TPS61158EVM-565 User's Guide

The Texas Instruments TPS61158EVM-565 evaluation module contains a TPS61158 integrated circuit (IC), helping designers evaluate the operation and performance of the TPS61158, which is a WLED driver providing integrated solutions for single-cell Li-ion battery powered backlight for small and media form factor LCD Display.

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1 Introduction

The EVM contains one DC / DC converter (See Table 1).

Table 1. Device and Package Configurations

Converter	IC	Package
U1	TPS61158	QFN 2 x 2 6L - DRV

1.1 Performance Specification Summary

The EVM is designed to operate from an input voltage source ranging from 2.7 V - 5.5 V, and provides a 30 mA maximum output current for the LED string. For each single channel, there can be 6 to 8 LEDs in series due to customer's application.

Table 2 provides a summary of the TPS61158EVM-565 performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 2. Performance Specification Summary

Specification	CONDITION	MIN	TYP	MAX	UNITS
VIN supply		2.7		5.5	V
I_{OUT}			20		mA
Number of LEDs in series as the load	JP3 shorted		6		
	JP4 shorted		7		
	JP5 shorted		8		

2 Jumper and Connector Setup

This section describes the jumpers and connectors on the EVM and how to properly connect, set up and use the TPS61158EVM-565.

2.1 Input/Output Connector Description

J1,J2 – Input are the power input terminals for the converter. The terminal blocks provide a power (VIN) and ground (GND) connection to allow the user to attach the EVM to a cable harness.

J3 – USB-TO-GPIO is for the 10-pin ribbon cable that connects the EVM to the USB-TO-GPIO interface box. It is only used when the software is used to EasyScale dimming.

JP1 – Output is the output terminal for the converter. The terminal block provides a connection for LED load and it allows the user to add a current meter between its two pins to measure the output current.

JP2-CTRL is the jumper used to enable the device and do the dimming. Connecting pin1 and pin 2 will toggle the EN high and enable the device. Connecting pin 2 and pin 3 will toggle the EN low and disable the device. A PWM signal or a controlled digital signal to pin 2 can set the device in dimming mode.

JP3, JP4, JP5 – Function has been described in Table 2.

2.2 Hardware Requirements

This EVM requires an external power supply capable of providing 2.7 V to 5.5 V at 0.5 A. To change the default current value (that is, implement dimming), the user can apply either a PWM signal to JP2-pin2 or digital control signal to JP2-pin2.

2.2.1 Normal Operation Wthout Dimming Control

No additional hardware is required.

2.2.2 PWM dimming

A function generator capable of driving the PWM pin with 1.2 V to V_{IN} amplitude and 20-kHz to 100-kHz PWM signal is required for PWM-controlled dimming.

2.2.2.1 One-wire Digital EasyScale

The user also can implement EasyScale dimming by using a digital control signal. The EVM kit includes a PC software compact disk(CD) and USB-TO-GPIO interface box which, when installed on a personal computer (PC) and connected to the EVM, allows the user to communicate with the EVM via a GUI interface. The minimum PC requirements are:

- 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

2.3 Test Setup

The input voltage range for the converter is 2.7 volts to 5.5 volts. A load should be applied to the output terminal for proper operation.

3 Operation

3.1 Non-Dimming Operation (default configuration)

For non-dimming operation of the TPS61158EVM-565, JP1, JP2 should be properly configured. The recommended setting using shorting blocks are shown in Table 3. The configuration for JP3 to JP5 is determined by the specific application.

Table 3. Final Jumper Settings

Reference Designator	Setting on Board
JP1	Short pin1 and pin2
JP2	Short pin1 and pin2

In this default configuration, the device will power up when power is applied.

3.2 PWM Dimming Operation

Remove the jumper on JP2 of default configuration, connect the appropriately configured function generator output between pin 2 and pin 3 (for GND connection) of JP2. The device powers up when VIN power the PWM signal are applied. The recommended PWM signal frequency is from 20 kHz to 100 kHz, and the PWM duty is from 1% to 100%. The regulated output current is directly proportional to the PWM signal duty cycle.

