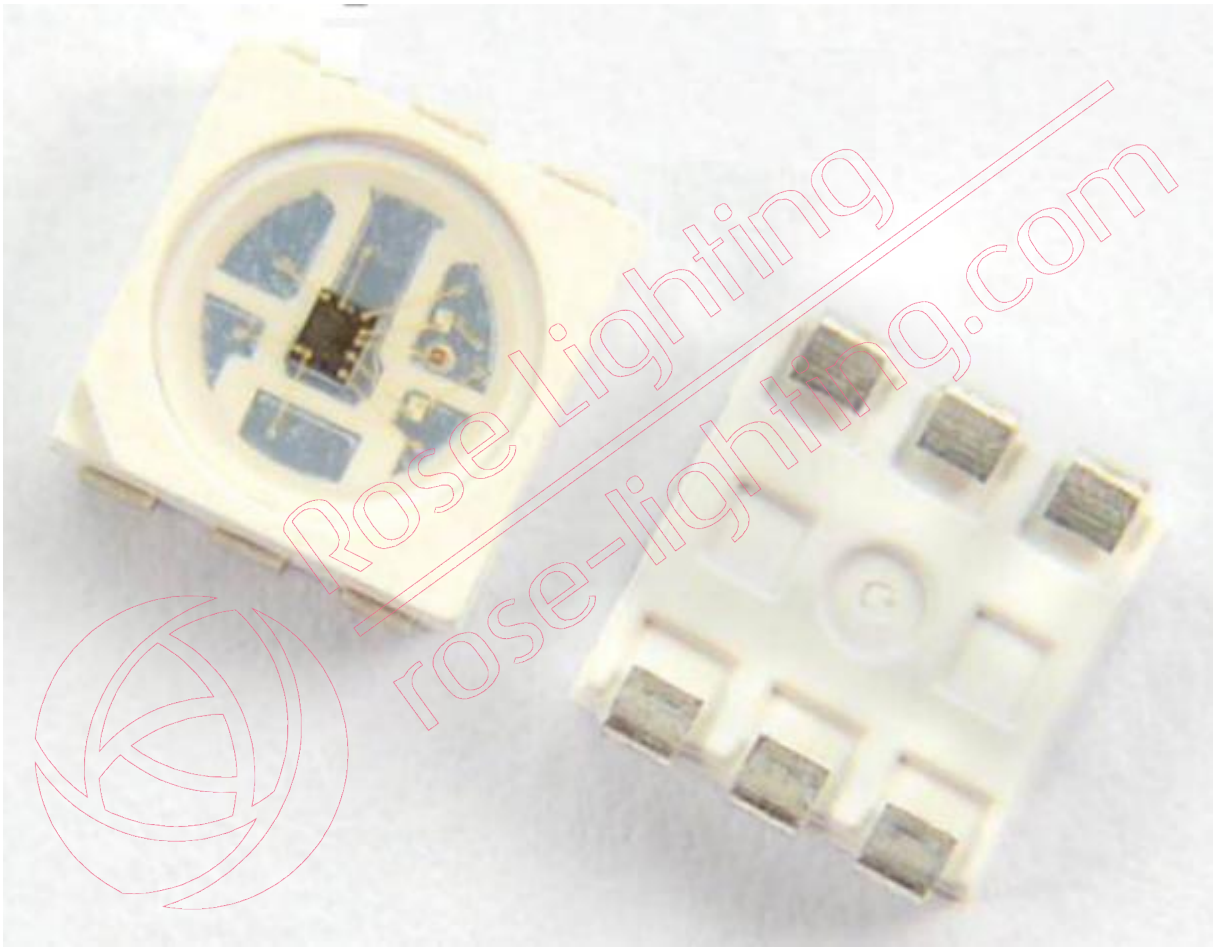
HD108 RGB Pixel led chip SPECIFICATION

The newest LED of HD108 LED with 16 bits

(R/G/B all 65536 gray scale)



