# HARVATEK Surface Mount PLCC IC+RGB LEDs DataSheet
## T37C3RGB-20C0001L2U1930
### (Preliminary)

## Features

- Support signal reshaping to pass control waveforms to next adjacent driver
- Cascading port transmission by a single data line
- Built-in current regulator, three-way drive.
- Optional maximal drive current：20mA.
- 256-step gray-scale output to allow 16,777,216 color display
- 32-step dimming control
- 2.4Khz PWM frequency
- Support 32-level current gain control for R/G/B channels
- Built-in power-on reset (2.6V)(@VDD=5V)
- Built-in brown-out reset(1.8V) (@VDD=5V)
- Support sleep and wake up mode (patent granted)
- Operating voltage 4.5~5.5V

## Applications

- Decorative LED lighting
- LED video display

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2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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## Label Specifications



- **HARVATEK P/N:**

| T | 37C | 3 | RGB- | 20C- | 0001 | L2 |
|---|-----|---|------|------|------|-----|
| **Product** | **Package** | **Dice Q'ty** | **Color** | **Current** | **Series Number** | **Taping** |
| L/F | 2.2(L)x2.2(W)x1.05(H) mm | 3.TRI | RGB (Full Color) | 20mA | X001~XZZZ | 1.Taping style 2. Q'ty |

- **Lot No.:**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|----|
| E | 1 | A | 1 | A | 2 | 2 | L | 1 | 2 |
| Code 1 2 | | Code 3 | Code 4 | Code 5 | Code 6 | Code 7 | Code 8 | Code 9 | Code 10 |
| | | Mfg. Year | Mfg. Month | Mfg. Date | Consecutive number | | Special code | | |
| Internal Tracing Code | | 2020-L 2021-M 2022-P 2023-Q … 2026-T 2027-V … 2030-Y 2031-Z … | 1:Jan. 2:Feb. … A:Oct. B:Nov. C:Dec. | 1:A 2:B 3:C … 26:Z 27:7 28:8 29:9 30:3 31:4 | 01~ZZ | | 000~ZZZ | | |

## Product Features

### Electro-Optical Characteristics

| Emitting Color | Material | Wavelength λ(nm) | I$_V$(mcd) | Test Condition | Viewing |
| --- | --- | --- | --- | --- | --- |
| | | λ$_D$ | Typical | PWM duty | Angle $2\theta\frac{1}{2}$ |
| R | AlGaInP | 620 | 838 | R：100%，20mA | 120 |
| G | InGaN | 525 | 1923 | G：100%，20mA | 120 |
| B | InGaN | 467.5 | 381 | B：100%，20mA | 120 |

### Package Outline Dimension and Recommended Soldering Pattern for Reflow Soldering

(Unit:mm Tolerance: +/-0.1)

| Outline Dim. | Suggest Soldering Pattern |
| --- | --- |
|  |  |

Soldering terminals may shift in the X,Y direction.

| No. | Symbol | Function description |
| --- | --- | --- |
| 1 | GND | Ground |
| 2 | NC | Empty foot and no connection inside |
| 3 | DO | Data output |
| 4 | BI | Auxiliary data signal input as DI function backup |
| 5 | DI | Data input |
| 6 | VDD | Supply voltage |

## Absolute Maximum Ratings

(Temperature=25℃)

| Characteristic | Symbol | Range | Units |
|---|---|---|---|
| Supply Voltage | $V_{DD}$ | 6 | V |
| Total DC Current | IF | 38 | mA |
| Operating Temperature Range | $T_{OPR}$ | -40~+85 | ℃ |
| Storage Temperature Range | $T_{STO}$ | -40~+85 | ℃ |

## Electrical characteristics

(Temperature=25℃)

| Characteristic | Symbol | Limit | | | Units | Note |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Supply Voltage | $V_{DD}$ | 4.5 | 5.0 | 5.5 | V | |
| Operation Current | $I_{DD}$ | | 0.42 | 0.55 | mA | |
| Standby Current | $I_{sleep}$ | | 1 | 5 | µA | |
| Input High "H" of DI、BI | $V_{IH}$ | 0.7*VDD | | $V_{DD}$+0.4 | V | |
| Input Low "L" of DI、BI | $V_{IL}$ | -0.4 | | 0.2*VDD | V | |
| Output High "H" of DO | $V_{OH}$ | 4.4 | | | V | |
| Output Low "L" of DO | $V_{OL}$ | | | 0.3 | V | |
| R、G、B Sink Current | $I_{SK}$ | 19 | 20 | 21 | mA | |
| Input Leakage | $I_{leak}$ | | | 1 | µA | |

