National Semiconductor

LM2574/LM2574HV
SIMPLE SWITCHER™ 0.5A Step-Down Voltage Regulator

General Description

The LM2574 series of regulators are monolithic integrated circuits that provide all the active functions for a step-down (buck) switching regulator, capable of driving a 0.5A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3V, 5V, 12V, 15V, and an adjustable output version.

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

The LM2574 series offers a high-efficiency replacement for popular three-terminal linear regulators. Because of its high efficiency, the copper traces on the printed circuit board are normally the only heat sinking needed.

A standard series of inductors optimized for use with the LM2574 are available from several different manufacturers. This feature greatly simplifies the design of switch-mode power supplies.

Other features include a guaranteed ±4% tolerance on output voltage within specified input voltages and output load conditions, and ±10% on the oscillator frequency. External shutdown is included, featuring 50 µA (typical) standby current. The output switch includes cycle-by-cycle current limiting, as well as thermal shutdown for full protection under fault conditions.

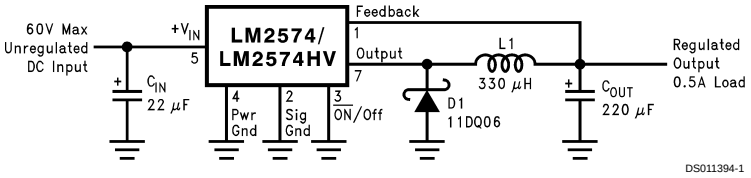
Features

- 3.3V, 5V, 12V, 15V, and adjustable output versions
- Adjustable version output voltage range, 1.23V to 37V (57V for HV version) ±4% max over line and load conditions
- Guaranteed 0.5A output current
- Wide input voltage range, 40V, up to 60V for HV version
- Requires only 4 external components
- 52 kHz fixed frequency internal oscillator
- TTL shutdown capability, low power standby mode
- High efficiency
- Uses readily available standard inductors
- 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 (Buck-Boost)

Typical Application (Fixed Output Voltage Versions)



Note: Pin numbers are for 8-pin DIP package.

Patent Pending
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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	
LM2574	45V
LM2574HV	63V
$\overline{ON}$ /OFF Pin Input Voltage	$-0.3V \le V \le +V_{IN}$
Output Voltage to Ground	
(Steady State)	−1V
Minimum ESD Rating	
(C = 100 pF, R = 1.5 kΩ)	2 kV
Storage Temperature Range	−65˚C to +150˚C
Lead Temperature	
(Soldering, 10 seconds)	260˚C
Maximum Junction Temperature	150˚C
Power Dissipation	Internally Limited

Operating Ratings

Temperature Range	
LM2574/LM2574HV	$-40˚C \le T_J \le +125˚C$
Supply Voltage	
LM2574	40V
LM2574HV	60V

LM2574-3.3, LM2574HV-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	LM2574-3.3 LM2574HV-3.3		Units (Limits)
			Typ	Limit (Note 2)	
SYSTEM PARAMETERS (Note 3) Test Circuit *Figure 2*					
V_{OUT}	Output Voltage	V_{IN} = 12V, I_{LOAD} = 100 mA	3.3		V
				3.234	V(Min)
				3.366	V(Max)
V_{OUT}	Output Voltage LM2574	$4.75V \le V_{IN} \le 40V$, $0.1A \le I_{LOAD} \le 0.5A$	3.3		V
				3.168/**3.135**	V(Min)
				3.432/**3.465**	V(Max)
V_{OUT}	Output Voltage LM2574HV	$4.75V \le V_{IN} \le 60V$, $0.1A \le I_{LOAD} \le 0.5A$	3.3		
				3.168/**3.135**	V(Min)
				3.450/**3.482**	V(Max)
η	Efficiency	V_{IN} = 12V, I_{LOAD} = 0.5A	72		%

