Hitachi Fluorescence Spectrophotometer

F-7000
Designed to Meet Your Needs for High-Quality Analytical Instrumentation.

Hitachi’s Superior Fluorescence Technology Has Created a New Generation of Fluorescence Spectrophotometers.

High S/N Ratio, Ultra-Fast Scanning, Compact Design, Multiple Accessories

- High sensitivity measurement (S/N 800 RMS) (equivalent to S/N 250 peak to peak)
- 60,000 nm/min ultra-high scanning speed, ideal for 3-D measurement
- Compact design (approx. 2/3 the size of the F-4500)
- A wide range of accessories accommodating various applications
Technologies Supporting Hitachi Fluorescence Spectrophotometers

**Precision Machining Technology** resulting in bright optics.

**Advanced Electric Circuit Technology** for high-speed processing.

**Controlled System Technology** ensures high accuracy.

- Stigmatic concave diffraction grating, mechanically ruled, resulting in a very bright monochromator of F-number 2.2.

  **Ruling engine.**
  A dividing engine for ruling diffraction gratings, invented in 1880s by Henry Augustus Rowland of Johns Hopkins University.
  Compared to a holographic grating, mechanically ruled gratings have the following advantages:
  1. Mirror-finished groove surface results in high diffraction efficiency.
  2. Groove spacing required for aberration correction can be adjusted, making it possible to have a greater correction effect.
  These characteristics of mechanically ruled gratings work well to create an excellent monochromator.

- Detection limit of fluorescein
  Due to enhanced sensitivity, the F-7000 Fluorescence Spectrophotometer can detect fluorescein concentrations one digit lower than its predecessor, the Model F-4500.
  The improved S/N ratio provides greater capabilities for trace-sample measurements.

### F-7000 Performance Supported by Technology

**High S/N: 800 (RMS), 250 (Peak to Peak)**

- **3-D Measurement**
  A 3-dimensional fluorescence spectrum can clearly distinguish slight differences that a 2-dimensional spectrum cannot detect.
  Measurements can now be carried out with higher accuracy than before.

**Calibration curve and spectrum overlay of fluorescein**
The automatic gain change-over function, a technique unique to Hitachi fluorescence spectrophotometers, has made it possible to generate calibration curves using up to 6-digit concentration values. An unknown sample can be quantitatively analyzed without additional sample preparation.

**Other functions**
- Automatic pre-scan function optimized for unknown sample measurement
- Ratio photometry (0 point correction) ensuring stable measurements
- High-resolution multi-stage slit with a resolution as small as 1nm
- Shutter control for minimizing sample deterioration

**Example of reaction tracing with a spectrum**
The fast-speed scanning enables users to carry out measurements that have been difficult with conventional instruments. In this example, an isomerization process of coumarin in kerosene was traced by spectrum measurement at 2-second intervals and displayed as a 3-D time-scan spectrum. This is a new function in the F-7000. Previously, a quick reaction which occurs within 1 minute could be measured only by using the fixed-wavelength method. The F-7000 is capable of following such a quick reaction because of its fast scanning, measuring the entire wavelength range within 1 second.

**3-dimensional time scan spectrum of coumarin for environmental applications**
Application Capabilities Unique to Hitachi

Industrial Material Field

Measurement of fluorescent materials

■ Organic EL material

In this example, the F-7000 was used to analyze the luminescent characteristic of trisaluminum complex powder used as a luminescent material for organic EL display. A solid sample holder, its powder cell, the photomultiplier R928F, and the filter set were used.

Scan speed: 12,000nm/min
Excitation slit: 5.0mm
Emission slit: 5.0mm
Photomultiplier voltage: 400V
Response: Automatic
Spectrum correction: Activated
Beam-cut filter (UV-39) used
Photomultiplier R928F used

The acquisition of these data was made possible by the 3-D measurement function and high-speed scanning capability of the F-7000.

Measurement of calcium in cell

The example below shows the phosphorescence spectrum and lifetime measurement of the Eu(tta)₃(TOPO)₂ complex, a rare earth element.

With the F-7000, the analysis of phosphorescence life of 1 ms order can be performed at room temperature without special accessories.

