2.3A, Switch Mode Li-Lon Battery Charger

Description

The SC62B23 is a complete switching battery charger for one (8.4V) cell lithium-ion battery.

The SC62B23 provides a small, simple and efficient solution to fast charge Li-ion battery. An external sense resistor sets the charge current with high accuracy.

An internal resistor divider and precision reference set the final float voltage to 8.4V. When the input supply is removed, the SC62B23 automatically enters a low current sleep mode.

The SC62B23 is available in the SOP-8L package.

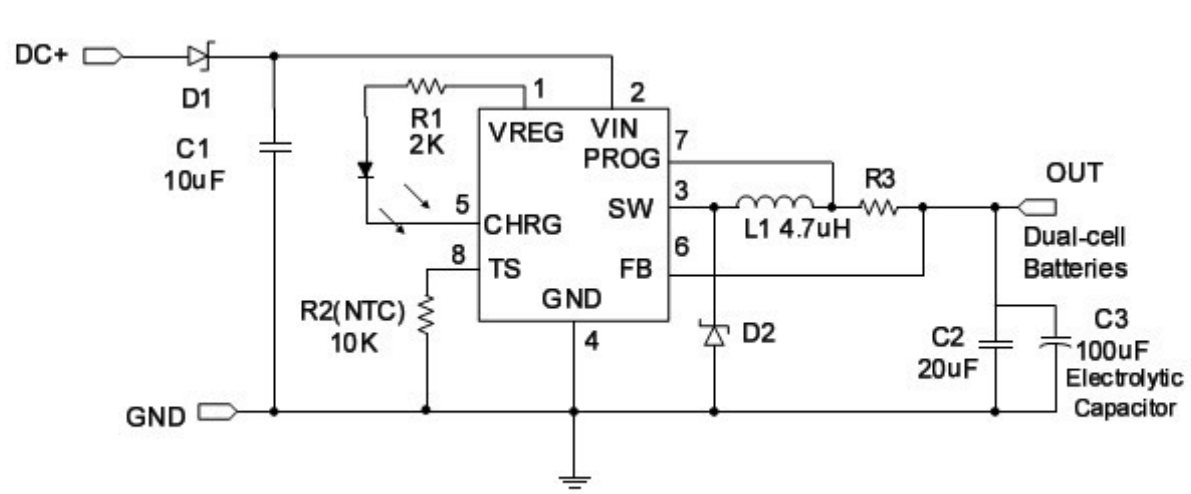
Features

- **Input Voltage Range: 9-16V**
- **Automatic Battery Recharge**
- **Automatic Shutdown When Input Supply is Removed**
- **Automatic Trickle Charging of Low Voltage Batteries**
- **End - Charge - Current Detection Output**
- **Constant Switching Frequency for Minimum Noise**
- **Battery Temperature Sensing**
- **Stable with Ceramic Output Capacitor**
- **SOP-8L Package**

Applications

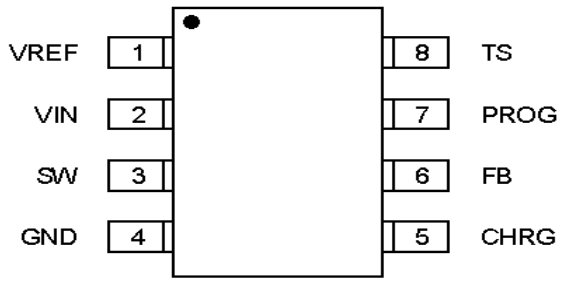
- **Charging Docks**
- **Portable MP3 Players**
- **Portable Computers，MID**

Typical Application



* **The charge current can be set by I_{OUT} = 0.09V/R3.**

Pin Configurations

Part Number	Pin Configurations
SC62B23 **SOP-8L**	

Pin Description

PIN SOP-8L	NAME	DESCRIPTION
1.	VREF	Voltage reference to drive LED.
2.	VIN	Positive Input Supply Voltage. It provides power to the charger. VIN can range from 9V to 16V and should be bypassed with at least a 10uF capacitor.
3.	SW	Switch Node Connection to inductor. This pin connects to the drain of the internal main power MOSFET switches.
4.	GND	Ground.
5.	CHRG	Open-Drain Charge Status Output. When the battery is charging, the CHRG pin is pulled low by an internal N-channel MOSFET. When the charge cycle is completed or reverse battery lockout / No AC is detected, CHRG is forced high impedance.
6.	FB	Feedback Pin. Receives the feedback voltage from the output.
7.	PROG	Charge Current Program. The output current is set by an external resistor according to the following formula: IOUT = 0.09V/R3.
8.	TS	Temperature Sense.

