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NEWS 2020 02

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New Inspection Unit Optically Detects Tiny Pinhole Defects as Small as 1 µm Diameter in Plate/Sheet Workpieces

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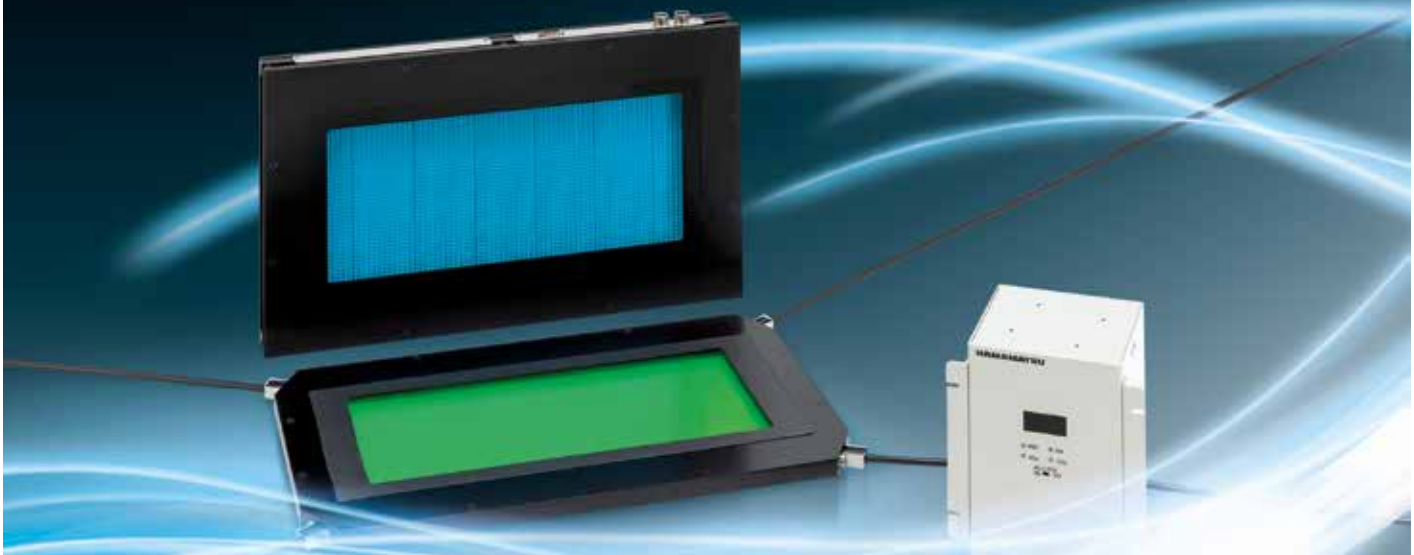
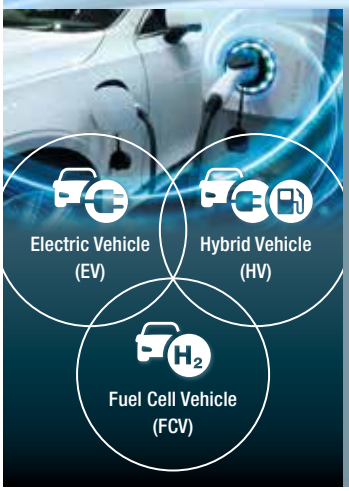
Optical Pinhole Inspection Unit C15477

Quickly Finds Tiny Pinholes, Even as Small as 1 µm in Diameter, by Applying Low-light Detection Technology! Reduces the Takt Time (Production) for Manufacturing In-vehicle Batteries.





Technical designs and innovations aimed at reducing environmental impact are appearing at a rapid pace. Typical examples of these innovations are next-generation vehicles such as EV, HV and FCA. Such technological innovations continue to achieve higher performance, lower cost and more efficient mass production. It is therefore essential to deliver high-accuracy and high-speed quality control in the manufacture of batteries and power supplies as they are core parts in next-generation vehicles. Our advanced photonics technology for the detection of low-light levels, will give the vital support needed in the manufacturing process.

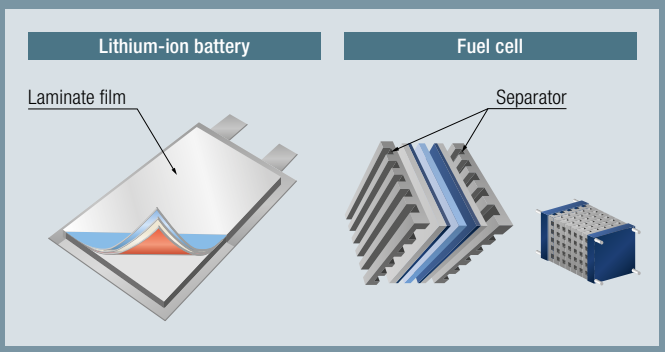
Optical pinhole inspection unit gives the support you need for producing core parts in this new age of EV and FCV.

Lithium-ion batteries offer large power capacity in a compact, light-weight unit and they can be recharged multiple times. These features have led to their widespread use in a variety of mobile devices. Although they are widely used, they still require extremely sophisticated manufacturing technology. This is especially true in the "cell" section that stores energy. The cell contains a flammable electrolyte that easily reacts with oxygen, making hermetic sealing essential to prevent even just gas vapors from leaking out. To ensure the sealing is complete, lithium-ion batteries and other fuel cells with similar structures must undergo 100 % inspection. This factor significantly increases production costs compared to conventional rechargeable batteries such as nickel and cadmium.

Our "optical pinhole inspection unit" is a powerful tool for solving this production cost issue. It finds pinhole defects by detecting light coming through the pinholes as electrical signals using a high-sensitivity photodetector, namely a "photomultiplier tube".

Compared to conventional methods used to identify pinholes such as a camera, our optical pinhole inspection unit offers high-speed and high-accuracy pinhole inspection. In the field of in-vehicle battery manufacturing, there is an increasing need for detecting even tinier pinhole defects, in larger and wider area workpieces. To meet these needs, our new optical pinhole inspection unit type "C15477" delivers higher sensitivity, and can inspect larger-size workpieces.

Inspection object examples



Use of a wide effective area photomultiplier tube, together with new signal processing technology, delivers high-speed detection of pinhole defects as tiny as 1 µm in diameter!

The C15477 is specifically designed for more advanced signal processing applications. It offers all the best features of our optical pinhole inspection unit, such as high accuracy, high-speed response and error monitoring function. These features, together with a wide effective area photomultiplier tube and new signal processing technology has allowed us to shrink the pinhole defect detection limit to 1 µm (one 1000th of a millimeter) in diameter. This means it can detect light from pinholes that are only one-fourth the size of pinholes detectable up to now. The C15477 is also designed to inspect large workpieces with just a single C15477 unit, therefore drastically cutting production takt time.

	 HAMAMATSU optical pinhole inspection units	 Visual inspection	 Camera inspection
Detection capability	★★★★ High detection capability	★	★★★
Type of workpiece for inspection	★★★ Accommodates a wide range of workpieces	★	★★★
Production line speed	★★★★ Accommodates high-speed conveyors	★	★★
Size of workpiece for inspection	★★★ Accommodates a wide range of sizes	★★★	★★
Initial cost	★★ Initial cost required for installing inspection unit	★★★	★
Running cost	★★★ Only power costs are required	★	★★
Position and size judgment	★ Basically impossible	★★	★★★★

Main features

Detects pinholes down to 1 µm in diameter with high accuracy!

A light source unit periodically irradiates pulsed light onto the workpiece. Light passing through pinhole defects are detected as electrical signals. These are separated from the constant ongoing signal (noise signal) by the use of a lock-in amplifier to enhance detection accuracy. This allows accurate detection of pinhole defects as tiny as 1 µm in diameter. Therefore, the C15477 can find light leaks, even from pinholes that are only one-fourth the area of pinholes detectable up to now.

Supports large workpieces up to 480 mm × 180 mm

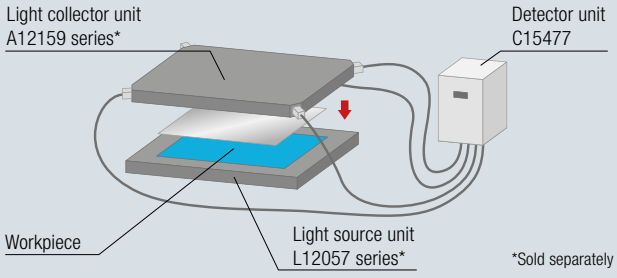
The light source unit and light collector unit are designed to process large workpieces up to 480 mm width by 180 mm depth. We also welcome requests for custom shapes and sizes.

Easier to use

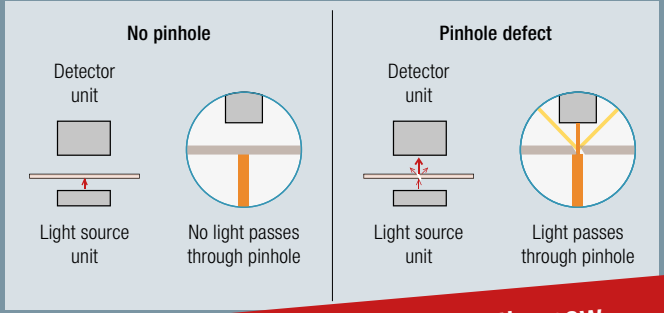
The amount of detectable light varies depending on the pinhole location. To minimize this variation, light passing through the pinhole is extracted from the four corners of the light collector unit. In our conventional products, four inspection units are required to detect each light signal. However, the C15477 uses a large-area photomultiplier tube that detects all light signals with just a single inspection unit. This enables easy and efficient pinhole inspections, while drastically reducing the installation space and cost.

