INTENSITY CODES

Intensity Code for Standard LEDs
(Ta=25°C Tolerance +/-15%)

Bin Code	Light intensity in mcd (IF<15mA)		Bin Code	Light intensity in mcd (IF<15mA)		Bin Code	Light intensity in mcd (IF<15mA)	
	min.	max.		min.	max.		min .	max.
F	0.1	0.2	R	15	20	ZB	550	700
G	0.2	0.35	S	20	30	ZC	700	1000
H	0.35	0.5	T	30	50	ZD	1000	1600
I	0.5	0.8	U	50	80	ZE	1600	2200
K	0.8	1.2	V	80	120	ZF	2200	2800
L	1.2	2	W	120	180	ZG	2800	3400
M	2	4	X	180	250	ZH	3400	4300
N	4	6	Y	250	320	ZM	4300	5200
P	6	10	Z	320	450	ZN	5200	6300
Q	10	15	ZA	450	550	ZP	6300	7400

Intensity Code for Displays
(Ta=25°C Tolerance +/-15%)

Bin Code	Light intensity in ucd (IF≤10mA)		Bin Code	Light intensity in ucd (IF≤10mA)	
	min.	max.		min.	max.
C	70	140	P	14000	21000
D	140	240	Q	21000	31000
E	240	360	R	31000	52000
F	360	560	S	52000	88000
G	560	900	T	88000	150000
H	900	1400	U	150000	255000
I	1400	2200	V	255000	433000
K	2200	3600	W	433000	736000
L	3600	5600	X	736000	1251000
M	5600	9000	Y	1251000	2126000
N	9000	14000	Z	2126000	3614000

Intensity Code for High Intensity LEDs
(Ta=25°C Tolerance +/-15%)

Bin Code	Light intensity in mcd (IF≥15mA)		Bin Code	Light intensity in mcd (IF≥15mA)	
	Min.	Max.		Min.	Max.
A	2	3	ZA	3100	3600
B	3	5	ZB	3600	4200
C	5	8	ZC	4200	5000
D	8	12	ZD	5000	6000
E	12	20	ZE	6000	7000
F	20	40	ZF	7000	8000
G	40	55	ZG	8000	9000
H	55	80	ZH	9000	11000
M	80	120	ZM	11000	14000
N	120	200	ZN	14000	18000
P	200	300	ZP	18000	22000
Q	300	400	ZQ	22000	27000
R	400	500	ZR	27000	35000
S	500	700	ZS	35000	43000
T	700	1000	ZT	43000	55000
U	1000	1300	ZU	55000	75000
V	1300	1600	ZV	75000	130000
W	1600	1900	ZW	130000	200000
X	1900	2300	ZX	200000	320000
Y	2300	2700	ZY	320000	490000
Z	2700	3100	ZZ	490000	800000

Intensity Codes for High Powered LEDs
(Ta=25°C Tolerance: +/-15%)

Bin Code	Luminous Flux in lm		Bin Code	Luminous Flux in lm	
	Min.	Max.		Min.	Max.
A1	0.5	0.6	B10	50	60
A2	0.6	0.7	B11	60	70
A3	0.7	0.8	B12	70	80
A4	0.8	1	B13	80	90
A5	1	1.2	B14	90	100
A6	1.2	1.4	C1	100	120
A7	1.4	1.7	C2	120	140
A8	1.7	2	C3	140	160
A9	2	2.4	C4	160	180
A10	2.4	2.9	C5	180	210
A11	2.9	3.5	C6	210	240
A12	3.5	4.2	C7	240	280
A13	4.2	5	C8	280	320
A14	5	6	C9	320	370
A15	6	7.2	C10	370	430
A16	7.2	8.6	C11	430	490
A17	8.6	10	C12	490	560
B1	10	12	C13	560	640
B2	12	14	C14	640	740
B3	14	17	C15	740	850
B4	17	20	C16	850	1000
B5	20	24	D1	1000	1200
B6	24	29	D2	1200	1400
B7	29	35	D3	1400	1600
B8	35	42	D4	1600	1800
B9	42	50	D5	1800	2100

