

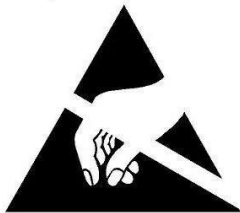
Product Specifications

Model: HD107S-2020

Description: 2020 SMD Smart LED

Document No: HD107S-2020RGB-RD001

Version No: A00



ELECTROSTAIC
SENSITIVE DEVICES



Product Overview

HD107S-2020 is an intelligent externally-controlled light source integrating drive control and LED light-emitting chips. Each LED light source acts as one pixel point. It is internally integrated with MCU digital interface, data latch, LED driver and other circuits. External MCU can realize independent grayscale control and cascading control for each chip to achieve color dot-matrix lighting.

Data transmission adopts clock-data two-wire serial protocol, featuring long transmission distance and strong anti-interference capability.

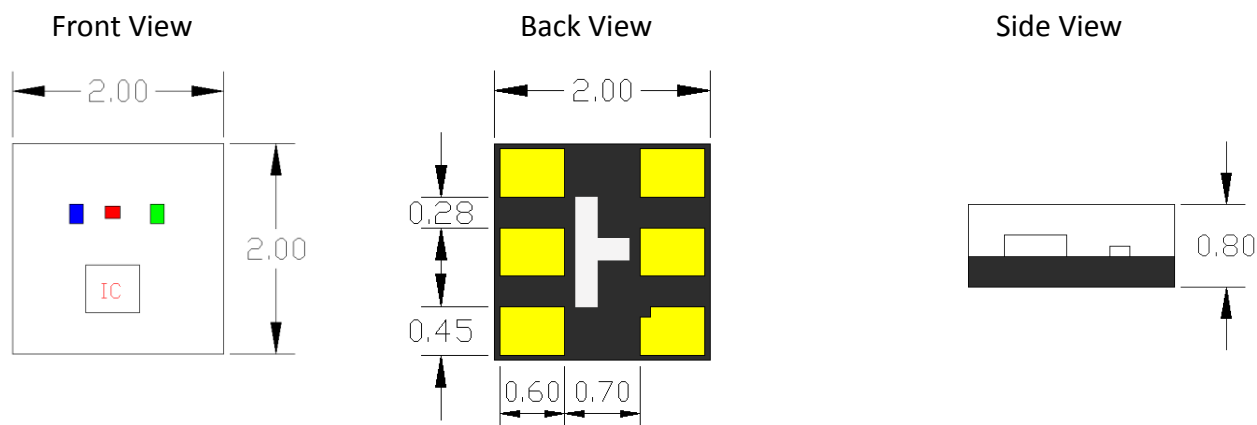
2. Main Application Fields

LED full-color character light strings, LED full-color flexible & rigid light bars, LED point light sources, LED pixel screens, LED special-shaped screens, LED full-color modules, automotive ambient lights, and ambient indicator lights for various electronic products.

3. Key Product Features

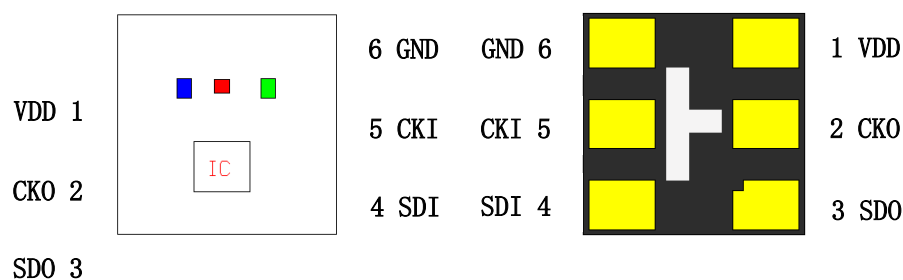
- Integrated LED and driver, forming a complete externally-controlled pixel point.
- Integrated two-wire serial cascading constant-current IC, adopting clock & data two-wire signal protocol.
- Default constant-current output of B/R/G LED chips: 17 mA for each channel.
- Max. clock input frequency: 32 MHz; Max. data transmission rate: 32 Mbps.
- PWM scanning frequency: 27 kHz.
- 8-bit data per color channel, 256-level adjustable grayscale with excellent color consistency.
- No power-on self-check mode; LED remains off without input signal.
- Chip-scale package; scattering viewing angle close to 180°.
- Compatible with SMT and wave-soldering processes.
- RoHS and REACH compliant materials.
- Moisture-sensitivity level: LEVEL 5.

