



**BRIGHTTEK**  
**BRIGHTTEK (EUROPE) LIMITED**

*Brighten up The World With LED!*



ISO/TS 16949:2009



BS EN ISO 14001:2004



QC 080000 IECQ HSPM

## PRODUCT DATASHEET

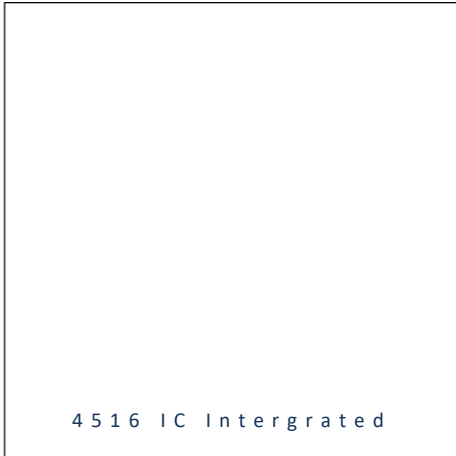


- ▶ PLCC Side View SMD with IC
- ▶ 4516ICSV 1.6t Series
- ▶ Red/Green/Blue

NOM67S11ICSV



Release Date: 11 August 2024 Version: A1.1



### 4516 IC-Integrated



#### FEATURES:

- **Package:** PLCC Side View STD Package with Integrated IC
- **Forward Current:** 20mA/Channel
- **Forward Voltage (typ.):** +4.5~+5.5V
- **Luminous Intensity (typ.):** 350/1500/240mcd\*
- **Colour:** Red/Green/Blue
- **Dominant Wavelength:** 633/527/457nm
- **Viewing angle:** 120°
- **Materials:**
  - Resin: Silicone (Water Diffused)
- **Operating Temperature:** -40~+85°C
- **Storage Temperature:** -40~+85°C
- **IC Feature:** One Pixel contains R, G, and B colour each can achieve 256 level brightness greyscales, which form 16,777,216 combination colours. Serial data transmission signal by DATA & CLK two lines. Support sleep/wake-up mode. In sleep mode current lower than 5µA.
- **Soldering methods:** IR Reflow soldering
- **Preconditioning:** acc. to JEDEC Level 2a
- **Packing:** 12mm tape with max.2000pcs/reel, ø180mm (7")

\* in order of Red/Green/Blue

#### APPLICATIONS:

- Automotive Interior Light
- Telecommunication
- Home Appliance
- Decoration Lighting
- Full Colour LED Strip
- Gaming Device



Support sleep/wake up mode. In sleep mode the LED's current was lower than 5µA

## CHARACTERISTICS:

### Absolute Maximum Characteristics (Ta=25°C)

| Parameter                                | Symbol             | Ratings     | Unit |
|--|--------------------|-------------|------|
| IC Power Supply Voltage                  | V <sub>DD</sub>    | Max. 6.5    | V    |
| Rate of Data Signal                      | F <sub>CLK</sub>   | 15          | MHz  |
| Max. LED Output Current                  | I <sub>OMAX</sub>  | 20/channel  | mA   |
| Power Dissipation                        | P <sub>D</sub>     | Max. 400    | mW   |
| Operating Temperature                    | T <sub>OPR</sub>   | -40~+85     | °C   |
| Storage Temperature                      | T <sub>STG</sub>   | -40~+85     | °C   |
| Electrostatic Discharge (HBM)            | ESD                | 6000        | V    |
| Thermal Resistance Junction/Solder Point | R <sub>THJ-S</sub> | 65/110/100* | °C/W |
| Soldering Temperature (10s)              | T <sub>SD</sub>    | 260         | °C   |

### Electrical & Optical Characteristics (Ta=25°C, V<sub>DD</sub>=5V)

| Parameter           | Symbol            | Values         |      |      | Unit | Test Condition |                     |
|---------------------|-------------------|----------------|------|------|------|----------------|---------------------|
|                     |                   | Min.           | Typ. | Max. |      |                |                     |
| Luminous Intensity  | R                 | I <sub>v</sub> | 280  | 350  | 440  | mcd            | V <sub>DD</sub> =5V |
|                     | G                 |                | 1200 | 1500 | 1900 |                |                     |
|                     | B                 |                | 190  | 240  | 300  |                |                     |
| Forward Voltage     | V <sub>F</sub>    |                | 4.5  | ---  | 5.5  | V              | ---                 |
| Dominant Wavelength | R                 | λ <sub>d</sub> | 630  | ---  | 636  | nm             | V <sub>DD</sub> =5V |
|                     | G                 |                | 524  | ---  | 529  |                |                     |
|                     | B                 |                | 455  | ---  | 460  |                |                     |
| Viewing Angle       | 2θ <sub>1/2</sub> |                | ---  | 120  | ---  | deg            | V <sub>DD</sub> =5V |

