Pierce through the darkness.

CS-2000A Spectroradiometer
World’s top level capability to detect extremely low luminance
**World's top level capability to detect extremely low luminance**

* As a polychromator type spectroradiometer (As of March 2014)

**1,000,000:1 contrast measurement is now possible!**

* When the peak luminance is 500 cd/m²

Opening the curtain on a new age in which people can experience theater ambiance with their home televisions. The Spectroradiometer CS-2000A enables high-accuracy mega-contrast measurements of the extremes from delicate shadows to glittering wavefronts which are key to image reproduction performance. This newest addition to the Konica Minolta lineup will contribute greatly to research and development as well as quality control of the most advanced FPDs.

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**0.0005 cd/m² opens new worlds**

With an additional decimal place of performance in measuring low luminosity even compared to our CS-2000, which was awarded the ADY 2008 grand prize, the CS-2000A helps open up a new stage of display development by enabling the measurement of contrast ratios up to 1 million to 1*1 which is being targeted by the latest FPD technology.

*1 Maximum luminance 500 cd/m²

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Instruments that push the extreme boundaries of practical application and cost performance to support design and development work.

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**Highly accurate measurement of luminances as low as 0.003 cd/m²**

Konica Minolta’s original optical design and signal-processing technologies provide accurate measurement of luminance/chromaticity down to extremely low luminances of 0.003 cd/m².

- Low-luminance measurements: From 0.003 cd/m²
- Measurement accuracy: ±2% (Luminance)

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**Quick measurements even at low luminance**

Designed to thoroughly eliminate mechanical and electrical noise factors, the CS-2000 makes quick measurements with good repeatability possible even at low luminance levels.

- Measurement time for 1 cd/m²:
  - Approx. 5 sec. (FAST mode)
- * Konica Minolta’s previous model CS-1000: Approx. 123 sec.

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**Low polarization error**

The polarization error generated when using a reflection-type diffraction grating has been minimized to 2% (measuring angle: 1°). This ensures more stable measurements of display devices that use polarization, such as LCDs.

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**Half bandwidth of 5 nm**

A half bandwidth of 5 nm, which is required for colorimetry (JIS Z 8724-1997, CIE122-1996), is ensured for the entire wavelength range, allowing accurate chromaticity measurements.

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**Selectable measuring angle for measurement of tiny areas**

The CS-2000 enables you to select the optimum measuring angle according to the application.

- Measuring angle selection: 1°, 0.2°, 0.1°
- Minimum measuring area: ø0.1 mm (when the optional close-up lens is attached)

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**Practical design**

- The operating temperature range of 5 to 35°C ensures reliable operation at temperatures in actual work environments.
- Measurement can be started after a warm-up time of only 30 seconds. (Measuring angle: 1°; Target luminance: 5 cd/m² or more; 23°C)

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**Stable measurement even of periodic light sources**

1. Internal synchronization measurement
   - Measurement at numerically-input frequency
2. External synchronization measurement
   - Measurement with line input of vertical synchronization signal to instrument
3. Multi-integration mode measurement
   - Measurement for reducing variations due to unsynchronized measurements or synchronized measurements of sources having irregular light-emission cycles
Measurements of various objects are possible by selecting the best-suited measuring angle.

1° is suitable for
Typical targets such as middle- and large-size display units
• LCD, PDP, or EL display panels
• LCD panels of cellular phones and digital cameras
• Radar and other instrument panels used in airplane cockpits
• Large outdoor display screens

0.2° is suitable for
Small light sources such as LEDs
• Car audio systems
• Instrument panels for automobiles
• Lamps, fluorescent tube backlights, and other light sources

0.1° is suitable for
Extremely small light sources or distant lights
• PDP or LCD pixels
• Cold-cathode tubes
• Brake lamps of automobiles
• Traffic signals

Measurements of various objects are possible by selecting the best-suited measuring angle.

