Fluorescence Spectrophotometer
F-4600

HITACHI
Inspire the Next

F-4600

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, Fast Scanning, Compact Design, Multiple Accessories

High sensitivity measurement (S/N 800 RMS)

Compact design (approx. 2/3 the size of the F-4500)

A wide range of accessories accommodating various applications

Hitachi Fluorescence Spectrophotometer

F-7000

F-4600

Middle range Fluorescence Spectrophotometer Released !

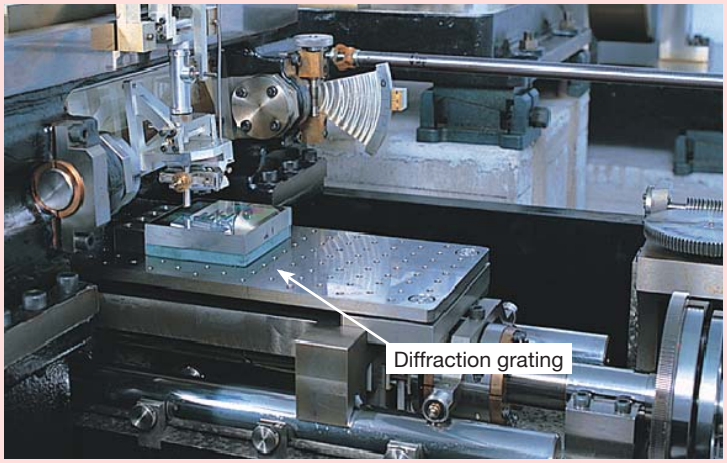
F-2700

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.

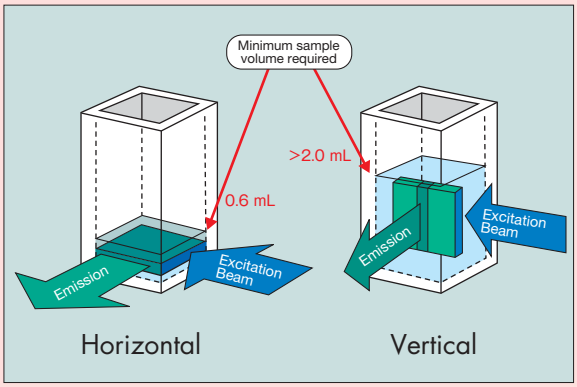
Ruling engine.
A dividing engine for ruling diffraction gratings, invented in 1880s by Henry Augustus Rowland of Johns Hopkins University.
Compared to a holographic grating, mechanically ruled gratings have the following advantages:
(1) Mirror-finished groove surface results in high diffraction efficiency.
(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.

F-4600 Performance Supported by Technology

Sample Volume

■ Horizontal vs. Vertical Beam Geometry

Horizontal beam geometry increases sensitivity by illuminating more of the sample with the excitation beam and reduces sample requirement to 0.6 mL in a standard 10 mm cuvette.



Hitachi's unique horizontal beam geometry increases sensitivity and reduces the sample volume required for a standard 10 mm cuvette. The horizontal beam provides additional illumination of the sample so that the emission and system sensitivity are increased.

Additionally, only 0.6 mL of sample is required in a standard 10 mm cuvette which is an important benefit for volume limited applications.

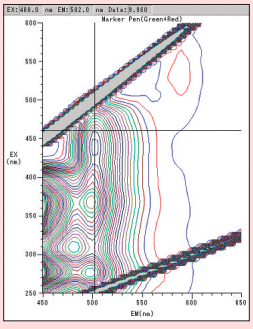
3-D Measurement

■ Data of fluorescent marker pen

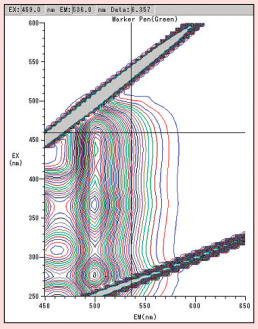
A 3-dimensional fluorescence spectrum can clearly distinguish slight differences that a 2-dimenstional spectrum cannot detect.

