HAMAMATSU
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NEWS 2014 02

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INTERNATIONAL YEAR OF LIGHT 2015

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Cover Story

Life Photonics – Innovative Solutions for Global Challenges

Today, the Earth's population is facing a multitude of global challenges including energy, agriculture and health. Issues, such as global warming and biodiversity are beginning to upset the balance of life itself on a global scale.

At Hamamatsu Photonics we use the term "Life Photonics" to describe research and development topics which embrace sustainability as a core value. We conduct our activities with an emphasis on diverse viewpoints and mutual interactions among individual engineers and researchers, so as to ultimately ensure a lasting future for every form of life on Earth.

Hamamatsu Photonics' corporate philosophy stresses the advancement of Photonics through extensive research and development. Today, more than ever, our Company has and continues to push the boundaries of what is possible with optical technologies.

The United Nations has proclaimed 2015 The International Year of Light and Light-Based Technologies, to raise awareness of how optical technologies promote sustainable development and provide solutions to worldwide challenges in energy, education, agriculture, communications and health.

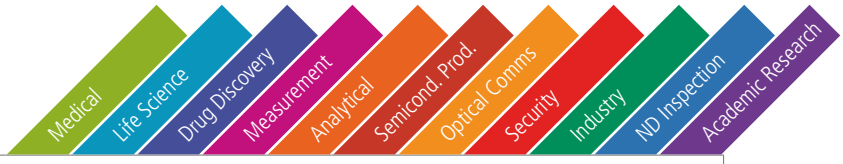
As a world-leading manufacturer, Hamamatsu Photonics is committed both to the development of optical technologies and to continue research towards finding innovative solutions.

We are already leading the way with innovative manufacturing techniques, allowing for the miniaturization of technology. One example of such innovation is our ultra-compact MEMS micro-spectrometer, developed using MEMS (Micro-Electro-Mechanical Systems) and newly designed optical systems. Such products will allow for the development of more compact, hand-held instrumentation for many applications including environmental monitoring such as air and water quality.

Photonics has a vast potential to open up new possibilities and working closely with researchers, collaborators and our customers, we will continue to open new applications using our technology.

Micro-spectrometer C12666MA

Content



R&D Interview

New miniaturized fingertip-sized spectrometer will open up new applications.

Micro-spectrometer C12666MA

It has been some 5 years since our thumb-sized mini-spectrometers (MS series) went on sale and drastically expanded the applications for spectrometers. Hamamatsu Photonics has now developed a cost-effective micro-spectrometer that is smaller than ever before. This micro-spectrometer is an ultra-small model with an extremely light weight of 5 grams. Though performance is largely the same as our current mini-spectrometers (MS series), the micro-spectrometer is more compact and rugged and comes at a low price. Applications include the field of consumer electronics, where a huge untapped market still exists. To find out more about the background of micro-spectrometer development, potential applications and future prospects, we talked to four staff members involved in developing this product.

Interviewees:

Katsuro Hikita *(Manufacturing Dept.)*

Katsumi Shibayama *(MEMS Dept.)*

Takafumi Yokino *(Manufacturing Dept.)*

Toshinori Ito *(Sales Promotion Dept.)*

World's smallest spectrometer

How did you go about turning the idea of a fingertip-sized micro-spectrometer into a product?

Shibayama: The usual image of a spectrometer is a large piece of equipment mounted on a table in a laboratory, but we persisted with R&D efforts aimed at developing a product that was highly portable and mobile in the smallest possible size. About 10 years ago we released palmtop-sized mini-spectrometers (TG series) and some 5 years ago released thumb-sized mini-spectrometers (MS series). However, our clients are still asking us to "make it smaller and make it less expensive." So, we got to work and developed the new micro-spectrometer.

Yokino: In contrast to the mini-spectrometers (MS series) which have a width of less than 3 centimeters, the micro-spectrometer is about 2 centimeters and achieves a drastic reduction in both volume and weight making it about 50 percent smaller and lighter than the MS series mini-spectrometers. We utilized metal in making the package of this new micro-spectrometer, while the package of the MS series is made of plastic. Specifically we changed over to a hermetically sealed package (see note) having a highly reliable and robust structure. This allowed us to drastically trim the cost and size while maintaining the same performance as the MS series.

Note: Hermetically sealed package is an airtight package sealed by metal-to-metal or glass-to-metal welding to protect internal components and keep out moisture.

What is the background behind the "make it smaller" demand from customers?

Ito: Conventional spectrometers are mostly used in measurement and industrial applications and, in terms of size and price they are not something used on an individual or private level. However, the appearance of the mini-spectrometers (MS series) on the market changed this concept, and work then started on making spectrometers even smaller and less expensive. But a further step forward was needed in both size and price in order to have them accepted for widespread use in the consumer electronics market.

Hikita: Small spectrometers can be built into compact devices. For example, we can expect to see new applications linked to smartphones or medical devices used at home.

Yokino: Considering uses at home and outdoors, we decided to employ a hermetically sealed package made from metal which are highly rugged and reliable, rather than using plastic that allows moisture to penetrate through it.

Are there similar products on the market?

Hikita: Yes, in terms of size, similar products are available. Strictly speaking however, they are not identical because our micro-spectrometer lets the light enter through a slit while rival products use optical fibers to guide the light.

Ito: So if you limit similar products to those spectrometers which allow direct input of light, then our product is the smallest in the world and exhibits high performance. Our product is likely to carve out a whole new area in the market.

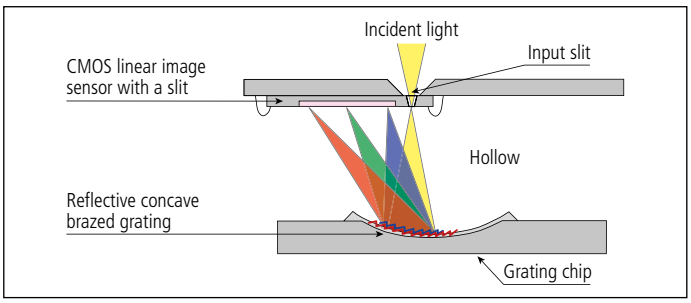
Achieving both a compact size and high performance using MEMS and image sensor manufacturing technology

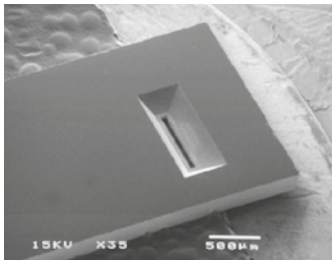
Please tell us how you were able to make it a smaller size compared to current products.

Shibayama: We achieved this by reviewing the optical design and component parts, optimizing MEMS technology and simplifying the structure. Our micro-spectrometer comprises of three sections which are a slit through which the light enters, a grating to spectrally diffract the light and an image sensor to detect the light. We utilized MEMS technology to manufacture those sections, so the MEMS technology was the main factor in allowing us to make a smaller micro-spectrometer. More specifically, we utilized MEMS dry etching technology to form the slit that passes light through to the image sensor, and also used a very fine molding technology called nanoimprinting to form a grating that diffracts the light.

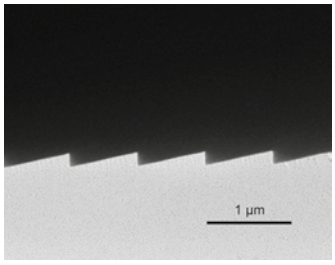
Yokino: There is a trade-off relation between the spectrometer size and performance characteristics. As the size becomes smaller, the resolution deteriorates and the performance also declines. Our micro-spectrometer employs a method that diffracts the light after internally reflecting it one time, and is designed to exhibit the highest possible performance that achieves both satisfactory size and performance characteristics in this type of spectrometer.

