PMA-12

Photonic multichannel analyzer

Scientific applications

- UV to visible spectroscopy
- Fluorescence spectroscopy
- Luminous efficiency measurement
- Chemiluminescence analysis
- Liquid chromatography
- Gas chromatography
- Raman scattering
- Discharge spectrum analysis
- Combustion analysis
- Micro spectroscopy

Industrial applications

- Water quality testing
- Evaluation of light emitting devices and light sources
- Photobiological safety assessment
- Impurities testing
- Film thickness measurements
- UV radiation measurements
- Plasma monitoring
- Chromaticity measurements
- Combustion monitoring
- Color filter evaluation

HAMAMATSU

PHOTON IS OUR BUSINESS

Photo-detector | **Spectrometer** | **Power supply**

Use of an optical fiber input makes spectral measurements easy.

New design:
Compact and easy to use system.

The PMA-12 is a compact spectral measurement system that combines a spectrometer and optical detector into one unit.
Because of the high sensitivity, spectra can easily be obtained in many applications, just by bringing the optical fiber close to the sample without the connection to a special light collection system. Since the spectrometer and photo-detector are manufactured with high machine accuracy, the PMA-12 is stable and can be used with confidence for long periods of time. The wavelength axis and spectral response characteristics are already calibrated, so spectral measurements can be carried out easily and accurately.

NEW

High sensitivity superior cost-performance model — C14631-01, -02, -03

The C14631, which has the thermoelectric cooling type as BT- CCD linear image sensor used for astronomical observation, realizes both high performance and low price by rational design.

Ultra-high sensitivity model — C10027-01, -02

This model uses a thermoelectrically cooled, back-thinned CCD linear image sensor with higher sensitivity and lower noise. The C10027-01 is an ultra-high sensitivity model that combines this sensor with a small Czerny-Turner spectrograph capable of measurements over a wide range from the ultraviolet to the near infrared with high wavelength resolution. The wavelength range for measurements is 200 nm to 950 nm for the C10027-01 and 350 nm to 1100 nm for the C10027-02.

Near infrared model — C10028-01, -02

These are models using InGaAs linear image sensors which are capable of measuring reflection and absorption spectra in the near infrared with a large dynamic range. The wavelength range for measurements is 900 nm to 1650 nm for the C10028-01 and 1600 nm to 2350 nm for the C10028-02.

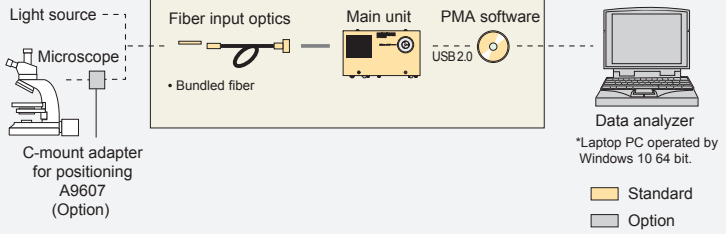
High time resolution model — C10029-01

Coupling an image intensifier with a thermoelectrically cooled, back-thinned CCD linear image sensor, it is possible to have both high-speed gate measurements at a maximum of 10 ns and ultra-high sensitivity. This model is capable of high temporal resolution measurements in the nanosecond range and measurements of faint light.

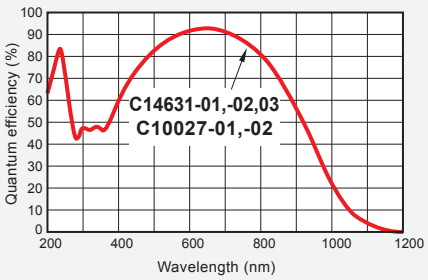
Features

- Spectrometer, photo-detector and power supply in a compact unit
- Real-time measurements (Simultaneous measurement of multiple wavelengths possible)
- Easy measurements with optical fiber
- Spectral response and wavelength axis calibrated
- Support many applications with the option

