High Power UV-C LED

SMD Modules and Arrays

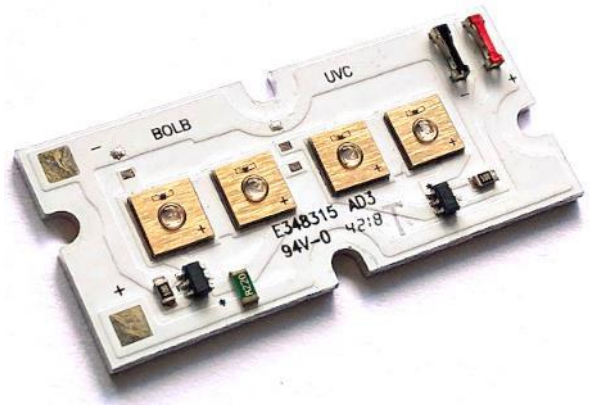
BOLB Inc.
Livermore, California
V1.53 March 2021

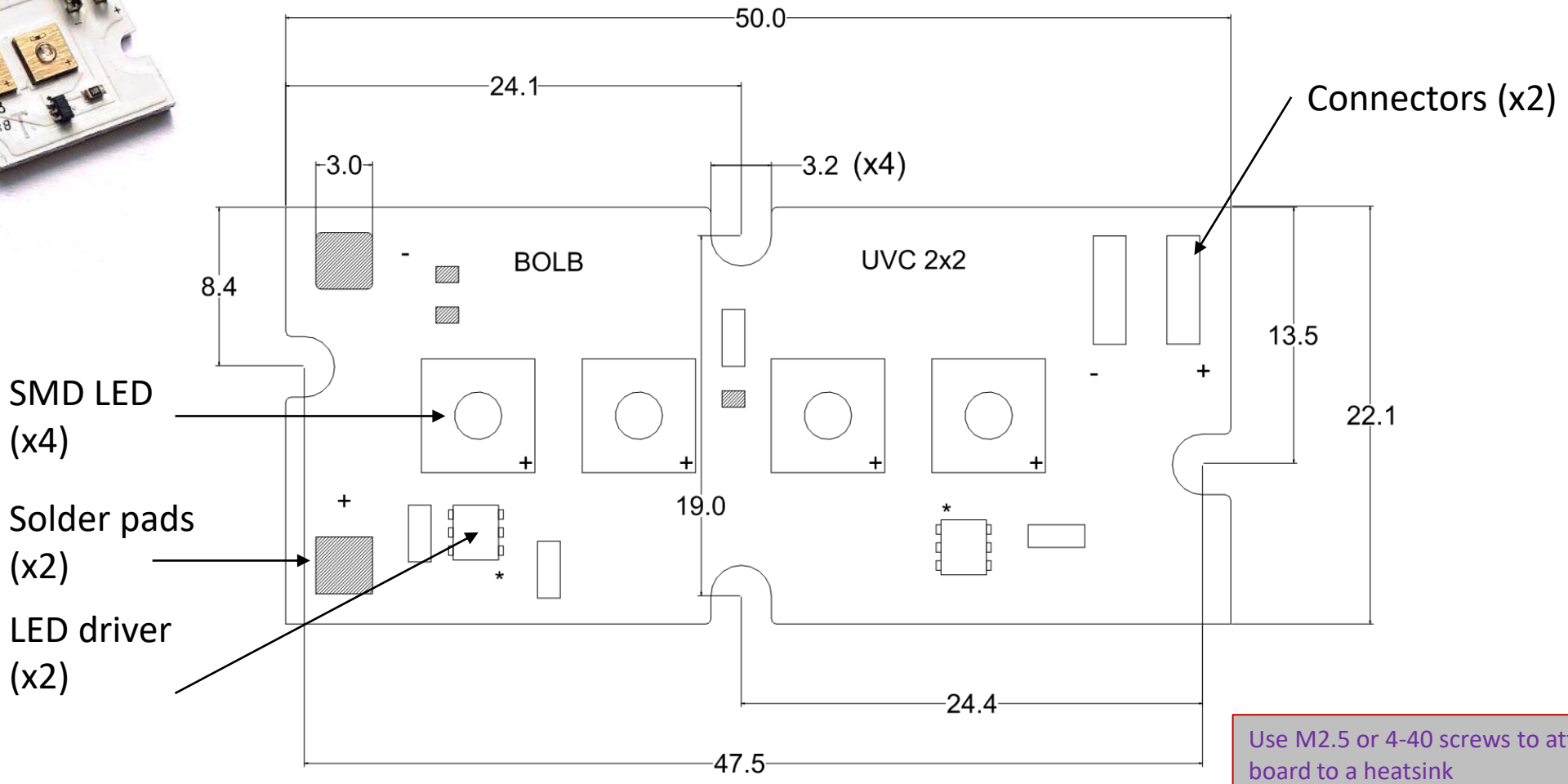
INFO@BOLB.CO

PLEASE OBSERVE UVC SAFETY PRECAUTIONS,
PROTECT YOUR EYS AND SKIN FROM UVC EXPOSURE.
ALL OPERATORS, OBSERVERS AND NEARBY PERSONNEL MUST BE PROTECTED

BOLB INC. IS NOT RESPONSIBLE FOR ANY HARM CAUSED BY
NEGLIGENCE IN SAFTY BY THE USERS

BOLB UVC Quad SMD LED Module Diagram With BCR- type drivers (units: mm)



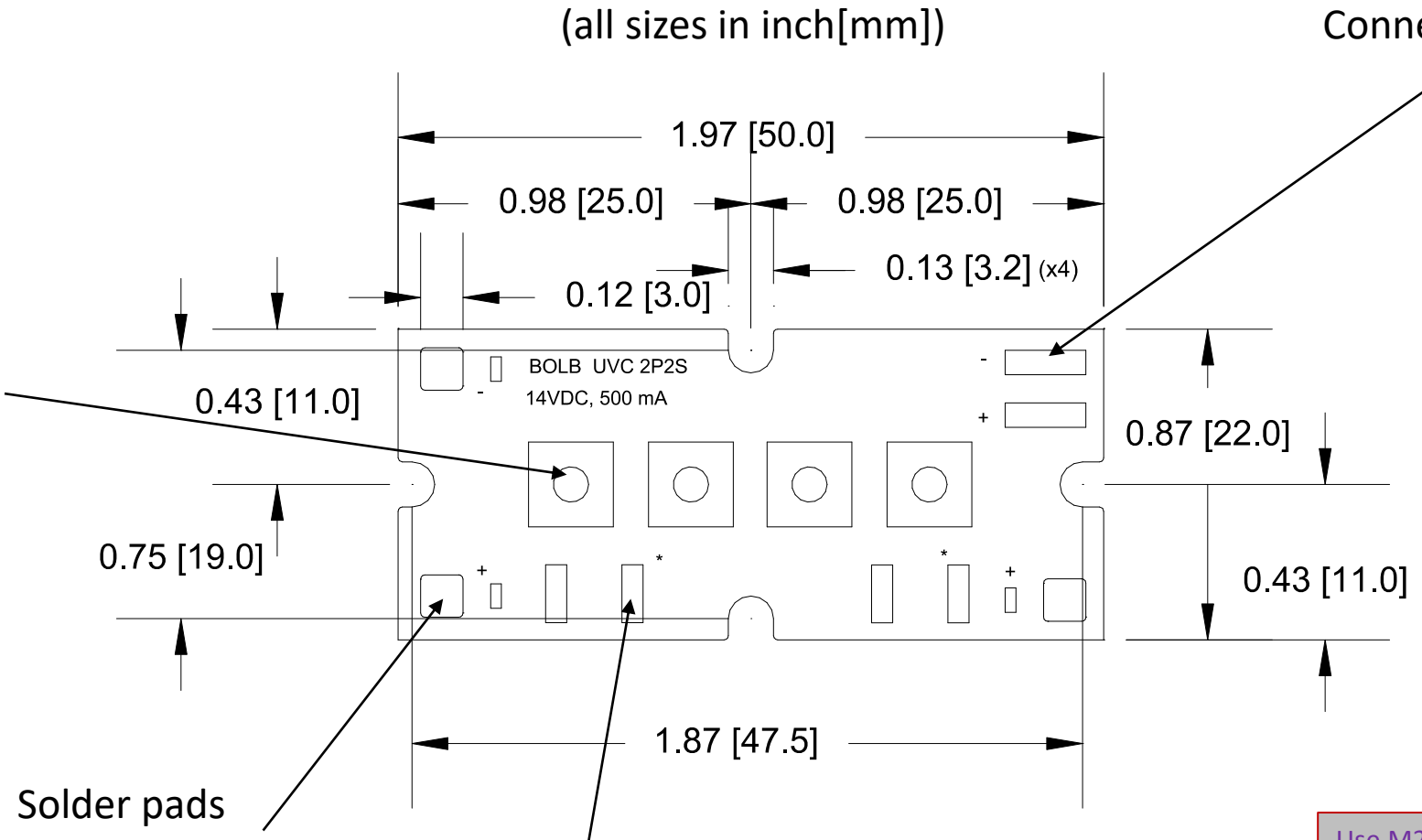


Use M2.5 or 4-40 screws to attach board to a heatsink
Thermal compound required between back of PCB and heatsink
Wire connection AWG-25 or AWG-24

