Description

The EC5037 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 1.5A at 5V at a supply voltage down to 3V. The maximum peak current in the step-up switch is limited to a value of 4A. The EC5037 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.

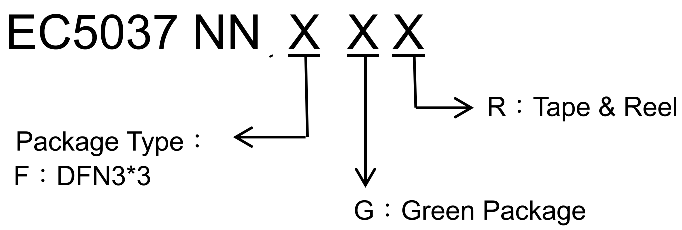
Features

◆Synchronous Step-up Converter with 2.5A
◆Output Current From 3V Input
◆Wide VIN Range From 2.5V 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 DFN3x3mm_10L Packages
◆RoHS Compliant (100% Green Available)

Applications

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

Ordering/Marking Information



Part No.	Marking	Temp. Range	Package	MOQ
EC5037NNFGR	EC5037 LLLLL YYWW	-40°C ~+85°C	DFN3*3	5,000/Reel

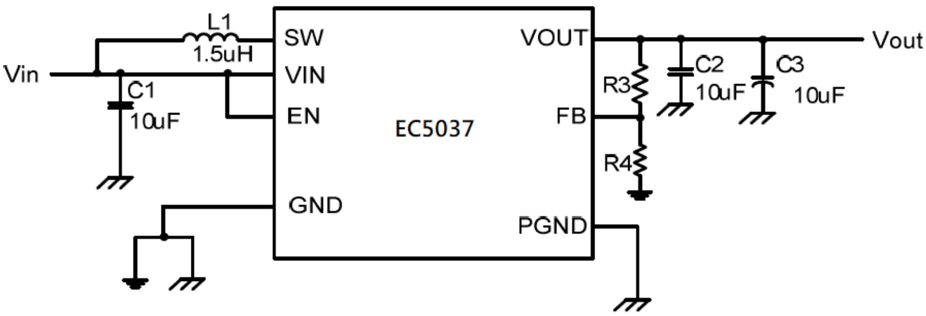
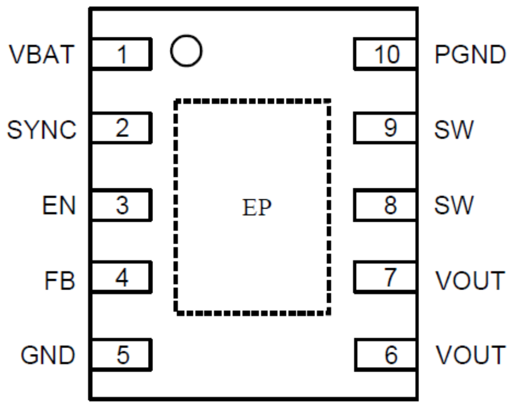


Figure 1. EC5037 Typical Application Circuit

Pin Configurations



EC5037 TOP View

Pin Description

NAME	PIN NO	DESCRIPTION
VBAT	1	Input Supply voltage
SYNC	2	Enable/disable pulse skip mode (1: VBAT disabled, 0: GND enabled)
EN	3	Enable input. (1: VBAT enabled, 0: GND disabled)
FB	4	Voltage feedback of adjustable versions. Connect FB to GND and set fixed 5.1V output voltage.
GND	5	Analog Ground pin. Connect GND to PGND under EP.
VOUT	6, 7	Step-up convert output
SW	8, 9	Step-up and rectifying switch input
PGND	10	Power Ground pin.
EP		Exposed pad must be soldered to achieve appropriate power dissipation. Connect EP to GND.

Absolute Maximum Rating (1)

Supply Voltage (VIN) ...………………...……… -0.3V to +6V
Lead Temperature ……..………………..…………………. 260°C
Output Voltage (VOUT) ..………………......... …-0.3V to +6V
Input Voltage (EN, FB, SW) ....…..... …..…..…-0.3V to +6V
Junction temperature range, TJ ………………. -40°C ~+135°C
Storage temperature range, Tstg ……….…..…. -55°C~+155°C
Peak Output Current …………………..……. Internally limited

Recommend Operating Conditions (2)

Input Voltage (VIN) ………………………..…. +2.9V to +5.5V
Operating Temperature Range ……………….. -40°C to +85°C
Output Voltage (VOUT) ………...…………….. +2.9V to +5.5V

Thermal Information (3,4)

Maximum Power Dissipation(TA=+25°C) ………….. 1.86W
DFN10 Thermal resistance(θJA) ……….…………… 40.3°C/W

Note(1): Stress exceeding those listed "Absolute Maximum Ratings" may damage the device.
Note(2): The device is not guaranteed to function outside of the recommended operating conditions.
Note(3): Measured on JESD51-7, 4-Layer PCB.
Note(4): The maximum allowable power dissipation is a function of the maximum junction temperature TJ_MAX, the junction to ambient thermal resistance θJA, and the ambient temperature TA. The maximum allowable continuous power dissipation at any ambient temperature is calculated by PD_MAX= (TJ_MAX-TA)/θJA. Exceeding the maximum allowable power dissipation will cause excessive die temperature, and the regulator will go into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage.

