HARVATEK Surface Mount PLCC IC+RGB LEDs DataSheet
T37S3RGB-20C000112U1930

(Preliminary)

Features

- Support signal reshaping to pass control waveforms to next adjacent driver
- Support control circuit to be integrated with RGB chips into a single package
- Cascading port transmission by dual-wire (clock and data) lines
- Support BI backup input data line to prevent data input failure from malfunction DI line
- Optional maximal drive current：20mA.
- 256-step gray-scale output to allow 16,777,216 color display
- 20Khz PWM frequency
- Support 32-level current gain control for R/G/B channels
- Support sleep and wake up mode
- Built-in power-on reset (2.3V)(@VDD=5V)
- Built-in brown-out reset(1.65V)(@VDD=5V
- Operating voltage 3.3~5.5V

Applications

- Decorative LED lighting
- Ambient lighting and full color strip for automotive

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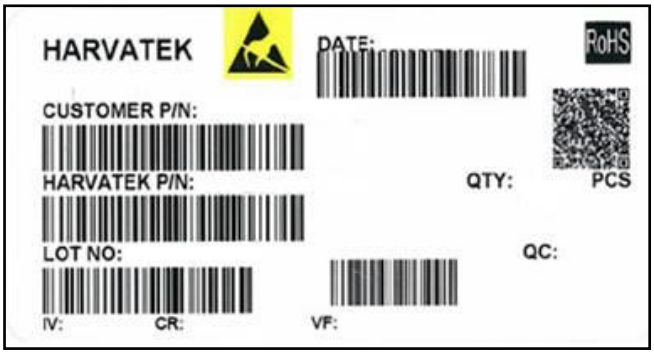
2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

Label Specifications



- **HARVATEK P/N:**

T 37S 3 RGB- 20C- 0001 12

Product	Package	Dice Q'ty	Color	Current	Series Number	Taping
LF	3.6(L)x3.5(W)x1.4(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

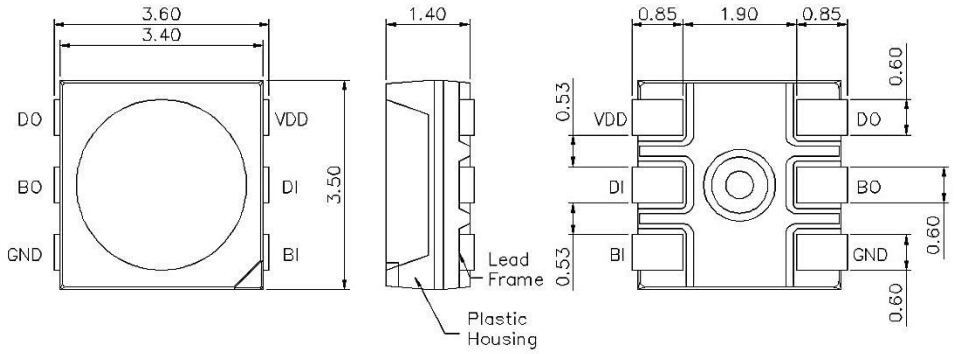
Electro-Optical Characteristics

Emitting Color	Material	Wavelength λ(nm)	I_V(mcd)	Test Condition 8bits	Viewing Angle $2\theta\frac{1}{2}$
		λ_D	Typical		
R	AlGaInP	620	730	R：[11111111]	120
G	InGaN	525.5	1637.5	G：[11111111]	120
B	InGaN	467.5	315	B：[11111111]	120

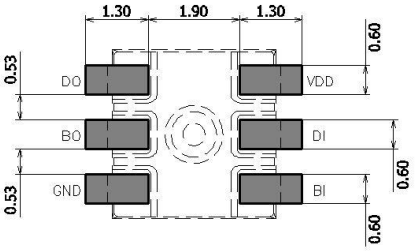
Package Outline Dimension and Recommended Soldering Pattern for Reflow Soldering

(Unit:mm Tolerance: +/-0.1)

Outline Dim.



Suggest Soldering Pattern



Soldering terminals may shift in the X,Y direction.

