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SM301/SM301-EX

User Manual



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Warranty and Liability

This SM product is warranted against defects in material and workmanship for a period of one year from the date of shipment. During the warranty period, Spectral Products will, without charge, repair or replace, at its discretion, the defective product, or components/parts.

For warranty service or repair, this product must be returned to a service facility designated by Spectral Products (SP). For products returned under warranty, the Buyer shall prepay shipping charges (including shipping charges, duties, and taxes for products returned to SP from another country), and SP will pay for shipping charges to return the product to the Buyer.

This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations, modifications, or repairs, if the serial number is altered, defaced, or removed, the improper or inadequate maintenance by the Buyer, Buyer-supplied software or interfacing, or improper site preparation or maintenance. No other warranty is expressed or implied. SP shall not be liable for any consequential damages, including without limitation, damages resulting from loss of use, as permitted by law.

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Product Description

The SM301/SM301-EX is a versatile, high performance PbS/PbSe array spectrometer.

Its active components include a TE cooler and a 256-element PbS/PbSe detector element array. Operation of the unit for research applications is easy with the included SM32Pro – Windows-based analysis software. The system is ideal for spectroscopic applications in the 1.0 to 3.0 micron (PbS) or 1.5 to 5.0 micron (PbSe) region.

The SM301/SM301-EX includes thermoelectric cooling to guarantee long-term operational stability. The SM301/SM301-EX employs a multiplexed PbS/PbSe array as its NIR detection element. The array is cooled, and the temperature is stabilized at around -15°C (down to -20°C at max) which ensures long-term operation stability. The dark signal can thus be automatically measured by the built-in electronics periodically and subtracted automatically.

Compared with conventional scanning NIR spectrometers the SM301/SM301-EX provides the multichannel detection advantage, both in reducing the measurement time and enhancing the measurement signal-to-noise ratio. The SM301/SM301-EX can operate at a readout rate of 2MHz or faster allowing fast measurement and averaging operations to be performed in a short time.

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Specifications

Physical Dimension	
Dimensions	6.81"X4.72"X3.86" (173mm x 120mm x 98.1mm)
Weight	5.5lbs (2.5kg)
Fiber Optic Connector	SMA905 N.A.=0.22 Optical Fiber Input
Detector	
Detector	SM301 : PbS Array
	SM301-EX : PbSe Array
Cooling	One Stage TE (thermo-electric) Cooling(-10°C)
Spectral Response Range	SM301 : ~1.0-3.0um
	SM301-EX : ~1.5-5.0um
Pixels	256
Pixel Size	40um X 450um (Pitch: 50um)
Optical Specification	
Wavelength Range	SM301 : ~1.0-3.0um / ~1.0-2.0um / ~1.5-3.0um
	SM301-EX : ~1.5-5.0um Standard
Optical Resolution	SM301 : ~20nm (1.0-3.0um) / ~10nm (1.0-2.0um) / ~15nm (1.5-3.0um)
	SM301-EX : ~25-30nm (1.5-5.0um)
Dark Noise RMS	~ 20 RMS counts in 16 bit (After Balancing)
Filter	None
Electrical Specification	
ADC resolution	16bit (0-65535)
Interface	USB 1.1/2.0 Compatible
Power Supply Input//Output	100-240Vac(47-63Hz) // 15.0Vdc & 1.6A
Computer	
Operating System	Windows 7/8.1/10 (32/64bit)
Software	SM32Pro (basic) & SMProMX (advanced)
Software Development Kit	Visual C++ DLL /LabVIEW VI SDK

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Items Included with Purchase

Ordering Information: Please indicate product number plus description when ordering

SM301 PbS NIR Spectrometer

SM301-EX PbSe MIR Spectrometer

- ☐ (1) SM301/SM301-EX SPECTROMETER
- ☐ (1) Power Supply wall charger [input: 100-240Vac, 47-63Hz, output: 15.0Vdc, 1.6A]
- ☐ (1) USB mini cable
- ☐ (2) USB drives containing SM32Pro and SMProMX software



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Software Installation

Please check with the SM32ProForSM301_Manual_2.1x.pdf for details regarding the SM32Pro software installation, and SMProMXv5.x.x_Manual.pdf for the SMProMX software installation.

