PMA-12
Photonic multichannel analyzer

[Scientific applications]
- UV to visible spectroscopy
- Fluorescence spectroscopy
- Raman scattering
- Chemiluminescence analysis
- Liquid chromatography
- Gas chromatography
- ICP emission analysis
- Discharge spectrum analysis
- Combustion analysis
- Micro spectroscopy

[Industrial applications]
- Water quality testing
- Evaluation of light emitting devices and light sources
- Chromaticity measurements
- Impurities testing
- Film thickness measurements
- UV radiation measurements
- Plasma monitoring
- Fruit testing
- Combustion monitoring
- Color filter evaluation

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PHOTON IS OUR BUSINESS
The PMA-12 is a compact spectral measurement apparatus that combines a spectrometer and optical detector into one unit. An optical fiber is used. Because of the high sensitivity, spectra can be obtained easily just by bringing the optical fiber close to the sample in normal applications, without a special light collection system. Since the spectrometer and photo-detector are fixed, 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.

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Sensitivity (mA/W)</th>
<th>Wavelength (nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C10544-01</td>
<td>High sensitivity superior cost-performance model</td>
<td></td>
<td>200 - 800</td>
</tr>
<tr>
<td>C10544-02</td>
<td></td>
<td></td>
<td>300 - 830</td>
</tr>
<tr>
<td>C10027-01</td>
<td>Ultra-high sensitivity model</td>
<td></td>
<td>200 - 950</td>
</tr>
<tr>
<td>C10027-02</td>
<td></td>
<td></td>
<td>350 - 1100</td>
</tr>
<tr>
<td>C10028-01</td>
<td>Near infrared model</td>
<td></td>
<td>900 - 1650</td>
</tr>
<tr>
<td>C10028-02</td>
<td></td>
<td></td>
<td>1600 - 2350</td>
</tr>
<tr>
<td>C10029-01</td>
<td>High time resolution model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C10544-01</td>
<td>Ultra-high sensitivity model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C10544-02</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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 characteristics calibrated
- Wide range of variations

**PMA-12 Standard Configuration**

- Light source
- Fiber input optics
- Main unit
- PMA software
- Data analyzer Laptop type
  - C10471-01 (Option)
  - C10471-02 (Option)
- C-mount adapter for positioning
  - A9607 (Option)
- Bundled fiber C10544-01, -02
- C10027-01, -02
- C10028-01, -02
- C10029-01

**CCD and BT-CCD linear image sensor**

![Graph showing sensitivity of CCD and BT-CCD linear image sensor](graph1)

**InGaAs linear image sensor**

![Graph showing sensitivity of InGaAs linear image sensor](graph2)

**I.I. + BT-CCD linear image sensor**

![Graph showing sensitivity of I.I. + BT-CCD linear image sensor](graph3)
Measurement modes

- **Standard measurements**
  This is the most basic measurement mode.
  Applications: emission spectra for light sources, fluorescence, plasma and the like.

- **Reflective measurements**
  This is the measurement mode for finding spectral reflectance.
  Applications: reflectance measurements for optical filters, coatings and the like.

- **Transmittance and absorption measurements**
  This is the measurement mode for finding spectral transmittance and absorption.
  Applications: measurements of transmittance and absorption in optical filters, films, solutions and the like.

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

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

Display modes

- **Spectrum display**
- **Display of changes over time**
- **Reflectivity display**
- **Absorbance display (OD)**
- **Spatial color coordinate display**
- **Color coordinate display**
- **Transmittance display**
- **3-D display**
Light source measurements

**Configuration**
- Standard PMA-12 configuration (C10027, C10029, etc.)
- Data analyzer C10471-01,02

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

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Emission spectrum measurements

**Configuration**
- Standard PMA-12 configuration (C10027, C10029, etc.)
- Data analyzer C10471-01,02
- C-mount adapter for positioning A9607
- OBJECTIVE LENS A4869
- Digital delay generator C13430-01

**Applications**
- Plasma component analysis
- Analysis of various emission phenomena

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Example of temporal resolution (gate operation) measurements
Reflective spectrum measurements

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

- **Configuration**
  - Standard PMA-12 configuration (C10544, C10027, etc.)
  - Data analyzer C10471-01,-02
  - 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 evaluation of paint, fabric, printed matter and the like**

- **Configuration**
  - Standard PMA-12 configuration (C10544, C10027, etc.)
  - Data analyzer C10471-01,-02
  - Halogen lamp L6758-11

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

Absorption spectrum measurements

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

- **Configuration**
  - Standard PMA-12 configuration (C10544, C10027, etc.)
  - Data analyzer C10471-01,-02
  - 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

Microscopic spectral measurements

**Spectral distribution measurements under a microscope**

- **Configuration**
  - Standard PMA-12 configuration (C10027, C10029, etc.)
  - Data analyzer C10471-01,-02
  - C-mount adapter for positioning A9607

- **Applications**
  - Measurement of bioluminescence
  - Measurements on semiconductor wafer, LCD and other microstructures
**Emission spectrum measurements**

For fluorescent samples such as fluorescent lamps and EL devices

Fluorescence indicator (Fluorescein) emission spectrum

Chemiluminescence emission spectrum

**Film thickness measurements**

Film thickness measurements using spectral reflectance or transmittance

ITO film interference spectrum

**Quantum yield measurement system**

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

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 specialized machine for OLED measurement.
Please refer the detail in specific brochure.
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˚ from 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 necessary 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 kind 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 UV to NIR wavelength.

