

PHILIPS LUMILEDS

Obtaining the Highest Candle Beam Power for Spotlights

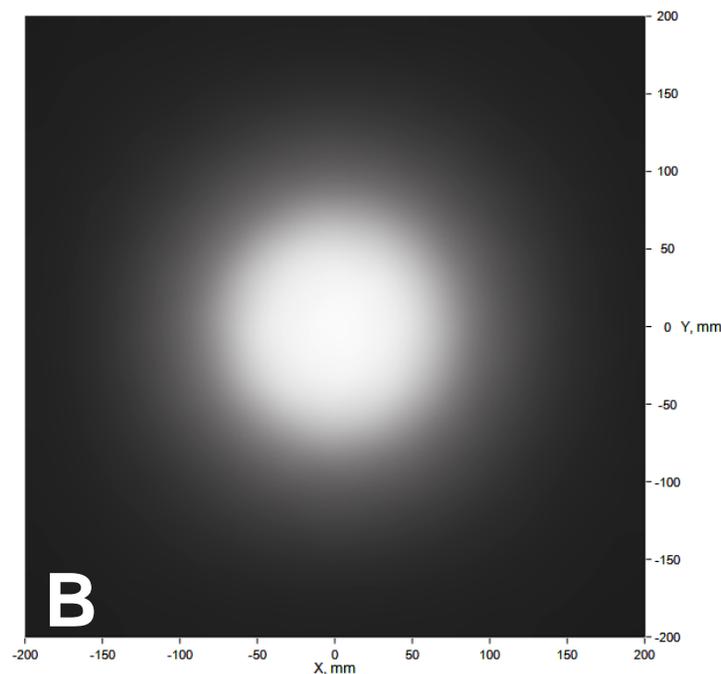
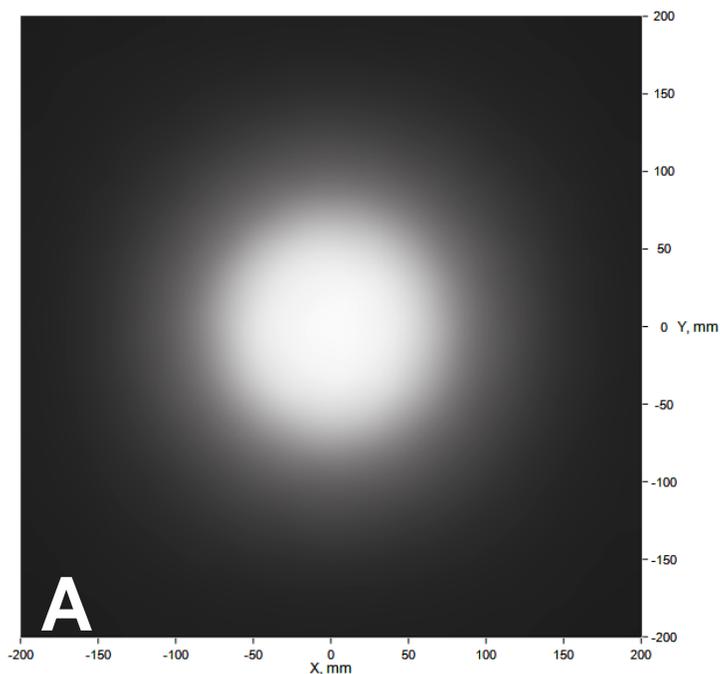
March 6, 2013

Orson Lo, Philips Lumileds Product Manager
Eric Senders, Philips Lumileds Segment Manager
Ramus Hautala, LEDiL Oy Business Director



Brightness of light source

Two identical 10° spots. Which source is brighter?