4. Dimension Drawing:



Note: All dimensions are in millimeters. Tolerance is ± 0.15 mm unless otherwise specified. Actual appearance shall be subject to samples.

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 / power-supply negative pin

6. Optical Parameters (Ta=25 °C, VDD=5 V)

Color	Wavelength (nm)	Luminous Intensity (mcd)	Luminous Flux (lm)
Red	620-625	400-800	1.2-2.2
Green	518-525	800-1500	2.8-4.0
Blue	465-470	300-700	0.8-1.8

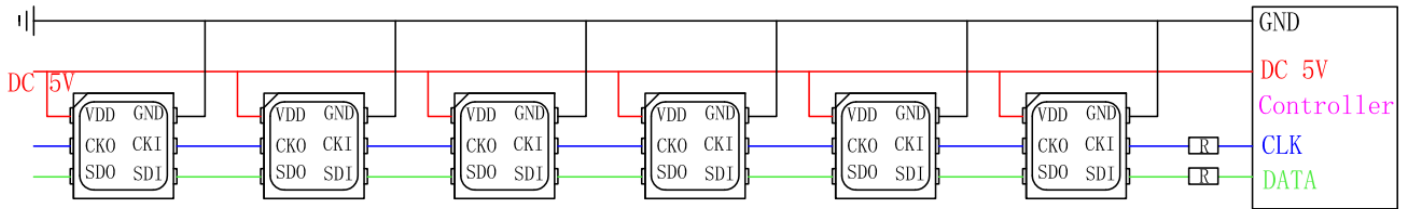
7. Absolute Maximum Ratings:

Parameter	Symbol	Range	Unit
Logic Supply Voltage	VDD	0.5~5.5	V
RGB Output Port Withstand Voltage	VDS	24	V
Logic Input Voltage	VI	-0.3~+VDD+0.3	V
Operating Temperature	Topt	-40~+85	°C
Storage Temperature	Tstg	-50~+85	°C
ESD Withstand Voltage (HBM)	VESD	3000	V

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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition
Chip Input Voltage	VDD	-	5	-	V	-
R/G/B Port Output Current	IOUT	-	17	-	mA	-
High-level Input Voltage	VIH	3.4	-	5.3	V	-
Low-level Input Voltage	VIL	-0.3	-	1.6	V	-
PWM Scanning Frequency	Fpwm	-	27	-	kHz	-
Quiescent Current	IDD	-	1	-	μA	-

9. Typical Application Circuit:



Protective resistors shall be connected in series for CKI, SDI inputs and CKO, SDO outputs. Resistance value R depends on the number of cascaded LEDs: more cascaded LEDs require smaller resistance. The recommended range is 27-51 Ω ; typical value 33 Ω .

Note: Diagrams are for circuit-design reference only; LED outline shall not be referred to.

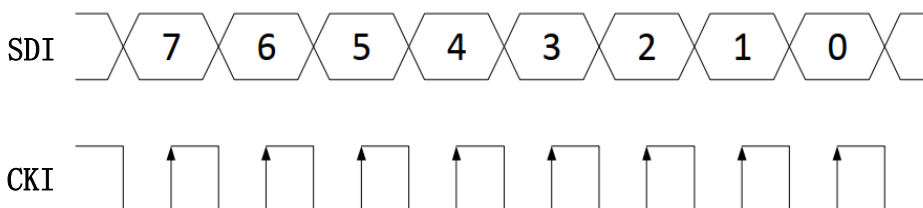
10. Description of Data Communication Protocol:

Two-wire communication protocol for N cascaded LEDs:

SDI	32 μ s0	LED1 Data	LED2 Data	LED3 Data		LED N Data	32 μ s1
	start byte	Data bytes 1	Data bytes 2	Data bytes 3		Data bytes N	End data byte

Display data bytes	111	Brightness (5 bits)	8-bit Blue	8-bit Green	8-bit Red
		MSB first	MSB first	MSB first	MSB first

start byte	0000 0000	0000 0000	0000 0000	0000 0000
end byte	1111 1111	1111 1111	1111 1111	1111 1111



256-Level Grayscale Setting:

Value (MSB...LSB)	Duty Cycle
0000 0000	0/256
0000 0001	1/256
0000 0010	2/256
.....	
1111 1101	253/256
1111 1110	254/256
1111 1111	255/256

Global Brightness Setting:

Value (MSB...LSB)	Current Adjustment Ratio
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 = $1 / ((64 + (32 \times \text{Number of LEDs})) \times \text{CKI cycle})$, unit: frames per second.

