National Semiconductor

# LM5574
# SIMPLE SWITCHER® 75V, 0.5A Step-Down Switching Regulator

## General Description

The LM5574 is an easy to use SIMPLE SWITCHER® buck regulator which allows design engineers to design and optimize a robust power supply using a minimum set of components. Operating with an input voltage range of 6 - 75V, the LM5574 delivers 0.5A of continuous output current with an integrated 750mΩ N-Channel MOSFET. The regulator utilizes an Emulated Current Mode architecture which provides inherent line regulation, tight load transient response, and ease of loop compensation without the usual limitation of low-duty cycles associated with current mode regulators. The operating frequency is adjustable from 50kHz to 500kHz to allow optimization of size and efficiency. To reduce EMI, a frequency synchronization pin allows multiple IC's from the LM(2)557x family to self-synchronize or to synchronize to an external clock. The LM5574 guarantees robustness with cycle-by-cycle current limit, short-circuit protection, thermal shut-down, and remote shut-down. The device is available in a TSSOP-16 package. The LM5574 is supported by the full suite of WEBENCH® On-Line design tools.

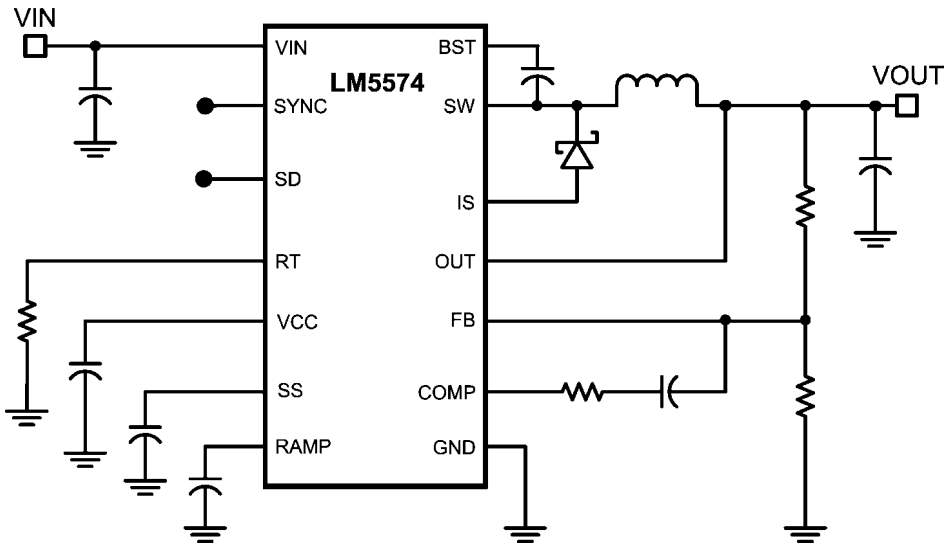
## Features

- Integrated 75V, 750mΩ N-channel MOSFET
- Ultra-wide input voltage range from 6V to 75V
- Adjustable output voltage as low as 1.225V
- 1.5% feedback reference accuracy
- Operating frequency adjustable between 50kHz and 500kHz with single resistor
- Master or slave frequency synchronization
- Adjustable soft-start
- Emulated current mode control architecture
- Wide bandwidth error amplifier
- Built-in protection

## Package

- TSSOP-16

## Simplified Application Schematic

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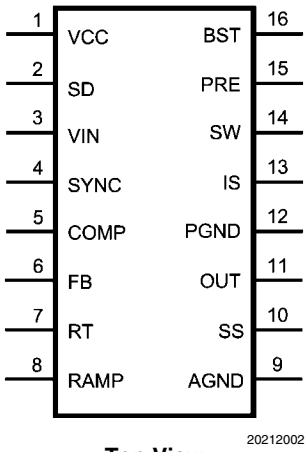
## Connection Diagram




**Top View**
**16-Lead TSSOP**

## Ordering Information

| Order Number | Package Type | NSC Package Drawing | Supplied As |
|---|---|---|---|
| LM5574MT | TSSOP-16 | MTC16 | 92 Units in Rail |
| LM5574MTX | TSSOP-16 | MTC16 | 2500 Units on Tape and Reel |

## Absolute Maximum Ratings (Note 1)

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

| | |
|---|---|
| $V_{IN}$ to GND | 76V |
| BST to GND | 90V |
| PRE to GND | 76V |
| SW to GND (Steady State) | -1.5V |
| BST to $V_{CC}$ | 76V |
| SD, $V_{CC}$ to GND | 14V |
| BST to SW | 14V |
| OUT to GND | Limited to Vin |
| SYNC, SS, FB, RAMP to GND | 7V |
| ESD Rating (Note 2) | |
| Human Body Model | 2kV |
| Storage Temperature Range | -65°C to +150°C |

## Operating Ratings (Note 1)

| | |
|---|---|
| $V_{IN}$ | 6V to 75V |
| Operation Junction Temperature | –40°C to + 125°C |

