National Semiconductor

LM2592HV
SIMPLE SWITCHER®Power Converter 150 kHz 2A Step-Down Voltage Regulator

General Description

The LM2592HV series of regulators are monolithic integrated circuits that provide all the active functions for a step-down (buck) switching regulator, capable of driving a 2A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3V, 5V, and an adjustable output version.

This series of switching regulators is similar to the LM2593HV, but without some of the supervisory and performance features of the latter.

Requiring a minimum number of external components, these regulators are simple to use and include internal frequency compensation†, improved line and load specifications and a fixed-frequency oscillator.

The LM2592HV operates at a switching frequency of 150 kHz thus allowing smaller sized filter components than what would be needed with lower frequency switching regulators. Available in a standard 5-lead TO-220 package with several different lead bend options, and a 5-lead TO-263 Surface mount package.

Other features include a guaranteed ±4% tolerance on output voltage under all conditions of input voltage and output load conditions, and ±15% on the oscillator frequency. External shutdown is included, featuring typically 90 µA standby current. Self protection features include a two stage current limit for the output switch and an over temperature shutdown for complete protection under fault conditions.

Features

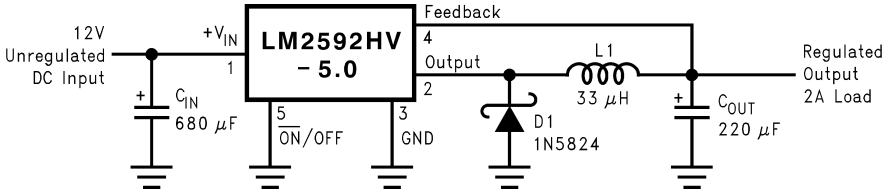
- 3.3V, 5V, and adjustable output versions
- Adjustable version output voltage range, 1.2V to 57V ±4% max over line and load conditions
- Guaranteed 2A output load current
- Available in 5-pin TO-220 and TO-263 (surface mount) Package
- Input voltage range up to 60V
- 150 kHz fixed frequency internal oscillator
- On/Off control
- Low power standby mode, I_Q typically 90 µA
- High Efficiency
- Thermal shutdown and current limit protection

Applications

- Simple high-efficiency step-down (buck) regulator
- Efficient pre-regulator for linear regulators
- On-card switching regulators
- Positive to Negative converter

Note: † Patent Number 5,382,918.

Typical Application (Fixed Output Voltage Versions)



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Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Maximum Supply Voltage (V_{IN})	63V
$\overline{ON}$/OFF Pin Voltage	−0.3 ≤ V ≤ +25V
Feedback Pin Voltage	−0.3 ≤ V ≤ +25V
Output Voltage to Ground (Steady State)	−1V
Power Dissipation	Internally limited
Storage Temperature Range	−65˚C to +150˚C
ESD Susceptibility	
Human Body Model (Note 2)	2 kV
Lead Temperature	
S Package	
Vapor Phase (60 sec.)	+215˚C
Infrared (10 sec.)	+245˚C
T Package (Soldering, 10 sec.)	+260˚C
Maximum Junction Temperature	+150˚C

Operating Conditions

Temperature Range	−40˚C ≤ T_J ≤ +125˚C
Supply Voltage	4.5V to 60V

LM2592HV-3.3 Electrical Characteristics

Specifications with standard type face are for T_J = 25˚C, and those with **boldface type** apply over **full Operating Temperature Range.**

Symbol	Parameter	Conditions	LM2592HV-3.3		Units (Limits)
			Typ (Note 3)	Limit (Note 4)	
SYSTEM PARAMETERS (Note 5) Test Circuit *Figure 1*					
V_{OUT}	Output Voltage	4.75V ≤ V_{IN} ≤ 60V, 0.2A ≤ I_{LOAD} ≤ 2A	3.3		V
				3.168/**3.135**	V(min)
				3.432/**3.465**	V(max)
η	Efficiency	V_{IN} = 12V, I_{LOAD} = 2A	76		

LM2592HV-5.0 Electrical Characteristics

Specifications with standard type face are for T_J = 25˚C, and those with **boldface type** apply over **full Operating Temperature Range.**

Symbol	Parameter	Conditions	LM2592HV-5.0		Units (Limits)
			Typ (Note 3)	Limit (Note 4)	
SYSTEM PARAMETERS (Note 5) Test Circuit *Figure 1*					
V_{OUT}	Output Voltage	7V ≤ V_{IN} ≤ 60V, 0.2A ≤ I_{LOAD} ≤ 2A	5		V
				4.800/**4.750**	V(min)
				5.200/**5.250**	V(max)
η	Efficiency	V_{IN} = 12V, I_{LOAD} = 2A	81		%

