

## General Description

MP5112/MP5113 is a power bank solution device which is highly integrated with switch charger, LED display cell and synchronous boost output.

The MP5112/MP5113 has two operating modes, charge mode and boost mode, to manage the system and battery power based on the state of the input.

When input power is present, the MP5112/MP5113 operates in charge mode. It automatically detects the battery voltage and charges the battery in the three phases: trickle current mode, constant current mode and constant voltage mode.

Boost will be enabled by pressing the KEY or insertion a load at standby mode when the battery voltage is higher than 3.2V.

## Application

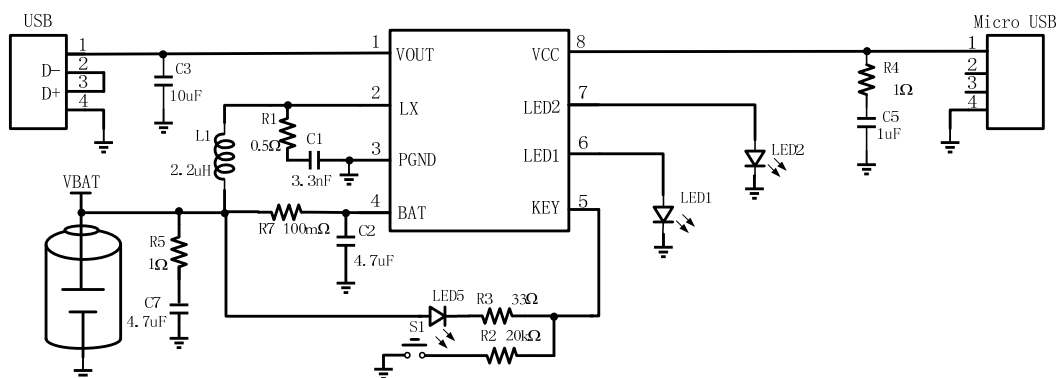
- Sub-Battery Applications
- Power-Bank Applications for Smart-Phone Tablet and Other Portable Devices

## Features

- ◆ Low quiescent current: 75uA
- ◆ Switch charge with high efficiency up to 90%@1A
- ◆ Charge current up to 1A

- ◆ Frequency for charger: 1MHz
- ◆ Charge current could be regulated by the temperature, this realize the maximum charge rate, without overheat risk
- ◆ C/10 charge terminated and recharge automatically
- ◆ Terminated charge voltage : 4.2V(MP5112)/4.35V(MP5113), the accuracy is  $\pm 1\%$
- ◆ Regulate the charge current refer to the adapter's ability automatically
- ◆ Boost output 5.05V with High efficiency up to 93%@1A
- ◆ Frequency for boost: 1MHz
- ◆ Output current up to 1.2A
- ◆ Detect the load automatically and auto shunt down at no load condition
- ◆ Original temperature management technology for boost
- ◆ Over-current protection ( OCP ), over voltage protection ( OVP ), over temperature protection ( OTP ) and short circuit protection ( SCP ) are integrated for boost
- ◆ 2 LEDs display to indicate the battery fuel gauge
- ◆ Single key for battery fuel gauge display; double key for torch; long key to shut down the boost
- ◆ Package: ESOP8/SOP8

## Typical Application Circuit (5.05V/1.2A)

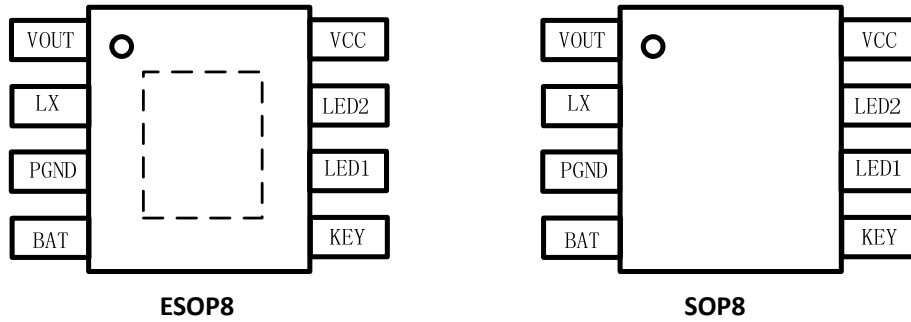


Typical application circuit for MP5112/MP5113

**PCB LAYOUT NOTES:**

1. **R1 and C1 must be close to LX pin, route LX through R1 and C1 firstly, and then to inductor.**
2. **The material of the caps must be X5R.**
3. C2, C7, R5 and R7 must be close to BAT pin, R4 and C5 must be close to VCC pin, route BAT and VCC from the chip through the capacitors firstly, then to the ports.
4. There is high frequency noise in inductor and LX routing, so reduce the routing area for inductor and LX, and far from sensitive devices.
5. The through-hole impedance should be considered for larger current routing such as VCC, LX, PGND, BAT and VOUT. The more through-hole, the better.