Electrical characteristics

TA = +25°C, 2.9V ≤ VIN ≤ 5.5V, unless otherwise noted. Typical values are at VIN= VEN =3.6V and VOUT=5V.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input voltage range VIN			2.5		5.5	V
Input Under-voltage Lockout Threshold VUVLO				2.2		V
Output voltage adjustable range VOUT			2.5		5.5	V
Feedback voltage VFB			490	500	510	mV
Oscillator frequency fOSC			640	800	960	kHz
NCH Switch Current Limit		VOUT= 5V		4		A
NCH Switch on resistance		VOUT= 5V		90		mΩ
PCH Switch on resistance		VOUT= 5V		90		mΩ
Shutdown Current		VEN = 0V, VIN = 3.6V		0.1	1	μA
Quiescent Current	VIN	VFB =0.55V , VOUT=5V		125	200	μA
EN logic low voltage					0.4	V
EN logic high voltage			1.4			V
EN leakage current		Clamped on GND or VIN	-1		1	μA
Thermal Shutdown				150		℃
Thermal Shutdown Hysteresis				20		℃

Functional Block Diagram

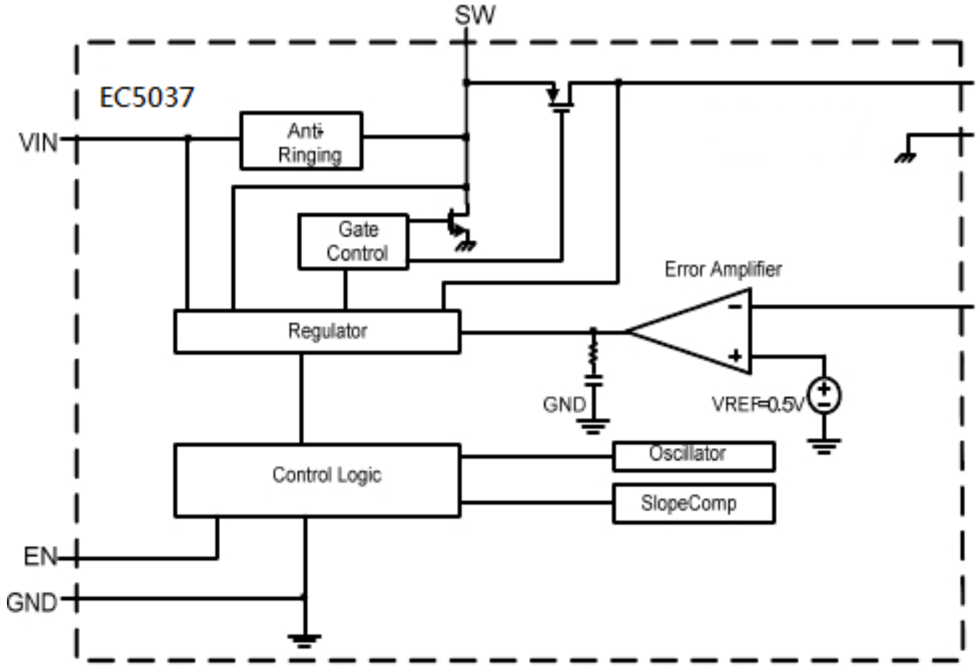
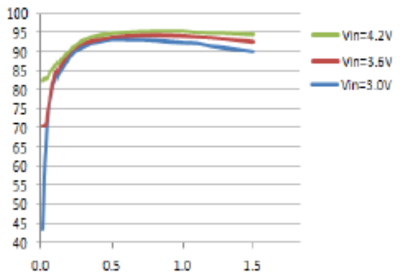


Figure 2. EC5037 Functional Block Diagram

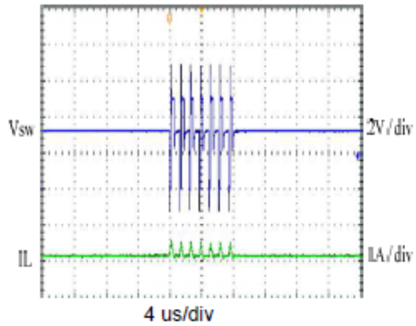
TYPICAL PERFORMANCE CHARACTERISTICS

VIN = 3.3V, EC5037 typical application circuit (Figure 1.), TA = +25°C, unless otherwise noted.

