Power LEDs for Machine Vision: Where to go – how to get there?

Gerrit-Willem Prins | November 2019 | Moscow

Light is OSRAM

Our Brand
LED ENGIN

OSRAM

Content

Company Introduction OSRAM / LED Engin

The new OSRAM: From Illumination to Photonics

Overview LED Engin

Business approach OSRAM and LED Engin

The New OSRAM: From Illumination to Photonics






Previous focus | Illumination
Emission of light

Photonics | Enabling new applications
Illumination, Sensing, Visualization, Treatment

Overview LED Engin

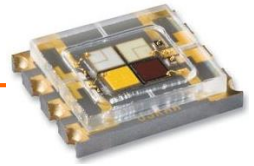
LED Engin, Inc. develops, manufactures, and sells advanced LED emitters, optics and light source modules in a unique, high-lumen density, compact, multi-die package.

LED Engin was acquired by OSRAM July 2017 and resides under OSRAM Opto Semiconductors

Key differentiation factors

- Patented compact high-power density multi-layer package for single and multi-die products
- Patented optics
- Broad range of product offerings to include custom solutions
- Industry leading tunable white light engine LuxiTune™

Business approach OSRAM and LED Engin



OSRAM is a leader in chips and packaged LEDs with focus on high-performing, professional applications by offering a solid range of highly reliable LED standards.

LED Engin offers top-of-the-bill packaged LEDS with focus on high-performing, professional beam applications by offering a range of super reliable, very compact standard LEDs and customized LEDs.

USPs LED Engin

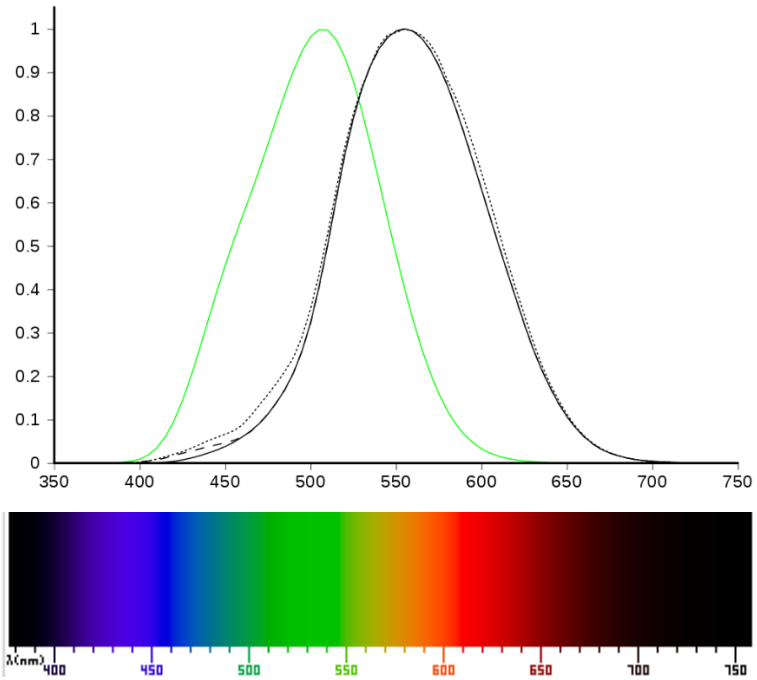
Revolutionary packaging technology

- Patented multi-die, high power density ceramic substrate
- Excellent heat management
- Multi-channel options with excellent colour mixing
- Low barrier to custom parts

