



## High Performance, Constant Current Switching Regulator For 8PCS White LED In Series

### General Description

The LP3311S is a 1MHz PWM boost switching regulator designed for constant current white LED driver applications. The LP3311S can drive a string of up to 8 white LED in series, ensuring uniform brightness and eliminating several ballast resistors. The LP3311S implements a constant frequency 1MHz PWM control scheme. The high frequency PWM operation also saves board space by reducing external component size. To improve efficiency, the feedback voltage is set to 200 mV, which reduces the power dissipation in the current setting resistor. Highly integration and internal compensation network minimizes as 5 external component counts. Optimized operation frequency can meet the requirement of small LC filters value and low operation current with high efficiency.

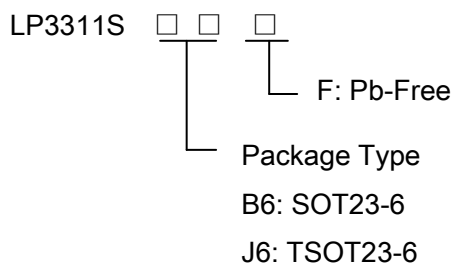
### Features

- ◆ High Efficiency: 93%
- ◆ 1MHz Fixed-Frequency PWM Operation
- ◆ Maximum Output Voltage up to 29V
- ◆ Operating Range : 2.7V to 6V
- ◆ Shutdown Supply Current:<1uA
- ◆ Available in SOT23-6 Package
- ◆ Built-in 29V Over Voltage Protection
- ◆ Minimize the External Component
- ◆ RoHS Compliant and 100% Lead (Pb)-Free

