5 V USB-input boost charger

Two series-connected lithium-ion cells • Integrated power MOSFET • ESOP8L

Overview

The CS5080E is a boost charging-management IC for two lithium-ion cells in series, powered from a 5 V input. Its asynchronous switching architecture and integrated power MOSFET minimize external components, solution size and bill-of-materials cost. The converter operates at 600 kHz, accepts up to 2 A input current and achieves 90% conversion efficiency.

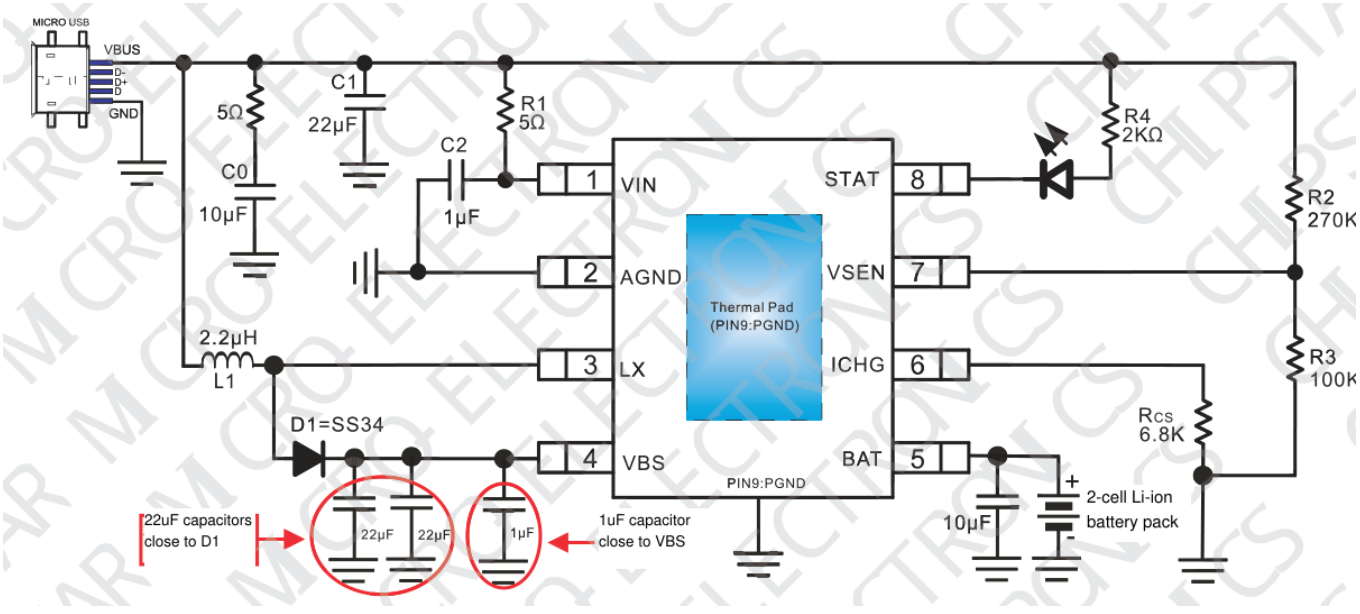
An adaptive input-current control loop intelligently adjusts the charging current to prevent excessive loading of the input adapter, allowing operation with a wide range of adapters. The device is available in a compact ESOP8L package and is rated for an operating temperature range of -40°C to +85°C.

Features

- 5 V / 2 A input; asynchronous switching boost charging
- Charging efficiency: 90%; externally adjustable charging current
- Automatic input-current adjustment for compatibility with different adapters
- LED charging-status indication; integrated power MOSFET
- 600 kHz switching frequency; supports a 2.2 µH inductor
- Output overvoltage and short-circuit protection
- Input undervoltage and overvoltage protection; IC overtemperature protection

