具有电量均衡功能的5V输入高效同步升压型1.2A双节锂电池充电器

High Efficiency, 1.2-A, 2-Cell Synchronous Boost Battery Charger with Cell Balancing for 5V Input

■ FEATURES

· High-efficiency 1.2-A, 800kHz Synchronous boost charger
    92% charge efficiency at 5V adapter, 7.2V battery, 1A charge

· Support 5V input and 2-cell Li-Ion battery
    Supports 4V-6V input voltage range with 16V absolute maximum input voltage rating
    Adaptive input current limit: 4-4.5V input
    OVP protection: 6.2V

· Charge voltage selectable: 8.4V / 8.7V

· Automatic Cell Balancing (HT4188)

· Short current / trickle current / constant current / constant voltage charge mode

· Programmable charge current by external resistor

· Status indication

· Charge timeout, Thermal regulation, Over temperature protection, Input voltage UVLO and OVP, Output short circuit / overcurrent / OVP protection, NTC

· Pb-free Packages, SOP8L-PP, SOP16L-PP

·高效的1.2A 800kHz开关模式同步升压充电器
    5V输入、7.2V电池、1A充电电流下，效率92%

·支持5V输入，给双节串联锂电池充电
    4V-6V范围内正常工作；4-4.5V自动调节输入电流；6.2V过压保护
    最大支持16V输入

·电池饱充电压8.4V和8.7V可选

·自动动态电量平衡功能（HT4188）

·短路涓流/预充涓流/恒流/恒压充电模式

·充电电流由外部电阻灵活调节

·LED状态显示

·保护：充电超时、芯片过热反馈调节、过温关断、输入过压、输入欠压、输出过流、输出过压、输出短路、NTC温度保护等

·SOP8L-PP, SOP16L-PP封装

■ APPLICATIONS

· Portable Speakers   · POS

· E-Cigarette   · Other portable electronic devices

·音箱   ·POS机   ·电子烟

·对讲机   ·其他便携式电子设备

■ ORDERING INFORMATION

Part Number	Package Type	Marking	Operating Temperature Range	MOQ/Shipping Package
HT4182SPET	SOP8L-PP	HT4182SPE UVWXYZ[1]	-40℃～85℃	Tube / 100pcs
HT4182SPER	SOP8L-PP	HT4182SPE UVWXYZ	-40℃～85℃	Tape and Reel / 2500pcs
HT4188SPET	SOP16L-PP	HT4188SPE UVWXYZ	-40℃～85℃	Tube / 50pcs
HT4188SPER	SOP16L-PP	HT4188SPE UVWXYZ	-40℃～85℃	Tape and Reel / 2500pcs

[1] UVWXYZ is production tracking code

■ DESCRIPTION

HT4182, HT4188 is a 5V input, 2A two-cell synchronous boost Li-Ion battery charger. The input terminal has UVLO and OVP protection.

HT4182, HT4188 adopts synchronous boost converter integrating switches to provide a high efficiency and small size solution. The charge current (max 1.2A) is programmable by an external resistor.

HT4182, HT4188 integrates multiple protection function including: charge timeout, thermal regulation, over temperature protection, Input voltage UVLO and OVP, Output short circuit / overcurrent / OVP protection and NTC. Abnormal status can be indicated by STAT terminal.

HT4188 integrates cell balancing function, which can automatically balance the charge current and battery voltage between two cells so that the life of the battery pack could be extended.

The device is available in SOP8L-PP, SOP16L-PP package.

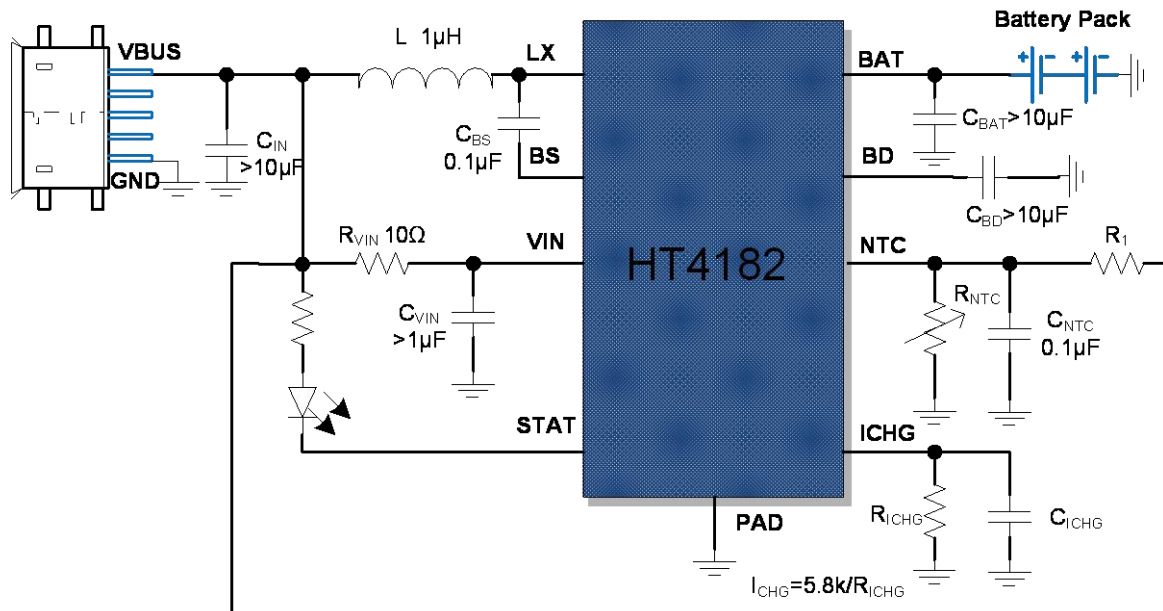HT4182, HT4188是一款5V输入，升压模式的充电管理IC，适用于双节串联锂电池。其能自适应任意5V电源进行充电，并且由输入过压、欠压保护。