Phosphorescence measurement

■ Rare earth element complex (Eu chelate)

The example below shows the phosphorescence spectrum and lifetime measurement of the Eu(tta)₃(TOPO)₂ complex, a rare earth element.

With the F-7000, the analysis of phosphorescence life of 1 ms order can be performed at room temperature without special accessories.

Phosphorescence spectrum measurement of Eu(tta)₃(TOPO)₂ complex

Phosphorescence lifetime of Eu(tta)₃(TOPO)₂ complex

Phosphorescence life (τ): 0.759ms

Biological Field

Measurement of intermolecular actions

■ FRET (Fluorescence Resonance Energy Transfer) and BRET (Bioluminescence Resonance Energy Transfer)

The Model F-7000 can measure the intermolecular activities such as FRET and BRET. Shown below are fluorescence spectra presenting the interactions between the subunit proteins of an ATP-active purine receptor.

Data provided by Mr. Takaaki Koshimizu, Kyoto University Graduate School of Pharmaceutical Sciences – Genomic Drug Discovery Science.

■ Measurement of calcium in cell

With the optional interacellular calcium measurement accessory, the F-7000 can measure fluorescence intensity values at two wavelengths in EGF-injected COS-7 cells (extracted from a monkey’s kidney), and calculate the concentrations of Ca²⁺.

The sample was a cultivated cell fluorescence-labeled by Fura2-AM. The change in Ca²⁺ concentrations in the live cell was also measured. During this analysis, the EGF receptor appeared in the COS-7 as the Ca²⁺ level increased due to EGF injection.

The Model F-7000 can measure biological samples with higher sensitivity and speed.

Phosphorescence measurement

■ Ca²⁺ concentration in cells

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The Model F-7000 can measure biological samples with higher sensitivity and speed.

Micro-plate Accessory

■ Features

- Automatic measurement using a 96 well microplate is available.
- Used as an autosampler, allows wavelength scan, time scan, and 3-dimensional measurement.
- Can be used in conjunction with the polarization accessory.

The acquisition of these data was made possible by the 3-D measurement function and high-speed scanning capability of the F-7000.

Wavelength (nm)

Concentration

Fluorescent intensity

Conc. WL 340, 510nm, WL 380, 510nm

0         50         100         150         200

sec

0         50         100         150         200

Ca²⁺ (nM)

EGF

100

200

0

100

200

0

Conc. WL 340, 510nm, WL 380, 510nm

Phosphorescence measurement of Eu(tta)₃(TOPO)₂ complex

Phosphorescence life measurement of Eu(tta)₃(TOPO)₂ complex

Phosphorescence lifetime of Eu(tta)₃(TOPO)₂ complex

Phosphorescence life (τ): 0.759ms

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Phosphorescence lifetime of Eu(tta)₃(TOPO)₂ complex

Phosphorescence life (τ): 0.759ms
Easy-to-Use Software with Powerful Functionality

The FL Solutions Software is a powerful tool for analysts to use a Hitachi F-7000 fluorescence spectrophotometer efficiently at their command and thereby generate the necessary reports.

### Basic Flow of Operations

- **Condition setting**
- **Sample name input**
- **Pre-scan**
- **Measurement**

#### New functions

- **Spectrum readout with preview**
  - Just by selecting a file name, the contents can be checked without opening the data.

- **Collective file conversion**
  - Multiple files can be converted simultaneously.
Corning 9863. Band pass filter from 250 to 390nm (not included)
Compatible with the 10-mm rectangular cell
Enhances sensitivity about two fold when used in a chromatography system.
Such as catecholamines when measured in aivie, a measurement of reaction processes after injecting a reagent.
(Micro syringe required, but not included.)

Intracellular Calcium measurement accessory (250-0345)
Software for measuring calcium (Ca) in cells. Used for the measurement of antigen-antibody reaction, biological cells, proteins, enzymes, and other samples for the medical and biochemical fields.

Compatible cells 10mm rectangular cell
Max. error due to cell changeover 3%, with the same sample and cell
Max. 3% in signal level difference
Test tube of outer dia. 10/12mm (250-0346)
Thermostatic cell holder with stirrer (P/N 250-0346).
A reagent can be injected using a micro syringe, without opening the sample compartment.
Facilitates the measurement of a reaction process after injecting a reagent.
(Micro syringes required, but not included.)

