SM16825E

Feature

- Operating voltage: 5~40V
- Constant-current characteristic:
- Built-in current gain modifies the OUTR/G/B/W/Y current by 10~300 mA
- Output current deviation≤ ±5%
- Low knee voltage: I_{OUT_RGBWY} =300mA@V_{DS}=0.8V, VDD=5V
- Adopt the RZ code protocol to transmit data
- RZ code data rate: 800 Kbps
- Dimming gray level: 65536 level
- Minimum output current turn-on pulse width: 160 ns
- The OUT selection PWM frequency is 4 KHz
- The OUT port is turned off by default when powering on
- Built-in over-temperature protection
- Support chip cascade application (DIN→DOUT)
- Built-in data shaping and data cascade without attenuation
- Support standby mode, standby current<2mW
- Packaging：ESOP8, EMSOP8

Application

- LED lighting
- LED backlight

Description

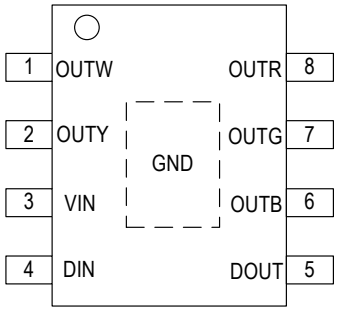
High output current accuracy and low-voltage constant current opening are two of the features of the SM16825E single-line, RZ code protocol, 5-channel low-voltage linear driver integrated circuit. In addition to a constant current drive module, over-temperature protection module, RZ code decoding module, and RZ code data shaping output module, the chip also includes an integrated high-voltage driver module for the OUT port. Each current gain adjustment step is 10 mA, the output current is configured to 10~300 mA, and OUTR/G/B/W/Y includes an integrated 5-bit current gain adjustment bit.

The SM16825E OUTR/G/B/W/Y lamp has gentle and smooth color adjustment, and it may be dimmed in 65536-level grayscale.

In order to achieve minimal standby power consumption, the SM16825E chip's DIN input standby signal enters standby mode. At the same time, the standby mode is automatically vacated upon detection of DIN input data.

The over-temperature protection function of the SM16825E enhances system reliability by lowering the output current when the internal temperature hits the over-temperature protection point.

