

2A, 1.5MHz Step-Down Converter in SOT23-5 Package

DESCRIPTION

The GM9308 is a high-efficiency, DC-to-DC step-down switching regulator, capable of delivering up to 2A of output current. The devices operate from an input voltage range of 2.6V to 6V and provide output voltages from 0.6V to VIN, making the GM9308 ideal for low voltage power conversions. Running at a fixed frequency of 1.5MHz allows the use of small inductance value and low DCR inductors, thereby achieving higher efficiencies. Other external components, such as ceramic input and output caps, can also be small due to higher switching frequency, while maintaining exceptional low noise output voltages. Built-in EMI reduction circuitry makes this converter ideal power supply for RF applications. Internal soft-start control circuitry reduces inrush current. Short-circuit and thermal-overload protection improves design reliability.

GM9308 is housed in a tiny SOT23-5L package

FEATURES

- ◆ Up to 96% Efficiency
- ◆ Up to 2A Max Output Current
- ◆ 1.5MHz Frequency
- ◆ Light Load operation
- ◆ Internal Compensation
- ◆ Tiny SOT23-5L Package

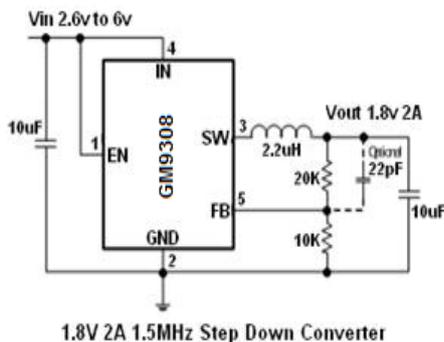
APPLICATIONS

- MIDs, Tablet PC
- Set Top Boxes
- USB ports/Hubs
- Hot Swaps
- Cellphones

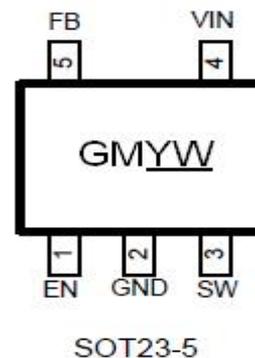
ORDERING INFORMATION

PART #	PACKAGE PIN	TOP MARK
GM9308	SOT23-5	GMYW └───┬─── DateCode └───┬─── Product └───┬─── Number

TYPICAL APPLICATION



PIN OUT & MARKING



ORDERING INFORMATION

PART No.	PACKAGE	Tape & Reel
GM9308	SOT23-5	3000/Reel

ABSOLUTEMAXIMUM RATINGS

Parameter	Value
Max Input Voltage	8V
Max Operating Junction Temperature(Tj)	125°C
Ambient Temperature(Ta)	-40°C -85°C
Max Power Dissipation(SOT23-5)	0.9W
Storage Temperature(Ts)	-40°C -150°C
ESD(HBM)	>2000V

ELECTRICAL CHACACTERISTICS

(V_{IN} = 5V, unless otherwise specified. Typical values are at TA = 25°C)

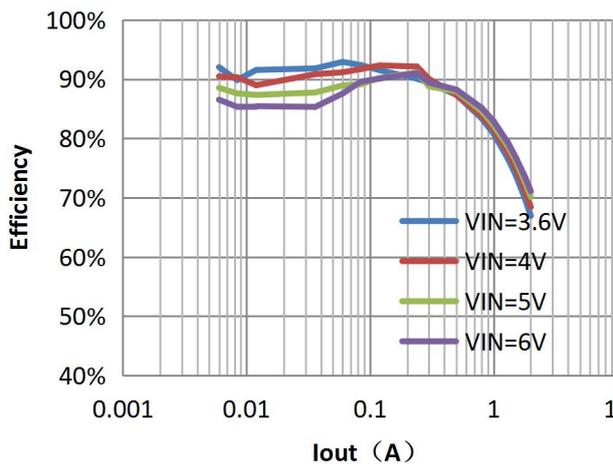
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _{in}	Input Voltage Range		2.6		6	V
V _{ref}	FB Feedback Voltage	V _{IN} = 5V	0.586	0.6	0.614	V
I _{fb}	Feedback Leakage current			0.1		uA
I _q	Quiescent Current	V _{FB} = 0.65V		90		uA
		Shutdown			1	uA
LnReg	Line Regulation	V _{IN} = 2.7 to 7V		0.1	0.2	%/V
LdReg	Load Regulation	I _{OUT} = 0.01A to 2A		0.1	0.2	%/A
F _{sw}	Switching Frequency			1.5		MHz
R _{dsonP}	PMOS R _{dson}			150		mΩ
R _{dsonN}	NMOS R _{dson}			120		mΩ
I _{limit}	Peak Current Limit			3		A
I _{swlk}	SW Leakage Current				1	uA
I _{enlk}	EN Leakage Current				1	uA
V _{h_en}	EN Input High Voltage		1.5			V
V _{l_en}	EN Input Low Voltage				0.5	V