A workpiece is sandwiched between the light source unit and light collector unit. Light passing through a pinhole defect is detected as an electrical signal. Unlike inspection methods using gases or fluids, this optical method applies no actual physical pressure to the workpiece during inspection.

Optical pinhole inspection setup



Principle of optical pinhole inspection



See page 19 to find out more about the new optical pinhole inspection unit C15477.

Our optical pinhole inspection units contribute to various industries and fields by utilizing features including high accuracy, high speed and no actual physical contact.

In addition to the inspection of materials in lithium-ion batteries and fuel cells, our optical pinhole inspection units are used in a broad spectrum of fields. They support a wide range of materials including metal and non-metal, transparent and non-transparent, thin and thick film. Our line-up, including custom products, will expand optical pinhole inspection applications further to include materials and parts for cans and molded packaging products. These advances in inspection technology will boost product quality to even higher levels.

Parts and material examples

Metal materials
Ex. Stainless steels, titanium, aluminium

Paper and nonwoven fabric
Ex. Paper, milk cartons, masks, fabric

Semi-transparent materials
Ex. Polyethylene, ceramic, teflon

Can and molded product examples

Beverage can and food cans

Aluminum battery pack

Aluminum blister pack

FTIR Engine C15511-01

Enables Infrared Spectroscopic Analysis on the Spot. Palm Size Fourier Transform Spectrometer.

Molecules each have unique vibrations, thereby absorbing infrared light of a specific wavelength. Infrared spectroscopic analysis, which utilizes this characteristic to analyze the components contained in substances, is used in a variety of fields from scientific research to industry. FTIR, which uses infrared spectroscopic analysis, is normally the stationary type, which requires analysis to be done by bringing samples to a laboratory or specialized institution. For this reason, Hamamatsu Photonics has developed "C15511-01", a palm-sized FTIR engine that supports near infrared light with a wavelength from 1.1 µm to 2.5 µm.

Its compact size means it can be incorporated into portable analytical instruments, enabling real-time infrared spectroscopic analysis at the location of the measurement subject.

Compactness and high accuracy achieved with MEMS technology

The "FTIR engine C15511-01" is a compact Fourier transform infrared spectroscopic module with high sensitivity to near infrared light in the range of 1.1 µm to 2.5 µm. A Michelson optical interferometer and control circuit are integrated into a palm-sized housing.

Generally FTIR features high resolution and high-speed measurement. We have made our FTIR engine more compact while retaining the features of the Fourier transform type by applying our unique MEMS technology and mounting technology to the optical interferometer.

Features

Detection performance comparable to previous stationary type devices

To eliminate the decrease in incident light level caused by miniaturization, we used our unique MEMS technology to develop a movable mirror with a diameter of 3 mm that composes the MEMS actuator, then improved it so that the reflected light can be used efficiently.

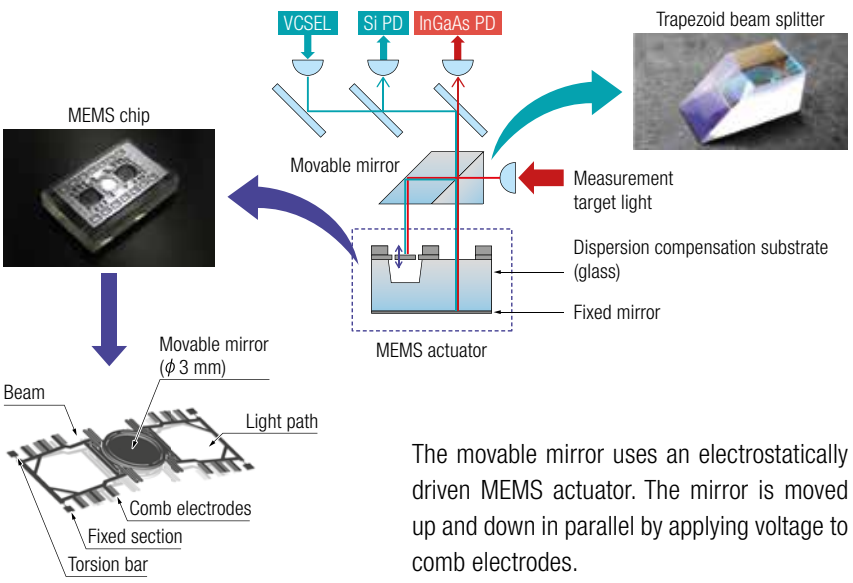
Using our mounting technology cultivated over many years, we have integrated the movable mirror and the fixed mirror as a MEMS chip, thereby making it compact and reducing error in the relative angle between the mirrors to about 1/100.

By optimizing the structure and drive method of the MEMS actuator and eliminating shaking when in operation, we have suppressed the spread of infrared light inside the optical interferometer and reduced loss. By doing this, we have achieved detection performance comparable to previous stationary type devices.

High wavelength reproducibility

Optical interference occurs when the light being measured (incident light) is split by a beam splitter, reflected by a movable mirror and a fixed mirror, and combined again. Interference light intensity, which changes depending on the position of the movable mirror, is detected by a photodetector (InGaAs PIN photodiode), then the signal is subjected to arithmetic processing (Fourier transform) to obtain an optical spectrum. By measuring the position of the movable mirror in the interferometer using a photodetector (Si PIN photodiode) and semiconductor laser (VCSEL), it is possible to obtain a optical spectrum with high wavelength reproducibility.

Optical system of FTIR engine



The movable mirror uses an electrostatically driven MEMS actuator. The mirror is moved up and down in parallel by applying voltage to comb electrodes.

Measurement examples

Using FTIR engine

In the near infrared region of 1.1 µm to 2.5 µm, many substances have unique absorption spectra, and these are applied to infrared spectroscopic analysis in various fields. There are two measurement methods for infrared spectroscopic analysis using FTIR engines:

1. Reflection measurement
2. Transmission measurement

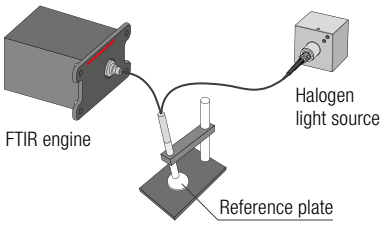
Using these measurement methods, we measured the spectra of sugar (glucose, sucrose) and alcoholic beverages (beer, sake, brandy).

Get more information about the FTIR Engine C15511-01 on www.hamamatsu.com

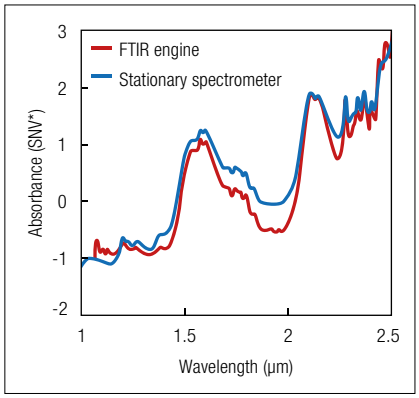
1. Reflection measurement

Absorbance comparison of sugar

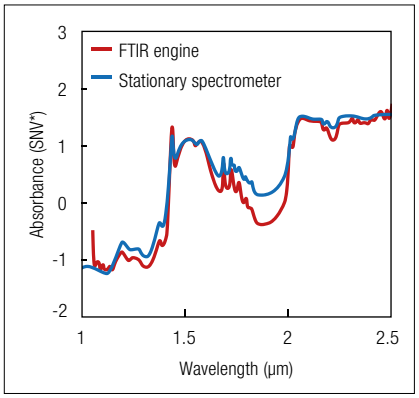
Comparing the reflection measurement results of sugar powder samples (glucose, sucrose) from the FTIR engine and from the stationary spectrometer, we found it was possible to accurately measure even minute peak patterns with the FTIR engine, similar to spectra obtained with the stationary spectrometer.



Glucose



Sucrose



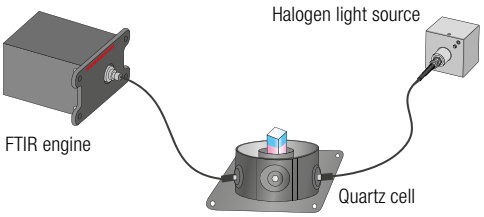
* SNV (Standard Normal Variate)

2. Transmittance measurement

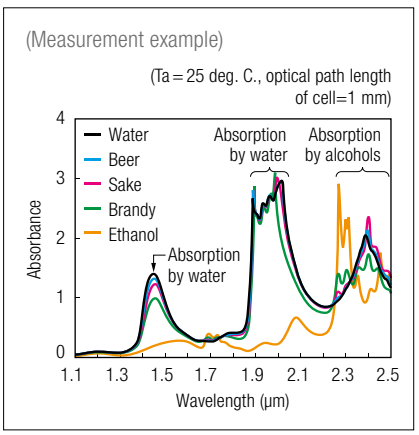
Comparison of absorbance of alcoholic beverages and estimation of alcohol concentration

In the near infrared region of 1.1 µm to 2.5 µm, there is absorption by the OH group of water (1.45 µm band, 1.9 µm band) and absorption by the CH group of alcoholic beverages (2.1 µm to 2.5 µm).