HT4182, HT4188采用同步升压结构，内置MOSFET，外围元件简单。通过调节外部电阻，可任意调节充电电流，最大支持1.2A，效率超过90%。
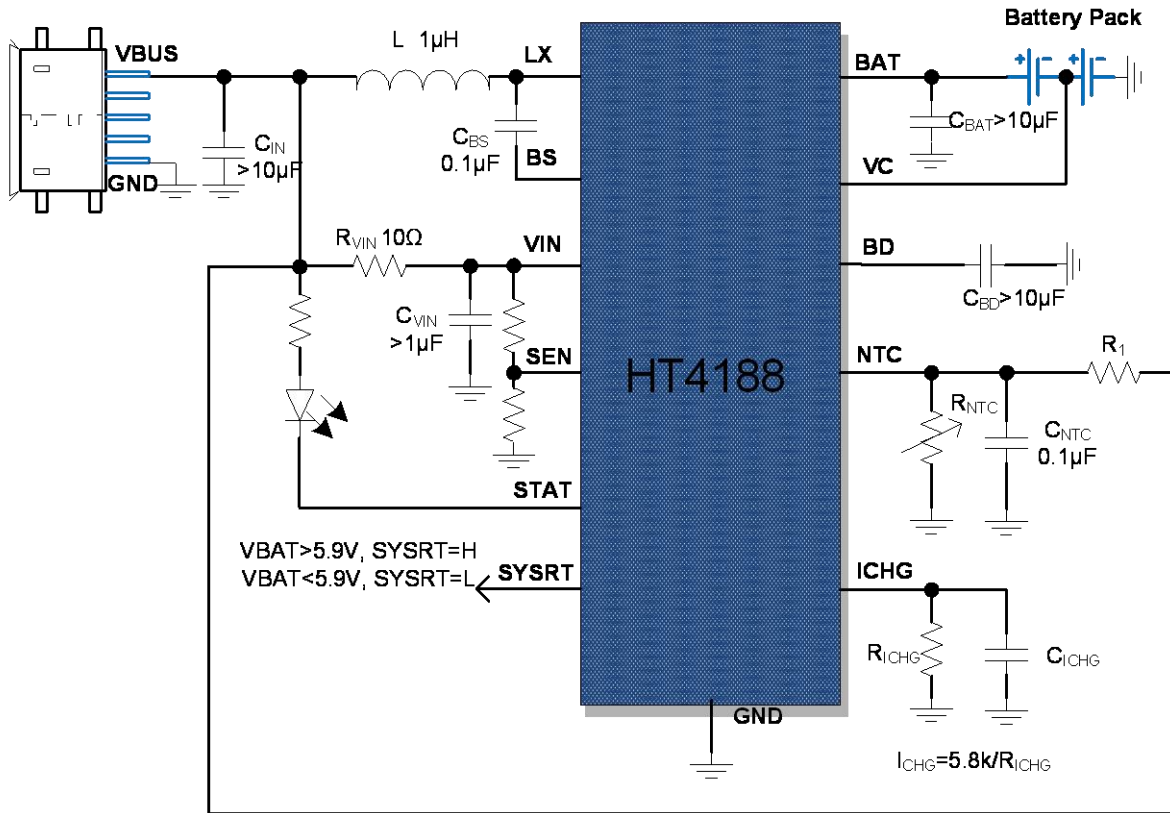
HT4182, HT4188具有多重保护功能：充电超时、芯片过热反馈调节、过温关断、输入过压、输入欠压、输出过流、输出过压、输出短路、NTC温度保护等。异常时，可通过LED进行异常指示。

HT4188还提供自动动态电量平衡功能，在充电时，自动均衡充电电量以平衡两节电池电压，提高电池包寿命。
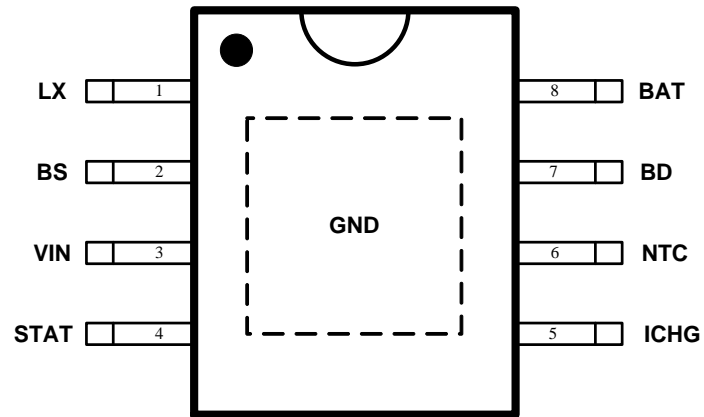
该产品提供SOP8L-PP, SOP16L-PP封装。

■ TYPICAL APPLICATION

$$I_{CHG}=5.8k/R_{ICHG}$$

Battery Pack

VBUS

C_{IN} >10µF

GND

L 1µH

C_{BS} 0.1µF

LX

BS

BAT

C_{BAT}>10µF

VC

R_{VIN} 10Ω

VIN

C_{VIN} >1µF

SEN

STAT

HT4188

BD

C_{BD}>10µF

NTC

R_{NTC}

C_{NTC} 0.1µF

R_1

VBAT>5.9V, SYSRT=H
VBAT<5.9V, SYSRT=L

SYSRT

ICHG

R_{ICHG}

C_{ICHG}

GND

I_{CHG}=5.8k/R_{ICHG}

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■ **TERMINAL CONFIGURATION**

LX	1	8	BAT
BS	2	7	BD
VIN	3	6	NTC
STAT	4	5	ICHG

GND

HT4182SPET, HT4182SPER

PGND	1	16	PGND
LX	2	15	BAT
LX	3	14	BAT
BS	4	13	BD
VIN	5	12	BD
SEN	6	11	NTC
STAT	7	10	VC
SYSRT	8	9	ICHG

EP

HT4188SPET, HT4188SPER

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■ **TERMINAL FUNCTION**

Terminal No.		Name	Description
SOP8L-PP	SOP16L-PP		
PAD	1, 16	GND	Ground. 地。
	PAD	NC	No connection, recommended to connect GND plane for thermal consideration. 无连接，建议接地，增加散热
1	2，3	LX	The switching node pin of the boost converter. 开关节点，连接电感。
2	4	BS	Power supply for high-side MOSFET gate driver. 提供同步整流的栅极驱动，串联 100nF 到 LX。
3	5	VIN	Power supply input. 电源输入端。
	6	SEN	VIN SENSE for Adaptive Current Limit. VIN 监测自动调节充电电流端。
4	7	STAT	Status indicator. 状态显示端，为开漏极结构。
	8	SYSRT	Battery status, when battery voltage is lower than 5.9V, it is pulled low, when battery voltage is higher than 5.9V, it is pulled high. 电池状态显示，电池电压低于 5.9V 时，引脚输出低，电池电压高于 5.9V 时，引脚输出高。
5	9	ICHG	Charge current setting. 充电电流设置端，外接电阻到地。
	10	VC	Mid-Point Between 2 Cells. 连接至双节串中间点。
6	11	NTC	Temperature Qualification Voltage. 温度保护输入端，接 NTC 电阻到地。
7	12, 13	BD	Blocking MOSFET Connection. 连接至内部 Blocking FET，接 10uF 电容到地。
8	14, 15	BAT	Battery Power Connection. 电池连接端。

■ SPECIFICATIONS[1]

● Absolute Maximum Ratings[2]

PARAMETER	Symbol	MIN	MAX	UNIT
LX, BAT, BD, STAT, NTC, BS, VIN supply voltage range	V_{VDD}	-0.3	18.0	V
ICHG	V_{ICHG}	-0.3	3.6	V
LX current peak	I_{LIM}		2.5	A
Operating temperature range	T_A	-40	85	℃
Operating junction temperature range	T_J	-40	150	℃
Storage temperature range	T_{STG}	-50	150	℃

