Description

SE8319 is a high efficiency buck converter optimized to drive high current LEDs. SE8319 controls a built-in MOSFET at switching frequency by a single R_T resistor. A single R_{CS} resistor sets the full scale LED string current up to 2A from supplies as high as 80 V.

In SE8319, enable, linear dimming and PWM dimming control is provide. The linear dimming can be implemented by applying a control voltage from 0.4 to 2.5V to the LD pin. The PWM dimming has very fast response time. The dimming frequency is up to 30 KHz, a high contrast ratio can be achieved.

The patent-pending linear dimming ultra-low offset voltage operational amplifier is a next generation OP designed to cover 0% dimming depth.

Additional features include thermal shutdown, cycle-by-cycle current limit and over-current protection, soft start, smart thermal gradual protection, Internal Spread Spectrum Frequency Modulation for Low EMI.

The SE8319 is available in the ESOP8 package.

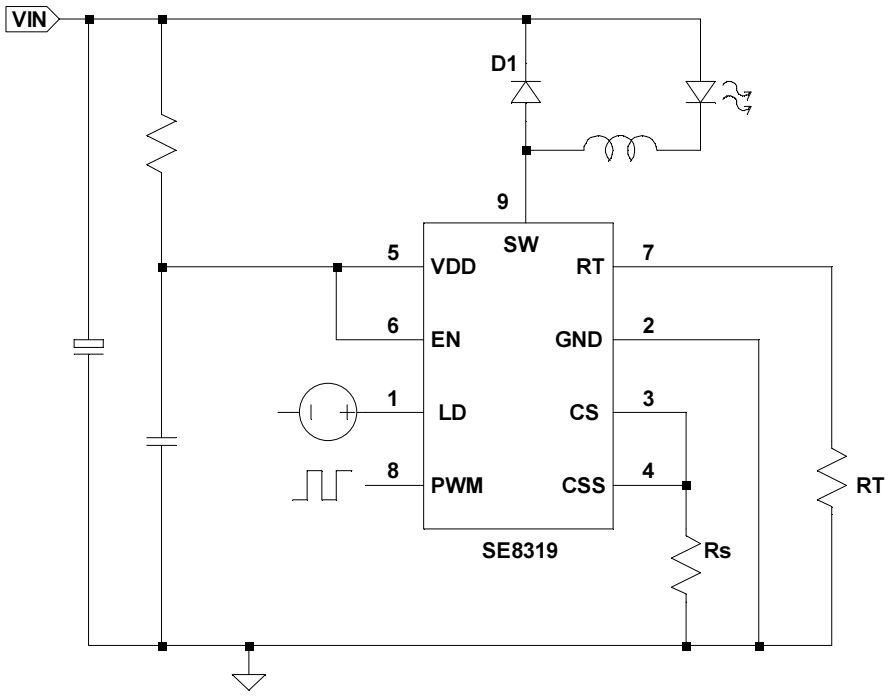
Features

- Wide Input Voltage Range: 4.5V～80V
- Built-in Power MOSFET, 150mΩ
- Output Current：10mA～2000mA
- patent-pending True-Zero 0% linear dimming
- Programmable Switching Frequency
- Internal Spread Spectrum Frequency Modulation for Low EMI
- COT control for high accuracy
- 0-100% duty control, smooth current control
- Over-current Protection（OCP）
- Over-Temperature Protection (OTP)
- EN/DIM Input for Enabling and Linear/PWM Dimming of LEDs
- Smart Thermal Gradual Protection

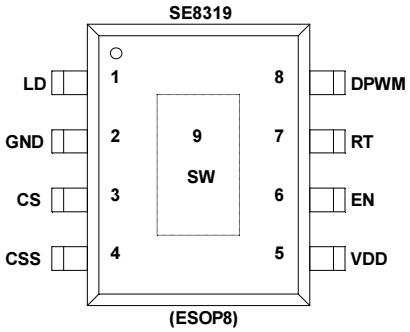
Applications

- luminaries, RGB lamp
- Automotive Lighting
- LED Flashlights

Typical Application Circuit



Pin Configuration



Pin Functions

PIN No.	Name	DESCRIPTION
1	LD	Linear Diming Input
2	GND	Ground
3	CS	Current Sense
4	CSS	Built-in MOSFET Source
5	VDD	Power Supply
6	EN	Enable
7	RT	Frequency Setting
8	DPWM	PWM Diming Input
9	SW	Built-in MOSFET Drain

