2.0A, 1 / 2Cells Li-ion Battery Switching Charger

DESCRIPTION

The VAS5175 is a 5V-24V input, highly integrated Li-ion/ Li-polymer battery switching charger IC with high accuracy charge current and voltage regulation. It closely monitors the battery pack temperature to allow charge progress only in a present temperature window. It also provides battery detection, pre-conditioning, charge termination, and charge status monitoring. The thermal regulation loop reduces charge current to maintain the junction temperature of 125°C during operation. If the junction temperature exceeds 155°C, it performs over-temperature shutdown and stops operating to ensure safety.

The VAS5175 is suitable for 1Cell / 2Cells battery charging. It integrates 24V rating, low Ron N-FET with a 1.0MHz synchronous buck for efficient battery charging and simply components and PCB design. VAS5175 is available in SOP8-e package.

Features

- 1MHz Synchronous Switching
- Built-in MOS
- Up to 2A Programmable Charge Current
- 1/2-cell battery
- Wide Input Voltage Range: 5.0V to 24V
- Up to 93% Efficiency
- Soft start
- Internal loop compensation
- Multiple protection
  - Output short circuit protection
  - NTC detection, Over temperature protection
  - Battery over-voltage protection (BOVP)
  - Safety Timer
  - Thermal feedback regulation @ Tj = 125
- Charge status indication
- Accuracy
  - ± 1% Battery Voltage Regulation (CV)
  - ± 10% Charge Current Regulation (CC)

Applications

- Notebook
- Electrical tools
- Bluetooth speakers
- POS
- Walkie-talkie

Typical Application Circuits

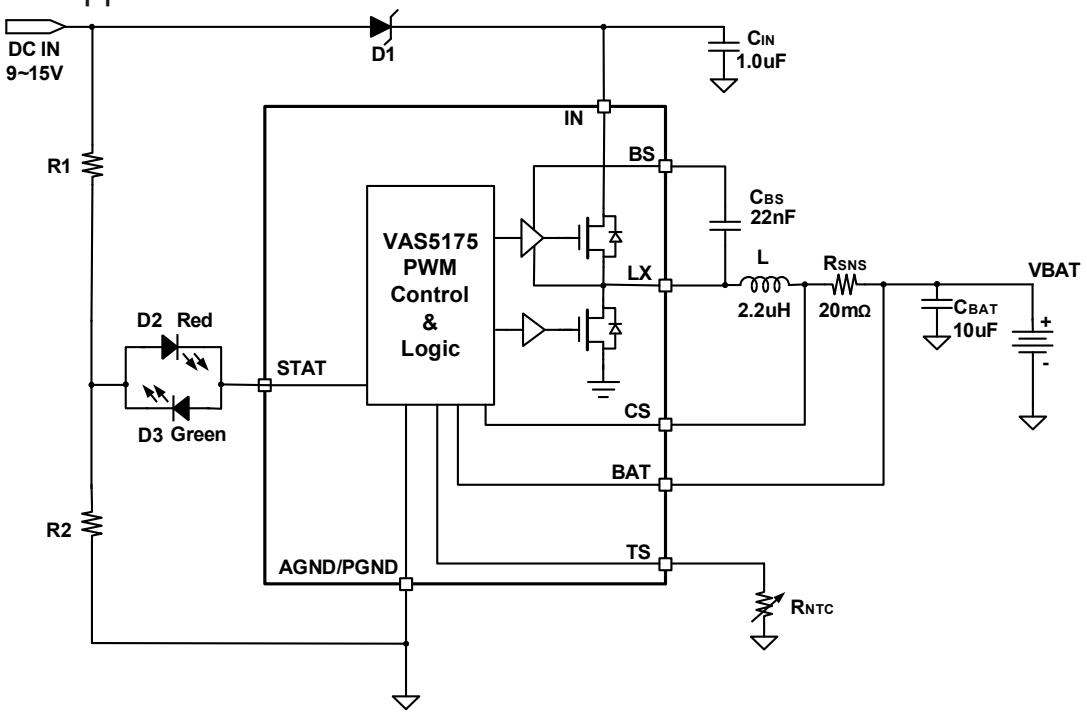


Figure 1. Typical Application Schematic for 2-Cells Battery (Block reverse current with a Schottky diode)

