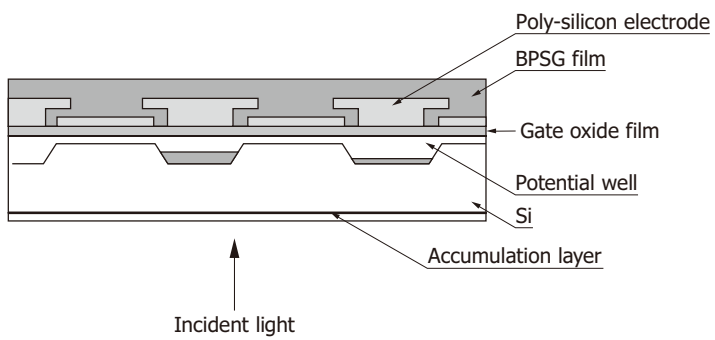
CCD image sensors

These realize high quantum efficiency in a wide spectral range.

The light incident surface of the front-illuminated CCD is formed on the surface of the silicon substrate on which the BPSG film, poly-silicon electrodes, gate oxide film, etc. are deposited, so incident light is mostly reflected or absorbed by that part. The quantum efficiency is therefore limited to approx. 40% at the highest in the visible region, and there is no sensitivity in the ultraviolet region.
The back-thinned CCD also has BPSG film, poly-silicon electrodes, gate oxide film, etc. deposited on the surface of the silicon substrate. It achieves high quantum efficiency over a wide spectral range thanks to its structure, in which light is incident from the backside of the silicon substrate. Besides having high sensitivity and low noise which are the intrinsic features of CCDs, back-thinned CCDs are also sensitive to electron beams, soft X-rays, ultraviolet, visible, and near infrared region.

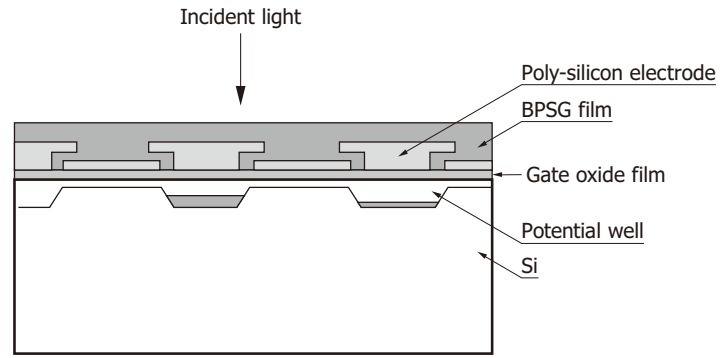
● Cross section of CCD

[Back-thinned type]



KMPDB0180EB

[Front-illuminated type]



KMPDB0179EB

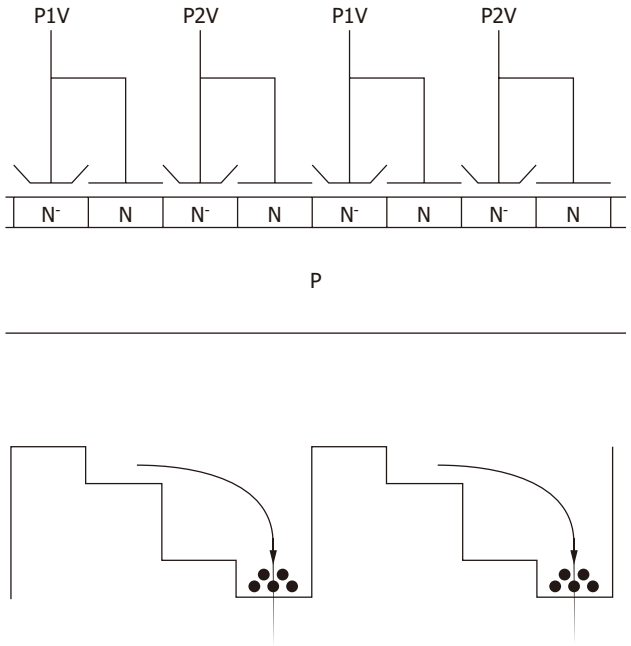
Resistive gate structure

CCD image sensors (built-in electronic shutter type)

Ordinary two-phase drive CCD

· One pixel contains multiple electrodes and a signal charge is transferred by applying different clock pulses to those electrodes
· No limit on pixel height and little image lag

● Schematic diagram and potential

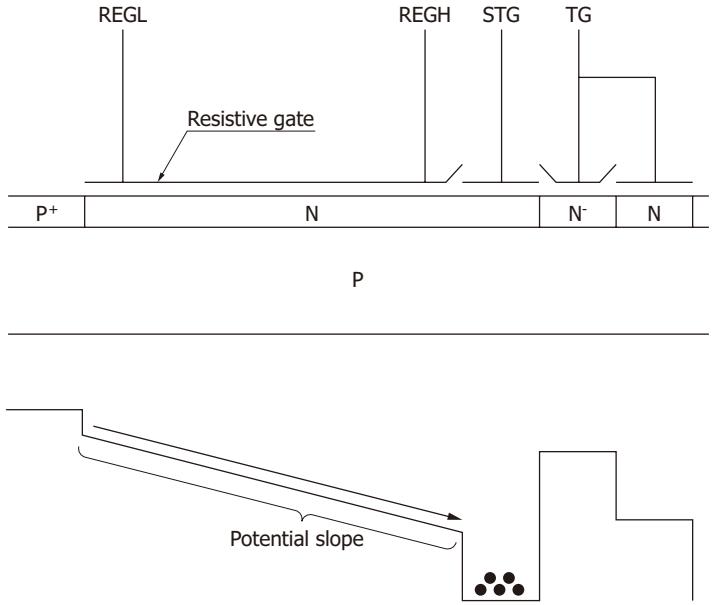


KMPDC0320EA

Resistive gate CCD

· Transfers signal charges by applying different voltages across the photosensitive area and forming a potential slope
· Faster transfer is possible when pixel height is a few millimeters, compared to the case where a two-phase drive CCD undergoes line binning to be used as a 1-D sensor.

● Schematic diagram and potential



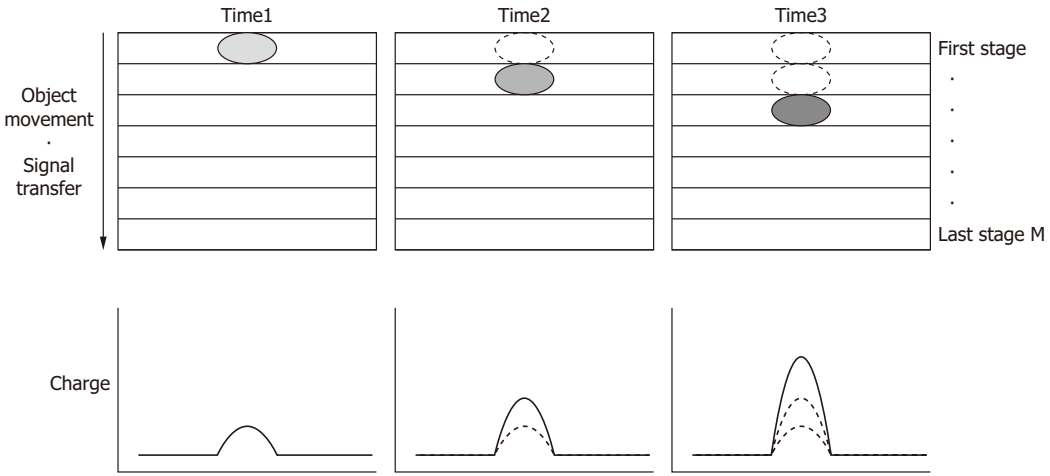
KMPDC0321EB

TDI operation

TDI-CCD image sensors

Schematic diagram of integrated exposure in TDI operation

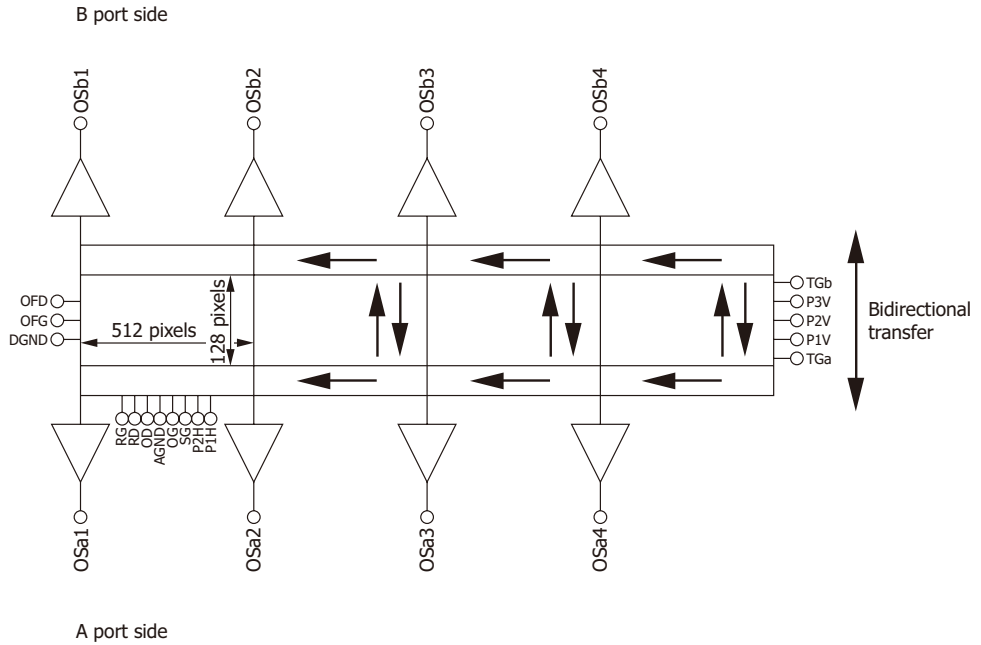
In FFT-CCD, signal charges in each column are vertically transferred during charge readout. TDI operation is a method that synchronizes the vertical transfer timing with the movement timing of the object incident on the CCD, so that signal charges are integrated a number of times equal to the number of vertical stages of the CCD pixels.



KMPDC0139EA

Sensor structure diagram (S10201-04-01)

By arranging multiple amplifiers and using multi-port output, we have made it capable of parallel image readout and achieved a high-speed line rate.

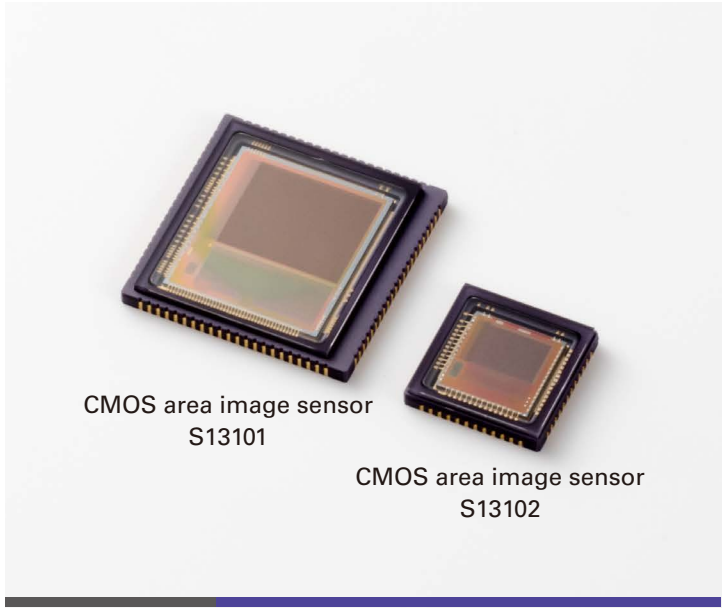


KMPDC0260EA

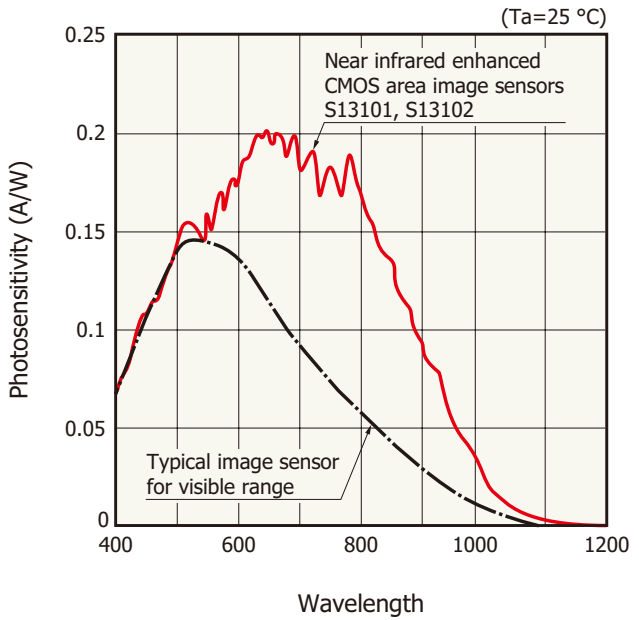
High near infrared sensitivity

CMOS image sensors

These CMOS image sensors have achieved high sensitivity in the near infrared region, using our unique photosensitive area technology.

