UV-C LED Modules for disinfection purposes

Today UV-C LED technology often is able to compete with traditional Low-Pressure Bulbs based on mercury technology in order to disinfect surfaces and air against microbes such as virus and bacteria.

Especially in applications where you need a compact design including narrow space and near field disinfection the LEDs are able to compete. I addition the LEDs have some advantages regarding unlimited on/off-turns, better durability and no needed warming up cycle. The LED technology is friendly to the environment as LEDs do not contain or create any pollutants such as mercury or ozone.

Based on practical experiences, tasks and third-party testing LED iBond has developed a modular program of UV-C LED Modules that can be integrated in various industrial applications where OEMs and other customers have a need for disinfection of equipment, processes or manufactured products. Today this is relevant in many different industries like food production, medical production, healthcare, ventilation industry, canteen operations, aviation industry, cleaning services and public services.

Design Consideration – UV exposure

LED iBond has during the last couple of years obtained empirical and practical experiences in designing UV-C LED modules to various industries. Under actual circumstances the killrate obtained by UV-C light is vary much depending on several factors:

- The actual light exposure (mJ/cm2) as result of input power (W) times the exposure time (sec)
- Type of pathogen (virus, bacteria or fungi)
- Condition on surfaces etc. (clean/unclean, roughness etc.)
- Air humidity

Example: Basic Design Model for Corona Virus (SARS-CoV-2)

Killrate	90%	99%	99,9%	99,99%
Needed mJ/cm2 (on surface)	1,0	4,8	11,7	22,2

Design Principle, Example – moving object: A 20 cm2 surface is to be disinfected 99,99% using an electrical input power of 6W and single light points. The time needed for exposure is 16 sec.

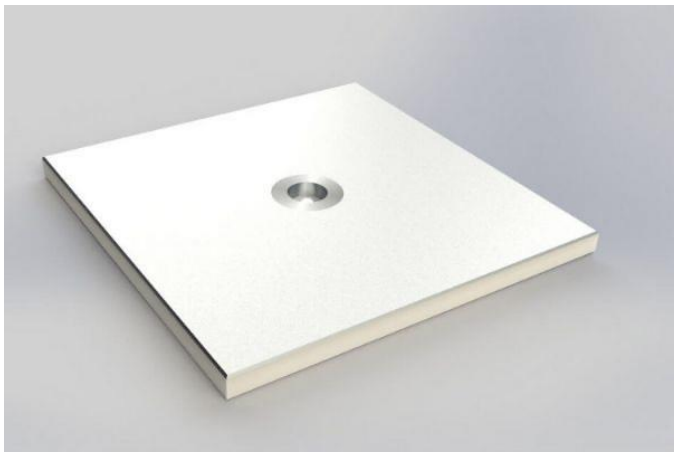
LED iBond UV-C LED modules

LED iBond modules can be supplied as single light points, as arrays of lights or as full 2D surface covering light components. The final choice and integration of LED iBonds UV-C Modules will typically be a result of a common application demand specification between the customer and LED iBond. Essential design consideration is required number of UV light sources and position in respect to object to be disinfected by the UV radiation.

TRACY®
Point and Linear Light modules

LED iBond Patented technology

GRACY
Point and Surface Light module
(2D - multiple LEDs)
LED iBond Patented technology



