Product Specification

Document number:	NMD-SPC-SK9810-EC20
Product model:	SK9810-EC20
Product description:	2.0x2.0x0.65mm Type 0.1Watt Power Embedded （MSL：4）
Version number:	02
Time:	2021-04-23

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1. Product Overview :

SK9810-EC20 is an intelligent external control LED light source with one line transmission three channel (RGB) drive control circuit and 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 and low power consumption; three channel constant current driver default output of 9ma, using single line output mode, the output of each chip in series is synchronous; the light is not on by default when power on. The data protocol adopts unipolar return code communication mode, single line transmission LED driver control chip, and the chip has built-in current gain adjustment function, which can set current 0.25ma ~ 9.0ma, a total of 16 current gain levels;

Channel data output 16 bit gray data, output real 65536 levels. The refresh rate of PWM signal is as high as 4kHz, which makes the display more delicate and smooth, and solves the problem of dark stripe in the picture;

2 . Main Application Field:

● LED full-color light string, led full-color module, led magic soft and hard light strip, LED guardrail tube, led appearance / scene lighting

● LED point light source, LED pixel screen, led special-shaped screen, all kinds of electronic products, electrical equipment, racing lamp..

3. Description:

● Chip SMD internal integration of high-quality serial cascade constant current IC; 5V power supply application; default power on does not light up; built-in power supply regulator circuit;

● The control circuit and chip are integrated into EC2020 components to form a complete external control pixel. The color temperature effect is uniform and consistent;

●Single line synchronous control, built-in unidirectional transmission function, cascade data shaping output; prevent data attenuation;

●4 bits current gain adjustment bits of outr / g / B and gray level adjusting circuit;

●Three way constant current drive, built-in high precision and high stability oscillator, current error < ± 5%;

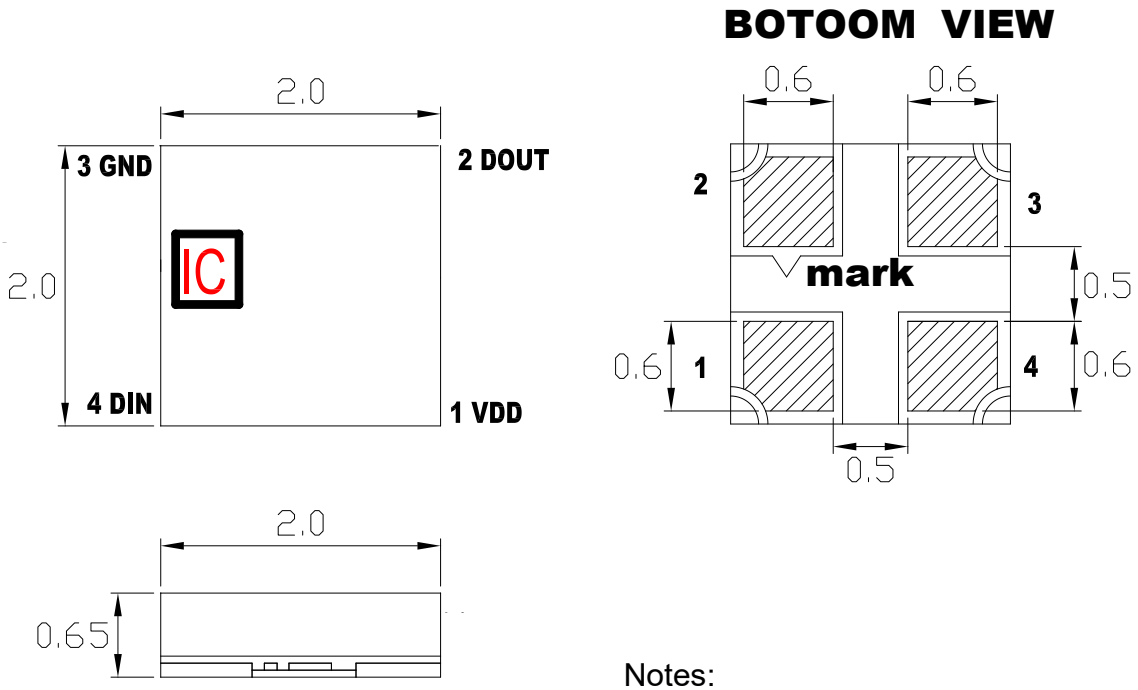
● Built in PWM patent technology, refresh rate up to 4kHz, signal transmission rate up to 800kbps;

● Data transmission mode: trst + 1st 48bits + 2nd 48bits + +N 48bits + 16bit current gain data + reset data, current gain data, when sending current gain data, it is necessary to send 16bits current gain adjustment bit; when sending RGB three color current gain bit, 4bits gain data of reserved bit is also filled in randomly, but cannot be empty; any data can be sent;

● Product support supports dynamic energy saving mode (automatic start stop);

●The product supports ultra-low power standby mode.