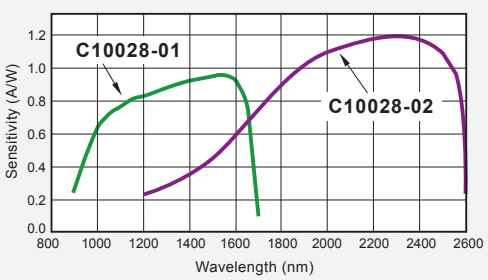
PMA-12 Standard Configuration



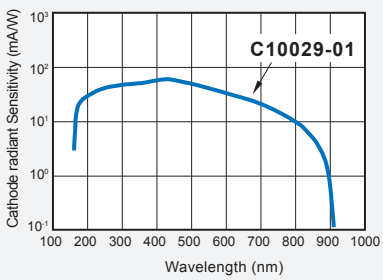
● BT- CCD linear image sensor



● InGaAs linear image sensor

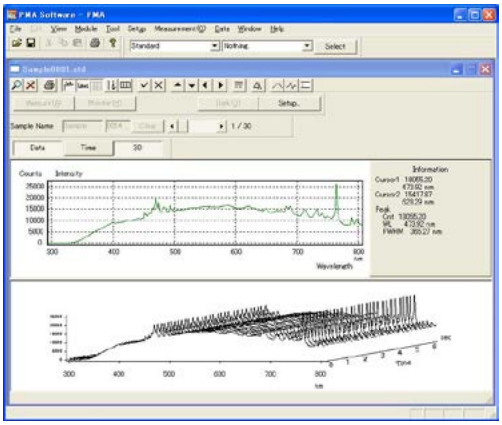


● I.I. + BT- CCD linear image sensor



SOFTWARE

Measurement modes



Standard measurements
This is the most basic measurement mode.
Applications: e.g. emission spectra for light sources, fluorescence, plasma and etc.

Reflective measurements
This is the measurement mode for finding spectral reflectance.
Applications: e.g. reflectance measurements for optical filters, coatings and etc.

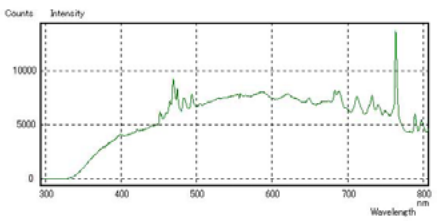
Transmittance and absorption measurements
This is the measurement mode for finding spectral transmittance and absorption.
Applications: e.g. measurements of transmittance and absorption in optical filters, films, solutions and etc.

Chromaticity measurements (light-source color)
This is the measurement mode for finding the light-source color for luminous bodies.
Applications: e.g. color evaluation in light sources for illumination, LEDs and etc.

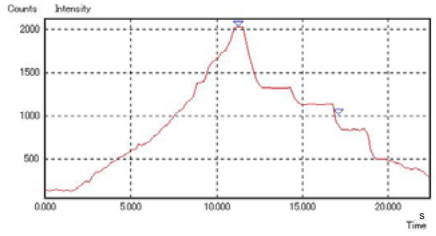
Chromaticity measurements (object color)
This is the mode for finding the color of objects that are either reflective or transmit light.
Applications: e.g. color evaluation of paint, fabric, printed matter and etc.

