

SEC2020 SPECTROMETER SYSTEM USER'S GUIDE - DEVICE -

 **ALS Co., Ltd**
Electrochemistry & Spectroelectrochemistry

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1. SEC2020 Spectrometer system

The SEC2020 Spectrometer system is a compact spectrometer system developed by ALS Co., Ltd and provided by BAS Inc. One unit can measure a wide wavelength range from ultraviolet to near infrared (UV/VIS/NIR) with high sensitivity, corresponding to optical measurements such as spectrum, absorbance, transmittance, reflectance, relative irradiance (fluorescence, emission) and concentration.

In addition, BAS, which also provides electrochemical measuring instruments, may also offer know-how for spectroelectrochemical measurement, electrochemical measurements combined with spectroscopy.

* Optional products may be prepared separately.



Figure 1-1 SEC2020 Spectrometer system

2. General Information

2-1. User Updates

In order to receive any updated information about product, and valuable information related to current and other ALS products, please register your e-mail address at our local distributors. We would like to know about your present status and interests regarding electrochemical analysis.

2-2. Technical changes

We reserve the right to make technical changes to improve the instrument without notice.

2-3. Damaged shipment

Breakage of any part of this instrument during shipping should be reported immediately to the freight handler and ALS Customer service.

It is necessary to keep the original packing box and contents for inspection by the freight forwarder. ALS will replace any new instrument damaged in shipping with an identical product as expediently as possible after the claim filing date. Claims not filed within 7 days after shipping may be invalid.

Do not return damaged goods to ALS directly. Please contact with your local distributor informing them of its damaged status.

They will contact with our service department.

2-4. Product warranty

ALS Co., Ltd warrants equipment manufactured by the company to be free from defects in material and workmanship for a period of 90 days from the date of shipment. This assumes normal usage under commonly accepted operating parameters. ALS agrees to either repair or replace, at its sole option and free of part charges to the buyer, any parts of such instrumentation which, under proper and normal conditions of use, prove to be defective within 90 days from date of shipment. Electrochemical cells and working electrodes are warranted for 30 days.

ALS neither assumes nor authorizes any person to assume for it any other liability in

connection with the sale, installation, service, or use of its instrumentation.

All products manufactured by ALS are tested and inspected prior to shipment. Upon prompt notification by the buyer, ALS will correct any defects in warranted equipment by its manufacture either by return of the item to our factory, or shipment of a repaired or replacement part. ALS will not be obliged, however, to replace or repair any piece of equipment which has been abused, improperly installed, altered, damaged or repaired by others. Defects in equipment do not include decomposition, wear, or damage by chemical action or corrosion.

This instrument is manufactured, either wholly or in part, for research purposes only. Use in medical diagnosis is not intended, implied or recommended by the manufacturer. Use for this purpose and accountability for the same rests entirely with the user.

Limited obligations covered by this warranty include:

In the case of instruments not of ALS manufacture, the original manufacturer's warranty applies.

Shipping charges under warranty are covered only in one direction. The buyer is responsible for shipping charges to the factory, if return of the part is required.

Expendable items including disposable items such as working electrode, reference electrodes, source lights, panel lights, fuses, etc. are excluded from the warranty

2-5. Service information

ALS provides a skilled service staff to solve your equipment oriented problems. For further details, please contact us by e-mail (sales@als-japan.com).

Following discussion of your specific difficulties, an appropriate course of action will be described and the problem resolved accordingly.

Please contact with local distributor and describe to them the problem you are having in full detail.

They will obtain a RETURN MERCHANDISE AUTHORIZATION NUMBER (RMA#). The RMA# identifies you as the sender. All correspondence and shipments should be sent to ALS.

3. System configuration

SEC2020 spectrometer system consists of four basic accessories. It consists of SEC2021 spectrometer, SEC2022 deuterium halogen light source, SEC2023 cuvette holder, and SEC2024 platform.



	Description	Qty
1	SEC2021 Spectrometer	1
2	SEC2022 Deuterium halogen light source	1
3	SEC2023 Cuvette holder	1
4	SEC2024 Platform	1
5	AC adaptor	1
6	Power cable	1
7	USB cable	1
8	Collimator	2
9	Fiber collimator	1
10	Platform screw	7
11	External device connection trigger cable	1
12	Trigger/Light source control cable	1
13	Plastic cuvette	1
14	SMA905 adaptor for light source	3
15	SMA905 adaptor for light shielding	2
16	Hexagon wrench 0.89mm	1
17	Hexagon wrench 1.50mm	1
18	Software (USB memory)	1
(19)	Quick manual	1
(20)	Wavelength Calibration Data Sheet	1
(21)	Linearity Test Data Sheet	1
(22)	Waterproof box	1
(23)	Warranty certificate	1

Figure 3-1 Configuration and List of accessories

3-1. SEC2021 Spectrometer

SEC2020 Spectrometer system is equipped with SEC2021 spectrometer as standard content. With highly functional grating and optical design, it is possible to measure a wide wavelength range from ultraviolet to near infrared (UV/VIS/NIR) with high sensitivity with one unit.



Figure 3-2 SEC2021 Spectrometer

Spectrometer specification	
Description	SEC2021-025-DUVN
Detector	2048 element linear silicon CCD array
Wavelength range	200 – 1025 nm
Grating	Blaze wavelength (300 nm)
Slit	25 μm
Wavelength resolution	1.3 nm
Fiber connector	SMA905 Core diameter: 600 μm NA = 0.22
Interface	USB 2.0
Operating system	Windows TM 8.1/10, 32/64 bit
Size (W x D x H)	86 x 110 x 32 mm

3-1-1. I/O Port Pin

The Pin number of the I/O port for the spectrometer controlling is showing below:

Pin No.	Signal	Definition	Function
1	Power	5V Output	When connecting to the PC's USB port, this pin is connected to VBUS. Up to 100 mA current
2	No connection		
3	No connection		
4	Output	Shutter	Shutter ON/OFF
5	Output	D2_ON	D2 lamp ON/OFF
6	Output	HAL_ON	Halogen lamp ON/OFF
7	Input	Trigger-IN	TTL
8	GND	GND	Ground

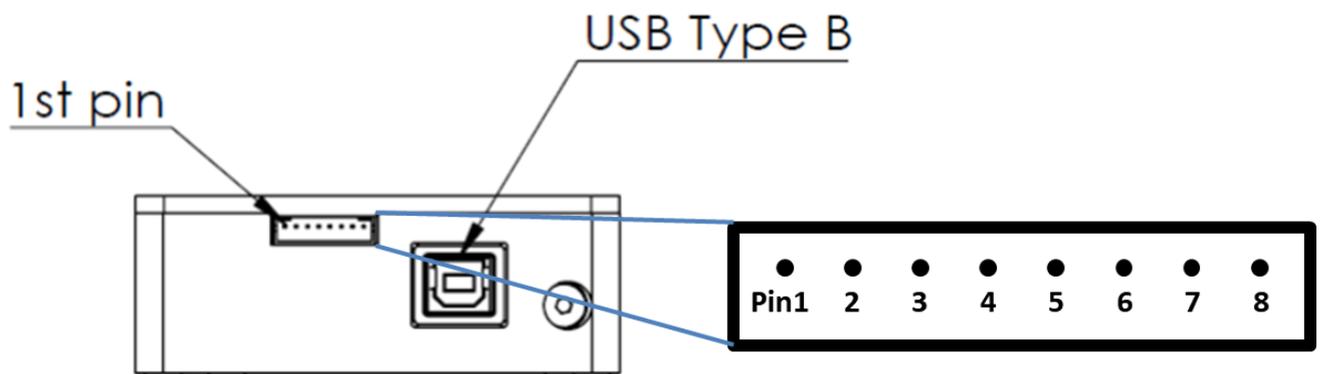


Figure 3-3 SEC2021 Spectrometer Port Pin number

3-2. SEC2022 Deuterium Halogen light source

SEC2020 Spectrometer system is equipped with SEC2022 deuterium halogen light source as standard content.