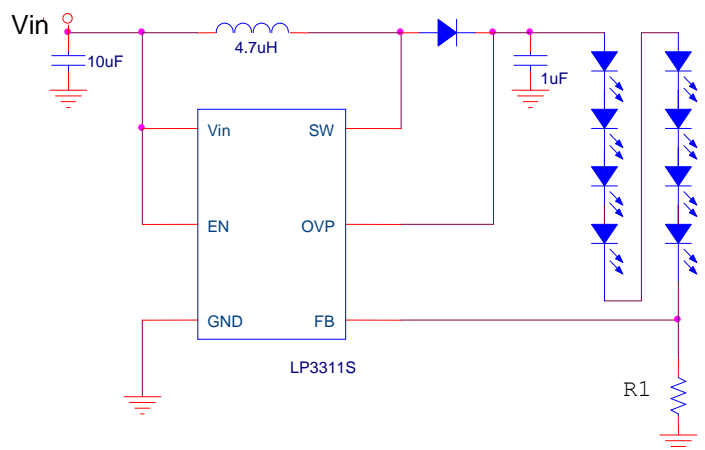
### Applications

- ◇ WLED Backlight driver
- ◇ OLED Backlight driver
- ◇ PDA
- ◇ MID/PTV

### Order Information



### Typical Application Circuit





## Functional Pin Description

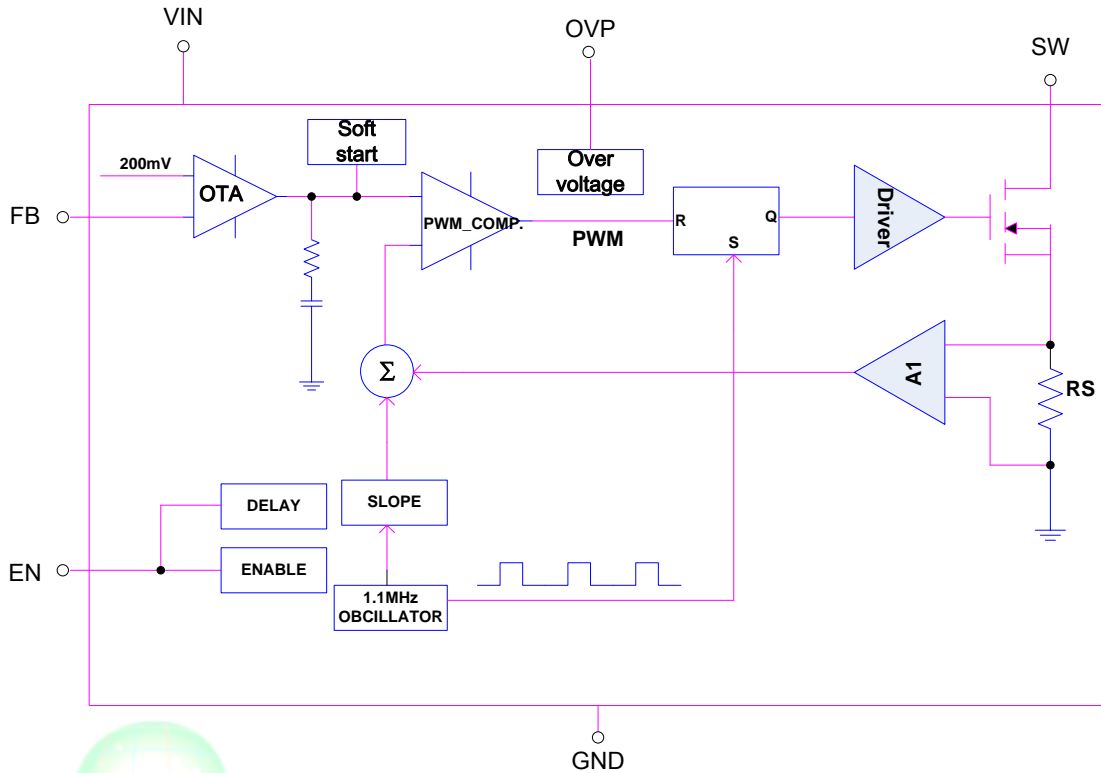
Package Type	Pin Configurations
T SOT23-6  SOT23-6	<p style="text-align: center;">SOT23-6 TSOT23-6</p>

## Pin Description

Pin	Name	Description
1	SW	Switch Pin. Connect this Pin to inductor and catch diode. Minimize the track area to reduce EMI.
2	GND	Ground Pin
3	FB	Feedback Reference Voltage Pin. Series connect a resistor between WLED and ground as a current sense. Sense the current feedback voltage to set the current rating.
4	EN	Chip Enable (Active High). Voltage sensing input to trigger the function of over voltage protection. Note that this pin is high impedance. There should be a pull low 100kΩ resistor connected to GND when the control signal is floating.
5	OVP	Over voltage pin.
6	Vin	Supply Input Voltage Pin. Bypass 1uF capacitor to GND to reduce the input noise.



### Function Block Diagram



### Absolute Maximum Ratings <sup>Note 1</sup>

- ◇ VIN PIN to GND ----- -0.3V to 6.5V
- ◇ SW /OVP PIN to GND ----- -0.3V to 36V
- ◇ The Other Pins ----- -0.3V to 5.5V
- ◇ Storage Temperature Range (TJ) ----- -65°C to 165°C
- ◇ Maximum Soldering Temperature (at leads, 10sec) ----- 260°C
- ◇ Maximum Power Dissipation (PD,TA<40°C) ----- 0.45W
- ◇ Thermal Resistance (JA) ----- 250°C/W
- ◇ Maximum Junction Temperature ----- 150°C
- ◇ Operating Junction Temperature Range (TJ) ----- -20°C to 80°C
- ◇ ESD Susceptibility HBM(Human Body Mode) ----- 2KV
- ◇ MM(Machine Mode) ----- 200V

