TPS60250EVM-185

Contents

List of Figures

List of Tables

1 Introduction

The Texas Instruments TPS60250EVM-185 evaluation module (EVM) helps designers evaluate the operation and performance of the TPS60250 white LED (WLED) driver for applications that are powered with one Li-ion or Li-polymer cell and require two or three separate banks of WLEDs. The TPS60250 contains a 1×/1.5× chargepump, as well as seven current sinks that are configured into a main display bank of four or five WLEDs and a sub-display bank of two WLEDs. Additionally, the fifth main display WLED can be configured to drive an aux display at up to 80 mA for backlighting a keypad or a weak camera flash.

2 Setup

This chapter describes the jumpers and connectors on the EVM, as well as how to properly connect, set up, and use the TPS60250EVM-185.

2.1 Input/Output Connector Descriptions

J1 – VIN

This is the positive input voltage connection to the converter. The EVM operates from any supply voltage between 3 V and 6 V. The leads to the input supply should be twisted and kept as short as possible to minimize EMI transmission and input voltage droop.

J2 – GND

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

J3 – USB to GPIO Connector

This is the connector for the interface box. Connect a ribbon cable of the interface box to this device.

J4 – VLED CATHODE DM5

This is the DM5 connection for using an external aux display WLED bank. Connect the cathode(s) of the external aux display bank to this input.

J5 – VLED ANODE DM5

This is the anode connection for using an external aux display WLED bank. Connect the anode(s) of the external aux display bank to this output.

JP1 – DM1

JP1 is used to connect the cathode of the DM1 LED to the DM1 pin on the TPS60250. Place a shunt on JP1 to connect the WLED to the DM1 input. Remove the shunt to measure the DM1 current or use an external WLED for DM1.

JP2 – DM2

JP2 is used to connect the cathode of the DM2 LED to the DM2 pin on the TPS60250. Place a shunt on JP2 to connect the WLED to the DM2 input. Remove the shunt to measure the DM2 current or use an external WLED for DM2.

JP3 – DM3

JP3 is used to connect the cathode of the DM3 LED to the DM3 pin on the TPS60250. Place a shunt on JP3 to connect the WLED to the DM3 input. Remove the shunt to measure the DM3 current or use an external WLED for DM3.

JP4 – DM4

JP4 is used to connect the cathode of the DM4 LED to the DM4 pin on the TPS60250. Place a shunt on JP4 to connect the WLED to the DM4 input. Remove the shunt to measure the DM4 current or use an external WLED for DM4.

JP5 – DM5

JP5 is used to connect the cathode of the DM5 LED to the DM5 pin on the TPS60250. Place a shunt on JP5 to connect the WLED to the DM5 input. Remove the shunt to measure the DM5 current or use an external WLED for DM5.

JP6 – DS1

JP6 is used to connect the cathode of the DS1 LED to the DS1 pin on the TPS60250. Place a shunt on JP6 to connect the WLED to the DS1 input. Remove the shunt to measure the DS1 current or use an external WLED for DS1.

JP7 – DS2

JP7 is used to connect the cathode of the DS2 LED to the DS2 pin on the TPS60250. Place a shunt on JP7 to connect the WLED to the DS2 input. Remove the shunt to measure the DS2 current or use an external WLED for DS2.

2.2 Equipment Requirements

In order for this EVM to operate properly, the following components must be connected and properly configured.

2.2.1 Personal Computer

A computer with a USB port is required to operate this EVM. The TPS60250 interface software, which is run on the personal computer (PC), communicates with the EVM via the PC USB port. The user sends commands to the EVM and reads the contents of the TPS60250 internal registers through the USB port.

2.2.2 Printed Circuit Board Assembly

The TPS60250EVM-185 PCB contains the TPS60250 IC and its required external components. This board contains several jumpers and connectors that allow the user to customize the board for specific operating conditions.

2.2.3 USB to I^2C Adapter

The HPA172 is the link that allows the PC and the EVM to communicate. The adapter connects to the PC with the supplied USB cable on one side and to the EVM though the supplied ribbon cable on the other. When the user writes a command to the EVM, the interface program, which is run from the PC, sends the command to the PC USB port. The adapter receives the USB command and converts the signal to an I^2C protocol. It then sends the I^2C signal to the TPS60250 board. When the user reads a status register from the EVM, the PC sends a command to read a register on the EVM. When the EVM receives the command, it reports the status of the register via the I^2C interface. The adapter receives the information on the I^2C interface, converts it to a USB protocol, and sends it to the PC.

