



Deuterium-Halogen Calibration Light Source

Installation and Operation Manual



For Products: DH-3PLUS-CAL, DH-3PLUS-BAL-CAL
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About This Manual

Document Purpose and Intended Audience

This document provides you with an installation section to get your system up and running, basic information about the calibration light source, and a log to save the time of the light source's use.

What's New in this Document

This version of the *Deuterium-Halogen Calibration Light Source Installation and Operation Manual* describes the re-engineered DH-3plus family of light sources. To verify that you have a re-engineered unit, look for the phrase "Assembled in USA" on the product label.

Document Summary

Chapter	Description
Chapter 1: Setup	Contains a list of package contents and unpacking instructions. Also contains procedures for connecting to a spectrometer.
Chapter 2: DH-3PLUS Specifications	Contains operating environment specifications, as well as other physical details of the product.
Chapter 3: Operating Instructions	Provides instructions for operating the DH-3PLUS lamp and the TTL shutter.
Appendix A: Calibration Basics	Provides an overview of the physics for radiometrically calibrated systems.
Appendix B: DH-3PLUS Use Log	Provides a sample log for recording lamp use.

Product-Related Documentation

You can access documentation for Ocean Optics products by visiting our website at <http://www.oceanoptics.com>. Select *Support* → *Technical Documents*, then choose the appropriate document form the available drop-down lists.

Ocean Optics offers a Glossary of spectroscopy terms to help you further understand your state-of-the-art products and how they function, located at: <http://oceanoptics.com/glossary/>.

- Detailed instructions for OceanView Spectrometer Operating Software is located at: <http://oceanoptics.com/wp-content/uploads/OceanViewIO.pdf>.

Upgrades

Occasionally, you may find that you need Ocean Optics to make a change or an upgrade to your system. To facilitate these changes, you must first contact Customer Support and obtain a Return Merchandise Authorization (RMA) number. Please contact Ocean Optics Application Scientist for specific instructions when returning a product.

Important Safety Notices

1. Do not remove or modify any installed safety device on this equipment. Doing so will void your warranty and create an unsafe operating environment.
2. Dangerous voltages are present in this device. There are NO user serviceable parts inside.
3. Only allow qualified personnel to operate this unit.
4. Do not use the unit if it is damaged in any way. Contact your dealer for repair or replacement information.
5. Always screw in the fiber optic cables before starting the instrument.



WARNING

Protective eyewear **must** be worn when using this equipment. Intense ultraviolet radiation is present.
Never look directly into the light beam, as this can cause eye damage.

Warranty

Light Source products are covered by Ocean Optics Exclusive Three Year Warranty. For details, please visit the following webpage:

<https://oceanoptics.com/wp-content/uploads/Warranty-Sheet.pdf>

There are no warranties for the bulbs/modules.

This instrument should not be used for any Clinical or Diagnostic purposes. Data generated in these areas is not warranted in any way by Ocean Optics, Inc.

Certifications and Compliance

ISO CERTIFICATION

Ocean Optics, the industry leader in miniature photonics, has been certified for ISO 9001:2008 applicable to the design and manufacture of electro-optical equipment since 2009.



WEEE COMPLIANCE

The WEEE symbol on the product indicates that the product must not be disposed of with normal household waste. Instead, such marked waste equipment must be disposed of by arranging to return to a designated collection point for the recycling of waste electrical and electronic equipment. Separating and recycling this waste equipment at the time of disposal will help to conserve natural resources and ensure that the equipment is recycled in a manner that protects human health and the environment.



This device has been tested and complies with the following standards:

EN 61326-1:2013

EN 61000-4-2:2009 / IEC 61000-4-2:2008

EN 61000-4-3:2006 / IEC 61000-4-3:2006

EN 61000-4-5:2006 / IEC 61000-4-5:2005

EN 61000-4-11:2004 / IEC 61000-4-11:2004

EN 55011: 2009/A1:2010 Group 1 Class A

ANSI C63.4:2003

FCC COMPLIANCE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which the user will be required to correct the interference at his own expense.



Chapter 1

Setup

Overview

The DH-3PLUS Series of Light Sources for the UV-VIS-NIR (210nm-2400nm, depending upon configuration) is a deuterium and halogen light source that provides known absolute intensity values at several wavelengths, expressed in $\mu\text{W}/\text{cm}^2/\text{nm}$. Since the spectral intensity of the DH-3PLUS Series can be traced to an intensity standard traceable to the National Institute of Standards and Technology (NIST), it is specifically designed for calibrating the absolute spectral response of your system.

