HD108 RGB Pixel led chip SPECIFICATION

The upgrade LED of HD108 LED but with 16 bits(65536 gray scale)

Model: HD108 5050 RGB Pixel LED chip

40MHz Clock Drive Frequency

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

V1.0.1Version Modification

Rev. No	Date	Reason of changes	Writer	Reviewer
V1.0	January 3, 2019	Create the document;	William Li	Zarine Wu
V1.0.1	March 18, 2019	Insert the block diagram; Add the part of “The difference of all kinds of digital LED”;	Tony He	Emily Smith

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

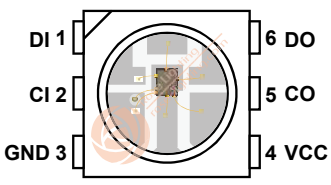
HD108 is a digital control LED light source which integrate control circuit and RGB LED chip in one package, and it provides the best full color lighting performance for RGB digital dimming control.
It featured a two-wire SPI interface instead of the proprietary one-wire protocol like WS2812, and many micro-controllers can drive it with their hardware SPI functions easily.
Also, HD108 is a more advanced version of digital RGB LED of APA102, so it is fully compatible with APA102.
It can operates at a oscillator frequency of 40MHz thus allowing a super fast data transmission rate and fastest PWM refresh rate over 27kHz, and it adjust the emitting color with 65536 (controlled by 16 bits) grades of gray scale and 32 grades (controlled by 5 bits) of brightness adjustment.
Requiring a minimum number of external components, HD108 is not needed a decoupling cAPAcitors at it`s power input pin. And it is available in 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 and Pure Gold lead inside
☐ Synchronization of two-line
☐ With higher energy saving mode, ideal for battery-powered application
☐ PWM refresh rate at around 27kHz
☐ Oscillator frequency / clock drive frequency / CKI: 40MHz
(APA102 with PWM frequency 20kHz, APA107 with 9kHz, sk9822 with 4.7kHz, sk6812/ws2812B with 800HZ)
HD108 Also date transmission speed: 40Mbps
☐ Built-in sleep function, no work no electric consumption
☐ Configurable positive output or negative RGB three-color LED output
☐ 256 Gray scale (8bits),
(16bits optional ,which will be on marker in September 2019),
5bit (32 level) brightness adjustment,
☐ Build-20ma constant current output With self-detection signal build in support for continuous oscillation PWM output, can be maintained static screen

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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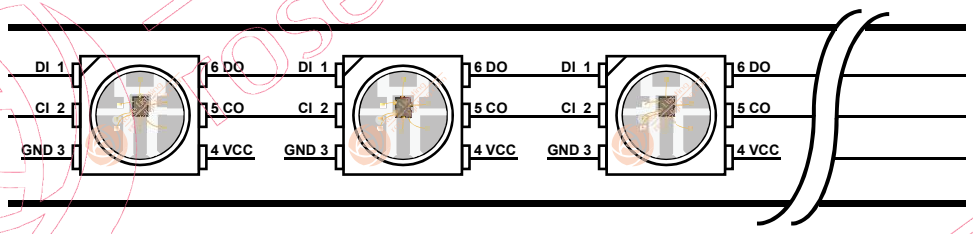
PIN Description

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

Typical Application



LED Specifications

Color	MCD	Refresh Rate	Voltage	Power Consumption	Weight (g)	Beam Angle	Dimensions (mm) L*W*H	Operating Temperature
R/G/B	R:400mcd G:1500mcd B:300mcd	400 fps	DC 5V	0.2W (MAX:1W)	1	145	5x5x1.4 3x3x1.4 2.0x2.0x0.6	-40-70℃

