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A HALMA COMPANY

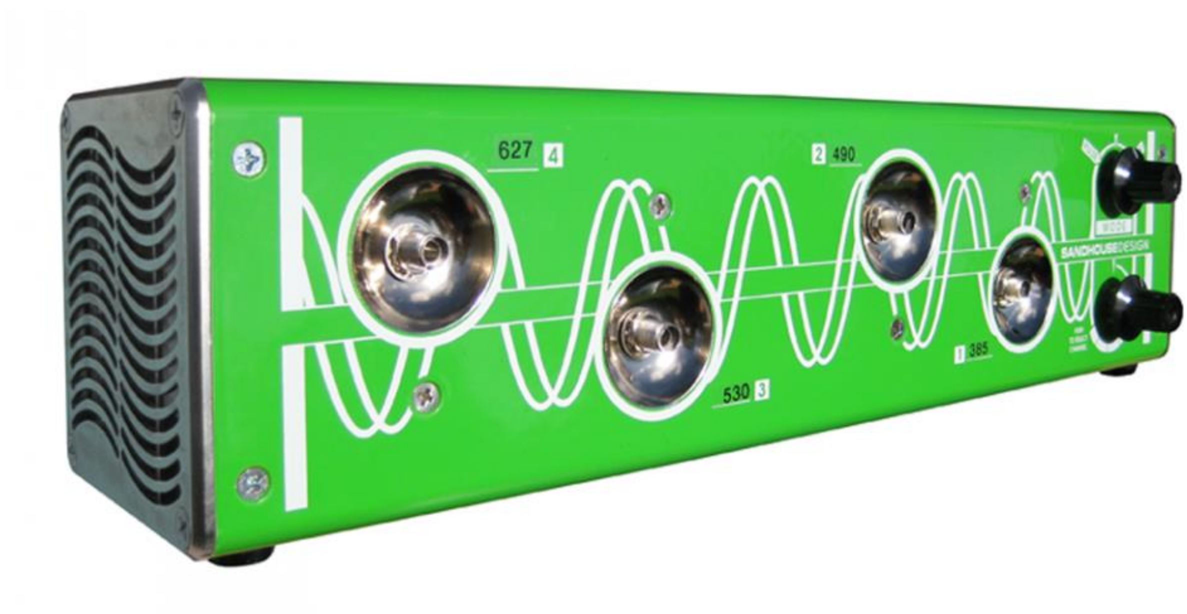
Multi-Channel LED Light Source

Installation and Operation Instructions

Description

Ocean Optics' Multi-Channel LED light source (MCLS) is designed to power four Ocean Optics LED modules. The constant current drivers each drive up to 2 amps continuously or 4 amps at 50% duty cycle. The user-changeable LED modules are automatically recognized and the drive current is adjusted accordingly. The light source can work as a standalone system or be controlled through the integrated USB interface.

The MCLS has 12 bits of intensity control for each LED. The USB interface, along with the LED Controller software, is used to access the powerful timing functions of the integrated time domain controller.



MCLS Light Source

LED Modules

The MCLS LED light source LEDs are available in nearly 50 different wavelength options. See the table below for a list of LED modules.

Part Number	Wavelength	FWHM	Min. Power Coupled into a 600 µm .22NA Fiber	Max. Drive Current CW	Max. Drive Current Pulsed	Max. Duty Cycle in Pulsed Mode
LLS-240	240	11 nm	2µW	30mA	200mA	1%
LLS-245	245	10 nm	2µW	20mA	200mA	1%
LLS-250	250	12 nm	5µW	30mA	200mA	1%
LLS-255	255	12 nm	5µW	30mA	200mA	1%
LLS-260	260	12 nm	15µW	30mA	200mA	1%
LLS-265	265	12 nm	15µW	30mA	200mA	1%
LLS-270	270	12 nm	15µW	30mA	200mA	1%
LLS-275	275	12 nm	15µW	30mA	200mA	1%
LLS-280	280	12 nm	15µW	30mA	200mA	1%
LLS-285	285	12 nm	15µW	30mA	200mA	1%
LLS-290	290	12 nm	15µW	30mA	200mA	1%
LLS-295	295	12 nm	15µW	30mA	200mA	1%
LLS-300	300	12 nm	15µW	30mA	200mA	1%
LLS-305	305	12 nm	15µW	30mA	200mA	1%
LLS-310	310	12 nm	15µW	30mA	200mA	1%
LLS-315	315	10 nm	15µW	30mA	200mA	1%
LLS-325	325	12 nm	15µW	30mA	200mA	1%
LLS-335	335	15 nm	20µW	30mA	200mA	1%
LLS-345	345	12 nm	20µW	30mA	200mA	1%
LLS-355	355	15 nm	20µW	30mA	200mA	1%
LLS-365	365	9 nm	1mW	500mA	1000mA	50%
LLS-385	385	10 nm	1mW	500mA	1000mA	50%
LLS-405	405	14 nm	750µW	500mA	1000mA	50%
LLS-455	455	20 nm	1mw	1500mA	3000mA	50%
LLS-470	470	25 nm	1mw	1500mA	3000mA	50%
LLS-490	490	20 nm	1mw	1000mA	3000mA	50%
LLS-505	505	30 nm	1mw	1500mA	3000mA	50%
LLS-530	530	35 nm	750µW	1500mA	3000mA	50%

