XS5802-SIP of Power Bank Total Solution

GENERAL DESCRIPTION

XS5802 is one SIP that it integrates Li-Battery Charge management、Li-Battery Protection and Boost converter in only TSSOP16-PP package.
This SIP can charge with 1A current and also can output 5V 1A to load such as smart phone or MID.
It only need few components and can reduce the BOM area and BOM cost.

FEATURES

- Charger input voltage-4.5V to 6V
- Charger current-MAX 1A
- Boost converter-MAX 20V output
- Boost converter-MAX 5V 1A
- Boost converter Frequency-1.2MHz
- Li Protection OCU-4.25V ODU-2.9V
- Li Protection OCP-3A
- Have UVLO、OTP 、Short protection
- TSSOP16-PP Package

APPLICATIONS

- Power bank for MID、PAD
- Power bank for Smart Phone

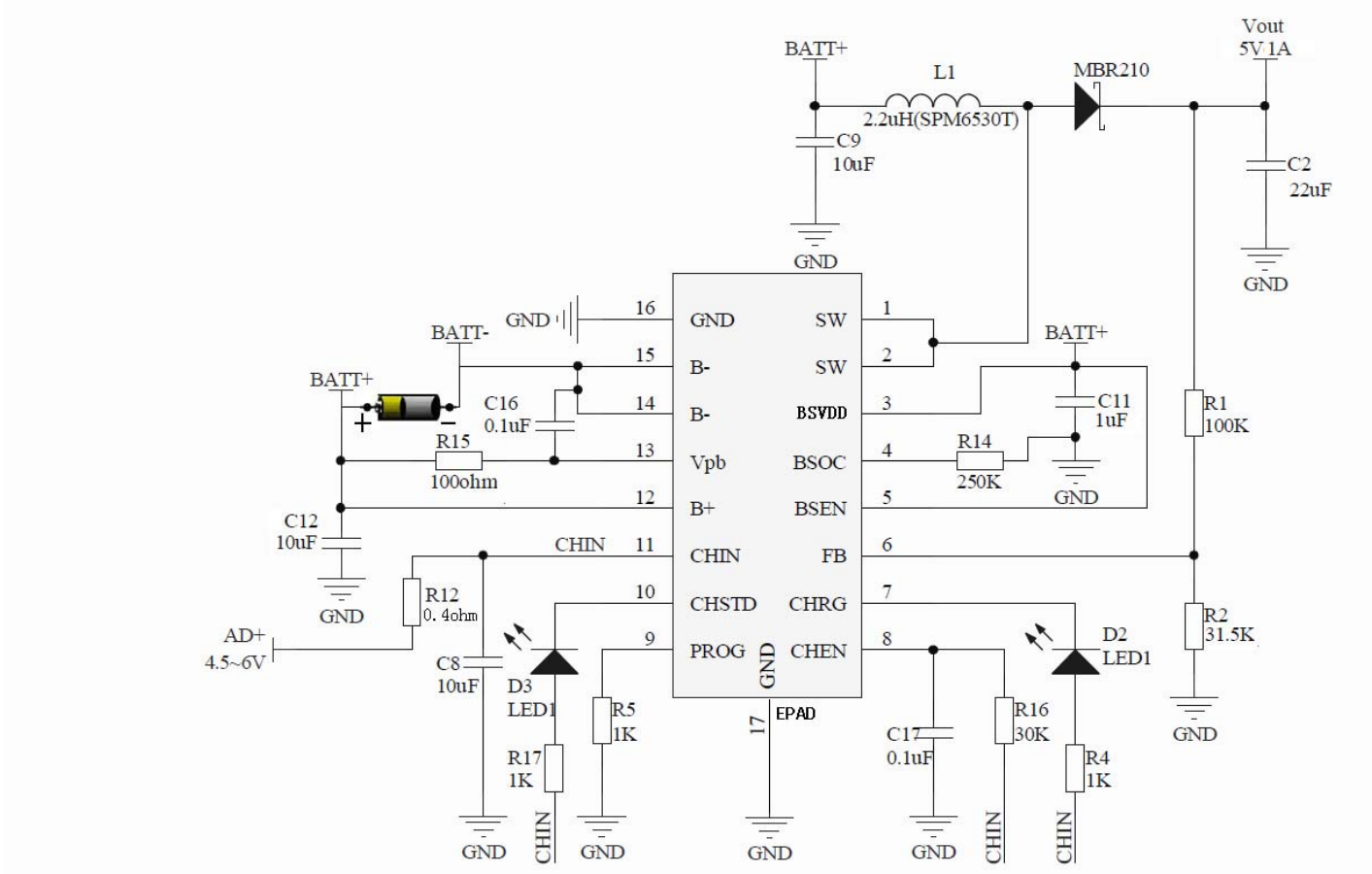


Figure 1. Typical Application Circuit1

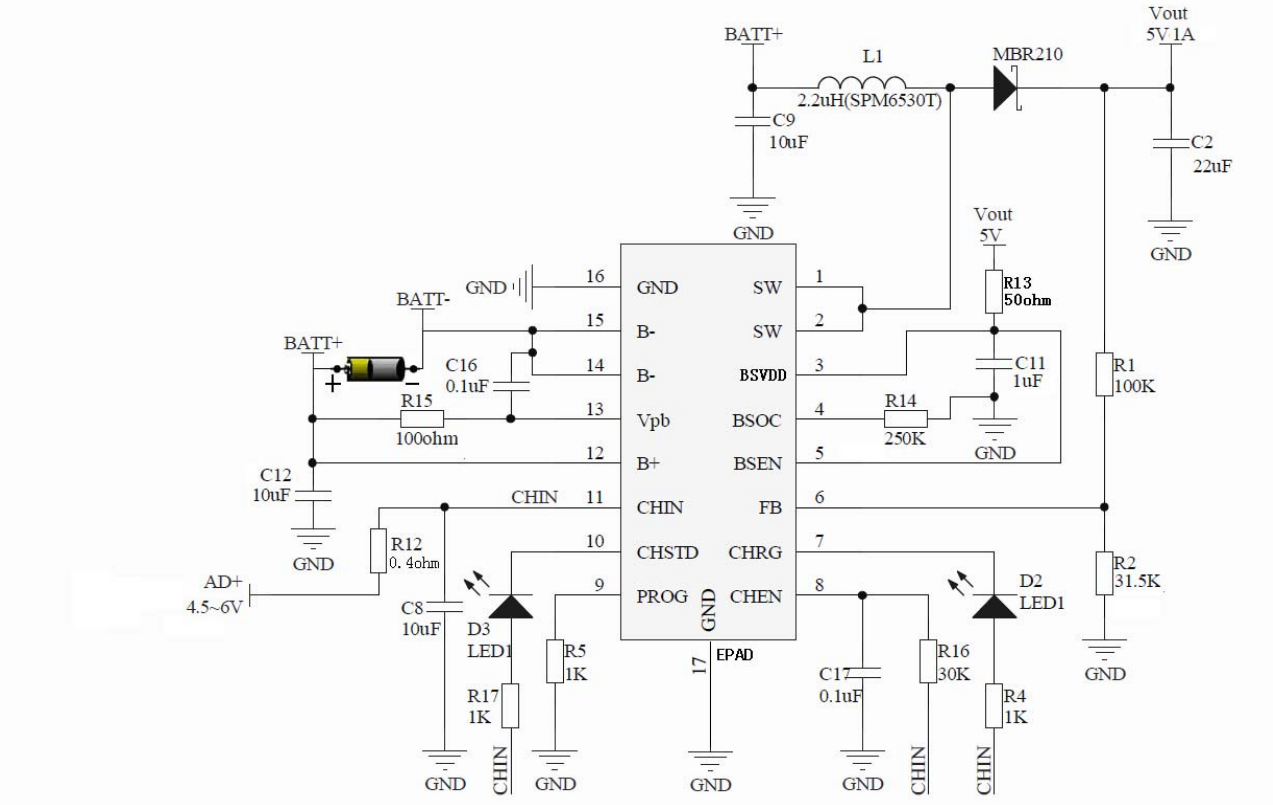


Figure 2. Typical Application Circuit2

Note: Circuit2 can improve efficiency of boost converter but must pay attention to PCB layout of Pin3 as below.

