High Accuracy Linear Li-Lon Battery Charger

Description

The SC69A10 is a complete constant-current /constant voltage linear charger for single cell lithium-ion batteries. Its package and low external component count make the SC69A10 ideally suited for portable applications. Furthermore, the SC69A10 is specifically designed to work within USB power specifications.

The charge voltage is fixed at 4.2V, and the charge current can be programmed externally with a single resistor. The SC69A10 automatically terminates the charge cycle when the charge current drops to 1/10th the programmed value after the final float voltage is reached.

The SC69A10 converters are available in the industry standard SOP8-PP power packages (or upon request).

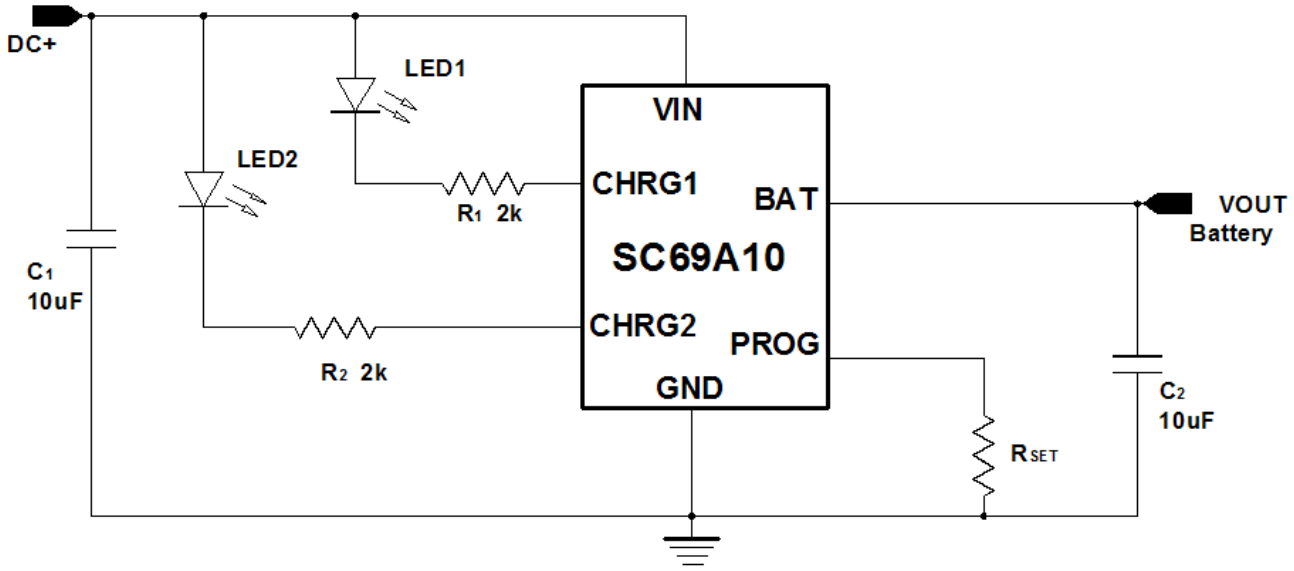
Features

- **Input Voltage Range: 4.5V-6.5V**
- **Programmable Charge Current Up to 1000mA**
- **Preset 4.2V Charge Voltage with ±1% Accuracy**
- **No MOSFET, Sense Resistor or Blocking Diode Required**
- **Constant-Current/Constant-Voltage Operation with Thermal Regulation to Maximize Charge Rate**
- **Charges Single Cell Li-Ion Batteries Directly from USB Port**
- **Automatic Recharge**
- **2.8V Trickle Charge Threshold**
- **Two sides of LED showing**
- **SOP-8PP Package**

Applications

- **Charges Single Cell Li-Ion Batteries**
- **Portable MP3 Players**
- **Wireless Headsets**
- **Bluetooth Applications**
- **Mobile power**

Typical Application

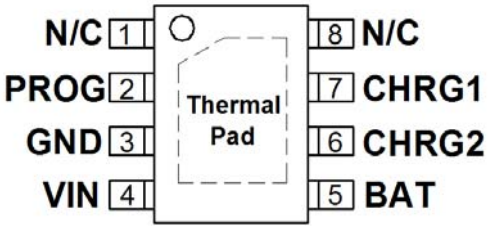


* The charge current can be set by :$I_{BAT}=(V_{PROG}/R_{SET})$ ≤900
* When charging in constant-current mode, the V_{PROG} is usually 1V.