INTENSITY CODES

Code for NPN Phototransistors
(Ta=25°C Tolerance +/-15%)

Bin Code	Photocurrent in mA		Bin Code	Photocurrent in mA	
	min.	max.		min.	max.
F	0.1	0.2	L	1.2	2
G	0.2	0.35	M	2	4
H	0.35	0.5	N	4	6
I	0.5	0.8	P	6	10
K	0.8	1.2			

Code for Infrared Emitting Diodes
(Ta=25°C Tolerance +/-15%)

Bin Code	Radiant intensity in mW/sr (IF=20mA)		Bin Code	Radiant intensity in mW/sr (IF=20mA)	
	min.	max.		min.	max.
AK	0.8	1.2	D	8	12
AL	1.2	2	E	12	20
A	2	3	F	20	40
B	3	5	G	40	55
C	5	8	H	55	80

WAVELENGTH CODES

Color Code for LEDs and Displays (Ta=25°C Tolerance: +/-1nm)

Bin Code	Dominant Wavelength in nm							
	Green		Aqua Green		True Green		Yellow	
	min.	max.	min.	max.	min.	max.	min.	max.
0	556	559			510	515		
1	559	561	497	501	515	520	581	584
2	561	563	501	504	520	525	584	586
3	563	565	504	506	525	530	586	588
4	565	567	506	508	530	535	588	590
5	567	569	508	510	535	540	590	592
6	569	571	510	512			592	594
7	571	573	512	515			594	597
8	573	575					597	600

Color Code for LEDs and Displays (Ta=25°C Tolerance: +/-1nm)

Bin Code	Dominant Wavelength in nm		Bin Code	Dominant Wavelength in nm	
	Blue			Blue	
	min.	max.		min.	max.
1	445	450	3A	471	473
2	450	455	3B	473	475
3	455	460	4A	475	477
1A	460	463	4B	477	479
1B	463	466	5A	479	481
2A	466	469	5B	481	483
2B	469	471	5C	483	486

SMD LED Products

Test Item	Test Conditions	Description	Reference Standard
Continuous operating	Ta=25°C T=1000hrs RH<75%RH, IF(Max)	The purpose of this test is to determine the resistance of the device when operating under electrical stress	EIAJ ED-4701 100 101
High temperature storage	Ta=100°C T=1000hrs	The purpose of this test is to evaluate the product durability after long-term storage in high temperature	EIAJ ED-4701 200 201
Low temperature storage	Ta=-40°C T=1000hrs	The purpose of this test is to evaluate the product durability after long-term storage in low temperature	EIAJ ED-4701 200 202
High temperature and humidity storage	Ta=60°C T=1000hrs RH=90%RH	The purpose of this test is to evaluate product durability under long-term high temperature and high humidity storage	EIAJ ED-4701 100 103
High temperature and humidity operating	Ta=60°C T=1000hrs RH=90%RH, IF(Max)	The purpose of this test is to determine the resistance of the device under electrical and thermal stress	EIAJ ED-4701 100 102
Solderability	Ta=245°C T=5sec	The purpose of this test is to evaluate solderability on leads of device	EIAJ ED-4701 300 303
Soldering resistance	Ta=260°C T=5sec	The purpose of this test is to determine the thermal resistance characteristics of the device to sudden exposures at extreme changes in temperature during Tin-dipping	EIAJ ED-4701 300 301
Temperature cycling	Ta=-40°C~25°C~100°C~25°C T=(30min~5min~30min~5min)×10cycles	The purpose of this test is to determine the resistance of the device to storage under extreme temperature for hours	EIAJ ED-4701 100 105
Temperature cycling operating	Ta=-40°C~25°C~100°C~25°C IF(Max) T=(30min~5min~30min~5min)×10cycles	The purpose of this test is to determine the resistance of the device under extreme temperature for hours	N/A
Thermal shock	Ta=-40°C~100°C T=15min~15min×100cycles	The purpose of this test is to determine the resistance of the device to sudden extreme changes in high and low temperature	EIAJ ED-4701 300 307