Order Information

Device	Package	Temp	Ship Info	Logo
SE8319	ESOP-8L	-40℃～105℃	Tape 4KPCS/Reel	SE8319

Absolute Maximum Ratings

Unless otherwise specified, $T_J = T_A = 25°C$

Description	Rating	UNIT
VDD, CS,CSS,LD,DPWM	-0.3~7	V
SW	-0.3~80	V
EN,RT	-0.3~VDD	V
Storage Temperature Range	-40~150	℃
Junction temperature	-40~125	℃
ESD HBM Mode	2000	V

Note: 1 Absolute Maximum Ratings are limits beyond which damage to the device may occur.

Note: 2 HBM Mode, 100pF, 1.5kΩ discharge.

Recommended Operating Conditions

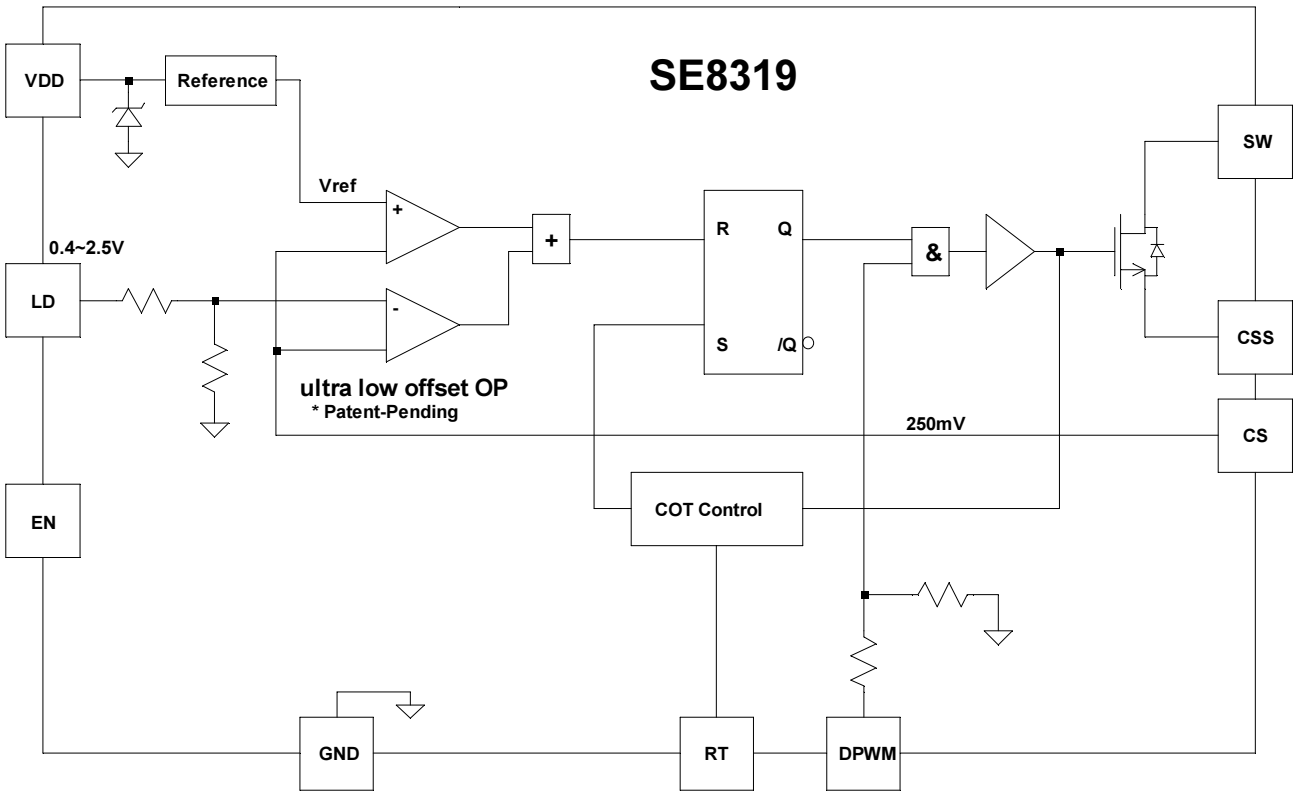
	MIN	MAX	UNIT
Input voltage, V_{IN}	4.5	80	V
DIM voltage	0	6	V
Junction temperature, T_J	-40	125	℃

