Nanjing extension of Microelectronics Co., Ltd.

NanJing Top PowerASIC Corp.

Data Sheet

DATASHEET

TP5400

(1A lithium battery and 5V / 1A boost control chip)

description

TP5400 A power source dedicated for the movement of Li-Ion battery charger and a constant 5V Boost controller sets the charging portion and the charging current precision voltage regulator, pre-charge, charge status and charging cut-off functions in one, can output the maximum 1A recharging current. And the boost circuit using CMOS Load current process for producing an extremely low VFM Switching DC / DC Boost converter. Having a very low load power consumption (less than 10uA), And the ability to boost output drive current reaches 1A . No external buttons, you can plug and play.

Charging section linear step-down mode, the built-in PMOSFET Plus anti-intrusion circuit, so no external sense resistor and blocking diode. Thermal feedback to automatically adjust the charging current to limit the die temperature during high power operation or high ambient temperature conditions, full voltage is fixed at 4.2V . Charge current can be set by an external resistor. When the battery reaches 4.2V Thereafter, the charging current is gradually decreased to the set current value 1/5 , TP5400 Automatically terminates the charge. Boost part of the same built-in power NMOSFET Smaller internal resistance can provide drive capacity 5V / 1A . Higher integration that TP5400 Only a small number of external components to work properly. TP5400 Integrated charging temperature protection, boost input power limiting loop, the current may be dynamically adjusted according to the load, and having a fast response and over-current shutdown. Boost converter with frequency of way, it is more domestic and foreign products have extremely low no-load power consumption, ripple, stronger drive capability, as well as greater efficiency.

Feature

Typical values of up to 1000mA ★ programmable charge current, maximum Reach 1.2A;

1A ★ boost up the output current (Vbat = 3.3V), the maximum transmission A 1.5A (Vbat = 3.8v);

★ automatic frequency adjustment (VFM), to adapt to different boost load (5V standby current load is less than 10uA), no buttons to start

Low battery voltage (less than 3V) automatically stops the boosting;

- A single lithium-ion battery mobile power dedicated circuit;
- High Efficiency Boost: 88% (Typ) ,maximum 90% ;
- Constant-current / constant-voltage operation, and having a charge rate can be achieved to maximize the risk of overheating in the absence of thermal regulation function;
- Accuracy of ± 1% of the preset charge voltage 4.2V;
- Accuracy of ± 2.5% of the preset boosting precision 5V;
- Maximum input of up to 9V;
- 2 indicates the state of charge: the LED open drain output driver;
- C / 5 charge termination current;
- Trickle charging 2.9V or less C / 5 ;
- Soft start reduces surge current charging;
- No MOSFET , Resistor or blocking diode detector;
- ESOP thermally enhanced 8-pin package.