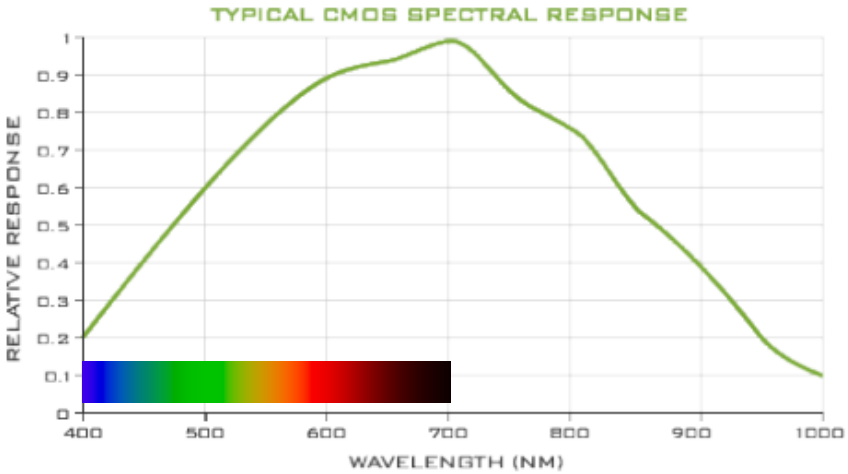
No compromises to reliability

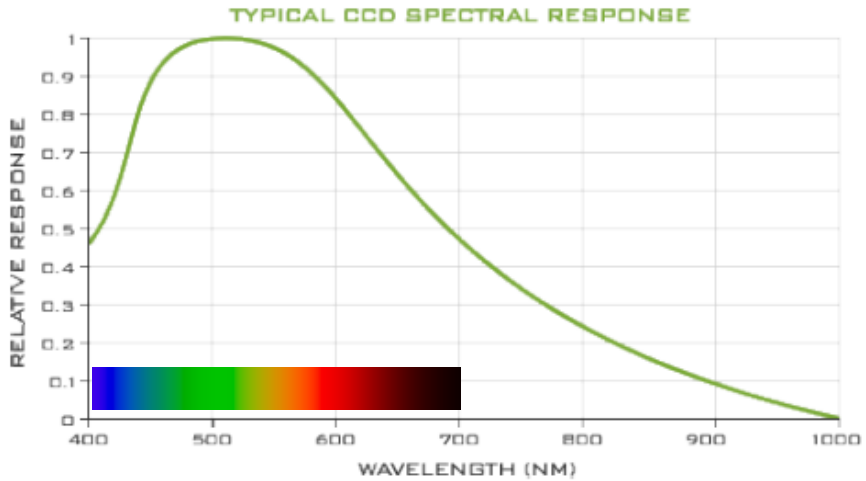
Content

Lighting LEDs are not optimal for camera vision

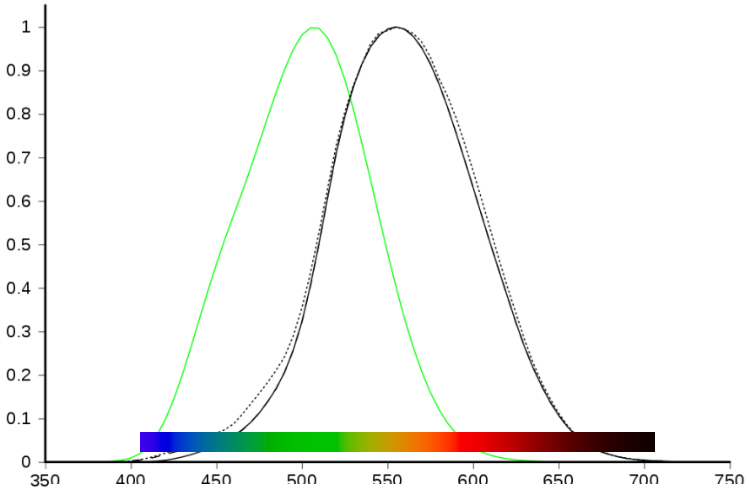


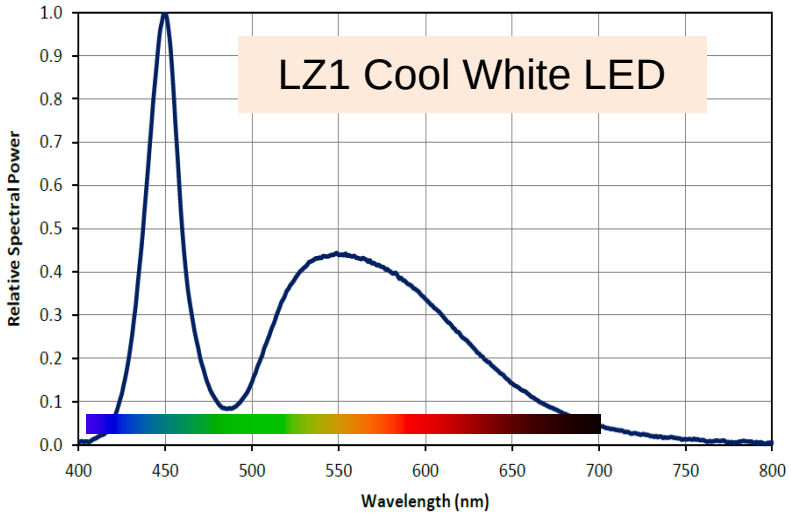
Photopic (black) and scotopic (green) luminosity functions.

