

Mini-spectrometer

[TM series]

C11697MB



Trigger function and a high sensitivity CMOS image sensor included

The C11697MB is a polychromator integrated with optical elements, an image sensor and a driver circuit. Light to be measured is guided into the entrance port of TM series through an optical fiber and the spectrum measured with the built-in image sensor is output from the USB port to a PC for data acquisition. The C11697MB is a mini-spectrometer with a high-sensitivity CMOS image sensor mounted on the optical system platform of the previous type C10083MD. The trigger function accepts even short-time integration so emission spectra from pulsed light can be measured. The readout time is drastically reduced, making the C11697MB ideal for LED test on industrial productions lines.

The C11697MB comes supplied with free evaluation software that allows setting measurement conditions, acquiring and saving data, and displaying graphs. Original measurement software can be designed on an end-user's side as DLL's function specification is disclosed.

Features

- Internal high sensitivity CMOS image sensor (rivaling that of a CCD)
- Trigger function included
- High-speed readout (2 ms approx.)
- Simultaneous charge integration type
- Wavelength conversion factor*1 is recorded in internal memory.

Applications

- Quality check on LED test line
- Measurement of pulsed light emission

*1: A conversion factor for converting the image sensor pixel number into a wavelength is recorded in the module. A calculation factor for converting the A/D converted count into the input light intensity is not provided.

Optical characteristics

Parameter	Value	Unit
Spectral response range	320 to 1000	nm
Spectral resolution (FWHM)*2	8 max.	nm
Wavelength reproducibility*3	-0.2 to +0.2	nm
Wavelength temperature dependence	-0.04 to +0.04	nm/°C
Spectral stray light*2 *4	-33 max.	dB

*2: Depends on the slit opening. Values were measured with the slit listed in the table "Structure".

*3: Measured under constant light input conditions

*4: When monochromatic light of 650 nm is input, spectral stray light is defined as the ratio of the count measured at the input wavelength, to the count measured in a region of the input wavelength ± 40 nm.

Electrical characteristics

Parameter	Specification	Unit
A/D conversion	16	bits
Integration time	30 to 100000	μ s
Interface	USB 2.0	-
Consumption current of USB bus power	250 max.	mA

Structure

Parameter	Specification	Unit
Dimensions (W × D × H)	94 × 90 × 55	mm
Weight	470	g
Image sensor	High sensitivity CMOS linear image sensor S11639	-
Number of pixels	2048	pixels
Slit (H × V) ^{*5}	70 × 800	μm
NA ^{*6}	0.22	-
Connector for optical fiber	SMA905D	-

*5: Entrance slit aperture size

*6: Numeric aperture (solid angle)

Absolute maximum ratings

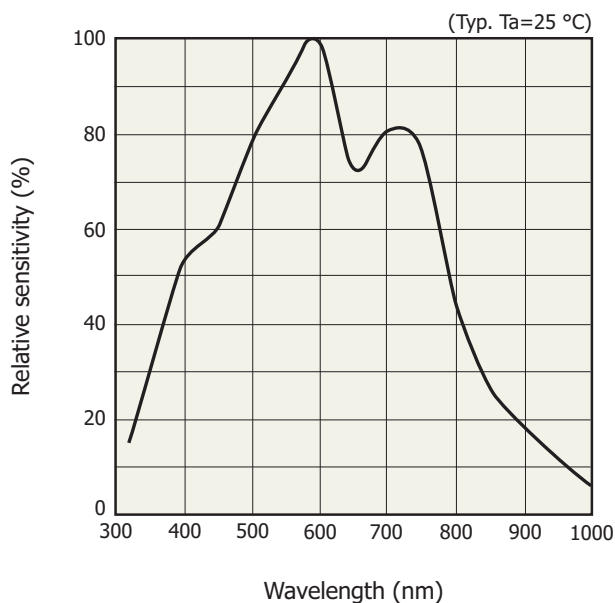
Parameter	Value	Unit
Operating temperature ^{*7}	+5 to +40	°C
Storage temperature ^{*7}	-20 to +70	°C

