2.0A, 1 / 2 节锂电池开关型充电器

产品概述

VAS5175H 是一款5V-24V输入,高度集成的开关型锂离子/聚合物电池充电芯片, 以高精度调节2A充电电流,和电池电压。它密切监测电池组的温度只在设置安全温度范围下允许充电,还提供电池检测、预充电调节、充电饱充和充电状态指示等功能。热反馈调节可降低充电电流并维持芯片内部温度以不超过 125°C 的条件下工作,如果结温超过 155°C,它将进行过热关断保护,停止工作以确保可靠度。

VAS5175H 适合单/两节电池充电,它集成 24V 耐压,低导通组抗的 N-型场效应晶体管以 1.0MHZ 同步降压管理实现高效率的锂电池充电并简化外围电路设计。VAS5175H 封装为 SOP8-e。

产品特点

- 1MHz 同步降压调节
- MOS 集成
- 可编程(Max.2A)恒流充电
- 1 / 2-节电池供电
- 电池单节 4.35V，双节 8.7V
- 5~24V 工作电压范围
- 高达 93%的效率
- 内部软启动
- 内部环路补偿
- 多重保护
  - 输出短路保护
  - 过温度保护
  - 电池过电压保护（BOVP）
  - 充电定时器
  - 热反馈调节@T_j=125C
  - NTC 检测, 温度异常充电暂停
- 充电状态指示
- 精确度
  ±1% 电池电压调节(CV)
  ±10% 充电电流调节(CC)

应用领域

- 平板电脑
- 电动工具
- 蓝牙音箱
- POS 机
- 无线对讲机

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Typical Application Circuits

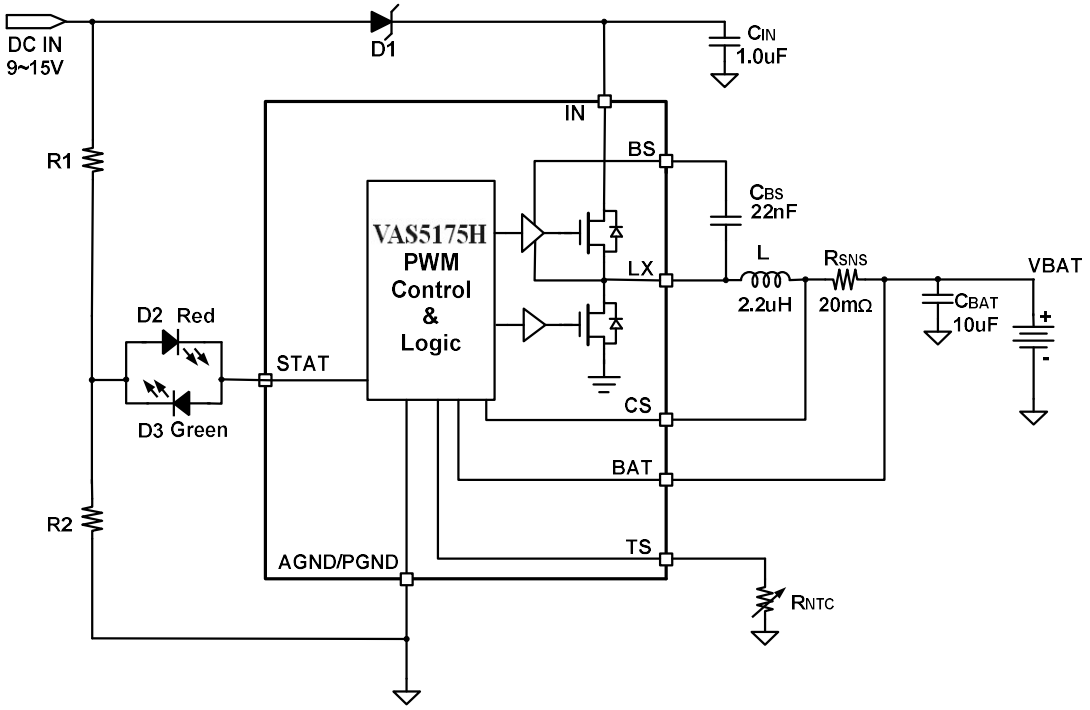


Figure 1. Typical Application Schematic for 2-Cells Battery (Block reverse current with a Schottky diode)