Display modes

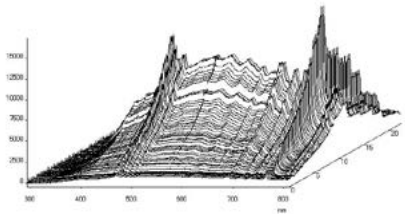
Spectrum display



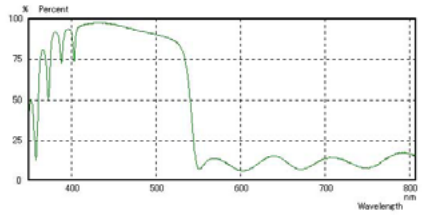
Display of changes over time



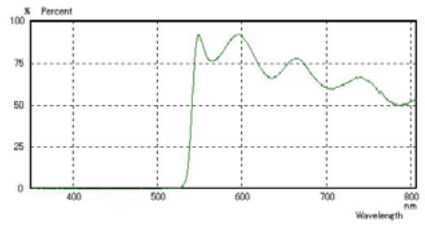
3-D display



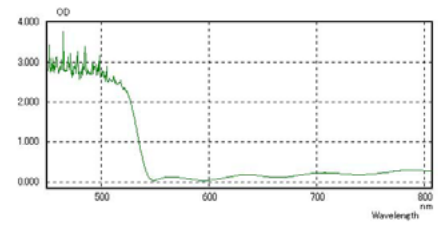
Reflectivity display



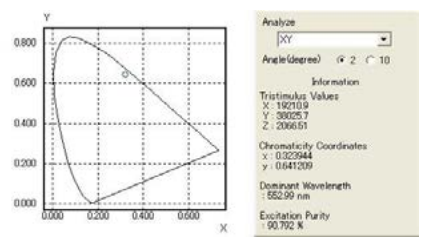
Transmittance display



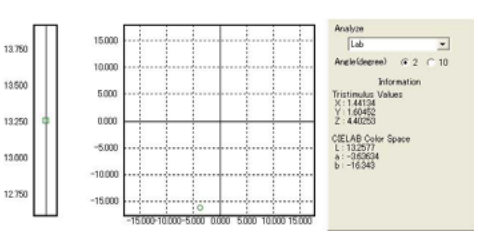
Absorbance display (OD)



Color coordinate display



Spatial color coordinate display

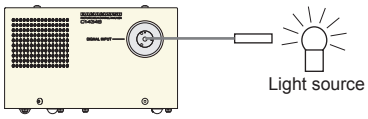


APPLICATION EXAMPLES

Light source measurements

Measurement of emission spectra in light sources such as lamps and LEDs

PMA-12



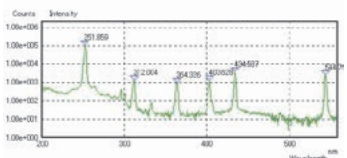
<Configuration>

- Standard PMA-12 configuration (C14631, C10027, etc.)

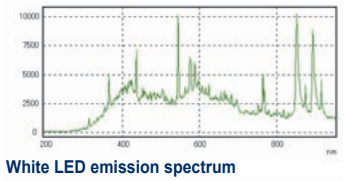
<Applications>

- Evaluation of color temperature and color rendering properties in light sources for illumination
- LED chromaticity evaluations
- Special applications of light source spectral evaluations

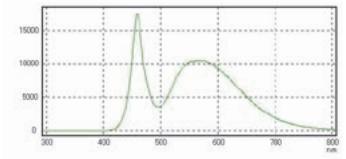
Germicidal lamp emission spectrum



Metal halide lamp emission spectrum

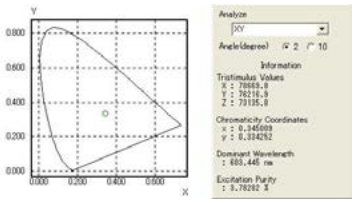


White LED emission spectrum

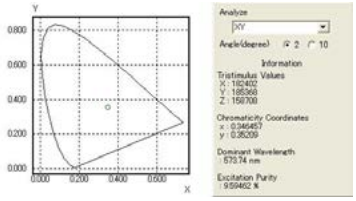


Analysis of light source color by emission spectrum
(chromaticity, color temperature, color rendering properties, etc.)

Metal halide lamp chromaticity evaluation



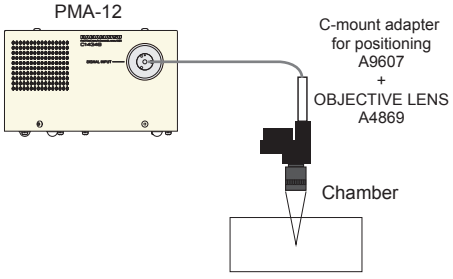
White LED chromaticity evaluations



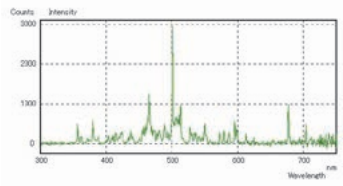
Emission spectrum measurements

Emission spectrum measurements for plasma, electric discharge, ablation and the like

