GREELED
格瑞电子

Fast PWM Rate

16bit Pixel led Datasheet

Specification

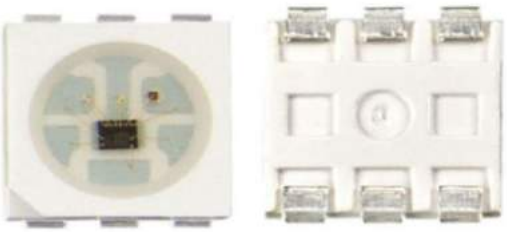
Model No.:APA102HB5050

Product: 5V SOP6 0.3W Pixel led

Document No.: SPC-TOP-C/230049

Issue Date :10-05-2023

Version: D-23



ELECTROSTAIC
SENSITIVE DEVICES

RoHS

CE

Greeled Approval		Customer Approval	
Aduit	Confirmation	Aprroval	Audit
Mr Chiang	Ms Lee		
Date:		□ Qualified	□ Disqualified
Reason:			

1.Feature:

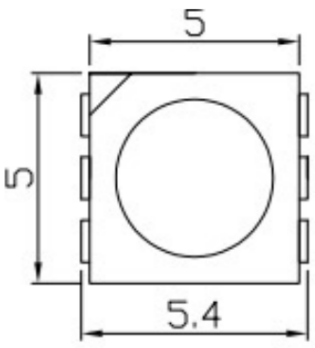
- RGB Chips and IC are integrated in one SMD5050 package as one pixel.Built in various function circuit units.
- Clock and data dual signal SPI Protocol,It is compatible with APA102
- The PWM scanning frequency up to 26KHz+.
- It can support data transmission rate at max 40Mhz Clock frequency(20Mbps)
- Double dimming function,64bit data frame, 5bit for dimming whole Red brightness, 5bit for dimming whole Green brightness, 5bit for dimming whole Blue brightness, 3*16bit 65536 grayscale to fixed color.
- Input voltage DC5V,Default output current 17mA Per color.
- No signal input when power on,No light.

2.Application:

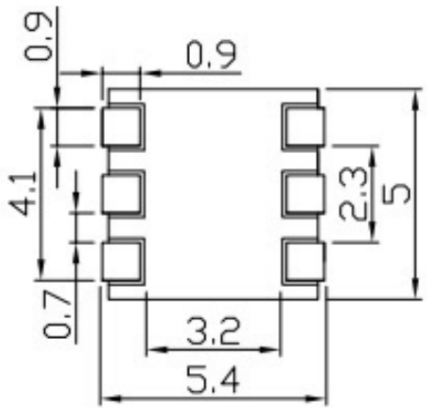
LED Billboard,LED Screen,Device etc.

3.Package dimension:

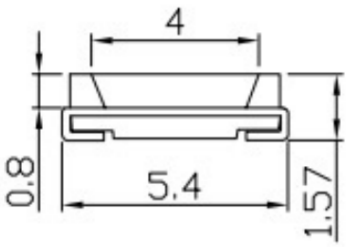
Front view



Back view

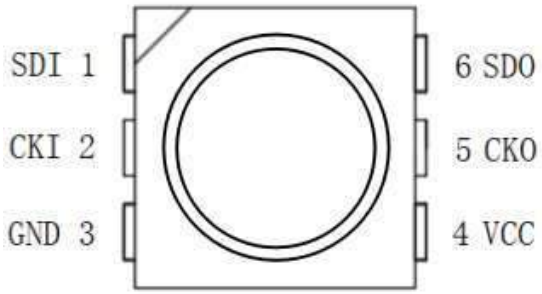


Side view



Remarks: All dimensions are marked in millimeters and the tolerance is ±0.15 mm, unless otherwise specified.

