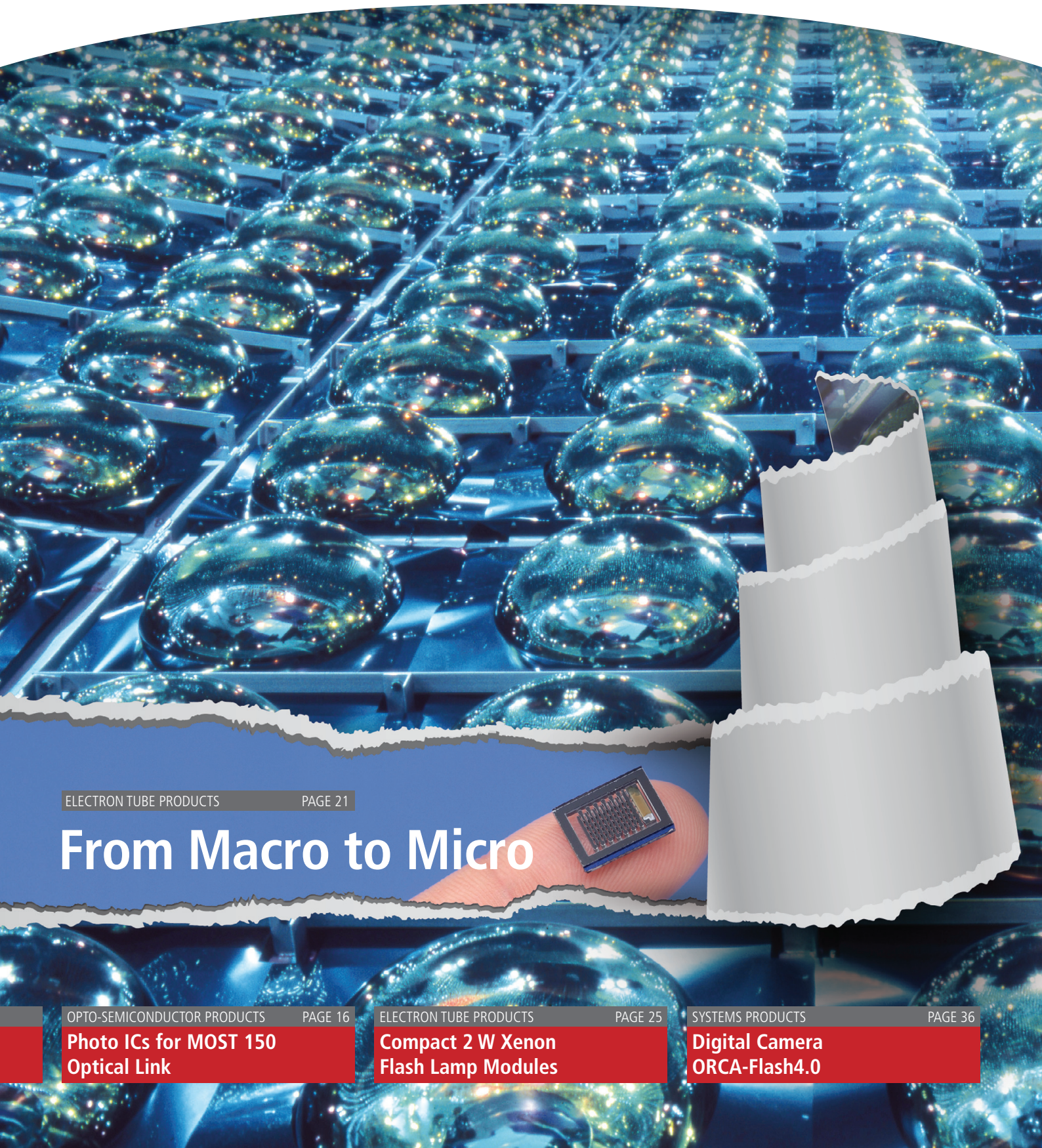
HAMAMATSU
NEWS 2013 01



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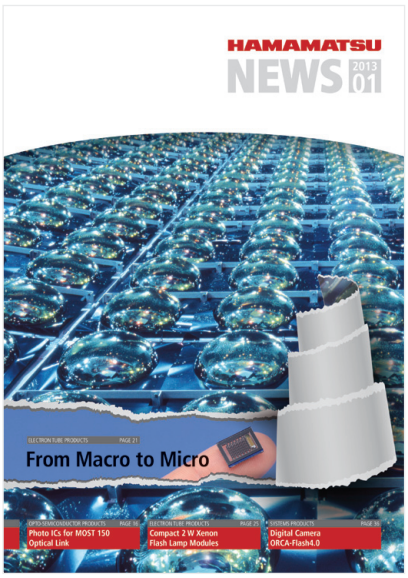
Cover Story

PMT line-up 8 inch, 10 inch, 13 inch, 20 inch



The front cover image shows Hamamatsu 20 inch Photomultiplier Tubes installed in the Super-Kamiokande, a neutrino observatory which is under Mount Kamioka near the city of Hida, Gifu Prefecture, Japan

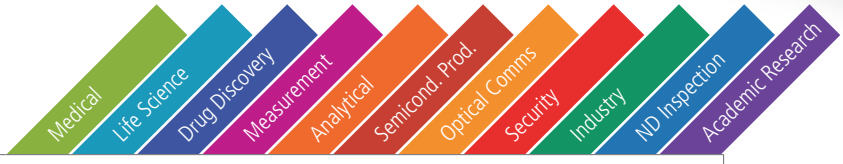
From Macro to Micro

In 1982, Hamamatsu Photonics, using their superior technical expertise and know how in the research and development of photomultiplier tube technology, successfully manufactured the world's largest 20 inch Photomultiplier Tubes. In 1983, the Kamioka Neutrino Observatory in Japan commenced the Kamiokande experiment using 1,000 20 inch PMTs. In 1987, the Kamiokande was the first experiment in the world to detect neutrinos produced by the Supernova in the Large Magellanic Cloud. In 1996, the much larger Super-Kamiokande (Super-K) experiment commenced using 11,200, 20 inch PMTs.

Since then, Hamamatsu has continued to develop in-house manufacturing processes and techniques to produce new technologies, striving to always push the boundaries of photonics technology. As a result of this continued development, Hamamatsu introduces the new MicroPMT, the world's smallest, next-generation ultra-compact photomultiplier tube. The MicroPMT was fabricated through the use of in-house semiconductor processes for MEMS (micro-electro-mechanical systems) devices. It can be mass produced, is only $1/7^{th}$ of the volume and $1/9^{th}$ of the weight of the smallest existing photomultiplier tube. The characteristics of the new MicroPMT will enable the development of compact high-precision measurement instruments, such as for point-of-care medical testing and environmental monitoring.

Hamamatsu continues to push the boundaries of research and the application of Photonics technology to provide state-of-the-art products to help you achieve your application goals, now and in the future, whether your application is fundamental physics research or the miniaturisation of photometric instruments, such as portable medical devices.

Content



		Medical	Life Science	Drug Discovery	Measurement	Analytical	Semicond. Prod.	Optical Comms	Security	Industry	ND Inspection	Academic Research
	OPTO-SEMICONDUCTOR PRODUCTS											
6	Electromagnetic MEMS Micromirrors S12236-S12238 Series		■		■	■				■		
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22	Photomultiplier Tubes R11265U-100/-200	■			■	■						■
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25	Compact 2 W Xenon Flash Lamp Modules L12336 Series	■	■	■	■	■				■		■
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	SYSTEMS PRODUCTS											
34	NanoZoomer-XR C12000		■	■								■
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38	Compact NIR Photoluminescence Lifetime Spectrometer				■	■						■
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Company News

Hamamatsu expands MOST portfolio

Hamamatsu Photonics released a new MOST25 SMD Fiber Optical Transceiver (FOT), part number P12304-01AT, which has already been added to the MOST compliance list. Using the same SMD package as the MOST150 SMD FOT with ferrule guides, it is covered with a Kapton tape to protect the inside, and comes in tape and reel. It enables fully automatic handling in production for pick-and-place machines and reflow soldering process.

With this additional product, Hamamatsu Photonics' MOST portfolio has been expanded to all FOT types specified by MOST Corporation. For the running MOST25 generation, Sidelookers (through-hole-mount package) for 5 V and 3.3 V operating voltage and the SMD version for 3.3 V are available. For the following MOST150 generation, a Sidelooker type and an SMD type for 3.3 V are offered.

The MOST25 FOTs have been running in stable series production with high quality and a failure rate close to 0 ppm for many years and the new MOST150 FOTs will be built into the first cars from the beginning of 2013.

MOST components

While the series start of the MOST150 generation is still running, Hamamatsu Photonics has already started the next developments for new high-speed network solutions and other automotive sensor technologies.

New Managing Director appointed at Hamamatsu Photonics UK Limited

We are pleased to announce that on the 1st October 2012, Tim Stokes was appointed as the new Managing Director of Hamamatsu Photonics UK Limited.

Now in his twentieth year with the Company, Tim started as a Sales Engineer and since 1998, held the position of General Sales Manager. He gained a BSc (Hons.) Physics at Manchester University and has nearly 25 years' experience within the industry.

Speaking of his appointment, Tim said "I am delighted to have been given this responsibility. Hamamatsu have always adopted a 'customer first' approach to our business and this will remain a core element in the future. I look forward to strengthening our relationships with our customers and contributing towards the future growth of the Company".

Tim Stokes

Quantitative Digital Pathology: The devil is in the details

By Amanda Lowe & Lars Pedersen

Digital pathology is often described as the scanning of a glass slide into a whole slide image; yet this is simply where the process begins. The true value of digital pathology is found at the end of the digital pathology workflow: in the interpretation and analysis of sub-cellular morphometric details within tissue samples.

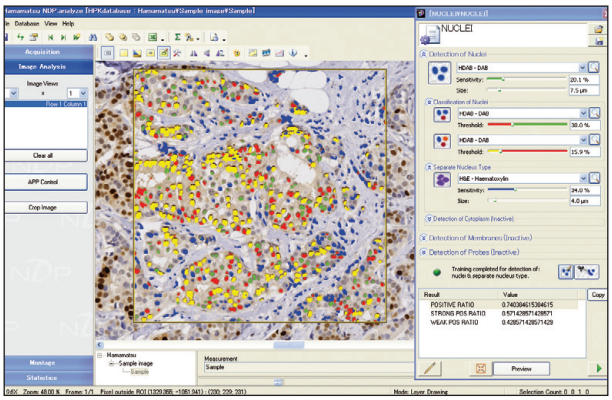
Acquisition of a whole slide image from a glass slide is done on a slide scanner, like the new Hamamatsu NanoZoomer-XR. Whole slide scanners capture a lot of valuable information quickly, however providing access to this information within the tissue samples can be difficult. Traditional methods to extract and interpret this information are labor intensive, semi-quantitative, and are often subjective when manual scoring techniques are applied.
To improve the quality of research results, and reduce the time it takes to obtain results, tissue sample information must be extracted from the whole slide images using an integrated quantitative digital pathology software like NDP.analyze.

Hamamatsu's NDP.analyze is powered by Visiopharm. Visiopharm is a leader in quantitative digital pathology with over 10 years of expertise in image analysis and pattern recognition. NDP.analyze is designed specifically for researchers. The integrated software provides simple controls for identification, classification, and quantification of nuclei, membrane, cytoplasm, and in situ hybridization signals. Through color deconvolution techniques software users work in true stain space.

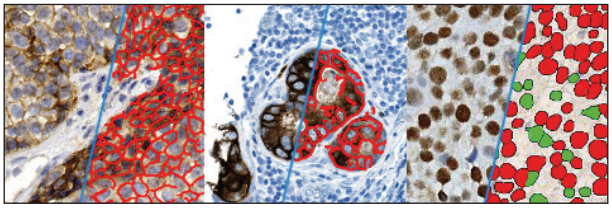
Even though the technology is advanced NDP.analyze is straightforward, the intuitive client interface makes it easy for users to create and save an analysis protocol package (APP) or open and tune an existing APP. Simply select structures, control detection sensitivity, classify nuclei as positive or negative, and determine the amount of cytoplasm you want to include.
The scientific knowledge and decisions made to create or tune an APP are never lost. A customer designed or modified APP can quickly be reopened and then executed by any authorized operator within NDP.analyze on regions of interest, a whole slide image, or batches of whole slide images.

Quantitative digital pathology automates the research workflow, illustrates and documents the tissue samples, and produces reproducible research data in less time.

NanoZoomer-XR C12000



Interface NDP.analyze



Examples

Authors: Amanda Lowe is the Director of Marketing and Lars Pedersen is the Director of Sales, Stereology for Visiopharm, Inc.

