PRODUCT

SynJet® Cooler for LED Spot Light with Heat Sink

Design Guide

Version 0.3
February 2010

NUVENTIX

Version History

Document Name: SynJet Spot Light Cooler with Heat Sink Design Guide
Document Number: MKTG-DOC-00074

Version and Date	Changes
Version 0.1, November 2009	Preliminary Review Draft (rev 11/06)
Version 0.2, December 2009	Preliminary Release
Version 0.3, February 2010	Preliminary Release

Nuventix, Inc.
4635 Boston Lane
Austin, TX 78735

www.nuventix.com

Phone: 512-382-8100
Fax: 512-382-8101
Contact Sales: 512-382-8100

Table of Contents

Chapter 1
Introduction

The SynJet Spot Light Cooler (SLC) is a patented, highly adaptable, quiet, active cooling solution for the solid state lighting industry. The SLC's flexible design is ideal for an extensive range of lighting options from recessed to track and is capable of cooling 8-35 watts. For additional adaptability, the SynJet can be adjusted to various cooling levels dependent upon thermal needs. The Spot Light Cooler form factor is extremely versatile, adept in building a broad product line for commercial applications.

Specially designed to provide active cooling, the SLC:

- allows maximum lumens output for long life
- provides excellent thermal management
- provides low energy consumption
- can double or triple lumen output over a passive cooling solution in the same form factor.

The SLC is available in five models optimized for specific cooling environment requirements:

- SynJet Spot Light Cooler, Standard setting, provides quiet, effective cooling in standard luminaire design environments with normal airflow and where low acoustics are important.
- SynJet Spot Light Cooler, High Performance setting, is optimized for maximum LED cooling and/or in a restricted airflow environment such as an enclosed box with little venting. This model provides greater cooling in areas less sensitive to the nominal increase in acoustics that the additional flow creates.
- SynJet Spot Light Cooler, Silent setting, is optimized for LED designs where silent acoustics are required in a compact package. This model is perfect for slightly lower power requirements but still maintaining small designs.
- SynJet Spot Light Cooler, Variable Control, is optimal for designs where the cooling level is adjusted real time based on environmental conditions. The variable control option is based on PWM input to the cooler.
- SynJet Spot Light Cooler, Passive, is optimized for lower power LED designs. Using the matching heatsink allows for the same compact package and appearance compatibility with the customer's family of higher power SynJet designs.

This document is applicable to all five models of the SynJet Spot Light Cooler.

Audience

The audience for this design guide is the luminaire design team to include:

- luminaire industrial designers
- thermal engineers
- mechanical engineers
- electrical engineers

Sections of this document may also provide valuable SLC application background for the luminaire marketing team and luminaire manufacturing engineers.

Related Documents

For additional information, refer to the following:

- *Nuventix Technology Overview*
- *SynJet Spot Light Cooler with Heat Sink Assembly Instructions*
- *SynJet Spot Light Cooler with Heat Sink Product Specification*
- *SynJet Spot Light Cooler with Heat Sink 2D Drawings*
- *SynJet Spot Light Cooler with Heat Sink 3D CAD Model, STEP file format*
- *SynJet Variable Control Application Note*
- The Nuventix web site at www.nuventix.com for:
    - Latest Document Updates
    - New Application Notes

Components

The following figures illustrate the components of the SLC. The exploded assembly shows the SynJet Cooler and the SynJet heat sink. It also shows optional user supplied items such as the reflector and a cosmetic cover cylinder.

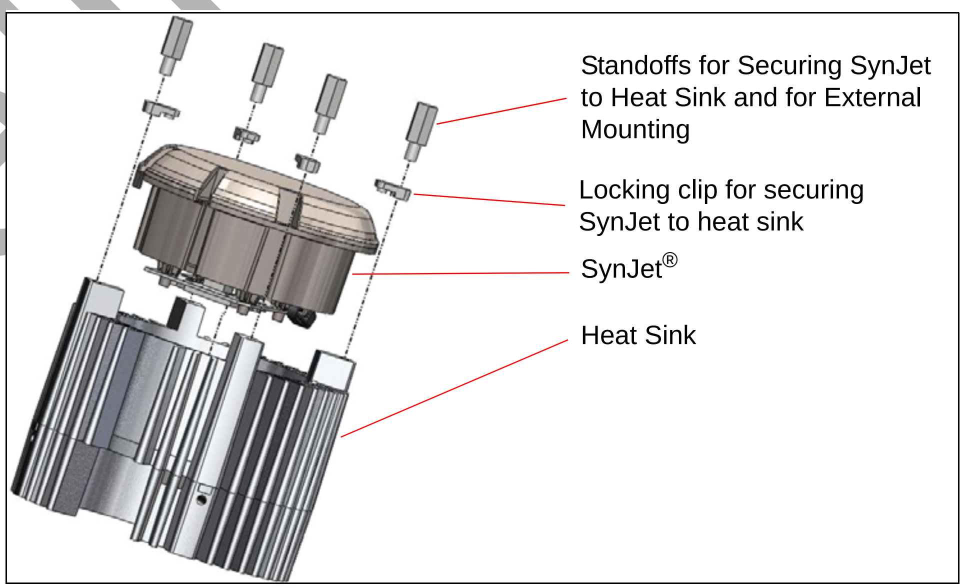


Figure 1: SynJet Spot Light Cooler and Heat Sink

Figure 2: SynJet Spot Light Cooler and Heat Sink With User Supplied Cover and Reflector

The following table describes each component.

Table 1: Component Description

Component	Description
SynJet Spot Light Cooler	The SynJet Spot Light Cooler is the air mover of the cooling system. The SynJet module works by creating turbulent, pulsated air-jets that are directed precisely into the heat sink fin channels where thermal management is needed.
Heat Sink and User Supplied Attachments - LED Array and Reflector	The heat sink spreads the heat dissipated from the LED Array over a large surface area. The LED Array attaches to the flat heat sink surface and the reflector will attach to the LED or the Heat Sink
SynJet Spot Light Cooler Driver Board	The driver board contains the components needed to operate the SynJet Spot Light Cooler.
SynJet Cooler to Heat Sink Attachment Points	The four attachment standoffs mate with tapped holes in the heat sink. The standoffs screw into the 4 M3 mounting holes on the heat sink and secure the locking clips to the heat sink and SynJet. For screw size information and details, see the SynJet Spot Light Cooler 2D Drawings.
SynJet Cooler - Attachment Points for User Supplied Optional Cosmetic Cover and/or External Mounting Bracket	The designer can use the standoff screws and/or the tapped holes in the heat sink for attachment of a cover or mounting hardware. The Twist-Lock Bumps on the heat sink can also be used for attachment. See the SynJet Spot Light Cooler 2D Drawings for details.
User Supplied Optional Cover Cylinder and/or Reflector	The user may add an optional cover for product style and attachment requirements. This cover may attach to the heat sink. It may be part of the fixture external attachment assembly.

