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PhlatLight LED
Development Kit Manual
DK-125M and DK-136M Series

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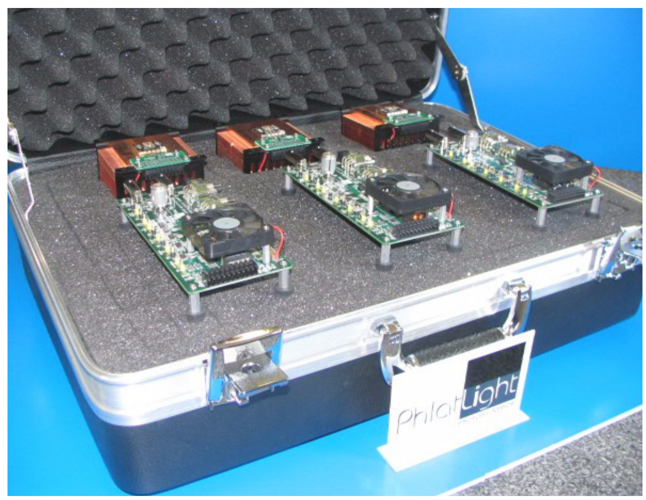
Table of Contents

1. Introduction



Luminus Devices' Chipsets have been designed from the ground up to illuminate light engines. They are the leading solid state light source optimized for high brightness applications. This evaluation kit is intended to be used for general evaluation of Luminus' Photonic-Lattice Technology, and to assist with designs. The evaluation kit consists of two chipsets of PhlatLight™ devices, heat sinks as well as electrical drivers for continuous and pulsed operation.

2. General Description

Each PhlatLight™ device in the kit has its own separate heat sink, cable assembly and driver card allowing easy interfacing to a wide variety of light engines or optical elements. This evaluation kit is designed for general purpose evaluation of PhlatLight™ devices. This kit is therefore not optimized for space or power efficiency. Heat sinks and drivers included in the evaluation kit are not intended to represent reference designs for final products. However, they can be used as starting points for further customization and optimization. The driver boards include functionality which is intended to make evaluation easy. Therefore, not all functionality included on the board will be needed in a product design.

PhlatLight™ devices can be operated in continuous (CW) mode or pulsed mode. In continuous mode operation the device is driven by a steady current. In pulsed mode the device is pulsed with a peak current value for intervals of time defined by a duty cycle. A 50% duty cycle means that the device is driven for 50% of the time at specified peak current. A 100% duty cycle will actually be a case of continuous operation. The driver card is designed to operate in both CW and pulsed modes.

Test points are provided on the driver card so that the device forward voltage, current, thermistor, and various other circuit functions can be monitored. The circuit layout uses 0805 and 1206 size components to encourage modification and experimentation as required by the user.

3. Evaluation Kit Contents

The evaluation kit contains:

1. Thermal management solution
   a. Heat sinks with fans (with < 0.3 °C/W thermal resistance from heat sink to ambient)
   b. Thermal interface material (eGraf thermal pads)
2. Electrical interface to PhlatLight™ devices
   a. Cables to connect tabs on devices to driver circuit
   b. Driver card for controlling operation for PhlatLight™ devices

*Typically at least 2 chipsets are purchased with the evaluation kit

A. Heat Sink Module

The heat sink module (Figure 1) consists of an air cooled heat sink, fan, connector and mounting bracket. The module can be bolted say to a light engine using four mounting holes on the bracket or stand upright on the bench using the optional stand-alone legs. All connections for driving the device, fan, and readouts for thermistor are made via a 10 pin Weidmuller 3.5mm pitch Omnimate connector. The module is designed to work with the Luminus driver card or can be used with the customers own driver along with a +12V supply for powering the fan. The Omnimate connector plug has screw clamps to allow for easy wiring.

All the heat sink modules are similar and are not specific to a particular device type or color.