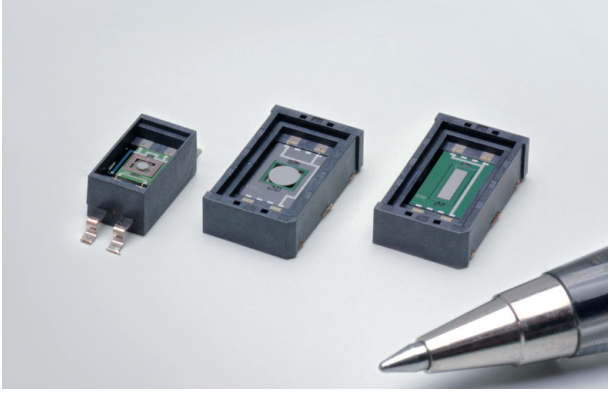
Electromagnetic MEMS Micromirrors S12236/S12237/S12238 Series

PRELIMINARY

Subminiature, low power consumption electromagnetic MEMS micromirrors

The S12236/S12237/S12238 series are electromagnetically driven micromirrors developed by leveraging our advanced MEMS (micro-electro-mechanical systems) technology. An ultra-miniaturized design was achieved by mounting a magnet beneath the mirror. Electrical current flowing in the coil along the periphery of the mirror in a magnetic field by the magnet generates a so-called Lorentz force by Fleming's rule that drives the mirror.

Hamamatsu electromagnetic MEMS micromirrors offer a wide optical deflection angle and high reflectivity as well as low power consumption. A dedicated evaluation circuit with a USB interface is also provided.



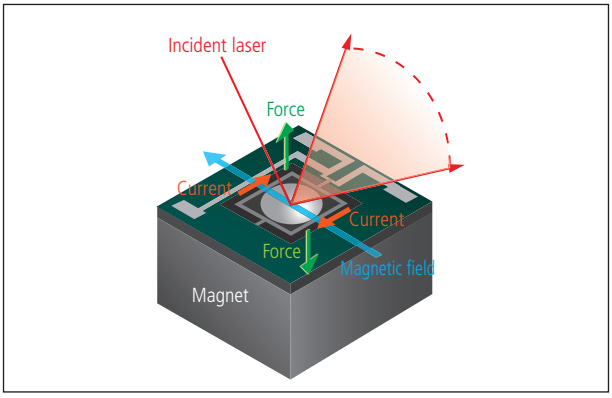
S12236-04P, S12236-08P, S12238-01P / S12237-03P / S12237-02P

Features

- Ultra-miniaturized design
- Low power consumption
- Wide optical deflection angle
- High-reflectivity mirror

Applications

- Micro projectors
- Head-up displays
- Barcode scanners
- Optical scanning devices



Operating Principle

Specifications: One-dimensional type

Parameter	S12236-04P	S12236-08P	S12237-02P	S12237-03P	Unit
Operation mode	Resonant mode		Static mode		-
Mirror size	φ1		4.1 × 1.1	φ2.6	mm
Resonance frequency	5.5	23	0.85	0.5	kHz
Optical deflection angle	± 33	±16	±16	±15	degrees
Dimensions	5.5 × 10 × 4.5		8.4 × 14.3 × 3.85		mm

Specifications: Two-dimensional type

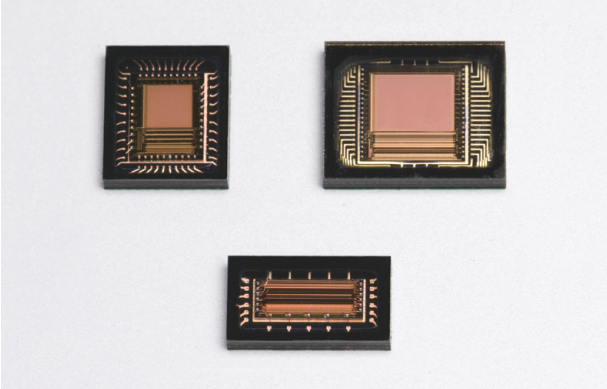
Parameter	S12238-01P		Unit
Axis	Fast axis	Slow axis	-
Operation mode	Resonant mode	Static mode	-
Mirror size	φ0.9 × 1.0 (elliptical)		mm
Resonance frequency	22.5	0.68	kHz
Optical deflection angle	±15	±10	degrees
Dimensions	5.5 × 10 × 4.5		mm

Distance Linear/Area Image Sensors S11961/S11962/S11963-01CR

Measures the distance to an object by TOF (time-of-flight) method

These distance image sensors are designed to measure the distance to an object by TOF method. When used in combination with a pulse modulated light source, these sensors output phase difference information on the timing that the light is emitted and received.

The sensor output signals are arithmetically processed by an external signal processing circuit or a PC to obtain distance data.



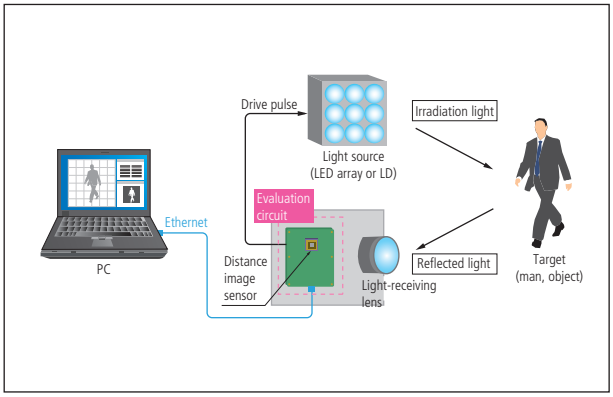
S11962-01CR, S11961-01CR, S11963-01CR

Features

- Real-time distance measurement
- Linear type or area type selectable to match your application
- Operates with minimal detection errors even under fluctuating background light (saturation measures included)

Applications

- Obstacle detection (self-driving vehicles, robots, etc.)
- Security (intrusion detection)
- Shape recognition (logistics, robots, etc.)
- Motion capture



Example of distance measurement diagram

Specifications

Parameter	S11961-01CR	S11962-01CR	S11963-01CR	Unit
Type	Linear	Area		-
Number of pixels	256	64 × 64	160 × 120	px
Pixel pitch	20	40	30	μm
Pixel height	50	40	30	μm
Spectral response range	400 to 1,100			nm
Peak sensitivity wavelength	800			nm

Wavelength-swept Light Source L12526

PRELIMINARY

OCT light source that delivers high-speed wavelength sweep (200 kHz)

The L12526 is a wavelength-swept light source developed for OCT (optical coherence tomography). It provides a high-speed wavelength sweep rate (200 kHz) suitable for measurements where high-speed is essential.

Hamamatsu wavelength-swept light source controls the wavelength by way of a voltage applied to the KTN (potassium tantalum niobate) crystal and so has no mechanically driven parts.

Features

- High-speed wavelength sweep: 200 kHz
- Coherence length: 7 mm min.
- Wavelength control using KTN crystal does not rely on mechanically driven parts

Applications

- Corneal examinations
- Coronary examinations
- Skin examinations
- Caries and periodontal disease examinations
- Semiconductor inspection equipment
- Hand-held inspection devices

L12526

Example of OCT image acquired using this light source

- Thumb viewed from finger pad
- Image size: 1.5 x 1.5 mm (optical path length)
- Vertical direction (from top to bottom) of image: From surface to inside of thumb

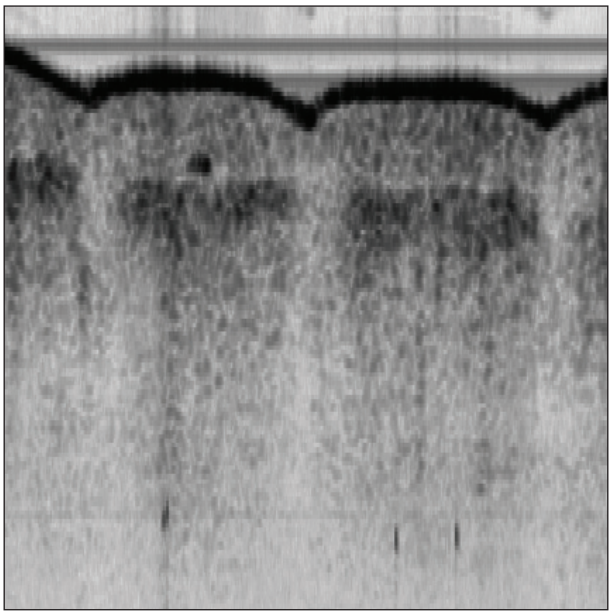


Image was acquired with the cooperation of the Computational Optics Group at the University of Tsukuba.

Specifications

Parameter	Specification	Unit
Scan rate	200	kHz
Center wavelength	1,320	nm
Wavelength sweep width min.	100	nm
Coherence length min.	7	mm
Optical output (average) min.	17	mW
Size	250 x 150 x 300	mm

CCD Linear Image Sensor S11490

High sensitivity in near infrared region, high-speed line rate

The S11490 is a back-thinned CCD linear image sensor designed using our advanced technology to deliver high sensitivity in the near infrared region. It also offers high-speed line rates of up to 200 kHz by multiport readout (30 MHz per port).

Features

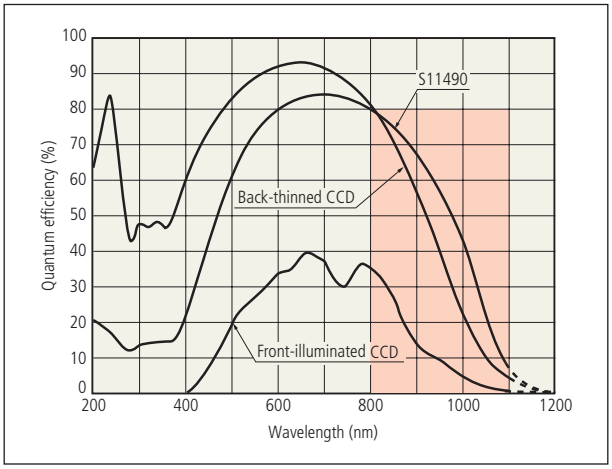
- High sensitivity in near infrared region:
  - QE = 70 % (λ = 900 nm)
  - QE = 40 % (λ = 1,000 nm)
- High-speed line rate: 200 kHz max.
- Low etaloning

Applications

- OCT (optical coherence tomography)
- Spectrophotometry

S11490

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



Specifications

Parameter	Specification	Unit
Number of effective pixels	1,024	px
Pixel pitch	24	µm
Pixel height	500	µm
Photosensitive area length	24.576	mm
Dynamic range	5,000	-
Spectral response range	320 to 1,100	nm

CCD Area Image Sensor S12071

High sensitivity in UV region, anti-blooming function included

The S12071 CCD area image sensor has a back-thinned structure that enables high sensitivity in the UV to visible region as well as a wide dynamic range, low dark current, and an anti-blooming function.

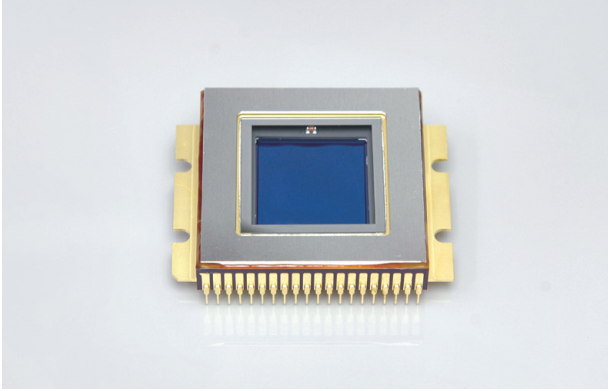
A dedicated driver circuit C12081 (with Camera Link and USB 2.0 interfaces) is also provided (sold separately).

Features

- High sensitivity in UV region
- One-stage TE-cooled type
- Anti-blooming function included
- Selectable readout port to match your application:
  - tap A: low noise amplifier (1 MHz max.)
  - tap B: high-speed amplifier (10 MHz max.)

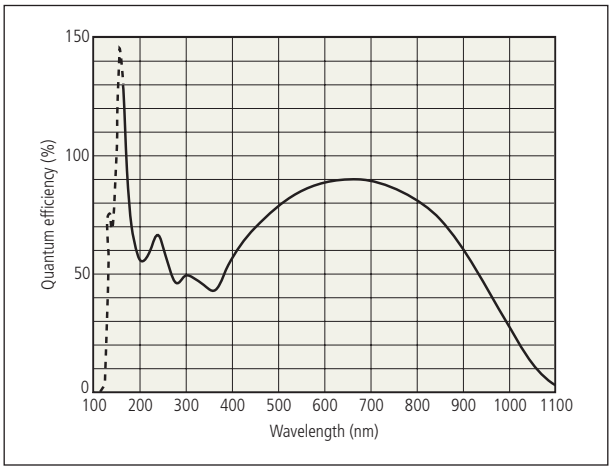
Applications

- ICP spectrophotometry
- Scientific measuring instrument
- UV imaging



S12071

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



Specifications

Parameter		Specification	Unit
Number of effective pixels		1,024 × 1,024	px
Pixel pitch		24	µm
Dynamic range	tap A	38,000	-
	tap B	7,000	
Dark current	Td = 25 deg. C.	100	e⁻/pixel/s
	Td = 0 deg. C.	7	
Spectral response range		165 to 1,100	nm

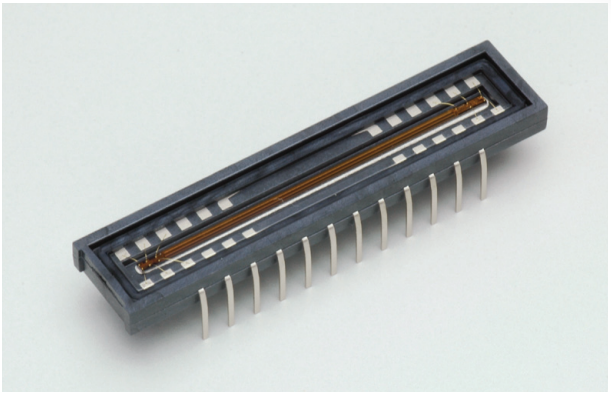
DEVELOPMENTAL

CMOS Linear Image Sensor S11639

High sensitivity, photosensitive area with vertically long pixels

The S11639 is a high sensitivity CMOS linear image sensor using a photosensitive area with vertically long pixels (14 x 200 µm). Other features include high sensitivity and high resistance in the UV region.

