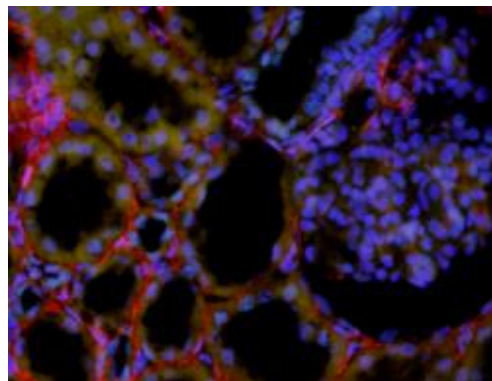
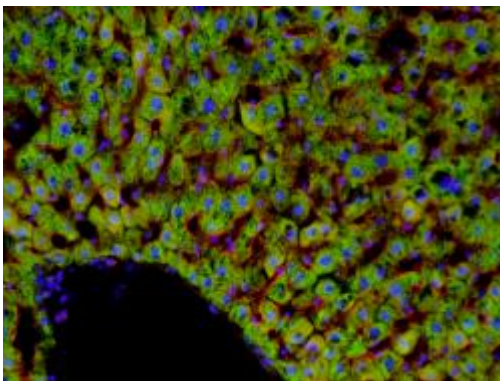
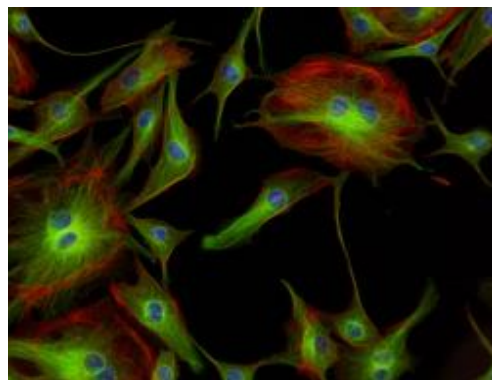
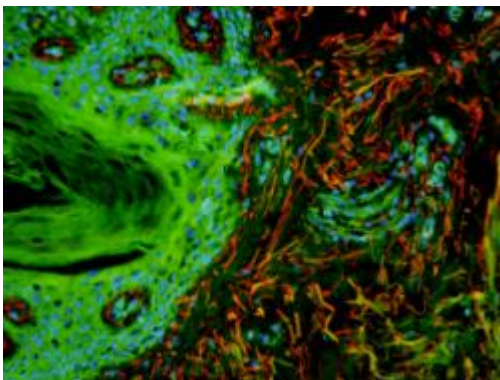


## CoolLED Commands Manual

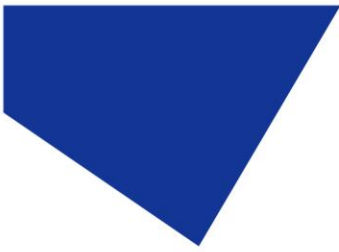
For the pE-4000, pE-300 Series and pE-340<sup>fura</sup>





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## 1 Introduction

This Essential Command Manual has been created to give developers the tools and understanding to integrate CoolLED devices into third-party software. The commands in this manual can be used to control pE-300<sup>white</sup>, pE-300<sup>ultra</sup>, pE-340<sup>fura</sup> and pE-4000 Illumination Systems.

## 2 Hardware

CoolLED systems have been designed to provide the user with a choice of ways of controlling the LED's functions:

- Manually via switches and an intensity control on the remote 'Control Pod'.
- From a PC using a USB virtual serial ports and software. This documentation describes the command set required for USB control.

On the reverse panel of the CoolLED Light Source, there are connectors which provide a choice for remote interfacing and control.

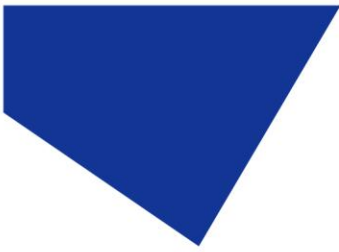
- TTL interfaces for hardware remote control (pE-300<sup>white</sup>, pE-300<sup>ultra</sup>, pE-340<sup>fura</sup> and pE-4000).
- Analogue port interfaces for remote hardware control (pE-4000 only).
- USB Virtual Serial Ports (pE-300<sup>white</sup>, pE-300<sup>ultra</sup>, pE-340<sup>fura</sup> and pE-4000).

### 2.1 TTL interface

This is the simplest method for remote control of the LED arrays. There is an individual TTL input for each physical light channel (except for the pE-300<sup>white</sup> which has a single Global TTL), which when set at a high, will switch on the specific array, overriding any manual settings on the remote pod or other remote-control signals. If rapid switching of the LEDs is required, this is the recommended method as it is independent of the state of the program cycle within the CoolLED Light Source.

### 2.2 Analogue interface

The pE-4000 Light Source offers four 0V-10V analogue inputs, with which external equipment may control the intensity of the light output. It also offers four 0V to 10V analogue outputs that may be used to control external equipment.



### 3 Guide to CoolLED Products & Essential Commands

#### 3.1 pE-300<sup>white</sup>, pE-300<sup>ultra</sup> & pE-340<sup>fura</sup>

The pE-300<sup>white</sup>, pE-300<sup>ultra</sup> and pE-340<sup>fura</sup> are simple light sources to operate. Considering the Control Pod helps explain the control options. Figure 1 shows the Control Pod for the pE-300<sup>white</sup> (the pE-300<sup>ultra</sup> and pE-340<sup>fura</sup> are very similar).

