

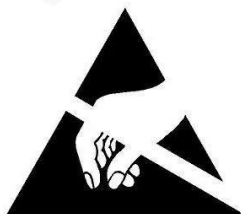
Product Specification

Product Model: HD108-2121

Description: 2121 SMD Smart LED

Document No.: HD108-2121RGB-RD001

Version No.: A001



ELECTROSTAIC
SENSITIVE DEVICES



1. Product Overview:

The HD108-2121 is an externally controlled smart light source that integrates the control driver and LED light-emitting chips, where each LED source acts as a single pixel point. It internally integrates circuits such as an MCU digital interface, data latches, and LED drivers. Through external MCU control, it achieves independent grayscale and cascade control of the chip to realize full-color dot matrix lighting control.

Data transmission uses a dual-line signal serial protocol for clock and data. This allows for long transmission distances and strong anti-interference capabilities.

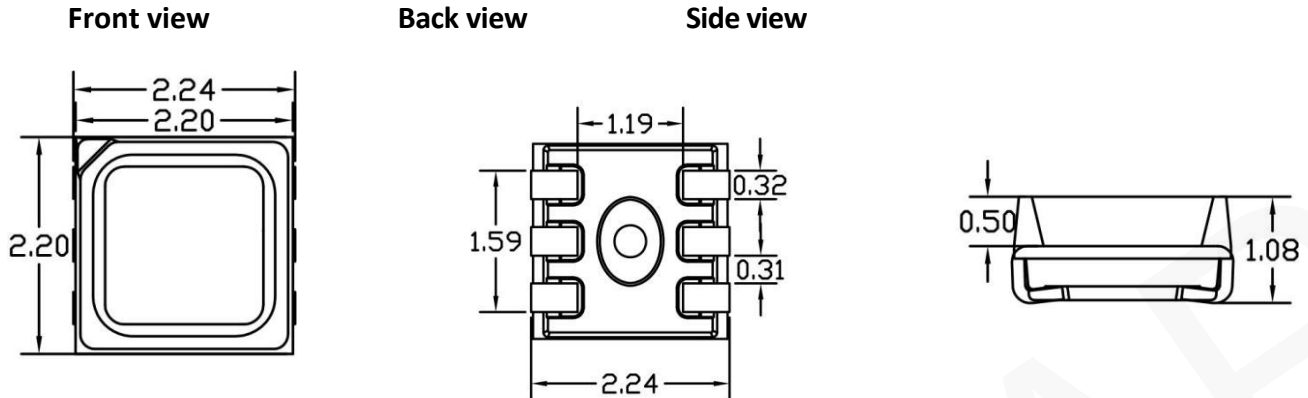
2. Main Application Fields:

LED full-color string lights, LED flexible/rigid strips, LED pixel lights, LED pixel screens, special-shaped LED screens, LED full-color modules, automotive atmosphere lights, and indicator lights for various electronic products

3. Key Product Features:

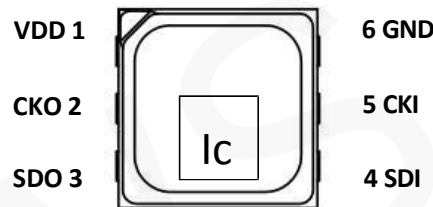
- Integrated driver and LED, forming a complete externally controlled pixel point.
- Integrated dual-line serial cascade constant current IC, with clock and data dual-line signal protocol.
- Default constant current output for B/R/G chips is **17mA** each.
- Supports a maximum clock signal input frequency of **32MHz**.
- Supports a maximum data signal transmission rate of **32Mbps**.
- PWM scanning frequency is **28KHz**.
- **16-bit data per color**, allowing for 65,536 levels of grayscale adjustment, resulting in delicate and smooth color transitions.
- Default status is off when powered on, with protocol brightness adjustment (5Bit 32 levels).
- SMD white bracket with **120° light-emitting angle**, offering high brightness and high stability.
- Suitable for **SMT process** and **wave soldering process**.
- Compliant with **RoHS and REACH** environmental standards.
- Moisture Sensitivity Level (MSL): **LEVEL4**.