Calibrated sources are guaranteed for the lesser of 50 hours of operation or 1 year from factory calibration. Due to low usage for guaranteed calibration, they are not intended to be used as an illuminant in day-to-day measurements.

Note

If you have a spectrometer setup that is highly sensitive, you may not be able to use the DH-3PLUS Series as a calibration source.



DH-3 plus Calibrated Light Source

Models Available

The following models are available in the DH-3PLUS Series:

Model	Default Calibration Wavelength (nm)	Optional Calibration Wavelength (nm)			Balanced Spectral Output
		DH-CAL-BF**	DH-EXT-CAL*	DH-EXT-CAL-BF**	
	DH-CAL *				
DH-3P-CAL	210-1100	250-1100	210-2400	250-2400	No
DH-3P-BAL-CAL	230-1100	250-1100	230-2400	250-2400	Yes

*Cosine Corrected

**Bare Fiber

The following sections provide instructions on unpacking and setting up your DH-3PLUS Series Light Source.

Unpacking the DH-3PLUS Series Light Source

► Procedure

1. Unpack your lamp assembly and power supply carefully. Although the lamp is rigidly mounted, dropping this instrument can cause permanent damage.
2. Inspect the outside of the instrument and make sure that there is no damage. Do not use the instrument if damage is present.
3. Use this instrument in a clean laboratory environment (see

4. [Operating](#) Environment).

Contents

Your DH-3PLUS Series Light Source package should contain the following:

- ❑ DH-3PLUS light source unit
- ❑ Power cord
- ❑ UV safety goggles
- ❑ One IC-DB15-2 interface cable for shutter operation
- ❑ Lamp Calibration Report for using the DH-3PLUS light source with a CC-3-UV-S cosine-corrected irradiance probe
- ❑ USB containing lamp calibration files
- ❑ Uncertainty report for unit
- ❑ Calibration certificate for unit
- ❑ Allen wrench for adjusting the cosine corrector

Connecting a Spectrometer to the DH-3PLUS

Before using a DH-3PLUS Series light source for the first time, check for transport damage. Be sure to adhere to all warnings on the unit and in this operational manual. Make sure you have your DH-3PLUS light source, your spectrometer, a CC-3 cosine-corrected irradiance probe, and Ocean Optics spectrometer operating software.

► Procedure

Use the following procedure to connect your DH-3PLUS light source to a spectrometer:

1. Loosen the set screw on the DH-3PLUS's SMA connector.
2. Screw the CC-3 cosine corrector onto the end of the fiber. The connection should be tight. Insert the CC-3 all the way into the DH-3PLUS's SMA connector.
3. Tighten the setscrew on the SMA connector of the DH-3PLUS with an Allen wrench. Connect the other end of the fiber into the SMA connector of the spectrometer.
4. Plug in the power cord.
5. Turn the unit on using the ON/OFF switch on the back of the light source.
6. Turn on the deuterium light and the halogen light on the front of the light source.
7. Allow the lamp to warm up for at least 15 minutes before using it. Place the DH-3PLUS horizontally.
8. Insert the calibration USB drive that came with your light source into your computer. This disk contains one ASCII file with the same information as the Lamp Calibration Reports that came with your DH-3PLUS. The file name contains the lamp's serial number, followed by **CC.LMP**. Copy these files to the desired directory on your computer.
9. Start your spectrometer operating software. See your spectrometer manual for instructions on calibrating the spectrometer with the DH-3PLUS.

Tips

When you perform measurements with the calibrated spectrometer system, record a new dark spectrum before each measurement. This minimizes the influence of a shifted dark spectrum.

Use a log to monitor the operation time of the light source. Recalibration of the light source after 50 hours of operation is recommended. A sample log is provided in Appendix B: [DH-3PLUS Use Log](#).

Chapter 2

DH-3PLUS Specifications

This section provides information on the operating environment and specifications of the DH-3PLUS Series light sources.