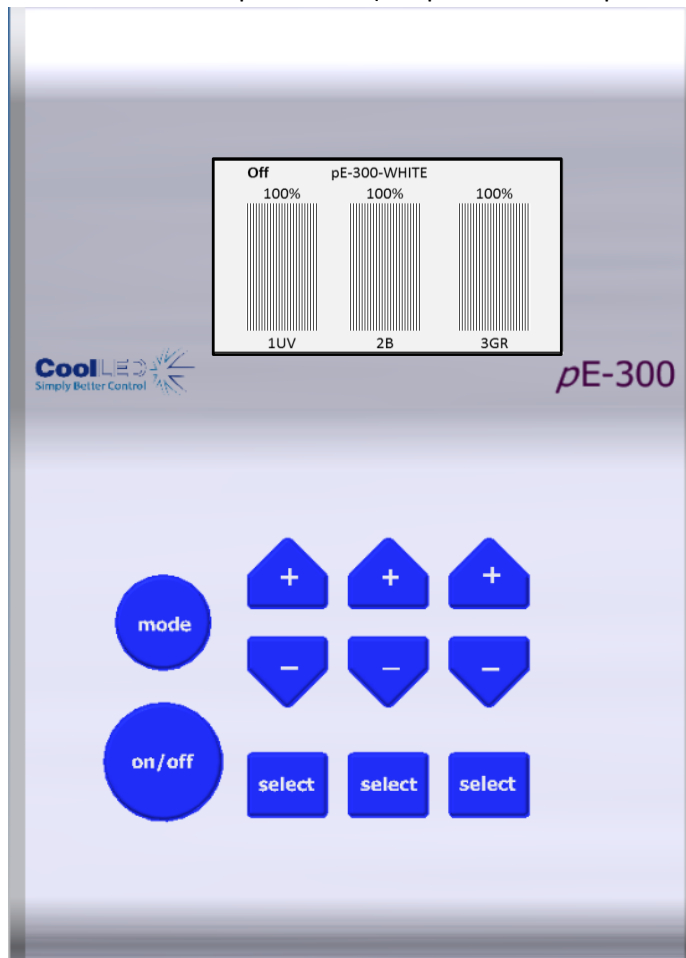


Figure 1: pE-300<sup>white</sup> Control Pod

As shown, the Control Pod consists of three channels that can be either selected or deselected. The large Global on/off button when 'on' will switch on the selected channels whilst leaving the deselected channels alone. When switched 'off' it will switch off any selected channels that are on.

Each channel can be selected or deselected by pressing the corresponding 'select' button. The button marked 'on/off' is the Global on/off. Each channel also has its own intensity control shown above the 'select' button. These buttons provide all possible control on the pE-300<sup>white</sup>.

A TTL-In is also available through the BNC connector on the pE-300<sup>white</sup> and this performs the same function as the Global on/off button but gives much more control over precise timing. The pE-300<sup>ultra</sup> and pE-340<sup>fura</sup> also have this BNC but additionally have individual BNC connections available to further control each channel.

The channels are named A, B and C from left to right on the Control Pod and the spectral regions assigned to A, B and C are in increasing wavelength with channel A being the UV (1UV) or violet\* (1V), B is the blue (2B) and channel C covers the green through yellow to red (3GR).

The CSS... commands can be used to select/deselect, turn on/off and also set the intensity. This command can be used specifically for a single channel or to all three channels together.

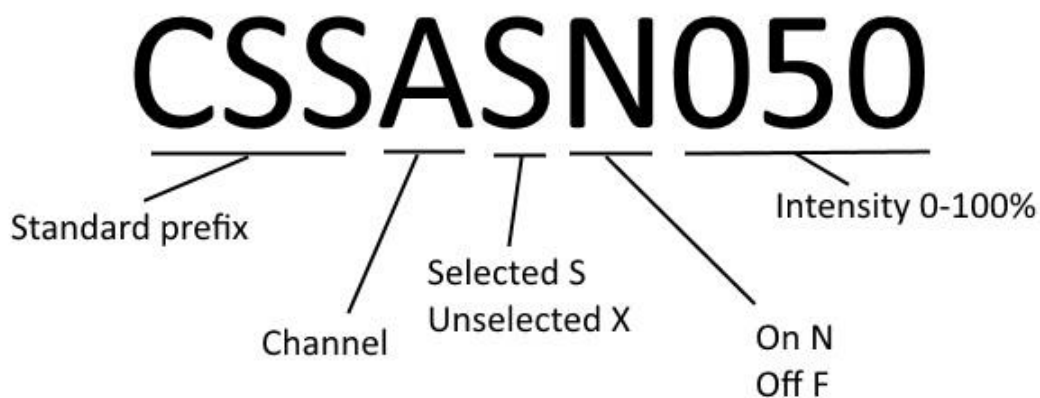


Figure 2: CSS short command structure

Examples:

- To select channel A but leave it off and set its intensity to 50% the following command would be used: **CSSASF050**
- To select channel A and have it on and set its intensity to 50% the following command could be used: **CSSASN050**
- To deselect channel A, which can then only be off, and have its intensity at 50% then the command is: **CSSAXF050**

N.B. As a default setting the XN state is not allowed through software or Control Pod control on the pE-300<sup>white</sup> and if used in a command the unit will force that channel into the XF state.

A longer version of the CSS command can be used as shown in Figure 3:

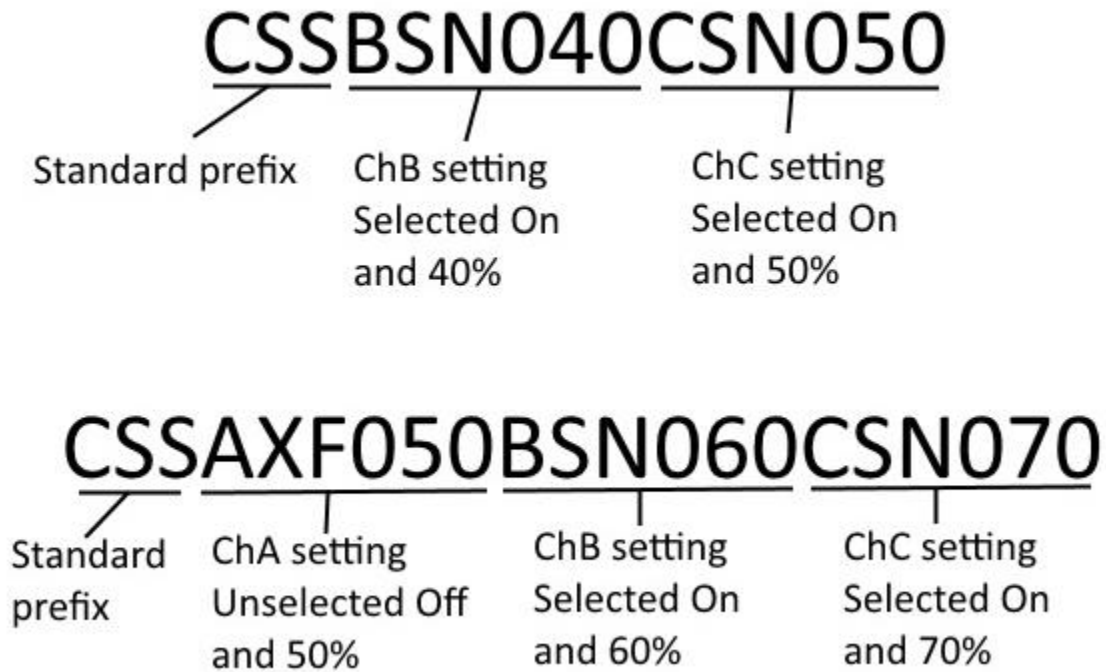
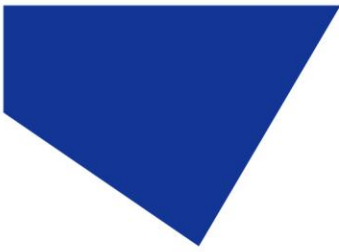


Figure 3: Longer CSS command structure. Not all channels need to be included in the command and channels can be written in any order after the prefix.