LED Displays

Test Item	Test Conditions	Description	Reference Standard
Continuous operating	Ta=25°C T=1000hrs RH<75%RH, IF(Max)	The purpose of this test is to determine the resistance of the device when operating under electrical stress	EIAJ ED-4701 100 101
High temperature storage	Ta=100°C T=1000hrs	The purpose of this test is to evaluate the product durability after long-term storage in high temperature	EIAJ ED-4701 200 201
Low temperature storage	Ta=-40°C T=1000hrs	The purpose of this test is to evaluate the product durability after long-term storage in low temperature	EIAJ ED-4701 200 202
High temperature and humidity storage	Ta=60°C T=1000hrs RH=90%RH	The purpose of this test is to evaluate product durability under long-term high temperature and high humidity storage	EIAJ ED-4701 100 103
Solderability	Ta=245°C T=5sec	The purpose of this test is to evaluate solderability on leads of device	EIAJ ED-4701 300 303
Soldering resistance	Ta=260°C T=5sec	The purpose of this test is to determine the thermal resistance characteristics of the device to sudden exposures at extreme changes in temperature during Tin-dipping	EIAJ ED-4701 300 301
Temperature cycling	Ta=-40°C~25°C~100°C~25°C T=(30min~5min~30min~5min)×10cycles	The purpose of this test is to determine the resistance of the device to storage under extreme temperature for hours	EIAJ ED-4701 100 105
Thermal shock	Ta=-40°C~100°C T=15min~15min×100cycles	The purpose of this test is to determine the resistance of the device to sudden extreme changes in high and low temperature	EIAJ ED-4701 300 307

Through-Hole LEDs

Test Item	Test Conditions	Description	Reference Standard
Continuous operating	Ta=25°C T=1000hrs RH<75%RH, IF(Max)	The purpose of this test is to determine the resistance of the device when operating under electrical stress	EIAJ ED-4701 100 101
High temperature storage	Ta=100°C T=1000hrs	The purpose of this test is to evaluate the product durability after long-term storage in high temperature	EIAJ ED-4701 200 201
Low temperature storage	Ta=-40°C T=1000hrs	The purpose of this test is to evaluate the product durability after long-term storage in low temperature	EIAJ ED-4701 200 202
High temperature and humidity storage	Ta=60°C T=1000hrs RH=90%RH	The purpose of this test is to evaluate product durability under long-term high temperature and high humidity storage	EIAJ ED-4701 100 103
High temperature and humidity operating	Ta=60°C T=1000hrs RH=90%RH, IF(Max)	The purpose of this test is to determine the resistance of the device under electrical and thermal stress	EIAJ ED-4701 100 102
Lead frame bending	Bend 90°C T=3 cycles	The purpose of this test is to evaluate products durability against mechanical stress applied to leads	N/A
Lead frame pulling	W=1kg T=30sec	The purpose of this test is to evaluate products durability against mechanical stress	N/A
Solderability	Ta=245°C T=5sec	The purpose of this test is to evaluate solderability on leads of device	EIAJ ED-4701 300 303
Soldering resistance	Ta=260°C T=5sec	The purpose of this test is to determine the thermal resistance characteristics of the device to sudden exposures at extreme changes in temperature during Tin-dipping	EIAJ ED-4701 300 302
Temperature cycling	Ta=-40°C~25°C~100°C~25°C T=(30min~5min~30min~5min)×10cycles	The purpose of this test is to determine the resistance of the device to storage under extreme temperature for hours	EIAJ ED-4701 100 105
Temperature cycling operating	Ta=-40°C~25°C~100°C~25°C IF(Max) T=(30min~5min~30min~5min)×10cycles	The purpose of this test is to determine the resistance of the device under extreme temperature for hours	N/A
Thermal shock	Ta=-40°C~100°C T=15min~15min×100cycles	The purpose of this test is to determine the resistance of the device to sudden extreme changes in high and low temperature	EIAJ ED-4701 300 307

