东莞市欧思科光电科技有限公司
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Factory : 7 Weier Road, Qishi Town, Dongguan City. guangdong province, China
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Specification

Document No.: OSK-SPC- SK9816

Product No.: SK9816

Sample No.: OPO123

Description: 5.5x5.0x1.6mm Top SMD Type 0.3Watt Power Single linetransmission And High grade grey level tegrated light source Intelligent control LED （5a)

Rev. No.: A/0

Date: 2021-03-23

Customer approval			Opsco approval		
Approval	Review	Confirmation	Approval	Review	Confirmation
			朱更生	吴振雷	周 凯
☐Qualified ☐Disqualified Stamp			Stamp		

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Change History

Date	Rev. No.	Changes/Reason of changes	Signature
2015-07-08	01	Initial Document	KEVIN ZHU
2017-07-14	02	Modify the usage specification	KEVIN ZHU
2018-05-18	03	Fix internal data structure	KEVIN ZHU
2019-01-21	04	Revision of Specification Format	KEVIN ZHU
2021-03-23	A/0	Modify product specifications andphotoelectric parameters	KAEN ZHOU

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1. Product Overview :

SK9816 is an intelligent external control LED light source that integrates a single-wire transmission three-channel (RGB) drive control circuit and a light emitting circuit. The product contains signal decoding module, data buffer, built-in constant current circuit and RC oscillator; internal integrated current gain control module, CMOS process, low voltage, low power consumption; default output of three-channel constant current driver is 19mA, single-wire output is adopted, The output actions of each chip in series are synchronized; the power-on default is no light. Unipolar NRZ data protocol of communication, the transmission-line LED driving control dedicated chip, while the chip built-in current gain adjustment function, setting the current 1.75mA ~ 19mA, a total of 16 current gain levels; refresh rate of the PWM signal is high 4KHz, displays become more smoother, dark streaks solve the shooting screen;

2. Main Application Field:

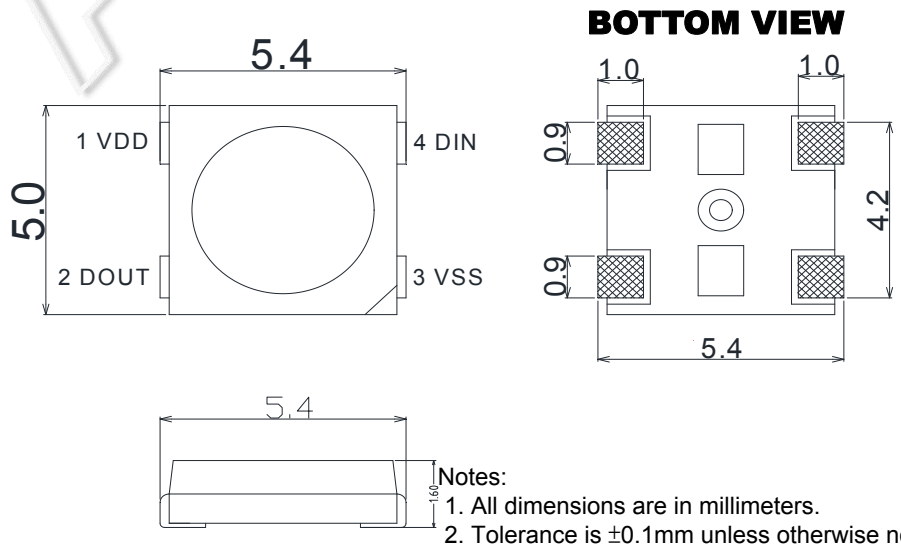
● **Full color LED string light, LED full color module, LED super hard and soft lights, LED guardrail tube, LED appearance / scene lighting**

● **LED point light, LED pixel screen, LED shaped screen, a variety of electronic products, electrical equipment etc..**

