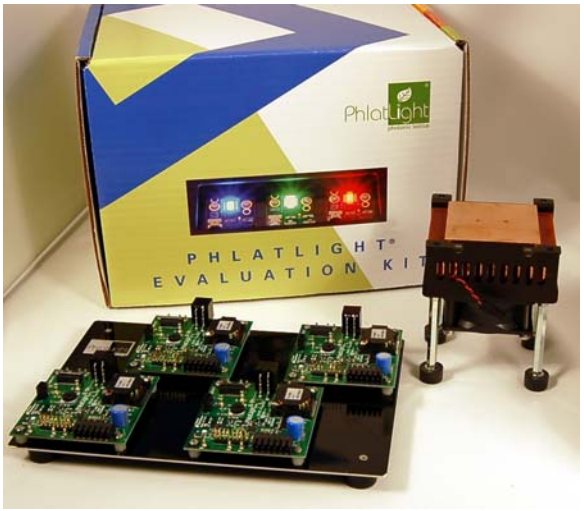
PhlatLight LED Development Kit Manual

DK-414N-4
DK-314N-3



Introduction:

PhlatLight LEDs, from Luminus Devices, have been designed from the ground up to enable a new class of illumination and projection systems. Benefiting from a suite of innovations in chip technology, packaging, and thermal management, PhlatLight LEDs allow designers to achieve efficient light engine designs and deliver high brightness solutions.

The DK-414N series of PhlatLight Development Kits was designed for fast and simple evaluation of PhlatLight products. The included electrical and thermal solutions enable customers to easily breadboard or prototype their system without time consuming and costly development of driver boards and heat sinks.

Designed to work with CBM-290-RGB and CBM-380-RGBW parts and capable of providing up to 14A per channel, the DK-414N development kits support various different drive conditions and use scenarios.

This plug and play solution can easily be connected to common laboratory equipment through standard connectors and allows system designers to save weeks in their development cycles.

Table of Contents:

1. Key Features

- Drive each color of CBM-290 or CBM-380 to full power
- Pulse frequencies of greater than 40kHz possible
- Analog current control via on-board potentiometers or external voltage
- Simple current and voltage measurements
- Fast rise and fall times - less than 1 microsecond
- Fast current level switching - less than 5 microseconds

2. Development Kit Contents

As seen in Figure 1, the content of each PhlatLight DK-414N Development Kit includes the following components:

- Heat sink
- Driver boards
- Cable assemblies
- Thermal interface materials and mounting hardware
- User manual

This development kit was designed with flexible features to allow for easy evaluation of PhlatLight LEDs. It was not optimized for size or for direct integration in end products. However, the underlying circuit and thermal design can be used as a reference by system designers. To this effect, the complete design files including schematics, mechanical drawings, and bills of materials are available upon request.

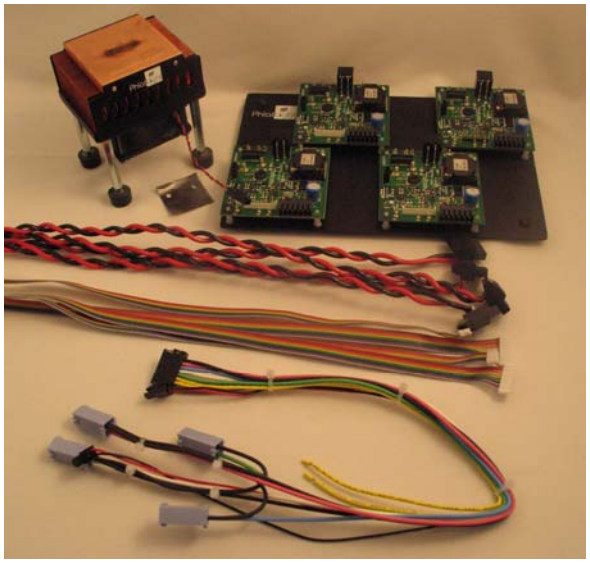


Figure 1: Single Channel Evaluation Kit Contents

2.1 Heat Sink

The heat sink is a high performance, low cost and compact air cooled copper sub mount with copper fins. Measuring 82 mm x 65 mm x 38mm, the heat sink occupies a very small volume. The typical thermal resistance from heat sink to ambient with the fan in operation is 0.3 ºC/W, thereby enabling significant power dissipation.

