



helieonTM
Lighting Innovation by Molex & Bridgelux

Design Guide

DESIGN GUIDE

1.0 INTRODUCTION

The Helieon lighting system is the first plug and play sustainable solid state lighting module to integrate high efficiency precision lighting with an easy to use socketed solution to accelerate innovation and enable the mass adoption of solid state lighting. Combining unmatched solid state lighting technology from Bridgelux and interconnect technology from Molex, the Helieon lighting system simplifies the process of designing, building, replacing and upgrading luminaires.

Helieon enables flexibility in changing the look and feel of the lighting installation with the simplicity of changing a light bulb. By emulating a traditional lighting socket, the Helieon system delivers an easy and familiar installation experience. Beam angle, color temperature and light output can all be easily changed with the simple twist of a wrist.

This document provides guidance to designers in selecting the most appropriate Helieon module for a specific lighting application. The Design Guide also demonstrates how the lighting system can be designed for flexibility, enabling the lighting environment to be easily modified at any time by interchanging different Helieon modules without the need to replace the fixed infrastructure of heat sink or electronic driver. The technical requirements for designing and assembling a luminaire are described in detail, ensuring that the performance and reliability of the Helieon lighting system are optimized. The critical design and assembly requirements include:

Thermal Management: Several performance characteristics of the Helieon system, including optical flux, forward voltage, color temperature and reliability are dependent on the operating temperature of the Helieon module. This document provides guidelines for selecting a suitable heat sink and for assembling a luminaire to ensure effective heat transfer from the Helieon module to the ambient environment via the heat sink.

Electrical Management: The Helieon system requires a constant current DC input. The selection of a suitable electronic driver is dependent on the specified current level, input and output voltage requirements and any dimming capability. Driver selection considerations are discussed including UL classification, regulatory issues and driver efficiency. A list of commercially available drivers is provided for a range of drive current options. Guidelines are also documented for electrically connecting the driver to the socket.

Optical Management: Helieon modules are available with narrow, medium and wide flood beam spread options that enable precision effects for a wide variety of lighting applications. Optical characterization data is provided to enable lighting designers to select the appropriate product option to meet design requirements.

Assembly and Installation: Recommended assembly procedures are described to ensure a reliable electrical connection from the module to the LED driver and a mechanically robust, thermally efficient contact between the module and the heat sink. The simple installation steps for mating and de-mating the module and socket are also included.

2.0 TABLE OF CONTENTS

	<u>Page</u>
3.0 Module Selection and Design for Interchangeability	4
4.0 Thermal Management	5
5.0 Electrical Management	11
6.0 Optical Management	17
7.0 Assembly and Installation	23
8.0 Appendix A: Product Ratings	28
9.0 Appendix B: Product Performance at Alternative Drive Currents	29

3.0 MODULE SELECTION AND DESIGN FOR INTERCHANGEABILITY

Helieon modules are available in a variety of light output, color temperature and beam angle options. Through proper luminaire design it is possible to enable flexibility of the lighting system to incorporate many or all of the Helieon module options. Helieon modules have been engineered to operate at the same nominal operating current, enabling compatibility of 800 and 1200 lumen modules with a single constant current driver. Selection of a driver with adequate output voltage range to accommodate multiple module configurations and a thermal management system which accounts for the highest thermal load expected is required to enable this level of flexibility in the lighting system.

Selecting the optimal Helieon module for a given luminaire design is achieved by following a few simple steps:

- Define the required color temperature, beam angle and quantity of light.
- If the quantity of light is defined as optical flux, the most appropriate module can be identified from the Typical Product Performance tables included in the Helieon Data Sheet. Note that Helieon has the flexibility to be operated under multiple drive current conditions, depending on system level light output and efficiency requirements.
- If the quantity of light is defined as lux at a given distance from the source, the most appropriate module can be identified from the photometric tables shown in the Optical Management section of this document. Note also that the lux data for each module option at a drive current of 1050mA is included in the Helieon Data Sheet. As noted above, other drive current options can be used with Helieon depending on design requirements.

The forward voltage and electrical power consumption are listed in the Typical Product Performance tables included in the Helieon Data Sheet. These parameters are required for selection of a suitable heat sink and driver, as described in further detail later in this document.

The Helieon lighting system is designed for flexibility by enabling different modules to be interchanged with a single heat sink and driver. To enable this interchangeability, the thermal solution must be designed to account for the highest power consumption and expected ambient condition at the selected drive current. Further information is included in the Thermal Management section of this document.

4.0 THERMAL MANAGEMENT

Effective thermal management is critical to achieve optimum performance and reliability of the Helieon lighting system. Several performance characteristics including optical flux, forward voltage and color temperature are dependent on the operating temperature of the module. This design guide provides recommendations for selecting a suitable thermal management solution and guidance for accurately measuring the temperature of the Helieon module under operating conditions.

Considerations for Heat Sink Design or Selection

There are many commercially available components, including heat sinks and heat pipes, which may be used with the Helieon module. The most commonly used components are heat sinks, typically made of aluminum or copper. Heat sinks conduct heat from a heat source and then convect the heat to the ambient. The required size of the heat sink depends on many variables, including application specific temperature requirements such as maximum ambient and case temperature limitations, the material composition of the heat sink, surface characteristics of the heat sink, and physical constraints for the application.

Considerations for heat sink selection:

- Use heat sinks with the largest surface area that is physically and economically feasible. As a general rule of thumb, for a well-ventilated aluminum heat sink, there should be 10 square inches of heat sink surface area for every 1W of energy dissipated. This area may be provided as a flat plate or via a finned extruded heat sink to minimize area used and reduce the volume of the thermal management solution. The use of pinned heat sinks, however, is not recommended.
- Orient the heat sink fins in a manner allowing hot air to flow upward and away from the heat sink and allowing cold air to flow onto the surfaces of the heat sink.
- Avoid constricting the airflow.
- If possible use natural convection to transfer heat from the heat sink to the ambient. Doing so avoids the potential reliability issues of fans.
- If natural convection is insufficient, then consider using fans, heat pumps, or liquid cooling elements that can dramatically increase the convection heat transfer coefficient and hence dramatically increase heat transfer. Active heat sinks can also significantly reduce the heat sink footprint.
- Use heat sinks with surfaces that have high emissivity values.
- Heat sink surfaces should be specified to maintain a flatness tolerance of 0.1mm and a surface roughness tolerance of RMS $\sqrt{16}$.

The minimum required surface area for an extruded aluminum heat sink with a black anodized finish is 10 square inches per watt of dissipated power. The exact requirement for heat sink surface area must be determined and validated by the luminaire designer and will depend on many design variables, including fin orientation and cold and hot air flow paths.

Included below is a partial list of commercially available thermal solutions that may be used with Helieon. In many cases the housing of the luminaire is designed to act as the heat sink, eliminating the need for an

additional thermal management component. This is by no means an exhaustive list and is for reference only. We do not warrant the use of these products with Helieon. Check with the product supplier for the latest specifications and availability. Any thermal solution must be thoroughly evaluated by the customer to ensure acceptable performance under application specific use conditions.

Manufacturer	Model	Type	Shape	Part Number
Nuventix	SynJet® Universal DLM Cooler	Active	Radial	HP25C-CALBL-001
All Axis Machining	Available Soon	Passive	Radial	N/A
Aavid Thermalloy - America	4.5 inch extrusion	Passive	Rect.	74765
Aavid Thermalloy - Europe	90mm extrusion	Passive	Rect.	OS499

Table 1: Partial list of heat sinks suitable for use with Helieon

Assembly of the Helieon Module to Ensure Optimal Thermal Performance

The socket must be carefully attached to the heat sink to ensure full thermal contact with the underlying heat sink when the module is mated with the socket. The attachment of socket to heat sink is fully described in the “Assembly and Installation” section of this design guide.

The Helieon module is supplied with a thermally conductive interface material which presses against the heat sink to create a thermally efficient interface once installed. This material is a “tacky” grey substance with a clear film cover for protection – DO NOT REMOVE THE COVER FILM. The use of thermal grease or other thermal interface materials is not required when mating the module with the socket; the included interface material provides adequate compliance.

