HM8010

Linear Li-Lon Battery Charger with Thermal protection

Features

- Programmable Charge Current Up to 800mA
- No MOSFET, Sense Resistor or Blocking Diode Required
- Constant-Current/Constant-Voltage Operation with Thermal Regulation 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
- Automatic Recharge
- 2.9V Trickle Charge Threshold
- Available in DFN3*3-10L Package

Applications

- Charger for Li-Ion Coin Cell Batteries
- Portable MP3 Players, Wireless Headsets
- Bluetooth Applications
- Multifunction Wristwatches

Description

The HM8010 is a complete constant-current/constant voltage linear charger for single cell lithium-ion batteries. Its package and low external component count make the HM8010 ideally suited for portable applications. Furthermore, the HM8010 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. The charge voltage is fixed at 4.2V, and the charge current can be programmed externally with a single resistor. The HM8010 automatically terminates the charge cycle when the charge current drops to $1/10^{th}$ the programmed value after the final float voltage is reached.

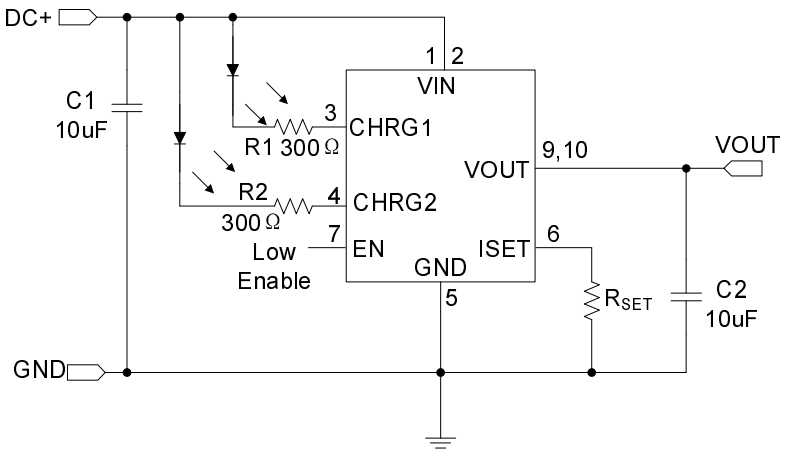
The HM8010 converters are available in the industry standard DFN3*3-10L power packages (or upon request).

Order Information

HM8010 - ① ② :

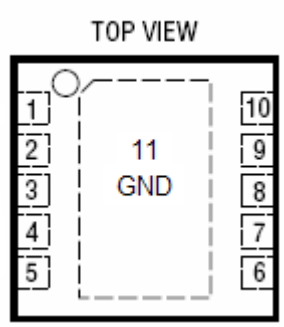
SYMBOL	DESCRIPTION
①	Denotes Output voltage: N: 4.2V
②	Denotes Package Types: J: DFN3*3-10L

Typical Application



* I_{OUT} = (V_{ISET}/R_{ISET})*900

Pin Assignment



DFN3*3-10L

PIN NUMBER DFN3*3-10L	PIN NAME	DESCRIPTION
1	VIN	Positive Input Supply Voltage.
2	VIN	Positive Input Supply Voltage.
3	CHRG1	Open-Drain Charge Status Output 1
4	CHRG2	Open-Drain Charge Status Output 2
5, 11	GND	Ground
6	ISET	Charge Current Set Pin
7	EN	ON/OFF Control (Low Enable)
8	N/C	Not Connect
9	VOUT	Charge Current Output
10	VOUT	Charge Current Output

Absolute Maximum Ratings (Note 1)

- Input Supply Voltage (VIN) ..... –0.3V to 7V
- CHRG1, CHRG2..... – 0.3V to VIN + 0.3V
- VOUT ..... –0.3V to 7V
- ISET..... –0.3V to 7V
- EN..... –0.3V to 7V
- VOUT Short-Circuit Duration ..... Continuous
- VOUT Pin Current 800mA
- Maximum Junction Temperature ..... 125℃
- Operating Ambient Temperature Range (Note 2)..... –40℃ to 85℃
- Storage Temperature Range ……..... –65 ℃to 125℃
- Lead Temperature (Soldering, 10 sec)..... 300℃

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: The HM8010 is guaranteed to meet performance specifications from 0°C to 70°C. Specifications over the –40°C to 85°C operating temperature range are assured by design, characterization and correlation with statistical process controls.

