

### General description

Worldsemi New generation digital led is specially designed for high resolution display application,each channel with 16bit gray scale,4bit gamma correction inside ,can achieve 20bit display effect.With 10KHZ Port refresh frequency,RGB color balance 3:6:1,pretty suitable for large display screen image.

High-tech integrated digital led,no need any external components including capacitor

With high stability dual-signal function,more simple and convenient to design, performance more stable.

The data transfer protocol use single NZR communication mode. After the pixel power-on reset, the DIN port receive data from controller, the first pixel collect initial 48bit data then sent to the internal data latch, the other data which reshaping by the internal signal reshaping amplification circuit sent to the next cascade pixel through the DO port. After transmission for each pixel, the signal to reduce 48bit. pixel adopt auto reshaping transmit technology, making the pixel cascade number is not limited the signal transmission, only depend on the speed of signal transmission.

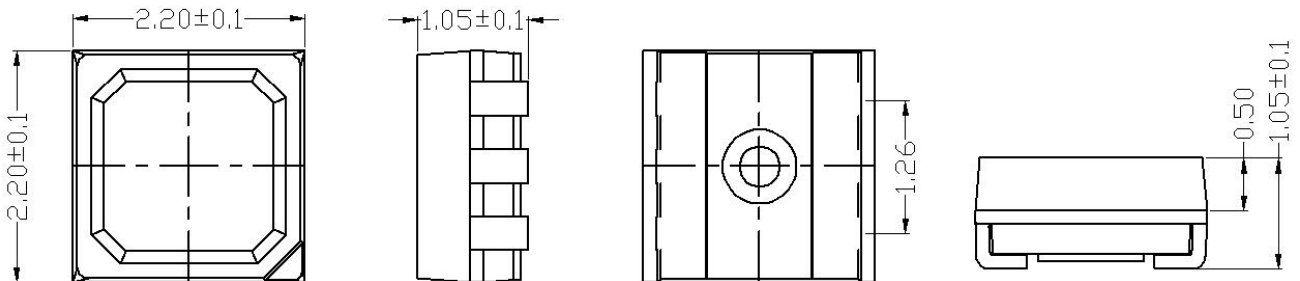
### Features and Benefits

- The control integrated circuit and the LED share the only power source.
- Control circuit and RGB chip are integrated in a package of **2121** components, to form a complete addressable pixel.
- Built-in signal reshaping circuit, after wave reshaping to the next driver, ensure wave-form distortion not accumulate.
- Built-in electric reset circuit and power lost reset circuit.
- OUT R / G / B output gray level: R,G,B 65536 gray scale(Built-in 4Bit GAMMA correction)
- RGB Port with 10KHz refresh frequency
- Cascading port transmission signal by single line.
- 2.1mm\*2.1mm\*1mm(L\*W\*H),Super tiny size
- Use standard display 3:6:1 brightness ratio color match.
- White light color temperature:6000K±500

