High Efficiency 1MHz, 2A Step Up Regulator   TD8208

General Description

TD8208 is a high efficiency, current-mode control Boost DC to DC regulator with an integrated 120mΩ $R_{DS(ON)}$ N-channel MOSFET. The fixed 1MHz switching frequency and internal compensation reduce external component count and save the PCB space. The build-in internal soft start circuitry minimizes the inrush current at start-up.

Features

- Wide input range:2-6V
- 1MHz switching frequency
- Minimum on time: 100ns typical
- Minimum off time: 100ns typical
- Max output voltage: 6V
- Low $R_{DS(ON)}$: 120mΩ
- RoHS Compliant and Halogen Free
- Compact package: SOT23-6

Applications

- Cell Phone and Smart Phone
- PDA, PMP, MP3
- Digital Camera

Package Types

SOT23-6

Figure 1. Package Types of TD8208

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Pin Configurations
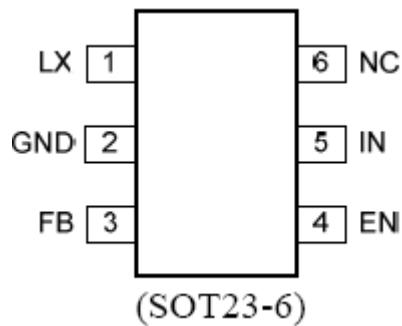
Figure 2 Pin Configuration of TD8208(Top View)

Pin Description

Pin Number	Pin Name	Description
1	LX	Inductor node. Connect an inductor between IN pin and LX pin.
2	GDN	GND
3	FB	Feedback pin. Connect a resistor R1 between V_{OUT} and FB, and a resistor R2 between FB and GND to program the output voltage: $V_{OUT}=0.6V*(R1/R2+1)$
4	EN	Enable control. High to turn on the part. Don't leave it floated.
5	IN	Power Input pin.
6	NC	

Ordering Information

$$\textbf{TD8208} \quad \square \quad \square$$

Circuit Type ————————————

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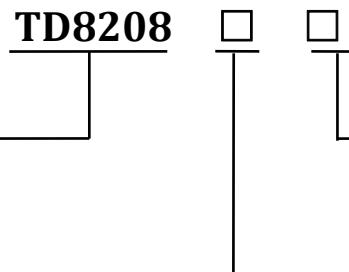
Packing:
Blank：Tube
R:Type and Reel

Function Block

Figure 3 Function Block Diagram of TD8208

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Absolute Maximum Ratings

EN, VDD, LX---7V

FB----------------------- --3.6V

Power Dissipation, P_D @ T_A = 25°C, SOT23-6 --- 0.6W

Package Thermal Resistance (Note 2)

SOT23-6, θ_{JA} --- 200°C/W

SOT23-6, θ_{JC} --- 130°C/W

Junction Temperature Range -- 125°C

Lead Temperature (Soldering, 10 sec.) --- 260°C

Storage Temperature Range -- -65°C to 150°C

Recommended Operating Conditions

VDD pin------------------------------- --- 2V to 6V

FB--- --- 0V to 1V

Junction Temperature Range -- -40°C to 125°C

Ambient Temperature Range -- -40°C to 85°C

## Electrical Characteristics

(V_{IN} = 3.3V, V_{OUT}=5V, I_{OUT}=100mA, T_A = 25°C unless otherwise specified)

Parameters	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Input Voltage Range	V_{IN}		2		6	V
Quiescent Current	I_Q	V_{FB}=0.66V		200		μA
Low Side Main FET	Rds(on)			120		mΩ
Main FET Current	I_{LIM1}		3			A
Switching Frequency	Fsw		0.8	1	1.2	MHz
Feedback Reference	V_{REF}		0.588	0.6	0.612	V
IN UVLO Rising	$V_{IN,UVLO}$				1.9	V
Thermal Shutdown	T_{SD}			150		°C

