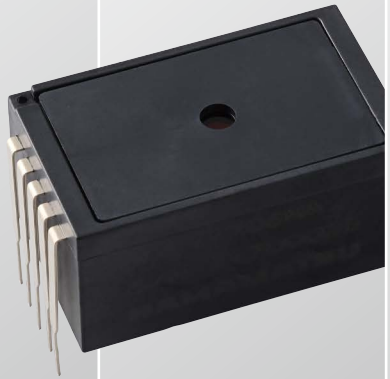
Compact spectrometers with built-in Hamamatsu image sensor, optical element, etc.

Mini-spectrometers



Related product

FTIR engines (FT-NIR spectrometer)

Portable NIR spectroscopic modules

MEMS-FPI spectroscopic modules

Ultra-compact near infrared spectrum sensor with MEMS-FPI tunable filter

Mini-spectrometers

We have more than 20 different mini-spectrometers for the ultraviolet to near infrared regions.

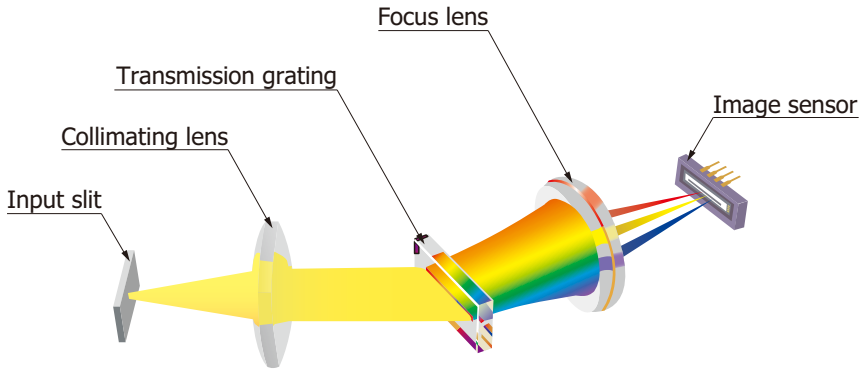
What are mini-spectrometers?

Mini-spectrometers are small spectrometers (polychromators) with an integrated optical system, image sensor, and driver circuit. They are portable devices that make them possible to do real-time measurement on-site.

Applications

- Color measurement
- Sugar content measurement
- Film thickness measurement
- Plastic screening
- Fluorescence measurement
- Environmental analysis
- Mobile measuring devices

● Example of mini-spectrometer optical system



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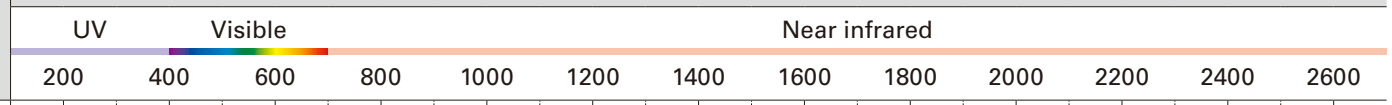
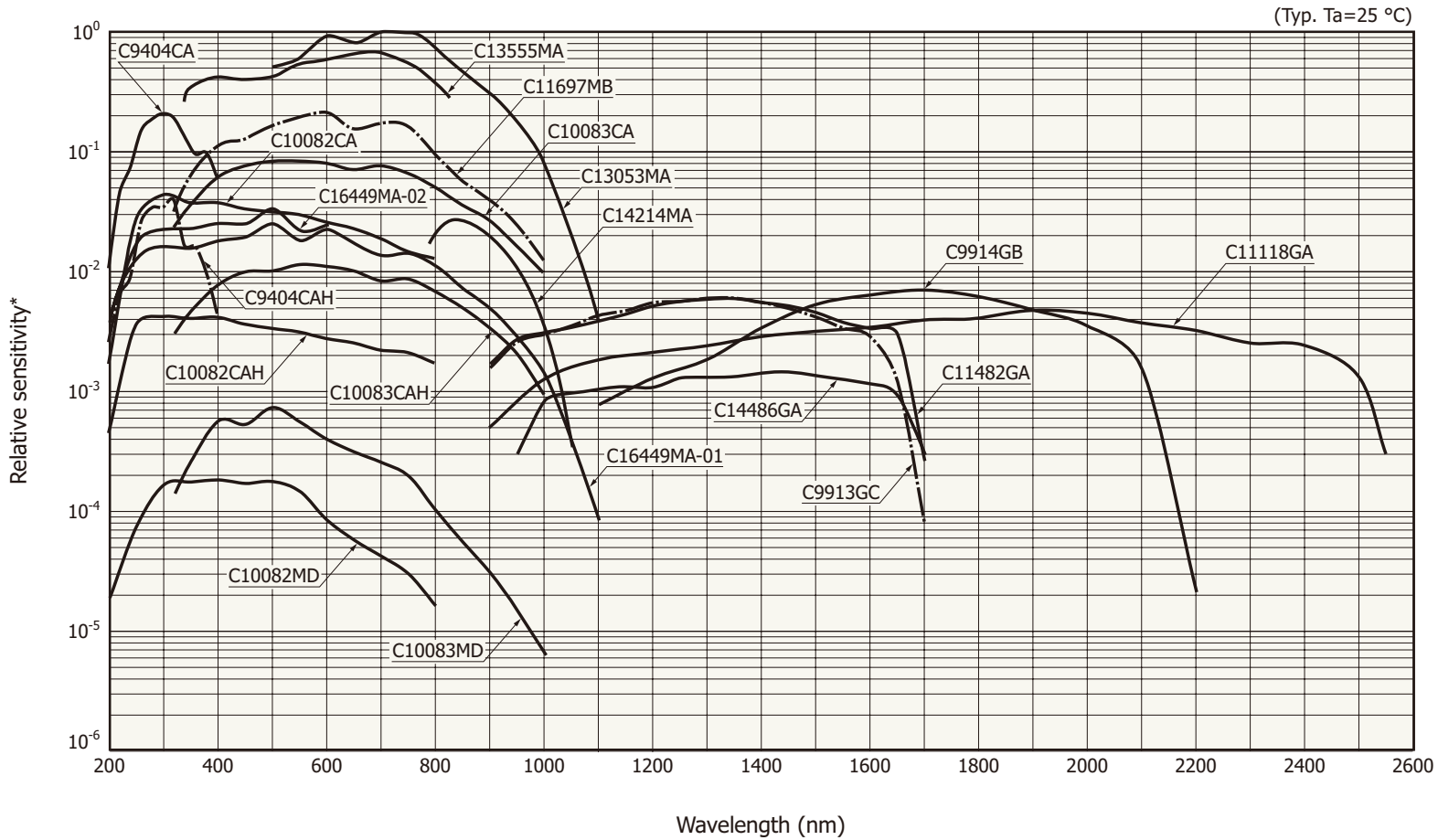
Ultra-small spectrometer heads (without a driver circuit) are also available.

