BRIGHTEK

BRIGHTEK (EUROPE) LIMITED

Brighten Up The World With LED !

ISO/TS 16949:2009 BS EN ISO 14001:2004 QC 080000 IECQ HSPM

# PRODUCT DATASHEET

ATTENTION
OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC SENSITIVE DEVICES

- PLCC6 with IC
- 1212 IC 0.42t
- Red/Green/Blue

Release Date: 31 December 2024 Version: A1.1

# N0M66S12IC

1212 IC Integrated

## 1212 IC-Integrated

RoHS Compliant

AUTOMOTIVE AEC-Q100 AUTOMOTIVE AEC-Q102

## FEATURES:

- **Package:** PLCC 6-Pins EIA STD Package with Integrated IC
- **Forward Current:** 3.63/3.63/3.63mA*
- **Luminous Intensity (typ.):** 460mcd mixed white
- **Colour:** Red/Green/Blue
- **IC Feature:**
  - ✓ Single data line employing a communication protocol that utilizes zero-return codes.
  - ✓ Built-in high-precision and high-stability oscillator. The serial data frequency is adjustable up to 1300kHz.
  - ✓ Data output re-shaping for accurate and long-distance transmission.
  - ✓ Built-in overvoltage protection.
  - ✓ 2 data input ports to allow breakpoint jumping.
- **Pixel:** Supports 65536 levels (16 bits) grayscale adjustment of each R/G/B single channel. Maximum 12mA of constant current output for each R/G/B channel with 5 bits dimming level.
- **Soldering methods:** IR Reflow soldering
- **MSL Level:** acc. to JEDEC Level 3
- **Packing:** 8mm tape with max.4000pcs/reel, ø180mm (7'')

* in order of Red/Green/Blue

## APPLICATIONS:

- Automotive Ambient Lightings
- Telecommunication
- Status Indicator
- Home Appliance
- Decoration Lighting
- Full Colour LED Strip
- Gaming Device
- Guardrail Tube
- Indoor Display Screen

## CHARACTERISTICS:

### Absolute Maximum Characteristics ($T_a$=25°C)

| Parameter | Symbol | Ratings | Unit |
|---|---|---|---|
| Forward Current | $I_F$ | 12 | mA |
| IC Power Supply Voltage | $V_{DD}$ | 4.0~7.5 | V |
| R/G/B Output Port Withstand Voltage | $V_{ds}$ | max. 9 | V |
| IC Input Voltage | $V_I$ | -0.5~+5.5 | V |
| Operating Temperature | $T_{OPR}$ | -40~+105 | °C |
| Storage Temperature | $T_{STG}$ | -40~+105 | °C |
| Junction Temperature | Tj | 125 | °C |
| Soldering Temperature | $T_{SD}$ | 260 | °C |
| ESD Withstand Voltage acc. ANSI/ESDA/JEDEC JS-001 | ESD | 4 | kV |

### Electrical & Optical Characteristics ($T_a$=25°C)

| Parameter | Symbol | Values | | | Unit | Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input Voltage | $V_{DD}$ | 4.5 | 5.0 | 5.5 | V | --- |
| R/G/B Output Drive Current | $I_O$ | 0.71 | 3.63 | 12 | mA | $V_{ds}$=1V |
| Input Voltage Level | $V_{IH}$ | 0.7$V_{DD}$ | --- | --- | V | --- |
| | $V_{IL}$ | --- | --- | 0.3$V_{DD}$ | V | --- |
| Current Deviation | $dI_O$ | --- | ±3 | ±5 | % | $V_{ds}$=1V; $I_O$=12mA |
| Dynamic IC Consumption | $I_{dd.dyn}$ | --- | --- | 1 | mA | Data input, light off |
| Quiescent Current | $I_{DD}$ | --- | --- | 5 | uA | No data in, light off |