With transmission measurement results, we were able to obtain characteristic spectra in the absorption bands of water and alcoholic beverages. In addition, with the results of estimating the alcohol concentration from absorbance in the 2.3 µm band, we confirmed that the estimated values and numerical values of components contained in the beverage matched, and that high accuracy measurement is possible with the stationary spectrometer.

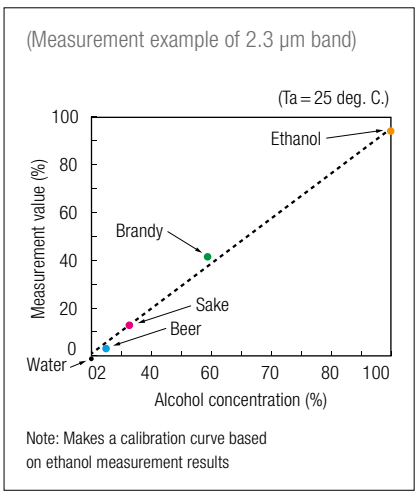


Absorption spectra of alcohols



Measurement: Hamamatsu Central Research Laboratory

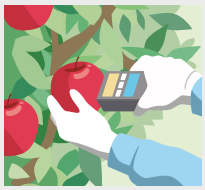
Alcohols concentration



Note: Makes a calibration curve based on ethanol measurement results

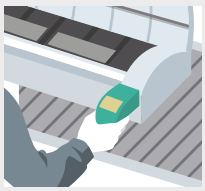
FTIR engines that greatly expand the potential of spectroscopic analysis

We expect to find many applications for FTIR engines in a wide range of situations where it was difficult to make measurements in a timely manner, including pre-harvest inspection of agricultural products, soil analysis, and plastic sorting, etc. Hamamatsu Photonics will further expand the potential of infrared spectroscopic analysis through this product.



Pre-harvest inspection of agricultual products

Soil analysis



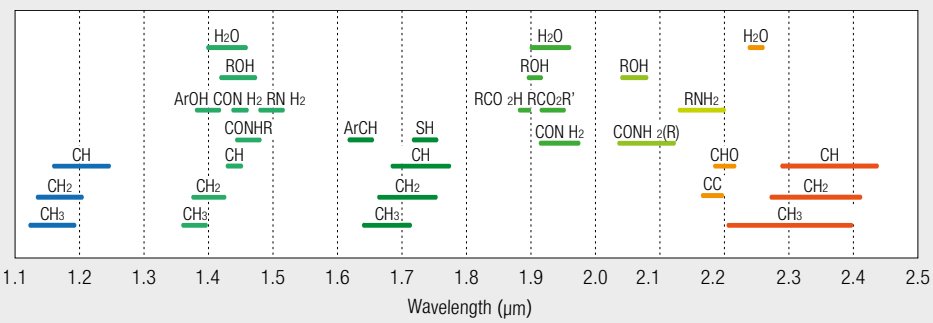
Plastic sorting

Material acceptance inspection

Applications

- Process analysis
- Material inspection
- Farm production inspection
- Plastic screening
- Concrete strength measurement
- Film thickness measurement
- Medical and healthcare equipment

Absorption wavelength range of substances



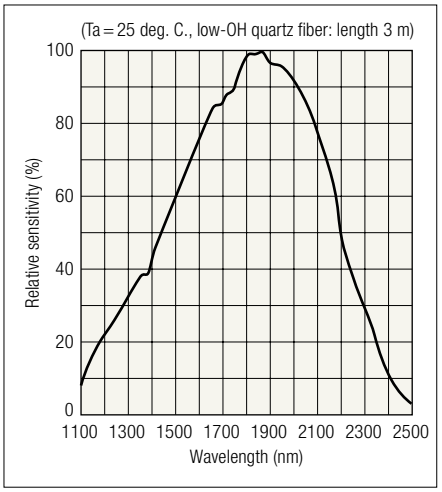
FTIR Engine C15511-01

Specifications

Parameter	Specification	Unit
Optical interferometer	Michelson interferometer (with a built-in ϕ3 mm movable mirror)	–
Photodetector	InGaAs PIN photodiode	–
Light input method	Optical fiber input type*1 (with SMA connector)	–
Interface	USB 2.0	–
Dimensions (W × D × H)	57 × 76 × 49 (excluding protrusions)	mm
Spectral response range	1100 to 2500	nm
Spectral resolution (FWHM)*2	5.7	nm
Wavelength reproducibility	±0.5	nm
Wavelength temperature dependence	±0.06	nm/deg. C.
Signal-to-noise-ratio*3, 4	1000 min.	–

*1 Optical fiber A15363-01 (core diameter = ϕ600 µm, NA = 0.22)
*2 Equivalent to 25 cm^{-1}
*3 Ratio of the peak value of the spectrum data when light is incident to the root mean square (rms) of noise in the dark state
*4 Incident light level = 40000 counts p-p min., integration count = 512, gain setting = 1 to 4

Spectral response (typical example)



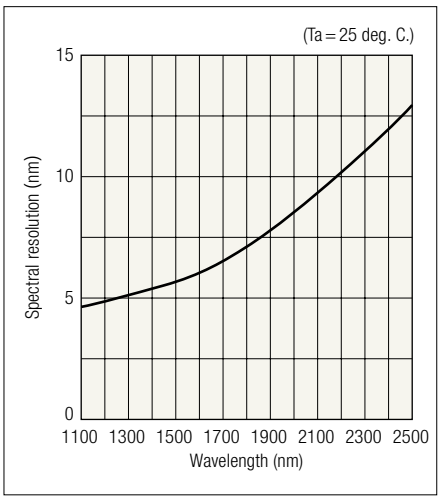
Compact Near-infrared Spectroscopy Module Which Can be Installed in Portable Analysis Instruments

The C15511-01 is a compact fourier transform infrared spectrometer (FTIR) engine that integrates a Michelson optical interferometer and control circuit into a palm-sized enclosure. Spectrum and absorbance can be measured by connecting a PC via USB. It can be applied to real-time measurement performed on site without bringing the measurement sample into the analysis room. In addition, it can also be used for continuous monitoring.

Features

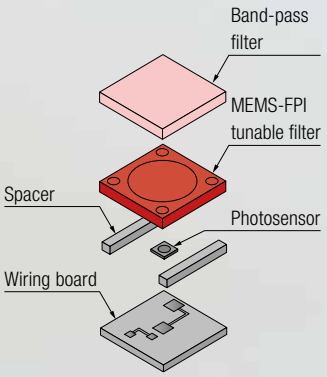
- Compact: palm size
- Optical fiber input type
- High Signal-to-Noise making it suitable for diffuse reflection, and absorbance measurements

Spectral resolution vs. wavelength (typical ex.)



Spectroscopic Module C15712, C15713, C15714

Internal structure of MEMS-FPI spectrum sensor

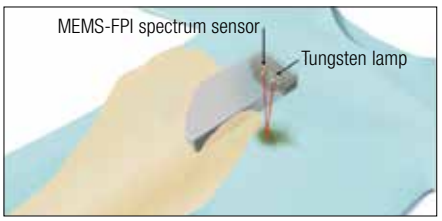


Specifications

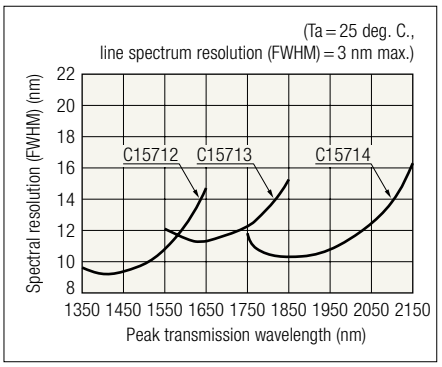
Parameter	C15712	C15713	C15714	Unit
Sensor	MEMS-FPI spectrum sensor			–
	C14272	C13272-03	C14273	
Spectral response range	1350 to 1650	1550 to 1850	1750 to 2150	nm
Spectral resolution (FWHM)*1 max.	18	20	22	nm
Wavelength reproducibility*2	±2			nm
Wavelength temperature dependence*3	±0.1			nm/deg. C.

*1 When light with a line spectrum resolution (FWHM) of 3 nm max. is incident using an optical fiber (core diameter= ϕ600 µm, NA = 0.22) and fiber adapter A15719
*2 Measured under constant light input and use conditions
*3 Topr = -5 to +50 deg. C.
C15712: λ = 1500 nm, C15713: λ = 1700 nm, C15714: λ = 1950 nm

Application example (fiber/dirt component analysis)



Spectral resolution vs. peak transmission wavelength (typical example)



Compact Spectroscopic Module with MEMS-FPI Spectrum Sensor and Light Source

This compact module has a built-in light source, control circuit, and MEMS-FPI spectrum sensor consisting of an InGaAs PIN photodiode and MEMS-FPI (Fabry-Perot Interferometer) tunable filter which can vary its transmission wavelength by changing the applied voltage. Spectrum and absorbance can be measured by connecting a PC via USB.

