

Opto-semiconductor Modules

Related products and circuits that enable semiconductor elements to operate at peak performance. A broad range of customization is available.



OPTO- SEMICONDUCTOR MODULE

Opto-semiconductor Modules

Related products and circuits that enable opto-semiconductor devices to operate at peak performance

We can also provide customized products. Feel free to contact us with your request.

Here at Hamamatsu Photonics, we use the unique opto-semiconductor technology that we have accumulated over the years to develop and manufacture Si photodiodes, APDs, MPPCs, image sensors, LEDs, and other opto-semiconductors. To make these opto-semiconductors easier to use and more widely used, we have developed opto-semiconductor modules that combine Hamamatsu opto-semiconductor, optic, circuit, mounting, software, and MEMS technologies. In addition to offering standard opto-semiconductor modules, Hamamatsu can also provide opto-semiconductor modules that are customized in accordance with the specifications that our customers request.



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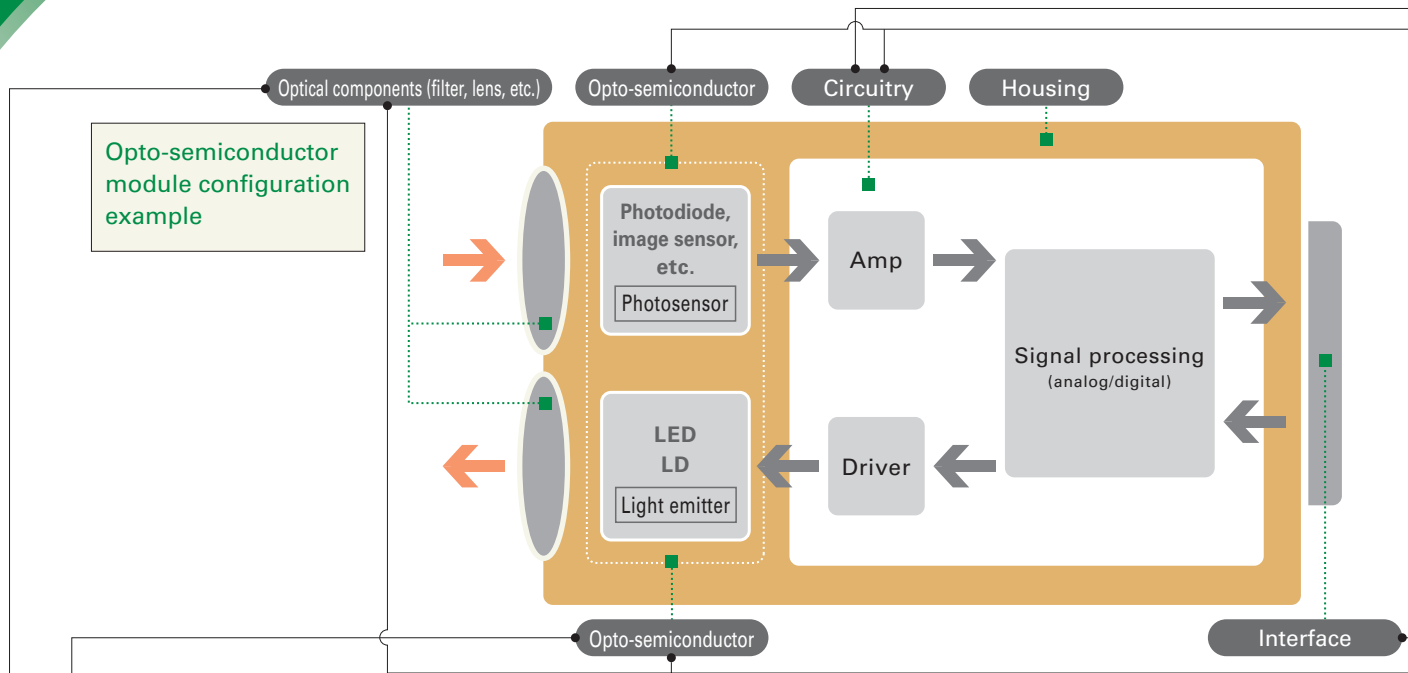
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Opto-semiconductor Modules

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Technologies That Create Opto-semiconductor Modules

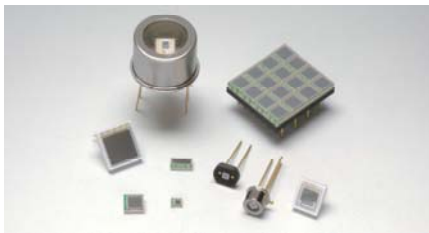


01 Opto-semiconductor technology

- The detector, which is the heart of the module, uses Hamamatsu opto-semiconductors, which have a long track record for many years in the fields of analysis, measurement, automotive, and consumer products.
- Not only can you select photosensors and light sources from the wide lineup of opto-semiconductors that Hamamatsu has developed, you can also have them custom designed to achieve the features that you want.



▲ Si photodiode and APD



▲ MPPC



▲ Image sensor



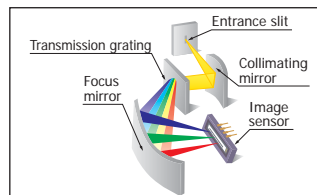
▲ LED

02 Optical technology

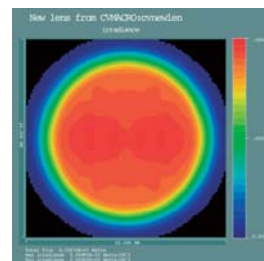
- Optimal optical design leads to high-performance modules.
- Use of simulations
We perform optics simulations in-house to create optical designs quickly and flexibly.



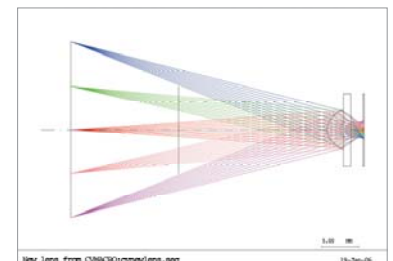
▲ Inside of a mini-spectrometer



▲ Optical system layout example of a mini-spectrometer

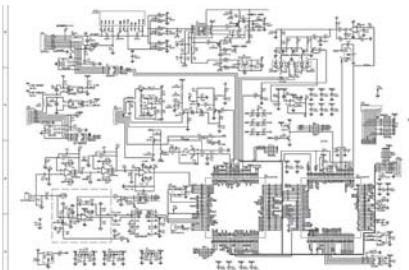


▲ Optical simulation example



03 Circuit technology

- Optimized for optical devices and applications
- Supports high sensitivity, low noise, high speed, and multiple channels



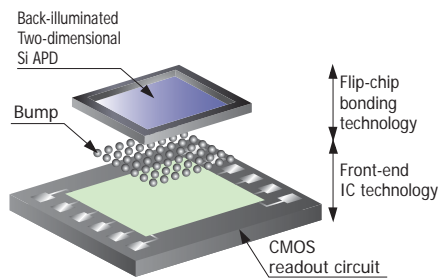
▲ Circuit example



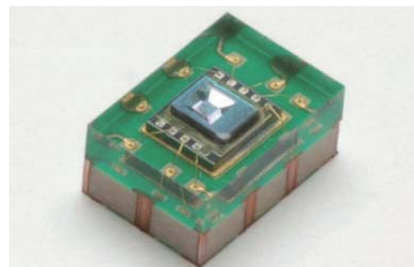
▲ Circuit mounting example

04 Mounting technology

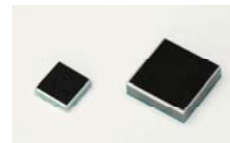
- Our mounting technology combines compactness, high functionality, and low cost.
 - Flip-chip bonding technology: A flip chip is directly bonded to a board through the use of a solder bump.
 - Front-end IC technology: A custom first-stage analog signal processing circuit and a photosensitive area are bonded together.
- COB (chip on board): A chip is directly mounted onto a board, and this results in a smaller mounting area, a thinner module, and a lower cost.
- A photosensor and optical component, etc. are bonded to a board, and this results in a smaller size and a lower cost.



▲ Example of our mounting technology applied



▲ Hybrid device (using front-end IC technology)



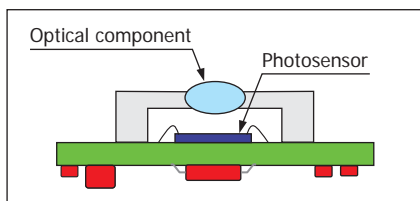
◀ Chip-size packages (Flip-chip bonding technology is used.)



◀ COB



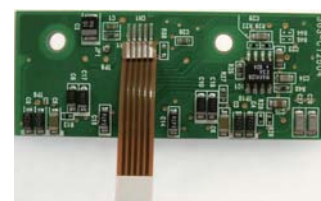
▲ Example in which a photosensor and an optical component are combined (optics module)



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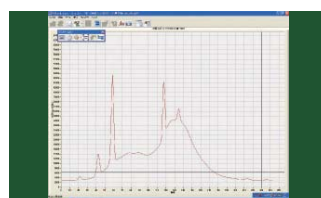


▲ Dual-sided mounting

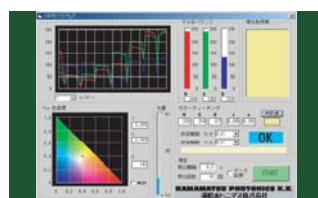


05 Software technology

- The sample software makes swift evaluation possible.
- Support for USB, RS-232C, and other types of interfaces is available.



▲ Mini-spectrometer measurement example

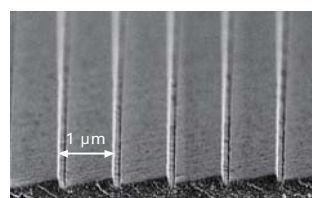


▲ Color sensor module measurement example

06 MEMS* technology

- High-precision micromachining
- Helps make modular components smaller and modules more functional

* Micro-electro-mechanical systems



▲ Magnified photograph of micro-grating



▲ Enlarged photo of slit

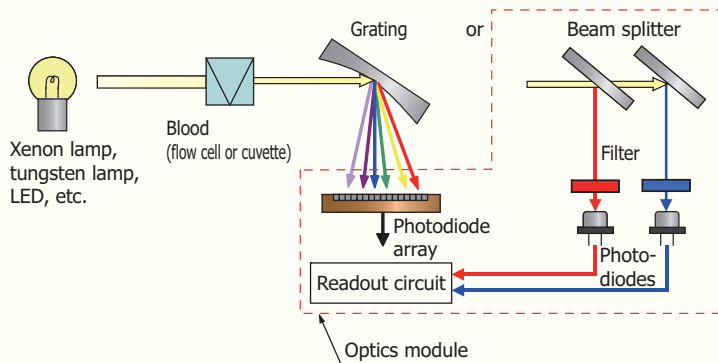
Customization example

Optics Module

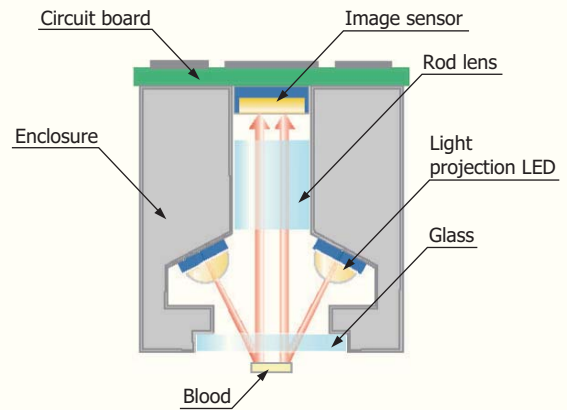
An optics module is a custom opto-semiconductor module that consists of a photosensor, a light source, optical components (lenses, filters, etc.), circuits (analog and digital), an enclosure, and the like.