The S11639 operates from a single 5 V supply making it suitable for use in low cost spectrometers.



S11639

Features

- High sensitivity: 1,000 V/(lx·s)
- Electronic shutter
- Single 5 V supply operation
- Video data rate: 10 MHz
- Conversion efficiency: 20 µV/e^-
- High sensitivity in UV to NIR region

Applications

- Spectrophotometry
- Position detection
- Image reading
- Encoders

Specifications

Parameter	Specification	Unit
Number of pixels	2,048	-
Pixel pitch	14	µm
Pixel height	200	µm
Photosensitive area length	28.672	mm
Spectral response range	200 to 1,000	nm

InGaAs Linear Image Sensor G12230-512WB

PRELIMINARY

Hybrid-structure linear image sensor (two 256-pixel photodiode arrays with different spectral response ranges)

The G12230-512WB is a hybrid-structure linear image sensor having two 256-pixel back-illuminated InGaAs photodiode arrays with spectral response ranges of 0.95 to 1.65 µm and 1.4 to 2.15 µm, which are bump-bonded to a single CMOS readout circuit.

This new structure allows high S/N over a broad spectral response range from 0.95 to 2.15 µm.

G12230-512WB

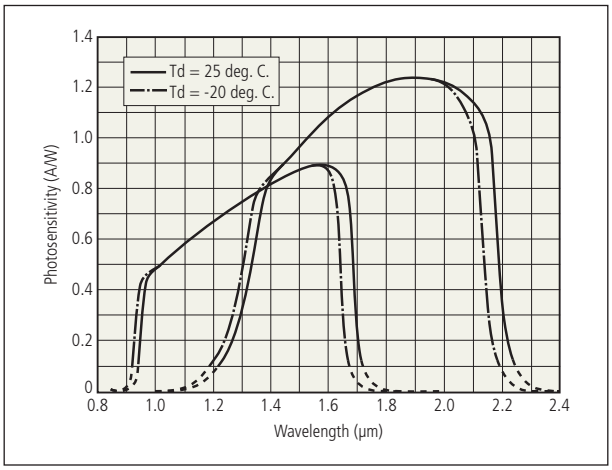
Features

- Spectral response range: 0.95 to 2.15 µm
- Two 256-pixel photodiode arrays with spectral response ranges of 0.95 to 1.65 µm and 1.4 to 2.15 µm
- Low dark current
- Low linearity error
- Pixel height: 250 µm, pixel pitch: 25 µm

Applications

- Spectrophotometry
- Analysis and measurement

Spectral response (Typ.)



Specifications

Parameter	Min.	Typ.	Max.	Unit
Spectral response range	-	0.95 to 2.15	-	µm
Conversion efficiency	-	16	-	nV/e⁻
Photoresponse non-uniformity	-	±5	-	%
Data rate	0.1	1	5	MHz

PRELIMINARY

Si/InGaAs Linear Image Sensor G12231-1024DF

Wide spectral response range, Silicon and InGaAs hybrid linear image sensor

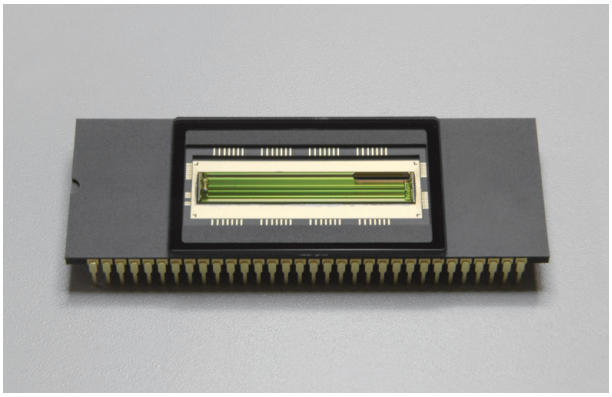
The G12231-1024DF is a unique image sensor that connects a back-illuminated InGaAs photodiode array to a CMOS image sensor by flip chip bonding to achieve a wide spectral response range.

Features

- Spectral response range: 0.4 to 1.7 µm
- Si linear image sensor (768 pixels, 25 µm pitch) + InGaAs linear image sensor (256 pixels, 25 µm pitch)
- Pixel height: 500 µm
- Continuous spectrum acquisition
- Optimal S/N at detection wavelength

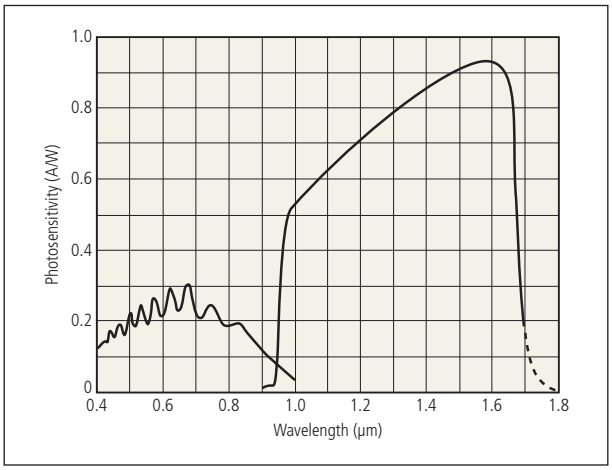
Applications

- Spectrophotometry



G12231-1024DF

Spectral response (Typ. Ta=25 deg. C.)



Specifications

Parameter	Specification	Unit
Spectral response range	0.4 to 1.7	µm
Number of pixels	1,024 [768 (Si) + 256 (InGaAs)]	px

InGaAs Area Image Sensor G12242-0707W

Near-infrared area image sensor with high resolution

The G12242-0707W is a high-resolution, near-infrared area image sensor that consists of a back-illuminated InGaAs photodiode array bump-connected to a CMOS readout circuit (ROIC: readout integrated circuit).

The internal timing generator allows analog video output and AD-TRIG output to be obtained by simply inputting an external master clock and master start pulses.

Features

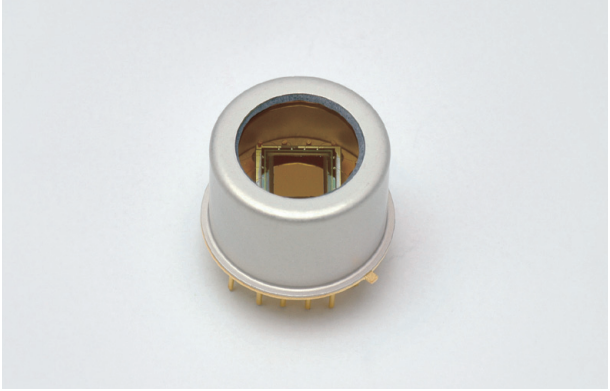
- Spectral response range: 0.95 to 1.7 µm
- 128 x 128 pixels (pixel pitch: 20 µm)
- High sensitivity: 2 µV/e^-
- Compact package (TO-8, two-stage TE-cooled type)
- Internal timing generator

Applications

- Near infrared image monitors
- Fluorescence imaging
- Emission monitors

Specifications

Parameter	Specification	Unit
Number of pixels	128 × 128	px
Pixel pitch	20	µm
Spectral response range	0.95 to 1.7	µm



G12242-0707W

Spectral response (Typ. Ta=25 deg. C.)

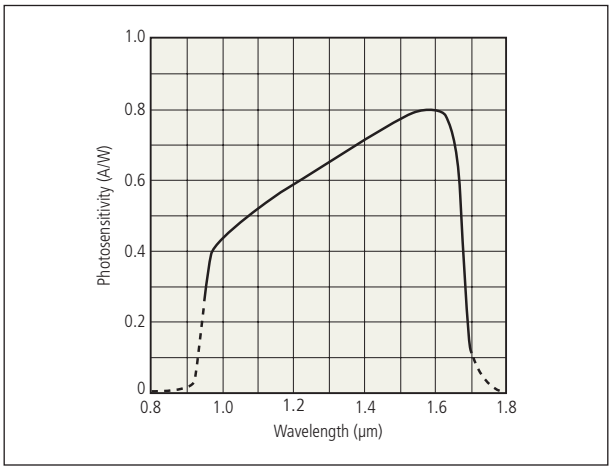
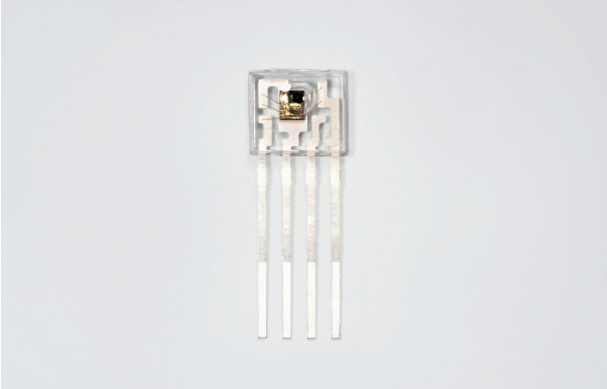


Photo ICs for Optical Link
S12511-, S12512-, S12423-, S12514-01SR

General-purpose photo IC receivers used for data transmission (POF)

These are photo IC receivers widely used for data transmission via POF (plastic optical fibers). These photo ICs are suitable for use with factory automation, electronic office devices, and digital audio equipment in harsh noise environments.

Various types are available with different transmission speeds: low speed (DC to 1 Mbps), semi-high speed (DC to 10 Mbps), and high speed (DC to 100 Mbps). LED transmitters are also provided (sold separately).



S12511-01SR

Features

- Four types available:
  - Low speed types (DC to 1 Mbps): High sensitivity type (for long-distance communication), very low current consumption type
  - Semi-high speed type (DC to 10 Mbps)
  - High-speed type (DC to 100 Mbps)
- Monolithic photo IC (miniature package)
- High immunity to electromagnetic induction noise
- Digital output

Applications

- Data transmission (factory automation, electronic office devices, digital audio equipment, etc.)

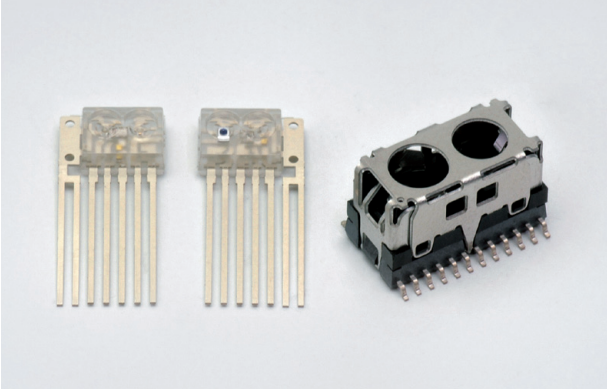
Specifications

Type No.	Type	Supply voltage	Transmission speed	Current consumption	Minimum receivable level
S12511-01SR	Low speed, high sensitivity (for long-distance communication)	3.3 ± 0.3 V	DC to 1 Mbps	10 mA	-40 dBm
S12512-01SR	Low speed, very low current consumption			0.5 mA	-25 dBm
S12423-01SR	For semi-high speed communication		DC to 10 Mbps	20 mA	-30 dBm
S12514-01SR	For high-speed communication		DC to 100 Mbps	30 mA	-20 dBm

Photo ICs for MOST 150 Optical Link L11354-01, S11355-01, P11379-03AT

FOT (fiber optic transceiver) for MOST 150

MOST (Media Oriented Systems Transport) is a type of in-vehicle network communication system that is increasingly installed in European-made vehicles. Hamamatsu provides transmitter photo IC, receiver photo IC, and transmitter/receiver photo IC designed as FOT for 150 Mbps MOST networks.



