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NEW

# Mini-spectrometer


**TF series** | C14486GA

## For near-infrared range, compact/thin case with InGaAs linear image sensor mounted

The mini-spectrometer TF series is a polychromator provided in a compact, thin case that houses optical elements, image sensor, and driver circuit. Spectrum data can be acquired by guiding measurement light into a mini-spectrometer through an optical fiber and transferring the measured results to a PC via the USB connection. Moreover, the trigger function that can be also used for short-term integration enables spectroscopic measurement of pulse emissions.
The product includes free evaluation software with functions for setting measurement conditions, acquiring and saving data, drawing graphs, and so on. Furthermore, the DLL function specifications are disclosed, so users can create their original measurement software programs.

### Features

- **Compact, thin case**
- **InGaAs linear image sensor built-in**
- **With trigger function**
- **High throughput using quartz transmission grating**
- **External power supply is not necessary (USB bus powered).**
- **Easy installation in devices**
- **Stores wavelength conversion factor*1 in internal memory**

### Applications

- **Sugar content of foods, moisture measurement**
- **Film thickness measurement**

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

### Structure

| Parameter | Specification | Units |
|---|---|---|
| Dimensions (W × D × H) | 80 × 60 × 12 | mm |
| Weight | 88 | g |
| Image sensor | InGaAs linear image sensor | - |
| Number of pixels | 256 | pixels |
| Slit*2 (H x V) | 25 × 250 | µm |
| NA*3 | 0.22 | - |
| Connector for optical fiber | SMA905D | - |

*2: Input slit aperture size
*3: Numeric aperture (solid angle)

### Absolute maximum ratings

| Parameter | Value | Units |
|---|---|---|
| Operating temperature*4 | +5 to +50 | °C |
| Storage temperature*4 | -20 to +70 | °C |

*4: 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.

## Optical characteristics

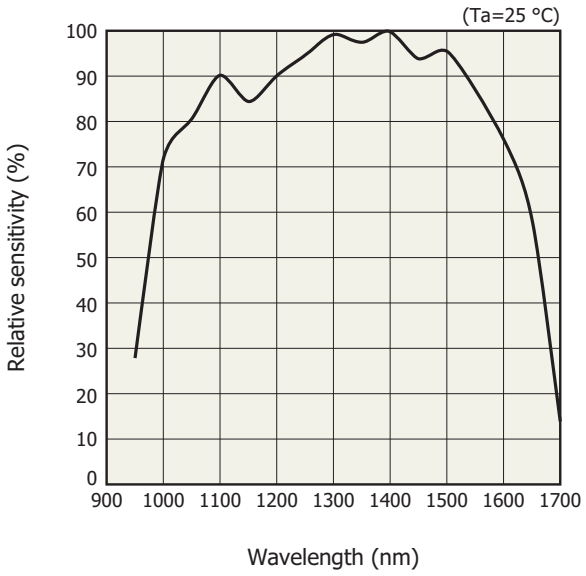
| Parameter | | Specification | Units |
|---|---|---|---|
| Spectral response range | | 950 to 1700 | nm |
| Spectral resolution (half width)*5 | Typ. | 5.0 | nm |
| | Max. | 7.0 | |
| Wavelength reproducibility*6 | | -0.4 to +0.4 | nm |
| Wavelength temperature dependence | | -0.05 to +0.05 | nm/°C |
| Spectral stray light*5 *7 | | -33 max. | dB |

*5: When the slit in the table in "Structure" is used. The spectral resolution depends on the slit.
*6: Measured under constant light input conditions
*7: The ratio of the count measured when a 1300 nm light is input to the count measured when a 1300 ± 40 nm light is input.

