

## Features and Benefits

- The control circuit and RGB chip are integrated in a **5050** components, to form an external control pixel.
- The **5V power supply** voltage effectively reduces the working current of the entire pixel point, lowers the voltage drop on the circuit board, and ensures to the greatest extent that the pixel points achieve good light mixing consistency when transmitted over a long distance.
- Using the built-in signal reshaping circuit to achieve the signal waveform shaping, and no distortion of waveform of signal takes place.
- The gray levels of each pixel's 4 basic colors are of 256 levels.
- The refresh frequency reaches to 4KHz.
- Serial cascade interface, data receiving and decoding depend on just one signal line.
- **Single-wire Self-By pass function.** One additional signal line is added to realize double signal transmission signal break-point continuous transmission. Any single pixel failure won't affect the overall display effect.
- Any two point the distance more than 5M transmission signal without any increase circuit.
- When the refresh rate is 30fps, cascade numbers is at least 1024 pixels.
- Data transmitting at speeds of up to 800Kbps.
- Good color consistency reliability, high cost-effective.

## Applications

- Consumer Electronics.
- Landscape lighting fields.
- Computer peripheral products, games devices and machinery equipment etc.

## General description

**WS2813B-RGBW-V1** is an intelligent control LED light source that the control circuit and RGB chip are integrated in a package of **5050** components. Its internal include intelligent digital port data latch and signal reshaping amplification drive circuit. The RGBIC LED contains an intelligent digital interface, data latch, signal shaping and amplification drive circuit, anti-reverse connection circuit, as well as a high-precision internal oscillator and a high-precision constant current control module, effectively ensuring the high consistency of the color of the LED.

**Single-wire Self-By pass function.** Any pixel's failure won't affect signal transfer and overall emitting color effect.

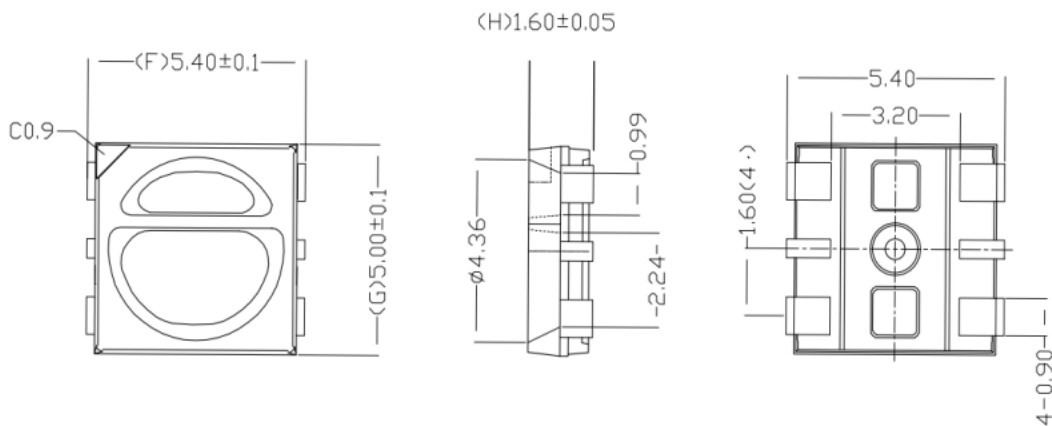
**IC use single single wire RZ protocol.** After the pixel power-on reset, the DIN port receive data from controller, the first pixel collect initial **32bit** data then sent to the internal data latch, the other data which reshaping by the internal signal reshaping amplification circuit sent to the next cascade pixel through the DO port. After transmission for each pixel, the signal to reduce **32bit**. Every pixel adopts auto-reshaping transmit technology, making the pixel cascade numbers are not limited to the signal transmission, only relate to the speed of signal transmission.

Refresh Frequency updates to **4KHz**, No flicker occurs even when captured by hd camera, which is very suitable for the use of HD Video Camera.

