LUXEON SunPlus Series for Horticulture

LEDs engineered to deliver the precise wavelengths of light needed to improve crop yield

The LUXEON SunPlus Series is purpose-built to enable ease of system design for Horticulture applications. The LUXEON SunPlus Series offers the only LEDs available today that are binned and tested based on Photosynthetic Photon Flux (PPF). The LUXEON SunPlus Series includes two different packages: LUXEON SunPlus 20 Line, which is 2.0mm x 2.0mm and LUXEON SunPlus 35 Line, which is 3.5mm x 3.5mm. The LUXEON SunPlus Series includes options for single driver solutions and multi-channel, color tunable solutions.

FEATURES AND BENEFITS

- 150° angle for uniform light distribution for greenhouse applications
- Two package options 2.0mm x 2.0mm and 3.5mm x 3.5mm for design freedom

PRIMARY APPLICATIONS

- Horticulture

DS171 LUXEON SunPlus Series for Horticulture Product Datasheet ©2017 Lumileds Holding B.V. All rights reserved.

Table of Contents

General Product Information 2
- Product Test Conditions 2
- Part Number Nomenclature 2
- Environmental Compliance 2

Performance Characteristics 3
- Product Selection Guide 3
- Optical Characteristics 3
- Electrical and Thermal Characteristics 4

Absolute Maximum Ratings 4

Characteristic Curves 5
- Spectral Power Distribution Characteristics 5
- Photon Output Characteristics 6
- Forward Current Characteristics 8
- Radiation Pattern Characteristics 9

Product Bin and Labeling Definitions 11
- Decoding Product Bin Labeling 11
- PPF Bins 12
- Color Bin Definitions 13
- Peak Wavelength Bins 13
- Forward Voltage Bins 14

Mechanical Dimensions 15

Reflow Soldering Guidelines 17
- JEDEC Moisture Sensitivity 17
- Solder Pad Design 18

Packaging Information 19
- Pocket Tape Dimensions 19
- Reel Dimensions 20

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General Product Information

Product Test Conditions

LUXEON SunPlus Series LEDs are tested and binned with a DC drive current of 350mA, at a junction temperature, T_j, of 85°C for LUXEON SunPlus 20 Line and 100mA at T_j=25°C for LUXEON SunPlus 35 Line.

Part Number Nomenclature

Part numbers for LUXEON SunPlus Series follow the convention below:

L 1 S P – **A A A B B** 0 **C C** 0 0 0 0 0

Where:

- **A A A** – designates color (FRD=Far Red, DRD=Deep Red, PRP=Purple, RYL=Royal Blue, LME=Lime and CW9=Cool White)
- **B B** – designates typical percentage of PPF in the blue spectrum (420 to 480nm) vs. the total PPF in the Photosynthetic Active Radiation (PAR) region (400 to 700nm), which applies only to purple LEDs (00=2.5%, 10=12.5% and 20=25%)
- **C C** – designates package size (20=2.0mm^2 and 35=3.5mm^2)

Therefore, the following part number is used for a LUXEON SunPlus 20 Royal Blue with a package size of 2.0mm^2:

L 1 S P – **R Y L** 0 0 0 **2 0** 0 0 0 0 0

Environmental Compliance

Lumileds LLC is committed to providing environmentally friendly products to the solid-state lighting market. LUXEON SunPlus Series is compliant to the European Union directives on the restriction of hazardous substances in electronic equipment, namely the RoHS Directive 2011/65/EU and REACH Regulation (EC) 1907/2006. Lumileds LLC will not intentionally add the following restricted materials to its products: lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE).

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Performance Characteristics

Product Selection Guide

Table 1. Product performance of LUXEON SunPlus Series at test conditions.

PRODUCT	COLOR	PEAK WAVELENGTH (nm)		PPF (µmol/s) [1] in PAR (400 to 700nm) [2]		PPF/W TYPICAL (µmol/J)	PART NUMBER
		MINIMUM	MAXIMUM	MINIMUM	TYPICAL		
LUXEON SunPlus 20 Line	Far Red	720	750	1.10	1.37 [3]	2.26	L1SP-FRD0002000000
	Deep Red	655	670	1.60	1.81	2.65	L1SP-DRD0002000000
	Royal Blue	445	455	1.90	2.04	2.11	L1SP-RYL0002000000
	Lime	–	–	1.50	1.59	1.66	L1SP-LME0002000000
	Cool White	–	–	1.40	1.51	1.57	L1SP-CW90002000000
LUXEON SunPlus 35 Line	Purple (2.5% Blue) [4]	–	–	0.45	0.51	1.80	L1SP-PRP0003500000
	Purple (12.5% Blue) [5]	–	–	0.50	0.58	2.02	L1SP-PRP1003500000
	Purple (25% Blue) [6]	–	–	0.55	0.63	2.24	L1SP-PRP2003500000
	Royal Blue	440	455	0.55	0.61	2.00	L1SP-RYL0003500000
	Lime	–	–	0.60	0.65	2.13	L1SP-LME0003500000

Notes for Table 1:
1. Lumileds maintains a tolerance of ±6.5% on µmol/s for LUXEON SunPlus 20 Line and ±7.5% on µmol/s measurements for LUXEON SunPlus 35 Line.
2. PAR is the photosynthetic active radiation from 400 to 700nm.
3. Far Red typical PPF is measured from 700 to 800nm.
4. PPF in blue spectrum (420–480nm) ranges from 0–5% of total PPF in PAR (400–700nm). Typical PPF in the blue spectrum is 2.5%.
5. PPF in blue spectrum (420–480nm) ranges from 10–15% of total PPF in PAR (400–700nm). Typical PPF in the blue spectrum is 12.5%.
6. PPF in blue spectrum (420–480nm) ranges from 20–30% of total PPF in PAR (400–700nm). Typical PPF in the blue spectrum is 25%.

Optical Characteristics

Table 2. Optical characteristics for LUXEON SunPlus Series at test conditions.

PART NUMBER	TYPICAL SPECTRAL HALF-WIDTH [1] (nm)	TYPICAL TEMPERATURE COEFFICIENT OF DOMINANT WAVELENGTH (nm/°C)	TYPICAL TOTAL INCLUDED ANGLE [2]	TYPICAL VIEWING ANGLE [3]
L1SP-FRD0002000000	20	0.06	175°	162°
L1SP-DRD0002000000	20	0.06	175°	162°
L1SP-RYL0002000000	20	0.03	175°	165°
L1SP-LME0002000000	80	-0.01	170°	145°
L1SP-CW90002000000	–	–	170°	150°
L1SP-xxxxx03500000	–	–	140°	115°

Notes for Table 2:
1. Spectral half-width is the spectral bandwidth at 50% of the peak intensity.
2. Total angle at which 90% of the total luminous flux is captured.
3. Viewing angle is the off axis angle from the LED centerline where the luminous intensity is ½ of the peak value.

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Electrical and Thermal Characteristics

Table 3. Electrical and thermal characteristics for LUXEON SunPlus Series at test conditions.

PART NUMBER	FORWARD VOLTAGE [1] (V_f)			TYPICAL TEMPERATURE COEFFICIENT OF FORWARD VOLTAGE [2] (mV/°C)	TYPICAL THERMAL RESISTANCE—JUNCTION TO SOLDER PAD (°C/W)
	MINIMUM	TYPICAL	MAXIMUM		
L1SP-FRD0002000000	1.50	1.73	2.30	-1.7	2.8
L1SP-DRD0002000000	1.50	1.95	2.30	-1.7	2.8
L1SP-RYL0002000000	2.50	2.75	3.50	-1.7	2.8
L1SP-LME0002000000	2.50	2.75	3.50	-2.7	2.8
L1SP-CW90002000000	2.50	2.75	3.50	-1.7	2.8
L1SP-PRPxx03500000	2.70	2.80	3.10	-2.0 to -4.0	8.0
L1SP-RYL0003500000	2.50	3.05	3.50	-2.5	35.0
L1SP-LME0003500000	2.80	3.05	3.50	-1.7	25.0

Notes for Table 3:
1. Lumileds maintains a tolerance of ±0.06V on forward voltage measurements.
2. Measured between 25°C and 85°C.