4.Pin diagram and function description：



No.	Symbol	Function description
1	SDI	Data signal input
2	CKI	Clock signal input
3	GND	Ground
4	VCC	Power supply
5	CKO	Clock signal output
6	SDO	Forwarding data signal out

5.RGB chip characteristic parameter Ta=25℃：

Color	Wavelength(nm)	Light Intensity（mcd）	Lumen（LM）
Red	620-630	480-800	1.5-2.5
Green	520-535	1200-1500	4.0-5.0
Blue	460-475	300-600	1.0-2.0

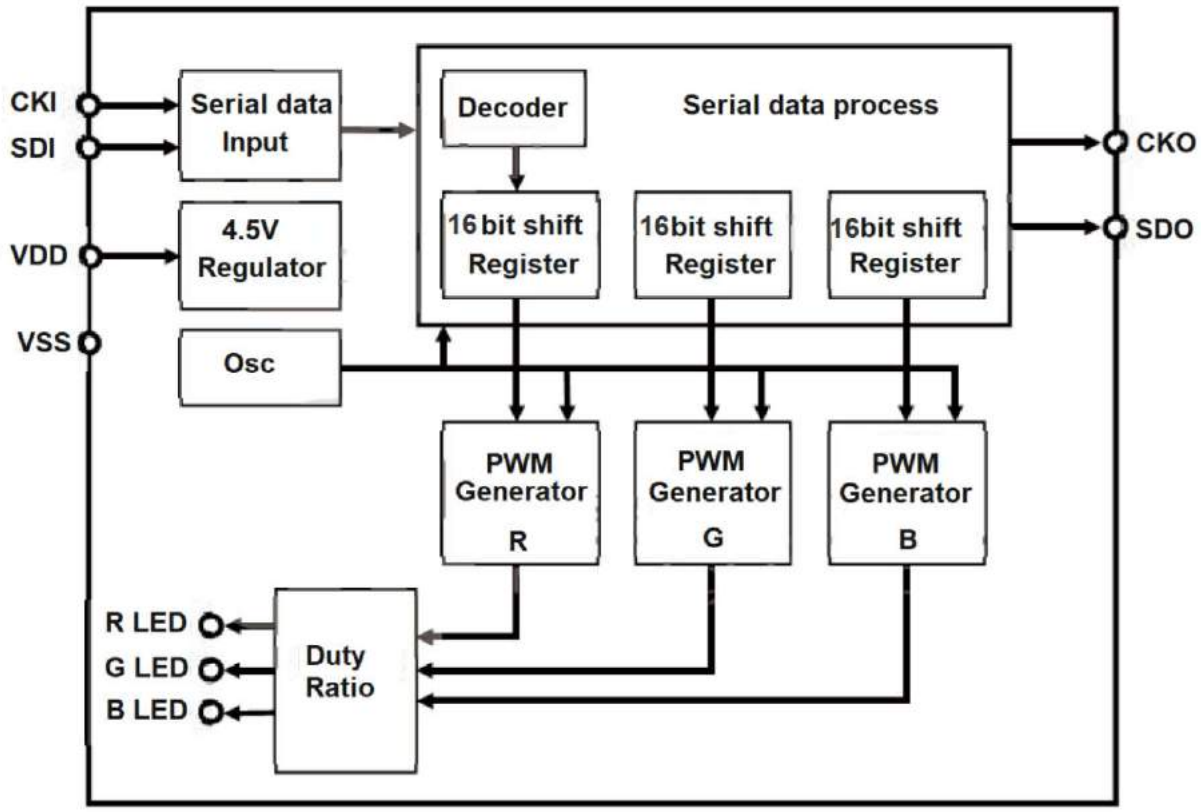
6.Electrical parameters (limit parameters, unless otherwise specified, Ta=25℃):

Parameter	Symbol	Range	Unit
Voltage	VDD	-0.5～+5.5	V
Logic input voltage	VI	GND-0.3～VDD+0.3	V
Working temperature	Topt	-40～+85	℃
Storage temperature	Tstg	-50～+85	℃
ESD pressure（Device mode）	VESD	200	V
ESD pressure（body mode）	VESD	2000	V

7.Electrical characteristics (if no special instructions, VDD=5V, Ta=25℃):

Parameter	Symbol	Min	Typical	Max	Unit	Test Conditions
The chip supply Voltage	VDD	-	5.0	5.3	V	-
R/G/B port output current	IOUT	-	17	20	mA	-
Clock high level width	TCLKH	-	-	＞30	ns	-
Clock low level width	TCLKL	-	-	＞30	ns	-
Data creation time	Tsetup	-	-	＞10	ns	-
PWM output frequency	Fpwm	-	26	28	KHz	-
Static current	IDD	-	1	-	uA	
Data rate	bps_max	-	-	20	Mbps	-
High level	VIH	3.5	-	5.3	V	
Low level	VIL	-0.3	-	1.5	V	

