5V Input, High Voltage Withstand, 0.85A Two Section Lithium Battery Boost Charging Management Circuit

General Description

The CS5092S is a 5V input, fixed 0.85A charging current, and supports the boost charging management IC for the series application of two lithium batteries. CS5092S integrates power MOS and adopts asynchronous switch architecture, so that it requires only a few peripheral devices during application, which can effectively reduce the overall scheme size and BOM cost. The working frequency of the boost switch charging converter of CS5092S is 500KHz.

The CS5092S has four built-in loops to control the charging process, namely, constant current (CC) loop, constant voltage (CV) loop, chip temperature adjustment loop, and intelligently adjust the charging current to prevent the output of the adapter from being pulled down, and match the input adaptive loops of all adapters.

CS5092S provides a slim SOT23-6L package type for customers to choose, and its rated working temperature range is - 40 ℃ to 85 ℃.

Features

- USB 5V Input Asynchronous Switch Boost Charging
- Working Voltage 3.6 ~ 6V, Chip Withstand Voltage 30V, Internal Integrated High Voltage Transistor
- Fixed 0.85A Charging Current
- Automatically Adjust Input Current to Match All Adapters
- Support LED Charging Status Indication
- 500KHz Switching Frequency
- Output Overvoltage / Short Circuit Protection
- Input Overvoltage Protection
- IC Over Temperature Protection
- IC Temperature Adaptive Adjustment
- ESD 2KV

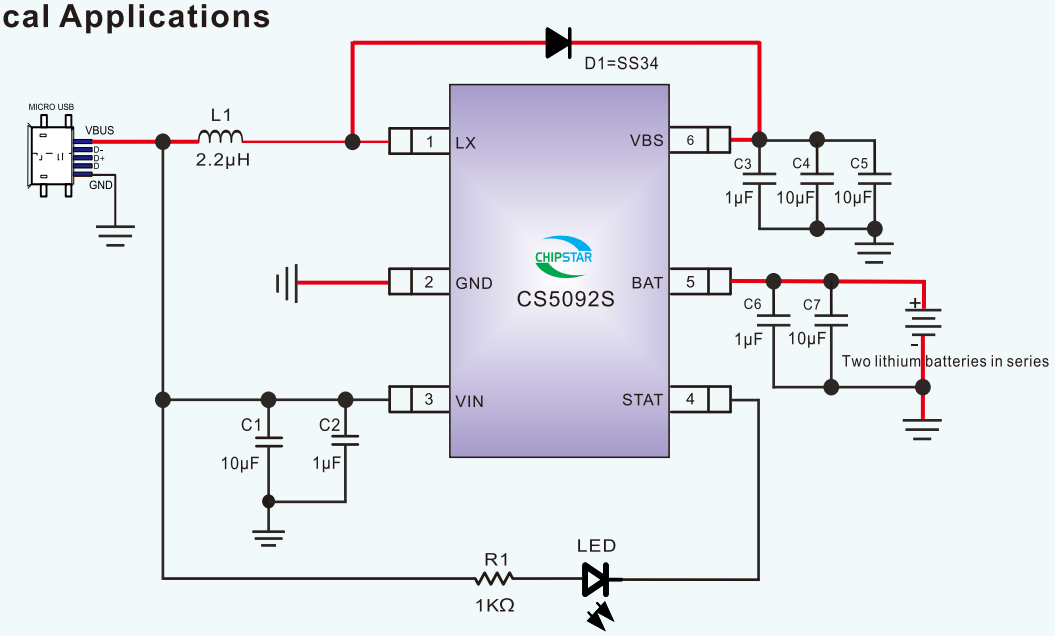
Applications

- Bluetooth Speakers
- E-Cigarette
- handheld transceiver
- POS Machine
- Lithium Battery Pack
- Toys