3.3 One-wire Digital EasyScale Dimming

Remove the jumper on JP2, prepare a PC running the TPS61158EVM-565 Controller software and USB-TO-GPIO interface box, and perform the following steps in any sequence:

- Remove the jumper on JP2 of the default configuration.
- Connect one end of the USB-TO-GPIO box to the PC using the USB cable and the other end to J3 of the TPS61158EVM-565 using the supplied 10-pin ribbon cable as shown in the following illustration. The connectors on the ribbon cable are keyed to prevent incorrect installation.
- Connect the power supply between J1 and J2 and turn on the power supply.
- Run the software as explained in the Software Installation and Operation section.

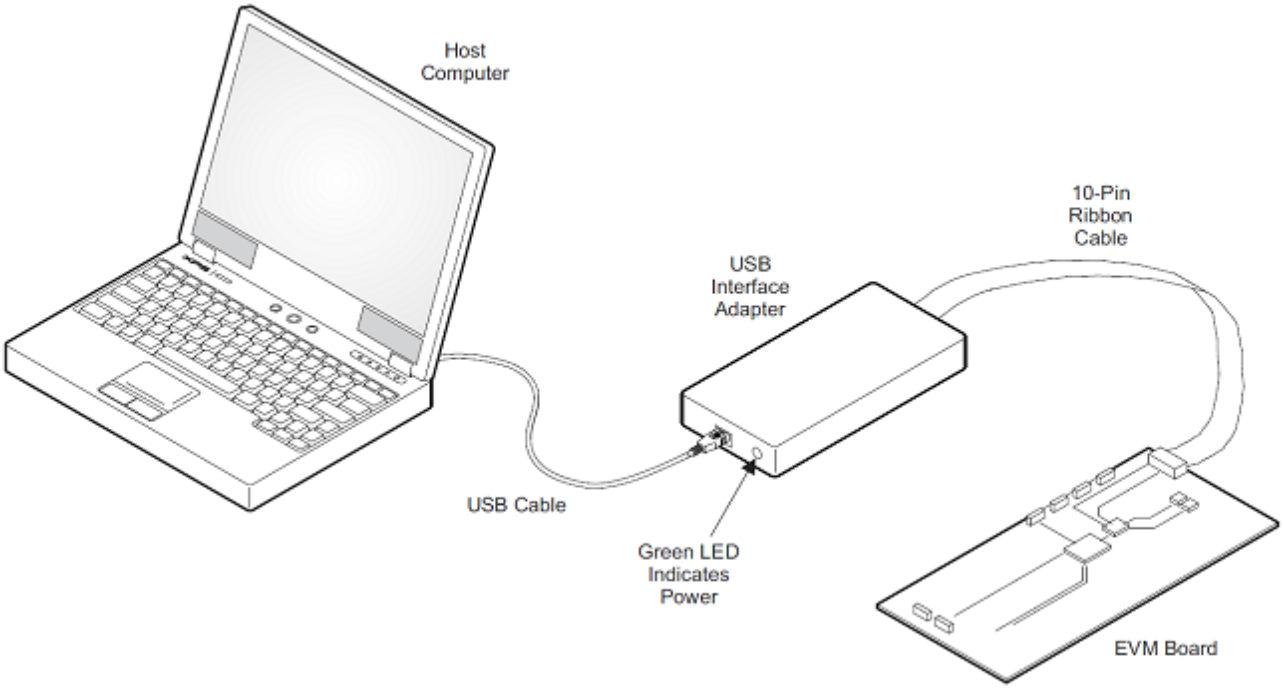

Figure 1. USB Interface Adapter

WARNING

This EVM has white LEDs that shine brightly. Protective eye wear and/or a diffuser to cover the white LED is recommended.

3.4 Software Installation and Operation

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 – http://www.ti.com/product/tps61158

Click on the install button; the PC gives a security warning and asks the user to install this application. Select Install to proceed. If a pre-release or Beta version is currently installed the your PC, then uninstall this version of the software before installing the final version from either the CD or the TI Web site.

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. Immediately following installation, the software automatically runs.

To run the software after installation, go to Start → all programs → Texas Instruments, Inc. → TPS61158 Controller EVM Software. At start-up, the software first checks the firmware version of the USB-TO-GPIO adapter box. If an incorrect firmware version is installed, the 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 and installs the software. Note that after the firmware is updated, the user must disconnect and then reconnect the USB cable between the adapter and PC, as instructed during the installation process. The host PC software also automatically searches on the Internet (if connected) for updates. If a new update is available, the software notifies the user of the update, downloads and installs the update.

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.

