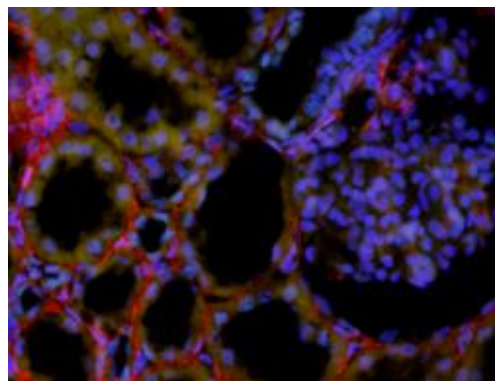
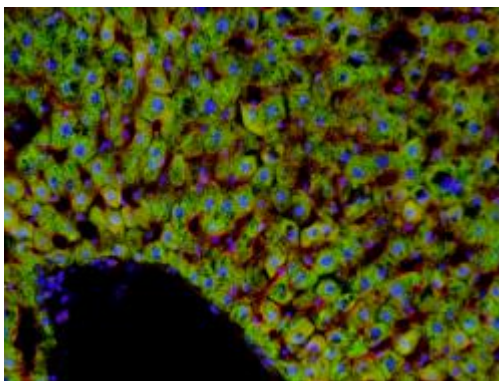
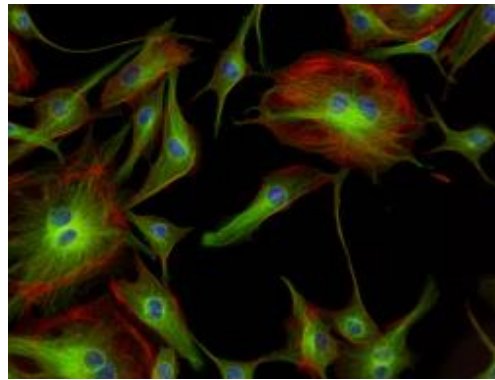
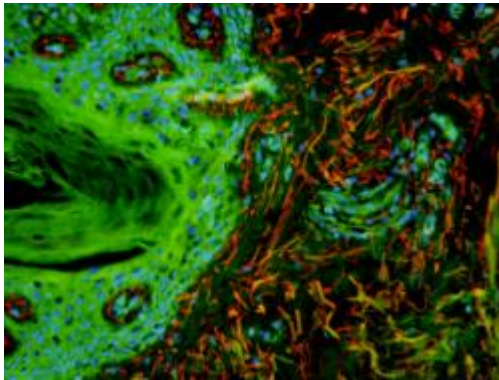


User Manual

pE-4000

Universal Fluorescence Excitation Source



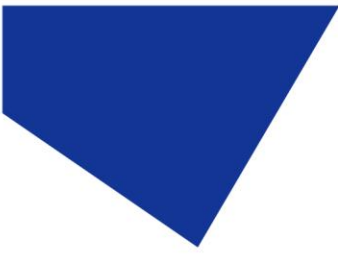
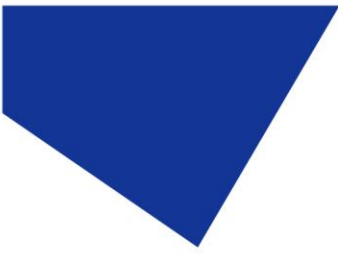


Table of Contents

1.	Introduction	3
2.	Safety Precautions.....	3
3.	Getting Started – System Components.....	5
4.	Installation and Setup	6
5.	LEDs in a Universal Illumination System	8
6.	Two Modes of Operation	10
7.	Manual Control Pod	11
8.	Control Pod Initialisation and White Mode	12
9.	Advanced Mode Pod Control	17
10.	White Mode Preset Programming	21
11.	Advanced Mode Preset Programming	23
12.	Remote control	24
13.	Analogue Mode Setup.....	27
14.	TTL Switching Performance.....	29
15.	Function Generator mode.....	30
16.	Fitting Excitation Filters.....	35
17.	Settings / Additional Information	36
18.	Fiber Options.....	37
19.	Software Updates.....	41
20.	Routine Care and Maintenance	41
21.	Product Specifications.....	42
22.	Product Options and Order Codes	43
23.	Warranty and Repairs	43
24.	Compliance.....	43
25.	Contact Details	44
26.	Appendices.....	45



1. Introduction

This manual should give you all the information required to install and operate your new light source.

Additional information can be found on our website at www.cooled.com

2. Safety Precautions

While LEDs are a much safer illumination system than the mercury and metal halide lamps that 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.

2.1.

UV light may be emitted from this product depending on the version/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.

2.2.

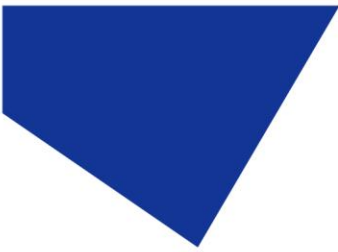
Always ensure that the Light Source is securely attached to the microscope (either directly or with a light guide and collimator, depending on the version) prior to turning on the power. This will minimise the risk of injury and damage.

2.3.

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.

2.4.

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.



2.5.

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.

2.6.

Any electronic equipment connected to this product must comply with the requirements of EN/IEC 60950.

2.7.

To clean the exterior of the Light Source, use a slightly dampened cloth with a simple water/detergent 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.

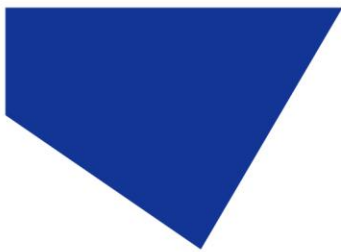
2.8.

This product conforms 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.

RISK GROUP 3
WARNING UV emitted from this product. Avoid eye and skin exposure to unshielded product.
WARNING Possibly hazardous optical radiation emitted from this product. Do not look at operating lamp. Eye injury may result.
CAUTION IR emitted from this product. Avoid eye exposure. Use appropriate shielding or eye protection

All warnings may not be applicable depending on the version/wavelength being used.

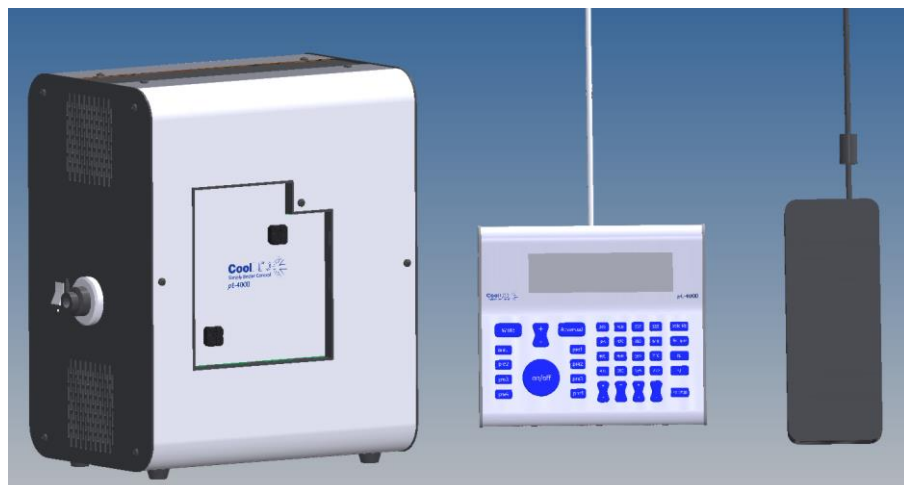


3. Getting Started – System Components

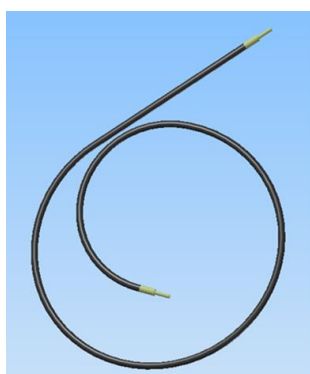
The CoolLED pE-4000 Universal Light Source is supplied with the following components:

Liquid Light Guide Version

1. Main Light Source with Optical Output for 3mm Liquid Light Guide
2. Manual Control Pod
3. DC Power Supply Type GST160A12-R7B
4. IEC Power Cable (not shown)
5. USB Cable (not shown)
6. User Guide (not shown)

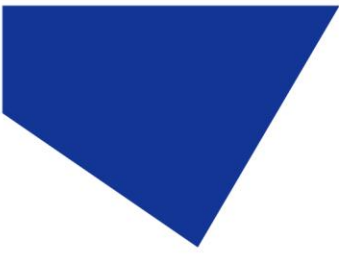


In addition to this list, it is likely that a light guide and Universal Collimator will also be supplied although there may be certain circumstances where this is not necessary as the user already has these components.



When un-packing the system, it is important to check the contents against the delivery note.

If any components are missing or appear damaged, please contact CoolLED or the distributor who supplied the equipment immediately.



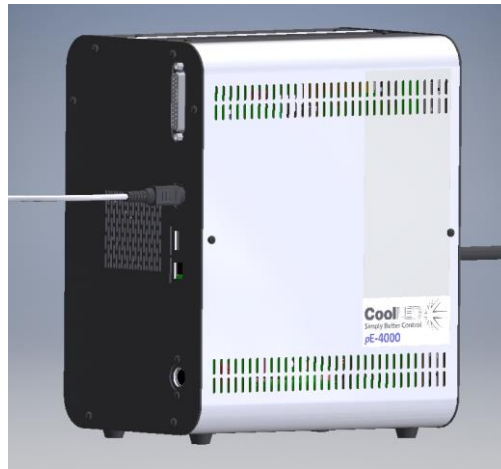
4. Installation and Setup

4.1.

Carefully unpack the components from the shipping cartons.

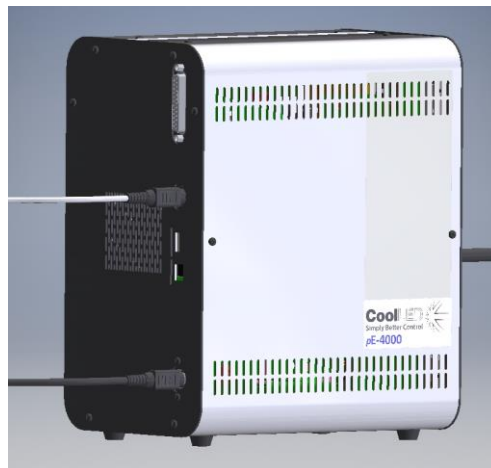
4.2.

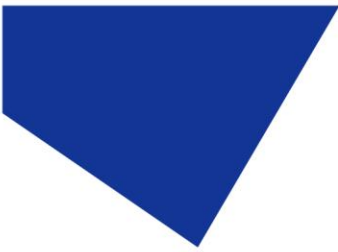
Insert the Pod Cable into the light source with the flat of the connector body on the outer side.



4.3.

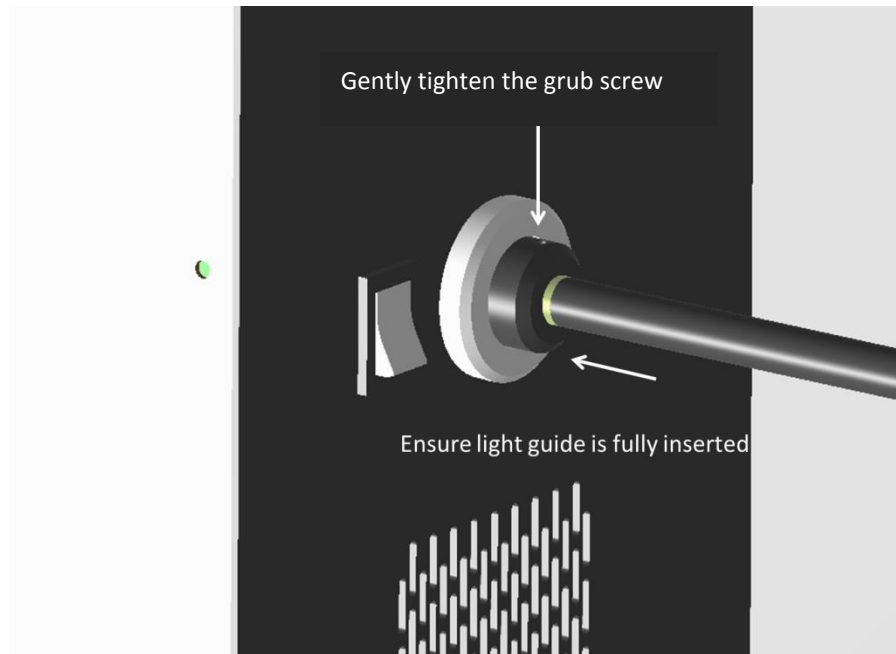
Connect the power connector from the DC power supply as shown, again with the flat of the connector body on the outer side. At this stage do not connect the mains power lead to the DC power supply.





4.4.

