AN-1568 LM5574 Evaluation Board

1 Introduction

The LM5574 evaluation board is designed to provide the design engineer with a fully functional power converter based on emulated current mode control to evaluate the LM5574 regulator IC. The evaluation board provides a 5V output with a 0.5A current capability. The ultra-wide input voltage ranges from 7V to 75V. The design operates at 300kHz, a good compromise between conversion efficiency and solution size. The printed circuit board consists of 2 layers of 2 ounce copper on FR4 material with a thickness of 0.06 inches. This application note contains the evaluation board schematic, Bill-of-Materials (BOM) and a quick setup procedure. Refer to the *LM5574/LM5574Q SIMPLE SWITCHER® 75V, 0.5A Step-Down Switching Regulator* (SNVS478) data sheet for complete circuit design information.

The performance of the evaluation board is as follows:

Input Range: 7 to 75V

Output Voltage: 5V

Output Current: 0 to 0.5A

Frequency of Operation: 300 KHz

Board Size: 2.1 X 1 X 0.4 inches

Load Regulation: 1%

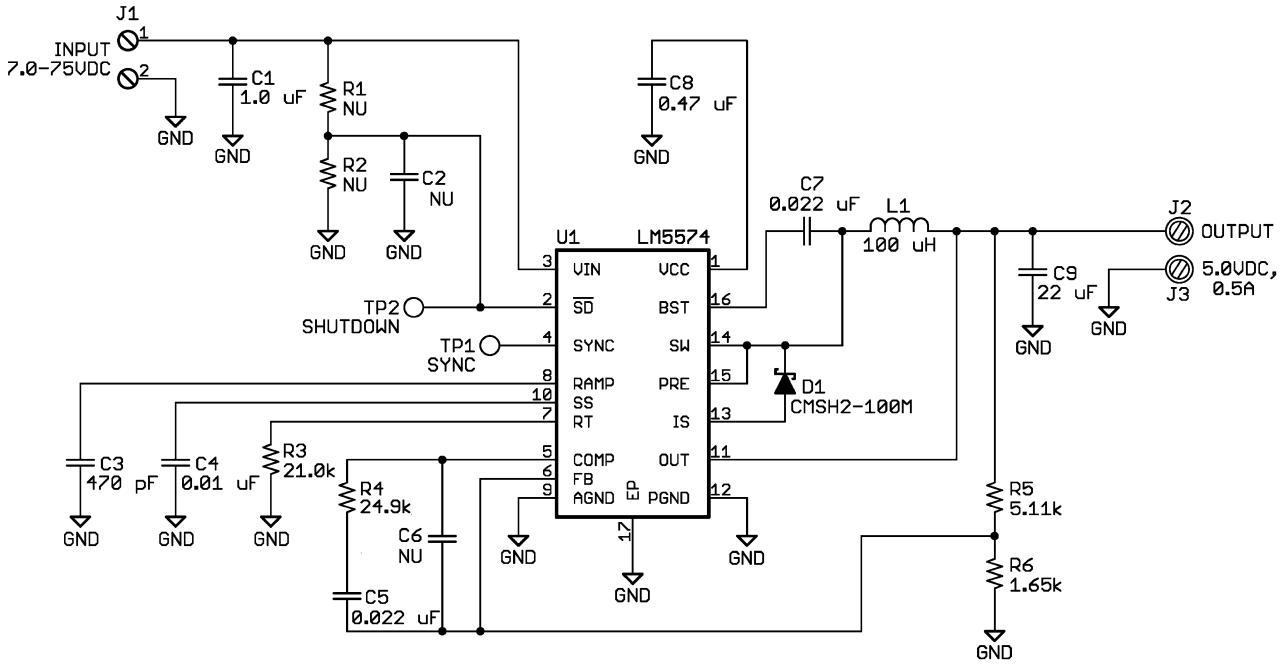
Line Regulation: 0.1%

Over Current Limiting

All trademarks are the property of their respective owners.

Copyright © 2007–2013, Texas Instruments Incorporated

2 Evaluation Board Schematic



3 Powering and Loading Considerations

Read this entire page prior to attempting to power the evaluation board.

3.1 Quick Setup Procedure

Step 1: Set the power supply current limit to 0.6A. Turn off the power supply. Connect the power supply to the Vin terminals.