3. Description:

● **Top SMD internal integrated high quality external control line serial cascade constant current IC; 5V application; default on electric lights;**
● **Control circuit and the RGB chip in SMD 5050 components, to form a complete control of pixel, color mixing uniformity and consistency;**
● **Single-wire synchronous control, built-in one-way transmission function, the concatenation shaped output; prevent attenuation data;**
● **OUTR/G/B each 4bits current gain adjustment bit, grayscale adjustment circuit ((gamma correction) 65536 gray scale adjustable);**
● **Current driver as high-accuracy and high stability oscillator, current error <± 5%.**
● **Built-in PWM patented technology, refresh rate up to 4KHz, signal transmission rate of 800Kbps.**
● **When sending current gain data, all need to send 16bits current gain adjustment bit. When sending RGB three-color current gain bits, the reserved 4bits gain data is also randomly input, but it can not be null; any data can be sent.**

4. Mechanical Dimensions:



Notes:
1. All dimensions are in millimeters.
2. Tolerance is ±0.1mm unless otherwise noted

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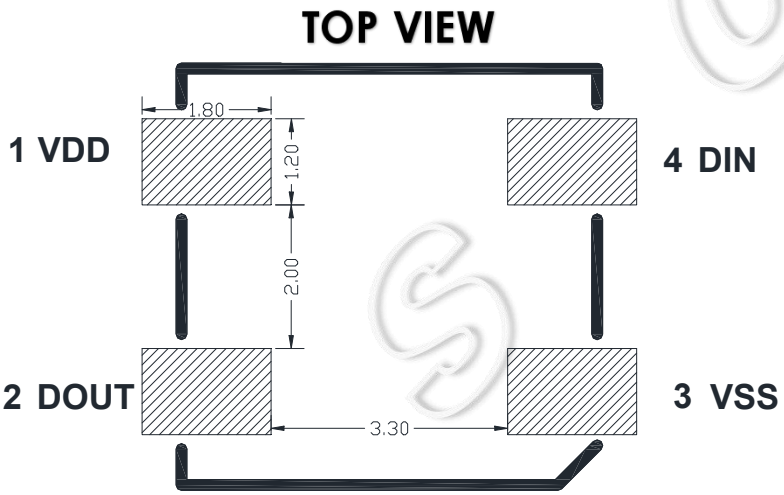
5. PIN configuration

Item	Symbol	Pin Name	Function description
1	VDD	Power	power supply pin
2	DOUT	Data Input	Series data output and internal strong drive output
3	VSS	Ground	The signal and power supply and grounding
4	DIN	Data Input	control signal Input data

6. Recommended dimensions for PCB



7. General description of product naming.

SK 9816-X-X

① ② ③ ④

①	②	③	④
Series	IC series and current code	PPA Surface Color	Packaging glue color
The default is to integrate the RGB chip with the IC in the 5.4x5.0x1.6mm package outline	Refers to the 9816 series IC 2~19MA current version（Adjustable current）	B: Black faceW: White face, usually not marked.	D: Represents diffusion/grindingW: It means transparent, not labeled.

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8. Electrical Parametres（Ta=25℃,VSS=0V）：

Parameter	Symbol	Range	Unit
Power supply voltage	VDD	+3.7～+5.5	V
Logic input voltage	V_{IN}	-0.4～VDD+0.4	V
Working temperature	Topt	-40~+85	℃
Storage temperature	Tstg	-40~85	℃
ESD pressure(HBM)	V_{ESD}	>2K	V
ESD pressure(DM)	V_{ESD}	200	V

9. Electrical/Optical Characteristics:

Color	SK9816 2-19mA	
	Dominate Wavelength(nm)	Luminance(mcd)
Red	620-625	320-580
Green	520-530	815-1275
Blue	460-470	160-320

