5V 1A 1MHz Step-up DC-DC Converter

GENERAL DESCRIPTION

The UCT6005 is a 5V 1A step-up DC/DC converter. The built-in power transistor is able to deliver up to 1A output current at 2.8V operating voltage. The 1MHz operating frequency allows the use of tiny, low cost and low profile external components.

Its internal 100mΩ N-MOSFET switch provides high efficiency even at heavy load conditions. Internal frequency compensation allows the use of ceramic output capacitors, reducing the output noise. The 0.5uA ultra-low shutdown current makes it suitable for battery-supplied systems.

The UCT6005 has Light-Load operation mode, which enhances the efficiency at light loading condition.

The UCT6005 have several protection functions, such as soft-start, current limiting, thermal shutdown, short-circuit protection, UVLO, and over-voltage protection.

The UCT6005 is available in SOT23-6 package.

FEATURES

- Built-in 2.5A MOSFET Switch
- High Efficiency: over 90%
- 1MHz Switching Frequency
- Low R_{DSON}:100mΩ@5V Output
- Reference Voltage: 0.6V
- Deliver up to 1A from a2.8V Supply
- Light-load Mode
- Soft-start, UVLO, SCP, OVP
- Thermal Shutdown
- Package type: SOT23-6

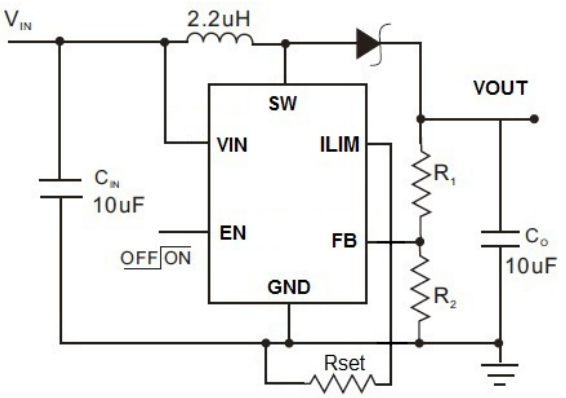
APPLICATIONS

- Local Power Systems
- Battery Back-up
- Audio Systems
- LED Driver

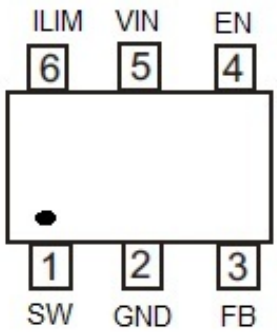
封装

- SOT23-6

TYPICAL APPLICATION CIRCUIT



PIN ASSIGNMENT



PIN DESCRIPTION

PIN No	SYMBOL	DESCRIPTTION
1	SW	Power Switch Output
2	GND	Ground
3	FB	Feed Back
4	EN	Chip Enable
5	VIN	Power Supply Input
6	ILIM	Limit Current Set Input

ABSOLUTE MAXIMUM RATINGS (Note 1)

SYMBOL	ITEM	RATING	UNIT
V_{IN}	Supply Voltage	-0.3~6.5V	V
V_{SW}	SW pin Voltage	-0.3~6.5V	V
V_{IO}	FB, EN pin Voltage	-0.3~6.5V	V
PD	Maximum Power Dissipation	0.4	W
PTR	Package Thermal Resistance SOT23-6, Θ_{JA}	200	℃/W
T_{STG}	Storage Temperature Range	-65~150	℃
T_{SOLDER}	Lead Temperature (Soldering)	260℃, 10s	

Note1: Absolute Maximum Ratings are threshold limit values that must not be exceeded even for an instant under any condition. Moreover, such values for any two items must not be reached simultaneously. Operation above these absolute maximum ratings may cause degradation or permanent damage to the device. These are stress ratings only and do not necessarily imply functional operation below these limits.