Example: For 1024 pixels with CKI = 1 MHz, frame rate = 30 fps.

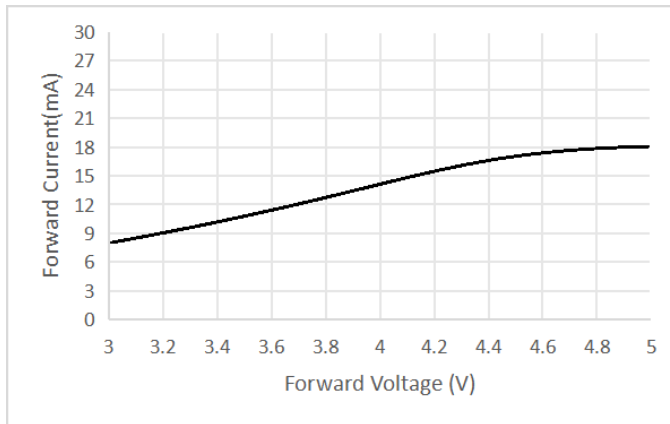
11. Data Structure:

B7	B6	B5	B4	B3	B2	B1	B0	G7	G6	G5	G4	G3	G2	G1	G0	R7	R6	R5	R4	R3	R2	R1	R0
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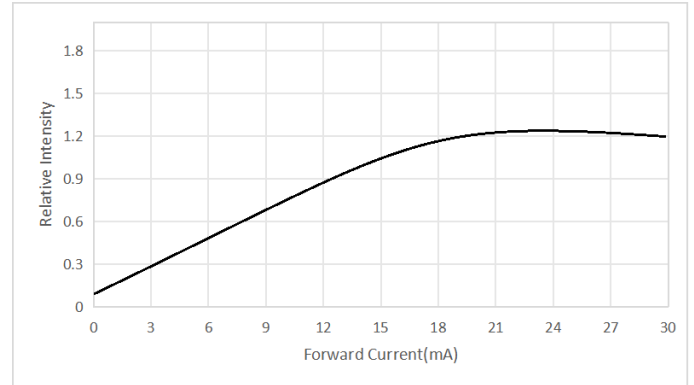
Note: Transmit MSB first; send data in B-G-R order (B7 → B6 → → R0).

12. Photo-Electrical Characteristic Curves:

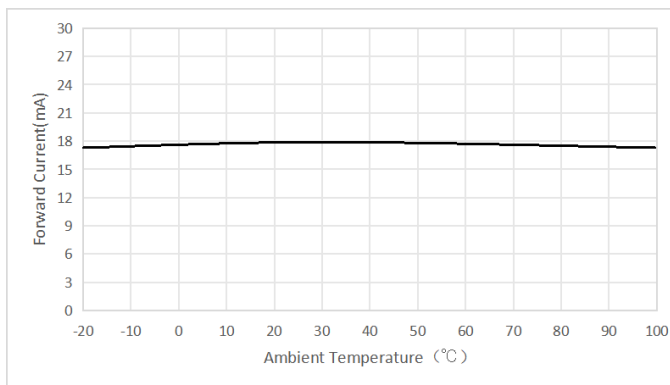
1. Forward Voltage vs Forward Current



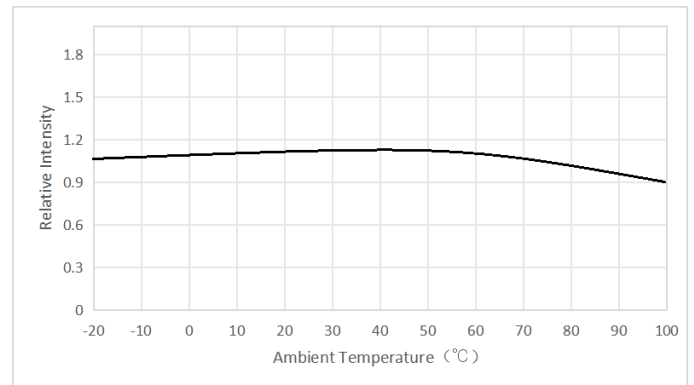
2. Forward Current vs Relative Luminous Intensity