Step 2: Connect the load, with a 0.5A capability, to the Vout terminals. Positive connection to J2 and negative connection to J3.

Step 3: The SD pin should be left open for normal operation.

Step 4: Set Vin to 24V with no load applied. Vout should be in regulation with a nominal 5V output.

Step 5: Slowly increase the load while monitoring the output voltage, Vout should remain in regulation with a nominal 5V output as the load is increased up to 0.5 Amps.

Step 6: Slowly sweep the input voltage from 7 to 75V, Vout should remain in regulation with a nominal 5V output.

Step 7: Temporally short the SD pin to GND to check the shutdown function.

Step 8: Increase the load beyond the normal range to check current limiting. The output current should limit at approximately 0.7A. The power supply (Vin source) current limit may need to be increased for this step. Cooling is critical during this step.

3.2 Air Flow

Prolonged operation with high input voltage at full power will cause the thermal shutdown circuit within the regulator IC to activate. A standalone fan with at lease 200 LFM should always be provided.

Copyright © 2007–2013, Texas Instruments Incorporated

3.3 Powering Up

Using the shutdown pin provided will allow powering up the source supply with the current level set low. It is suggested that the load be kept low during the first power up. Set the current limit of the source supply to provide about 1.5 times the anticipated wattage of the load. As you remove the connection from the shutdown pin to ground, immediately check for 5 volts at the output.

A quick efficiency check is the best way to confirm that everything is operating properly. If something is amiss you can be reasonably sure that it will affect the efficiency adversely. Few parameters can be incorrect in a switching power supply without creating losses and potentially damaging heat.

3.4 Over Current Protection

The evaluation board is configured with over-current protection. The output current is limited to approximately 0.7A. The thermal stress is quite severe while in an overloaded condition, limit the duration of the overload and provide sufficient cooling (airflow).

3.5 Synchronization

A SYNC pin has been provided on the evaluation board. This pin can be used to synchronize the regulator to an external clock or multiple evaluation boards can be synchronized together by connecting their SYNC pins together. Refer to the LM5574 datasheet for complete information.

4 Performance Characteristics

Efficiency Plots

Figure 1 shows the conversion efficiency versus output current for several input voltage conditions.

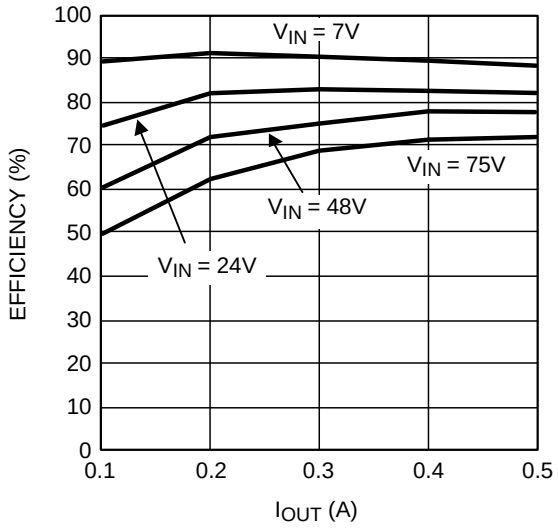
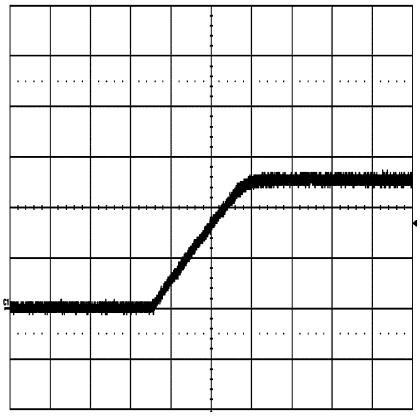


Figure 1. Efficiency Plots

Copyright © 2007–2013, Texas Instruments Incorporated

Turn-on Waveform

When applying power to the LM5574 evaluation board a certain soft-start sequence occurs. Figure 2 shows the output voltage during a typical start-up sequence.

