Standalone Linear Li-Ion Battery Charger

General Description

LN5060 is a complete constant-current & constant voltage linear charger for single cell Lithium-ion and Lithium-Polymer batteries. Its SOT-23 package and low external component count make LN5060 ideally suited for portable applications. Furthermore, the LN5060 is specifically designed to work within USB power specification. At the same time, LN5060 can also be used in the standalone Lithium-ion and Lithium-Polymer battery charger.

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 can be programmed externally with a single resistor. The LN5060 automatically terminates the charge cycle when the charge current drops to 1/10th the programmed value after the final float voltage is reached.

When the input supply (wall adapter or USB supply) is removed, the LN5060 automatically enters a low current stage, dropping the battery drain current to less than 2uA. The LN5060 can be put into shutdown mode, reducing the supply current to 25uA.

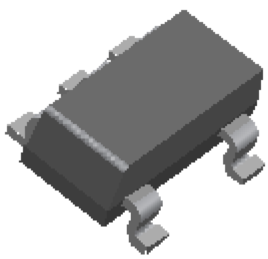
Other features include charge current monitor, undervoltage lockout, automatic recharge and a status pin to indicate charge termination and the presence of an input voltage.

Features

- Programmable Charge Current Up to 800mA.
- No MOSFET, Sense Resistor or Blocking Diode Required.
- Constant-Current/Constant-Voltage Operation with Thermal Protection to Maximize Charge Rate without Risk of Overheating.
- Charges Single Cell Li-Ion Batteries Directly from USB Port.
- Preset 4.2V Charge Voltage with ±1% Accuracy.
- 25uA Supply Current in Shutdown.
- 2.9V Trickle Charge Threshold
- Available Without Trickle Charge.
- Soft-Start Limits Inrush Current.
- Available in 5-Lead SOT-23 Package.

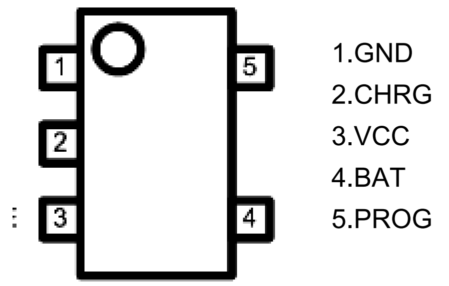
Applications

- Cellular Telephones, PDA's, MP3 Players.
- Charging Docks and Cradles
- Bluetooth Applications



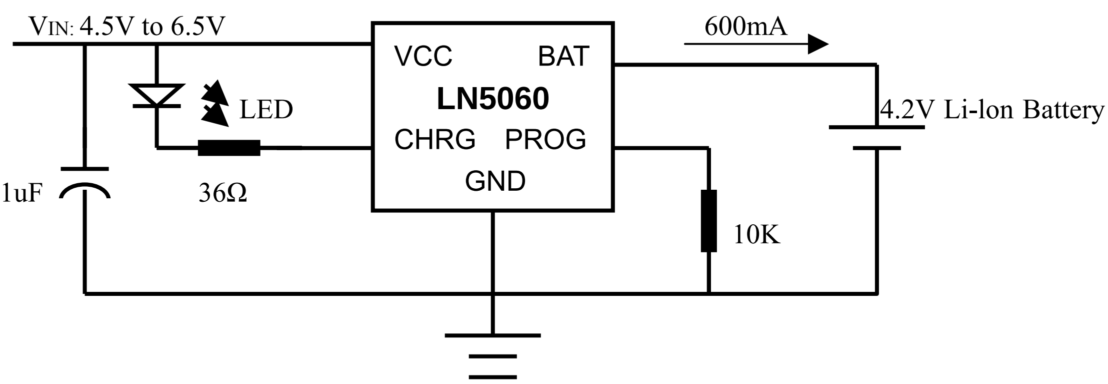
SOT-23-5 Package

Pin Configuration



SOT-23-5

Typical Application



600mA Single Cell Li-Ion Charger

Absolute Maximum Ratings[1]

Parameter	Symbol	Value	Units
Input Supply Voltage	Vcc	10	V
PROG Voltage	VPROG	VCC+0.3	V
BAT Voltage	VBAT	7	V
CHRG Voltage	VCHRG	10	V
BAT Short-Circuit Duration		Continuous	
BAT Pin Current	IBAT	800	mA
PROG Pin Current	IPROG	800	uA
Maximum Junction Temperature	TJ	125	℃
Storage Temperature	TS	-65 to +125	℃
Lead Temperature(Soldering,10 sec)		300	℃

Operating Rating[2]

Parameter	Symbol	Value	Units
Supply Input Voltage	VIN	-0.3 to +10	V
Junction Temperature	TJ	-40 to +85	℃

Electrical Characteristics

V_{IN} = 5V; TJ = 25°C; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Vcc	Input Supply Voltage		4.25		6	V
Icc	Input Supply Current	Charge Mode[2] ,RPORG=10K		190		uA
		Standby Mode(Charge Terminated)		85		uA
		Shutdown Mode(RPORG Not Connected, Vcc＜VBAT ,or Vcc＜VUV		12		uA
VFLOAT	Regulated Output (Float) Voltage	0℃≤TJ≤85℃, IBAT=40mA		4.2		V
IBAT	BAT Pin Current	RPORG=10K，Current Mode		110		mA
		RPORG=2K, Current Mode		500		mA
		Standby Mode,VBAT=4.2V		4		uA
		Shutdown Mode (RPORG Not Connected)		±1		uA
		Sleep Mode, Vcc=0V		±1		uA
ITRIKL	Trickle Charge urrent	VBAT＜VTRIKL， RPORG=10K		12		mA
VTRIKL	Trickle Charge Threshold Voltage	RPORG=10K, VBAT Rising		2.9		V
VUV	Vcc Undervoltage Lockout Threshold	From Vcc Low to High		3.4		V
VUVHYS	Vcc Undervoltage Lockout Hysteresis			170		mV