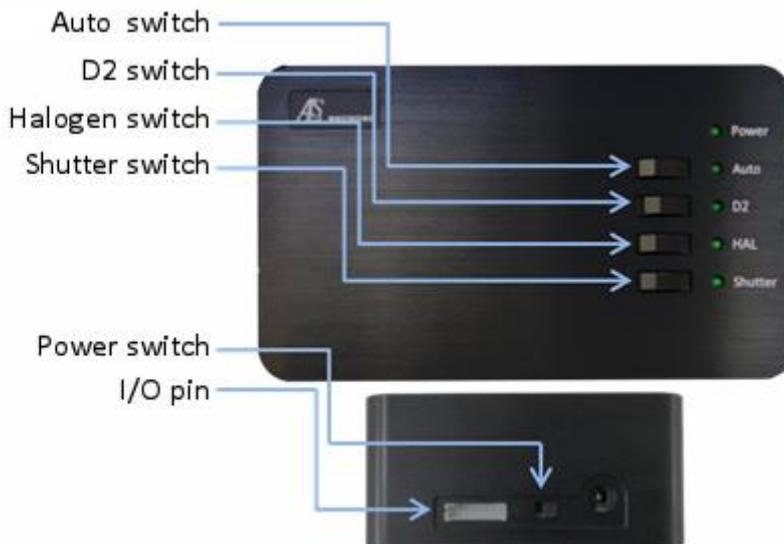


Figure 3-4 Switch location for the light source

Light source specification	
Description	SEC2021-025-DUVN
Light type	Deuterium halogen light source
Wavelength range	200 – 1700 nm
Stability	< 0.1 %
Drift	< 0.25 % h
Bulb life	> 1000 h (D2 lamp) > 2000 h (halogen lamp)
Fiber connector	SMA905
Size (W x D x H)	100 x 165 x 46 mm

3-2-1. Manual mode

- ① Connect the power cord and turn on the Power switch. When the switch is on, the Power LED lights up.
- ② Turn off the Auto switch (Auto LED turns off).
- ③ Next, depending on the purpose, turn on D2 switch (D2 LED lights up) or turn on the Halogen switch (HAL LED lights up), and turn on lamps alone or both.
- ④ When you slide the Shutter switch and the LED lights up, the optical path opens, and when the Shutter LED turns off, the optical path is blocked.

3-2-2. Automatic mode

- ① Connect the spectrometer and the light source with Trigger/Light source control cable.
- ② Connect the spectrometer and the PC with USB cable.
- ③ Turn on the Power switch of the light source and turn on the Auto switch (Auto LED lights up).
- ④ **SEC Spectra** software controls D2, halogen and shutter operation. Check ON/OFF of each switch by LED status.

Caution: Turning on the power switch before connecting the Trigger/Light source control cable, it does not work properly. Please be careful to turn on the light source only after connecting the Trigger/Light source control cable for light source control.



Figure 3-5 Connection of the trigger cable for light source control

3-2-3. I/O Port Pin

The Pin number of the I/O port for the light source controlling is showing below:

Pin No.	Signal	Definition	Function
1	No connection		
2	No connection		
3	No connection		
4	Input	Shutter	Shutter ON/OFF
5	Input	D2_ON	D2 lamp ON/OFF
6	Input	HAL_ON	Halogen lamp ON/OFF
7	No connection		
8	GND	GND	Ground

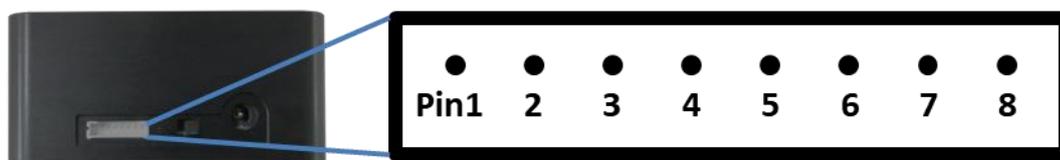


Figure 3-6 Pin number for the deuterium halogen light source

3-3. SEC2023 Cuvette holder

It is used to set the cuvettes and plate samples inside. It can also be connected to the collimator, fiber collimator or optical path, as well as the SMA905 adaptor for light shielding.



Figure 3-7 Cuvette holder

3-4. SEC2024 Platform

Fixing the SEC2021 Spectrometer, SEC2022 Deuterium halogen light source, and SEC2023 Cuvette holder onto the SEC2024 Platform, it enables a stable installation of the instrument*.



Figure 3-8 Platform for instrument fixing

*Fix the devices by screwing the instrument from the side with the platform screw.

Caution: Please be careful not to lift the device from the platform, because there is a possibility that it comes off, even after fixing.

3-5. Other accessories

3-5-1. AC adaptor and Power cable

It is an AC adaptor and Power cable for the SEC2022 Deuterium halogen light source.

Power supply specification

AC input range	100 – 240 V
DC output range	12 V (max. 3.34 A)

3-5-2. USB cable

It is used for the connection of the SEC2021 Spectrometer to the PC.

3-5-3. Collimator

It is used as a fitting when connecting SEC2023 Cuvette holder and SMA905 compatible optical fiber. And the connected collimator lens can extract light from ultraviolet and visible light source in parallel. If light is irradiated from the opposite side, it can be focused on a pinhole. In addition, you can adjust the focal position, by loosening the fixing screw using the supplied hexagonal wrench 0.89 mm and sliding the inner cylinder. It is also possible to remove the inner cylinder. For how to use it, please refer to “[Figure 4-2 Attach the collimator \(with inner cylinder removed\) to the cuvette holder](#)”.



Figure 3-9 Collimator

3-5-4. Fiber collimator

Connecting as a joint between SEC2023 Cuvette holder and SEC2021 Spectrometer, light uptake efficiency is increased. For measurements using cuvette holders, the use of fiber collimator is recommended. In addition, you can adjust the focal position, by loosening the fixing screw using the supplied hexagonal wrench 1.5 mm and sliding the inner cylinder.



Figure 3-10 Fiber collimator

3-5-5. External device connection trigger cable

Connecting the SEC2021 Spectrometer and external device with an External device connection trigger cable, the START/STOP of the spectrometer measurement can be controlled by measuring operation external device.



Figure 3-11 External device connection trigger cable

3-5-6. Trigger/Light source control cable

Connecting the SEC2021 Spectrometer and the SEC2022 Deuterium halogen light source with this cable, ON/OFF control of D 2 and halogen lamp and shutter switch can be controlled by **SEC Spectra**. Connect the connector with all cords connected to the pin to the SEC2021 Spectrometer and connect the other connector to the SEC2022 Deuterium halogen light source.

Also, the two free cords, like the External device connection trigger cable, can control the spectrometer measurement with the operation of the external devices. Connect the black cord to the ground of the external device and the brown cord to the trigger out of the external device.



Figure 3-12 Trigger/Light source control cable

3-5-7. Plastic cuvette

Cuvette used for absorbance, transmittance, fluorescence and concentration of gas or liquid samples measurement. Other 10 mm square cuvettes, in quartz glass or similar, can be for the measurement.

3-5-8. SMA905 adaptor for light source

It is used as a fitting when connecting SEC2023 cuvette holder and fiber with SMA905 connector.



Figure 3-13 SMA905 adaptor for light source

3-5-9. SMA905 adaptor for light shielding

When measuring with the SEC2023 cuvette holder, it is used to block the external light.