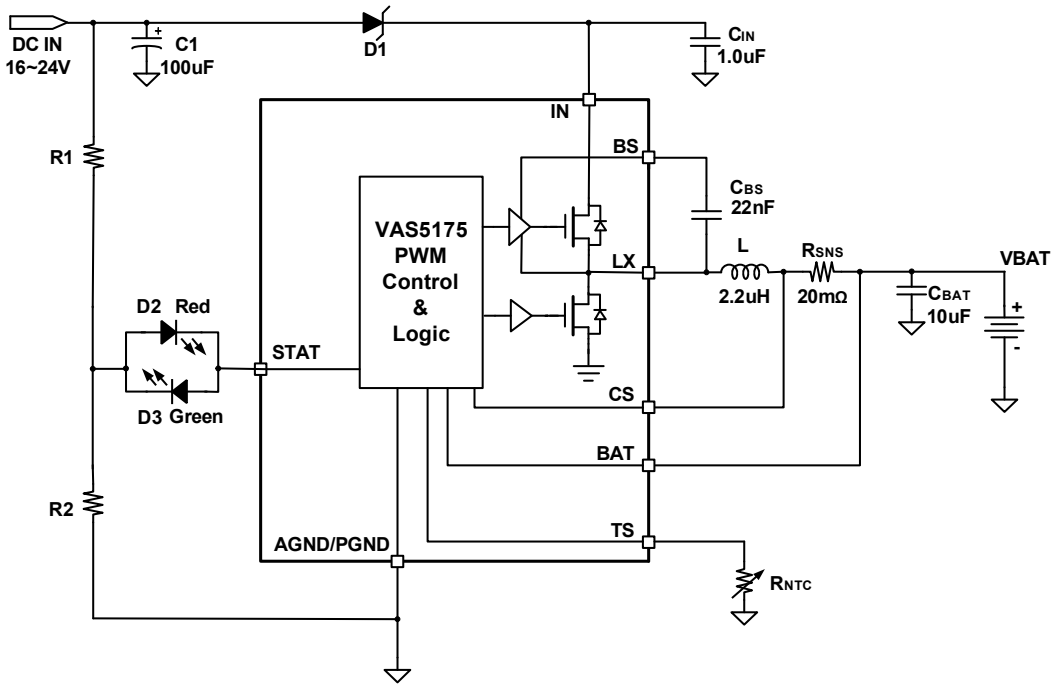


Figure 2. Typical Application Schematic for 2-Cells Battery if Input Power Exceeded 15V
(add C1=100uF electrolytic capacitor for surge protection)

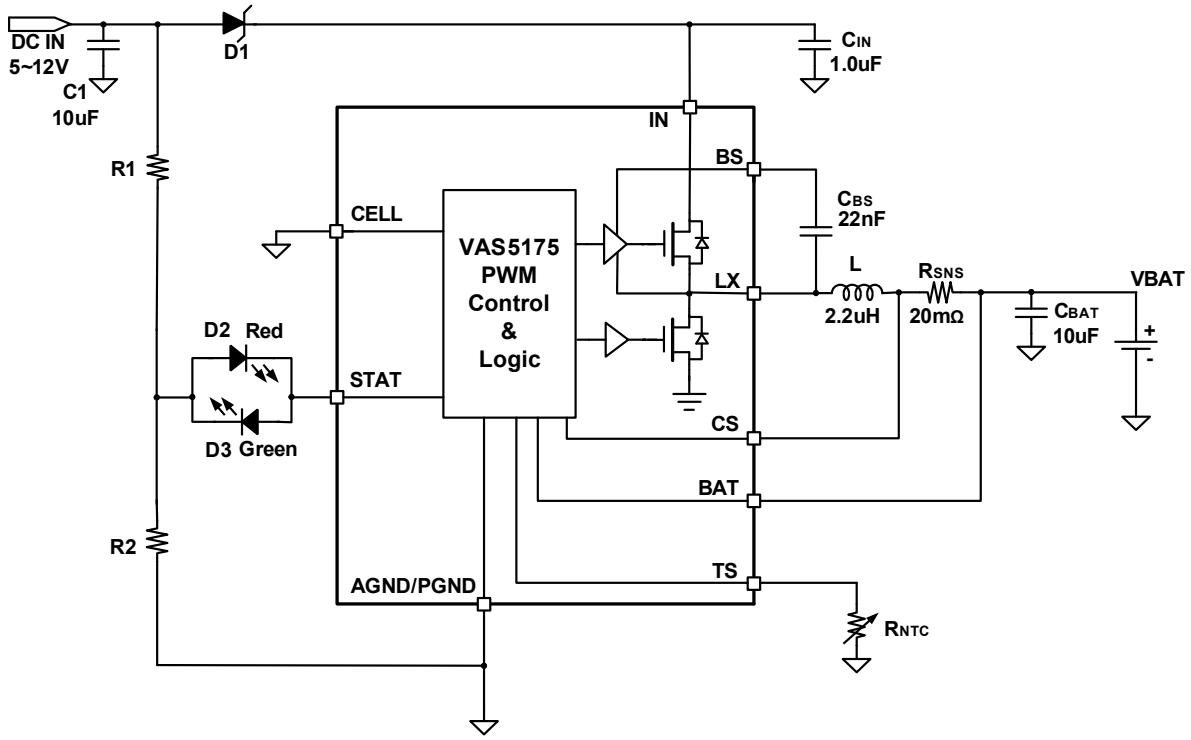
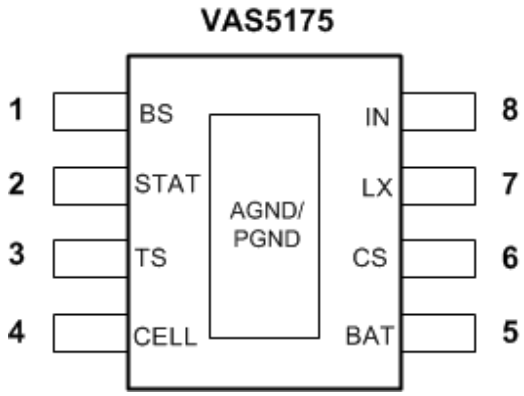