RECOMMANDED OPERATING RANGE

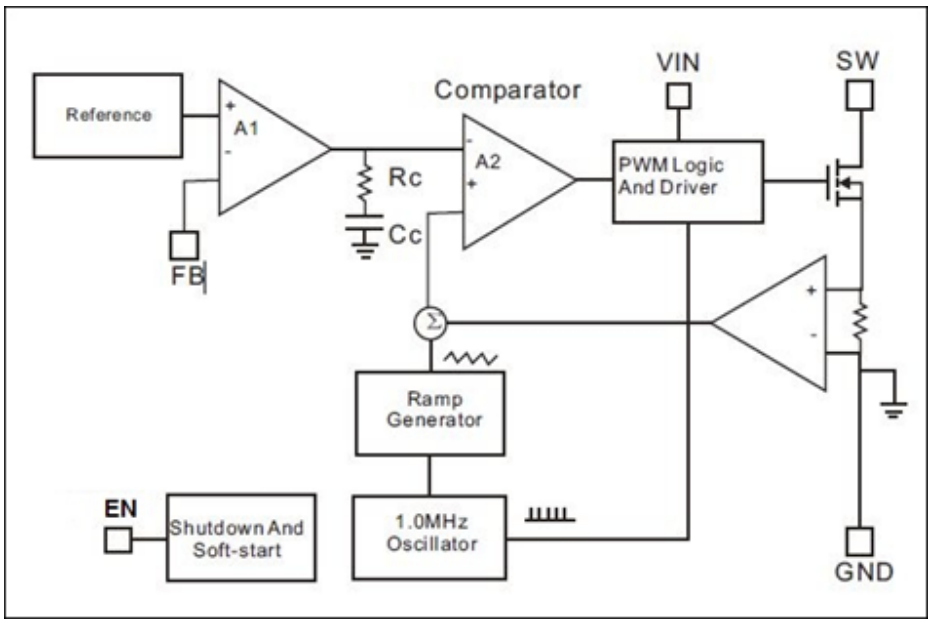
SYMBOL	ITEMS	VALUE	UNIT
V_{IN}	VIN Supply Voltage	2.5 to 5.5	V
T_{OPT}	Operating Temperature	-40 to +85	℃

ELECTRICAL CHARACTERISTICS

(V_{IN}=3.6V, V_{OUT}=5.0V, load current=0, T_A =25℃, unless otherwise specified.)

SYMBOL	ITEM	TEST CONDITION	MIN	TYP	MAX	UNIT
V_{IN}	Input Voltage Range		2.5		5.5	V
I_Q	Quiescent Current	V_{FB}=0.7V, V_{EN}=V_{IN}		65	120	μA
I_{SHDN}	Shutdown Current	V_{EN}=0		0.5	1	μA
V_{FB}	Reference Voltage		0.588	0.6	0.612	V
I_{LIMIT}	Current Limit			2.5		A
f_{OSC}	Switching Frequency			1.0		MHz
R_{ON}	On Resistance of MOSFET	I_{SW}=-100mA		100		mΩ
I_{SW}	SW Leakage Current	V_{EN}=0, V_{SW}=0 or 5V, V_{IN}=5V		0.1	1	μA
V_{ENH}	EN High Voltage Level		1.5			V
V_{ENL}	EN Low Voltage Level				0.4	V
I_{EN}	EN Leakage Current			0.1	1	μA
T_{COEF}	Temperature Co-efficiency			100		ppm/℃
T_{SD}	Thermal Shutdown Temperature			150		℃
△TSD	Thermal Shutdown Hysteresis			20		℃

SIMPLIFIED BLOCK DIAGRAM



OPERATION DESCRIPTION

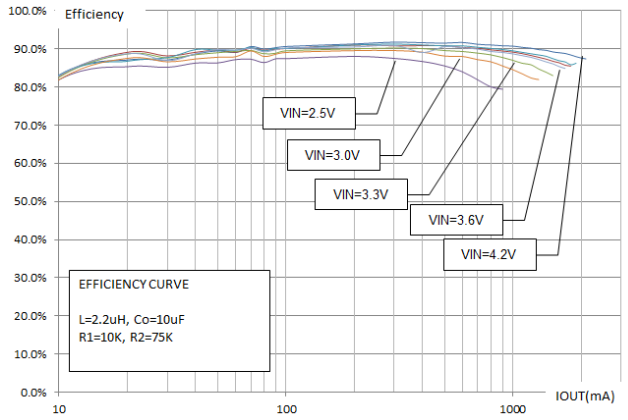
The UCT6005 is a 5V 1A step-up converter. The low R_{DSON} NMOSFET switch enables the device to maintain high efficiency over a wide range of load current. Operation of the feedback loop which sets the peak inductor current to keep the output in regulation can be best understood by referring to the Block Diagram.

