

User Manual

pE-10



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1. Introduction

The CoolLED pE-10 is designed primarily with multiplex fluorescence imaging in mind, though it could also have appeal simply as a highly wavelength-flexible light source for microscopes and instruments used for a wide range of imaging applications. The pE-10 has LED wavelengths from 365 nm to 850 nm. These are spectrally spaced to enable filter-based spectral separation such that use of spectral unmixing algorithms can be avoided.

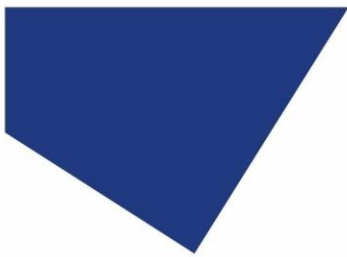
At the time of design, the LED wavelengths match the commercially available SpectraSplit® 10 filter sets from Kromnigon. A range of commercially available fluorochromes from a number of manufacturers can work with the pE-10 and SpectraSplit® 10.

This user manual provides all the information required for installation and safe operation. For additional details, as well as other valuable LED illumination resources, please see the CoolLED website: www.cooled.com.

2. Safety Precautions

Warning: While LEDs are much safer than the mercury and metal halide lamps they replace in microscopy applications, precautions should still be taken with this product. When operating or maintaining this product, please observe the following safety precautions at all times. Failure to do so may result in personal injury or damage to other items.

- Please ensure that only the power supply and cord supplied are used with this equipment.
- The AC cord supplied with this light source must only be used with the equipment supplied.
- UV and IR light may be emitted from this product depending on the wavelength selected. Avoid eye and skin exposure. Never look directly into the light output beam from the Light Source or accessories. The emissions could damage the cornea and retina of the eye if the light is observed directly.
- Always ensure that the Light Source is securely attached to the microscope via a light guide and collimator, prior to turning on the power. This will minimise the risk of injury and damage.
- If for any reason the Light Source is to be operated when not attached to a microscope, all personnel should wear eye shielding and clothing to protect the exposed skin.
- Disconnecting the mains supply is achieved by unplugging the power cord from the power supply block or the Light Source. Only plug in the power cable once the Light Source is attached to the microscope.



- There are no serviceable parts within the Light Source. Removing any of the screws and covers will result in the safety of the Light Source being impaired. The DC power supply unit should be inspected periodically throughout the lifetime of the system.
- Any electronic equipment connected to this product must comply with the requirements of EN/IEC 60950.
- The Light Source is for Indoor use only.
- To clean the exterior of the Light Source, use a slightly dampened cloth with a simple water solution only. Avoid the optical surfaces and lenses. Cleaning of optics should only be carried out using optical wipes and fluids. Please note that the DC power supply unit should be isolated prior to cleaning.

2.1 Safety Standards

This product has been assessed to the requirements of the Safety Standards as follows:

EN/IEC 61010-1:2010	Safety requirements for Electrical Equipment for Measurement, Control and Laboratory use.
EN62471:2008	Photo-biological Safety of Lamps and Lamp Systems/ Guidance on manufacturing requirements relating to non-laser optical radiation safety. Risk Group 3.