● Recommended Operating Condition

PARAMETER	Symbol	CONDITION	MIN	TYP	MAX	UNIT
VIN supply voltage range	V_{IN}		4.0		5.5	V
LX, BAT, BD, STAT, BS voltage range	V_{DD}		0		16	V
ICHG, NTC voltage range	V_O		0		3.3	V
LX current peak	I_{LIM}				2.5	A
Operating temperature	T_a		-40	25	85	℃

● Electrical Characteristics

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Quiescent Current						
Battery discharge current	I_{BAT}	Shutdown IC, V_{BAT} = 8.4V, VIN = 0V		10		uA
Input quiescent current	I_{IN}	Disable charge, VIN = 5V		1		mA
Bias Supply						
Supply voltage	VIN		4		6	V
VIN under voltage lockout threshold	V_{UVLO}			4		V
VIN under voltage lockout hysteresis	ΔV_{UVLO}			0.4		V
Input overvoltage protection	V_{OVP}			6.2		V
Input overvoltage protection hysteresis	ΔV_{OVP}			0.7		V
Oscillator and PWM						
Switching frequency	f_{SW}			800		kHz
Max LS-FET on Duty	D_{MAX}			85		%
LS-FET minimum on time	T_{MINON}			100		ns
Power MOSFET						
RDS(ON) of LS-FET	R_{NFET_M}			80		mohm
RDS(ON) of HS-FET	R_{NFET_R}			40		mohm
RDS(ON) of Blocking FET	R_{NFET_M}			40		mohm
Voltage Regulation						
2-Cell regulation voltage	V_{BAT_REG}		8.36	8.4	8.44	V
2-Cell recharge voltage	V_{BATR}			8.2		V
Battery voltage rising threshold to start constant current charge mode	V_{TRK_R}			5.8		V
Battery voltage falling threshold to stop constant current charge mode	V_{TRK_F}			5.5		V
Battery voltage rising threshold to start trickle current charge mode	V_{SHORT_R}			2		V
Battery voltage falling threshold to stop trickle current charge mode	V_{SHORT_F}			1.8		V

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[1] Depending on parts and PCB layout, characteristics may be changed.

[2] 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 under recommended operating conditions is not implied. Exposure to absolute–maximum–rated conditions for extended periods may affect device reliability
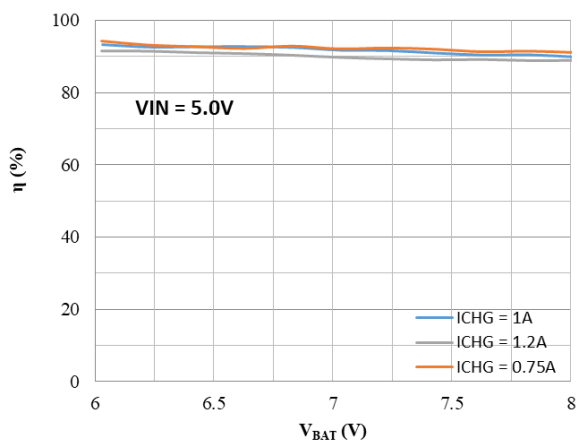
Charge Current						
Charge current for constant current charge mode	I_{CC}			5.8k/R_{ICHG}		A
Charge current for trickle current charge mode	I_{TC}			20%		I_{CC}
Charge current in short mode	I_{SHORT}			10%		I_{CC}
Termination current	I_{TERM}			10%		I_{CC}
Battery Voltage OVP						
Output voltage OVP threshold	V_{OVP}		105%	110%	115%	V_{CV}
Input Voltage Threshold for Adaptive Current Limit						
VIN Voltage	V_{IN_th}			4.5		V
Voltage reference of SEN therminal	V_{SEN_th}			1.1		V
SYSRT terminal						
High logic of SYSRT	V_{H_SYSRT}			3.3		V
Low logic of SYSRT	V_{L_SYSRT}			0		V
SYSRT threshold	V_{SYS_th}	V_{BAT} voltage rising		5.9		V
Hysteresis for SYSRT threshold	V_{HY_SYS}			0.1		V
Timer						
Trickle current charge timeout	T_{TC}			50		min
Constant current charge timeout	T_{CC}			5.5		hour
Battery Thermal Protection NTC						
Under temperature protection	UTP		70%	75%	80%	VIN
Under temperature protection hysteresis		Falling edge		5%		
Over temperature protection	OTP		28%	30%	32%	
Over temperature protection hysteresis		Rising edge		3%		
Cell Balancing						
Cell balancing current	I_{CB}	Battery with higher voltage V_{CELLx}		V_{CELLx}/120		A
Cell balancing start VBAT voltage threshold	V_{CB_th}			7.8		V
Cell balancing start VBAT voltage hysteresis	V_{CB_sys}			0.1		V
Cell balancing start cell voltage difference threshold	V_{DIFF_th}			0.08		V
Cell balancing start cell voltage difference hysteresis	V_{DIFF_sys}			0.01		V
Thermal Regulation and Thermal Shutdown						
Thermal regulation threshold	T_{REG}	Rising threshold		125		℃
Thermal regulation foldback ratio				0.25		I_{CC}
Thermal shutdown temperature	T_{SD}	Rising threshold		160		℃
Thermal shutdown temperature	T_{SDHYS}			30		℃

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■ TYPICAL OPERATING CHARACTERISTICS

Charge Efficiency

VIN = 5.0V

ICHG = 1A
ICHG = 1.2A
ICHG = 0.75A

η (%)

V$_{BAT}$ (V)

Charge Efficiency

VIN = 5.0V

CV mode

η (%)