Measurements can now be carried out with higher accuracy than F-4500*.

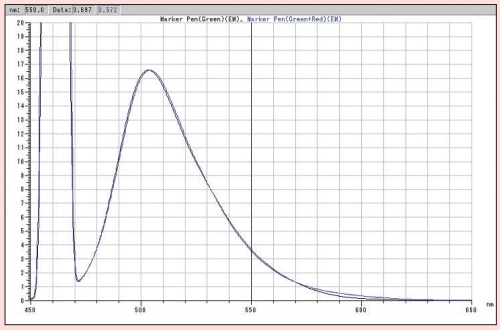
* Hitachi Fluorescence Spectrophotometer F-4500



3-dimensional spectrum of fluorescent marker pen (green × red)



3-dimensional spectrum of fluorescent marker pen (green)

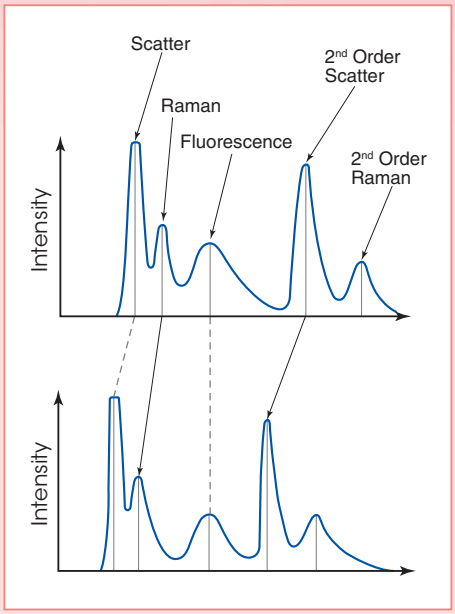


2-dimensional spectrum (excitation wavelength 460 nm)

Automatic Pre-scan function

■ Features Specified by Fluorescence Spectroscopists Help You Obtain Optimum Results.

The pre-scan function automatically shifts the optimum excitation wavelength to confirm true emission fluorescence and eliminate any possibility of a scatter band being erroneously selected. A true emission fluorescence peak does not shift with the change in excitation wavelength.

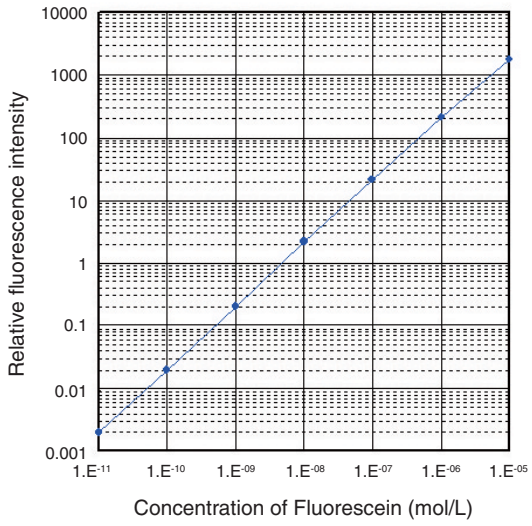


Pre-scan function ensures automatic and fast selection of the optimum excitation and emission wavelengths for your unknown samples. This unique pre-scan method eliminates any chance of mistaking light scatter as a fluorescence band by automatically shifting the selected excitation wavelength and monitoring the intensity and wavelength of the subsequent emission peaks.

Measures up to 6-digit concentration values

■ Calibration curve 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

- Ratio photometry (0 point correction) ensuring stable measurements
- High-resolution multi-stage slit with a resolution as small as 1 nm
- Shutter control for minimizing sample deterioration