Features

- Compact and thin: 32 (W) × 74 (D) × 16 (H) mm
- MEMS-FPI spectrum sensor and light source are installed
- External power supply not necessary: USB 2.0 bus powered
- Transmission wavelength shift due to the ambient temperature change is corrected
- High speed measurement

Applications

- Moisture detection
- Food inspection
- Farm product inspection
- Plastic screening
- Fiber identification, etc.

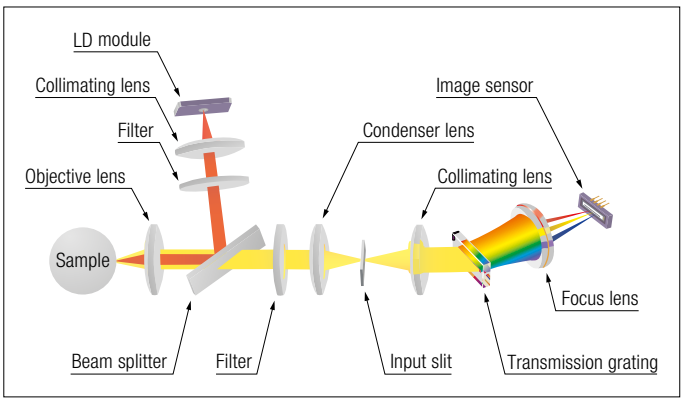
Spectroscopic Module C15471

Specifications

Parameter	C13560	NEW C15471	Unit
Laser output max.	15	50	mW
Spectral range	400 to 1850	200 to 2500	cm^{-1}
Spectral resolution	10		cm^{-1}
Dimensions (W × D × H)*	80 × 60 × 12.5	130 × 60 × 20	mm
Interface	USB 2.0		–

* Excluding a SERS substrate holder

Optical component layout



Raman Spectroscopy Module Capable of Photometry in a Wide Spectral Range

This module detects weak Raman scattered light. It uses a mini-spectrometer equipped with a high sensitivity CMOS image sensor as the base, consists of a 785 nm semiconductor laser suitable for generation of Raman scattered light, a filter and beam splitter for separating laser light and Raman scattered light, a driver circuit, and a signal processing circuit.

Differences from the previous product

It features a temperature compensation function to stabilize the laser while maintaining the palm size of the conventional product C13560. Stable Raman measurement is possible with fewer calibrations in an outdoor environment where the ambient temperature changes significantly.

Features

- Built-in laser, spectrometer and driver circuit
- Compact and lightweight

Applications

- Environment
  (water quality inspection, agricultural and toxic substance inspection)
- Safety control
  (foreign matter checking in foods and medicine)

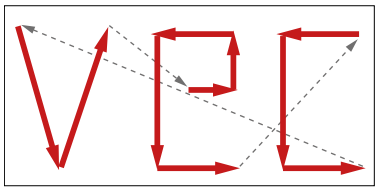
MEMS Mirror S13124-01

MEMS mirror lineup

Parameter	S12237-03P	S13989-01H	NEW S13124-01
Appearance			
Type	For 1D scanning	For 2D scanning	For 2D scanning
Scanning mode	1-axis linear scan	2-axis raster scan	2-axis linear scan
Mirror size (material)	ϕ2.6 mm (aluminum)	ϕ1.23 mm (aluminum)	ϕ1.95 mm (aluminum)
Optical deflection angle	±15°	Fast axis: ±20° Slow axis: ±12°	Fast axis; ±10° Slow axis: ±10°
Drive frequency	100 Hz max.	Fast axis: 29.3 kHz typ. Slow axis: 100 Hz max.	Fast axis: 90 Hz max. Slow axis: 90 Hz max.
Recommended operating temperature	-20 to +70 deg. C.	-20 to + 60 deg. C.	-20 to +70 deg. C.

Vector scanning

Images can be drawn with one stroke of laser scanning. (See the below for example).



Compact, High Performance, and Linear Mode Electromagnetically Driven Two-dimensional Laser Scanning MEMS Mirror

An electromagnetically driven mirror that incorporates our unique MEMS technology. The device was made smaller by arranging the magnet beneath the mirror and achieves two-dimensional scanning in linear mode. Electrical current flowing in the coil surrounding the mirror produces a Lorentz force based on Fleming's rule that drives the mirror. Hamamatsu MEMS mirrors offer a wide optical deflection angle and high mirror reflectivity.

Differences from the previous product

With drive current, the optical deflection angle of the mirror can be accurately controlled two-dimensionally in linear mode.

Features

- Two-dimensional scanning in linear mode: Capable of vector scanning and step operation
- Compact, low voltage operation: Suitable for installation into devices
- Equipped with window material: Prevents foreign matter contamination
- Evaluation circuit is available: C15087 (sold separately)

Applications

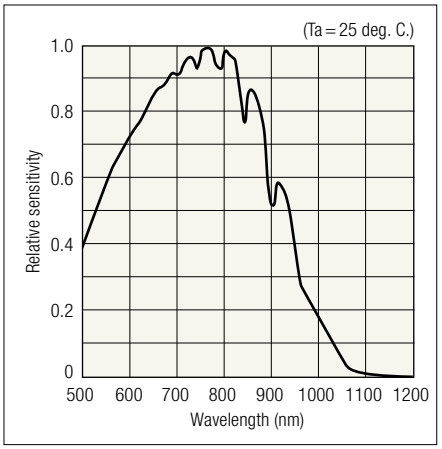
- Machine vision
- Laser measurement
- Laser material processing
- Various laser scanning unit

Distance Image Sensors S15452-01WT, S15453-01WT, S15454-01WT

Specifications

Parameter	S15452-01WT	S15453-01WT	S15454-01WT	Unit
Type	Linear		Area	–
Number of effective pixels	64	256	96 × 72	Pixels
Pixel size (H × V)	20 × 50		50 × 50	µm
Pixel pitch	20		50	µm

Spectral response



High Near Infrared Sensitivity Measures the Distance to an Object by TOF Method

These sensors measure the distance to an object by TOF (time-of- flight) method. When used in combination with a pulse modulated light source, these sensors output phase difference information on the timing that light is emitted and received. Distance data can be obtained by performing calculations on the output signal with an external signal processing circuit or on a PC.

Differences from the previous product

By using a backside-illuminated structure, higher sensitivity is achieved in the near infrared region than previous products (S11961-01CR, S11962-01CR, S11963-01CR, S12973-01CT).

Features

- High sensitivity in the near IR region
- Improved tolerance to background light
- Small WLP* type

Applications

- Obstacle detection
- Security
- Shape recognition
- Motion capture
- Touchless interface

* Wafer level package

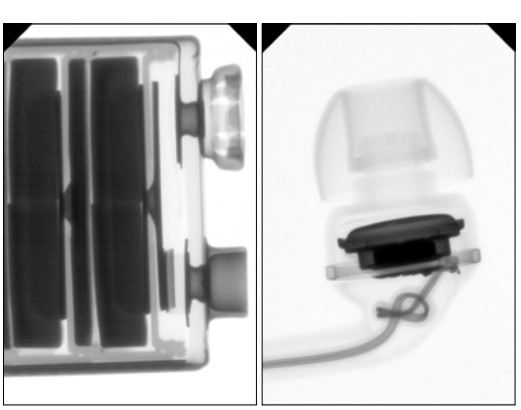
NEW OPTO-SEMICONDUCTOR PRODUCTS

CMOS Area Image Sensor S15683-12

Specifications

Parameter	Specification	Unit
Photosensitive area (H × V)	26 × 34	mm
Pixel size (H × V)	20 × 20	µm
Number of effective pixels (H × V)	1300 × 1700	Pixels
Radiation tolerance (60 kV)	1,000,000	Gy
X-ray tube voltage	20 to 90	kV

Imaging example



X-ray Non-destructive Inspection Sensor Connecting to PC via USB

This product has an APS (active pixel sensor) type CMOS area image sensor and USB interface, built in to a compact housing. The fiber optic plate (FOP) covering the image sensor provides 1 million Gy of radiation resistance, in order to protect the image sensor from X-rays.