Insert the liquid light guide into the light output port on the front panel of the light source as shown. Ensure that the end of the light guide is fully inserted and gently tighten the grub screw to retain it in position. See [Section 18](#) when using fibre and other light delivery systems.



4.5.

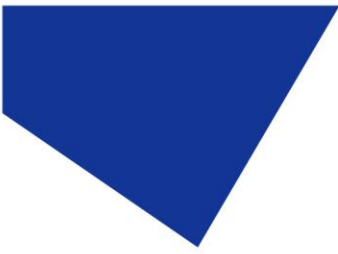
Ensure that there is free airflow in front and behind the light source so that the cooling system is not impaired. Air is drawn in from the front through the two grills and blown out through the single grill on the back of the light source. A gap of 200mm on either side is sufficient. All the images show the light source in the correct orientation, seated on its four rubber feet. It should not be operated sitting on its side or upside down.

4.6.

Connect the second end of the liquid light guide into the microscope requiring illumination. If using the pE-Universal Collimator, refer to the User Manual for the correct installation.

4.7.

With the light guide correctly fitted between the light source and the microscope, it is safe to connect the mains power. Connect the mains lead supplied to a convenient socket, plug in the IEC connector into the DC power supply and switch the power on at the socket. The pE4000 can now be switched on using the power switch on the front of the light source.



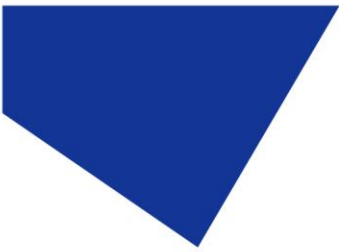
5. LEDs in a Universal Illumination System

5.1.

Conventional 'white light' sources used for fluorescence microscopy (e.g. mercury lamps) have a single element which emits light in a series of peaks across the spectrum, giving the effect of white light. LEDs are different in that a single LED element will emit light in a particular colour. To create a white light source that is useable in this application, LEDs of different wavelengths have to be combined together with the peaks selected to match the fluorescence stains being used by the biologist. This combination process requires the light from an individual LED wavelength to be collected by collimating optics and then either transmitted through, or reflected by a dichroic mirror. While it is technically feasible to use multiple sets of LEDs, optics and dichroics to combine many different wavelengths, the costs and efficiencies of these components limits the number of wavelengths that can be included into a commercially viable product. Where work on a fluorescence microscope is limited to four or six different stains, LED sources have been used but there has been reluctance by many users to take advantage of all the benefits that LEDs provide due to the limited range of stains that can be excited. The pE-4000 Universal Illumination System overcomes these limitations.

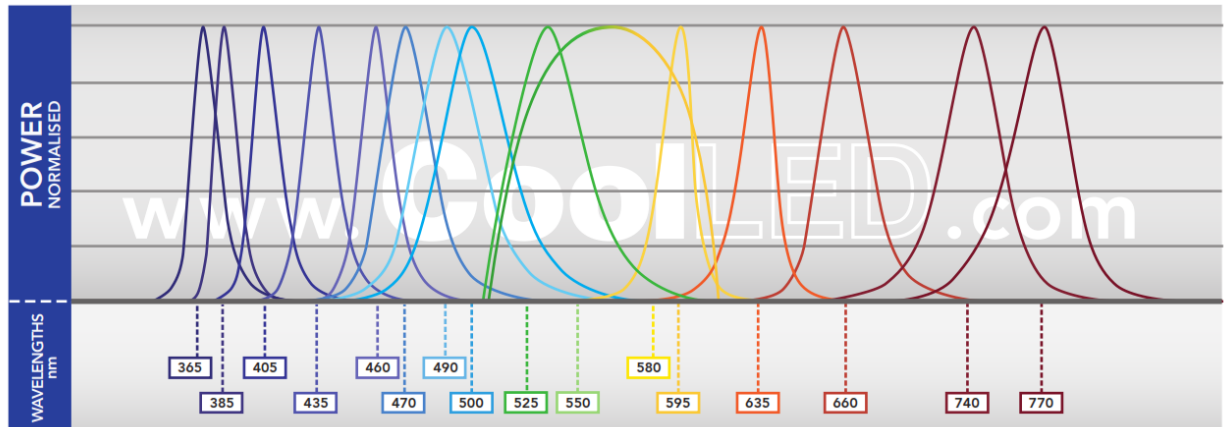
5.2.

The pE-4000 is a 4 channel illumination system with each channel having one of four different wavelengths that can be selected by the user. There are only four sets of optics, drive electronics and thermal management elements and only three dichroics to combine the four channels. When a different wavelength is selected for a particular channel, the LEDs are physically moved automatically by an internal mechanism so that swapping wavelengths can be achieved by a simple push of a button in less than 2 seconds.



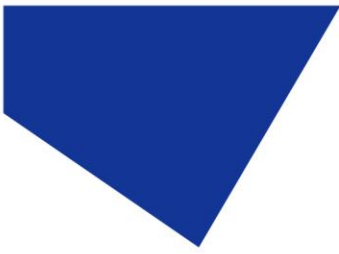
5.3.

The pE-4000 provides the user with 16 selectable wavelengths spread across 4 separate channels. Each channel can be individually controlled, both in terms of intensity and rapid switching.



5.4.

The wavelengths range from UV at 365nm for DAPI, through the visible spectrum and then out to IR at 770nm so that all the existing and up-and-coming stains can be excited by this single Universal Illumination System.



6. Two Modes of Operation

6.1.

To be a truly Universal Illumination System the pE-4000 needs to fulfil the needs of all users. Those engaged in fluorescence microscopy have very different needs. There are biologists not skilled in fluorescence microscopy who want a simple to use, reliable and repeatable excitation source. Multi-user laboratory managers are particularly keen to keep the light source controls simple so teaching their users is easy. There are other microscopists involved in research where precise control of the excitation source is paramount.

6.2.

The pE-4000 Control Pod has been arranged to fulfil these needs of these different groups by providing two modes of operation:

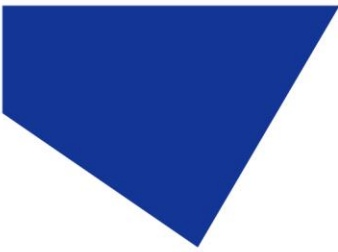
- a: White Mode for those users only needing basic controls.
- b: Advanced Mode where precise control of excitation is required.

6.3.

In White Mode the Control Pod functionality is limited to 4 presets, an on/off button and an up/down intensity control. Each preset can be pre-programmed to give the best wavelengths to use with the filter cubes on a particular microscope. All the user has to do is to select the appropriate preset and switch those LEDs on when required, altering the overall intensity if needed. The preset settings are stored in non-volatile memory and so will not be lost when the mains supply is removed.

6.4.

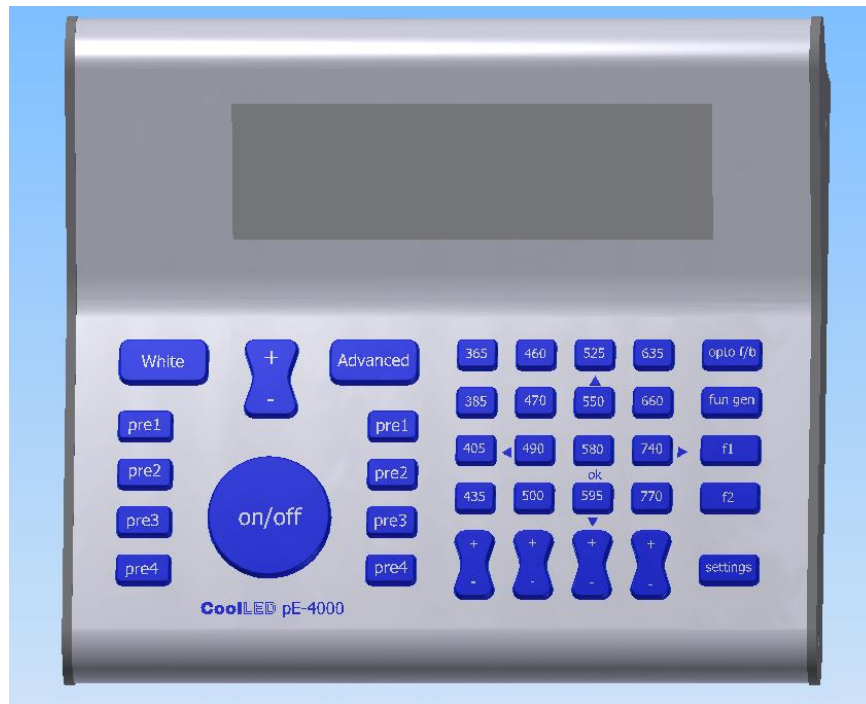
In Advanced Mode, the user has full control of wavelength selections, individual intensity controls and a broad range of additional features to allow the performance of the light source to be matched to the specific fluorescence work being undertaken. A full description of these features is given in later sections of this user manual.



7. Manual Control Pod

7.1.

The manual Control Pod has been designed to give the user easy control of the LEDs within the light source. There is a series of push button switches and a wide LCD display providing information on the status of the LEDs.

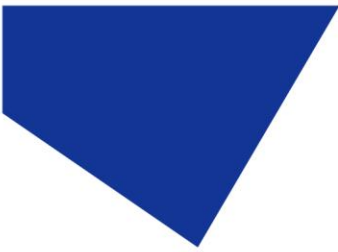


7.2.

The Control Pod allows the user to operate the system in either of the two modes outlined in [Section 6](#). Pressing the White button sets the light source into White Mode. Pressing the Advanced button changes the mode into Advanced.

7.3.

On power up, the system will always start in White Mode.



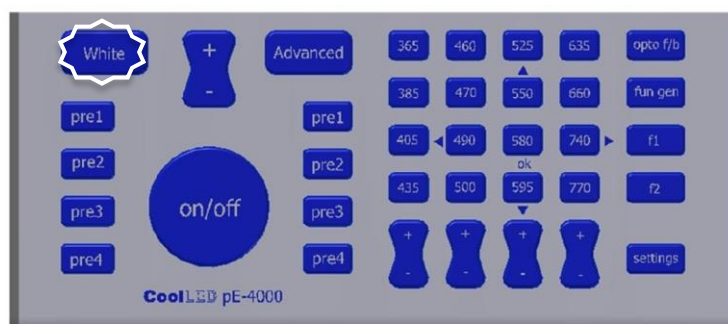
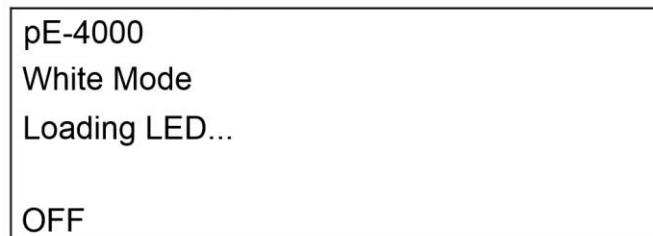
7.4.

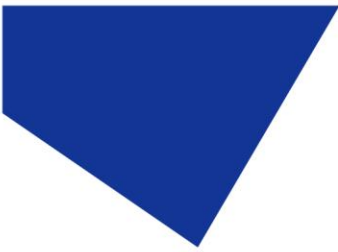
While the Control Pod has many buttons, they have been laid out to provide easy and intuitive control of the light source. The next few sections of this manual provide a guide of how to operate the Control Pod. Once running the Light Source for the first time, it is recommended to run through the sequences to become familiar with the controls and to see how easy it is to make changes. Having been designed as a universal light source, it does cover a wide range of applications. However it is still fundamentally a simple system and most users should find it only takes a short time to become fully conversant with its controls.

8. Control Pod Initialisation and White Mode

8.1.

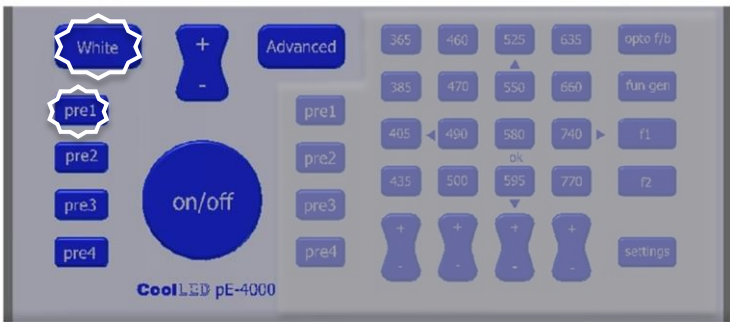
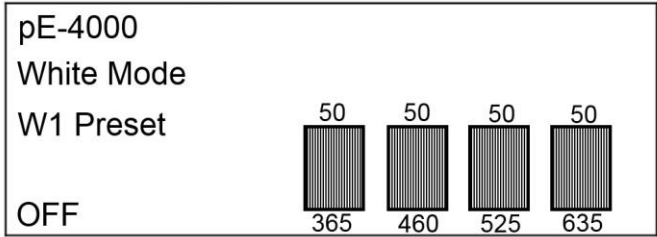
When the pE-4000 is first switched on there is an initial product recognition screen followed by the following. This will last the time it is necessary to initialise the stepper motors and system – normally around 5 seconds. During this period all buttons will be disabled.





