

General Description

The EC3689 devices provide a power supply solution for products powered by either a one-cell Li-Ion or Li-polymer battery. The converter generates a stable output voltage that is either adjusted by an external resistor divider or fixed internally on the chip. It provides high efficient power conversion and is capable of delivering output currents up to 2.1A at 5.3V at a supply voltage down to 2.9V. The maximum peak current in the step-up switch is limited to a value of 5.5A. The EC3689 operates at 800KHz switching frequency and enters pulse-skip-mode (PSM) operation at light load currents to maintain high efficiency over the entire load current range. During shutdown, the load is completely disconnected from the battery.

Features

- ◆ Synchronous Step-up Converter with 2.1A Output Current From 2.9V Input
- ◆ Wide V_{IN} Range From 2.9V to 5.5V
- ◆ Input Under-voltage Lockout Protection
- ◆ Fixed and Adjustable Output Voltage
- ◆ Built-in Output Over-voltage Protection
- ◆ Light-Load Pulse Skip Mode
- ◆ Load Disconnect During Shutdown
- ◆ Output Short Circuit Protection
- ◆ Thermal Shutdown Protection
- ◆ Available in a SOP8(Exposed PAD) Packages

APPLICATIONS

- ◆ Power Bank
- ◆ USB Charging Port (5V)
- ◆ DC/DC Micro Modules

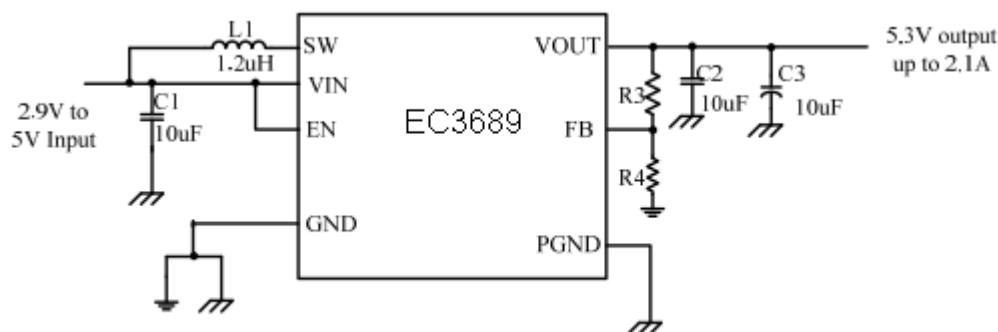
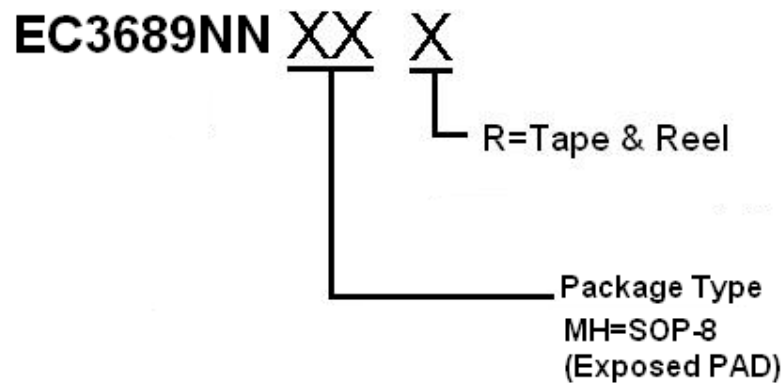


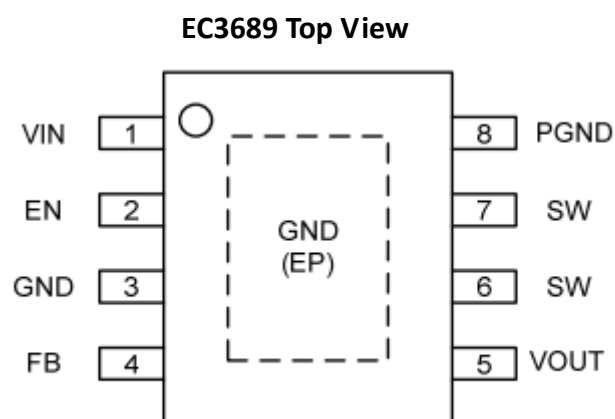
Figure 1. EC3689 Typical Application Circuit