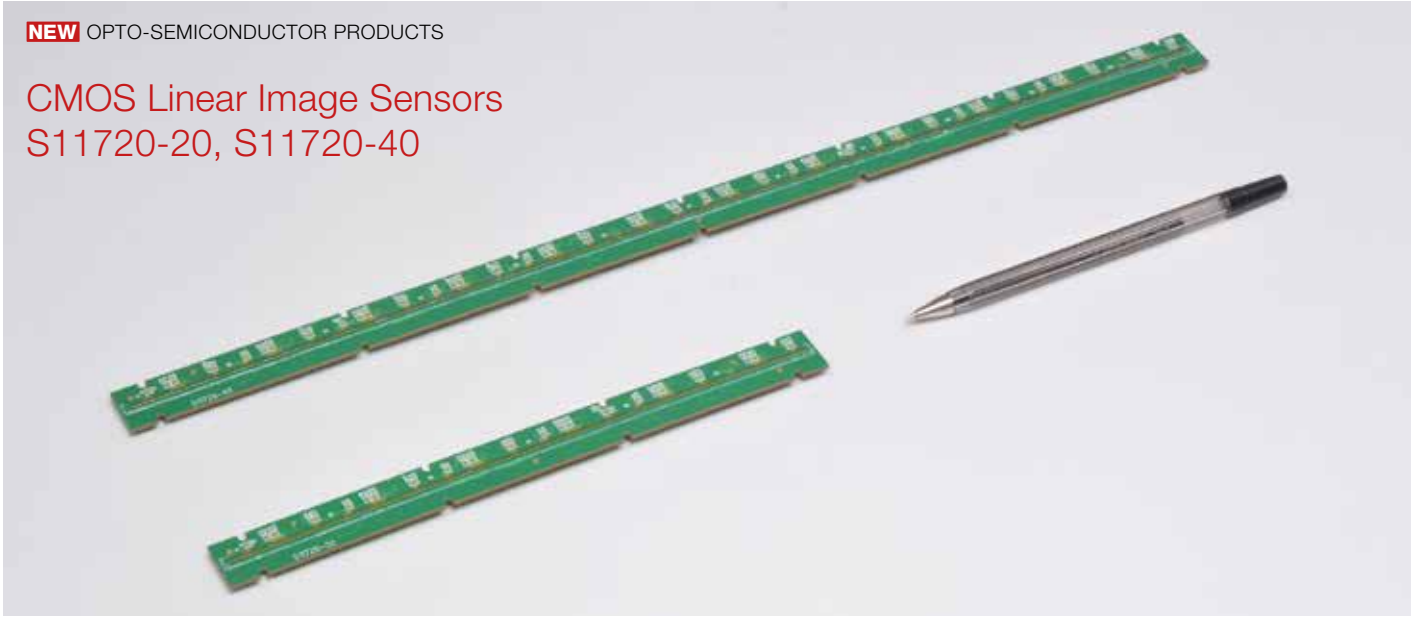
Features

- High resolution
- Compact
- Low cost
- USB interface

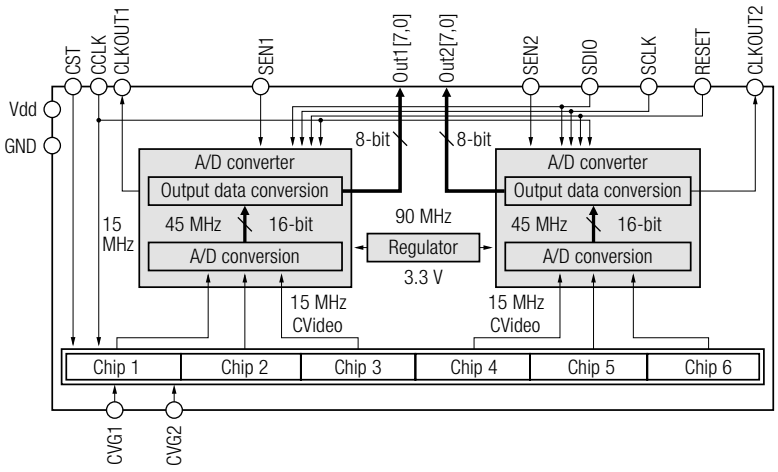
Applications

- Non-destructive inspection (Electronic parts, metal welds, etc.)
- X-ray focal point observation

CMOS Linear Image Sensors
S11720-20, S11720-40



Block diagram S11720-20



Long Photosensitive Area Image Sensors with CMOS Chips Arranged in a Single Row

CMOS linear image sensors developed for close contact optical systems. These long photosensitive area image sensors with CMOS chips arranged in a row, enable high sensitivity and high-speed readout in a wide range.

Features

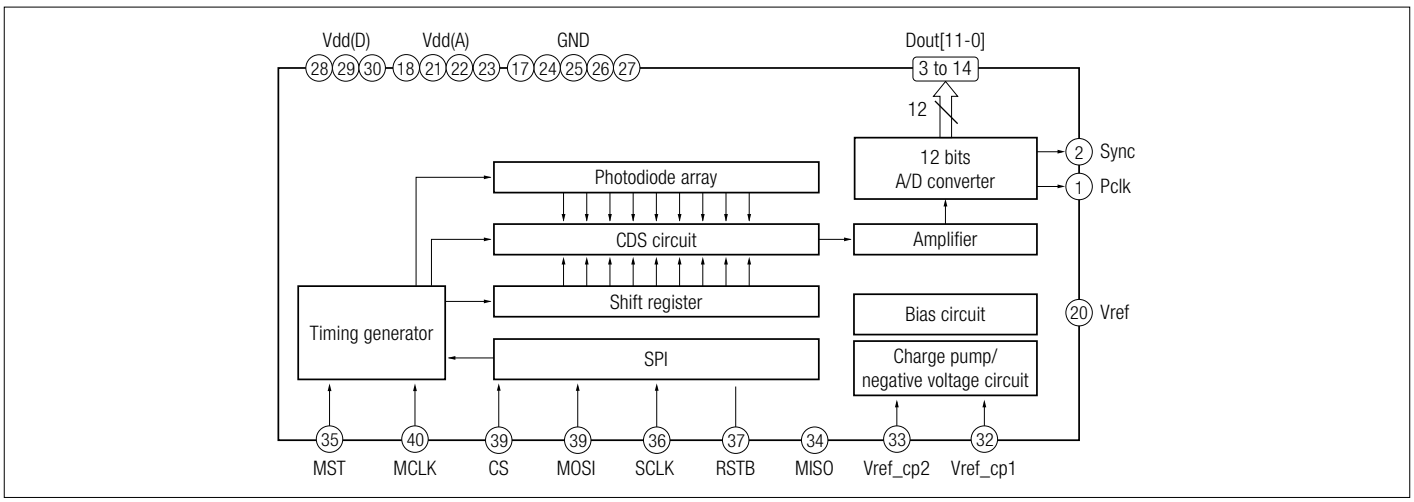
- Effective photosensitive area length:
  194.97 mm (1536 pixels): S11720-20
  390.04 mm (3072 pixels): S11720-40
- Pixel size: 127 × 127 µm (200 dpi)
- High-sensitivity: 40800 V/lx·s (gain = 8)
- High-speed readout: 45.4 klines/s
- SPI communication function
- Built-in 16-bit A/D converter

Applications

- Film inspection
- Printed circuit board appearance inspection
- Print inspection
- Industrial line scan camera

CMOS Linear Image Sensor S15611

Block diagram



40 MHz Operation, Digital Output

This CMOS linear Image sensor has achieved a readout speed of 40 MHz max. and a line rate of 34 kHz max.

The Image sensor has a timing generator, bias generator, 12-bit A/D converter, and is easy to handle because of its digital I/O.

Features

- Pixel size: 7 (H) µm × 200 (V) µm
- 1024 pixels
- Effective photosensitive area length: 7.168 mm
- High-speed readout: 40 MHz max.
- Simultaneous integration of all pixels
- Variable integration time function (electronic shutter function)
- SPI communication function (partial readout, offset adjustment)
- Built-in 12-bit A/D converter

Applications

- Encoders
- Position detection
- Machine vision

NEW OPTO-SEMICONDUCTOR PRODUCTS

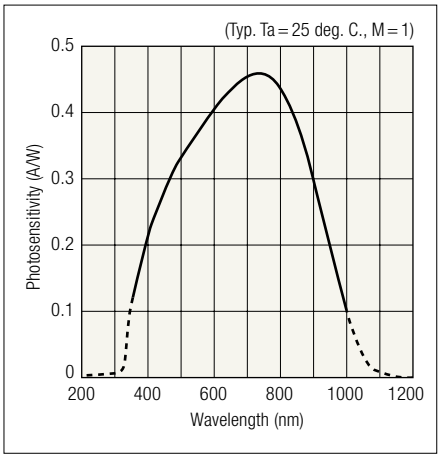
Si APD Array S15249

Specifications

Parameter	Specification	Unit
Package	COB (chip on board)	–
Dimensions (W × D × H)	13.2 × 4.5 × 1.65	mm
Photosensitive area (per element)	0.7 × 2.0	mm
Spectral response range	350 to 1000	nm
Peak sensitivity wavelength*1	620	nm
Breakdown voltage*2	160	V
Cutoff frequency*3	100	MHz

*1 M = 50
*2 I_D = 100 µA
*3 M = 50, λ = 450 nm, R_L = 50 Ω

Spectral response



High Short-wavelength Sensitivity Surface Mount Type 1 × 16 ch APD Array

This 16-element APD array achieves high sensitivity and low-bias operation in the short-wavelength region. The gap between the elements is small (60 µm), enabling a compact package. It is also possible to arrange and use multiple products.

