

UV-VIS-NIR Spectrophotometer

# UV-3600i Plus



# Leading the Way to New Solutions

## Perfect for a Wide Variety of Applications

Spectral evaluation functionality enables unique pass/fail judgments for quality control.

During measurements, data can be automatically sent to Excel® in real time for using macros to automatically obtain desired values.

## Highest Sensitivity in Class with Three Detectors

This model includes a photomultiplier tube (PMT) detector for the ultraviolet-to-visible light region and InGaAs and cooled PbS detectors for the near-infrared region.

A multipurpose large sample compartment and an integrating sphere with three-detector capability enable high-sensitivity measurement of even solid samples.

## High Resolution, Ultra-Low Stray Light, and Wide Measurement Wavelength Range

High resolution (max. 0.1 nm) and ultra-low stray light (max. 0.00005 % at 340 nm) are achieved.

The measurement wavelength range from 185 to 3300 nm supports spectrophotometric measurements for a wide variety of applications.

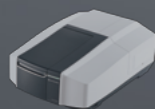
The grating-grating type monochromator design enables highly accurate measurements.

## UV-i Selection

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UV-1900i



UV-2600i/2700i



UV-3600i Plus



SolidSpec™-3700i

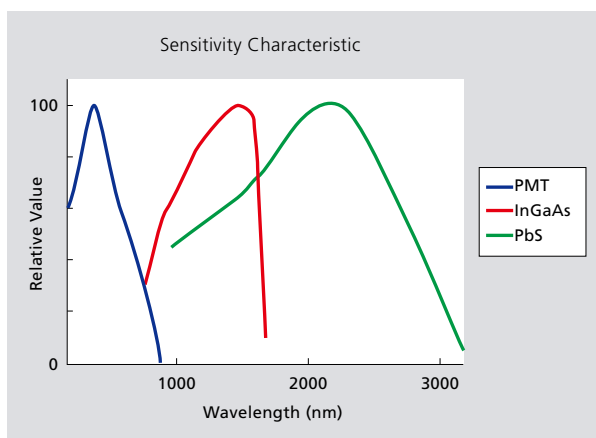
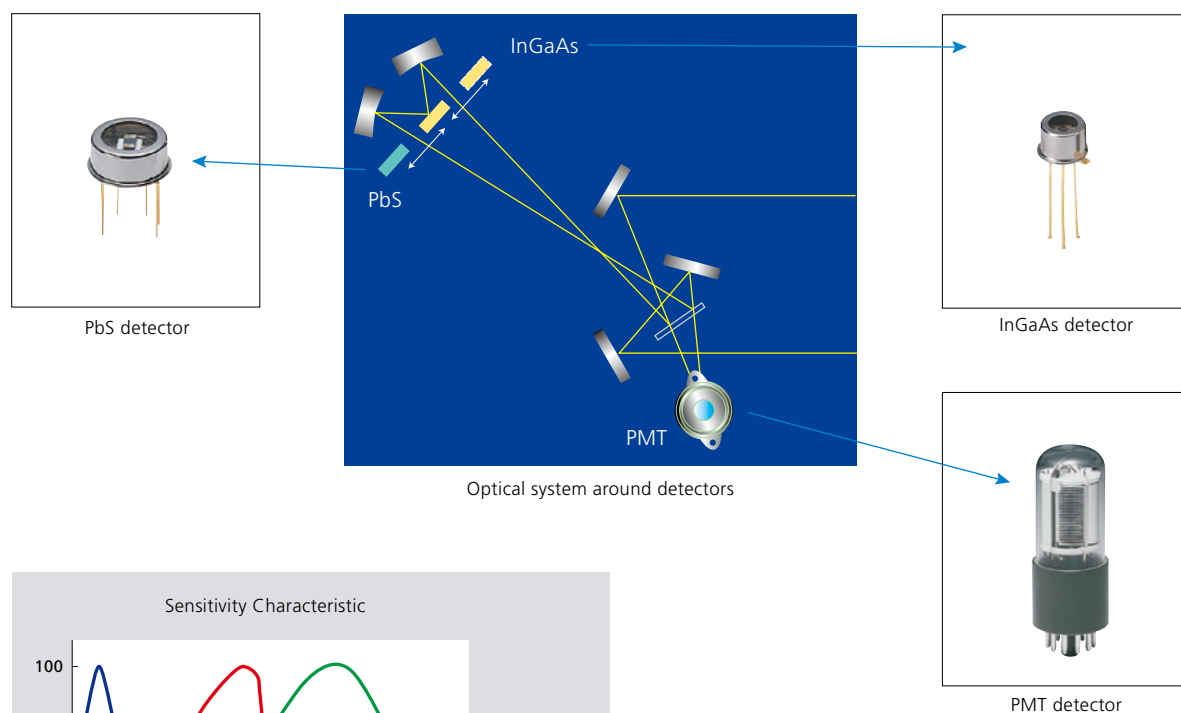


 SHIMADZU

UV-3600i Plus  
UV-VIS-NIR SPECTROPHOTOMETER

# Highest Sensitivity in Class with Three Detectors

The UV-3600i Plus provides precise transmittance or reflectance measurements in the ultraviolet to near-infrared regions. The level of sensitivity in the near-infrared region is significantly enhanced by using the combination of an InGaAs detector and a cooled PbS detector for this region. Spectra can be obtained without interruption for the entire range, with a high level of sensitivity and precision.



Conventional spectrophotometers use a PMT (photomultiplier tube) for the ultraviolet and visible region and a PbS detector for the near-infrared region. Neither detector, however, is very sensitive near the wavelength of 900 nm. This prevents high-sensitivity measurements in this range. The UV-3600i Plus makes it possible to take high-sensitivity measurements in the switchover range by incorporating an InGaAs detector as shown in the figure on the left.

## Relationship between Detectors and Measurable Range

	165 nm	380 nm	780 nm	3300 nm
	UV	Visible	NIR	
PMT	185~1000 nm			
InGaAs			700~1800 nm	
PbS				1600~3300 nm

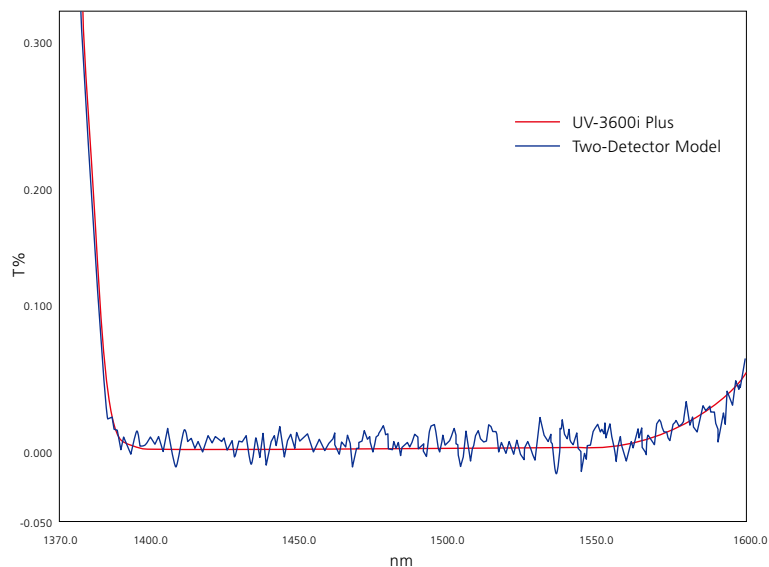
Switching between the photomultiplier tube and the InGaAs detector is possible in the range of 700 to 1,000 nm (the default switchover wavelength is 830 nm). Switching between the InGaAs detector and the PbS detector is possible in the range of 1,600 to 1,800 nm (the default switchover wavelength is 1,650 nm).