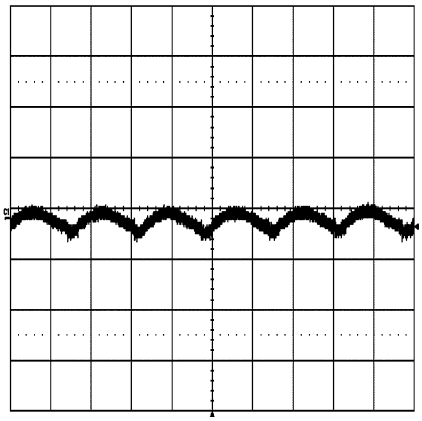


Conditions: Input Voltage = 36VDC, Output Current = 0.4A
Trace 1: Output Voltage Volts/div = 2V
Horizontal Resolution = 500 µsec/div

Figure 2. Turn-On Waveform

Output Ripple Waveform

Figure 3 shows the output voltage ripple. This measurement was taken with a very short ground clip and 20MHZ bandwidth limiting.



Conditions: Input Voltage = 36VDC Output Current = 0.4A Bandwidth Limit = 20MHz
Trace 1: Output Ripple Voltage Volts/div = 50mV
Horizontal Resolution = 2 µsec/div

Figure 3. Output Ripple Waveform

Copyright © 2007–2013, Texas Instruments Incorporated

5 Layout and Bill of Materials

The Bill of Materials is shown in Table 1, including the manufacturer and part number.

Table 1. 5V, 0.5A Demo Board Bill of Materials

ITEM		PART NUMBER	DESCRIPTION	VALUE
C	1	C3225X7R2A105M	CAPACITOR, CER, TDK	1µ, 100V
C	2	OPEN	NOT USED	
C	3	C0805A471K1GAC	CAPACITOR, CER, KEMET	470p, 100V
C	4	C2012X7R2A103K	CAPACITOR, CER, TDK	0.01µ, 100V
C	5	C2012X7R2A223K	CAPACITOR, CER, TDK	0.022µ, 100V
C	6	OPEN	NOT USED	
C	7	C2012X7R2A223K	CAPACITOR, CER, TDK	0.022µ, 100V
C	8	C2012X7R1C474M	CAPACITOR, CER, TDK	0.47µ, 16V
C	9	C3225X7R1C226M	CAPACITOR, CER, TDK	22µ, 16V
D	1	CMSH2-100M	DIODE, 100V, CENTRAL	
L	1	DR74-101	INDUCTOR, COOPER	100µH
R	1	OPEN	NOT USED	
R	2	OPEN	NOT USED	
R	3	CRCW08052102F	RESISTOR	21kΩ
R	4	CRCW08052492F	RESISTOR	24.9kΩ
R	5	CRCW08055111F	RESISTOR	5.11kΩ
R	6	CRCW08051651F	RESISTOR	1.65kΩ
U	1	LM5574	REGULATOR, Texas Instruments	