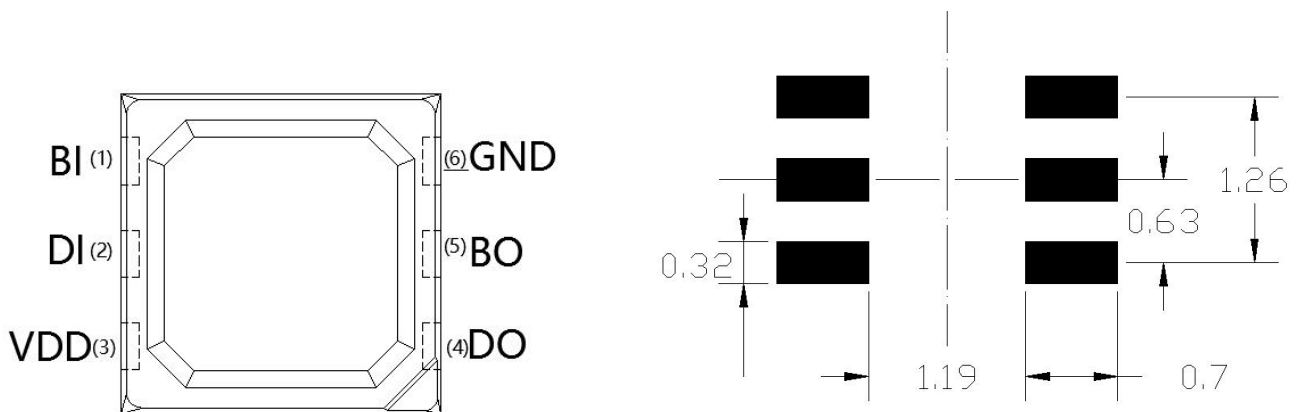
### Applications

- LED transparent screen, LED pixel screen, LED special-shaped screen, various electronic products.

### Mechanical Dimensions (Unit:mm)



### PIN Configuration



Recommended pad size(Unit: mm)

### PIN Function

| NO. | Symbol | PIN               | Function description           |
|-----|--------|-------------------|--------------------------------|
| 1   | BI     | BACKUP DATA INPUT | Backup data signal input PIN   |
| 2   | DI     | DATA IN           | Control data signal input PIN  |
| 3   | VDD    | POWER SUPPLY      | Power supply PIN               |
| 4   | DO     | DATA OUT          | Control data signal output     |
| 5   | BO     | BACKUP DATA OUT   | Secondary data out PIN         |
| 6   | GND    | GROUND            | Ground, data & power grounding |

**Absolute Maximum Ratings (TA=25°C, VSS=0V)**

| Parameter                      | Symbol           | Ratings                    | Unit |
|--------------------------------|------------------|----------------------------|------|
| Power supply voltage           | V <sub>DD</sub>  | +3.7~+5.5                  | V    |
| Logical Input Voltage          | V <sub>I</sub>   | -0.3V~V <sub>DD</sub> +0.7 | V    |
| Quiescent Current              | I <sub>DD</sub>  | <0.8                       | mA   |
| Operation junction temperature | T <sub>opt</sub> | -25~+85                    | °C   |
| Storage temperature range      | T <sub>stg</sub> | -40~+105                   | °C   |

**Electrical Characteristics (TA=25°C, V<sub>DD</sub>=5V, V<sub>SS</sub>=0V)**

| Parameter                   | Symbol              | Min                | Typ  | Max                 | Unit | Conditions                                       |
|-----------------------------|---------------------|--------------------|------|---------------------|------|--|
| Port output current         | I <sub>out</sub>    | 10                 | 10.5 | 11.5                | mA   | OUTR+OUTG+OUTB                                   |
| Input Current               | I <sub>I</sub>      | —                  | —    | ±1                  | μA   | V <sub>I</sub> =V <sub>DD</sub> /V <sub>SS</sub> |
| High-level input voltage    | V <sub>IH</sub>     | 0.7V <sub>DD</sub> | —    | —                   | V    |  |
| Low-level input voltage     | V <sub>IL</sub>     | —                  | —    | 0.3 V <sub>DD</sub> | V    |  |
| Hysteresis voltage          | V <sub>H</sub>      | —                  | 0.35 | —                   | V    |  |
| Dynamic current consumption | I <sub>DD</sub> dyn | —                  | 0.7  | 1                   | mA   | OUTR,OUTG,OUTB =OFF<br>DO=open circuit           |
| Power consumption           | PD                  | —                  | —    | 250                 | mW   | T <sub>a</sub> =25°C                             |
| Signal output sink current  | I <sub>odo</sub>    | —                  | —    | 45                  | mA   |  |

**Switching Characteristics (TA=25°C, V<sub>DD</sub>=5V, V<sub>SS</sub>=0V, unless otherwise specified)**

| Parameter               | Symbol           | Min. | Typ. | Max. | Unit | Test Condition<br>(Working current) |
|-------------------------|------------------|------|------|------|------|-------------------------------------|
| Transmission delay time | t <sub>PLZ</sub> | —    | —    | 300  | ns   | CL=15pF, DIN→DO, RL=10KΩ            |
| Fall time               | t <sub>THZ</sub> | —    | —    | 120  | μs   | CL=300pF, OUTR/OUTG/OUTB            |
| Input capacity          | C <sub>I</sub>   | —    | —    | 15   | pF   | —                                   |