L11354-01, S11355-01, P11379-03AT

Features

- Fast communication up to 150 Mbps
- Sidelooker type and SMD type available
- 3.3 V operation
- Wide operating temperature range: -40 to +95 deg. C.
- Compatible with reflow soldering
- Sleep function embedded

Applications

- In-vehicle (MOST) networks
- Data transmission

Specifications

Type No.	Type	Package	Transmission speed
L11354-01	Transmitter photo IC	Sidelooker plastic package	150 Mbps
S11355-01	Receiver photo IC		
P11379-03AT	Transmitter/receiver photo IC	SMD type (integrated with optical fiber connector)	

Si PIN Photodiode S12158-01CT

COB (chip on board) type compatible with lead-free reflow soldering

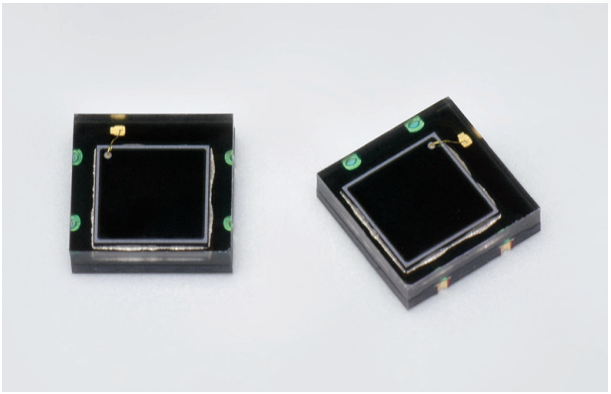
The S12158-01CT is a visible to near-infrared Si PIN photodiode compatible with lead-free reflow soldering. It utilizes a small, thin COB package with no leads and so requires only minimal component mounting space.

Features

- Small, thin COB package with no leads
- Photosensitive area: 2.77 × 2.77 mm
- High sensitivity: 0.7 A/W (λ = 960 nm)

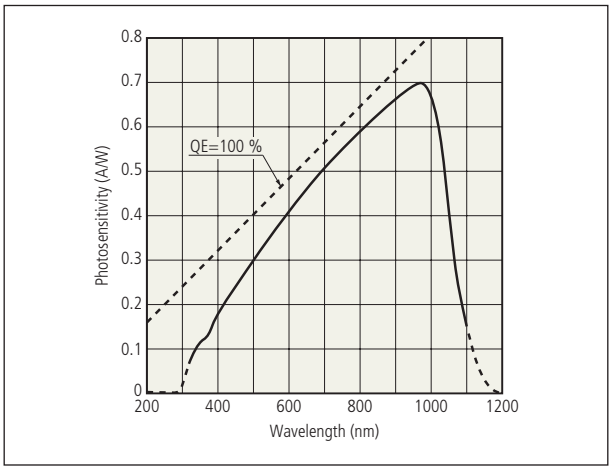
Applications

- Free space optics
- Optical switches
- Laser radars



S12158-01CT

Spectral response (Typ. Ta=25 deg. C.)



Specifications

Parameter	Condition	Min.	Typ.	Max.	Unit
Spectral response range		-	320 to 1,100	-	nm
Peak sensitivity wavelength		-	960	-	nm
Photosensitivity	λ = 960 nm	0.6	0.7	-	A/W
Cutoff frequency	V_R = 12 V, R_L = 50 Ω, -3 dB	10	25	-	MHz

Si APDs
S12508 Series

Low bias, high-speed Si APD for 900 nm band

The S12508 series Si APDs are designed to provide maximum sensitivity at a wavelength in the 900 nm band where optical rangefinders are increasingly used.

When detecting light near 900 nm, the S12508 series offers faster response and lower bias operation than the existing Si APD.

Features

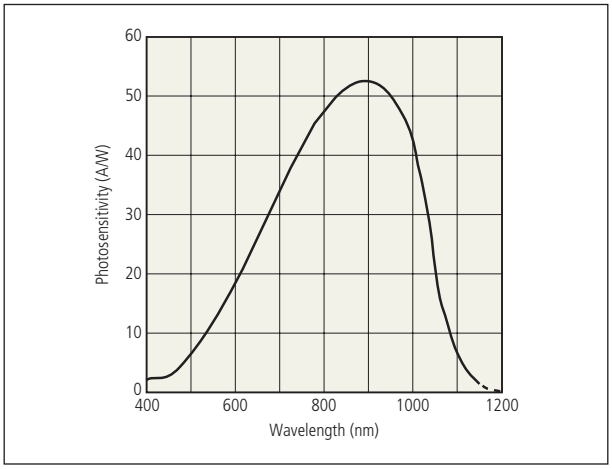
- Peak sensitivity wavelength: 900 nm (gain = 100)
- Low bias operation: Breakdown voltage = 150 V max.
- High-speed response: Cutoff frequency = 1 GHz typ. (S12508-02)

Applications

- Optical rangefinders

S12508-02, S12508-05

Spectral response (Typ. Ta=25 deg. C., M=100)



Specifications

Parameter	Condition	S12508-02	S12508-05	Unit
Photosensitive area		φ0.2	φ0.5	mm
Spectral response range		400 to 1,150		nm
Breakdown voltage max.	I_D = 100 μA	150		V
Temperature coefficient of breakdown voltage		0.5		V/deg. C.
Cutoff frequency	M = 100, λ = 900 nm, R_L = 50 Ω, -3 dB	1	0.9	GHz

Two-Color Detector K11908-010K

Broad spectral response range by two InGaAs PIN photodiodes with different ranges, stacked one over the other

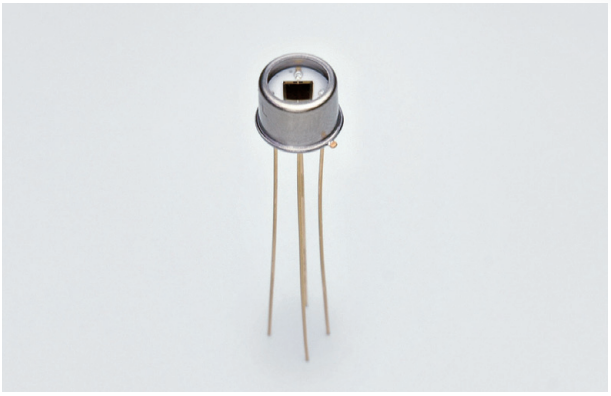
The K11908-010K is a two-color detector using two InGaAs PIN photodiodes with different cutoff wavelengths of 1.7 µm and 2.55 µm, which are arrayed along the same optical axis. The K11908-010K offers a broad spectral response range (0.9 to 2.55 µm) and low noise.

Features

- Two InGaAs PIN photodiodes with different cutoff wavelengths of 1.7 µm and 2.55 µm are arrayed along the same optical axis
- Broad spectral response range: 0.9 to 2.55 µm
- Low noise, low dark current

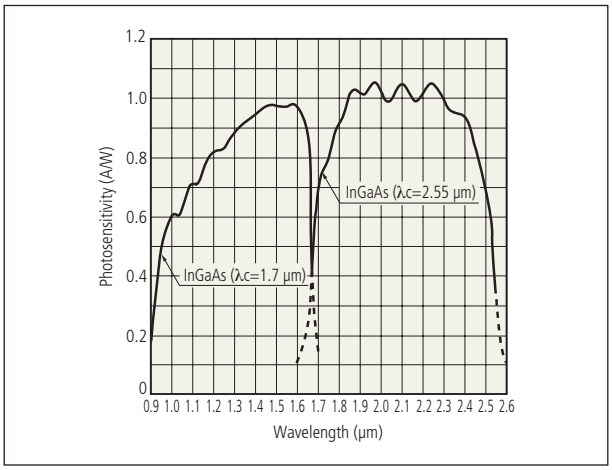
Applications

- Radiation thermometry
- Spectrophotometry
- Optical measurement



K11908-010K

Spectral response (Typ. Ta=25 deg. C.)



Specifications

Parameter		Specification	Unit
Spectral response range	InGaAs (λc = 1.7 µm)	0.9 to 1.7	µm
	InGaAs (λc = 2.55 µm)	1.7 to 2.55	
Peak sensitivity wavelength	InGaAs (λc = 1.7 µm)	1.55	µm
	InGaAs (λc = 2.55 µm)	2.1	

Infrared LED
L12170

High-speed, high power LED encapsulated in a low cost package

The L12170 is a low-cost bullet package LED with high speed and high power.

Features

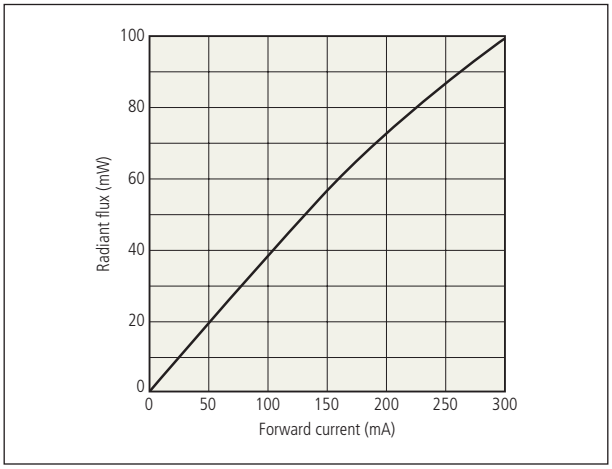
- Low cost package: bullet type
- High-speed response
- High output power

Applications

- Infrared lighting
- Measuring devices
- Industrial equipment

L12170

Radiant flux vs. forward current (Typ. Ta=25 deg. C.)



Specifications

Parameter	Condition	Min.	Typ.	Max.	Unit
Forward current		-	-	300	mA
Peak emission wavelength	I_F = 50 mA	840	870	900	nm
Radiant flux	I_F = 50 mA	16	20	-	mW
	I_{FP} = 3 A, tw = 10 µs, Duty ratio = 1%	-	1	-	W
Cutoff frequency	I_F = 50 mA ± 1 mAp-p	25	40	-	MHz

µPMT Assembly H12400-00-01

World's smallest, thinnest, lightest PMT assembly*

This µPMT (micro photomultiplier tube) is a high-sensitivity photosensor using a newly developed µPMT that is tinier and thinner than ever before and combined with a voltage divider circuit.

The extremely small size of this µPMT allows miniaturizing equipment sizes and boosts performance.

Features

- Sensor head is separate from the circuit to allow measurement in small, narrow spaces.

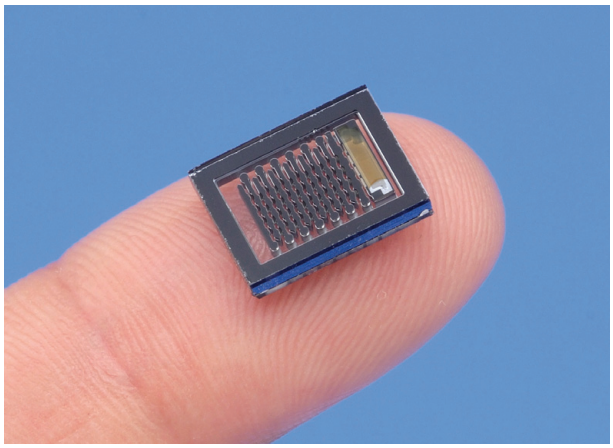
Applications

- Compact, high sensitivity photometric systems:
  - Portable medical devices
  - Portable environmental measurement devices
  - Medical monitors, etc.

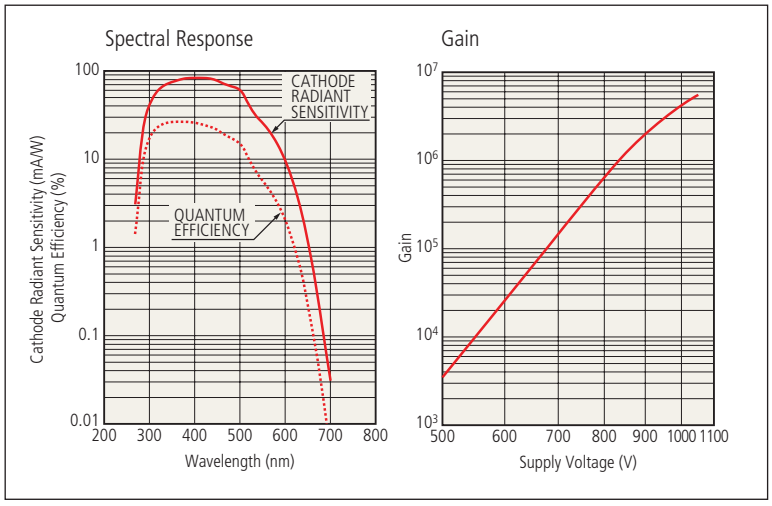
* As of Dec. 2012, based on our research

µPMT is registered trademark of Hamamatsu Photonics K.K. in Japan, USA and EU.

H12400-00-01



Spectral response/Gain



Specifications

Parameter	Specification	Unit
Spectral response range	300 to 650	nm
Wavelength of maximum response	420	nm
Minimum effective photocathode (X x Y)	3 x 1	mm
Quantum efficiency (typ.) *1	26	%
Gain (typ.) *2	2 x 10^6	-
Anode dark current (typ.) *2 *3	0.3	nA
Time response (anode pulse rise time) (typ.) *2	1.2	ns

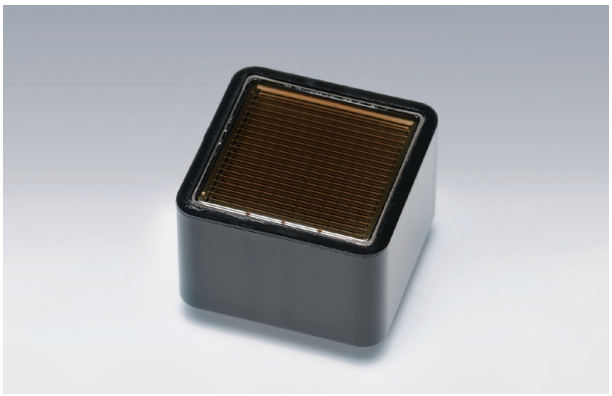
*1 At peak wavelength
*2 Supply voltage 900 V, at 25 deg. C.
*3 After 30 min storage in darkness

Photomultiplier Tubes R11265U-100/-200

Photomultiplier tube with high collection efficiency

The R11265U series are 1-inch square metal package photomultiplier tubes with metal channel dynodes. These have a shorter tube length than the currently available product (R8900U) and their collection efficiency is increased from 73 % to 90 %.

