TPS62351EVM

This User's Guide describes the characteristics, operation, and use of the TPS62351EVM-122 Evaluation Module (EVM). This EVM demonstrates the Texas Instruments TPS62351 800 mA, 3 MHz, synchronous, step down converter with I²C™ interface. This User's Guide includes setup instructions, a schematic diagram, a bill of materials (BOM), and PCB layout drawings for the evaluation module.

Contents

List of Figures

List of Tables

1 Introduction

1.1 Requirements

To operate this EVM properly, the user must connect and properly configure the following components.

A computer with a USB port is required to operate this EVM. The TPS62351 interface software runs on the PC and communicates with the EVM via the PC's USB port. The user can send commands to the internal registers of the TPS62351 through the USB port.

1.1.1 Personal Computer Requirements

- Windows2000™ or WindowsXP™ operating System
- USB port
- Minimum of 30 MB of free hard disk space (100 MB recommended)
- Minimum of 256 MB of RAM

1.1.2 Printed circuit board assembly

The TPS62351EVM-122 PCB contains the TPS62351 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.

1.1.3 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 writing a command 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^2C™ protocol, and sends the I^2C™ signal to the TPS62351 EVM board.

1.1.4 Software

Texas Instruments has provided software to assist the user in evaluating this EVM. The software can be installed from the supplied CD or downloaded from the web at www.ti.com.

2 Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, setup, and use the TPS62351EVM-122.

2.1 Input/Output Connector Descriptions

2.1.1 J1 –VIN Converter 1

This is the positive input supply voltage to converter 1. The leads to the input supply should be twisted and kept as short as possible to minimize EMI transmission.

2.1.2 J2 – GND Converter 1

This is the return connection for the input power supply of converter 1.

2.1.3 J3 – I^2C™ Input Converter 1

This connector is the I^2C™ input for converter 1.

2.1.4 J4 –VIN Converter 2

This is the positive input supply voltage to converter 2. The leads to the input supply should be twisted, and kept as short as possible to minimize EMI transmission.

2.1.5 J5 – GND Converter 2

This is the return connection for the input power supply of converter 2.

2.1.6 J6 – I²C™ Input Converter 2

This connector is the I²C™ input for converter 2.

2.1.7 J7 – VOUT Converter 1

This is the positive connection for the output of converter 1. Connect this pin to the positive input of the load.

2.1.8 J8 – GND Converter 1

This is the return connection for the output of converter 1.

2.1.9 J9 –VOUT Converter 2

This is the positive connection for the output of converter 2. Connect this pin to the positive input of the load.

2.1.10 J10 – GND Converter 2

This is the return connection for the output of converter 2.

2.1.11 J11 – SYNC INPUT Converter 2

This connector is used to synchronize the switching of the TPS62351 to an external clock source. Pin 1 of J4 connects to the SYNC pin of the TPS62351 on converter 2. Pin 2 of J4 is connected to the ground of the TPS62351 on converter 2. The SYNC input has a 1-mΩ pull-down resistor installed on the EVM board.

2.1.12 JP1 –SDA Converter 1

This jumper is used to tie the I²C™ SDA pin of the TPS62351 to either a 10-kΩ pull-up resistor to the input voltage or to short the SDA pin to ground. The shunt can be removed if the I²C™ master has its own pull up or operates from a voltage that is different than the input voltage of the TPS62351. The Texas Instruments USB Interface Adapter provides an active pull up so no jumper should be installed when using the adapter supplied with the EVM.

2.1.13 JP2 – SDA Converter 2

This jumper is used to tie the I²C™ SDA pin of the TPS62351 to either a 10-kΩ pull-up resistor to the input voltage or to short the SDA pin to ground. The shunt can be removed if the I²C™ master has its own pull up or operates from a voltage that is different than the input voltage of the TPS62351. The Texas Instruments USB Interface Adapter provides an active pull up so no jumper should be installed when using the adapter supplied with the EVM.

2.1.14 JP3 – SCL Converter 1

This jumper is used to tie the I²C™ SCL pin of the TPS62351 to either a 10-kΩ pull-up resistor to the input voltage or to short SCL to ground. The shunt can be removed if the I²C™ master has its own pull up or operates from a voltage that is different than the input voltage of the TPS62351. The Texas Instruments USB Interface Adapter provides an active pull up so no jumper should be installed when using the adapter supplied with the EVM.

2.1.15 JP4 – SCL Converter 2

This jumper is used to tie the I²C™ SCL pin of the TPS62351 to either a 10-kΩ pull-up resistor to the input voltage or to short SCL to ground. The shunt can be removed if the I²C™ master has its own pull up or operates from a voltage that is different than the input voltage of the TPS62351. The Texas Instruments USB Interface Adapter provides an active pull up so no jumper should be installed when using the adapter supplied with the EVM.

2.1.16 JP5 –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. This pin should never be left floating.

2.1.17 JP6 –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.

2.1.18 JP7 –VSEL Converter 1

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.

2.1.19 JP8 – ENABLE Converter 2

This jumper enables or disables the converter. Connect the shorting jumper from the center ENABLE pin to either the ON or OFF position. This pin should never be left floating.

2.2 Software Setup

If installing from a CD, insert the CD and run Setup.exe, follow all the prompts to allow the software to be installed.

If installing from the web, go to the following URL 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, the pc should give a security warning to the user, and ask if the user wants 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 the user to install a new version if it 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 Converter 1 (upper board)

Configure JP1, JP3, JP5 and JP7 using a shorting block. Jumpers JP1 and JP3 are used to connect the SDA and SCL lines of the I^{2}C™ interface to a pull-up resistor to the input voltage. The USB Interface Adapter supplied with the EVM has its own internal pull-up resistors. Jumpers JP1 and JP3 should be left open with no jumper installed when using the USB Interface Adapter supplied with the EVM.

Configure the jumper on JP7 to the desired setting. Shorting between VSEL and HIGH (pin 1 and 2) makes the TPS62351 power up with the output voltage set by the VSEL1 register. Shorting between VSEL and LOW (pin 2 and 3) makes the TPS62351 power up with the output voltage set by the VSEL0 register.

Configure JP5 as desired. Shorting between EN and ON (pin 1 and 2) enables the TPS62351. Shorting between EN and OFF (pin 2 and 3) disables the TPS62351. The EN pin must be tied high (enabled) in order to establish communications with the IC via the I^{2}C™ interface. The TPS62351 powers up with the device disabled no matter how JP5 is set. The software must enable the TPS62350 in order to produce a voltage at the output.

2.4 Hardware Setup Converter 2 (lower board)

Configure JP2, JP4, JP6 and JP8 using a shorting block. These jumpers are used to connect the SDA and SCL lines of the I^{2}C™ interface to a pull-up resistor to the input voltage. The USB Interface Adapter supplied with the EVM has its own internal pull-up resistors so no additional pull-up is required. No jumper is necessary if the Texas Instruments USB Interface Adapter is used to communicate with the TPS62351EVM board and JP2 and JP4 should be left open.