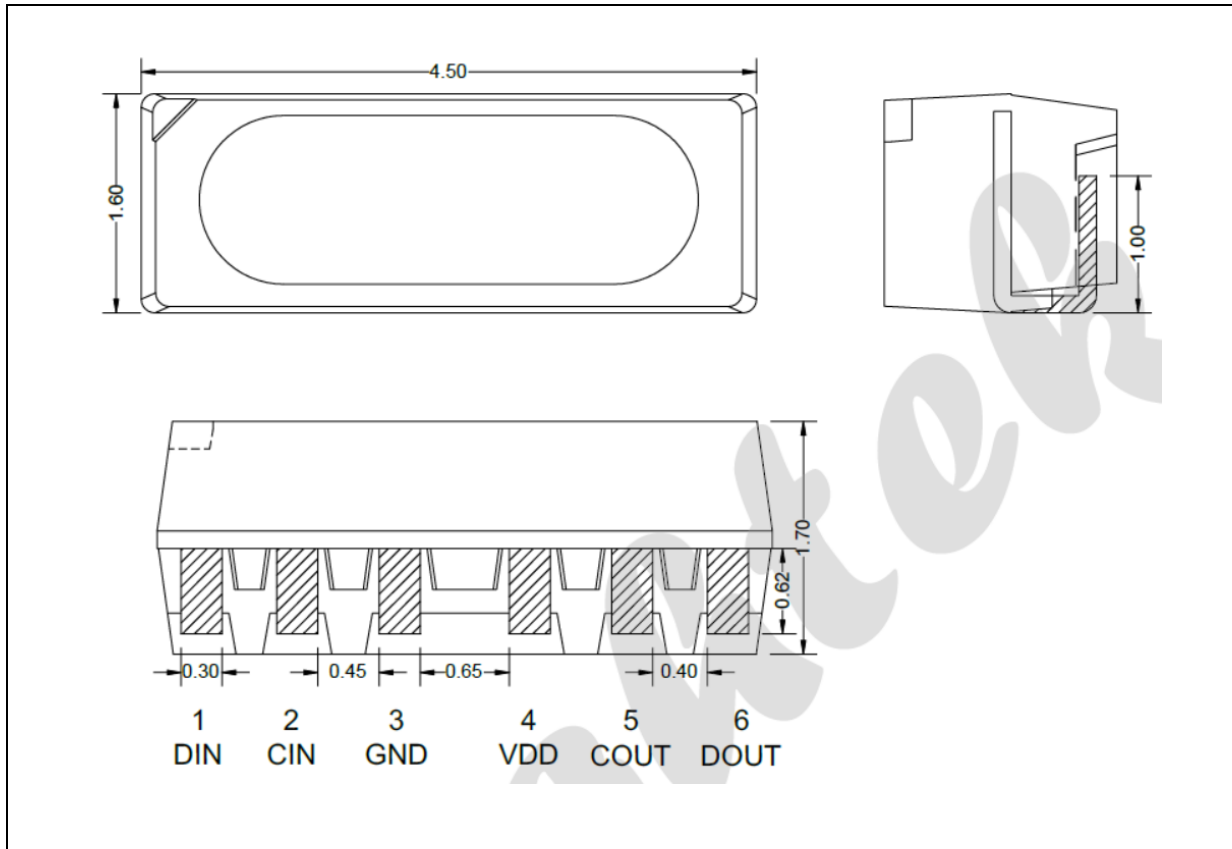
- Luminous intensity is measured with a light sensor and filter combination that approximates the CIE eye-response curve.
- 2θ<sub>1/2</sub> is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
- The dominant wavelength, λ<sub>d</sub> is derived from CIE chromaticity diagram and represents the single wavelength which defines the color of the device. Peak emission wavelength tolerance is ±1nm.

Electrical & Optical Characteristics (Ta=25°C, V<sub>DD</sub>=5V)

| Parameter              | Symbol             | Values |      |                      | Unit | Test Condition        |
|------------------------|--------------------|--------|------|----------------------|------|-----------------------|
|                        |                    | Min.   | Typ. | Max.                 |      |                       |
| Supply Voltage         | V <sub>DD</sub>    | 4.5    | 5.0  | 5.5                  | V    | ---                   |
| Input Voltage Level    | V <sub>IH</sub>    | 2.7    | ---  | V <sub>DD</sub> +0.4 | V    | ---                   |
|                        | V <sub>IL</sub>    | -0.4   | ---  | 1.0                  | V    |                       |
| Clock High Level Width | T <sub>CLKH</sub>  | 30     | ---  | ---                  | ns   | ---                   |
| Clock Low Level Width  | T <sub>CLKL</sub>  | 30     | ---  | ---                  | ns   | ---                   |
| Data Set-Up Time       | T <sub>SETUP</sub> | 10     | ---  | ---                  | ns   | ---                   |
| Data Hold Time         | T <sub>HOLD</sub>  | 5      | ---  | ---                  | ns   | ---                   |
| Working Current (IC)   | I <sub>DD</sub>    | ---    | ---  | 2                    | mA   | I <sub>out</sub> =OFF |
| Static Current         | I <sub>sleep</sub> | ---    | ---  | 5                    | μA   | Sleep Mode            |
| Rate of Data Signal    | F <sub>CLK</sub>   | 1      | ---  | 15                   | MHz  | ---                   |