8.Block Diagram



9.Data communication protocol description (Dual signal SPI Protocol):

(1) The data format as below

SDI

128 bit 0	LED 1	LED 2	LED 3	----------	LED N	32 bit 0
Start Frame	Data Frame	Data Frame	Data Frame		Data Frame	End Frame

Start Frame 128bit

0000 0000 ---0000	0000 0000 --- 0000	0000 0000 --- 0000	0000 0000 --- 0000
32bit	32bit	32bit	32bit

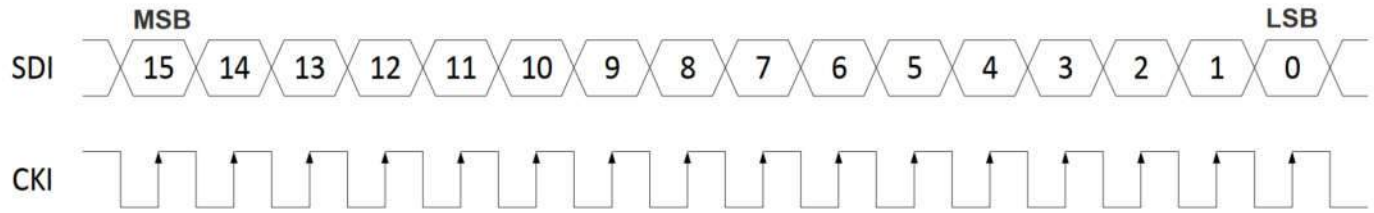
Data Frame

1	Brightness adjustment			BLUE	GREEN	RED
1bit	B	G	R	16bit	16bit	16bit
	5bit	5bit	5bit			
	High bit priority			High bit priority	High bit priority	High bit priority

End Frame

00000000	00000000	00000000	00000000
8bit	8bit	8bit	8bit

Each updated data format include 128 bit 0 start frame ,many 64 bit data frame and 32bit 0 end frame.Min 128 bit 0 are required for it to initiate a new data update, and increasing the number of zeroes does not affect. The Data frame consists of brightness adjustment bit and BGR bit, and it is identified by the first 1 following the start frame.The LED output color is updated immediately after the first valid data frame, and the most significant bit of the data frame has to be "1", as it is used to identify the start of the data frame. Brightness adjustment bit: 15 bit ,5bit/color (32 level) brightness setting, while controlling R,G,B three-color constant current output value, if set the brightness adjustment bit for the 1000011000001000(Blue 16/31, G 24/31,Red 8/31 of original PWM setting) See diagram below:



brightness adjustment (5bit per color) MSB---------LSB	Percentage of driving Current
00000	0/31
00001	1/31
----------	---------
01010	6/31
01011	7/31
---------	--------
10100	20/31
---------	--------
11111	31/31

(2) 16bit Per color, R/G/B 256Grayscale setting

R/G/B grayscale setting (16bit) MSB---------LSB	Duty Ratio Brightness level
0000 0000 0000 0000	0/65535
0000 0000 0000 0001	1/65535
----------	---------
0000 0000 0101 0000	80/65535
0000 0000 0101 0001	81/65535
---------	--------
1000 0000 1010 0000	32928/65535
---------	--------
1111 1111 1111 1111	65535/65535

(3) Color bit sending sequence

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
G15	G14	G13	G12	G11	G10	G9	G8	G7	G6	G5	G4	G3	G2	G1	G0
R15	R14	R13	R12	R11	R10	R9	R8	R7	R6	R5	R4	R3	R2	R1	R0

Note: The high bit is sent first, and the data is sent in the order of (B15 → B14 →……R0)