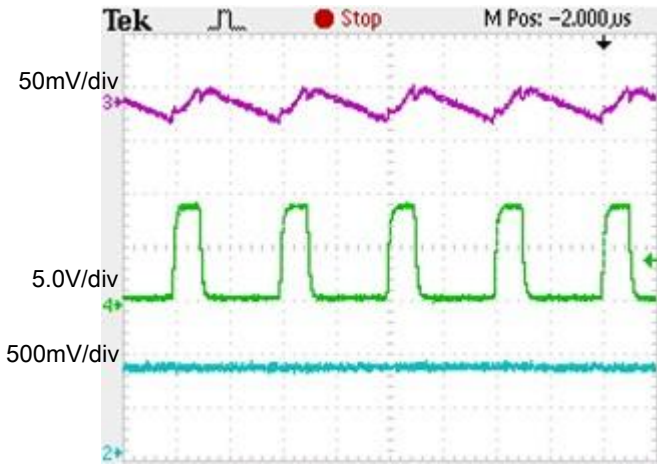


## Electrical Characteristics

Parameter	Symbol	Test Condition	Min	Typ.	Max	Units
System Supply Input						
Operation voltage Range	VDD		2.7		6	V
Under Voltage Lock Out	VDD		2.2	2.4	2.6	V
Supply Current	IDD	FB=0.2V, Switch		430	550	uA
Shut Down Current	IDD	VEN < 0.4V		0.1	1	uA
Line Regulation		VIN : 3.0~4.3V		2		%
Oscillator						
Operation Frequency	FOSC			1		MHz
Maximum Duty Cycle			93			%
Feedback Voltage	LP3311S		185	200	215	mV
MOSFET						
On Resistance of MOSFET	RDS(ON)			0.4		Ω
SW Current Limit	ILM		1.3	1.5		A
Protection						
OVP Threshold	VOVP			29		V
OVP Sink Current				5		μA
Shut Down Voltage	VEN				0.4	V
Enable on Voltage	VEN		1.4			V
PWM EN Dimming range			100		1000K	Hz