4. Mechanical Dimensions:

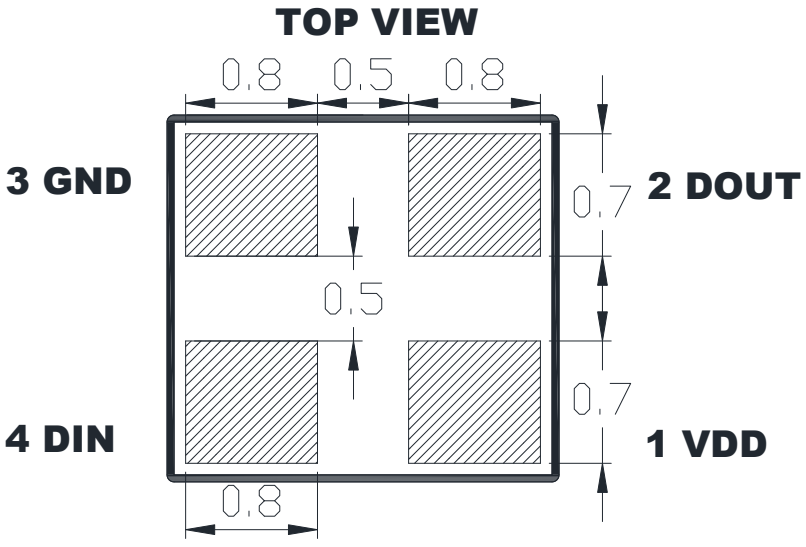


Notes:
1. All dimensions are in millimeters.
2. Tolerance is ±0.1mm unless otherwise noted

5. PIN configuration

NO.	Symbol	Function description
1	VDD	Power supply LED
2	DOUT	Control data signal output
3	GND	Ground
4	DIN	Control data signal input

6. Recommended dimensions for PCB



7. General description of product naming

SK 9810-EC20

① ② ③

①	②	③
Series	IC series and current code	package outline
The default is to integrate the RGB chip with the IC in the	Refers to the 98 series IC 0.25-9mA current version	2.0x2.0x0.65mm package outline

8. Electrical parameters （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~+80	℃
Storage temperature	Tstg	-40~+80	℃
ESD pressure(HBM)	V_{ESD}	2K	V
ESD pressure(DM)	V_{ESD}	200	V

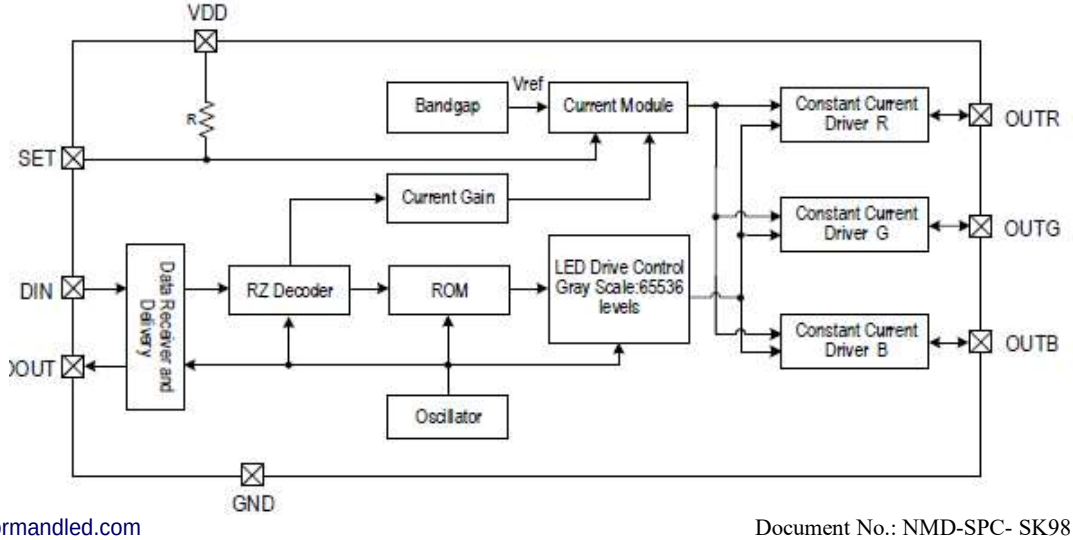
9. Electrical/Optical Characteristics:

SK9810-EC20 9mA		
Color	Dominate Wavelength(nm)	Luminance(mcd)
RED	620-625	60-240
GREEN	520-535	120-450
BLUE	460-475	30-120