SOLDERING INSTRUCTIONS

1. Manual soldering operations should only be for repairs and reworks unless otherwise noted on product specifications.
2. Maximum soldering iron temperatures for manual soldering:
   a. Pb-Sn solder: 300°C
   b. Pb-Free solder: 350°C
   c. All LEDs using InGaN material (e.g. Blue, Green, White): 280°C
3. The soldering iron should never touch the epoxy lens. Contact duration with the component should not exceed 3 seconds.
4. Do not apply stress or pressure to the leads when the component is heated above 80°C as possible damage to the internal wire bonds may occur.
5. During soldering, component covers and holders should leave enough clearance to avoid any stress applied to the LED. Refer to below diagram (Fig. 1) for examples of proper method.

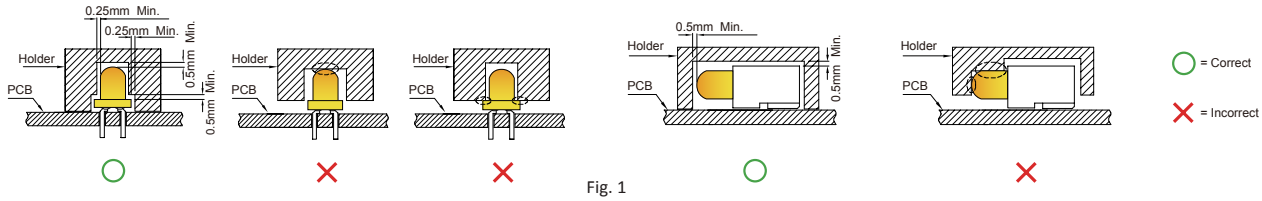
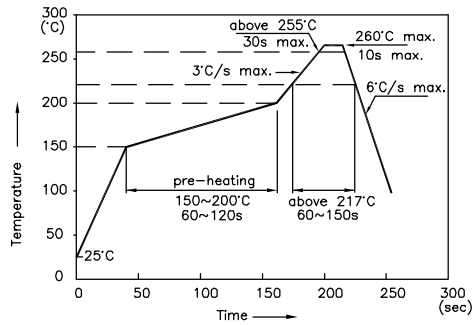


Fig. 1

6. Refer to below diagrams for recommended soldering profiles.
   a. SMD LEDs: Reflow Soldering – Pb-Free Solder (Fig. 2) | Pb-Sn Solder (Fig. 3)
      -No more than two soldering passes except SMD CBIs which should not exceed one pass
   b. Through-hole LEDs: Wave Soldering – Pb-Free Solder (Fig. 4) | Pb-Sn Solder (Fig. 5)
      -No more than one soldering pass

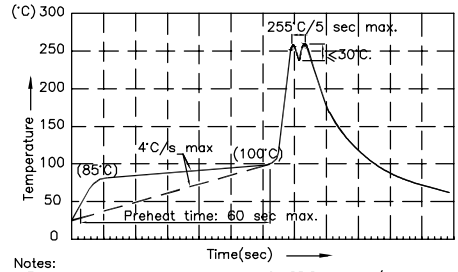
Reflow Soldering Profile for SMD Products (Pb-Free Components)



Notes:
1. All temperatures refer to the center of the package, measured on the package body surface facing up during reflow.
2. Do not apply any stress to the LED during high temperature conditions.
3. Maximum number of soldering passes: 2

Fig. 2

Wave Soldering Profile (Pb-Free Solder)



Notes:
1.Recommend pre-heat temperature of 105°C or less (as measured with a thermocouple attached to the LED pins) prior to immersion in the solder wave with a maximum solder bath temperature of 260°C
2.Peak wave soldering temperature between 245°C ~ 255°C for 3 sec (5 sec max).
3.Do not apply stress to the epoxy resin while the temperature is above 85°C.
4.Fixtures should not incur stress on the component when mounting and during soldering process.
5.SAC 305 solder alloy is recommended.
6.No more than one wave soldering pass.
7.During wave soldering, the PCB top-surface temperature should be kept below 105°C.