Absolute Maximum Ratings

- VIN, , VSW ---------- –0.3V to 20V
- VCHRG ---------- – 0.3V to 7V
- VPROG ---------- –0.3V to16V
- SW Pin Current ---------- 4A
- Operating Temperature Range ---------- –40℃ to 85℃
- Operating Junction Temperature ---------- –40℃ to 125℃
- Storage Temperature Range ---------- –65℃ to 125℃
- Lead Temperature (Soldering, 10 sec) ---------- 300℃

Electrical Characteristics

Operating Conditions: T_A=25 ℃, V_{IN}=9V, R3 = 0.1Ω unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	SC62B23			UNITS
			MIN	TYP	MAX	
V_{IN}	Input Voltage Range		8.85		16	V
I_{IN}	Input Supply Current	Current Mode		260		μA
I_{SLEEP}	V_{IN} Sleep Current	V_{IN}=7V V_{OUT}=7.22V		40		μA
F_{OSC}	Oscillator Frequency			0.69		MHz
EFFI	Efficiency	V_{IN}=9V, V_{OUT}=8V		95		%
		V_{IN}=12V, V_{OUT}=8V		93		
Precharge Comparator						
V(min)	Precharge threshold	VIN=9V		5.5		V
Precharge Current Regulation						
$I_{(PRECHG)}$	Precharge current regulation	R1=0.1,V_{IN}=9V		89		mA
V_{RCH} comparator（Battery Recharge Threshold）						
V（RCH)	Recharge threshold	V_{IN}=12V		$V_{O(REG)}$ -330mV		V
Battery Voltage Regulation Constant-current Charge						
$V_{O(REG)}$	Output voltage		8.32	8.4	8.49	V
V_{PROG}– V_{FB}	Current regulation threshold			90		mV
CHRG Pin						
$V_{OL(CHRG)}$	$V_{OL(CHRG)}$ Output（low）voltage			<0.15		V
TS Pin						
$V_{TS-COLD}$	TS Pin Threshold Voltage(cold)	V_{TS} from Low to High		2.422		V
V_{TS-HOT}	TS Pin Threshold Voltage(hot)	V_{TS} from High to Low		0.479		V
I_{TS}	TS Pin Output Current			99.5		μA

Application Information

The SC62B23 is an advanced switch mode charger for two-cell Li-Ion applications. Refer to Operation Flow Chart in this section.