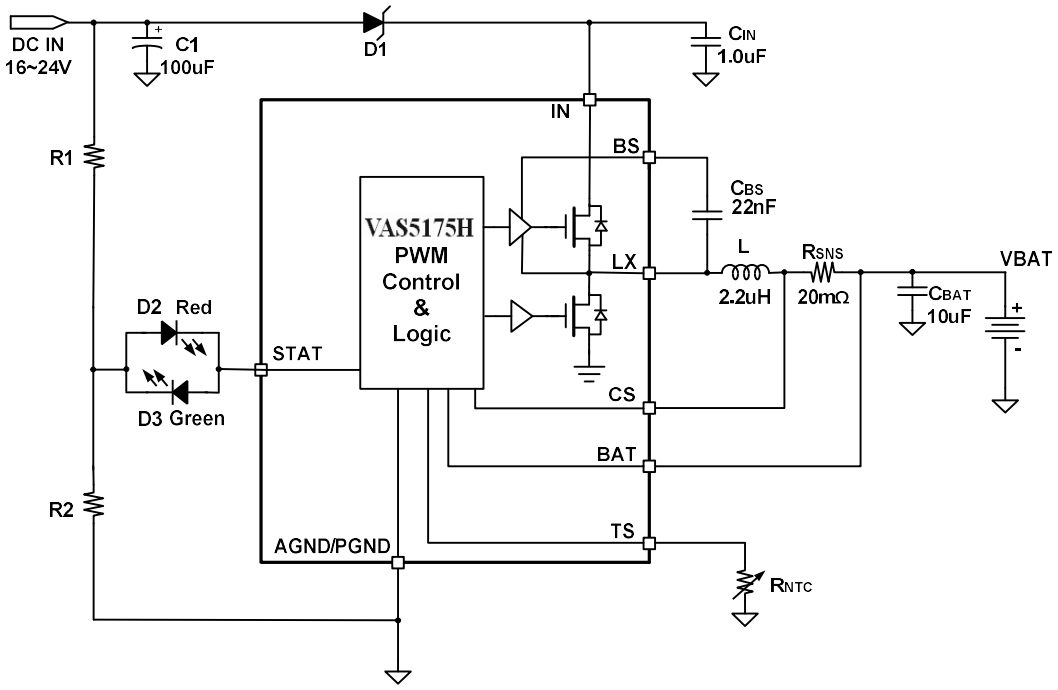


Figure 2. Typical Application Schematic for 2-Cells Battery if Input Power Exceeded 15V
(add C1=100uF electrolytic capacitor for surge protection)

