SM16804PB

Feature

- Built-in power clamp module, input power voltage: 5~24V
- The default constant current value of OUT R/G/B/W is 19mA
- OUT R/G/B/W power-on state: closed
- OUT R/G/B/W port withstand voltage 26V
- OUT R/G/B/W output gray level: 65536 levels (GAMMA correction)
- OUT R/G/B /Weach 4bits current gain adjustment bit
- Patented SM-PWM control technology, refresh rate is up to 4KHz
- Synchronous refresh for the same frame display data
- Adopt single-line return-to-zero code SID data protocol
- Data serial cascade transmission, strong anti-interference ability
- Signal transmission rate: 800Kbps
- Package: SOP8

Application

- Interior LED decorative lighting
- Architectural appearance/scene lighting
- Pointolite, luminous character,
- LED SMD, line lamp

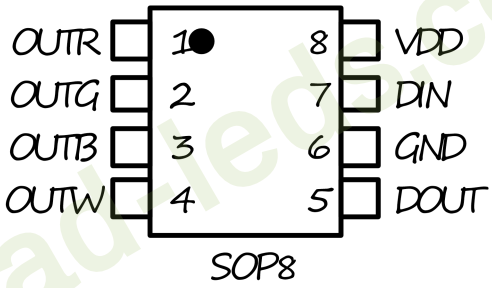
Description

SM16804PB is a four-channel LED driver control chip, using single-wire return-to-zero code SID data protocol.

The default output current of SM16804PB is 19mA, and the current can be set to 1.8mA~19mA through the current gain adjustment function, a total of 16 current gain levels.

SM16804PB outputs 65536 gray scales (GAMMA correction), which makes the display effect more delicate and smooth. The refresh rate is as high as 4KHz, which solves the problem of dark stripes on the shooting screen.

Pin Diagram



Internal Function Diagram

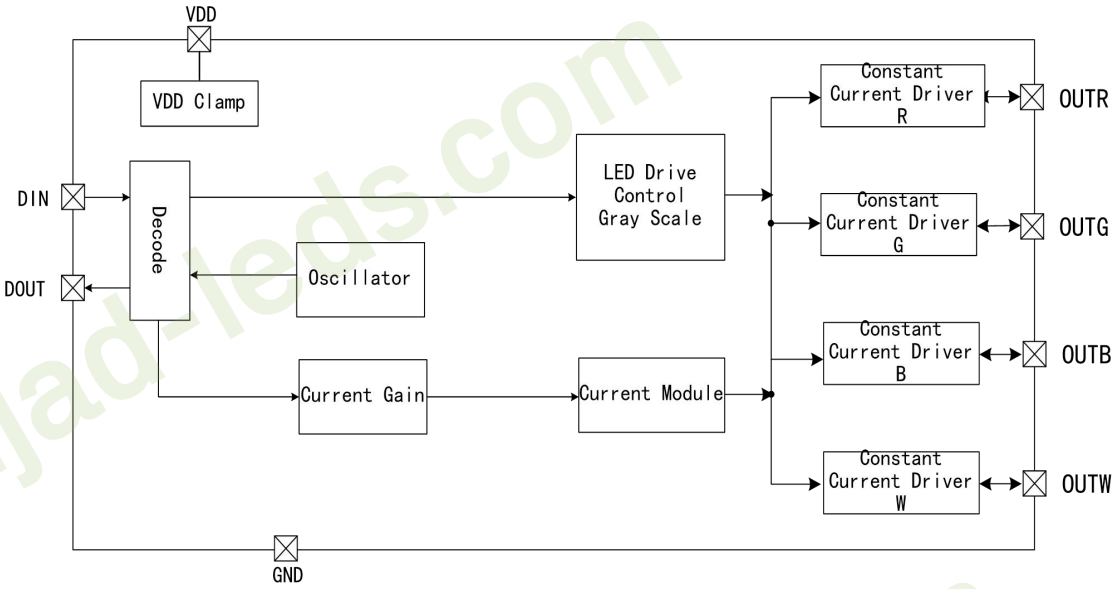


Fig. SM16804PB Internal Function Diagram

Pin Description

Pin No.	Pin Name	Pin Description
1	OUTR	Constant current driver port
2	OUTG	Constant current driver port
3	OUTB	Constant current driver port
4	OUTW	Constant current driver port
5	DOUT	Cascade signal output port/signal input port
6	GND	Ground
7	DIN	Signal input port/cascade signal output port
8	VDD	Power supply

Order Information

Type	Package	Packing		Reel Size
		Tube	Tape	
SM16804PB	SOP8	100000 pcs/box	4000 pcs/ tape	13 inches

Absolute Maximum Parameter (Note 1)

Unless otherwise stated, T_A=25°C.