Electrical Characteristics

Unless otherwise specified, -40℃ ≤ $T_J = T_A$ ≤ 125℃, V_{IN} =12 V

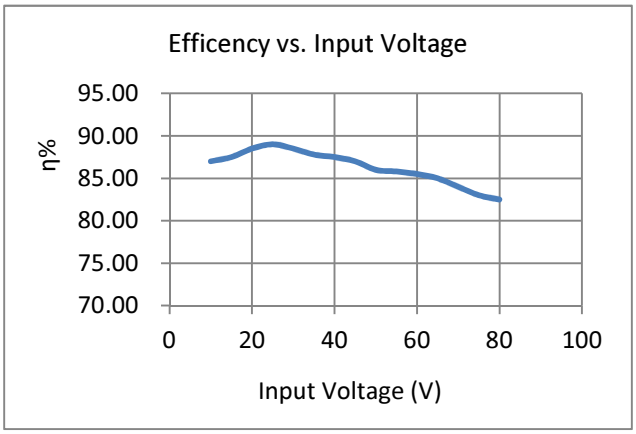
Parameter	Symbol	Conditions	Min	Typical	Max	Unit
Power Supply						
Chip Voltage	V_{DD}		4.5		6	V
Chip Current	I_{VDD}				2	mA
VDD Start up	UVLO		3.5	3.85	4.2	V
UVLO Hys	△UVLO				0.5	V
EN High	$V_{EN(HI)}$			2.5		V
EN Low	$V_{EN(LOW)}$			2.1		V
PWM Dimming						
PWM High	$V_{PWM(HI)}$		2.4			V
PWM Low	$V_{PWM(LOW)}$				1	V
PWM Sink Res	R_{PWM}			100		KΩ
Linear Dimming						
LD Range	V_{LD}		0.4		2.5	V
LD Sink Res	R_{LD}			100		KΩ
Current Sense						
CS Voltage	V_{CS}		236	246	256	mV
MOSFET Stage						
On Resistance	Ron			150		mΩ
BV	V_{DS}				100	V
Oscillator						
Fixed OFF Time	T_{OFF}	RT=100K		6.5		μS
		RT=400K		26		μS
Max Duty	D_{MAX}				100	%
Blank Time	T_{BLANK}			200		nS
Temperature						
OTP start	T_{START}			120		℃
OTP shutdown	T_{END}			170		℃

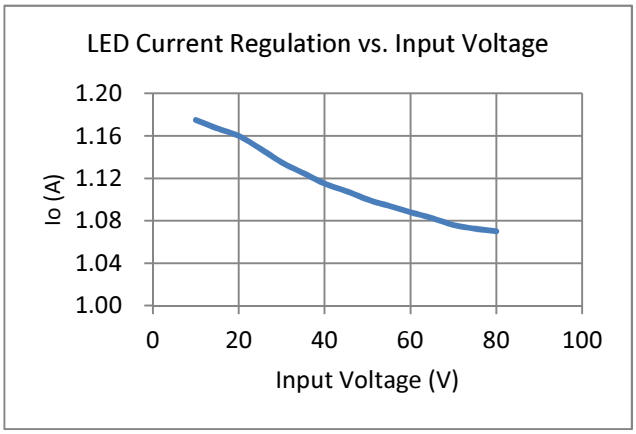
Functional Block Diagram



TYPICAL OPERATION CHARACTERISTICS

（V_{IN}=12V～80V,V_{OUT}=9.8V,I_{OUT}=1.2A,C_{IN}=10uF,L=100uH.）





Dimming plots

（V_{IN}=12V～80V,V_{OUT}=9.8V,I_{OUT}=1.2A,C_{IN}=10uF,L=100uH.）

Linear Dimming (True 0% Dimming)

