AN-2202 LM34927 Integrated Secondary Side Bias Regulator for Isolated DC-DC Converters

1 Introduction

An isolated bias supply is implemented in this evaluation board with LM34927 Constant-On-Time regulator. The LM34927 regulator integrates both the high and low side power switches essential for creating isolated buck converter.

The board specifications are as follows:

- Input Range: 20 V to 100 V
- Primary Output Voltage: 10 V
- Secondary (Isolated) Output Voltage: 9.5 V
- Maximum Load Current (Primary + Secondary): 300 mA
- Maximum Power Output: 3 W
- Nominal Switching Frequency: 750 kHz
- Efficiency (FIN = 48 V, IOUT2 = 300 mA): 76 percent
- Board size: 2 inch x 2 inch
2 UVLO Threshold and Hysteresis

The UVLO resistors are selected using the following two equations:

\[ V_{IN(HYS)} = I_{HYS} R_1 \]  
\[ V_{IN(UVLO,rising)} = 1.225V \times \left( \frac{R_1}{R_2} + 1 \right) \]

On this evaluation board \( R_1 = 127 \, k\Omega \) and \( R_2 = 8.25 \, k\Omega \), resulting in UVLO rising threshold at \( V_{IN} = 20.5 \, V \) and a hysteresis of 2.54 V.

3 Board Connection And Start-Up

The input connections are made using TP1 (VIN) and TP2 (GND) terminals. The primary output appears at TP3 (VOUT1) and TP4 (GND). The secondary (isolated) output is available across TP5 (VOUT2) and TP6 (IGND). The input voltage should be gradually increased above UVLO set point of 20.5 V. Both the outputs (VOUT1 and VOUT2) should be close to 10 V at this point. This board is designed to function with input voltage range of 20 V to 100 V. The minimum VIN threshold can be changed by changing the UVLO resistors R1, R2. VIN should not exceed 100 V.
The magnetics in this design is optimized for solution size, and therefore limits the output power. **The total load at the output should not exceed 300 mA otherwise the coupled inductor will saturate/overheat which can destroy both the coupled inductor and the regulator IC U1.** If a sustained over-current situation is to be tolerated, a coupled inductor with higher saturation and rms ratings should be used. The board schematic is shown in Figure 2.

![Schematic](image-url)
# Bill of Materials

## Table 1. Bill of Materials

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Mfg., Part Number</th>
<th>Package</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>U1</td>
<td>Sync Switching Regulator</td>
<td>Texas Instruments, LM34927</td>
<td>LLP-8</td>
<td>100V, 0.6A</td>
</tr>
<tr>
<td>T1</td>
<td>Coupled Inductor, 1500 VDC</td>
<td>Coilcraft, LPD5030V-333ME</td>
<td>5mm x 5mm</td>
<td>33uH, 0.47A</td>
</tr>
<tr>
<td></td>
<td>Alternate Part</td>
<td>Wurth, 750312750</td>
<td>8.28mm x 6.60mm</td>
<td>22uH, 0.76A</td>
</tr>
<tr>
<td>D1</td>
<td>Schottky Diode</td>
<td>Diodes Inc., DFLS1100-7</td>
<td>Pwr–DI123</td>
<td>100V, 1A</td>
</tr>
<tr>
<td>D2</td>
<td>Schottky Diode</td>
<td>Diodes Inc., SDM10U45-7</td>
<td>SOD–523</td>
<td>40V, 100mA</td>
</tr>
<tr>
<td>C1</td>
<td>Ceramic Capacitor</td>
<td>TDK, C3225X7R2A225K</td>
<td>1210</td>
<td>2.2uF, 100V, X7R</td>
</tr>
<tr>
<td>C2</td>
<td>Ceramic Capacitor</td>
<td>TDK, C1608X7R1C103K</td>
<td>0603</td>
<td>0.01uF, 16V, X7R</td>
</tr>
<tr>
<td>C3</td>
<td>Ceramic Capacitor</td>
<td>Murata, GRM21BR72A474KA73L</td>
<td>0805</td>
<td>0.47uF, 100V, X7R</td>
</tr>
<tr>
<td>C4</td>
<td>Ceramic Capacitor</td>
<td>TDK, C2012X7R1E105K</td>
<td>1210</td>
<td>1uF, 16V, X7R</td>
</tr>
<tr>
<td>C5</td>
<td>Ceramic Capacitor</td>
<td>TDK, C1608X7R1C103K</td>
<td>0603</td>
<td>1uF, 16V, X7R</td>
</tr>
<tr>
<td>C6</td>
<td>Ceramic Capacitor</td>
<td>Murata, GRM188R72A332KA01D</td>
<td>0603</td>
<td>3300pF, 100V, +/-5%</td>
</tr>
<tr>
<td>C7</td>
<td>Ceramic Capacitor</td>
<td>AVX, 0603YC104KAT2A</td>
<td>0603</td>
<td>0.1uF, 16V, X7R</td>
</tr>
<tr>
<td>R1</td>
<td>Resistor</td>
<td>Vishay/Dale, CRCW0805127KFKEA</td>
<td>0805</td>
<td>127k ohm, 1%</td>
</tr>
<tr>
<td>R2</td>
<td>Resistor</td>
<td>Vishay/Dale, CRCW08058K25FKEA</td>
<td>0805</td>
<td>8.25k ohm, 1%</td>
</tr>
<tr>
<td>R3</td>
<td>Resistor</td>
<td>Vishay/Dale, CRCW0805130KFKEA</td>
<td>0805</td>
<td>130k ohm, 1%</td>
</tr>
<tr>
<td>R4</td>
<td>Resistor</td>
<td>Panasonic, ERJ-3EKF7321V</td>
<td>0603</td>
<td>7.32k ohm, 1%</td>
</tr>
<tr>
<td>R5</td>
<td>Resistor</td>
<td>Panasonic, ERJ-3EKF1001V</td>
<td>0603</td>
<td>1.0k ohm, 1%</td>
</tr>
<tr>
<td>R6</td>
<td>Resistor</td>
<td>Yageo, RC0603JR-070RL</td>
<td>0603</td>
<td>0 ohm</td>
</tr>
<tr>
<td>R7</td>
<td>Resistor</td>
<td>Yageo, RC0603JR-070RL</td>
<td>0603</td>
<td>0 ohm</td>
</tr>
<tr>
<td>R8</td>
<td>Resistor</td>
<td>Panasonic, ERJ-3EKF4642V</td>
<td>0603</td>
<td>46.4k ohm, 1%</td>
</tr>
<tr>
<td>R10</td>
<td>Resistor</td>
<td>Panasonic, ERJ-6GEYJ202V</td>
<td>0805</td>
<td>2k ohm, 5%</td>
</tr>
</tbody>
</table>
5 Performance Curves