Configure the jumper on JP6 to the desired setting. Shorting between VSEL and HIGH (pin 1 and 2) makes the TPS62351 power up with the output voltage set by the VSEL1 register. Shorting between VSEL and LOW (pin 2 and 3) makes the TPS62351 power up with the output voltage set by the VSEL0 register.

Configure JP8 as desired. Shorting between EN and ON (pin 1 and 2) enables the TPS62351. Shorting between EN and OFF (pin 2 and 3) disables the TPS62351. The EN pin must be tied high (enabled) in order to establish communications with the IC via the I^{2}C™ interface. The TPS62351 powers up with the device disabled no matter how JP8 is set. The software must enable the TPS62350 in order to produce a voltage at the output.

2.5 Hardware Setup Connection to Host Computer (upper or lower board)

Connect the USB Interface Adapter to the host computer using the supplied USB cable. Connect the desired converter on the TPS62351EVM 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.

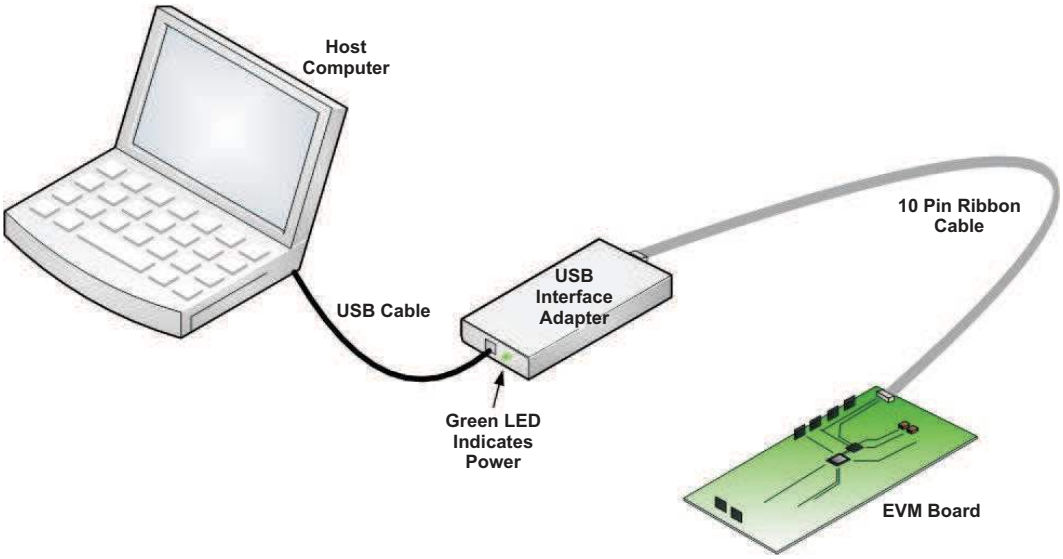

Figure 1. Quick Connection Diagram USB Interface Adapter

Connect an input voltage supply to the TPS62351EVM board. The TPS62351 uses an input voltage between 2.7 V and 5.5 V. Connect the positive input voltage to J1 for converter 1 or J4 for converter 2. Connect the input voltage return (ground) connection to J2 for converter 1 or J5 for converter 2.

3 Operation

This section provides descriptions of the EVM Software.

3.1 Operation

The supplied software is used to communicate with the TPS62351 EVM. Click on the icon on the host computer to start the software. If there is no icon on the host computer then use the *start* button in the lower left hand corner of the screen to browse the program folders to find the software. Once started, the software will ask which version of the IC is on the board. Check the *TPS62351* 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 the internet (if connected) for updates. If a new update is available, the software will notify the user of the update, and downloads the update.

The main control panel for the user interface has three main page tabs, *EVM Configuration*, *Output Controls* and *Preferences*. The software will initialize 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 2 shows the user interface with the *Output Control* tab selected. The TPS62351 powers up with the output disabled no matter how ENABLE jumper is configured. The ENABLE jumper must be set to ENABLED in order for the TPS62351EVM software to communicate with the IC. Once the ENABLE jumper is set to ENABLE, the software can be used to turn on the output of the converter. Push the *EN_DCDC* button on the *Output Control* tab to turn the output of the converter on.

The *Output Control* tab is used to change the output voltage of the TPS62351 via the register settings. The page has two pull down 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.

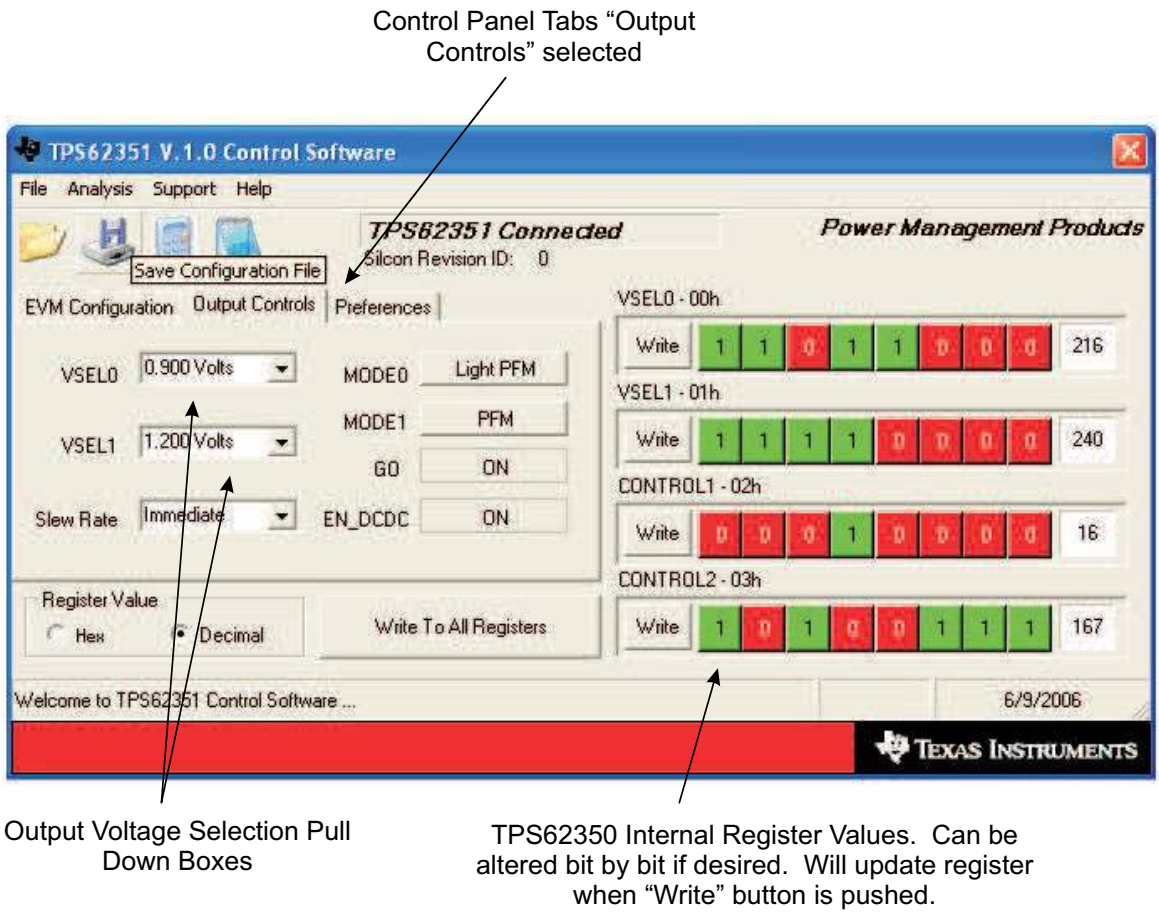

Figure 2. *Output Controls* Tab

Figure 3 shows the page of the *Preference* 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 one or zero in the register displays. The preference 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 pull down boxes, that are too high for the application being tested.