Long life xenon lamp (150W) (250-1600)
Performance guaranteed life: 500 hours (150 hours in case of standard lamp)

Thermo centrifuge water bath and cell required, but not included.
Enables a fluorescence measuring range of 200 to 900nm (200 to 700nm with standard photomultiplier).

Automatic Polarization accessory for UV/Vis (5J0-0137)
Used for the measurement, calculation and data recording of fluorescence polarization angle and fluorescence anisotropy. Optimized for the measurement of antigen-antibody reaction, biological cells, proteins, enzymes, and other samples for the medical and biochemical fields.

Polarization accessory for VIS (5J0-0156)
Used to measure the polarization angle in the UV-VIS region (with 650-0155) and in the VIS region (5J0-0156).

Sub standard light source (115V) (5J0-0135)
Sub standard light source (220-240V) (5J0-0136)
Required for correction of emission spectrum at longer wavelengths.

Filter set (650-0157)
Empirical a set of polarizer and analyzer
Comes with filter set, grid line, and filter sheet (650-0156).

Temperature range 360 - 730nm (5J0-0137)
260 - 700nm (5J0-0138)

Photomultiplier R928F (650-1246)

Used to measure the polarization angle in the UV-VIS region (with 650-0155) and in the VIS region (5J0-0156).
The 650-0156 provides a higher accuracy in VIS region.

Polarization accessory for UV/Vis (650-0155)
Used for the measurement, calculation and data recording of fluorescence polarization angle and fluorescence anisotropy. Optimized for the measurement of antigen-antibody reaction, biological cells, proteins, enzymes, and other samples for the medical and biochemical fields.

Micro cell (650-0116)

Low scatter micro cell (650-0171)
Used for the measurement of trace samples of around 0.2ml, with almost the same sensitivity as that obtained by using a 10mm cell.
The low scatter micro cell using a black quartz mask has a low scatter beam and is effective for high sensitivity analysis of trace samples.

Minimum sample volume approx. 0.2ml.

Report generation program (5J0-0306)
Used to customize measurement reports. In addition to allowing user selection of size and position of report items, comments font, and graphs, calculations could be automatically executed using the spreadsheet function.
 FUNCTIONS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-dimensional measurement</td>
<td>Contour plotting (fluorescence/phosphorescence), bird’s eye view</td>
</tr>
<tr>
<td></td>
<td>Readout of EX/EM spectra from contour</td>
</tr>
<tr>
<td></td>
<td>Peak detection</td>
</tr>
<tr>
<td></td>
<td>Calculation between files (+, −, ×, ÷)</td>
</tr>
<tr>
<td>Wavelength scan</td>
<td>Fluorescence/phosphorescence/luminescence spectra</td>
</tr>
<tr>
<td></td>
<td>Synchronous spectra/repetitive measurement/CAT</td>
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<tr>
<td></td>
<td>Excitation spectrum correction (200 to 600nm)</td>
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<tr>
<td></td>
<td>Emission spectrum correction (200 to 600nm)</td>
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<td></td>
<td>Emission longer wavelength spectrum correction (500 to 800nm)</td>
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<tr>
<td></td>
<td>Emission longer wavelength spectrum correction (500 to 800nm)</td>
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<tr>
<td>3-dimensional time scan measurement</td>
<td>Contour plotting (fluorescence/phosphorescence), bird’s eye view</td>
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<tr>
<td></td>
<td>Readout of time scan/EM spectra from contour</td>
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<td></td>
<td>Peak detection</td>
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<tr>
<td></td>
<td>Calculation between files (+, −, ×, ÷)</td>
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<tr>
<td></td>
<td>Differentiation (first to fourth order)</td>
</tr>
<tr>
<td>Time scan measurement mode</td>
<td>Time scan fluorescence/phosphorescence measurement mode (minimum data interval 1.0ms)</td>
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<tr>
<td></td>
<td>Phosphorescence attenuation curve measurement</td>
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<tr>
<td></td>
<td>Rate calculation</td>
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<tr>
<td></td>
<td>Tracing, scale conversion, graph axis conversion</td>
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<tr>
<td></td>
<td>Smoothing</td>
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<tr>
<td></td>
<td>Calculation between files (+, −, ×, ÷)</td>
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<tr>
<td></td>
<td>Differentiation (first to fourth order)</td>
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<tr>
<td></td>
<td>Area calculation</td>
</tr>
<tr>
<td>Photometry mode</td>
<td>Quantitative analysis (fluorescence/phosphorescence/luminescence)</td>
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<tr>
<td></td>
<td>Two/three-wavelength calculation</td>
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<tr>
<td></td>
<td>Calibration curve (linear, quadratic, cubic, polynomial), factor enterable</td>
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<tr>
<td></td>
<td>Peak ratio, peak area, quantization via differentiation</td>
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<td>Interruption, sample blank measurement, data deletion</td>
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<tr>
<td></td>
<td>Calibration curve data correction, calibration curve tracing</td>
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<tr>
<td></td>
<td>Cumulative data averaging</td>
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<tr>
<td></td>
<td>Statistic calculation</td>
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<tr>
<td>Others</td>
<td>Automatic sensitivity measurement function</td>
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<tr>
<td></td>
<td>Pre-scan</td>
</tr>
<tr>
<td></td>
<td>Data transport and graph copying to Microsoft® Excel</td>
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<tr>
<td></td>
<td>Print preview function</td>
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</table>

