



芯鼎盛

1.5A, 60V Step-Down

Features

Overview

The TX4144 is a monolithic step-down switch-mode converter with a built-in power MOSFET. The TX4144 achieves 1.5 A over a wide input supply range of 6-60 V maximum output current and has excellent line voltage and load regulation.

The TX4144 uses PWM current-mode operation for easy loop stabilization and fast transient response.

The TX4144 provides an external FS pin to set the operating frequency with an external resistor.

The TX4144 integrates protection features including cycle-by-cycle current limit and thermal shutdown.

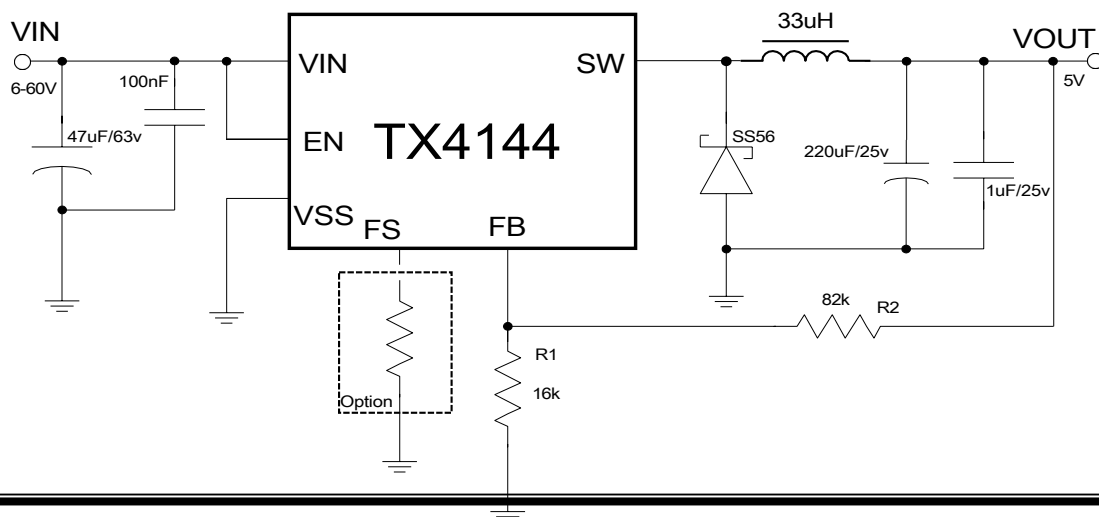
The TX4144 is available in a SOP8 package and has few peripheral components.

- ◆ Maximum output current of 1.5A
- ◆ 60V/2A Internal Power MOSFET
- ◆ Up to 93% efficiency
- ◆ Frequency adjustable
- ◆ Thermal shutdown
- ◆ Cycle-by-cycle overcurrent protection
- ◆ Wide input voltage range: 6~60V
- ◆ Adopted SOP8 package

Applications

- ◆ Distributed Power Systems
- ◆ Battery charger
- ◆ Industrial Power Systems
- ◆ Car recorder, car charger, floor sweeper