The bolt pattern on the front face of the sink allows for easy mounting of all CBM series modules.

2.2 Driver Board

The driver circuit, designed around National Semiconductor's LM3433 IC, is designed to provide up to 14A of current to a CBM-290 or CBM-380 PhlatLight LED.

The driver board is fully capable of driving the LEDs in either CW or pulsed mode. An external function generator is required for generating the pulse trains in PWM mode. Frequencies up to 40 kHz are supported.

The driver requires a 12VDC input from an external AC/DC source. The external PWM voltage input range is between 0 – 5V. Care must be taken to not exceed these voltages as it may cause permanent damage to the driver board.

2.3 Cable Assembly

Each development kit includes all of the cables necessary for proper setup. The primary cables included are as follows:

- Power supply to driver board
- Driver board to LED
- Driver control interface cable

For optimum performance, it is not recommended to increase the length of the driver to LED cable. A longer cable can result in increased inductance and noise when pulsing the LEDs.

2.4 Thermal Interface Material (TIMs) and Mounting Hardware

Also included in the kit are precut sheets of a high performance thermal interface material (eGraf HiTherm 1205) and the required mounting hardware for the devices.

M2.5x6 screws are provided for attachment of CBM package types.

Figure 2: TIM cut for CBM package types.

3. User Instructions

CAUTION: DO NOT SET ALL DRIVERS AT MAXIMUM CURRENT OUTPUT! DOING SO WILL CAUSE DAMAGE TO THE LED MODULE.

The following procedure explains how to setup the PhlatLight Evaluation Kit. It is recommended that the table be equipped with ESD protection.

Important Note: The driver board is capable of providing 14A of current to any color. Each color has different drive limitations. Care must be taken to ensure the proper current is applied to each color. Consult the product data sheets for current limitations of specific devices.

Equipment Required by User

In order to power and use the development kit, some additional equipment is required. Table 1 lists the type of equipment as well as a suggested part. An additional list of other compatible power supplies is provided in Appendix B.

Lab Equipment	Recommended Part
12V Lab Power Supply	Lambda ZUP20-20
Oscilloscope	Tektronix TDS 3024B
Waveform Generator	Agilent 33220A
Multimeter	Fluke 187
Photodetector	Thorlabs PDA10A

Table 1: Additional Lab Equipment

3.1 PhlatLight Device Mounting Instructions

1. Use a thermal pad of an area slightly larger than the area of the core-board (Figure 6).

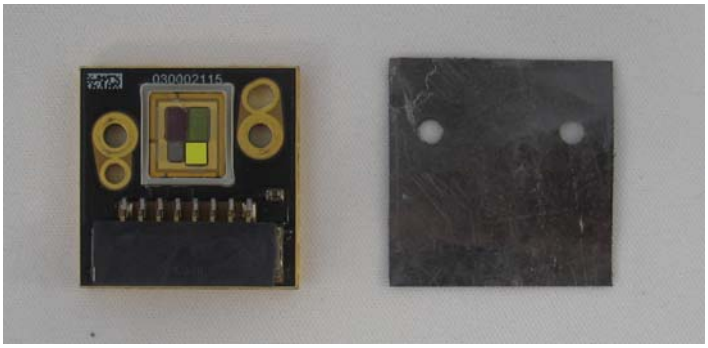


Figure 3: PhlatLight device and an appropriate thermal interface material

2. Prepare the heat sink surface by dusting or removing any particulates that have accumulated on the surface. Place the thermal pad on the heat sink with pre-drilled holes matching the hole pattern on the core board of the device (Figure 4).