### LED Characteristics

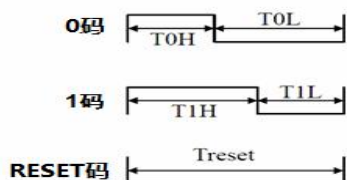
| Parameter          | Symbol      | Color                   | Test Condition: VDD=5V |      |      |      |
|--------------------|-------------|-------------------------|------------------------|------|------|------|
|                    |             |                         | Min.                   | Typ. | Max. | Unit |
| Luminous intensity | IV          | Red                     | 80                     | 125  | 150  | mcd  |
|                    |             | Green                   | 200                    | 270  | 350  |      |
|                    |             | Blue                    | 30                     | 40   | 60   |      |
| Wavelength         | $\lambda d$ | Red                     | 620                    |      | 625  | nm   |
|                    |             | Green                   | 522                    |      | 527  |      |
|                    |             | Blue                    | 470                    |      | 475  |      |
| Color Coordinate   | X           | CCT:<br>6000K $\pm$ 500 |                        | 0.32 |      |      |
|                    | Y           |                         |                        | 0.33 |      |      |
| Luminous Angle     |             |                         | -                      | 120  | -    | Deg  |

### Data Transfer Time

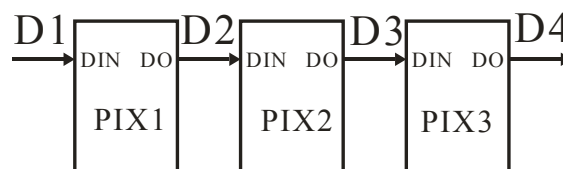
|  |                              |                   |
|--|------------------------------|-------------------|
| T0H  | 0 code, high voltage time    | 200ns~320ns       |
| T1H  | 1 code, high voltage time    | 520ns~800ns       |
| T0L  | 0 code, low voltage time     | 800ns~1.2 $\mu$ s |
| T1L  | 1 code, low voltage time     | 480ns-1 $\mu$ s   |
| RES  | Frame unit, low voltage time | >280 $\mu$ s      |
| Data Cycle: T0H+T0L $\geq$ 1.25 $\mu$ s; T1H+T1L $\geq$ 1.25 $\mu$ s |                              |                   |