Measurement of Case Temperature (T_{case})

After a luminaire has been designed it is critical to experimentally validate the effectiveness of the thermal management solution. Typically this is achieved through building a prototype, simulating worst-case use conditions, and measuring T_{case}. When simulating worst-case use conditions ensure the following:

- Convection conditions are realistic depending on actual assumed use conditions.
- Material properties and dimensions, including wall thicknesses, surface areas, and component sizes are representative of the design.
- Surface properties, including color and roughness properties, are representative of the design.
- Additional heat sources that may impact the thermal performance are included, such as a power supply that is placed inside a luminaire enclosure or imbedded into the heat sink.

Once the representative prototype is built, and realistic use conditions are simulated, T_{case} may be measured to validate the design.

Special care is required when measuring the case temperature to ensure measurement accuracy. The following approach is recommended for attaching the thermocouple to the temperature measurement area of the Helieon module to minimize measurement errors:

- Use a 36 gauge or smaller diameter K-type thermocouple.
- Ensure that the thermocouple is properly calibrated.
- Attach the thermocouple bead, or junction, to the T_{case} measurement area shown in Figure 1. To do this, snake the thermocouple wire through the open bay on the Helieon socket, next to the bay from which the electrical wires exit the socket. Next, place the thermocouple bead on the prescribed temperature measurement area. Temporarily secure the thermocouple using Kapton tape. Apply a small amount of a fast curing, low viscosity, and thermally conductive adhesive around the base of the thermocouple bead.
- Using the back of a thin diameter wood stick, such as a tooth pick or the wooden end of a cotton swab, press on the thermocouple bead to ensure contact with the aluminum heat spreader. Allow the adhesive to cure. **DO NOT ACCELERATE ADHESIVE CURE TIME USING A HOT AIR GUN.** Doing so may damage or distort the clear film on the base of the module and have a negative impact on the thermal performance of the module. Remove as much of the wooden stick as possible.
- It is critical that the entire thermocouple bead is secured tightly against the case. There should be no air gaps between the thermocouple tip and the case.

After applying power to the Helieon module, T_{case} will increase with time as the assembly heats up. Eventually the lighting assembly will reach a steady state temperature. The time required to reach a steady state temperature depends on the thermal time constant of the assembly, but is likely to be in the range of 45 minutes to an hour. Maintain the Helieon module T_{case} at or below the maximum case temperature listed in the maximum product ratings table in the Helieon Data Sheet to ensure functionality and reliability. Note that the operating temperature limits refer to the case temperature, not the ambient or junction temperature.

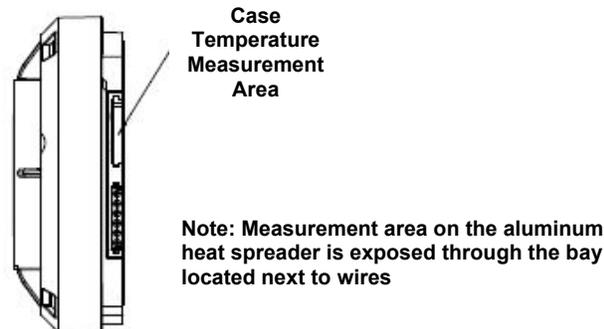


Figure 1: Case temperature measurement area. Attach the thermocouple bead to the aluminum heat spreader that is exposed through the open bay in the socket. If a temperature probe is used to measure T_{case}, ensure the tip of the probe touches the aluminum heat spreader.

For quick and approximate measurements, a temperature probe may be used to measure T_{case} . These measurements are conducted by inserting a measurement probe through the open bay indicated in Figure 1 to contact the tip of the temperature probe with the aluminum heat spreader in the area indicated. Figure 2 shows how a temperature probe may be used to measure T_{case} .

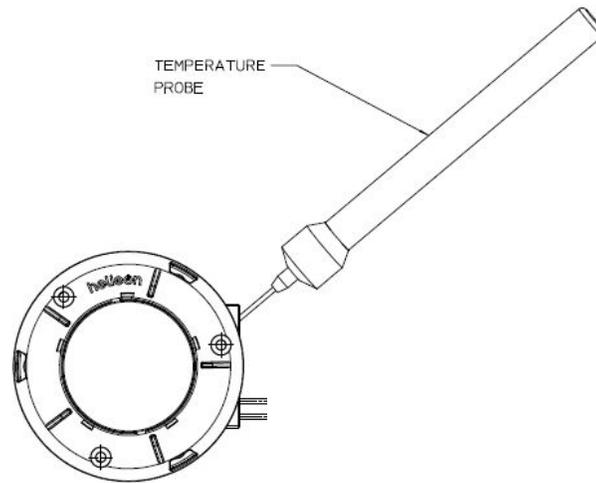
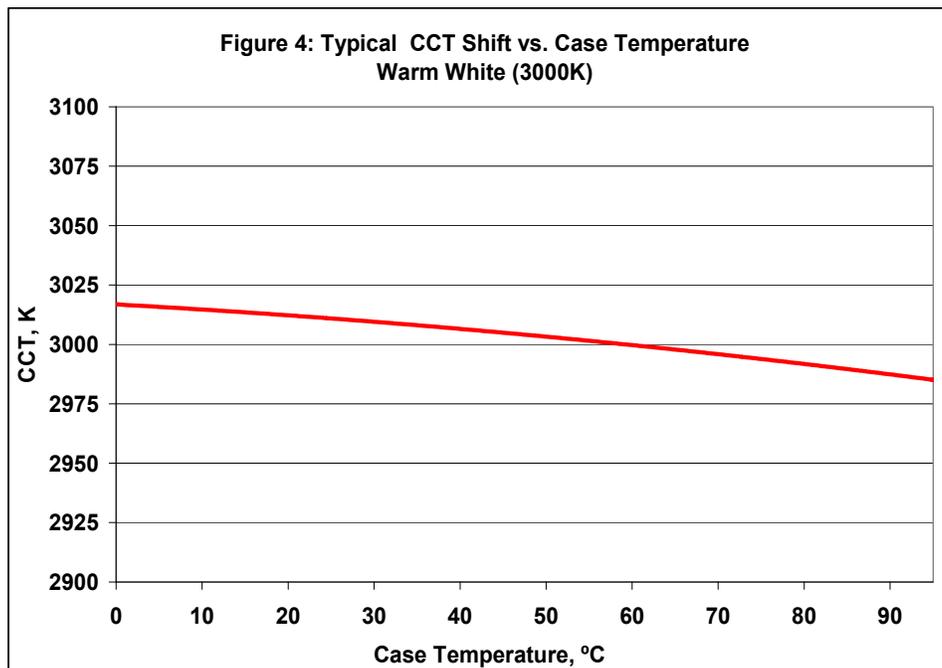
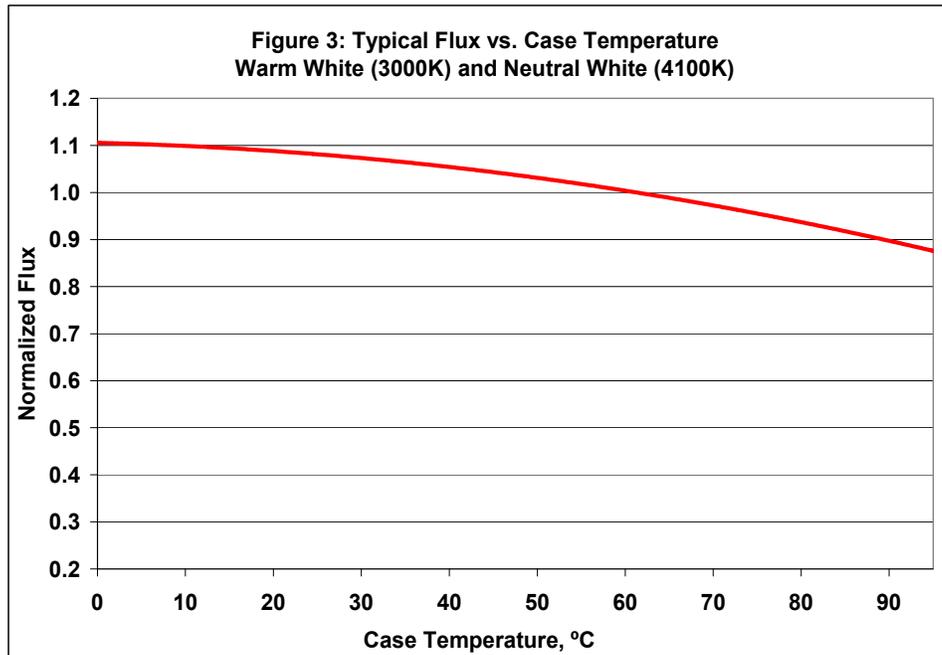
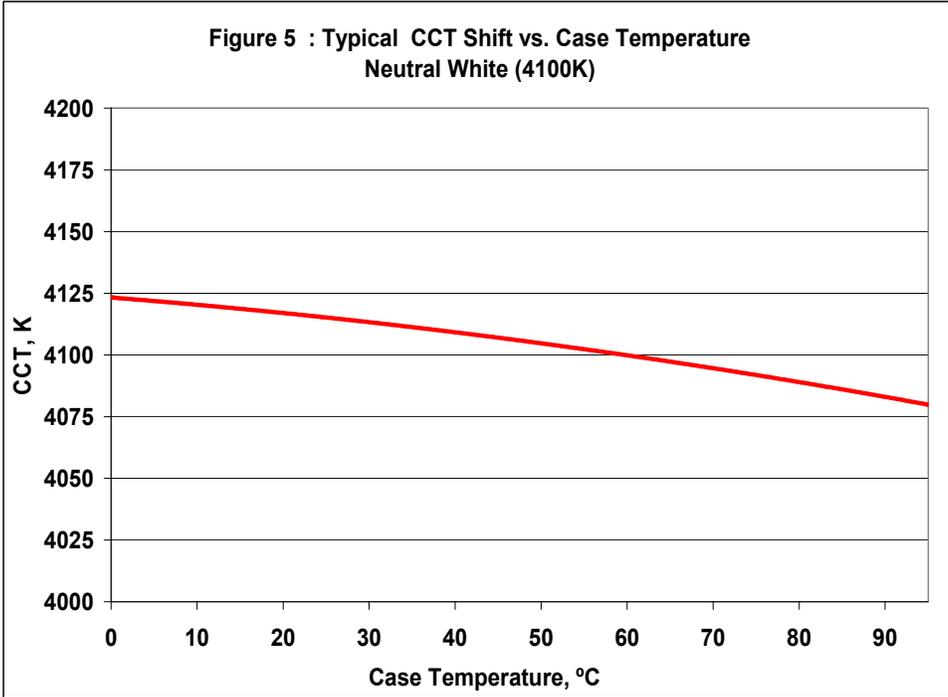