Part Number	Wavelength	FWHM	Min. Power Coupled into a 600 µm .22NA Fiber	Max. Drive Current CW	Max. Drive Current Pulsed	Max. Duty Cycle in Pulsed Mode
LLS-590	590	14 nm	750µW	700mA	1400mA	50%
LLS-617	617	20 nm	750µW	700mA	1400mA	50%
LLS-627	627	20 nm	750µW	700mA	1400mA	50%
LLS-Cool White	VIS 6500K CCT	N/A	1mw (measured at 550nm)	1500mA	3000mA	50%
LLS-Neutral White	VIS 4100K CCT	N/A	1mw (measured at 550nm)	1500mA	3000mA	50%
LLS-Warm White	VIS 3000K CCT	N/A	1mw (measured at 550nm)	1500mA	3000mA	50%

Standalone Operation

The Multi-Channel light source can be used without the USB interface. The USB controller has two interface knobs on the front as shown in Figure 2. The top knob is the power/mode switch. Turn this knob to the right, (clockwise), for CW (continuous operation). When the knob is turned fully counter-clockwise the light source will be in pulsed operation. The system initially defaults to a low frequency, low duty cycle pulse.

This frequency and duty cycle can only be changed via the USB interface. However, once the desired timing and intensity configuration is set up via the PC interface, this configuration can be stored into the light source for standalone operation.

The switch is returned to the middle position to power the system "off".

The bottom knob is "intensity control." To increase the intensity, press the knob in once.

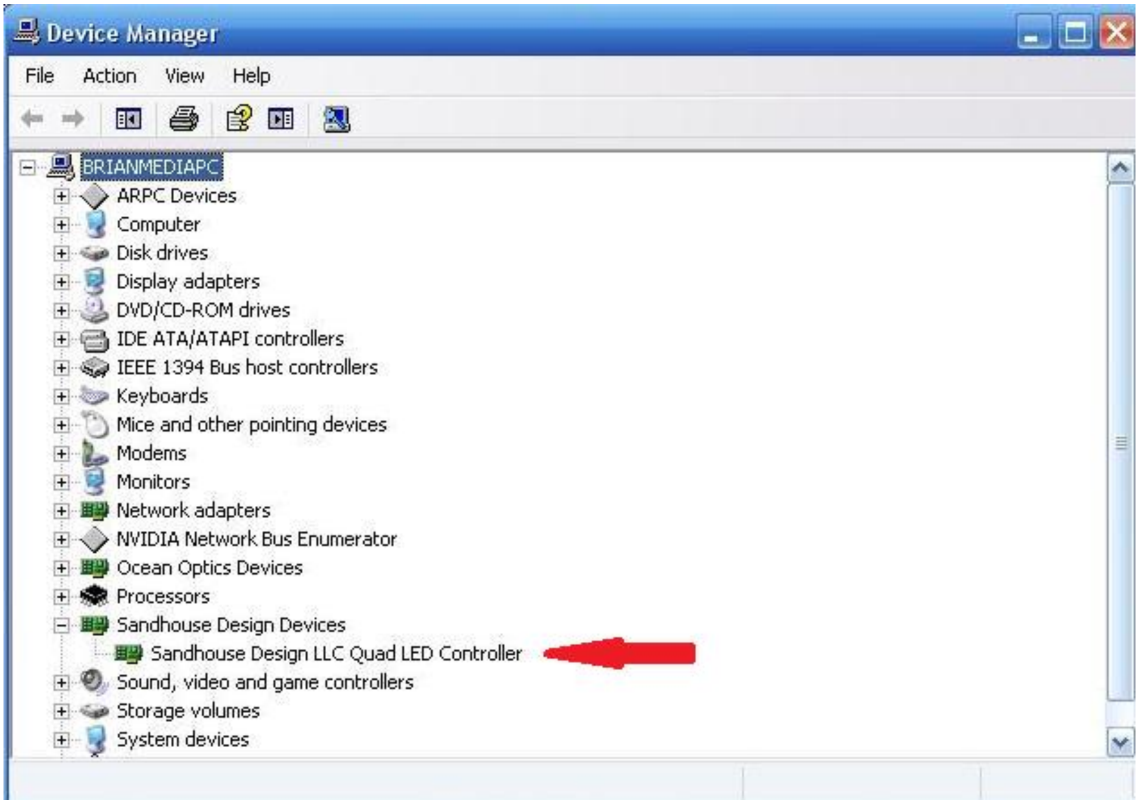
The first channel will blink several times. Rotate the knob clockwise to increase the output, and decrease the intensity by turning the knob counterclockwise. Two full rotations of the knob will take the output from 0 to 100% output. The next channel can be adjusted by pressing the control knob in. The LED will blink several times and the user can then rotate the knob to change the intensity. Repeat this cycle to rotate through the remaining channels, (the system will eventually time out and return to an idle state).