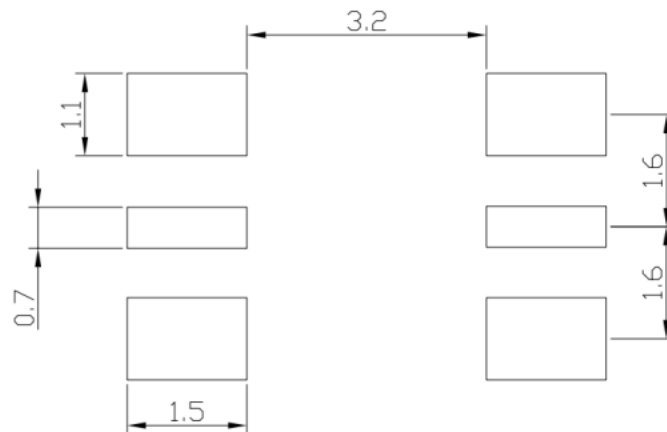
RESET time > **280μs**, it won't cause wrong reset while interruption, it supports the lower frequency and chip MCU.

## Mechanical Dimensions(Unit:mm)

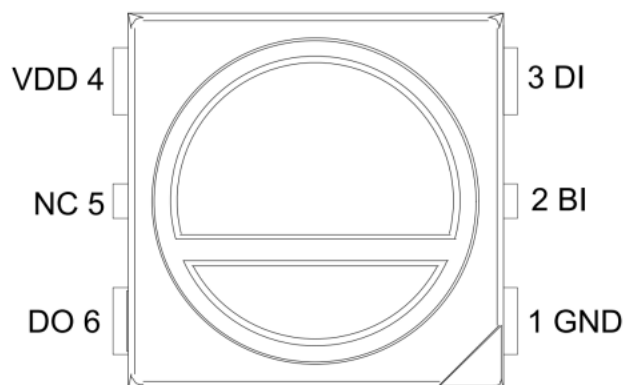
Tolerance:  $\pm 0.15\text{mm}$



## Recommended pad size (unit: mm)



## PIN Configuration



## PIN Function

| NO. | Symbol | PIN | Function description               |
|-----|--------|-----|------------------------------------|
| 1   | GND    | GND | Data & Power Grounding             |
| 2   | BIN    | BIN | Backup Control data signal input   |
| 3   | DIN    | DIN | Control data signal input          |
| 4   | VDD    | VDD | LED POWER SUPPLY, connect to “+5V” |
| 5   | NC     | NC  | Non connected                      |
| 6   | DO     | DO  | Control data signal output         |

## Absolute Maximum Ratings( $T_A=25^{\circ}\text{C}$ , $V_{SS}=0\text{V}$ )

| Parameter             | Symbol    | Ratings            | Unit               |
|-----------------------|-----------|--------------------|--------------------|
| Power supply voltage  | $V_{DD}$  | +3.7~+5.3          | V                  |
| Logical Input Voltage | $V_I$     | -0.7~ $V_{DD}+0.7$ | V                  |
| Working Temperature   | $T_{opt}$ | -40~+85            | $^{\circ}\text{C}$ |
| Storage temperature   | $T_{stg}$ | -40~+85            | $^{\circ}\text{C}$ |

## Electrical Characteristics ( $T_A=25^{\circ}\text{C}$ , $V_{CC}=5\text{V}$ , $V_{SS}=0\text{V}$ )

| Parameter         | Symbol   | Min.        | Tpy. | Max.         | Unit          | Conditions          |
|-------------------|----------|-------------|------|--------------|---------------|---------------------|
| Quiescent Current | $I_o$    | —           | 0.6  | —            | mA            | DC=5V               |
| Input Current     | $I_I$    | —           | —    | $\pm 1$      | $\mu\text{A}$ | $V_I=V_{DD}/V_{SS}$ |
| High-level Input  | $V_{IH}$ | $0.7V_{DD}$ | —    | $V_{DD}+0.7$ | V             | $D_{IN}$            |
| Low-level Input   | $V_{IL}$ | -0.7        | —    | $0.3V_{DD}$  | V             | $D_{IN}$            |