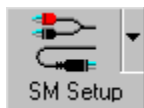
Initialization for SM301

In the case of SM301/SM301-EX, not like other SM series spectrometers, after installing the software, the user needs to check some parameters on the software before measuring data. The following checkpoints and steps are based on the **SM32Pro** software.

Check Points before measuring real data

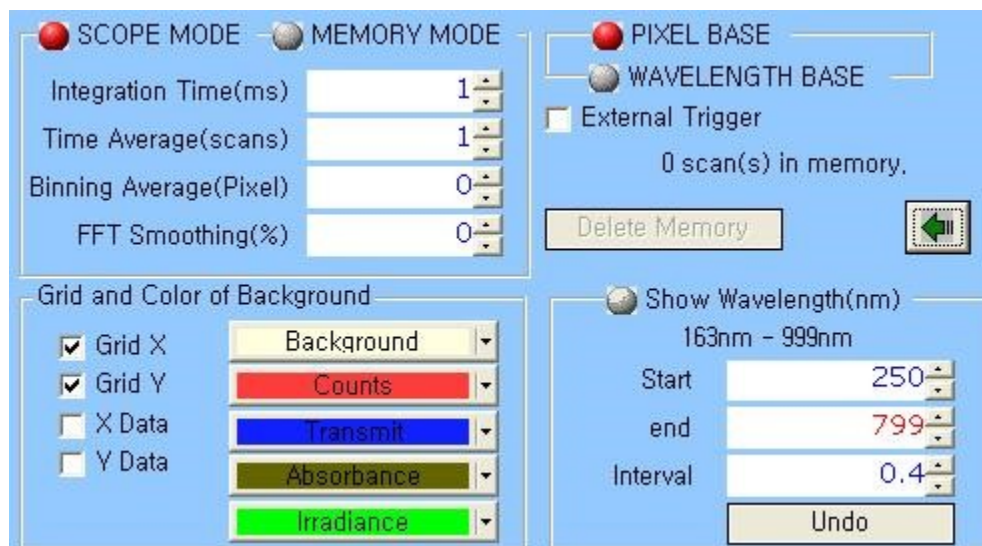
When running the software at first, the user should check the two important settings/configurations. In the **SM Setup**, the user should set proper values to show the spectral data as needed. The **Balance** has to be done first before measuring the real data and whenever any setting is changed.

2-1. SM Setup



The SM Setup function allows you to change operating parameters for the spectrometers. Clicking the top right arrow can activate the pulldown dialog boxes.

SM setup dialog box:



SCOPE MODE ☒ **MEMORY MODE** ☐

Integration Time(ms)

Time Average(scans)


Binning Average(Pixel)

FFT Smoothing(%)

PIXEL BASE ☒ **WAVELENGTH BASE** ☐

☐ External Trigger

0 scan(s) in memory.

Delete Memory 

Grid and Color of Background

☒ Grid X

☒ Grid Y

☐ X Data

☐ Y Data

Show Wavelength(nm) ☐

163nm - 999nm

Start

end

Interval

Undo

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SCOPE MODE is the default-operating mode, which enables the live updating of the measurements.

MEMORY MODE will be entered automatically when a playback operation is performed. The playback of recorded spectra can be achieved by using the **Import** command button. To exit the repeating playback of recorded spectra, the user needs to use this dialog box to change from **RECORD MODE** back to **SCOPE MODE**.

The **Integration Time** is to set the exposure time of the detector. It can be up to 200msec but we'd recommend <50msec at max starting from 1msec. The **Time Average** is to average the given number of scans. It helps to reduce the noise level. It would make the data reading slow but doesn't distort any spectral signal unless the data changes per time. The **Binning Average** is also used to reduce the noise by averaging the given number of neighbor pixels' values. The larger the value, the gentler the data is, but the data is distorted. In general, when there is a spectrum having a narrow bandwidth, data is severely distorted. In the case of a continuous wavelength light source having a wide bandwidth, the noise may be reduced. The **FFT Smoothing** is to reduce the noise in the translated frequency domain. As **Binning Average** increases, the spectrum of the form with narrow bandwidth is distorted. In general, dark noise can be significantly improved in continuous wavelength light sources with wide bandwidth.