No.	Symbol	Function description
1	DO	Data output
2	BO	backup output
3	GND	Ground
4	VDD	Supply voltage
5	DI	Data input
6	BI	Backup input

Absolute Maximum Ratings

(Temperature=25℃)

Characteristic	Symbol	Range	Units
Supply Voltage	V_{DD}	6.0	V
Total DC Current	IF	70	mA
Operating Temperature Range	T_{OPR}	-40~+85	℃
Storage Temperature Range	T_{STO}	-40~+85	℃

Electrical characteristics

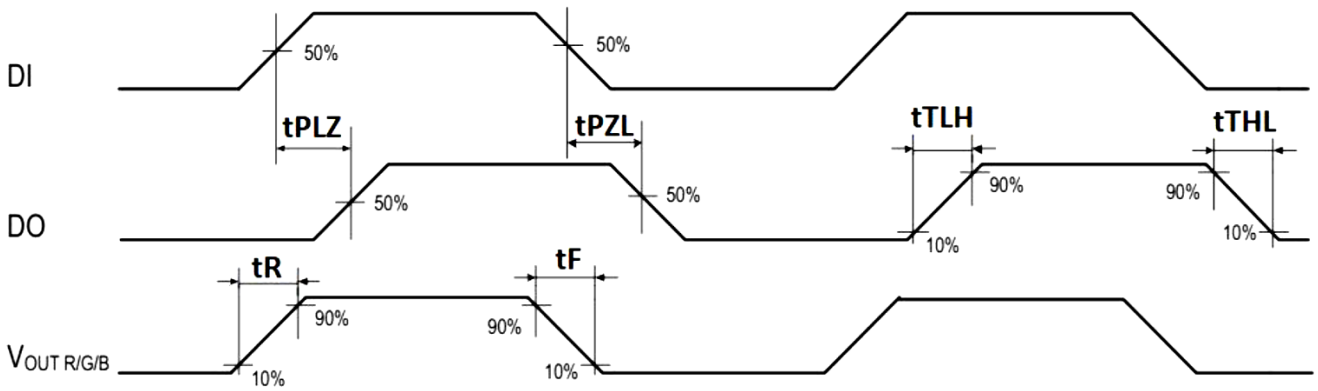
(Temperature=25℃)

Characteristic	Symbol	Limit			Units
		Min.	Typ.	Max.	
Supply Voltage	V_{DD}	3.3	5.0	5.5	V
Operation Current	I_{OP}		0.45	0.65	mA
Standby Current	I_{sleep}			5	μA
Input High “H”	V_{IH}	0.6*V_{DD}		V_{DD}+0.4	V
Input High “L”	V_{IL}	-0.4		V_{DD}*0.2	V
Output High “H”	V_{OH}	4.4			V
Output Low “L”	V_{OL}			0.3	V
Input High “H” of DI、BI	V_{IH}	0.6*V_{DD}		V_{DD}+0.4	V
Input Low “L” of DI、BI	V_{IL}	-0.4		0.2*V_{DD}	V
R、G、B Sink Current	I_{SINK}	19	20	21	mA
R、G、B Current Gain	G_{level}		31		mA/level

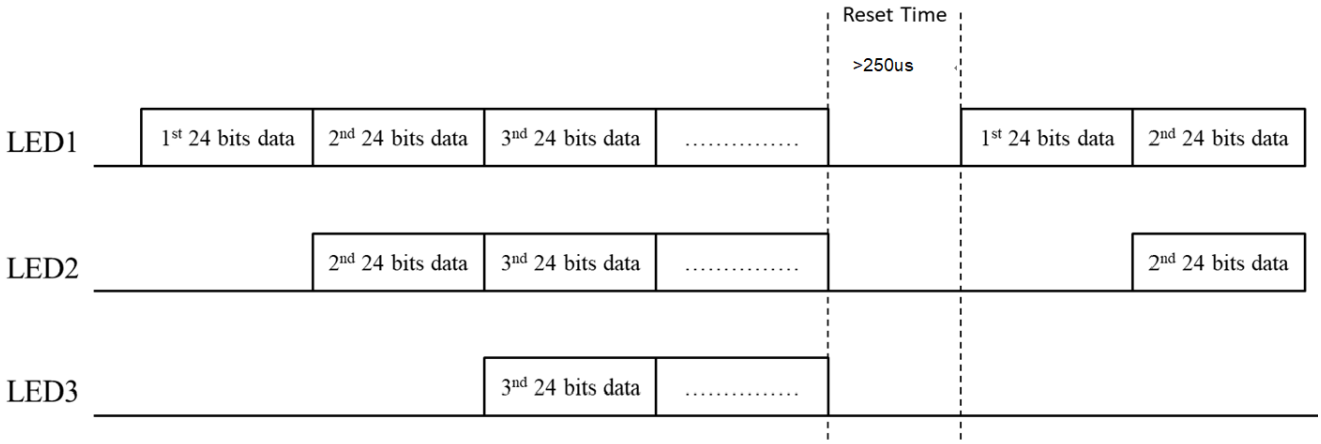
Dynamic characteristics

(Temperature=25℃)