Absolute Maximum Ratings

Table 4a. Absolute maximum ratings for LUXEON SunPlus 20 Line.

PARAMETER	FAR RED		DEEP RED		ROYAL BLUE	LIME	COOL WHITE
DC Forward Current [1, 2]	700mA	1050mA	700mA	1050mA	1050mA	1225mA	1225mA
Peak Pulsed Forward Current [1, 3]	875mA	1300mA	875mA	1300mA	1300mA	1550mA	1550mA
LED Junction Temperature [1] (DC & Pulse)	135°C	120°C	135°C	120°C	135°C	135°C	135°C
ESD Sensitivity (ANSI/ESDA/JEDEC JS-001-2012)	Class 3B						
Operating Case Temperature [1]	-40 to 125°C		-40 to 125°C		-40 to 125°C	-40 to 110°C	-40 to 125°C
LED Storage Temperature	-40°C to 135°C						
Soldering Temperature	20°C to 260°C						
Allowable Reflow Cycles	3						
Reverse Voltage ($V_{reverse}$)	LUXEON LEDs are not designed to be driven in reverse bias						

Table 4b. Absolute maximum ratings for LUXEON SunPlus 35 Line.

PARAMETER	PURPLE	ROYAL BLUE	LIME
DC Forward Current [1, 2]	300mA	200mA	200mA
Peak Pulsed Forward Current [1, 3]	350mA	480mA	240mA
LED Junction Temperature [1] (DC & Pulse)	125°C		
ESD Sensitivity (ANSI/ESDA/JEDEC JS-001-2012)	Class 2		
Operating Case Temperature [1]	-40°C to 105°C	-40°C to 95°C	-40°C to 105°C
LED Storage Temperature	-40°C to 105°C	-40°C to 95°C	-40°C to 105°C
Soldering Temperature	20°C to 260°C		
Allowable Reflow Cycles	3		
Reverse Voltage ($V_{reverse}$)	LUXEON LEDs are not designed to be driven in reverse bias		

Notes for Tables 4a and 4b:
1. Proper current derating must be observed to maintain the junction temperature below the maximum allowable junction temperature.
2. Residual periodic variations due to power conversion from alternating current (AC) to direct current (DC), also called "ripple," with frequencies ≥100Hz and amplitude of ≤15% of the maximum allowable DC forward current are acceptable, assuming the average current throughout each cycle does not exceed the maximum allowable DC forward current at the corresponding maximum junction temperature.
3. Pulsed operation with a peak drive current equal to the stated peak pulsed forward current is acceptable if the pulse-on time is ≤5ms per cycle and the duty cycle is ≤50%.
4. Transient reverse voltages and surge currents due to electrical switching or supply interruptions are acceptable if these events do not last for more than 10ms, the amplitude of the reverse voltage does not exceed 5V and the reverse current is less than 220uA.
5. Max 5V reverse for up to 10s is an acceptable beginning of life, one time test condition.

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Characteristic Curves

Spectral Power Distribution Characteristics

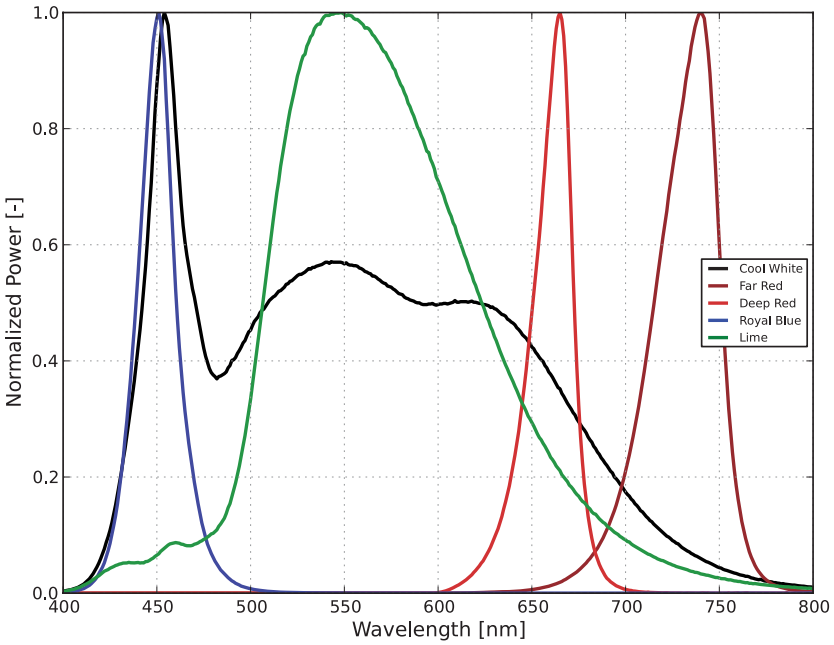

Figure 1a. Typical normalized power vs. wavelength for LUXEON SunPlus 20 Line at 350mA, T_j=85°C.

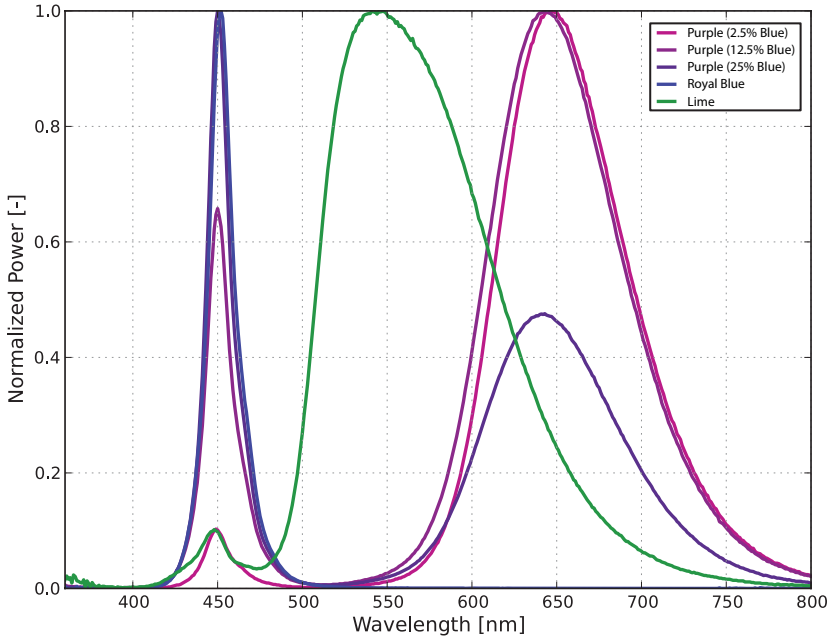

Figure 1b. Typical normalized power vs. wavelength for LUXEON SunPlus 35 Line at 100mA, T_j=25°C.

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Photon Output Characteristics

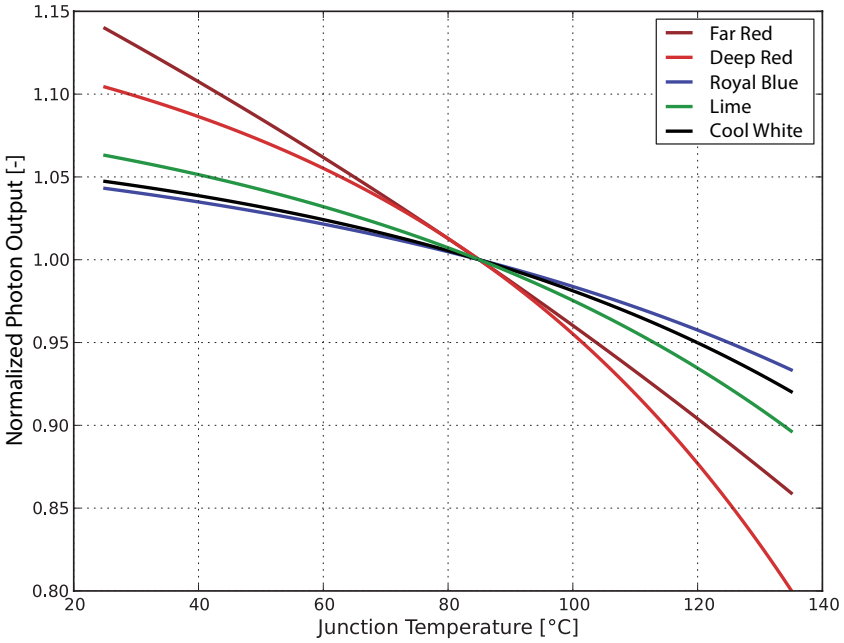

Figure 2a. Typical normalized photon output vs. junction temperature for LUXEON SunPlus 20 Line at 350mA.