*7: No dew condensation

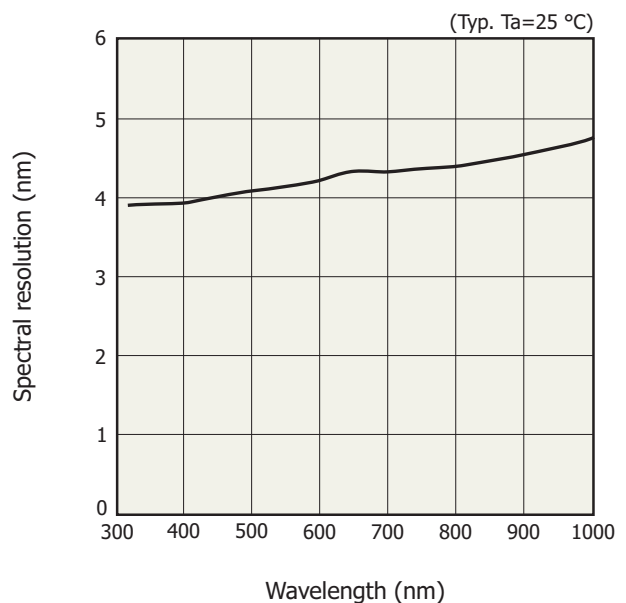
When there is a temperature difference between a product and the surrounding area in high humidity environment, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.

Note: Exceeding the absolute maximum ratings even momentarily may cause a drop in product quality. Always be sure to use the product within the absolute maximum ratings.

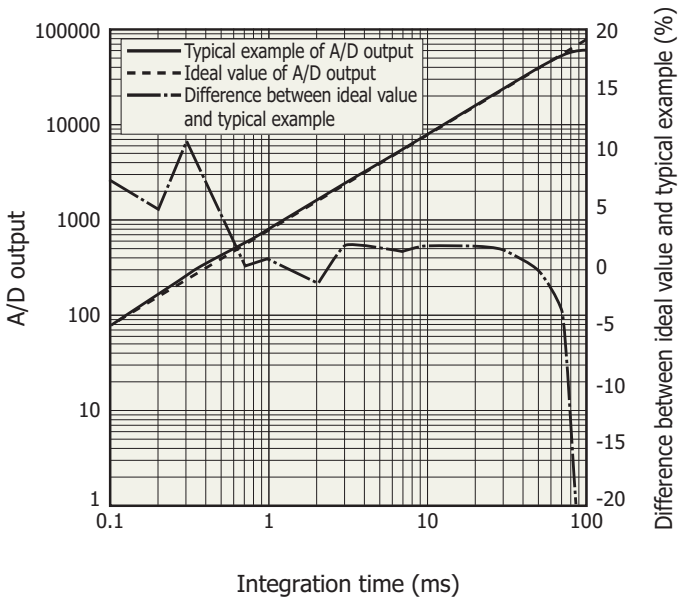
Spectral response



Spectral resolution vs. wavelength



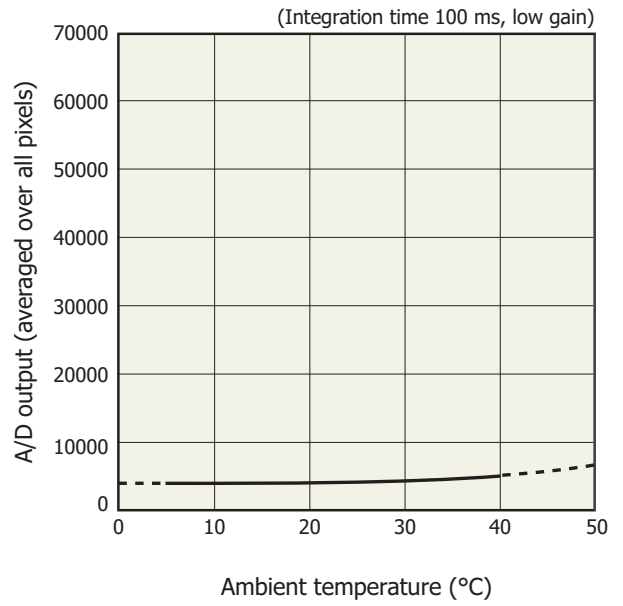
Linearity (typical example)



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A/D output is the output with dark output is subtracted when light is input. The difference between the ideal value and typical example contains a measurement error. The smaller the A/D output, the larger the measurement error.