Symbol	Description	Range	Unit
VDD	Operation voltage	-0.4~+5.5	V
V_I	Logic input voltage	-0.4~VDD+0.4	V
BV_{OUT}	OUT R/G/B/W withstand voltage	30	V
I_{clamp}	Maximum VDD clamp current	20	mA
RθJA	PN junction to ambient thermal resistance	130	°C/W
P_D	Power consumption (Note 3)	0.5	W
T_J	Operating junction temperature	-40~+150	℃
T_{STG}	Storage temperature	-55~+150	℃
V_{ESD}	HBM ESD	> 2	KV

Note 1: The maximum output power is limited to chip junction temperature, the maximum limit means that the chip can be damaged beyond the scope of the work. The maximum limit value is the work in the limit parameter range, the device function is normal, but it is not completely guaranteed to meet the individual performance indexes.

Note 2: RθJA measures the flow of water according to the JEDEC JESD51 thermal measurement standard on the single-layer thermal conductivity test board under T_A=25°C.

Note 3: The maximum power consumption is decreased when temperature rising, this depends on T_{JMAX}, RθJA and T_A Maximum allowable power consumption is $P_D = (T_{JMAX}-T_A)/$ RθJA or the lower value of the value given in the limit range.

Electric Operating Parameter (Note 4, 5)

Unless otherwise stated, T_A=25°C.

Symbol	Description	Condition	Min.	Typ.	Max.	Unit
VDD	Internal clamp voltage	External power supply VCC=12V, the current-limited resistance between VCC and VDD is 470Ω	4.8	5.2	5.5	V
I_{DD}	Quiescent current	VDD=4. 5V，I_{OUT}"OFF"	-	11	-	mA
V_{IH}	Input signal threshold voltage	DIN or DOUT: high level input	0.7xVD	-	-	V
V_{IL}		DIN or DOUT: low level input	-	-	0.3xVD	V
I_{OH}	DOUT output current DOUT sink current	DOUT output high, connect a 10Ω resistor in series to GND	-	-48	-	mA
I_{OL}		DOUT output low, power supply to VDD sink current	-	57	-	mA
$I_{OUT\_R/G/B/W}$	OUT R/G/B/W output current	V_{DS}=2V，The REXT port: NC, current gain setting 0000~1111	1.8	-	19	mA
V_{DS}	OUT R/G/B/W constant current knee point voltage	I_{OUT}=19mA	-	0.6	-	V
%VS.V_{DS}	OUT R/G/B/W output current variation	I_{OUT}=19mA，V_{DS}=1.0~3.0V	-	0.5	-	%
%VS.VD		I_{OUT}=19mA，VDD=4.5~5.5V	-	0.5	-	%
%VS.T_A		I_{OUT}=19mA，T_A=-40~+85℃	-	3.0	-	%
I_{IEAK}	OUT R/G/B/W leak	V_{DS}=26V，I_{OUT}"OFF"	-	-	1	uA

Note 4: The electrical operating parameters define the DC/AC parameters of the device within the working range and under test conditions that ensure a specific performance indicator. The specification does not guarantee the accuracy of the parameters that are not given the upper and lower limit values, but the typical values reflect the performance of the device.

Note 5: The minimum and maximum parameter range of the datasheet is guaranteed by the test, and the typical value is guaranteed by design, test or statistical analysis.

Switching Characteristic

Unless otherwise stated, VDD=5V, T_A=25°C.