Handling

The thermal, mechanical, and electrical aspects of the luminaire are key design challenges.

The LED drive circuit, the SynJet driver circuit, plus other power and control circuits in the luminaire, have typical industry levels of built-in ESD tolerance. However, unusual environmental conditions and handling can create exceptional levels of ESD that could cause damage.

IMPORTANT! Electrostatic Discharge (ESD) is a significant cause of electronic circuit failure. A failure may:

- be immediate
- occur later due to a weakened component
- appear as an early service life failure.

An industry-standard assembly and test area must have proper ESD protected work stations. In addition, the staff must have ESD prevention education.

The SLC electronics require industry-standard care and use of proper ESD protection during assembly and test.

When handling the SLC, use care with the wiring and the circuit card. The SLC is designed for normal assembly operations. With excessive force, the wires and components can be over-stressed and broken.

The SLC plastic housing has been designed to withstand normal assembly forces. Clamping or force fits can create very strong local forces that could damage or weaken the cooler housing, thus creating an early life failure risk.

The SLC contains magnets. Small particles of iron, screws, and other magnetic materials from secondary machining or materials that are loose in the assembly area may be attracted to the housing or the PCBA. They could interfere with performance or cause a failure. Process steps should be included to be sure any particles are removed after machining. Similarly, the assembly work area should be free of magnetic particles.

To prevent ESD or mechanical force induced failures; integrate precautions in the design process for handling, assembly, testing, and shipment packaging of the final product.

Chapter 2
Thermal Design

This section discusses thermal design considerations for SLC luminaire design. The thermal designs illustrated within this section are reference examples for the lighting designer. These models are to demonstrate common spot light applications and possible use cases. Most important to note are the inlet and outlet vents to provide the maximum cooling performance, even in restricted flow conditions.

The SLC generates turbulent pulses of air which efficiently dissipate heat from any surface. The LEDs are mounted on the face of the heat sink and the heat spreads to the fins where the turbulent pulses along with the entrained air flow created by the SynJet Spot Light Cooler dissipate the heat to the surrounding air.

The SLC comes with a standard heat sink and its design has been tested and qualified.

SynJet Spot Light Cooler Airflow

SLC airflow is generated from a ring of rectangular nozzles that are directed at the channels between the heat sink fins shown in the following figure.

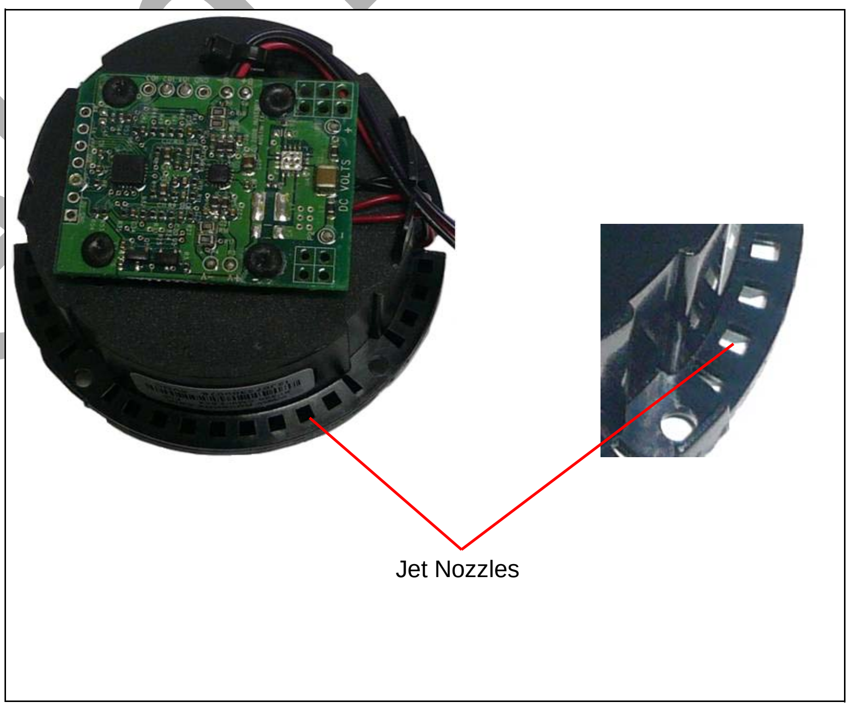


Figure 3: SynJet Spot Light Cooler Nozzles

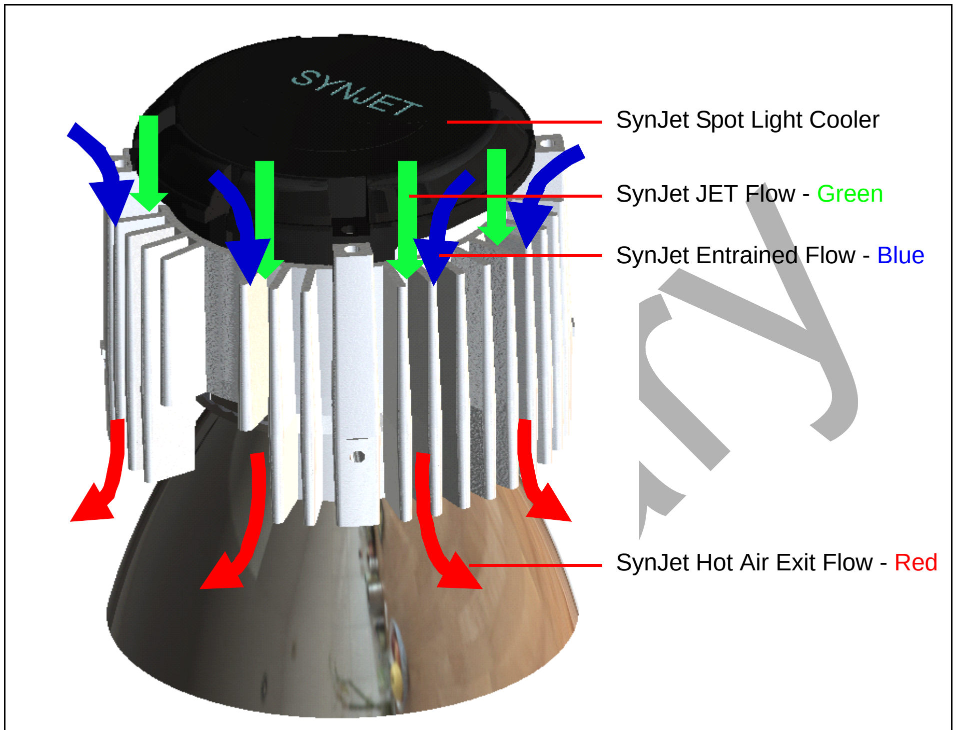


Figure 4: SynJet Spot Light Cooler Air Flow

The SLC nozzles:

