violumas
High Power UV LED Solutions

Boston Electronics

Violumas Services

2024

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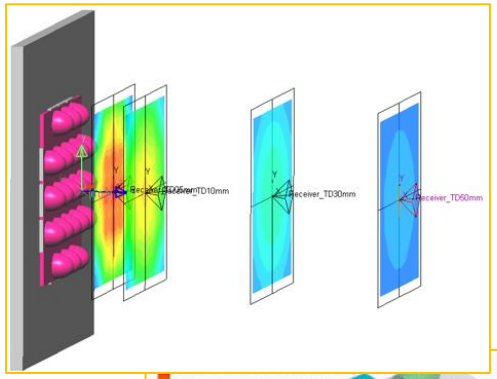
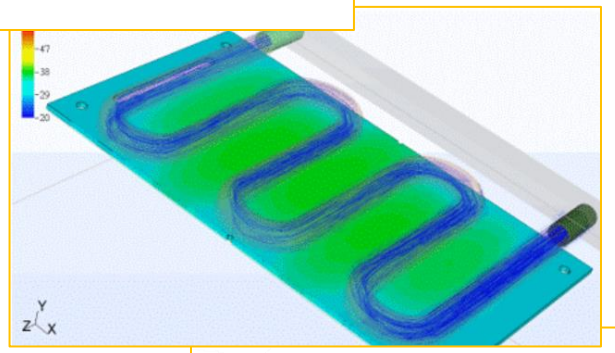
UV LED Services & Expertise

- Optical Simulation & Design
  - Optical modeling & design using industry standard software to optimize LED count, array layout, and optics
  - Integration of standard & custom materials with specific transmission, reflection, and scattering profiles

- Thermal Simulation & Design
  - Optimized cooling design for achieving target junction temperatures within overall system
  - CFD analysis for precise modeling of temperature distribution, transfer, airflow, and heat flux
  - Prototyping & high-volume manufacturing of passive, active, or liquid cooling components

- Custom UV LED Solutions
  - Optimization of LED array design with optical design software
  - Multi-wavelength & circuit design capability
  - Prototyping & mass production (including design for manufacturing)
  - Testing with calibrated integrating spheres & radiometric sensors
  - Full module integration with optimized cooling solution, driver selection, and assembly





Optical Simulation & Design

Leverage optical expertise for an efficient, targeted UV LED system.

Optical Simulation & Design

Violumas offers optical simulation & design services for many types of UV LED applications to help ensure you are maximizing efficiency & minimizing the cost of your UV light source.

We use the latest optical simulation software (Zemax and LightTools) to create accurate models of your unique system. CAD models and material characteristics can be incorporated into the model, and custom assemblies can also be accommodated.

Optical design projects can include Violumas standard LED products, alternative suppliers' LED products, or a fully customized solution. We can incorporate off-the-shelf optics or design custom lenses fitted to your unique needs. If you have an existing design, Violumas can also provide recommendations on design improvement from an engineering & costs-saving perspective.

Services are typically charged on an hourly basis and the total number of hours will depend on the complexity of your project.* Deliverables include an optical simulation report which would include the necessary analyses & results, as well as any applicable design and drawings files (e.g., custom developments).

A non-disclosure agreement (NDA) can be signed if required to protect the confidentiality of your project.

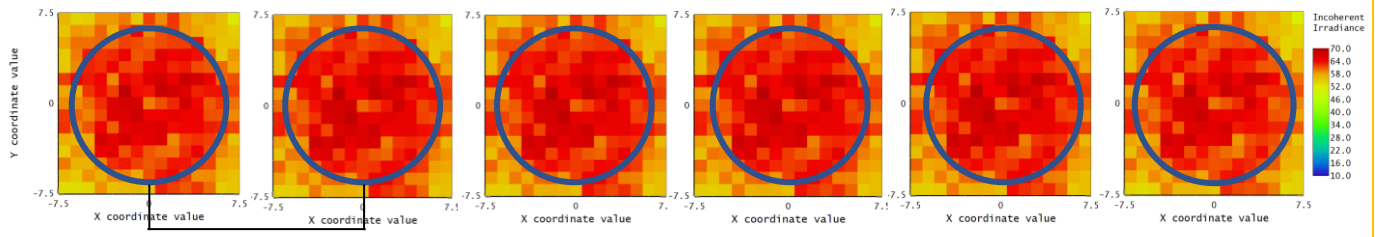
**For new customers, several hours of complimentary services or a preliminary optical simulation report may be provided free of charge.*

Optical Simulation Example

- Application: Disinfection efficacy testing with inoculated coupons
- Goal: Determining optimal Violumas LEDs and throw distance to achieve specific dosage level (>500mJ/cm^2)
- Deliverables:
  - Recommended Violumas LEDs
  - Optimal LED spacing & arrangement
  - Optimal throw distance
  - Achievable intensity & uniformity
  - Required exposure time

Irradiance (Center Coupon)	Value	Unit
Maximum	70.1	mW/cm^2
Minimum	58.2	mW/cm^2
Average	62.7	mW/cm^2
Uniformity (Ave/Max)	91	%
Uniformity (Min/Max)	83	%

Irradiance (Edge Coupon)	Value	Unit
Maximum	69.5	mW/cm^2
Minimum	57.7	mW/cm^2
Average	62.8	mW/cm^2
Uniformity (Ave/Max)	90	%
Uniformity (Min/Max)	83	%