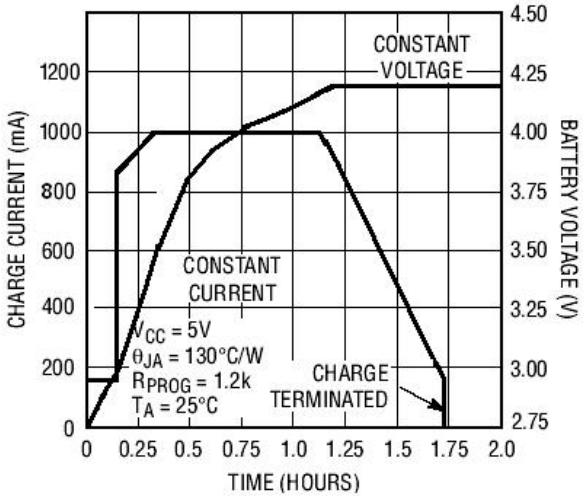
application

- mobile power
- Portable devices

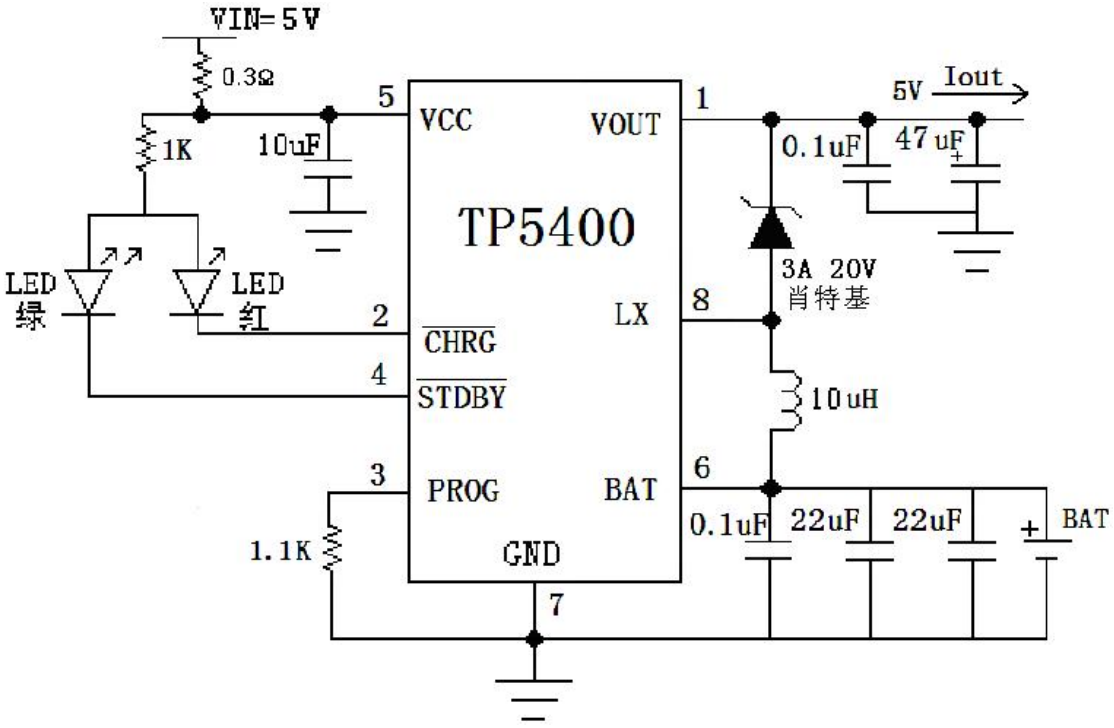
Absolute Maximum Ratings

- Input supply voltage (V_{CC}): - 0.3V ~ 10V
- PROG : -0.3V ~ V_{CC} + 0.3V
- BAT : 0V ~ 7V
- LX : -2V ~ 10V
- VOUT : -0.3V ~ 10V
- $\overline{CHRG}$: -0.3V ~ 10V
- BAT Short circuit duration: Continuous
- BAT Pin Current: 1200mA
- Boost maximum output current 1.8A / 5V
- Temperature 145℃ Junction
- Working temperature range: -40 ℃ ~ 85 ℃
- Storage Temperature Range: -65 ℃ ~ 125 ℃
- Lead Temperature (welding time of 10 seconds): 260 ℃

Complete charging cycle (1000mAh battery)

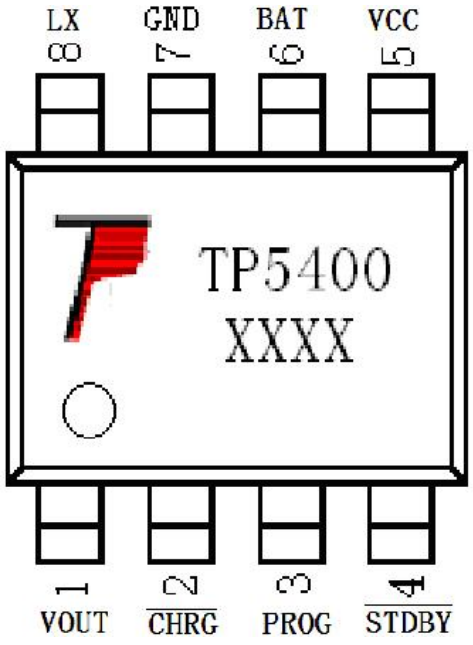


typical application



A single lithium-ion battery 1A And boost 5V Export 1A Controller

Package / Ordering Information



8 Pin ESOP Package (bottom finned

Fins recommended ground)

XXXX Production date (Zhou)