We integrate our technologies to provide optics modules whose specifications meet the requirements of our customers, such as modules for blood analysis. A blood analysis device measures the light absorbance of blood and the fluorescence that results when blood reacts with reagents and is exposed to light. Blood analysis devices are used to detect the quantities of a variety of substances that are found in blood.

▼ Optics module used in a blood analysis device



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Process for developing a custom product

Not only do we modify the specifications of our standard opto-semiconductor modules, we can also design new custom products.

Requests from the customer >>>

01

Functionality and performance that the customer wants to achieve

02

External dimensions

03

Price

Assessment of the specifications >>>

Opto-semiconductor

You can select from a wide lineup of standard products or have a new device developed.

Optics

Suitable optical designs (for lenses, mirrors, filters, etc.) that are based on vast experience

Circuit

Unique Hamamatsu analog and digital circuit designs that can handle low light levels (we can handle circuit design and pattern design)

Software

We have the flexibility to design firmware for microcontrollers, FPGAs, DSPs, etc., as well as application software.

Design

Simulation

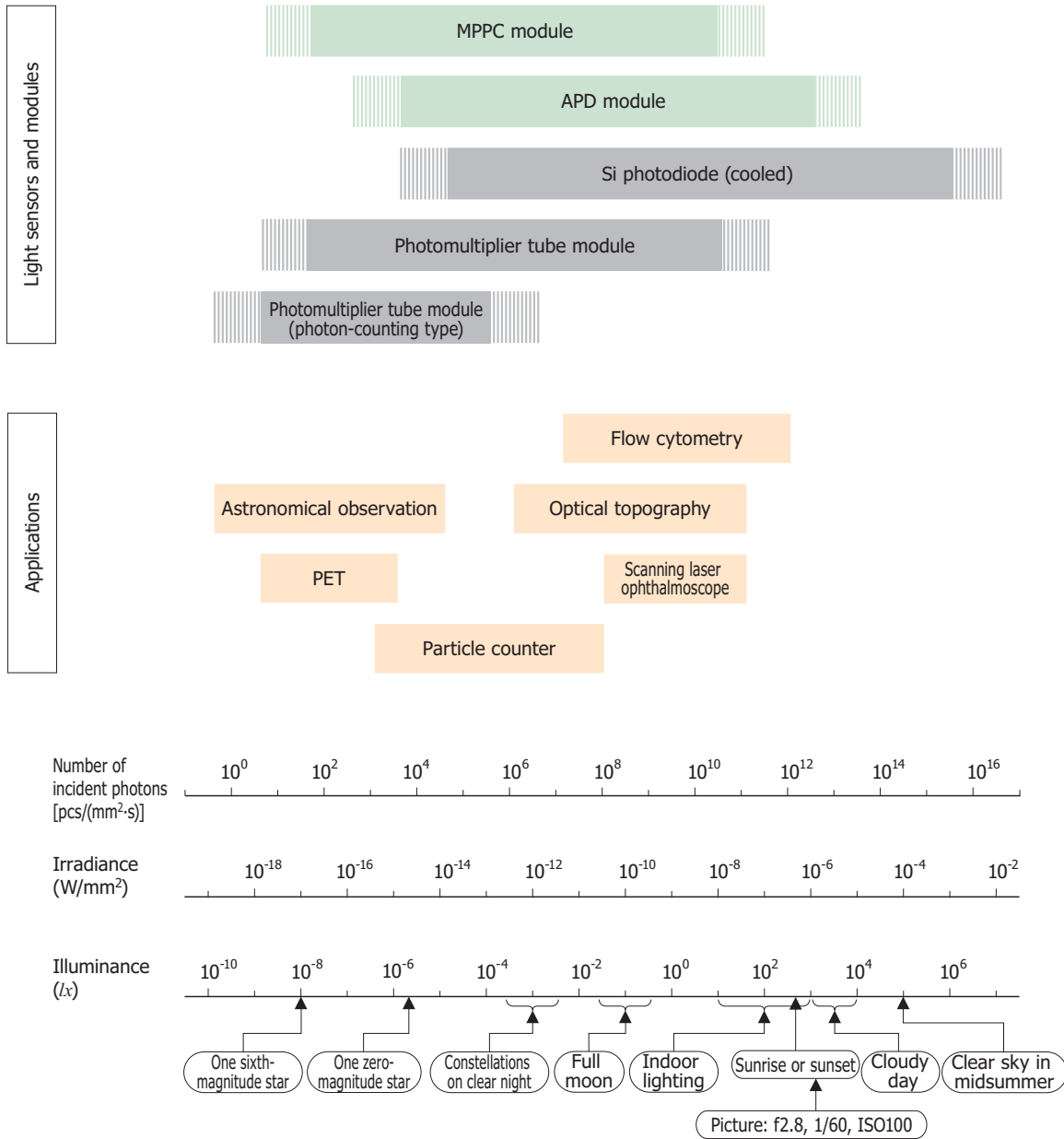
Testing

Evaluation

Mass production

Low-light-level detection modules

Examples of optical sensors and modules that correspond to different light levels and applications



Note: Reference data

Correlation between the number of incident photons, irradiance, and illuminance is shown for light at $\lambda = 555 \text{ nm}$.

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MPPC modules

Hamamatsu MPPC modules are optical measurement modules capable of measuring light over a wide range of light levels (10 orders of magnitude) from the photon-counting region up to the nW (nano watt) region. MPPC modules contain a signal amplifier circuit, a high-voltage power supply circuit, and other components needed for MPPC operation. MPPC modules operate just by connecting them to a power supply (± 5 V, etc.).





Analog output type

(Typ. $T_a=25^\circ\text{C}$, $\lambda=\lambda_p$, unless otherwise noted)

Type no.	Photo W x D x H (mm)	Photosensitive area (mm)	Pixel pitch	Internal MPPC	Noise equivalent power	High-band cutoff frequency	Temperature control	Supply voltage	Features
C11209-110	 45 x 38 x 13	1 x 1	10 μm	S12571-010C	3 fW/Hz ^{1/2}	40 MHz (rise time: 500 ps)	Temperature compensation (non-cooled)	+5 V	<ul style="list-style-type: none"> High speed Compact size
C11205-150	 50 x 50 x 19.6	1 x 1	50 μm	S12571-050C	0.8 fW/Hz ^{1/2}	7 MHz	Temperature compensation (non-cooled)	± 5 V	<ul style="list-style-type: none"> High sensitivity (1×10^9 V/W)
C11205-350		3 x 3		S12572-050C	2 fW/Hz ^{1/2}				
C12662-150	 98 x 60 x 35	1 x 1	50 μm	S12576-050	0.2 fW/Hz ^{1/2}	7 MHz	TE-cooled (-20 $^\circ\text{C}$)	± 5 V	<ul style="list-style-type: none"> High sensitivity (1×10^9 V/W) Low noise
C12662-350		3 x 3		S12577-050	0.4 fW/Hz ^{1/2}				



Digital output type

(Typ. $T_a=25^\circ\text{C}$, $\lambda=\lambda_p$, unless otherwise noted)

Type no.	Photo W x D x H (mm)	Photosensitive area (mm)	Pixel pitch	Internal MPPC	Dark count	Maximum count rate	Temperature control	Supply voltage	Features
C12661-150	 98 x 60 x 35	1 x 1	50 μm	S12576-050	2.5 kcps	10 Mcps	TE-cooled (-20 $^\circ\text{C}$)	± 5 V	<ul style="list-style-type: none"> High photon detection efficiency (35%) Low dark count Low afterpulse
C12661-350		3 x 3		S12577-050	25 kcps				
C11202-050	 98 x 60 x 35	$\phi 50 \mu\text{m}$	—	Single pixel type	7 cps	30 Mcps	TE-cooled (-20 $^\circ\text{C}$)	± 5 V	<ul style="list-style-type: none"> High photon detection efficiency (70%) Low dark count Low afterpulse
C11202-100		$\phi 100 \mu\text{m}$	—		30 cps	20 Mcps			


Starter kits

(Typ. $T_a=25^\circ\text{C}$, $\lambda=\lambda_p$, unless otherwise noted)

Type no.	Photo W x D x H (mm)	Photosensitive area (mm)	Pixel pitch	Internal MPPC	Temperature control	Supply voltage	Features
C11208-150	 98 × 60 × 35	1 × 1	50 μm	S12576-050	TE-cooled (-10 °C)	USB bus power	• Suitable for initial MPPC evaluations; supports 3 outputs (analog,digital, and pulse count value) • USB bus power drive
C11208-350		3 × 3		S12577-050	TE-cooled (0 °C)		
C12332	 70 × 50 × 11.4	Evaluates any non-cooled MPPC (sold separately)			Temperature compensation (non-cooled)	±5 V	• Simple initial MPPC evaluations • Includes C11204-01 power supply for MPPC • Measurable just by setting MPPC operating voltage from PC

Power supply module

(Typ. $T_a=25^\circ\text{C}$, $V_s=+5$ V, unless otherwise noted)

Type no.	Photo W x D x H (mm)	Input voltage range	Output voltage range	Ripple noise typ.*1	Temperature stability typ.	Setting resolution	Features
C11204-01	 19.4 x 17 x 6.3	5 V	50 to 90 V	0.1 mVp-p	± 10 ppm/ $^\circ\text{C}$	1.8 mV	<ul style="list-style-type: none"> Includes high-precision temperature compensation function (temperature stability: ± 10 ppm/$^\circ\text{C}$ typ.) Various settings possible via serial interface

*1: No load; recommended circuit is used














APD modules

These modules combine APDs, low-noise amplifiers, and bias power supplies in a compact form.