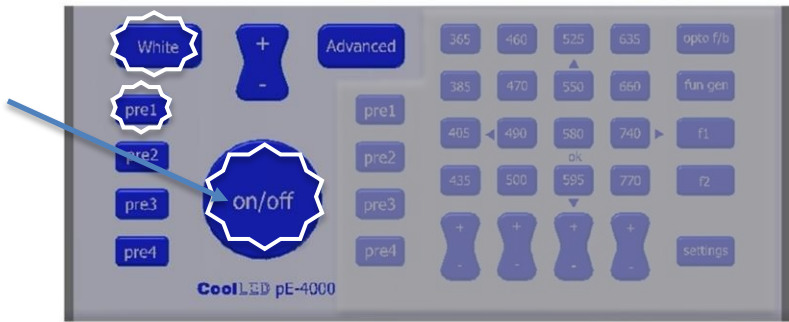
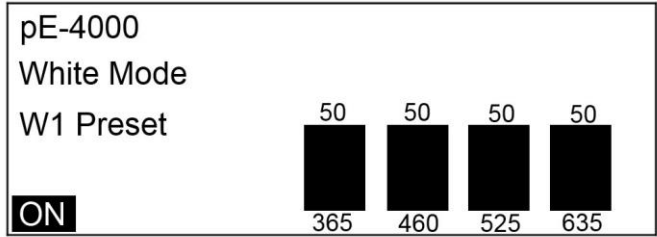
8.2.

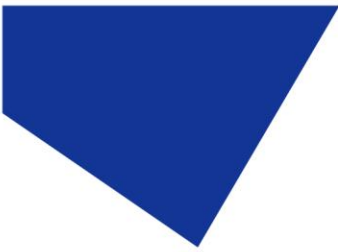
Once initialised, the system defaults to White Mode and to preset 1. The buttons which are active are backlit. In White Mode all the advanced buttons are disabled (except for 'Advanced'). The display indicates the wavelength selection and their intensities for the active preset.



8.3.

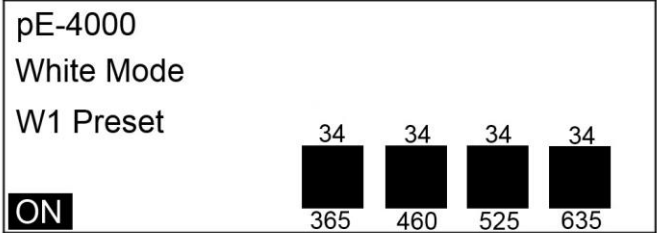
Press the On/Off button once to switch on the LEDs. The display bars go solid to indicate that the preset LEDs are on.





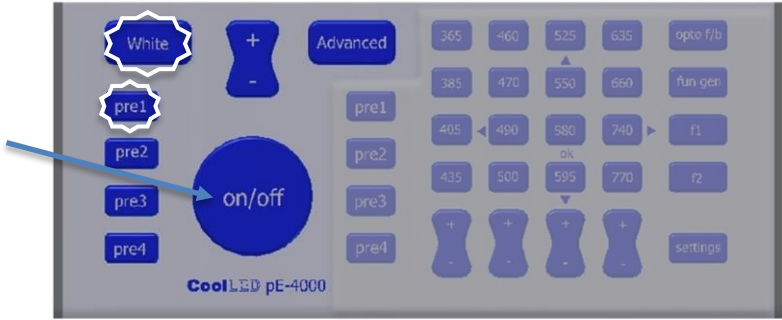
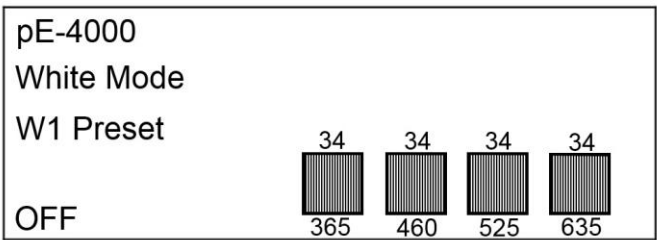
8.4.

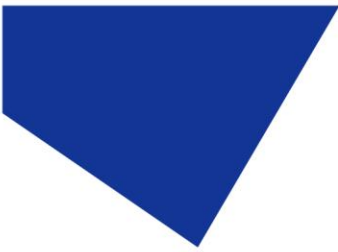
Use the master intensity control to vary all intensities in 1% steps. The display indicates the variation from the preset value. If the intensities are set at different values, then the balance between the channels will be maintained. The range of the adjustment is limited to the lowest intensity reaching 0% and the highest intensity reaching 100%.



8.5.

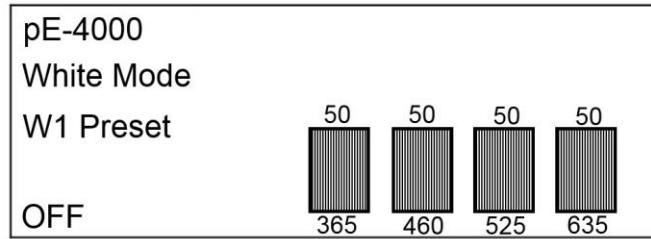
Press the on/off button again to switch off the LEDs.





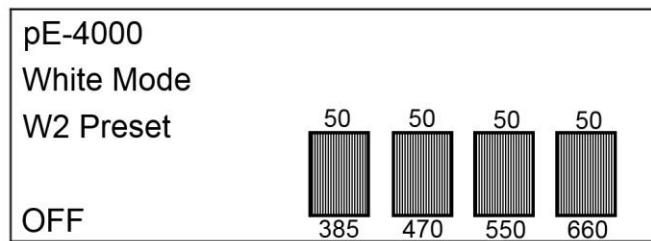
8.6.

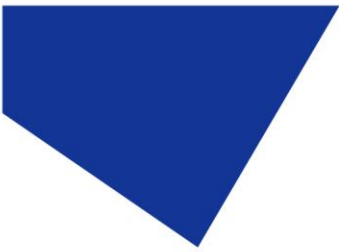
Press the pre1 button to revert to the preset 1 intensity settings.



8.7.

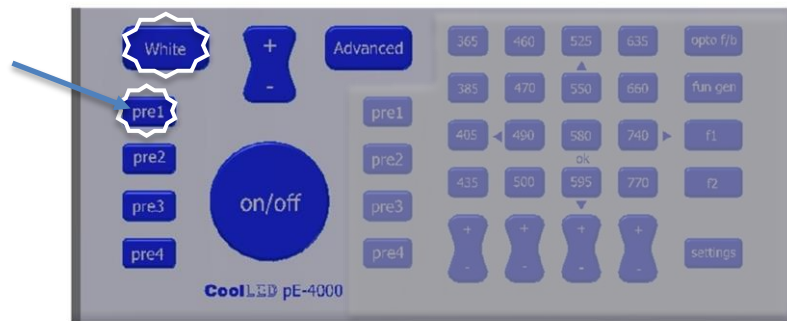
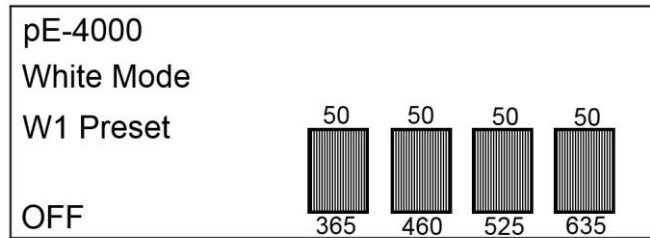
Press another preset button to change to a white light matched to another filter cube set.





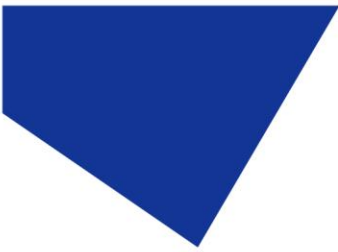
8.8.

To revert to preset 1, simply press the pre1 button again.



8.9.

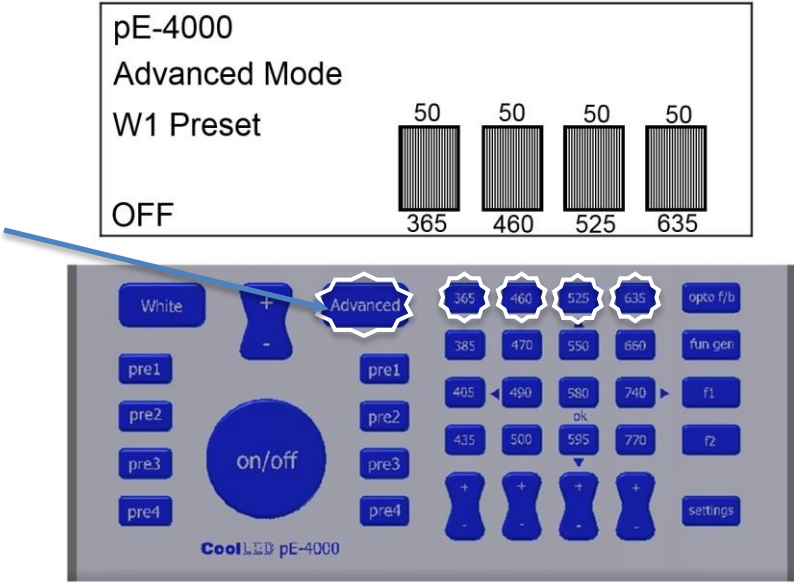
For instructions on how to program the presets, see [Section 10](#).



9. Advanced Mode Pod Control

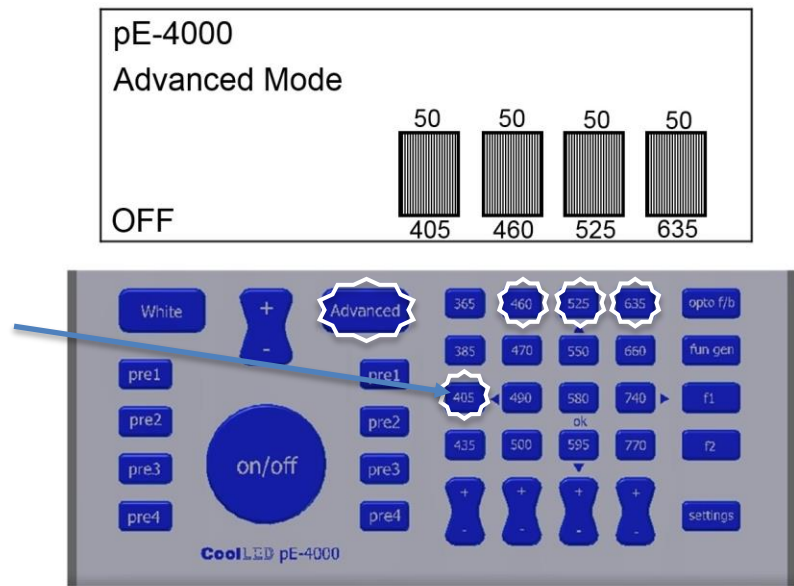
9.1.

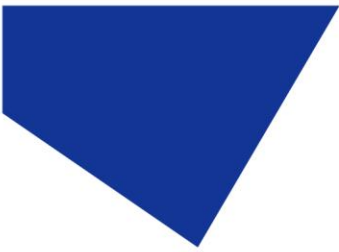
Press the Advanced button to change to Advanced Mode. All the buttons are now enabled. Previous settings remain unchanged in moving from White to Advanced, including the status of the on/off. If under White Mode, the LEDs were on, then in pressing the Advanced button, they will remain on, and vice versa.



9.2.

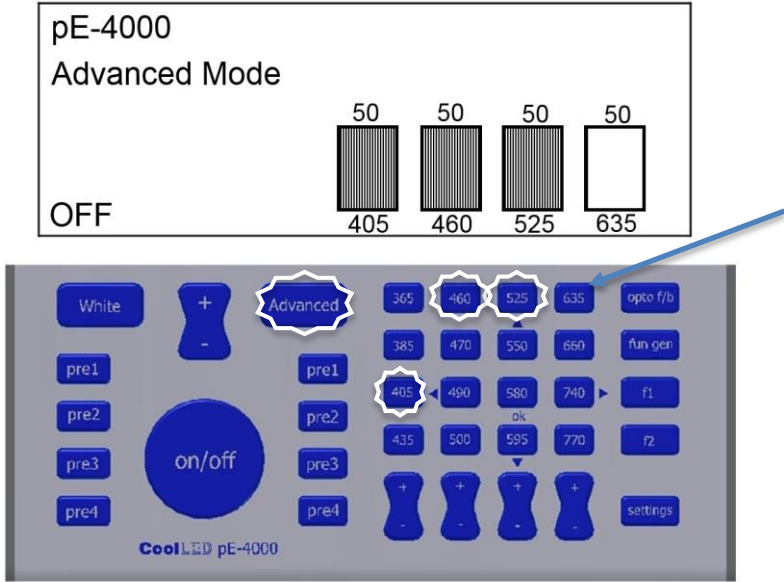
Press an alternative wavelength to change channel selection. The intensity of the newly selected wavelength will be the same as it was the last time it was selected in Advanced Mode.