The R11265U-100 uses an SBA photocathode and the R11265U-200 a UBA photocathode, both having significantly enhanced quantum efficiency.



R11265U-100/-200

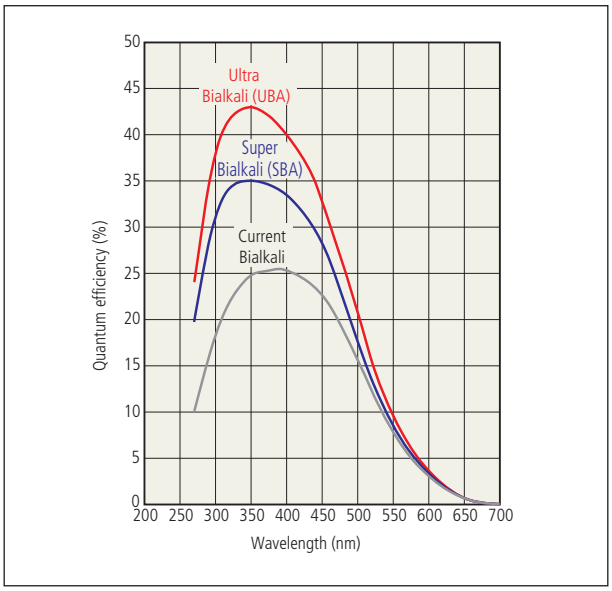
Features

- High collection efficiency: 90 %
- High quantum efficiency: SBA/UBA photocathodes
- High-speed response

Applications

- Analytical instruments
- Medical devices and instruments
- Measuring devices
- Industrial equipment
- Academic research

Spectral response



Specifications

Parameter	R11265U-100	R11265U-200	Unit
Effective area	23 x 23		mm
Spectral response range	300 to 650		nm
Photocathode type	SBA	UBA	-
Quantum efficiency (typ.) at 350 nm	35	43	%
TTS (Transit time spread) (FWHM)	0.27		ns

Cooled Side-on Photomultiplier Tube R9182-01

Low noise with cooled multialkali photocathode

The R9182-01 is a 28 mm (1-1/8 inch) side-on photomultiplier tube with a directly cooled cathode. The R9182-01 can be used as a replacement for conventional 28 mm (1-1/8 inch) side-on photomultiplier tubes.

It allows low-light-level measurement in the near infrared region.

Features

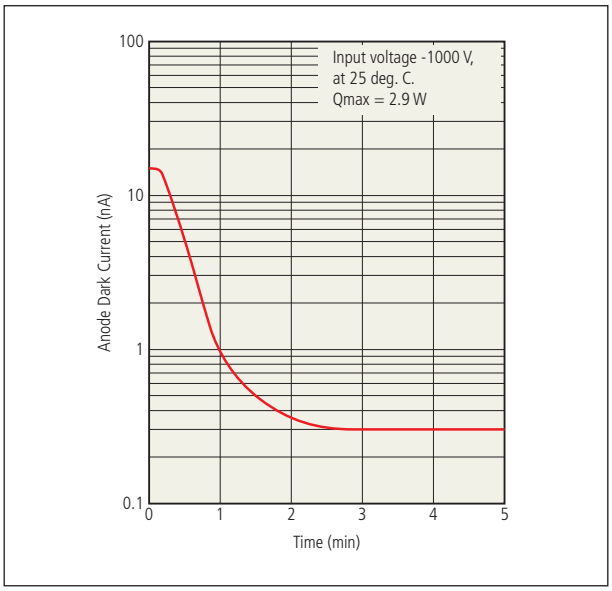
- Reduced dark current by photocathode cooling

Applications

- Analytical equipment
- Medical equipment
- Fluorescence microscopes

R9182-01

Cooling characteristics



Specifications

Parameter	Specification	Unit
Spectral response range	185 to 900	nm
Wavelength of maximum response	450	nm
Effective photocathode area	10 x 14	mm
Cathode luminous sensitivity	525	µA/lm
Anode dark current (when cooled)*	0.3	nA

* Input voltage -1000 V, at 25 deg. C.
After 30 min storage in darkness

Amplifier Unit C12419

Inverting amplifier with a bandwidth from DC to 1 MHz

The C12419 is a current-to-voltage conversion amplifier unit that inverts and amplifies the electrical current input from a photomultiplier tube, and outputs a positive voltage.

Features

- Frequency bandwidth DC to 1 MHz

Applications

- Output signal readout from photomultiplier tube and photodiode

C12419

Specifications

Parameter	Specification	Unit
Supply voltage	±15	V
Frequency bandwidth (-3 dB)	DC to 1 MHz	-
Current-to-voltage conversion factor	1	V/µA
Maximum output signal voltage (at 50 Ω load resistance)	+3	V
Max. output noise voltage (at 50 Ω load resistance)	1	mV rms

Compact 2 W Xenon Flash Lamp Modules L12336 Series

World's smallest light source ideal for portable/compact analytical instruments*

Integrating a 2 W xenon flash lamp, a highly stable power supply and a trigger socket for lamp operation, the L12336 ranks as the world's smallest module among 2 W input xenon flash lamps.

Compared to conventional 5 W modules, the L12336 series offers 1.4 times higher emission efficiency and more than 2 times higher repetitive emission frequency of 1250 Hz. This will help shorten the time required for measurement and analysis.

L12336

Features

- World's smallest modules among 2 W input xenon flash lamps
- Battery operation possible
- High output power
- High stability

Applications

- Spectrophotometry
- Blood analysis
- Environmental analysis
- Laboratory testing
- Semiconductor inspection

* As of Dec. 2012, based on our research

Specifications

Parameter	L12336				Unit
	-01	-02	-03	-04	
Light output spectral range	185 to 2000				nm
Main discharge voltage variable range	400 to 600				V
Main discharge capacitance	0.141	0.094	0.047	0.020	µF
Maximum average input (continuous)	2				W
Light output stability (typ.)	0.5				% CV
Guaranteed life (2 W operation)	1×10^9				flashes
Maximum repetitive emission frequency	177	266	532	1250	Hz

Opto-Spectrum Generator L12194-00-39070/-43079

Emits light at any wavelength in visible spectrum range

The L12194 emits light at any desired wavelength in the visible to near infrared region in 1 nm steps. Adopting a newly developed high efficiency optical system makes the L12194 more compact than existing light sources that utilize a diffraction grating, and also provides a higher output.

Features

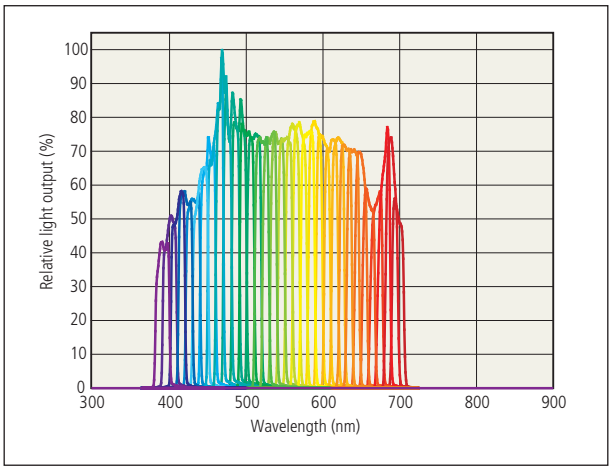
- Continuously tunable wavelength over a wide spectrum from 390 to 700 nm or 430 to 790 nm
- Spectral bandwidth of 20 nm (FWHM)
- Wavelength tuning at 50 nm/s
- Same light output level at each wavelength
- Average light output of more than 15 mW
- Emission wavelength, intensity and time controllable from PC using irradiation programs (supplied with control software)

Applications

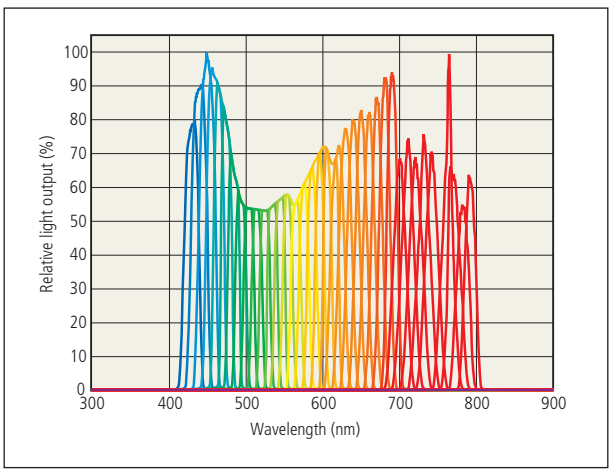
- Solar simulator (light source for solar cell inspection)
- Photocatalyst
- Light source for phosphor excitation and analytical instruments
- Light stimulus for bioluminescence
- Semiconductor inspection
- Semiconductor failure analysis
- Monochromatic light sources
- Retinal cell evaluation

L12194

Spectral distribution example (390 nm to 700 nm)



Spectral distribution example (430 nm to 790 nm)



RF Electric Discharge Type Excimer Lamps L11751, E11752, C11753

Material "surface modification" and "dry cleaning" by light

Vacuum UV light at 172 nm emitted from this excimer lamp generates ozone and a large amount of active oxygen, and at the same time, molecular bonds of organic matter adhering to a material surface are broken up by light.

This enhances the hydrophilic properties of the material surface and removes the organic contaminants. This excimer lamp also exhibits less flicker and uniformly irradiates a large area through the use of a long, flat bulb and RF discharge.

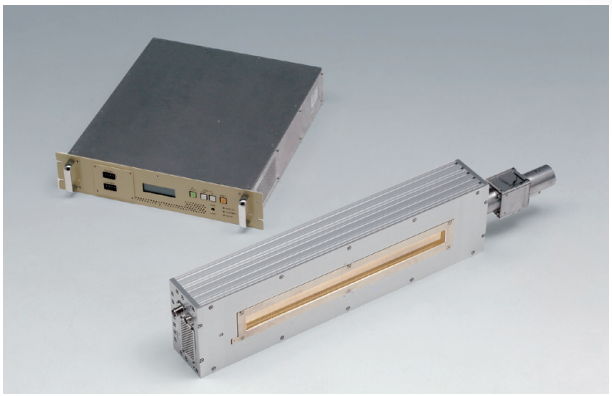
This product consists of an excimer lamp (L11751), a lamp housing (E11752), and a power supply (C11753).

Features

- Less flicker: RF discharge
- Uniform irradiation over a large area: Flat, long lamp
- Instantaneous ON/OFF
- No damage and no dust generation: Process by light

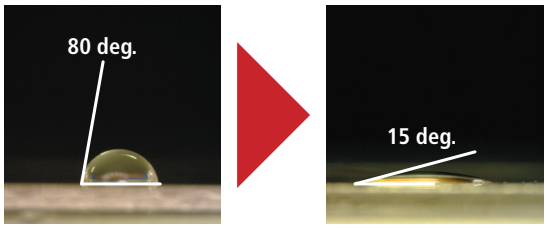
Applications

- Surface modification
- Dry cleaning



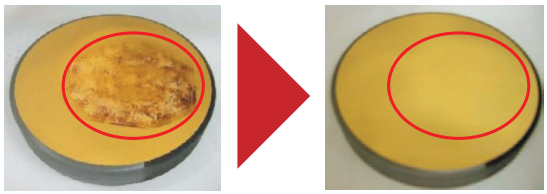
L11751, E11752, C11753

Surface modification of PET plastic



Before irradiation — After irradiation

Dry cleaning of gold-coated mirror for laser



Before irradiation — After irradiation

VUV Ionizer
L12542

Removing static electricity from large areas under depressurized conditions

The L12542 VUV Ionizer emits vacuum UV light with a radiation angle about 3 times wider than that of conventional products (L10366) using a MgF_2 window deuterium lamp, and removes electrostatic charges from large surface areas.

This eliminates the need to use two or more light sources with smaller irradiation angles that are normally required to remove electrostatic charges from materials with large surface areas.