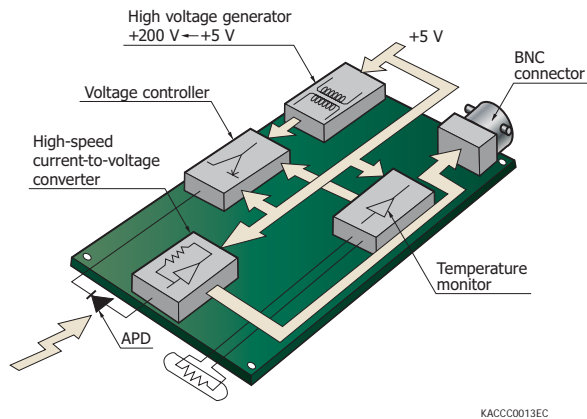
(Typ. $T_a=25^\circ\text{C}$, unless otherwise noted)

Type		Type no.	Photo W × D × H (mm)	Effective photosensitive area (mm) ^{*1}	Built-in APD	Cutoff frequency		Photoelectric conversion sensitivity λ=800 nm (V/W)	Minimum detection limit λ=800 nm	Temperature stability of gain 25 ± 10 °C (%)	Supply voltage (V)
						Low speed	High speed				
Standard	For near infrared light		 80 × 50 × 23	φ1.0	S12023-10	4 kHz	100 MHz	-6.83 × 10 ⁴	3 nW rms	±2.5	+5
				φ3.0	S2384		80 MHz	-2.25 × 10 ⁴	3.6 nW rms		
	For short wavelengths			φ1.0	S12053-10		100 MHz	-2.46 × 10 ⁴ *2	5 nW rms *2		
				φ3.0	S5344		40 MHz	-1.89 × 10 ⁴ *2	6.3 nW rms *2		
High sensitivity			 80 × 50 × 23	φ1.5	S3884	DC	10 MHz	1.50 × 10 ⁶	630 pW rms	±2.5	±12
				φ3.0	S2384		100 kHz	-1.50 × 10 ⁸	6.3 pW rms		
High stability		C10508	 55 × 65.6 × 19.6	φ1.0	S12023-10	DC	10 MHz	1.25 × 10 ⁷	63 pW rms	±5.0 max. (0 to 40 °C)	±5
High speed		C5658	 28 × 50 × 60	φ0.5	S12023-05	50 kHz	1 GHz	2.50 × 10 ⁵	16 nW rms	±5.0	+12
TE-cooled type		C4777-01	 106.6 × 60 × 40	φ3.0	S4315-04 Two-stage TE- cooled type	DC	5 kHz	-1.25 × 10 ⁹	0.14 pW rms	±3.0	±15 +5

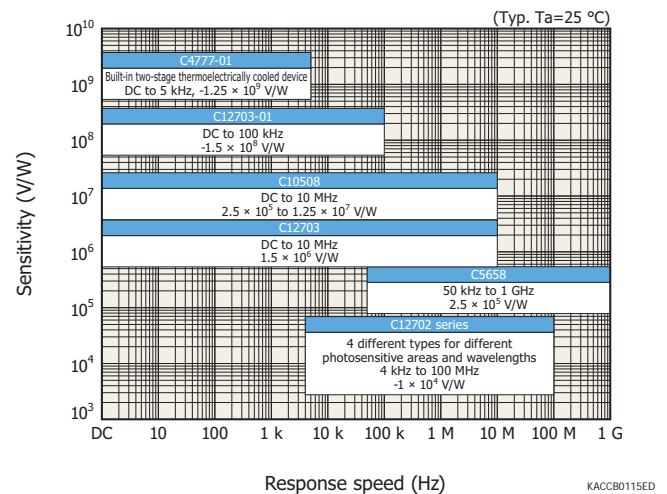
*1: Area in which a typical gain can be obtained

*2: $\lambda=620\text{ nm}$

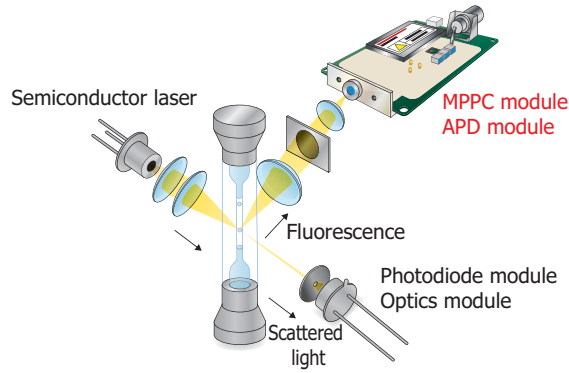
Block diagram (C12702 series)



Sensitivity and response speed



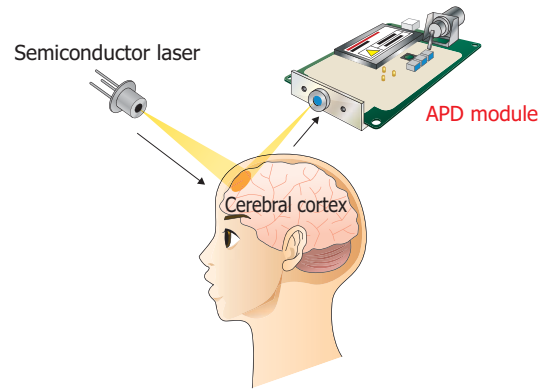
Flow cytometry



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So that the type, number, and nucleic acids (DNA and RNA) of cells can be detected, a liquid that contains cells is made to flow at high speeds and is irradiated with a laser. The resulting faint fluorescence is detected.

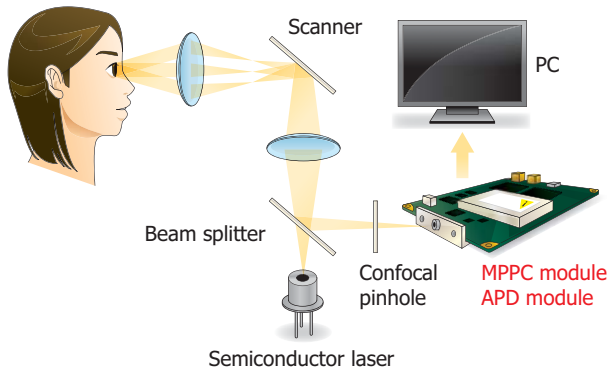
Optical topography



KACCC0594EA

So that changes in the amount of blood flow in the cerebral cortex can be detected, near infrared light is irradiated from above the head, an APD module detects scattered light, and changes in the hemoglobin density of the blood are thereby detected.

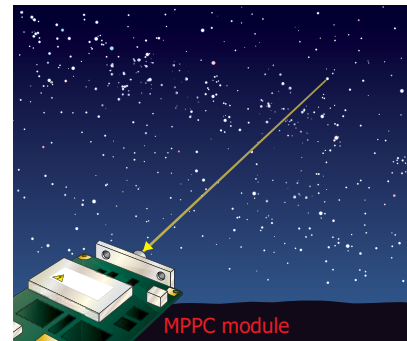
Scanning laser ophthalmoscope (SLO)



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In ophthalmoscopy, for safety reasons, the light that is irradiated into the eye-ball must have a low intensity. MPPC and APD modules can be used to detect faint reflected light from the eye with superior resolution and contrast.

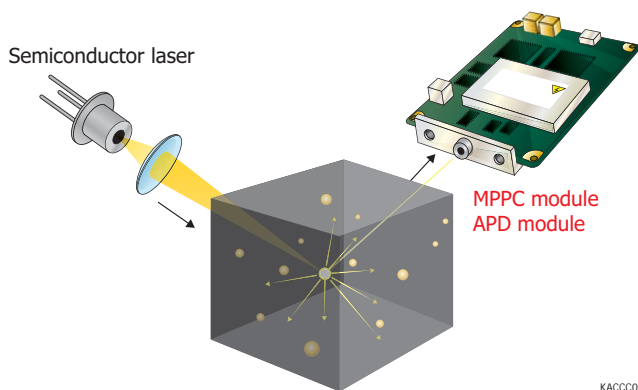
Astronomical observation



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MPPC modules are used to capture low light levels from space and observe the activities of heavenly bodies.

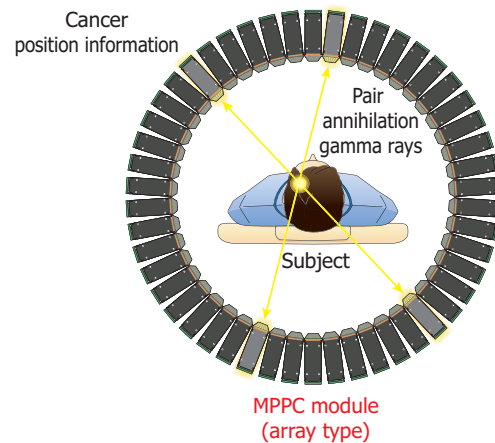
Particle counter



KACCC0597EA

When a laser is made to pass through a chamber that contains a gas or liquid, the quantity and size distributions of the particles in the chamber can be determined through the detection of the light that is scattered by the particles.

PET (positron emission tomography)



KACCC0598EA

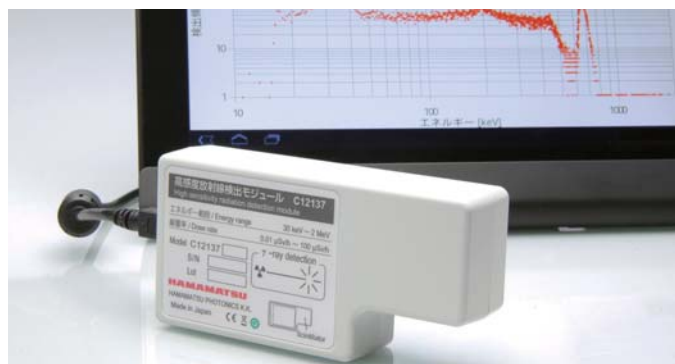
MPPCs that are arranged 360° around an object detect pair annihilation gamma rays, and the location of a target, such as cancer, can be determined on the basis of the detected intersections.

Radiation detector modules





High sensitivity type

The C12137 series is a radiation detector module containing a scintillator and MPPC (multi-pixel photon counter) designed to detect gamma rays such as ^{137}Cs (Cesium-137). The scintillator converts incident gamma rays into a visible light which is detectable by the MPPC even at very low light levels to ensure highly accurate measurement of low energy gamma rays. The signal processing circuit and A/D converter come housed in a compact case with a USB interface.



