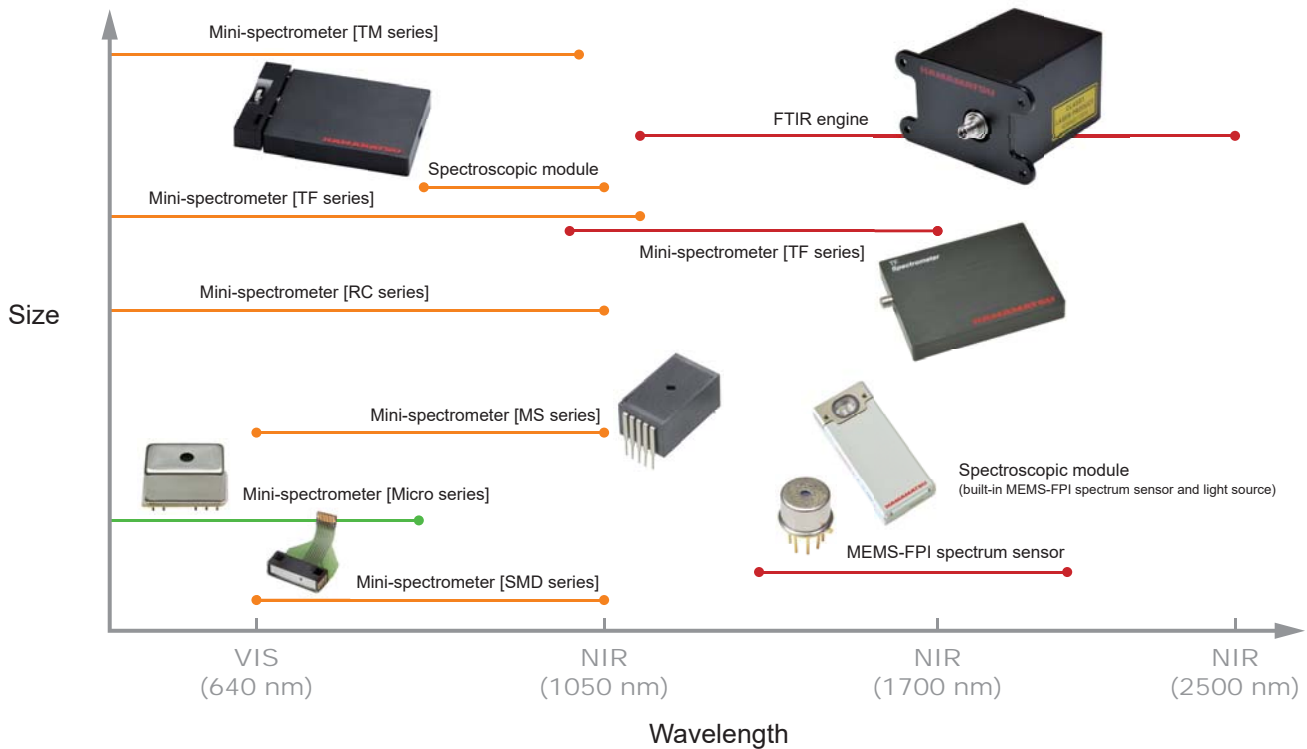


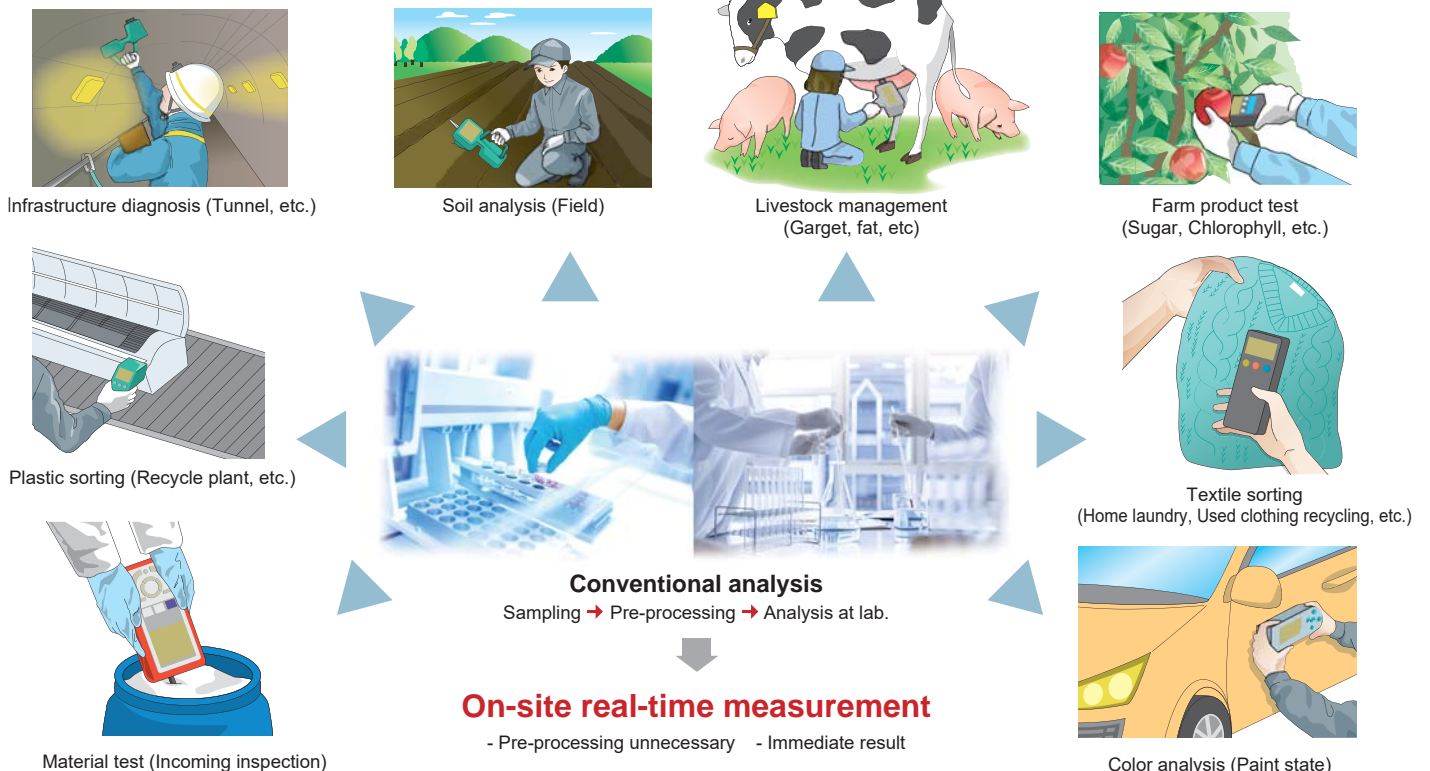
Spectrum sensors / Spectrometers for portable simple analysis

Hamamatsu offers spectrum sensors and spectrometers that enable real-time measurements in the field. It can be installed in a variety of equipment, including environmental measurement equipment, color measurement equipment, and production lines.

Product map of Hamamatsu's Spectrum sensors and Spectrometers for portable simple analysis



Application examples



FTIR engine

C15511-01



Compact spectrometer module with built-in Michelson optical interferometer

The C15511-01 Fourier transform infrared spectrometer (FTIR) engine is compact enough to carry in just one hand. A Michelson optical interferometer and control circuit are built 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 as well as continuous monitoring.