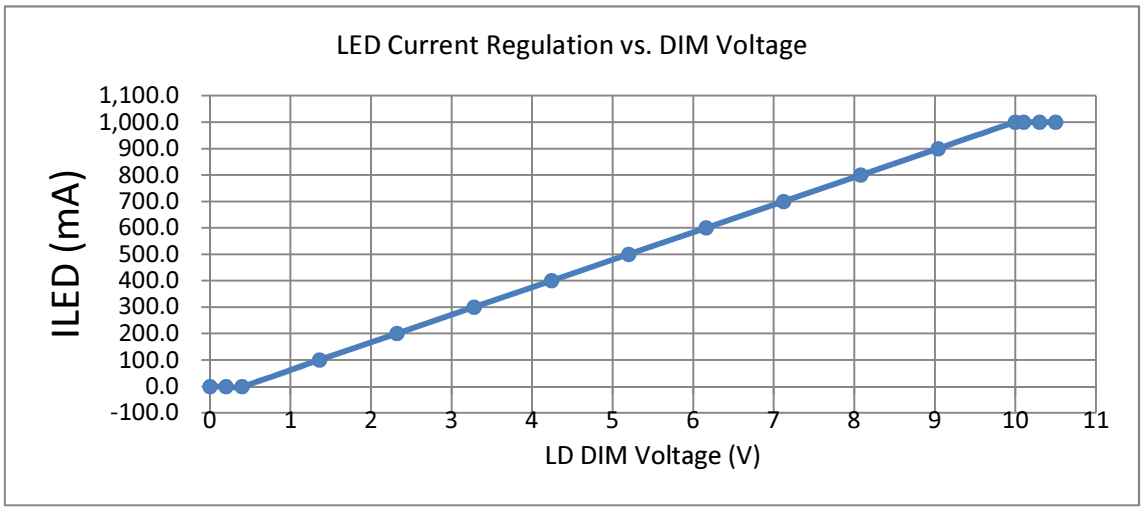
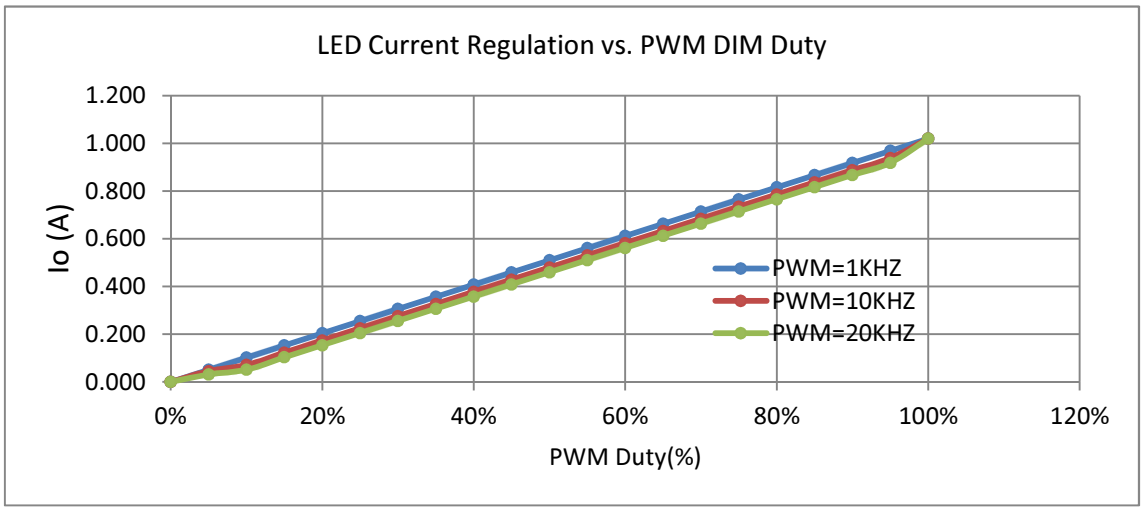


Figure- Whole DIM Range (0~10V)

PWM Dimming (up to 30 KHz)

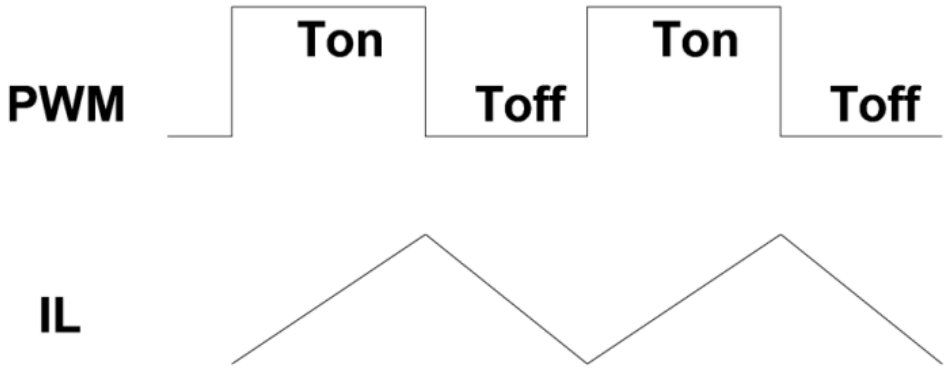


Detailed Description

The SE8319 is a high efficiency step−down regulator designed to drive series or parallel connected high−power LEDs.