● SPECIFICATIONS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>Sensitivity</td>
<td>S/N 800 or better (RMS) using Raman band of water</td>
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<tr>
<td></td>
<td>S/N 250 or better (Peak to Peak)</td>
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<tr>
<td></td>
<td>Excitation wavelength 350nm, bandpass 5nm, response 2s</td>
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<tr>
<td>Minimum sample volume</td>
<td>0.6mL (in use of standard 10mm rectangular cell)</td>
</tr>
<tr>
<td>Photometric principle</td>
<td>Monochromatic light monitoring ratio calculation</td>
</tr>
<tr>
<td>Light source</td>
<td>150W xenon lamp, self-deoxygenating lamp house</td>
</tr>
<tr>
<td>Monochromator</td>
<td>Stigmatic concave diffraction grating: 900 lines/mm, F2.2</td>
</tr>
<tr>
<td></td>
<td>Brazed wavelength: Excitation side 300nm, emission side 400nm</td>
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<tr>
<td>Measuring wavelength range (on both EX and EM)</td>
<td>200 to 750nm, and zero-order light (Expandable up to 900nm with optional detector)</td>
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<tr>
<td>Bandpass</td>
<td>Excitation side: 1, 2.5, 5, 10, 20nm</td>
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<tr>
<td></td>
<td>Emission side: 1, 2.5, 5, 10, 20nm</td>
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<tr>
<td>Resolution</td>
<td>1.0nm</td>
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<tr>
<td>Wavelength accuracy</td>
<td>1nm</td>
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<tr>
<td>Wavelength scan speed</td>
<td>30, 60, 240, 1,200, 2,400, 12,000, 30,000, 60,000nm/min</td>
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<tr>
<td>Wavelength drive speed</td>
<td>60,000nm/min</td>
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<tr>
<td>Response</td>
<td>Response from 0 to 98%: 0.002, 0.004, 0.01, 0.05, 0.1, 0.5, 2, 4 s</td>
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<tr>
<td>Photometric value range</td>
<td>–9999 to 9999</td>
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<td>Data processing unit</td>
<td>PC: Windows® XP Professional</td>
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<tr>
<td>Printer</td>
<td>Printer compatible with Windows® XP</td>
</tr>
<tr>
<td>Dimensions/weight</td>
<td>Spectrophotometer: 620 W × 520 D × 300 H mm (excluding protrusions)/41kg</td>
</tr>
<tr>
<td></td>
<td>Working temperature/humidity</td>
</tr>
<tr>
<td>Power consumption (spectrophotometer)</td>
<td>100, 115, 220, 230, 240 V AC, 50/60 Hz, 380 VA</td>
</tr>
<tr>
<td>FL Solutions program</td>
<td>Standard software</td>
</tr>
</tbody>
</table>

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NOTICE: For proper operation, follow the instruction manual when using the instrument.
Specifications in this catalog are subject to change with or without notice, as Hitachi High-Technologies Corporation continues to develop the latest technologies and products for our customers.

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