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TX4137 Product Data Sheet

(0.6A, 60V, 1MHz Step-Down Converter)

Overview

The TX4137 is a monolithic step-down switch-mode converter with built-in power MOSFETs.

The TX4137 achieves 0.6 A peak output current over a wide 5.5-60 V input supply range and Excellent line and load regulation.

TX4137 adopts PWM current mode operation, the loop is easy to stabilize and provide fast transient response.

The TX4137 integrates protection features including cycle-by-cycle current limiting and thermal shutdown.

TX4137 adopts SOT23-6 package and has few peripheral components.

Features

ÿ0.6A peak output currentÿ0.9ÿ internal power MOSFETÿCan start up with large output capacitorsÿOutput stable with low ESR ceramic capacitorsÿWide input voltage range: 5.5-60V

ÿEfficiency up to 90%

ÿFixed 1 MHz frequency

ÿThermal shutdown

ÿCycle-by-cycle overcurrent protection

ÿUsing SOT23-6 package

Application Areas

ÿElectricity meterÿDistributed power system

ÿBattery Charger

ÿPre-regulator for linear regulator

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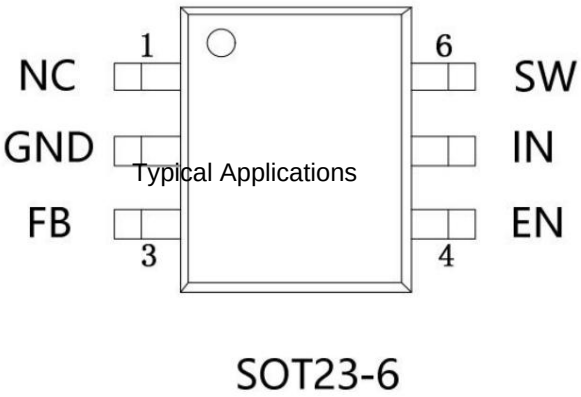
Pin Definition



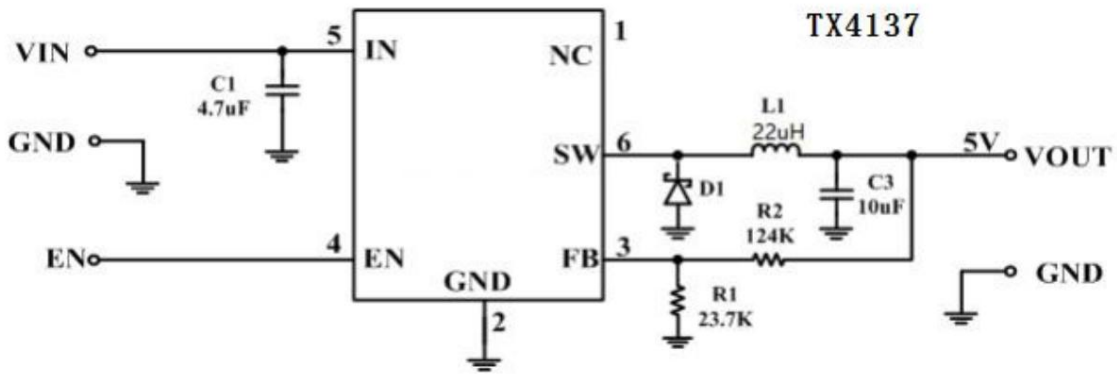
SOT23-6

Typical Applications

Functional Description

Pin	Name	Description
1	NC	Dangling
2	GND	Grounding
3	FB	output feedback voltage pin
4	EN	chip enable pin
5	IN	Chip power
6	SW	switch output pin