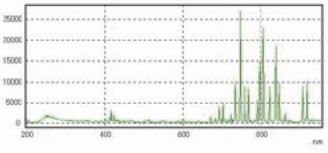
PMA-12



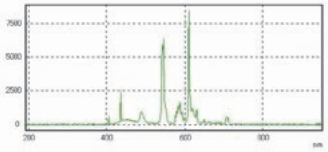
Electric discharge emission spectrum



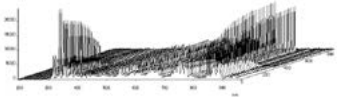
Emission spectrum during oxide film etching



Emission spectrum during nitride film etching



Temporal changes in plasma emission spectrum



<Configuration>

- Standard PMA-12 configuration (C14631, C10027, etc.)

Options

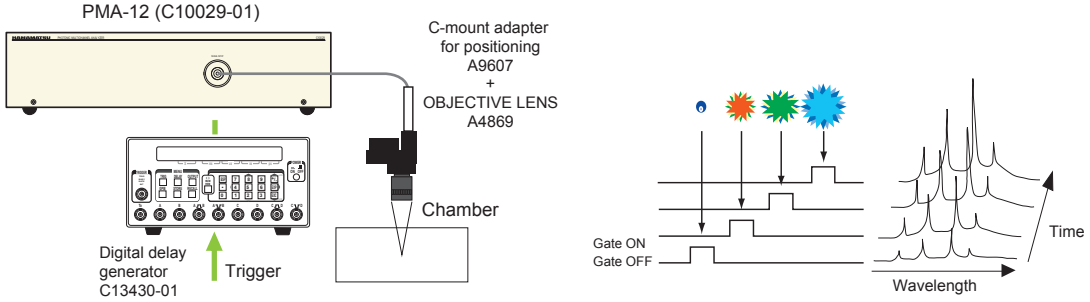
- C-mount adapter for positioning A9607
- OBJECTIVE LENS A4869
- Digital delay generator C13430-01

<Applications>

- Plasma component analysis
- Analysis of various emission phenomena

Example of temporal resolution (gate operation) measurements

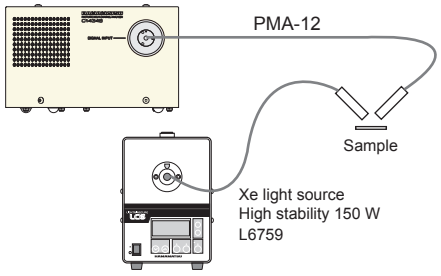
PMA-12 (C10029-01)



APPLICATION EXAMPLES

Reflective spectrum measurements

Measurement of spectral reflectance in optical filters, anti-reflective films (AR coatings) and the like

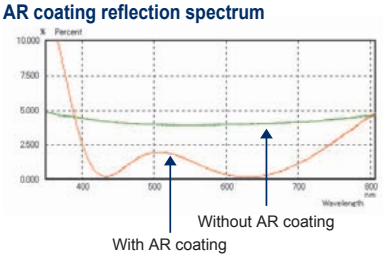


<Configuration>
- Standard PMA-12 configuration (C14631, C10027, etc.)

Options
- Xe light source high stability 150 W L6759
- Optical split fiber UV to VIS 2 m A10193-01

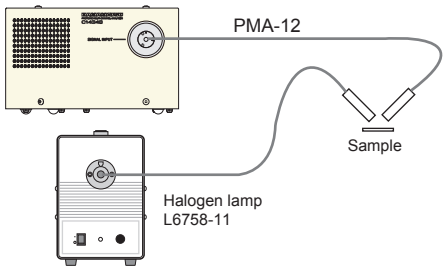
<Applications>
- Inspection of coatings
- Monitoring thin film growth

AR coating reflection spectrum



Object color measurements

Object color measurement of paint, fabric, printed matter and the like

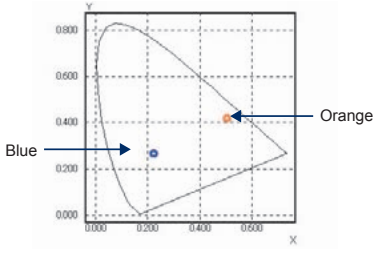


<Configuration>
- Standard PMA-12 configuration (C14631, C10027, etc.)

