HAMAMATSU
PHOTON IS OUR BUSINESS

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	µs
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	-

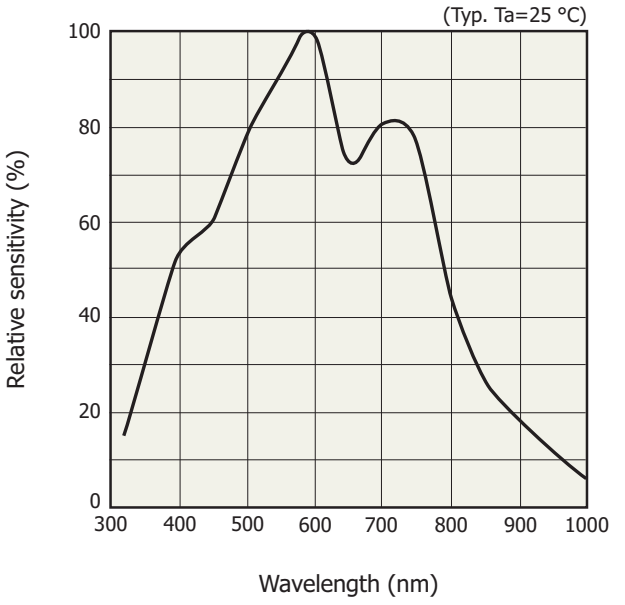
*5: Entrance slit aperture size
*6: Numeric aperture (solid angle)

Absolute maximum ratings

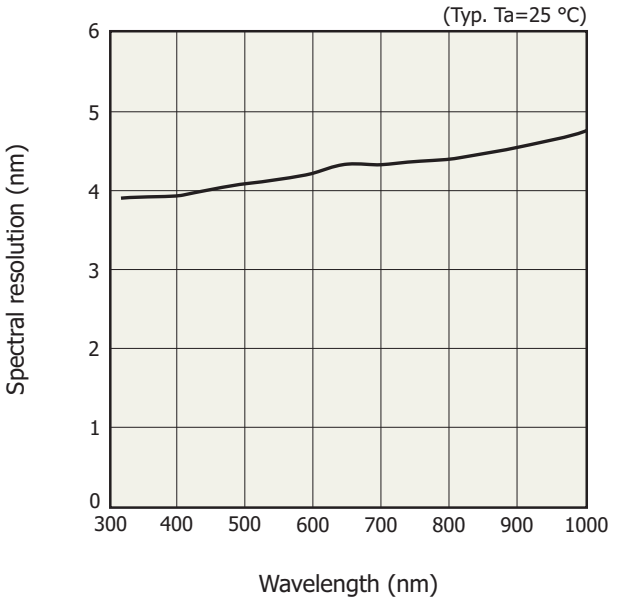
Parameter	Value	Unit
Operating temperature*7	+5 to +40	°C
Storage temperature*7	-20 to +70	°C

*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.