## Comparison of Two Detector and Three Detector Models

The UV-3600i Plus is newly equipped with an InGaAs detector in addition to the photomultiplier tube (PMT) and cooled PbS detectors.

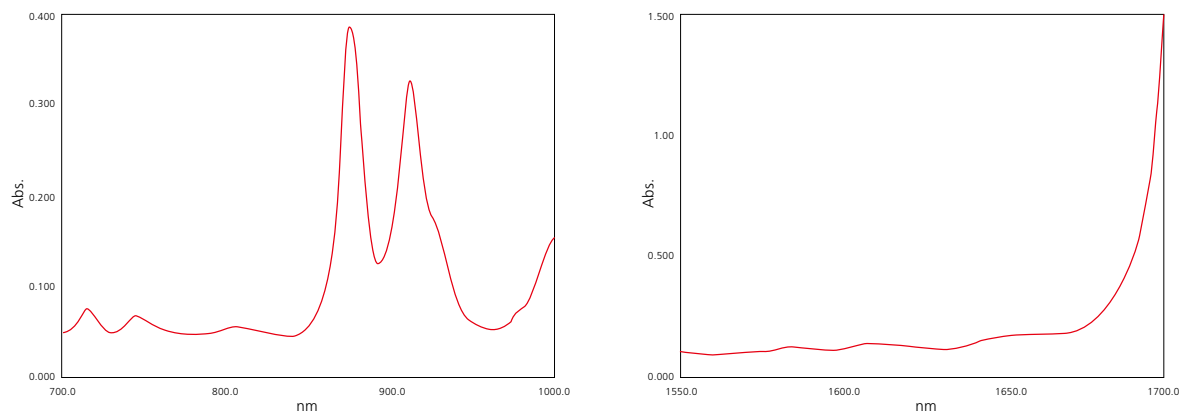
That results in less noise than a two-detector (PMT and PbS detectors) model, especially in the region detected by the InGaAs detector (900 to 1600 nm).

The figure on the right shows transmittance spectra (spectral bandwidth 2nm) for water measured with the UV-3600i Plus (InGaAs detector and cooled PbS detector) and a two-detector model (PbS detector) in the range of 1,370 to 1,600 nm. The noise level is significantly less with the UV-3600i Plus. (A mesh filter is used on the reference- beam side to maintain balance with the sample-beam side.)



## High-Accuracy Measurement

Noise and bump caused by switching detectors is minimized to assure accurate measurement. Noise or bump is hardly observed even when using a transmission cell with a long optical path of 50 or 100 mm.



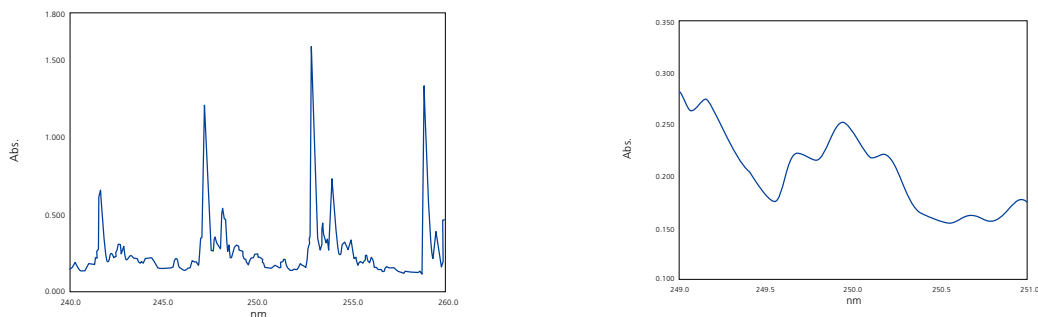
The figures above on the left and right are, respectively, transmittance spectra for ethylbenzene (obtained using a cell with an optical path of 100 mm) and cyclohexane (obtained using a cell with an optical path of 10 mm). No baseline change is observed at the detector changeover wavelengths (870 and 1,650 nm).

# High Resolution, Ultra-Low Stray Light, and Wide Measurement Wavelength Range

The UV-3600i Plus is equipped with a high-performance, grating-grating double monochromator, and achieves a low stray-light level with high resolution. The wavelength range is 185 to 3,300 nm. This instrument can perform spectrophotometry for various types of samples, ranging from those requiring high resolution, such as gas samples, to highly concentrated liquid samples.

## High-Resolution Spectra of Benzene Gas

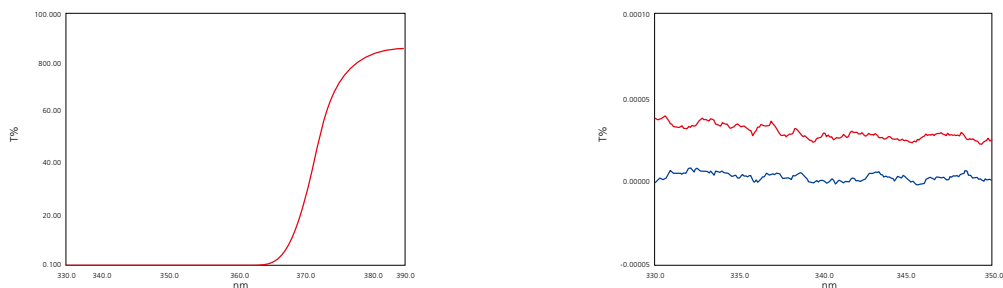
The spectrum shown on the left was obtained by enclosing benzene gas in a cell with an optical-path length of 10 mm and performing measurement. The spectral bandwidth is 0.1 nm. The triplet in the neighborhood of 250 nm (enlarged on the right) can be clearly observed. This instrument allows high-resolution spectra to be measured with little noise.



## Ultra-Low Stray-Light Level of 0.00005 % Max. (340 nm)

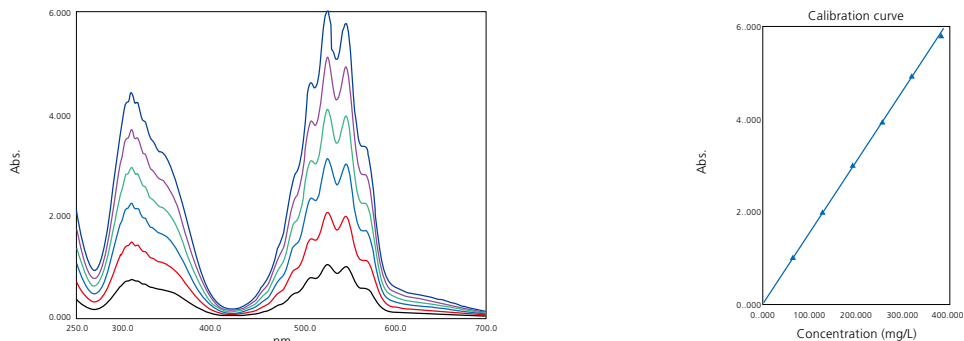
The figure below on the left is a spectrum for aqueous  $\text{NaNO}_2$  solution, and the figure on the right shows an enlarged view of the neighborhood of 340 nm. In the figure on the right, the red spectrum is for aqueous  $\text{NaNO}_2$  solution and the blue spectrum is the 0 % line obtained when a shutter block is inserted on the sample-beam side. The UV-3600i Plus achieves an ultra-low stray-light level of less than 0.00005 % at 340 nm.

