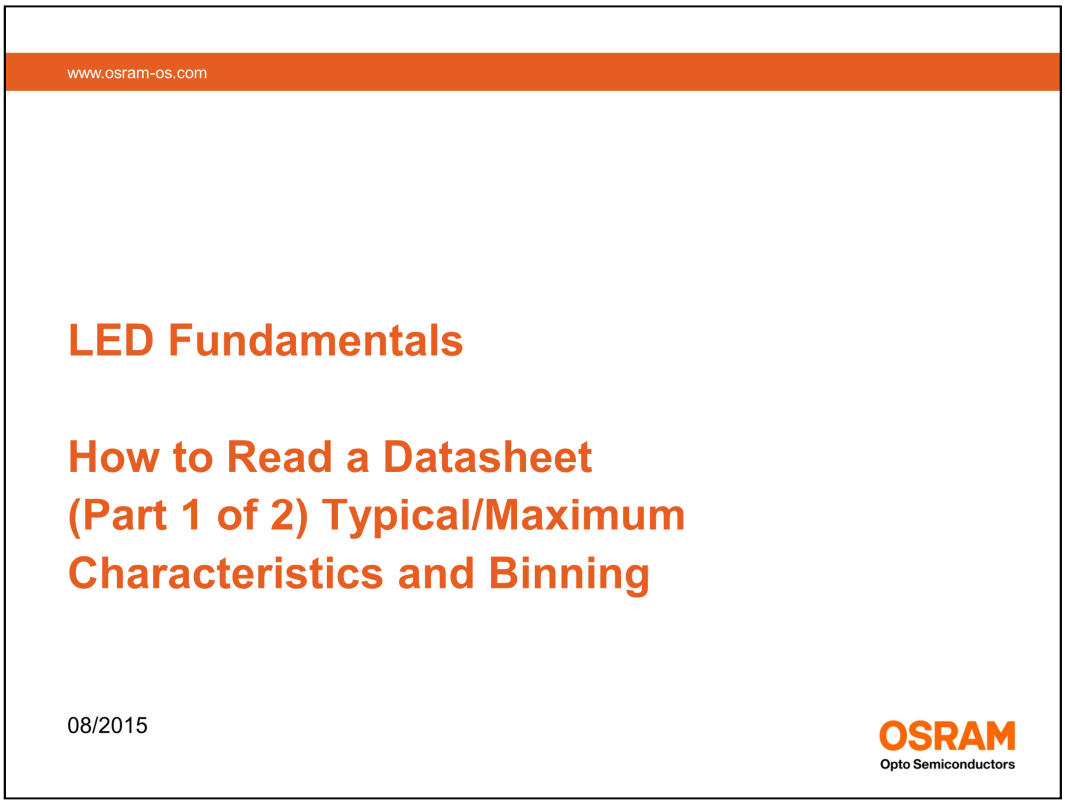
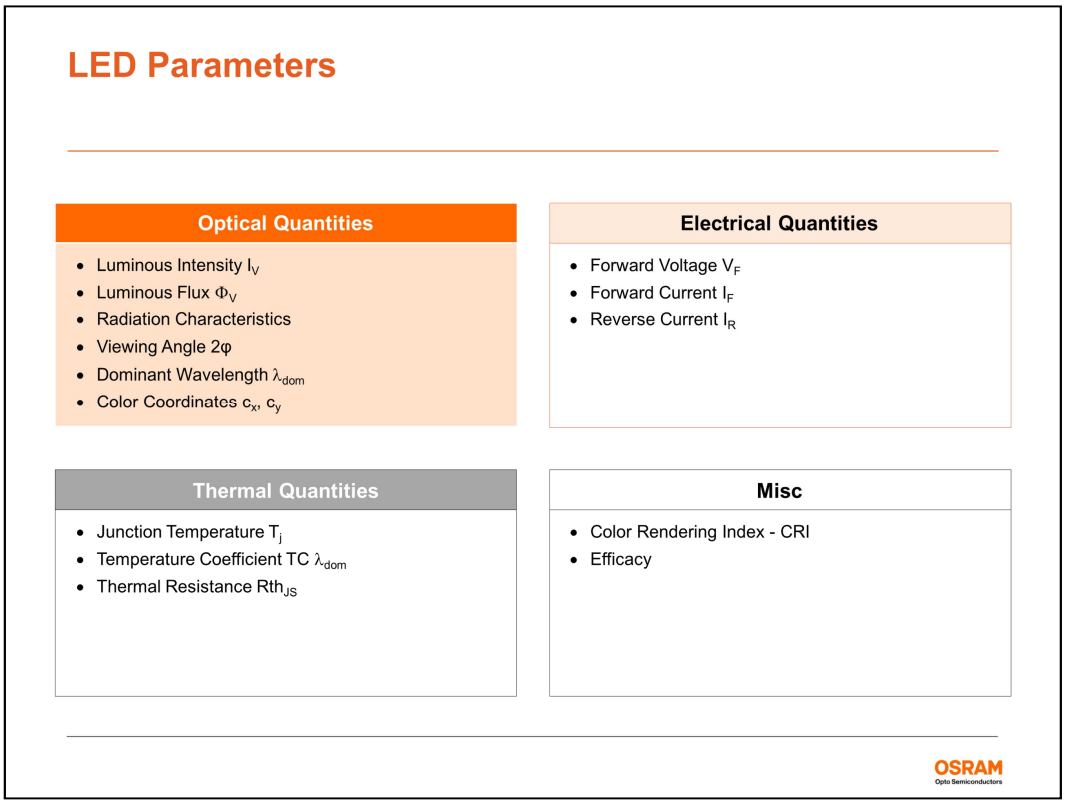