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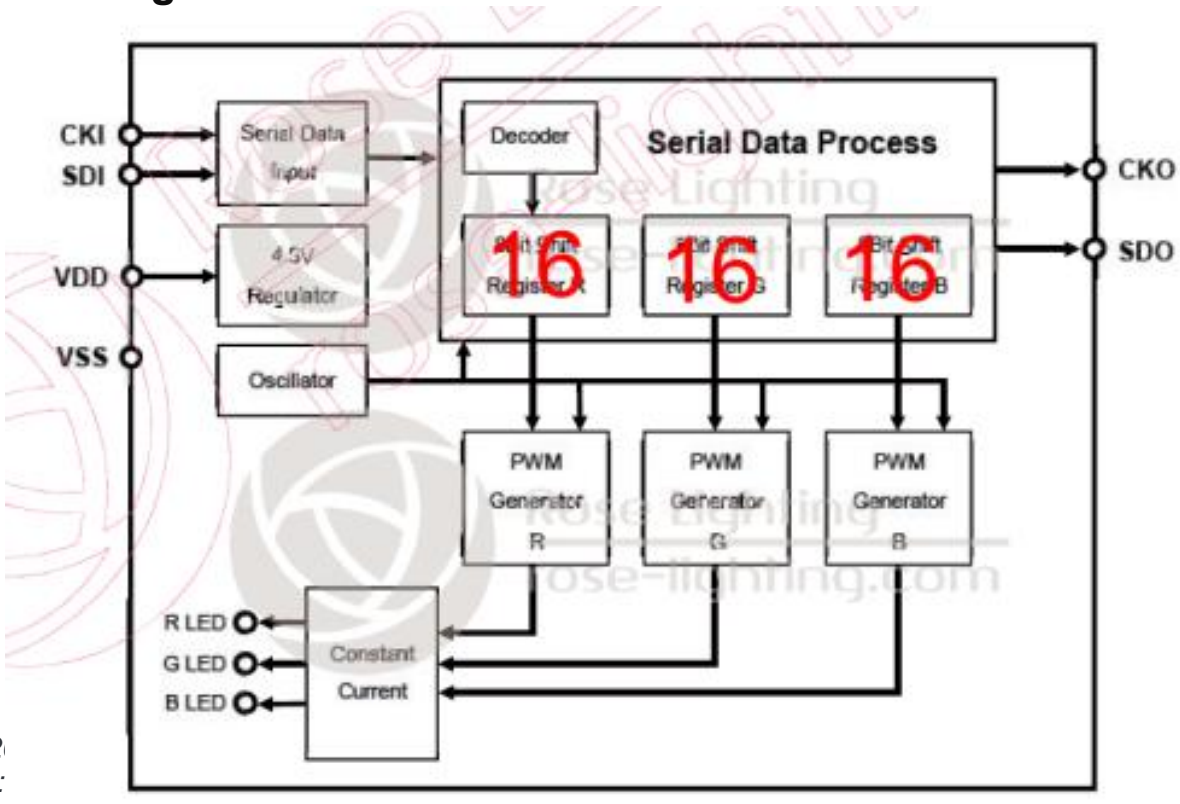
Absolute Maximum Ratings (Ta=25℃,VSS=0V)

Parameter	Symbol	Range	Unit
Power Supply Voltage	VDD	-0.5~+5.5	V
Logic Input Voltage	VIN	-0.3~VDD+0.3	V
Working Temperature	Topt	-20~+80	℃
Storage Temperature	Tstg	-50~+120	℃
ESD Pressure	VESD	4K	V

Electrical Parameters (TA=-20 ~ +70 ℃, VDD=4.5 ~ 5.5V,VSS=0V)

Parameter	Symbol	Min	Typical	Max	Unit	Test conditions
Supply voltage	VDD	---	5.0	5.3	V	---
The maximum current of LED	Imax	---	---	20	mA	---
The clock high level width	TCLKH	---	---	>30	ns	---
The clock low level width	TCLKL	---	---	>30	ns	---
Data set up time	Tsetup	---	---	>10	ns	---
The frequency of PWM	Fpwm	---	+ 27	---	KHz	---
Static power consumption	IDD	---	0	---	mA	---
MAX Transfer Speed	Fts_max	---	40	---	MHz	---