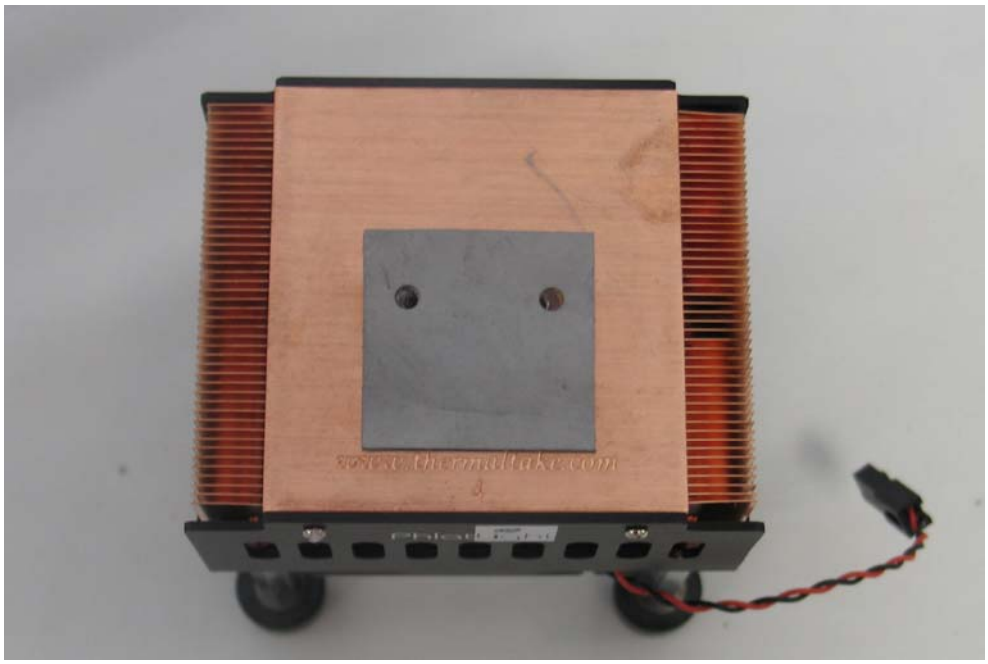


Figure 4: Thermal interface material placed on heat sink

3. Place the device on the thermal pad, taking care that the hole patterns match.

4. Insert screws in the holes of the coreboard and tighten. To ensure equal pressure is exerted by all screws, alternate tightening each screw until the board is securely fastened. The device is now mounted and ready for electrical connections.

3.2 Electrical Connections

The following sections assume that the user has all of the equipment listed in Table 1.

1. Prepare the power supply and ensure the power supply being used is capable of providing enough power to the devices. A fully powered CBM-290 or CBM-380 module can draw >90W, thus the power supply should be set to a minimum of 8A at 12V. Power off the supply until all connections are established and the board settings are ready.

2. Attach all of the wiring included in the kit. The black, 12" ERNI cable connects the LED to the driver boards at P10. Consult Appendix E to view the electrical pinout and determine what color the driver boards will be controlling. Thermistors can be left unconnected or connected to the thermistor test points located at THERM1 and THERM2 on any driver board. Check to be sure the short 2-pin fan cable is connected to a driver board at the J10 position. It can connect to any of the boards.

Note: The DK-414N-4 will be connected to 4 driver boards using all 4 connectors. The DK-414N-3 will only use 3 driver boards so 1 connector (for white LED in DK-414N-4) will be not be connected to anything.

