# HM1803-SIP of Power Bank Total Solution

## GENERAL DESCRIPTION

HM1803 is one SIP that it integrates Li-Battery Charge management.Battery power indicator.WLED Torch controller . Boost converter and Li-Battery protection in only TSSOP20-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 26V output
- Boost converter- 5V 1A
- Boost converter Frequency-1.2MHz
- Can set current limit with one resistor
- Li Protection OCU-4.25V ODU-2.9V
- Li Protection OCP-3A
- 4 Level battery power indicator
- Max 100mA WLED Torch Out
- BSR control Logic
- Have UVLO、OTP
- 20-Pin TSSOP-PP Package

## APPLICATIONS

Power bank for MID、PAD
Power bank for Smart Phone

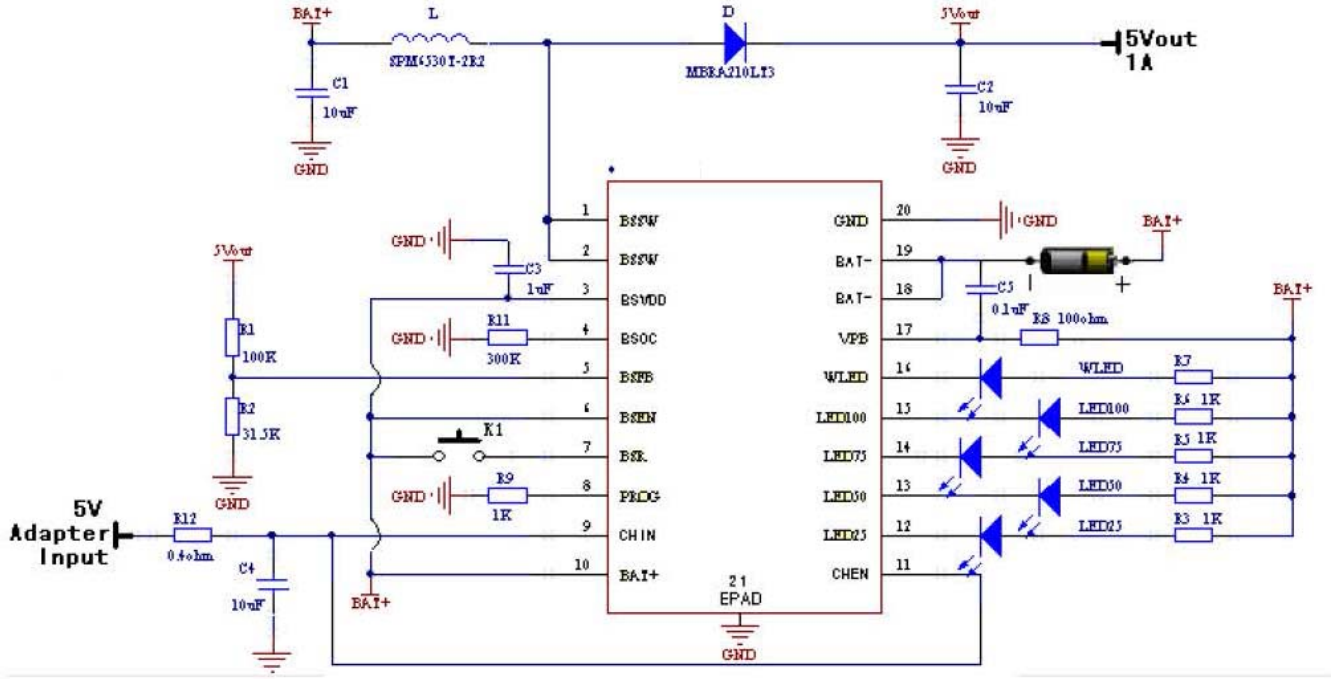



**Figure 1. Typical Application Circuit1**

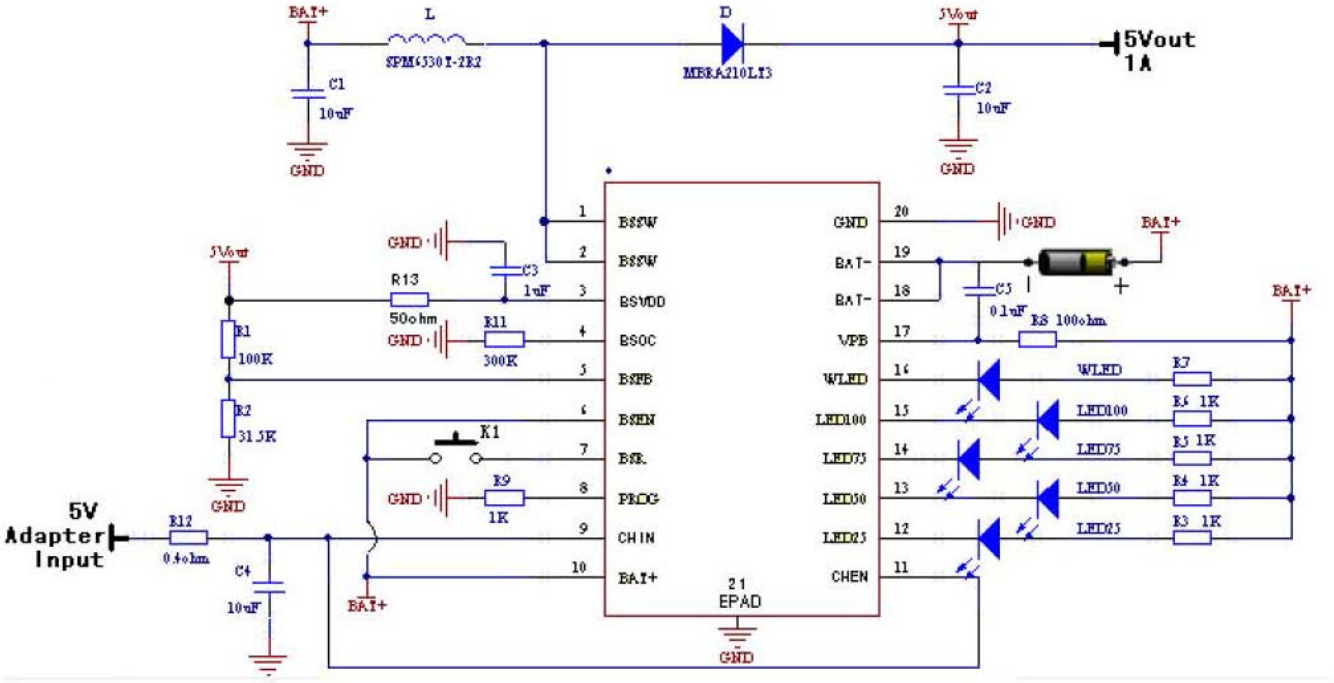



**Figure 2. Typical Application Circuit2**

**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 |
|---|---|---|---|---|---|---|
| HM1803 | -40°C to 85°C | 4.5~6V | ADJ | 1A | TSSOP-PP | 20 |