Welcome to this presentation on How to Read a Datasheet Part One of Two, part of OSRAM Opto Semiconductors‘ LED Fundamental series.

In this presentation we will examine the key parameters specified on the first 12 pages of an LED datasheet from OSRAM Opto Semiconductors.



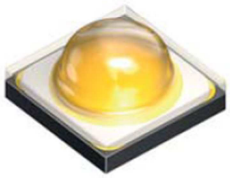
The datasheet captures some of the most important technical characteristics of an LED. These include electrical, optical and thermal quantities; knowledge of which is paramount for an LED system design.

Also, it has information on ordering codes, labelling and packaging of the LEDs.

We will look at each one of these quantities in detail as we flip through each page of a datasheet. In this presentation we will look at the OSLON Square datasheet.

OSLON Square (GW CSSRM1)

Higher performance. Lower thermal resistance. Extended range of driving conditions. This is the second generation OSLON Square.



Features:

- **Package:** SMT ceramic package with silicone resin and silicone lens
- **Viewing angle at 50 % I_V:** 120°
- **Color:** 2400 K - 5000 K (warm and neutral white)
- **CRI:** min. 80 (typ. 82)
- **Luminous Flux:** typ. 202 lm @ 3000 K, 85 °C
- **Luminous efficacy:** typ. 100 lm/W @ 3000 K, 85 °C
- **Corrosion Robustness:** Superior Corrosion Robustness
- **Lumen Maintenance:** Test results according to IESNA LM-80 available

Applications

- Accent and effect lighting
- Museum lighting
- Shop lighting
- Spot lights
- Stage lighting
- Retrofits and fixtures

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Page 1 of the datasheet presents a summary of the key features of the LED. Common parameters such as luminous flux, luminous efficacy and CRI are typically found on the first page so that the user can quickly understand the general performance of the device.

In addition, it provides a list of typical applications where this LED could be used and contains a picture of the LED package.