Figure 3. Typical Application Schematic for 1-Cells Battery

PIN Configuration

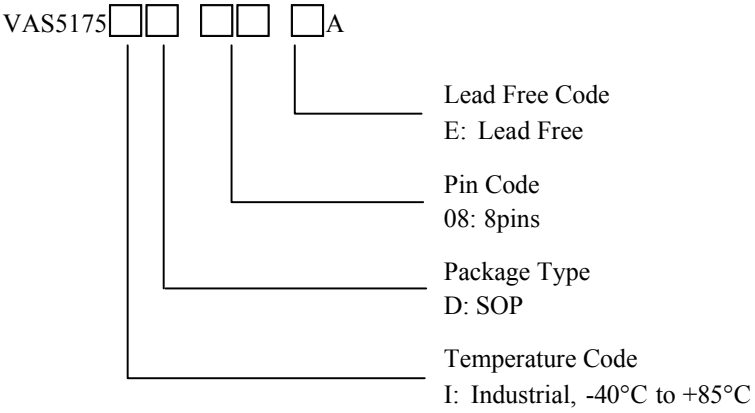
Package	PIN-OUT
SOP8-e	

PIN Description

PIN NO.	Name	Description			
1	BS	Bootstrap pin. Connect a capacitor (10~22nf) between LX and BS pin.			
2	STAT	status indication			
		Hi-Z	High	Low	Blinking
		Sleep Mode	Charge Done	Charging	Fault Condition
3	TS	Battery temperature NTC input. Connect a NTC to Battery, 10K NTC (B-Constant=3950K) is recommended. Connect this pin to ground can disable NTC function. ** TS pin is recommended to use 0.1uF ceramic capacitors to filter noise.			
4	CELL	Charge cell selection pin. Set to Float for the 2 cells; Pull down for 1 cell; Don't pull up;			
5	BAT	Battery voltage detection, charging voltage regulation and current sense input. Use 0.1uF capacitors between BAT and AGND for common-mode filtering. ** Use at least 10uF ceramic capacitors at B+ terminal on PCB.			
6	CS	Current sense input pin. Use 0.1uF capacitors between CS and AGND for common-mode filtering.			
7	LX	Switch output, connect to the inductor. Use a 10-22nF BS capacitor across the LX and BS to supply high side driver.			
8	IN	Input power pin. Need at least 1uF ceramic capacitors connect to AGND. If input voltage exceeds 15V, it is recommended to use 100uF electrolytic capacitor to absorb and protect the plug-in surge.			
9	PGND/ AGND	Chip ground and package exposed pad. Connect to the PCB ground.			