## Electrical & Optical Characteristics ($T_a$=25°C, $V_{DD}$=5V)

| Parameter | | Symbol | Values | | | Unit | Test Condition |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| Luminous Intensity | R | $I_V$ | --- | 70 | --- | mcd | $I_F$=3.63mA |
| | G | | --- | 310 | --- | | $I_F$=3.63mA |
| | B | | --- | 65 | --- | | $I_F$=3.63mA |
| | W | | 250 | 460 | 630 | | $I_F$=10.89mA |
| Dominant Wavelength | R | $\lambda_D$ | --- | 624 | --- | nm | $I_F$=3.63mA |
| | G | | --- | 528 | --- | | $I_F$=3.63mA |
| | B | | --- | 469 | --- | | $I_F$=3.63mA |
| Colour Coordinate | X | --- | --- | 0.2200 | --- | --- | $I_F$=10.89mA |
| | Y | | --- | 0.2783 | --- | --- | |
| Viewing Angle | | $2\theta_{1/2}$ | --- | 120 | --- | deg | $I_F$=10.89mA |

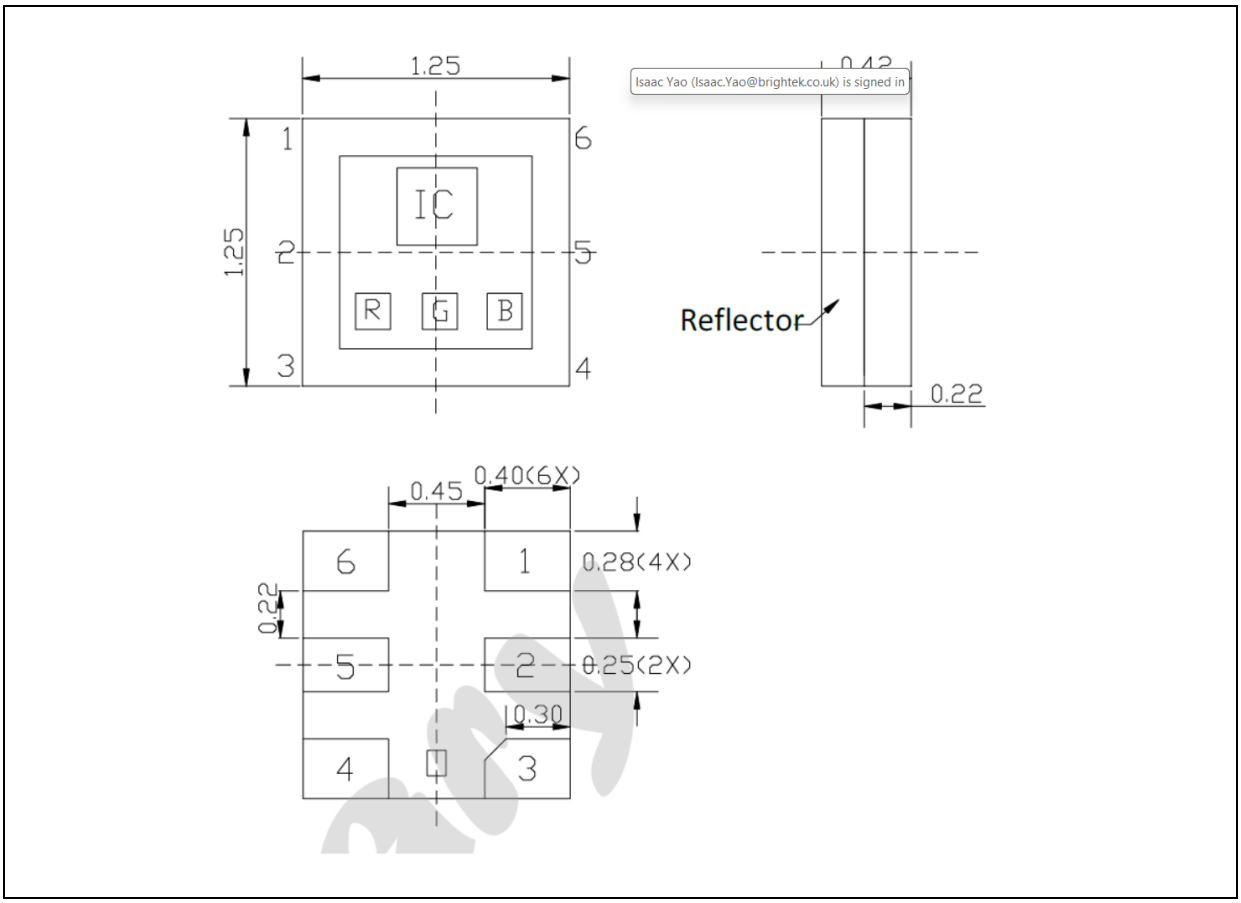
1. Luminous Intensity: ±10%mcd, Dominant Wavelength: ±1.0nm, Color Coordinate: ±0.005