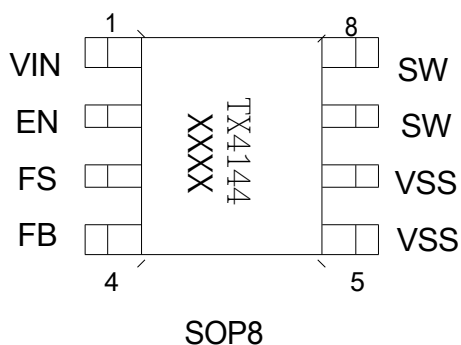
Typical Application Circuit Diagram



Package and

Pin

Assignment



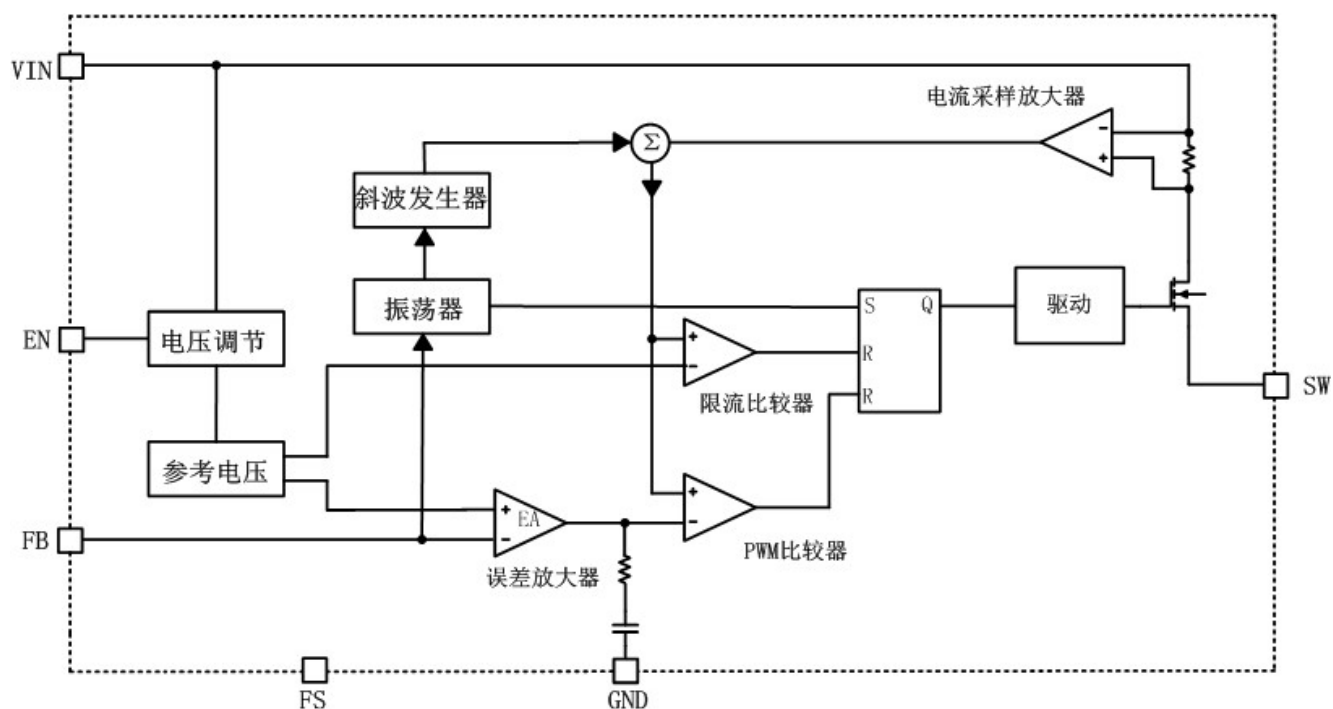
Pin

Definiti

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Pin No.	Foot er Name	Descriptio n
1	VIN	Chip Power
2	EN	Chip enable pin
3	FS	Operating frequency setting foot
4	FB	Output feedback voltage pin
5,6	VSS	Grounding
7,8	SW	Switch output pin

Internal Circuit Block Diagram



Limit parameters (Note 1)

Symb ols	Des crip tion	Paramet er Range	Unit
VIN	VIN, EN pin operating voltage range	-0.3~65	V
VSW	SW pin operating voltage range	- 0.3~VIN+0.3	V
Vmax	FB, FS pin operating voltage range	-0.3~6	V
IEN_SINK	EN pin current filling	100	μ A
TA	Operating temperature range	-40~85	oC
PSOP8	Maximum power	0.8	W

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	consumption in SOP8 package		
TSTG	Storage temperature range	-45~150	oC
TSD	Welding temperature range (time less than 30 seconds)	260	oC
VESD	Electrostatic withstand voltage value (human model)	2000	V

Note 1: The limit parameters are the operating range beyond those specified in the table above may result in device damage. And working under the above limit conditions may affect the reliability of the device.

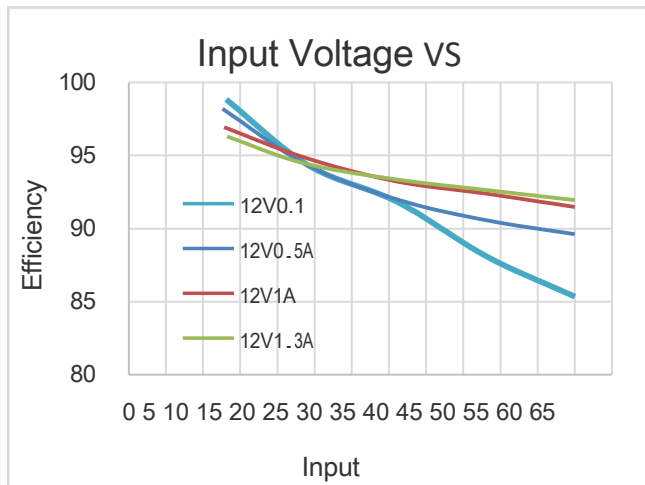
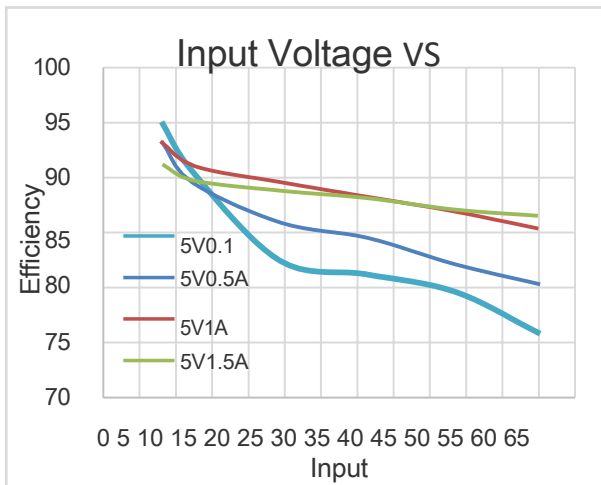
Electrical characteristics ($V_{IN} = 12V$, $T_A = 25^{\circ}C$ unless otherwise noted)