# PIN CONFIGURATION

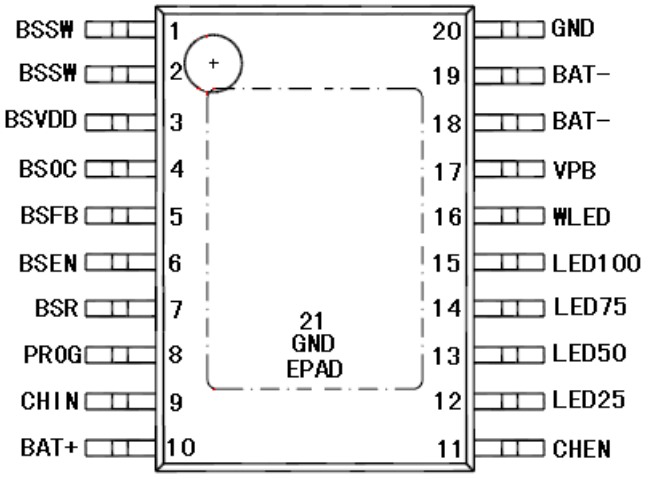



**Figure 3. PIN Configuration**

## PIN DESCRIPTION

| PIN NUMBER | PIN NAME | PIN DESCRIPTION |
|---|---|---|
| 1, 2 | BSSW | Boost Converter's Switching pin |
| 3 | BSVDD | Boost power supply pin, Should connect 1uF to GND as close as possible |
| 4 | BSOC | SW current limit setting pin, Set current limit by Rset or analog Voltage |
| 5 | BSFB | Boost Converter's Feedback pin. it can set 5Vout with two resistors. |
| 6 | BSEN | Boost enable pin, When higher than 1.5V, this pin turns the IC on. When lower than 0.3V, this pin turns the IC off. |
| 7 | BSR | Connect with one tact switch，press the tact switch to see battery power or get on /off WLED. |
| 8 | PROG | Charge Current Program, Charge Current Monitor and Shutdown Pin. |
| 9 | CHIN | Positive Input Supply Voltage, should be bypassed with at least a 10uF capacitor. |
| 10 | BAT+ | Li-Battery's Positive Pole，should be bypassed with at least a 10uF capacitor. |
| 11 | CHEN | Battery charger enable pin，When higher than 1.5V, this pin turns the IC on. When lower than 0.3V, this pin turns the IC off. |
| 12 | LED25 | Battery power indicator pin1. The resistor sets the current of LED，normally use 1K |
| 13 | LED50 | Battery power indicator pin2 The resistor sets the current of LED，normally use 1K |
| 14 | LED75 | Battery power indicator pin3 The resistor sets the current of LED，normally use 1K |
| 15 | LED100 | Battery power indicator pin4 The resistor sets the current of LED，normally use 1K |
| 16 | WLED | WLED Torch out pin. The resistor sets the current of WLED, Iwled=(Vbat-Vthod)/Rset |
| 17 | VPB | The Power Supply of Li-Protection section，Should connect 0.1uF capacitor between Vpb and BAT- as close as possible and 100ohm resistor to BAT+ |
| 18,19 | BAT- | Li-Battery's Negative Pole |
| 20,21 | GND | Ground and EPAD，Please connect EPAD/GND with mass metal ground |

## 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 CHIN; | -0.3 to 7 | V |
| BSFB ； BSVDD； BSOC;BSEN; LEDxx; WLED; BSR;VPB;BAT+;BAT- | -0.3 to 5 | V |
| SW Voltage | Vin+0.3 to 26 | V |
| PROG Voltage | -0.3~Vcc+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 | VCC | | 4.5 | | 6.0 | V |
| Regulated Charge Voltage | Vfloat | 0°C ⩽ TA ⩽ 85°C, Icharge = 40mA | 4.158 | 4.22 | 4.260 | 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 | -15 | -30 | 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 |
| Recharge Battery threshold Voltage | ∆ Vrecg | $V_{FLOAT}$ - $V_{RECHRG}$ | | 150 | 300 | mV |
| WLED torch current | Iwled | Vbat=4.2V | | | 100 | mA |
| LEDxx current | Iled | Vbat=4.2V | | | 5 | mA |
| Boost output voltage range | Vout | | | 26 | | V |
| Regulated Feedback Voltage | $V_{FB}$ | | 1.188 | 1.2 | 1.212 | V |
| Inductor Current limit | $I_{lim}$ | Roc=300K | | 2.3 | | A |
| Inductor Current limit | $I_{lim}$ | Voc=0.9V | | 2.1 | | A |
| Boost Convert Oscillator Frequency | $F_{OSC}$ | | 0.9 | 1.2 | 1.5 | MHz |
| 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 | $I_{IOV1}$ | $(V_{BAT+})-(V_{BAT-})=3.5V$ | 2.1 | 3 | 3.9 | A |
| Load Short-Circuiting Detection of Li BAT-Protection | $I_{SHORT}$ | $(V_{BAT+})-(V_{BAT-})=3.5V$ | 10 | 20 | 30 | A |

# FUNCTIONAL DESCRIPTION

## NORMAL OPERATION

HM1803 integrates Li-Battery Charge management . Battery power indicator . WLED Torch controller and Boost converter in only TSSOP20-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.

It also integrates battery power indicator with 4 levels. And one WLED Torch controller with about 10~50mA output capacity

Boost section can give us 5V 1A~1.5A capacity to mobile devices.

For 5V 1.5A~2A, you can use typical application circuit3.

## 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 | |
| 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 C1 and C4 reduces input voltage ripple, low ESR ceramic capacitor is highly recommended. For power bank application, A 10uF ceramic capacitor is at least. The input capacitor should be placed as close as possible to CHIN Pin/ BAT+ Pin 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 10uF or 22uF ceramic output capacitor C2 is suitable for most applications. Such as GRM21BR60J106 or GRM21BR60J226

If input capacitor is far away from BSVDD Pin，please add another 1uF capacitor C3 as close as possible.