Typical Applications



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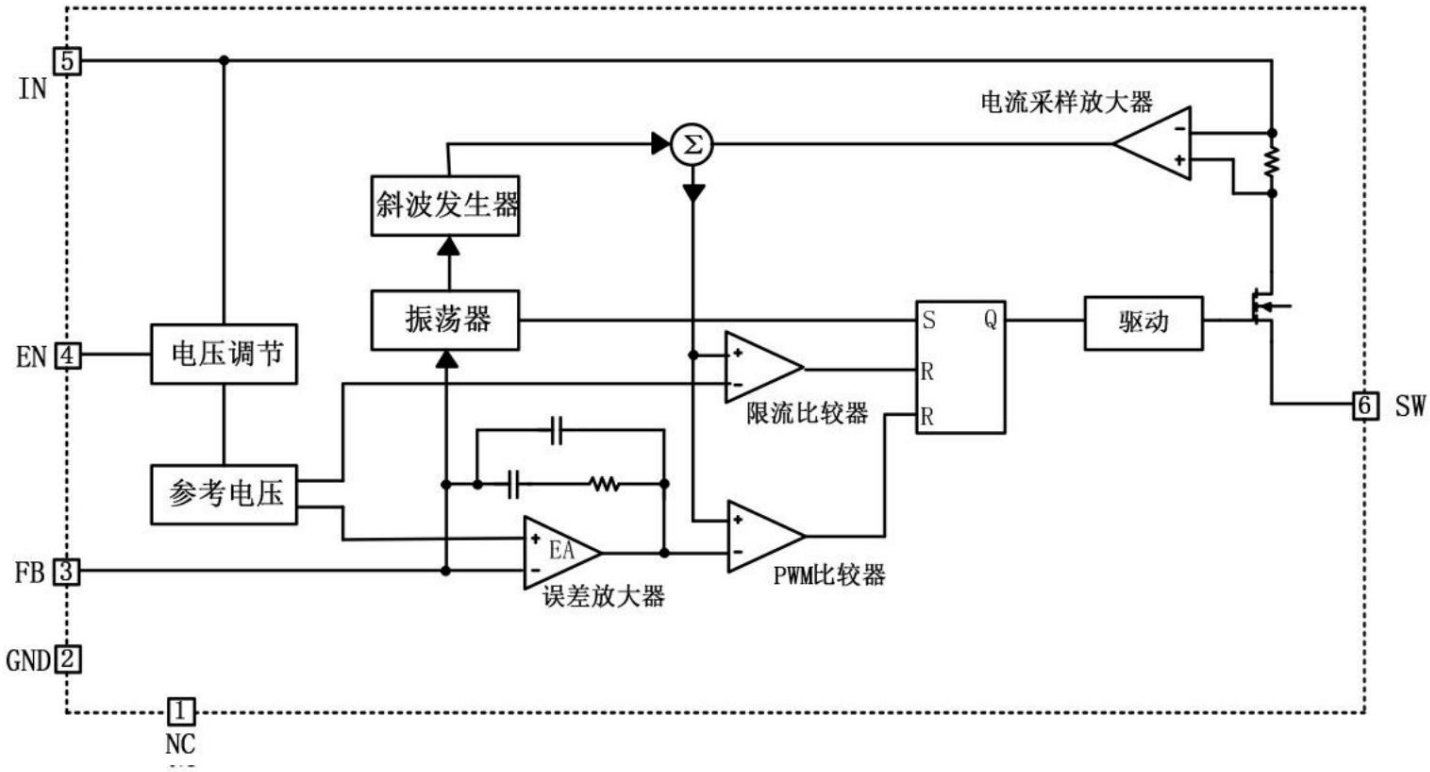
Circuit Diagram



极限参数 (注1)

符 号	描述	参数范围	单位
V_{IN}	IN 脚工作电压范围	-0.3~65	V
V_{SW}	SW 脚工作电压范围	-0.3~V_{IN}+0.3	V
Vmax	EN 脚、FB 脚工作电压范围	-0.3~6	V
I_{EN_SINK}	EN 脚灌电流	100	μA
T_A	工作温度范围	-40~125	°C
$P_{SOT23-6}$	SOT23-6 封装最大功耗	0.25	W
T_{STG}	存储温度范围	-45~150	°C
T_{SD}	焊接温度范围(时间小于 30 秒)	260	°C
V_{ESD}	静电耐压值（人体模型）	2000	V

注 1：极限参数是指超过上表中规定的工作范围可能会导致器件损坏。而工作在以上极限条件下可能会影响器件的可靠性。

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电特性(除非特别说明，V_{IN}=12V，T_A=25°C)