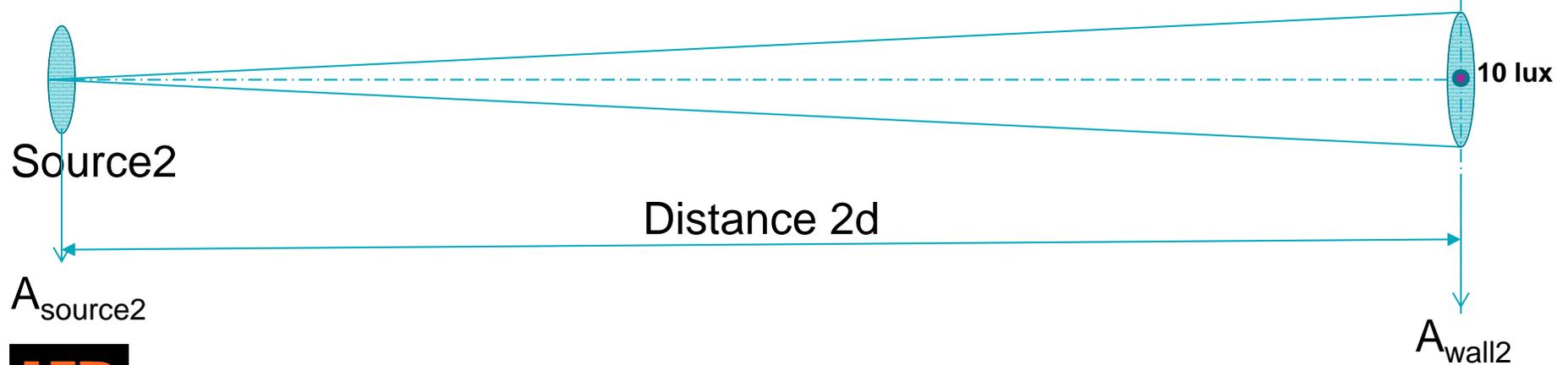
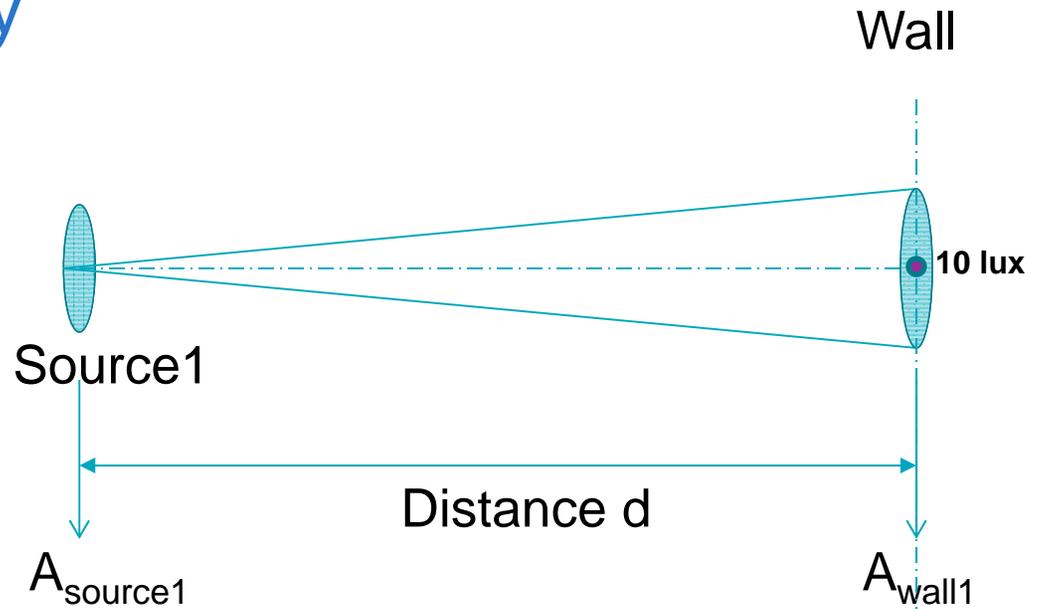
Depends on distance from wall, lamp size, reflector size.

Illuminance & Intensity

To get equal Illuminance on wall,
 I_{source2} needs to be $4 \cdot I_{\text{source1}}$



Source 2 needs to be 4 times brighter
than Source 1 at twice the distance



Imagine same distance: What about lamp size?

Assuming we need ~4000 lm

- Which one has the highest lumen density?
- Which one has the lowest?

Lowest Lumen density



Highest Lumen density



This results in the following light situations

Low Lumen Density:
Uniform, Diffuse lighting



High Lumen Density:
Intense, impactful lighting



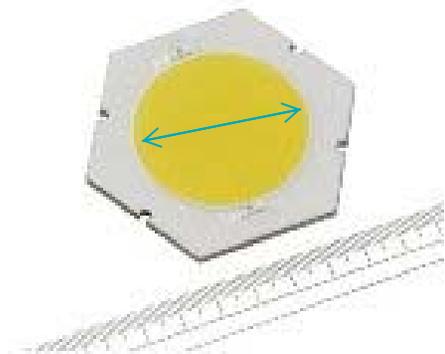
Courtesy: Amerlux, Cloé Boutiques Las Vegas, US