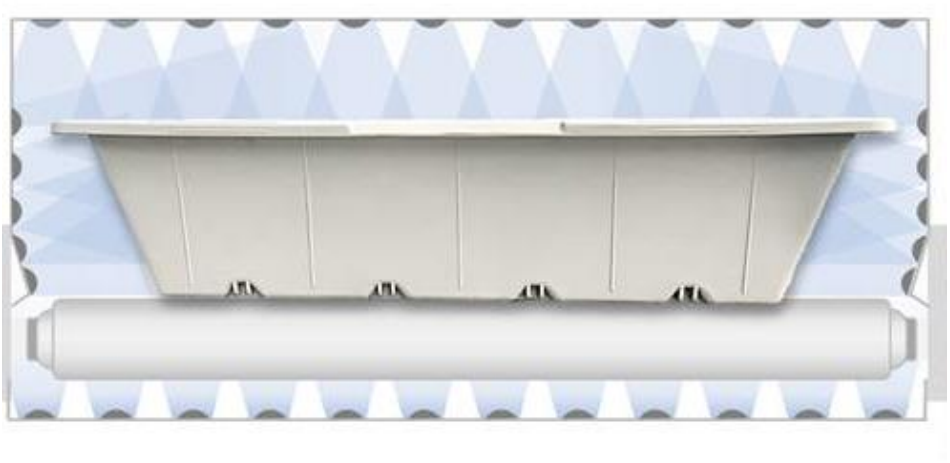
Due to the relatively low efficiency of LED based UV light sources, thermal management in the design of the modules is essential. In applications where the electrical input power is high relatively to the heat convection of the light module you sometimes would need to integrate active cooling fans or similar.

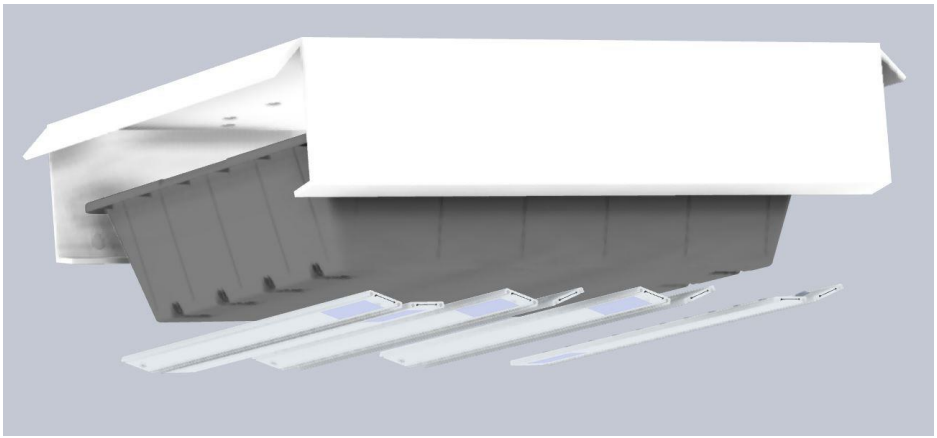
LED iBond can give further advice on integration of UV-C LED Modules in individual cases. LED iBond offers several standard linear modules including versions with cooling fans.

Use Case - Integration of UV-C LED Modules in a tunnel for disinfection of trays at a security line

