



## General Description

The XL1509 is a monolithic IC designed for a step-down DC/DC converter, and own the ability of driving a 3A load without additional transistor. It saves board space. The external shutdown function can be controlled by logic level and then come into standby mode. The internal compensation makes feedback control having good line and load regulation without external design. Regarding protected function, thermal shutdown is to prevent over temperature operating from damage, and current limit is against over current operating of the output switch. If current limit function occurs and is down below 40.5V, the switching frequency will be reduced.

The XL1509 operates at a switching frequency of 150KHz thus allow smaller sized filter components than what would be needed with lower frequency switching regulators. Other features include a guaranteed  $\pm 4\%$  tolerance on output voltage under specified input voltage and output load conditions, and  $\pm 15\%$  on the oscillator frequency.

The chips are available in a standard 8-lead SOP-8 package.

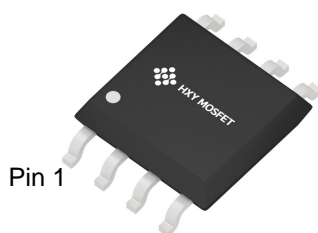
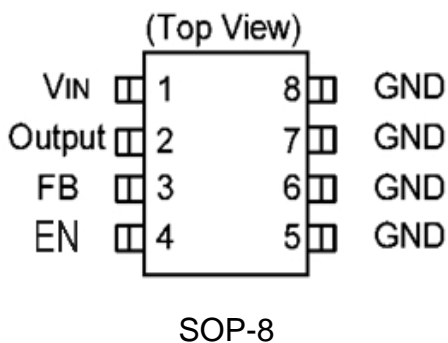
## Features

- 3.3V,5V,12V and Adjustable Output Version
- Output Adjustable Voltage From 1.23V to 37V
- Fixed 150KHz Switching Frequency
- Voltage Mode Non-synchronous PWM Control
- ON/OFF Shutdown Control Input
- Wide 4.5V to 40V Input Voltage Range
- Output Load Current:3A
- Low Power Standby Mode
- Built-in Switching Transistor on Chip

## Application

- Simple High-Efficiency Step-down Regulator
- On-card Switching Regulators
- Positive to Negative Converter

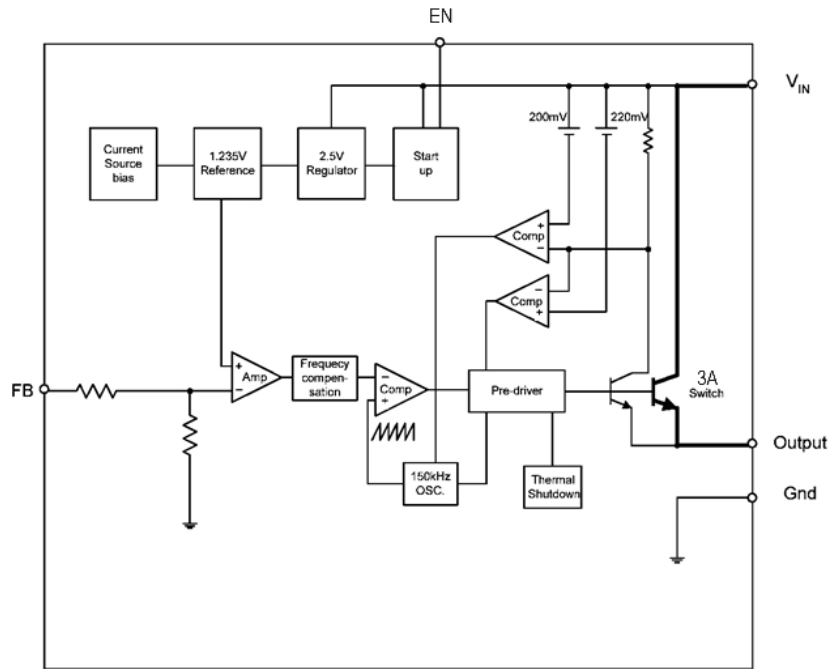
## Pin Configuration And Descriptions



Name	Description
V <sub>IN</sub>	Supply Voltage Input
Output	Power Switching Output
GND	Ground
FB	Output Voltage Feedback Control
EN	ON/OFF Shutdown



