Spectrophotometer Meeting a Wide Range of Analytical Needs from Liquid to Solid Sample Measurements

- Measurable over a broad absorbance range thanks to low stray light and low noise. (Model U-3900: -3.8 to 3.8 Abs, 0 to 300%T  Model U-3900H: -5.5 to 5.5 Abs, 0 to 300%T)
- Stable monochromator in double beam optics
  (Baseline flatness Model U-3900 : within ±0.0003 Abs, Model U-3900H : within ±0.0004 Abs)
- Simple instrument control and diversified quantitative analysis supported by UV Solutions program for U-3900 (in connection with PC)
- A full range of accessories for covering both liquid and solid sample measurements

**Single monochromator**

**U-3900**

Stray light : 0.015% or less
Photometric range : -3.8 to 3.8 Abs

Two types available for selection according to sample and application purpose.
Usable over an extensive field including analyses of water quality, the environment, biotechnology, drug manufacture and materials.

**Double monochromator**

**U-3900H**

Stray light : 0.00025% or less
Photometric range : -5.5 to 5.5 Abs

Adoption of Stigmatic Concave Diffraction Grating

Hitachi Model U-3900/U-3900H spectrophotometer adopts a Seya-Namioka mount monochromator and a stigmatic concave diffraction grating.

Because a concave diffraction grating is usable for both converging and dispersing light, it allows composition of an optical system with a small number of mirrors. In this design, loss of light and aberration are suppressed, so a bright optical system can be configured.

Stable Optics with Double Beam

As a light source, a Wl lamp (visible region) and a D2 lamp (ultraviolet region) are provided for selective use according to measuring wavelength range.

Double beam optics is adopted for ensuring stable measurements, in which the monochromatic beam selected with a monochromator is split into reference beam and sample beam with a rotating mirror (sector mirror) and the beams are directed into the sample compartment.

In one model, the U-3900, a spherical mirror is used before the entrance slit. In the other model, the U-3900H, a grating is used before the entrance slit.

Since the Model 320 was launched in 1979, Hitachi medium-size spectrophotometers have been employed by customers in 25 countries.
Hardware

Hardware structure with priority given to ease of operation and data reliability.

**USB communication structure attaching greater importance to ease of operation**

USB communication is adopted between the spectrophotometer and PC. And, because the top face of the spectrophotometer is flat, a notebook PC can be mounted on it. Therefore, the spectrophotometer and PC can be connected promptly.

**Incorporation of double monochromator**

Due to mounting of a double monochromator which uses Hitachi’s original stigmatic concave diffraction grating, an excellent linearity is ensured up to high concentrations. Hence, highly reliable quantitative analysis is possible.

**Measurement with change in scan speed for ultraviolet region**

Scan speed is changeable for the ultraviolet region. In this wavelength region, noise can be reduced by slowing down the scan speed. Owing to this feature, a noise-suppressed spectrum is obtainable over the entire range from visible to ultraviolet region by a single scan.

**Effective in trace sample measurement**

Satisfactory measurement is achievable even with 5, 25 and 50 μL micro-sample cells because the beam is finely converged in the sample compartment.

*Shown here are spectra determined in the ultraviolet region by measuring nucleic-acid adenosine with a micro-sample cell (internal volume 25 μL). A high S/N ratio was obtained.*

**Ease of maintenance (in lamp replacement)**

Lamp cable is connected by means of a socket, so each lamp can be removed or inserted without using a tool such as flat-head screwdriver.

**Stable baseline**

The Model U-3900 series assures a stable baseline in a wavelength range from 190 to 850 nm. (Baseline flatness Model U-3900 : within ±0.0003 Abs, Model U-3900H : ±0.0004 Abs)

*Data can be measured stably even in a long-time measurement of enzyme activity, etc.*

**Original differential feedback system**

Sample signal, reference signal and zero point rise are always monitored and photomultiplier voltage is changed so that the sample or reference signal, whichever larger, becomes constant, whereby minus absorbance can be measured. Also, measurement in a broad dynamic range is allowed, e.g., difference spectrum measurement with different samples set on reference and sample sides.

**Effective measurement in ultraviolet region**

Scan speed is changeable for the ultraviolet region. In this wavelength region, noise can be reduced by slowing down the scan speed. Owing to this feature, a noise-suppressed spectrum is obtainable over the entire range from visible to ultraviolet region by a single scan.

*Shown here are spectra determined in the ultraviolet region by measuring nucleic-acid adenosine with a micro-sample cell (internal volume 25 μL). A high S/N ratio was obtained.*
Software

"UV Solutions for U-3900" program has been prepared for efficient instrument control and various quantitations. A series of operations from analysis method setup to data processing can be initiated by clicking each button.

Enriched functions such as data comparison and preview are supported by UV Solutions for U-3900.

