TPS62350EVM-201 Evaluation Module

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^2C interface. This document includes setup instructions, a schematic diagram, a bill of materials, and PCB layout drawings for the evaluation module.

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Trademarks

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

- Microsoft® Windows® 2000 or Windows XP operating system
- 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^2C protocol, and sends the I^2C 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.

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^2C Input

This connector is the I^2C 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-MΩ 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^2C 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^2C 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^2C 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^2C 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

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

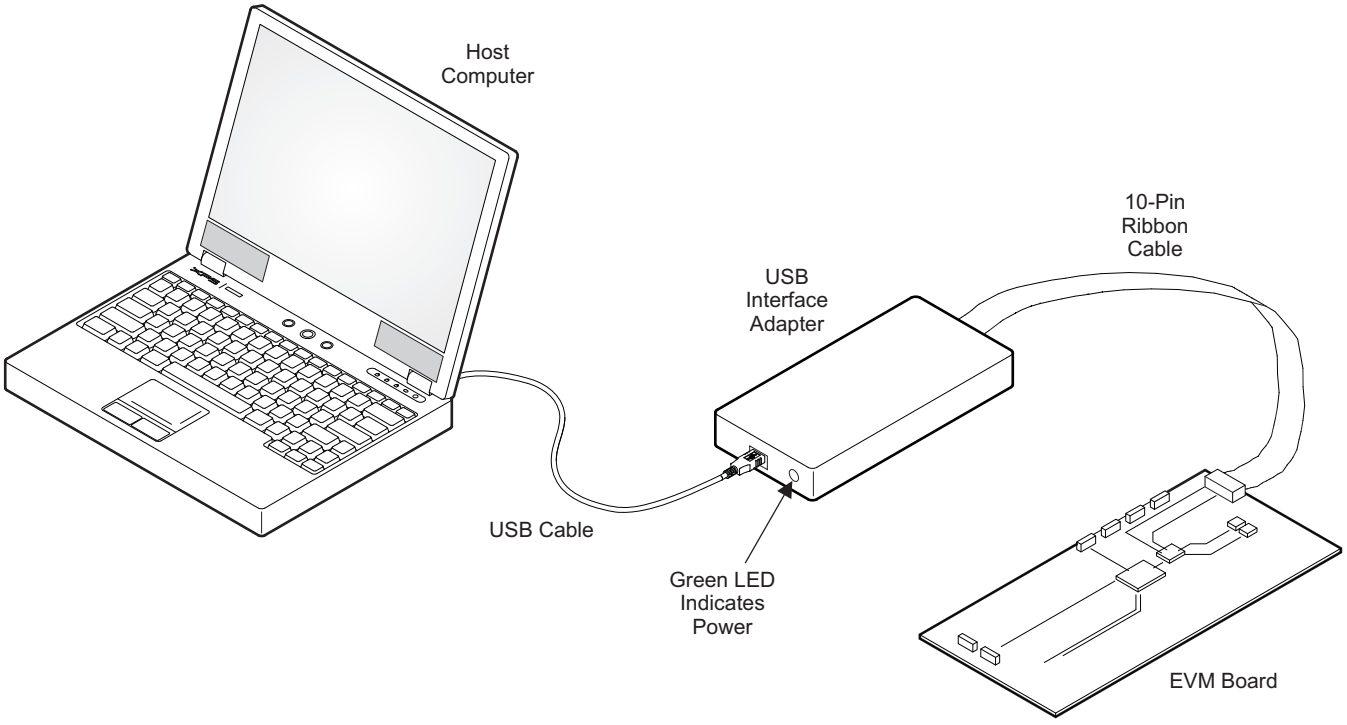
Configure JP1, JP2, JP3, and JP4 using a shorting block. These jumpers are used to connect the SDA and SCL lines of the I^2C interface to a pullup resistor to the input voltage. The USB interface adapter supplied with the EVM has its own internal pullup resistors; therefore, no additional pullup is required. 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.

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.

USB Interface Adaptor Quick Connection Diagram



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.