The same situation would be valid for LED

Imagine ~7000 lumens needed

More diffuse

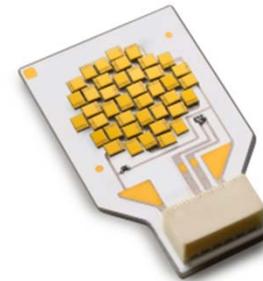
Light Emitting Surface
determines



7000 lm out of **35mm LES**

More impact

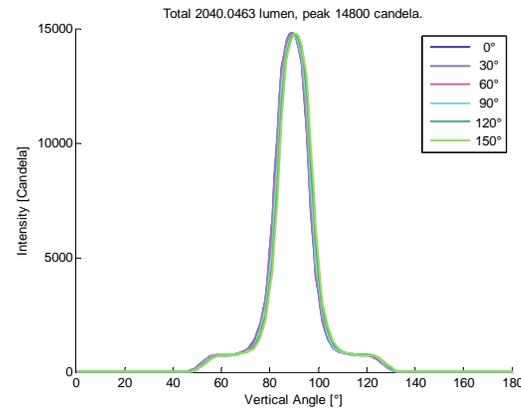
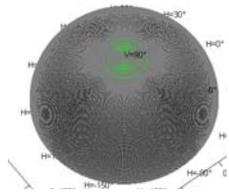
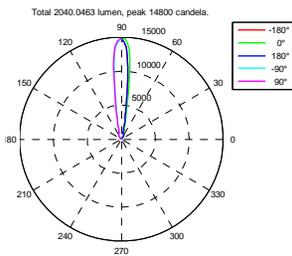
Light Emitting Surface
determines



7000 lm out of **17mm LES**

Competitive Analysis

What does a smaller LES mean?
Assuming a given reflector (height and diameter)

