# 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

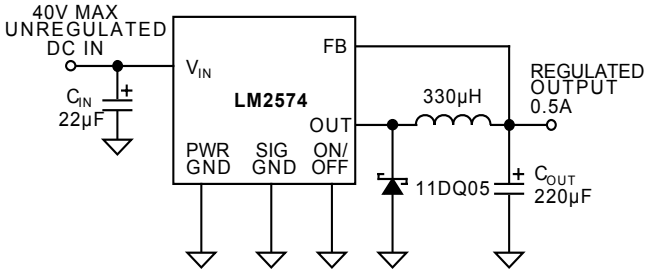
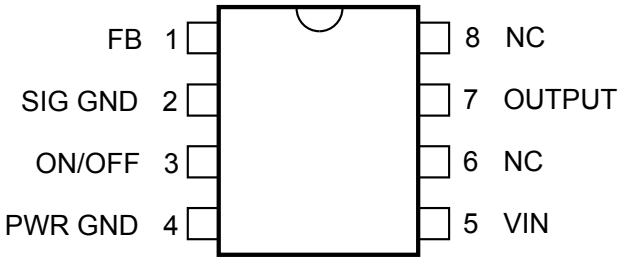



**Figure 1. Fixed Output Regulator Circuit**

## 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<br>**1.180** | 1.230 | 1.267<br>**1.280** | V<br>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<br>**3.135** | 3.3 | 3.432<br>**3.465** | V<br>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<br>**4.750** | 5.0 | 5.200<br>**5.250** | V<br>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<br>**500** | nA<br>nA |
| **Device Parameters, Fixed and Adjustable Regulators** | | | | | | |
| $f_o$ | Oscillator Frequency | **Note 8** | 47<br>**42** | 52 | 58<br>**63** | kHz<br>kHz |
| $V_{SAT}$ | Saturation Voltage | $I_{OUT}$ = 0.5A(4) | | 0.8 | 1.2<br>**1.4** | V<br>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<br>**0.65** | 1.0 | 1.6<br>**1.8** | A |
| $I_L$ | Output Leakage Current | $V_{IN}$, **Note 6**, Output = 0V<br>**Note 6**, Output = –1V | | <br>7.5 | 2<br>30 | mA |
| $I_Q$ | Quiescent Current | **Note 6** | | 5 | 10 | mA |
| $I_{STBY}$ | Standby Quiescent Current | ON/OFF Pin = 5V (OFF) | | 50 | 200 | µA |
| $\theta_{JA}$ | 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<br>**2.4** | 1.4 | | V<br>V |
| $V_{IL}$ | ON/OFF Input Level | $V_{OUT}$ = 5V | | 1.2 | 1.0<br>**0.8** | V<br>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

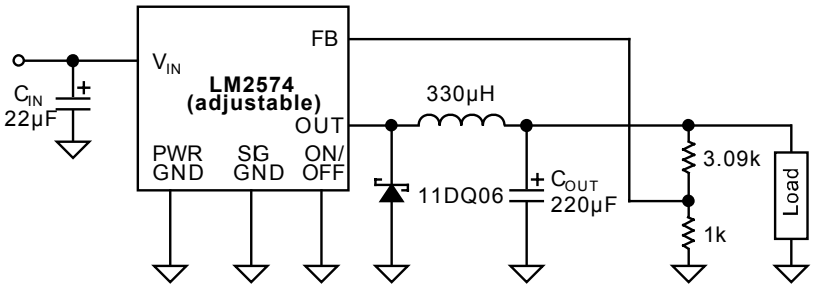



**Figure 2. Adjustable Regulator Test Circuit**

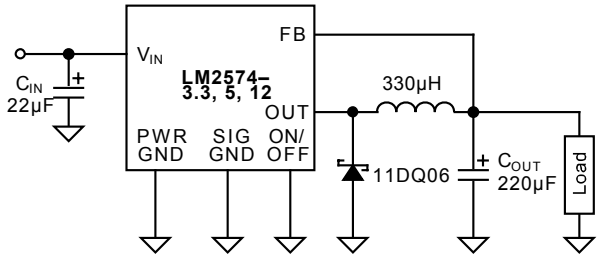
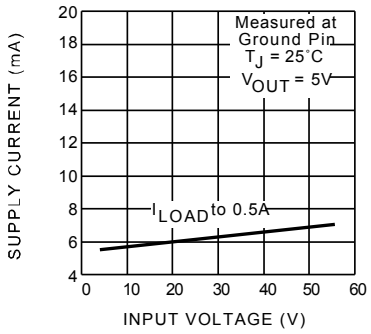