Front View of MCLS Light Source

USB Interface

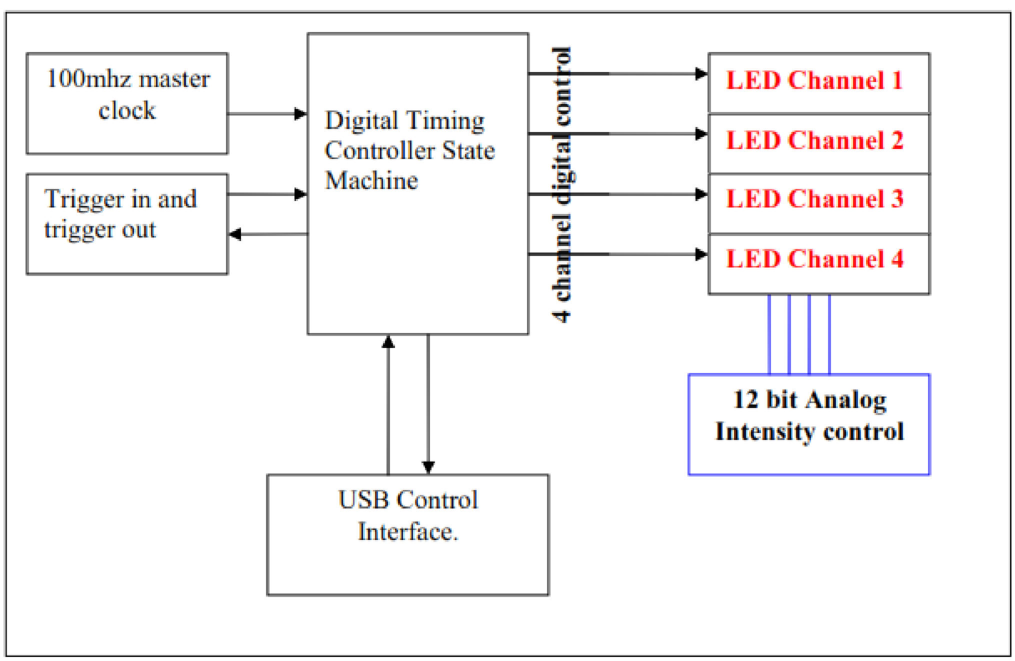
Prior to plugging in the supplied USB cable to the host PC, install the LED controller software. The SDK for custom code development is also available there. This can be downloaded from the CD that came with your light source.

Once the software is installed, plug in the USB interface and turn the controller on. When the USB controller is properly installed, it will show up in the device manager as "Sandhouse Design LLC Quad LED Controller" as shown below.