Fig. 4

Reflow Soldering Profile (Pb-Sn Solder)

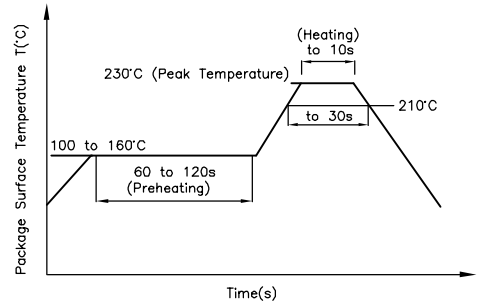


Fig. 3

Wave Soldering Profile (Pb-Sn Solder)

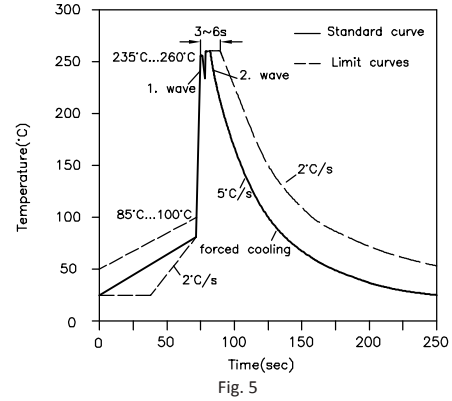


Fig. 5

7. Refer to the appropriate product datasheet for details on specific soldering pay layout. To ensure proper bonding and setting of the LED, solder paste must be evenly applied to each soldering pad. Refer to below diagram (Fig. 6) for example of improper solder application.

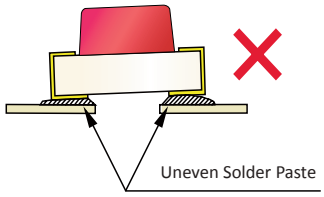


Fig. 6

8. After soldering, allow at least three minutes for the component to cool to room temperature before further processing.
9. Refer to below table for summary of soldering instructions for dip, wave, and manual solder. Note that these are considered general instructions and all soldering notes indicated above should take precedence.

Types	Dip soldering / *Wave Soldering			Iron soldering (with 1.5mm iron tip)		
	Temperature of the soldering bath	Maximum soldering time	Distance from solder joint to package	Temperature of soldering iron	Maximum soldering time	Distance from solder joint to package
LEDs	<=260°C	3s	>=2mm	<=350°C	3s	>2mm
	<=260°C	5s	>=5mm	<=350°C	5s	>5mm
SMDs	/	/	/	<=350°C	3s (one time only)	/
DISPLAYs	*<=260°C	*3s	*>2mm	<=350°C	3s	>2mm

APPLICATION NOTES

Cleaning

1. Do not use harsh organic solvents such as acetone, trichloroethylene, Chlorsan, and/or diflon solvent for cleaning as they may cause damage or hazing to the LED lens.
2. Do not use acidic solvents or unknown chemicals for cleaning as they may damage or degrade the LED. Always check the properties of the chemical to ensure it will not corrode or damage epoxy resin, silicone resin, silver plating, or organosilicates.
3. Recommended solvents for cleaning: deionized water or isopropyl alcohol.
4. Special attention should be taken if other chemicals are used for cleaning as they may damage the epoxy lens or housing.
5. Any cleaning should take place at room temperature and the wash duration should not exceed one minute.
6. Use forced-air drying immediately following water wash to remove excess moisture.

Lead Forming

1. Any lead forming or bending must be done prior to soldering.
2. Avoid bending leads at the same point more than once as it may compromise the integrity of the leads.
3. Minimum clearance of 3mm is required between the base of the LED lens and the bend location. Refer to below diagram (Fig. 7).

Fig. 7

4. Lead forming should only be done with proper tools such as a jig and/or radio pliers. The upper section of the leads should be secured firmly such that the bending force is not exerted on the LED body. Refer to below diagram (Fig. 8) for recommended lead bending method.