Series	Products	Spectral response range (nm)
For ultraviolet range	High sensitivity C10082CA, High resolution C10082CAH, Wide dynamic range C10082MD	200 to 800
	High resolution C16449MA-02	200 to 600
	High sensitivity C9404CA, High resolution C9404CAH	200 to 400
For ultraviolet to near infrared range	High sensitivity C16449MA-01	190 to 1100
For visible range	High sensitivity C10083CA, High resolution C10083CAH, Wide dynamic range C10083MD, High sensitivity C11697MB	320 to 1000
	High sensitivity C13555MA	340 to 830
For visible to near infrared range	High near IR sensitivity C9405CC, High sensitivity C13053MA	500 to 1100
For near infrared range	Non-cooled type C11482GA, Cooled type C9913GC	900 to 1700
	Cooled type C9914GB	1100 to 2200
	Cooled type C11118GA	900 to 2550
	Compact type C14486GA	950 to 1700
For Raman spectroscopy	High resolution C14214MA	790 to 1050



Note: See P.13 for details on spectrometer heads.

Spectral response



* A/D count when constant light level enters optical fiber
(Fiber core diameter: 600 µm, assuming no attenuation in optical fiber)

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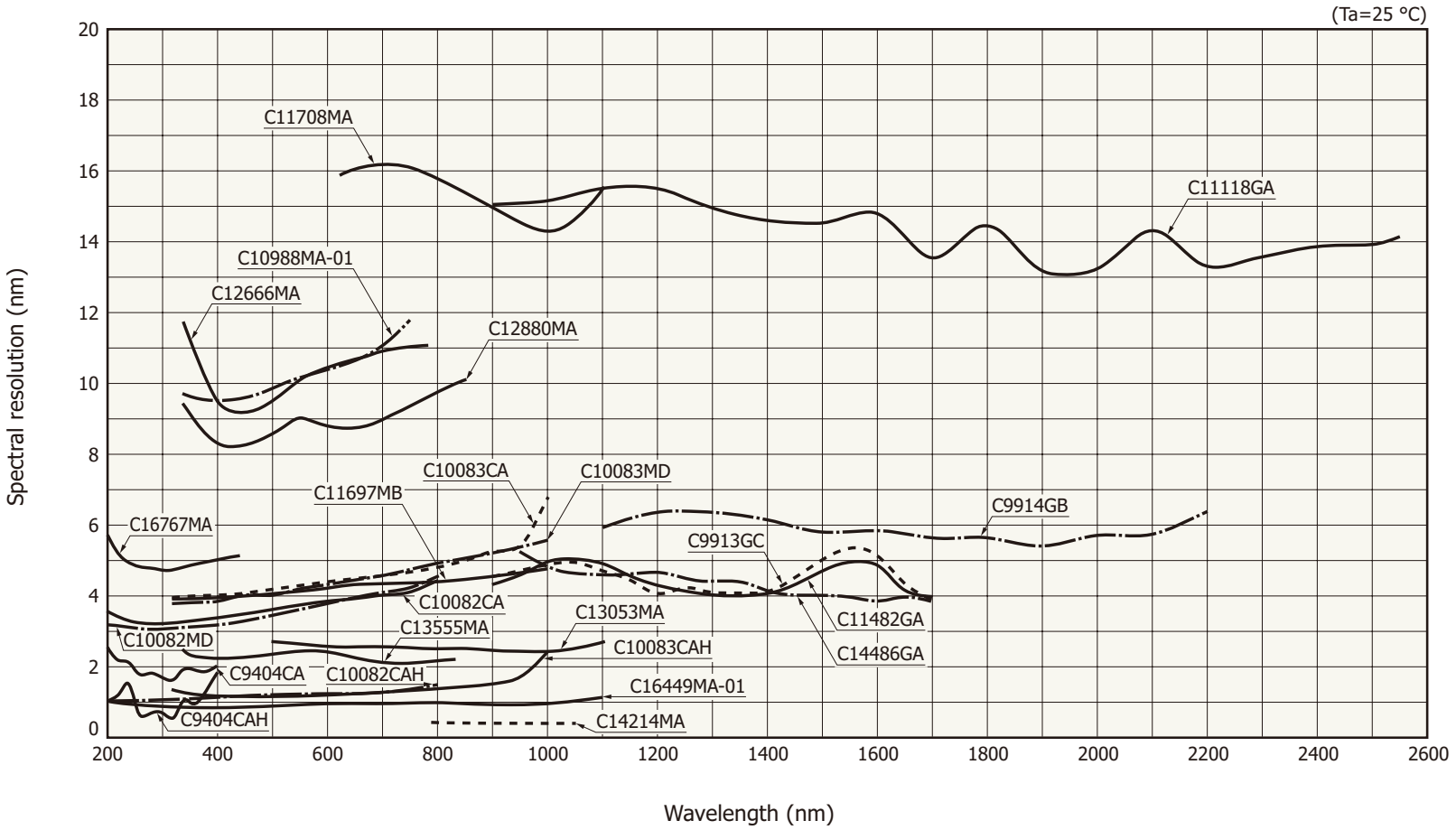
Spectral resolution vs. wavelength (typical example)



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For ultraviolet range

These are products with sensitivity in the ultraviolet range.