(A mesh filter is used on the reference-beam side to maintain balance with the sample-beam side.)



## Linearity up to Absorbance Level 6

The figure below on the left shows spectra obtained by measuring aqueous  $\text{KMnO}_4$  solution at six concentration levels. A mesh filter was inserted on the reference-beam side and a differential method was used to perform measurement up to absorbance level 6. Using negative absorbance enables measurement with little noise, even at high absorbance levels. The figure below on the right shows the calibration curve using peak absorbances in the vicinity of 525nm for aqueous  $\text{KMnO}_4$  solution, and shows that linearity is maintained up to absorbance level 6.

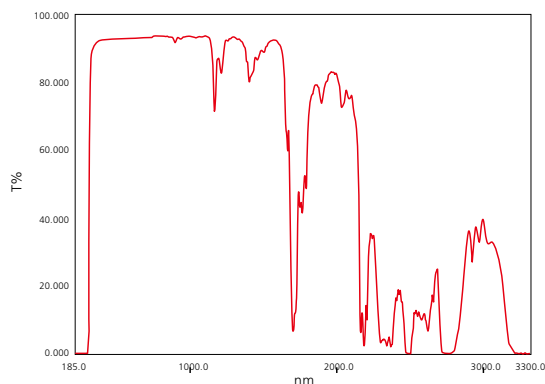


## Covers a Wide Wavelength Range from Ultraviolet to Near-Infrared

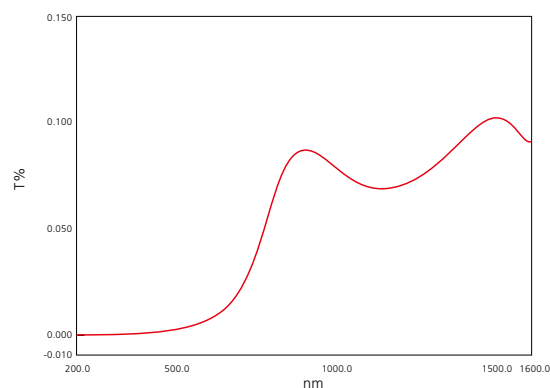
The wavelength range of 185 to 3,300 nm enables measurement over the ultraviolet, visible, and near-infrared regions. In addition, the acquired spectra exhibit little noise across the entire range.

The figure on the right shows a spectrum obtained by measuring toluene in the range of 185 to 3,300 nm using a cell with an optical path length of 2 mm.

Spectra in the ultraviolet, visible, and near-infrared regions can be obtained.

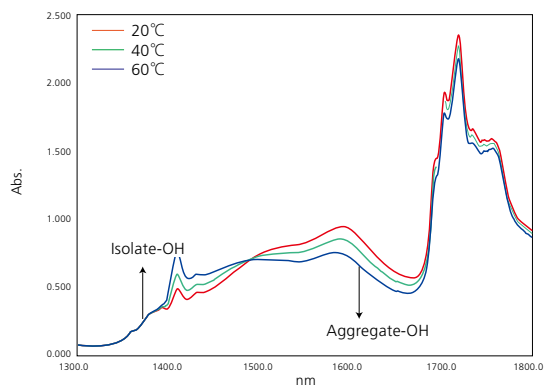


The figure on the right shows the spectrum for a low-transmittance film on a silica wafer in the range of 200 to 1,600 nm. Although the film is a special type of film with a transmittance of almost zero, it has been measured with high precision and little noise. (A mesh filter is used on the reference-beam side to maintain balance with the sample-beam side.)



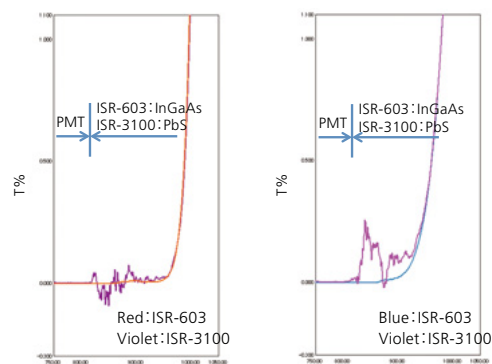
Molecules of alcohol such as 1-butanol are thought to consist of a mixture of non-hydrogen-bonded isolates and aggregates formed through relatively weak hydrogen-bonding between OH groups. As the temperature rises, the hydrogen-bonding becomes weaker and the aggregates separate into isolates.

The figure on the right shows near-infrared spectra for 1-butanol obtained at 20 °C, 40 °C, and 60 °C. The peaks in the neighborhood of 1,400 nm that become larger as the temperature increases are OH peaks for a non-hydrogen-bonded isolate. The peaks in the neighborhood of 1,600 nm that become smaller as the temperature increases are OH peaks for a hydrogen-bonded aggregate.



Even a multipurpose large sample compartment and an integrating sphere unit are equipped with three-detectors capability as with the UV-3600i Plus main unit.

The figure to the right shows near-infrared spectra measured from a silicon wafer using the UV-3600i Plus model with an ISR-603 unit (InGaAs and cooled PbS detectors) attached. The InGaAs detector results in less noise and enables higher sensitivity measurements than the PbS detector, even for solid samples.

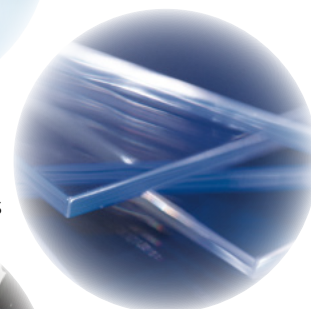
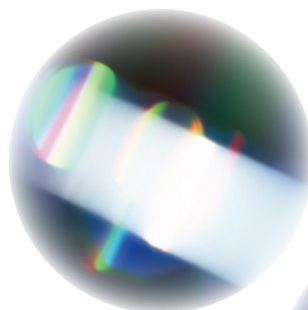




# Extensive Selection of Application Programs for a Wide Variety of Applications

## Electrical, Electronics, and Optics

High-absorbance measurement of polarizing films  
Reflection measurement of multilayer films  
Absolute reflectance measurement of highly reflective mirrors  
Spectral characteristic measurement of beam splitters  
Relative emission measurement of LEDs  
Transmittance measurement of quartz plates  
Absolute reflectance measurement of anti-reflection coatings  
Transmittance measurement of functional films  
Diffuse reflectance measurement and band gap measurement of semiconductor materials  
Transmittance measurement of solar cell cover glass, etc.