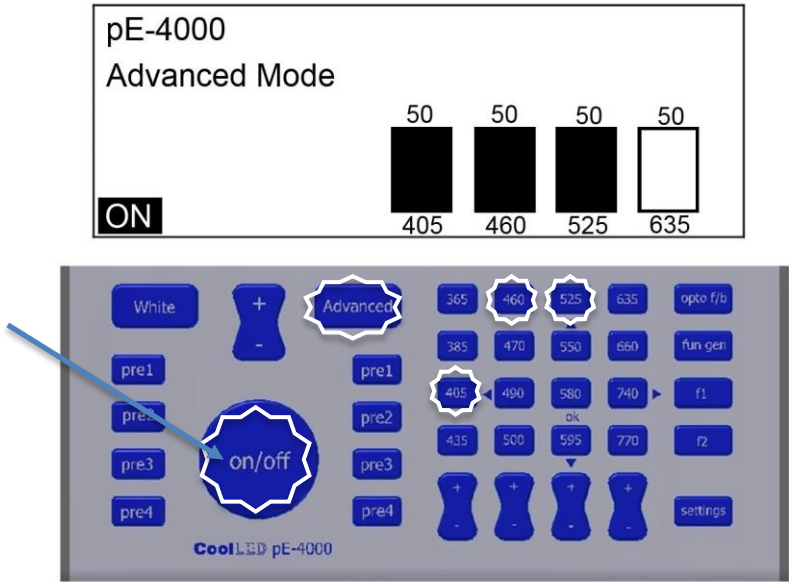
9.3.

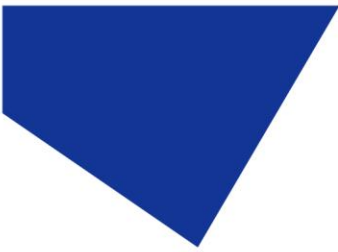
Press a wavelength button to deselect it.



9.4.

Press the on/off button to switch on selected LEDs.





9.5.

Vary the intensity of a channel selected wavelength in 1% steps.

pE-4000
Advanced Mode

Wavelength (nm)	Intensity (%)
405	50
460	70
525	50
635	50

ON

Remote control interface showing buttons for White, +, -, Advanced, and various wavelength buttons (365, 385, 405, 435, 460, 470, 490, 500, 525, 550, 580, 595, 635, 660, 740, 770). The 460 nm button is highlighted with a white dashed border. A blue arrow points to the 460 nm button.

9.6.

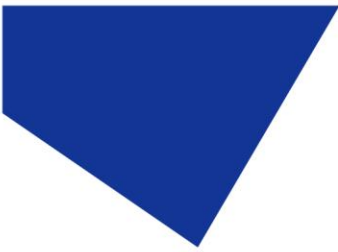
Press the selected wavelength button to switch off that wavelength.

pE-4000
Advanced Mode

Wavelength (nm)	Intensity (%)
405	50
460	70
525	50
635	50

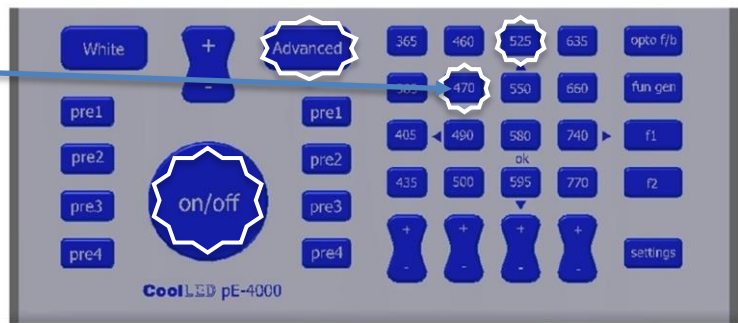
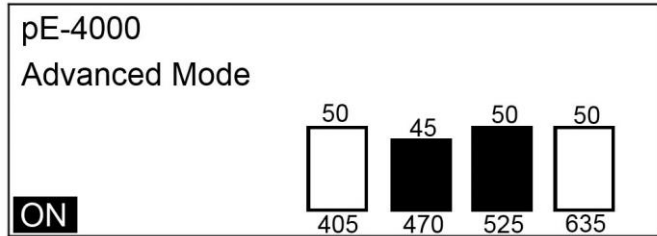
ON

Remote control interface showing buttons for White, +, -, Advanced, and various wavelength buttons (365, 385, 405, 435, 460, 470, 490, 500, 525, 550, 580, 595, 635, 660, 740, 770). The 405 nm button is highlighted with a white dashed border. A blue arrow points to the 405 nm button.



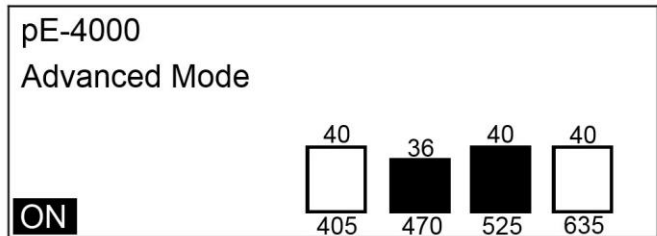
9.7.

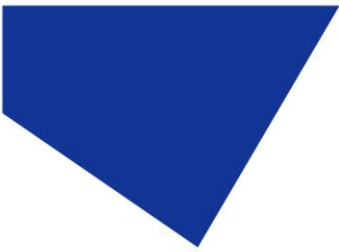
Change the wavelength selected in a channel. The intensity of the new wavelength is set at the value last used when selected in Advanced Mode.



9.8.

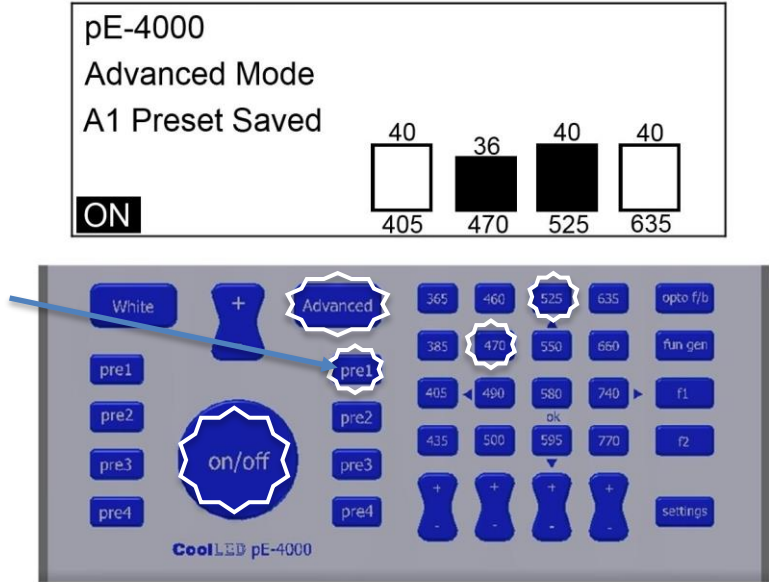
Reduce the intensities of all channels in 1% steps with the use of the master intensity button. The balance between channels will be maintained.





9.9.

To save the wavelength and intensity selection, press and hold one of the Advanced preset buttons for 3 seconds. The display will indicate once the selection has been saved to the specific preset button.

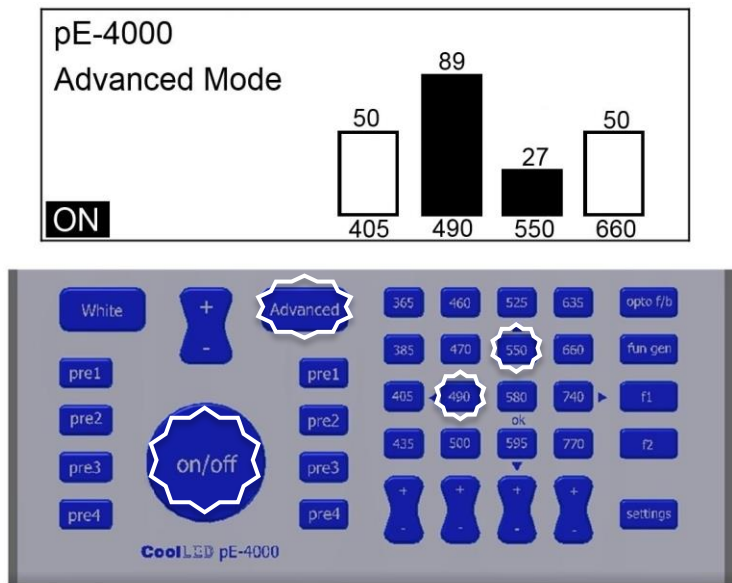


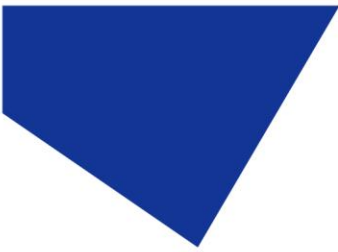
10. White Mode Preset Programming

10.1.

Programming the White Mode presets is carried out via the Advanced Mode.

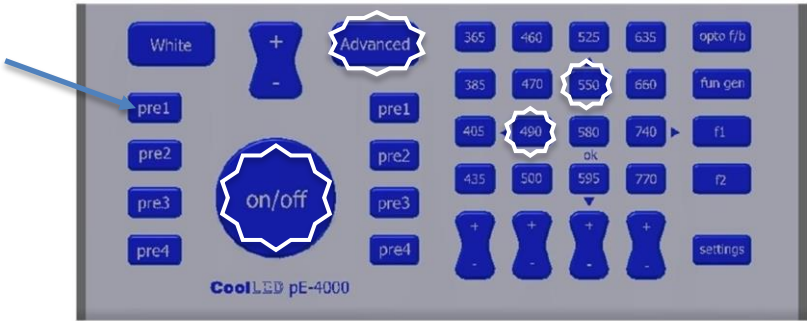
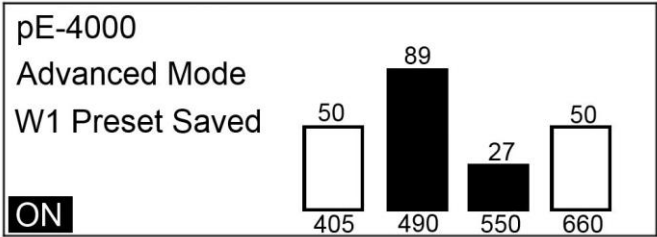
Enter the Advanced Mode and set up the wavelengths and intensities to match the filter sets being used on the microscope.





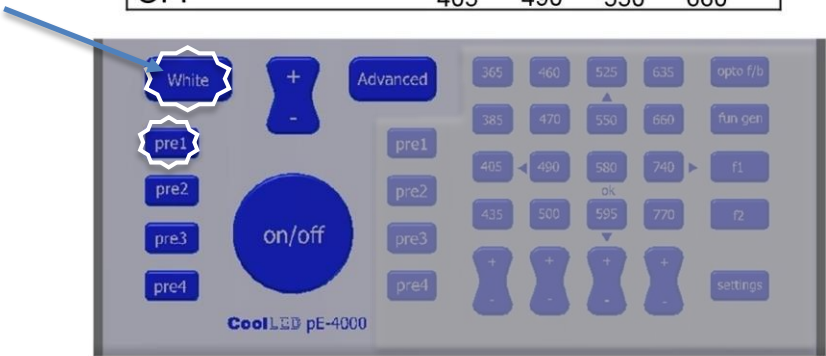
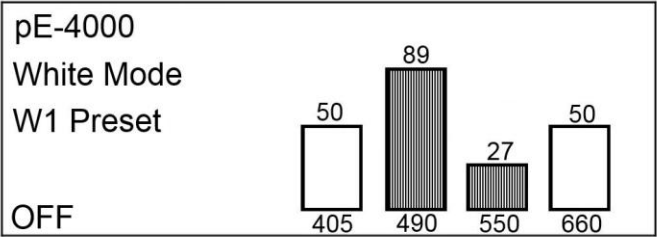
10.2.

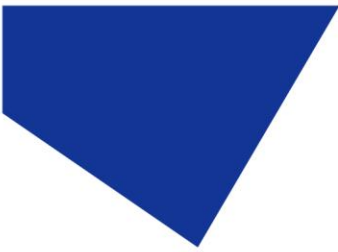
Press and hold a White Mode preset button for 3 seconds. On releasing the button the display will temporarily indicate that the selection has been saved to that specific White Mode preset.



10.3.