Features

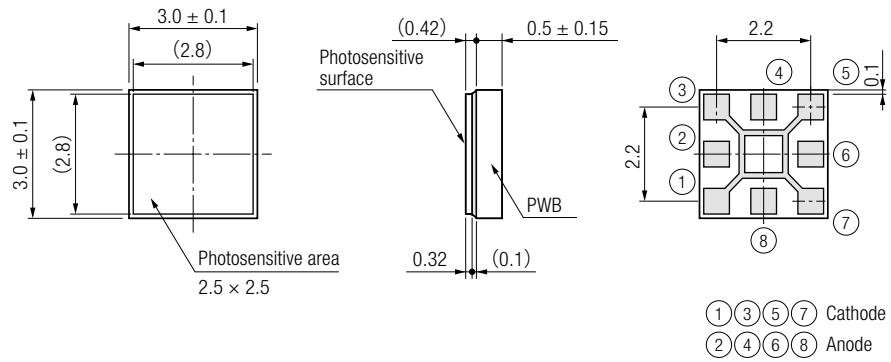
Gap between elements is small: 60 µm
Small variation between elements
Low-bias operation: 160 V typ.

Applications

- Flow cytometer
- Particle measurement

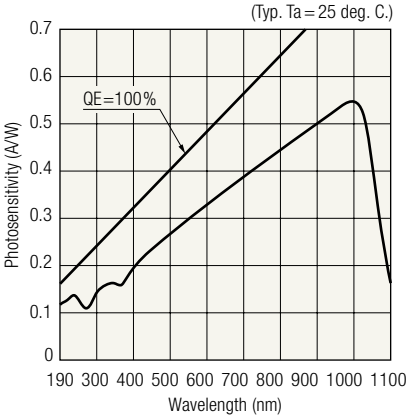
Si Photodiode
S15289-33

Dimensional outline (unit: mm)

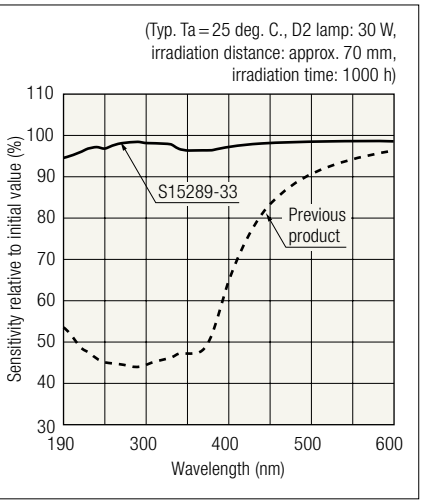


Tolerance unless otherwise noted: ±0.15

Spectral response



Changes in spectral response due to UV light irradiation



Back-illuminated Si Photodiode with CSP* Structure and High UV Tolerance

This is a backside-illuminated type Si photodiode that has achieved high reliability against ultraviolet light. It exhibits low sensitivity deterioration under UV light irradiation and is suitable for applications such as monitoring intense UV light sources. It is designed with minimal dead space around the product making it possible to arrange multiple products side by side.

Features

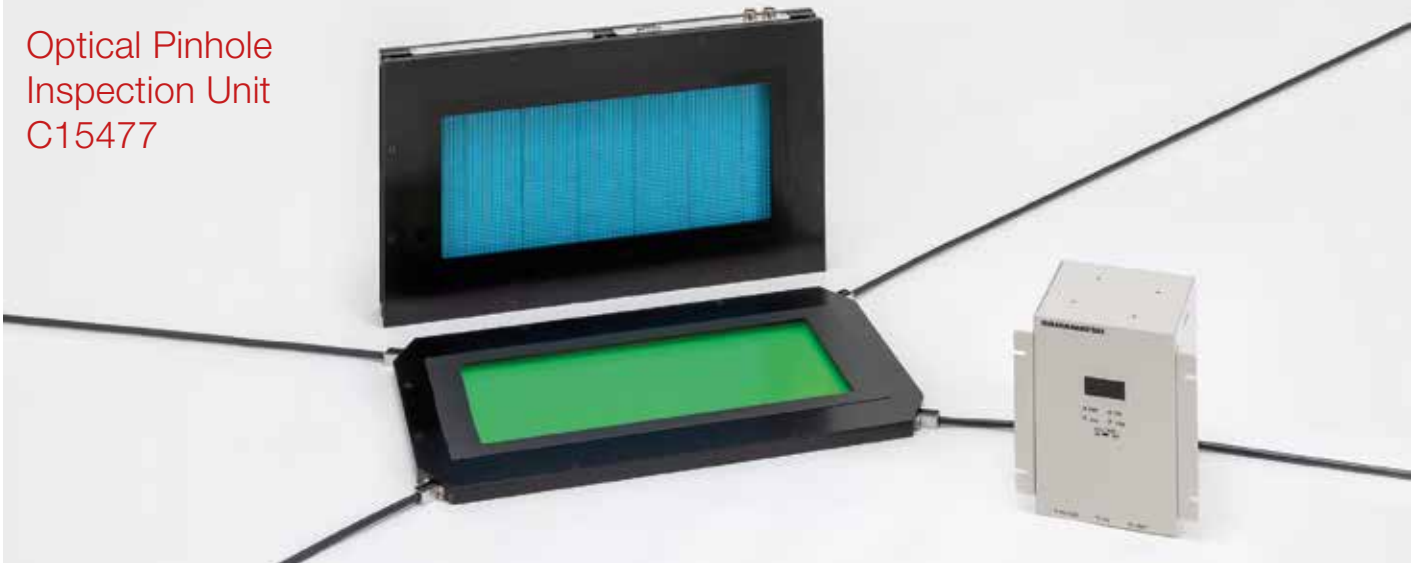
- High sensitivity in UV region: QE = 75 % (λ = 200 nm)
- High UV tolerance
- Compatible with lead-free solder reflow

Application

- Monitoring UV light source
- Atmosphere analyzer etc.

* Chip Size Package

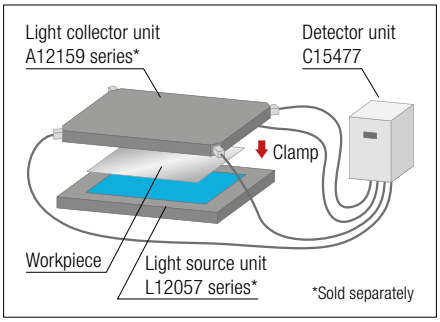
Optical Pinhole Inspection Unit C15477



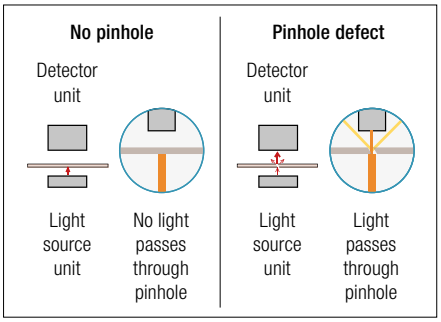
Specifications

Parameter	Specification	Unit
Minimum detectable pinhole size	ϕ1	µm
Detection area	480 × 180	mm
Input voltage (DC)	24	V
Current consumption	0.5	A

Optical pinhole inspection setup



Principle of optical pinhole inspection



Optically Detects Tiny Pinhole Defects as Small as 1 µm in Diameter in Plate/Sheet Workpieces

The C15477 is designed to detect pinhole defects as small as 1 µm in diameter in large plate/sheet workpieces and does all this quickly with just a single unit. A light source unit irradiates light on a workpiece. A light collector unit efficiently collects the light passing through the pinhole defects in the workpiece. This is then detected as an electrical signal by the photomultiplier tube, which is a highly sensitive photodetector, making it easier and more accurate to find even tiny pinhole defects in the workpiece. Compared to other methods for detecting pinholes, such as the use of fluids or gases, this optical method applies no actual physical pressure to the workpiece during inspection. The C15477 will improve inspection accuracy and speed for tasks such as inspecting pinhole defects in fuel cell separators for fuel cell vehicles, aluminum laminate films for pouch rechargeable batteries, and pressed thin plates.

Features

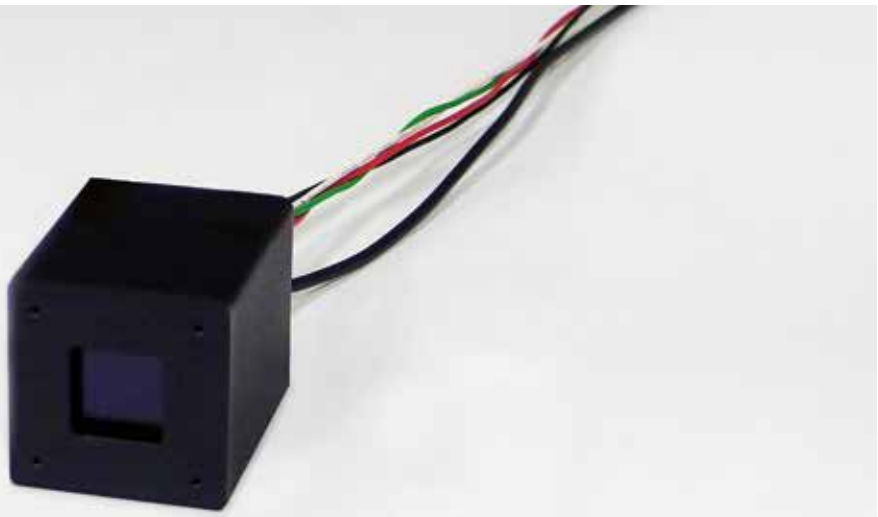
- High-accuracy and high-speed detection
- Non-contact inspection
- Custom design available to match workpiece size
- Pinhole determination based on desired threshold setting
- Monitoring function for light source degradation, sensor error, and light-shielding error
- Auto-calibration function