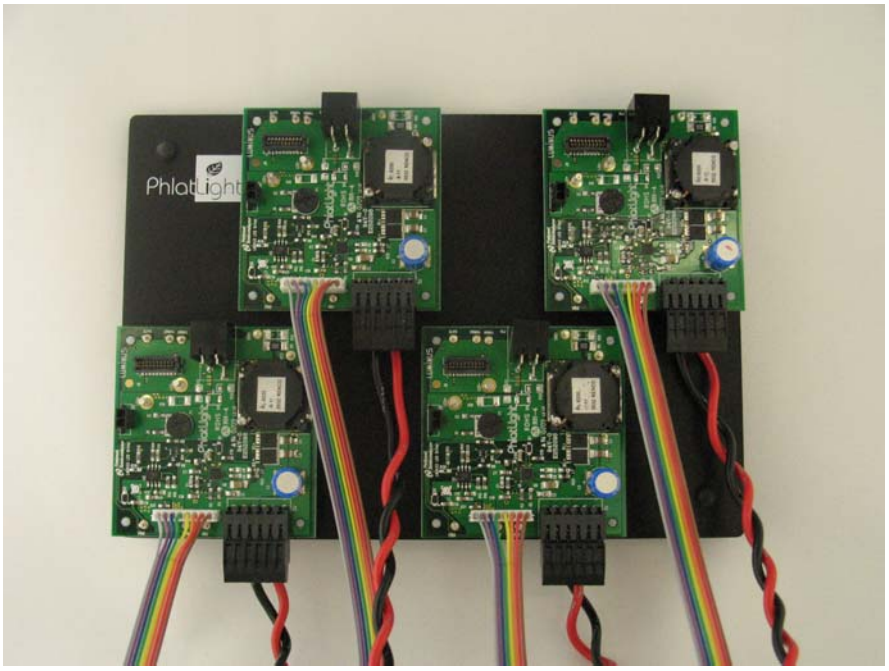


Figure 5: Completed electrical connections on DK-414N-4

3. Info about input power cable and signal cable.

4. Operating Instructions

There are multiple different ways the PhlatLight DK-414N Development Kit can be operated. The LEDs can be driven in continuous, current controlled mode via on board POTs or through an external analog voltage. Additionally, each channel has inputs for an external function generator signal to pulse the LEDs and is capable of pulsing at frequencies of greater than 40kHz.

1. To change the current when either the interface board or driver board is enabled, rotate the on board POT. Clockwise rotation increases the current, while counter-clockwise rotation will decrease the current.

2. To change the current externally, attach a 0-5V signal to the ADJ pins on the signal cable. When hooking up the 0-5V signal, ensure that the ground cable is attached to the "GND" pin and the positive cable is attached to the "ADJ" pin. The current to the LED will adjust with the voltage signal. A higher voltage corresponds with a higher current. It is recommended not to exceed a 5V signal, as components may overheat.

3. To measure the current going to the LED, use a volt meter and measure the voltage across the sense resistor on the driver board. For ease of probing, two test studs have been placed to the left and right of "R15". Figure 6 shows the location of the test studs on the driver board. Figure 7 shows a conversion plot between the sense resistor voltage and the current going to the LED. The current can also be calculated by the following formula:

$$I_{LED} = \frac{V_{Sense}}{R_{Sense}} \qquad \textbf{Equation 1}$$

where V_{Sense} is the voltage measured across the sense resistor in Volts (V) and R_{Sense} is the value of the sense resistor in Ohms. The sense resistor value is 0.005Ω. The output value will the be current going to the LED in amps (A).

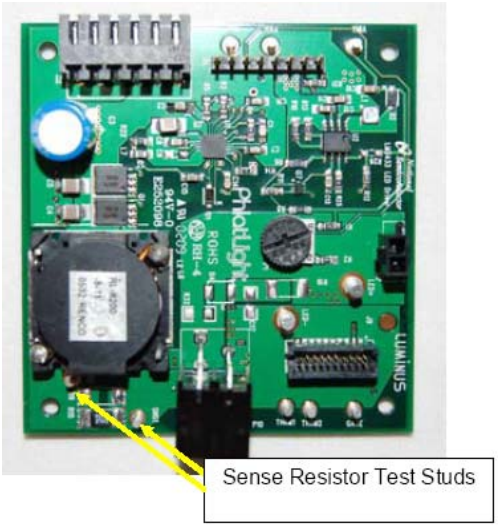


Figure 6: Sense resistor location on driver board

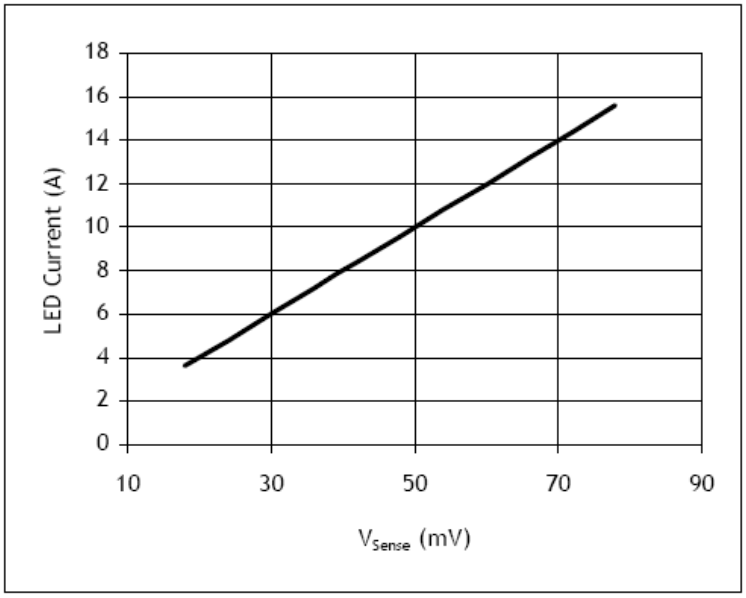


Figure 7: LED Current vs. V_{sense} voltage

4. To modulate the LEDs through PWM, connect a function generator to the PWM pins on the signal cable. The pulse output should be set to 0-5V, where 5V represents off and 0V represents on.