## Electrical Characteristics

Specifications with standard typeface are for $T_J$ = 25°C, and those with **boldface** type apply over full **Operating Junction Temperature range**. $V_{IN}$ = 48V, $R_T$ = 32.4kΩ unless otherwise stated. (Note 3)

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **STARTUP REGULATOR** | | | | | | |
| VccReg | Vcc Regulator Output | | **6.85** | 7.15 | **7.45** | V |
| | Vcc LDO Mode turn-off | | | 9 | | V |
| | Vcc Current Limit | Vcc = 0V | | 25 | | mA |
| **VCC SUPPLY** | | | | | | |
| | Vcc UVLO Threshold | (Vcc increasing) | **5.03** | 5.35 | **5.67** | V |
| | Vcc Undervoltage Hysteresis | | | 0.35 | | V |
| | Bias Current (Iin) | FB = 1.3V | | 3.7 | **4.5** | mA |
| | Shutdown Current (Iin) | SD = 0V | | 57 | **85** | µA |
| **SHUTDOWN THRESHOLDS** | | | | | | |
| | Shutdown Threshold | (SD Increasing) | **0.47** | 0.7 | **0.9** | V |
| | Shutdown Hysteresis | | | 0.1 | | V |
| | Standby Threshold | (Standby Increasing) | **1.17** | 1.225 | **1.28** | V |
| | Standby Hysteresis | | | 0.1 | | V |
| | SD Pull-up Current Source | | | 5 | | µA |
| **SWITCH CHARACTERSICS** | | | | | | |
| | Buck Switch Rds(on) | | | 750 | **1500** | mΩ |
| | BOOST UVLO | | | 4 | | V |
| | BOOST UVLO Hysteresis | | | 0.56 | | V |
| | Pre-charge Switch Rds(on) | | | 70 | | Ω |
| | Pre-charge Switch on-time | | | 250 | | ns |
| **CURRENT LIMIT** | | | | | | |
| | Cycle by Cycle Current Limit | RAMP = 0V | **0.6** | 0.7 | **0.8** | A |
| | Cycle by Cycle Current Limit Delay | RAMP = 2.5V | | 75 | | ns |
| **SOFT-START** | | | | | | |
| | SS Current Source | | **7** | 10 | **14** | µA |
| **OSCILLATOR** | | | | | | |
| | Frequency1 | | **180** | 200 | **220** | kHz |
| | Frequency2 | $R_T$ = 11kΩ | **425** | 485 | **545** | kHz |
| | SYNC Source Impedance | | | 11 | | kΩ |
| | SYNC Sink Impedance | | | 110 | | Ω |
| | SYNC Threshold (falling) | | | 1.3 | | V |
| | SYNC Frequency | $R_T$ = 11kΩ | **550** | | | kHz |
| | SYNC Pulse Width Minimum | | **15** | | | ns |

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **RAMP GENERATOR** | | | | | | |
| | Ramp Current 1 | Vin = 60V, Vout=10V | **467** | 550 | **633** | µA |
| | Ramp Current 2 | Vin = 10V, Vout=10V | **36** | 50 | **64** | µA |
| **PWM COMPARATOR** | | | | | | |
| | Forced Off-time | | **416** | 500 | **575** | ns |
| | Min On-time | | | 80 | | ns |
| | COMP to PWM Comparator Offset | | | 0.7 | | V |
| **ERROR AMPLIFIER** | | | | | | |
| | Feedback Voltage | Vfb = COMP | **1.207** | 1.225 | **1.243** | V |
| | FB Bias Current | | | 17 | | nA |
| | DC Gain | | | 70 | | dB |
| | COMP Sink / Source Current | | **3** | | | mA |
| | Unity Gain Bandwidth | | | 3 | | MHz |
| **DIODE SENSE RESISTANCE** | | | | | | |
| $D_{SENSE}$ | | | | 250 | | mΩ |
| **THERMAL SHUTDOWN** | | | | | | |
| Tsd | Thermal Shutdown Threshold | | | 165 | | °C |
| | Thermal Shutdown Hysteresis | | | 25 | | °C |
| **THERMAL RESISTANCE** | | | | | | |
| $\theta_{JC}$ | Junction to Case | | | 30 | | °C/W |
| $\theta_{JA}$ | Junction to Ambient | | | 90 | | °C/W |

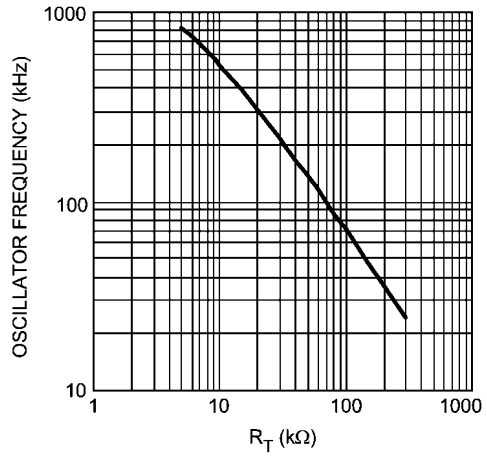
**Note 1:** Absolute Maximum Ratings are limits beyond which damage to the device may occur. Operating Ratings are conditions under which operation of the device is intended to be functional. For guaranteed specifications and test conditions, see the Electrical Characteristics.