Parameters	Symbol	Test conditions	Minimum value	Typical values	Maximum value	Unit
Feedback voltage	V_{FB}	$6V < V_{IN} < 60V$	0.8	0.82	0.84	V
Feedback current	I_{FB}	$V_{FB} = 0.85V$			0.1	μA
Switching tube leakage current	I_{SW_LKG}	$V_{EN} = 0V$, $V_{SW} = 0V$			1	μA
Current Limiting Threshold	I_{LIM}			2.4		A
Oscillator frequency	f_{SW}	FS Suspension		140		kHz
		FS Connect 470k Ω to ground		450		
Maximum Duty Cycle	D_{MAX}	$V_{FB} = 0.6V$		95		%
Minimum opening time	T_{ON}			100		ns
Undervoltage lockout rising voltage	U_{VLO_R}			5.5		V
Undervoltage lockout hysteresis voltage	U_{VLO_HYS}			700		mV
EN Rising Threshold	V_{EN_R}			1.1		V
EN Decrease Threshold	V_{EN_F}			0.8		V
EN Hysteresis	V_{EN_HYS}			300		mV

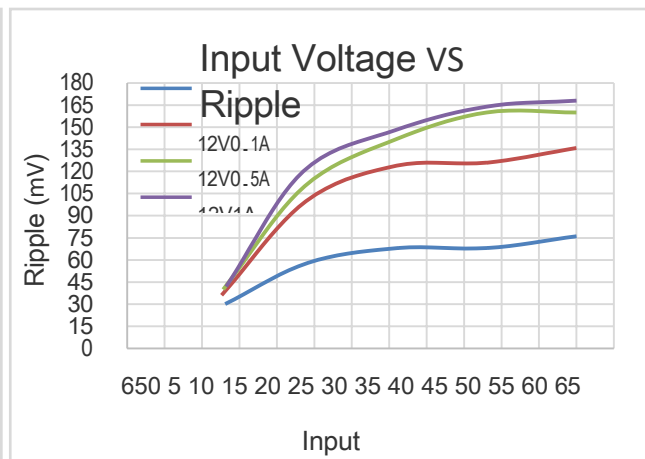
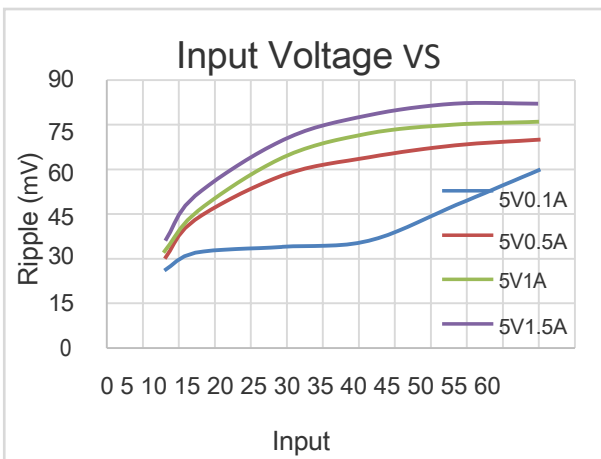
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Threshold						
EN Output Current	IEN	$V_{EN} = 2V$		0.1		μA
		$V_{EN} = 0V$		0.1		
V_{IN} Turn-off current	IS	$V_{EN} = 0V$		1		μA
V_{IN} Static current	IQ	$V_{EN} = 2V, V_{FB} = 1V$		0.15	0.2	mA
Thermal shutdown	TSD			165		$^{\circ}C$
Thermal shutdown hysteresis	TSD_HYS			20		$^{\circ}C$