Applications

- Fuel cell separators
- Aluminum laminate films for pouch rechargeable batteries
- Pressed thin plates

NEW ELECTRON TUBE PRODUCTS

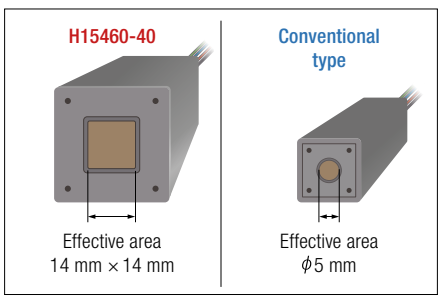
Photosensor Module H15460-40



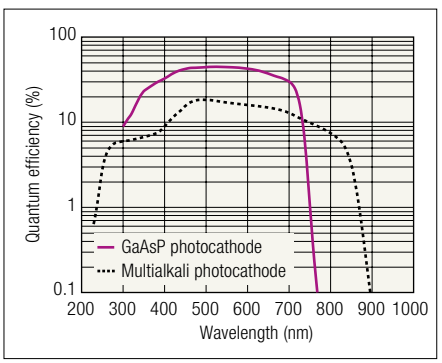
Specifications

Parameter	Specification	Unit
Effective area	□14	mm
Spectral response range	300~740	nm
Frequency bandwidth (-3 dB)	DC~30 MHz	–
Current-to-voltage conversion factor	0.02	V/uA
Ripple noise (peak to peak) (max.)	1	mV

Size comparison



Spectral response (typ.)



Delivers a Wide Field-of-view and High Resolution in Two-photon Excitation Microscopy

The H15460-40 is a photosensor module which employs a GaAsP photocathode with high sensitivity in the visible region. It has a wide photosensitive area of 14 mm × 14 mm and a built-in amplifier which delivers low noise and high speed operation.

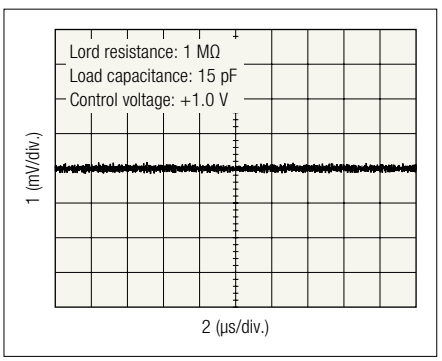
Features

- Large effective area: 14 mm × 14 mm
- High sensitivity: GaAsP photocathode
- Low noise, high frequency bandwidth amplifier used

Application

- Two-photon excitation microscopy

Ripple noise (typ.)

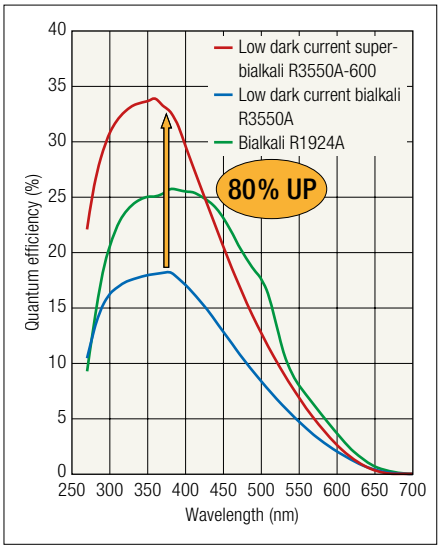


Head-on Type Photomultiplier Tube R3550P-600

Specifications

Parameter	R3550P-600	R1924P	Unit
Photocathode type	Low noise super-bialkali	Bialkali	–
Anode dark count at 25 deg. C. (typ.)	30	100	s^{-1}
Anode dark count at 37 deg. C. (typ.)	50	350	s^{-1}
Maximum operating temperature	70	50	deg. C.
Vibration resistance	200		m/s^2
Shock resistance	1000		m/s^2

Spectral response



Newly Developed Bialkali Photocathode that Offers High Sensitivity and Low Noise

The R3550P-600 is a 25 mm diameter head-on photomultiplier tube developed for use in photon counting applications. Compared to a bialkali photocathode photomultiplier tube (R1924P) with the same shape, the R3550P-600 is low noise and designed to minimize the noise increase, even when the ambient temperature rises, allowing stable operation up to 70 deg. C. In addition, when compared to our previous product (R3550P) with a low-noise bialkali photocathode, the quantum efficiency of the R3550P-600 is enhanced by 80 % (increased from 18 % to 33 % at 375 nm). The R3550P-600 will improve accuracy in low-light-level measurement applications, while maintaining low-noise performance.

Features

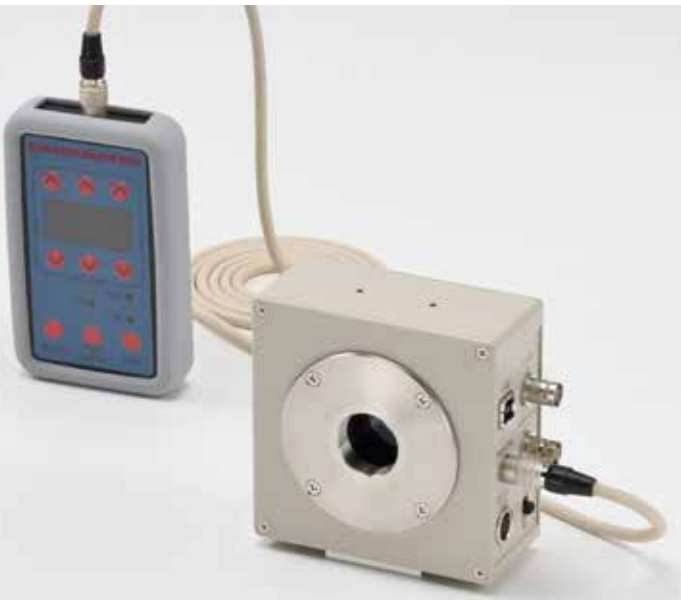
- High sensitivity
- Low noise
- Less noise increase even at higher temperatures
- Stable operation up to 70 deg. C.
- High vibration and shock resistance

Applications

- Chemiluminescence measurement
- Biomedical fluorescence measurement
- Hygiene monitor
- Level gauge

NEW ELECTRON TUBE PRODUCTS

High Speed Gated Image Intensifier Unit C14245

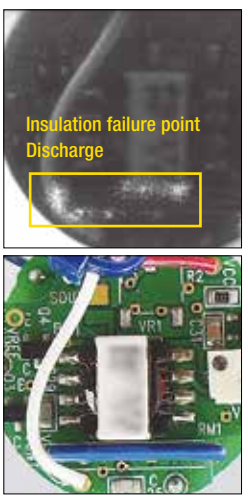


Specifications

Parameter		Specification			Unit
Photocathode type		Multialkali	GaAsP	GaAs	–
Spectral response range		185 to 900	280 to 720	370 to 920	nm
Input/output faceplate size*		ϕ18			mm
Image intensification (typ.)	1MCP	1.1×10^4	2.2×10^4	4.0×10^4	(lm/m^2)/lx
	2MCP	4.0×10^6	5.0×10^6	9.6×10^6	
Limiting resolution (typ.)	1MCP	64			Lp/mm
	2MCP	57			

* Type with 25 mm diameter is also available.

Imaging example



UV visualization: Discharge due to insulation failure
Photocathode: Multialkali

C14245 imaging

Visible image

Compact Image Intensifier Unit with a Gate Function of 3 ns to DC

The C14245 series consists of an image intensifier (I.I.), a high-voltage power supply circuit and a gate drive circuit, all in a compact cubic housing. The unit easily connects to the body of most large-sized high-performance cameras, which has been difficult for our previous product (C9546 series) with an L shape configuration. The lens mount, C or F, can be selected to meet the application needs.

Features

- Compact and lightweight: 100 mm (W) × 100 mm (H) × 45 mm (D)
- Cubic shape easily connects to camera
- Available with three spectral response ranges from UV to near IR
- Excessive light protection included
- C-mount and F-mount easily exchangeable

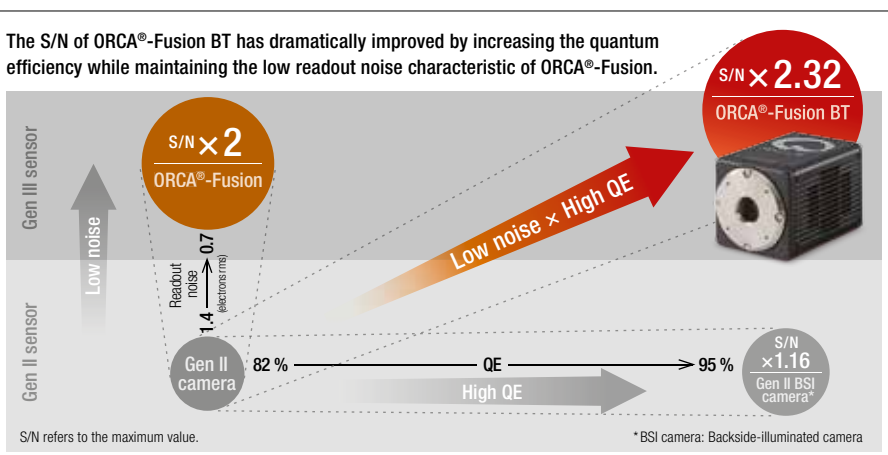
Application

- Discharge observation
- Observation of invisible phenomena in UV and near IR regions
- Observation of high-speed phenomena
- Observation of low light emissions under microscope
- Cell observation by fluorescence
- Night surveillance

ORCA®-Fusion BT Digital CMOS Camera C15440-20UP

S/N comparison of scientific CMOS cameras

The S/N of ORCA®-Fusion BT has dramatically improved by increasing the quantum efficiency while maintaining the low readout noise characteristic of ORCA®-Fusion.