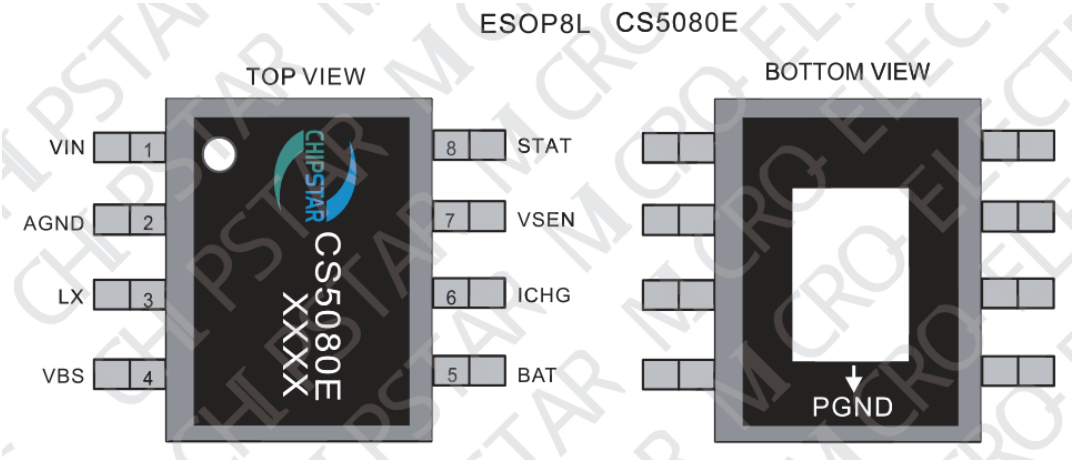
Applications: Bluetooth speakers, electronic cigarettes and two-way radios.
Package: ESOP8L.

Typical application circuit



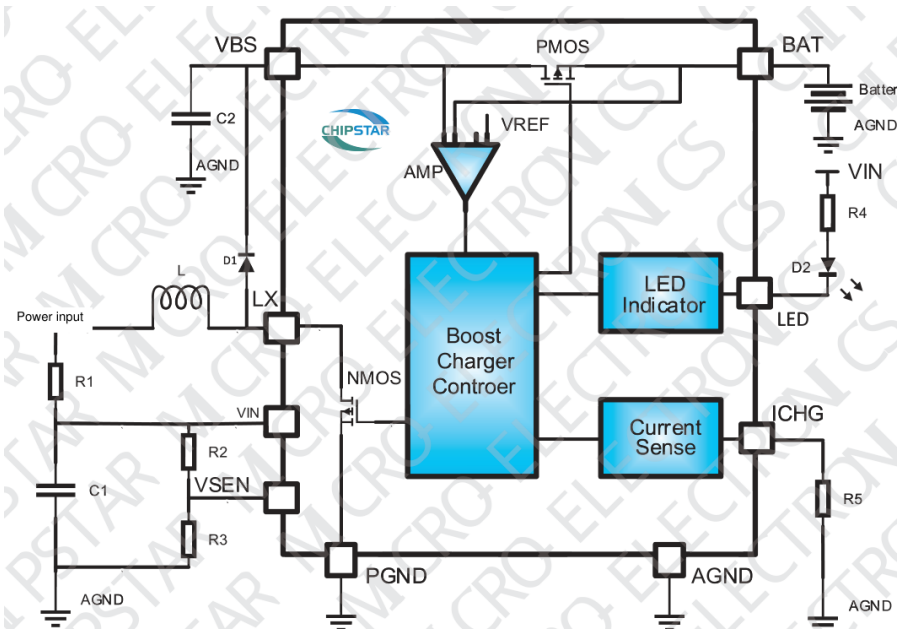
Note: L1 is a 2.2 µH CD54 power inductor with a saturation current of 3.5 A. Place the 22 µF capacitors close to D1 and the 1 µF capacitor close to the IC VBS pin.

Pin configuration and block diagram



Pin	Name	Type	Function
1	VIN	Power	Power supply
2	AGND	Ground	Analog ground
3	LX	Input	Switching node; inductor connection
4	VBS	Output	Boost-converter output
5	BAT	Power	Battery connection
6	ICHG	Input	Charging-current control; current is set by a resistor to ground
7	VSEN	Input	Input-voltage sensing and shutdown. Below 1.2 V, charging current is limited; below 0.4 V, the IC shuts down.
8	STAT	Output	Charging-status indicator output
Thermal pad	PGND	Ground	Power ground

Functional block diagram



Ratings and ordering information

Absolute maximum ratings[1]

Symbol	Description	Value	Unit
VDD	Supply voltage with no signal input	8.0	V
VI	Input voltage	-0.3 to VDD + 0.3	V
TJ	Junction temperature	-40 to +150	°C
TSDR	Lead temperature (soldering, 10 seconds)	260	°C
TSTG	Storage temperature	-65 to +150	°C

Recommended operating conditions

Symbol	Description	Value	Unit
VDD	Input voltage	3.44 to 7.0	V
TA	Ambient temperature	-40 to +85	°C
TJ	Junction temperature	-40 to +125	°C

Thermal information[2]

Symbol	Description	Value	Unit
θJA (ESOP8)	Junction-to-ambient thermal resistance	40	°C/W

Ordering information

Part number	Package	Device marking	Packing	Quantity
CS5080E	ESOP-8L	CS5080E / XXXX	Tube	100 units
CS5080E	ESOP-8L	CS5080E / XXXX	Tape and reel	4000 units

ESD ratings

Human-body model (HBM): ±4 kV
Machine model (MM): ±400 V

1. These are device stress limits only. Operation beyond these limits is not recommended and may impair reliability or cause permanent damage.