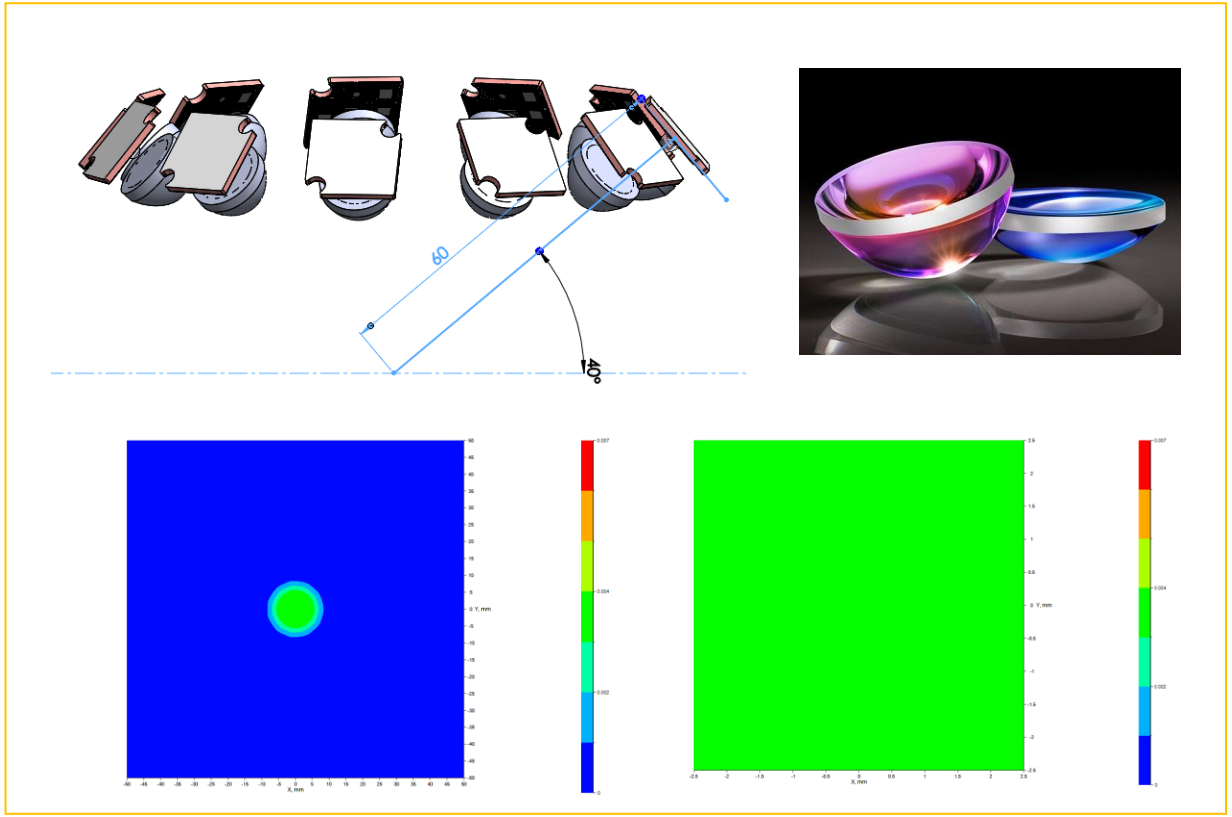


60mm Center Coupon Edge Coupon

Disclaimer: Results shown are provided as an example only.

Optical Simulation Example

- Application: Multi-LED, focused illumination on small spot size (5mm^2) with secondary optics
- Goal: Determining optimal aspheric lens + Violumas LED to achieve minimum intensity & uniformity (0.3W/cm^2; >95%)
- Deliverables:
  - Recommended aspheric lens type & optimal placement of secondary optics
  - Recommended Violumas LED
  - Optimal LED count & arrangement
  - Achievable intensity & uniformity



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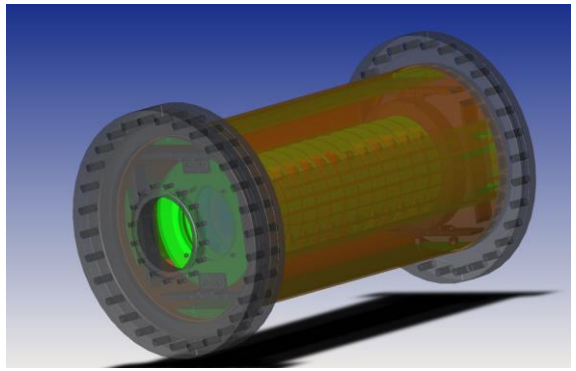
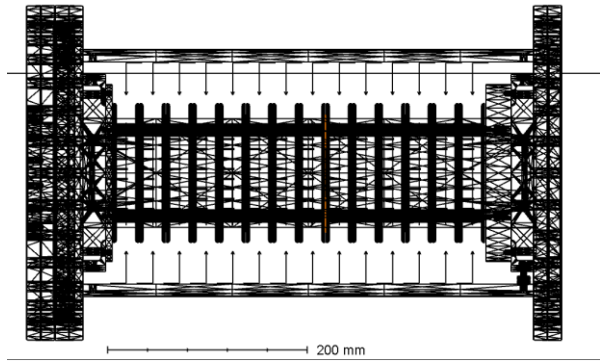
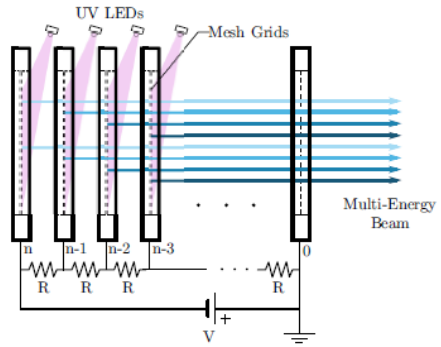
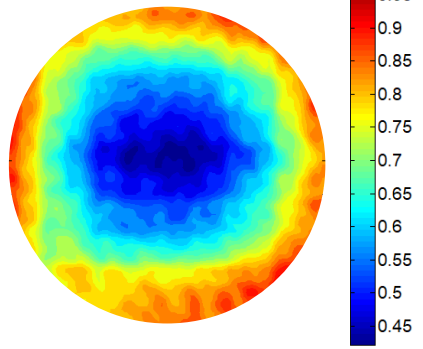
Optical Simulation Example