Block Diagram

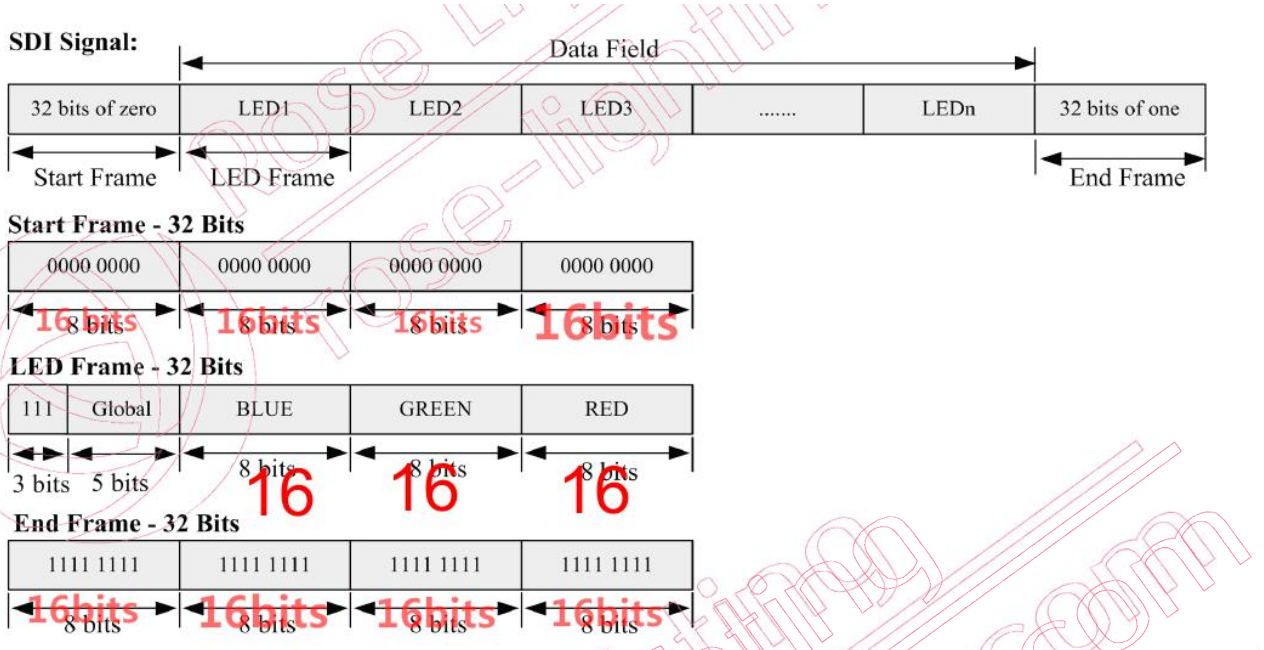


Operating Characteristic

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 under 40MHz. 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 32 zeroes, 32 bits for every LED frame and an end frame of 32 ones.A minimum of 32 zeroes are required for it to initiate a new data update, and increasing the number of zeroes does not affect.
The LED frame consists of global bit and RGB bit, and it is identified by the first one bit following the start frame.The LED output color is updated immediately after the first valid LED frame, and the most significant bit of the LED frame has to be “1”, as it is used to identify the start of the frame. And the next two bits serve no function but recommend to set them to “1”.
Global bit: 5 bit (32 level) brightness setting, while controlling R,G,B three-color constant current output value, if set the global bit for the 10000(16/31) is the output current is half again the original PWM settings. See diagram below:

DATA MSB←→LSB	Percentage of Driving Current
00000	0/31
00001	1/31
000	2/31
…..	…..
11110	30/31

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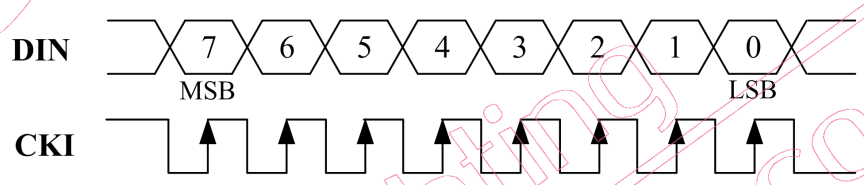
11111	31/31(max)