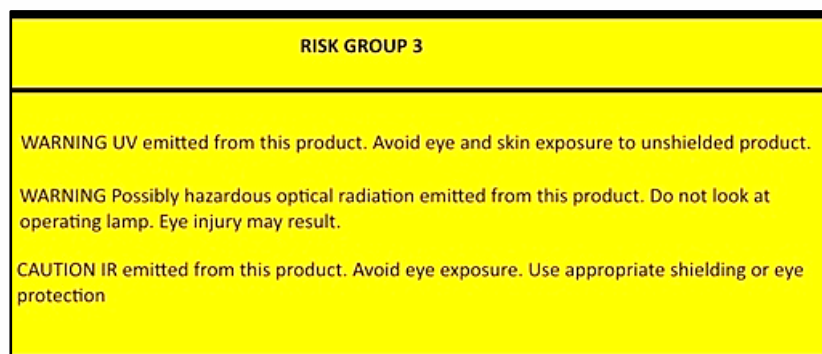


Figure 1: Risk Group 3 Warning Label

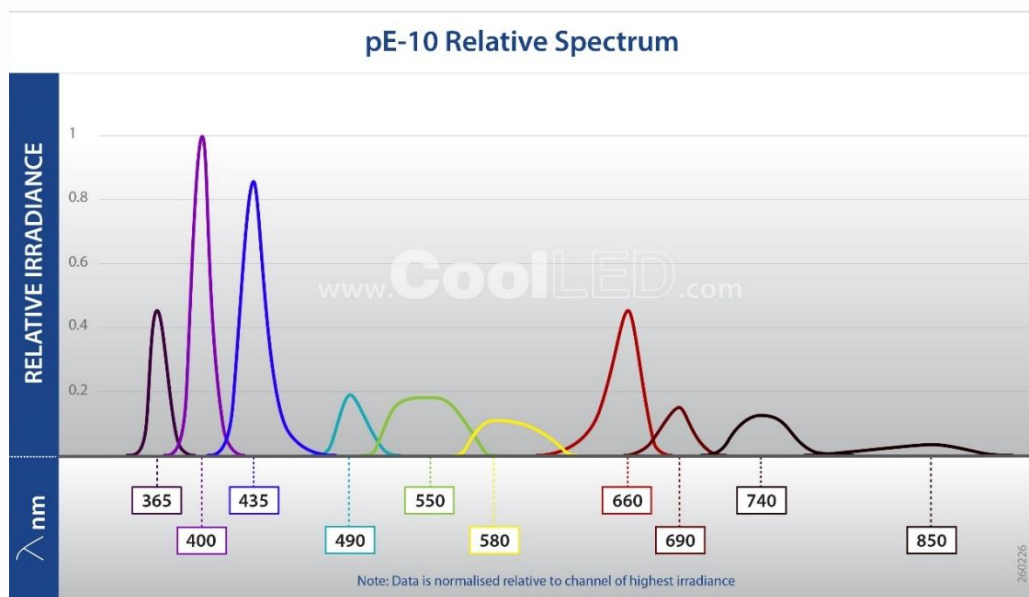
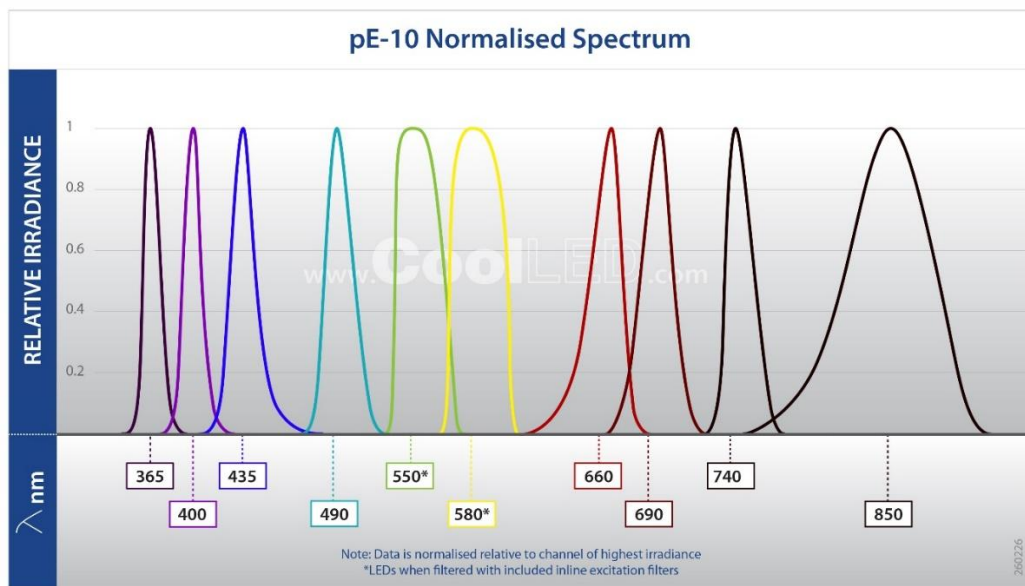
2.2 EMC compliance

This product is tested to the requirements of standard IEC/EN 61326-1 concerning electromagnetic compatibility. This is a Class B product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

3. Product Overview

3.1. LED Overview

The pE-10 is a ten-channel Illumination System, with each of the ten channels covering a distinct spectral region to match to common fluorophores and their relevant filter sets, from DAPI in the UV to CF850 in the near infra-red. Each channel is individually controllable, allowing only the required LEDs to be illuminated and the irradiance of these to be adjusted to provide the desired signal.



