apogee®

INSTRUMENTS

OWNER'S MANUAL

ULTRAVIOLET INDEX & ULTRAVIOLET-B SENSOR

Models SU-321

Rev: 9-Jan-2024

APOGEE INSTRUMENTS, INC. | 721 WEST 1800 NORTH, LOGAN, UTAH 84321, USA
TEL: (435) 792-4700 | FAX: (435) 787-8268 | WEB: APOGEEINSTRUMENTS.COM

TABLE OF CONTENTS

CERTIFICATE OF COMPLIANCE

EU Declaration of Conformity

This declaration of conformity is issued under the sole responsibility of the manufacturer:

Apogee Instruments, Inc.
721 W 1800 N
Logan, Utah 84321
USA

for the following product(s):

Models: SU-321
Type: Ultraviolet Index and Ultraviolet-B Sensor

The object of the declaration described above is in conformity with the relevant Union harmonization legislation:

2014/30/EU	Electromagnetic Compatibility (EMC) Directive
2011/65/EU	Restriction of Hazardous Substances (RoHS 2) Directive
2015/863/EU	Amending Annex II to Directive 2011/65/EU (RoHS 3)

Standards referenced during compliance assessment:

EN 61326-1:2013	Electrical equipment for measurement, control, and laboratory use – EMC requirements
EN 63000:2018	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Please be advised that based on the information available to us from our raw material suppliers, the products manufactured by us do not contain, as intentional additives, any of the restricted materials including lead (see note below), mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), polybrominated diphenyls (PBDE), bis (2-ethylhexyl) phthalate (DEHP), butyl benzyl phthalate (BBP), dibutyl phthalate (DBP), and diisobutyl phthalate (DIBP). However, please note that articles containing greater than 0.1 % lead concentration are RoHS 3 compliant using exemption 6c.

Further note that Apogee Instruments does not specifically run any analysis on our raw materials or end products for the presence of these substances, but we rely on the information provided to us by our material suppliers.

Signed for and on behalf of:
Apogee Instruments, January 2024

Bruce Bugbee
President
Apogee Instruments, Inc.

CE

CERTIFICATE OF COMPLIANCE

UK Declaration of Conformity

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Apogee Instruments, Inc.
721 W 1800 N
Logan, Utah 84321
USA

for the following product(s):

Models: SU-321
Type: Ultraviolet Index and Ultraviolet-B Sensor

The object of the declaration described above is in conformity with the relevant UK Statutory Instruments and their amendments:

2016 No. 1091	The Electromagnetic Compatibility Regulations 2016
2012 No. 3032	The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

Standards referenced during compliance assessment:

BS EN 61326-1:2013	Electrical equipment for measurement, control, and laboratory use – EMC requirements
BS EN 63000:2018	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

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UK CA

INTRODUCTION

Ultraviolet (UV) radiation constitutes a portion of the electromagnetic spectrum from 100 to 400 nm and is further subdivided into three wavelength ranges: UV-A (315 to 400 nm), UV-B (280 to 315 nm), and UV-C (100 to 280 nm). Much of the UV-B and all the UV-C wavelengths from the sun are absorbed by Earth's atmosphere. There are also multiple artificial UV light sources available.

Most UV sensors designed for sunlight measurements are sensitive to UV radiation in the UV-A or UV-B ranges. Apogee Instruments SU-300 series UV-I/UV-B sensors detect UV radiation from 270 to 315 nm and are calibrated to output UV Index measurements. UV Index is a relative metric that scales with the intensity of UV radiation that causes sunburn in humans. Measured UV Index can be converted to energy flux density units of watts per square meter (W m^{-2}, equal to Joules per second per square meter) or photon flux density units of micromoles per square meter per second (µmol m^{-2} s^{-1}).

Typical applications of UV-I/UV-B sensors include incoming UV radiation measurement in outdoor environments, aimed at informing people of potential for UV exposure and sunburn, or in laboratory use with artificial radiation sources (e.g., germicidal lamps).

Apogee Instruments SU-300 series UV-I/UV-B sensors consist of a sintered quartz diffuser, photodiode, and signal processing circuitry mounted in an anodized aluminum housing and a cable to connect the sensor to a measurement device. SU-300 sensors are designed for continuous UV-I/UV-B radiation measurement in indoor or outdoor environments. The SU-300 series outputs an analog voltage that is directly proportional to UV-I/UV-B radiation incident on a planar surface (does not have to be horizontal) where the radiation emanates from all angles of a hemisphere.

SENSOR MODELS

This manual covers the SDI-12 protocol model SU-321 UV-I/UV-B sensor (listed in bold below). Additional models are covered in their respective manuals.

Model	Signal
SU-300	0-2 mV
SU-321	**SDI-12**

The model number and serial number are located on the bottom of the sensor. If manufacturing date of a sensor is required, please contact Apogee Instruments with the serial number of the sensor.

