HAMAMATSU

Mini-spectrometers

RC series | C11007MA C11008MA C11009MA C11010MA

Compact and low cost
C11009MA, C11010MA: for installation into measurement equipment

HAMAMATSU mini-spectrometer RC series is a family of compact polychromators integrated with a reflection grating and a CMOS linear image sensor. Two types are available: mini-spectrometer modules (C11007MA, C11008MA) with a driver circuit, and mini-spectrometer heads (C11009MA, C11010MA) for installation into measurement equipment, which contain an optical system and an image sensor in a compact case.
Mini-spectrometer modules have a USB port that connects to a PC for spectrum data collection. They come with sample software for setting measurement conditions, acquiring and saving data, and displaying data graphs, as well as with driver software and DLL. In mini-spectrometer heads, incident light is dispersed into a spectrum which is photoelectrically converted by the image sensor and output as video signals.

Features

C11007MA, C11008MA (Module)

- **Integrating spectrometer head and drive circuit**
- **Spectral measurement using PC**
- **No external power supply required: USB bus power**
- **A/D conversion: 16-bit**
- **Wavelength conversion factor *1 is recorded in internal memory.**

C11009MA, C11010MA (Head)

- **For installation into measurement equipment**
- **Integrating optical system and image sensor into a compact case**
  C11009MA: 28 × 28 × 28 mm
  C11010MA: 35 × 28 × 20 mm
- **Low cost**

Applications

C11007MA, C11009MA

- **Installation into measurement equipment**
- **Chemical measurement**
- **Visible light source testing**
- **Color measurement, etc.**

C11008MA, C11010MA

- **Installation into measurement equipment**
- **Chemical measurement**
- **Measurement of saccharic in fruits**
- **Various industrial measurements**

Selection guide

Spectrometer module

Product No.	Product type	Spectral response range (nm)	Spectral Resolution (nm)	Interface	Light input method
C11007MA	RC-VIS-MOS	340 to 780	9	USB 1.1	fiber
C11008MA	RC-SWNIR-MOS	640 to 1050	8		

Spectorometer head (for installation into measurement equipment)

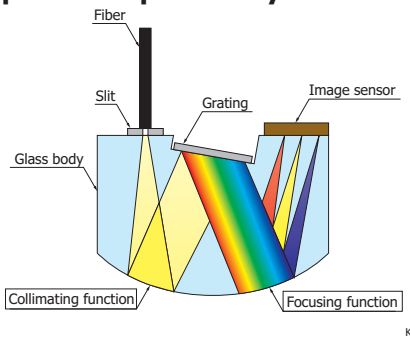
C11009MA	RC-VIS-MOS	340 to 780	9	-	fiber
C11010MA	RC-SWNIR-MOS	640 to 1050	8		

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

Structure of C11009MA, C11010MA

The C11009MA, C11010MA are offered in small size, low-cost units achieved by integrating optical components into a glass body. The reflective grating mounted on the glass body is a plastic-molded replica grating.

Optical component layout



Optical characteristics

Parameter	RC-VIS-MOS		RC-SWNIR-MOS		Unit
	C11007MA (Spectrometer module)	C11009MA (Spectrometer head)	C11008MA (Spectrometer module)	C11010MA (Spectrometer head)	
Spectral response range	340 to 780		640 to 1050		nm
Spectral resolution Max (Spectral response half width) *2	9		8		nm
Wavelength reproducibility *3	±0.5				nm
Wavelength temperature dependence	0.05				nm/°C
Spectral stray light *2 *4	-30				dB
Broadband stray light *2 *5	-25		-23		dB

*2: Depends on the slit opening. Values were measured with the slit listed in the table "General ratings / Absolute maximum ratings".
*3: Measured under constant light input conditions
*4: When monochromatic light of λ=550 nm (C11007MA, C11009MA) or λ=850 nm (C11008MA, C11010MA) is input, spectral stray light is defined as the ratio of the count measured at the input wavelength, to the count measured at a wavelength 40 nm longer or shorter than the input wavelength.
*5: The ratio of the transmittance in the transmitting wavelength region of an optical filter (C11007MA/C11009MA: OG530, C11008MA/C11010MA: RG850) to that in the blocking region