The TPS61158 IC has a 5-bit register that stores the feedback voltage to which the error amplifier will regulate the FB pin. In EasyScale dimming mode, a digital command should be sent to the IC via the CTRL pin to change this register to one of 32 discrete settings; thereby, changing the FB voltage. The software provides a GUI interface in Figure 2 after the software start-up.

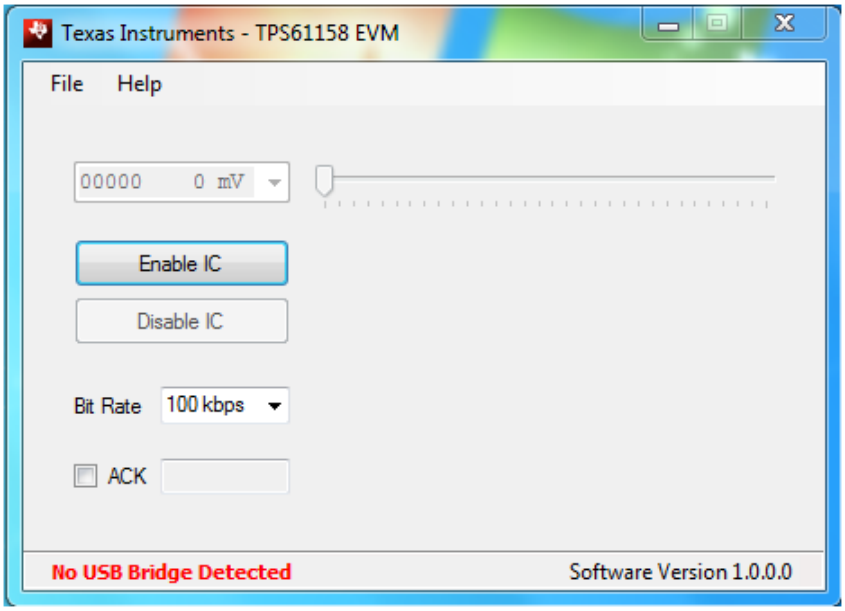

Figure 2. GUI Interface of EasyScale Dimming

The user clicks on the “Enable IC” button to enable the IC and enter the EasyScale dimming mode. If the hardware has already been connected and powered on, moving the slider runs the dimming operation. See Figure 3.

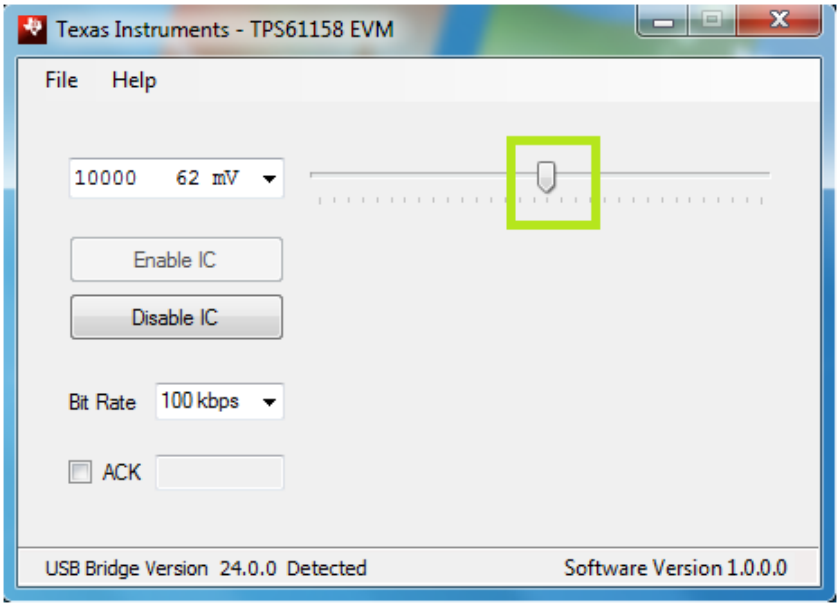

Figure 3. Operation of EasyScale Dimming

The default bit transmission rate is 100 kbps, but the software also supports other bit rate options between 10 kbps to 100 kbps. The user can easily change the bit rate directly by a drop-down box. See a screen shot of the software in Figure 4.