4. System Components

The CoolLED pE-10 Illumination System is supplied with the following components:

- Main Light Source with Optical Output for 3 mm liquid light guide
- Excitation filter holder with two cleanup filters (550/40 and 580/40)
- DC Power Supply type GST160A12-R7B
- IEC Power Cable
- USB Cable
- User Guide (USB stick)
- A variety of Hex keys

In addition to the components listed above, it is possible that a liquid light guide, collimator or additional accessories will be supplied. When un-packing the system, it is important to check the contents against the delivery note.



Figure 2: (clockwise) pE-10 Light Source, Filter Holder, pE-10 Power Supply

5. Reference Diagrams

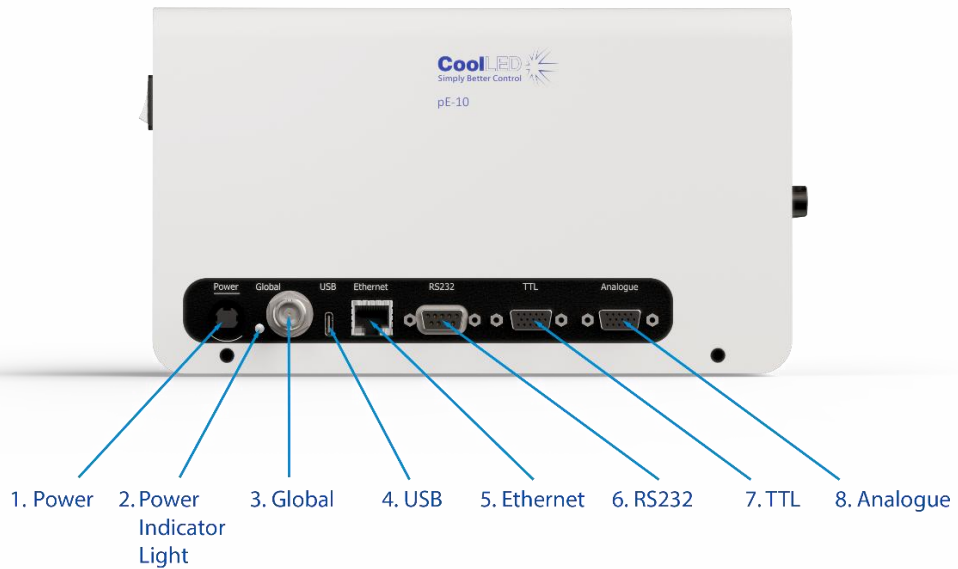


Figure 3: Control panel



Figure 4: Light output



Figure 5: Filter holder view

Item	Description	Item	Description
1	Power socket	7	Channel TTL
2	Power indicator light	8	Channel analogue
3	Global TTL input (global shutter)	9	Light output for LLG
4	USB-C	10	LLG retention screws
5	Ethernet	11	On/off switch
6	RS-232	12	Filter holder

6. Installation

6.1. Connecting the Liquid Light Guide

1. Insert a free end of a 3 mm liquid light guide into the Light Source, ensuring that the light guide is fully inserted in the Light Source output barrel (Figure 6).
2. While holding the liquid light guide securely in place, use the 1.5 mm Hex Key to gently fasten retention grub screw found at the output of the Light Source (Figure 7).



Figure 6



Figure 7

Do not over-tighten the liquid light guide retention grub screws. Over-tightening may damage the liquid light guide or the Light Source and result in an unsafe or poorly performing installation.

3. Ensure free airflow around the Light Source so that the cooling system is not impaired. A gap of 100 mm around the light source is sufficient. For optimal cooling performance the Light Source should only be operated in the orientation shown throughout this document, stood on its four rubber feet.
4. For microscopes that permit direct liquid light guide insertion, insert and secure the free end as per the microscope manufacturer's instructions.
 - For microscopes that do not permit direct liquid light guide insertion, the free end of the liquid light guide must be fed into a collimator such as the CoolLED pE-Universal Collimator. For information on installation, optical adjustment and moving to a different microscope, please see:

www.cooled.com/products/accessories/pe-universal-collimator

Note: For optimal performance, we recommend using the CoolLED universal collimator, which can be configured to suit the specific microscope setup. When properly adjusted, it typically provides superior irradiance and homogeneity, compared to alternative collimators.