## Pin Configuration

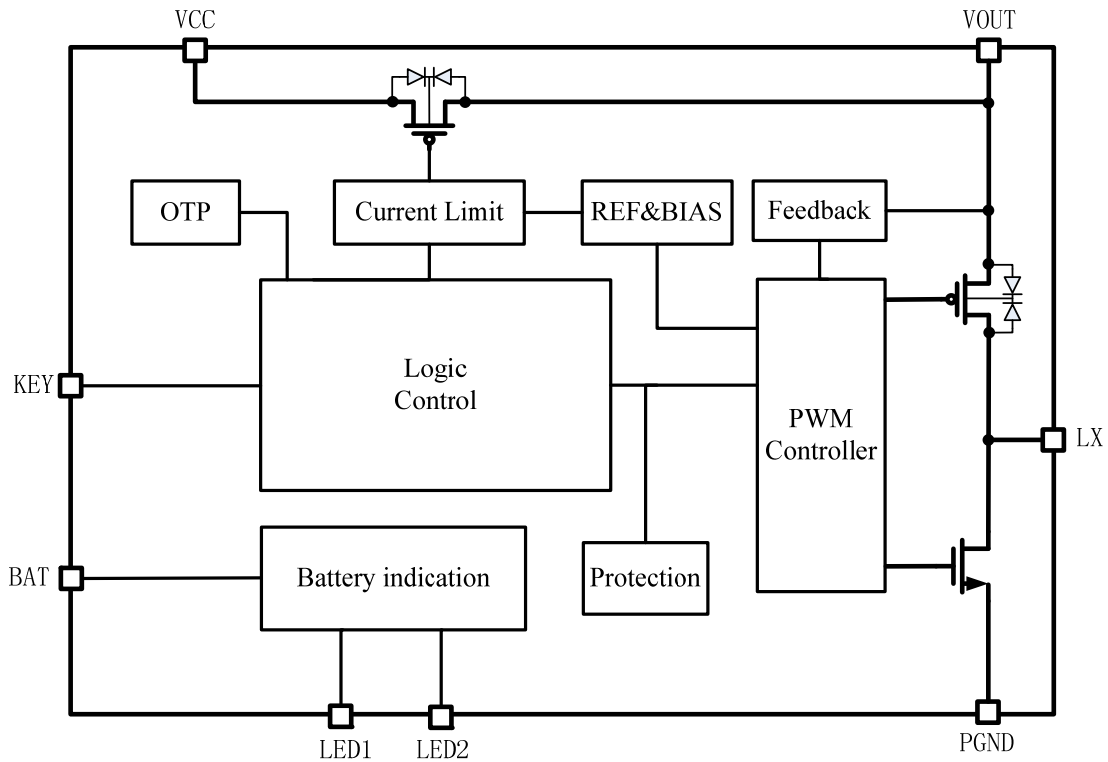


Pin Name	Port	I/O	Function
VOUT	1	O	BOOST output
LX	2	O	Switching output
PGND	3	-	Power GND
BAT	4	I	Battery anode
KEY	5	I	Button control input and torch output
LED1	6	O	Battery fuel gauge display 1
LED2	7	O	Battery fuel gauge display 2
VCC	8	I	Adapter input
EPAD (ESOP8)	-	-	Exposed PAD, Power GND

## Ordering Information

Part Number	Package	Top Mark	Package Qty
MP5112ES	ESOP8	MP5112ES	4000
MP5113ES	ESOP8	MP5113ES	4000
MP5112S	SOP8	MP5112S	4000
MP5113S	SOP8	MP5113S	4000

## Function Diagram



## Electrical Characteristics

### Absolute ratings <sup>(1)</sup>

Parameter	Min	Max	Unit
All pin to GND	-0.3	+6	V
Storage temperature range	-65	150	°C
Operation temperature range	-40	85	°C
Junction temperature range	-40	150	°C
HBM (Human body Model)	2K	-	V
MM (Machine Model)	200	-	V