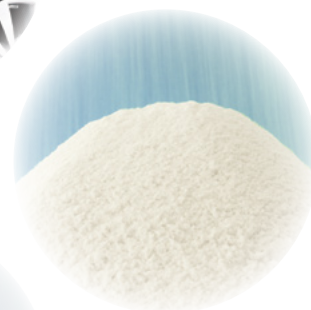
## Construction

Transmittance measurement of window glass and window glass films  
Reflectance measurement of paints and building materials



## Transportation Equipment

LiDAR collision avoidance sensor evaluation system



## Pharmaceuticals, Cosmetics, and Life Sciences

Cosmetic color measurement and ultraviolet screening measurement  
Measurement of drugs containing crystallization water  
Measurement of moisture in plants  
Measurement of various amino acids  
Quantitation of proteins and nucleic acids  
Near-infrared measurement of pharmaceutical components



## Chemicals

Transmittance and color measurements of plastic materials  
Reflectance measurement of silica-based white powdered materials  
Thickness measurement of thin films  
Near-infrared measurement of organic solvents  
Haze measurement of plastics



## Foods

Diffuse reflectance measurement of wheat flour  
Quantitation of vitamins, food additives, and minerals  
Quantitation of phenol elution in containers and packaging materials



## Textiles

Transmittance and reflectance measurements and ultraviolet screening measurement of textiles  
Color measurement of textiles





## Electrical, Electronics, and Optics

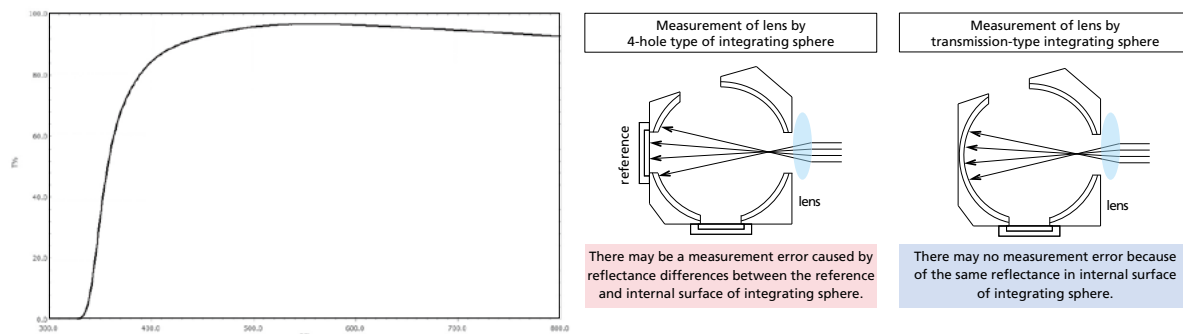
### Transmittance Measurement of Lenses

Imaging devices, such as mobile phones, digital cameras, and security cameras, are all equipped with lenses. The transmittance of a lens is one factor that determines lens performance. However, because the lens itself focuses light, it is an especially difficult type of sample to measure accurately.

Because of the focal capability of lenses, the total light passing through the spectrophotometer during the measurement of the baseline can be different than after passing through the lens during measurement due to refraction. In such cases, the use of an integrating sphere can be used to collect all the light passing through the lens and provide for more accurate measurements. In addition, using the transmission-type integrating sphere included with the BIS-603 can reduce measurement errors.

Using an MPC-603A multipurpose large sample compartment with an optional V-stage enables transmittance measurements for various size and length lenses.

The MPC-603A and BIS-603 are an ideal combination for measuring lenses.



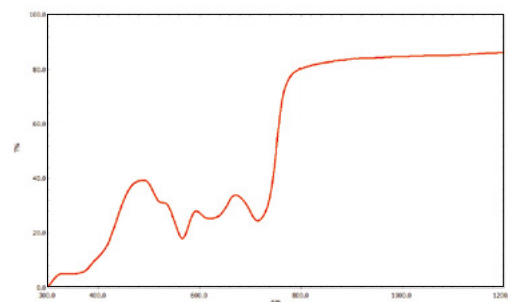
## Electrical, Electronics, and Optics

### Transmittance Measurement of Very Small Samples

The current miniaturization of various products, such as sensors, means that the measurement of very small samples is now required. The figure shows the results of a transmission spectrum measurement on a micro-sensor window.

When measuring very small samples, the light beam must be adjusted to the sample size. Therefore, by using the UV-3600i Plus in combination with an optional MPC-603A multipurpose large sample compartment, small beam aperture unit (P/N 206-22051-41), and small sample holder (P/N 206-28055-41), the optical system can be configured to enable measurement of even micro areas by focusing the beam down to diameters as small as 2 mm $\phi$ .

The MPC-603A is a UV-3600i Plus option that enables the measurement of various samples ranging from small large.



#### Options Used for Measurements

##### MPC-603A Multi-Purpose Large-Sample Compartment



##### Micro Beam Lens Unit



##### Micro Sample Holder



##### Others

- V stage
- BIS-603 Sample Base Plate Integrating Sphere Set

# Options Used for Measurements

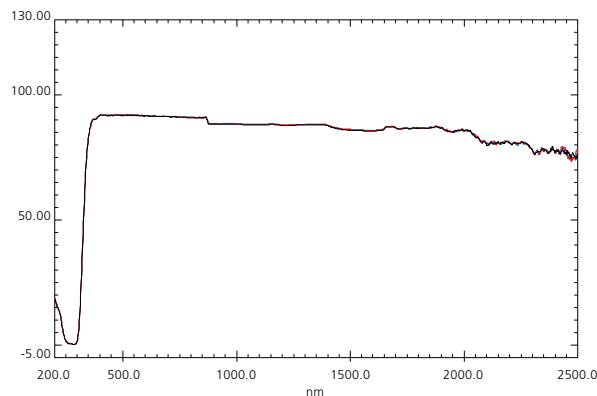


## Electrical, Electronics, and Optics

### Transmittance Measurement of Rolled Plate Glass for Solar Cell

Rolled plate glass is a plate glass with rough surface. When it is scanned by a small integrating sphere, large steps at the detector switching wavelength may occur, and correct results may not be obtained. When run by an ISR-1503 with an of 150 mm $\varnothing$ , and the sample was turned with 0, 45 and 90 degree, obtained spectra were almost same. And those spectra had very small steps at the detector switching wavelength.

In addition to rolled plate glass for solar cell, it is useful for measuring special fibers that cause diffusion.

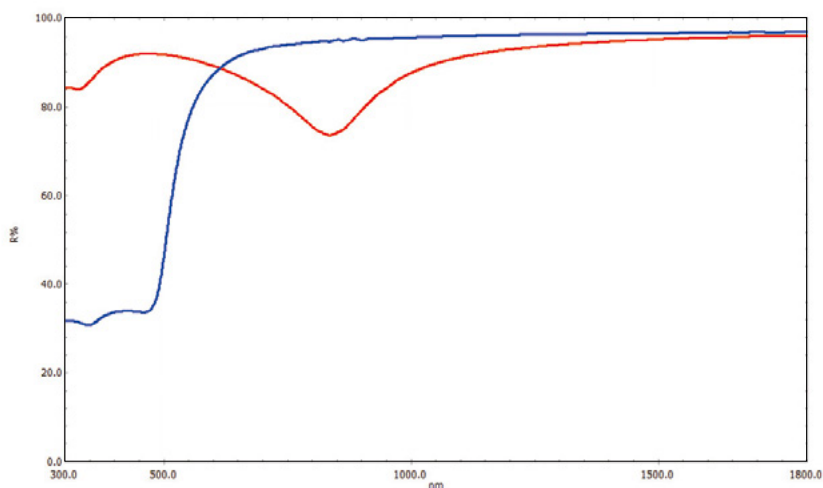


## Electrical, Electronics, and Optics

### Absolute Reflectance Measurement of Mirrors

The reflectance of mirrors used in telescopes, lasers, and some other devices is extremely important because it serves as a factor in determining their performance. The total light reflecting off of a sample can be composed of a specular component and a diffuse component. For mirrors, the specular reflectance is the reflectance component of significance. In addition, reflectance measurements can be made as relative to the reflectance of a background material or as absolute. Absolute values of specular reflectance are determined by use of an absolute reflectance measurement (ASR) accessory. The figure below shows the results of measuring a mirror.