PIN DESCRIPTION

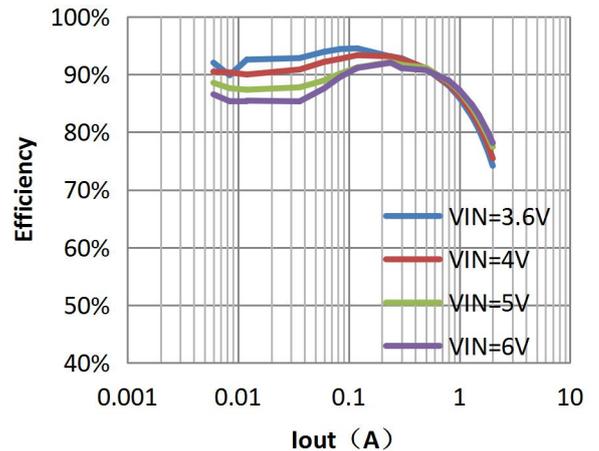
PIN #	NAME	DESCRIPTION
1	EN	Enable pin for the IC. Drive this pin high to enable the part, low to disable.
2	GND	Ground
3	SW	Inductor Connection. Connect an inductor Between SW and the regulator output.
4	IN	Supply Voltage. Bypass with a 10 μ F ceramic capacitor to GND
5	FB	Feedback Input. Connect an external resistor divider from the output to FB and GND to set the output to a voltage between 0.6V and VIN

TYPICAL CHARACTERISTICS

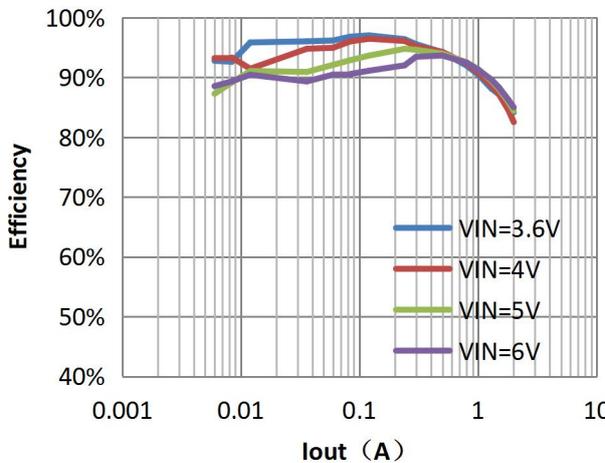
Efficiency Vs I_{OUT} V_{out}=1.2v



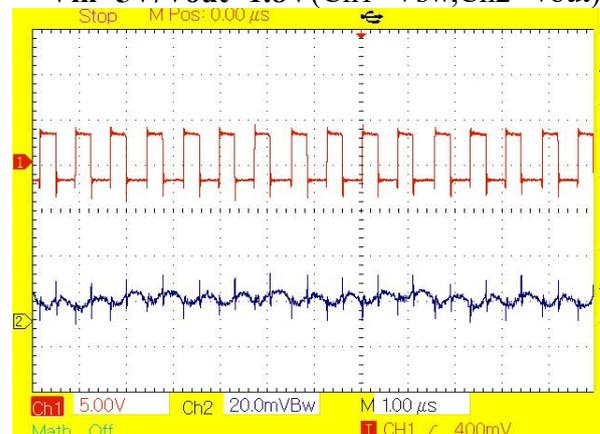
Efficiency Vs I_{OUT} V_{out}=1.8v



Efficiency Vs I_{OUT} V_{out}=3.3v



Output Ripple and SW at 1.5A load
Vin=5V/Vout=1.8V (Ch1=V_{sw}, Ch2=V_{out})



FUNCTION DESCRIPTION

The GM9308 high efficiency switching regulator is a small, simple, DC-to-DC step-down converter capable of delivering up to 2A of output current. The device operates in pulse-width modulation (PWM) at 1.5MHz from a 2.6V to 6V input voltage and provides an output voltage from 0.6V to V_{IN} , making the GM9308 ideal for on-board post-regulation applications. An internal synchronous rectifier improves efficiency and eliminates the typical Schottky free-wheeling diode. Using the on resistance of the internal high-side MOSFET to sense switching currents eliminates current-sense resistors, further improving efficiency and cost.