- provide for air intake and for exhaust
- create synthetic jets

Figure 4 illustrates air flow through the SLC and the heat sink. In addition to the flow that is directly created by the SLC jet nozzles (green arrows), air is also entrained (blue arrows) due to the phenomenon known as the jet ejector effect. This is the same effect felt when a large vehicle passes by and air rushes in to follow it. The entrained air adds to the overall flow generated by the SLC. The SLC jets multiply the air flow into the heat sink channels. This increases the amount of cool air mixing with the hot air next to the fin surfaces that has been disturbed by the synthetic jet turbulent pulse. The hot air (red arrows) flows out of the luminaire and mixes with the room air.

These actions significantly improve heat transfer from the fins to the ambient air. If the SLC operates in free air with no flow restrictions, the best thermal performance is achieved.

Chapter 1 describes the five SynJet Spot Light Coolers. Each has been optimized for specific cooling, acoustics, and power requirements. These alternatives give the designer additional flexibility. The following sections discuss several design constraints and examples.

Unrestricted Flow

The following figures show examples of unrestricted air flow to and from the SLC.

Example 1: Open Air Track Fixture

Figure 5 shows an example of the SLC with heat sink and reflector element in an Open Air Track Fixture. The SynJet pulses create entrained flow between the heat sink fins and hot exit air is exhausted along the outer surface of the reflector shell. The entire flow path has no restrictions. This example shows one of the most effective thermal solution configurations because there is no cylindrical can or other flow limiting structure next to the entrainment or exit flow paths. Since the reflector fits within the heat sink diameter it does not block exit flow.

Figure 5: SynJet Spot Light Cooler with Reflector - Track Fixture

Example 2: Pendant Light

Figure 6 shows the SLC with heat sink in a pendant light design. In this design the flow is also unrestricted.

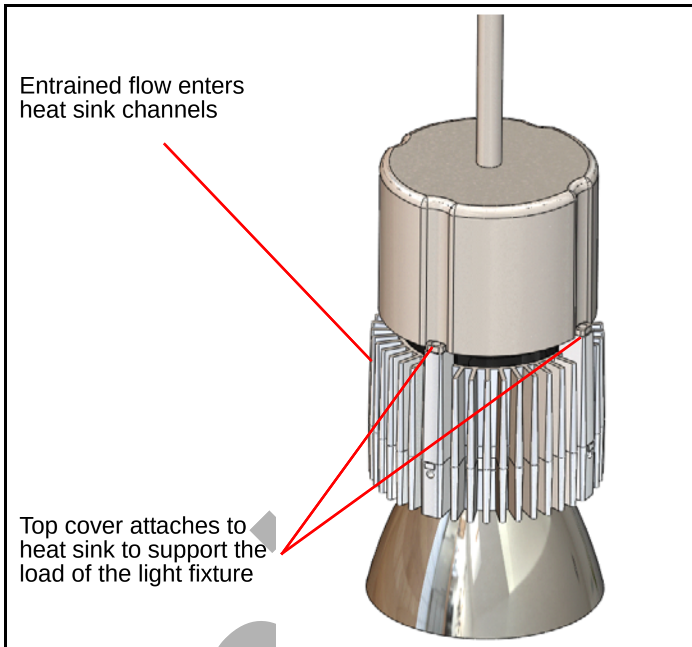


Figure 6: SynJet Spot Light Cooler - Pendant Light

Restricted Flow

As discussed in *SynJet Spot Light Cooler Airflow* on page 9, the SLC creates significant additional flow from entraining ambient air. If the SLC is installed in restricted flow areas, thermal performance could degrade. Generally, the design should not block the inlet flow of air to be entrained along its path to the heat sink channels and the jet nozzles. Likewise, the heat sink fin exit channel openings and the flow path to the room ambient air should not be obstructed.

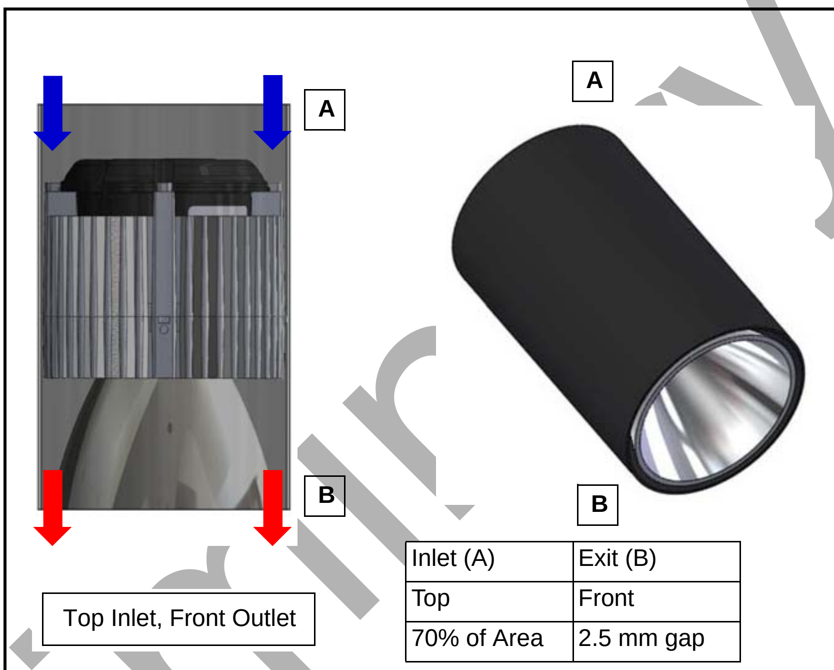
Mounting structures or trim rings can create flow blockages, so the design of a luminaire to heat sink support structure and possible trim ring should be evaluated for air flow interference.

Usually, testing a physical model is required to determine the actual performance. The SynJet Spot Light Cooler, High Performance model is recommended for these applications.

In the following several figures, the user has added a cylindrical cover to the outside of the SynJet cooler and heat sink. Each figure shows flow restriction, but it also indicates the inflow and exit flow path openings to provide necessary cooling air flow. These are intended to be representative examples of several design options. The luminaire designer may select others based on styling and other considerations. Design concepts should be reviewed early in the process with Nuventix Sales/Applications engineering for thermal cooling performance.