## Block Diagram



## Absolute Maximum Ratings

Characteristics	Symbol	Value	Unit
Supply Voltage	V <sub>IN</sub>	+40	V
ON/OFF pin input voltage	V <sub>SD</sub>	-0.3~V <sub>IN</sub>	V
Feedback pin voltage	V <sub>FB</sub>	-0.3~V <sub>IN</sub>	V
Output voltage to ground	V <sub>OUT</sub>	-1	V
Power dissipation	PD	Internally limited	W
Storage temperature	T <sub>stg</sub>	-65~+150	°C
Operating temperature	T <sub>opr</sub>	-40~+125	°C
Operating voltage	V <sub>OP</sub>	+4.5~+40	V



## Electrical Characteristics

(Refer to the test circuit,  $V_{IN}=12V$  for 3.3V,5V,adjustable version and  $V_{IN}=24V$  for the 12V version,  $I_{LOAD}=0.5A$ )

Characteristics	Symbol	Test Conditions	Min	Typ	Max	Unit
Feedback Bias Current	$I_{FB}$	$V_{FB}=1.3V$ (Adjustable version only)		50	100	nA
Oscillator Frequency	$F_{osc}$		127	150	173	kHz
Saturation Voltage	$V_{SAT}$	$I_{OUT}=2A$ , No outside circuit $V_{FB}=0V$ force driver on		1.2	1.5	V
Max. Duty Cycle(ON)	DC	$V_{FB}=0V$ force driver on	93	98		%
Min. Duty Cycle(OFF)		$V_{FB}=12V$ force driver off		0		
Current Limit	$I_{CL}$	Peakcurrent, Nooutside circuit $V_{FB}=0V$ force driver on	3.0	4.0		A
Output Leakage Current(Output=0)	$I_L$	No outside circuit $V_{FB}=12V$ force driver off			2	mA
Output Leakage Current(Output=-1)		$V_{IN}=40V$		5	20	mA
Quiescent Current	$I_Q$	$V_{FB}=12V$ force driver off		5	10	mA
Standby Quiescent Current	$I_{STBY}$	ON/OFF pin=5V $V_{IN}=40V$		50	200	$\mu A$
ON/OFF pin Logic Input Threshold Voltage	$V_{IL}$	Low(regulator ON)			0.6	V
	$V_{IH}$	High(regulator OFF)	2.0			
ON/OFF pin Logic Input Current	$I_H$	$V_{LOGIC}=5.0V$ (OFF)		12	30	$\mu A$
ON/OFF pin Input Current	$I_L$	$V_{LOGIC}=0.5V$ (ON)		0	10	
Thermal Resistance	$\Theta_{JC}$	Junction to case		15		$^{\circ}C/W$
Thermal Resistance with Copper Copper Area of Approximately 3 in <sup>2</sup>	$\Theta_{JA}$	Junction to ambient		70		$^{\circ}C/W$



Characteristics	Symbol	Test Conditions	Min	Typ	Max	Unit
XL1509-ADJ						
Output Feedback	V <sub>FB</sub>	4.5V ≤ V <sub>IN</sub> ≤ 40V 0.2A ≤ I <sub>LOAD</sub> ≤ 3A V <sub>OUT</sub> programmed for 3V	1.193	1.230	1.267	V
Efficiency		V <sub>IN</sub> = 12V, I <sub>LOAD</sub> = 3A		74		%
XL1509-3.3V						
Output Voltage	V <sub>OUT</sub>	4.75V ≤ V <sub>IN</sub> ≤ 40V 0.2A ≤ I <sub>LOAD</sub> ≤ 3A	3.168	3.300	3.432	V
Efficiency		V <sub>IN</sub> = 12V, I <sub>LOAD</sub> = 3A		76		%
XL1509-5V						
Output Voltage	V <sub>OUT</sub>	7V < V <sub>IN</sub> < 40V 0.2A ≤ I <sub>LOAD</sub> ≤ 3A	4.80	5.00	5.20	V
Efficiency		V <sub>IN</sub> = 12V, I <sub>LOAD</sub> = 3A		83		%
XL1509-12V						
Output Voltage	V <sub>OUT</sub>	15V ≤ V <sub>IN</sub> ≤ 40V 0.2A ≤ I <sub>LOAD</sub> ≤ 3A	11.52	12.00	12.48	V
Efficiency		V <sub>IN</sub> = 25V, I <sub>LOAD</sub> = 3A		90		%

## Function Description

### Pin Function +V<sub>IN</sub>

This is the positive input supply for the IC switching regulator. A suitable input bypass capacitor must be presented at this pin to minimize voltage transients and to supply the switching currents needed by the regulator.

### Ground

Circuit ground.

### Out put

Internal switch. The voltage at this pin switches between (+V<sub>in</sub> - V<sub>sat</sub>) and approximately - 0.5V, with a duty cycle of approximately V<sub>out</sub> / V<sub>in</sub>. To minimize coupling to sensitive circuitry, the PC board copper area connected to this pin should be minimized.

