


A futuristic hallway with blue lighting and a grid floor. The walls and ceiling are dark, and the floor is a light blue grid. The lighting is a vibrant blue, creating a high-tech atmosphere. The hallway is empty, and the perspective is from the end of the hallway looking down its length.

UV Lighting

EMEA
Components

ARROW



The UV market has seen tremendous growth over the past several years. This is not only the result of technological advances in the manufacturing of solid-state UV devices, but the ever-increasing demand for environmentally friendly methods of producing UV light which is currently dominated by mercury lamps.

Technology that makes live brilliant

Components – EMEA

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Electromagnetic Radiation Spectrum

Ultraviolet light occurs between the visible and x-ray spectrums

The Ultraviolet wavelength range is specified as 100 to 400 nm; however, many optoelectronic companies also consider wavelengths as high as 430 nm to be in the UV range.

Ultraviolet light gets its name due to the “violet” color it produces in the visible portion of the spectrum although much of the output of UV light is not visible to the human eye

Upper UV-A LEDs (390–420 nm range)

Have been available since years and have been traditionally used in applications such as counterfeit detection or validation (Currency, Driver’s license, Documents etc.) and Forensics (Crime scene investigations). The power output requirements for these applications are very low and these are by far the cheapest UV LEDs.

Middle UV-A LEDs: (350–390 nm)

Component area has seen the greatest growth over the past several years. The majority of are for UV curing of both commercial and industrial materials such as adhesives, coatings, and inks. LEDs offer significant advantages over traditional curing technologies such as mercury or fluorescent due to increased efficiency, lower cost of ownership and system miniaturization. The trend to utilizing LEDs for curing is increasing and the rapid advances in manufacturing as well as increasing volumes are steadily driving down prices.

Lower UVA-B and UVB (300–350 nm)

Are the most recent introduction to the marketplace. These devices offer the potential to be used in a variety of applications including UV curing, biomedical, DNA analysis and various types of sensing.

UVC ranges (approximately 250–280 nm)

Benefited from improved UV-C LED technology, more and more manufacturers showcase UV-C LED products. UV-C LED can be utilized in food preservation, air purification and water disinfection markets, holding huge market demand potential. Users can easily install UV-C LED products onto existing home appliances and take advantage of the technology.

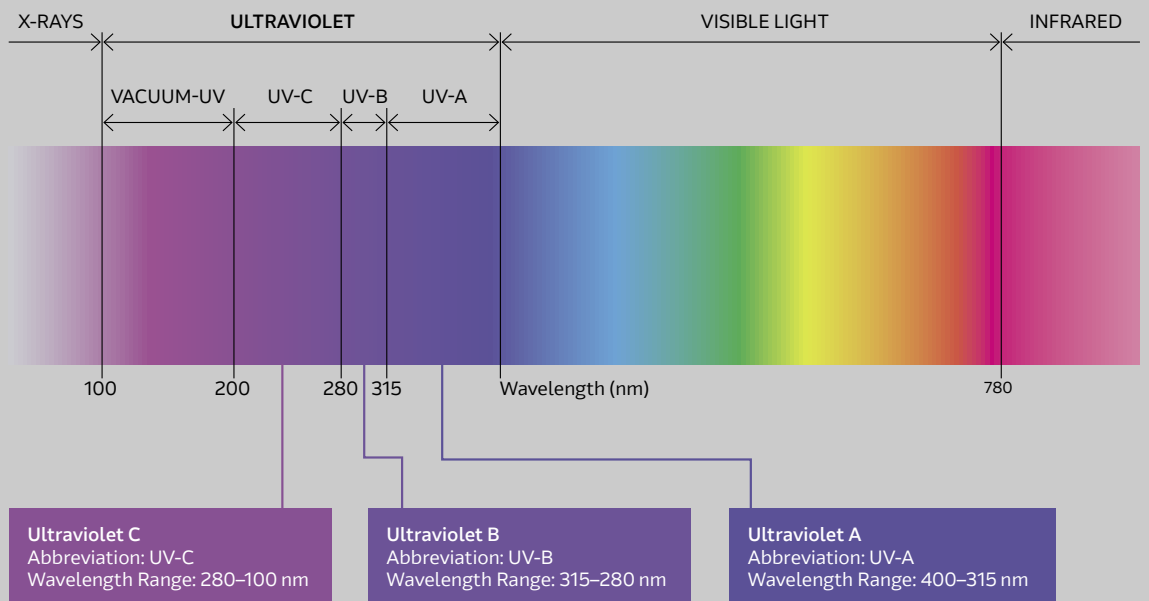
UV-A		
Application	Product	Wavelength
Curing	3D Printing	385–405 nm
Curing	Adhesive	365 nm
Curing	Exposure	385–405 nm
Curing	Nail Curing	405 nm
Deodorizing	Air Purifying System	365 nm
Deodorizing	Refrigerator	365 nm

UV-C/UV-B		
Application	Product	Wavelength
Sterilization	Surface Disinfection	275 nm
Sterilization	Air Purifier	275 nm
Sterilization	Water Purifier	275 nm
Sterilization	Ice Maker	275 nm
Medical	Skin Care	310–340 nm
Horticulture	Plant Growth	285–325 nm

There is significant overlap in all 3 of the UV spectral ranges; therefore, one must consider not only what is best for the application, but also what is the most cost-effective solution, since the lower in wavelength, typically the higher the LED cost.