Note: PC not supplied with the C12137.

(Typ. $T_a=25^\circ\text{C}$, unless otherwise noted)

Item	C12137	C12137-01
Photo W × D × H (mm)	 110 × 55 × 27	 71 × 55 × 60.5
Detector	MPPC	
Scintillator	CsI(Tl) 13 × 13 × 20 mm	CsI(Tl) 38 × 38 × 25 mm
Counting efficiency min.*1	40 cpm	400 cpm
Energy range	30 keV to 2 MeV	
Energy resolution*2	8%	8.5%
Measurement range*2 *3	0.01 $\mu\text{Sv/h}$ to 100 $\mu\text{Sv/h}$	0.001 $\mu\text{Sv/h}$ to 10 $\mu\text{Sv/h}$
Measurement error*4	$\pm 20\%$	
Sampling time	1 to 60 seconds (adjustable)	
Interface	USB 2.0 (Full Speed) Supports Windows 7® SP1 (32-bit/64-bit version) and Windows® XP SP3 (32-bit version)*5	
Power supply	USB bus power (150 mA typ.)	

*1: ^{137}Cs , 0.01 $\mu\text{Sv/h}$

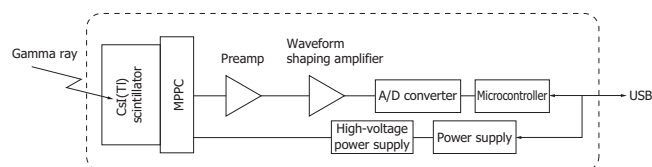
*2: ^{137}Cs , 662 keV

*3: Lower limit depends on environmental radiation.

*4: Not including attenuation and counting fluctuations caused by shielding material

*5: Windows is either registered trademark or trademark of Microsoft Corporation in the United States and other countries.

Block diagram (C12137)



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Radiation detector modules incorporating a compact and high-gain MPPC (multi-pixel photon counter) offer the following features:

► Detection of low energy gamma rays (down to 30 keV) and energy discrimination

The C12137 series is capable of acquiring an energy spectrum as well as providing accurate energy discrimination. ^{137}Cs is known to decay while emitting gamma rays at energies around 662 keV and around 32 keV. Acquiring an energy spectrum down to low energy gamma rays around 30 keV allows determining whether those gamma rays are derived from ^{137}Cs . When the energy of gamma rays entering a scintillator falls to a low level, the light level emitted from the scintillator in response to the gamma rays is also very low. The C12137 series uses a high sensitivity MPPC that allows detecting gamma rays over a wide range from low energy gamma rays around 30 keV on up to about 2 MeV.

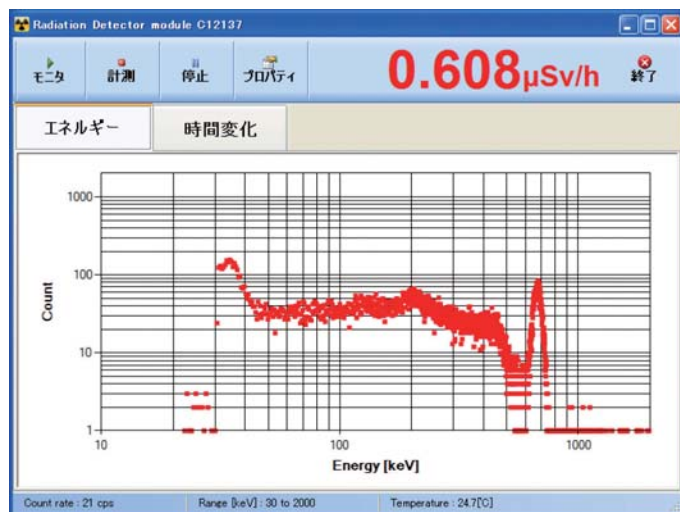
Due to high gain and ability to detect low light levels, the MPPC is also effective in shortening the measurement time. Enhancing the photon detection efficiency to shorten measurement time usually requires a larger scintillator. However, light produced in a larger scintillator usually attenuates while traveling through the scintillator toward the detector. This degrades the lower detection limit, making it difficult to detect low energy gamma rays. Compared to PIN photodiodes and APD, the MPPC has a higher gain capable of detecting low light levels and so can make measurements of low energy gamma rays even when used with a larger scintillator.

► Sample software

Hamamatsu also provides sample software for initial evaluation of our radiation detector modules.

Basic sample software functions are setting measurement parameters, acquiring and saving data, and displaying measurement data graphs. To help users develop their own application software for operating our radiation detector module while installed into equipment, we also provide function specifications and source codes of the sample software.

Sample software (For Windows)



► Related products



Charge amplifier H4083
(Low noise amplifier for detecting X-rays,
radiation, and high energy particles)

► Product lineup and customized products



Besides the C12137/-01 radiation detector modules, we also offer customized products including different scintillator sizes and shapes, and data communication interfaces that meet your specific requirements.

Mini-spectrometers
















Mini-spectrometers are compact devices that include a grating and other optical elements and an image sensor.

There are modular types that have a built-in driver circuit and head types that do not have a built-in driver circuit.

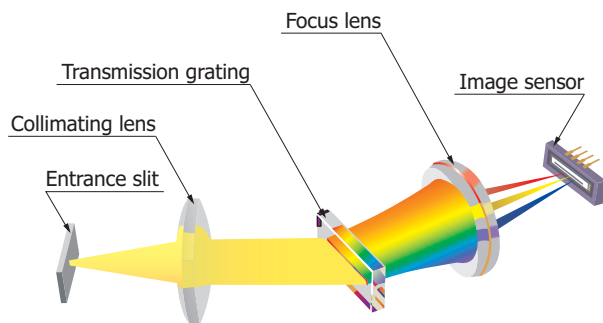


(Typ. Ta=25 °C, unless otherwise noted)

Type no.	Photo W × D × H (mm)	Type	Spectral response range (nm)	Wavelength resolution (nm)	Built-in image sensor	Features
C10082CA		High sensitivity TM-UV/VIS-CCD	200 to 800	6 max.	Back-thinned CCD image sensor	• Suitable for spectroscopic measurement (fluorescence measurement, etc.) of low light levels
C10082CAH	95 × 92 × 76	High resolution TM-UV/VIS-CCD		1 typ.		
C10082MD		Wide dynamic range TM-UV/VIS-MOS		6 max.	CMOS linear image sensor	• Suitable for use in environments with high light levels (light source spectrometry, absorbance measurement, etc.)
C10083CA		High sensitivity TM-VIS/NIR-CCD	320 to 1000	8 max. (320 to 900 nm)	Back-thinned CCD image sensor	• Suitable for spectroscopic measurement (fluorescence measurement, etc.) of low light levels
C10083CAH	95 × 92 × 76	High resolution TM-VIS/NIR-CCD		1 typ. (320 to 900 nm)		
C10083MD		Wide dynamic range TM-VIS/NIR-MOS		8 max.	CMOS linear image sensor	• Suitable for use in environments with high light levels (light source spectrometry, absorbance measure- ment, etc.)
C11697MA	94 × 90 × 55	Triggering TM-VIS/NIR-MOS-II			CMOS image sensor with amp array	• Triggering • Suitable for spectroscopic measurement using pulsed light
C9404CA		High sensitivity TG-UV-CCD	200 to 400	3 max.	Back-thinned CCD image sensor	• Suitable for spectroscopic measurement (fluorescence measurement, etc.) of low light levels
C9404CAH	125.7 × 115.7 × 75	High resolution TG-UV-CCD		1 typ.		
C9405CB		High sensitivity TG-SWNIR-CCD-II	500 to 1100	5 max. (550 to 900 nm)	High infrared sensitivity back-thinned CCD image sensor	• High near-infrared sensitivity • Suitable for spectroscopic measurement (fluorescence measurement, etc.) of low light levels
C11713CA		High resolution TG-RAMAN-I	500 to 600	0.3 typ.	Back-thinned CCD image sensor	• Suitable for Raman spectrometry
C11714CA	120 × 70 × 60	High resolution TG-RAMAN-II	790 to 920			
 C11482GA		No cooling TG2-NIR	900 to 1700	7 max.	InGaAs linear image sensor	• For near infrared range • A low-noise, cooled type is available.
C9913GC		Low noise (cooled type) TG-cooled-NIR-I				
C9914GB		Low noise (cooled type) TG-cooled-NIR-II	1100 to 2200	8 max.		
C11118GA	142 × 218 × 80	Low noise (cooled type) TG-cooled-NIR-III	900 to 2550	20 max.		
C11007MA		Spectrometer module RC-VIS-MOS	340 to 780	9 max.	CMOS linear image sensor	• Compact • Inexpensive • For incorporating into devices
C11008MA	55 × 48 × 100	Spectrometer module RC-SWNIR-MOS	640 to 1050	8 max.		
C11009MA	28 × 28 × 28	Spectrometer head RC-VIS-MOS	340 to 780	9 max.		
C11010MA	35 × 20 × 28	Spectrometer head RC-SWNIR-MOS	640 to 1050	8 max.		
C10988MA-01		Spectrometer head MS-VIS-MOS	340 to 750	14 max.	CMOS linear image sensor	• Thumb size • Slit input
C11708MA	276 × 13 × 16.8	Spectrometer head MS-SWNIR-MOS	640 to 1050	20 max.		

Elemental technologies that go into making mini-spectrometers

Optical system layouts (typical example: TG series)



KACCC0256EA

The wavelength dispersive elements of the mini-spectrometers (TM and TG series) use a transmission grating (quartz) fabricated by a holographic process. The holographic process is a technique suited for mass production, and a grating can be formed directly onto the matrix, instead of replicating the grating. This grating can separate light into a spectrum precisely and improve measurement throughput. It also reduces stray light levels.

Also, the detector, which is the heart of the mini-spectrometer, uses Hamamatsu image sensors, which have performed exceptionally for many years in the fields of analysis and measurement.

The mini-spectrometer was developed and produced from these elemental technologies.