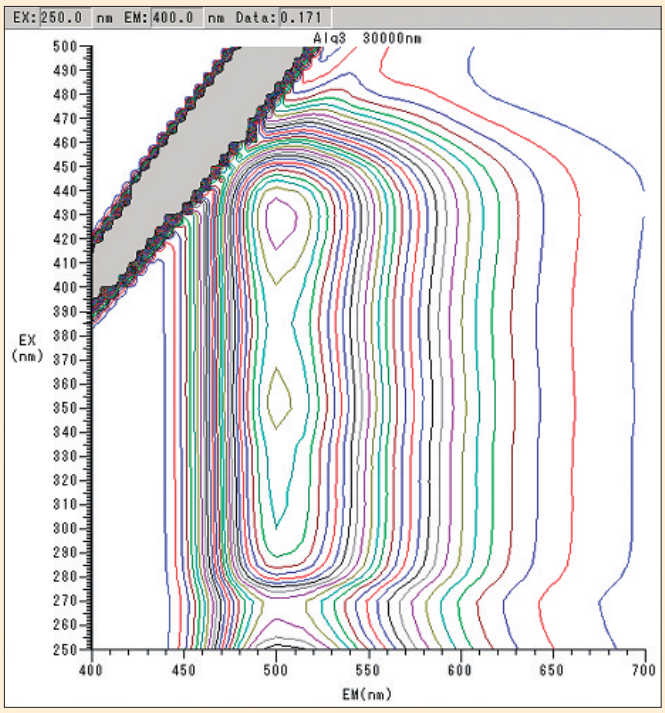
Industrial Material Field

Measurement of fluorescent materials

■ Organic EL material

In this example, the F-4600 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: 12,000 nm/min
Excitation slit: 5.0 nm
Emission slit: 5.0 nm
Photomultiplier voltage: 400 V
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-4600.

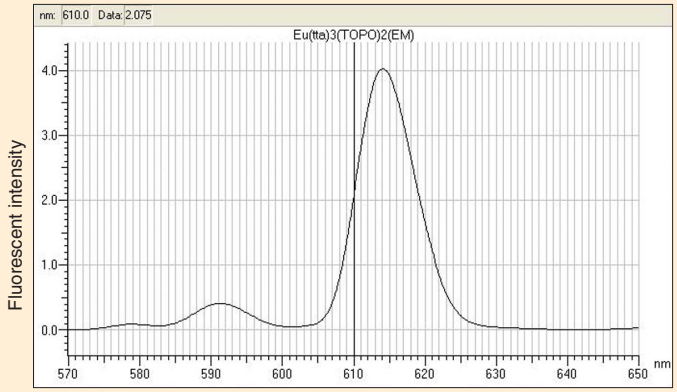
Pharmaceutical Field

Phosphorescence measurement

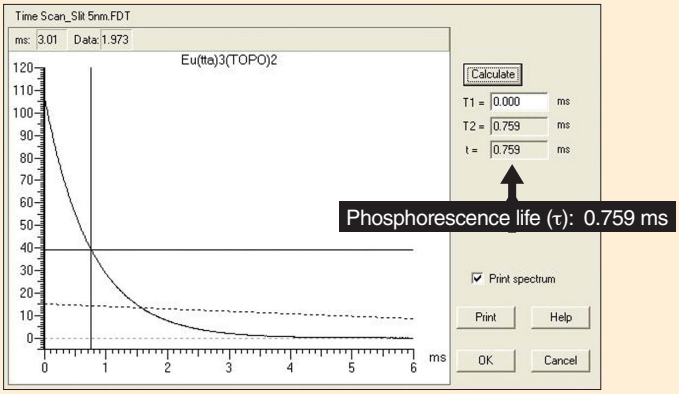
■ Rare earth element complex (Eu chelate)

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-4600, 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 life measurement of $Eu(tta)_3(TOPO)_2$ complex