Optional close-up lens allows measurements of areas as tiny as ø0.1 mm. Not only general display units but also small targets can be measured.

### Measuring distance vs. measuring area

<table>
<thead>
<tr>
<th>Measuring distance</th>
<th>Measuring angle (Units: mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1°</td>
</tr>
<tr>
<td>When a close-up lens is attached</td>
<td>55.0</td>
</tr>
<tr>
<td>350</td>
<td>ø1.39</td>
</tr>
<tr>
<td>500</td>
<td>ø5.00</td>
</tr>
<tr>
<td>1,000</td>
<td>ø16.66</td>
</tr>
<tr>
<td>2,000</td>
<td>ø34.18</td>
</tr>
</tbody>
</table>

* The measuring distance is the distance from the objective lens or the end of the metal frame of the close-up lens.
Comparison of repeatability

* Comparison with Konica Minolta’s previous model CS-1000 for target luminance of 0.1 cd/m²
* The y-axis indicates the logarithm when the average of the CS-2000 measured values is assumed to be 1.

High repeatability achieved by an instrument design which thoroughly eliminated mechanical and electrical noise factors.

Scotopic vision measurement

It is known that the sensitivity of human vision shifts to blue region in dark environments, but past instruments did not have scotopic measurement function. CS-2000A achieves sufficient capability to make it possible with CS-S10w Professional (standard accessory).

Scotopic vision

In the human eye, there are 2 types of photoreceptor cells, which are cone cells and rod cells. Cone cells are sensitive to color and rod cells are sensitive to only brightness. As brightness decreases, the activity of rod cells becomes stronger, and the condition in which only rod cells are working is called scotopic vision. The peak of spectral luminous efficiency of scotopic vision is shifted toward blue from the green peak of photopic vision (vision under brighter conditions) and thus blue objects are perceived to be brighter.

Measured luminance vs. Measurement times

(Units: sec.)

<table>
<thead>
<tr>
<th>Luminance (cd/m²)</th>
<th>NORMAL mode</th>
<th>FAST mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.003</td>
<td>243</td>
<td>35</td>
</tr>
<tr>
<td>0.01</td>
<td>243</td>
<td>35</td>
</tr>
<tr>
<td>0.1</td>
<td>155</td>
<td>27</td>
</tr>
<tr>
<td>1</td>
<td>19</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>300</td>
<td>3.7</td>
<td>3.7</td>
</tr>
</tbody>
</table>

Measurement subject: Standard light source A

* All time indications are approximate values.

Using as a reference instrument

CS-2000/CS-2000A can be used as a reference instrument for Konica Minolta’s Luminance Meters in various industrial fields.

System Diagram

- Standard accessories
- Optional accessories
- Lens Cap
- Screw for focus ring lock
- CS-2000 main unit
- Calibration certificate (CS-2000)
- 3-point calibration certificate (CS-2000A)
- Eyepiece with ND filter
- CCD Camera Adapter
- AC Adapter
- USB cable (2 m)
- PC (commercially available)
- Data Management Software CS-S10w Professional Edition
- ND filter (1/10)
- CS-A33 (without data)
- CS-A34 (1/100)
- Close-up lens CS-A35
- White Calibration Plate CS-A5 (without data)
- CS-A5 (with data)
- CS-A5 (with data and calibration certificate)
- Storage Case CS-A30
- Tripod CS-A3
- Pan Head CS-A4
- Reference instrument
- CA-2500A
- CA-310
- CS-100A
With this software, the CS-2000 and CS-2000A can be controlled from a personal computer to display measured data in various graphs or lists, to transfer data to spreadsheet software, or to copy-and-paste data. CS-S10w offers various data management, analysis and evaluation options to assist in research and development or quality control.