Timing waveform diagram

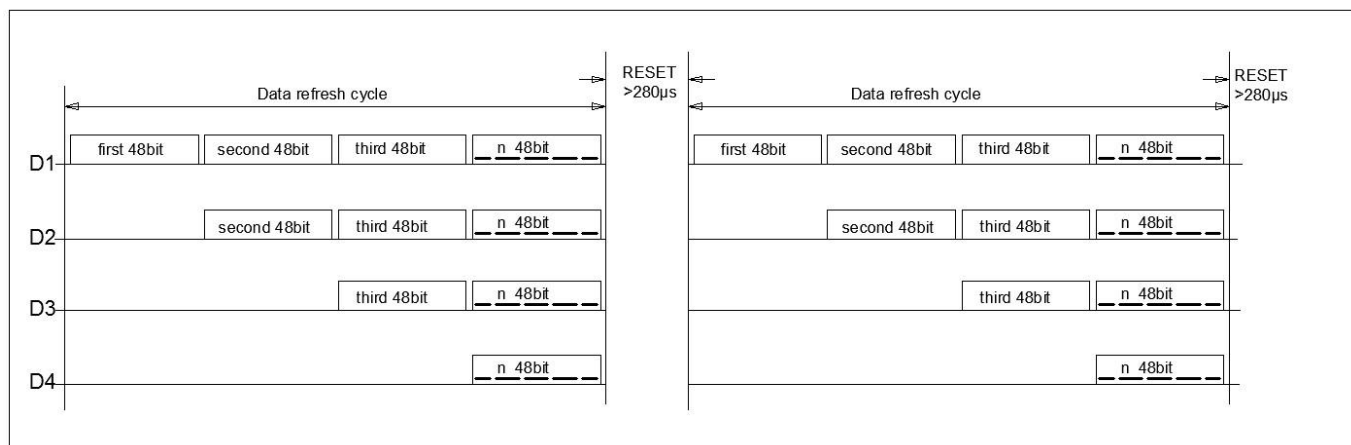
Sequence Chart



Cascade Method:



Data Transmission Method



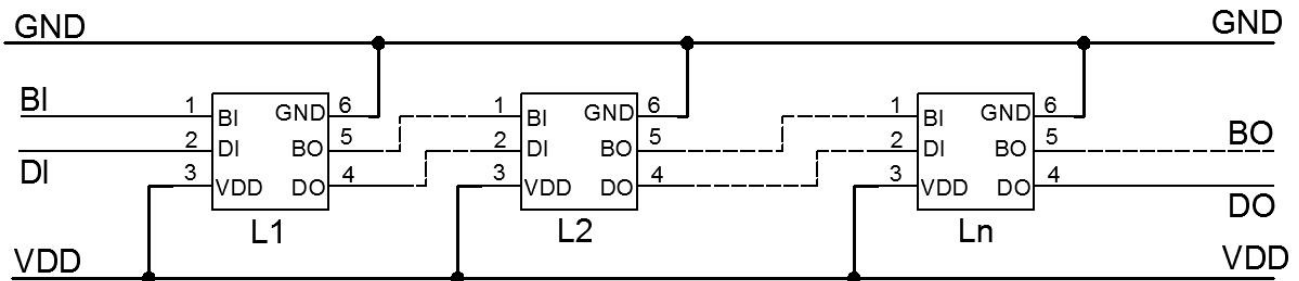
Note: The data of D1 is send by MCU, and D2, D3, D4 through pixel internal reshaping amplification to transmit.

Composition of 48bit Data

|     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| D0  | D1  | D2  | D3  | D4  | D5  | D6  | D7  | D8  | D9  | D10 | D11 |
| G15 | G14 | G13 | G12 | G11 | G10 | G9  | G8  | G7  | G6  | G5  | G4  |
| D12 | D13 | D14 | D15 | D16 | D17 | D18 | D19 | D20 | D21 | D22 | D23 |
| G3  | G2  | G1  | G0  | R15 | R14 | R13 | R12 | R11 | R10 | R9  | R8  |
| D24 | D25 | D26 | D27 | D28 | D29 | D30 | D31 | D32 | D33 | D34 | D35 |
| R7  | R6  | R5  | R4  | R3  | R2  | R1  | R0  | B15 | B14 | B13 | B12 |
| D36 | D37 | D38 | D39 | D40 | D41 | D42 | D43 | D44 | D45 | D46 | D47 |
| B11 | B10 | B9  | B8  | B7  | B6  | B5  | B4  | B3  | B2  | B1  | B0  |

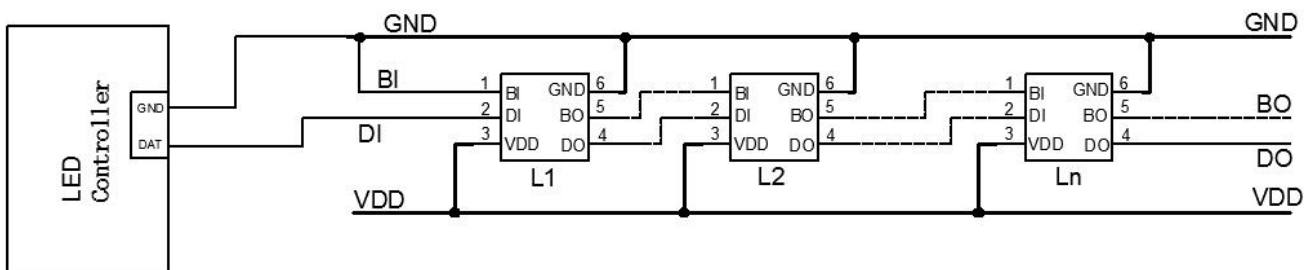
Note: Data transmit in order of GRB, high bit data at first.