### Typical Operating Characteristics



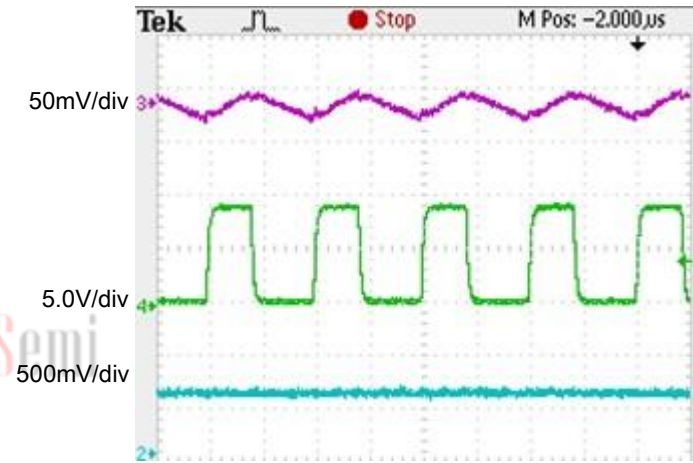
Vin=3V Iout=3S9P



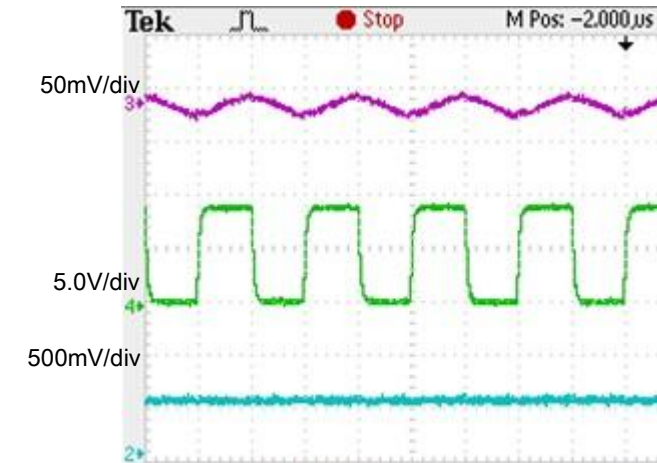
Vin=3.5V Iout=3S9P



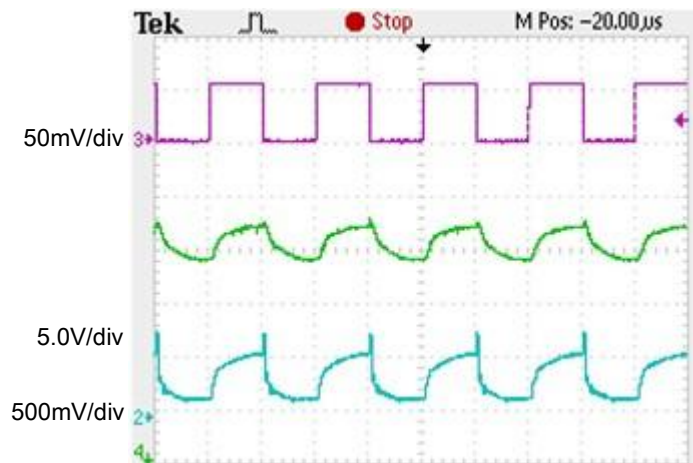
Vin=3.7V Iout=3S9P



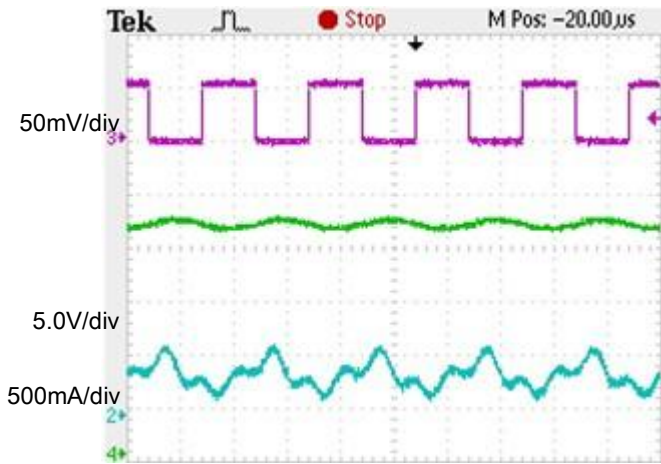