Type no.	Type	Spectral response range (nm) (UV / Visible / Near infrared; 200 400 600 800)	Spectral resolution typ. (nm)	S/N max.	External power supply	Built-in image sensor	Size (mm)	Photo
C10082CA	High sensitivity	200 to 800	4	446 : 1	+5 V	Back-thinned CCD S10420-1106-01	95 × 92 × 76	
C10082CAH	High resolution	200 to 800	1	446 : 1	+5 V	Back-thinned CCD S10420-1106-01	95 × 92 × 76	
C10082MD	Wide dynamic range	200 to 800	4	4390 : 1	Not required (USB bus power only)	CMOS linear image sensor S8378-1024Q	94 × 90 × 55	
C9404CA	High sensitivity	200 to 400	2	446 : 1	+5 V	Back-thinned CCD S10420-1006-01	125.7 × 115.7 × 75	
C9404CAH	High resolution	200 to 400	1	446 : 1	+5 V	Back-thinned CCD S10420-1006-01	125.7 × 115.7 × 75	
C16449MA-02	High sensitivity	200 to 600	0.45	316 : 1	Not required (USB bus power only)	High-sensitivity CMOS image sensor	80 × 75 × 25	

For ultraviolet to near infrared range

It is a wide spectral response type with sensitivity extending from the UV region.

Type no.	Type	Spectral response range (nm)	Spectral resolution typ. (nm)	S/N max.	External power supply	Built-in image sensor	Size (mm)	Photo
		UV / Visible / Near infrared 200 400 600 800 1000 1200						
C16449MA-01	High resolution	190 to 1100	1	316 : 1	Not required (USB bus power only)	High-sensitivity CMOS image sensor	80 × 75 × 25	

For visible range

These are products with sensitivity in the visible range.