Model: HD108-RGB5050

V1.2

Modification Record

Rev. No	Date	Reason of changes	Editor	Reviewer
V1.0	Jan 3, 2019	Create the document;	William Li	Zarine Wu
V1.0.1	Mar18, 2019	Insert the block diagram; Add the part of “The difference of all kinds of digital LED”;	Tony He	Emily Smith
V1.1.0	Nov 22, 2020	Insert the block diagram; Add the part of “The difference of all kinds of digital LED”;	Tony He	Zarine Wu
V1.2	July 14, 2022	Revise Electrical Parameters; Improve the instructions for use;	Tony He	Zarine Wu

Contact

Rose Lighting Technology
Website: www.rose-lighting.com
Tel: +86-186-7564-9004 (wechat, whatsapp, QQ, skype)
Email: info@rose-lighting.com

HD108

Fastest Digital Addressable RGB Pixel LED

Description

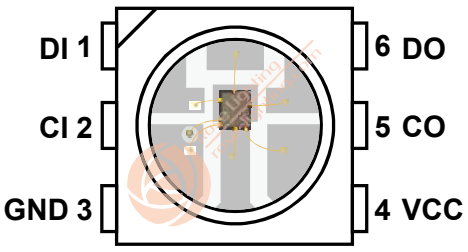
HD108 is a digital control LED light source which integrate control circuit and RGB LED chip in one package, and it provides the best full color lighting performance for RGB digital dimming control.
It featured a two-wire SPI interface instead of the proprietary one-wire protocol like WS2812, and many micro-controllers can drive it with their hardware SPI functions easily.
Also, HD108 has a bigger improvement to the digital RGB LED of APA102 and APA107 which support 65536 (16bits) grade color depth in R/G/B.
It can operates at a clock frequency of over 20MHz thus allowing a super fast data transmission rate.
Requiring a minimum number of external components, HD108 is not needed a decoupling capacitor at it`s power input pin. and it is compatible with a standard 6-lead 5050 package.
HD108 internally include intelligent digital port data latch, signal reshaping amplification drive circuit and a programmable constant current driver for RGB leds, effectively ensuring the pixel point light color consistent.

Features

☐ CMOS process, low voltage, low power consumption
☐ Higher brightness efficiency,large lighting beam
☐ Pure cooper bracket
☐ 5V power supply level, Power on no light in default
☐ Built-in high precision and high stability oscillator
☐ Built-in sleep function, no work no electric consumption
☐ PWM refresh rate at 28kHz
☐ Maximum Clock drive frequency / CKI: 40MHz (under extreme conditions)
☐ 16bits (65536 grades) Gray scale, 5bit (32 level) brightness adjustment for each R/G/B color

Applications

LED lamp, LED Strip, LED pixel module, LED billboard, LED screen



1	DI	Data Input
2	CI	Clock Input
3	GND	--
4	VCC	5V
5	CO	Clock Output
6	DO	Data Output

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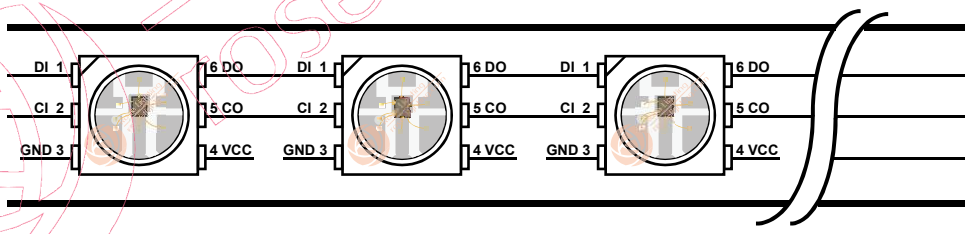
www.rose-lighting.com
Email: info@rose-lighting.com

PIN Description

Item	Symbol	Pin Name	Function Description
1	DI	Data Input	Control Signal Input Data
2	CI	CLK Input	Control Signal Input Clock Data
3	GND	Ground	Ground of Signal And Power Supply
4	VCC	Power	Power Supply Pin
5	CO	CLK Output	Control Signal Output Clock Data
6	DO	Data Input	Control Signal Output Data