Pin Definition



ESOP8/EMSOP8

Internal Function Diagram

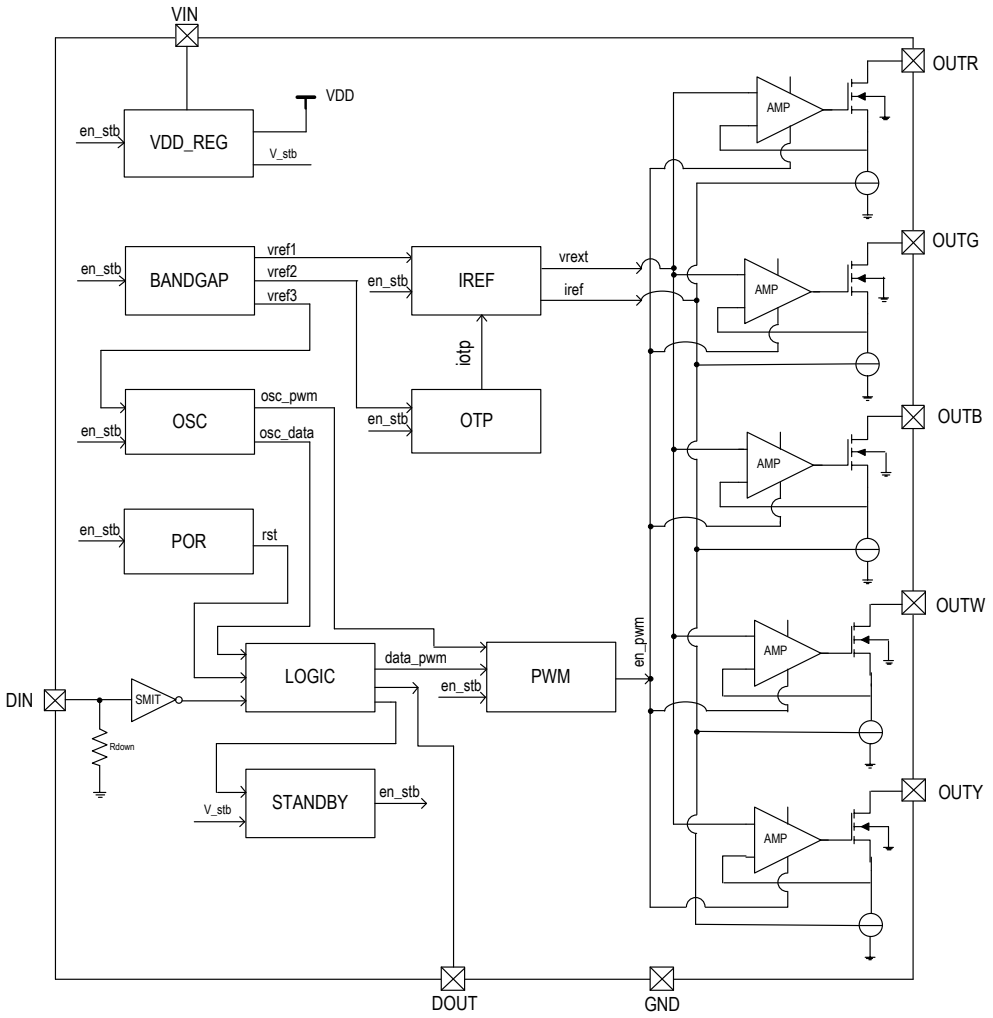


Fig. SM16825EInternal functional block diagram

Pin Description

No.	Pin Name	Pin Description
1	OUTW	Drive current port
2	OUTY	Drive current port
3	VIN	Power supply
4	DIN	RZ code data input
5	DOUT	Cascade data output
6	OUTB	Drive current port
7	OUTG	Drive current port
8	OUTR	Drive current port
Island	GND	Ground

Order Information

Type	Package	Packing		Reel Size
		Tube	Tape	
SM16825E	ESOP8	100000 pcs/box	4000 pcs/tape	13 inches
	EMSOP8	/	4000pcs/tape	13 inches

Absolute Maximum Parameter

Unless otherwise stated, T_A=25°C.

Symbol	Parameter	Range		Unit
VIN	Power supply voltage	5~40		V
DIN	Logic input voltage	-0.4~5.5		V
BV_{OUT}	Breakdown voltage of the OUT RGBWY	45		V
I_{OUT_MAX}	Maximum output current of the OUT RGBWY	300		mA
RθJA	PN junction to ambient thermal resistance (Note 1)	ESOP8	65	°C/W
		EMSOP8	60	
P_D	Power consumption (Note 2)	ESOP8	1.25	W
		EMSOP8	1.15	
T_J	Operating junction temperature	-40~150		°C
T_{STG}	Storage temperature	-55~150		°C
V_{ESD}	HBM (Human Body Discharge Mode)	2		KV

Note 1: $R_{\theta JA}$ was measured on a single-layer thermal conductivity test plate according to the JEDEC JESD51 thermal measurement standard under natural convection at T_A = 25 ° C.

Note 3: The maximum power consumption will definitely decrease when the temperature increases, which is also determined by T_{JMAX}, $R_{\theta JA}$, and the ambient temperature T_A. The maximum permissible power consumption is $P_D = (T_{JMAX}-T_A)/R_{\theta JA}$, or the lower of the value given in the limit range.

Electric Operating Parameter (Note 3, Note 4)

Unless otherwise stated, VIN=24V, T_A=25°C.