Figure 3. Efficiency at 750 kHz, VOUT1=10V

Figure 4. Steady State Waveform (VIN=48V, IOUT1=100mA, IOUT2=200mA)

Figure 5. Step Load Response (VIN=48V, IOUT1=0, Step Load on IOUT2=100mA to 200mA)
Figure 6. Board Silkscreen
Figure 7. Board Top Layer
Figure 8. Board Bottom Layer
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
- **Audio**: [www.ti.com/audio](http://www.ti.com/audio)
- **Amplifiers**: [amplifier.ti.com](http://amplifier.ti.com)
- **Data Converters**: [dataconverter.ti.com](http://dataconverter.ti.com)
- **DLP® Products**: [www.dlp.com](http://www.dlp.com)
- **DSP**: [dsp.ti.com](http://dsp.ti.com)
- **Clocks and Timers**: [www.ti.com/clocks](http://www.ti.com/clocks)
- **Interface**: [interface.ti.com](http://interface.ti.com)
- **Logic**: [logic.ti.com](http://logic.ti.com)
- **Power Mgmt**: [power.ti.com](http://power.ti.com)
- **Microcontrollers**: [microcontroller.ti.com](http://microcontroller.ti.com)
- **RFID**: [www.ti-rfid.com](http://www.ti-rfid.com)
- **OMAP Applications Processors**: [www.ti.com/omap](http://www.ti.com/omap)
- **Wireless Connectivity**: [www.ti.com/wirelessconnectivity](http://www.ti.com/wirelessconnectivity)

### Applications
- **Automotive and Transportation**: [www.ti.com/automotive](http://www.ti.com/automotive)
- **Communications and Telecom**: [www.ti.com/communications](http://www.ti.com/communications)
- **Computers and Peripherals**: [www.ti.com/computers](http://www.ti.com/computers)
- **Consumer Electronics**: [www.ti.com/consumer-apps](http://www.ti.com/consumer-apps)
- **Energy and Lighting**: [www.ti.com/energy](http://www.ti.com/energy)
- **Industrial**: [www.ti.com/industrial](http://www.ti.com/industrial)
- **Medical**: [www.ti.com/medical](http://www.ti.com/medical)
- **Security**: [www.ti.com/security](http://www.ti.com/security)
- **Space, Avionics and Defense**: [www.ti.com/space-avionics-defense](http://www.ti.com/space-avionics-defense)
- **Video and Imaging**: [www.ti.com/video](http://www.ti.com/video)

Copyright © 2013, Texas Instruments Incorporated