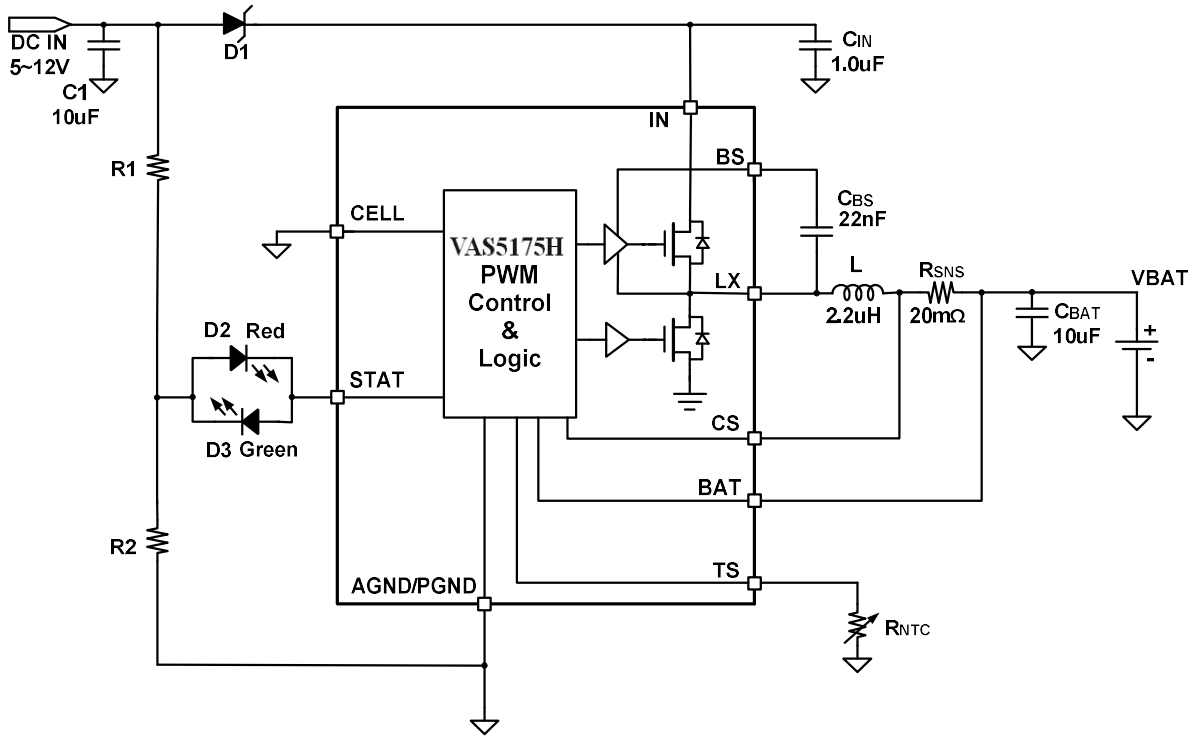
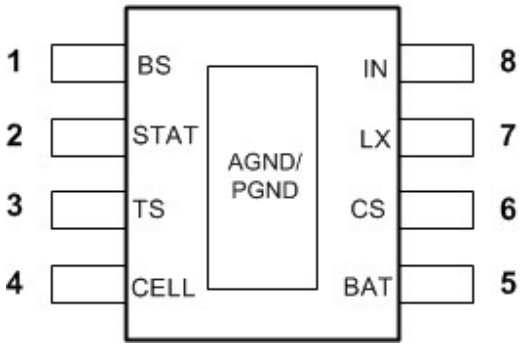


Figure 3. Typical Application Schematic for 1-Cells Battery

PIN Configuration

Package	PIN-OUT
SOP8-e	

PIN Description

PIN NO.	Name	Description			
1	BS	Bootstrap 引脚。 在 LX 和 BS 之间使用 10~22nF 的瓷片电容连接。			
2	STAT	状态输出			
		Hi-Z	High	Low	Blinking
		休眠模式	充电完成	充电中	异常
3	TS	电池温度采样端口，连接到电池温度调节器端子(NTC)，如果不连接到电池，可以连接至地以屏蔽NTC功能。推荐选料10K NTC (B-Constant=3950K)。 **TS引脚对地建议使用0.1uF瓷片电容，避免干扰			
4	CELL	充电节数选择引脚。 浮空为预设 2 节电池充电；下拉做 1 节充电；不可上拉；			
5	BAT	电池电压检测、充电电压调节和电流检测输入。BAT 与 AGND 使用 0.1uF 电容做共模滤波。 ** PCB 电池接点 B+对地建议使用 1.0uF 并联 10uF 瓷片电容			
6	CS	电流检测输入引脚。CS 与 AGND 建议接 0.1uF 做共模滤波。			
7	LX	开关电流输出引脚，连接电感。 使用 10-22nF BS 电容跨接于 LX 与 BS 引脚之间用于上管驱动线路供电。			
8	IN	芯片电源。使用 1uF 瓷片电容连接 AGND。 **输入电压超过 15V 以上时，建议于电源接点处使用 100uF 电解电容做为浪涌电压的吸收与保护。			
9	PGND/ AGND	底部焊盘。连接到 PCB 的地。			