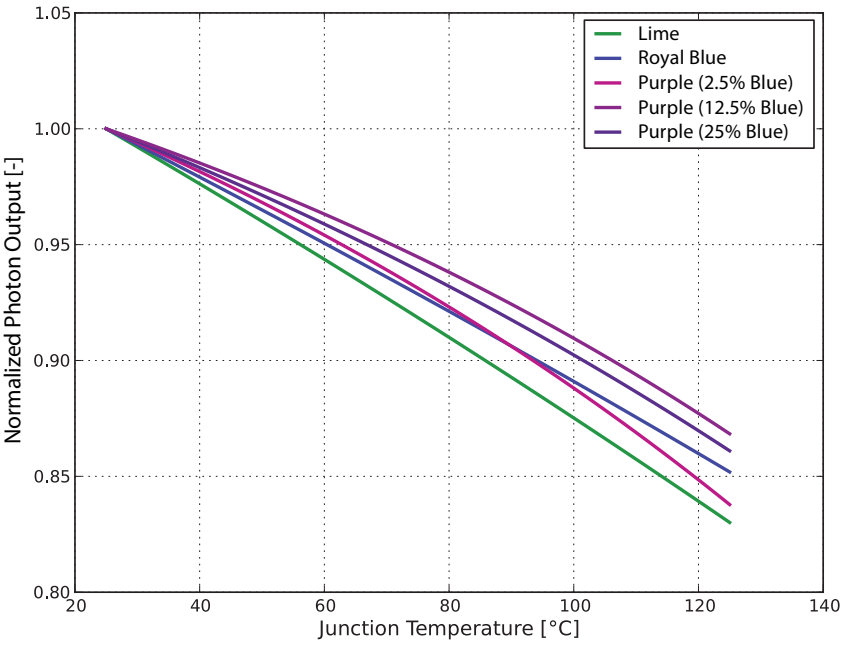

Figure 2b. Typical normalized photon output vs. junction temperature for LUXEON SunPlus 35 Line at 100mA.

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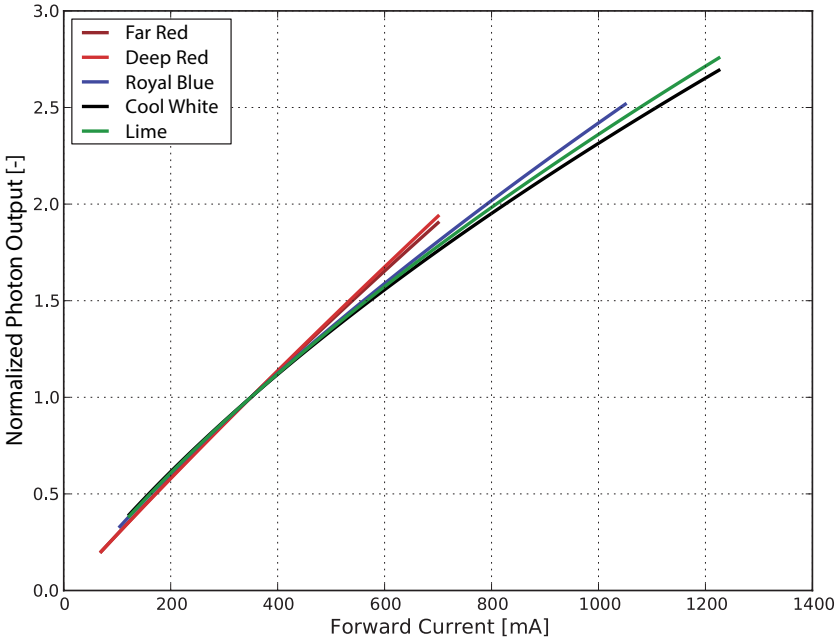

Figure 2c. Typical normalized photon output vs. forward current for LUXEON SunPlus 20 Line at T_j=85ºC.

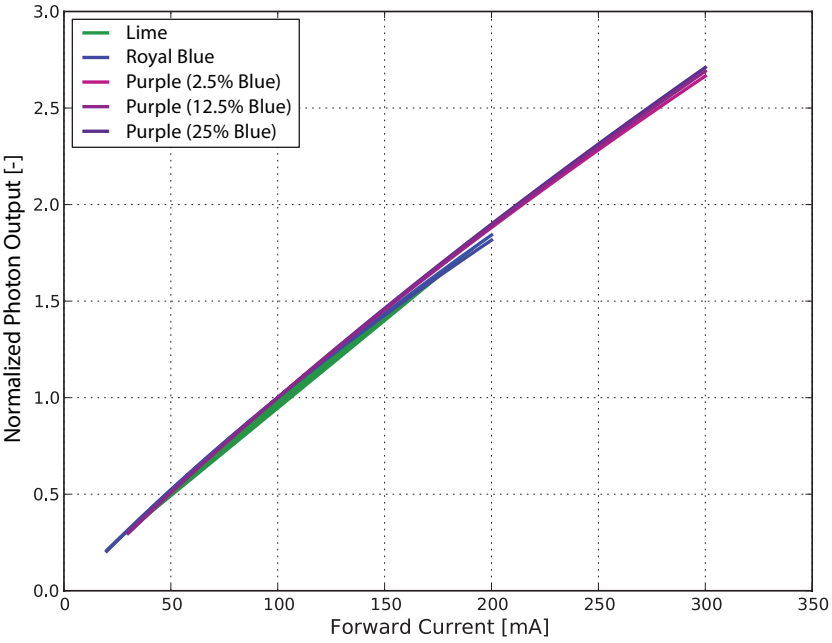

Figure 2d. Typical normalized photon output vs. forward current for LUXEON SunPlus 35 Line at T_j=25°C.

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Forward Current Characteristics

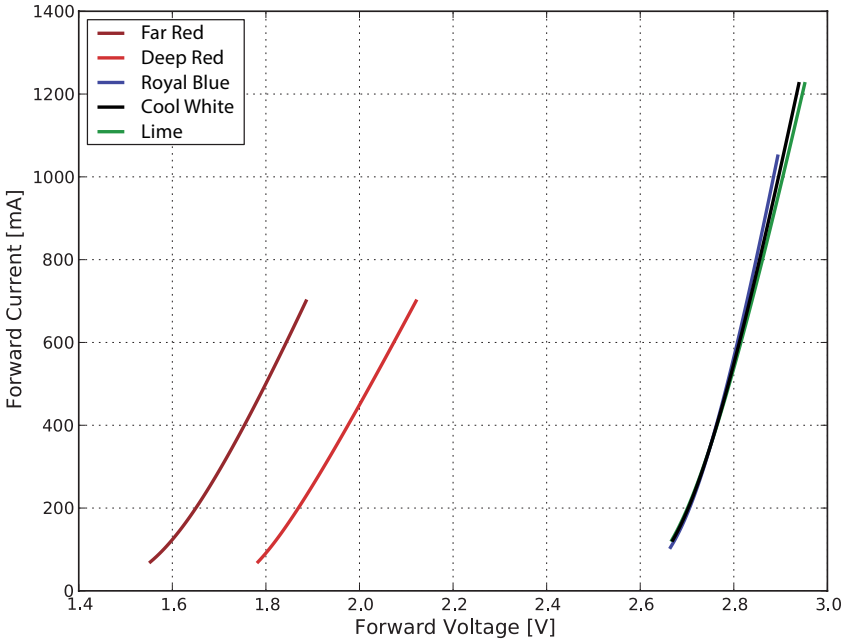

Figure 3a. Typical forward current vs. forward voltage for LUXEON SunPlus 20 Line at T_j=85°C.