2. Provide suitable PCB heat dissipation. Connect the exposed thermal pad on the underside of the CS5080E to a large PCB heat-spreading area and to ground.

Electrical characteristics

Unless otherwise specified: VIN = 5 V, RICHG = 6.8 kΩ, L = 2.2 µH.

Parameter	Test condition	Min.	Typ.	Max.	Unit
Input supply voltage		3.60		7.0	V
Supply undervoltage threshold	VIN falling		3.45		V
Undervoltage hysteresis			100		mV
Supply overvoltage threshold	VIN falls after OVP on rising input		6.23		V
Overvoltage hysteresis			500		mV
IC quiescent current	No battery		1		mA
IC shutdown current	VBAT > VIN		10.0		µA
IC shutdown current	0.6 V < VBAT < VIN		11.0		µA
IC shutdown current	VBAT < 0.6 V		8.0		µA
Battery leakage current	Charge complete		22.0		µA
Battery leakage current	IC off; VBAT = 8.4 V		3.8		µA
Battery leakage current	VIN = 0 V		0.02		µA
Float charging voltage		8.31	8.40	8.44	V
Recharge voltage hysteresis[1]			200		mV
Trickle-charge cutoff voltage			5.6		V
Battery short-circuit threshold			2		V
Blocking MOSFET fully-on voltage	VBAT > VIN; VTRON = VBAT - VIN		170		mV
Switching frequency			600		kHz
Switching NMOS on-resistance			80		mΩ
Blocking PMOS on-resistance			120		mΩ
VSEN logic-high threshold		0.6			V
VSEN logic-low threshold				0.4	V
BAT overvoltage protection			8.80		V
Constant-current charging current	RICHG = 6.8 kΩ; VIN = 5 V		0.85		A
Trickle-charge current	RICHG = 6.8 kΩ; VIN = 5 V		140		mA
Short-circuit charging current	RICHG = 6.8 kΩ; VIN = 5 V		75		mA
Charge termination current	RICHG = 6.8 kΩ; VIN = 5 V		120		mA
Current gain	AI = ICC / IICHG		5800		
ICHG clamp voltage	Constant-current mode		1		V
VSEN current-limit threshold			1.2		V
Thermal protection temperature			140		°C
Thermal protection hysteresis			30		°C

1. The source table is partly obscured. The 200 mV recharge difference is also supported by the 8.4 V / 8.2 V thresholds described on page 5.

Operation and application guidance

Functional overview

The CS5080E is an asynchronous boost charger for two series-connected lithium-ion cells, with a 3.6-5.5 V input and 1 A output. It operates at 600 kHz and includes comprehensive charging protection. An external resistor sets the charging current. Adaptive input-current regulation prevents overloading the adapter and minimizes external component count and system cost.

Charging sequence

The device uses CC/CV charging. Below 2 V battery voltage, it charges at ICC/20. Above 2 V but below 5.6 V, it charges at ICC/10. Above 5.6 V it enters constant-current mode. Near 8.4 V it changes to constant-voltage mode. Charging stops when the current falls below 100 mA. After charge completion, charging restarts if the battery falls to 8.2 V or below.

Protection functions

Input overvoltage, output overvoltage or overtemperature immediately disables boost charging. If the battery voltage falls below VSHORT, output undervoltage protection turns off the main power MOSFET; the blocking MOSFET operates linearly and charges at ICC/20. Short-circuit protection is released when the battery rises above VSHORT.

Adaptive input-current limiting

High charging current may cause the adapter voltage to fall. If VSEN falls below its internal 1.2 V reference, the adaptive loop reduces duty cycle and charging current, thereby reducing the load on the input supply.

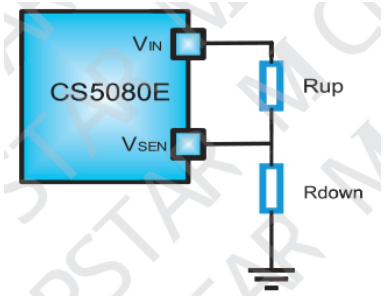
Enable and LED indication

VSEN also enables the IC; below 0.4 V the IC is off. During charging, the LED stays on; after completion, it turns off. For input/output overvoltage, output short circuit, IC overtemperature, or no battery, the LED flashes at 1.3 Hz.

