Cooling Solutions for the lighting industry

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The engineer's choice

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- Target markets
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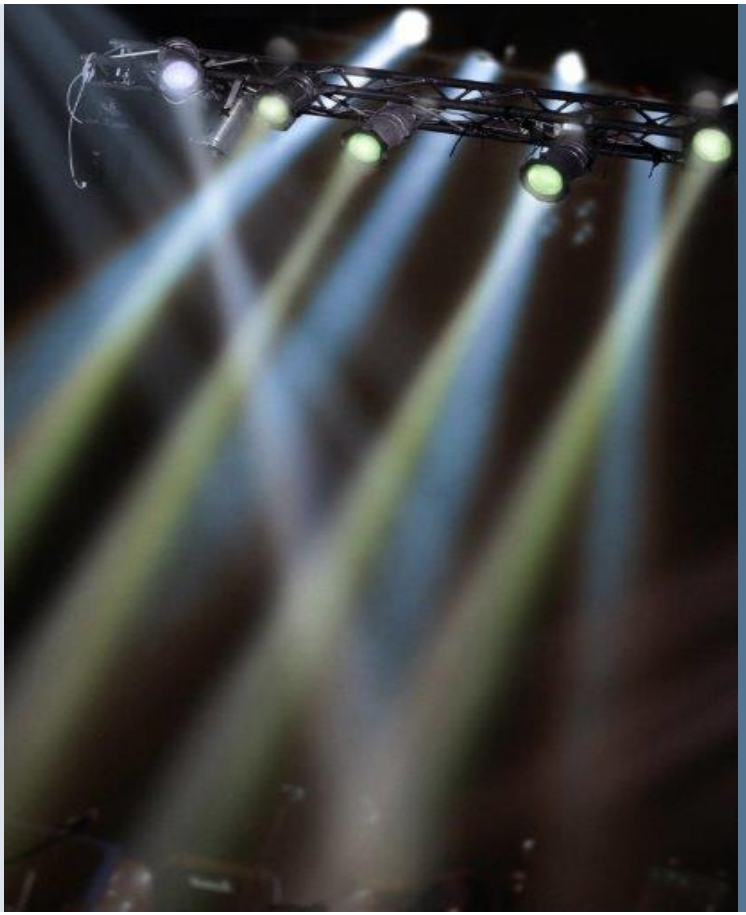
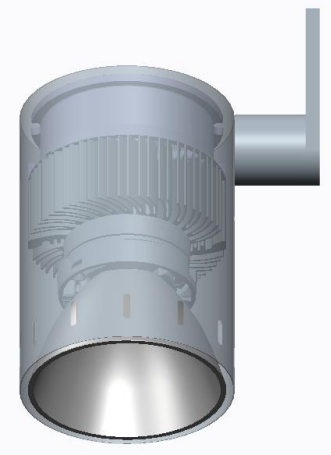
- Active cooling solutions for CoBs
- Key advantages of ebm-papst solutions
- Considerations for choosing an active cooling solution
- Brochure and datasheets



Lighting market overview / requirements

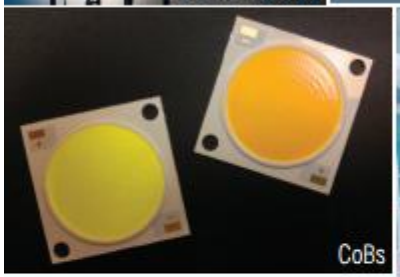
- Light engines and LEDs with a lumen count in excess of ~3000 lumens often require forced convection as a means to minimize the mechanical footprint of the solution. COBs (Chips-on-Board) are driving this trend.
- Active cooling enables longer life with quality CRI (color rendering index) and increased efficacy
- Air mover life expectancy must exceed that of the lumenaire (>50K hours)
- Target markets include architectural, retail, industrial, arena, theatrical and commercial
- Spot, track, cylinder, high bay & “downlights” are strong candidates for active cooling solutions

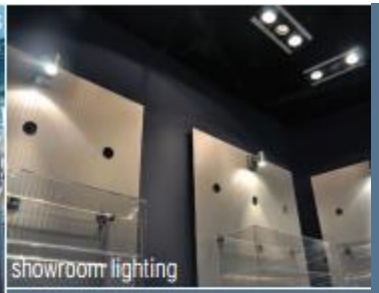


Why ebm-papst?