During the first switching phase, an external high voltage power MOSFET allows the inductor current to charge linearly until the peak maximum level is reached, at which point the MOSFET is switched off and the second phase commences, allowing the inductor current to then flow through the Schottky diode circuit and discharge linearly during one constant off time set by RT resistor.

The switching architecture ensures the device will always operate at COT (Constant Off-Time) mode. This operating mode results in an average LED current which is controlled by the peak current and the off time.



LED Analog Dimming

Applying a DC voltage from 0.4V to 2.5V on the LD Pin can adjust output current from 0 to 100% of I_{OUTNOM}.

Recommended dimming range is from 0% to 100%. If the DIM Pin is brought higher than about 2.5V, the LED current will be clamped to 100% of I_{OUTNOM} while if the LD voltage falls below the threshold of 0.4V, the output switch will turn off.

The patent-pending linear dimming ultra low offset voltage operational amplifier is a next generation OP designed to cover 0% dimming depth. This design features the highest depth in the market, not just an incredible depth of 0%, but also no LED flicker when close to 0%. This True-Zero technology is for 0% dimming.

LED PWM Dimming

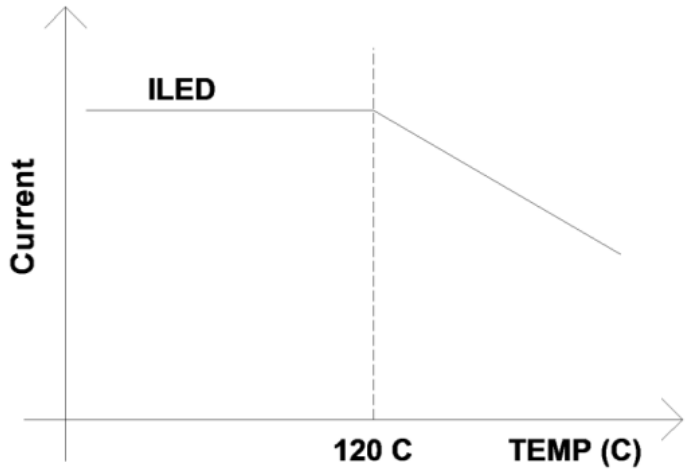
The LED brightness can be controlled by applying a periodic pulse signal to the DPWM pin and varying its frequency and/or duty cycle. The PWM frequency is up to 20~30 KHz (depend on real application).

Spread Spectrum Frequency Modulation

Switching regulators can be particularly troublesome for applications where electromagnetic interference (EMI) is a concern. To improve the EMI performance, the SE8319 includes a spread spectrum frequency feature. Simple digital circuits were used to fed a quasi-triangle wave into the internal oscillator to modulate the switching frequency between about ±90% of the base frequency. The Spread Spectrum modulation introduces an insignificant amount of jitter to the clock.

Thermal Gradual Protection

SE8319 use a smart thermal gradual protection method to reduce the average current of the LEDs continuously in a slope dimming characteristic, not abruptly shutdown chip.



Setting Switching Frequency

The switching frequency of the SE8319 should be programmed in a proper range. The following equation shows the relationship between F_{SW} and V_{IN}, V_{LED}, R_T

$$F_{OSC} = \frac{1-D}{T_{OFF}} = 1.03\frac{V_{IN}-V_{LED}}{R_T V_{IN}} \times 10^{11}\ (Hz)$$

$$L = V_{LED}\frac{T_{OFF}}{30\% \times I_{LED}} = 3.24\frac{V_{LED}}{I_{LED}}R_T \times 10^{-12}$$

$$L = V_{LED} \times \frac{V_{IN}-V_{LED}}{0.3 I_{LED} V_{IN}} \times \frac{1}{F_{OSC}}$$