Dark output vs. ambient temperature (typical example)

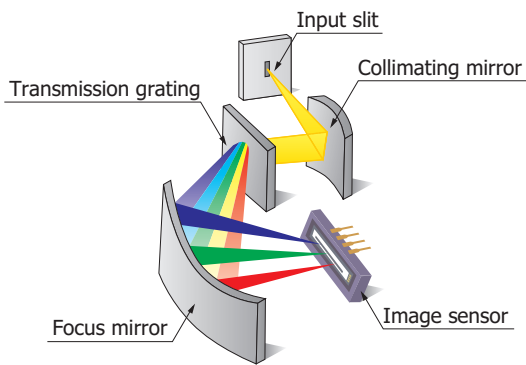


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A/D output is the sum of the sensor and circuit offset outputs and the sensor dark output.

Optical component layout

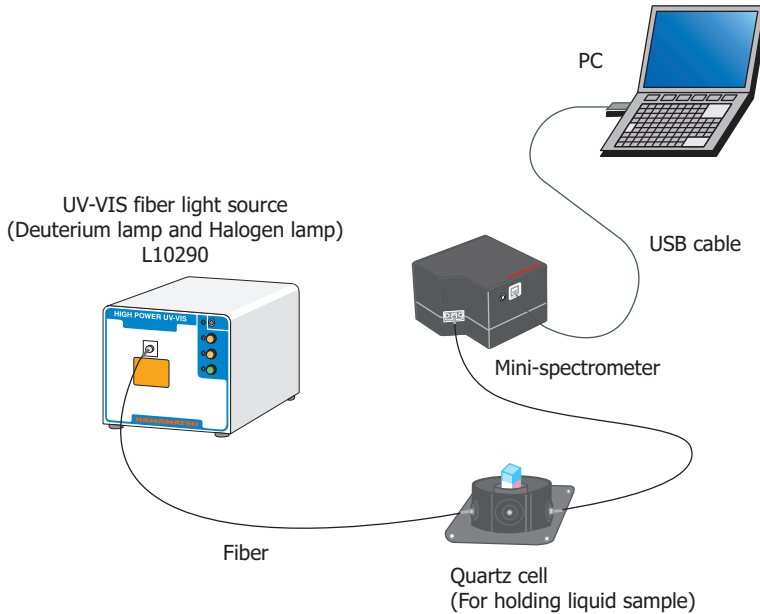
TM series mini-spectrometers use a transmission holographic grating made of quartz and precision optical components arranged on a rugged optical base, making it possible to deliver high throughput and highly accurate optical characteristics.



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Connection example (transmission light measurement)

Light to be measured is guided into the entrance port of TM series through an optical fiber and the spectrum measured with the built-in image sensor is output through the USB port to a PC for data acquisition. There are no moving parts inside the unit so stable measurements are obtained at all times. An optical fiber that guides light input from external sources allows a flexible measurement setup.



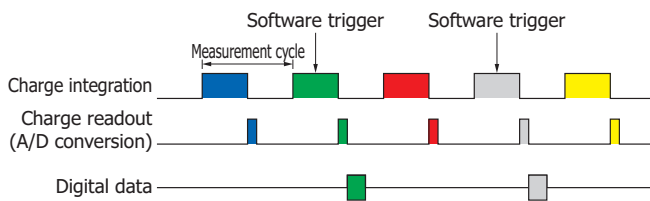
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Trigger operation mode

The C11697MB has trigger operation modes as shown below. These operation modes can be selected on the evaluation software that comes with the C11697MB.

(1) Data measurement at software trigger input (asynchronous)

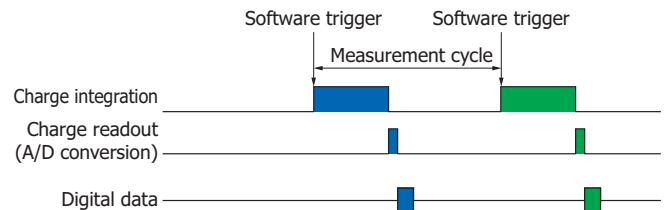
This mode acquires digital data that is first converted after a software trigger input from a PC.



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(2) Data measurement at software trigger input (synchronous)

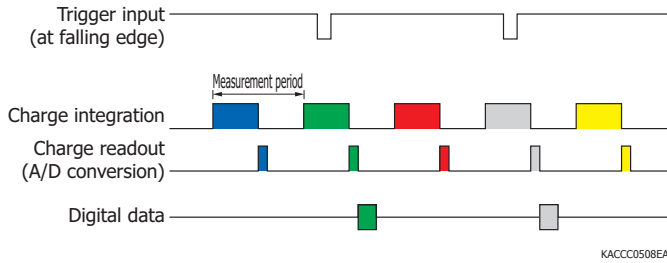
This mode starts sensor operation (integration) after a software trigger input from a PC.



