

700mA Charge + 1A Synchronous Boost PMIC

General Description

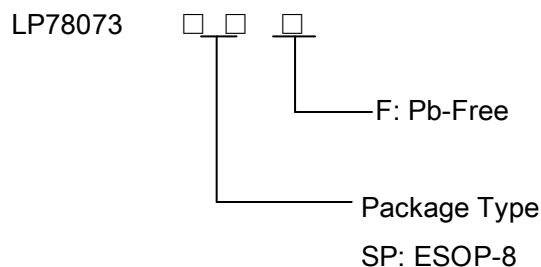
The LP78073 is a PMIC, which has 1ch Charger and 1ch Synchronous Boost Converter with ESOP-8 package.

Its charger is a complete constant-current constant voltage linear charger for single cell lithium-ion batteries. Furthermore, the LP78073 is specifically designed to work within USB power specifications. No external sense resistor is needed, and no blocking diode is required due to the internal MOSFET architecture. Thermal feedback regulates the charge current to limit the die temperature during high power operation or high ambient temperature. The charge voltage is fixed at 4.2V, and the charge current is fixed to 700mA. The charger automatically terminates the charge cycle when the charge current drops to 1/10th the ISET rammed value after the final float voltage is reached. When the input supply (wall adapter or USB supply) is removed, the LP78073 automatically enters a low current state, dropping the battery drain current to less than 180µA.

Other features include charge current monitor, short current protection, under voltage lockout, automatic recharge and a status pin to indicate charge termination and the presence of an input voltage.

Boost converter is Synchronous current mode boost DC-DC converter. Its PWM circuitry with built-in 2A Current power MOSFET makes this converter highly power efficiently. The non-inverting input and its error amplifier is connected to an internal 1000mV precision reference voltage.

Order Information



Features

- ◆ **Charger:**
 - Fixed Charge Current 700mA
 - No MOSFET, Sense Resistor or Blocking Diode Required
 - Constant-Current/Constant-Voltage Operation with Thermal Regulation to Maximize Charge Rate Without Risk of Overheating
- ◆ **Boost:**
 - 1.0A Output Current Synchronous Boost Converter at VIN=3V
 - 900KHz fixed frequency switching
 - High Switch On Current: 2A
 - Low RDS(ON) Integrated Power Mosfet
 - Efficiency is 96%
- ◆ Built-in OVP, OTP, OCP, Soft-Star
- ◆ Low Standby Current Less Than 180uA
- ◆ Few External Component Reduce Cost
- ◆ Consumption Available in ESOP-8 Package
- ◆ RoHS Compliant and 100% Lead (Pb)-Free