I$_{BAT}$ (A)
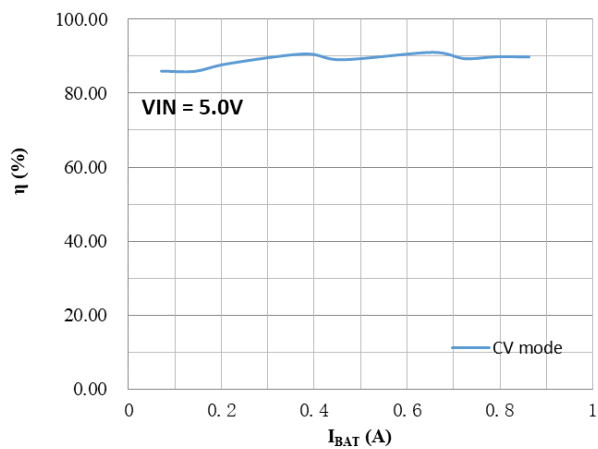
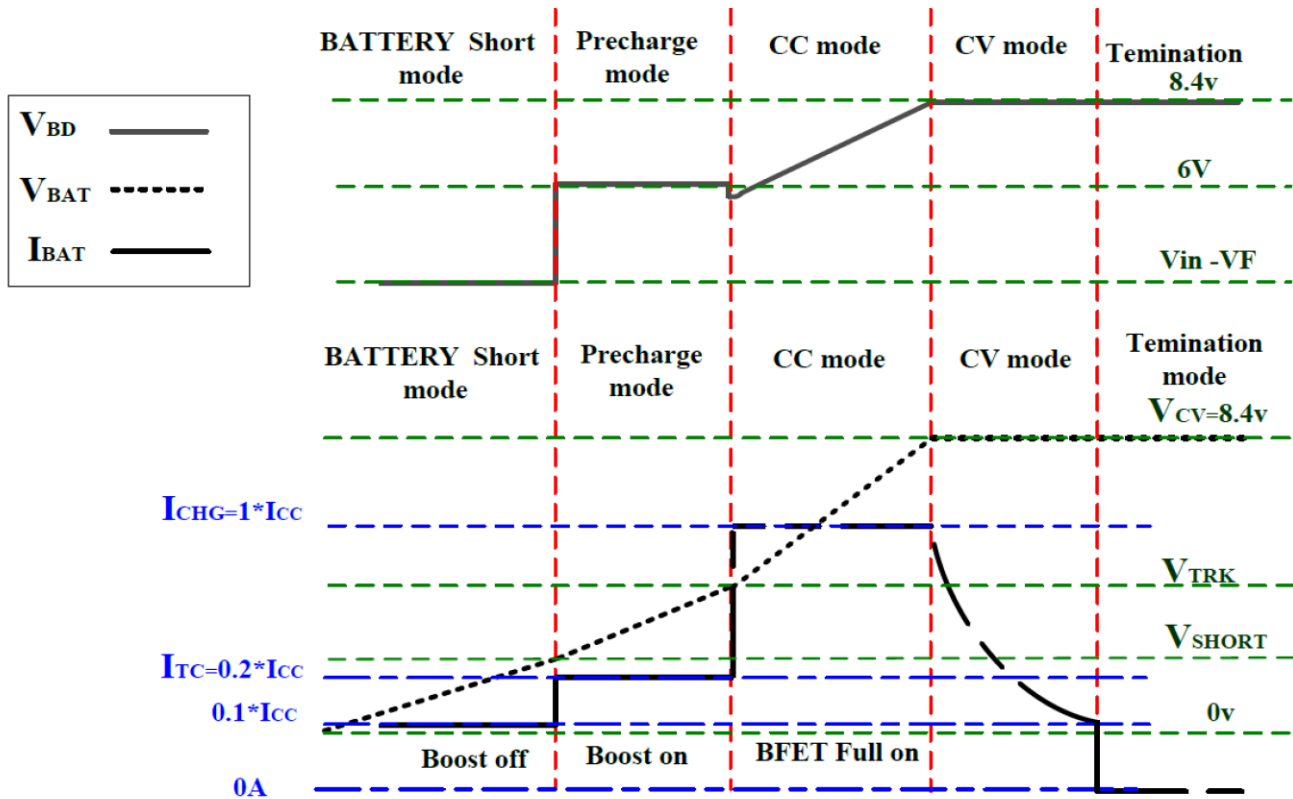■ **APPLICATION INFORMATION**

1. *Charge process*

Figure 1 Charge Process

2. *Charge current*

The charge current can be set through the resistor R_{ICHG} pulled from ICHG pin to Ground. The charge current $I_{CHG} = \frac{5.8K}{R_{ICHG}}$. Once the die temperature is higher than 125℃ or the voltage of VIN is lower than 4.5V, the charge current will be adaptively decreased.

在 ICHG 引脚端对地下拉电阻 R_{ICHG}，可设置充电最大电流，充电电流 $I_{CHG} = \frac{5.8K}{R_{ICHG}}$。在高温环境、VIN 电压低于 4.5V 等情况下，充电电流会减小。

3. *Short Mode*

If V_{BAT} is lower than V_{SHORT} (Typically 2V) and the input power is normally supplied, the HS-FET turns off, Blocking FET works in linear mode, and the battery will be charged through body diode of HS-FET by 10% I_{CC} .

在输入电源正常接入时，若 V_{BAT} 小于 V_{SHORT}(典型值 2V)，HS-FET 将被关闭，芯片通过 HS-FET 二极管充电，Blocking FET 进入线性模式，并提供 10% I_{CC} 的电流给电池充电。

4. *Pre-charge / Trickle charge mode*

If V_{BAT} is higher than V_{SHORT} (Typically 2V) but lower than the threshold of trickle charge (Typically 6V) and the input power is normally supplied, the boost converter activates and regulates the V_{BD} at 6V, and the blocking FET wokrs in linear mode, the charge current will be 20% I_{CC}. If the duration of trickle charge exceeds 50min, and the VBAT is still lower than the threshold of trickle charge (Typically 6V), the charge mode turns off, abnormal status is indicated through STAT.

在输入电源正常接入时，当电池电压处于 V_{SHORT} 和 V_{TRK} 之间，升压启动，V_{BD} 设置在 6V 进入预充电模式，Blocking FET 仍旧处于线性模式，并提供 20% I_{CC} 的电流给电池充电。如果预充电模式时间超过 50 分钟，而电池电压无法达到 V_{TRK} 阈值，充电模式将会关闭并在 STAT 上指示异常。

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5. Constant current charge mode

If V_{BAT} is higher than the threshold of trickle charge (Typically 6V) and the input power is normally supplied, the device works in constant current charge mode, the boost converter remains active, the charge current is $I_{CHG} = \frac{5.8K}{R_{ICHG}}$.

当电池电压超过 V_{TRK} 阈值，芯片进入恒流充电模式，升压仍旧启动，充电电流 $I_{CHG} = \frac{5.8K}{R_{ICHG}}$。

6. Constant voltage charge mode

If V_{BAT} reaches threshold of constant voltage charge (Typically 8.4V) and the input power is normally supplied, the device works in constant volage charge mode, the boost converter remains active, the charge current is decreased consequently.

当电池电压达到恒压充电 V_{CV} 阈值(典型 8.4V)，芯片进入恒压充电模式，升压仍旧启动，充电电流逐渐减小。

7. Charge termination

Once the charge current is lower than the termination current threshold I_{TERM} (typically 10% I_{CC}), STAT is hight-Z to indicate the battery is fully charged, all FETs are turned off, and the charge current falls to zero.

在恒压充电模式，芯片监控充电电流的大小，当充电电流小于充电停止电流 I_{TERM} （典型值 10% I_{CC}）时，STAT 输出为高阻表示电池充饱，芯片关断停止充电，充电电流为 0。当电池电压跌落至 8.2V 以下，系统将重新给电池充电。

8. Status indicator

(1) Charge-in-process, STAT is low.