- Industry leader in air movement technology, design and thermal management competence
- Global organization
- Reputation for the world's highest quality fan and blower products
- Strong synergy with lighting market requirements
- Total solutions provider
- Diversity of market solutions

Target markets





Benefits of active vs. passive cooling

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- **Size** Fixture sizes can be reduced by 4-6X
- **More light**! 50-100% increase in lumen output compared to a passively cooled fixture
- **Reduced cost $** Elimination of large and costly heat sinks
- **Improved lifetime and CRI!** Reduction in LED junction temperatures delivers a longer lifetime for the lamp and higher CRIs

Active cooling solutions for CoBs

- CoBs are an ideal candidate for active cooling solutions due to high thermal power and ability to drive light output higher within smaller form factor lamp designs
- ebm-papst offers a wide variety of reference designs for common CoBs and light engines including CREE, Bridgelux, Philips, Xicato, Luminus and others
- Current reference designs offer the industry's quietest fan operating at only 7 dB(A) - humans cannot hear below 12 dB(A)

Reference designs for common CoBs and light engines
More are on their way!

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Nominal Data		Nominal voltage	Acoustic noise	Thermal power dissipation capability*	Fan speed	Total mass	Power input	Lifetime (at 20°C)	Lifetime (at 20°C)	Lifetime (at 40°C)	Lifetime (at 40°C)
CoB / LED OEM	**Type**	**VDC**	**dB(A)**	**W**	**rpm**	**g**	**W**	**hours**	**years**	**hours**	**years**
High Powered CoBs	PG1W-012-119-XX	12	16	150	1200	582	1.1	176,000	20.0	97,500	11
Bridgelux Vero 10/13/18	PG1W-012-060-13	12	7	60	1800	197	0.18	197,500	22.5	87,500	10
Bridgelux Fortimo SLM	PG1W-012-060-09	12	19	130	3000	672	0.42	137,500	15.7	80,000	9
Cree CXA 20/25	PG1W-012-060-07	12	7	50	1800	227	0.18	197,500	22.5	87,500	10
Cree CXA	PG1W-012-060-08	12	7	50	1800	627	0.18	197,500	22.5	87,500	10
Cree LMH2	PG1W-012-060-11	12	7	73	1800	191	0.18	197,500	22.5	87,500	10
Philips SLM	PG1W-012-060-06	12	7	50	1800	217	0.18	197,500	22.5	87,500	10
Xicato XSM	PG1W-12-60-M3BN**	12	7	38	1800	147	0.18	197,500	22.5	87,500	10
Xicato XLM	PG1W-12-60-L3BN**	12	7	53	1800	277	0.18	197,500	22.5	87,500	10

Note: Voltages are based on base fan models. Other voltages available upon request. Lifetime L_{10} per IPC 9591.
**Various mounting options available. Refer to data on pages 17-18 of this brochure. *Application dependant.

Key advantages of ebm-papst solutions

- Reliability / Lifetime
- Low noise 7 – 20 dB(A)
- Efficiency
- Design / Engineering support = CFD
- Improved light quality
- Higher CRIs
- Lower LED junction temperatures
- Smaller fixture designs
- More light output / less fixtures needed

Reliability / Lifetime

- Lighting market demands ultra high reliability components - this includes fans
- Most lighting OEMs offer a 5 to 10 year warranty
- ebm-papst fans have lifetime values in the 100k-200k hour range (10-20 years) - “ebm-papst fans will outlive everything in the lamp!”
- ebm-papst manufactures the world’s most reliable fans