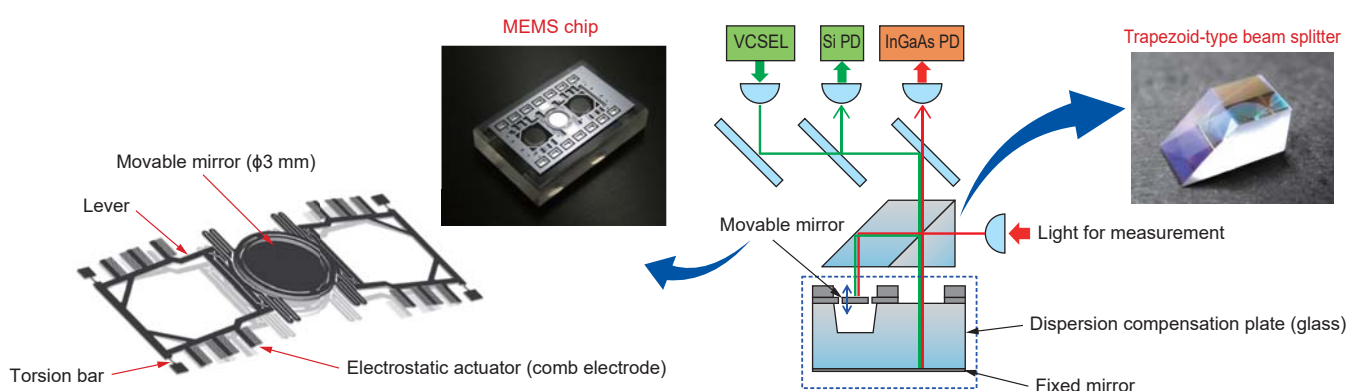
Specifications (Ta=25 °C unless otherwise noted)

Parameter	Min.	Typ.	Max.	Unit
Spectral response range	1100 to 2500			nm
Spectral resolution (FWHM)	-	5.7	8	nm
Wavelength reproducibility	-0.5	-	+0.5	nm
Wavelength temperature dependence	-0.06	-	+0.06	nm/°C
Signal-to-noise ratio	10000	-	-	-
Dimensions (W × D × H)	49 × 57 × 76 (excluding protrusions)			mm
Weight	Approx. 300			g
Optical interferometer	Michelson interferometer (with a built-in $\phi 3$ mm movable mirror)			g
Photodetector	InGaAs PIN photodiode			-
Light input method	Optical fiber input type (with SMA connector)			-
Interface	USB 2.0			-
A/D conversion	-	16	-	bit
Drive frequency	225	275	325	Hz
USB bus power current consumption	-	450	500	mA
Operating temperature	+5 to +50			°C
Storage temperature	-20 to +70			°C

Structure

The optical interferometer has a built-in light input section, beam splitter, fixed mirror, movable mirror ($\phi 3$ mm), and photodetector. The photodetector acquires light intensity signals that vary depending on the position of the movable mirror. The optical spectrum is obtained by processing (Fourier transform) these light intensity signals.

The FTIR engine has a built-in semiconductor laser (VCSEL: vertical cavity surface emitting laser) for monitoring the movable mirror position, which allows spectrum measurement with high wavelength accuracy.



MEMS-FPI spectrum sensors

C14272, C13272-03, C14273



Ultra-compact near infrared spectrum sensor that integrates MEMS tunable filter and photosensor