## Switching Characteristics ($T_a$=25°C)

| Parameter | Symbol | Values | | | Unit | Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Rate of Data Signal | $F_{DIN}$ | --- | 1 | 1.3 | MHz | $V_{DD}$=5V |
| Oscillation Frequency | $F_{OSC}$ | --- | 8 | --- | MHz | $V_{DD}$=5V |
| PWM Frequency | $F_{PWM}$ | --- | 4 | --- | KHZ | --- |
| Output Current Conversion Time | $T_r$ | --- | --- | 60 | ns | $V_{ds}$=1.5V; $I_O$=12mA |
| | $T_f$ | --- | --- | 60 | ns | |
| Transmission Delay Time | $T_{pzl}$ | --- | --- | 200 | ns | $D_{IN}$ → $D_{OUT}$ |

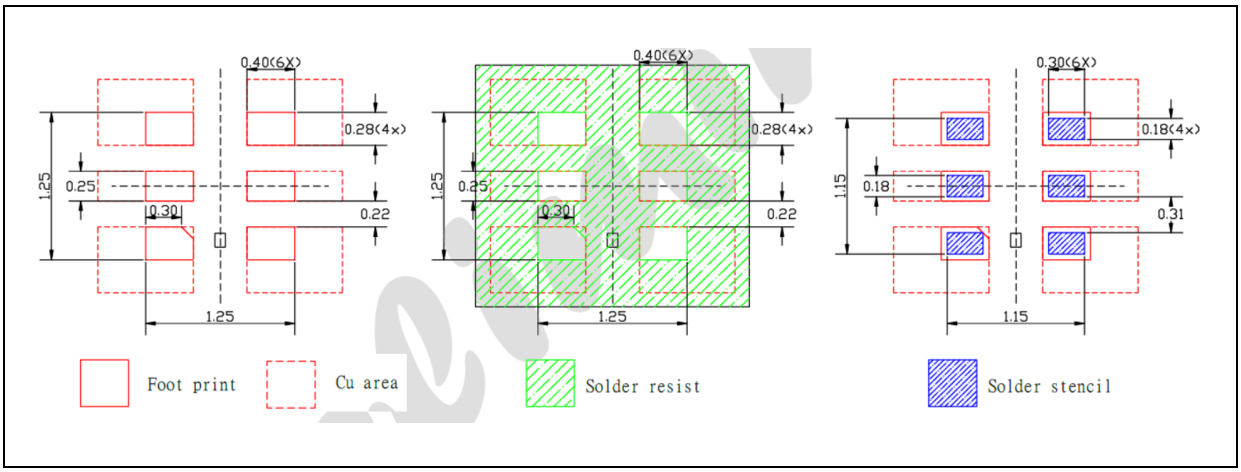
## OUTLINE DIMENSION:

Package Dimension:



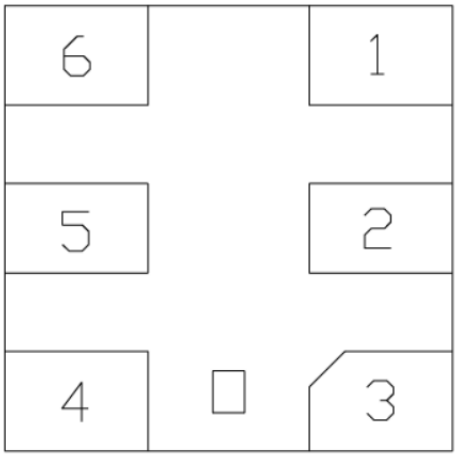

1. All dimensions are in millimetre (mm).
2. Tolerance ±0.1mm, unless otherwise noted.

Recommended Soldering Pad Dimension:




1. Dimensions are in millimetre (mm).
2. Tolerance ±0.1mm with angle tolerance ±0.5°.

## PIN CONFIGURATION:



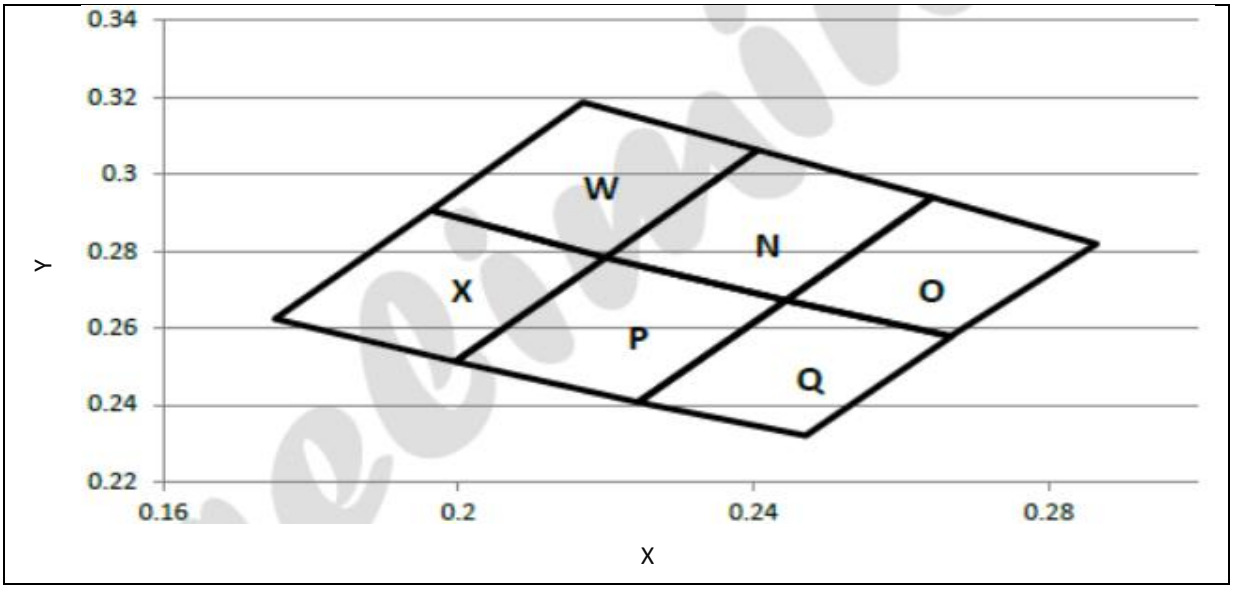

| No. | Symbol | Function Description |
|---|---|---|
| 1 | DIN2 | Control Data Signal Input 2 |
| 2 | DIN1 | Control Data Signal Input 1 |
| 3 | VDD | Power Supply Voltage |
| 4 | DOUT1 | Control Data Signal Output1 |
| 5 | NC | Not Connected |
| 6 | GND | Ground |

## BINNING GROUPS:

Luminous Intensity Classifications ($I_F$=10.89mA, $V_{DD}$=5V, $T_a$=25°C):

| Code | Min. | Max. | Unit |
|---|---|---|---|
| 16 | 250 | 320 | mcd |
| 17 | 320 | 400 | |
| 18 | 400 | 500 | |
| 19 | 500 | 630 | |

## CIE CHROMATICITY DIAGRAM:



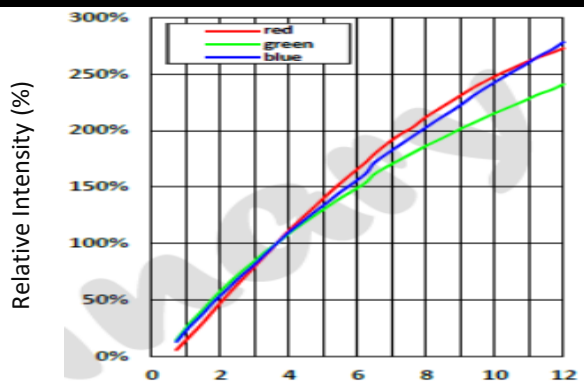

Chromaticity Coordinates Classifications:

| | 1 | | 2 | | 3 | | 4 | |
|---|---|---|---|---|---|---|---|---|
| | X | Y | X | Y | X | Y | X | Y |
| W | 0.1963 | 0.2907 | 0.2169 | 0.3188 | 0.2406 | 0.3064 | 0.2200 | 0.2783 |
| N | 0.2200 | 0.2783 | 0.2406 | 0.3064 | 0.2643 | 0.2940 | 0.2444 | 0.2672 |
| X | 0.1963 | 0.2907 | 0.1752 | 0.2624 | 0.1996 | 0.2513 | 0.2200 | 0.2783 |
| P | 0.2200 | 0.2783 | 0.1996 | 0.2513 | 0.2244 | 0.2407 | 0.2444 | 0.2672 |
| O | 0.2444 | 0.2672 | 0.2643 | 0.2940 | 0.2865 | 0.2819 | 0.2667 | 0.2578 |
| Q | 0.2444 | 0.2672 | 0.2244 | 0.2407 | 0.2471 | 0.2320 | 0.2669 | 0.2579 |