Order Information

Order Number	Package Type	QTY/Reel	Green Status	Operation temp range
VAS5175HID08E	SOP8-e	2500	RoHS	-40 °C to 85°C

VAS5175H □□ □□ □

Lead Free Code
E: Lead Free

Pin Code
08: 8pins

Package Type
D: SOP

Temperature Code
I: Industrial, -40°C to +85°C

Absolute Maximum Ratings

Parameters	Maximum Ratings
IN, CS, BAT, STAT	-0.3V to 24V
BS	-0.3V to 28V
LX	-2V to 24 V
TS	-0.3V to 7V
PGND	-0.3V to +0.3V
CS-BAT	-0.5V to +0.5V
Junction temperature range	-40°C to +150°C
Storage temperature range	-65°C to +150°C
Lead Temperature	260°C
Maximum Power Dissipation	2W
ESD (HBM)	2000V

Electrical Characteristics

Symbol	Parameter	Condition	SPEC			Unit
			Min.	Typ.	Max.	
Operating Conditions						
V_{IN_OP}	IN input voltage operation range during charging		4.5		24	V
Quiescent Current						
I_{BAT}	Battery discharge current (sum of currents into IN, CS, BAT)	V_{IN} < V_{UVLO}, V_{BAT} > V_{IN}, T_J=0°C to 85°C, Sleep Mode		20	50	uA
		V_{IN} > V_{UVLO}, V_{IN} > V_{BAT}, Charge Done		10	30	uA
I_{AC}	Adapter supply current (current into IN)	V_{IN} > V_{UVLO}, V_{IN} > V_{BAT}, Charge disabled		2	3	mA
		V_{IN} > V_{UVLO}, V_{IN} > V_{BAT}, Charge enabled, switching		10		mA
Charge Voltage Regulation						
V_{BAT_REG}	BAT regulation voltage	1 cell, measured on BAT	4.29	4.35	4.37	V
		2 cells, measured on BAT	8.60	8.7	8.75	V
	Charge voltage regulation accuracy	T_J=-20℃ to 125℃	-1		1	%
Charge Current Regulation						
V_{CS-BAT_PC}	Charge Current Full Scale Sense Voltage in Pre-Charge	R_{SNS}=20mΩ	1.5	3	4.5	mV
V_{CS-BAT_CC}	Charge Current Full Scale Sense Voltage in Constant Current Charge	R_{SNS}=20mΩ	27	30	33	mV
Charge Termination						
K_{TERM}	Termination set factor	Termination of fast charge current		10		%
t_{TERM_DEG}	Deglitch time	V_{BAT} > V_{RCH} and I_{CHG} < I_{TERM}		1.3		S