**Easy comparison of measured data**
Measured data can be compared easily by overlaying spectra or in Abs value at the specified wavelength. (A maximum of 10 spectra can be compared at 12 specified wavelengths).

**Factor of data processing (quantitation) changeable**
"Correction factor," "decimal digits of concentration" and "concentration unit" are settable on the sample table window. Setting can be determined in consideration of a sample to be measured, its concentration, etc.

**Reuse of analysis method for measured data**
When it is desired to carry out measurement by the same analysis method as used for the already measured data, the "Apply analysis method" button is usable. The analysis method can be loaded and applied to a new measurement by clicking this button.

**Control of lamp ON time**
Total operation (ON) time of the WI and D2 lamps used in the U-3900 series can be checked on the software. This time counting is usable as a reference for judging the replacement time point for each lamp.

**Measured data exportable to commercially available software**
Data such as measured spectrum can be pasted to Microsoft® Word and Microsoft® Excel, and converted into an ASCII text file. Using such software, a report form can be edited.
More Function with U-3900/3900H spectro-photometer

Enhanced large sample compartment Accessory

When installing this enhanced sample compartment and additional accessories in U-3900/U-3900H UV-VIS spectrophotometer, you can measure the reflection characteristic, polarization property caused by incidence angle and transmission of solid sample and optical component, like reflected plate. With using φ10mm integrating sphere, diffusely emitted light from sample are detected in this instrument. With this enhanced sample compartment, it is possible to measure solid sample φ10mm at maximum. In addition, when installing 5°/45° specular reflection accessory, specular reflection measurement can be realized.

Realize 190 to 1100nm range wavelength measurement

When changing to near infrared corresponding detector in U-3900/U-3900H spectrophotometer, you can measure samples which has absorption wavelength between 190 to 1100nm. For example, you are able to evaluate transmission of visible light. Enhanced large sample compartment enables you to measure large samples transmission.

Accessories

- Glass filter holder
- Reflectance accessory
- Microliter syringe
- Electronic thermostatted auto sipper
- AS-1010 autosampler
- Electronic thermostatted cell holder
- Flow cell unit
- LC flow cell unit

Accessories Expediting Application to Multi-Sample Measurement, Micro-volume Sample and Many Others

Micro cell holder

(P/N 122-0060)

Suitable for micro-sample measurement in medical and biochemical fields.

Specifications

- Wavelength range: 190 to 1100nm
- Carryover: 1% or less
- Minimum sample volume: 0.6 mL
- Cell capacity: Approx. 50 μL
- Temperature range: 220 to 800 nm
- Setting accuracy: Within ±0.0025 Abs

Auto sipper

(P/N 2J1-0105)

This auto sipper is provided with a sample recovery function and other versatile functions. In combination with an autosampler, this unit makes it possible to carry out automated fast-seeing analysis.

Specifications

- Flow range: 1% to 60% T
- Sample tube size: Outside diameter 15 mm, height 105 mm
- Temperature range: Room temperature to 40˚C
- Temperature stability: Within ±0.3˚C

Water circulated cell holder

(P/N 210-2111)

Water from a thermostatic oven is circulated through this cell holder to maintain a sample cell at a constant temperature. (Temperature control: R and S)

Specifications

- Water circulated cell holder: (P/N 131-0306/0307)
- Electronic thermostatted cell holder: (P/N 131-0301/0302)

Electronic thermostatted cell holder

(P/N 131-0301/0302)

In protein and nucleic acid melting measurement, sample temperature can be changed continuously to determine variation in absorbance. Being an electronic thermostatted type, this cell holder is capable of quick heating and cooling. Sample temperature can be increased and decreased isothermally. Because this holder is equipped with a stirrer, the internal cell temperature can be kept uniform. (Temperature control: R and S)

Micro flow cell unit

(P/N 210-2113)

Suitable for continuous measurement of a micro-quantity of sample.

Specifications

- Connection tubing: Teflon tube of outside diameter 4 mm and inside diameter 2 mm
- Spot temperature: 0˚C to 100˚C (settable in increments of 0.1˚C)
- Temperature stability: Within ±0.3˚C
- Temperature range: Room temperature to 40˚C
- Temperature control accuracy: Within ±0.1˚C

Flow cell unit

(P/N 210-2173)

The inside of this cell is structured to minimize stagnation of liquid and adhesion of air bubbles.