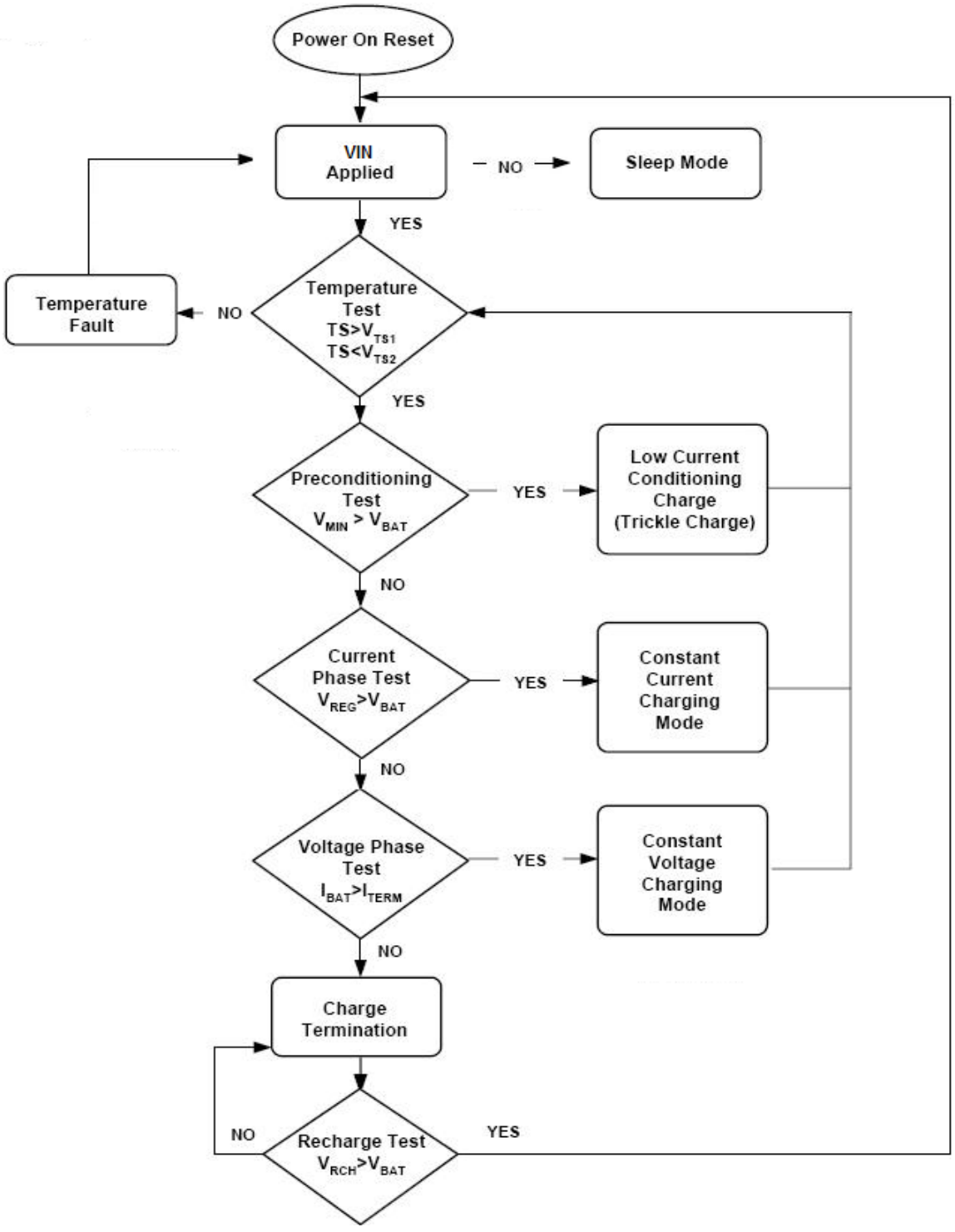
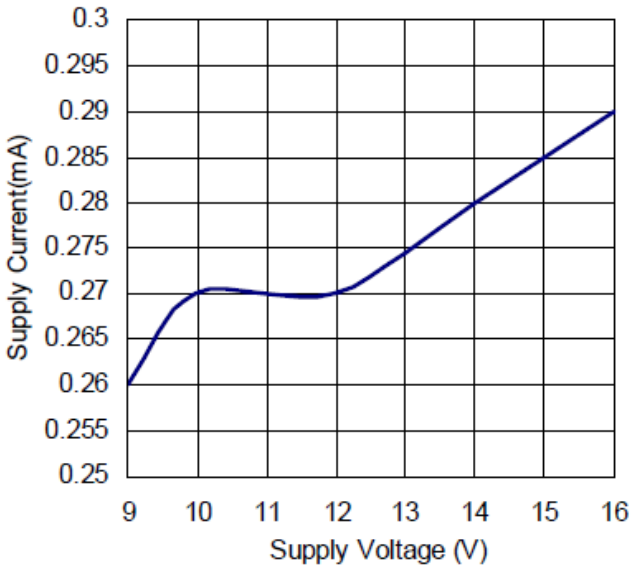