Symbol	Parameter	Condition	SPEC			Unit
			Min.	Typ.	Max.	
Input Under-Voltage Lock-Out Comparator (UVLO)						
V_{UVLO}	DC under-voltage rising	Measure on IN		4.1		V
$V_{UVLO-HSY}$	DC under-voltage	Measure on IN		3.9		V
Sleep Comparator (Reverse Discharging Protection)						
V_{SLEEP}	Sleep mode threshold	V_{IN}-V_{BAT} falling		50		mV
$V_{SLEEP-HYS}$	Hysteresis	V_{IN}-V_{BAT} rising		250		mV
$t_{SLEEP-DC}$	Deglitch to disable charge	V_{IN}-V_{BAT} falling		1		mS
$t_{SLEEP-FALL}$	Deglitch to enter Sleep	V_{IN}-V_{BAT} falling		1		mS
$t_{SLEEP-RISE}$	Deglitch to exit Sleep	V_{IN}-V_{BAT} rising		1.3		S
Bat Low Comparator						
V_{LOWV}	Pre-charge to fast charge transition threshold	1 cell, measured on BAT	2.8	2.9	3.0	V
		2 cells, measured on BAT	5.7	5.8	5.9	V
$V_{LOWV-HYS}$	Fast charge to pre-charge hysteresis	1 cell, measured on BAT		100		mV
		2 cells, measured on BAT		200		mV
$t_{pre2fast}$	V_{LOWV} rising deglitch	Delay to start fast charge current		25		mS
$t_{fast2pre}$	V_{LOWV} falling deglitch	Delay to start pre-charge current		25		mS
V_{SHORT}	Battery short voltage	measured on BAT		2.2		V
V_{SHORT_HY}	Battery short voltage hysteresis	measured on BAT		2.4		V
I_{SHORT}	Battery short bias			10		mA
Re-Charge Comparator						
V_{RECHG}	Re-charge Threshold, below regulation voltage limit, $V_{BAT-REG}$-V_{BAT}	2 cells, measured on BAT	50	100	150	mV
		2 cells, measured on BAT	100	130	160	mV
$t_{RECH-RISE_DEG}$	V_{RECHG} rising deglitch	V_{BAT} decreasing below V_{RECHG}		25		mS

Symbol	Parameter	Condition	SPEC			Unit
			Min.	Typ.	Max.	
$t_{RECH-FALL_DEG}$	V_{RECHG} falling deglitch	V_{BAT} increasing above V_{RECHG}		25		mS
Bat Over-Voltage Comparator						
V_{OV_RISE}	Over-voltage rising threshold	As percentage of V_{BAT_REG}		110		%
V_{OV_FALL}	Over-voltage falling threshold	As percentage of V_{BAT}		105		%
Thermal Regulation						
T_{J_REG}	Junction Temperature	Charging		125		℃
Thermal Shutdown Comparator						
T_{SHUT}	Thermal shutdown temperature	Temperature rising		155		℃
$T_{SHUT-HYS}$	Thermal shutdown hysteresis	Temperature falling		30		℃
$t_{SHUT-RISE-DEG}$	Thermal shutdown deglitch	Temperature rising		25		uS
Thermistor Comparator						
I_{TS}	TS bias current		70	76	82	μA
V_{LTF}	Cold temperature threshold, TS pin voltage rising threshold	Charger suspends charge		3.0		V
V_{LTF_HYS}	Cold temperature hysteresis, TS pin voltage falling threshold	Charger recovery charge		2.6		V
V_{HTF}	Hot temperature TS pin voltage falling threshold	Charger suspends charge		300		mV
$t_{TS-CHG-SUS}$	Deglitch time for temperature out of range detection	$V_{TS} > V_{LTF}$, or $V_{TS} < V_{TCO}$, or $V_{TS} < V_{HTF}$		1.3		S

Symbol	Parameter	Condition	SPEC			Unit
			Min.	Typ.	Max.	
$t_{TS-CHG-RSM}$	Deglitch time for temperature out of range detection	$V_{TS} < V_{LTF}-V_{LTF-HYS}$ or $V_{TS} > V_{TCO}$, or $V_{TS} > V_{HTF}$		1.3		S
High-Side FET Over-Current Comparator (Cycle by Cycle)						
I_{OCP_HSFET}	Current limit on HSFET	Measure on HSFET		4.0		A
Internal PWM						
F_{SW}	PWM switching frequency		0.80	1.0	1.05	MHz
$T_{SW-DEAD}$	Driver dead time	$V_{IN} > 5V$		50		nS
R_{DS-HI}	High Side RON	$V_{BS}-V_{SW}=5V$			150	mΩ
R_{DS-LO}	Low Side RON	$V_{REGN}=5V$			150	mΩ
Safety Timer						
$T_{PRE-CHARGE}$	Pre-charge timer		52	60	68	min
$T_{TAPER-CHARGE}$	Taper-charge timer	$V_{BAT} > V_{RCH}$ and $I_{CHG} < I_{TERM}$, STAT goes high	34	40	46	min

