



# Mini-spectrometer

[ TG series ]

C11118GA

## Long-wavelength type (to 2.55 $\mu\text{m}$ ) near-infrared mini-spectrometer

HAMAMATSU TG series mini-spectrometers are polychromators integrated with optical elements and an image sensor. Light to be measured is guided into the entrance port of TG 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 C11118GA has sensitivity extending to longer wavelengths (up to 2.55  $\mu\text{m}$ ) than the existing C9914GB (up to 2.2  $\mu\text{m}$ ). The C11118GA comes with sample software for setting measurement conditions, acquiring and saving spectrum data, and displaying data graphs, as well as with the evaluation software and DLL.

### Features

- Spectral response range: 0.9 to 2.55  $\mu\text{m}$
- Compatible with USB 2.0 interface
- High throughput due to transmission grating made of quartz
- Highly accurate optical characteristics
- Low noise: cooled type
- Compact design for easy assembly
- Wavelength conversion factor <sup>\*1</sup> is recorded in internal memory
- Compatible with external trigger

<sup>\*1</sup>: 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.

### Applications

- Measurement of C-H group absorption (2.3  $\mu\text{m}$  band)
- Soil analysis and component analysis

### Optical characteristics (Ta=25 °C)

Parameter	Specification	Unit
Spectral response range	0.9 to 2.55	$\mu\text{m}$
Spectral resolution (spectral response half width) <sup>*2</sup>	20 max.	nm
Wavelength reproducibility <sup>*3</sup>	-0.8 to +0.8	nm
Wavelength temperature dependence	-0.08 to +0.08	nm/°C
Spectral stray light <sup>*2</sup> <sup>*4</sup>	-30 max.	dB

<sup>\*2</sup>: Depends on the slit opening. Values were measured with the slit listed in the table "Structure/Absolute maximum ratings".

<sup>\*3</sup>: Measured under constant light input conditions, etc.

<sup>\*4</sup>: When monochromatic light of  $\lambda=1700$  nm 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.

## Electrical characteristics (Ta=25 °C)

Parameter	Specification	Unit
A/D conversion	16	bits
Integration time*5	6 to 40000*6	μs
Interface	USB 2.0	-
USB bus power current consumption	250 max.	mA
Current consumption for cooling element (+5 V)*7	2.8 max.	A
Current consumption for cooling fan (+12 V)*7	0.2 max.	A

\*5: Depends on the image sensor dark current.

\*6: Excluding defective pixels

\*7: Maximum value in steady state. Note that inrush current flows at start-up.

## Structure / Absolute maximum ratings

Parameter	Specification	Unit
Dimensions (W × D × H)	142 × 218 × 80	mm
Weight	1.7	kg
Image sensor	InGaAs linear image sensor (G9208-256W)	-
Number of pixels*8	256	pixels
Slit*9 (H × V)	140 × 250	μm
NA*10	0.22	-
Connector for optical fiber	SMA905D	-
Image sensor cooling temperature	-20	°C
Operating temperature*11	+5 to +35 (+5 to +30*12)	°C
Storage temperature*11	-20 to +70	°C

\*8: Up to 3 discontinuous defective pixels might exist (at low gain). Defective pixels are those whose electrical and optical characteristics do not meet our specifications.

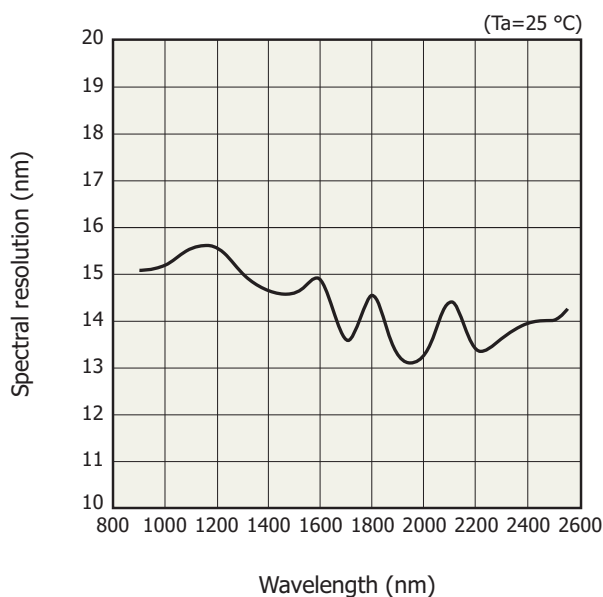
\*9: Entrance slit aperture size

\*10: Numerical aperture (solid angle)

