

## Boost Converter With 2.1A Switch In Tiny SOT-23 Package

### DESCRIPTION

The EUP2511 is a high performance current mode, PWM step-up converter. With an internal 2.1A, 150mΩ MOSFET, it can generate 5V at up to 900mA output current from a 3.6V supply. The fixed 600KHz operating frequency allows small inductors and fast transient response. The internal compensation structure will reduce board size and the application cost. Integrated internal soft-start also reduces inrush current during start-up.

The EUP2511 regulates the output voltage up to 6V from either a 2-cell NiMH/NiCd or a single-cell Li-Ion battery.

The EUP2511 is offered in SOT23-5 package.

### FEATURES

- 90% Efficiency
- 2.1A, 150mΩ Power MOSFET
- Adjustable Output Voltage
- Input Voltage Range 2.7V-5V
- 600kHz Operating Frequency
- 0.5μA Shutdown Current
- Available in SOT23-5 Package
- RoHS Compliant and 100% Lead(Pb)-Free Halogen-Free

### APPLICATIONS

- Mobile Phones
- GPS PND
- Portable media
- Handheld games

### Typical Application Circuit

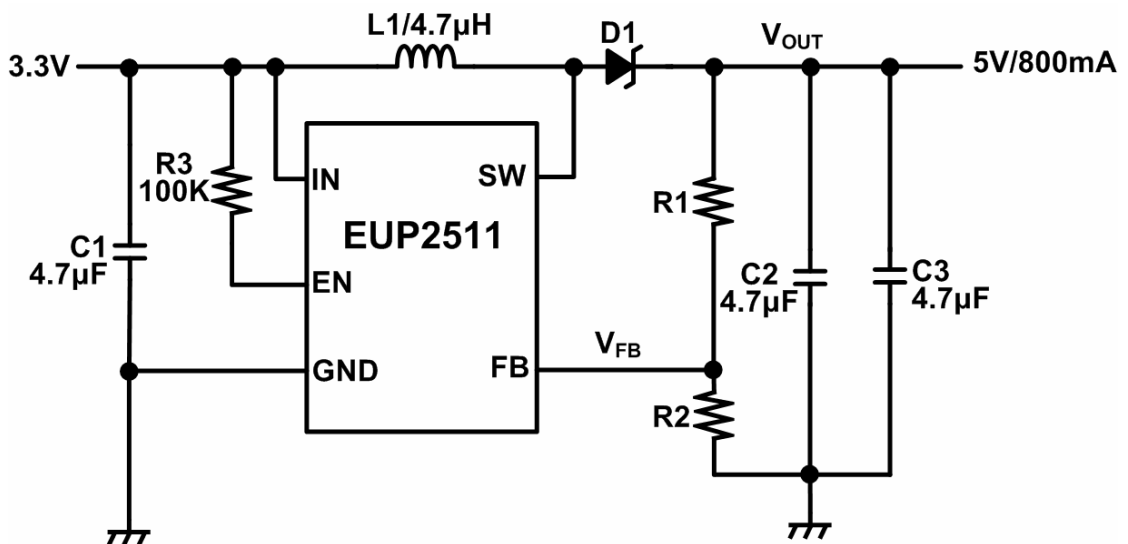


Figure1.