**UV light for LEDs can be broken down into 3 areas:
These are classified as UV-A, UV-B and UV-C**





Industrial stainless steel container with UV radiation markings.

UVA

UVA spectrum is the safest of the three various spectra of UV light, although high exposure has been linked to skin cancer in humans as well as other potential issues such as accelerating skin aging. LEDs are highly directional with very narrow viewing angles. Looking directly into a UV LED can be harmful to the eyes.

UVC/UVB

These LED lamps should always be shielded and never be viewable to the naked eye even though it may appear that little or no light is emanating from the device. Exposure to these wavelengths may cause skin cancer and temporary or permanent vision loss or impairment. All UV devices should have warning labels similar to the label shown here

CAUTION!



1. LEDs emit very strong UV radiation during operation.
2. Don't look directly into the LED light when in operation as UV radiation can harm your eyes.
3. To prevent even inadequate exposure, wear protective eyewear.
4. If LEDs are embedded in devices, please indicate warning labels against the UV LED used.
5. Avoid prolonged exposure to skin or other tissue during operation.
6. Keep out of reach of children.
7. Take appropriate precautions around pets and other living organisms to avoid UV exposure.
8. Specifications and dimension are subject to change without notice.

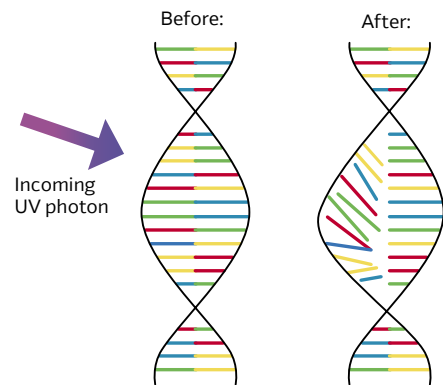
Focus Application: Disinfection (UV-C)

Because UV disinfection does not rely on chemicals or filtration materials, it can be used effectively and safely.

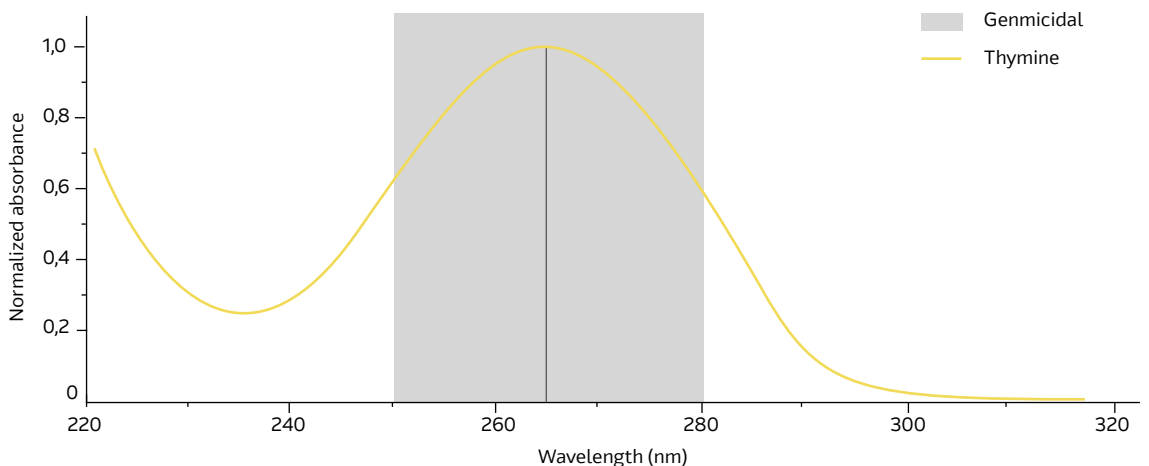
UVC – DNA Absorbance Wavelength

275 nm UVC LED has the same sterilization effect as 254 nm by tube. When exposing microorganisms to UVC light (254–280 nm), the light penetrates through their cell walls and disrupts the structure of their DNA molecules, prohibiting reproduction.

UV-C sterilization has several advantages like rapidity, thoroughness, non-pollution, easy operation and low use and maintenance costs, which is the most advanced, effective, and economical disinfection.



UVC Absorbance of DNA



Benefits of UV-C vs. Chemical Disinfection

Use of UV over chemical disinfection is recognized in several legislative directives across the world, including the European Drinking Water Directive. Benefits of UV-C over chlorine disinfection include:

- No disinfection by-products or toxins
- No volatile organic compound (VOC) or toxic air emissions
- Does not require storage of hazardous material
- Requires minimal space for equipment and contact chamber
- Does not affect the smell or taste or the minerals in the water
- Deactivation of chlorine-resistant microorganisms such as Cryptosporidium and Giardia
- No corrosion effects

- Virus: Sterilizing effect reaching 99%: 59 mJ/cm²
- Disinfection performance is a function of the UV dose
- Microorganisms do not respond to UV light in the same way

$$* \text{Dosage} = \text{Energy} = \text{Irradiance (mW/cm}^2) * \text{Time (sec)} = \text{mJ/cm}^2$$

UV dosage

- When exposing micro-organisms will die or lose its viability under adequate dose of UV in a certain time
- In line with the standards on disinfection and sterilization technology, each kind of microorganism has its own specific dosage of UV-C, the dosage is equal to the product of irradiation intensity and exposure time