For typical application circuit2, the 1uF capacitor C3 must be added close to BSVDD as possible as you can. 50ohm~100ohm resistor R13 also must be add close BSVDD. The BSVDD power supply must get from Cout – C2 to reduce spike.

## 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:
$I_{charge} = (V_{PROG}/R_{PROG}) \bullet 1000$.

## OUTPUT VOLTAGE PROGRAMMING

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

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

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

## OC SETTING1( SETTING CURRENT LIMIT BY ONE RESISTOR)

HM1803 can be adjusted SW current limit by one resistor connected with BSOC pin. 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 resistor.

Please do not let it float.

| 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 , 250K~300Kohm is suitable.

## OC SETTING2( SETTING CURRENT LIMIT BY ANALOG VOLTAGE)

HM1803 also can be adjusted SW current limit by one analog voltage connected with OC 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.

## 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.

## WLED CURRENT SETTING

The WLED current is effected by Battery voltage、WLED's threshold voltage and setting resistor.

The maxim WLED current is 100mA，Please do not exceed it.

The equation is Iwled=($V_{BAT}$−Vthod)/Rset.

Normally we set the resistor as 50ohm~100ohm 。That's enough.

The WLED ON/OFF can work during charging or discharging, the control logic is as below:

| ON | OFF |
|---|---|
| Press BSR tact switch 3s | Press BSR tact switch 3s |

The battery voltage is lower, the holding time is longer and maybe exceed 3s.

## BATTERY POWER INDICATOR LOGIC

1: LEDxx to Vbat：

| | LED25 | LED50 | LED75 | LED100 |
|---|---|---|---|---|
| Vbat | 3.6V | 3.84V | 4.0 V | 4.22V |
| % Power Indicator | 25% | 50% | 75% | 100% |

2: Charging Status (Adapter present)

| % Power Indicator | LED25 | LED50 | LED75 | LED100 |
|---|---|---|---|---|
| 0---25% | 0.5HZ Twinkle | OFF | OFF | OFF |
| 25%---50% | ON | 0.5HZ Twinkle | OFF | OFF |
| 50%---75% | ON | ON | 0.5HZ Twinkle | OFF |
| 75%---100% | ON | ON | ON | 0.5HZ Twinkle |
| 100% Full | OFF | OFF | OFF | OFF |

After Charging finished, the LEDxx will get on for about 6s with logic as above when you press BSR tact switch。And after last about 6s, the LEDxx will get off.

3: No Charging Status(Adapter Not present)

LEDxx will get on after press BSR tact switch(rising edge trigger) and last 6s.

| % Power Indicator | LED25 | LED50 | LED75 | LED100 |
|---|---|---|---|---|
| 75%以上 | ON 6s | ON 6s | ON 6s | ON 6s |
| 50%---75% | ON6s | ON 6s | ON 6s | OFF |
| 25%---50% | ON 6s | ON 6s | OFF | OFF |
| 0%---25% | 0.5HZ Twinkle 6s | OFF | OFF | OFF |

## PCB LAYOUT GUIDE

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

2） $C_1$ must be close to Pins CHIN and GND. Also C4 must be close to Pins BSVDD and GND，