Electrical characteristics

Parameter	C11007MA (Spectrometer module)	C11009MA (Spectrometer head)	C11008MA (Spectrometer module)	C11010MA (Spectrometer head)	Unit
A/D conversion	16	-	16	-	bits
Integration time	5 to 10000	-	5 to 10000	-	ms
Interface	USB 1.1	-	USB 1.1	-	-

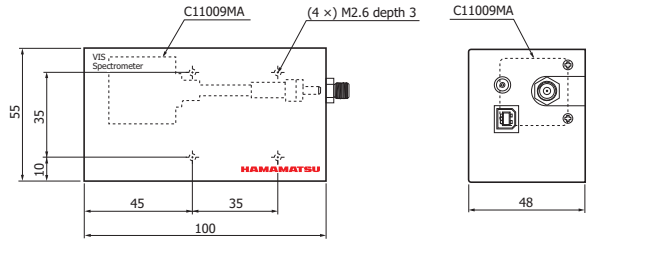
General ratings/Absolute maximum ratings

Parameter	C11007MA (Spectrometer module)	C11009MA (Spectrometer head)	C11008MA (Spectrometer module)	C11010MA (Spectrometer head)	Unit
Dimensions	55 (W) × 48 (H) × 100 (D)	28 (W) × 28 (H) × 28 (D)	55 (W) × 48 (H) × 100 (D)	35 (W) × 20 (H) × 28 (D)	mm
Built-in head	C11009MA	-	C11010MA	-	-
Image sensor	CMOS linear image sensor (S8378-256N)		Infrared enhanced type CMOS linear image sensor		-
Number of pixels	256				pixels
Slit *6	70 (H) × 550 (V)		70 (H) × 2500 (V)		µm
Optical N.A.	0.22				-
Fiber core diameter	600				µm
Optical fiber connector	SMA905				-
Operating temperature *7	+5 to +40				°C
Storage temperature *7	-20 to +70				°C

*6: Entrance slit aperture size of the incorporated image sensor
*7: No condensation

Dimensional outlines (unit: mm, tolerance unless otherwise noted: ±0.5)

C11007MA



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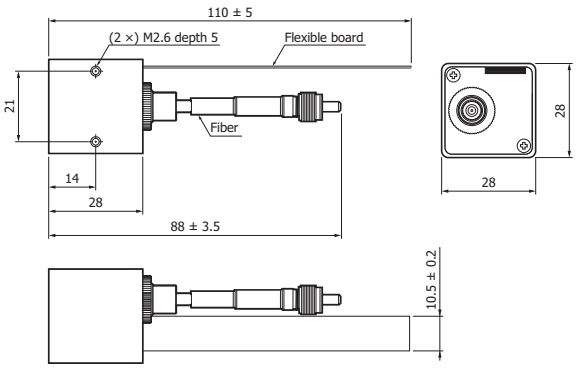
C11009MA



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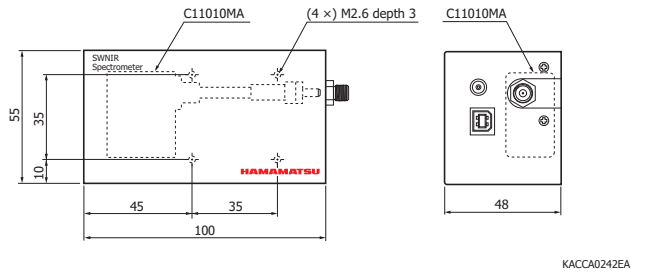
C11008MA



