PFM Boost(Step-Up) Multi-Cell Ni-Mh Battery Charger IC

Description

FH53387 is a PFM mode boost(step-up) battery charge management chip with operating voltage range between 2.7V to 6.5V. It is specially designed for multi-cell Ni-Mh battery charge management with fewer external components. FH53387 adopts constant current and maintenance mode to charge battery.

On power up, FH53387 enters constant current charging mode, the external N-channel MOSFET is turned on, inductor current rises. When inductor current reaches upper threshold, the N-channel MOSFET is turned off, then inductor is discharged, the energy stored in inductor is transferred to battery.

When the inductor current is discharged to its lower threshold, the N-channel MOSFET is turned on again. When FB pin voltage rises to 1.124V(Typ.), FH53387 enters maintenance mode, in which the input current is reduced, in the meantime a timer is started. The charge process will not be terminated until the time out occurs or FB pin voltage reaches 1.205V. In termination mode, the N-channel MOSFET is turned off. When FB pin voltage falls below recharge threshold, the FH53387§ enters charge mode again. FH53387§ switching frequency can be up to 1.0MHz, which makes a small-profile inductor usable.

If battery voltage is lower than input voltage by a diode drop, FH53387 will increase the off time to 5us to reduce the charge current as a protection for battery with the joint action of external N-channel and P-channel MOSFET. The other features include chip enable input, status indication, etc.

FH53387 is available in 10-pin SSOP package.

Features

- Input Voltage Range: 2.7V to 6.5V
- Operating Current: 300uA@V_{IN}=5.0V
- Inductor Current Detection
- Can be Powered by Solar-Panel
- Switching Frequency up to 1.0MHz
- Maintenance Charge Mode to Guarantee Fully-charged Battery
- Charging terminated by Timer
- Automatic Recharge
- Output Power up to 35.0W
- Protection for Low Battery Voltage and Short battery
- Automatic Adaptability to Input Supply with Limited Driving Capability
- Chip Enable Input
- Battery Overvoltage Protection
- Status Indication
- Operating Temperature: -40℃ to 85℃
- Available in SSOP-10L Package
- Lead-free, RoHs-Compliant and Halogen free

Applications

- Toys
- Electric Tools
- Car Models, Aero-modeling
- Standalone NIMH Battery Charger

ABSOLUTE MAXIMUM RATINGS

VIN, CSN and CE Voltage ……..….... −0.3V to 7.00V

BAT Voltage …………….......….... −0.3V to 18.0V

CSN and VIN Voltage ………………. −0.3V to 0.30V

STAT, LDRV and HDRV Voltage …........ −0.30V to VIN

FB, CT Voltage .... −0.30V to VIN

Maximum Junction Temperature .... 150℃

Operating Temperature Range .... −40℃ to 85℃

Storage Temperature …………............... −65℃ to 150℃

Lead Temperature(Soldering, 10s) .... 260℃

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device.

These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied.

Exposure to absolute maximum rating conditions for extended periods may affect device reliability.
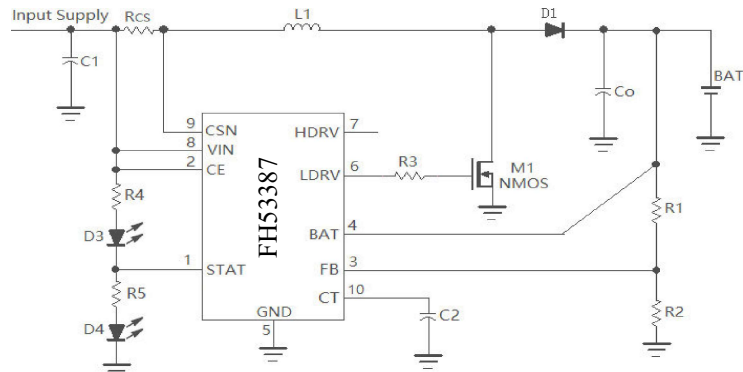
Typical Application Circuit