Typical Performance Characteristics

Efficiency vs Load Current

V_{IN}=3.5V, V_{OUT}=5V

Load Transient

(V_{IN}=3.3V, V_{OUT}=5V, I_{load}=0.12~1.2A)

$V_{OUT(AC)}$ 0.2V/div

I_O 0.5A/div

Time(100μs/div)

Startup from V_{IN}

(V_{IN}=3.3V, V_{OUT}=5V, I_{load}=1.2A)

V_{IN} (2V/div)

V_{OUT} (2V/div)

I_o (0.5A/div)

Time(2ms/div)

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Shutdown from V_{IN}

(V_{IN}=3.3V, V_{OUT}=5V, I_{load}=1.2A)

V_{IN} (2V/div)

V_{OUT} (2V/div)

I_o (0.5A/div)

Time(400μs/div)

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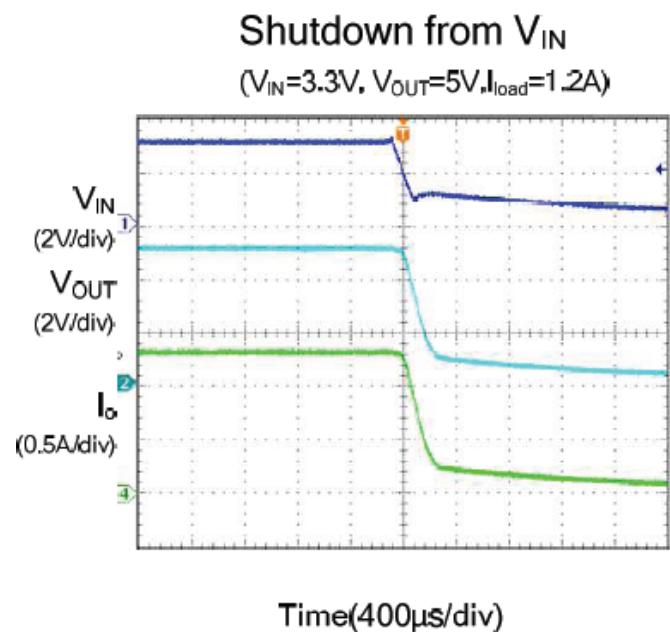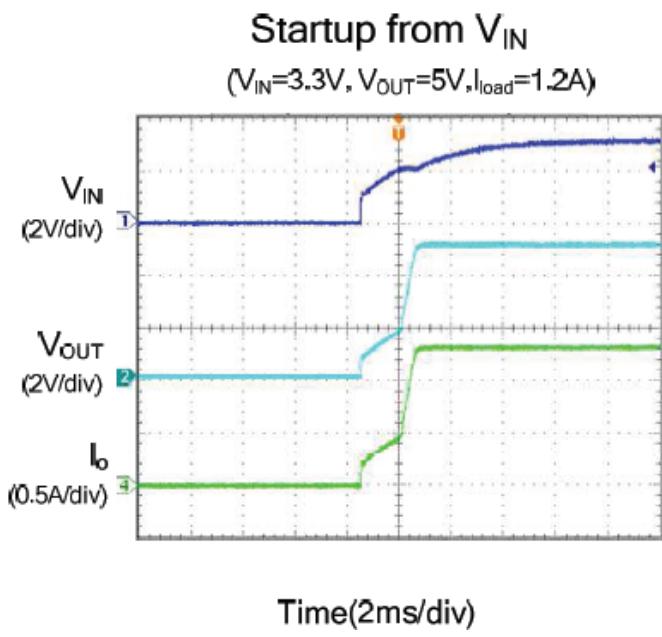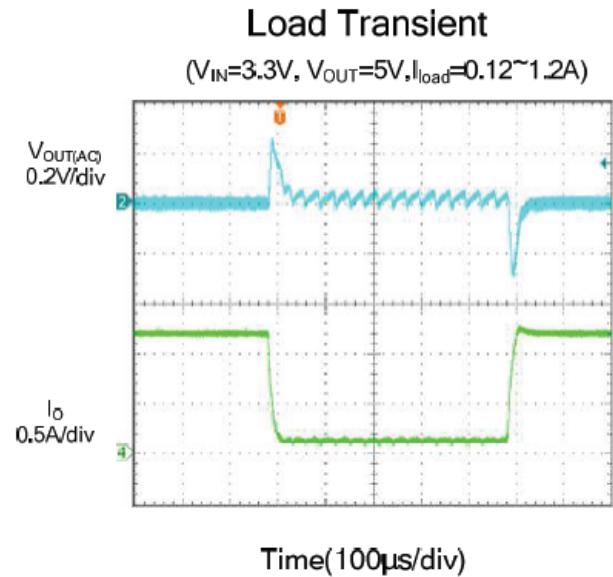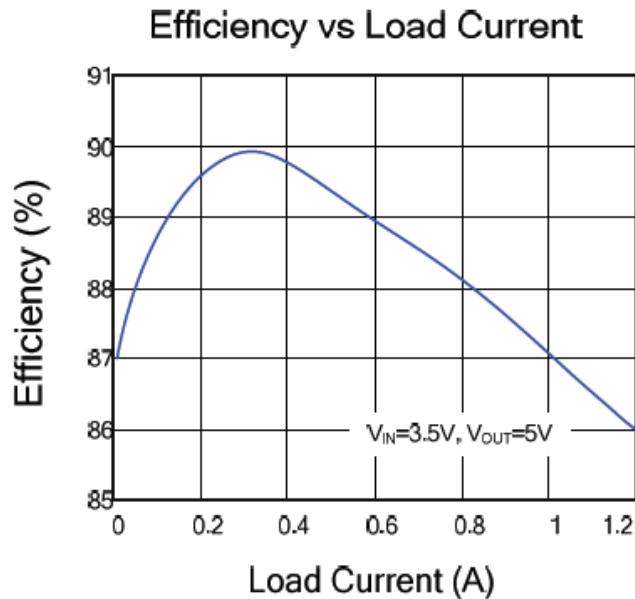
Startup from Enable
(V_{IN}=3.3V, V_{OUT}=5V, I_{load}=1.2A)