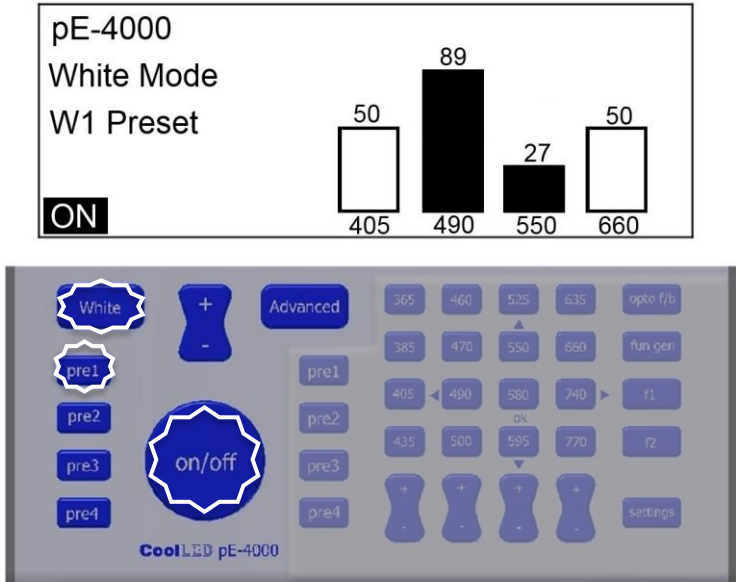
Press 'White' button to change to White mode. The last preset button used becomes the selected one.





10.4.

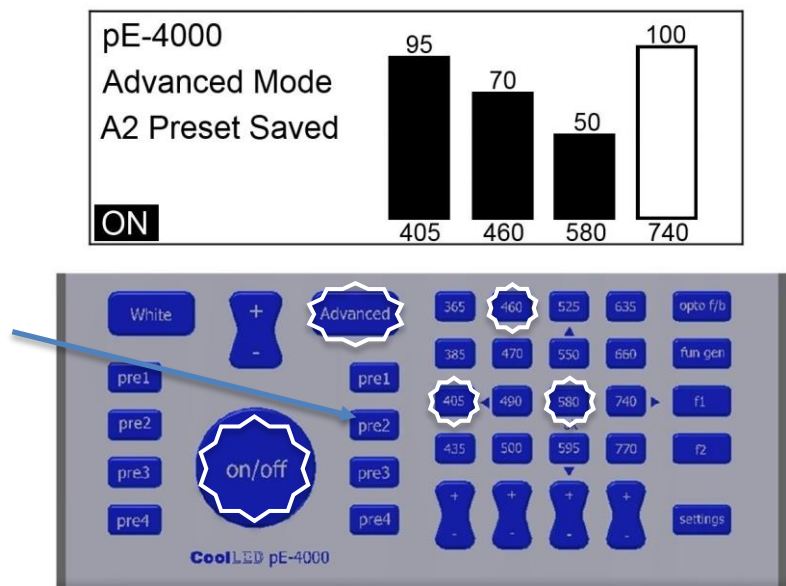
Press the on/off button to switch on the LEDs and operate the Pod as per [section 8](#).

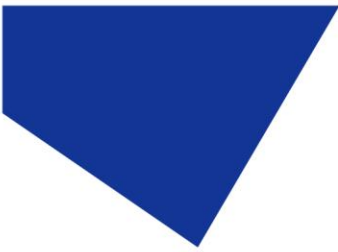


11. Advanced Mode Preset Programming

11.1.

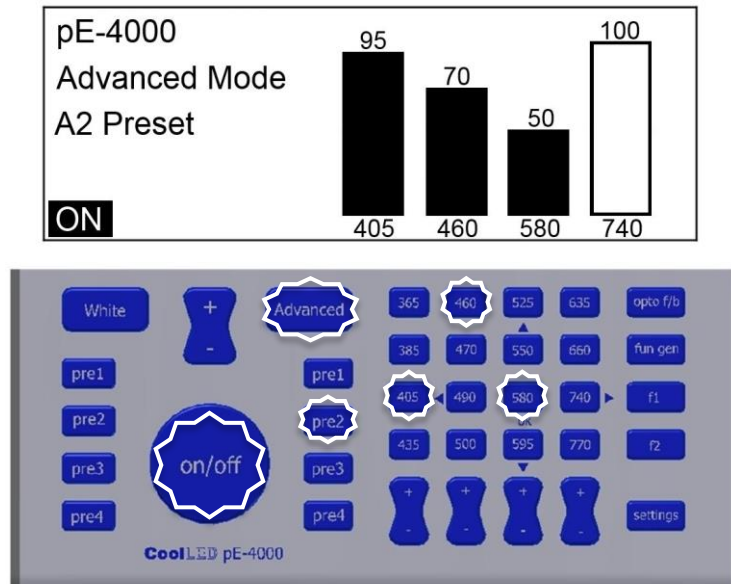
When in Advanced Mode, it is possible to save the wavelength selection and intensities by pressing and holding one of the Advanced preset buttons for 3 seconds.





11.2.

The system will stay in preset 2 until there is a change to intensity, a change in wavelength selection, a change in preset or a change to White Mode.



12. Remote control

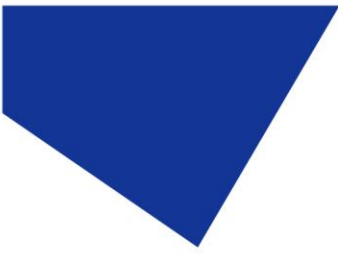
12.1.

The pE-4000 can be controlled remotely in a number of ways:

- Under software controls via a USB interface.
- Via digital TTL signals.
- Via analogue voltages.

12.2.

A USB B socket is positioned on the rear panel of the light source. The interface is a 'virtual COM port' style and a setup procedure is necessary to enable communication between a PC and the light source. See [Appendix 1](#) for more details.



12.3.

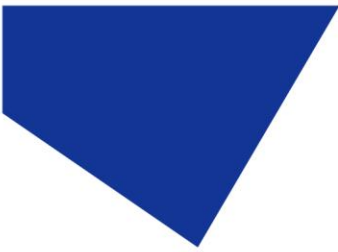
There is a comprehensive range of TTL inputs and TTL outputs provided via a 25way 'D-type' connector on the rear panel of the light source. [Section 5](#) of this User Guide describes how the pE-4000 is structured around 4 channels, labelled as Channel A, Channel B, Channel C and Channel D. Each channel has an individual TTL input control and a mirrored TTL output. In addition there is a single TTL input which works in parallel with the on/off switch such that a 'high' on this input will switch on all the LEDs which are selected on the Pod. To compliment this TTL input, there is a mirrored TTL output, labelled as 'Sync Out' which can be used to trigger cameras etc.

12.4.

For those users who wish to modulate or remotely control the intensity of the LEDs, each of the four channels are provided with an analogue input. Varying these inputs between 0-10V controls the output intensities from 0 to 100% (See [Section 13](#) for instructions on how to set this mode of operation).

12.5.

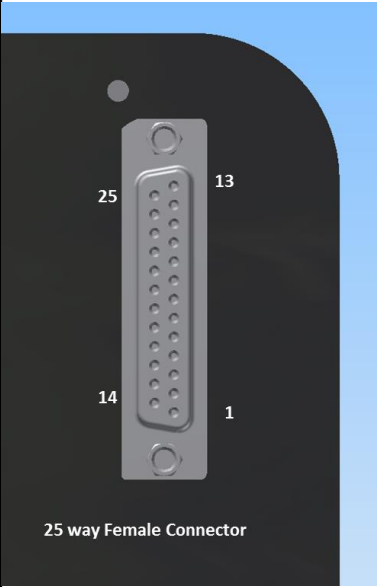
To extend the ways of integrating the pE-4000 into imaging systems and applications, four additional channels of control are provided, Channels E, F, G and H. Each channel has both a TTL and an Analogue output which can be set by external imaging software via the pE-4000 USB interface. These signals can be used to control additional light sources, e.g. the CoolLED pE100^{wht} for transmitted illumination, or other elements of the microscope imaging system.



12.6.

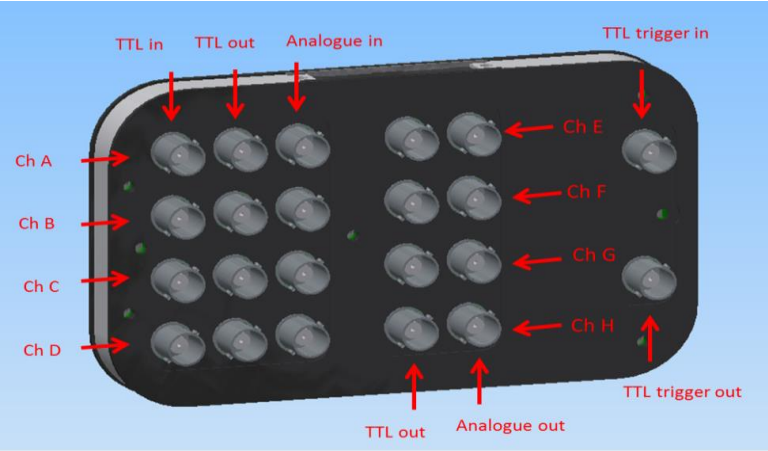
All the TTL and Analogue input and output connections are provided via a 25 way 'D- type' female connector. The connections are as follows:

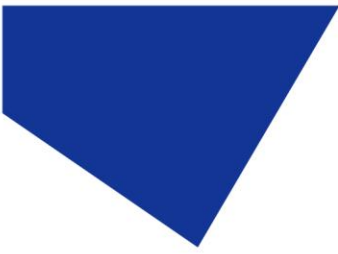
Pin No	Pin Function
1	Channel H Analogue Output
2	Channel F Analogue Output
3	Channel D Analogue Input
4	Channel B Analogue Input
5	Gnd
6	TTL Trigger Output
7	Channel H TTL Output
8	Channel F TTL Output
9	Channel D TTL Output
10	Channel B TTL Output
11	Channel D TTL Input
12	Channel B TTL Input
13	5 V
14	Channel G Analogue Output
15	Channel E Analogue Output
16	Channel C Analogue Input
17	Channel A Analogue Input
18	Gnd
19	TTL Trigger Input
20	Channel G TTL Output
21	Channel E TTL Output
22	Channel C TTL Output
23	Channel A TTL Output
24	Channel C TTL Input
25	Channel A TTL Input



12.7.

For those users who are set up to use BNC cables, an additional 25 way rear pE-Expansion Box is available which fits on the back of the pE-4000.





13. Analogue Mode Setup

13.1.

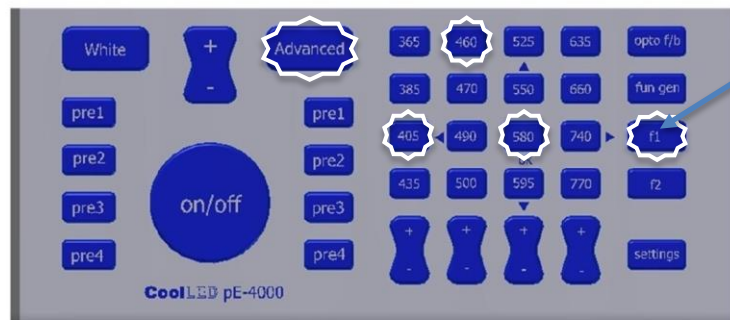
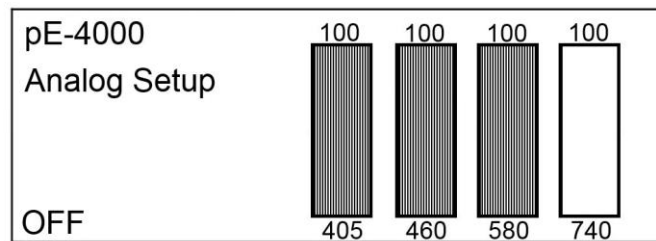
Each wavelength can be set to be controlled from an analogue input voltage rather than the Pod controls or the individual channel TTL inputs. The setup process is accessed via the Advanced Mode.

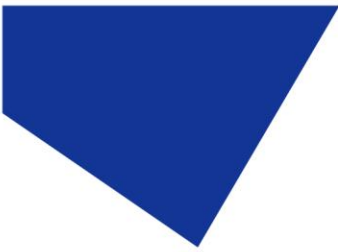
13.2.

Press the Advanced button to access the Advanced Mode.

13.3.