Parameter	Symbol	Min.	Typ.	Max.	Units	Note
Propagation delay time	tPLZ			80	ns	DI->DOUT
Rising time	tTHL		15		ns	
Falling time	tTLH		15		ns	
Vout_RGB Rising time	tR		50		ns	I_{LED} = 20mA
Vout_RGB Falling time	tF		50		ns	
Data rate	F_{Data}		800		KHz	

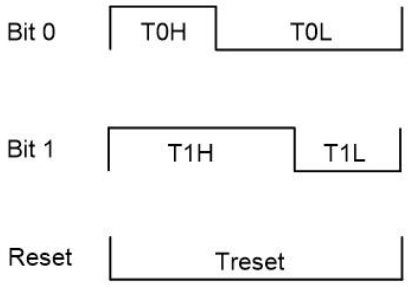


Data Transfer Protocol



The single wire data transfer protocol supports 24-bit data for each LED RGB display data refresh. The device receives 24-bit data and passes the remaining data to next LED. The 24-bit data consist of red 、green and blue data, each with 8-bit width, and are transferred with MSB first. Each of the 8-bit data determines 256-level PWM pulse used to control R/G/B channels. The transferred data are recognized based on the pulse widths received by the device. A low bit 0 is represented by a 0.3us high pulse followed by a 0.9us low pulse. A high bit 1 is represented by a 0.9us high pulse followed by a 0.3us low pulse. A low pulse ≧ 250us is used to issue a reset command to the device to start a new cycle of serial commands.

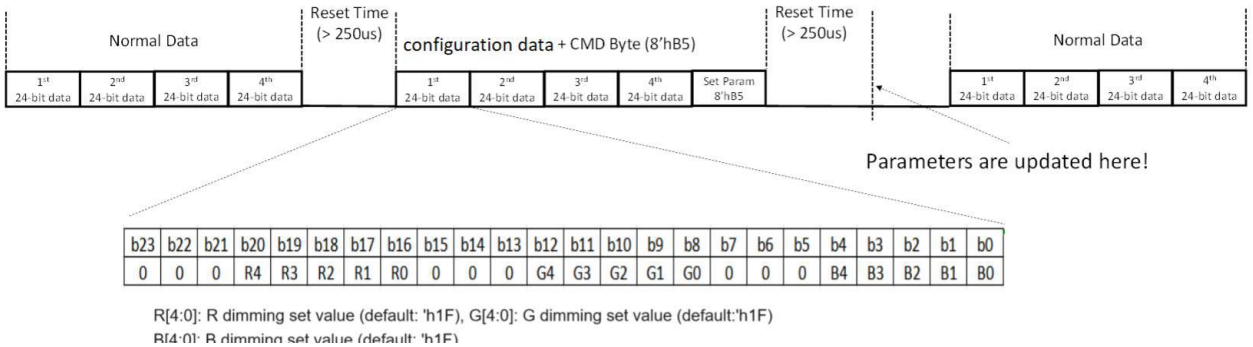
symbol	Min	Typ.	Max	Unit
T	1.15	---	---	μs
T0H	0.20	0.30	0.40	
T0L	0.80	0.90	1.00	
T1H	0.80	0.90	1.00	
T1L	0.20	0.30	0.40	
Reset	250	---	---	



Dimming Control(Current Gain)

The device supports an 32-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 the 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.



b23	b22	b21	b20	b19	b18	b17	b16	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
0	0	0	R4	R3	R2	R1	R0	0	0	0	G4	G3	G2	G1	G0	0	0	0	B4	B3	B2	B1	B0

R[4:0]: R dimming set value (default: 'h1F), G[4:0]: G dimming set value (default:'h1F)
B[4:0]: B dimming set value (default: 'h1F)

