THORLABS

SPDC810
Spontaneous Parametric Down-Conversion Source

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

Chapter 2 Safety

2.1. Laser Classification

Per 21 C.F.R. §1040.10 and IEC 60825-1:2014, the SPDC810 source is classified as a Class 1 laser. The latter form of the classification is used throughout the rest of this manual.

WARNING

Do not open the SPDC810 Source.

No access to the interior of the device is required to adjust the device or perform any maintenance function. There are no user serviceable parts inside. Opening the device will void the warranty and may expose you to laser light in excess of the designated laser classification.

2.2. Laser Safety Labels

Figure 1 Laser Safety Label per IEC 60825-1:2014 §7.

WARNING

Optical alignment and laser service should only be performed by qualified professionals.

WARNING

Always wear appropriate laser safety eyewear during setup and operation of the laser.

Safe practices and proper usage of safety equipment should be taken into consideration when operating lasers. The eye is susceptible to injury, even from very low levels of laser light. Laser emission in the visible and near infrared spectral ranges has the greatest potential for retinal injury, as the cornea and lens are transparent to those wavelengths, and the lens can focus the laser energy onto the retina.

2.3. Resources

Safety of laser products –
Part 1: Equipment classification and requirements
IEC 60825-1:2014
ISBN 978-2-8322-1499-2

PERFORMANCE STANDARDS FOR LIGHT-EMITTING PRODUCTS
21 C.F.R. §1040

Laser Safety Guide
Laser Institute of America
ISBN 978-1-940168-03-6
www.lia.org/store/product/laser-safety-guide

Chapter 3 Description

3.1. Introduction

Thorlabs' SPDC810 is a collinear type-II Spontaneous Parametric Down-Conversion (SPDC) source. Inside, a nonlinear crystal converts individual 405 nm photons into pairs of orthogonally polarized 810 nm photons in a single event. These pairs are split by polarization into two channels and delivered to the two polarization maintaining (PM) fiber outputs.

The 405 nm photons are produced by an integrated diode laser with an adjustable power of up to 150 mW. The efficiency of the down-conversion process is approximately 10^{-12}, leading to an output power on the order of femtowatts.

3.2. Shipping List

- SPDC810 Head
- DS12 Power Supply
- RS232 Cable

3.3. Connections

Figure 2 Side Panel Connections on SPDC810 Head

The SPDC810 head connections are as follows:

- Left Fiber Bulkhead: "Signal" Channel
- Right Fiber Bulkhead: "Idler" Channel
- 9-Pin D-Sub: Serial (RS232) Connection to Pump Laser
- M8 Power Connection (Top Right): Connects to 12 V DC Supply

3.4. Operating Conditions and Environmental Requirements

In order to achieve optimal performance of the laser system, please observe the following guidelines.

3.4.1. Temperature Range

Control of the ambient room temperature is important for stable operation of the system. The lab temperature should be in the range of 18 °C - 25 °C.

If unpacking the device for the first time and it is extremely cold (from shipping conditions, for instance), allow it to come to room temperature before opening the sealed internal bag. This will prevent condensation on internal optics and damage or permanent reduction in performance.

3.4.2. Heat

The SPDC810 crystal temperature is regulated by an oven, which can produce up to 25 W of heat. Under some conditions, the temperature of the SPDC810 housing may reach 50 °C. Make sure that there is sufficient clearance around the device (approximately 1" on all sides) to allow airflow.

3.4.3. Air Quality and Humidity

The SPDC810 source is not hermetically sealed. Small amounts of contamination and moisture can penetrate the enclosure. An excessively dusty or humid environment will damage the system.

The humidity should be controlled to avoid condensation and resultant damage to optical components. The system should not be placed close to air handling vents (cooling or heating), so as to avoid sudden changes of humidity and/or temperature.

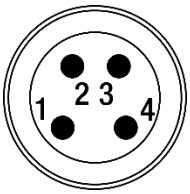
Chapter 4 Setup and Operation

4.1. Before Starting

All users should read and understand the safety information in this manual before operating the equipment. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

4.2. Power

Before connecting the power supply to the mains voltage, first connect the power supply to the device and, then, plug in the mains power to the power supply. Communication with the device is almost immediate, but up to an hour may be required for the device to come to thermal equilibrium.