Marking Information

Device	Marking	Package	Shipping
LP78073SPF		SP: ESOP-8	3K/REEL

Applications

- ✧ MID/Pad
- ✧ Power Bank
- ✧ Smart Phone
- ✧ Bluetooth Applications

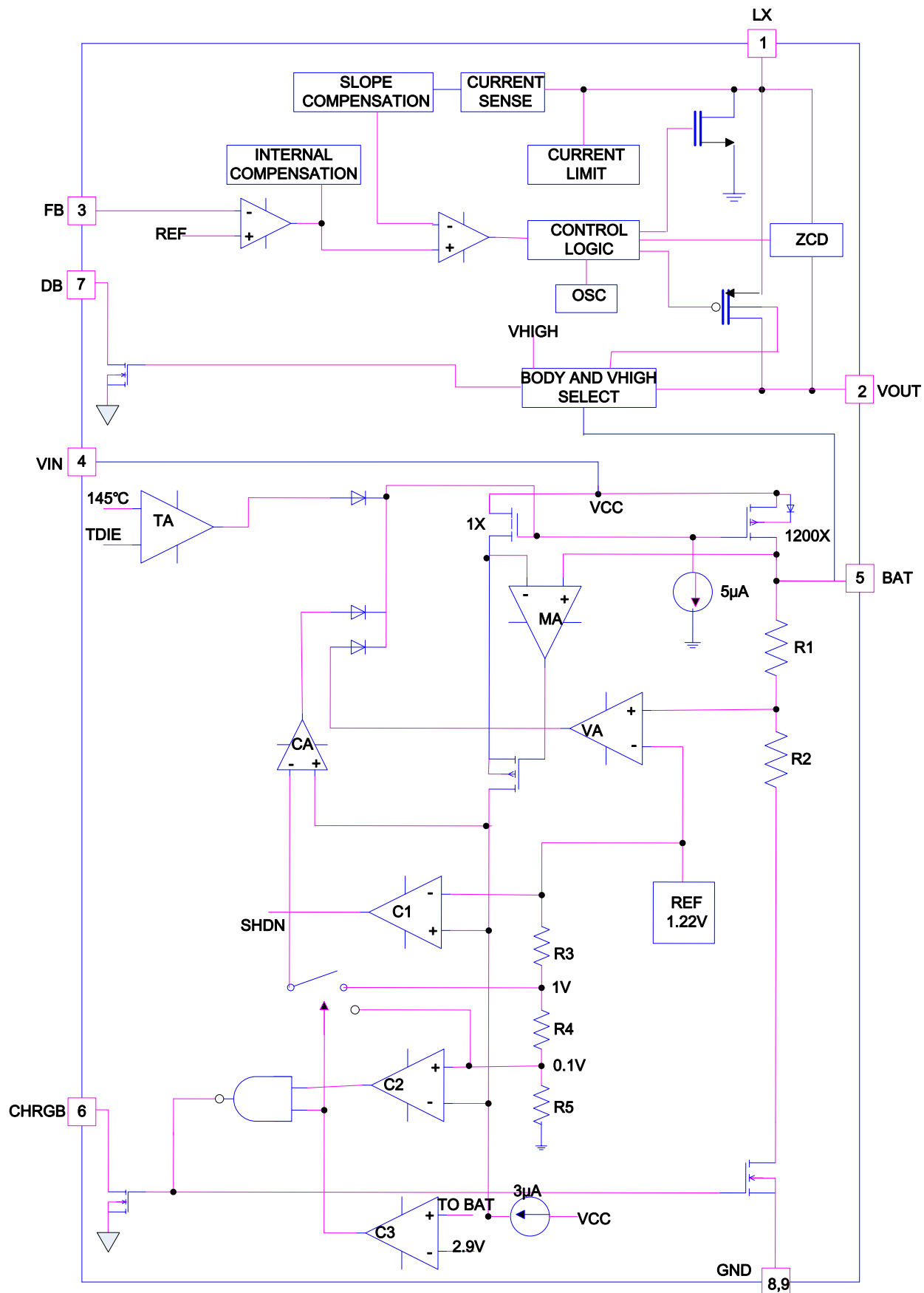
Functional Pin Description

Package Type	Pin Configurations
ESOP-8	

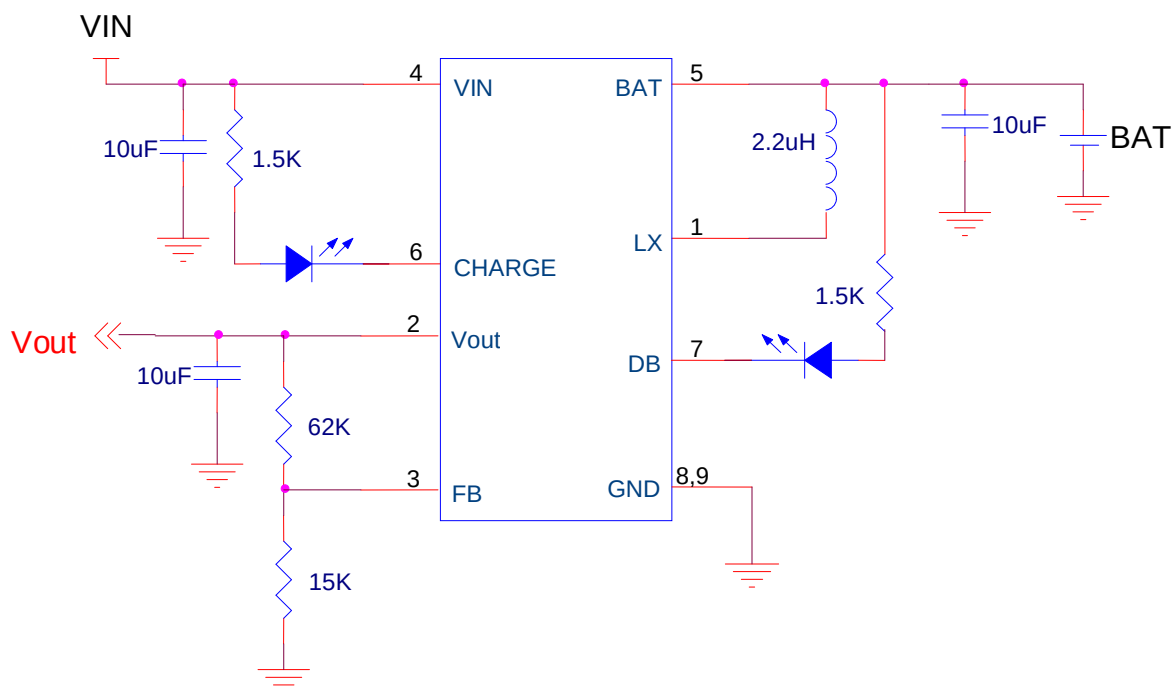
Pin Description

PIN No.	PIN	DESCRIPTION
1	LX	Boost Output switching node. SW is the drain of the internal low-side N-Channel MOSFET and high-side P-Channel MOSFET. Connect the inductor to LX to Complete the step-up converter.
2	VOUT	Output pin of boost.
3	FB	Boost Feedback pin. The pin voltage is 1.0V.
4	VIN	VIN is the input power source. Connect to a wall adapter.
5	BAT	BAT is the connection to the battery. Typically a 10 μ F Tantalum capacitor is needed for stability when there is no battery attached. When a battery is attached, only a 0.1 μ F ceramic capacitor is required.