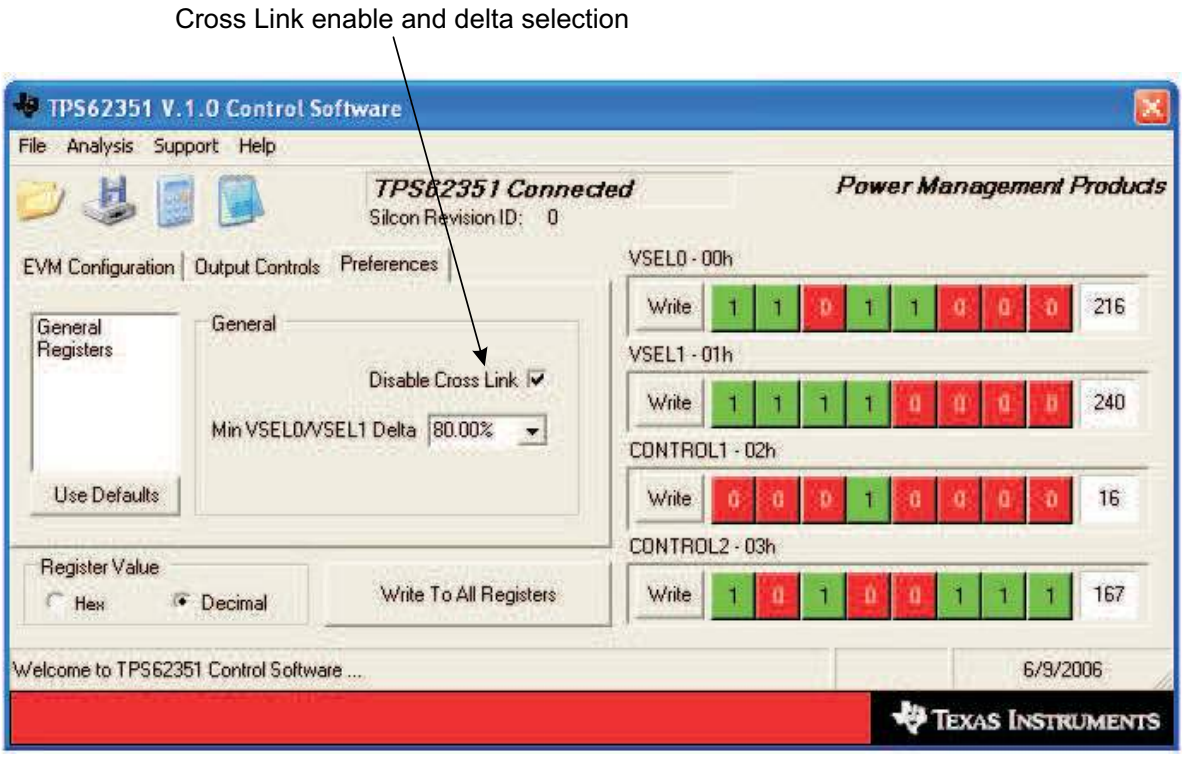

Figure 3. *Preferences* Tab

All three tabs show the bit representation of all four internal registers of the TPS62351. 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 will only update the register that is displayed next to it. The *Write To All Registers* button will update all four registers with one push.

4 Test Results

This section provides typical performance waveforms for the TPS62351EVM-122 board.