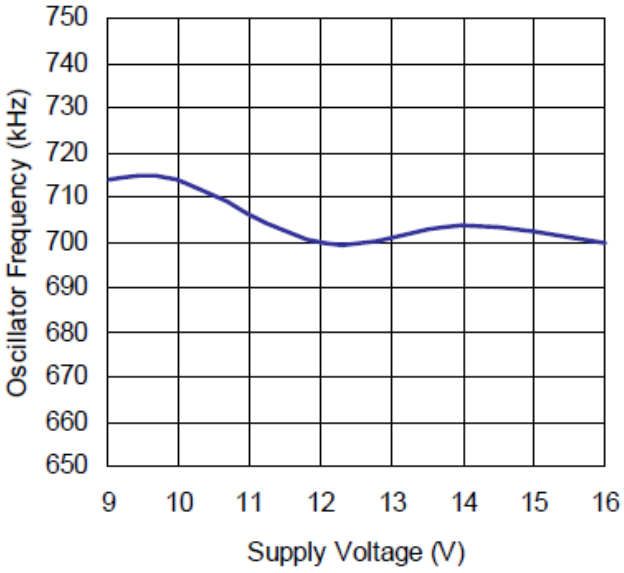
Figure 1: Operation Flow Chart

Typical Performance Characteristic

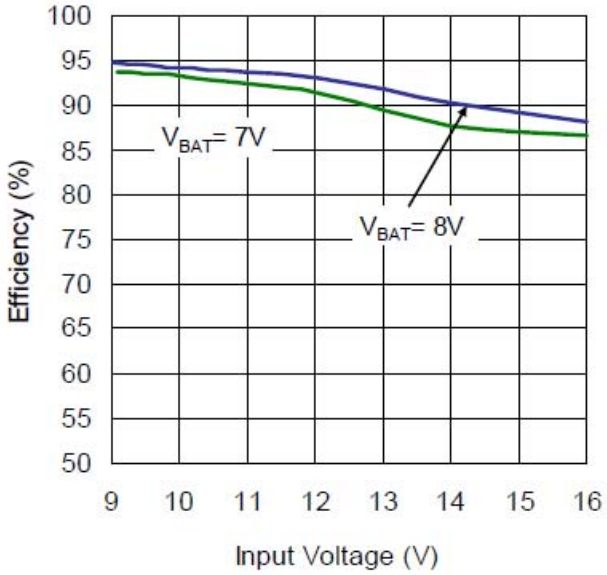
Supply Current vs. Supply Voltage



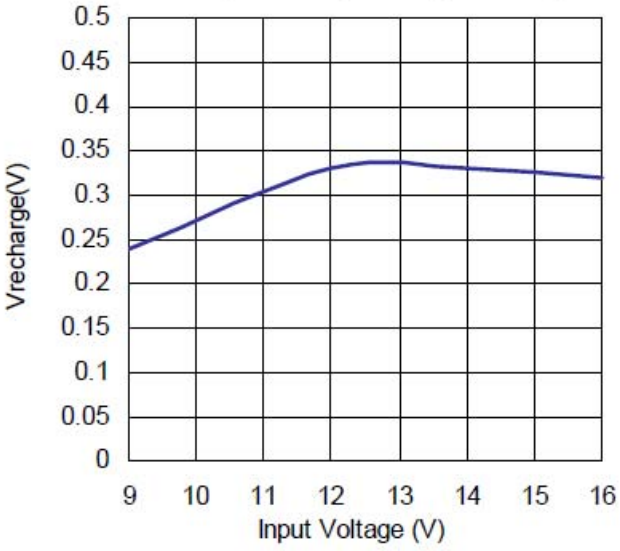
Oscillator Frequency vs.Supply Voltage
(Vout=8V)



Efficiency vs. Input Voltage



Recharge Voltage Offset from Full
Charged Voltage vs. Input Voltage



Qualification and Precharge

When power is applied, the SC62B23 starts a charge-cycle i f a battery is already present or when a battery is inserted. Charge qualification is based on battery temperature and voltage.

The SC62B23 suspends charge if the battery temperature is outside the V_{TS1} to V_{TS2} range and suspends charge until the battery temperature is within the allowed range. The SC62B23 also checks the battery voltage. If the battery voltage is below the precharge threshold V(min) , the SC62B23 uses precharge to condition the battery. The conditioning charge rate $I_{(PRECHG)}$ is set at approximately 10% of the regulation current. The conditioning current also minimizes heat dissipation in the external pass-element during the initial stage of charge. See Figure 2 for a typical charge-profile.