Typical Application



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Absolute Maximum Ratings (Ta=25℃,VSS=0V)

Parameter	Symbol	Range	Unit
Power Supply Voltage	VDD	-0.5~+5.5	V
Logic Input Voltage	VIN	-0.3~VDD+0.3	V
R/G/B output current	IOUT	17	mA
Working Temperature	Topt	0~70	℃
Storage Temperature	Tstg	-50~125	℃
ESD Pressure（HBM）	VESD	2K	V

Electrical Parameters (TA=-20 ~ +70 ℃, VDD=5.0V, VSS=0V)

Parameter	Symbol	Min	Typical	Max	Unit
Supply voltage	VDD	4.3	5.0	5.3	V
The maximum current of LED	Imax	---	17	20	mA
High level voltage	VIH	2.7	-	5.3	V
Low level voltage	VIL	-0.3	-	0.7	V
The frequency of PWM	Fpwm	---	28	---	KHz
Static power consumption	IDD	---	---	1	uA

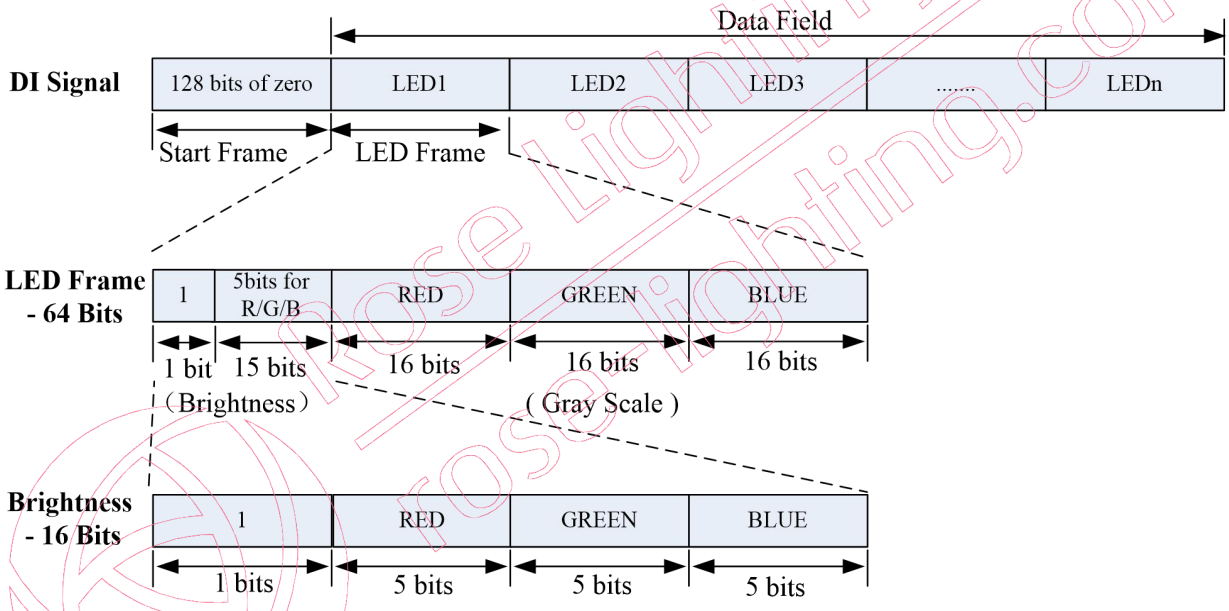
Remarks: The power supply voltage range of hd108 is recommended to be 4.3v~5.5v, which will not affect lumens. When the power supply voltage is lower than 3.7V, it will significantly affect the color temperature of white.