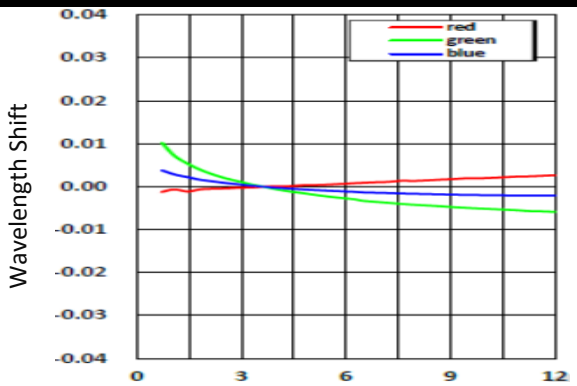
1. Tolerance Luminous Intensity: ±10%mcd, Color Coordinate: ±0.005

## ELECTRO-OPTICAL CHARACTERISTICS:

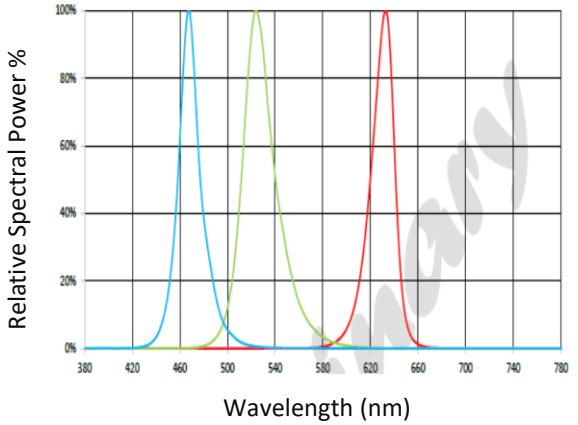
### Relative Luminous Intensity v.s. Forward Current