Specifications

Specification	Value
Spectral Range (calibrated): Cosine corrected DH-3PLUS-BAL-CAL DH-3PLUS-BAL-CAL DH-3PLUS-CAL DH-3PLUS-CAL Bare Fiber DH-3PLUS-BAL-CAL DH-3PLUS-BAL-CAL DH-3PLUS-CAL DH-3PLUS-CAL	230-1100 standard 230-2400 extended 210-1100 standard 210-2400 extended 250-1100 standard 250-2400 extended 250-1100 standard 250-2400 extended
Dimensions (LWH):	13.8 cm x 6.3 cm x 6.1 cm; 5.4" x 2.5" x 2.4"
Power Requirements:	85-264 V, 50/60 Hz
Power Consumption:	Approximately 78VA
Time to Stabilized Output	40 minutes – deuterium 20 minutes – tungsten halogen
Connector	CC-3-UV-S or 6.35 mm barrel for cosine corrector

Operating Environment

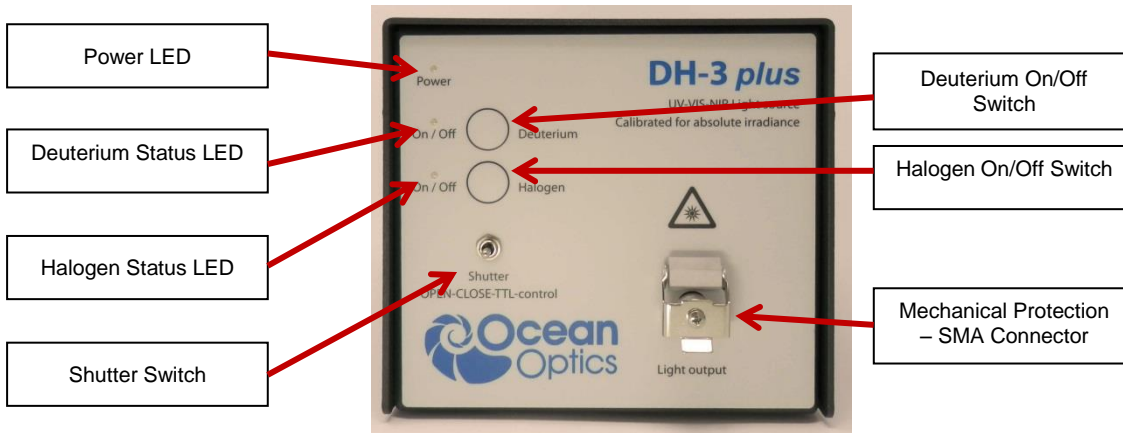
The following table provides information on optimizing the operating environment of your DH-3PLUS calibration light source.

Moisture	5-95% without condensation at 40°C
Ventilation	Unit should be situated so that its location or position does not interfere with proper ventilation.
Temperature	5°C – 35°C. Unit should be situated away from any device that emits excessive heat.
Object and Liquid Entry	Unit should be positioned so that objects do not fall on top of the unit. Additionally, ensure that no liquids are spilled into the enclosure through openings.

DH-3PLUS Components

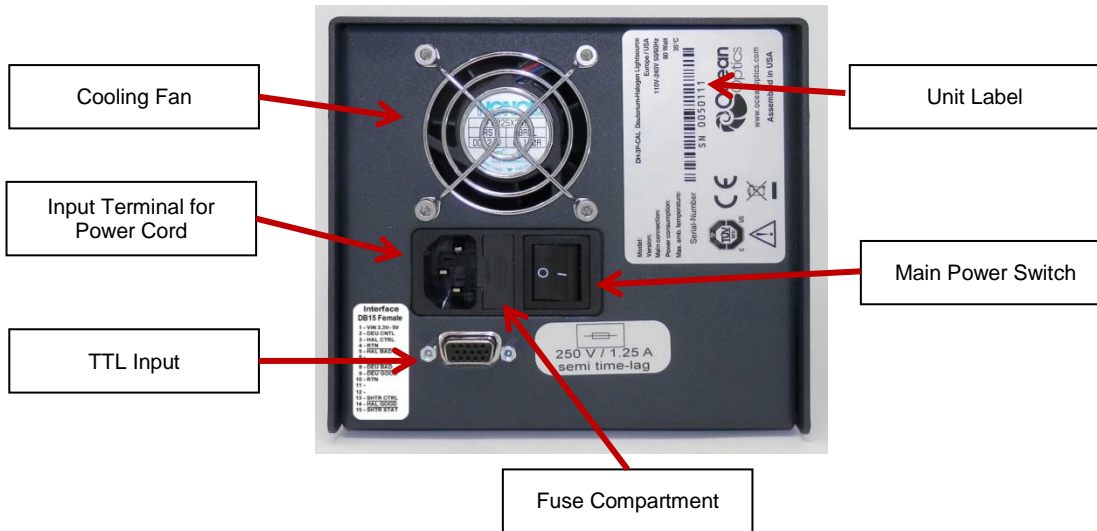
The following sections describe the components located on the front and rear of the DH-3plus unit.