Specifications

- Connection tubing: quartz flow cell unit
- Connection tubing: Teflon tube of outside diameter 4 mm and inside diameter 2 mm
- Temperature range: 0˚C to 100˚C
- Temperature stability: Within ±0.3˚C
- Temperature control accuracy: Within ±0.1˚C

LC flow cell unit

(P/N 210-2131)

A flow cell especially designed for liquid chromatography.
6-cell positioner with temperature control
(PIN 210-2115)
A maximum of three 10 mm cells can be mounted on each of the sample and reference beam sides. Sample temperature can be maintained at a constant level by circulating temperature-regulated water through the cell holder section. (Temperature control: R and S)

Specifications
- Temperature range: 20 to 40˚C
- Resolution: ±0.5% (at 100%T)
- With input of tristimulus values (X, Y, Z), psychometric chroma coordinates (a*, b*), chromaticity coordinates (x, y), and chrominance coordinates (u*, v*)

5-position turret cell holder
(PIN 210-2110)
Five 10 mm rectangular cells can be mounted on the sample beam side, and they can be changed over externally. (Temperature control: R and S)

Specifications
- Cell size: Minimum : 12 x 25 mm
- Sample thickness: 0.5 to 5 mm
- Aperture ratio: 350 to 750 nm

150 integrating sphere accessory
(PIN 2J2-0176)
Designed for diffuse reflectance measurement of a solid sample surface. A sample can be placed between the polarizer and analyzer for measurement of optical rotary power.

Specifications
- Aperture ratio: 2° visual field
- Chromaticity coordinates (x, y)
- Reflectance correction (reflectance)

Polarizer holder
(PIN 210-2130)
Sample beam is linearly polarized for measurement of absorption characteristics or specular reflectance measurement of a turbid sample. With an aperture ratio as small as 2%, this unit is suitable for high-accuracy colorimetric measurement.

Specifications
- Aperture ratio: 380 to 780 nm
- Relative luminous efficiency of CIE light adaptation

Refractor
(PIN 2J2-0177)
Using mirror reflection of a sample, relative reflectance is measured with respect to the standard light source. (reflectance) conform to JIS R3106. This program is designed for diffuse reflectance measurement of a solid sample surface, making it possible to carry out high-accuracy color measurement analysis. The measurement method conforms to JIS B 2270. A photometric value ranging from 780 to 1020 nm can be taken in, and calculations are performed on tristimulus values (X, Y, Z), psychometric lightness values (L*, L’), psychometric chroma coordinates (a*, b*), and chromaticity coordinates (x, y). With input of tristimulus values (X, Y, Z) of a standard sample and tristimulus values of an sample, chromaticity calculation is performed (A value, 44°, 60°, 84°).

Specifications
- First peak wavelength in spectrum (nm)
- Number of interference peaks
- Reflectance factor
- Manually entered data

Application Measurement
Continuing to the last method for sheet glass transmittance and reflectance, specified in the AS (Japanese Industrial Standards).

1. Visible Transmittance (Reflectance) Measurement Program
Based on transmittance or specular reflectance of sheet glass are measured in the visible wavelength range. Using these measured values, visible light transmittance or visible light reflectance are automatically calculated with respect to the standard light (X) specified by CIE (Commission Internationale de l’Eclairage).

Specifications
- Minimum: 12 x 25 mm
- Maximum: 190 x 13 mm
- Wavelength range: 380 to 780 nm

2. Sum-of-Products Calculation Program
The above mentioned visible light transmittance (reflectance) and color radiator transmittance (reflectance) conform to AS R3106. This program is formulated as a general form for calculation of these values. For each wavelength, a measured value is multiplied by coefficient data. Up to five wavelength intervals and normalization factor can be set arbitrarily in use of this program.

Specifications
- With input of tristimulus values (X, Y, Z), psychometric chroma coordinates (a*, b*), chromaticity coordinates (x, y), and chrominance coordinates (u*, v*)

3. Weight Factor Input Program
With this program, a correction value (weight factor) for each wavelength interval can be input in a wavelength range of 380 to 780 nm. Using the input values, the sum-of-products program is carried out. Up to five wavelength intervals can be assigned individually, and up to 400 data points can be specified.

4. Spectrum Correction Program
A photometric value at each wavelength is multiplied by correction coefficient, and the result of multiplication is displayed and recorded in a graph. A correction factor can be specified arbitrarily by the user. This program is particularly useful for absolute reflectance spectral measurement.

Specifications
- Minimum: 12 x 25 mm
- Maximum: 190 x 13 mm
- Wavelength range: 380 to 780 nm
- Manually entered value

5. Correction Coefficient Input
This program is designed to input correction coefficient data up to 400 points can be specified.

6. Film Thickness Calculation
In case with the reflectance accessory, this program allows the following measurements:

A. A thickness of a film object is calculated according to the measured interference spectrum. The results of calculation are displayed on the CRT monitor and output onto the printer for recording.

B. Photometric values of measured interference between standard peaks and valleys can be printed out automatically.

C. Photometric values of measured interference between standard peaks and valleys and measured film thickness is calculated, and the resultant data can be displayed on the CRT monitor and output into the printer for recording.

Specifications
- Minimum: 12 x 25 mm
- Maximum: 190 x 13 mm
- Wavelength range, and normalization factor can be set arbitrarily in use of this program.