## Typical Application Circuit (continued)

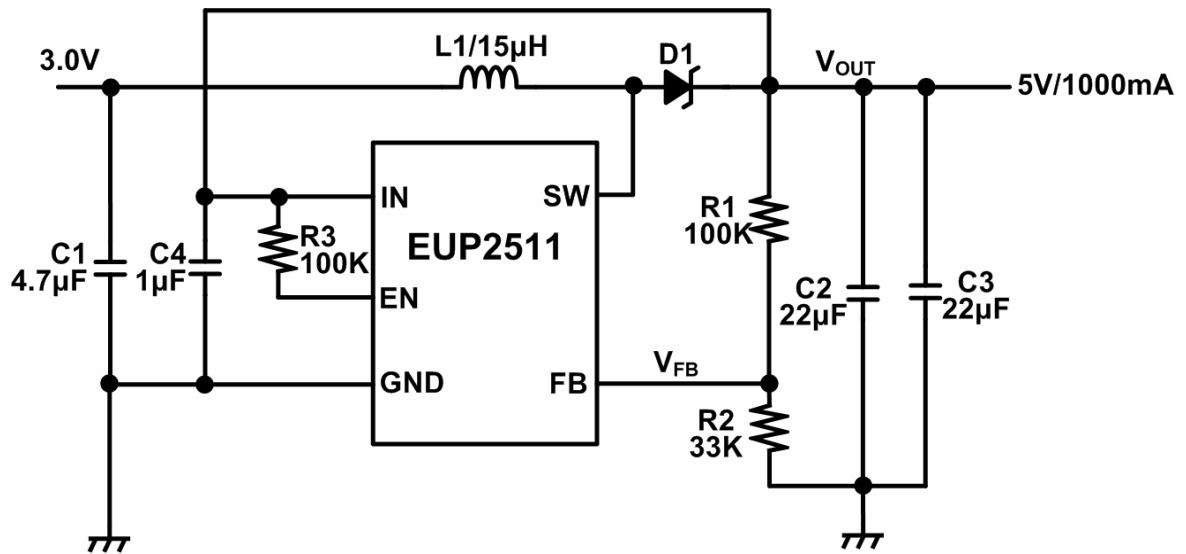


Figure2.

## Pin Configurations

Package Type	Pin Configurations
SOT23-5	

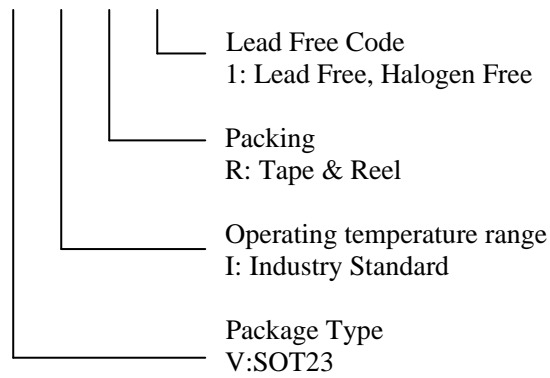
## Pin Description

PIN	SOT23-5	DESCRIPTION
EN	1	Shutdown pin logic input. High = Enabled, low = Shutdown.
GND	2	Ground.
IN	3	Input Voltage. Input Range: 2.7V to 5V.
SW	4	Switch Pin. Drain of the internal Power Switch.
FB	5	Feedback Pin.

## Ordering Information

Order Number	Package Type	Marking	Operating Temperature Range
EUP2511VIR1	SOT23-5	XXXXX AU00	-40 °C to 85°C