## Switching characteristics

| Parameter | Symbol | Min | Typical | Max | Unit | Note |
|---|---|---|---|---|---|---|
| Propagation delay time | tPLZ | | | 80 | ns | |
| Falling time | tTHL | | 15 | | ns | DI → DO |
| Rising time | tTLH | | 30 | | ns | |
| Falling time | tR | | 80 | | ns | |
| Rising time | tF | | 80 | | ns | |
| Data rate | $F_{data}$ | | 1428 | | KHz | |

| 05/21/2025 | **Preliminary** |
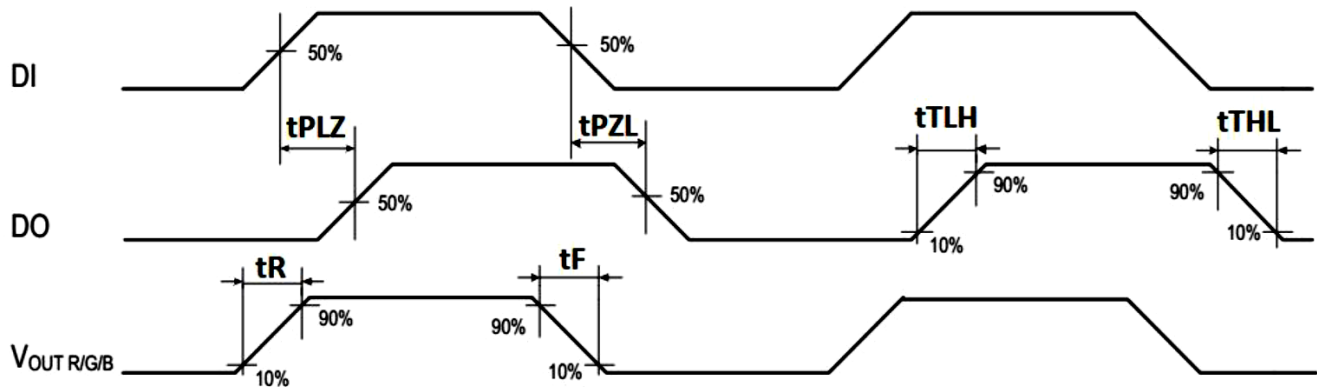
## Cascading data structure
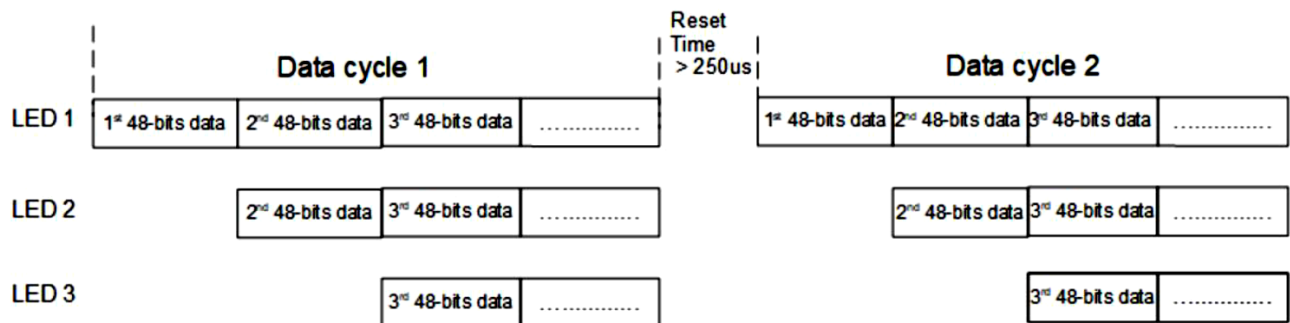


The single wire data transfer protocol supports 48-bit data for each LED RGB display data refresh. The device receives 48-bit data and passes the remaining data to next LED. The 48-bit data consist of red、green and blue data, each with 16-bit width, and are transferred with MSB first. Each of the 16-bit data determines 65536-level PWM pulse used to control R/G/B channels.