Operating Characteristic

HD108 is a full color digital control LED, and it uses a standard two wire SPI protocol, one clock line and one data line. Each LED has two inputs and two outputs which can be daisy chained, so it has a great advantage of being supported by standard micro-controller periphery and it is insensitive to timing variations, and the data can be transferred reliably at an arbitrary clock rate over 20MHz. HD108 uses PWM frequency of 27KHz to drive the R/G/B LED inside with constant current.

NOTE: The maximum clock rate is mainly limited by the parasitics of the wiring, so take care of the layout of components and wiring.

The data format is shown below.



Each update of data format consists of a start frame of 128 zeroes, 64 bits for every LED frame.
A minimum of 128 zeroes are required to initiate a new data update, and increasing the number of zeroes does not affect.
The LED frame consists of brightness bits and RGB gray scale bits, and it is identified by the first one bit following the start frame.

Brightness bits: 5 bits (32 level) for R/G/B brightness setting, while controlling R,G,B three-color constant current output value separately and in turn correspondingly.

DATA MSB←→LSB	Percentage of Driving Current
00000	1/32
00001	2/32
000	3/32
.....	.....
11110	32/32
11111	32/32(max)

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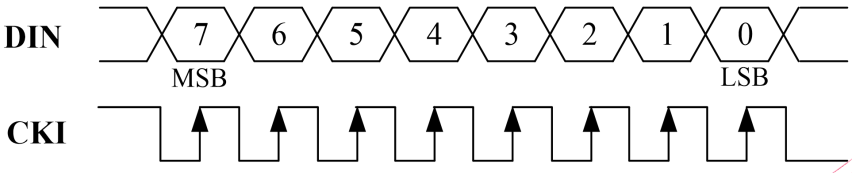
RGB gray scale bits: 16 bit (65536 level) gray scale setting, while controlling R,G,B color depth, and it generates 2^{48} colors.

DATA MSB←→LSB	Duty Cycle
0000 0000 0000 0000	0/65535
0000 0000 0000 0001	1/65535
0000 0000 0000 0010	2/65535
.....	.....
1111 1111 1111 1110	65534/65535
1111 1111 1111 1111	65535/65535(max)

The HD108 receives a valid SPI signal and outputs a valid SPI signal to the next devices. Once a device detects a start frame, it will interpret the next“1” bit as start of its LED frame. 64 bits are clocked into the shift registers, while zeroes are pushed to the output. After the entire LED frame has been read, any subsequent data is simply forwarded until another start frame is detected. The data line is valid only during the rise edge of the clock signal.

The one-byte of data format is shown below:



Calculation of Refresh Rate & Number of LED points

Refresh Rate :

Frame rate = 1 / [(128 + (64 x points)) x T-CKI] ;

unit: frames per second,

T-CKI: cycle of clock drive frequency;

Number of LED points = (F-CKI / Frame rate - 128) / 64;

To increase the number of cascaded LEDs, needs to increase the CKI frequency or decrease the frame rate.

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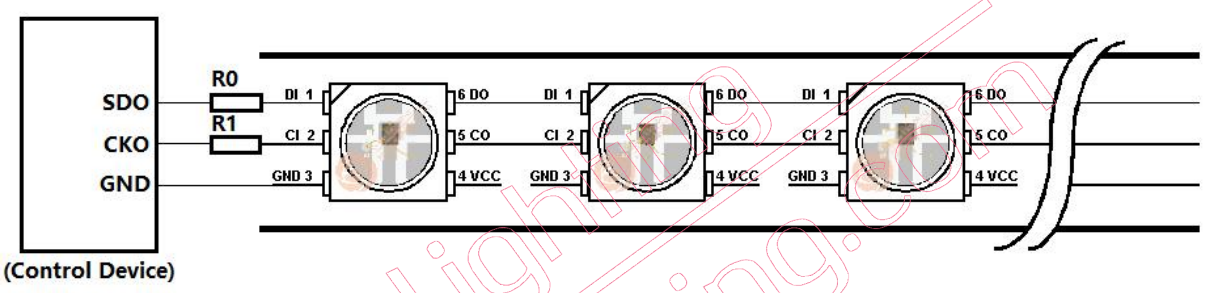
Typical application circuit