- Application: Multi-electron gun development with 365nm light
- Goal: Designing custom UV LED array to achieve intensity & uniformity within unique system (0.12W/cm^2; >90%)
- Deliverables:
  - Design of custom LED array (including LED type, beam angle, and spacing) to meet intensity requirements within provided system CAD (material characteristics included)









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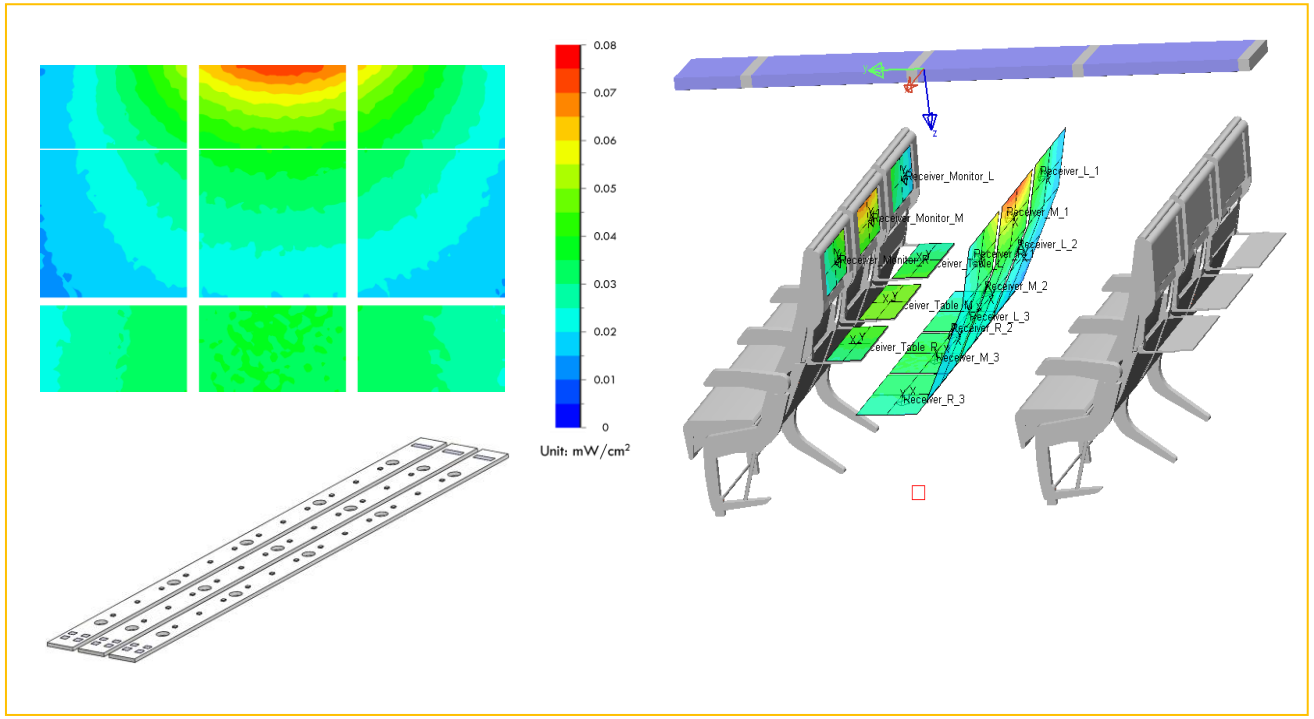
Optical Simulation Example

- Application: Surface disinfection on theater seating (3D surfaces)
- Goal: Determining optimal Violumas LED & beam angle to achieve minimum intensity (1mW/cm^2)
- Deliverables:
  - Recommended Violumas LED product
  - Optimal LED positioning & arrangement
  - Achievable intensity & uniformity on multiple curved surfaces



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Thermal Simulation & Design

Increase UV LED output and lifetimes with proper thermal management.

Thermal Simulation & Design

Thermal management is a critical part of maintaining an efficient and reliable UV LED light source. Violumas offers thermal simulation & design services to optimize cooling efficiency within your overall system.