10. The IC electrical parameters (unless otherwise specified, TA=-20 ~ +70 ℃, VDD=5.0V, VSS=0V):

Parmeter	Symbol	Min	Typical	Max	Unit	Test conditions
The chip supply voltage	VDD	3.5	5.0	5.5	V	---
Static power consumption	I_{DD}	---	2.5	---	mA	VDD=4.5V,Iout"OFF"
The signal input flip threshold	VIH	0.7*VDD	---	---	V	VDD=5.0V
	VIL	---	---	0.3*VDD	V	
The biggest LED output current	I_{max}	1.75	---	19.0	mA	V_{DS} =2V, current gain setting 0000~1111
The frequency of PWM	FPWM	---	4.0	---	KHZ	---
OUT R/G/B leak current	I_{leak}	---	---	1	uA	V_{DS} =15V, Iout"OFF"
OUT R/G/B constant current knee point voitage	V_{DS-s}	---	0.5	---	V	I_{OUT} =5mA
		---	0.7	---	V	I_{OUT} =12mA
		---	0.7	---	V	I_{OUT} =19mA
OUTR / G / B port current variation	%VS.V_{DS}	---	1.0	---	%	V_{DS} =1~3V, I_{OUT} =19mA
	%VS.VDD	---	1.0	---	%	VDD =4.2~5.2V, I_{OUT} =19mA
	%VS . Temp.	---	---	6.0	%	I_{OUT} =19mA,Temp=-40~+85℃

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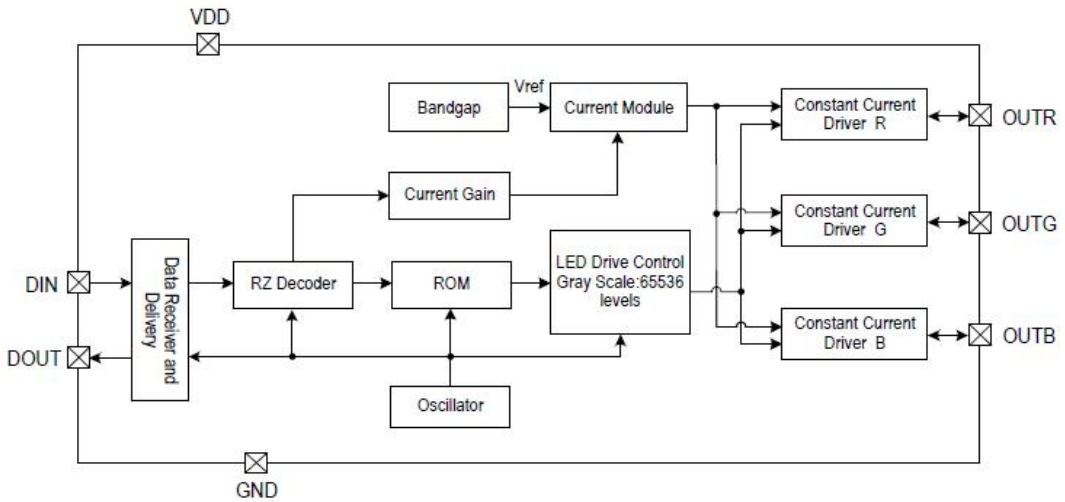
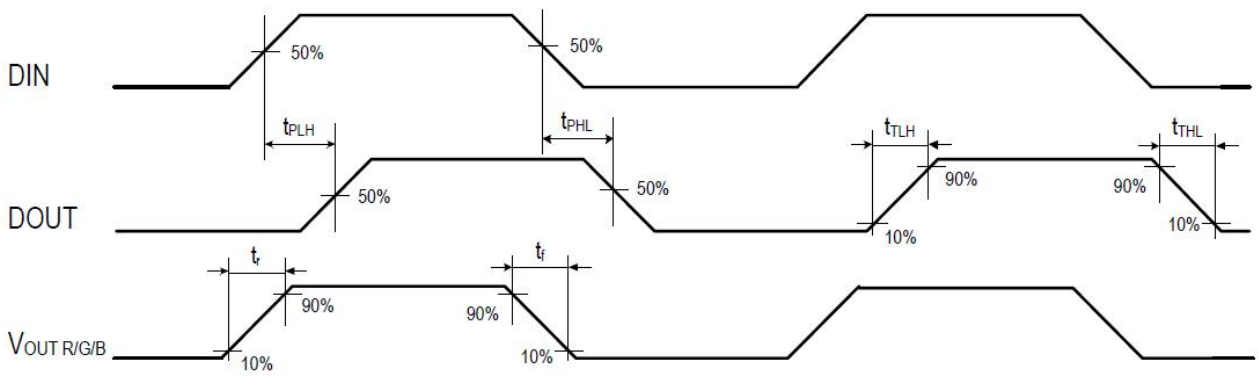
11. Internal functional framework