BOLB UVC Quad SMD LED Module Diagram
AL- type drivers

Start: July 2020

New BOLB UVC 2x2 Lamp drawing
Symmetrical design
(all sizes in inch[mm])



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Thermal compound required between back of PCB and heatsink
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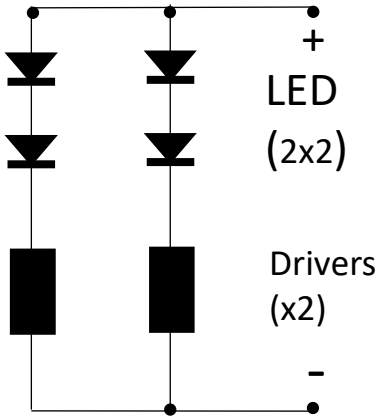
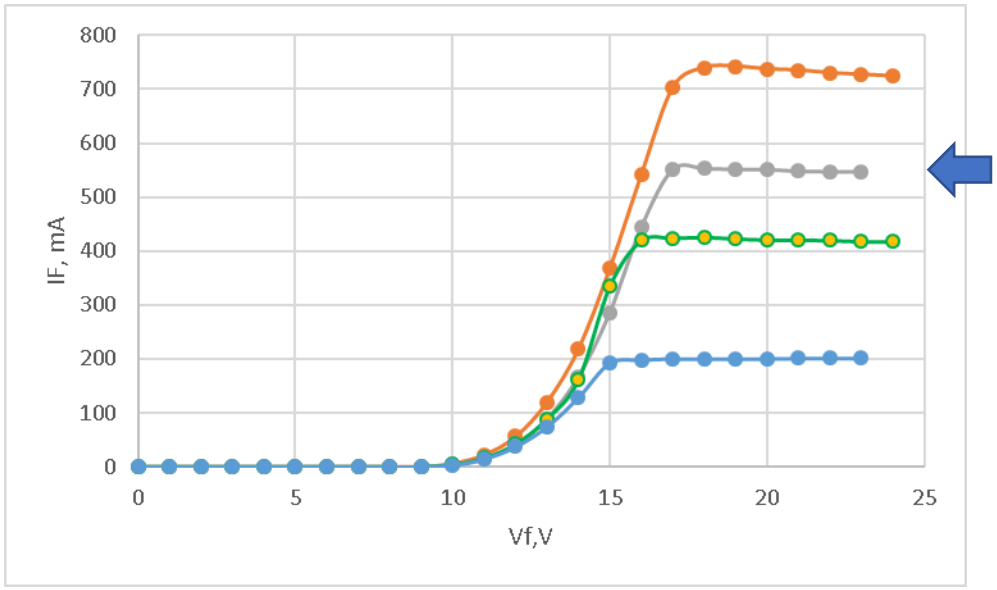
Schematic Electrical Connections
Quad SMD 2p 2s



Driver I-V Can Be Set According to Customer Requests

Driver I-V Can Be Set According to Customer Requests



For this shipment

Notes

1. Active cooling highly recommended
2. Thermal paste required to mount PCB onto heatsink
3. Current stabilization (up to 700 mA) provided by onboard driver
4. External power supply accepts 16-19V DC, 1.5A, voltage stabilization recommended
5. PCB has 2 connectors (wires AWG-22 to 25) for connection to power supply. No soldering required.

2p2s SMD LED Module
Performance at 25°C Ambient with Active Cooling

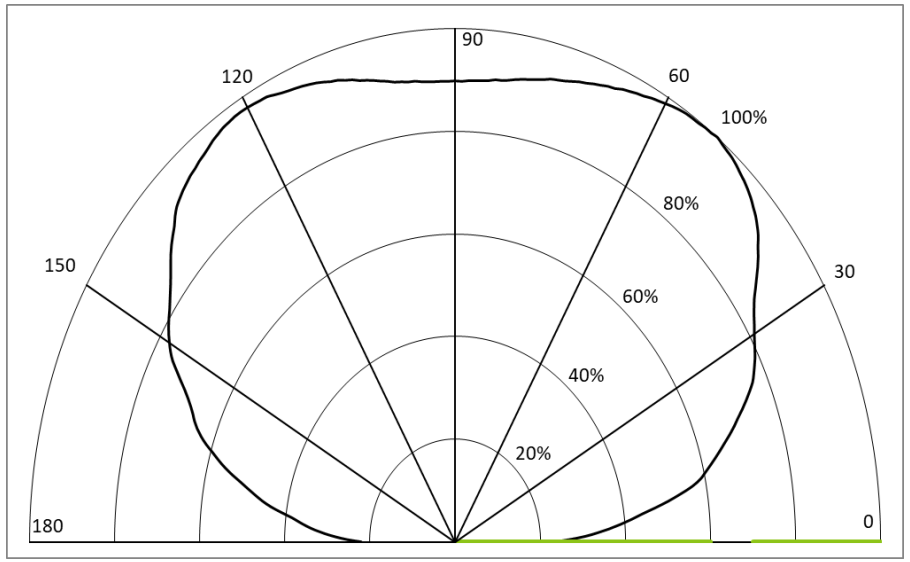
Standard drive current = 350mA per chip

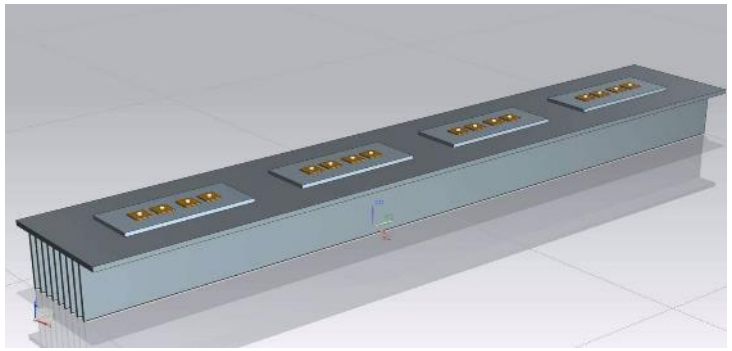
Parameter	Symbol	Unit	Min.	Typ.	Max
Peak Wavelength	λp	nm	265	270	275
Radiant Flux	ϕe	mW	320*	360*	400*
			450**	500**	600**
Forward Voltage	VF	V	15	16	19
Forward Current	IF	A	0.2	0.6	0.7
Spectrum Half Width	Δλ	nm	-	11	-
View Angle	2θ½	°	-	150	-
Thermal Resistance	RJ-b	℃/W	-	<10 (TBD)	-