Pin	Description
1	Not Connected
2	Not Connected
3	+12 V
4	Ground

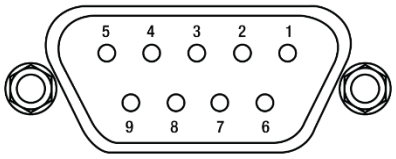
Figure 3 Pin Descriptions for M8 Male Connector on the Housing

4.3. Fiber Coupling

Connect appropriate fiber patch cables to the output ports of the device. We recommend using the P1-780PM-FC-* Thorlabs patch cables for maintaining polarization. If polarization information does not need to be retained, P1-780Y-FC-* or P1-780A-FC-* cables can be used. Patch cables should be clean and free of debris before being attached to the two output ports; see section 5.1 Connector Cleaning.

4.4. Serial Communication

The RS232 serial connection allows direct control of the integrated 405 nm pump laser.



Pin	Description
1	Data Carrier Detect (DCD)
2	Received Data (RxD)
3	Transmitted Data (TxD)
4	Data Terminal Ready (DTR)
5	Signal Ground (GND)
6	Data Set Ready (DSR)
7	Request to Send (RTS)
8	Clear to Send (CTS)
9	Ring Indicator (RI)

Figure 4 Pin Descriptions for RS232 Female Connector on the Housing

Connect a serial cable between a terminal-capable device (typically a PC) and the SPDC. Serial settings should be:

RS232 Communication Settings	
Baud Rate	115200
Data Bits	8
Stop Bits	1
Parity	None
Flow Control	XON / XOFF
Line Ending	CR-LF
Backspace	^H

4.4.1. Terminal Commands and Queries

All commands and queries are in **lower case** letters.

Text in [ ] is optional. To signify variables, (value, type) will be used. {Units} will be called out for reference to the reader only, should not be included in typed commands, but may be in returned data.

Command/Query				Description
ch[annel]	1	pow[er]	(power, float)	Set pump power in mW[a]
di[sable]	1			Disable pump[a]
echo	off			Disable echoing of characters from pump
echo	on			Enable echoing of characters from pump
en	1			Enable pump channel
id				Returns ID of pump
la[ser]	on			Activate pump diode driver
la[ser]	off			Deactivate pump diode driver
prom[pt]	off			Disable pump prompt handshake
prom[pt]	on			Enable pump prompt handshake
reset	sys			Reboot pump
sa[mple]	cur[rent]			Sample pump current continuously {mA}
sa[mple]	temp[erature]			Sample pump diode temp continuously {°C}
serial				Returns serial number of pump
sh[ow]	cur[rent]			Shows actual pump diode current
sh[ow]	limit			Returns limits of all pump settings
sh[ow]	pow[er]			Returns self-measured pump power {µW}
sh[ow]	temp[erature]	sys[tem]		Returns pump baseplate temperature {°C}
sh[ow]	temp[erature]			Returns pump diode temperature {°C}
sh[ow]	tim[er]			Returns pump & pump diode uptime {s}
sta[tus]	ch[annel]	1		Returns pump channel status[a]
sta[tus]	la[ser]			Returns pump laser driver status
sta[tus]	supp[ly]			Returns pump supply voltage status
sta[tus]	temp[erature]			Returns pump driver temperature status
sta[tus]	up			Returns pump system and laser uptime
ver				Returns pump firmware version

[a] The pump laser has only one channel. Using a channel number other than 1 has no effect.

4.5. Operation

Wait for a `CMD>` prompt before sending commands. All commands are case-sensitive and should be lower case.

The pump power can be set before or after enabling emission. For example, to set the pump power to 10 mW, send the following commands over the serial interface:

```
ch 1 pow 10
```

To check the current power setting:

```
sh pow
```

To turn on the pump laser and enable the pump's channel 1, send the following commands over the serial interface:

```
la on
en 1
```

To turn the SPDC810 off:

```
la off
```

Once channel 1 has been enabled, `la on` and `la off can be used` to turn it on and off.

4.6. Lifetime

The internal 405 nm pump laser has a limited lifetime. To maximize the useful life of the SPDC810, the pump laser should be turned off when the device is not being used. See Chapter 7 Specifications for details.

Chapter 5 Maintenance

5.1. Connector Cleaning

Fiber patch cables and the connector tips inside the bulkhead connector should be cleaned every time before a connection is made. Failure to do so may result in damage to the patch cord, the internal fiber connector, or both.

WARNING

DO NOT connect fiber patch cords to the bulkhead connectors without cleaning the fiber tips first. Failure to follow this precaution may result in permanent damage to the unit.

Thorlabs recommends our FCC-7020 universal fiber connector cleaner (pictured below) for cleaning the tips of patch cords. To use:

1. Open the door on top of the FCC-7020.
2. Pull the white tape out until the perforations clear the window.
3. Place the tip of the patch cord flat against the white tape on either the right or left side.
4. Drag the tip down the white tape front.
5. Repeat steps 3 - 4 on the opposite end of the patch cord.