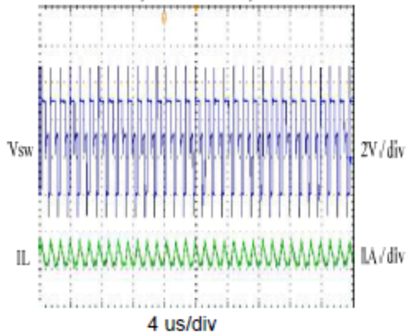
Efficiency vs. Load Current



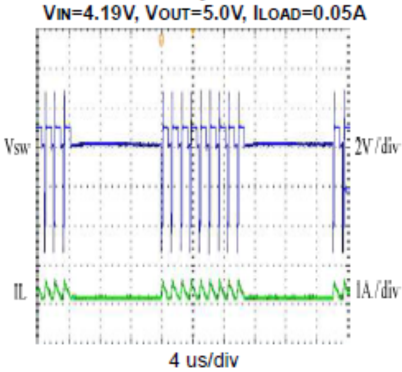
Steady State
VIN=3.3V,VOUT=5.0V,ILOAD=0A



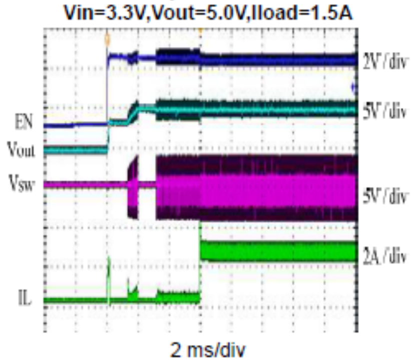
Steady State
VIN =3.3V, VOUT=5.0V, ILOAD=0.1A



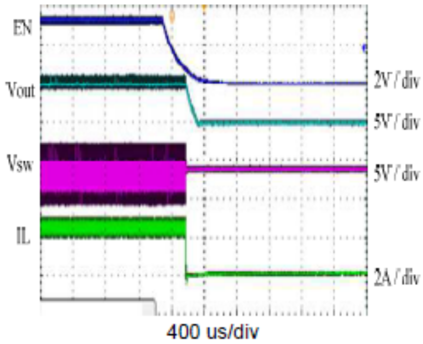
Steady State
VIN=4.19V, VOUT=5.0V, ILOAD=0.05A



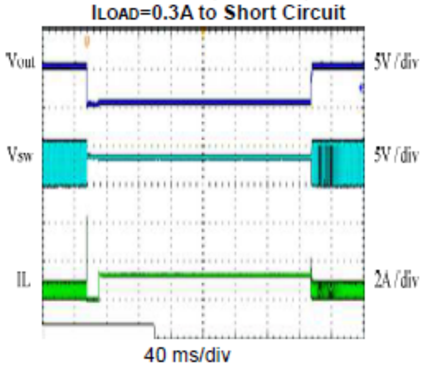
Startup from Enable
Vin=3.3V,Vout=5.0V,Iload=1.5A



Shutdown from Enable
VIN =3.3V, VOUT=5.0V,
ILOAD=1.5A



Short Circuit
VIN =3.3V, VOUT=5V,
ILOAD=0.3A to Short Circuit



Detailed Description

The EC5037 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 4A. An internal temperature sensor prevents the device from getting overheated in case of excessive power dissipation.

Application Information

Because of the high integration of EC5037, 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.

Switching Frequency Selections

The EC5037 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 VOUT, can be calculated using Equation 1:

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

Inductor Selection

The EC5037 800kHz high switching frequency allows for the use of small surface mount inductors. For high efficiency, choose inductors with high frequency core material, such as ferrite, to reduce core losses. Also to improve efficiency, choose inductors with bigger size for a given inductance. The inductor should have low DCR (copper-wire resistance) to reduce I2R losses, and must be able to handle the peak inductor current without saturating. The inductor DC current rating should be greater than the maximum input average current. For the full 2.5Amp output current applications, the inductor shall have enough core volume to support peak inductor currents up to 3.5A range and DCR less than 30mΩ. The highest peak current through the inductor and the switch depends on the output load, converter efficiency η, the input voltage (VBAT), and the output voltage (VOUT). Estimation of the maximum average inductor current can be done using Equation 3:

$$I_L = I_{OUT} \times \frac{V_{OUT}}{V_{BAT} \times \eta} \qquad \text{(Equation 3)}$$

For example, for an output current of 1.5A at 5V with 85% efficiency, at least 3A of average current flows through the inductor at a minimum input voltage of 3V.