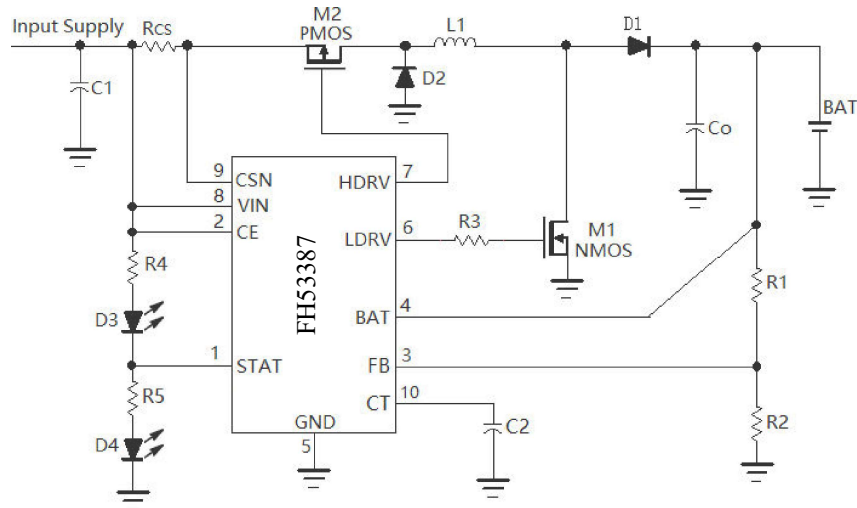**Figure 1. Typical Application Circuit**

(No protection for low or short battery)

Figure 2. Typical Application Circuit
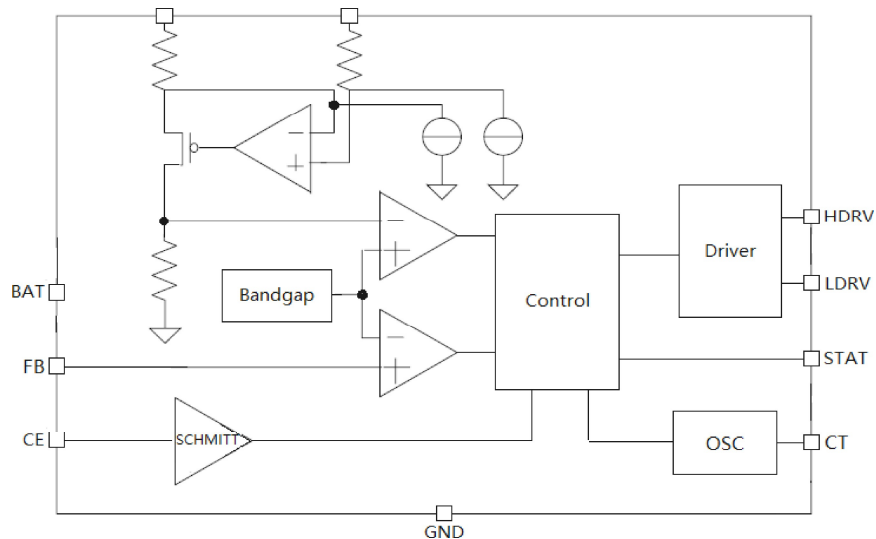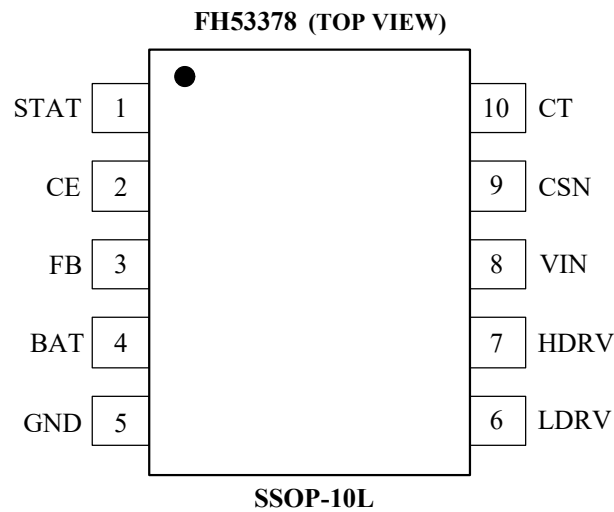
(Protection for low or short battery)

Block Diagram

Figure 3. Block Diagram

Pin Assignment

FH53378 (TOP VIEW)

```
       ┌─────────────┐
STAT │1 ●          10│ CT
  CE │2            9 │ CSN
  FB │3            8 │ VIN
 BAT │4            7 │ HDRV
 GND │5            6 │ LDRV
       └─────────────┘
```