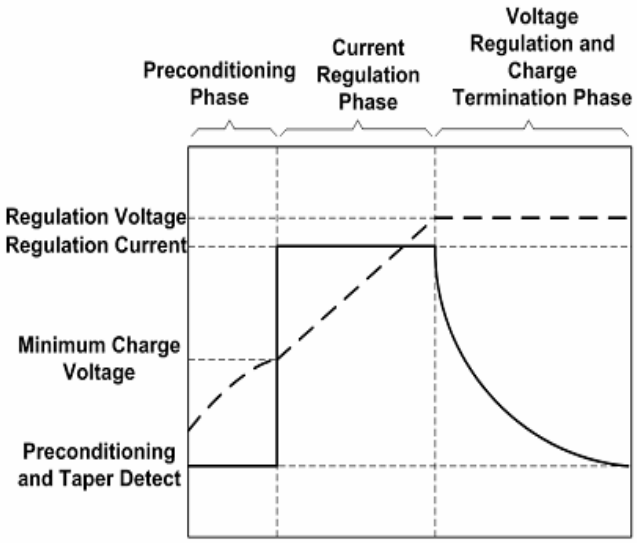


Figure 2: Typical Charge Profile

Current Regulation Phase

The SC62B23 regulates current while the battery-pack voltage is less than the regulation voltage, $V_{O(REG)}$. The SC62B23 monitors charge current by the voltage drop across a sense-resistor, R3, in series with the battery pack, and the resistor, R3, connected to the PROG pin. In order to set the current, first choose R3 based on the regulation threshold $V_{IREG} = V_{PROG} – V_{FB}$ across this resistor. The following formula calculates the value of the Sense resistor:

$$R3 = \frac{V_{IREG}}{I_{OCHARGE}}$$

Battery Voltage Regulation

The voltage regulation feedback occurs through the FB pin. This input is tied to the positive side of the battery pack. The SC62B23 monitors the battery-pack vo ltage between the FB and V_{SS} pins. The SC62B23 is offered in a fixed two-cell voltage version (8.4 V).

Charge Termination Recharge

The SC62B23 monitors the charging current during the voltage-regulation phase. The SC62B23 declares a done condition and terminates charge when the current drops to the charge termination threshold, I_{TERM}. A new charge cycle begins when the battery voltage falls below the V_{RCH} threshold.

Battery Temperature Monitoring

A negative temperature coefficient (NTC) thermistor located close to the battery pack can be used to monitor battery temperature and will not allow charging unless the battery temperature is within an acceptable range.

Connect a 10kΩ thermistor from the NTC pin to ground. With the 99.5µA pull-up current source, the Hot temperature voltage threshold is 479mV. For Cold temperature, the voltage threshold is set at 2.422V with 99.5µA of pull-up current. The charge cycle begins or resumes once the temperature is within the acceptable range.

Charge Status Indication

The SC62B23 reports the status of the charge on the CHRG pin. The following table summarized the operation of the CHRG pin. The CHRG pin can be used to drive a chip LED.

CONDITION	CHRG Pin
Battery conditioning and charging	Low
Temperature fault or sleep mode	Hi-Z
Charge complete(done)	Hi-Z

Trickle Charge

At the beginning of a charge cycle, if the battery voltage is below the trickle charge threshold, the charger goes into trickle charge.

Low-Power Sleep Mode

When the input supply is disconnected, the charger automatically enters power-saving sleep mode. This feature prevents draining the battery pack during the absence of V_{IN}.