SEM photo of a grating

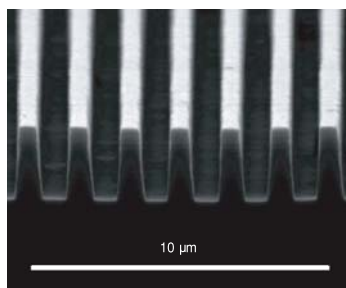
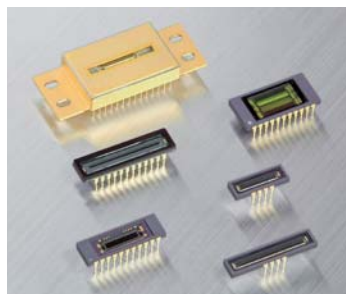
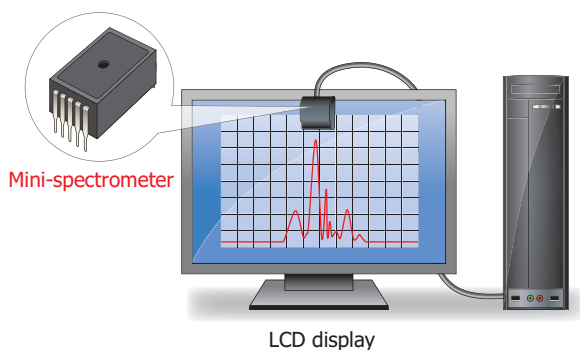


Image sensors that are built into the mini-spectrometers



Application examples

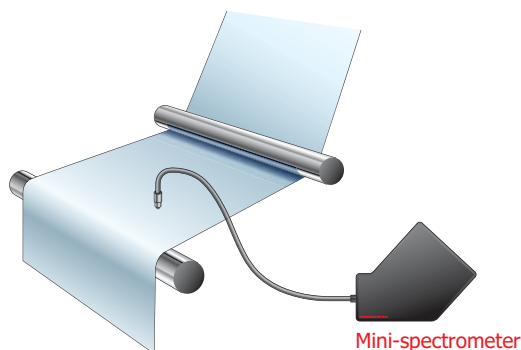
Display color measurement



KACCC0599EA

The emission spectrum of an LCD display is monitored through the use of a mini-spectrometer.

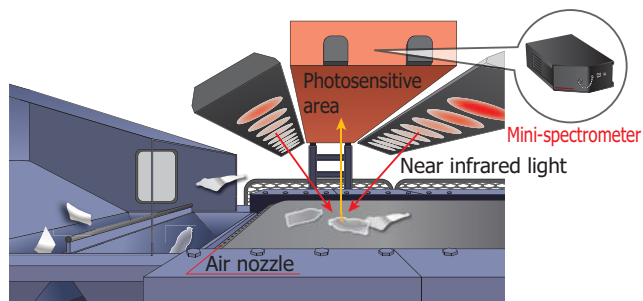
Film thickness measurement



KACCC0600EA

White light interferometry can be used to determine the thickness of a film on the basis of the number of reflected light's spectral peaks, refractive index, and incident light angle.

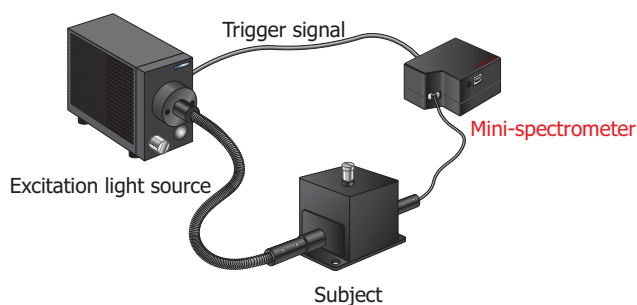
Plastic selection



KACCC0601EA

Near-infrared light is emitted onto plastics. Different types of plastics absorb different wavelengths, and this fact is used to separate the plastics.

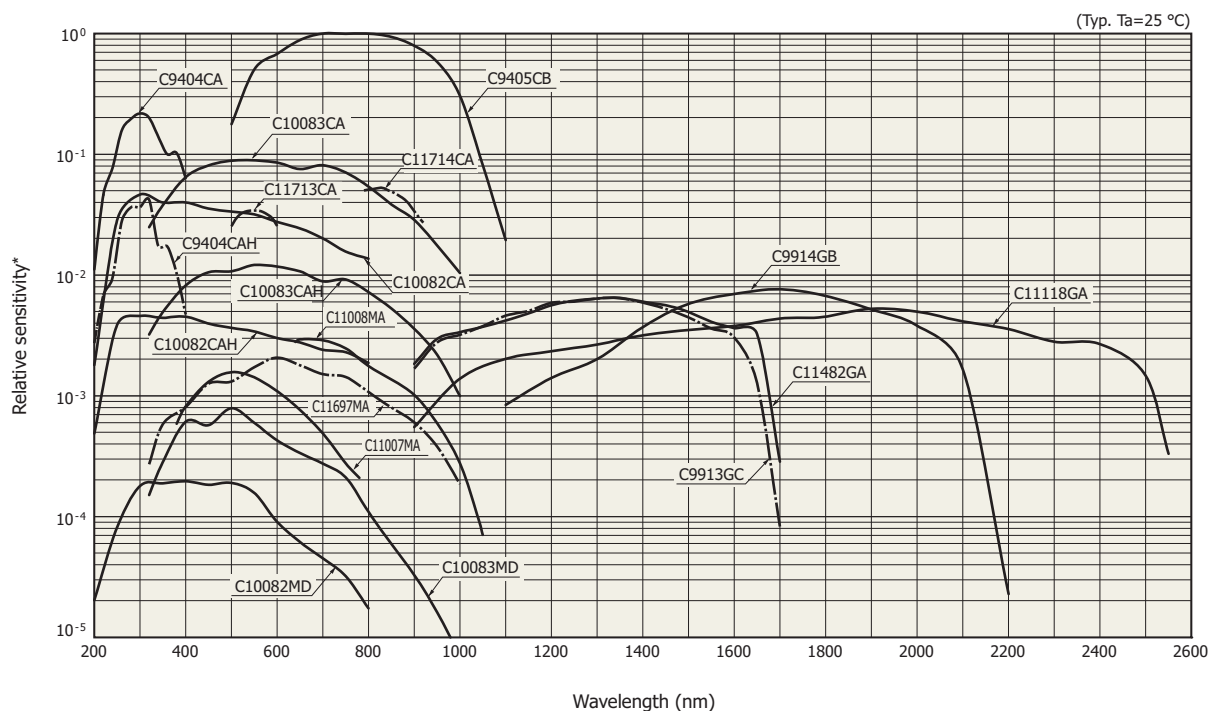
Fluorescence measurement



KACCC0602EA

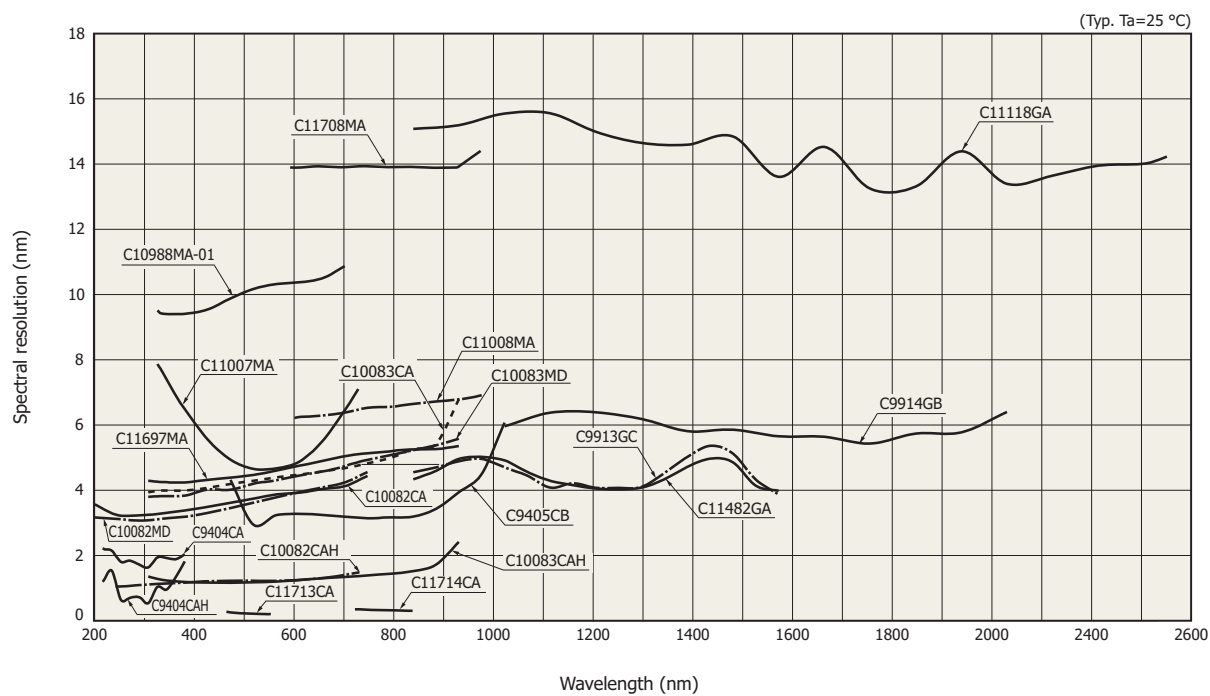
The emission spectra of fluorescent lights, organic EL devices, and other luminescent materials are measured.

Spectral response (relative data)



KACCB0137EG

Spectral resolution vs. wavelength (typical example)



KACCB0139EG

Light position, light-level, and color detection modules

Photodiode modules Photosensor amplifiers




Photodiode modules are high precision photodetectors that have built-in Si photodiodes and current-to-voltage conversion circuits. Because the output from these photodiode modules is an analog voltage signal, it can be easily measured with a voltmeter, etc.

Photosensor amplifiers are current-to-voltage conversion amplifiers that can amplify the weak photocurrent of a photodiode with low noise levels.