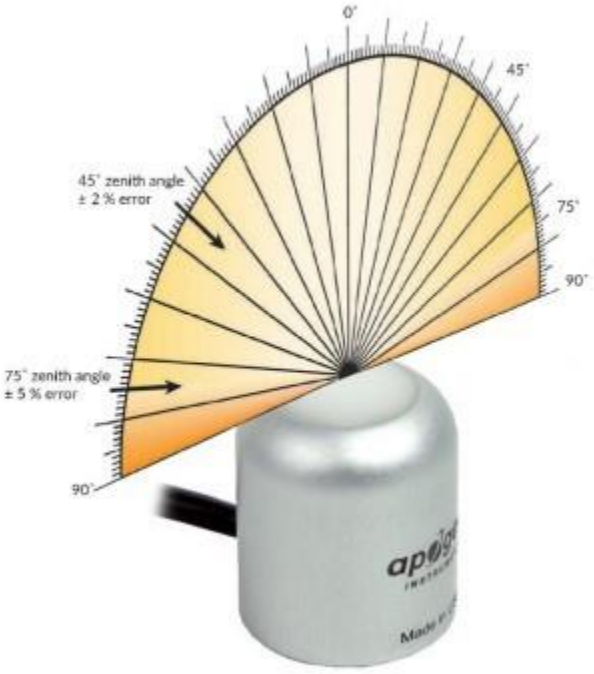
SPECIFICATIONS

	SU-321-SS
Power Supply	5.5 to 24 V DC
Current Draw	1.4 mA (quiescent), 1.8 (active)
Calibration Factor	Custom for each sensor and stored in the firmware
Calibration Uncertainty	± 10 %
Measurement Range	0 to 20 UV Index
Measurement Repeatability	Less than 0.5 %
Long-term Drift	Less than 5 % per year
Non-linearity	Less than 1 %
Response Time	0.6 s, time for detector signal to reach 95 % following a step change; fastest data transmission rate for SDI-12 circuitry is 1 s
Field of View	180°
Spectral Range	270 to 315 nm (wavelengths where response is greater than 50 % of maximum; see Spectral Response on page 9)
Directional (Cosine) Response	± 2 % at 45°, ± 5 % at 75°
Temperature Response	Less than 0.1 % per C
Operating Environment	-30 to 85 C; 0 to 100 % relative humidity
Dimension	30.5 mm diameter, 37 mm height
Mass (5 m of cable)	140 g
Cable	5 m of shielded, twisted-pair wire; TPR jacket (high water resistance, high UV stability, flexibility in cold conditions); pigtail lead wires; stainless steel (316), M8 connector

Calibration Traceability

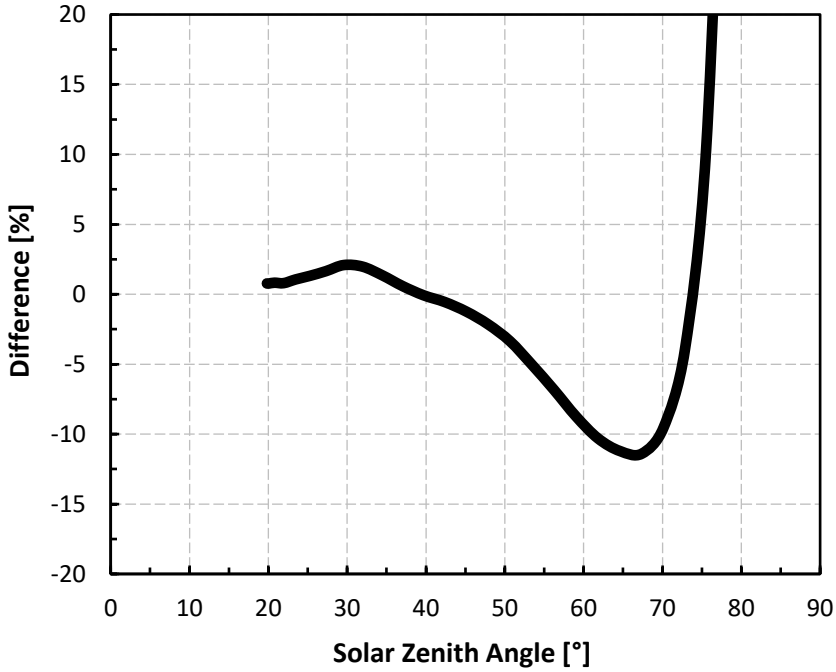
Apogee UV-I/UV-B series sensors are calibrated through side-by-side comparison to the mean of four transfer standard UV-I/UV-B sensors under spectroradiometer under sunlight (clear sky conditions) in Logan, Utah. The transfer standard UV-I/UV-B sensors are calibrated through side-by-side comparison to an Apogee model PS-300 spectroradiometer under sunlight (clear sky conditions) in Logan, Utah. The PS-300 is calibrated with a quartz halogen lamp traceable to the National Institute of Standards and Technology (NIST).