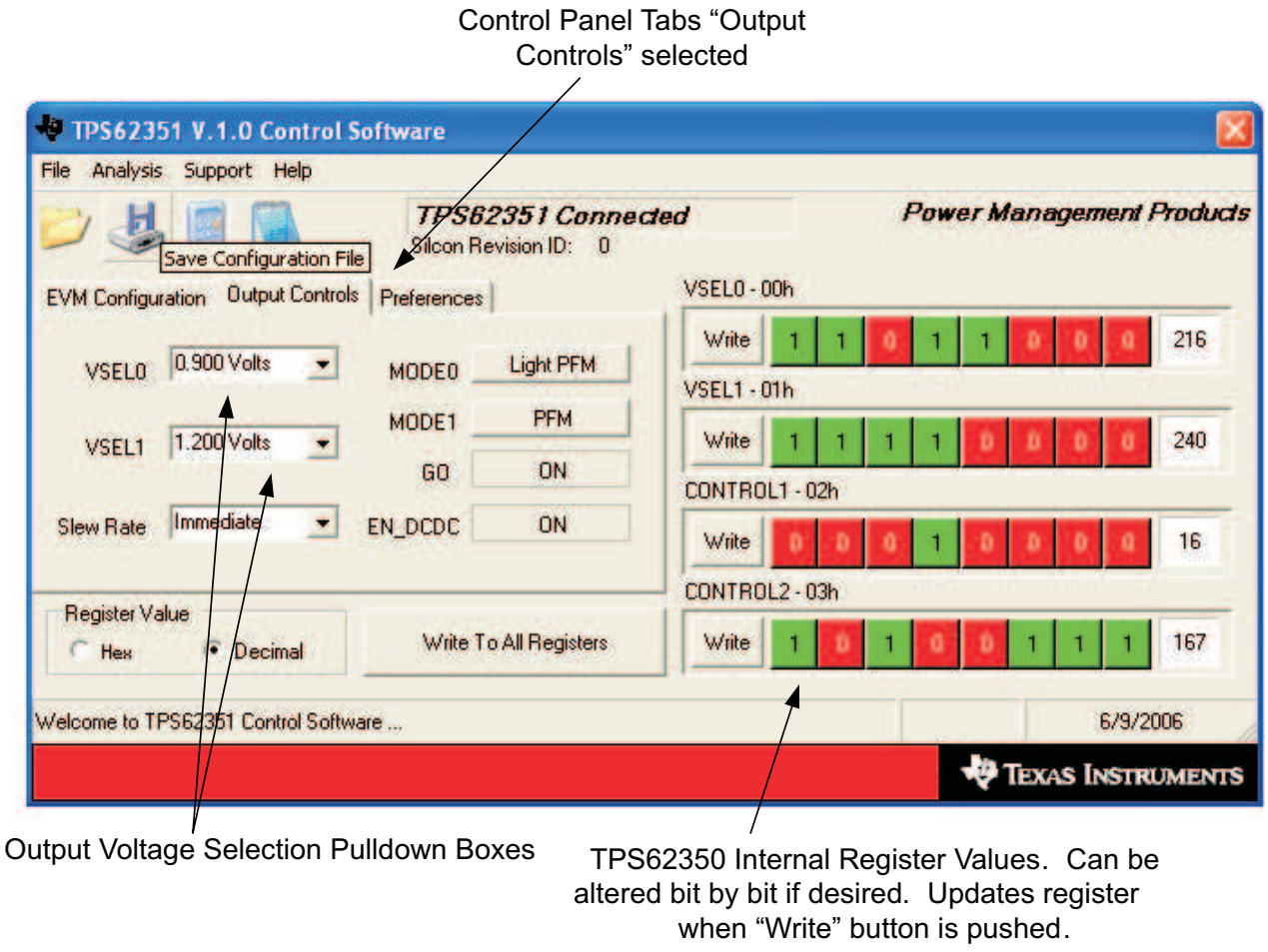


Figure 1. *Output Controls* Tab

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 pull-down boxes, that are too high for the application being tested.