An absolute reflectance attachment, which enables measuring the reflectance of mirrors, can be installed on the optional MPC-603A unit.



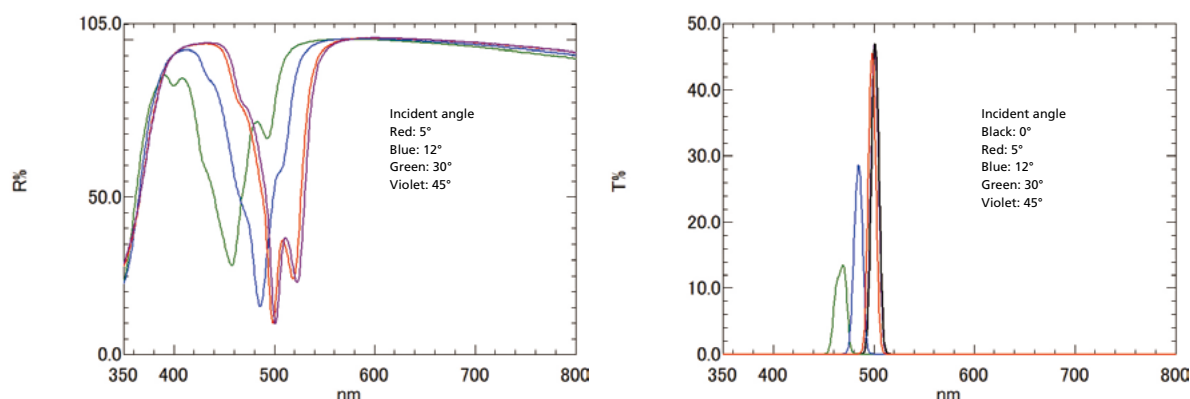


## Electrical, Electronics, and Optics

### Evaluating Multilayer Dielectric Films

Multilayer dielectric films are used to coat lenses, mirrors, filters, and various other optical elements used in cameras, binoculars, and other optical devices. The figures below show results from measuring a multilayer dielectric film band-pass filter as the incident light angle is varied. By using the UV-3600i Plus in combination with an optional MPC-603A multipurpose large sample compartment and variable angle measurement attachment, transmittance and absolute reflectance can be measured as the angle of incidence is varied for various light. The results confirm that, because of the multilayer film structure, varying the incident angle changes which wavelengths are transmitted and reflected.

Shimadzu's unique aperture design provides condensed light with an excellent signal-to-noise ratio, which means it can be converted easily to highly collimated light to accommodate customer measurement requirements.

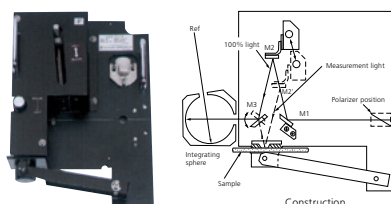


### Options Used for Measurements

#### ISR-1503 Integrating Sphere Attachment



#### ASR-3105/3112/3130/3145 Absolute Reflectance Attachment



#### Variable Angle Measurement Unit for MPC-603A



#### Large Polarizer Set, Polarizer Type I, Type II, Type III



#### Others

- Multipurpose Large-Sample Compartment (MPC-603A)
- BIS-603 Sample Base Plate Integrating Sphere Sets

# Options Used for Measurements



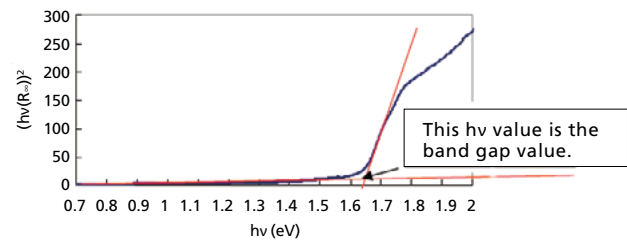
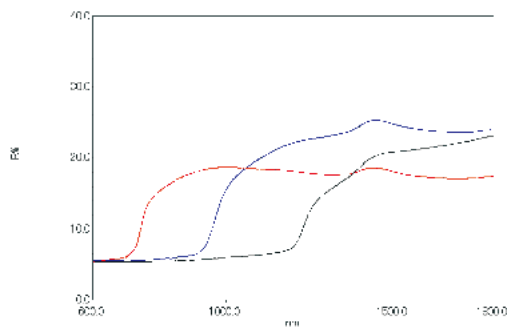
## Electrical, Electronics, and Optics

### Band Gap Calculation

Research into solar-cell and photocatalytic materials often involves the measurement of the band gap\*, which is a basic physical property of the materials. Shown below are the diffuse reflectance spectra of three semiconductor materials used in the production of solar cells using the ISR-603 integrating sphere. The absorption edge, the wavelength where the reflectance decreases, differs depending upon the sample type. This difference indicates a difference in the band gap of the samples.

The band gaps of the samples were calculated using the Tauc method, and were determined to be 1.63 eV for CuGaSe<sub>2</sub> (red line), 1.27 eV for CuIn<sub>0.5</sub>Ga<sub>0.5</sub>Se<sub>2</sub> (blue line) and 0.99 eV for CuInSe<sub>2</sub> (black line).

\* The band gap refers to the energy difference between the top of the valence band filled with electrons and the bottom of the conduction band devoid of electrons. The wavelength range of the UV-3600i Plus is extremely effective for band gap calculations.



Materials	Band Gap Value
CuGaSe <sub>2</sub>	1.63 eV (757 nm)
CuIn <sub>0.5</sub> Ga <sub>0.5</sub> Se <sub>2</sub>	1.27 eV (977 nm)
CuInSe <sub>2</sub>	0.99 eV (1253 nm)

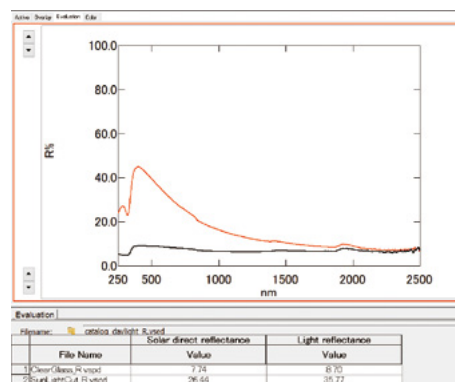
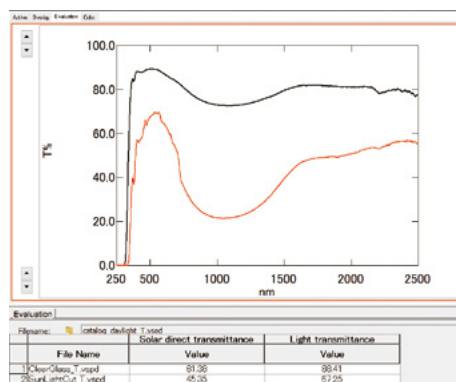


## Construction

### Measuring the Transmittance (Solar Transmittance) of Window Glass

In recent years, measures to offset the effects of global warming and heat islands have included the incorporation of various kinds of functional glass into modern building materials. These new glass materials reduce the transmittance of infrared radiation and also offer thermal insulation potential. Solar transmittance is defined by JIS as an index that represents the transmission characteristics of sunlight, from visible to near-infrared light. The figure below shows spectral data of transparent glass and suncut glass, and solar transmissivity/reflectance calculation results. It reveals that solar transmittance varies depending on the type of glass.

This method of measuring solar transmittance requires a 250 to 2100 nm measurement range and an integrating sphere. The combination of the UV-3600i Plus and ISR-603 is ideal for solar transmittance measurements.

