Application Report
SNVA402A–July 2009–Revised April 2013

AN-1982 Small, Wide Input Voltage Range LM2842 Keeps LEDs Cool

ABSTRACT

The world seems to be poised to make the leap to LED lighting. Incandescent has been deemed too inefficient, which it is, and fluorescent lighting often does not achieve the lifetime it claims. Fluorescent also has another set of baggage, dangerous chemicals. So the logical choice that most people believe can take the crown is high brightness (HB) LEDs. HBLEDs are becoming more attractive as the manufacturers of such devices are making great strides in increasing the lumens per watt that they can produce, which improves the efficiency. It will not be long before LEDs produce significantly more lumens per watt than current fluorescent lamps.

Contents

List of Figures

1 Introduction

Two of the main initial areas of focus for replacement with LED lighting are low voltage down lighting and track lighting. These would include replacements for standard sizes such as MR16, PAR20, PAR25, PAR30, and PAR38. Texas Instruments already offers a variety of solutions for driving multiple LEDs beautifully for such applications including the LM342x and LM340x series of LED drivers. But regardless of how the LEDs are driven they have one issue: They produce heat. In these small enclosures a heatsink with free flowing air is often not enough. This forces the designer of the fixture into a situation where some forced air is required. The most practical solutions for a fixture of such size are either a DC fan or a more elegant and rugged solution provided by the Synjet®. A fan is generally a more cost effective solution and can run off either 5VDC or 12VDC rail but it can be difficult to fit into these enclosures and has a lifetime measuring in the tens of thousands of hours at best. On the other hand the Synjet is designed specifically to fit into each of these enclosures, runs off of 5VDC, and has a life span on the order of 100k hours.

The standard inputs for these systems can be either a DC system or an AC system. 12VAC and 24VAC systems have been common for some time for low voltage lighting, but 12VDC and 24VDC systems are making a push and are becoming more common. Since there are many 12V systems it makes for an easier design to drive a 5V cooling mechanism. But since there are multiple systems that could provide a very wide input voltage range, particularly in the case of the AC inputs, it would be nice to have one solution that could take the wide input range and provide the 5V rail while taking up very little space and could easily fi t into such enclosures. Fortunately the LM2842 does this quite nicely as does the LM2841 for the smaller fixtures.

The DC input systems offer the easiest and most simple solution as a regulator with a wide input voltage range can take this voltage directly and convert it to a 5V rail. Typical solutions including both the fan and the Synjet require between 100 mA and 600 mA to power them. The LM2841 can supply up to 300 mA for the smaller cooling systems while the LM2842 can supply up to 600 mA for the larger, more powerful cooling systems. Figure 1 shows the LM2842 designed to take either a 12VDC or 24VDC input and provide the 5V rail necessary. The entire solution for driving up to 600 mA only takes about 1/4 square inch of PCB real estate making it easy to fit into any of the retrofit fixtures. The LM2841 would be an identical design for the lower current applications but would allow for a physically smaller inductor and would take up less space.

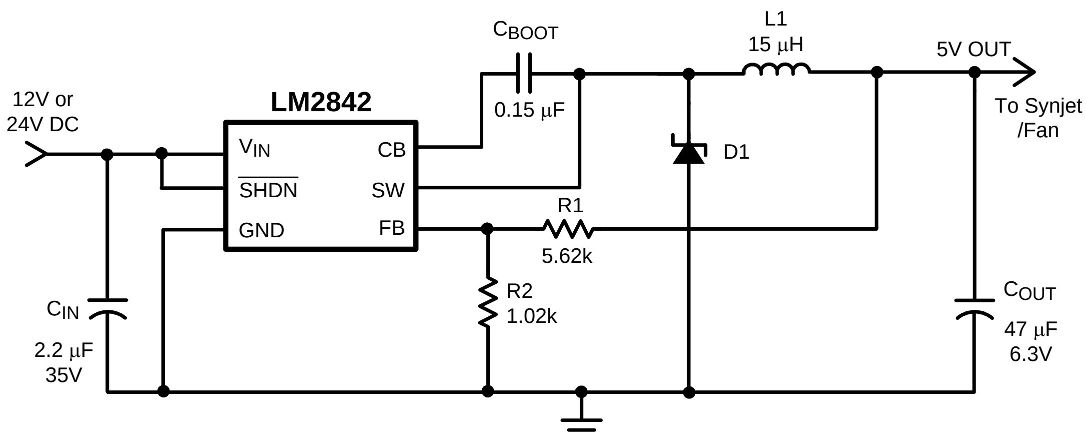

Figure 1. DC Input 5VDC Output

However, as mentioned, many 12VAC and 24VAC systems are still in place throughout the world and it is most often desirable to be able to retrofi t and use these systems rather than replacing them with a more modern DC system. Th is means that a design with a wide input voltage range must be used. This can be done rather simply by using a bridge rectifier and a larger amount of input capacitance to form a crude AC-DC converter. Given line tolerances, a 24VAC system could provide peaks nearing 40V. But you would also like to be able to minimize the input capacitance which would allow the input to fall as low as 10V to 12V. The LM2841 and LM2842 can accommodate such a wide input voltage range with sufficient power supply rejection to keep the output perfectly steady at 5V. Figure 2 and Figure 3 show the circuits for a 12VAC system and a 24VAC system respectively.