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
f_{PWM}	OUT R/G/B/W output PWM frequency	I_{OUT}=19mA, OUT R/G/B/W connects 200Ω resistor to VDD	-	4	-	KHz
t_{PLH}	Signal transmission delay	DOUT load capacitor to ground: 30pF DIN to DOUT signal: transmission delay	-	73	-	ns
t_{PHL}			-	73	-	ns
t_{TLH}	DOUT transfer time	DOUT load capacitor to ground: 30pF	-	3.0	-	ns
t_{THL}			-	3.0	-	ns
t_r	OUT R/G/B/W transfer time	I_{OUT}=19mA, OUT connects 200Ω resistor to VDD, load capacitor to ground: 15pF	-	55	-	ns
t_f			-	50	-	ns

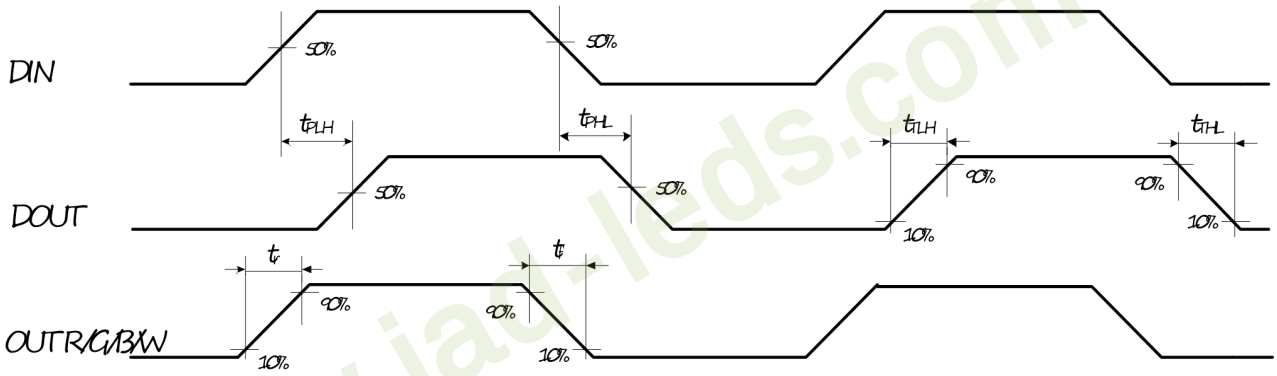


Fig. SM16804PB Dynamic parameter test diagram

Data Communication Protocol

1、Code Description

The protocol of the SM16804PB 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.

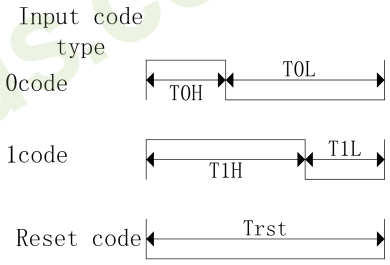


Fig. SM16804PB RZ code data communication protocol diagram

Symbol	Parameter	Min.	Typ.	Max.	Allowable	Unit
T0H	0，HIGH level	-	0.3	-	±0.05	us
T0L	0，LOW level	-	0.9	-	±0.05	us
T1H	1，HIGH level	-	0.9	-	±0.05	us
T1L	1，LOW level	-	0.3	-	±0.05	us
Trst	Reset，LOW level	200	-	-	-	us

2、Protocol Data Format：

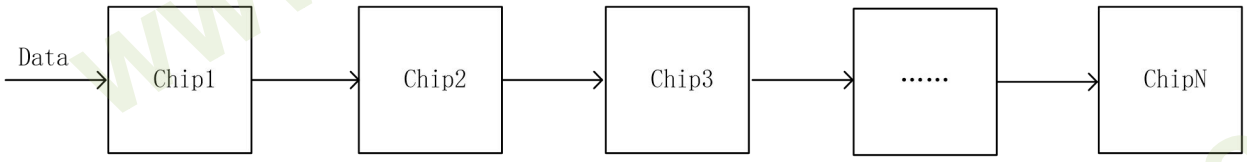
Trst+ First chip 32bits data +Second chip 32bits data +……+ The N chip32bits data +16bits current gain +Trst