6	CHARGB	Open-Drain Charge Status Output. When the battery is charging, the CHARGB pin is pulled low by an internal N-channel MOSFET. When the charge cycle is completed, the pin is pulled High.
7	DB	Open-Drain boost load Status Output. When output of the boost is light, this pin is pulled low by an internal N-channel MOSFET.
8,9	GND	GND is the connection to system ground.

Function Block Diagram



Application Circuit



Absolute Maximum Ratings

- ✧ Input Voltage to GND (VIN) ----- -0.3V to 7V
- ✧ VOUT ----- -0.3V to 7V
- ✧ BAT, ISET, CHARGB ----- -0.3V to VIN+0.3V
- ✧ BAT Short-Circuit Duration ----- Continuous
- ✧ Maximum Junction Temperature ----- 125°C
- ✧ Operating Junction Temperature Range (TJ) ----- -40°C to 85°C
- ✧ Maximum Soldering Temperature (at leads, 10 sec) ----- 260°C

Thermal Information

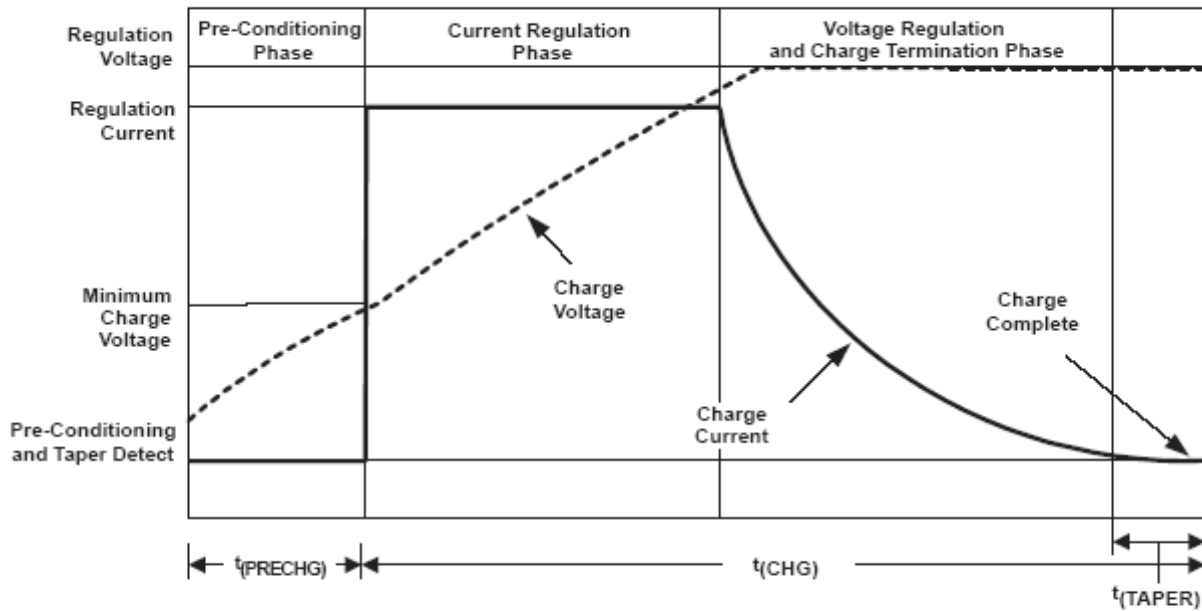
- ✧ Maximum Power Dissipation (PD, TA<40°C) ----- 2.0W
- ✧ Thermal Resistance (JA) ----- 46°C/W