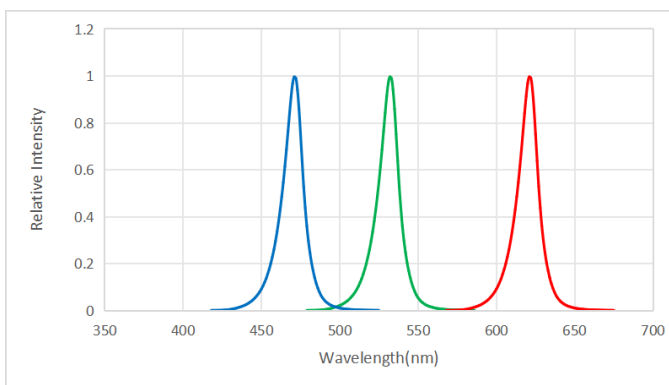
3. Ambient Temperature vs Forward Current



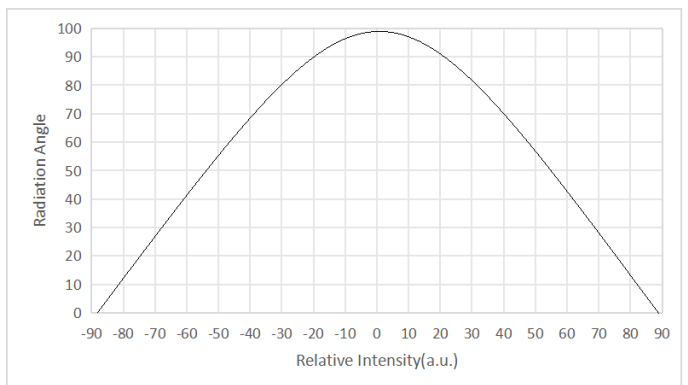
4. Ambient Temperature vs Relative Luminous Intensity