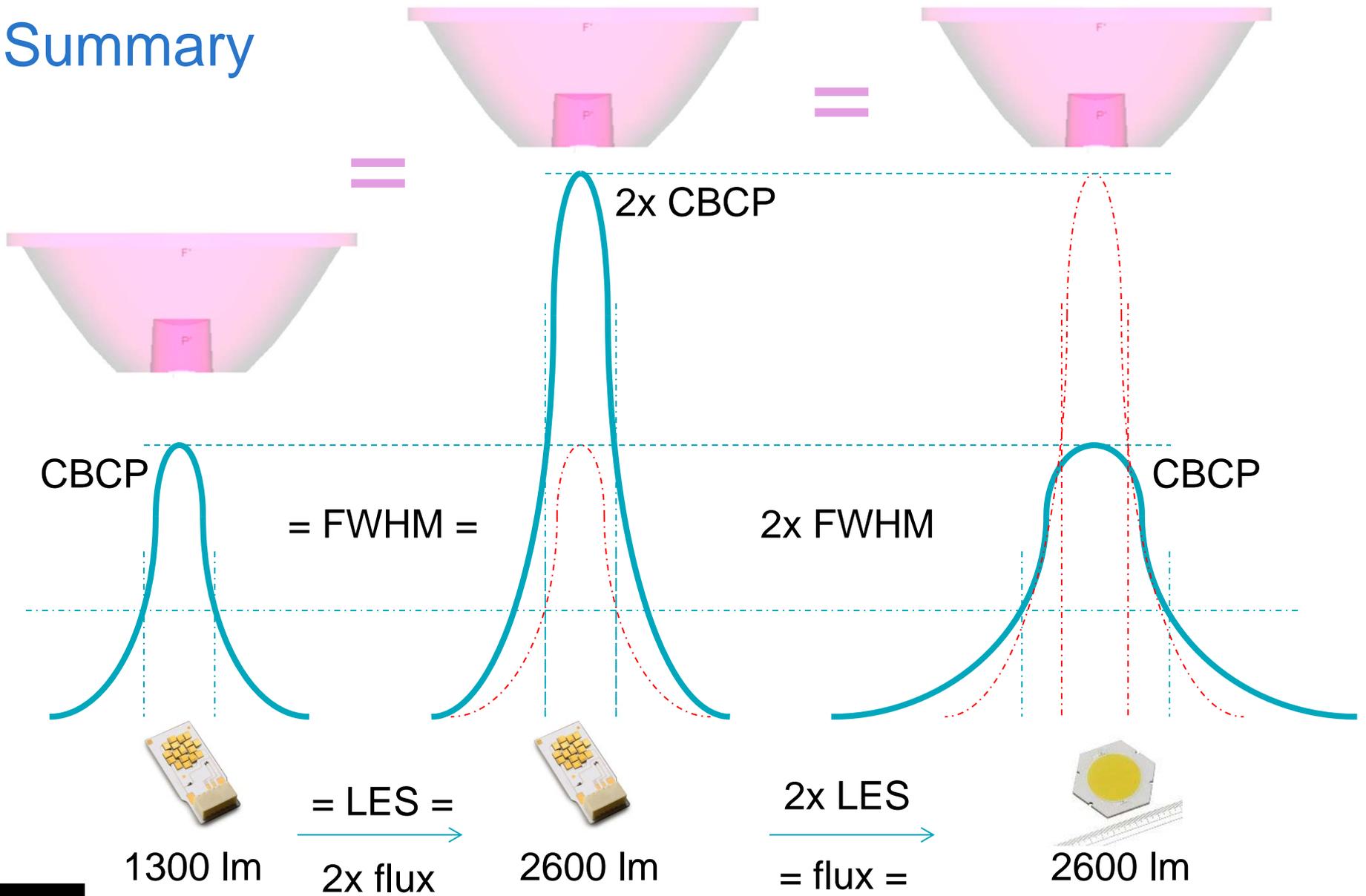


	LED option 1	LED Option 2
Flux (lm)	2000 lm	2000 lm
LES (diameter)	17 mm	35 mm (x2)
FWHM degrees	10°	20° (x2)
Candelas per lumen	15 Cd	10 Cd (x0.67)
Example Cd @ 2000lm	30,000 Cd	20,000 Cd



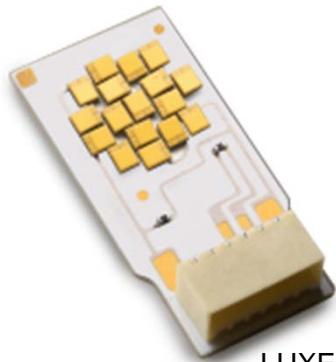
Leading in LES means smaller beam angles and better Center Beam Candle Power

Summary



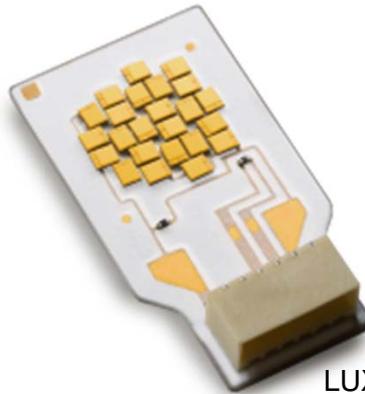
LUXEON S leading in Lumen Density

Leading LES for different lumen packages



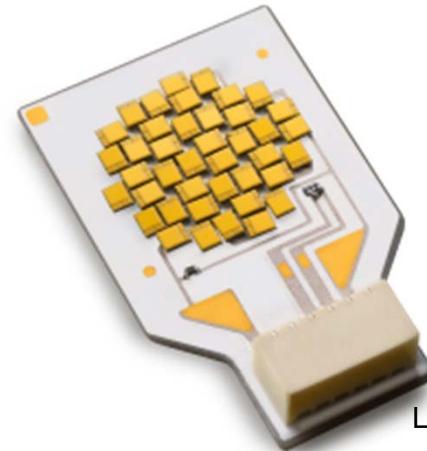
LUXEON S2000

700mA
2600 lm



LUXEON S3000

700mA
3700 lm

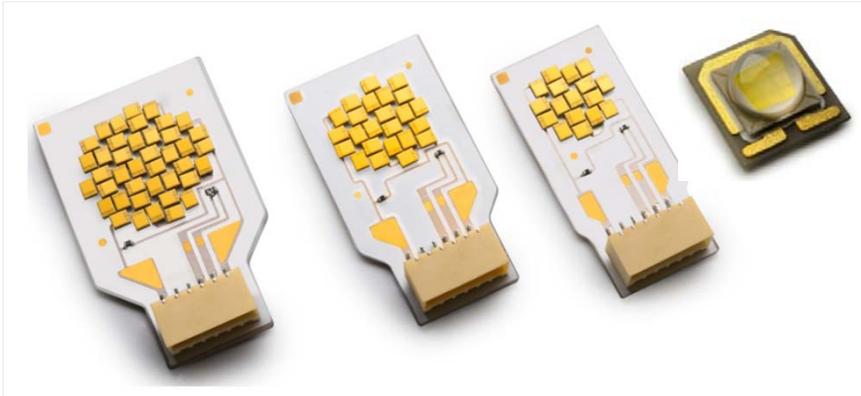


LUXEON S5000

700mA
6300 lm

LUXEON S High Lumen Density Family

Best punch and easy integration



Product Description

High lumen and density array with elegant solderless clamping solution at compact footprint

Copy Points

Punch, lumen density, beam angles, R9, color over angle, solderless

Target Application

Spotlights, Architecture, Entertainment

Product Value Proposition

Brings merchandises to life because it packs a punch and creates sharp shadow due to its high density, crisp, sparkling, high R9 light beams