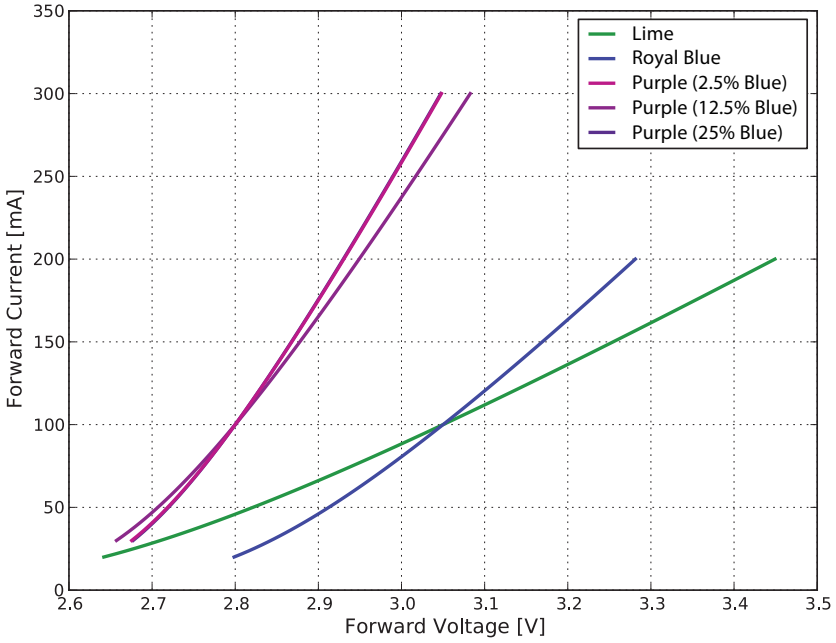

Figure 3b. Typical forward current vs. forward voltage for LUXEON SunPlus 35 Line at T_j=25°C.

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Radiation Pattern Characteristics

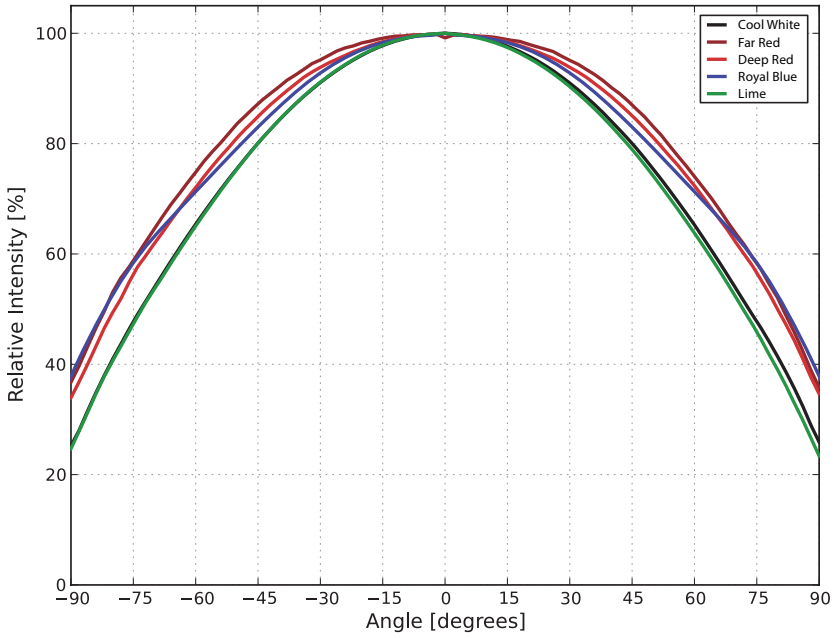

Figure 4a. Typical radiation pattern for LUXEON SunPlus 20 Line at 350mA, T_j=85°C.

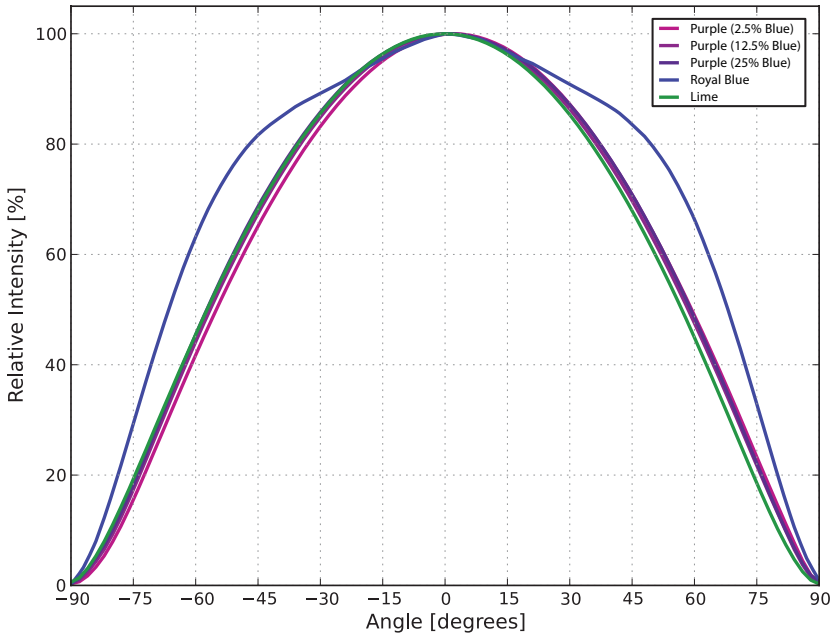

Figure 4b. Typical radiation pattern for LUXEON SunPlus 35 Line at 100mA, T_j=25°C.

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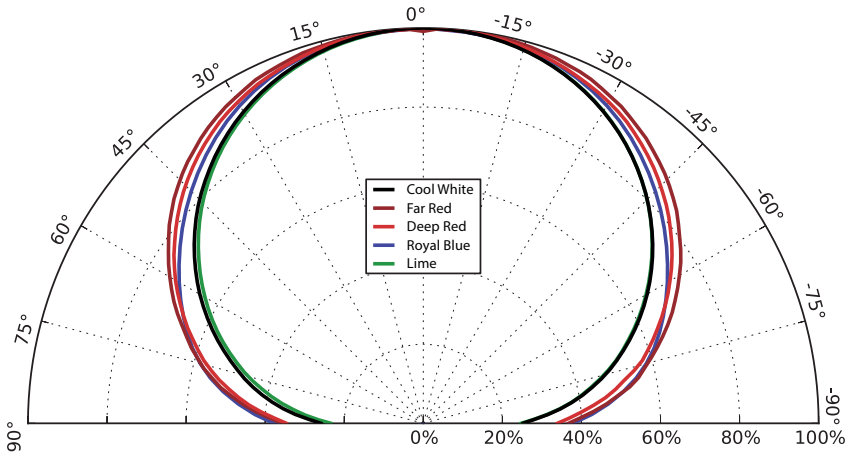

Figure 5a. Typical polar radiation pattern for LUXEON SunPlus 20 Line at 350mA, T_j=85°C.