Orders models
TP5400-ESOP8
Device Marking
TP5400
Physical picture

Electrical characteristics

The ● denotes specifications which apply over the full operating temperature range, otherwise specifications are T_A = 25 ℃, V_{CC} = 5V Unless otherwise noted.

symbol	parameter	condition		Min	Typ	Max	Units
V_{CC}	Input supply voltage		●	4.0	5	9.0	V
I_{CC}	Input supply current	Charging mode, R_{PROG} = 10K	●		1504040400	500	μA
		Standby mode (charge termination) Stop	●			100	μA
		mode (R_{PROG} not connected,	●			100	μA
		$V_{CC} < V_{BAT}$,or $V_{CC} < V_{UV}$) Step-up				100	μA
		start					μA
V_{FLOAL}	Stable output (floating) voltage 0 ℃ ≤ T_A ≤ 85 ℃, I_{BAT} = 40mA			4.158	4.2	4.242	V
I_{BAT}	BAT Pin current (In addition to stated Vbat = 4.0v)	R_{PROG} = 1.5K , The charging mode	●	700	7401000	8001050	mA
		R_{PROG} = 1.1K , No load boost	●	950			mA
		charge mode, V_{BAT} = 3.8V	●		- 10	- 100	μA
I_{TRIKL}	Trickle charge current	$V_{BAT} < V_{TRIKL}$, R_{PROG} = 1.5K	●	150	200	250	mA
V_{TRIKL}	Trickle charge threshold voltage	R_{PROG} = 1.5K, V_{BAT} rise		2.8	2.9	3.0	V
V_{UV}	V_{CC} Undervoltage lockout threshold from V_{CC} Low to High		●	3.4	3.6	3.8	V
I_{TERM}	C / 5 Termination current threshold	R_{PROG} = 1.5K	●	150	200	250	mA
V_{PROG}	PROG Pin voltage	R_{PROG} = 1.5K , The charging mode	●	0.9	1.0	1.1	V
$V_{\overline{CHRG}}$	$\overline{CHRG}$ Low voltage output pin CHRG	$I_{\overline{CHRG}}$ = 5mA			0.3	0.6	V
$V_{\overline{STDBY}}$	$\overline{STDBY}$ Pin output low STDBY	$I_{\overline{STDBY}}$ = 5mA			0.3	0.6	V
ΔV_{RECHRG}	Threshold voltage of the rechargeable battery	V_{FLOAT}- V_{RECHRG}		100	150	200	mV
T_{LIM}	Defining a temperature model of the junction temperature				120		℃
Charging R_{ON}	Charging MOS Tube "on" resistance (in V_{CC} versus BAT between)				450		mΩ
t_{ss}	Soft start time	I_{BAT} = 0 to I_{BAT} = 1200V / R_{PROG}			20		us
t_{TERM}	Termination Comparator Filter Time	I_{BAT} Drops I_{CHG} / 5 the following		0.8	1.8	4	ms
VOUT	Boost Output 5V	Load Resistance RL = 1k		4.875	5	5.125	V
V_{BatLOW}	Battery undervoltage protection	Vbat From 3.6V decline	●	2.9	3	3.1	V
$V_{BatHigh}$	Battery undervoltage protection unlock	Vbat From 2.7V rise	●	3.2	3.3	3.4	V
Fosc	The oscillation frequency			300	400	500	KHZ
η boost	boost efficiency	V_{BAT} = 3.8VI_{OUT} = 500mA			90		%
η boost	boost efficiency	V_{BAT} = 3.8VI_{OUT} = 1000mA			88		%
Dty	The maximum duty cycle				75		%
Boost R_{ON}	Boost NMOS Resistance tube	V_{LX} = 0.4V			120		mΩ
I_{Lxleak}	Boost NMOS Tube leakage current	V_{LX} = 6V				1	uA
Ilmt_nmos	Boost switch restrictor				4	4.5	A

Pin Function

VOUT (Pins 1): Output voltage detection pin.

Boost connection 5V An output terminal.

CHRG **(Pins 2): Charging the charging state of the open-drain output terminal indicated.** When the battery is being charged,

CHRG Internal switch pin is pulled low, indicating the charging progress; otherwise CHRG Pin is high impedance.