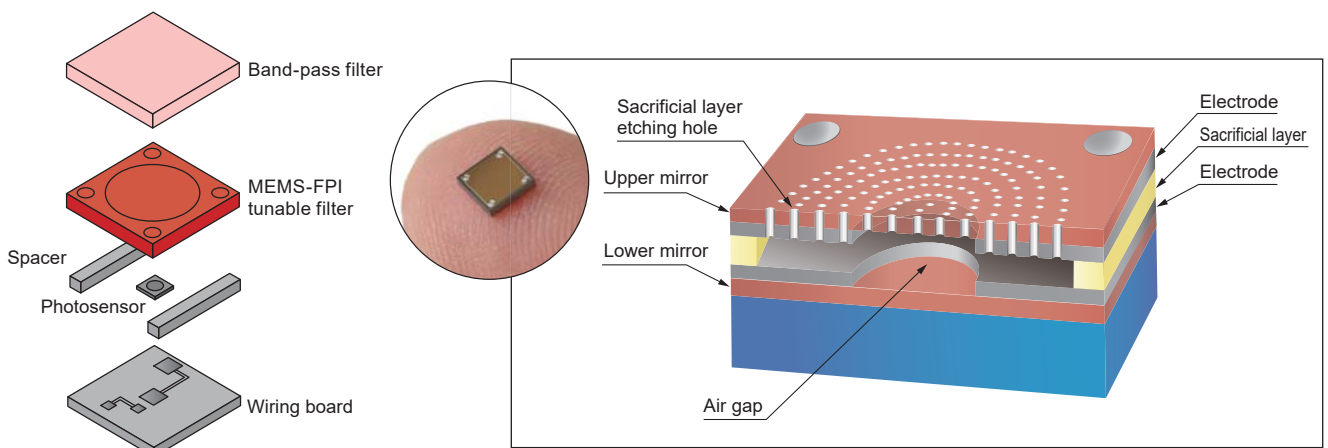
The MEMS-FPI spectrum sensor is an ultra-compact sensor that houses a MEMS-FPI (Fabry-Perot Interferometer) tunable filter that can vary its transmission wavelength depending on the applied voltage and InGaAs PIN photodiode in a single package.

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

Parameter	C14272	C13272-03	C14273	Unit
Spectral response range	1.35 to 1.65	1.55 to 1.85	1.75 to 2.15	μm
Spectral resolution (FWHM)	18 max.	20 max.	22 max.	nm
Wavelength temperature dependence	0.3	0.4	0.3	nm/°C
Wavelength reproducibility		±2		nm
Dark current	10 max.	100 max.	150 max.	nA
Photodetector	InGaAs PIN photodiode			-
Package	TO-5			-
Weight	1			g
Storage temperature	-40 to +125			°C
Operating temperature	-40 to +85			°C
Evaluation circuit (sold separately)	C13294-02			-

Structure

A spectrum sensor combining an MEMS-FPI tunable filter and a single element InGaAs photodiode. Unlike regular spectrometers, it does not require optical components such as grating or mirrors nor multi-channel photosensors such as image sensors, enabling an extremely compact form and mass production.



Spectroscopic modules

C15712, C15713, C15714



Compact module with MEMS-FPI spectrum sensor and light source

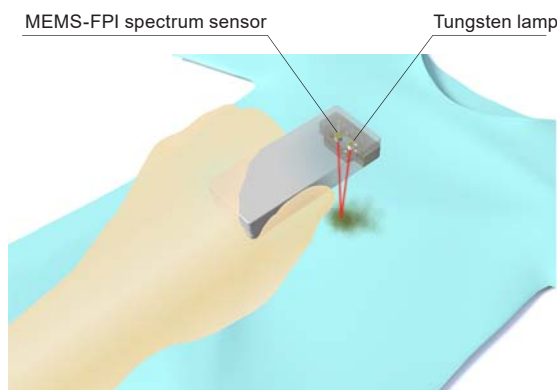
This compact module has a built-in light source, control circuit, and MEMS-FPI spectrum sensor consisting of an InGaAs PIN photodiode and MEMS-FPI (Fabry-Perot Interferometer) tunable filter which can vary its transmission wavelength by changing the applied voltage. Spectrum and absorbance can be measured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