Type no.	Type	Spectral response range (nm) (UV / Visible / Near infrared; 200 400 600 800 1000)	Spectral resolution typ. (nm)	S/N max.	External power supply	Built-in image sensor	Size (mm)	Photo
C10083CA	High sensitivity	320 to 1000	5	446 : 1	+5 V	Back-thinned CCD S10420-1106-01	95 × 92 × 76	
C10083CAH	High resolution	320 to 1000	1	446 : 1	+5 V	Back-thinned CCD S10420-1106-01	95 × 92 × 76	
C10083MD	Wide dynamic range	320 to 1000	5	4390 : 1	Not required (USB bus power only)	CMOS linear image sensor S8378-1024Q	94 × 90 × 55	
C11697MB	High sensitivity	320 to 1000	5	260 : 1	Not required (USB bus power only)	High-sensitivity CMOS linear image sensor S11639	94 × 90 × 55	
C13555MA	High sensitivity	340 to 830	2.3	230 : 1	Not required (USB bus power only)	High-sensitivity CMOS linear image sensor	80 × 60 × 12	

For visible to near infrared range

These are products with sensitivity in the visible to near infrared range.

Type no.	Type	Spectral response range (nm) UV / Visible / Near infrared (200 400 600 800 1000 1200)	Spectral resolution typ. (nm)	S/N max.	External power supply	Built-in image sensor	Size (mm)	Photo
C9405CC	High near IR sensitivity	500 to 1100	4	446 : 1	+5 V	Back-thinned CCD S16010-1006	125.7 × 115.7 × 75	
C13053MA	High sensitivity	500 to 1100	2.5	230 : 1	Not required (USB bus power only)	High-sensitivity CMOS linear image sensor	80 × 60 × 12	

For near infrared range

These are products with sensitivity in the near infrared range.

Type no.	Type	Spectral response range (nm)	Spectral resolution typ. (nm)	S/N max.	External power supply	Built-in image sensor	Size (mm)	Photo
C11482GA	Non-cooled type	900 to 1700	5	7700 : 1	Not required (USB bus power only)	InGaAs linear image sensor G9204-512DA	38.5 × 106 × 86	
C9913GC	Cooled type	900 to 1700	5	6100 : 1	+5 V, +12 V	InGaAs linear image sensor G9204-512SA	142 × 218 × 82	
C9914GB	Cooled type	1100 to 2200	6	6100 : 1	+5 V, +12 V	InGaAs linear image sensor	142 × 218 × 82	
C11118GA	Cooled type	900 to 2550	15	7700 : 1	+5 V, +12 V	InGaAs linear image sensor G9208-256WB-02	142 × 218 × 82	
C14486GA	Compact type	950 to 1700	5	6900 : 1	Not required (USB bus power only)	InGaAs linear image sensor	80 × 60 × 12	

Near infrared

800 1000 1200 1400 1600 1800 2000 2200 2400 2600

For Raman spectroscopy

It is a product with sensitivity in the Raman spectroscopy.

Type no.	Type	Spectral response range (nm) UV / Visible / Near infrared (200 400 600 800 1000)	Spectral resolution typ. (nm)	S/N max.	External power supply	Built-in image sensor	Size (mm)	Photo
C14214MA	High resolution	790 to 1050	0.4	230 : 1	Not required (USB bus power only)	High-sensitivity CMOS linear image sensor	100 × 60 × 12	

Spectrometer heads

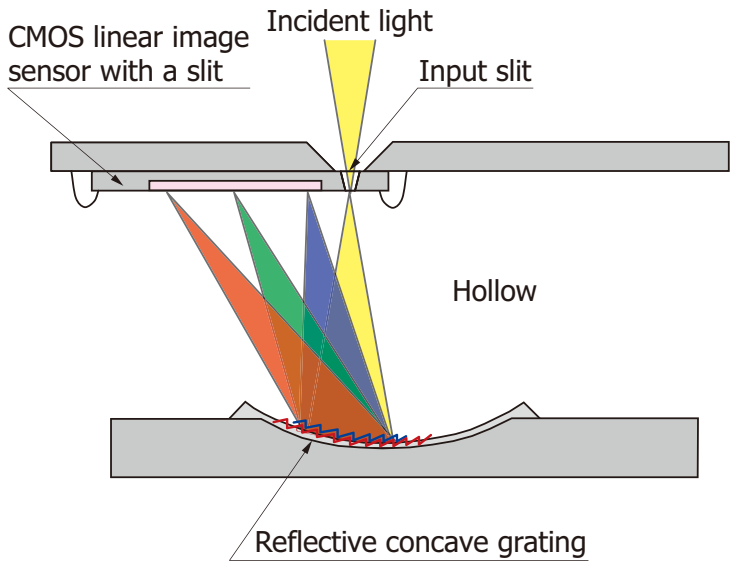
The compact spectrometer heads (without a driver circuit) integrate an optical system and an image sensor.