LM2574-5.0, LM2574HV-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	LM2574-5.0 LM2574HV-5.0		Units (Limits)
			Typ	Limit (Note 2)	
SYSTEM PARAMETERS (Note 3) Test Circuit *Figure 2*					
V_{OUT}	Output Voltage	V_{IN} = 12V, I_{LOAD} = 100 mA	5		V
				4.900	V(Min)
				5.100	V(Max)
V_{OUT}	Output Voltage LM2574	$7V \le V_{IN} \le 40V$, $0.1A \le I_{LOAD} \le 0.5A$	5		V
				4.800/**4.750**	V(Min)
				5.200/**5.250**	V(Max)
V_{OUT}	Output Voltage LM2574HV	$7V \le V_{IN} \le 60V$, $0.1A \le I_{LOAD} \le 0.5A$	5		
				4.800/**4.750**	V(Min)
				5.225/**5.275**	V(Max)
η	Efficiency	V_{IN} = 12V, I_{LOAD} = 0.5A	77		%

LM2574-ADJ, LM2574HV-ADJ
Electrical Characteristics (Continued)

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, I_{LOAD} = 100 mA.

Symbol	Parameter	Conditions	LM2574-ADJ / LM2574HV-ADJ		Units (Limits)
			Typ	Limit (Note 2)	
SYSTEM PARAMETERS (Note 3) Test Circuit *Figure 2*					
V_{FB}	Feedback Voltage LM2574	7V ≤ V_{IN} ≤ 40V, 0.1A ≤ I_{LOAD} ≤ 0.5A V_{OUT} Programmed for 5V. Circuit of *Figure 2*	1.230	 1.193/**1.180** 1.267/**1.280**	V V(Min) V(Max)
V_{FB}	Feedback Voltage LM2574HV	7V ≤ V_{IN} ≤ 60V, 0.1A ≤ I_{LOAD} ≤ 0.5A V_{OUT} Programmed for 5V. Circuit of *Figure 2*	1.230	 1.193/**1.180** 1.273/**1.286**	 V(Min) V(Max)
η	Efficiency	V_{IN} = 12V, V_{OUT} = 5V, I_{LOAD} = 0.5A	77		%

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, V_{IN} = 25V for the 12V version, and V_{IN} = 30V for the 15V version. I_{LOAD} = 100 mA.

Symbol	Parameter	Conditions	LM2574-XX / LM2574HV-XX		Units (Limits)
			Typ	Limit (Note 2)	
DEVICE PARAMETERS					
I_b	Feedback Bias Current	Adjustable Version Only, V_{OUT} = 5V	50	100/**500**	nA
f_O	Oscillator Frequency	(see Note 10)	52	 47/**42** 58/**63**	kHz kHz(Min) kHz(Max)
V_{SAT}	Saturation Voltage	I_{OUT} = 0.5A (Note 4)	0.9	 1.2/**1.4**	V V(max)
DC	Max Duty Cycle (ON)	(Note 5)	98	 93	% %(Min)
I_{CL}	Current Limit	Peak Current, (Notes 4, 10)	1.0	 0.7/**0.65** 1.6/**1.8**	A A(Min) A(Max)
I_L	Output Leakage Current	(Notes 6, 7) Output = 0V Output = −1V Output = −1V	 7.5 	2 30	mA(Max) mA mA(Max)
I_Q	Quiescent Current	(Note 6)	5	 10	mA mA(Max)
I_{STBY}	Standby Quiescent Current	$\overline{ON}$ /OFF Pin= 5V (OFF)	50	 200	µA µA(Max)
θ_{JA} θ_{JA} θ_{JA} θ_{JA}	Thermal Resistance	N Package, Junction to Ambient (Note 8) N Package, Junction to Ambient (Note 9) M Package, Junction to Ambient (Note 8) M Package, Junction to Ambient (Note 9)	92 72 102 78		˚C/W

All Output Voltage Versions
Electrical Characteristics (Continued)

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, V_{IN} = 25V for the 12V version, and V_{IN} = 30V for the 15V version. I_{LOAD} = 100 mA.