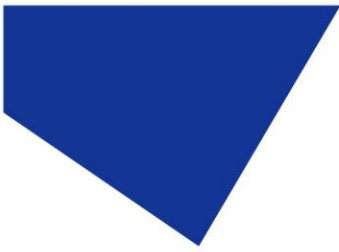
The second-long CSS command shown above sets all three channels in a single command line. In this example ChA is set to the deselected state which is always 'off' and at 50% intensity. ChB is set to selected and 'on' and 60%, ChC is set to selected and 'on' and at 70%. Notice that the intensity can be described by two or three digits. In this example, the Global on/off button on the Control Pod will first switch off ChB and ChC. A second press will switch on ChB and ChC. As ChA is deselected, the Global on/off will have no effect on it.

The Global on/off commands that will switch on or switch off all selected are:

- CSN**    All selected channels on.
- CSF**    All selected channels off.

The Light Source channel intensities can be set individually using the short or longer versions of the CSS command as described above. A Global intensity command is also available which will change the intensity of all three channels but still maintain the relative intensity between channels. This command is:

- CS+**    Increment intensity setting on all channels
- CS-**    Decrement intensity setting on all channels



If the intensity settings on each channel are identical then this command will increase or decrease the intensity of each channel by an identical amount of 1%. If the channels are on different settings then the change will vary between channels in order to maintain the relative balance.

As shown on the Control Pod screen in Figure 1, the wavelength labels of each channel are displayed along the bottom of the screen under the channel intensity bars. This information can also be acquired from the Light Source by the command:

**LAMS** Elicits information about the wavelengths that are available.

The status of the channels can be provided by using the command:

**CSS?** Elicits a response giving the status of all channels.

This will elicit a response from the Light Source in the form of the long CSS command giving details of all channels, as shown in Figure 3.

The pE-300<sup>white</sup> can also be set in a mode that will provide continual reporting of the intensity of each channel and whether it is set to on or off. The commands to set this reporting are:

**XLIVE=YES** Switches on regular reporting of the status of each channel.

**XLIVE=NO** Switches off this regular reporting.

Information of the level of firmware and hardware of the system can be acquired by using the following command:

**XVER** Elicits information about software and hardware versions.

Each command should be in upper case and terminated by a carriage return (CR), and each response from the pE-300<sup>white</sup>, pE-300<sup>ultra</sup> and pE-340<sup>fura</sup> is terminated by a carriage return and line feed (CR) (LF).

### 3.2 pE-4000

The pE-4000 Light Source has a similar operating method to the pE-300<sup>white</sup>. The Control Pod operation will be briefly covered here to explain the control but a more detailed description can be found in the pE-4000 User Manual.

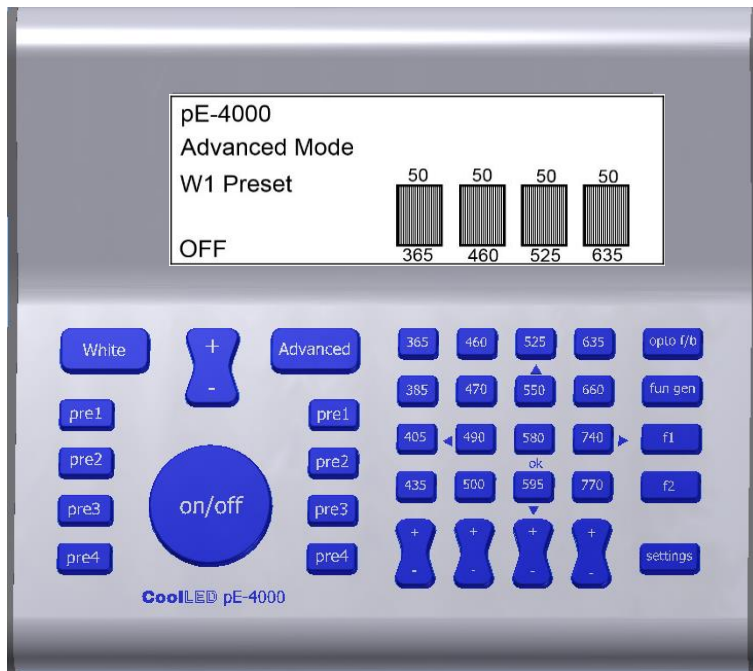
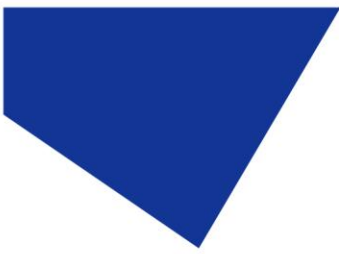


Figure 4: pE-4000 Control Pod.

The pE-4000 Control Pod consists of two distinct regions referred to as the 'White' mode and 'Advanced' mode. When first switched on the system defaults into the White mode and can be switched into the Advanced mode by pressing the 'Advanced' button. The White mode is intentionally limited in its control options and is only available through the Control Pod. We will therefore only consider the Advanced mode on the Control Pod when describing control options available through software.

As seen on the pE-4000 Control Pod, four channels of four wavelengths each are available with each channel aligned vertically in four columns. Channel A is the left-most column and consists of wavelengths 365, 385, 405 and 435. The next column is ChB, followed by ChC and ChD as shown in Figure 5.





Channel A	Channel B	Channel C	Channel D
365	460	525	635
385	470	550	660
405	490	580	740
435	500	595	770
+ -	+ -	+ -	+ -

Figure 5: Channels A-D assigned to pE-4000 wavelengths.

Each of the four channels can have only one wavelength in use at a time. This can be set in one of three states by software:

- Deselected
- Selected and off
- Selected and on

As a default setting, the XN state is not allowed through software or the Control Pod on the pE-4000 and if used in a command the unit will force that channel into the XF state.

The deselected and on state XN (SN) is an anomalous special condition state only possible through the use of the per-channel TTL-In inputs. If a channel is deselected and one of the per-channel TTL-In inputs goes high the wavelength in place on that channel will switch on and into the XN state.

In this case the Global on/off button, the Global TTL In and the CSN/CSF commands will have no effect on the channel as it is in the deselected state. Regular software or Control Pod control can be regained over any channel in the XN state simply by putting it into the selected state.



Just like on the pE-300<sup>white</sup> Control Pod 'select' button, alternative presses of a wavelength button (e.g. '365') will move that wavelength between the selected and deselected state. A Global on/off button is also available on the pE-4000 Control Pod that will with alternative presses switch on and off any selected wavelengths. The software control commands for these functions are also identical to the commands as described previously for the pE-300<sup>white</sup>, pE-300<sup>ultra</sup> and pE-340<sup>fura</sup>.