Ordering Information

Type: Typ:	Color Temperature Farbtemperatur [K]	Luminous Flux 1) page 27 Lichtstrom 1) Seite 27 I_F = 700 mA, T_S = 85 °C Φ_V [lm]	Ordering Code Bestellnummer
GW CSSRM1.EC-LTMP-5YC8-1	2400	150 ... 194	Q65111A5207
GW CSSRM1.EC-LUMQ-5U8X-1	2700	164 ... 210	Q65111A5206
GW CSSRM1.EC-MPMR-5R8T-1	3000	180 ... 224	Q65111A5205
GW CSSRM1.EC-MPMR-5O8Q-1	3500	180 ... 224	Q65111A5231
GW CSSRM1.EC-MQMS-5L7N-1	4000	194 ... 240	Q65111A5268
GW CSSRM1.EC-MQMS-5J7K-1	4500	194 ... 240	Q65111A5269
GW CSSRM1.EC-MQMS-5H7I-1	5000	194 ... 240	Q65111A5270

- Luminous Flux at binning current is listed in lumens (lm) or millilumens (mlm).
- Color Temperature is listed in Kelvin (K).
- Example **GW CSSRM1.EC-MQMS-5L7N-1**
  - **MQMS:** One brightness bin MQ, MR, or MS will be shipped for any one reel.
  - **5L7N:** One chromaticity bin from 5L7N will be shipped for any one reel.
  - **1:** One forward voltage bin will be shipped for any one reel.

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Page 2 lists the part numbers for specific color temperatures of the LED. Part numbers include the order bins which indicate the brightness, chromaticity coordinates and forward voltages of the LED.

An explanation of a part number is listed on this slide. For example, the part number GW CSSRM1.EC-MQMS-5L7N-1 tells the user that they can receive LEDs from: brightness bins MQ, MR, or MS, chromaticity coordinate bins 5L to 7N, and any forward voltage bin.

A single reel of LEDs will contain only one brightness bin, one chromaticity bin, and one forward voltage bin. For example, the user will never receive a single reel of LEDs that contains a mixture of MQ and MR brightness groups.

The luminous flux min to max range for each part number indicates the minimum value of the lowest bin to the maximum value of the highest bin available.

An ordering code, or a Q number, is assigned to each part number and is generally used to enter sample order requests for specific part numbers.

Maximum Ratings

Parameter Bezeichnung	Symbol Symbol	Values Werte	Unit Einheit
Operating temperature range Betriebstemperatur	T_{op}	-40 ... 125	°C
Storage temperature range Lagertemperatur	T_{stg}	-40 ... 110	°C
Junction temperature absolute * Sperrschichttemperatur absolut *	$T_{j, abs}$	150	°C
Junction temperature Sperrschichttemperatur	T_j	135	°C
Forward current Durchlassstrom (T_S = 85 °C)	I_F	200 ... 1800	mA
Surge current Stoßstrom	I_{FM}	2000	mA
Reverse current 2) page 27 Sperrstrom 2) Seite 27	I_R	200	mA
ESD withstand voltage ESD Festigkeit (acc. to ANSI/ESDA/JEDEC JS-001 - HBM, Class 3B)	V_{ESD}	8	kV

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Page 3 lists the maximum ratings for the LED. Careful review of the system design should be conducted to ensure that the LED is never operated outside of the values listed on this page. In this datasheet, it can be seen that the LED should not be exposed to an operating temperature lower than -40° C or greater than 125° C.

Typical Characteristics

Characteristics (T_S = 85 °C; I_F = 700 mA)
Kennwerte

Parameter Bezeichnung		Symbol Symbol	Values Werte	Unit Einheit
Viewing angle at 50 % I_V Abstrahlwinkel bei 50 % I_V	(typ.)	2φ	120	°
Forward voltage [3] page 27 Durchlassspannung [3] Seite 27	(min.) (typ.) (max.)	V_F V_F V_F	2.70 2.90 3.20	V V V
Reverse voltage Sperrspannung (I_R = 20 mA)	(max.)	V_R	1.2	V
Color reproduction index [4] page 27 Farbwiedergabe Index [4] Seite 27 (2700 K - 5000 K)	(typ.) (min.)	R_a R_a	82 80	- -
Real thermal resistance junction / solder point [5] page 27 Realer Wärmewiderstand Sperrschicht / Lötpad [5] Seite 27	(typ.) (max.)	$R_{th\ JS\ real}$ $R_{th\ JS\ real}$	3 3.9	K/W K/W
"Electrical" thermal resistance junction / solder point [5] page 27 "Elektrischer" Wärmewiderstand Sperrschicht / Lötpad [5] Seite 27 (with efficiency η_e = 31 %)	(typ.) (max.)	$R_{th\ JS\ el}$ $R_{th\ JS\ el}$	2.1 2.7	K/W K/W

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Page 4 lists the values for several key parameters of the LED at the binning current (700mA) and solder point temperature of 85° C.