(2) Charge termination, STAT is high-Z.

(3) Fault, STAT is alternatively switched between low and high-Z with 1Hz frequency.

Fault conditon includes: VIN OVP, UTP / OTP in NTC terminal, and charge timeout.

An LED diode can be placed between VIN and STAT, so that the LED can indicate the status:

(1) Charge-in-process, LED on.

(2) Charge termination, LED off.

(3) Fault, LED flashing.

(1) 充电中：STAT 拉低；

(2) 充电完成：STAT 高阻；

(3) 异常状态：STAT 高低交替，频率 1Hz。

异常状态包括：VIN OVP, NTC 发生高温或低温关断，充电超时。

可在 VIN 与 STAT 间连接 LED，则 LET 可显示状态：

(1) 充电中：LED 常亮；

(2) 充电完成：LED 灯灭；

(3) 异常状态：LED 闪烁。

9. Protection Principle

When the input over voltage protection, the output over voltage protection, the thermal protection or the timeout protection happens, the LS-FET of the boost charger is turned off immediately. The HS-FET and the blocking FET are turned off later when the current is down to zero.

When the V_{BAT} is lower than V_{SHORT}, the short circuit protection happens, the LS-FET is turned off firstly, the blocking FET enters linear mode with 10% I_{CC} charging current. When V_{BAT} recovers back to be higher than V_{SHORT}, the boost charger restarts to work and regulates V_{BD} at 6V. The linear charge current is increased from 10% I_{CC} to trickle current.

当输入过压保护、输出过压保护、过温保护启动时，LS-FET 关闭，随后当电流降至 0，HS-FET 和 blocking FET 关闭。

当 VBAT 低于 V_{SHORT}，短路保护启动，LS-FET 关闭，blocking FET 进入线性模式，充电电流 10% I_{CC}。当 VBAT 高于 V_{SHORT} 后，升压启动，V_{BD} 设置在 6V 进入预充电模式，Blocking FET 仍旧处于线性模式，并提供 20% I_{CC} 的电流给电池充电。

10. Adaptive input current limit

HT4182, HT4188 has adaptive input current limit function. Once the deivce starts to charge, the output charging current I_{CC} is ramped up softly and the VIN drop is monitored simultaneously.

When the input voltage drop is too large and VIN is lower than V_{IN_DPM} (typically 4.5V) , the charging current, the charging current is deceased so that the VIN would recover back.

为防止适配器超出负荷能力，当 VIN 电压小于 4.5V 时，充电电流将会减小，使 VIN 可以钳位在 4.5V 的电压。

11.   *NTC terminal*

HT4182, HT4188 monitors battery temperature by measuring NTC voltage. The controller triggers the UTP or OTP when the volage of NTC reaches the threshold of UTP (V_{HTF}) or OTP (V_{LTF}). The temperature sensing network is showed as below.

Choose R_1 and R_{NTC} to program the proper UTP and OTP points.

电池温度由 NTC 引脚的电压测量得到，建议在 NTC 引脚和地之间接一个 100nF 的瓷片电容。NTC 的电压由一个 NTC 电阻和外部的电阻分压器得到，芯片比较 TS 的电压，当电压处于 V_{LTF} 和 V_{HTF} 之间时，允许充电。如果电池的温度超出这个区间，芯片停止充电，直到电池温度回到 V_{LTF} 和 V_{HTF} 之间。
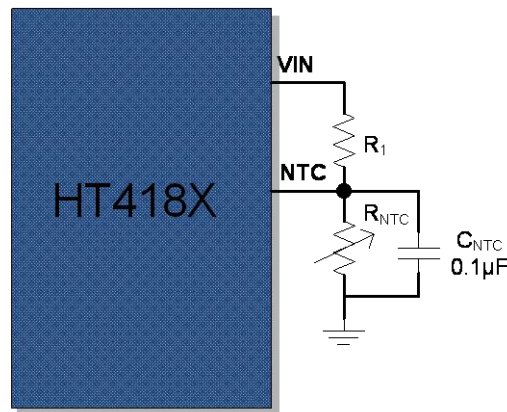
Figure 2 NTC Terminal Configuration

12.   *Cell Balancing (HT4188)*

When VBAT is higher than 7.8V, HT4188 detects the volatge difference between the 2 batteries. Once the voltage difference is higher than 80mV, cell balancing function starts. The balancing current $I_{CB} = V_{CELLx}/120$, in which V_{CELLx} is the battery voltage with higher voltage.

当电池电压超过 7.8V，电池均衡线路启动，芯片检测两节电池的电压。如其中一节电池电压超过另外一节电池电压 80mV，均衡功能启动，均衡电流 $I_{CB} = V_{CELLx}/120$, V_{CELLx} 为电压高的电池的电压。

13.   *Application information*

(1) Input capacitor C_{IN}

The ripple current through input capacitor is greater than

$$I_{CIN\_RMS} = \frac{V_{IN} \times (V_{OUT} - V_{IN})}{2\sqrt{3} \times L \times F_{SW} \times V_{OUT}}$$

X5R or X7R ceramic capacitors with greater than 4.7uF capacitance are recommended to handle this ripple current.

(1) 输入电容C_{IN}

输入电容的流纹波超过

$$I_{CIN\_RMS} = \frac{V_{IN} \times (V_{OUT} - V_{IN})}{2\sqrt{3} \times L \times F_{SW} \times V_{OUT}}$$

建议使用超过4.7uF的瓷片电容处理这个电流纹波。

(2) Output capacitor C_{OUT}

The output capacitor is selected to handle the output ripple noise requirements. This ripple voltage is related to the capacitance and its equivalent series resistance (ESR). For the best performance, it is recommended to use X5R or better grade low ESR ceramic capacitor. The voltage rating of the output capacitor should be higher than the maximum output voltage. The minimum required capacitance can be calculated as:

$$C_{OUT} = \frac{I_{CC}}{F_{SW} \times V_{OUT} \times V_{RIPPLE}}$$

V_{RIPPLE} is the peak to peak output ripple, I_{CC} is the setting charge current.

For HT4182, HT4188, output capacitor is paralleled by C_{BD} and C_{BAT}, for smaller output ripple noise, each capacitor with greater than 10uF capacitance is recommended.

(3) Inductance L

There are several considerations in choosing this inductor:

Choose the inductance to provide the desired ripple current. It is suggested to choose the ripple current to be about 40% of the average input current. The inductance is calculated as:

$$L = (\frac{V_{IN}}{V_{OUT}})^2 \times \frac{(V_{OUT} - V_{IN})}{I_{CC} \times F_{SW} \times 40\%}$$

Where F_{SW} is the switching frequency and I_{CC} is the setting charge current.

The HT4182, HT4188 is quite tolerant of different ripple current amplitude. Consequently, the final choice of inductance can be slightly off the calculation value without significantly impacting the performance.