ORDERING INFORMATION

PART NUMBER	TEMP RANGE	VIN	OUTPUT VOLTAGE (V)	CHARGE CURRENT	PACKAGE	PINS
XS5802	-40°C to 85°C	4.5~6V	ADJ	1A	TSSOP-PP	16

PIN CONFIGURATION

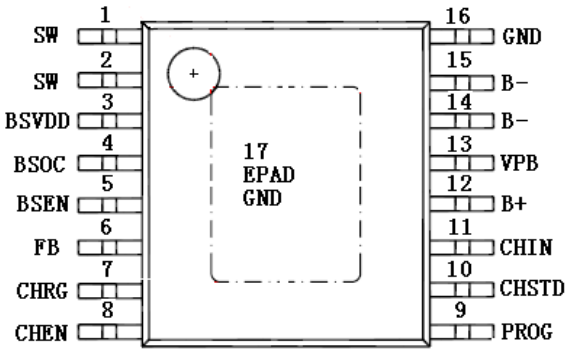


Figure 3. PIN Configuration

PIN DESCRIPTION

PIN NUMBER	PIN NAME	PIN DESCRIPTION
1,2	SW	Boost Converter's Switching pin
3	BSVDD	Boost power supply pin, Should connect 1uF to GND as close as possible
4	BSOC	Boost Converter's current limit setting pin，For 5Vout 1A application，you can select 250K~300Kohm resistor to GND or one analog voltage connects BSOC pin to set current limit (see detail description as below)
5	BSEN	Boost Converter's Enable pin
6	FB	Boost Converter's Feedback pin. it can set 5Vout with two resistors.
7	CHRG	Open-Drain Charge Status Output， When the battery is charging, the CHRG pin is pulled low by an internal N-channel MOSFET. When the charge cycle is completed, CHRG pin will be in a high-impedance state.
8	CHEN	Charge Enable Pin
9	PROG	Charge Current Program, Charge Current Monitor and Shutdown Pin.
10	CHSTD	The completion of battery charging instructions side. When the battery charge is complete, CHSTD pulled low by internal switches, indicating the completion of charging. In addition, CHSTD pin will be in a high-impedance state.
11	CHIN	Positive Input Supply Voltage, should be bypassed with at least a 10uF capacitor.
12	B+	Li-Battery's Positive Pole，should be bypassed with a 10uF capacitor as close as possible
13	VPB	The Power Supply of Li-Protection section，Should connect 0.1uF capacitor between Vpb and B- as close as possible and 100ohm resistor to B+
14,15	B-	Li-Battery's Negative Pole
16,17	GND	Ground and EPAD

ABSOLUTE MAXIMUM RATINGS

(Note: Do not exceed these limits to prevent damage to the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.)

PARAMETER	VALUE	UNIT
Supply Voltage VIN; CHRG\CHEN\CHSTD Voltage	-0.3 to 7	V
FB Voltage; Vpb Voltage; B+\B-; BSEN pin; BSOC voltage	-0.3 to 5	V
SW Voltage	Vin+0.3 to 15	V
PROG Voltage	-0.3~CHIN+0.3	V
Icharge	1.2	A
PROG Pin current	1.2	mA
Operating Ambient Temperature	-40 to 85	°C
Maximum Junction Temperature	150	°C
Storage Temperature	-55 to 150	°C
Lead Temperature (Soldering, 10 sec)	260	°C

ELECTRICAL CHARACTERISTICS

(V_{IN} = 3.6V, T_A= 25°C unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input Voltage Range	CHIN		4.5		6.0	V
Regulated Charge Voltage	Vfloat	0°C ⩽ TA ⩽ 85°C, Icharge = 40mA	4.158	4.2	4.242	V
PROG pin Voltage	Vprog	R_{PROG} =1k, Current mode	0.93	1.0	1.07	V
Charge current	Icharge	R_{PROG} =2k,Current mode	450	500	550	mA
		R_{PROG} =1k,Current mode	900	1000	1100	mA
		Standby mode,Vbat=4.2V	0	-2.5	-6	uA
Trickle charge current	Itrikl	Vbat<Vtrikl,Rprog=1k	90	100	110	mA
Trickle charge Threshold Voltage	Vtrikl	R_{PROG} =10K，Vbat Rising	2.8	2.9	3.0	V
Trickle voltage hysteresis voltage	Vtrhys	R_{PROG} =10K	60	80	110	mV
CHRG pin Output low voltage	Vchrg	Ichrg=5mA		0.35	0.6	V
CHSTD pin Output low voltage	Vchstd	Ichstd=5mA		0.35	0.6	V
CHEN、BSEN voltage	Ven		0.3	1	1.5	V
Recharge Battery threshold Voltage	∆ Vrecg	V_{FLOAT} - V_{RECHRG}		100	200	mV
Overcharge Detection Voltage of Li BAT-Protection	V_{CU}		4.225	4.25	4.275	V
Overcharge Release Voltage of Li BAT-Protection	V_{CL}		4.075	4.10	4.125	V
Overdischarge Detection Voltage of Li BAT-Protection	V_{DL}		2.85	2.9	2.95	V
Overdischarge Release Voltage of Li BAT-Protection	V_{DR}		2.95	3.0	3.05	V
Overdischarge Current1 Detection of Li BAT-Protection	I_{IOV1}	(V_{B+})-(V_{B-})=3.5V	2.1	3	3.9	A
Load Short-Circuiting Detection of Li BAT-Protection	I_{SHORT}	(V_{B+})-(V_{B-})=3.5V	10	20	30	A
Boost output voltage range	Vout		20			V
Regulated Feedback Voltage	V_{FB}		1.118	1.2	1.212	V
Peak Inductor Current	I_{PEAK}	Rset=150K Vin=3.3V Vout=5V	0.8	1	1.2	A
Peak Inductor Current	I_{PEAK}	Rset=500K Vin=3.3V Vout=5V	2.2	2.55	2.9	A