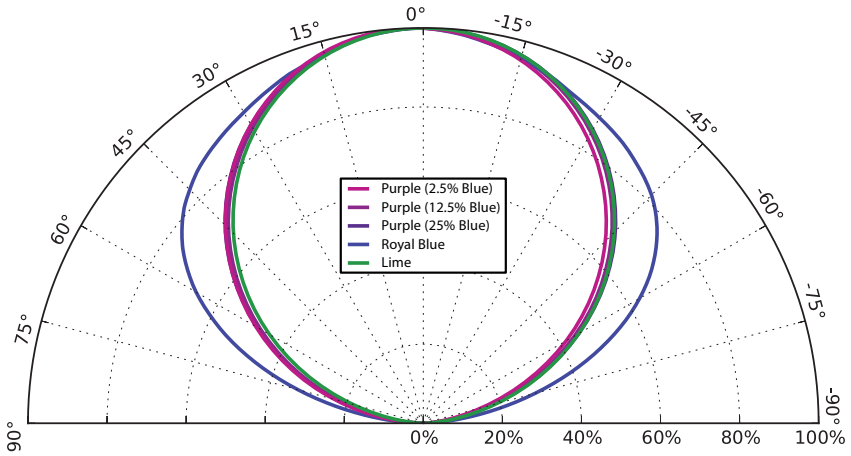

Figure 5b. Typical polar radiation pattern for LUXEON SunPlus 35 Line at 100mA, T_j=25°C.

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Product Bin and Labeling Definitions

Decoding Product Bin Labeling

In the manufacturing of semiconductor products, there are variations in performance around the average values given in the technical datasheet. For this reason, Lumileds bins LED components for luminous flux or radiometric power, color point, peak or dominant wavelength and forward voltage.

All emitters packaged within a reel are of the same bin combination.

LUXEON SunPlus 35 Royal Blue LEDs are labeled using a 3-digit alphanumeric CAT code following the format below:

A B C

Where:

A – designates PPF bin (example: B=0.50 to 0.55 µmol/s, C=0.55 to 0.60 µmol/s)

B – designates peak wavelength bin (example: 3=440 to 445nm, 4=445 to 450nm, 5=450 to 455nm)

C – designates forward voltage bin (example: E=2.50 to 2.75V, F=2.75 to 3.00V, G=3.00 to 3.25V)

Therefore, a LUXEON SunPlus 35 Royal Blue with a PPF range of 0.50 to 0.55 µmol/s, peak wavelength of 445 to 450nm and a forward voltage range of 3.00 to 3.25V has the following CAT code:

B 4 G

LUXEON SunPlus 20 Line and all other LUXEON SunPlus 35 Line LEDs are labeled using a 4-digit alphanumeric CAT code following the format below:

A B B C

Where:

A – designates PPF bin (example: L=1.80 to 1.90 µmol/s, M=1.90 to 2.00 µmol/s)

B B – designates color or peak wavelength bin (example: 40=445 to 450nm, 50=450 to 455nm)

C – designates forward voltage bin (example: E=2.50 to 2.70V, F=2.70 to 2.90V)

Therefore, LUXEON SunPlus 20 Royal Blue with a PPF range of 1.90 to 2.00 µmol/s, peak wavelength of 445 to 450nm and a forward voltage range of 2.70 to 2.90V has the following CAT code:

M 4 0 F

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PPF Bins

Tables 5a and 5b list the standard PPF bins for LUXEON SunPlus Series. Although several bins are outlined, product availability in a particular bin varies by production run and by product performance.

Table 5a. PPF bin definitions for LUXEON SunPlus 20 Line.

BIN	PPF [1] (µmol/s)	
	MINIMUM	MAXIMUM
A	0.80	0.90
B	0.90	1.00
C	1.00	1.10
D	1.10	1.20
E	1.20	1.30
F	1.30	1.40
G	1.40	1.50
H	1.50	1.60
J	1.60	1.70
K	1.70	1.80
L	1.80	1.90
M	1.90	2.00
N	2.00	2.10
P	2.10	2.20
Q	2.20	2.30

Notes for Table 5a:
1. Lumileds maintains a tolerance of ±6.5% on µmol/s measurements.

Table 5b. PPF bin definitions for LUXEON SunPlus 35 Line.

BIN	PPF [1] (µmol/s)	
	MINIMUM	MAXIMUM
A	0.45	0.50
B	0.50	0.55
C	0.55	0.60
D	0.60	0.65
E	0.65	0.70
F	0.70	0.75
G	0.75	0.80
H	0.80	0.85
J	0.85	0.90
K	0.90	0.95
L	0.95	1.00

Notes for Table 5b:
1. Lumileds maintains a tolerance of ±7.5% on µmol/s measurements.

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Color Bin Definitions

Table 6. Color bin definitions for LUXEON SunPlus Series.

PRODUCT	COLOR	BIN [1]
LUXEON SunPlus 20	Lime	10
	Cool White	50
LUXEON SunPlus 35	Purple (2.5% Blue)	H1
	Purple (12.5% Blue)	H3
	Purple (25% Blue)	H5
	Lime	L1

Notes for Table 6:
1. Lumileds maintains a tester tolerance of + 0.005 on color bin coordinates

Peak Wavelength Bins

Table 7. Peak wavelength bins for LUXEON SunPlus Series.

PRODUCT	COLOR	BIN	PEAK WAVELENGTH [1] (nm)	
			MINIMUM	MAXIMUM
LUXEON SunPlus 20	Far Red	10	720	750
	Deep Red	10	655	670
	Royal Blue	40	445	450
		50	450	455
LUXEON SunPlus 35	Royal Blue	3	440	445
		4	445	450
		5	450	455

Notes for Table 7:
1. Lumileds maintains a tolerance of ±2.0nm on peak wavelength measurements.

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Forward Voltage Bins

Table 8. Forward voltage bin definitions for LUXEON SunPlus Series.

PRODUCT	COLOR	BIN	FORWARD VOLTAGE [1] (V_f)	
			MINIMUM	MAXIMUM
LUXEON SunPlus 20 Line	Far Red Deep Red Royal Blue Lime Cool White	Z	1.50	1.70
		A	1.70	1.90
		B	1.90	2.10
		C	2.10	2.30
		D	2.30	2.50
		E	2.50	2.70
		F	2.70	2.90
		G	2.90	3.10
		H	3.10	3.30
		J	3.30	3.50
LUXEON SunPlus 35 Line	Royal Blue	E	2.50	2.75
		F	2.75	3.00
		G	3.00	3.25
		H	3.25	3.50
	Purple Lime	S	2.70	2.80
		T	2.80	2.90
		V	2.90	3.00
		W	3.00	3.10
		X	3.10	3.20
		Y	3.20	3.30
		Z	3.30	3.50

Notes for Table 8:
1. Lumileds maintains a tolerance of ±0.06V on forward voltage measurements for LUXEON SunPlus 20 Line and ±0.1V for LUXEON SunPlus 35 Line.