**Typical Application Circuit:**

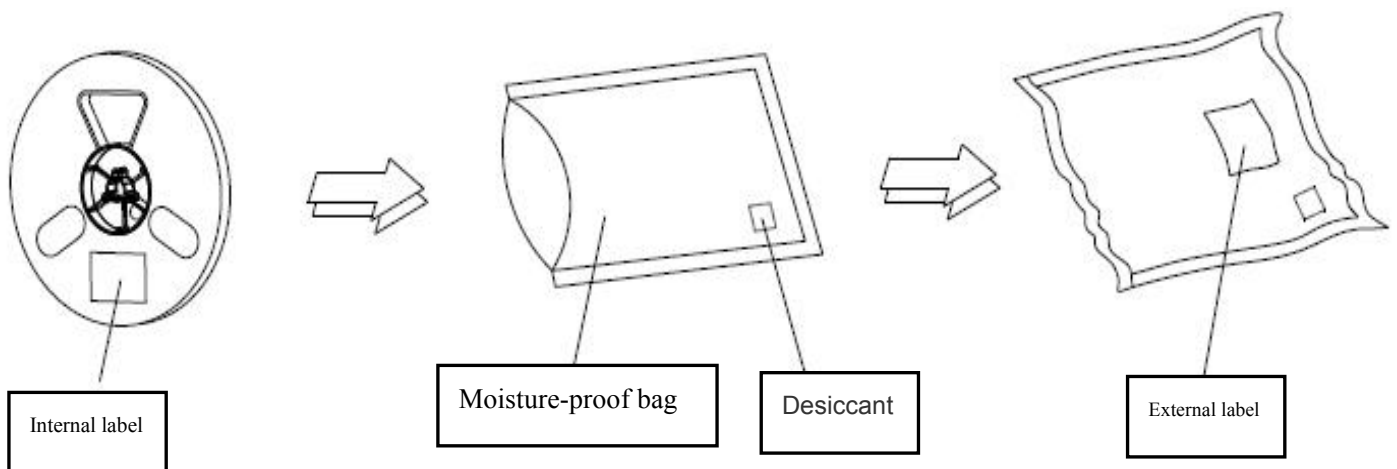


No need any external components;

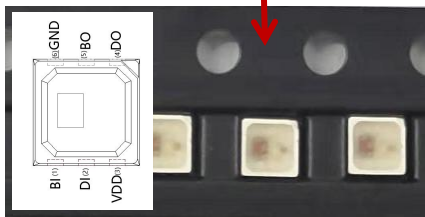
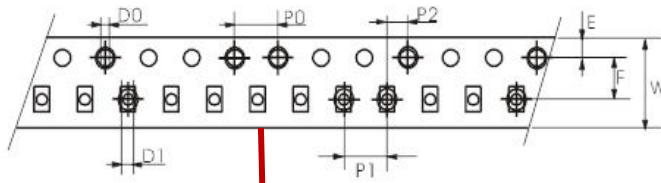
**Signal wiring diagram: The first LED BI is connected to GND**



**Packaging method and quantity: 4000PCS /Bag**



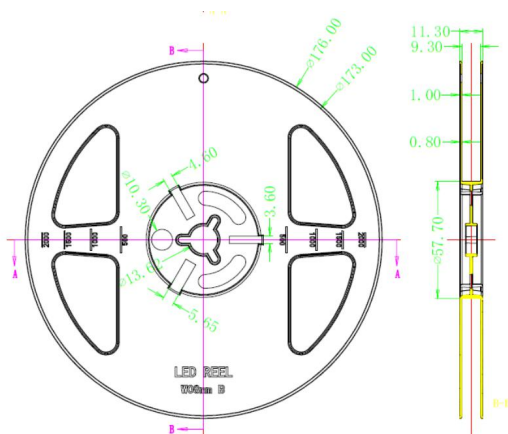
## Carrier specification and LED braid position