Vin=4.2V Iout=3S9P



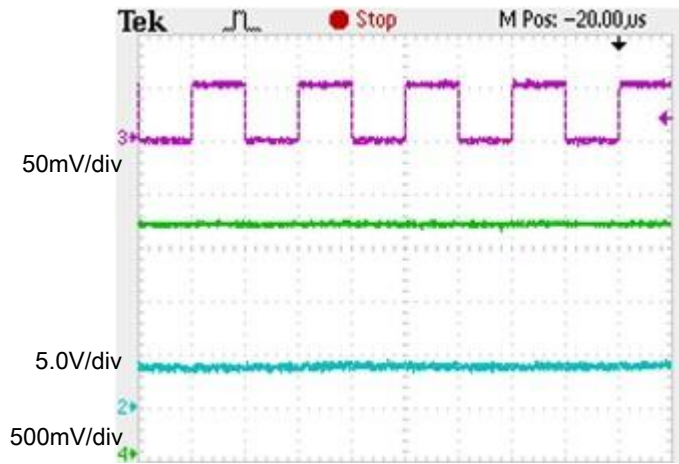
Vin=5V Iout=3S9P



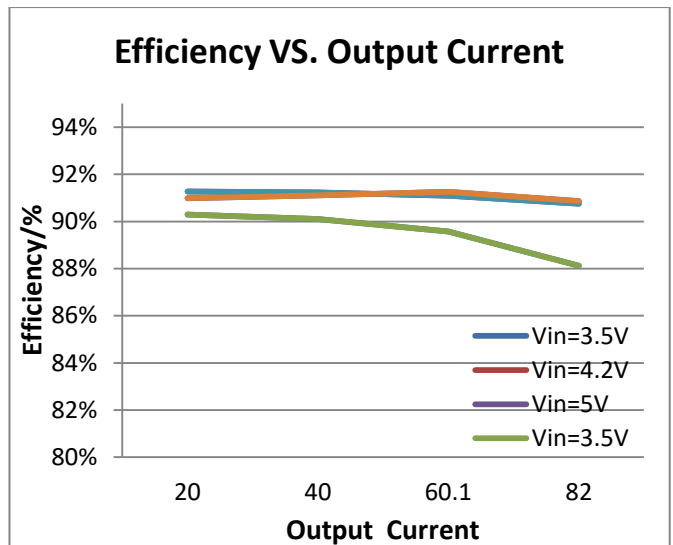
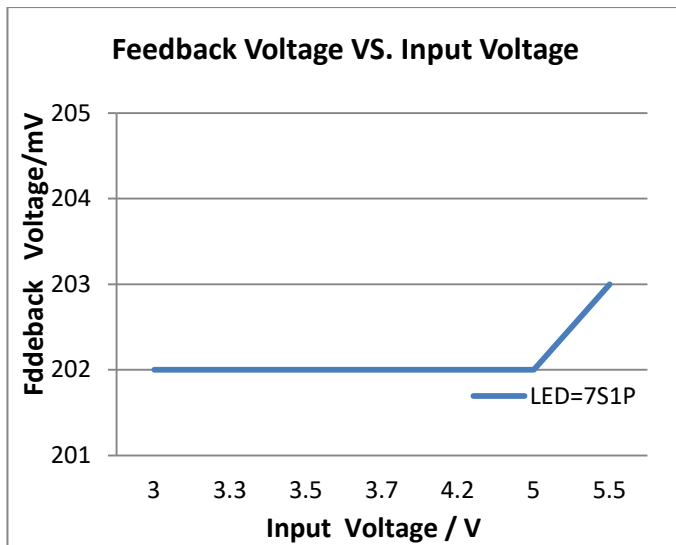
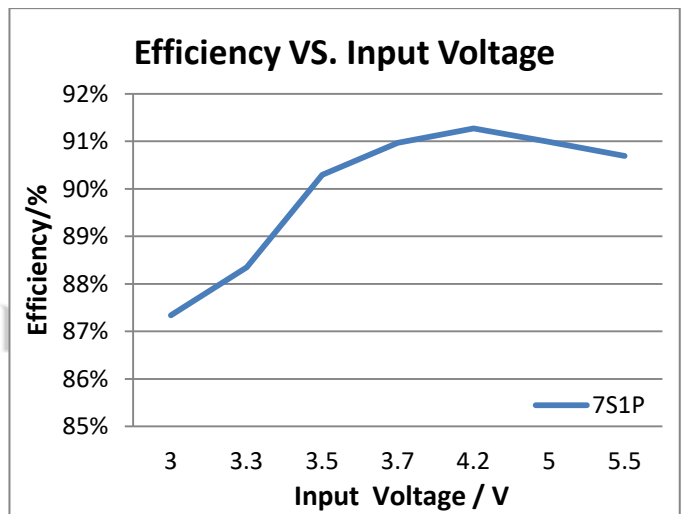
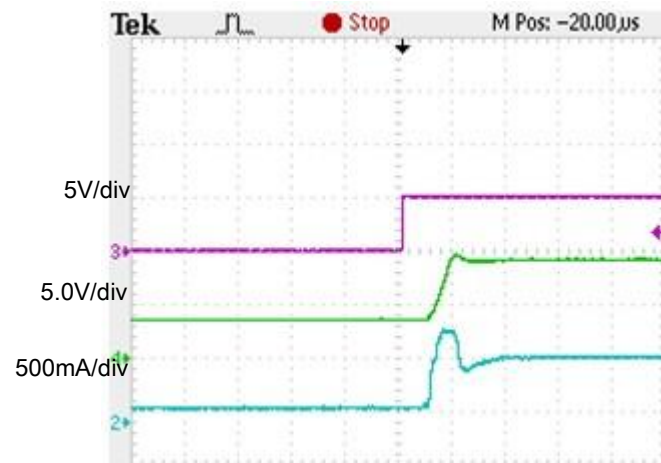
EN=1KHz