4. Dimensions:



Note: All dimensions are in millimeters (mm), and unless otherwise specified, the tolerance is ± 0.15 mm.

5. Pin Definition:



No.	Symbol	Pin Name	Function Description
1	VDD	Power Positive	Positive power supply pin
2	CKO	Clock Output	Clock signal output pin
3	SDO	Data Output	Data signal output pin
4	SDI	Data Input	Data signal input pin
5	CKI	Clock Input	Clock signal input pin
6	GND	Power Negative	Ground or negative power supply pin

6. Optical Parameters: ($T_a=25^{\circ}\text{C}$, $V_{DD}=5\text{V}$)

Color	Wavelength (nm)	Luminous Intensity (mcd)	Luminous Flux (lm)
Red	620-630	380-800	1.0-2.0
Green	520-530	600-1500	2.0-4.8
Blue	460-470	380-800	1.0-2.0

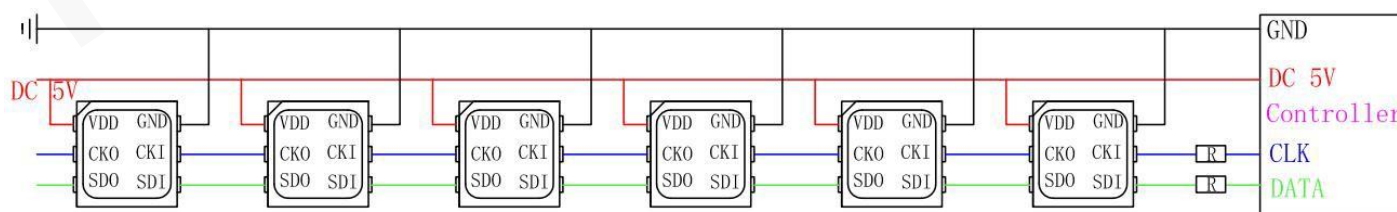
7. Absolute Maximum Ratings:

Parameter	Symbol	Range	Unit
Logic Power Voltage	Vdd	0.5 ~ 5.5 ⁵⁹	V ⁶⁰
RGB Output Port Withstand Voltage	Vds	24 ⁶¹	V ⁶²
Logic Input Voltage	Vi	-0.3 ~ +VDD+0.3 ⁶³	V ⁶⁴
Operating Temperature	Topt	-40 ~ +85 ⁶⁵	°C ⁶⁶
Storage Temperature	Tstg	-50 ~ +85 ⁶⁷	°C ⁶⁸
ESD Withstand Voltage (HBM)	Vesd	3000 ⁶⁹	V ⁷⁰

8. Electrical Characteristics: (Ta=25°C, VDD=5V)

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
Chip Input Voltage	Vdd	-	5 ⁷⁶	-	V ⁷⁷	-
R/G/B Port Output Current	Iout	-	17 ⁷⁸	-	mA ⁷⁹	-
High-Level Input Voltage	Vih	3.4 ⁸⁰	-	5.3 ⁸¹	V ⁸²	-
Low-Level Input Voltage	Vil	-0.3 ⁸³	-	1.6 ⁸⁴	V ⁸⁵	-
PWM Scanning Frequency	Fpwm	-	27 ⁸⁶	-	KHz ⁸⁷	-
Quiescent Current	Idd	-	1 ⁸⁸	-	uA ⁸⁹	-

9. Typical Application Circuit:



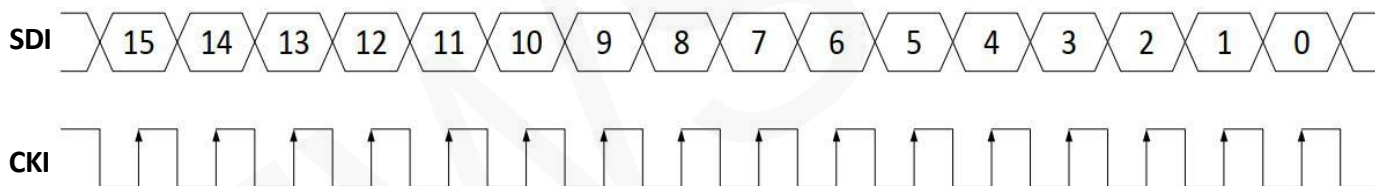
It is recommended to connect **protection resistors (R)** in series to the input pins CKI, SDI and output pins CKO, SDO. The value of R depends on the number of LEDs in the cascade; the more LEDs, the smaller the R. Newstar generally recommended to use a value between 27 Ω and 51 Ω , typically suggesting trying 33 Ω .