Front Panel



Component	Description
Deuterium On/Off	Press the DEUTERIUM button to turn the Deuterium lamp on or off. The bulb requires a warm-up time of 20 seconds before the Deuterium lamp is illuminated. You must allow the bulb to warm up to receive accurate data from the lamp. LED to the left of the button lights green upon successful illumination or red to indicate lamp malfunction.
Power LED	Indicates the power state of the DH-3PLUS.
Mechanical Protection – SMA Connector	Covered to protect users from unintentionally looking directly at the beam of light. Connect the fiber cable to the DH-2000 BEFORE turning the lamp on to avoid unnecessary exposure to UV radiation. Always wear proper eye protection when using the DH-2000 lamp.
Halogen On/Off	Press the HALOGEN button to turn the Halogen lamp on or off. LED to the left button lights green upon successful illumination or red to indicate lamp malfunction.
Shutter Mode Switch	Sets the operational mode of the shutter. Open indicates that the shutter is constantly open; Closed indicates that the shutter is constantly closed; TTL indicates that the shutter is operated via the rear panel connector (see Rear Panel).

Rear Panel



Component	Description
Main Power Switch	Turn on to supply power to the unit. The Power LED lights when this switch is in the ON position.
Fuse Compartment	Contains the fuse to protect the unit against overload: 2.0 Amp, 250 V slow blow. Littlefuse part # 0218002
Input Terminal for Power Cord	Plug power cord into this terminal. Note: Only connect the power cable to the lamp when the Main Power Switch is in the OFF position. THE INSTRUMENT MUST BE CONNECTED TO A GROUNDED (EARTHED) OUTLET
TTL Input	D-SUB 15-pin connector for automatic shutter control and remote lamp enable
Unit Label	<ul style="list-style-type: none"> - Model DH-3PLUS-CAL Deuterium-Halogen Lightsource -or- DH-3PLUS-BAL-CAL Deuterium-Halogen Lightsource - Version Europe / USA - Main connection 110 / 240V 50-60Hz - Power consumption 80 Watt - Max. Ambient Temperature 35°C - Serial-No. xxxxxx
Cooling Fan	Cools the interior of the DH-3PLUS. Do not obstruct.

Calibration Label

A calibration label is attached to both the shipping box and the light source. The label identifies the calibration performed on the unit (shown in red oval, below) and the date of the calibration, as well as the serial number of the light source.



The calibration acronyms are defined in the following table:

Calibration Acronym	Description
CC	Cosign Corrector - Standard Range
CC EXT	Cosign Corrector – Extended Range
BF	Bare Fiber - Standard Range
BF EXT	Bare Fiber - Extended Range
CC & BF	Cosign Corrector and Bare Fiber
CC& BF EXT	Cosign Corrector and Bare Fiber Extended Range

Pinout Information

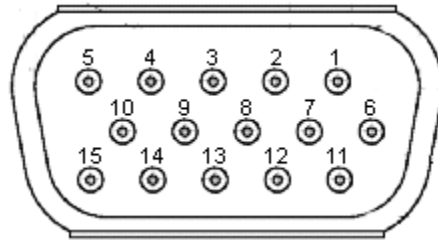
The following table contains pinout information for the DH-3PLUS Light Sources:

Pin	Description
1	Must be pulled up by use to 2.6V to 5 Volts
2	Deuterium Lamp – Turns the Deuterium Lamp on/off when 2.6V to 5V is applied to the pin (Rising Edge ON, Rising Edge OFF). *
3	Halogen Lamp - Turns the Halogen Lamp on/off when 2.6V to 5V is applied to the pin (Rising Edge ON, Rising Edge OFF). *
4	Light Source Ground
5	HAL_BAD: In the event the Halogen lamp is bad, this will be active low, otherwise it will be hi. This equates to the Red Halogen LED on the front. Note this LED usually flashes briefly at power up
6	NA
7	NA
8	D_BAD: In the event the Deuterium lamp is bad, this will be active low, otherwise it will be hi. This equates to the Red Deuterium LED on the front
9	D_GOOD: This is active low when the Deuterium is on. It will toggle at 1 Hz during warm up, just like the Green Deuterium LED on the front
10	Shutter Ground
11	NA
12	NA
13	Lamp Enable Signal (Rising Edge ON, Rising Edge OFF, 2.6V to 5V). *
14	HAL_GOOD: This is active low when the Halogen is on. Just like the Green Halogen LED on the front.
15	SHTR_STAT: Should be active HI if the shutter is OPEN
15	SHTR_STAT: Should be active HI if the shutter is OPEN