Type no.	Type	Spectral response range (nm)	Spectral resolution typ. (nm)	S/N max.	Built-in image sensor	Size (mm)	Photo
C16767MA	For ultraviolet range	190 to 440	5.5	293 : 1	High-sensitivity CMOS linear image sensor	20.1 × 12.5 × 10.1	
C12666MA	Wide dynamic range	340 to 780	12	5300 : 1	CMOS linear image sensor	20.1 × 12.5 × 10.1	
C12880MA	High sensitivity	340 to 850	12	291 : 1	High-sensitivity CMOS linear image sensor	20.1 × 12.5 × 10.1	
C11708MA	For near IR	640 to 1050	15	5300 : 1	CMOS linear image sensor	27.6 × 16.8 × 13	

Optical system in the compact spectrometer heads

The miniaturization of the spectrometer head has been achieved by employing a CMOS image sensor with a slit formed by etching and a grating fabricated by nanoimprinting within the optical system.

C12666MA, C12880MA, C16767MA



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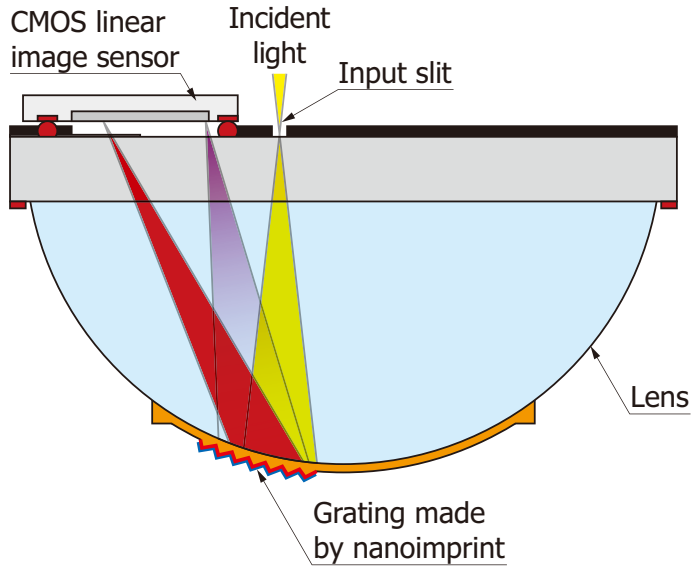
The metal package provides high humidity resistance (C12666MA, C12880MA). Low cost is achieved because it is a hollow type.

C11708MA



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The glass used does not expand easily with rising temperatures, so the temperature dependency of the wavelength is extremely small.

Mini-spectrometers

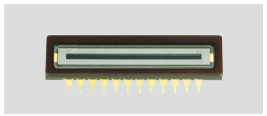
Technologies

Mini-spectrometers, employ MOEMS (micro-opto-electro-mechanical-systems) technology, combining an image sensor / optical system and MEMS.

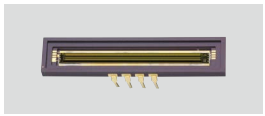
MOEMS technologies

Image sensors

· Uses one of Hamamatsu image sensor lineup to support various wavelengths
· Available with custom design

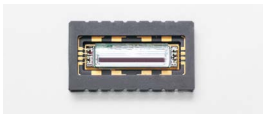


▲ CCD image sensor



▲ High-sensitivity CMOS linear image sensor

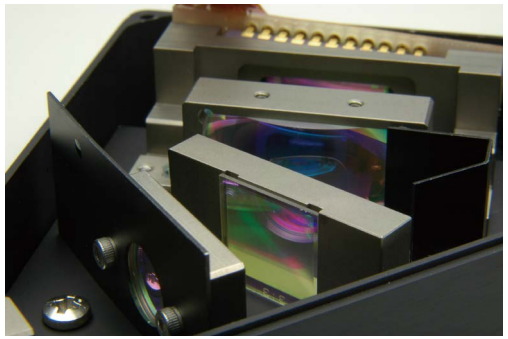
▲ TE-cooled InGaAs linear image sensor



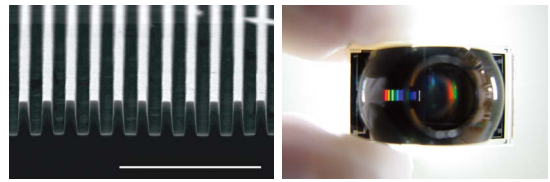
▲ IR-enhanced CMOS linear image sensor

Optical system

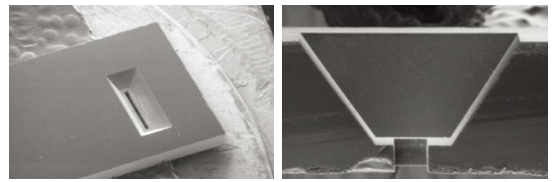
· Optical design suitable for spectrometers
· Optical simulation



