LED Light Achieves The Colour Rendering Of Sunlight

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Design en engineering trends voor LED-applicaties

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The Evolution of Light



The latest mass market technology is the LED.



Records, Records, Records, ...

For the past 20 years one record about LEDs was chasing another record....



- Efficiency record
- Brightness record
- Smallest package
- Highest lumen package
- Whitest white

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Will it go on like this?



LED Price & Performance Development



The annual steps of efficiency increases and price reductions are continuously getting smaller

Good for the end customer - A challenge for every company in the lighting industry



How can we differentiate over the next years?

One solution to the problem could be the Light Quality,

but

LIGHT ≠ LIGHT

and

3000K, CRI90 ≠ 3000K, CRI90

Color Mixing and Correlated Color Temperature







more fairly the color performance

New metrics can create confusion

Not fully adopted

Colour Metrics To Evaluate Colour Quality



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Well stablished industry standard



Limited to just 8 pastel tones Penalizes saturated colors Never became a standard Penalizes CCTs < 2800K

Saturated color samples



Understanding TM-30

Tradeoff between fidelity and gamut (Rf vs Rg)

Color shift in any direction will reduce fidelity

There is a fundamental limiting relationship between fidelity and gamut. Perfect fidelity (Rf=100) can only be obtained when colors exactly match those under the reference illuminant, thus yielding no variation in chroma (Rg =100).

Color Distortion Graphics Interpretation

Shows the shifts in chromaticity from the reference illuminant to the light source being evaluated. Where the light source extends beyond the boundary of the reference illuminant, those hues will be more vivid and saturated







Examples For Colour Vector Graphics



Original	Desaturated	Red-Enhanced	
CRI = 95	CRI = 80	CRI = 80	
<i>R</i> _f = 93	<i>R</i> _f = 78	R _f = 78	
R _g = 100	R _g = 90	R _g = 110	







Crisp Colour Technology For Saturated And Vivid Colours





Standard LED – 3000K, CRI90 (Lumileds)





Crisp Colour LED – 3000K, CRI90 (Lumileds)





Luxeon Stylist Series in COB and MidPower

TECHNOLOGY		СоВ		MP		
	сст	1202s		1216	3535L (100mA)	2835 (120mA)
2700К Золок Золок Золок Золок Золок	2700K	653 lm		5,549 lm	33 lm	41 lm
	3000К	700 lm		5,859 lm	35 lm	43 lm
	3250K	720 lm		6,102 lm	37 lm	45 lm
	3500K	729 lm		6,210 lm	37 lm	46 lm
= CrispColor	4000K	767 lm		6,515 lm	38 lm	47 lm
	5000K	796 lm		6,766 lm	40 lm	50 lm

Typ. Values







SunLike Technology vs Conventional White LEDs















SunLike LEDs' CCTs Cover The Full Day

TRI-R achieved to provide extremely diverse range of CCT versus to typical LED. Its capability can produce from candle fire's (2000K) to mid-afternoon of fine weather day's (6500K).





Higher Contrast With SunLike LEDs





100

SunLike LED: 2700K, CRI97 (Seoul Semiconductor)





SunLike COBs From Seoul Semiconductor

МЈТ СОВ

SunLike 6W MJT COB



SunLike 10W MJT COB



SunLike 15W MJT COB



SunLike 25W MJT COB



Part No. SAWS06614	4				
Size (mm) 13.5x13.5					
LES (Φ) 6					
Rated IF (A) 0.17 A					
Typ. Vf @Tj=85 36.1 V					
3000K 516 lm					
4000K 550 lm					
@1]=85 5000K 557 lm					
Part No. SAWS1083A					
Size (mm) 13.5x13.5					
LES (Φ) 9.8					
Rated IF (A) 0.29 A					
Typ. Vf @Ti=85 34.8 V					
3000K 900 lm					
Typ. Flux 4000K 955 lm					
@1j=85 5000K 970 lm					
@1j=85 5000K 970 lm					
@1j=85 5000K 970 lm Part No. SAWS1564/	4				
@1j=85 5000K 970 lm Part No. SAWS1564/ Size (mm) 19x19	Ą				
(g/1j=85) 5000K 970 lm Part No. SAWS1564/ Size (mm) 19x19 LES (Φ) 14.5	Ą				
(g/l)=85 5000K 970 lm Part No. SAWS1564/ Size (mm) 19x19 LES (Φ) 14.5 Rated IF (A) 0.43 A Transfer 25.0 V	A				
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Advantages & Benefits

- Sunlike spectrum
- CRI ≥ 97 & R1~R14 >90
- Rf=97, Rg=102 under TM30-15 (2700K ~ 5000K)
- 3000K~5000K line up. 2700K &
 6500K to be available soon
- IEC62471, RG1





SunLike MidPower From Seoul Semiconductor

3030

SunLike 3030



Size (mm)	30 x 30						
CRI (Min.)	96						
CCT	2700	3000	4000	5000	6500		
Power (W)	0.2						
Vf (V)	2.96						
lf (A)	0.065						
Flux (Im)	19.5	20.2	21.2	21.2	20.2		
lm/W	98	101	106	106	101		

Advantages & Benefits

- Sunlike spectrum
- CRI ≥ 96
- Linear application for retail , Architectural Appl.
- 2700K~6500K line up.
- IEC62471, RG0(exempt)



Go For Differentiation

- CCT and CRI do not allow to evaluate the quality of colour renderings when objects become illuminated with LED light.
- Lumileds and Seoul Semiconductor offer COBs and Mid Power LEDs with better colour rendering quality.
- COBs and Mid Power LEDs allow spot light luminaires, downlights, linear and area luminaires to be realized in best colour renderings.





Summary

- Because of the price & performance development of LEDs new differentiation criteria gain importance. The profitability of LED luminaires or LED lighting systems are under pressure.
- Colour quality becomes a clear differentiation criteria.
- There is no metrics currently which describes light quality or true colour rendering in a fair and easily understandable way.
- The best way to evaluate the colour rendering differences of illuminated objects is to physically compare light sources and make up one's mind after individual reviews.
- The challenge to take on is to find new ways how to market better light qualities without the CRI number.





Thank you.

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