2.2.4 Software

Texas Instruments provides software to assist the user in evaluating this EVM. Check the TPS60250EVM-185 product folder (http://www.ti.com/tool/tps60250evm-185) on the TI Web site for the latest version of the software.

2.2.5 Power Supplies

The TPS60250 EVM requires one power supply for operation. It may need to supply several hundred mA, depending on the WLED currents.

2.3 Operation

The following steps must be followed before the EVM can be operated.

1. Install the TPS6025xEVM software.
2. Connect the input voltages to the EVM.
3. Configure all EVM jumpers to the factory settings in Table 1.
4. Connect the ribbon cable between the EVM and the USB-TO-GPIO (HPA172) adapter.
5. Connect the USB cable between the computer and USB-TO-GPIO adapter
6. Run the TPS6025xEVM software.

Table 1. Factory EVM Jumper Settings

Jumper	Shunt Location
JP1	Installed
JP2	Installed
JP3	Installed
JP4	Installed
JP5	Installed
JP6	Installed
JP7	Installed

2.3.1 TPS6025x Software Operation

The software is designed to work with the entire TPS60250/1/2 family of devices. A screenshot of the software is shown in Figure 1. Upon being opened, the software asks the user to select which particular EVM is installed.

The top part of the software contains a link to the device datasheet as well as buttons to read and write all the registers.

The bottom part of the software indicates that the USB-to-GPIO adaptor is installed and working properly. It also notes the I^2C bus speed (100 kHz).

2.3.1.1 Left Half of Software GUI - Settings

This portion of the software allows the user to enable/disable the different banks of LEDs using simple check boxes. Open lamp detection may be enabled/disabled using the provided check box. Refer to the TPS60250 data sheet for a description of the open lamp detection. Additionally, a pulldown box (MODE) is available to control the aux display settings. The aux display may be grouped with main display or set for the separate high-current (80 mA) aux display. When using the high-current setting, it is suggested that separate LEDs are connected between the J5 (cathode connection) and J6 (anode connection) connectors. The LEDs installed on the EVM are rated for 30-mA dc current and may be damaged at the higher current. Selecting the shutdown option in the Aux Display pulldown menu disables all of the LEDs and places the IC in a low-power shutdown mode. The internal registers are not changed in this mode.

Another MODE pulldown box allows selection of what switching mode is used to drive the WLEDs: auto switch, forced 1x, or forced 1.5x. Finally, there are 3 pulldown boxes at the bottom to set the WLED current for each of the banks.

2.3.1.2 Right Half of the GUI - Register Map

This portion of the software allows the user to change the registers on a bit level. All this functionality is already included in the easy to use boxes and pulldowns on the left half side of the GUI.

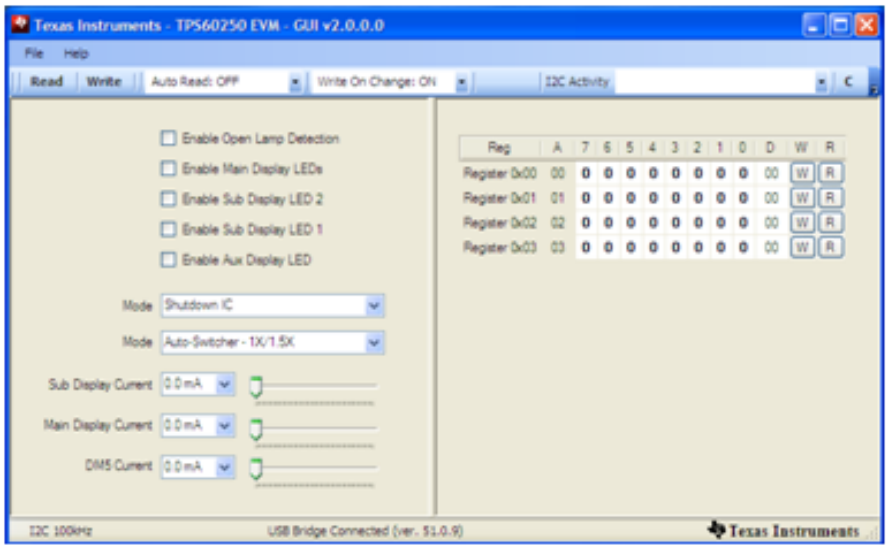

Figure 1. TPS60250 Software Screenshot

3 Board Layout

This chapter provides the TPS60250EVM-185 board layout and illustrations.