Application Information

1. Typical Operation Theory

The charger of VAS5175H is optimized for charging 1 / 2-cells Li-ion or Li-polymer batteries. It charges a battery with constant current (CC) and constant voltage (CV) profile. In CV mode, if charge current reaches 1/10 constant current threshold, STAT goes Hi to indicate charge full. The typical charge profile is illustrated as below.

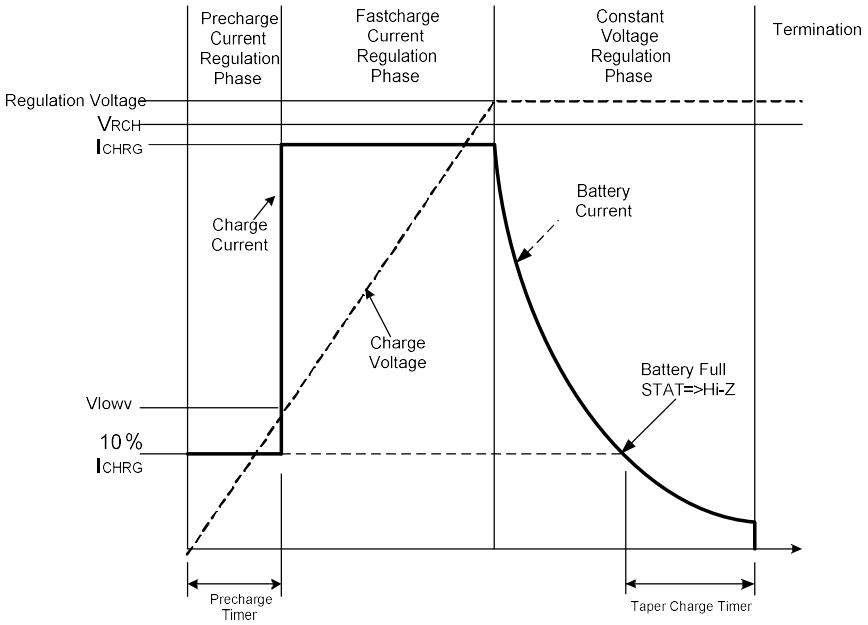


Figure 3. Typical Charging Profile

2. Battery Voltage Regulation

The VAS5175H offers a high accuracy voltage regulator for the charging voltage. Battery regulation voltage is 4.35V for 1cell and 8.7V for 2cells typ.

3. Battery Current Regulation

Battery current is sensed by current sensing resistor R_{SNS} connected between CS and BAT. The full-scale differential voltage between CS and BAT is 30mV. The equation for charge current is:

$$I_{CHG} = \frac{V_{CS-\quad_CC}}{R_{SNS}}$$

Under high ambient temperature, the charge current will fold back to keep IC temperature not exceeding 125°C.

4. Battery Pre-charge Current Regulation

On Power-up, if the battery voltage is below the VLOWV threshold, the VAS5175H applies the pre-charge current to the battery. This pre-charge feature is intended to revive deeply discharged cells. If the VLOWV threshold is not reached within 60 mins of initiating pre-charge, the charger turns off and a FAULT is indicated on the status pins.

For VAS5175H, the pre-charge current is set as 10% of the fast charge rate.

$$I_{PRECHG} = \frac{0.1 * V_{CS-BA\ _CC}}{R_{SNS}}$$

5. Charge Termination

The charger monitors the charging current during the voltage regulation phase. Termination is detected when the BAT voltage is higher than recharge threshold and the charge current is less than the termination current threshold, as calculated below. Termination only indicate "Charge Complete" at STAT pin with Hi and chip will not stop switching charge loop until 40mins taper charge timer expired.

$$I_{TERM} = \frac{0.1 * V_{CS-BA\ _CC}}{R_{SNS}}$$

7. Re-Charge

A new charge cycle is initiated when one of the following conditions occurs:

- The battery voltage falls below the recharge threshold
- A power-on-reset (POR) event occurs
- The battery is removed and reinserted, and then the charge current is above 0.2C.