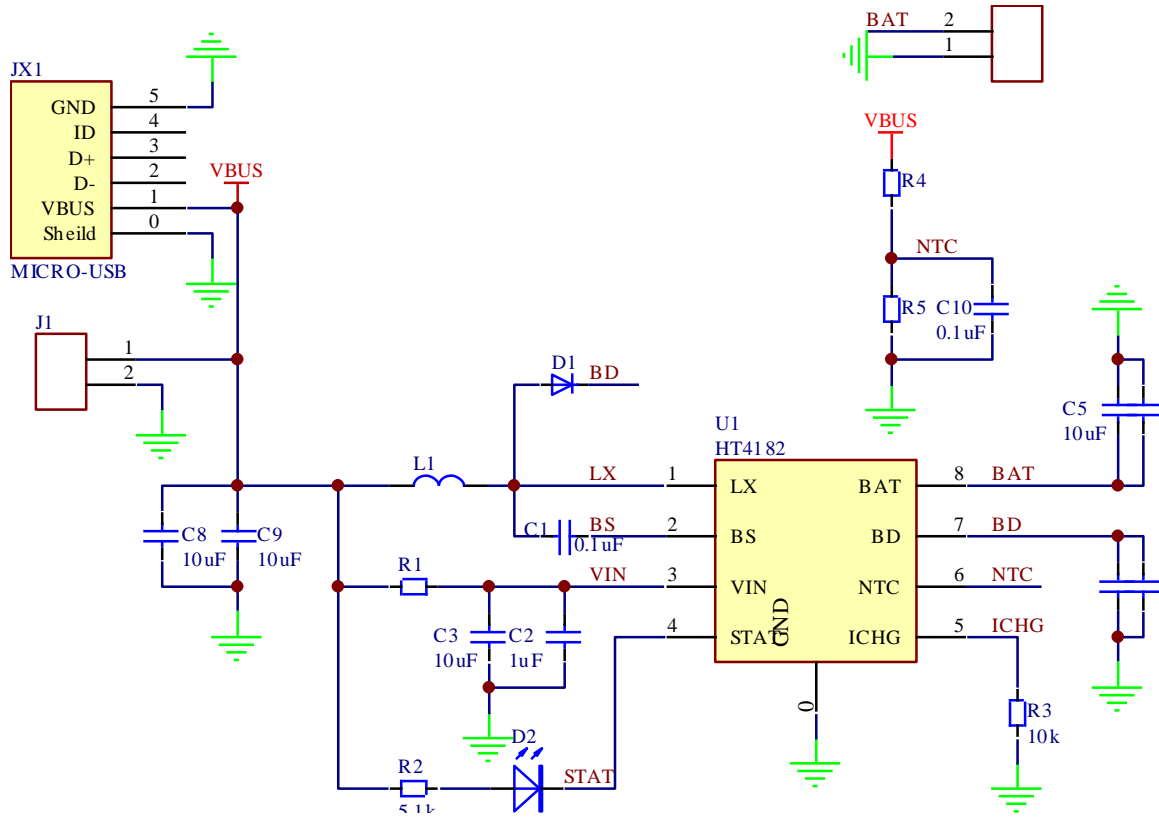The saturation current rating of the inductor must be selected to be greater than the peak inductor current under full load conditions.

$$I_{SAT} > \frac{V_{OUT}}{V_{IN}} \times I_{CC} + (\frac{V_{IN}}{V_{OUT}})^2 \times \frac{(V_{OUT} - V_{IN})}{2 \times F_{SW} \times L}$$

The DCR of the inductor and the core loss at the switching frequency must be low enough to achieve the desired efficiency requirement. It is desirable to choose an inductor with DCR<10mohm to achieve a good overall efficiency.

(2) 输入电容C_{IN}

输出电容用来处理的压纹波需求，该电压纹波和输出容的值等效串联阻（ESR）相关。建议使用X5R或者更低ESR的电容，来达到比较好的效果。电容耐压值需高于最大输出电压。最奥的输出电容值可计算如下：

$$C_{OUT} = \frac{I_{CC}}{F_{SW} \times V_{OUT} \times V_{RIPPLE}}$$

其中V_{RIPPLE}是输出纹波峰值，I_{CC}是设定的充电电流。对于HT4182, HT4188，输出电容是C_{BD}和C_{BAT}的并联。建议使用两个超过10uF瓷片电容。

(3) 电感L

在选择电感时需考虑：

选择电感值来设定流纹波。建议把电流纹波设置在平均电流的40%，电感值计算如下：

$$L = (\frac{V_{IN}}{V_{OUT}})^2 \times \frac{(V_{OUT} - V_{IN})}{I_{CC} \times F_{SW} \times 40\%}$$

