LM2574

52kHz Simple 0.5A Buck Regulator

General Description

The LM2574 family is a series of easy to use fixed and adjustable switching voltage regulators. The LM2574 contains all of the active circuitry necessary to construct a stepdown (buck) switching regulator and requires a minimum of external components.

The LM2574 is available in 3.3V and 5V fixed output versions, or an adjustable version with an output voltage range of 1.23V to 37V. Output voltage is guaranteed to ±4% for specified input and load conditions.

The LM2574 can supply 0.5A while maintaining excellent line and load regulation. The output switch includes cycle-by-cycle current limiting, as well as thermal shutdown for full protection under fault conditions.

An external shutdown connection selects operating or standby modes. Standby current is less than 200µA.

Heat sinks are generally unnecessary due the regulator's high efficiency. Adequate heat transfer is usually provided by soldering all package pins to a printed circuit board.

The LM2574 includes internal frequency compensation and an internal 52kHz fixed frequency oscillator guaranteed to ±10% of the frequency.

Circuits constructed around the LM2574 use a standard series of inductors which are available from several different manufacturers.

All support documentation can be found on Micrel's web site at www.micrel.com.

Features

- 3.3V, 5V, 12V, and adjustable output versions
- Adjustable version output 1.23V to 37V ±4% max. over line and load conditions.
- Guaranteed 0.5A output current
- Wide input voltage, up to 40V
- Thermal shutdown and current limit protection
- Requires only 4 external components.
- Shutdown capability (standby mode)
- Low power standby mode < 200µA Typical
- High-efficiency
- 52kHz fixed frequency internal oscillator
- Uses standard inductors

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

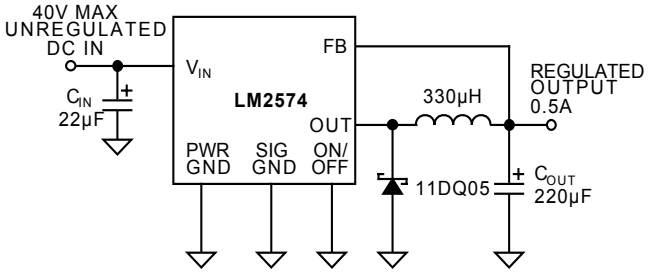
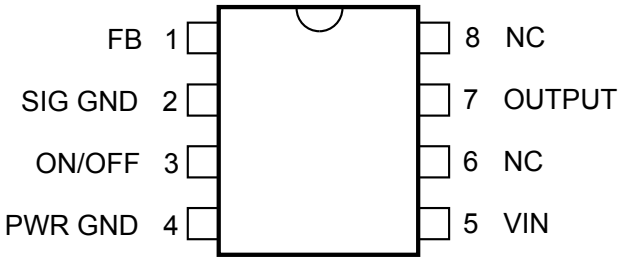


Figure 1. Fixed Output Regulator Circuit

Ordering Information

Part Number		Junction Temp. Range	Package
Standard	**Pb-Free**		
LM2574BN	LM2574YN	–40ºC to +85ºC	8-pin Plastic DIP
LM2574-3.3BN	LM2574-3.3YN	–40ºC to +85ºC	8-pin Plastic DIP
LM2574-5.0BN	LM2574-5.0YN	–40ºC to +85ºC	8-pin Plastic DIP

Pin Configuration



8-Pin DIP (N)

Absolute Maximum Ratings(1)

Maximum Supply Voltage
LM2574 ..... 45V
OFF Pin Input Voltage ..... $-0.3V \le V \le V_{IN}$
Output Voltage to Ground (Steady State) ..... –1V
Power Dissipation ..... Internally Limited
Storage Temperature Range (T_S) ..... –65°C to +150°C
Minimum ESD Rating
C = 100pF, R = 1.5kΩ 2kV
FB Pin 1kV
Lead Temperature (soldering, 10 sec.) ..... 260°C

Operating Ratings(1)

Supply Voltage
LM2574 ..... 40V
Temperature Range
LM2574 ..... $-40°C \le T_J \le +125°C$
Maximum Junction Temperature (T_J ..... 150°C

Electrical Characteristics(2)

Specifications with standard typeface are for T_J = 25°C, and those with boldface type apply over full Operating Temperature Range. Unless otherwise specified, V_{IN} = 12V, and I_{LOAD} = 100mA.