Photodiode modules, Signal processing unit

(Typ. Ta=25 °C)

Type no.	Photo W × D × H (mm)	Features	Photosensitive area (mm)		Photo- sensitivity (mV/nW)	Conversion impedance (V/A)	Frequency bandwidth	Output	Puwer supply	Sample software
C10439-01	 19 × 46 × 52	•These modules have built-in photo- diodes. Suitable for light level monitors, color-difference meters, and flow meters	Si	2.4 × 2.4	H: 500 L: 5	H: 10 ⁹ L: 10 ⁷	H: 10 Hz L: 1 kHz	Analog	External power supply (±5 to ±12 V)	-
C10439-02				5.8 × 5.8						
C10439-03				10 × 10						
NEW C10439-07				2.4 × 2.4						
NEW C10439-08			5.8 × 5.8	H: 0.5 L: 0.005	H: 1 kHz L: 100 kHz					
NEW C10439-09	10 × 10									
NEW C10439-10	 19 × 50 × 52		InGaAs	φ1	H: 1 L: 0.01					
NEW C10439-11				φ3						
C10475	 110 × 100 × 30	•Signal processing unit for the C10439series	-	-	-	-	-	RS-232C	AC adapter (+12) or battery (one 9 V battery)	○

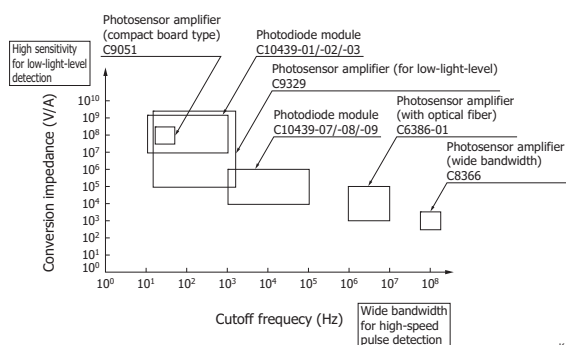
Photosensor amplifiers

(Typ. Ta=25 °C, unless otherwise noted)

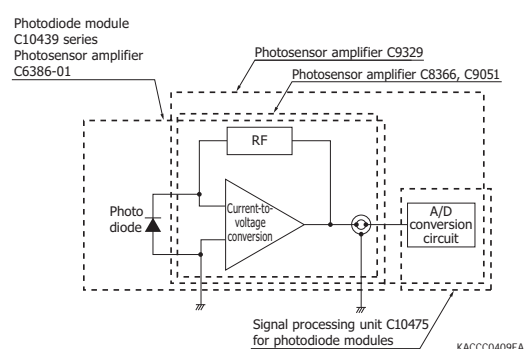
Type no.	Photo W × D × H (mm)	Features	Photodiode	Photo- sensitivity (mV/μW)	Conversion impedance (V/A)		Frequency bandwidth	Output	Power supply	Sample software
C6386-01	 115 × 90 × 40	<ul style="list-style-type: none">• Optical fiber included• Suitable for plasma monitors and for detecting scratches and defects in metal and glass	Built-in (optical fiber) photosensitive size φ2 mm, NA 0.56)	30	H	10 ⁵	DC to 1 MHz	Analog	External power supply (±15 V) or batteries (two 9 V batteries)	-
				3	M	10 ⁴	DC to 3 MHz			
				0.3	L	10 ³	DC to 10 MHz			
C8366	 19 × 52 × 46	<ul style="list-style-type: none">• Fast and compact• Suitable for high-speed light measurement (laser power monitoring, etc.)	Sold separately (high-speed Si PIN PD; photosensitive area φ0.4 to φ5 mm)	-	10 ³		DC to 100 MHz	Analog	External power supply (±15 V)	-
C9051	 50 × 19 × 50	<ul style="list-style-type: none">• Compact board type• Suitable for optical power meters and illuminometers	Sold separately (terminal capacitance of 5 nF or less)	-	10 ⁸		DC to 16 Hz	Analog	AC adapter (+12 V)	-
C9329	 115 × 90 × 40	<ul style="list-style-type: none">• Ultra-low noise and high gain• Suitable for low-light-level detection and precise photometry	Sold separately (terminal capacitance of 5 nF or less)	-	H	10 ⁹	DC to 16 Hz	Analog RS-232C	AC adapter (+12 V) or battery (one 9 V battery)	○
					M	10 ⁷	DC to 1.6 kHz			
					L	10 ⁵				

Note: Please refer to the datasheet for more information. We can also provide customized products. Please contact the sales office for more information.









Conversion impedance vs. cutoff frequency



Block diagram

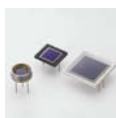

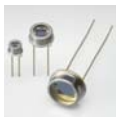




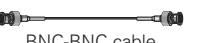
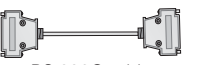

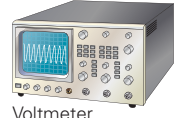






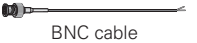

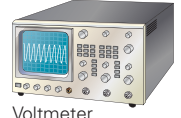




Connection example of photodiode module and signal processing unit

Photodiode module	Signal processing unit	Power supply and PC
 <p>C10439 series (with built-in photodiode)</p>  <p>Photodiode module connection cable (for power supply)*1</p>  <p>BNC-BNC cable (for signal)*1</p>	 <p>C10475</p>	 <p>AC adapter*1</p>  <p>RS-232C cable</p>  <p>AC 100 to 240 V 50/60 Hz</p>  <p>PC</p>

*1: Accessory for C10475 signal processing unit

Connection examples of photosensor amplifiers

Si photodiode	Photosensor amplifier	Power supply, measuring instrument, and PC
<p>For ArF excimer laser</p>  <p>S8551, S8552, S8553</p>  <p>BNC cable</p> <p>For high-precision photometry</p>  <p>BNC cable</p> <p>Infrared high sensitivity S2386/S2387 series For UV to infrared range S1336/S1337 series Infrared sensitivity suppressed type S1226/S1227 series</p> <p>BNC connector included</p>  <p>S2281 series</p>	<p>Ultra-low noise and high gain</p>  <p>C9329*2</p> <p>Small board type</p>  <p>C9051</p>	 <p>AC adapter*3</p>  <p>BNC-BNC cable</p>  <p>RS-232C cable</p>  <p>AC 100 to 240 V 50/60 Hz</p>  <p>Voltmeter, oscilloscope, etc.</p>  <p>PC</p>
<p>High-speed Si PIN photodiode</p>  <p>S3071, S3072, S3399, S3883, S5821 S5971, S5972, S5973 series</p> <p>Insert the leads into the socket of the C8366</p>	<p>High-speed type</p>  <p>C8366</p> <p>Optical fiber included (with built-in photodiode)</p>  <p>C6386-01*2</p>	 <p>Power cable*3</p>  <p>BNC-BNC cable</p>  <p>BNC cable</p>  <p>AC 100 to 240 V 50/60 Hz</p>  <p>Power supply (±15 V)</p>  <p>Voltmeter, oscilloscope, etc.</p>  <p>PC (with A/D conversion board)</p>

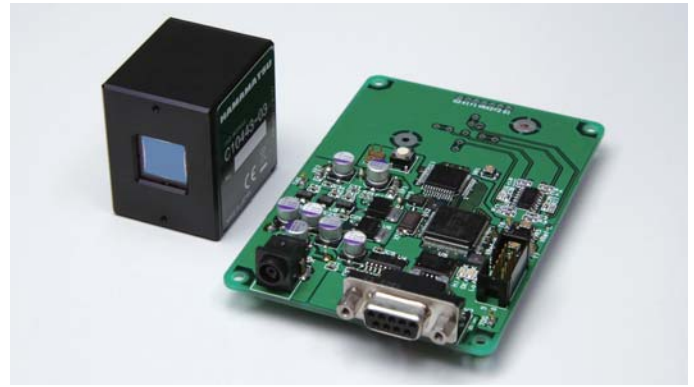
*2: Can also be driven by a 0006P rectangular 9 V battery

*3: Accessory for photosensor amplifiers





PSD modules PSD signal processing circuits

The PSD modules are position detection modules that combine a PSD (position sensitive detector) and a current-to-voltage conversion circuit in a compact case. By using a PSD module with a signal processing unit for PSD modules (sold separately), you can acquire analog and digital position signals. PSD signal processing circuits use a current-to-voltage conversion circuit to convert the photocurrent from a PSD to voltage. Some types of signal processing units process the resulting voltage signal and output an analog voltage, while others process the signal, convert it to digital data using an A/D converter, and then output the resulting signal.



PSD modules and signal processing unit





(Typ. Ta=25 °C)

Type no.	Photo W × D × H (mm)	Features	Built-in PSD Photosensitive area (mm)	Position resolution (μm)	Position detection error (μm)	Frequency bandwidth (kHz)	Output	Power supply	Sample software
C10443-01		•These modules have built-in PSDs.	PSD	4 × 4	0.5	±70	Analog	External power supply (±5 to ±12 V)	-
C10443-02				9 × 9	1	16			
C10443-03				12 × 12	1.4	16			
NEW C10443-04				12 × 12	1.4	160			
NEW C10443-06			4-element photodiode	10 × 10	-	160			
C10460		•Signal processing unit for C10443-01/-02/-03	-	-	5	*1	Analog RS-232C	AC Adapter (+12 V)	○

*1: ±3%

PSD signal processing circuits

(Typ. Ta=25 °C)

Type no.	Photo W × D × H (mm)	Compatible PSDs			Conversion impedance (V/A)	Rise time (μs)	Output	Power supply	Sample software
		Type no.	Photosensitive area (mm)	Position resolution (μm)					
C3683-02		One-dimensional PSD	S4581-04	1 × 2	2.5	H 10 ⁶	22	Analog	External power supply (±15 V)
			S4583-04, S8673	1 × 3	3.8	M 10 ⁵			
			S4584 series, S3274-05	1 × 3.5	4.4	L 10 ⁴			
			S7105 series	1 × 4.2	5.3				
			S5629 series, S3931	1 × 6	7.5				
			S3932	1 × 12	15				
			S8543	0.7 × 24	30				
C9068			S3270	1 × 37	47	10 ⁵	*2	RS-232C	AC adapter (+12 V)
C4674-01*3		Two-dimensional PSD	S5990-01	4 × 4	1	H 10 ⁶	22	Analog	External power supply (±15 V)
			S5991-01	9 × 9	1.2	M 10 ⁵			
			S2044	4.7 × 4.7	2.3	L 10 ⁴			
C9069*3			S1880	12 × 12	3	10 ⁵	*2	RS-232C	AC adapter (+12 V)

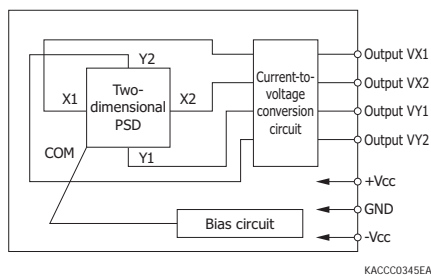
*2: Signal conversion time=5 ms min.

*3: Also supports quadrant photodiodes. Please contact the sales office for more information.

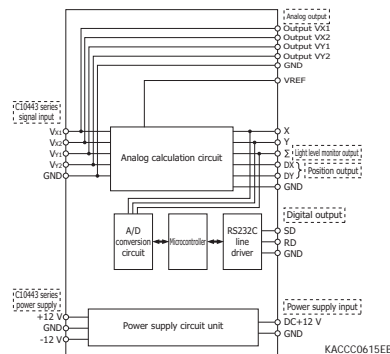
Note: Please refer to the datasheet for more information. We can also provide customized products. Please contact the sales office for more information.