Figure 2: Using a temperature probe to measure the case temperature

Typical Light Output Characteristics vs. Temperature

The Helieon Data Sheet includes typical product performance at the recommended operating case temperature of 60°C. Helieon can be operated under a wide variety of operating conditions, provided that the maximum rated temperature of 95°C is not exceeded. The typical temperature dependence of flux and color temperature, normalized to 60°C, is shown in figures 3, 4 and 5.





5.0 ELECTRICAL MANAGEMENT

The selection of a suitable electronic driver is critical to achieve optimal performance from the Helieon lighting system. Proper driver design allows for interchangeability of modules with varying beam angles, intensity and color in the luminaire without changing the driver.

General Driver Recommendations

LED drivers convert available input power into the required output current and voltage, and are analogous to ballasts used with fluorescent and other conventional light sources. Figure 6 illustrates a constant current source driven by a mains power supply. When selecting a driver for use with Helieon we recommend the following basic guidelines:

- Drive the Helieon module using constant current sources, not constant voltage sources.
- Do not apply a reverse voltage to the Helieon module.
- Use pulse width modulation (PWM) for dimming.

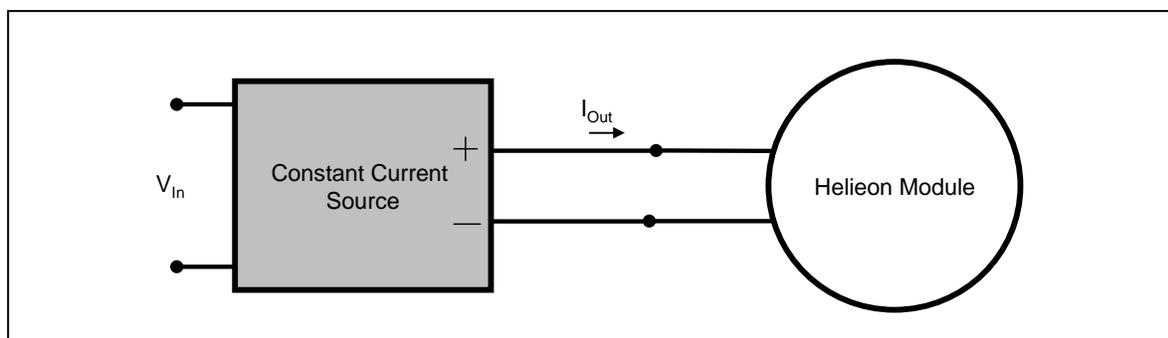


Figure 6: Illustration of a driver accommodating a mains input voltage requirement

Some luminaire designs may use multiple Helieon Modules, driven at the same forward current, in a single luminaire. For these designs we recommend the following driver configurations:

- Use a single constant current driver to drive multiple Helieon modules in series.
- Use a single driver with multiple constant current output channels to individually drive multiple Helieon modules.
- Use multiple constant current drivers to drive multiple Helieon modules.

The following additional guidelines should also be observed:

- Do not drive the Helieon modules with constant voltage sources.
- Do not drive the Helieon modules in a parallel circuit, doing so may result in inconsistent performance between modules.

Dimming

Helieon is compatible with dimming drivers. Dimming can be used to control the lighting environment by reducing light output, simultaneously reducing energy consumption and operational costs.

When dimming the Helieon module, we recommend the use of pulse width modulation (PWM), which provides a pulsed current to the light source with a varying frequency. The use of PWM dimming ensures luminaire to luminaire consistency over a wide range of output levels.

PWM describes the optimal output signal from the driver, not the signal to the driver that triggers and controls dimming. Different types of dimmers signal and control dimming in different ways. For example, TRIAC (Triode for Alternating Current) dimmers modify the input signal from the mains to the driver. Figure 7 illustrates TRIAC dimming. TRIAC dimmers are common in residential applications as they work well with the installed electrical system and require no modification to the existing wiring. Two types of TRIAC dimmers are common, leading edge and trailing edge. Fewer drivers are available which are compatible with a leading edge TRIAC output signal. Drivers compatible with leading edge TRIAC output signals are typically also compatible with trailing edge TRIAC output signals. TRIAC dimmable drivers tend to be less efficient than other types of dimming drivers.

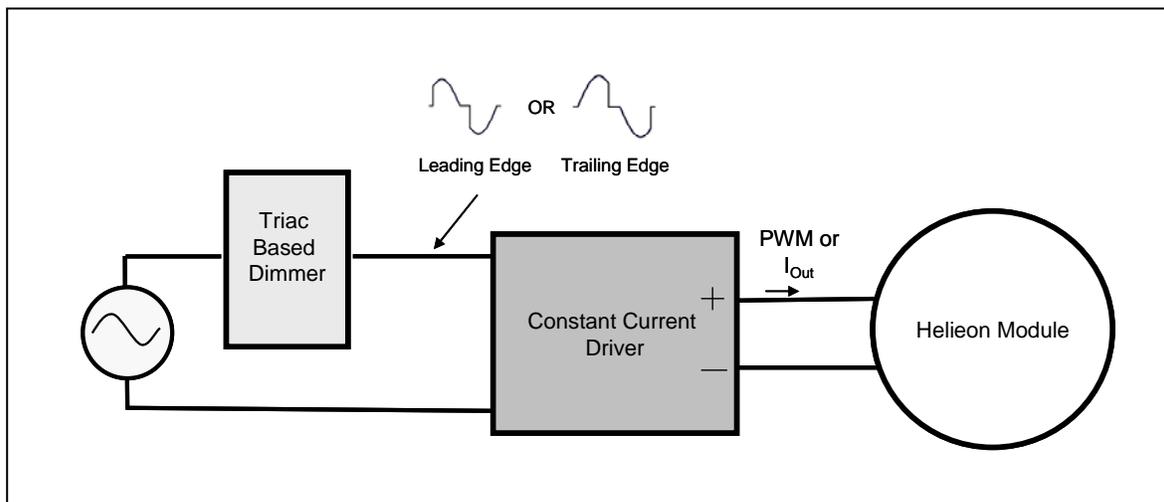


Figure 7: Illustration of a TRIAC dimmable driver connected to the main and to a constant current driver. Note how the input signal to the driver is not a smooth wave but a broken wave form. Both leading edge and trailing edge TRIAC input signals to the driver are shown

Another common dimmer is the 0 to 10V control dimmer, shown in Figure 8. In addition to the mains input, these drivers require an analog control voltage in the range 0V to 10V. This voltage signal controls the constant current output to the light source either by managing the pulse width in a PWM driver or more commonly by regulating the magnitude of the DC current. 0V to 10V dimmers are generally considered to be more cumbersome to implement compared to TRIAC dimmers in residential applications due to the additional wiring requirements, however they are used frequently in new industrial and commercial applications as they can deliver a higher efficiency solution.

