# LM2675

Application Note 1120 LM2675-5.0EVAL 1A Step-Down High-Efficiency SIMPLE SWITCHER Evaluation Board



Literature Number: SNVA011B

# LM2675-5.0EVAL 1A Step-Down High-Efficiency SIMPLE SWITCHER Evaluation Board

National Semiconductor Application Note 1120 Wanda Garrett February 1999



## Introduction

The LM2675 SIMPLE SWITCHER step-down regulator provides all the active functions for a step-down regulator capable of driving a 1A load with excellent line and load regulation. Switching frequency is internally set to 260 kHz, allowing smaller-sized filter components than would be needed with lower-frequency switching regulators. The internal switch is an 0.25 $\Omega$  DMOS device, providing very high-efficiency power conversion. With this high efficiency, the copper traces on the printed circuit board are the only heat sinking needed.

The LM2675-5.0EVAL evaluation board is a fully-assembled and tested surface-mount regulator that provides a  $5V\pm1.5\%$  output at up to 1A, from an input of 8V to 40V. The overall efficiency is typically as high as 90%. The operating temperature range is 0°C to +85°C.

### **Evaluation Board Design**

This evaluation board is designed for supplying 5V at up to 1 Amp to a load. The input voltage range is 8V to 40V. Components, shown in the schematic of *Figure 1*, were selected based on the design procedure in the LM2675 datasheet.

Layout is very important in switching regulator designs. Rapidly switching currents associated with wiring inductance can

generate voltage transients which can cause problems. For minimal inductance and ground loops, the traces which carry the highest currents (input, ground, switch, and output signals) are relatively wide and short. The external components are located physically close to the IC.

Components in this design were selected according to the design procedure in the LM2675 datasheet. The input capacitor  $C_{\rm IN}$  was chosen for its voltage rating and RMS current rating. A 40V maximum input requires a capacitor with voltage rating of at least 1.25x40, or 50V. A conservative estimate of RMS input current is approximately 1/2 the DC load current. The input capacitor chosen for this application has a voltage rating of 50V and an RMS current rating of 900 mA. The inductor and output capacitor were selected for a combination of good regulator stability and compact size, according to the design tables in the datasheet.

While the LM2675 has an ON/OFF control, this has not been provided on the evaluation board.

The parts list for this board is given in *Table 1*, while contact information for the component manufacturers is given in *Table 2*.

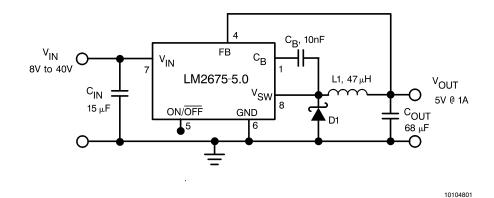


FIGURE 1. LM2675-5.0EVAL Schematic

**TABLE 1. Parts List (Bill of Materials)** 

Designator	Description	
U1	LM2675M-5.0 National Semiconductor SIMPLE SWITCHER voltage converter	1
C <sub>IN</sub>	15 μF, 50V Solid Tantalum, Sprague type 594D	1
C <sub>OUT</sub>	68 μF, 16V Solid Tantalum, Sprague type 595D	
D1	1A, 40V Schottky rectifier	1
L1	47 μH Power Inductor, Coilcraft D03316-473	1
Св	0.01 μF, 50V Ceramic	1

SIMPLE SWITCHER® is a registered trademark of National Semiconductor Corporation

#### **Evaluation Board Design** (Continued)

**TABLE 2. Component Manufacturers** 

Manufacturer	Phone	FAX	Internet
National Semiconductor	(800) 272-9959	(800) 737-7018	www.national.com
Coilcraft Inc.	(800) 322-2645	(708) 639-1469	www.coilcraft.com
Coilcraft Inc., Europe	+44 1236 730 595	+44 1236 730 627	www.coilcraft.com
Sprague/Vishay	(207) 324-7223	(207) 324-4140	www.vishay.com

## Operating the Evaluation Board

The input source for the LM2675-5.0 evaluation board must be greater than 8V for proper startup and operation. The maximum input voltage is 40V, including transients. During startup, the LM2675 may be left unloaded. If a load is connected, the peak current drawn from the source may be as great as 2.2A (for a full 1A load). A source with a lower current limit will slow down the startup of the regulator. If its current limit is sufficiently low, typically at or near the steadystate input current level, the regulator may not start up at all.

The load for the evaluation board can be from 0 Amps (an open-circuit) to 1 Amp. Higher load currents can activate the LM2675 current limit, which will shut the regulator down until the load is reduced.

## Designing with the LM2675

The LM2675 SIMPLE SWITCHER step-down converters are available in fixed output voltages of 3.3V, 5.0V, 12V, and an adjustable output version, each rated for a 1A load.

A family of standard inductors for use with the LM2675 are available from several manufacturers, which greatly simplifies the design of switch-mode power supplies. The datasheet also includes selection guides for diodes and capacitors designed to work in these switching regulator designs.

While the LM2675 product datasheet contains an easy, straight-forward design procedure, design software is also available, which further simplifies the system design. "LM267X Made Simple" is available from the Power Management Products section of National Semiconductor's web site at www.national.com/appinfo/power/index.html.

#### LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

- 1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
- 2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.



Email: support@nsc.com

www.national.com

National Semiconductor Europe

Fax: +49 (0) 180-530 85 86 Email: europe.support@nsc.com Deutsch Tel: +49 (0) 69 9508 6208 English Tel: +44 (0) 870 24 0 2171

Français Tel: +33 (0) 1 41 91 8790

**National Semiconductor** Asia Pacific Customer Response Group Tel: 65-2544466 Fax: 65-2504466 Email: ap.support@nsc.com **National Semiconductor** Tel: 81-3-5639-7560 Fax: 81-3-5639-7507

#### IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

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

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI 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 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. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

#### Products Applications

Audio www.ti.com/audio Communications and Telecom www.ti.com/communications **Amplifiers** amplifier.ti.com Computers and Peripherals www.ti.com/computers dataconverter.ti.com Consumer Electronics www.ti.com/consumer-apps **Data Converters DLP® Products** www.dlp.com **Energy and Lighting** www.ti.com/energy DSP dsp.ti.com Industrial www.ti.com/industrial Clocks and Timers www.ti.com/clocks Medical www.ti.com/medical Interface interface.ti.com Security www.ti.com/security

Logic Space, Avionics and Defense <u>www.ti.com/space-avionics-defense</u>

Power Mgmt power.ti.com Transportation and Automotive www.ti.com/automotive

Microcontrollers microcontroller.ti.com Video and Imaging www.ti.com/video

RFID <u>www.ti-rfid.com</u>

OMAP Mobile Processors www.ti.com/omap

Wireless Connectivity www.ti.com/wirelessconnectivity

TI E2E Community Home Page <u>e2e.ti.com</u>