V_{LED}: LED output voltage

V_{IN}: Input voltage

R_T: Resistor at Pin RT

Setting LED Current

The LED current I_{LED} of the SE8319 is programmable by a sense resistor R_{CS}.

$$R_{CS} = \frac{0.25}{1.3 \times I_{LED}} = \frac{0.192}{I_{LED}}$$

Drive LEDs Application

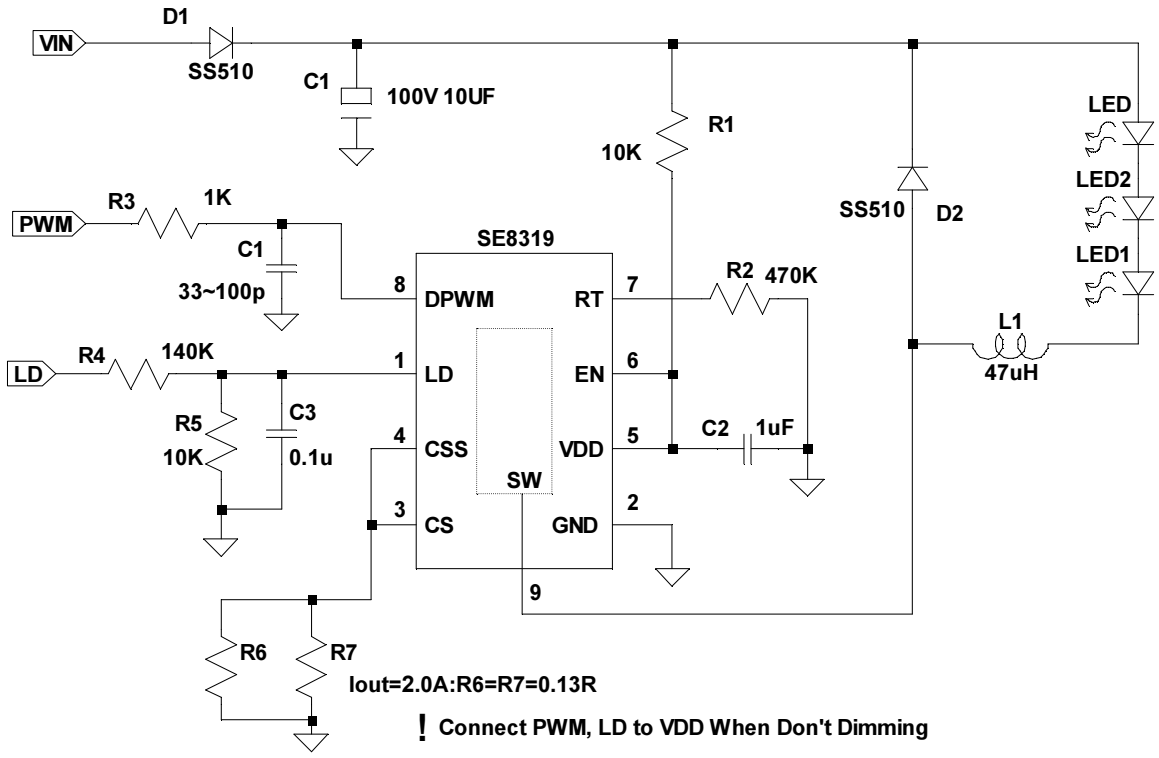


Figure V_{IN}=5~80V, I_{LED}=1.33A

Test Results:

LD Voltage (V)	LED Current (mA)	LD Voltage (V)	LED Current (mA)
10.5	1000	2.0	164.2
10.0	1000	1.2	83.5
9.0	892.0	0.6	20.8
8.0	790.0	0.45	5.21
7.0	685.0	0.41	1.04
6.0	584.0	0.4	0
5.0	481.0	0.2	0
4.0	374.0	0	0

PACKAGING INFORMATION

ESO-8 mechanical data

Size / Signal	Min	Typ	Max	Size / Signal	Min	Typ	Max
A	4.80		5.00	C	1.30		1.60
A1	0.356		0.456	C1	0.55		0.65
A2	1.27TYP			C2	0.55		0.65
A3	0.345TYP			C3	0.00		0.09
B	3.80		4.00	C4	0.203		0.233
B1	5.80		6.20	D	1.05TYP		
B2	5.00TYP			D1	0.40		0.80
* Unit=mm							

Package dimensions