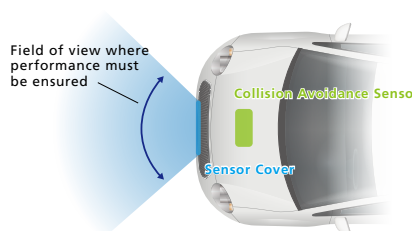
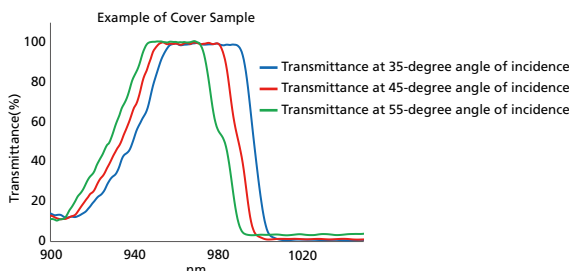




## Transportation Equipment

### LiDAR Collision Avoidance Sensor Evaluation System

LiDAR is a technology essential for self-driving vehicles. It measures the distance to and position of obstructions by scanning with laser light to measure the light reflected from obstructions. The results below were measured from the protective cover of a collision avoidance sensor as the incident light angle was varied. Considering that the transmittance level changes as the incident angle is varied, the results indicate that the laser wavelength used for the sensor should be near 960 nm, where transmittance does not decrease for the given cover material.

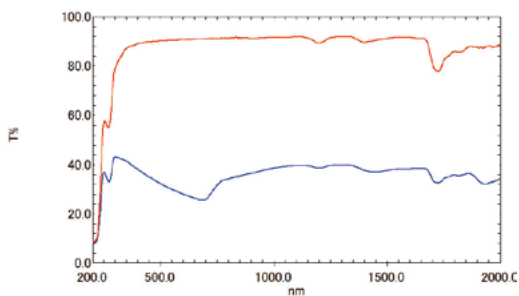


## Chemicals

### Haze Measurement of Plastics

Because plastics are widely used now, clear plastic materials, such as lenses, are required. Haze value is one kind of evaluation of transmittance for plastics. Haze value is calculated by determining the ratio of total transmittance and diffuse reflectance. A smaller haze value indicates a clearer material. The ISR-1503 with an of 150 mmø can mount a transmittance sample horizontally. Shown here is a measurement result of a misty plastic plate. Spectra were ones of total transmittance and diffuse reflectance. Haze value was 32.9.

ISR-1503 with an of 150 mmø is suitable for Haze measurement.



**Haze Value (%) =32.9**

Calculated by Total transmittance and  
Diffuse reflectance.

Note  
Obtained Haze value may differ from values obtained with  
dedicated Haze meters.

### Options Used for Measurements

#### ISR-603 Integrating Sphere Attachment



### Solar Radiation Calculation Software

This software calculates solar transmittance/reflectance from measured spectra.

- The main calculation items are visible light transmittance/reflectance, total light transmittance/reflectance, near infrared reflectance, ultraviolet transmittance, CIE damage factor, and skin damage factor.
- The related items of JIS, ISO and GB/T can be calculated.

#### Others

- MPC-603A Multi-Purpose Large-Sample Compartment
- Variable Angle Measurement Unit for MPC-603A
- Excel® macro program for band gap
- Color Calculation Software

# Options Used for Measurements



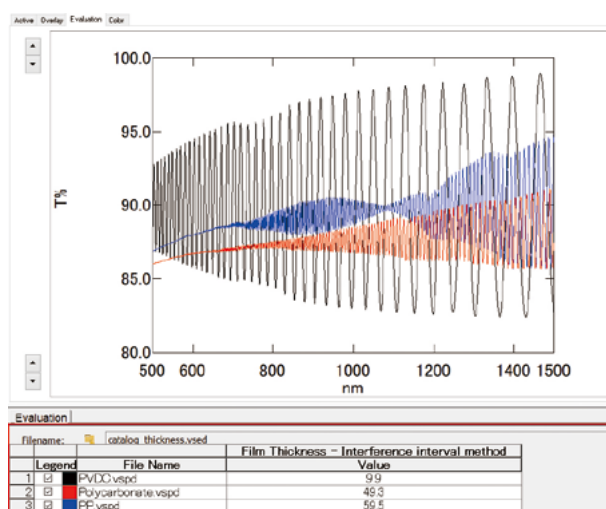
## Chemicals

### Film Thickness Measurement

Interference wave patterns sometimes occur when light passes through a transparent film. The film thickness of a sample can be determined by using the interference waveform. The black line is for polyvinylidene chloride film, the red line is for polycarbonate film, and the blue line is for polypropylene film.

The values of 9.9  $\mu\text{m}$ , 49.3  $\mu\text{m}$ , and 59.5  $\mu\text{m}$  were calculated from the interference waveforms using the optional film thickness calculation.

Note: The refractive index of the sample must be entered in order to perform the calculation.



### Options Used for Measurements

#### Film Holder



#### Film Thickness Calculation Software

This software calculates the film thickness from the measured spectrum using the interference interval method. (An input of the refractive index of the sample is required to calculate the film thickness.)

- The interference method calculates the film thickness from the distance between the peaks of the interference waveform (Baray). You can set the detection parameters for the peak (Baray) and the incident angle and wavelength range for the film thickness calculation.

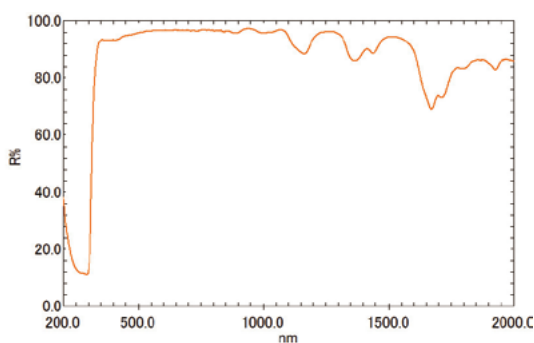


## Pharmaceuticals

### Measurement of Anhydrous Caffeine in Cold Remedy

Anhydrous caffeine is included in cold medicines. The figure below shows the results of measuring anhydrous caffeine using a powdered sample holder. It enables volumes as small as 0.16 mL to be measured easily.

The combination of the UV-3600i Plus, ISR-603, and powdered sample holder is ideal for the diffuse reflectance measurement of powder.



### Options Used for Measurements

#### Powdered Sample Holder



#### ISR-603 Integrating Sphere Attachment



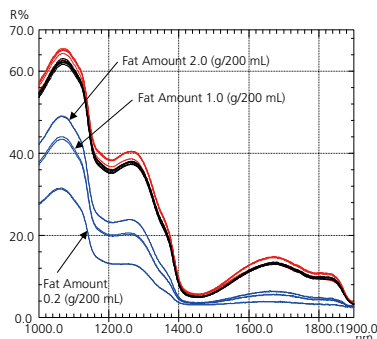




## Foods

### Quantitation of Amount of Fat in Foods

Recently, fat-modified products have become widely available. The Gerber method and Roesse-Gottlieb method are usually used to determine the fat level in milk, a process that requires a long measurement time. Therefore, the measurement was conducted using a combination of the spectral reflectance method and multivariate analysis. The figure below shows the spectral reflectance spectrum of a milk sample, which was placed in a screw tube and measured by the UV-3600i Plus and ISR-603. The quantitation of the amount of fat was conducted by generating a calibration curve using the spectrum and fat amount data.