| R15 | R14 | R13 | .... | R3 | R2 | R1 | R0 | G15 | G14 | G13 | .... | G3 | G2 | G1 | G0 | B15 | B14 | B13 | .... | B3 | B2 | B1 | B0 |
|-----|-----|-----|------|----|----|----|----|-----|-----|-----|------|----|----|----|----|-----|-----|-----|------|----|----|----|----|

The transferred data are recognized based on the pulse widths received by device.
A low bit 0 is represented by a 0.22us high pulse followed by a not less than 0.5us low pulse. A high bit 1 is represented by a 0.465us high pulse followed by a not less than 0.255us low pulse. A low pulse $\geq$ 250us is used to issue a reset command to
The device to start a new cycle of serial commands

| symbol | Parameter | Min | Typ. | Max | Units |
|--------|-----------|-----|------|-----|-------|
| T0H | 0 code, high-level time | 180 | 220 | 260 | ns |
| T1H | 1 code, high-level time | 440 | 465 | 490 | ns |
| T0/T1 | bit code period | 720 | | | ns |
| Reset | Reset code, low-level time | 250 | | | µs |
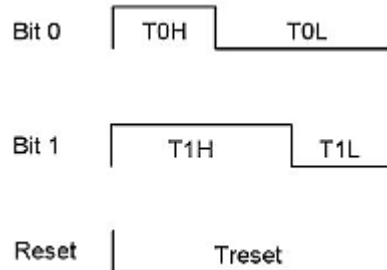


## Dimming Control(Current Gain)

The device supports an 16-level current gain control to adjust sink current of R/G/B channels. This feature enables dimming control of LED lighting. Each of the red, green and blue channels can be controlled individually, which in turn not only to save power consumption, but also to fine-tune the color temperature of R/G/B LEDs.

To set the current gain of the R/G/B channel of device, the controller should issue the dimming configuration data of each LED first, then the 8-bit digits only with 8'hB5 and the reset command are followed, the current gain command will take effect immediately.
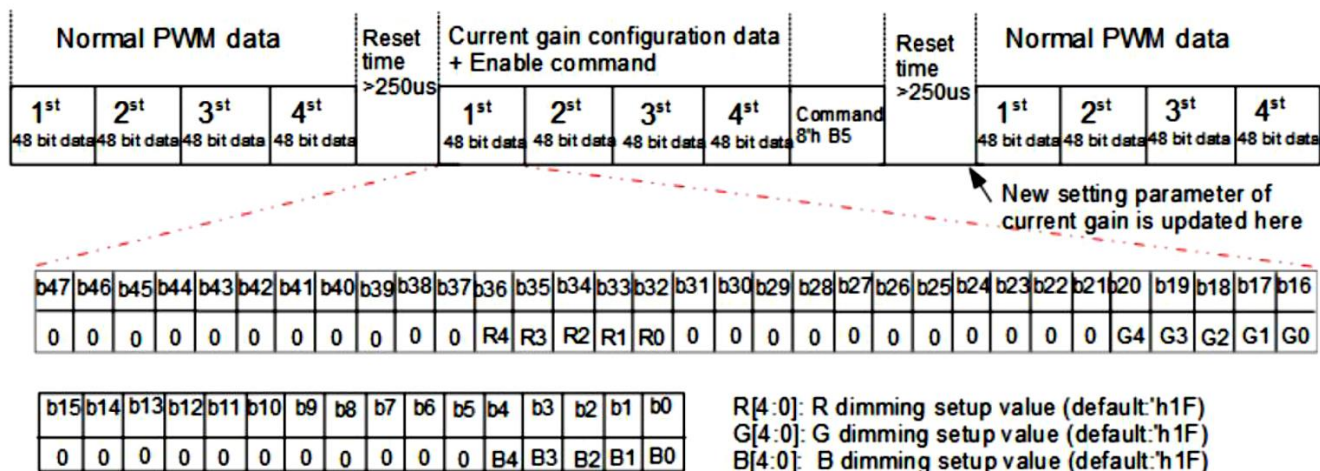
The maximum output current of each R/G/B channels is then determined as below
(ISK=12mA or 20mA).