6.2. Power Connection

With the pE-10 installed in its final location, it is now safe to connect the mains power, using the following steps.

1. Ensure the on/off switch on the back panel of the Light Source is in the off position.
2. Connect the Power Supply to the Light Source by inserting the Power Supply connector into the power socket marked on the side panel of the Light Source (Figure 3). Use the markings surrounding the power socket for correct orientation.
3. Once the pE-10 is mounted to a microscope, ensure that adequate clearance remains at the rear of the unit such that the PSU cable can be removed if required.

7. Light Source Control

With the pE-10 connected to the microscope, the following steps initiate and modulate illumination.

7.1. Software via USB connectivity

To communicate with the pE-10 for software control, connect the PC and Light Source, using the following instructions:

1. Connect the USB-A end of the supplied USB cable to an available PC port.
2. Connect the USB-C end to the Light Source (Figure 3).
3. The interface uses a virtual COM port, and Windows 10 or newer Operating Systems will automatically detect the pE-10.

7.2. TTL Triggering

TTL triggering maximises the switching speed of the LEDs to provide precise control of the excitation light reaching the sample.

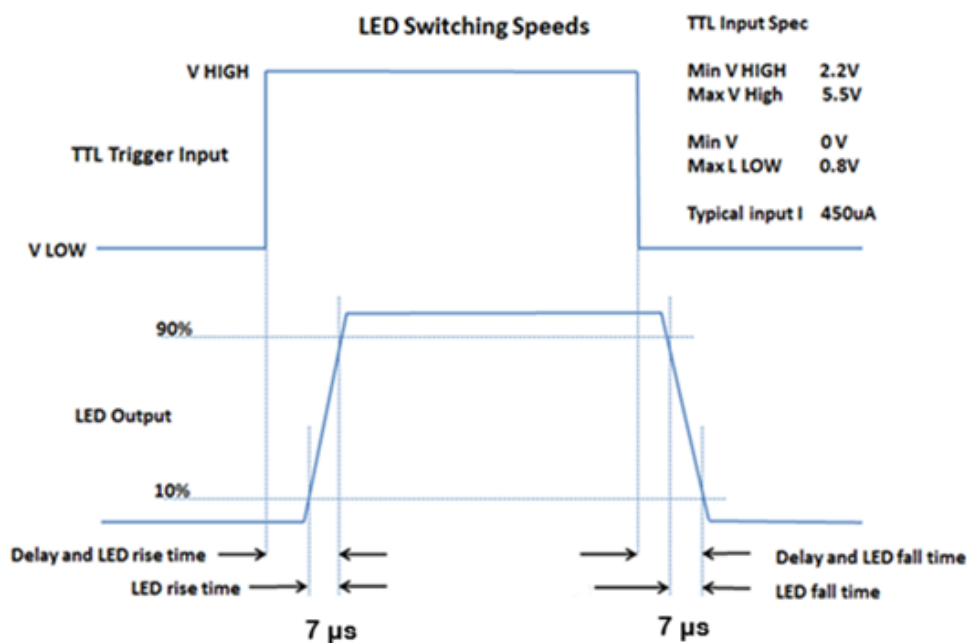


Figure 8: Voltage requirements and TTL triggering speeds when triggered at 100% intensity. There will be slight differences in speed between channels and at different intensities.

7.2.1 Global Triggering

The pE-10 includes a Global TTL Input (Figure 3) via a BNC Connector Jack (Female Socket 50 Ω) which provides the facility to control the overall illumination state of the Light Source using a TTL-output from a device such as a camera. Channels can be selected using either LightBridge (coming soon) or third-party software.

7.2.2. Channel Triggering

Individual LED channel TTL triggering is possible using the multi-pin TTL Inputs (Figure 3). The intensities of the selected channels are set using LightBridge or third-party software.

NOTE: Breakout cables are not currently available from CoolLED due to there being no clear standard, commercial solution. Please contact CoolLED to discuss this in more detail when looking for a solution.