*G1N
** G2H

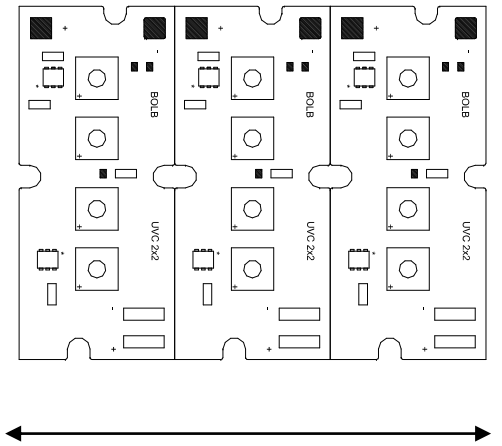
Single SMD LED Emission Pattern

Relative Intensity vs. Angle

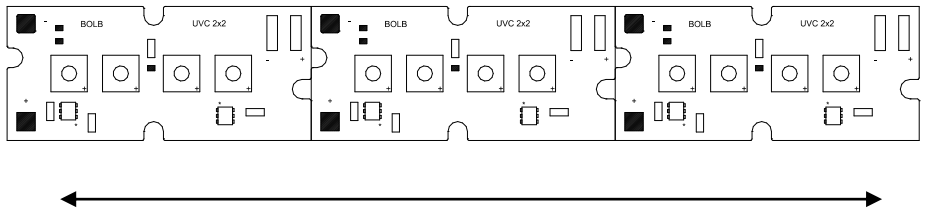




Parallel Assembly

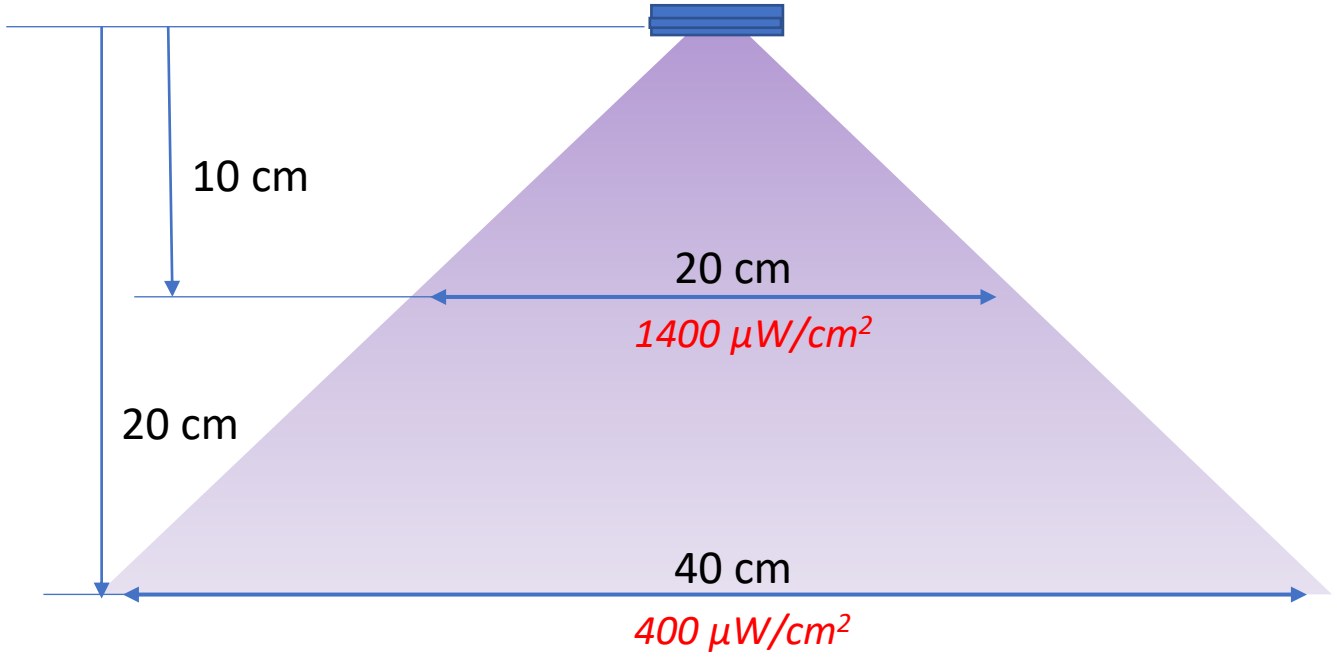


Longitudinal Assembly



2P2S Module (15V, 500 mA, 400 mW) surface intensity data

0.4 W_{opt} UVC LED Lamp



Irradiance values are very calibration-sensitive It's not uncommon to see intensity meters calibrated for Mercury lamp provide wrong irradiance values by a factor of 2x-3x.

Please contact Bolb for assistance.

2P2S Module Low Lens Intensity Data (short distance)				
Distance, mm	10	20	**30**	50
Intensity, mW/cm²	64	24.6	**12.7**	4.87

2P2S Module (15V, 500 mA, 400 mW) surface intensity data

Po Intensity (µW/cm2)		2P2S Module lateral distance (cm)		
	vertical distance (cm)	0	20	50
2P2S 15V, 0.5A	20	396	175	30
	40	93	77	28
	60	40	36	20
	80	23	22	15
	100	15	15	11
	120	10	10	8

Irradiance values are very calibration-sensitive
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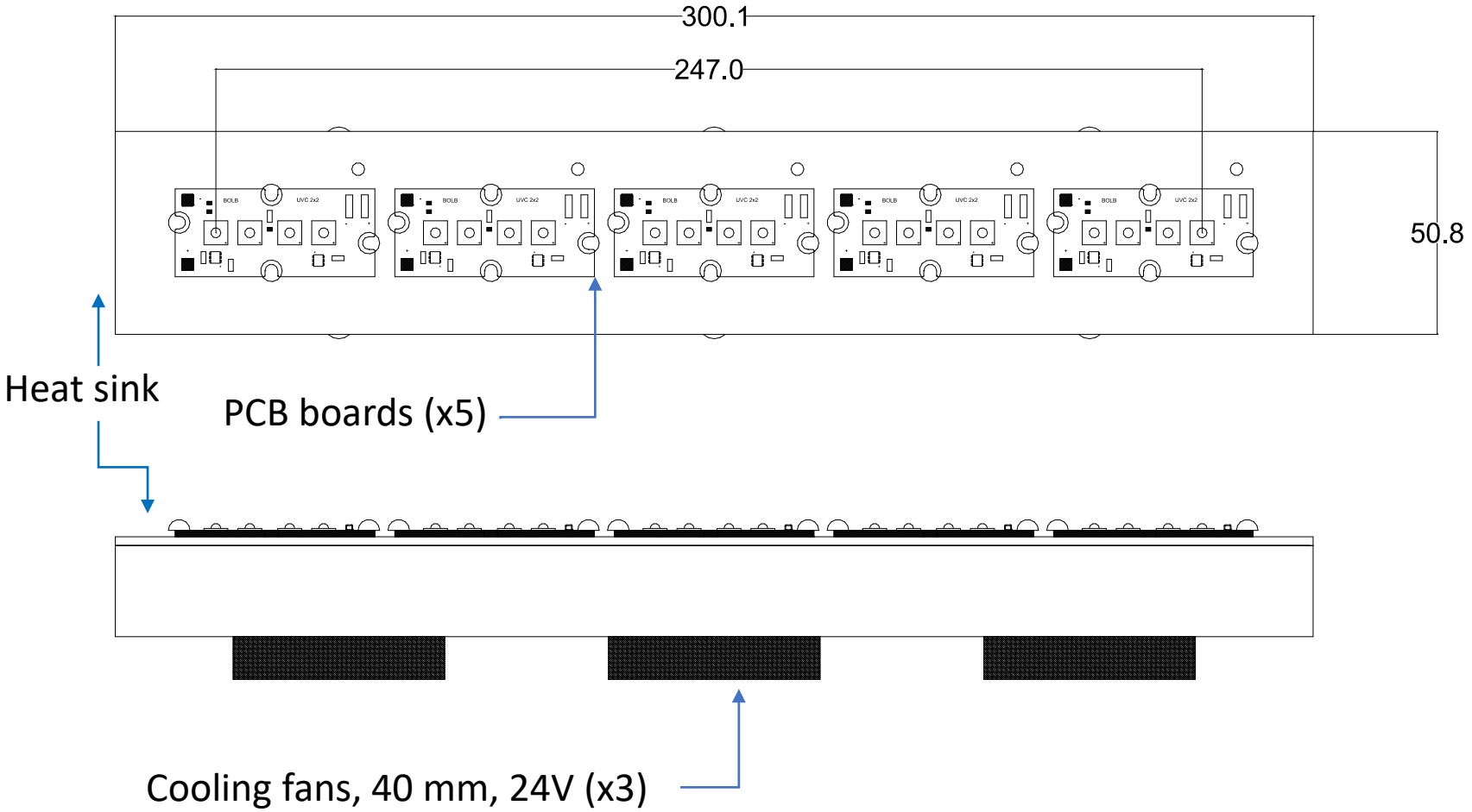
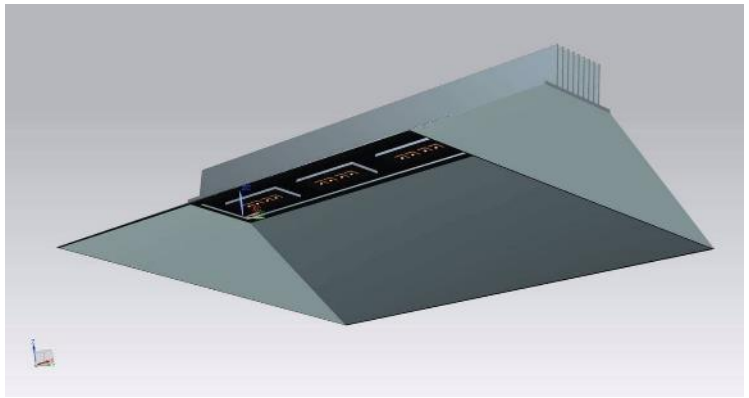
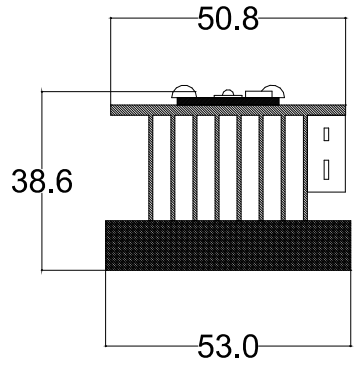
Example: Longitudinal Assembly Lamp design (all sizes in mm)







Example: 8 x Quad SMD LED Strip Lamp
All 8 Segments in Parallel Connection
Performance at 25°C Ambient with Active Cooling