Case 1:

In Figure 7, an enclosing cylinder has been added to surround the SynJet/heat sink and lighting assembly. The cover has openings [A] in the top end and there is an open space [B] between the reflector perimeter and the can perimeter at the light output end. The entrained air can enter through the top openings, flow through the heat sink fins, and exit through the open ring. The entrance flow and exit flow are parallel to the light exit path.

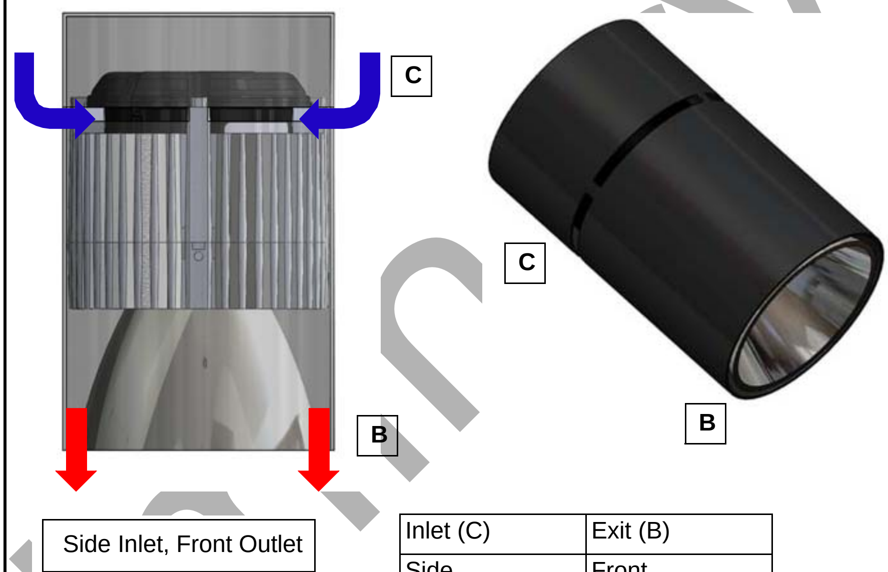


Inlet (A)	Exit (B)
Top	Front
70% of Area	2.5 mm gap

Figure 7: Restricted Airflow - Case 1

Case 2:

In Figure 8, an enclosing cylinder has been added to surround the SynJet/heat sink and lighting assembly. The cover has openings [C] in the upper portion of the side of the cylinder just above the upper edge of the heat sink fins and the area where the jets enter the fin channels. These openings provide the entrained air intake. There is an open space [B] between the reflector perimeter and the cover perimeter at the light output end. The entrained air can enter through the cylinder upper side openings, flow through the heat sink fins, and exit through the open ring. The exit flow is parallel to the light exit path.

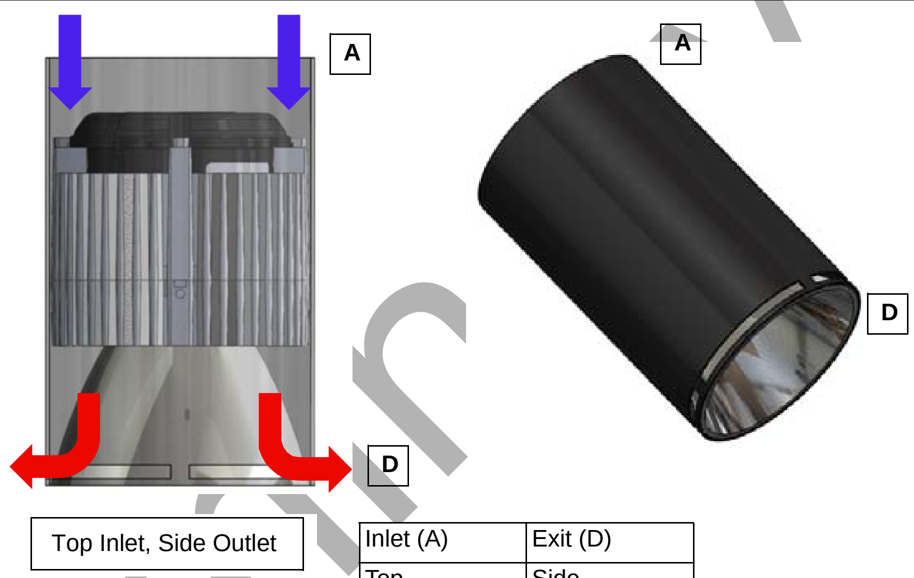


Inlet (C)	Exit (B)
Side	Front
10 mm ring gap	2.5 mm gap

Figure 8: Restricted Airflow - Case 2

Case 3:

In Figure 9, an enclosing cylinder has been added to surround the SynJet/heat sink and lighting assembly. The can has openings [A] in the top end. These openings provide the entrained air intake. It flows through the heat sink fins, and exit through the lower row [D] of side openings. The exit flow is deflected by the reflector and exits through the side openings at an angle to the light exit path. This option could be used if the designer prefers to completely block the front of the light with a glass plate, decorative element, etc.

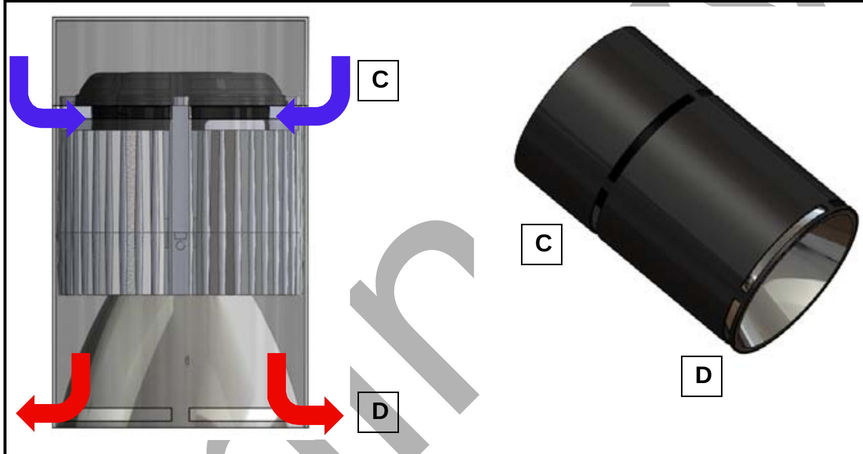


Inlet (A)	Exit (D)
Top	Side
70% of Area	3 mm ring gap

Figure 9: Restricted Airflow - Case 3

Case 4:

In Figure 10, an enclosing cylinder has been added to surround the SynJet/heat sink and lighting assembly. The cover has openings [C] in the upper portion of the side of the cylinder just above the upper edge of the heat sink fins and the area where the jets enter the fin channels. These openings provide the entrained air intake. There is another row [D] of openings in the cylinder surface near the light exit end of the cylinder. The entrained air can enter through the cylinder upper side openings, flow through the heat sink fins, and exit through the lower openings. The exit flow is deflected by the reflector and exits through the side openings at an angle to the light exit path.



