

# TPS62350EVM-201

This user's guide describes the characteristics, operation, and use of the TPS62350EVM-201 evaluation module (EVM). This EVM demonstrates the Texas Instruments TPS62350 800-mA, 3-MHz, synchronous, step-down converter with I<sup>2</sup>C interface. This document includes setup instructions, a schematic diagram, a bill of materials, and PCB layout drawings for the evaluation module.

## Contents

1	Introduction .....	1
2	Setup .....	2
3	Operation .....	4
4	Test Results .....	7
5	Board Layout .....	8
6	Schematic and Bill of Materials .....	13

## List of Figures

1	<b>Output Controls</b> Tab .....	5
2	<b>Preferences</b> Tab .....	6
3	Start-up From Enable .....	7
4	Output Ripple.....	7
5	Load Transient, 1-mA to 180-mA Step .....	8
6	Load Transient, 210-mA to 1-mA Step .....	8
7	Assembly Layer .....	9
8	Top Layer Routing .....	10
9	Bottom Layer Routing .....	11
10	Layer 2 Routing .....	12
11	Layer 3 Routing .....	13
12	TPS62350EVM-201 Schematic .....	14

## List of Tables

1	HPA201A Bill of Materials.....	15
---	--------------------------------	----

## 1 Introduction

### 1.1 Requirements

To operate this EVM properly, connect and properly configure the following components:

A personal computer (PC) with a USB port is required to operate this EVM. The TPS62350 interface software runs on the PC and communicates with the EVM via the PC's USB port. Commands can be sent to the internal registers of the TPS62350 through the USB port.

#### Personal Computer Requirements

- Windows™ 2000 or Windows™ XP operating system

Windows is a trademark of Microsoft Corporation.

I<sup>2</sup>C is a trademark of Philips Corporation.

VeriSign is a trademark of VeriSign, Inc..

## Setup

---

- USB port
- Minimum of 30 MB of free hard disk space (100 MB recommended)
- Minimum of 256 MB of RAM

### Printed-Circuit Board Assembly

The TPS62350EVM-201 PCB contains the TPS62350 IC and its required external components. This board contains several jumpers and connectors that enable the user to customize the board for specific operating conditions.

### USB Interface Adapter

The USB interface adapter is the link that allows the PC and the EVM to communicate. One end of the USB interface adapter connects to the PC with the supplied USB cable; the other side of the USB interface adapter connects to the EVM with the supplied ribbon cable.

When a command is written to the EVM, the interface program running on the PC sends the commands to the PC USB port. The USB interface adapter receives the USB command, converts the signal to an I<sup>2</sup>C protocol, and sends the I<sup>2</sup>C signal to the TPS62350 EVM board

### Software

Texas Instruments provides software to assist in evaluating this EVM. The software can be installed from the supplied CD or downloaded from the Texas Instruments Web site at [www.ti.com](http://www.ti.com).

## 2 Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, set up, and use the TPS62350EVM-201.

### 2.1 Input/Output Connector Descriptions

#### 2.1.1 J1 – VIN

This is the positive input supply voltage to the converter. The leads to the input supply should be twisted and kept as short as possible to minimize EMI transmission.

#### 2.1.2 J2 – GND

This is the return connection for the input power supply of the converter.

#### 2.1.3 J3 – I<sup>2</sup>C Input

This connector is the I<sup>2</sup>C input for the converter.

#### 2.1.4 J4 – SYNC INPUT

This connector is used to synchronize the switching of the TPS62350 to an external clock source. Pin 1 of J4 connects to the SYNC pin of the TPS62350. Pin 2 of J4 is connected to the ground of the TPS62350. The SYNC input has a 1-M $\Omega$  pulldown resistor installed on the EVM board.

#### 2.1.5 J5 – VOUT

This is the positive connection from the output of the converter. Connect this pin to the positive input of the load.

#### 2.1.6 J6 – GND

This is the return connection for the output of the converter.

### 2.1.7 JP1 – SDA Converter 1

This jumper is used to tie the I<sup>2</sup>C SDA pin of the TPS62350 to either a 10-kΩ pullup resistor to the input voltage or to short the SDA pin to ground. The shunt can be removed if the I<sup>2</sup>C master has its own pullup or operates from a voltage that is different than the input voltage of the TPS62350. The Texas Instruments USB interface adapter provides an active pullup; therefore, do not install a jumper when using the adapter supplied with the EVM.

### 2.1.8 JP2 – SCL Converter 1

This jumper is used to tie the I<sup>2</sup>C SCL pin of the TPS62350 to either a 10-kΩ pullup resistor to the input voltage or to short SCL to ground. The shunt can be removed if the I<sup>2</sup>C master has its own pullup or operates from a voltage that is different than the input voltage of the TPS62350. The Texas Instruments USB interface adapter provides an active pullup; therefore, do not install a jumper when using the adapter supplied with the EVM.

### 2.1.9 JP4 – ENABLE Converter 1

This jumper enables or disables the converter. Connect the shorting jumper from the center ENABLE pin to either the ON or OFF position. Never leave this pin floating.

### 2.1.10 JP3 – VSEL Converter 2

This jumper is used to select the output voltage of the converter. Placing a shunt between pins 1 and 2 (HIGH and VSEL) sets the output voltage of the converter to the voltage defined by the internal VSEL1 register. Placing a shunt between pins 2 and 3 (VSEL and LOW) sets the output voltage of the converter to the voltage defined by the internal VSEL0 register.

## 2.2 Software Setup

If installing from a CD, insert the CD and run Setup.exe; follow all the prompts to install the software.

If installing from the TI Web site, go to the URL, [www.ti.com](http://www.ti.com)

---

**Note:** This installation page is best viewed with Microsoft Internet Explorer browser (It may not work correctly with other browsers)

---

Click on the install button; your PC should give you a security warning and ask if you want to install this application. Select Install to proceed.

With both types of installation, the software attempts to install the Microsoft Dot Net Framework 2.0 (if it is not already installed) This framework is required for the software to run.

After installation, the software should automatically run.

During future use of the software, it may prompt you to install a new version if one becomes available on the Web.

---

**Note:** VeriSign™ Code Signing is used to prevent any malicious code from changing this application. If at any time in the future the binaries are modified, the code will no longer attempt to run.