Options
- Halogen lamp L6758-11

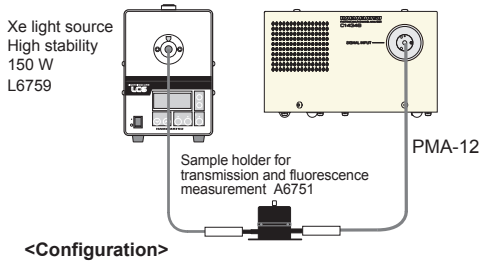
<Applications>
- Paint inspections
- Color evaluations in printed matter, fabric, plastics, etc.

Paper object color (chromaticity coordinates)



Absorption spectrum measurements

Spectral transmittance and absorption measurements in optical filters, films, solutions and the like

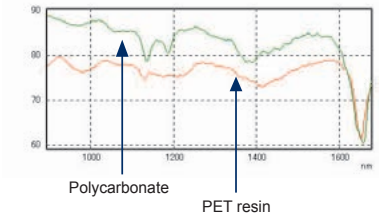


<Configuration>
- Standard PMA-12 configuration (C14631, C10027, etc.)

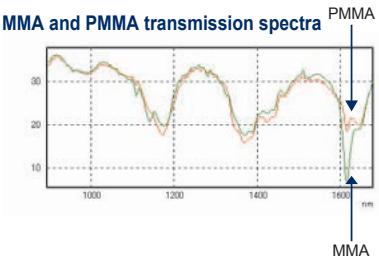
Options
- Xe light source high stability 150 W L6759
- Sample Holder for transmission and fluorescence measurement A6751

<Applications>
- Absorption spectrum evaluations for solutions and films
- Component analysis for samples
- Monitoring chemical changes

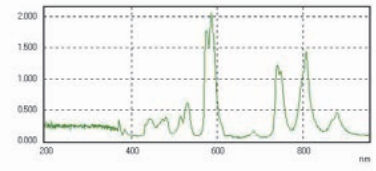
Component analysis of plastics using transmission spectra (polycarbonate and PET resins)



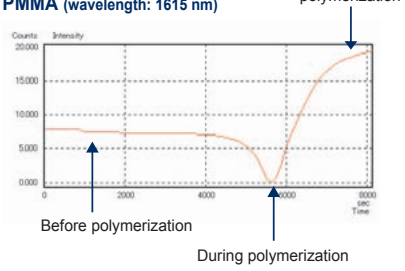
MMA and PMMA transmission spectra



Didymium film absorption spectrum

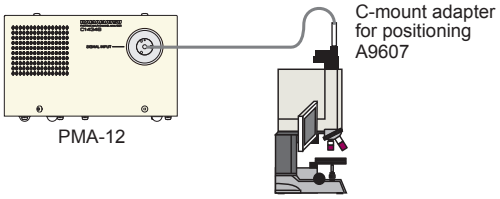


Changes of transmission in the polymerization from MMA to PMMA (wavelength: 1615 nm)



Microscopic spectral measurements

Spectral distribution measurements under a microscope



<Configuration>
- Standard PMA-12 configuration (C14631, C10027, etc.)