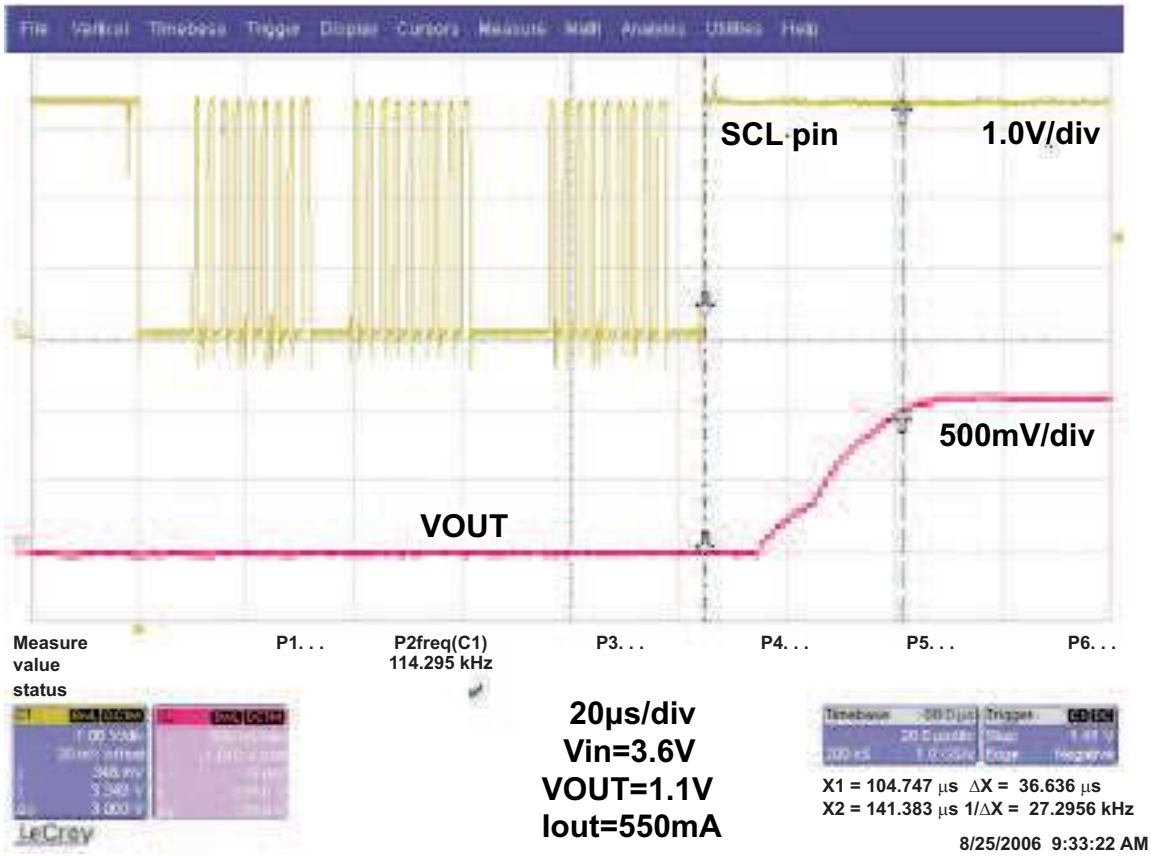

Figure 4. Start Up From Software Enable

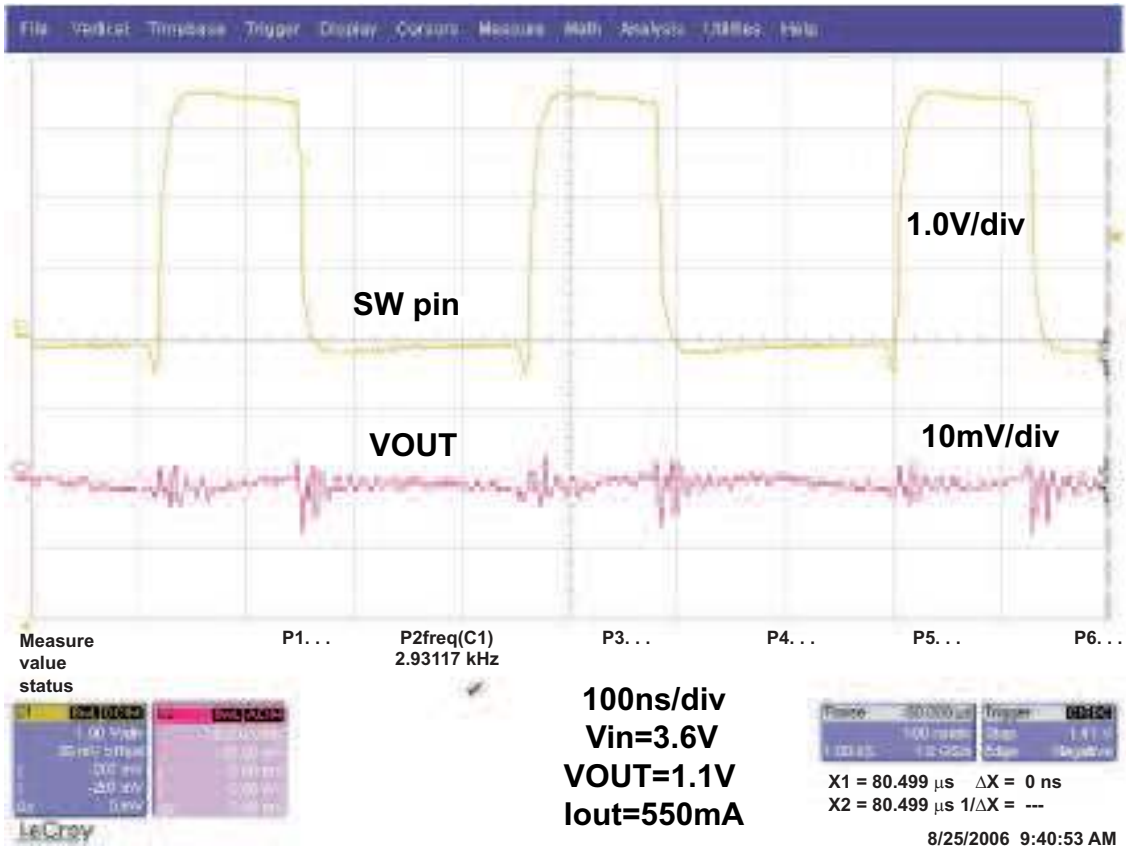

Figure 5. Output Ripple

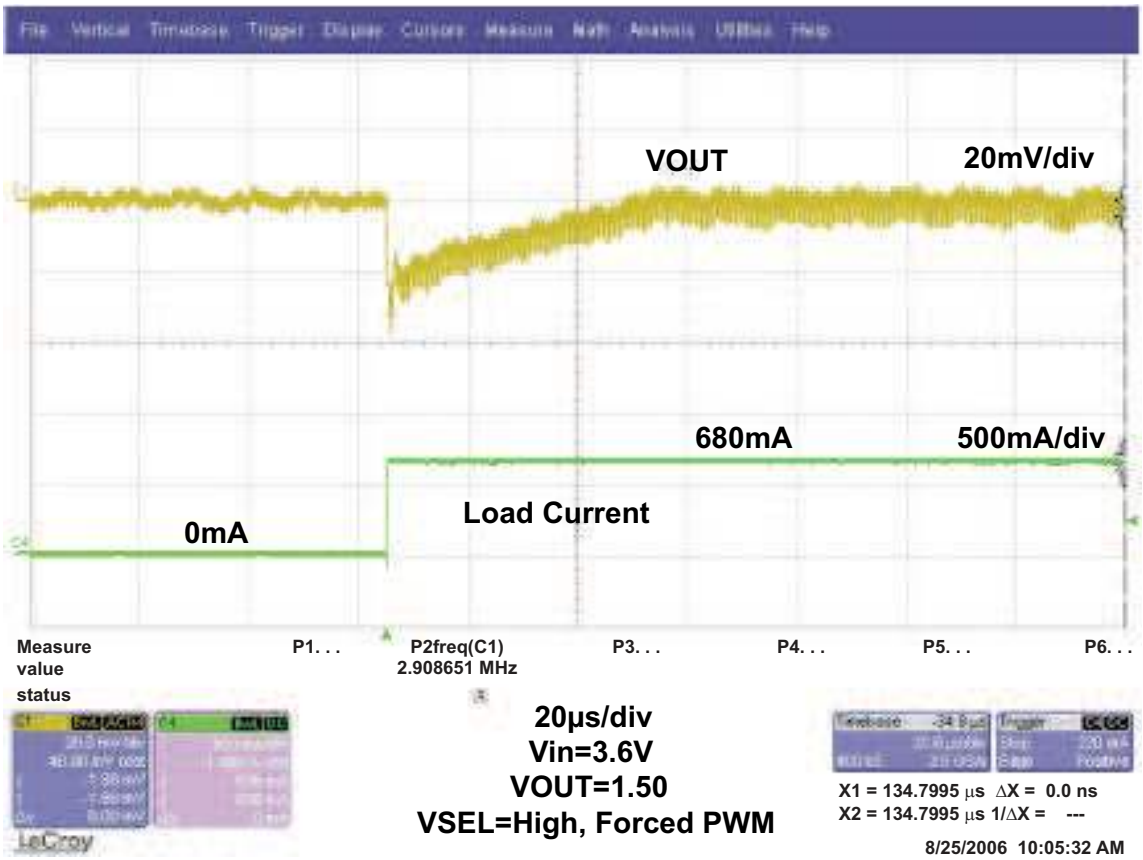

Figure 6. Load Transient, 0 mA to 680 mA Step

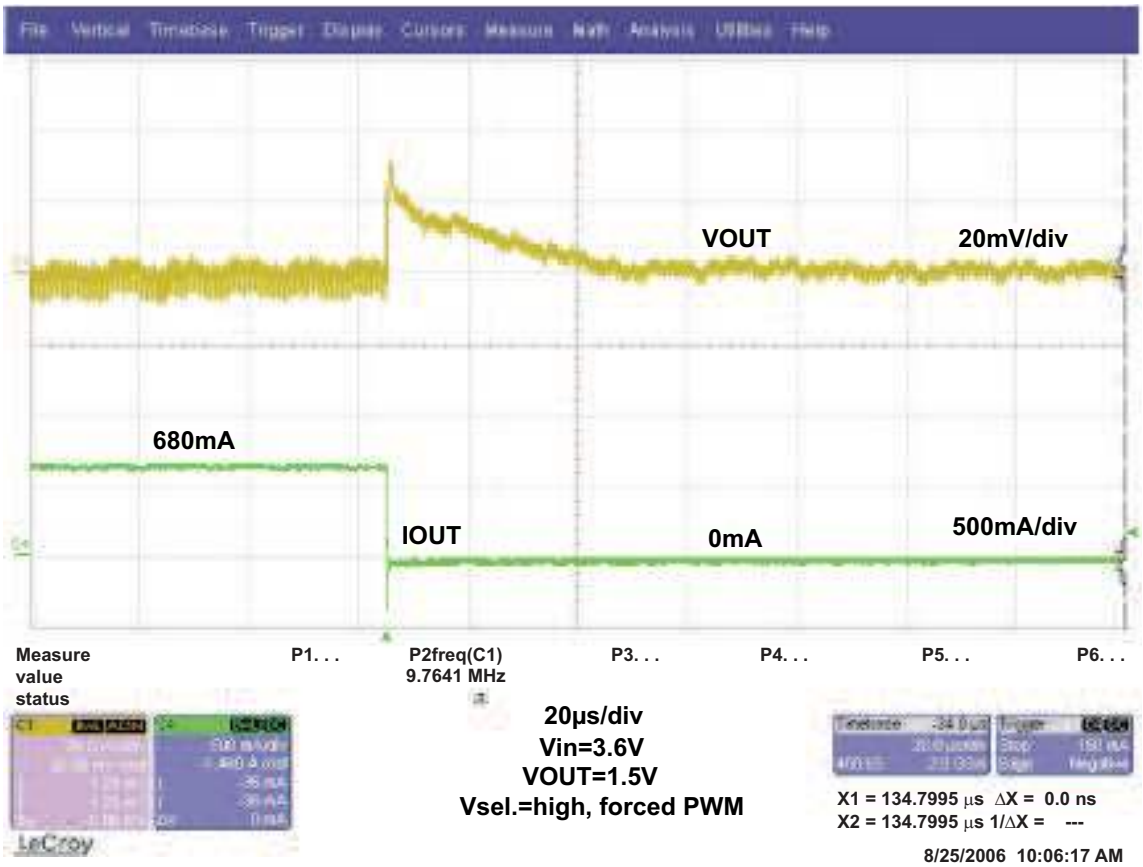

Figure 7. Load Transient, 680 mA to 0 mA Step

5 Board Layout

This section provides the TPS62351EVM-122 board layout and illustrations.

5.1 Layout

Board layout is critical for all high frequency switch mode power supplies. Figure 8through Figure 11show the board layout for the TPS62351EVM-122 PWB. 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 the specific layout guidelines.