CONDITION	LED1	LED2
Battery charging	ON	OFF
Charge complete	OFF	ON

Figure 1: Typical Application Circuit with Two LEDs

Pin Configurations

Part Number	Pin Configurations
SC69A10 SOP-8PP	

Pin Description

PIN	NAME	DESCRIPTION
1、8	N/C	No Connect.
2.	PROG	Charge Current Program, Charge Current Monitor and Shutdown Pin. The charge current is programmed by connecting a 1% resistor, RPROG, to ground. When charging in constant-current mode, this pin servos to 1V. In all modes, the voltage on this pin can be used to measure the charge current using the following formula: $I_{BAT}=(V_{PROG}/R_{SET})$ ∅900
3	GND	Ground.
4.	VIN	Positive Input Supply Voltage. It Provides power to the charger VIN can range from 4.5V to 6.5V and should be bypassed with at least a 1uF capacitor.
5.	BAT	Charge Current Output. It should be bypassed with at least a 1μF capacitor. It Provides charge current to the battery and regulates the final float voltage to 4.2V. An internal precision resistor divider from this pin sets the float voltage which is disconnected in shutdown mode.
6.	CHRG2	Charge Complete Status Output. See CHRG pin (Pin 7).
7.	CHRG1	Open-Drain Charge Status Output. When the battery is charging, the CHRG1 pin is pulled low by an internal N-channel MOSFET. When the charge cycle is completed, high impedance is forced to the CHRG1 and CHRG2 (pin 6) is pulled low, indicating an “AC present” condition.
9.	Thermal Pad	The Thermal Pad Pin must connect to the ground of PCB.

Absolute Maximum Ratings

- Input Supply Voltage (V_{IN}) ---------- –0.3V to 7V
- PROG ---------- – 0.3V to V_{IN} + 0.3V
- CHRG1/CHRG2 ---------- –0.3V to 7V
- V_{BAT} ---------- –0.3V to 7V
- I_{BAT} Pin Current ---------- 1000mA
- Maximum Junction Temperature ---------- 125℃
- Operating Ambient Temperature Range ---------- –40℃ to 85℃
- Storage Temperature Range ---------- –65℃ to 125℃
- Lead Temperature (Soldering, 10 sec) ---------- 300℃

Electrical Characteristics

Operating Conditions: T_A=25℃, V_{CC}=5V unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	SC69A10			UNITS
			MIN.	TPY.	MAX.	
V_{IN}	Input Supply Voltage		4.5	5	6.5	V
I_{CC}	Input Supply Current	Standby Mode (Charge Terminated)		43		μA
		Shutdown Mode (R_{PROG} Not Connected, V_{IN} < V_{BAT})		80		μA
V_{FLOAT}	Regulated Output (Float) Voltage	0℃≤T_A≤ 85℃		4.2		V
I_{BAT}	BAT Pin Current	R_{PROG} = 10k, Current Mode		90		mA
		R_{PROG} = 1.5k, Current Mode		600		mA
		Standby Mode, V_{BAT} = 4.2V		7		μA
		Shutdown Mode (R_{PROG} Not Connected)		13		μA
		Sleep Mode, V_{CC} = 0V		0.1		μA
I_{MBAT}	Maximum Charge Current	R_{PROG} = 0.9k		1000		mA
V_{TRIKL}	Trickle Charge Threshold Voltage	R_{PROG} = 10k, V_{BAT} Rising		2.8		V
I_{TERM}	C/10 Termination Current Threshold	R_{PROG} = 1.5k		58		mA
V_{PROG}	VPROG PROG Pin Voltage	R_{PROG}=1.5k, Current Mode		1		V
ΔV_{RECHRG}	DVRECHRG Recharge Battery Threshold Voltage	V_{FLOAT} - V_{RECHRG}		220		mV

Application Information

The SC69A10 is a single cell lithium-ion battery charger using a constant-current/constant-voltage algorithm. It can deliver up to 900mA of charge current (using a good thermal PCB layout) with a final float voltage accuracy of ±1%. No blocking diode or external current sense resistor is required; thus, the basic charger circuit requires only few external components. Furthermore, the SC69A10 is capable of operating from a USB power source.

Normal Charge Cycle

A charge cycle begins when the voltage at the VIN pin rises above 4.5V and a 1% program resistor is connected from the PROG pin to ground or when a battery is connected to the charger output. If the BAT pin is less than 2.8V, the charger enters trickle charge mode.

In this mode, the SC69A10 supplies approximately 1/10 the programmed charge current to bring the battery voltage up to a safe level for full current charging. When the BAT pin voltage rises above 2.8V, the charger enters constant-current mode, where the programmed charge current is supplied to the battery. When the BAT pin approaches the final float voltage (4.2V), the SC69A10 enters constant-voltage mode and the charge current begins to decrease. When the charge current drops to zero, the charge cycle ends.