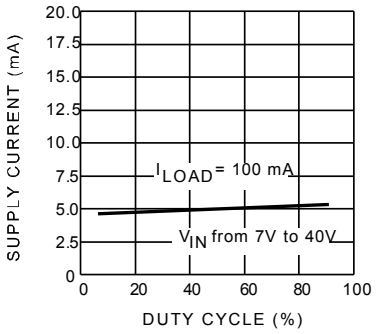

**Figure 3. Fixed Regulator Test Circuit**

## Typical Characteristics (Circuit of Figure 1)

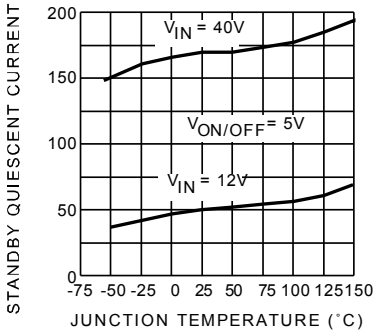
**Supply Current**



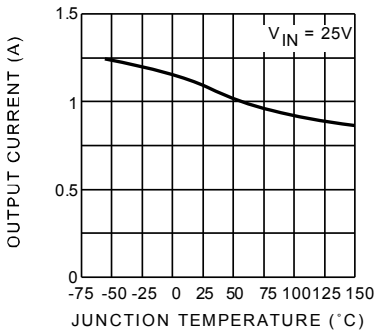

**Supply Current vs. Duty Cycle**



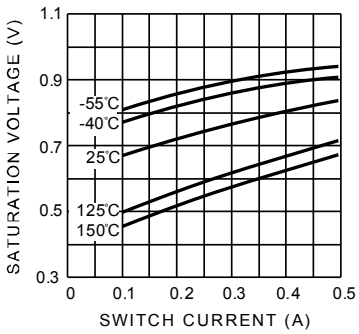

**Standby Quiescent Current**



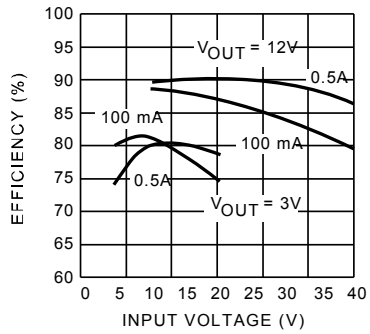

**Current Limit**



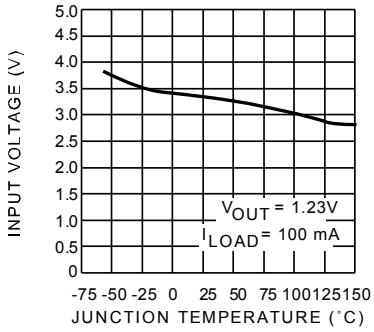

**Switch Saturation Voltage**



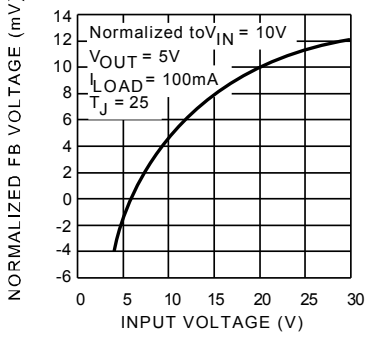

**Efficiency**



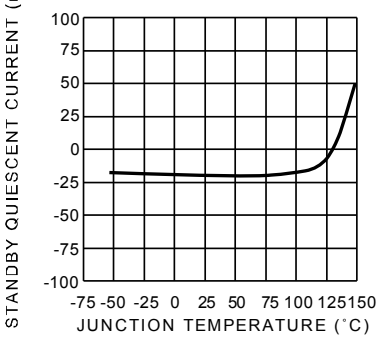

**Minimum Operating Voltage**



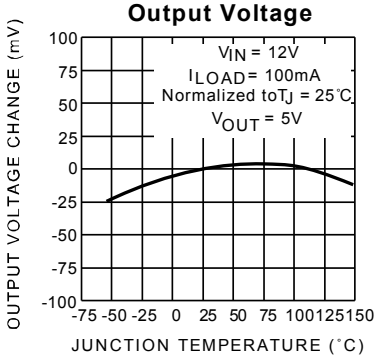

**Line Regulation**



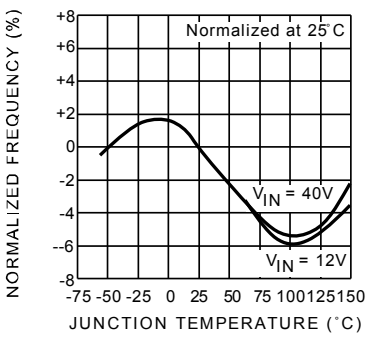