- **Display**
  - Spectral graph, spectral data list, chromaticity diagram

- **Color space**
  - Lxy, LUv, L'Tu, XYZ, dominant wavelength, excitation purity, scotopic luminosity

- **Calculation**
  - Four basic arithmetic operations and function processing of spectral data

- **Mode selection**
  - Normal mode, contrast mode, RGB mode, RGB & contrast mode, object color mode

- **Instrument control**
  - Averaging measurement, interval measurement, user calibration

- **Data management**
  - Reading/saving files; managing data by using folders; creating, saving and reading templates with various graphs designed and laid-out by users; displaying data with graphs

- **Data evaluation**
  - Observer/illuminant setting, color rendering property evaluation, statistic value display for each folder, box tolerance setting, multiple point setting for display evaluation, non-uniformity (mura) display, contrast display, polygonal tolerance setting

Multiple data objects can be copied and pasted to spreadsheet software.

**System requirements**
- **OS**
  - Windows® Windows® 7 Professional 32-bit, 64-bit
  - Windows® 8.1 Pro 32-bit, 64-bit
  - Windows® 10 Pro 32-bit, 64-bit

- **CPU**
  - Pentium® III 600 MHz equivalent or faster

- **Memory**
  - 128 MB or more

- **Hard disk**
  - 60 MB or more of free space for installation

- **Display**
  - 1,024 x 768, 256 colors minimum

- **Other**
  - CD-ROM drive for installation, USB port for instrument connection

**Data Management Software CS-S10w Professional** (Standard accessory)

With this software, the CS-2000 and CS-2000A can be controlled from a personal computer to display measured data in various graphs or lists, to transfer data to spreadsheet software, or to copy-and-paste data. CS-S10w offers various data management, analysis and evaluation options to assist in research and development or quality control.
Main specifications of CS-2000/2000A

<table>
<thead>
<tr>
<th>Model</th>
<th>CS-2000/2000A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength range</td>
<td>380 to 780 nm</td>
</tr>
<tr>
<td>Wavelength resolution</td>
<td>0.9 nm/pixel</td>
</tr>
<tr>
<td>Display wavelength bandwidth</td>
<td>1.0 nm</td>
</tr>
<tr>
<td>Wavelength precision</td>
<td>±0.3 nm (Median wavelength: 435.8 nm, 546.1 nm, 643.8 nm; Hg-Cd lamp)</td>
</tr>
<tr>
<td>Spectral bandwidth</td>
<td>5 nm or less (half bandwidth)</td>
</tr>
<tr>
<td>Measuring angle (selectable)</td>
<td>1°, 0.2°, 0.1°</td>
</tr>
<tr>
<td>Measurement luminance range (Standard light source A)</td>
<td>0.003 to 5,000 cd/m²</td>
</tr>
<tr>
<td>Minimum measuring area (ø1 mm when using close-up lens)</td>
<td>0.0125 to 125,000 cd/m²</td>
</tr>
<tr>
<td>Minimum measuring area (ø0.2 mm when using close-up lens)</td>
<td>0.005 to 50,000 cd/m²</td>
</tr>
<tr>
<td>Minimum measuring area (ø0.1 mm when using close-up lens)</td>
<td>0.001 to 5,000 cd/m²</td>
</tr>
<tr>
<td>Minimum measuring distance</td>
<td>350 mm (55 mm when using close-up lens)</td>
</tr>
<tr>
<td>Minimum spectral radiance display</td>
<td>1.0x10⁻⁵ W/sr m², nm</td>
</tr>
</tbody>
</table>

**Accuracy:**

- **Chromaticity (Standard light source A)**
  - x,y : ±0.003 (0.003 to 0.005 cd/m² and more)
  - x,y : ±0.002 (0.0005 to 0.003 cd/m²)
  - x : ±0.001 (0.0005 to 0.003 cd/m²)
  - y : ±0.001 (0.0005 to 0.003 cd/m²)

- **Repeatability:**
  - Chromaticity (2σ)
    - 0.4% (0.0005 to 0.001 cd/m²)
    - 0.2% (0.0005 to 0.001 cd/m²)
    - 0.1% (0.0005 to 0.001 cd/m²)