12. Switching characteristics (VCC = 5V ± 5%, Ta = 25 ° C):

Parameter	Symbol	Min	Typical	Max	Unit	Test conditions
The speed of data transmission	F_{PWM}	---	4.0	---	KHZ	I_{OUT} =19mA,OUT R/G/B connects 200Ω resistor to VDD
Signal transmission delay	T_{PLH}	---	65	---	ns	DOUT load capacitor to ground:30pF DIN to DOUT signal,transmission delay
	T_{PHL}	---	55	---	ns	
DOUT Transfer time	T_{TLH}	---	3.0	---	ns	DOUT load capacitor to ground:30pF
	T_{THL}	---	3.0	---	ns	
OUT R/G/B transfer time	T_r	---	55	---	ns	I_{OUT} =19mA,OUT R/G/B connects 200Ω resistor to VDD load capacitor to ground:15pF
	T_f	---	60	---	ns	



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13. Data communication protocol:

(1) Code Description:

The protocol of the SK9816 adopts single polarity RZ code, LOW level must be contained in each code element. Each code element in the protocol initiates with HIGH level , and the width of the HIGH level time determines 0 code or 1 code.

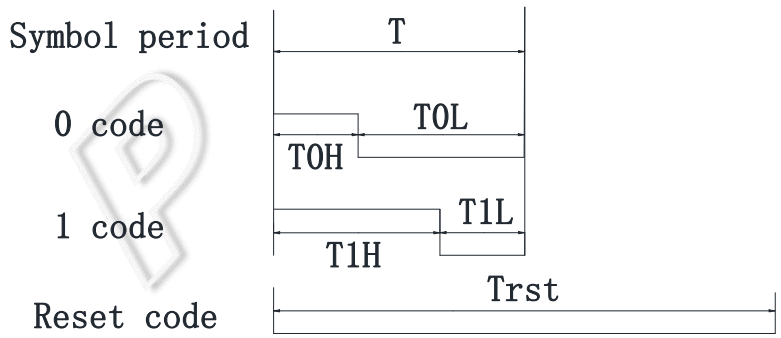
Symbol		Min.	Typ.	Max.	Unit
T	Code element period	1.20	--	--	μs
T0H	0 , HIGH level	0.2	0.3	0.4	μs
T0L	0 , LOW level	0.8	0.9	--	μs
T1H	1 , HIGH level	0.8	0.9	1.0	μs
T1L	1 , LOW level	0.2	0.3	--	μs
Trst	Reset，LOW level	>80	--	--	μs

When writing the program, the minimum code period is 1.2us.

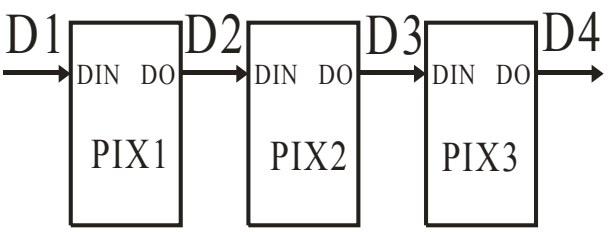
The high level time of 0 and 1 code should be in accordance with the specified scope of the above table, and the low level time of 0 yards and 1 yard is less than 20us.

14. Timing waveform:

Input code:



Connection mode:



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(2) Protocol Data Format:

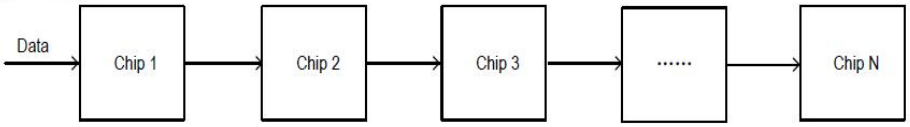
Trst+ First chip 24bits data +Second chip 24bits data +……+ The N chip 24bits data +16bits current gain +Trst