Boost Convert Oscillator Frequency	F_{OSC}		0.9	1.2	1.5	MHz

FUNCTIONAL DESCRIPTION

NORMAL OPERATION

XS5802 integrates Li-Battery Charger 、 Li-Battery Protection and Boost converter in only TSSOP16-PP package

Adapter inputs 5V voltage and charges the battery. After the battery is full, get off the adapter . And then we can boost up to 5V to charge the mobile advices when they is empty.

Li-Battery Charger can set charge current by PROG resistor. Normal charging current is set from 0.5A to 1A. It will go into trickle charge mode to protect Li-Battery when BAT voltage is below 2.9V.

Li-Battery Protection can detect the battery cell's status such as Vcu、Vcl，Temp、short-cut、Over-current and take action to protect battery cell.

Boost section can give us 5V 1A capacity to mobile devices.

THERMAL OR SHORT-CUT PROTECTION

A thermal shutdown is implemented to prevent damages due to excessive heat and power dissipation. Typically the thermal shutdown threshold is 150℃ .When the thermal shutdown is triggered the device stops switching until the temperature falls below typically 136℃.Then the device starts switching again.

If the Boost converter's Vout is short to GND，the IC will shut down and you should recharge the battery to get rid of this status.

APPLICATION INFORMATION

INDUCTOR SELECTION

In normal operation, the inductor maintains continuous current to the output. The inductor current has a ripple that is dependent on the inductance value. The high inductance reduces the ripple current.

Selected inductor by actual application:

Manufacturer	*Part Number*	*Inductance (uH)*	*DRC max (Ohms)*	*Dimensions L*W*H(mm3)*
Murata	LQH44PN	2.2	0.049	4*4*1.7
		3.3	0.065	
		4.7	0.08	
		10	0.16	
	LQH5BP	2.2	0.030	5*5*2
		3.3	0.044	
		4.7	0.058	
		10	0.106	
TDK	SPM6530T	2.2	0017	7.1*6.5*3
		3.3	0.027	
		4.7	0.036	

Manufacturer	Part Number	Inductance (uH)	DRC max (Ohms)	Dimensions L*W*H(mm3)
WURTH	744373 24022	2.2	0.061	4.4*4.05
	744777004	4.7	0.025	7.3*7.3*4.5

Table 1. Recommend Surface Mount Inductors

If output voltage is 5V ， you can use 2.2uH~ 4.7uH, If output voltage is 12V, 4.7uH~ 10uH is OK，

Normal application: Input 3.3V (3.6V or 4.2V) to Output 5V 9V 12V ;

Input 5V to Output 9V 12V

CAPACITOR SELECTION

The input capacitor reduces input voltage ripple to the converter, low ESR ceramic capacitor is highly recommended. For power bank application, A 10uF ceramic capacitor is used. The input capacitor should be placed as close as possible to CHIN and GND. Such as Murata GRM21BR60J106 or TDK C3216X5R1A106M

A low ESR output capacitor is required in order to maintain low output voltage ripple. one 10~22uF ceramic output capacitor is suitable for most applications. Such as GRM21BR60J226 or TDK C3216X5R1A226M

B+-Pin 3 should be bypassed with a 1uF capacitor as close as possible, B+-Pin12 should be bypassed with a 10uF capacitor as close as possible.

For typical application circuit2, the 1uF capacitor must be added close to BSVDD as possible as you can. 50ohm~100ohm resistor also must be add close BSVDD. The BSVDD power supply must get from Cout to reduce spike. and PCB layout wires must avoid switching lines such as SW or Diode.