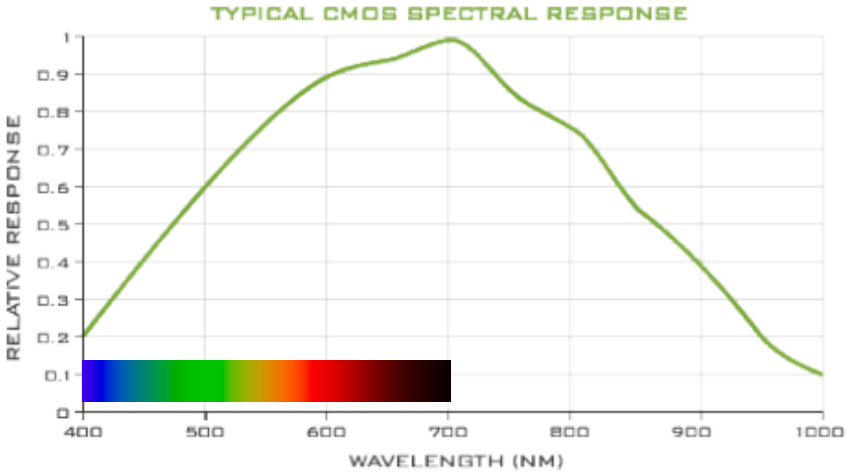


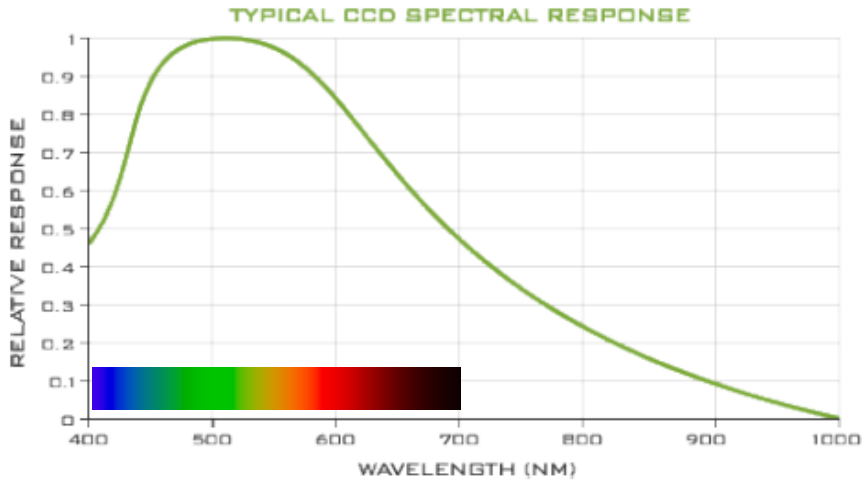


Lighting LEDs are not optimal for camera vision

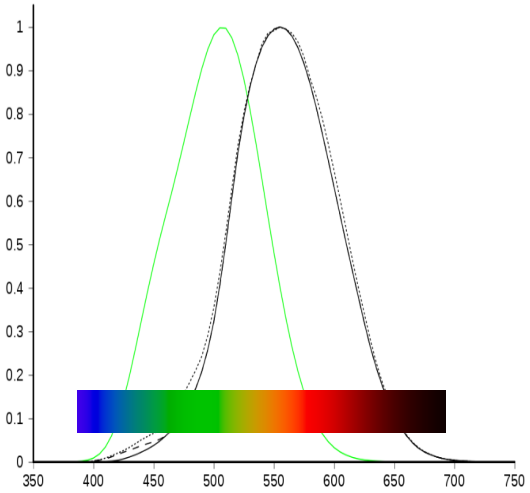


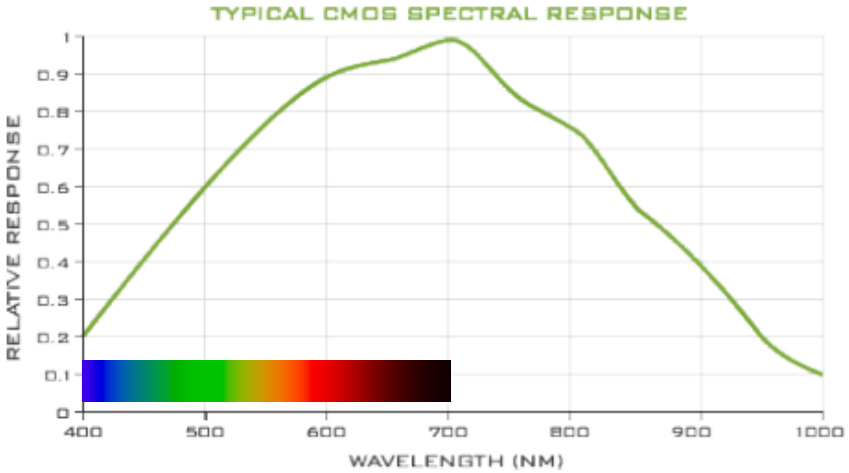


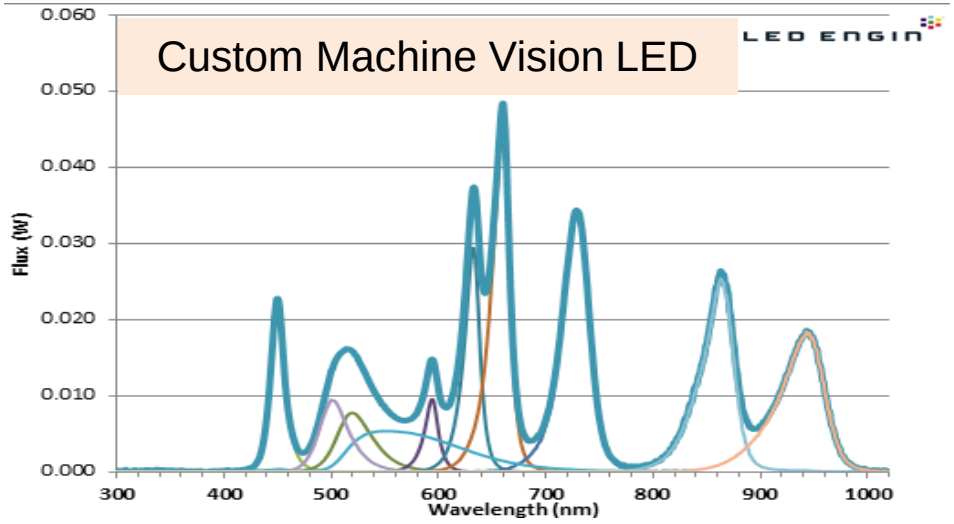


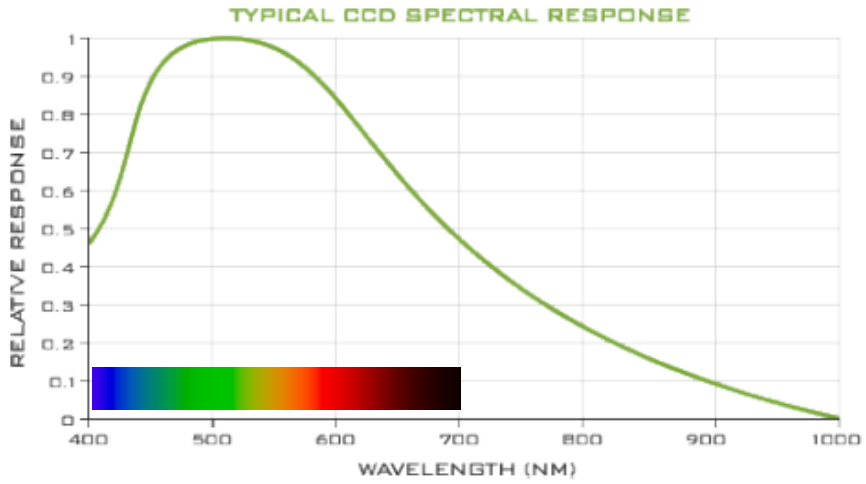


Lighting LEDs are not optimal for camera vision: configure your optimal LED for high S/N performance



