EVOA1550F & EVOA1550A
Electronic Variable Optical Attenuators

User Guide

Table of Contents

Chapter 1 Warning Symbol Definitions

Below is a list of warning symbols you may encounter in this manual or on your device.

Symbol	Description
	Direct Current
	Alternating Current
	Both Direct and Alternating Current
	Earth Ground Terminal
	Protective Conductor Terminal
	Frame or Chassis Terminal
	Equipotentiality
	On (Supply)
	Off (Supply)
	In Position of a Bi-Stable Push Control
	Out Position of a Bi-Stable Push Control
	Caution: Risk of Electric Shock
	Caution: Hot Surface
	Caution: Risk of Danger
	Warning: Laser Radiation
	Caution: Spinning Blades May Cause Harm
	Caution: ESD Sensitive Components

Chapter 2 Safety

CAUTION

The following statement applies to the products covered in this manual, unless otherwise specified herein. The statement for other products will appear in the accompanying documentation. Inputs and outputs must only be connected with shielded connection cables.

Only with written consent from Thorlabs may changes to single components be carried out or components not supplied by Thorlabs be used.

This product has been tested and found to comply with the limits according to IEC 61326-1 for using connection cables shorter than 3 meters (9.8 feet).

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules, and meets all requirements of the Canadian Interference Causing Equipment Standard ICES-003 for digital apparatus. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

Thorlabs is not responsible for any radio television interference caused by modifications of this equipment or the substitution or attachment of connecting cables and equipment other than those specified by Thorlabs. The correction of interference caused by such unauthorized modification, substitution or attachment will be the responsibility of the user. The use of shielded I/O cables is required when connecting this equipment to any and all optional peripheral or host devices. Failure to do so may violate FCC and ICES rules.

The safety of any system incorporating the equipment is the responsibility of the assembler of the system.

If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

This instrument should be kept clear of environments where liquid spills or condensing moisture are likely. It is not water resistant. To avoid damage to the instrument, do not expose it to spray, liquids, or solvents.

The components inside this instrument are ESD sensitive. Take all appropriate precautions to discharge personnel and equipment before making any electrical connections to the unit.

Chapter 3 Introduction & Quick Start

3.1. Introduction

The EVOA1550F and EVOA1550A are electronically controlled variable optical attenuators (EVOAs) for single mode fiber applications. The control knob allows analog adjustment of the attenuation, while the digital meter reports the actual output power. A key feature is the Power Lock function, which allows the user to lock the output power level by using the VOA as a power stabilizer.

These EVOAs are designed for use with standard single mode fiber (e.g. SMF-28e+) and accept either FC/PC connectors (Item # EVOA1550F) or FC/APC connectors (Item # EVOA1550A). The wavelength selector switch accesses calibrated settings for 1310 nm and 1550 nm, and also provides a position which the user can calibrate for any wavelength from 1250 nm to 1625 nm.

The unit is battery powered and can last for hundreds of hours on a single charge. Charging can be done through the utility side panel with either the included external power supply or a USB mini-B cable (not included). The side panel also provides an external modulation input and a power monitoring output via SMA connectors.