Cosine Response



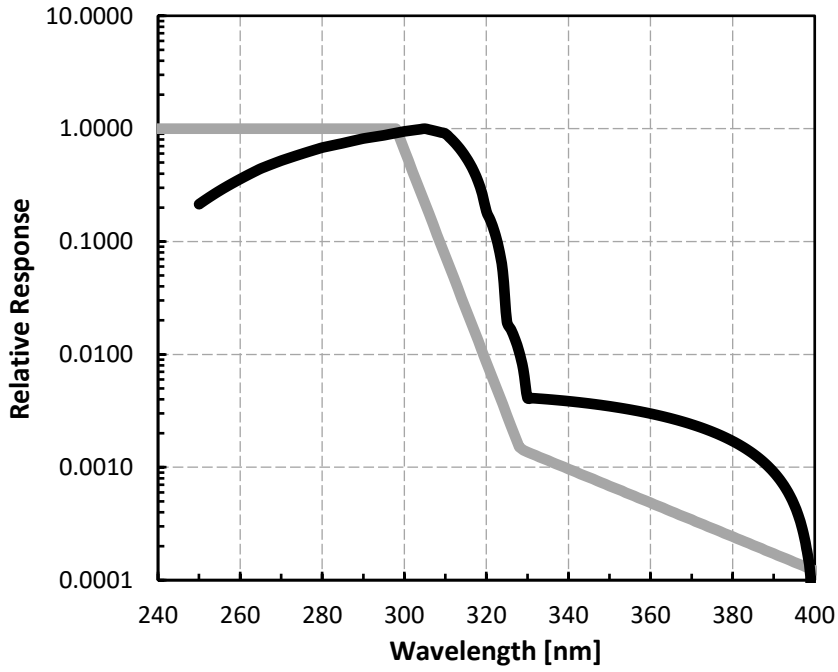
Directional, or cosine, response is defined as the measurement error at a specific angle of radiation incidence. Directional error for Apogee SU-300 series UV-I/UV-B sensors is approximately ± 2 % and ± 5 % at solar zenith angles of 45° and 75°, respectively.

Cosine Response Graph



Mean cosine response of four Apogee UV-I/UV-B sensors. Cosine response was calculated as the relative difference of UV-I/UV-B sensors from a reference UV-I/UV-B sensor deployed outdoors. These data are the average of the AM and PM response.

Spectral Response



Spectral response estimate of Apogee SU-300 UV-I/UV-B sensors. Spectral response was modeled from sensitivity of the photodetector and transmittance of the diffuser. Gray line is the Erythemal Action Spectrum and provides a relative indication of skin damage caused by UV radiation.

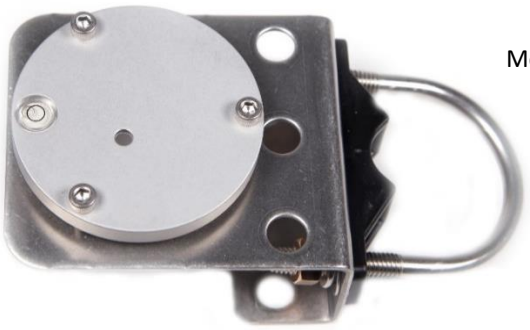
DEPLOYMENT AND INSTALLATION

Mount the sensor to a solid surface with the nylon mounting screw provided. To accurately measure UV-I/UV-B incident on a horizontal surface, the sensor must be level. An Apogee Instruments model AL-100 Leveling Plate is recommended to level the sensor when used on a flat surface or being mounted to surfaces such as wood. To facilitate mounting on a mast or pipe, the Apogee Instruments model AL-120 Solar Mounting Bracket with Leveling Plate is recommended.

Nylon Screw: 10-32x3/8

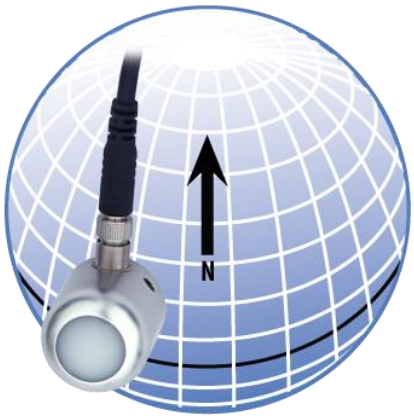
Model AL-100

Nylon Screw: 10-32x3/8



Model AL-120

To minimize azimuth error, the sensor should be mounted with the cable pointing toward true north in the northern hemisphere or true south in the southern hemisphere. Azimuth error is typically less than 1 %, but it is easy to minimize by proper cable orientation.



In addition to orienting the cable to point toward the nearest pole, the sensor should also be mounted such that obstructions (e.g., weather station tripod/tower or other instrumentation) do not shade the sensor. **Once mounted, the black cap should be removed from the sensor.** The black cap can be used as a protective covering for the sensor when it is not in use.

CABLE CONNECTORS

Apogee sensors offer cable connectors to simplify the process of removing sensors from weather stations for calibration (the entire cable does **not** have to be removed from the station and shipped with the sensor).