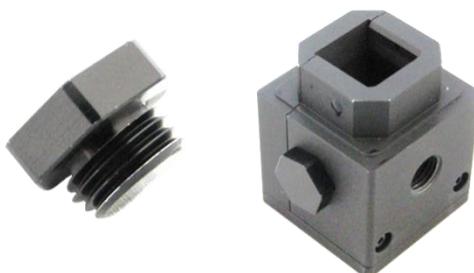


Figure 3-14 SMA905 adaptor for light shielding

3-5-10. Hexagon wrench

It is used for loosening of the fixing screw attached to the housing of the collimator lens, to adjust the focal position of the collimator lens. The 0.89 mm wrench corresponds to a collimator, and the 1.50 mm wrench corresponds to a fiber collimator. The 1.50 mm wrench is also used to fix the position of the variable slits on the cuvette holder, as shown in “[Figure 4-4 Side of the cuvette holder](#)”.

3-5-11. Software (USB memory)

Software for the SEC2020 Spectrometer system includes installer of **SEC Spectra** and the detailed instruction manuals for the software and device.

3-5-12. Quick manual

SEC2020 Spectrometer system content list, **SEC Spectra** software installation and measurement setting method are briefly introduced.

3-5-13. Wavelength Calibration Data Sheet

SEC2021 Spectrometer is calibrated at the factory before shipment, and low mercury lamp is used as the reference light source. In SEC2020, calibration is carried out with higher degree polynomials using mercury's representative bright lines.

3-5-14. Linearity Test Data Sheet

Before shipment, the CCD sensitivity of the SEC2021 spectrometer is not linear with respect to intensity, and sensitivity varies depending on individual CCDs. Therefore, each spectrometer is subjected to linearity correction, and the linearity correction table is stored in each spectrometer.

3-5-15. Waterproof box

Waterproof box for the storage of all contents of the instrument, and can be used for the easily carry of the system.

3-5-16. Warranty certificate

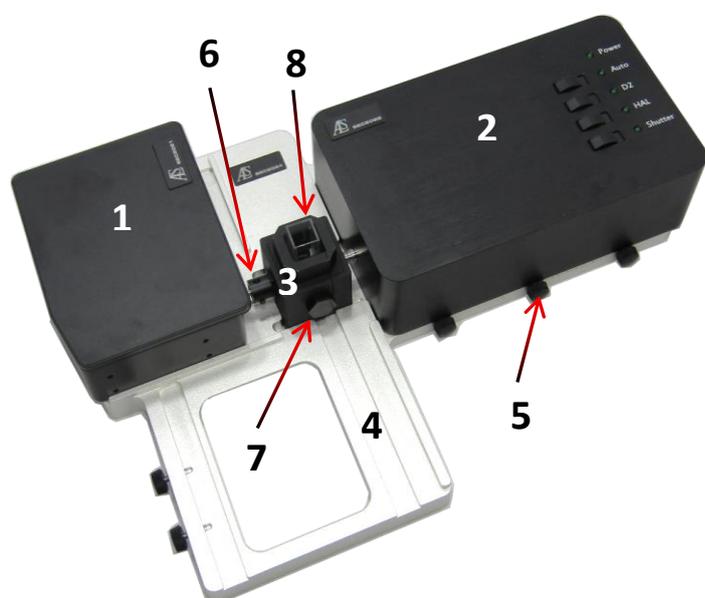
Based on this warranty certificate, the repair will be free of charges for one year from the purchase date.

4. Instrument setting for absorbance / transmittance measurement

Absorbance / transmittance measurement using the SEC2020 spectrometer system and **SEC Spectra** is calculated from the spectrum of light that has passed through the reference object (inject lank solvent into the cuvette) and the object to be measured (inject ample solution nto the cuvette). Therefore, to measure the absorbance/transmittance, first measure the transmitted light spectrum of the reference object (baseline measurement), then set the object to be measured and measure the transmitted light. When the measurement is completed, the program automatically calculates the absorbance / transmittance spectrum.

4-1. Example 1. Using cuvette

Set the cuvette containing the sample (gas or liquid) and measure the absorbance and transmittance. Also, by switching to the concentration mode, quantitative analysis of concentration is also possible.



Configuration example

	PC (sold separately)
1	SEC2021 Spectrometer
2	SEC2022 Deuterium halogen light source
3	SEC2023 Cuvette holder
4	SEC2024 Platform
5	Platform screw
6	Fiber collimator
7	SMA905 adaptor for light shielding
8	Plastic cuvette

Figure 4-1 Absorbance / Transmittance measurement example using cuvette

- ① First, set the spectrometer and light source as shown in Figure 4-1 Connect the fiber collimator to the cuvette holder and connect it to the spectrometer. Fix it with platform screws on the platform. Connect the SMA905 adaptor for light shielding to the both sides of the cuvette holder. When placing the light source on the platform, fix with the platform screw at the position where the light irradiation port is closest to the cuvette holder**.
- ② Turn on the power switch of the light source and turn on the D2 and halogen lamps. Wait from 20 to 30 minutes until the light source stabilize.
- ③ Open the **SEC Spectra** software, and then open the shutter, set the cuvette containing blank solvent or gas to the cuvette holder, and acquire the reference spectrum*.
- ④ While setting the cuvette, close the shutter (do not turn off the light source), and acquire the dark spectrum*.
- ⑤ Open the shutter and set the cuvette containing the sample to be measured into the cuvette holder and perform the measurement.

*For the acquisition method, please refer to “SEC2020 SPECTROMETER SYSTEM USER'S GUIDE - SOFTWARE -”.

The above step ① is an example of basic setup, you can also attach **the collimator with inner cylinder removed to the cuvette holder and install the light source so that it enters the collimator. More stable measurement is available.