Rsink = ISK * (R[4]*16/31+R[3]*8/31 + R[2]*4/31 + R[1]*2/31 + R[0]*1/31)

Gsink = ISK * (G[4]*16/31+G[3]*8/15 + G[2]*4/15 + G[1]*2/15 + G[0]*1/15)

Bsink = ISK * (B[4]*16/31+B[3]*8/15 + B[2]*4/15 + B[1]*2/15 + B[0]*1/15)

By default, R[4:0] = G[4:0] = B[4:0] = 0x1F.

## Sleep and wake-up mode

The device supports sleep/wake-up modes for power-saving purpose. When receiving
48-bit 0's RGB data, 8-bit 0x5A special data, and a reset command, the device will enter
sleep mode. In sleep mode, the built-in oscillator and associated circuitry is disabled. The
quiescent current of device is less than 1uA (typ) in sleep mode.

A sleeping device wakes up from sleep mode when detecting an input rising edge on
DI or BI pin. Normally a positive pulse on DI or BI pin can be used as a wake-up trigger.
After waking up, all sleeping circuits in the device return to normal working mode within
1ms. To wake-up the next cascaded the device, the received positive pulse on DI pin is
passed to DO pin, which connected to DI pin of the next the device, and in turn wakes up
the next device. Hence, all cascaded sleeping device can wake up successively.

Since it takes 1ms for a sleeping device returning to normal functioning mode, it is
recommended for MCU to wait for 1ms to send display data and commands after issuing a
wake-up pulse.

In case a mal-functioned device exists in an LED strip, the one next to the
mal-functioned device determines the sleep/wake-up mode through BI pin, instead of
DI pin.

In an LED strip, it is possible to set certain device active, while the others in sleep
mode. As an example, the following commands are for two leading active device and other
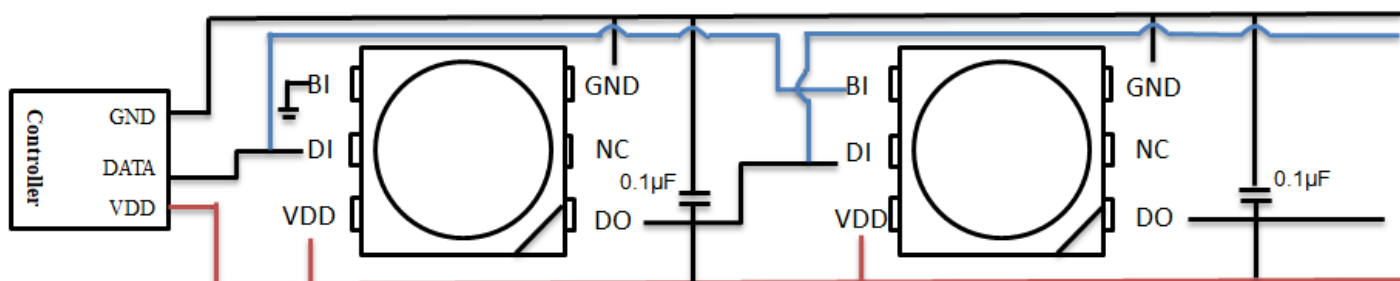sleeping the device.

| | | |
|---|---|---|
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As an example of sleep/wake-up commands shown below, the first device is kept
active and the remaining the device enter sleep mode by 48-bit 0's and an ending 0x5A
byte. Later on, a positive pulse wakes up all sleeping device.
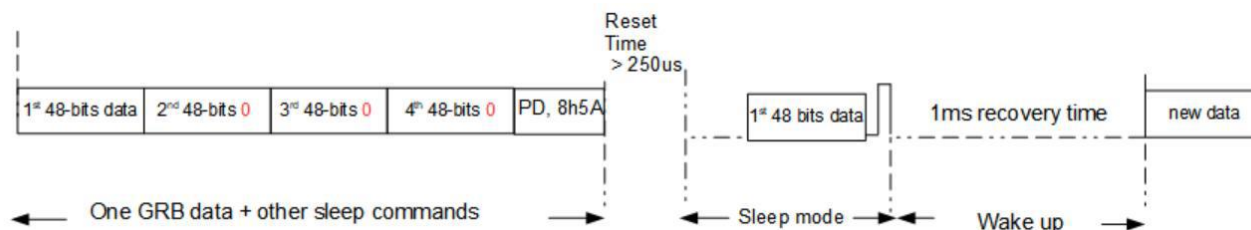