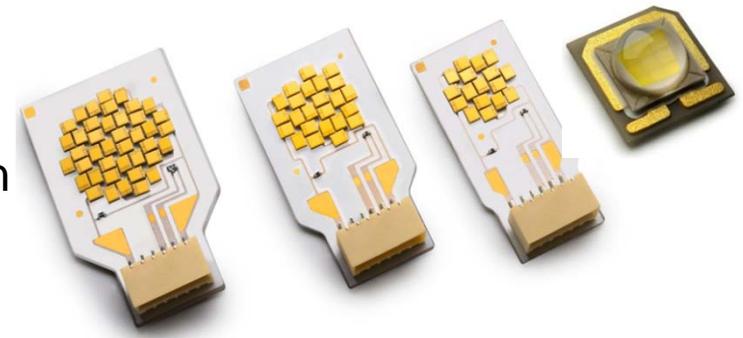
Features/Benefits

- Industry leading flux density $>50 \text{ lm/mm-sq}$, $>50\text{K}$ candela, make narrow beam possible at compact footprint in 1000-8000+ lumen packages
- $<15\text{-}20 \text{ pt}$ color over angle enable uniform and consistent light fixture color point
- $>80 \text{ R9}$ lights merchandises up with vivid color
- Single 3-step MacAdam, flux, and V_f binning simplify design and eliminate bin management
- On board connector allow solderless assembly

LUXEON S High Lumen Density Family

High lumen/density array with solderless clamping and compact footprint

- >50 lumen per mm-sqrd flux density, >50K candela
- <15-20 pt color over angle
- >80 R9 output
- Single 3-step MacAdam, single flux and V_f bin
- On board UL rated connector and NTC chip
- 1000-8000+ lumen packages



Brings merchandises to life because it packs a punch and creates sharp shadow due to its high density, crisp, consistent, high R9 light beams



LUXEON S High Lumen Density Family

Why is center beam candle power so important

- Why is **Center Beam Candle Power** so important?
 - It enables **smaller optical solutions**
 - It enables **lower beam angle designs**
 - It creates **more crisp beam** like halogen, unlike diffuse fluorescent lighting
 - It allows customers to work with optical reflectors in addition to lens which are:
 - **Lower cost**
 - **More efficient**
 - **More glare friendly**

LUXEON S High Lumen Density Family

Ideal replacement for CDM lighting

LUXEON S

Traditional CDM



Start/warm up time	<ul style="list-style-type: none"> Instant on 	<ul style="list-style-type: none"> >3-5 min
Dimmability	<ul style="list-style-type: none"> Dimmable down to <10% at improved Lm/W 	<ul style="list-style-type: none"> Need extra dimming electronics at lower Lm/W
Lifetime L70 (70% lumen output)	<ul style="list-style-type: none"> >60,000 hrs* 	<ul style="list-style-type: none"> 12,000-15,000 hrs
Quality of light	<ul style="list-style-type: none"> >80 R9, >90 CRI 	<ul style="list-style-type: none"> >80 R9, >90 CRI
Color consistency	<ul style="list-style-type: none"> <3 step MacAdam 	<ul style="list-style-type: none"> 4-5 step MacAdam
Efficacy**	<ul style="list-style-type: none"> >90 Lm/W 	<ul style="list-style-type: none"> >90 Lm/W
Environmental impact	<ul style="list-style-type: none"> No hazardous materials, no UV and IR emission 	<ul style="list-style-type: none"> Contain Mercury, emit UV and IR

* Lifetime strongly depend on operating conditions (i.e., operating current, operating temperature)

** LUXEON S 2000/3000/5000 typical efficacy for 3000K 80CRI, average lamp efficacy for CDM

LUXEON S High Lumen Density Family

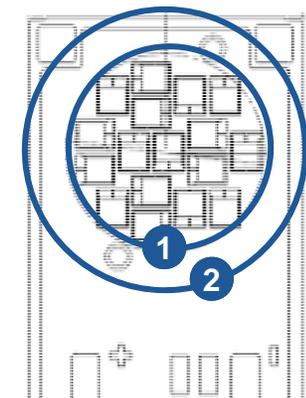
Delivers higher lumen density and better color over angle

LUXEON S value vs next best alternative

- Company A COB light emitting surface is **92%** larger vs. LUXEON S2000
- LUXEON S2000 has **94%** higher lumen density*
- Color-over-angle (COA) for LUXEON S2000 is up to **50%** better
- LUXEON S2000 offers **elegant solder less clamping** that enable easy integration and lower system cost