SET CHARGE CURRENT

The charge current is programmed by connecting a 1% resistor, R_{PROG}, PROG pin 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:

$I_{charge} = (V_{PROG}/R_{PROG}) \cdot 1000$.

OUTPUT VOLTAGE PROGRAMMING

The output voltage is set by a resistive divider according to the following equation:

$$R_1 = R_2 \times \left(\frac{V_{OUT}}{1.2} - 1 \right)$$

Typically choose R2=30K and determine R1 from the following equation:

For example, you can select R2=31.5K R1=100K to set 5Vout

DIODE SELECTION

According to max Iout and max Vout, you can select suitable diode. Normally we select diode If=(1.5~2)*Ioutmax and VR=(1.5~2)*Voutmax. For high efficiency，suggest that you select low Vf Schottky diode.

For example, 5V 1Aout power bank application, you can select MBRA210LT3 or SS24. Using MBRA210LT3, you can get higher efficiency.

OC SETTING1(SETTING CURRENT LIMIT)

XS5802 can be adjusted SW current limit by one resistor connected with BSOC pin。The setting sheet is as below(Vbattery=3.3V Vout=5V)---Only list the typical Ilim number，the actual data may be in +/- 20% above them ,because of some discrete data from IC and resistor.

Rset （ohm）	Ilim(typ)
500K	2.7A
400K	2.5A
300K	2.3A
250K	2.1A
200K	1.5A
180K	1.3A
150K	1A
120K	0.7A
100K	0.45A

For 3V~4.2Vin to 5V 1A out , 250Kohm is suitable.

OC SETTING2(SETTING CURRENT LIMIT BY ANALOG VOLTAGE)

XS5802 also can be adjusted SW current limit by one analog voltage connected with BSOC pin。and One 0.1uF capacitor need to be placed close to OC pin . Analog voltage can be got from MCU I/O output. The setting sheet is as below(Vin=3.6V Vout=5V)---Only list the typical Ilim number，the actual data may be in +/- 20% above them because of some discrete data from IC and the analog voltage.

Please do not let it float.

Analog Volatge（V）	Ilim(typ)
1.16V	3.10A
1.00V	2.80A
0.90V	2.10A
0.85V	1.85A
0.80V	1.60A
0.75V	1.42A
0.70V	1.21A
0.65V	1.00A
0.60V	0.75A
0.55V	0.60A
0.50V	0.35A

For 3V~4.2Vin to 5V 1A out , 0.85V~0.90V is suitable.

For 3V~4.2Vin to 5V 1.5A out , 1.00V is suitable. ,(Note: Input/Output capacitor need to be 22uF at least. And

more thermal action is needed for 5V 1.3A~1.5A out.)

PCB LAYOUT GUIDE

1） It is desirable to maximize the PCB copper area connecting to GND pin to achieve the best thermal and noise performance. If the board space allowed, a ground plane is highly desirable