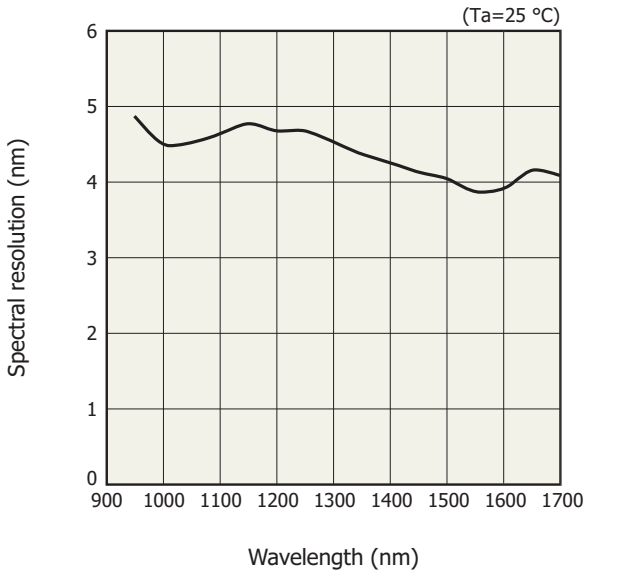
## Electrical characteristics

| Parameter | | Specification | Unit |
|---|---|---|---|
| A/D conversion | | 16 | bit |
| Integration time | | 1 to 100000 | µs |
| Interface | | USB 2.0 | - |
| USB bus power current consumption | Typ. | 220 | mA |
| | Max. | 250 | |

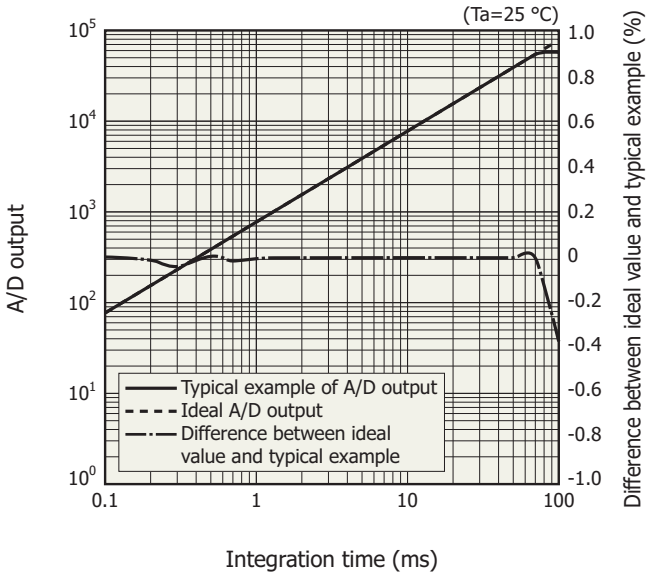
## Spectral response (typical example)




## Spectral resolution vs. wavelength (typical example)

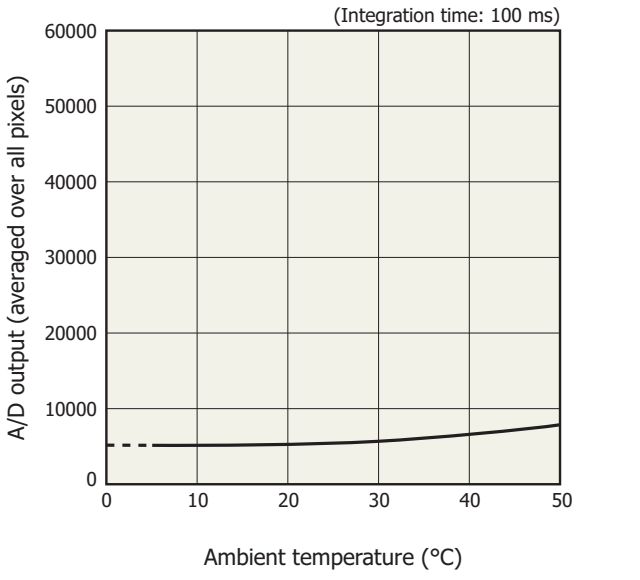


## Linearity (typical example)




A/D output is the output with dark output 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

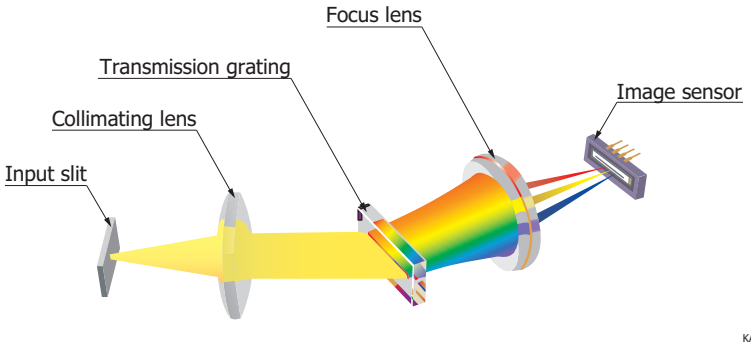
## Dark output vs. temperature (typical example)