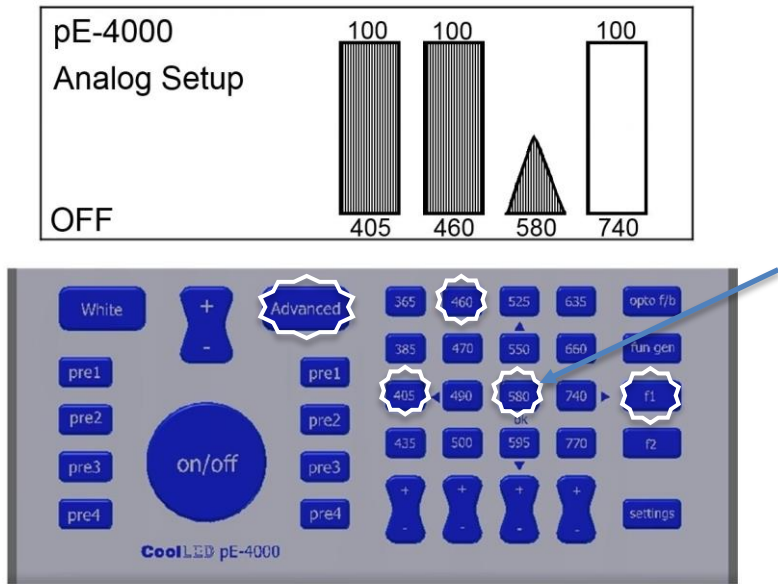
Press the f1 button to access the Analogue Inputs setup.





13.4.

Press the wavelength button corresponding to the wavelength which is required to be under analogue control. The symbol on the screen will change to an icon representing analogue control.



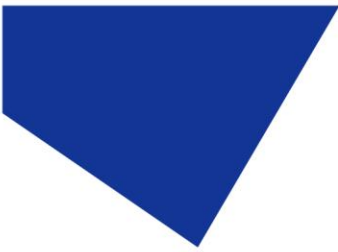
Press the f1 button to revert to Advanced Mode operation but with the specific wavelength set for analogue control. In the example shown, the 580nm LED will now only be controllable from a voltage between 0-10V applied to the Channel C Analogue Input pin of the 25 way connector. For the LED to operate there is an additional requirement to press the on/off button.

13.5.

It is possible to have a mixture of LEDs under analogue control and standard Pod control at the same time.

13.6.

To change a wavelength back from analogue control to standard Pod intensity control, from the Advanced Mode, press the f1 button followed by the wavelength button. The display will revert to the vertical bars. Press the Advanced Mode button again to return to Advanced Mode operation.



14. TTL Switching Performance

14.1.

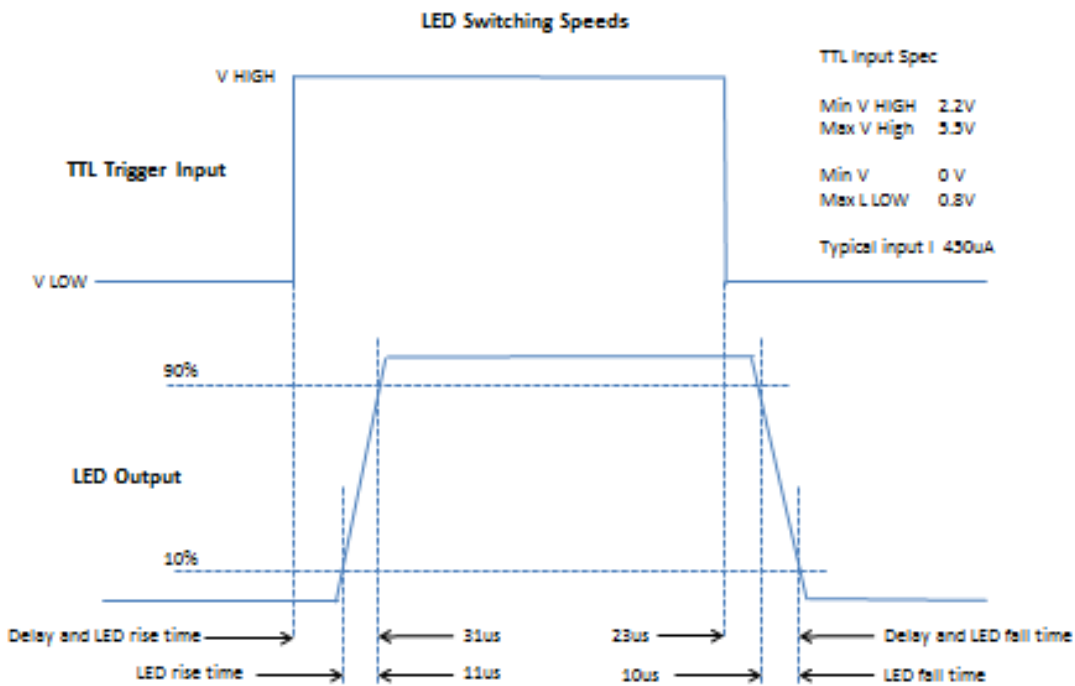
For applications where the fastest switching times of the LEDs is required, TTL signals should be used as they are not limited by the operation speed of the USB connection and software.

14.2.

The wavelengths and their intensities should be selected manually by the Pod. Alternatively the intensities can be controlled via the USB with the appropriate imaging software.

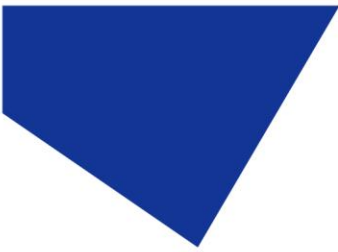
14.3.

The following diagram provides the threshold values for the TTL input together with the switching speeds. It is important that the maximum input of 5.5V is not exceeded as this could result in damage to the internal circuitry.



14.4.

With fast repetitive switching, the Pod display will not be able to respond at the same speed and so can get out of sync. If after a train of pulsing, the display on the Pod indicates that the LEDs are on while they are actually off, simply press the on/off button to reset the display correctly.



15. Function Generator mode

The pE-4000 has been designed with an inbuilt Function Generator to allow users to create ramps, pulses and sine waves without the need for any additional hardware. This section describes how to operate this feature.

This mode is only available from firmware version 2.0.0 (see [Section 17.2](#) for instructions on how to find out the installed firmware version).

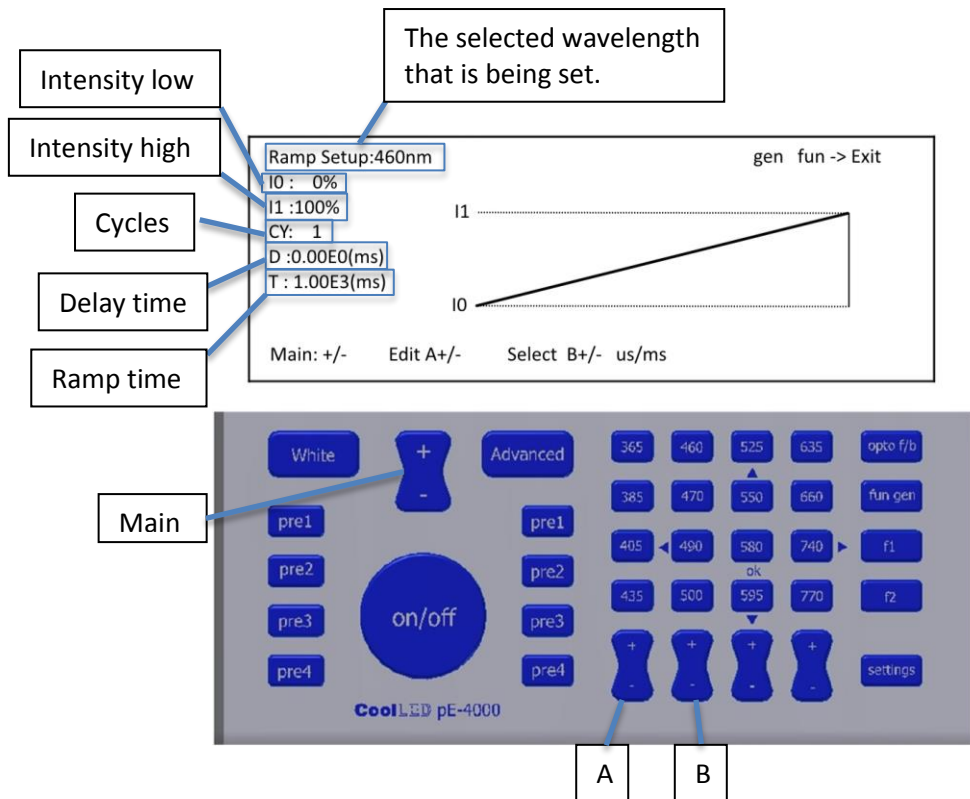
15.1. Accessing Function Generator mode

To switch the pE-4000 into Function Setup mode press the “fun gen” button on the Control Pod once. Once in Function Setup mode, pressing the button of a selected wavelength repeatedly will cycle through the options of selecting a ramp, pulse or sine wave. These are indicated by differences of the intensity bar on the Control Pod display.

Once a function has been selected, hold down the corresponding wavelength button on the Control Pod. This will change the display to a setup screen for the chosen function.

15.2. Ramp Setup

Following the steps in Section 15.1 and selecting a ramp will display the following screen on the Control Pod.

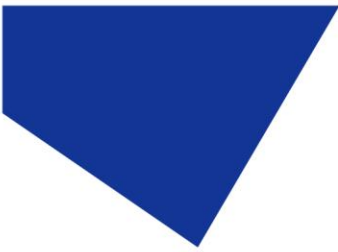


The diagram illustrates the Ramp Setup screen on the Control Pod display and the physical buttons on the device. The screen displays the following information:

- Intensity low:** I0: 0%
- Intensity high:** I1: 100%
- Cycles:** CY: 1
- Delay time:** D: 0.00E0(ms)
- Ramp time:** T: 1.00E3(ms)
- Selected wavelength:** Ramp Setup:460nm
- Graph:** A graph showing a ramp from I0 to I1.
- Navigation:** Main: +/-, Edit A+/-, Select B+/- us/ms

The physical device has the following buttons:

- Main:** A button labeled 'Main' pointing to the 'White' button.
- White:** A button labeled 'White'.
- Advanced:** A button labeled 'Advanced'.
- fun gen:** A button labeled 'fun gen'.
- Wavelength buttons:** 365, 460, 525, 635, 385, 470, 550, 660, 405, 490, 580, 740, 435, 500, 595, 770.
- Navigation buttons:** +, -, ok, f1, f2, settings.
- Buttons A and B:** Two buttons labeled 'A' and 'B' pointing to the '460' and '525' buttons respectively.



To step through the setting options on the display, press the “+” or “-” button of the channel A intensity control. The currently selected field’s value shall appear shaded on the Control Pod display.

To adjust the value of the selected field, press the “+” or “-” button on the global intensity control (labelled in the above image as “Main”).

To alter the units of the “delay time” and “ramp time” fields between milliseconds (ms) and microseconds (μ s), press the “+” or “-” button of the channel B intensity control. See Section 15.5 for operating instructions.

Listed below are brief definitions of the adjustable fields that are used in this mode:

Intensity low:

The intensity level at which the ramp will begin.

Intensity high:

The intensity level at which the ramp will end.

Cycles:

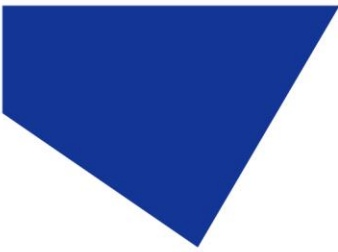
The number of times that you wish for the ramp to repeat. This field can set between 1 and 999 or to infinitely repeat (∞).

Delay time:

The time delay before the ramp begins.

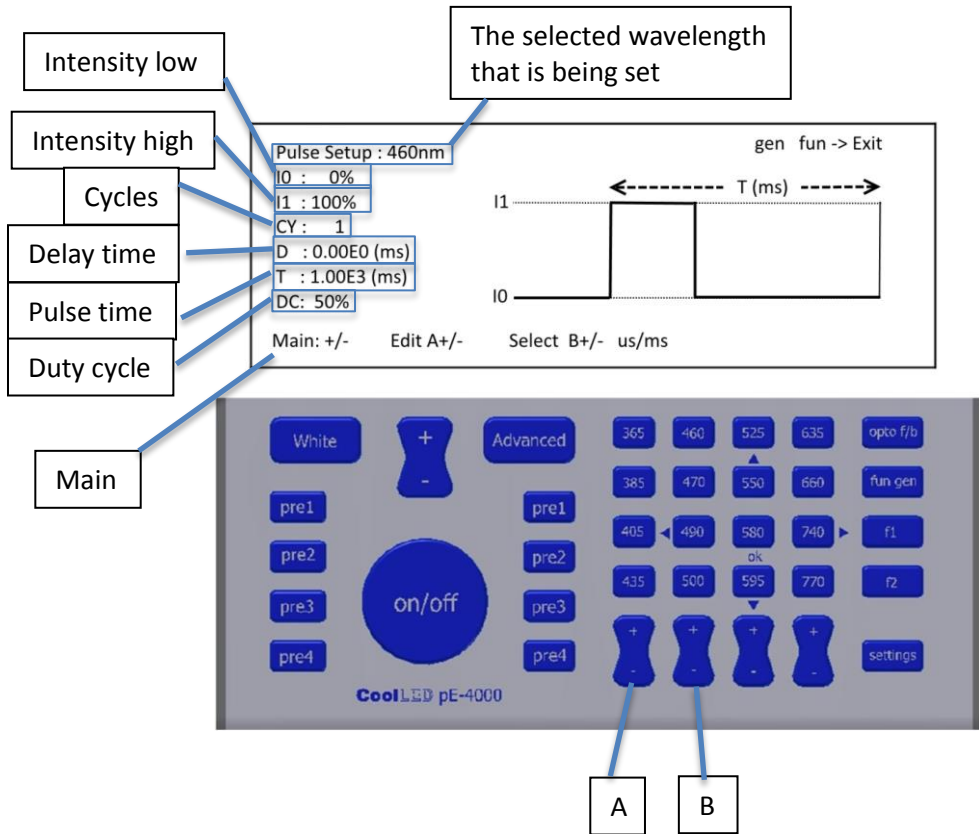
Ramp time:

The duration of time for the ramp to go from the Intensity low to the Intensity high.