Optical component layout (C12666MA)





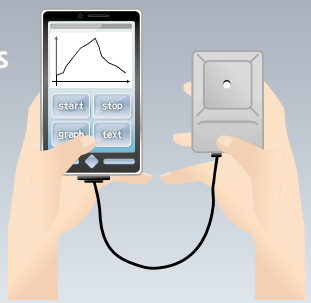
Enlarged image of CMOS linear image sensor with slit – light input side (back side of chip)



Enlarged image of brazed grating

R&D Interview

Possibilities offered by new applications through miniaturizing spectrometers



Simple color measurements using smart phones

Color adjustment of color printer

How did you solve the problems you faced in trying to cut costs?

Shibayama: Mini-spectrometers (MS series) utilize a glass lens as the medium for transmitting light. Glass offers the advantage of providing the required accuracy for the spectrometers if the dimensional accuracy of the glass itself is maintained. However, the cost of glass lenses is high, so we had to give up on glass lenses and find a substitute to meet demands for lower cost.

Yokino: In the MS series, mini-spectrometers, a grating is formed on the glass lens by nanoimprinting. However, if the nanoimprinting failed, the glass lens would then be unusable causing the problem of higher costs. So instead of forming a grating on the glass lens, we re-evaluated the possibility of fabricating the grating as a separate unit. This would allow eliminating glass to fabricate the grating and would also prove effective in lowering the cost.

What type of sensor is used in the micro-spectrometer?

Yokino: The micro-spectrometer uses an image sensor integrated with an input slit. Using this type of sensor allows us to reduce the spectrometer to a fingertip size. After the incident light is diffracted by the grating, short wavelength light reaches a position very close to the input slit. If the slit is separated from the sensor, extremely fine positioning is required, because failing to achieve this fine positioning degrades spectral performance. The slit integrated with the sensor does not create this positioning problem.

Shibayama: We also added a cutoff filter (see note) to this image sensor integrated with the input slit. When fabricating the mini-spectrometers (MS series), we mounted an image sensor on the glass wiring board which had metal wiring and formed the cutoff filter on this glass wiring board. However, in the case of the micro-spectrometer, we gave up on glass and utilized a hollow space to convey the light, so directly forming a cutoff filter for the image sensor in this way was an indispensable part of the process.

Ito: Besides the basic function that the image sensor receives light, the image sensor itself has an added value as it includes an input slit and a cutoff filter. Having both image sensor technology and MEMS technology is our unique advantage.

Note: Cutoff filter is a filter that cuts off stray light components such as multiple reflected light and diffraction order light other than the measurement light.

Providing specifications ideal for customer application development work

What kind of applications do you foresee for micro-spectrometers?

Ito: We are currently receiving requests for applications involving color, such as portable colorimeters and the checking of colors in printed material, etc. The advance from mini-spectrometers (MS series) to micro-spectrometers has also increased inquiries for handheld medical devices which are related to POC (Point of Care) tasks. Utilizing a small, low priced but highly reliable package that does not allow moisture penetration has proved successful.

Hikita: Our position is that we should assist customers to develop spectrometer applications for providing consumer electronic products. We therefore believe that our main role is to provide the specifications needed by customers to make spectrometer applications a reality.

Can you also produce custom designs to meet customer needs?

Ito: We first verify the customer's requested specifications and the estimated quantity and if the project is likely to require an adequate number of products, then we can come up with a design that matches the requirements. When we receive a request, our engineers will then start discussions while still at an early stage.

Can you give a specific example of discussions with the customer?

Hikita: For example, there was talk about making a glucose monitor for diabetic patients. If a product could be made that uses light to diagnose the glucose level, then this would relieve the patient of a huge burden. To help make this product a reality, we first verify the necessary specifications and then make the necessary coordination and adjustments.

Yokino: The micro-spectrometer was introduced at our technology exhibition "Photon Fair 2013" held in November last year and we received positive feedback from visitors. We prepared a concept module linked with a smartphone to demonstrate applications such as color analysis. The results led to specific discussions for use in spectral analysis and other applications. We obtained significant results from showing the customers the module itself and having them imagine how it would actually work.

Ito: At Photon Fair, there were many customers who were interested in coupling the micro-spectrometer to smartphones. There were also some unique inquiries such as whether it could be used for adjusting the lighting in theatres or whether it could be used to teach children about light wavelengths at school. The small size prompted people to think, "I wonder if it could be used for this purpose?" and so was effective in stirring up people's imaginations for new applications. In most cases, there is a target application and a product is then made to match that application, but making such a small micro-spectrometer will most likely create new applications. You might call it a phenomenon that works in reverse. Putting aside the question of what can actually be accomplished, I feel it really expands future possibilities.

It was officially released in March of this year, how has the reaction been since then?

Hikita: Prior to its official release, we had already samples available at the end of last year, which resulted in nearly 100 samples being purchased by customers including many from overseas. Some customers commented, "Even in this small size it still gives accurate measurements" along with other such positive responses.

Building No. 13 (Main Factory)

Ito: In September of this year, our new Building No. 13 at our main factory site will be starting operation. There we will be doing product development and setting up a mass-production system for in-vehicle devices and mobile terminals such as the micro-spectrometer based on MEMS technology, while drawing up plans to deal with increasing customer demands.

What type of development trends do you foresee from here onward?

Shibayama: Though micro-spectrometers are now available in a size that can be placed on a fingertip, we are getting requests from customers such as "we want you to make it thinner and smaller." Current methods that reflect the light one time have reached their limit in terms of size, so to respond to an even wider range of needs, we are constantly incorporating new ideas into our designs to develop even smaller devices.

Hikita: Up until now we have taken the stance of only providing hardware, leaving the circuit and software development up to the customer. However, if we could also provide these extra requirements to the customer, then our products would be even easier to use. My section is in charge of module development, so rather than just the device level, we are now starting to prepare to provide software and module products that contain the necessary circuits.

Company News

New facility for the development and mass production of MOEMS-based products

Hamamatsu Photonics K.K. completed construction of a new purpose-built factory for the development and mass production of MOEMS-based opto-semiconductor devices and modules, "Building No. 13", at Solid State Division. Hamamatsu Photonics has been developing MOEMS technology for nearly 10 years. Since that time, our Company has continued to further develop such technology and introduce new manufacturing techniques to design many new advanced products.

Building No. 13 was constructed for the development and mass production of MOEMS devices to meet the increased market demands for small, high performance opto-semiconductor products from the automotive and smart phone industries.

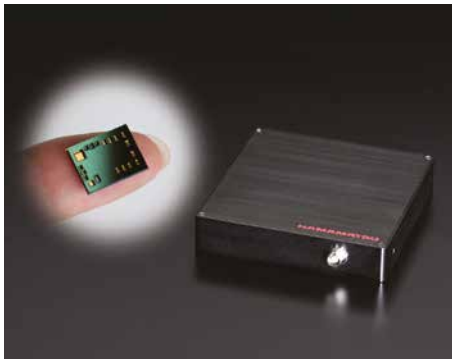
The products to be made at the new facility are as follows:

1. High-precision and electromagnetically-activated laser scanning MEMS micromirrors for in-vehicle head up displays and portable microprojectors.
2. Opto-semiconductor devices for the world's first MEMS-fabricated ultra-small and inexpensive MEMS-FTIR (fourier transform infrared) spectrometer modules which incorporate fingertip size FTIR engines that consist of Michelson interferometers and optical fiber guides for infrared detector elements.

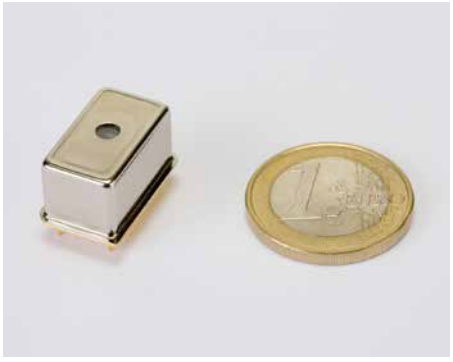
3. The world's first small and inexpensive multi-function photo ICs that integrate three types of sensors (color, illuminance, and proximity) plus display functions into a single flip chip package for smartphones.
4. Micro-spectrometers which are thumb-sized devices that combine optical devices with image sensors by using MEMS technology for portable measurement instruments such as small spectrometers for measuring food freshness and small gas analyzers for measuring ambient contaminant concentration.

