ProLight Opto
Technology Corporation

ProLight PN6N-4LxE-9PRx
4W Power LED
Technical Datasheet
Version: 1.6

ProLight Opto ® PN6N Series

Features

·High flux per LED
·Good color uniformity
·Industry best moisture sensitivity Level – JEDEC Level 1
·Lead free reflow soldering
·More energy efficient than incandescent and most halogen lamps
·Instant light (less than 100ns)
·No UV

Main Applications

·Entertainment Lighting
·Commercial Lighting
·Outdoor Lighting

Introduction

·PN6N qualifies as the JEDEC Level 1 MSL sensitivity level and suitable for SMD process, Pb_free reflow soldering capability, and full compliance with EU Reduction of Hazardous Substances (RoHS) legislation.

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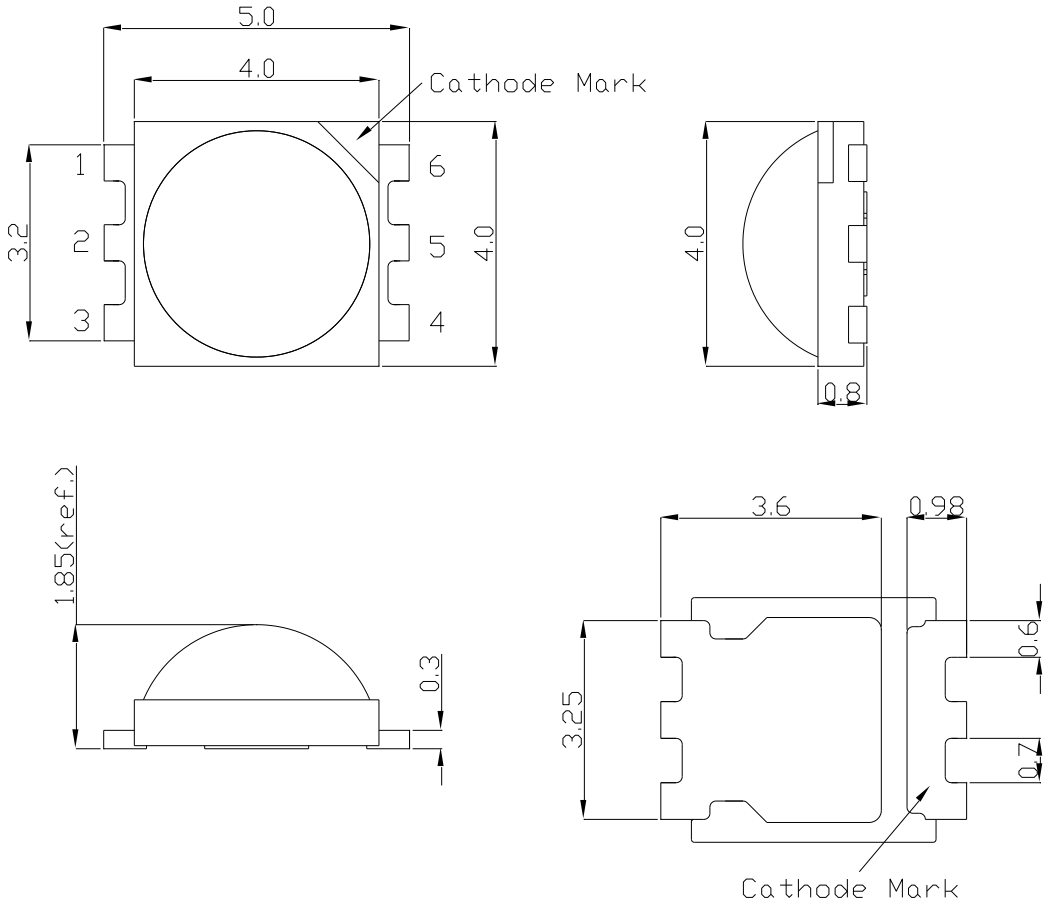
2019/10
DS-0598

Emitter Mechanical Dimensions



Notes:

1. The cathode side of the device is denoted by the chamfer on the part body.
2. Electrical insulation between the case and the board is required. Do not electrically connect either the anode or cathode to the slug.
3. Drawing not to scale.
4. All dimensions are in millimeters.
5. Unless otherwise indicated, tolerances are ± 0.10mm.
6. Please do not bend the leads of the LED, otherwise it will damage the LED.
7. **Please do not use a force of over 3kgf impact or pressure on the lens of the LED, otherwise it will cause a catastrophic failure.**

*The appearance and specifications of the product may be modified for improvement without notice.

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Flux Characteristics at 120mA, T_J = 25°C

Radiation Pattern	Color	Part Number Emitter	Luminous Flux Φ_V (lm) Minimum	Luminous Flux Φ_V (lm) Typical	lm/W Typical	CRI Minimum
Lambertian	White	PN6N-4LWE-9PR7	165	180	176	70
	Neutral White	PN6N-4LNE-9PR7	150	174	170	70
	Warm White	PN6N-4LVE-9PR7	150	157	153	70
	White	PN6N-4LWE-9PR8	150	167	163	80
	Neutral White	PN6N-4LNE-9PR8	140	164	160	80
	Warm White	PN6N-4LVE-9PR8	140	158	155	80
	White	PN6N-4LWE-9PR9	120	136	123	90
	Neutral White	PN6N-4LNE-9PR9	110	130	127	90
	Warm White	PN6N-4LVE-9PR9	110	123	120	90

- ProLight maintains a tolerance of ± 7% on flux and power measurements.
- Please do not drive at rated current more than 1 second without proper heat sink.

Electrical Characteristics at 120mA, T_J = 25°C

Color	Forward Voltage V_F (V) Min.	Typ.	Max.	Thermal Resistance Junction to Slug (°C/ W)
White	7.5	8.5	9.5	5
Neutral White	7.5	8.5	9.5	5
Warm White	7.5	8.5	9.5	5

- ProLight maintains a tolerance of ± 0.1V for Voltage measurements.

Optical Characteristics at 120mA, T_J = 25°C

Radiation Pattern	Color	Color Temperature CCT Min.	Typ.	Max.	Total included Angle (degrees) $\theta_{0.90V}$	Viewing Angle (degrees) $2\theta_{1/2}$
Lambertian	White	4745 K	5900 K	7030 K	160	140
	Neutral White	3700 K	3975 K	4250 K	160	140
	Warm White	2850 K	3000 K	3250 K	160	140

- ProLight maintains a tolerance of ± 5% for CCT measurements.