PROG (Pins 3): Setting charge current, the charge current monitoring and shutdown pin. Between the pin and connected to a precision 1% Resistor R_{PROG} The charging current may be set. When charging at the constant current mode, the voltage is maintained at pin 1V .

PROG Pin may also shut down the charger. Setting resistor and disconnect the inside a 2.5 μ A The current

PROG Pin is pulled high. When the voltage reaches the pin 2.7V When the shutdown threshold voltage, the charger enters shutdown mode, charging is stopped and the input supply current drops

40 μ A . Re R_{PROG} Ground will Chargers

Restore normal operation.

STDBY **(Pins 4): Indicating completion of charging the battery terminal.** When the battery is fully charged STDBY Internal switch is pulled low to indicate the completion of charging. In addition, STDBY The pin is in high impedance state.

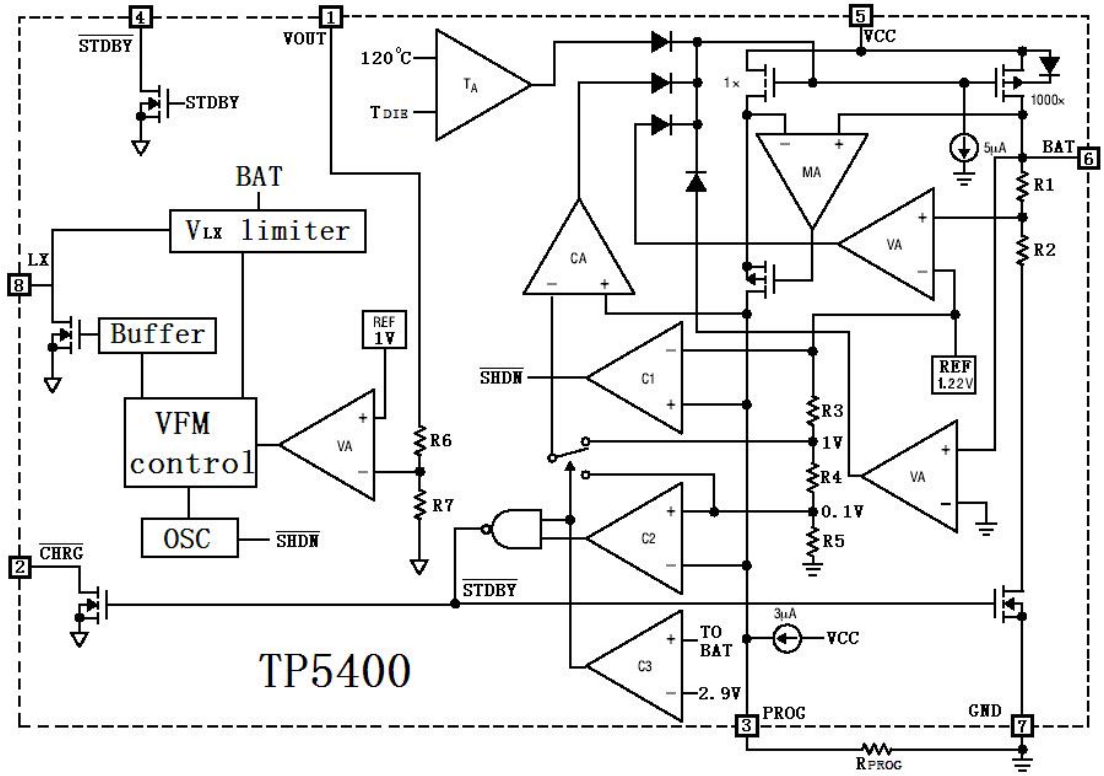
V_{CC} (Pins 5): Charger input power supply voltage. Charge input power pin. Typical values 5V And shall adopt at least one 10 μ F Bypass capacitor. when V_{CC} Drops BAT Pin voltage 30mV Within, TP5400 Charging portion enters shutdown mode, thereby boosting I_{BAT} Drops 10 μ A the following.

BAT (Pins 6): A charging current output. The pin and the final charging current to the battery float voltage is adjusted to 4.2V . A precision resistor divider internal float voltage setting of the pin, in shutdown mode, the internal resistor divider is disconnected, the internal operating power boost mode.