It is important to note, the 24VAC input has a higher RMS voltage and therefore the LM2842 draws less current. It also has a higher peak. Due to these facts a lower value input capacitor can be used to maintain an acceptable operating input voltage to the LM2842. Also important to note is that the circuits in Figure 2 and Figure 3 are designed for the full output current of 600 mA. It becomes apparent that if the cooling system uses less current, then less input capacitance could be used further reducing the circuit size. For example, if the LM2842 were to be substituted with the LM2841 running a maximum of 300 mA of output current, then the input capacitance could be cut in half.

Th is article does not focus on the LED drive circuitry itself since that is a subject for another article. But it does show that thermal management of the LEDs does not have to be a difficult issue if you have the right drive tools available. Visit http://www.ti.com/lsds/ti/apps/lighting/end_equipment.page for more information on Texas Instrument's LED drivers and to use WEBENCH® LED Designer.

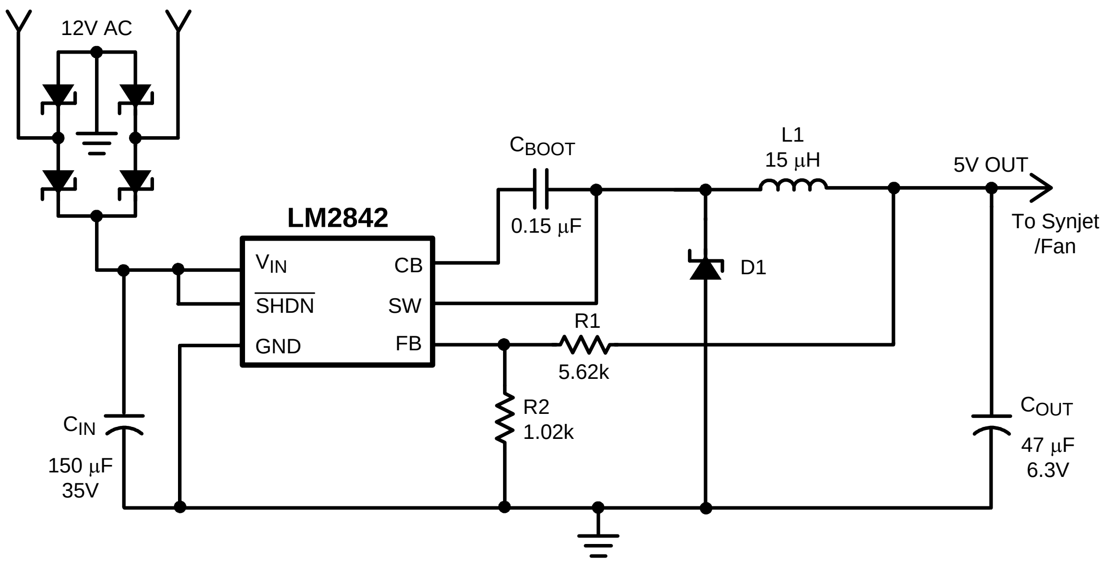

Figure 2. 12VAC Input to 5VDC Output

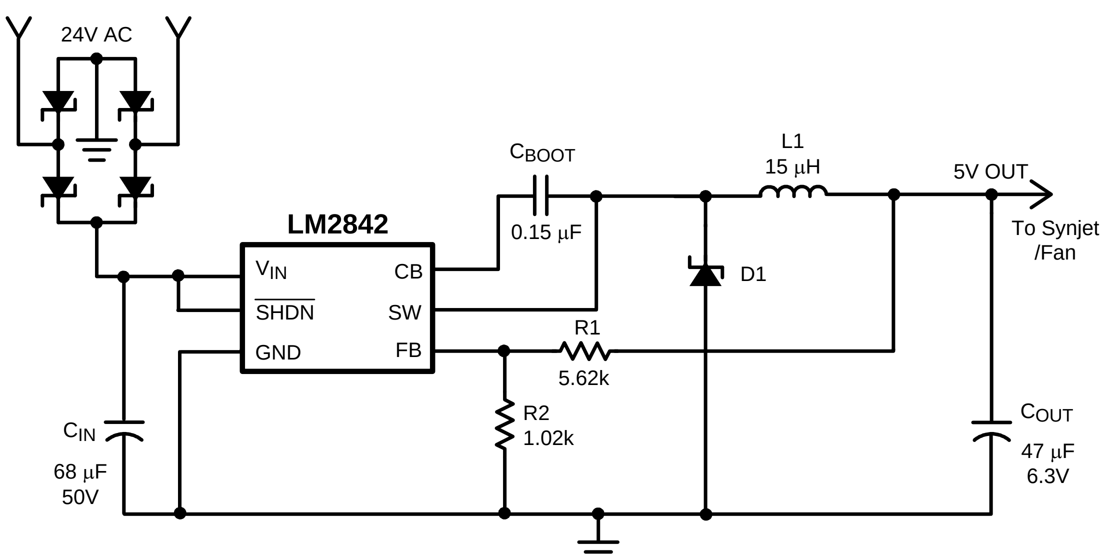

Figure 3. 24VAC Input to 5VDC Output

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