Side Inlet, Side Outlet

Inlet (C)	Exit (D)
Side	Side
10 mm ring gap	3 mm ring gap

Figure 10: Restricted Airflow - Case 4

In the four examples above, each had one inlet area and one exit area to provide the necessary open cross-section area. Other luminaire designer options could include a combination of area choices, such as inlet area, half from the top and half from the side. The example figures show rectangular shaped openings. The designer may select other shapes, such as circles, tear-drops, or spirals. A review of the planned opening geometries and their locations with Nuventix Sales/Applications Engineering is recommended.

Luminaire Design Concepts

The following section displays a range of reference designs to illustrate how the Spot Light incorporating a SynJet could appear as a finished luminaire.

NOTE: These examples are models only and not actual manufactured lights.

Design Example 1

The following contemporary lamp style (Figure 11) allows for a highly enclosed form factor with entrance and exit flow parallel to the light exit path as shown in *Case 1:* on page 13. Suitable for track lighting applications, this assembly is extremely versatile and ideal for restricted flow environments.

Figure 11: Design Example 1

Design Example 2

This modern luminaire style (Figure 12) allows for minimal venting to enable entrance flow from the sides with exit flow parallel to the light as shown in *Case 2:* on page 14. Fitting for contemporary track and pendant lighting applications, this classic assembly is well-suited for commercial and retail environments.

Figure 12: Design Example 2

Design Example 3

This sleek industrial luminaire style (Figure 13) allows for air flow from the back with exit flow out the sides as shown in *Case 3:* on page 15. This assembly is ideal if the lamp design requires a glass plate or decorative element to cover the front of the light.

Figure 13: Design Example 3

Design Example 4

This refined luminaire style (Figure 14) allows for a diversity of form factors with both the entrance air and exit able to flow from the sides as shown in *Case 4:* on page 16. A classic track and pendant lighting form factor, this assembly showcases the luminaire design with minimum component exposure.

Figure 14: Design Example 4

Thermal Interface Material (TIM)

The thermal design discussion to this point has focused on improving forced-convection air flow to transfer heat from the heat sink to the ambient air. Also important is good conduction of heat from the LED to the heat sink. TIM is a critical component of the design and there are several choices available to the designer:

- thermal grease
- paste
- thermal epoxy
- thermal pads, etc.

Selection depends on the LED/heat sink attachment design and planned assembly process. Refer to *LED Mounting* on page 23 in this document for additional information.

Because applications using the SLC vary widely, Nuventix does not specify a TIM. Nuventix Sales can provide suggestions and consultation regarding your unique implementation.

It is the customer's responsibility for final selection of the material and verification of its effectiveness.

Design Consultation and Support

Nuventix Thermal/Mechanical Applications Engineers are available to review the SynJet Spot Light Cooler's thermal and mechanical integration into luminaire concept designs. The review can also include:

- thermal performance testing plan and preliminary data
- acoustic testing plan and preliminary data
- SLC air flow and entrainment optimization

SLC design and optimization is significantly different from traditional fan cooling or passive cooling designs. To maximize the benefits of SLC cooling, Nuventix recommends a joint consultation and review early in the luminaire design concept development stage. This consultation should include the luminaire design team and Nuventix Applications Engineering.

To achieve the best cooling solution, a custom modification to the SLC or to the heat sink may be desirable. Nuventix can provide optional custom design services. Specifications, costs, and timing are subject to mutual agreement. Please contact Nuventix Sales.

Chapter 3
Acoustic Design

This section discusses acoustic considerations for your SLC installation.

The SLC and heat sink design has been optimized for maximum cooling and near silent operation.

Customer-added features such as housings, reflectors, ducting, attachment structures, etc. may change the acoustic performance. These features can also change the cooling performance as discussed in Chapter 2 *Thermal Design*.

When air flow is forced to change velocity, direction, or pressure; then the local disturbance creates acoustic artifacts. The following are some examples of features that increase acoustic air flow noise and vibration.

- Narrow ducts or flow constrictions.

  The velocity increases and then decreases. Local turbulences can be created. This produces forces on walls and support structures that can cause vibration. Each of these can be the source of acoustic wave (noise) creation.

- Ducting or a cowling placed closely along or surrounding the heat sink.

  Constriction and vibration issues similar to those described for narrow ducts or flow constrictions. If the ducting or cowling is close fitting, this creates additional noise.

- Sharp turns in the flow path.

  Disrupted, uneven flow causes additional noise.

- Obstructions in the flow path such as posts, fins, dividers.

  Obstructions can produce local turbulences and acoustics.

- Loosely attached items, deflectors, metal or plastic tabs, wiring, that may vibrate in the flow.

  Additionally, the loose item may hit another part of the assembly which adds to noise generation.

- Delicate support structures that do not hold the assembly firmly.

To obtain the best acoustic performance, these considerations along with standard engineering practices should be followed. Building mechanical models of the design and measuring acoustic and cooling performance is recommended. Nuventix Sales can provide suggestions and consultation.

Chapter 4
Mechanical Design

This chapter discusses mechanical design considerations for the SLC and LED luminaire product and its installation. Refer to the SynJet Spot Light Cooler 2D Drawings for dimensions, sub-assembly views, tapped hole positions, and screw sizes.

LED Mounting

This section provides information on connecting the SLC with heat sink to an LED or LED array.

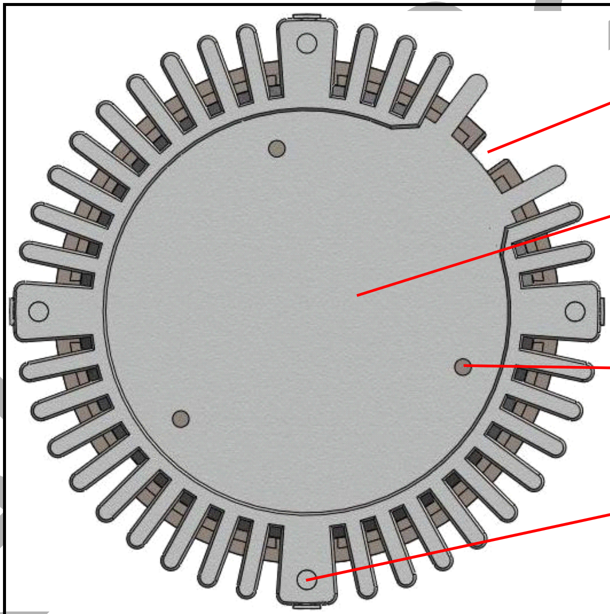


Figure 15: LED Mounting

Mounting Surface for LEDs

To mount an LED array or MCPCB to the SLC, the inner center of the heat sink has a flat surface area as shown in the figure above. The LED array is attached to this surface. This surface is machined and provides a flat surface to make good thermal contact with the LED MCPCB or other mounting board. Standard mounting options for various LED hole patterns are available. Nuventix can add custom hole patterns. Requests for custom holes should be reviewed with Nuventix Sales. Refer to the 2D Mechanical Drawings for details. TIM should be used to provide better heat transfer between MCPCB and heat sink.