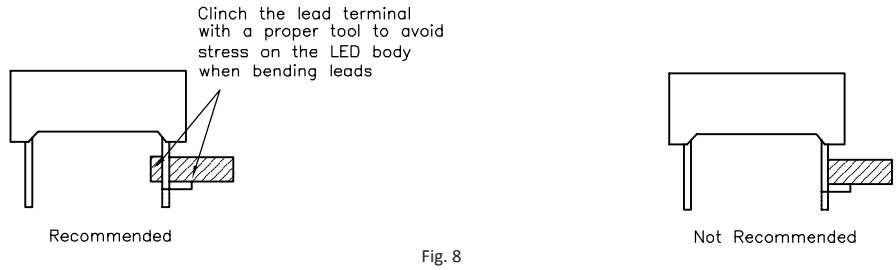


Fig. 8

ESD Precautions

InGaN/GaN material LEDs are sensitive to electrostatic discharge (ESD) and other transient voltage spikes. ESD and voltage spikes can affect the component's performance due to increased reverse current and/or decreased forward voltage. This may result in reduced light intensity and/or component failure. Static discharge may occur when static sensitive LEDs come in contact with the user or other conductive devices. ESD sensitive LEDs must incorporate protective circuitry to prevent ESD and to control voltage spikes in order to stay within the maximum voltage specified.

SunLED products are stored in anti-static bags for protection during transportation and storage. However, below anti-static measures should always be noted when handling static sensitive components.

1. Operators must wear anti-static wristbands.
2. Operators must wear anti-static suits when entering work areas with conductive machinery and materials.
3. All test instruments and production machinery must be grounded.
4. Avoid static build up by minimizing friction between the LED and its surroundings.
5. Relative Humidity between 40% ~ 60% is recommended in ESD-protected work areas to reduce static build up. Reference JEDEC/J-STD-033 and JEDEC/JESD625-A standards.
6. All workstations that handle ESD sensitive components must maintain an electrostatic condition of 150V or less.
7. Anti-static material/packaging should be used when parts are being stored and/or transported.
8. All anti-static measures noted above should be periodically checked and inspected to ensure proper functionality.

Design Notes

1. Protective current-limiting resistors should be used in conjunction with LEDs to ensure parts are operating within specified current range.
2. The driving circuit should be designed to avoid reverse voltages and transient voltage spikes when the circuit is in both on & off states. Prolonged reverse bias may cause metal migration leading to an increase in leakage current or causing a short circuit.

3. Prevent exposure of LEDs to environments containing high moisture or corrosive gases.
4. Excess operating temperature and/or forward current should be avoided as it may lead to accelerated degradation or failure of the LED. Always refer to the most updated datasheet for driving conditions.
5. When LEDs are mounted in a parallel configuration, there should be individual current-limiting resistors in series with each LED. Refer to below diagram (Fig.9) for an example of a recommended set up.

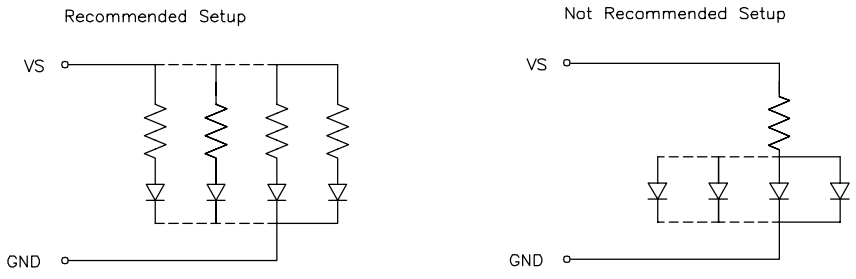


Fig. 9

6. Mounting direction of SMD components should be placed perpendicular to the direction of PCB travel. This will ensure the solder wets on each lead simultaneously during reflow and prevent shifting of LEDs. Refer to below diagram (Fig.10) for examples of recommended mounting direction.

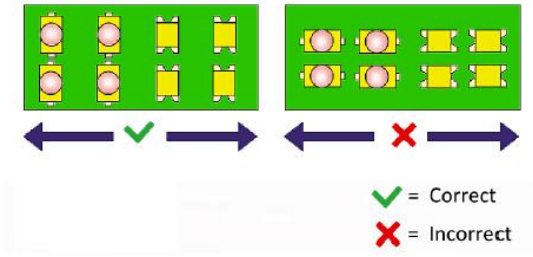


Fig. 10

7. High-power LED devices require optimization of heat dissipation. Increasing the size of metal mounting surface and proper application of thermal conductive paste will help improve heat dissipation. Refer to below diagram (Fig.11) and product datasheets for specific design recommendations.