Standard drive current = 350mA per chip

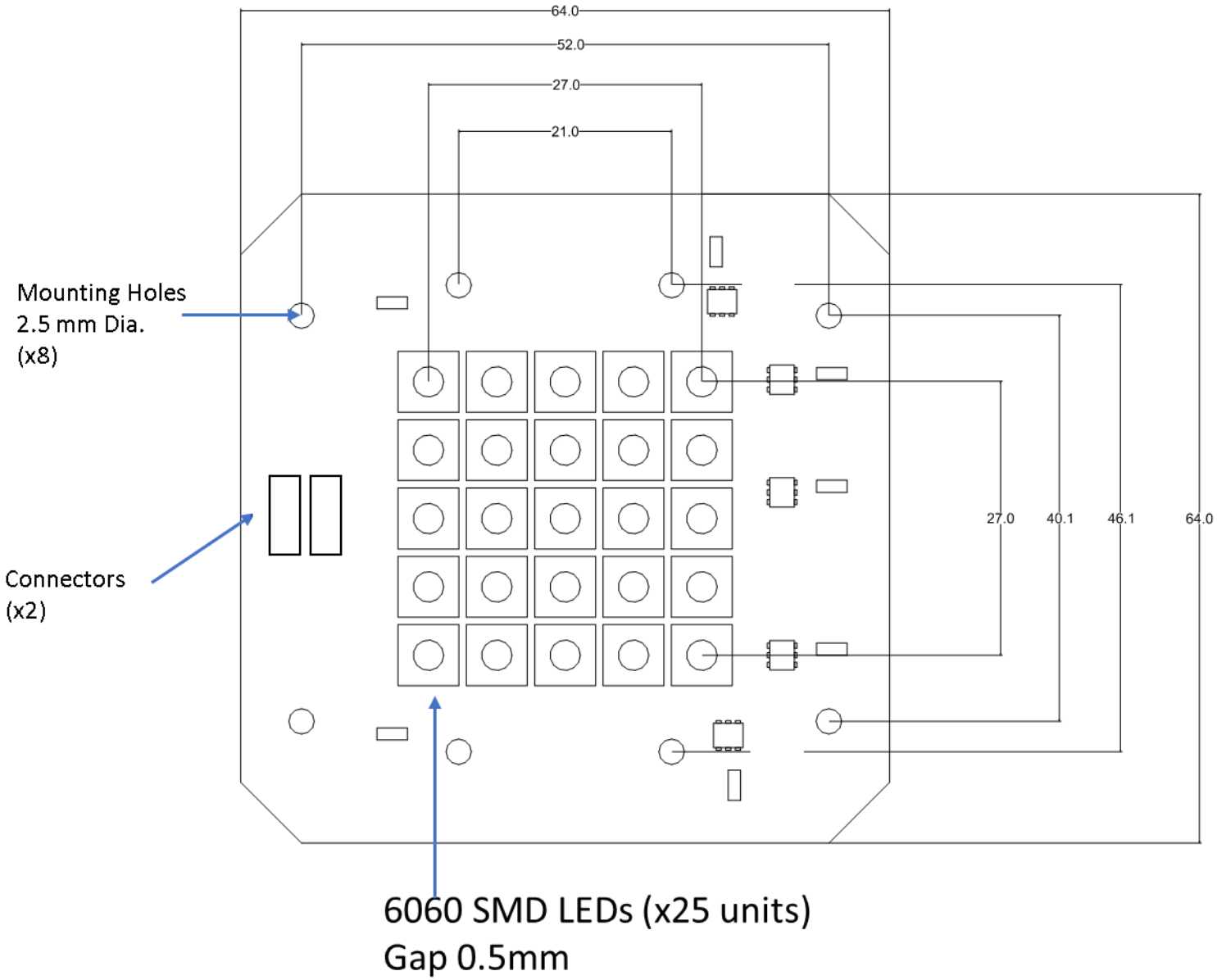
Parameter	Symbol	Unit	Min.	Typ.	Max
Peak Wavelength	λp	nm	265	270	275
Radiant Flux	ϕe	W_{opt}	2.5*	2.8*	3.2*
Forward Voltage (LED + Driver Electronics)	VF	V	16	18	20
Forward Current	IF	A	-	5.6	
Spectrum Half Width	Δλ	nm	-	11	-
View Angle	2θ½	°	-	150	-
Thermal Resistance	RJ-b	°C/W	-	<10 (TBD)	-

*G1N Model LEDs

Low lens (left, 150-degrees emission)

Tall lens (right, 35-degrees emission)

BOLB UVC LED 5x5 SMD Array Diagram with BCR type drivers (mm)

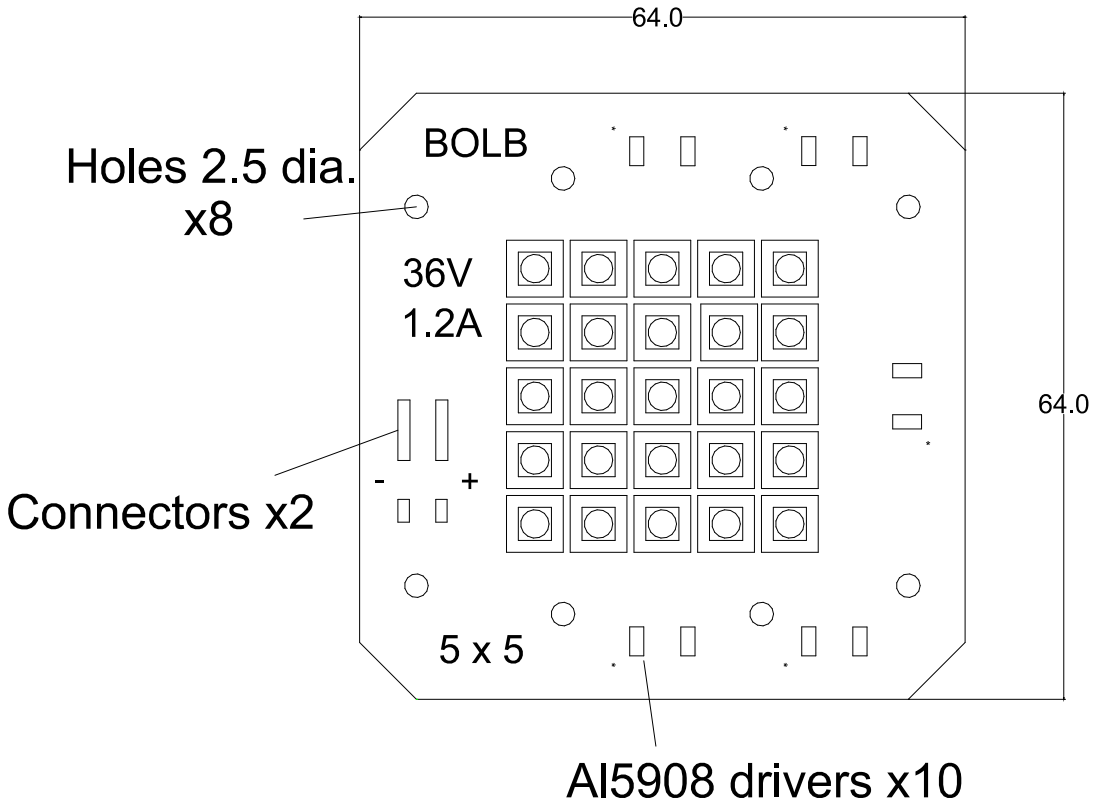


Circuit description:
5 parallel branches of 5-in-series LEDs
Each parallel branch has a separate driver for high fault-tolerance.
Input current, will stabilized and self-regulated by constant current drivers mounted on the PCB board.
Input voltage: stabilized 36-40 volts DC.

Power supply (voltage and current regulation) recommendation:
Output voltage: stabilized 36 volts DC , max driving current 1.8A
Power supply (voltage regulation only) recommendation:
Output voltage: 36 volts DC (>2A)
Battery recommendation:
Output voltage: 36 VDC (>2A)

BOLB UVC LED 5x5 SMD Array Diagram with new AL- type drivers (sizes in mm)

Start: July 2020



All circuits configuration, positions of holes, connectors and SMD are the same as in module with BCR type drivers.

5 parallel branches of 5-in-series LEDs
Each parallel branch has a separate driver for high
fault-tolerance

Input current: 2-3 Amp, will self-regulate to 250mA or 350mA per
chip, depending on customer request.

Input voltage: 36-40 volts, will self-regulate to ensure constant current output.

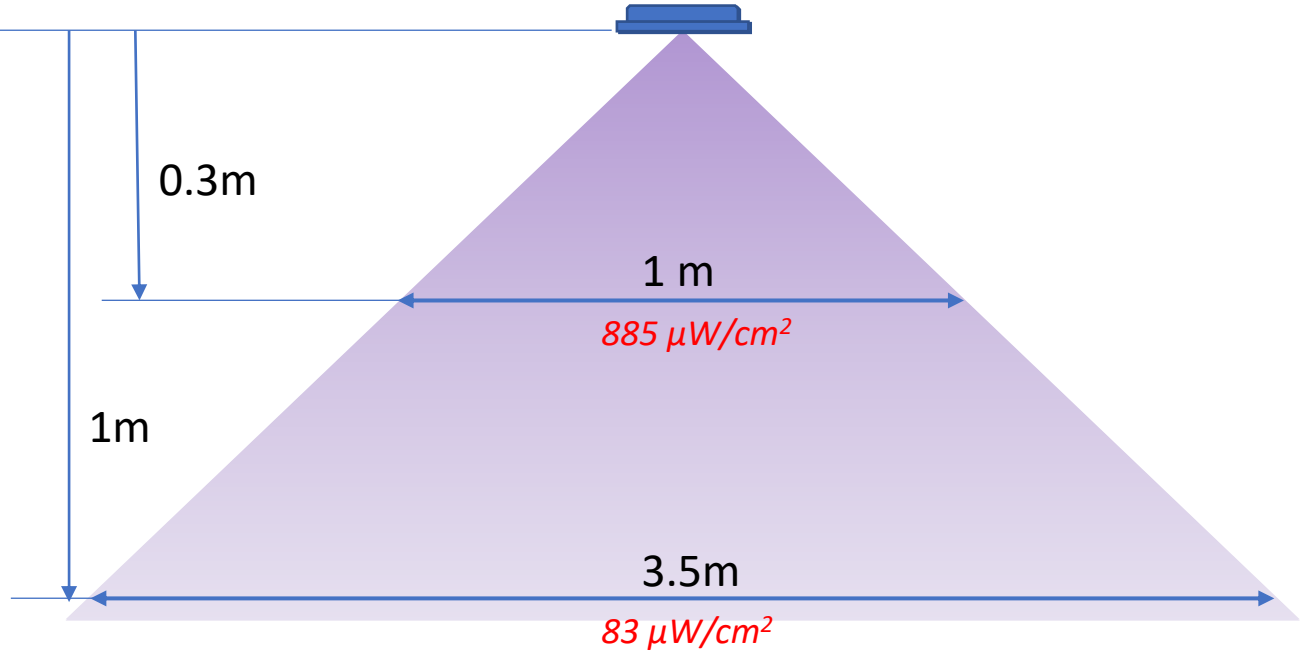
Performance at 25°C ambient and active cooling