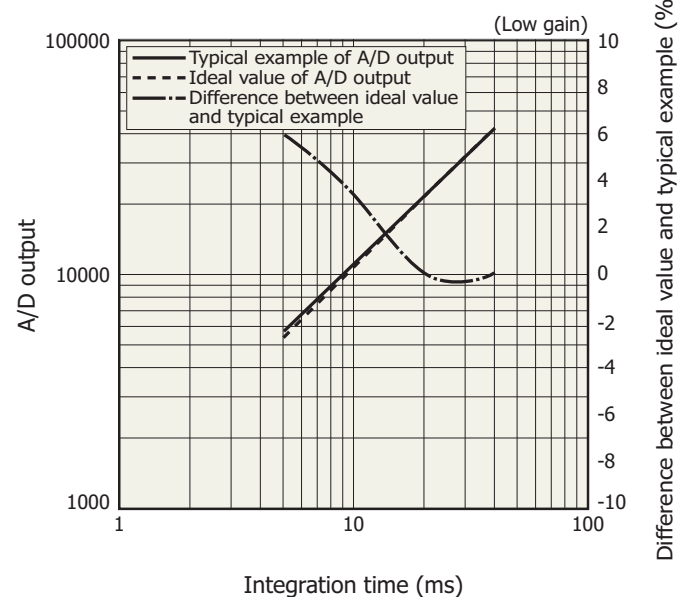
\*11: No condensation

\*12: Operating temperature capable of cooling control

## Spectral resolution vs. wavelength (typical example)

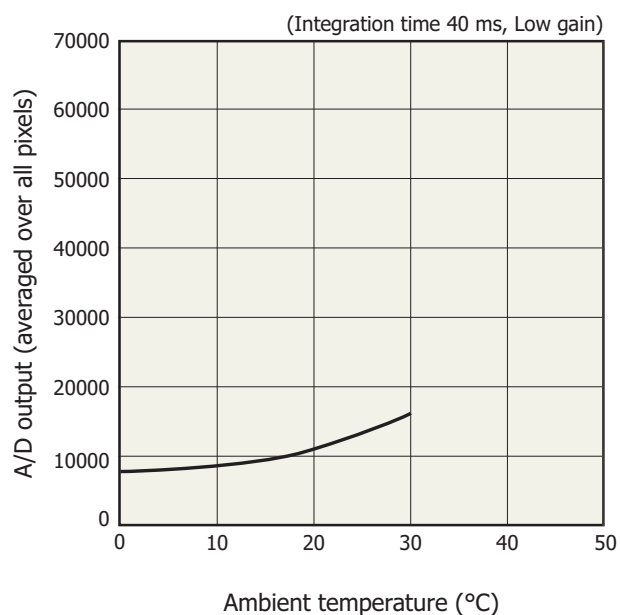


## Linearity (typical example)



Note: 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)

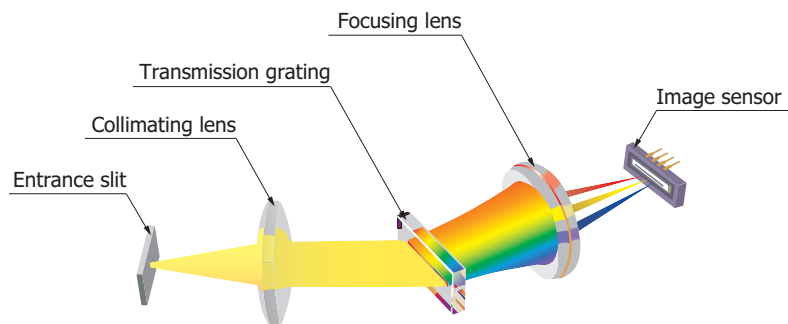


Note: A/D output is the sum of the sensor and circuit offset outputs and the sensor dark output.