The ruggedized M8 connectors are rated IP68, made of corrosion-resistant marine-grade stainless-steel, and designed for extended use in harsh environmental conditions.

Cable connectors are attached directly to the head.

Instructions

Pins and Wiring Colors: All Apogee connectors have six pins, but not all pins are used for every sensor. There may also be unused wire colors inside the cable. To simplify datalogger connection, we remove the unused pigtail lead colors at the datalogger end of the cable.

If a replacement cable is required, please contact Apogee directly to ensure ordering the proper pigtail configuration.

A reference notch inside the connector ensures proper alignment before tightening.

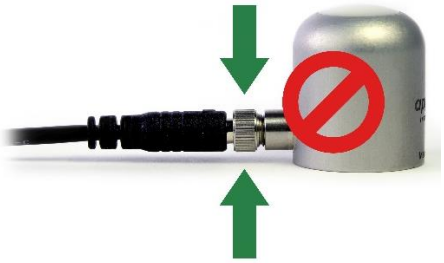
Alignment: When reconnecting a sensor, arrows on the connector jacket and an aligning notch ensure proper orientation.

Disconnection for extended periods: When disconnecting the sensor for an extended period of time from a station, protect the remaining half of the connector still on the station from water and dirt with electrical tape or other method.

When sending sensors in for calibration, only send the sensor head.

Tightening: Connectors are designed to be firmly finger-tightened only. There is an o-ring inside the connector that can be overly compressed if a wrench is used. Pay attention to thread alignment to avoid cross-threading. When fully tightened, 1-2 threads may still be visible.

WARNING: Do **not** tighten the connector by twisting the black cable or sensor head, only twist the metal connector (green arrows).

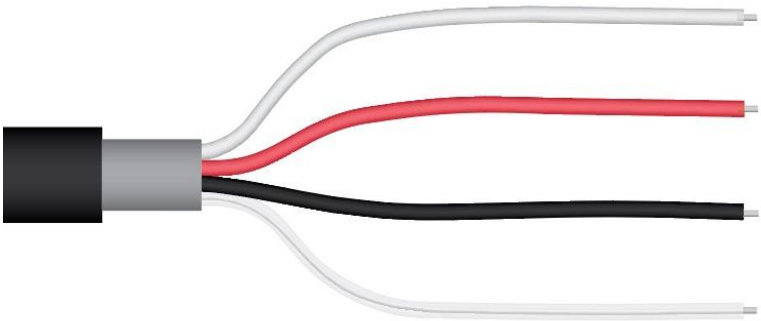


Finger-tighten firmly

OPERATION AND MEASUREMENT

The SU-321 UV-I/UV-B sensor has an SDI-12 output; UV radiation is returned in digital format. Measurement of SU-321 UV-I/UV-B sensors require a measurement device with SDI-12 functionality that includes the M or C command.

Wiring for SU-321



White: Positive (signal from sensor)

Red: Input Power

Black: Ground (from sensor signal and output power)

Clear: Shield/Ground

Sensor Calibration

The SU-321 UV-A sensor has sensor-specific calibration coefficients determined during the custom calibration process. Coefficients are programmed into the microcontrollers at the factory.

Sensor Noise Reduction

To reduce noise in the signal, Apogee recommends enabling averaging of 10 measurements in the sensor. For more information on how to enable measurement averaging, see the Running Average Command section.

SDI-12 Interface

The following is a brief explanation of the serial digital interface SDI-12 protocol instructions used in Apogee SU-321 UV-I/UV-B sensors. For questions on the implementation of this protocol, please refer to the official version of the SDI-12 protocol: http://www.sdi-12.org/specification.php (version 1.4, August 10, 2016).

Overview

During normal communication, the data recorder sends a packet of data to the sensor that consists of an address and a command. Then, the sensor sends a response. In the following descriptions, SDI-12 commands and responses are enclosed in quotes. The SDI-12 address and the command/response terminators are defined as follows:

Sensors come from the factory with the address of "0" for use in single sensor systems. Addresses "1 to 9" and "A to Z", or "a to z", can be used for additional sensors connected to the same SDI-12 bus.

"!" is the last character of a command instruction. In order to be compliant with SDI-12 protocol, all commands must be terminated with a "!". SDI-12 language supports a variety of commands. Supported commands for the Apogee Instruments SU-221 UV-A sensors are listed in the following table ("a" is the sensor address. The following ASCII Characters are valid addresses: "0-9" or "A-Z").

Supported Commands for Apogee Instruments SU-321 UV-I/UV-B Sensor

Instruction Name	Instruction Syntax	Description
Send Identification Command	aI!	Send identification information
Measurement Command	aM!	Tells the sensor to take a measurement
Measurement Command w/ Check Character	aMC!	Tells the sensor to take a measurement and return it with a check character
Change Address Command	aAb!	Changes the address of the sensor from a to b
Concurrent Measurement Command	aC!	Used to take a measurement when more than one sensor is used on the same data line
Concurrent Measurement Command w/ Check Character	aCC!	Used to take a measurement when more than one sensor is used on the same data line. Data is returned with a check character.
Address Query Command	?!	Used when the address is unknown to have the sensor identify its address
Get Data Command	aD0!	Retrieves the data from a sensor
Running Average Command	aXAVG!	Returns or sets the running average for measurements

Make Measurement Command: M!