At the start of each clock cycle a latch in the PWM logic is set and the NMOSFET switch is turned on. The sum of a voltage proportional to the switch current and a slope compensating voltage ramp is fed to the positive input to the PWM comparator. When this voltage exceeds either a voltage proportional to the 2.5A current limit or the PWM control voltage, the latch in the PWM logic is reset and NMOS switch is turned off. The PWM control voltage at the output of the error amplifier is the amplified and compensated difference between the feed- back voltage on the FB pin and the internal reference voltage of 0.6V. If the control voltage increases, more current is delivered to the output. When the control voltage exceeds the I_{LIM} reference voltage, the peak current is limited to 2.5A. The current limit helps to protect the UCT6005 internal switch and external components connected to it. If the control voltage decreases, less current is delivered to the output. During load transients control voltage may decrease to the point where no switching occurs until the feedback voltage drops below the reference.

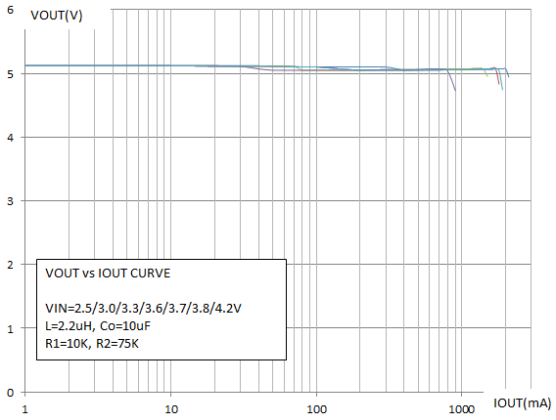
The UCT6005 has an integrated soft-start feature which slowly ramps up the feedback control node from 0V. The soft-start is initiated when EN is pulled high

TYPICAL OPERATING CHARACTERISTICS

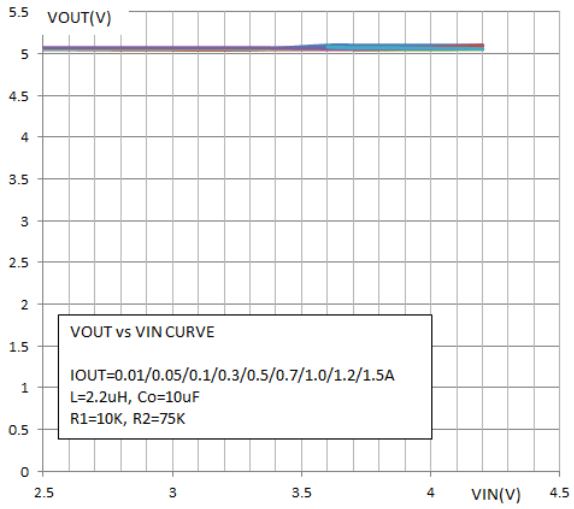
Tested under TA=25°C, unless otherwise specified