10. Data Communication Protocol Description:

Dual-line communication protocol for cascading N LEDs:

SDI	128ps0	LED1 Data	LED2 Data	LED3 Data		LED N Data
	Start Byte	Data Byte 1	Data Byte 2	Data Byte 3		Data Byte N

Display Data Byte	1	5 bits for brightness adjustment	16 bits for Blue data	16 bits for Green data	16 bits for Red data
		Highest bit first	Highest bit first	Highest bit first	Highest bit first



Grayscale set:

data (MSB...LSB)	Duty cycle
0000 0000 0000 0000	0/65536
0000 0000 0000 0001	1/65536
0000 0000 0000 0010	2/65536
.....	
1111 1111 1111 1101	65533/65536
1111 1111 1111 1110	65534/65536
1111 1111 1111 1111	65535/65536

Overall Brightness Adjustment:

data (MSB...LSB)	current adjustment
0 0000	0/31
0 0001	1/31
0 0010	2/31
.....	
1 1101	29/31
1 1110	30/31
1 1111	31/31

Refresh Rate:

Frame Rate = $1/((128+(64*\text{dot}))*\text{CKI times})$ (Unit: frames/second) *Example: For 1024 points and CKI frequency of 1MHZ, the frame rate is 15 frames/second*

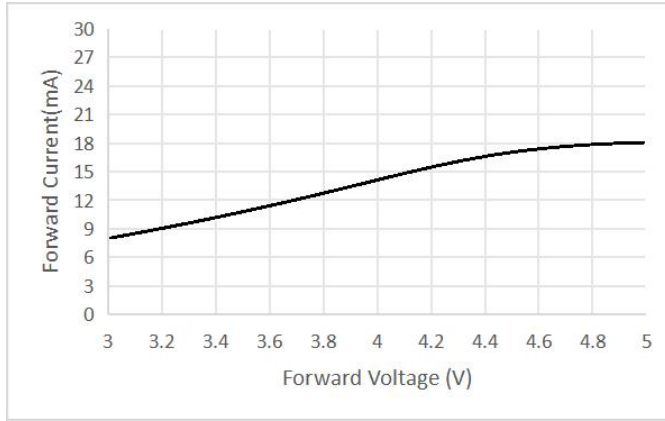
11. Data Structures:

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
G15	G14	G13	G12	G11	G10	G9	G8	G7	G6	G5	G4	G3	G2	G1	G0
R15	R14	R13	R12	R11	R10	R9	R8	R7	R6	R5	R4	R3	R2	R1	R0

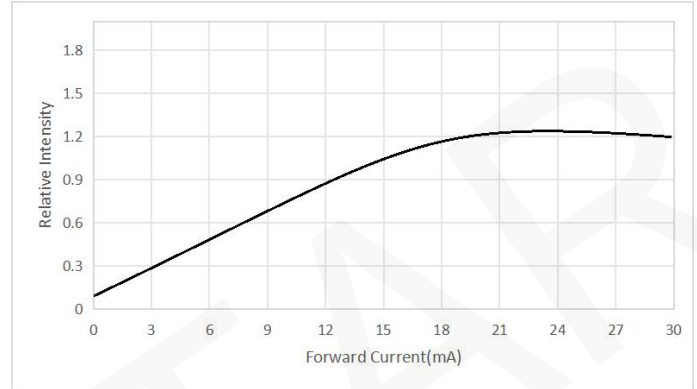
Note: The most significant bit is sent first, and data is sent in BGR order. (B15 → B14 →... G15...R0)