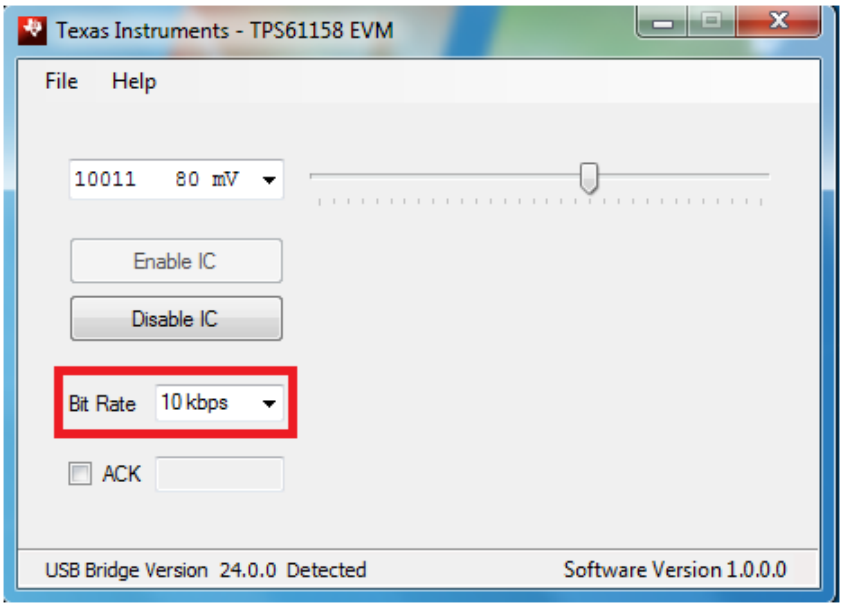

Figure 4. Bit Rate Change

3.5 Test Results

This section provides typical efficiency for the TPS611158EVM-565 board.

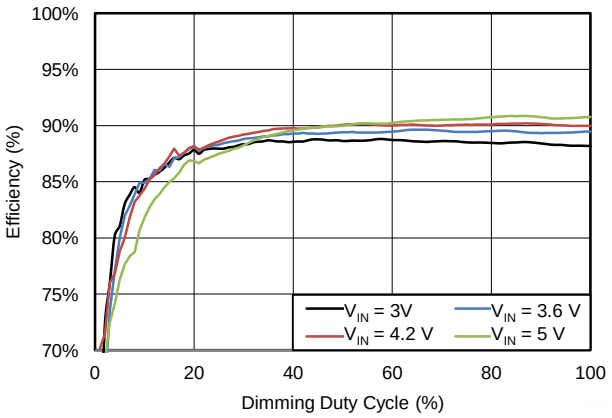

Figure 5. Efficiency vs Dimming Cycle, 6 LEDs

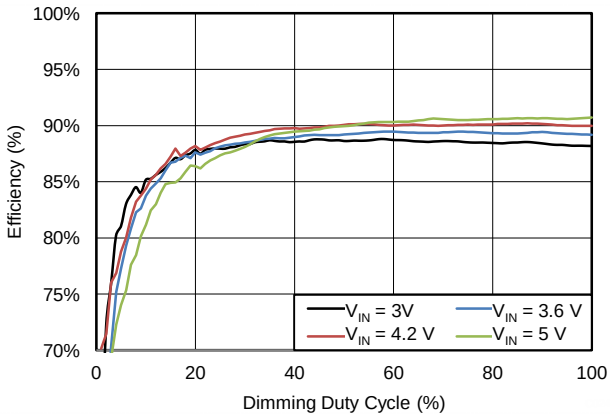

Figure 6. Efficiency vs Dimming Cycle, 7 LEDs

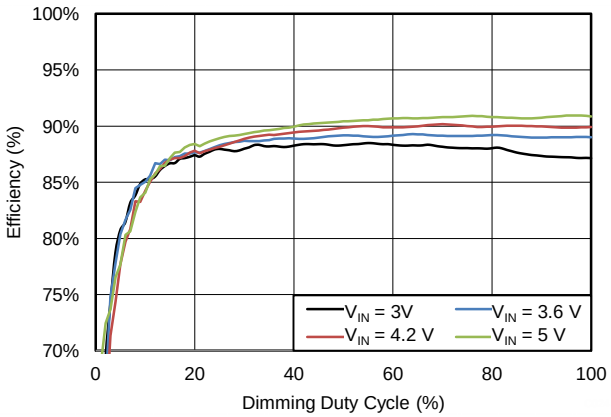

Figure 7. Efficiency vs Dimming Cycle, 8 LEDs

4 Board Layout

Figure 8, Figure 9 and Figure 10 show the board layout for the TPS61158EVM-565. The EVM offers resistors, capacitors and jumpers. Jumpers are provided to configure the device.