When the **PIXEL BASE** display mode is selected, the wavelength display on X-axis will be supported in Scope Mode (*see also Graph Display Control Buttons* below) by clicking the "W" button on the Graph Display Control at the upper right corner of the main window. The **PIXEL BASE** displays the wavelengths on the X-axis per the detector pixels corresponding to appropriate modes. The wavelength increment is the actual wavelength difference between two adjacent detector pixels. If you'd like to show the spectral data from the whole detector pixels, the **PIXEL BASE** display mode has to be selected.

When **WAVELENGTH BASE** is enabled, the customized wavelength range can be set up in the extended dialog box (by clicking the green arrow button). The **Show Wavelength(nm)** can be enabled in this base. The **start** wavelength, the **end** wavelength, and the wavelength **interval** can be set up after activating the **Show Wavelength(nm)**. Those values must be located within the real full wavelength range shown right under the **Show Wavelength(nm)** button.

In the Grid and Color of Background pane, the color of each line and the graphic window background can be selected. The **Grid X** and/or the **Grid Y** are/is to present the scales on the coordinates. If the **X Data** and/or the **Y Data** are/are activated, the X and/or Y values will be displayed per the mouse pointer position on the graphic window.

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2-2. Balance of detector pixels



The detector should be balanced once at least, before doing the real optical measurements. It is also required to be done whenever the integration time or other configuration value was changed. Balancing the detector is used for setting a stable baseline. Without this “balancing”, the signal shown on the graph window is not reliable. The pull-down dialog box allows setting the TE Cooler On/Off option and the Charge of the Capacitor.

When you click the button, the internal shutter operates to create a dark condition and acquire Dark data. After the acquisition is completed, the shutter is opened again.

Balance dialog box:



TE Cooler OFF ☐ TE Cooler Error ☐
☐ TE Cooler Power ☐ TE Cooler Stable ☐
TE Cooler Temp. (deg C) Apply
Temperature stability information (mK)
-1592mK 3185mK
25.28 mK
TEC power dissipation (W)
0W 50W
0.06 W
Global Skim
☒ Without Global Skim ☐ With Global Skim
☐ Auto Global Skim
Balancing Charge Capacitor
TEC Monitor
STAB 25.276 mK VREF 2.473 V
ITEC -0.012 A VTEC -5.173 V
Samples/Reading

The TE Cooler can be turned on or off by selecting the **TE Cooler ON/TE Cooler OFF**. When the TE Cooler was on with no problem, the **TE Cooler Power** indicator will turn to “Green”. If the TE Cooler turns off, the indicator will turn to “Gray”. Once the TE Cooler becomes stabilized, the **TE Cooler Stable** indicator will turn to “Green”. If you change the **TE Cooler Temperature**, the **TE Cooler Stable** indicator will turn to Gray and turn back to Green when it’s stabilized. If there’s any potential problem occurs

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during the TE Cooling process, the **TE Cooler Error** indicator will turn to “Red”. And if the potential problem becomes the real problem, this indicator will stay “Red”. If not, it will turn back to “Gray”.

The user can define the target temperature of the TE Cooler by putting the target temperature at the “**TE Cooler Temp. (deg C)**” and clicking the “**Apply**” button. The available TE Cooler temperature is from -20 deg Celsius to +20 deg Celsius and the recommended value is “-10 deg Celsius”. Depending on the ambient temperature, the user may need to adjust this temperature. At cool ambient conditions, the user can lower the TE Cooler temperature, which will make the signal more stable, and vice versa. If the TE Cooler temperature was set too low compared to the ambient temperature, the TE Cooler may fail to reach the target temperature, and then it will turn off automatically and give the “**TE Cooler Error**” message.

The **TE Cooler Temperature Offset Indicator (mC)** shows how much the temperature on the TE Cooled detector offset from the target TE Cooler temperature. It has to stay in the middle of the indicating bar with a small offset temperature. It is not the “real value” but just a theoretical value based on the feedback information from the TE Cooler. When the TE Cooler turns off, it may give some unrealistic negative/positive values.