12. Photoelectric property curves:

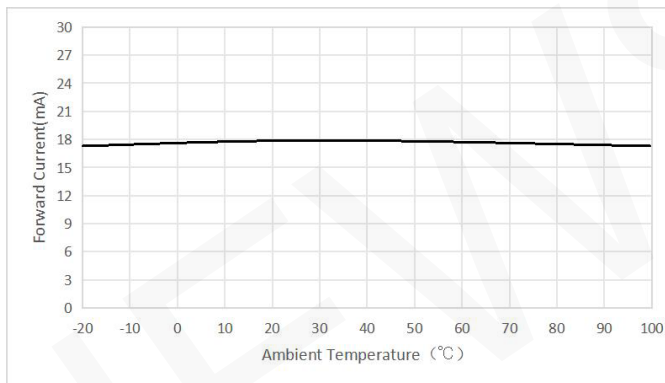
1. Forward voltage and forward current characteristic curves



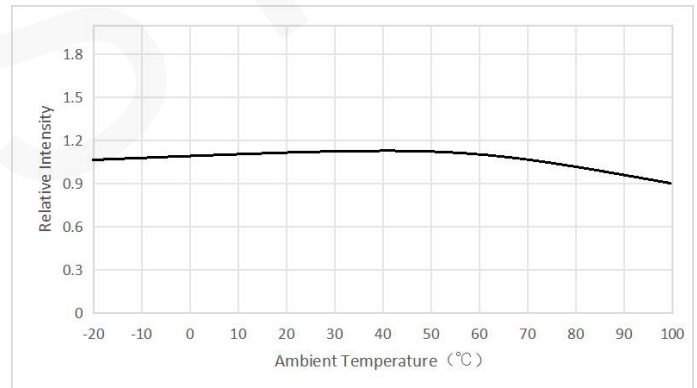
2. Forward current versus relative light intensity characteristic curve



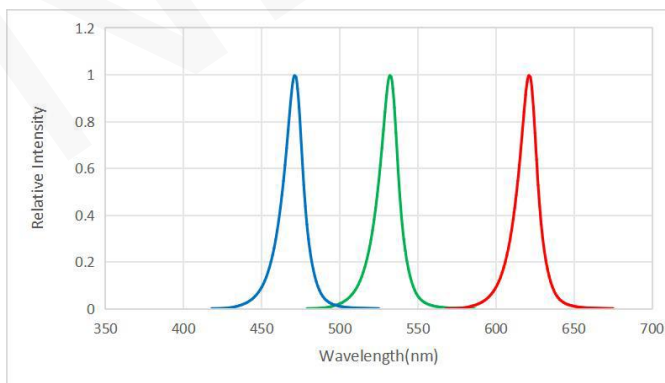
3. Ambient temperature versus forward current characteristic curves



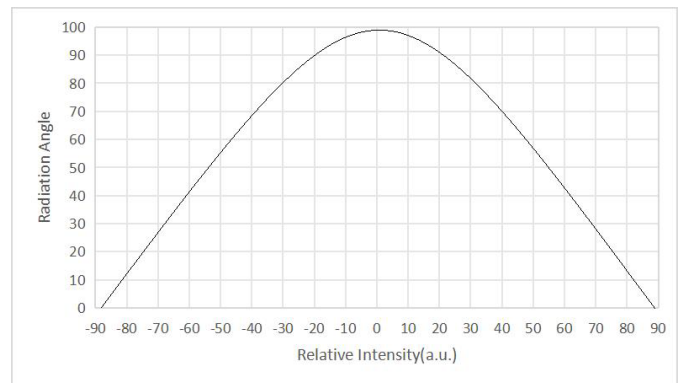
4. Ambient temperature and relative light intensity. characteristic curves