UNIT:MM

| SYMBOL | SPEC      |
|--------|-----------|
| B0     | 2.35±0.1  |
| P0     | 4.00±0.1  |
| P1     | 4.00±0.1  |
| P2     | 2.00±0.1  |
| T      | 0.18±0.1  |
| E      | 1.75±0.1  |
| F      | 3.50±0.1  |
| D0     | 1.50±0.1  |
| D1     | 1.00±0.1  |
| W      | 8.00±0.1  |
| 10P0   | 40.00±0.2 |

## Reel Packing Specifications (Unit: mm)



## TOP SMD LED Using Instructions

### 1. Summary

To make the best use of WORLDSEMI's LED, please refer to the below precautions, they are of same usage method as other electronic components.

### 2. Cautions

#### 2.1. Dust & Cleaning

The surface of the LED is encapsulated with modified epoxy resin because it plays a very good role in protecting the optical performance and aging resistance. The modified epoxy resin is easy to stick with

dust and must be kept clean. When there's a certain amount of dust on the surface of the LED, it won't affect brightness, but dust proof should be taken care of. Promoting the use of unsealed package in preference to others and the assembled LEDs should be placed in a clean container.

Avoid using the organic solvents to clean the dust on the LED surface and it's necessary to confirm whether the cleaning fluid will dissolve the LED.

Do not clean the LEDs by the ultrasonic. Some parameters affecting the LED performance must be evaluated if have no alternative but to the ultrasonic cleaning method, such as ultrasonic power, baking time and assembly conditions, etc.

## 2.2. Moisture-proof packaging

TOP SMD LEDs are moisture sensitive components. LEDs are packaged in aluminum foil bag to prevent the from absorbing moisture during transport and storage. A desiccant is placed in the bags to absorb moisture. If the LED absorbs moisture, then it evaporates and expands when in reflow process, which may break the colloid from the bracket and damage the optical performance of LED. For this reason, moisture-proof packaging is to prevent the from absorbing moisture during transport and storage. The moisture resistance rating of WORLDSEMI's LED is: **LEVEL 5a**.

**Tabel I - IPC/JEDEC J-STD-020 Moisture/Reflow Sensitivity Classification**

| MSL Level | Workshop Life                |             |
|-----------|------------------------------|-------------|
|           | Time                         | Conditions  |
| LEVEL1    | Unlimited                    | ≤30°C/85%RH |
| LEVEL2    | 1 Year                       | ≤30°C/60%RH |
| LEVEL2a   | 4 Weeks                      | ≤30°C/60%RH |
| LEVEL3    | 168 Hours                    | ≤30°C/60%RH |
| LEVEL4    | 72 Hours                     | ≤30°C/60%RH |
| LEVEL5    | 48 Hours                     | ≤30°C/60%RH |
| LEVEL5a   | 24 Hours                     | ≤30°C/60%RH |
| LEVEL6    | Take-out and Use immediately | ≤30°C/60%RH |

## 2.3. SMT patch description

1. Please use it under the condition of  $T < 30^{\circ}\text{C}$  and  $\text{RH} < 60\%$ ;
2. The product opening period to the reflow soldering completion time period is controlled within 24H;
3. If time-out occurs, it is necessary to dehumidify and bake the LED.