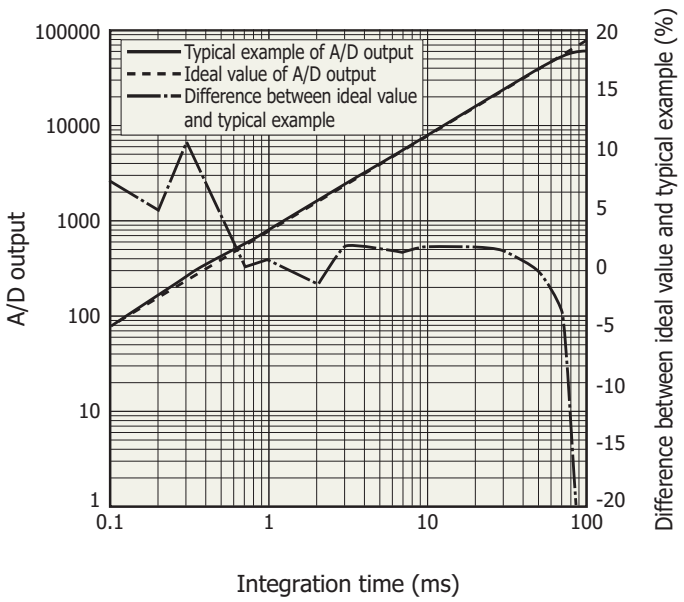
Spectral response



Spectral resolution vs. wavelength



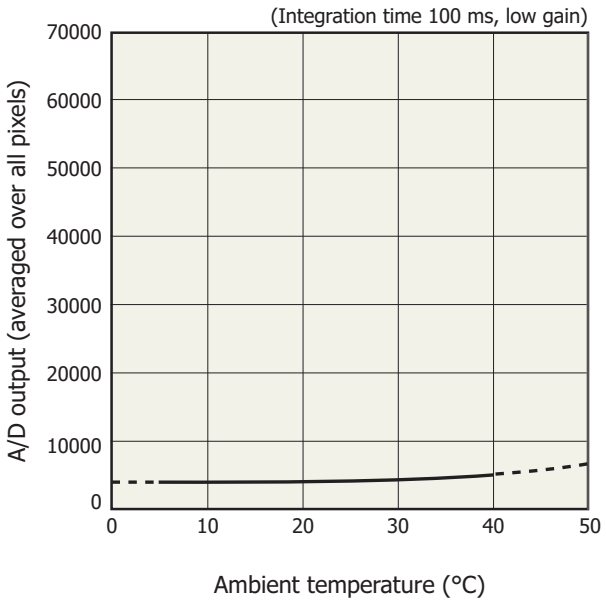
Linearity (typical example)



KACCB0356EA

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)

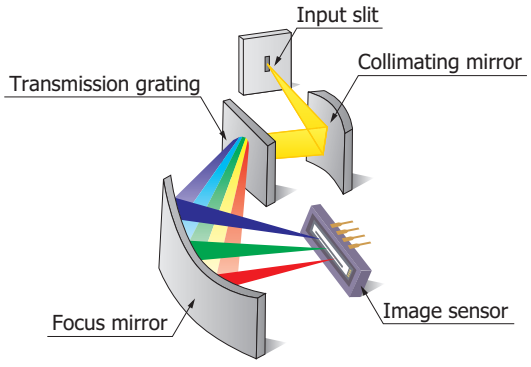


KACCB0357EA

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

Optical component layout

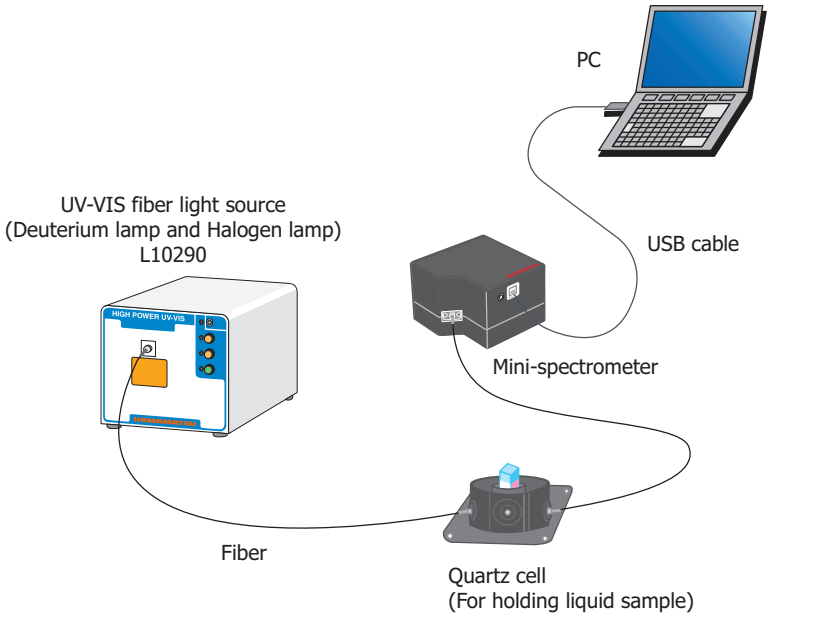
TM series mini-spectrometers use a transmission holographic grating made of quartz and precision optical components arranged on a rugged optical base, making it possible to deliver high throughput and highly accurate optical characteristics.



KACCC0287EB

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.