### Recommend operation conditions <sup>(2)</sup>

Input voltage -----	2.9V to 5.5V
Junction temperature range -----	-40°C to 125°C
Operation temperature range -----	-20°C to 85°C

#### Note:

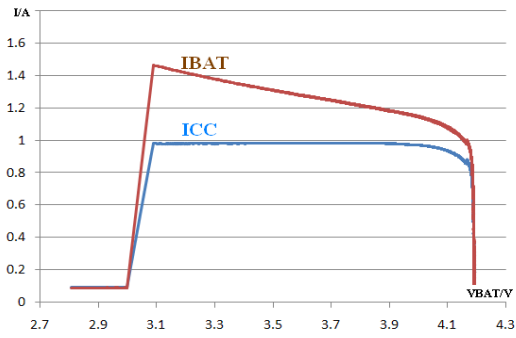
- (1) Exceeding these ratings may damage the device.
- (2) The device is not guaranteed to function outside of its operating conditions.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
VCC	Charger input voltage		4.4	5	6	V
VCC <sub>OVP</sub>	VCC OVP threshold		5.8	6	6.2	V
V <sub>UV</sub>	VCC UVLO threshold		4.3	4.4	4.5	V
IIN <sub>LIMIT</sub>	VCC current limit threshold		1.0	1.2	1.4	A
IIN <sub>OIP</sub>	VCC OCP threshold		-	3	-	A
V <sub>SHORT</sub>	VOUT SCP threshold		3.9	4	4.1	V
R <sub>IN</sub>	VCC current limit switch ON resistance	VCC=5V	-	150	-	mΩ
R <sub>PMOS</sub>	High side PMOS ON resistance		-	120	-	mΩ
R <sub>NMOS</sub>	Low side NMOS ON resistance		-	100	-	mΩ
IP <sub>PMOS</sub>	High side peak current limit		-	2.5	-	A
IP <sub>NMOS</sub>	Low side peak current limit		-	2.2	-	A
I <sub>LEAKAGE</sub>	VOUT to VCC leakage		-	0	5	uA
T <sub>OV</sub>	OTP threshold		-	150	-	°C
T <sub>HYS</sub>	OTP hysteresis		-	20	-	°C
I <sub>STDB</sub>	Quiescent current		-	75	-	μA
I <sub>KEY</sub>	Pull up current at KEY		4	6	8	uA
T <sub>KEY_S</sub>	Single KEY detect time		-	50	-	mS
T <sub>KEY_L</sub>	Long KEY detect time		-	1.2	-	S
I <sub>LED</sub>	LED1~LED2 output current	VLED1~2=2.5V	-	2	-	mA
I <sub>WLED</sub>	WLED sink current	VWLED=0.5V	-	100	-	mA
<b>Charger Mode (VCC=5V, Ta=25°C, unless otherwise noted )</b>						
F <sub>CHARGER</sub>	Charger switch frequency		0.8	1	1.2	MHz
V <sub>FLOAT</sub>	Terminated charge voltage	0°C≤TA≤85°C, (MP5112)	4.158	4.2	4.242	V
		0°C≤TA≤85°C, (MP5113)	4.307	4.35	4.393	V
ΔV <sub>RECHRG</sub>	Recharge hysteresis	V <sub>FLOAT</sub> -V <sub>RECHRG</sub>	150	200	250	mV
I <sub>VCC</sub>	CC mode charge current	V <sub>BAT</sub> =3.7V	0.9	1	1.1	A
I <sub>TRIKL</sub>	TC mode charge current	V <sub>BAT</sub> <V <sub>TRIKL</sub>	0.07	0.1	0.13	A
η	Charger efficiency	V <sub>BAT</sub> =3.7V	-	90%	-	
V <sub>TRIKL</sub>	TC mode to CC mode threshold		2.9	3	3.1	V
V <sub>TRHYS</sub>	CC mode to TC mode Hysteresis		-	200	-	mV
I <sub>TERM</sub>	Terminated current		-	100	-	mA
T <sub>min</sub>	Minimum ON time		-	0	-	ns
D <sub>MAX</sub>	Max. duty ratio		-	100	-	%
V <sub>BAT<sub>OVP</sub></sub>	Battery OVP threshold		4.4	4.5	4.6	V
<b>Boost mode (VCC=5V, Ta=25°C, unless otherwise noted )</b>						