*This pull up is only required to use the OUTPUT signals on pins 5, 8, 9, 14, and 15. The input control signals on pins 2, 3, and 13 do not require this pull up.

A label on the rear of the unit also provides pin information.

Pinout Diagram



Parts List

Part Number	Description
DH-3P-CAL	Deuterium Tungsten-Halogen Light Source, Calibrated, 210-1100nm
DH-3P-BAL-CAL	Deuterium Tungsten-Halogen Light Source, Balanced and Calibrated, 230-1100nm
Littlefuse 0218002	Fuse
DH-CAL	Calibration service for DH light sources DH-3P-CAL: 210-1100nm DH-3P-BAL-CAL: 230-1100nm
DH-CAL-BF	Bare fiber calibration service for DH sources DH-3P-CAL: 250-1100nm DH-3P-BAL-CAL: 250-1100nm
DH-EXT-CAL	Extended range calibration service for DH sources DH-3P-CAL: 210-2400nm DH-3P-BAL-CAL: 230-2400nm
DH-EXT-CAL-BF	Extended range bare fiber calibration service for DH sources DH-3P-CAL: 250-2400nm DH-3P-BAL-CAL: 250-2400nm

Operating Instructions

Operating the Lamp

The following sections provide instructions on operating the deuterium and halogen lamps in the DH-3PLUS Light Source. The DH-3PLUS unit must be in a horizontal position for it to work.

Starting Main Power

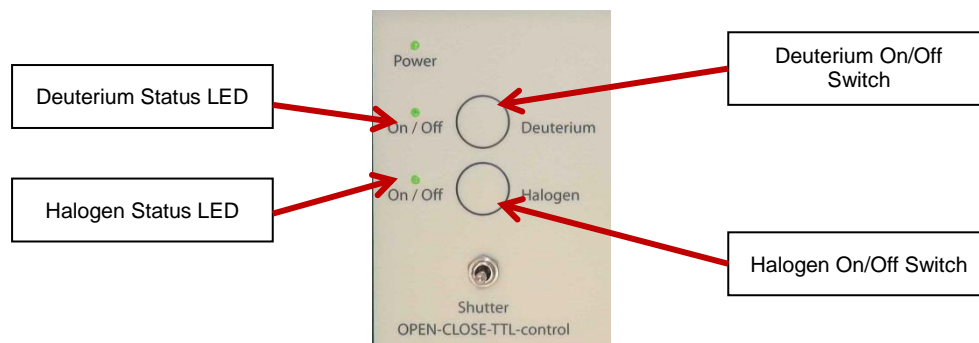
To apply main power to the unit,

1. Ensure that the Main Power Switch is OFF. Then, connect the power cord to the Terminal Input on the rear panel of the unit.
2. Turn the Main Power Switch ON. The Power LED lights, indicating that the unit is receiving power. The Status LED blinks momentarily after the main power is switched on. The deuterium and halogen bulbs remain off after power-on; they must be turned on separately.

Manual Operation of Lamp

Starting the Lamp

Press the DEUTERIUM or HALOGEN On/Off switch down to ignite the desired lamp. The LED blinks green until the lamp illuminates (approximately 20 seconds for the deuterium lamp, 1-2 seconds for the halogen lamp.)



After successful illumination, the two-color LED beneath the lamp's On/Off switch lights up green to indicate that the lamp is on. Should the lamp fail to light, the two-color LED lights up red. This indicates a malfunction of the lamp. Press the On/Off switch again to reset the lamp. See [Troubleshooting](#) for more information.



Protective eyewear must be worn when using this equipment - Intense ultraviolet radiation present.

Never look directly into the light beam, as this can cause eye damage.