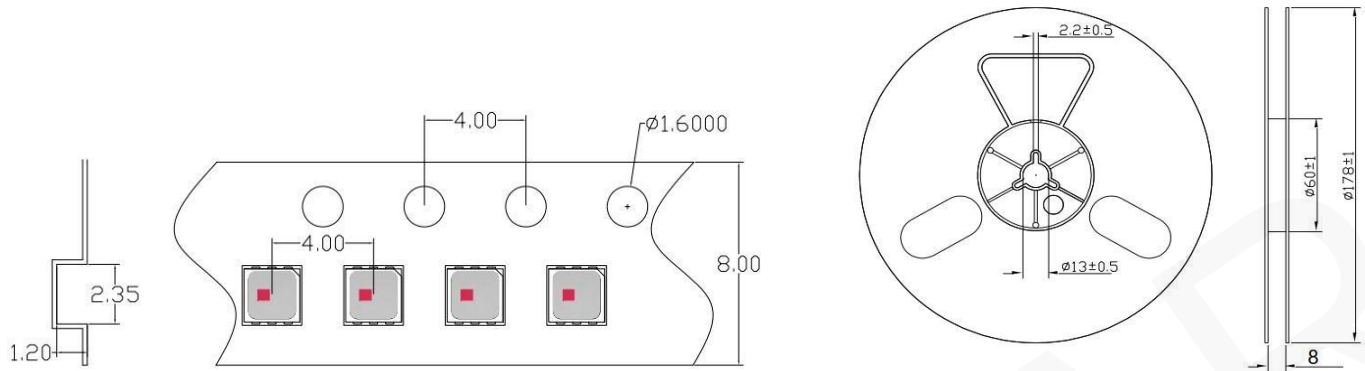
5. Spectral distribution diagram



6. Radiation curve



13. Packaging:

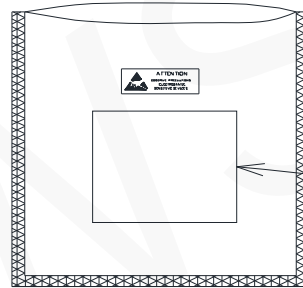


Carrier tape specifications

Reel specifications

Note: The tolerance is $\pm 0.1\text{mm}$, unit: mm.

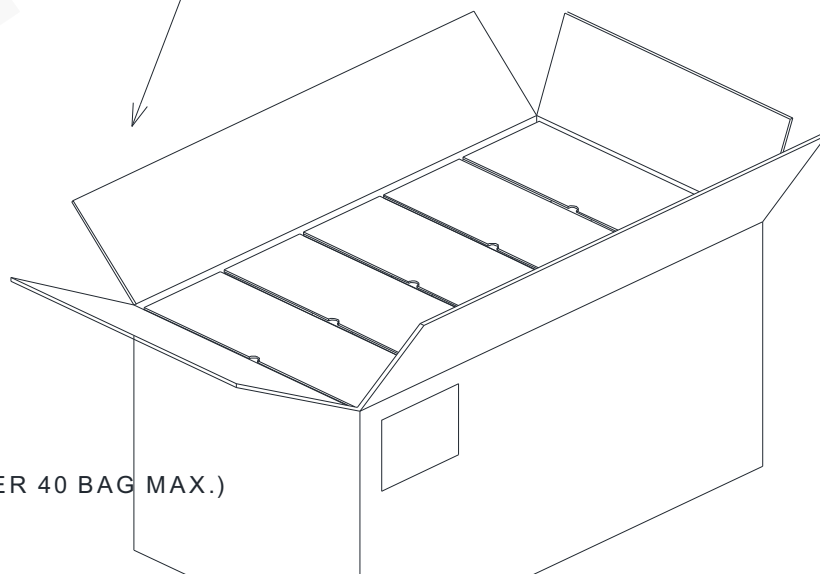
ESD POLYETHYLENE BAG



LED SMD
PRODUCT NO. : HD108-2121
QUANTITY: 4000PCS
Lot No.: NST2025051002-11
DATE: 2025-05-10

LABEL SKETCHING

CARDBOARD (INNER 40 BAG MAX.)



The reel pack is applied in SMD LED. The LEDs are packed in cardboard boxes after packaging in normal or anti-electrostatic bags. cardboard boxes will be used to protect the LEDs from mechanical shocks during transportation. The boxes are not water resistant and therefore must be kept away from water and moisture.