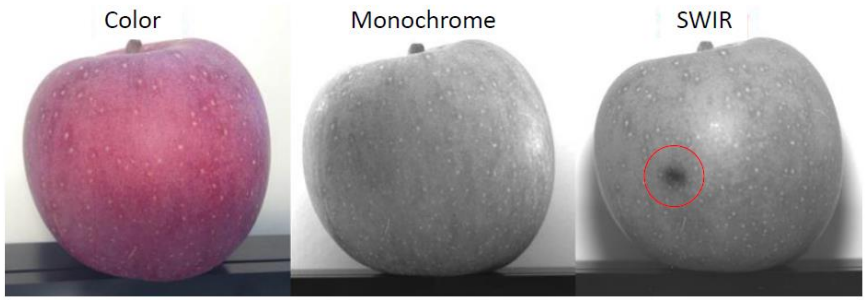






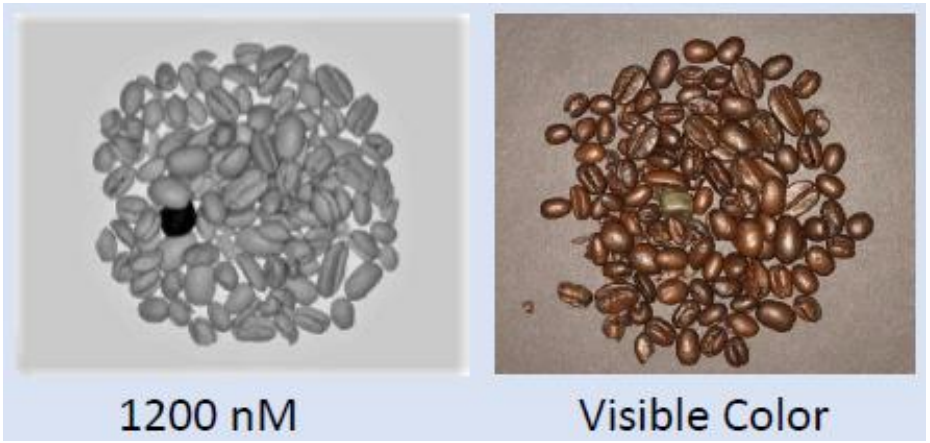
Human eye versus cameras – detection

Machine Vision: Food Inspection



Machine Vision: Consumer Inspection

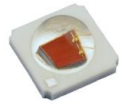
Machine Vision: Food Inspection



Lamps versus LEDs

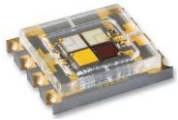
Optical:

Full spectrum	-	spectral building blocks
Filters	-	electronic colour channels
Reflectors / lenses	-	lenses
CRI fixed	-	CRI adjustable
CCT fixed	-	CCT adjustable



Mechanical:

Single source	-	single-multi source
Determined by lamp	-	determined by heat
Fragile	-	Robust



Electrical:

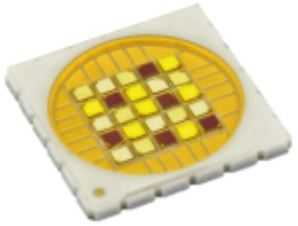
Single channel	-	single-multi channel
Robust	-	Fragile

Reliability:

Lamp weakest link	-	Electronics weakest link

Flexibility:

Highly standardised lamps	-	Standards & Customised
Very few offerings/brands	-	Variety platforms/brands



Legislation:

Bans filament lamps / Mercury	-	No barriers

Challenges in selecting LEDs

Radiant power

Compactness / radiation density

Wavelength / spectrum / controls

Colour mix / homogeneity

Life time reliability / stability

Heat management

Standard / custom

Low power

Medium Brightness

High power

1W

3W

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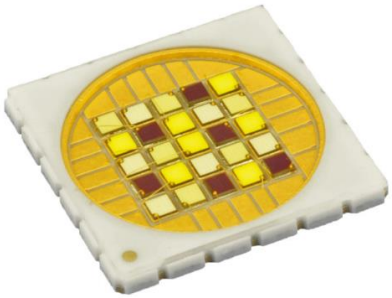

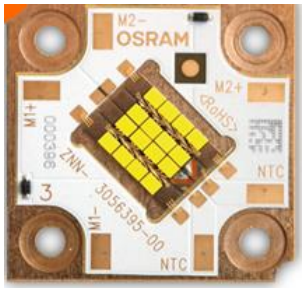

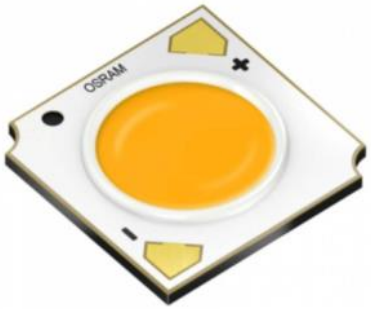

Low power — Medium Brightness — **High power**

1W — 3W

Challenges in selecting LEDs

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Wavelength / spectrum

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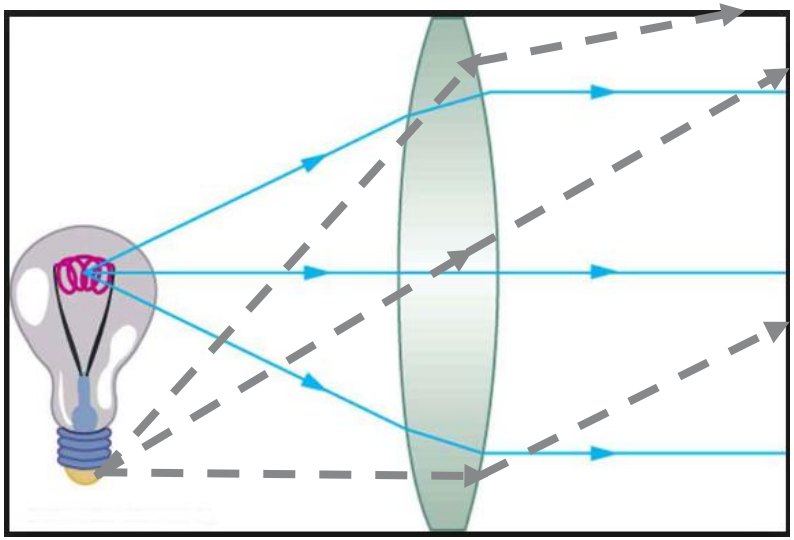
Standard / custom