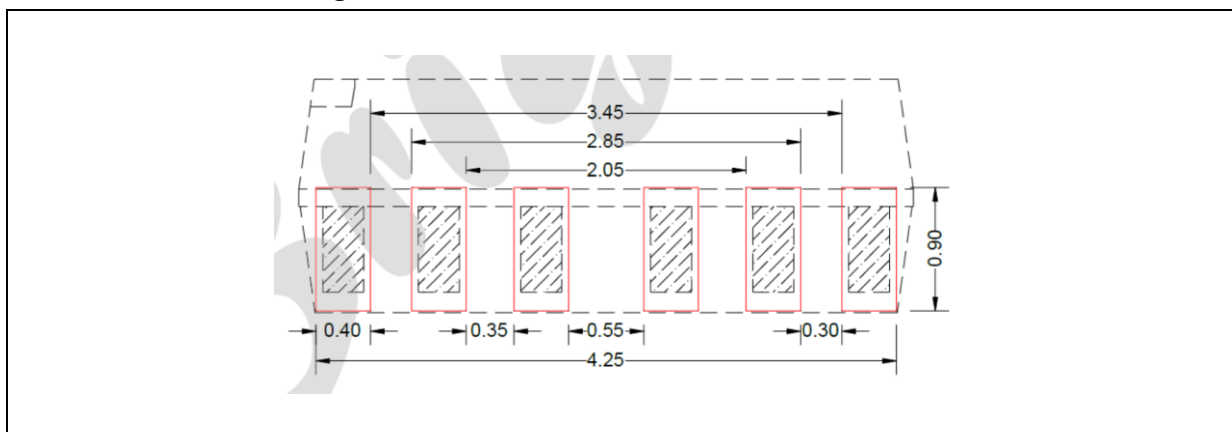
## OUTLINE DIMENSION:

Package Dimension:



1. All dimensions are in millimetre (mm).
2. Tolerance  $\pm 0.1\text{mm}$ , unless otherwise noted.

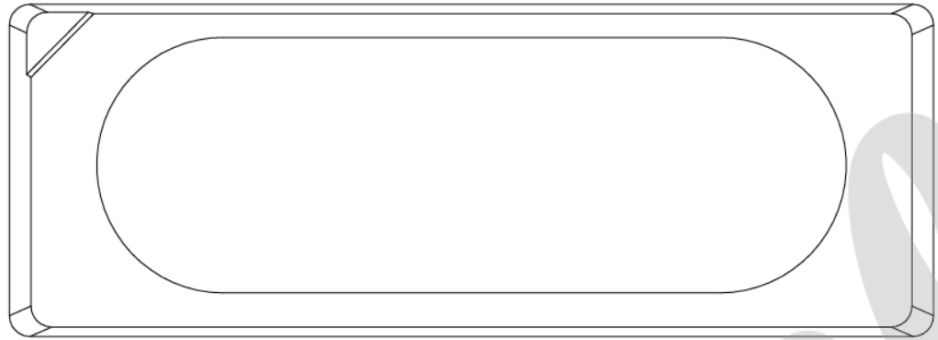
Recommended Soldering Pad Dimension:



1. Dimensions are in millimetre (mm).
2. Tolerance  $\pm 0.1\text{mm}$  with angle tolerance  $\pm 0.5^\circ$ .

**PIN CONFIGURATION:**


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1      2      3      4      5      6  
 DIN   CIN   GND   VDD   COUT   DOUT

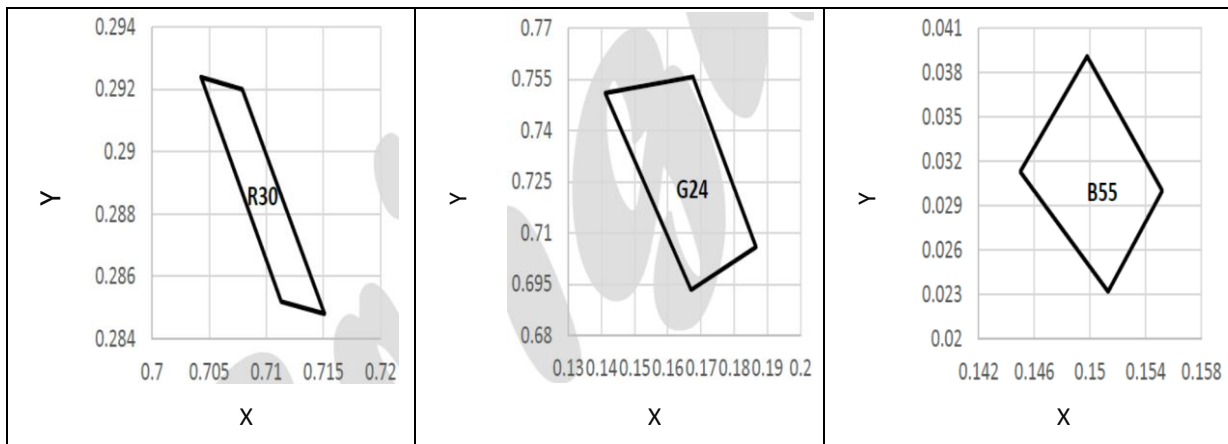
| No. | Symbol | Function Description |
|-----|--------|----------------------|
| 1   | DI     | Data Input           |
| 2   | CI     | Clock Input          |
| 3   | GND    | Ground               |
| 4   | VDD    | Supply Voltage       |
| 5   | CO     | Clock Output         |
| 6   | DO     | Data Output          |