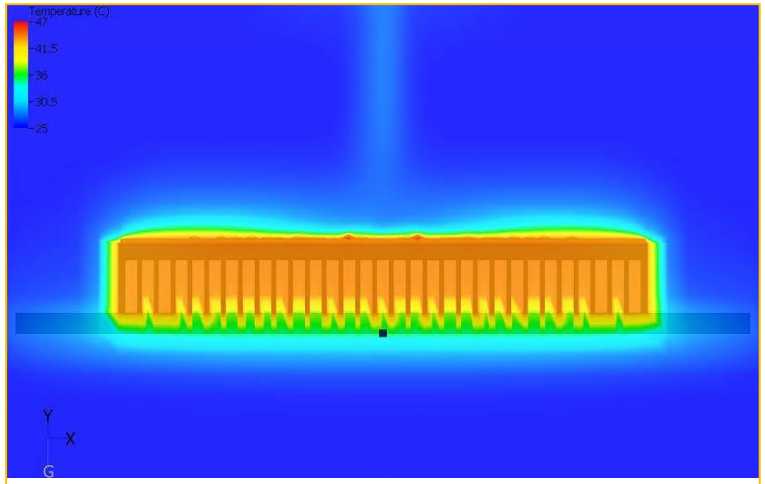
We use the latest thermal simulation software (6SigmaET and Icepak) to create accurate models of your unique system. Submitting CAD models and/or mechanical properties is highly encouraged, as it is important to first define the requirements and constraints for the allowable thermal solution.

While some UV LEDs can be sufficiently cooled with a heatsink or fan-cooled heatsink, other high-power systems will require liquid cooling. Whether you need to validate an existing heatsink or develop a custom cooling solution for your UV LEDs, Violumas can work with you to achieve low LED junction temperatures and ensure temperature stability, thereby extending the lifetime and value of your system.

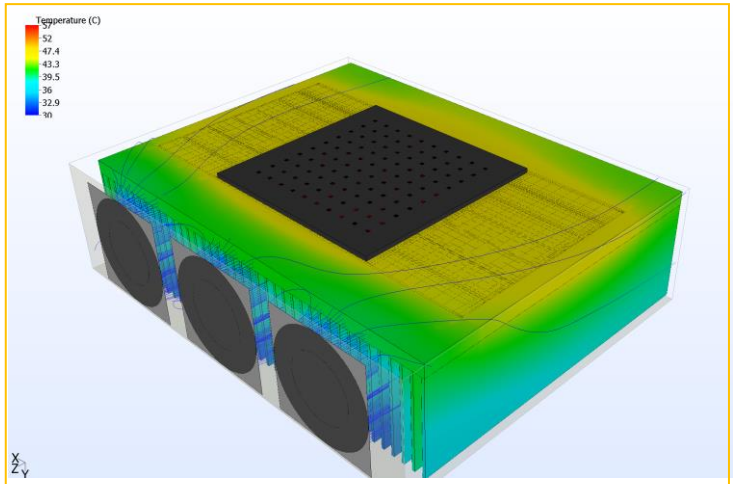
Services are typically charged on an hourly basis and the total number of hours will depend on the complexity of your project. Deliverables include a thermal simulation report which would include the necessary analyses & results, as well as any applicable design and drawings files (e.g., custom developments). Prototyping and volume production of thermal solutions are supported by our sister company Cofan USA.

A non-disclosure agreement (NDA) can be signed if required to protect the confidentiality of your project.

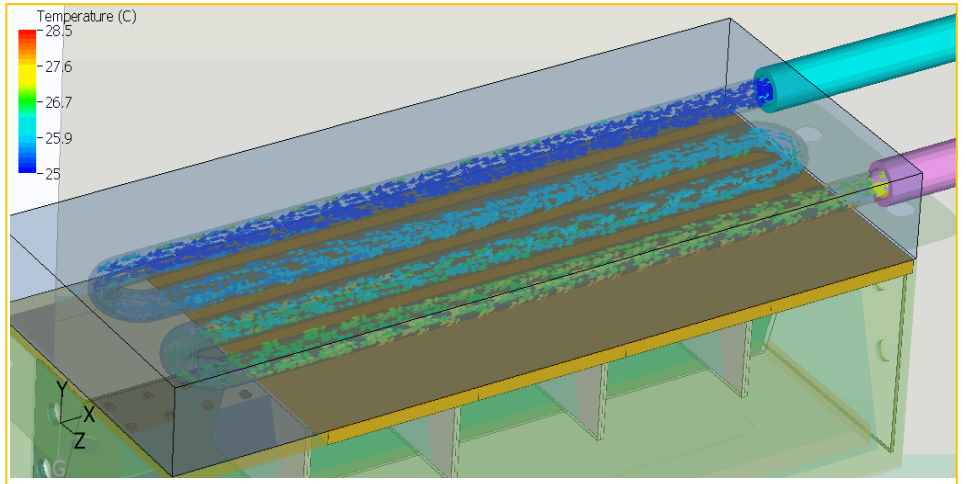
Thermal Simulation Examples



LED Design: 77W 365nm Array
Thermal Load: 26W
Thermal Design: Aluminum heatsink
Max. LED Junction Temperature: <45°C



LED Design: 170W 365nm/385nm Array
Thermal Load: 485W
Thermal Design: Aluminum heatsink & fans
Max. LED Junction Temperature: <72°C



LED Design: 3.3W 265nm Array
Thermal Load: 165W
Thermal Design: Copper cold plate & liquid chiller system
Max. LED Junction Temperature: <58°C

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Custom UV LED Solutions

Achieve application-specific target requirements with a fully integrated solution.