KACCB0257EA

### Optical component layout

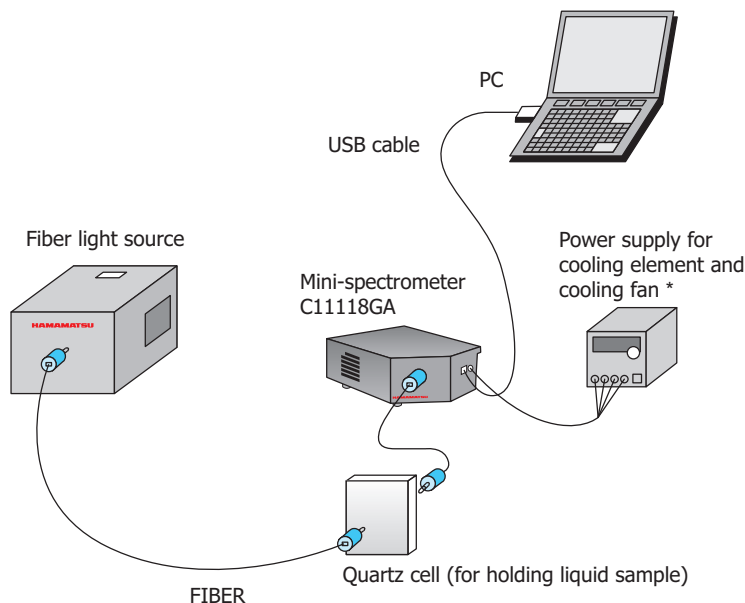
TG series mini-spectrometers use a transmission holographic grating made of quartz and precision optical components arranged on a rugged optical base, making it possible to deliver high throughput and highly accurate optical characteristics.



KACCC0256EA

### Connection example (transmission light measurement)

Light to be measured is guided into the entrance port of TG 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.



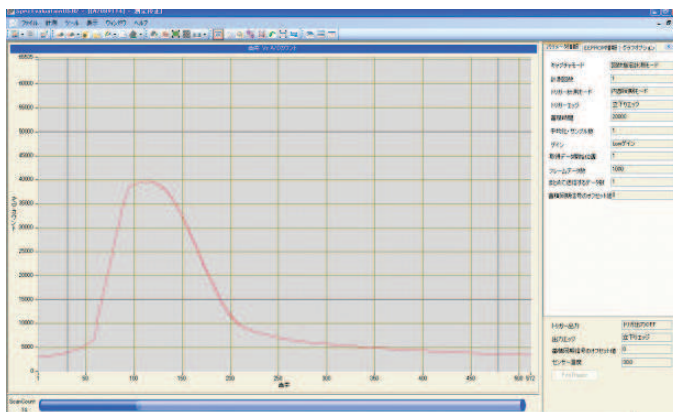
\* External power supply should be prepared by the user.

KACCC0490EA

### Evaluation software (supplied with unit)

Installing the evaluation software (SpecEvaluationUSB2.exe)<sup>\*13</sup> 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.

<sup>\*13</sup>: Compatible OS: Microsoft® Windows® XP Professional SP3 (32-bit)<sup>\*14</sup>  
 Microsoft® Windows® Vista Business SP2 (32-bit)<sup>\*14</sup>  
 Microsoft® Windows® 7 Ultimate SP1 (32-bit)<sup>\*14</sup>  
 Microsoft® Windows® 7 Ultimate SP1 (64-bit)<sup>\*14</sup>

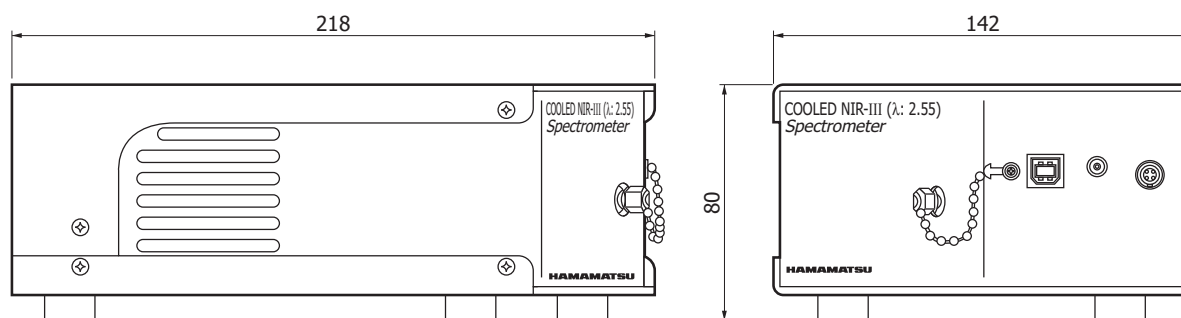
DLL for controlling hardware is also provided.