World Health Organization Approved Irradiation Energy

World Health Organization (WHO) Required UV Dosage*

- Bacteria: Sterilizing effect reaching 99%: 7 mJ/cm²

Sterilization Principles			
	UV-C	Chlorine	Ozone
Desinfection Methods	Physical	Chemical	Chemical
Capital Investment	Low	Low	High
Operation Costs	Low	Medium	High
Maintenance Charges	Low	Medium	High
Desinfection Effects	Very Good	Good	Unstable
Harmfulness to Humans	Very Low	Medium	High
Residual Toxic Substances	No	Yes	Yes
Change to Water and Air	No	Yes	Yes

Lethal Dose of UV-C on Various Bacteria and Viruses Microorganism			
Scientific Name	Type of Microorganism	Disease	Lethal Dose of UV (μWSec/cm ²)
Bacillus subtilis	Bacterium	-	22,000
Bacteriophage	Virus	-	6,600
Coxsackie virus	Virus	Intestinal Infection	6,300
Shigella spores	Bacterium	Bacillary Dysentery	4,200
Escherichia coli	Bacterium	Food Poisoning	6,600
Fecal coliform	Bacterium	Intestinal Infection	6,600
Hepatitis A virus	Virus	Hepatitis	8,000
Influenza virus	Virus	Influenza	6,600
Legionella pneumophila	Bacterium	Legionellosis	12,300
Salmonella typhi	Bacterium	Typhoid Fever	7,000
Staphylococcus aureus	Bacterium	Food Poisoning, Toxic Shock Syndrome, etc.	6,600
Streptococcus spores	Bacterium	Throat Infection	3,800

Disinfection, Studies and Research papers

Airborne SARS-CoV-2 Is Rapidly Inactivated by Simulated Sunlight

“This study examined effect of simulated sunlight, relative humidity, and suspension matrix on stability of SARS-CoV-2 in aerosols.” Published By: Oxford University Press



The potential virucidal effects of UV-C irradiation on SARS-CoV-2

“UV-C irradiation is highly effective in inactivating and inhibiting SARS-CoV-2 replication.” Published By: Medrxiv.org



Inactivation of Viruses on Surfaces by Ultraviolet Germicidal Irradiation

“Ultraviolet germicidal irradiation (UV-C) is considered a promising method to inactivate viruses.” Published By: National Science Council, China



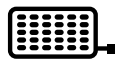


Lighting Integrated Projects

Since 2018 Arrow offers customers the possibility to order customized solutions developed and/or manufactured through a network of integration partners.



Level 1
Packaged LED



Level 2
LEDs on PCB*



Level 3
Module:
LEDs + optics +
thermal + driver*



Level 4
Ledinaire:
Level 3 + optic design
(custom)*



Level 5
Lighting System:
Ledinaire + controls
(smart light)*



Level 6
End-user-solution:
Partner system
(data analytics)*

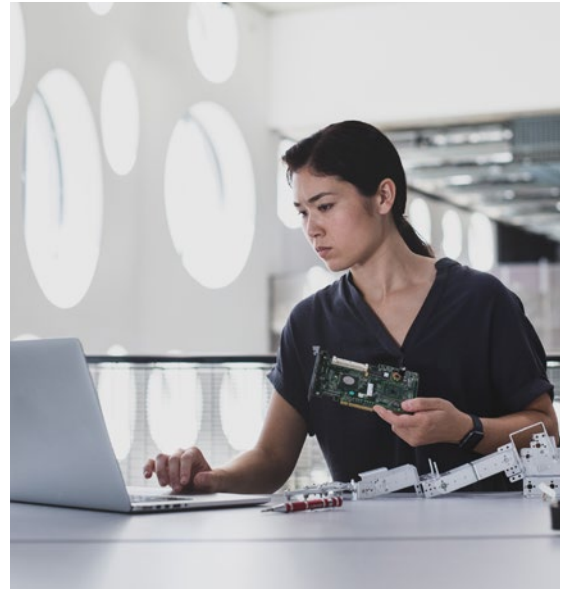
Arrow IoT & ECS

*Arrow Lighting Integration Partners

Arrow Lighting Kit

LEDs will always be the heart of a lighting solution. But to build a luminaire you also need power, connectors, optics, sensors and more.

As a full solution provider and one-stop-shop for lighting, Arrow sells all necessary elements that you need to develop and manufacture your lighting solutions. Feel free to contact us when you need support on UV-LEDs and remember that we can help you find all the other components you may need.