10. The IC electrical parameters (unless otherwise specified, TA=-20 ~ +70 ℃,VDD=4.5 ~ 5.5V, VSS=0V):

Parmeter	Symbol	Min	Typical	Max	Unit	Test conditions
The chip supply voltage	V_{DD}	---	5.2	---	V	---
Static power consumption	I_{DD}	---	0.13	---	mA	VDD=4.5V, I_{out} "OFF"
The signal input flip threshold	V_{IH}	0.7*VDD	---	---	V	VDD=5.0V DIN OR DOUT
	V_{IL}	---	---	0.3*VDD	V	
Drive current of outr / g / B / W port	I_{out}	0.25	---	9.0	mA	V_{DS} =2V, Current gain setting 0000~1111
The frequency of PWM	F_{PWM}	---	4.0	---	KHZ	---
Out R / G /B leakage current	I_{leak}	---	---	1	uA	V_{DS} =15V, I_{OUT} "OFF"
OutR/ G / B constant current inflection point voltage	V_{DS-S}	---	0.5	---	V	I_{OUT} =2.5mA
		---	0.6	---	V	I_{OUT} =6mA
		---	0.7	---	V	I_{OUT} =9mA
Current variation of outR / G / B port	%VS.V_{DS}	---	1.0	---	%	V_{DS} =1~3V, I_{OUT} =9mA
	%VS.VDD	---	1.0	---	%	VDD =4.0~5.2V, I_{OUT} =9mA
	%VS . Temp.	---	---	6.0	%	I_{OUT} =9mA,Temp=-40~+85℃

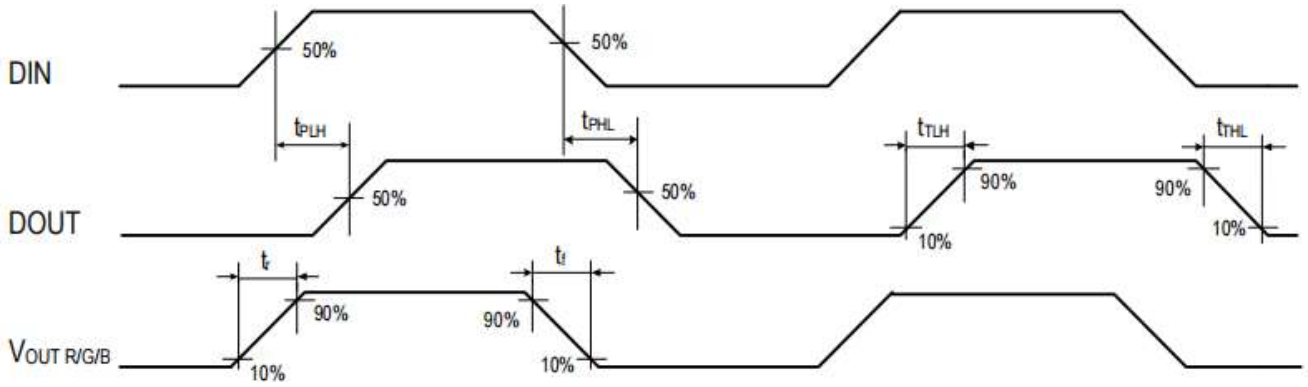
11. Internal functional framework



12. Switching characteristics(VCC=5V Ta=25 ℃):

Parameter	Symbol	Min	Typical	Max	Unit	Test conditions
The frequency of PWM	F_{PWM}	---	4.0	---	KHZ	IOUT = 9ma, out R / g / B port is connected with 200 Ω resistor in series to VDD
Dout transmission delay	T_{PLH}	---	100	---	ns	The earth load capacitance of the dout port is 30pf, and the signal transmission delay from DIN to dout
	T_{PHL}	---	100	---	ns	
Dout conversion time	T_{TLH}	---	20	---	ns	Load capacitance to ground of dout port 30pf
	T_{THL}	---	10	---	ns	
OUT R/G/B conversion time	t_r	---	20	---	ns	IOUT = 9ma, out R / g / B port is connected with 200 Ω resistor in series to VDD,The load capacitance to ground is 15pF
	t_f	---	20	---	ns	