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Mechanical Dimensions

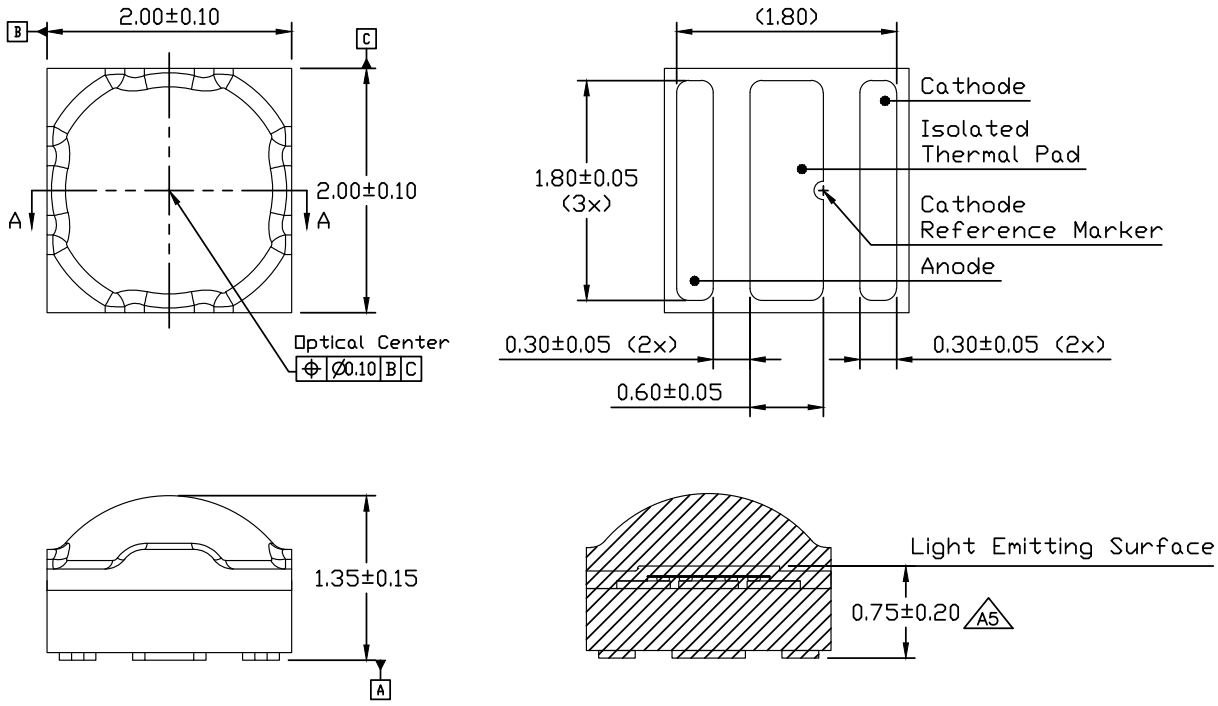

Figure 6a. Mechanical dimensions for LUXEON SunPlus 20 Line.

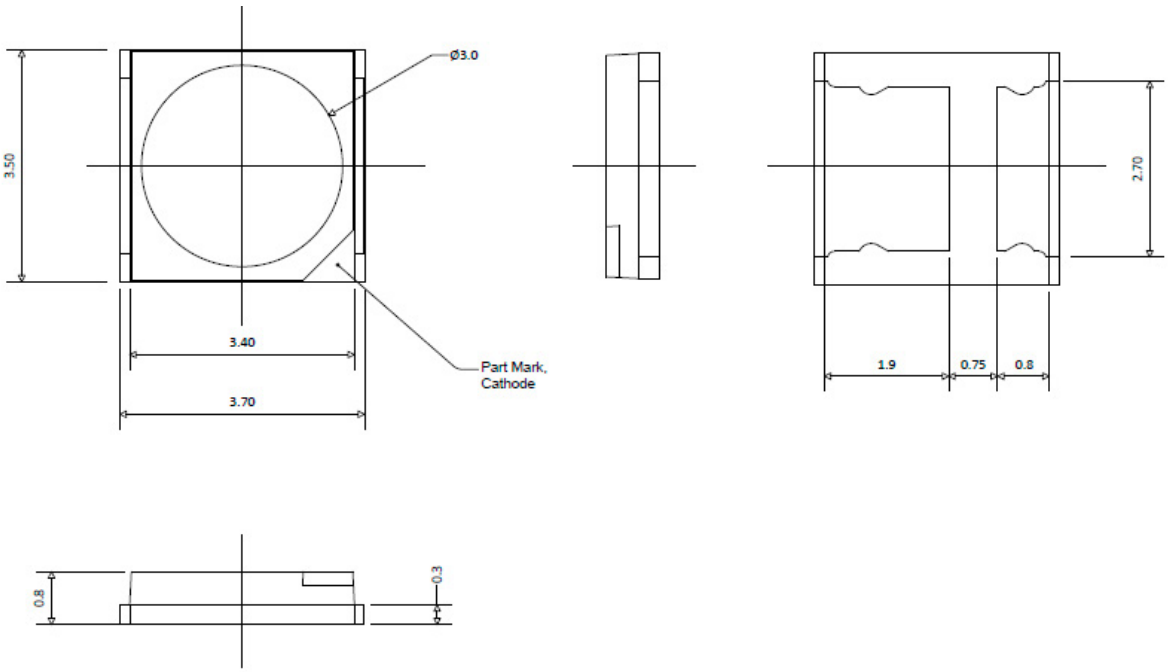

Figure 6b. Mechanical dimensions for L1SP-PRPxx03500000.

Notes for Figures 6a and 6b:
1. Drawings are not to scale.
2. All dimensions are in millimeters.

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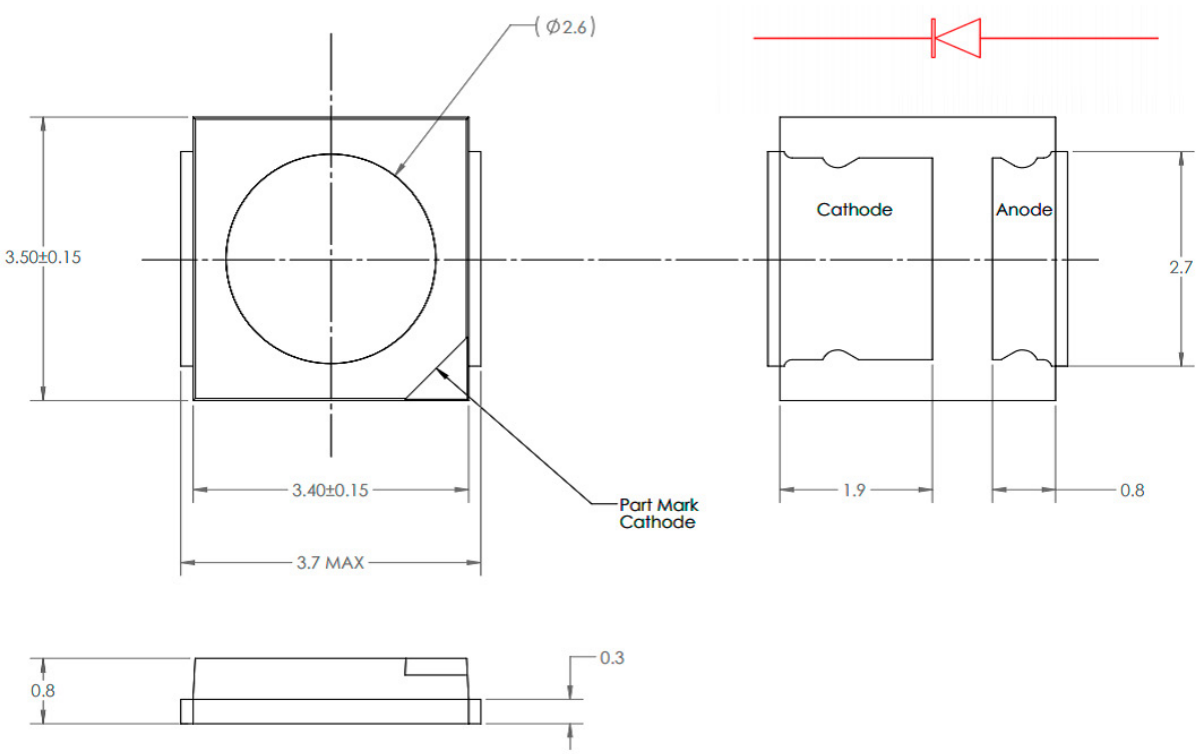

Figure 6c. Mechanical dimensions for L1SP-RYL0003500000 and L1SP-LME0003500000.

Notes for Figure 6c:
1. Drawings are not to scale.
2. All dimensions are in millimeters.