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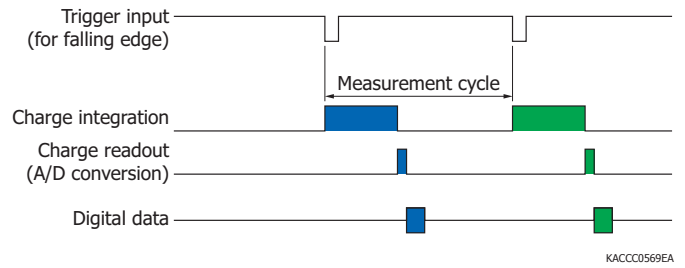
(3) Data measurement at external trigger input (asynchronous)

This mode acquires digital data that is first converted after the edge (rising or falling edge selectable) of an external trigger input to the external trigger terminal.



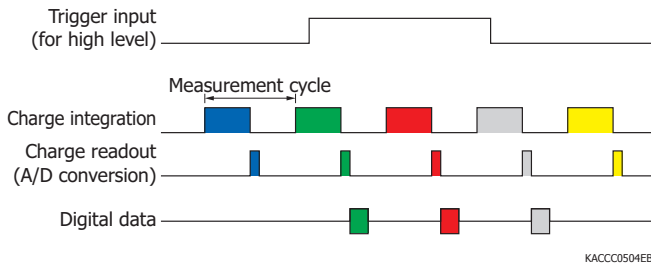
(4) Data measurement at external trigger input (synchronous)

This mode starts sensor operation (integration) at the edge (rising or falling edge selectable) of an external trigger input to the external trigger terminal, and acquires digital data.



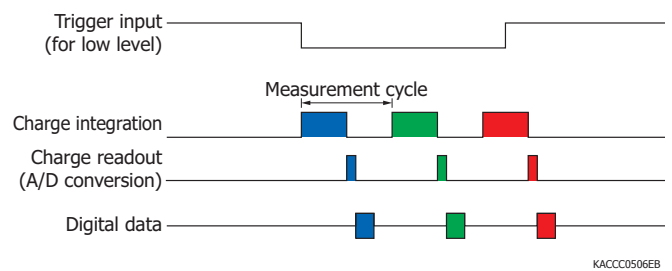
(5) Measurement by external trigger input level (asynchronous)

This mode acquires digital data when an external trigger (high or low level selectable) is input to the external trigger terminal.



(6) Measurement by external trigger input level (synchronous)

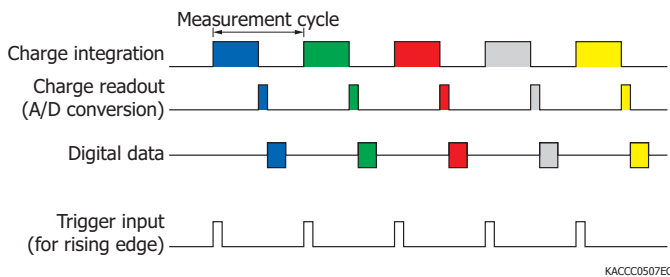
This mode starts sensor operation (integration) when an external trigger (high or low level selectable) is input to the external trigger terminal, and acquires digital data.



In either of the modes (1) to (6), the input trigger is ignored if the trigger input interval is shorter than the mini-spectrometer measurement period.

(7) Trigger signal output

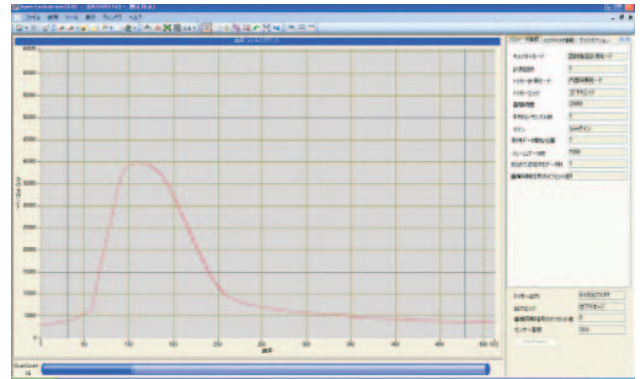
An integration start timing (pulse width: 10 μ s) can be output from the external trigger terminal. (trigger output edge: rising or falling edge selectable)



❏ Evaluation software package (supplied with unit)

Installing the evaluation software (SpecEvaluationUSB2.exe)*8 into your PC allows running the following basic tasks:

- Measurement data acquisition and save
- Measurement condition setup
- Module information acquisition
(wavelength conversion factor, polychromator type, etc.)
- Graphic display
- Arithmetic function
Pixel number to wavelength conversion
Comparison calculation with reference data
(transmittance, reflectance)
Dark subtraction
Gaussian approximation
(peak position and count, FWHM)



Note: Up to 8 mini-spectrometers can be connected and used with one PC.