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 UV to NIR wavelength.

Data analyzer C10471-01,-02
A data analyzer is provided. There are the C10471-01 notebook model and the C10471-02 desktop model

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.

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.

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 pin-hole. (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

<table>
<thead>
<tr>
<th>Model</th>
<th>C10544-01</th>
<th>C10544-02</th>
<th>C10027-01</th>
<th>C10027-02</th>
<th>C10028-01</th>
<th>C10028-02</th>
<th>C10029-01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photo-detector</td>
<td>CCD linear image sensor</td>
<td>BT-CCD linear image sensor</td>
<td>InGaAs linear image sensor</td>
<td>I.I. + BT-CCD linear image sensor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wavelength (nm)</td>
<td>300 to 800</td>
<td>340 to 830</td>
<td>200 to 950</td>
<td>350 to 1100</td>
<td>900 to 1650</td>
<td>1600 to 2350</td>
<td>200 to 860</td>
</tr>
<tr>
<td>Wavelength resolution (FWHM)*1</td>
<td>&lt; 3 nm</td>
<td>&lt; 2 nm</td>
<td>&lt; 2.5 nm</td>
<td>&lt; 9 nm</td>
<td>&lt; 3 nm</td>
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<tr>
<td>Exposure time</td>
<td>19 ms to 64 s (1 ms to 64 s)</td>
<td>19 ms to 64 s (1 ms to 64 s)</td>
<td>5 ms to 64 s (1 ms to 64 s)</td>
<td>5 ms to 50 ms (1 ms to 64 s)</td>
<td>19 ms to 64 s (1 ms to 64 s)</td>
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<tr>
<td>Gate time*2</td>
<td>–</td>
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<td>–</td>
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<td>–</td>
<td>10 ns</td>
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<tr>
<td>Gate repetition</td>
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<td>–</td>
<td>–</td>
<td>–</td>
<td>20 kHz</td>
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<tr>
<td>Number of photosensitive device channels</td>
<td>1024 ch</td>
<td>1024 ch</td>
<td>256 ch</td>
<td>900 ch</td>
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<tr>
<td>Pixel size</td>
<td>24 μm × 3.07 mm</td>
<td>24 μm × 2.928 mm</td>
<td>50 μm × 250 μm</td>
<td>24 μm × 2.928 mm*2</td>
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<tr>
<td>Device cooling temperature</td>
<td>0 °C</td>
<td>-15 °C</td>
<td>-10 °C</td>
<td>-15 °C</td>
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<tr>
<td>Read-out noise</td>
<td>18</td>
<td>16</td>
<td>12 500</td>
<td>16*3</td>
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<td></td>
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<tr>
<td>Dark current</td>
<td>400 (0°C : 20 ms)</td>
<td>75 (-15 °C : 20 ms)</td>
<td>20 000 (-10 °C : 20 ms)</td>
<td>2.5 × 10^7 (-15 °C : 20 ms)</td>
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<tr>
<td>AD resolution</td>
<td>16 bit</td>
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<tr>
<td>Spectrograph</td>
<td>Concave spherical grating type</td>
<td>Czerny-Turner type</td>
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<td></td>
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<td>Spectrograph F number</td>
<td>3</td>
<td>4</td>
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<tr>
<td>Fiber receiving area</td>
<td>Φ 1 mm</td>
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<td></td>
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<tr>
<td>Fiber type</td>
<td>Bundled fiber Ø 12 mm SUS tube</td>
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<tr>
<td>Fiber length</td>
<td>1.5 m*4</td>
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<td>External trigger input</td>
<td>TTL level / High impedance</td>
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<td></td>
</tr>
<tr>
<td>Interface</td>
<td>USB 2.0</td>
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<td></td>
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</tr>
<tr>
<td>Power supply</td>
<td>AC 100 V to AC 240 V, 50 Hz / 60 Hz (Power supply voltage variation ±10 %)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*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.

#### Main unit

<table>
<thead>
<tr>
<th>Model</th>
<th>C10544-01, 02</th>
<th>C10027-01, 02</th>
<th>C10028-01, 02</th>
<th>C10029-01</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>202</td>
<td>333</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C10028-01, 02</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>202</td>
<td>333</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C10029-01</td>
<td></td>
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</tr>
</tbody>
</table>

#### Fiber input optics for C10544, 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  
  - Spectral signals consistency calibration  
  - Dark current correction  
  - Display functions —— Spectrum display  
  - Display temporal waveform fluctuations  
  - Wavelength axis display —— Wavelength, Wave number, Raman shift, energy (eV)  
  - Brightness axis display —— Linear, Logarithm  
  - Cursor analysis functions —— Wavelength (wave number, 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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