Note 4、 Note 5、 Note 6： As shown in the figure below



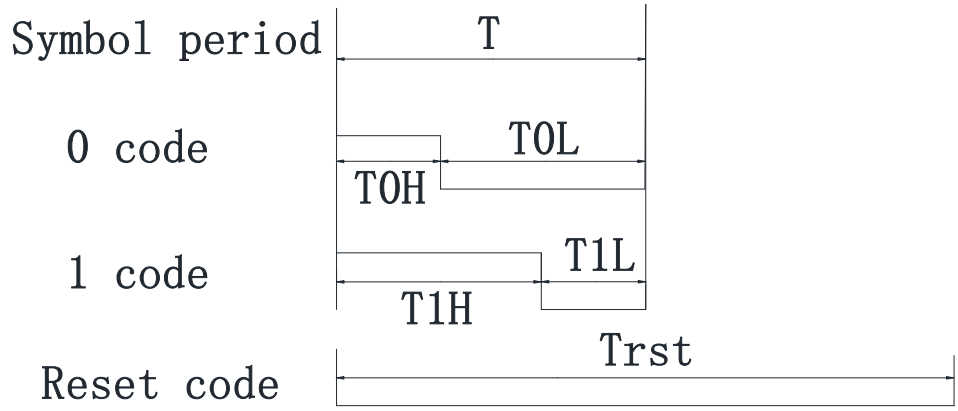
13. The data transmission time :

Name		Min.	Standard value	Max.	Unit
T	Code period	**1.20**	--	--	**μs**
T0H	0 code, high level time	**0.2**	**0.30**	**0.4**	**μs**
T0L	0 code, low level time	**0.8**	**0.9**	--	**μs**
T1H	1 code, high level time	**0.8**	**0.9**	**1.0**	**μs**
T1L	1 code, low level time	**0.2**	**0.3**	--	**μs**
Trst	Reset code，low level time	**>200**	--	--	**μs**

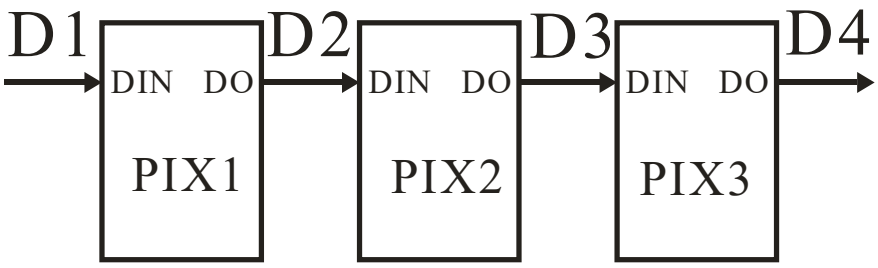
1. The protocol adopts unipolar return to zero code, and each symbol must have a low level. Each symbol in this protocol starts from high level, and the high level time width determines "0" code or "1" code.2. When writing program, the minimum code period is 1.2 μ s.3. The high-level time of "0" code and "1" code shall be in accordance with the above table, and the low-level time of "0" code and "1" code shall be less than 20 μ s

14. Timing waveform:

Input code:



Connection mode:



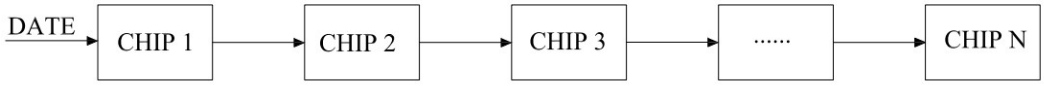
(2) Protocol data format:

RGB three color lamp bead application data format:

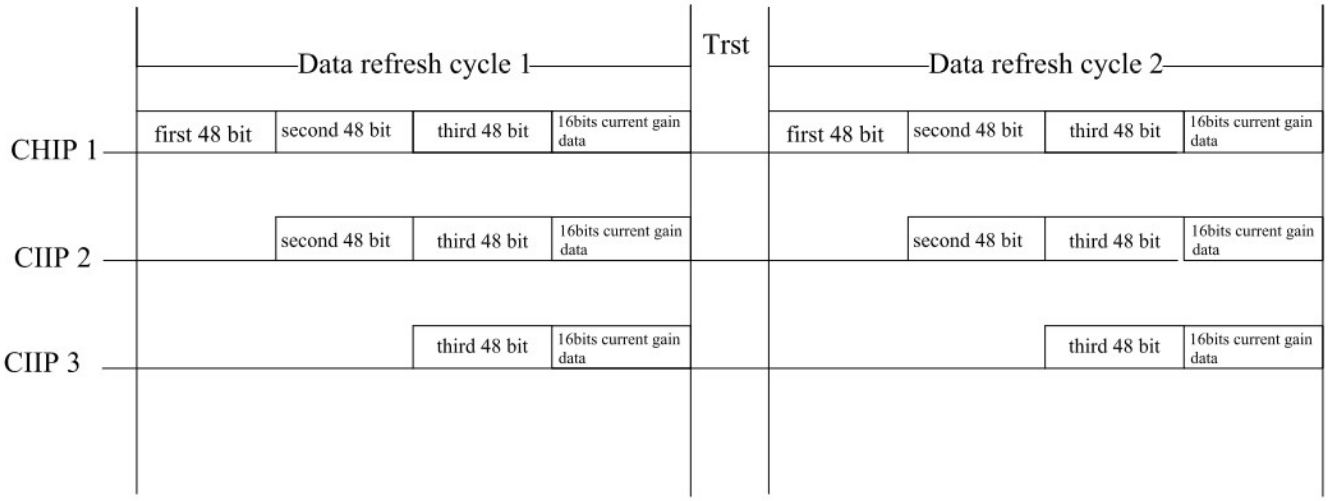
Trst + 48bits data of the first chip + 48bits data of the second chip + +48bits data + 16bits current gain data + trst.
48bits gray data structure: the high bit is in front and sent in the order of RGB.