Detailed competitive comparison vs. Citizen

Product	Diameter mm	LES mm ²	Lumen density* Lm/mm ²	COA points	Connector
1 LUXEON S2000	10.5	86	45	<15-20	YES
2 Company A	14.5	165	17	>25-30	NO



LUXEON S2000

* For 3000K/80CRI, estimated based on max lumen output @ 85°C at max operating DC current for each respective LED
Confidential

LUXEON S High Lumen Density Family

Smallest light emitting surface and highest lumen density

Product	S2000			S3000			S5000		
	Diameter mm	LES mm ²	Lumen density* Lm/mm ²	Diameter mm	LES mm ²	Lumen density* Lm/mm ²	Diameter mm	LES mm ²	Lumen density* Lm/mm ²
1 LUXEON S	10.5	86	45	13.5	132	42	17.0	227	41
2 Company A COB	14.5	165	17	14.5	165	24	22.0	380	17
3 Company B COB	15.0	177	16	15.0	177	31	n/a	n/a	n/a
4 Company C COB	16.5	214	13	31.0	755	8	31.0	755	11

* For 3000K/80CRI, estimated based on max lumen output @ 85°C at max operating DC current for each respective LED
Confidential

LUXEON S High Lumen Density Family

There is comprehensive ECO system enabling quick luminaries design

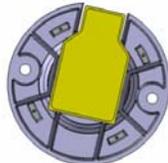
Clamp

- LEDil design shown here, Zhaga compliance screw hole pattern, **available now**

Top view



Bottom view

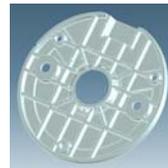


- Lumiled design, fully Zhaga compliance, **sample available soon**

Top view

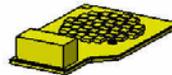
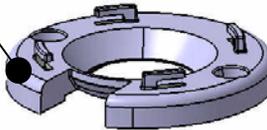
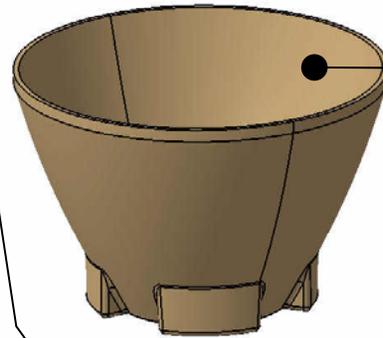


Bottom view



Driver

- Have list of compatible drivers
- Successfully built prototypes using *Philips Xitanium* and *Roal* drivers



Optic solution

- Multiple designs available from multiple optic designers (i.e., LEDil, Jordan, Baihong, Ledlink, NATA, in-house Lumileds)
- Performance for various designs were validated, more to be added

Heat sink

- Will supply system design requirements and guidelines
- Successfully built prototypes using *Westfield* passive and *SynJet Nuventix* active heat sink

Actively evaluating and expanding ECO system solutions, please visit the following links for additional designs, or reach out to our Technical Solution Mgr (TSM)