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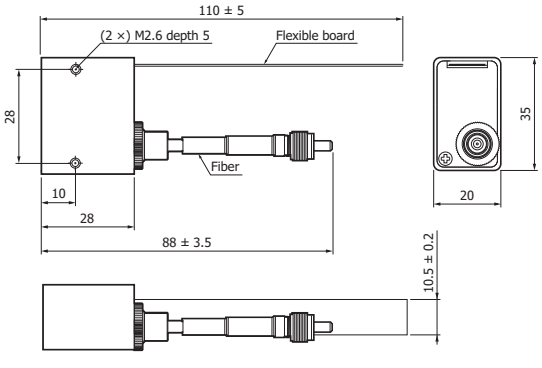
C11010MA



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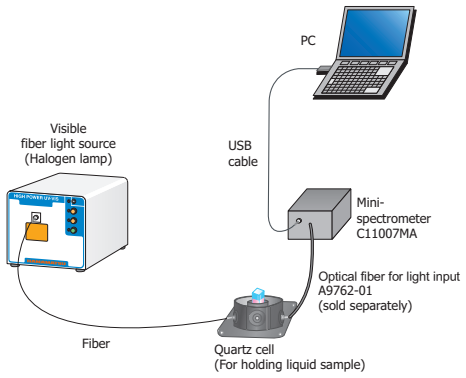
Connection example (transmission light measurement)

Light to be measured is guided into the entrance port of RC 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 measurement are obtained at all times. An optical fiber that guides light input from external sources allows a flexible measurement setup.



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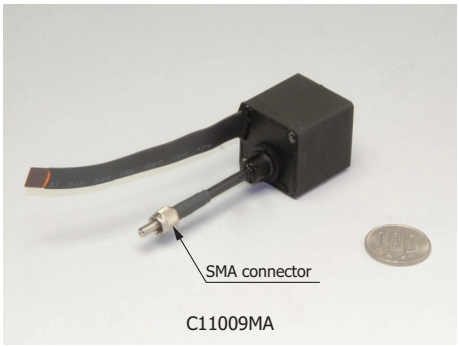
Light input method

For mini-spectrometer head (C11009MA, C11010MA), an SMA connector is attached with the other end of the optical fiber. Light can be easily guided by hooking up this connector to the SMA receptacle of an external unit. If the optical fiber connected to mini-spectrometer RC series is shorter than needed, an optical fiber of the desired length can be added by connecting a relay unit.



C11009MA

Optical fibers for light input (A9762-01, A9763-01)

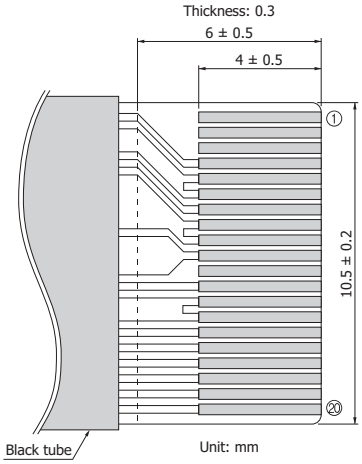
As optional accessories for use with mini-spectrometer modules (C11007MA, C11008MA), HAMAMATSU provides UV-VIS (UV resistant) and VIS-NIR optical fibers (core diameter 600 µm). The mini-spectrometer heads (C11009MA, C11010MA) integrate an optical fiber.

Type No.	Product name	Applicable mini-spectrometer	Core diamater (µm)	Specification
A9762-01	UV-VIS optical fiber (UV resistant)	C11007MA	600	N.A.=0.22 Length 1.5 m, both ends terminated with SMA905D connector
A9763-01	VIS-NIR optical fiber	C11008MA	600	N.A.=0.22 Length 1.5 m, both ends terminated with SMA905D connector

Electrical connections with an external circuit (C11009MA, C11010MA)

The flexible printed circuit board protruding from the head or module is used make electrical connections to an external circuit.