*8: Compatible OS: Microsoft® Windows® 7 Professional SP1 (32-bit, 64-bit)
Microsoft Windows 8 Professional (32-bit, 64-bit)
Microsoft Windows 10 Professional (32-bit, 64-bit)

DLL for controlling hardware is also provided.

You can develop your own measurement programs by using a following software development environment.

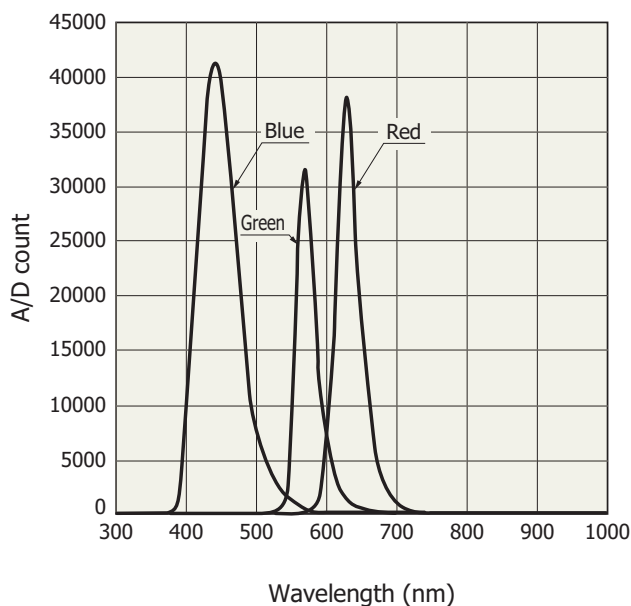
Microsoft Visual Studio® 2008 (SP1) Visual C++®

Microsoft Visual Studio 2008 (SP1) Visual Basic®

Note: Microsoft, Windows, Visual Studio, Visual C++ and Visual Basic are either registered trademarks or trademarks of Microsoft Corporation in the United States and other countries.

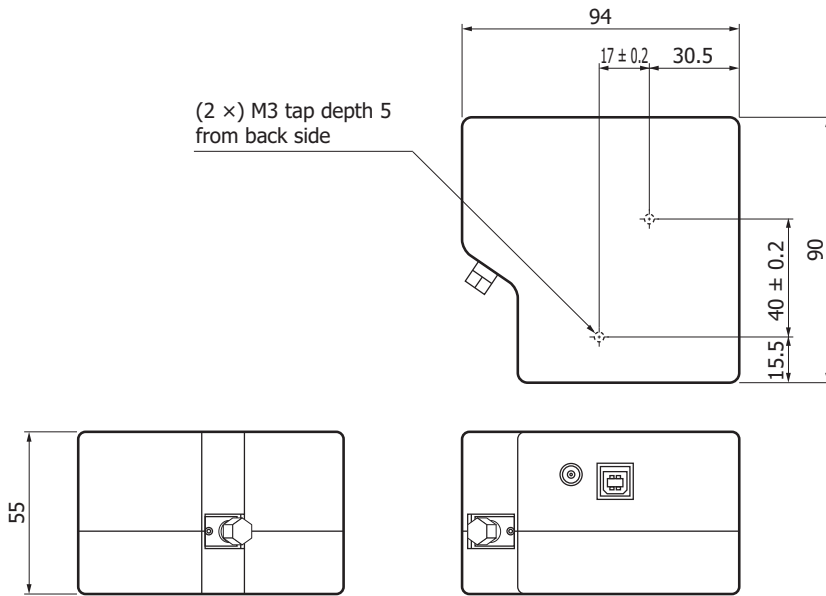
❏ Measurement example

Measurement of visible LED



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Dimensional outline (unit: mm)



Tolerance unless otherwise noted: ±0.5
Weight: 470 g

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Accessories

- USB cable
- Dedicated software (evaluation software, sample software, DLL)