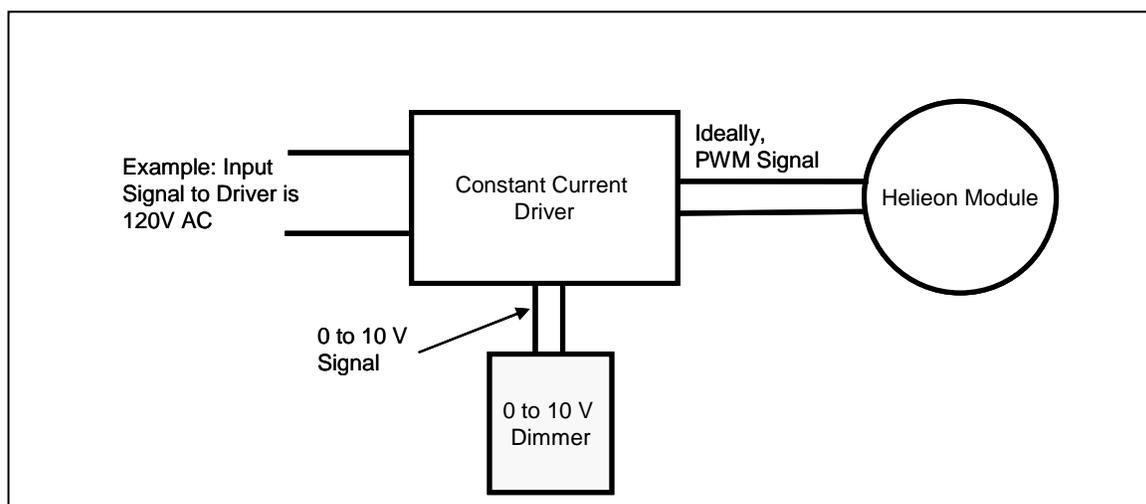


Figure 8: Illustration of an LED driver with 0 to 10 V dimming.

Driver Selection

A driver should be selected to enable operation over the entire voltage range of the selected Helieon module or modules. The typical voltage for each Helieon module is included in the Typical Product Performance tables in the Helieon Data Sheet. Note that the voltage range of the driver should be selected to allow sufficient guard band for a $\pm 10\%$ tolerance on the typical voltages shown in the Helieon Data Sheet. Additional guard band will be required if the module is operated at a case temperature other than the 60°C values listed. Typical temperature coefficients of forward voltage are shown in Table 2.

Helieon Module Part Number	Typical Temperature Coefficient of Forward Voltage, $\Delta V_f/\Delta T_c$ (mV/°C)
180081-22X0	-8
180081-23X0	-12
180081-42X0	-8
180081-43X0	-12

Table 2: Typical temperature coefficients of forward voltage for Helieon modules

Customers who would like to drive the Helieon Modules at alternative drive currents can do so by first determining the desired output current and then determining the output voltage range associated with the desired current.

Graphs showing the relationship between current, optical flux and forward voltage can be found in Appendix B for all products.

It is the responsibility of the designer to ensure that the selected LED driver meets all local regulatory requirements. We also recommend consideration of the following specifications when selecting or designing an LED driver.

- Power Factor – Power factors greater than 0.9 are recommended.
- Efficiency – Design or select drivers that are highly efficient over the range of loads expected in the lighting system.
- Reliability – The expected life of the LED driver should match that of the lighting system.
- Safety – Ensure compliance to all regulatory and approbation requirements.
- Feedback Features – Some applications may benefit, or require, LED drivers that include active feedback.
- Ripple – Ripple is the small and unwanted residual periodic variation of the direct current output of an AC to DC LED driver. Ripple values that are less than $\pm 10\%$ are recommended.
- Noise – Specify an LED driver with low noise to avoid interference and/or violation of regulated standards.
- Dimming – To reduce the apparent brightness, use Pulse Width Modulation for dimming to deliver consistent performance between lighting systems over a broad range of light output levels.

UL Class 2 and CIE/LPS Drivers

When selecting a driver we recommend using drivers that are specified as Class 2, as defined by UL. Class 2 drivers have the following characteristics:

- They are isolated from the input supply with double insulation
- The output voltage is less than 60V DC or less than 30V AC rms in the US
- The output voltage is less than 42V DC or less than 30V AC rms in Canada
- They provide limited output power, which is dependent on the output voltage (i.e. 12V 60W max, 24-60V 100W max)

Please refer to UL specifications for current definitions and detailed information on drivers. In countries where CIE specifications apply, LPS (Limited Power Supply) drivers are recommended. Note that SELV (Safe Extra Low voltage) drivers may or may not be Class 2. Also, please do not confuse UL Class 2 with UL Class II. UL Class II only refers to the level of isolation.

Commercially Available Drivers

Designers have options when it comes to selecting commercially available LED drivers. Many manufacturers produce drivers which work well with Helieon modules to enable rapid system design. Table 3 lists a subset of commercially available drivers that meet the technical requirements necessary to drive the Helieon modules, such as output voltage, output constant current, and power requirements. This is not an exhaustive list and is for reference only. We do not warrant the use of these drivers with the Helieon module products. Check with the supplier of the LED driver for the latest information in specifications and availability. Any LED driver that is selected must be thoroughly evaluated by the customer to ensure that all applications specific requirements are met.

Supplier	Driver Part Number	V AC In (V)	I out (mA)	Dimming	Efficiency (%)	V DC Out (V)
Harvard Engineering PLC	CL700S-240-B or C	198 to 265	700	YES, Optional	88	9 to 48
Hatch	LCBP018-WJ-UNV	90 to 300 V	700	NO	TBD	3 to 27
LighTech	LED-36-700-120-D	120	700	TRIAC	80	5.6 to 42
LUMOtech	L05016i	120 or 240	700 (Adjustable)	1 to 10V, Pulse Switch, or Potentiometer	85	1 to 20
Meanwell	LPC-35-700	90 to 264	700	NO	85	9 to 48
Advance	LED-120A-0024 -10D	120	1050	0 to 10V	80	10.4 -24.6
Inventronics	EUC-025S105PS(6)	90 to 305	1050	0 to 10V or Potentiometer	82	8 to 24
LighTech	LED-36-1050-120-D	120	1050	TRIAC	80	5.6 to 42
Meanwell	LPC-35-1050	90 to 264	1050	NO	85	9 to 30
Thomas Research	TRC-025S105DS	90 to 305	1050	0 to 10V or Potentiometer	82	8 to 24
Advance	LED120A1400C24F	120	1400	NO	TBD	2.4 to 24
Autec Power Systems	LEDWC-035S140YT - DS	90 to 305	1400	0 to 10V or Potentiometer	87	8 to 24
Inventronics	EUC-035S140DT(6)	90 to 305	1400	0 to 10V or Potentiometer	85	8 to 24
Meanwell	LPC-35-1400	90 to 264	1400	NO	85	9 to 24
Thomas Research	TRC-040S140DS	90 to 305	1400	0 to 10V or Potentiometer	82	10 to 29

Table 3: Partial list of LED drivers suitable for use with all Helieon modules

Connecting the Driver to the Socket

The Helieon socket is supplied with two 6-inch 20 AWG Teflon-coated double insulated stranded wires for connecting the socket to the electronic driver. The wires are color coded to ensure proper connection, red for positive and black for negative. Please ensure proper polarity during electrical connection to avoid damage to the Helieon module.