G15	G14	G13	G12	G11	G10	G9	G8	G7	G6	G5	G4	G3	G2	G1	G0	R15.....R0	B15.....B0
Bits47…….....bits0																	

System topology



Input data flow of each chip (taking 3 chips as an example)



(3) Current gain adjustment parameters:

The current gain data is 16 bits in total, including 4 bits of reserved bits and 4 bits of current gain adjustment bits of red, green and blue lights, respectively, corresponding to 4 bits (S3 ~ S0). The system sends 4 bits of red light, 4 bits of green light, 4 bits of blue light, 4 bits of reserved bit, S3 of high bit and S0 of low level

Transmission format of current gain parameters			
R	**G**	**B**	**Reserved bit**
S3 , S2 , S1 , S0	**S3 , S2 , S1 , S0**	**S3 , S2 , S1 , S0**	**S3 , S2 , S1 , S0**

Note: the reserved bit data does not affect the current gain adjustment, but can not be left blank when sending data. The data bits must be filled to send arbitrary data.

The maximum output current of out R / g / B is 9ma. At the same time, users can set other current values by changing the current gain value. Refer to the table below for specific current values

Current regulation level	Current gain adjustment bit				Corresponding current value (MA)
	S3	S2	S1	S0	
1	0	0	0	0	0.25
2	0	0	0	1	0.85
3	0	0	1	0	1.4
4	0	0	1	1	2.0
5	0	1	0	0	2.6
6	0	1	0	1	3.15
7	0	1	1	0	3.75
8	0	1	1	1	4.35
9	1	0	0	0	4.9
10	1	0	0	1	5.5
11	1	0	1	0	6.1
12	1	0	1	1	6.65
13	1	1	0	0	7.25
14	1	1	0	1	7.85
15	1	1	1	0	8.4
16	1	1	1	1	9.0

Note:

1. Recommended current: 1 ~ 9 current regulation level

2. Based on the product heat dissipation, the recommended maximum current of this product is 4.9mA, and the current regulation level is 10-16, which is not recommended

Description of standby mode

(1) Power on by default into standby mode, wake up after receiving any data of DIN, then display and control normally(2) In normal display control, if you want to enter the standby mode, the 16 bit current gain data needs to send the standby command in the following format:

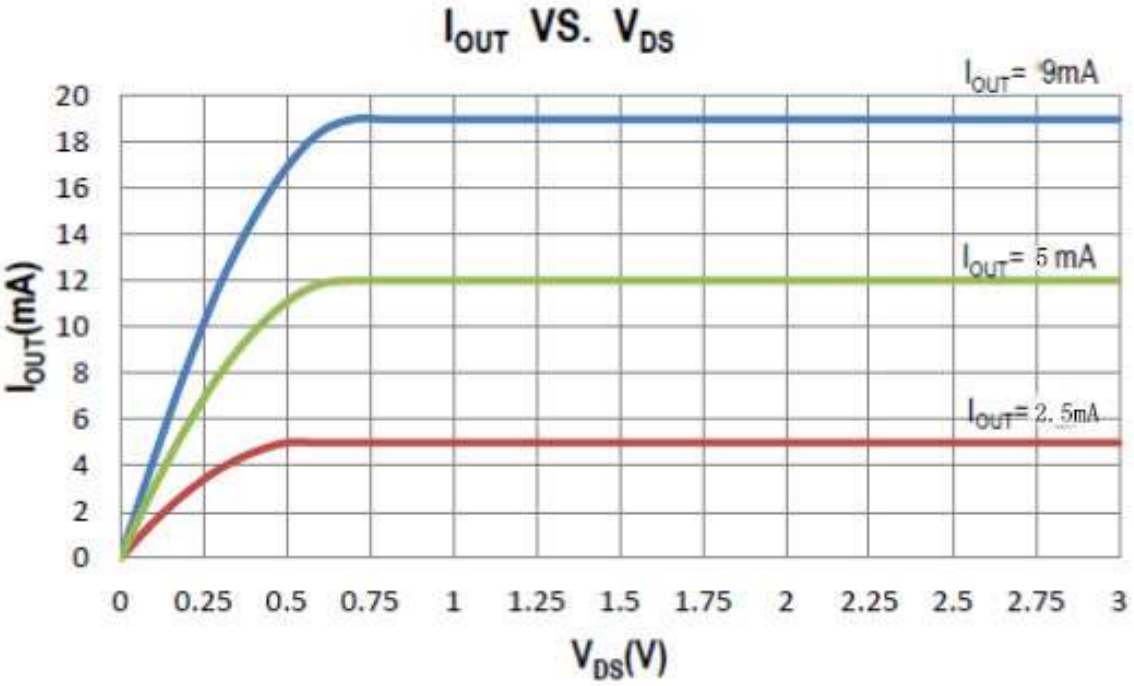
GR3	GR2	GR1	GR0	GG3	GG2	GG1	GG0	GB3	GB2	GB1	GB0	S3	S2	S1	S0
GR3	GR2	GR1	GR0	GG3	GG2	GG1	GG0	GB3	GB2	GB1	GB0	0	0	1	1