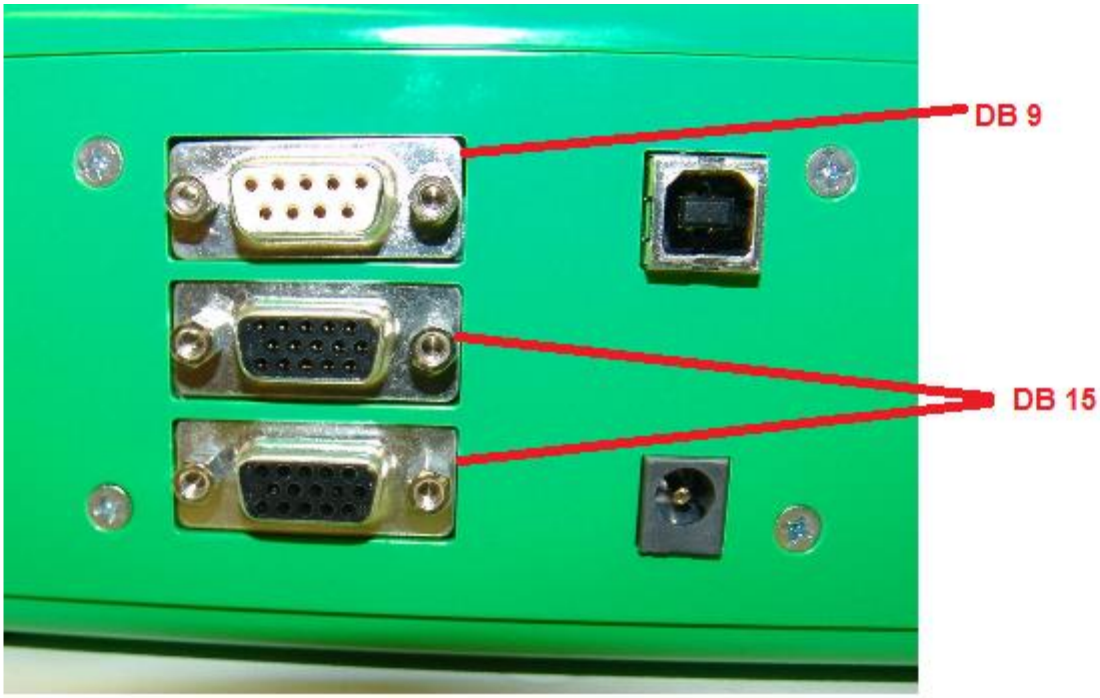
Block Diagram

The figure below shows a basic block diagram for the control functions of the Multi-Channel light source. Each channel is independently controlled and the Digital State machine is used to define the timing of the system.



Connectors

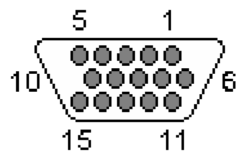
The following figure shows the Interface connections to the Light source. The DB9 connection at the top is for interfacing to external triggers. The two DB15 connectors are both used for daisy chaining additional light sources.



DB 9

Pin #	Description
1	Test out
2	Spectrometer trigger out
3	N/C
4	Test in
5	Spectrometer trigger in
6	Daisy chain trigger out
7	Gnd
8	Daisy chain trigger in
9	Lamp enable in

DB 15



Pin #	Description
1	Pulse. Use for pulsed mode.
2	N/C
3	Lamp enable
4	N/C.
5	N/C
6	N/C
7	SCL
8	SDA
9	Ground
10	Ground
11	N/C
12	N/C
13	Daisy chain in/out
14	Daisy chain out/in
15	N/C

Timing Controls and Setting Counters

The basis of the time domain controller is the main 100mhz clock. This fast clock is divided down by a 24 bit counter to obtain a primary clock. The secondary counters for the LED states now have a more reasonable clock size to function from. The counter will add up the entered number of clocks before changing state. For example, a value of 50,000 in this field will yield a period of 1ms. This 1ms is a convenient quantity to work with and hence the default.

Once the primary clock is programmed, the off time and on time of the LED channels are derivatives of this. So a value of 1000 in the low counter will yield a 1 second pulse. (1ms*1000=1 second). A value of 10= 10ms. It is important to note that the LED channels always operate the "off state" first and then the "on state".

The trigger out delay is based directly from the 100mhz clock and has a very large counter. This enables this trigger to be at any point in the LED cycle or after it has turned off.

LED Pulsed Modes

- **Free Running:** In this mode the LED counters just cycle independent of each other and possible triggers.

- **Sequential:** The LED counters reset consecutively, Channel one resets runs its' off time, then on time and then signals LED 2 to start it's cycle. This repeats through all of the channels. If the Daisy Chain mode is enabled, a signal will be sent to the next light source in the chain to signal the process, otherwise Channel 1 will start again.
- **Synchronized:** In Synchronized mode, the LED counters all start at the same time. The cycle will not repeat until the longest period is finished. At which time the "off time" of all of the LEDs start synchronously.

Trigger Modes

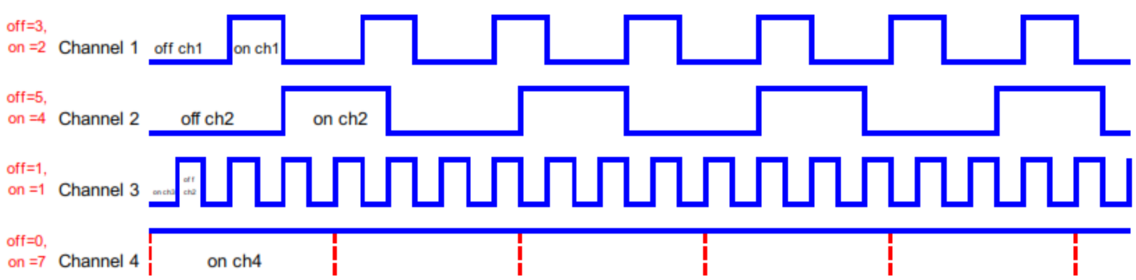
- **Free Running:** In this mode, the light source is not waiting for a trigger. This is the default mode.
- **External Trigger**: In this mode, the light source is waiting for the trigger to come in on pin 5 of the DB9 connection.
- **Internal Trigger**: In this mode, the light source triggers itself internally. It works off of the same trigger that it uses internally.