3.1 Layout

Board layout is critical for all switch mode power supplies. Figure 2 through Figure 4 show the board layout for the TPS60250EVM-185 PCB.

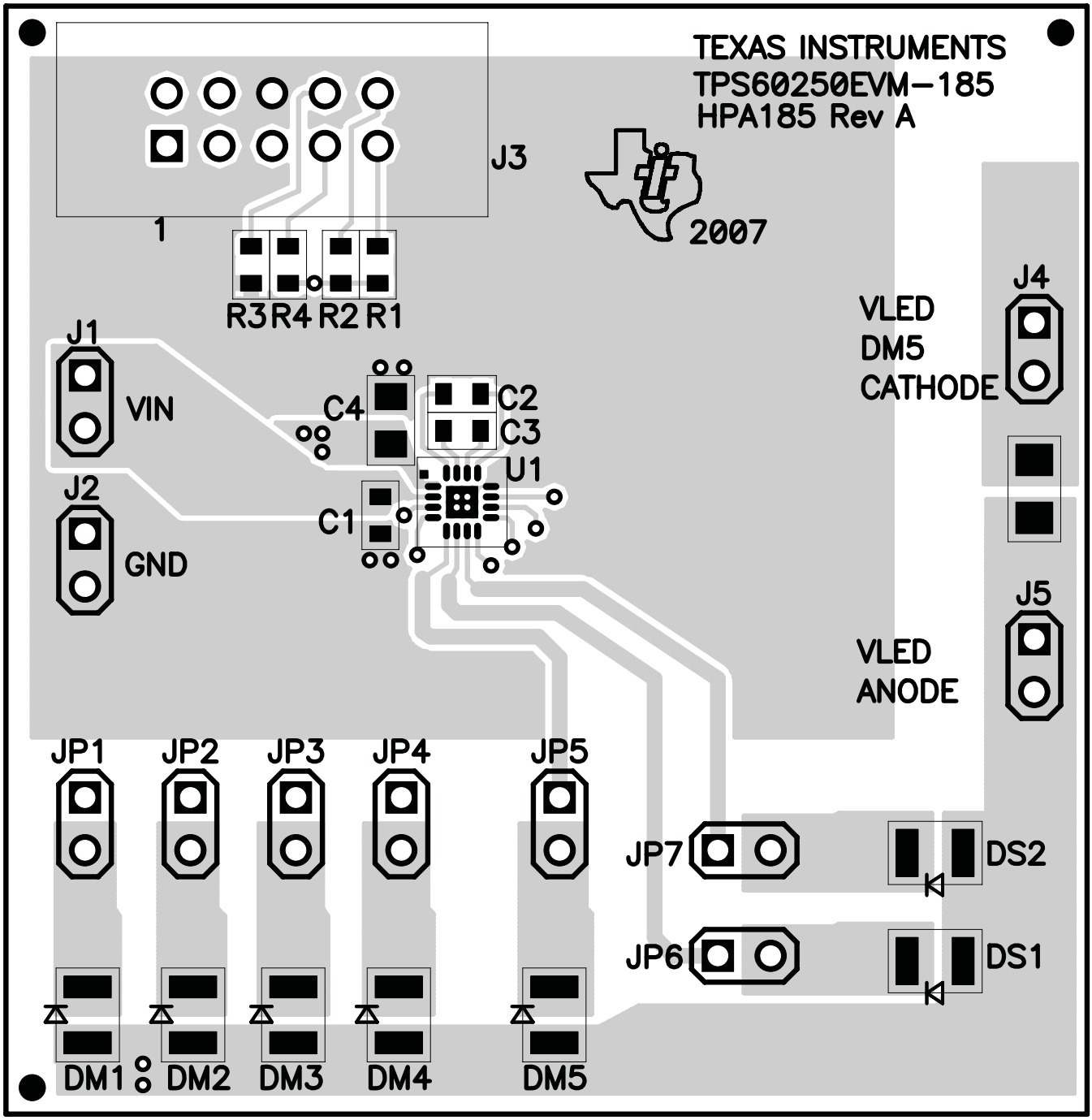

Figure 2. Assembly Layer

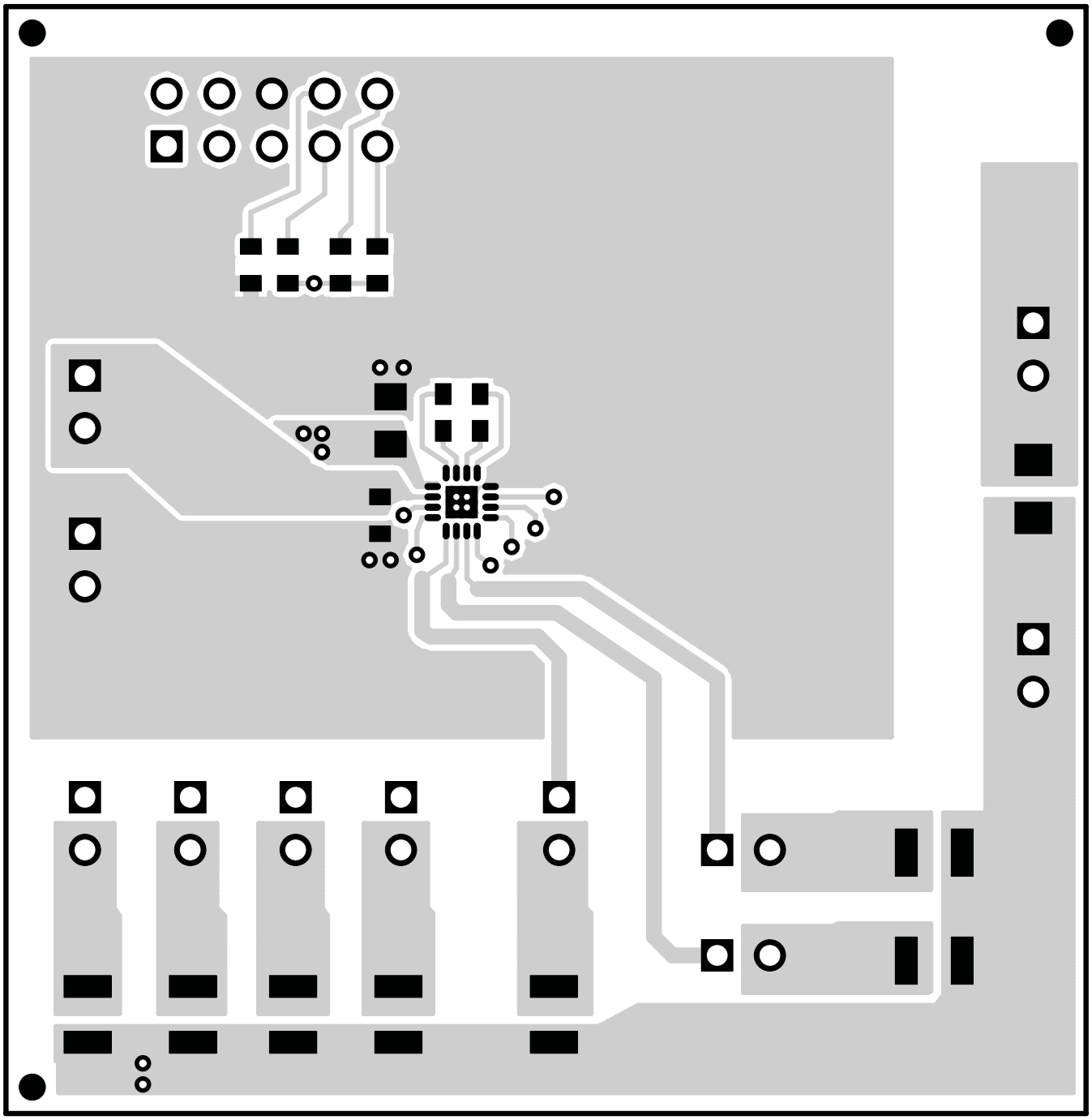

Figure 3. Top Layer Routing

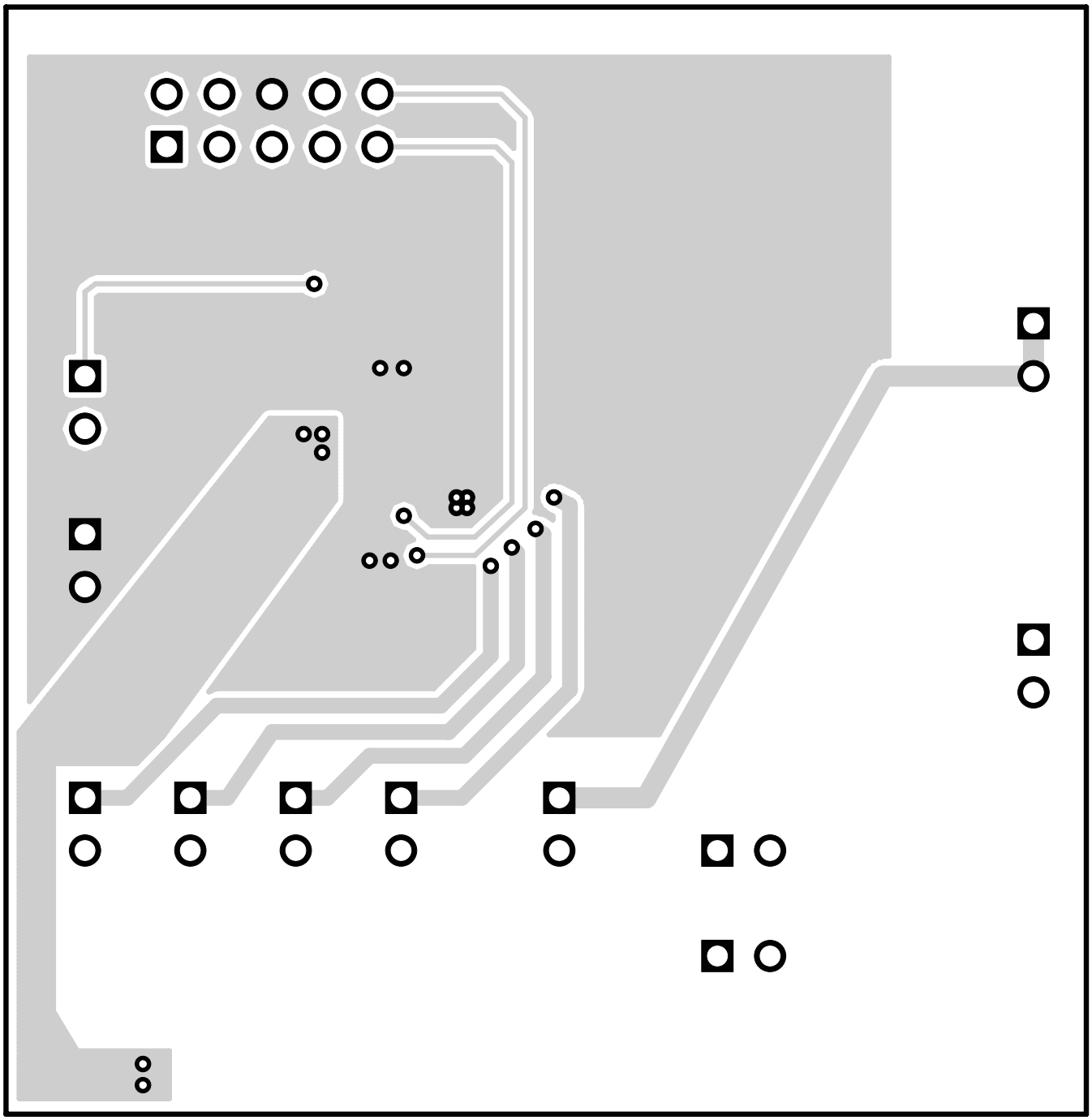

Figure 4. Bottom Layer Routing

4 Schematic and Bill of Materials

This chapter provides the TPS60250EVM-185 schematic and bill of materials.