This new facility will enable us to meet market demands for mass production and contribute further to product development in the medical, industrial and environmental fields.

MEMS Micromirrors



MEMS-FTIR



Micro-spectrometer

NEW

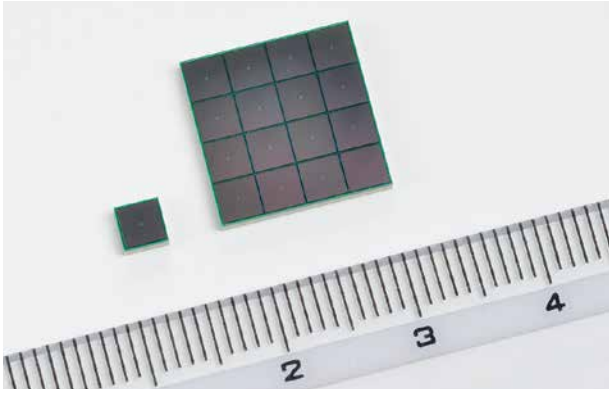
MPPC, MPPC Array S12641/S12642/S12892/S12894 Series

MPPC formable into large sensitive areas with small dead space by narrow-pitch tiling

These MPPCs use through-silicon via (TSV) to minimize non-sensitive portions around the photosensitive area. The 4-side buttable structure allows arraying of multiple MPPC elements in two dimensions at narrow intervals.

Features

- COB (chip on board) package with minimal dead space
- Tiling forms a large sensitive area
- Low afterpulse
- Excellent uniformity

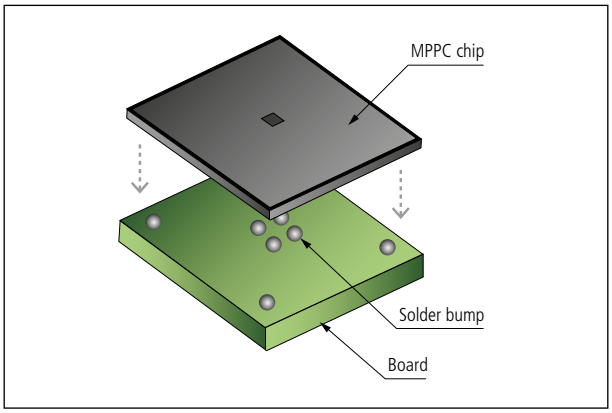


S12641PA-50, S12642-0404PA-50

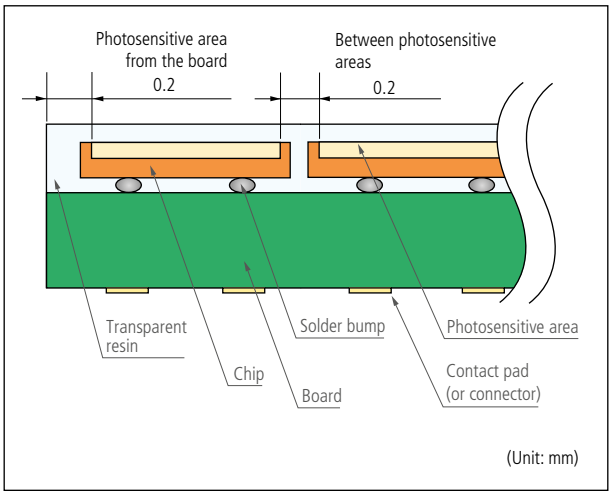
Specifications

Type No.	Effective photosensitive area	Pixel pitch	Coating	Package
S12892PA-50	2 mm x 2 mm	50 µm	Resin (100 µm)	Surface mount type
S12641PA-50	3 mm x 3 mm			
S12894PA-50	6 mm x 6 mm			
S12642-0404PA-50	3 mm x 3 mm (4 x 4 ch array)	50 µm		Surface mount type
S12642-0404PB-50				With connector
S12642-0808PA-50	3 mm x 3 mm (8 x 8 ch array)			Surface mount type
S12642-0808PB-50				With connector
S12642-1616PA-50	3 mm x 3 mm (16 x 16 ch array)		Thin film (20 µm)	Surface mount type
S12642-1616PB-50				With connector

Structure



Details around package (array type)



MPPC Array Module C12677/C12678/C12679-01, -02, -03, -04

NEW

Photon-counting modules integrating an MPPC array

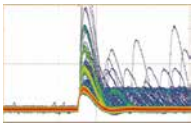
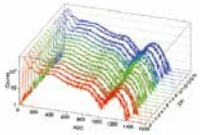
These MPPC array modules incorporate an MPPC array, a current-to-voltage converter circuit, a high-voltage power supply circuit and a temperature compensation circuit. They are designed to maximize MPPC array performance to provide excellent photon counting characteristics. Three types of output formats (analog, digital, MCA) are available.

C12677/C12678/C12679-01, -02, -03, -04

Features

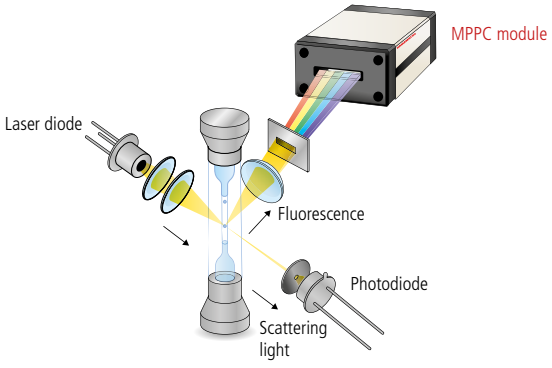
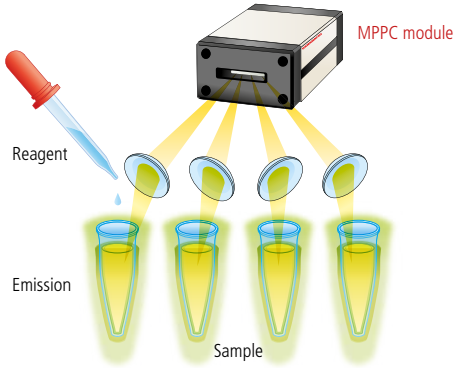
- Choice of 3 output formats: analog, digital, and MCA (Multi Channel Analyzer)
- Integrates a high-voltage power supply and a temperature compensation circuit into one module

Specifications

	C12677 series	C12678 series	C12679 series
Output format	Analog 	Digital 	MCA 

	C12677/8/9/-01	C12677/8/9/-02	C12677/8/9/-03	C12677/8/9/-04
Effective photo-sensitive area/ch array arrangement	3 x 3 mm (50 µm pitch) 4 x 4 ch array 	3 x 3 mm (50 µm pitch) 1 x 16 ch array	0.7 x 2 mm (50 µm pitch) 1 x 16 ch array	1 x 1 mm (15 µm pitch) 1 x 16 ch array

Application examples

Flow cytometry	Fluorescence measurement
	

NEW

Balanced Detector C12668-01/-02

Balanced detectors that minimize multiple reflections

The C12668-01 and C12668-02 are differential amplification type photoelectric conversion modules containing two photodiodes developed in-house having well-matched characteristics. The photodiodes are connected in a direction that cancels out the photocurrent of each photodiode and the common mode noise of the two incident light rays. The minute difference in light level is treated as a displacement signal which is converted into an electrical signal and output.

These balanced detectors are suitable for OCT (optical coherence tomography) used for ophthalmic diagnosis and the like (see "Ophthalmic diagnosis image").

The tiny differences in signal light that are generated when backscatter light from a subject interferes with reference light can be converted into electrical signals with these balanced detectors.