Symbol	Characteristic	Test Condition	Min.	Typ.	Max.	Unit
VIN	External power supply	--	5	-	36	V
VDD	Power supply	VIN=24V，RIN=2.2KΩ	4.5	5.0	5.3	V
IDD1	Quiescent operating current	OUT RGBWY all turn off	-	0.6	-	mA
IDD2		I_{OUT_RGBWY} = 150mA	-	3.0	-	mA
I_{STB}	Standby current	Standby mode, VIN=24V	-	-	100	uA
V_{IH}	DIN flips high	DIN input high level	2.8	-	-	V
V_{IL}	DIN flips low	DIN input low level	-	-	1.5	V
I_{OH_DOUT}	DOUT output current	DOUT output high level	-	22	-	mA
I_{OL_DOUT}	DOUT sink current	DOUT output low level	-	26	-	mA
I_{OUT}	OUT RGBWY driver current	OUT RGBWY current gain: 00000~11111	10	-	300	mA
dI_{OUT}	Chip-to-chip I_{OUT} bias	I_{OUT_RGBWY} = 10~300mA	-	±5	-	%
	In-chip I_{OUT} bias		-	±3	-	%
V_{DS_S}	constant current knee voltage of the OUT RGBWY	I_{OUT_RGBWY} =150 mA	-	0.5	-	V
		I_{OUT_RGBWY} = 300 mA	-	0.8	-	V
f_{PWM}	I_{OUT_RGBWY} frequency	PWM dimming frequency	3.5	4.0	4.5	KHz
$BV_{\_OUT}$	Breakdown voltage of the OUT RGBWY	OUT RGBWY turn off, sink current = 1uA	40	-	-	V
I_{OUT} VS. Temp	I_{OUT_RGBWY} temperature characteristics	I_{OUT_RGBWY} =150mA, Temp = -40~125°C	-	-2	-	%
T_{SC}	Start point of current negative temperature compensation (Note 5)	--	-	125	-	°C
Delay	OUT RGB and WY switching hysteresis	I_{OUT_RGBWY} turn on	-	120	-	ns
Rdown	DIN pull-down resistor	--	80	100	120	KΩ
t_{TLH}	I_{OUT_RGBWY} rise time	I_{OUT_RGBWY} =150 mA, the OUT is connected to a 22Ω resistor to a 5V power supply, and the load capacitance to ground is C_L=20pF	-	100	-	ns
t_{THL}	I_{OUT_RGBWY} drop time		-	80	-	ns

Note 3: Electrical operating parameters define the DC and AC parameters of the device within the operating range and under test conditions that guarantee specific performance specifications. The specification does not guarantee accuracy for parameters for which no upper or lower limit values are given, but typical values are reasonable reflections of device performance.

Note 4: The minimum and maximum parameter ranges of the datasheet are guaranteed by testing, and the typical values are guaranteed by design, testing, or statistical analysis.

Note 5: The starting point of current negative temperature compensation is the internal set temperature of 125 °C.

Data Format

The SM16825E protocol uses a unipolar RZ code, and each symbol must have a low level. Each symbol in this protocol starts high, and the time width of the high determines the "0" or "1" code.

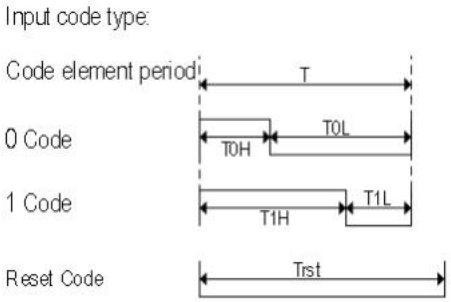


Fig. SM16825E RZ code data communication protocol diagram

Symbol	Parameter	Min.	Typ.	Max.	Unit
T	Code element period	1200	-	-	ns
T0H	0, HIGH level	200	300	400	ns
T0L	0, LOW level	800	900	-	ns
T1H	1, HIGH level	800	900	1000	ns
T1L	1, LOW level	200	300	-	ns
Trst	Reset, LOW level	200	-	-	us

Note 6: When writing a program, the minimum symbol cycle is 1.2us

Note 7： 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 code and 1 code is less than 20us.

The SM16825E inputs 80 bits of data for a single chip, including 16 bits of grayscale data for each OUT RGBWY; The 32-bit data at the end of each frame includes: 5-bit current gain data for each OUT RGBWY, a2-bit standby enable bit (2b'10 into standby), and a 5-bit reserved bit (all 1 is recommended). As shown in the figure below, both the grayscale data and the current gain data are highly advanced.

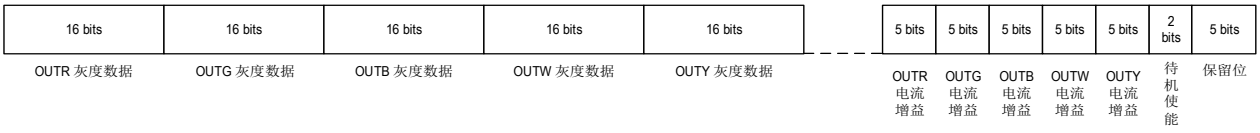


Fig.SM16825E Single-chip data format

The SM16825E cascaded data format is shown in the figure below, in which, after the RESET time, the cascaded N chips synchronously refresh the data and output the corresponding RGBWY current.