In the practical application circuit, in order to prevent the instantaneous high voltage generated by the hot plug of the product during the test from damaging the IC internal signal input and output pins, the protective resistors should be connected in series at the signal input and output terminals. In addition, in order to make the IC chips work more stably, a decoupling capacitor between the lamp beads is recommended;

Application 1: for soft light or hard light bar, if the transmission distance between light beads is short, it is recommended to connect protective resistors in series at the input and output ends of the signal clock line, that is R0 = R1 about 500Ω;

Application 2: it is used for modules or general special-shaped products. The transmission distance between lamp beads is long. Due to different wire and transmission distance, it is connected in series at both ends of the signal clock line, and the protective resistance will be slightly different, subject to actual use.

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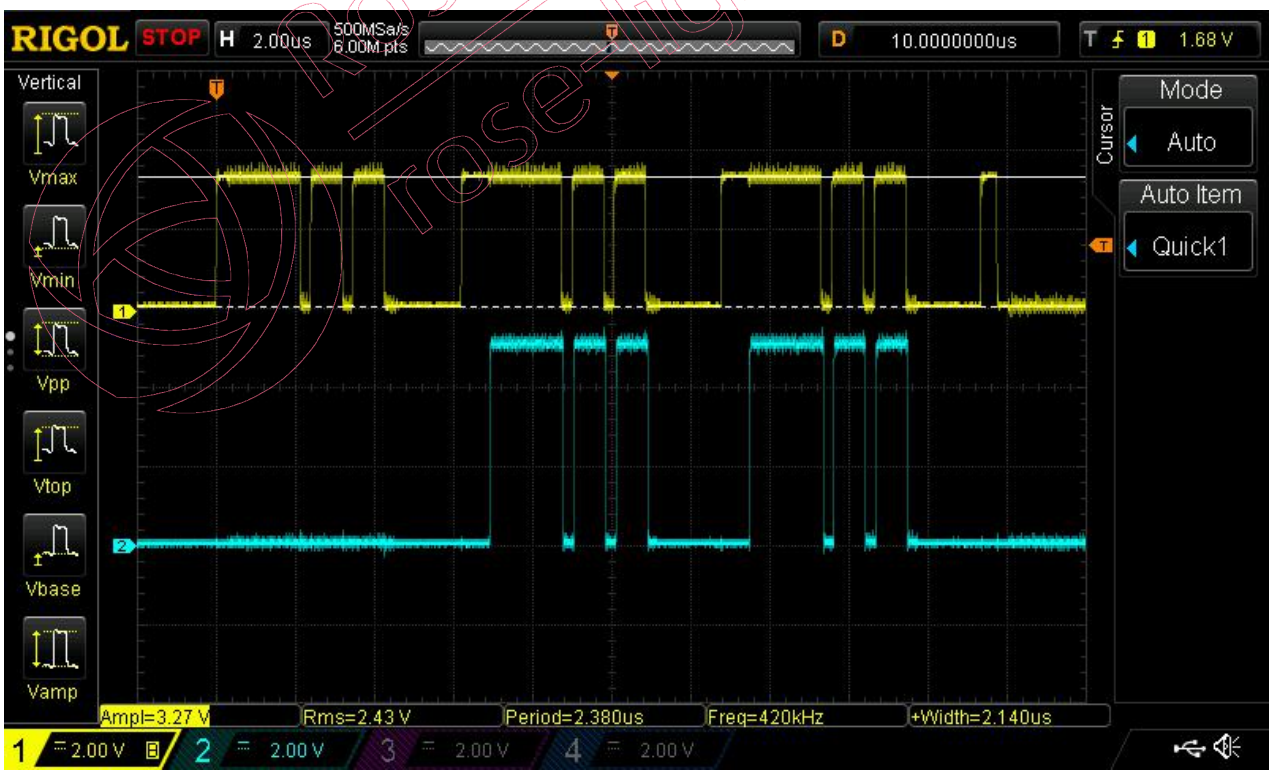
About level conversion

When HD108 is powered with 5.0V, and the common ground wire of a 3.3V device and HD108 is connected, the 3.3V device can directly drive HD108 to work normally without level conversion circuit.