Note: in standby mode, the out port is closed.

15. Constant current characteristics:

(1) : constant current curve

After reaching the inflection point of constant current, the output current of sk9810 is not affected by VDS of out port.



(2) : output current setting

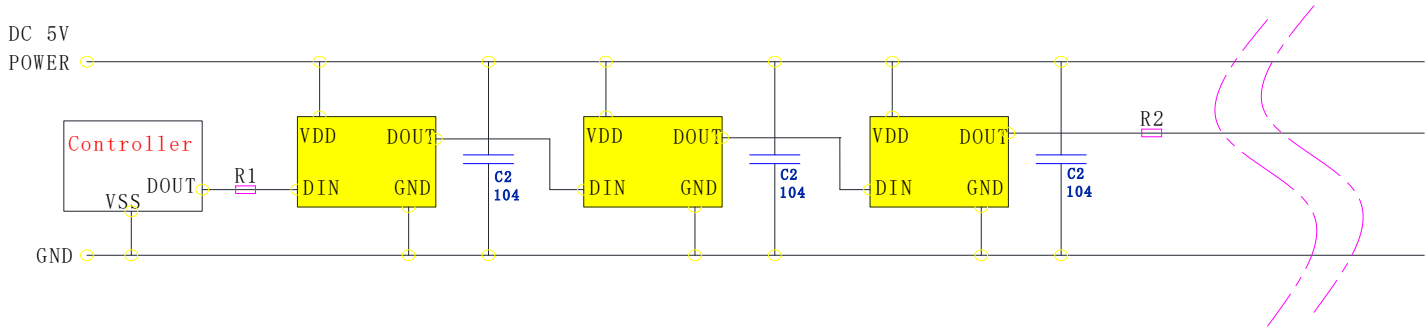
The maximum output current value of the chip OUTR/G/B is 18mA, that is, when the current gain is 16 levels, the maximum current value is 18mA. When the current gain is level 1~16, the output current value is set by the following equation:

$$I_{out}(mA) = 0.5 + 1.17 * (G - 1)$$

Among them, G is the current gain level 1~16, when G=1, Iout=0.25, when G=16, Iout=9mA

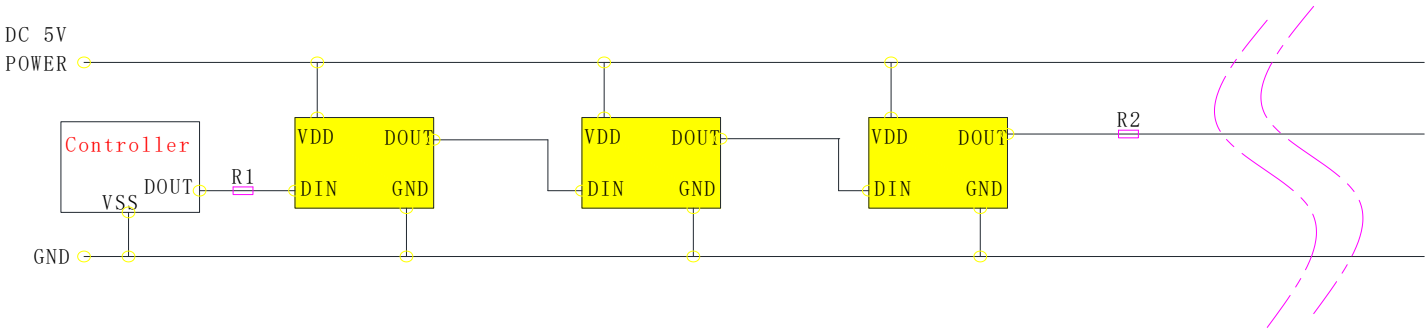
16. Typical application circuit:

Typical application circuit one:



Capacitor-free version application circuit two:

It must be ensured that the power supply used by the product does not damage the LED by clutter and spikes; and the maximum number of cascaded LEDs is ≤30Pcs.