Setting the input regulation voltage

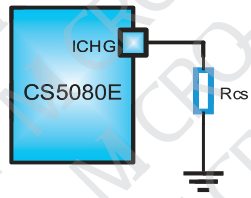
VSEN monitors VIN through a resistor divider. When VSEN falls below 1.2 V, the controller reduces duty cycle and charging current. Choose Rup and Rdown to set the input regulation voltage:

VIN = VSEN × (Rdown + Rup) / Rdown
where VSEN = 1.2 V.



Setting the charging current

The resistor Rcs from ICHG to ground determines the constant-current charging level:
ICC = 1 × 5800 / Rcs
ICC is in amperes when Rcs is in ohms.



Input capacitors

To suppress voltage spikes caused by USB hot-plugging and reduce ripple, place a 100 µF electrolytic capacitor near the USB input. Place an additional 1 µF capacitor close to VIN to filter high-frequency noise.

Boost-output capacitors

Use two 22 µF, 0805 ceramic capacitors as close as possible to the Schottky diode cathode. Place an additional 1 µF capacitor close to VBS to filter high-frequency noise.

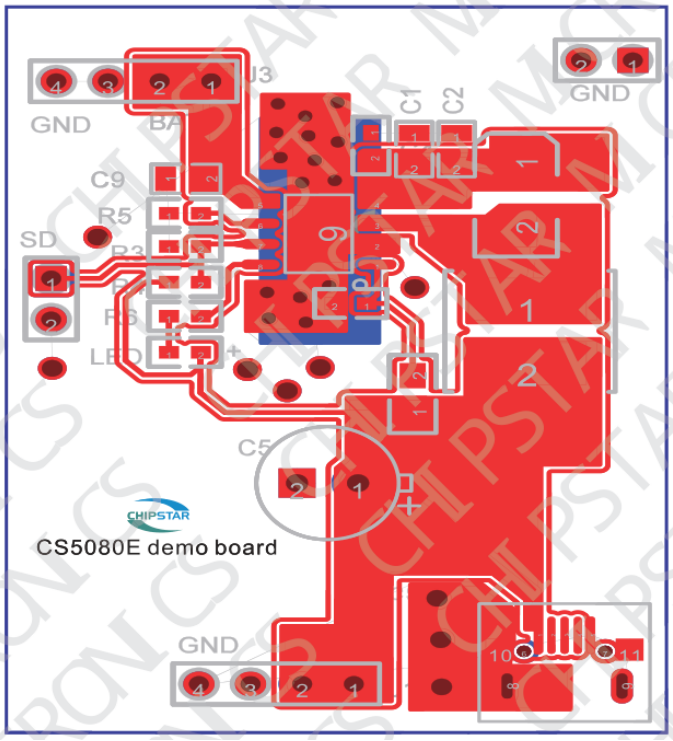
Inductor selection

Select ripple current at about 40% of average inductor current:
L = (VIN / VOUT)² × (VOUT - VIN) / (ICC × FSW × 40%)
Ensure saturation current exceeds the peak current throughout the charging range:
ISAT.MIN > (VIN / VOUT) × ICC + (VIN / VOUT)² × (VOUT - VIN) / (2 × FSW × L)

FSW is switching frequency and ICC is the programmed charging current. Moderate changes in inductance are tolerated. Minimize DCR and core losses. Recommended: 2.2 µH, 3.5 A saturation current, CD54 power inductor.

PCB layout recommendations

CS5080E reference PCB layout



Layout guidelines

• Make power traces as wide as possible and supply the CS5080E through a dedicated power trace.

• Keep the main BOOST current paths short and wide.

• Keep the LX trace as short as possible to reduce EMI.

• Connect the inductor and Schottky diode directly with short, wide traces; avoid vias in this connection.