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Electro-Optical Characteristics, T_J = 25°C

I_F (mA)	V_F (V)	Power (W)	PN6N-4LWE-9PR7		PN6N-4LNE-9PR7		PN6N-4LVE-9PR7	
			Flux (lm)	lm/W	Flux (lm)	lm/W	Flux (lm)	lm/W
60	8.18	0.49	92.1	187.7	89.0	181.5	80.3	163.9
120	8.50	1.02	180.0	176.3	174.0	170.5	157.0	153.9
180	8.77	1.58	262.8	166.5	254.1	160.9	229.3	145.1
240	9.03	2.17	340.6	157.2	329.3	152.0	297.1	136.9
300	9.26	2.78	414.6	149.3	400.8	144.3	361.6	130.1
360	9.48	3.41	484.0	141.8	467.9	137.1	422.2	123.8
420	9.69	4.07	549.6	135.1	531.3	130.6	479.4	117.8
450	9.78	4.40	581.2	132.0	561.8	127.6	506.9	115.2

I_F (mA)	V_F (V)	Power (W)	PN6N-4LWE-9PR8		PN6N-4LNE-9PR8		PN6N-4LVE-9PR8	
			Flux (lm)	lm/W	Flux (lm)	lm/W	Flux (lm)	lm/W
60	8.18	0.49	85.4	174.2	83.9	171.0	80.8	164.8
120	8.50	1.02	167.0	163.6	164.0	160.7	158.0	154.8
180	8.77	1.58	243.8	154.5	239.5	151.7	230.7	146.1
240	9.03	2.17	316.0	145.9	310.4	143.2	299.0	138.0
300	9.26	2.78	384.7	138.5	377.8	136.0	364.0	131.0
360	9.48	3.41	449.0	131.6	441.0	129.2	424.8	124.5
420	9.69	4.07	509.9	125.3	500.7	123.1	482.4	118.6
450	9.78	4.40	539.2	122.5	529.5	120.3	510.1	115.9

I_F (mA)	V_F (V)	Power (W)	PN6N-4LWE-9PR9		PN6N-4LNE-9PR9		PN6N-4LVE-9PR9	
			Flux (lm)	lm/W	Flux (lm)	lm/W	Flux (lm)	lm/W
60	8.18	0.49	69.6	141.8	66.5	135.6	62.9	128.3
120	8.50	1.02	136.0	133.2	130.0	127.4	123.0	120.5
180	8.77	1.58	198.6	125.8	189.8	120.2	179.6	113.8
240	9.03	2.17	257.4	118.8	246.0	113.5	232.8	107.4
300	9.26	2.78	313.3	112.8	299.5	107.8	283.3	102.0
360	9.48	3.41	365.7	107.2	349.5	102.4	330.7	96.9
420	9.69	4.07	415.2	102.1	396.9	97.6	375.6	92.3
450	9.78	4.40	439.1	99.8	419.7	95.4	397.1	90.2

- All values are reference only.

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Absolute Maximum Ratings

Parameter	White/Neutral White/Warm White
DC Forward Current (mA)	450
Peak Pulsed Forward Current (mA)	540 (less than 1/10 duty cycle@1KHz)
ESD Sensitivity (HBM per MIL-STD-883E Method 3015.7)	> ±500V
LED Junction Temperature	120°C
Operating Board Temperature at Maximum DC Forward Current	-40°C - 90°C
Storage Temperature	-40°C - 120°C
Soldering Temperature	JEDEC 020c 260°C
Allowable Reflow Cycles	3
Reverse Voltage	Not designed to be driven in reverse bias

Forward Voltage Bin Structure

Color	Bin Code	Minimum Voltage (V)	Maximum Voltage (V)
White	A	7.5	8.0
	B	8.0	8.5
	D	8.5	9.0
	E	9.0	9.5
Neutral White	A	7.5	8.0
	B	8.0	8.5
	D	8.5	9.0
	E	9.0	9.5
Warm White	A	7.5	8.0
	B	8.0	8.5
	D	8.5	9.0
	E	9.0	9.5

- ProLight maintains a tolerance of ± 0.1V for Voltage measurements.

Note: Although several bins are outlined, product availability in a particular bin varies by production run and by product performance. Not all bins are available in all colors.

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Photometric Luminous Flux Bin Structure

Color	Bin Code	Minimum Photometric Flux (lm)	Maximum Photometric Flux (lm)	Available Color Bins
PN6N-4LWE-9PR7	X2	165	180	All
	Y1	180	195	【1】
	Y2	195	210	【1】
PN6N-4LNE-9PR7	X1	150	165	All
	X2	165	180	【1】
	Y1	180	195	【1】
	Y2	195	210	【1】
PN6N-4LVE-9PR7	X1	150	165	All
	X2	165	180	【1】
	Y1	180	195	【1】
PN6N-4LWE-9PR8	X1	150	165	All
	X2	165	180	【1】
	Y1	180	195	【1】
PN6N-4LNE-9PR8	W2	140	150	All
	X1	150	165	【1】
	X2	165	180	【1】
	Y1	180	195	【1】
PN6N-4LVE-9PR8	W2	140	150	All
	X1	150	165	【1】
	X2	165	180	【1】
PN6N-4LWE-9PR9	V2	120	130	All
	W1	130	140	【1】
	W2	140	150	【1】
	X1	150	165	【1】
PN6N-4LNE-9PR9	V1	110	120	All
	V2	120	130	【1】
	W1	130	140	【1】
	W2	140	150	【1】
PN6N-4LVE-9PR9	V1	110	120	All
	V2	120	130	【1】
	W1	130	140	【1】

- ProLight maintains a tolerance of ± 7% on flux and power measurements.
- The flux bin of the product may be modified for improvement without notice.
- 【1】The rest of color bins are not 100% ready for order currently. Please ask for quote and order Possibility.

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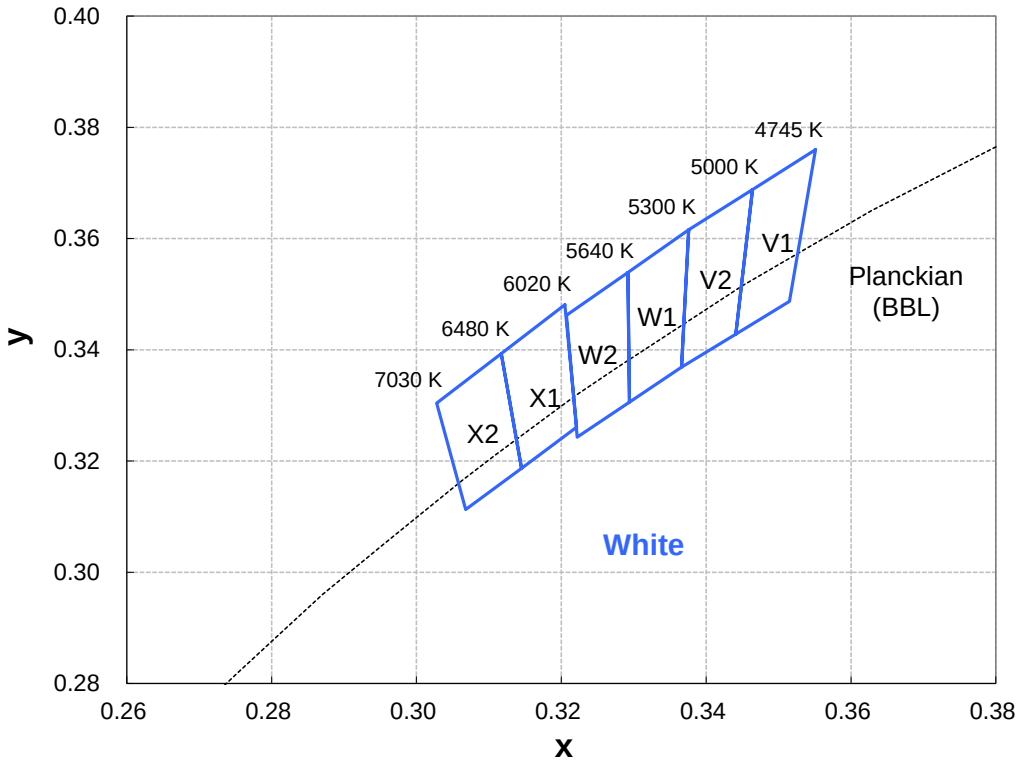
Color Bins at 120mA, T_j = 25°C