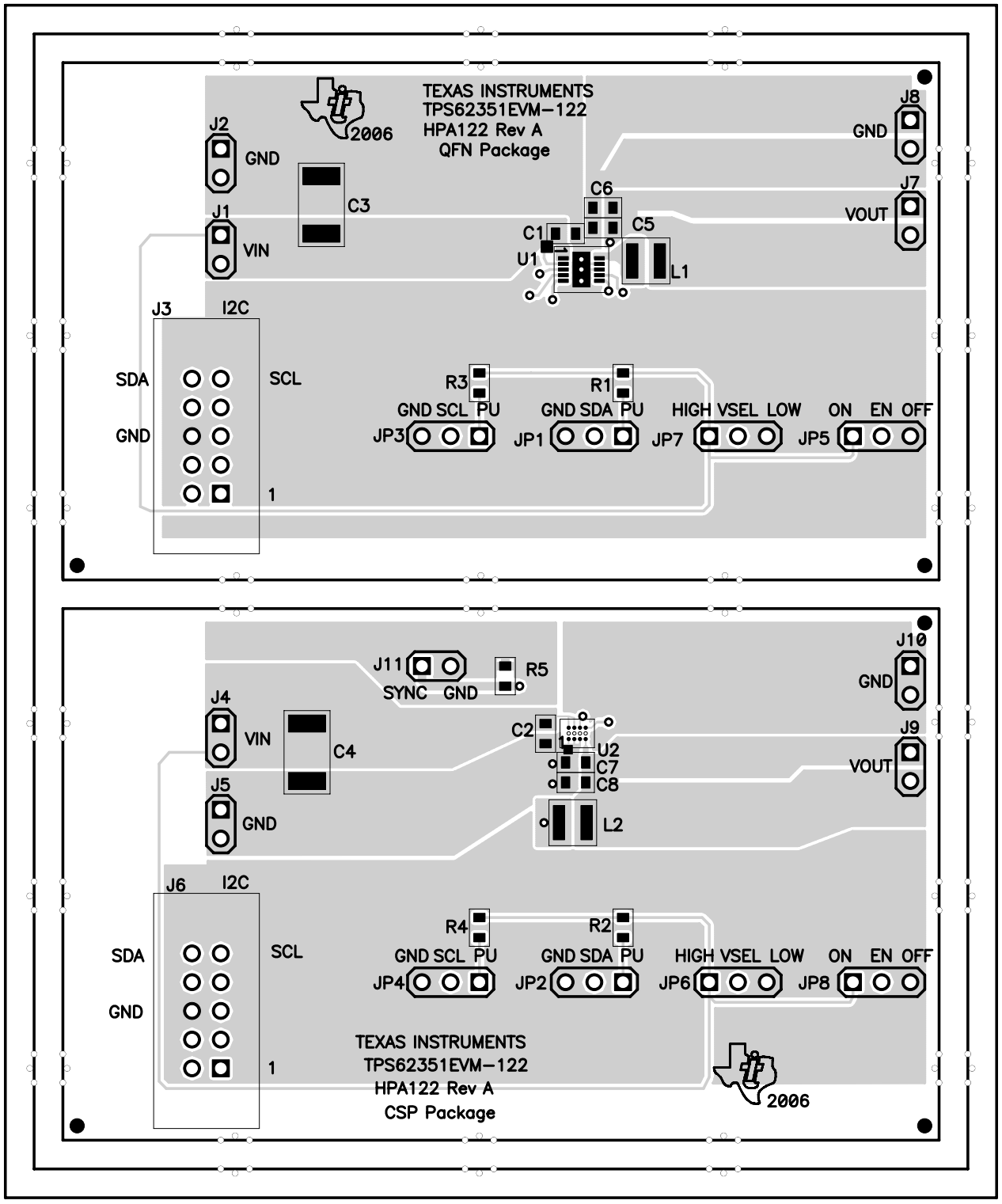

Figure 8. Assembly Layer

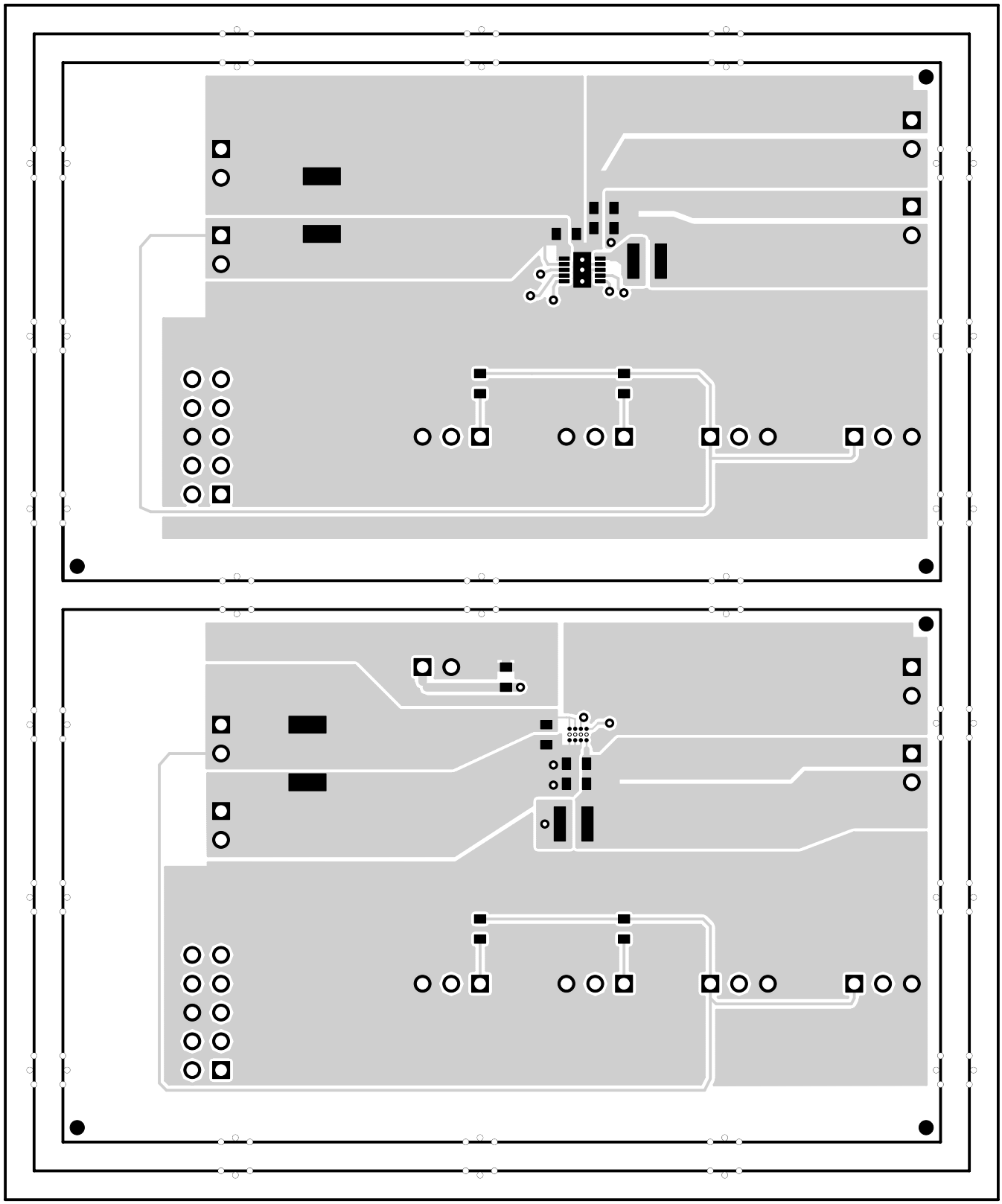

Figure 9. Top Layer Routing

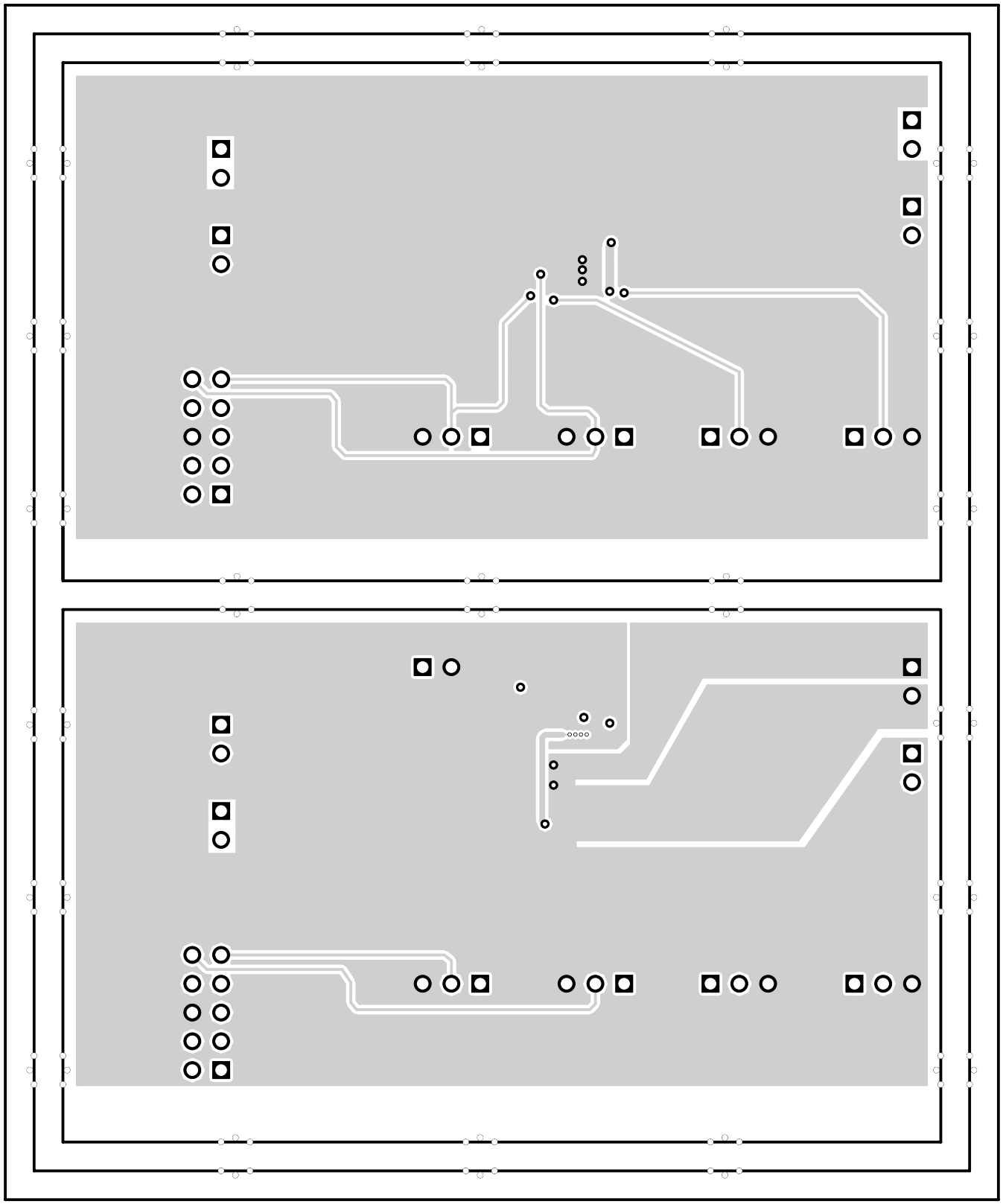

Figure 10. Bottom Layer Routing

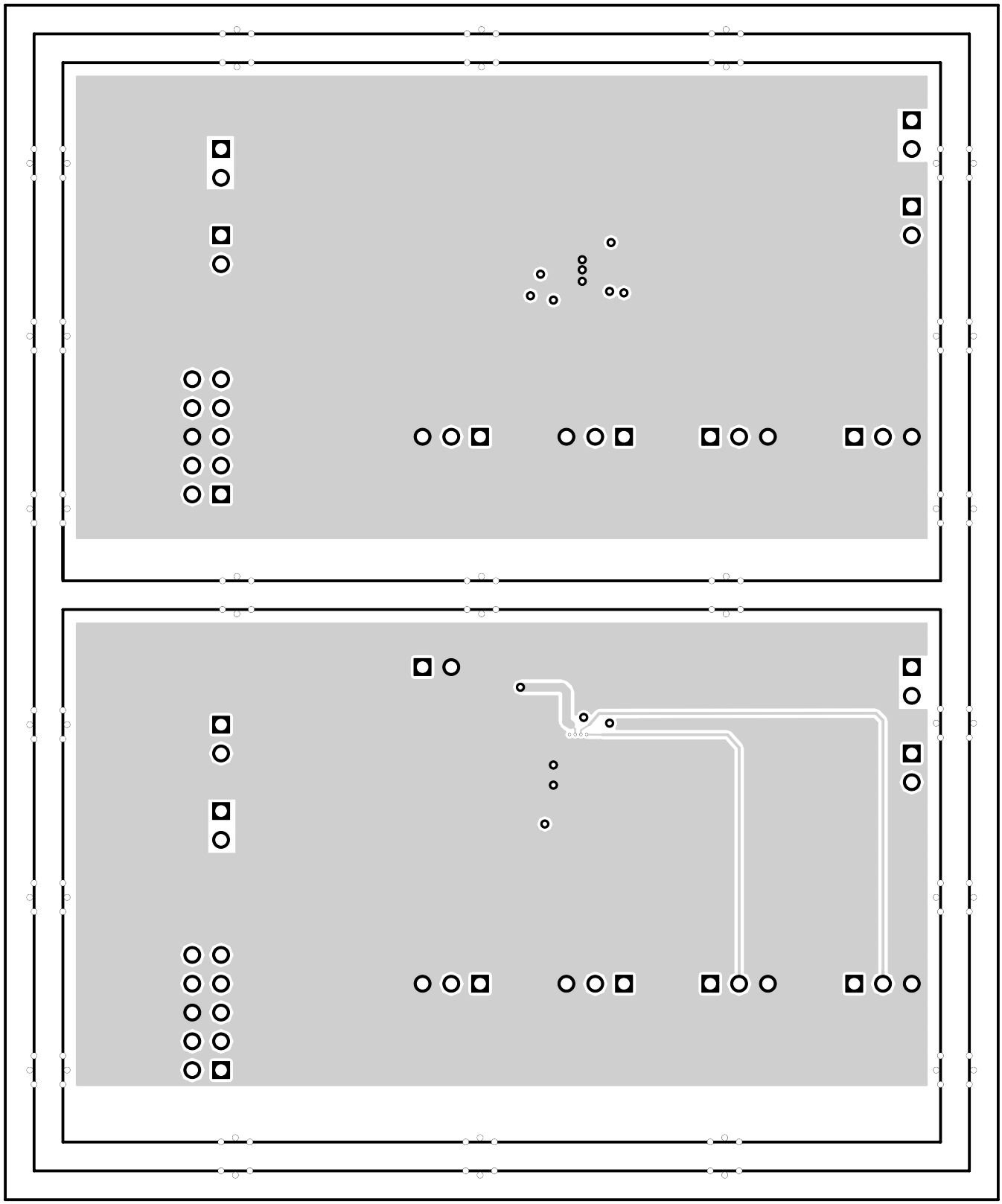

Figure 11. Layer 2 Routing

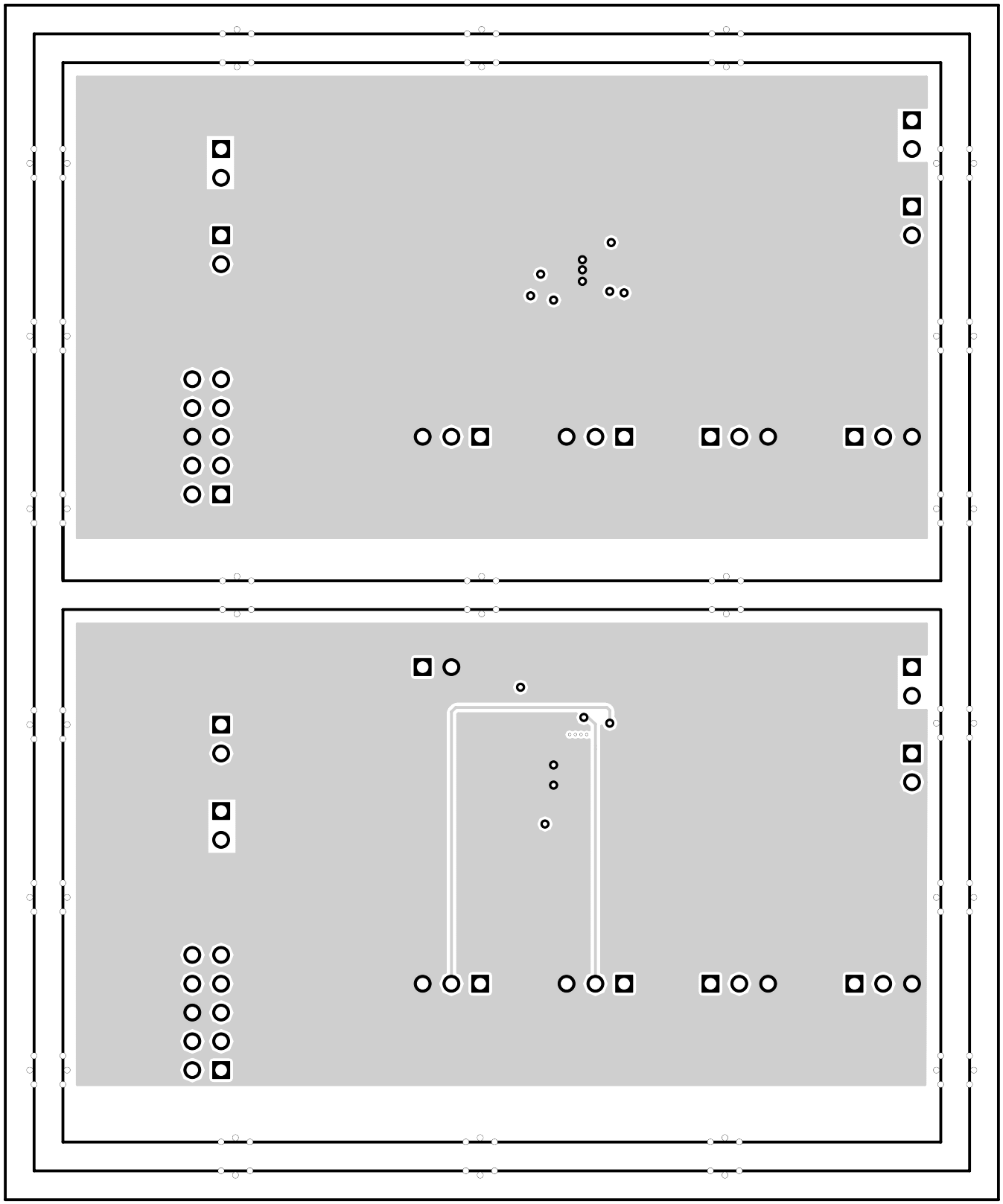

Figure 12. Layer 3 Routing

6 Schematic and Bill of Materials

This section provides the TPS62351EVM-122 schematic and bill of materials.

6.1 Schematic

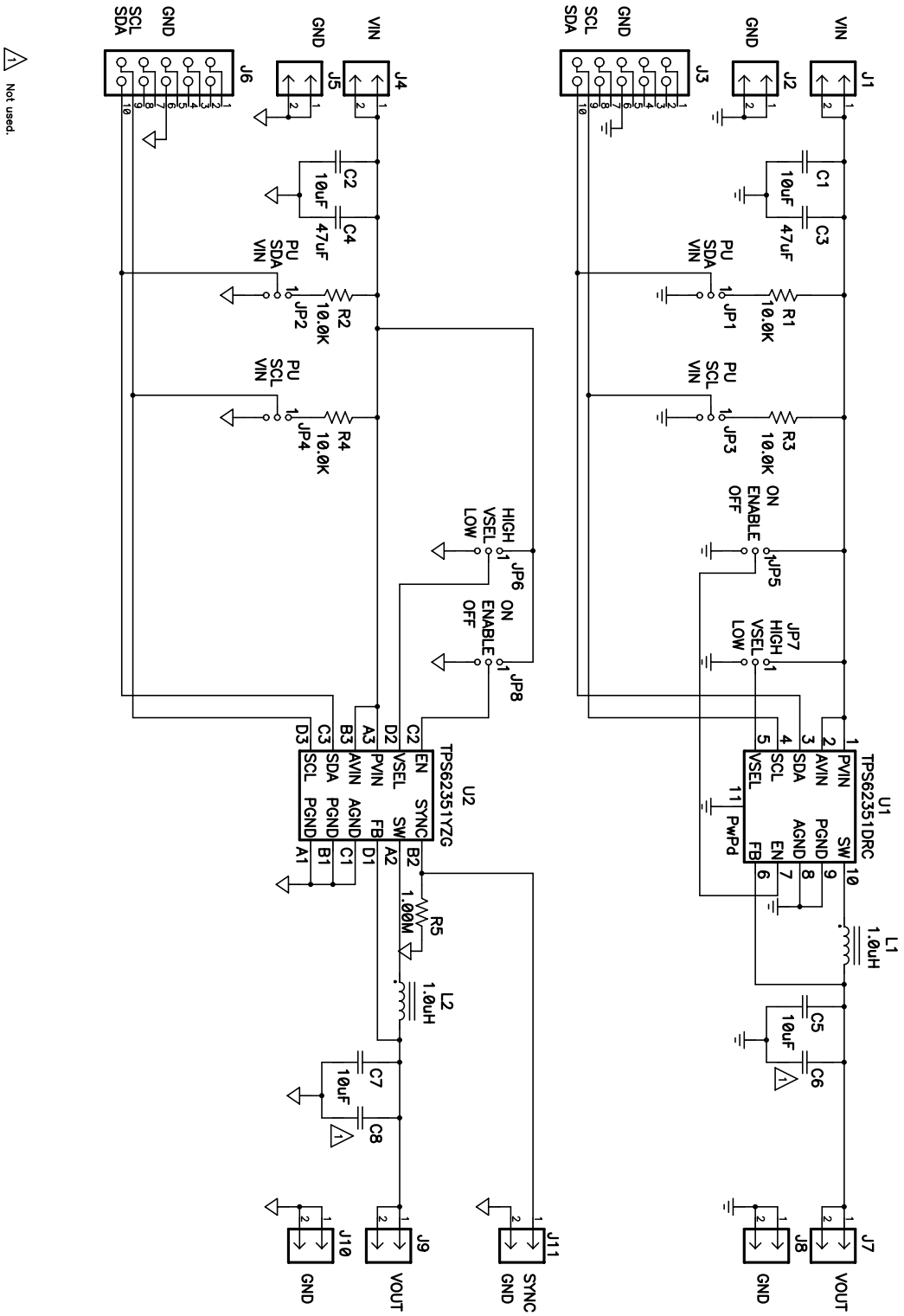

Figure 13. TPS62351EVM-122 Schematic

6.2 Bill of Materials

Table 1. HPA122A BOM

COUNT	RefDes	Value	Description	Size	Part Number	MFR
4	C1, C2, C5, C7	10uF	Capacitor, Ceramic, 6.3V, XR5, 10%	0603	C1608X5R0J106KT	TDK