Features

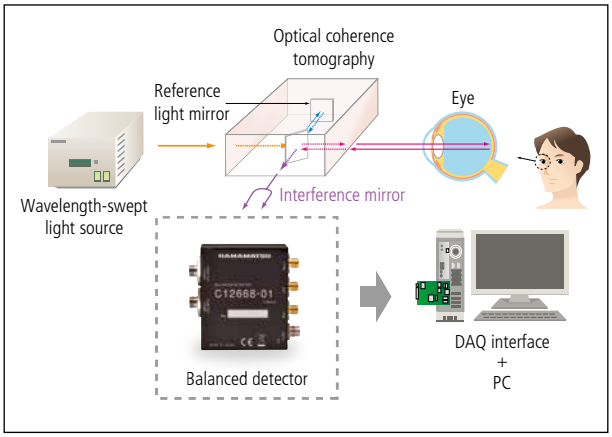
- Employs our unique structure that reduces multiple reflections at the incident light wavelength of 1.0 µm or 1.3 µm
- Cutoff frequency: 200 MHz
- CMRR (Common-Mode Rejection Ratio): 35 dB

Application

- OCT

C12668-01, C12668-02

Ophthalmic diagnosis image



Specifications

Parameter	C12668-01	C12668-02	Unit
Photodiode incorporated	InGaAs PIN photodiode		-
Wavelength	1.0	1.3	µm
Frequency response range	DC to 200		MHz
CMRR	35		dB
Trans-impedance gain	3×10^4		V/A
Output impedance	50		Ω
Input section	FC receptacle (APC polished)		-
Output section	SMA receptacle		-
Supply voltage	±12 (200 mA)		V
Dimensions	65 x 75 x 25		mm

CCD Linear Image Sensor S12379

NEW

Front-illuminated CCD with high-speed response and high sensitivity

The S12379 is a front-illuminated CCD linear image sensor with a high-speed line rate designed for machine vision applications.

Features

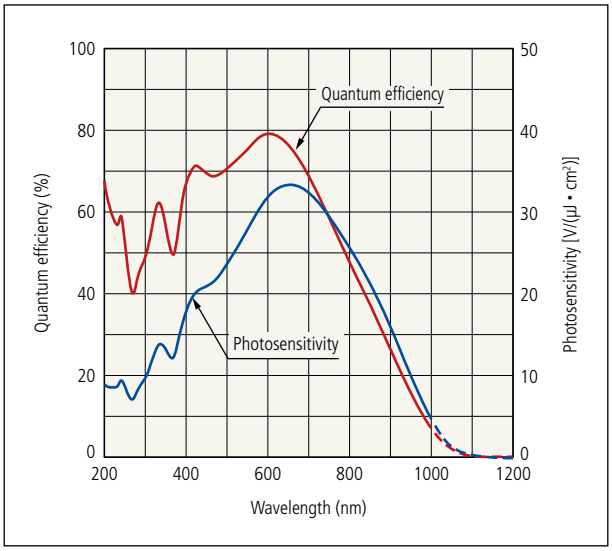
- Pixel size: 8 x 8 µm
- 2,048 pixels
- High-speed multiple port readout: 40 MHz max. x4 ports
- High CCD node sensitivity: 21 µV/e⁻
- Anti-blooming function

Applications

- Machine vision
- High-speed image reading

S12379

Spectral response (without window) (Typ. Ta = 25 deg. C.)



Specifications

Parameter	Specification	Unit
Pixel size (HxV)	8 x 8	µm
Number of effective pixels	2,048	pixels
Line rate	72	kHz
CCD node sensitivity	21	µV/e⁻
Dark output (Average of all effective pixels)	30	e⁻/pixel/ms
Readout noise*1	20	e⁻ rms
Spectral response range	200 to 1,000	nm

*1 Readout frequency 40 MHz

NEW

Two Color Detectors K12728-010K, K12729-010K

Wide spectral response range, compact ceramic package

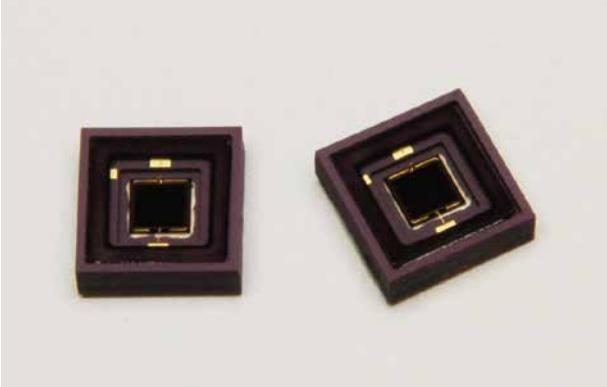
The K12728-010K and K12729-010K are two-color detectors housed in a compact ceramic package. To cover a wide spectral response range, these detectors contain two photodiodes having different spectral response along the same optical axis. They feature low noise and low dark current and support reflow soldering.

Features

- Wide spectral response range:
  - 320 to 1,650 nm (K12728-010K)
  - 900 to 2,550 nm (K12729-010K)
- Compact, low noise, low dark current
- Suitable for reflow soldering

Applications

- Spectrophotometry
- Radiation thermometer

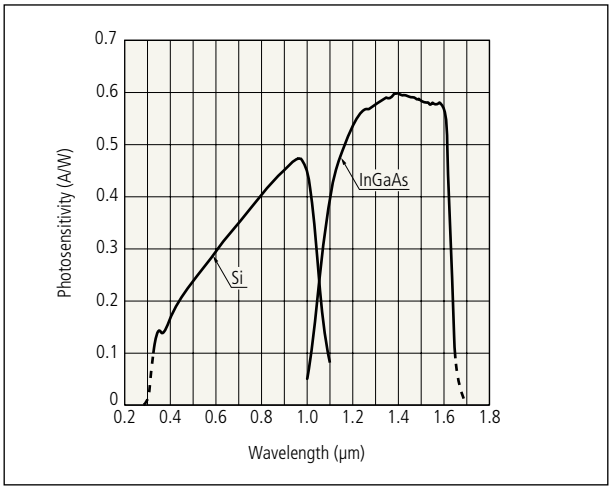


K12729-010K

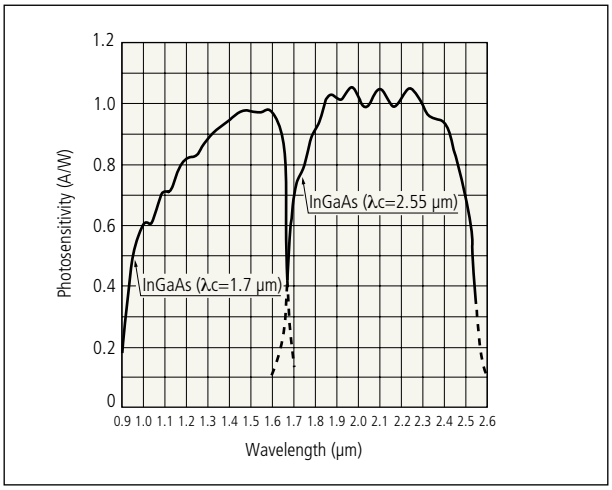
Specifications

Parameter	Condition	K12728-010K		K12729-010K		Unit
Photosensitive area size	-	Si	2.4 x 2.4	InGaAs	2.4 x 2.4	mm
		InGaAs	ϕ 1.0	Extended-InGaAs	ϕ 1.0	
Spectral response range	-	Si	0.32 to 1.1	InGaAs	0.9 to 1.7	μm
		InGaAs	1.1 to 1.65	Extended-InGaAs	1.7 to 2.55	
Photosensitivity	-	Si	0.45	InGaAs	0.95	A/W
		InGaAs	0.55	Extended-InGaAs	1	
Dark current max.	V_R = 10 mV	Si	100	InGaAs	10,000	pA
		InGaAs	0.4	Extended-InGaAs	3,500	nA
Cutoff frequency	V_R = 0 V	Si	2	InGaAs	2	MHz
		InGaAs	10	Extended-InGaAs	6	

Spectral response K12728-010K (Typ. Ta = 25 deg. C.)



Spectral response K12729-010K (Typ. Ta = 25 deg. C.)