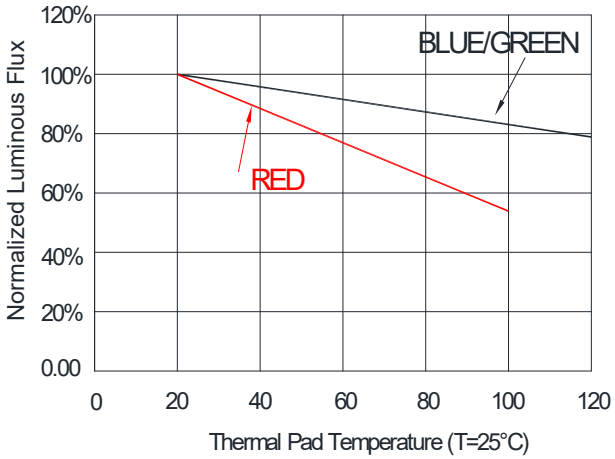


In the actual application circuit, in order to prevent the product from damaging the internal power supply and signal input and output pins of the IC when the product is plugged and unplugged during testing, protection resistors should be connected in series at the signal input and output terminals. In addition, in order to make the IC chips work more stably, the decoupling capacitors between the lamp beads are essential;

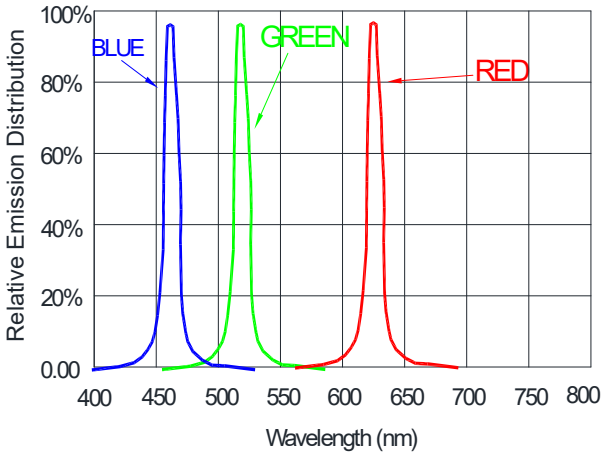
1. **It is generally not recommended to omit the decoupling capacitors connected at both ends of the product; if it must be omitted, make sure that the power supply used meets the requirements of the application circuit 2 above;**
2. **The signal input and output terminals of the product must be connected in series with protective resistors R1/R2. Because of the different wire materials and transmission distances, the protective resistors connected in series at both ends of the signal line will be slightly different; the size of R1/R2 depends on the cascade lamp The number of beads, the greater the number of cascades, the smaller the R1/R2, and the longer the transmission distance between the beads. Generally, it is recommended to set a value between 20-2KΩ, and the recommended value is usually about 500 ohms; it depends on the actual use;**

17. Standard LED Performance Graph:

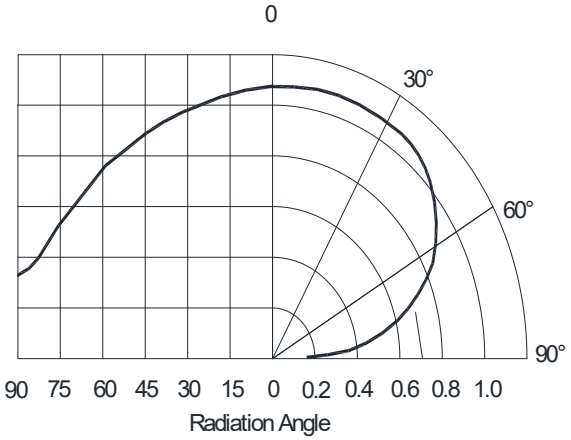
Thermal Pad Temperature vs. Relative Light Output