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Reflow Soldering Guidelines

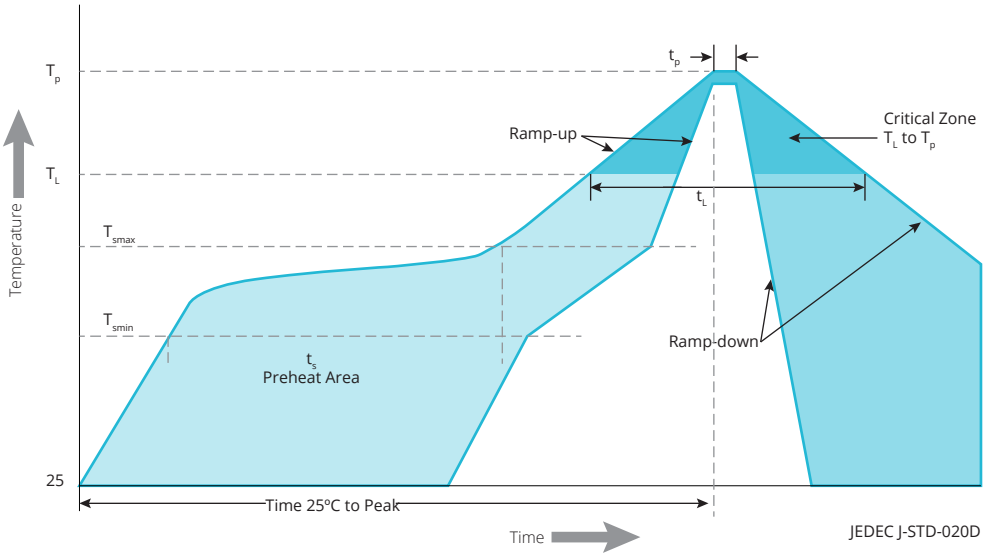

Figure 7. Visualization of the acceptable reflow temperature profile as specified in Table 9.

Table 9. Reflow profile characteristics for LUXEON SunPlus Series.

PROFILE FEATURE	LEAD-FREE ASSEMBLY	
	LUXEON SUNPLUS 20 LINE	LUXEON SUNPLUS 35 LINE
Preheat Minimum Temperature (T_{smin})	150°C	
Preheat Maximum Temperature (T_{smax})	200°C	
Preheat Time (t_{smin} to t_{smax})	60 to 120 seconds	
Ramp-Up Rate (T_L to T_p)	3°C / second maximum	
Liquidus Temperature (T_L)	217°C	
Time Maintained Above Temperature T_L (t_L)	60 to 150 seconds	10 to 30 seconds
Peak / Classification Temperature (T_p)	260°C	
Time Within 5°C of Actual Temperature (t_p)	20 to 40 seconds	10 to 30 seconds
Ramp-Down Rate (T_p to T_L)	6°C / second maximum	
Time 25°C to Peak Temperature	8 minutes maximum	

JEDEC Moisture Sensitivity

Table 10. Moisture sensitivity levels for LUXEON SunPlus Series.

PRODUCT	LEVEL	FLOOR LIFE		SOAK REQUIREMENTS STANDARD	
		TIME	CONDITIONS	TIME	CONDITIONS
LUXEON SunPlus 20 Line	1	Unlimited	≤30°C / 85% RH	168 Hours +5 / -0	85°C / 85% RH
LUXEON SunPlus 35 Line	2	1 Year	≤30°C / 60% RH	168 Hours +5 / -0	85°C / 60% RH

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Solder Pad Design

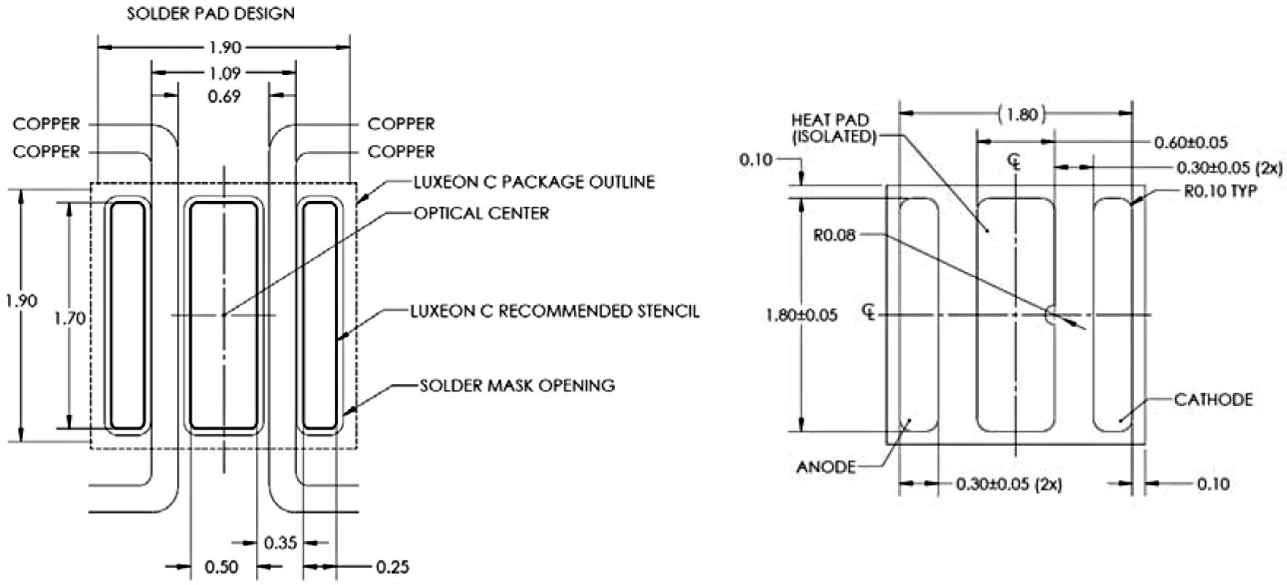

Figure 8a. Recommended PCB solder pad layout for LUXEON SunPlus 20 Line.

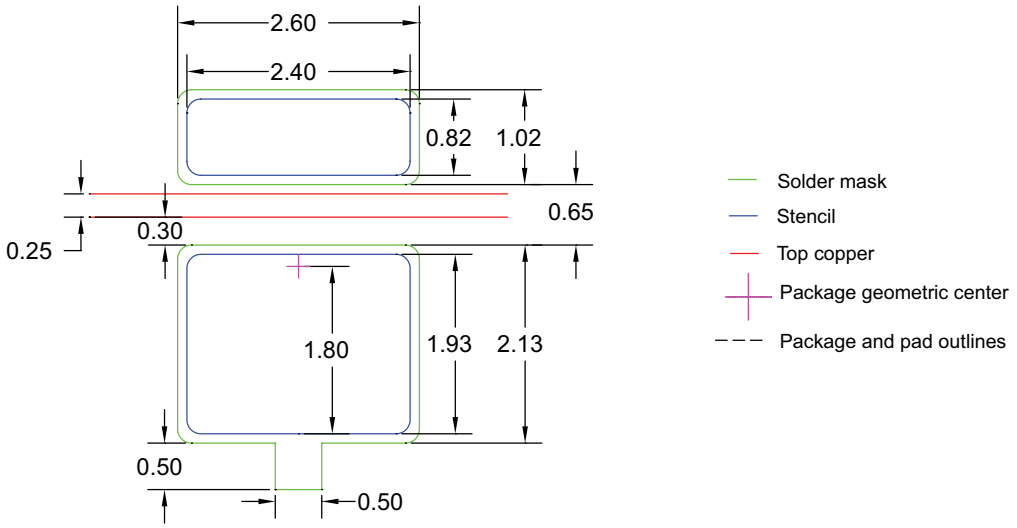

Figure 8b. Recommended PCB solder pad layout for LUXEON SunPlus 35 Line.

Notes for Figures 8a and 8b:
1. Drawings are not to scale.
2. All dimensions are in millimeters.