Turning the Lamp Off

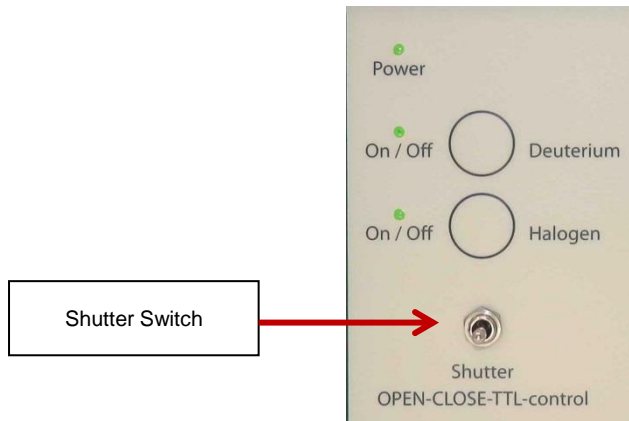
Turn the Deuterium or Halogen lamp off by tapping the appropriate ON/OFF switch. Wait 60 seconds before powering off the unit.

Warming Up the Lamp

After starting the lamp, it must be followed by a warm-up period. The Deuterium lamp requires 40 minutes, while the Tungsten-Halogen lamp requires 20 minutes of operation to reach a state of thermal equilibrium sufficient for calibration of equipment. During this warm-up period, the intensity of the output power can vary substantially.

Manual Operation of the Shutter

The shutter on your DH-3PLUS device may be operated either manually or remotely by utilizing the shutter switch on the front of the unit.



Manually set the operating mode of the DH-3PLUS with the Shutter Switch as follows:

- OPEN - Shutter open
- CLOSE - Shutter closed
- TTL – Remote operation of shutter

Remote Operation of the LAMP and Shutter

For remote operation, plug the D-SUB 15-pin connector into the appropriate socket on your spectrometer.

USE ONLY THE CABLE PROVIDED OR A CUSTOM CABLE DESIGNED TO INTERFACE WITH THE PINOUTS AS DESCRIBED IN THE PINOUT INFORMATION SECTION. DO NOT USE A VGA VIDEO CABLE.

- Set the front panel shutter switch to the TTL position
- Pin 2 of the connector is the Deuterium LAMP ON/OFF control.
- Pin 3 of the connector is the Halogen LAMP ON/OFF control.
- Pin 13 of the connector is the shutter control. (HIGH=OPEN, LOW=CLOSE)

Refer to [Pinout Information](#) for information on the operation of lamp and shutter.

Chapter 4

Troubleshooting

Deuterium Lamp

If the power supply or Deuterium lamp does not seem to be functioning properly, check the following:

Issue	Probable Cause	Resolution
Power switches on, but no LEDs light.	Line power not present	Check line voltage
	Fuse defective	Check fuse
Deuterium lamp does not light. The two-color LED under the Deuterium On/Off switch lights up red, indicating an error.	Deuterium lamp too hot	Allow the Deuterium lamp to cool down (20 minutes). Press On/Off switch again to reset the Deuterium Tungsten-Halogen lamp, then press again to restart.
	Deuterium lamp life exhausted	Replace Deuterium lamp
	Deuterium lamp's internal connection plug is not closed correctly.	Open unit and close connector plug.
Deuterium lamp turns off during operation.	Deuterium lamp too hot	Turn off the unit. Allow the unit to cool down for at least 20 minutes. Once the unit has cooled down, turn the Deuterium lamp back on.

Halogen Lamp

If the Halogen lamp does not seem to functioning properly, check the following:

Issue	Probable Cause	Resolution
Halogen lamp does not work after pressing On/Off switch	Deuterium lamp is warming up	Wait until the Deuterium lamp has lit and try again
	Halogen lamp is defective	Replace the Halogen lamp
LED does not light after switching on the Halogen lamp	Internal power supply is defective	Disconnect the unit from the main power source and contact your dealer for repair or replacement

Bulb Replacement

All service, including bulb replacements, must be performed by Ocean Optics, Inc.

To initiate service, navigate to: <https://oceanoptics.com/support/rma/> to obtain a RMA (Return Merchandise Authorization) number.

It is very important that you obtain a RMA number.

Please **DO NOT SHIP** merchandise to Ocean Optics, Inc. without prior authorization.

Calibration Basics

Overview

Calibrated systems, independent of the particular calibrated unit, are always traceable to national standards. A calibrated item is comparable to all calibrated items which are calibrated for the same calibrated unit.

Each measurement result has an uncertainty, and the level of uncertainty is given either for one single standard deviation ($k = 1$) or for two standard deviations ($k = 2$), which is often named as expanded uncertainty.