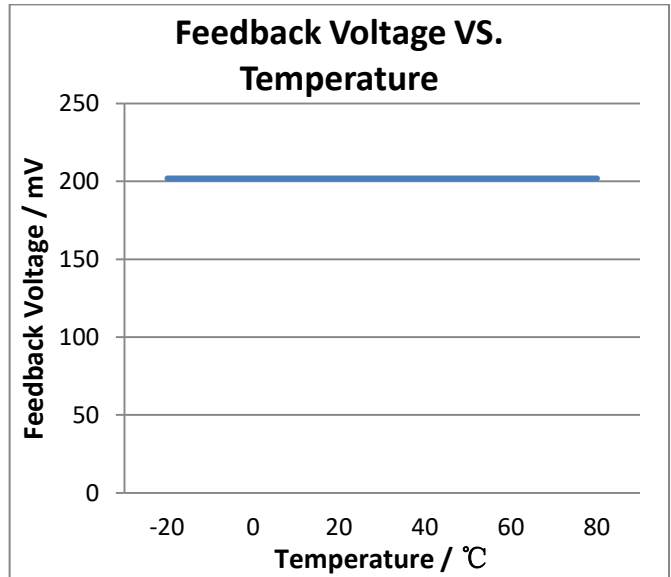
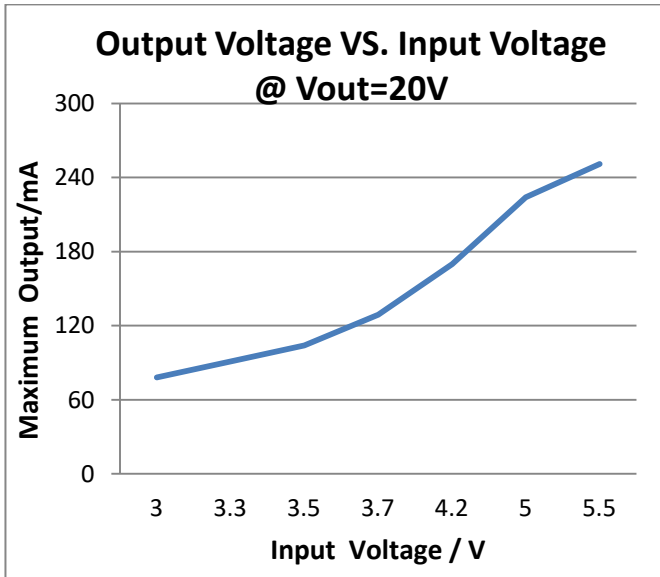
EN=10KHz



EN=100KHz









## Applications Information

### LED Current Control

The LP3311S regulates the LED current by setting the current sense resistor (R1) connecting to feedback and ground. The internal feedback reference voltage is 200mV. The LED current can be set from following equation easily.

$$I_{LED} = 200mV / R1$$

In order to have an accurate LED current, precision resistors are preferred (1% is recommended). The table for R1 selection is shown below.

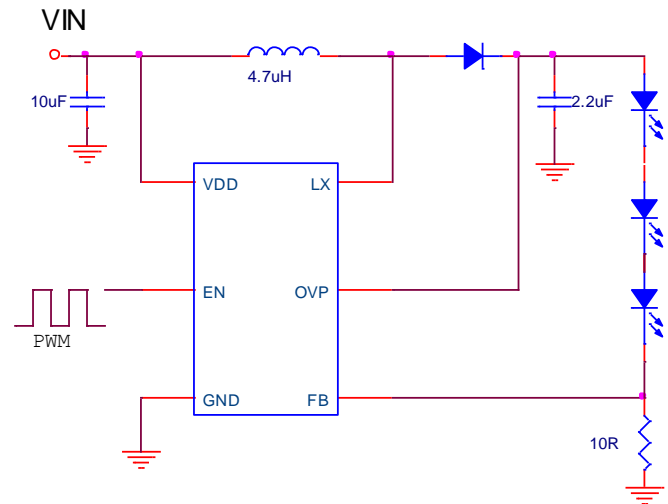
### Inductor Selection

The recommended value of inductor for 2 to 8 WLEDs applications are 4.7 to 22μH. Small size and better efficiency are the major concerns for portable device, such as LP3311S used for mobile phone. The inductor should have low core loss at 1MHz and low DCR for better efficiency. To avoid inductor saturation current rating should be considered.