Timing Diagrams

The timing charts below demonstrate the various modes. The counters in all of the samples use the same values for the off and on parts of the clock cycle. This is the value shown in red on the left of the chart. For Example channel 1 shows 3 counts of the "primary clock" for the off cycle, and 2 counts for the on cycle.

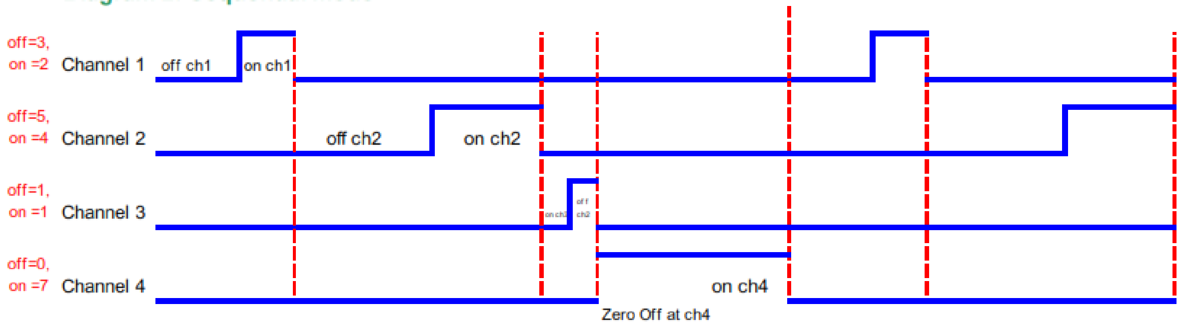
- **Free Running Mode**. As can be seen in the in Diagram 1, each channel operates based on the high period and low period of the clock and independent of each other. The internal and external triggers are not compatible with "free running "mode and will not be shown further.

Diagram 1: Free Running



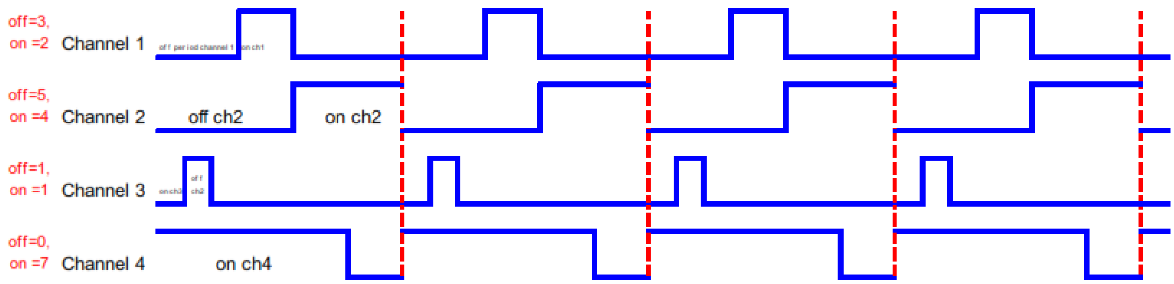
- **Sequential Mode** is shown in Diagram 2. In this mode, the off period and on period of each channel are executed, consecutively. In this mode, only one LED will be on at a time. The channel changes state after the "on time" is done. Notice that the off time for channel 4 is set to 'zero'. Therefore, LED 4 goes straight to turning on when channel 3's "on" time is complete.