Compactness

- **Beam definition**
  - Narrow beam
  - Sharp cut-off
- **More radiation on target**
  - Lux
  - W/cm2

Challenges in selecting LEDs

Radiant power
Compactness / radiation density
Wavelength / spectrum
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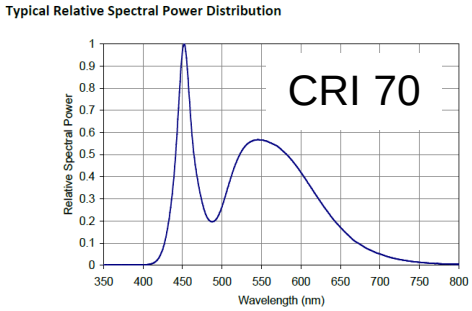
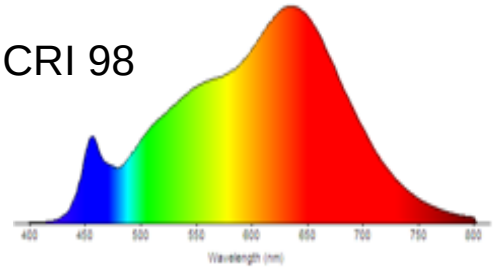
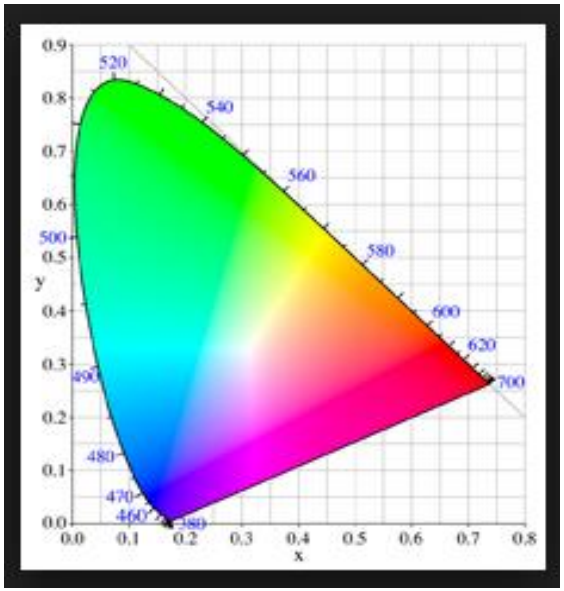
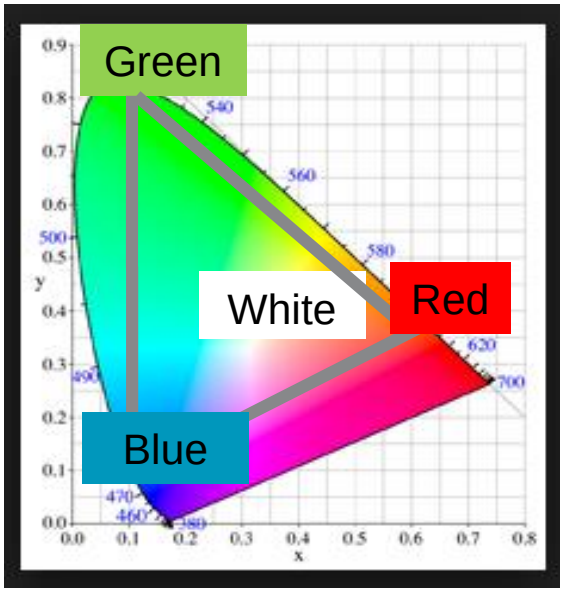
Standard / custom







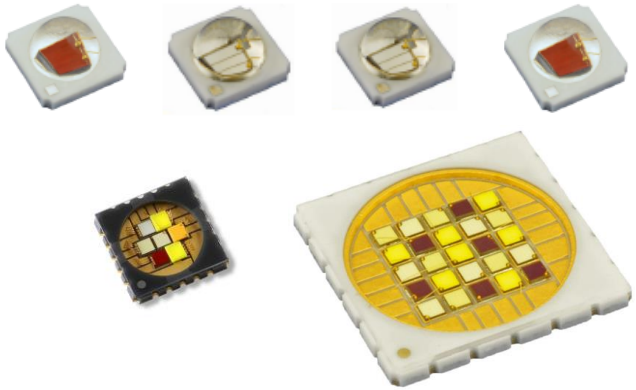


Spectral aspects

- **1 colour can be achieved by various spectra**
- **Human eye vs. CMOS**
- **Lamp: filter colours**
  LED: add colours

Challenges in selecting LEDs

Radiant power
Compactness / radiation density
Wavelength / spectrum
Colour mix / homogeneity
Life time reliability / stability
Heat management
Standard / custom