The customer may perform a secondary machining operation to add features to the mounting surface (such as additional threaded holes) since it is difficult to anticipate all the applications. The customer may alternatively choose to use a thermal epoxy method.

Reflector Mounting

The SLC cooler heat sink is designed to accommodate various styles and shapes of reflectors. However, the design of the heat sink does limit the diameter of the reflector at the heat sink exit. Also, the maximum reflector diameter should be kept below 70 mm to allow for proper airflow in restricted flow conditions, where the air is exiting the front of the assembly. See Figure 16 and refer to the 2D Mechanical Drawings for additional details.

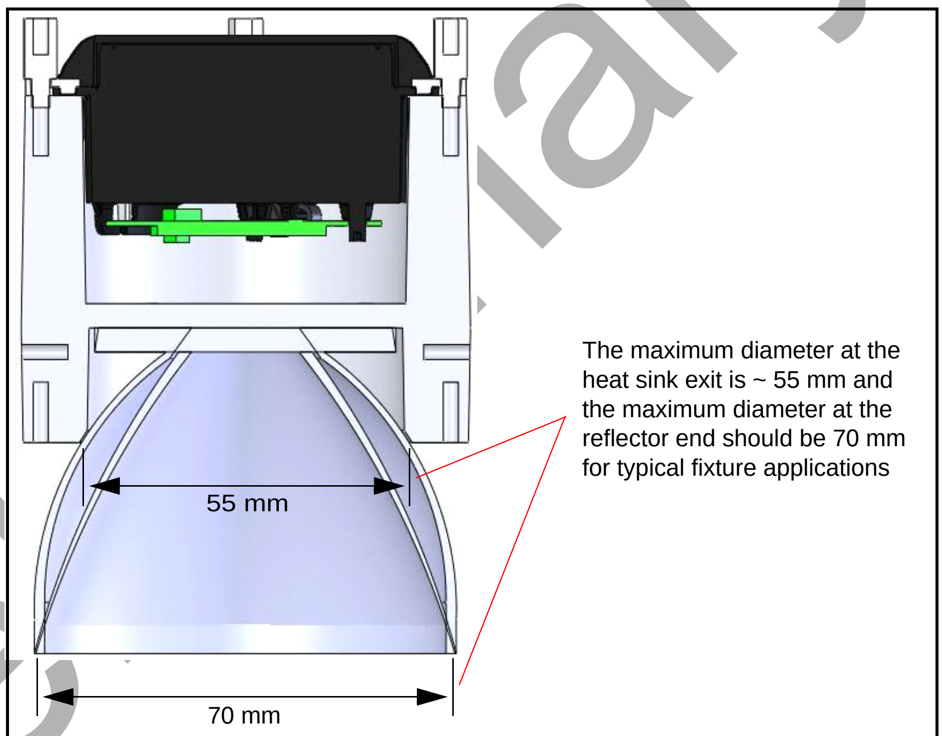


Figure 16: Reflector Size

Power Wire Routing for LEDs and SynJet

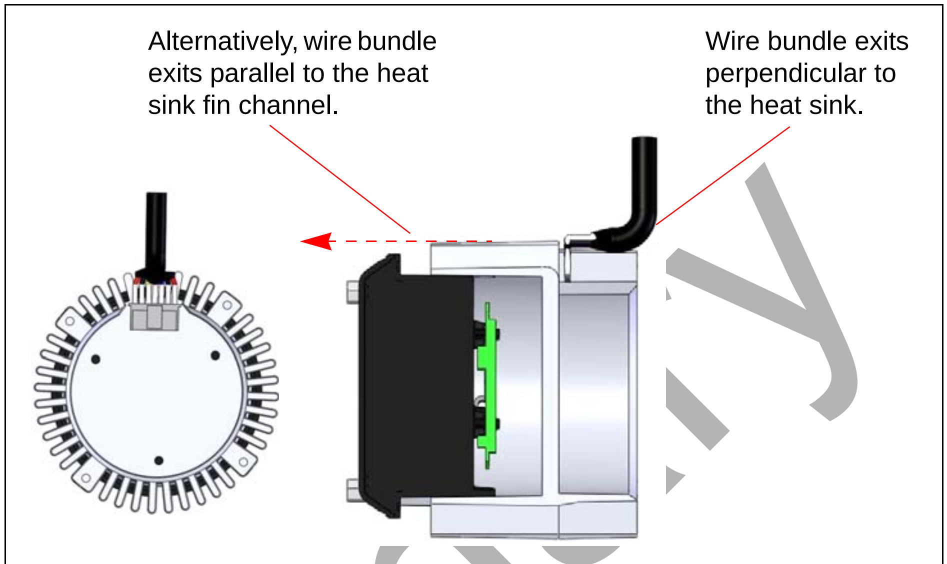


Figure 17: Wire Routing

The SLC heat sink has a clearance slot between the wide fin attachment points. This allows power wires from the LEDs and the power wires plus the control wire from the SynJet Driver Card to be placed in the channel to route to the exit point and then to the external power sources. The figure above shows the exit points and wire routing. The wire bundle can be routed to exit perpendicular to the heat sink fins, or it can be routed to exit upward past the cooler.

SynJet Spot Light Cooler Attachment to Heat Sink

This section discusses attachment of the heat sink to the SLC.