## BINNING GROUPS:

Luminous Intensity Classifications ( $V_{DD}=5V$ ,  $I_F=20mA$ ):

|       | Code | Min. | Max. | Unit |
|-------|------|------|------|------|
| Red   | 1    | 280  | 350  | mcd  |
|       | 2    | 350  | 440  |      |
| Green | 1    | 1200 | 1500 | mcd  |
|       | 2    | 1500 | 1900 |      |
| Blue  | 1    | 190  | 240  | mcd  |
|       | 2    | 240  | 300  |      |

Chromaticity Coordinate Classifications ( $V_{DD}=5V$ ,  $I_F=20mA$ ):

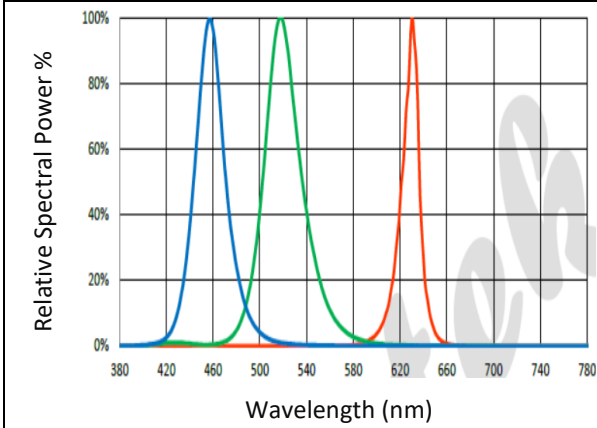


|     | 1      |        | 2      |        | 3      |        | 4      |        |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|
|     | X      | Y      | X      | Y      | X      | Y      | X      | Y      |
| R30 | 0.7043 | 0.2924 | 0.7079 | 0.2920 | 0.7151 | 0.2848 | 0.7113 | 0.2852 |
| G24 | 0.1676 | 0.7558 | 0.1411 | 0.7510 | 0.1670 | 0.6934 | 0.1866 | 0.7059 |
| B55 | 0.1450 | 0.0313 | 0.1513 | 0.0232 | 0.1552 | 0.0300 | 0.1498 | 0.0391 |

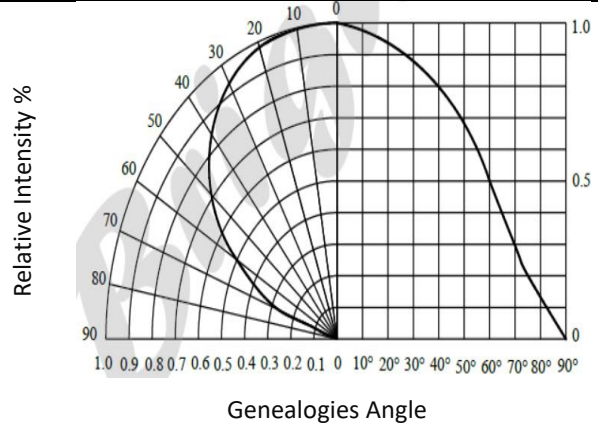
1. Tolerance of X/Y:  $\pm 0.005$ .