Block diagrams

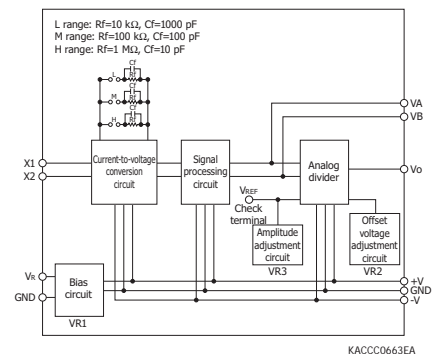
C10443 series PSD module







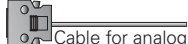
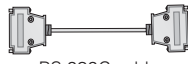

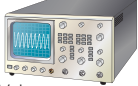

C10460 signal processing unit for PSD module



C3683-02 PSD signal processing circuit
























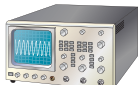



Connection example of PSD module (C10443-01/-02/-03) and signal processing unit

PSD Module	Signal processing unit	Power supply, measuring instrument, and PC
 <p>C10443-01/-02/-03 (with built-in PSD)</p> <p>PSD module connection cable (for signal and power supply)*4</p> 	 <p>C10460</p>	 <p>AC adapter*4</p>  <p>Cable for analog output*4</p>  <p>RS-232C cable</p>  <p>AC 100 to 240 V 50/60 Hz</p>  <p>Voltmeter, oscilloscope, etc.</p>  <p>PC</p>

*4: Accessory for C10460 signal processing unit

Connection example of PSD signal processing circuits

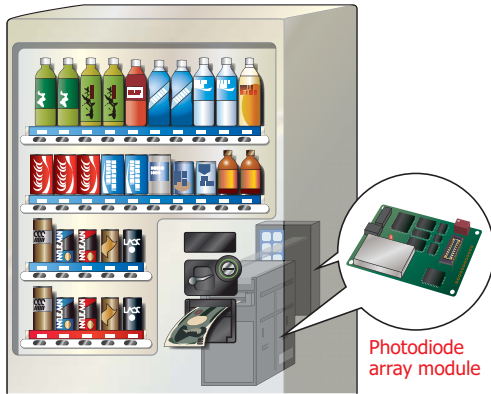
PSD	PSD signal processing circuit	Power supply, measuring instrument, and PC
<p>One-dimensional PSDs</p>  <p>Plastic packages S4581-04, S4583-04 S8673 S4584 series S3274-05 S7105 series S5629 series</p>  <p>3-conductor shielded cable</p>  <p>Ceramic packages S3931*5 S3932*5 S8543 S3270*5</p>	<p>Analog voltage output</p>  <p>C3683-02</p>	 <p>9-conductor unterminated cable</p>  <p>Probe for voltmeter or oscilloscope (x 1)</p>  <p>Power supply (± 15 V)</p>  <p>Voltmeter, oscilloscope, etc.</p>  <p>PC (with A/D conversion board)</p>
	<p>RS-232C output</p>  <p>C9068</p>	 <p>AC adapter*6</p>  <p>AC 100 to 240 V 50/60 Hz</p>
<p>Two-dimensional PSDs</p>  <p>Surface mount type S5990-01, S5991-01</p>  <p>Board for mounting*6 S5990-01, S5991-01</p>  <p>5-conductor shielded cable</p>  <p>Ceramic/metal packages S1880*5 S2044*5</p>	<p>RS-232C output</p>  <p>C9069</p>	 <p>RS-232C cable</p>  <p>PC</p>
	<p>Analog voltage output</p>  <p>C4674-01</p>	 <p>9-conductor unterminated cable</p>  <p>Probe for voltmeter or oscilloscope (x 2)</p>  <p>Power supply (± 15 V)</p>  <p>Voltmeter, oscilloscope, etc.</p>  <p>PC (with A/D conversion board)</p>

*5: Can also be directly mounted on a PSD signal processing circuit

*6: Accessory for PSD signal processing circuit

Application examples

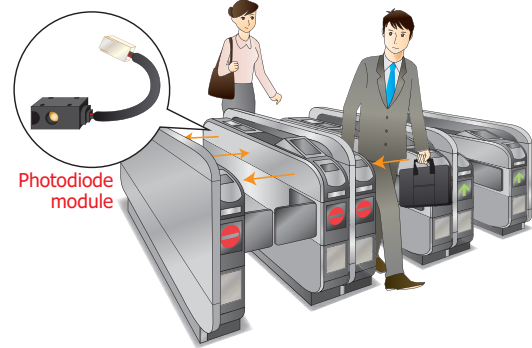
Vending machine



KACCC0603EA

Photodiode modules can be used to detect the width and length of paper money and thereby determine its authenticity.

Automatic ticket inspection device



KACCC0604EA

Photodiode modules can be used to inspect passengers and baggage and to reduce ticket processing mistakes.

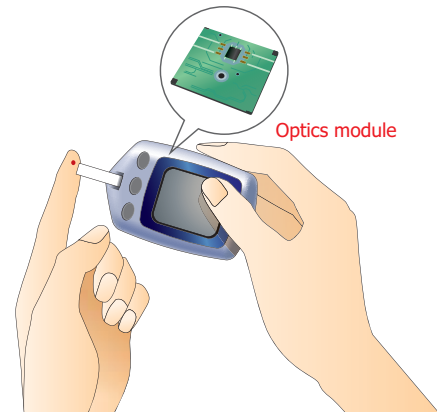
IH cooking heater



KACCC0605EA

Photodiode modules can be used to detect the temperature at the bottom of a pan.

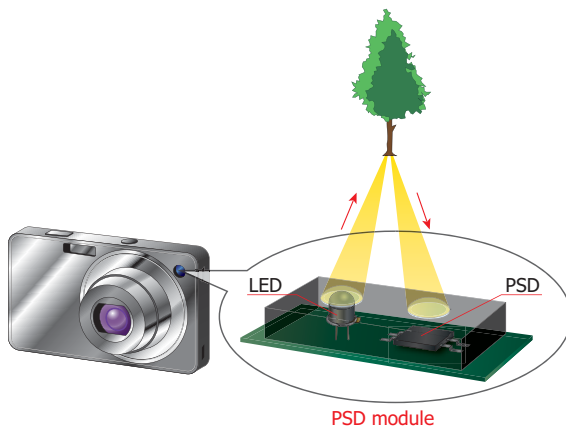
Blood analysis



KACCC0606EA

Optics modules can be used to measure blood-sugar levels (glucose concentration) on the basis of how light that is irradiated onto blood is reflected.

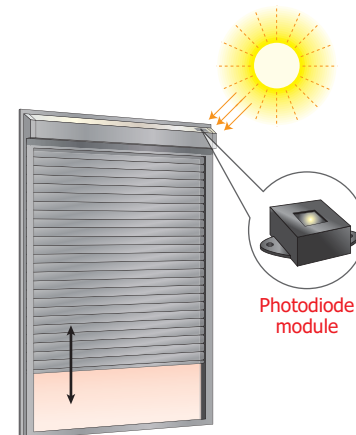
Camera autofocus



KACCC0607EA

A PSD module detects how infrared light emitted onto the object is reflected, and this information is used to calculate the distance to the object.

Solar position detection



KACCC0608EA

Photodiode modules (or PSD modules) can be used to detect sunlight and open and close shutters or blinds.




Color sensor modules

In addition to modules with built-in color sensors, we also offer evaluation circuits that you can mount color sensors onto. These products can be used for LCD display color monitoring, simple color detection, etc.



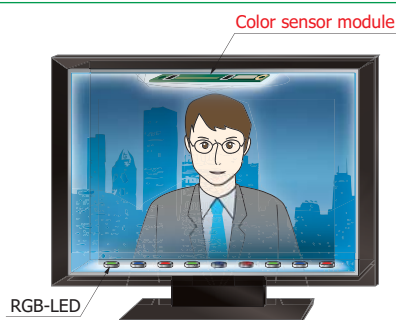
Color sensor modules, Color sensor evaluation circuit

(Typ. Ta=25 °C)

Product name	Color sensor module			Color sensor evaluation circuit
Type no.	C9303-03	C9303-04	C9315	C9331
Photo				
Features	Standard type	High gain type	<ul style="list-style-type: none">•For RGB information measurement of object color•Has an internal white LED as the light source, converts the reflected light into RGB data, and outputs the data to a PC•Measures small areas using an objective optical fiber•12-bit digital output (RS-232C compatible)	<ul style="list-style-type: none">•Current-to-voltage conversion amplifier allowing a HAMAMATSU color sensor (S7505-01, S9032-02) to be mounted
	<ul style="list-style-type: none">•Compact design that enables attachment to the side of the LCD backlight's light-guide plate			
Light source	No		Yes (white LED)	No
Color sensor	Yes		Yes	No
Conversion impedance	R: 91 kΩ G: 91 kΩ B: 100 kΩ	R: 680 kΩ G: 680 kΩ B: 680 kΩ	—	Variable (1×10^5 to $5.1 \times 10^5 \Omega$)
Bandwidth	DC to 16 kHz (-3 dB)	DC to 2.4 kHz (-3 dB)	Digital output period: 0.2 s	DC to 14 kHz (-3 dB)
Light source measurement	Yes		No	Yes
Applications	<ul style="list-style-type: none">•White balance detection of LCD backlight (RGB-LED type)		<ul style="list-style-type: none">•Measurement of object color•Color monitoring of opaque body (molded parts, painting, printing, cosmetics, etc.)•Simple detection of color difference	<ul style="list-style-type: none">•Measurement of light source color•Evaluation of S7505-01 and S9032-02
Accessories	<ul style="list-style-type: none">•Dedicated cable with connector		<ul style="list-style-type: none">•Dedicated AC adapter•Sample software (data acquisition, recording, relative chromaticity Yxy display not conforming to CIE)•White reference card	—

Application examples

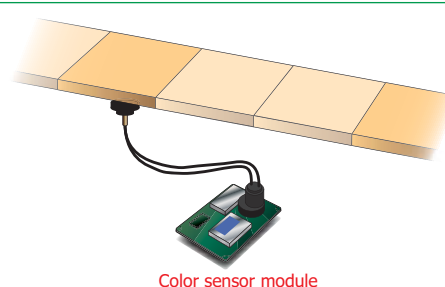
Color adjustment for LCD backlights



KACCC0609EA

The white balance of the LCD backlight's light-guide plate is detected, the RGB-LED light level is controlled, and the color of the LCD backlight is made to be consistent.

Color detection of products



KACCC0610EA

A color sensor module can be used to detect color differences in an object through the irradiation of light from the built-in LED onto the object and then the conversion of the reflected light into R, G, and B parameters.