Symbol	Parameter	Condition	Min	Typ	Max	Units
System Parameters, Adjustable Regulators(3), Test Circuit *Figure 2*						
V_{OUT}	Feedback Voltage	V_{IN} = 12V, I_{LOAD} = 0.1A, V_{OUT} = 5V	1.217	1.230	1.243	V
V_{OUT}	Feedback Voltage (LM2574)	$0.1A \le I_{LOAD} \le 0.5A$, $7V \le V_{IN} \le 40V$, V_{OUT} = 5V	1.193 **1.180**	1.230	1.267 **1.280**	V V
η	Efficiency	V_{IN} = 12V, I_{LOAD} = 0.1A, V_{OUT} = 5V		78		%
System Parameters, 3.3V Regulators(3), Test Circuit *Figure 3*						
V_{OUT}	Output Voltage	V_{IN} = 12V, I_{LOAD} = 0.1A, V_{OUT} = 3.3V	3.234	3.3	3.366	V
V_{OUT}	Output Voltage (LM2574-3.3)	$0.1A \le I_{LOAD} \le 0.5A$, $4.75V \le V_{IN} \le 40V$, V_{OUT} = 3.3V	3.168 **3.135**	3.3	3.432 **3.465**	V V
η	Efficiency	V_{IN} = 12V, I_{LOAD} = 0.1A		73		%
System Parameters, 5V Regulators(3), Test Circuit *Figure 3*						
V_{OUT}	Output Voltage	V_{IN} = 12V, I_{LOAD} = 0.1A, V_{OUT} = 5V	4.900	5.0	5.100	V
V_{OUT}	Output Voltage (LM2574-5.0)	$0.1A \le I_{LOAD} \le 0.5A$, $7V \le V_{IN} \le 40V$, V_{OUT} = 5V	4.800 **4.750**	5.0	5.200 **5.250**	V V
η	Efficiency	V_{IN} = 12V, I_{LOAD} = 0.1A, V_{OUT} = 5V		78		%

Notes:

1. *"Absolute Maximum Ratings"* indicate limits beyond which damage to the device may occur. *"Operating Ratings"* indicate for which the device is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see *"Electrical Characteristics."*
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 testing.
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 Figure 1 test circuit, system performance will be shown in system parameters section of *"Electrical Characteristics."*

Electrical Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Units
Device Parameters, Adjustable Regulator						
I_B	Feedback Bias Current	V_{OUT} = 5V		50	100 **500**	nA nA
Device Parameters, Fixed and Adjustable Regulators						
f_o	Oscillator Frequency	**Note 8**	47 **42**	52	58 **63**	kHz kHz
V_{SAT}	Saturation Voltage	I_{OUT} = 0.5A(4)		0.8	1.2 **1.4**	V V
DC	Max Duty Cycle (ON)	**Note 5**	93	98		%
I_{CL}	Current Limit	Peak Current, $t_{ON} \le 3\mu s$(4)	0.7 **0.65**	1.0	1.6 **1.8**	A
I_L	Output Leakage Current	V_{IN}, **Note 6**, Output = 0V **Note 6**, Output = –1V		 7.5	2 30	mA
I_Q	Quiescent Current	**Note 6**		5	10	mA
I_{STBY}	Standby Quiescent Current	ON/OFF Pin = 5V (OFF)		50	200	µA
θ_{JA}	Thermal Resistance	N Package, Junction to Ambient(7)		85		°C/W
On/Off Control, Fixed and Adjustable Regulators Test Circuit *Figures 2, 3*						
V_{IH}	ON/OFF Input Level	V_{OUT} = 0V	2.2 **2.4**	1.4		V V
V_{IL}	ON/OFF Input Level	V_{OUT} = 5V		1.2	1.0 **0.8**	V V
I_{IH}	ON/OFF Logic Current	ON/OFF = 5V (OFF)		4	30	µA
I_{IL}	ON/OFF Logic Current	ON/OFF = 0V (ON)		0.01	10	µA