Flat Panel Type Multianode Photomultiplier Tube Assembly H12700 Series

NEW

High collection efficiency
Single photon counting at every anode (pixel)

Compared to the currently available model (H8500), the H12700 series has a higher collection efficiency that was increased from 60 %* to 87 %* and also offers a narrower transit time spread (TTS), improved from 0.4 ns to 0.28 ns. Single photon peaks can be detected on all channels. The H12700 series is a direct replacement for the H8500 since the dimensional outlines and anode pinout are identical. Two types are available with different HV (high voltage) input methods: a cable input type (H12700A) and a pin input type (H12700B).

*Simulated value

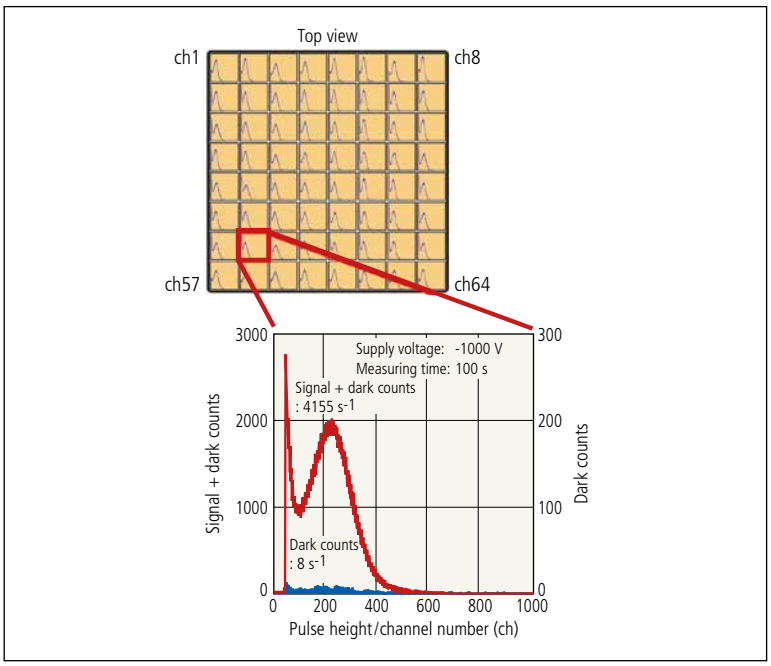
Features

- Wide effective area ratio: 87 %
- Large effective area: 48.5 mm x 48.5 mm
- Fast time response: TTS 0.28 ns
- Good single photon pulse height distribution on every anode (pixel)
- High quantum efficiency: 33 % typ.

Applications

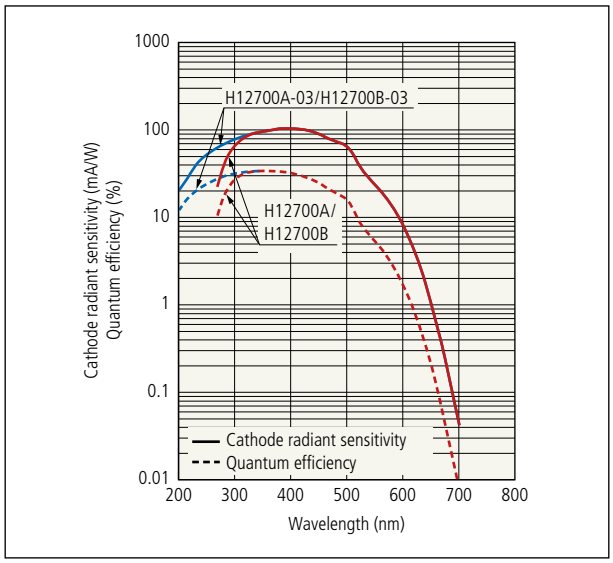
- Academic research (RICH, calorimeter, gamma ray telescope, etc.)
- Medical diagnosis equipment (PET, gamma camera, etc.)
- 2D radiation imaging

Single photon counting example



Left: H12700A, Right: H12700B

Spectral response



Specifications

Parameter	Value		Unit
Suffix	none	-03	-
Spectral response range	300 to 650	185 to 650	nm
Window material	Borosilicate glass	UV glass	-
Photocathode type	Bialkali		-
Effective photocathode area (X x Y)	48.5 x 48.5		mm
Anode type	Matrix 64 ch (8 x 8)		-
Anode pitch	6		mm
TTS (FWHM) (typ.)*1	0.28		ns

*1 Per channel, supply voltage -1,000 V, at 25 deg. C.

NEW

Metal Package Photomultiplier Tube R9880U-04/-113

UV light detectable TO-8 metal package type photomultiplier tube

The R9880U-04 and -113 utilize UV-transmitting glass as the window material to detect ultraviolet light. The R9880U-04 detects low level light in a wide spectral range from the UV to near infrared. The R9880U-113 detects low level light in the UV to visible range and provides high quantum efficiency.

Features

- Capability of detecting UV region
- Fast time response
- High gain
- Compact and lightweight

Applications

- Fluorescence analysis
- Spectrophotometry
- Scattered light detection

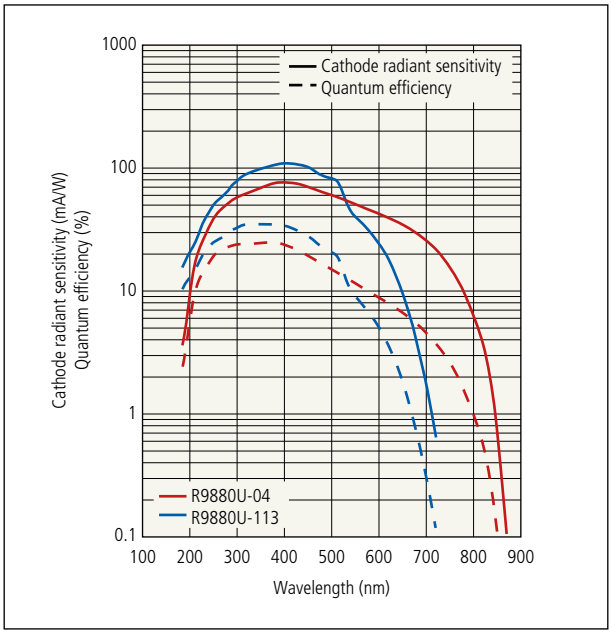
R9880U-04/-113

Specifications

Parameter	R9880U-04	R9880U-113	Unit
Spectral response range	185 to 870	185 to 700	nm
Photocathode type	Multialkali	SBA (Super Bialkali)	-
Gain (typ.)*1	2 x 10^6		-
Rise time (typ.)*1	0.57		ns

*1 Supply voltage 1,000 V, at 25 deg. C.

Spectral response



Side-on Type Photomultiplier Tube R12829, R12896

NEW

R12829: Ideal for detection in 800 nm range
R12896: Wide spectral response range 160 nm to 900 nm

The R12829 has a photoelectric conversion efficiency 1.5 times higher than the previous model (R3896) and so helps improve photometric equipment accuracy. The R12896 covers a spectral response range from 160 to 900 nm which is wider than the 185 nm to 830 nm range of the former model (R3896). The R12829 and R12896 can be used as a direct replacement for typical 28mm (1-1/8 inch) diameter side-on photomultiplier tubes since the dimensions and pinout are the same.