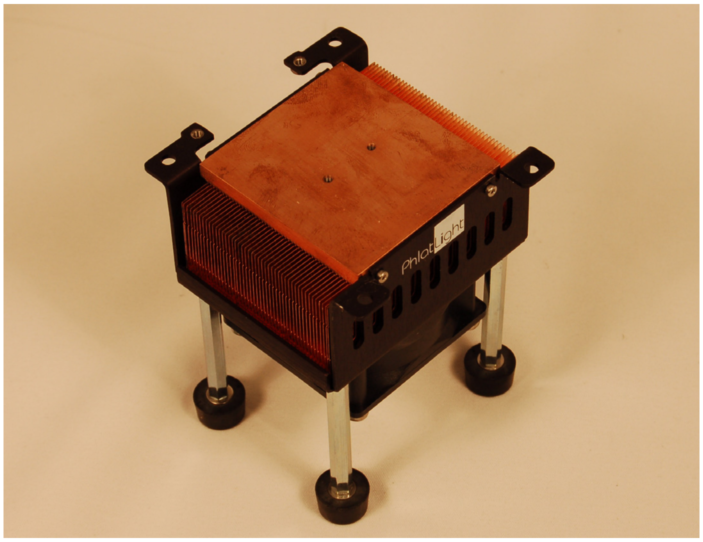


Figure 1: Heat sink module

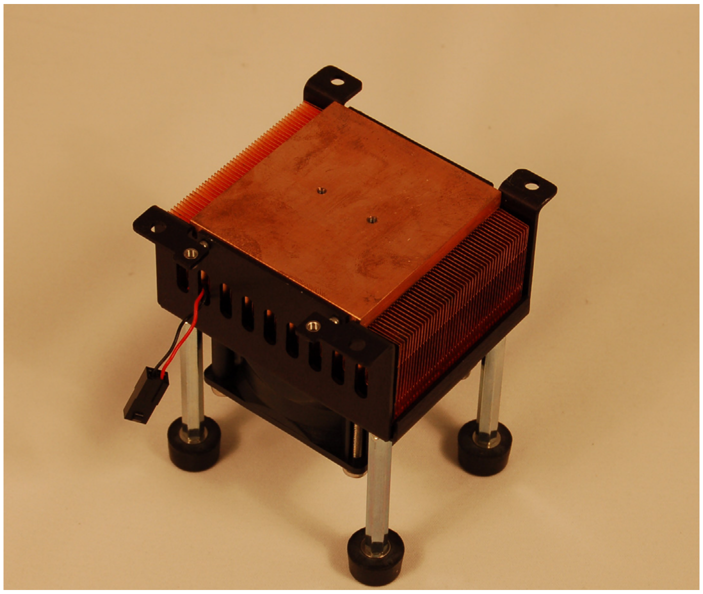


Figure 2: Heat sink module

B: Cable Assembly

Each device connects to its own driver via a 12" long cable. For optimum performance it is best not to increase the length of the cable. Figure 3 shows picture of the device to driver cable.

The color code for the wires is as follows:

RED 18 gauge wire:	PhlatLight™ anode
BLACK18 gauge wire:	PhlatLight™ cathode
WHITE/BLUE 24 gauge wire:	Thermistor connections
RED 24 gauge wire:	Fan +12V power
BLACK 24 gauge wire:	Fan negative return (GND)

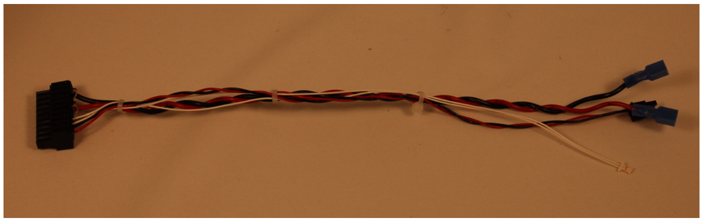


Figure 3: Device to driver cable assembly

Figure 4 and Figure 5 show how to connect the connectors of cable assembly to the connectors on the heat sink module and the driver card. Note that the cable assembly connectors are positioned such that the screw heads are always facing towards user. The connectors on each end of the cable are the same. Always make sure that connection is made such that the heavy gauge wires are hooked up to the anode and cathode of the device. Reversing the cable may damage the cable.

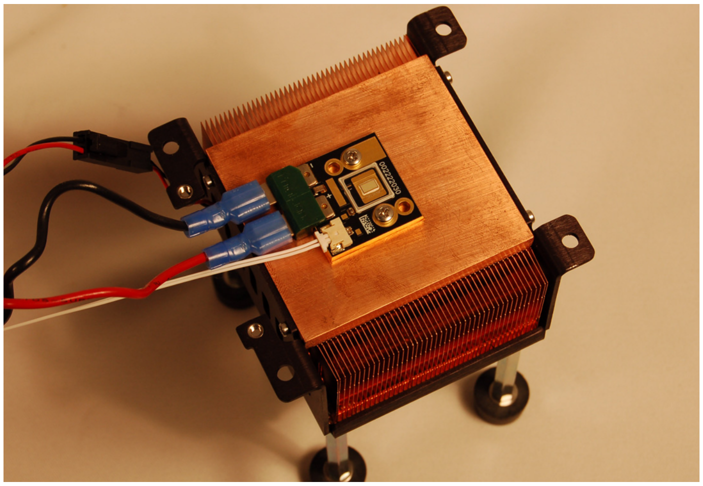


Figure 4: Connection to heat sink module

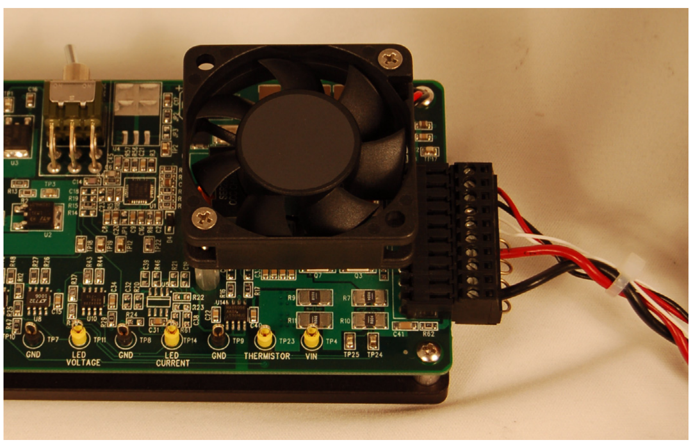


Figure 5: Connection to driver card (cable from device)

In addition, each driver card connects to a power supply by means of a 36" cable. See Figure 6 for a picture of the 2 types of connectors on the power supply cable. One end has banana plugs to facilitate connection to a power supply and the other end has a 2 pin socket block connector.