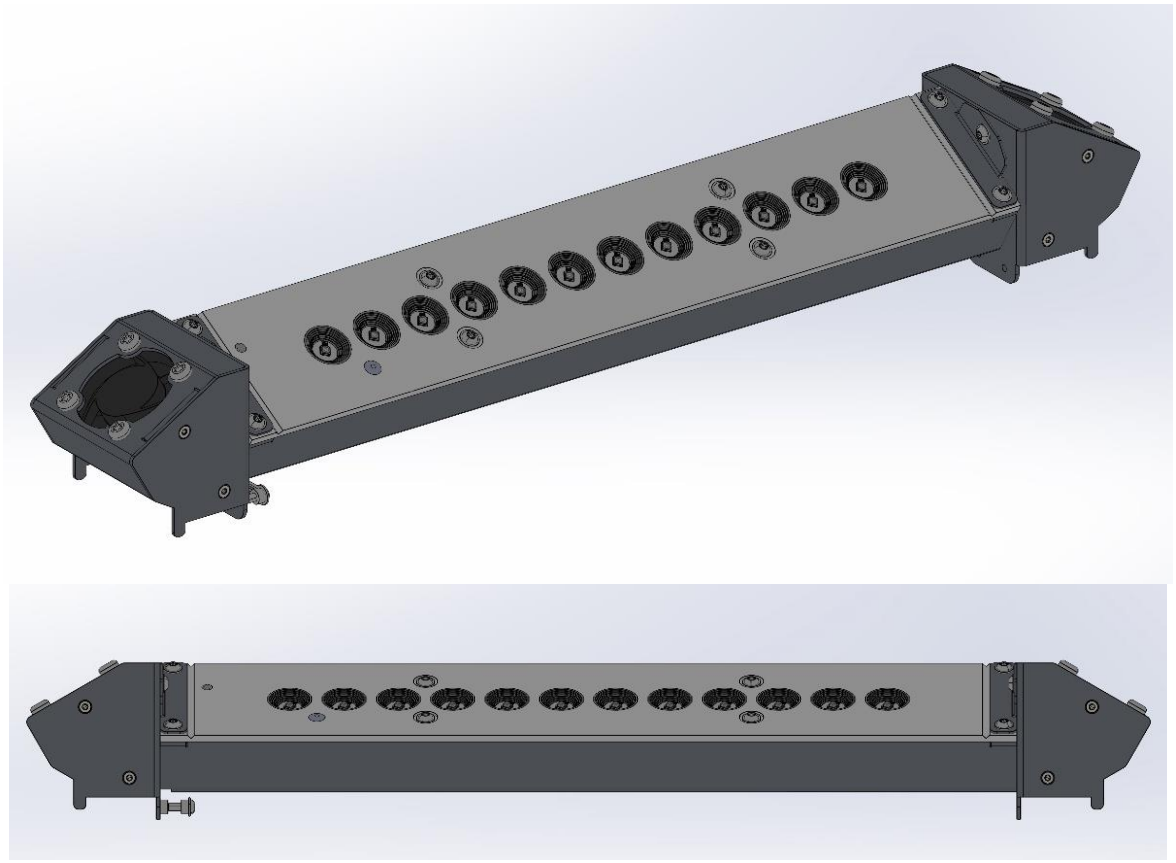
KEY USPs

- Up to 99.9% disinfection rate
- No interference with line speed and throughput
- Slim construction for both retrofit and new lane editions
- Exchangeable LED bulbs
- Long service life, less maintenance
- Up to 30 % lower TCO vs mercury alternative





Air cooled linear light modules with 12 LEDs - designed for LED Aviation:



The device is a sustainable UV-C part of an application for disinfection of trays. The innovative design constructed on LED iBond's patented ACP framework provides a compact near-field UV-C LED kit optional for both retrofit and for new installations.

Product Description

- UV-C disinfection device for build-in by OEMs
- For indoor use
- High UV-C output
- UV wavelength 270-280 nm
- Active cooling
- UV-C lifetime > 12.000 hrs (B50P70)

Total Cost of Ownership:

Total Cost of Ownership calculation (TCO, using a total application life span of 12 years) can be established including a comparison with a traditional LP Mercury based UV-C solution. The TCO showed 30% improvement by using the UV-C LED based modular design depending on the integration with the customer software control system. The main reason for this improvement is related to several factors:

- The possibility of replacing the individual LED light points during maintenance or upgrading of LEDs
- Near field light exposures around all critical edges and surfaces
- Longer lifetime of LEDs and no light on/off limitations
- No hazardous materials used in the application

It is expected that UV-C LED efficiency will be improved by a factor of 3-4 during the next few years which will improve the TCO of the modular LED design significantly.

Design:

Based on the use case and information about the requires amount of UV radiation, the layout of the individual LED modules and required number of light sources can be determined.

With established models it was possible to calculate both the light intensity and the UV-C energy delivered to each cm2 of the surface on the tray (inside, outside, around edges etc.). The energy doses were calculated by knowing the speed of the tray through the tunnel, in this example each part of the tray was exposed approx. 6 seconds.

LED ibond offers design assistance to customers with specific use cases and customized LED modules.