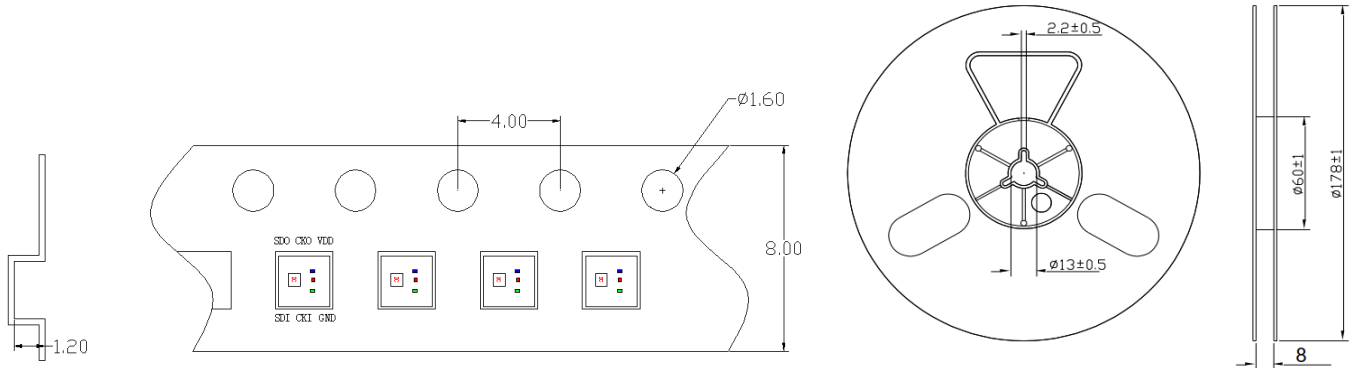
5. Spectral Distribution



6. Radiation Pattern



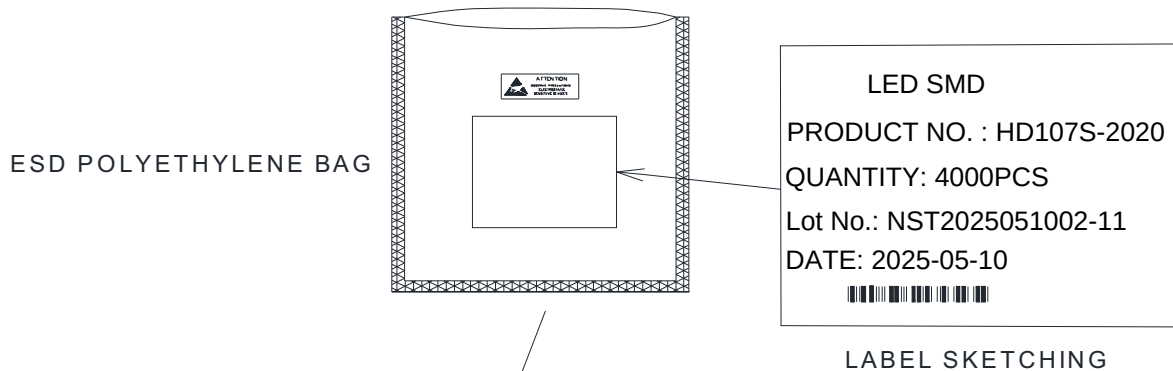
13. Packaging Specification:



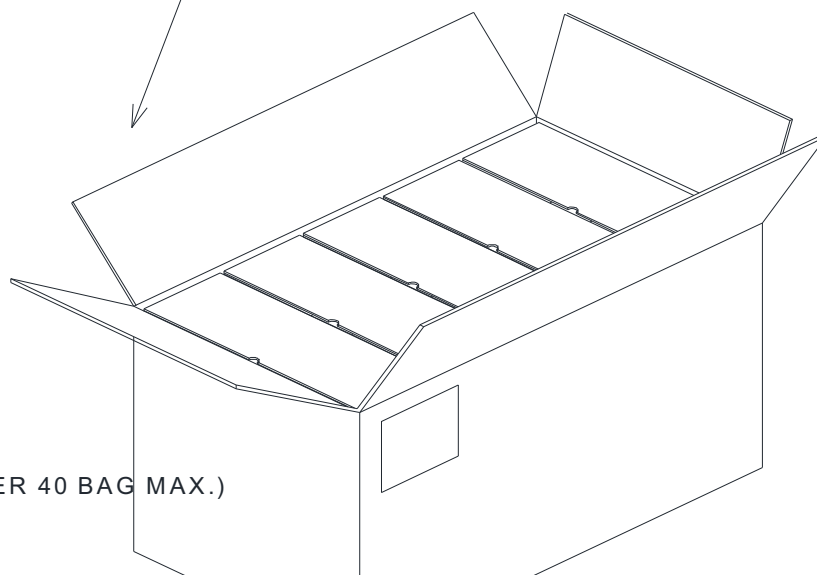
Carrier tape specification

Reel specification

Note: Tolerance for marked dimensions: ± 0.1 mm; unit: mm.



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 Condition	Duration / Cycles	Sample Qty	Reference Standard	Ac/Re
Reflow Soldering Resistance	260 °C /10 sec	2 Cycle	25 PCS	JEITA ED-4701 300 301	0/1
Thermal Shock	-40 °C 30 min ↑↓ 10 sec 100 °C 30 min	200 cycles	100 PCS	MIL-STD-202G	0/1
High-Temperature & High-Humidity Storage	Ta=85 °C, RH=85%	500 hours	25 PCS	JEITA ED-4701 100 103	0/1
High-Temperature Storage	Ta=85 °C	500 hours	25 PCS	JEITA ED-4701 200 201	0/1
Low-Temperature Storage	Ta=-40 °C	500 hours	25 PCS	JEITA ED-4701 200 202	0/1
Room-Temperature Aging	Ta=25 °C, IF=Typical Value	1000 hours	25 PCS	JESD22-A108D	0/1

15. Operating Instructions:

1. Packaging & Storage:

SMD LEDs are moisture-sensitive devices. Aluminum-foil bags prevent moisture absorption during transportation and storage, with desiccant inside. Absorbed moisture will expand during reflow soldering, causing delamination between encapsulant and lead frame or bond-wire damage and device failure. Therefore vacuum moisture-proof packaging is required. This product moisture-sensitivity level: LEVEL 4.