Features

- Wide irradiation angle
- Long life: 2,000 hours guaranteed*
- No air flow required
- No residual potential
- High neutralization under depressurized conditions

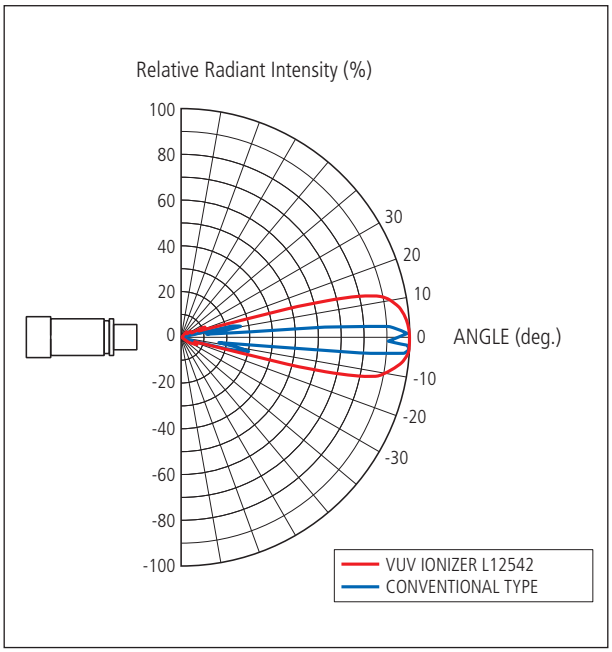
Applications

- Static electricity removal:
  - Dechucking of electrostatic chucks
  - Semiconductor process equipment
  - LCD manufacturing equipment
  - Organic EL manufacturing equipment
  - Hard disk manufacturing equipment
  - Film manufacturing equipment

* Lamp life end is defined as the point when light output at 230 nm falls to 50 % of its initial value or when output fluctuation exceeds 0.05 % (p-p).

L12542

Light distribution characteristics



High Power Photoionizer L11754

Static electricity removal by irradiating light (soft X-ray method)

The L11754 removes electrostatic charges by utilizing a higher output than our previous photoionizer. Features still include maintenance-free operation, zero dust generation, no overshooting, and no need for air flow, yet electrostatic charge removal is also boosted to shorten the time required to eliminate electrostatic charges.

Wide-ranging removal of static electricity in a short time improves the cycle time in production.

L11754

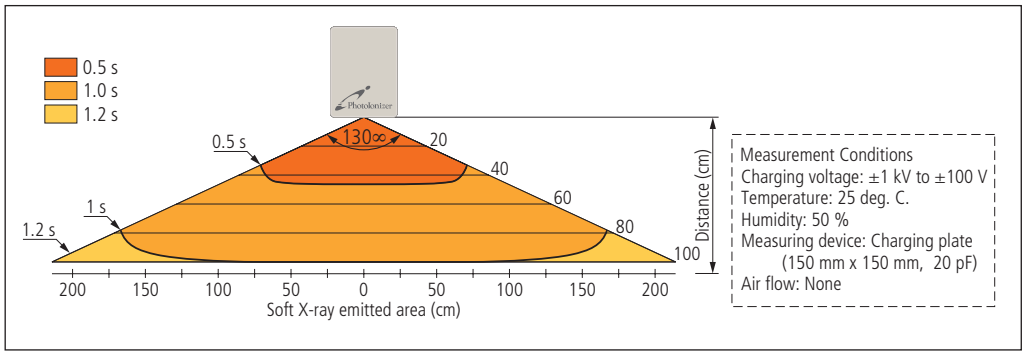
Features

- Quickly removes electrostatic charges from products and materials conveyed on high-speed production lines
- Effectively removes electrostatic charges over a wide range and using only a small number of heads
- 10 steps variable output

Applications

- Static electricity removal

Electrostatic charge removal effect



160 kV Open Type Microfocus X-Ray Source L10711-02

Improved stability due to minimized thermal effects and focal point shift by cooling

The L10711-02 is a microfocus X-ray source developed for submicron CT. It delivers a minimum resolution of 0.25 µm and also improves stability by using a water cooled mechanism that prevents thermal effects and minimizes focal point shift.

L10711-02

Features

- High resolution
- Minimal focal point shift
- No high voltage cable required
  (integrated with high voltage power supply)
- Easy replacement of maintenance parts

Applications

- Non-destructive inspection
- X-ray CT
- X-ray inspection:
  - Electronic part
  - Printed circuit board
  - Metallic part
  - Polymer material
  - Living organism

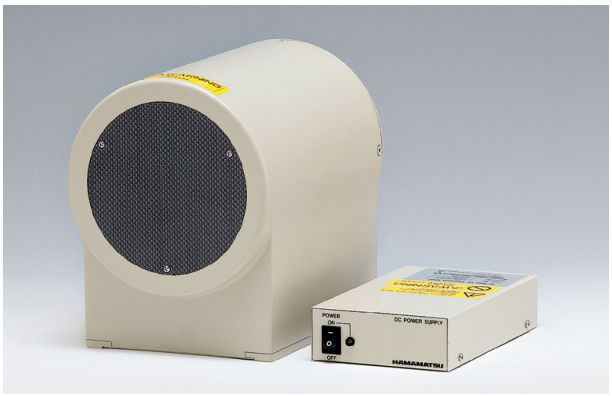
Specifications

Parameter	Specification	Unit
Tube voltage	20 to 160	kV
Tube current	0 to 200	µA
Max. output	8	W
Min. resolution	0.25	µm
X-ray beam angle	Approx. 140	degrees
FOD (Focus to object distance)	0.5	mm

X-Ray I.I. (Image Intensifier) Digital Camera Unit C7336-05

X-ray digital camera with 2.8 million pixels

The C7336-05 consists of a 4-inch image intensifier (X-ray I.I.) and a 2.8 million pixel CMOS image sensor. It captures X-ray images in real-time at an X-ray energy of 20 keV or higher, which are clear and sharp compared to those from ordinary analog cameras. The video output is directly storable in a PC via an IEEE 1394b interface.



C7336-05

Features

- Digital output
- High resolution, high contrast
- High-speed readout
- Low noise
- Low distortion

Applications

- X-ray imaging equipment
- Industrial X-ray CT scanner
- In-line X-ray inspection system:
  - Electronic part
  - Printed circuit board
  - Resin part
  - Metallic part
  - Food product
  - Beverage product
  - Pharmaceutical

Specifications

Parameter	Specification		Unit
Number of effective pixels (H x V)	1,920 x 1,440		px
Frame rate	30	45	frames/s
Video output	12	8	bit
Interface	IEEE1394b x 2bus		-

FAC (Fast-Axis Collimating) Lens J10919-01/-02

Highly efficient utilization of light from LD

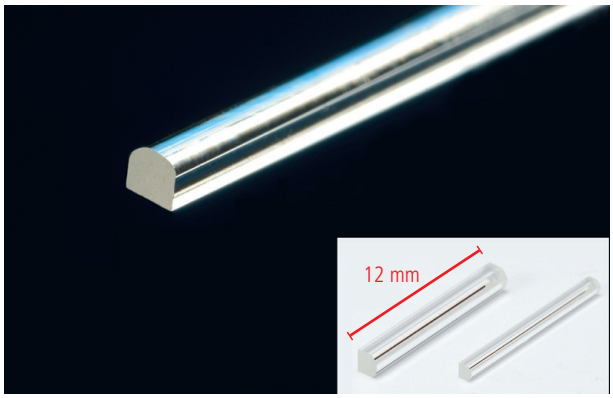
This lens efficiently utilizes dispersed light by collimating the light spreading from a semiconductor laser into a beam with a radiation angle of only a few millirads.

Features

- Aspherical micro-cylindrical lens
- Minimal variations in characteristics make it ideal for mass production
- Emission points aligned along B-B' axis without distortion (suppressed smile)
- No unwanted output in undesired directions (suppressed side lobes)

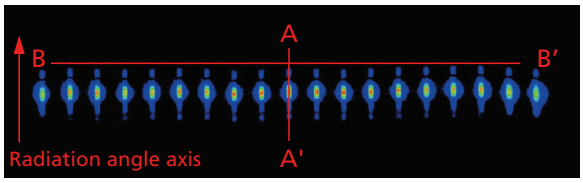
Applications

- Collimation of light spreading along FAST axis from semiconductor laser

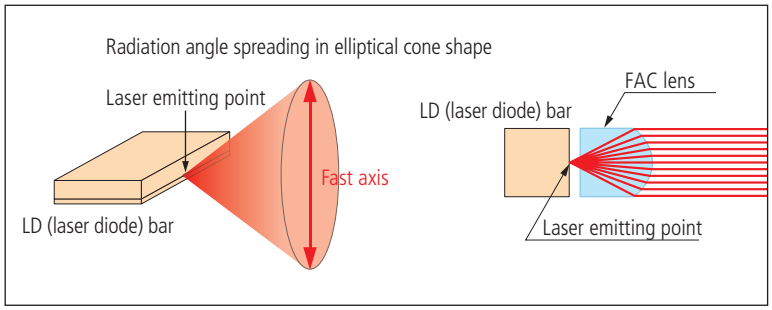


J10919

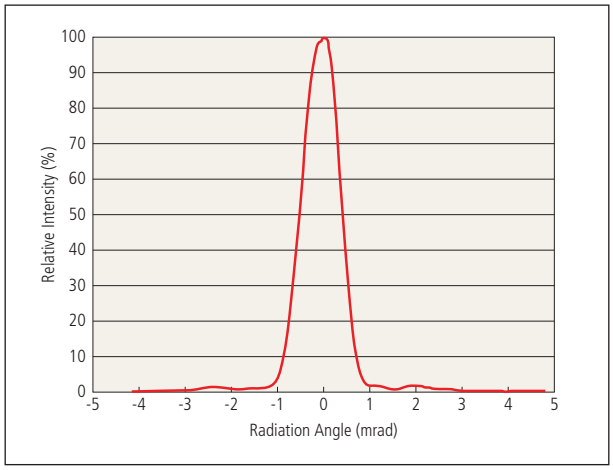
Output distribution image when installed to LD bar



Collimating light



A–A' profile

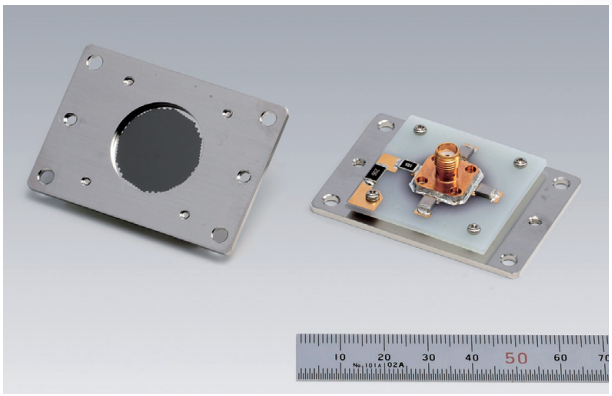


Compact MCP Assembly F12334-11

Compact and thin MCP assembly with easy maintenance

The F12334-11 is a compact MCP assembly usable in various applications ranging from general-purpose measurements to ion detection in TOF-MS (time-of-flight mass spectrometry).

Its thin and flat shape permits installation in cramped spaces typically found in most equipment designs. Maintenance and servicing of this MCP assembly are quite easy since there are only 2 wiring connections.



F12334-11

Features

- Easy maintenance since there are only 2 wiring connections
- Robust MCP
- Compact and thin
- Output terminal: SMA connector

Applications

- Ion detection (TOF-MS, etc.)
- Electron beam detection
- X-ray detection
- Vacuum UV light detection

Specifications

Parameter	Specification	Unit
Outer size (W x H x D)	38 x 54 x 15.1	mm
Effective area	φ20	mm
Gain (min.)*	1 x 10^6	-
Pulse width (FWHM)	1.5	ns

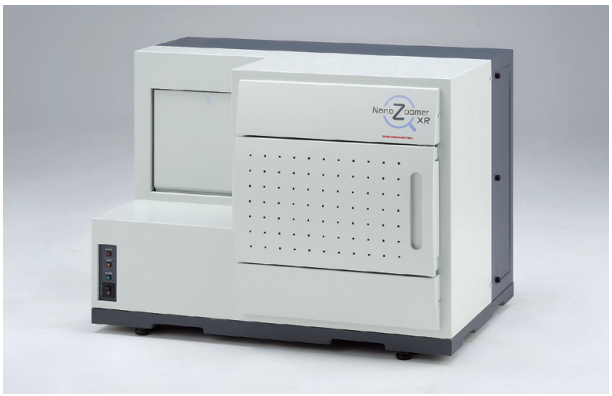
* at HV: -2.1 kV

NanoZoomer®-XR C12000

High-throughput and high-resolution digital slide scanner

The NanoZoomer series of slide scanning systems from Hamamatsu have been widely accepted as a very reliable way of transforming glass slides into digital slides of superb image fidelity.

The new NanoZoomer-XR has all the virtues of the existing NanoZoomer range of slide scanning systems augmented by newly developed features to significantly minimise the time required to process batches of slides.