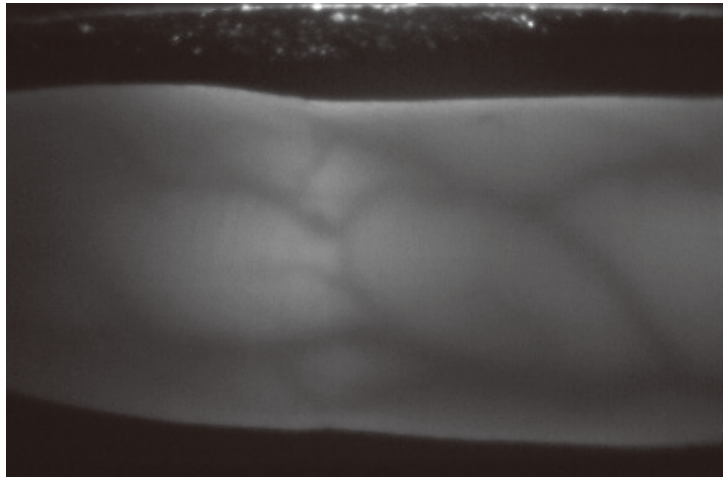


● Spectral response (typical example)



KMPDB0489EA

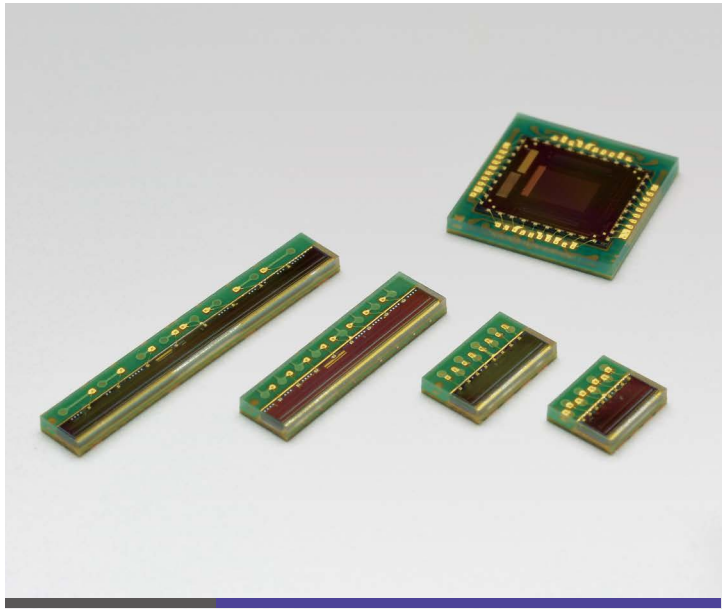
● Imaging example of finger veins using near infrared enhanced CMOS area image sensor



Compact, thin COB package

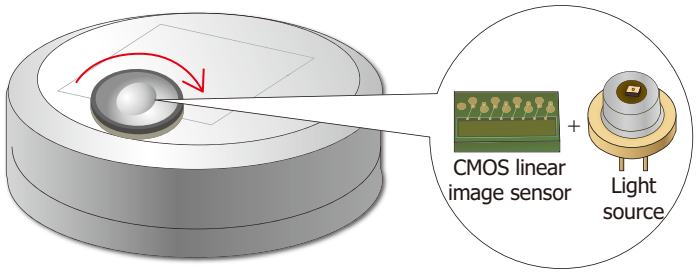
CMOS image sensors

The CMOS image sensors in a compact, thin COB (chip on board) package contributes making equipment compact and low cost. They can be used in a wide range of applications, including barcode readers and encoders.



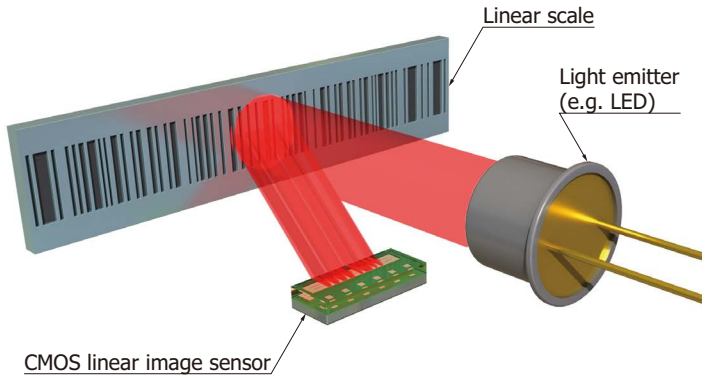
● Application examples of CMOS linear image sensors

[Rangefinder (robot cleaner)]



KMPDC0914EB

[Encoder]

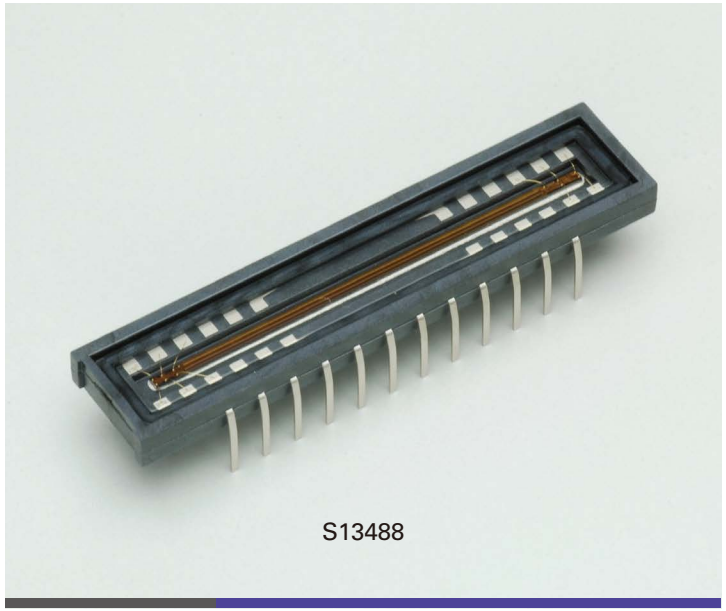


KMPDC0913EA

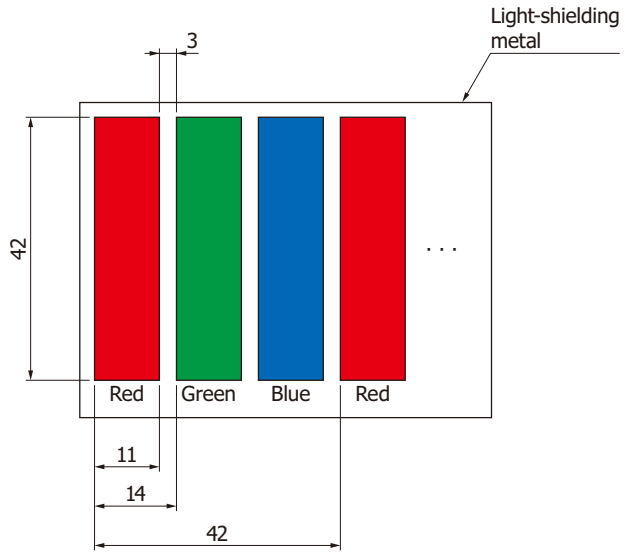
With color filters

CMOS linear image sensor

This type has color filters that transmit only light of a specific wavelength on the photodiode of the CMOS linear image sensor. It can acquire color information of the measurement target.

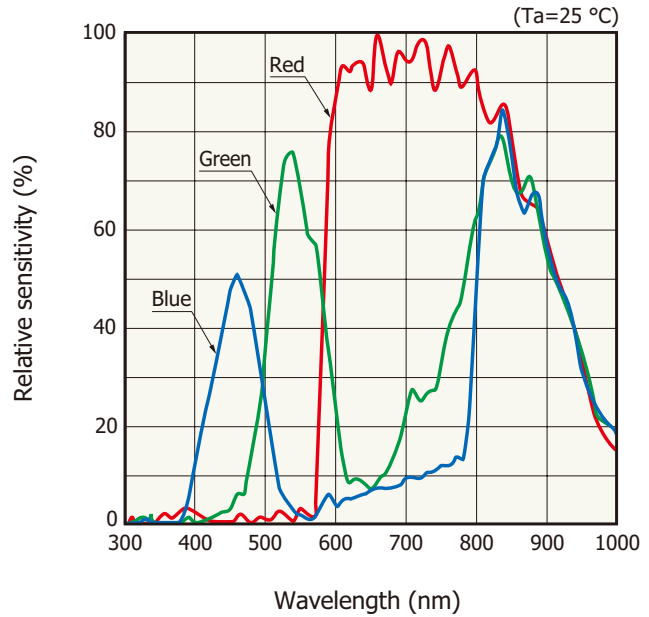


● Enlarged view of color filters (unit: µm)



KMPDC0911EA

● Spectral response (typical example)



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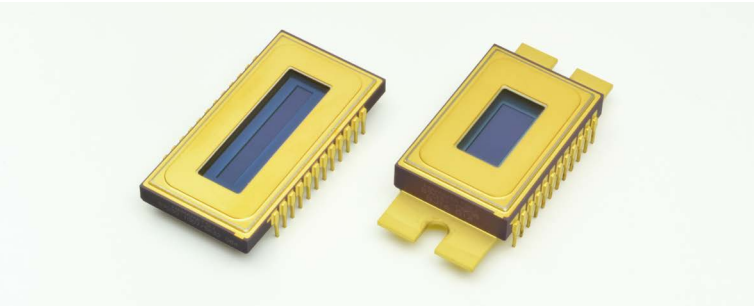
CCD image sensors

Standard type

These products offer low noise, low dark current, and wide dynamic range, so they can detect very low-level light by lengthening the integration time.



High performance

UV enhanced type

These CCDs exhibit high sensitivity in the UV region.

NIR enhanced type

High sensitivity in the near infrared region of 800 nm or longer has been realized.

Large full well type

The products realize a wide dynamic range.

High resolution type

The products are low noise CCDs with a small pixel size (12 × 12 µm).

High-speed readout type

The products are capable of high-speed readout with built-in high-speed amplifier.

Highly functional

Built-in electronic shutter type

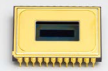
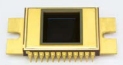
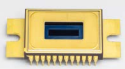
Any integration timing can be set.

TDI operation type

During high-speed imaging, the products can obtain high S/N images even under low-light-level conditions.

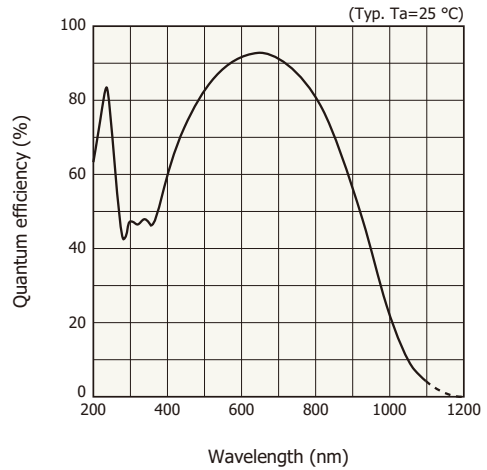
Standard type

These offer low noise and low dark current, so they can detect very low-level light by lengthening the integration time. By doing binning operation (an operation which adds signals of pixels in the vertical direction), they can be used as a linear image sensor that is long in the vertical register direction, so they are suitable for detectors of spectrophotometers.