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

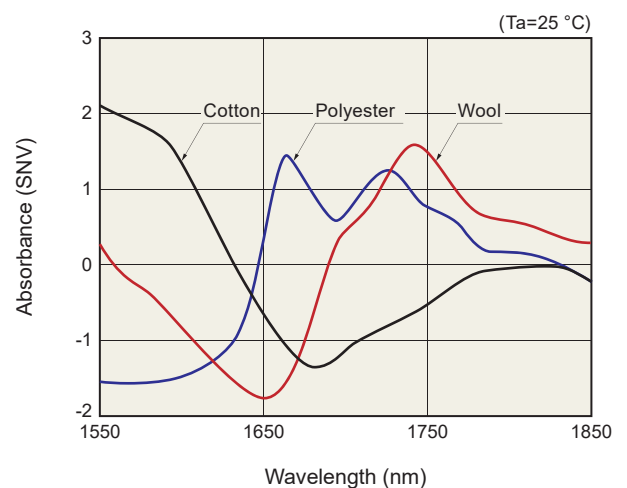
Parameter	C15712	C15713	C15714	Unit
Sensor	MEMS-FPI spectrum sensor			-
	C14272	C13272-03	C14273	
Light source	Tungsten lamp			-
Interface	USB 2.0 micro-B			-
Dimensions (W × D × H)	32 × 74 × 16			mm
Weight	82			g
Operating temperature	-5 to +50			$^\circ\text{C}$
Storage temperature	-20 to +70			$^\circ\text{C}$
Spectral response range	1350 to 1650	1550 to 1850	1750 to 2150	nm
Spectral resolution (FWHM)	18 max.	20 max.	22 max.	nm
Wavelength reproducibility	± 2 t yp.			nm
Wavelength temperature dependence	-0.1 to +0.1			nm/ $^\circ\text{C}$

Measurement example

Measured the reflection spectrum of a cloth using this module.



Absorbance spectrum of cloth



Mini-spectrometers [TF series]

C13555MA, C13053MA, C14486GA






Thin type, different wavelength types available

These mini-spectrometers are a thin type that has achieved 12 mm thickness while maintaining high performance. At the C13555MA and C13053MA, the incorporation of a high-sensitivity CMOS image sensor has achieved high sensitivity equivalent to that of a CCD and low power consumption.

The 14486GA is near infrared type mounted with InGaAs linear image sensor.

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

Parameter	C13555MA	C13053MA	C14486GA	Unit
Product				-
Type	High sensitivity		For near NIR	-
Spectral response range	340 to 830	500 to 1100	950 to 1700	nm
Spectral resolution (FWHM)	2.3 typ., 3.0 max.	2.5 typ., 3.5 max.	5.0 typ., 7.0 max.	nm
Wavelength reproducibility	-0.2 to +0.2	-0.4 to +0.4	-0.4 to +0.4	nm
Wavelength temperature dependence	-0.04 to +0.04		-0.05 to +0.05	nm/°C
Spectral stray light	-33 max.		-33 max.	dB
A/D conversion	16			bit
Integration time	11 to 100000		1 to 100000	μs
Interface	USB 2.0			-
USB bus power current consumption	250 max.			mA
Driving external power supply	Not needed			V
Dimensions (W × D × H)	80 × 60 × 12			mm
Weight	88			g
Image sensor	High-sensitivity CMOS linear image sensor		InGaAs linear image sensor	-
Number of pixels	512		256	Pixels
Slit (H × V)	25 × 250		25 × 250	μm
NA	0.22		0.22	-
Connector for optical fiber	SMA905D			-
Operating temperature	+5 to +50			°C
Storage temperature	-20 to +70			°C
Trigger compatible	Software trigger External trigger			-

Note: C13054MA and C14214MA for Raman spectroscopy are also available.

Spectroscopic module

C13560



SERS detection module

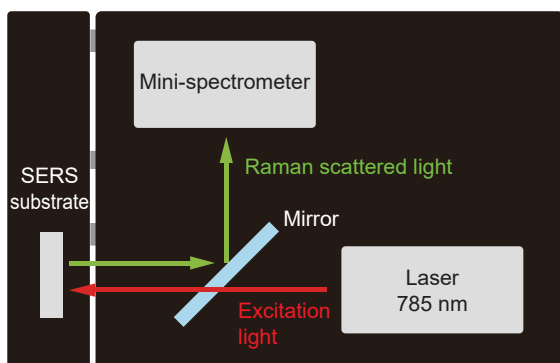
The C13560 spectroscopic module is a ultra-compact Raman spectroscopic module that incorporates a mini-spectrometer, compact optical system, and other Hamamatsu original technologies. The dedicated SERS substrate J13856-01 is used to perform Raman spectroscopy. It is also possible to perform Raman spectroscopy without using the J13856-01. It can be used for simple onsite point-of-care testing (POCT) and other screening tests.