- 24bits gray scale data structure: High levels first, sent by the order of RGB

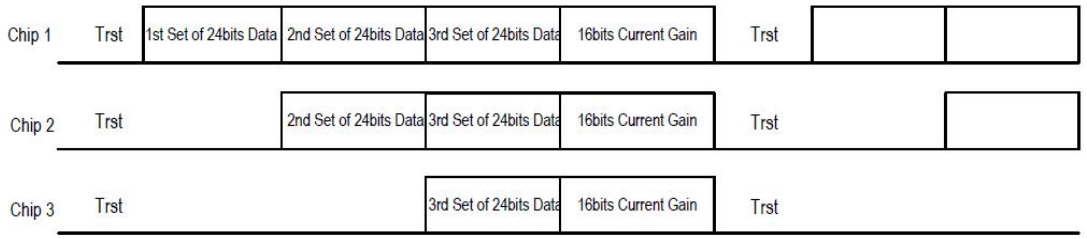
R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0

bit23……bit0

- System Topological Graph:



- Input Data Stream of every chip (3 chips as an example):



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Total current gain data:16bits, with 4 reserved bits and 4 bits RGB current gain adjustment for each color, respectively Correspond 4bits(S3~S0). The system order is to send 4 bits of R first, then 4 bits G, 4bits of B, 4 bits of reserved. High

Level S3 sent first , low level S0 at last.

Current gain parameter transmission format			
Red（R)	**Green（G)**	**Blue（B)**	**Reserved bit**
S3 , S2 , S1 , S0	**S3 , S2 , S1 , S0**	**S3 , S2 , S1 , S0**	**S3 , S2 , S1 , S0**

Note: Reserved bits data do not affect current gain adjustment.

Maximum output current of OUT R/G/B is 19mA. Users can regulate other current value by changing current gain value. The current value refers to the sheet below :

Current regulation level	Current gain adjustment bit				Corresponding current value (mA)
	S3	S2	S1	S0	
1	0	0	0	0	1.75
2	0	0	0	1	2.90
3	0	0	1	0	4.05
4	0	0	1	1	5.20
5	0	1	0	0	6.35
6	0	1	0	1	7.50
7	0	1	1	0	8.65
8	0	1	1	1	9.80
9	1	0	0	0	10.95
10	1	0	0	1	12.10
11	1	0	1	0	13.25
12	1	0	1	1	14.40
13	1	1	0	0	15.55
14	1	1	0	1	16.70
15	1	1	1	0	17.85
16	1	1	1	1	19.00

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15. Constant Current Characteristic:

When it gets to constant current knee point voltage, MW1863-DICE output current is not affected by V_{DS}.

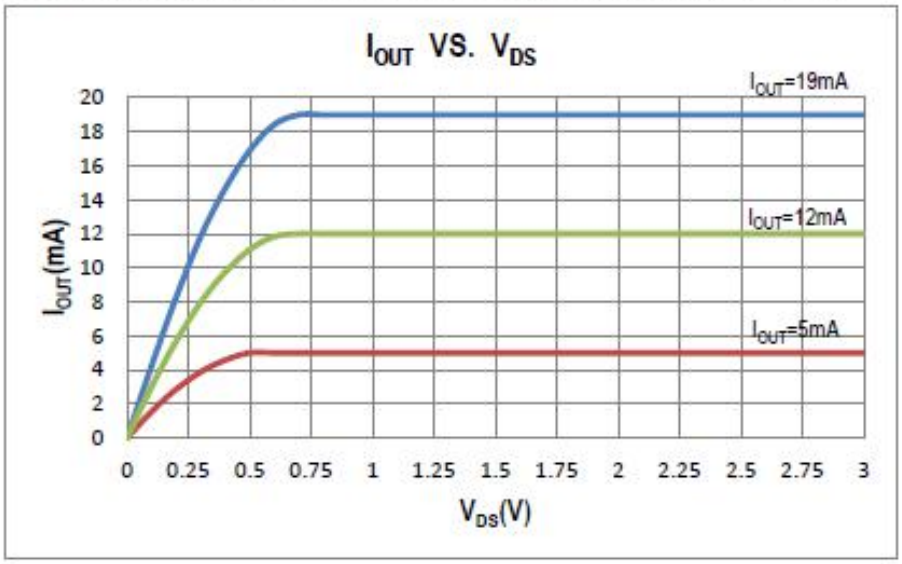

Fig. Relationship diagram between I_{OUT} and V_{DS}

Output Current Setting

Maximum OUT R/G/B output current is 19mA. When current gain is in 16-level, the maximum current value is 19mA.