Custom UV LED Solutions

Leveraging Violumas' holistic expertise in optical, thermal, and electrical design, custom UV LED solutions can be provided to meet your exact requirements in various UV applications. As a one-stop-shop solutions provider, we can provide services from consultation to full-scale development of your unique UV LED product.

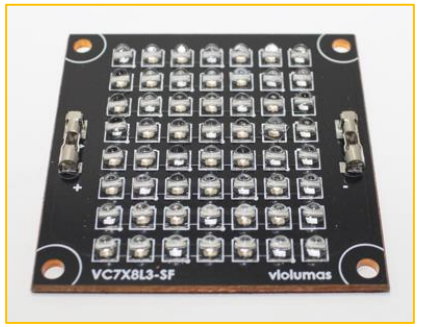
Violumas designs and manufactures custom solutions in-house with specialties in chip-on-board (COB) products, MCPCB design, thermal design, and full module integration including the light source, thermal solution, and power supply. Our expertise and experience allows for development of the most efficient (performance-wise and cost-wise) solutions tailored to your specific application needs.

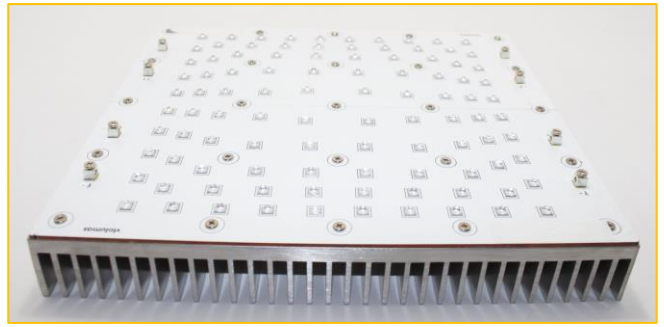
Along with prototyping, Violumas provides assembly and testing services to ensure your evaluations proceed smoothly and that the necessary performance levels are met. On a larger scale, our ISO-certified facilities can serve as an OEM and support volume production along with ongoing technical support.

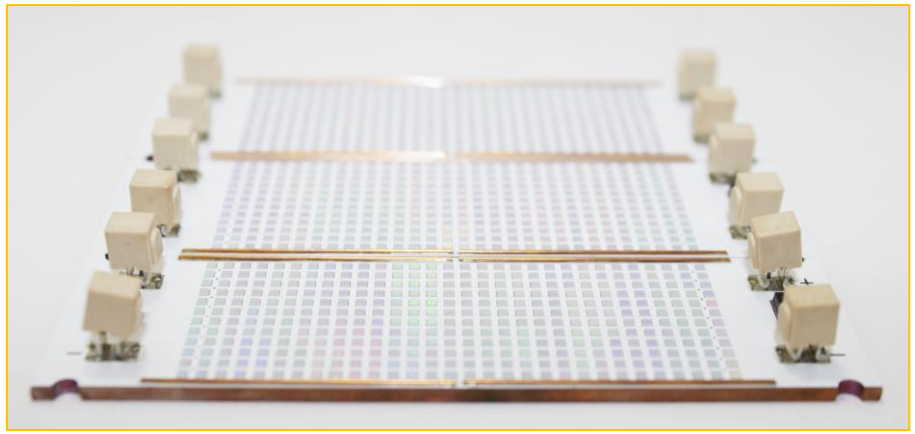
Custom UV LED Solutions

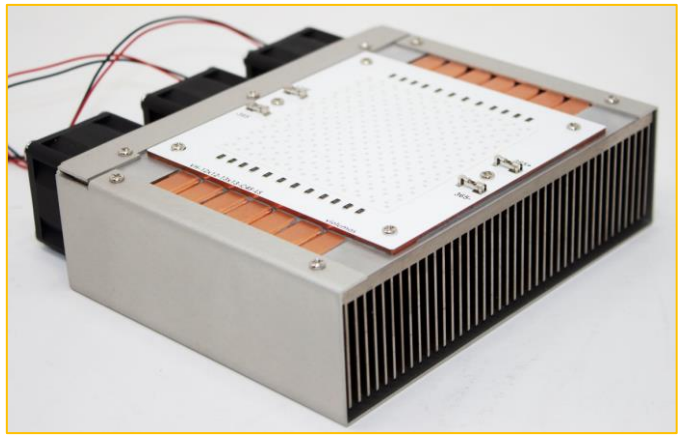
Violumas supports:

- Multi-wavelength & multi-circuit designs
- High-density & high-intensity designs
- Specialized optics
- Unique geometries and form factors
- Integration of specified electrical components (e.g., thermistors, connectors, ESD protection devices) as well as and visible or IR LEDs









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The Process

Violumas collects target requirements such as:
- Wavelength(s)
- Irradiance Target
- Illumination Area
- Throw Distance
- Uniformity Target
- CAD Model and/or System Details
- Mechanical Constraints

Additional requested information may involve:
- NDA Contract
- Project Budget
- Target Timeline

Violumas prepares work order & proposal for optical simulation & design.
- Once the work order is approved, optical simulation & design reports will be provided as a charged service.
- Preliminary reports may be provided free-of-charge (case by case basis).
- This process may be iterative with several simulation & design phases.