GND (Pins 7): Ground

LX (Pin 8): And the power MOSFET output of the booster circuit.

Block diagram



working principle

TP5400 is a use of constant current / constant voltage to a single lithium-ion battery and a boost discharging controller. It is possible to provide 1000mA charging current (by means of a good thermal PCB layout). NMOS power boost circuit built-tube, only the external inductor and a capacitance of a Schottky diode and a small amount of boost to complete 5V output.

When connecting the load terminal VOUT, TP5400 provides a 5V voltage source, the driving capacity of 1A.

Charge cycle

When the Vcc pin voltage rises above the UVLO threshold level and the PROG pin is connected to ground and a setting resistor connected to a battery when the charger output, a charging cycle begins. If the BAT pin is less than 2.9V, the charger trickle precharge mode. In this mode, TP5400 provides a constant current charge current is 1/5, so that the current and voltage up to a safe level, for full current charge.

When the BAT pin voltage rises above 2.9V, the charger enters the constant current mode, where a constant charging current to the battery. When the BAT pin voltage reaches the final float voltage (4.2V), TP5400 enters a constant voltage mode, and the charge current begins to decrease. When the charge current drops to the value 1/5, the charging cycle is ended.

The charging current is set

The charging current is to use a connection PROG A resistor between the pin and ground to set. Setting resistor and the charging current is calculated using the following equation to determine the approximate value of resistor according to a necessary charging current,

formula: $I_{BAT} = \frac{1100}{R_{PROG}}$

Customer applications, R_{PROG} Determining the relationship between the charging current is shown in the table:

R_{PROG} (Ω)	I_{BAT}
10k	130mA
5k	245mA
2k	560mA
1.5k	740mA
1.1k	1000mA

Charge termination

When the charging current is reduced to 1/5 of the set value after reaching the final float voltage, the charging cycle is terminated. This condition is achieved by using an internal filter of a comparator monitoring the PROG pin is detected. When the PROG pin voltage falls below 200mV for longer than t_{TERM} (One When the like is 1.8ms), charging is terminated. The charging current is latched off, TP5400 enters standby mode, where the input supply current to 40μA. (Note: C / 5 termination failure and thermal limit trickle charge mode).

When charging, the load transient causes the voltage on the PROG pin BAT pin charge current drops in value between the DC briefly reduced to 1/5 200mV or less. The 1.8ms filter time comparator (t_{TERM}) Ensure that Transient nature of the load does not lead to premature termination of the charging cycle. Once the average value of the charging current drops to 1/5 or less, TP5400 terminates the charge cycle and ceases to provide any current through the BAT pin. In this state, all loads on the BAT pin must be powered by a battery.

In standby mode, TP5400 BAT pin voltage continuously monitored. If this voltage drops 4.1V recharging limit switches (V_{RECHRG}) Or less, the other Charge cycle begins again and supplying current to the battery. When the charge cycle manually re-started in a standby mode, it must be removed and then input voltage is applied, or be shut down the charger and start using the PROG pin.

A charging status indicator (CHRG STDBY)

TP5400 Two open-drain status output terminal, CHRG with STDBY . When the charger is in the charging state, CHRG Is pulled low, in other states, CHRG In a high impedance state. When the battery charger is not received, CHRG Output pulse signal indicate that the battery. When the battery connecting terminal BAT Pin external capacitance 10uF Time CHRG Blinking period about 0.5-2 second.

When no status indication function, unused status outputs to ground.

Indicator status may refer to the following table:

charging	red light CHRG	Green STDBY
Charging status	bright	Destroy
Battery is fully charged state	Destroy	bright
No battery status	Flashing	
When the step-up operation	Destroy	Destroy

Charging undervoltage lockout

An internal undervoltage lockout circuit monitors the input voltage, and limiting or more before the door was raised to Vcc undervoltage lockout keeps the charger in shutdown mode. UVLO circuitry will keep the charger in shutdown mode. If the UVLO comparator is tripped, then the Vcc voltage rises higher than before the battery charger will not exit 50mV shutdown mode.

In the case where the charge blocking, 3V lithium cell is higher than the voltage boosting circuit starts automatically.