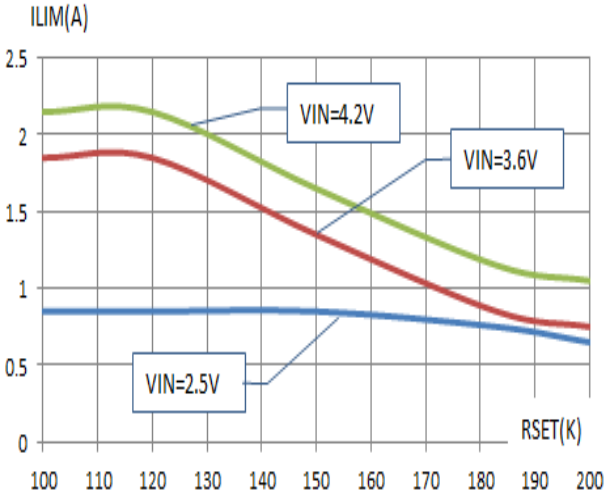
Efficiency



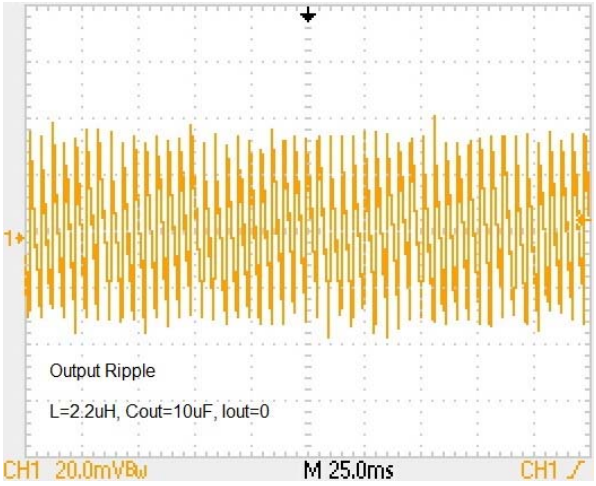
Load Regulation



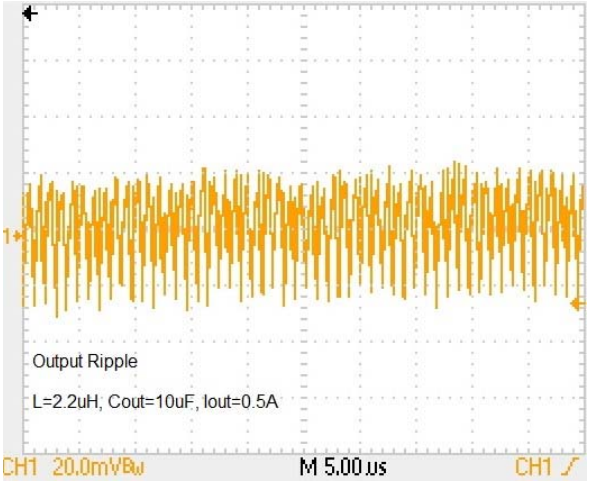
Line Regulation



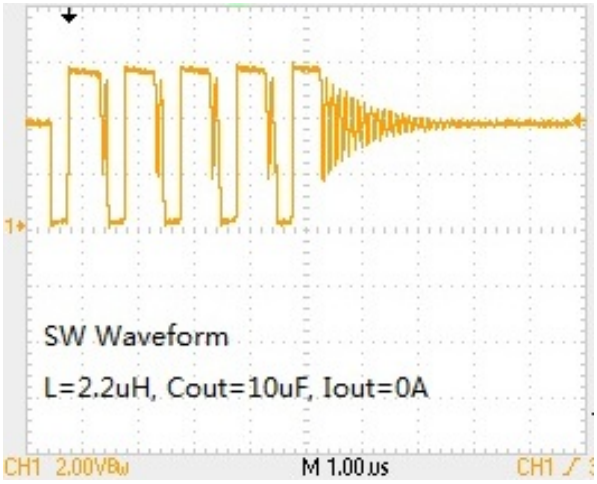
Current Limit vs RSET



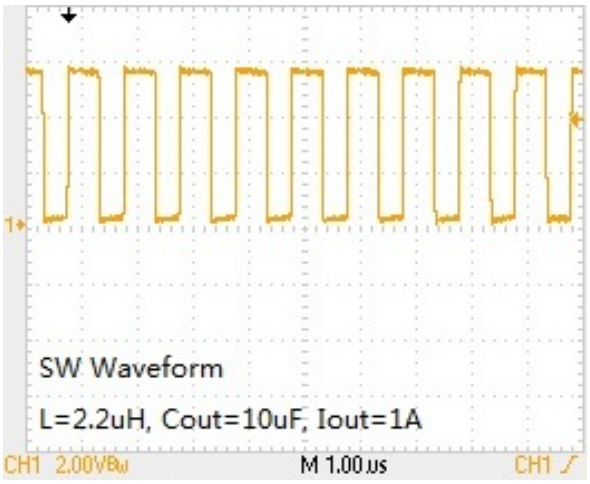
Output Ripple for Light Load



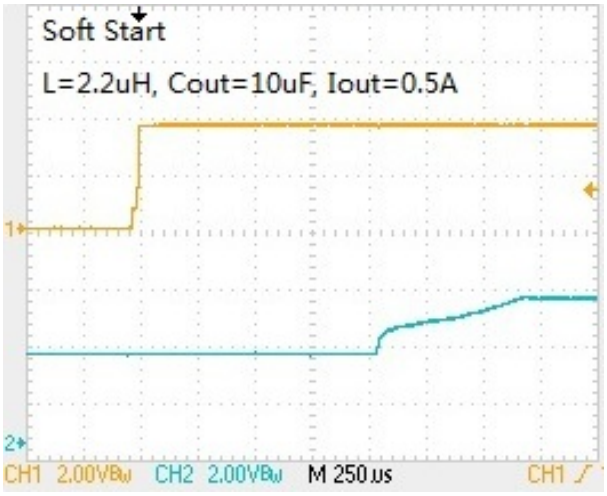
Output Ripple for Normal Load



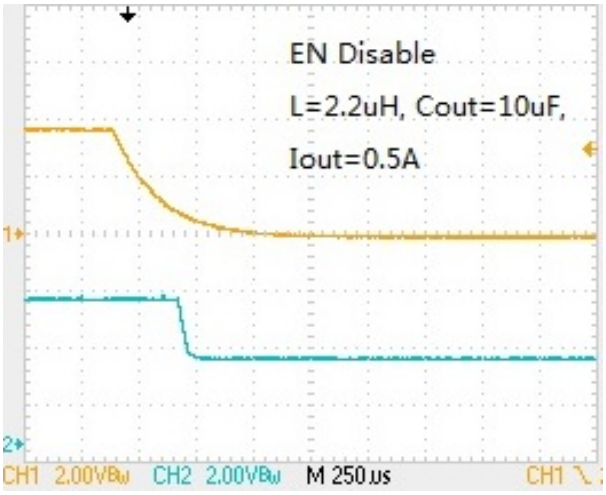
SW Waveform for Light Load



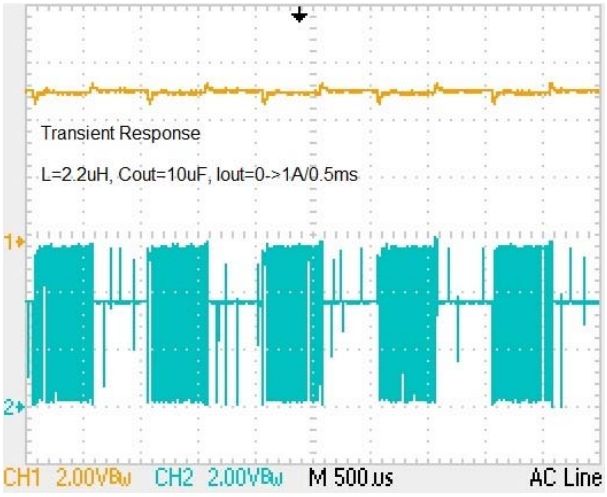
SW Waveform for Normal Load



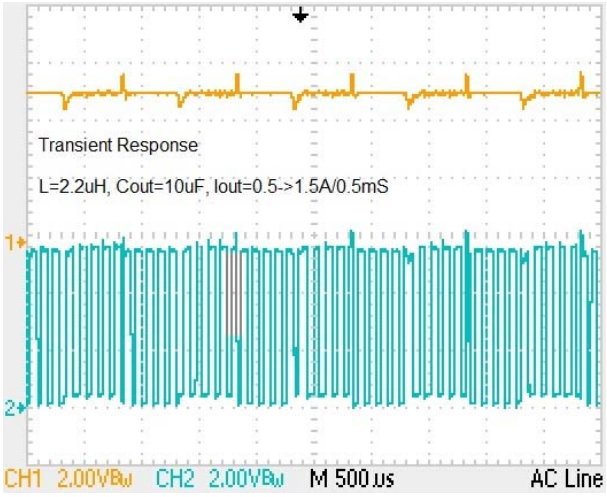
En Enable and Soft Start



En Disable



Transient Response Light/Normal Load



Transient Response Normal/Normal Load

APPLICATION INFORMATION

- **Inductor Selection**

The UCT6005 can utilize small surface mount inductors ascribed to its 1MHz switching frequency. A 2.2μH or 4.7μH inductor will be the best choice for most UCT6005 applications. The inductor should have low DCR (DC resistance) to reduce the I^2R power losses, and must be able to handle the peak inductor current without saturating. Several inductor manufacturers are listed in the table below.

Manufacturer	Part Number	Inductance (uH)	DRC (Ω)	Dimensions (mm3)
Murata	LQH5BPN	2.2	0.03	5*5*2
Murata	LQH32PN	2.2	0.06	3.2*2.5*1.7
Sumida	CDRH3D16	2.2	0.03	4*4*1.8
Sumida	CDRH3D16	4.7	0.07	4*4*1.8

- **Output Voltage Setup**

In the adjustable version, the output voltage is set by a resistive divider according to the following equation:

VOUT=VFB*(1+R1/R2)

Typically choose R1=100K and determine R2 from the above equation.

Connect a small capacitor across R1 feed forward capacitance at the FB pin for better performance.