Loop Operation

GM9308 uses a PWM current-mode control scheme. An open-loop comparator compares the integrated voltage-feedback signal against the sum of the amplified current-sense signal and the slope compensation ramp. At each rising edge of the internal clock, the internal high-side MOSFET turns on until the PWM comparator terminates the on cycle. During this on-time, current ramps up through the inductor, sourcing current to the output and storing energy in the inductor. The current mode feedback system regulates the peak inductor current as a function of the output voltage error signal. During the off cycle, the internal high-side P-channel MOSFET turns off, and the internal low-side N-channel MOSFET turns on. The inductor releases the stored energy as its current ramps down while still providing current to the output.

Current Sense

An internal current-sense amplifier senses the current through the high-side MOSFET during on time and produces a proportional current signal, which is used to sum with the slope compensation signal. The summed signal then is compared with the error amplifier output by the PWM comparator to terminate the on cycle.

Current Limit

There is a cycle-by-cycle current limit on the high-side MOSFET. When the current flowing out of SW exceeds this limit, the high-side MOSFET turns off and the synchronous rectifier turns on. GM9308 utilizes a frequency fold-back mode to prevent overheating during short-circuit output conditions. The device enters frequency fold-back mode when the FB voltage drops below 200mV, limiting the current to I_{PEAK} and reducing power dissipation. Normal operation resumes upon removal of the short-circuit condition.

Soft-start

GM9308 has an internal soft-start circuitry to reduce supply inrush current during startup conditions. When the device exits under-voltage lockout (UVLO), shutdown mode, or restarts following a thermal-overload event, the soft-start circuitry slowly ramps up current available at SW.

UVLO and Thermal Shutdown

If V_{IN} drops below 2.4V, the UVLO circuit inhibits switching. Once V_{IN} rises above 2.6V, the UVLO clears, and the soft-start sequence activates. Thermal-overload protection limits total power dissipation in the device. When the junction temperature exceeds $T_J = +160^{\circ}\text{C}$, a thermal sensor forces the device into shutdown, allowing the die to cool. The thermal

sensor turns the device on again after the junction temperature cools by 15°C, resulting in a pulsed output during continuous overload conditions. Following a thermal-shutdown condition, the soft-start sequence begins.

DESIGN PROCEDURE

Setting Output Voltages

Output voltages are set by external resistors. The FBthreshold is 0.6V.

$$R_{TOP} = R_{BOTTOM} \times [(V_{OUT} / 0.6) - 1]$$

Input Capacitor and Output Capacitor

Selection

The input capacitor in a DC-to-DC converter reduces current peaks drawn from the battery or other input power source and reduces switching noise in the controller.

The impedance of the input capacitor at the switching frequency should be less than that of the input source so high-frequency switching currents do not pass through the input source. Input ripple with a ceramic capacitor is approximately as follows:

$$V_{RIPPLE} = I_{L(PEAK)} [1 / (2\pi \times f_{OSC} \times C_{IN})]$$

If the capacitor has significant ESR, the output ripple component due to capacitor ESR is as follows:

$$V_{RIPPLE(ESR)} = I_{L(PEAK)} \times ESR$$

The output capacitor keeps output ripple small and ensures control-loop stability. The output capacitor must also have low impedance at the switching frequency.