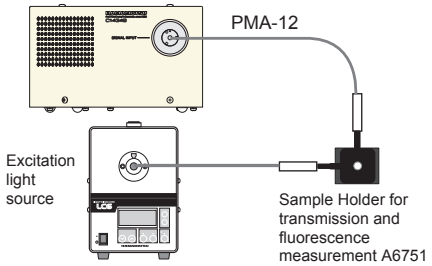
Options
- C-mount adapter for positioning A9607

<Applications>
- Measurement of bioluminescence
- Measurements on semiconductor wafer, LCD and other microstructures

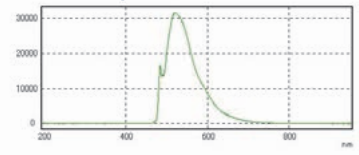
APPLICATION EXAMPLES

Emission spectrum measurements

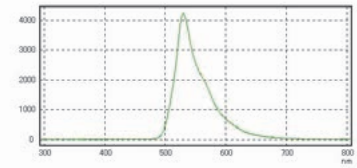
For fluorescent samples such as fluorescent lamps and EL devices



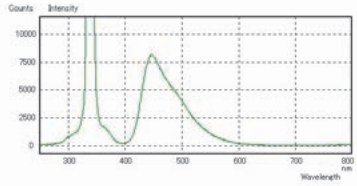
Fluorescence indicator (Fluorescein) emission spectrum



Chemiluminescence emission spectrum



Emission spectrum of fluorescent materials (Fluorescent lamp)



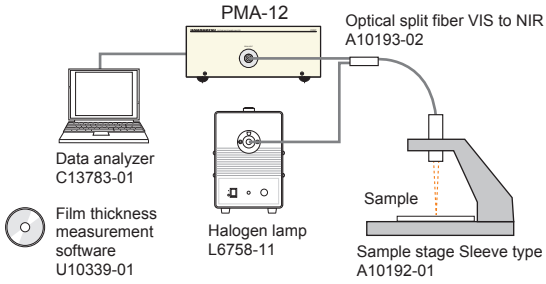
<Configuration>
- Standard PMA-12 configuration (C14631, C10027, etc.)

Options
- Excitation light source: laser, xenon lamp, etc.
- Sample Holder for transmission and fluorescence measurement A6751

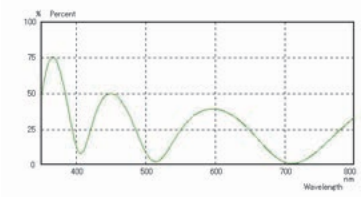
<Applications>
- Fluorescence spectroscopy
- Monitoring chemical light emissions

Film thickness measurements

Film thickness measurements using spectral reflectance or transmittance



ITO film interference spectrum



<Configuration>
- Standard PMA-12 configuration (C10027)

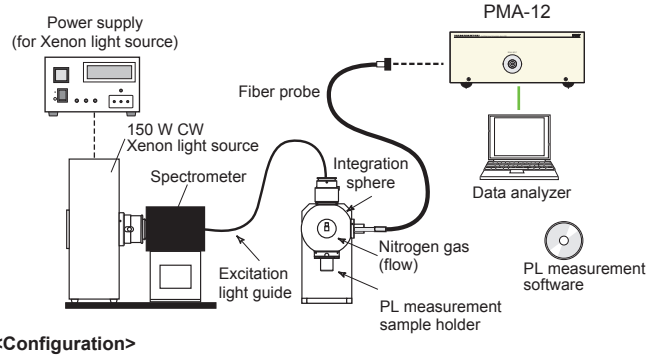
Options
- Halogen lamp L6758-11
- Optical split fiber VIS to NIR 2 m A10193-02
- Film thickness measurement software U10339-01

<Applications>
- Monitoring thin film growth
- Film thickness management
- Resist film thickness measurements

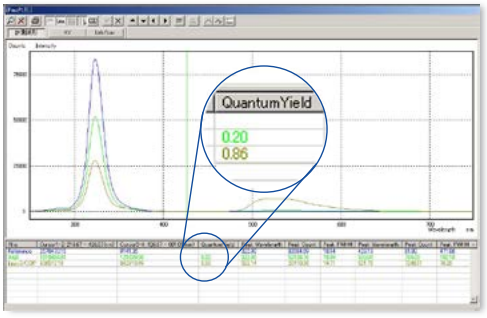
Optical Gauge series
C10178,C10323
We can offer a special machine for film thickness measurements.
Please refer to the details in a specific brochure.