Typical Lead Time: 1-3 weeks

Development of confirmed optical design is initiated.
- Based on the optical design, final drawings will be prepared for manufacturing purposes.
- If needed, custom cooling solution development would initiate once LED design is completed (additional lead time of 1-2 weeks).

Typical Lead Time: 1 week

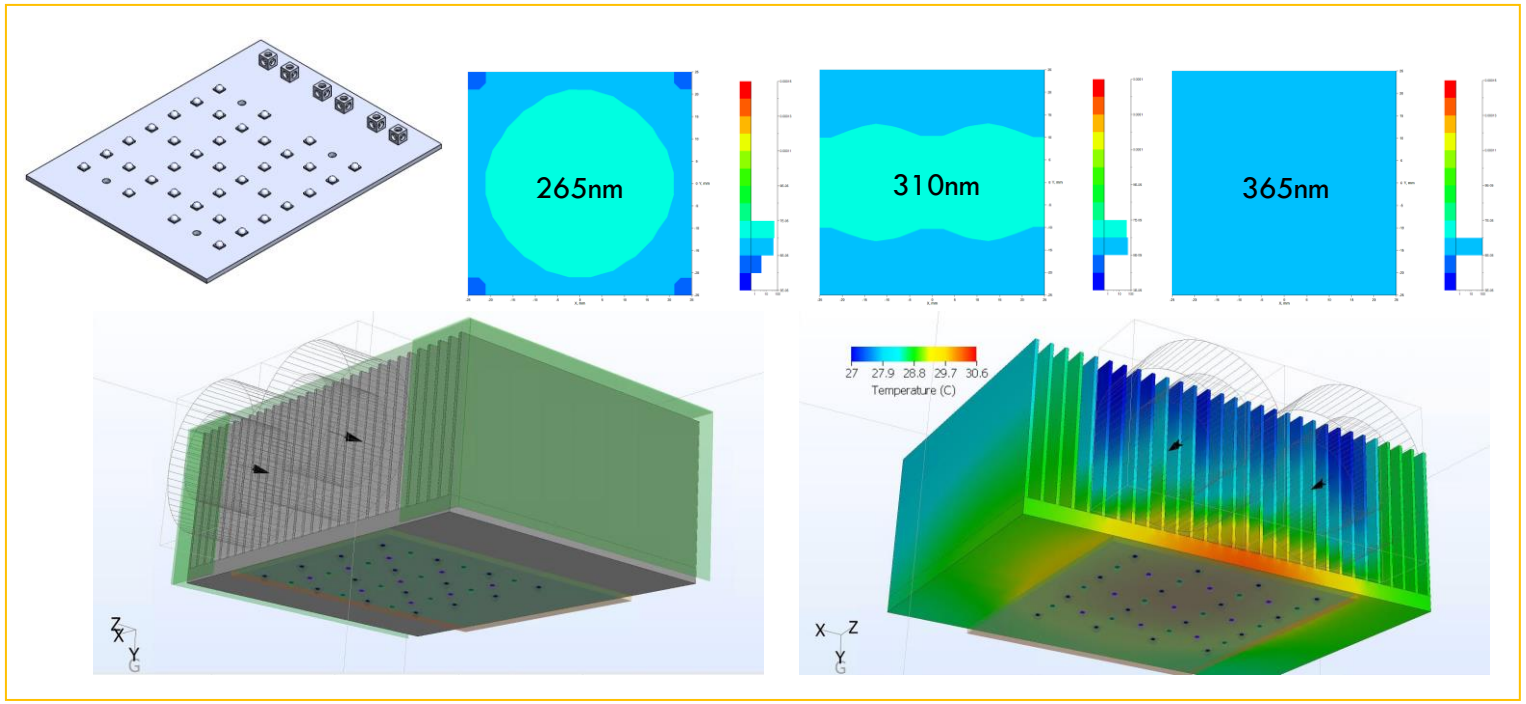
Prototyping of sample units begins after the final drawings & designs are confirmed.
- Prototyping charges will be applied as a one-time fee for low quantity sampling.
- PSU recommendation may be provided.
- Assembly & testing services can be provided

Typical Lead Time: 6-8 weeks

Violumas provides volume production and ongoing technical support.
- The Violumas team will be available to provide any necessary technical support throughout the lifetime of custom developed solutions.
- The final product will be continuously revisited for any improvement opportunities.

Custom Solution Example

- Application: Multi-wavelength water quality research
- Goal: Design custom LED module to achieve specific intensity (individual circuit control for 3 wavelengths)
- Deliverables:
  - Design of custom LED array (including LED type, beam angle, and spacing) to meet intensity requirements
  - Design of thermal solution (custom fan-cooled heatsink)
  - Prototyping & assembly of entire module
  - Dimmable driver kits to power LEDs