Symbol	Parameter	Conditions	LM2574-XX LM2574HV-XX		Units (Limits)
			Typ	Limit (Note 2)	
$\overline{ON}$ /OFF CONTROL Test Circuit *Figure 2*					
V_{IH}	$\overline{ON}$ /OFF Pin Logic	V_{OUT} = 0V	1.4	2.2/**2.4**	V(Min)
V_{IL}	Input Level	V_{OUT} = Nominal Output Voltage	1.2	1.0/**0.8**	V(Max)
I_H	$\overline{ON}$ /OFF Pin Input Current	$\overline{ON}$ /OFF Pin = 5V (OFF)	12	 30	µA µA(Max)
I_{IL}		$\overline{ON}$ /OFF Pin = 0V (ON)	0	 10	µA 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: 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.

Note 3: External components such as the catch diode, inductor, input and output capacitors can affect switching regulator system performance. When the LM2574 is used as shown in the *Figure 2* test circuit, system performance will be as shown in system parameters section of Electrical Characteristics.

Note 4: Output pin sourcing current. No diode, inductor or capacitor connected to output pin.

Note 5: Feedback pin removed from output and connected to 0V.

Note 6: Feedback pin removed from output and connected to +12V for the Adjustable, 3.3V, and 5V versions, and +25V for the 12V and 15V versions, to force the output transistor OFF.

Note 7: V_{IN} = 40V (60V for high voltage version).

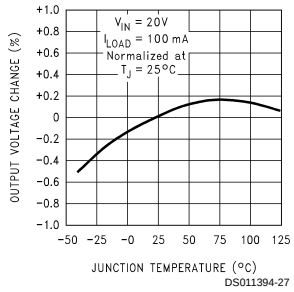
Note 8: Junction to ambient thermal resistance with approximately 1 square inch of printed circuit board copper surrounding the leads. Additional copper area will lower thermal resistance further. See application hints in this data sheet and the thermal model in Switchers Made Simple software.

Note 9: Junction to ambient thermal resistance with approximately 4 square inches of 1 oz. (0.0014 in. thick) printed circuit board copper surrounding the leads. Additional copper area will lower thermal resistance further. (See Note 8.)

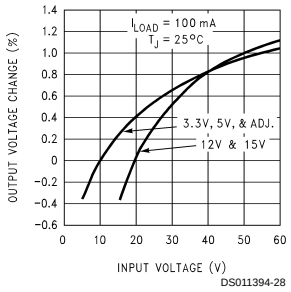
Note 10: The oscillator frequency reduces to approximately 18 kHz in the event of an output short or an overload which causes the regulated output voltage to drop approximately 40% from the nominal output voltage. This self protection feature lowers the average power dissipation of the IC by lowering the minimum duty cycle from 5% down to approximately 2%.

Typical Performance Characteristics (Circuit of *Figure 2*)