Electrical Characteristics

(The specifications which apply over the full operating temperature range, otherwise specifications are at TA = 25°C. VIN = 5V, unless otherwise noted.)

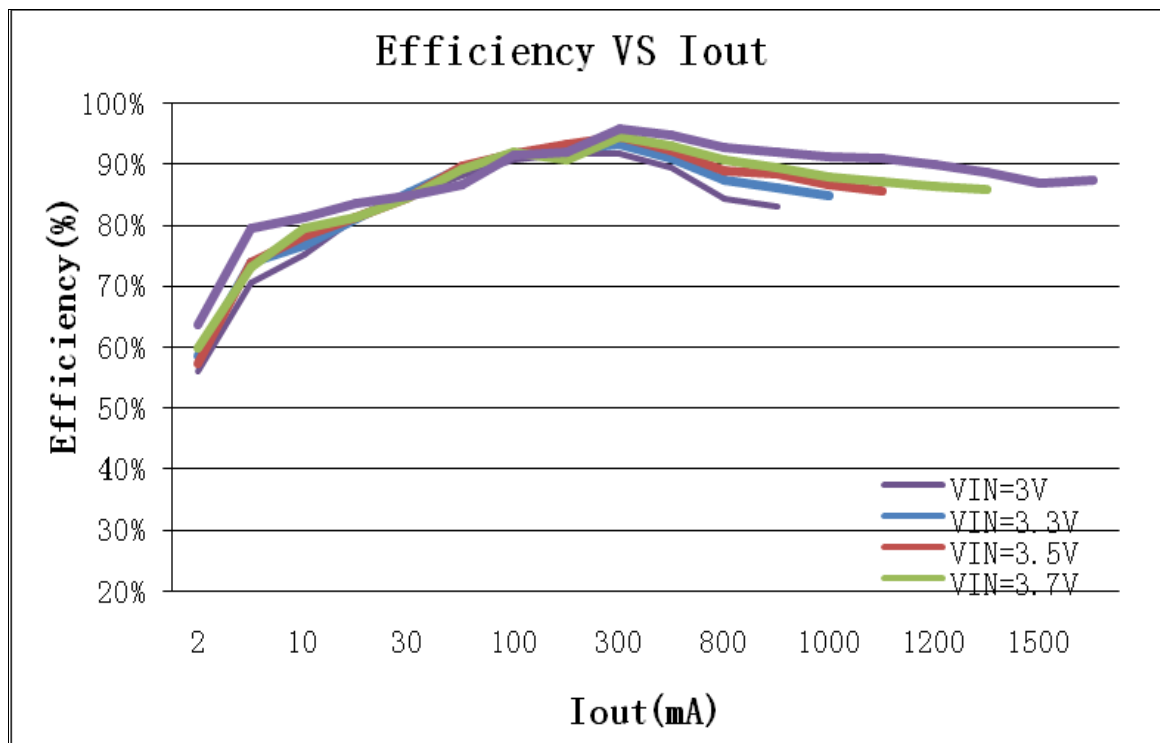
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP.	MAX	UNITS
Charge						
VIN	Adapter/USB Voltage Range		4.2	5	6.5	V
ICC	Input Supply Current	Charge Mode		300	1000	uA
		Standby Mode (Charge Terminated)		200	500	
		Shutdown Mode (VIN < VBAT)		25	50	
VFLOAT	Regulated Output Voltage	0°C ≤ TA ≤ 85°C	4.158	4.2	4.242	V
IBAT	BAT Pin Current	VBAT=3.7V		700		mA
ITRIKL	Trickle Charge Current	VBAT < VTRIKL		70		mA
VTRIKL	Trickle Charge Threshold Voltage	VBAT Rising	2.8	2.9	3.0	V
VTRHYS	Trickle Charge Hysteresis Voltage			400		mV
VASD	VIN – VBAT Lockout Threshold Voltage	VIN from Low to High		630		mV
		VIN from High to Low		130		mV
ITERM	C/10 Termination Current Threshold	Terminal current / Charge current		0.1		mA/mA
ICHARGE	CHARGE Pin Pull Down Current			5		mA
ΔVRESTAT	Recharge Battery Threshold Voltage	VFLOAT - VRESTAT		100		mV
TOTP	Over Temperature Protection				120	°C
Boost						
Vout	Output Voltage Range		Vbat		6	V
Ibat	Supply Current	VIN=3V, Vout=5V, IOUT=0mA		120	180	uA
Vfb			0.98	1.0	1.02	V
Rds(on)	High-Side P-mosfet			100		mΩ
	Low-Side N-mosfet			60		mΩ
Fosc				900		KHz
ILimit	Maximum Current Through SW pin			2		A
IOCP	Short Circuit Current			350		mA