- 32bits gray scale data structure: High levels first, sent by the order of RGBW

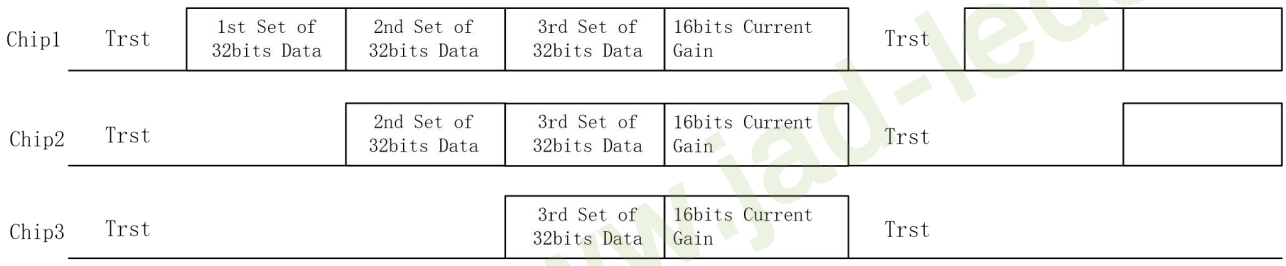
R7	R6	R5	R4	R3	R2	R1	R0	G7	…	G0	B7	…	B0	W7	…	W0

bit31……

- System Topological Graph:



- Input Data Stream of every chip:



Current Gain Adjustment Description

Total current gain data: 16bits, with 4 reserved bits and 4 bits RGBW current gain adjustment for each color, respectively correspond 4bits（S3~S0）. The system order is to send 4 bits of reserved first, then 4 bits of R, 4 bits of G, 4 bits of B,4 bits of W, High level S3 sent first , low level S0 at last.

Current Gain Data Format			
Red LED（R）	Green LED（G）	Blue LED（B）	White LED（W）
S3，S2，S1，S0	S3，S2，S1，S0	S3，S2，S1，S0	S3，S2，S1，S0

OUT R/G/B/W defaults to a maximum output of 19mA. At the same time, the user can set other current values by changing the current gain value. For specific current values, please refer to the following table:

Current Gain Level G	Current-gain regulation position				Corresponding current value (mA)
	S3	S2	S1	S0	
1	0	0	0	0	1.8
2	0	0	0	1	3.0
3	0	0	1	0	4.1
4	0	0	1	1	5.3
5	0	1	0	0	6.4
6	0	1	0	1	7.6
7	0	1	1	0	8.7
8	0	1	1	1	9.9
9	1	0	0	0	11
10	1	0	0	1	12.2
11	1	0	1	0	13.3
12	1	0	1	1	14.5
13	1	1	0	0	15.6
14	1	1	0	1	16.8
15	1	1	1	0	17.9
16	1	1	1	1	19

Constant Current Characteristic

When it gets to constant current knee point voltage, SM16804PB output current is not affected by V_{DS}.