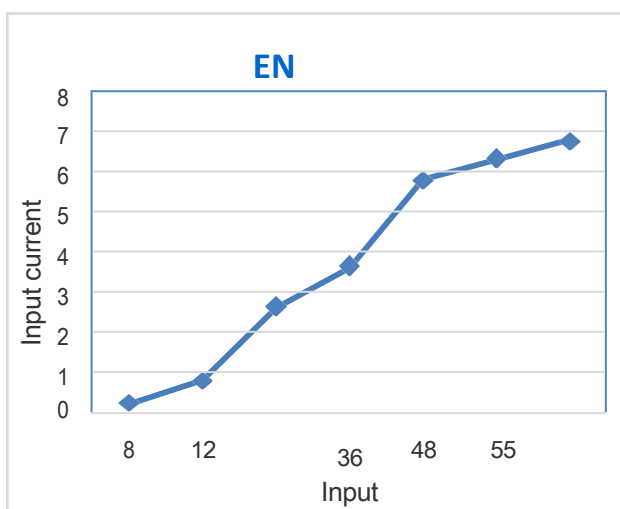
Typical application test characteristic curve



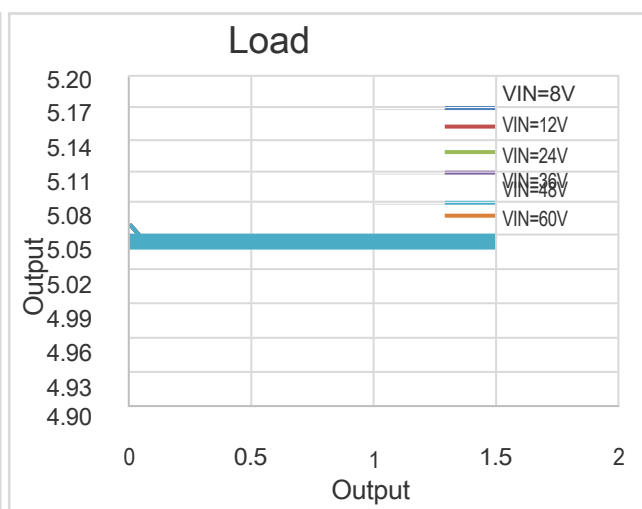
Input Voltage VS Efficiency



Input Voltage VS Ripple



EN Off Current



Output Voltage VS Output Current

Application Guide

Overview

The TX4144 is a current-mode buck regulator where the output voltage of the EA is proportional to the peak current of the inductor.

At the beginning of the cycle, 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, and the rising edge of CLK triggers the RS trigger high, turning M1 on to connect the inductor to the input power supply via SW.

The increasing inductor current is sampled and amplified by the current sampling amplifier. The ramp compensation is superimposed on the current sampling amplifier output and sent to the PWM comparator for comparison along with the EA output. The inductor current is renewed via an external Schottky diode D1.

The feedback voltage FB is compared with the reference voltage of 0.82V by EA, and the EA output increases when the voltage of FB pin is lower than 0.82V. The output voltage of EA is proportional to the peak current of the inductor, and an increase in the EA output voltage increases the output current.

The TX4144 comes with a soft start of 0.6ms. The soft-start prevents the output voltage from overshooting during the start-up phase. When the chip starts, the internal circuitry generates a soft-start voltage SS that rises with 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 masked. When SS is greater than the internal reference voltage, the internal reference voltage controls the EA.

Output voltage setting

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 taken as follows:

$$R1 = \frac{R2}{\frac{V_{out}}{0.82V} - 1}$$

Table 1 below shows the resistor values for common output voltages

Vout (V)	R1 (KΩ)	R2 (KΩ)
1.8	52 (1%)	62 (1%)
2.5	40.2 (1%)	82 (1%)

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3.3	27.4 (1%)	82 (1%)
5	16 (1%)	82 (1%)
12	6 (1%)	82 (1%)

Inductance value

For most applications, the DC current rating of the inductor should be at least 25% greater than the maximum load current. To achieve higher efficiency, the

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The DC resistance of the inductor should be less than 200mΩ. The value of inductance can be calculated by the following formula:

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

where ΔI_L is the inductor ripple current.

The ripple current of the inductor is taken as 30% of the maximum load current, and the maximum peak current of the inductor is calculated by the following equation:

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

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

Input capacitance value

The input capacitor is used to reduce the inrush current of the input power supply and to suppress switching noise. The capacitance of the input capacitor at the switching frequency should be less than the impedance of the input source to prevent high frequency switching currents from flowing into the input. Electrolytic capacitors with low ESR and low temperature coefficient can be used. 47μ F electrolytic capacitors in parallel with 100nF ceramic capacitors are recommended for most applications. For applications with high input voltages, electrolytic capacitors at the input can also suppress input voltage spikes during switching.