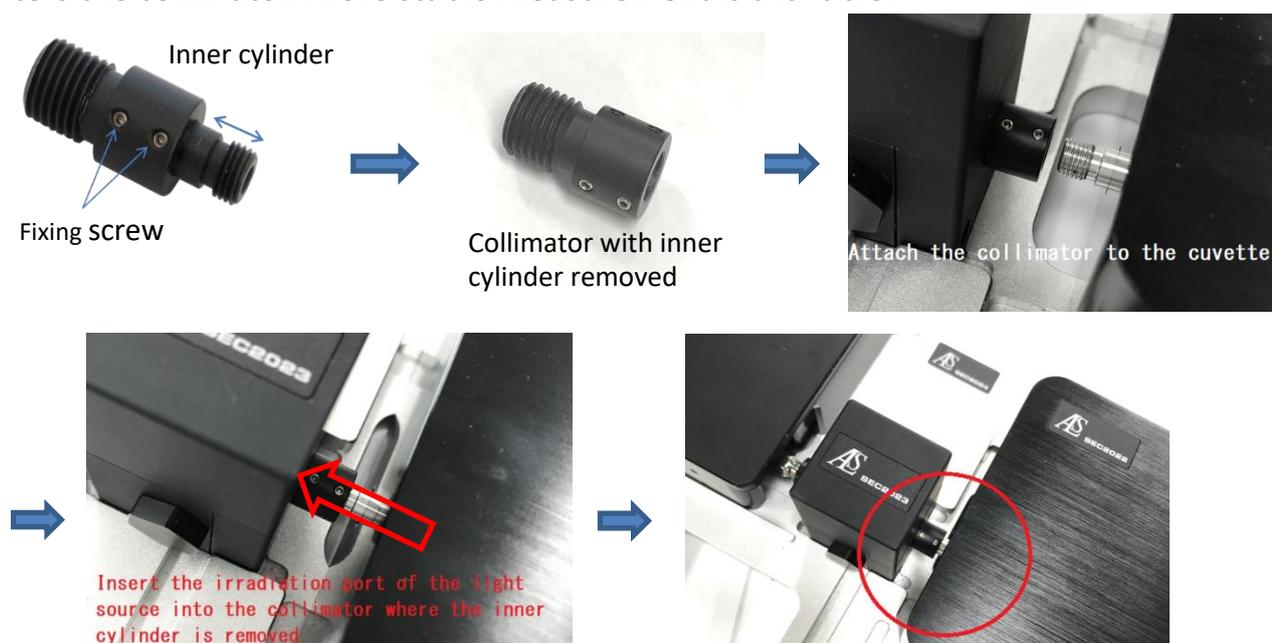
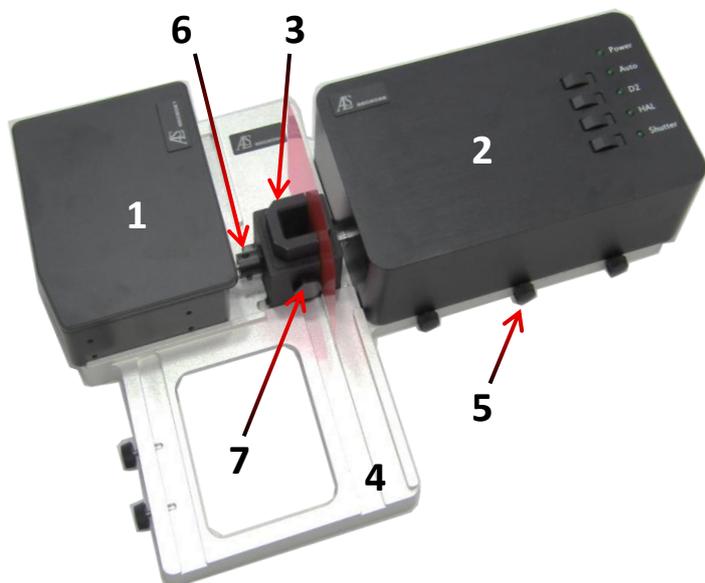


Figure 4-2 Attach the collimator (with inner cylinder removed) to the cuvette holder

4-2. Example 2. Using thin film

Set the thin film in the cuvette holder and measure the absorbance and transmittance.



Configuration example

	PC (sold separately)
1	SEC2021 Spectrometer
2	SEC2022 Deuterium halogen light source
3	SEC2023 Cuvette holder
4	SEC2024 Platform
5	Platform screw
6	Fiber collimator
7	SMA905 adaptor for light shielding

Figure 4-3 Absorbance / Transmittance measurement example thin film

- ① Set the instrument in the same way as measurement using cuvette.
- ② Warming up the light source in the same way as measurement using cuvette.
- ③ Open the **SEC Spectra** software, and then open the shutter, slide the side of the cuvette holder and set the reference film or make air as reference spectrum*.
- ④ Close the shutter and acquire the dark spectrum*.
- ⑤ Open the shutter, set the thin film to be measured, and perform the measurement.

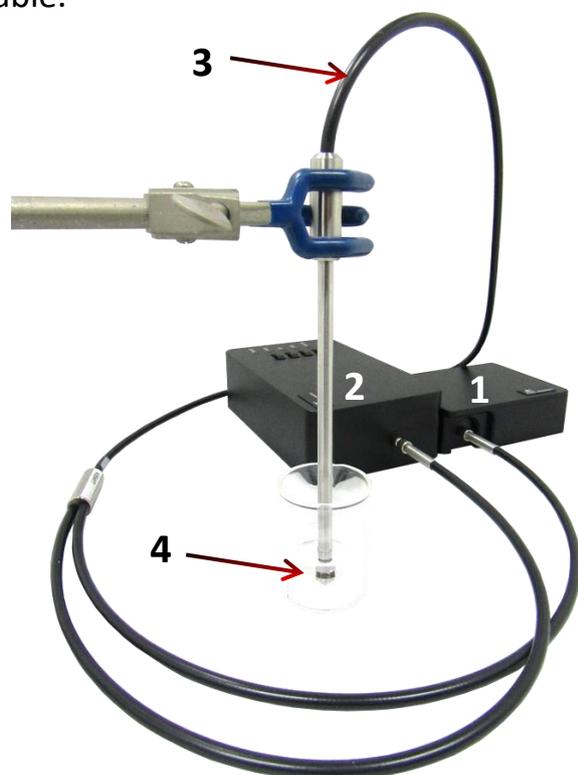
*For the acquisition method, please refer to “SEC2020 SPECTROMETER SYSTEM USER’S GUIDE - SOFTWARE -”.



Figure 4-4 Side of the cuvette holder

4-3. Example 3. Using probe

Since immersion probe is measured by immersing the probe directly in the sample, troublesome sampling is unnecessary. 2, 5, 10, 20 mm optical path length tip are available.



Configuration example

	PC (sold separately)
1	SEC2021 Spectrometer
2	SEC2022 Deuterium halogen light source
3	5.4mm Monocoil all legs, Low Sol 300um UV, 1.5m Total length with round nut (sold separately)
4	PD-U10 10mm tip (sold separately)

Figure 4-5 Absorbance / Transmittance measurement example using transmission dip probe

- ① Transmission dip probe has two branches which are connected to the spectrometer and light source, respectively.
- ② Warming up the light source in the same way as measurement using cuvette..
- ③ Open the **SEC Spectra** software, open the shutter and immerse the transmission dip probe in a container, containing solvent or solution. At this time, remove bubbles adhering to the optical path tip and acquire the reference spectrum*.
- ④ Keep immersed, close the shutter and acquire the dark spectrum*.
- ⑤ Open the shutter, immerse the transmission dip probe in the solution to be measured, and perform the measurement.

*For the acquisition method, please refer to "SEC2020 SPECTROMETER SYSTEM USER'S GUIDE - SOFTWARE -".

5. Instrument setting for reflectance measurement

Reflectance measurement using SEC2020 spectrometer system and **SEC Spectra** is calculated from the reflected light from the reference object and that from the object to be measured. Therefore, similar to the measurement of absorbance, to measure the reflectance, first irradiate the reference object with a light source and measure the reflected light, then measure the light reflected on the object to be measured. When the measurement is completed, the program automatically calculates the reflectance spectrum. A separate high-power light source is required because it is necessary to irradiate stronger light to detect the reflected spectrum.

5-1. Application example using reflectance probe

The optical fiber of the light source and the optical fiber for measurement are incorporated into the reflected light measurement probe, and the reflection spectrum measurement can be performed simply by fixing with a dedicated probe holder.