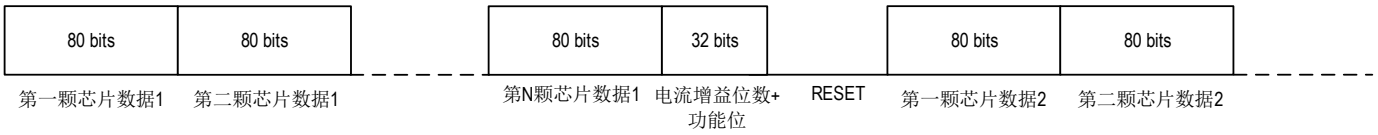


Fig.SM16825E cascading data format

Standby Mode

The SM16825E has a built-in standby mode; that is, when the standby command data input by DIN is 2b'10, it will enter the standby mode, and the standby current calculation formula is as follows:

I_STB=（VIN-6）/420Kohm，

In the formula, VIN is the chip input voltage.

Wake-up Mode

After DIN inputs normal data, the chip automatically exits the standby state, the current frame data is invalid, and the second frame data after waking up is valid data.

Constant Current Characteristic

1） After the voltage of the OUT RGBWY port reaches the constant current inflection point, the output current is stable and no longer changes with the increase of the terminal voltage V_{DS} of the OUT RGBWY; At the same time, the constant current setting and control technology ensure that the output current deviation between chips is ≤ ± 5%.

2） As shown in the figure below, when the constant current inflection point is reached, the output current is minimally affected by the OUT RGBWY port voltage V_{DS}.

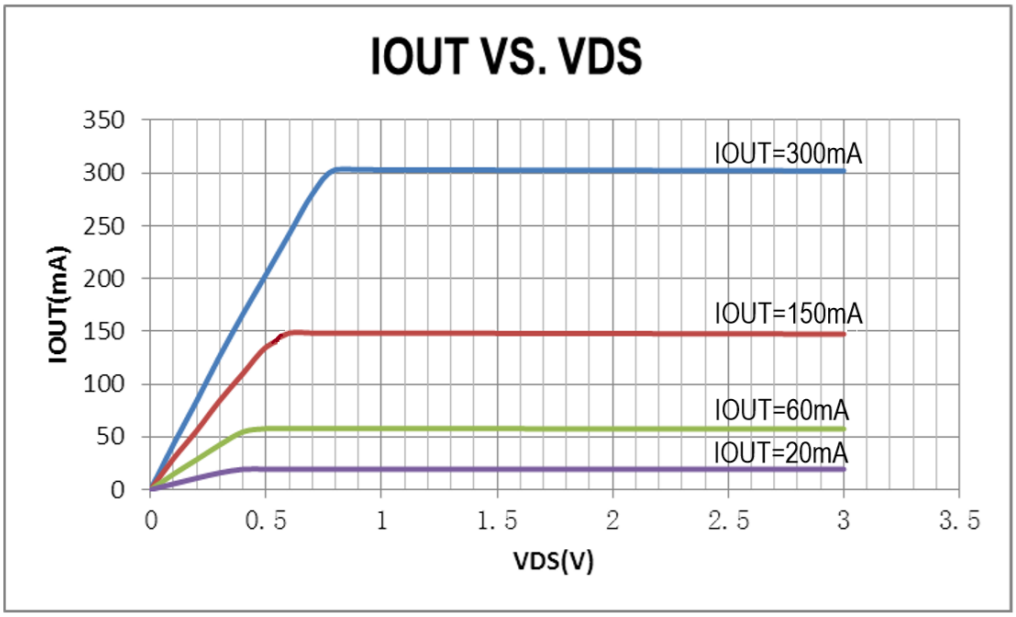


Fig. diagram of the output current I_{OUT_RGBWY} vs. the OUT RGBWY port voltage V_{DS} (VIN=24V)

Temperature Compensation

With the SM16825 built-in temperature compensation function, when the chip reaches the 125 ºC over-temperature point, the output current will be reduced to ensure that the chip temperature will not be too high and improve the reliability of the chip.