R12829, R12896

Features

- Replacement for the conventional product
- High sensitivity, high gain
- High quantum efficiency in 800 nm range (R12829)
- Wide spectral response (R12896)

Applications

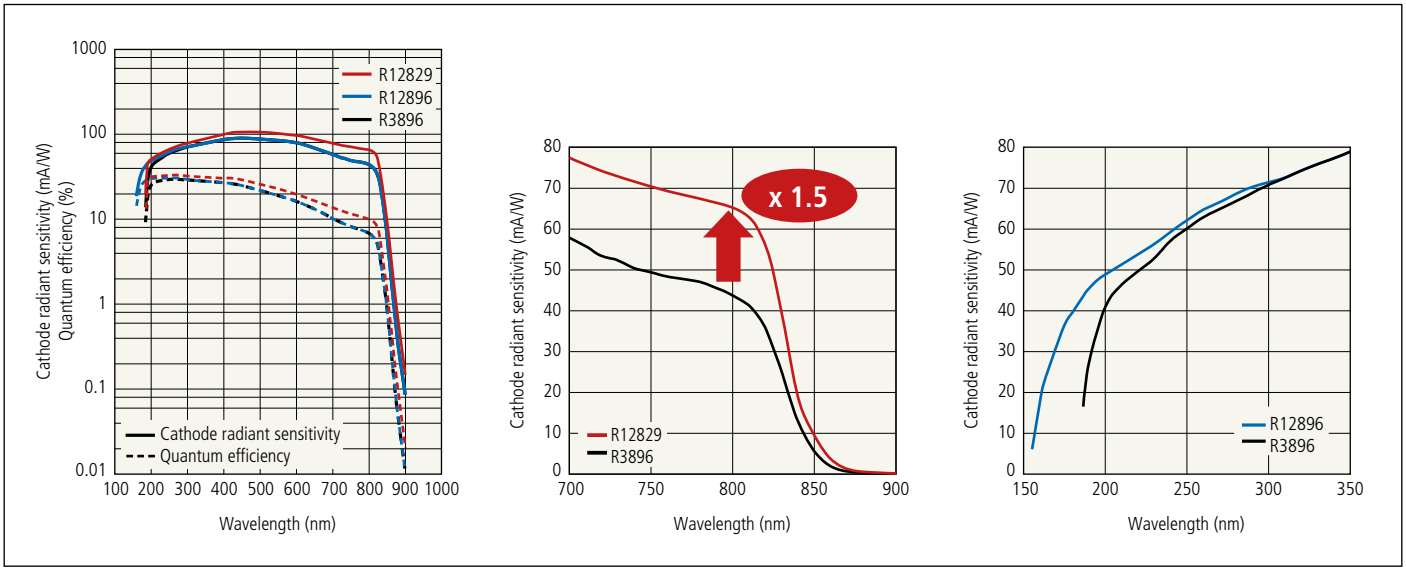
- Fluorescence analysis
- Spectrophotometry
- Scattered light detection

Specifications

Parameter	R12829	R12896	Unit
Spectral response range	185 to 900	160 to 900	nm
Cathode radiant sensitivity	65 at 800 nm	47 at 194 nm	mA/W
Gain (typ.)*1	1.3 x 10^7	9.5 x 10^6	-

*1 Supply voltage 1,250 V, at 25 deg. C.

Spectral response characteristics



NEW

Linear Array Multianode PMT Module with GaAsP Photocathode H12310-40, H12311-40

High sensitivity
Individual gain control function

The H12310-40 and H12311-40 are 16 channel linear array multianode PMT modules with a GaAsP photocathode that offers higher sensitivity than multialkali photocathodes in the visible light region. The gain on each channel can be controlled to adjust the output. These PMT modules use a newly developed electrode that improves collection efficiency and therefore enhances detection efficiency. The H12311-40 is basically identical to the H12310-40, except for the cooler attached to cool the photocathode to reduce noise and dark current.

Features

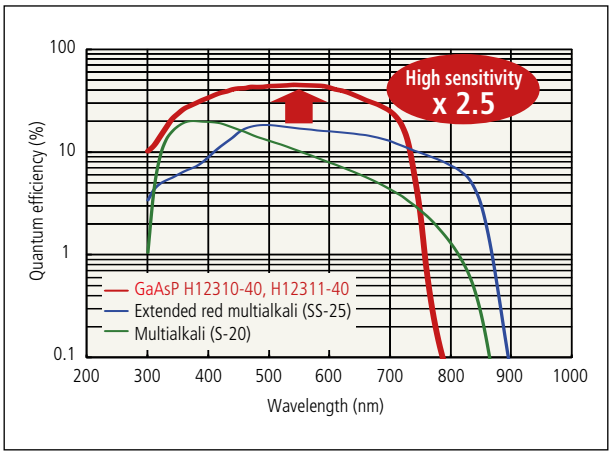
- High sensitivity in visible range
- High quantum efficiency 45 % typ.
- Gain can be controlled individually for each channel
- Reduced dark current due to cooling effect (H12311-40)

Applications

- Flow cytometer
- Microscopy
- Fast spectrophotometer, etc.

H12310-40, H12311-40

Quantum efficiency



Specifications

Parameter	Specification	Unit
Spectral response range	300 to 720	nm
Quantum efficiency (typ.)*1	45	%
Gain (typ.)*2	1 x 10^6	-
Crosstalk (typ.)	2	%
Anode dark current (typ.)*2, 3	0.5	nA

*1 At peak wavelength 540 nm
*2 Supply voltage 1,000 V, at 25 deg. C.
*3 Per channel, after 30 min storage in darkness

Photon Counting Head H11870 Series

NEW

Low power consumption Alarm signal for excessive light detection

The H11870 series is a photon counting head with a wide photosensitive area, consisting of a 25 mm (1 inch) diameter head-on photomultiplier tube, a high-voltage power supply, and a photon counting circuit. The H11870 series features low current consumption, reduced to about 2/3^{rds} that of the currently available model (H7360) and provides an alarm signal for excessive light detection, making it even easier to use. The H11870 series also includes a wide-band width circuit to deliver high count rate performance. The high voltage for the photomultiplier tube and the discriminator setting are already adjusted to optimal levels, so photon counting measurement can start just by supplying +5 volts. A flange, useful for mounting the head on an installation plate, is also provided.

H11870 Series

Features

- Low power consumption
- Alarm signal for excessive light detection
- Wide sensitive area – effective photocathode area ϕ22 mm

Application

- Blood analyzer

Specifications

Parameter	H11870-01	H11870-02	H11870-03	Unit
Spectral response range	300 to 650		300 to 850	nm
Input voltage	+5			V
Max. input current	100			mA
Count linearity*1	6 x 10^6			s^{-1}
Pulse-pair resolution	18			ns
Output pulse width	9			ns
Output pulse height (typ.)*2	+2.2			V

*1 Random pulse, at 10 % count loss.
*2 At +5 V input voltage, load resistance = 50 Ω

NEW

Amplifier Unit C9999-01

Switchable output signal polarity, Frequency bandwidth DC to 10 MHz

The C9999-01 is an amplifier unit that amplifies input signals (current or voltage) in an inverted or non-inverted mode. The output signal polarity can be selected with a switch.

Features

- Frequency bandwidth: DC to 10 MHz
- Current-to-voltage conversion factor: 10 mV/µA
- Output signal polarity selector switch

Application

- Output signal readout from photomultiplier tube and photodiode

C9999-01

Specifications

Parameter	Specification	Unit
Supply voltage	±5	V
Frequency bandwidth (-3 dB)	DC to 10 MHz	-
Current-to-voltage conversion factor (at 50 Ω load resistance)	10	mV/µA
Maximum output signal voltage (at 50 Ω load resistance)	±1.3	V
Maximum output noise voltage	2	mV rms

Opto-Spectrum Generator L12194-00-70130

NEW

Emits any desired wavelength in near infrared range

The L12194-00-70130 Opto-Spectrum Generator emits light in the near infrared region by selecting any desired wavelength in 1 nm steps. Using a highly stable lamp and unique optical systems developed in-house, the Opto-Spectrum Generator is designed to be compact and yet deliver high stability, high output and high efficiency. Since the L12194-00-70130 is a new product line-up that emits light in the near infrared range (700 nm to 1300 nm), these Opto-Spectrum Generators are now available in three spectral ranges: 390 nm to 700 nm, 430 nm to 790 nm, and 700 nm to 1,300 nm. Select the type that matches your application.