## Typical Circuit of an RGB LED strip application

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## Precaution for Use

1. The chips should not be used directly in any type of fluid such as water, oil, organic solvent, etc.
2. When the LEDs are illuminating, the maximum ambient temperature should be first considered before operation.
3. LEDs must be stored in a clean environment. A sealed container with a nitrogen atmosphere is necessary if the storage period is over 3 months after shipping.
4. The LEDs must be used within 24 hrs after unpacked. Unused products must be repacked in an anti-electrostatic package, folded to close any opening and then stored in a dry and cool space.
5. The appearance and specifications of the products may be modified for improvement without further notice.
6. The LEDs are sensitive to the static electricity and surge. It is strongly recommended to use a grounded wrist band and anti-electrostatic glove when handling the LEDs. If a voltage over the absolute maximum rating is applied to LEDs, it will damage LEDs. Damaged LEDs will show some abnormal characteristics such as remarkable increase of leak current, lower turn-on voltage and getting unlit at low current.
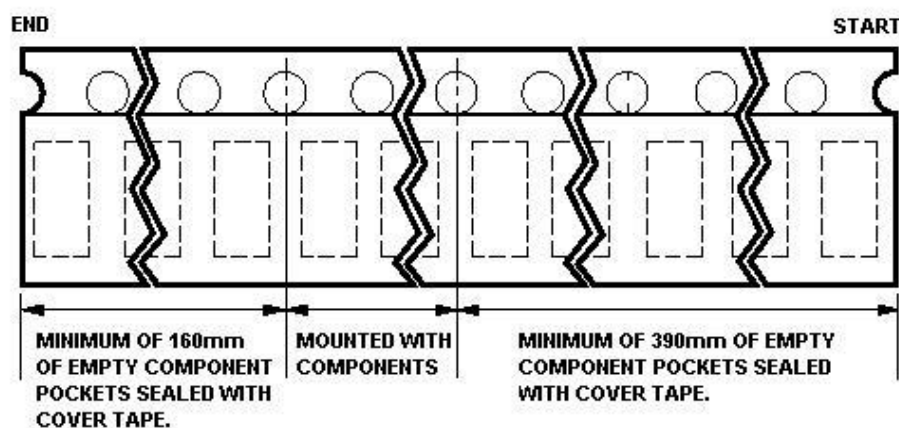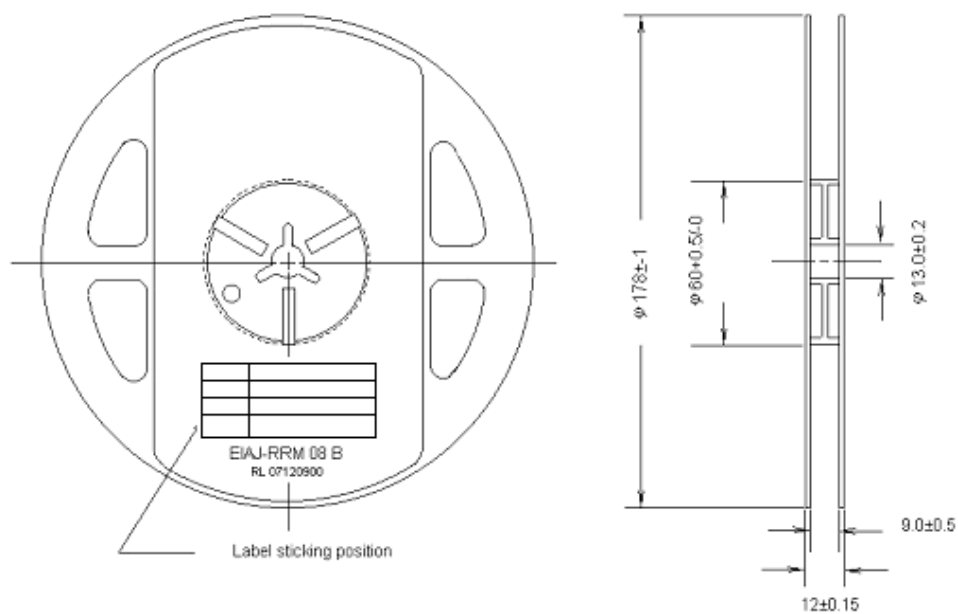
**Packaging**