The maximum output current of each R/G/B channels is then determined as below (ISK=20mA)

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

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

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

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

Sleep and wake-up mode

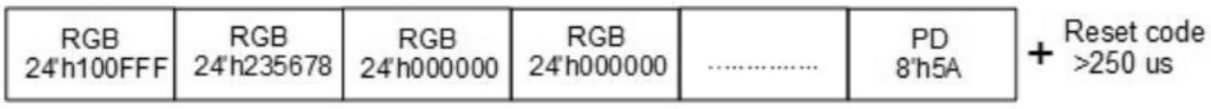
The device supports sleep/wake-up modes for power-saving purpose. When receiving 24-bit 0's RGB data,8-bit 0x5A special data, and a reset command, device will enter sleep mode. In sleep mode, the built-in oscillator and associated circuitry is disabled. The quiescent current of the device is less than 5uA (typ) in sleep mode.

A sleeping the device wakes up from sleep mode when detecting an input rising edge on DI or BI pin.

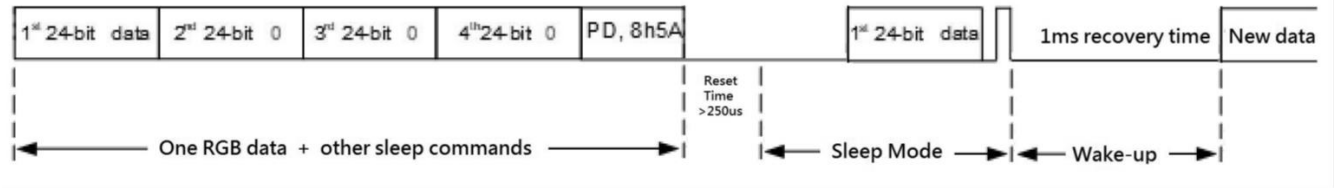
Normally a positive pulse on DI or BI pin can be used as a wake-up trigger. After waking up, all sleeping circuits in the device return to normal working mode within 1ms. To wake-up the next cascaded the device ,the received positive pulse on DI pin is passed to DO pin, which connected to DI pin of the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

Since it takes 1ms for a sleeping the 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.

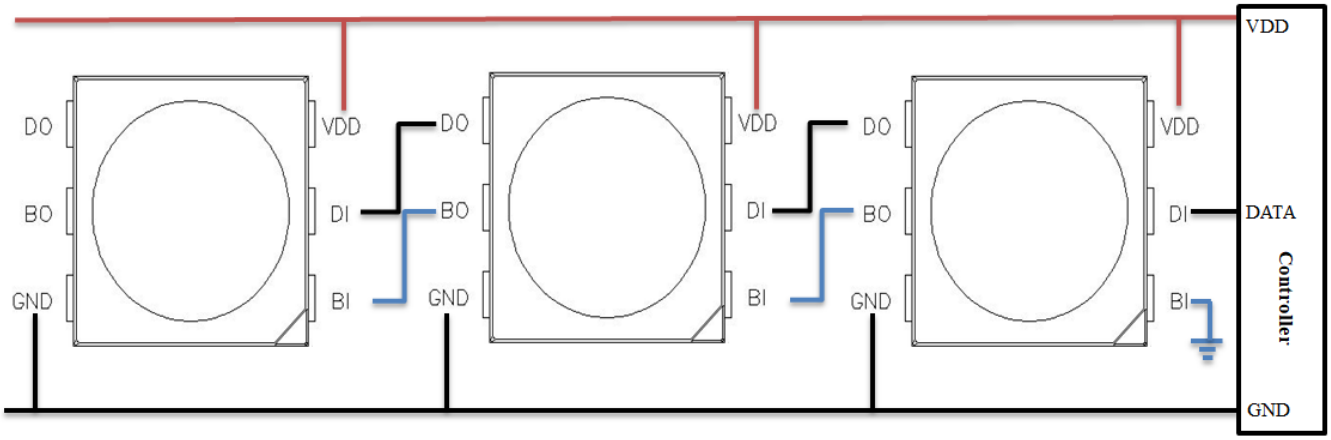
In case a mal-functioned the device exists in an LED strip, the one next to the mal-functioned the device determines the sleep/wake-up mode through BI pin, instead of DI pin.In an LED strip, it is possible to set certain the device active, while the others in sleep mode. As an example ,the following commands are for two leading active the device and other sleeping the device.