MEMS



▲ Grating that uses nanoimprint

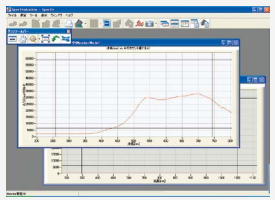


▲ Image sensor with a through-hole slit

Software

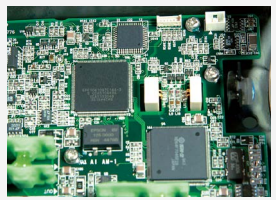
Supports various communication interfaces (e.g., USB)

Evaluation software available ▶



Circuits

· Unique driver circuits
· Evaluation circuits available for spectrometer heads

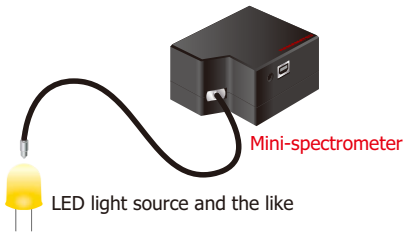


Mini-spectrometers

Application examples

Mini-spectrometers can be incorporated into a variety of devices and are used in a wide range of applications.

Color measurement (e.g., LED light source)



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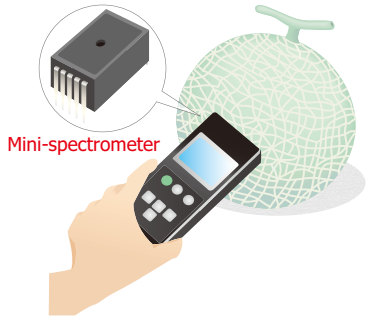
A mini-spectrometer is used to perform spectral measurement and inspect LEDs or the like.

Sugar content measurement



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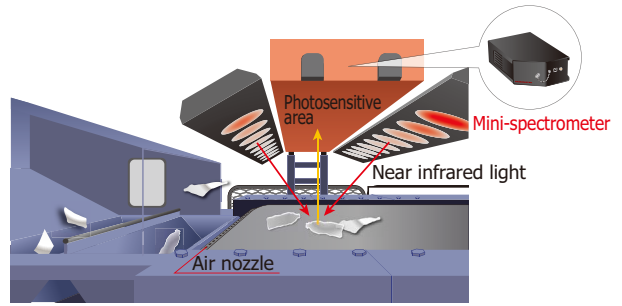
A mini-spectrometer is used in applications such as handy brix meters, which measure sugar content by abdorbance.

Plastic screening



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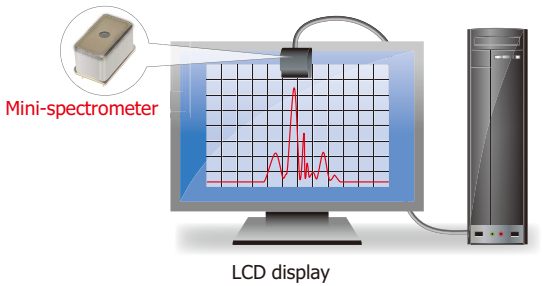
Plastic screening is performed by using the fact that when near infrared light is directed at plastic, the wavelengths that are absorbed varies depending on the material.

Display color measurement



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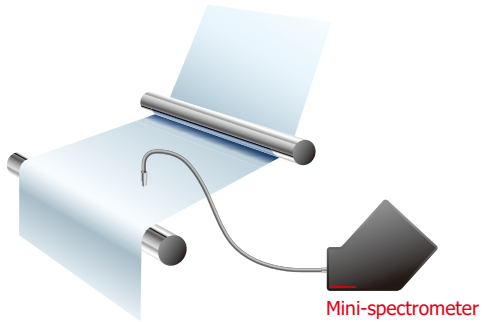
The emission spectrum of LCDs is monitored with a mini-spectrometer.

Film thickness measurement



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White light interferometry is used to measure the spectrum peak count, film refractive index, and film thickness from the light incident angle.

Environmental analysis

KACCC0798EB

A mini-spectrometer is used in environmental analysis of water, soil, and the like.

Mini-spectrometers

Accessories

Accessories for mini-spectrometers (sold separately) are available.

Input optical fibers A16962 series, A16963 series

UV/visible optical fiber (UV resistant) and visible/NIR optical fiber are available.

Type no.	Product name	Core diameter (μm)	Minimum bend radius (mm)	Specification
A16962-01	Ultraviolet/visible optical fiber (UV resistant)	600	132	NA=0.22 1.5 m in length, with SMA905D connector on each end Operating temperature: 0 °C to +60 °C Storage temperature: -10 °C to +70 °C
A16962-02		800	176	
A16963-01	Visible/near infrared optical fiber	600	132	
A16963-02		800	176	

External trigger coaxial cables A10670, A12763

Cable	Applicable mini-spectrometers	Length (m)
A10670	C9404CA, C9404CAH, C10082CA, C10082CAH, C10082MD, C10083CA, C10083CAH, C10083MD, C11118GA, C11697MB, C11482GA	1.5
A12763	C13555MA, C13053MA, C14486GA, C14214MA, C16449MA-01, C16449MA-02	

2 W xenon flash lamp modules L13651 series

These lamp modules integrate a 2 W xenon flash lamp with a power supply and trigger socket, and are designed to extract maximum performance from the lamp.