White Binning Structure Graphical Representation



White Bin Structure

Bin Code	x	y	Typ. CCT (K)	Bin Code	x	y	Typ. CCT (K)
V1	0.3551	0.3760	4890	W2	0.3292	0.3539	5830
	0.3464	0.3688			0.3207	0.3462	
	0.3441	0.3428			0.3222	0.3243	
	0.3515	0.3487			0.3294	0.3306	
V2	0.3464	0.3688	5150	X1	0.3205	0.3481	6250
	0.3376	0.3616			0.3117	0.3393	
	0.3366	0.3369			0.3145	0.3187	
	0.3441	0.3428			0.3221	0.3261	
W1	0.3376	0.3616	5470	X2	0.3117	0.3393	6750
	0.3292	0.3539			0.3028	0.3304	
	0.3294	0.3306			0.3068	0.3113	
	0.3366	0.3369			0.3145	0.3187	

- Tolerance on each color bin (x , y) is ± 0.005

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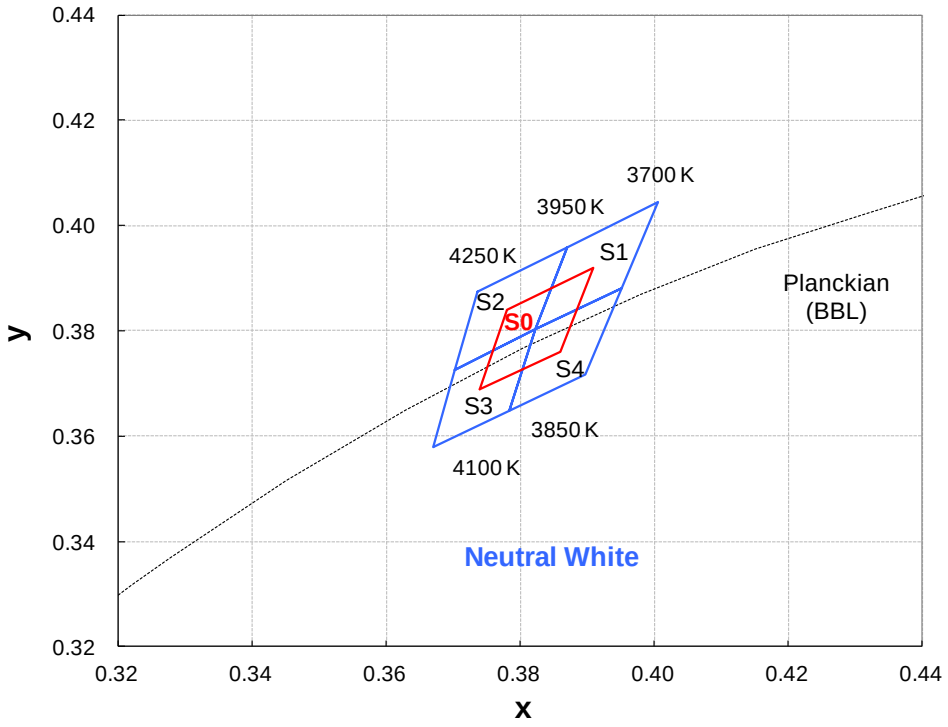
Color Bin

Neutral White Binning Structure Graphical Representation



Neutral White Bin Structure

Bin Code	x	y	Typ. CCT (K)	Bin Code	x	y	Typ. CCT (K)
S1	0.3871	0.3959	3825	S2	0.3736	0.3874	4100
	0.4006	0.4044			0.3871	0.3959	
	0.3952	0.3880			0.3823	0.3803	
	0.3823	0.3803			0.3703	0.3726	
S4	0.3823	0.3803	3825	S3	0.3703	0.3726	4100
	0.3952	0.3880			0.3823	0.3803	
	0.3898	0.3716			0.3784	0.3647	
	0.3784	0.3647			0.3670	0.3578	
S0	0.3740	0.3690	3975				
	0.3780	0.3840					
	0.3910	0.3920					
	0.3860	0.3760					

- Tolerance on each color bin (x , y) is ± 0.005

Note:
1. Although several bins are outlined, product availability in a particular bin varies by production run and by product performance. Not all bins are available in all colors.
2. ProLight **SmartBin** is working to make the color bin smarter, by selecting that intelligence is infused into major **S0** bin with minor S1-S4 bins and processes that make assembly easily

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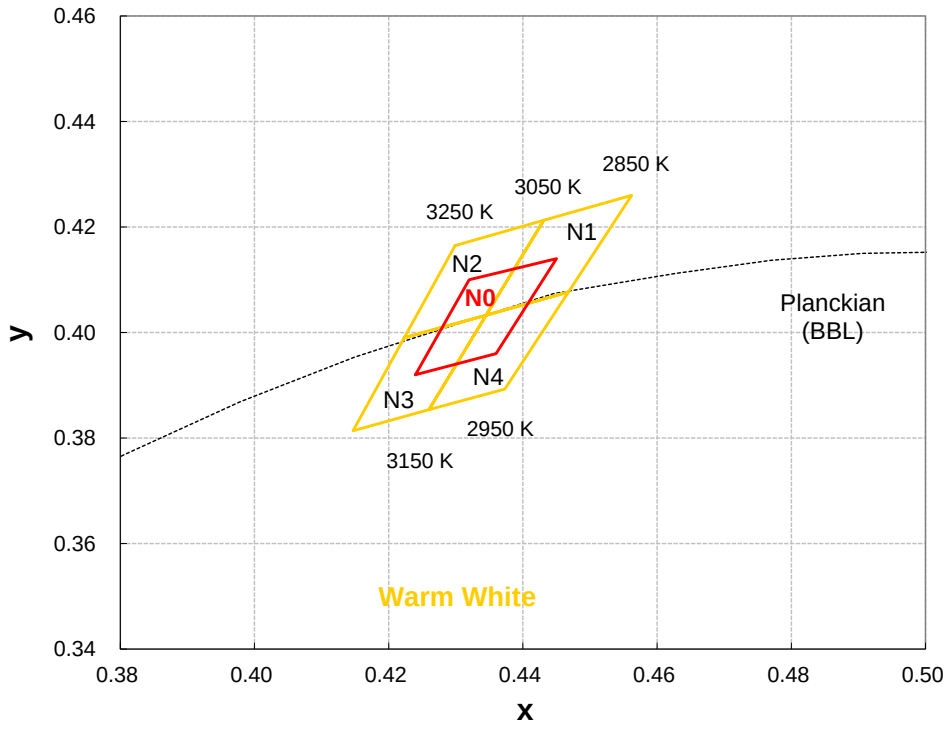
Color Bin

Warm White Binning Structure Graphical Representation



Warm White Bin Structure

Bin Code	x	y	Typ. CCT (K)	Bin Code	x	y	Typ. CCT (K)
N1	0.4431	0.4213	2950	N2	0.4299	0.4165	3150
	0.4562	0.4260			0.4431	0.4213	
	0.4468	0.4077			0.4345	0.4033	
	0.4345	0.4033			0.4223	0.3990	
N4	0.4345	0.4033	2950	N3	0.4223	0.3990	3150
	0.4468	0.4077			0.4345	0.4033	
	0.4373	0.3893			0.4260	0.3854	
	0.4260	0.3854			0.4147	0.3814	
N0	0.4240	0.3920	3050				
	0.4320	0.4100					
	0.4450	0.4140					
	0.4360	0.3960					

- Tolerance on each color bin (x , y) is ± 0.005

Note:

1. Although several bins are outlined, product availability in a particular bin varies by production run and by product performance. Not all bins are available in all colors.
2. ProLight **SmartBin** is working to make the color bin smarter, by selecting that intelligence is infused into major **N0** bin with minor N1-N4 bins and processes that make assembly easily