Features

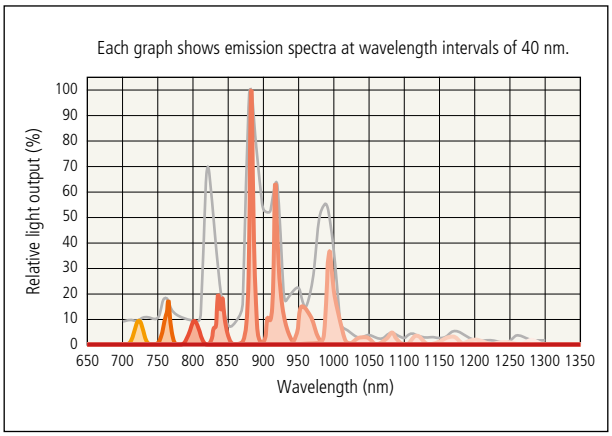
- Selectable any desired wavelength in 1 nm steps
- Compact: W 144 mm x H 236.5 mm x D 513.5 mm
- Easy wavelength control from your PC (sample software is supplied)

Applications

- Light simulus to living body
- Spectral characteristic evaluation of devices
- Optical property evaluation of materials
- Illumination

L12194-00-70130

Emission spectrum example



Specifications

Parameter	Specification	Unit
Emission wavelength range	700 to 1,300	nm
Spectral radiation half bandwidth	Approx. 15	nm
Wavelength tunable width	1	nm
Irradiation intensity*1	1 or more	mW
Light output stability	within ±5	%

*1 Initial irradiation (reference values) measured at the output end of the A10014-50-0110 light guide (sold separately) attached to the OSG. Measured with NOVA PD300-UV made by OPHIR.

NEW

130 kV Sealed Type Microfocus X-ray Source L10941-01

Wide X-ray beam angle max. 126 degrees

Compared to the currently available model (L9181-05), the L10941-01 microfocus X-ray source offers a wider X-ray emission angle enlarged from 100 degrees to 126 degrees. Its FOD (focus to object distance) and minimal focal spot are also reduced to allow high-magnification imaging in a more oblique direction.

L10941-01

Features

- Wide x-ray beam angle
- No high voltage cable connection required
  (High voltage power supply is integrated with the main unit)
- External control via RS-232C interface

Applications

- Non-destructive inspection
- X-ray CT
  - Electronic components
  - Printed circuit boards
  - Plastic components
  - Metal components

Specifications

Parameter	Specification	Unit
Tube voltage	40 to 130	kV
Tube current	10 to 390	μA
Max. output	39	W
X-ray focal spot size (nominal value)	10 to 60	μm
Max. X-ray beam angle (nominal value)*1	126±3	degrees
FOD (Focus to object distance)	Approx. 11.2	mm

*1 Vertical direction 126±3 degrees, parallel direction 104±3 degrees to electron gun

Near Infrared CCD Camera C3077-80

High sensitivity imaging in NIR region

The C3077-80 is a VGA format CCD camera which has high sensitivity in the near infrared region. In comparison to our conventional model, spectral response at 900 nm is increased more than twice using our high sensitivity CCD image sensor. The high sensitivity in NIR region offered by the C3077-80 make it suitable for imaging inside a silicon device.

Feature

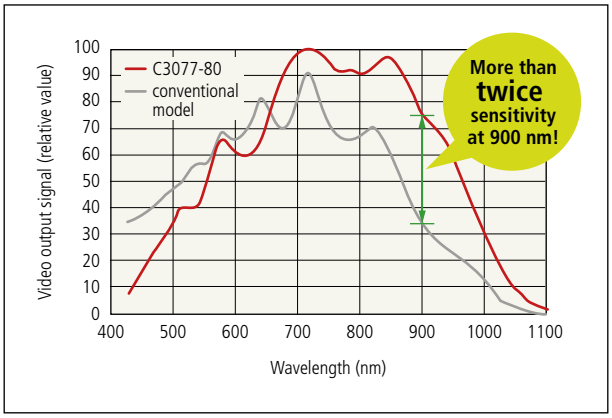
- High sensitivity in the NIR region
- EIA output

Applications

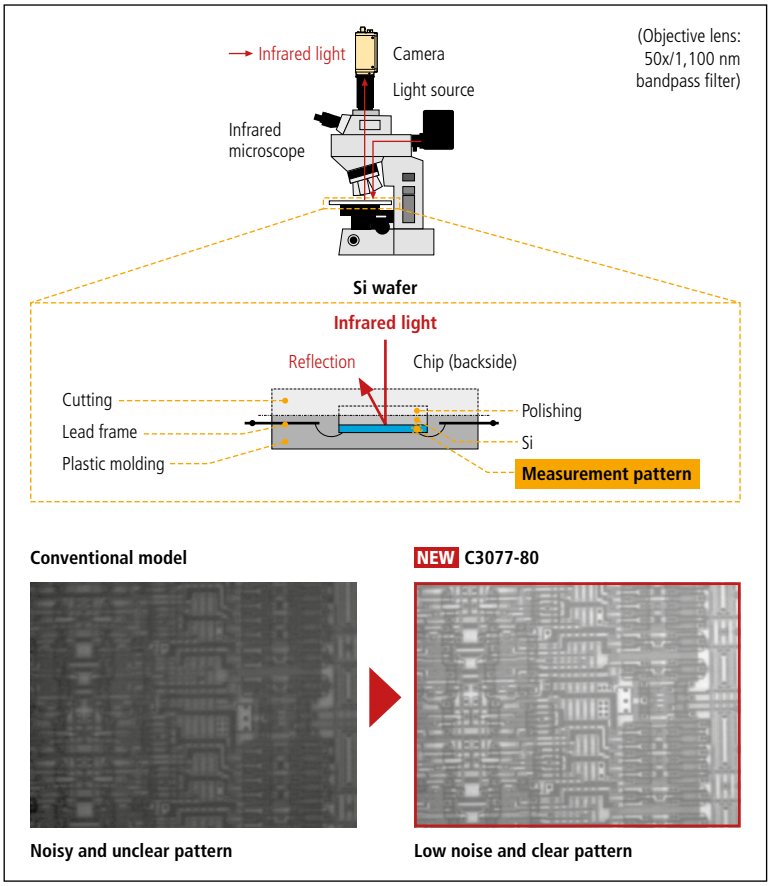
- Si wafer/device alignment
- COG alignment
- Si device internal inspection
- Ceramic substrate inspection

C3077-80

Spectral response



Pattern image inside a silicon device by NIR illumination



Terahertz Wave Generator/Detector Module G13080 Series

PRELIMINARY

Integrated module of photoconductive antenna chip and lens for THz electromagnetic wave

The G13080 series are THz electromagnetic wave emission/detection modules, in which a LT-GaAs "Low-Temperature-grown GaAs" based photoconductive antenna chip and a lens for THz electromagnetic waves are integrated.

Difference from conventional product

This new series achieves the output power of about 2.4 times more signal strength (about 6 times more optical power) of the conventional G10620 series.

Features

- Suitable for both emission and detection
- No need for alignment between photoconductive antenna chip and lens
- Easy connection to other devices

Applications

- Far-infrared Spectroscopy
- Non-destructive Inspection for Industrial Field, Non-contact measurement for biological tissue
- Structure Inspection
- Security, etc.

G13080 Series

Specifications

Parameter	Symbol	Value	Unit
Applied voltage	V_{op}	30	V
Average input optical power*1, 2	P_{ave}	10	mW

*1 The beam diameter in the chip surface is more than 10 μm($1/e^2$) in diameter.
*2 Use a femtosecond laser, which has center wavelength from 760 nm ~ 820 nm and repetition rate from 50 MHz to 150 MHz.

Quantum Cascade Laser L12007-1354H-C (X), L12007-1392H-C (X)

PRELIMINARY

An optimum mid-infrared CW laser diode for molecular gas analysis

Quantum cascade lasers are semiconductor lasers that offer peak emission in the mid-IR range (4 µm to 10 µm). They have gained considerable attention as a new light source for mid-IR applications such as molecular gas analysis.