Order Information

Order Number	Package Type	QTY/Reel	Green Status	Operation temp range
VAS5175ID08EA	SOP8-e	2500	RoHS	-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	4.15	4.2	4.22	V
		2 cells, measured on BAT	8.30	8.35	8.41	V
	Charge voltage regulation accuracy	T_J=-20℃ to 125℃	-1		1	%
Charge Current Regulation						
$V_{CS\text{-}BAT\_PC}$	Charge Current Full Scale Sense Voltage in Pre-Charge	R_{SNS}=20mΩ	1.5	3	4.5	mV
$V_{CS\text{-}BAT\_CC}$	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		%

Symbol	Parameter	Condition	SPEC			Unit
			Min.	Typ.	Max.	
t_{TERM_DEG}	Deglitch time	$V_{BAT} > V_{RCH}$ and $I_{CHG} < I_{TERM}$		1.3		S
Input Under-Voltage Lock-Out Comparator (UVLO)						
V_{UVLO}	AC under-voltage rising	Measure on IN		4.1		V
$V_{UVLO-HSY}$	AC 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

Symbol	Parameter	Condition	SPEC			Unit
			Min.	Typ.	Max.	
$t_{RECH-RISE\_DEG}$	V_{RECHG} rising deglitch	V_{BAT} decreasing below V_{RECHG}		25		mS
$t_{RECH-FALL\_DEG}$	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

Symbol	Parameter	Condition	SPEC			Unit
			Min.	Typ.	Max.	
$t_{TS-CHG-SUS}$	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
$t_{TS-CHG-RSM}$	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 VAS5175 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.

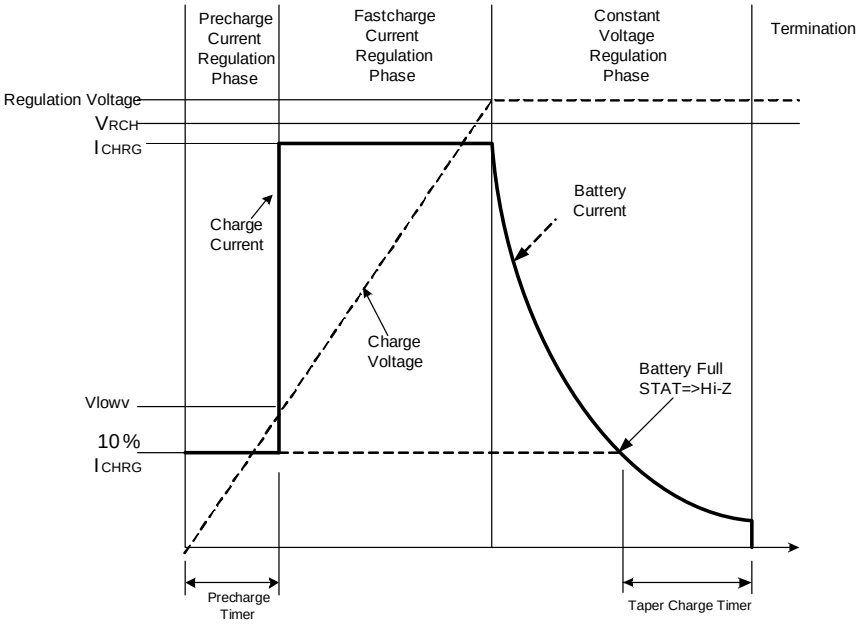


Figure 3. Typical Charging Profile

2. Battery Voltage Regulation

The VAS5175 offers a high accuracy voltage regulator for the charging voltage. Battery regulation voltage is 4.20V for 1cell and 8.35V 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:

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

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 VAS5175 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 VAS5175, the pre-charge current is set as 10% of the fast charge rate.

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

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.

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

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.