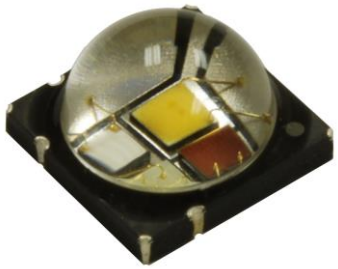


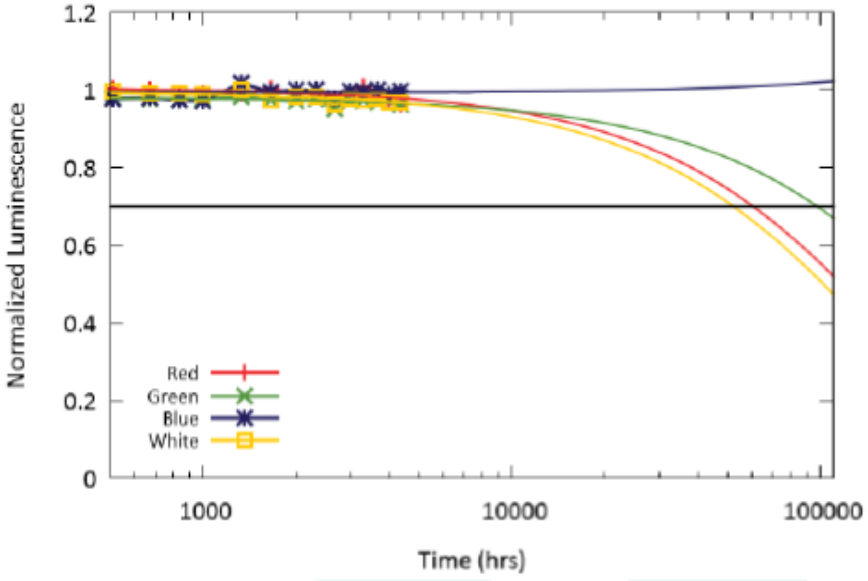
In-source colour mix

- **Single lens system**
- **Near-field colour mix**
- **More natural look**
- **Spectral homogeneity on target**

Challenges in selecting LEDs

Radiant power
Compactness / radiation density
Wavelength / spectrum
Colour mix / homogeneity
Life time reliability / stability
Heat management
Standard / custom





Life time
- **Defects**
- **Lumen maintenance**

Test	Test Conditions
Lumen Maintenance Test	I_F=700mA; T_C=45C; Tj=80C

TM-21 Exponential Lifetime Prediction

% from t0	Lifetime (hrs) Red	Lifetime (hrs) Green	Lifetime (hrs) Blue	Lifetime (hrs) White
70	>20,000	>20,000	>20,000	>20,000

Challenges in selecting LEDs

Radiant power
Compactness / radiation density
Wavelength / spectrum
Colour mix / homogeneity
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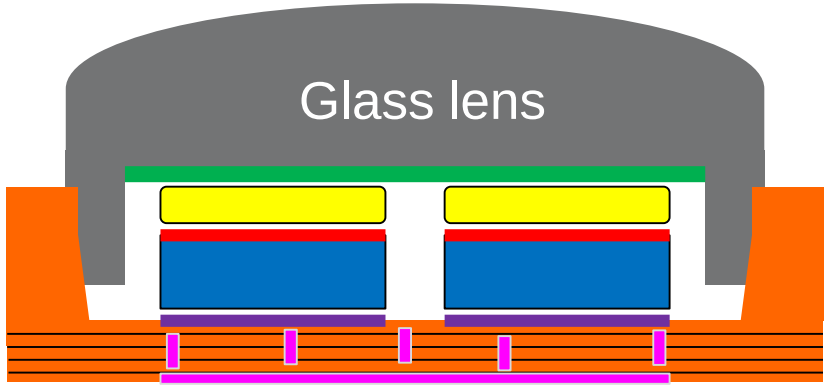
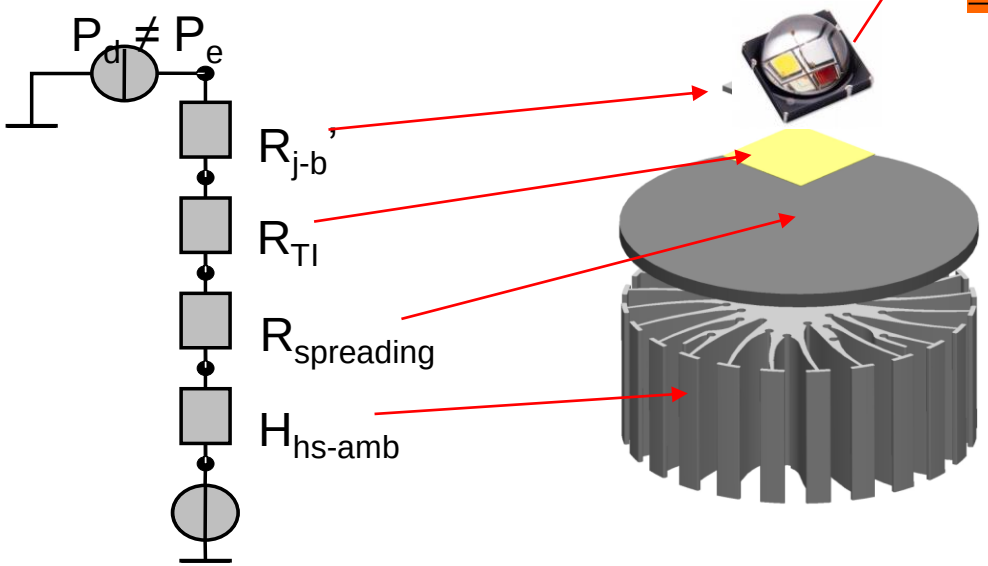
Heat management
Standard / custom





Heat management

- **10C higher Tj: 50% shorter life**
- **>50% of input power to be heat dissipated**
- **Size, airflow, LED-module**

Challenges in selecting LEDs

Radiant power
Compactness / radiation density
Wavelength / spectrum
Colour mix / homogeneity
Life time reliability / stability
Heat management
Standard / custom

White CCTs

WW 3000K Warm White
GW 3000K CRI98 Gallery White
NW 4000K Neutral White
CW 5500K Cool White
CW 6500K Cool White