The PCB provides 1 oz copper planes on the top and bottom to dissipate heat.

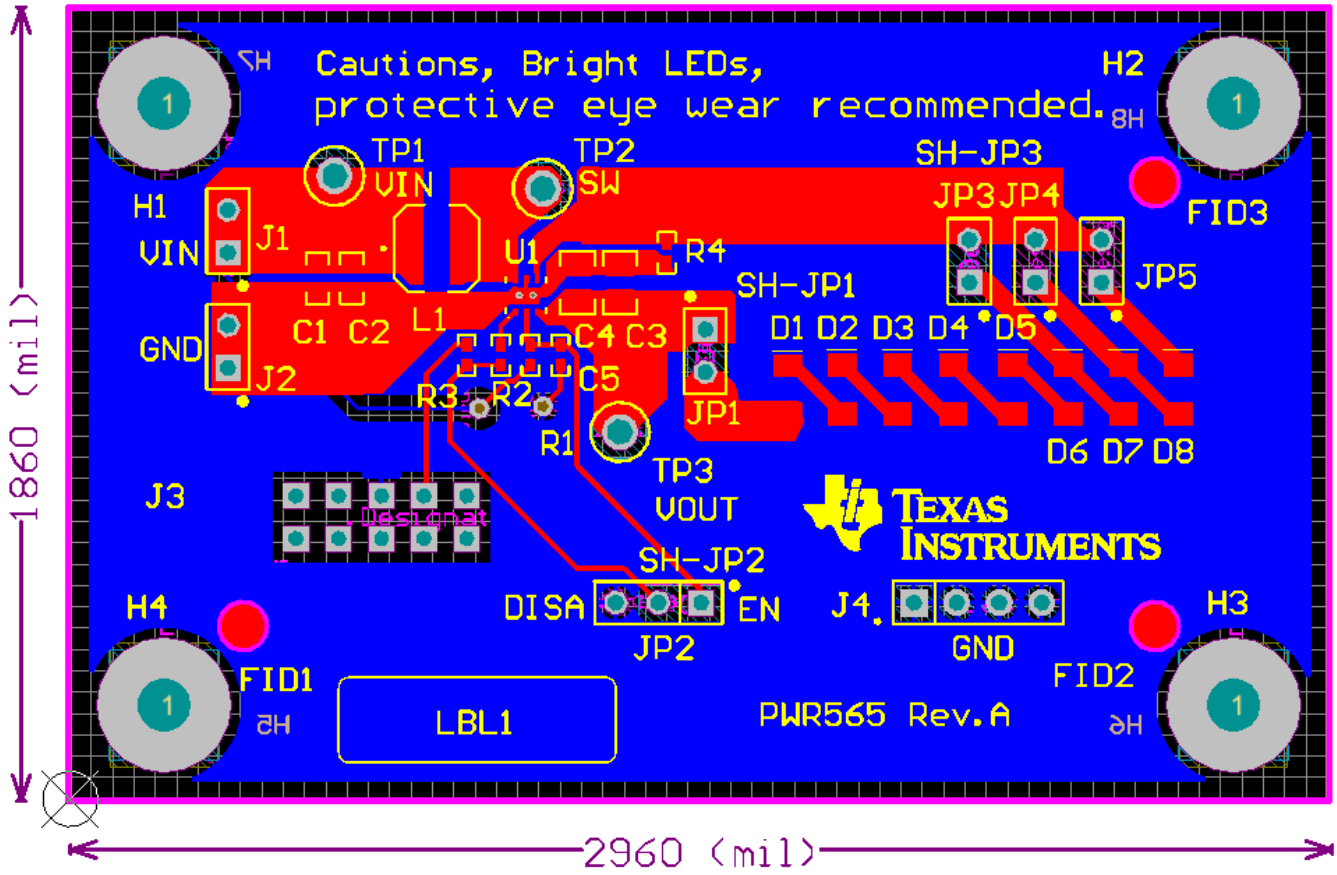

Figure 8. Top Assembly

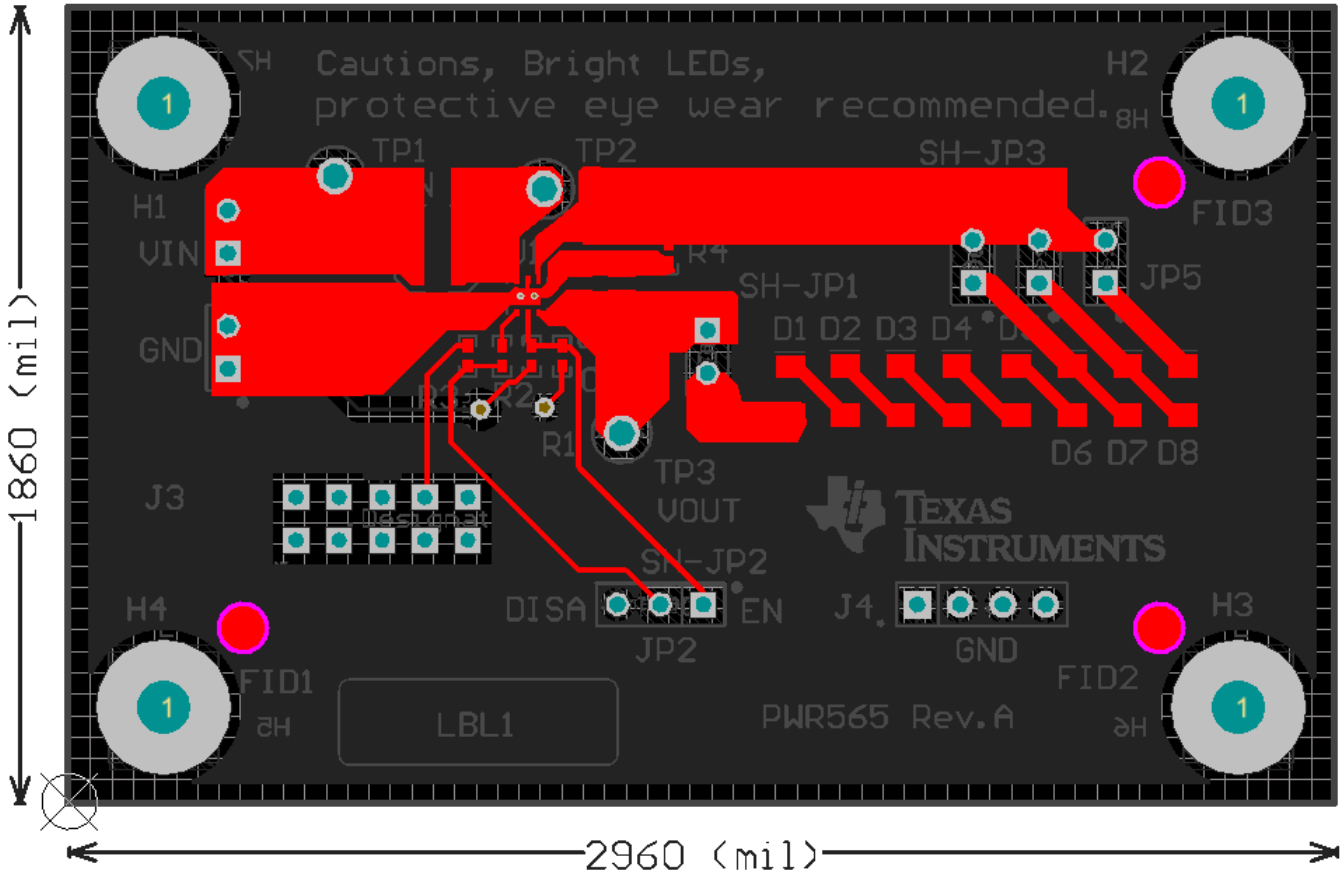

Figure 9. Top Layer Routing

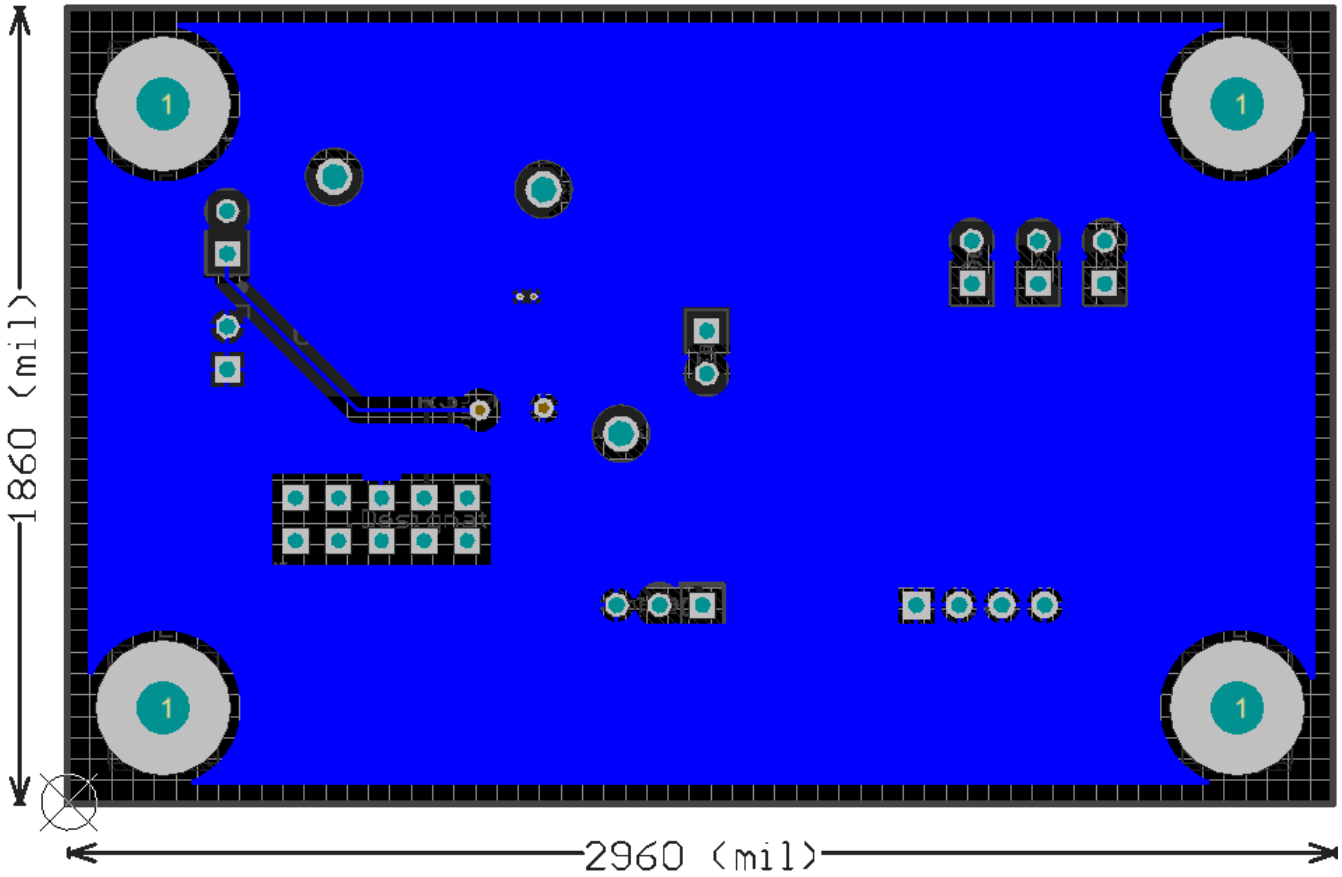

Figure 10. Bottom Layer Routing

5 Schematics

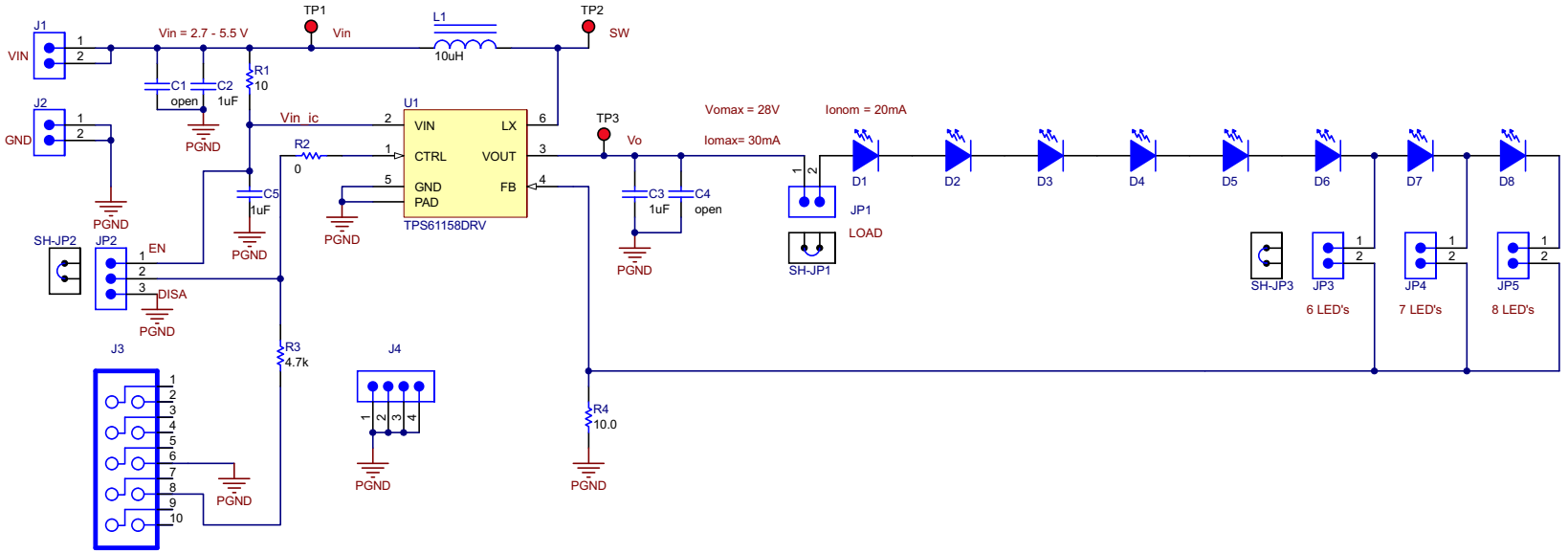

Figure 11. TPS61158EVM-565 Schematic

6 Bill of Materials

Table 4. TPS61158EVM-565 BOM

Ref Des	Qty	Value	Description	Package Reference	Part Number	Manufacturer
J3	1	N2510-6002RB	Connector, Male Straight 2x5 pin, 100mil spacing, 4 Wall	0.338 x 0.788 inch	N2510-6002RB	3M