EN (5V/div)
V_{OUT} (2V/div)
I_o (0.5A/div)

Time(2ms/div)
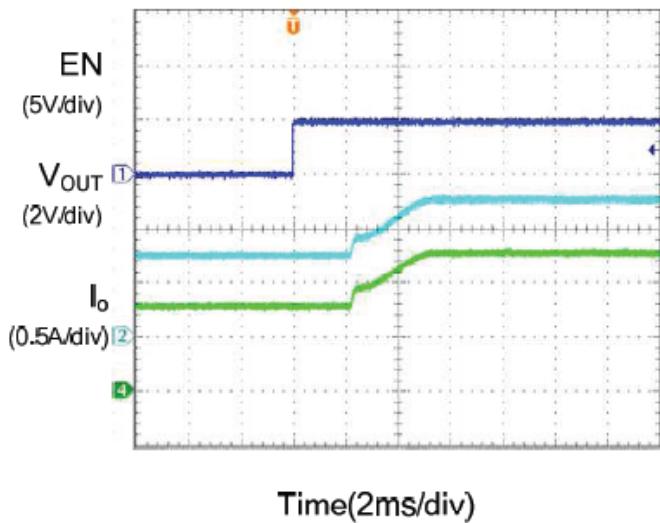
Shutdown from Enable
(V_{IN}=3.3V, V_{OUT}=5V, I_{load}=1.2A)
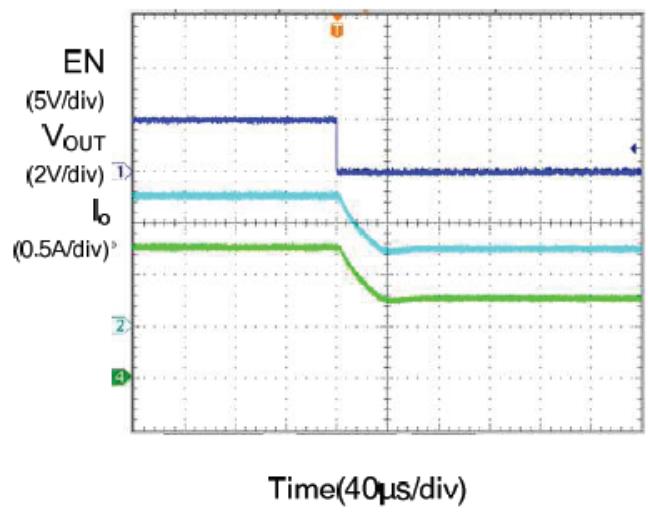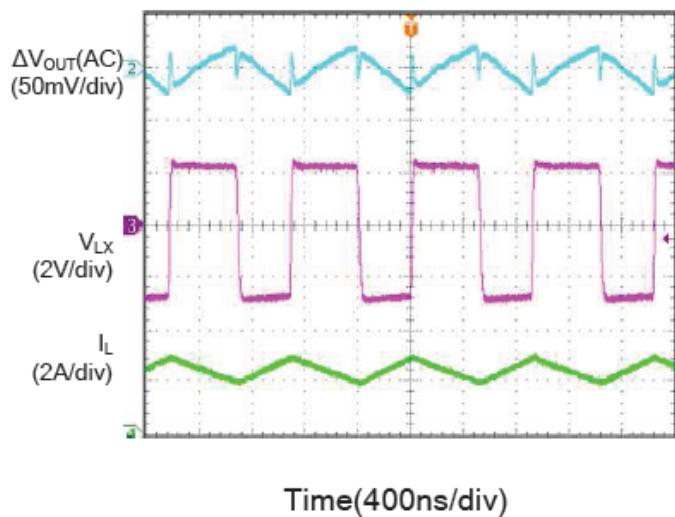
EN (5V/div)
V_{OUT} (2V/div)
I_o (0.5A/div)

Time(40μs/div)

Output Ripple
(V_{IN}=3.3V, V_{OUT}=5V, I_O=1.2A)

ΔV_{OUT}(AC) (50mV/div)
V_{LX} (2V/div)
I_L (2A/div)

Time(400ns/div)

Output Ripple
(V_{IN}=3.3V, V_{OUT}=5V, I_O=0.6A)

ΔV_{OUT}(AC) (50mV/div)
V_{LX} (2V/div)
I_L (1A/div)

Time(400ns/div)

Output Ripple
(V_{IN}=3.3V, V_{OUT}=5V, I_O=0.12A)

ΔV_{OUT}(AC) ②
(50mV/div)

V_{LX} ③
(2V/div)

I_L
(0.5A/div)

Time(10µs/div)