EUP2511 □ □ □ □



## Block Diagram

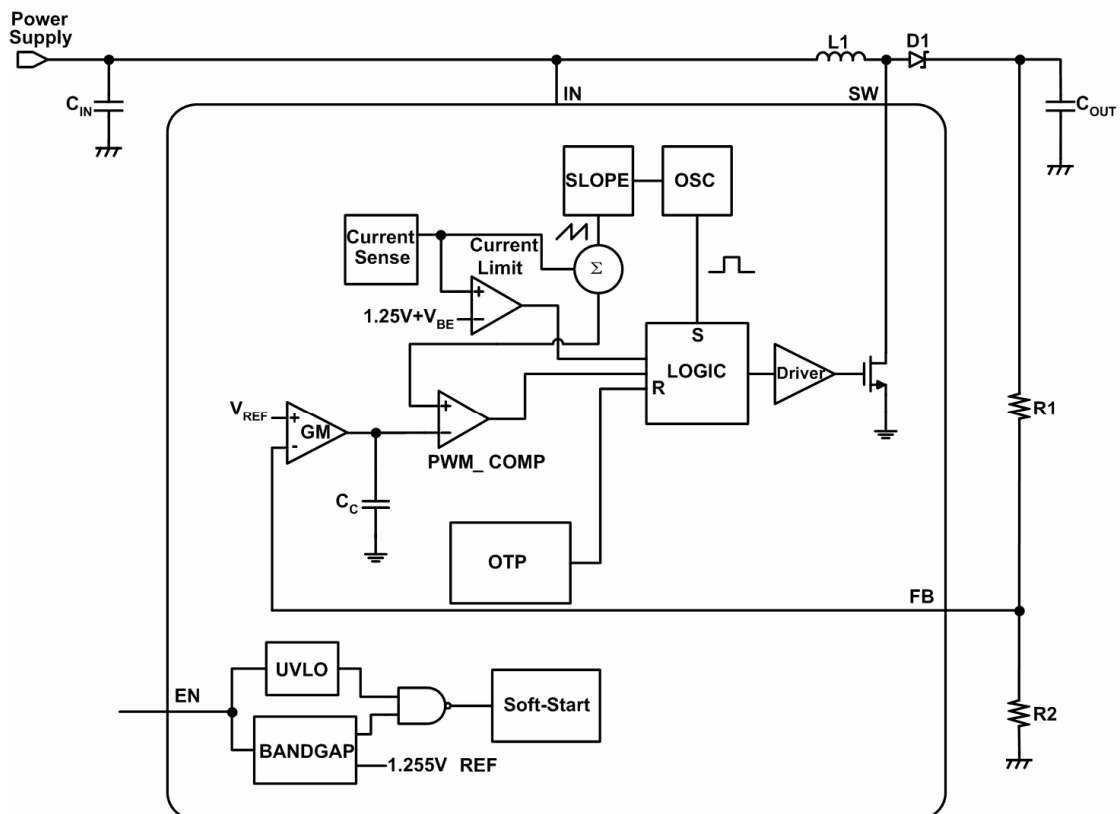


Figure3.

## Absolute Maximum Ratings

- Supply Voltage,  $V_{IN}$  ----- -0.3V to 6V
- SW ----- -0.3V to 6V
- The Other Pins ----- -0.3V to 6V
- Power Dissipation, PD@  $T_A=25^\circ\text{C}$   
   SOT23-5 ----- 0.488W
- Package Thermal Resistance  
    $\theta_{JA}$  (SOT23-5) ----- 205°C/W
- Maximum Junction Temperature ----- 125°C
- Lead Temperature (Soldering, 10sec.) ----- 260°C
- Storage Temperature Range ----- -65°C to 150°C

## Recommended Operating Conditions

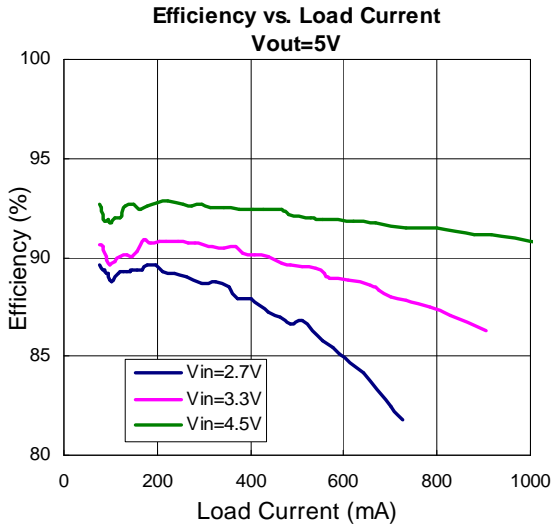
	Min.	Max.	Unit
Supply voltage, $V_{IN}$	2.7	5	V
Operating free-air temperature, $T_A$	-40	85	°C

## Electrical Characteristics

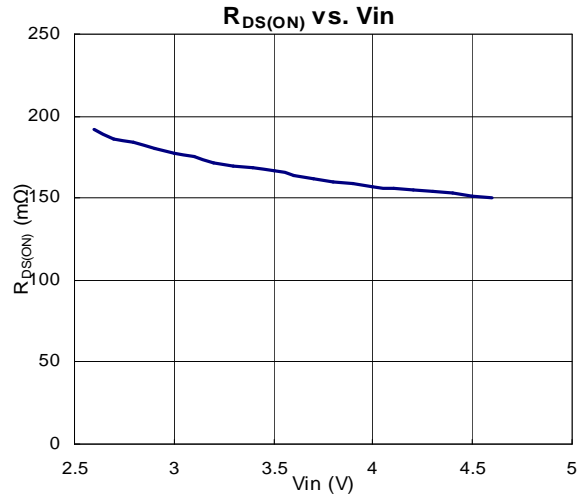
( $V_{IN}=3.3\text{V}$ ,  $V_{OUT}=5\text{V}$ ,  $I_{OUT}=200\text{mA}$ ,  $C_{OUT}=10\mu\text{F}$ ,  $C_{IN}=2.2\mu\text{F}$ ,  $L1=4.7\mu\text{H}$ ,  $R1=41.2\text{K}\Omega$ ,  $R2=13.3\text{K}\Omega$ ,  $T_A=-40^\circ\text{C}$  to  $85^\circ\text{C}$ . Unless otherwise noted. Typical values are at  $T_A=25^\circ\text{C}$ )