Package

- SOT23-6L

Typical Applications



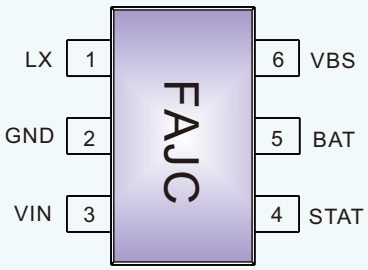
CS5092S Application Circuit

Note:

(1) L1 is a power inductor with a saturation current of 3A, and SS34 is a low-voltage drop Schottky diode.
(2) All chip capacitors need to be as close to the chip pin layout as possible.
(3) To further improve the EMI performance, it is necessary to add an absorption network composed of RC (resistor and capacitor) between pin 1 and ground.
(4) When hot plug operation is required at the battery end, or inductive load such as motor is connected, it is suggested to add another capacitor of at least 100μF beside C7 to further improve reliability.
(5) Pin 4 of the chip, namely the STAT pin, is an output pin of open drain OD structure, which outputs 0 level or high resistance state. If this pin is not used at all, it is recommended to be grounded.
(6) It is recommended to add a 1KΩ resistor to the ground at the pin 4 of the chip to eliminate the phenomenon that the voltage at the pin 4 may not be 0 when the input power is unplugged due to the reverse leakage current of the Schottky diode itself.
(7) The solid red line in the figure shows the path of high current flow.

PIN Configuration and Functions

SOT23-6L CS5092S(TOP VIEW)



PIN NO.	NAME	TYPE	DESCRIPTION
1	LX	I	Switch node pin , connect to external inductor.
2	GND	-	Ground pin.
3	VIN	P	Power input pin.
4	STAT	O	Charge status indication pin.
5	BAT	P	Battery positive pin.
6	VBS	P	Boost output pin.

Absolute Maximum Ratings [1]

SYMBOL	PARAMETER	VALUE	UNIT
VMAX	VIN, BAT, LX, VBS, STAT	-0.3~30	V
T_J	Junction operating temperature range	-40~150	℃
T_{STG}	Storage temperature range	-60~150	℃
T_{SDR}	Lead temperature (Soldering, 10 sec.)	260	℃

Recommended Operating Conditions

SYMBOL	PARAMETER	VALUE	UNIT
V_{IN}	Input voltage	3.6~6	V
T_J	Junction operating temperature range	-40~125	℃
T_A	Ambient temperature range	-40~85	℃

Thermal Information [2]

SYMBOL	PARAMETER	VALUE	UNIT
θ_{JA}(SOT23)	Package thermal resistance - chip to environment thermal resistance	170	℃/W

Ordering Information

Product Name	Package Type	Device Marking	Reel Size (Inch)	Tape width	Quantity
CS5092S	SOT23-6L		7″	8mm	3000 units

ESD Range

HBM (Human Body Model) ---------- ±2kV

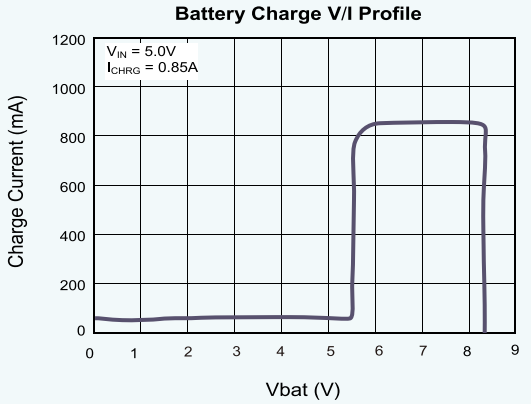
MM (Machine model) ---------- ±200V

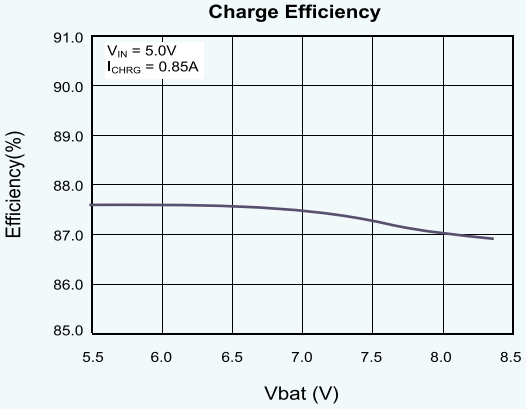
1. The above parameters are only the limit values of device operation. It is not recommended that the working conditions of the device exceed the limit values. Otherwise, the reliability and life of the device will be affected, and even permanent damage will be caused.