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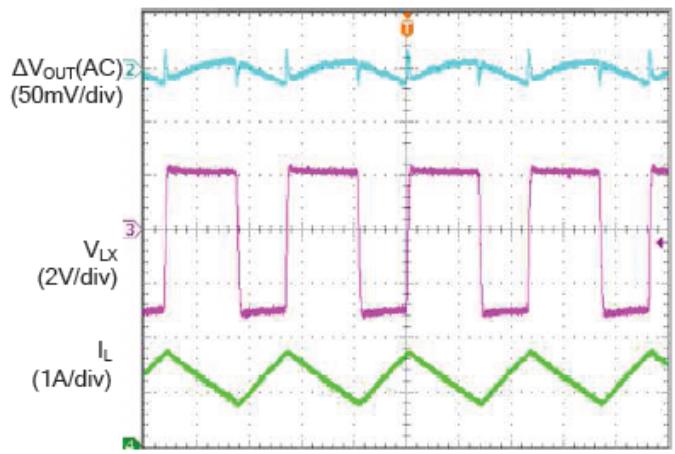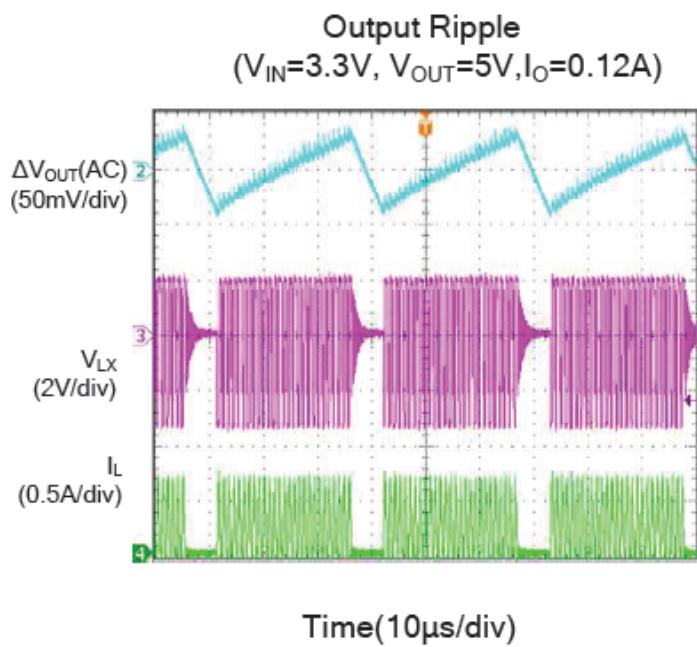
Typical Application Circuit1