Diagram 2: Sequential mode



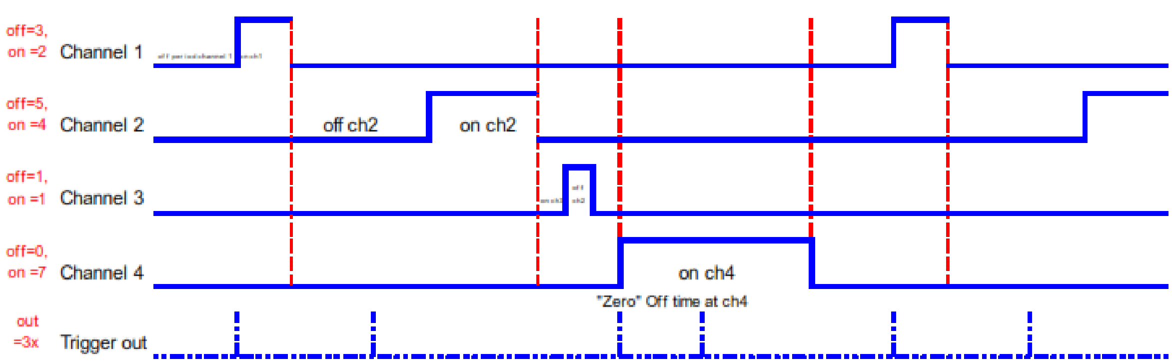
- **Synchronous Mode**: as shown in Diagram 3. In this mode all LED counters restart together. When the longest total period of all 4 channels is done, the process restarts. It is important to note here, the "off time" of the LEDs run first. In this example, Channel two has the longest period (off time, plus on time).

Diagram 3: Synchronous



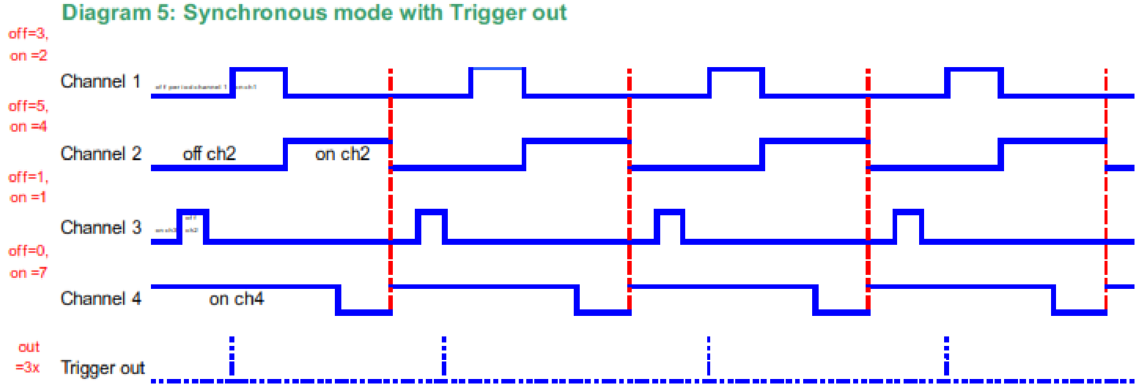
- **Sequential Mode with Trigger out enabled:** The trigger out is derived directly from the master clock (100mhz). Therefore it is adjustable in 20ns increments. This counter is large and can trigger at any point over the range of the LED's cycle including any time after it. Notice that the trigger counter starts from the beginning of the off period. The next LED cycle will not start until the trigger out timer is done. The channel cycle time is defined by whichever is longer, the length of time to the trigger out, or the LED period. A demonstration of this point can be seen in the timing of channel 3. The controller does not switch to channel 4 until the trigger out is activated.

Diagram 4: Sequential mode with Trigger out



- **Synchronous Mode with trigger out:** Shown in Diagram 5. This is simply the synchronous mode with the trigger out programmed to be at approximately 3ms. Because this signal is derived directly from the main clock, It is necessary to program it in terms of 20ns increments. This is actually programmed in increments of 20ns, the value here would be 150,000. In this example the longest period is channel 2. The cycle will not repeat until this counter is finished.

Diagram 5: Synchronous mode with Trigger out



- **Sequential "Trigger in" Mode:** This mode is demonstrated in Diagram 6. There is a 24 bit counter than can be used to delay the trigger coming in from a spectrometer or other external source. (This additional counter is not used in this example,) Once a cycle starts, all subsequent triggers are ignored. An example of this can be seen during channel 2's cycle where another trigger comes in and is ignored by the controller. It is important to note in this example that the trigger out is still active and can be used simultaneously with "trigger in."