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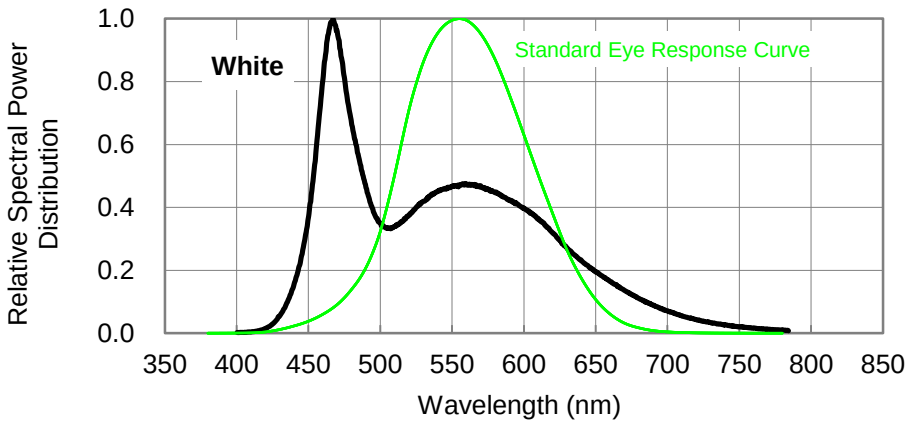
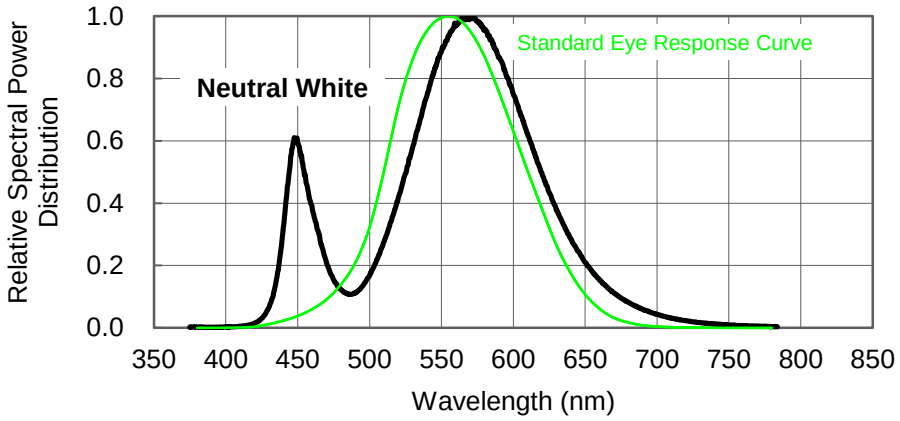
Color Spectrum, T_j = 25°C

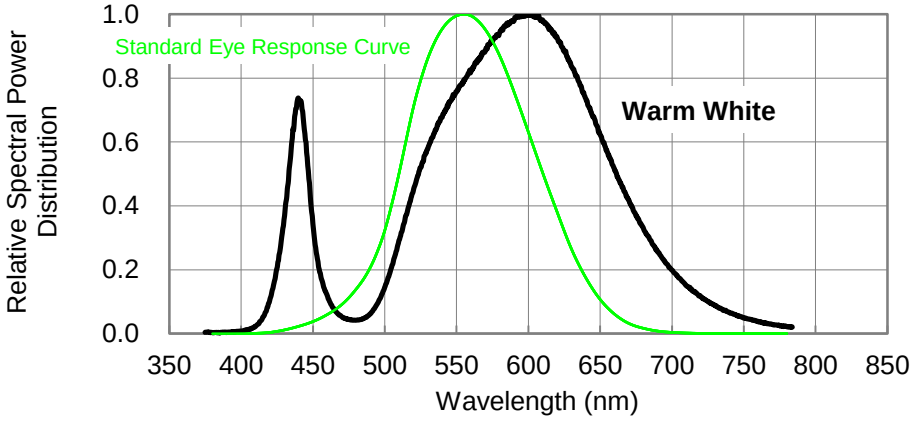
1. PN6N-4LWE-9PR7



2. PN6N-4LNE-9PR7



3. PN6N-4LVE-9PR7



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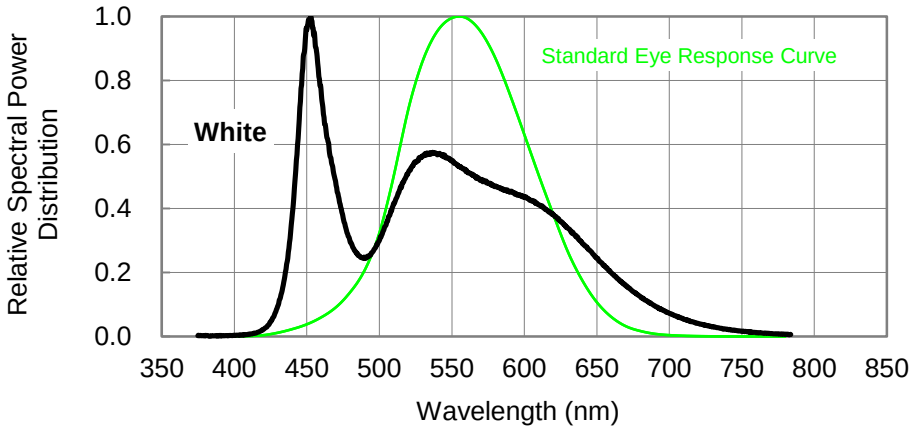
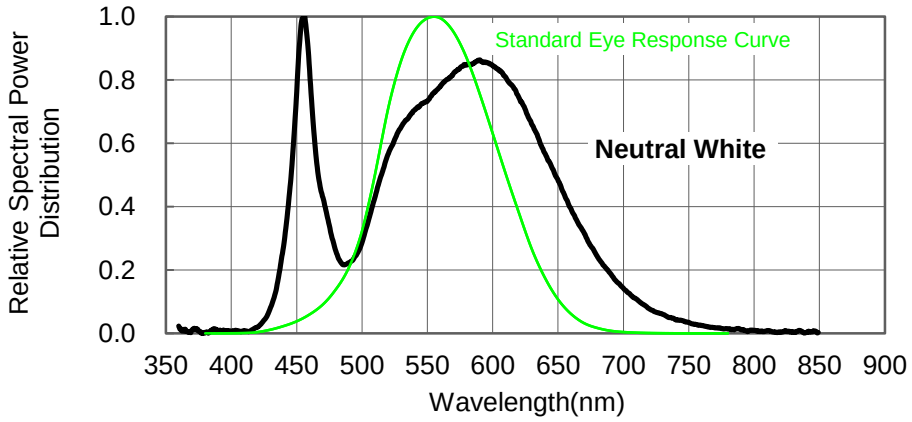
Color Spectrum, T_j = 25°C