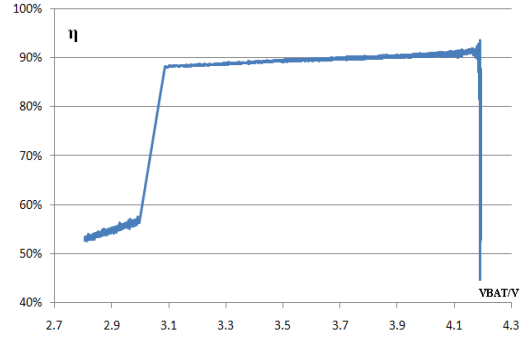
V <sub>BAT</sub>	Battery operation voltage		2.9		4.35	V
V <sub>OUT</sub>	Output voltage	V <sub>BAT</sub> =3.7V	4.95	5.05	5.15	V
V <sub>UV_BAT</sub>	Battery UVLO threshold voltage		2.85	2.9	2.95	V
V <sub>HYS_BAT</sub>	Battery UVLO threshold hysteresis		0.2	0.3	0.4	V
F <sub>SW</sub>	Boost switch frequency	T <sub>a</sub> =60°C	-	1	-	MHz
I <sub>OUT</sub>	Output current	V <sub>BAT</sub> =2.9~4.2V	-	1.2	-	A
η	Efficiency	V <sub>BAT</sub> =4.2V V <sub>OUT</sub> =5.05V & I <sub>OUT</sub> =1A	93	-	-	%
D <sub>MAX</sub>	Max. duty ratio		-	85	-	%
T <sub>min</sub>	Min. ON time			100		ns
I <sub>END</sub>	Discharge terminated current		-	40	-	mA
V <sub>RIPPLE</sub>	Output ripple voltage	V <sub>OUT</sub> =5.05V & I <sub>OUT</sub> =1A	-	100	-	mV
T <sub>SHUT</sub>	V <sub>OUT</sub> and LED auto shut down detection time for I <sub>END</sub>		-	16	-	S
V <sub>SHORT</sub>	Short circuit protection threshold voltage		-	4.3	-	V
V <sub>OVP</sub>	OVP threshold voltage		-	5.5	-	V
T <sub>SS</sub>	Soft start time		-	1.2	-	ms

**TYPICAL PERFORMANCE CHARACTERISTICS**

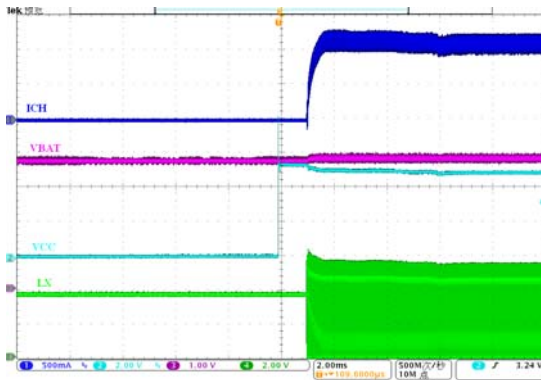
VCC=5V, VBAT=3.7V, VOUT=5.05V, Co=10uF, L1=2.2uH unless otherwise noted.