The viewing angle, which is the full width half maximum of the luminous intensity of the LED, is listed in degrees.

The minimum, typical and maximum values of forward voltage at the binning current are listed.

Forward voltage is measured during a current pulse of 8 msec, with an internal reproducibility of +/- 0.05 V.

The maximum reverse voltage is listed.

Typical and minimum Color Rendering Index, or CRI, values are listed.

CRI values are measured during a current pulse of 25msec, with an internal reproducibility of +/-2.

Typical and maximum values of real and electrical thermal resistance from junction to solder point of the LED package are listed in K/W. The electrical thermal resistance value represents the junction to solder point resistance as if the total input power is converted to thermal energy. The real thermal resistance takes into account that a portion of the input power is converted into light energy. This is noted as the efficiency of the LED. In this example, the OSLON Square is noted as being 31% efficient, which means that 31% of the input power is converted to light output.

Brightness and Forward Voltage Groups

Brightness Groups
Helligkeitsgruppen

Group Gruppe	Luminous Flux 1) page 27 Lichtstrom 1) Seite 27 (min.) Φ_V [lm]	Luminous Flux 1) page 27 Lichtstrom 1) Seite 27 (max.) Φ_V [lm]	Luminous Intensity 6) page 27 Lichtstärke 6) Seite 27 (typ.) I_V [cd]
LT	150	164	52
LU	164	180	57
MP	180	194	62
MQ	194	210	67
MR	210	224	72
MS	224	240	77

Forward Voltage Groups 3) page 27
Durchlassspannungsgruppen 3) Seite 27

Group Gruppe	(min.) V_F [V]	(max.) V_F [V]
K2	2.70	2.80
L1	2.80	2.90
L2	2.90	3.00
M1	3.00	3.10
M2	3.10	3.20

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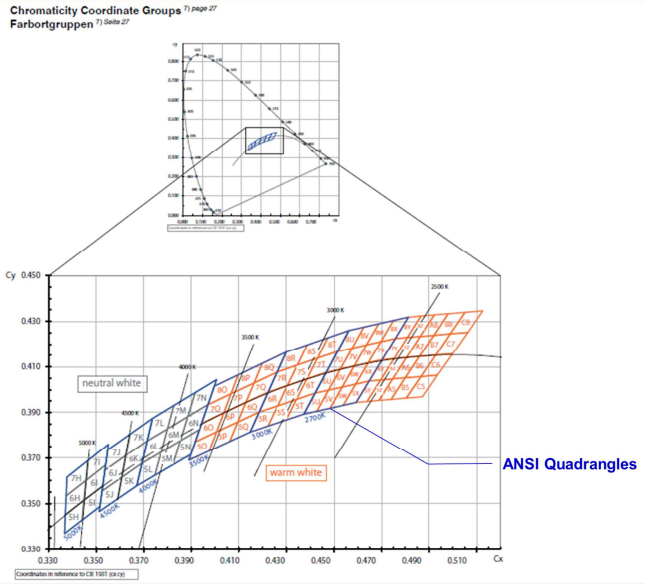
Page 5 lists the brightness and voltage bins (or groups) available. The min and max luminous flux value and typical intensity value are listed for each brightness bin.

In a similar manner, the min and max values for each voltage bin are also specified.

Individual brightness or voltage bins cannot be ordered.

On the other hand, no reel of parts ever contains more than one brightness bin or forward voltage bin.

Chromaticity Coordinates



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Page 6 of the datasheet has a plot of the binning groups linked to the part numbers listed on Page 2 of the datasheet on the CIE 1931 chart.