其中F_{SW}是开关频率，I_{CC}是设定的充电电流。不同纹波对HT4182, HT4188的影响很小，因此最终的电感值选择可以和计算有所偏差。

电感的饱和电流必须比满负荷工作时的尖峰电流大。

$$I_{SAT} > \frac{V_{OUT}}{V_{IN}} \times I_{CC} + (\frac{V_{IN}}{V_{OUT}})^2 \times \frac{(V_{OUT} - V_{IN})}{2 \times F_{SW} \times L}$$
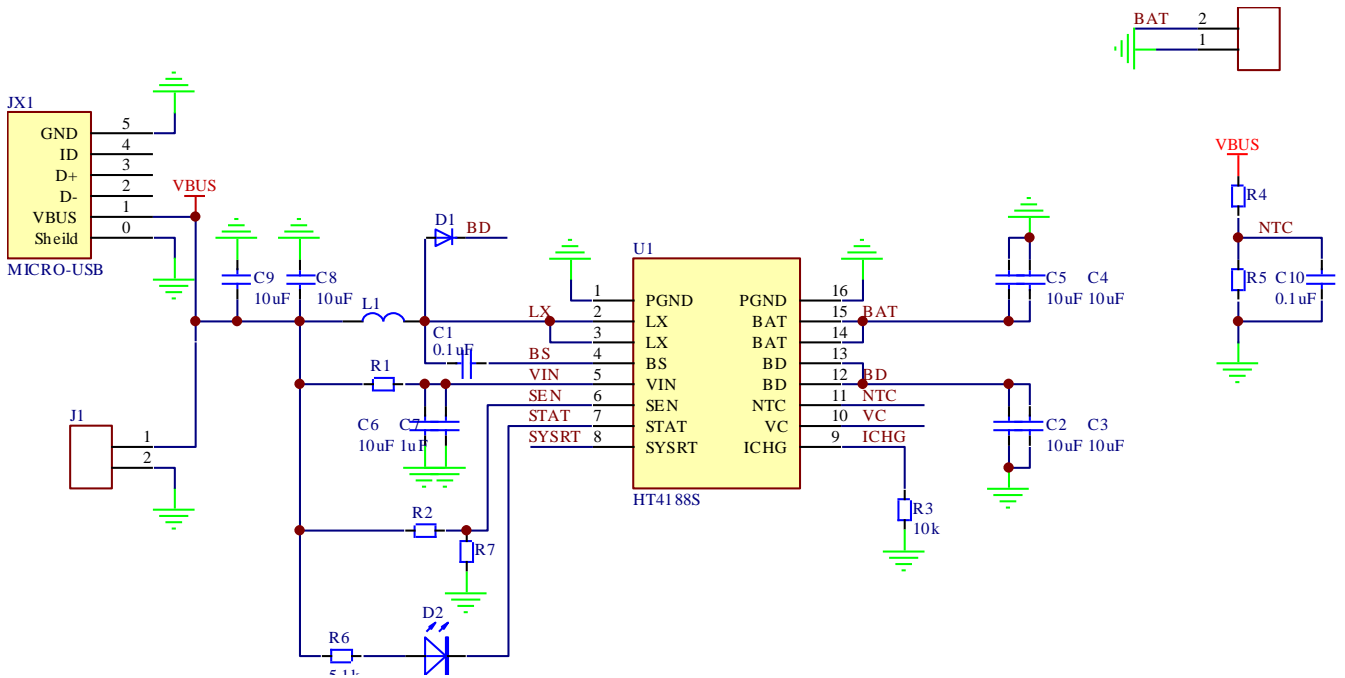
考虑到效率的需求，电感的DCR需要足够小，建议小于10mohm。
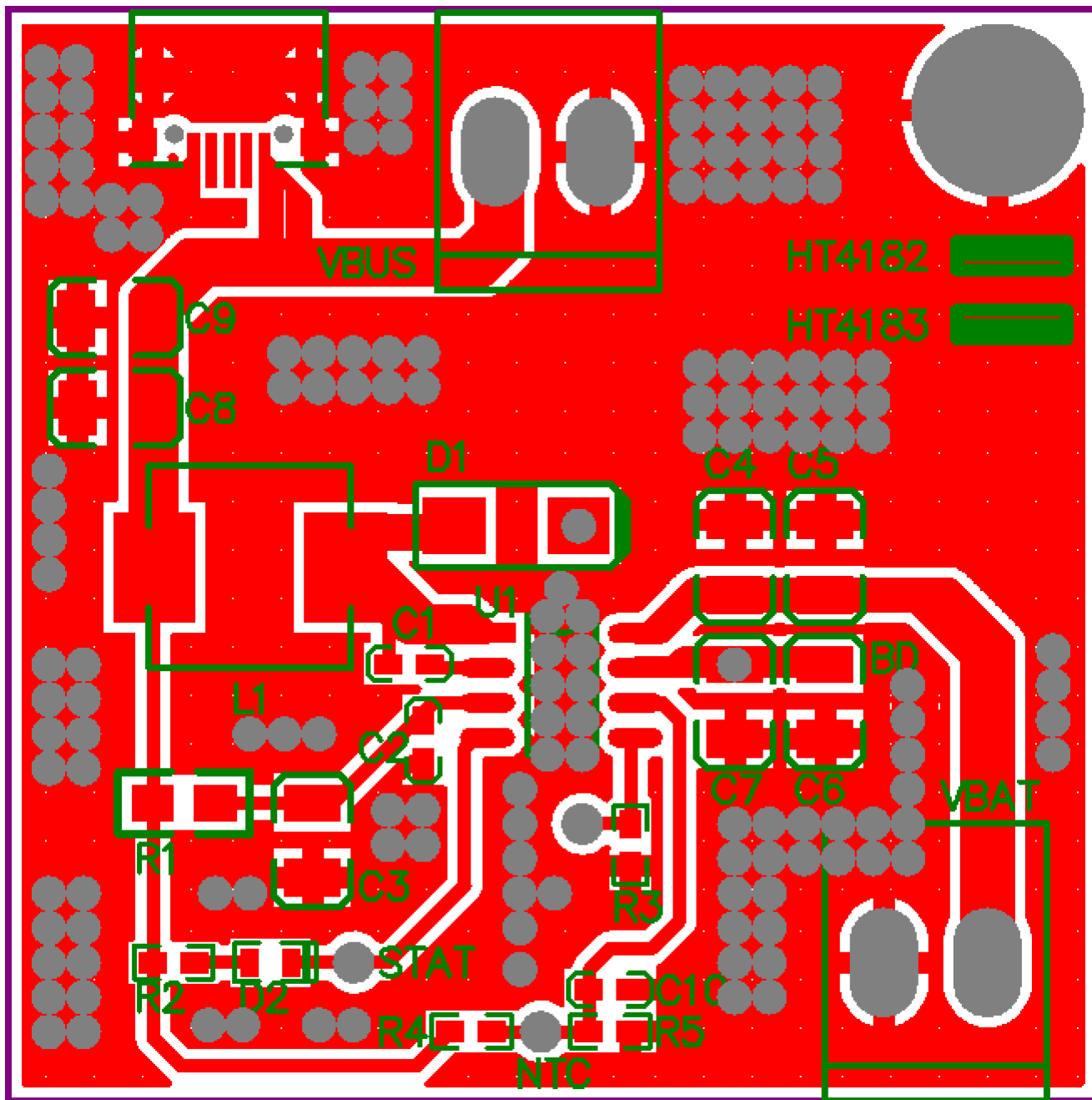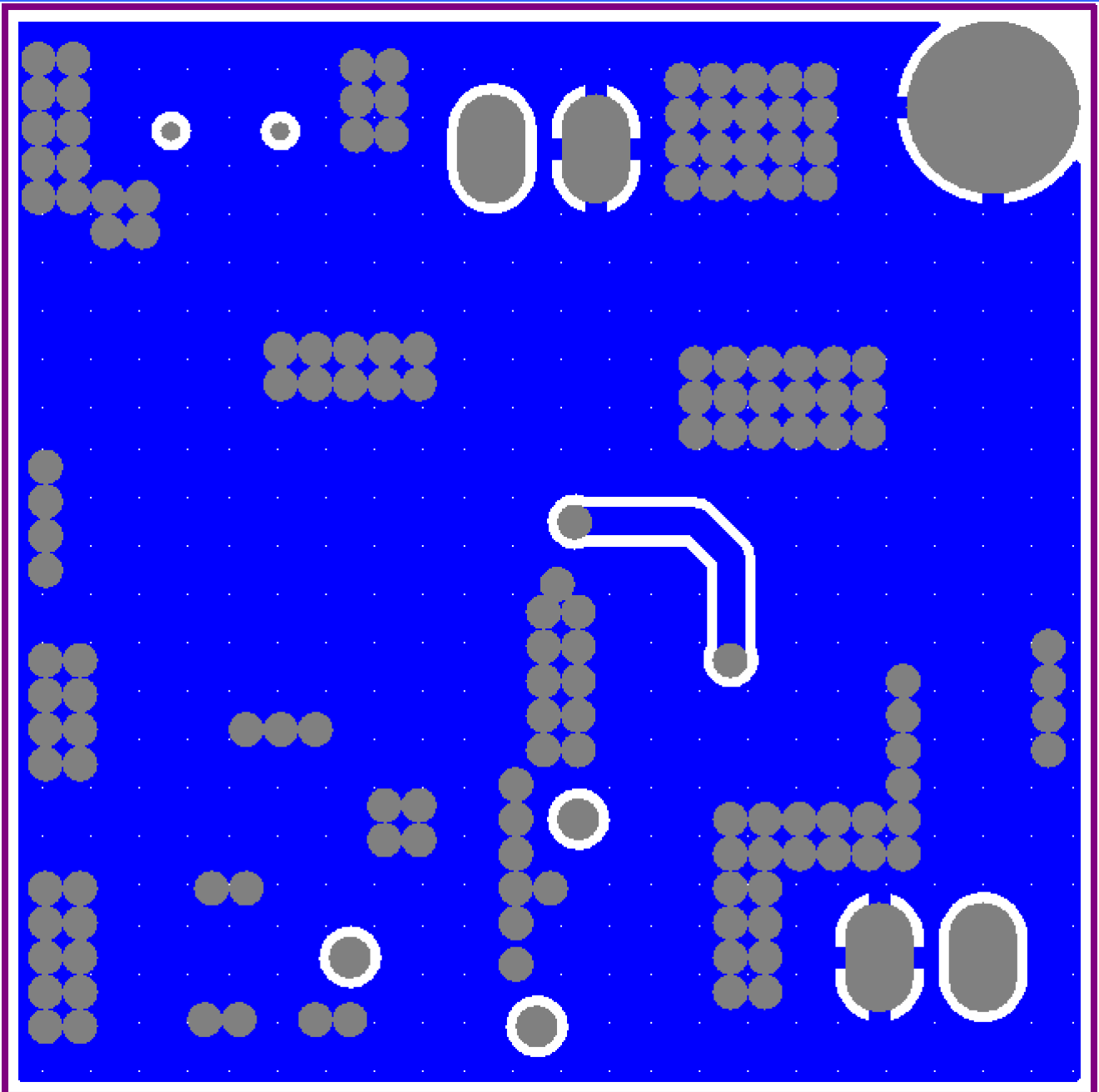
14. *Typical Circuit Diagram*