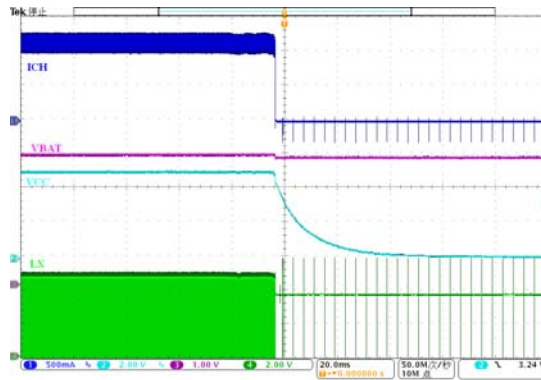
Charge current curve



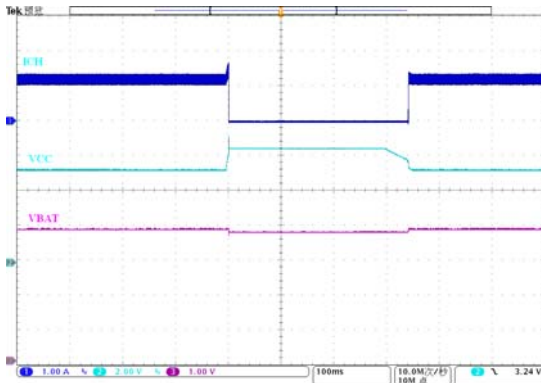
Charge efficiency curve



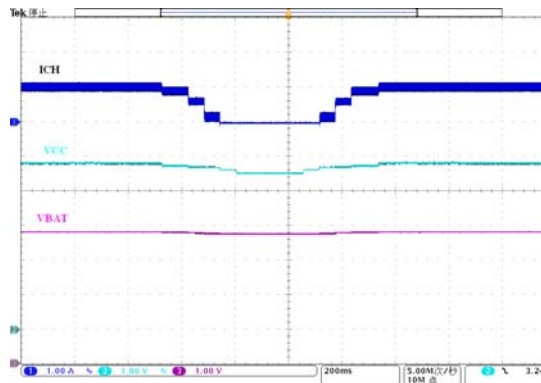
VCC insert



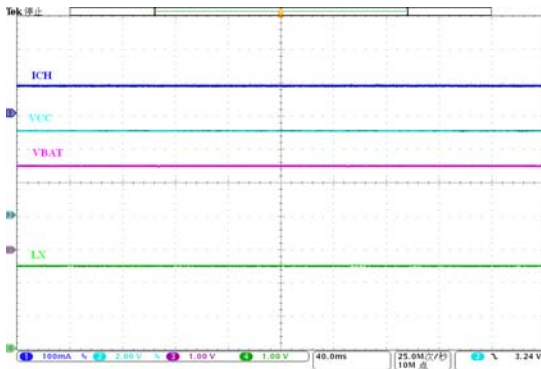
VCC extraction



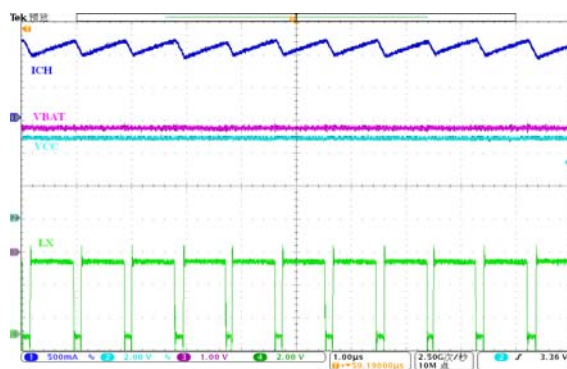
VCC OVP



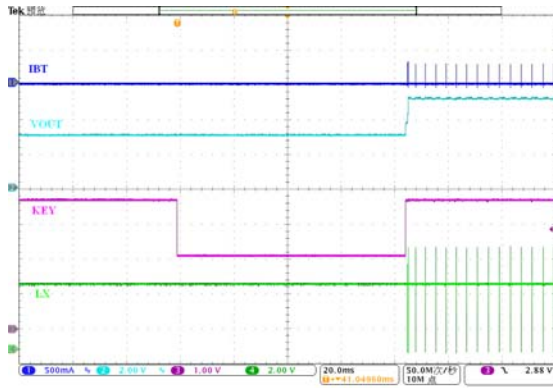
VCC regulate charge current



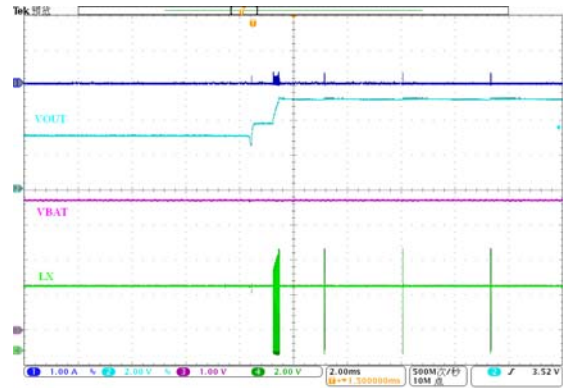
TC mode charge



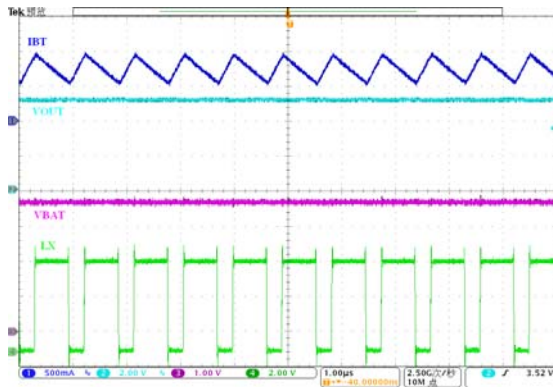
CC mode charge



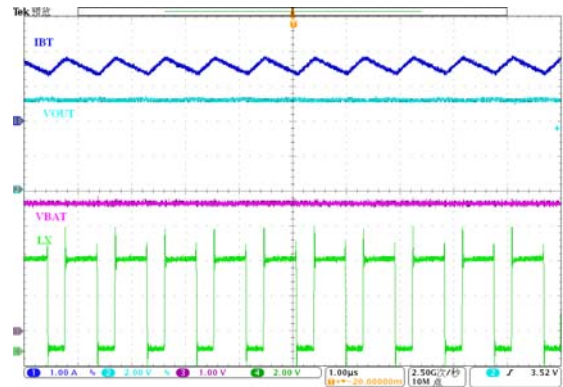
Single pressing the KEY



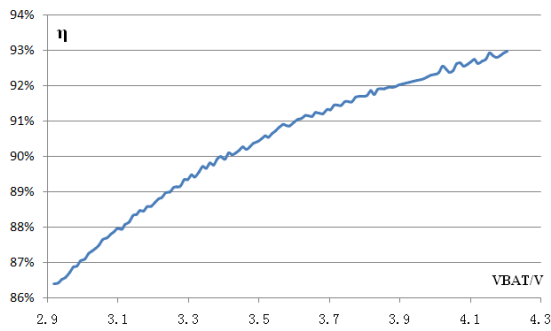
Auto detect the load



Boost Switch Waveform with 0.5A load



Boost Switch Waveform with 1A load



Discharge Efficiency Curve with 1A load



## FUNCTIONAL DESCRIPTION:

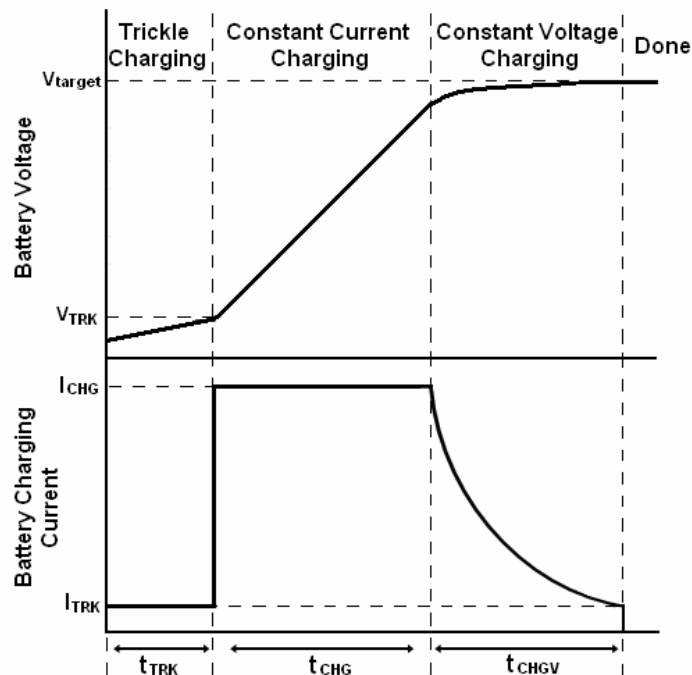
The MP5112/MP5113 provides fully protection for the system, which includes system over temperature protection (OTP) and battery over voltage protection (BOVP). Once these protections are triggered, the system will shut down automatically. In the charger mode, if a protection is triggered, the charger will shut down, once the abnormal is removed, the charger will recover immediately. In the boost mode, if a protection is triggered, the boost will shut down the output, once the abnormal is removed, the boost will not recover but return to standby mode, until pressing the KEY can restart the boost.

### VCC Current Limit Switch

The VCC current limit switch limits the Max.VCC current to 1.2A and defends the reverse current from VOUT to VCC. It also controls the current from VCC to VOUT and from VCC to VBAT.