Current Gain Adjustment (D5~D1 from high to low)

Current gain (G)	D5	D4	D3	D2	D1	Current (mA)
1	0	0	0	0	0	10.2
2	0	0	0	0	1	20.3
3	0	0	0	1	0	30.4
4	0	0	0	1	1	40.5
5	0	0	1	0	0	50.6
6	0	0	1	0	1	60.7
7	0	0	1	1	0	70.8
8	0	0	1	1	1	80.9
9	0	1	0	0	0	91
10	0	1	0	0	1	101.1
11	0	1	0	1	0	111.2
12	0	1	0	1	1	121.3
13	0	1	1	0	0	130.7
14	0	1	1	0	1	140.6
15	0	1	1	1	0	150.5
16	0	1	1	1	1	160.2
17	1	0	0	0	0	170
18	1	0	0	0	1	179
19	1	0	0	1	0	188.5
20	1	0	0	1	1	198
21	1	0	1	0	0	207.8
22	1	0	1	0	1	216.8
23	1	0	1	1	0	226.4
24	1	0	1	1	1	235.8
25	1	1	0	0	0	245
26	1	1	0	0	1	254.4
27	1	1	0	1	0	263.6
28	1	1	0	1	1	272.8
29	1	1	1	0	0	282
30	1	1	1	0	1	291
31	1	1	1	1	0	300
32	1	1	1	1	1	310

