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### Description

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The BM1509HV are monolithic IC designed for a step-down DC/DC converter, and own the ability of driving a 2A 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  $V_{FB}$  is down below 0.5V, the switching frequency will be reduced. The BM1509HV 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 output version included fixed 3.3V, 5V, 12V, and an adjustable type. The chips are available in a standard 8-lead SOP-8 package.

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### Features

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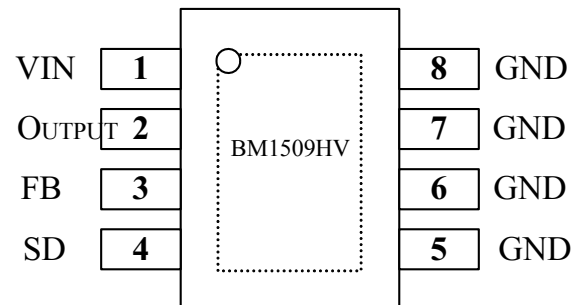
- Output Voltage: 3.3V, 5V, 12V and Adjustable Output Version
- Adjustable Version Output Voltage Range, 1.23V to 18V+4%
- 150KHz +15% Fixed Switching Frequency
- Voltage Mode Non-Synchronous PWM Control
- Thermal-Shutdown and Current-Limit Protection
- ON/OFF Shutdown Control Input
- Operating Voltage can be up to 48V
- Output Load Current: 2A
- SOP-8 Packages
- Low Power Standby Mode
- Built-in Switching Transistor On Chip
- SOP-8: Available in "Green" Molding Compound (No Br, Sb)
- Lead Free Finish/ RoHS Compliant (Note 1)

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### Pin Assignments

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#### TOP VIEW



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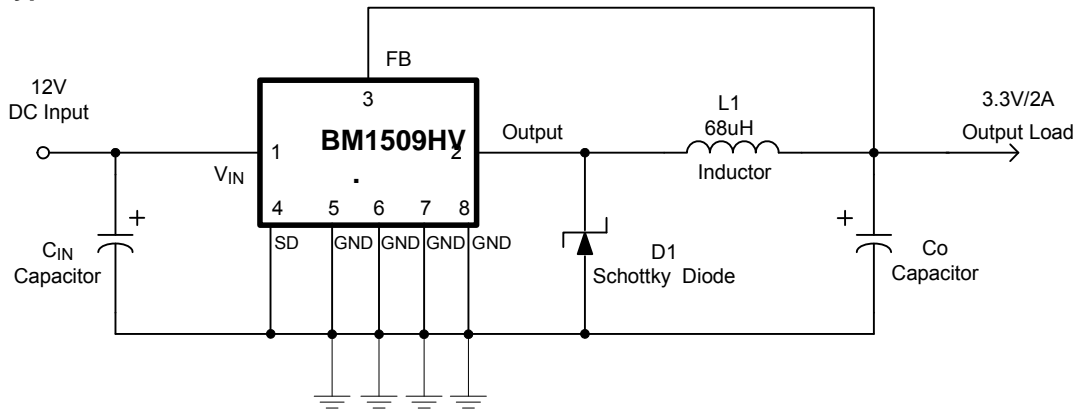
### Applications

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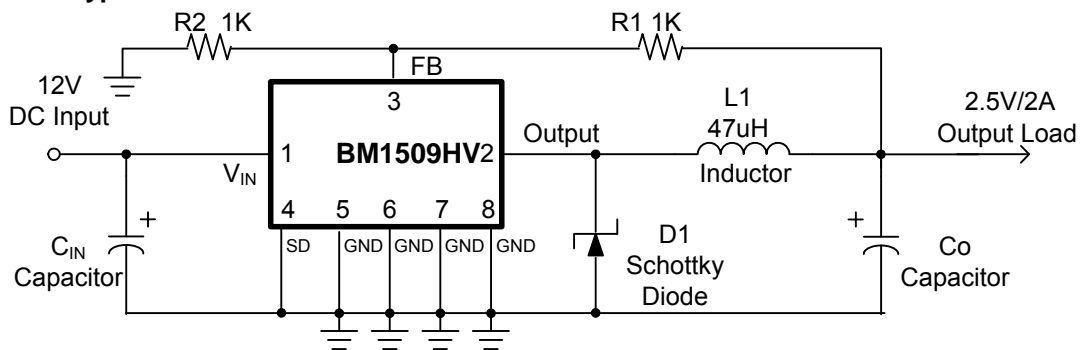
- Simple High-Efficiency Step-Down Regulator
- On-Card Switching Regulators
- Positive to Negative Converter