Lighting Kit Products Examples



LED Driver

- Diodes
- Infineon
- Microchip
- On Semiconductor



Optics

- Ledil
- Gaggione



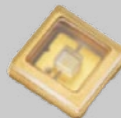
LED Power Supply

- Moons
- Osram
- Meanwell



Sensors

- ams
- Panasonic



UV ABC LEDs

- Osram Opto Semiconductors
- Lumileds
- Liteon
- Vishay
- Everlight
- Cree



IP&E Products

- TE
- Amphenol
- AVX
- Molex
- Wago

UV LED vs Traditional CCFL Light Sources

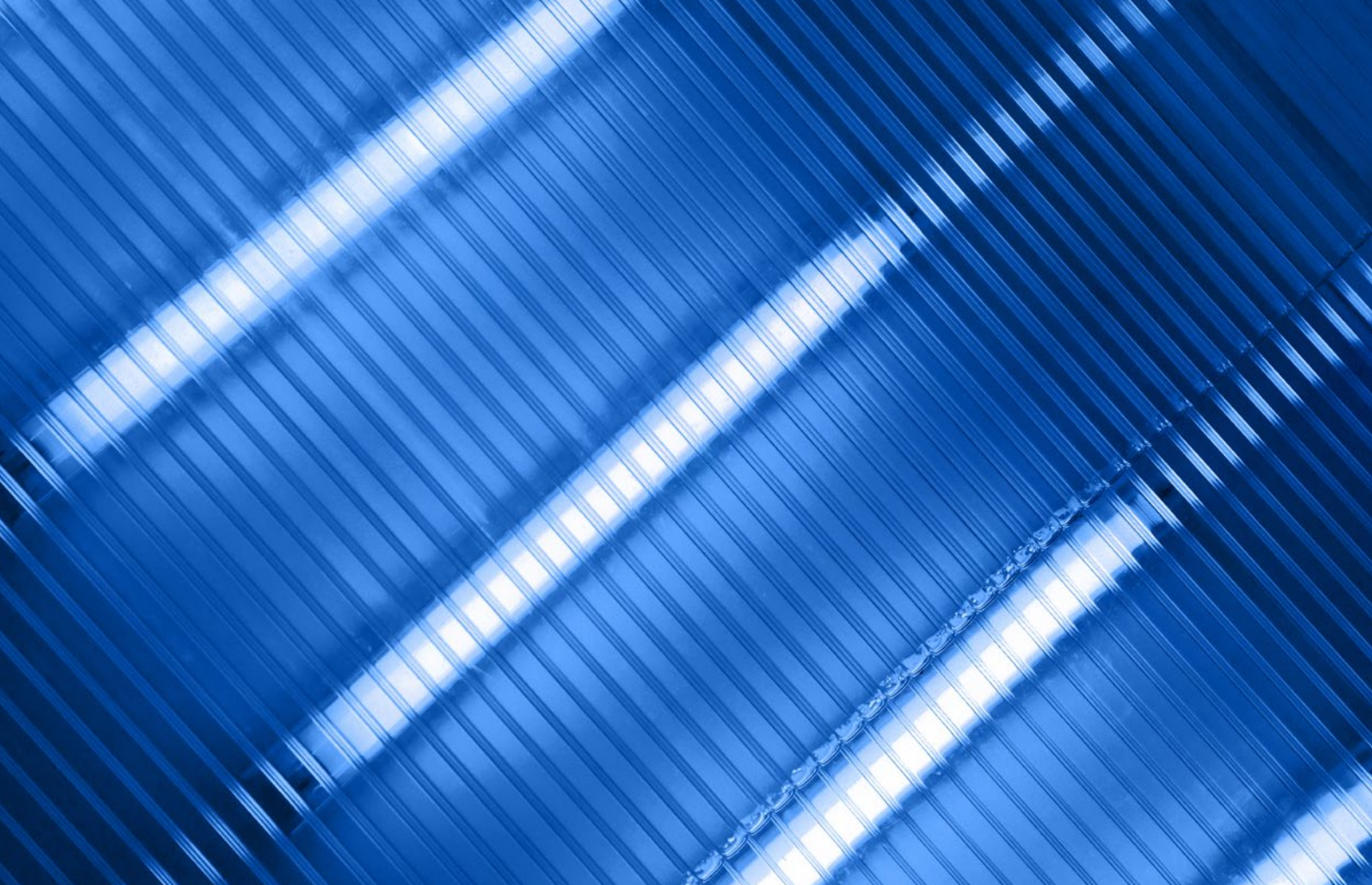
Conventional systems using mercury lamps operate at 254 nm (UVC) with ~35 % eff

UV LEDs do not contain toxic mercury often found in CCFLs lamps. They are much smaller and more durable than CCFLs and are more resistant to vibration and impact, resulting in less product breakage and reduced waste and maintenance expense as well. 254 nm is not the peak absorption wavelength of bacteria and viruses, but is a convenient line of mercury.

It was expected that the peak of 260 to 265 nm would be the most effective wavelength range for disinfection.