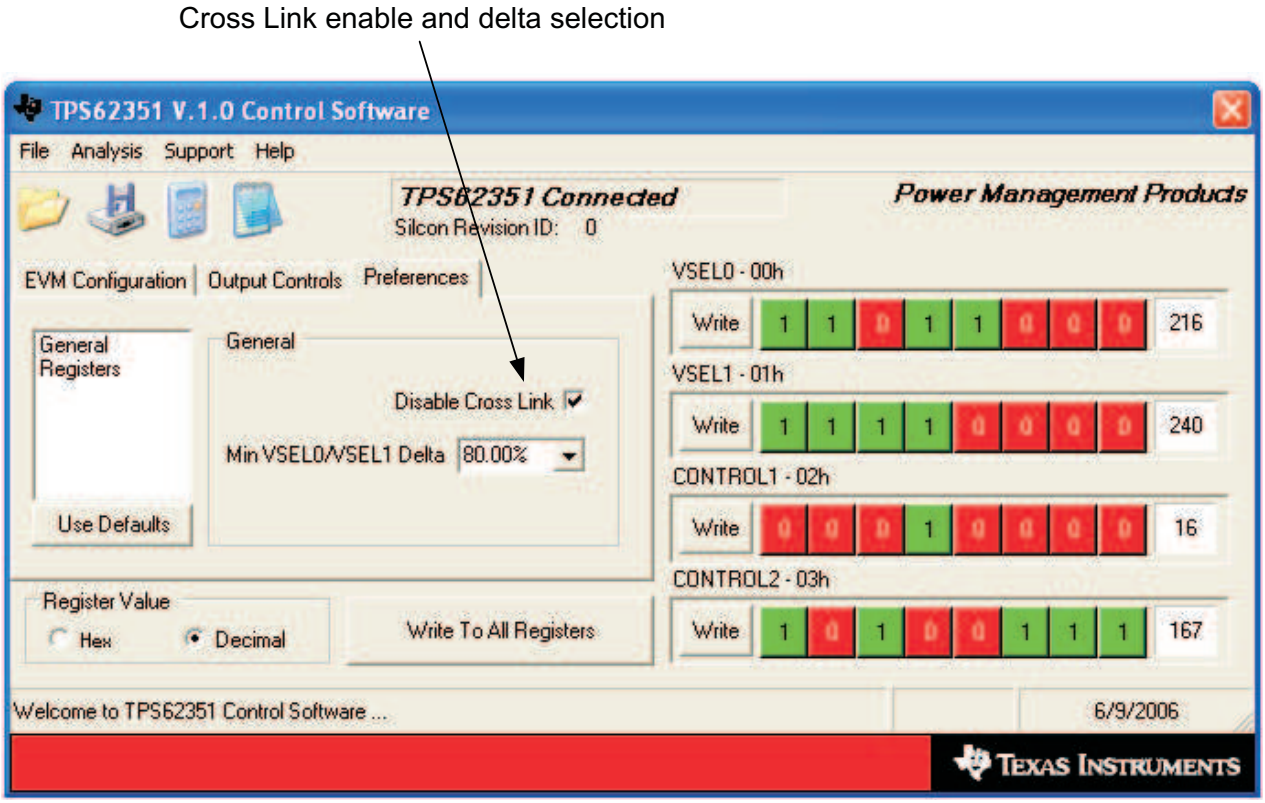


Figure 2. *Preferences* Tab

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.