For OSRAM Opto Semiconductors' white LEDs, such as this one, the color binning is based on the ANSI standard quadrangles for color temperature. In addition, any one color bin will fit within a 3-step MacAdams ellipse. This binning strategy is known as Fine White Binning. The Fine White Binning approach allows OSRAM to address any specific color requirements the user may have.

Color Chromaticity Groups

Color Chromaticity Groups [7] page 27
Farbortgruppen [7] Seite 27

Group Gruppe	Cx	Cy	Group Gruppe	Cx	Cy	Group Gruppe	Cx	Cy
A5	0.4689	0.3953	5M	0.3746	0.3624	6T	0.4342	0.3957
	0.4740	0.3957		0.3773	0.3726		0.4386	0.4048
	0.4747	0.4047		0.3822	0.3670		0.4420	0.3985
	0.4800	0.4052		0.3853	0.3776		0.4468	0.4077
A6	0.4747	0.4047	6M	0.3773	0.3726	7T	0.4386	0.4048
	0.4800	0.4052		0.3799	0.3828		0.4430	0.4138
	0.4805	0.4141		0.3853	0.3776		0.4468	0.4077
	0.4860	0.4146		0.3885	0.3882		0.4515	0.4168
A7	0.4805	0.4141	7M	0.3799	0.3828	8T	0.4430	0.4138
	0.4860	0.4146		0.3826	0.3931		0.4474	0.4228
	0.4863	0.4234		0.3885	0.3882		0.4515	0.4168
	0.4920	0.4239		0.3916	0.3987		0.4562	0.4260
A8	0.4863	0.4234	5N	0.3822	0.3670	5U	0.4373	0.3893
	0.4920	0.4239		0.3853	0.3776		0.4420	0.3985
	0.4922	0.4329		0.3898	0.3716		0.4428	0.3906
	0.4980	0.4334		0.3934	0.3825		0.4477	0.3998
B5	0.4740	0.3957	6N	0.3853	0.3776	6U	0.4420	0.3985
	0.4800	0.4052		0.3885	0.3882		0.4468	0.4077
	0.4804	0.3963		0.3934	0.3825		0.4477	0.3998
	0.4866	0.4057		0.3970	0.3935		0.4526	0.4090
B6	0.4800	0.4052	7N	0.3885	0.3882	7U	0.4468	0.4077
	0.4860	0.4146		0.3916	0.3987		0.4515	0.4168
	0.4866	0.4057		0.3970	0.3935		0.4526	0.4090
	0.4928	0.4152		0.4006	0.4044		0.4576	0.4183
B7	0.4860	0.4146	5O	0.3890	0.3690	8U	0.4515	0.4168
	0.4920	0.4239		0.3916	0.3772		0.4562	0.4260
	0.4928	0.4152		0.3975	0.3731		0.4576	0.4183
	0.4989	0.4246		0.4006	0.3815		0.4625	0.4275

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Pages 7, 8, 9 and 10, give the chromaticity coordinates of each bin shown on Page 6.

The chromaticity coordinates listed represent the corner points for each bin on the CIE 1931 x,y chart.

Group Name on Label

Group Name on Label
Gruppenbezeichnung auf Etikett
Example: MP-5R-K2
Beispiel: MP-5R-K2

Brightness Helligkeit	Chromaticity Coordinate Farbort	Forward Voltage Durchlassspannung
MP	5R	K2

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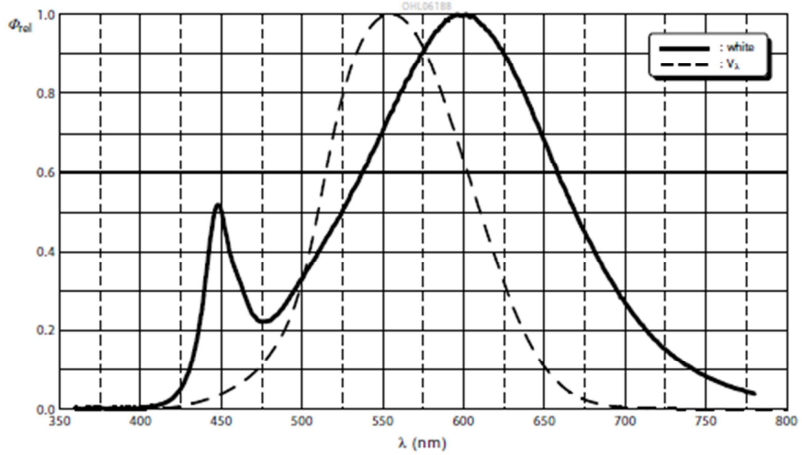
As mentioned previously, a single reel of LEDs will only contain 1 type of each bin. Page 11 shows an example of how the bin names would appear on a label.