Features

- Compact: 42 mm × 42 mm × 37 mm
- Operates on 5 V mobile battery
- Long life: 1 × 10^9 flash
- Repetition rate: 1250 Hz max.
- Broad spectrum: UV region to middle IR region

Note: We offer a catalog of xenon flash lamps.

FTIR engines (FT-NIR spectrometer)

Compact FT-NIR spectroscopic modules that can be incorporated into portable measuring instruments and in-line measuring instruments

C1511-01

C16551-01

The Fourier transform infrared spectrometer (FTIR) engines are compact enough to carry in just one hand. A Michelson optical interferometer and a control circuit are built into a palm-sized case. Spectrum and absorbance can be measured by connecting a PC via USB.

Features

- Compact
- High speed 275 frames/s typ. (C16511-01)
- Optical fiber input type
- High S/N
- Suitable for diffuse reflection measurements and absorbance measurements
- Spectral response range: 1100 nm to 2500 nm
- Ethernet compatible (C16511-01)

Applications

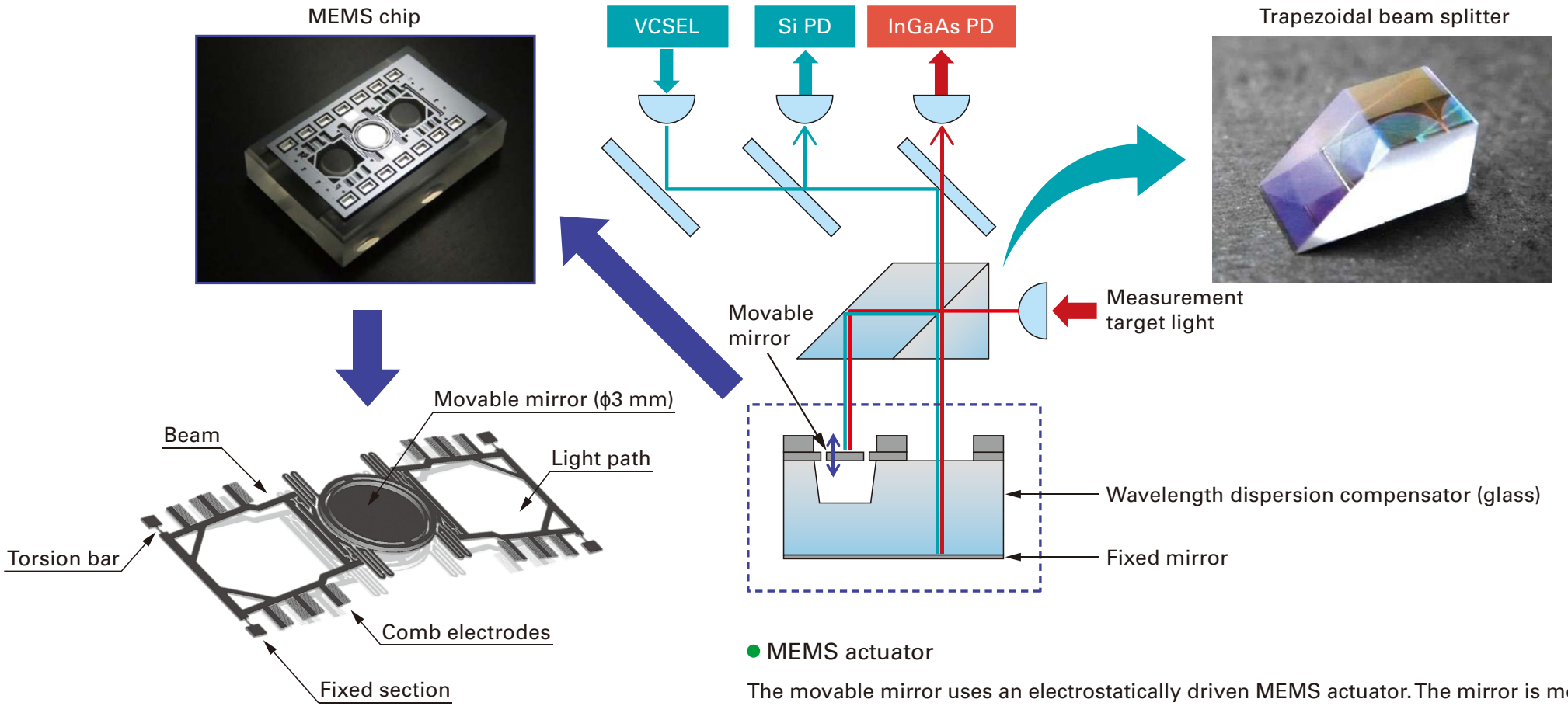
- FA, PAT (Process Analytical Technology)
- Bioprocess analysis
- Material analysis
- Farm product and food inspection
- Plastic sorting
- Medicines inspection