The full list of available wavelengths can be read from the pE-4000 using the LAMBDA command.

**LAMBDA** Elicits information for all available wavelengths and their assigned channel position.

The pE-4000 response to the LAMBDA command is as follows; the four positions within each channel A-D are assigned numbers 0-3:

**LAMBDA:A0=365**

**LAMBDA:A1=385**

**LAMBDA:A2=405**

**LAMBDA:A3=435**

**LAMBDA:B0=460**

**LAMBDA:B1=470**

**LAMBDA:B2=490**

**LAMBDA:B3=500**

**LAMBDA:C0=525**

**LAMBDA:C1=550**

**LAMBDA:C2=580**

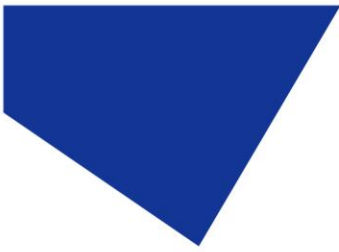
**LAMBDA:C3=595**

**LAMBDA:D0=635**

**LAMBDA:D1=660**

**LAMBDA:D2=740**

**LAMBDA:D3=770**



The ability to load one wavelength from a choice of four is unique to the pE-4000. In order to load a wavelength into the ready-for-use position, the desired wavelength only needs to have its button pressed on the Control Pod. The 'LOAD' command is used to load a wavelength as follows, with 405nm being the desired wavelength in this example.

**LOAD:405** Loads 405nm into position.

The intensity of each wavelength is stored so that the intensity setting is returned when the given wavelength is moved into the ready for use position.

The 'LAMS' command only responds with the wavelengths currently in the ready-for-use position along with the channel they are in.

**LAMS** Elicits information about the wavelength available in each channel

A typical response to the LAMS command would be as follows:

**LAM:A:365**

**LAM:B:460**

**LAM:C:525**

**LAM:D:635**

The CSS commands work on channel information and so only control the wavelengths currently in the ready-for-use position. They can also be used to select/deselect, turn on/off and also set the intensity. This command can be used specifically for a single channel or for all four channels together.

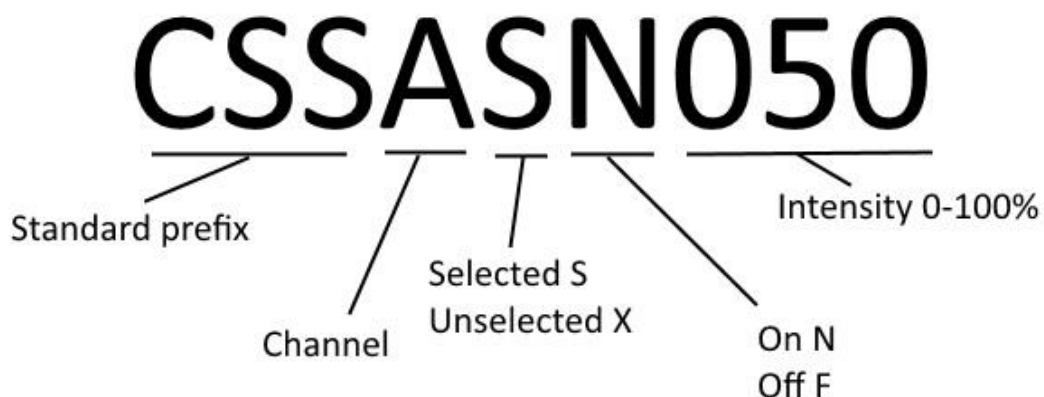
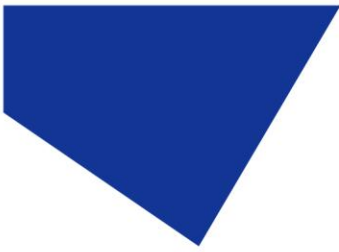


Figure 6: CSS short command structure.



Examples:

- To select channel B but leave it off and set its intensity to 50% the following command would be used: **CSSBSF050**
- To select channel B and have it on and set its intensity to 50% the following command could be used: **CSSBSN050**
- To deselect channel B, which can then only be off, and have its intensity at 50% then the command is: **CSSBXF05**

A longer version of the CSS command can be used:

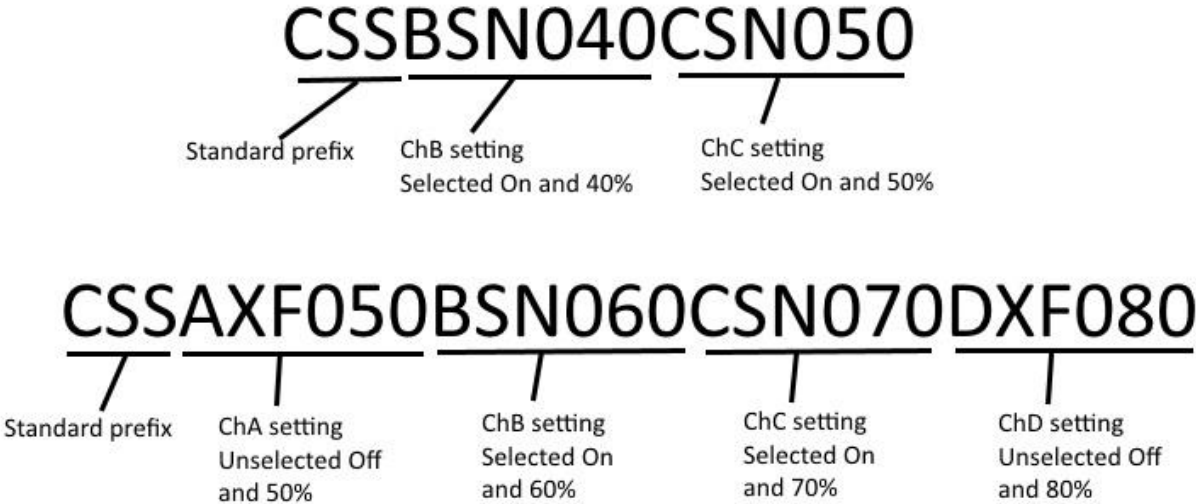


Figure 7: Longer CSS command structure. Not all channels need to be included in the command and channels can be arranged in any order after the CSS prefix.

The second-long CSS command shown in Figure 7 sets all four channels in a single command line. In this example, ChA is set to the deselected state which is always off and at 50% intensity. ChB is set to selected and on and 60%, ChC is set to selected and on and at 70% and finally ChD is set to deselected and 80%.

The status of the pE-4000 channels can be provided by using the 'CSS?' command.

**CSS?** Elicits a response giving the status of all channels.

This will elicit a response from the Light Source in the form of the long CSS command giving details of all channels A-D, as shown in Figure 7.