The following figures show the test waveforms of CI and Co, Di and DO respectively (yellow is CI/DI, blue is CO/DO). When the amplitude of the input CI and DI signals is 3.3V, HD108 can stably work and shape and output the signal.



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Test of Switching Characteristics

Because different devices driving hd108 have different driving capabilities, typically, HD108 can operates at a clock frequency of over 20MHz thus allowing a super fast data transmission rate, under ideal driving conditions, it can reach 40MHz.
The following figure shows the signal waveforms of CI and DI under TA=25℃, VDD=5.0V, VSS=0V, FCKI=15Mhz, yellow indicates DI signal, blue indicates CI signal.

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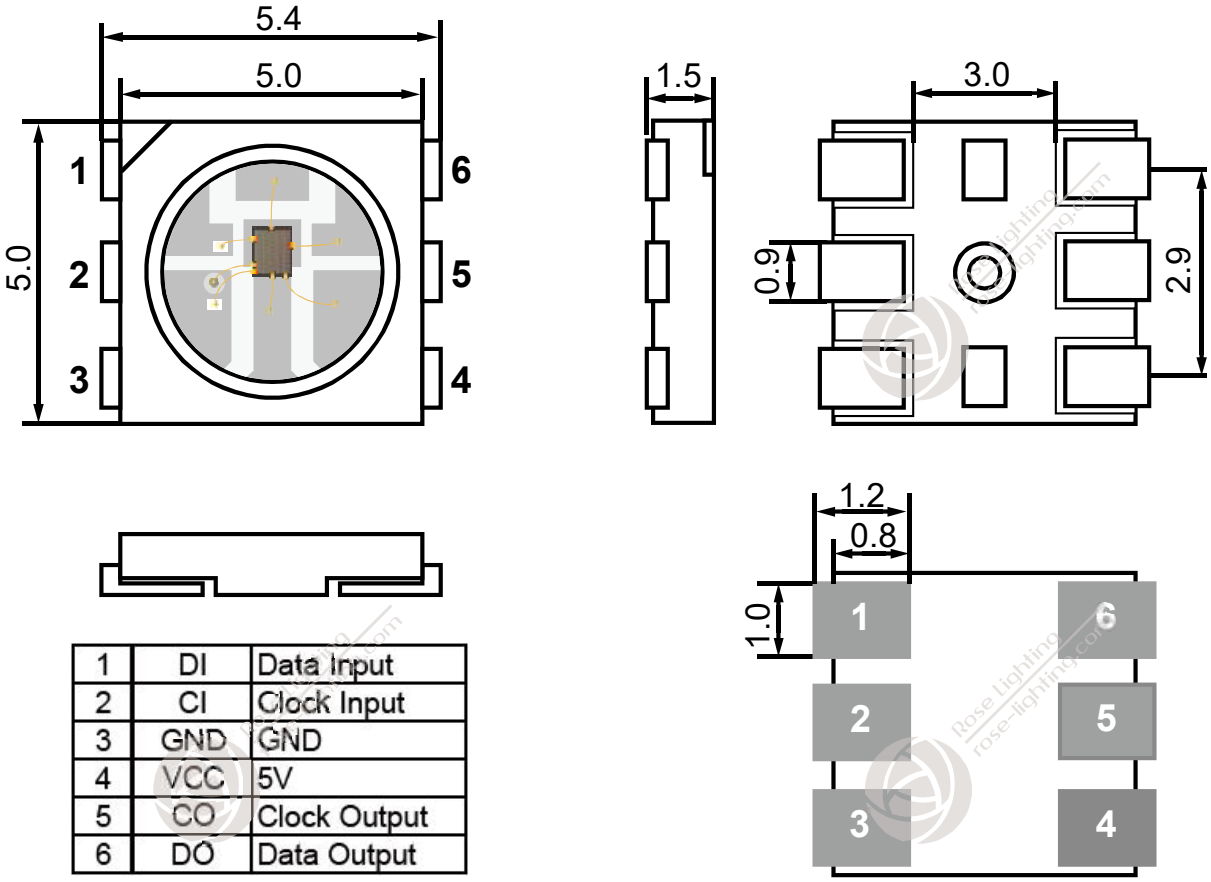
Package of HD108