参数	符号	测试条件	最小值	典型值	最大值	单位
反馈电压	V_{FB}	4.5V< V_{IN} < 60V	0.792	0.812	0.832	V
反馈电流	I_{FB}	V_{FB} = 0.85V			0.1	μA
开关管导通电阻	RDS（ON）			0.9		Ω
开关管漏电流	I_{SW_LKG}	V_{EN} = 0V, V_{SW} = 0V			1	μA
电流限制阈值	I_{LIM}		1.0	1.25	1.5	A
振荡器频率	f_{SW}	V_{FB}= 0.6V	0.8	1	1.2	MHz
最大占空比	D_{MAX}	V_{FB} = 0.6V		95		%
最小打开时间	τ_{ON}			100		ns
欠压锁定上升电压	U_{UVLO_R}			5.5		V
欠压锁定迟滞电压	U_{UVLO_HYS}			500		mV
EN 上升阈值	V_{EN_R}			1.35		V
EN 下降阈值	V_{EN_F}			1.17		V
EN 迟滞阈值	V_{EN_HYS}			180		mV
EN 输出电流	I_{EN}	V_{EN} = 2V		3.1		μA
		V_{EN}= 0V		0.1		
V_{IN} 关断电流	I_S	V_{EN} = 0V		3		μA
V_{IN} 静态电流	I_Q	V_{EN} = 2V, V_{FB} = 1V		0.7	0.8	mA
热关断	T_{SD}			165		°C
热关断迟滞	T_{SD_HYS}			20		°C

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Overview

TX4137 is a current mode buck regulator. The output voltage of EA is proportional to the peak current of the inductor. At the beginning of the cycle, the power tube M1

is turned off. The output voltage of EA is greater than the output of the current sampling amplifier. The output of the current comparator is low. The rising edge of 1MHz CLK triggers the RS trigger to high, turning on M1 and connecting the inductor to the input power supply through SW.

The increasing inductor current is sampled and amplified by the current sampling amplifier. The ramp compensation is superimposed on the output of the current sampling amplifier and sent to the PWM comparator together with the output of EA for comparison. When the output of the current sampling amplifier with ramp compensation superimposed is greater than the output of EA, the RS trigger is reset and turns off M1. The inductor current continues to flow through the external Schottky diode D1.

The feedback voltage FB is compared with the reference voltage of 0.81V through EA. When the voltage of the FB pin is lower than 0.81V, the EA output increases.

The output voltage of EA is proportional to the peak current of the inductor. When the output voltage of EA increases, the output current also increases. big.

TX4137 comes with a 0.6ms soft start. Soft start prevents the output voltage from overshooting during the startup phase. When the chip starts, the internal circuit generates a soft start voltage SS that rises at a fixed slope. When SS is lower than the internal reference voltage, SS is used as the reference voltage for EA, and the internal reference voltage is shielded. When SS is greater than the internal reference voltage, the internal reference voltage controls EA.

When there is a very large output capacitor at the output (for example, 2200ýF or larger), the output voltage rises slower than SS, because the current required to charge the large output capacitor is greater than the maximum output current capability of the chip at this time. During the startup phase, the chip operates in the maximum current limiting state until the output voltage Vo rises to a stable value.

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The output voltage is set by

the voltage divider resistors R1 and R2 connected to the FB pin. The feedback resistor (R2) also sets the bandwidth of the feedback loop through the internal compensation network. The value of R1 is as follows:

$$R1 = \frac{R2}{\frac{Vout}{0.812V} - 1}$$

下表 1 列出了常用输出电压的电阻取值

Vout（V）	R1（KΩ）	R2（KΩ）
1.8	102（1%）	124（1%）
2.5	59（1%）	124（1%）
3.3	40.2（1%）	124（1%）
5	23.7（1%）	124（1%）
12	8.2（1%）	113（1%）

Inductance value

For most applications, the inductor's DC current rating should be at least 25% greater than the maximum load current.

To achieve higher efficiency, the DC resistance of the inductor should be less than 200mÿ. The value of the inductor can be selected from the following formulas:

The formula is calculated:

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L \times f_{SW}}$$

Where ÿIL is the inductor ripple current

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The ripple current of the inductor is 30% of the maximum load current. The maximum peak current of the inductor is given by the following formula:

The formula is calculated:

$$I_{L\ (MAX)} = I_{LOAD} + \frac{\Delta I_L}{2}$$

In light load mode (less than 100mA), a large value inductor can be used to improve efficiency.