Quantum yield measurement system

Measurement of quantum yield, external quantum efficiency, brightness light distribution characteristics



[Screen showing emission spectrum]



<Configuration>
- Standard PMA-12 configuration (C10027)

<Applications>
- Research of fluorescence materials in physics or chemistry
- Quantum yield measurement of emission materials
- Internal quantum yield measurement of fluorescence materials

Absolute PL quantum yield spectrometer C9920-02,-02G,-03,-03G
External quantum efficiency measurement system C9920-12
Light distribution measurement system C9920-11
We can offer a special machine for OLED measurements.
Please refer to the details in a specific brochure.

OPTIONS

Sample Holder for transmission and fluorescence measurement
A6751

This is a dedicated holder with an integrated condensing lens for the use with vials.

Reflection measurement optics
A9665

These are optics making it possible to illuminate the sample at 45˚ to the light source and measure the reflected light.

Variable angle reflection measure optics
A10687

These are optics making it possible to change the angle of input and output ports at maximum 60˚ and measure the reflected light and fluorescence.

Digital delay generator
C13430-01

This outputs the gate pulse used for an external trigger and gate operation.

Optical split fiber
A10193-01,-02

It is very useful for reflectance measurement or film thickness measurement. We have two kinds of fiber. One is A10193-01 for visible range and the other is A10193-02 for from visible range to near infrared range.

C-mount fiber adapter
A6399

This is an adapter for securing the fiber input optics to the C-mount of a microscope or the like. The A6399 is usable in the UV to NIR.

C-mount adapter for positioning
A9607

In addition to the function of the C-mount fiber adapter, the measurement position can be checked. The A9607 is usable in the UV to NIR.

OBJECTIVE LENS
A4869

Condensing lens for UV.
f=50 mm, F3.5
(A6399 or A9607 required)

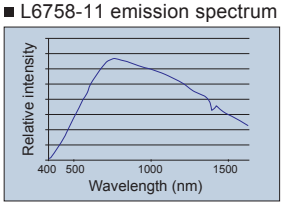
Integrating sphere
A5640

This is the integrating sphere for getting complete diffuse light. You can get even intensity light without spread of light source or influence of directional characteristics.
(A6399 required)

Halogen lamp
L6758-11

This is a halogen light source with output wavelengths from 400 nm to 1600 nm for excitation and absorption measurements.

■ L6758-11 emission spectrum

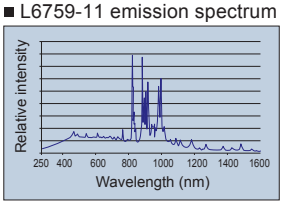


* Light guide connector A10194-01 is needed to connect with 2 split fiber.

Xe light source High stability 150 W
L6759

This is a high stability xenon light source with output wavelengths from 250 nm to 1600 nm for excitation and absorption measurements.

■ L6759-11 emission spectrum



Attenuation fiber adapter
A10474-01

This adaptor is used when the light power is too strong. It can reduce the input light power by using a pinhole.
(fading rate approx 1 /20 to 1 /500)

Software library
U10472-01

This is the software library which controls the PMA-12 series.

Color measurement library U10473-01

This is the software library which controls the PMA-12 series and calculates the chromaticity.