Switching Characteristics ( $T_A=25^{\circ}\text{C}$ ,  $V_{CC}=5\text{V}$ ,  $V_{SS}=0\text{V}$ )

| Parameter               | Symbol    | Min | Tpy | Max | Unit          | Condition                                                   |
|-------------------------|-----------|-----|-----|-----|---------------|-------------------------------------------------------------|
| Oscillation frequency   | $F_{osc}$ | —   | 800 | —   | KHz           | —                                                           |
| Transmission delay time | $t_{PLZ}$ | —   | —   | 300 | ns            | $CL=15\text{pF}, DIN \rightarrow DOUT, RL=10\text{K}\Omega$ |
| Fall time               | $t_{THZ}$ | —   | —   | 120 | $\mu\text{s}$ | $CL=300\text{pF}, OUTR/OUTG/OUTB$                           |
| Data transmission rate  | $F_{MAX}$ | 600 | —   | —   | Kbps          | Duty cycle 50%                                              |
| Input capacity          | $C_I$     | —   | —   | 15  | pF            | —                                                           |

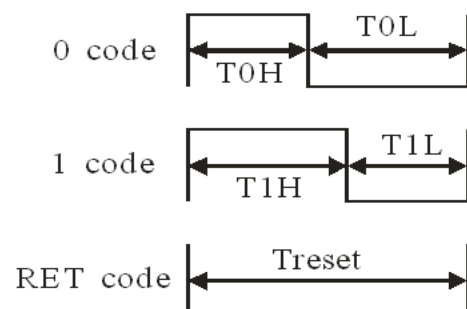
## LED Characteristics

| Parameter         | Symbol        | Color | Quiescent Current: 2mA |     |      |      | Condition<br>(Working current) |
|-------------------|---------------|-------|------------------------|-----|------|------|--------------------------------|
|                   |               |       | Min                    | Tpy | Max  | Unit |                                |
| Brightness        | IV            | Red   | 300                    | /   | 500  | mcd  | 15mA                           |
|                   |               | Green | 800                    | /   | 1500 |      |                                |
|                   |               | Blue  | 200                    | /   | 400  |      |                                |
|                   |               | W     | 1500                   | /   | 2500 |      |                                |
| Wavelength        | $\lambda_d$   | Red   | 620                    | /   | 630  | nm   | 15mA                           |
|                   |               | Green | 515                    | /   | 525  |      |                                |
|                   |               | Blue  | 465                    | /   | 475  |      |                                |
| Color Temperature | Pure White    |       | 6000                   | -   | 6500 | K    | W=15mA                         |
|                   | Natural White |       | 3500                   | -   | 4500 |      |                                |
|                   | Warm White    |       | 2700                   | -   | 3200 |      |                                |

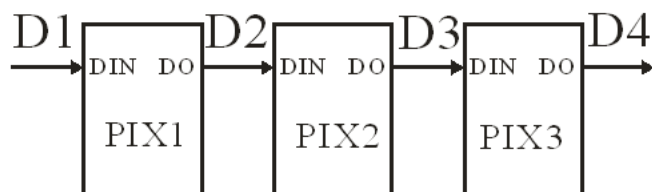
## Data Transfer Time

|                         |                            |                        |
|-------------------------|----------------------------|------------------------|
| <b>T0H</b>              | 0-code, High-level time    | 220ns~380ns            |
| <b>T1H</b>              | 1-code, High-level time    | 580ns~1 $\mu\text{s}$  |
| <b>T0L</b>              | 0-code, Low-level time     | 580ns~1 $\mu\text{s}$  |
| <b>T1L</b>              | 1-code, Low-level time     | 580ns~1 $\mu\text{s}$  |
| <b>RES</b>              | Frame unit, Low-level time | > 280 $\mu\text{s}$    |
| <b>T<sub>DATA</sub></b> | Data cycle(TH+TL)          | $\geq 1.25\mu\text{s}$ |