Typical Application

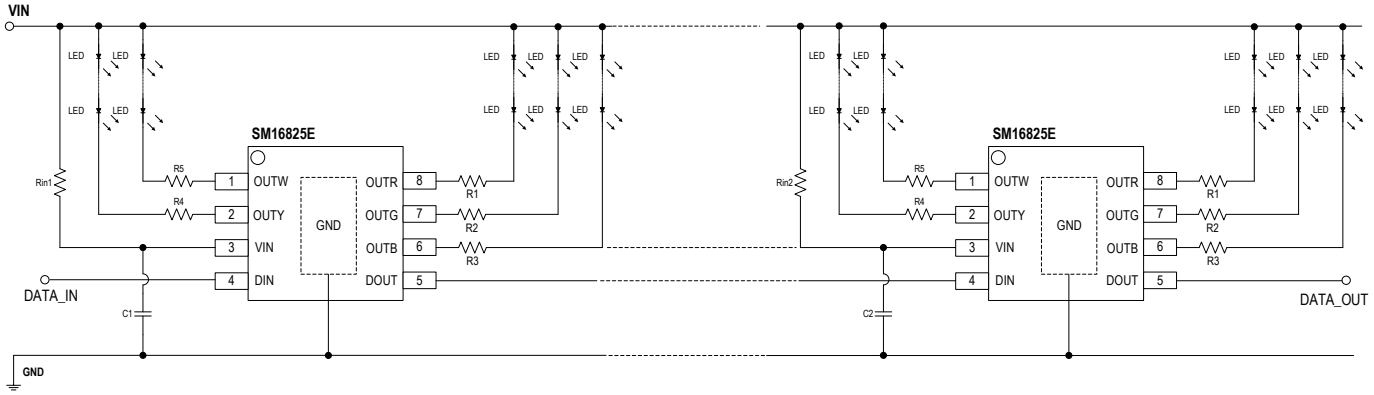


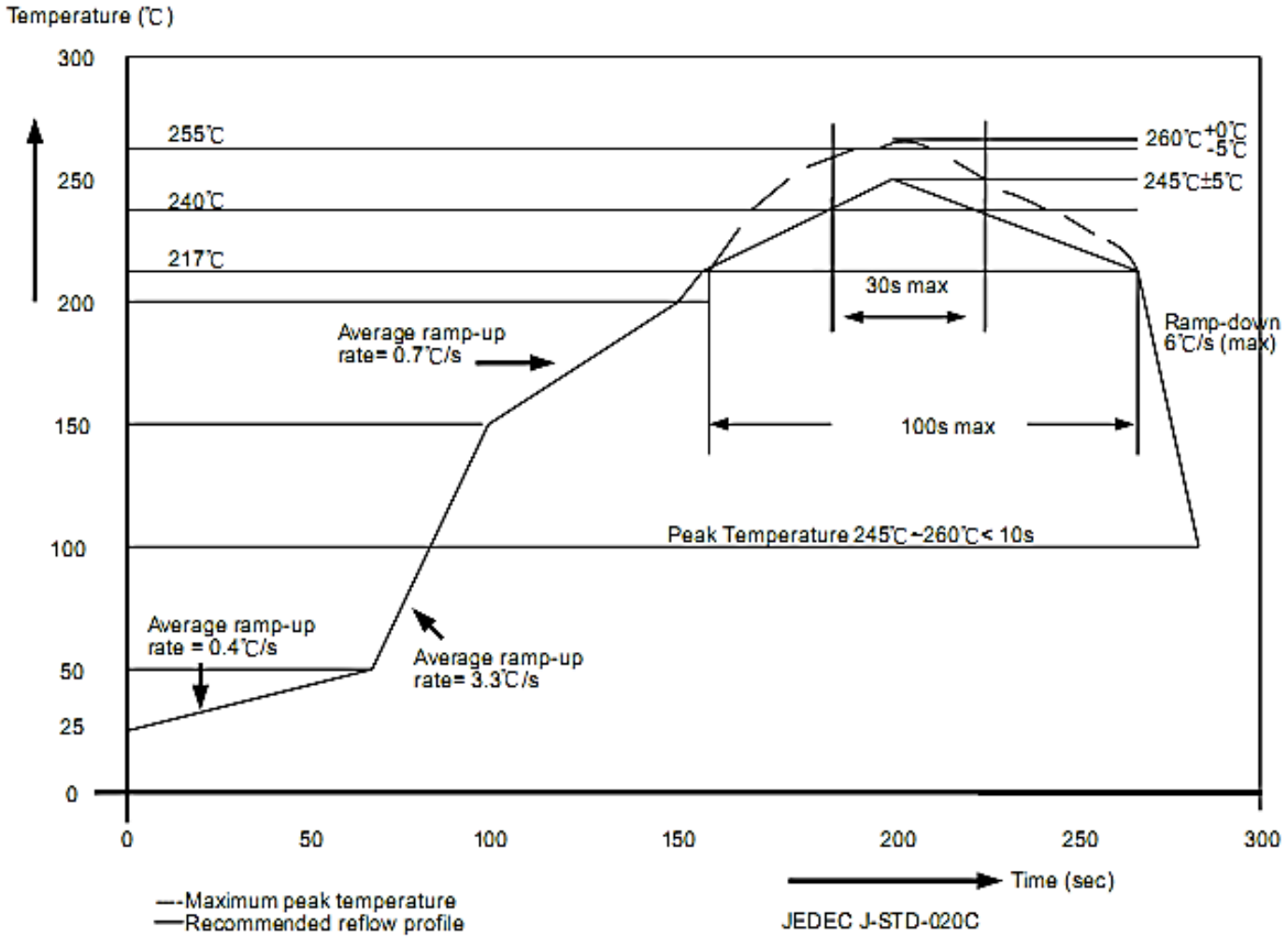
Fig. SM16825E diagram of a typical application scheme

In the figure above, VIN is the system input voltage, and the device list is as follows:

Device type	Device Name	Device Function	Device parameters
Resistance	R1~R10	OUT RGBWY port voltage-limiting resistor	Select the resistance value to ensure that the voltage of OUT RGBWY is 1~2V
	Rin1、Rin2	VIN port current-limiting resistor	2.2K~4.7KΩ
Capacitance	C1、C2	VIN port filter capacitor	100nF/50V or 1uF/50V

Encapsulation Soldering Process

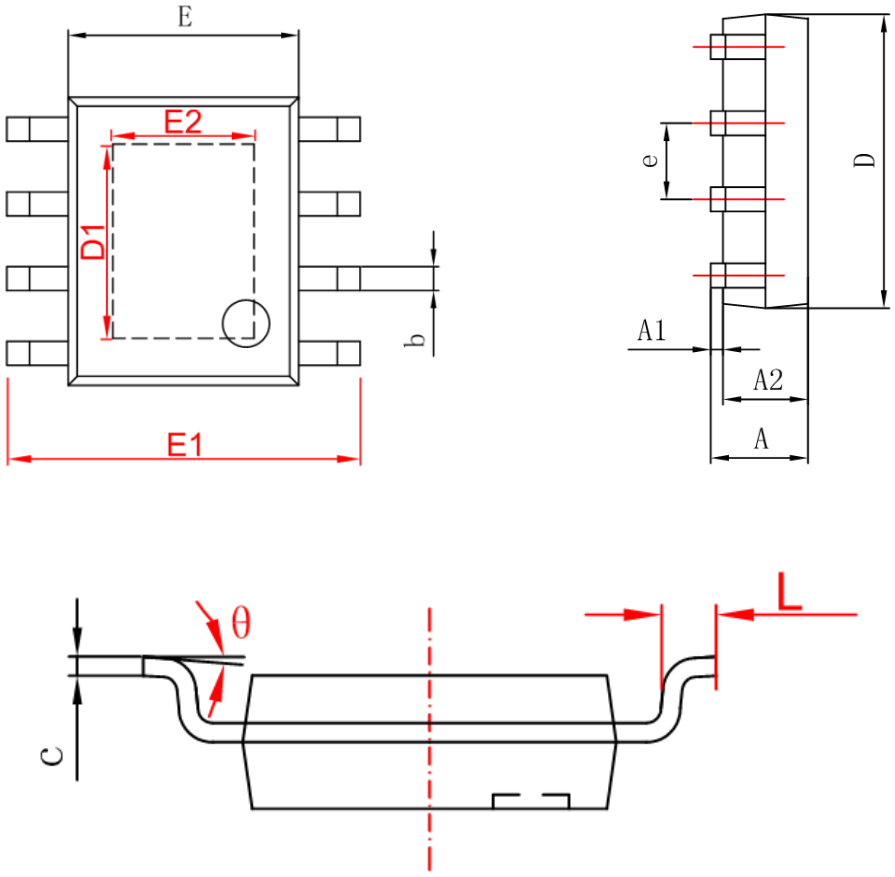
Semiconductors of Sunmoon follow the European RoHs standard, and solder temperature in the encapsulation soldering process follows the J-STD-020 standard.