Input and Output Capacitors

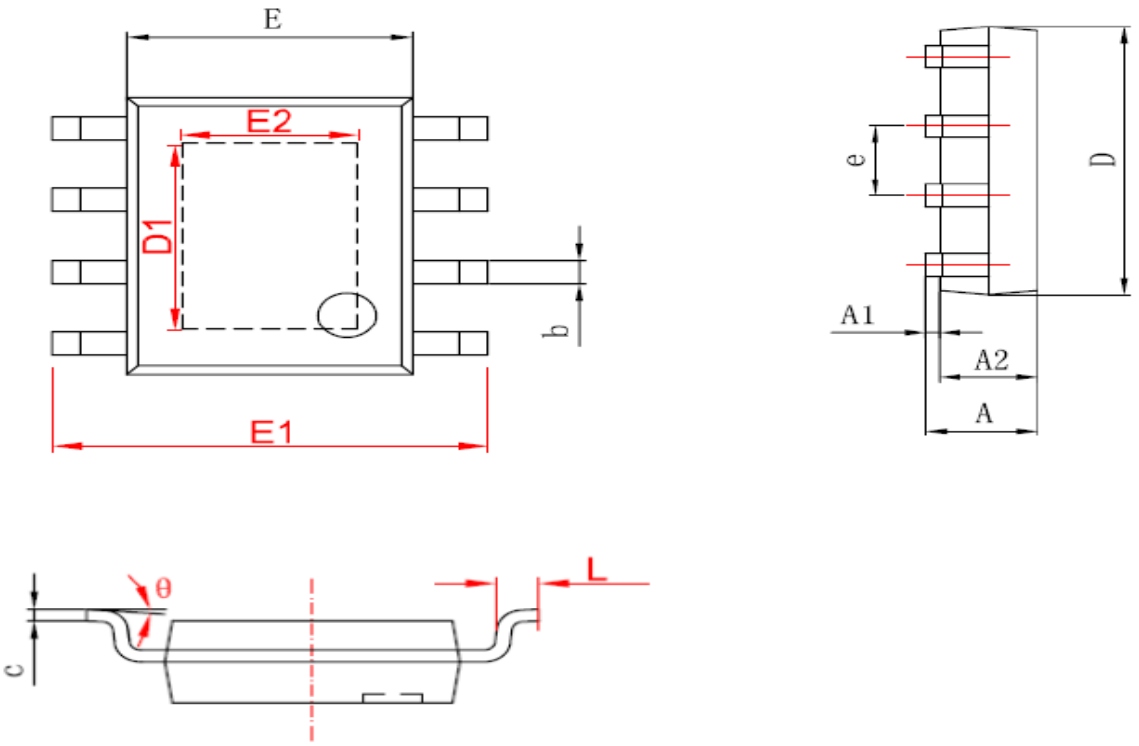
Since the input capacitor is assumed to absorb all input switching ripple current in the converter, it must have an adequate ripple current rating. Worst-case RMS ripple current is approximately one-half of output charge current. Actual capacitance value is not critical. Solid tantalum capacitors have a high ripple current rating in a relatively small surface mount package, but caution must be used when tantalum capacitors are used for input bypass. High input surge currents can be created when the adapter is hot-plugged to the charger and solid tantalum capacitors have a known failure mechanism when subjected to very high turn-on surge currents. Selecting the highest possible voltage rating on the capacitor will minimize problems. Consult with the manufacturer before use.The selection of output capacitor C_{OUT} is primarily determined by the ESR required to minimize ripple voltage and load step transients. The output ripple ΔV_{OUT} is approximately bounded by:

$$\Delta V_{OUT} \le \Delta I_L \left(ESR + \frac{1}{8 f_{OSC} C_{OUT}} \right)$$

Since ΔI_L increases with input voltage, the output ripple is highest at maximum input voltage. Typically,once the ESR requirement is satisfied, the capacitance is adequate for filtering and has the necessary RMS current rating.Switching ripple current splits between the battery and the output capacitor depending on the ESR of the output capacitor and the battery impedance. EMI considerations usually make it desirable to minimize ripple current in the battery leads. Ferrite beads or an inductor may be added to increase battery impedance at the 500kHz switching frequency. If the ESR of the output capacitor is 0.2Ω and the battery impedance is raised to 4Ω with a bead or inductor, only 5% of the current ripple will flow in the battery.

Packaging Information

SOP-8L Package Outline Dimension



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.050	0.150	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
D1	3.202	3.402	0.126	0.134
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
E2	2.313	2.513	0.091	0.099
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°