Proper operation is best monitored by using a photo detector to observe the light output from the LED

Appendix A: Electrical Design Considerations

It is important to note that the CBM-290 and CBM-380 PhlatLight LEDs are built in a common anode configuration. That is, the copper core-board is at a positive electrical potential in operation. If this is not factored into the design, it becomes difficult to properly control each color. The DK-414N development kit addresses this by configuring the devices in a grounded common anode topology. As a result, the LED anode is kept at ground and the cathode is at a negative potential. The LED anode can be in direct electrical contact with the heat sink without concern of electrical contact with other LEDs. A basic schematic is shown below in figure 8. It is important to note that while the heat sink is at ground, there is still power passing through it. For further information, please contact Luminus.

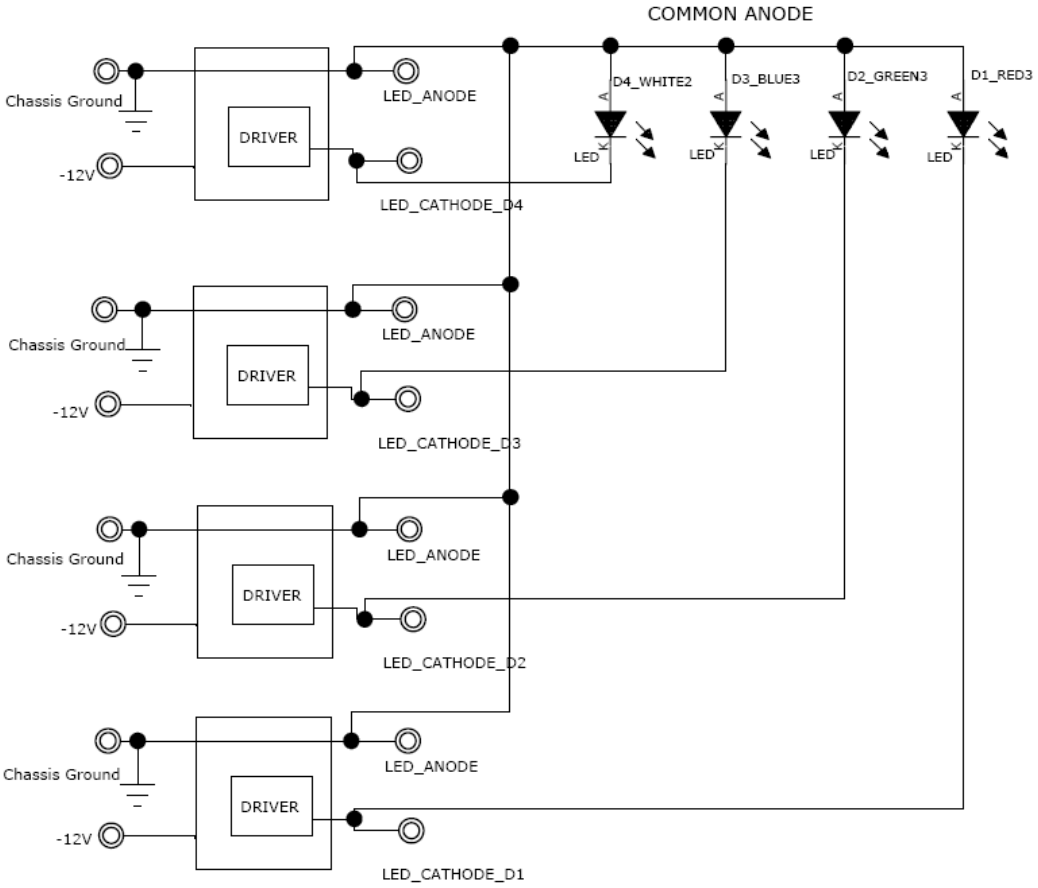


Figure 8: Grounded common anode topology

Appendix B: Isolated AC-DC Power Supplies

Table 2 shows a list of isolated AC-DC power supplies. A power supply with isolated outputs is required to properly drive the DK-414N drivers. Failure to use a similar power supply will result in a malfunctioning board. Various different power supplies are listed in the table. For best efficiency, it is recommended to select a power supply that closely matches the required power.