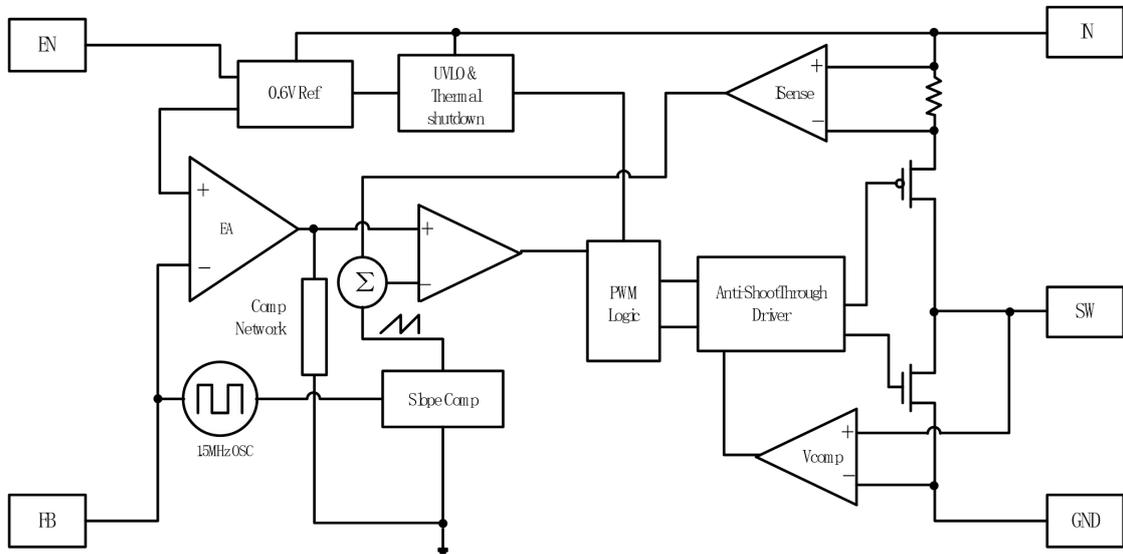
Ceramic, polymer, and tantalum capacitors are suitable, with ceramic exhibiting the lowest ESR and high-frequency impedance.

Inductor Selection

A reasonable inductor value (L_{IDEAL}) can be derived from the following:

$$L_{IDEAL} = [2(V_{IN}) \times D(1 - D)] / I_{OUT} \times f_{OSC}$$

BLOCK DIAGRAM

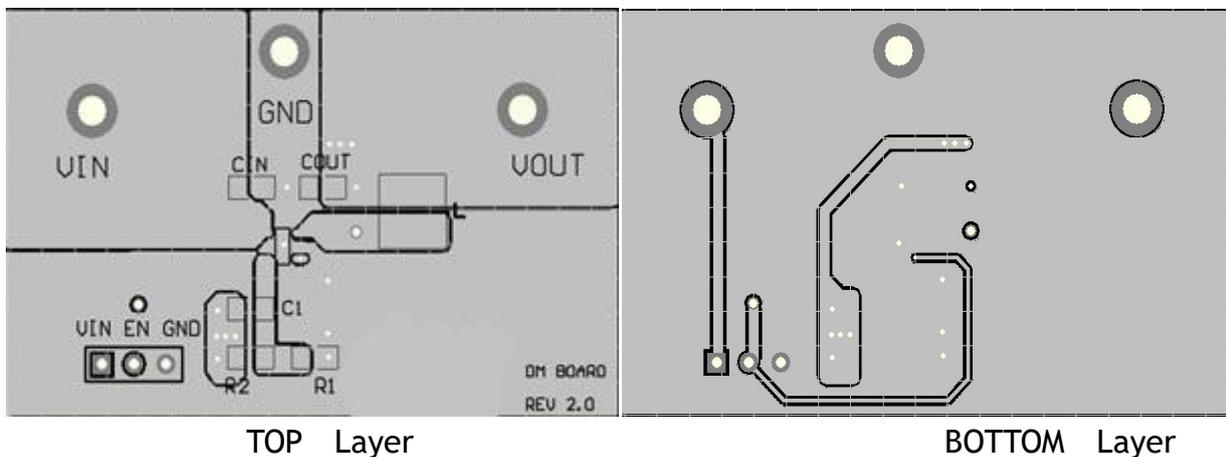


PCB LAYOUT GUIDE

PCB layout is very important to achieve stable operation. It is highly recommended to duplicate EVB layout for optimum performance.

If change is necessary, please follow these guidelines and take Figure for reference.

- 1) Keep the path of switching current short and minimize the loop area formed by input cap, high-side MOSFET and low-side MOSFET.
- 2) Bypass ceramic capacitors are suggested to be put close to the Vin pin.
- 3) Ensure all feedback connections are short and direct. Place the feedback resistors and compensation components as close to the chip as possible.
- 4) Rout SW away from sensitive analog areas such as FB.
- 5) Connect IN, SW, and especially GND respectively to a large copper area to cool the chip to improve thermal performance and long-term reliability.



PACKAGE OUTLINE

SOT23-5 PACKAGE OUTLINE AND DIMENSIONS

