



CELMA

*Federation of National Manufacturers Association for
Luminaires and Electrotechnical Components for
Luminaires in the European Union*



Joint CELMA / ELC LED Forum Light + Building Fair 14 April 2010

2010 State of the art of LED modules

Dr. Peter Besting

LED modules Overview

- LED modules may well be the **lamps of the future**
- Many LED based luminaires will be using a LED module



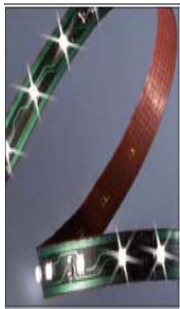
- A great variety of point, line and surface LED modules is expected to cover all outdoor and indoor, professional and consumer applications

LED modules

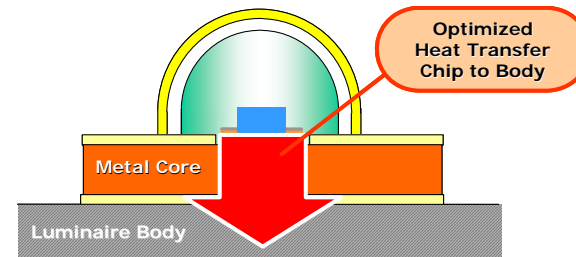
Benefits

- LED modules provide all the benefits of basic LED technology
- Depending on the application, LED modules can offer **distinct advantages** over LED lamps

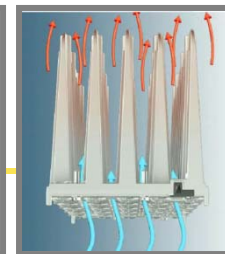
- Freedom /Flexibility for luminaire design
e.g. dimensions & geometry



- Optimization of technologies
e.g. thermal behaviour



- Customized solutions & new opportunities



LED modules Classification

■ Integral versus built-in



Integral

i.e. module not replaceable
after integration in the luminaire



Built-in

i.e. module can be exchanged
without damaging the luminaire

■ Self-ballasted versus non-self-ballasted



Self-ballasted

i.e. driver included in the module,
module can be connected directly to mains



Non-self-ballasted

i.e. separate driver required,
connection to mains via driver



LED modules Performance

■ Efficacy

- Today: Indoor – 60 lm/W Outdoor – 90 lm/W
- **Energy efficiency** has become a **key buying factor**

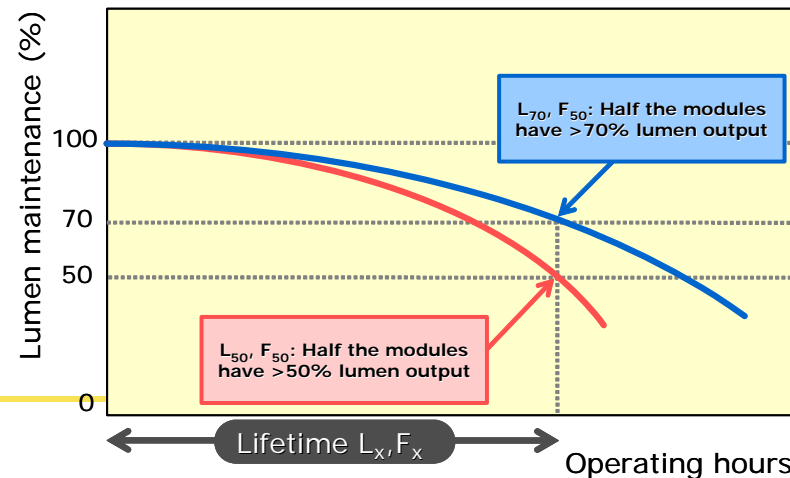
■ Light Quality

- All CCTs available from **warm white** to **cool white**
- Multi-phosphor: CRI > 90



■ Lifetime & Failure rate (L_x, F_x)