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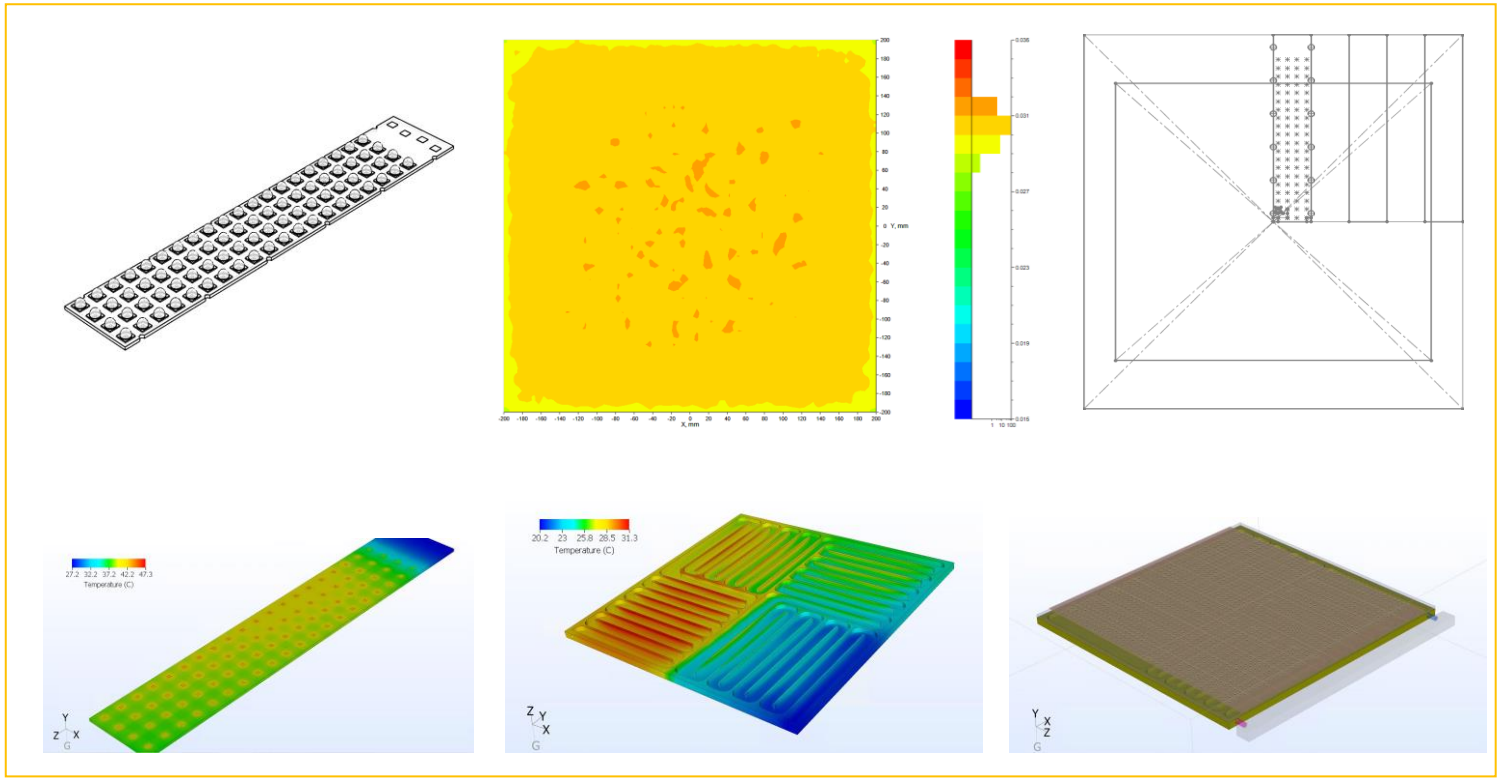
Custom Solution Example

- Application: High resolution additive manufacturing for large area (4m^2)
- Goal: Design custom LED solution to achieve specific intensity & uniformity level (4W/cm^2; >90%)
- Deliverables:
  - Design of custom LED array (including LED type, beam angle, and spacing) to meet target intensity & uniformity
  - Design of thermal solution (custom cold plate with liquid chiller system)
  - Prototyping & assembly of entire module
  - Dimmable driver kits to power LEDs