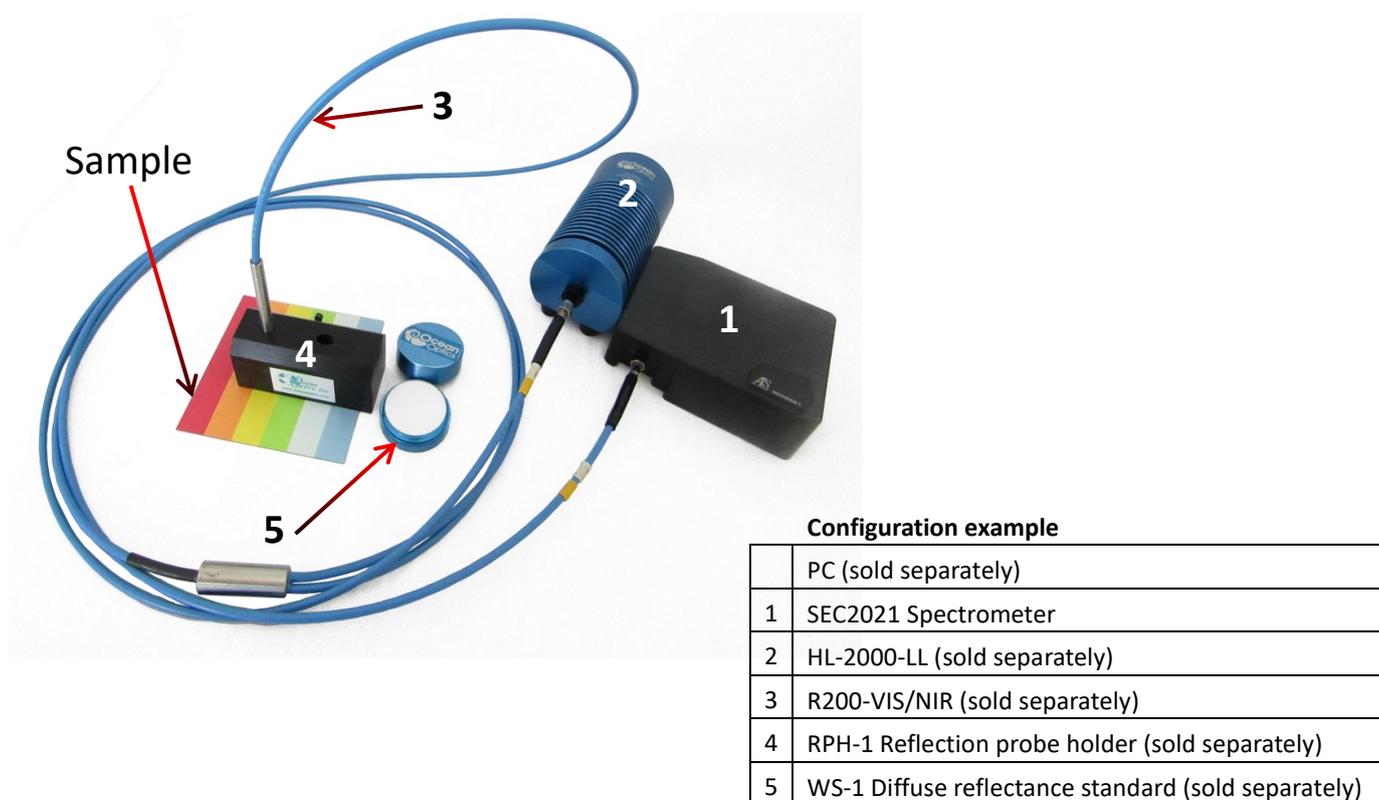


Figure 5-1 Reflectance measurement using reflection probe

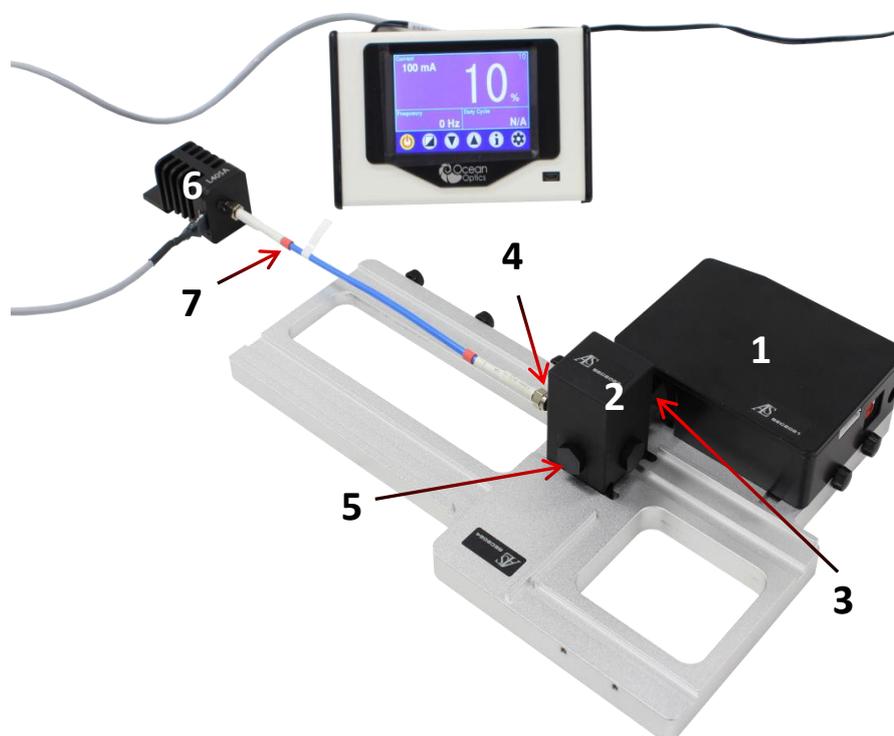
- ① Reflection probe has two branches which are connected to the spectrometer and light source, respectively.
- ② Warming up the light source in the same way as “4-1.Example 1. Using cuvette”.
- ③ Open the **SEC Spectra** software, open optical path and place the reflection probe holder on reflectance standard plate. Insert the probe into the hole drilled at 45 degrees, fix the probe tip to the position where the spectrum intensity is maximized, then acquire the reference spectrum*.
- ④ Close the optical path and acquire the dark spectrum*.
- ⑤ Open the optical path, place the probe holder on the sample to be measured, and start measurement.

*For the acquisition method, please refer to “SEC2020 SPECTROMETER SYSTEM USER'S GUIDE - SOFTWARE -”.

6. Instrument setting for fluorescence measurement

By irradiating and exciting the fluorescent sample with LED light, the irradiated weak fluorescence spectrum of the sample is detected at a 90 degree angle. In this case, a strong excitation light is required, so we recommend an optional high power LED light source.

6-1. Application example using high power LED



Configuration example

	PC (sold separately)
1	SEC2021 Spectrometer
2	SEC2023 Cuvette holder
3	Fiber collimator
4	SMA905 adaptor for light source or Collimating lens (sold separately)
5	SMA905 adaptor for light shielding or Mirror screw plug (sold separately)
6	LMS Series High power LED light source (sold deparately)
7	400-micron Fiber, solarization-resistant, 25 cm (sold deparately)

Figure 6-1 Fluorescence measurement using high power LED light source

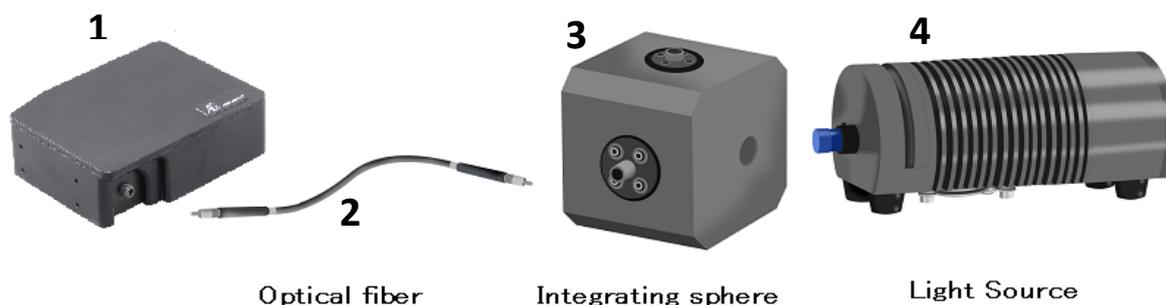
- ① The spectrometer and the light source are set as shown in Figure 6-1.
Set the fiber collimator to the cuvette holder and connect it to the spectrometer. And, then set it to the platform, and fix with the platform screws. In addition, attach the collimator lens or the SMA 905 adapter for light source to the cuvette holder optical path, at a 90 ° position, and connect the LED light source with a optical fiber. Attach the light shielding adapter to the remaining open optical path sides of the cuvette holder. Moreover, by preparing a mirror plug for fluorescence measurement in place of the light shielding adapter, it is possible to obtain greater fluorescence intensity.
- ② Turn on the LED light source and adjust the intensity.
- ③ Open the **SEC Spectra** software and set to the spectrum mode.
- ④ Set the solution containing the fluorescent substance in the cuvette holder and perform the Spectrum measurement*.
- ⑤ It is also possible to measure relative irradiance of the fluorescence by following the procedure for measuring relative irradiance. For the details, please refer to “7-2. Application example using a cuvette holder”.