In the pE-4000 condition shown in the longer form in Figure 7, the Global on/off button on the Control Pod will first switch Off ChB and ChC. A second press will switch On ChB and ChC. As ChA and ChD are deselected the Global on/off will have no effect on them.



The pE-4000 can also be set into a mode that will provide continual reporting of the intensity of each channel and whether it is set to on or off. The 'XLIVE' command provides this function.

- XLIVE=YES** Switches on regular reporting of the status of each channel.
- XLIVE=NO** Switches off this regular reporting.

The Global on/off commands that will switch on or switch off all selected are:

- CSN** Sets all selected channels to on.
- CSF** Sets all selected channels to off.

The Light Source channel intensities can be set individually using the short or longer versions of the CSS command as described above. There is a Global intensity button on the pE-4000 that will change the intensity of all four channels simultaneously but still maintain the relative intensity between channels. The command for this is:

- CS+** Increment intensity setting on all channels.
- CS-** Decrement intensity setting on all channels.

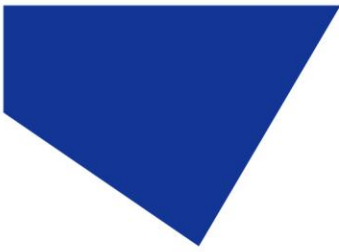
If the intensity settings on each channel are identical then this command will increase or decrease the intensity of each channel by an identical amount of 1%. If the channels are on different settings then the change will vary between channels in order to maintain the relative balance.

Information of the pE-4000 level of firmware and hardware can be acquired by using the following command:

- XVER** Elicits information about software and hardware versions.

This information can also be seen on the Control Pod screen by pressing the 'settings' button when in the Advanced mode then using the Global intensity control '+' to move into the 'Information 1' screen.

The pE-4000 has the ability to accept 4 analogue input signals, each one corresponding to one of the four channels A-D. The analogue signal voltage of between 0-10V will be translated by the pE-4000 into an intensity setting of between 0-100% on the corresponding channel. The pE-4000 system must first have the channels that are intended to work in this analogue format set into the analogue mode. This can be done using the Control Pod by first pressing the F1 button and then pressing the wavelength that is wanted to operate in the analogue mode. Pressing the same wavelength button again will deselect it from the analogue mode while the F1 button is still active. When the F1 button is active it will be backlit. To stop wavelengths responding to the analogue function in this way F1 should be deselected by pressing it again, so that its backlight goes off.



When a wavelength is set into the analogue mode, the intensity bar on the Control Pod screen will turn into a curve shaped icon used to represent analogue mode (see below).

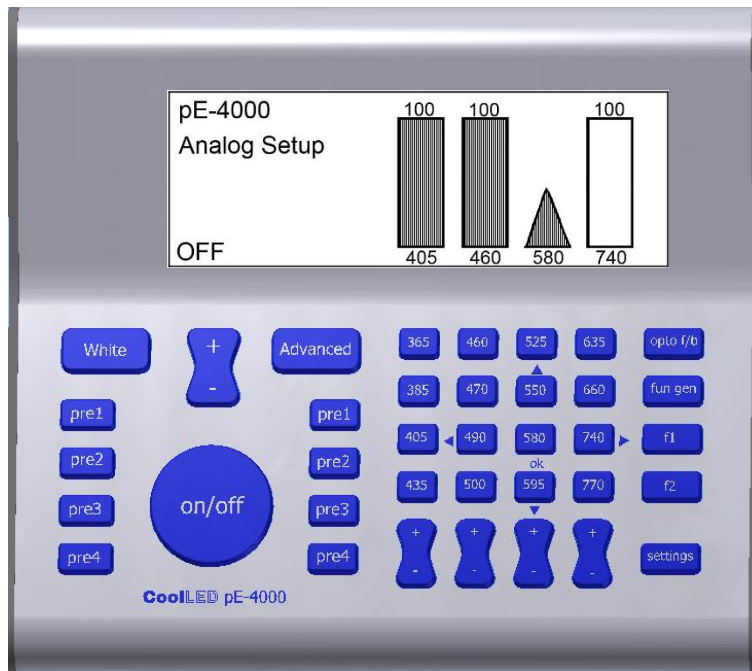


Figure 8: The 580nm wavelength is set into the Analogue mode.

The analogue inputs can be seen clearly on the pE-Expansion Box that is commonly used to interface with the 25 pin D-Type connector as shown in Figure 9.

Through software control the current wavelength on a channel can be set into analogue mode by the 'ANxN' command. In this example, the current ready-for-use wavelength on ChC is set into analogue mode:

**ANCN** Sets current wavelength on channel C into analogue mode, primed for input.

**ANCF** Sets the current wavelength on channel C out of the analogue mode.

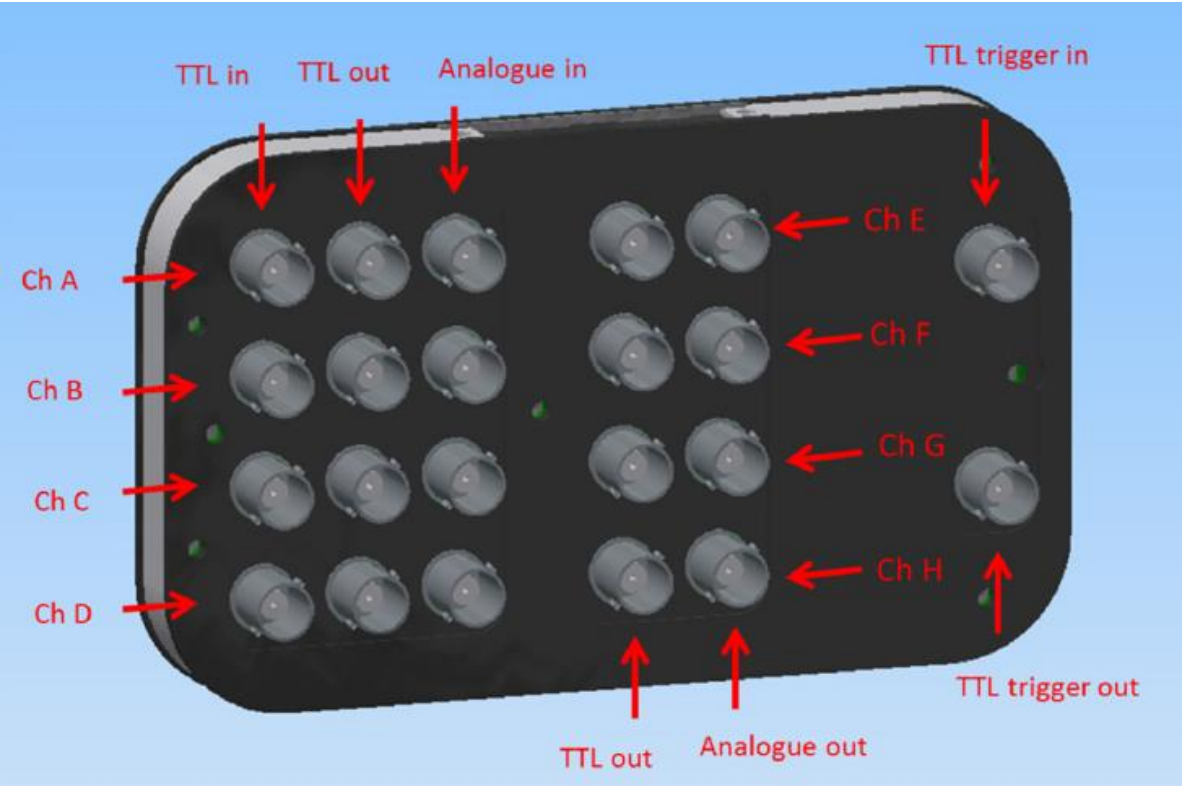
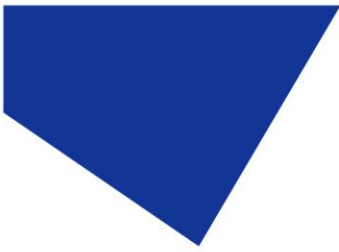