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

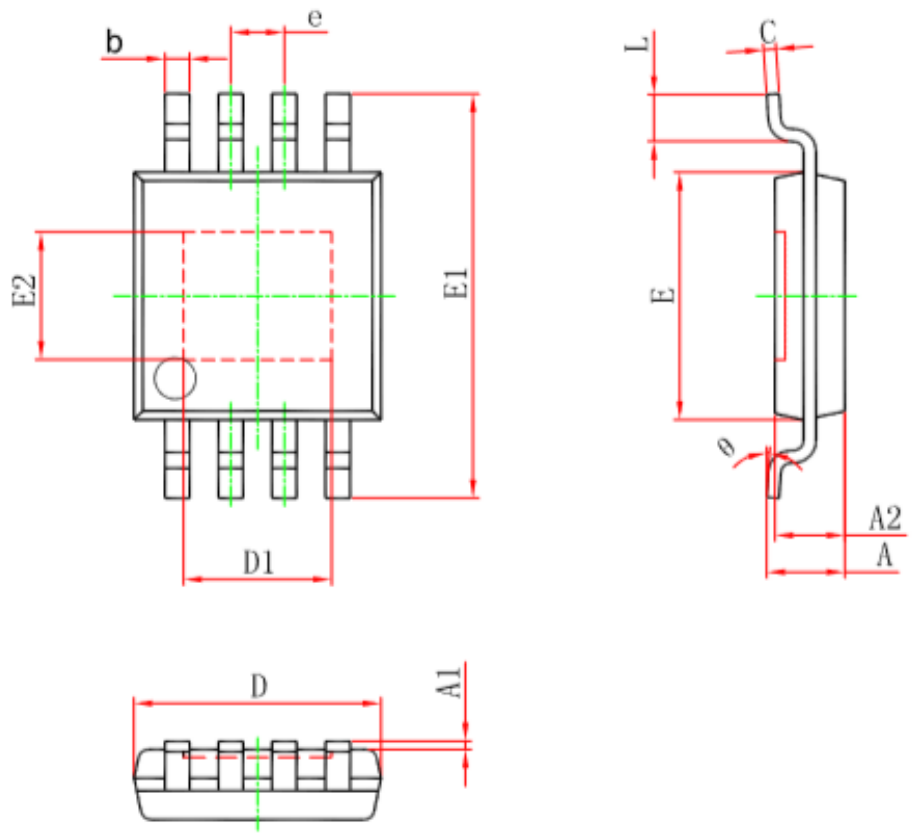
Package

ESOP8



Symbol	Min(mm)	Max(mm)
A	1.25	1.95
A1	-	0.1
A2	1.25	1.75
b	0.25	0.7
c	0.1	0.35
D	4.6	5.3
D1	3.12(REF)	
E	3.7	4.2
E1	5.7	6.4
E2	2.34(REF)	
e	1.270(BSC)	
L	0.2	1.5
Θ	0°	10°

EMSOP8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
D1	1.700	1.900	0.067	0.075
e	0.65 (BSC)		0.026 (BSC)	
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
E2	1.450	1.650	0.057	0.065
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

Revision Record

Date	Revision	Revision Contents
2020-06-01	IBSSZOV1.0	First edition
2021-05-10	IBSSZIV1.1	Modify the current gain current value to 10.2~310 mA

Declaration

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