The make measurement command signals a measurement sequence to be performed. Data values generated in response to this command are stored in the sensor's buffer for subsequent collection using “D” commands. Data will be retained in sensor storage until another “M”, “C”, or “V” command is executed. M commands are shown in the following examples:

Command	Response	Response to 0D0!
aM! or aM0!	a0011<cr><lf>	Returns UV Index
aM1!	a0011<cr><lf>	Returns watts
aM2!	a0011<cr><lf>	Returns detector millivolts
aM3!	a0011<cr><lf>	Returns µmol
aM4!	a0011<cr><lf>	Returns angle offset from vertical in degrees. (0 degrees if pointed up, 180 degrees if pointed down.)

where a is the sensor address (“0-9”, “A-Z”, “a-z”) and M is an upper-case ASCII character.

The data values are separated by the sign “+”, as in the following example (0 is the address):

Command	Sensor Response	Sensor Response when data is ready
0M0!	00011<cr><lf>	0<cr><lf>
0D0!	+3.0<cr><lf>	
0M1!	00011<cr><lf>	0<cr><lf>
0D0!	+30.0<cr><lf>	
0M2!	00011<cr><lf>	0<cr><lf>
0D0!	+6.0<cr><lf>	
0M3!	00011<cr><lf>	0<cr><lf>
0D0!	+12.0<cr><lf>	
0M4!	00011<cr><lf>	0<cr><lf>
0D0!	0+90.2<cr><lf>	

where 3.0 is the UV Index, 30.0 is watts, 1.0 is mV, and 20.0 is µmol.

Concurrent Measurement Command: aC!

A concurrent measurement is one which occurs while other SDI-12 sensors on the bus are also making measurements. This command is similar to the “aM!” command, however, the nn field has an extra digit and the sensor does not issue a service request when it has completed the measurement. Communicating with other sensors will NOT abort a concurrent measurement. Data values generated in response to this command are stored in the sensor's buffer for subsequent collection using “D” commands. The data will be retained in the sensor until another “M”, “C”, or “V” command is executed:

Command	Response	Response to 0D0!
aC! or aC0!	a00101<cr><lf>	Returns UV Index
aC1!	a00101<cr><lf>	Returns watts
aC2!	a00101<cr><lf>	Returns detector millivolts
aC3!	a00101<cr><lf>	Returns µmol
aC4!	a00101<cr><lf>	Returns angle offset from vertical in degrees. (0 degrees if pointed up, 180 degrees if pointed down.)

where a is the sensor address (“0-9”, “A-Z”, “a-z”, “*”, “?”) and C is an upper-case ASCII character.

For example (0 is the address):

Command	Sensor Response
0C0!	000101<cr><lf>
0D0!	+3.0<cr><lf>
0C1!	000101<cr><lf>
0D0!	+30.0<cr><lf>
0C2!	000101<cr><lf>
0D0!	+6.0
0C3!	000101<cr><lf>
0D0!	+12.0<cr><lf>
0C4!	000101<cr><lf>
0D0!	0+90.2<cr><lf>

where 3.0 is the UV Index, 30.0 is watts, 1.0 is mV, and 20.0 is µmol.

Change Sensor Address: aAn!

The change sensor address command allows the sensor address to be changed. If multiple SDI-12 devices are on the same bus, each device will require a unique SDI-12 address. For example, two SDI-12 sensors with the factory address of 0 requires changing the address on one of the sensors to a non-zero value in order for both sensors to communicate properly on the same channel:

Command	Response	Description
aAb!	b<cr><lf>	Change the address of the sensor

where a is the current (old) sensor address (“0-9”, “A-Z”), A is an upper-case ASCII character denoting the instruction for changing the address, b is the new sensor address to be programmed (“0-9”, “A-Z”), and ! is the standard character to execute the command. If the address change is successful, the datalogger will respond with the new address and a <cr><lf>.

Send Identification Command: aI!

The send identification command responds with sensor vendor, model, and version data. Any measurement data in the sensor's buffer is not disturbed:

Command	Response	Description
"aI!"	a14Apogee SU-221vvvByyxx…xx<cr><lf>	The sensor serial number and other identifying values are returned

where a is the sensor address (“0-9”, “A-Z”, “a-z”, “*”, “?”), 421 is the sensor model number, vvv is a three-character field specifying the sensor firmware version, Byy is the hardware version, and xx...xx is serial number.