Charge Characteristic



Typical Charging Profile

Boost Efficiency



Application Information

The LP78073 is a single cell lithium-ion battery charger using a constant-current/constant-voltage algorithm. It can deliver up to 700mA of charge current (using a good thermal PCB layout) with a final float voltage accuracy of $\pm 1\%$. The LP78073 includes an internal P-channel power MOSFET and thermal regulation circuitry. No blocking diode or external current sense resistor is required; thus, the basic charger circuit requires only two external components. Furthermore, the LP78073 is capable of operating from a USB power source.

Normal Charge Cycle

A charge cycle begins when. If the BAT pin is less than 2.9V, the charger enters trickle charge mode. In this mode, the LP78073 supplies approximately 70mA to bring the battery voltage up to a safe level for full current charging.

When the BAT pin voltage rises above 2.9V, the charger enters constant-current mode, where the charge current is 700mA. When the BAT pin approaches the final float voltage (4.2V), the LP78073 enters constant-voltage mode and the charge current begins to decrease. When the charge current drops to 1/10 of the 700mA, the charge cycle ends.

Charge Status Indicator (CHARGE_B)

The charge status output has two different states: strong pull-down and high impedance. The strong pull-down state indicates that the LP78073 is in a charge cycle. Once the charge cycle has terminated, the pin state is determined by under voltage lockout conditions. A weak pull-down indicates that the battery is not connecting to chip. High impedance indicates that the charge cycle is terminated.

Automatic Recharge

Once the charge cycle is terminated, the LP78073 continuously monitors the voltage on the BAT pin using a comparator with a 2ms filter time (t_{RECHARGE}). A charge cycle restarts when the battery voltage falls below 4.1V (which corresponds to approximately 80% to 90% battery capacity). This ensures that the battery is kept at or near a fully charged condition and eliminates the need for periodic charge cycle initiations.

Boost Output voltage Setting

Set the output voltage by selecting the resistive voltage divider ratio. The voltage divider drops the output voltage to the 1.0V feedback voltage. Use a 100K resistor for R2 of the voltage divider. Determine the high-side resistor R1 by the equation:

$$V_{\text{out}} = (R1/R2 + 1) \times V_{\text{FB}}$$

$$V_{\text{out}} = (R1/R2 + 1) \times 1.0V$$

Table:

Vout	R1	R2	C3
3.3V	100K	230K	22pF
5V	100K	400K	22pF

Power Dissipation

The conditions that cause the LP78073 battery charger to reduce charge current through thermal feedback can be approximated by considering the total power dissipated in the IC. For high charge currents, the LP78073 power dissipation is approximately:

$$P_D = (V_{\text{ADP}} - V_{\text{BAT}}) \times I_{\text{CHG}} + P_{\text{D_BUCK}} + (V_{\text{INA}} - V_{\text{OUTA}}) \times I_{\text{OUTA}}$$

Where PD is the total power dissipated within the IC, ADP is the input supply voltage, V_{BAT} is the battery voltage, I_{BAT} is the charge current and $P_{\text{D_BUCK}}$ is the power dissipation due to the regulator. $P_{\text{D_BUCK}}$ can be calculated as:

$$P_{\text{D_BUCK}} = V_{\text{OUTB}} \times I_{\text{OUTB}} \left(\frac{1}{\eta} - 1 \right)$$

Where V_{OUTB} is the regulated output of the switching regulator, I_{OUT} is the regulator load and η is the regulator efficiency at that particular load.