Please refer to the data sheet for the driver selected to determine how to correctly connect the electrical leads from the socket to the driver. It is recommended to use a maximum wire gauge of 20 AWG to connect the socket to the driver. Common methods for attaching the wires from the socket and driver include:

- Solder the wires together and then completely cover the solder joint using shrink tubing.
- Connect the wires using wire nuts.

When connecting the wires, ensure compliance to all local regulatory and approbation requirements including UL, IEC and CSA.

6.0 OPTICAL MANAGEMENT

Beam Intensity Over Angle

The Helieon Modules are uniquely designed to produce a variety of precision controlled beam angles well suited for many lighting applications. This broad range of optical performance options allows the designer to maximize the effective performance of the light source based on application specific requirements. Three different beam angle options are available: 24°, 32°, and 50°. Figures 9, 10 and 11 show the relative light intensity over angle for each of these options.

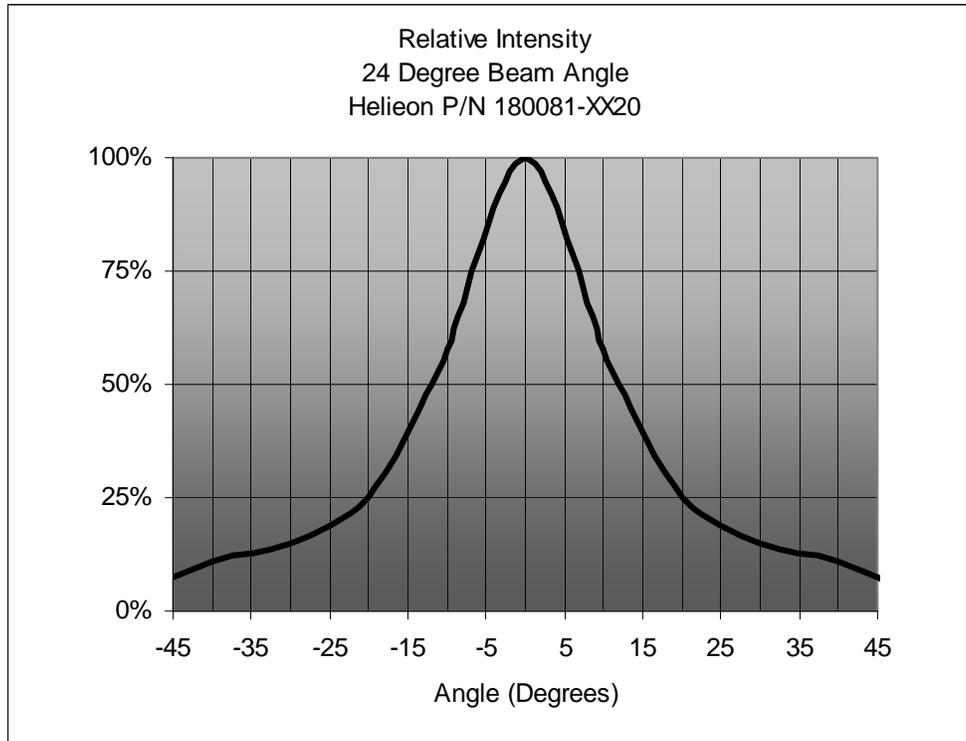


Figure 9: Relative light intensity of a Helieon module with a 24 degree beam

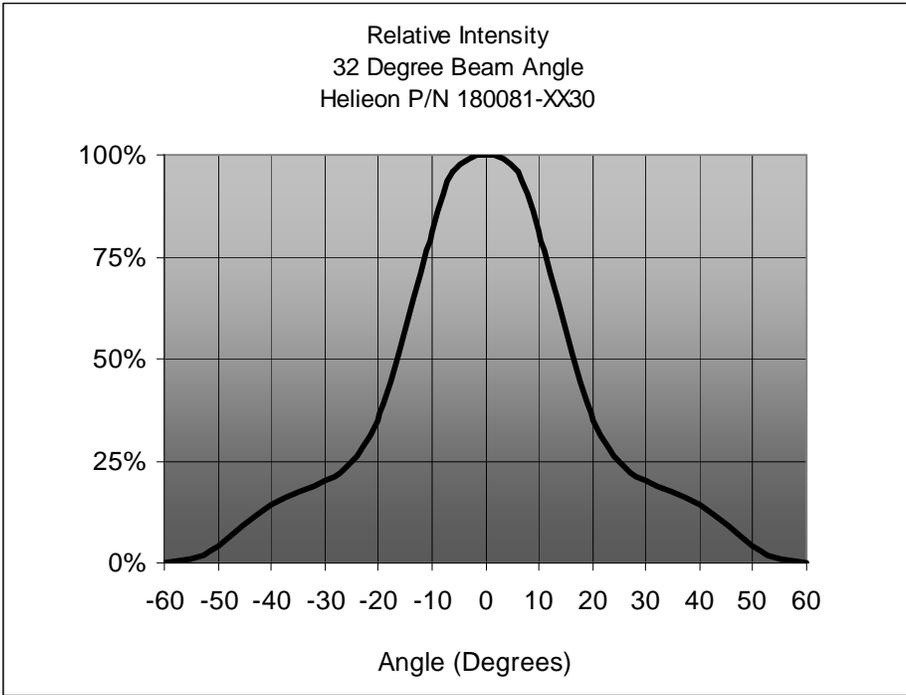


Figure 10: Relative light intensity of a Helieon module with a 32 degree beam

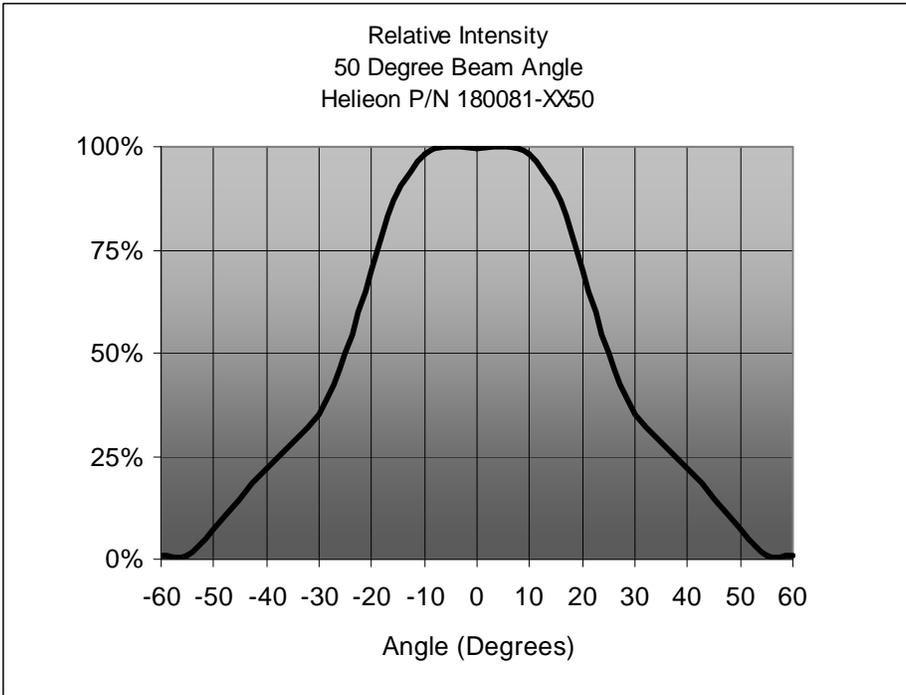
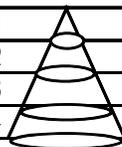


Figure 11: Relative light intensity of a Helieon Module with a 50 degree beam

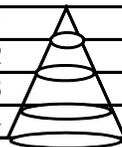
Photometric Characteristics

The photometric performance, including illuminance at varying distances from the light source for all beam angle options is included below in Tables 4, 5 and 6. As noted previously in this document, Helieon has been engineered to enable a high degree of flexibility in luminaire designs. As such, Helieon can be operated under a wide variety of operating conditions and under multiple operating current conditions. The tables below include typical photometric conditions for all Helieon module products at drive currents of 700mA, 1050mA and 1400mA. Photometric performance will vary if additional alternative use conditions are specified in the design of the lighting system. All values listed assume operation at a case temperature of 60°C.