Take care not to twist the connector while cleaning.

Instructions for using the FBC250 are located on the Thorlabs website.

FCC-7020
Fiber Cleaning Cloth Spool

FBC250
Bulkhead and Connector Cleaner

A complete line of Thorlabs' fiber optic cleaning products can be found on the web at www.thorlabs.com.

5.2. Alignment

The internal alignment of the SPDC810 is very sensitive and may become misaligned during shipping and handling.

WARNING

DO NOT OPEN THE DEVICE. DOING SO WILL VOID THE WARRANTY. IF THE DEVICE IS OPENED, EXPOSURE TO LASER LIGHT IN EXCESS OF CLASS 1 LIMITATIONS MAY OCCUR.

Note that specialized photodetectors and electronics are required to measure the output of the SPDC810. Without such equipment, a useful signal for alignment will not be available. Refer to the SPDC810 specifications for information needed to choose appropriate detection equipment.

The x and y adjustments of a single internal mirror are available through access holes on the side of the SPDC810 housing (see Figure 3). The internal adjusters accept a 5/64" or 2 mm hex driver. See Chapter 8 Mechanical Drawing for the location of these adjustors on the device housing.

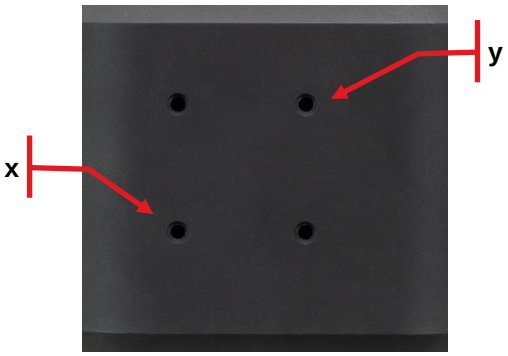


Figure 5 Mirror Alignment Adjusters

Before using these adjusters, make sure that you have some coincidence signal. You should only make changes to these adjusters when viewing the live coincidence signal rate.

The alignment precision required for time-correlated photons is significantly more challenging than the alignment necessary to achieve uncorrelated photons in both channels. The alignment that generates the maximum correlated photon pairs is not guaranteed to be at the exact maximum for generation of all photons (looking at each channel in isolation).

Chapter 6 Troubleshooting

Description	Possible cause	Solution
Zero or low photons	Internal misalignment	Perform the mirror adjustment described in 5.2 Alignment.
	Low pump power	Increase the pump power.
	Dirty or damaged fibers	Inspect and clean the bulkhead connectors and patch cables.
Wavelengths of the signal and idler channels are different	Crystal temperature has not stabilized	Allow more time for the crystal temperature to stabilize.
	Device overheating	Ensure that the device has sufficient room for cooling and that the ambient temperature meets requirements.
Serial communication cannot be established	Incorrect serial settings	Confirm RS232 settings described in 4.4.
	Incorrect cabling	The provided cable is appropriate for most RS232 scenarios. However, non-standard configurations are common. For other configurations, refer to the connector diagram in section 4.4 to help in choosing appropriate cabling.

Chapter 7 Specifications

Item #	SPDC810
Operating Wavelength	810 ± 2 nm
η_{si} (Detector Excluded)[a,b]	>0.45
Max Pairs/Second	>450 kHz
Wavelength Stability[a]	±2.5 nm
Temperature Control	No
$g^{(2)}(\tau = 0)$[a,c]	<0.1
Extinction Ratio[a]	>17 dB
Lifetime	>2500 Hours of Pump Emission
Pump Laser Power[d]	10 mW to 150 mW
User Serviceable	No
Input Voltage	100 - 240 V
Frequency	50 - 60 Hz
Power Consumption	25 W (Max)
Interface	RS232 Serial
Room Temperature	18 °C to 25 °C
Storage Temperature	-10 °C to 60 °C
Humidity	Non-Condensing
Dimensions (L x W x H)	10.13" x 6.41" x 2.24" (257.2 mm x 162.7 mm x 56.9 mm)
Weight	2.6 kg

a. For a Pump Laser Power of 35 mW

b. η_{si} is the heralding ratio and can be determined using $\frac{C}{\sqrt{P_s P_i}}$, where *C* respresents the coincidence counts and P_s and P_i are the raw counts on the signal and idler channels, respectively.

c. Second-Order Correlation Measurement at Zero Time Delay[1]

d. The SPDC810 can be used at lower pump powers, but specifications will not be met.