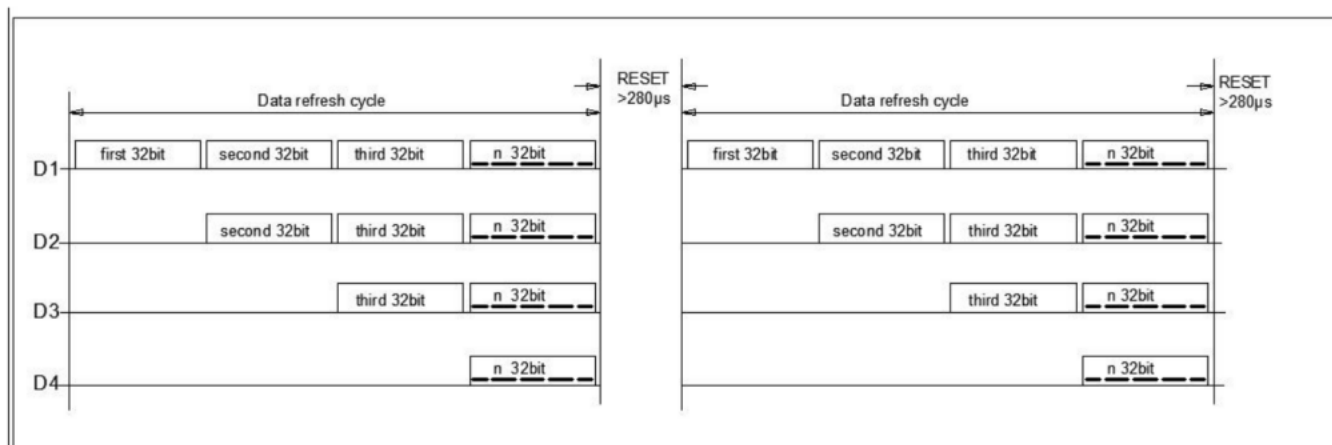
## Sequence chart



## Cascade method



## Data Transmission Method



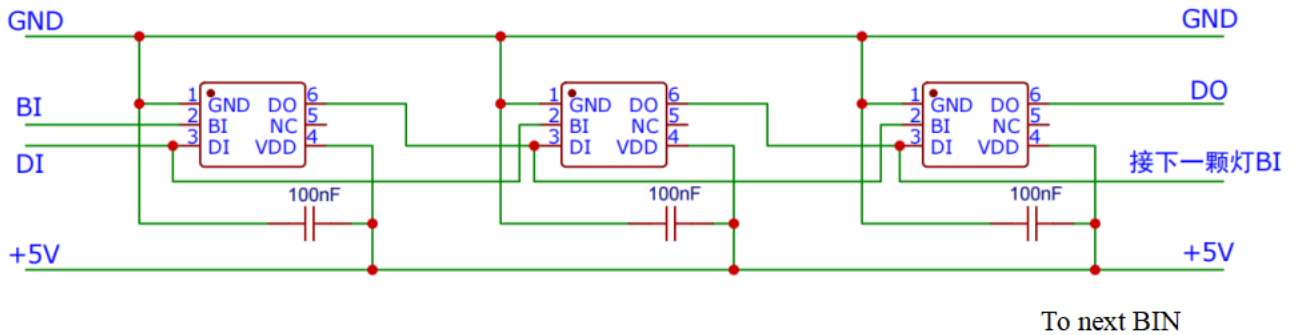
Note: D1 is the data from MCU, and D2, D3, D4 are from Cascade Circuits.

## Composition of 32bit data

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| G | G | G | G | G | G | G | G | R | R | R | R | R | R | R | R | B | B | B | B | B | B | B | B | W | W | W | W | W | W | W | W |
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

Note: Data transmit in order of GRBW, high bit data is first.

## Typical Application Circuit:



Cn is the filter capacitor of the LED's VDD pin, Cn= 100nf.

## Remark:

1. DIN is the main input signal and BIN is the bypass input signal. Under normal circumstances, the IC extracts signals from the DIN. When one IC among them is damaged, the latter IC extracts the signal from the BIN without affecting the signal transmission of the subsequent ics.
2. For the finished product application, the BIN pin of the first IC can't be left floating. It is recommended to connect it to GND.