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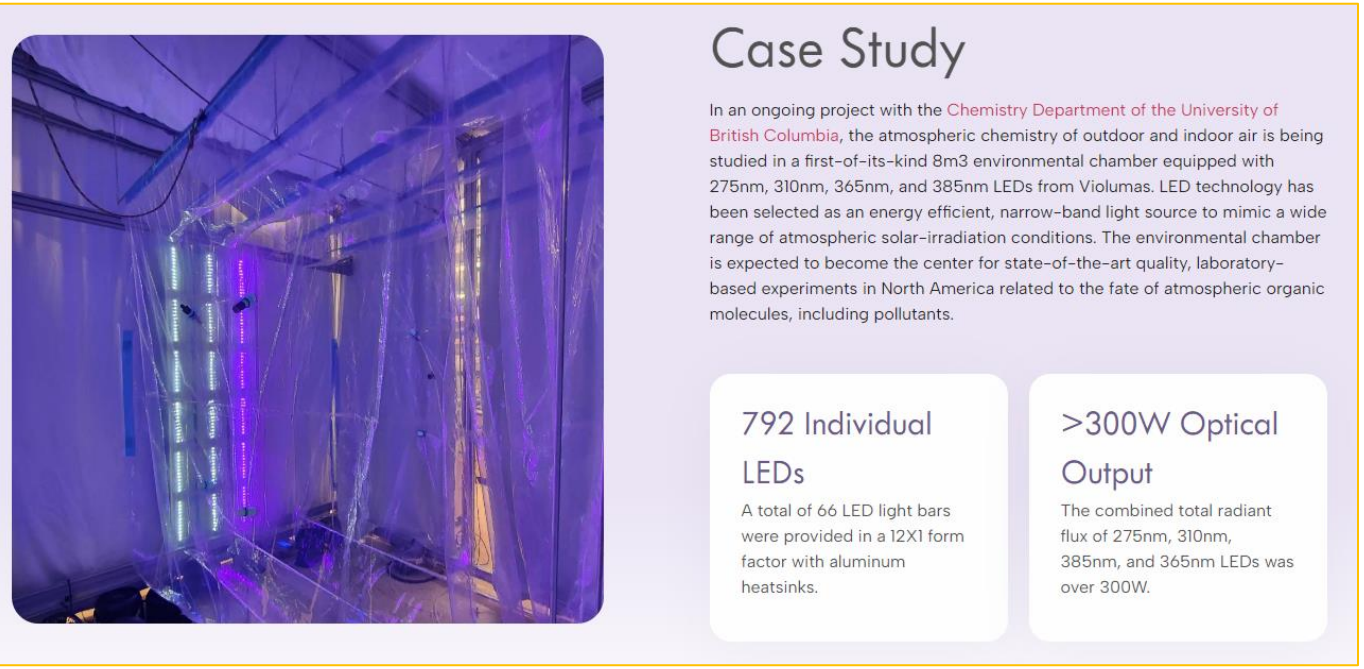
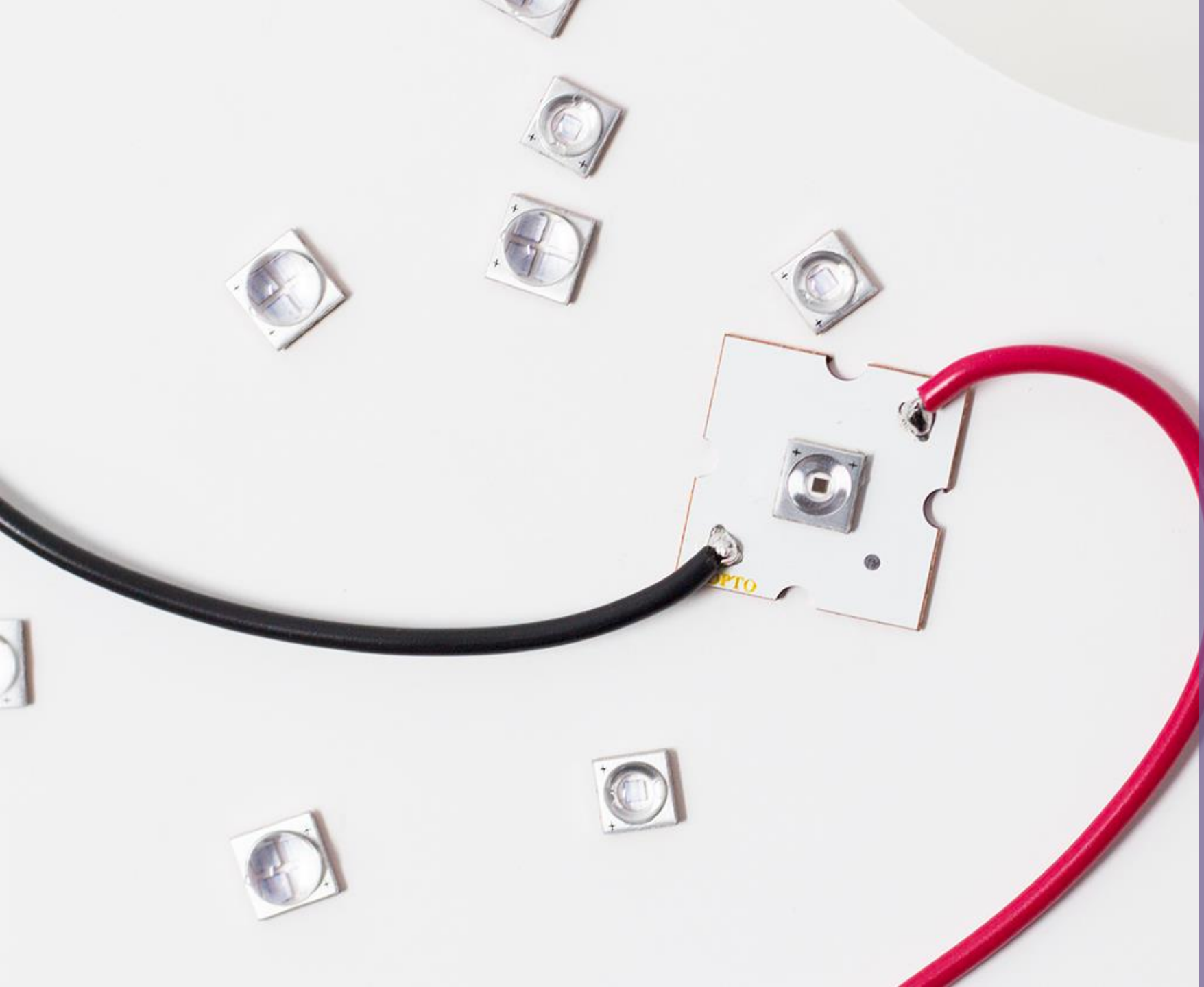
Collaboration with Global Researchers

- To further the cause of eco-friendly, energy-efficient UV lighting applications, Violumas is extending support to academic institutions for running specific research and development projects.
- If you are a part of a publicly-funded research institution, you may be eligible to receive a research subsidy for Violumas products and/or services.



Learn more at https://violumas.com/research-with-violumas/.



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