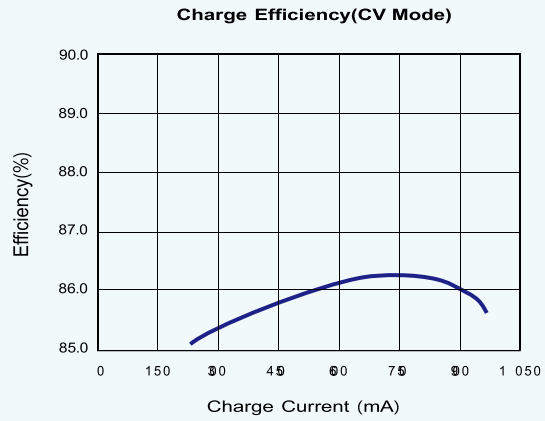
Electrical Characteristics (V_{IN}=5V，L=2.2uH, unless otherwise specified)

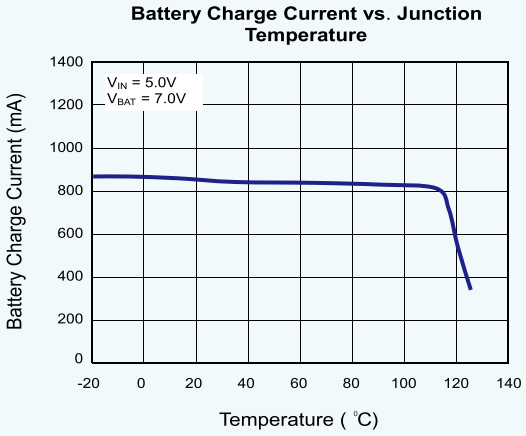
SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{IN}	Supply voltage		3.6		6	V
VIN_{OVP}	VIN over voltage protection	VIN rising		6		V
ΔVIN_{OVP}	VIN over voltage protection hysteresis			200		mV
I_Q	Input quiescent current			1		mA
I_{BAT}	Battery leakage current	Charging complete		16		μA
		V_{IN}=0V		7		
V_{CV}	Terminal battery voltage		8.34	8.42	8.50	V
ΔV_{RCH}	Recharge voltage			250		mV
V_{TRK}	TC charge mode battery voltage threshold	VBAT rising		5.6		V
V_{SHORT}	Battery short threshold	VBAT falling		2.2		V
V_{OVPB}	BAT over voltage threshold			9.2		V
F_{SW}	Switching frequency			500		KHz
V_{TRON}	Block Power MOS full on	$V_{BAT}>V_{TRK}$ $V_{TRON}= V_{BAT}-V_{IN}$		150		mV
I_{CC}	CC charge mode current			0.85		A
I_{TC}	TC charge mode current			60		mA
I_{BS}	Output short circuit charge mode current			60		mA
I_{TERM}	Terminate charge current			80		mA
T_{REG}	Chip thermal regulation threshold			120		℃
T_{SD}	Thermal shutdown temperature			150		℃
ΔT	Thermal shutdown temperature hysteresis			20		℃
TMR_{TC}	Trick charge time limit			9.5		Hour
$TMR_{CC/CV}$	CC/CV charge time limit			15.5		Hour

Typical Operating Characteristics (TA=25°C,unless otherwise noted)









CS5092S Application Points

1. Charge Process

CS5092S adopts complete CC/CV charging mode. When the battery voltage is less than 5.6V, the system charges the battery with trickle current. When the battery voltage is greater than 5.6V, the system enters the constant current charging mode. When the battery voltage approaches 8.4V, the system enters the constant voltage mode. When the system enters the constant voltage mode, if the charging current is less than the terminating charging current, the system will stop charging, indicating that the battery is fully charged. After that, if the battery voltage drops below the restart voltage, the system will restart to charge the battery. The charging current I_{CC} here refers to the current value flowing from the bat port to the positive electrode of the battery.