Symbol	Parameter	Conditions	EUP2511			Unit
			Min.	Typ.	Max.	
	Supply Voltage			3.3	5.5	V
UVLO	Under Voltage Lock Out	Rising or Falling	2.2	2.37	2.6	V
$I_{CC}$	Supply Current	Continuous Switching, $V_{IN}=3.3\text{V}$		0.6	1	mA
$I_{SD}$	Shutdown Current	$V_{IN}=3.3\text{V}$ , $V_{EN}<0.4\text{V}$		0.1	1	μA
<b>Oscillator</b>						
$F_{OSC}$	Switching Frequency		450	600	750	KHz
$D_{MAX}$	Maximum Duty Cycle		60	70	80	%
<b>Reference Voltage</b>						
$V_{FB}$	Feedback Voltage		1.2	1.255	1.3	V
<b>MOSFET</b>						
$R_{DS(ON)}$	On Resistance of MOSFET	$V_{IN}=3.6\text{V}$		0.18	0.3	Ω
		$V_{IN}=5\text{V}$		0.15	0.25	
$I_{LIM}$	Current Limit		1.7	2.1	2.4	A
<b>Control and Protection</b>						
$V_{EN1}$	Shutdown Voltage		0.4	0.7		V
$V_{EN2}$	Enable Voltage			0.7	1.4	V
$I_{EN}$	EN Pin Input Leakage Current				0.1	μA

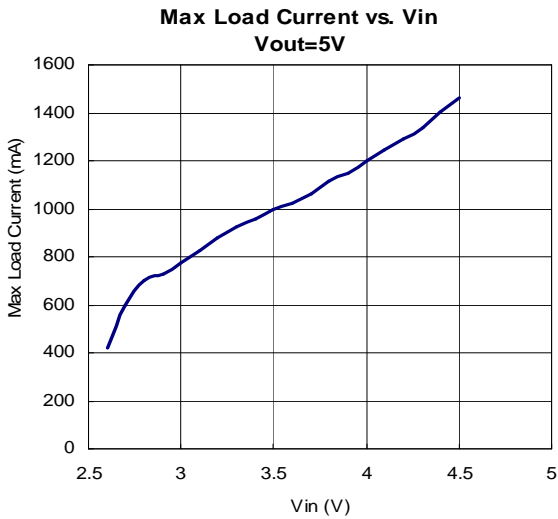
**Typical Operating Characteristics**  
**Test Condition Figure 1.**