The color code for the wires is as follows:

RED 14 gauge wire: "+" of power supply

BLACK14 gauge wire: "-" of power supply

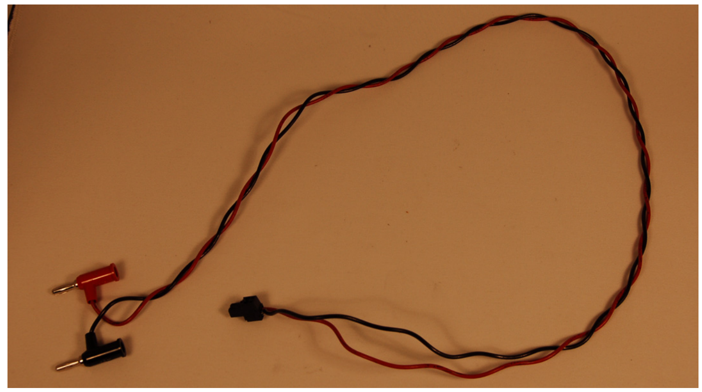


Figure 6: Power supply cable connectors

There is only one correct way to connect this cable to the driver card. Figure 7 shows how to connect the cable to the driver card. Note that the cable assembly connector is positioned such that the screw heads are always facing towards user.

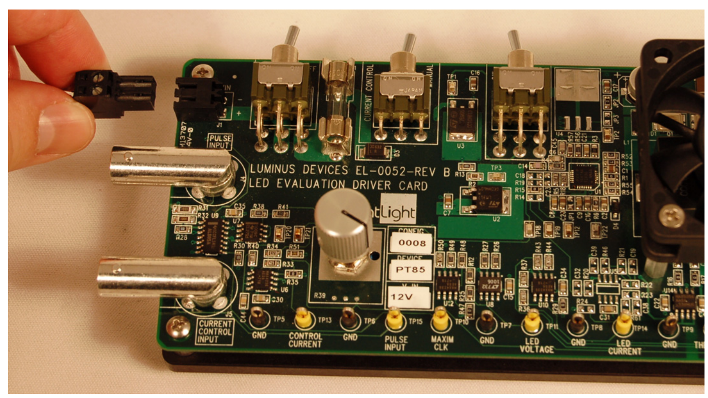


Figure 7: Power supply cable to driver card

C: Driver Card

A driver card is designed for operating PhlatLight™ devices up to the recommended operating currents. For each device type, namely, PT120/CBT120 and PT85 there is a separate driver card designed specifically for that device. The input voltage requirements for a given driver card vary depending on the functionality that is expected of the card. Table 1 gives a brief overview about key driver card parameters and its compatibility across PhlatLight™ products family.

Table 1: Driver Card Configurations

Driver Card	Input Voltage	Output Current (CW)	Output Current (Pulsed)	Evaluation Options for PhlatLight™ Products Family
PT120/ CBT120	12V	18A	30A	PT85: Yes[1] PT120: Yes CBT120: Yes
PT85	12V	13A	22A	PT85: Yes PT120: Yes[2] CBT120: Yes[3]

1 The output current provided by the driver card can exceed recommended operating currents for PT85 devices

2 The PT120 devices can only be operated up to 13A in CW and 22A in pulsed mode with this card

3 The CBT120 device can only be operated up to 13A in CW and 22A in pulsed mode with this card

A driver card for a device type can be used for all colors of that particular device type. E.g. a PT85 driver card can be used for RED, GREEN or BLUE color. However, users should refer to the technical data sheets of a device to check the recommended operating currents.

Figure 8 shows the top view of a PT120/CBT120 driver card. The pins, switches and readouts that are commonly expected to be used are shown. The overall layout of driver card for PT85 is similar to the PT120/CBT120 driver card layout. However, component values are changed to match desired operation range.