When the VCC voltage is larger than 4.4V and less than 6V, the current limit switch Start to work. When the current in VCC is up to 1A or the VCC voltage close to 4.6V, then the charge current is reduced to make sure the current to VOUT. When the current in VCC is larger than 1.2A, the VOUT voltage will decrease, once the VOUT voltage is less than 4V, the current limit switch and charger will shut down and enter to hiccup mode. When the hiccup mode lasts for 2 seconds, the chip will shut down and locked, only single pressing the key or VCC insertion can unlock the chip.

### Charge Mode



MP5112/MP5113 integrated a charge cell internally, to charge the battery with trickle current mode, constant current mode and constant voltage mode by the build-in power MOSFE respect to the battery voltage. The constant current is set to 1A internally.

MP5112/MP5113 can decrease the charge current automatically, when the junction temperature exceed 100°C, This characteristic can help the user to make the best use of charging capability, and no worry about overheat damage.

The chip will start to charge the battery, when VCC is over 4.4V and higher than the battery voltage. When the battery voltage is under 3V, MP5112/MP5113 works in trickle current mode with 0.1A charge current; when the battery voltage is over 3V, MP5112/MP5113 works in constant current mode with 1A charge current. When the battery voltage is close to 4.2V, the charge current decrease gradually, and get into constant-voltage mode, the charge cycle will be ended until the charge current decrease to the terminated charge current. MP5112/MP5113 will restart a new charge cycle automatically, when the battery voltage decrease to the threshold of recharge voltage.

MP5112/MP5113 can regulate the charge current refer to the adapter's current ability, and no worry about the adapter over load damage.

### **Boost Mode**

MP5112/MP5113 provides a synchronous boost output, which can output 1.2A at 5.05V. The efficiency is up to 93%. The switching frequency is 1MHz, which can reduce the peripheral components size effectively. In the standby mode, the quiescent current is 75uA, when a load is inserted or pressing the KEY at the standby mode, the boost start to work.

The boost output voltage is set to 5.05V internally. The output current is limited by peak current to 1.2A in heavy load mode. In the light load mode, MP5112/MP5113 will enter PFM mode to guarantee the regulation capability of output voltage and efficiency. When the output current is lower than the terminated current (typical 40mA), and lasts for 16S, MP5112/MP5113 will shut down the LEDs and VOUT to the standby mode. Long pressing the KEY for 1.2S can also shut down the boost.

To guarantee safe operation, MP5112/MP5113 has over-current protection (OCP), other safety features include over-voltage protection (OVP), short circuit protection (SCP), over-temperature protection (OTP) and battery under-voltage protect (UVLO). When the OTP or UVLO happened, MP5112/MP5113 will shut down the boost and enter to standby mode, until pressing the KEY can recover the VOUT. When the OCP or SCP happened, MP5112/MP5113 will shut down and enter to hiccup mode. When the hiccup mode lasts for 2 seconds, the chip will shut down and locked, only single key or VCC insertion can unlock the chip. MP5112/MP5113 can prevent the output reverse current thanks to the body control of power PMOS.

When the battery voltage goes down to the UVLO voltage, the boost will shut down automatically, and be locked to the UVLO state. Only VCC is powered or press the KEY, then the UVLO state will be reset.

## KEY and Torch

In the standby mode, single pressing the KEY can check the battery fuel gauge, and start the boost in the same time. Single pressing the KEY can also reset the abnormal state and VBAT UVLO state. Double pressing the KEY can open and close the torch. Pressing the KEY for 1.2S can shut down the boost.

## LED Display

LED display has three modes: LED charge display, LED discharge display and checking battery fuel gauge display.

### LED charge display

In LED charge display mode, the LED2 continuously flashes to indicate the state of charging the battery, and the flashing frequency is 1Hz. When the battery charge is finished, the LED2 will turn on.

Battery voltage	Fuel gauge	DLED1	DLED2
4.2V/4.35V	100%	off	on
0V-4.2V/4.35V	0%-100%	off	flashing

### LED discharge display

In the LED discharge display mode, the LEDs show the battery fuel gauge with DLED1 on. When the VBAT voltage is less than 3.2V, the DLED1 flashes with 1Hz.