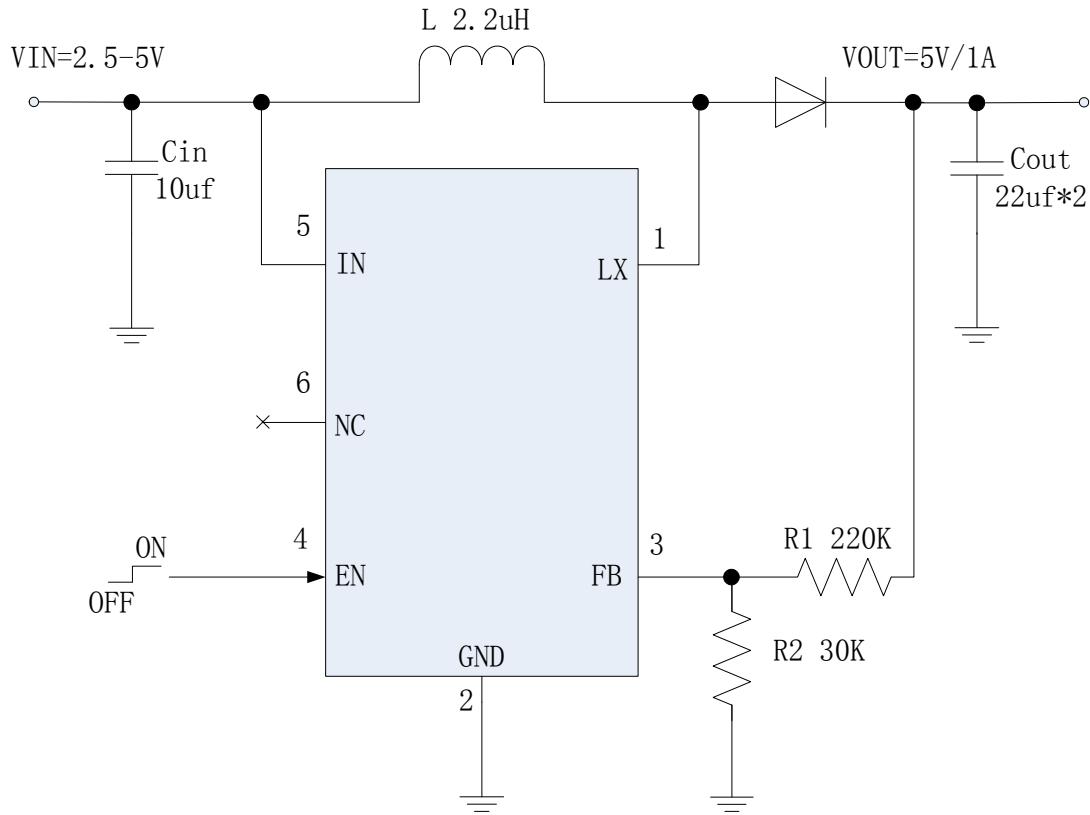
Typical Application Circuit2
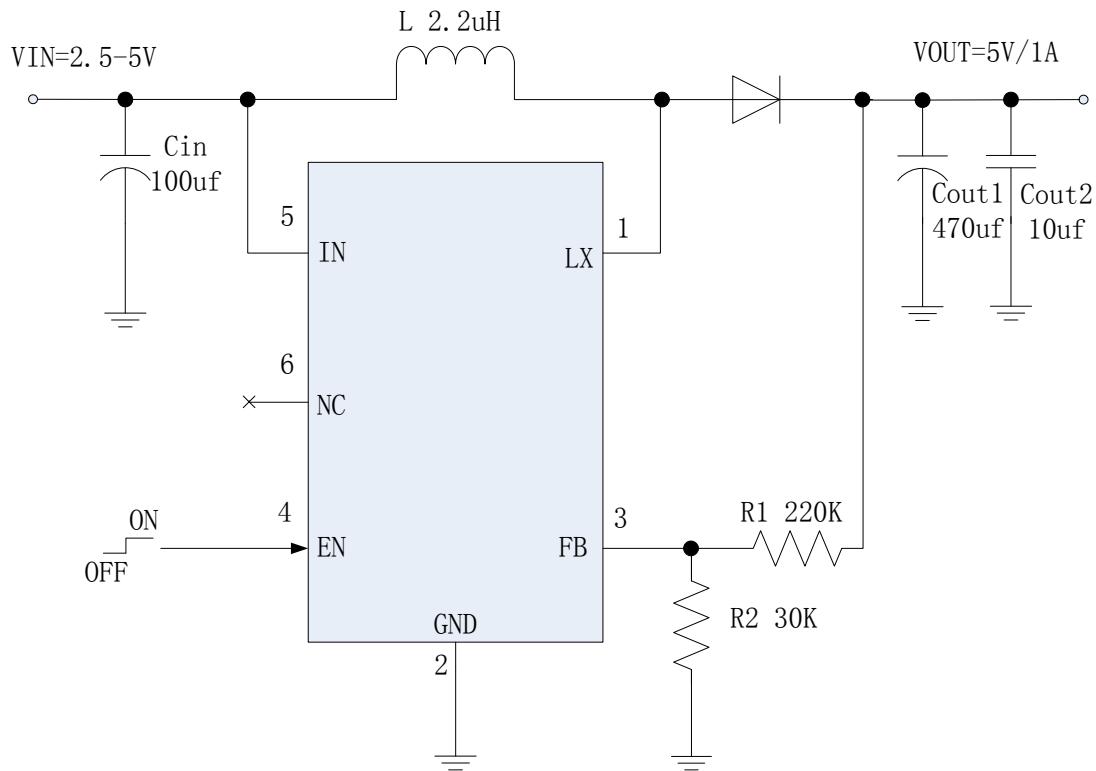
**High Efficiency 1MHz, 2A Step Up Regulator   TD8208**