Ordering Information



Part Number	Package	Marking	Marking Information
EC3689NNMHR	SOP-8 (Exposed PAD)	3689 LLLLL YYWWT	1. LLLLL : Lot No 2. YYWW : Date Code 3. T : Internal Track Code

Pin Configuration



Pin Description

NAME	PIN NO.	DESCRIPTION
VIN	1	Input Supply voltage
EN	2	Enable input.(1/VIN enabled,0/GND disabled)
GND	3	Analog Ground pin. Connect GND to PGND under EP.
FB	4	Voltage feedback of adjustable versions. Connect FB to GND and set fixed 5.05V output voltage.
VOUT	5	Step-up convert output
SW	6, 7	Step-up and rectifying switch input
PGND	8	Power Ground pin.
EP		Exposed pad must be soldered to achieve appropriate power dissipation. Connect EP to GND.

Absolute Maximum Ratings(1)

Symbol	Parameter	Rating	Unit
V_{IN}	Supply Voltage	-0.3 to +6	V
V_{OUT}	Output Voltage	-0.3 to +6	V
$V_{FB}/V_{SW}/V_{EN}$	Input Voltage	-0.3 to +6	V
I_{PK}	Peak Output Current	Internally Limited	A
T_{LED}	Lead Temperature	260	°C
T_J	Junction Temperature	-40 ~ +135	°C
T_{STG}	Storage Temperature	-55 ~ +155	°C

Thermal Characteristics

Symbol	Parameter	Typical Value	Unit
Θ_{JA}	Junction-to-Ambient Resistance in free air	38.2	°C/W
P_D	Maximum Power Dissipation($T_A=25^{\circ}\text{C}$)	2.6	W

Recommended Operating Conditions(2)

Symbol	Parameter	Rating	Unit
V_{IN}	Supply Voltage	+2.9 to +5.5	V
V_{OUT}	Output Voltage	+2.9 to +5.5	V
T_{OP}	Operating Temperature	-40 ~ +85	°C

Note (1): Stress beyond those listed under “Absolute Maximum Ratings” may damage the device.

Note (2): The device is not guaranteed to function outside the recommended operating conditions.

Electrical Characteristics

$T_A = +25^{\circ}\text{C}$, $2.9\text{V} \leq V_{\text{IN}} \leq 5.5\text{V}$, unless otherwise noted. Typical values are at $V_{\text{IN}} = V_{\text{EN}} = 3.6\text{V}$ and $V_{\text{OUT}} = 5\text{V}$.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input voltage range V_{IN}		2.5		5.5	V
Input Under-voltage Lockout Threshold V_{UVLO}			2.2		V
Output voltage adjustable range V_{OUT}		2.5		5.5	V
Fixed Output Voltage	FB=GND	4.95	5.05	5.15	V
Feedback voltage V_{FB}		490	500	510	mV
Oscillator frequency f_{OSC}		640	800	960	KHz
NCH Switch Current Limit	$V_{\text{OUT}} = 5\text{V}$		5.5		A
NCH Switch on resistance	$V_{\text{OUT}} = 5\text{V}$		75		m Ω
PCH Switch on resistance	$V_{\text{OUT}} = 5\text{V}$		75		m Ω
Shutdown Current	$V_{\text{EN}} = 0\text{V}$, $V_{\text{IN}} = 3.6\text{V}$		0.1	1	μA
Quiescent Current(V_{IN})	$V_{\text{FB}} = 0.55\text{V}$, $V_{\text{OUT}} = 5\text{V}$		125	200	μA
EN Logic Low Voltage				0.4	V
EN Logic High Voltage		1.4			V
EN Leakage Current	Clamped on GND or V_{IN}	-1		1	μA
Thermal Shutdown			150		$^{\circ}\text{C}$
Thermal Shutdown Hysteresis			20		$^{\circ}\text{C}$