Electrical Characteristics

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

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	Input Supply Voltage		4.5	5.0	5.5	V
I_{IN}	Input Supply Current	Standby Mode (Charge Terminated) I		48		μA
		Shutdown Mode (R_{ISET} Not Connected, V_{IN} < V_{BAT})		80		μA
V_{FLOAT}	Regulated Output (Float) Voltage	0℃≤T_A≤85℃, I_{BAT} = 50mA	4.15	4.2	4.24	V
I_{BAT}	BAT Pin Current	R_{ISET} = 10k, Current Mode		90		mA
		R_{ISET} = 2k, Current Mode		450		mA
		Standby Mode, V_{BAT} = 4.2V		7		μA
		Shutdown Mode (R_{PROG} Not Connected)		13		μA
		Sleep Mode, V_{IN} = 0V		0.1	1	μA
I_{TRIKL}	Trickle Charge Current	V_{BAT} < V_{TRIKL}, R_{PROG} = 2k		45		mA
V_{TRIKL}	Trickle Charge Threshold Voltage	R_{ISET} = 10k, V_{BAT} Rising		2.9		V
I_{TERM}	C/10 Termination Current Threshold	R_{ISET} = 2k		45		mA
V_{PROG}	PROG Pin Voltage	R_{ISET} = 2k, Current Mode		1		V
ΔV_{RECHRG}	Recharge Battery Threshold Voltage	V_{FLOAT} - V_{RECHRG}		250		mV
R_{ON}		Power FET “ON” Resistance (Between V_{CC} and BAT)		660		mΩ

Pin Description

VIN (Pin 1/ Pin 2): Positive Input Supply Voltage. It Provides power to the charger VIN can range from 4.5V to 5.5V and should be bypassed with at least a 10uF capacitor. When VIN drops to within 20mV of the OUT pin voltage, the HM8010 enters shutdown mode, dropping I_{OUT} to less than 1uA.

CHRG1, CHRG2 (Pin 3, 4): Open-Drain Charge Status Output. The open-drain CHRG1 and CHRG2 outputs indicate various charger operations as shown in the following table. These status pins can be used to drive LEDs or communicate to the host processor. Note that OFF indicates the open-drain transistor is turned off.

Table 1. Status Pins Summary

CHARGE STATE	CHRG1	CHRG2
Precharge in progress	ON	OFF
Fast charge in progress	ON	OFF
Charge done	OFF	ON
Sleep mode	OFF	OFF

GND (Pin 5, 11): Ground.

ISET (Pin 6): Charge Current Set Pin. The charge current is programmed by connecting a 1% resistor, R_{ISET}, 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: $I_{OUT} = (V_{ISET}/R_{ISET})*900$, The ISET pin can also be used to shut down the charger. Disconnecting the program resistor from ground allows a weak current to pull the ISET pin high.

EN (Pin 7): ON/OFF Control (Low Enable). The EN digital input is used to disable or enable the charge process. A low-level signal on this pin enables the charge and a high-level signal disables the charge and places the device in a low-power mode.

N/C (Pin 8): No Connect.

VOUT (Pin 9/ Pin 10): Charge Current Output. It should be bypassed with at least a 10uF 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.

Operation

The HM8010 is a single-cell lithium-ion battery charger using a constant-current/constant-voltage algorithm. It can deliver up to 800mA of charge current (using a good thermal PC board layout) with a final float voltage accuracy of ±1%. The HM8010 includes an internal P-channel power MOSFET and thermal regulation circuitry. No blocking diode or external current sense resistor is required and the HM8010 is capable of operating from a USB power source.

Normal Charge

Charging begins when EN is low, the voltage at the VIN pin rises above the 4.5V and a program resistor is connected from the ISET pin to ground. If the VOUT pin voltage is below 2.9V, the charger enters trickle charge mode. In this mode, the HM8010 supplies approximately 1/10 the programmed charge current to bring the battery voltage up to a safe level for full current charging.