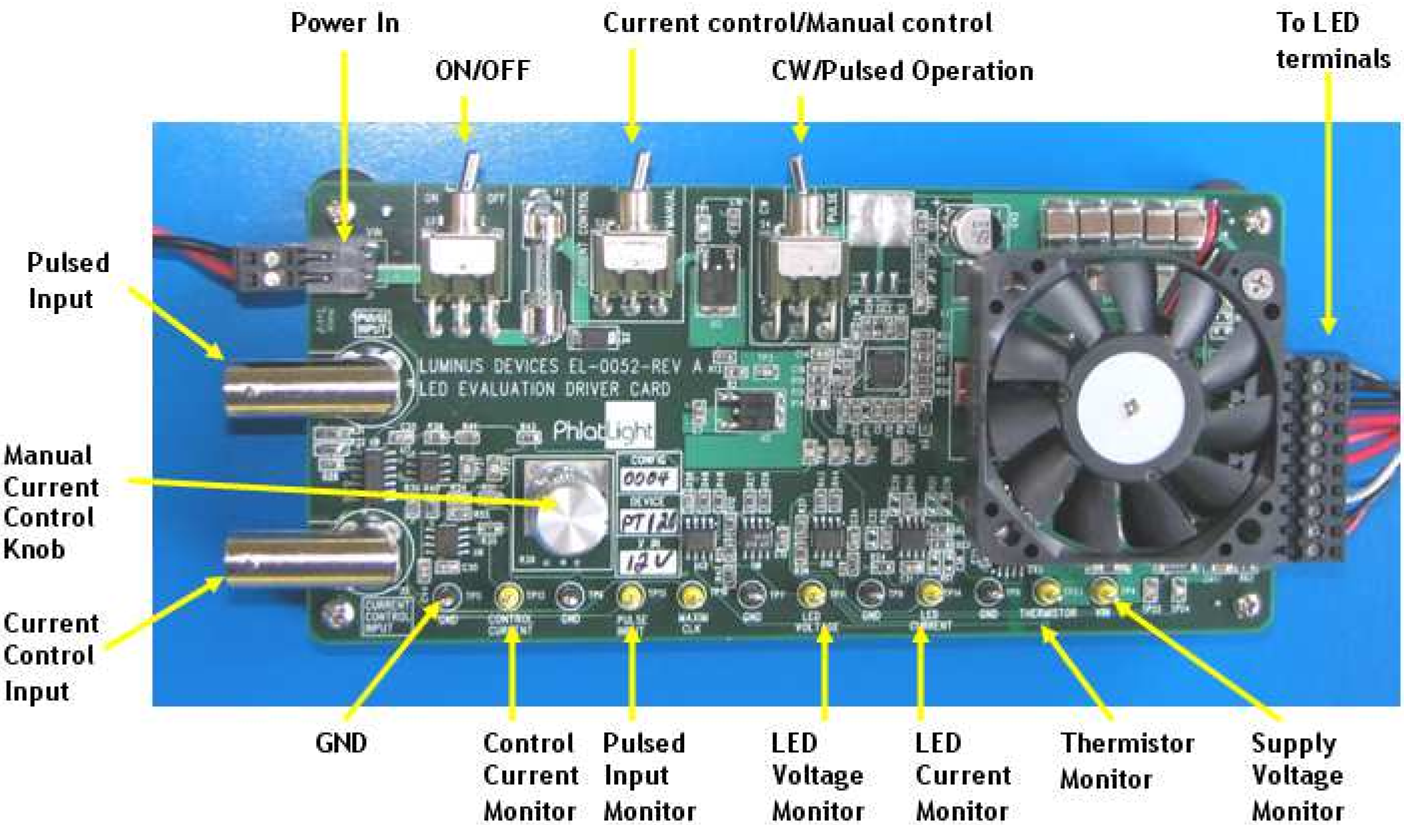


Figure 8: Driver card pin layout (example of PT120/CBT120 driver card)

4. Use Instructions

A. PhlatLight™ Device Mounting Instructions

For precautions for ESD and guidelines for device window cleanliness, refer to Appendix B and C respectively.

Careful application of the thermal interface material (eGraf thermal pad) is required to minimize thermal resistance. The following procedure describes recommended steps for mounting of PhlatLight™ devices on heat sink.

1. Use a thermal pad of an area slightly larger than the area of the core board (Figure 9).

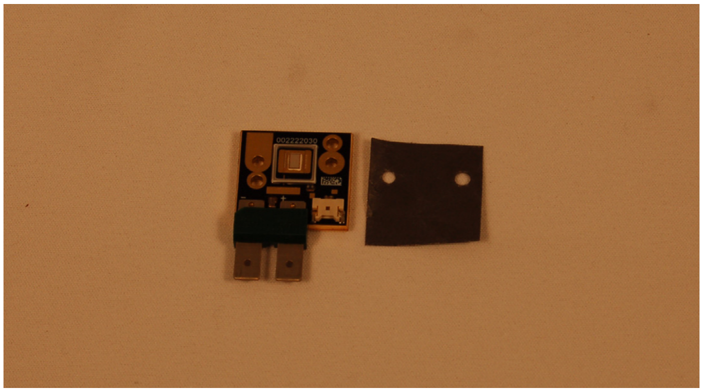


Figure 9: Thermal pad and device

2. Place the thermal pad on the heat sink with pre-drilled holes matching the hole pattern on the core board of the device (Figure 11).

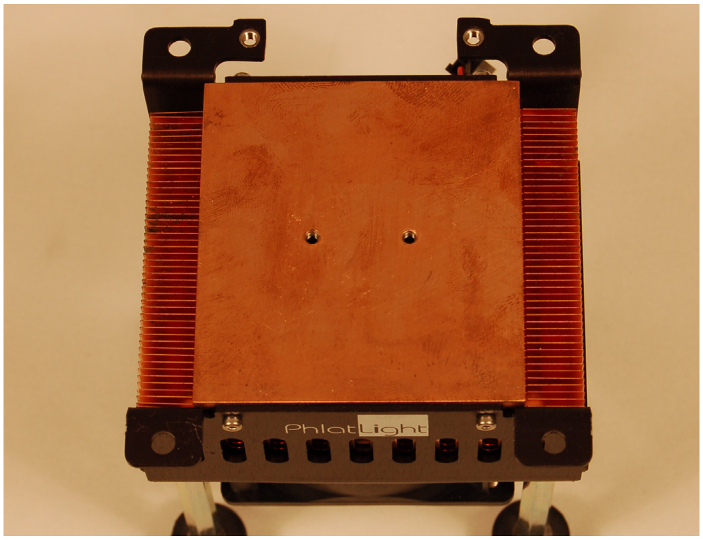


Figure 10: Pre-drilled holes

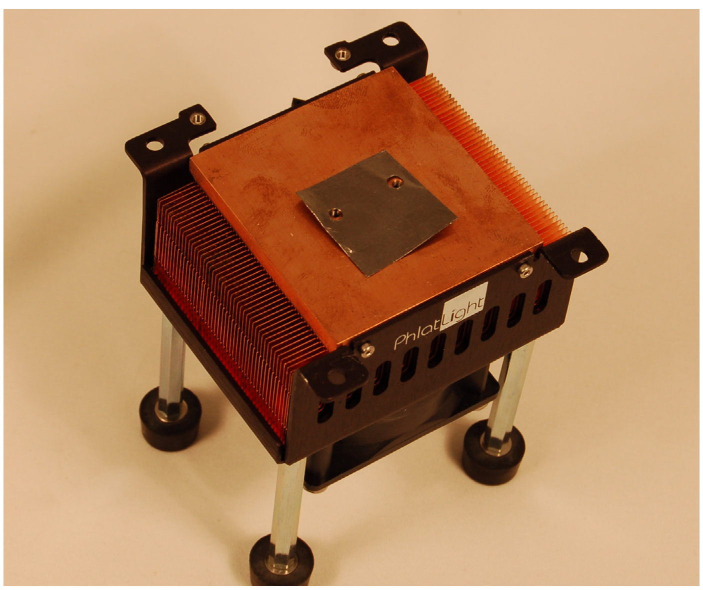


Figure 11: Thermal pad on heat sink

3. Carefully place the device on the thermal pad such that the hole patterns match and also the tabs from the leads from the device align well with the solder tabs of the PCB (Figure 12).