---

## 2.3 Hardware Setup

Configure JP1, JP2, JP3, and JP4 using a shorting block. These jumpers are used to connect the SDA and SCL lines of the I<sup>2</sup>C interface to a pullup resistor to the input voltage. The USB interface adapter supplied with the EVM has its own internal pullup resistors; therefore, no additional pullup is required. No jumper is necessary if the Texas Instruments USB interface adapter is used to communicate with the TPS62350EVM board, and JP1 and JP2 should be left open.

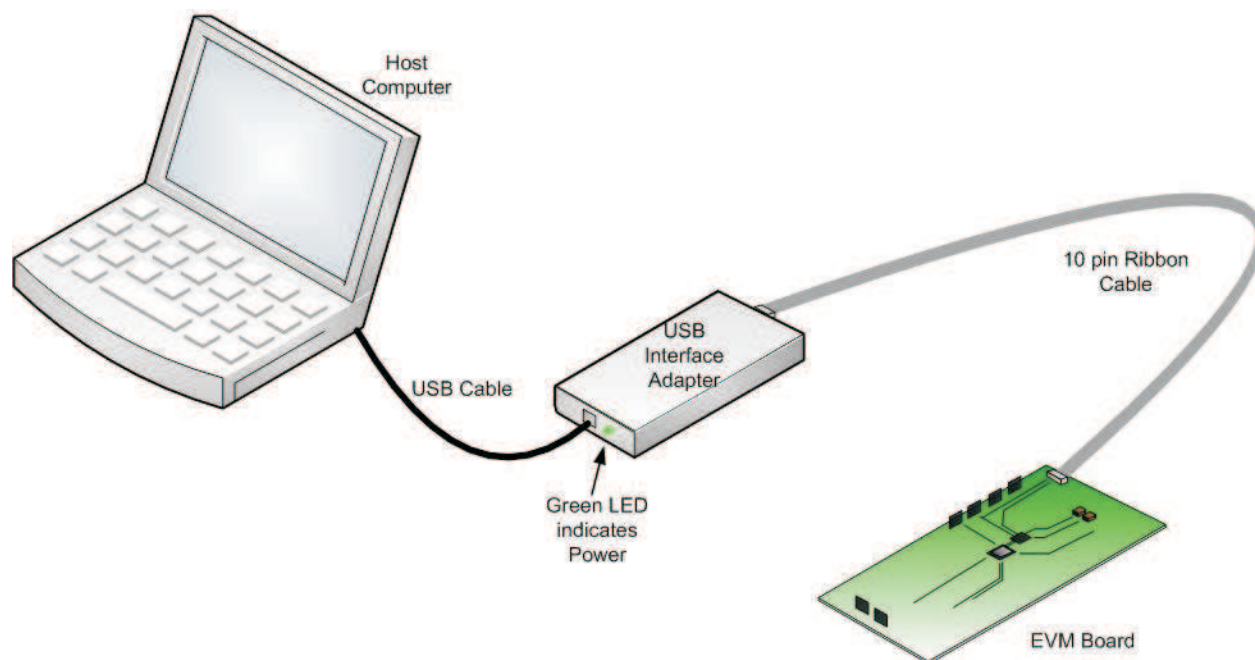
## Operation

Configure the jumper on JP3 to the desired setting. Shorting between VSEL and HIGH (pins 1 and 2) makes the TPS62350 power up with the output voltage set by the VSEL1 register. Shorting between VSEL and LOW (pins 2 and 3) makes the TPS62350 power up with the output voltage set by the VSEL0 register.

Configure JP4 as desired. Shorting between EN and ON (pins 1 and 2) enables the TPS62350. Shorting between EN and OFF (pins 2 and 3) disables the TPS62350.

Connect the USB interface adapter to your PC using the supplied USB cable. Connect the TPS62350EVM board to the USB interface adapter using the supplied 10-pin ribbon cable. The connectors on the ribbon cable are keyed to prevent incorrect installation.

### Quick Connection Diagram USB Interface Adapter



Connect an input voltage supply to the TPS62350EVM board. The TPS62350 uses an input voltage between 2.7 V and 6 V. Connect the positive input voltage to J1. Connect the input voltage return (ground) connection to J2.