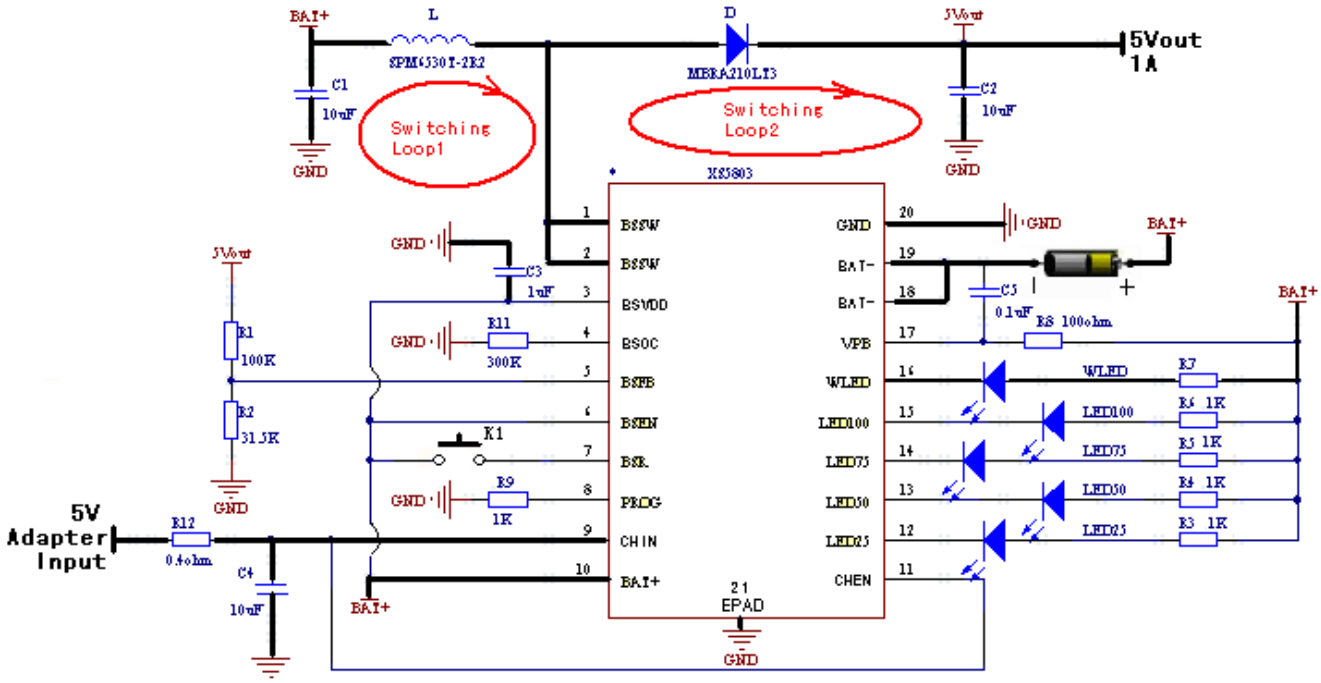
3） The PCB copper area associated with SW pin must be minimized to avoid the potential noise problem.

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

6） For typical application circuit3, the 1uF capacitor must be added close to BSVDD as possible as you can.50ohm~100ohm resistor also must be add close to BSVDD. The BSVDD power supply must get from Cout to reduce spike.