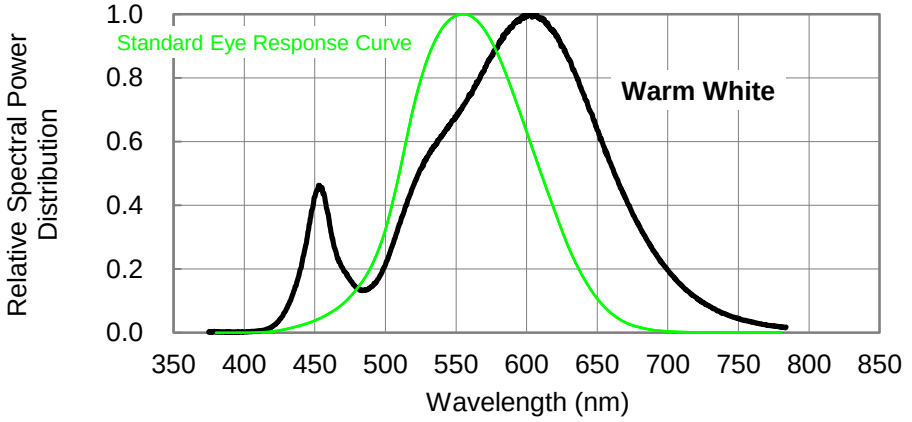
4. PN6N-4LWE-9PR8



5. PN6N-4LNE-9PR8



6. PN6N-4LVE-9PR8



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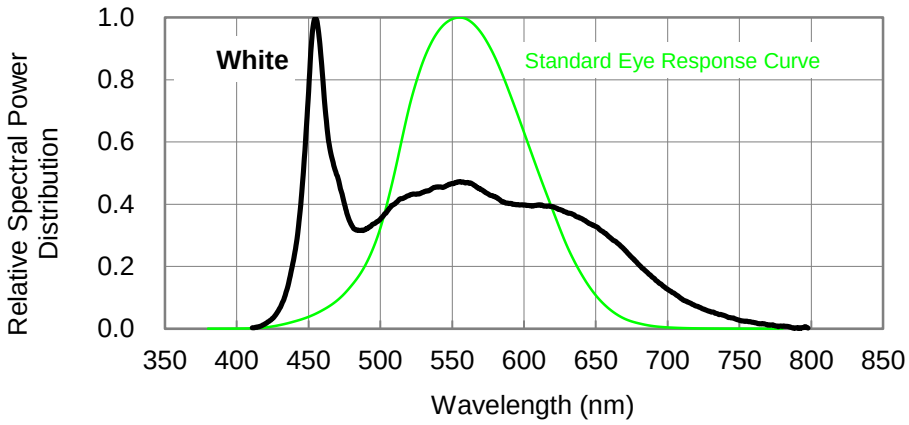
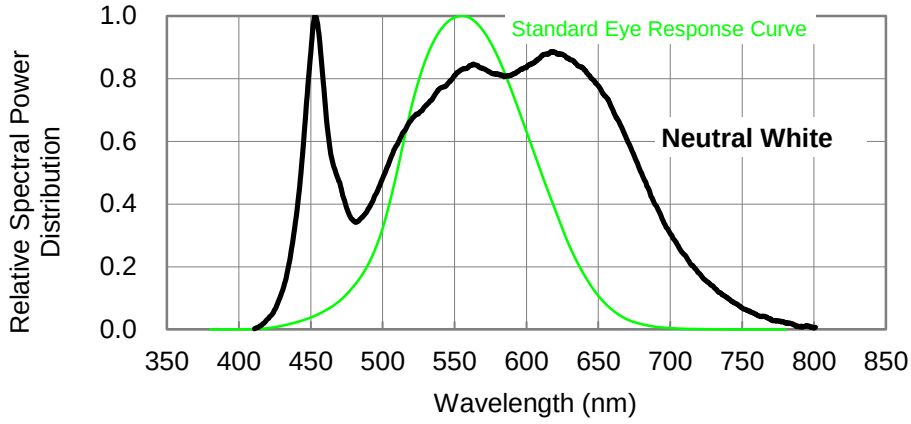
Color Spectrum, T_j = 25°C

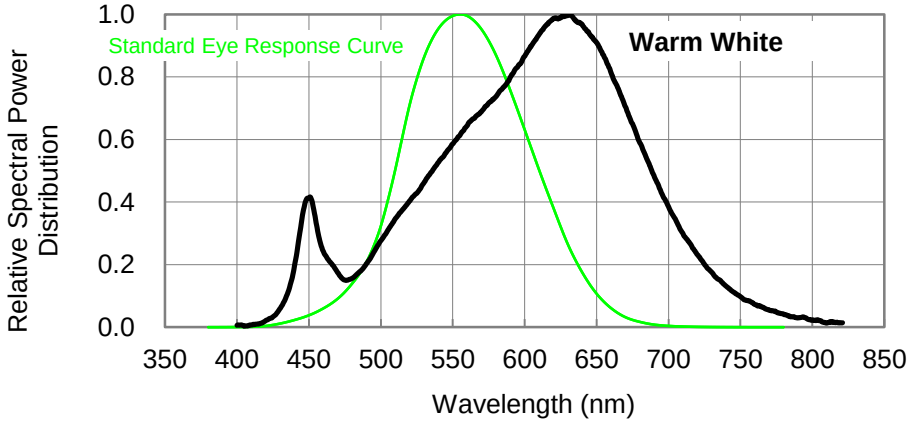
7. PN6N-4LWE-9PR9



8. PN6N-4LNE-9PR9



9. PN6N-4LVE-9PR9



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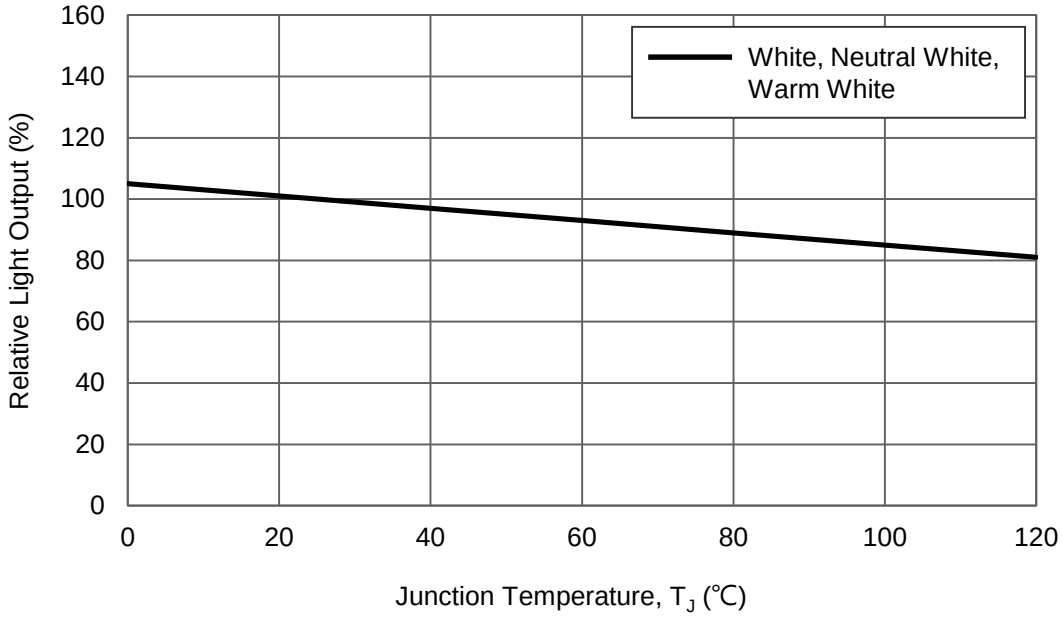
Light Output Characteristics

Relative Light Output vs. Junction Temperature at 120mA



Forward Current Characteristics, T_J = 25°C

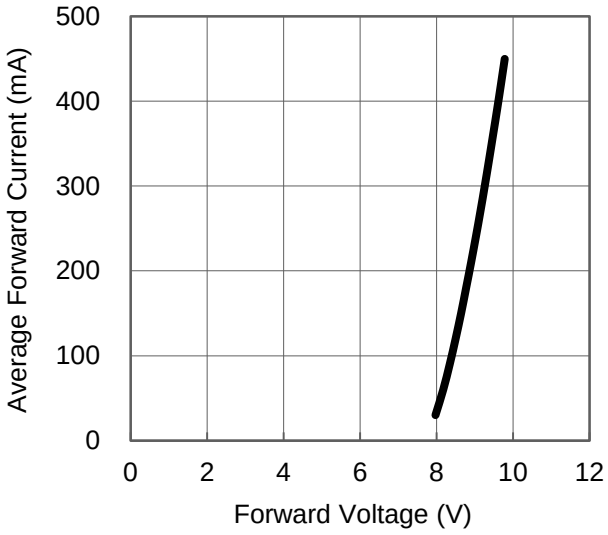


Fig 1. Forward Current vs. Forward Voltage for White, Neutral White, Warm White.