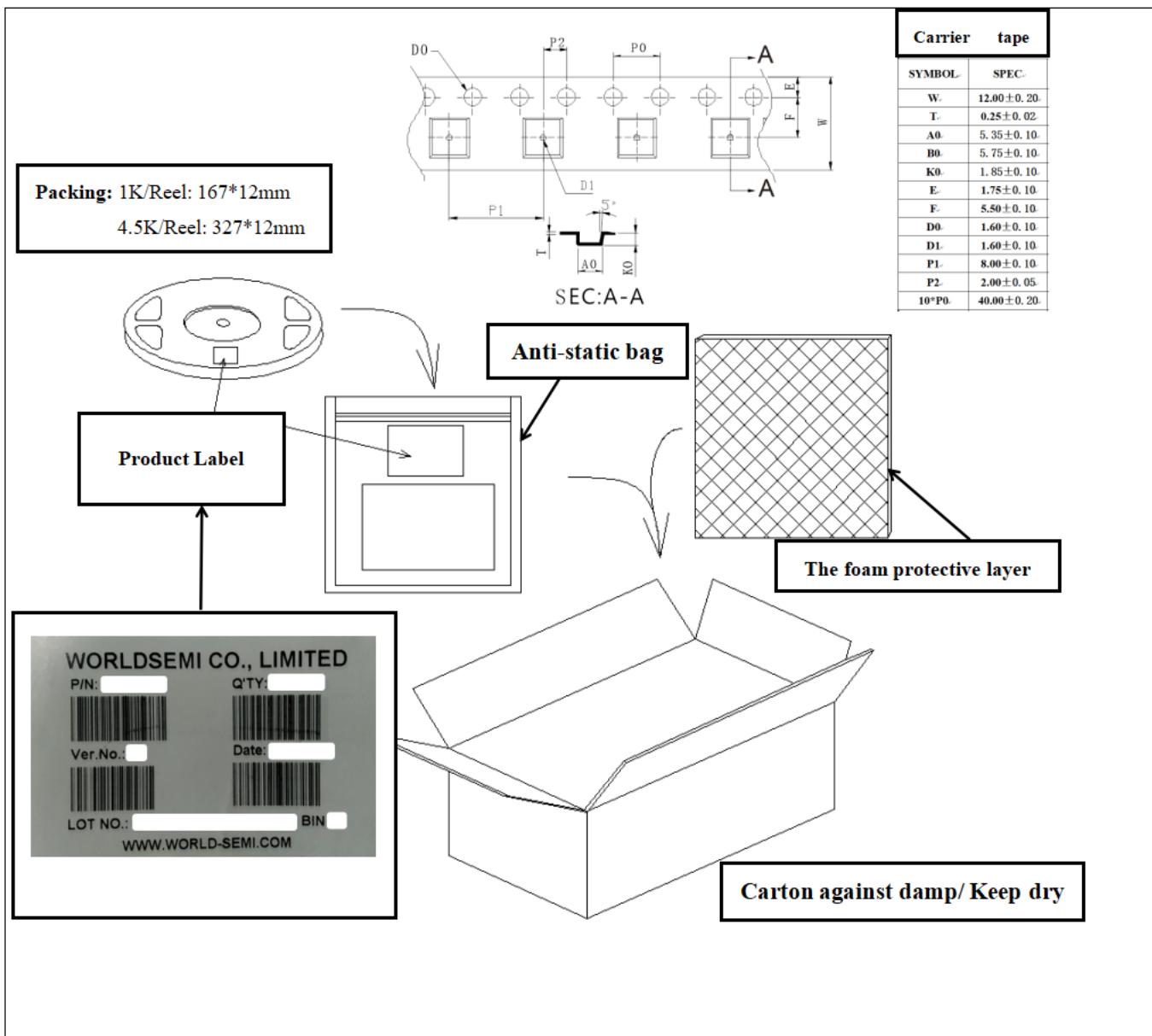


WORLDSEMI

## Packing Standard

# WS2813B-RGBW-V1

Intelligent control LED  
integrated light source





## WORLDSEMI 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        |
| <b>LEVEL5a</b> | <b>24 Hours</b>              | <b>≤30°C/60%RH</b> |
| LEVEL6         | Take-out and Use immediately | ≤30°C/60%RH        |



2.3.1 It is recommended that opening the Vacuum plastic bag before SMT, and put the whole reel into the oven for dehumidification and drying (**Bake at 70 ~ 75°C  $\cong$  24H**);

2.3.2 From the led taken out of the oven to the completion of high temperature welding (including multiple reflow welding, tin immersion, wave soldering, heating maintenance and other high temperature operations/operations), the time period shall be controlled **within 24Hours** (Under condition of **T<30°C, RH<60%**);