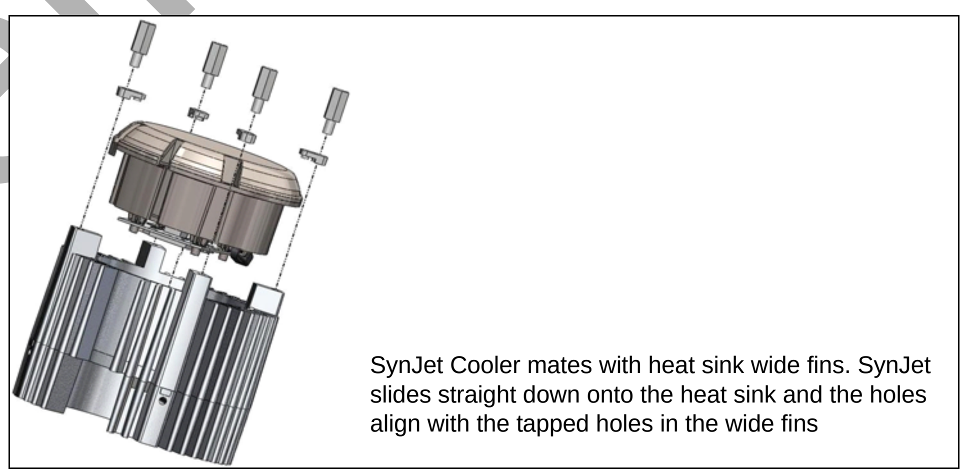


Figure 18: SynJet SLC and Heat Sink Assembly

The rim of the cooler has four holes that can be aligned with the tapped holes in the four flat areas on the wide fins on the heat sink. The alignment should also be checked for proper wire exit routing. The four standoff screws used for attachment should have Loctite 222 MS applied to the threads to assure a tight fit for the life of the luminaire. They should be tightened to a torque value of 0.45 N-m (4 inch-lbs) ± 10%. Refer to the SynJet Spot Light Cooler 2D Drawings for dimensions, sub-assembly views, tapped hole positions, retainer washer details, and screw sizes.

Heat Sink Attachment to Luminaire

The SLC with heat sink can be attached to the Luminaire by using the optional tapped holes in the ends of the wide heat sink fins. As shown in the figure below, four optional tapped holes, parallel to the light exit path, are available at the light exit end of the heat sink (D). Another four tapped holes are located in the other end of each wide fin (A). Their direction is also parallel to the light path.

The designer can use these points for attachment to the rest of the luminaire, such as the cylindrical can or the track fixture shown in figures in Chapter 2 Thermal Design.

The tapped holes in the light exit end of the heat sink may also be used to hold a reflector or optical element in place.

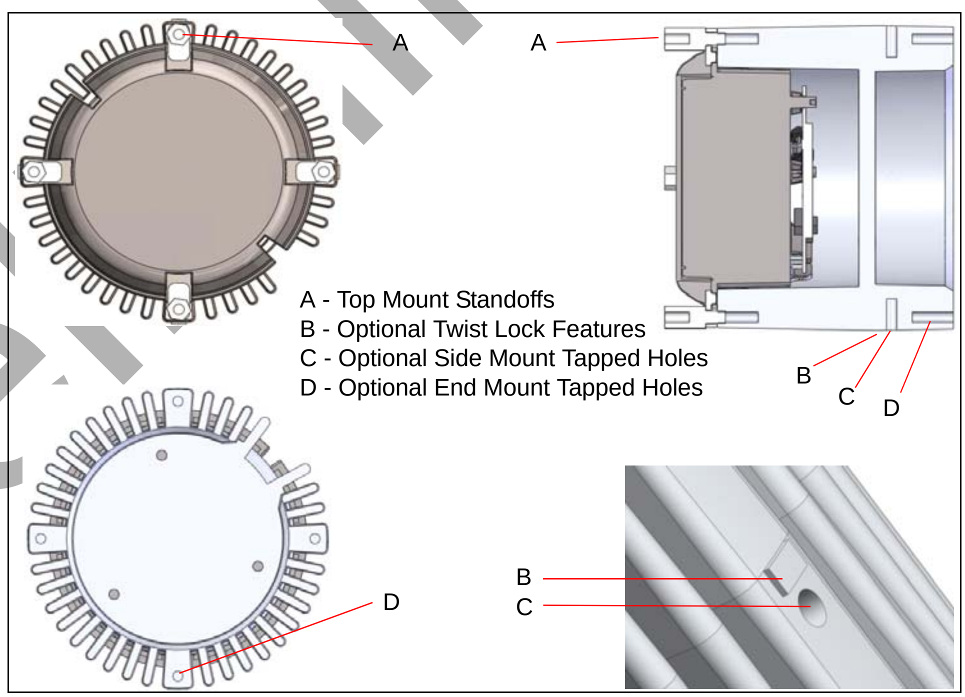


Figure 19: Attachments Points

Another mounting option for attaching the cover to the heat sink is to use the protrusions on the heat sink as part of a twist lock attachment (B). The cover must have the mating grooves designed in properly to align and mate with the optional protrusions from the heat sink, but when designed properly this option offers an assembly that minimizes or eliminates the fasteners. See the figures below for additional details. Also refer to the 2D Mechanical Drawings.

A third perimeter row of four optional tapped hole is located mid way along the heat sink fins (C).