24 Degree Viewing Angle		3000 K		4100 K	
Distance (m)	Effective Diameter (m)	Helieon P/N 180081-2220	Helieon P/N 180081-2320	Helieon P/N 180081-4220	Helieon P/N 180081-4320
		Center Illuminance (lux)	Center Illuminance (lux)	Center Illuminance (lux)	Center Illuminance (lux)
1	0.43	860	1110	1000	1390
2	0.85	210	280	250	350
3	1.28	100	120	110	150
4	1.70	50	70	60	90



32 Degree Beam Angle		3000 K		4100 K	
Distance (m)	Effective Diameter (m)	Helieon P/N 180081-2230	Helieon P/N 180081-2330	Helieon P/N 180081-4230	Helieon P/N 180081-4330
		Center Illuminance (lux)	Center Illuminance (lux)	Center Illuminance (lux)	Center Illuminance (lux)
1	0.63	750	990	910	1320
2	1.26	190	250	230	330
3	1.89	80	110	100	150
4	2.52	50	60	60	80



50 Degree Beam Angle		3000 K		4100 K	
Distance (m)	Effective Diameter (m)	Helieon P/N 180081-2250	Helieon P/N 180081-2350	Helieon P/N 180081-4250	Helieon P/N 180081-4350
		Center Illuminance (lux)	Center Illuminance (lux)	Center Illuminance (lux)	Center Illuminance (lux)
1	0.93	460	620	510	800
2	1.87	120	150	130	200
3	2.80	50	70	60	90
4	3.73	30	40	30	50

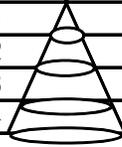
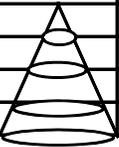
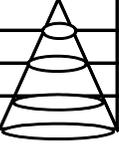


Table 4: Illuminance measured in lux and effective diameter at varying distances from the light source, 700 mA constant current operation

24 Degree Viewing Angle		3000 K		4100 K	
Distance (m)	Effective Diameter (m)	Helieon P/N 180081-2220 Center	Helieon P/N 180081-2320 Center	Helieon P/N 180081-4220 Center	Helieon P/N 180081-4320 Center
		Illuminance (lux)	Illuminance (lux)	Illuminance (lux)	Illuminance (lux)
1	0.43	1240	1580	1460	2000
2	0.85	310	400	370	500
3	1.28	140	180	160	220
4	1.70	80	100	90	130



32 Degree Beam Angle		3000 K		4100 K	
Distance (m)	Effective Diameter (m)	Helieon P/N 180081-2230 Center	Helieon P/N 180081-2330 Center	Helieon P/N 180081-4230 Center	Helieon P/N 180081-4330 Center
		Illuminance (lux)	Illuminance (lux)	Illuminance (lux)	Illuminance (lux)
1	0.63	1090	1420	1320	1890
2	1.26	270	350	330	470
3	1.89	120	160	150	210
4	2.52	70	90	80	120



50 Degree Beam Angle		3000 K		4100 K	
Distance (m)	Effective Diameter (m)	Helieon P/N 180081-2250 Center	Helieon P/N 180081-2350 Center	Helieon P/N 180081-4250 Center	Helieon P/N 180081-4350 Center
		Illuminance (lux)	Illuminance (lux)	Illuminance (lux)	Illuminance (lux)
1	0.93	670	880	750	1140
2	1.87	170	220	190	290
3	2.80	70	100	80	130
4	3.73	40	60	50	70

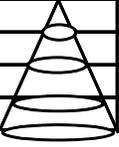
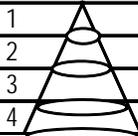
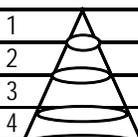


Table 5: Illuminance measured in lux and effective diameter at varying distances from the light source, 1050 mA constant current operation

24 Degree Viewing Angle		3000 K		4100 K	
Distance (m)	Effective Diameter (m)	Helieon P/N 180081-2220 Center	Helieon P/N 180081-2320 Center	Helieon P/N 180081-4220 Center	Helieon P/N 180081-4320 Center
		Illuminance (lux)	Illuminance (lux)	Illuminance (lux)	Illuminance (lux)
1	0.43	1500	2020	1860	2530
2	0.85	380	500	470	630
3	1.28	170	220	210	280
4	1.70	90	130	120	160



32 Degree Beam Angle		3000 K		4100 K	
Distance (m)	Effective Diameter (m)	Helieon P/N 180081-2230 Center	Helieon P/N 180081-2330 Center	Helieon P/N 180081-4230 Center	Helieon P/N 180081-4330 Center
		Illuminance (lux)	Illuminance (lux)	Illuminance (lux)	Illuminance (lux)
1	0.63	1320	1810	1690	2400
2	1.26	330	450	420	600
3	1.89	150	200	190	270
4	2.52	80	110	110	150



50 Degree Beam Angle		3000 K		4100 K	
Distance (m)	Effective Diameter (m)	Helieon P/N 180081-2250 Center	Helieon P/N 180081-2350 Center	Helieon P/N 180081-4250 Center	Helieon P/N 180081-4350 Center
		Illuminance (lux)	Illuminance (lux)	Illuminance (lux)	Illuminance (lux)
1	0.93	810	1120	950	1460
2	1.87	200	280	240	360
3	2.80	90	120	110	160
4	3.73	50	70	60	90

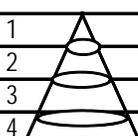


Table 6: Illuminance measured in lux and effective diameter at varying distances from the light source, 1400 mA constant current operation

IES Files and Source Models

Additional design resources are under development to assist in successful optical designs. IES files and optical source models and ray trace files compatible with a wide variety of optical design software will be available from the Helieon web site soon. Please contact your local sales representative for the latest information regarding the availability of these files.

Helieon Module Clear Cover

The Helieon module features a clear cover optic. This cover optic protects the light emitting area and reflector from potential damage due to physical contact or debris. The cover may be removed, but care must be taken to ensure that the optical area of the module, including the reflector, is not contacted or contaminated as this can have a negative impact on the performance. Instructions for removing the cover optic are provided in the Assembly and Handling section of this document.

7.0 ASSEMBLY AND INSTALLATION

Helieon employs innovative interconnect technology, resulting in a separable socket and module solution. This allows the light source to be changed with the simplicity of changing a light bulb enabling the lighting environment to be modified in a very user-friendly manner. The module is mated to the socket with a simple twist and click action that creates both an electrical connection to the socket and a thermally robust mechanical contact with the underlying heat sink. The module is de-mated with an equally simple twist and click.

The installation process for the Helieon module provides an extremely robust solution. The thermal interface and electrical connections engage without twisting or grinding of the contacts during the installation process, eliminating concerns of creating wear on these contacts during multiple installation and removal cycles. The rotation of the body of the module, separated from the thermal and electrical contact points, provides the necessary force and pressure to ensure electrical and thermal contact without risking damage to the interfaces.

Basic handling precautions are described together with simple instructions for installing the socket and for mating and de-mating the module to and from the socket in this section. Recommendations are provided for managing the electrical cable, supplied pre-connected to the socket, required for connecting the socket to the electronic driver.

Basic Handling

EXERCISE CAUTION - the resin area can reach elevated temperatures during operation and may cause damage or injury to the user if touched. Allow the Helieon module to cool for a sufficient period of time before handling.

The Helieon module is engineered to be extremely robust, but the product should still be handled with care. Do not touch the yellow resin area within the Helieon module as it may cause damage to the light source or change the beam pattern created by the source. If debris contacts the resin area, ensure the Helieon module is switched off and has cooled before gently removing the debris using the tip of a cotton swab soaked in isopropyl alcohol (rubbing alcohol). As isopropyl alcohol is highly flammable it is important to allow the module to cool before handling. **DO NOT** attempt to clean the Helieon module while it is switched on

Attachment of the Socket to the Heat Sink

Careful attachment of the socket to the heatsink is required to ensure effective thermal contact. The socket should be mounted to a surface with a flatness tolerance within 0.13mm (0.005 inches), and should be attached with three M3 screws at the specified locations (see Figure 12) with a location tolerance of ± 0.13 mm and an angular tolerance of $\pm 1/2^\circ$. The screws must be mounted perpendicular to the mounting surface to maintain flatness requirements. Staying within the screw tolerance bounds will ensure correct orientation and mounting of the socket.