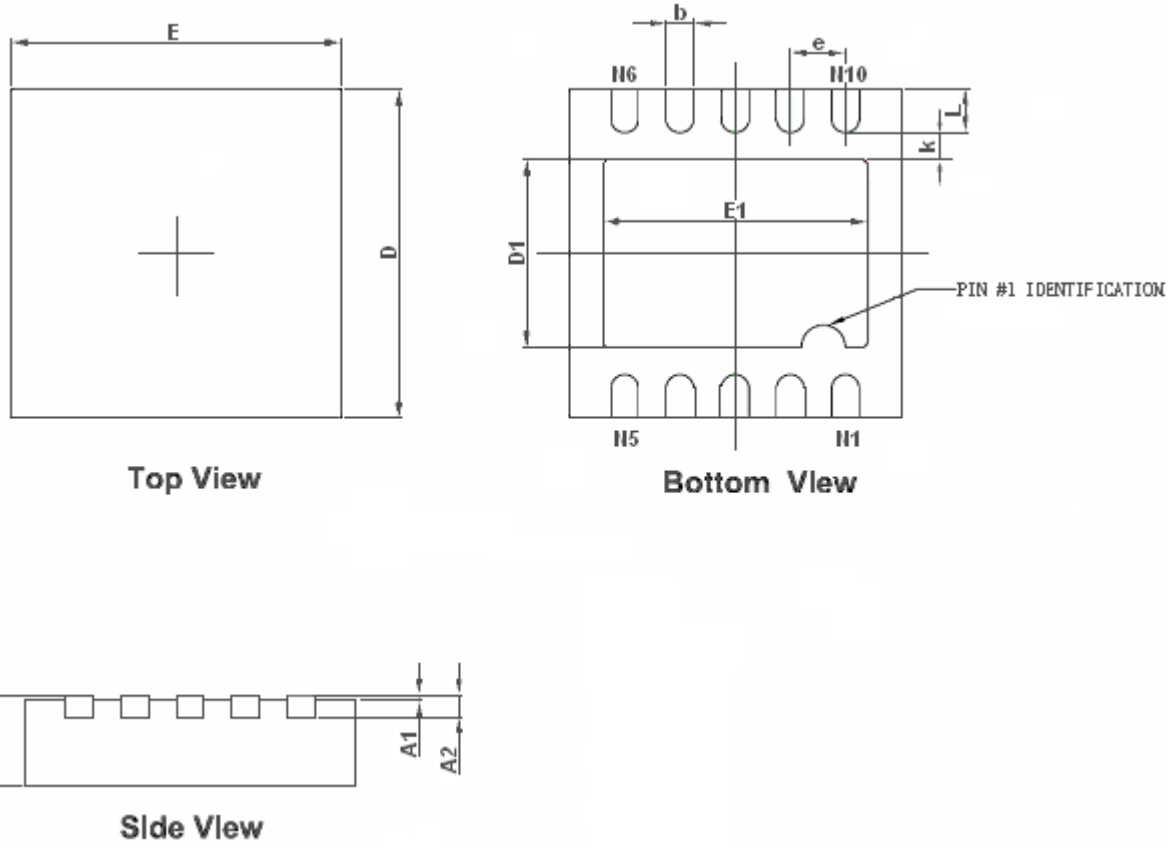
When the BAT pin voltage rises above 2.9V, the charger enters constant-current mode, where the programmed charge current is supplied to the battery. When the VOUT pin approaches the final float voltage (4.2V), the HM8010 enters constant-voltage mode, and the charge current begins to decrease.

VIN 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

DFN3*3-10L Package Outline Dimension



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.700/0.800	0.800/0.900	0.028/0.031	0.031/0.035
A1	0.000	0.050	0.000	0.002
A2	0.153	0.253	0.006	0.010
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
D1	1.600	1.800	0.063	0.071
E1	2.300	2.500	0.091	0.098
k	0.200MIN		0.008MIN	
b	0.200	0.300	0.008	0.012
e	0.500TYP		0.020TYP	
L	0.300	0.500	0.012	0.020