The inductor value has a direct effect on ripple current. Let the parameter ΔIL represent the inductor peak-peak ripple current. The inductor ripple current contributes to the output current ripple that must be filtered by the output capacitor. Therefore, choosing high inductor ripple currents impacts the selection of the output capacitor. Higher values of ΔIL lead to discontinuous mode (DCM) operation at moderate to light loads. The inductor ripple current ΔIL decreases with higher inductance or frequency and increases with higher VIN. Estimation of the inductor ripple current can be done using Equation 3:

$$\Delta I_L = \frac{V_{IN}}{f_{OSC} \bullet L} \left(1 - \frac{V_{IN}}{V_{OUT}} \right) \qquad \text{(Equation 3)}$$

The EC5037 step-up converters can 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 COUT = 20μF. To minimize radiated noise, use a toroidal or shielded inductor.

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 20~47μF.

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:

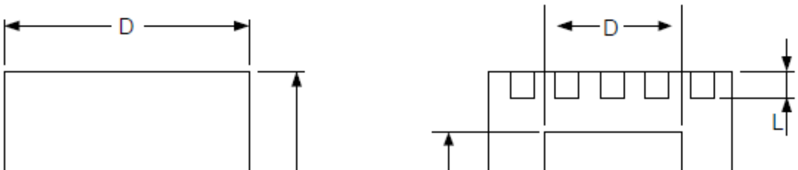
High speed switching path (SW, PGND and VOUT with wide PCB traces) must be kept as short as possible.
Solder the EC5037 PGND and GND pins to the ground plane.
Choose a bigger size 1.5uH Inductor with the lowest DCR value for given PCB space

The maximum junction temperature (T_J) of the EC5037 devices is 125℃.The thermal resistance of the DFN10 package is $R_{\theta JA}$ = 40.3℃/W, if the Exposed PAD is soldered. Specified regulator operation is assured to a maximum ambient temperature T_A of +50℃. Therefore, the maximum power dissipation for the DFN10 package it is about 1.86W. More power can be dissipated if the maximum ambient temperature of the application is lower.

$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_A}{R_{\theta JA}} = \frac{125^\circ C - 50^\circ C}{40.3^\circ C / W} = 1.86W$$

Packaging Information

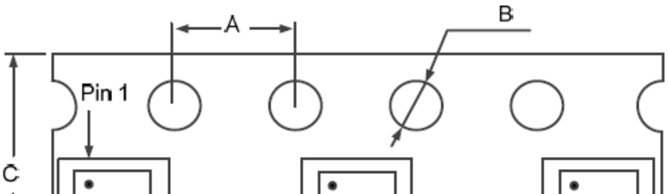
DFN3*3



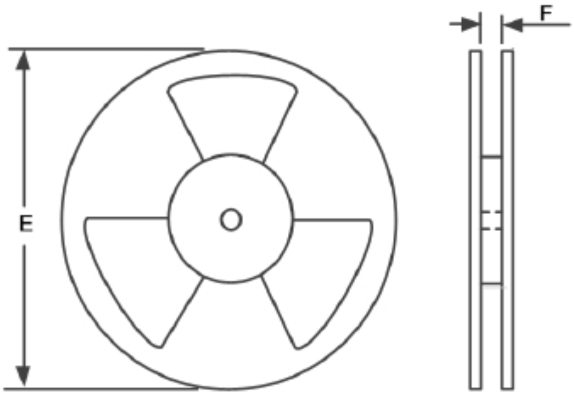
SYMBOLS	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	0.70	0.80	0.028	0.031
A1	0.00	0.05	0.000	0.002
b	0.18	0.30	0.007	0.012
D	2.90	3.10	0.114	0.122
D1	2.50		0.098	
E	2.90	3.10	0.114	0.122
E1	1.60		0.063	
e	0.50		0.020	
L	0.30	0.50	0.012	0.020

Carrier Tape & Reel Dimensions

1.Orientation / Carrier Tape Information :



2.Rokreel Information :



3.Dimension Details :

PKG Type	A					F	Q'ty/Reel
DFN 10L 3x3	4.0 mm	1.5 mm	12.0 mm	8.0 mm	13 inches	13.0 mm	5,000

Reflow Profile

Classification Of IR Reflow Profile

Reflow Profile	Green Assembly

Average Ramp-Up Rate (Tsmin to Tp)	1~2℃/second
Preheat & Soak -Temperature Min(Tsmin) -Temperature Max(Tsmax) -Time(tsmin to ts tsmax)	150℃ 200℃ 60~180 seconds
Time maintained above: -Temperature(TL) -Time(tL)	217℃ 40~50 seconds
Peak Temperature(Tp)	250 +0/-5 ℃
Time within 5℃ of actual Peak Temperature(tp)	15 seconds max.
Ramp-Down Rate	3℃/second max.
Time 25℃ to Peak Temperature	8 minutes max.

Note: For all temperature information, please refer to topside of the package, measured on the package body surface.