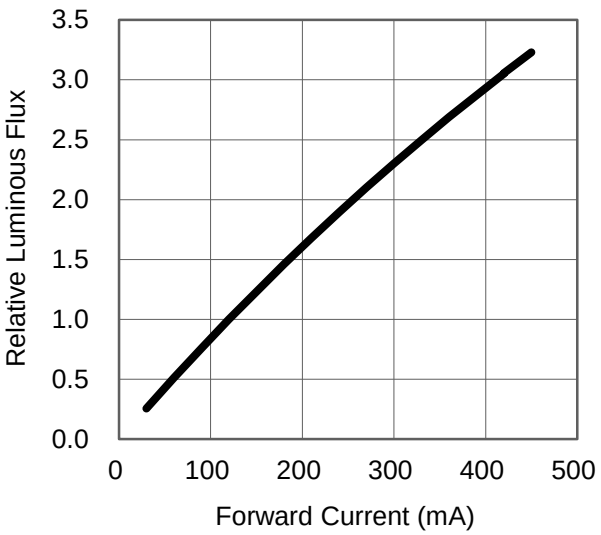


Fig 2. Relative Luminous Flux vs. Forward Current for White, Neutral White, Warm White at T_J=25 maintained.

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Typical Representative Spatial Radiation Pattern

Lambertian Radiation Pattern

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Moisture Sensitivity Level - JEDEC Level 1

Level	Floor Life		Soak Requirements			
			Standard		Accelerated Environment	
	Time	Conditions	Time (hours)	Conditions	Time (hours)	Conditions
1	Unlimited	≤30˚C / 85% RH	168 +5/-0	85˚C / 85% RH	NA	NA

- The standard soak time includes a default value of 24 hours for semiconductor manufature's exposure time (MET) between bake and bag and includes the maximum time allowed out of the bag at the distributor's facility.
- Table below presents the moisture sensitivity level definitions per IPC/JEDEC's J-STD-020C.

Level	Floor Life		Soak Requirements			
			Standard		Accelerated Environment	
	Time	Conditions	Time (hours)	Conditions	Time (hours)	Conditions
1	Unlimited	≤30˚C / 85% RH	168 +5/-0	85˚C / 85% RH	NA	NA
2	1 year	≤30˚C / 60% RH	168 +5/-0	85˚C / 60% RH	NA	NA
2a	4 weeks	≤30˚C / 60% RH	696 +5/-0	30˚C / 60% RH	120 +1/-0	60˚C / 60% RH
3	168 hours	≤30˚C / 60% RH	192 +5/-0	30˚C / 60% RH	40 +1/-0	60˚C / 60% RH
4	72 hours	≤30˚C / 60% RH	96 +2/-0	30˚C / 60% RH	20 +0.5/-0	60˚C / 60% RH
5	48 hours	≤30˚C / 60% RH	72 +2/-0	30˚C / 60% RH	15 +0.5/-0	60˚C / 60% RH
5a	24 hours	≤30˚C / 60% RH	48 +2/-0	30˚C / 60% RH	10 +0.5/-0	60˚C / 60% RH
6	Time on Label (TOL)	≤30˚C / 60% RH	Time on Label (TOL)	30˚C / 60% RH	NA	NA

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Qualification Reliability Testing

Stress Test	Stress Conditions	Stress Duration	Failure Criteria
Room Temperature Operating Life (RTOL)	25°C, I_F = max DC (Note 1)	1000 hours	Note 2
Wet High Temperature Operating Life (WHTOL)	85°C/60%RH, I_F = max DC (Note 1)	1000 hours	Note 2
Wet High Temperature Storage Life (WHTSL)	85°C/85%RH, non-operating	1000 hours	Note 2
High Temperature Storage Life (HTSL)	110°C, non-operating	1000 hours	Note 2
Low Temperature Storage Life (LTSL)	-40°C, non-operating	1000 hours	Note 2
Non-operating Temperature Cycle (TMCL)	-40°C to 120°C, 30 min. dwell, <5 min. transfer	200 cycles	Note 2
Mechanical Shock	1500 G, 0.5 msec. pulse, 5 shocks each 6 axis		Note 3
Natural Drop	On concrete from 1.2 m, 3X		Note 3
Variable Vibration Frequency	10-2000-10 Hz, log or linear sweep rate, 20 G about 1 min., 1.5 mm, 3X/axis		Note 3
Solder Heat Resistance (SHR)	260°C ± 5°C, 10 sec.		Note 3
Solderability	Steam age for 16 hrs., then solder dip at 260°C for 5 sec.		Solder coverage on lead

Notes:
1. Depending on the maximum derating curve.
2. Criteria for judging failure

Item	Test Condition	Criteria for Judgement	
		Min.	Max.
Forward Voltage (V_F)	I_F = max DC	--	Initial Level x 1.1
Luminous Flux or Radiometric Power (Φ_V)	I_F = max DC	Initial Level x 0.7	--
Reverse Current (I_R)	V_R = 5V	--	50 μA

* The test is performed after the LED is cooled down to the room temperature.

3. A failure is an LED that is open or shorted.

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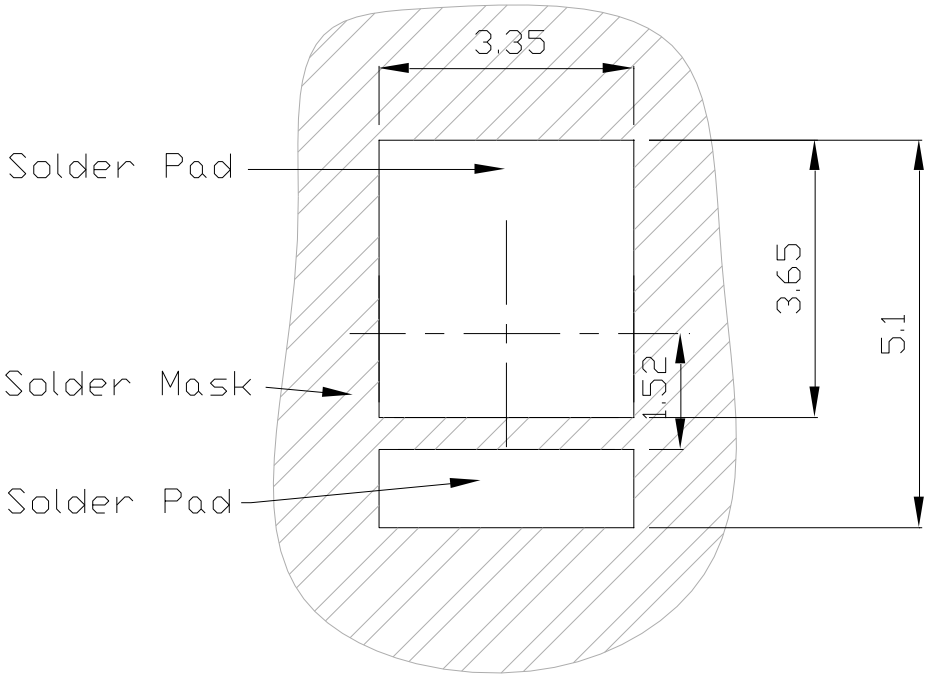
Recommended Solder Pad Design



- All dimensions are in millimeters.