Current gain is in 1~16-level, output current value is set by the formula below:

$$I_{OUT}(mA) = 1.75 + 1.15 \times (G - 1)$$

G is current gain (1~16-level). When G=1, I_{OUT}=1.75mA, when G=16, I_{OUT}=19mA.

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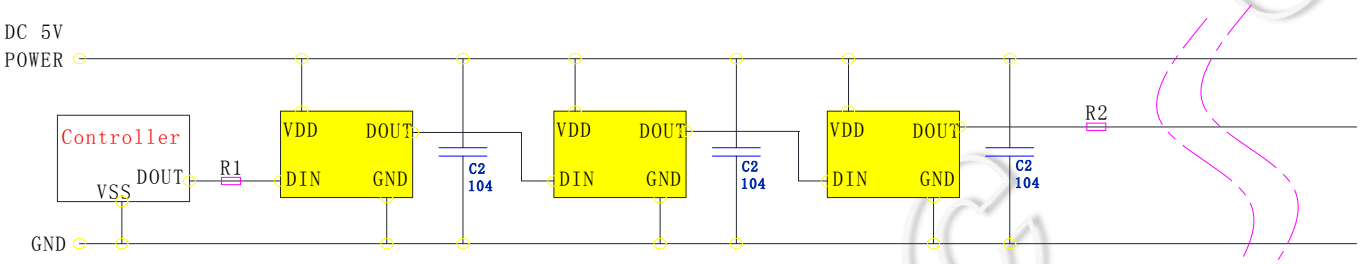
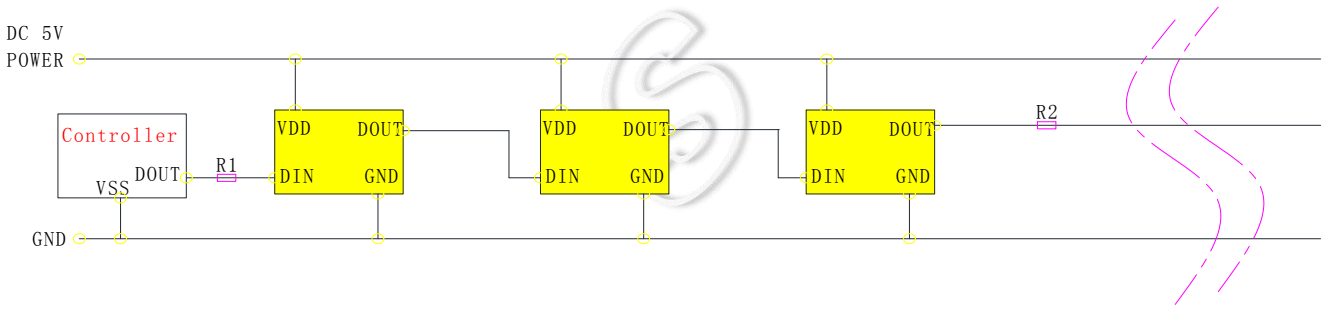
16. The typical application circuit:

Typical application circuit One:



Capacitance-free application circuit Two:
We must ensure that no product power spike noise and damage to the LED used; and the maximum number cascaded LED ≤30Pcs.



In the practical application circuit, in order to prevent the instantaneous high-voltage damage to the internal power supply and signal input and output pin of IC caused by the charged plug of the product during the test, the protective resistance should be connected in the signal input and output end. In addition, in order to make each IC chip work more stably, the decoupling capacitance between each lamp bead is essential.