J4	1		Header, TH, 100mil, 4x1, Gold plated, 230 mil above insulator	4x1 Header	TSW-104-07-G-S	Samtec, Inc.
JP2	1		Header, 100mil, 3x1, Tin plated, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions
L1	1	10uH	Inductor, Shielded Drum Core, Ferrite, 10uH, 1.25A, 0.2 ohm, SMD	LPS4018	LPS4018-103MLB	Coilcraft
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650"H x 0.200"W	THT-14-423-10	Brady
R1	1	10	RES, 10 ohm, 5%, 0.063W, 0402	0402	CRCW040210R0JNED	Vishay-Dale
R2	1	0	RES, 0 ohm, 5%, 0.063W, 0402	0402	RC0402JR-070RL	Yageo America
R3	1	4.7k	RES, 4.7k ohm, 5%, 0.063W, 0402	0402	CRCW04024K70JNED	Vishay-Dale
R4	1	10.0	RES, 10.0 ohm, 1%, 0.063W, 0402	0402	CRCW040210R0FKED	Vishay-Dale
SH-JP1, SH-JP2, SH-JP3	3	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M
TP1, TP2, TP3	3	Red	Test Point, TH, Multipurpose, Red	Keystone5010	5010	Keystone
U1	1		30V WLED Driver with Integrated Power Diode, DRV0006A	DRV0006A	TPS61158DRV	Texas Instruments
C1	1	open	CAP, CERM, 1uF, 10V, +/-10%, X5R, 0603	0603	C1608X5R1A105K	TDK
C4	1	open	CAP, CERM, 1uF, 50V, +/-10%, X7R, 0805	0805	GRM21BR71H105KA12L	MuRata
PCB	1					Any

7 Related Documentation From Texas Instruments

30V WLED Driver with Integrated Power Diode data sheet (SLVSBR3)

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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.

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.

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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. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards (such as UL, CSA, VDE, CE, RoHS and WEEE) which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. 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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Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

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