LM2592HV-ADJ Electrical Characteristics

Specifications with standard type face are for T_J = 25˚C, and those with **boldface type** apply over **full Operating Temperature Range.**

Symbol	Parameter	Conditions	LM2592HV-ADJ		Units (Limits)
			Typ (Note 3)	Limit (Note 4)	
SYSTEM PARAMETERS (Note 5) Test Circuit *Figure 1*					
V_{FB}	Feedback Voltage	4.5V ≤ V_{IN} ≤ 60V, 0.2A ≤ I_{LOAD} ≤ 2A	1.230		V
		V_{OUT} programmed for 3V. Circuit of *Figure 1*.		1.193/**1.180**	V(min)
				1.267/**1.280**	V(max)
η	Efficiency	V_{IN} = 12V, V_{OUT} = 3V, I_{LOAD} = 2A	75		%

All Output Voltage Versions Electrical Characteristics

Specifications with standard type face are for T_J = 25˚C, and those with **boldface type** apply over **full Operating Temperature Range**. Unless otherwise specified, V_{IN} = 12V for the 3.3V, 5V, and Adjustable version. I_{LOAD} = 500 mA

Symbol	Parameter	Conditions	LM2592HV-XX		Units (Limits)
			Typ (Note 3)	Limit (Note 4)	
DEVICE PARAMETERS					
I_b	Feedback Bias Current	Adjustable Version Only, V_{FB} = 1.3V	10		nA
				50/**100**	nA (max)
f_O	Oscillator Frequency	(Note 6)	150		kHz
				127/**110**	kHz(min)
				173/**173**	kHz(max)
V_{SAT}	Saturation Voltage	I_{OUT} = 2A (Note 7) (Note 8)	1.10		V
				1.3/**1.4**	V(max)
DC	Max Duty Cycle (ON)	(Note 8)	100		%
	Min Duty Cycle (OFF)	(Note 9)	0		
I_{CLIM}	Switch current Limit	Peak Current, (Note 7) (Note 8)	3.0		A
				2.4/**2.3**	A(min)
				3.7/**4.0**	A(max)
I_L	Output Leakage Current	(Note 7) (Note 9) (Note 10) Output = 0V		50	µA(max)
		Output = −1V	5		mA
				30	mA(max)
I_Q	Operating Quiescent	$\overline{SD}$ /SS Pin Open (Note 9)	5		mA
	Current			10	mA(max)
I_{STBY}	Standby Quiescent	$\overline{SD}$ /SS pin = 0V (Note 10)	90		µA
	Current			200/**250**	µA(max)
θ_{JC}	Thermal Resistance	TO220 or TO263 Package, Junction to Case	2		˚C/W
θ_{JA}		TO220 Package, Juncton to Ambient (Note 11)	50		˚C/W
θ_{JA}		TO263 Package, Juncton to Ambient (Note 12)	50		˚C/W
θ_{JA}		TO263 Package, Juncton to Ambient (Note 13)	30		˚C/W
θ_{JA}		TO263 Package, Juncton to Ambient (Note 14)	20		˚C/W
ON/OFF CONTROL Test Circuit *Figure 1*					
	$\overline{ON}$ /OFF Pin Logic Input		1.3		V
V_{IH}	Threshold Voltage	Low (Regulator ON)		**0.6**	V(max)
V_{IL}		High (Regulator OFF)		**2.0**	V(min)
I_H	$\overline{ON}$ /OFF Pin Input Current	V_{LOGIC} = 2.5V (Regulator OFF)	5		µA
				15	µA(max)
I_L		V_{LOGIC} = 0.5V (Regulator ON)	0.02		µA
				5	µA(max)

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics.

Note 2: The human body model is a 100 pF capacitor discharged through a 1.5k resistor into each pin.

Note 3: Typical numbers are at 25˚C and represent the most likely norm.

Note 4: All limits guaranteed at room temperature (standard type face) and at **temperature extremes (bold type face)**. All room temperature limits are 100% production tested. All limits at **temperature extremes** are guaranteed via correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level (AOQL).

Note 5: External components such as the catch diode, inductor, input and output capacitors can affect switching regulator system performance. When the LM2592HV is used as shown in the *Figure 1* test circuit, system performance will be as shown in system parameters section of Electrical Characteristics.