Flame eyes (monitors)

The “flame eye” is a sensor that monitors flames in oil boilers and heating equipment. It detects light emitted from the flame so that the combustion state can be observed. Because this flame eye has a photo IC diode instead of a conventional CdS photoconductive cell, it provides stable detection performance. The flame eye is easy to install because the sensor is integrated into the cable assembly. Two types of flame eyes with different light input directions (a head-on type and a side-on type) are available.

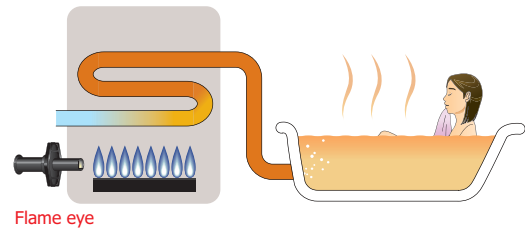
Features

- Internal photo IC diode
The internal photo IC diode boosts the photocurrent generated from the photodiode approx. 13000 times.
The photo IC diode outputs current and can be used the same as a photodiode applied with a reverse voltage.
- Spectral response that is suitable for detecting oil burner flames, etc.
- Cable assembly for easy installation into equipment
- Small output current variations and good output linearity



Application example

Observation of the combustion condition of a hot-water heater



KACCC0611EA

Detects light emitted from the flame so that the combustion state can be observed.



Sunlight sensor

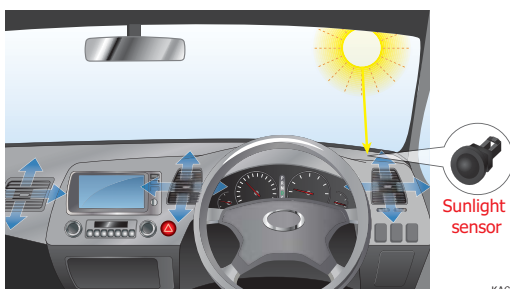
Sunlight sensors detect the light level of sunlight and ambient light. A photodiode with superb linearity relative to the light level is built in a small case with a connector.

Features

- High reliability (for automotive use)
- The optical design of the cover makes it possible to adjust the directivity for different applications.

Application examples

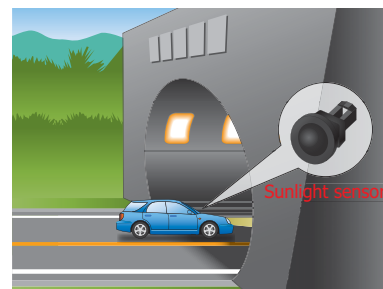
Sunlight sensor



KACCC0612EA

A sunlight sensor can be used to detect the amount of sunshine to control the volume of air flow of an automotive air conditioner.

Auto light sensor



KACCC0613EA

The ambient light level is detected, and headlights are automatically turned on in tunnels and dark environments.

Related products and circuits for infrared detectors and image sensors





Infrared detector modules with preamps

These modules integrate preamps and various infrared detectors. Modules are available for a variety of different wavelength ranges. You can detect infrared light simply by connecting a DC power supply.



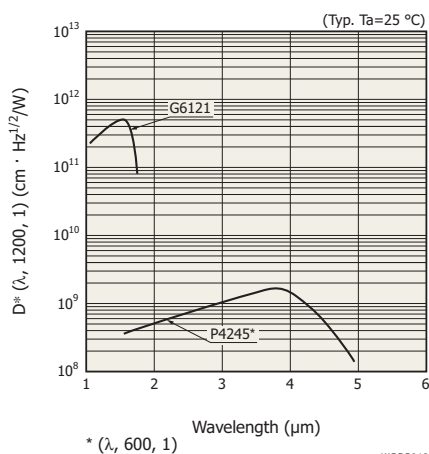
(Typ. $T_a = 25^\circ\text{C}$)

Type	Type no.	Photo	Detector (built-in)	Photosensitive area (mm)	Cooling	Measurement condition	Cutoff wavelength on the long wavelength side (μm)	Peak sensitivity wavelength (μm)
						Element temperature (°C)		
Room- temperature type	G6121		InGaAs (G8370-05)	φ5	No cooling	25	1.70	1.55
	P4245		PbSe (P9696-03)	3 × 3			4.8	4.0
	C12496-046		Photon drag (B749)	φ4.6			-	10.6
TE-cooled type	G6122		InGaAs (G5852-21)	φ1	TE-cooling	-15	2.05	1.95
	G6122-03		InGaAs (G5853-21)				2.56	2.3
	G6126		InGaAs (G8605-25)	φ5			1.66	1.55
	P4638		PbS (P2682-01)	4 × 5			3.1	2.4
	P4639		PbSe (P9696-203)	3 × 3			5.0	4.1
	C12495-211S	MCT (P3981)	1 × 1	-25		4.3	3.6	
	C12492-210	InAs (P10090-21)	φ1	-28		3.45	3.25	
	P4631-03		InSb (P6606-310)	1 × 1		-58	6.3	4.5
	C12495-311M		MCT (P2750)				5.5	4.8
	C12495-111L		MCT (P3257-101)			-3	11.5	6.5
Metal dewar type	G7754-01		InGaAs (G5853-01)* ¹	φ1	Liquid nitrogen	-196	2.4	2.0
	G7754-03		InGaAs (G5853-03)* ¹	φ3			5.5	5.3
	P7751-01* ²		InSb (P5968-060)	φ0.6			14.0	12.0
	P7751-02* ²		InSb (P5968-200)	φ2				
	C12495-411V* ²		MCT (P2748-40)	1 × 1				

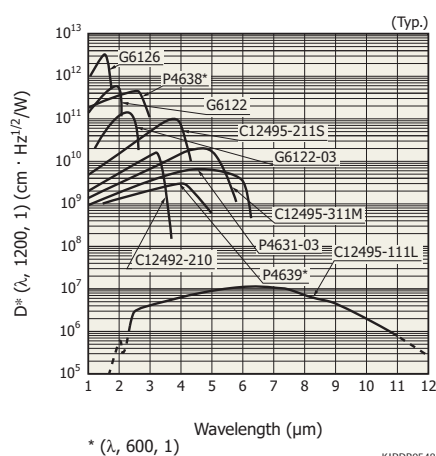
*1: Chip
*2: FOV=60°

Spectral response

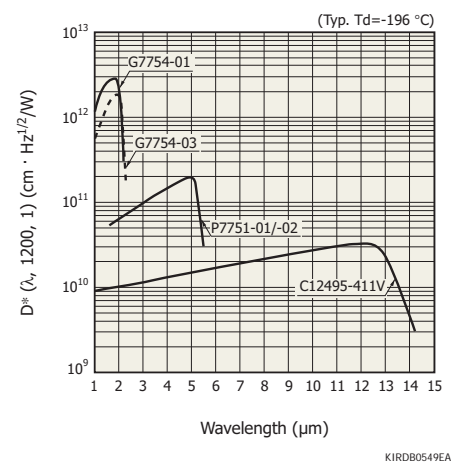
Room-temperature type



TE-cooled type



Metal dewar type





Multichannel detector heads

Because the electronics and signal processing of image sensors are more complicated than those of single-element sensors, we offer multichannel detector heads that can be connected to sensors and used. It's easy to use these detector heads with a controller and software to gather data.



Type	Type no.	Output	Applicable sensors	
For front-illuminated CCD image sensor	C7020	Analog	S9970 series	Sold separately
	C7020-02		S9972 series	
	C7021		S9971-0906/-1006/-1007	
	C7021-02		S9973-1007	
	C7025		S9971-1008	
	C7025-02		S9973-1008	
For back-thinned CCD image sensor	C7040	Analog	S7030 series, S11500-1007	Sold separately
	C7041		S7031 series	
	C7043		S7033 series	
	C7044		S7034 series	
	C7180		S7170-0909	
	C7181		S7171-0909-01	
	C10150		S10140 series	
	C10151		S10141 series	
	C9047 series	Digital	S9037 series	
For NMOS linear image sensor	C5964 series	Analog	S5930/S5931/S8382/S8383 series	Built-in
	C8892		S3901 to S3904/S8380/S8381 series (excluding S3901-1024Q and S3904-2048Q)	Sold separately
For InGaAs linear image sensor	C10854	Camera Link	G10768 series	Sold separately
	C8061-01	Analog	G9201/G9203/G9211/G9213-256S G9202/G9204/G9212/G9214-512S	
	C8062-01		G9205/G9206/G9207/G9208-256W	
For InGaAs area image sensor	C11512	Camera Link	G11097-0606S	Sold separately
	C11512-01		G11097-0707S	

Related products

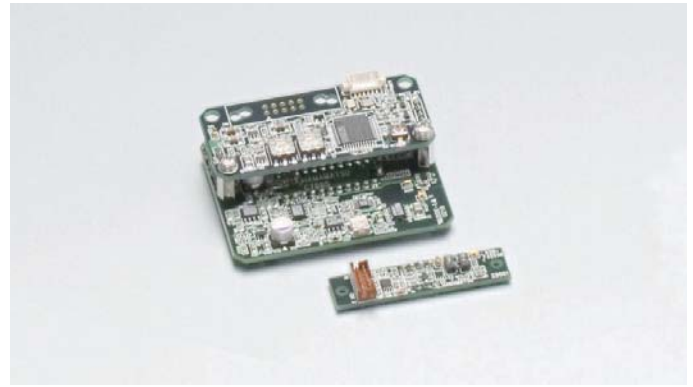


Controller for multichannel detector head
C7557-01
(Applicable with analog output type CCD/NMOS/
InGaAs multichannel detector heads)



Circuits for image sensors

These are driver circuits and pulse generators for CCD, NMOS, and CMOS image sensors.



(Typ. Ta=25 °C)

Type	Type no.	Features	Applicable sensors	
Driver circuit for CCD image sensor	C11287	Signal frequency: 250 kHz, USB 2.0	S10420-01/S11510 series	Sold separately
	C11288	Signal frequency: 4 MHz, USB 2.0	S11071 series	
	C11165-01	Signal frequency: 6 MHz, USB 2.0	S11155/S11156-2048-01	
Driver circuit for NMOS image sensor	C7884, C7884G*	High-precision, current output type	S3901 to S3904 series S8380/S8381 series (excluding S3901-1024Q and S3904-2048Q)	
	C7884-01, C7884G-01*	Low noise, current output type		
Pulse generator for NMOS image sensor	C8225-01	Master start interval: 1 μ s to 50 s (1-2-5 sequence)	C7884 series	
Driver circuit for CMOS image sensor	C9001	Single power supply (+5 V) operation	S8377/S8378 series	
	C10808 series	Supports variable integration time	S10111 to S10114 series	
Driver circuit for InGaAs image sensor	C10820	High-gain settings for low light levels	G9494 series	

*With a pulse generator



Date.

No.

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