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

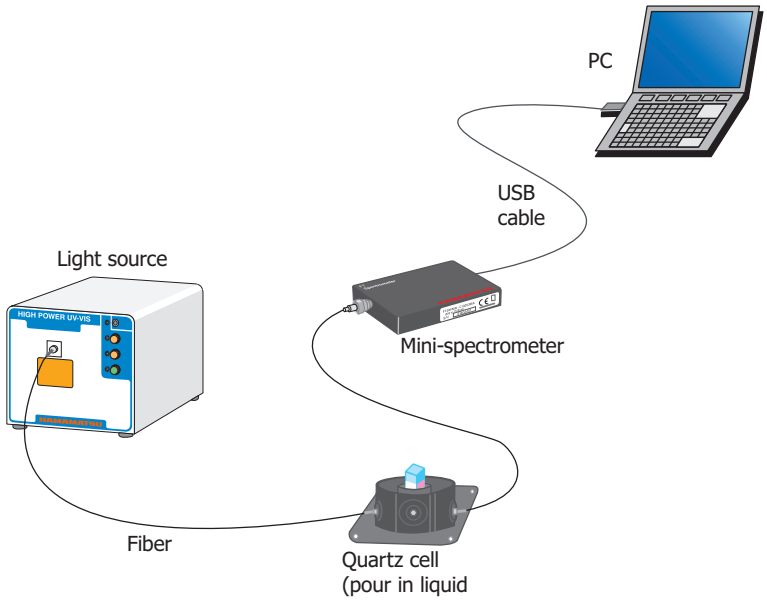
## Optical component layout

The mini-spectrometer TF series employs a transmission holographic grating made of quartz and an optical system arranged on a robust optical base to produce high throughput and highly accurate optical characteristics.



## Connection example (transmitted light measurement)

Spectrum data can be acquired by guiding measurement light into a mini-spectrometer through an optical fiber and transferring the measured results to a PC via the USB connection. Since there are no moving parts inside the device, constantly stable measurements can be expected. Moreover, the optical guiding section uses an optical fiber making connection to the measured object flexible.

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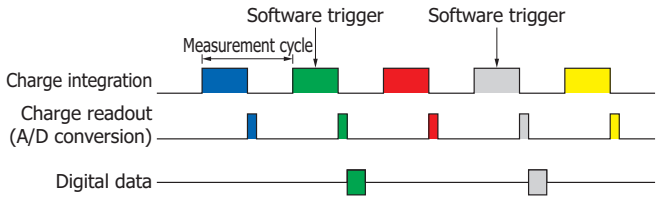
## Trigger operation modes

In the C14486GA, the following trigger operation modes are available. You can switch between these modes from the evaluation software supplied with the C14486GA.

### (1) Asynchronous data measurement at software trigger input

The first piece of digital data that is converted after a software trigger is applied from the PC is acquired.

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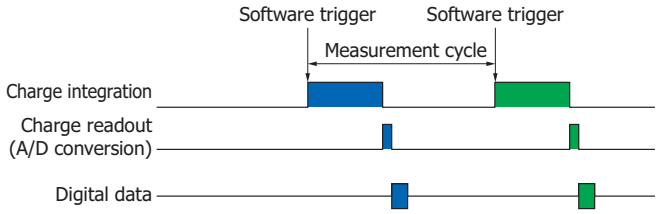
### (2) Synchronous data measurement at software trigger input

Sensor operation (integration) starts when a software trigger is applied from the PC.

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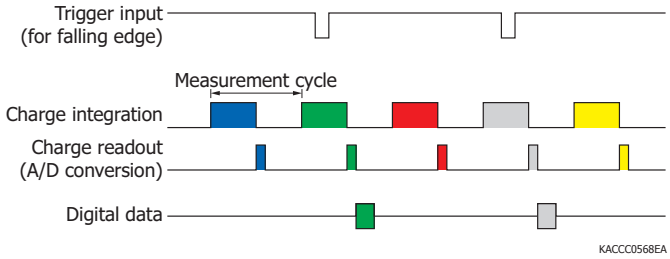
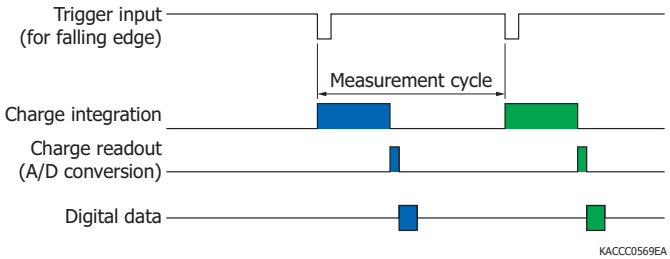
### (3) Asynchronous data measurement at external trigger input

The first piece of digital data that is converted after an external trigger edge (rising or falling edge can be specified) is applied to the external trigger terminal is acquired.