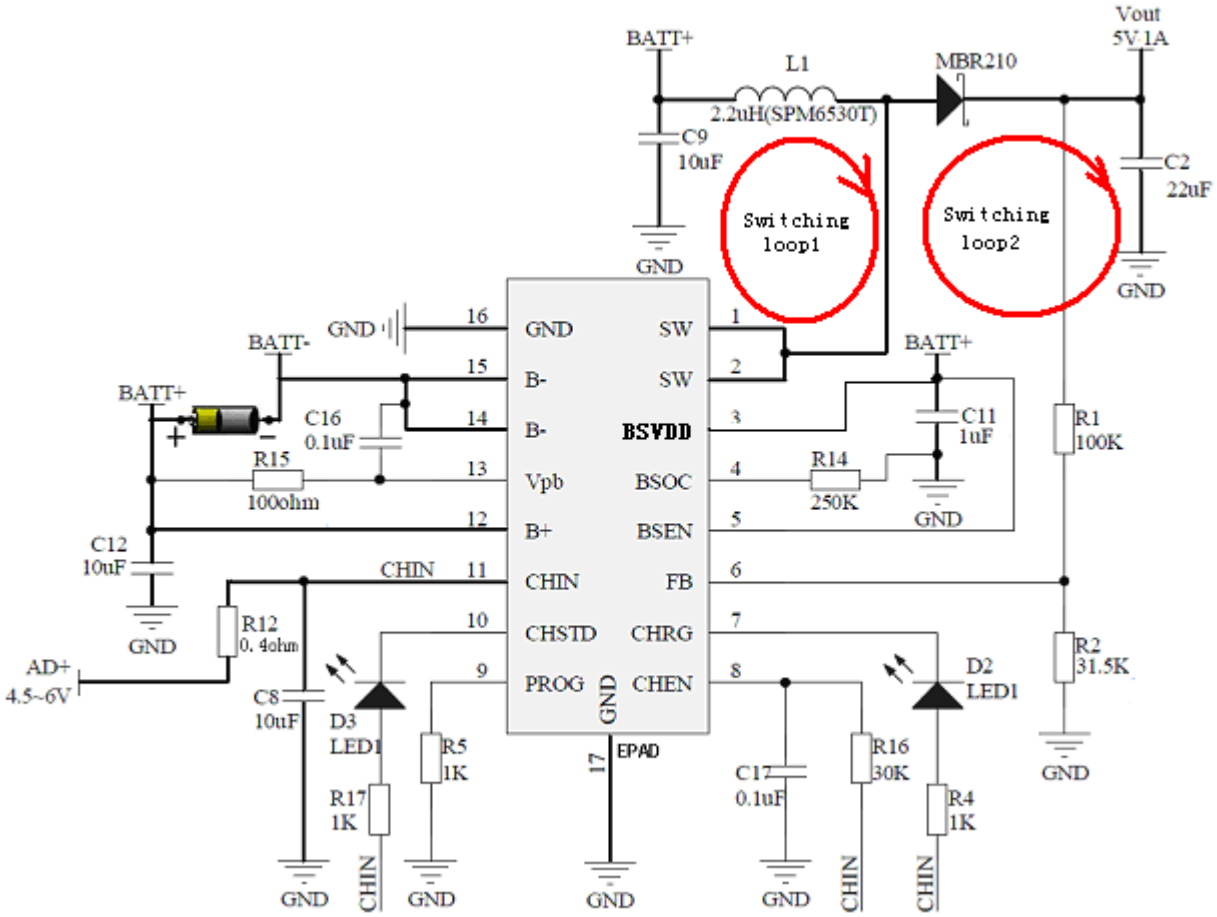
2） C_{IN} must be close to Pins CHIN and GND. The loop area formed by C_{IN} and GND must be minimized. C_{B+} or C_{pb} is the same

3） The PCB copper area associated with SW pin must be minimized to avoid the potential noise problem.

Just like Switching loop1 and Switching loop2, should minimize their area to avoid EMI problem.

4） The components R1 and R2, and the trace connecting to the FB pin must NOT be adjacent to the SW net on the PCB layout to avoid the noise problem

5） Please make sure that the big current circuits are board and short to reduce the circuit Rdson is minimum，for example，please place the Positive pole of Li-Battery Cell close to Pin12-B+(not Pin 3) as possible to reduce B+ big current circuits' Rdson.