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Packaging Information

Pocket Tape Dimensions

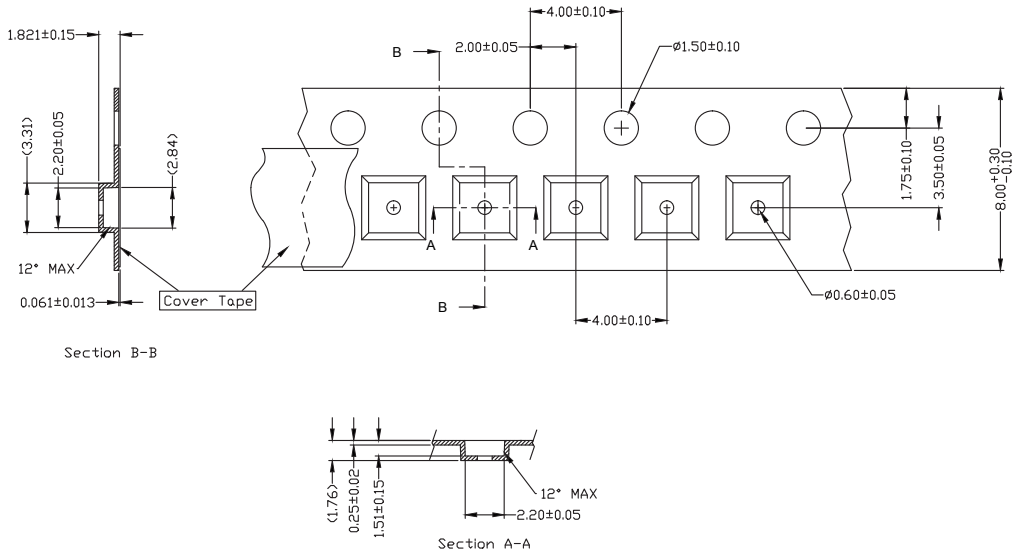

Figure 9a. Pocket tape dimensions for LUXEON SunPlus 20 Line.

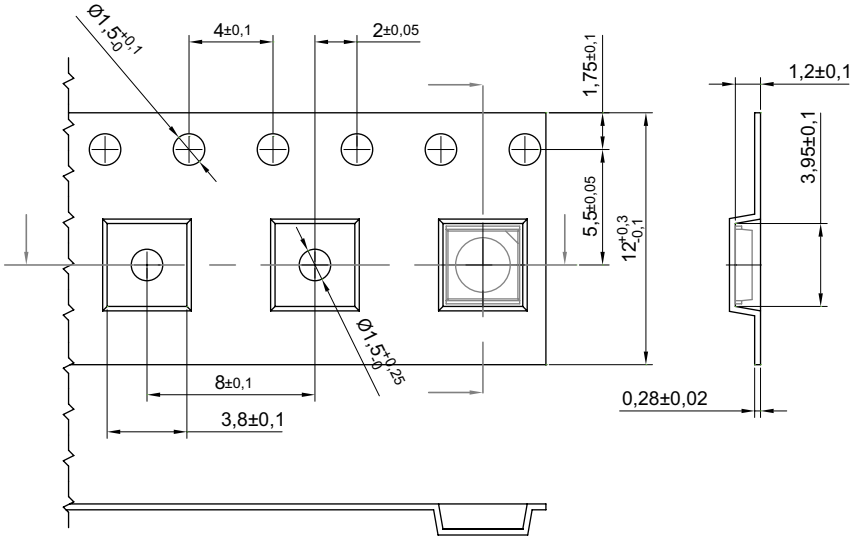

Figure 9b. Pocket tape dimensions for LUXEON SunPlus 35 Line.

Notes for Figures 9a and 9b:
1. Drawings are not to scale.
2. All dimensions are in millimeters.

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Reel Dimensions

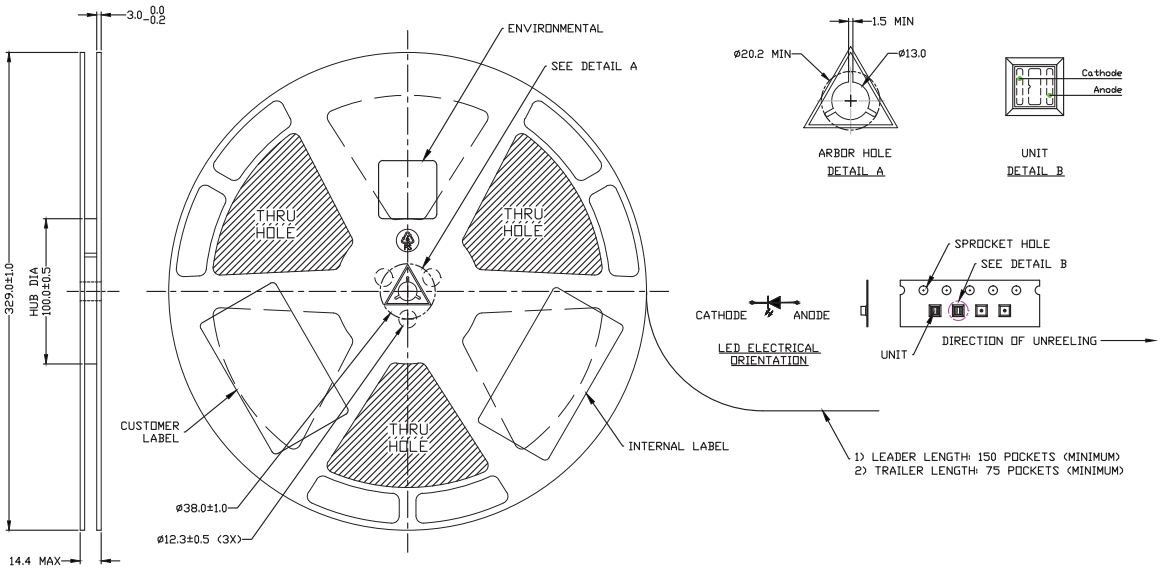

Figure 10a. Reel dimensions for LUXEON SunPlus 20 Line.

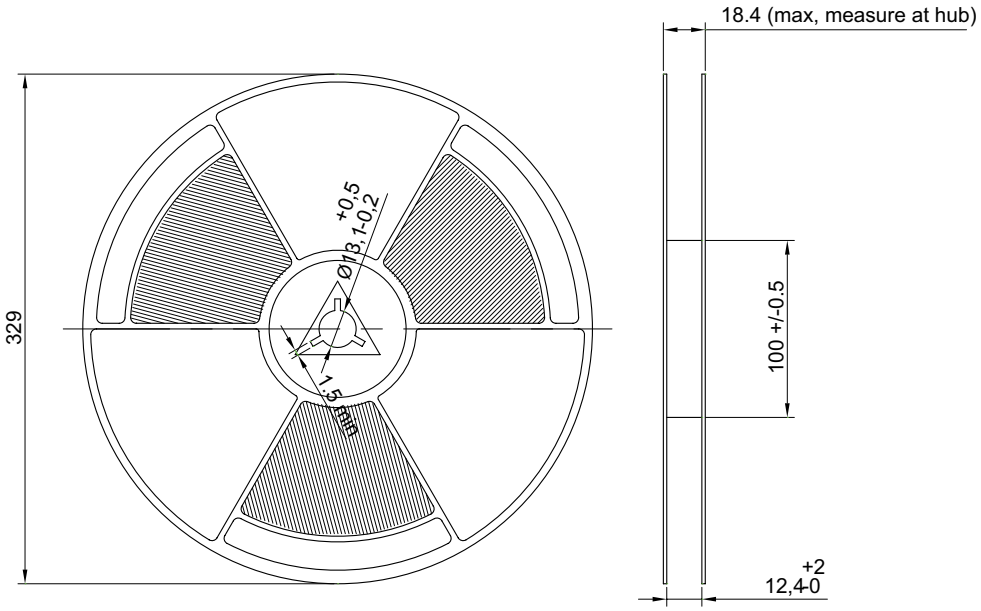

Figure 10b. Reel dimensions for LUXEON SunPlus 35 Line.

Notes for Figures 10a and 10b:
1. Drawings are not to scale.
2. All dimensions are in millimeters.

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Companies developing automotive, mobile, IoT and illumination lighting applications need a partner who can collaborate with them to push the boundaries of light. With over 100 years of inventions and industry firsts, Lumileds is a global lighting solutions company that helps customers around the world deliver differentiated solutions to gain and maintain a competitive edge. As the inventor of Xenon technology, a pioneer in halogen lighting and the leader in high performance LEDs, Lumileds builds innovation, quality and reliability into its technology, products and every customer engagement. Together with its customers, Lumileds is making the world safer, better and more beautiful—with light.

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