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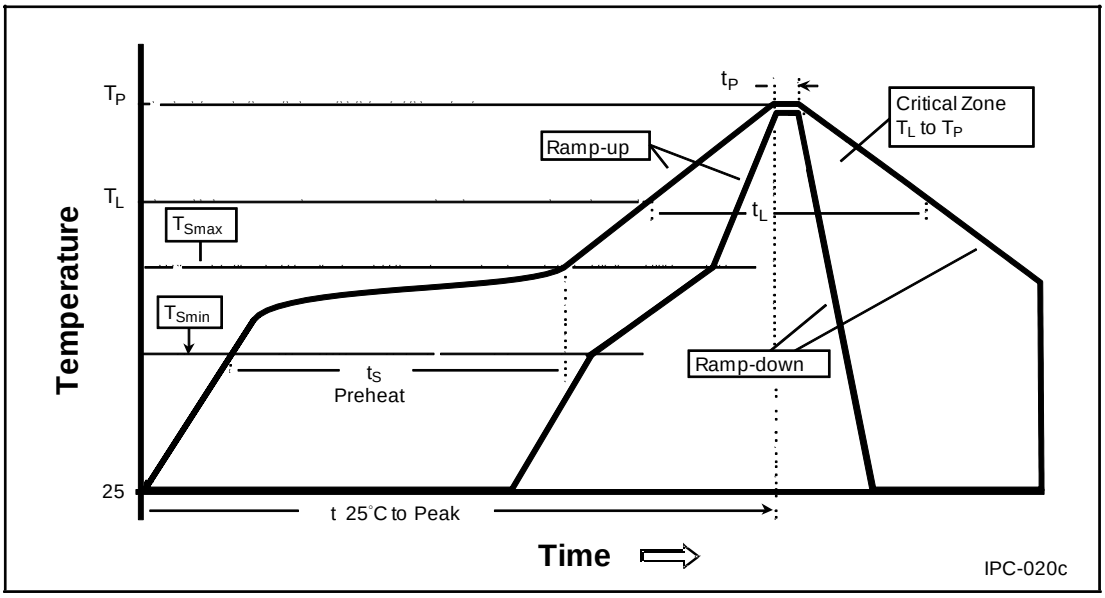
Reflow Soldering Condition

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average Ramp-Up Rate (T_{Smax} to T_P)	3°C / second max.	3°C / second max.
Preheat – Temperature Min (T_{Smin}) – Temperature Max (T_{Smax}) – Time (t_{Smin} to t_{Smax})	 100°C 150°C 60-120 seconds	 150°C 200°C 60-180 seconds
Time maintained above: – Temperature (T_L) – Time (t_L)	 183°C 60-150 seconds	 217°C 60-150 seconds
Peak/Classification Temperature (T_P)	240°C	260°C
Time Within 5°C of Actual Peak Temperature (t_P)	10-30 seconds	20-40 seconds
Ramp-Down Rate	6°C/second max.	6°C/second max.
Time 25°C to Peak Temperature	6 minutes max.	8 minutes max.



- **We recommend using the M705-S101-S4 solder paste from SMIC (Senju Metal Industry Co., Ltd.) for lead-free soldering.**
- **Do not use solder pastes with post reflow flux residue>47%. (58Bi-42Sn eutectic alloy, etc) This kind of solder pastes may cause a reliability problem to LED.**
- All temperatures refer to topside of the package, measured on the package body surface.
- Repairing should not be done after the LEDs have been soldered. When repairing is unavoidable, a double-head soldering iron should be used. It should be confirmed beforehand whether the characteristics of the LEDs will or will not be damaged by repairing.
- Reflow soldering should not be done more than three times.
- When soldering, do not put stress on the LEDs during heating.
- After soldering, do not warp the circuit board.

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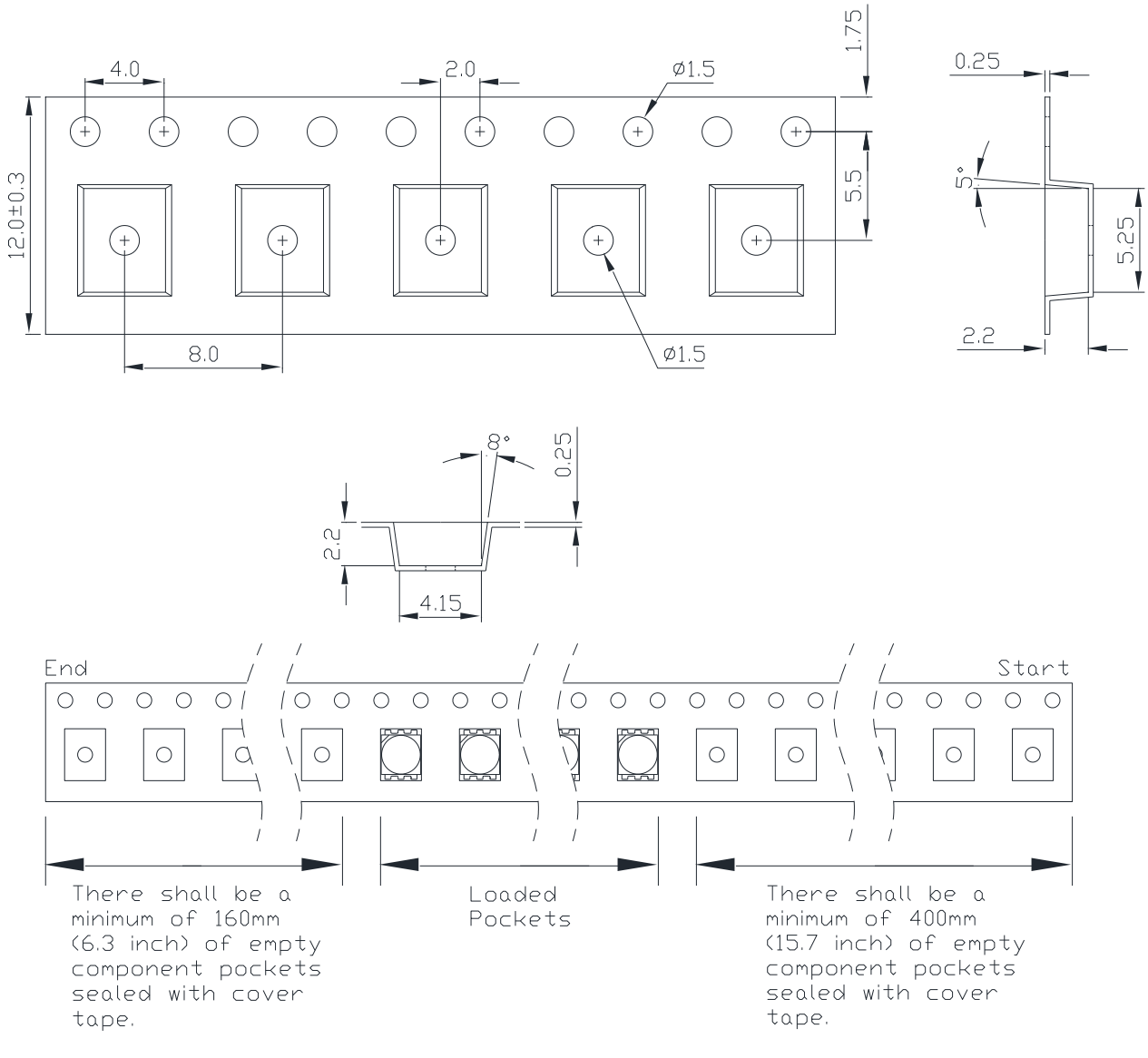
Emitter Reel Packaging



Notes:
1. Drawing not to scale.
2. All dimensions are in millimeters.
3. Unless otherwise indicated, tolerances are ± 0.10mm.