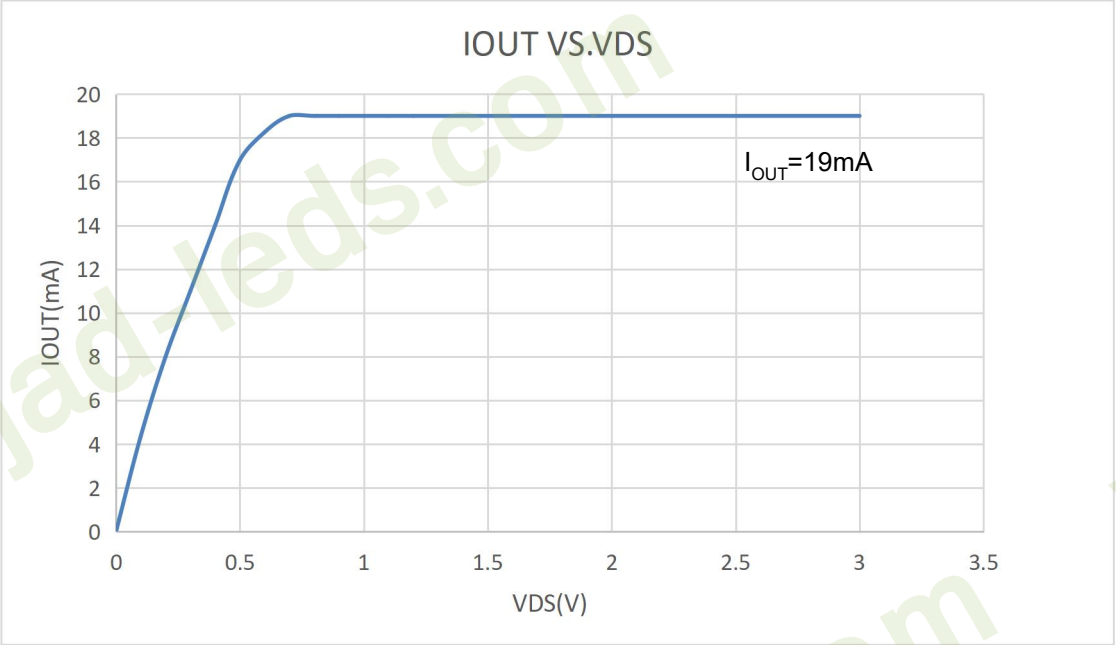


Fig. Relationship diagram between I_{OUT} and V_{DS}

Typical Application

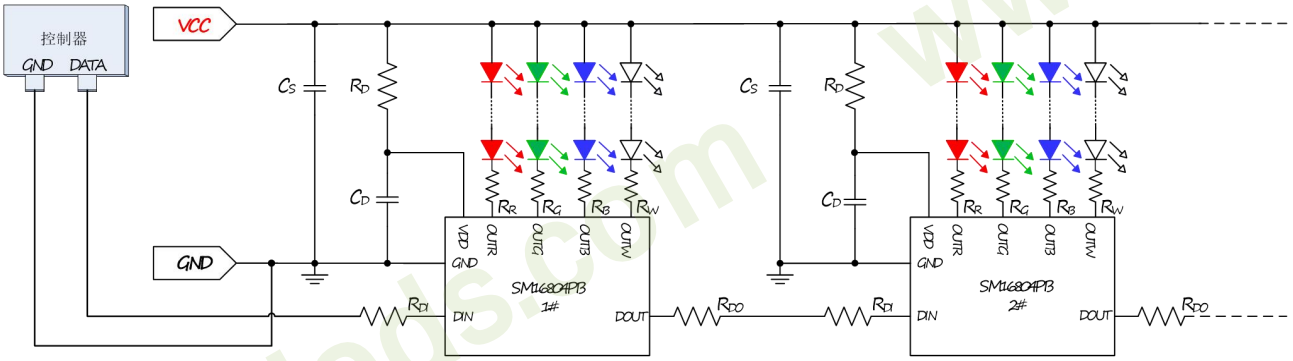


Fig. SM16804PB Typical application diagram

SM16804PB typical application circuit parameters include external input voltage VCC, power supply filter capacitor C_S, chip current limiting resistor RD, VDD voltage regulator CD and R/G/B/W LED voltage divider resistors RR, RG, RB, DIN signal input port series resistance RDI, DOUT signal output port series resistance RDO.

（1）VCC is input voltage of power supply, R_D is current-limiting resistor to prevent positive and negative pole in reverse which may cause chip damage. Chip power supply voltage: $VDD = VCC - I_{DD} \times R_D$, I_{DD} is the chip quiescent current, the value of R_D must guarantee that VDD > 3V. The larger the RD resistance, the lower the system power consumption, but the weaker the system's anti-interference ability; the smaller the RD resistance, the greater the system power consumption and the higher the operating temperature. The resistance RD should be selected reasonably according to the system application environment during design. The design reference values of different input power supply voltage VCC and current limiting resistor RD are as follows:

VCC(V)	5	6	9	12	15	18	24
R_D(Ω)	33	100	300	510	1K	1.5K	2K

（2）C_S is the capacitance of the system power supply to the ground, used to reduce power fluctuations, 0.1uF~10uF capacitors can be selected according to the actual load of the system, and electrolytic capacitors are recommended when the load is large;

（3）C_D is chip filter capacitor for keeping VDD voltage's stable and guarantee normal operation. Recommend 100nF.

（4）R_{DI} is signal input protection resistor for preventing electric plug, positive and negative pole and signal line in reverse which would damage the signal input port.

（5）R_{DO} is signal input protection resistor for preventing electric plug, positive and negative pole and signal line in reverse which would damage the signal output port.