RGB bit: 16 bit (265536 level) gray scale setting, while controlling R,G,B color depth, and it generates 16777216 colors, if set the RGB bit for the “00000000 00000000 11111111” is the output of full RED. See diagram below:

DATA MSB←→LSB	Duty Cycle
0000 0000	0/256
0000 0001	1/256
0000 0010	2/256
.....	.....
1111 1110	254/256
1111 1111	65535/65536(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 (more than 31 zero bits), it will interpret the next “1” bit as start of its LED frame. 32 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 / [(64 + (32 x points)) x T-CKI] ;
unit: frames per second,
T-CKI: cycle of clock drive frequency;
Such as: 1024 points of LED, CKI frequency is 1MHz, T-CKI is 1/1MHz = 1us, so the frame rate = 1/ [(64+ (32 x 1024)) x 0.000001s] = 30.458 fps. It means refreshing about 30 frames in a second.
Number of LED points = (F-CKI / Frame rate - 64) / 32;
To increase the number of cascaded LEDs, needs to increase the CKI frequency or decrease the frame rate.

The difference of all kinds of digital LED

HD108 RGB pixel led chip with PWM refresh Rate >27kHz and PWM frequency is 40MHZ.
APA102 original RGB pixel led chip with PWM refresh rate 20kHz and PWM frequency is 20MHZ.
APA102C (packaged in china) (fake APA102).
SK9822 RGB pixel led chip with PWM refresh rate 4.7kHz and PWM frequency 2MHZ.

The comparison chart is as follows:

Chip-Set	Led Type	DATA (R6)	CLK (R7)	Color Bits	Data Rate	PWM Frequency
APA102C (fake APA102)	APA012C	√	√	8	20Mbps	20kHz
WS2801	WS2801	√		8	1Mbps	2.5kHz
WS2812/WS2811	WS2812/ WS2811	√		8	800kbps	400Hz
SK9822	SK9822	√	√	8	2Mbps	4.7kHz
APA107	APA107	√	√	8	30Mbps	9kHz
HD108	HD108	√	√	8,16	40Mbps	>27kHz
APA102 (original type)	APA102	√	√	8	20Mbps	20kHz
GS8208	GS8208	√		12	800kbps	800Hz
TM1804	TM1804	√		8	800kbps	400Hz
UCS1903	UCS1903	√		8	800kbps	Unknown
P9813	P9813	√	√	8	1-15Mbps	4.5kHz
SK6812	SK6812	√	√	8	800k bps	400 HZ
WS2815	WS2815	√		18	800kbps	800Hz

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Remark

HD107S 2020-RGB /HD107S 3535-RGB /HD107S 5050-RGB on the market already, The HD107S 5050-RGBW will on market In November2019

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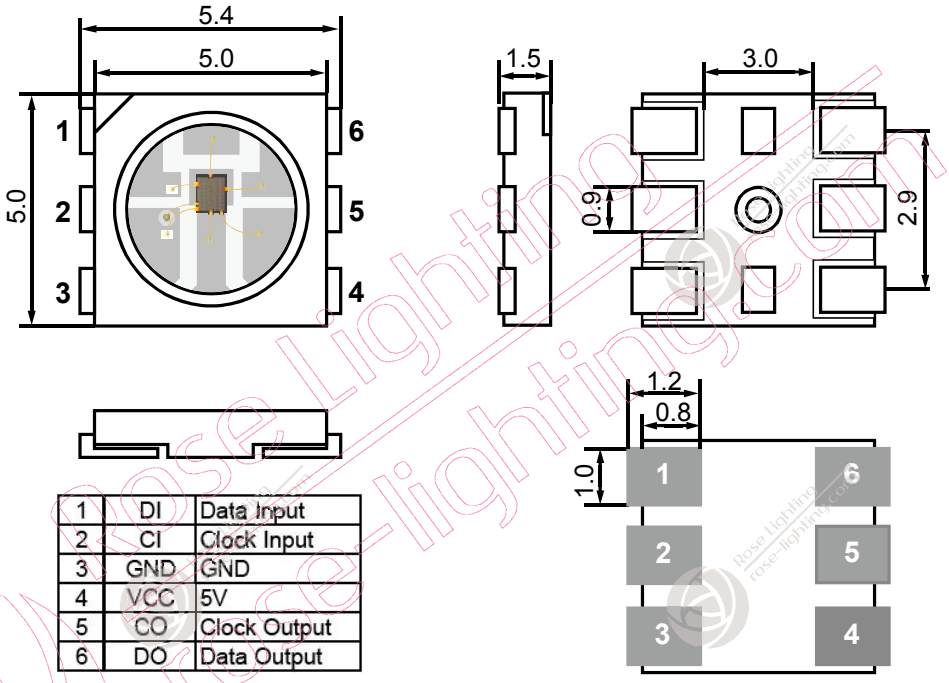
Package information for HD108 5050 RGB