· Mating connectors:
FH12-20S-0.5SV vertical type (Made by HIROSE electric)
FH12 52745-2090 horizontal type (Made by MOLEX)



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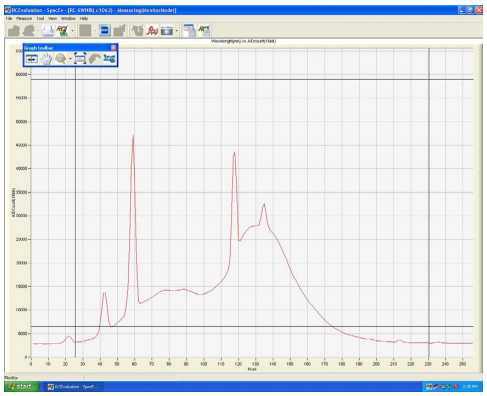
Pin No.	Terminal name	I/O	Discription	Pin No.	Terminal name	I/O	Discription
①	NC	-	No connection	⑪	NC	-	No connection
②	NC	-	No connection	⑫	GAIN	I	Gain setting
③	NC	-	No connection	⑬	A.GND	-	Analog GND
④	EOS	O	EOS (end of scan) signal	⑭	A.GND	-	Analog GND
⑤	A.GND	-	Analog GND	⑮	ST	I	Sensor scan start signal
⑥	A.GND	-	Analog GND	⑯	CLK	I	Sensor scan sync signal H-CMOS compatible
⑦	VIDEO	O	Video signal output	⑰	SDA	O	Thermosensor output signal
⑧	A.GND	-	Analog GND	⑱	SCL	I	Thermosensor driver signal
⑨	A.GND	-	Analog GND	⑲	D.GND	-	Thermosensor digital GND
⑩	+5 V	I	Power supply of image sensor: +5 V	⑳	VCC	I	Power supply of thermosensor: +3.3 V

Note:
· Pins 4 to 10 and 12 to 16 are connected to the image sensor.
For information on drive specifications, refer to "CMOS linear image sensor S8377/S8378 series" datasheet.
· Pins 17 to 20 are connected to the internal thermosensor (DALLAS DS1775R).

Dedicated software (C11007MA, C11008MA)



Installing the dedicated software package (containing sample software, device driver, DLL)*10 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 operation
  - Pixel number to wavelength conversion
  - Dark subtraction
  - Comparison calculation with reference data (transmittance, reflectance)
  - Gaussian approximation (peak position and count, FWHM)

Note: This product cannot operate with the software that comes with the mini-spectrometer TM or TG series.

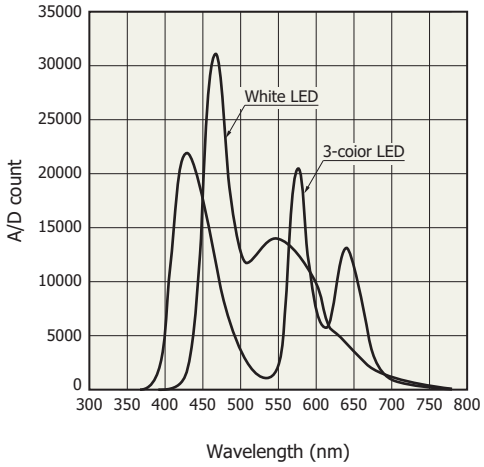
*10: Compatible OS: Microsoft Windows Professional Edition 2000 (SP3 or later) and XP (SP1 or later)

Device driver and DLL for controlling hardware are also provided.
You can develop your own measurement programs by using a software development environment that includes Microsoft Visual C++ and Visual Basic*11. The DLL provides functions such as USB port open/close, measurement condition setup, measurement data and module information acquisition.

*11: Operation of the device driver and DLL has been verified only with Microsoft Visual C++® and Visual Basic®.
Microsoft Visual C++ and Microsoft Visual Basic are either registerd trademarks or trademarks of Microsoft Corporation in the United States and other countries.