Diagram 6: Sequential "Trigger in" mode (shown with trigger out)

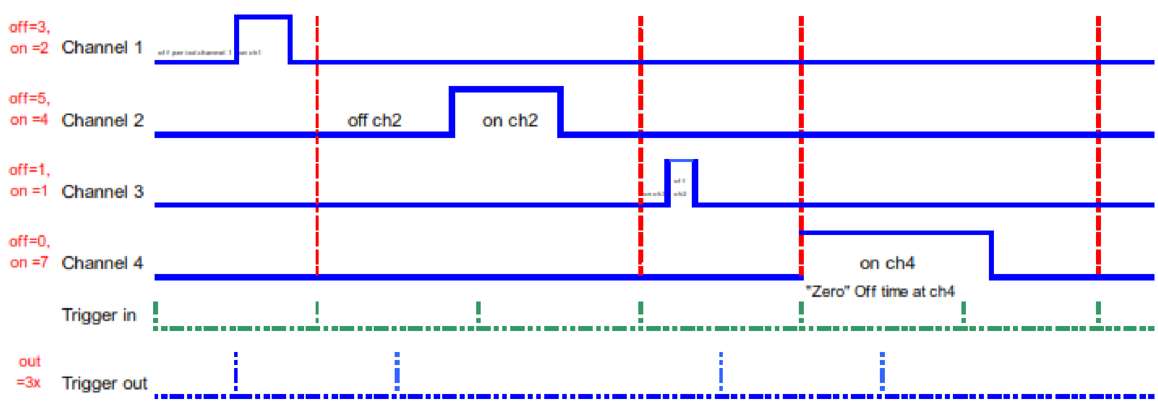
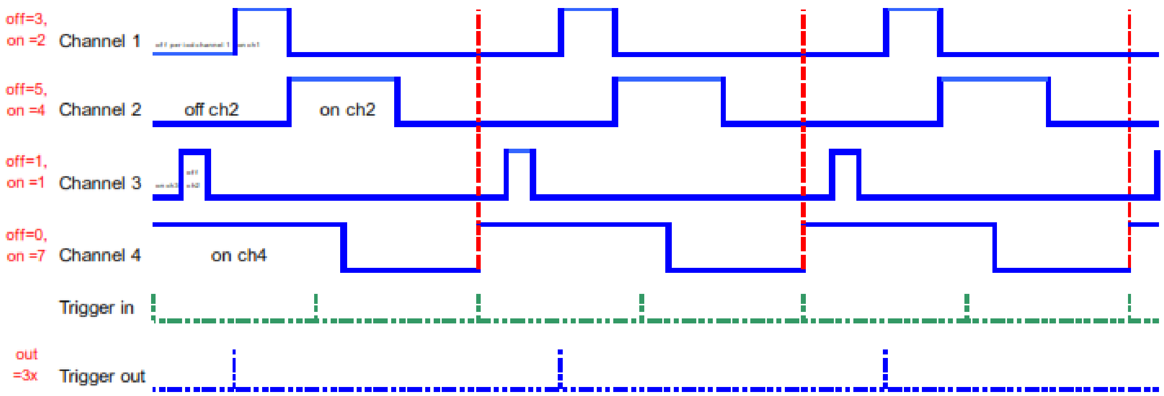
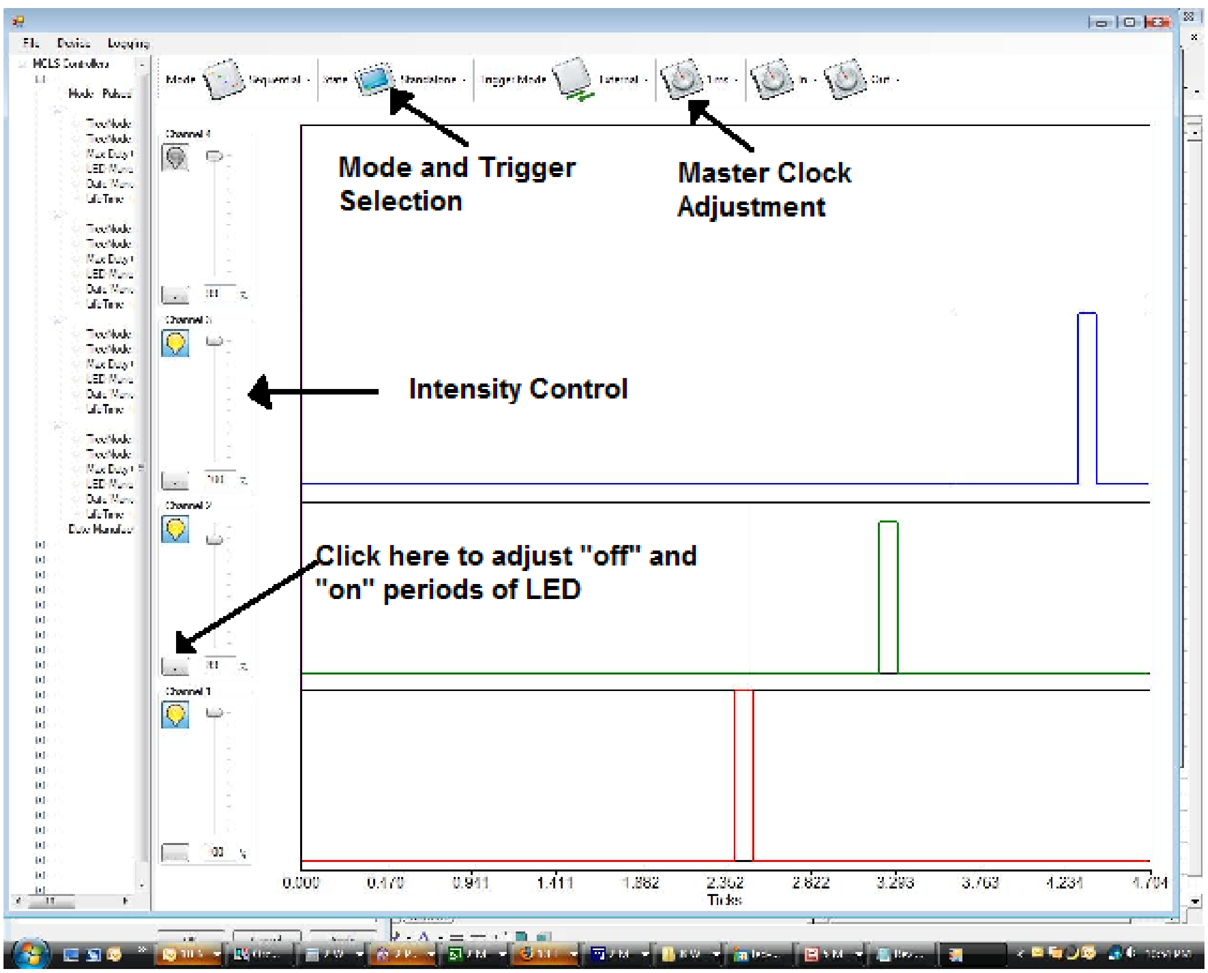