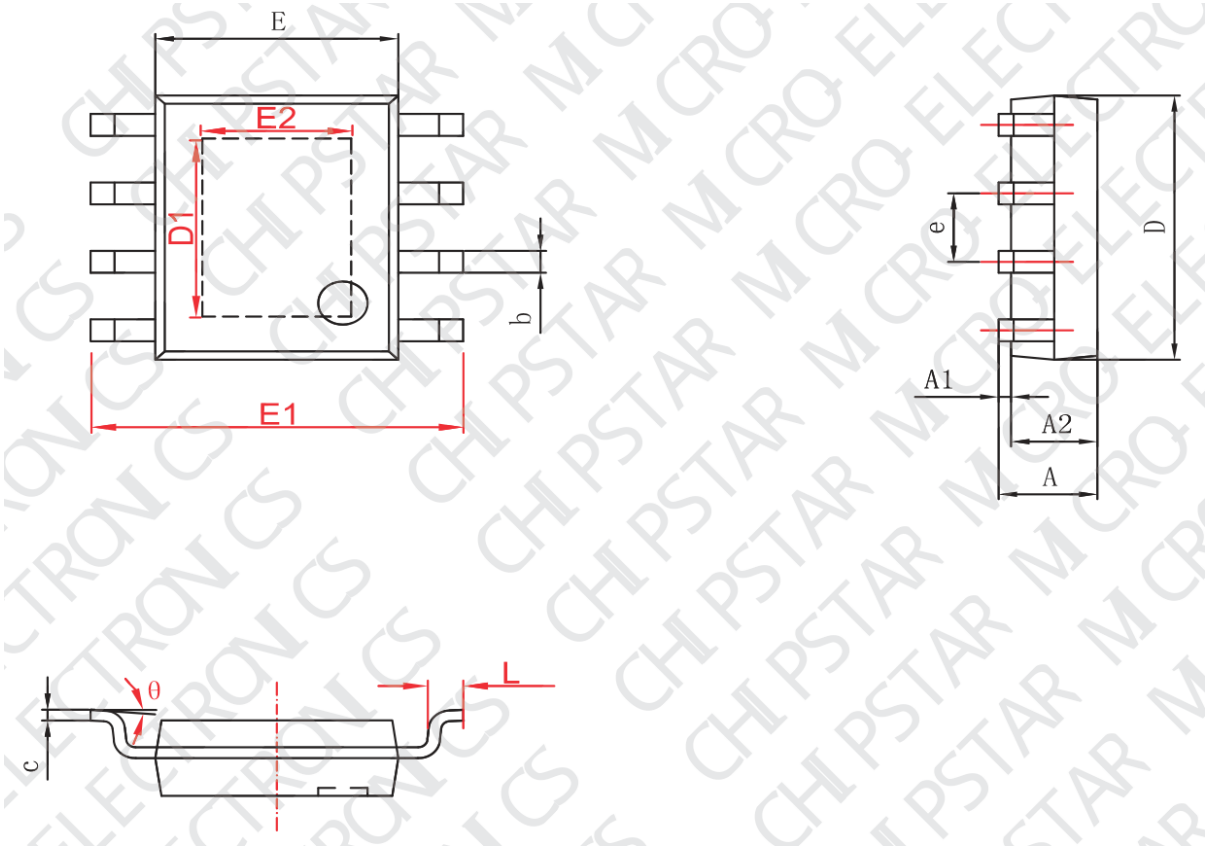
• Place the input capacitor as close to the IC as possible.

• The exposed thermal pad is power ground. Connect it reliably to ground and to a large PCB copper area for heat dissipation.

Reference layout reproduced from the original manufacturer datasheet.

Package information

CS5080E ESOP8L



Symbol	Millimeters: min.	Millimeters: max.	Inches: min.	Inches: max.
A	1.350	1.750	0.053	0.069
A1	0.050	0.150	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
D1	3.202	3.402	0.126	0.134
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
E2	2.313	2.513	0.091	0.099
e	1.270 (BSC)	1.270 (BSC)	0.050 (BSC)	0.050 (BSC)
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	9°

Notes: (1) All primary dimensions are in millimeters. (2) Refer to JEDEC MO-187.
Values are reproduced as printed; the source lists different maximum θ values in the two unit columns.

Handling precautions and notices

CAUTION: ELECTROSTATIC-SENSITIVE DEVICE
Use protective measures when handling ESD-sensitive components.

MOS-device handling precautions

Static electricity can be generated in many environments. The following precautions help prevent damage to MOS devices caused by electrostatic discharge:

- Personnel must be grounded using an antistatic wrist strap.
- Equipment enclosures must be grounded.
- Tools used during assembly must be grounded.
- Use conductive or antistatic packaging for storage and transport.

Manufacturer notices

Shanghai Chipstar Micro-electronics Co., Ltd. reserves the right to change this datasheet without prior notice. Obtain the latest version before use and verify that the information is complete and current.

Semiconductor products may malfunction or fail under certain conditions. The purchaser is responsible for incorporating appropriate safety standards and protective measures into system design and equipment manufacture to prevent personal injury or property damage resulting from product failure.

To improve product quality, Shanghai Chipstar Micro-electronics Co., Ltd. will continue to provide customers with improved products.

Document information

English translation of the supplied CS5080E datasheet (May 2017, Rev. 1.2). Original technical drawings and manufacturer attribution are retained. Numerical values, formulas and internal inconsistencies are reproduced from the source rather than silently corrected.

SE Elektronika

www.superelektronika.pl