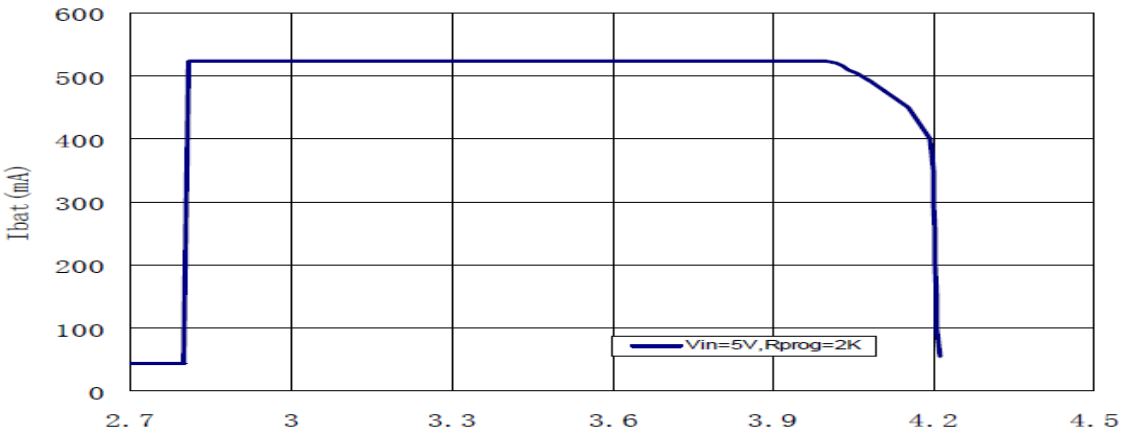


BIG CURRENT CIRCUIT

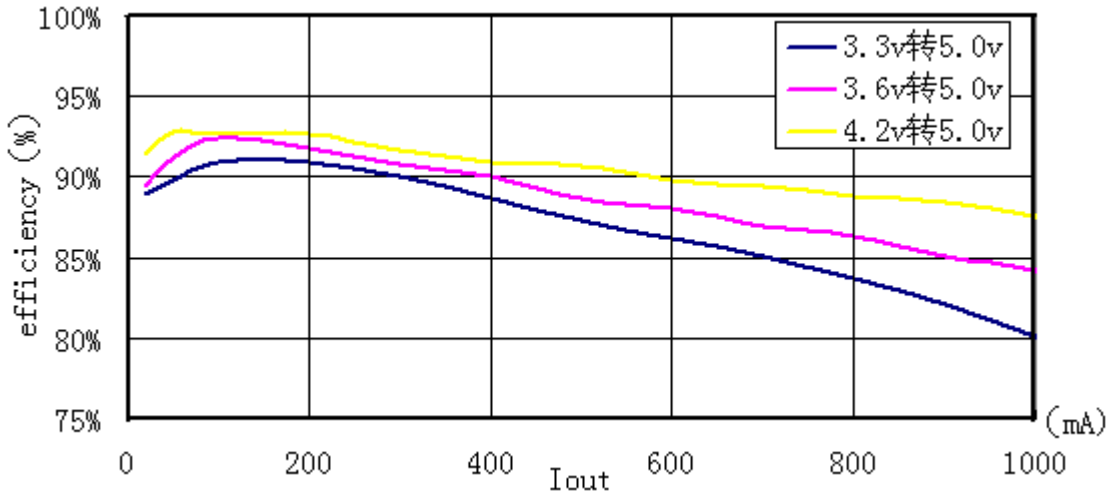
As above(Heavy lines)

TYPICAL PERFORMANCE CHARACTERISTICS

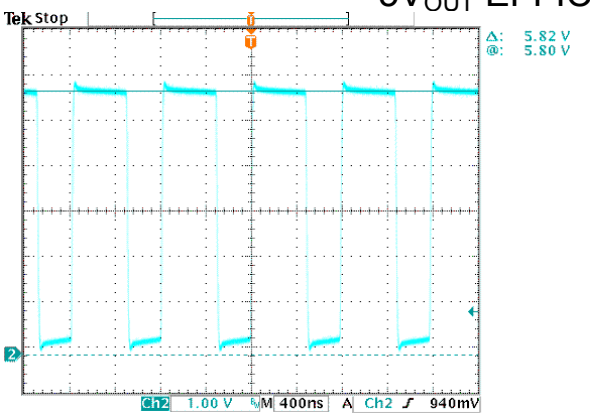
(L=2.2uH-SPM6530T2R2, CIN=10uF, C_{BAT+}=10uF，Cout=22uF, D=MBRA210LT3 Vin=5V if not mentioned)



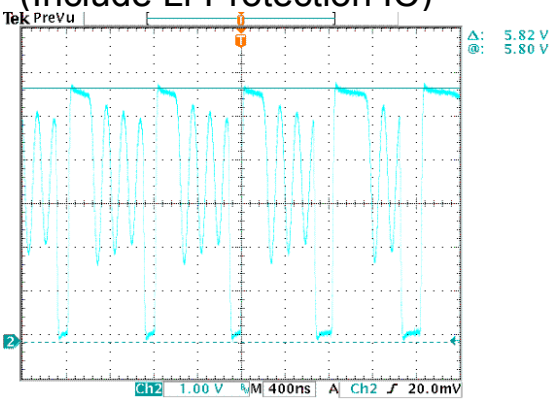
BATTERY CHARGER CURVE



$5V_{OUT}$ EFFICIENCY (Include Li-Protection IC)