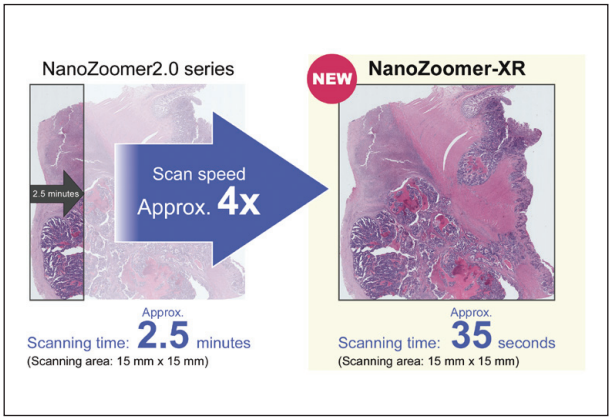
NanoZoomer-XR C12000

Features

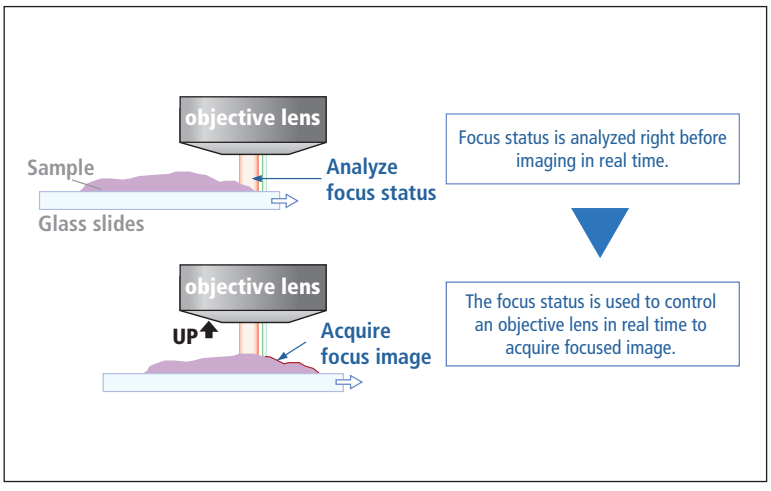
- Very high speed slide scanning for rapidly processing large volumes of slides
- 30 s at 20x magnification and 35 s at 40x magnification for 15 x 15 mm tissue section
- 320 slide loading system for automatically handling large batches of slides
- Dynamic pre-focusing (DPF) provides sharp focus on the entire specimen
- Automatic slide quality check - evaluates scanned digital slide and gene rates a focus score of its quality
- NDP.view2 - an advanced digital slide viewer for fast and easy viewing of digital slides

NanoZoomer is registered trademark of Hamamatsu Photonics K.K. in EU, Japan and USA.

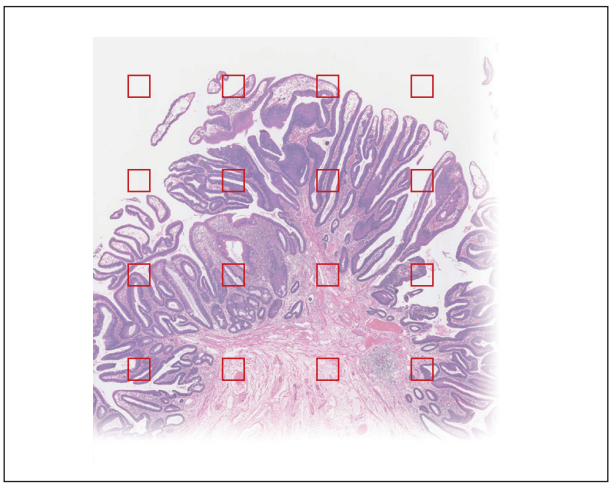
Scanning speed



Dynamic pre-focusing



Automatic focus scoring



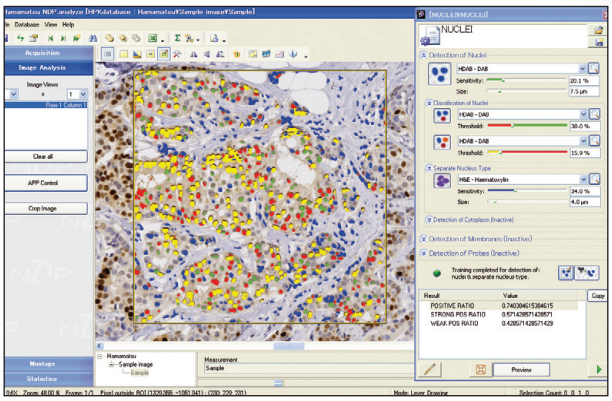
IHC Image Analysis Software NDP®.analyze U12356

Whole slide IHC image analysis software (Option for NanoZoomer)

The NDP.analyze is a research tool for extracting subcellular morphometric data from whole slide images. It is designed specifically for research pathologists, providing simple controls for identification, classification, and quantification of nuclei, membrane, and cytoplasm. It can work in true stain space (through color deconvolution).

Features

- Designed for research pathologists
- Easy to use and low-cost computation
- Immediate productivity



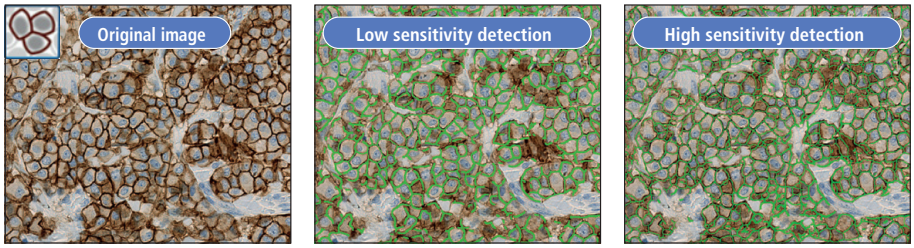
Interface NDP.analyze

Analysis

Membrane analysis

e.g., HER2, EGFR

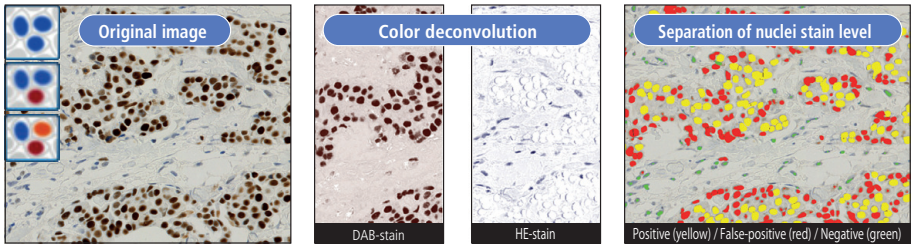
Sensitivity of membrane detection can be adjusted by the user with the slide bar, and the settings can be saved as a user protocol.



Nuclei analysis

e.g., ER, PgR, Ki-67

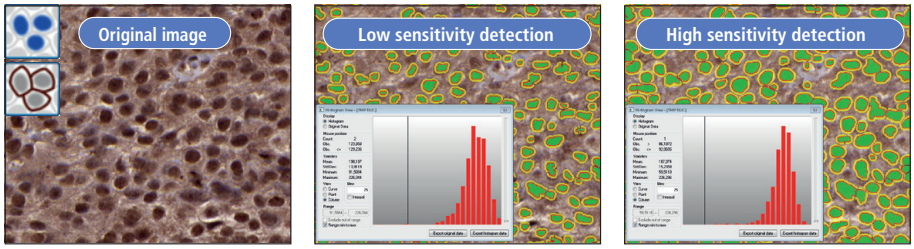
The NDP.analyze allows for differentiation of the nuclei based on positivity.



Cytoplasm

e.g., α-SMA

The intensities of IHC-staining for nuclear and cytoplasmic biomarkers can be characterized/ quantified and readily displayed graphically in a histogram.



Digital Camera ORCA®-Flash4.0 C11440-22CU

New connectivity through USB 3.0 interface allows you to get images simply to laptop computers

A game changer from inception and a proven performer since its release, the Hamamatsu ORCA-Flash4.0 just got better. Every ORCA-Flash4.0 includes ImageConductor connectivity™, so that it's enabled for both USB 3.0 (default) and high speed CameraLink. If your imaging tempo is 30 frames/s, then the default configuration with USB 3.0 is right for you.

If you need something a little more lively... presto, just add a CameraLink board now or later, to achieve 100 frames/s of full 4-megapixel images. Both options deliver the same low noise, high quantum efficiency imaging for unprecedented sensitivity. With Hamamatsu's versatile ImageConductor connectivity, you direct the show.

Features

- High resolution: 4.0 megapixels at 6.5 x 6.5 µm pixels
- Exceptional sensitivity: Over 70 % at 600 nm
- High-speed readout:
  - 100 frames/s at full resolution (Camera Link)
  - 30 frames/s at full resolution (USB 3.0)
- Low noise: 1.3 electrons (median) at 100 frames/s

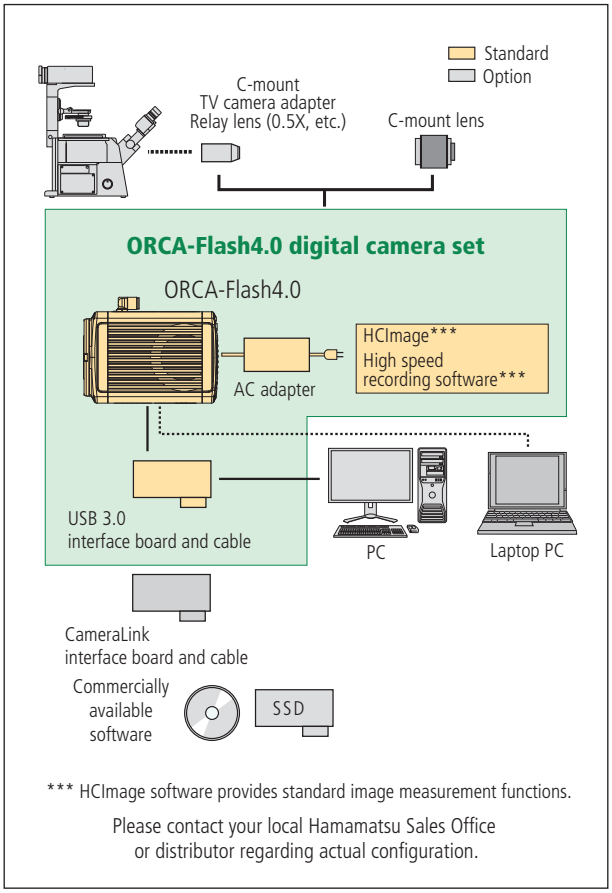
Applications

- Super-resolution imaging
- High-speed calcium ion imaging
- NIR semiconductor inspection

ORCA is registered trademark of Hamamatsu Photonics K. K. in France, Germany, Japan, UK and USA.

ORCA-Flash4.0 C11440-22CU

Configuration



*** HCImage software provides standard image measurement functions.

Please contact your local Hamamatsu Sales Office or distributor regarding actual configuration.

The new ORCA-Flash4.0 USB:

Outstanding performance today.
Upgradable for your needs tomorrow.

- 4.0 Mpixels
- USB 3.0
- 30 frames/s (at full resolution)

4.0 3.0 30

Compact NIR Photoluminescence Lifetime Spectrometer C12132

For measuring photoluminescence (PL) lifetime of PV materials

The compact NIR photoluminescence lifetime spectrometer C12132 series is designed for measuring photoluminescence (PL) spectrum and PL lifetime in the NIR region (580 nm to 1,400 nm). A YAG laser is also included in the main unit.

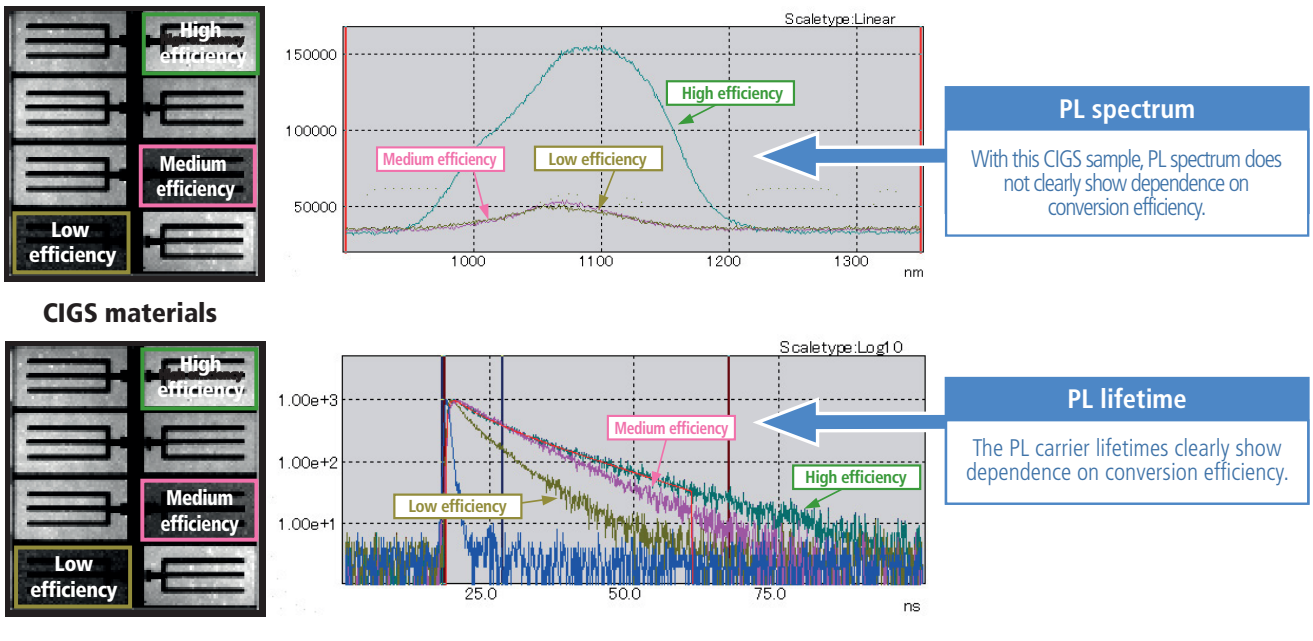
PL spectrum and PL lifetime of PV materials have a close relationship with the conversion efficiency. Accordingly the PL spectrum and the PL lifetime are both important parameters in the material development and its quality control.