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 24-bit 0's and an ending 0x5A byte. Later on, a positive pulse wakes up all sleeping the device.



Typical Circuit of an RGB LED strip application

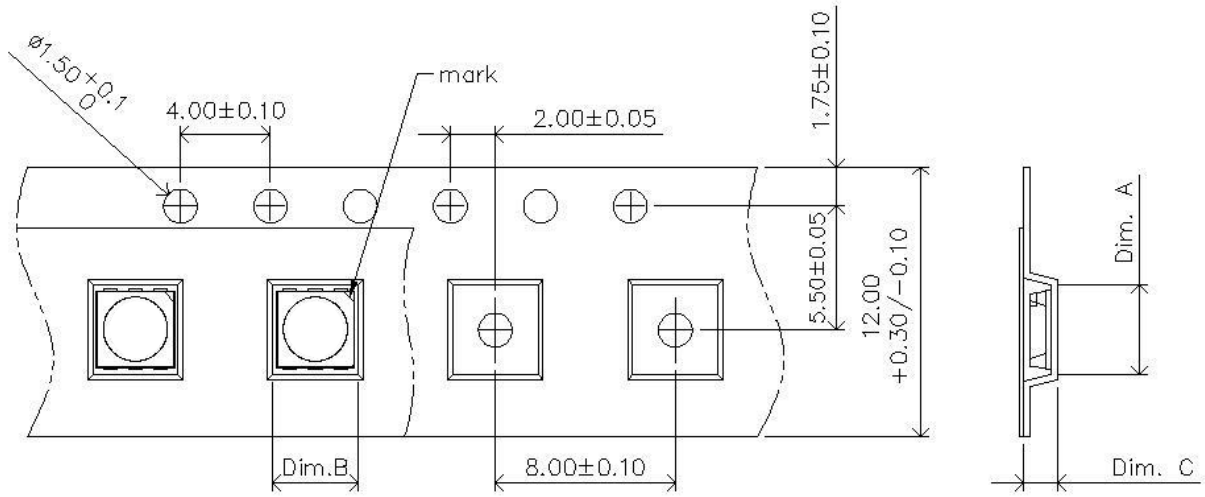


Precaution for Use

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 hours 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.