**Tape Dimension**

$\varnothing 1.50^{+0.10}_{-0.00}$ — Mark

4.00±0.05    2.00±0.05

1.75±0.10

8.00±0.20

4.00±0.10

3.50±0.05
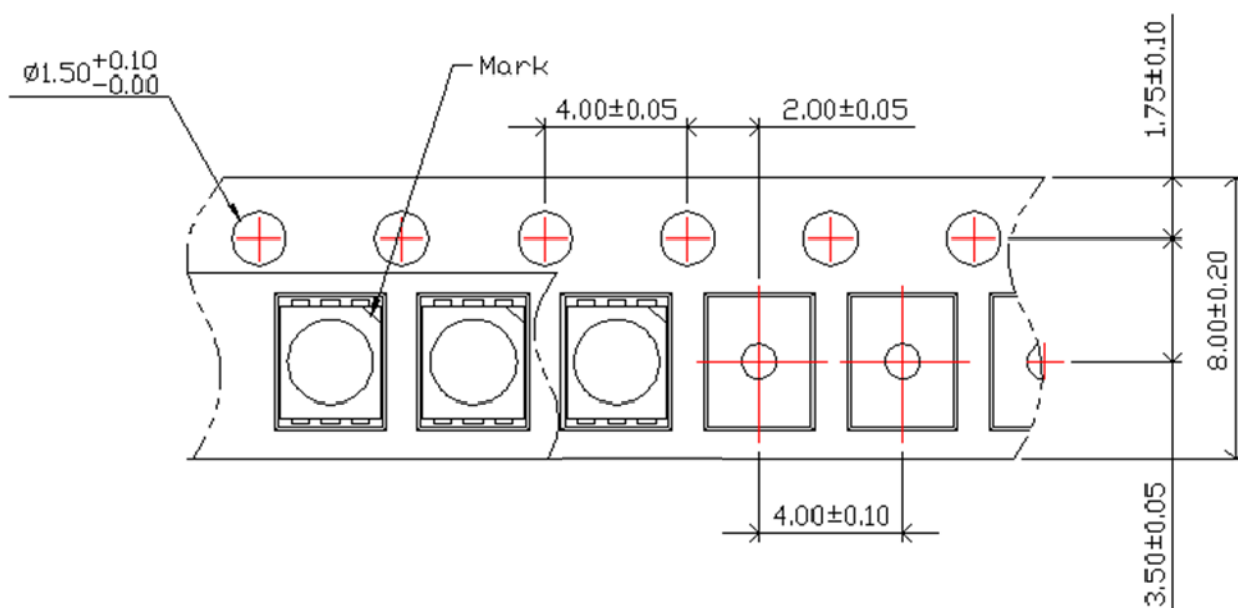
| Dim. A | Dim. B | Dim. C | Q'ty/Reel |
|--------|--------|--------|-----------|
| 2.40±0.05 | 2.40±0.05 | 1.21±0.05 | 2000 |

Unit : mm

END                                    START

MINIMUM OF 160mm OF EMPTY COMPONENT POCKETS SEALED WITH COVER TAPE.    MOUNTED WITH COMPONENTS    MINIMUM OF 390mm OF EMPTY COMPONENT POCKETS SEALED WITH COVER TAPE.