[1] *More information can be found in P. Granger, G. Roger, and A.Aspect, "Experimental Evidence for a Photon Anticorrection Effect on a Beam Splitter: A New Light on Single-Photon Interference," Europhysics Letters, vol. 1, no. 4, pp. 173, 1985.*

Chapter 8 Mechanical Drawing

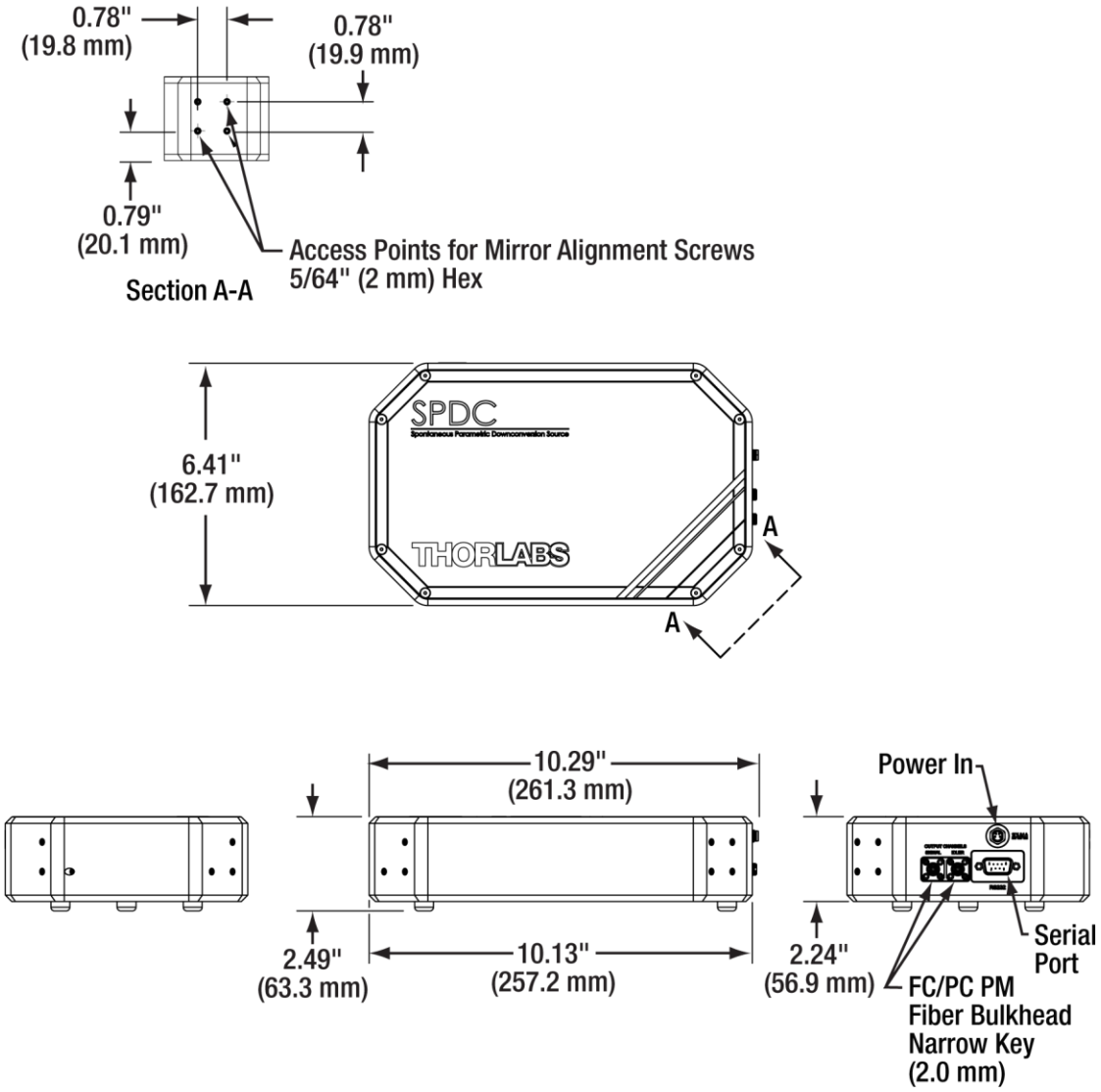
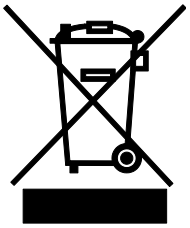