8. Safety Timers

As a safety backup, the charger also provides an internal fixed 60 minutes pre-charge safety timer. And fixed 40 minutes taper charge timer for additional charge capacity, it start once termination is happened.

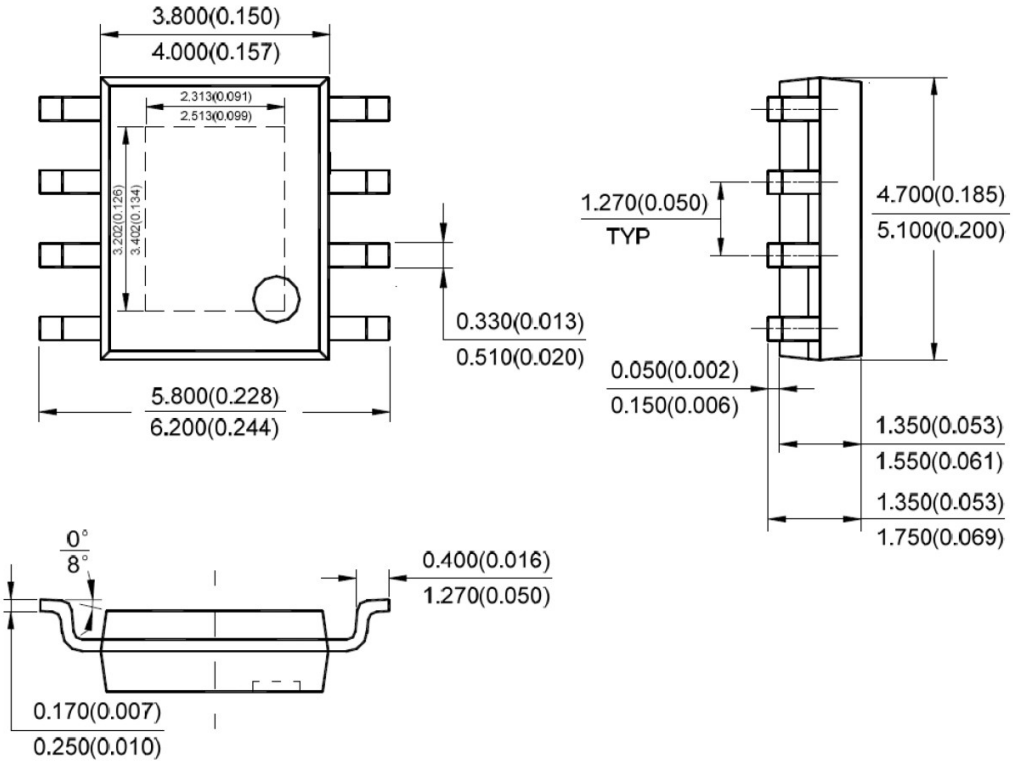
9. Soft-Start Charger Current

The charger automatically soft-starts the charger regulation current every time the charger goes into fast-charge to ensure there is no overshoot or stress on the output capacitors or the power converter. The soft-start consists of stepping-up the charge regulation current into 8 evenly divided steps up to the programmed charge current.

10. Temperature Qualification

The TS pin output a zero TC current to bias a negative temperature coefficient thermistor (TS) which connect to AGND. The controller continuously monitors battery temperature by measuring the voltage between the TS pin and AGND, it compares this voltage against its internal thresholds to determine if charging is allowed. To initiate a charge cycle, the battery temperature must be within the VLTF to VHTF thresholds. If battery temperature is outside of this range, the controller suspends charge and waits until the battery temperature is within the VLTF to VHTF range. The controller suspends charge by turning off the PWM MOSFETs. A 10K TS with B-Constant around 3950k is recommended for application.