Compact NIR Photoluminescence Lifetime Spectrometer C12132

Features

- PL lifetime measurement in 580 to 1,400 nm
- Measures PL spectrum as the standard function
- Measures PL lifetime down to 200 ps using deconvolution
- Multipoint measurement (Option)
- Low temperature measurement (Option)

Working example

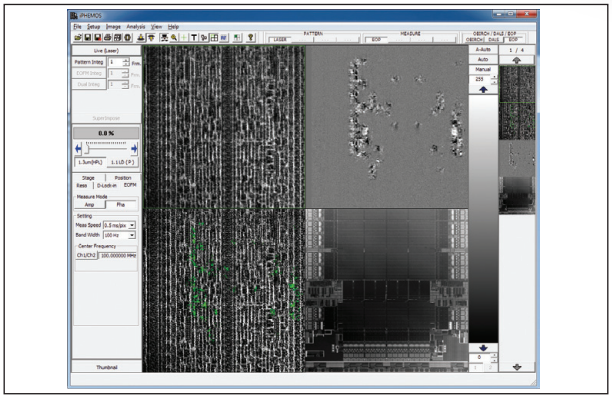


EO Probing Unit C12323

Monitoring status of a transistor – New option available for PHEMOS, THEMOS and µAMOS series

The EO Probing Unit is a tool to observe a transistor's status through the Si substrate using an incoherent light source. It is composed of the EOP (Electro Optical Probing) to measure operation voltage of a transistor rapidly, and the EOFM (Electro Optical Frequency Mapping) to image active transistors at a specific frequency.

With a NanoLens, high resolution and high sensitivity can be obtained.

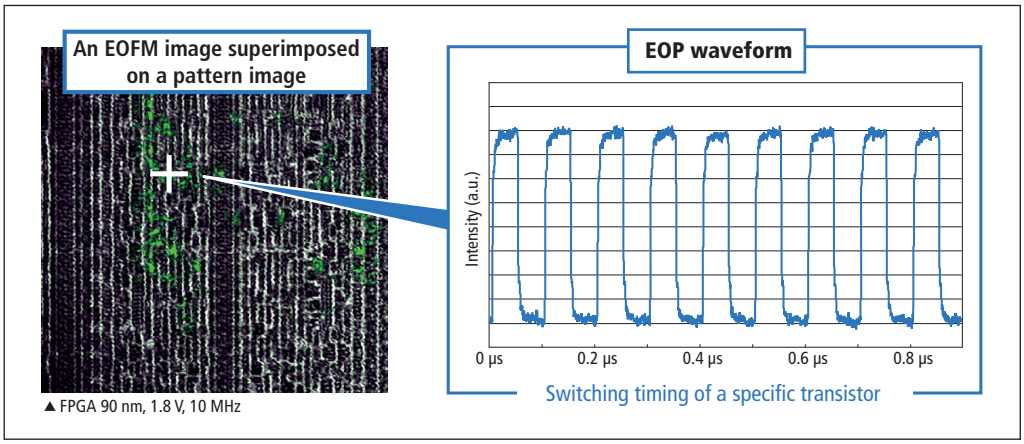


Interface EO Probing Unit

Features

- High quality pattern image with no interference fringe
- No sample damage by incoherent light source
- EOP waveform with high S/N ratio in 2 seconds
- Easy-to-use software identical to the PHEMOS, THEMOS, and µAMOS series interface

Working example



▲ FPGA 90 nm, 1.8 V, 10 MHz

Quantum Cascade Lasers
L12014, L12015, L12016

A new light source for mid-IR applications such as molecular gas analysis

Quantum cascade lasers are semiconductor lasers that offer peak emission in the mid-IR range (4 to 7 µm). They have gained considerable attention as a new light source for mid-IR applications such as molecular gas analysis.

Features

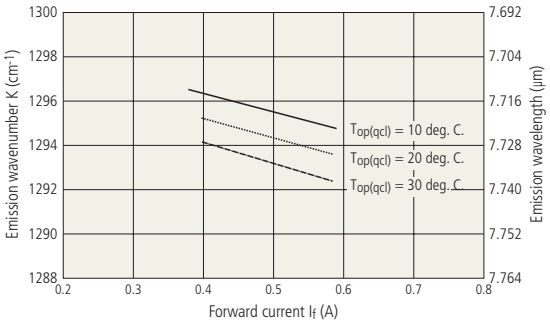
- Mid-IR laser (4 to 7 µm)
- Compact, lightweight

Applications

- Trace gas analysis:
  - Environmental measurement
  - Combustion gas measurement
  - Plasma measurement
  - In vivo gas analysis

L12014, L12015, L12016

Characteristics example L12007-1294H-C



Parameter	Symbol	Condition	Typical value
Temperature coefficient of wavenumber	δK_T	I_f fixed	-0.1 cm^{-1}/deg.C.
Current coefficient of wavenumber	δK_C	$T_{op(qcl)}$ fixed	-0.01 cm^{-1}/mA

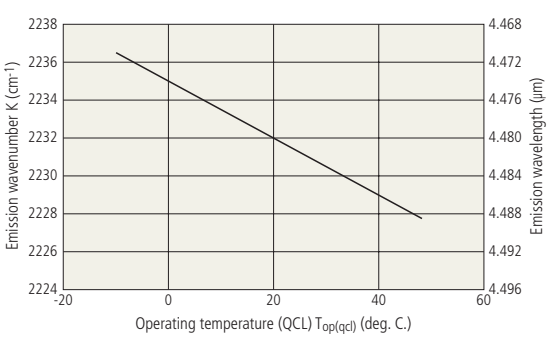
Lineup DFB-CW Type

Type No.	Wavelength	Wavenumber
L12004-2190H-C	4.57 µm	2,190 cm^{-1}
L12005-1900H-C	5.26 µm	1,900 cm^{-1}
L12006-1631H-C	6.13 µm	1,631 cm^{-1}
L12007-1294H-C	7.73 µm	1,294 cm^{-1}

Lineup DFB-Pulsed Type

Type No.	Wavelength	Wavenumber
L12014-2231T-C NEW	4.48 µm	2,231 cm^{-1}
L12015-1901T-C NEW	5.26 µm	1,901 cm^{-1}
L12016-1630T-C NEW	6.13 µm	1,630 cm^{-1}
L12017-1278T-C	7.82 µm	1,278 cm^{-1}

Characteristics example L12014-2231T-C



Parameter	Symbol	Condition	Typical value
Temperature coefficient of wavenumber	δK_T	I_{fp} fixed	-0.15 cm^{-1}/deg. C.

3 Stack Pulsed Laser Diode L11854-307-05

High power 905 nm pulsed laser diode with 3 stack emission layers in a single chip

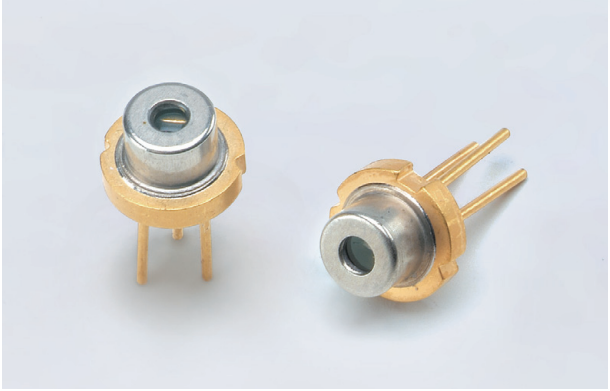
The L11854-307-05 is a small packaged, 905 nm, high power pulsed laser diode. The PLD chip has 3 stack layers which realize both high peak power and clear emission pattern, and it can help to improve measurement accuracy for applications such as laser range finder.

Features

- Radiant peak output power: ≥ 21 W
- Peak emission wavelength: 905 nm
- Emitting area size: 70 × 10 µm

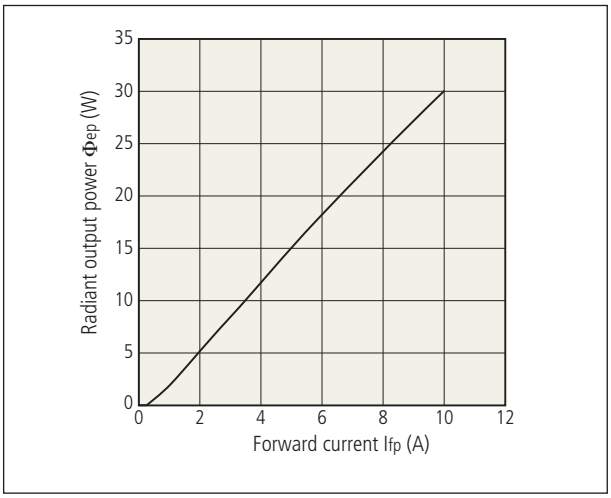
Applications

- Laser range finder
- Security
- Measuring instruments

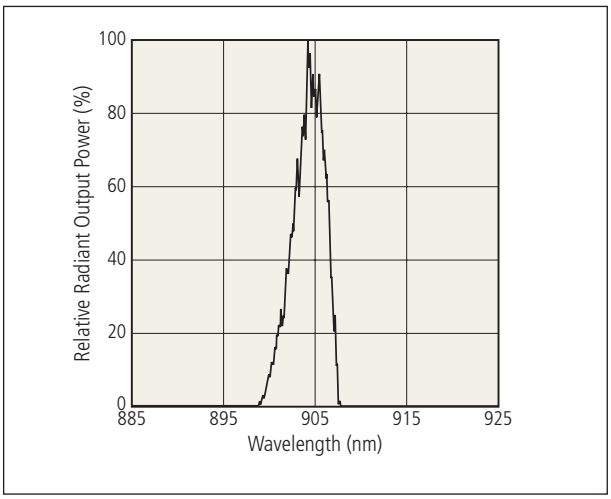


L11854-307-05

Radiant output power vs. Forward current (typ.) (Typ. Ta=25 deg. C.)



Emission spectrum (typ.) (I_{fp} = 7 A, Typ. Ta=25 deg. C.)



Global Exhibitions 2013

USA

January 2013

SLAS
Jan 12-16 2013, Orlando, FL, USA

February 2013

Biophysical Society Meeting
Feb 2-6 2013, Philadelphia, PA, USA

BIOS
Feb 2-3 2013, San Francisco, CA, USA

Photonics West
Feb 5-7 2013, San Francisco, CA, USA

MDM West
Feb 12-14 2013, Anaheim, CA, USA

APEX
Feb 19-21 2013, San Diego, CA, USA

March 2013

Pittcon
March 17-20 2013, Philadelphia, PA, USA

May 2013

Defense, Security and Sensing
May 7-9 2013, Baltimore, MD, USA

CYTO
May 19-23 2013, San Diego, CA, USA

June 2013

ASMS
June 9-13 2013, Minneapolis, MN, USA

MDM East
June 18-20 2013, Philadelphia, PA, USA

July 2013

AACC
July 30-Aug 1 2013, Houston, TX, USA

September 2013

WMIC
Sept 18-21 2013, Savannah, GA, USA

October 2013

MDM Minneapolis
Oct 30-31 2013, Minneapolis, MN, USA

November 2013

ISTFA
Nov 5-6 2013, San Jose, CA, USA

Neuroscience
Nov 9-13 2013, San Diego, CA, USA

December 2013

RSNA
Dec 1-5 2013, Chicago, IL, USA

MRS
Dec 3-5 2013, Boston, MA, USA

Cell Biology
Dec 14-18 2013, New Orleans, LA, USA

EUROPE

January 2013

Elektronik
Jan 22-23 2013, Gothenburg, Sweden

February 2013

13th Vienna Conference on Instrumentation
Feb 11-13 2013, Vienna, Austria

March 2013

ECR
March 7-11 2013, Vienna, Austria

XV Neutrino Telescopes Workshop
March 12-15 2013, Venezia, Italy

Photonics
March 25-27 2013, Moscow, Russia

April 2013

IOP Nuclear Physics Conference
April 8-10 2013, York, England

International MOST Conference & Exhibition
April 23 2013, Esslingen, Germany

May 2013

Laser World of Photonics
May 13-16 2013, Munich, Germany

Sensor & Test
May 14-16 2013, Nuremberg, Germany

June 2013

Forum LABO
June 4-7 2013, Paris, France

24th Annual Meeting of the European Society of Paediatric and Neonatal Intensive Care (ESPNIC)
June 12-15 2013, Rotterdam, Netherlands

September 2013

Vision
Sept 24-26 2013, Stuttgart, Germany

MipTec
Sept 24-27 2013, Basel, Switzerland

October 2013

54th Annual Meeting of the European Society for Paediatric Research
Oct 11-14 2013, Porto, Portugal

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