Power	Manufacturer	Input	Output V/I	Size	Mounting	Part #
30W	CUI Inc.	AC 85-264 VAC (47-400Hz)	12V / 2.5A	3.7" x 2" x 0.85"	Thru-hole/SMT	FSK-S30-12U
50W	Omron	AC 85-264VAC (47-63Hz)	12V / 4.2A	5" x 3.34" x 1.57"	DIN Rail	S8SP-05005
50W	Lambda Power	AC 90-264VAC (47-63Hz)	12V / 3A	3.62" x 1.46" x 6.26"	Enclosed/Chassis mount	SWS Series
60W	Globtek Inc.	AC 90-264VAC (47-440Hz	12V / 5A	5.24" x 2.39" x 1.62"	External/Desktop	DPS50
75W	Lambda Power	C 90-264VAC (47-63Hz)	12V / 6.3A	3.7" x 1.69" x 6.69"	Enclosed/Chassis mount	SWS Series
100W	Lambda Power	AC 90-264VAC (47-63Hz)	12V / 8.5A	3.78" x 1.77" x 7.4"	Enclosed/Chassis mount	SWS Series
100W	Elpac Power	AC 100-264VAC (47-63Hz)	12V / 8.3	7.36" x 4.33" x 2.32"	External/Desktop	FWP10012-D8F-NC
125W	Power-One So-lutions	AC 90-264VAC (47-63Hz)	12V / 10.5A	5" x 3" x 1.25"	Open Frame	MBP125-1012
120W	AULT Inc.	AC 100-264VAC (47-63Hz)	12V / 10A	9" x 2.9" x 2"	Medical/External	MW122RA12X XF01
150W	Lambda Power	AC 90-264VAC (47-63Hz)	12V / 12.5A	3.9" x 2" X 7.8"	Enclosed/Chassis mount	SWS Series

Table 2: List of AC/DC power supplies with an isolated output

Appendix C: Driver Specification

Input Specifications	Value	Unit	Note
Input Voltage	12	V	
Max Supply current/channel	7	A	
Efficiency	>90	%	
Output Specifications	**Value**	**Unit**	**Note**
Max output current	17	A	
Output current ripple (pulsed)	<10	%	Of set current
Output Pulse Rise time	<1	us	
Output Pulse Fall Time	<1	us	
Output Setting Time	<5	us	min current to max
Control Specifications	**Value**	**Unit**	**Note**
Max Pulse Frequency	>40	kHz	
Duty Cycle Range	0-100	%	