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

Microsoft® Visual Studio® 2008 (SP1) Visual C++<sup>\*14</sup>

Microsoft® Visual Studio® 2008 (SP1) Visual Basic<sup>\*14</sup>

<sup>\*14</sup>: 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.

**Dimensional outline (unit: mm, tolerance unless otherwise noted:  $\pm 0.5$ )**

Weight: 1.7 kg

KACCA0258EC

**Accessories**

- USB cable
- Dedicated software (evaluation software, DLL)
- Power supply connector for cooling element and cooling fan (FGG0B304CLAD56 made by LEMO S.A.)

**Options (sold separately)**

Type no.	Product name	Specification
A10670	Coaxial cable for external trigger	1.5D-2V, Length 1.5 m Connector (one side) <ul style="list-style-type: none"><li>· LEMO connector (FFA00S250 made by LEMO)</li><li>· BNC connector (BNC-P-1.5V-CR made by DDK)</li></ul>
A9763-01	Fiber for visible/near infrared range	Core diameter $\phi 600 \mu\text{m}$ , NA=0.22, Length 1.5 m Connector (both ends): SMA905D



The C11118GA conforms to the European EMC directives (Applied standard: EN 61326-1 Class B).

## Mini-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 series	TM-UV/VIS-CCD High sensitivity																6	Back-thinned type 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 type CCD image sensor
C10083CAH		TM-VIS/NIR-CCD High resolution			320 to 1000												1* (λ=320 to 900 nm)		
C10083MD		TM-VIS/NIR-MOS Wide dynamic range																8	CMOS linear image sensor
<div>NEW</div> C11697MA		TM-VIS/NIR-MOS-II Trigger-compatible																8	CMOS image sensor with amp array
C9404CA	TG series	TG-UV-CCD High sensitivity		200 to 400														3	Back-thinned type CCD image sensor
C9404CAH		TG-UV-CCD High resolution																1*	Back-thinned type CCD image sensor
<div>NEW</div> C9405CB		TG-SWNIR-CCD-II IR-enhanced				500 to 1100												5 (λ=550 to 900 nm)	IR-enhanced back-thinned CCD image sensor
<div>NEW</div> C11713CA		TG-RAMAN-I High resolution				500 to 600												0.3*	Back-thinned type CCD image sensor
<div>NEW</div> C11714CA		TG-RAMAN-II High resolution						790 to 920										0.3*	Back-thinned type CCD image sensor
C9406GC	TG series	TG-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	
C11007MA	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
			200	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600			
C11009MA	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	

### Ultra-compact type 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			
C10988MA	MS series	MS-VIS-MOS Spectrometer head															14	CMOS linear image sensor
<div>NEW</div> C11708MA		MS-SWNIR-MOS Spectrometer head															20	

Information described in this material is current as of January, 2012.

Product specifications are subject to change without prior notice due to improvements or other reasons. Before assembly into final products, please contact us for the delivery specification sheet to check the latest information.

Type numbers of products listed in the delivery specification sheets or supplied as samples may have a suffix "(X)" which means preliminary specifications or a suffix "(Z)" which means developmental specifications.

The product warranty is valid for one year after delivery and is limited to product repair or replacement for defects discovered and reported to us within that one year period. However, even if within the warranty period we accept absolutely no liability for any loss caused by natural disasters or improper product use.

Copying or reprinting the contents described in this material in whole or in part is prohibited without our prior permission.

# 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, P.O.Box 6910, Bridgewater, N.J. 08807-0910, 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 Trépu, 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: Smidesvägen 12, SE-171 41 Solna, 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) 02-935-81-733, Fax: (39) 02-935-81-741

China: Hamamatsu Photonics (China) Co., Ltd.: 1201 Tower B, Jiaming Center, No.27 Dongsanhuan Beilu, Chaoyang District, Beijing 100020, China, Telephone: (86) 10-6586-6006, Fax: (86) 10-6586-2866