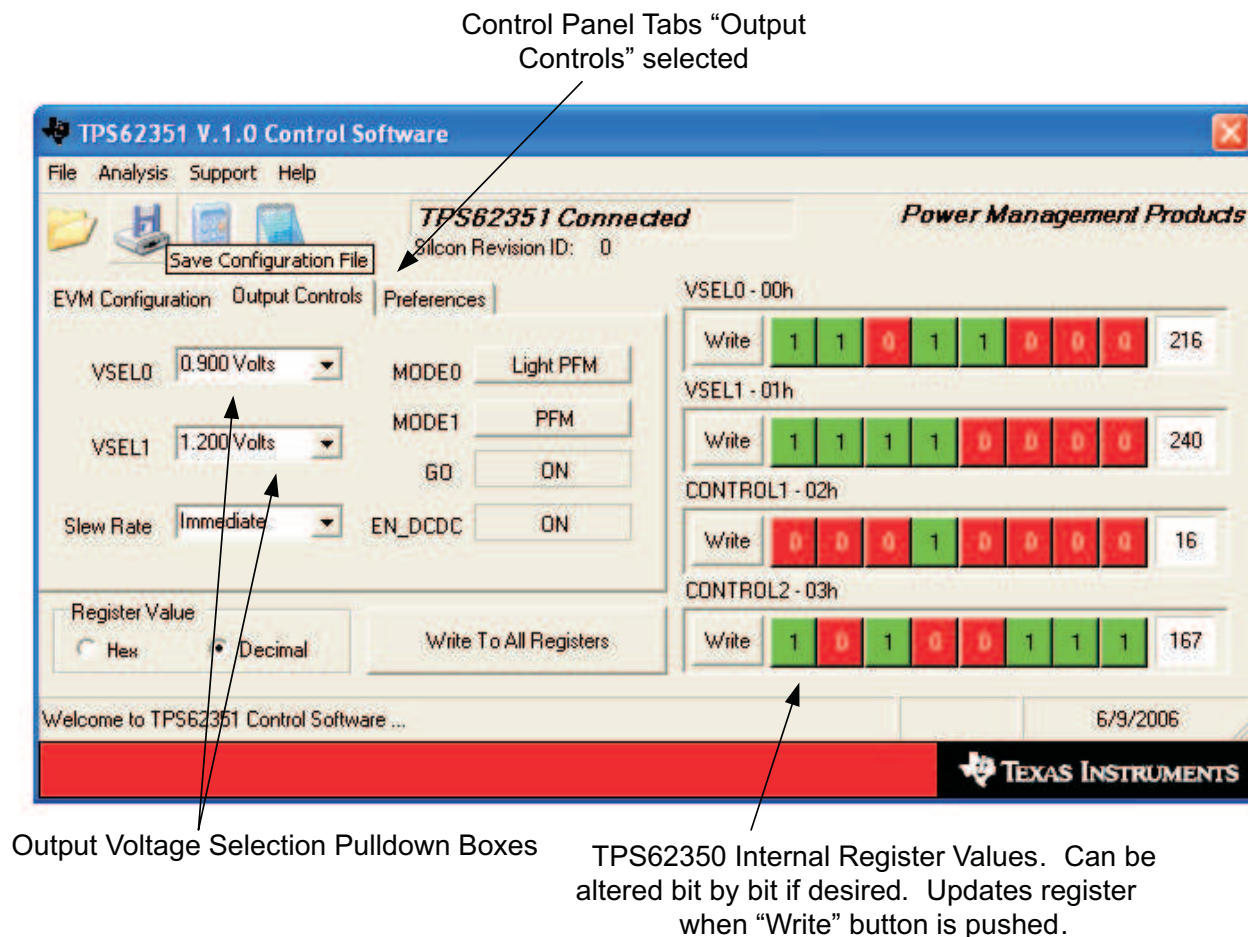
## 3 Operation

This section provides descriptions of the EVM software.

The supplied software is used to communicate with the TPS62350EVM. Click on the icon on the host computer to start the software. The software asks which version of the IC is on the board. Check the *TPS62350* box, and click the *continue* box. The software displays the main control panel for the user interface. When initialized, the host computer software automatically searches on the Internet (if connected) for updates. If a new update is available, the software notifies the user of the update and downloads it.

The main control panel for the user interface has three main page tabs, *EVM Configuration*, *Output Controls*, and *Preferences*. The software initializes with the *EVM Configuration* tab selected. This page can be used to set register values that correspond to the hardware configuration of the EVM. The EVM can be operated with the default values.

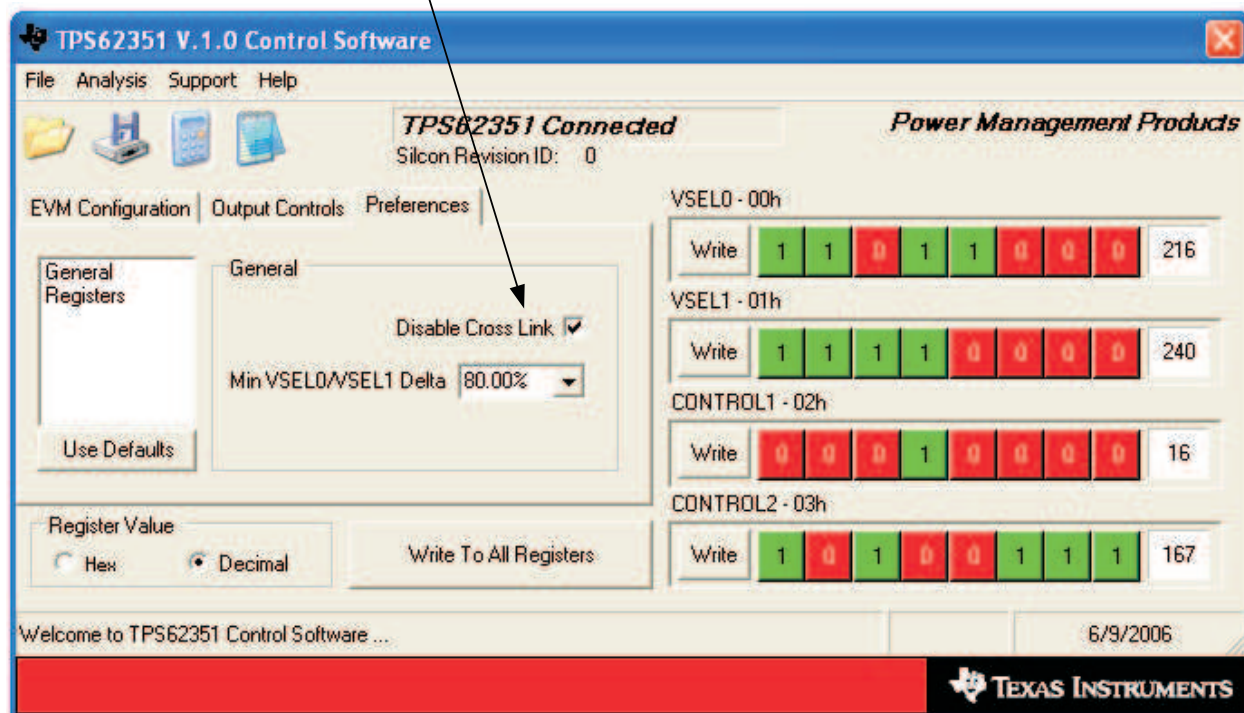
Figure 1 shows the user interface with the *Output Control* tab selected. This page is used to change the output voltage of the TPS62350 via the register settings. The page has two pulldown boxes, one for VSEL0 and one for VSEL1, with the available output voltage. The voltages listed in the boxes assume PWM mode of operation, so the actual output voltage of the EVM varies from the listed values at light loads.



**Figure 1. Output Controls Tab**

Figure 2 shows the page of the *Preferences* tab. The *Preferences* page is used to change the look of the user interface such as the text color or the color of the boxes used to display a logic 1 or 0 in the register displays. The Preferences page also provides an option for cross-linking the values in the VSEL0 and VSEL1 registers within a selectable percentage. The default is no cross-linking. If cross-linking is enabled, then the difference between VSEL0 and VSEL1 cannot exceed the selected percentage. This feature provides a method to limit the ratio of voltages that can be selected. This can be used to avoid inadvertently selecting output voltages, in the output voltage pulldown boxes, that are too high for the application being tested.