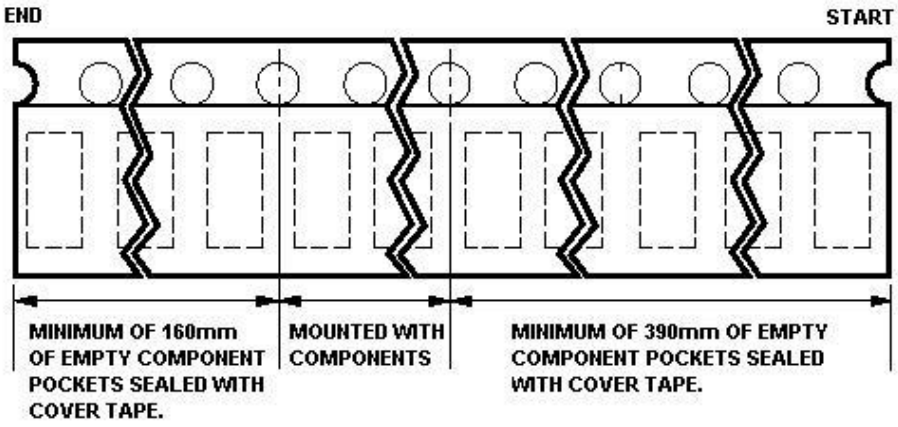
Packaging

Tape Dimension



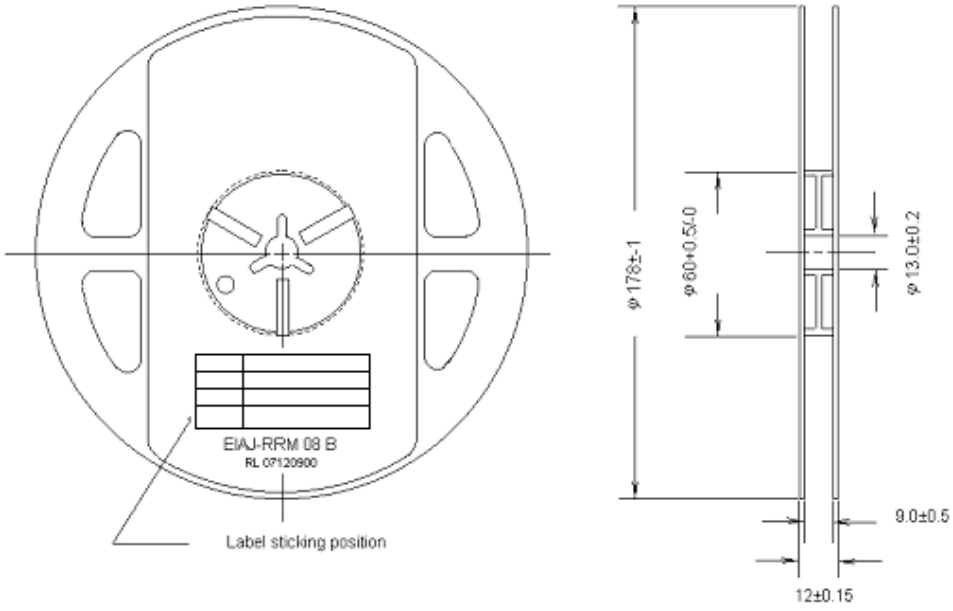
Dim. A	Dim. B	Dim. C	Q'ty/Reel
3.80±0.10	4.00±0.10	1.20±0.10	2000