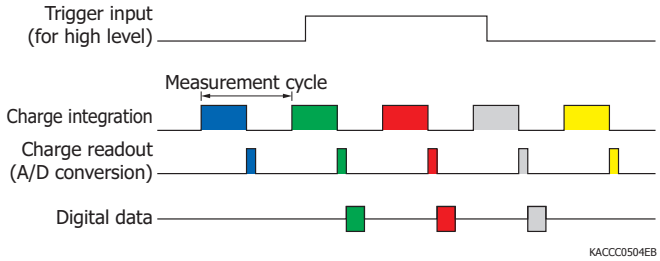

### (4) Synchronous data measurement at external trigger input

Sensor operation (integration) starts when an external trigger edge (rising or falling edge can be specified) is applied to the external trigger terminal, and then the digital data is acquired.



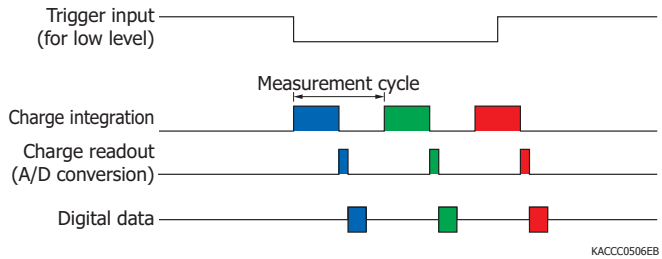

### (5) Asynchronous data measurement at external trigger input level

Digital data is acquired when an external trigger (high level or low level can be specified) is applied to the external trigger terminal.




### (6) Synchronous data measurement at external trigger input level

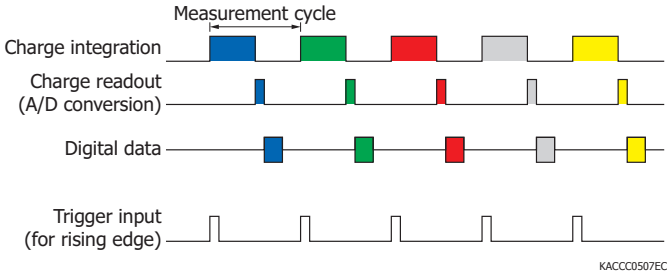
Sensor operation (integration) starts when a trigger (high level or low level can be specified) is applied to the external trigger terminal, and then the digital data is acquired.




In any of the modes (1) to (6), if the trigger input cycle is shorter than the measurement cycle of the spectrometer, the input trigger is ignored.

### (7) External trigger signal output

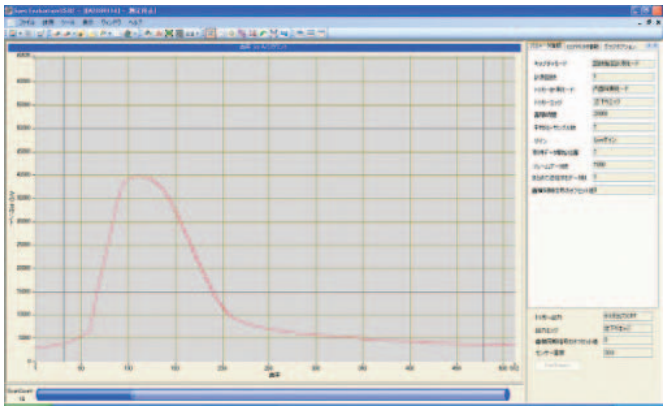
The start timing (pulse width: 10 µs) of integration can be output from the external trigger terminal (trigger output edge: rising or falling edge can be specified).



## Evaluation software (accessory)

By installing the evaluation software (SpecEvaluationUSB2.exe)*8 into a PC, you can perform the following basic operations.