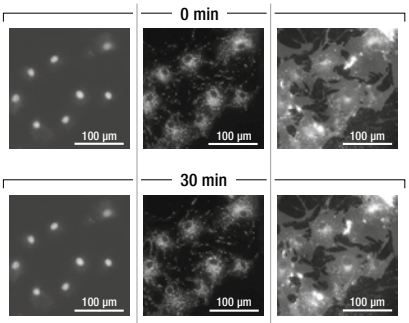
S/N refers to the maximum value.

*BSI camera: Backside-illuminated camera

Time-lapse live cell imaging by low light excitation

By suppressing the excitation light that causes phototoxicity and photobleaching, long-term observation in living cells has been made possible.

Sample: H9c2, Objective lens: Apo TIRF 60XC (NA1.49), ND: 8, Interval: 15 sec



Nucleus: HCS NuclearMask Stains / Exposure 20 ms

Mitochondria: Mito Tracker / Exposure 500 ms

Membrane: CellMask Plasma Membrane stains / Exposure 500 ms

A Perfect Fusion of Low Noise and High Quantum Efficiency

The ORCA®-Fusion BT is a digital CMOS camera that adopts the latest Backside-illuminated sensor. By increasing the quantum efficiency while maintaining the low readout noise characteristic of the ORCA®-Fusion, the S/N (signal-to-noise), has been dramatically improved. The ORCA®-Fusion BT demonstrates high performance not only in low light areas but also in bright areas.

Features

- Low readout noise: 0.7 electrons (rms)
- High QE: 95 % @ 550 nm
- Large field of view:
  2304 pixels × 2304 pixels (5.3M pixels), sensor with diagonal dimension of 21.176 mm
- High resolution:
  Pixel size 6.5 µm × 6.5 µm

Applications

- Wide-field fluorescence microscopy
- Time-lapse live cell imaging
- Lightsheet microscopy
- Super resolution microscopy
- Synchrotron radiation imaging

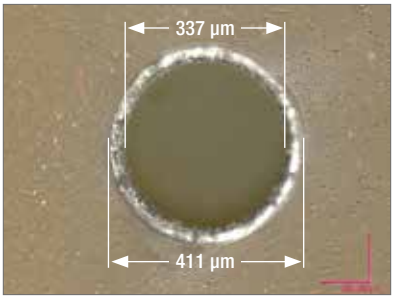
Pulsed Fiber Laser
L15187

Specifications

Parameter	Specification	Unit
Wavelength	1064	nm
Average output power	30	W
Repetition rate	80~200	kHz
Polarization	Linear	–
Polarization direction	Vertical	–
Pulse width	200~700	ns

Processing example 1

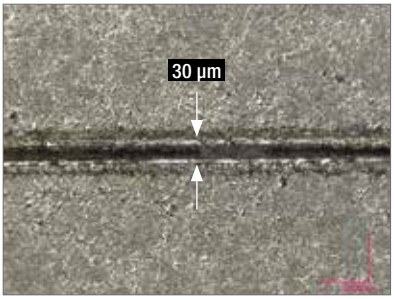
Material: Polyimide film
Pulse width: 50 ns*



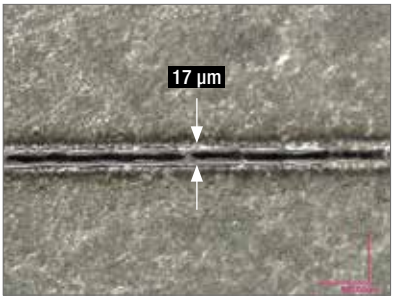
* Pulse width: 50 ns is custom-made.

Processing example 2

Material: SUS
Pulse width: 50 ns



Material: SUS
Pulse width: 700 ns



Nanosecond Pulsed Fiber Laser Configurable for Any Processing Condition

Nanosecond pulsed fiber laser which is linearly polarized achieving high reliability. Since independent control of pulse width and repetition rate is possible, processing conditions can be set for various kinds of applications.

In addition, pulse time waveforms can be set to the default.

Features

- Independent control of pulse width and repetition rate
- High beam quality
- Linear polarization
- Fiber-out type

Applications

- Surface modification
- Marking
- Thin film removal
- Cutting
- Laser CVD

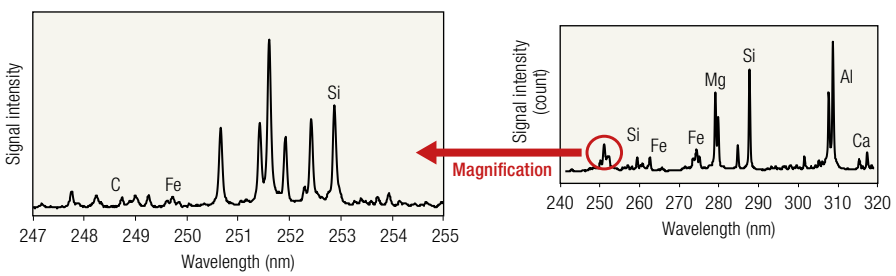
Pulsed Solid State Laser L15438-01

Specifications

Parameter	Specification	Unit
Wavelength	1064	nm
Pulse energy	8	mJ
Repetition rate	Singleshot to 10*	Hz
Pulse width	<2	ns
Cooling method	Air cooling	–
Remarks	Built in laser driver (DC+24 V/ Max. 2 A)	–

* By inputting a trigger signal externally via TTL, the laser is output from the single shot to 10 Hz range.

Example of coal-ash fuel content detection test (Applications for LIBS)



The measurement of elemental compositions of Fe, Si, Ca, Al and C which are main components of coal, coal ash, steel slag and etc.

Data courtesy of Prof. Yoshihiro Deguchi (Faculty of science and engineering, industry, graduate school of society, Tokushima University)

Pulsed Solid State Laser Built-in Laser Driver Ideal for LIBS Light Sources

This is a simple, low-cost and high-output pulsed solid state laser light source that incorporates a laser control unit such as an optical pulse generator and a thermal control circuit.

It can be used as the light source for various kinds of analytical instruments (LIBS, etc).

Features

- Low power consumption
- Simple handling
- Rugged design

Applications

- Light source for analytical instruments
- Range Finder
- Ablation

Pulsed Solid State Laser L15776 Series

L15776-01

L15776-02/-03

Specifications

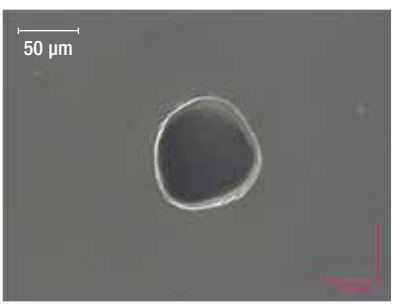
Parameter	L15776-01	L15776-02	L15776-03	Unit
Wavelength	266	532	1064	nm
Repetition rate*1	50			kHz
Pulse width*1, 2	0.35		0.5	ns
Pulse energy*1, 2	23	66	110	µJ
Dimensions (W × H × D)	410 × 215 × 403 (excluding protrusions)	365 × 215 × 360 (excluding protrusions)		mm

*1 Average value over 1 minute during operation at a repetition rate of 50 kHz.
Repetition rate can be varied in steps from a single shot to (50,000/n) Hz (n = 1, 2, …, 50000).

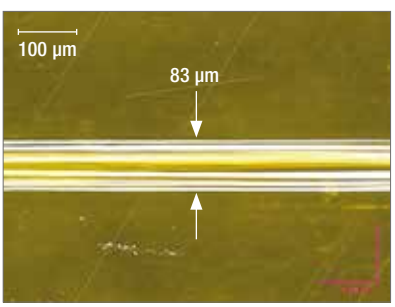
*2 In L15776-01, if the actual value deviated from this specification due to long-term use, the characteristics can be recovered by manual shifter or temperature adjustment.

Processing example

Details: Drilling (Percussion)
Material: PET



Details: Line trench
Material: Polyimide film



The Most Suitable Sub-Nanosecond Pulsed Laser for Micro Processing

A passively Q-switched laser with short pulse and high beam quality, suitable for a wide variety of micro material processing applications.

Applications

- Micro processing (dicing, drilling)
- Surface modification (repair)

Features

- Sub-nanosecond pulse
- High repetition, variable repetition rate
- Built-in feedback function
- Compact
- High robustness

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