（6）R_R、R_G、R_B 、R_w are the voltage divider resistors of the OUT R/G/B/W port respectively, which are used to reduce the voltage of the OUT R/G/B/W port and reduce the power consumption of the chip. The calculation formula is $R_R/R_G\,R_B R_w(\Omega)=\frac{VCC-V_{DS}-N\times V_{LED}}{I_{OUT}}$, where VCC is the external input voltage and V_{LED} is the LED light

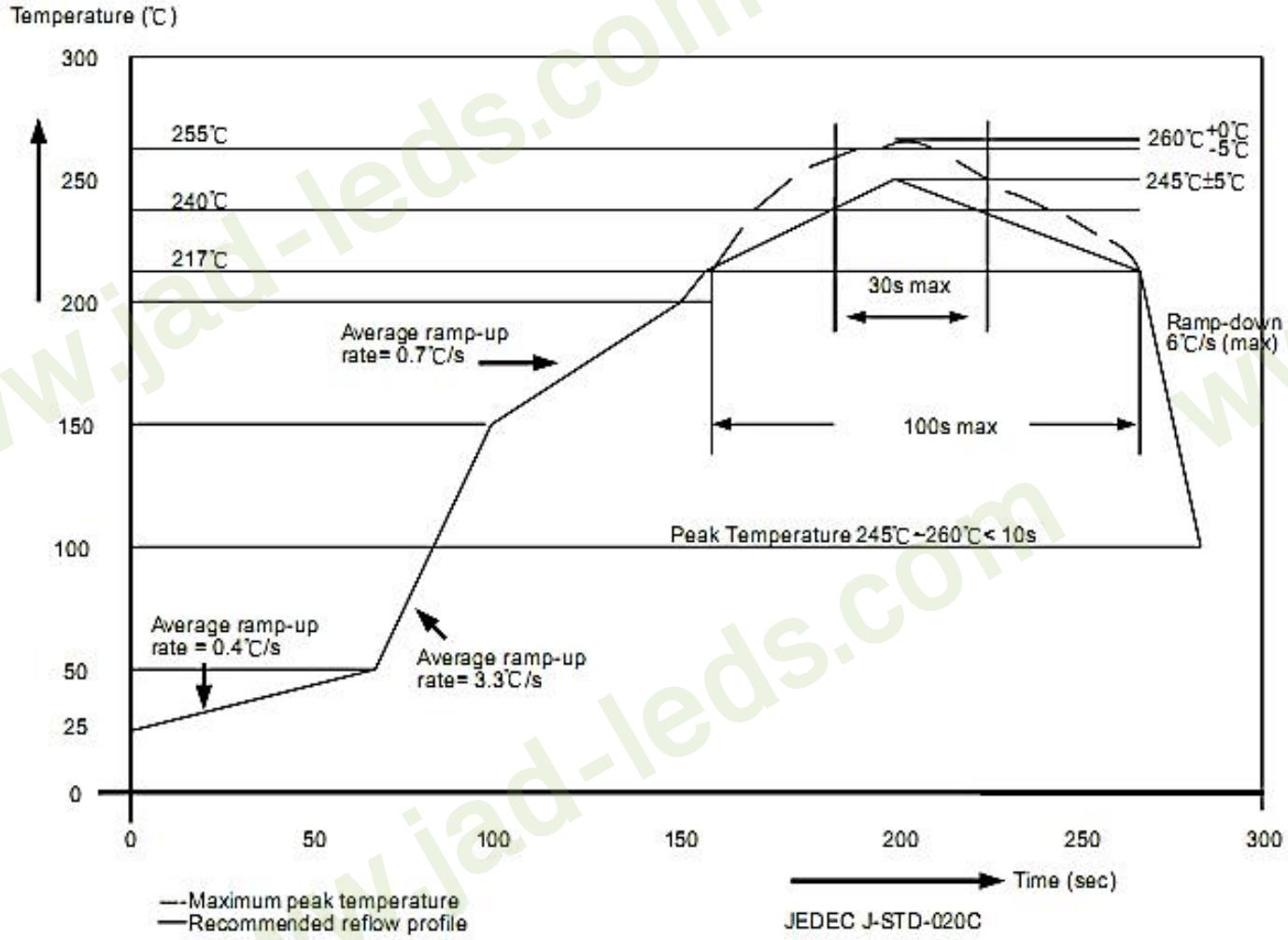
turn-on voltage drop, I_{OUT} is the port output current, and V_{DS} is the chip OUT R/G/B/W port voltage. In actual applications, it should be ensured that the value of V_{DS} is higher than the constant current inflection point voltage, and at the same time, the chip generates less power loss. The specific application shall prevail. The reference value of the voltage drop V_{LED} of different color lamp beads is as follows: The voltage drop of the red lamp is about 2.0~2.2V, and the voltage drop of green,blue and white is about 3.0~3.2V. Please refer to the actual specifications of the lamp beads for details.