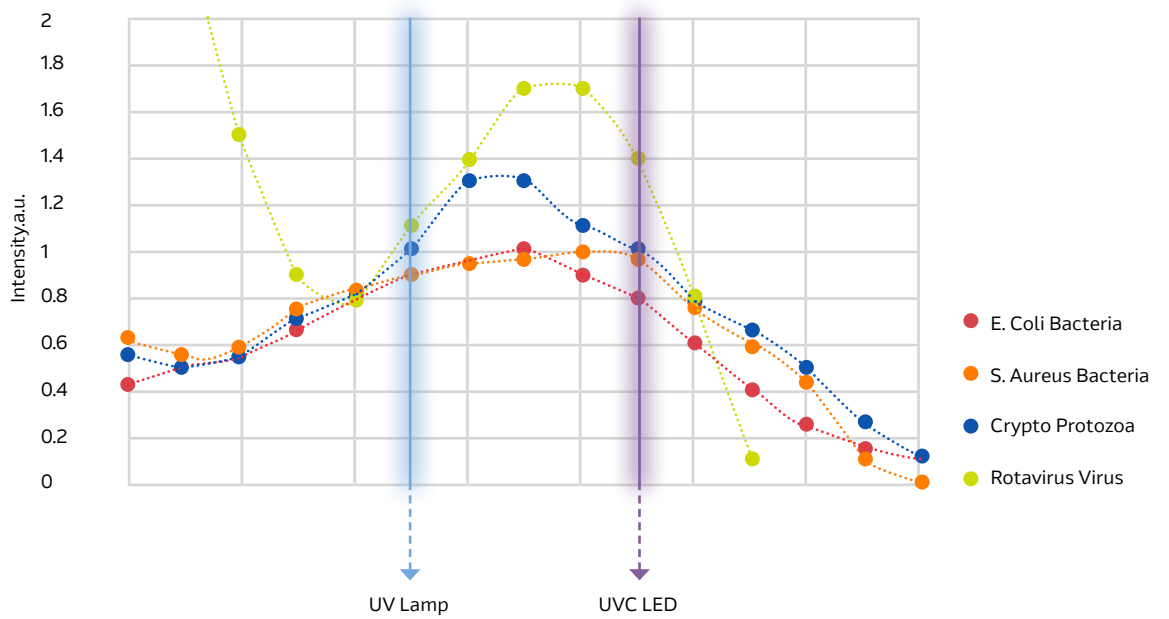
However, due to the absorption of water, a wavelength range of 275 to 280 nm proved to be the most effective for microbial disinfection in tap water and deionized water.

Comparison Key Features		
	UV-LED	Mercury Lamp
Wavelengths	Monochromatic and selectable (Application-and energy-optimized selections possible)	Broad (MP) or monochromatic (LP) (In some cases inefficient filter solutions necessary)
Forward Voltage	5~7 V (DV driving, low voltage, simple, safe)	100~Several 10,000 V (AC driving, high voltage, complex, risky)
Size	mm, order (Small, light, robust, easy design)	Dozens mm to meter order (Bulky, radial, fragile)
Radiant Heat	None (Heat can be removed by thermal management, no heat radiation to the object)	High (Uncontrolled IR and heat emission to surface resp. to the object)
Warm-up Time	None (Instant ON/OFF)	Up to several minuted (Requires mechanical shutters)
Lifetime	Over 10,000 hours	3,000~5,000 hours
Environmental Burden	Safe (Mercury free, sustainable, RoHS and REACH compliant)	Critical (contains mercury, fragile)



Spectral Sensitivity referenced to 254 nm radiation

The UVC LED 275 nm disinfection efficiency is similar to 253 nm tube as shown in below diagram. UVC LEDs with 275 nm and equivalent radiant power as the tube can be used for disinfection.





OSRAM
Opto Semiconductors

Ultraviolet Light – UV LEDs from OSRAM Opto Semiconductors

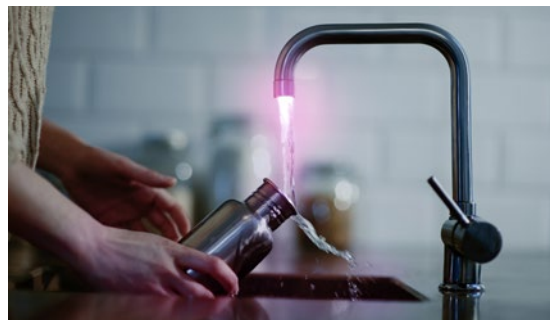
Light for making the world healthier and improve human well-being is part of our mission.

As one of the world's leading manufacturers, OSRAM Opto Semiconductors introduced its first LED UV-C products in the low and mid power range at the end of 2020.

Osram has been active in the UV area for many years and developed in-depth knowledge of UV technology from participating in various research projects with partners from industry and research.

The OSLON® UV series is designed to provide efficient UV-C radiation for but not limited to medical, home goods and consumer applications. It allows for flexible designs for various types of UV-C applications in the

areas of air, water and surface disinfection and purification, as well as treatment or sensing. Design possibilities are endless and range from point-of-use water treatment, air purification in portal devices or air conditioning systems.



The OSOLON® UV 3636 series marks the beginning of a comprehensive portfolio in the UV-C LED sector and is available in a low- and a mid-power version and features compact dimensions of 3.6 mm x 3.6 mm. With a wavelength of 275 nanometers, both versions are ideal for disinfection applications.

The low-power version achieves 4.5 milliwatts at 30 milliamperes. The mid-power version impresses with 42 milliwatts at 350 milliamperes.



4.7 mW OSOLON® UV 3636 – SU CULBN1.VC

Package: Ceramic package with integrated glass cover

Typ. Radiation: 120° (Lambertian emitter)

Color: typ. $\lambda_{peak} = 275.0$ nm (• ultraviolet (UV-C))

ESD: 2 kV acc. to ANSI/ESDA/JEDEC JS-001 (HBM)

Radiant Flux: typ. 4.7 mW

Radiant Efficiency: typ. 2.6 %



42 mW OSOLON® UV 3636 – SU CULDN1.VC

Package: Ceramic package with integrated glass cover

Typ. Radiation: 120° (Lambertian emitter)

Color: typ. $\lambda_{peak} = 275.0$ nm (• ultraviolet (UV-C))

ESD: 5 kV acc. to ANSI/ESDA/JEDEC JS-001 (HBM)