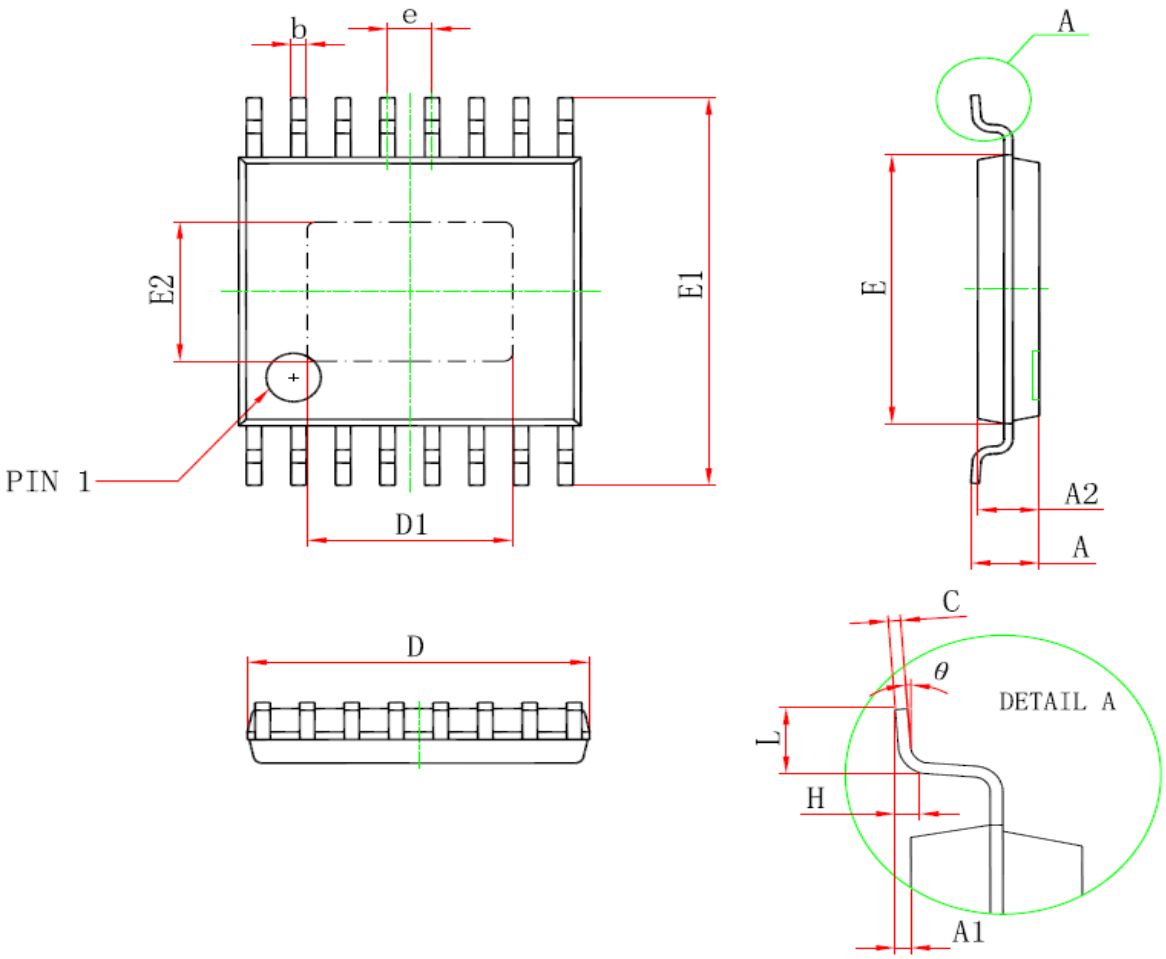
PWM SWITCHING CONTINUOUS



PWM SWITCHING DISCONTINUOUS

CONDUCTION MODE CONDUCTION MODE

TSSOP16/PP PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
D	4.900	5.100	0.193	0.201
D1	2.900	3.100	0.114	0.122
E	4.300	4.500	0.169	0.177
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
E1	6.250	6.550	0.246	0.258
E2	2.200	2.400	0.087	0.094
A		1.100		0.043
A2	0.800	1.000	0.031	0.039
A1	0.020	0.150	0.001	0.006
e	0.65 (BSC)		0.026(BSC)	
L	0.500	0.700	0.02	0.028
H	0.25(TYP)		0.01(TYP)	
θ	1°	7°	1°	7°

In order to increase the driver current capability of XS5802 and improve the temperature of package, Please ensure Epad and enough ground PCB to release energy.

PROUCT CHANGE NOTICE LIST

NO	Updated date	Version update	Update content
1	2013-3-26	Rev 0.1	Create datasheet
2	2013-8-30	Rev 0.2	Update BSOC pin using guide
3	2013-9-12	Rev 0.3	Add Vout -Supply-BSVDD schematic
4	2013-10-21	Rev 0.4	S5802 transfer to XS5802