Diagram 7: Synchronous "Trigger in" mode (shown with trigger out)





Exchanging an LED Module

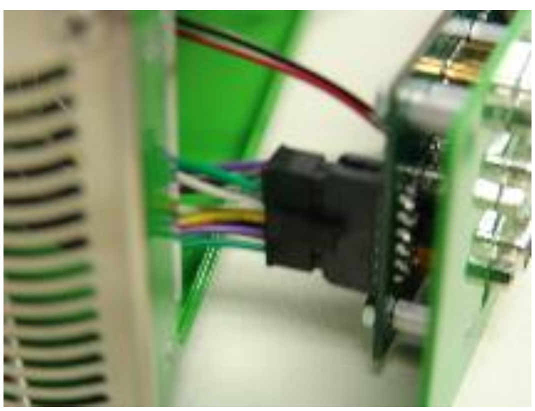
The LED modules are user changeable (see *LED Modules*).

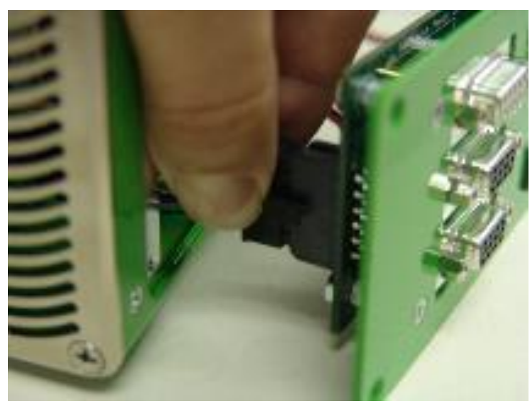
► *Procedure*

To change a module,

1. Unscrew the back panel of the LED light source. To do this, remove the four screws around the perimeter of the panel.

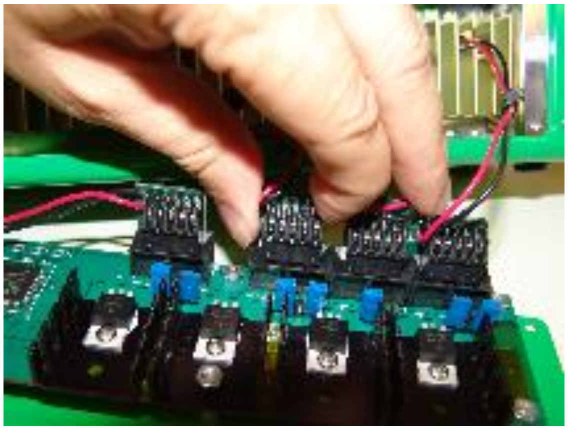
2. Remove the switch panel connection to gain full access to the back panel.





3. Remove the module.

4. Loosen the plugs by gently rocking them from side to side.



5. Use a 5/16 nut driver to exchange the LED module.