15.3. Pulse Setup

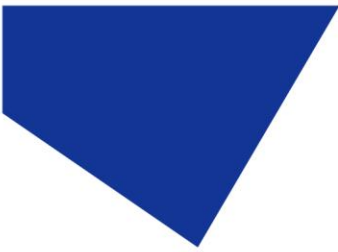
Following the steps in Section 15.1 and selecting a pulse will display the following screen on the Control Pod.



To step through the setting options on the display, press the “+” or “-” button of the channel A intensity control. The currently selected field’s value shall appear shaded on the Control Pod display.

To adjust the value of the selected field, press the “+” or “-” button on the global intensity control (labelled in the above image as “Main”).

To alter the units of the “delay time” and “pulse time” fields between milliseconds (ms) and microseconds (μ s), press the “+” or “-” button of the channel B intensity control. See Section 15.5 for operating instructions.



Listed below are brief definitions of the adjustable fields that are used in this mode:

- Intensity low:** The intensity level at which the pulse is at its low state.
- Intensity high:** The intensity level at which the pulse is at its high state.
- Cycles:** The number of times that you wish for the pulse to repeat. This field can set between 1 and 999 or to infinitely repeat (∞).
- Delay time:** The time delay before the pulse begins.
- Pulse time:** The duration of time to complete an entire period.
- Duty cycle**
The ratio between the duration that the pulse is in the intensity high state and the entire period (for example a period with a 50% duty cycle would mean that the light is in the intensity high state for half of the time).

15.4. Sine Setup

Following the steps in Section 15.1 and selecting a sine wave will display the following screen on the Control Pod.

The screenshot shows the 'Sine Setup' screen on the CoolLED pE-4000 Control Pod. The screen displays the following settings:

- Sine Setup : 460nm
- I0 : 0%
- I1 : 100%
- CY : 1
- D : 0.00E0 (ms)
- f : 1.00E3 (Hz)

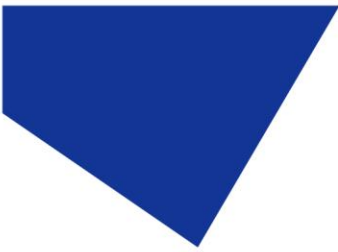
Labels on the left side of the screen point to these settings:

- Intensity low (points to I0)
- Intensity high (points to I1)
- Cycles (points to CY)
- Delay time (points to D)
- Frequency (points to f)

Other labels include:

- 'The selected wavelength that is being set' pointing to the 'Sine Setup : 460nm' header.
- 'Main' pointing to the '+' and '-' buttons on the physical keypad.
- 'A' and 'B' pointing to the '+' and '-' buttons on the physical keypad.

The screen also features a sine wave graph with axes labeled 'I1', 'I0', and 'f (Hz)'. At the bottom of the screen, it says 'Main: +/- Edit A+/- Select B+/- us/ms'.



To step through the setting options on the display, press the “+” or “-” button of the channel A intensity control. The currently selected field’s value shall appear shaded on the Control Pod display.

To adjust the value of the selected field, press the “+” or “-” button on the global intensity control (labelled in the above image as “Main”).

To alter the units of the “delay time” field between milliseconds (ms) and microseconds (μ s), press the “+” or “-” button of the channel B intensity control. See Section 15.5 for operating instructions.

Listed below are brief definitions of the adjustable fields that are used in this mode:

Intensity low:

The intensity level of the low signal of the sine wave.

Intensity high:

The intensity level of the high signal of the sine wave.

Cycles:

The number of times that you wish for the sine wave to repeat. This field can set between 1 and 999 or to infinitely repeat (∞).

Delay time:

The time delay before the sine wave begins.

Frequency:

The frequency that you wish for the sine wave to run at in Hertz.

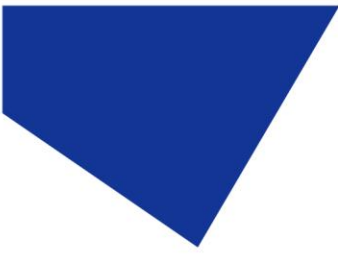
15.5. Operating the function settings

Once either a ramp, pulse or sine wave has been selected and setup press the “fun gen” button once to return to the main Control Pod display.

To start operation press the “on/off” button once.

If a number of cycles was selected in the setup then a percentage figure shall be displayed with the completion level. Once the selected number of cycles has been completed the display shall state “done”.

If the number of cycles is set to infinity then operation shall continue until the “on/off” button is pressed to stop.



16. Fitting Excitation Filters

16.1.

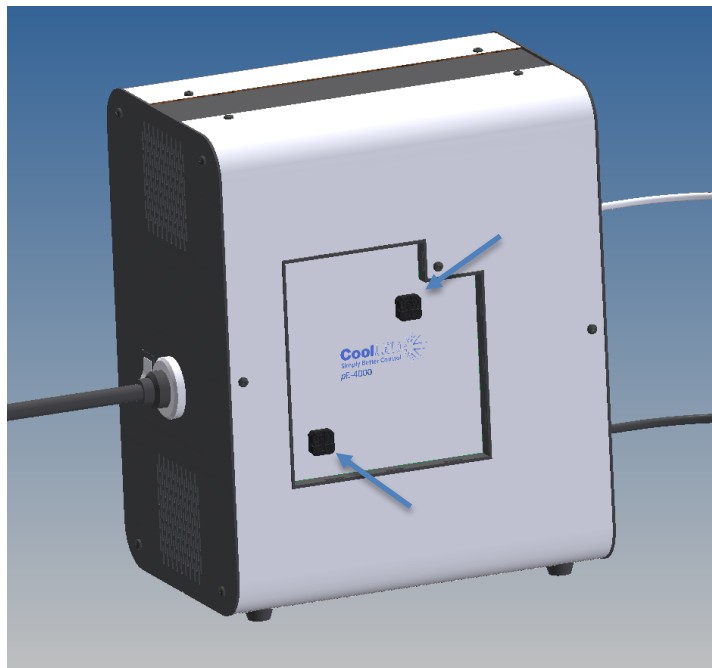
Excitation filters can be added to each of the four channels prior to their combination by the internal dichroics. This means that simple single band filters can be used for each wavelength in a multiband imaging system.

16.2.

The filter slides do not come as standard but can be procured separately either at the time of purchasing the pE-4000 or at a later date. See ordering codes in [Section 22](#).

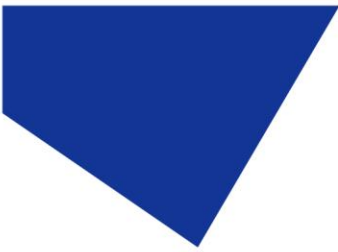
16.3.

To access the slots for the filter slides, use a coin or similar tool to rotate and release the catches on the side of the light source.



16.4.

The four slots for each of the four channels are clearly marked. The arrows at the side of the slots indicate the direction of the light to help with the correct orientation of the filters when they are being installed.

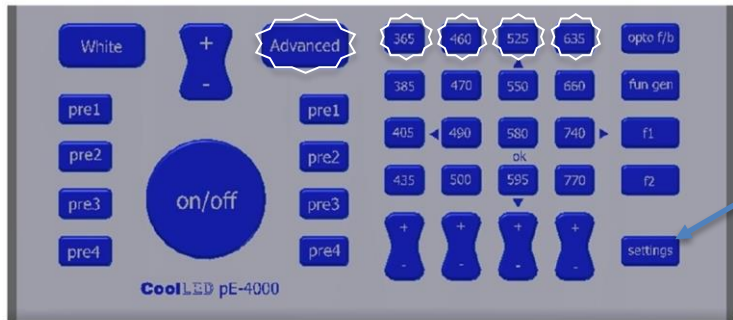
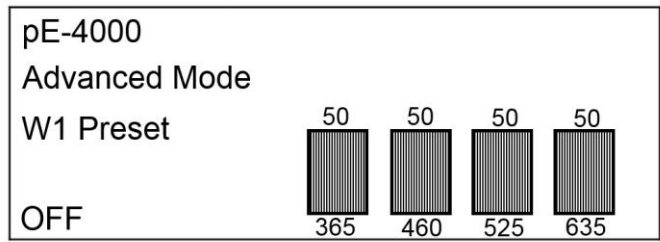


17. Settings / Additional Information

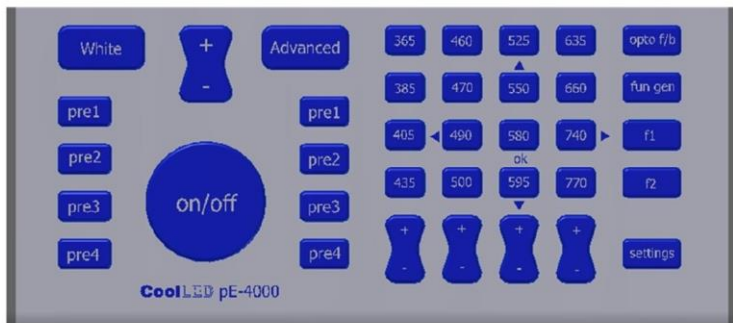
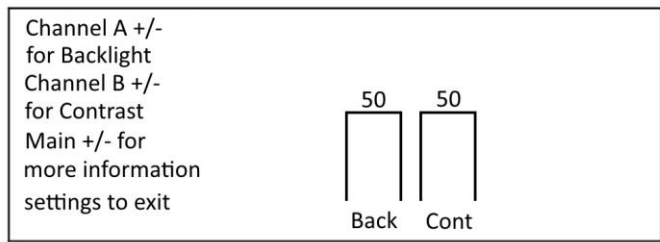
17.1.

Display Backlight and Contrast settings

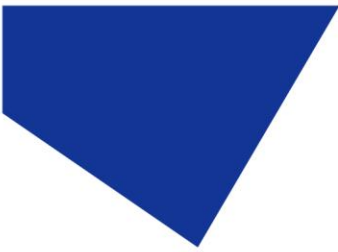
The Pod display settings can be adjusted to suit the lighting environment that the instrument is being operated in.



From the Advanced Mode, press the settings button to view the backlight and contrast settings for the Control Pod display.



To adjust the display settings to suit the lighting conditions, use the “+” & “-” for channel A (Backlight) and channel B (Contrast). When the levels have been optimised press the Settings button again to return to the Advanced Mode.



17.2.

System Information

The Control Pod is capable of displaying information about the system such as firmware versions, hardware versions, LAM usage and system usage.

From the Advanced Mode, press the settings button. The backlight and contrast settings will initially be displayed.

Press the “+” button once on the global intensity control to display the first information screen. This displays information such as the firmware versions of the system components.

Pressing the “+” button of the global intensity control again will display timer information for the wavelengths in channels A & B, as well as a system timer and a timer for the current session.

Pressing the “+” button of the global intensity control once more will display timer information for the wavelengths in channels C & D, as well as a system timer and a timer for the current session.

The time displayed next to the wavelengths is in hours and refers to the time that the corresponding LEDs are illuminated.

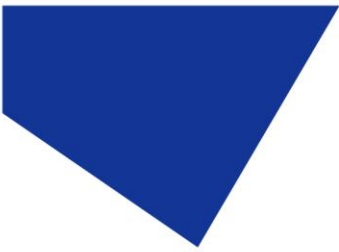
The system time is in hours and refers to the time that light source is powered (the LEDs are not necessarily illuminated in this period).

The current session time is in hours, minutes and seconds and refers to the amount of time that the light source has been powered in the current session (the LEDs are not necessarily illuminated in this period). This value will reset every time the power to the light source is cycled.