Electrical Characteristics

V_{IN} = 5V; TJ = 25°C; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
VMSD	Manual Shutdown Threshold Voltage	PROG Pin Rising		1.25		V
		PROG Pin Rising		1.2		V
VASD	Vcc-VBAT Lockout Threshold Voltage	Vcc from Low to High		100		mV
		Vcc from High to Low		30		mV
ITERM	C/10 Termination Current Threshold	RPORG=10K[4]		0.1		mA/mA
		RPORG=2K		0.1		MA/mA
VPORG	PROG Pin Voltage	RPORG=10K，Current Mode		1.03		V
ICHRG	CHRG Pin Weak Pull-Down Current	VCHRG=5V		20		uA
VCHRG	CHRG Pin Output Low Voltage	ICHRG=5mA		0.35		V
△ VRECHRG	Recharge Battery Threshold Voltage	V FLOAT-VRECHRG		100		mV
TLIM	Thermal Protection Temperature			120		℃
Tss	Soft-Start Time	IBAT=0 to 1000V/RPROG		100		us
TRECHARGE	Recharge Comparator Filter Time	VBAT High to Low		2		ms
TTERM	Termination Comparator Filter Time	IBAT Falling Below ICHG/10		1000		us
IPROG	PROG Pin Pull-Up Current			1		uA

Note 1: Exceeding the absolute maximum rating may damage the device.

Note 2: The device is not guaranteed to function outside its operating rating.

Note 3: Supply current includes PROG pin current(appeoximately 100uA) but does not include any current delivered to the battery through the BAT pin (approximately 100mA).

Note 4: ITERM is expressed as a fraction of measured full charge current with indicated PROG resistor.

Application Hints

Stability Considerations

The constant-voltage mode feedback loop is stable without an output capacitor provided a battery is connected to the charger output. With no battery present,an output capacitor is recommended to reduce ripple voltage.When using high value, low ESR ceramic capacitors, it is recommended to add a 1Ω resistor in series with the capacitor. NO series resistor is needed if tantalum capacitors are used. In constant-current mode, the PROG pin is in the feedback loop, not the battery. The constant-current mode stability is affected by the impedance at the PORG pin, With no additional capacitance on the PROG pin, the charger is stable with program resistor values as high as 20K. However, additional capacitance on this node reduces the maximum allowed program resistor. The pole frequency at the PORG pin should be kept above 100KHz.

VCC Bypass Capacitor

Many types of capacitors can be used for input bupassing, 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 1.5Ω resistor in series with a ceramic capacitor will minimize start-up voltage transients.

Power Dissipation

The conditions that cause the LN5060 to reduce charge current through thermal feedback can be approximated by considering the power dissipated in the IC. Nearly all of this power dissipation is generated by the internal MOSFET-this is calculated to be approximately:

$$PD=(VCC-VBAT)\times IBAT$$

The approximate ambient temperature at which the thermal feedback begins to protect the IC is:

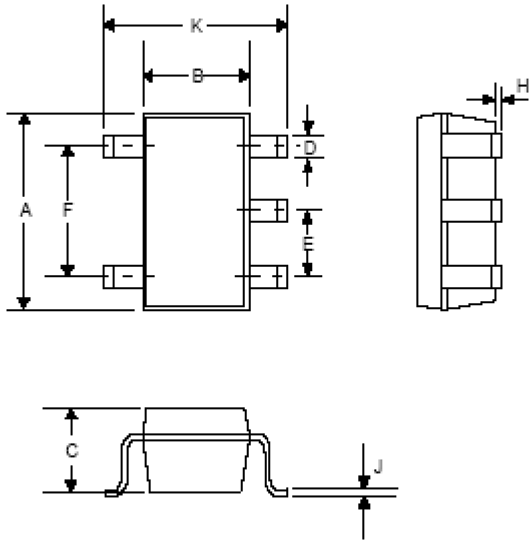
$$T_A = 120°C - P_D\theta_{JA}$$

$$T_A = 120°C - (V_{CC} - V_{BAT}) \cdot I_{BAT} \cdot \theta_{JA}$$

Thermal Considerations

Because of the small size of the thin SOT-23 package, it is very important to use a good thermal PC board layout to maximize the avaliable charge current. The termal path for the heat generated by the IC is from the die to the copper lead frame, through the package leads, (especially the ground lead) to the PC board copper. The PC board copper is the heat sink. The footprint copper pads should be as wide as possible and expand out to larger copper areas to spread and dissipate the heat to the surrounding ambient. Other heat sources on the board, not related to the charger, must also be considered when designing a PC board layout because they will affect overall temperature rise and the maximum charge current.

Outline Drawing SOT-23-5



DIMENSIONS				
DIM^N	INCHES		MM	
	MIN	MAX	MIN	MAX
A	0.110	0.120	2.80	3.05
B	0.059	0.070	1.50	1.75
C	0.036	0.051	0.90	1.30
D	0.014	0.020	0.35	0.50
E	-	0.037	-	0.95
F	-	0.075	-	1.90
H	-	0.006	-	0.15
J	0.0035	0.008	0.090	0.20
K	0.102	0.118	2.60	3.00