Copyright © 2007–2013, Texas Instruments Incorporated

6 PCB Layout

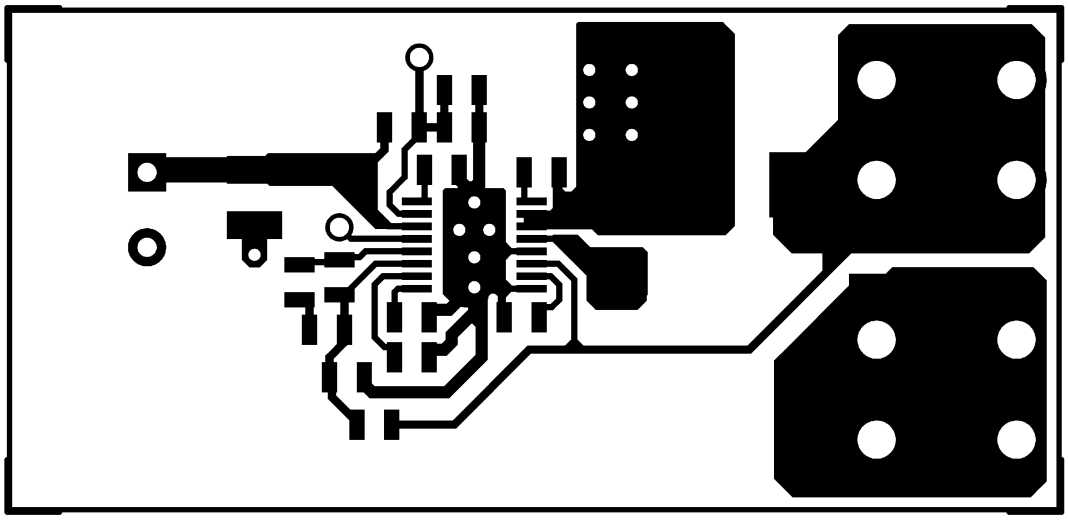


Figure 4. Component Side

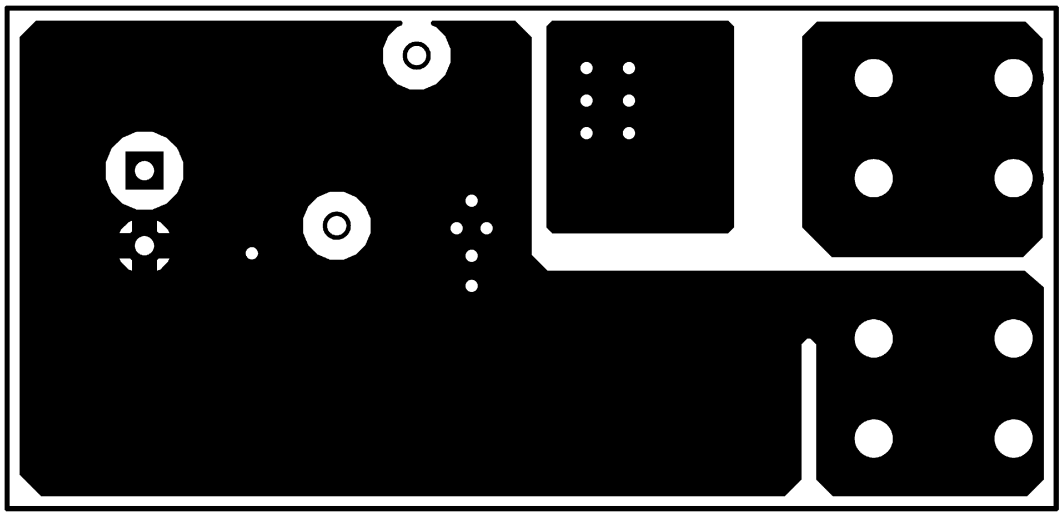


Figure 5. Solder Side

Copyright © 2007–2013, Texas Instruments Incorporated

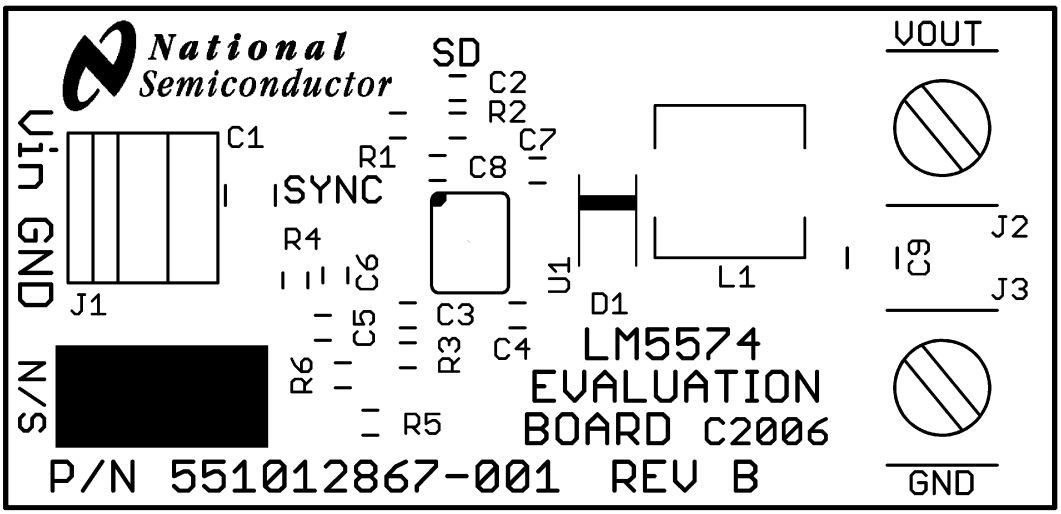


Figure 6. Silkscreen

Copyright © 2007–2013, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2013, Texas Instruments Incorporated