1	DI	Data Input
2	CI	Clock Input
3	GND	GND
4	VCC	5V
5	CO	Clock Output
6	DO	Data Output

Remarks:

1. The unit of the above marks is in metric;
2. Unless otherwise noted, the dimensional tolerance is ± 0.1mm.

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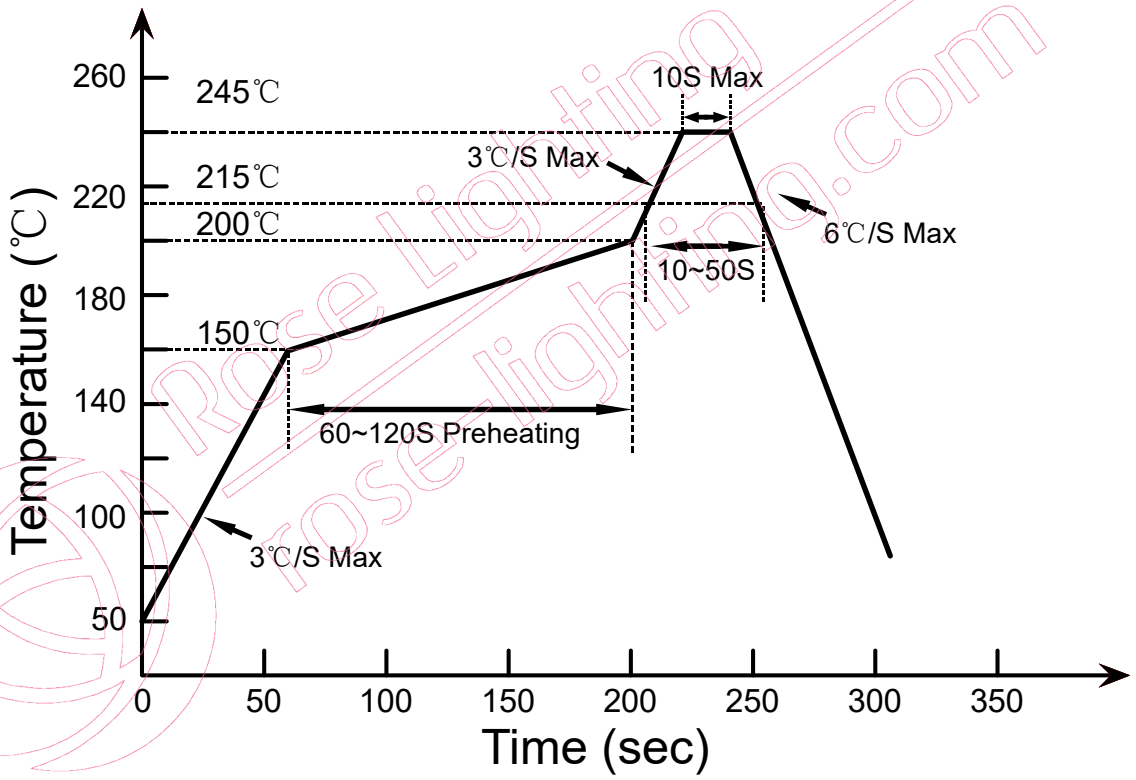
Recommended Reflow Characteristic

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.



Remarks:
1. These general guidelines may not apply to all PCB designs and reflow soldering configurations.
2. All temperatures referred are measured on the surface of the package body.

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