Type no.	Spectral response range (nm)	Spectral resolution (nm)
	Near infrared	
	800 1000 1200 1400 1600 1800 2000 2200 2400 2600	
C15511-01 C16511-01	1100 to 2500	5.7 typ. (λ=1533 nm)

Optical system

The optical interferometer of the FTIR engine consists of a MEMS chip, as well as the light input section, beam splitter, fixed mirror, and photodetector.

Optical system of FTIR engine



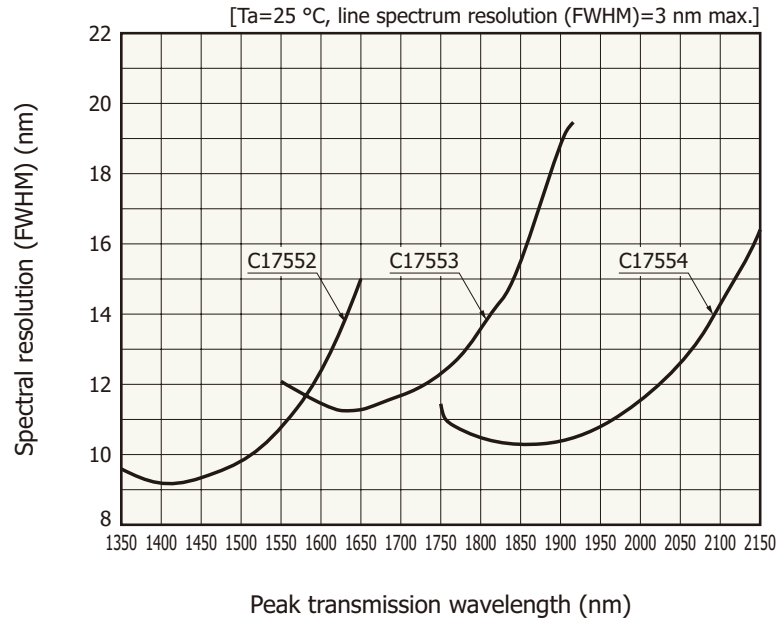
● MEMS actuator

The movable mirror uses an electrostatically driven MEMS actuator. The mirror is moved up and down in parallel by applying voltage to comb electrodes.

MEMS-FPI spectroscopic modules

These compact modules have a built-in MEMS-FPI spectrum sensor and light source.

Spectral resolution vs. peak transmission wavelength (typical example)



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MEMS-FPI spectroscopic modules	Spectral response range (nm)	Spectral resolution (full width at half maximum max.) (nm)
	Near infrared	
	800 1000 1200 1400 1600 1800 2000 2200	
C17552	1350 to 1650	18
C17553	1550 to 1920	21
C17554	1750 to 2150	22

Compact spectrometers for near infrared range

A wide variety of compact spectrometers for the near infrared region are available.

Product name	Type no.	Spectral response range (nm)	Features	Spectroscopic technology	Spectral resolution (nm)	Size (mm)	Photo
FTIR engine (FT-NIR spectrometer)	C15511-01	1100 to 2500	High precision measurement, high wavelength accuracy	MEMS-FTIR	5.7 typ. (λ=1533 nm)	49 × 57 × 76	
FTIR engine (FT-NIR spectrometer)	C16511-01	1100 to 2500	High precision measurement, high wavelength accuracy, ethernet compatible	MEMS-FTIR	5.7 typ. (λ=1533 nm)	68 × 57 × 76	
MEMS-FPI spectroscopic modules	C17552 C17553 C17554	1350 to 1650 1550 to 1920 1750 to 2150	Compact, suitable for portable devices, excellent high-volume producibility, built-in light source	Fabry-Perot	22 max. (C17554, λ=2150 nm)	74 × 32 × 16	
Mini-spectrometer	C14486GA	950 to 1700	High-speed measurement, high sensitivity	Grating	5.0 typ.	80 × 60 × 12	

- Disclaimer
- Precautions / Mini- spectrometers

www.hamamatsu.com

- Information described in this material is current as of September 2025.
- Product specifications are subject to change without prior notice due to improvements or other reasons. Before using these products, always contact us for the delivery specification sheet to check the latest specifications.

HAMAMATSU PHOTONICS K.K.

KACC0002E31 Sep. 2025 DN

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