*For the acquisition method, please refer to “SEC2020 SPECTROMETER SYSTEM USER'S GUIDE - SOFTWARE -”.

7. Instrument setting for Relative Irradiance measurement

Relative Irradiance measurement is a measurement method for confirming the spectral waveform and relative intensity of an emission sample such as LED, illumination, fluorescence, and electrochemical emission by referring to a light source with known color temperature. Like the transmittance, it is a method for evaluating the emission intensity distribution relative to the reference light source. In order to measure the relative irradiance, it is necessary to know the color temperature of the referenced light source. Commonly, a high power light source is used. The software automatically calculates the relative irradiance spectrum by measuring the reference source and the sample light, respectively.

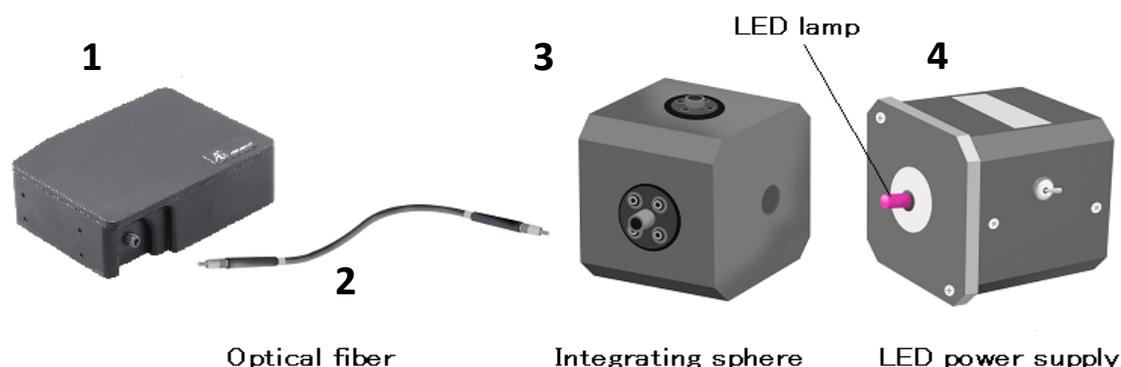
7-1. Application example using an integrating sphere



Configuration example

	PC (sold separately)
1	SEC2021 Spectrometer
2	QP400-2-UV/VIS 400 μ m optical fiber 2m (sold separately)
3	Integrating sphere (sold separately)
4	HL-2000-LL Tungsten Halogen Source (sold separately)

Figure 7-1 Relative Irradiance measurement of reference light source



Configuration example

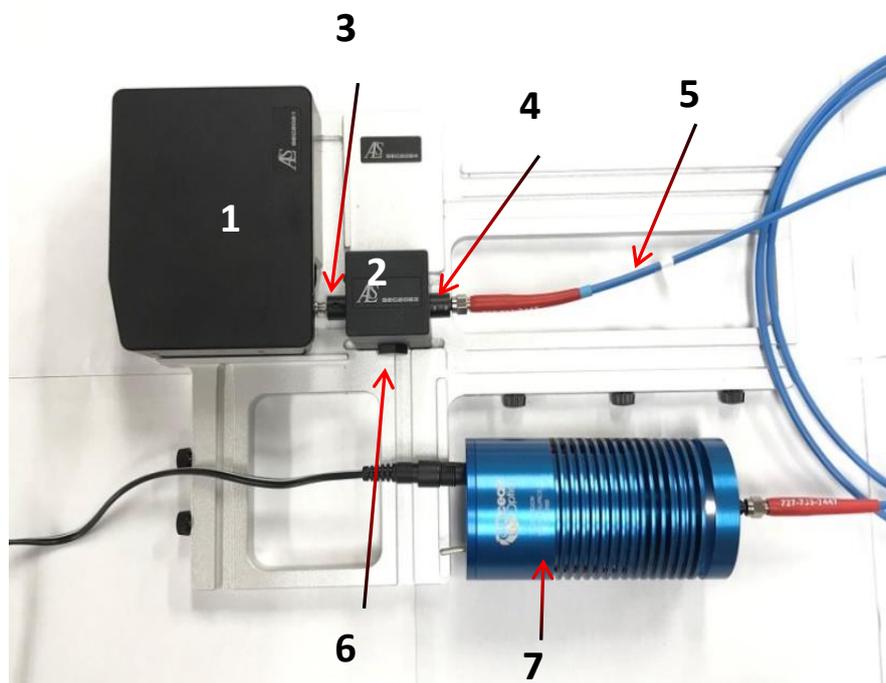
	PC (sold separately)
1	SEC2021 Spectrometer
2	QP400-2-UV/VIS 400 μ m optical fiber 2m (sold separately)
3	Integrating sphere (sold separately)
4	LED power supply (sold separately)

Figure 7-2 Relative Irradiance measurement of LED lamp

- ① First, as shown in Figure 7-1, connect the integrating sphere to the spectrometer by an optical fiber.
- ② Set the reference light source with known color temperature to the integrating sphere.
- ③ Start up the **SEC Spectra** software.
- ④ Enter the color temperature of the reference light source in the settings for relative irradiance measurement. The reference spectrum is acquired with the reference light source turned on, and the dark spectrum is acquired with the reference light source shielded*.
- ⑤ Remove the light source and set a sample LED on the integrating sphere to measure the relative irradiance, as shown in Figure 7-2.

*For the acquisition method, please refer to “SEC2020 SPECTROMETER SYSTEM USER’S GUIDE - SOFTWARE -”.

7-2. Application example using a cuvette holder



Configuration example

	PC (sold separately)
1	SEC2021 Spectrometer
2	SEC2023 Cuvette holder
3	Fiber collimator
4	SMA905 adaptor for light source or Collimator
5	P50-2-VIS/NIR 50 μ m optical fiber 2m (sold separately)
6	SMA905 adaptor for light shielding or Mirror screw plug (sold separately)
7	HL-2000-LL Tungsten Halogen Source (sold separately)

Figure 7-3 Relative Irradiance measurement of reference light source

- ① First, Set the fiber collimator to the cuvette holder and connect it to the spectrometer. And, then set it to the platform, and fix with the platform screws.
- ② In addition, attach the collimator lens or the SMA 905 adapter for light source to the cuvette holder optical path, at 180 ° position, and connect the reference light source with an optical fiber. Attach the light shielding adapter to the remaining two open optical path sides of the cuvette holder.

- ③ Start up the **SEC Spectra** software. Enter the color temperature of the reference light source in the settings for relative irradiance measurement. The reference spectrum is acquired with the reference light source turned on, and the dark spectrum is acquired with the reference light source shielded*.
- ④ Remove the light source and set sample into the cuvette holder. For fluorescence measurement, install an excitation light source at 90 ° position as show in “6-1. Application example using high power LED”. And turn on the light source to measure the relative irradiance of the sample. The fluorescence intensity distribution measured at this time is the corrected spectrum based on the reference light source.