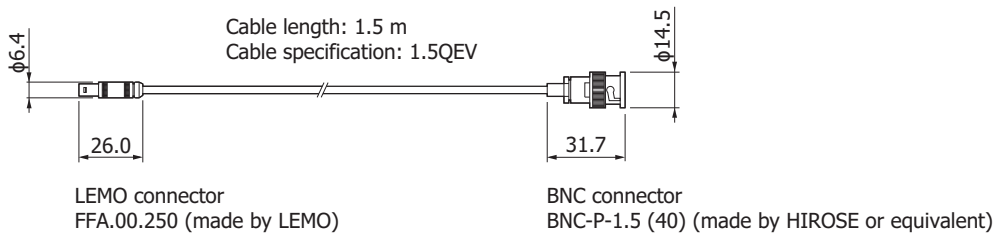
Options (sold separately)

- Optical fiber for light input

Type no.	Product name	Core diameter (μm)	Specification
A9762-01	Fiber for UV/visible range (resistance to UV)	600	NA=0.22, length 1.5 m, connectorized SMA905D at both ends

- Coaxial cable for external trigger input A10670

Dimensional outline (unit: mm)



KACCA0220EB

Mini-spectrometer/micro-spectrometer lineup

Type no.	Type	Spectral response range (nm)													Spectral resolution max. (nm)	Image sensor		
		200	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600				
C10082CA	TM-UV/VIS-CCD High sensitivity																6	Back-thinned CCD image sensor
C10082CAH	TM-UV/VIS-CCD High resolution		200 to 800														1*	
C10082MD	TM-UV/VIS-MOS Wide dynamic range																6	CMOS linear image sensor
C10083CA	TM-VIS/NIR-CCD High sensitivity																8 (λ=320 to 900 nm)	Back-thinned CCD image sensor
C10083CAH	TM-VIS/NIR-CCD High resolution																1* (λ=320 to 900 nm)	
C10083MD	TM-VIS/NIR-MOS Wide dynamic range																8	CMOS linear image sensor
C11697MB	TM-VIS/NIR-MOS-II Trigger-compatible																8	High-sensitivity CMOS linear image sensor
C9404CA	TG-UV-CCD High sensitivity		200 to 400														3	Back-thinned CCD image sensor
C9404CAH	TG-UV-CCD High resolution																1*	
C9405CB	TG-SWNIR-CCD-II IR-enhanced																5 (λ=550 to 900 nm)	IR-enhanced back-thinned CCD image sensor
C11713CA	TG-RAMAN-I High resolution																0.3*	Back-thinned CCD image sensor
C11714CB	TG-RAMAN-II High resolution																0.3*	IR-enhanced back-thinned CCD image sensor
C11482GA	TG2-NIR Non-cooled type																7	InGaAs linear image sensor
C9913GC	TG-cooled NIR-I Low noise (cooled type)																7	
C9914GB	TG-cooled NIR-II Low noise (cooled type)																8	
C11118GA	TG-cooled NIR-III Low noise (cooled type)																20	
C13053MA	TF-SWIR-MOS-II Compact, thin case																3.5	High-sensitivity CMOS linear image sensor
C13054MA	TF-RAMAN Compact, thin case																0.4*	
C13555MA	TF-VIS-MOS-II Compact, thin case																3	CMOS linear image sensor
C11007MA	RC-VIS-MOS Spectrometer module																9	
C11008MA	RC-SWNIR-MOS Spectrometer module																8	IR-enhanced CMOS linear image sensor

* Typ.

For installation into mobile measuring equipment

Type no.	Type	Spectral response range (nm)													Spectral resolution max. (nm)	Image sensor		
		200	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600				
C11009MA	RC-VIS-MOS Spectrometer head																9	CMOS linear image sensor
C11010MA	RC-SWNIR-MOS Spectrometer head																8	IR-enhanced CMOS linear image sensor

For installation into mobile measuring equipment (ultra-compact)

Type no.	Type	Spectral response range (nm)													Spectral resolution max. (nm)	Image sensor		
		200	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600				
C11708MA	MS-SWNIR-MOS Spectrometer head																20	CMOS linear image sensor
C12666MA	Spectrometer head																15	CMOS linear image sensor
C12880MA	Spectrometer head																15	High-sensitivity CMOS linear image sensor

Related information

www.hamamatsu.com/sp/ssd/doc_en.html

■ Precautions

- Disclaimer
- Mini-spectrometers

■ Technical information

- Mini-spectrometers

Information described in this material is current as of December 2017.

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