Note 6: The switching frequency is reduced when the second stage current limit is activated. The amount of reduction is determined by the severity of current overload.

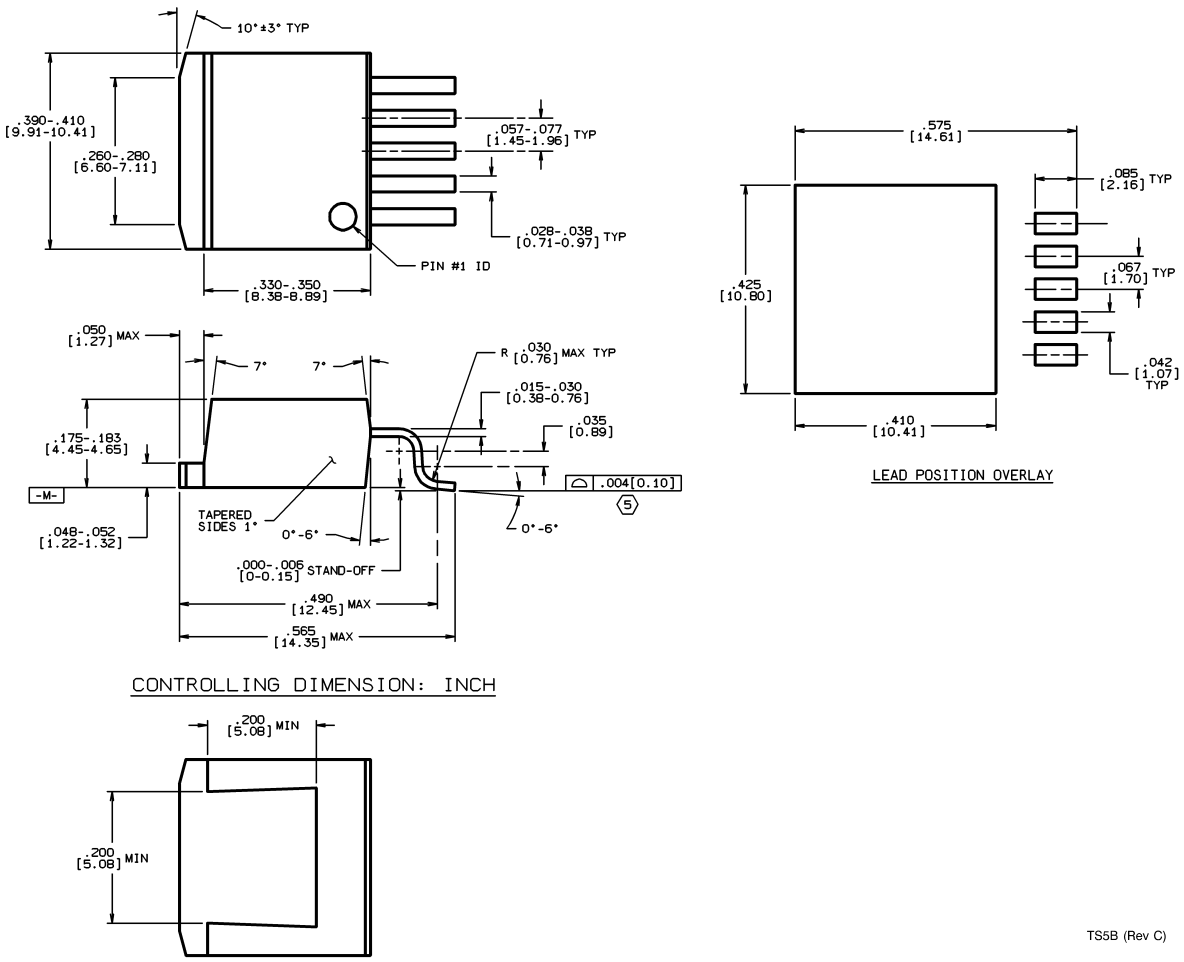
Note 7: No diode, inductor or capacitor connected to output pin.

Note 8: Feedback pin removed from output and connected to 0V to force the output transistor switch ON.

Note 9: Feedback pin removed from output and connected to 12V for the 3.3V, 5V, and the ADJ. version to force the output transistor switch OFF.

Note 10: V_{IN} = 60V.

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



5-Lead TO-263 Bent and Formed Package
Order Number LM2592HVS-3.3, LM2592HVS-5.0 or LM2592HVS-ADJ
NS Package Number TS5B

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