This reel of LEDs will only have the MP brightness bin, the 5R chromaticity coordinate bin and the K2 forward voltage bin.

The label on the packaging will clearly indicate this information to the user.

Spectral Emission

Relative Spectral Emission - V(λ) = Standard eye response curve [6] *page 27*
Relative spektrale Emission - V(λ) = spektrale Augenempfindlichkeit [6] *Seite 27*
$\Phi_{rel} = f(\lambda)$; $T_S = 85$ °C; $I_F = 700$ mA



V_λ is the human eye sensitivity curve

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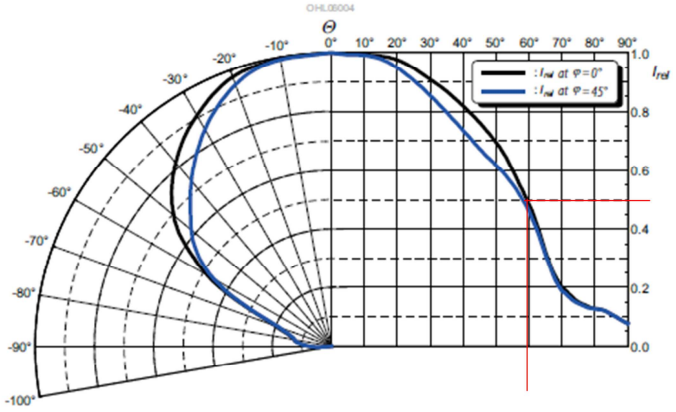
Page 12 overlays the typical relative spectral emission curve of the LED at the solder point temperature of 85° C and binning current of 700mA on the human eye response curve.

The x-axis is the wavelength given in nanometers and the y-axis is the relative radiant power given in arbitrary units.

Radiation Characteristics

Radiation Characteristics [6] page 27
Abstrahlcharakteristik [6] Seite 27
$I_{rel} = f(\varphi)$; $T_S = 85$ °C



- For OSLON Square (GW CSSRM1) the radiation curve hits the 50% line at (φ)60°
- Therefore the viewing angle (2 φ) is here equivalent 120°

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Page 12 also shows the radiation characteristics of the LED.

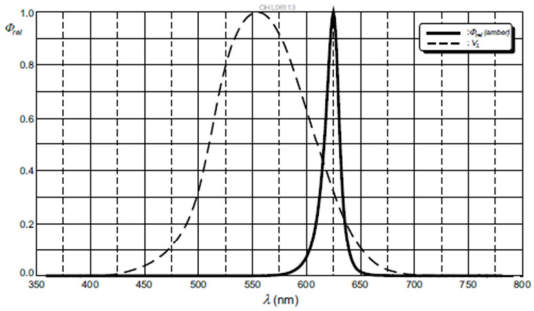
The angle where the luminous intensity decreases to 50% of the maximum is defined as the viewing angle for the LED.

For the OSLON Square the radiation curve hits the 50% line at an angle of (φ) 60° .

Therefore, the viewing angle (2 φ) is 120° .