**Feedback Pin Current**



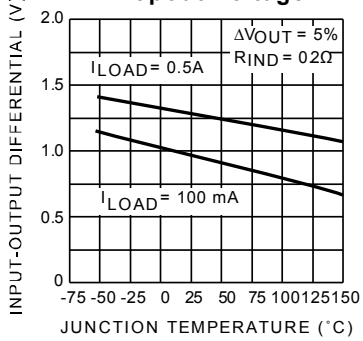

**Normalized Output Voltage**




**Oscillator Frequency**

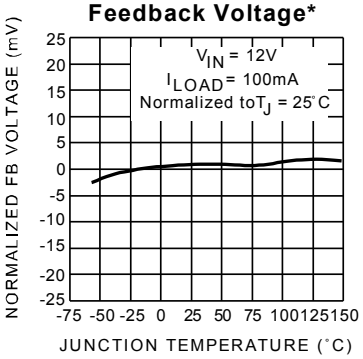



**Dropout Voltage**

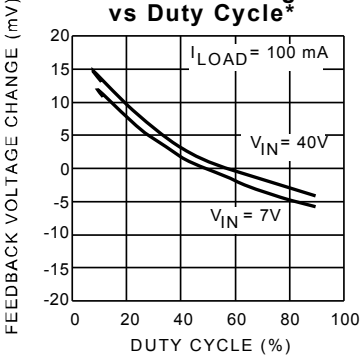


## Typical Performance Characteristics (continued)

**Normalized Feedback Voltage***

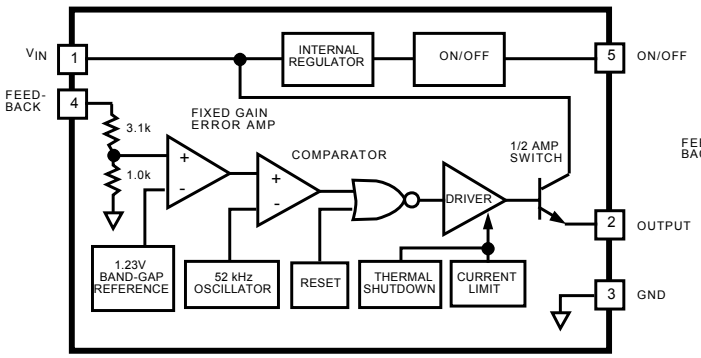



**Feedback Voltage vs Duty Cycle***



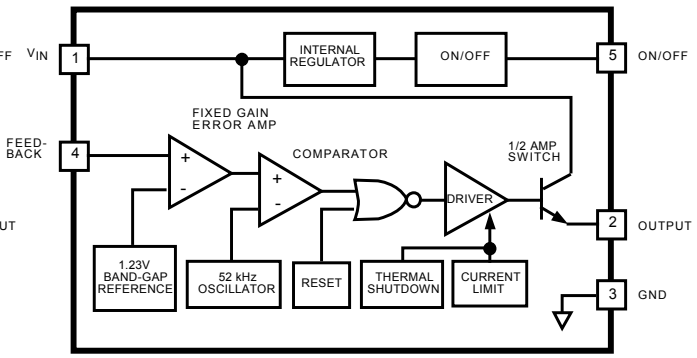

* Adjustable version only

## Block Diagrams



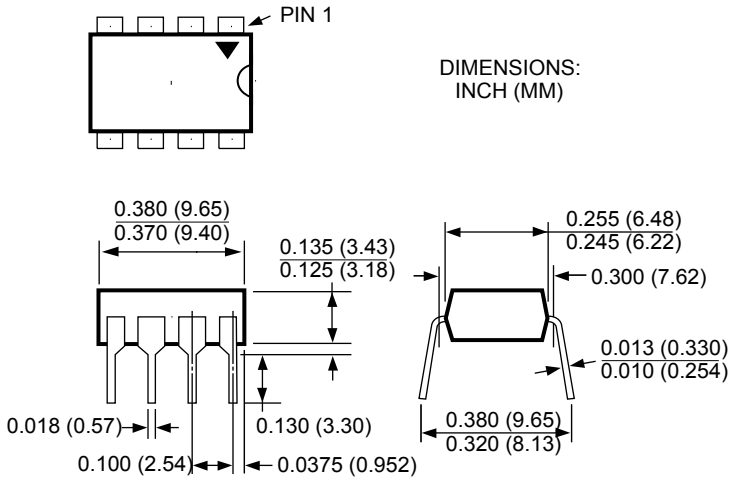

Note: Pin numbers are for the TO-220 package

**Fixed Regulator**




**Adjustable Regulator**

## Package Information




**8-Pin DIP (N)**

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