3.2. Features

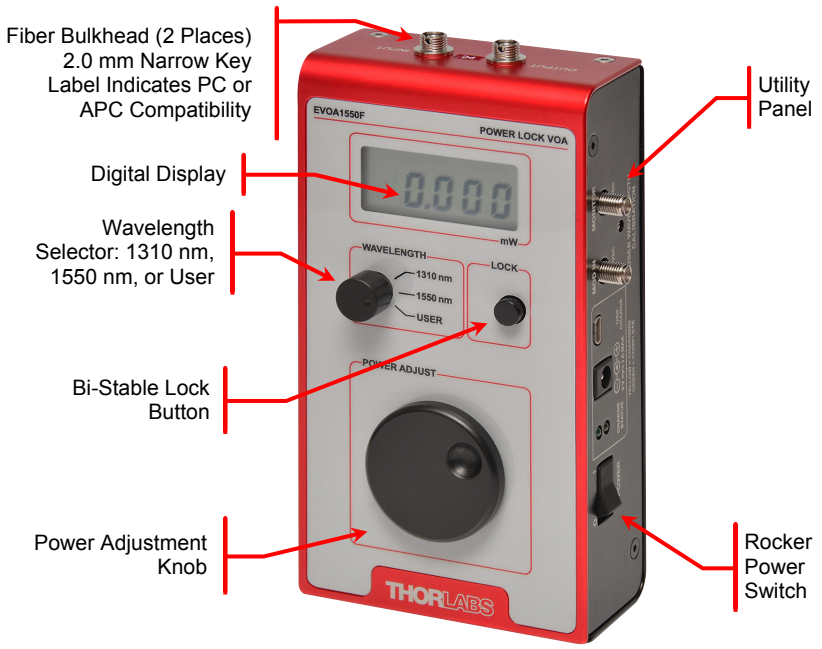


Figure 1 Front View

3.3. Fiber Interface & Utility Panels

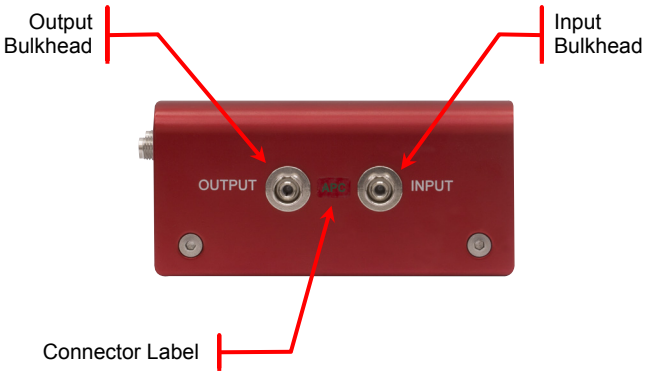


Figure 2 Fiber Interface Panel (Top View)

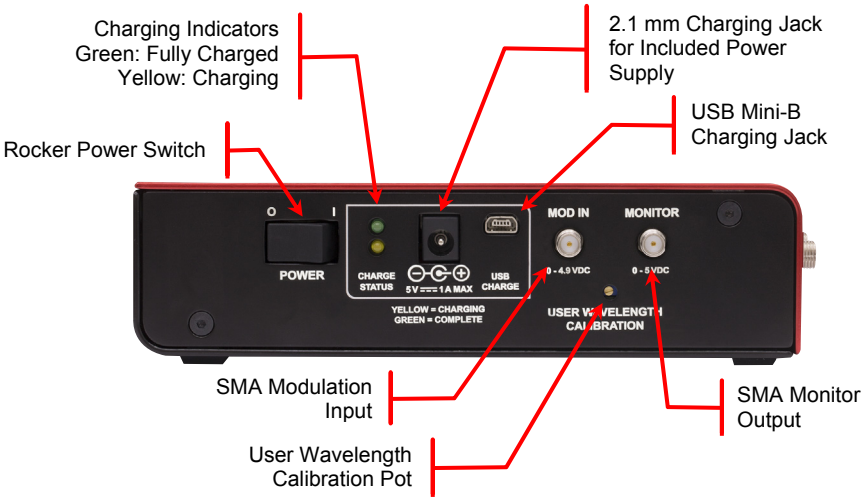


Figure 3 Utility Panel (Side View)

3.4. Quick Start Guide

ESD CAUTION

The components inside these products are sensitive to electrostatic discharge (ESD). Take all appropriate precautions, including grounding personnel and equipment, before making any connections to the unit.

In the box, you should find the EVOA and its power supply with a 2.1 mm coaxial plug that matches the power input jack on the side of the unit.

Follow these simple instructions to get started as quickly as possible:

1. **Make sure the unit is sufficiently charged.** It is shipped about 50% charged. Using the included power supply, it typically takes 5 hours to reach a full charge (starting from the “Low Battery” indicator) that lasts for hundreds of hours.
2. **Connect input and output fiber patch cables (single mode only) to the bulkheads.** Make sure they are clean. We recommend the FCC-7020 Fiber Connector Cleaner and the FBC1 Bulkhead Cleaner for fiber tips and bulkheads, respectively.
3. **Select the desired wavelength with the selector knob.** The unit is factory calibrated for both 1310 nm and 1550 nm. Other wavelengths in the 1250 - 1625 nm range can be user calibrated.
4. **Turn the rocker power switch ON.**
5. **Adjust the attenuation to get the desired output power on the digital display.**
6. **Press the Lock button to hold the power setting (optional).** A green LED will blink to indicate a successful lock. A red LED will blink if the unit cannot find a lock.
7. **Release the Lock button to make any further adjustments.**

Chapter 4 Operating Instructions & Details

4.1. Overview

This chapter provides deeper details about the EVOA and its operation. To get started with using the EVOA, refer instead to the Quick Start Guide (Section 3.4).