Lifetime values - axials

Type		Series	Dimensions	Temperature range	Lifetime	Lifetime
			mm	°C	hours	years
Axials		400, 400F, 412F	40 x 10 / 20	-20... +85°C[1]	120,000 / 90,000 / 115,000	13.7 / 10.3 /13.1
		500F	50 x 15	-20...+85°C[1]	120,000	13.7
		600F, 620	60 x 15 / 25	-20...+85°C[1]	120,000 / 305,000	13.7 / 34.8
		8200J, 8400N, 8450	80 x 38 / 25	-20...+70°C[2]	237,500 / 305,000 / 305,000	27.1 / 34.8 / 34.8
		3200J, 3400N	92 x 38 / 25	-20...+70°C[2]	265,000 / 305,000	30.3 / 34.8
		4100N, 4300, 4400F, 4400FGLLA	119 x 38 / 32 / 25	-20...+75°C[3]	305,000 / 322,500 / 285,000	34.8 / 36.8 / 32.5

Lifetime values - radials

Type		Series	Dimensions	Temperature range	Lifetime	Lifetime
			mm	°C	hours	years
Radials		RLF35	51 x 15	-20...+70°C[3]	227,500	26
		RL48	76 x 27	-20...+70°C[2]	265,000	30.3
		RL65	97 x 93.5 x 33	-20...+70°C[2]	227,500	26

Notes:[1] -4 to 185°F; [2] -4 to 158°F; [3] -4°F to 167°F
Lifetime L10 per IPC 9591 at 20°C ambient. Values are dependent on speed and application

Low noise

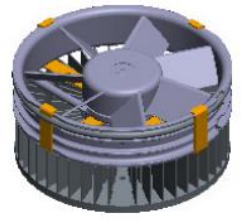
- Industry-leading low acoustic noise performance
- Fans with noise signatures as low as 7dB(A). Competitors are 16dB(A) and higher.
- Ambient noise in an office is 35 dB(A)
- Humans cannot hear below 12 dB(A)
- Virtual silent operation
- Major advantage for ebm-papst solutions!

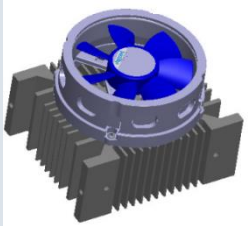
Efficiency

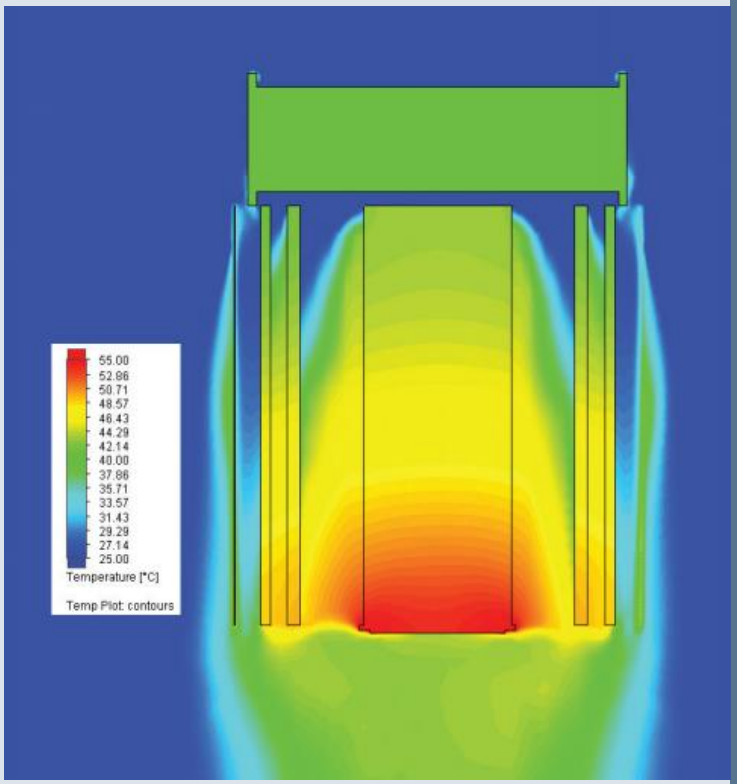
- ebm-papst offers active cooling solutions that draw as little as less than ½ of 1 watt of energy
- German designed motors offer industry leading efficiency
- ebm-papst products share strong synergy with utility green initiatives and installation requirements