2.3.3 After the LED paste is printed on the PCBA, SMT process should be completed as soon as possible, **it is recommended not to exceed 1H**;

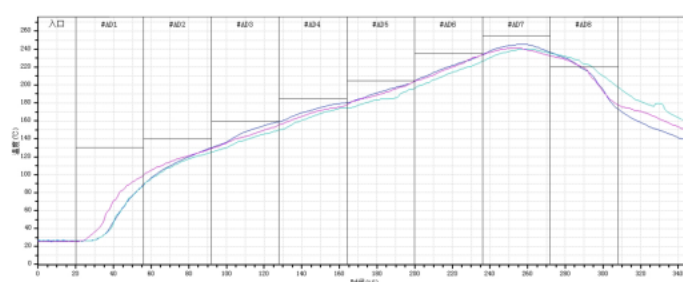
2.3.4 Bulk material LED, such as production surplus, machine material, maintenance material, can not be used directly if exposed to the air for a long time. It is recommended to be dehumidified and dried before being used.

**Whole reel baking: 70 ~ 75°C\*  $\cong$  24H or bulk led baking: 120°C\* 4H.**

### 3. SMT Reflow

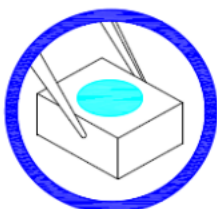
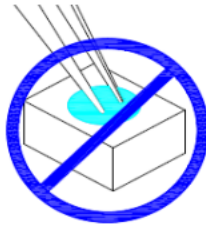
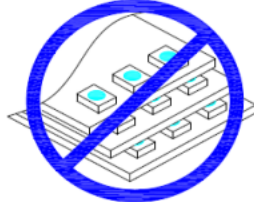
Refer to the parameters listed below, the experimental results prove that the TOP SMD LED meets the JEDEC J-STD-020C standards. As a general guideline, it is recommended to follow the SMT reflow temperature curve recommended by the solder paste manufacturer.

| Curve Description                         | Lead-free |
|-------------------------------------------|-----------|
| 30°C ~ 150°C preheating slope             | 1~4 °C/s  |
| 30°C ~ 150°C preheating time              | 60~120 s  |
| 150°C to 200°C constant temperature slope | 0~3 °C/s  |
| 150°C ~ 200°C constant temperature time   | 60~120 s  |
| LIQUID REGION temperature (TL)            | 217°C     |
| Peak Temperature (Tp)                     | 245°C     |
| Reflow slopeTime (tp)                     | 0~3 °C/s  |
| Reflow soldering time                     | 45~90 s   |
| Cooling Rate                              | -4~0 °C/s |
| Room Temperature to Peak Holding Time     | <6 min    |



Remarks: 1. All the above temperatures refer to the temperatures measured on the surface of the package body

## 4. 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

| Version № | Status Bar | Modify Content Summary                                                                                                      | Date     | Reviser       | Approved    |
|-----------|------------|-----------------------------------------------------------------------------------------------------------------------------|----------|---------------|-------------|
| V1.0      | N          | New                                                                                                                         | 20260331 | He WenBin     | Yin HuaPing |
| V1.1      | M          | Modify the description of data transmission time                                                                            | 20260608 | He WenBin     | Yin HuaPing |
| V1.2      | M          | Update the logo;<br>Optimize the application circuit;<br>Add a description of "signal transmission rate" and recommend pads | 20260717 | Chen YongZhao | Yin HuaPing |
| V1.3      | M          | Format Adjustment                                                                                                           | 20260730 | Chen YongZhao | Yin HuaPing |
| V1.4      | M          | Change P/N to WS2813B-RGBW-V1                                                                                               | 20260828 | Chen YongZhao | Yin HuaPing |
|           |            |                                                                                                                             |          |               |             |
|           |            |                                                                                                                             |          |               |             |

## Remarks:

1. Initial version: V1.0; Parameter added or modified, version number plus "0.1", for example: V1.0→ V1.1
2. Major version design or more parameters modified, version number plus "1.0", for example: V1.0→V2.0
3. With no version number attached to part number
4. Status bar: N--New, A--Add, M--Modify, D--Delete