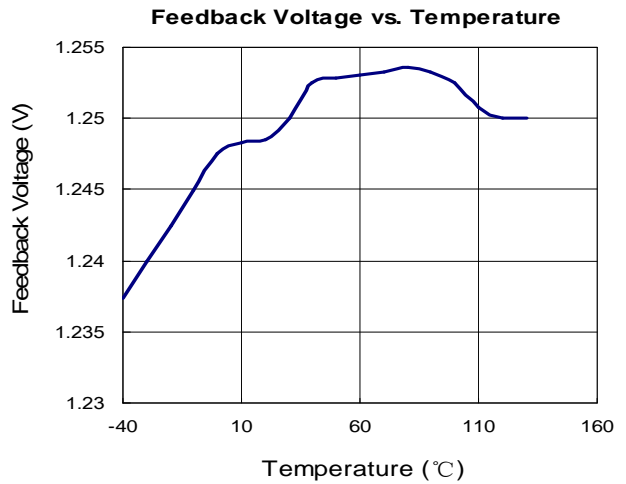
**Figure4.**



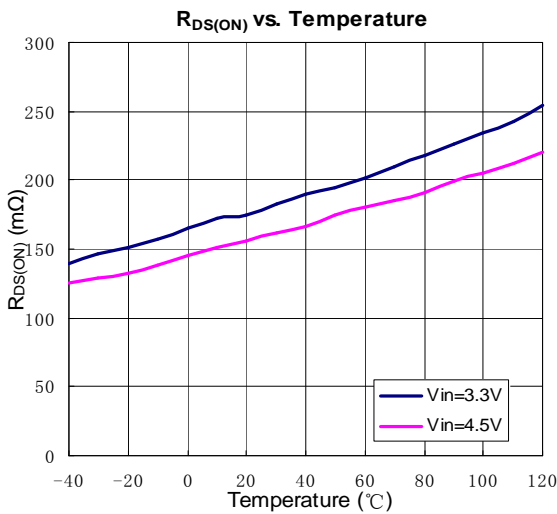
**Figure5.**



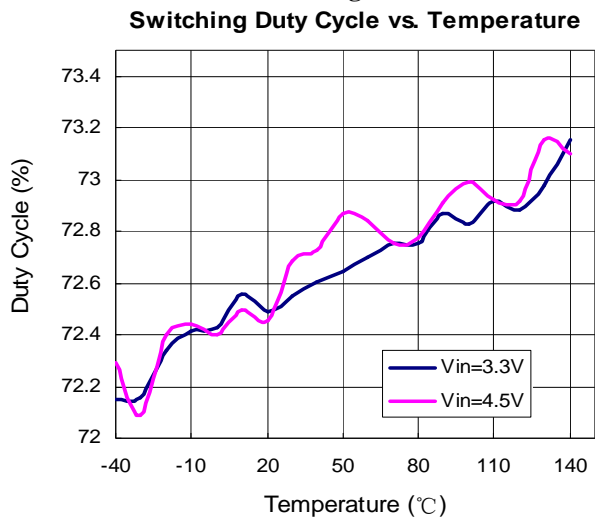
**Figure6.**



**Figure7.**



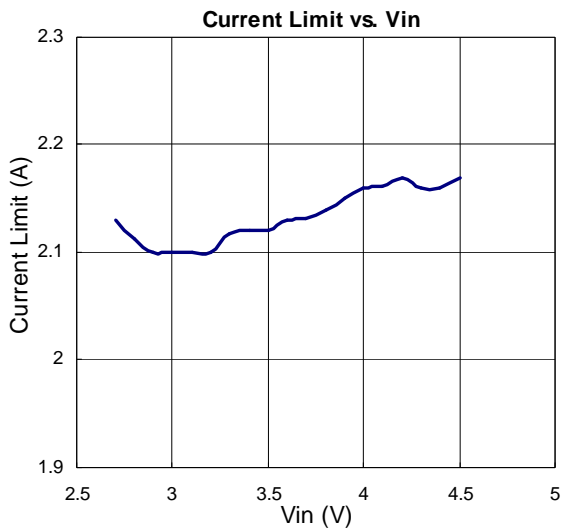
**Figure8.**



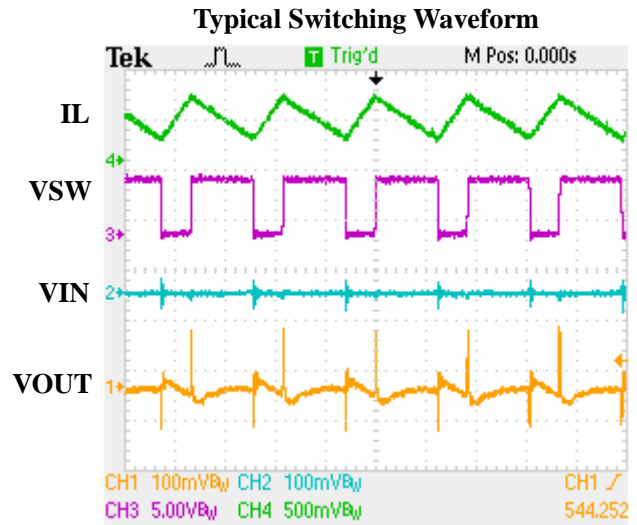
**Figure9.**

**Typical Operating Characteristics (continued)**

Test Condition Figure 1.