Cross Link enable and delta selection



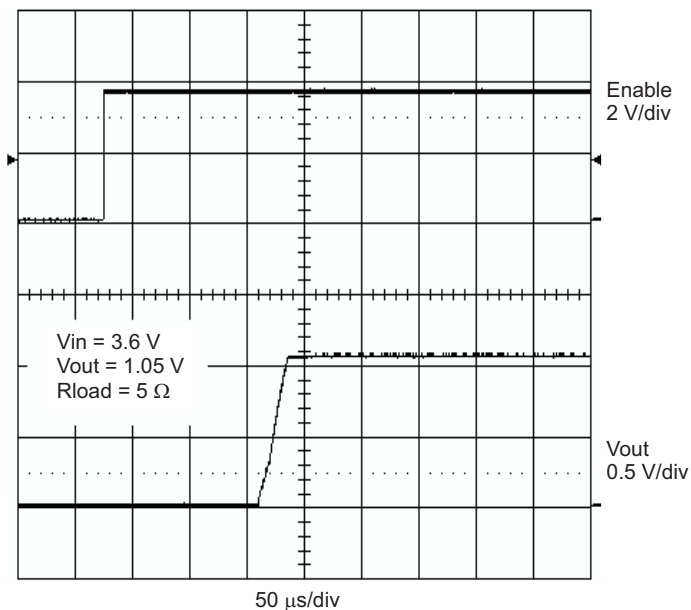
**Figure 2. Preferences Tab**

All three tabs show the bit representation of all four internal registers of the TPS62350. These bits can be individually altered by clicking on them. Clicking on a bit does not immediately change the register value of the IC. The *Write* button must be pushed to update the register with the newly selected bit values. Each register display has its own *Write* button that only updates the register that is displayed next to it. The *Write To All Registers* button updates all four registers with one push.

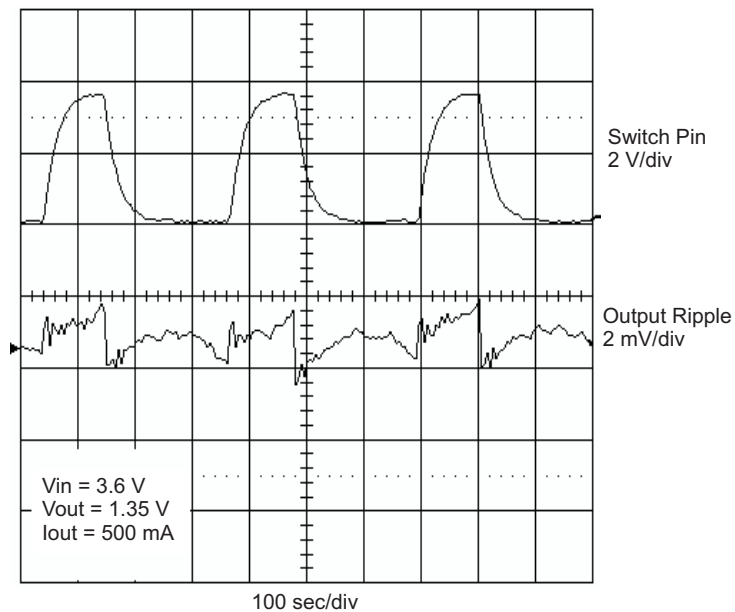


## 4 Test Results

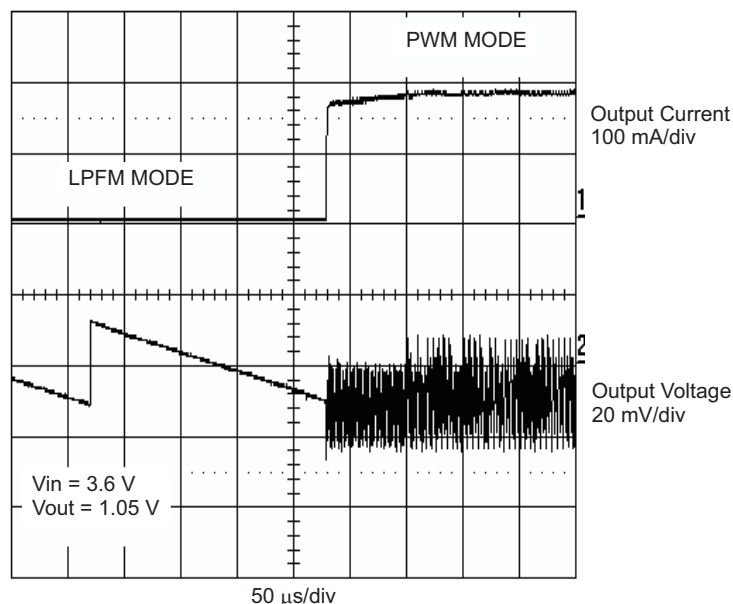
This section provides typical performance waveforms for the TPS62350EVM-201 board.



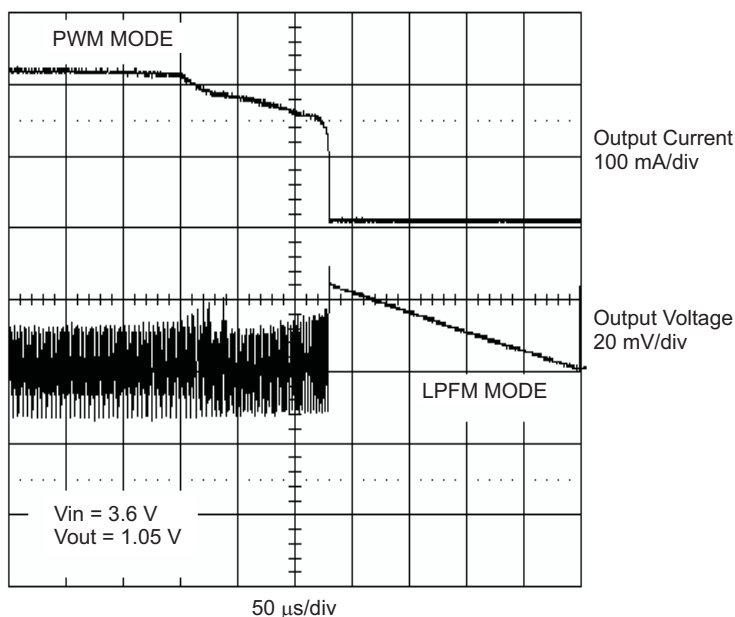
**Figure 3. Start-up From Enable**



**Figure 4. Output Ripple**



**Figure 5. Load Transient, 1-mA to 180-mA Step**



**Figure 6. Load Transient, 210-mA to 1-mA Step**

## 5 Board Layout

This section provides the TPS62350EVM-201 board layout and illustrations.