18. Fiber Options

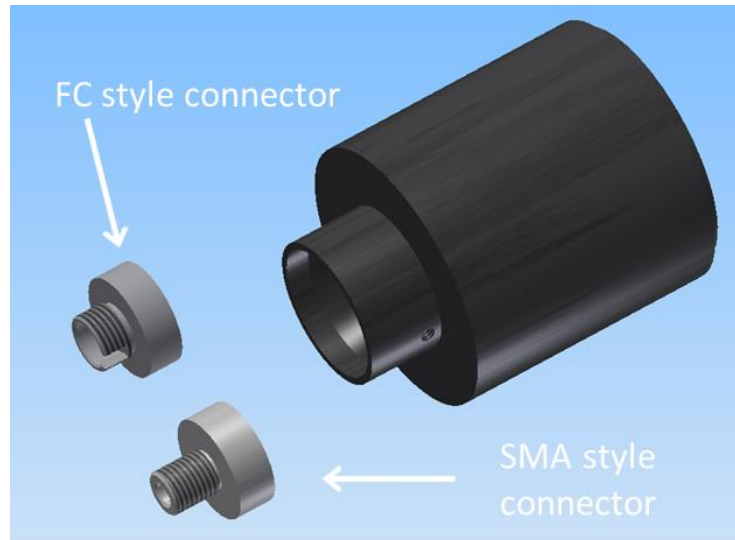
18.1.

The pE-4000 has a number of options for light delivery from the light source to the microscope or other systems requiring illumination. The standard method is via a 3mm diameter liquid light guide. Fibers with either SMA or FC connectors can also be used with the pE-4000. The light source can either be supplied with this option fitted, or the additional optics module can be bought separately and changed over following the instructions below.



18.2.

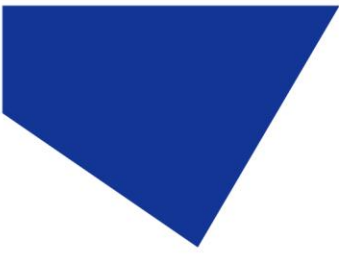
The fiber optics module is supplied with two interchangeable connector options to suit the commonly used connectors in fluorescence microscopy.



18.3.

To change between SMA and FC, simply loosen the grub screw on the side of the collar which releases the connector. Replace with the alternative connector, ensuring that it is fully inserted before tightening up the grub screw.



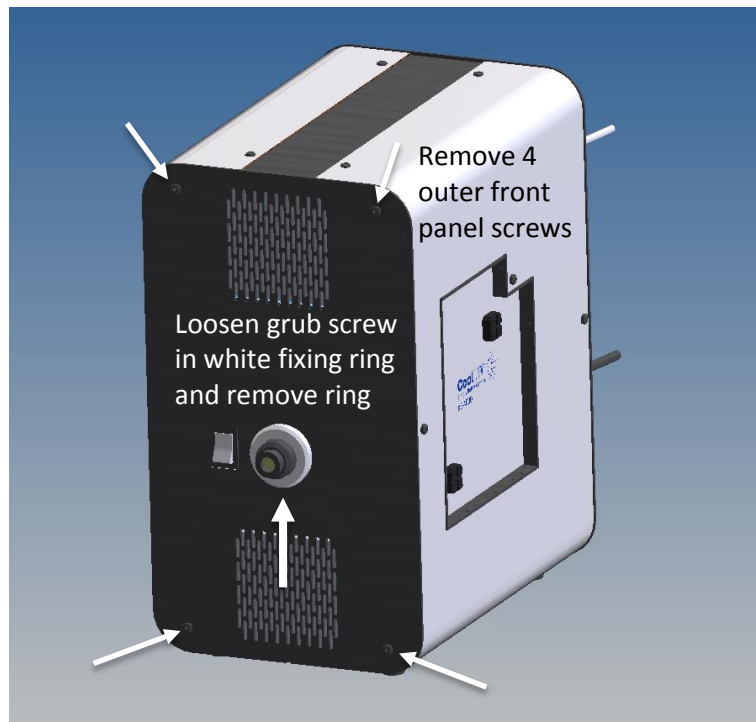


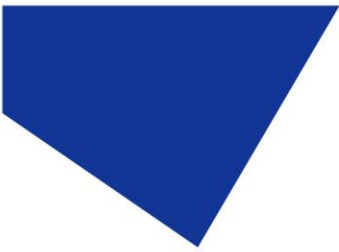
18.4.

To change between the liquid light guide optics module and the fiber optics module a simple procedure needs to be followed. First disconnect the light source from the power supply and remove any liquid light guide or fiber that is fitted.

18.5.

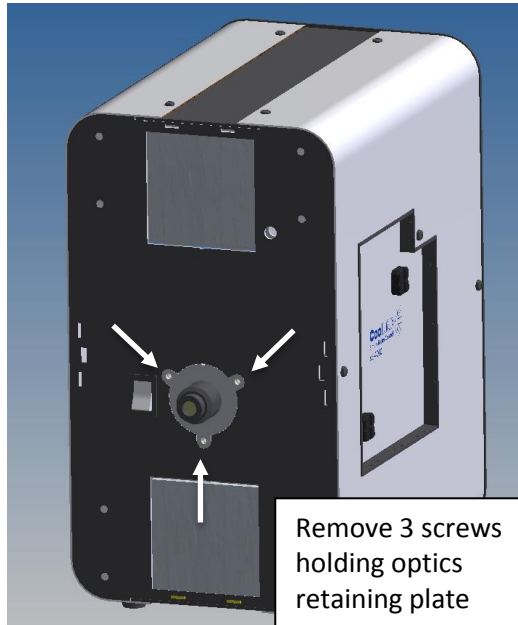
Remove the outer front panel as shown.





18.6.

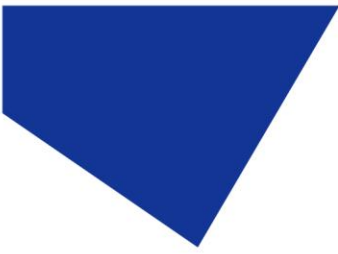
Now with access to the inner front panel, remove the three screws holding the optics retaining plate in position.



18.7.

Release the fitted liquid light guide or fiber optics module as shown, taking care not to touch the lenses.





18.8.

Now fit the alternative optics module, ensuring that it has been fully located on its back internal edge.

18.9.

Re-assemble the optics module retaining plate and front cover, taking care to ensure that the air filters are retained over the fronts of the fans.

19. Software Updates

For information about updating the firmware of the Illumination System please contact support@cooled.com.

20. Routine Care and Maintenance

20.1.

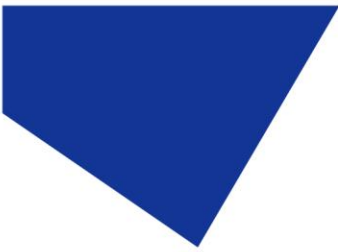
Apart from cleaning or replacing air filters, the pE-4000 will require little or no maintenance throughout its life.

20.2.

The Light Source is cooled by internal fans which draw air in from the front panel grills. The air is forced through two channels into which those components that get hot are thermally linked. The warmed air is then vented through the single rear grill. The forced air is isolated from the optical parts of the light source to prevent a build-up of dust on these components which would impair their performance. To maintain the performance of the internal heat-sinks, two air filters are retained in front of each fan. It is recommended that every 12 months these filters should be removed and cleaned. To gain access to the filters, first remove the white circular ring around the light guide input by releasing the grub screw on its lower edge. Then unscrew the 4 front screws and remove the filters. Beat the filters to remove any dust. If there is an excessive build-up of dust, replacement filters are available from CoolLED.

20.3.

Cleaning of the external surfaces can be carried out with a mild soap and water solution used to lightly dampen a lint-free cloth. It is important to ensure that the power to the System is isolated prior to cleaning. Ensure that no liquid is allowed to enter the product through vents and panel edges. Avoid optical surfaces.



20.4.

Cleaning of optical surfaces maybe necessary if debris or finger prints accidentally come into contact with the lens during installation.

20.5.

In the first instance remove any loose debris with an air duster (aerosol or rubber blower).

20.6.

Fingerprints or other liquid-type contaminants should be removed using standard lens cleaning procedures. Do not flood the lens surfaces with fluid as liquid could enter the product and cause damage.

21. Product Specifications

21.1.

Power requirements
110-240Va.c 50/60Hz 2.0A

21.2.

Power consumption

Standby (i.e. no LEDs on)	Max 6W
Single wavelength operation	Max 24W
Dual wavelength operation	Max 44W
Triple wavelength operation	Max 52W
Quad wavelength operation	Max 60W

21.3.

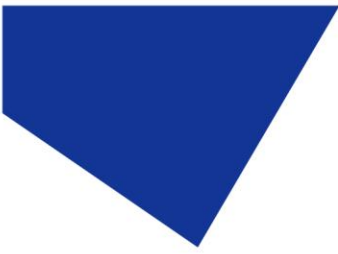
Dimensions

pE-4000 Light Source	150mm (w) x 220mm (d) x 260mm (h)
	-weight 3.5kg
pE-4000 Control Pod	154mm (w) x 135mm (d) x 40mm (h)
	-weight 0.95kg
Power Supply	164mm (w) x 64mm (d) x 35mm (h)
	-weight 0.58kg

21.4.

Environmental Operating Conditions

Operating	5 – 35°C
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22. Product Options and Order Codes

See website ([Microscope Illuminators | LED Illumination Systems | CoolLED](#)) for full details of product options and order codes.

23. Warranty and Repairs

Please refer to CoolLED's current Warranty Policy available on our website [CoolLED Warranty - CoolLED](#). 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 check to avoid confusion.

For any warranty queries or in the event of the product developing a fault, make contact with support@cooled.com for further assistance. You shall be asked to provide your microscope make and model, the product serial number and a brief description of the issue. You shall then be issued with a Support Case to manage your issue.

24. Compliance

24.1. WEEE

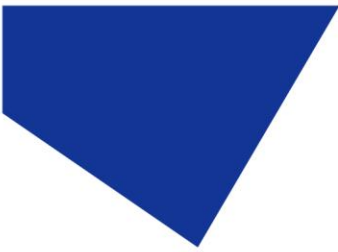
All qualifying products that are subject to the WEEE Directive and supplied by CoolLED are compliant with the WEEE marking requirements. Such products are marked with the "crossed out wheelee bin" WEEE symbol and in accordance with European Standard EN 50419.

CoolLED Certificate No: WEEE/GB4236XX

24.2. RoHS

Based on information obtained from our component suppliers, this statement certifies that ALL products manufactured and supplied by CoolLED Ltd are in compliance with Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (also known as "RoHS").

This declaration is correct to the best of CoolLED Ltd knowledge, information and belief at the date of its release.



24.3. CoolLED's Recycling Program

At CoolLED, we recognize the importance of preserving the global environment. We are proud to provide a Recycling Program that enables CoolLED customers and end-users to send back used CoolLED Light Sources for recycling, free of charge.

Together we can reduce the burden on our environment through responsible disposal and recycling of End-of-Life Light Sources. You can help us by filling in our online contact form and providing us with your contact details and the serial number of the CoolLED Light Source that you wish to return and we will collect it free of charge.

If you are taking delivery of a replacement CoolLED Light Source, why not send the old one back in the packing box of the new one?

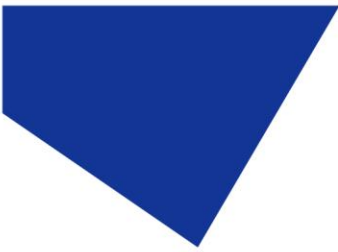
25. Contact Details

CoolLED Ltd
Unit 3
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River Way
Andover
Hampshire
SP10 1NS
UK

Phone +44 (0)1264 323040 (Worldwide)
 1-800-877-0128 (USA + Canada)

Email info@cooled.com

Online www.cooled.com



26. Appendices

Appendix 1

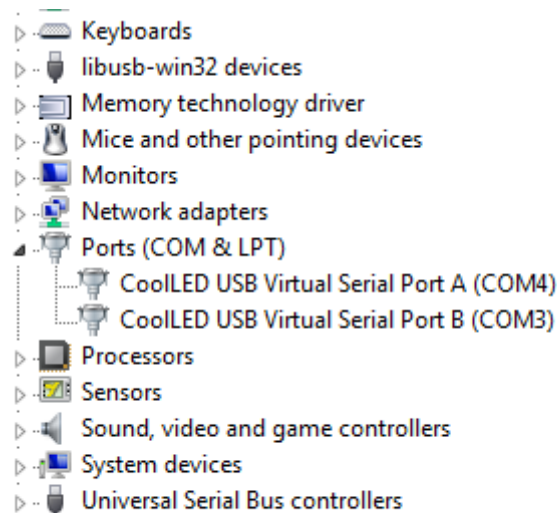
Installing your CoolLED system on Windows machines

When you first plug your CoolLED system into your PC with the USB cable Windows will ask for a driver file unless one has already been installed. You should point Windows to the file available from CoolLED.

If you do not have the driver file you can download this from the CoolLED website by following the instructions on the following page:

<http://www.cooled.com/product-detail/imaging-software/>

Once the CoolLED device has been successfully installed into Windows you should look at the Virtual COM ports assigned by going into Device Manager. Look within Ports (COM & LPT).



Windows PC Device Manager screen.

In this example the pE-4000 has been assigned two COM ports, COM3 and COM4. Either COM port may be used for control.