TTL Port 15 Position D-Sub, High Density Receptacle, Female Sockets Connector			
Pin #	Name	Type	Maximum Rate Input/Output Voltages
1	550 nm	Digital Input	$0 \leq V_{in} \leq 5.5 \text{ V}$
2	435 nm	Digital Input	$0 \leq V_{in} \leq 5.5 \text{ V}$
3	690 nm	Digital Input	$0 \leq V_{in} \leq 5.5 \text{ V}$
4	TTL OUT 1	Digital Output	$0 \leq V_{out} \leq 3.3 \text{ V (typ)}$ $0.4 \text{ (max)} \leq V_{out} \leq 2.9 \text{ V(min)}$
5	GLOBAL In	Digital Input	$0 \leq V_{in} \leq 5.5 \text{ V}$
6	GROUND	Power	-
7	400 nm	Digital Input	-
8	365 nm	Digital Input	-
9	TTL OUT 2	Digital Output	$0 \leq V_{out} \leq 3.3 \text{ V (typ)}$ $0.4 \text{ (max)} \leq V_{out} \leq 2.9 \text{ V(min)}$
10	GROUND	Power	-
11	740 nm	Digital Input	$0 \leq V_{in} \leq 5.5 \text{ V}$
12	660 nm	Digital Input	$0 \leq V_{in} \leq 5.5 \text{ V}$
13	580 nm	Digital Input	$0 \leq V_{in} \leq 5.5 \text{ V}$
14	850 nm	Digital Input	$0 \leq V_{in} \leq 5.5 \text{ V}$
15	500 nm	Digital Input	$0 \leq V_{in} \leq 5.5 \text{ V}$



Figure 9: Physical position of TTL channels

7.3. Analogue

The irradiance of the LEDs in the pE-10 can be set by applying an analogue voltage to the relevant multi-pin connector (Figure 3). A signal of 0-10 V can be applied to the Analogue inputs and relates to 0-100% irradiance. For example, a 6.5 V signal applied to an input will set the channel to 65% irradiance.

NOTE: Breakout cables are not currently available from CoolLED due to there being no clear standard, commercial solution. Please contact CoolLED to discuss when looking for a solution.

Analogue Port			
15 Position D-Sub, High Density Receptacle, Female Sockets Connector			
Pin #	Name	Type	Maximum Rate Input/Output Voltages
1	550 nm	Analogue Input	$0 \leq V_{in} \leq 10 \text{ V}$
2	435 nm	Analogue Input	$0 \leq V_{in} \leq 10 \text{ V}$
3	690 nm	Analogue Input	$0 \leq V_{in} \leq 10 \text{ V}$
4	ANALOGUE OUT 1	Analogue Output	$0 \leq V_{out} \leq 10 \text{ V}$
5	INTERLOCK	Digital Input	$0 \leq V_{in} \leq 5.5 \text{ V}$
6	ANALOGUE GROUND	Power	-
7	400 nm	Analogue Input	-
8	365 nm	Analogue Input	-
9	ANALOGUE OUT 2	Analogue Output	$0 \leq V_{out} \leq 10 \text{ V}$
10	GROUND	Power	-
11	740 nm	Analogue Input	$0 \leq V_{in} \leq 10 \text{ V}$
12	660 nm	Analogue Input	$0 \leq V_{in} \leq 10 \text{ V}$
13	580 nm	Analogue Input	$0 \leq V_{in} \leq 10 \text{ V}$
14	850 nm	Analogue Input	$0 \leq V_{in} \leq 10 \text{ V}$
15	500 nm	Analogue Input	$0 \leq V_{in} \leq 10 \text{ V}$



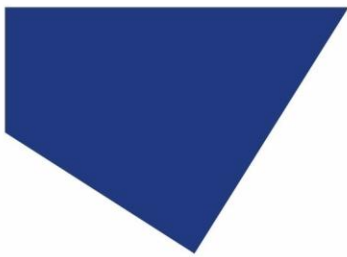
Figure 10: Physical position of analogue channels

7.4. RS-232

The pE-10 is fitted with a connector to allow RS-232 communication (Figure 3). A commands document is available upon request, which details the required serial commands.



Figure 11: Physical position of RS-232 channels



8. Inline Excitation Filters

For high-speed, high-contrast applications, the pE-10 accepts 25 mm excitation filters within the excitation filter holder.

8.1. Excitation Filter Positions



Figure 12: pE-10 inline excitation filter holder, showing LED positions.