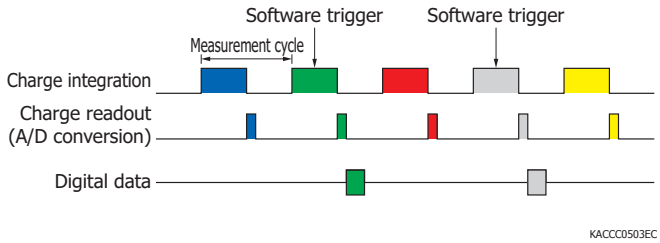


Trigger operation mode

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

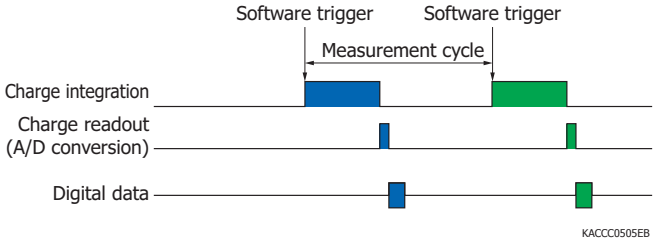
(1) Data measurement at software trigger input (asynchronous)

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



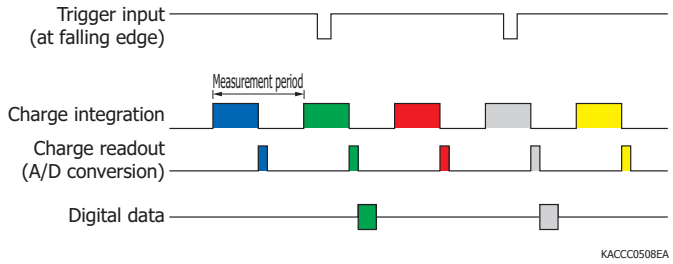
(2) Data measurement at software trigger input (synchronous)

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



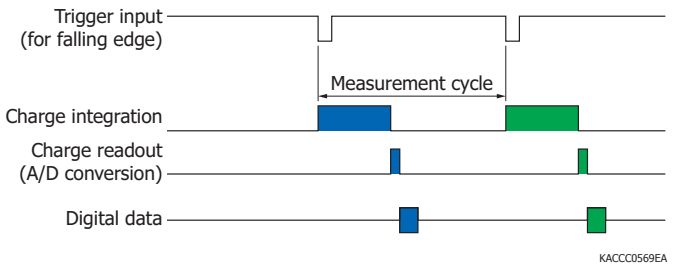
(3) Data measurement at external trigger input (asynchronous)

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.



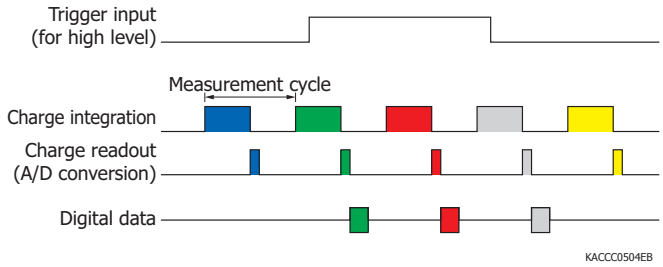
(4) Data measurement at external trigger input (synchronous)

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.



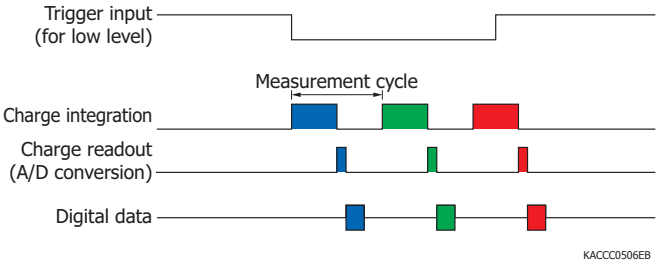
(5) Measurement by external trigger input level (asynchronous)

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)

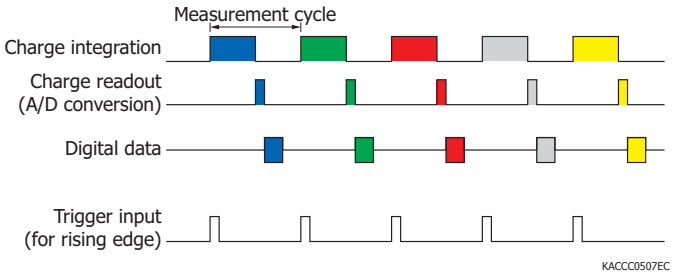
This mode starts sensor operation (integration) when an external trigger (high or low level selectable) is input to the external trigger terminal, and acquires digital data.