Automatic restart

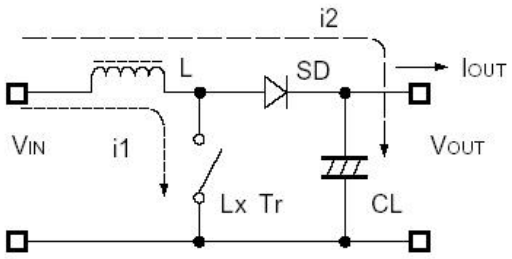
Once the charge cycle is terminated, TP5400 immediately takes time having a 1.8ms filter (*RECHARGE* *t*)of Comparator continuously monitors the voltage on the BAT pin. When the battery voltage drops below 4.1V (corresponding to approximately 80% of the battery capacity to 90%) or less, the charge cycle begins again. This ensures that the battery needs to be maintained at (or near) a fully charged state, and eliminates the periodic charge cycle starts. In the recharge cycle, CHRG Output pin to re-enter a strong pull-down state, STDBY Output pin to re-enter a high-impedance state.

Charging current soft start

TP5400 comprises a charging cycle for the start soft-start circuit to minimize the inrush current. When a charge cycle is initiated, the charging current will rise in about 20mS in full from zero to the full scale value. During startup, it can play a role in minimizing the transient current load on the power supply.

Booster discharge circuit

Boosting circuit using an inductor for energy storage, and bleed through the common power source with an input terminal, so as to obtain an output voltage higher than the input voltage. As shown below:



In the booster circuit 3V-4.2V, the booster circuit automatically starts without access to power and charge battery voltage, continuously outputs 5V constant voltage source. When the voltage at the other BAT 3V-4.2V, the power source Vcc and the input is less than 3.8V, or Vcc <Vbat + 50mV and when PROG pin floating, the booster will work. Lithium boosting circuit with voltage protection function, when the battery voltage up to 3V, TP5400 will automatically turn off the booster.

Boosting circuit has a very low load current at no-load normal standby state, the average load current is less than approximately 10uA, thus ensuring efficient lithium battery still retain their charge longer vacant standby, extended mobile power standby time of the system.

Lithium battery voltage automatic shutdown

Lithium boosting circuit with voltage protection function, when the battery voltage up to 3V, TP5400 will automatically turn off the booster. When the lithium battery to recover more than 3.3V, stop state has been canceled, boost recovery efforts.