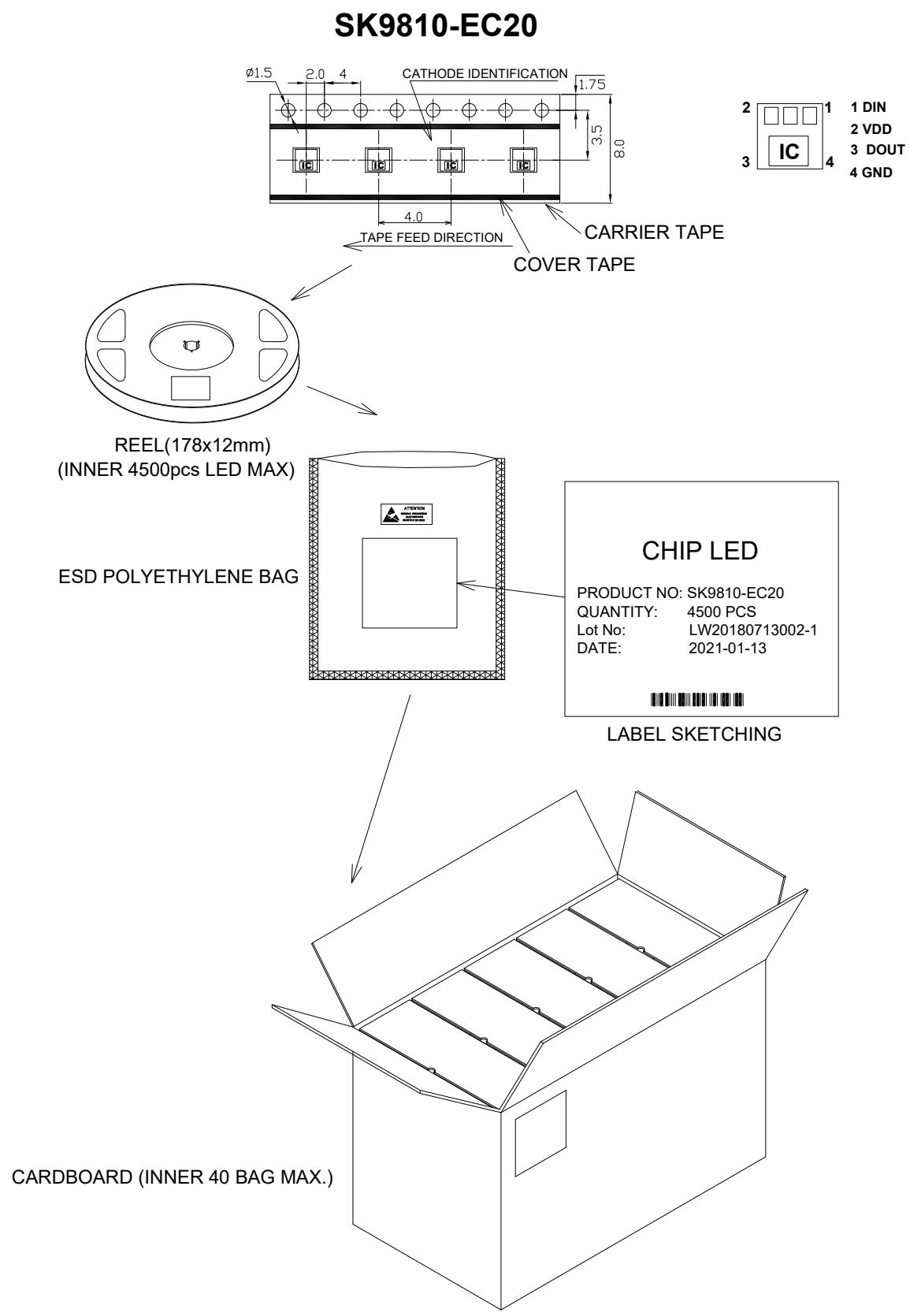
Wavelength Characteristics



Typical Radiation Pattern 120°



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.

19. Reliability Test :

NO.	Test item	Test Conditions	Reference	Criterion
1	Thermal Shock	-20℃*15min～80℃*15min 100cycles	MIL-STD-202G	0/64
2	High Temperature Storage	Ta= 100℃ 1000hrs	JEITA ED-4701 200 201	0/64
3	Low Temperature Storage	Ta= -40℃ 1000hrs	JEITA ED-4701 200 202	0/64
4	High Temperature High Humidity Storage	Ta=85℃ RH=85% 1000hrs	JEITA ED-4701 100 103	0/64
5	Temperature Cycle	-20℃~25℃~80℃~25℃ 30min~5min~30min~5min 100 cycles	JEITA ED-4701 100 105	0/64
6	Resistance to Soldering Heat	Tsld = 260℃, 10sec. 2times	JEITA ED-4701 300 301	0/64
7	Room temp Life Test	Ta＜35℃, IF:Typical current, 3000hrs	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	