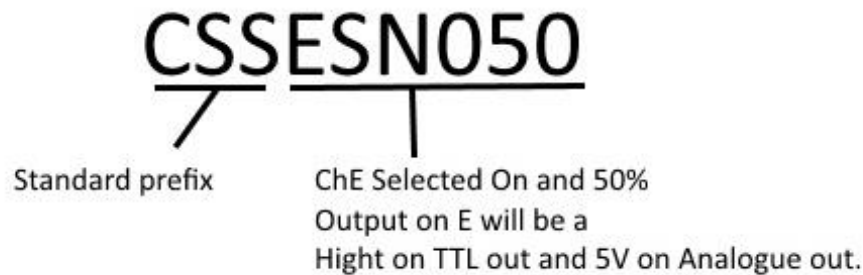
Figure 9: Expansion Box that fits onto the 25-way D-Type connector on the pE-4000.

As can be seen in Figure 9 the pE-Expansion Box shows TTL and Analogue outputs for 4 channels E-H. These outputs are available for controlling peripheral devices such as a pE-100. The TTL out high/low can be seen as an on/off and the voltage that is put onto the Analogue out of 0-10V can be considered as an intensity of 0-100%. Considering the outputs in this form explains the control approach which is similar to that used on channels A-D.



CSS commands can be used to control the outputs on Channels E-H. The command can be used in its short or long form as shown in Figure 10:

Short, specific CSS command type



Long CSS command type

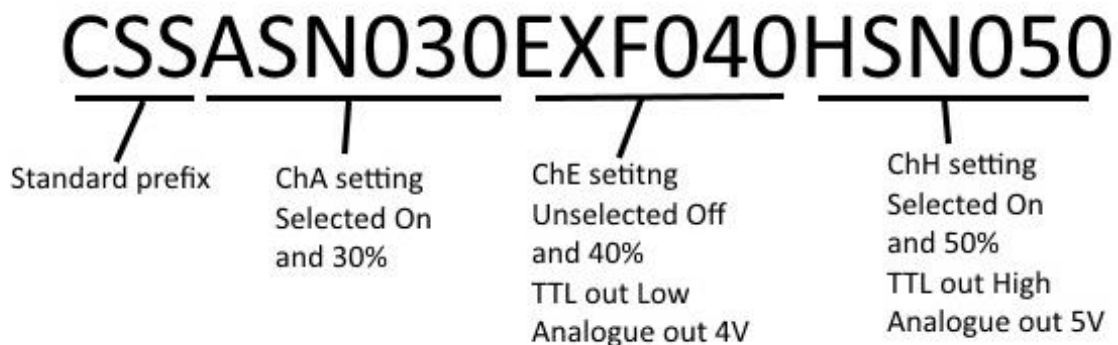


Figure 10: CSS commands that address output channels E-H.

If desirable, the Control Pod can be locked out during software operation. This feature can reduce the risk of an experiment or routine being accidentally interrupted by a Control Pod button press. The 'PORT:P' commands are used to control this. The 'P' stands for Control Pod.

**PORT:P=OFF**      Disables all Control Pod inputs.

**PORT:P=ON**      Re-enables the Control Pod inputs.

Each command should be in upper case and terminated by a carriage return (CR). Each response from the pE-4000 is terminated by a carriage return (CR) and line feed (LF).





## 4 Software

### 4.1 Setting up the USB Interface

The USB interface is it is compatible with all versions of Windows from Windows XP onwards via its use of Microsoft's own built-in drivers for Virtual Serial Ports. This means that CoolLED devices behave very much as an ordinary COM port on your Windows PC and can be controlled by any application that uses COM ports correctly. While this means that no special drivers are required, there is a requirement to tell Windows about our hardware via '.INF' driver file. This is a file named 'CoolLED-pE.inf' and is available from the CoolLED website:

<https://www.cooled.com/wp-content/uploads/2018/05/cooled-driver.zip>

When you first plug the pE system into your PC via the USB interface, Windows will tell you it has found new hardware. It will ask you for the location of the driver file. Point Windows to the location where you saved the .inf file.

### 4.2 Control Text Strings

The base interface between a controlling computer and pE is a simple set of text commands and responses usually sent via a USB 'Virtual Serial Port' interface. These command strings are typically a few characters long, comprising of standard ASCII characters which are always terminated by an end of line character, either <cr> or <lf>. Commands are not case-sensitive but for simplicity and consistency in this manual capitalisation is used.

### 4.3 Baud Rate

The recommended baud rate for the pE-300<sup>white</sup>, pE-300<sup>ultra</sup>, pE-340<sup>fura</sup> and pE-4000 is 57600.

### 4.4 Synchronisation

It is important to note that the logic of CoolLED systems is to execute one command line at a time; the device will only send a response after its given action has been completed. The device will not action any further commands until the response is given.

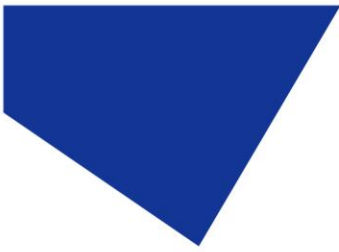
### 4.5 pE Commands

The CSS command and response have the form: CSS[xsn]. The letter 'x' defines the channel (A to H), 's' refers to S (Selected) or X (Not selected), 'n' refers to N (On) or F (Off) and 'nnn' is the intensity in integer percent. The response will always be alphabetic order, but may use more or fewer channels (the pE-4000 offers additional channels E to H for TTL + Analogue outputs, where On/Off controls the TTL and intensity controls the analogue output).