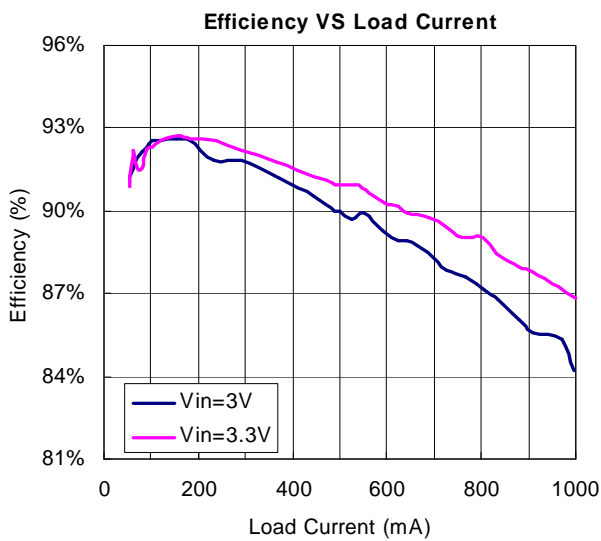


**Figure10.**

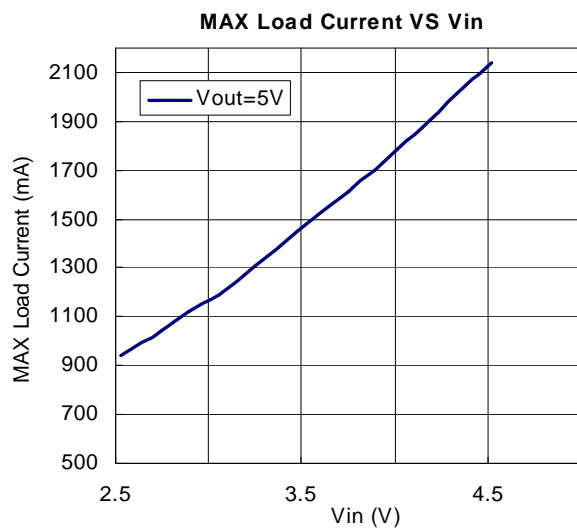


**Figure11.**

Test Condition Figure 2.



**Figure12.**



**Figure13.**

## Application Information

The EUP2511 uses a 600KHz fixed-frequency, current-mode regulation architecture to regulate the output voltage. The EUP2511 measures the output voltage through an external resistive voltage divider and compares that to the internal 1.25V reference to generate the error voltage. The current-mode regulator compares the error voltage to the inductor current to regulate the output voltage. The use of current-mode regulation improves transient response and control loop stability.

## Output Voltage

An external feedback resistor divider is required to divide the output voltage down to the nominal 1.25V reference voltage. The current drawn by the resistor network should be limited to maintain the overall converter efficiency. The maximum value of the resistor network is limited by the feedback input bias current and the potential for noise being coupled into the feedback pin. Selecting R2 in the range of 10kΩ to 50 kΩ. The boost converter output voltage is determined by the relationship:

$$V_{OUT} = V_{FB} \times \left[ 1 + \frac{R_1}{R_2} \right]$$

The nominal VFB voltage is 1.255V

## Inductor Selection

The inductor selection determines the output ripple voltage, transient response, output current capability, and efficiency. Its selection depends on the input voltage, output voltage, switching frequency, and maximum output current. For most applications, a 4.7μH inductor is recommended for 600KHz. The inductor maximum DC current specification must be greater than the peak inductor current required by the regulator. The peak inductor current can be calculated:

$$I_{L(PEAK)} = \frac{I_{OUT} \times V_{OUT}}{V_{IN}} + 1/2 \times \frac{V_{IN} \times (V_{OUT} - V_{IN})}{L \times V_{OUT} \times FREQ}$$

## Output Capacitor

Low ESR capacitors should be used to minimize the output voltage ripple. Multilayer ceramic capacitors (X5R and X7R) are preferred for the output capacitors because of their lower ESR and small packages. Tantalum capacitors with higher ESR can also be used. The output ripple can be calculated as:

$$\Delta V_O = \frac{I_{OUT} \times D}{F_{SW} \times C_O} + I_{OUT} \times ESR$$

Choose an output capacitor to satisfy the output ripple and load transient requirement. A 4.7μF to 10μF ceramic capacitor is suitable for most application.