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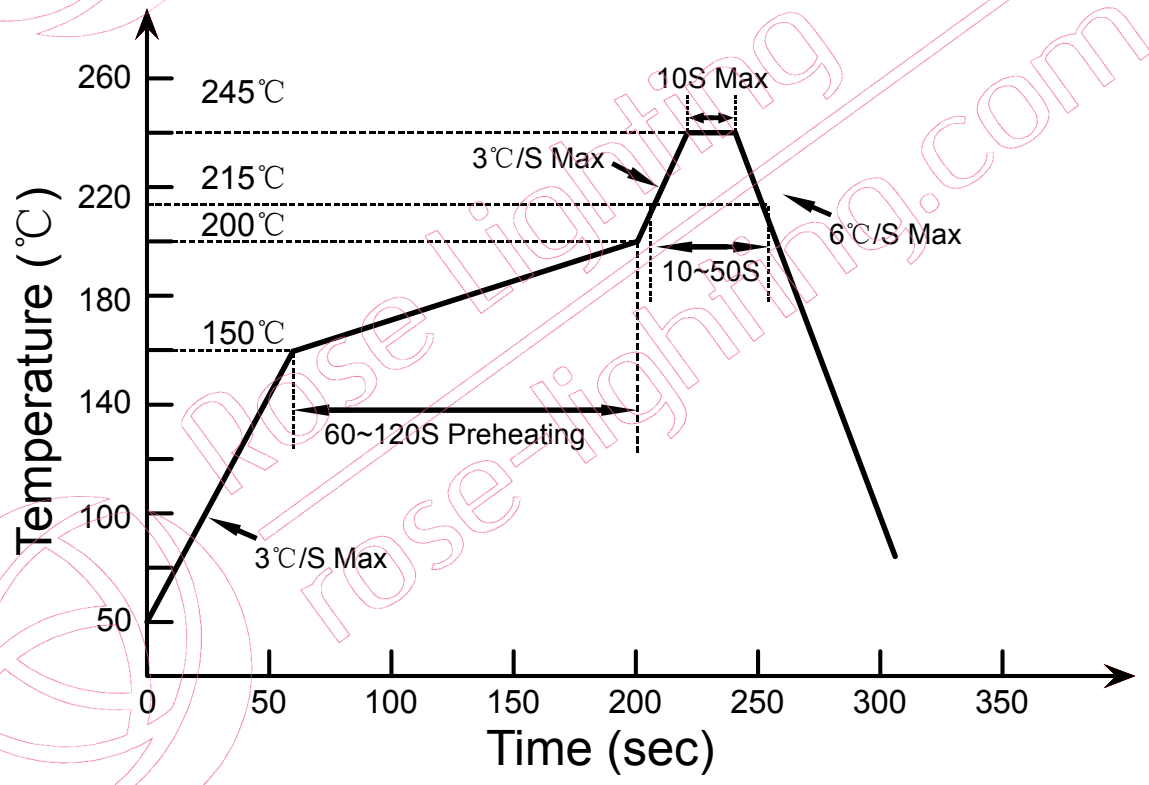
Recommended Reflow Characteristic (Lead-Free Solder)



Note: All temperatures refer to topside of the package, measured on the package body surface.

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