2	C3, C4	47uF	Capacitor, Ceramic, 10V, XR5, 20%	1812	C4532X5R1A476M	TDK
0	C6, C8	Open	Capacitor, Ceramic, vvV	0603		
9	J1, J2, J4, J5, J7 - J11		Header, 2 pin, 100mil spacing, (36-pin strip)	0.100 x 2	PTC36SAAN	Sullins
2	J3, J6		Connector, Male Straight 2x10 pin, 100mil spacing, 4 Wall	0.338 x 0.788	2510-6002UB	3M
8	JP1 - JP8		Header, 3 pin, 100mil spacing, (36-pin strip)	0.100 x 3	PTC36SAAN	Sullins
2	L1, L2	1.0uH	Inductor, SMT, 1.6A, ±30%	0.118 x 0.118	LPS3010-102NLC	Coilcraft
4	R1 - R4	10.0k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R5	1.00M	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	U1		IC, 3MHz Synchronous Step Down Converter with I^2C 800mA	QFN-10	TPS62351DRC	TI
1	U2		IC, 3MHz Synchronous Step Down Converter with I^2C 800mA	QFN-12	TPS62351YZG	TI
1	--		PCB, 4.15 In x 3.45 In x 0.062 In		HPA122	Any
8	--		Shunt, 100 mil, Black	0.100	929950-00	3M

6.3 Related Documentation From Texas Instruments

TPS62351 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.

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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 2.7 V to 5.5 V and the output voltage range of 0.9 V to 1.6875 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		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
RFID	www.ti-rfid.com	Telephony	www.ti.com/telephony
Low Power Wireless	www.ti.com/lpw	Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265