Samples	Amount of Fat Shown on the Milk Carton Package (g/200mL)	Estimation Results Using Multiple Regression Analysis Methods	Estimation Results Using PLS Regression Methods	Estimation Results Using Support Vector Regression Analysis Methods
Creamy 3 (1 <sup>st</sup> time)	9.5	8.87 (6.6%)	9.57 (0.7%)	9.72 (2.3%)
Creamy 3 (2 <sup>nd</sup> time)	9.5	8.89 (6.4%)	9.67 (1.6%)	9.47 (0.3%)
Regular 3 (1 <sup>st</sup> time)	7.6	8.04 (5.8%)	8.40 (10.5%)	7.88 (3.7%)
Regular 3 (2 <sup>nd</sup> time)	7.6	7.59 (0.1%)	7.71 (1.4%)	7.31 (3.8%)
Low Fat 3 (1 <sup>st</sup> time)	2.0	2.24 (12.0%)	1.78 (11.0%)	2.01 (0.5%)
Low Fat 3 (2 <sup>nd</sup> time)	2.0	2.36 (18.0%)	1.72 (14.0%)	1.86 (7.0%)

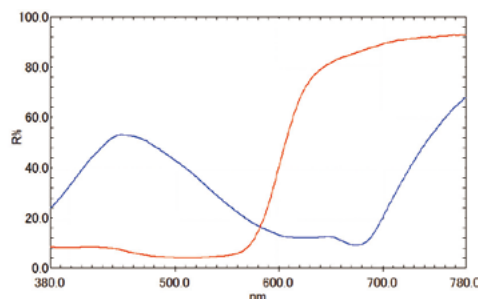


## Textiles

### Diffuse Reflectance Measurement of Various Fabrics

The diffuse reflectance spectra of various textiles were measured in the visible region using the ISR-603 integrating sphere attachment. The blue line indicates a blue fabric and the red line indicates a red fabric. The blue fabric mainly reflects short-wavelength blue light, so it appears blue, while the red fabric mainly reflects long-wavelength red light, so it appears red.

The combination of the UV-3600i Plus and the ISR-603 is ideal for measuring color. Also, the optional color measurement software enables colors to be calculated and displayed in a variety of color space models.



### Options Used for Measurements

#### Film Holder



#### Powdered Sample Holder



#### Other

- ISR-603 Integrating Sphere Attachment

#### Color Calculation Software

Software that calculates the color value of a measurement from the measured spectrum. You can display a graph of the chromaticity coordinates xy in the XYZ colorimetric system or a graph of the luminosity index/color coordinates in CIELAB.

- Contains the main calculation items for the XYZ colorimetric system, CIELAB, CIELUV, Munsell colorimetric system, mentality, yellowness, whiteness, and color difference.
- You can calculate items related to JIS and ASTM colors. \*
- For various calculations, you can set the measurement illuminant and observation viewing angle.

#### UPF Calculation Software

Software to calculate UPF (ultraviolet shielding factor) from a measured spectrum.

- UPF, UVA, UVB, UV block rate, UV block rate (UVA, UVB) can be calculated.
- You can calculate related items of JIS, DIN, BS, AATCC, AS/NZAA, GB/T. \*

\* Please contact us for details on the corresponding standard.

# Standard Software: LabSolutions™ UV-Vis

Enables higher productivity and provides for a more convenient analytical environment.



## Setting Parameters

### Smooth Operability

#### Four Measurement Modes

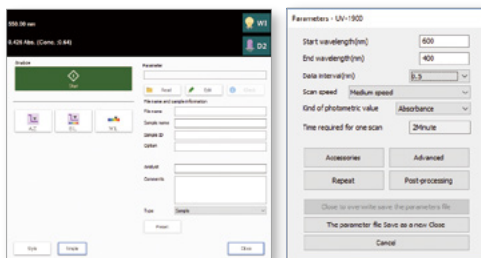
Four separate measurement modes: spectral, quantitative, photometric, time-course, automatic measurement (optional) enable measurements to be performed using intuitive operations.



Four Measurement Mode Windows

#### Instrument Control Panel

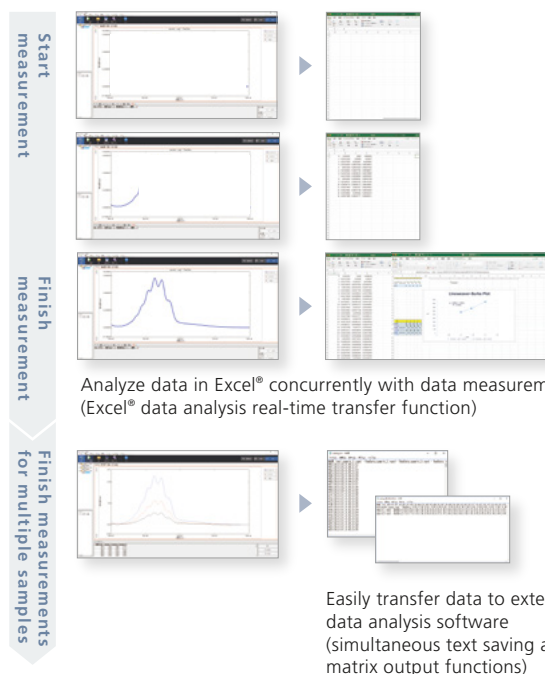
Instrument parameter settings can be specified via panels that are separate from the measurement window. The control panels include various functionality that is laid out for superior visibility. Each measurement window connects seamlessly to the corresponding parameter settings window.



## From Measurement to Data Output

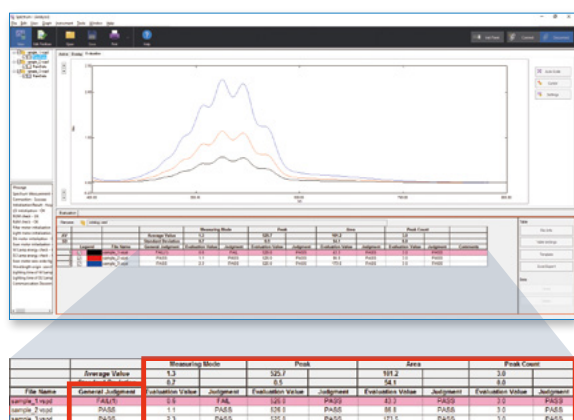
### Improved Productivity of Data Analysis Operations

Data analysis and data output operations can be performed at the same time (simultaneously) as data measurement. Time spent outputting or analyzing data can also be reduced by simultaneously sending data to an Excel® spreadsheet in real time or saving data as text. The software can also automatically perform post-processing of measured data, such as processing/correcting spectra, and perform pass/fail judgments of measurement results (automatic spectral evaluation).

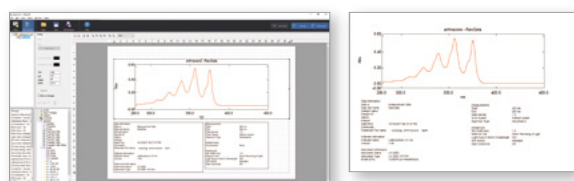




By specifying various evaluation criteria for measurement results, spectra judgments can be made automatically.



In the report creation window, reports can either be prepared based on a previously specified report format or freely laid out based on various parameters, data, or other elements.