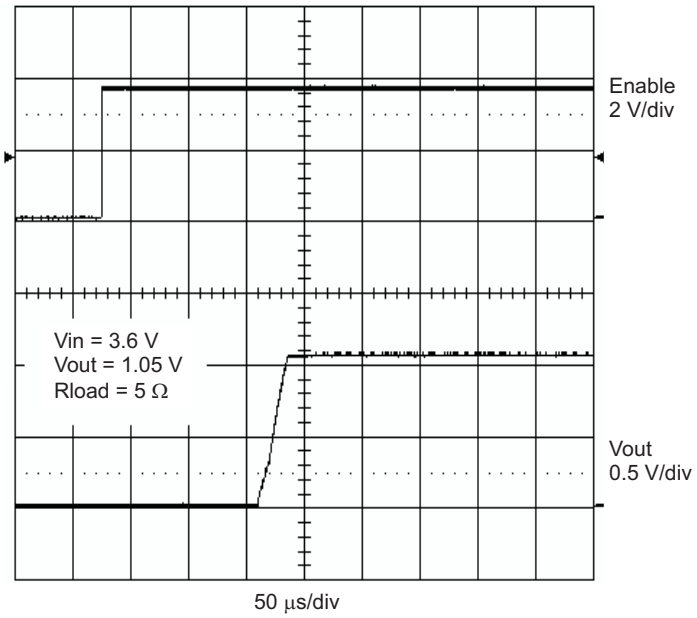


Figure 3. Start-up From Enable

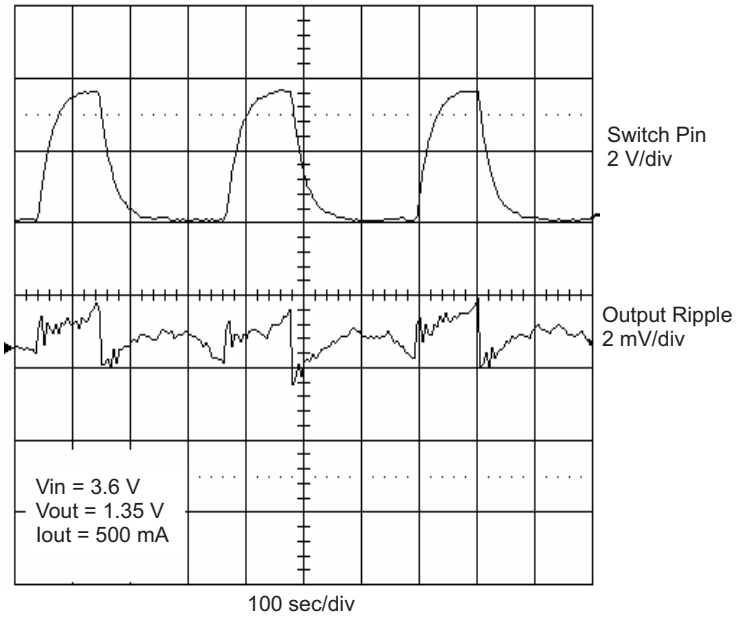


Figure 4. Output Ripple

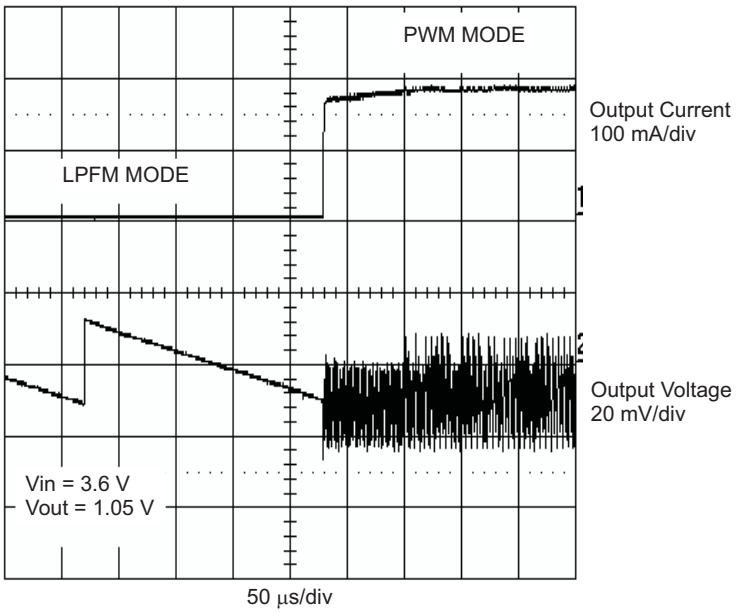


Figure 5. Load Transient, 1-mA to 180-mA Step

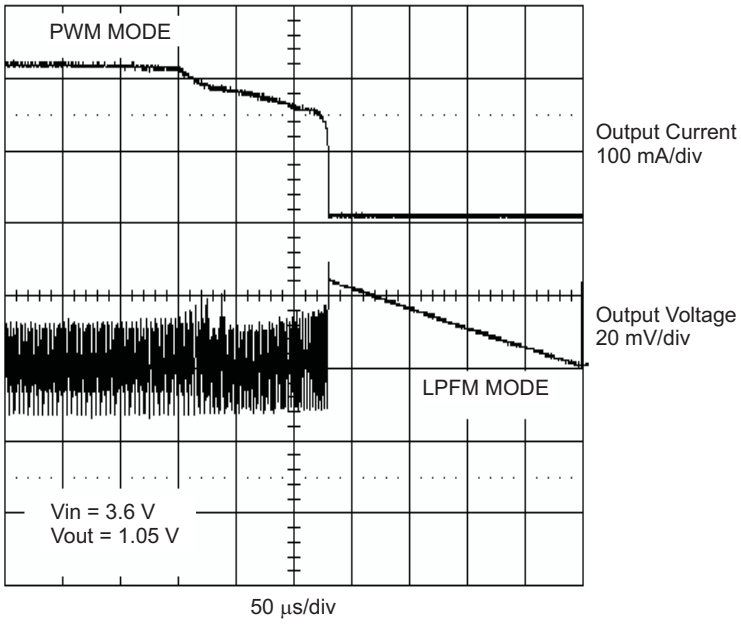


Figure 6. Load Transient, 210-mA to 1-mA Step

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.