A calibrated device should give trusted results; therefore, the calibration has to be done by the metrologist following a previously defined and proven calibration procedure. Clear documentation of the calibration setup and of the calibrated devices used is an indispensable requirement.

Calibration for Absolute Irradiance

Absolute irradiance has the physical unit $\mu\text{W}/\text{nm}/\text{cm}^2$. The interpretation is as follows: This is the wavelength resolved electromagnetic radiation which is emitted through an area [cm^2].

When you attach a cosine corrector correctly at the mounting of the light source then the amount of light has a defined electromagnetic radiation power per surface area of your cosine corrector.

More detailed information can be found at:

<http://oceanoptics.com/frequentlyaskedquestions/light-sources-radiometric/>

Uncertainty Level Calculation for DH-3PLUS-BAL-CAL

Each realistic measurement has an uncertainty and therefore, a calibration has an uncertainty. The uncertainty should be validated seriously since this reflects how reliable the calibration is. The following international standards define the uncertainty and are describing how the uncertainty should be derived:

- IEC Guide 115: *Application of uncertainty of measurement to conformity assessment activities in the electrotechnical sector.*
- JCGM100:2008: GUM 1995 with minor corrections

Ocean Optics calibrations are done in relation to these international standards.

Ocean Optics provides a calibration of the DH-3PLUS *plus*-CAL on an absolute irradiance scale in $\mu\text{W}/\text{nm}/\text{cm}^2$. The sources of uncertainties taken into account are listed below in the example. The actual values are listed in the individual calibration certificate for your light source. The calibration certificate contains more detailed information.

Sources of Uncertainties

	Quantity	Source of uncertainty
1.	R	Uncertainty in reproducibility [R], caused by switching on/off
1.1	S	Stability[S] within 50 hours of operation
2.	T & F	Influence of temperature [T] and humidity [F] in the air. The temperatures during calibration have a temperature range of 19 °C to 25 °C. The humidity might have influence for the calibration in the NIR for length larger than 1100 nm.
3.	d	Uncertainty in mounting distance of the detector probe (e.g. Cosine Corrector. 1.8 % per 0.1 mm; integrating sphere minimal; bare fiber same as cc)
4.	ROT	Uncertainty from rotation [ROT] or centering of the detector probe
5.	D_Lambda	Uncertainty caused by wavelength calibration of the spectrometer [D_Lambda[QE]=0,3 nm, D_Lambda[NirQ512]= 1-5 nm]
6.	D_AbsIrrad	Uncertainty of the NIST traceable calibration light source and NIST traceable white standard on the calibration stand
7.	StrayL	Influence from spectrometers internal stray light
8.	T_TEC_	Influence of the sensor temperature [TEC] of the spectrometer.
9.	Dark	Influence from uncertainties of the measured dark level.
10.	Rep	Repeatability of the used spectrometer system
11.	SP_Lin	Linearity of the spectrometer system
12.	Bend	Uncertainty caused by bending [Bend] of the fibers.

These factors are taken into account for deriving the wavelength for resolved levels of uncertainty (listed below).

Standard Uncertainties and Uncertainty Budgets in % at Wavelength

For DH-3P (-BAL) CAL Cosine Corrector Calibration

	Uncertainty Budgets in [%] at Wavelength										
	Wavelength (nm)										
	UV Calibration			Standard VIS Calibration				Extended Calibration			
	230	250	300	400	500	600	1000	1400	1600	2000	2400
Standard deviation k = 1	7.7	6.9	6.5	6.0	4.1	3.9	3.8	4.3	5.6	10.6	11.7
k = 2	15.4	13.8	13.0	12.0	8.2	7.7	7.7	8.5	11.2	21.2	23.5

For DH-3P (-BAL) CAL Bare Fiber Calibration

	Uncertainty Budgets in [%] at Wavelength										
	Wavelength (nm)										
	UV Calibration			Standard VIS Calibration				Extended Calibration			
	230	250	300	400	500	600	1000	1400	1600	2000	2400
Standard deviation k = 1	N/A	9.5	8.7	8.1	6.8	6.7	6.7	6.9	7.8	11.9	12.9
k = 2	N/A	19.0	17.4	16.1	13.6	13.4	13.3	13.8	15.6	23.8	25.9

Place the light source horizontally. A value of 6 % of expanded uncertainty must be taken into account for vertical placement.

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