Parameter	Symbol	Unit	Min.	Typ. 350mA/LED	Max 500mA/LED
Peak Wavelength	λp	nm	255	270	280
Radiant Flux	ϕe	W_{opt}	2.0	2.2*	2.5*
Forward Voltage (LED + Driver electronics)	VF	V	30	33	40
Forward Current	IF	A	-	1.75	2.50
Spectrum Half Width	Δλ	nm	-	11	-
View Angle	2θ½	°	-	150	-
Thermal Resistance	RJ-b	°C/W	-	<10 (TBD)	-

*G1N

Light intensity data for 5x5 UVC Lamp (25 chips) .

2.5 W_{opt} UVC LED Lamp HS lens



Irradiance values are very calibration-sensitive
It's not uncommon to see intensity meters calibrated for Mercury lamp provide wrong irradiance values by a factor of 2x-3x.

Please contact Bolb for assistance.

5x5 Module Low Lens Intensity Data (short distance)				
Distance, mm	**5**	**10**	**20**	**30**
Intensity, mW/cm²	**195**	**164**	**79**	**50**

Intensity data for 5x5 UVC LED Array (low-lens, with reflector 60 degree)

5x5 UVC LED Lamp
With Heatsink Attached

Irradiance values are very calibration-sensitive
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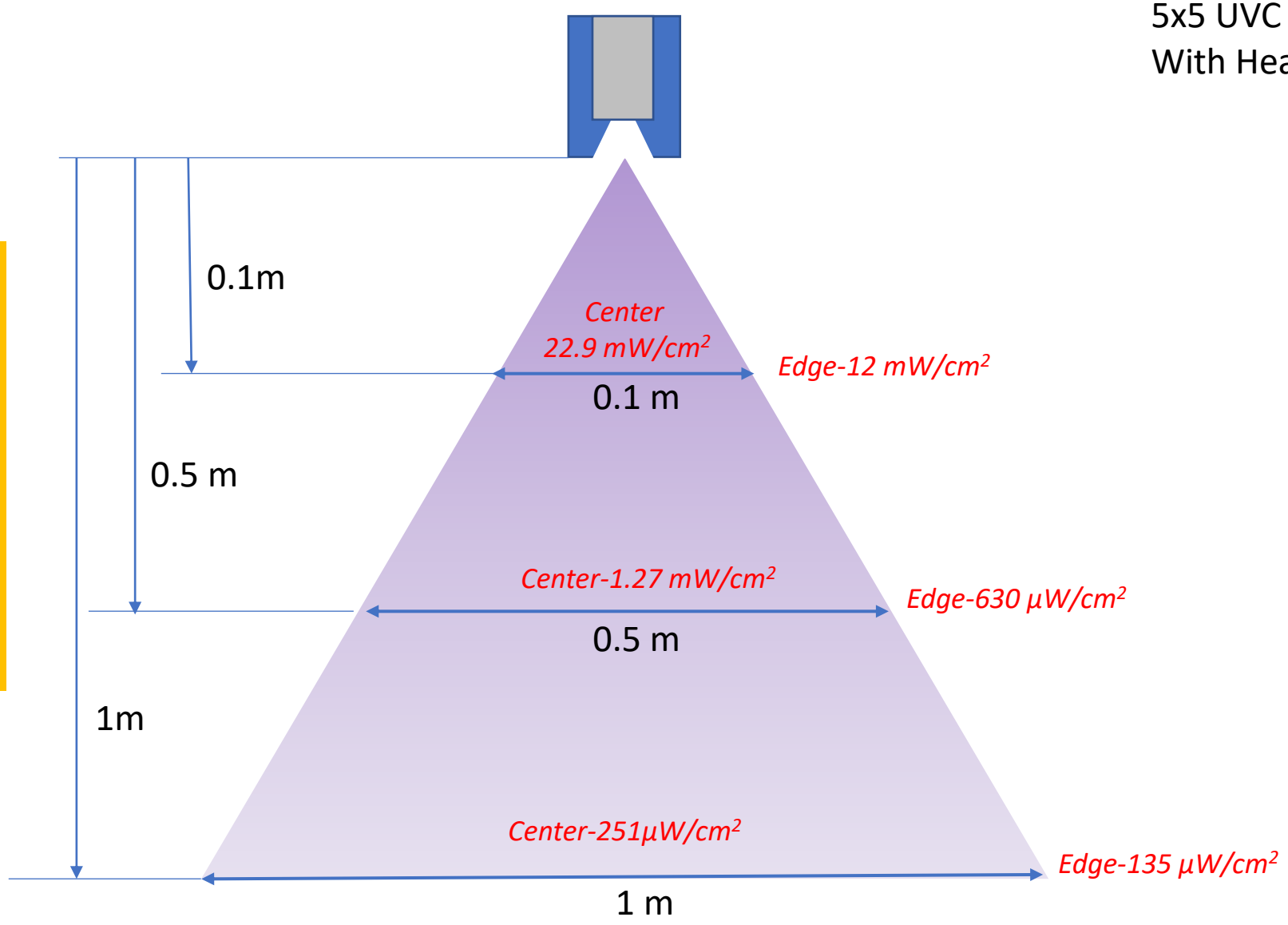


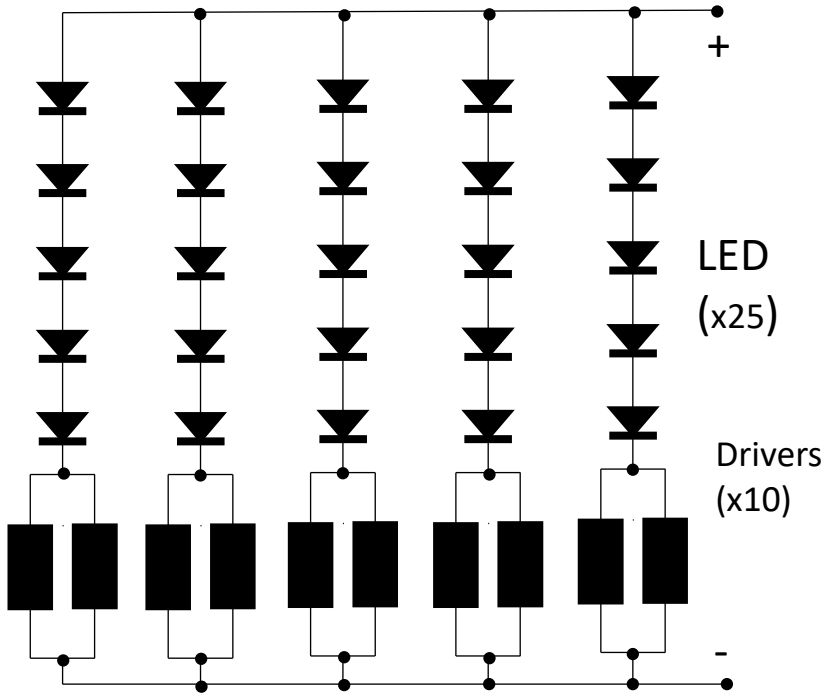
Comparison of Intensity data for BLAZAR lamp
with low-lens(L) 5x5 modules

Po Intensity (µW/cm2)		5x5 Module			BLAZAR with reflector		
		lateral distance (cm)			lateral distance (cm)		
	vertical distance (cm)	0	20	50	0	20	50
Blazar L 36V, 2.0W	20	1770	894	121	7660	553	1
	40	515	353	136	1700	609	32
	60	214	205	112	718	453	109
	80	133	119	81	394	284	118
	100	83	77	60	251	202	103
	120	60	56	46	176	145	84

Comparison of Intensity data for BLAZAR lamp
with tall lens (TL) 5x5 modules

Po Intensity (mW/cm2)		5x5 Module			BLAZAR with reflector		
		lateral distance (cm)			lateral distance (cm)		
	vertical distance (cm)	0	20	50	0	20	50
Blazar TL , 36V, 2.0W	20	5.75	0.74	0.06	8.65	0.50	0.00
	40	1.47	0.44	0.12	2.25	0.64	0.06
	60	0.66	0.26	0.10	0.92	0.41	0.10
	80	0.41	0.18	0.09	0.66	0.25	0.09
	100	0.28	0.27	0.08	0.41	0.23	0.09
	120	0.17	0.13	0.05	0.29	0.19	0.08