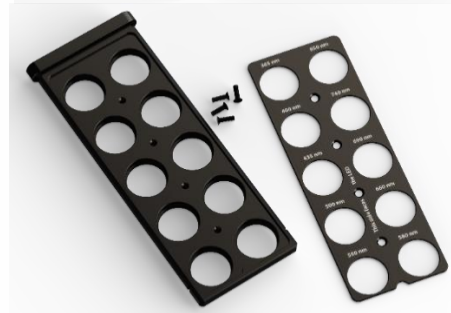
8.2. Fitting Excitation Filters

Two excitation filters are included with the pE-10 to narrow the spectral output of the 550 nm and 580 nm LEDs. The 550 nm excitation filter is marked as 'BP550/40', and the 580 nm excitation filter is marked as 'BP580/40'. To install these, or other filters, into the relevant positions of the filter holder (Figure 12), take the following steps:

1. Gently pull the excitation filter holder to remove it from the Light Source (do not loosen the screws).



2. Using a hex key, loosen the four retaining screws holding the securing plate holder. Remove the securing plate and put to one side.

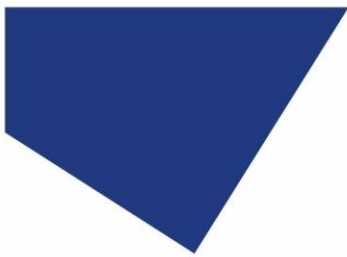


3. Slot the filter into the filter holder, in the relevant position according to the labels on the securing plate (Figure 12).

Note: Most excitation filters have a directional arrow on the side. Excitation filters should be installed in the holder with this arrow pointing down

4. Replace securing plate and gently fasten the retaining screws.
- Insert filter holder into the Light Source. Due to the shape of the filter holder, the filter can only be fitted in the correct orientation.





9. Product specifications

9.1. Power requirements

110-240 V a.c.	50/60 Hz	2.0 A	PSU (+/-10% Fluctuation)
12VDC		11.5A	Light Source

9.2. Power consumption

Standby mode	max 6 W
Ten channels at 100%	max 125 W

9.3. Dimensions

Light Source	260 mm (w) x 180 mm (d) x 145 mm (h)
	-weight 3 kg
Power Supply	175 mm (w) x 72 mm (d) x 35 mm (h)
	-weight 0.58 kg

9.4. Environmental Operating Conditions

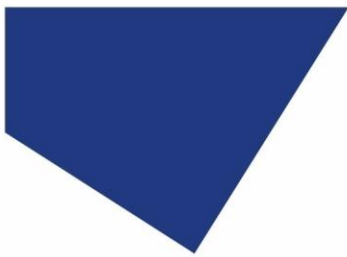
Operating Altitude: $\leq 3,000$ m asl
Working Temperature: 5 ~ 35 °C
Working Humidity: 20 % ~ 90% RH non-condensing
Storage Temp. & Humidity: -40 ~ +85°C, 10 ~ 95 % RH
Input Voltage Range: 100 ~ 240 VAC Input Frequency Range: 50 ~ 60 Hz
Pollution Degree 2 - Normally only nonconductive pollution occurs.
Temporary conductivity caused by condensation is to be expected.

10. Warranty and Repairs

Please refer to CoolLED's Warranty Policy available on the company website:

www.cooled.com/support/cooled-warranty/

Although warranty terms are fixed at the time of ordering according to the terms and conditions of sale in place, the Warranty Policy may be subject to periodic change, so please contact us to avoid confusion. For any warranty queries or in the event of the product developing a fault, email support@cooled.com for assistance. You will be asked to provide your microscope make and model, the Light Source serial number, and a description of the problem.



11. Compliance

For current compliance statements and environmental information please refer to our website:
www.coolled.com/support/environment/

12. Recycling

At CoolLED, we recognise the importance of preserving the environment and are proud to offer a Recycling Program to our customers. The CoolLED Recycling Program is a free service that permits customers to return any CoolLED Light Sources to CoolLED for recycling once it has reached the end of their useful life. The program is designed to reduce the burden on our environment through the responsible disposal and recycling of End-of-Life Light Sources. To participate in the program, complete our online contact form found at www.coolled.com/contact/contact-form and provide us with your contact details and the serial number of the CoolLED Light Source you wish to recycle. CoolLED will arrange for the collection of the Light Source free of charge.

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