Table 1: MSL definition per IPC/JEDEC J-STD-020

Moisture-Sensitivity Level	Floor Life after Opening	Condition
LEVEL 1	Unlimited	$\leq 30^{\circ}\text{C}$ /85 % RH
LEVEL 2	1 year	$\leq 30^{\circ}\text{C}$ /60 % RH
LEVEL 2a	4 weeks	$\leq 30^{\circ}\text{C}$ /60 % RH
LEVEL 3	168 hours	$\leq 30^{\circ}\text{C}$ /60 % RH
LEVEL 4	72 hours	$\leq 30^{\circ}\text{C}$ /60 % RH
LEVEL 5	48 hours	$\leq 30^{\circ}\text{C}$ /60 % RH
LEVEL 5a	24 hours	$\leq 30^{\circ}\text{C}$ /60 % RH
LEVEL 6	Use-upon-removal	$\leq 30^{\circ}\text{C}$ /60 % RH

1.1 Storage of Unopened Vacuum Package

Store SMD LEDs in dry cabinet with desiccant. Environment: $20-30^{\circ}\text{C}$, humidity below 60%. Storage time shall not exceed 3 months.

1.2 Storage & Handling after Package Opening

- Check expiry date and package for leakage before opening.
- Floor life after opening aluminum-foil bag: within $\leq 30^{\circ}\text{C}$ /60 % RH, online usage time ≤ 24 hours. If environment is not satisfied, operation time shall not exceed 2 hours.
- Remaining parts after opening shall be resealed within 12 hours under $\leq 30^{\circ}\text{C}$ /60 % RH and stored per clause 1.1.

1.3 Unopened & intact vacuum package

- Within 90 days: can be used directly.
- 90-180 days: low-temperature baking required before use.

1.4 Unopened & intact vacuum package over 180 days

High-temperature baking is mandatory prior to usage.

2. Device Baking / De-humidification

2.1 Low-Temperature Baking

2.1.1 Remove full reels from vacuum bag. 2.1.2 Bake on original reels in flat arrangement to avoid reel deformation. 2.1.3 Bake complete reels at 70 °C for 24 hours. Do not bake above 70 °C, carrier tape will deform. 2.1.4 Proceed to production only after baking completion. 2.1.5 Low-temperature baking is recommended for all color LEDs for better performance.

2.2 High-Temperature Baking

2.2.1 Unwind tape sorted by color bin; spread LEDs thinly on stainless-steel tray, thickness ≤ 2 cm. 2.2.2 Conventional SMD: 80 °C/2 h $\sim$ 135 °C/4-8 h. 2.2.3 Chip-scale LEDs: 80 °C/2 h $\sim$ 135 °C/2-4 h. Cool naturally in oven for 30 min then complete taping within 4 hours. Keep parts in dry cabinet (RH $\leq 30\%$) while waiting. 2.2.4 After taping, bake at 70 °C for 12-24 h then vacuum-seal. Avoid excessive baking to prevent oxidation.

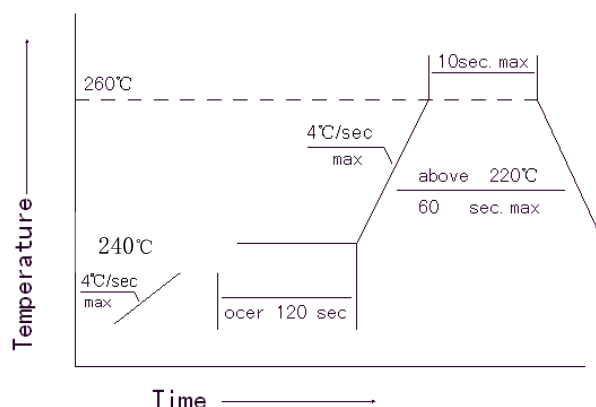
2.3 Moisture Control for Pre-soldered Assemblies

2.3.1 For assemblies requiring secondary SMT / high-temperature processes: after first soldering, exposure under ≤ 30 °C /60 % RH must not exceed 2 hours before second high-temperature processing. If storage interval is long, bake at 70 °C $\pm$ 5 °C for ≥ 12 hours, vacuum-seal and store in dry cabinet. Re-bake ≥ 12 hours at 70 °C $\pm$ 5 °C before second high-temperature processing. Low-temp bake: 70 °C $\pm$ 5 °C, ≥ 12 h; High-temp bake: 130 °C $\pm$ 5 °C, 4-6 h.