### Dimming control

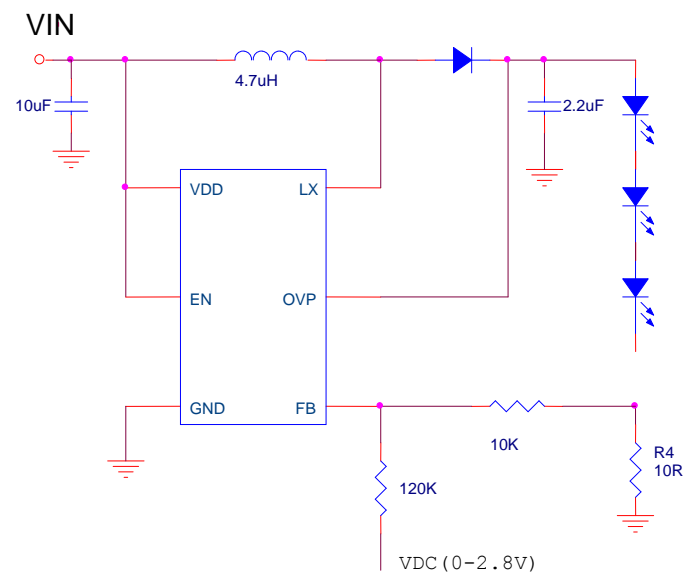
#### a. Using a PWM Signal to EN Pin

For controlling the LED brightness, the LP3311S can perform the dimming control by applying a PWM signal to EN pin. The internal soft-start and wide range dimming frequency from 100Hz to 1MHz can insignificantly reduce audio noise when dimming. The average LED current is proportional to the PWM signal duty cycle. The magnitude of the PWM signal should be higher than the maximum enable voltage of EN pin, in order to let the dimming control perform correctly.



#### b. Using a DC Voltage

Using a variable DC voltage to adjust the brightness is a popular method in some applications. The dimming control using a DC voltage circuit is shown below. According to the Superposition Theorem, as the DC voltage increases, the voltage contributed to VFB increases and the voltage drop on R2 decreases, i.e. the LED current decreases. For example, if the VDC range is from 0V to 2.8V, the selection of resistors in figure sets dimming control of LED current from 20mA to 0mA.

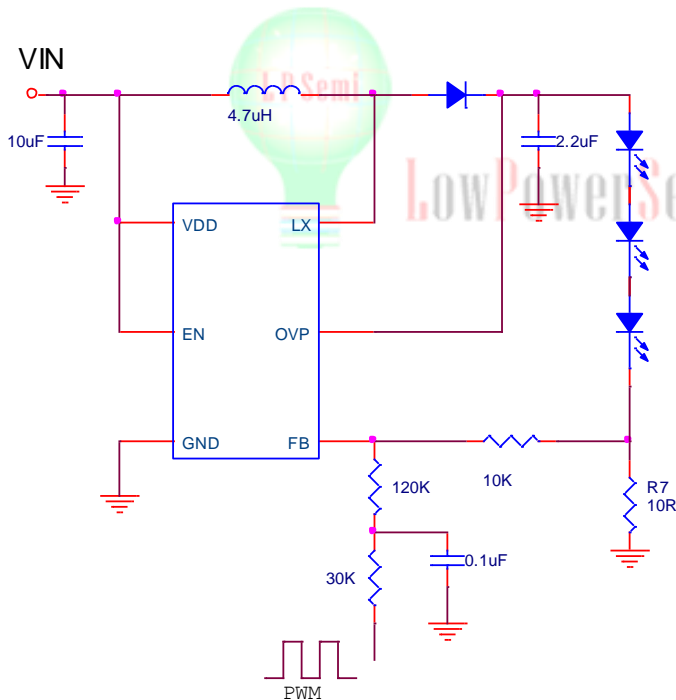






c. Using a Filtered PWM signal

Another common application is using a filtered PWM signal as an adjustable DC voltage for LED dimming control. A filtered PWM signal acts as the DC voltage to regulate the output current. The recommended application circuit is shown in the figure . In this circuit, the output ripple depends on the frequency of PWM signal. For smaller output voltage ripple (<100mV), the recommended frequency of 2.8V PWM signal should be above 2kHz. To fix the frequency of PWM signal and change the duty cycle of PWM signal can get different output current. According to the application circuit below, output current is from 20.5mA to 4mA by adjusting the PWM duty cycle from 10% to 90%.