And thermally connected to heat sink considerations

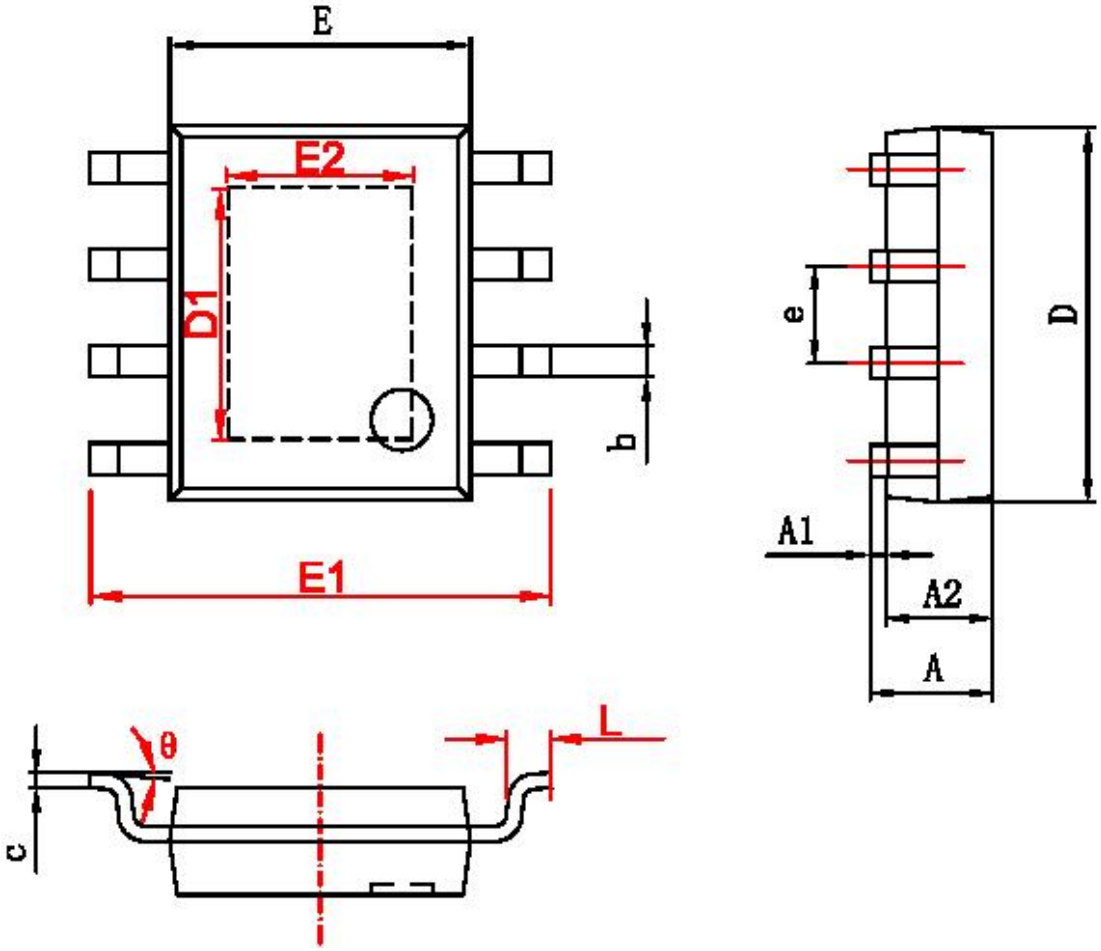
due to ESOP8 Package small dimensions, high-current applications may cause poor cooling effect of the charging current is reduced by the temperature protection. Recommended bottom of the chip and a heat sink PCB Copper connection, the bottom fin may be grounded or floating, other potential unacceptable. Using a sophisticated thermal design PC Plate layout to maximize the available charge current may be used, it is equally important. For dissipate IC Cooling path of the generated heat from the chip to the lead frame, and reach through the lead (in particular, a ground lead) after the peak PC Board copper. PC Board copper heat sink. The footprint copper pads should be as wide, and extends outwardly to a large copper area to spread the heat to the surroundings. When performing PC Board layout design, other heat sources related to the charger board also must be considered, because they will affect overall temperature rise and the maximum charge current has been affected.

V_{cc} Bypass capacitor

Various types can be input bypass capacitor. However, care must be taken when using multilayer ceramic capacitors. Because some types of ceramic capacitors having a self-resonant and It features high Q value, therefore, under certain start conditions (such as the battery charger is connected to the power supply input and a work) may produce a high voltage transient signals, recommended or tantalum electrolytic capacitor.

Package Description

8 Pin ESOP Package (Unit mm)



字符	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°

TP5400 Note the use of the test

1 To ensure the reliable use of various circumstances, prevent the chip spikes and voltage spikes caused by the reliability Drop, recommended TP5400 Applications Vcc , BAT with VOUT The capacitance required to end close to the chip pin preferably, should not be too far away, and strongly recommends parallel 0.1uF Ceramic capacitor close to the pin.

2 , BAT End of the capacitor values recommended two parallel 22uF capacitance, VOUT End of the capacitance value of not less than 47 μ F (Too small, the capacitance value of the chip unstable, strong demand VOUT End of tantalum or electrolytic capacitors), and have a good frequency characteristic. In addition, due to the LX Switching the driving transistor generates a voltage spike at turn-off, capacitor's pressure value of at least the output voltage of the design 3 Times.

3 Inductance value 3.3-22uH recommend 10uH . Further, the external inductor DC resistance to be small, for receiving the flow value High magnetic saturation and will not work.

4 , An external diode having a Schottky diode should choose a high switching speed, recommended SS32 .

5 The chip is designed to drive large loads, the peripheral components as small as possible from the chip, the connection The shorter the better. In particular received VOUT Component minus terminal shall make wiring length short and capacitance.

6 , GND Terminal should be fully grounded, or zero potential inside the chip will vary with the switching current, resulting in Work unstable.