7. Film Thickness Calculation Program
With this program, a correction value (weight factor) for each wavelength interval can be input in a wavelength range of 380 to 780 nm. Using the input values, the sum-of-products program is carried out. Up to five wavelength intervals can be assigned individually, and up to 400 data points can be specified.

Specifications
- Minimum: 12 x 25 mm
- Maximum: 190 x 13 mm
- Wavelength range: 380 to 780 nm
- Manually entered data

8. Angle of Incidence
Manual entered value
A: First peak wavelength in spectrum (nm)
A: Last peak wavelength in spectrum (nm)
### Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>U-3900</th>
<th>U-3900H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monochromator</td>
<td>Diffraction grating Single monochromator Seya-Namioka mount</td>
<td>Diffraction grating-Diffraction grating Double monochromator Seya-Namioka mount</td>
</tr>
<tr>
<td>Wavelength range</td>
<td>190 to 900 nm*1</td>
<td>190 to 900 nm*1</td>
</tr>
<tr>
<td>Spectral bandpass</td>
<td>0.1, 0.5, 1, 2, 4, 5 nm (6 steps)</td>
<td>0.1, 0.5, 1, 2, 4, 5 nm (6 steps)</td>
</tr>
<tr>
<td>Stray light</td>
<td>≤ 0.015%</td>
<td>≤ 0.0025%</td>
</tr>
<tr>
<td>Wavelength accuracy</td>
<td>±0.1 nm (at 656.1 nm after wavelength calibration)</td>
<td>±0.1 nm (at 656.1 nm after wavelength calibration)</td>
</tr>
<tr>
<td>Wavelength setting repeatability</td>
<td>±0.05 nm</td>
<td>±0.05 nm</td>
</tr>
<tr>
<td>Photometric mode</td>
<td>Abs : 3 to 3.8 Abs (effective range)</td>
<td>Abs : 3 to 3.8 Abs (effective range)</td>
</tr>
<tr>
<td>Photometric accuracy (checked with NIST SRM930)</td>
<td>±0.002 Abs (1 to 0.5 Abs)</td>
<td>±0.002 Abs (1 to 0.5 Abs)</td>
</tr>
<tr>
<td>Photometric repeatability (checked with NIST SRM930)</td>
<td>±0.001 Abs (1 to 0.5 Abs)</td>
<td>±0.001 Abs (1 to 0.5 Abs)</td>
</tr>
</tbody>
</table>

**Response**

- High resolution, standard
- Baseline flatness: Within ±0.0003 Abs (190 to 850 nm)
- Baseline stability: Within ±0.0002 Abs/hr (at 500 nm, 2 hours after power-on)

**Light source**

- Adjustment-free deuterium lamp (D lamp) Ultraviolet region
- Adjustment-free tungsten iodide lamp (50 W) Visible region

**Light source changeover**

- Automatic changeover linked with wavelength changeover: Selectable in a range of 325 to 370 nm

**Operating temperature/humidity**

- Temperature: 15 to 35°C, Humidity: 25 to 85% (non-condensing)

**Weight**

- 45 kg (spectrophotometer main unit)
- 50/60 Hz, 300 VA (excluding personal computer and printer)

**UV Solutions program**

- Standard software

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### Software Functions (common to U-3900/U-3900H)

#### Wavelength/Time Scan, Measurement and Data Processing

- Wavelength shift (Go to A)
- 100%/T adjustment (auto zero)
- Automatic wavelength calibration
- Detector zero adjustment

#### Photometry

- Measuring condition setting
- Condition loading
- Condition saving (desired number of files, file overwriting/deletion possible)
- Automatic start function (measuring conditions automatically set upon startup of software)

#### Recording/Display

- Printout and display of spectrum/change with time
- Spectrum loading with preview
- Spectrum saving
- Spectrum printout/display

#### Data processing

- Rescaling (numerical value input, cursor input)
- Spectrum trace
- Smoothing
- Peak detection
- Data printout
- Printout of wavelength/time at fixed intervals
- Graph axis conversion
- Spectral calculation (arithmetic calculation/coefficient calculation)
- Differentiation (1st to 4th order)
- Data reset
- Rate calculation (only in time scan mode)
- Spectrum selection
- Spectrum display window

#### Miscellaneous

- File conversion (ASCII/JCAMP)
- Setting of number of decimal places for display
- Cell length conversion
- Data transfer/graph copy to Microsoft® Excel
- Print preview
- Display of lamp ON time

### Standard Equipment

- 24-bit spectrophotometer main unit
- 1 set
- Tools
- 1 set
- Instruction manual
- 1 set

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NOTES:

1. Absorption cells are not included in the standard equipment, and thus should be prepared separately.  
2. A PC set is not supplied as standard equipment. It should be prepared separately.

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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.