*For the acquisition method, please refer to “SEC2020 SPECTROMETER SYSTEM USER'S GUIDE - SOFTWARE -”.

8. Synchronization with other instruments

The SEC20210 spectrometer system supports **Trigger Mode** for synchronized measurement with external device. Depending on the trigger mode, you can control data acquisition of SEC2021 spectrometer with external Input/Output signal. It is a function developed to synchronize spectroscopic measurement and time course measurement with external measurement.

8-1. Mode of operation

The **SEC Spectra** software controls the data acquisition in the following two ways by changing of the external TTL signal applied to the I/O port the SEC2021 spectrometer. In the case of "SW Level Trigger", the measurement starts when the external input TTL signal changes from Low level to High level, and stops when the external input TTL signal changes from High level to Low level. In the case of "SW continuous trigger", the measurement starts when the external input TTL signal changes from Low level to High level, but when it changes from High level to Low level, the measurement does not stop and it is designed to measure continuously until stopped by software.

By using trigger mode, if the external device is set to output the TTL signal at the same time as the (electrochemical) measurement starts, the SEC2021 spectrometer accept the input signal and will start the data acquisition at the same timing.

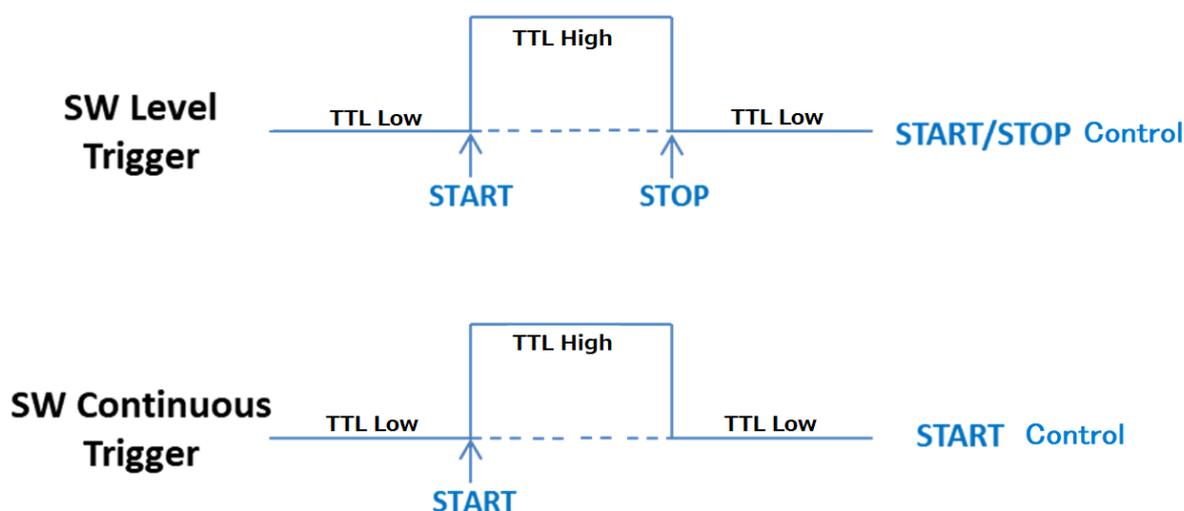
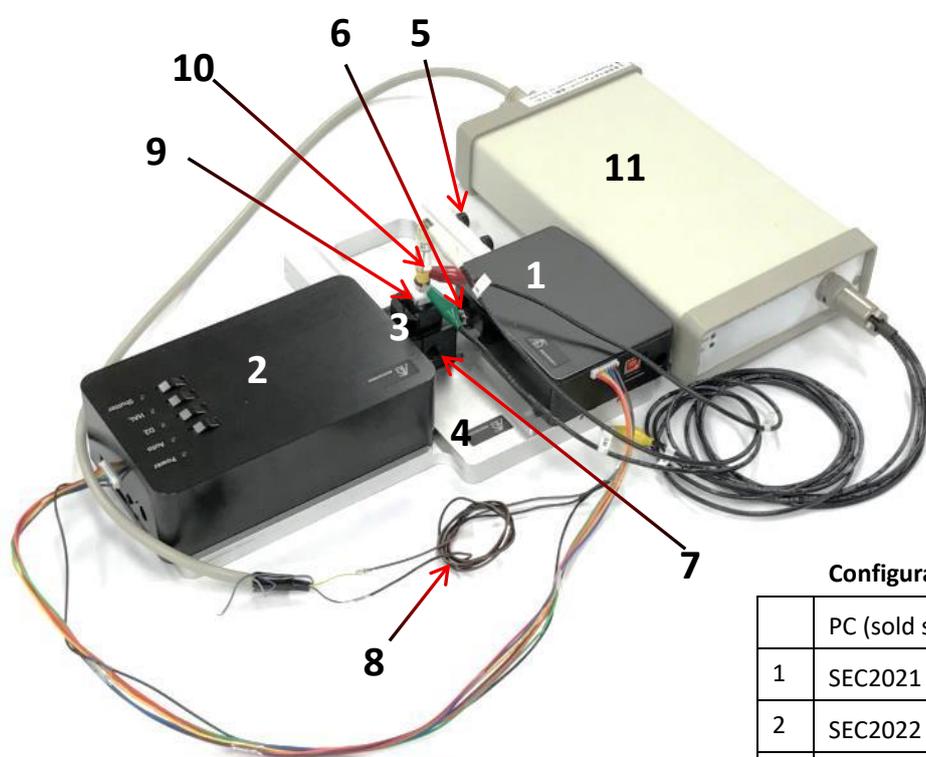


Figure 8-1 Trigger operation schematic of SEC Spectra

Note on signal voltage level: The digital input signal is at TTL level.

8-2. Application example of Spectroelectrochemical measurement in trigger mode

Spectroelectrochemical measurement is a measurement method that performs spectroscopic measurement and electrochemical measurement at the same time. This time, we will introduce an example of combination of time course of absorbance measurement and electrochemical measurement using Model 2325 Bi-Potentiostat shown in the figure below. Model 2325 dedicated software is used for electrochemical measurements and **SEC Spectra** software is used for spectroscopic measurements.



Configuration example

	PC (sold separately)
1	SEC2021 Spectrometer
2	SEC2022 Deuterium halogen light source
3	SEC2023 Cuvette holder
4	SEC2024 Platform
5	Platform screw
6	Fiber collimator
7	SMA905 adaptor for light shielding
8	Trigger/Light source control cable
9	SEC-CT Thin Layer Quartz Glass Spectro-electrochemical cell kit (Pt) (sold separately)
10	RE-1BP Reference electrode (Ag/AgCl) (sold separately)
11	Model2325 Bi-Potentiostat (sold separately)

Figure 8-2 Spectroelectrochemical measurement setup using Model 2325 Bi-potentiostat



Figure 8-3 SEC2021 trigger terminal

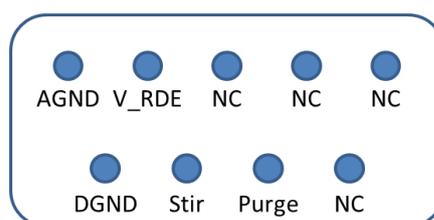


Figure 8-4 I/O port of Model 2325

Instrument settings

- ① First, connect the Trigger/Light source control cable to the SEC2021 spectrometer as shown in Figure 8-3. As shown in Figure 8-2, connect the Ground (GND) (black) and Trigger In (brown) terminals from the spectrometer to the potentiostat terminals, respectively. For Model 2325 Bi-Potentiostat, connect the DGND of the I/O port (Figure 8-4) on the back side of Model 2325 to the Ground terminal of SEC2021 spectrometer, and connect V_RDE to the Trigger In terminal.
- ② Turn on the power of the Model 2325 Bi-Potentiostat.