## 5 Full Command Set

<b>Command:</b>	<b>CSS?</b>
Description:	Elicits a status map response for all channels.
pE-300 <sup>white</sup> pE-300 <sup>ultra</sup> & pE-340 <sup>fura</sup> Example Response:	CSSAXF050BSF050CSF050CRLF
pE-4000 Example Response	CSSAXF050BSF050CSF050DSF050CRLF
<hr/>	
<b>Command:</b>	<b>CSS. . . . .</b>
Description:	Sets channel intensities. e.g. CSSASN10BSF20CXF30
pE-300 <sup>white</sup> pE-300 <sup>ultra</sup> & pE-340 <sup>fura</sup> Example Response:	CSSASN10BSF20CXF30CRLF
pE-4000 Example Response:	CSSASN10BSF20CXF30DSN40CRLF
<hr/>	
<b>Command:</b>	<b>LAMBDA S</b>
Description:	LAMBDA enquiry: Elicits information about the wavelengths available.
pE-300 <sup>white</sup> & pE-300 <sup>ultra</sup> Example Response:	LAMBDA:A0:1UVCRLF  LAMBDA:B0:2BCRLF  LAMBDA:C0:3GRCRLF
pE-340 <sup>fura</sup> Example Response	LAMBDA:A0:340CRLF  LAMBDA:B0:380CRLF  LAMBDA:C0:3WTCRLF
<hr/>	



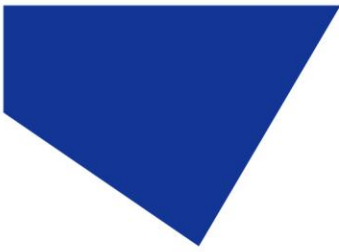
<p>pE-4000 Example Response:</p>	<p>LAMBDA:A0=365CRLF  LAMBDA:A1=385CRLF  LAMBDA:A2=405CRLF  LAMBDA:A3=435CRLF  LAMBDA:B0=460CRLF  LAMBDA:B1=470CRLF  LAMBDA:B2=490CRLF  LAMBDA:B3=500CRLF  LAMBDA:C0=525CRLF  LAMBDA:C1=550CRLF  LAMBDA:C2=580CRLF  LAMBDA:C3=595CRLF  LAMBDA:D0=635CRLF  LAMBDA:D1=660CRLF  LAMBDA:D2=740CRLF  LAMBDA:D3=770CRLF</p>
<p><b>Command:</b></p>	<p><b>LAMS</b></p>
<p>Description:</p>	<p>LAM enquiry: Elicits information about the wavelengths ready for use.</p>
<p>pE-300<sup>white</sup> &amp; pE-300<sup>ultra</sup> Example Response:</p>	<p>LAM:A:1UVCRLF  LAM:B:2BCRLF  LAM:C:3GRCLF  LAM:D:----CRLF</p>



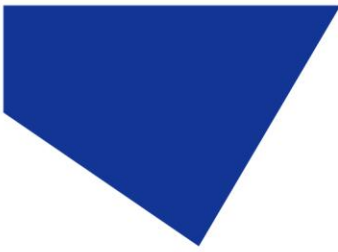
pE-340 <sup>fura</sup> Example Response	LAM:A:340 LAM:B:380 LAM:C:WHT LAM:D:----
pE-4000 Example Response:	LAM:A:365CRLF LAM:B:460CRLF LAM:C:525CRLF LAM:D:635CRLF
<b>Command:</b>	
<b>LOAD: NNN</b>	
Description:	Asks a pE-4000 to load an LED. E.g LOAD:470
pE-300 <sup>white</sup> pE-300 <sup>ultra</sup> & pE-340 <sup>fura</sup> Example Response:	N/A
pE-4000 Example Response: (2 responses are given: one is a channel status response and the other is the loaded LAM response)	CB050FCRLF LAM:B:470CRLF
<b>Command:</b>	
<b>ANxN &amp; ANxF</b>	
Description:	Switches analogue control input on or off on the current wavelength on specified channel. e.g. ANAN puts channel A into analogue mode, whilst ANAF switches it off.
pE-300 <sup>white</sup> pE-300 <sup>ultra</sup> & pE-340 <sup>fura</sup> Example Response to ANAN:	ANANCRLF
pE-300 <sup>white</sup> pE-300 <sup>ultra</sup> & pE-340 <sup>fura</sup> Example Response: ANAF:	ANAFCRLF
pE-4000 Example Response to ANAN:	ANANCRLF
pE-4000 Example Response to ANAF:	ANAFCRLF



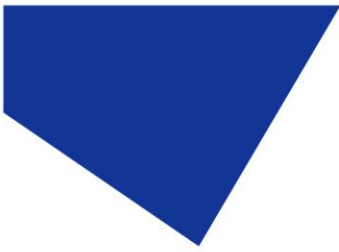
<b>Command:</b>	<b>CSn</b>
Description:	Similarly to the Global TTL input, this switches on or off selected channels. E.g. CSn, CSF
pE-300 <sup>white</sup> pE-300 <sup>ultra</sup> & pE-340 <sup>fura</sup> Example Response: (Channels A & B are selected)	CA010NCRLF CB020NCRLF CSSASN010BSN020CXF030CRLF
pE-4000 Example Response: (Channels A, B, C & D are selected)	CA050NCRLF CB050NCRLF CC050NCRLF CD050NCRLF CSSASN050BSN050CSN050DSN050CRLF
<b>Command:</b>	<b>C[+-]</b>
Description:	Changes intensity of all channels in Global increments and decrements. E.g. CS+
pE-300 <sup>white</sup> pE-300 <sup>ultra</sup> & pE-340 <sup>fura</sup> Example Response: (All channels at 20, CS+ command issued)	CA021FCRLF CB021FCRLF CC021FCRLF
pE-4000 Example Response: (All channels at 50, CS+ command issued)	CA051FCRLF CB051FCRLF CC051FCRLF CD051FCRLF



Command:	XVER
Description:	Version enquiry: Elicits various information about the software and hardware versions
pE-300 <sup>white</sup> pE-300 <sup>ultra</sup> & pE-340 <sup>fura</sup> Example Response:	<pre>XFW_VER=2.2.9CRLF XHW_VER=1CRLF XDATA_VER=1.0CRLF XPOD_FW=2.0.0 CRLF</pre>
pE-4000 Example Response:	<pre>XFW_VER=2.0.14CRLF XHW_VER=1CRLF XDATA_VER=1.0CRLF XPOD_FW=2.0.1CRLF XFW_BAK:A=2.0.3CRLF XFW_BAK:B=2.0.3CRLF XFW_BAK:C=2.0.3CRLF XFW_BAK:D=2.0.3CRLF</pre>