The **TE Cooler Power Indicator (W)** shows the currently consuming power of the TE Cooler and can be a good indicator of how well the TE Cooler temperature was set for the current ambient temperature. If it shows too high, it means the TE Cooler temperature was set too low compared with the ambient temperature, and vice versa. The ideal maximum consumption power is 10W but if it becomes over 5W and stays for a while then the TE Cooler will turn off with an error. Empirically, it is recommended to set the TE Cooler temperature to make this **TE Cooler Power Indicator** at 1W around (+/-30%).

The capacitor charge value for balancing the detector can be set by choosing the value from the **Charge Capacitor** combo box. 1pF, 4pF, 7pF, 10pF, 11pF, 14pF, 17pF and 20pF are available. For noise purposes, it would be desirable to make the sample capacitor larger, but that might result in an unacceptable loss of signal during the charge sharing. The default value is 4pF or 7pF for the PbSe array detector and 7pF or 10pF for the PbS array detector.

The Global Skim selection is to set whether to use global dark current subtraction or not. The default is “**Without Global Skim**” and it is strongly recommended to use this one in general situations. Using “**With Global Skim**” will add a small amount of noise to the overall pixel noise. The “**With Global Skim**” option is provided for the cases where the per-pixel correction (balancing) circuits within the readout integrated circuit cannot converge properly due to too high of detector dark current which is rarely encountered and only happens with extremely low impedance detectors or very high operating temperatures with extended integration times. If any of these cases happen and it’s needed to use the Global Skim, “**Auto Global Skim**” is strongly recommended although it takes a much longer time for the balancing.

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When the **TE Cooler Stable** indicator turns to “Green”, the “**Balancing**” button will be activated. Then the user can start the detector (dark) balancing by clicking this button. The mechanical shutter in the spectrometer will automatically block the input light. After the balance, the result (test signal) will be shown in the graphic panel in this window, and it should be close to FLAT. If there are some strange/large peaks or valleys in the resulting curve, this means that at some pixels the dark level conditions were over their tolerances. In this case, you should redo the balance after changing the “charge capacitor” value and/or integration time until you get the resulting curve close to FALT.

At the bottom of the TEC Monitor, you can monitor the status of the TEC device.

ITEC – a voltage related to the current in the TE element

TMON – a voltage that provides temperature stability information

VTEC – a voltage related to the voltage across the TE element

VREF – the internal reference voltage for the TE controller

***NOTE:** Before doing the real optical measurements, this Balancing must be executed at least once. The spectrum signal without the balancing is not the real data. Also, whenever any parameter like integration time is changed, it should be executed to balance the detector in the dark condition again. The internal shutter will be closed to block any input light to make the dark condition when the Balance begins and then opened when it ends, automatically.

Run SM32Pro

Once you finish the Balance, the baseline should be at ~7000 counts. In the case of the PbSe detector, the detector material itself has Piezo-electric properties. Because the material resistance keeps changing as the current keeps flowing, the baseline of the detector keeps drifting over time. Users can notice that after balancing the baseline goes up slowly as time goes by. Before measuring important data, Balancing is strongly recommended. PbS doesn't have this issue but if the baseline becomes “noisier” after a certain time, then “Balancing” is recommended.

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External Trigger Mode

SM301-EX supports External Trigger Mode and can operate in synchronization with external events. In External Trigger Mode, connect an external trigger device to the rear panel of the spectrometer and send a TTL signal to the spectrometer to begin the measurement. External Trigger Input Connector uses Mini SMB type. You can purchase Mini SMB Type cable separately.

1. SM301-EX Backside Panel

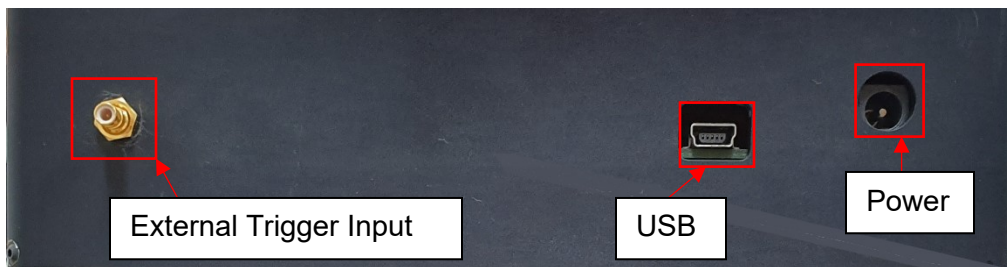
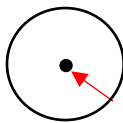