1. The two ends of the product and decoupling capacitors are generally not recommended omitted; must be omitted, shall ensure compliance with the requirements of said application circuit using two power supply;

2. The signal input and output of the product must be connected in series with the protection resistors R1/R2. The size of R1/R2 depends on the number of cascaded lamp beads. The larger the number of cascades is, the smaller the R1/R2 is. Generally recommended at 200- Values between 2000 ohms are usually recommended around 500 ohms;

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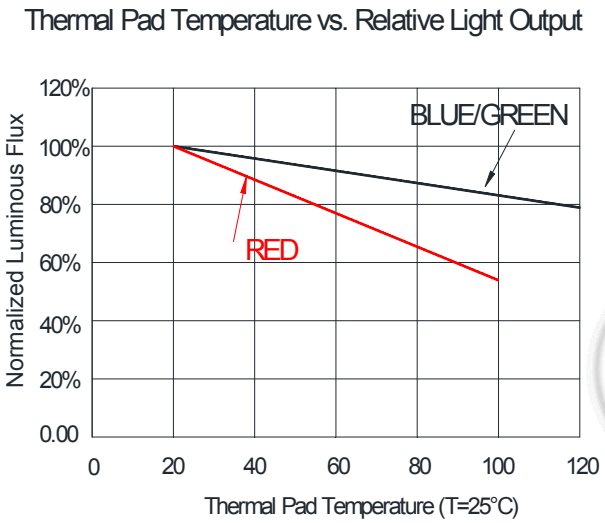
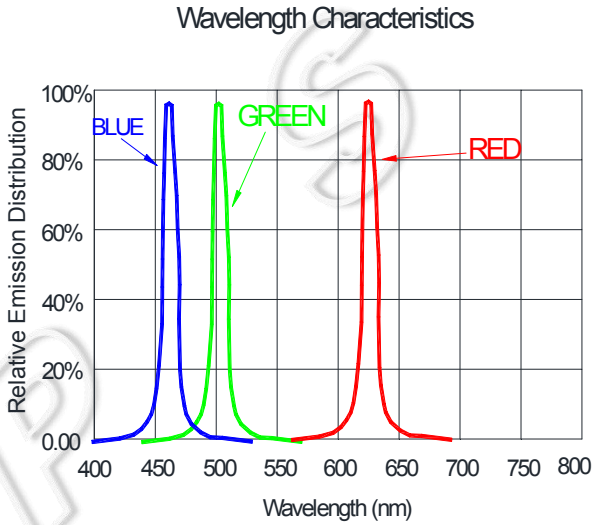
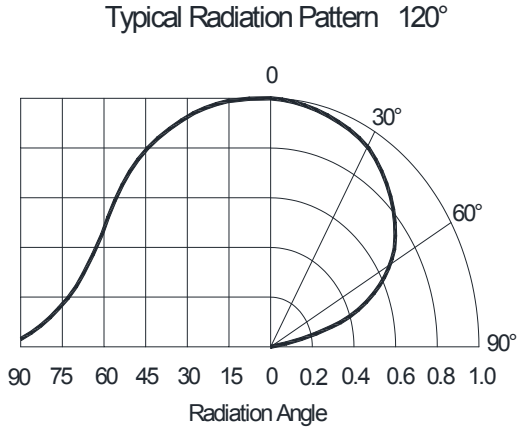
17. Standard LED Performance Graph:







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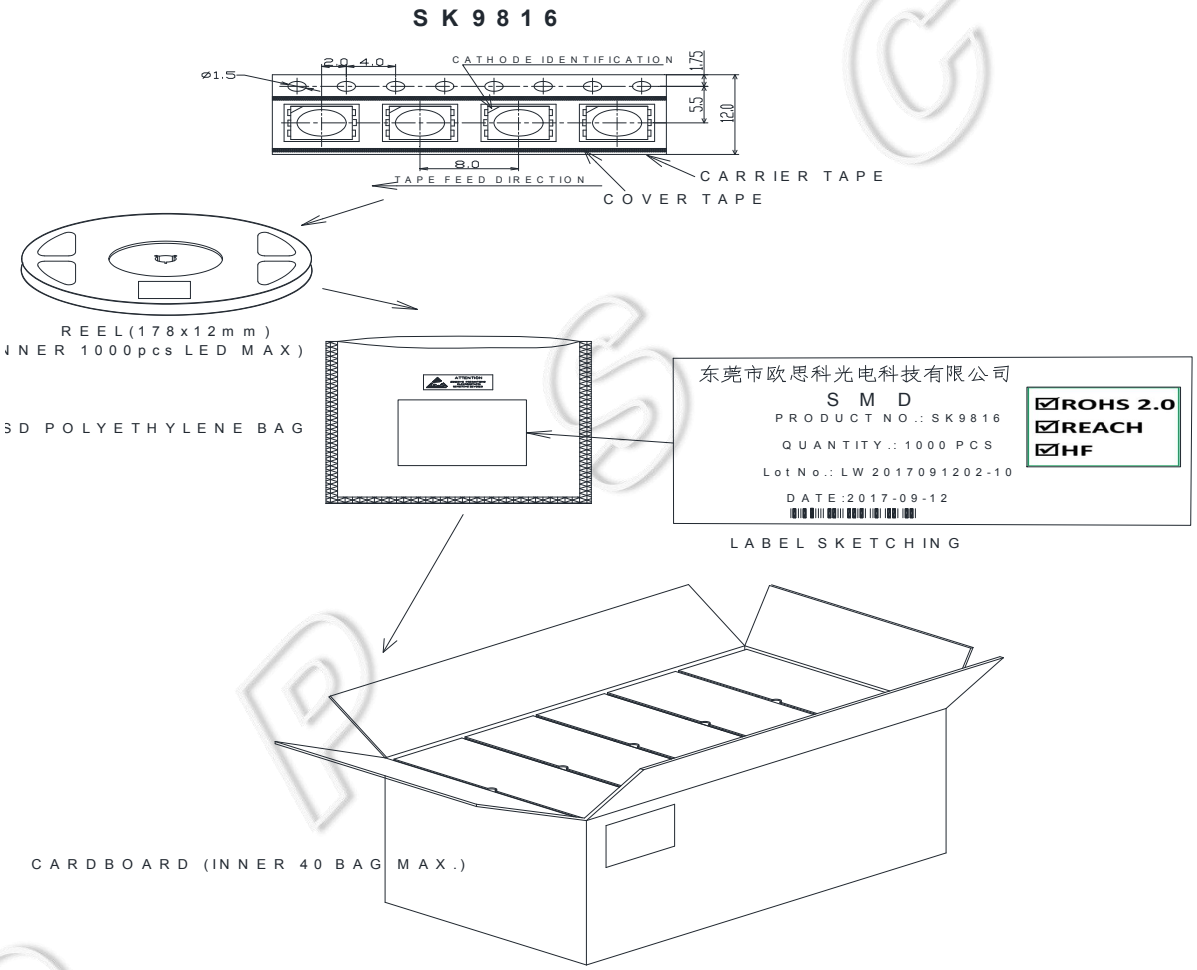
18. Packaging Standard:



The reel pack is applied in SMD LED. The LEDs are packed in cardboard boxes after packaging in normal or anti-electrostatic bags. cardboard boxes will be used to protect the LEDs from mechanical shocks during transportation. The boxes are not water resistant and therefore must be kept away from water and moisture.

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19. Reliability Test :

NO.	Test item	Test Conditions	Reference	Criterion
1	Thermal Shock	100 ± 5° C ~ -40° C ± 5° C 15min~15min 100 cycles	MIL-STD-202G	0/22
2	High Temperature Storage	Ta= +100°C 1000hrs	JEITA ED-4701 200 201	0/22
3	Low Temperature Storage	Ta= -40°C 1000hrs	JEITA ED-4701 200 202	0/22
4	High Temperature High Humidity Storage	Ta=60°C RH=90% 1000hrs	JEITA ED-4701 100 103	0/22
5	Temperature Cycle	-40°C~25°C~100°C~25°C 30min~5min~30min~5min 100 cycles	JEITA ED-4701 100 105	0/22
6	Resistance to Soldering Heat	Tsld = 260° C, 10sec. 2 times	JEITA ED-4701 300 301	0/22
7	Room temp Life Test	25° C, IF: Typical current , 1000hrs	JESD22-A 108D	0/22

Criteria for Judging the Damage:

Item	Symbol	Test Condition	Limit	
			Min	Max
Luminous Intensity	IV	DC=5V, Typical current	Init. Value*0.7	---
Resistance to Soldering Heat	---	DC=5V, Typical current	No dead lights or obvious damage	