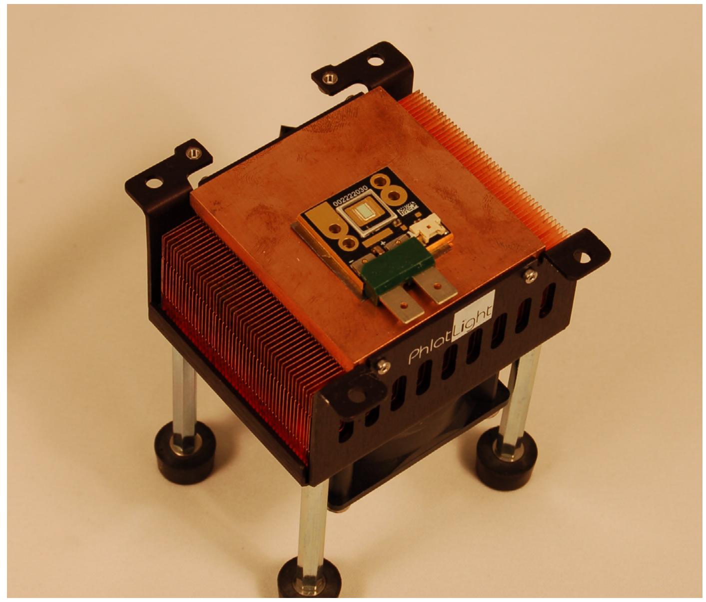


Figure 12: Device aligned on heat sink

4. Insert screws in the holes of the core board. Tighten the screws with a screw driver in a pattern such that each screw is tightened alternatively and there is equal pressure by all the screws on the core board. Tighten those making sure that there are no gaps between the core board and heat sink (Figure 13). To ensure this, we recommend using a torque wrench to tighten the screws with torque settings of 40 Oz-Inches (0.2825 Newton-meter in metric units.)

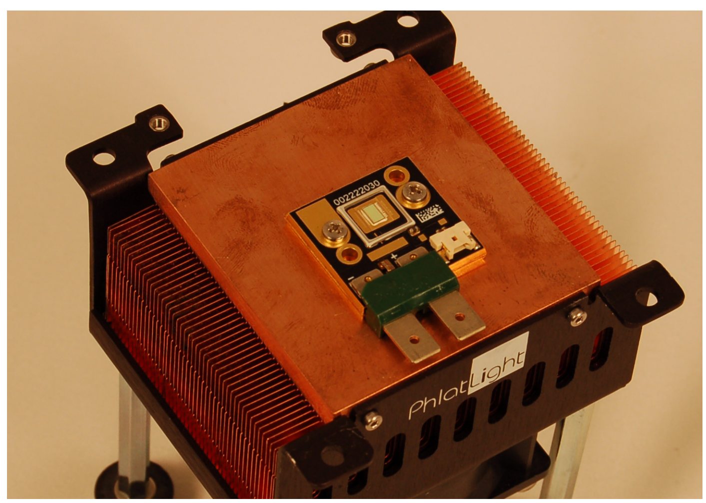


Figure 13: Device mounted on heat sink and is now ready for electrical connections

B. Additional Lab Equipment Needed By User

Table 2 suggests additional lab equipment needed for evaluating PhlatLight™ devices.

Table 2: Additional lab equipment

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

The Lambda power supply recommended in Table 2 assumes operation of one device at a time.

C. Driver Card Operation Step-by-step Instructions

Arrange the evaluation kit, required lab power supplies and measurement equipment (e.g. digital multimeters, oscilloscope) preferably on one table. Refer to Figure 16 for an example of equipment set up for evaluation (no wire connections shown). It is recommended that the table is equipped with ESD (Electrostatic Sensitive Device) safe arrangement. Please refer to Appendix for ESD precautions.