Radiant Flux: typ. 42 mW

Radiant Efficiency: typ. 2.1 %

UV-C LED Families

Family	Class	Dimensions	Angle	Wavelength Typ	Ref Voltage Typ	Radiant Power Typ	Foward Current	I max
SU CULBN1.VC-AGAM-67-4F4G	UVC	3.6x3.6 mm	120°	275 nm	6 V	4,7 mW	30 mA	40 mA
SU CULDN1.VC-MAMF-67-4E4F	UVC	3.6x3.6 mm	120°	275 nm	5,7 V	42 mW	350 mA	500 mA

LED Engin UV-A LEDs



LuxiGen™ UV Emitters				
Typical Performance	LZ1-Series	LZ4-Series	LZC-Series	LZP-Series
Radiant flux* (mW)	–	–	–	–
UV 365nm peak	1360 @ 700 mA 1930 @ 1000 mA	3800 @ 700 mA 4800 @ 1000 mA**	–	–
Violet 385, 395, 405nm peak	1900 @ 1000 mA	5600 @ 700 mA	16500 @ 700 mA	33000 @ 700 mA

* See specific product datasheet for T_c restrictions when driven at maximum drive current in steady state.


** Flat lens ermitter

UV LED Overview




























UV-C Product Families

Manufacturer	Package	Family	Class	Dimension (mm)	Angle (°)	Wave-length Typ (nm)	Ref Voltage Typ (V)	Radiant Power Typ (mW)	Foward Current (mA)	I max (mA)
LITEON		LTPL-G35UVC275GS	UVC	3.5x3.5x1.68	120	275	6	4,5	40	80
LITEON		LTPL-G35UV275GS-P	UVC	3.5x3.5x1.68	120	277	5,7	6	40	80
LITEON		LTPL-G35UV275GC-E	UVC	3.5x3.5x1.68	120	277	6	12	100	150
LITEON		LTPL-G35UV275GC-P	UVC	3.5x3.5x1.68	120	275	5,7	14	100	150
LITEON		LTPL-G35UV275GR-E	UVC	3.5x3.5x1.68	120	275	6	21	180	280
LITEON		LTPL-G35UV275GR-P	UVC	3.5x3.5x1.68	120	275	5,7	25	180	280
LITEON		LTPL-G35UV275GZ-P	UVC	3.5x3.5x1.68	120	275	6,2	50	350	600
LITEON		LTPL-G35UV275GH-P	UVC	3.5x3.5x1.68	120	275	6,7	81	700	800
LITEON		LTPL-W35UVC275GH	UVC	3.5x3.5x1.65	120	275	6,7	150	600	700
VISHAY		VLMU35CL20-275-120	UVC	3.45 x 3.45 x 1.8	120	275	6,8	2,5	20	30
VISHAY		VLMU35CB20-275-120	UVC	3.45 x 3.45 x 1.8	120	275	6,3	10	100	150
VISHAY		VLMU35CT20-275-120	UVC	3.45 x 3.45 x 1.8	120	275	6	19	150	200
EVERLIGHT		ELUC3535NUB-P7085Q05075020-S21Q	UVC	3.5x3.5x1.3	120	275	5,75	2	20	40
EVERLIGHT		ELUC3535NUB-P7085Q15070100-S22Q	UVC	3.5x3.5x1.1	120	275	6	10	100	150

UV-B Product Families

Manufacturer	Package	Family	Class	Dimension (mm)	Angle (°)	Wave-length Typ (nm)	Ref Voltage Typ (V)	Radiant Power Typ (mW)	Foward Current (mA)	I max (mA)
LITEON		LTPL-G35UV308GS	UVB	3.5x3.5x1.68	120	308	5,9	7,3	40	80
LITEON		LTPL-G35UV308GC	UVB	3.5x3.5x1.68	120	308	5,5	12,7	100	150
LITEON		LTPL-G35UV308GR	UVB	3.5x3.5x1.68	120	308	5,4	22,5	180	280
LITEON		LTPL-G35UV308GH	UVB	3.5x3.5x1.68	120	308	5,2	37,6	350	700