Type no.	Pixel size [μm (H) × μm (V)]	Number of effective pixels	Line rate*1 Frame rate*2	Cooling*3	Photo	Dedicated driver circuit (sold separately)
S7170-0909	24 × 24	512 × 512	0.9 frames/s	Non-cooled		C7180
S7030-0906		512 × 58	418 lines/s			C7040
S7030-0907		512 × 122	316 lines/s			
S7030-1006		1024 × 58	213 lines/s			
S7030-1007		1024 × 122	160 lines/s			
S7171-0909-01		512 × 512	0.9 frames/s	One-stage TE-cooled		C7181
S7031-0906S		512 × 58	418 lines/s			C7041
S7031-0907S		512 × 122	316 lines/s			
S7031-1006S		1024 × 58	213 lines/s			
S7031-1007S		1024 × 122	160 lines/s			
S12071*4		1024 × 1024	Tap A: 0.1 frames/s Tap B: 1.5 frames/s			–

*1: Full line binning (typ.) *2: Area scanning (typ.)
*3: Two-stage TE-cooled type (S7032-1006/-1007) is available upon request (made-to-order products). *4: With anti-blooming function
Note: Windowless types are also available.

● Spectral response (without window)



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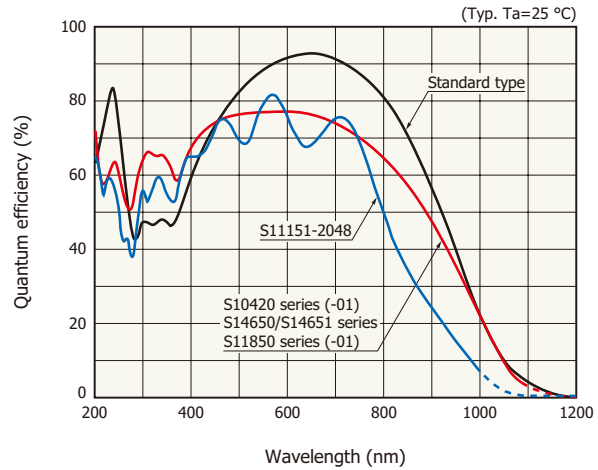
UV enhanced type

These CCDs exhibit high quantum efficiency in the UV region.

Type no.	Pixel size [μm (H) × μm (V)]	Number of effective pixels	Line rate* (lines/s)	Cooling	Photo	Dedicated driver circuit (sold separately)
S10420-1004-01	14 × 14	1024 × 16	221	Non-cooled		C11287-01
S10420-1006-01		1024 × 64	189			
S10420-1104-01		2048 × 16	116			
S10420-1106-01		2048 × 64	106			
S14650-1024		1024 × 192	95			
S14650-2048		2048 × 192	68			
S11850-1006-01		1024 × 64	189	One-stage TE-cooled		C11860
S11850-1106-01		2048 × 64	106			
S14651-1024		1024 × 192	95			
S14651-2048		2048 × 192	68			
S11151-2048	14 × 200	2048 × 1	484	Non-cooled		C11160

* Full line binning (typ.)
Note: Windowless types are also available.

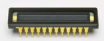
● Spectral response (without window)



KMPDC0674EB

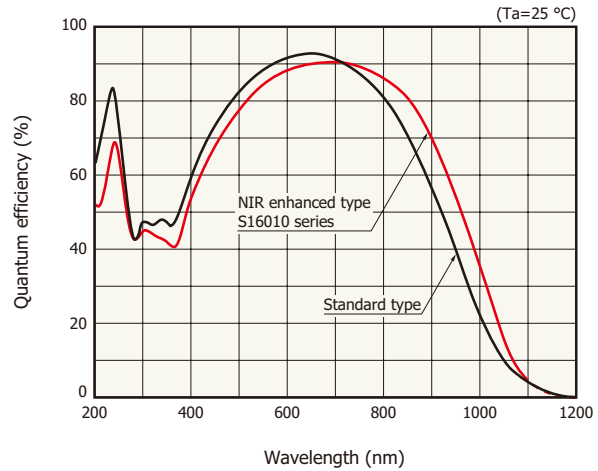
NIR enhanced type

These back-thinned CCDs exhibit high sensitivity in the near infrared region. They are used for Raman spectroscopy.

Type no.	Pixel size [μm (H) × μm (V)]	Number of effective pixels	Line rate* (lines/s)	Cooling	Photo	Dedicated driver circuit (sold separately)
S16000-1007 NEW	24 × 24	1024 × 122	160	Non-cooled		C7040
S16001-1007S NEW				One-stage TE-cooled		C7041
S16010-1006	14 × 14	1024 × 64	189	Non-cooled		C11287-01
S16010-1106		2048 × 64	106	Non-cooled		
S16011-1006		1024 × 64	189	One-stage TE-cooled		C11860
S16011-1106		2048 × 64	106			

* Full line binning (typ.)
Note: Windowless types are also available.

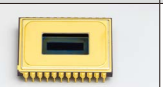
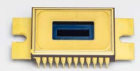
● Spectral response
(without window, typical example)



KMPDB0329EC

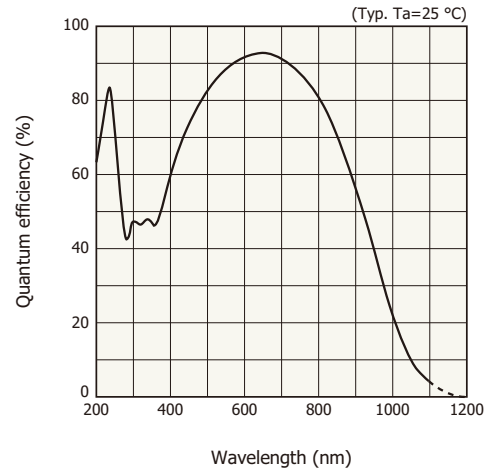
Large full well type

These have a wide dynamic range and are widely used for spectroscopic measurement.

Type no.	Pixel size [µm (H) × µm (V)]	Number of effective pixels	Line rate*1 (lines/s)	Full well capacity (ke⁻) Vertical	Full well capacity (ke⁻) Horizontal*2	Cooling	Photo	Dedicated driver circuit (sold separately)
S7033-0907	24 × 24	512 × 122	316	320	3400	Non-cooled		C7043
S7033-1007		1024 × 122	160					
S7034-0907S		512 × 122	316			One-stage TE-cooled		C7044
S7034-1007S		1024 × 122	160					

*1: Full line binning (typ.)
*2: Linearity=±1.5%
Note: Two-stage TE-cooled type (S7035 series), windowless type are also available.

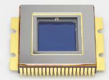
● Spectral response (without window)



KMPDB0673EA

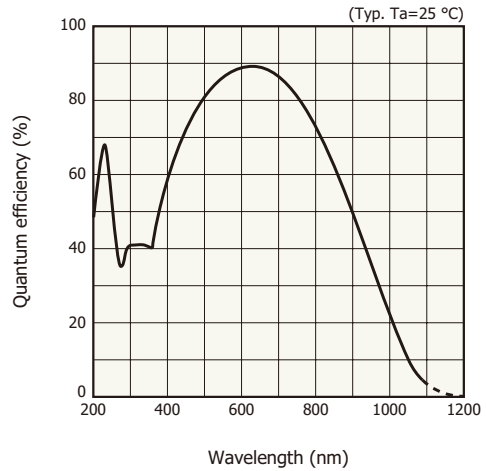
High resolution type

These are low noise CCDs with a small pixel size (12 × 12 µm).

Type no.	Pixel size [µm (H) × µm (V)]	Number of effective pixels	Line rate*1 (lines/s)	Cooling*2	Photo	Dedicated driver circuit (sold separately)
S10140-1107-01	12 × 12	2048 × 122	107	Non-cooled		C10150-01
S10140-1108-01		2048 × 250	80			
S10140-1109-01		2048 × 506	40			
S10141-1107S-01		2048 × 122	107	One-stage TE-cooled		C10151-01
S10141-1108S-01		2048 × 250	80			
S10141-1109S-01		2048 × 506	40			
S12101*3		2048 × 2048	Tap A: 0.02 frames/s Tap B: 2.4 frames/s			–

*1: Full line binning (typ.)
*2: Note: Two-stage TE-cooled type [S10142 series (-01)] is available upon request (made-to-order products).
*3: With anti-blooming function
Note: Windowless types are also available.

● Spectral response (without window)



KMPDB0688EA

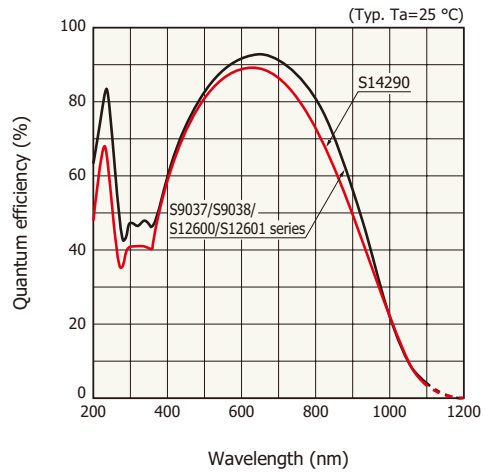
High-speed readout type

This type has a built-in high-speed readout amplifier.

Type no.	Pixel size [µm (H) × µm (V)]	Number of effective pixels	Data rate (MHz)	Line rate* (lines/s)	Cooling	Photo
S9037-0902	24 × 24	512 × 4	10	16300	Non-cooled	
S9037-1002		1024 × 4		8100		
S9038-0902S		512 × 4		16300	One-stage TE-cooled	
S9038-1002S		1024 × 4		8100		
S12600-1006		1024 × 58	5	2097	Non-cooled	
S12600-1007		1024 × 122		1162		
S12601-1006S		1024 × 58		2097	One-stage TE-cooled	
S12601-1007S		1024 × 122		1162		
S14290	24 × 500	1024 × 1		10000	Non-cooled	

* Full line binning (typ.)
Note: Windowless types are also available.

● Spectral response (without window)

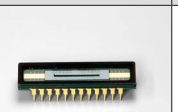
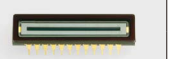
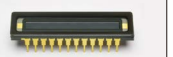


KMPDB0689EA

High resolution

High-speed readout type

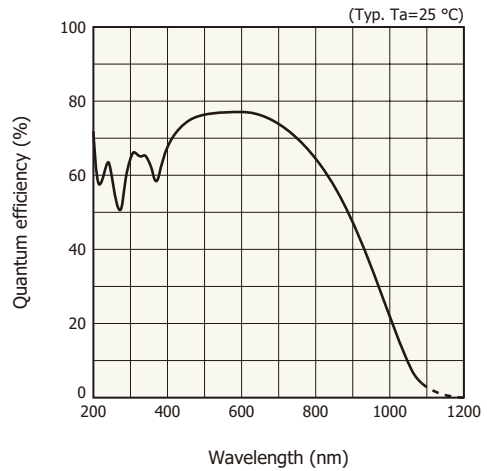
These CCDs have a small pixel size and a data rate of 10 MHz.

Type no.	Pixel size [μm (H) × μm (V)]	Number of effective pixels	Data rate (MHz)	Line rate* (lines/s)	Number of ports	Cooling	Photo	Dedicated driver circuit (sold separately)
S11071-1004	14 × 14	1024 × 16	10	1777	1	Non-cooled		C11288-01
S11071-1006		1024 × 64		751				
S11071-1104		2048 × 16		1303				
S11071-1106		2048 × 64		651				
S11851-1106-01		2048 × 64		651		One-stage TE-cooled		–
S14660-1024		1024 × 192		296		Non-cooled		C11288-01
S14660-2048		2048 × 192		148				
S14661-1024		1024 × 192		296		One-stage TE-cooled		–
S14661-2048		2048 × 192		148		One-stage TE-cooled		
S13240-1107	12 × 12	2048 × 122		921		Non-cooled		–
S13240-1108		2048 × 250		539				
S13240-1109		2048 × 506		203				

* Full line binning (typ.)
Note: Windowless types are also available.