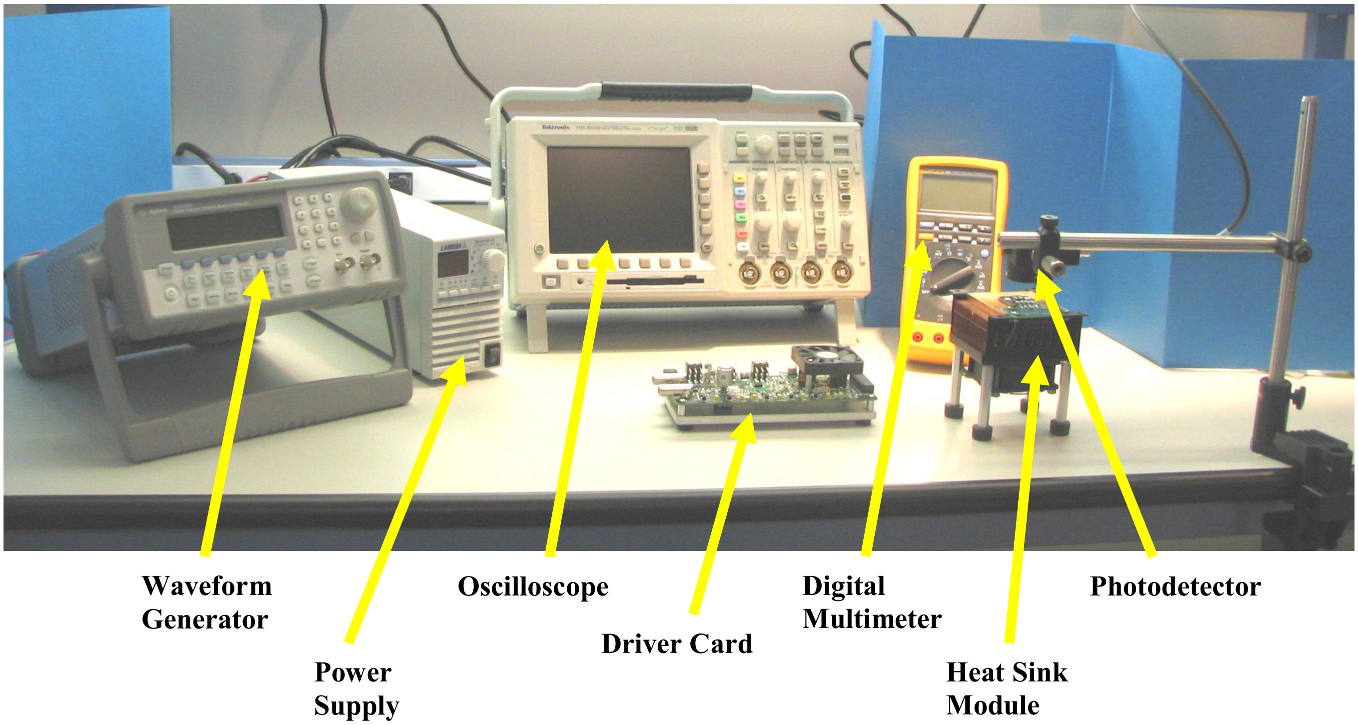


Figure 16: Equipment set up for PhlatLight™ evaluation (example)

Mount the devices on heat sinks as discussed in section A. Then go through the following steps to evaluate the devices.

1. Make sure power supply is OFF and the power switch (ON/OFF switch in Figure 8) on the driver card is OFF.
2. Connect driver card to heat sink module on which device is mounted.
3. Connect power supply to driver card using the cable supplied with the kit.
4. Turn the Current Control Knob on the driver card all the way counter clockwise.
5. Set middle switch (Current Control/Manual Control switch in Figure 8) to "Manual".
6. Set right switch (CW/Pulsed switch in Figure 8) to "CW" for continuous operation.
7. Turn on power supply and set to correct output voltage, 12V, as specified for the driver card.
8. Turn power switch on driver card to "ON". The device may be slightly lit at this point.
9. Check to make sure that the two fans, one on driver card and one on heat sink module, are running.
10. Using a digital voltmeter (DVM) check that the supply voltage on the driver card is correct. You should use the test point "TP4" which is labeled "VIN" at lower right corner of card. If this voltage is zero check to see if the fuse is blown.
11. Connect DVM to "GND" and "LED CURRENT" test points to

monitor current through the device. The output is 10mV/Amp. It is good practice to always monitor this output to make sure that the device is always driven within its limits.

12. Turn the knob on the driver card clockwise while monitoring the current. This will drive more current in the device.

13. To operate in pulse mode, connect a pulse generator to "Pulse Input" BNC. Pulse Generator should have an output signal set to TTL levels or 0-5V. Using an oscilloscope, monitor the pulse generator output at the "PULSE INPUT" test point.

14. Turn the current control knob all the way counter clockwise and set the right switch to "PULSE". The driver card is now operating the device in pulse mode. The "Current Control" knob sets the amplitude of the current and the pulse generator sets the width of the pulse. Proper operation is best monitored by using a photodetector to monitor device's light output. Current amplitude can still be monitored using the "LED CURRENT" test point.

16. Device current amplitude can also be controlled using an external signal. Connect a signal source (0-5V max) to the "CURRENT CONTROL INPUT" BNC. Monitor using the "CURRENT CONTROL" test point. Switch the middle switch to "CURRENT CONTROL" and the driver now uses the input signal instead of the current control knob to set the LED current amplitude. This input can be used both in CW and Pulse mode. Note that the max output current corresponds to 5V input and is the maximum level specified for the specific driver card regardless of whether operation is CW or Pulse.

Note 1: Due to the high amount of current generated by the driver card, there is some audible noise created by the circuit. This issue is known and is being worked on for next revision of the driver card.

Note 2: Always refer to the technical data sheet of the device for recommended operating current values.

Figures 17, 18 and 19 show oscilloscope traces for a GREEN PhlatLight™ PT120 device operated at 30A, 50% duty cycle and 2.88kHz frequency. The pink trace is the input pulse and the green trace is the photodetector output. These traces are shown for reference. Actual waveforms may depend on individual driver boards, devices and settings.

Figure 17 shows the input and output pulse.