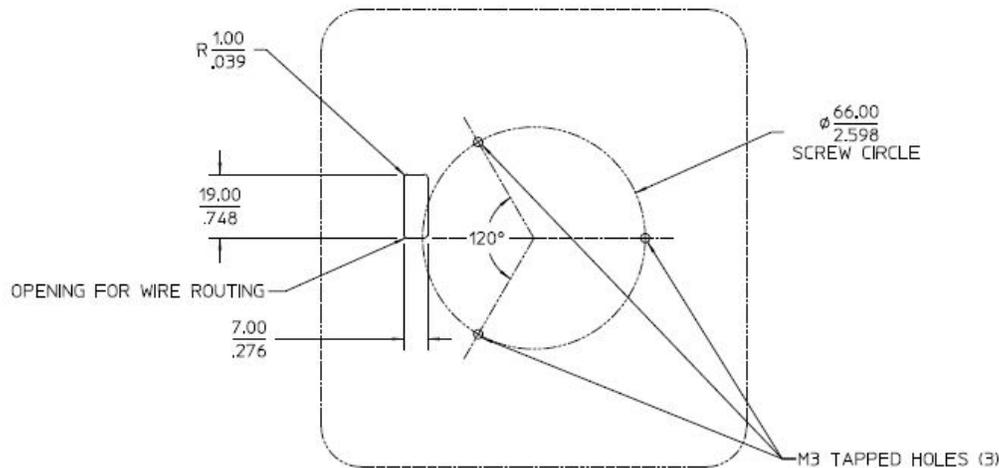


Figure 12: Socket mounting screws and dimensions

Mating and De-Mating the Module and Socket

The module is mated and de-mated with the socket with a very simple twist and click action illustrated in Figure 13 and described by the following instructions.

Mating

- Rotate the module in a clockwise direction until the module drops into the socket. Electrical and thermal connections have engaged at this point.
- Continue to turn the module in the same direction until there is a physical and audible click. The module is now fully locked into position and ready for operation.
- The driver or power supply should be connected to the socket. It is important that the module should be installed in the socket before power is applied to the driver to avoid damage to either the module or the driver.

De-Mating

- Disconnect the power supply to the driver.
- Rotate the module in a counter-clockwise direction until there is a physical and audible click. The module will disengage at this point.

- Continue rotating the module in a counter-clockwise direction until the module can be easily lifted from the socket and removed.

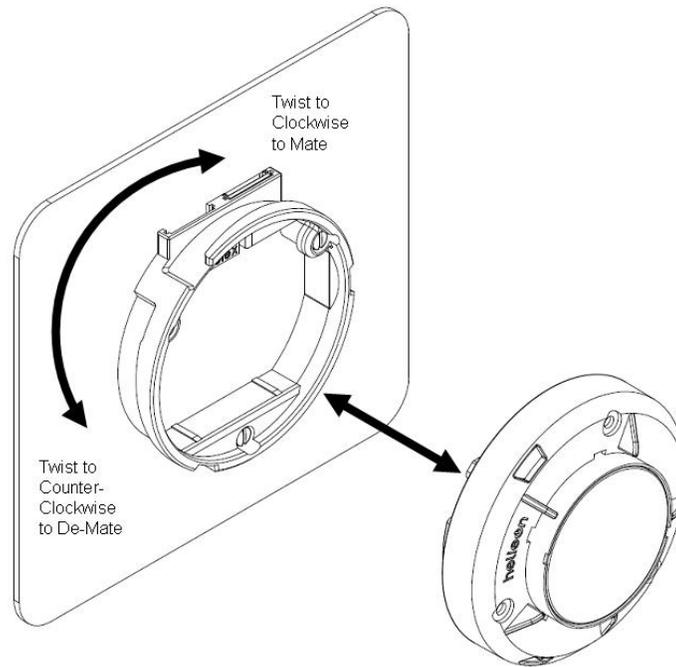


Figure 13: The Helieon module mates and de-mates with a twist of the wrist

Management of the Electrical Cable

The socket is supplied with two 6" 20 AWG Teflon-coated double insulated stranded wires for connecting the socket to the electronic driver. The cable is supplied as shown in Figure 14a, with wires extending parallel to the mounting plane. The Helieon socket has been designed to allow for a 90° bend as shown in Figure 14b if the application requires this orientation. To bend the wires, carefully grip the socket and wires and gently bend the wires to achieve the 90° orientation, being careful not to over bend or apply excess force to the connection of the wires to the socket.

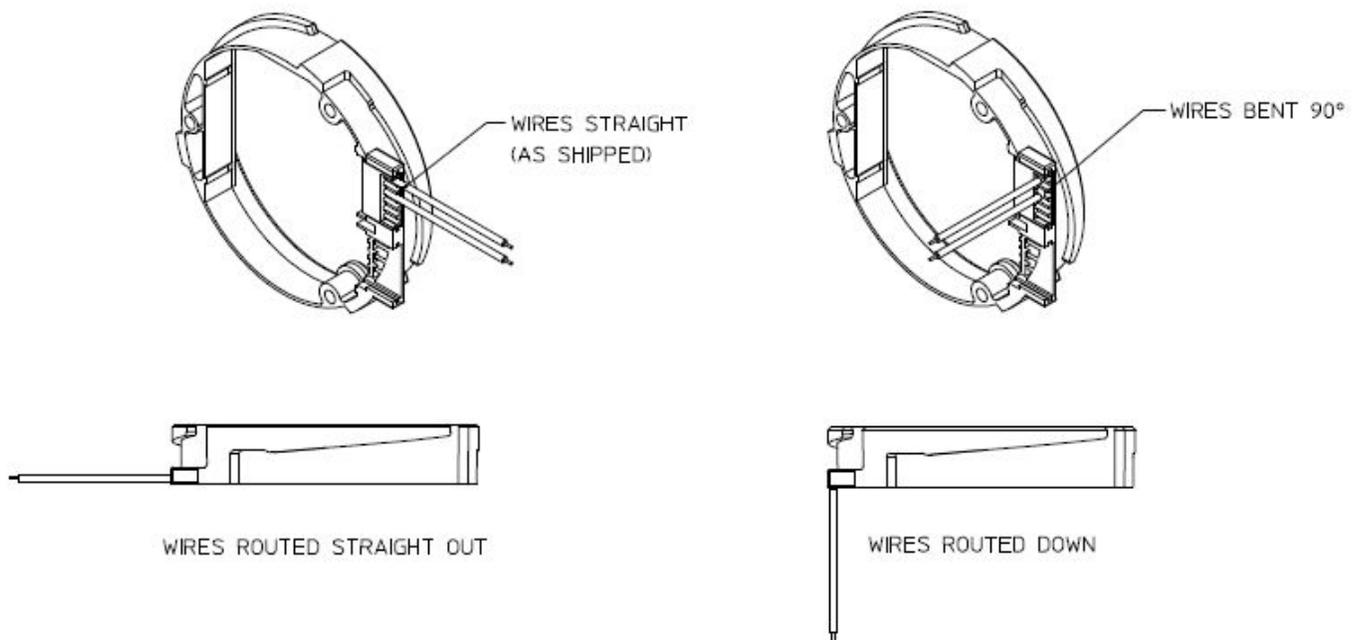


Figure 14a
Helieon socket with wires as supplied

Figure 14b
Helieon Socket with 90° bend option

Please refer to the data sheet for the driver selected to determine how to correctly connect the electrical leads from the socket to the driver. The wires connected to the socket are color coded to indicate polarity, red for positive and black for negative leads. It is recommended to use a maximum wire gauge of 20 AWG to connect the socket to the driver. Common methods for attaching the wires from the socket and driver include:

- a. Solder the wires together and then completely cover the solder joint using shrink tubing.
- b. Connect the wires using wire nuts.

When connecting the wires, ensure compliance to all local regulatory and approbation requirements including UL, IEC and CSA.