<b>Command:</b>	<b>XLIVE</b>
Description:	<p>Channel Reporting:</p> <p>XLIVE=YES: Reports channel state regularly at 10 second intervals.</p> <p>XLIVE=NO: Reports only as a response to channel commands.</p>
pE-300 <sup>white</sup> pE-300 <sup>ultra</sup> & pE-340 <sup>fura</sup> Example Response:	<p>XLIVE=YESCRLF</p> <p>CA010FCRLF</p> <p>CB020FCRLF</p> <p>CC030FCRLF</p>
pE-4000 Example Response:	<p>XLIVE=YESCRLF</p> <p>CA010FCRLF</p> <p>CB020FCRLF</p> <p>CC030FCRLF</p> <p>CD040FCRLF</p>
<b>Command:</b>	<b>PORT:P=</b>
Description:	<p>Control Pod Toggling:</p> <p>PORT:P=ON: Pod control is enabled</p> <p>PORT:P=OFF: Pod control is disabled</p>
pE-300 <sup>white</sup> pE-300 <sup>ultra</sup> & pE-340 <sup>fura</sup> Example Response to PORT:P=ON:	PORT:P=ONCRLF
pE-300 <sup>white</sup> pE-300 <sup>ultra</sup> & pE-340 <sup>fura</sup> Example Response to PORT:P=OFF:	PORT:P=OFFCRLF
pE-4000 Example Response to PORT:P=ON:	PORT:P=ONCRLF
pE-4000 Example Response to PORT:P=OFF:	PORT:P=OFFCRLF



<b>Command:</b>	<b>SEQA[0-3]:nnnB[0-3]:nnnC[0-3]:nnn</b>
Description:	<p>Sequence Runner Control (pE-300<sup>ultra</sup> &amp; pE-340<sup>fura</sup> only): This steps through a preset sequence on the Global TTL on the rising edge.</p> <p>Where nnn denotes the channel intensity, 0-3 is sequence number, 0 means the channel is unselected</p> <p>e.g. SEQA2:050B0:033C1:080</p> <p>To stop the sequence runner, send any valid CSS standard command</p>
pE-300 <sup>ultra</sup> & pE-340 <sup>fura</sup> Example Response:	<i>CRLFQA2:050B0:033C1:080CR</i>
<b>Command:</b>	<b>SEQ?</b>
Description:	<p>Sequence Enquiry (pE-300<sup>ultra</sup> &amp; pE-340<sup>fura</sup> only)</p>
pE-300 <sup>ultra</sup> & pE-340 <sup>fura</sup> Example Response:	<p><i>SEQ:A2:050CRLF</i></p> <p><i>SEQ:B0:033CRLF</i></p> <p><i>SEQ:C1:080CRLF</i></p>





## Appendix A: Graphical User Interface Construction

The fundamental controls necessary for an LED system can be covered by four simple control functions as are listed below. Some suggestions of how a GUI may be designed are given only to provide some assistance if needed.

- a) The ability to read in and load available wavelengths on the GUI.
  - The 'LAMS' command on the pE-4000 is used to read the ready for use wavelengths but also to read in the fixed wavelength descriptions on the pE-300<sup>white</sup>.
  - The 'LAMBDAS' command on the pE-4000 allows all available wavelengths to be read in and possibly displayed in a drop-down menu or list as shown in Figure 11.
  - 'LOAD:xxx' command on the pE-4000. Loading wavelengths may be achieved by clicking on the desired wavelength through a drop-down menu or list.
- b) The ability to set the intensity of each channel.
  - The CSS commands allow the intensity to be set independently for each channel. This could be provided as a slider mechanism in the GUI or as a box where intensity can be set directly, or as both. This can be seen in Figure 11.
  - The CS+ and CS- commands can also be used as a Global intensity control if desired.
- c) The ability to select or deselect the wavelengths that are ready for use.
  - The short or long CSS command may be used for the purpose of setting the channel state into 'XF' or 'SF'. The ability to select only the wavelengths of interest means that unneeded wavelengths can be left off when using a Global on/off control.
- d) The ability to switch on and off the desired wavelengths.
  - The CSS commands can do this for each channel independently, e.g. CSSASN100. This could be incorporated as a checkbox for each channel.
  - The CSN and CSF commands can be used as a Global on/off for selected channels. This command may be considered as a shutter and exist as a separate button.

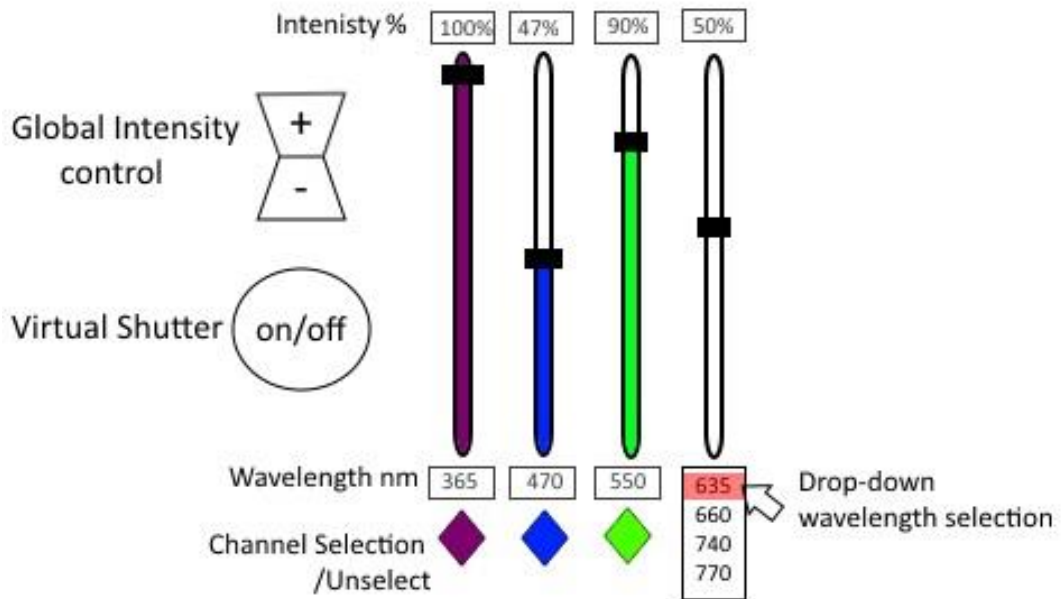


Figure 11: Example of a GUI.

Figure 11 shows a mixture of GUI controls that may be applied to the control of the pE-4000 or pE-300<sup>white</sup>. This is only covering the most basic control but the designer may include other functions, for example the analogue mode option and control for the extra channels E-H.