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

Parameter		Specification	Unit
Laser	Excitation wavelength	785	nm
	Output	5, 10, 15	mW
	Line width	0.2	nm
Detection area	Detector	High-sensitivity CMOS linear image sensor	-
	Spectral range	400 to 1850	cm ⁻¹
	Resolution	10	cm ⁻¹
USB bus power consumption		0.9 max.	W
Dimensions (W × D × H)		96* × 14.5 × 60	mm
Weight		90	g
Interface		USB 2.0	-
Operating temperature		+15 to +35	°C
Storage temperature		-10 to +50	°C
Power supply voltage		5.25	V

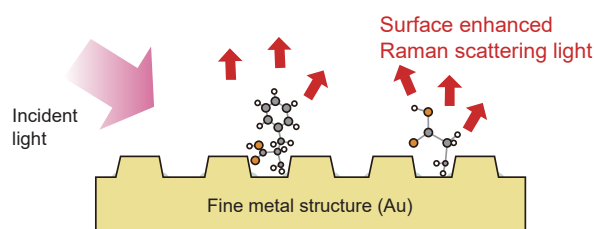
* With the SERS substrate holder and module close together (spacing adjustable with the focus knob)

> Internal structure



> SERS substrate J13856-01 (sold separately)

A surface-enhanced Raman spectroscopy (SERS) substrate enhances the Raman scattered light from the molecules, making high-sensitivity Raman spectroscopic analysis possible.



Mini-spectrometers [SMD series]

C14384MA-01



High sensitivity in the near infrared region (to 1050 nm), ultra-compact grating type spectrometer

The C14384MA-01 is an ultra-compact grating type spectrometer that provides high sensitivity in the near infrared region. As such, it is capable of acquiring continuous spectrum. The product has been downsized through Hamamatsu unique optical design, which helps to further reduce the size of mobile devices.

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

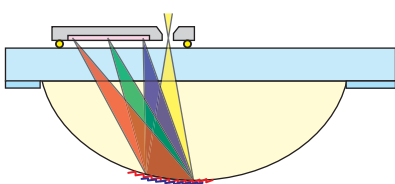
Parameter	Specification	Unit
Spectral response range	640 to 1050	nm
Spectral resolution (FWHM)	640 to 800 nm	25 max.
	800 to 1050 nm	20 max.
Wavelength reproducibility	±0.5	nm
Wavelength temperature dependence	±0.1	nm/°C
Spectral stray light	-23 max.	dB
Dimensions (W × D × H)	11.5 × 4.0 × 3.1*	mm
Weight	0.3	g
Image sensor	High-sensitivity CMOS linear image sensor with a slit	-
Number of pixels	256 (including optical black)	Pixels
Slit (H × V)	15 × 300	μm
NA	0.22	-
Operating temperature	+5 to +50	°C
Storage temperature	-20 to +70	°C
Trigger compatible	-	-
Evaluation circuit (sold separately)	C14989 + C15036	-

* Flexible cable not included

> Structure

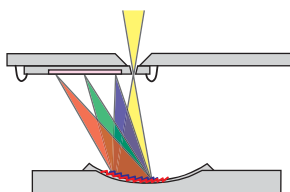
Smaller mini-spectrometers

■ MS series



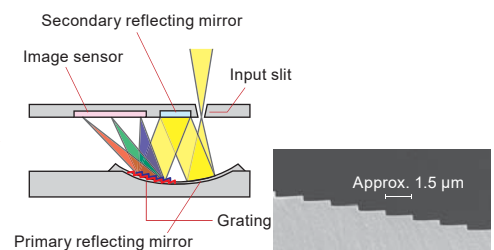
The wavelength temperature dependence is extremely small as the glass material utilized resists expansion due to temperature change.

■ Micro series



The use of a CAN package delivers high humidity tolerance. The air light path lowers costs.