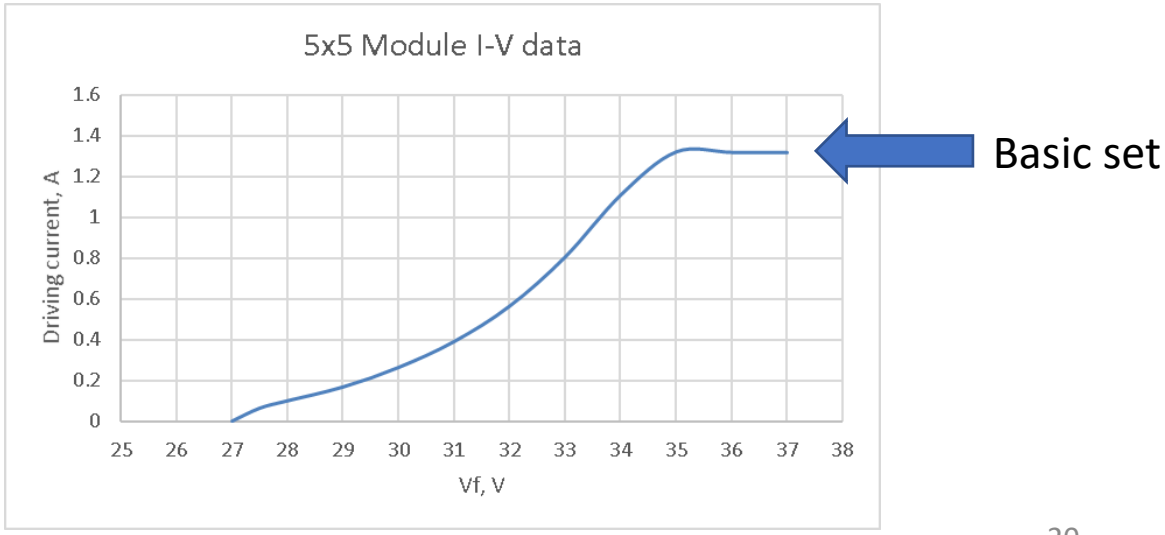
Schematic of Electrical Connections



Specifications

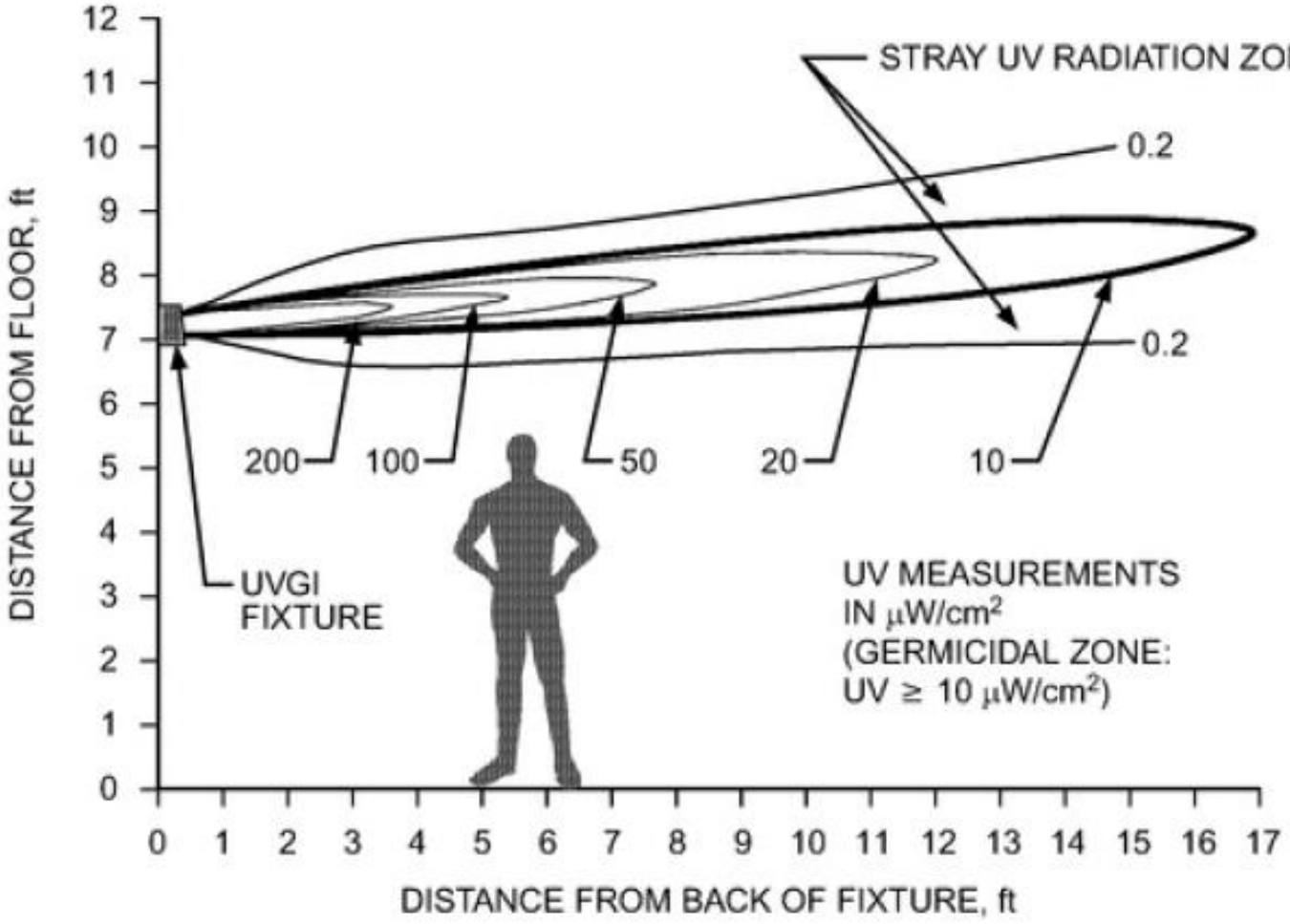
1. Active liquid cooling required for operation at >=100W.
2. Thermal paste required to mount PCB onto heatsink
3. Power supply- 36-40V DC, 3A with voltage stabilization.
4. PCB has 2 connectors (wires AWG-23 or 24) for connection to power supply. No soldering required.
5. Option: a fused silica protective cover

Driver I-V Can Be Set According to Customer Requests



FY21 BD/APP Focus Area: Upper Room Air UVGI Fixtures

Source: 2019 ASHRAE Handbook and: CIE TC 6-52



BOLB 5x5 Array
SMD6060 or SMD2020

Po Intensity (mW/cm2)		5x5 Module lateral distance (cm)			BLAZAR with reflector lateral distance (cm)		
	vertical distance (cm)	0	20	50	0	20	50
Blazar TL , 36V, 2.0W	20	5.75	0.74	0.06	8.65	0.50	0.00
	40	1.47	0.44	0.12	2.25	0.64	0.06
	60	0.66	0.26	0.10	0.92	0.41	0.10
	80	0.41	0.18	0.09	0.66	0.25	0.09
	100	0.28	0.27	0.08	0.41	0.23	0.09
	120	0.17	0.13	0.05	0.29	0.19	0.08

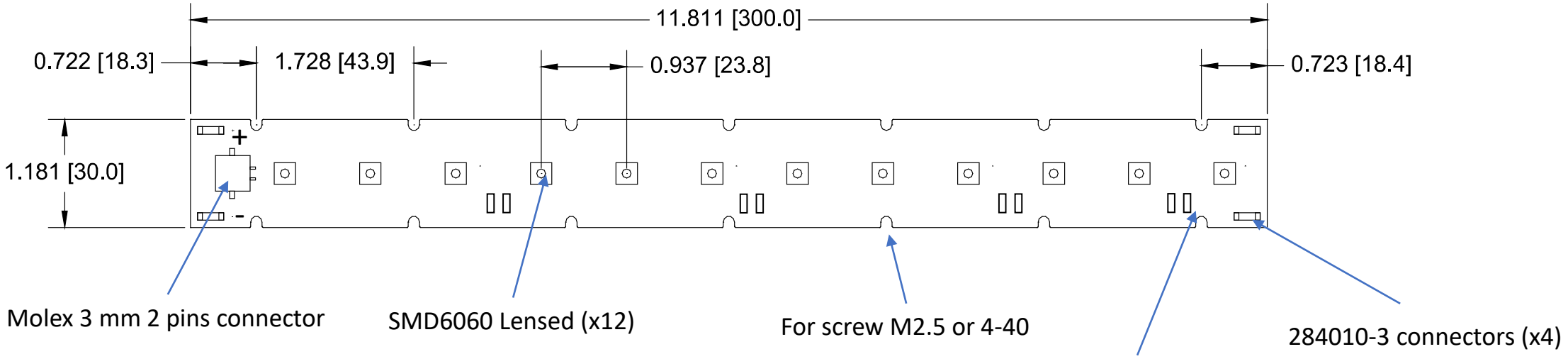
5X5 tall lens | 5x5 tall lens + reflector

Example at 4ft from fixture:
36W Hg lamp: peak 100µW/cm^2
5x5 Blazar: 170-290 µW/cm^2