In a typical application, according to different input voltages and different numbers of lamp beads, the recommended values of the corresponding parameters are as follows:

VCC(V)	Number of LEDs serially connected to OUT port (pcs)	R_D(Ω)	C_D(nF)	R_{DI}(Ω)	R_{DO}(Ω)	R_R(Ω)	R_G(Ω)	R_B(Ω)	R_W(Ω)
5	1	33	100	-	-	-	-	-	-
12	3	510	100	51	150	150	-	-	-
24	6	2K	100	100	300	510	150	150	150

Encapsulation Soldering Process

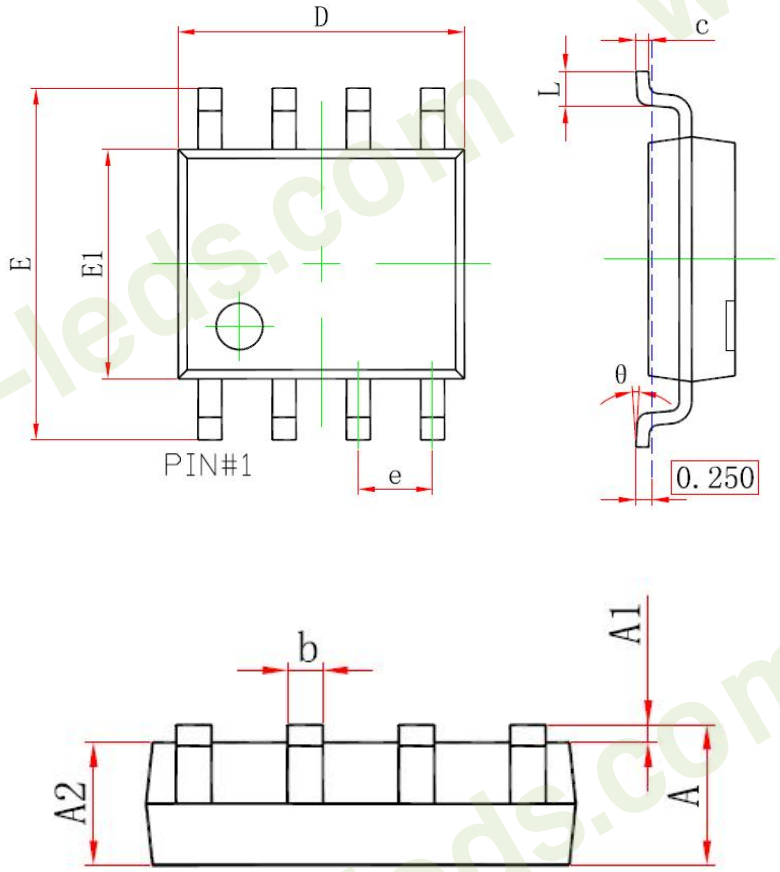
Semiconductors of Sunmoon follow the European RoHs standard, solder temperature in encapsulation soldering process follows J-STD-020 standard.



Encapsulation Thickness	Volume mm^3 < 350	Volume mm^3：350~2000	Volume mm^3 ≥ 2000
<1.6mm	260+0℃	260+0℃	260+0℃
1.6mm~2.5mm	260+0℃	250+0℃	245+0℃
≥2.5mm	250+0℃	245+0℃	245+0℃

Package

SOP8



Symbol	Min(mm)	Max(mm)
A	1.25	1.95
A1	-	0.25
A2	1.25	1.75
b	0.25	0.7
c	0.1	0.35
D	4.6	5.3
e	1.27(BSC)	
E	5.7	6.4
E1	3.7	4.2
L	0.2	1.5
θ	0°	10°

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