■ SMD series



The extremely lightweight and compact format enables mounting in mobile devices and drones.

Mini-spectrometers [Micro / MS series]

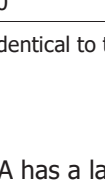
C12666MA, C12880MA, C11708MA



Finger-tip sized, ultra-compact spectrometer head

Based on an advanced MOEMS technology, a thumb-sized ultra-compact spectrometer heads have been achieved by combining an input-slit-integrated CMOS image sensor and grating formed through nanoimprint on a convex lens. As they employ an easily mountable package, you can use them as though they were sensors.

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

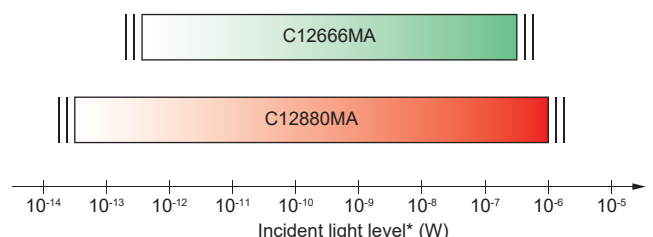
Parameter	Micro series		MS series	Unit
	C12666MA	C12880MA	C11708MA	
Product				-
Type	Spectrometer head Wide dynamic range	Spectrometer head High sensitivity	Spectrometer head For near NIR	-
Spectral response range	340 to 780	340 to 850	640 to 1050	nm
Spectral resolution (FWHM)	15 max.		20 max.	nm
Wavelength reproducibility	-0.5 to +0.5			mm
Wavelength temperature dependence	-0.1 to +0.1		-0.05 to +0.05	nm/°C
Spectral stray light	-25 max.			dB
Dimensions (W × D × H)	20.1 × 12.5 × 10.1		27.6 × 16.8 × 13	mm
Weight	5		9	g
Image sensor	CMOS linear image sensor	High-sensitivity CMOS linear image sensor	CMOS linear image sensor	-
Number of pixels	256	288	256	Pixels
Slit (H × V)	50 × 750	50 × 500	75 × 750	μm
NA	0.22			-
Operating temperature	+5 to +50			°C
Storage temperature	-20 to +70			°C
Trigger compatible	-			-
Evaluation circuit (sold separately)	C14465-10	C13016	C14465	-

Note: We also provide the C12880MA-10, which is identical to the C12880MA except that it has an SMA connector.

Measurable incident light level

CMOS image sensor built into the C12666MA has a large saturation charge, and that built into the C12880MA has a large charge-to-voltage conversion gain.

To perform high S/N measurement, the C12666MA is recommended when the incident light level is high and the C12880MA when the level is low.



* Input spot diameter: 800 μm (λ=550 nm)
 The measurable light level is calculated from the settable integration time.
 The settable integration time is different between the C12666MA and C12880MA.
 The S/N during measurement is not taken into account.

Main Products

Opto-semiconductors

- Si photodiodes
 - APD
 - MPPC®
 - Photo IC
 - Image sensors
 - PSD
 - Infrared detectors
 - LED
 - Optical communication devices
 - Automotive devices
 - Flat panel sensors
 - MEMS devices
 - Mini-spectrometers
 - Opto-semiconductor modules
-

Electron Tubes

- Photomultiplier tubes
 - Photomultiplier tube modules
 - Microchannel plates
 - Image intensifiers
 - Xenon lamps / Mercury-xenon lamps
 - Deuterium lamps
 - Light source applied products
 - Laser applied products
 - Microfocus X-ray sources
 - X-ray imaging devices
-

Imaging and Processing Systems

- Cameras / Image processing measuring systems
 - X-ray products
 - Life science systems
 - Medical systems
 - Semiconductor failure analysis systems
 - FPD / LED characteristic evaluation systems
 - Spectroscopic and optical measurement systems
-

Laser Products

- Semiconductor lasers
 - Applied products of semiconductor lasers
 - Solid state lasers
-

Information described in this material is current as of October 2020.

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