## ELECTRO-OPTICAL CHARACTERISTICS (Full PWM):

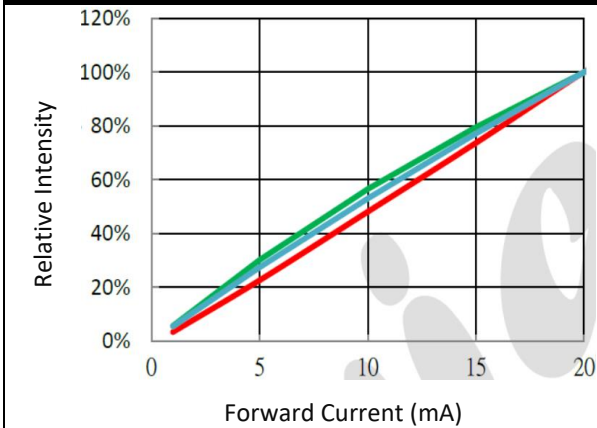
Relative Spectral Power v.s. Wavelength



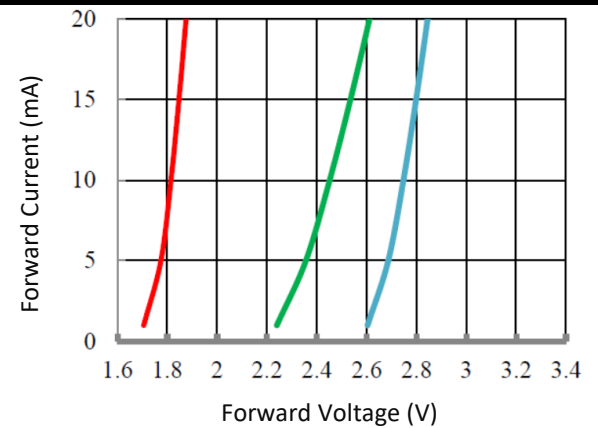
Directive Radiation



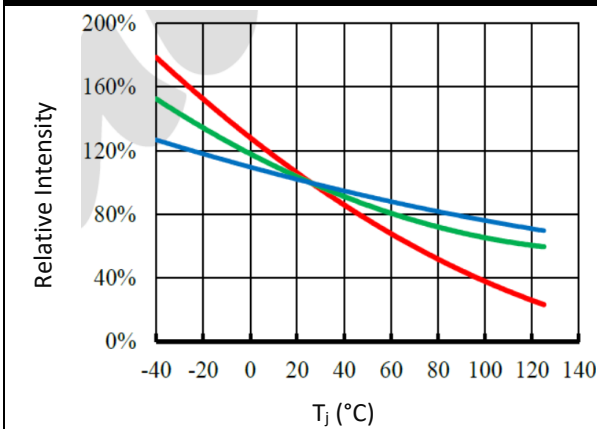
Relative Intensity v.s. Forward Current



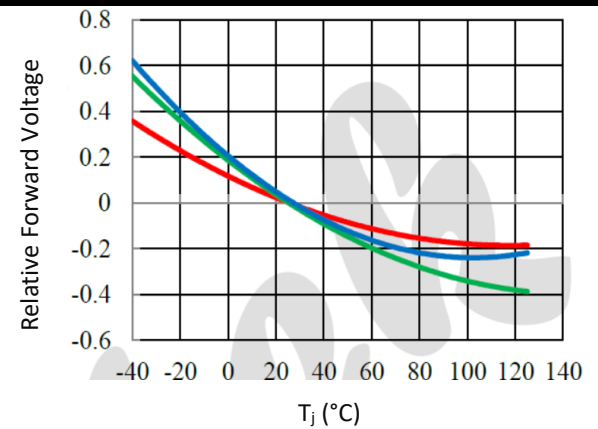
Forward Current v.s. Forward Voltage



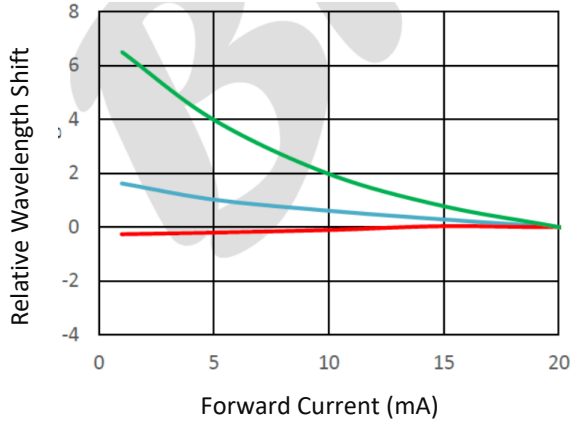
Relative Intensity v.s. Temperature



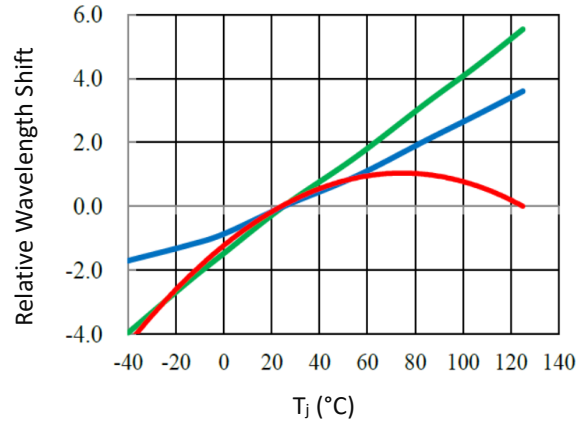
Relative Forward Voltage v.s. Temperature