LA CPDP

Relative Spectral Emission - V(λ) = Standard eye response curve [6] page 22
Relative spektrale Emission - V(λ) = spektrale Augenempfindlichkeit [6] Seite 22
$\Phi_{rel} = f(\lambda)$; $T_S = 25$ °C; $I_F = 350$ mA



Parameter Bezeichnung		Symbol Symbol	Values Werte	Unit Einheit
Wavelength at peak emission Wellenlänge d. emittierten Lichtes	(typ.)	λ_{peak}	625	nm
Dominant Wavelength [3] page 22 Dominantwellenlänge [3] Seite 22	(min.) (typ.) (max.)	λ_{dom} λ_{dom} λ_{dom}	609 617 620	nm nm nm
Spectral bandwidth at 50% $I_{rel\,max}$ Spektrale Bandbreite b. 50% $I_{rel\,max}$	(typ.)	Δλ	16	nm

Peak wavelength

Wavelength with the highest emitted electromagnetic power

Dominant wavelength

Wavelength considering human eye sensitivity; defines the color we can see

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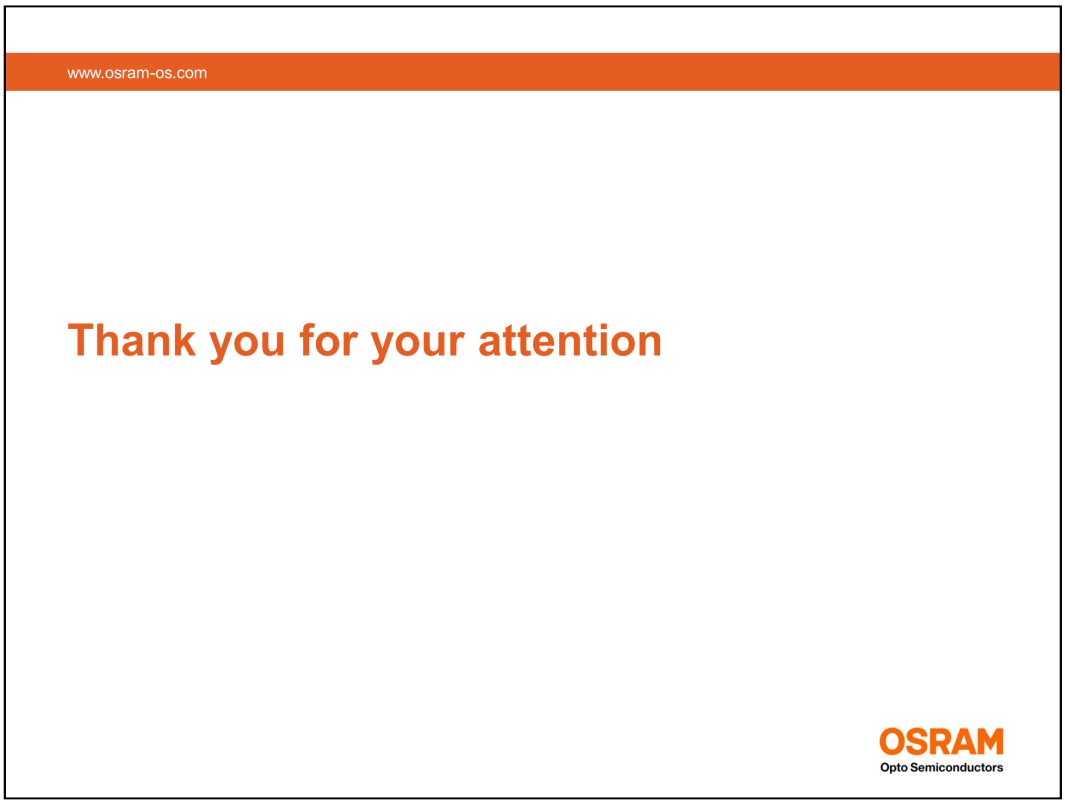
This slide is a deviation from the white LED being discussed to a monochromatic LED datasheet to illustrate a few key parameters mentioned in a monochromatic LED datasheet.

Monochromatic LEDs specify peak wavelength, dominant wavelength and spectral bandwidth.

Dominant wavelength is the single wavelength that is perceived by the human eye, and is defined as the wavelength of monochromatic light that has the same apparent color as the light source.



For information on characteristic curves, dimensions and packaging, please refer to part two of How to Read a Datasheet.

Thank you for viewing this presentation by OSRAM Opto Semiconductors.

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