Difference from conventional product

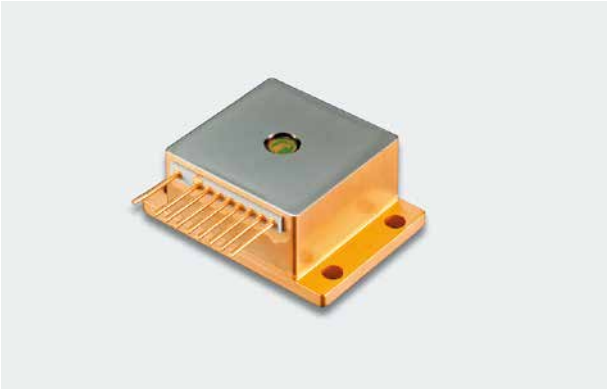
These DFB-CW types are suitable for sulfur oxide (SO_2, SO_3) analysis.

Features

- Emit CW mid-IR laser under room temperature
- Single mode operation
- Compact, lightweight
- Emission Wavelength
  - L12007-1354H-C (X): 7.39 µm (typ.)
  - L12007-1392H-C (X): 7.18 µm (typ.)

Application

- IR molecular spectroscopy (sulfur oxides)



L12007-1354H-C (X), L12007-1392H-C (X)

Specifications

Parameter	Specification		Unit
	L12007-1354H-C (X)	L12007-1392H-C (X)	
Wavelength	7.39	7.18	µm
Wave number	1,354	1,392	cm^{-1}
Output power	20 (min.)		mW
Threshold current	1.0 (max.)		A
Target gas	SO_2	SO_3	-

PRELIMINARY

Super Luminescent Diode L12856-04 (X)

Infrared emitter with high radiant flux density and low coherency

The super luminescent diode (SLD) is an infrared emitter that has the advantages of both the laser diode and the LED; high radiant flux density and low coherency. The SLD was developed as a device that compensates for the disadvantages of laser diodes such as their coherent noise. It is therefore ideal for applications where a higher S/N ratio is essential, for example in optical measurements and optical communications. A photodiode chip has also been mounted within the same package for monitoring the SLD output.

Difference from conventional product

This new series achieves about 3 times more (10 mW) radiant output power of the conventional L8414 series.

Features

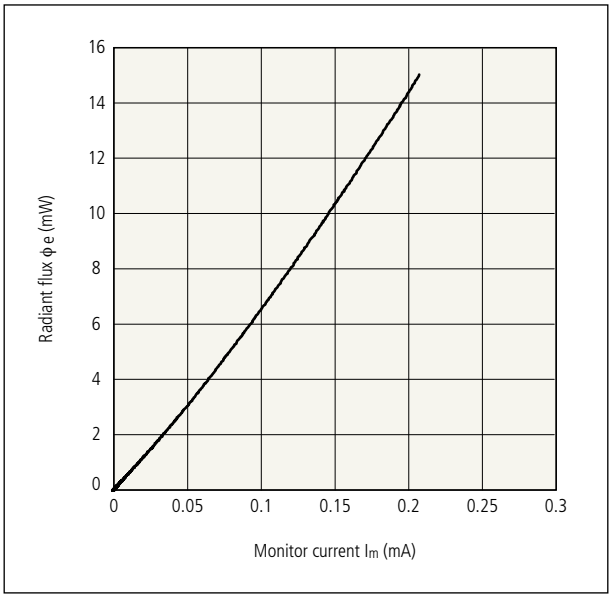
- High radiant flux density
- Low coherency

Applications

- Optical communication
- Optical measurement light source

L12856-04 (X)

Radiant flux vs. Monitor current (typ.) (T_{op} (C) = 25 deg. C.)



Specifications

Parameter		Symbol	Conditions	Value	Unit
Center wavelength		λc	ϕe = 10mW	830±10	nm
Spectral radiation half bandwidth		Δλ		10	nm
Operating current		Iop		120	mA
Operating voltage		Vop		1.8	V
Beam spread angle	Horizontal	θ//	ϕe = 10mW FWHM	8	degree
	Vertical	θ⊥		36	
Monitor current		Im	ϕe = 10mW	0.12	mA

Global Exhibitions 2014 and 2015

USA

October 2014

Convergence
Oct 21-22 2014, Detroit, MI

OSA Frontiers In Optics
Oct 21-22 2014, Tuscon, AZ

MD&M Minneapolis
Oct 29-30 2014, Minneapolis, MN

Micro TAS
Oct 26-30 2014, San Antonio, TX

BMES Annual Meeting
Oct 22-25 2014, San Antonio, TX

Assembly Show
Oct 28-30 2014, Rosemont, IL

November 2014

ISFTA
Nov 9-13 2014, Houston, TX

NSS
Nov 11-13 2014, Seattle, WA

Neuroscience
Nov 15- 19 2014, Washington, DC

RSNA
Nov 30-Dec 4 2014, Chicago, IL

December 2014

MRS Fall Meeting
Dec 2-4 2014, Boston, MA

ASCB Annual Meeting
Dec 6-10 2014, Philadelphia, PA

January 2015

Consumer Electronics Show
Jan 6-9 2015, Las Vegas, NV

February 2015

SLAS
Feb 7-11 2015, Washington, DC

BIOS
Feb 7-8 2015, San Francisco, CA

Photonics West
Feb 10-12 2015, San Francisco, CA

Biophysical Society Annual Meeting
Feb 7-11 2015, Baltimore, MD

MD&M West
Feb 10-12 2015, Anaheim, CA

March 2015

Pittcon
March 8-12 2015,New Orleans, LA

April 2015

SPIE Defense, Security & Sensing
April 20-24 2015, Baltimore, MD

May 2015

CLEO
May 12-14 2015, San Jose, CA

EUROPE

October 2014

Photonex
Oct 15-16 2014, Coventry, England

Herbsttagung der Österreichischen Gesellschaft für Pathologie
Oct 16-18 2014, Graz, Austria

Issues with Tissues Symposium
Oct 18 2014, London, England

Oxford Biomedical Imaging Festival
Oct 23 2014, Oxford, England

November 2014

Vision
Nov 4-6 2014, Stuttgart, Germany

Nordic Symposium on Digital Pathology
Nov 5-6 2014, Linköping, Sweden

Optics & Photonics in Sweden
Nov 11-12 2014, Gothenburg, Sweden

Electronica
Nov 11-14 2014, Munich, Germany

Auto Electronics Show
Nov 11-12 2014, Birmingham, England

Carrefour Pathologie
Nov 17-21 2014, Paris, France

Nov2K Science Symposium
Nov 20-21 2014, Stockholm, Sweden

December 2014

The Pathology Congress
Dec 2-4 2014, London, England

Digital Pathology Congress
Dec 4-5 2014, London, England

January 2015

17. Bamberger Morphologietage
Jan 23-25 2015, Bamberg, Germany

TOM – Trends in optical Micromanipulation
Jan 25-30 2015, Obergurgl, Austria

February 2015

43. Jahrestagung der Deutschen Gesellschaft für Thorax-, Herz- und Gefäßchirurgie
Feb 8-11 2015, Freiburg, Germany

March 2015

ECR – European Society of Radiology
March 5-9 2015, Vienna, Austria

Photonics
March 16-19 2015, Moscow, Russia

FOM – Focus on Microscopy
March 29-April 1 2015, Goettingen, Germany

April 2015

Fysica
April 10 2015, Eindoven, Netherlands

Elektronik 2015
April 14-May 15 2015, Gothenburg, Sweden

Affidabiltà e Tecnologie
April 22-23 2015, Torino, Italy

May 2015

E-MRS
May 11-14 2015, Lille, France

SPS-IPC-Drives Italia
May 12-14 2015, Parma, Italy

Sensor und Test
May 19-21 2015, Nuremberg, Germany

ELMI
May 19-22 2015, Sitges, Spain

XIII Pisa Meeting on Advanced Detectors
May 23-30 2015, La Biodola, Italy

June 2015

Laser World of Photonics
June 22-25 2015, Munich, Germany

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