Board layout is critical for all high-frequency, switch-mode power supplies. [Figure 7](#) through [Figure 11](#) show the board layout for the TPS62350EVM-201 PCB. The nodes with high-switching frequencies and currents are kept as short as possible to minimize trace inductance. Careful attention has been given to the routing of high-frequency current loops and a single-point grounding scheme is used. See the data sheet for specific layout guidelines.



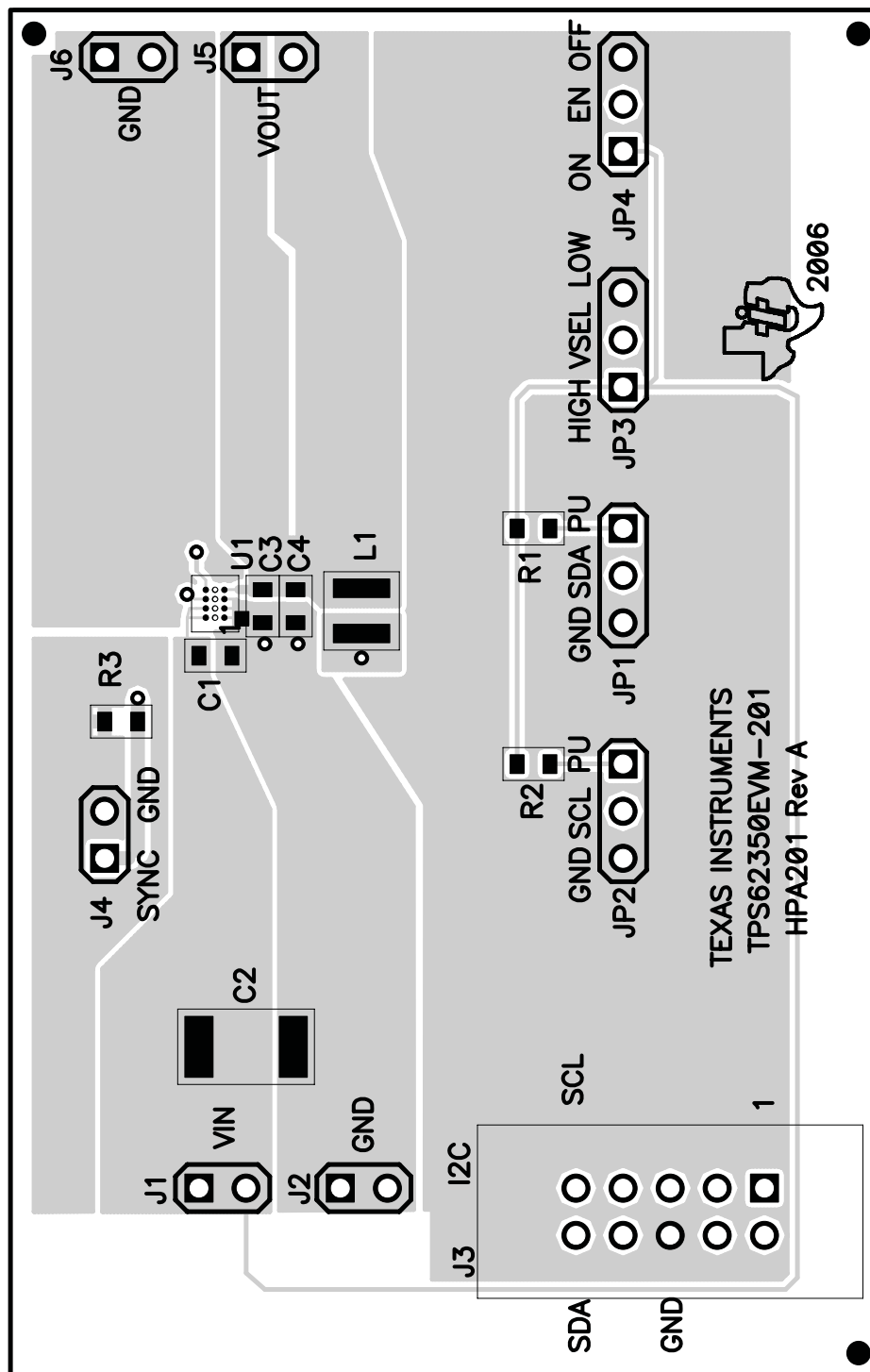


Figure 7. Assembly Layer

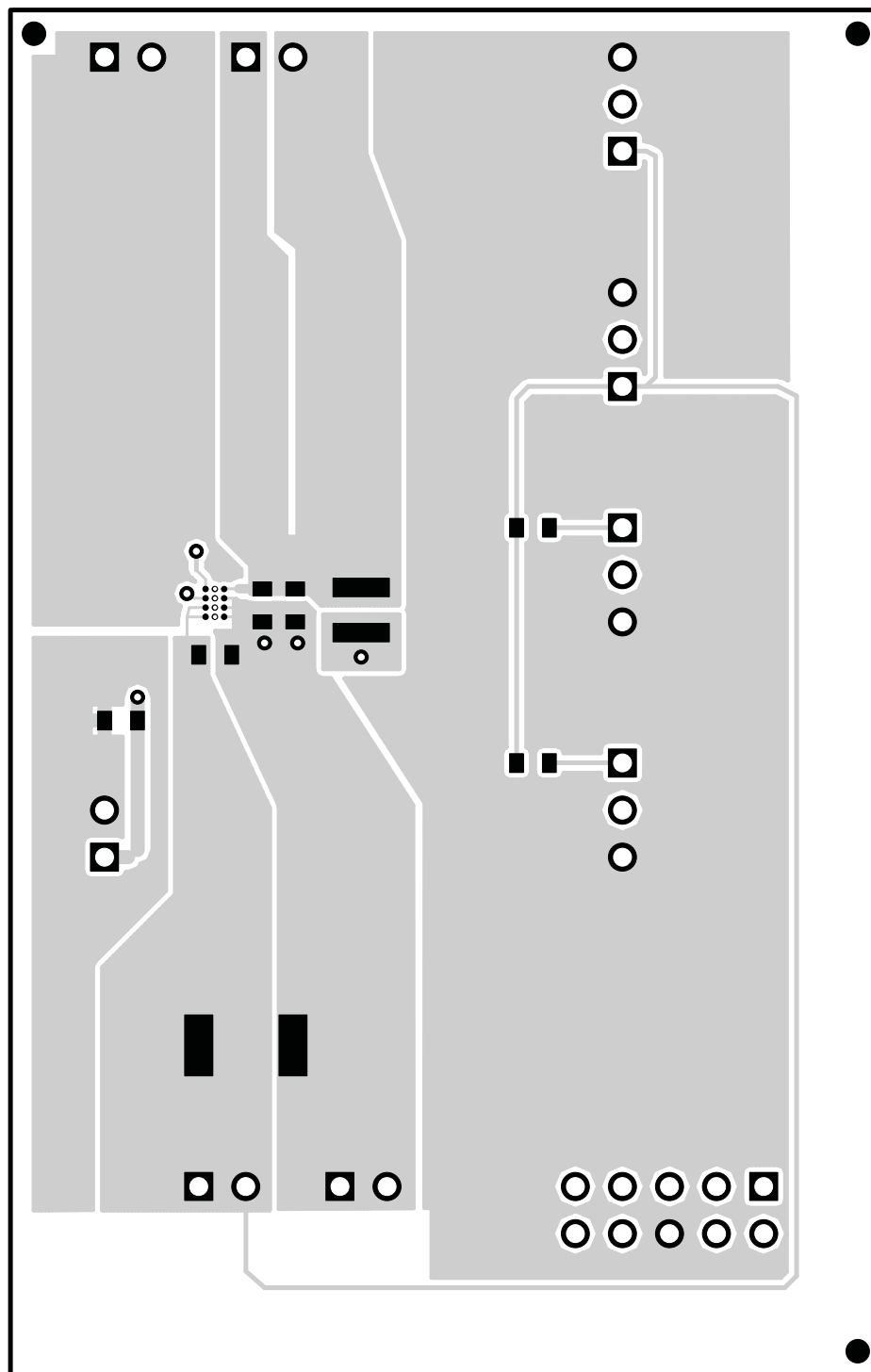


Figure 8. Top Layer Routing

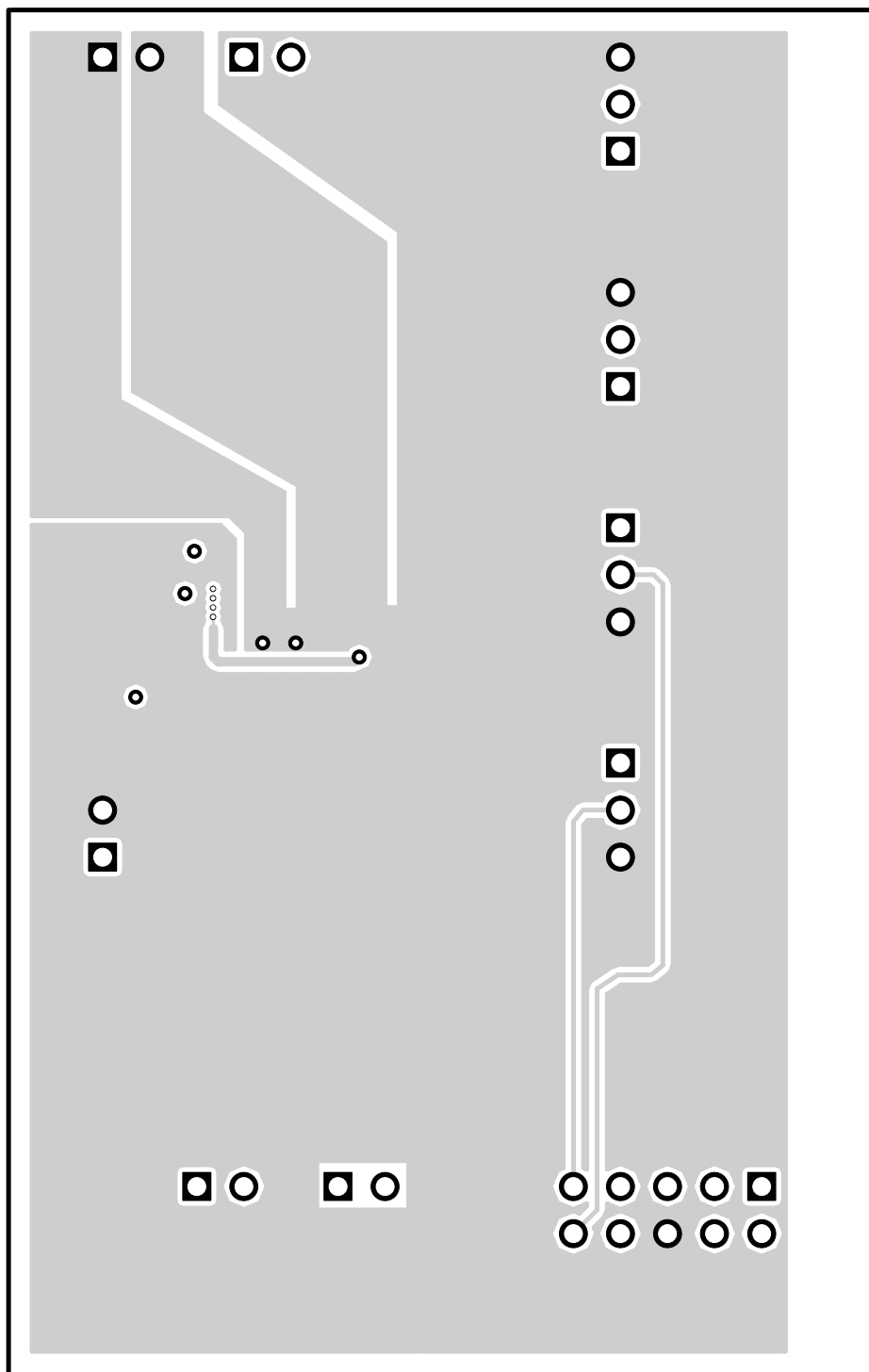
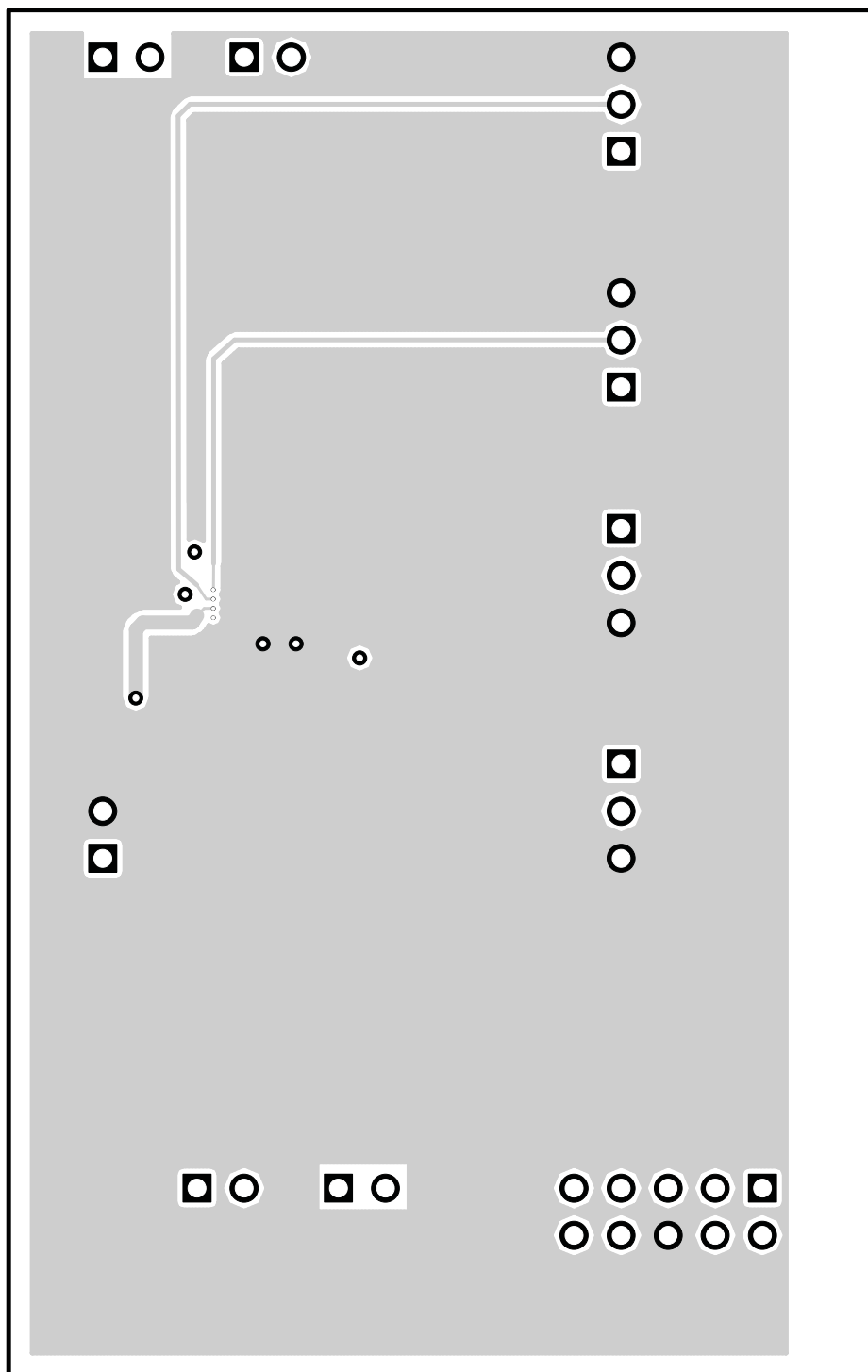