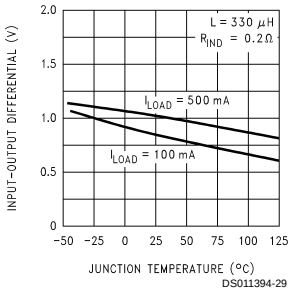
Normalized Output Voltage



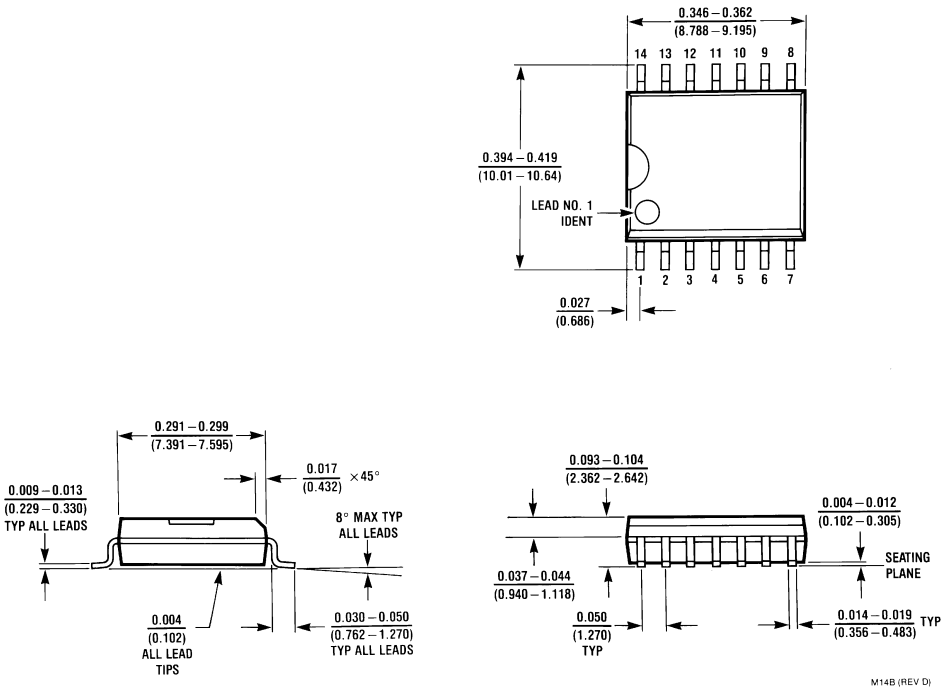
Line Regulation



Dropout Voltage

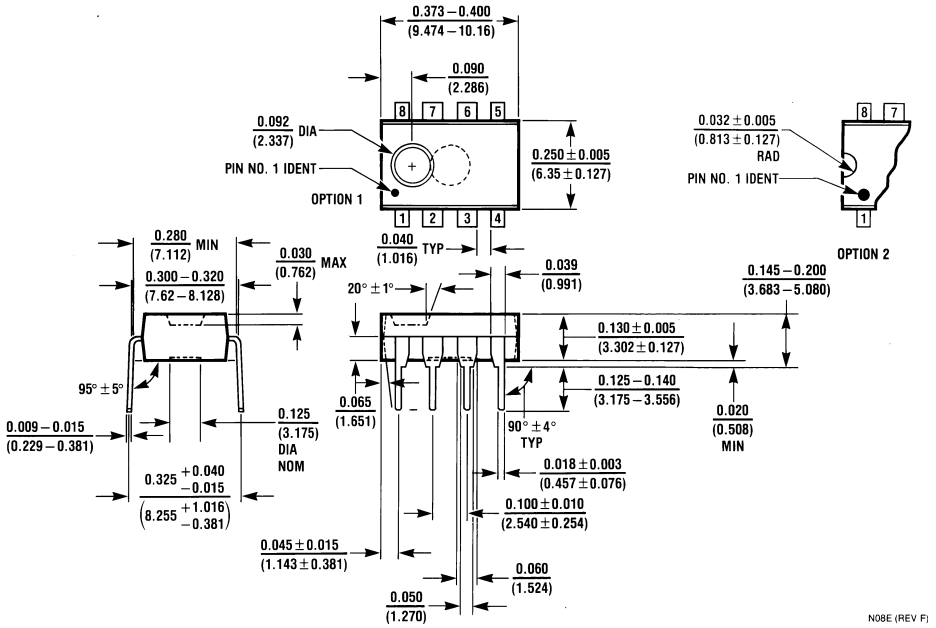


Physical Dimensions inches (millimeters) unless otherwise noted



14-Lead Wide Surface Mount (WM)
Order Number LM2574M-3.3, LM2574HVM-3.3, LM2574M-5.0, LM2574HVM-5.0, LM2574M-12, LM2574HVM-12, LM2574M-15, LM2574HVM-15, LM2574M-ADJ or LM2574HVM-ADJ
NS Package Number M14B

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



8-Lead DIP (N)
Order Number LM2574M-3.3, LM2574HVM-3.3, LM2574HVN-5.0, LM2574HVN-12, LM2574HVN-15, LM2574HVN-ADJ, LM2574N-5.0, LM2574N-12, LM2574N-15 or LM2574N-ADJ
NS Package Number N08A

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