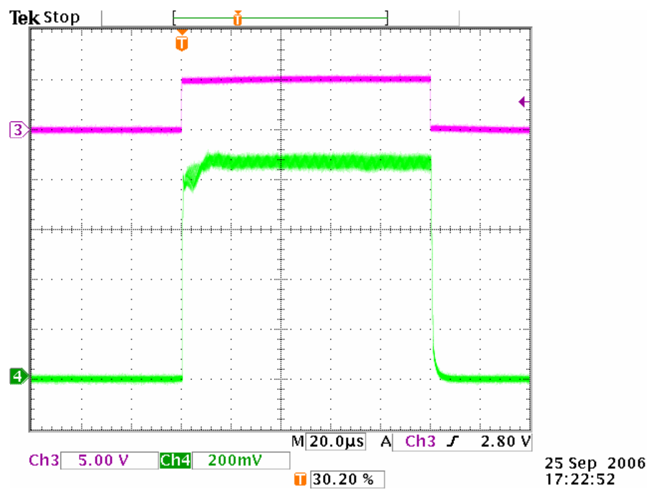


Figure 17: Input and output pulse (example)

Figure 18 shows the rise time of the output pulse (rise time 1 µs). Figure 19 shows the fall time of the output pulse (fall time 1 to 2 µs).

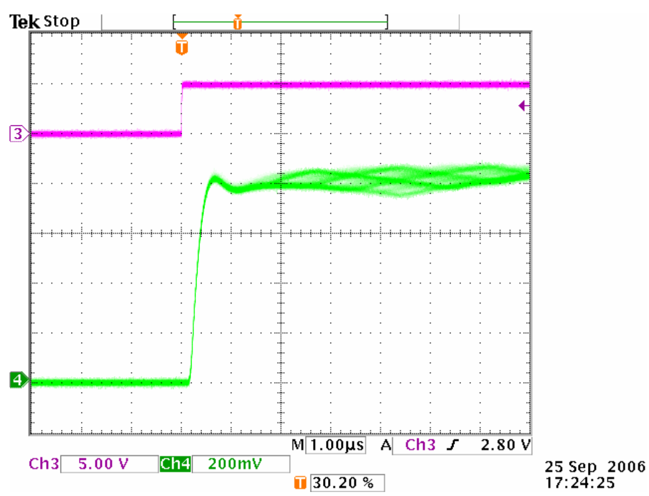
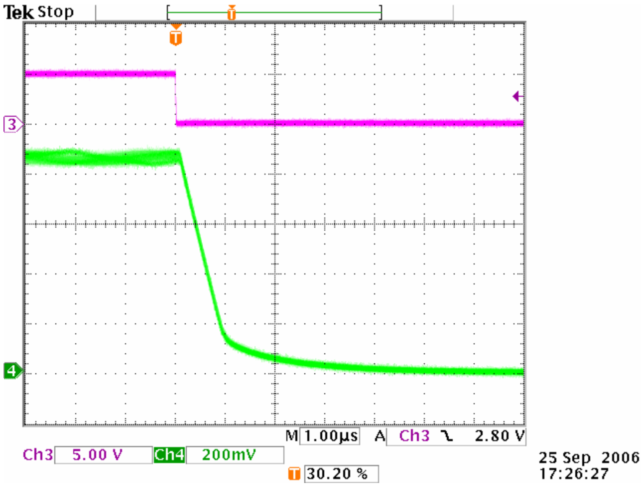


Figure 18: Rise time (example)

Figure 19: Fall time (example)



Appendix

A. Thermistor Reading

The thermistor on the core-board of a PhlatLight™ device facilitates measurement of core-board temperature during operation. The procedure to calculate the thermistor temperature for a device is in operation is as follows.

1. Measure the voltage (V_{OUT}) at the "THERMISTOR" test point on the driver card using a DVM.
2. Use the chart in Figure 20 to calculate the thermistor temperature.