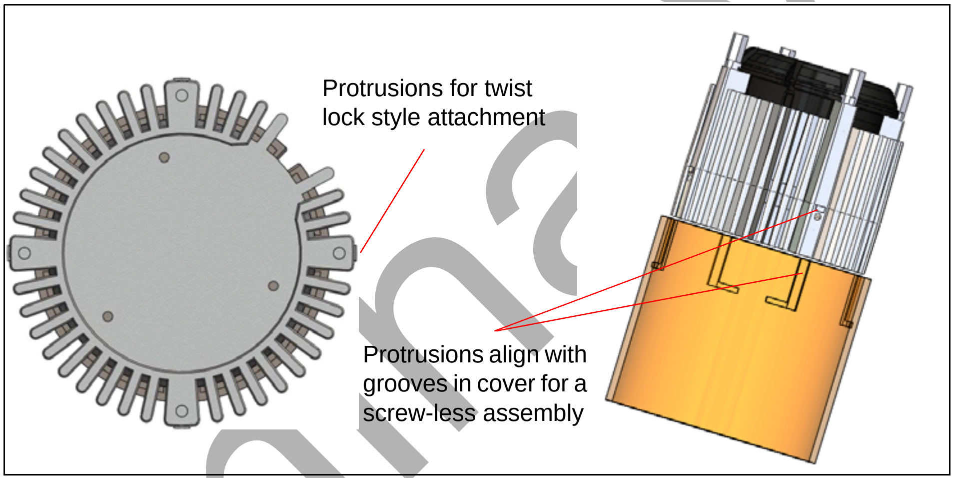


Figure 20: Twist Lock Feature

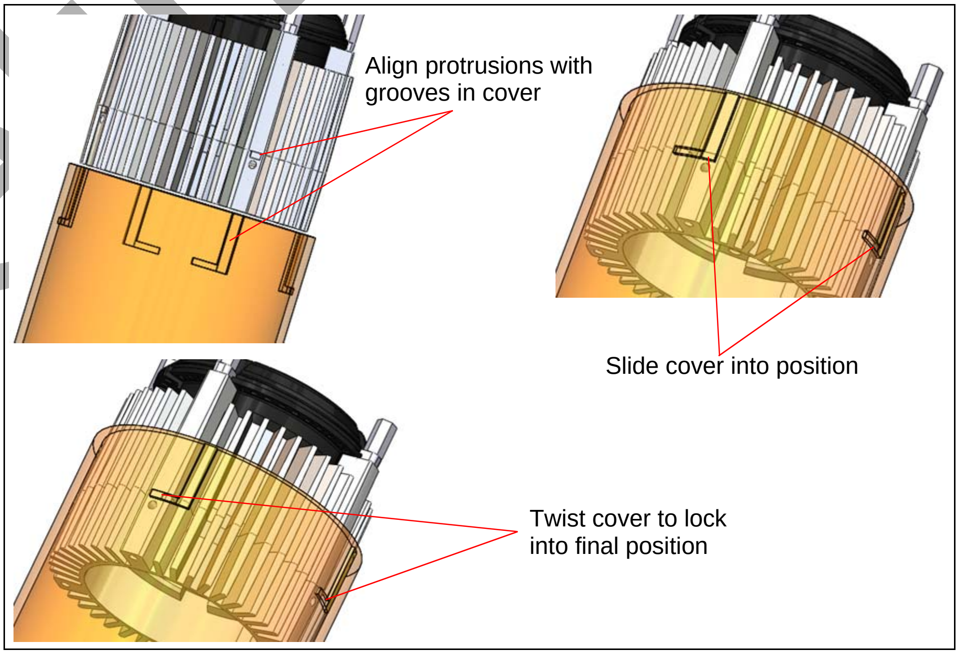


Figure 21: Twist Lock Assembly

Integrating the SynJet Spot Light Cooler with a Customer-Designed Heat Sink

This section outlines considerations when planning to integrate the SLC with a customer-designed heat sink.

The standard SLC heat sink is optimized for maximum effectiveness. Review the heat sink design, and all design comments in this document, before developing your custom designs. Review the 3D CAD Model and the 2D Drawings for actual dimensions and design details of the SLC with heat sink.

IMPORTANT! The SynJet air flow with the synthetic jets and entrainment is not the same as a traditional fan's air flow. Traditional fan or passive cooling design practices do not necessarily apply. Additionally, it is important to review the custom design concept with Nuventix Sales early in the process.

Nuventix strongly recommends an early joint concept review with the luminaire design team and Nuventix Sales/ Applications Engineering to achieve the best cooling solution with minimal design iteration.

Chapter 5
Electrical Design

This chapter discusses electrical considerations for SLC installation.

Requirements

The following table summarizes electrical specifications from the *SynJet Spot Light Cooler with Heat Sink Product Specification*.

Table 2: Electrical Requirements

	Voltage, VDC			Ripple	Current, mA		Power, W
Configuration	Nominal	Min	Max		Min	Max	Avg
High Performance	5	4.75	5.25	150 mv	10	160	1.0
Standard					10	80	0.5
Silent					10	40	0.3
High Performance	12	10.8	13.2		10	200	1.2
Standard					10	100	0.6
Silent					10	67	0.4

LEDs are typically driven using a constant-current source, but the SLC requires a constant-voltage source. Driving the SLC with a constant-current source can cause the input voltage to rise above the maximum allowed value, damaging the SLC electronics and voiding the warranty.

If the voltage source has current overload limiting built in, the level should be set above the maximum current noted in Table 2.

Current Waveform

The SLC current waveform is sinusoidal and varies between the minimum and maximum specifications shown in Table 2. This waveform is a sine wave, typically 80 to 160 Hz, with a DC offset. The power source must handle this load variation and remain within specification.

For example, the SynJet SPOT LED LIGHT (12V Standard Model) Cooler requires an average power of 0.6 watts from the power source. This load varies from 0.120 watts (12v x 10 ma) to about 1.2 watts (12v x 100 ma). This short term peak cyclic load means the short term power required from the source is twice the average as shown in Table 2.

When power is switched on, it also must supply sufficient current to charge input capacitance (22 µF typical) to 5 or 12 Vdc in 10 µsec to 10 msec.

For the most efficient conversion to 5 or 12 Vdc, the power source selected is often a switching regulator. Attention should be given to verification of its proper operation over the minimum to maximum current load conditions to avoid voltage regulation and EMI problems.

If the electrical design includes LED drive current circuits and SynJet voltage regulator circuits on the same PCBA, then the layout should include standard analog design practices including separation of the grounds and signal traces.

Connection Specifications

The SLC comes with two input power leads. The total wire run length from the source to the SLC PCBA should not exceed the length specified in Table 3. For total wire lengths beyond this, consult with Nuventix Sales.

Carefully review wire routing design and check for sources of noise coupling to see if additional filter circuitry is needed to ensure reliable operation.

Do not subject the SLC to voltage spikes greater than a 14-V peak (12 V plus 2 V spike) for the 12-V and 6-V (5 V plus 1 V spike) for the 5 V. A filter/snubber may be needed when using electromechanical contacts to switch power on or off to the SLC to keep the voltage spikes at or below the specified limit.

The SLC meets applicable international specifications for EMI (radiated, conducted, and susceptibility) when properly installed. Keep the power wiring as short as possible to avoid the creation of potential problems. Refer to the *SynJet Spot Light Cooler with Heat Sink Product Specification* for a list of applicable certifications met.

Table 3, Power and Control Wiring Specifications, provides details for the wiring. The SLC comes with two input power wires and one control wire. The length includes 10 mm of the wire stripped and tinned at the end.

Table 3: Power and Control Wiring Specification

	VDC	Gnd	Control	Overall Length	AWG (Stranded)	Wire Diameter
Power and Control	Red	Black	Blue	600 mm	26	1.02 (±0.04) mm
	Red	Black	Blue	240 mm	26	1.02 (±0.04) mm

Disclaimer/Warranty

Customers are responsible for testing products for their unique applications. Any information furnished by Nuventix and its agents is believed to be accurate and reliable. However, since every potential application cannot be anticipated, Nuventix makes no warranties as to the fitness, merchantability, or suitability of any Nuventix products for any specific or general uses. Nuventix shall not be liable for incidental or consequential damages of any kind.

Contact Nuventix

Nuventix Inc.
4635 Boston Lane
Austin, TX 78735
512-382-8100 (phone)
512-382-8101 (fax)
www.nuventix.com

For company and product information:
info@nuventix.com

For sales information:
sales@nuventix.com

NUVENTIX