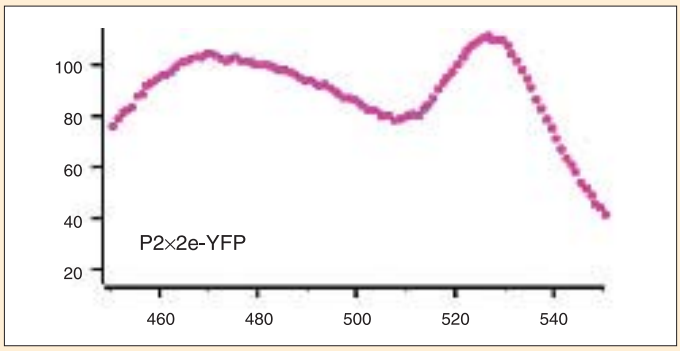
Biological Field

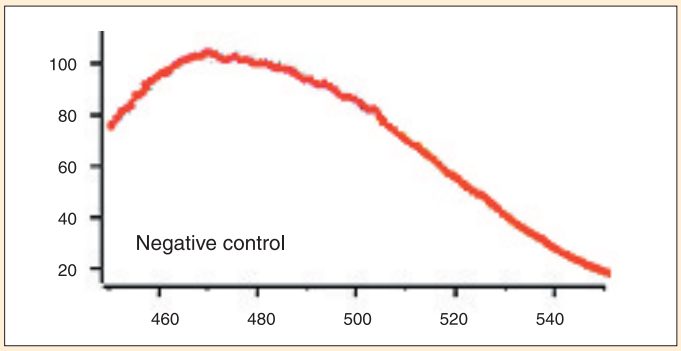
Measurement of intermolecular actions

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

The Model F-4600 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

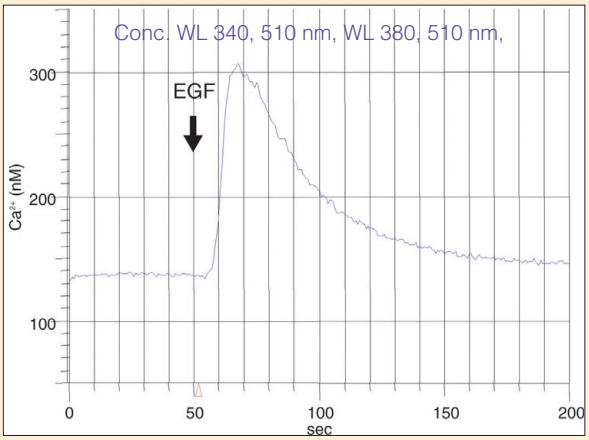
■ Ca^{2+} concentration in cells

With the optional interacellular calcium measurement accessory, the F-4600 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 Ca^{2+}.

The sample was a cultivated cell fluorescence-labeled by Fura2-AM.

The change in Ca^{2+} concentrations in the live cell was also measured. During this analysis, the EGF receptor appeared in the COS-7 as the Ca^{2+} level increased due to EGF injection.

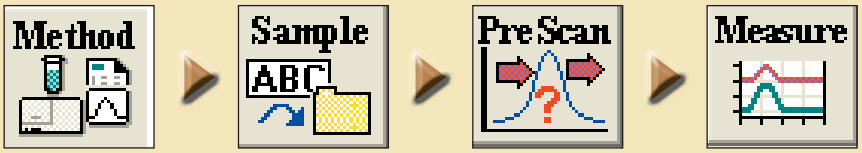
The Model F-4600 can measure biological samples with higher sensitivity and speed.



Easy-to-Use Software with Powerful Functionality

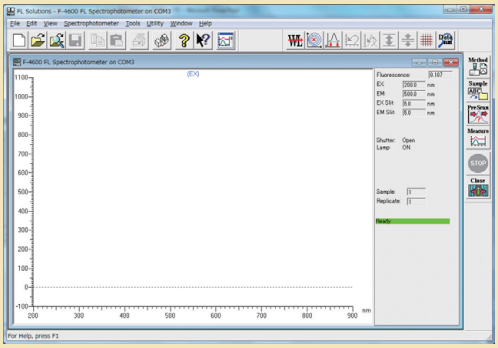
The FL Solutions Software is a powerful tool for analysts to use a Hitachi F-4600 fluorescence spectrophotometer efficiently at their command and thereby generate the necessary reports.