Package Information(SOP8-e)



Classification Reflow Profiles

Profile Feature	Pb-Free Assembly
Preheat & Soak Temperature min (Tsmin) Temperature max (Tsmax) Time (Tsmin to Tsmax) (ts)	150°C 200°C 60-120 seconds
Average ramp-up rate (Tsmax to Tp)	3°C/second max.
Liquidous temperature (TL) Time at liquidous (tL)	217°C 60-150 seconds
Peak package body temperature (Tp)*	Max 260°C
Time (tp)** within 5°C of the specified classification temperature (Tc)	Max 30 seconds
Average ramp-down rate (Tp to Tsmax)	6°C/second max.
Time 25°C to peak temperature	8 minutes max.

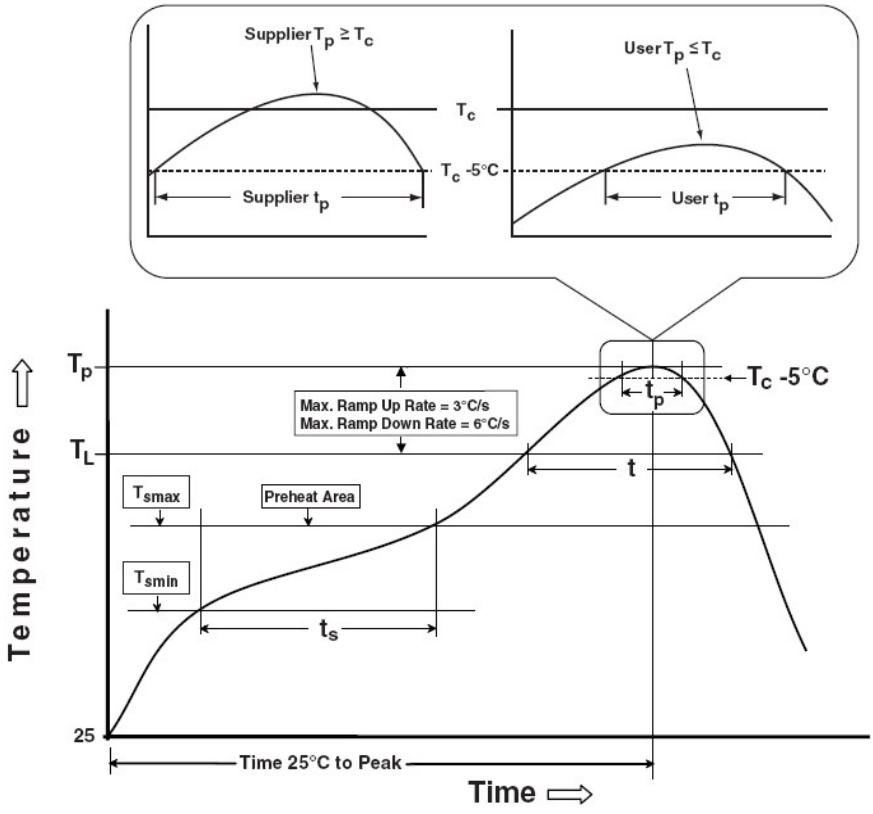


Figure 21. Classification Profile

CAUTION

Storage Conditions

1) This product should be used within 12 months after delivered. Store in manufacturer's package keeping the seal of aluminum coated baggage or tightly re-closed box with the following conditions.
[Temperature:8℃...30℃,Humidity:30%...70% R.H.]

2) Keep the seal of aluminum coated baggage immediately before usage.

3) After breaking the seal of aluminum coated baggage, this product should be used within 1 week on the following conditions.
[Temperature:≤30℃, Humidity: ≤60% R.H.]