Input capacitor value Input capacitor

is used to reduce the impact current of input power supply and suppress switching noise. The capacitive reactance of input capacitor at switching frequency should be less than the impedance of input source, which can prevent high-frequency switching current from flowing into input terminal. Low ESR and low temperature coefficient ceramic capacitor X5R or X7R can be used. For most applications, the capacitance of 4.7ÿF is sufficient. For applications with higher input voltage, electrolytic capacitor should be connected in parallel at input terminal to suppress input voltage spike when switching on and off.

Output capacitor value The output

capacitor can keep the output ripple voltage small and ensure the stability of the feedback loop. The output capacitor must have a sufficiently small capacitive reactance at the switching frequency. Low ESR ceramic capacitors X5R or X7R can be used. For most applications, a capacitance of 22ÿF is sufficient.

PCB Layout Note PCB

layout is critical for stable operation of the circuit. Please follow the following layout guidelines: 1) Keep the switch

current path as short as possible and minimize the power loop area (the power loop is composed of input capacitors, MOS and Schottky diodes). 2) The power ground->Schottky diode->SW pin connection path should be as short and wide as

possible. 3) Make sure the feedback resistor is close to the chip and the traces should be short.

4) The SW trace should be kept away from the FB feedback signal.

5) IN, SW, and GND need to be connected with large copper foil to improve chip heating and improve long-term stability.

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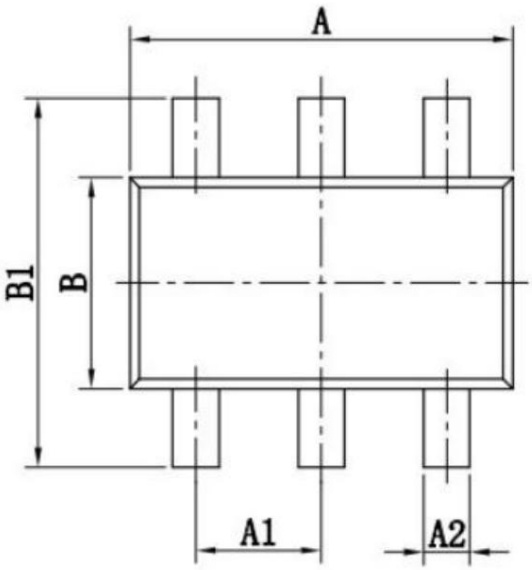
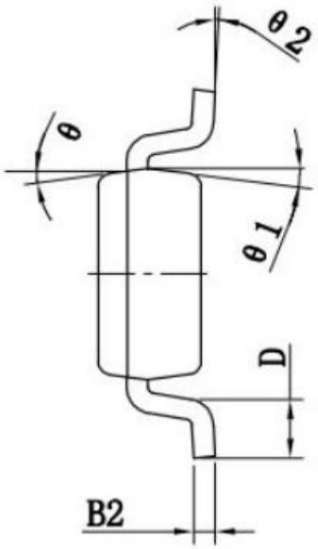
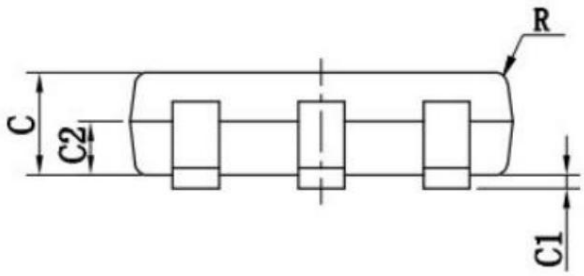
Packaging information

SOT23-6 Package Parameters







尺寸/SIZE 标注/SYMBOL	最小/MIN(mm)	最大/MAX(mm)	尺寸/SIZE 标注/SYMBOL	最小/MIN(mm)	最大/MAX(mm)
A	2.820	3.020	C1	0.000	0.100
A1	0.950(BSC)		C2	0.378	0.438
A2	0.350	0.500	D	0.300	0.600
B	1.600	1.700	θ	9° TYP4	
B1	2.650	2.950	θ1	10° TYP4	
B2	0.080	0.200	θ2	0~8°	
C	0.700	0.800			