Function Description

Because of the high integration in the TD8208 IC, the application circuit based on this regulator IC is rather simple. Only input capacitor C_{IN}, output capacitor C_{OUT}, inductor L and feedback resistors (R_1 and R_2) need to be selected for the targeted applications specifications.

Feedback resistor dividers R_1 and R_2:

Choose R_1 and R_2 to program the proper output voltage. To minimize the power consumption under light loads, it is desirable to choose large resistance values for both R_1 and R_2. A value of between 10k and 1M is recommended for both resistors. If R_1=200k is chosen, then R_2 can be calculated to be:

$$R_2 = (R_1 \times 0.6V)/(V_{OUT} - 0.6V)$$
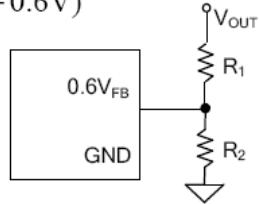
Output capacitor C_{OUT}:

The output capacitor is selected to handle the output ripple noise requirements. Both steady state ripple and transient requirements must be taken into consideration when selecting this capacitor. For the best performance, it is recommended to use X5R or better grade ceramic capacitor with 25V rating and more than two pcs 10uF capacitor.

Input capacitor C_{IN}:

The ripple current through input capacitor is calculated as:

$$I_{CIN\_RMS} = \frac{V_{IN} \cdot (V_{OUT} - V_{IN})}{2\sqrt{3} \cdot L \cdot F_{SW} \cdot V_{OUT}} (A)$$

To minimize the potential noise problem, place a typical X5R or better grade ceramic capacitor really close to the VDD and GND pins. Care should be taken to minimize the loop area formed by C_{IN}, and VDD/GND pins. In this case a 22uF low ESR ceramic capacitor is recommended.

Boost inductor L:

There are several considerations in choosing this inductor.

1) Choose the inductance to provide the desired ripple current. It is suggested to choose the ripple current to be about 40% of the maximum average input current. The inductance is calculated as:

$$L = \left(\frac{V_{IN}}{V_{OUT}}\right)^2 \frac{(V_{OUT} - V_{IN})}{F_{SW} \times I_{OUT, MAX} \times 40\%}$$

where F_{SW} is the switching frequency and $I_{OUT,MAX}$ is the maximum load current.

The TD8208 regulator IC is quite tolerant of different ripple current amplitude. Consequently, the final choice of inductance can be slightly off the calculation value without significantly impacting the performance.

2) The saturation current rating of the inductor must be selected to be greater than the peak inductor current under full load conditions.

$$I_{STA,MIN} > \left(\frac{V_{OUT}}{V_{IN}}\right) \times I_{OUT\_MAX} + \frac{V_{IN}(V_{OUT} - V_{IN})}{2 \times F_{SW} \times L \times V_{OUT}}$$

3) The DCR of the inductor and the core loss at the switching frequency must be low enough to achieve the desired efficiency requirement. It is desirable to choose an inductor with DCR<50mohm to achieve a good overall efficiency.

Enable Operation

Pulling the EN pin low (<0.4V) will shut down the device. During the shut down mode, the TD8208 shut down current drops to lower than 1uA, Driving the EN pin high (>2.0V) will turn on the IC again.

Diode Selection

Schottky diode is a good choice for high efficiency operation because of its low forward voltage drop and fast reverse recovery. The current rating of the diode must meet following:

$$I_D(RMS) \approx \sqrt{(I_{OUT} \times I_{PEAK})}$$

The schottky diode reverse breakdown voltage should be larger than the output voltage.

Layout Design:

The layout design of TD8208 regulator is relatively simple. For the best efficiency and minimum noise problems, we should place the following components close to the IC: C_{IN}, L, R_1 and R_2.

1) It is desirable to maximize the PCB copper area connecting to GND pin to achieve the best thermal and noise performance. If the board space allowed, a ground plane is highly desirable.

2) C_{IN} must be close to Pins IN and GND. The loop area formed by C_{IN} and GND must be minimized.

3) The PCB copper area associated with LX pin must be minimized to avoid the potential noise problem.

4) The components R_1 and R_2, and the trace connecting to the FB pin must NOT be adjacent to the LX net on the PCB layout to avoid the noise problem.

5) If the system chip interfacing with the EN pin has a high impedance state at shutdown mode and the IN pin is connected directly to a power source such as a Li-Ion battery, it is desirable to add a pull down 1Mohm resistor between the EN and GND pins to prevent the noise from falsely turning on the regulator at shutdown mode.

Package Information

SOT23-6 Package Outline Dimensions

Design Notes