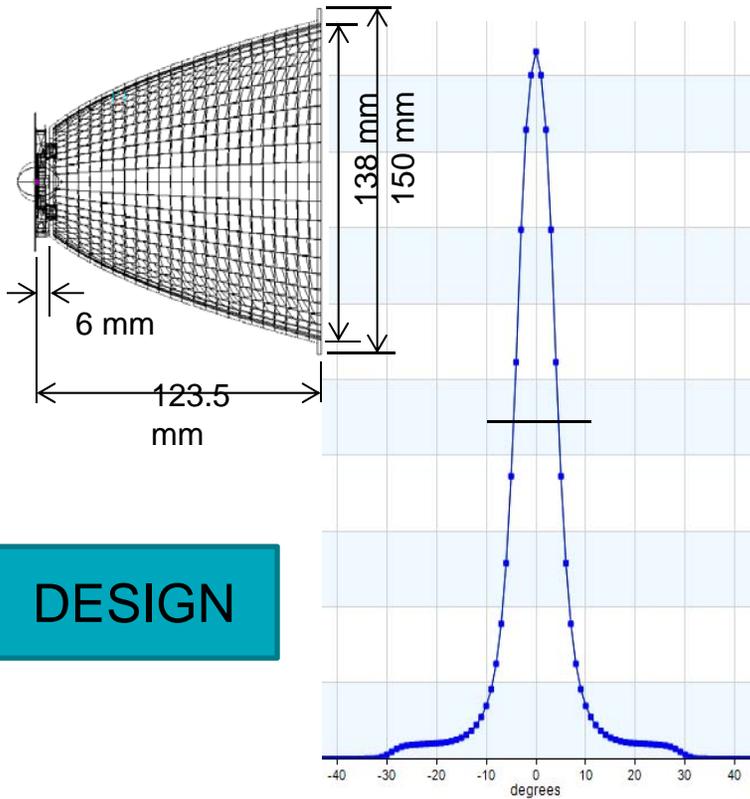
<http://www.luxeonecosystem.com>

<http://www.luxeonapplicationsteam.com>

LUXEON S

Selected design concept has shown high up to 100K CBCP

>100K Cd CBCP with 8° Reflector



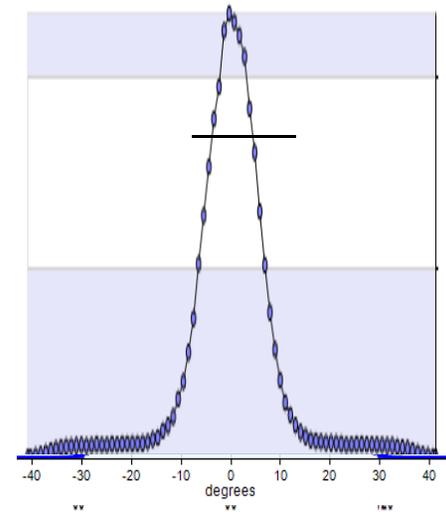
DESIGN

>60K CBCP with 12° Reflector



Angela/Angelina
LEDIL reflectors

D: 82-119mm
H: 31-74 mm



DEMO

- ✓ Large format metallized reflectors
 - Diameter:
 - ANGELA: 119,5 mm
 - ANGELINA: 82 mm
 - Height:
 - ANGELA: 74,3 mm
 - ANGELINA: 31 mm
- ✓ Recessed downlight & interior architectural lighting
- ✓ Narrow angle spot beam (ANGELA-S 11°)
- ✓ Spot, Medium and Wide beams
- ✓ LEDiL LUXEON S basepart available



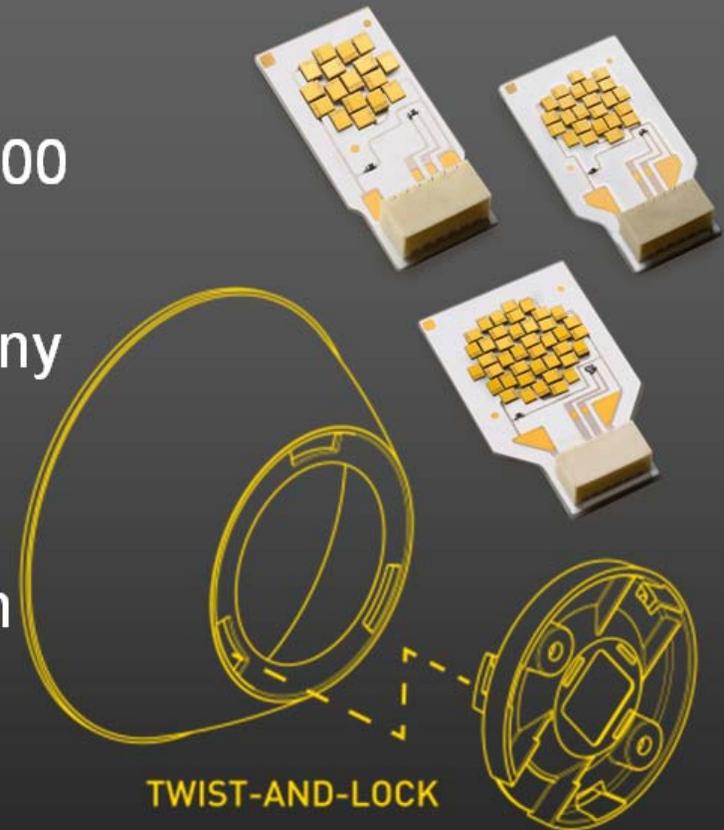
NEW REFLECTOR FAMILIES

LUXEON S COMPLIANT LEDiL BASEPARTS & REFLECTORS

PHILIPS
LUMILEDS

Ingenious & Versatile design

- ✓ 3 different baseparts covering LUXEON S2000, S3000 and S5000
- ✓ Each basepart will accommodate any LEDiL Angela Angelina reflector
- ✓ Easy to use "Twist & Lock" design