Design / Engineering support

- Strong design resources at our North American headquarters allow for tailored and customized cooling solutions to exact customer requirements
- CFD (computational fluid dynamic) CAD is used to design and optimize the cooling solution to customer specifications
- Speeds up design process for customized solutions







Considerations for choosing an active cooling solution

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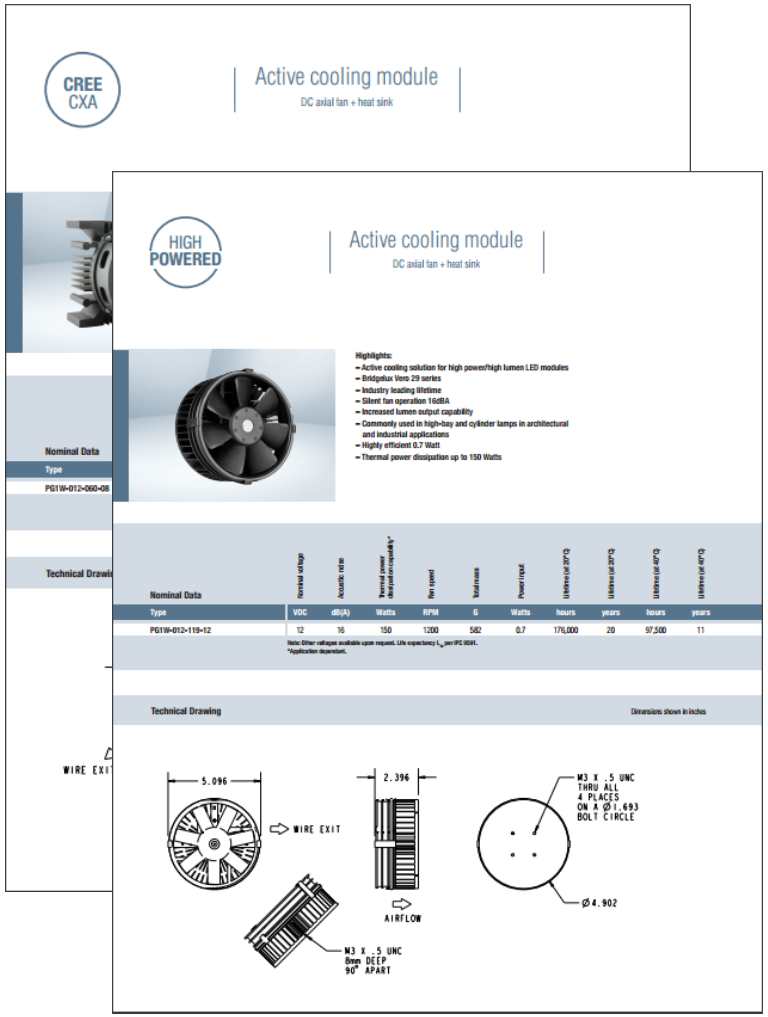
- How many lumens are to be cooled?
- What is the configuration? (cylinder, track, etc.)
- What is the thermal power (watts)?
- What is the maximum mechanical envelope size for the active cooling solution?
- What is the acoustic limit for your design?
- What is the target hour life for the lamp / fan?
- What is the voltage range available for the fan?
- What is the target price for the fan or fan-sink cooling assembly?
- CoB, light engine or other?
- What is the LED target case / junction temp?

Brochure and datasheets

(Click on image to “go-to”)



Thank you

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