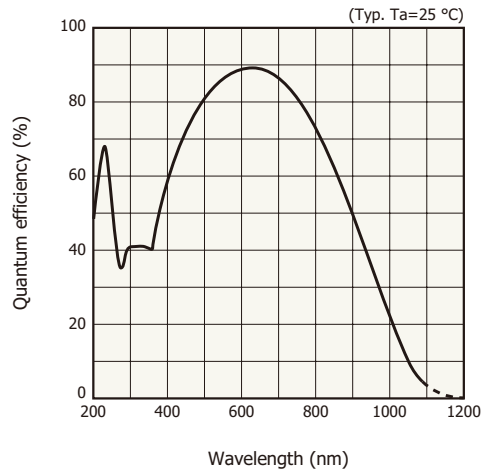
● Spectral response (without window)

[S11071/S11851/S14660/S14661 series]



KMPDB0316EA

[S13240 series]

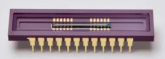
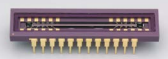
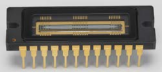
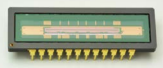


KMPDB0688EA

High resolution

High-speed readout type

These CCDs have a small pixel pitch. The S12379 and S15729-01 realize high-speed line rate with multi-port readout.

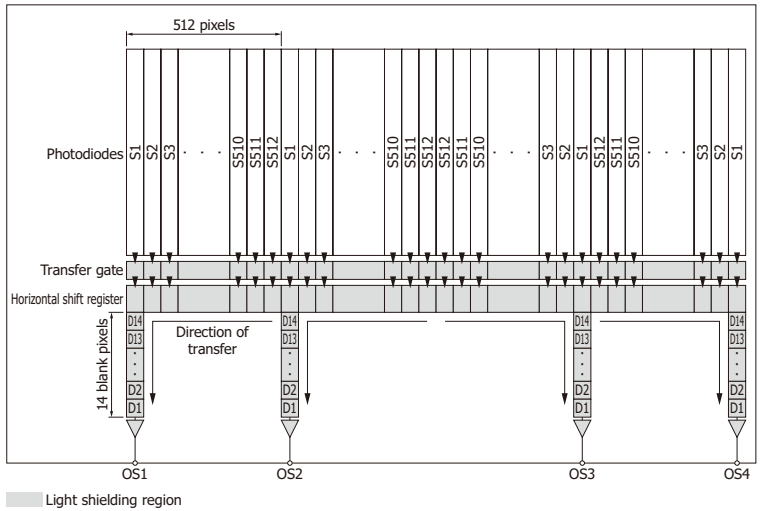
Type no.	Pixel size [μm (H) × μm (V)]	Number of effective pixels	Data rate (MHz)	Line rate (lines/s)	Number of ports	Cooling	Photo	Dedicated driver circuit (sold separately)
S13241-1107S	12 × 12	2048 × 122	10	921*1	1	One-stage TE-cooled		—
S13241-1108S		2048 × 250		539*1				
S13241-1109S		2048 × 506		203*1				
S12551-1024	14 × 14	1024 × 1	40	37900*2	1	Non-cooled		—
S12551-2048		2048 × 1		19200*2				—
S12379	8 × 8	2048 × 1		72000	4			—
S15729-01	10 × 180	2048 × 1		70000				C15821-2351

*1: Full line binning (typ.)
*2: With electronic shutter (line rate when electronic shutter is not used)
Note: Windowless types are also available.

Device structure

(schematic of CCD chip as viewed from top of dimensional outline)

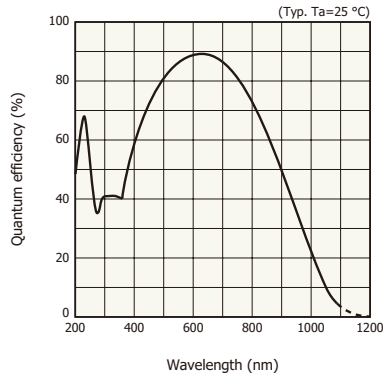
[S15729-01 (4 ports)]



KMPDC0862EA

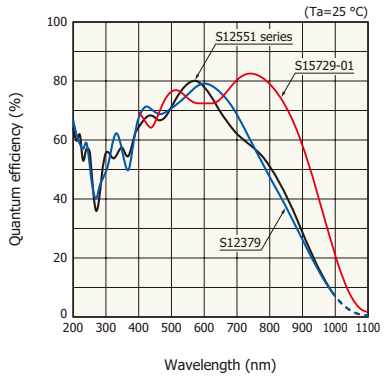
Spectral response (without window)

[S13241 series]



KMPDB0688EA

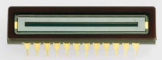
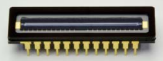
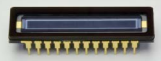
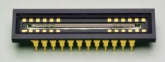
[S12551 series, S12379, S15729-01]



KMPDB0679EA

Built-in electronic shutter type

These are CCD linear image sensors for spectrophotometry with a built-in electronic shutter function. High-speed transfer is enabled by adopting a resistive gate structure (except for S15351-2048).

Type no.	Pixel size [µm (H) × µm (V)]	Number of effective pixels	Line rate (lines/s)	Cooling	Photo	Dedicated driver circuit (sold separately)
S11155-2048-02	14 × 500	2048 × 1	2327	Non-cooled		C11165-02
S11156-2048-02	14 × 1000					
S13255-2048-02	14 × 500			One-stage TE-cooled		–
S13256-2048-02	14 × 1000					
S15254-2048	14 × 200		2356	Non-cooled		C15361-2105
S15257-2048	14 × 2500		2294			
S15351-2048	14 × 200		1180			C15361-1105

Note: Windowless types are also available.

Related products

CMOS linear image sensors for spectrophotometry

High sensitivity type

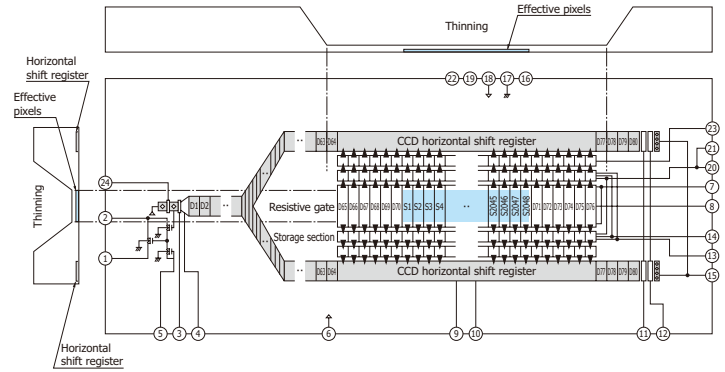
CMOS linear image sensors for industrial equipment

High sensitivity type

Device structure

(schematic of CCD chip as viewed from top of dimensional outline)

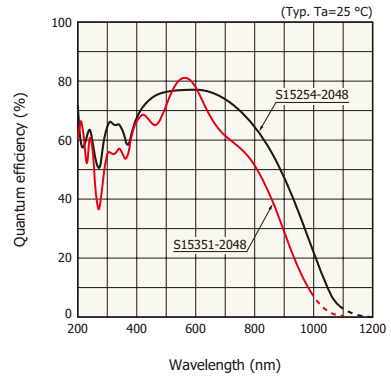
[S11155/S11156/S13255/S13256-2048-02, S15254/S15257-2048]



KMPDC0543EB

Spectral response (without window)

[S15254-2048, S15351-2048]



KMPDB0680EA

TDI-CCD image sensors

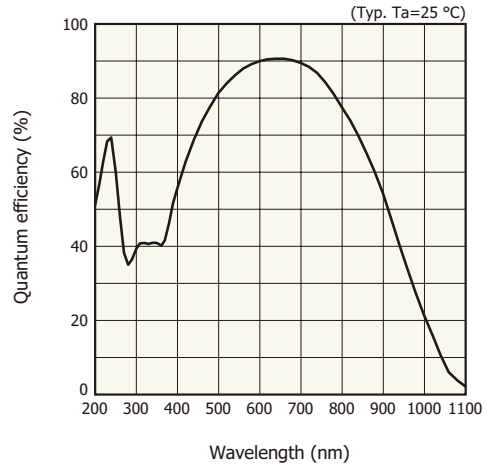
High S/N images can be obtained when moving objects are subjected to integration while being exposed to light during high-speed imaging. The S14810 and S14813 have a hybrid structure combining TDI-CCD and CMOS readout circuit. With the photosensitive area technology that Hamamatsu has cultivated over many years, the S14813 realizes the highest level of UV sensitivity and UV resistance in the world.

Type no.	Pixel size [µm (H) × µm (V)]	Number of effective pixels	Number of ports	Pixel rate (MHz/port)	Line rate (lines/s)	Vertical transfer	Photo	Applicable camera (sold separately)
S10200-02-01	12 × 12	1024 × 128	2	30	50000	Bidirectional		–
S10201-04-01		2048 × 128	4					C10000-801* C10000-A01*
S10202-08-01		4096 × 128	8					–
S10202-16-01		4096 × 128	16		100000			–
S14810		1024 × 128	1024	0.1	100000			–
S14813								

*The C10000 series camera is a product of Hamamatsu's System Division.
Note: TDI: time delay integration

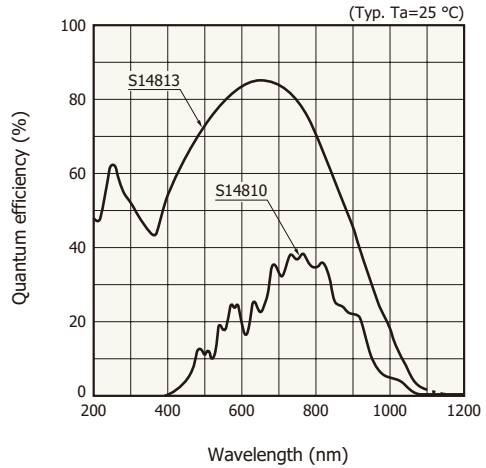
● Spectral response

[S10200/S10201/S10202 series]



KMPDB0269EC

[S14810, S14813]

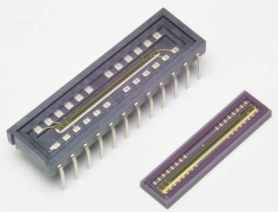


KMPDB0580EA

CMOS image sensors

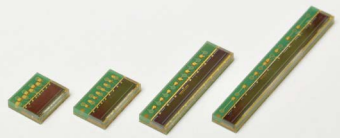
CMOS linear image sensors for spectrophotometry

These have vertically long pixels, realizing high quantum efficiency in the ultraviolet to visible regions.



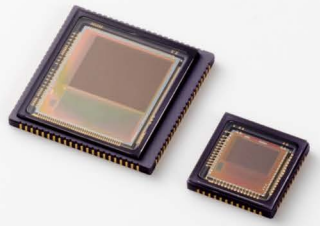
CMOS linear image sensors for industrial equipment

We offer sensors suitable for position detection, encoders, line scan cameras, and more. These are equipped with a timing generator and signal processing amplifier, and are driven by a simple input pulse and a single power supply.



CMOS area image sensors

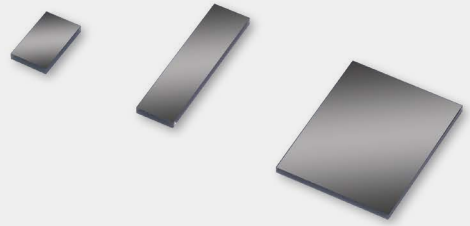
We offer a type that has high sensitivity in the UV and near IR region.



Highly functional CMOS image sensors

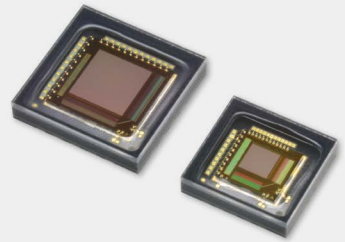
Distance image sensors

These sensors measure the distance to an object by TOF (time-of-flight) method. When used in combination with a pulse modulated light source, these sensors output phase difference information on the timing that the light is emitted and received.



Profile sensors

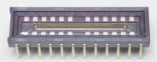
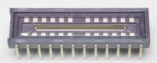
These high-performance sensors are specialized for acquiring 2D projection data.