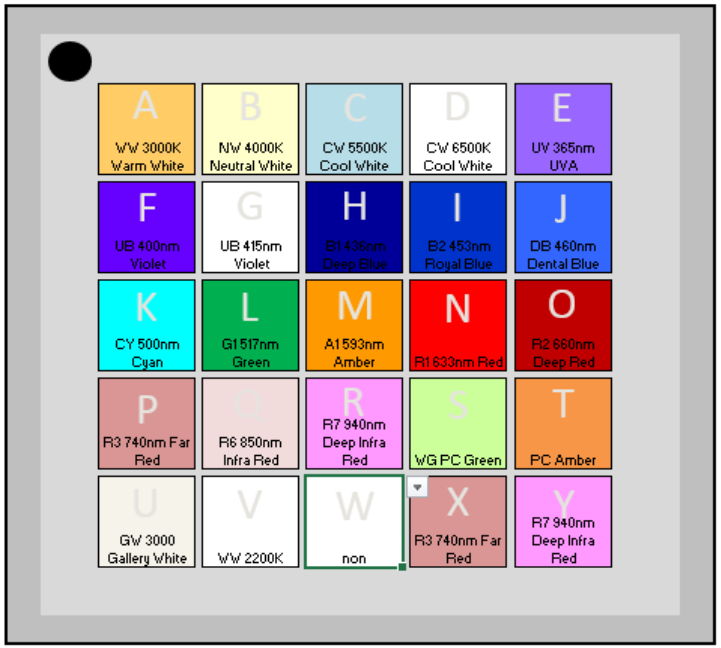
Phosphor-based specialty colors:

PC Amber 590nm
SS 2200K Sunset
PC Green

Direct Colors

UV 365nm UVA
UA 400nm Violet (in 5 nm bins)
B1 436nm Deep Blue
B2 450nm Royal Blue
DB 460nm Dental Blue
CY 500nm Cyan
G1 523nm Green
A1 590nm Amber
R1 623nm Red
R2 660nm Deep Red
R3 740nm Far Red
R6 850nm Infra Red
R7 940nm Deep Infra Red

Select die color by pull-down menu at the die location.



Customised configuration:

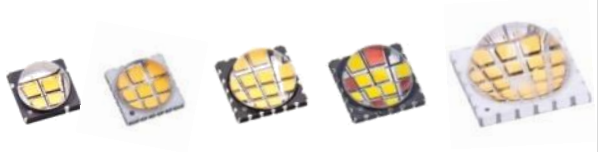
- **4-die up to 25-die**
- **Wide choice of colours**
- **Design your own**

Content

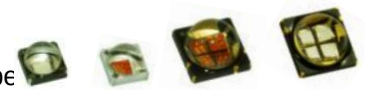
Classics

Level 1 Emitters & Optics

White
GW 2700K / 3000K/
CW 5500K / 6500K
LZ4/LZ9/LZC/LZP



Single Color
Red, Green, Blue, Ambe
LZ1/LZ4



Multi-color
RGB, RGBA, RGBW
LZ4/LZC

Specialty
UV – 365nm, violet – 400nm, dental blue,
Red – 660nm, 740nm / 850nm
LZ1/LZ4/LZC/LZP

LuxiGen™ LEDs

Engines

MCPCB Options For all packages

TIR Optics

TIRs and Mounting Options

LuxiTune™

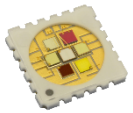
Classics

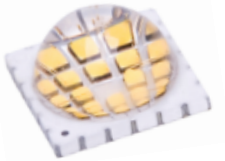
LuxiGen Emitters

NEW: 60W LZ7 Plus

7x7mm, 6 colours





		LZ1	LZ4	LZ7	LZ9	LZC	LZP
Product Information	**Number of die**	1	4	7	9	12	24 or 25
	Dimensions L x W , mm	4.4 x 4.4	7.0 x 7.0	7.0 x 7.0	7.0 x 7.0	9.0 x 9.0	12.0 x 12.0
	Nominal Drive Current mA	1000	700	700	700	700	700
	Maximum Drive Current mA	1500	3000	850-1500	800	1200	1200
	Thermal Resistance ºC/W	6.0 4.2 for UV/DB	0.9	1.4	1.3	0.7	0.5
Color / CCT offering	**White (CCT)** : 2700K, 3000K, 5500K, 6500K	✓	✓	*contact factory*	✓	✓	✓
	Direct Colors: Red, Green, Blue, Amber	✓	✓		*contact factory*	✓	✓
	Multi-color: RGB, RGBA, RGBW	NA	✓		NA	✓	✓
	RGBW-Cyan-Amber-Violet	NA	NA	✓	NA	NA	NA
	Specialty wavelengths (λ_P):						
	Deep Red (660nm), Far Red (740nm), Infrared (850nm, 940nm)	✓	✓	*contact factory*	*contact factory*	*contact factory*	*contact factory*
	Dental Blue (460nm)	✓	✓				
	UV (λ_P):						
	Violet (385 - 410nm)	✓	✓	NA	NA	✓	✓
	UVA (365nm)	✓	✓	NA	NA	NA	NA

Next to ‘classics’: ‘customs’

Customisation directions:

- Reeling:
  - Exact quantity per reel (e.g. multitudes of 90)
  - Reeling custom bin sequence
- Configuration:
  - Custom die configuration on 4-die to 25-die platform
  - Custom binning (flux, wavelength)
  - Reeling custom bin sequence
- PC Spectrum:
  - Custom spectrum: phosphor development & qualification
- Populated on custom MCPCB

Business case needed:

- Reeling, Configuration, Populated: $100k/year
- PC Spectrum: $ 500k/year

Start-up cost (NRE):

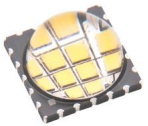
- Provisional datasheet + samples: $ 4000- $ 5000 total


LQ1


LQ4


LQ7


LQ9


LQC


LQP

Next to ‘classics’: ‘customs’

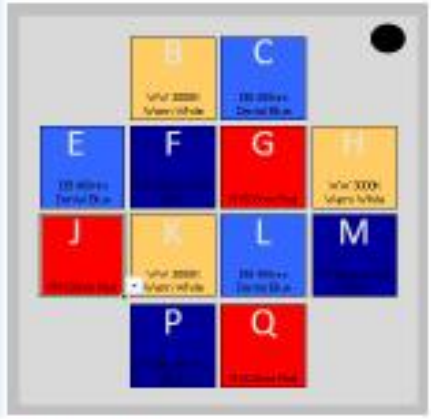
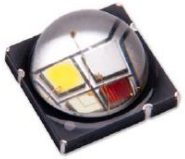