### Feedback

Senses the regulated output voltage to complete the feedback loop.

### EN

Allows the switching regulator circuit to be shutdown using logic level signals thus dropping the total input supply current to approximately 150uA. Pulling this pin below a threshold voltage of approximately 1.3V turns the regulator on, and pulling this pin above 1.3V shuts the regulator down. If this shutdown feature is not needed, the EN pin can be wired to the ground pin.



### Thermal Considerations

The SOP-8 package needs a heat sink under most conditions. The size of the heatsink depends on the input voltage, the output voltage, the load current and the ambient temperature. The XL1509 junction temperature rises above ambient temperature for a 3A load and different input and output voltages. The data for these curves was taken with the XL1509 (SOP-8 package) operating as a buck-switching regulator in an ambient temperature of 25°C(still air). These temperature increments are all approximate and are affected by many factors. Higher ambient temperatures requires more heat sinker.

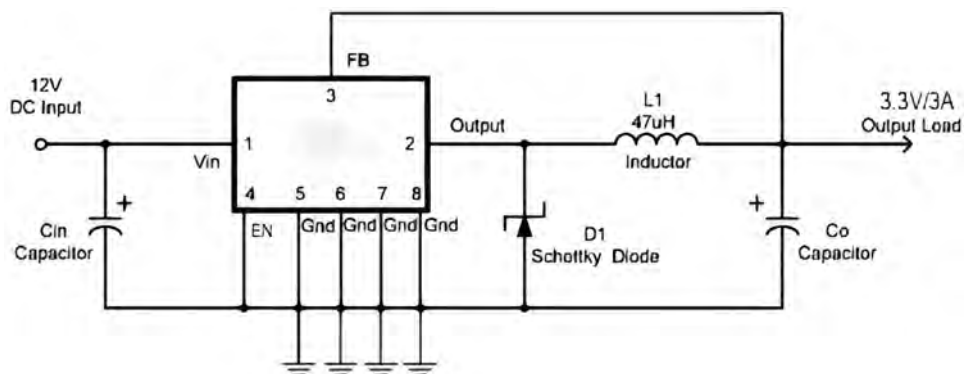
For the best thermal performance, wide copper traces and generous amounts of printed circuit board copper should be used in the board layout. (One exception is the output (switch) pin, which should not have large areas of copper.) Large areas of copper provide the best transfer of heat(lower thermal resistance) to the surrounding air,and moving air lowers the thermal resistance even further.

Package thermal resistance and junction temperature increments are all approximate. The increments are affected by a lot of factors. Some of these factors include board size, shape, thickness, position, location, and even board temperature. Other factors are, trace width, total printed circuit copper area, copper thickness, single or double-sided, multi-layer board and the amount of solder on the board.

The effectiveness of the PC board to dissipate heat also depends on the size, quantity and spacing of other components on the board, as well as whether the surrounding air is still or moving. Furthermore, some of these components such as the catch diode will add heat to the PC board and the heat can vary as the input voltage changes. For the inductor, depending on the physical size, type of core material and the DC resistance, it could either act as a heat sink taking heat away from the board, or it could add heat to the board.