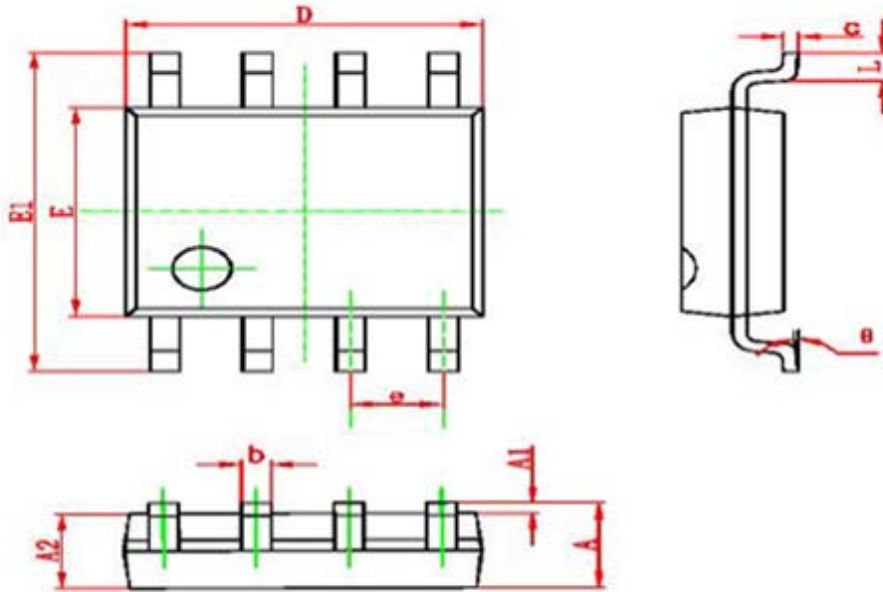
Battery voltage	Fuel gauge	DLED1	DLED2
>3.2V	5%-100%	on	off
2.90V-3.2V	0%-5%	flashing	off
<2.90V(UVLO)	-	off	off

### Checking battery fuel gauge display

In the standby mode, single pressing the KEY will enable the boost, and then enter to checking battery fuel gauge display mode for 16S.

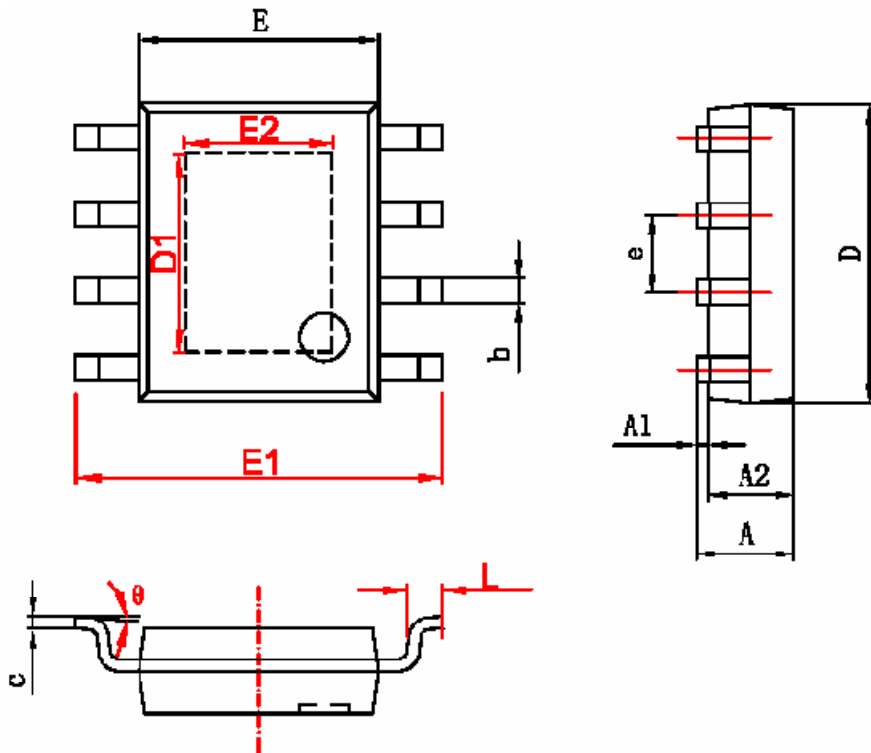
Battery voltage	Fuel gauge	DLED1	DLED2
>3.2V	0%-100%	on	off
<3.2V	-	off	off

SOP8 PACKAGE OUTLINE



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	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

ESOP8 PACKAGE OUTLINE



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
theta	0°		8°	

All specs and applications shown above subject to change without prior notice.