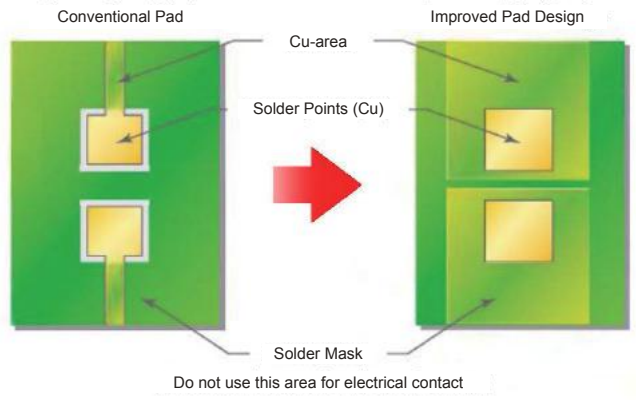


Fig. 11

8. High temperatures may reduce component's performance and reliability. Please refer to individual product datasheets for specific details on operable temperature range and effects of temperature on the LED.

STORAGE CONDITIONS

Storage, MSL, and Humidity Conditions

SMD LEDs are considered moisture sensitive and storage/usage precautions must be taken to prevent damage to the internal materials. Excess moisture trapped within the component may cause internal vapor pressure during solder reflow leading to possible delamination of the die or wire bond.

1. Do not store or expose LEDs in an environment where high levels of moisture or corrosive gases are present and keep away from rapid transitions in ambient temperature.

   Recommended storage conditions for each type of LED product as per below:

Product Type	Temperature	Humidity
SMD LED	< 40°C	< 90%RH
Through-hole LED	≤ 30°C	< 60%RH
LED Displays	5°C to 30°C	< 60%RH

Note: Above conditions are based on products in original sealed packaging

2. All SMD LEDs are packaged in moisture barrier bags (MBB) with a label indicating the moisture sensitivity level (MSL).

a. Storage conditions for unopened MBB: Temperature < 40°C, Humidity < 90%RH with shelf life of 24 months.

b. Floor life for opened MBB follows the corresponding MSL as per below:

IPC/JEDEC J-STD-020

MSL	Floor Life	
	Time	Conditions
1	Unlimited	≤30°C / 85%RH
2	1 Year	≤30°C / 60%RH
2a	4 Weeks	≤30°C / 60%RH
3	168 Hours	≤30°C / 60%RH
4	72 Hours	≤30°C / 60%RH
5	48 Hours	≤30°C / 60%RH
5a	24 Hours	≤30°C / 60%RH
6	Time indicated on label	≤30°C / 60%RH

3. All SMD LEDs are packaged with desiccants and a humidity indicator card (HIC). If the LEDs are not used within the specific floor life or if the HIC has indicated presence of moisture, the following baking procedure must be taken:

Condition	Temperature	Humidity	Bake Duration
LED inside carrier	60°C ± 3°C	<5% RH	100 hours
LED outside carrier tape	110°C	-	10 hours

*Not more than once

Additional Notes

1. LED devices may contain Gallium Arsenide (GaAs). GaAs dust and fumes are toxic and harmful if ingested. Do not expose LEDs to chemical solvents and/or break open LED devices.
2. The light output from UV, blue, and high-power LEDs may cause injury to the human eye when viewed directly.
3. Semiconductor devices can fail or malfunction due to their sensitivity to electrical fluctuation and physical stress. In design development, please make certain that SunLED products are used within the specified operating conditions as indicated on our most current product datasheets. The user is responsible to observe and follow all safety measures to avoid situations where the failure or malfunction of a SunLED product could cause injury, property damage, or the loss of human life.
4. Reference https://www.SunLED.com/TechnicalNotes.asp for complete technical notes.