SSOP-10L

Pin Description

No.	Symbol	Description
1	STAT	**Status Indication Output.** CMOS output. STAT pin's being high means charger is in charging state; and charger is in termination state when STAT pin is low.
2	CE	**Chip Enable Input.** A high input will put the device in the normal operating mode. Pulling the CE pin to low level will put the FH53387 into disable mode. The CE pin can be driven by TTL or CMOS logic level.
3	FB	**Battery Voltage Feedback Input.** Battery voltage is fedback to the FH53387 through this pin. The FH53387 determines the charge mode based on the FB pin voltage. As shown in Figure 1, the battery terminal voltage at BAT pin : $$V_{BAT} = V_{FB} \times (1 + R1 / R2)$$
4	BAT	**Battery Positive Terminal.** BAT pin should be tied to battery's positive terminal to monitor battery voltage.
5	GND	**GND.** Ground, namely the negative terminal of input supply and battery.
6	LDRV	**Gate Drive for external N-Channel MOSFET.** Connect LDRV pin to the gate of external N-Channel MOSFET.
7	HDRV	**Gate Drive for external P-Channel MOSFET.** Connect HDRV to the gate of external P-Channel MOSFET. If there is no need to consider the cases such as battery voltage being lower than input supply or short battery, then the P-Channel MOSFET is not needed, and leave HDRV pin floating.
8	VIN	**Positive Terminal of Input Supply.** FH53387's internal circuit is powered by this pin, VIN is also the positive terminal of inductor current sensing.
9	CSN	**Negative Terminal of Inductor Current Sensing.** A current sense resistor R_{CS} between VIN pin and CSN pin is used to sense inductor current, also the input current. In constant current mode, (VIN−CSN) is regulated between 85mV and 125mV.
10	CT	**Timing Capacitor Connection Input.** The timing capacitor should be connected between CT pin and GND. The timing function is started once FH53387 enters maintenance mode, and the timing time is determined by the following equation: $$t_{timing} = 12.18 \times 10^9 \times C2$$ Where C2 is the capacitance of capacitor C2 in Fig.1 and Fig.2.

PFM Mode 升压型多节镍氢电池充电控制集成电路

器件概述

FH53387 是一款工作于2.7V 到 6.5V 的PFM升压型多节镍氢电池充电控制集成电路，可以对4节到12节镍氢电池进行充电管理。FH53387采用恒流模式和维持充电模式对电池进行充电管理，内部集成有基准电压源，电感电流检测单元，电池电压检测电路和外驱场效应晶体管驱动电路等，具有外部元件少，电路简单等优点。

当接入输入电源后， FH53387 进入恒流充电状态，控制片外 N 沟道 MOSFET 导通，电感电流上升，当上升到外部电流检测电阻设置的上限时，片外 N 沟道场效应晶体管截止，电感电流下降，电感中的能量转移到电池中。当电感电流下降到外部电流检测电阻设置的下限时，片外 N 沟道场效应晶体管再次导通，如此循环。当FB管脚电压达到1.125V(典型值)时，FH53387 进入维持充电模式，此时输入电流减小为恒流状态的 66%，同时启动内部定时器。当内部定时结束或者 FB 管脚电压达到 1.205V时，充电过程结束，片外N沟道场效应管保持截止状态。当 FB管脚电压下降到再充电阈值 (1.105V) 时，FH53387 再次进入充电状态。FH53387 最高工作频率可达1.0MHz，工作温度范围从 -40℃ 到 +85℃。

当电池电压低于输入电压或电池短路时，FH53387在片外 N 沟道场效应管和 P 沟道场效应管的共同作用下，用较小电流继续对电池充电，对电池起到保护作用。

其他功能包括芯片使能输入，状态指示输出端等。

FH53387 采用 10 管脚的 SSOP10封装。

极限参数

VIN，CSN 和CE 管脚电压 ....－0.3V to 6.50V

BAT 管脚电压 ……………....…－0.3V to 18.0V

CSN 与VIN 管脚电压……………..－0.3V to 0.3V

STAT，LDRV 和 HDRV 管脚电压...－0.3V to VIN

FB，和CT 管脚电压 ....－0.3V to VIN

注:

超出以上所列的极限参数可能造成器件的永久损坏。

以上给出的仅仅是极限范围，在这样的极限条件下工作，器件的技术指标将得不到保证， 长期在这种条件下还会影响器件的可靠性。

电气特性

- 输入电压范围：2.7V 到 6.5V
- 工作电流：300微安@VIN=5V
- 电感电流检测
- 适合太阳能供电应用
- 高达1MHz开关频率
- 维持充电模式保证电池充满
- 定时结束充电
- 自动再充电功能
- 高达35W输出功率
- 当电池电压低于输入电压或者电池短路时，以较小电流充电。
- 输入电源的自适应功能
- 芯片使能输入端
- 电池端过压保护
- 状态指示输出
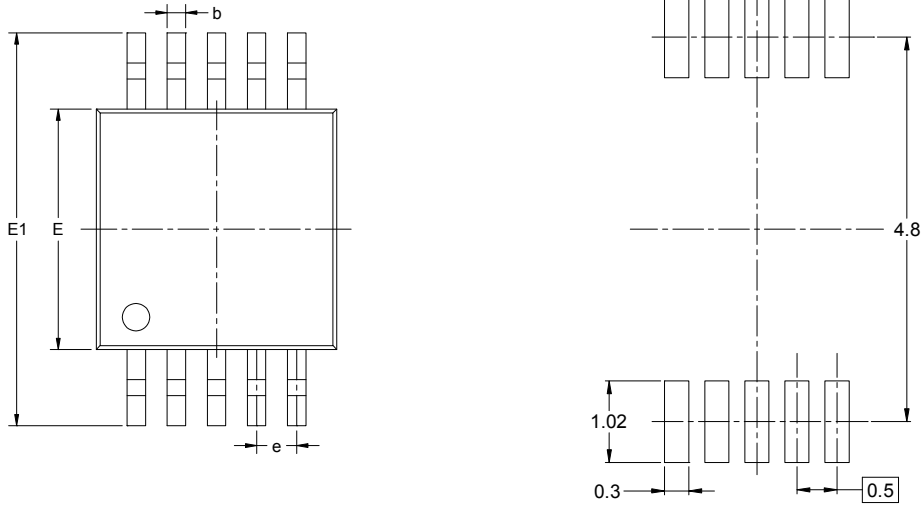- 工作温度范围: -40℃ to85℃
- 10管脚SSOP10封装
- 产品无铅，满足rohs指令要求，不含卤素
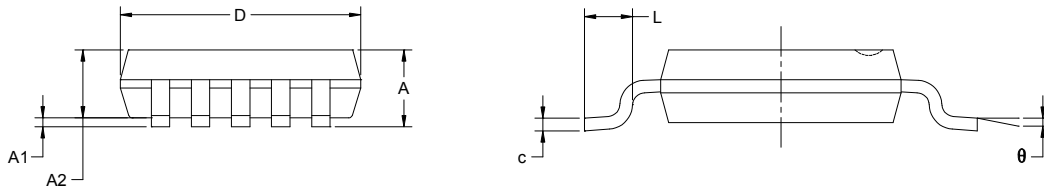
应用领域

- 玩具
- 电动工具
- 独立充电器
- 独立镍氢电池充电器

最大结温 .... 150℃

工作温度范围 …...........................… -40℃ to 85℃

存储温度 …………..…………....... －65℃ to 150℃

焊接温度(10秒) .... 260℃

FH53387

Package Information

Type: SSOP-10L

RECOMMENDED LAND PATTERN(Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.300	0.450	0.012	0.018
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.000 BSC		0.039 BSC	
L	0.400	1.270	0.016	0.050
θ	0°	8°	1°	8°

Ordering Information

Part Number	Voltage Range	Features	Operating Temperature	Package Type	Top Mark	SPQ
FH53387S10	2.7V ~ 6.5V	● PFM Boost(Step-Up) ● Switch frequency: 1.0MHz ● Output power: 35.0W ● Powered by Solar-Panel	-40℃ to 85℃	SSOP-10L	FH53387 X̲ X Y̲ Z	4000PCS/Reel

Note:

➢ **FH53387** devices are Pb-free and RoHs compliant.

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