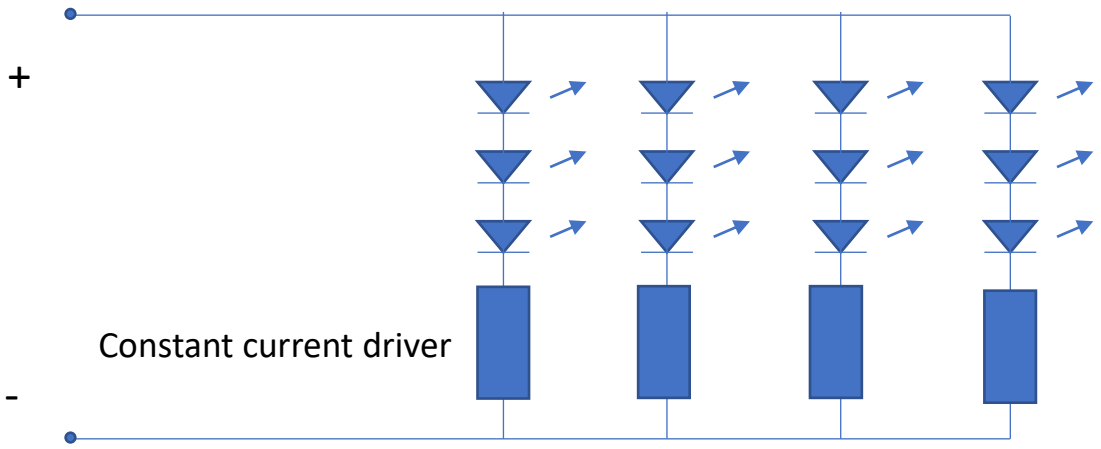
12” Stripe module

Heat sink is required

Units in inches [mm]



Electrical scheme



12” Stripe. Electrical connection- 3S4P with serial connected current stabilization driver for each branch.
Power supply- 24V DC , current set 0.8-1.4A (nominally set at 1.0A)

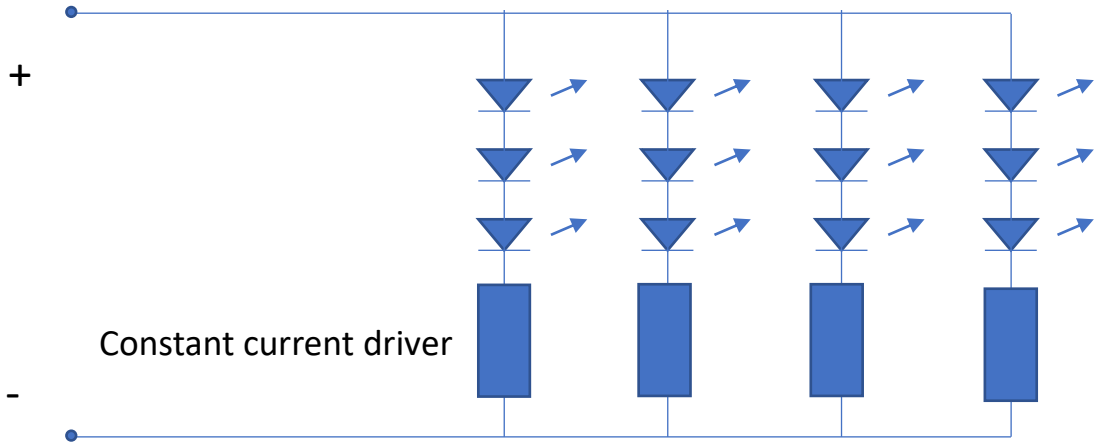
12” Stripe module performance at 25°C ambient and active cooling

Parameter	Symbol	Unit	Min. 100mA/LED	Typ. 250mA/LED	Max 350mA/LED
Peak Wavelength	λp	nm	255	270	280
Radiant Flux	ϕe	W_{opt}	0.5	1.2	1.8
Forward Voltage (LED + Driver electronics)	VF	V	22	24	28
Forward Current	IF	A	0.4*	1.0*	1.4*
Spectrum Half Width	Δλ	nm	-	11	-
View Angle	2θ½	°	-	150	-
Thermal Resistance	RJ-b	°C/W	-	<10 (TBD)	-

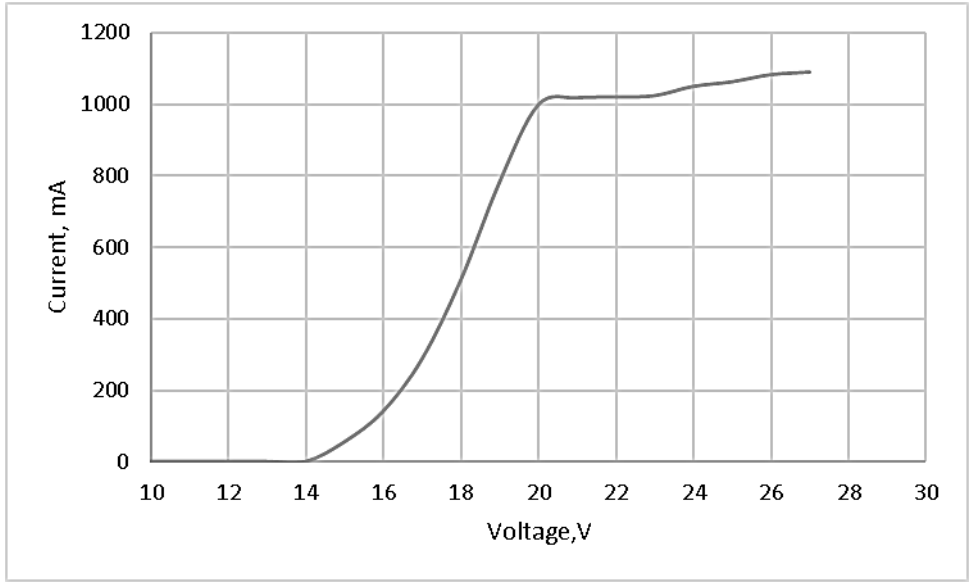
*set by BOLB (optional)

12” Stripe. Electrical connection- 3S4P with serially connected current stabilization driver for each branch.
Power supply- 24V DC , current set 0.8-1.4A (nominal setting: 1.0A)

Electrical diagram



I-V data for 12” Stripe module



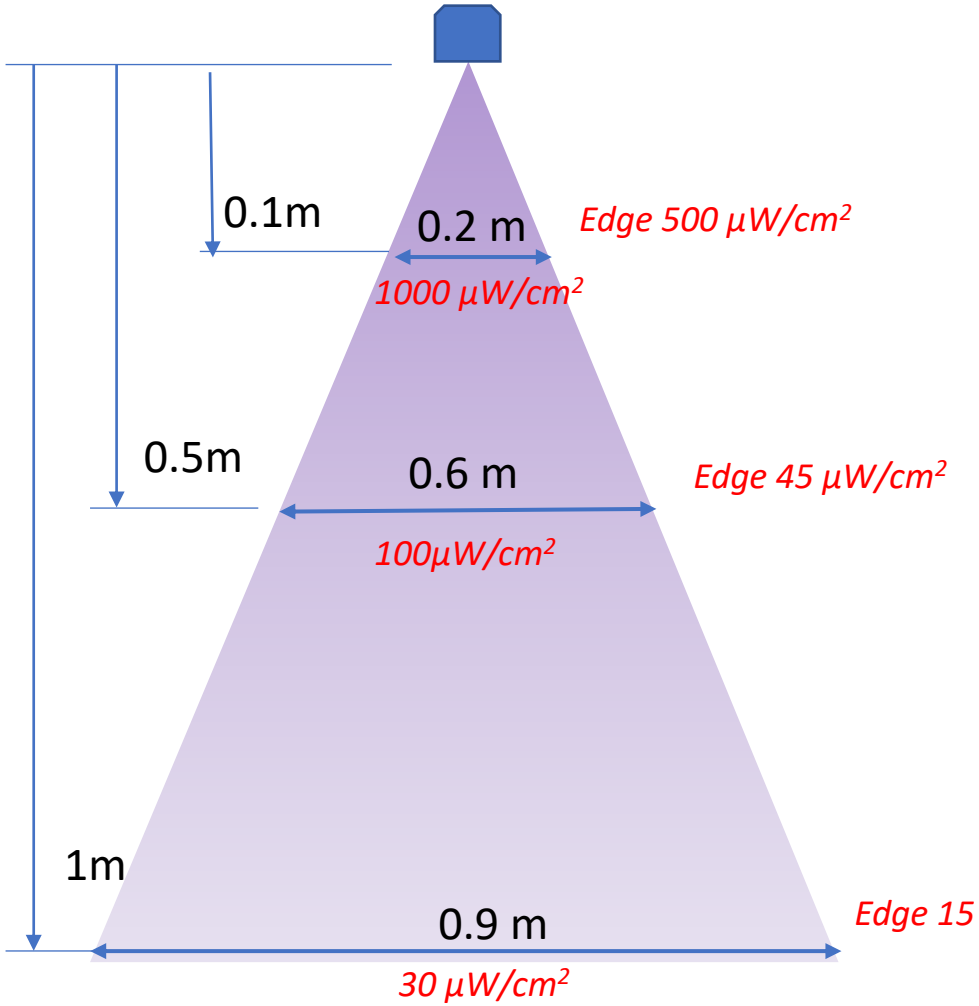
Irradiance values are very calibration-sensitive It's not uncommon to see intensity meters calibrated for Mercury lamp provide wrong irradiance values by a factor of 2x-3x.