Functional Block Diagram

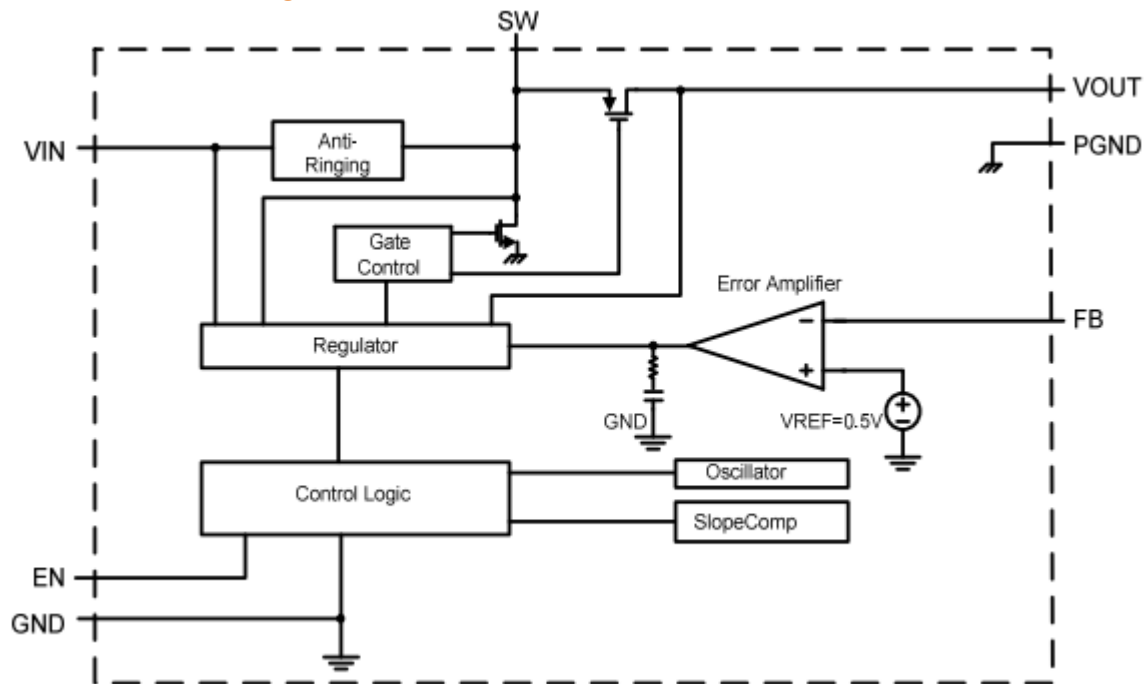


Figure 2. EC3689 Functional Block Diagram

Detailed Description

The EC3689 is based on a fixed frequency current mode pulse width modulation topology. The peak current of the NMOS switch is sensed to limit the maximum current flowing through the switch and the inductor. The typical peak current limit is set to 5.5A. An internal temperature sensor prevents the device from getting overheated in case of excessive power dissipation.

Application Information

Because of the high integration of EC3689, the application circuit is simple. Only input capacitor CIN, output Capacitor COUT, inductor L, output feedback resistors R3, R4 need to be selected for the targeted applications specifications.

Setting the Output Voltage

The EC3689 output voltage can be adjusted with an external resistor divider (See Figure 1). The typical value of the voltage on the FB pin is 500mV. The maximum allowed value for the output voltage is 5.5 V. Choose the bottom resistor R4 in the 100kΩ~500kΩ range to set the divider current at 1 μA or higher. The value of resistor R3, depending on the needed output voltage V_{OUT}, can be calculated using Equation 1:

$$R3 = R4 \times \left(\frac{V_{OUT}}{V_{FB}} - 1 \right) = 200k\Omega \times \left(\frac{V_{OUT}}{500mV} - 1 \right) \quad (\text{Equation 1})$$

Inductor Selection

The inductor DC current rating should be greater (by some margin) than the maximum input average current. The highest peak current through the inductor and the switch depends on the output load, converter efficiency η , the input voltage (VIN), and the output voltage (VOUT). Estimation of the maximum average inductor current can be done using Equation 2:

$$I_L = I_{OUT} \times \frac{V_{OUT}}{V_{IN} \times \eta} \quad (\text{Equation 2})$$

For example, for an output current of 2A at 5V with 90% efficiency, at least 3.8A of average current flows through the inductor at a minimum input voltage of 2.9V.

The EC3689 step-up converters have been optimized to operate with an effective inductance in the range of 1μH to 2.2μH and with output capacitors in the range of 20μF to 100μF. The internal compensation is optimized for an output filter of L = 1.5μH and C_{OUT} = 20μF. Larger or smaller inductor values can be used to optimize the performance of the device for specific operating conditions.

Input Capacitor

Place at least a 10 μF input ceramic capacitor close to the IC is to improve transient behavior of the regulator and EMI behavior of the total power supply circuit.