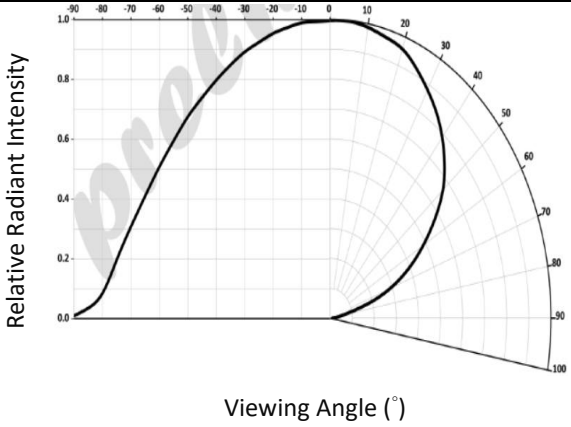

### Wavelength Shift v.s. Forward Current



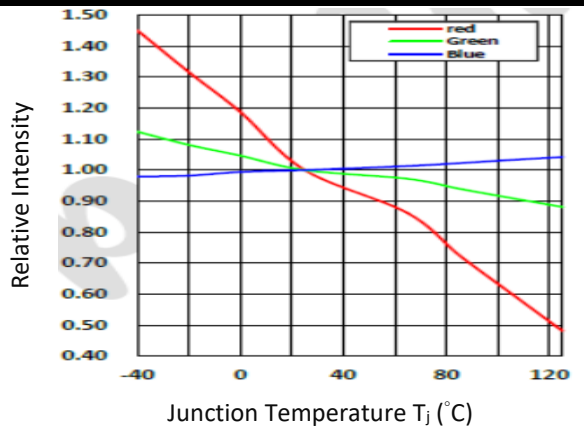

### Relative Spectral Power v.s. Wavelength



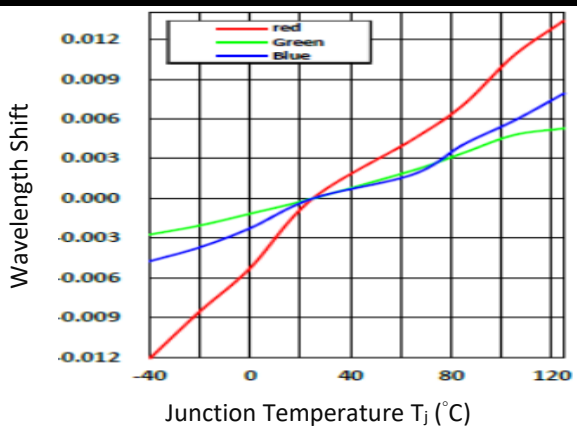

### Directive Radiation




### Relative Intensity v.s. Temperature




### Dominant Wavelength v.s. Temperature

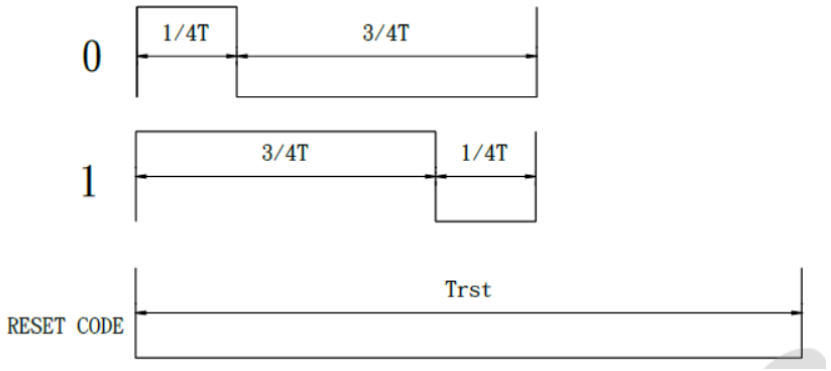


## Function Description:

1. Current Gain (Dimming Level) Regulation

| RGB Gain Setting | RGB Output（mA） | | |
|---|---|---|---|
| 0 | 0.71 | 10 | 6.47 |
| 1 | 1.07 | 11 | 6.83 |
| 2 | 1.46 | 12 | 7.22 |
| 3 | 1.81 | 13 | 7.60 |
| 4 | 2.18 | 14 | 7.96 |
| 5 | 2.55 | 15 | 8.34 |
| 6 | 2.94 | 16 | 8.73 |
| 7 | 3.30 | 17 | 9.08 |
| 8 | 3.63 | 18 | 9.40 |
| 9 | 3.98 | 19 | 9.77 |
| A | 4.36 | 1A | 10.15 |
| B | 4.74 | 1B | 10.54 |
| C | 5.11 | 1C | 10.90 |
| D | 5.48 | 1D | 11.27 |
| E | 5.87 | 1E | 11.67 |
| F | 6.24 | 1F | 12.00 |

2. Timing Wave Form:




3. Data Transfer Time:

| Item | Description | Typical | Tolerance |
|---|---|---|---|
| TOH | 0 code, high voltage time | 0.24μs | ±10% |
| TOL | 0 code, low voltage time | 0.48μs | ±10% |
| T1H | 1 code, high voltage time | 0.48μs | ±10% |
| T1L | 1 code, low voltage time | 0.24μs | ±10% |
| Trst | reset time, low voltage time | ≥80μs | - |

4. Composition of 48bit Data:

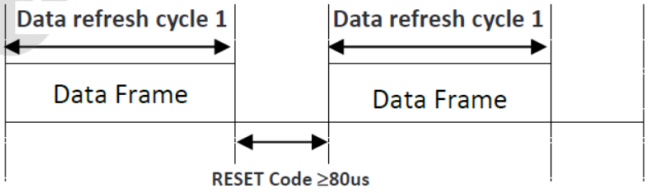
| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R15 | R14 | ... | R1 | R0 | G15 | G14 | ... | G1 | G0 | B15 | B14 | ... | B1 | B0 |

LED brightness 48bits data structure, high bit is sent first, and data is sent in the order of RGB

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GR4 | GR3 | GR2 | GR1 | GR0 | GG4 | GG3 | GG2 | GG1 | GG0 | GB4 | GB3 | GB2 | GB1 | GB0 |

RGB gain 15bits data structure, high bit is sent first, and data is sent in the order of RGB