Unit : mm



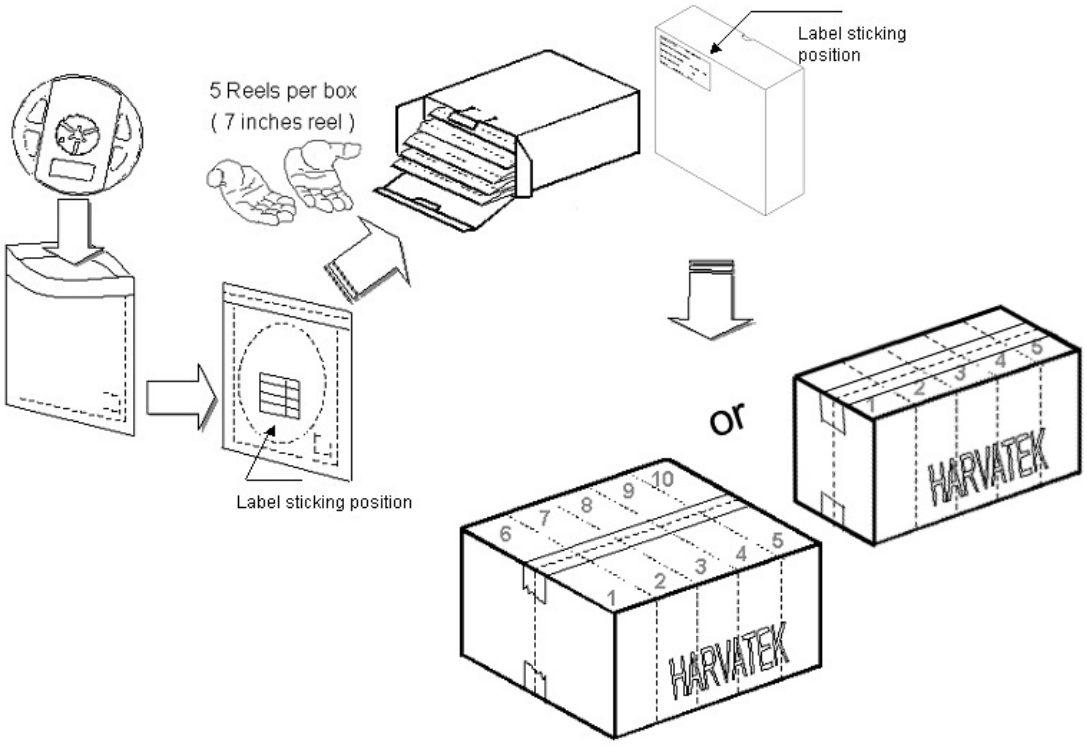
Reel

Dimension



Unit : mm

Packing



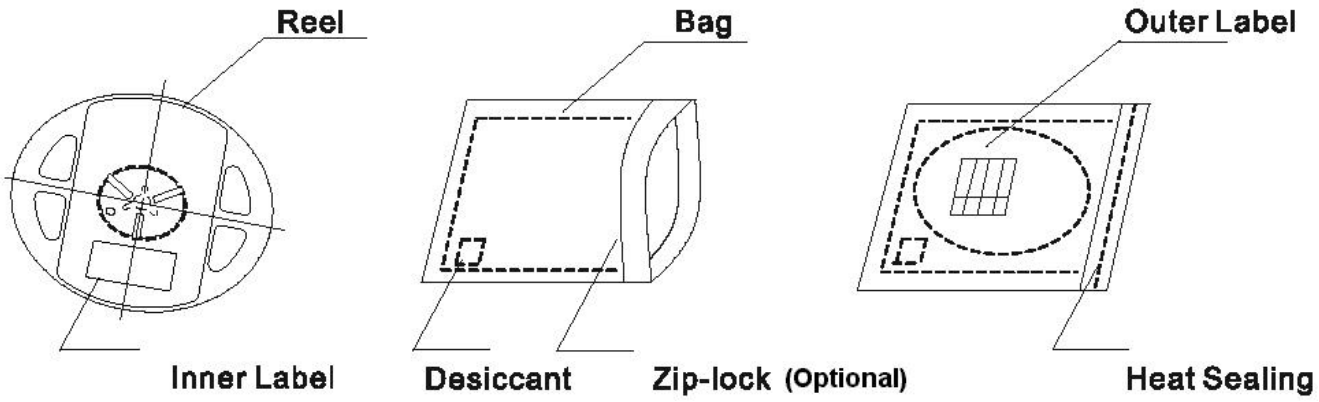
5 or 10 boxes per carton is available depending on shipment quantity.

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.

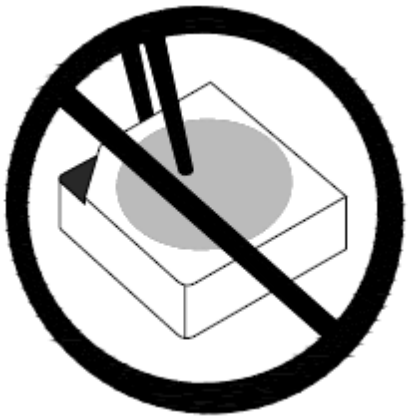


Figure 1

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.

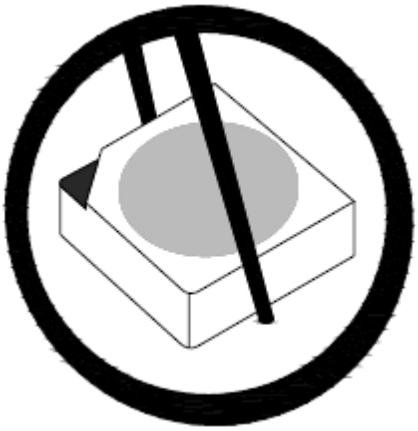


Figure 2

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.

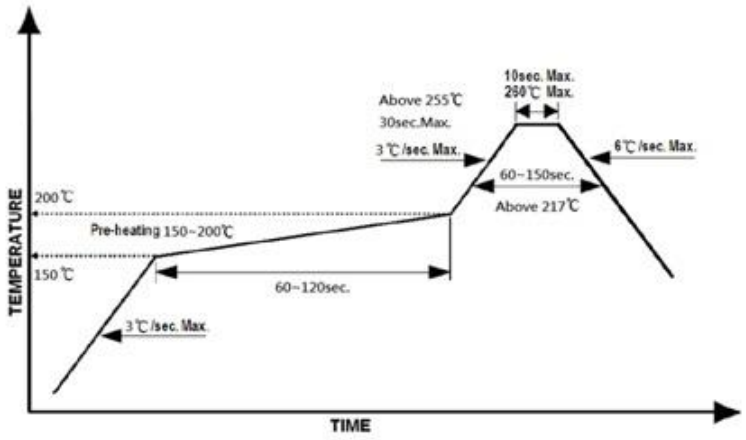
This is assured by choosing a pick and place nozzle which is large than LEDs reflector area.

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

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	07/10/2025	-