Wavelength Shift v.s. Forward Current



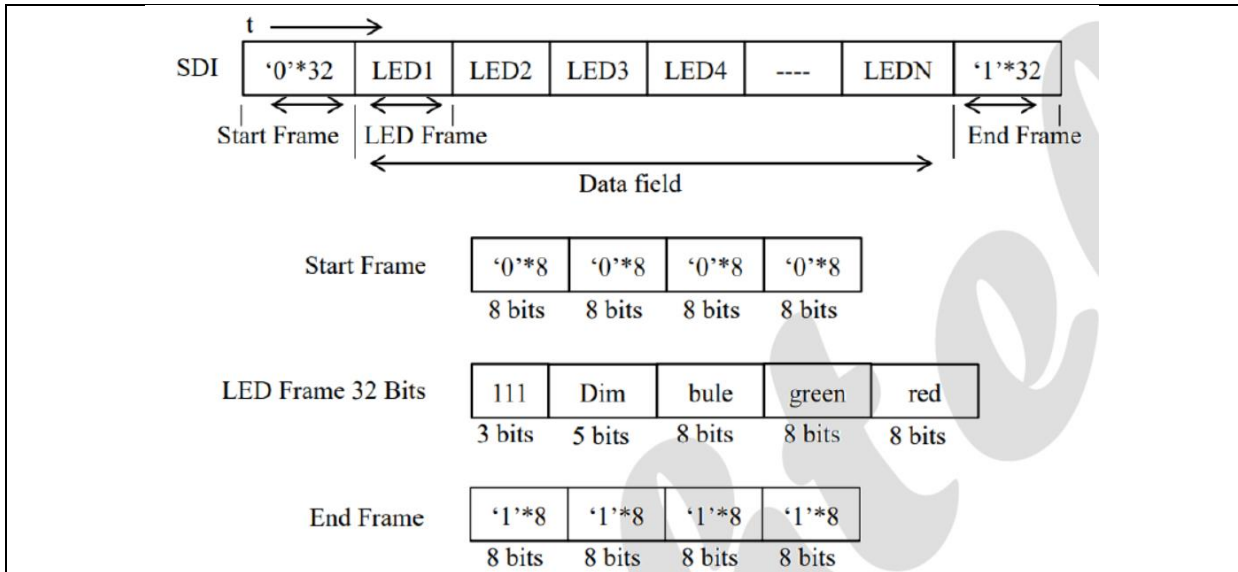
Wavelength Shift v.s. Temperature





## Function Description:

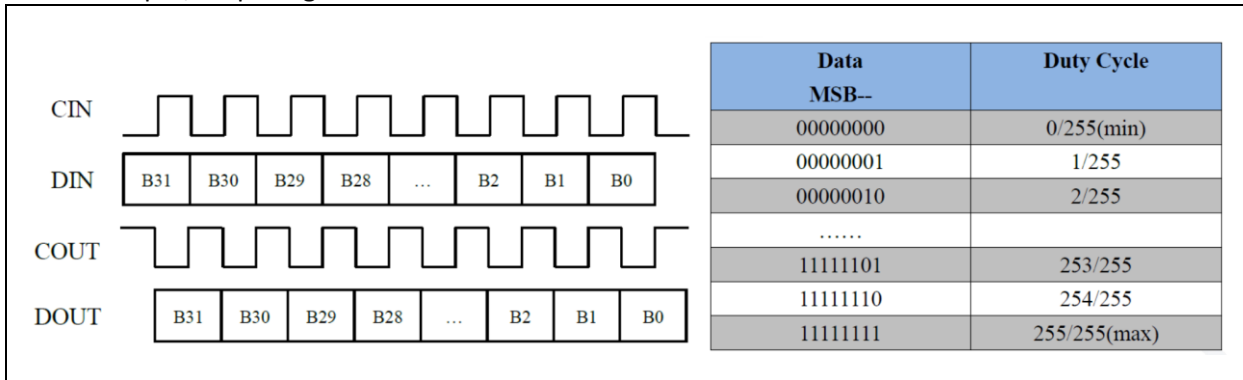
### 1. Tandem N-LED:



### 2. 5-Bit (level 32) brightness adjustment (simultaneous control of OUTR/OUTG/OUTB three port current):

| DATA<br>MSB ↔ LSB | Driving Current |
|-------------------|-----------------|
| 00000             | 0/31            |
| 00001             | 1/31            |
| 00010             | 2/31            |
| ---               | ---             |
| 11110             | 30/31           |
| 11111             | 31/31 (max)     |

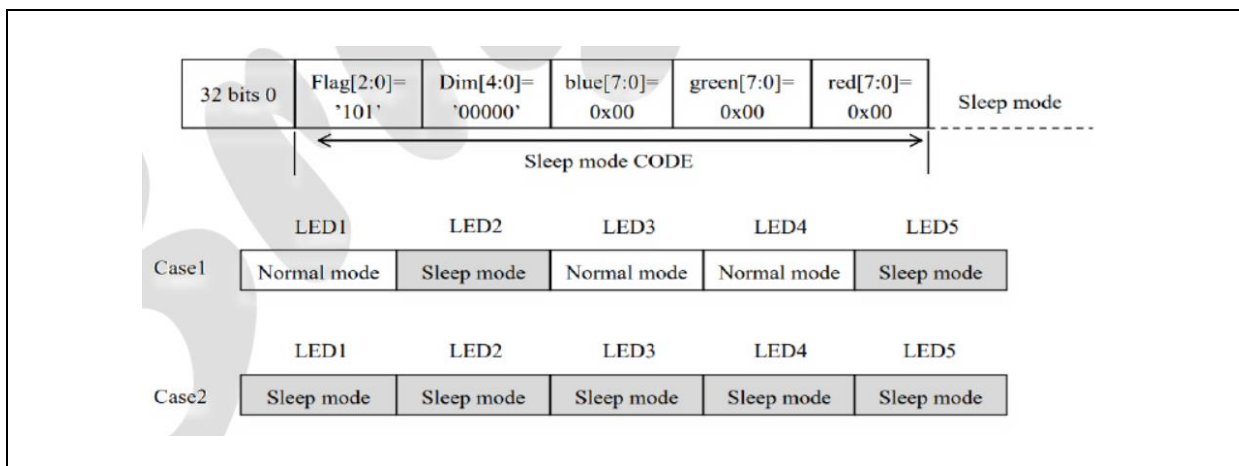
### 3. PWM input/output signal relations:



#### 4. Sleep and power saving mode:

LED supports sleep/wake-up modes for power-saving purposes. After the IC receives 24-bit 0's BGR data (that is B[7:0]=8h00, G[7:0]=8h00, R[7:0]=8h00), in the meantime, both of the data in 3-bits FLAG and 5-bits DIMMING is 8h'A0' (that is FLAG[2:0] =3b101 and DIMMING [4:0] =5b00000), the IC will enter sleep mode, its current is about 1uA.