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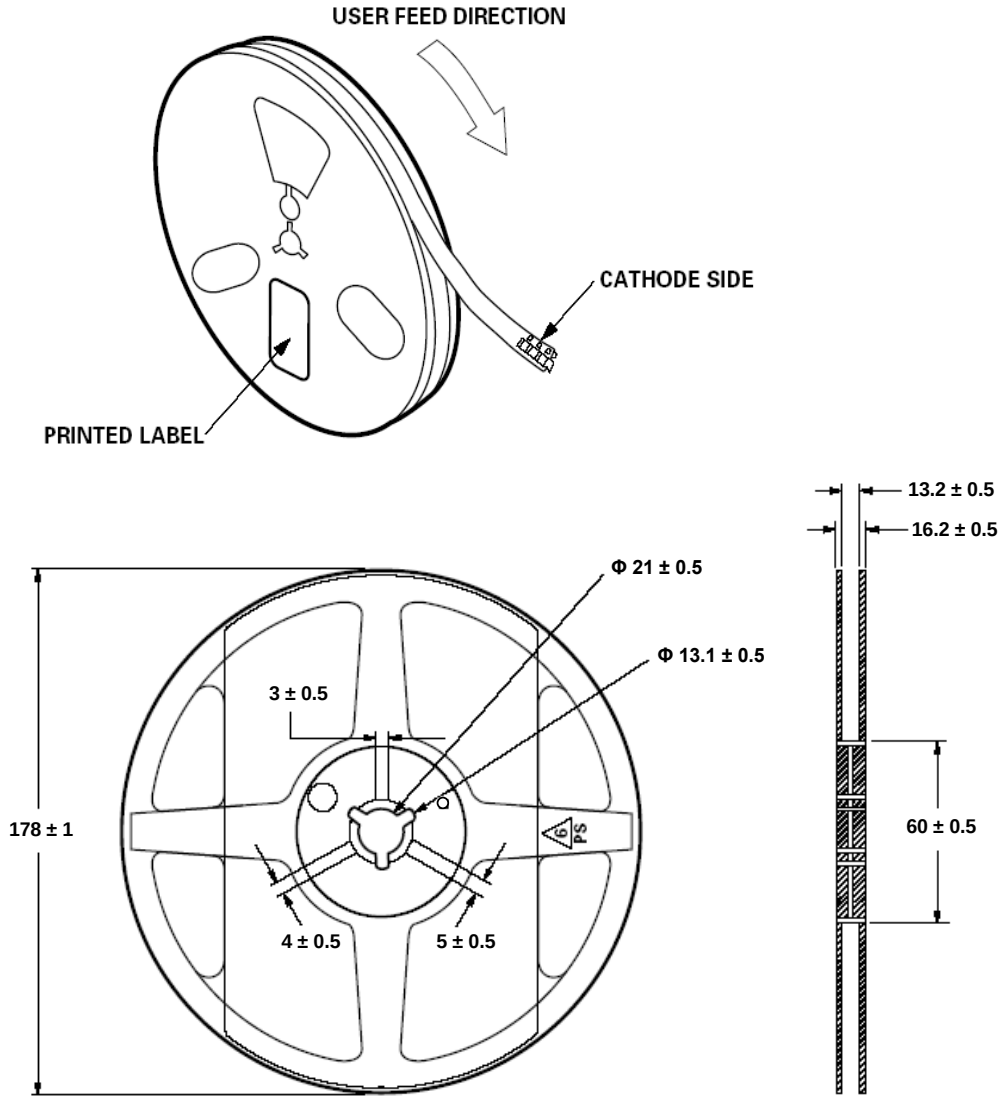
Emitter Reel Packaging



Notes:
1. Empty component pockets sealed with top cover tape.
2. 250, 500 and 1000 pieces per reel.
3. Drawing not to scale.
4. All dimensions are in millimeters.

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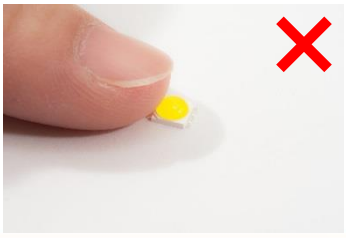
Precaution for Use

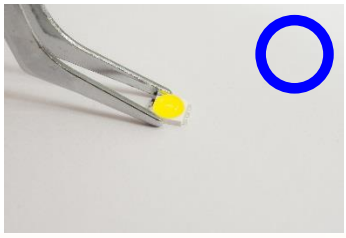
- Storage
  Please do not open the moisture barrier bag (MBB) more than one week. This may cause the leads of LED discoloration. We recommend storing ProLight's LEDs in a dry box after opening the MBB. The recommended storage conditions are temperature 5 to 30°C and humidity less than 40% RH. It is also recommended to return the LEDs to the MBB and to reseal the MBB.
- The slug is is not electrically neutral. Therefore, we recommend to isolate the heat sink.
- **We recommend using the M705-S101-S4 solder paste from SMIC (Senju Metal Industry Co., Ltd.) for lead-free soldering.**
- **Do not use solder pastes with post reflow flux residue>47%. (58Bi-42Sn eutectic alloy, etc) This kind of solder pastes may cause a reliability problem to LED.**
- **Electric Static Discharge (ESD) Protection**
  The LEDs are STATIC SENSITIVE device. ESD protection or surge voltages shall be considered and taken care in the initial design stage, and whole production process.
  The following protection is recommended:
  (1) A wrist band or an anti-electrostatic glove shall be used when handling the LEDs.
  (2) All devices, equipment and machinery must be properly grounded.
- Any mechanical force or any excess vibration shall not be accepted to apply during cooling process to normal temperature after soldering.
- Please avoid rapid cooling after soldering.
- Components should not be mounted on warped direction of PCB.
- Repairing should not be done after the LEDs have been soldered. When repairing is unavoidable, a heat plate should be used. It should be confirmed beforehand whether the characteristics of the LEDs will or will not be damaged by repairing.
- This device should not be used in any type of fluid such as water, oil, organic solvent and etc. When cleaning is required, isopropyl alcohol should be used.
- When the LEDs are illuminating, operating current should be decide after considering the package maximum temperature.
- The appearance, specifications and flux bin of the product may be modified for improvement without notice. Please refer to the below website for the latest datasheets.
  http://www.prolightopto.com/

Handling of Silicone Lens LEDs

Notes for handling of silicone lens LEDs

- Please do not use a force of over 3kgf impact or pressure on the silicone lens, otherwise it will cause a catastrophic failure.
- The LEDs should only be picked up by making contact with the sides of the LED body.
- Avoid touching the silicone lens especially by sharp tools such as Tweezers.
- Avoid leaving fingerprints on the silicone lens.
- Please store the LEDs away from dusty areas or seal the product against dust.
- When populating boards in SMT production, there are basically no restrictions regarding the form of the pick and place nozzle, except that mechanical pressure on the silicone lens must be prevented.
- Please do not mold over the silicone lens with another resin. (epoxy, urethane, etc)





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