SPECIFICATIONS

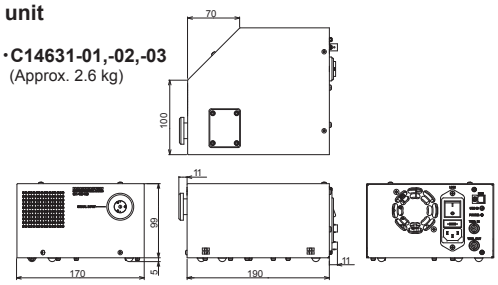
Model	C14631-01	C14631-02	C14631-03	C10027-01	C10027-02	C10028-01	C10028-02	C10029-01
Photo-detector	BT- CCD linear image sensor			BT- CCD linear image sensor		InGaAs linear image sensor		I.I. + BT- CCD linear image sensor
Wavelength (nm)	300 to 800	250 to 840	300 to 1040	200 to 950	350 to 1100	900 to 1650	1600 to 2350	200 to 860
Wavelength resolution (FWHM)*1	≦3 nm	≦3 nm (Less than 750 nm)	≦4 nm	< 2 nm	< 2.5 nm	< 9 nm		< 3 nm
Exposure time (Internal trigger Mode)	18 ms to 64 s			19 ms to 64 s		5 ms to 64 s	5 ms to 0.05 s	19 ms to 64 s
Gate time*2	–			–		–	–	≧10 ns
Gate repetition	–			–		–	–	≦ 200 kHz
Number of photosensitive device channels	1024 ch			1024 ch		256 ch		900 ch
Pixel size	24 µm × 1392 µm			24 µm × 2928 µm		50 µm × 250 µm		24 µm × 2928 µm*3
Device cooling temperature	0 ˚C			-15 ˚C		-10 ˚C		-15 ˚C*3
Read-out noise	16			16		12 500		16*3
Dark current (electrons/scan)	128 (0 ˚C : 20 ms)			75 (-15 ˚C : 20 ms)		20 000 (-10 ˚C : 20 ms)	2.5×10^7 (-10 ˚C : 20 ms)	75*3 (-15 ˚C : 20 ms)
AD resolution	16 bit							
Spectrograph	Concave spherical grating type			Czerny-Turner type				
Spectrograph F number	3			4				
Fiber receiving area	Φ1 mm							
Fiber type	Bundled fiber Φ12 mm SUS tube							
Fiber length	2 m			1.5 m				
External trigger input	TTL level/High impedance							
Interface	USB 2.0*4							
Power supply	AC 100 V to AC 240 V, 50 Hz / 60 Hz (Power supply voltage variation ±10 %)							

*1 Confirmed with mercury and argon atomic beams. *2 The gate time is controlled by the external gate pulse width. *3 I.I. characteristics are not included. *4 A 1.5 m cable is included as standard.

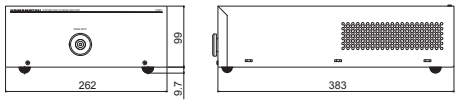
Dimensional outlines (Unit : mm)

Main unit

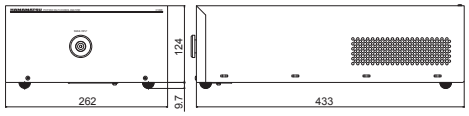
·C14631-01,-02,-03 (Approx. 2.6 kg)



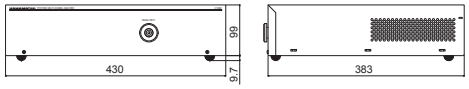
C10027-01, -02 (Approx. 5.7 kg)



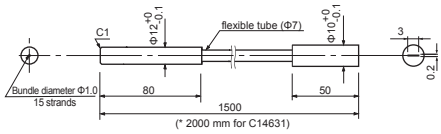
C10028-01, -02 (Approx. 9.0 kg)



C10029-01 (Approx. 10.0 kg)



Fiber input optics for C14631, C10027, C10028, C10029 (Approx.100 g)



Basic software for PMA-12 U6039-01

- Measurement functions ····· Monitoring measurement, Data measurement
- Temporal resolution measurement functions ··· Temporal fluctuation of spectra, Temporal fluctuation in reflectivity and transmissivity
- Data acquisition condition settings ····· Exposure time settings, Memory integration count assignment
- Calibration/correction ····· Wavelength axis calibration, Sensitivity inconsistency calibration, Dark current correction
- Display functions ····· Spectrum display, Display temporal waveform fluctuations
- Wavelength axis display ····· Wavelength, Wavenumber, Raman shift, energy (eV)
- Brightness axis display ····· Linear, Logarithmic
- Cursor analysis functions ····· Wavelength (wavenumber, etc.) vs. intensity, Peak detection, FWHM measurement, Integrated intensity
- Other analytical functions ····· Smoothing, Differential waveform, Color calculation (XYZ, xy, uv, Lab)

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