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## Reel Dimension



EIAJ-RRM 08 B
RL 07120800

Label sticking position

Unit : mm

## Packing



5 Reels per box
( 7 inches reel )

Label sticking position

Label sticking position

or
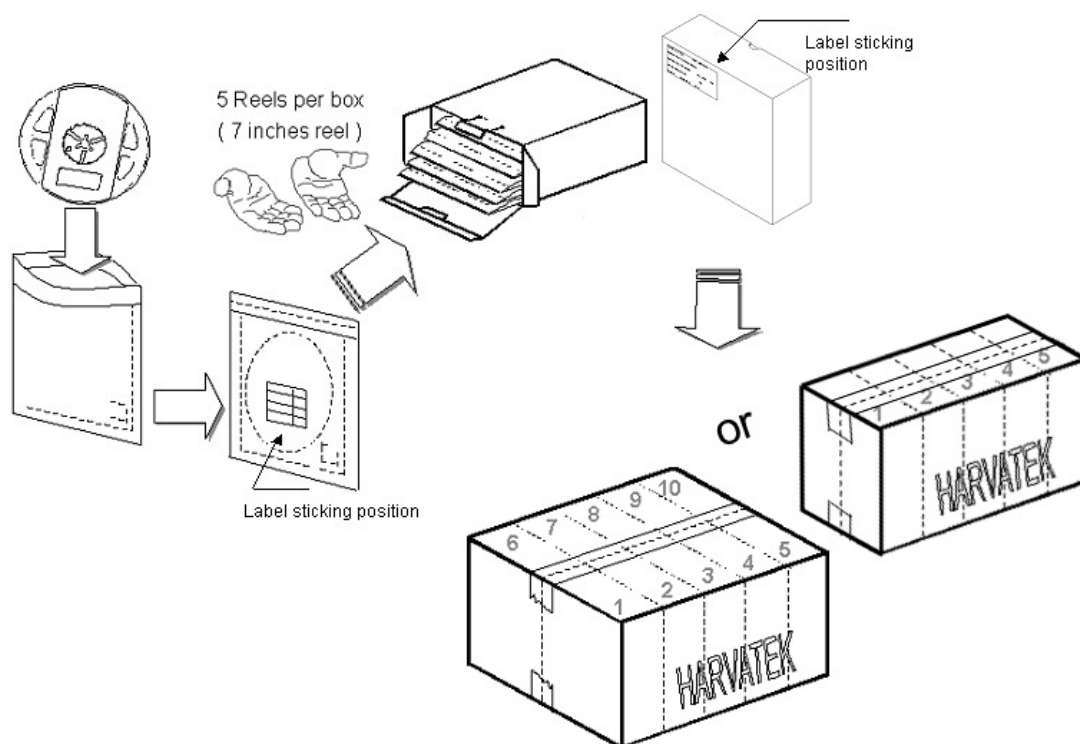
5 or 10 boxes per carton is available depending on shipment quantity.

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## Dry Pack

All SMD optical devices are **MOISTURE SENSITIVE**. Avoid exposure to moisture at all times during transportation or storage. Every reel is packaged in a moisture protected anti-static bag. Each bag is properly sealed prior to shipment.

Upon request, a humidity indicator will be included in the moisture protected anti-static bag prior to shipment.

The packaging sequence is as follows:
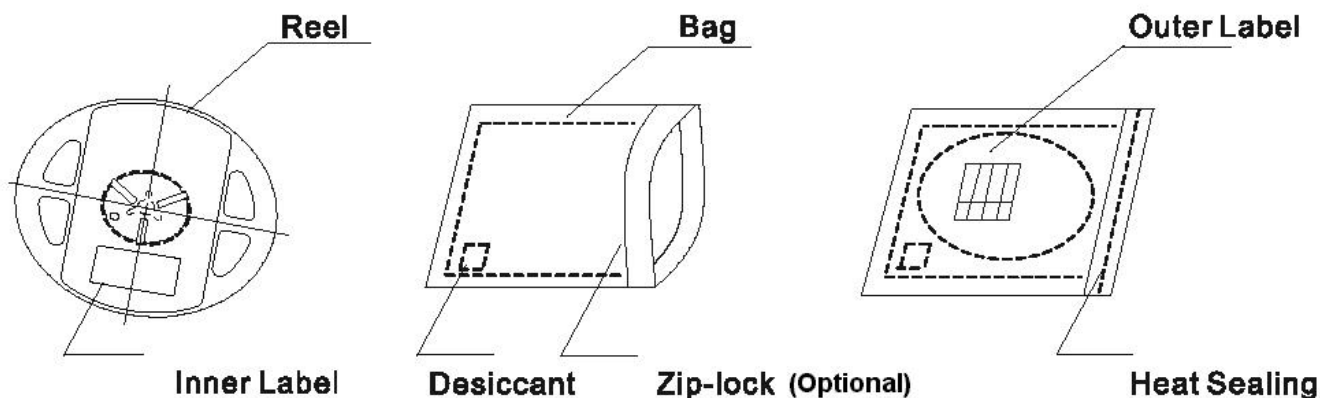


## Baking

Baking before soldering is recommended when the package has been unsealed for 48 hours. The conditions are as followings:

1. 60±3℃×(12~24hrs)and<5%RH, taped reel type.
2. 100±3℃×(45min~1hr), bulk type.
3. 130±3℃×(15min~30min), bulk type.