Value of output capacitance

The output capacitor maintains a small output ripple voltage and ensures the stability of the feedback loop. The output capacitor must have a sufficiently small capacitive reactance at the switching frequency. Electrolytic capacitors with low ESR can be used, and for most applications a capacitance of 220μ F is sufficient.

The output is connected with a low ESR ceramic capacitor to reduce the output ripple and stabilize the output.

Enable Control EN

Enable pin EN is used to control the enable application of the chip, which can be added to the MCU control, not to control the enable application, which can be directly pulled up to VIN pin, not overhanging.

Operating frequency setting FS

The operating frequency setting FS is used to control the chip's operating frequency, which can be determined by connecting different external resistors to ground for different operating frequencies

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f_{SW} . The external resistor R_{FS} is obtained from the following equation:

$$R_{FS} = \frac{140}{f_{SW} - 140}$$

Where, f_{SW} is the operating frequency in KHz, it is recommended that f_{SW} take the maximum value of 500KHz, typical operating frequency 140KHz (FS)
(pin overhang); R_{FS} in $M\Omega$.

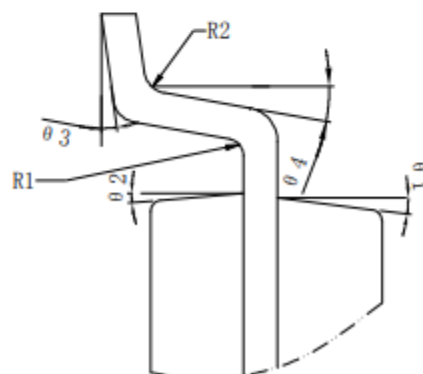
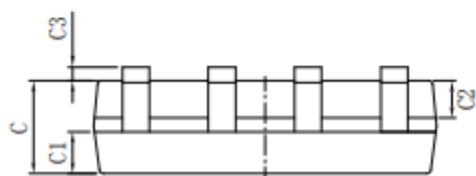
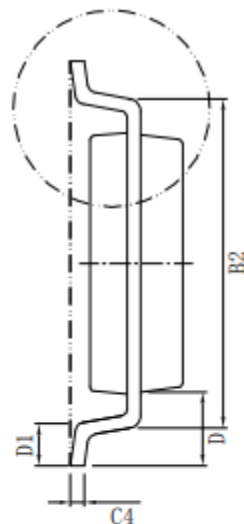
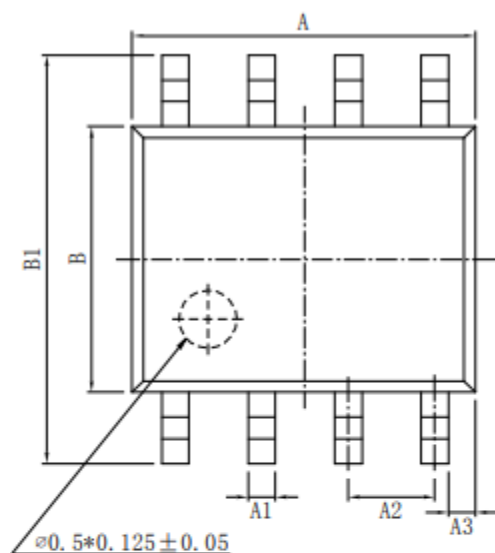
PCB Layout Notes

PCB layout is critical to the stable operation of the circuit. Please follow the following layout guidelines:

- 1) Keep the switching current path alignment as short as possible and minimize the power loop area (the power loop consists of the input capacitor, MOS and Schottky diode).
- 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 alignment should be short.
- 4) SW alignment should be away from the FB feedback signal.
- 5) The 100nF ceramic chip capacitor at the VIN input should be close to the chip pin end.
- 6) VIN, SW, GND need to be connected with large copper foil to improve chip heating and long-term stability.

Package Information

SOP8 package parameters



标注	尺寸	最小 (mm)	最大 (mm)	标注	尺寸	最小 (mm)	最大 (mm)
A		4.80	5.00	C3		0.05	0.20
A1		0.356	0.456	C4		0.203	0.233
A2		1.27TYP		D		1.05TYP	
A3		0.345TYP		D1		0.40	0.80
B		3.80	4.00	R1		0.20TYP	
B1		5.80	6.20	R2		0.20TYP	
B2		5.00TYP		0 1		17° TYP4	
C		1.30	1.60	0 2		13° TYP4	
C1		0.55	0.65	0 3		0° ~ 8°	
C2		0.55	0.65	0 4		4° ~ 12°	