Figure 1. SM301-EX Backside Panel



Connector Part Number: J719-ND

Type: Mini SMB
External Trigger Input

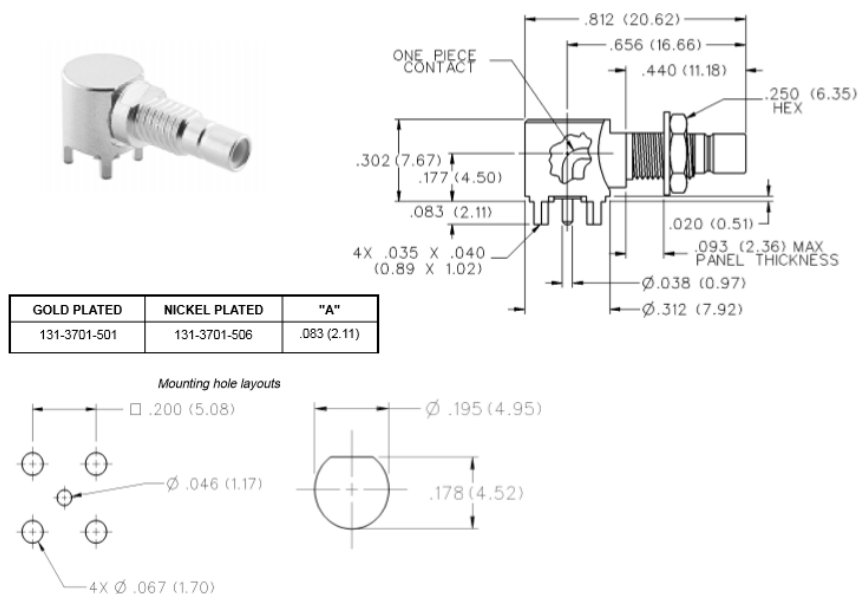


Figure 2. External Trigger Input Connector Drawing

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2. Trigger Input TTL Signal

Input signal recognition mode of External Trigger mode is Falling Edge and Rising Edge mode.

Falling Edge mode is when the TTL signal changes from High (5V) → Low (0V).

Rising Edge mode recognizes when the TTL signal changes from Low (0V) → High (5V).

A. Falling Edge



Figure 3. Falling Edge TTL Input

B. Rising Edge

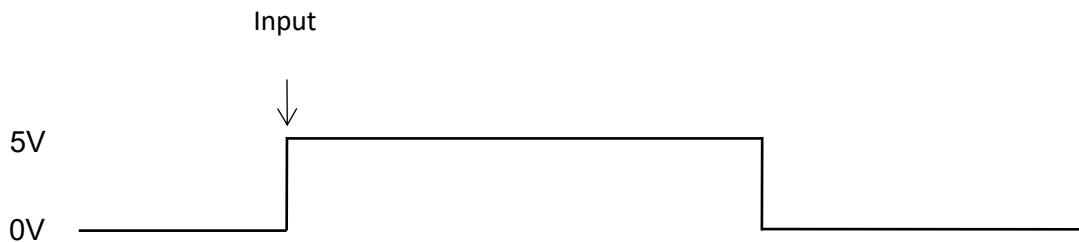


Figure 4. Rising Edge TTL Input

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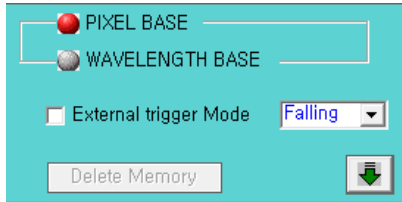
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3. Software Settings API Functions

A. SM32ProForSM301R6



You can set External Trigger Mode with this button.



After checking and setting the external trigger mode, the SM301-EX will wait until the trigger is inputted. To set internal trigger mode again, uncheck the box.