Basic Flow of Operations

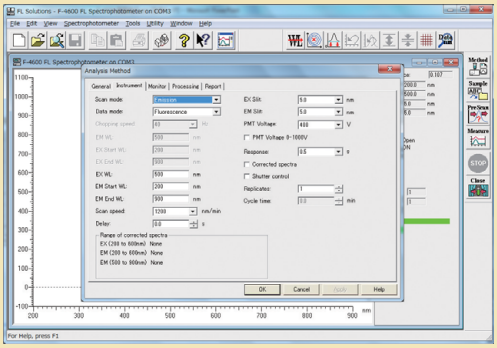


Condition setting → Sample name input → Pre-scan → Measurement

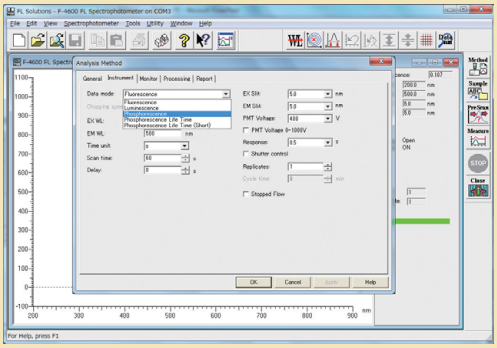
Measurement window



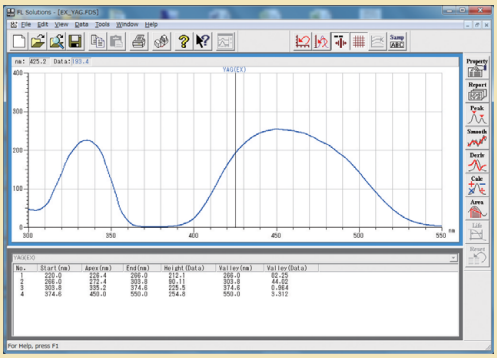
Spectrum measurement



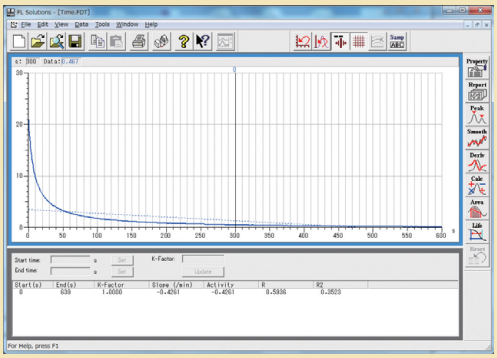
Time scan measurement



Data processing window



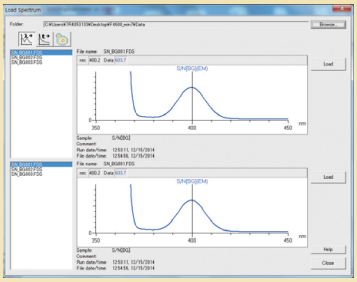
Data processing window



New functions

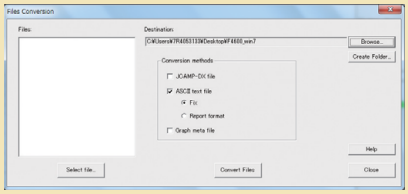
■ Spectrum readout with preview

Just by selecting a file name, the contents can be checked without opening the data.

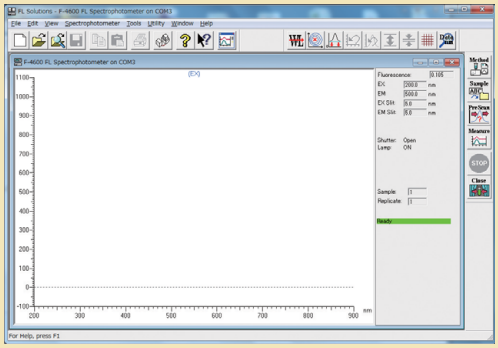


■ Collective file conversion

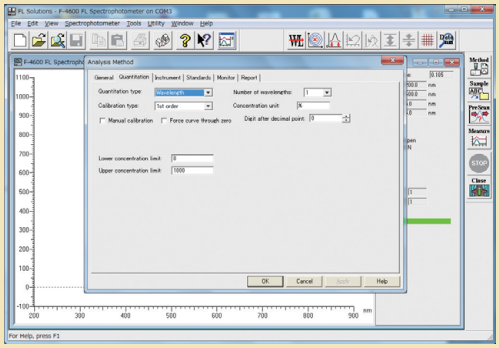
Multiple files can be converted simultaneously.