Running Average Command

The running average command can be used to set or query the number of measurements that are averaged together before returning a value from a M! or MC! command. For example, if a user sends the command “0XAVG10!” to sensor with address 0, that sensor will average 10 measurements before sending the averaged value to the logger. To turn off averaging, the user should send the command “*a*XAVG1!” to the sensor. To query the sensor to see how many measurements are being averaged, send the command “*a*XAVG!” and the sensor will return the number of measurements being averaged (see table below). The default for sensors is to have averaging turned off.

Command Name	Characters Sent	Response	Explanation
Query running Average	*a*XAVG!	*An*	*a* = sensor address, *n* = number of measurements used in average calculation. Note: *n* may be multiple digits
Set running Average	*a*XAVG*nn*!	*A*	*a* = sensor address, n = number of measurements to be used in average calculation. Note: *n* may be any value from 1 to 100.

UV-I/UV-B Measurements and Spectral Errors

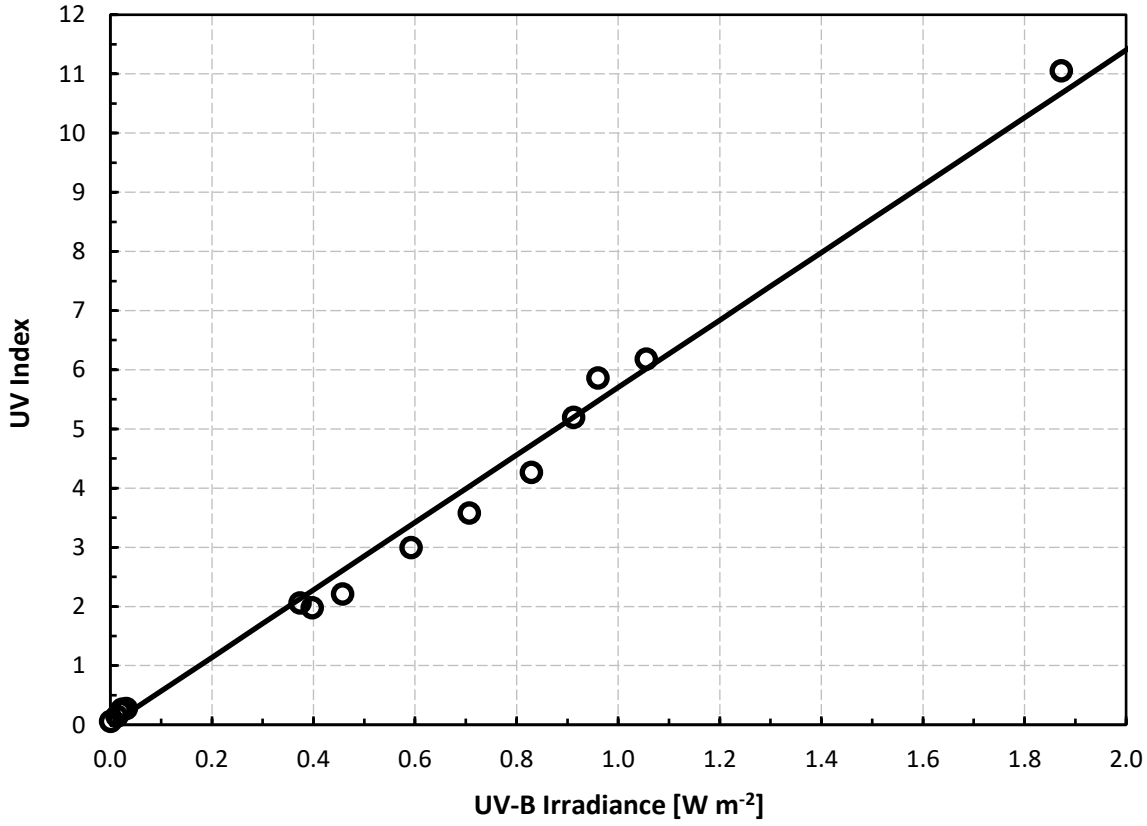
Apogee Instruments model SU-300 UV-I/UV-B sensors are calibrated to measure ultraviolet radiation from the sun between 280 and 315 nm in Watts per square meter (calibration factor is 1.75 W m^{-2} per mV). In addition to naturally occurring UV-I/UV-B radiation from the sun, there are many electric light sources that emit UV-I/UV-B radiation (e.g., cool white fluorescent, metal halide, mercury arc, and germicidal lamps). Although the relative wavelengths of UV-I/UV-B radiation differ among sunlight and electric lights, the error estimates shown in the table below indicate the SU-300 provides reasonable estimates of UV-I/UV-B radiation coming from electric lamps (table provides spectral error estimates for UV-I/UV-B radiation measurements from radiation sources other than clear sky solar radiation). For most common lamps, the error is less than 10 %. The SU-300 is particularly useful for determining the UV-I/UV-B filtering capacity of the transparent plastic and glass barriers that are commonly used below electric lamps.