## Stronger Data Management

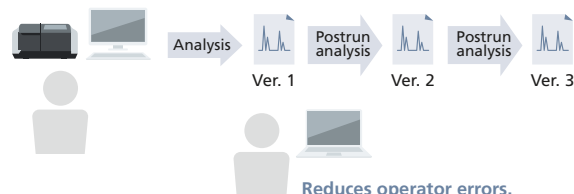
In addition to regular file management in folders on a PC, ideal solutions for saving data in a database with sophisticated security functionality and compliance with ER/ES-related regulations are also available.

## Optional Software

LabSolutions DB UV-Vis  
LabSolutions CS UV-Vis

## Database Management

Managing data in a database can prevent the overwriting or deletion of analysis data. Furthermore, during postrun analysis, the data can be managed using version numbers, so there are no concerns about overwriting the data.



# Accessories

## Basic Measurement

**Film Holder**  
(P/N 204-58909)



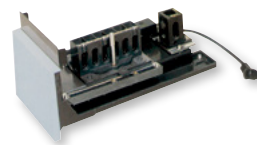
This holder is used to hold films, filters, and other items. It is compatible with sample sizes between a minimum W16 x H32 mm and maximum W80 x H40 mm.

**Rotating Film Holder**  
(P/N 206-28500-41)



This film holder enables in-plane rotation of samples centered on the optical axis. It is compatible with sample sizes up to 33 x 30 mm.

**Multi-Cell Sample Compartment (Six Cells)**  
(P/N 206-69160-41)



This holds up to six cells on the sample side. It is controlled automatically.

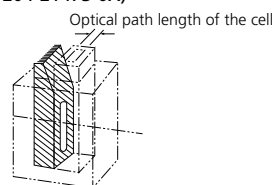
## Short Optical Path, Long Optical Path, Micro-Volume Measurement

**Long-Path Rectangular Cell Holder**  
(P/N 204-23118-01)



This holds rectangular cells with an optical path length of 10, 20, 30, 50, 70, or 100 mm.

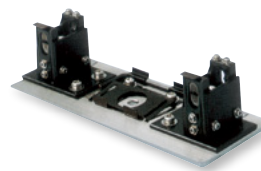
**Spacers for Short-Path Cells**  
(P/N 204-21473-0X)



This standard cell holder is required for short optical path cells.

P/N	Available cells
-01	2mm
-02	5mm
-03	1mm

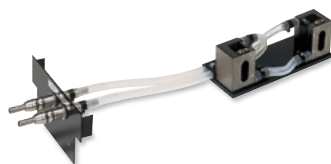
**Super-Micro Cell Holder**  
(P/N 206-14334)



This cell holder is for supermicro cells. Volumes between 50 and 200  $\mu$ L can be measured, depending on the type of black cell used.

## Constant-Temperature Measurement

**Constant-Temperature Cell Holder**  
(P/N 202-30858-44)



This cell holder controls the cell temperature by circulating constant-temperature water. The operating temperature range is 5 to 90 °C (requires a separate constant-temperature water circulator). A four-cell model is also available (P/N: 204-27206-02).

**Thermoelectrically Temperature-Controlled Cell Holder (TCC-100)**  
(P/N 206-29510)



This device can control the temperature of cells on both the sample and reference side. The temperature-control range is 7 to 60 °C. The temperature can be adjusted only on the sample side and 6 sets are available (P/N 206-29500). The temperature-control range of 6 sets is 16 to 60 °C.

**Thermoelectric Single-Cell Holder (S-1700)**  
(P/N 206-23900)



This holder (including a stirrer) can be programmed to increase/decrease the temperature on the sample side. The temperature-control range is 0 to 110 °C. Cooling water must be circulated to cool the Peltier element.

## Reflectance Measurement

**Specular Reflectance Measurement Attachment (5° Incident Angle)**  
(P/N 206-14046-58)



This device enables specular reflectance measurements. The angle of incidence to the sample is 5 degrees. It is compatible with sample sizes from 7 mm in diameter up to 160 x 100 mm and up to 15 mm thick.

## Integrating sphere units.

### Integrating Sphere Attachment (ISR-603) (P/N 207-20100-58)



This attachment enables relative diffuse or specular reflectance measurements. The angle of incidence to the sample can be set by setting it to zero or eight degrees in combination with functionality for switching between sample and reference sides of the spectrophotometer. The measurement wavelength range is 220 to 2600 nm. It is compatible with reflectance samples up to 100 mm in diameter and 15 mm thick.

### Integrating Sphere Attachment (ISR-1503) (P/N 207-20900-58)



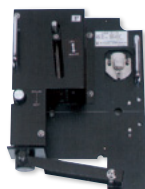
This integrating sphere with a 150 mm internal diameter and maximum 4.0 % aperture ratio is compliant with a variety of regulations. The measurement wavelength range is 220 to 2500 nm. A small sample holder for transmittance, a standard cell holder for direct detection, a powdered sample holder, a film holder, and other dedicated accessories are available.

### Multipurpose Large-Sample Compartment MPC-603A (P/N 207-23550-41)



This multipurpose sample compartment can be used to freely measure the transmittance or reflectance of variously shaped samples. The measurement wavelength range is 220 to 2600 nm. It is compatible with transmittance sample sizes up to 305 mm in diameter and 50 mm thick or up to 204 mm in diameter and 300 mm thick, or reflectance sample sizes up to 305 mm in diameter and 50 mm thick.

### Absolute Reflectance Attachments



These attachments are installed in a multipurpose large-sample compartment to enable absolute specular reflectance measurements of solid samples. The compatible sample size range is 20 to 150 mm square and up to 30 mm thick. A sample base plate integrating sphere set is required.

P/N	Incident angle	Wavelength range
206-16817-58	5°	300 to 2400 nm
206-16100-58	12°	300 to 2500 nm
206-15001-58	30°	300 to 2300 nm
206-15002-58	45°	300 to 2300 nm

### Variable Angle Measurement Unit for MPC-603A (P/N 207-23490-42)



This device enables absolute reflectance measurements of solid samples, with the incident and reflection angles set to any angle. Measurement wavelength range is 250 to 1650 nm. It is compatible with sample sizes from 20 to 70 mm square and between 2 and 15 mm thick. The incident angle can be set between 5 and 70 degrees.

### Large Polarizer Assy / Polarizer Assys



These enable control of polarization characteristics of incident light on samples.

P/N	Type	Wavelength range
206-15694-40	Large type	250 to 2300 nm
206-13236-41	Type I	400 to 800 nm
206-13236-42	Type II	260 to 700 nm
206-13163-40	Type III	260 to 2300 nm

### Powdered Sample Holder (for Integrating Sphere) (P/N 206-89065-41)



This powdered sample holder is for installation in an integrating sphere.

### Micro Sample Holder (P/N 206-28055-41)



This holds small samples against the integrating sphere. It is compatible with sample sizes from 5 to 10 mm square and between 0.5 and 2 mm thick.

## Various other accessories

### Liquid Samples



[https://www.shimadzu.com/an/molecular\\_spectro/uv/accessory/liquid/guide.html](https://www.shimadzu.com/an/molecular_spectro/uv/accessory/liquid/guide.html)

### Solid Samples



[https://www.shimadzu.com/an/molecular\\_spectro/uv/accessory/solid/guide.html](https://www.shimadzu.com/an/molecular_spectro/uv/accessory/solid/guide.html)



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- Allows a system to monitor and diagnose itself, handle any issues during data acquisition without user input, and automatically behave as if it were operated by an expert.
- Supports the acquisition of high quality, reproducible data regardless of an operator's skill level for both routine and demanding applications.

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