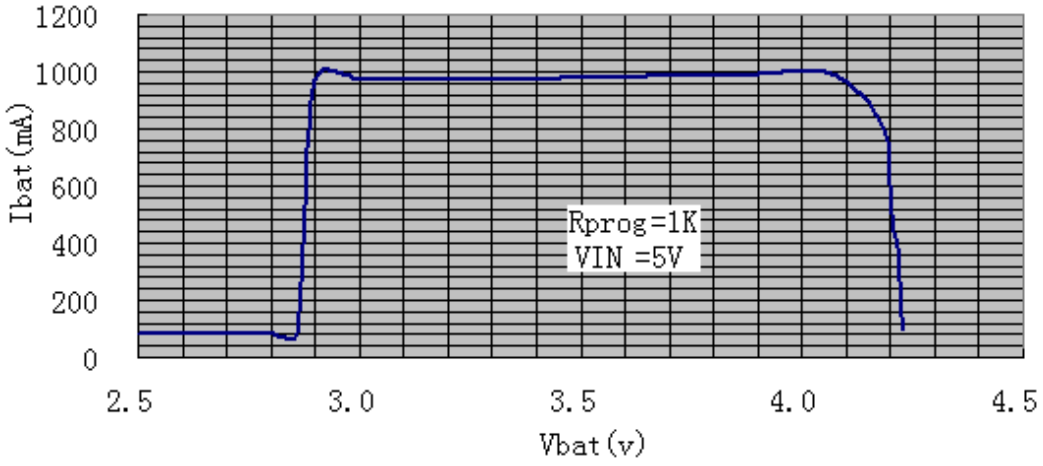



**BIG CURRENT CIRCUIT**

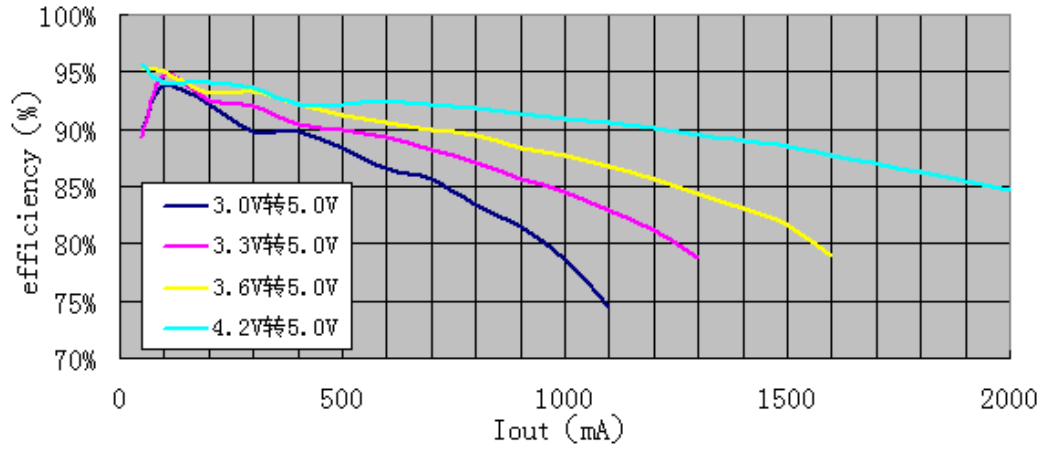
**As above(Heavy Lines)**

# TYPICAL PERFORMANCE CHARACTERISTICS

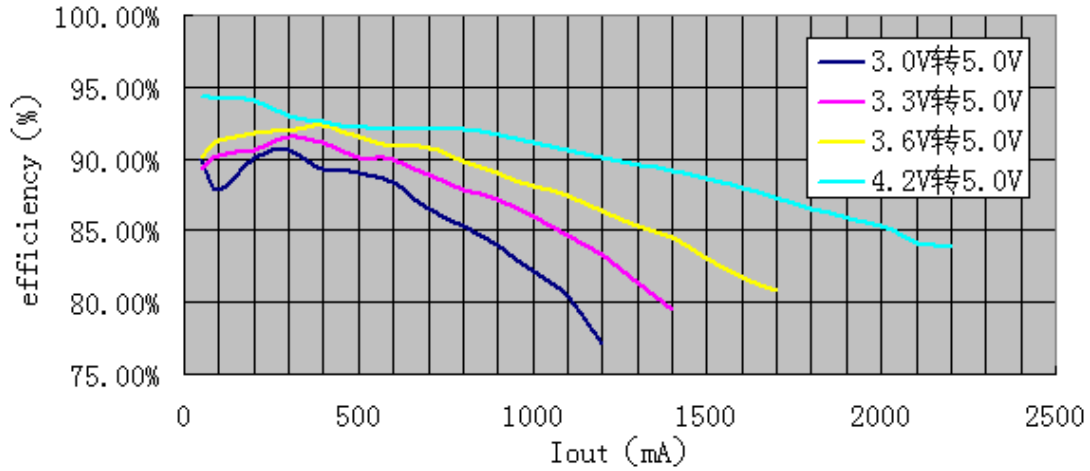
(L=2.2uH-SPM6530T2R2, C1=C2=C4=10uF， D=MBRA210LT3 Vin=5V if not mentioned)