Table 3: Driver board Specifications

Appendix D: Driver Board Schematic and Pinout

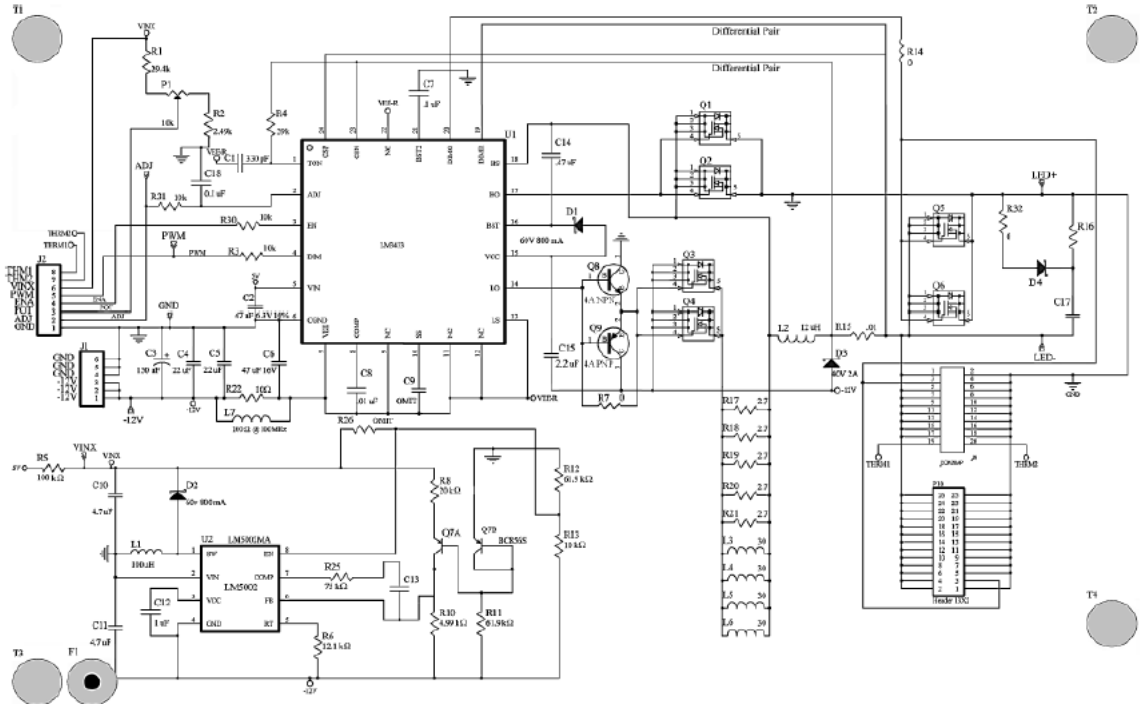


Figure 9: Driver board schematic and pinout

Appendix E: Cable and Connector Pinout Info

Pinout for CBM-290:

1. Anode (+)
2. Red (-)
3. NC
4. Blue (-)
5. Green (-)
6. Therm
7. Therm
8. Anode (+)

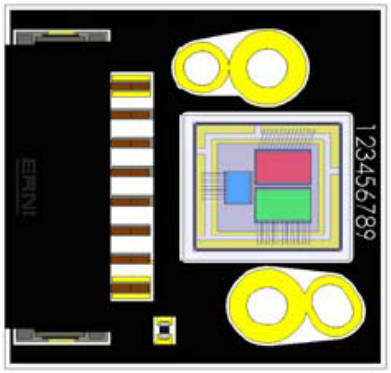


Figure 10: CBM-290 pinout

Pinout for CBM-380:

1: Anode (+)
2: Red (-)
3: Blue (-)
4: White (-)
5: Green (-)
6: Thermistor
7: Thermistor
8: Anode (+)

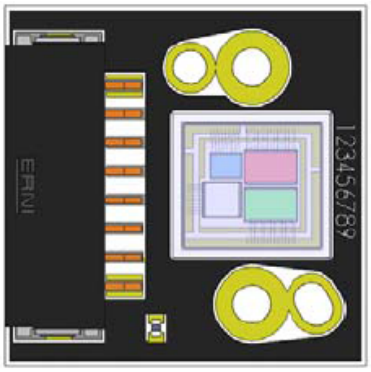


Figure 11: CBM-380 pinout

Driver Board pin	Comment
Pin 1	GND
Pin 2	Analog ADJ
Pin 3	POT
Pin 4	Enable
Pin 5	PWM
Pin 6	Vinx
Pin 7	Thermistor
Pin 8	Thermistor

Table 4: Driver Board, Signal

Driver Board pin	Comment
Pin 1	-12V
Pin 2	-12V
Pin 3	-12V
Pin 4	GND
Pin 5	GND
Pin 6	GND

Table 5: Driver Board, Power

Fan pin	Comment
Pin 1	+12
Pin 2	GND

Table 6: Fan

The products, their specifications and other information appearing in this document are subject to change by Luminus Devices without notice. Luminus Devices assumes no liability for errors that may appear in this document, and no liability otherwise arising from the application or use of the product or information contained herein. None of the information provided herein should be considered to be a representation of the fitness or suitability of the product for any particular application or as any other form of warranty. Luminus Devices' product warranties are limited to only such warranties as accompany a purchase contract or purchase order for such products. Nothing herein is to be construed as constituting an additional warranty. No information contained in this publication may be considered as a waiver by Luminus Devices of any intellectual property rights that Luminus Devices may have in such information. PhlatLight® is a registered trademark of Luminus Devices, Inc., all rights reserved. This product is protected by U.S. Patents 6,831,302; 7,074,631; 7,083,993; 7,084,434; 7,098,589; 7,105,861; 7,138,666; 7,166,870; 7,166,871; 7,170,100; 7,196,354; 7,211,831; 7,262,550; 7,274,043; 7,301,271; 7,341,880; 7,344,903; 7,345,416; 7,348,603; 7,388,233; 7,391,059; Patents Pending in the U.S. and other countries.

Luminus Devices
1100 Technology Park Dr.
Billerica, MA 01821
E-mail: sales@luminus.com

978-528-8000 (T)
978-528-8001 (F)
www.luminus.com