External Trigger Mode Related API Functions

`spSetExtTrgMode()` : Enables or disables External Trigger mode

`spConfigTrigger()` : Trigger Input Detection Mode setting

`spConfigTriggerDelay()` : TTL signal input time out setting

See the example SDK code and SDK for SM301-EX Manual for details on using the function.

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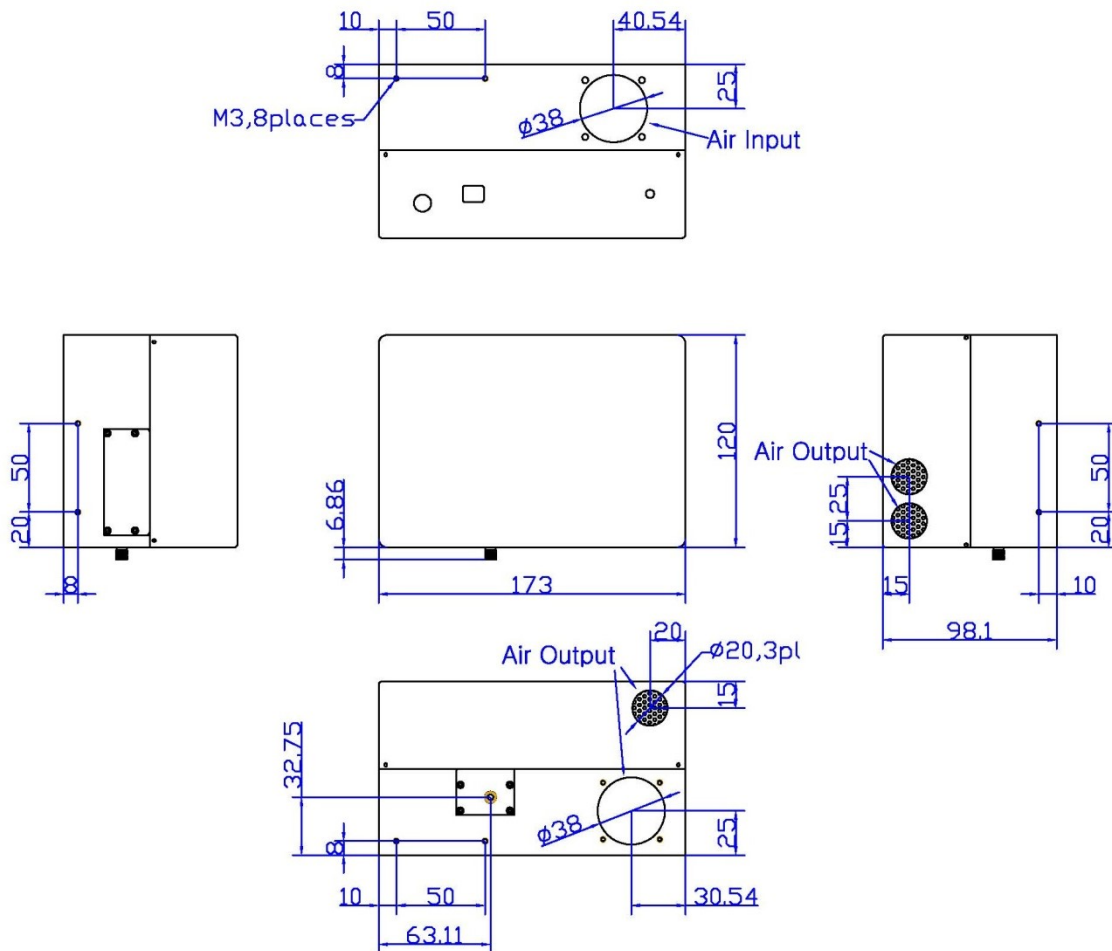
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SM301-EX Dimensions



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Website: <http://www.spectralproducts.com>

Email: support@spectralproducts.com

To help us serve you most efficiently, please collect some information for us before you call:

1. A detailed description of your problem
2. The specific error or error message you received
3. Your system information;
 - a. Software version
 - b. A version of Windows (98, ME, 2000, NT, XP, etc.)
 - c. Unit Serial Number

Our technical staff can be most effective if you are sitting at the computer while consulting technical support.