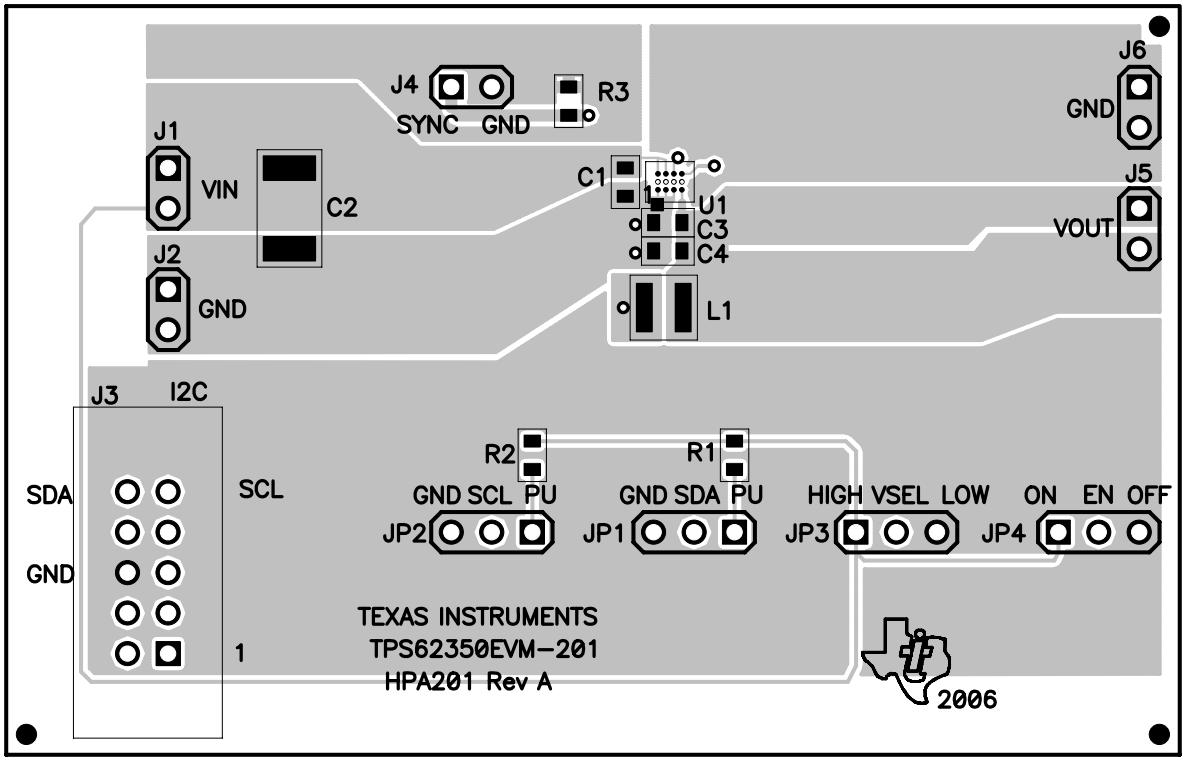


Figure 7. Assembly Layer

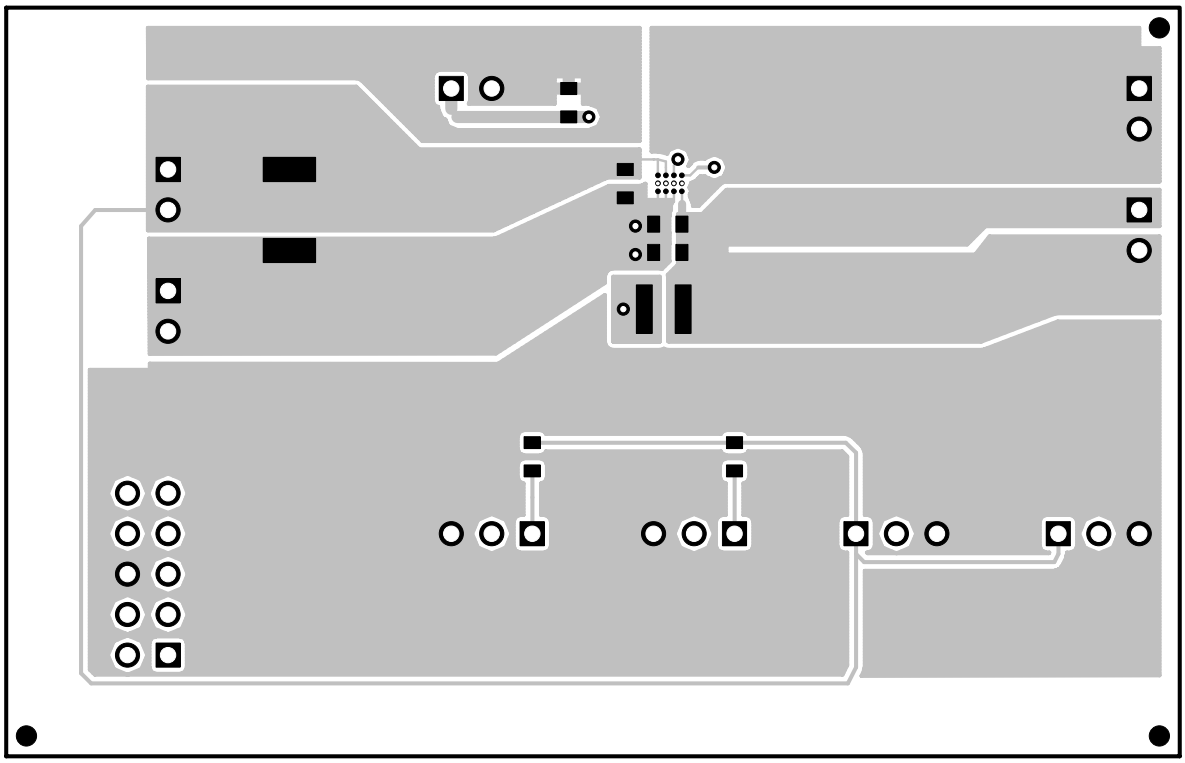


Figure 8. Top Layer Routing

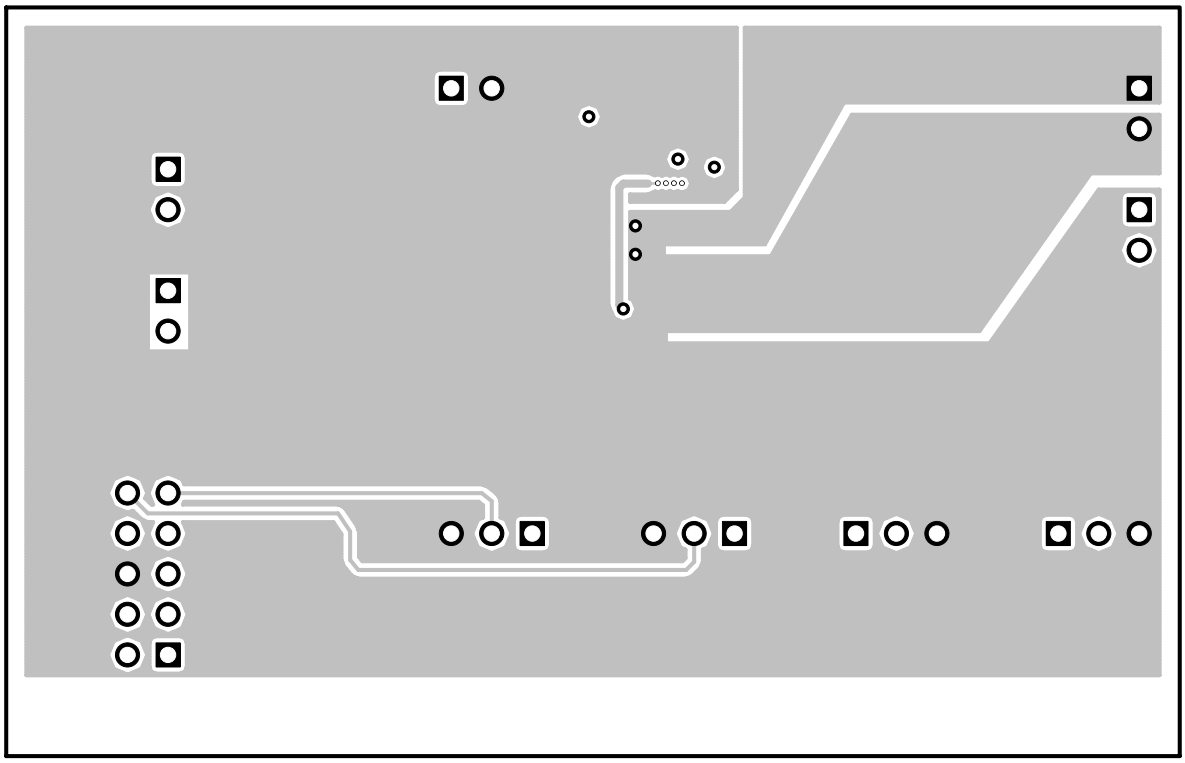


Figure 9. Bottom Layer Routing

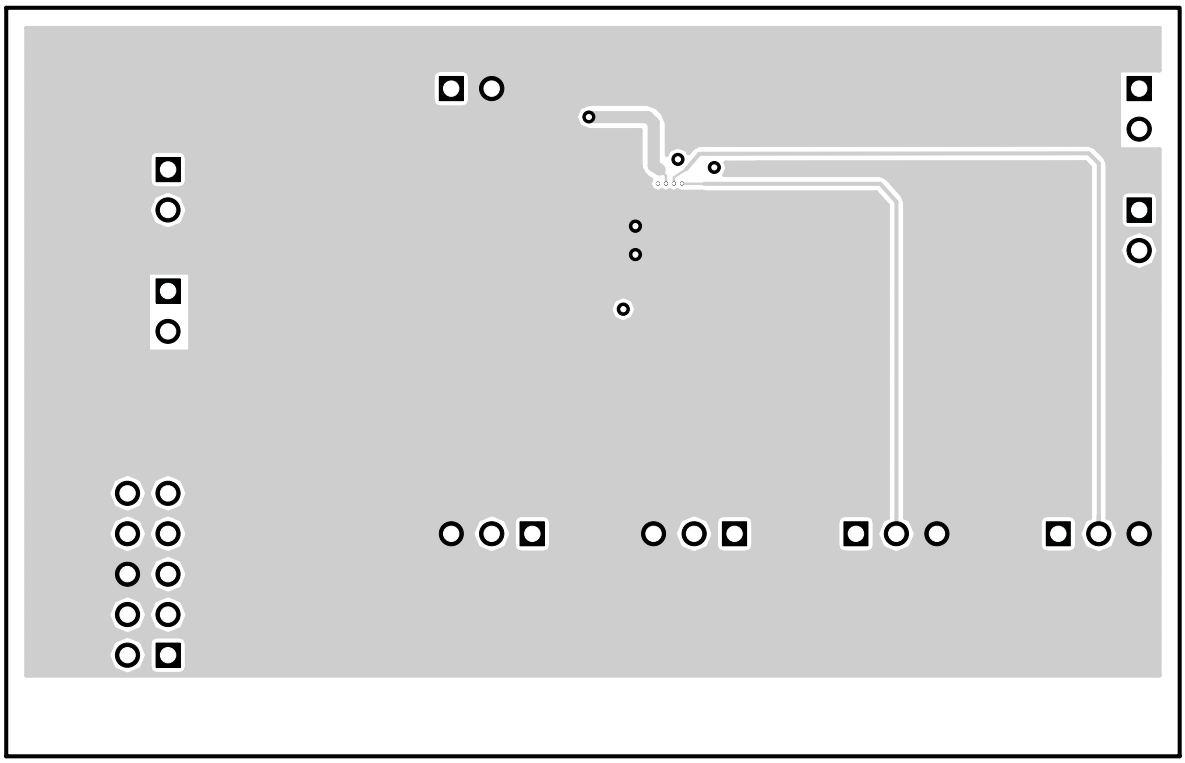


Figure 10. Layer 2 Routing

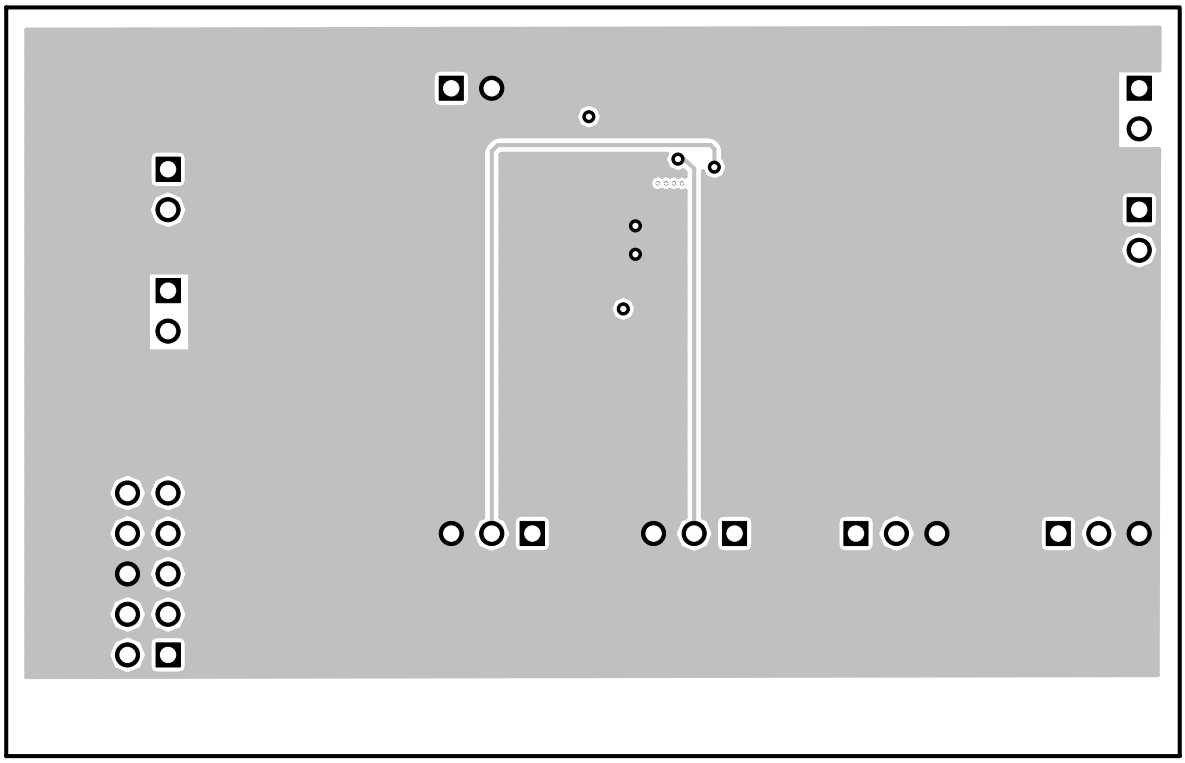


Figure 11. Layer 3 Routing

6 Schematic and Bill of Materials

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

6.1 Schematic

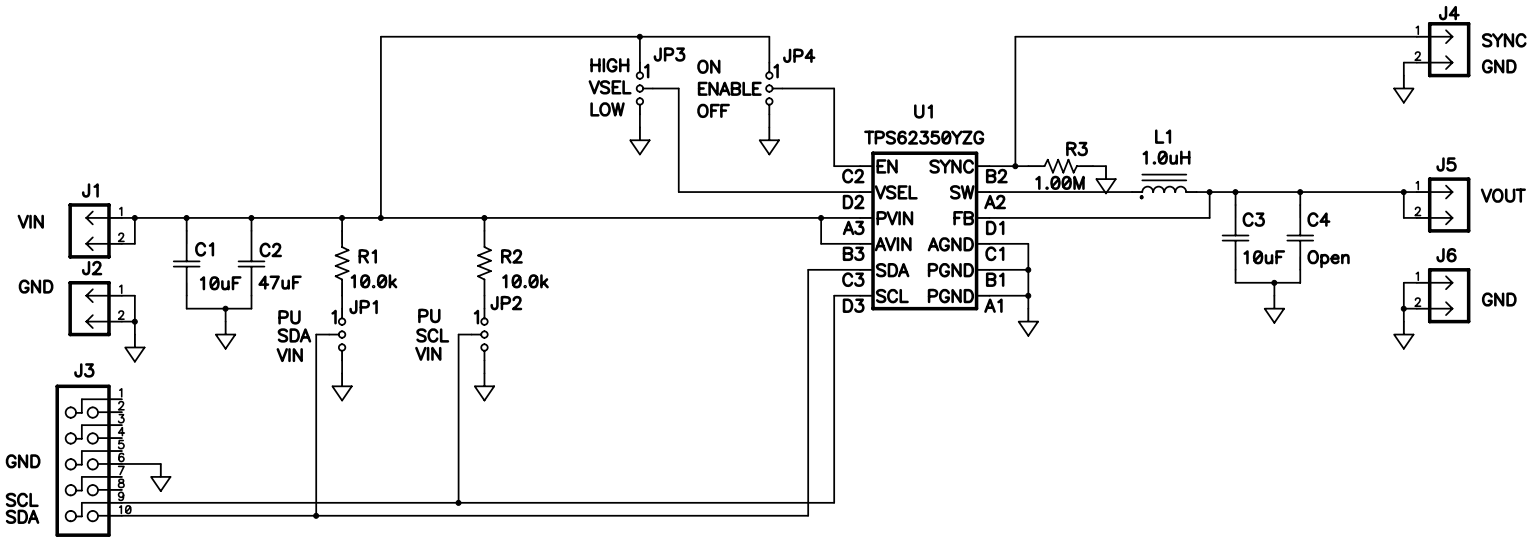