Measurement examples

(1) White LED and 3-color LED measurements (C11007MA)



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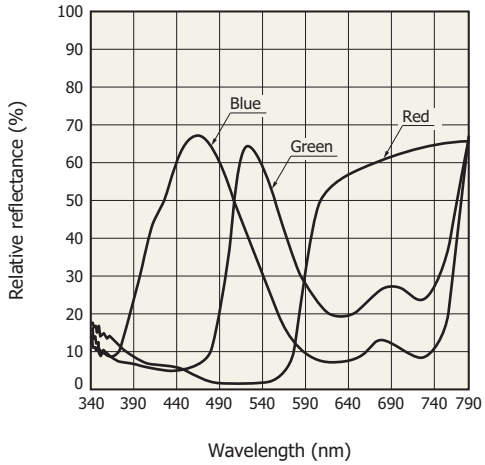
(2) Reflected light from color paper (C11007MA)

Relative reflectance with 100 % being equal to reflectance of white plate



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Accessories (C11007MA, C11008MA only)

- USB cable
- Dedicated software (sample software, device driver, DLL)

CE

The C11007MA and C11008MA conform to the European EMC directives (Applied standard: EN 61326-1 Class B).

Mini-spectrometer line-up

Type No.	Type		Spectral response range (nm)	Spectral resolution Max. (nm)	Image sensor
C10082CA	TM series	TM-UV/VIS-CCD High sensitivity	200 to 800	6	Back-thinned type CCD image sensor
C10082CAH	TM series	TM-UV/VIS-CCD High resolution	200 to 800	1*	Back-thinned type CCD image sensor
C10082MD	TM series	TM-UV/VIS-MOS Wide dynamic range	200 to 800	6	CMOS linear image sensor
C10083CA	TM series	TM-VIS/NIR-CCD High sensitivity	320 to 1000	8 (λ=320 to 900 nm)	Back-thinned type CCD image sensor
C10083CAH	TM series	TM-VIS/NIR-CCD High resolution	320 to 1000	1* (λ=320 to 900 nm)	Back-thinned type CCD image sensor
C10083MD	TM series	TM-VIS/NIR-MOS Wide dynamic range	320 to 1000	8	CMOS linear image sensor
C9404CA	TG series	TG-UV-CCD High sensitivity	200 to 400	3	Back-thinned type CCD image sensor
C9404CAH	TG series	TG-UV-CCD High resolution	200 to 400	1*	Back-thinned type CCD image sensor
C9404MC	TG series	TG-UV-MOS Wide dynamic range	200 to 400	3	CMOS linear image sensor
C9405CA	TG series	TG-SWNIR-CCD High sensitivity	500 to 1100	5 (λ=550 to 900 nm)	Back-thinned type CCD image sensor
C9405MC	TG series	TG-SWNIR-MOS Wide dynamic range	500 to 1100	5 (λ=550 to 1100 nm)	NMOS linear image sensor
C9406GC	TG series	TG-NIR Non-cooled type	900 to 1700	7	InGaAs linear image sensor
C9913GC	TG series	TG-cooled NIR-I Low noise (cooled type)	900 to 1700	7	InGaAs linear image sensor
C9914GB	TG series	TG-cooled NIR-II Low noise (cooled type)	1100 to 2200	8	InGaAs linear image sensor
C11118GA	TG series	TG-cooled NIR-III Low noise (cooled type)	900 to 2550	20	InGaAs linear image sensor
C11007MA	RC series	RC-VIS-MOS Spectrometer module	340 to 780	9	CMOS linear image sensor
C11008MA	RC series	RC-SWNIR-MOS Spectrometer module	640 to 1050	8	CMOS linear image sensor

* Typ.

For installation into measurement equipment

Type No.	Type		Spectral response range (nm)	Spectral resolution Max. (nm)	Image sensor
C11009MA	RC series	RC-VIS-MOS Spectrometer head	340 to 780	9	CMOS linear image sensor
C11010MA	RC series	RC-SWNIR-MOS Spectrometer head	640 to 1050	8	CMOS linear image sensor

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