Please contact Bolb for assistance.

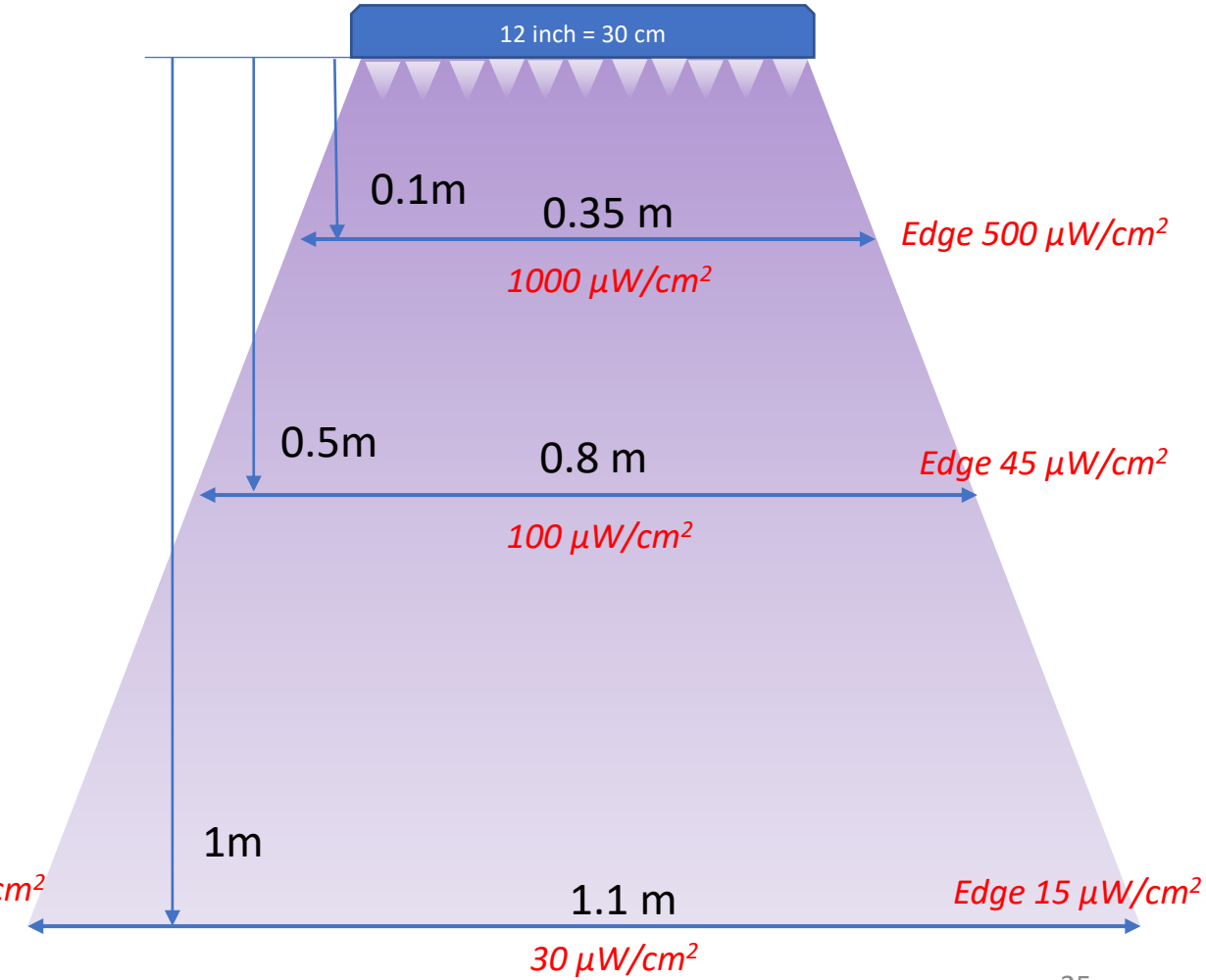
Light intensity data for 12" Stripe UVC Lamp

1.2W flux power (no reflector).

Beam spread profile looking from one end down the length of stripe

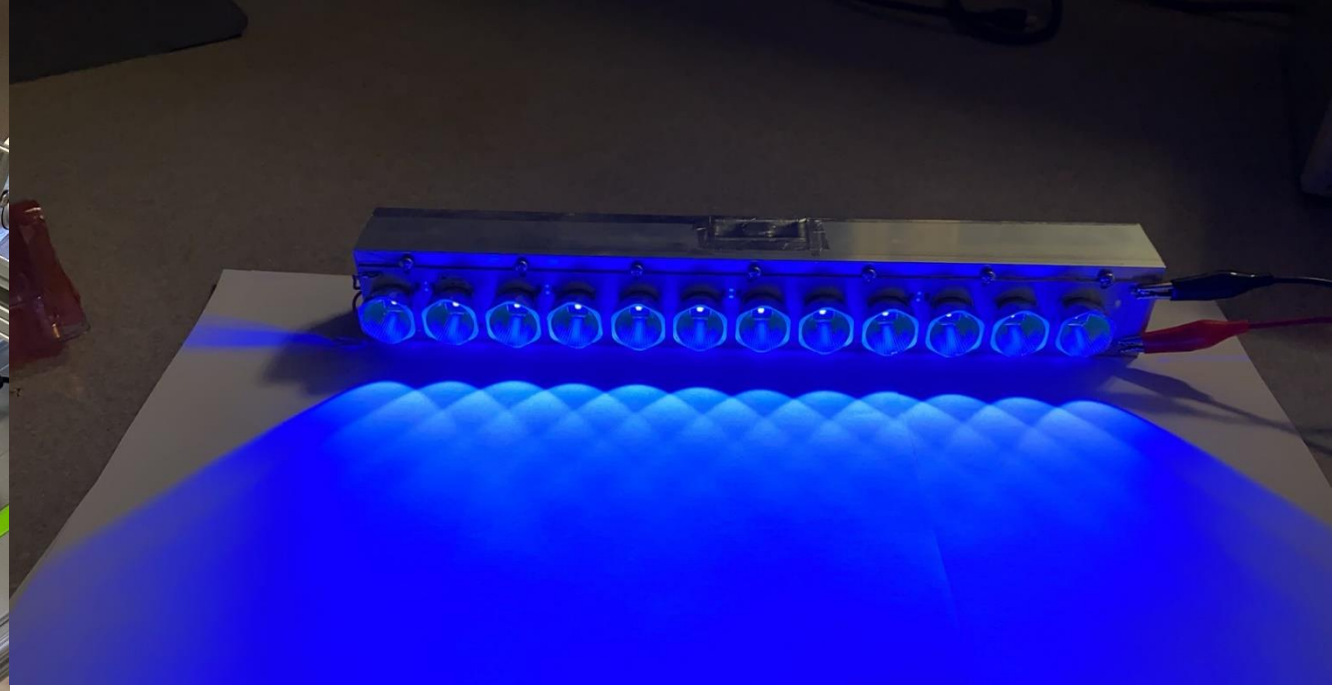


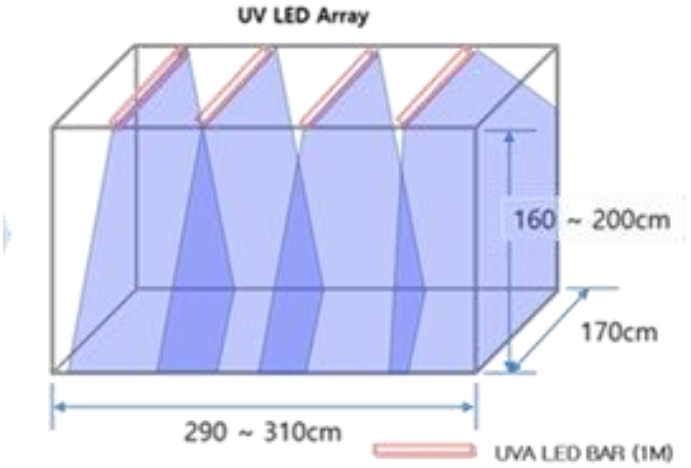
Lengthwise beam spread as viewed from the side of the stripe



Light intensity data for 12” Stripe UVC Lamp 1.2W flux power (no reflector).

12" Module Short Distance Intensity Data		
distance (mm)	Intensity above LED (mW/cm2)	Intensity between LED (mW/cm2)
5	18.0	7.1
10	12.2	9.5
15	7.9	6.7
20	5.7	5.5
30	3.8	4.0
40	2.8	2.7
50	2.3	2.2





Intensity @ 1.6m = 75uW
Intensity @ 2.0m = 48uW

Estimated time to achieve 99% kill of salmonella <100 sec

Version Notes:

V1.1 April 2020: Updated irradiance values based on silicon detector readings, added warning.
V1.3 May 2020: Updated external power supply requirements.
V1.5 January 2021: Updated for intensity data.

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