UV-A Product Families

Manufacturer	Package	Family	Class	Dimension (mm)	Angle (°)	Wavelength Typ (nm)	Ref Voltage Typ (V)	Radiant Power Typ (mW)	Foward Current (mA)	I max (mA)
VISHAY		VLMU3500...60	UVA	3.5x3.5x2.9	60	385, 395, 405	3,4	780	500	700
VISHAY		VLMU3500...120	UVA	3.5x3.5x2.9	120	385, 395, 405	3,4	780	500	700
VISHAY		VLMU3500...130	UVA	3.5x3.5x2.9	130	385, 395, 405	3,4	780	500	700
VISHAY		VLMU3511...130	UVA	3.5x3.5x2.1	130	365	3,6	1000	600	700
VISHAY		VLMU3520...120	UVA	3.5x3.5x2.9	120	385, 395, 405	3,4	1000	500	1200
VISHAY		VLMU3520...60	UVA	3.5x3.5x2.9	60	385, 395, 405	3,4	1000	500	1200
VISHAY		VLMU1610...135	UVA	1.6x1.6x1.4	135	365	3,4	23	20	60
LITEON		LTPL-C034UVExxx	UVA	3.5x3.5x2.1	130	430 405 395 385 365	3,6 3,6 3,7 3,7 3,7	810 810 780 760 630	350	500
LITEON		LTPL-C034UVGxxx	UVA	3.5x3.5x2.1	130	430 405 395 385 365	3,6 3,6 3,7 3,7 3,7	1455 1455 1425 1400 1340	700	1000
LITEON		LTPL-C16UVExxx	UVA	1.6x1.6x0.8	135	430 405 395 385 365	3,6 3,6 3,7 3,7 3,7	440 440 420 410 340	350	500
LITEON		LTPL-K28UVMxxx	UVA	2.8x3.5x0.7	120	430 405 395 385 365	3,1 3,1 3,2 3,3 3,3	21 21 20 20 17	20	40
LITEON		LTPL-C036UVExxx	UVA	3.5x3.5x3.2	30	430 405 395 385 365	3,6 3,6 3,7 3,7 3,7	690 690 670 660 530	350	500
LITEON		LTPL-C036UVGxxx	UVA	3.5x3.5x3.2	55	430 405 395 385 365	3,6 3,6 3,7 3,7 3,7	1230 1230 1210 1190 1140	700	1000
LITEON		LTPL-S35UVGxxxL	UVA	3.5x3.5x1.5	120	430 405 395 385 365	3,9 3,9 4,0 4,0 4,0	2380 2380 2350 2310 2220	1000	1500
LITEON		LTPL-S35UVGxxxF	UVA	3.5x3.5x2.8	60	430 405 395 385 365	3,9 3,9 4,0 4,0 4,0	2380 2380 2350 2310 2220	1000	1500
LUMILEDS		LUXEON UV FC1	UVA	1.0x1.0	140	385, 395, 405, 415	3,1	750	500	1000
LUMILEDS		LUXEON UV FC2	UVA	2.0x2.0	140	385, 395, 405, 415	3,1	1200	1000	2000
LUMILEDS		LUXEON UV U1	UVA	1.7x1.3	140	385, 395, 405, 415	3,1	650	500	1000
LUMILEDS		LUXEON UV U2	UVA	2.12x1.72	138	385, 395, 405, 415	3,1	1300	1000	2000
EVERLIGHT		ELUA2016OGB-x..x-VA1M	UVA	2.0x1.6	120	365, 385, 395, 405	3,5	25	20	20
EVERLIGHT		ELUA2016OGB-x..x-V21M	UVA	2.0x1.6	120	365, 385, 395, 405	3,5	70	60	100
EVERLIGHT		ELUA2016OGB-x..x-VD1M	UVA	2.0x1.6	120	365, 385, 395, 405	3,5	600	500	700
EVERLIGHT		ELUA3020LUB-x..x-VA1D	UVA	3.0x2.0	120	365, 385, 395, 405	3,5	30	20	30
EVERLIGHT		ELU-A2835TG0-x..x-VA1D(CM)	UVA	2.8x3.5	120	365, 395	3,5	250	150	
EVERLIGHT		ELUA3535OGB-x..x-V31M	UVA	3.5x3.5	120	365	3,5	400	250	350
EVERLIGHT		ELUA3535OGB-x..x-VD1M	UVA	3.5x3.5	120	365, 385, 395, 405	3,5	1200	500	700
EVERLIGHT		ELUA3535OG5-x..x-VD1M	UVA	3.5x3.5	50	365, 385, 395, 405	3,5	1200	500	700

Why to use Ledil optics in UV lighting

While optics decrease the amount of transmitted light from the LED, they provide much higher in-use-efficacy for the application. The gain is even more valuable when every particle of the non-visible wavelength needs to find its target. Durable optics made from elastic silicone do not require additional protective covers such as glass on top. Accurate light control allows efficient usage in more advanced applications like upper air UVGI.

Optics can help to optimise need for number of other components and assembly phases needed – resulting in more cost efficient luminaires.



VIOLETTA

Single silicone lens for near-field UV-C applications

- Unique silicone lens with high UV transmittance
- Easy to achieve ingress protection (IP) with sandwich mount between faceplate and PCB
- Single lens format allows for a wide variety of luminaire designs

Features

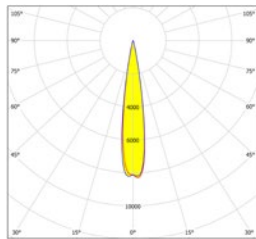
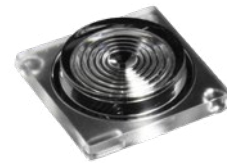
- 21.7 x 21.7 mm, H 6.51–6.6 mm
- Made from silicone
- Over 80 % efficiency in 280 nm
- Shares the same footprint with LEDiL ROSE
- Multiple installation methods:
 - Steel frame
 - Potting
 - Sandwich type sealing

Typical Applications

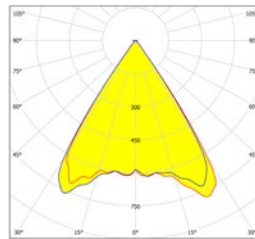
- Near-field UV-C irradiation
- Handheld sanitizers, hand dryers, UV-appliances, water bottles, hand-held lamps

Compatibility

- CSP and ceramic high power UVC LEDs up to 7070 package size



F17822_VIOLETTA-S



F17826_VIOLETTA-W

VIOLET

The first standard silicone optic in the world designed specifically for UV-C applications