Radiation Source (Error Calculated Relative to Sun, Clear Sky)	Expected EFD Error [%]	Expected PFD Error [%]
Clear Sky	0.0	0.0
Overcast	-2.1	-8.9
Direct Normal	-0.1	-0.5
Diffuse Blue	0.1	0.3
Mercury Arc	3.7	8.9
T12 Fluorescent UV-A Enhanced	-0.1	3.0
UU-enhanced T5 Cool White Fluorescent	1.9	4.8

Converting from UV Index to UV-B in Units of W m^{-2} and μmol m^{-2} s^{-1}

There is a relatively linear relationship between UV Index and UV-B irradiance for sunlight (see graph below), suggesting UV-B irradiance can be approximated from UV Index measurements from the SU-300 UV-I/UV-B sensor. To convert from UV Index to UV irradiance in units of W m^{-2}, divide UV Index by 5.7 (slope of the line in the graph below).

UV-B irradiance (in units of W m^{-2}) can be converted to UV-B photon flux density by dividing UV-B irradiance (in units of W m^{-2}) by the average energy content of solar UV-B photons, 0.384 J per μmol. To convert UV Index to UV-B photon flux density, divide the UV Index measurement by 2.2 (slope of the line in the graph below multiplied by 0.384 J per μmol).



Relationship between UV Index and UV-B irradiance (in units of W m^{-2}). Data are from multiple solar spectra representing a wide range of atmospheric conditions. Slope of the line is 5.7, with an $r^2 = 0.99$.

MAINTENANCE AND RECALIBRATION

Blocking of the optical path between the target and detector can cause low readings. Occasionally, accumulated materials on the diffuser of the SU-300 series UV-I/UV-B sensors can block the optical path in three common ways:

1. Moisture or debris build-up on the diffuser.
2. Dust during periods of low rainfall.
3. Salt deposit accumulation from evaporation of sea spray or sprinkler irrigation water.

SU-300 series sensors have a domed diffuser and housing for improved self-cleaning from rainfall, but active cleaning may be necessary. Dust or organic deposits are best removed using water, or window cleaner, and a soft cloth or cotton swab. Salt deposits should be dissolved with vinegar and removed with a cloth or cotton swab. **Never use solvents such as alcohol or acetone to clean the sensor.** Use only gentle pressure when cleaning the diffuser with a cotton swab or soft cloth, to avoid scratching the outer surface. The vinegar should be allowed to do the cleaning, not mechanical force. **Never use an abrasive material or cleaner on the diffuser**.

It is recommended that UV-I/UV-B sensors be recalibrated every two years. See the Apogee webpage for details regarding return of sensors for recalibration (http://www.apogeeinstruments.com/tech-support-recalibration-repairs/).

TROUBLESHOOTING AND CUSTOMER SUPPORT

Independent Verification of Functionality

If the sensor does not communicate with the datalogger, use an ammeter to check the current draw. It should be near 1.4 mA when the sensor is not communicating and spike to approximately 1.8 mA when the sensor is communicating. Any current draw greater than approximately 6 mA indicates a problem with power supply to the sensors, wiring of the sensor, or sensor electronics.

Compatible Measurement Devices (Dataloggers/Controllers/Meters)

Any datalogger or meter with SDI-12 functionality that includes the M or C command.

An example datalogger program for Campbell Scientific dataloggers can be found on the Apogee webpage at https://www.apogeeinstruments.com/downloads/#datalogger.

Zero Offset Error

With the use of certain dataloggers it is possible to measure a non-zero voltage (zero offset) when the sensor output should be zero (no UV irradiance incident on diffuser). This offset can be corrected by adding or subtracting the measured offset from the sensor output. However, if the offset is substantial, and your sensor is outputting unrealistic values then it may need to be recalibrated. In this case, contact Apogee customer support to recalibrate the sensor.

Modifying Cable Length

SDI-12 protocol limits cable length to 60 meters. For multiple sensors connected to the same data line, the maximum is 600 meters of total cable (e.g., ten sensors with 60 meters of cable per sensor). See Apogee webpage for details on how to extend sensor cable length (http://www.apogeeinstruments.com/how-to-make-a-weatherproof-cable-splice/).

Unit Conversion

SU-300 series UV-I/UV-B sensors are calibrated in energy flux units of W m^{-2}. It is possible to convert the energy flux value to photon flux units of µmol m^{-2} s^{-1} using a conversion factor. Below is an example of how to convert energy flux units to photon flux.

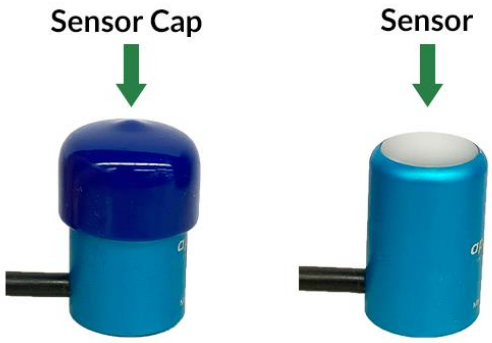
1) Calculate the sensor output in units of J m^{-2} s^{-1}.

$$6\ mV * 10\ \frac{W m^{-2}}{mV} = 60 \frac{W}{m^2} = 60 \frac{J}{m^2 s}$$

2) Multiply the energy flux units by the conversion factor. It's important to note that each light source needs a specific conversion factor. The conversion factor used in the example equation is the sunlight conversion factors.

$$\frac{60\ {}^{J}/_{m^2 s}}{0.327\ {}^{J}/_{\mu mol}} = 183.5\ \frac{\mu mol}{m^2 s}$$

NOTE: Remove protective cap before using any sensor.