Figure 12. TPS62350EVM-201 Schematic

6.2 Bill of Materials

Table 1. HPA201A Bill of Materials

Count	Ref Des	Value	Description	Size	Part Number	MFR
2	C1, C3	10μF	Capacitor, ceramic, 6.3V, X5R, 10%	0603	C1608X5R0J106KT	TDK
1	C2	47μF	Capacitor, ceramic, 10V, X5R, 20%	1812	C4532X5R1A476M	TDK
1	L1	1.0μH	Inductor, SMT, 1.6A, ±30%	3mm x 3mm	LPS3010-102NLC	Coilcraft
2	R1, R2	10.0k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R3	1.00M	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	U1		IC, 3MHz synchronous step down converter with I^2C, 800mA	CSP-12	TPS62350YZG	TI

6.3 Related Documentation From Texas Instruments

TPS62350, TPS62351 800-mA, 3-MHz Synchronous Step-Down Converter With I^2C Compatible Interface in Chip Scale Packaging data sheet (SLVS540)

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (July 2006) to A Revision	Page
• Updated *HPA201A Bill of Materials*.	13

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

3 *Regulatory Notices:*

   3.1 *United States*

      3.1.1 *Notice applicable to EVMs not FCC-Approved:*

      FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

      3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

      CAUTION

      This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

      Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

      FCC Interference Statement for Class A EVM devices

      NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

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