2. Protection Function

CS5092S has perfect battery charging protection function. When the chip has overvoltage at the input end, overvoltage and overtemperature at the output end, the boost charging function will be turned off immediately. When the battery voltage is lower than V_{SHORT}, the output short-circuit protection function is turned on, the main power tube is turned off first, and the Block tube will enter the linear mode and charge the battery with a small short-circuit mode charging current; When the battery voltage is higher than V_{SHORT}, the output short-circuit protection function is turned off.

3. Adaptive Input Current Limit Function

CS5092S is equipped with a special loop, which can automatically adjust the charging current to protect the input DC power into the overdrive state. Because the large charging current will lead to the drop of input power supply voltage. With the decrease of the power supply voltage, the input of the internal adaptive loop operational amplifier also drops. When the internal reference value is reduced, the built-in adaptive loop will automatically adjust the duty cycle of the system, so as to reduce the charging current, thus reducing the driving pressure of the input power supply, so that the output voltage is fixed at 4.2V.

4. Chip Temperature Adaptive Adjustment Function

CS5092S has a built-in temperature control loop. When the chip is in the constant current charging process, if the temperature rises to 120 ℃, the temperature control loop will start to work. The charging current will gradually decrease, and the chip temperature will drop. Finally, the chip temperature will stabilize at the set value, thus playing the role of protecting the chip.

5. LED Indicator

- The charging process is always on, and it will be extinguished when fully charged.
- In case of input over voltage, battery over voltage, battery short circuit, charging time timeout, chip over temperature, flicker at the frequency of 1.6Hz.

6. Selection of Inductance

The following factors shall be considered when selecting inductive type:

- Determine the ripple current of the inductance.

Generally, the recommended ripple current of inductance is 40% of the average current of inductance, and its calculation formula is as follows:

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

F_{SW} is the switching frequency, and the charging current set by I_{CC} is quite adaptable to different ripple amplitudes, so even if the value of the final inductance deviates slightly from the calculated value, it will not affect the overall performance of the system.

- The saturation current of the selected inductor must be greater than the peak current of the inductor when the system is working in the full load range.

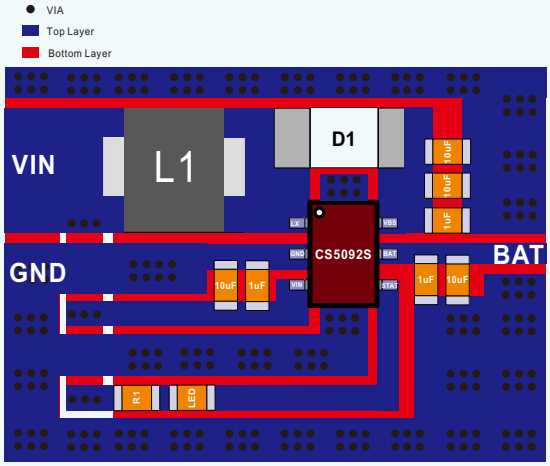
$$I_{SAT.MIN} > \frac{V_{OUT}}{V_{IN}} * I_{CC} + (\frac{V_{IN}}{V_{OUT}})^2 * \frac{V_{OUT}-V_{IN}}{2*F_{SW}*L}$$

- The DCR and core loss of the inductor must be as low as possible to obtain better system efficiency.
- We recommend the use power inductor with a inductance of 2.2μH and a saturation current of 3A.