For spectrophotometry

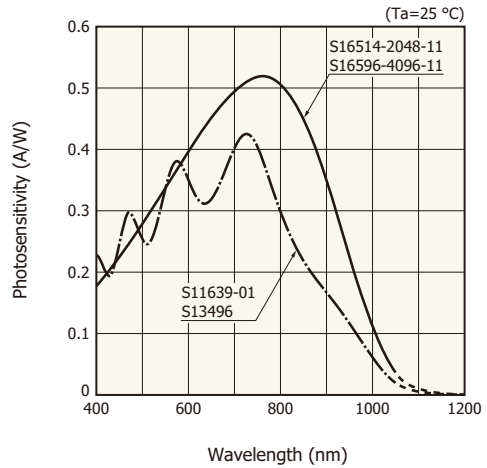
High sensitivity type

These are high sensitivity CMOS linear image sensors employing a photosensitive area with vertically long pixels. High sensitivity and high durability have been achieved even in the ultraviolet region. The S16514-2048-11 and S16596-4096-11 realize high sensitivity in near IR region and smooth spectral response.

Type no.	Pixel height (μm)	Pixel pitch (μm)	Number of pixels	Line rate max. (lines/s)	Photo	Dedicated driver circuit (sold separately)
S16528-1024-11	200	28	1024	8960		C13015-01
S11639-01*1		14	2048	4672		C13015-01
S15739-1024*2			1024	8960		
S13014*2			512	16556		C13015-01*3
S14739-20			256	28735		
S13496*1		7	4096	2387		C13015-01
S15796-2048*2			2048	4672		C13015-01
S15796-1024*2			1024	8960		C13015-01*3
S16514-2048-11		14	2048	4672		C13015-01
S16596-4096-11		7	4096	2387		

*1: We also offer types with light-shielding pixels (S11639-11, S13496-11). *2: Surface mount type is also available. *3: A conversion board is required during use.

● Spectral response (typical example)



KMPDB0707EA

Related products

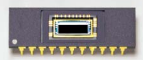
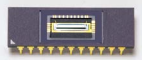
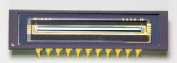
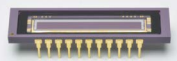
CCD image sensors

Built-in electronic shutter type

For spectrophotometry

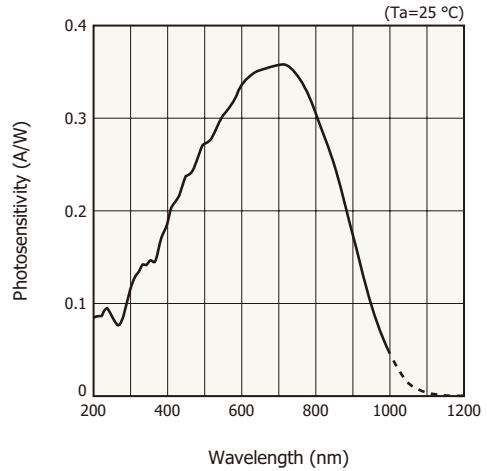
Large saturation charge type

This current output type features high UV sensitivity and smooth spectral response. It has a large saturation charge and integration time is variable for each pixel, so it can efficiently detect the dispersed very low-level light.

Type no.	Pixel height (mm)	Pixel pitch (μm)	Number of pixels	Line rate max. (lines/s)	Photo	Dedicated driver circuit (sold separately)
S10121-128Q-01	2.5	50	128	1923		C10808 series
S10121-256Q-01			256	969		
S10121-512Q-01			512	486		
S10122-128Q-01	0.5		128	3846		
S10122-256Q-01			256	1938		
S10122-512Q-01			512	972		
S15908-512Q	2.5	50	512	486		C10808 series
S15909-1024Q		25	1024	243		

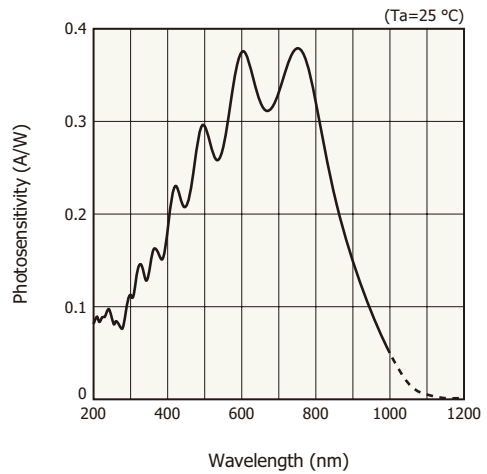
● Spectral response (typical example)

[S15908-512Q, S15909-1024Q]



KMPDB0623EA

[S10121/S10122 series]



KMPDB0442EA

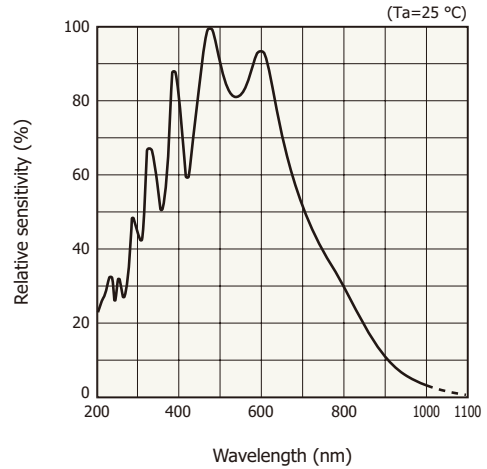
For spectrophotometry

These linear image sensors have a built-in readout circuit.

Type no.	Pixel height (μm)	Pixel pitch (μm)	Number of pixels	Line rate max. (lines/s)	Photo
S8377-128Q	500	50	128	3846	
S8377-256Q			256	1938	
S8377-512Q			512	972	
S8378-256Q		25	256	1938	
S8378-512Q			512	972	
S8378-1024Q			1024	487	
S9226-03	125	7.8	1024	194	
S9226-04					

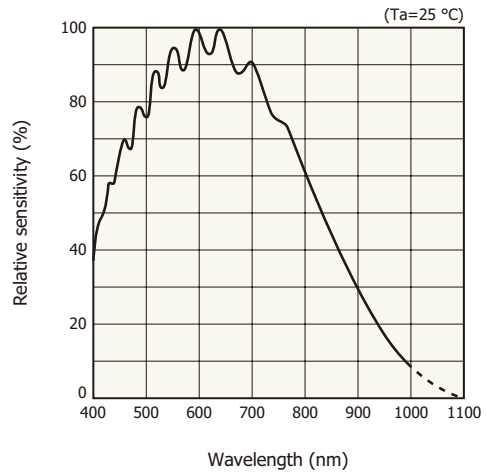
● Spectral response
(typical example, without window)

[S8377/S8378 series]



KMPDB0213EC

[S9226 series]

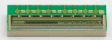
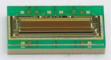
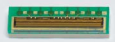


KMPDB0229EC

For industrial equipment

Resin-sealed type package

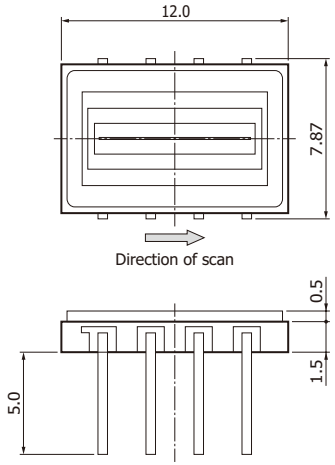
These are a compact and surface mounted high-volume production type.

Type no.	Pixel height (μm)	Pixel pitch (μm)	Number of pixels	Line rate max. (lines/s)	Photo
S10226-10	125	7.8	1024	194	
S10227-10	250	12.5	512	9434	
S11106-10	63.5	63.5	128	67568	
S11107-10	127	127	64	119048	
S12443	125	7	2496	3924	
S13131-512	63.5	5.5	512	3787	
S13131-736			736	2659	
S13131-1536			1536	1288	
S13434-2496		5.25	2496	796	

Size of ceramic package and resin-sealed type package

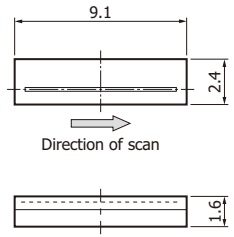
The following products have the same photosensitive area size (7.9872 × 0.125 mm), but the resin-sealed type package is more compact and thin.

[Ceramic package]



KMPDA0172EH

[Resin-sealed type package S10226-10]



KMPDA0315EC

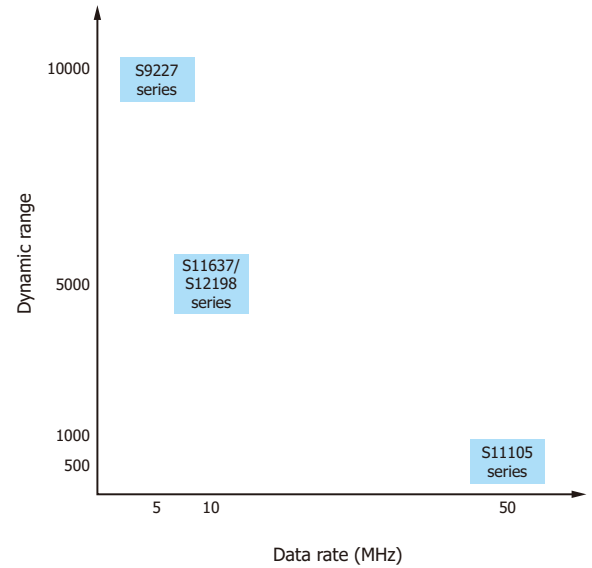
For industrial equipment

High-speed readout type

These CMOS image sensors are capable of high-speed readout.

Type no.	Pixel height (μm)	Pixel pitch (μm)	Number of pixels	Line rate max. (lines/s)	Photo
S9227-03	250	12.5	512	9434	
S9227-04					
S11105	250	12.5	512	88652	
S11105-01				88495	
S11637-1024Q	500	12.5	1024	9487	
S11637-2048Q			2048	4812	
S12198-512Q-01	500	25	512	18450	
S12198-1024Q-01			1024	9487	

● Dynamic range vs. data rate

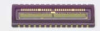
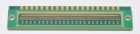
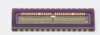
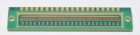


KMPDB0678EA

For industrial equipment

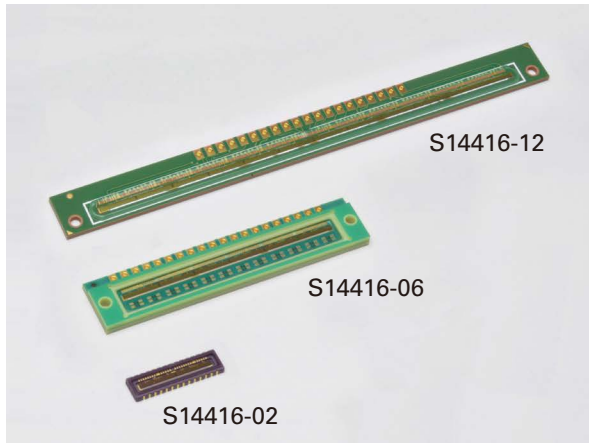
High-speed readout type

These CMOS image sensors are capable of high-speed readout.

Type no.	Pixel height (μm)	Pixel pitch (μm)	Number of pixels	Line rate max. (lines/s)	Photo
S14416-02	63.5	63.5	256	36231	
S14416-06			768	12690	
S14416-12			1536	6426	
S14417-02	127	127	128	67567	
S14417-06			384	24752	

S14416 series

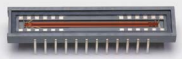
The S14416-02/-06/-12 are products with 128-element photodiode arrays arranged in 2/6/12 parts respectively. Select a product of the size that matches your detection target.



For industrial equipment

High sensitivity type

We have realized high sensitivity by incorporating an amplifier for each pixel.