5. Data transmission method:

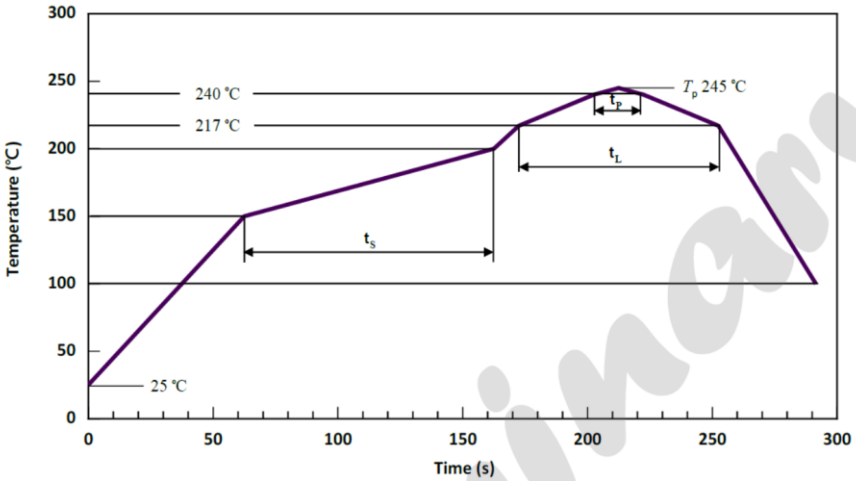



| | | | | | |
|---|---|---|---|---|---|
| **LED1 DIN** | LED1 (48bits) | LED2 (48bits) | ..... | LEDN (48bits) | RGB (15bits) |
| **LED2 DIN** | | LED2 (48bits) | ..... | LEDN (48bits) | RGB (15bits) |
| **LEDN DIN** | | | | LEDN (48bits) | RGB (15bits) |

Note: The data frame D(1) is the data sent by the MCU, and D(2) and D(N) are the data that the cascade circuit automatically reshapes and forwards.

## RECOMMENDED SOLDERING PROFILE:

Lead-free Solder IR Reflow:




| Profile Feature | Symbol | Pb-Free (SnAgCu) Assembly | | | Unit |
|---|---|---|---|---|---|
| | | Minimum | Recommendation | Maximum | |
| Ramp-up Rate to Preheat<br>25 °C to 150 °C | | | 2 | 3 | K/s |
| Time ts<br>$T_{Smin}$ to $T_{Smax}$ | $t_S$ | 60 | 100 | 120 | s |
| Ramp-up Rate to Peak<br>$T_{Smax}$ to $T_P$ | | | 2 | 3 | K/s |
| Liquids Temperature | $T_L$ | | 217 | | °C |
| Time Above Liquids Temperature | $t_L$ | | 80 | 100 | s |
| Peak Temperature | $T_P$ | | 245 | 260 | °C |
| Time Within 5 °C of the Specified Peak Temperature $T_P$ - 5 K | $T_P$ | | | 10 | s |
| Ramp-Down Rate<br>$T_P$ to 100 °C | | | 3 | 4 | K/s |
| Time<br>25 °C to $T_P$ | | | | 480 | s |



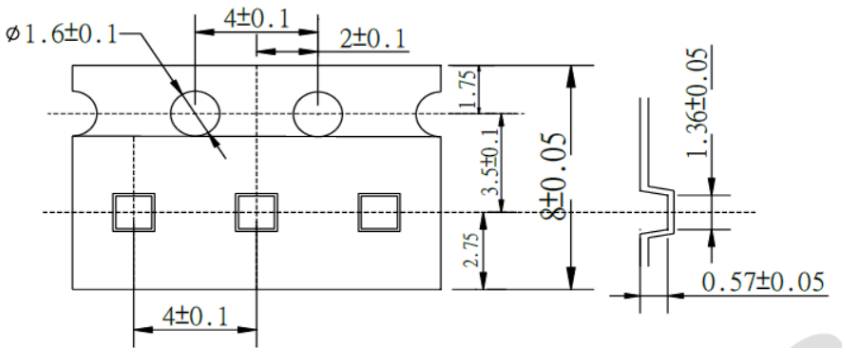
Note:

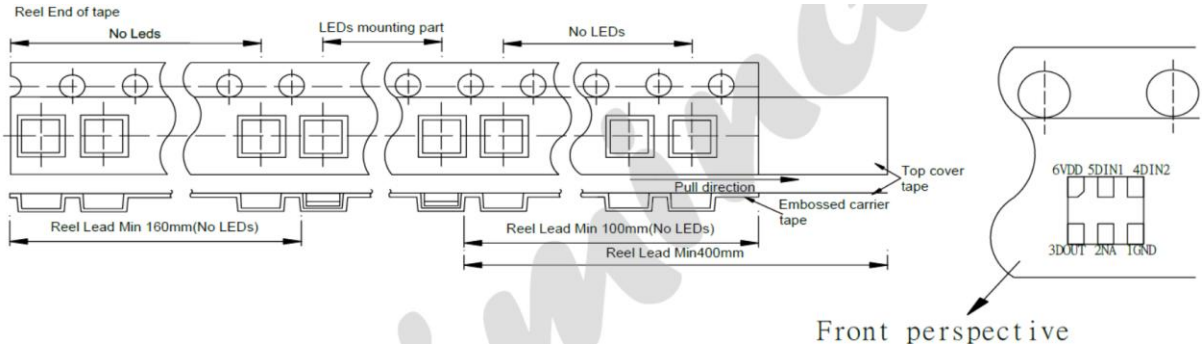
1. We recommend the reflow temperature 240°C (±5°C). The maximum soldering temperature should be limited to 260°C.
2. Maxima reflow soldering: 2 times.
3. Before, during, and after soldering, should not apply stress on the components and PCB board.

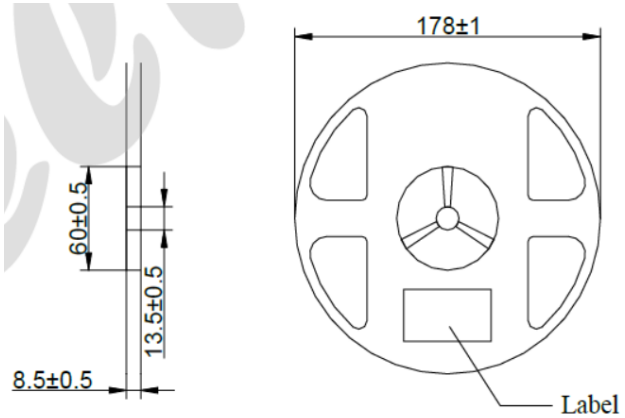
## PACKING SPECIFICATION:

Reel Dimension:

Max.4000pcs/reel



## 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 a week. Otherwise, they should be kept in a damp-proof box with descanting agent stored at R.H.<10% and apply baking before use.

### Over-Current Proof:

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

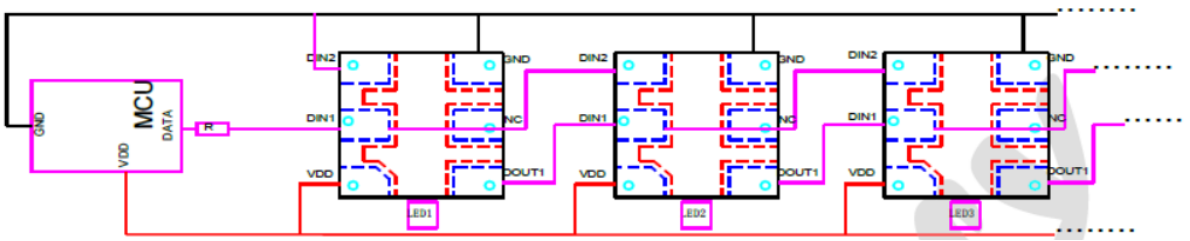
### Baking:

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.

### Typical Application Circuit:




When connecting the first LED to the MCU, a resistor R needs to be connected in series between its signal input line and the MCU. The value of R depends on the number of cascaded LEDs. The more LEDs cascaded, the lower the resistance R used. Generally, the recommended setting ranges between 100 and 1K. The suggested value typically falls around 300 ohms. To ensure more stable LED operation, it is necessary to include a parallel capacitor between the VDD and GND of the first LED.

### 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-electrosatic glove is recommended when handing the LED all time. All devices, equipment, machinery, work tables, and storage racks must be properly grounded.

## REVISION RECORD:

| Version | Date | Summary of Revision |
|---|---|---|
| A1.0 | 27/03/2024 | Datasheet set-up. |
| A1.1 | 31/12/2024 | Revise package dimensions and ESD level. |