Notes:

4. Output (pin 2) sourcing current. No diode, inductor, or capacitor connected to input.
5. Feedback (pin 4) removed from output and connected to 0V.
6. Feedback (pin 4) removed from output and connected to 12V to force the output transistor OFF.
7. Junction-to-ambient thermal resistance with approximately 1 square inches of PC board copper surrounding the leads.

Test Circuit

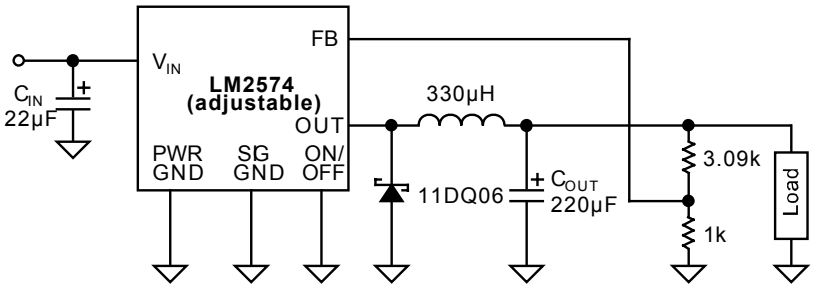


Figure 2. Adjustable Regulator Test Circuit

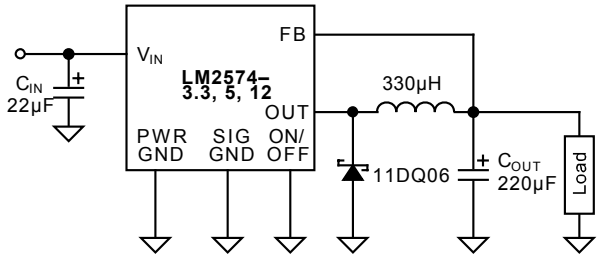
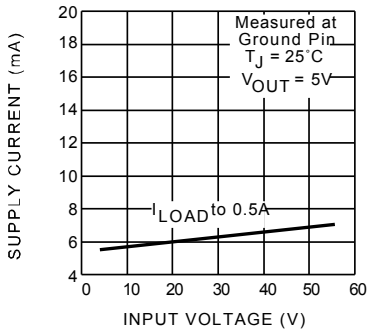


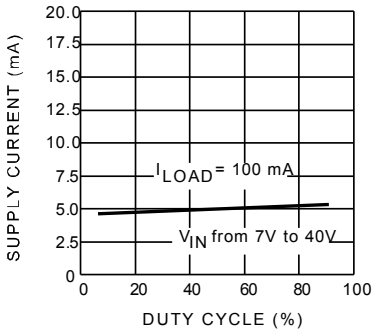
Figure 3. Fixed Regulator Test Circuit

Typical Characteristics (Circuit of Figure 1)