Type no.	Pixel height (μm)	Pixel pitch (μm)	Number of pixels	Line rate max. (lines/s)	Photo	Dedicated driver circuit (sold separately)
S11108	14	14	2048	4672		—
S12706	7	7	4096	2387		C13015-01
S13488-01	42	14	2048	4672		—
S13828	84	28	1024	8960		C13015-01

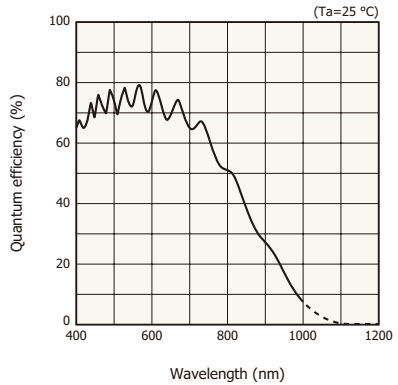
Related product

CCD image sensors

Built-in electronic shutter type

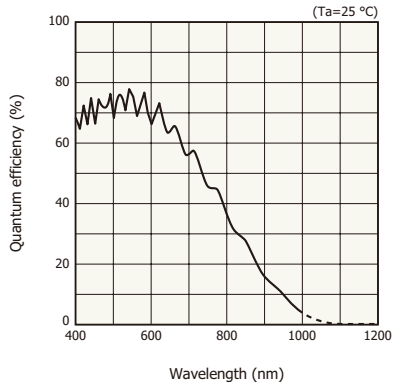
● Spectral response (typical example, without window)

[S11108]



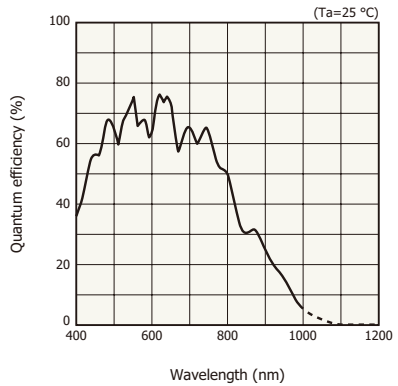
KMPDB0684EA

[S12706]



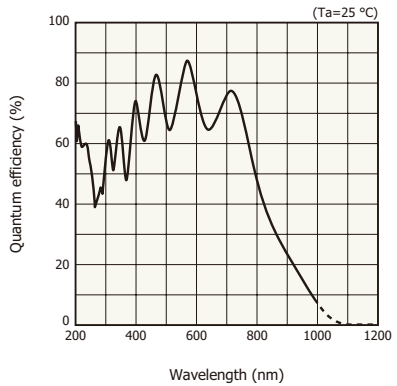
KMPDB0685EA

[S13488-01]



KMPDB0686EA

[S13828]



KMPDB0687EA

For industrial equipment

Digital output type

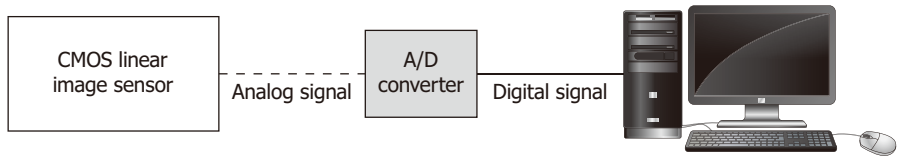
These are linear image sensors with a built-in A/D converter. The S15611-10 realizes smooth spectral response.

Type no.	Pixel height (μm)	Pixel pitch (μm)	Number of pixels	Line rate max. (lines/s)	Photo
S10077	50	14	1024	972	
S11720-20	127	127	1536	45400	
S11720-40			3072		
S13774	7	7	4096	100000 (high-speed mode)	
S14772	14	14	2048	125000 (high-speed mode)	
S15611	200	7	1024	34000	
S15611-10 NEW					
S15778	7	7	8192	100000 (high-speed mode)	
S16074* NEW	7 9.3 14	7 9.3 14	4160 3120 2080	35000 46000 65000	

* 3 lines of pixel sizes (7 × 7 μm, 9.3 × 9.3 μm, 14 × 14 μm) are arranged in parallel in the photosensitive area and can be switched with SPI settings.

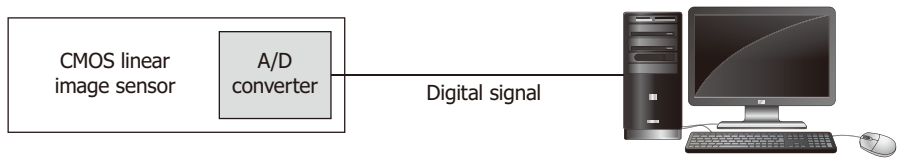
A/D conversion of CMOS linear image sensors

[Analog output type]



KMPDC0901EA

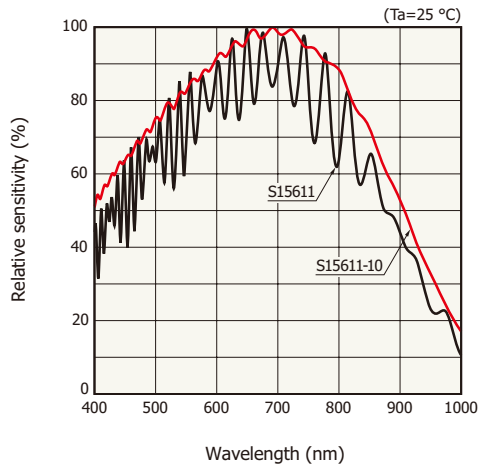
[With A/D converter (digital output type)]



KMPDC0902EA

Spectral response (typical example)

[S15611, S15611-10]



KMPDB0712EA

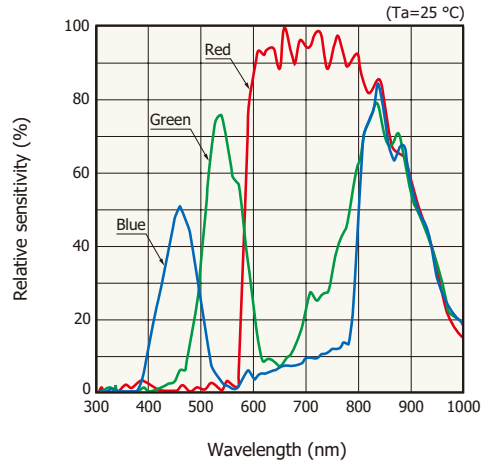
For industrial equipment

With RGB color filters

This CMOS linear image sensor has sensitivity to red (630 nm), green (540 nm), and blue (460 nm) light. Each pixel has a filter in the order RGB, so it can obtain the color information of the measurement target.

Type no.	Pixel height (μm)	Pixel pitch (μm)	Number of pixels	Line rate max. (lines/s)	Photo
S13488	42	14	2048	4672	

● Spectral response (typical example)



KMPDB0483EB

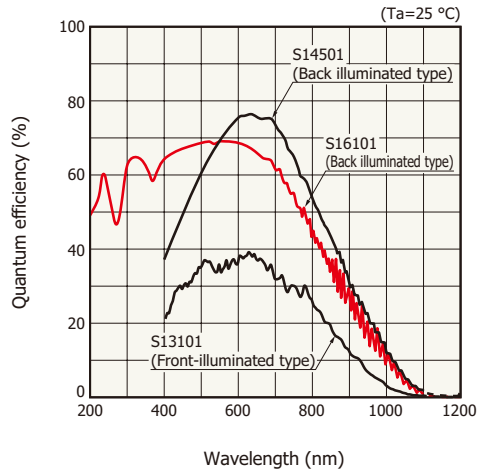
Note: This sensor also has sensitivity in the infrared region, so cut off incident infrared light as needed.

CMOS area image sensors

These APS (active pixel sensor) type CMOS area image sensors have high sensitivity in the UV and near infrared light. They integrate a timing generator, bias generator, amplifier, A/D converter, and are easy to handle because of all-digital I/O.

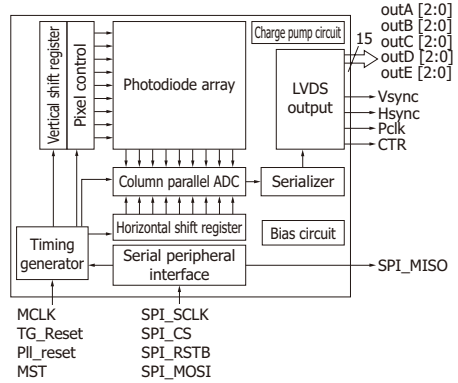
Type no.	Pixel size [μm (H) × μm (V)]	Number of effective pixels	Spectral response range (nm)	Frame rate max. (frames/s)	Type	Photo
S16101 NEW	7.4 × 7.4	1280 × 1024	200 to 1100	146	Back-illuminated type	
S14501			400 to 1100			
S13101	7.4 × 7.4	1280 × 1024	400 to 1100	146	Front-illuminated type	
S13102		640 × 480		78		
S13499	9.9 × 9.9	659 × 494		75		
S14250	50 × 50	30 × 30		344		

Spectral response
(S16101, S14501, S13101, typical example)



KMPDB0639EA

Block diagram
(S16101, S14501, S13101)



KMPDC0529EC

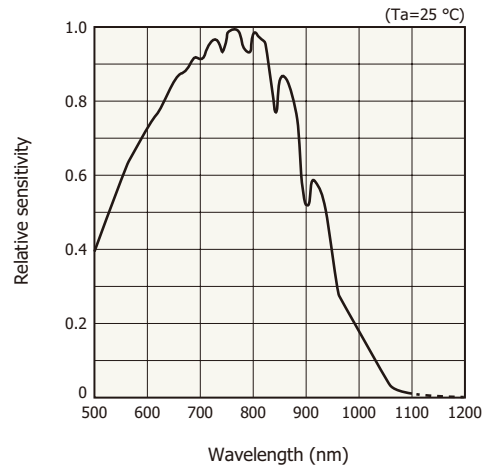
Distance linear image sensors

The distance image sensors are designed to measure the distance to an object by TOF method. When used in combination with a pulse modulated light source, these sensors output phase difference information on the timing that the light is emitted and received. Distance data can be obtained by performing calculation on the signals with an external signal processing circuit or a PC.

Type no.	Pixel height (μm)	Pixel pitch (μm)	Number of effective pixels	Video data rate max. (MHz)	Photo
S15452-01WT	50	20	64	5	
S15453-01WT			256		

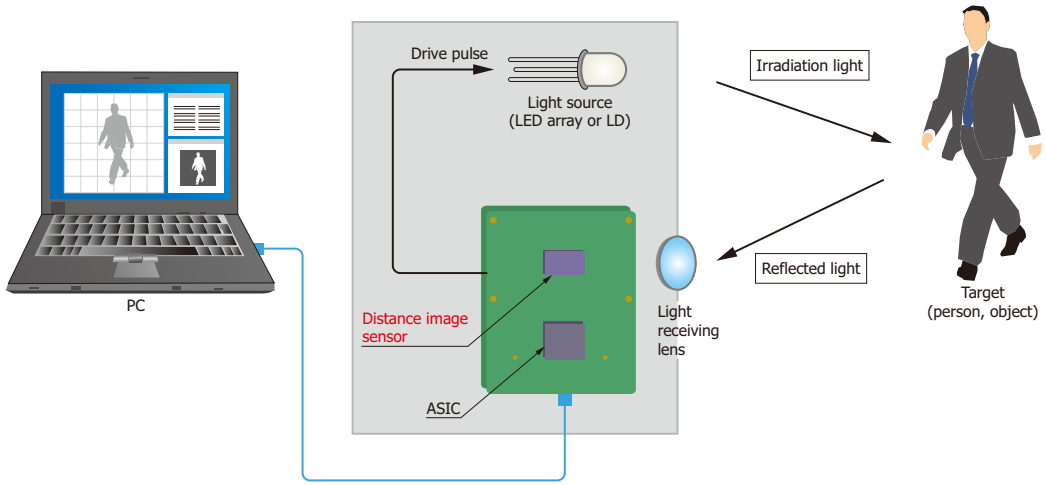
Note: An evaluation kit is available. Contact us for detailed information.