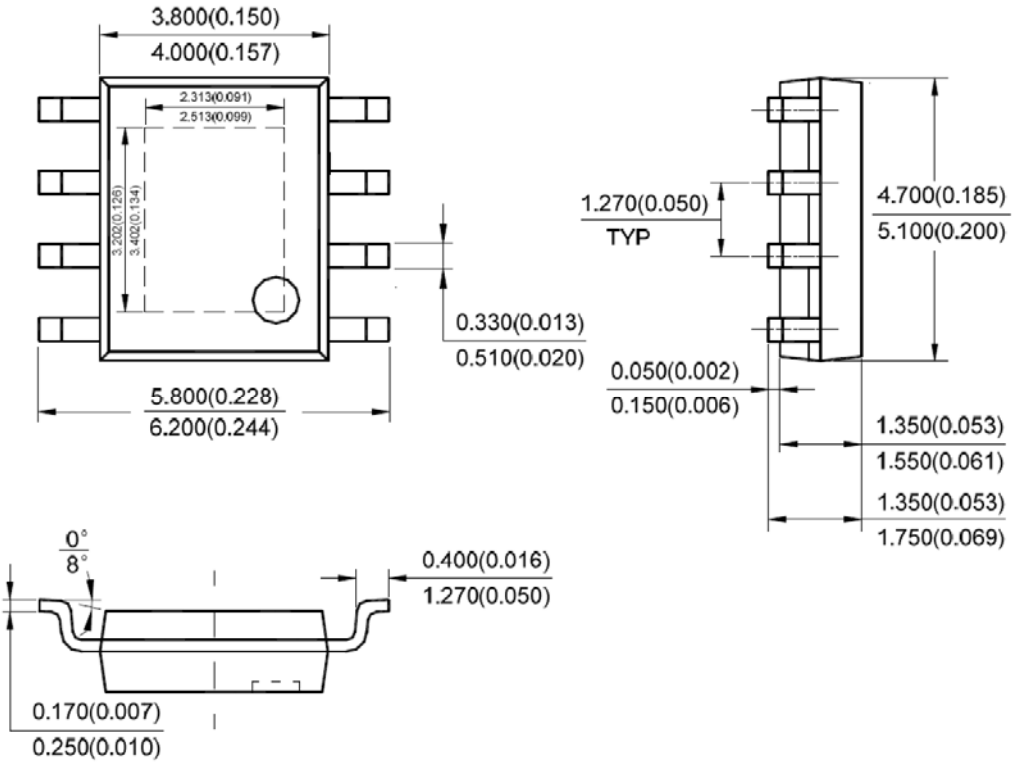
9. Soft-Start Charger Current

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.

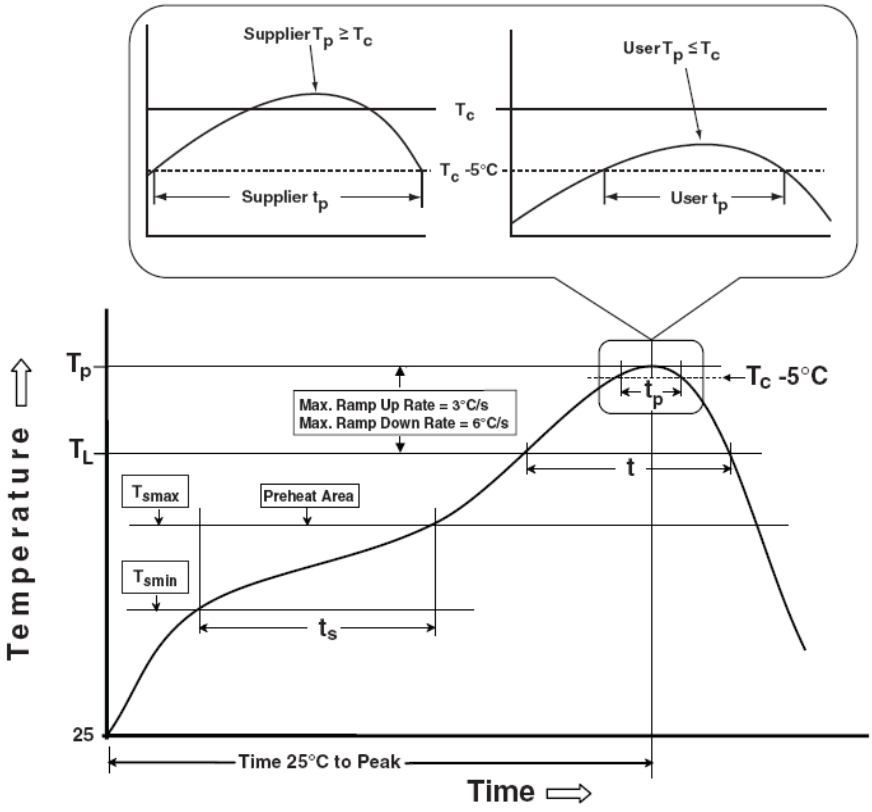


Figure 21. Classification Profile

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.]

单击下面可查看定价，库存，交付和生命周期等信息

>>Chiplead(奇力科技)