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

**Note 3:** Min and Max limits are 100% production tested at 25°C. Limits over the operating temperature range are guaranteed through correlation using Statistical Quality Control (SQC) methods. Limits are used to calculate National's Average Outgoing Quality Level (AOQL).

# Typical Performance Characteristics

**Oscillator Frequency vs $R_T$**

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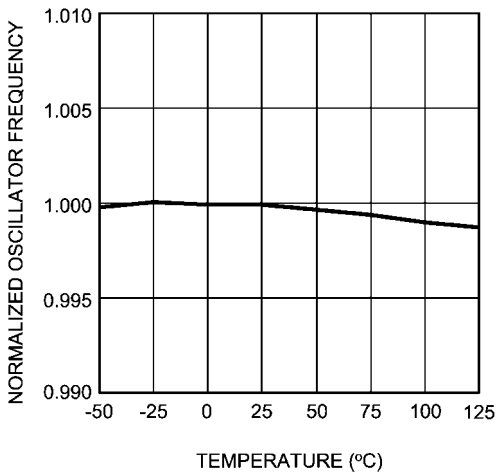
**Oscillator Frequency vs Temperature**
**$F_{OSC}$ = 200kHz**

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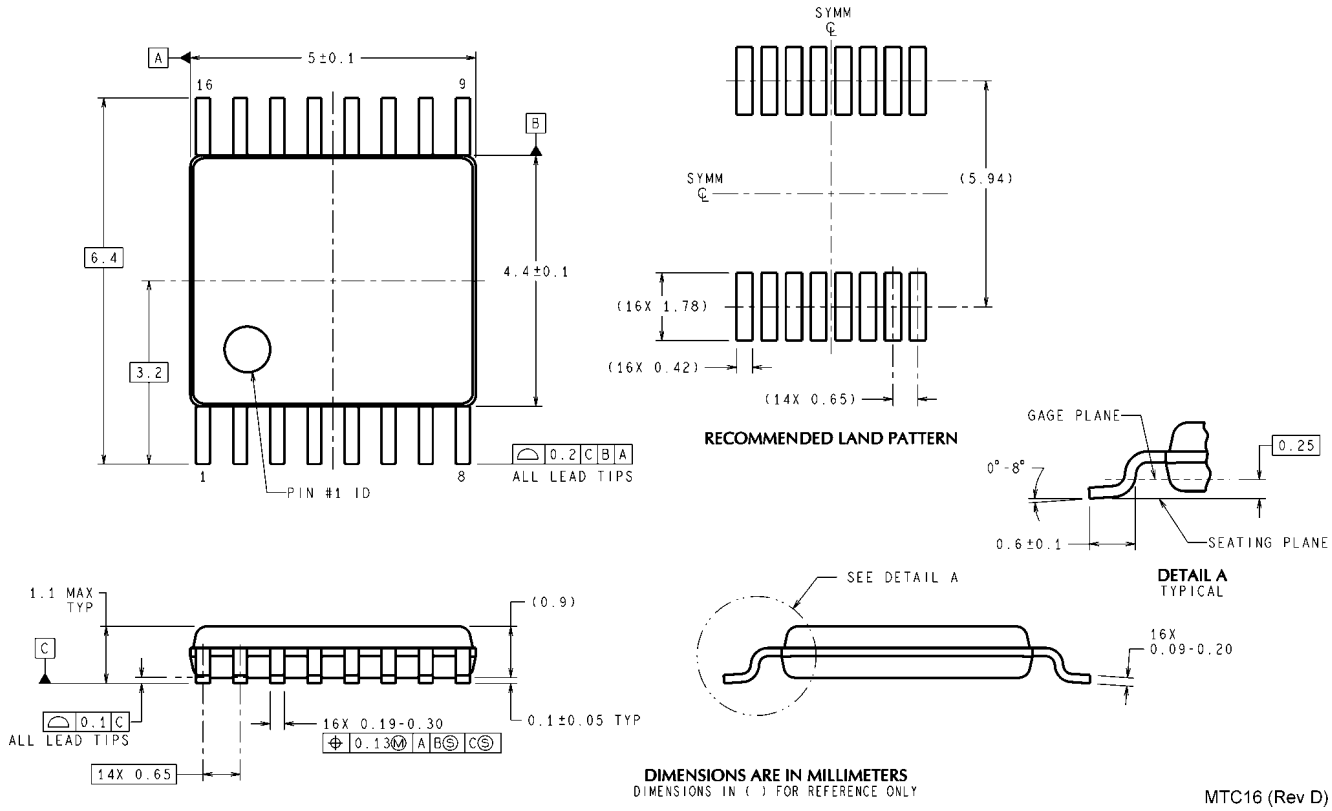
## Physical Dimensions inches (millimeters) unless otherwise noted




**16-Lead TSSOP Package**
**NS Package Number MTC16**