● Spectral response



KMPDB0564EA

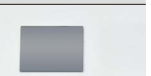
● Configuration example of distance measurement



KMPDC0417EE

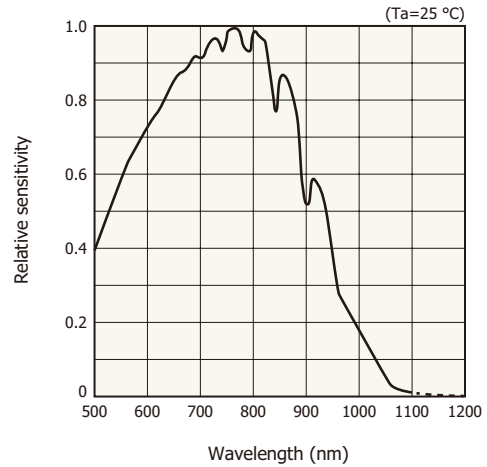
Distance area image sensors

The distance image sensors are designed to measure the distance to an object by TOF method. When used in combination with a pulse modulated light source, these sensors output phase difference information on the timing that the light is emitted and received. Distance data can be obtained by performing calculation on the signals with an external signal processing circuit or a PC.

Type no.	Pixel size [μm (H) × μm (V)]	Pixel pitch (μm)	Number of effective pixels	Video data rate max. (MHz)	Photo
S15454-01WT	50 × 50	50	96 × 72	10	
S16443-01WT	20 × 50	20 (H) × 201.5 (V)	128 × 8	10	
S16444-01WT	20 × 50	20 (H) × 201.5 (V)	320 × 20	10	

Note: An evaluation kit is available. Contact us for detailed information.

● Spectral response



KMPDB0564EA

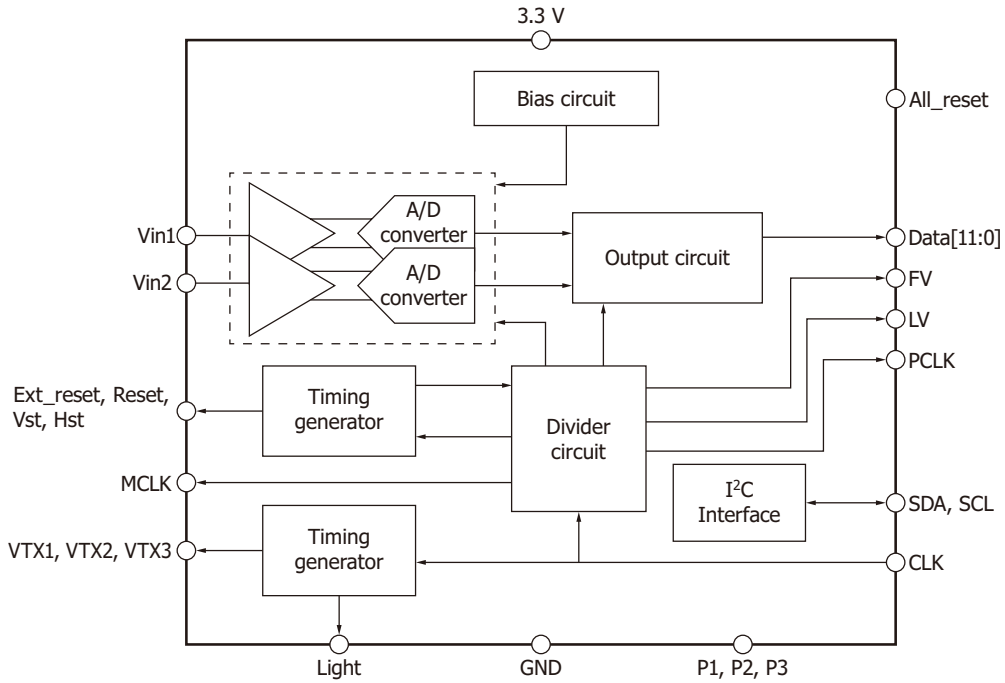
ASIC

for distance image sensor

The peripheral circuits required for driving and signal processing of the distance image sensors are integrated into the ASIC.

H15472-01

● Block diagram



SDA: serial data
SCL: serial clock

KACCC1053EA

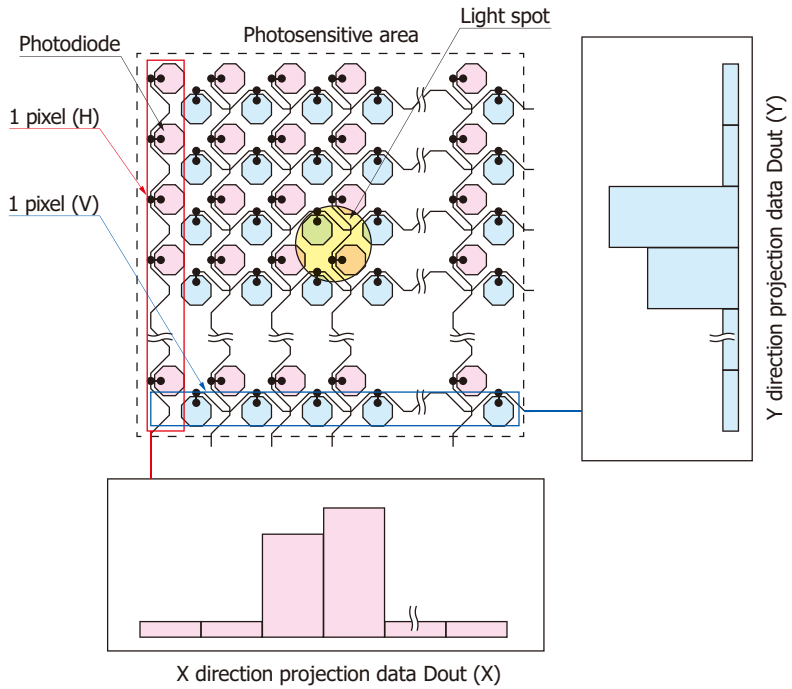
Profile sensors

These high-speed frame rate CMOS image sensors are specialized for acquiring 2-D projection data. It is possible to detect multiple light spots simultaneously. The S15366 series integrate the center-of-gravity calculation circuit and they can directly output the center-of-gravity position coordinates.

Type no.	Number of lines (X/Y directions)	Pixel pitch (μm)	Frame rate 8-bit max. (frames/s)	Photosensitive area [mm (H) × mm (V)]	Photo
S9132	256	7.8	3200	1.9968 × 1.9968	
S15366-256			3156		
S15366-512	512		1602	3.9936 × 3.9936	

Operating principle

In the photosensitive area arranged two-dimensionally, the photosensitive area for the X-direction projection data is connected in one vertical column, and the photosensitive area for the Y-direction projection data is connected in one horizontal row using metal wiring. Output of the photosensitive area of the same line is read out as added data, making it possible to acquire projection data in the X/Y directions. The amount of data per frame is small, achieving a high frame rate.



KMPDC1038EA

X-ray image sensors

For radiography

These large area, high resolution CMOS area image sensors are used in X-ray radiography equipment.

TDI-CCD area image sensors

TDI operation enables X-ray imaging of large subjects. They can be used for X-ray radiography equipment, and for industrial in-line non-destructive inspection.

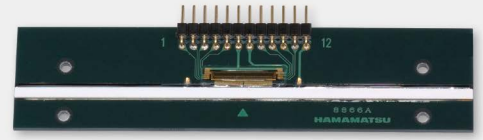
For non-destructive inspection

CMOS area image sensors

These CMOS image sensors can be connected to a PC via USB. They have a thicker FOP, realizing high radiation resistance.

Photodiode arrays with amplifier

The products can be used for in-line industrial product inspection equipment, foreign matter inspection equipment, etc. for canned and retort foods.



For radiography

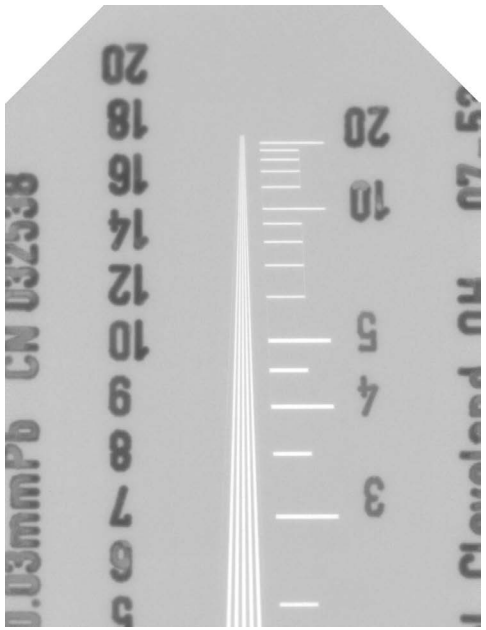
CMOS area image sensors

These are large area, high resolution CMOS area image sensors.
We have a type with FOP (fiber optic plate) input window and a type with a cable to be used for simple X-ray imaging. They have LDVS digital output with a built-in 14-bit A/D converter.

Type no.	Scintillator	Pixel size [µm (H) × µm (V)]	Number of effective pixels	Frame rate* (frames/s)	Photo
S10830-12	CsI (+ FOP)	20 × 20	1000 × 1500	0.9	
S10834-12					
S10831	CsI (+ FOP)	20 × 20	1300 × 1700	0.6	
S10835-12					

* Global clock=20 MHz
Note: Please prepare a circuit for driving the sensor.

● X-ray imaging example (S10835-12)



For non-destructive inspection

CMOS area image sensors

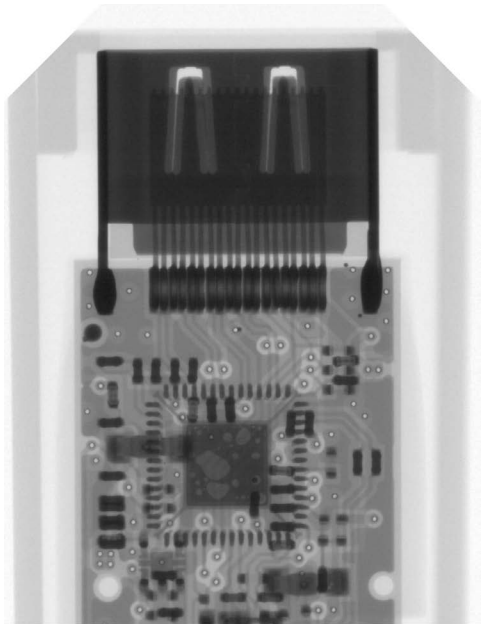
This product has an APS type CMOS area image sensor and USB interface, built into a compact housing. The fiber optic plate (FOP) protects the X-ray image sensor to realize 1 million Gy* of radiation resistance.

Type no.	Scintillator	Pixel size [µm (H) × µm (V)]	Number of effective pixels	Frame rate (frames/s)	Photo
S15683-13	CsI (+ FOP)	20 × 20	1300 × 1700	0.46	

* X-ray tube voltage=60 kV, without Al filter

● X-ray imaging example

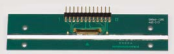
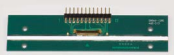
[Electronic part]



For non-destructive inspection

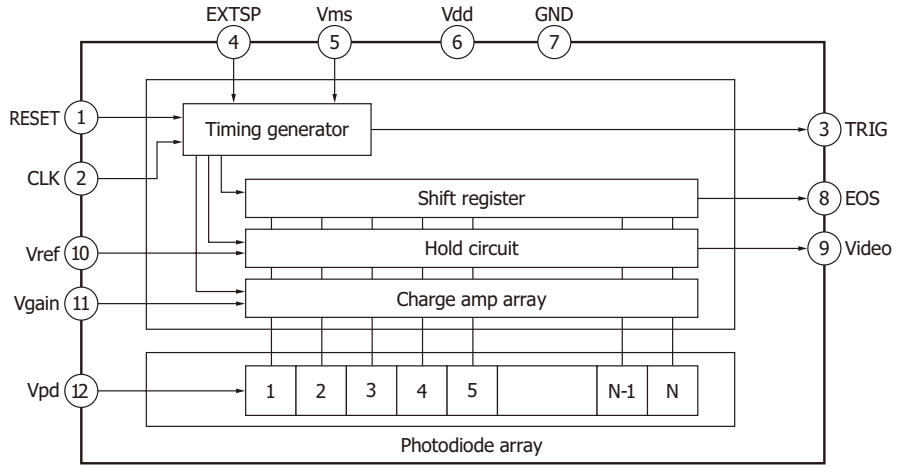
Photodiode arrays with amplifier

The photodiode arrays with an amplifier consist of a Si photodiode array and a CMOS signal processing IC chip. A phosphor sheet is attached to the photosensitive area, making it suitable for non-destructive inspection.