It is not necessary to perform worst-case power dissipation scenarios because the LP78073 will automatically reduce the charge current to maintain the die temperature at approximately 125°C.

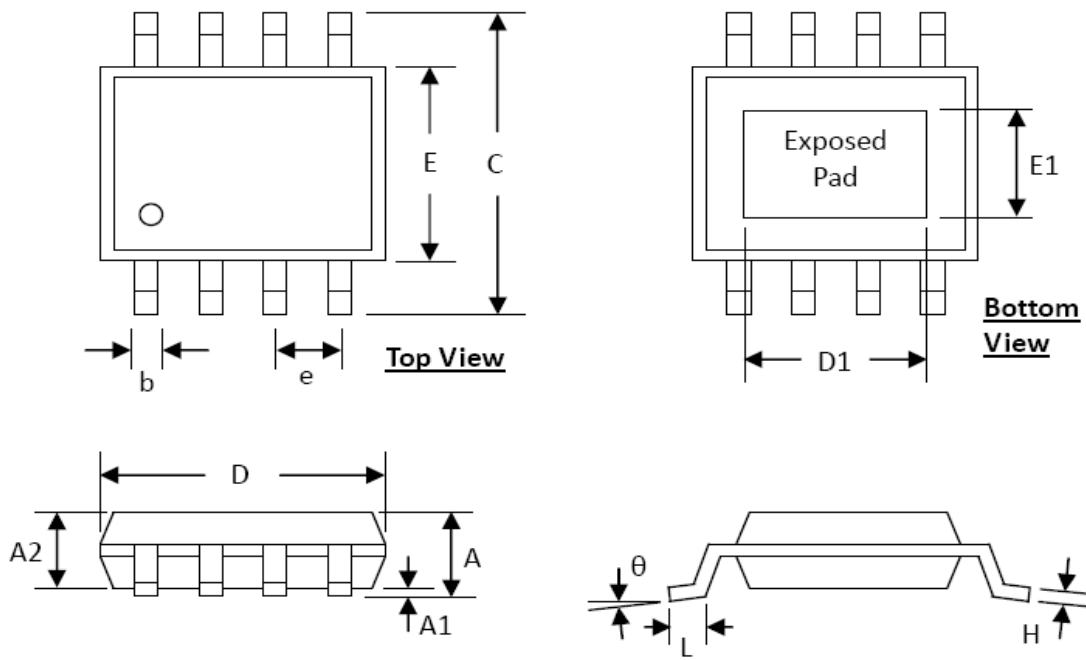
PCB Layout Considerations

It is important to pay special attention to the PCB layout. The following provides some guidelines:

- To obtain optimal performance, the decoupling capacitor from Vin to GND and the output filter capacitors from OUT to GND should be placed as close as possible to the LP78073, with short trace runs to GND pins.
- All low-current GND connections should be kept separate from the high-current charge or discharge paths from the battery. Use a single-point ground technique incorporating both the small-signal ground path and the power ground path.
- The high-current charge paths into IN and from the OUT pins must be sized appropriately for the maximum charge current in order to avoid voltage drops in these traces.

Packaging Information

ESOP-8



SYMBOLS	DIMENSION (MM)		DIMENSION (INCH)	
	MIN	MAX	MIN	MAX
A	1.30	1.70	0.051	0.067
A1	0.00	0.15	0.000	0.006
A2	1.25	1.52	0.049	0.060
b	0.33	0.51	0.013	0.020
C	5.80	6.20	0.228	0.244
D	4.80	5.00	0.189	0.197
D1	3.15	3.45	0.124	0.136
E	3.80	4.00	0.150	0.157
E1	2.26	2.56	0.089	0.101
e	1.27 BSC		0.050 BSC	
H	0.19	0.25	0.0075	0.0098
L	0.41	1.27	0.016	0.050
θ	0°	8°	0°	8°