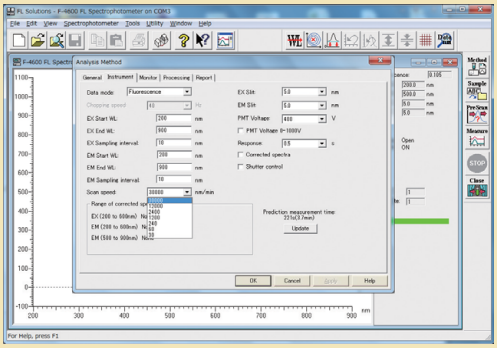
Measurement window



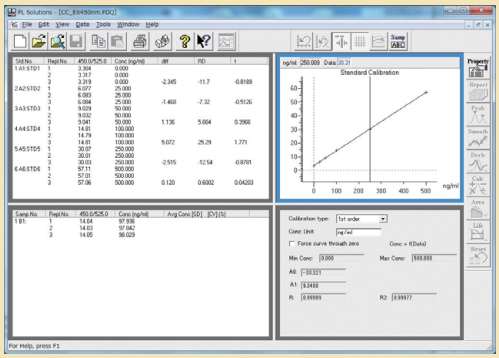
Quantitative calculation



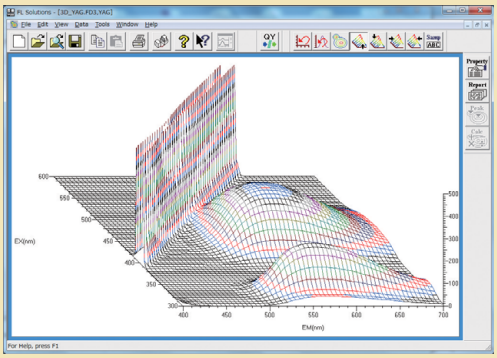
3-dimensional measurement



Data processing window



Data processing window



A Luxurious Array of Accessories for Applications in Extensive Fields

■ Flow cell unit for 55 µL (250-0331)

■ Flow cell unit for 180 µL (250-0332)

Provides high sensitivity measurements due to a design that avoids measuring fluorescence near the flow path.
An increased cell capacity is particularly effective for high sensitivity analysis of elements such as catecholamines when measured in combination with a high performance liquid chromatography system.

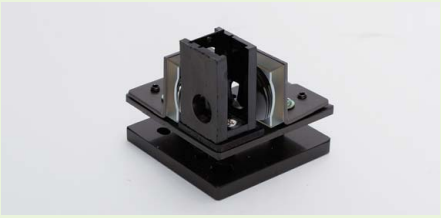
P/N	Cell capacity (Flow cell)	Cell capacity (Cell part)
250-0331	55 µL	18 µL
250-0332	180 µL	90 µL

■ High sensitivity cell holder (5J0-0124)

Enhances sensitivity about two fold when used with the 10 mm rectangular cell.
Compatible with the 10 mm rectangular cell (not included)

Compatible cell	10 mm rectangular cell

(Cell must be prepared separately.)



■ Sample sipper accessory (5J0-0123)

Streamlines successive operations of sample sipping, measurement and result printout. Effective for automatic measurement of liquid samples in quality control and clinical chemical analysis.

Cell capacity	About 180 mL
Carryover	2 % or less (Conditions) Sample: 1 mg/L quinine sulfate Blank: 0.1 mol/L dilute sulfuric acid Sipping quantity: 2.5 mL

■ Thermostatic cell holder (250-0330)

Temperature-controlled water keeps the temperature of the 10 mm rectangular cell constant. This holder is appropriate for analysis of biochemical samples.

Temperature range	5 to 60 °C

(Requires, but does not includes a thermostatted water bath and a cell)

■ 4-turret sample compartment (250-0339)

Ideal for quantitative analysis when using 10 mm rectangular cells.