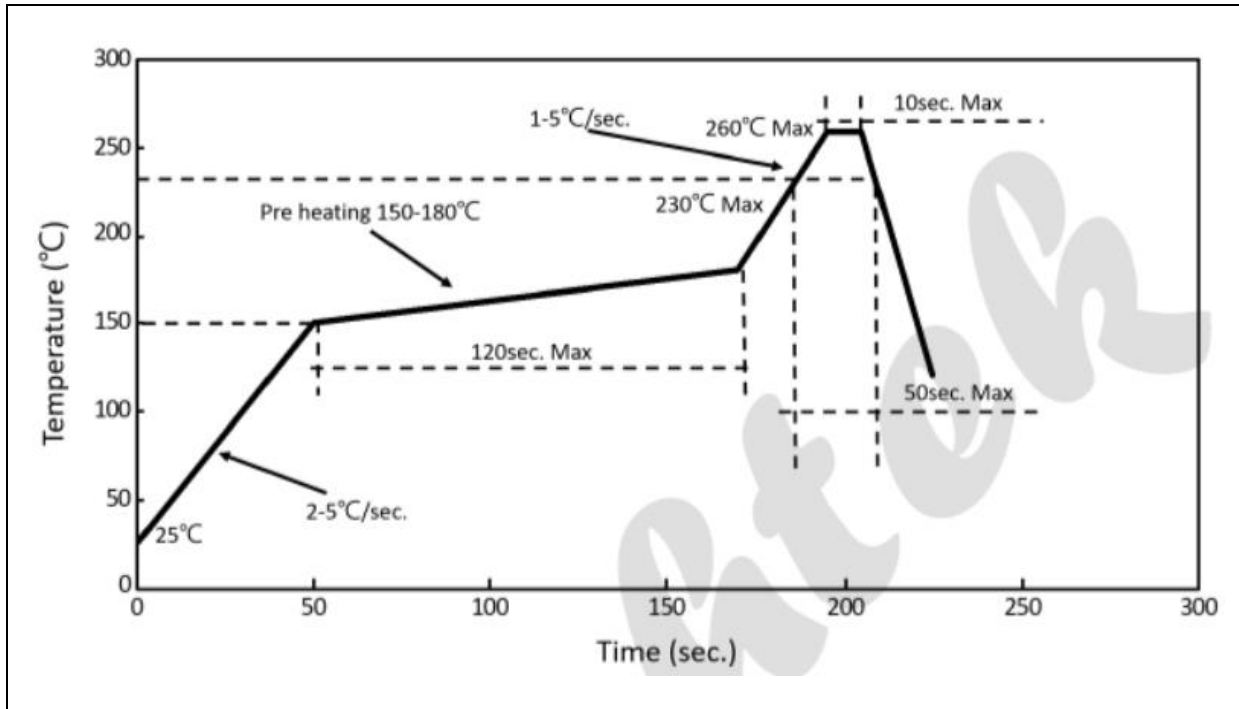
The IC will wake up from sleep mode once receiving the new data with the data of Flag[2:0], DIMMING [4:0] is not 8h"A0"; after wake-up, all sleeping circuits in IC return to normal working mode within1ms. Since it takes 1ms for a sleeping IC returning to normal function mode, it is recommended for a host to wait for 1ms to send display data and command after issuing a wake-up command.



In case 1, while lamp2 is under sleep mode, in the following data transfer process, the state of lamp 2 will be not changed as long as the 32 bits data for lamp 2 is received with data of FLAG[2:0], DIMMING[4:0] being 8h"A0". It means lamp2 will keep in sleep mode as well. In this situation, lamp2 can pass through the remaining data to lamp 3 (32bits) to change the display data of lamp 3. In other words, the sleeping chip is able to pass the data to the next chips.

## RECOMMENDED SOLDERING PROFILE:

Lead-free Solder IR Reflow:

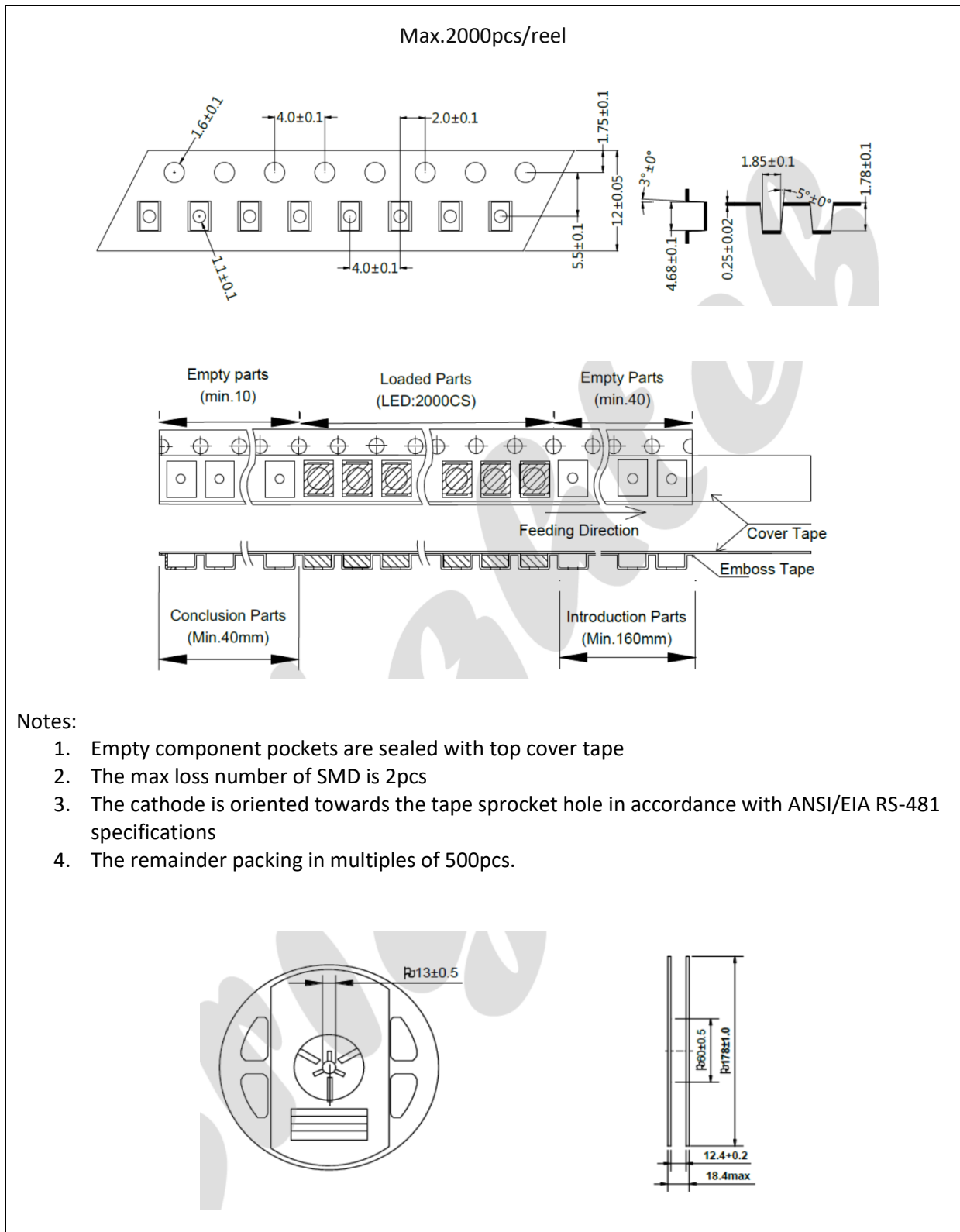


Note:

1. We recommend the reflow temperature 240°C ( $\pm 5^\circ\text{C}$ ). The maximum soldering temperature should be limited to 260°C.
2. Maximum reflow soldering: 3 times.
3. Before, during, and after soldering, should not apply stress on the components and PCB board.

## PACKING SPECIFICATION:

Reel Dimension:



## PRECAUTIONS OF USE:

### Storage:

It is recommended to store the products in the following conditions:

- Humidity: 60% R.H. Max.
- Temperature: 5°C~30°C (41°F ~86°F).

Shelf life in sealed bag: 12 months at 5°C~30°C and <60% R.H.

Once the package is opened, the products should be used within 4 weeks. Otherwise, they should be kept in a damp-proof box with desiccating agent <10% R.H. and apply baking.

### Over-Current Proof:

Must apply resistors for protection otherwise slight voltage shift will cause big current change and burn-out will happen.

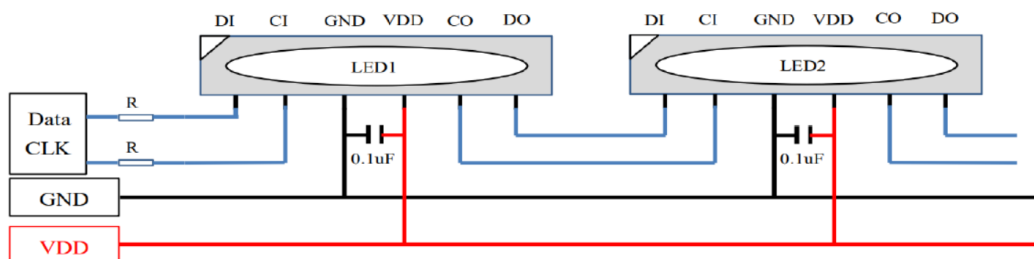
### Baking:

It is recommended to bake the LED before soldering if the pack has been unsealed for longer than 24hrs. The suggested baking conditions are as followings:

- 60±3°C x 6hrs and <5%RH, taped / reel package.

It's normal to see slight color fading of carrier (light yellow) after baking in process.

### Testing Circuit:



When the first LED is connected to the MCU, a resistance R is needed in series between its signal input line and the MCU. The size of R depends on the number of cascade beads. The more cascades, the smaller resistance R is used. It is generally recommended that the value be between 100-1K. Usually the recommended value is around 300R. In order to make the LEDs work more stably, a parallel capacitor is needed between VDD and GND of each.

### Cleaning:

Use alcohol-based cleaning solvents such as isopropyl alcohol to clean the LED carrier / package. Avoid putting any stress force directly on to the LED lens.

### ESD (Electrostatic Discharge):

Static Electricity or power surge will damage the LED. Use of a conductive wrist band or anti-electrostatic glove is recommended when handling the LED all time. All devices, equipment, machinery, work tables, and storage racks must be properly grounded.

**REVISION RECORD:**

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| Version | Date       | Summary of Revision             |
|---------|------------|---------------------------------|
| A1.0    | 17/11/2022 | Datasheet set-up.               |
| A1.1    | 11/08/2024 | Update automotive certificates. |