Thermal Considerations

For continuous operation, do not exceed absolute maximum operation junction temperature. The maximum power dissipation depends on the thermal resistance of IC package, PCB layout, the rate of surroundings airflow and temperature difference between junction to ambient.

The maximum power dissipation can be calculated by following formula :

$$PD(MAX) = ( T_J(MAX) - T_A ) / q_{JA}$$

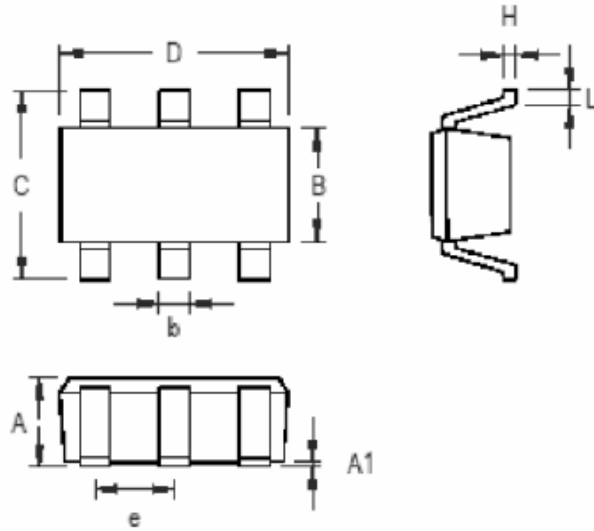
Where T<sub>J</sub>(MAX) is the maximum operation junction temperature, T<sub>A</sub> is the ambient temperature and the q<sub>JA</sub> is the junction to ambient thermal resistance. For the recommended operating conditions specification of LP3311S, the maximum junction temperature of the die is 125°C. The junction to ambient thermal resistance q<sub>JA</sub> is layout dependent. The junction to ambient thermal resistance for TSOT-23-6 package is 250°C/W on the standard JEDEC51-3 single layer thermal test board. The maximum power dissipation at T<sub>A</sub> = 25°C can be calculated by following formula :

$$PD(MAX) = (125°C - 25°C) / (250°C/W) = 0.4W$$

The maximum power dissipation depends on operating ambient temperature for fixed T<sub>J</sub>(MAX) and thermal resistance q<sub>JA</sub>.

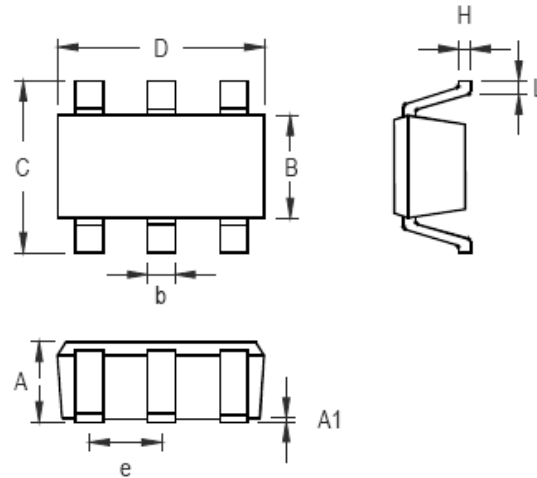


### Packaging Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.889	1.295	0.031	0.051
A1	0.000	0.152	0.000	0.006
B	1.397	1.803	0.055	0.071
b	0.250	0.560	0.010	0.022
C	2.591	2.997	0.102	0.118
D	2.692	3.099	0.106	0.122
e	0.838	1.041	0.033	0.041
H	0.080	0.254	0.003	0.010
L	0.300	0.610	0.012	0.024

**SOT-23-6 Surface Mount Package**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.700	1.000	0.028	0.039
A1	0.000	0.100	0.000	0.004
B	1.397	1.803	0.055	0.071
b	0.300	0.559	0.012	0.022
C	2.591	3.000	0.102	0.118
D	2.692	3.099	0.106	0.122
e	0.838	1.041	0.033	0.041
H	0.080	0.254	0.003	0.010
L	0.300	0.610	0.012	0.024

TSOT-23-6 Surface Mount Package