Max. error due to cell changeover 3 %, with the same sample and cell

(Cell must be prepared separately.)

■ 8-turret sample compartment (250-0333)

Effective for multi-sample measurements. Allows selection of up to eight 10 mm rectangular cells/ test tubes for rapid quantitative analysis.

Compatible cells	10 mm rectangular cell
	Test tube of outer dia. 10/12 mm and height 105 mm or less Error due to cell changeover Max. 3 % in signal level difference with the same sample and 10 mm rectangular cell

(Cell not included)

■ Electronic Thermostatted Cell Holder, Constant temperature control (115 V) (5J0-0141)

■ Electronic Thermostatted Cell Holder, Constant temperature control (220–240 V) (5J0-0142)

Effective for the analysis of biochemical samples as temperature can be maintained constant. It is electrically operated and rapid heating and cooling are possible.

Compatible cells	10 mm rectangular cell
Temperature range	10 to 60 °C

Dry gas and cell required, but not included.

■ Electronic Thermostatted Cell Holder, Programmable temperature control (115 V) (5J0-0143)

■ Electronic Thermostatted Cell Holder, Programmable temperature control (220–240 V) (5J0-0144)

Effective for the analysis of biochemical samples as temperature can be maintained or changed by using the program function.

Compatible cells	10 mm rectangular cell
Temperature range	0 to100 °C

Dry gas, cooling water bath and cell required, but not included.

■ Low temperature measurement accessory (5J0-0112)

Used for fluorescence/phosphorescence measurement at a liquid-nitrogen temperature.
The micro-structure of a sample which does not appear at normal temperature can be measured with this accessory.

Sample tube	Outer dia. 5 or 8 mm
Measurement temperature	–196 °C

(liquid nitrogen temperature)

■ Absorbance cell holder (650-0165)

Used for measuring absorbance.
Allows to measure absorbance without influence from fluorescence due to the simultaneous scanning using the excitation and emission wavelengths (in synchronous spectrum measurement mode).

Compatible with the 10 mm rectangular cell

(not included)

■ Thermostatic cell holder with stirrer (250-0346)

A magnetic stirrer is used to stir sample solutions to ensure higher thermal accuracy in measurement.

Minimum sample requirement	2.5 mL (10 mm rectangular cell), 0.4 mL (micro-flow cell)
Stirrer speed	500 to 1,200 rpm
Temperature range	5 to 60 °C

Thermostatted water bath and cell required, but not included.

■ Micro sampling assembly (5J0-0111)

Used in combination with the thermostatted 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 syringe required, but not included.)

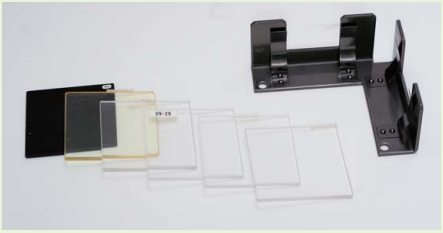
■ Intracellular Cation measurement program (5J2-0308)

Software for measuring calcium (Ca) in cells. Can be used with pH measurement reagent (such as BCECF) along with Ca measurement reagents (Quin 2, Fura 2, Indo 1). Up to 4 sets of measurement wavelengths can be selected, and the entire process from the measurement to the calculation of Ca concentration is automated. Reaction process can be simultaneously monitored at multiple wavelengths.

■ Filter set (650-0157)

Contains the following filters:

Corning 9863.	Band pass filter from 250 to 390 nm only.
UV-29, UV-31, UV-35, UV-39, UV-43	Cut off filters for wavelengths shorter than 290, 310, 350, 390 and 430 nm respectively.



■ Long life xenon lamp (150 W) (250-1600)

Performance guaranteed life: 500 hours
(150 hours in case of standard lamp)

■ Solid sample holder (650-0161)

Optimized for the measurement of solid samples, powder samples, or highly concentrated solutions. It is designed to prevent the specular reflection from the sample surface from entering the emission monochromator. Includes a powder cell.

Sample thickness is 13 mm max.