4.1 Schematic

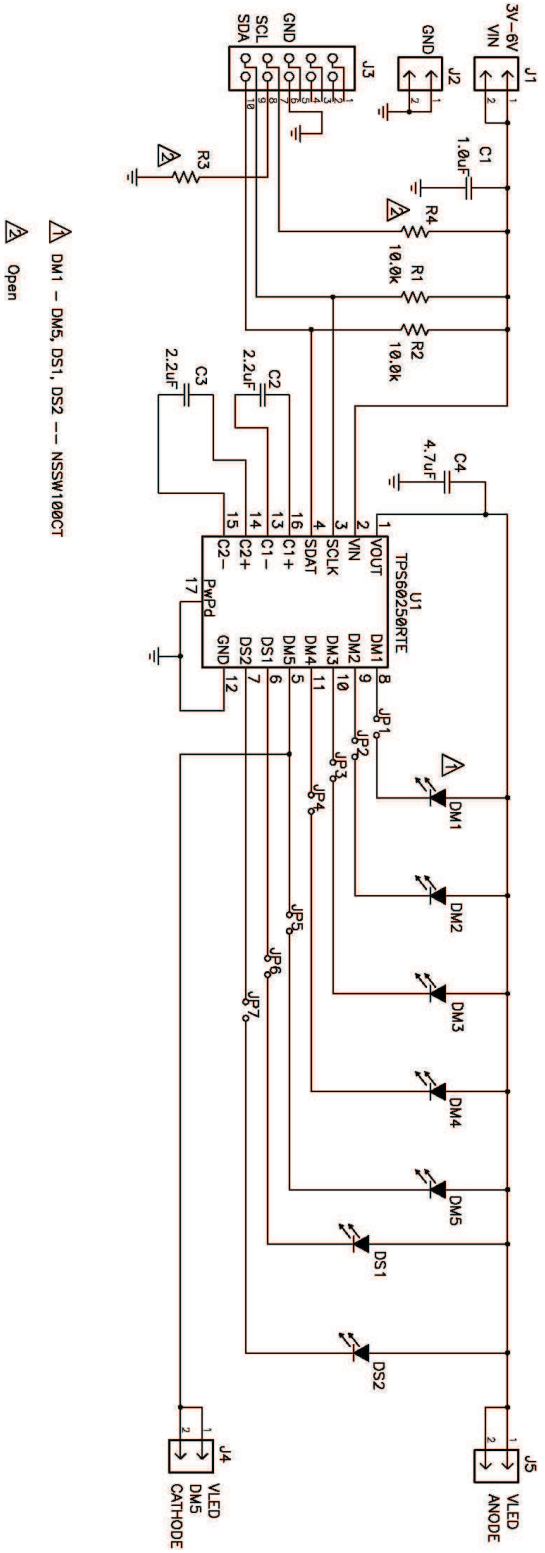

Figure 5. TPS60250EVM-185 Schematic

4.2 Bill of Materials

Table 2. TPS60250EVM-185 Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
1	C1	1.0uF	Capacitor, Ceramic, 25V, X5R, 10%	0603	GRM188R61E105KA12	muRata
2	C2, C3	2.2uF	Capacitor, Ceramic, 10V, X5R, 10%	0603	GRM188R61A225KE34	muRata
1	C4	4.7uF	Capacitor, Ceramic, 10V, X5R, 10%	0805	GRM21BR61A475KA73	muRata
7	DM1 - DM5, DS1, DS2		Diode. LED, White	0.079 × 0.118	NSSW100CT	Nichia
2	R1, R2	10.0k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	R3, R4	Open	Resistor, Chip, 1/16W, 1%	0603		
1	U1		IC, High Efficiency Charge Pump for 7 WLEDS with I^2C Interface	QFN-16	TPS60250RTE	TI

Related Documentation From Texas Instruments

TPS60250 data sheet (SLVS769)

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As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module 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 or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment 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.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

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

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

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.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

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

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). 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.

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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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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.

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.

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1. Use this product 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 this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

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