Typical Application Circuit

**(1) Fixed Type Circuit**



**(2) Adjustable Type Circuit**

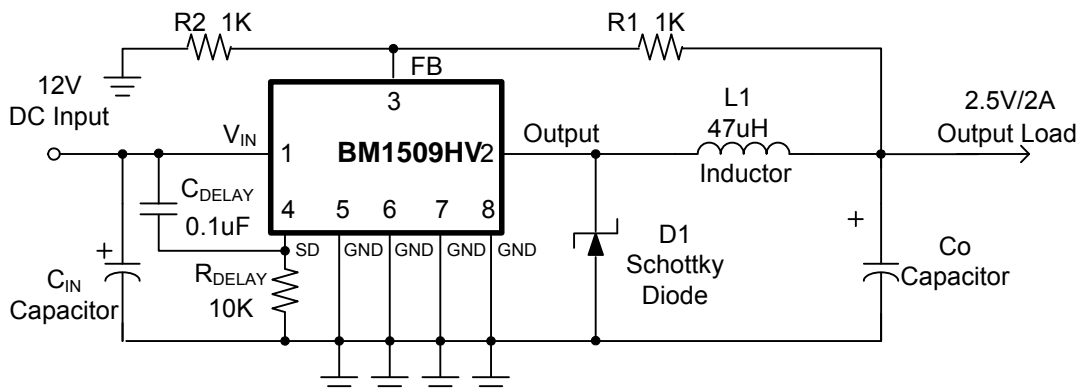


$$V_{OUT} = V_{FB} \times \left(1 + \frac{R1}{R2}\right)$$

$$V_{FB} = 1.23V$$

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

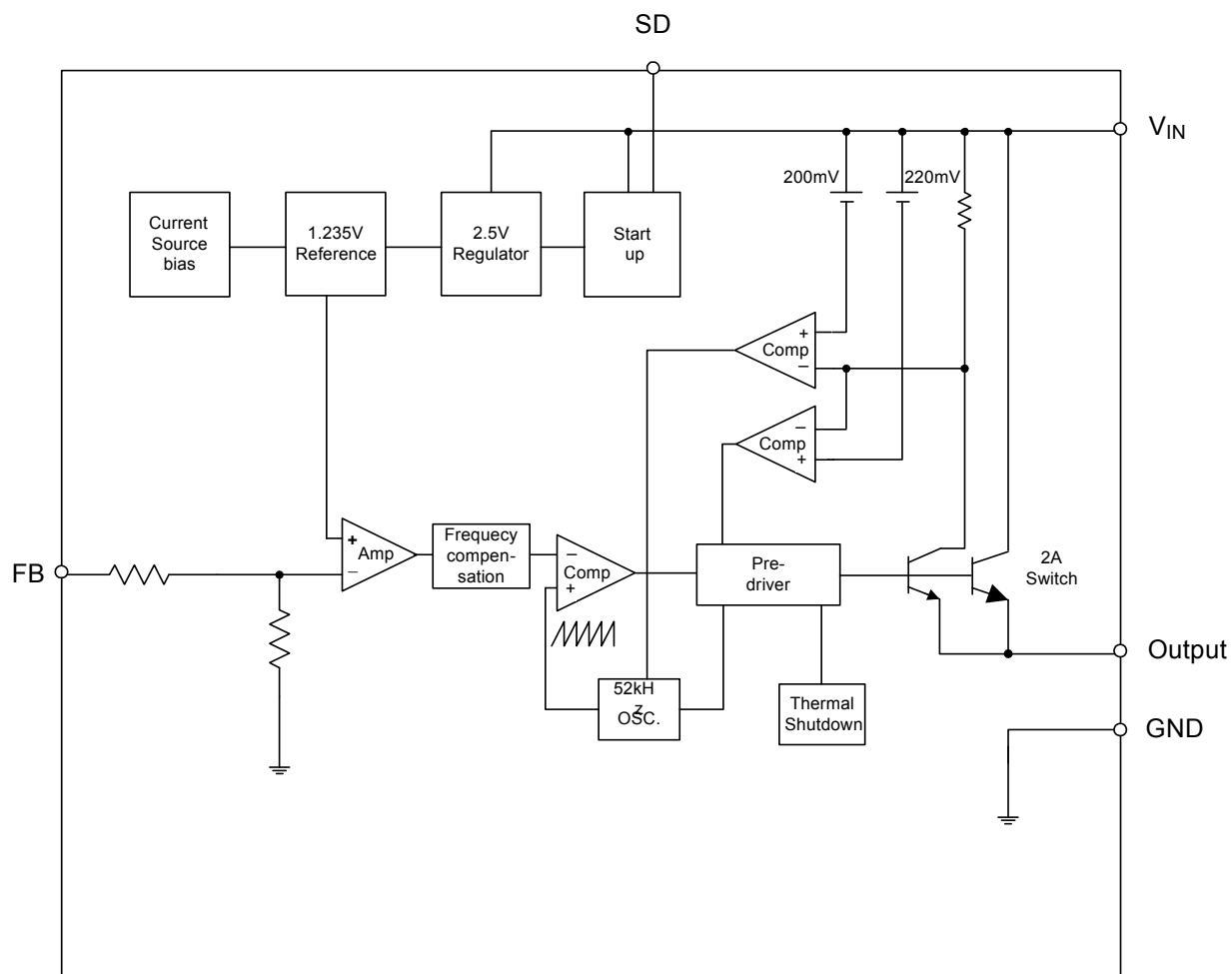
**(3) Delay Start Circuit**



Pin Descriptions

Pin Name	Description
V <sub>IN</sub>	Operating voltage input
Output	Switching output
GND	Ground
FB	Output voltage feedback control
SD	ON/OFF Shutdown

Functional Block Diagram



**Absolute Maximum Ratings**

Symbol	Parameter	Rating	Unit
ESD HBM	Human Body Model ESD Protection	2	KV
ESD MM	Machine Model ESD Protection	200	V
$V_{IN}$	Supply Voltage	+48	V
$V_{SD}$	ON/OFF Pin Input Voltage	-0.3 to +18	V
$V_{FB}$	Feedback Pin Voltage	-0.3 to +18	V
$V_{OUT}$	Output Voltage to Ground	-1	V
$P_D$	Power Dissipation	Internally Limited	W
$T_{ST}$	Storage Temperature	-65 to +150	°C
$T_J$	Operating Junction Temperature	-40 to +125	°C

**Recommended Operating Conditions**

Symbol	Parameter	Min	Max	Unit
$I_{OUT}$	Output Current	0	2	A
$V_{OP}$	Operating Voltage	4.5	48	V
$T_A$	Operating Ambient Temperature	-20	85	°C

**Electrical Characteristics**

Unless otherwise specified,  $V_{IN} = 12V$  for 3.3V, 5V, adjustable version and  $V_{IN} = 18V$  for the 12V version.  $I_{LOAD} = 0.5A$   
 Specifications with **boldface type** are for full operating temperature range, the other type are for  $T_J = 25^\circ C$ .