2.3.2 Reflow soldering for more than two times is not recommended. If necessary, perform risk evaluation and first-article confirmation; take thermal impact on other components into consideration.

3. Soldering:

3.1 Surface-mount LEDs comply with JEDEC J-STD-020C. Recommended thermal profile parameters:



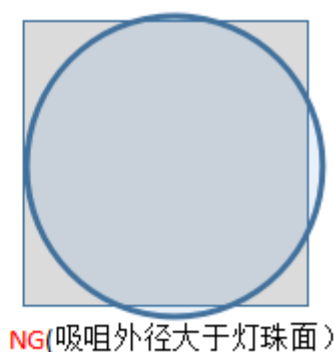
Profile Parameter	Leaded Solder	Lead-Free Solder
Avg. Ramp-up Rate (Ts max to Tp)	Max. 3 °C/s	Max. 3 °C/s
Preheat Minimum (Ts min)	100 °C	150 °C
Preheat Maximum (Ts max)	150 °C	200 °C
Preheat Time (Ts min-Ts max)	60-120 s	60-180 s
Liquidus Temperature (TL)	183 °C	217 °C
Time above Liquidus (tL)	60-150 s	60-150 s
Peak Temperature (TP)	215 °C	240 °C
Time within ± 5 °C of actual peak	<10 s	<10 s
Cool-down Rate	Max. 6 °C/s	Max. 6 °C/s
Total time from 25 °C to peak	Max. 6 min	Max. 6 min

3.2 Manual Soldering

Manual soldering iron and hot-plate operation are not recommended.

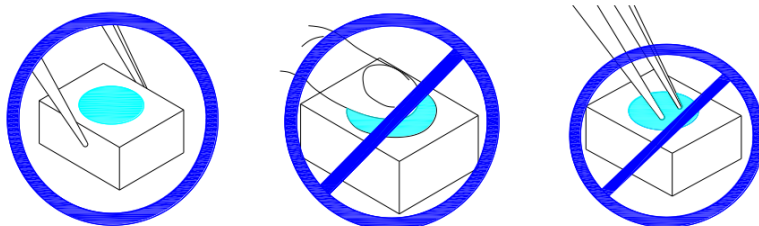
4. SMT Nozzle Requirements:

(The blue circle indicates the inner diameter of the nozzle, as shown in Figure 1 and Figure 2)

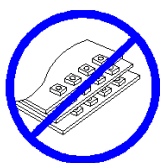


To prevent air leakage, outer diameter of SMT nozzle shall not exceed LED body dimension; inner diameter should be as large as possible. Nozzle tip shall be soft material to avoid scratching LED encapsulant. Component dimension parameters must be correctly set in pick-and-place machine.

5. Component Handling: Handle parts with tweezers. Do not press encapsulant or scratch encapsulant with sharp objects,



Do not stack components. Stacking may damage internal circuits.



Do not apply in acidic environment with $\text{pH} < 7$.

6. Hazardous Substance Control:

When applying coating materials contacting LED: bromine content per single substance < 900 PPM; chlorine content per single substance < 900 PPM. Total bromine + chlorine in encapsulant < 1500 PPM.

7. Thermal Design Considerations

Thermal design is critical for LED products. Consider heat generation from LEDs, PCB thermal resistance, LED population density and input power which raise junction temperature. Ensure operating conditions stay within absolute maximum ratings of this specification when setting driving power, taking maximum ambient temperature into account. Maximum operating temperature at LED GND pad shall not exceed 50°C .

8. ESD & Surge Protection

Electrostatic discharge and surge can damage LEDs. Always wear anti-static wrist strap and gloves when handling LEDs. All equipment and instruments shall be properly grounded. Perform electrical test before shipment to screen ESD-damaged units. Circuit design shall include protection against electrical surge damage.

9. Disclaimer

9.1 Manufacturer assumes no liability for failures caused by operation outside specification limits. 9.2 LED emits strong light which may cause eye injury. Avoid prolonged direct visual observation of illuminated LED. 9.3 Consult our technical staff for detailed specifications before mass production. 9.4 Product appearance and specifications are subject to change without prior notice.

This operating manual may not cover all possible field conditions. We apologize for any inconvenience caused.