Output Capacitor

The output capacitor must completely supply the load during the charging phase of the inductor. A reasonable value of the output capacitance depends on the speed of the load transients and the load current during the load change. It is recommended to use X7R ceramic capacitors placed as close as possible to the VOUT and PGND pins of the IC. A recommended output capacitance value is around 20~100μF. Note that high capacitance ceramic capacitors have a DC Bias effect, which will have a strong influence on the final effective capacitance. A 10 V rated 0805 capacitor with 10μF can have an effective capacitance of less 5μF at an output voltage of 5V.

Layout consideration

Use wide and short traces for the main current path and for the power ground tracks. The input capacitor, output capacitor, and the inductor should be placed as close as possible to the IC. Use a common ground node for power ground and a different one for analog ground to minimize the effects of ground noise. Connect these ground nodes at any place close to the ground pins of the IC.

Thermal information

Implementation of integrated circuits in low-profile and fine-pitch surface-mount packages typically requires special attention to power dissipation. Many system-dependent issues such as thermal coupling, airflow, added heat sinks and convection surfaces, and the presence of other heat-generating components affect the power-dissipation limits of a given component.

Three basic approaches for enhancing thermal performance are listed below:

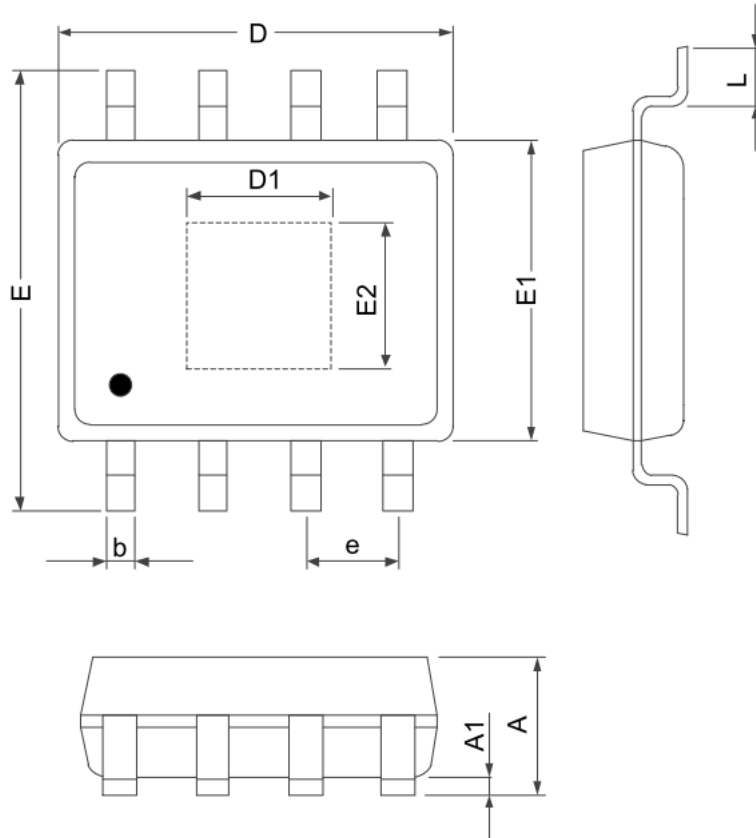
- Improving the power dissipation capability of the PCB design
- Improving the thermal coupling of the component to the PCB
- Introducing airflow in the system

The maximum junction temperature (T_J) of the EC3689 devices is 125°C. The thermal resistance of the SOP8 (Exposed PAD) package is $R_{\theta JA} = 38.2^\circ\text{C/W}$, if the Exposed PAD is soldered. Specified regulator operation is assured to a maximum ambient temperature T_A of +50°C. Therefore, the maximum power dissipation for the SOP8(Exposed PAD) package it is about 1.96W. More power can be dissipated if the maximum ambient temperature of the application is lower.

$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_A}{R_{\theta JA}} = \frac{125^\circ\text{C} - 50^\circ\text{C}}{38.2^\circ\text{C/W}} = 1.96\text{W}$$

Package Information

SOP-8(Exposed PAD) Package Outline Dimension



SYMBOLS	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
D	4.90		0.193	
E1	3.90		0.153	
D1	2.00		0.081	
E2	2.00		0.081	
E	5.80	6.20	0.228	0.244
L	0.40	1.27	0.016	0.050
b	0.31	0.51	0.012	0.020
e	1.27		0.050	