The block diagram below (Figure 4) depicts the unit's basic architecture. The EVOA is controlled by analog electronics. The front panel provides a power adjustment knob, a digital output power display, and Power Lock capability.

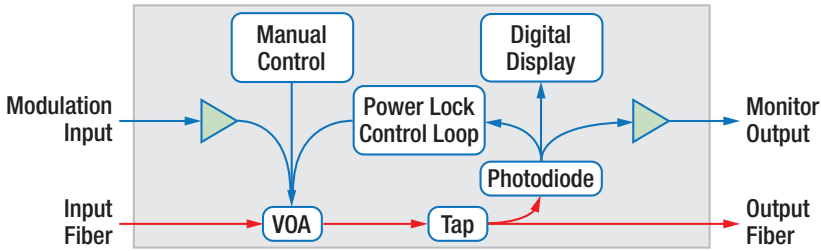


Figure 4 Basic Architecture of EVOA

Starting from the left of Figure 4: The light in the input fiber is coupled directly into a MEMS-based variable optical attenuator (VOA), and the attenuated light is sampled by a low-percentage tap. The tap output is sent into a photodiode whose signal is used by the digital output power display, the Power Lock control loop, and the SMA monitor output. The attenuation value can be controlled by the manual power adjustment knob, the Power Lock control loop, or the SMA modulation input.

When the power is switched off, the EVOA defaults to a mid-range attenuation whose value is independent of the knob position.

4.2. Powering & Charging the Unit

The EVOA is powered by an internal rechargeable Li-ion battery which provides approximately 300 hours of continuous operation on a full charge. The battery's internal circuits prevent full discharge after the Low Battery indicator appears on the display. To charge the unit, use either the 2.1 mm coaxial power cord that is included with the EVOA, or use a USB mini-B cable and charger (not included). If the device continues to be used while the Low Battery indicator is active, it will eventually be shut down by the battery's safety circuits.

The 2.1 mm coaxial power cord will provide 1 A of charging current and hence the fastest charging time. In contrast, the charging current provided by a USB cable is up to 500 mA, as determined by the power source. For example, some

USB chargers (e.g., for phones or tablets) will provide a maximum of 500 mA, while others (e.g., those on a PC) will be as low as 100 mA. All charging rates are sufficient to power the device while simultaneously charging the battery, but charging will take longer at lower currents.

Two LEDs on the side utility panel indicate the charging status of the unit. A yellow LED indicates that charging is in progress, while a green LED indicates that charging is complete. If both LEDs are lit, there is a battery fault. Please contact Thorlabs' tech support (techsupport@thorlabs.com) if this occurs.

When the power is switched on, the attenuation will be set at the value determined by the position of the manual power adjustment knob. If this value is not known, we recommend rotating it completely counterclockwise before switching the power on. This will ensure maximum attenuation.

When the power is switched off, a voltage remains on the internal VOA, such that there will still be mid-range attenuation even when the power is off. This is a precautionary feature that uses virtually no current, as the EVOA is an ultra-low current device. This feature does not drain the battery meaningfully faster than the battery itself would lose charge otherwise.

4.3. Fiber Connections

The fiber patch cable input and output bulkheads (see Figure 2) are both FC style. They may be ordered with PC- or APC-style internal connectors:

- Item # EVOA1550F has FC/PC connectors.
- Item # EVOA1550A has FC/APC connectors.

The fiber patch cable and connectors should be cleaned whenever a connection is made. We recommend the FCC-7020 Fiber Connector Cleaner and the FBC1 Bulkhead Cleaner for fiber tips and bulkheads, respectively. See Chapter 5, Maintenance & Repair, for guidance.

4.4. Wavelength Selection & Calibration

The digital output power display gives the calibrated output power at the wavelength indicated by the selector knob. The first and second knob positions are for 1310 nm and 1510 nm, while the third position (labeled "USER") can be calibrated by the user for any wavelength in the 1250 - 1625 nm operating range. The user calibration trimpot is located on the side utility panel.

To calibrate the USER position on the knob, the following tools are required:

- A single mode laser source at the desired wavelength,
- An accurate power meter for that wavelength,
- Input and output fiber patch cables, and
- A small flathead screwdriver to adjust the trimpot.