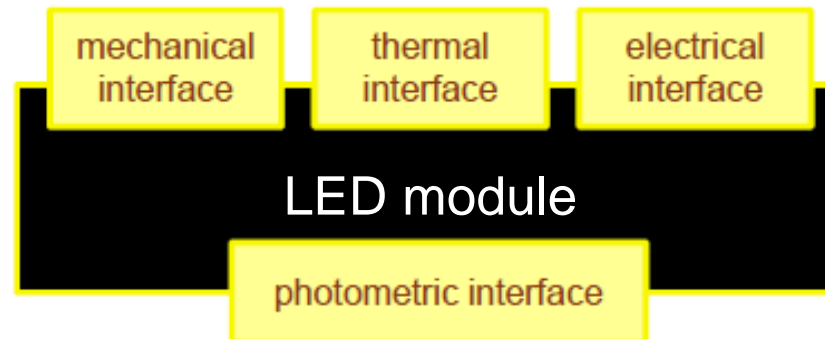
- Lumen maintenance combined with survival factor





LED modules Interfaces

- LED modules are interlinked via **external interfaces** to the luminaire



- LED modules also have various **internal interfaces**
 - Mechanical and thermal connection of LED to PCB
 - Power supply from driver to LED with brightness & colour control (CCT tuning) and failure protection



LED modules Standardization & Regulation

- **Standards** are the basis of **transparency & comparability**

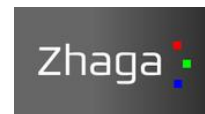
- Essential specifications on Safety & Performance
- Characterization of features and measurement methods



- **Regulations** specify **legally binding** minimum requirements

- Regulations usually refer to the relevant international standards.

- Interface standardization enables **stable design platforms** for luminaires makers and create further market confidence and market growth



- LED modules are also available as **customized solutions**



LED modules Future EcoDesign

Part 2 – Efficacy

- EU regulations specifying **minimum** performance levels are in progress. Corresponding ELC/CELMA proposal just published
- EU implementation expected 2011
- ELC/CELMA propose to allow only LED modules with efficacy levels **>50 lm/W** (2012) increasing to **>60 lm/W** (2015)

Application date	Maximum rated power for a given rated luminous flux (Φ)		
Stage 1 (ca. 2012)	$P_{\max} = 0,24v\Phi + 0,0103\Phi$...	for $\Phi = 600 \text{ lm}$
	$P_{\max} = 0,0200\Phi$...	for $\Phi > 600 \text{ lm}$
Stage x (ca. 2015)	$P_{\max} = (0,24v\Phi + 0,0103\Phi)/1,20$...	for $\Phi = 600 \text{ lm}$
	$P_{\max} = 0,0167\Phi$...	for $\Phi > 600 \text{ lm}$

Note: These values apply for self-ballasted modules measured at maximum operating temperature after degradation of 15%. The efficacies apply to all CCTs, i.e. also for warm-white (least efficient LEDs).



- Performance levels specified relate also to parameters determining **light quality**, e.g. Colour Rendering Index

Functionality parameter	Stage 1		Stages 2 and 3	
Minimum lamp lifetime (for L70,F50)	= 15000 h			
Minimum number of switching cycles before failure	= 7500 cycles (30 sec on/off) without failure			
Power Factor	P = 2 W	None	P = 2 W	None
	2W < P = 25W	PF > 0,50	2W < P = 25W	PF > 0,55
	P > 25W	PF > 0,90	P > 25W	PF > 0,90
Starting time	< 0,5 sec			
Run-up time to 95% rated lumen output	< 30 sec			
Max. early failure rate (at 10% of rated life in hrs)	= 2%			
CRI (acc CIE 13.3:1995)	> 80 (resp. > 65 for Outdoor and Industrial applications)			

- The relevance of **CE compliance** increases. Effective **market surveillance** and enforcement is of growing importance



Conclusion

- ELC & CELMA are actively lobbying EU Commission to embody these recommendations for LED modules in future EcoDesign Regulation on Directional Lamps



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**Thank you very much
for your kind attention!**

www.celma.org – www.elcfed.org