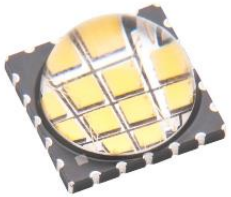
Fig. 1. LuxiGen™ emitter cross-section and customizable die combination in a LZC emitter

LQ1: custom binning

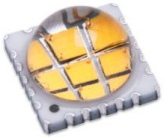


LQ4: custom config

LQ7: custom config
7 channel



LQC: custom config 12-channel



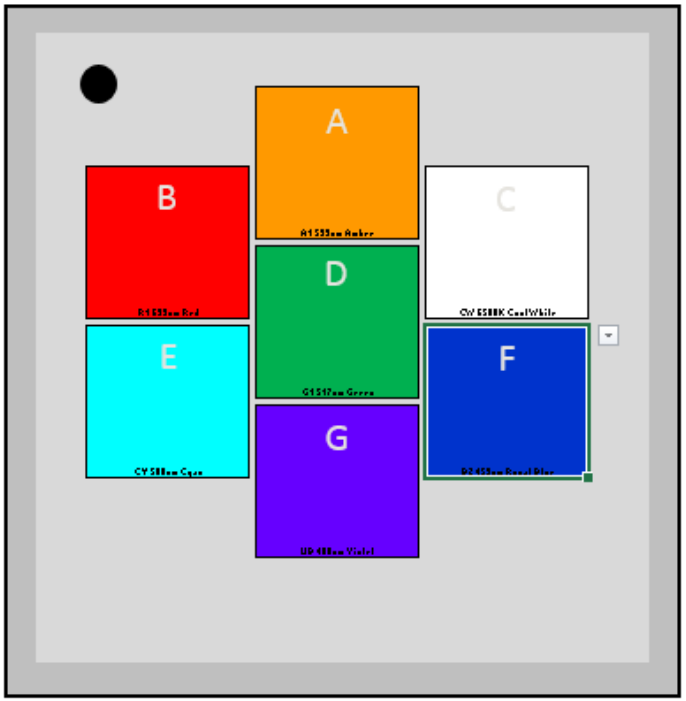
LQ9: custom config
3-channel

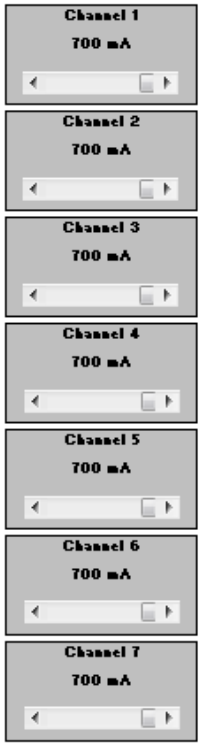
LQP: custom config 24-25 die, 5-4 channel

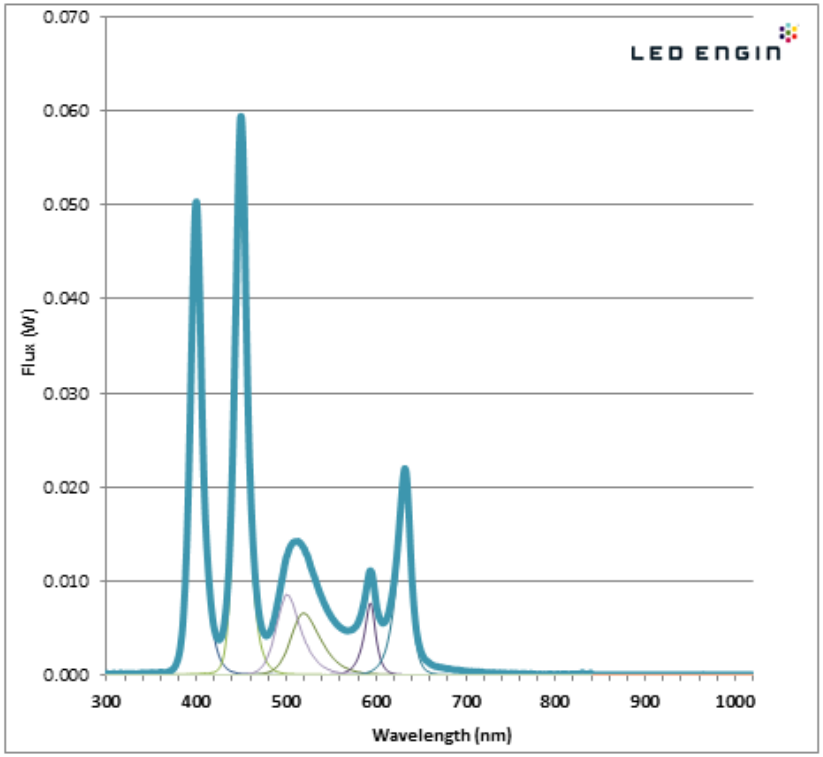
https://media.osram.info/im/img/osram-dam-7411798//LED_Engin_productliterature_custom_LuxiGen_emitters_rev3_11012018.pdf

Next to ‘classics’: ‘customs’

Select die color by pull-down menu at the die location.







LQ7 - N 4 MX 00 - 0xxx

Die	Color	Percentage dimmer	Channel
A		100%	2
B		100%	1
C		100%	3

Total flux:	3.67	W
Total flux:	627.07	lm
Total N:	15.09	µmol/sec

Values are a linear approximation from 0-700mA

Content

Power LEDs for Machine Vision:
Where to go – how to get there

Radiation sources: From standard lamps to classic and custom LEDs

Reliable business partner:
The new OSRAM: From Illumination to Photonics
LED Engin, the OSRAM brand for flexibility, reliability and custom LEDs

Your success: Configure your custom LED and build better appliances!

Thank you.

Power LEDs for Machine Vision: Where to go – how to get there?

Gerrit-Willem Prins | November 2019 | Moscow

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