Helieon Module Clear Cover

The Helieon module features a clear cover optic, shown in Figure 15. This cover optic protects the light emitting area and reflector from potential damage due to physical contact or debris. The cover optic is held in place via a snap fit and may be removed by inserting the tip of a small flat screwdriver into the noted slots and gently pushing the optic away from the Helieon module. Removal of the clear cover optics will result in a slight increase in light output from the module compared to the values listed in the Helieon Data Sheet.

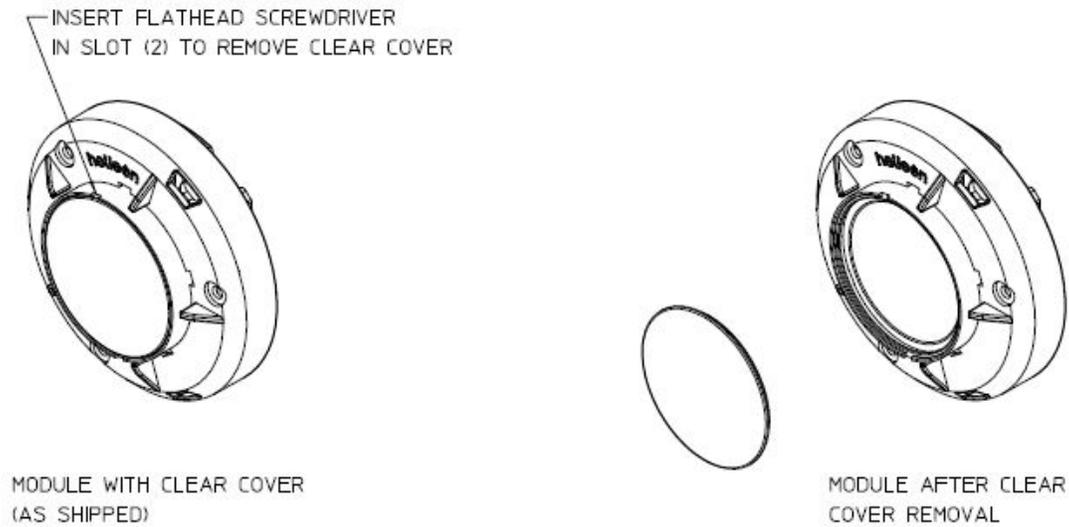


Figure 15: Removal of clear module cover optic

8.0 APPENDIX A

Maximum Product Ratings

The Helieon modules should not be operated outside the maximum ratings listed below:

Parameter	Maximum Rating
Maximum DC Forward Current	2000mA
Minimum DC Forward Current ⁽¹⁾	600mA
Maximum Peak Pulsed Current ⁽²⁾	2800mA
Maximum Reverse Voltage ⁽³⁾	-20V
Operating Case Temperature	-40°C to +95°C
Storage Temperature	-40°C to +105°C

Notes:

1. Driving these high current devices at low currents can result in variations in performance. For low current operation, pulse width modulation is recommended
2. A maximum duty cycle of 100% is recommended when operating the Helieon module at the maximum peak pulsed current specified
3. LEDs are not designed to be driven with a reverse voltage

9.0 APPENDIX B

Product Performance at Alternative Drive Currents

Typical product performance data is shown in the product data sheet for drive currents of 700mA, 1050mA and 1400mA. There are many commercially available drivers from multiple suppliers at these current levels as described in the “Electrical Management” section of this Design Guide. Customers may also drive the Helieon modules at currents that are different to 700mA, 1050mA or 1400mA. The desired driver characteristics for alternative drive currents can be easily determined from figure 16 showing the variation of optical flux with drive current and from figures 17 and 18 showing the variation of forward voltage with drive current.

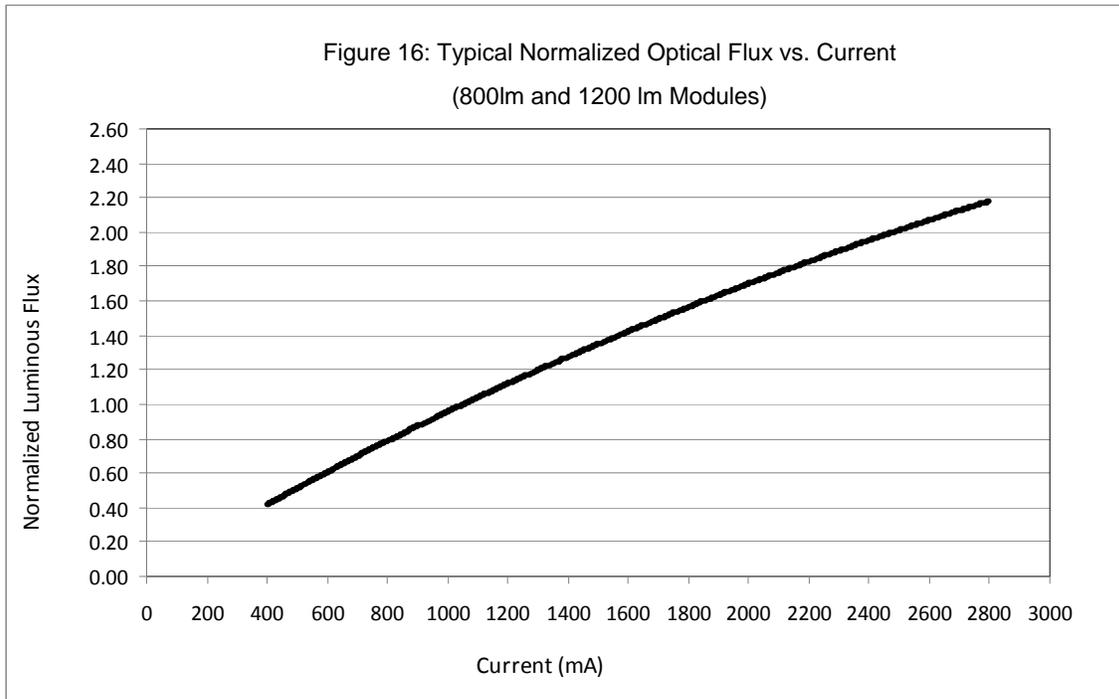


Figure 17: Typical Current vs. Voltage, 800lm Modules

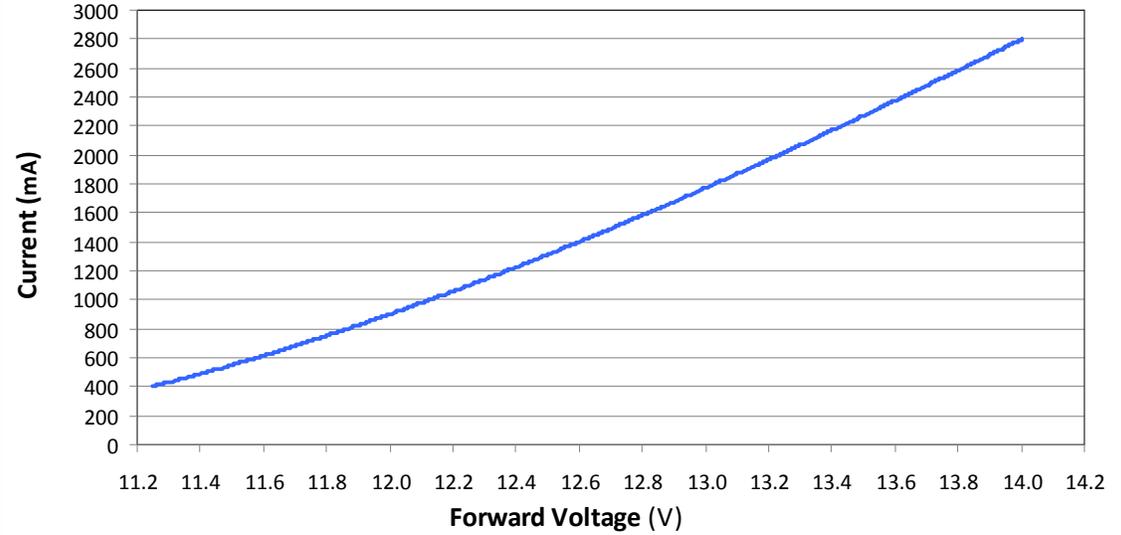


Figure 18: Typical Current vs. Voltage, 1200lm Modules