Figure 9. Bottom Layer Routing



### Figure 10. Layer 2 Routing

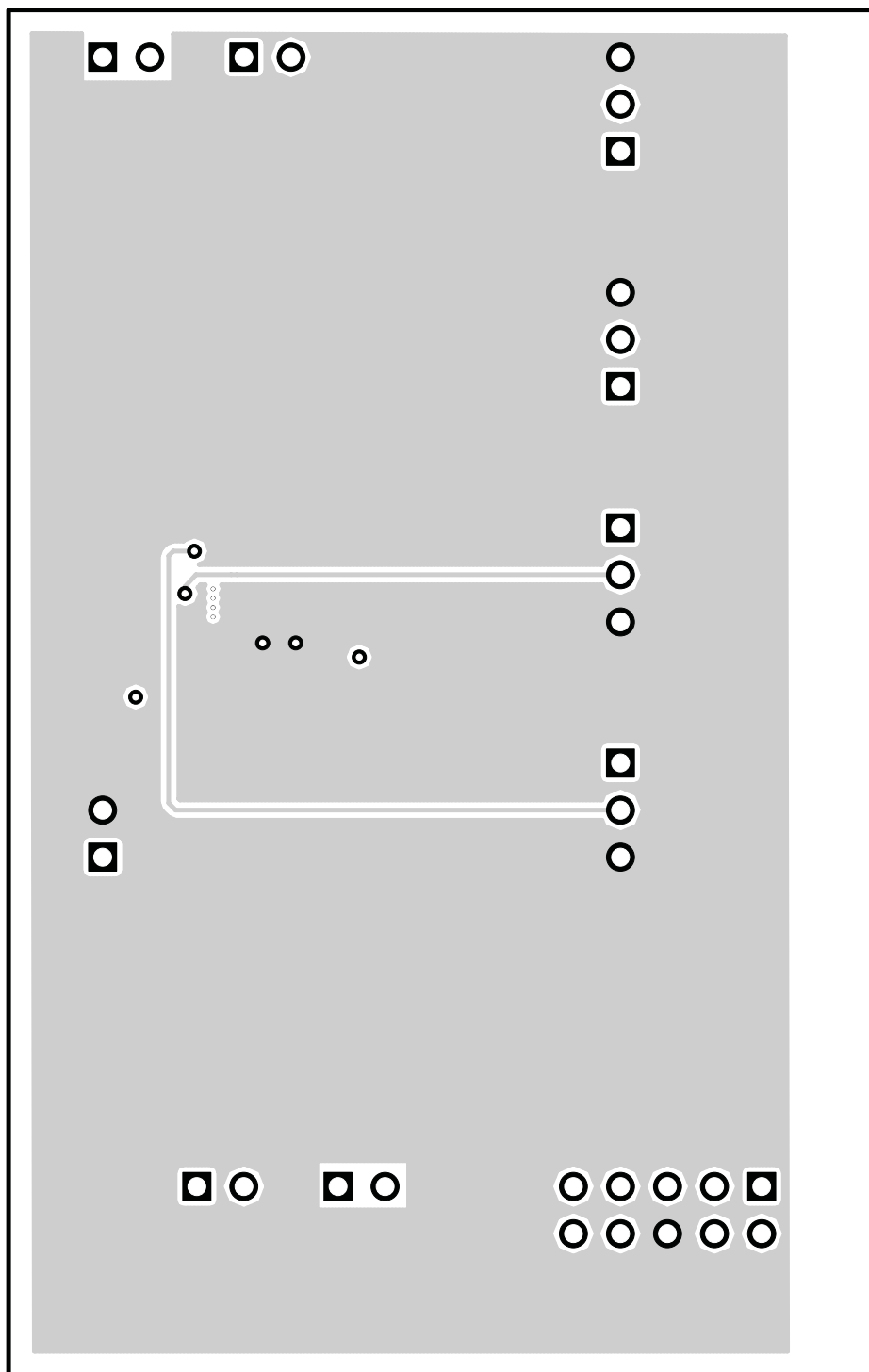


Figure 11. Layer 3 Routing

## 6 Schematic and Bill of Materials

This section provides the TPS62350EVM-201 schematic and bill of materials.