- Acquire and save measured data
- Set measurement conditions
- Module information acquisition (wavelength conversion factor, mini-spectrometer type, etc.)
- Display graphs
- Arithmetic functions
  - Pixel number to wavelength conversion
  - Calculation in comparison with reference data (transmittance, reflectance)
  - Dark subtraction
  - Gaussian approximation (peak position and count, FWHM)

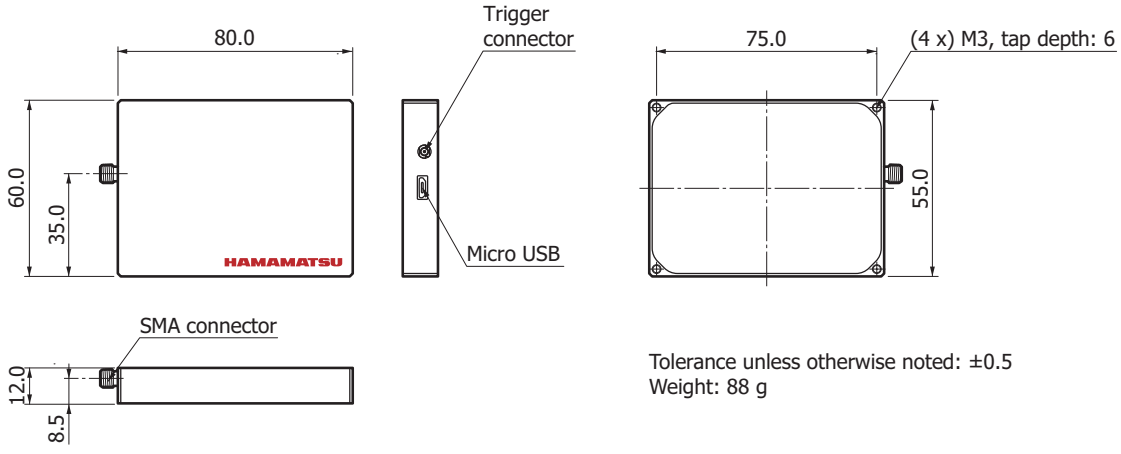


Note: Up to eight mini-spectrometers can be connected to a single PC and used.

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

A DLL for controlling the hardware is available.
Users can develop original measurement programs using the following development platform.
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/or other countries.

## Dimensional outline (unit: mm)




Tolerance unless otherwise noted: ±0.5
Weight: 88 g

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## Accessories

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

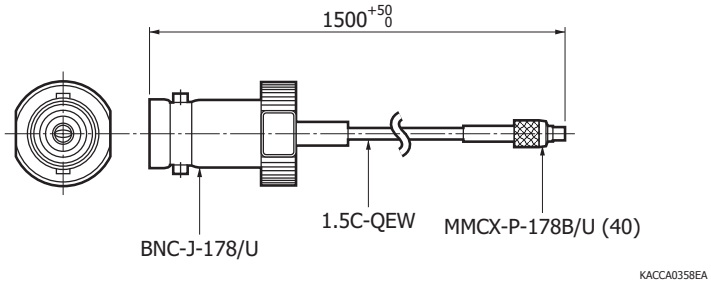
## Options (sold separately)

· Input optical fiber

| Type no. | Product name | Core diameter (µm) | Specifications |
|---|---|---|---|
| A9763-01 | Fiber for visible/near infrared range | 600 | NA=0.22, length=1.5 m, low cost<br>With SMA905D connector on each end |
| A9763-05 | | 400 | NA=0.22, length=1.5 m, small bending radius at fiber section<br>With SMA905D connector on each end |

· External trigger input coaxial cable A12763

■ Dimensional outline (unit: mm)



## Mini-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-illuminated type 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 (Wavelength 320 to 900 nm) | Back-thinned CCD image sensor |
| C10083CAH | | TM-VIS/NIR-CCD High resolution | | 1* (Wavelength 320 to 900 nm) | |
| C10083MD | | TM-VIS/NIR-MOS Wide dynamic range | | 8 | CMOS linear image sensor |
| C11697MB | | TM-VIS/NIR-MOS-II Trigger compatibility | | 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* | Back-thinned CCD image sensor |
| C9405CB | | TG-SWNIR-CCD-II IR enhanced | 500 to 1100 | 5 (Wavelength 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 | |
| C13555MA | Mini-spectrometer TF Series | TF-VIS-MOS-II Compact, thin case | 340 to 830 | 3 | High-sensitivity CMOS linear image sensor |
| C13053MA | | TF-SWIR-MOS-II Compact, thin case | 500 to 1100 | 3.5 | |
| C14486GA | | TF-NIR Compact, thin case | 950 to 1700 | 5* | InGaAs linear image sensor |
| C13054MA | | TF-RAMAN Compact, thin case | 790 to 920 | 0.4* | High-sensitivity CMOS linear image sensor |
| C14214MA | | TF-RAMAN Compact, thin case | 790 to 1050 | 0.6 | |
| 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. Value

For incorporation into mobile measurement devices

| 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 incorporation into mobile measurement devices (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



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Cat. No. KACC1264E01 Aug. 2018 DN