Caution: If you turn on the power of the Model 2325 Bi-Potentiostat before connecting the Trigger/Light source control cable, it will not work properly. Please be careful to turn on after setting the instrument.

Preparation for absorbance measurement

- ③ Since the absorbance will be measured, set the instrument in the same way as “4-1. Example 1. Using cuvette”. And warm up the light source.
- ④ As shown in Figure 8-2, set the reference solution in a dedicated quartz cuvette for spectroelectrochemical measurement and set it in the cuvette holder. Set the working electrode, counter electrode of the **Thin Layer Quartz Glass Spectroelectrochemical cell kit**, and a separate reference electrode in the quartz cuvette.
- ⑤ Start up the **SEC Spectra** software. Open the shutter and acquire the reference

spectrum*.

- ⑥ Close the shutter and acquire the dark spectrum*.
- ⑦ Open the shutter, replace the reference solution with the sample to be measured, set the electrodes and set the cuvette in the cuvette holder. Connect the cell cable from Model 2325 Bi-Potentiostat to the corresponding working, counter and reference electrode, respectively.

Preparation of trigger mode

- ⑧ Select “SW Level Trigger” or “SW Continuous Trigger” in the trigger setting of the **SEC Spectra** software, then the software goes into trigger mode and will be in measurement standby state.

Setting of time course measurement conditions

- ⑨ To measure the change of a specific wavelength, create a “Strip Chart” measurement of the **SEC Spectra** software and set the measurement conditions such as specific wavelength to be recorded in the settings*.
- ⑩ To measure the change of the spectrum in the entire wavelength range, return to the measurement target window you want to record in “Time Sequence” measurement (for example: Absorbance measurement) of the **SEC Spectra** software, and set the measurement conditions in “Time Sequence” measurement*. Press the recording start button.
- ⑪ When the above sequential settings are completed, the **SEC Spectra** software is ready for trigger measurement.

External device TTL signal output setting

- ⑫ Set the external device to output TTL High level signal during the measurement. In the case of Model 2325, open the “SETUP” screen of the dedicated software as shown in Figure 8-5, enter “Rotation speed (rpm)” of “RDE Setting” as 3000, check “Rotate RDE” under “During Run”, and click “OK”.

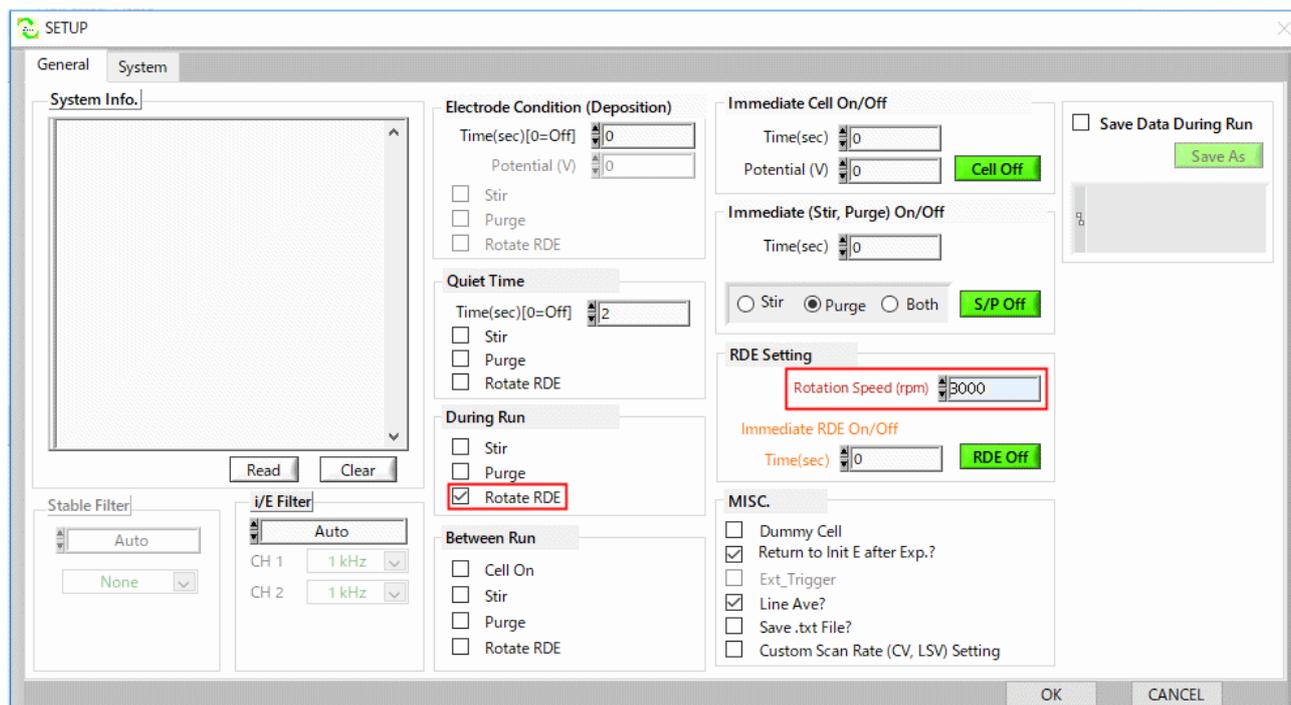


Figure 8-5 Model 2325 SETUP screen

Spectroelectrochemical measurement in trigger mode

- ⑬ By starting electrochemical measurement from the software of model 2325, the spectral signal on the **SEC Spectra** software screen starts to move in conjunction and the time course of absorbance is recorded according to the conditions set in steps ⑨ and ⑩.

Caution: Do not change the measurement screen or conditions during measurement.

- ⑭ When set to “SW Level Trigger”, absorbance measurement will stop automatically when the measurement of Model 2325 is completed. On the other hand, when “SW Continuous Trigger” is set, absorbance measurement will be stopped manually by the **SEC Spectra** software.
- ⑮ After stopping the measurement, you need to click on save icon in “Strip Chart” window to save the recording results. For "Time Sequence" measurement, the recorded results are saved in a preset folder.

*For the acquisition and setting method, please refer to “SEC2020 SPECTROMETER SYSTEM USER’S GUIDE - SOFTWARE -”.

9. EU Declaration of Conformity

EC DECLARATION OF CONFORMITY

Manufacturer's name: BAS Inc.
Manufacturer's address: 1-28-12, Mukojima, Sumida-ku, Tokyo,
131-0033, Japan
E-mail: sales@als-japan.com

Declare that the DoC is issued under our sole responsibility and belongs to the following product;

Product Name: UV/Visible Spectrometer system and accessories
Model Number: SEC2020
Serial Number: OS361AC55009057- OS361AC55009278
OS361AC55009059- OS361AC55010641
OS361AC55009064- OS361AC55009285

The object of the declaration described above is in conformity with the relevant union harmonization legislation;

EMC Directive 2014/30/EU
Low Voltage Directive(LVD) 2014/35/EU
Restriction of the use of certain hazardous substances(RoHS) 2011/65/EU

The following harmonised standards and technical specifications have been applied:

EN61326-1: 2013 Emission and Immunity Requirements
EN61010-1: 2010 + Corrigendum 1: 2011 Safety Requirements
EN61010-2-201: 2013 Safety Requirements
EN50581: 2012 RoHS Requirements

Tokyo, Japan Mar 8, 2018 Masao Asano *Masao Asano*
(Place) (Date of issues) name

10. Contact us

This is the SEC2020 Spectrometer System User's Guide - Device - Edition. If you have any technical problems or questions, please feel free to contact us.

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