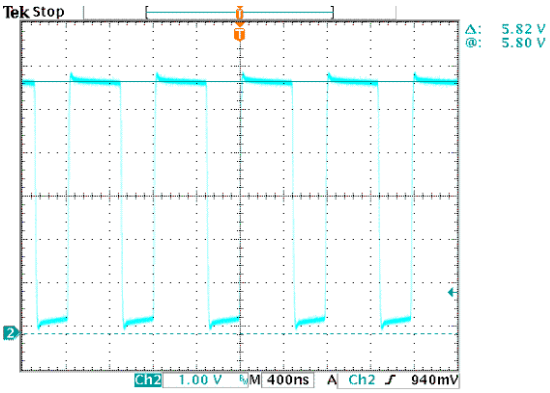

**BATTERY CHARGER CURVE**



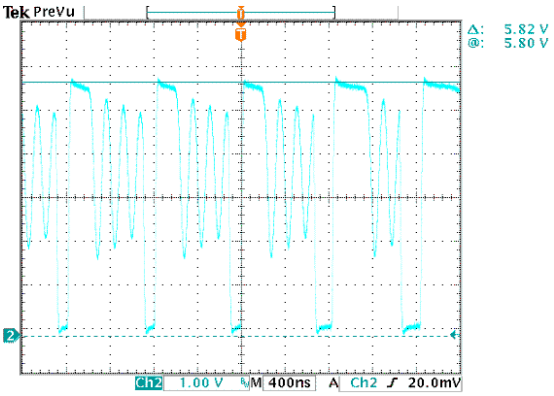

**$5V_{OUT}$ EFFICIENCY- INCLUDE LI-PROTECTION (TYPICAL APPLICATION CIRCUIT1)**




**$5V_{OUT}$ EFFICIENCY- INCLUDE LI-PROTECTION (TYPICAL APPLICATION CIRCUIT2)**




PWM SWITCHING CONTINUOUS CONDUCTION MODE



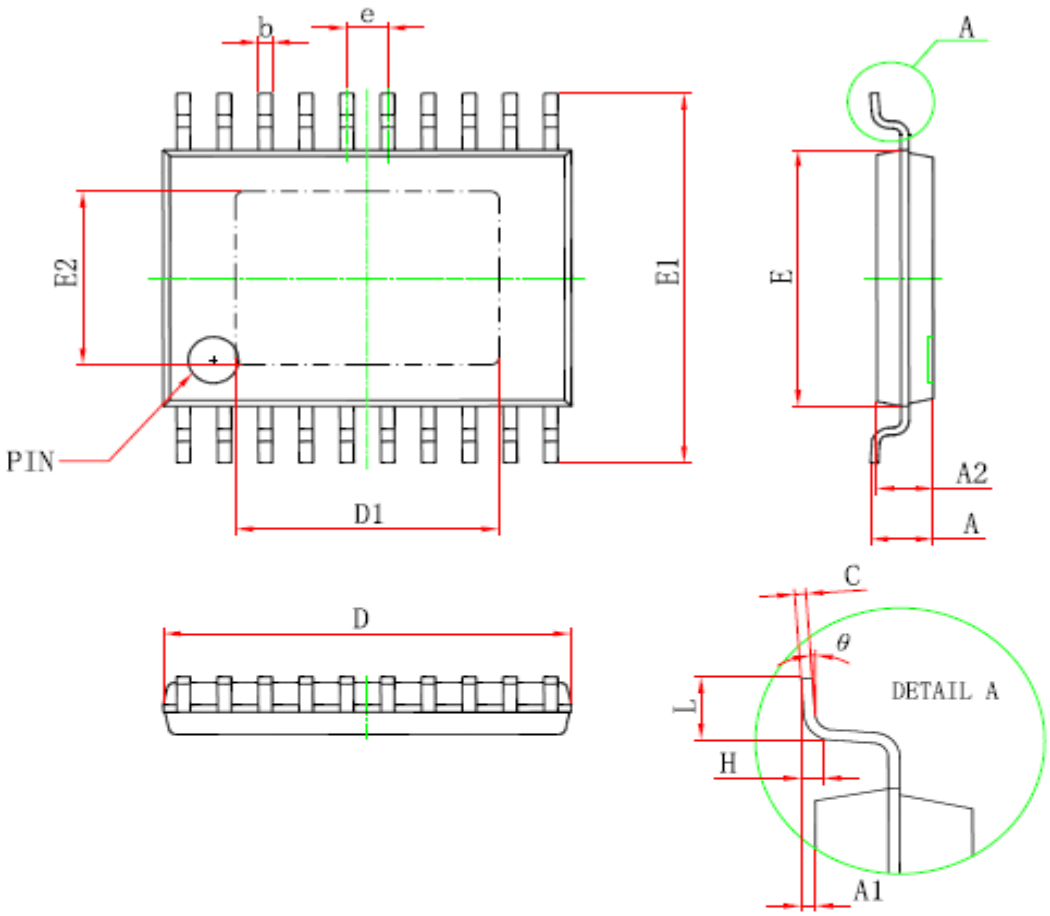

PWM SWITCHING DISCONTINUOUS CONDUCTION MODE

**NOTES:**

The efficiency is tested under normal temperature, the actual current driver capability is 70% ~90% of the max current in sheet consider of high temperature surrounding status

# PACKAGE OUTLINE

## TSSOP20/PP PACKAGE OUTLINE DIMENSIONS




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| D | 6.400 | 6.600 | 0.252 | 0.259 |
| D1 | 4.100 | 4.300 | 0.165 | 0.169 |
| 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 | 2.900 | 3.100 | 0.114 | 0.122 |
| 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 HM1803 and improve the temperature of package, Please ensure Epad and enough ground PCB to release energy.**