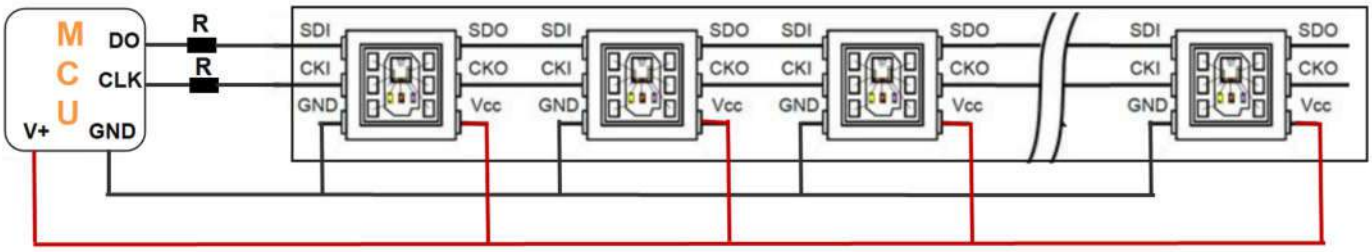
(4) Calculate refresh rate

Refresh rate=1/((256+(64*Pixel Qty))*T-CKI) (unit frame/second)
T-CKI means Clock cycle
For example: 1024 Pixel, CKI frequency is 2Mhz,
T-CKI is 1/2MHz = 0.5us, so the refresh rate = 1/ [(256+ (64 x 1024)) x 0.0000005s] = 30.38 fps.
It means refresh rate about 30 frames in a second

(5) Calculate the number of pixel

Number of LED pixel = (F-CKI / refresh rate - 256) / 64;
F-CKI means Clock frequency
Do increase the number of cascaded pixel, it needs to increase the CKI frequency or decrease the refresh rate.

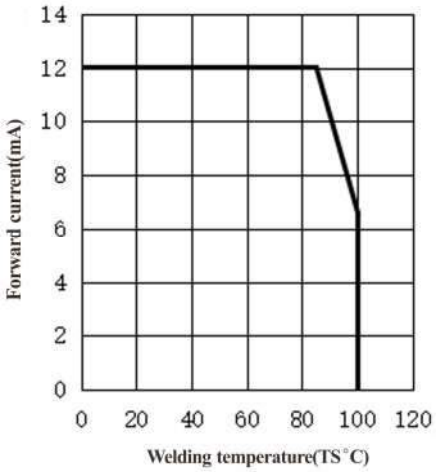
10.Typical application circuit：



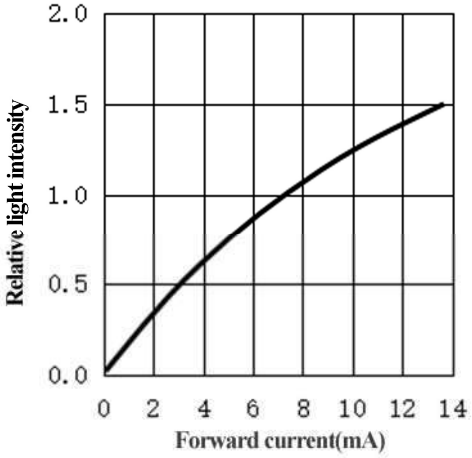
The signal input and output terminals of the product need to be connected in series with a protective resistor R when necessary . The value of the protective resistor R depends on the number of cascaded led. The more the number of cascades, the smaller the R. Generally, The value between 27-51 ohms is recommended. The recommended value is around 33 ohms.

11.Typical optical characteristic curve:

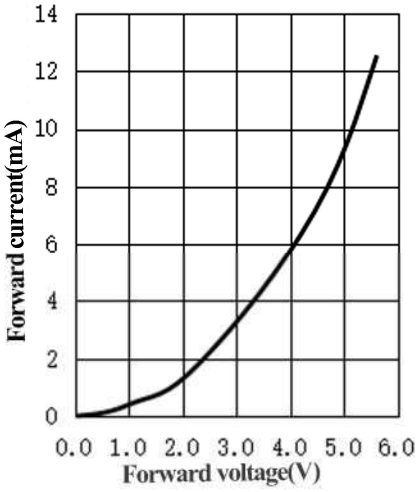
Welding temperature VS Forward current



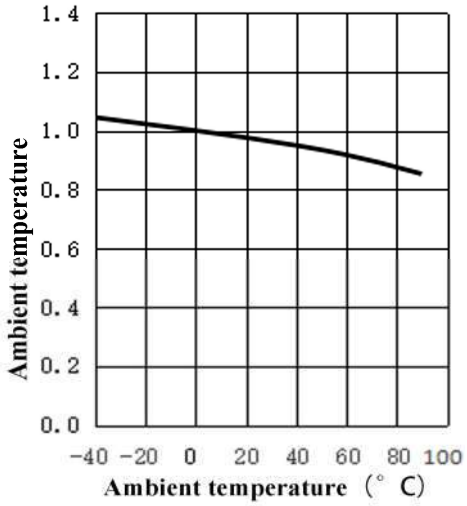
Forward current VS Relative light intensity