RETURN AND WARRANTY POLICY

RETURN POLICY

Apogee Instruments will accept returns within 30 days of purchase as long as the product is in new condition (to be determined by Apogee). Returns are subject to a 10 % restocking fee.

WARRANTY POLICY

What is Covered
All products manufactured by Apogee Instruments are warranted to be free from defects in materials and craftsmanship for a period of four (4) years from the date of shipment from our factory. To be considered for warranty coverage an item must be evaluated by Apogee.

Products not manufactured by Apogee (spectroradiometers, chlorophyll content meters, EE08-SS probes) are covered for a period of one (1) year.

What is Not Covered
The customer is responsible for all costs associated with the removal, reinstallation, and shipping of suspected warranty items to our factory.

The warranty does not cover equipment that has been damaged due to the following conditions:

1. Improper installation, use, or abuse.

2. Operation of the instrument outside of its specified operating range.

3. Natural occurrences such as lightning, fire, etc.

4. Unauthorized modification.

5. Improper or unauthorized repair.

Please note that nominal accuracy drift is normal over time. Routine recalibration of sensors/meters is considered part of proper maintenance and is not covered under warranty.

Who is Covered
This warranty covers the original purchaser of the product or other party who may own it during the warranty period.

What Apogee Will Do
At no charge Apogee will:

1. Either repair or replace (at our discretion) the item under warranty.

2. Ship the item back to the customer by the carrier of our choice.

Different or expedited shipping methods will be at the customer's expense.

How To Return an Item

1. Please do not send any products back to Apogee Instruments until you have received a Return Merchandise Authorization (RMA) number from our technical support department by submitting an online RMA form at www.apogeeinstruments.com/tech-support-recalibration-repairs/. We will use your RMA number for tracking of the service item. Call (435) 245-8012 or email techsupport@apogeeinstruments.com with questions.

2. For warranty evaluations, send all RMA sensors and meters back in the following condition: Clean the sensor's exterior and cord. Do not modify the sensors or wires, including splicing, cutting wire leads, etc. If a connector has been attached to the cable end, please include the mating connector – otherwise the sensor connector will be removed in order to complete the repair/recalibration. ***Note:*** *When sending back sensors for routine calibration that have Apogee's standard stainless-steel connectors, you only need to send the sensor with the 30 cm section of cable and one-half of the connector. We have mating connectors at our factory that can be used for calibrating the sensor.*

3. Please write the RMA number on the outside of the shipping container.

4. Return the item with freight pre-paid and fully insured to our factory address shown below. We are not responsible for any costs associated with the transportation of products across international borders.

Apogee Instruments, Inc.
721 West 1800 North Logan, UT
84321, USA

5. Upon receipt, Apogee Instruments will determine the cause of failure. If the product is found to be defective in terms of operation to the published specifications due to a failure of product materials or craftsmanship, Apogee Instruments will repair or replace the items free of charge. If it is determined that your product is not covered under warranty, you will be informed and given an estimated repair/replacement cost.

PRODUCTS BEYOND THE WARRANTY PERIOD

For issues with sensors beyond the warranty period, please contact Apogee at techsupport@apogeeinstruments.com to discuss repair or replacement options.

OTHER TERMS

The available remedy of defects under this warranty is for the repair or replacement of the original product, and Apogee Instruments is not responsible for any direct, indirect, incidental, or consequential damages, including but not limited to loss of income, loss of revenue, loss of profit, loss of data, loss of wages, loss of time, loss of sales, accruement of debts or expenses, injury to personal property, or injury to any person or any other type of damage or loss.

This limited warranty and any disputes arising out of or in connection with this limited warranty ("Disputes") shall be governed by the laws of the State of Utah, USA, excluding conflicts of law principles and excluding the Convention for the International Sale of Goods. The courts located in the State of Utah, USA, shall have exclusive jurisdiction over any Disputes.

This limited warranty gives you specific legal rights, and you may also have other rights, which vary from state to state and jurisdiction to jurisdiction, and which shall not be affected by this limited warranty. This warranty extends only to you and cannot by transferred or assigned. If any provision of this limited warranty is unlawful, void, or unenforceable, that provision shall be deemed severable and shall not affect any remaining provisions. In case of any inconsistency between the English and other versions of this limited warranty, the English version shall prevail.

This warranty cannot be changed, assumed, or amended by any other person or agreement