Follow these simple steps to calibrate the USER position:

1. Switch the wavelength selector knob to the USER position.
2. Send an optical input into the input bulkhead at the wavelength of interest. We recommend an input power of a few mW for the best accuracy.
3. Rotate the manual power adjustment knob completely clockwise to set it at minimum attenuation.
4. Attach the power meter to the output fiber patch cable. (Make sure the power meter is set to the correct wavelength.)
5. Adjust the user calibration trimpot so that the power value on the digital display agrees with the value shown on the power meter.
6. At this point, we recommend making a note of the user wavelength and placing a piece of tape over the trimpot to prevent accidental adjustments.

4.5. Attenuation Control

The user can control the attenuation using two analog methods.

The first and simplest method is to rotate the manual power adjustment knob on the front panel (see Figure 1). This knob provides the full range of attenuation. Rotating it clockwise increases the output power, while rotating it counterclockwise decreases the output power. The knob has ten full rotations.

The second method is to apply a voltage to the SMA modulation input on the side utility panel (see Figure 3). This input allows for modulation from DC to 1 kHz. See Section 4.7, Modulation Input & Monitor Output Connections, for details.

4.6. Digital Output Power Display

The digital output power display uses the signal from the tap output (see Section 4.1) to calculate the calibrated output power before the tip, in mW, at 1310 nm, 1510 nm, or the user wavelength. The display offers 4.5 digits of resolution (the leftmost digit has a maximum value of 1). The display range will auto-scale for low or high input power, and changes over at about 15 mW.

The digital display also has a Low Battery warning that indicates when the battery needs to be charged. The warning appears while there is still sufficient charge remaining for the Li-ion battery not to degrade.

4.7. Modulation Input & Monitor Output Connections

The side utility panel (see Figure 3) provides two SMA connectors: an input for analog modulation and an output for power monitoring.

The modulation input allows the user to control the attenuation by applying an AC or DC voltage of up to 4.9 V. AC drive signals of up to 1 kHz can be used for high-speed modulation of the output power. Note that for the modulation input to use the full attenuation range of the unit, the manual control knob must be fully rotated clockwise to the maximum power (minimum attenuation) setting. This is because the external input simply adds voltage to the internal VOA (shown in Figure 4), which is biased at almost 0 V at minimum attenuation.

The monitor output provides a voltage that is proportional to the output power. The conversion gain is 20 mV/mW, which results in a full-scale voltage of 4 V for 200 mW of output power. The monitor circuit has a response bandwidth of 1 kHz minimum / 2 kHz typical.

4.8. Power Lock

Power Lock is a unique feature that locks the output power at a user-defined level. When this mode is active, the EVOA will continuously adjust the attenuation in order to keep the output power constant as the input power changes. This is ideal for use in long-term measurements where the optical power needs to be fixed.

When the Lock button is engaged (see Figure 1), the Power Lock control circuit will designate the output power on the digital display as the output power setpoint. This circuit has a maximum bandwidth of 1 Hz.

Note that pushing the button may cause a slight offset in the output power, which is due to the resolution of the sample-and-hold circuit. If the manual power adjustment knob is rotated while Power Lock is active, then disengaging the button will cause the output power to jump to the value determined by the knob.

The indicator LED next to the Lock button will flash green intermittently when Power Lock is active and successfully holding the output power constant. If the EVOA loses the lock, then the indicator light will flash red. This typically indicates that the input power has changed significantly enough that the EVOA can no longer successfully compensate.

If this occurs, but then the input power returns to the original range, the control circuit will reengage the lock and the indicator will flash green. If the lock does not reestablish, then disengage the Lock button, rotate the manual knob to the desired output power, and engage the button again.

Power Lock performs best when the input fluctuations are confined to within reasonable limits. In order for it to maintain the output power at the setpoint and respond to changes in input power quickly, the input power must always be greater than the sum of the output power and the EVOA insertion loss. As a rule of thumb, if the input power is 2X the output power setpoint, the 1% settling time (i.e., the time until the output power returns to within 1% of the setpoint) is <0.5 seconds. For smaller ratios, the 1% settling time will increase, but the power will still stabilize.

Chapter 5 Maintenance & Repair

The EVOA should not require regular maintenance. If necessary, the housing can be cleaned using a soft cloth moistened with a mild glass cleaner. Do not use chemical solvents or harsh cleaning solutions on the display, and do not spray cleaning solutions directly onto the unit.

The EVOA does not contain any user-repairable components. If malfunctions occur, please contact Thorlabs' technical support (techsupport@thorlabs.com). Do not disassemble the unit. There are no user-serviceable components inside.