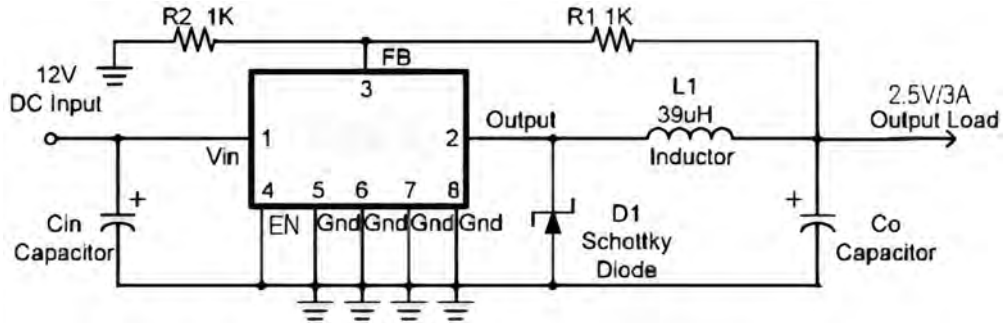
### Application Circuit

#### Fixed Type Circuit





### Adjustable Type Circuit

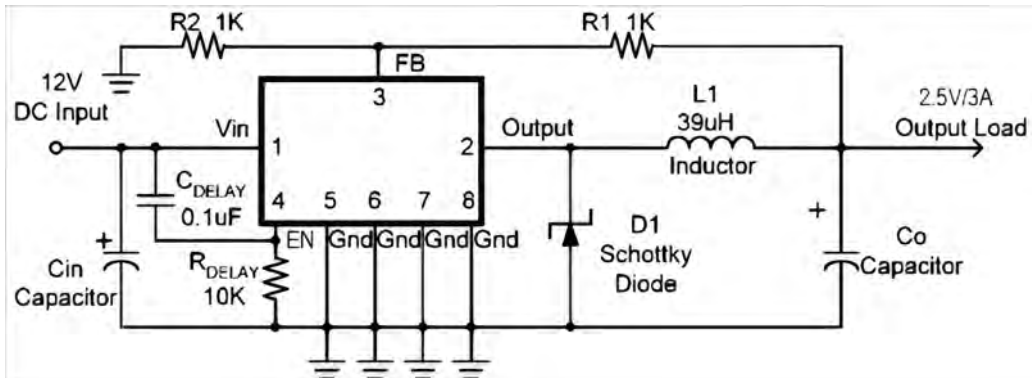


$$V_{out} = V_{FB} \times \left(1 + \frac{R1}{R2}\right)$$

$$V_{FB} = 1.23V$$

$$R2 = 1K \sim 3K$$

### Delay Start Circuit

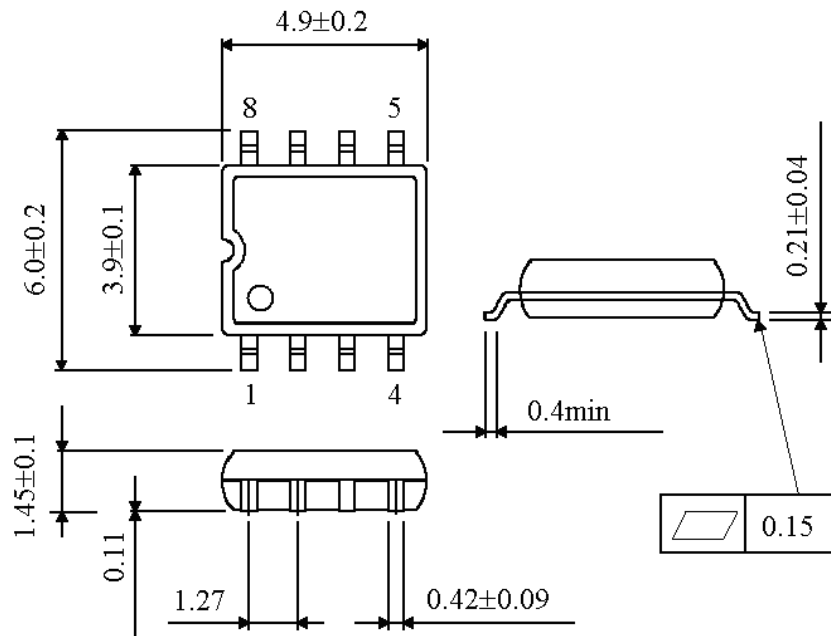




## Outline Drawing

SOP-8

Unit: mm





### Attention

- Any and all HUA XUAN YANG ELECTRONICS products described or contained herein do not have specifications that can handle applications that require extremely high levels of reliability, such as life-support systems, aircraft's control systems, or other applications whose failure can be reasonably expected to result in serious physical and/or material damage. Consult with your HUA XUAN YANG ELECTRONICS representative nearest you before using any HUA XUAN YANG ELECTRONICS products described or contained herein in such applications.
- HUA XUAN YANG ELECTRONICS assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all HUA XUAN YANG ELECTRONICS products described or contained herein.
- Specifications of any and all HUA XUAN YANG ELECTRONICS products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.
- HUA XUAN YANG ELECTRONICS CO.,LTD. strives to supply high-quality high-reliability products. However, any and all semiconductor products fail with some probability. It is possible that these probabilistic failures could give rise to accidents or events that could endanger human lives, that could give rise to smoke or fire, or that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.
- In the event that any or all HUA XUAN YANG ELECTRONICS products(including technical data, services) described or contained herein are controlled under any of applicable local export control laws and regulations, such products must not be exported without obtaining the export license from the authorities concerned in accordance with the above law.
- No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written permission of HUA XUAN YANG ELECTRONICS CO.,LTD.
- Information (including circuit diagrams and circuit parameters) herein is for example only ; it is not guaranteed for volume production. HUA XUAN YANG ELECTRONICS believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.
- Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the HUA XUAN YANG ELECTRONICS product that you intend to use.