HT4182

BAT 2
1

VBUS

R4

NTC

R5 C10
0.1 uF

JX1
GND 5
ID 4
D+ 3
D- 2
VBUS 1
Sheild 0

VBUS

MICRO-USB

J1
1
2

C5
10uF

D1 BD

U1
HT4182

LX
L1

C1
BS 0.1uF

R1
VIN

C3 C2
10uF 1uF

D2
R2
5.1k STAT

C8 C9
10uF 10uF

1	LX	BAT	8	BAT
2	BS	BD	7	BD
3	VIN	NTC	6	NTC
4	STAT	ICHG	5	ICHG

GND
0

R3
10k

HT4188

BAT 2
1

VBUS

R4

NTC

R5 C10
0.1 uF

JX1
GND 5
ID 4
D+ 3
D- 2
VBUS 1
Sheild 0

VBUS

MICRO-USB

J1
1
2

C9 C8
10uF 10uF

L1

D1 BD

C1
0.1uF

R1

C6 C7
10uF 1uF

R2

R7

D2

R6
5.1k

U1

1	PGND	PGND	16	
2	LX	BAT	15	BAT
3	LX	BAT	14	
4	BS	BD	13	
5	VIN	BD	12	BD
6	SEN	NTC	11	NTC
7	STAT	VC	10	VC
8	SYSRT	ICHG	9	ICHG

HT4188S

C5 C4
10uF 10uF

C2 C3
10uF 10uF

R3
10k

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15. *PCB Layout*

HT4182

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HT4188

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■ PACKAGE OUTLINE

SOP8L-PP
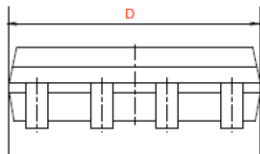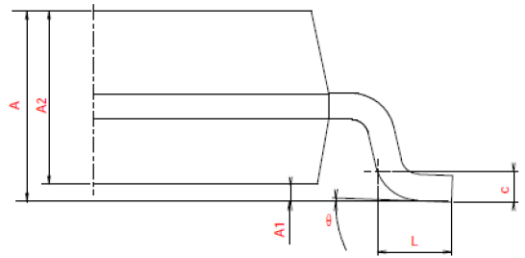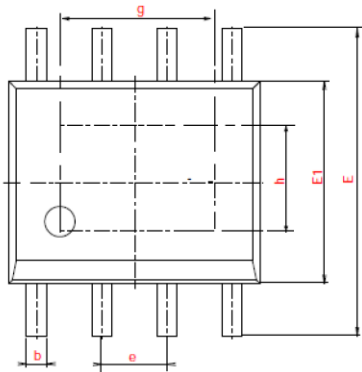
名称	尺寸	
	Min	Max
A	1.45	1.75
A1	0.05	0.15
A2	1.35	1.55
b	0.3	0.5
c	0.22	0.28
D	4.7	5.1
E	5.8	6.2
E1	3.85	4.05
L	0.4	1.27
θ	0°	8°
e	1.270 (BSC)	
h	2.4	
g	3.3	

SOP16L-PP
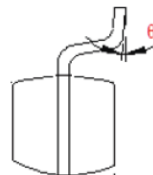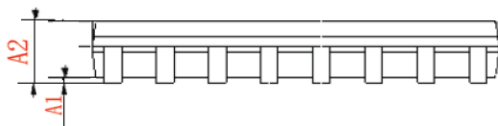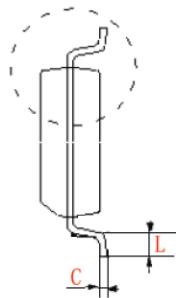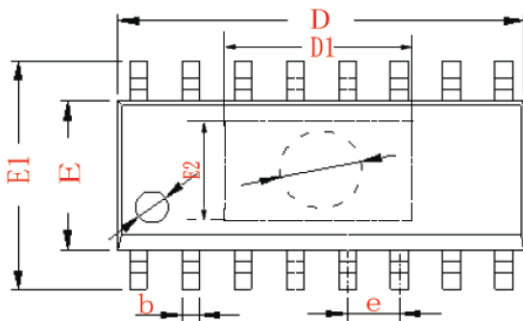
名称	尺寸	
	Min	Max
A1	0.1	0.25
A2	1.25	1.55
b	0.33	0.51
E	3.8	4
E1	5.8	6.2
D	9.8	10.2
e	1.27BSC	
C	0.17	0.25
L	0.4	1.27
θ	0°	8°
D1	4.3	4.6
E2	2.3	2.5