CS5092S PCB NOTE

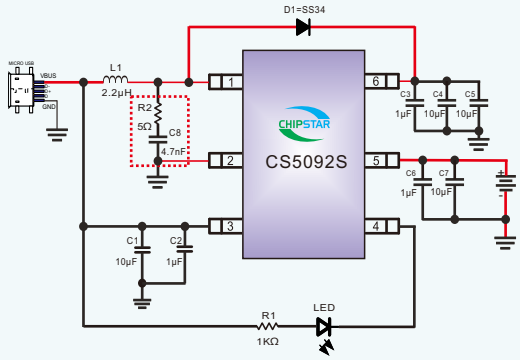
The PCB shown in the figure is only for reference and does not mean that the customer must completely follow the figure below to layout and route their own products. Please make layout and wiring according to the actual components and product requirements, but there are general principles:

- The power wiring shall be as wide as possible, and CS5092S shall be supplied with power from the power wiring alone.
- The ground wire shall be routed on the same layer to avoid through-hole jumper and be short and thick.
- LX wiring shall be as short as possible to reduce EMI.
- Inductance and Schottky shall be directly short and thick connected to avoid via jumper.
- The capacitor at the power end should be placed as close to the chip as possible.



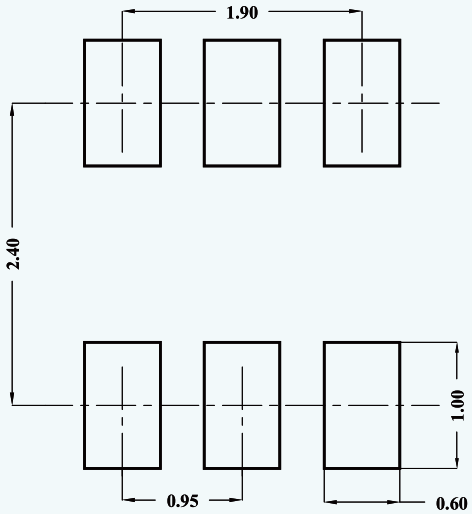
CS5092S Recommended Design for Reducing EMI Interference

In the scheme requiring EMI / EMC, the interference of cs5092s switching signal needs to be reduced. We recommend adding RC absorbing network at LX end, which can effectively reduce the radiation of switching signal. The specific recommended design is as follows:

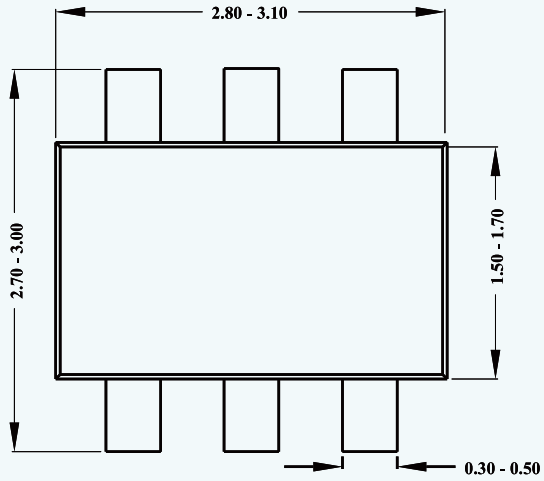


Package Information

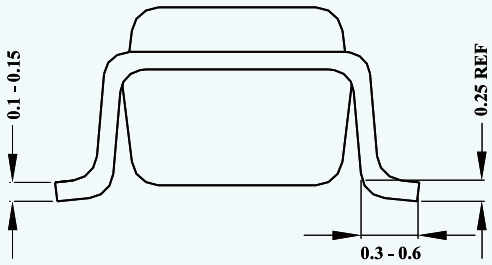
CS5092S SOT23-6L

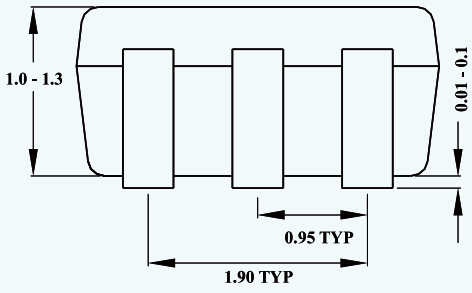


Recommended Pad Layout



Top View





Notes: All dimension in MM
All dimension don't not include mold flash & metal burr