- Special silicone for high UV transmittance
- Lens and stainless steel frame made from highly resistant UV materials
- Enables creation of more cost-efficient solutions than with quartz glass
- Can be used with up to 4 LED clusters* for maximum efficiency and output

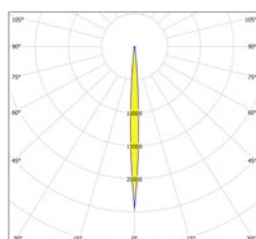
Typical Applications

- Disinfection (surface, air, water)
- Horticultural lighting (prevention of plant diseases etc)

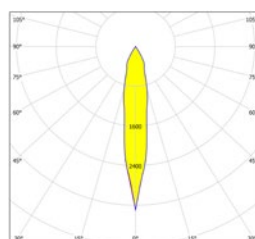
Compatibility

- CSP and ceramic high power UVC LEDs up to 7070 package size

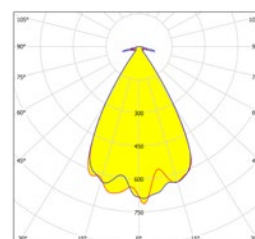
*Depends on LED



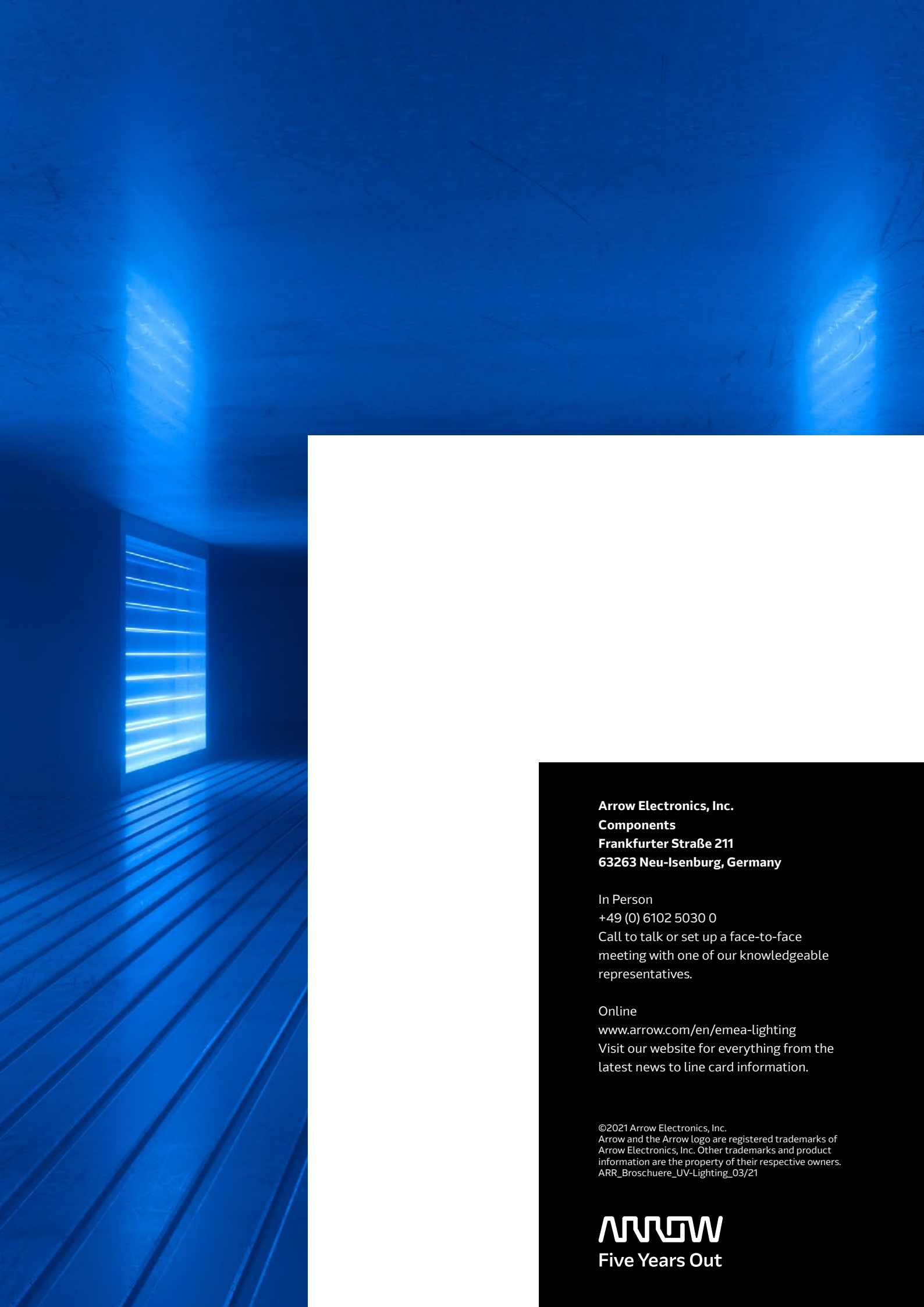
FN17810_VIOLET-12X1-RS



FN17294_VIOLET-12X1-S



FN17818_VIOLET-12X1-W



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ARR_Broschuere_UV-Lighting_03/21

ARROW
Five Years Out