The end faces of any fiber patch cables being connected to the EVOA should be cleaned every time a connection is made. Use, for example, Thorlabs' FCC-7020 Fiber Connector Cleaner (sold separately). The end faces of the EVOA's internal connectors can be easily damaged by dirty fiber ends, and if damage occurs, the unit will need to be returned to Thorlabs for repair.

The EVOA's internal connectors can be cleaned using, for example, Thorlabs' FBC1 Fiber Bulkhead Cleaner (sold separately). The FBC1 allows the internal connector to be cleaned without removing it from the unit.

Figure 5 FCC-7020 Fiber Connector Cleaner

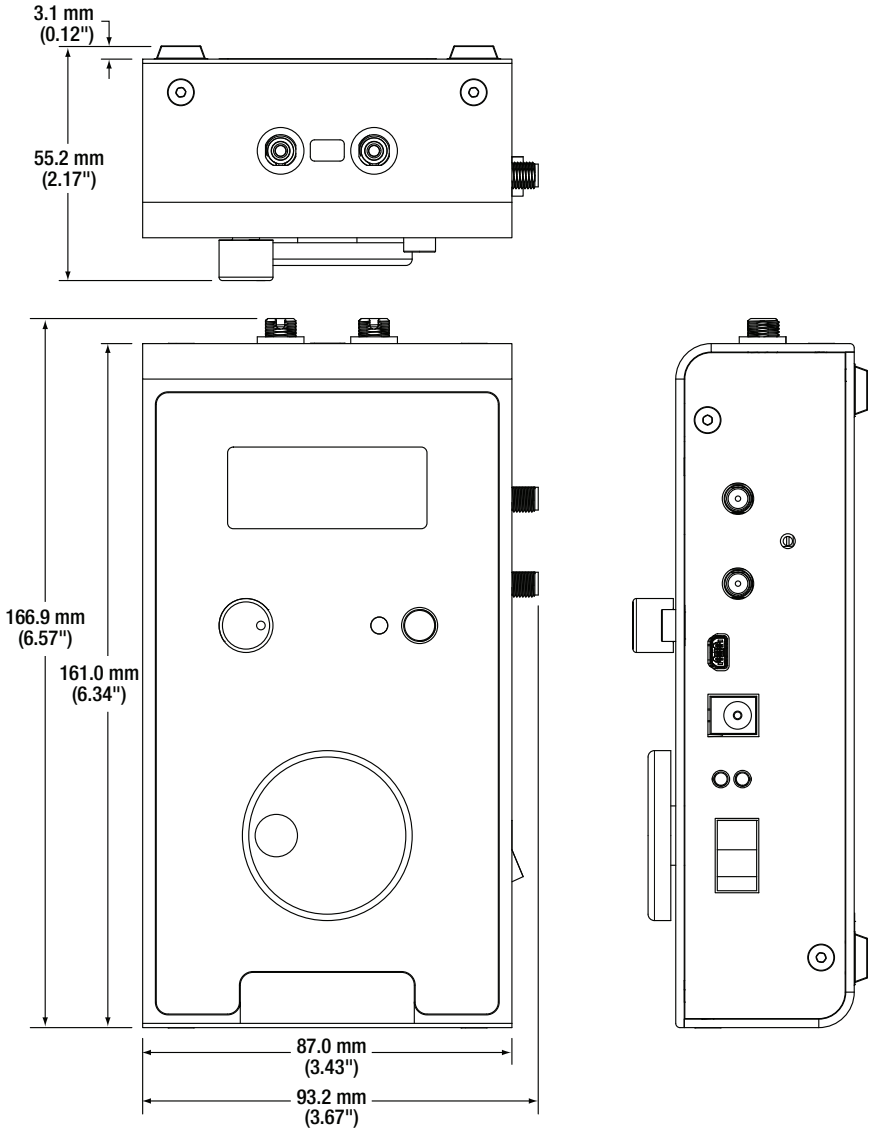
Figure 6 FBC1 Fiber Bulkhead Cleaner

Chapter 6 Specifications

6.1. General Specifications

Item #	EVOA1550F	EVOA1550A
Fiber Interfaces	2.0 mm Narrow Key FC/PC	2.0 mm Narrow Key FC/APC
Wavelength Range	1250 - 1625 nm	
Input Power	200 mW (Max) Absolute Maximum: 250 mW	
Attenuation	Minimum: 1.5 dB (Typ.) Maximum: >25 dB	
Return Loss	≥40 dB	
Digital Display Resolution	4.5 Digits, Auto-Ranging	
Digital Display Accuracy	5% (Typ.) 10% (Max)	
Internal Fiber	SMF-28	
Modulation Input		
Input Voltage	0 V to 4.9 V Absolute Maximum: 5.0 V	
Input Impedance	High Z	
Bandwidth	DC to 1 kHz (Typ.)	
Connector	Female SMA	
Monitor Output		
Conversion Gain	20 mV/mW	
Output Impedance	High Z	
Bandwidth	DC to 1 kHz (Min) DC to 2 kHz (Typ.)	
Connector	Female SMA	
Battery Specifications		
Battery Life	300 h (Typ.) from Full Charge	
Battery Charge	3000 mAh	
Battery Charging Time	5 h (Typ.) from 2.1 mm Coaxial Barrel Jack	
Battery Charging Input Power	5 VDC; Up to 1 A	
Battery Charging Connectors	2.1 mm Coaxial Barrel Jack (1 A) Female USB Mini-B Connector (Up to 500 mA)	
Physical Specifications		
Dimensions	166.9 mm x 93.2 mm x 55.2 mm (6.57" x 3.67" x 2.17")	
Operating Temperature	10 to 40 °C	
Storage Temperature	0 to 50 °C	
Relative Humidity	5% to 85% RH (Non-Condensing)	

6.2. Mechanical Drawings

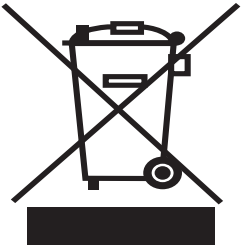


Chapter 7 Regulatory

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

This offer is valid for Thorlabs electrical and electronic equipment:

- Sold after August 13, 2005
- Marked correspondingly with the crossed out “wheelie bin” logo (see right)
- Sold to a company or institute within the EC
- Currently owned by a company or institute within the EC
- Still complete, not disassembled and not contaminated



Wheelie Bin Logo

As the WEEE directive applies to self contained operational electrical and electronic products, this end of life take back service does not refer to other Thorlabs products, such as:

- Pure OEM products, that means assemblies to be built into a unit by the user (e.g. OEM laser driver cards)
- Components
- Mechanics and optics
- Left over parts of units disassembled by the user (PCB’s, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

Waste Treatment is Your Own Responsibility

If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

Ecological Background

It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of life products will thereby avoid negative impacts on the environment.

Chapter 8 Certificate of Compliance

THORLABS
www.thorlabs.com

EU Declaration of Conformity

in accordance with EN ISO 17050-1:2010

We: Thorlabs Inc.

Of: 56 Sparta Avenue, Newton, New Jersey, 07860, USA

in accordance with the following Directive(s):

Low Voltage Directive (LVD)

Electromagnetic Compatibility (EMC) Directive

Restriction of Use of Certain Hazardous Substances (RoHS)

Eco-Design Directive

hereby declare that:

Model: ***EVOA1550F, EVOA1550A***

Equipment: ***Power Lock VOA***

is in conformity with the applicable requirements of the following documents:

EC No 278/2009 Eco-Design Requirements for External Power Supplies 2009

and which, issued under the sole responsibility of Thorlabs, is in conformity with Directive 2011/65/EU of the European Parliament and of the Council of 8th June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment, for the reason stated below:

does not contain substances in excess of the maximum concentration values tolerated by weight in homogenous materials as listed in Annex II of the Directive

I hereby declare that the equipment named has been designed to comply with the relevant sections of the above referenced specifications, and complies with all applicable Essential Requirements of the Directives.

Signed: *On:* 14 March 2016

Name: Ann Strachan

Position: Compliance Manager

EDC - EVOA1550F, EVOA1550A -2016-03-14

CE 16

Chapter 9 Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at www.thorlabs.com/contact for our most up-to-date contact information.

USA, Canada, and South America
Thorlabs, Inc.
sales@thorlabs.com
techsupport@thorlabs.com

UK and Ireland
Thorlabs Ltd.
sales.uk@thorlabs.com
techsupport.uk@thorlabs.com

Europe
Thorlabs GmbH
europe@thorlabs.com

Scandinavia
Thorlabs Sweden AB
scandinavia@thorlabs.com

France
Thorlabs SAS
sales.fr@thorlabs.com

Brazil
Thorlabs Vendas de Fotônicos Ltda.
brasil@thorlabs.com

Japan
Thorlabs Japan, Inc.
sales@thorlabs.jp

China
Thorlabs China
chinasales@thorlabs.com

THORLABS

www.thorlabs.com