- **Current Limit Setting**

The maximum output current is adjustable by connecting a resistor between the ILIM pin of the UCT6005 and ground, referring to the application circuit. The value can be determined roughly by the below table for a 3.6V application:

IMAX	RSET
1A	170KΩ
1.1A	164KΩ
1.2A	158KΩ
1.3A	152KΩ
1.4A	146KΩ
1.5A	140KΩ
1.6A	134KΩ

Please be noted that the current limit increases as VIN increases, and at least 20% redundancy is suggested to leverage the variation.

- **Diode Selection**

A Schottky diode is recommended for use with the UCT6005. Use of a low forward voltage diode such as the ON Semiconductor MBRA210LT3 is recommended. A Schottky diode rated at 2A is recommended for use with the UCT6005.

- **Input Capacitor Selection**

The input capacitor reduces input voltage ripple to the converter, low ESR ceramic capacitor is highly recommended. For most applications, a 10~22uF capacitor is used. The input capacitor should be placed as close as possible to VIN and GND.

- **Output Capacitor Selection**

A low ESR output capacitor is required in order to maintain low output voltage ripple. In the case of ceramic output capacitors, capacitor ESR is very small and does not contribute to the ripple, so a lower capacitance value is acceptable when ceramic capacitors are used. A 22uF ceramic output capacitor is suitable for most applications.

- **Soft-start**

The UCT6005 has internal soft-start circuitry to reduce supply inrush current during startup conditions. When the device starts or restarts, the soft-start circuitry slowly ramps up current available at SW.

- **UVLO and Thermal Shutdown**

If IN drops below 2.5V, the UVLO circuit inhibits switching. Once IN rises above 2.5V, the UVLO clears, and the soft-start sequence activates. Thermal-overload protection limits total power dissipation in the device. When the junction temperature exceeds TJ= +160°C, a thermal sensor forces the device into shutdown, allowing the die to cool. The thermal sensor turns the device on again after the junction temperature cools by 15°C, resulting in a pulsed output during continuous overload conditions. Following a thermal-shutdown condition, the soft-start sequence begins.

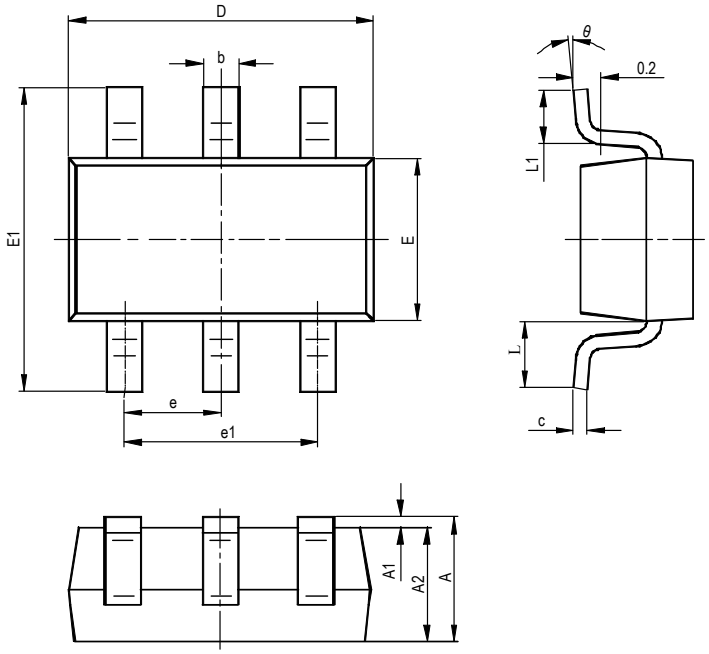
- **Layout Guideline**

Layout is critical to achieve clean and stable operation. The switching power stage requires particular attention. Follow these guidelines for good PC board layout:

1) Place decoupling capacitors as close to the IC as possible
2) Connect input and output capacitors to the same power ground node with a star ground configuration then to IC ground.
3) Keep the high-current paths as short and wide as possible. Keep the path of switching current short. Avoid vias in the switching paths.
4) If possible, connect VIN, SW, and GND separately to a large copper area to help cool the IC to further improve efficiency and long-term reliability.
5) Ensure all feedback connections are short and direct. Place the feedback resistors as close to the IC as possible.
6) Route high-speed switching nodes away from sensitive analog area.

PACKAGE OUTLINE

SOT23-6



SYMBOL	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.400	0.012	0.016
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950TYP		0.037TYP	
e1	1.800	2.000	0.071	0.079
L	0.700REF		0.028REF	
L1	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°