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

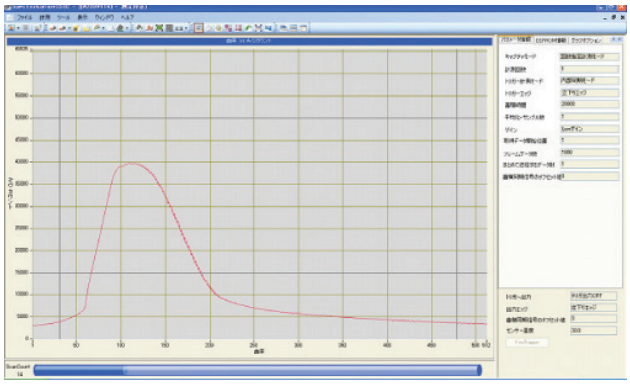
An integration start timing (pulse width: 10 µs) can be output from the external trigger terminal. (trigger output edge: rising or falling edge selectable)



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)



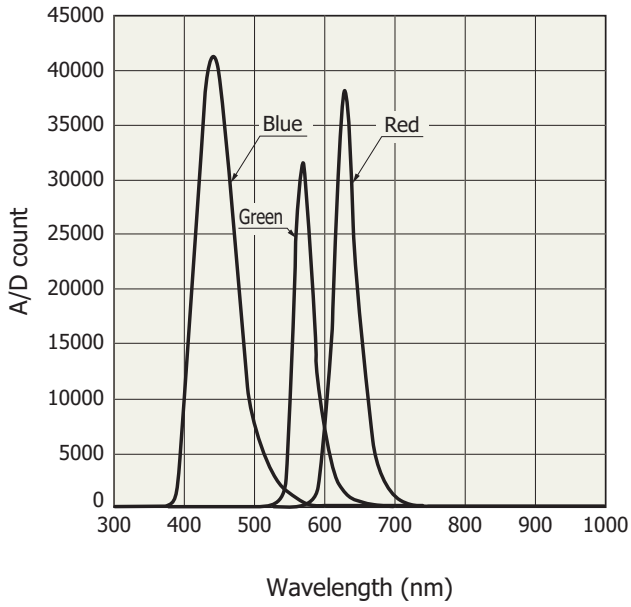
Note: Up to 8 mini-spectrometers can be connected and used with one PC.

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

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 registerd trademarks or trademarks of Microsoft Corporation in the United States and other countries.

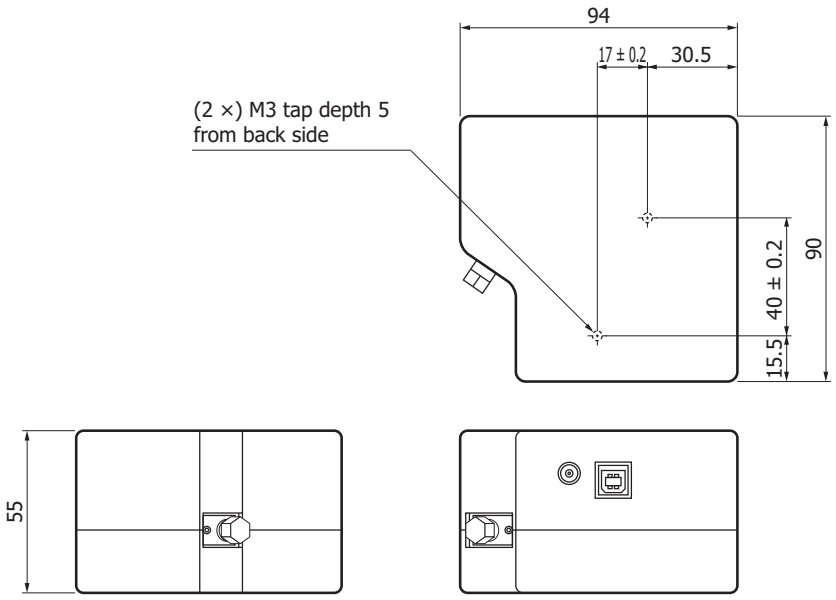
Measurement example

Measurement of visible LED



KACCB0223EA

Dimensional outline (unit: mm)



Tolerance unless otherwise noted: ±0.5
Weight: 470 g

KACCA0171EE

Accessories

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

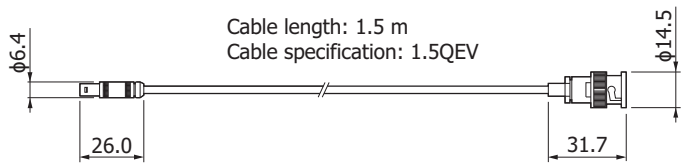
Options (sold separately)

· 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)



LEMO connector
FFA.00.250 (made by LEMO)

BNC connector
BNC-P-1.5 (40) (made by HIROSE or equivalent)