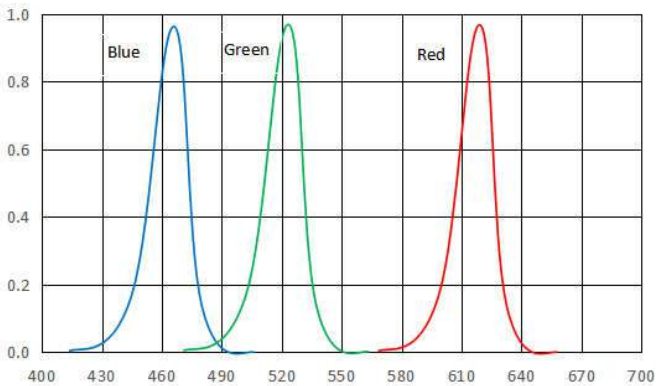
Forward voltage VS Forward current



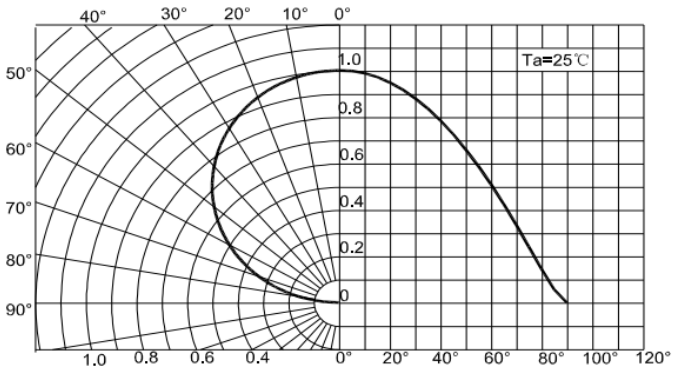
Ambient temperature VS Rrelative light intensity



Relative spectral distribution chart

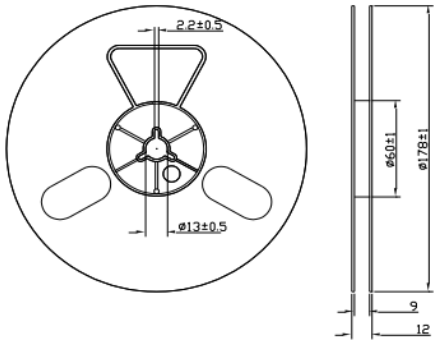


Relative spectral distribution chart

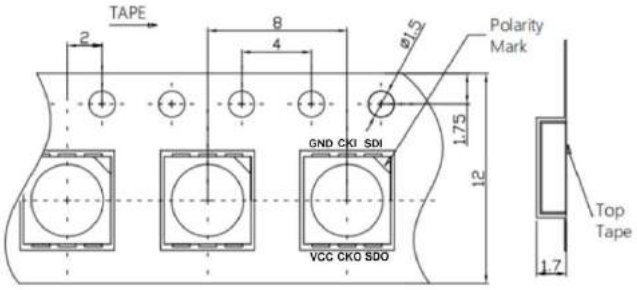


12.Packing specifications:

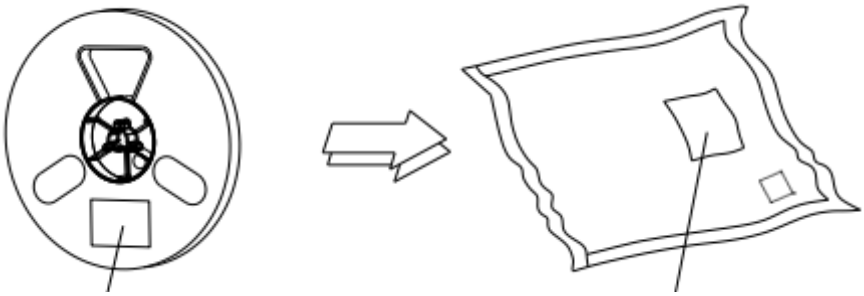
Reel size:



Carrier tape specifications (unit: mm)



Moisture-proof bag packaging:



Label Label

Note: The marked tolerance is ±0.1mm, unit: mm

Model No.	Description	Qty/bag	Bag/Ctn
APA102HB5050	SMD5050,6feet,RGB,16bit/color	1000pcs	50bag

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