14. Reliability Verification:

Item	Test Conditions	Validation Time /Cycle	QTY	Reference Standard	Ac/R e
Reflow Soldering Resistance Validation	260℃/10sec	2Cycle	25PCS	JEITA ED-4701 300 301	0/1
Thermal Shock Validation	-40℃ 30min ↑↓ 10sec 100℃ 30min	200 cycles	100PCS	MIL-STD-202G	0/1
High Temperature and High Humidity Storage	Ta=85℃ RH=85 %	500 hours	25PCS	JEITA ED-4701 100 103	0/1
High Temperature Storage	Ta=85℃	500 hours	25PCS	JEITA ED-4701 200 201	0/1
Low Temperature Storage	Ta=-40℃	500 hours	25PCS	JEITA ED-4701 200 202	0/1
Ambient temperature aging	Ta=25℃ IF=Typical value	1000 hours	25PCS	JESD22-A 108D	0/1

15. Storage and Operation Instructions:**Operation Instructions****1. Packaging Storage:**

SMD LEDs are moisture-sensitive components. Aluminum foil packaging is used to prevent the LEDs from absorbing moisture during transportation and storage. A desiccant is also placed inside the packaging to absorb moisture. If the LEDs absorb moisture, the moisture will expand during reflow soldering, causing the colloid to detach from the bracket or damaging the bond wires, leading to product failure. For this reason, vacuum moisture-proof packaging is used to prevent moisture from entering the packaging bag. This product has a moisture resistance rating of LEVEL4.

Table 1: Definition of Material Moisture Resistance Level (MSL) as Specified by IPC/JEDEC J-STD-020

Moisture resistance rating	Workshop lifespan after packaging is opened	
	Time	Condition
LEVEL1	No limited	$\leq 30^{\circ}\text{C}/85\% \text{ RH}$
LEVEL2	1 year	$\leq 30^{\circ}\text{C}/60\% \text{ RH}$
LEVEL2a	4 weeks	$\leq 30^{\circ}\text{C}/60\% \text{ RH}$
LEVEL3	168 hours	$\leq 30^{\circ}\text{C}/60\% \text{ RH}$
LEVEL4	72 hours	$\leq 30^{\circ}\text{C}/60\% \text{ RH}$
LEVEL5	48 hours	$\leq 30^{\circ}\text{C}/60\% \text{ RH}$
LEVEL5a	24 hours	$\leq 30^{\circ}\text{C}/60\% \text{ RH}$
LEVEL6	Ready to use	$\leq 30^{\circ}\text{C}/60\% \text{ RH}$

1.1 Vacuum Packaging Storage: It is recommended that SMD series newstar LEDs be stored in a desiccant cabinet with a built-in desiccant at a temperature of 20°C - 30°C and a humidity below 60%, for a period not exceeding 3 months.

1.2 Storage and Use After Unpacking:

- Before unpacking, check the expiration date and ensure there are no leaks.
- Environmental lifespan of vacuum aluminum bags after unpacking: In environments $\leq 30^{\circ}\text{C}/60\% \text{ RH}$, online use is not recommended to exceed 24 hours. If the above environmental requirements are not met, newstar recommended that the unpacking operation time not exceed 2 hours.
- Residual material after opening should be sealed within 12 hours in a workshop environment $\leq 30^{\circ}\text{C}/60\% \text{ RH}$ and stored according to conditions 1.1.

1.3 LED devices in vacuum packaging that are not opened and are in good condition (without being resealed) can be used directly within 90 days. However, LED devices within 90-180 days need to be dehumidified at low temperature before use.

1.4 LED devices in vacuum-sealed packaging that are intact (not resealed) but have been stored for more than 180 days must undergo high-temperature dehumidification before use.

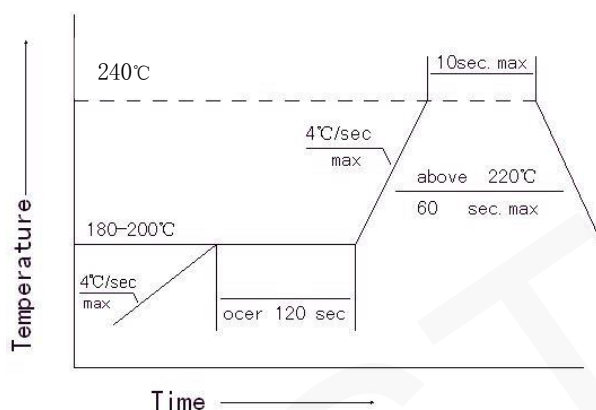
2. Product Dehumidification:**2.1 Low-Temperature Dehumidification:**

- Unpack the vacuum packaging and remove the entire reel of LED devices.