## Precautions

1. Avoid exposure to moisture at all times during transportation or storage.
2. Anti-Static precaution must be taken when handling GaN, InGaN, and AlGaInP products.
3. It is suggested to connect the unit with a current limiting resistor of the proper size. Avoid applying a reverse voltage beyond the specified limit.
4. Avoid operation beyond the limits as specified by the absolute maximum ratings.
5. Avoid direct contact with the surface through which the LED emits light.
6. If possible, assemble the unit in a clean room or dust-free environment.

**Handling of Silicone Resin LEDs**

Handling Indications

During processing, mechanical stress on the surface should be minimized as much as possible.

Sharp objects of all types should not be used to pierce the sealing compound.



Figure 1

In general, LEDs should only be handled from the side. By the way, this also applies to LEDs without a silicone sealant, since the surface can also become scratched.
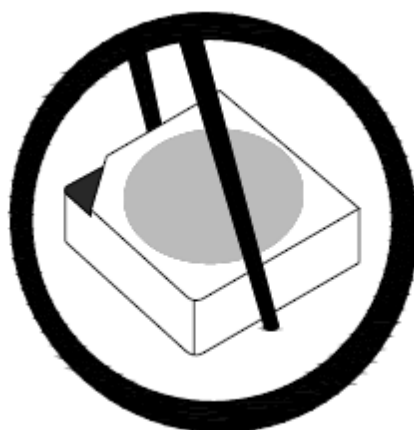


Figure 2

When populating boards in SMT production, there are basically no restrictions regarding the form of the pick and place nozzle, except that mechanical pressure on the surface of the resin must be prevented.

This is assured by choosing a pick and place nozzle which is large than LEDs reflector area.

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## Reflow Soldering

Recommend soldering paste specifications:

1.  Operating temp.: Above 217℃, 60~150 sec.

2.  Peak temp.:260℃ Max., 10sec Max.

3.  Reflow soldering should not be done more than two times.

4.  Never attempt next process until the component is cooled down to room temperature after reflow.

5.  The recommended reflow soldering profile (measured on the surface of the LED terminal) is as following:

    Lead-free Solder Profile
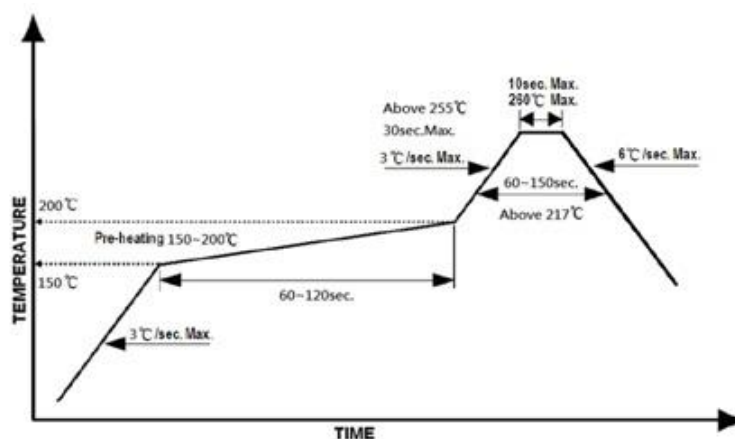


## Reworking

- Rework should be completed within 5 seconds under 260 $^O$C.
- The iron tip must not come in contact with the copper foil.
- Twin-head type is preferred.

## Cleaning

Following are cleaning procedures after soldering:

- An alcohol-based solvent such as isopropyl alcohol (IPA) is recommended.
- Temperature x Time should be 50$^o$C x 30sec. or <30$^o$C x 3min
- Ultrasonic cleaning: < 15W/ bath; bath volume ≤ 1liter
- Curing: 100 $^O$C max, <3min

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## Cautions of Pick and Place

- Avoid stress on the resin at elevated temperature.
- Avoid rubbing or scraping the resin by any object.
- Electric-static may cause damage to the component. Please ensure that the equipment is properly grounded. Use of an ionizer fan is recommended.

## Revise History

| Rev. | Descriptions | Date | Page |
|------|-------------|------|------|
| 1.0 | Preliminary | 05/21/2025 | - |
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