- **Chromaticity (Standard light source A)**
  - x,y : ±0.015 (0.0005 to 0.001 cd/m²)
  - x : ±0.015 (0.0005 to 0.001 cd/m²)
  - y : ±0.015 (0.0005 to 0.001 cd/m²)

- **Repeatability:**
  - Chromaticity (2σ)
    - 0.4% (0.0005 to 0.001 cd/m²)
    - 0.2% (0.0005 to 0.001 cd/m²)
    - 0.1% (0.0005 to 0.001 cd/m²)

- **Chromaticity (Standard light source A)**
  - x,y : ±0.002 (0.0005 to 0.001 cd/m²)
  - x : ±0.002 (0.0005 to 0.001 cd/m²)
  - y : ±0.002 (0.0005 to 0.001 cd/m²)

- **Repeatability:**
  - Chromaticity (2σ)
    - 0.4% (0.0005 to 0.001 cd/m²)
    - 0.2% (0.0005 to 0.001 cd/m²)
    - 0.1% (0.0005 to 0.001 cd/m²)

**Accuracy:**

- **Chromaticity (Standard light source A)**
  - x,y : ±0.003 (0.003 to 0.005 cd/m² and more)
  - x,y : ±0.002 (0.0005 to 0.003 cd/m²)
  - x : ±0.001 (0.0005 to 0.003 cd/m²)
  - y : ±0.001 (0.0005 to 0.003 cd/m²)

- **Repeatability:**
  - Chromaticity (2σ)
    - 0.4% (0.0005 to 0.001 cd/m²)
    - 0.2% (0.0005 to 0.001 cd/m²)
    - 0.1% (0.0005 to 0.001 cd/m²)

- **Chromaticity (Standard light source A)**
  - x,y : ±0.015 (0.0005 to 0.001 cd/m²)
  - x : ±0.015 (0.0005 to 0.001 cd/m²)
  - y : ±0.015 (0.0005 to 0.001 cd/m²)

- **Repeatability:**
  - Chromaticity (2σ)
    - 0.4% (0.0005 to 0.001 cd/m²)
    - 0.2% (0.0005 to 0.001 cd/m²)
    - 0.1% (0.0005 to 0.001 cd/m²)

**Polarization error**:

- 1°: 2% or less (400 to 780 nm)
- 0.1° and 0.2°: 3% or less (400 to 780 nm)

**USB Interface**

**Weight**

- 6.2 kg

**Dimensions (Units: mm)**

<table>
<thead>
<tr>
<th>Filter thread diameter</th>
<th>ø6.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>125.0</td>
<td>125.0</td>
</tr>
<tr>
<td>85.5</td>
<td>85.5</td>
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<tr>
<td>65.7</td>
<td>65.7</td>
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<tr>
<td>59.2</td>
<td>59.2</td>
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<td>51.1</td>
<td>51.1</td>
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<td>45.7</td>
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<td>40.5</td>
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<td>37.0</td>
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<td>15.6</td>
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</tr>
<tr>
<td>11.5</td>
<td>11.5</td>
</tr>
<tr>
<td>7.7</td>
<td>7.7</td>
</tr>
<tr>
<td>5.2</td>
<td>5.2</td>
</tr>
</tbody>
</table>

**SAFETY PRECAUTIONS**

- For correct use and your safety, be sure to read the instruction manual before using the instrument.
- Always connect the instrument to the specified power supply voltage. Improper connection may cause a fire or electric shock.

KONICA MINOLTA, INC.

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New Jersey, U.S.A.

Konica Minolta Sensing Europe B.V.
European Headquarters/ BENELUX

German Office
French Office

Turkey

Italian Office

Konica Minolta (CHILDRA) Investment Ltd.

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Konica Minolta Sensing Korea Co., Ltd.

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