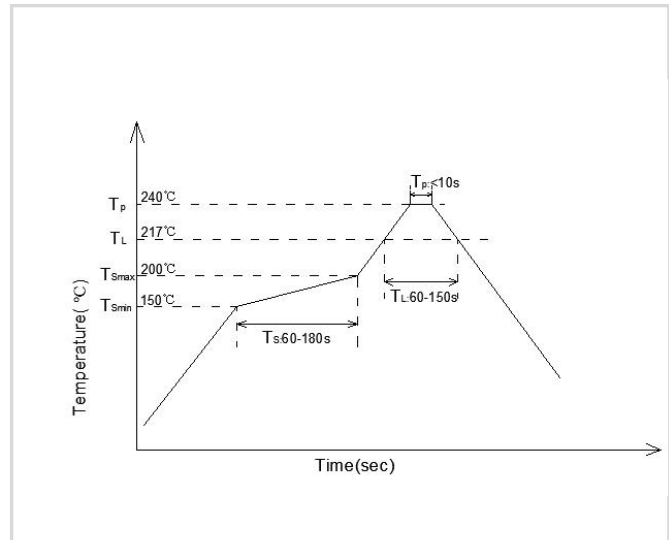
## 2.4 Demand for dehumidification: $75^{\circ}\text{C} / > 24\text{H}$



### 3.SMT Reflow

Refer to the parameters listed below, the experimental results prove that the TOP SMD LED meets the JEDEC J-STD-020C standards. As a general guideline, it is recommended to follow the SMT reflow temperature curve recommended by the solder paste manufacturer.

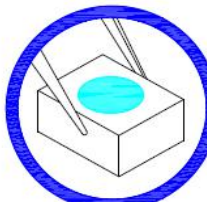
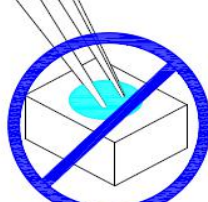
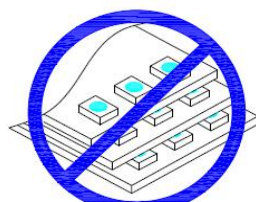

| Curve Description   | Lead-free |
|---|-----------|
| The lowest preheat temperature (T <sub>smin</sub> )                         | 150°C     |
| The highest preheat temperature (T <sub>smax</sub> )                        | 200°C     |
| Preheating time (T <sub>smin</sub> to T <sub>smax</sub> ) (t <sub>s</sub> ) | 60-180 S  |
| Average rate of temperature rise (T <sub>smax</sub> to T <sub>p</sub> )     | <3°C/S    |
| LIQUID REGION temperature (T <sub>L</sub> )                                 | 217°C     |
| LIQUID REGION Holding Time (t <sub>L</sub> )                                | 60-150 S  |
| Peak Temperature (T <sub>p</sub> )  | 240°C     |
| High Temperature Region(T <sub>p</sub> -5°C) Holding                        | <10 S     |
| Cooling Rate  | <6°C/S    |
| Room Temperature to Peak Holding Time                                       | <6 min    |



Remarks:

1. These general guidelines may not apply to all PCB designs and reflow soldering configurations.
2. All temperatures referred are measured on the surface of the package body.

### 3. Assembly Precautions

|   |  |  |   |
|---|--|--|---|
| 1. Clip the LED from its side.  | 2. Neither directly touch the gel surface with the hand or sharp instrument, it may damage its internal circuit. | 3. Not to be double stacked, it may damage its internal circuit.                     | 4. Can not be stored in or applied in the acidic sites of PH<7.                       |
|  |                               |  |  |

**Modify Record**

| <b>Version №</b> | <b>Status Bar</b> | <b>Modify Content Summary</b> | <b>Date</b> | <b>Reviser</b> | <b>Approved</b> |
|------------------|-------------------|-------------------------------|-------------|----------------|-----------------|
| V1.0             | N                 | New-Official release          | 20200106    | Shen JinGuo    | Yin HuaPing     |
| V1.1             | M                 | Delete PCB layout description | 20200519    | Shen JinGuo    | Yin HuaPing     |
|                  |                   |                               |             |                |                 |
|                  |                   |                               |             |                |                 |

Remarks:

1. Version number plus "0.1" if for add & modify parameters, eg. V1.0 → V1.1
2. Major revision or many parameters modified, version number plus "1.0", eg. V1.0 → V2.0
3. No version number is attached to Part Number

Initial version: V1.0, Status bar: N--New, A--Add, M--Modify, D--Delete.