Type no.	Pixel height (mm)	Pixel pitch (mm)	Number of pixels	Drive voltage (V)	Line rate (lines/s)	Charge amplifier feedback capacitance* (pF)	Photo	Dedicated driver circuit (sold separately)
S11865-64G	0.8	0.8	64	5	14678	0.5		C9118-01
S11865-128G	0.6	0.4	128	5	7568	0.5		
S13885-128G	0.6	0.4	128	3.3	7568	0.125		—
S11865-256G	0.3	0.2	256	5	3844	0.5		
S13885-256G	0.3	0.2	256	3.3	3844	0.125		
S11866-64G-02	1.6	1.6	64	5	14678	0.5		C9118-01
S11866-128G-02	0.8	0.8	128	5	7568	0.5		
S13886-128G	0.8	0.8	128	3.3	7568	0.125		—

* High gain
Note: We also offer a type without a phosphor sheet.

● Block diagram (S11865-64G/-128G, S11866-64G-02/-128G-02)



KMPDC0153EA

Driver circuit C9118-01

This CMOS driver circuit is designed for the photodiode arrays with amplifier S11865/S11866 series. It is possible to configure a long and narrow image sensor by combining this product with a compatible photodiode array with amplifier (sold separately) and arranging multiple combinations in line. It operates with two signal inputs, MCLK and M-RESET, and a single +5 V power supply.

TDI-CCD area image sensors

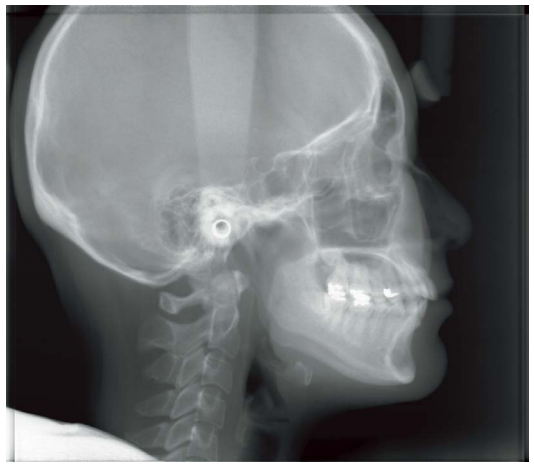
These are long and narrow type CCDs coupled with FOS.
They are used for X-ray radiography and non-destructive X-ray inspection, etc.

Type no.	Scintillator	Pixel size [μm (H) × μm (V)]	Number of effective pixels	Line rate*1 max. (lines/s)	Photo
S7199-01*2	CsI (+ FOP)	48 × 48	1536 × 128 (× 2-chip buttable)	2100	
S8658-01*2			1536 × 128 (× 3-chip buttable)		

*1: TDI scanning
*2: We also offer types (S7199-01F, S8658-01F) that have no scintillator, with only the FOP coupled.

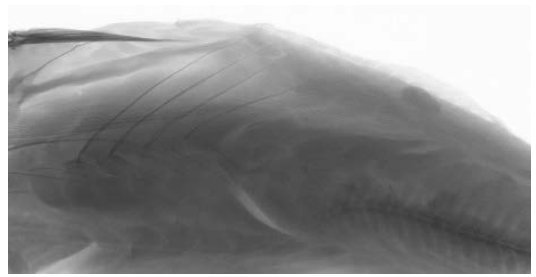
● X-ray imaging examples

[Cephalo]

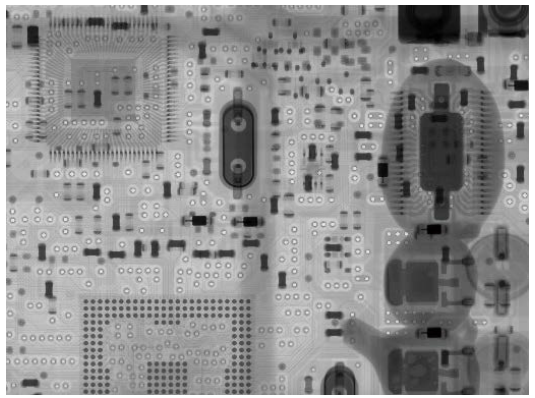


[Panorama]

[Fish bone]



[Printed circuit board]



CCD multichannel detector heads

These products have a housing with a built-in driver circuit for a back-thinned CCD (sold separately) with a care of heat dissipation.

Type no.	Output	Cooling	Applicable sensors (sold separately)
C7040	Analog	Non-cooled	S7030 series, S16000-1007
C7041		One-stage TE-cooled	S7031 series, S16001-1007S
C7043		Non-cooled	S7033 series
C7044		One-stage TE-cooled	S7034 series
C7180		Non-cooled	S7170-0909
C7181		One-stage TE-cooled	S7171-0909-01
C10150-01		Non-cooled	S10140 series (-01)
C10151-01		One-stage TE-cooled	S10141 series (-01)

Note: A multichannel detector head for the two-stage TE-cooled type CCD area image sensors (back-thinned type) S7032 series is also available.

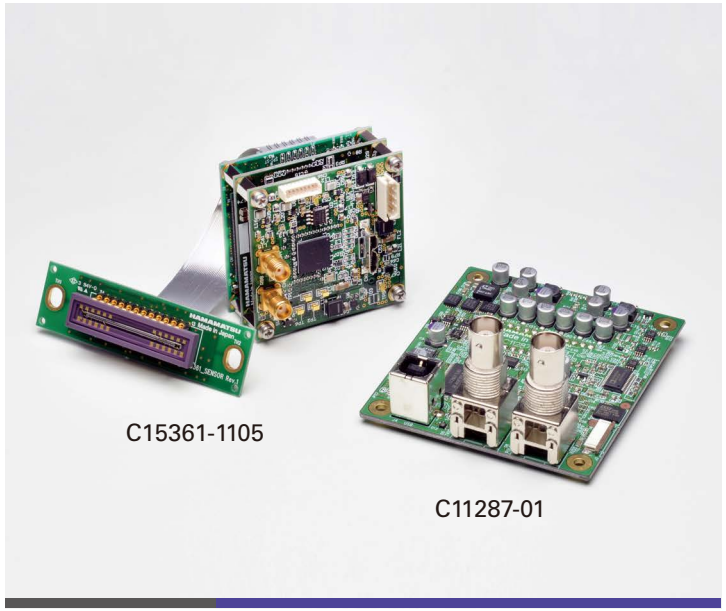
Multichannel detector head controller C7557-01

This controller was developed for basic operation of multichannel photometry. By connecting it to a Hamamatsu multichannel detector head and a PC, it allows easy control of the detector head and data acquisition with the use of dedicated software that comes with the unit.

Driver circuits

for CCD image sensors

CCD image sensors can be evaluated by using these low-price driver circuits.



C15361-1105

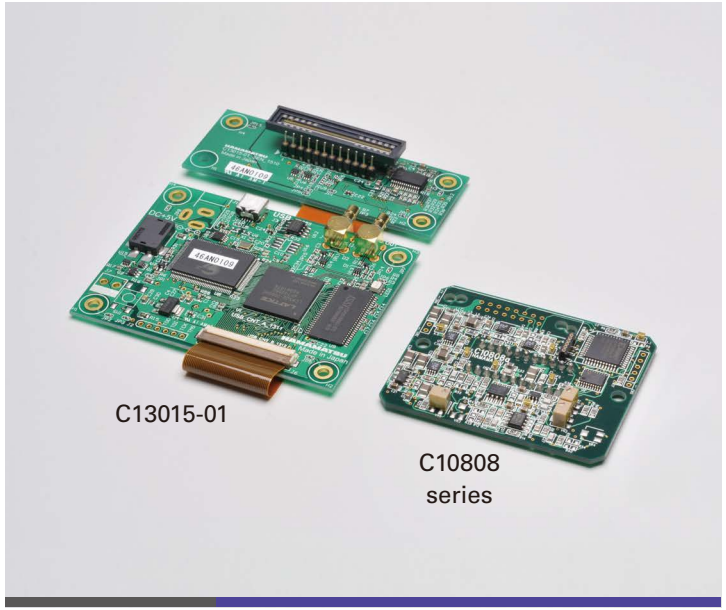
C11287-01

Type no.	Interface	Line rate max. (lines/s)	Applicable sensors (sold separately)
C11160	USB 2.0	483	S11151-2048
C11287-01		210	S10420-1004-01
		180	S10420-1006-01, S16010-1006
		110	S10420-1104-01
		100	S10420-1106-01, S16010-1106
		90	S14650-1024
		70	S14650-2048
C11288-01		1420	S11071-1004
		1040	S11071-1104
		600	S11071-1006
		520	S11071-1106
		290	S14660-1024
		150	S14660-2048
C11165-02		2780	S11155-2048-02, S11156-2048-02
C11860		126	S11850-1006-01, S16011-1106
		100	S14651-1024
		83	S11850-1106-01, S16011-1106
		71	S14651-2048
C15361-1105	USB 3.1 Gen1	2340	S15351-2048
C15361-2105		2340	S15254-2048
		1870	S15257-2048

Driver circuits

for CMOS image sensors

CMOS image sensors can be evaluated by using these low-price driver circuits.



Type no.	Features	Applicable sensors (sold separately)
C10808 series	High-speed readout type (C10808) and low-noise type (C10808-01), both equipped with integration time function	S10121 to S10124-01 series, S15908-512Q, S15909-1024Q
C13015-01	Built-in 16-bit A/D converter, interface: USB 2.0, single power supply operation: USB bus powered (+5 V)	S11639-01, S12706, S13496, S16528-1024-11, S16514-2048-11, S16596-4096-11, S15796 series, S15739-1024, S13014, S14739-20, S13828

Image sensor module

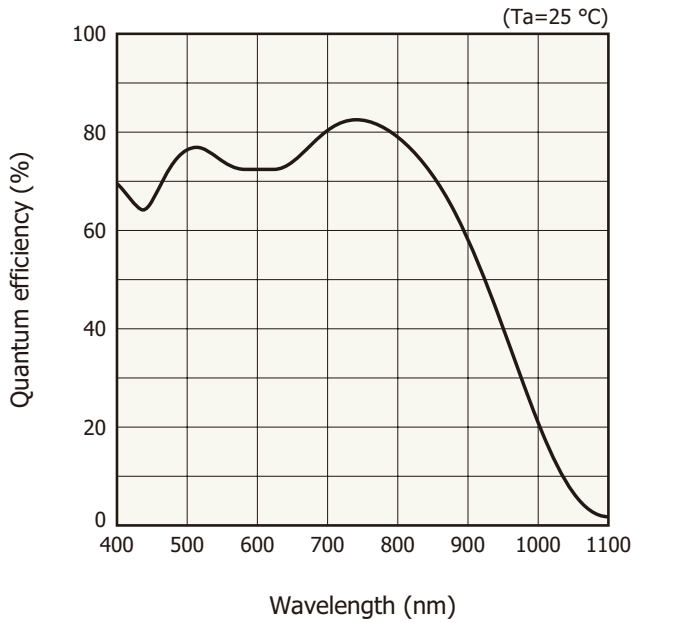
This module for OCT has a built-in CCD image sensor.

Type no.	Line rate max. (lines/s)	Interface	Built-in sensor
C15821-2351	70000	CameraLink	S15729-01

Features

- High-speed line rate: 70000 lines/s
- Number of pixels: 2048 pixels (512 pixels × 4 taps)
- Single 12 V power supply operation
- High near infrared sensitivity (>60%, λ=850 nm)
- CameraLink interface
- Flat field correction function
- External input synchronization mode
- With evaluation software

● Spectral response (typical example)



KMPDB0611EA

Technical notes

- CCD image sensors
- CMOS linear image sensors
- Profile sensors S15366 series

Precautions

- Disclaimer
- Safety consideration
- Image sensors
- Unsealed products
- Surface mount type products
- Resin-sealed CMOS linear image sensors

Inquiries from online

www.hamamatsu.com

- Information described in this material is current as of May 2023.
- Product specifications are subject to change without prior notice due to improvements or other reasons. Before using these products, always contact us for the delivery specification sheet to check the latest specifications.

HAMAMATSU PHOTONICS K.K.

KMPD0002E28 May 2023 DN

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