KACCA0220EB

Mini-spectrometer/micro-spectrometer lineup

Type no.	Type		Spectral response range (nm)	Spectral resolution max. (nm)	Image sensor
C10082CA	Mini-spectrometer TM series	TM-UV/VIS-CCD High sensitivity	200 to 800	6	Back-thinned CCD image sensor
C10082CAH		TM-UV/VIS-CCD High resolution		1*	
C10082MD		TM-UV/VIS-MOS Wide dynamic range		6	CMOS linear image sensor
C10083CA		TM-VIS/NIR-CCD High sensitivity	320 to 1000	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	Mini-spectrometer TG series	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	500 to 1100	5 (λ=550 to 900 nm)	IR-enhanced back-thinned CCD image sensor
C11713CA		TG-RAMAN-I High resolution	500 to 600	0.3*	Back-thinned CCD image sensor
C11714CB		TG-RAMAN-II High resolution	790 to 920	0.3*	IR-enhanced back-thinned CCD image sensor
C11482GA	Mini-spectrometer TG series	TG2-NIR Non-cooled type	900 to 1700	7	InGaAs linear image sensor
C9913GC		TG-cooled NIR-I Low noise (cooled type)		7	
C9914GB		TG-cooled NIR-II Low noise (cooled type)	1100 to 2200	8	
C11118GA		TG-cooled NIR-III Low noise (cooled type)	900 to 2550	20	
C13053MA	Mini-spectrometer FT series	FT-SWIR-MOS-II Compact, thin case	500 to 1100	3.5	High-sensitivity CMOS linear image sensor
C13054MA		FT2-RAMAN Compact, thin case	790 to 920	0.4*	
C11007MA	Mini-spectrometer RC series	RC-VIS-MOS Spectrometer module	340 to 780	9	CMOS linear image sensor
C11008MA		RC-SWNIR-MOS Spectrometer module	640 to 1050	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
C11009MA	Mini-spectrometer RC series	RC-VIS-MOS Spectrometer head	340 to 780	9	CMOS linear image sensor
C11010MA		RC-SWNIR-MOS Spectrometer head	640 to 1050	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
C11708MA	Mini-spectrometer MS series	MS-SWNIR-MOS Spectrometer head	640 to 1050	20	CMOS linear image sensor
C12666MA	Micro-spectrometer	Spectrometer head	340 to 780	15	CMOS linear image sensor
C12880MA		Spectrometer head	340 to 850	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

HAMAMATSU www.hamamatsu.com

HAMAMATSU PHOTONICS K.K., Solid State Division
1126-1 Ichino-cho, Higashi-ku, Hamamatsu City, 435-8558 Japan, Telephone: (81) 53-434-3311, Fax: (81) 53-434-5184
U.S.A.: Hamamatsu Corporation: 360 Foothill Road, Bridgewater, N.J. 08807, U.S.A., Telephone: (1) 908-231-0960, Fax: (1) 908-231-1218
Germany: Hamamatsu Photonics Deutschland GmbH: Arzbergerstr. 10, D-82211 Herrsching am Ammersee, Germany, Telephone: (49) 8152-375-0, Fax: (49) 8152-265-8
France: Hamamatsu Photonics France S.A.R.L.: 19, Rue du Saule Trapu, Parc du Moulin de Massy, 91882 Massy Cedex, France, Telephone: 33-(1) 69 53 71 00, Fax: 33-(1) 69 53 71 10
United Kingdom: Hamamatsu Photonics UK Limited: 2 Howard Court, 10 Tewin Road, Welwyn Garden City, Hertfordshire AL7 1BW, United Kingdom, Telephone: (44) 1707-294888, Fax: (44) 1707-325777
North Europe: Hamamatsu Photonics Norden AB: Torshamnsgatan 35 16440 Kista, Sweden, Telephone: (46) 8-509-031-00, Fax: (46) 8-509-031-01
Italy: Hamamatsu Photonics Italia S.r.l.: Strada della Moia, 1 int. 6, 20020 Arese (Milano), Italy, Telephone: (39) 02-93581733, Fax: (39) 02-93581741
China: Hamamatsu Photonics (China) Co., Ltd.: B1201, Jiaming Center, No.27 Dongsanhuan Beilu, Chaoyang District, Beijing 100020, China, Telephone: (86) 10-6586-6006, Fax: (86) 10-6586-2866

Cat. No. KACC1218E02 Oct. 2015 DN