- 1.2 Bake the LEDs on the original reel, laying them flat to prevent deformation.
- 1.3 Place the entire reel of LEDs in a 70°C oven and bake for 24 hours. (Note: Do not bake the entire reel of LED devices at temperatures above 70°C, as the LED reel carrier is prone to deformation at temperatures above 70°C.).
- 1.4 LED devices can only be used for normal operation after baking is complete.
- 1.5 It is recommended that all color light products be dehumidified at low temperatures for better performance.
 - 1.5.1.1 1.5.1 High-Temperature Dehumidification Method: After separating the LED chips according to their BIN grade, unwrap the tape and lay them flat on a stainless steel tray. The thickness of the flat layer should not exceed 2 cm.
 - 1.5.1.2
 - 1.5.1.3 1.5.1.1 Standard SMD LED chips: 80°C/2H - 135°C/4~8H
 - 1.5.1.4
 - 1.5.1.5 1.5.1.2 Chip LED chips: 80°C/2H - 135°C/2~4H. After naturally cooling in the oven for half an hour, begin tape winding. Tape winding must be completed within 4 hours (during this time, the LED chips should be placed in a drying cabinet; newstar recommended to control the humidity in the drying cabinet below 30% RH).
 - 1.5.1.6
 - 1.5.1.7 1.5.1.3 After tape winding, dehumidify at 70°C/12~24H and then vacuum pack. Prolonged baking is not recommended to avoid oxidation.
 - 1.5.1.8
 - 1.5.1.9 1.5.2 Moisture Control for Assembled LED Components
 - 1.5.1.10
 - 1.5.1.11 1.5.2.1 For products requiring secondary SMT processes or high temperatures, necessary moisture control should be implemented before secondary soldering after the initial soldering. Exposure to ($\leq 30^{\circ}\text{C}/60\%\text{RH}$) conditions should not exceed 2 hours. If the interval between secondary high-temperature production is long, the material after the initial soldering must undergo necessary dehumidification (baking in an oven at $70^{\circ}\text{C}\pm 5^{\circ}\text{C}$ for at least 12 hours), followed by vacuum sealing and storage. Alternatively, the product can be stored in a constant temperature and humidity chamber, and dehumidified again before the secondary high-temperature production (baking in an oven at $70^{\circ}\text{C}\pm 5^{\circ}\text{C}$ for at least 12 hours) to ensure the product remains dry before the high-temperature process. Low-humidity baking conditions: $70^{\circ}\text{C}\pm 5^{\circ}\text{C}$ for at least 12 hours. High-temperature baking conditions: $130^{\circ}\text{C}\pm 5^{\circ}\text{C}$ for 4–6 hours.
 - 1.5.1.12
 - 1.5.1.13 1.5.2.2 Reflow soldering is not recommended for more than 2 hours. For subsequent tests and above, reliability risks and first article acceptance must be assessed in advance if necessary, and the effects of high-temperature baking must be considered for other components.

1.6 Welding:

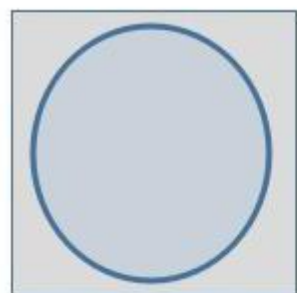
1.6.1 Reflow Soldering: Surface mount LEDs must conform to JEDEC J-STD-020C standard. The following principles are recommended:



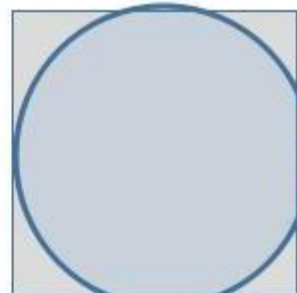
Temperature Curve Characteristics	Lead Solder	Lead-Free
Average ramp rate (Ts max to Tp)	Max 3°C/second	Max 3°C/second
Preheat: Minimum temperature (Ts min)	100°C	150°C
Preheat: Maximum temperature (Ts max)	150°C	200°C
Preheat: Time (ts min to ts max)	60-120 seconds	60-180 seconds
Time maintained above temperature: Temperature (TL)	183 °C	217 °C
Time maintained above temperature: Time (tL)	60-150 seconds	60-150 seconds
Peak / classification temperature (TP)	215 °C	240 °C
Time within 5°C of actual peak temperature (tp)	<10 seconds	<10 seconds
Cooling rate	Max 6°C/second	Max 6°C/second
Time required to ramp from 25 °C to peak temperature	Max 6 minutes	Max 6 minutes

1.6.2 Manual soldering: Manual soldering with a soldering iron and a heated platform is not recommended.

1.7 SMT nozzle requirements: (Blue circles indicate the nozzle inner diameter as shown in Figure 1 and Figure 2)



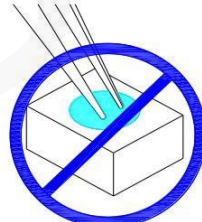
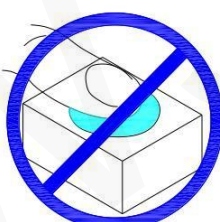
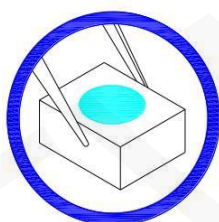
OK(吸咀外径小于灯珠面)



NG(吸咀外径大于灯珠面)

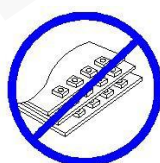
To prevent air pressure leakage, the outer diameter of the SMD nozzle must not exceed the size of the LED, the inner diameter of the nozzle should be as large as possible, and the tip of the nozzle should be made of a soft material to prevent scratching or damaging the surface of the LED colloid during suction. The size of the component must be accurate in the pick-and-place machine.

1.8 Material handling method: Use tweezers to pick up the material. Do not press the colloid or puncture it with sharp objects. Do not stack the material.



Do not stack the products together, as this may damage the internal circuitry.

Do not use in acidic environments with a pH < 7.



1.9 Control of Hazardous Substances:

When applying any materials to LED products, please pay attention to hazardous substance control. The content of bromine alone must be less than 900 PPM, and the content of chlorine alone must be less than 900 PPM. When applying to LED products, the total content of bromine and chlorine in the outer encapsulant must be less than 1500 PPM.

1.10 Thermal Design Requirements:

For LED products, heat dissipation design is crucial. When designing the product, consider the heat generated by the LEDs, the thermal resistance of the PCB board, the density of the LED array, and the input power, all of which contribute to temperature increases. To avoid excessive heat generation, ensure the LEDs operate within the maximum specifications required in the product datasheet. When setting the LED drive

power, the maximum ambient temperature should be taken into account. The maximum operating temperature of the product should not exceed 50°C (i.e., $\leq 50^{\circ}\text{C}$, referring to the operating temperature at the GND pin of the LED).

8. Antistatic and surge protection:

Static electricity and power surges can damage LED products. Therefore, appropriate protective measures must be taken. To protect LED products, anti-static wrist straps and gloves must be worn whenever and wherever LEDs are handled. All equipment and instruments must be grounded. It is recommended that each product undergo relevant electrical testing before shipment to identify defective products caused by static electricity. The potential for power surges to damage LEDs should be considered during circuit design.

9. Special Statement:

9. 1 Our company will not be liable for any problems arising from use outside the specifications.
9. 2 LEDs can emit very strong light that can damage the eyes. Precautions should be taken, and prolonged direct viewing of LED lights with the naked eye should be avoided.
9. 3 Before large-scale use, you should communicate with relevant personnel in our company to understand more detailed specifications.
9. 4 We regret that we may not be able to notify you in a timely manner of any changes to the shape and specifications of LED products.

This instruction manual cannot cover all the problems that customers may encounter during use. We apologize for any inconvenience this may cause.