Figure 6 Mechanical Drawing of the SPDC810 Photon-Pair Source

Chapter 9 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

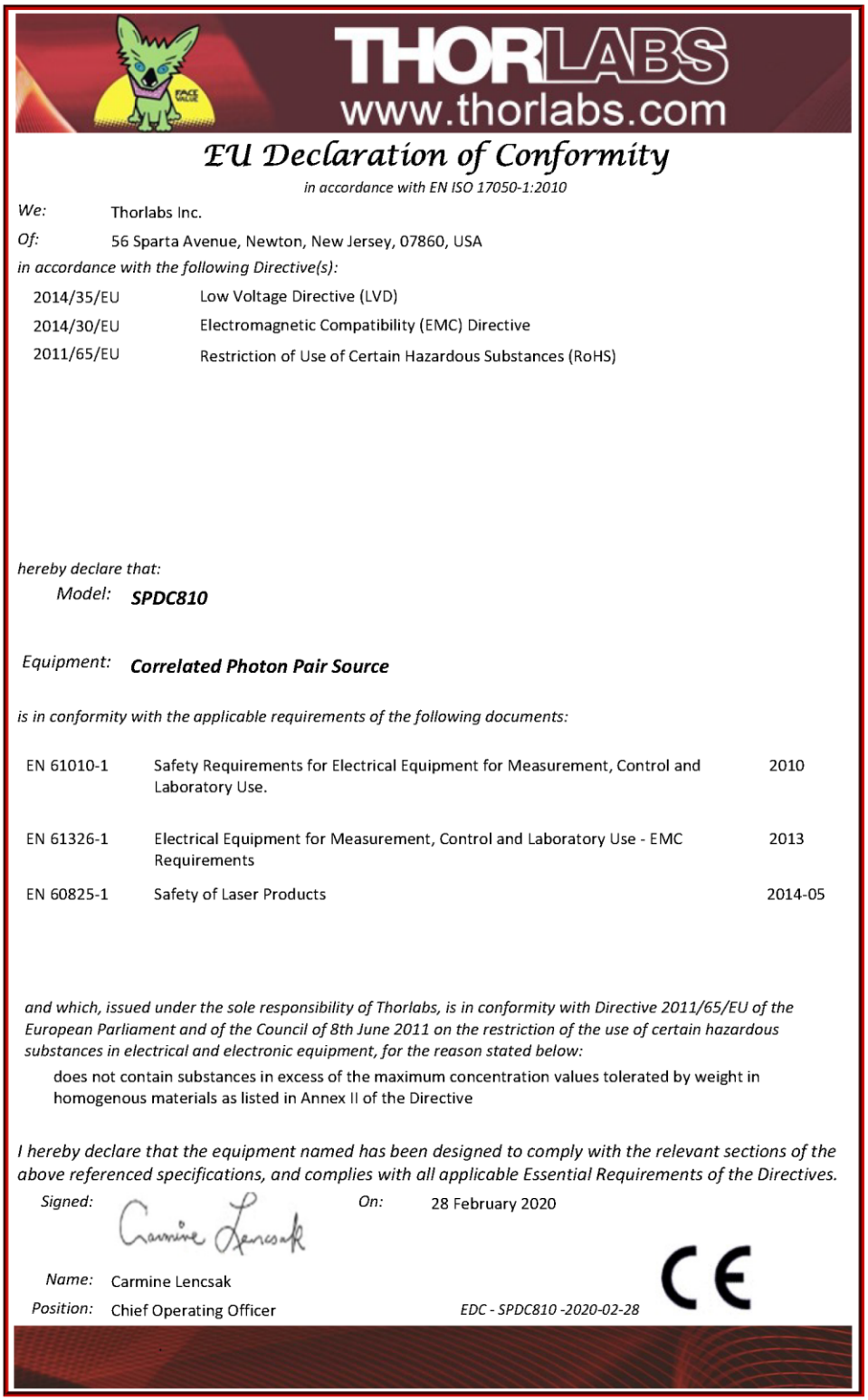
If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

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 10 Declaration of Conformity



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):

2014/35/EU	Low Voltage Directive (LVD)
2014/30/EU	Electromagnetic Compatibility (EMC) Directive
2011/65/EU	Restriction of Use of Certain Hazardous Substances (RoHS)

hereby declare that:

Model: ***SPDC810***

Equipment: ***Correlated Photon Pair Source***

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

EN 61010-1	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use.	2010
EN 61326-1	Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements	2013
EN 60825-1	Safety of Laser Products	2014-05

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: Carmine Lencsak *On:* 28 February 2020

Name: Carmine Lencsak

Position: Chief Operating Officer

EDC - SPDC810 -2020-02-28

CE

Chapter 11 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.

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UNLEASHED