LUXEON S + BASEPART + REFLECTOR

INTEGRATED AS A SYSTEM

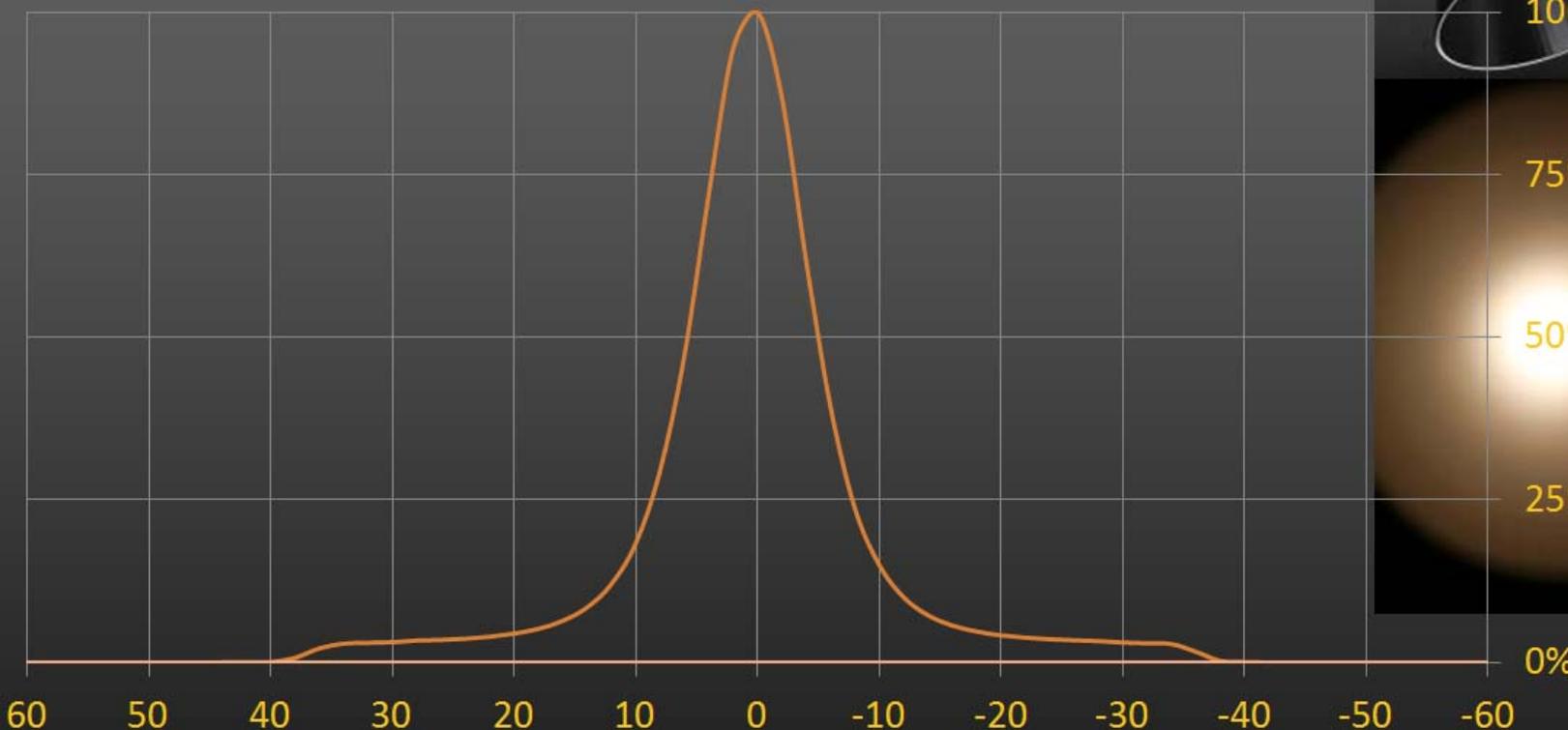
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LUMILEDS

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LEDiL
A WORLD OF
INNOVATION

Relative Intensity ANGELA-S_S2000

Relative intensity of CA13565_ANGELA-S-S2000



100%

75%

50%

25%

0%

LED
professional

ANGELA and ANGELINA

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CBCP & Angles (preliminary) LUXEON S2000



	LUXEON S2000	LUXEON S5000
Angela-S	27 500 cd	45 000 cd
Angela-M	TBD	TBD
Angela-W	7 200 cd	TBD
Angelina-S	10 500 cd	TBD
Angelina-M	5 700 cd	TBD
Angelina-W	4 500 cd	TBD

	Angela-S	Angela-M	Angela-W	Angelina-S	Angelina-M	Angelina-W
50%	11°	TBD	26°	17°	25°	30°
10%	25°	TBD	70°	50°	92°	96°



Summary

- ✓ Questions?
- ✓ Comments?
- ✓ Please contact LEDiL sales or
tech.support

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www.ledil.com



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