Symbol	Parameter		Conditions	Min	Typ.	Max	Unit
$I_{FB}$	Feedback Bias Current		$V_{FB} = 1.3V$ (Adjustable version only)		-10	-50 <b>-100</b>	nA
$F_{OSC}$	Oscillator Frequency			127 <b>110</b>	150	173 <b>173</b>	KHz
$F_{SCP}$	Oscillator Frequency of Short Circuit Protect		When current limit occurred and $V_{FB} < 0.5V$ , $T_a = 25^\circ C$	10	30	50	KHz
$V_{SAT}$	Saturation Voltage		$I_{OUT} = 2A$ No outside circuit $V_{FB} = 0V$ force driver on		1.25	1.4 <b>1.5</b>	V
DC	Max. Duty Cycle (ON)		$V_{FB} = 0V$ force driver on		100		%
	Min. Duty Cycle (OFF)		$V_{FB} = 12V$ force driver off		0		
$I_{CL}$	Current Limit		Peak current No outside circuit $V_{FB} = 0V$ force driver on	3			A
$I_L$	Output = 0	Output Leakage	No outside circuit $V_{FB} = 12V$ force driver off			-200	uA
	Output = -1	Current	$V_{IN} = 22V$		-5		mA
$I_Q$	Quiescent Current		$V_{FB} = 12V$ force driver off		5	10	mA
$I_{STBY}$	Standby Quiescent Current		ON/OFF pin = 5V $V_{IN} = 22V$		70	150 <b>200</b>	uA
	$V_{IL}$	ON/OFF Pin Logic Input		Low (regulator ON)	-	0.6	
$V_{IH}$	Threshold Voltage		High (regulator OFF)	2.0	1.3	-	V
$I_H$	ON/OFF Pin Logic Input Current		$V_{LOGIC} = 2.5V$ (OFF)			-0.01	uA
$I_L$	ON/OFF Pin Input Current		$V_{LOGIC} = 0.5V$ (ON)		-0.1	-1	
$\theta_{JA}$	Thermal Resistance		SOP-8	Junction to case		15	$^\circ C/W$
$\theta_{JC}$	Thermal Resistance with a copper area of approximately 3 in <sup>2</sup>		SOP-8	Junction to ambient		70	$^\circ C/W$

**Electrical Characteristics**

Specifications with **boldface type** are for full operating temperature range, the other type are for  $T_J = 25^\circ\text{C}$ .

	Symbol	Parameter	Conditions	$V_{\text{Min}}$	Typ.	$V_{\text{Max}}$	Unit
BM1509HV-ADJ	$V_{\text{FB}}$	Output Feedback	$4.5\text{V} \leq V_{\text{IN}} \leq 22\text{V}$ $0.2\text{A} \leq I_{\text{LOAD}} \leq 2\text{A}$ $V_{\text{OUT}}$ programmed for 3V	1.193 <b>1.18</b>	1.23	1.267 <b>1.28</b>	V
	$\eta$	Efficiency	$V_{\text{IN}} = 12\text{V}$ , $I_{\text{LOAD}} = 2\text{A}$	76	76		%
BM1509HV-3.3V	$V_{\text{OUT}}$	Output Voltage	$4.75\text{V} \leq V_{\text{IN}} \leq 22\text{V}$ $0.2\text{A} \leq I_{\text{LOAD}} \leq 2\text{A}$	3.168 <b>3.135</b>	3.3	3.432 <b>3.465</b>	V
	$\eta$	Efficiency	$V_{\text{IN}} = 12\text{V}$ , $I_{\text{LOAD}} = 2\text{A}$	78	78		%
BM1509HV-5V	$V_{\text{OUT}}$	Output Voltage	$7\text{V} \leq V_{\text{IN}} \leq 22\text{V}$ $0.2\text{A} \leq I_{\text{LOAD}} \leq 2\text{A}$	4.8 <b>4.75</b>	5	5.2 <b>5.25</b>	V
	$\eta$	Efficiency	$V_{\text{IN}} = 12\text{V}$ , $I_{\text{LOAD}} = 2\text{A}$	83	83		%
BM1509HV-12V	$V_{\text{OUT}}$	Output Voltage	$15\text{V} \leq V_{\text{IN}} \leq 22\text{V}$ $0.2\text{A} \leq I_{\text{LOAD}} \leq 2\text{A}$	11.52 <b>11.4</b>	12	12.48 <b>12.6</b>	V
	$\eta$	Efficiency	$V_{\text{IN}} = 15\text{V}$ , $I_{\text{LOAD}} = 2\text{A}$	90	90		%