## Schottky Diode

In selecting the Schottky diode, the reverse break down voltage, forward current and forward voltage drop must be considered for optimum converter performance. The diode must be rated to handle 2A, the current limit of the EUP2511. The breakdown voltage must exceed the maximum output voltage. Low forward voltage drop, low leakage current and fast reverse recovery will help the converter to achieve the maximum efficiency.

## Selecting Input Capacitor for Boost Converter

An input capacitor is required to serve as an energy reservoir for the current which must flow into the coil each time the switch turns ON. This capacitor must have extremely low ESR, so ceramic is the best choice. A nominal value of 4.7μF is recommended, but larger values can be used. Since this capacitor reduces the amount of voltage ripple seen at the input pin, it also reduces the amount of EMI passed back along that line to other circuitry.

## Maximum Output Current

The output current capability of the EUP2511 is a function of current limit, input voltage, operating frequency, and inductor value. The output current capability is governed by the following equation:

$$I_L = I_{L-AVG} + (1/2 \times \Delta I_L)$$

Where:

$I_L$  = MOSFET current limit

$I_{L-AVG}$  = average inductor current

$\Delta I_L$  = inductor ripple current

$$\Delta I_L = \frac{V_{IN} \times \left[ \left( V_O + V_{DIODE} - V_{IN} \right) - V_{IN} \right]}{L \times \left( V_O + V_{DIODE} \right) \times F_S}$$

$V_{DIODE}$  = Schottky diode forward voltage, typically,

0.6V

$F_S$  = switching frequency, 600KHz.

$$I_{L-AVG} = \frac{I_{OUT}}{1-D}$$

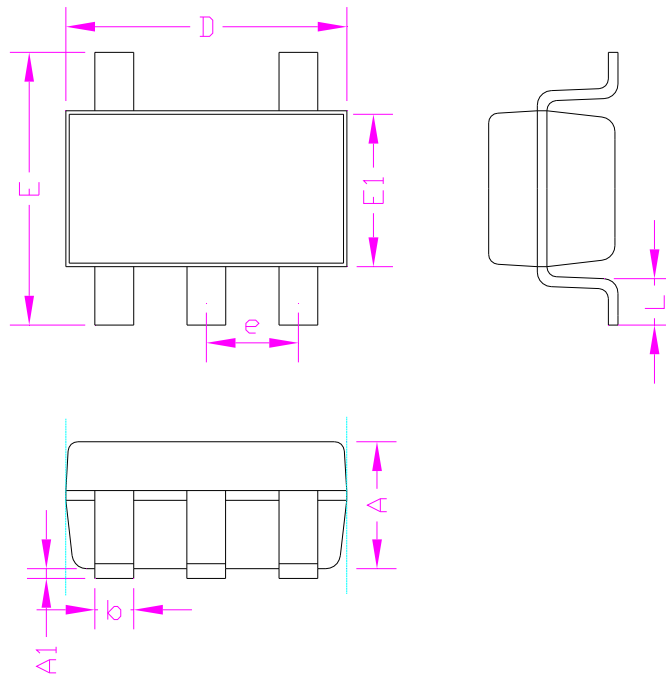
D = MOSFET turn-on ratio:

$$D = 1 - \frac{V_{IN}}{V_{OUT} + V_{DIODE}}$$

## **Layout Considerations**

High frequency switching regulators require very careful layout for stable operation and low noise. All components must be placed as close to the IC as possible. SW is of high noise, a small area is recommended on PCB layout to reduce EMI and high frequency noise injection. All feedback components must be kept close to the FB pin to prevent noise injection on the FB pin trace. The ground return of C1 and C2 should be tied close to the GND pin.



**Package Information****SOT23-5**

SYMBOLS	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	-	1.30	-	0.052
A1	0.00	0.15	0.000	0.006
D	2.90		0.114	
E1	1.60		0.063	
E	2.60	3.00	0.102	0.118
L	0.30	0.60	0.012	0.024
b	0.30	0.50	0.012	0.020
e	0.95		0.037	