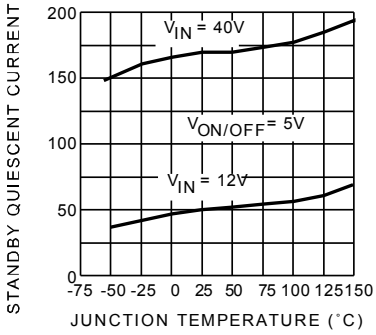
Supply Current



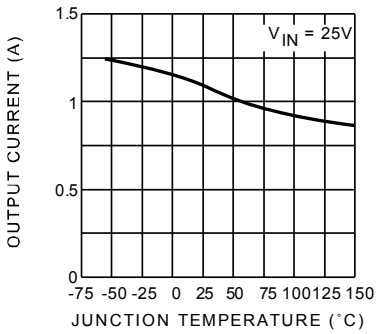
Supply Current vs. Duty Cycle



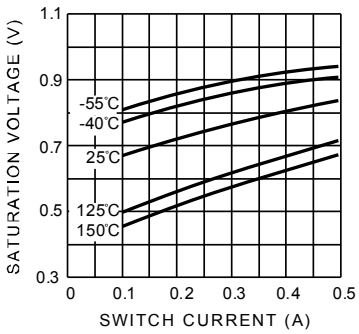
Standby Quiescent Current



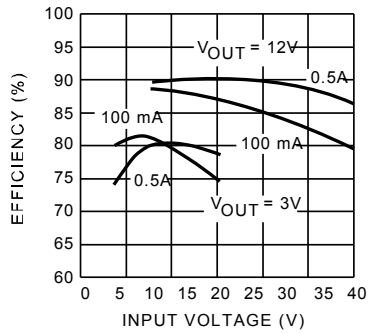
Current Limit



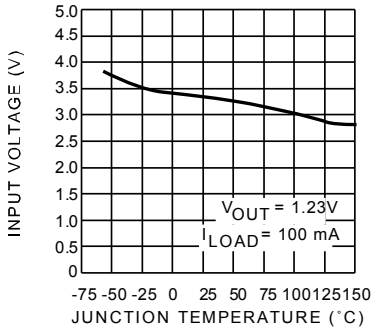
Switch Saturation Voltage



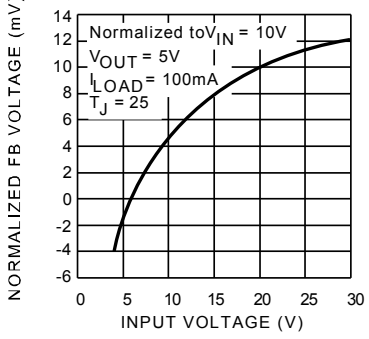
Efficiency



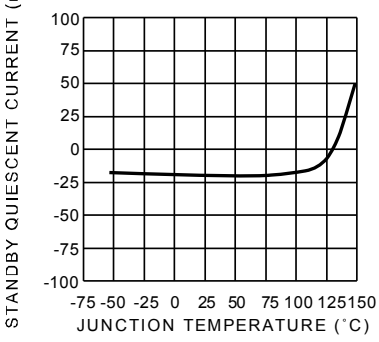
Minimum Operating Voltage



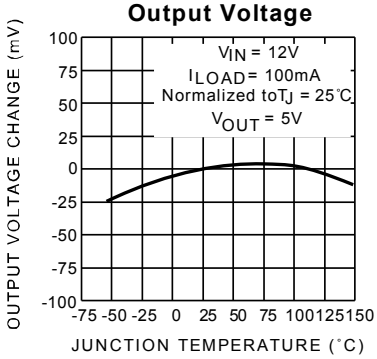
Line Regulation



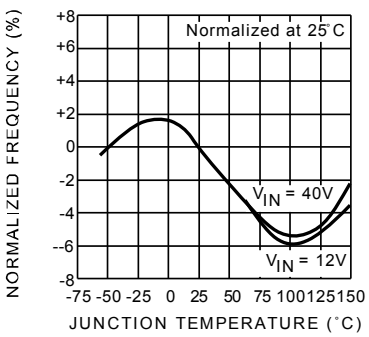
Feedback Pin Current



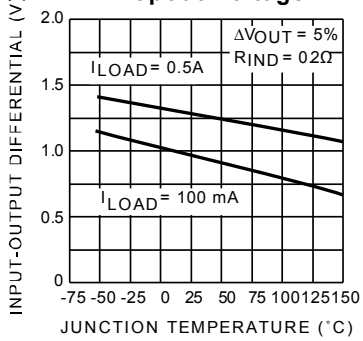