## 6.1 Schematic

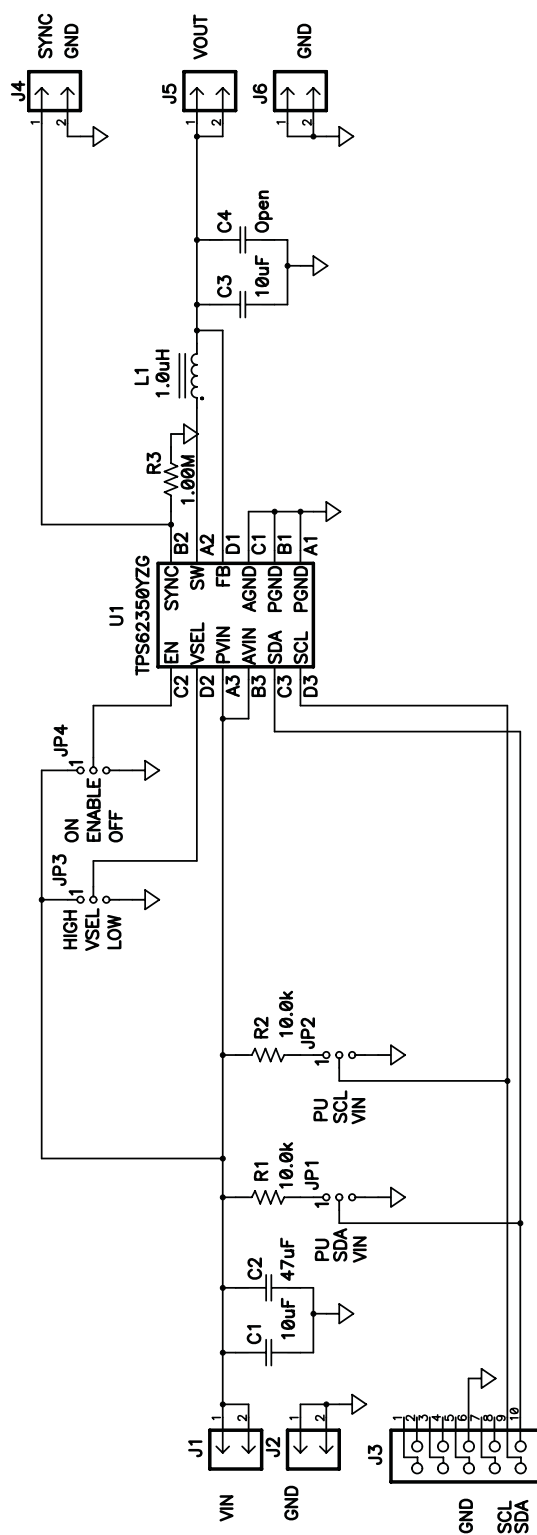


Figure 12. TPS62350EVM-201 Schematic

## 6.2 Bill of Materials

**Table 1. HPA201A Bill of Materials**

Count	Ref Des	Value	Description	Size	Part Number	MFR
2	C1, C3	10 $\mu$ F	Capacitor, ceramic, 6.3V, X5R, 10%	0603	C1608X5R0J106KT	TDK
1	C2	47 $\mu$ F	Capacitor, ceramic, 10V, X5R, 20%	1812	C4532X5R1A476M	TDK
0	C4	Open	Capacitor, ceramic, vvV	0603		
5	J1, J2, J4–J6		Header, 2 pin, 100mil spacing, (36-pin strip)	0.100 × 2	PTC36SAAN	Sullins
1	J3		Connector, Male Straight 2×10 pin, 100 mil spacing, 4 Wall	0.338 × 0.788	2510-6002UB	3M
4	JP1–JP4		Header, 3 pin, 100 mil spacing, (36-mil strip)	0.100 × 3	PTC36SAAN	Sullins
1	R1, R2	1.0 $\mu$ F	Inductor, SMT, 1.6A, $\pm$ 30%	0.118 × 0.118	LPS3010-102NLC	Coilcraft
2	R3	10.0 $\mu$ F	Resistor, Chip, 1/16W, 1%	0.603	Std	Std
1	U1	1.00M	Resistor, Chip, 1/16W, 1%	0.603	Std	Std
1	–		IC, 3MHz synchronous step down converter with I <sup>2</sup> C, 800mA	CSP-12	TPS62350YZG	TI
1	–		PCB, 3.05 In × 1.85 In × 0.062 In		HPA201	Any
4			Shunt, 100 mil, Black	0.100	929950-00	3M

## 6.3 Related Documentation From Texas Instruments

TPS62350, TPS62351 800-mA, 3-MHz Synchronous Step-Down Converter With I<sup>2</sup>C™ Compatible Interface in Chip Scale Packaging data sheet ([SLVS540](#))



## EVALUATION BOARD/KIT IMPORTANT NOTICE

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and therefore may not meet the technical requirements of these directives or other related directives.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

TI currently deals with a variety of customers for products, and therefore our arrangement with the user **is not exclusive**.

TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein**.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please contact the TI application engineer or visit [www.ti.com/esh](http://www.ti.com/esh).

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used.

### FCC Warning

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

### EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 2.7 V to 6 V and the output voltage range of 0.75 V to 1.5375 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than 85°C. The EVM is designed to operate properly with certain components above 85°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2006, Texas Instruments Incorporated

## 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 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.

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

Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
Low Power Wireless	<a href="http://www.ti.com/lpw">www.ti.com/lpw</a>

### Applications

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
Video & Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
Wireless	<a href="http://www.ti.com/wireless">www.ti.com/wireless</a>

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2007, Texas Instruments Incorporated