Charge Termination

A charge cycle is terminated when the charge current falls to 1/10th the programmed value after the final float voltage is reached. This condition is detected by using an internal, filtered comparator to monitor the PROG pin.

When charging, transient loads on the BAT pin can cause the PROG pin to fall below 100mV for short periods of time before the DC charge current has dropped to 1/10th the programmed value. Once the average charge current drops below 1/10th the programmed value, the SC69A10 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 supplied by the battery.

The SC69A10 constantly monitors the BAT pin voltage in standby mode. If this voltage drops below the 4V recharge threshold (V_{RECHRG}), another charge cycle begins and current is once again supplied to the battery. To manually restart a charge cycle when in standby mode, the input voltage must be removed and reapplied, or the charger must be shut down and restarted using the PROG pin.

Thermal Limiting

An internal thermal feedback loop reduces the programmed charge current if the die temperature attempts to rise above a preset value of approximately 120°C. This feature protects the SC69A10 from excessive temperature and allows the user to push the limits of the power handling capability of a given circuit board without risk of damaging the SC69A10 The charge current can be set according to typical (not worst-case) ambient temperature with the assurance that the charger will automatically reduce the current in worst-case conditions. Thin SOT power considerations are discussed further in the Applications Information section.

Automatic Recharge

A charge cycle restarts when the battery voltage falls below 4V (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

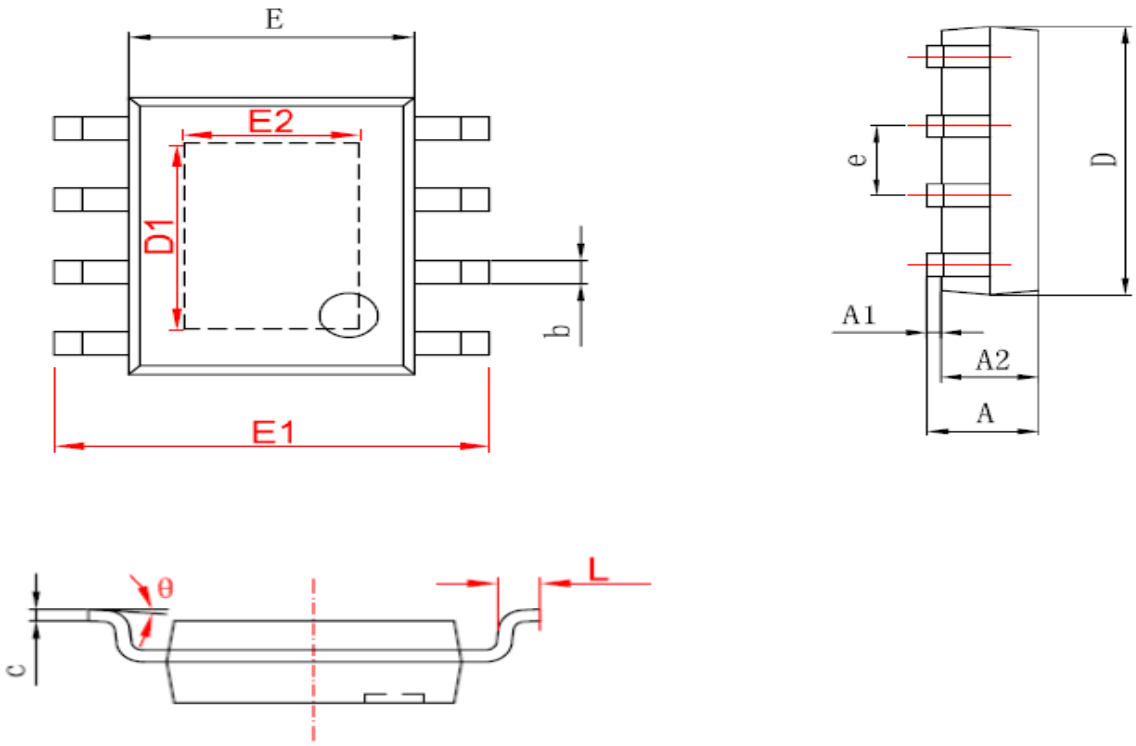
initiations.

VCC Bypass Capacitor

Many types of capacitors can be used for input bypassing; however, caution must be exercised when using multilayer ceramic capacitors. Because of the self-resonant and high Q characteristics of some types of ceramic capacitors, high voltage transients can be generated under some start-up conditions, such as connecting the charger input to a live power source. Adding a 1.5W resistor in series with an X5R ceramic capacitor will minimize start-up voltage transients.

Packaging Information

SOP-8PP 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°