Normalized Output Voltage



Oscillator Frequency

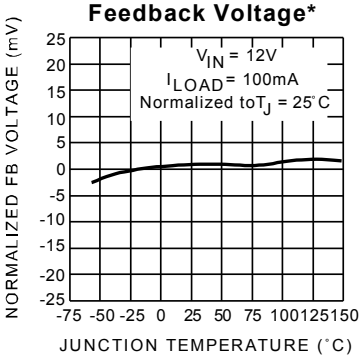


Dropout Voltage

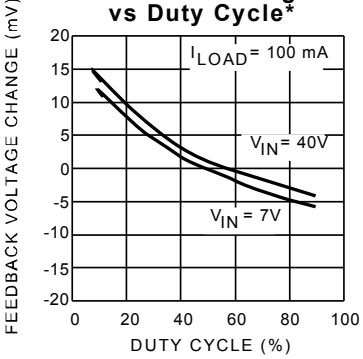


Typical Performance Characteristics (continued)

Normalized Feedback Voltage*

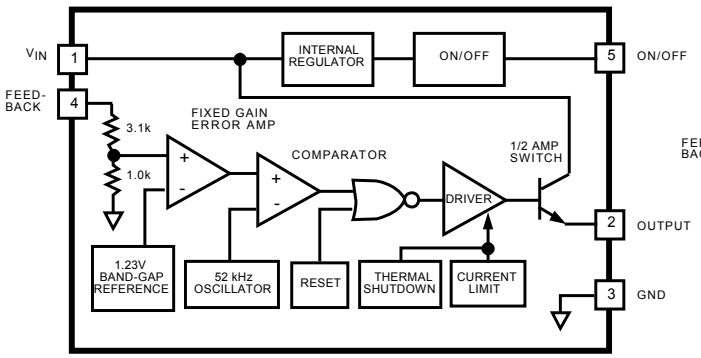


Feedback Voltage vs Duty Cycle*



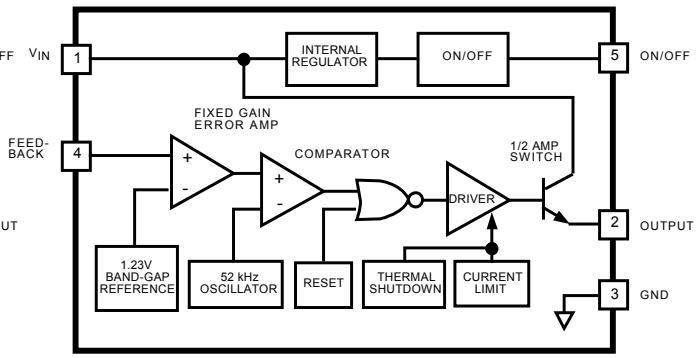
* Adjustable version only

Block Diagrams



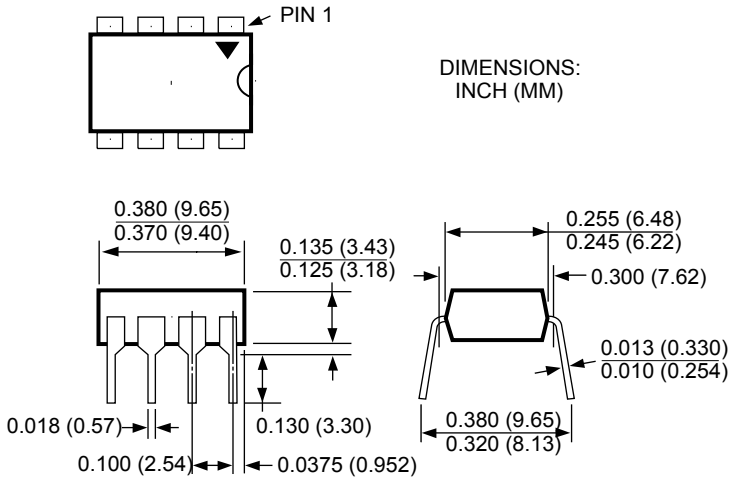
Note: Pin numbers are for the TO-220 package

Fixed Regulator



Adjustable Regulator

Package Information



8-Pin DIP (N)

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