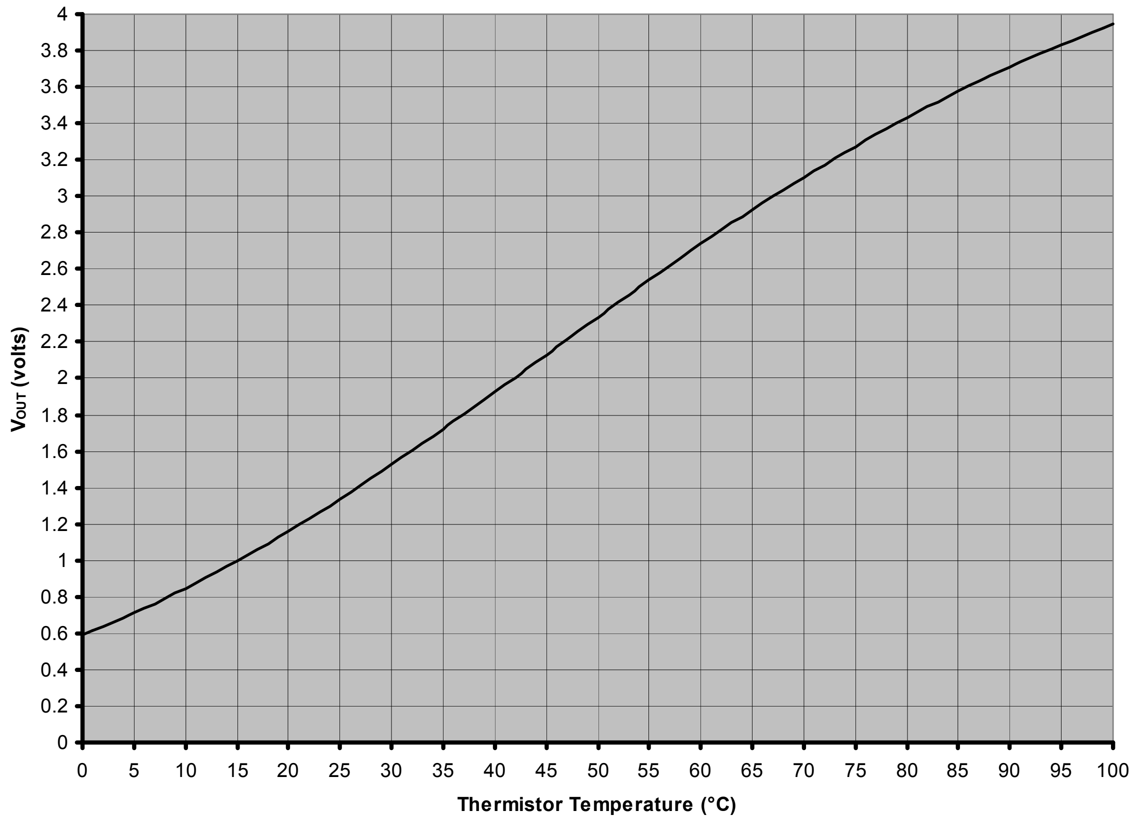


Figure 20: Thermistor temperature calculation chart

B. Precautions for ESD (Electrostatic Sensitive Devices)

PhlatLight™ devices are electrostatic sensitive. Static Electricity is generated by the simple contact and separation of materials, by movement of people and by air currents. ESD-type damage can create hidden failures. This means that the failure may not actually show up until the device is used for a period of time. The following procedures are essential in minimizing the risk of damage to PhlatLight™ devices due to electrostatic discharge.

1. When a person carries a PhlatLight™ device (in conductive carriers or trays) to another bench, prior to placing the units on a static dissipative/conductive surface, he/she must first touch the surface with his/her bare hand in order to drain any static electricity from their body.
2. Handling all PhlatLight™ devices shall be done at ESD controlled work station. All ESD workstations shall have conductive/static dissipative work surfaces to prevent generation and build-up of static charges. Each mat/laminate surface shall be connected by a grounding wire to ground.
3. Personnel grounding is required prior to handling any PhlatLight™ devices. This can be done by using wrist straps or ground cords.
4. Tweezers, gloves or finger cots must be worn when handling all PhlatLight™ devices.
5. PhlatLight™ devices should be stored in covered conductive trays whenever possible.

C. PhlatLight™ Window Cleanliness

The glass window in a PhlatLight™ device serves as a protection for the die and also for the wire bonds. It is important that the window is clean to ensure optimum brightness when the device is in operation. The following can be done to keep the window clean:

1. Do not touch the window with bare fingers.
2. Always use tweezers, gloves or finger cots while handling devices.
3. If there is any debris on top of the window (e.g. caused by the thermal interface material), first saturate Texwipes Tx 609 (or equivalent) cloth or Q-Tips in Isopropanol and then clean the affected surface.

D. Heat Sink Module Drawing - Top View

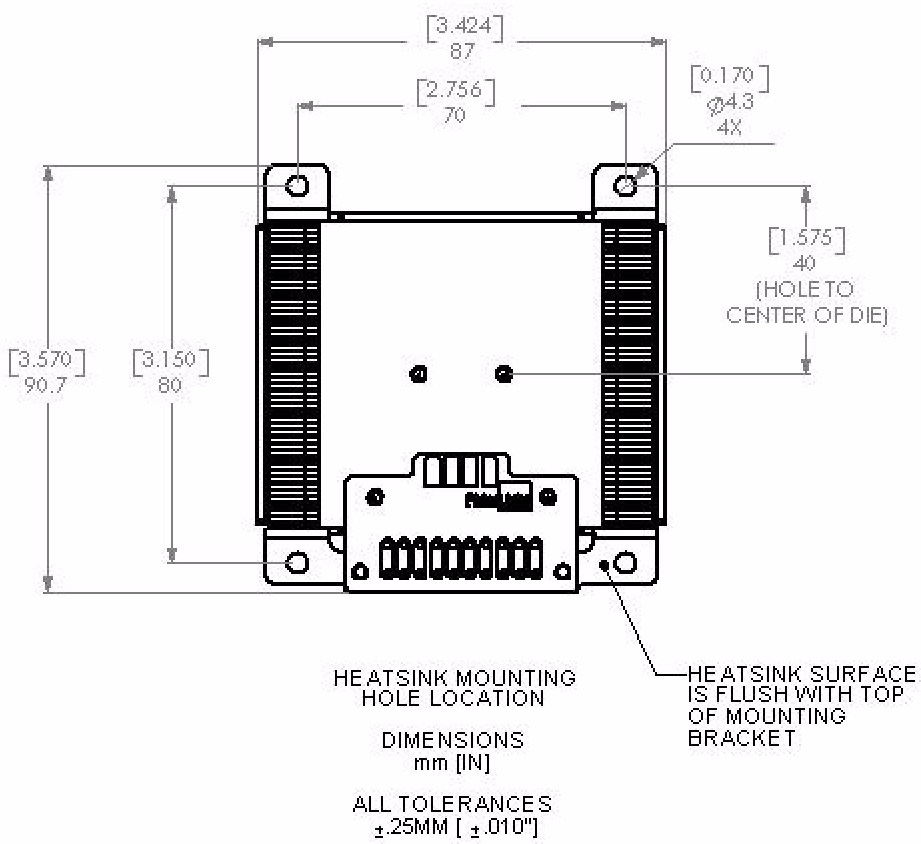


Figure 21: Heat sink module drawing - top view

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