■ Sub standard light source (115 V) (5J0-0135)

■ Sub standard light source (220-240 V) (5J0-0136)

Required for correction of emission spectrum at longer wavelengths.

Emission side correction range	200 to 800 nm (200 to 600 nm with standard light source)

(Requires Photomultiplier R928F (650-1246).)

■ Polarization accessory for UV/VIS (650-0155)

■ Polarization accessory for VIS (650-0156)

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

Wavelength range	260 to 700 nm (650-0155)
	380 to 730 nm (650-0156)

■ Automatic Polarization accessory UV/ for VIS (5J2-0137)

■ Automatic Polarization accessory for VIS (5J2-0138)

Used for the measurement, calculation and data recording of fluorescence polarization angle and fluorescence anisotropy. Optimized for the measurement of antigen-anti body reaction, biological cells, proteins, enzymes, and other samples for the medical and biochemical fields.

Wavelength range	380 - 730 nm (5J0-0137) 260 - 700 nm (5J0-0138)
Polarizer rotation	0 to 90° automatic repetitive rotation on both excitation and emission sides
Measured items	Change of fluorescence polarization angle vs. time, fluorescence polarization angle, fluorescence anisotropy

■ Micro cell (650-0113)

■ Low scatter micro cell (650-0171)

Used for the measurement of trace samples of about 0.2 mL with almost the same sensitivity as that obtained by using a 10 mm 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. 0.2 mL

■ Report generator program (5J2-0306)

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.

SPECIFICATIONS

ITEM	DESCRIPTION	
Sensitivity (Raman light of water)	Noise: Background	S/N 7,500 or above*1
	Noise: Peak	800 or above*2
Minimum sample volume	0.6 mL (in use of standard 10 mm rectangular cell)	
Photometric principle	Monochromatic light monitoring ratio calculation	
Light source	150 W xenon lamp, self-deozonating lamp house	
Monochromator	Stigmatic concave diffraction grating: 900 lines/mm, F2.2 Brazed wavelength: Excitation side 300 nm, emission side 400 nm	
Measuring wavelength range (on both EX and EM)	200 to 900 nm, and zero-order light	
Bandpass	Excitation side: 1, 2.5, 5, 10 nm Emission side: 1, 2.5, 5, 10, 20 nm	
Resolution	1.0 nm (at 546.1 nm)	
Wavelength accuracy	±2 nm	
Wavelength scan speed	30, 60, 240, 1,200, 2,400, 12,000, 30,000 nm/min	
Wavelength drive speed	60,000 nm/min	
Response	Response from 0 to 98 %: 0.004, 0.01, 0.05, 0.1, 0.5, 2, 4, 8 s	
Photometric value range	–9999 to 9999	
Data processing unit	PC: Windows® 7	
Printer	Printer compatible with Windows® 7	
Dimensions/weight	Spectrophotometer: 620 W × 520 D × 300 H mm (excluding protrusions)/41 kg	
Working temperature /humidity	15 to 35 °C, 45 to 80 % (condensation not allowed, 70 % or less at 35 °C or higher)	
Power consumption (spectrophotometer)	100, 115, 220, 230, 240 V AC, 50/60 Hz, 380 VA	
FL Solutions program	Standard software	

*1 EX 350 nm, Slit 10 nm, Response 4 s
*2 EX 350 nm, Slit 10 nm, Response 2 s
* MICROSOFT, Windows and EXCEL are either registered trademarks or trademarks of Microsoft Corporation in the United States and /or other countries.

CE labeled model is available

FUNCTIONS

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

NOTES 1. A PC set is not supplied as standard equipment.
It should be prepared separately.

Science Ring

The Hitachi High-Tech Group aims to be a global leader in the "Observation", "Measurement" and "Analysis" scientific and analysis fields,maintains points of contact with customers in a wide range of disciplines and actively works to provide advanced high added value solutions.
The logo mark is centered on the "S" from "Science" , which represents the form created and connected through our cooperation as a good partner to customers and society that has its roots in our technologies, and which is expressed as organic spheres encircled by a ring.
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