Spectroradiometer CS-2000

NEW

Highly precise spectral radiance/chromaticity measurement possible from 0.003 cd/m²

Achieving 100,000 : 1 contrast measurement

World's top level capability to detect extremely low luminance

The essentials of imaging
World's top level capability to detect extremely low luminance
* As a polychromator type spectroradiometer (As of November 2007)

100,000:1 contrast measurement is now possible!
* When the peak luminance is 300 cd/m²

Since the commencement of high-definition TV broadcasting, there is an accelerating proliferation of high-quality display devices which support full HD for reproduction of sharp, high-resolution images. State-of-the-art technology is now achieving tone reproduction with contrasts of 100,000 : 1, offering an almost-real feeling. This has spurred technical competition for reproduction of "blacker blacks" in particular, resulting in the need for an instrument that can measure extremely low luminance.

In addition, the development of various light-emitting devices, including organic electroluminescent (EL) displays as well as conventional LCD and plasma displays, requires more accurate spectrum analysis. The CS-2000 is a polychromator-type spectroradiometer which achieves 100,000 : 1 contrast measurement with the world's top level capability to detect extremely low luminance levels of 0.003 cd/m².

- **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)

- **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.

- **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.

- **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.

- **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)

- **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)

- **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

Measuring diameter viewed through viewfinder

Measuring distance vs. measuring area (Units: mm)

<table>
<thead>
<tr>
<th>Measuring distance</th>
<th>1°</th>
<th>0.2°</th>
<th>0.1°</th>
</tr>
</thead>
<tbody>
<tr>
<td>When a close-up lens is attached</td>
<td>55.0</td>
<td>ø1.00</td>
<td>ø0.20</td>
</tr>
<tr>
<td>350</td>
<td>70.9</td>
<td>ø1.39</td>
<td>ø0.28</td>
</tr>
<tr>
<td>500</td>
<td>ø5.00</td>
<td>ø1.00</td>
<td>ø0.50</td>
</tr>
<tr>
<td>1,000</td>
<td>ø7.78</td>
<td>ø1.56</td>
<td>ø0.78</td>
</tr>
<tr>
<td>2,000</td>
<td>ø16.66</td>
<td>ø3.33</td>
<td>ø1.67</td>
</tr>
<tr>
<td>3,000</td>
<td>ø34.18</td>
<td>ø6.84</td>
<td>ø3.42</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.
High repeatability achieved by an instrument design which thoroughly eliminated mechanical and electrical noise factors.

### Measured luminance vs. Measurement times

<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.

### Technology

The optical sensor, which is the heart of the CS-2000, was designed through precise analysis in order to eliminate the influence of thermal distortion of its components on the measurement values.

Thermal analysis diagram of the sensor block
With this software, the CS-2000 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 mode**
  - Lx, y, Luv, L, T, ∆u, v, XYZ, dominant wavelength, excitation purity

- **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

**System requirements**
- **OS**
  - Windows® 2000 Professional SP4,
  - Windows® XP Professional SP2/×64 Edition,
  - Windows® Vista Business 32-bit (x86)/64-bit (x64)
- **CPU**
  - Pentium® III 600 MHz equivalent or faster (recommended)
- **Memory**
  - 128 MB or more (256 MB or more recommended)
- **Hard disk**
  - 60 MB or more of free space for installation
- **Display**
  - 1024 x 768, 256 colors minimum
- **Other**
  - CD-ROM drive for installation, USB port for instrument connection

**Data Management Software CS-S10w Professional (Standard accessory)**
## Major specifications of CS-2000

<table>
<thead>
<tr>
<th>Model</th>
<th>CS-2000</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 range (Standard light source A)</td>
<td>0.003 to 5,000 cd/m², 0.075 to 125,000 cd/m², 0.3 to 500,000 cd/m²</td>
</tr>
<tr>
<td>Minimum measuring area</td>
<td>ø5 mm, ø1 mm, ø0.5 mm (ø1 mm when using close-up lens)</td>
</tr>
<tr>
<td>Minimum measuring distance</td>
<td>350 mm (55 mm when using close-up lens)</td>
</tr>
<tr>
<td>Minimum luminance display</td>
<td>0.00002 cd/m²</td>
</tr>
<tr>
<td>Accuracy: Luminance (Standard light source A)</td>
<td>±2%</td>
</tr>
<tr>
<td>Accuracy: Chromaticity (Standard light source A)</td>
<td>±0.003 (0.003 to 0.05 cd/m²), ±0.002 (0.05 to 0.5 cd/m²), ±0.001 (0.5 to 5,000 cd/m²)</td>
</tr>
<tr>
<td>Repeatability: Luminance (2σ) (Standard light source A)</td>
<td>0.4% (0.003 to 0.05 cd/m²), 0.3% (0.05 to 0.1 cd/m²), 0.15% (0.1 to 5,000 cd/m²)</td>
</tr>
<tr>
<td>Repeatability: Chromaticity (2σ) (Standard light source A)</td>
<td>0.002 (0.003 to 0.005 cd/m²), 0.001 (0.005 to 0.1 cd/m²), 0.0006 (0.1 to 0.2 cd/m²)</td>
</tr>
<tr>
<td>Polarization error</td>
<td>±1°: 2% or less (400 to 780 nm), ±0.1° and ±0.2°: 3% or less (400 to 780 nm)</td>
</tr>
<tr>
<td>Integration time</td>
<td>Fast: 0.005 to 16 sec., Normal: 0.005 to 120 sec.</td>
</tr>
<tr>
<td>Measurement time</td>
<td>1 sec. minimum (Manual mode) to 243 sec. maximum (Normal mode)</td>
</tr>
<tr>
<td>Color space mode</td>
<td>L, xy, Luv, L*uv, XYZ, spectral graph, dominant wavelength, excitation purity</td>
</tr>
<tr>
<td>Interface</td>
<td>USB 1.1</td>
</tr>
<tr>
<td>Operating temperature/humidity range</td>
<td>5 to 35°C, relative humidity 80% or less with no condensation</td>
</tr>
<tr>
<td>Storage temperature/humidity range</td>
<td>0 to 35°C, relative humidity 80% or less with no condensation</td>
</tr>
<tr>
<td>Power</td>
<td>AC adapter (100 - 240 V, 50/60 Hz)</td>
</tr>
<tr>
<td>Current consumption</td>
<td>Approx. 20 W</td>
</tr>
<tr>
<td>Size</td>
<td>158 (W) x 262 (H) x 392 (D) mm</td>
</tr>
<tr>
<td>Weight</td>
<td>6.2 kg</td>
</tr>
</tbody>
</table>

*1: Average of 10 measurements in Normal mode at a temperature of 23±2°C and a relative humidity of 65% or less.
*2: 10 measurements in Normal mode at a temperature of 23±2°C and a relative humidity of 85% or less.

### Outer dimensions (Units: mm)

![Outer dimensions diagram]

The specifications and drawings given here are subject to change without prior notice.
- If you have any questions about specifications, please contact your Konica Minolta representative.