TPS61162AEVM-564 and TPS61163AEVM-564 User's Guide

The Texas Instruments TPS61162AEVM-564 and TPS61163AEVM-564 evaluation modules (EVMs) contain a TPS61162A or TPS61163A integrated circuit (IC), respectively. These EVMs help designers evaluate the operation and performance of the TPS61162A or TPS61163A, which are dual-channel 2 WLED drivers providing highly integrated solutions for single-cell Li-ion battery powered backlight for small and media form factor LCD.

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1   Introduction

The EVM contains one DC-to-DC converter (see Table 1).

Table 1. Device and Package Configurations

CONVERTER	IC	PACKAGE
U1	TPS61162AYFF or TPS61163AYFF	WCSP

1.1   Performance Specification Summary

The EVM is designed to operate from an input voltage source ranging from 2.7 to 6.5 V, and provides a 60-mA maximum output current for dual-channel LEDs. For each single channel, there can be 4 to 12 LEDs in series, based on the customer's application.

Table 2 provides a summary of the TPS61162AEVM-564 and TPS61163AEVM-564 performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 2. Typical Performance Specification Summary

	CONDITION		MIN	TYP	MAX	UNIT
	One Channel	**Two Channels**				
V_{IN} supply			2.7		6.5	V
I_{OUT}				40		mA
Number of LEDs in series as the load	JP6 or JP7 shorted	JP6 and JP7 shorted		4		
	JP8 or JP9 shorted	JP8 and JP9 shorted		5		
	JP10 or JP11 shorted	JP10 and JP11 shorted		6		
	JP12 or JP13 shorted	JP12 and JP13 shorted		7		
	JP14 or JP15 shorted	JP14 and JP15 shorted		8		
	JP16 or JP17 shorted	JP16 and JP17 shorted		9		
	JP18 or JP19 shorted	JP18 and JP19 shorted		10		
	JP20 or JP21 shorted	JP20 and JP21 shorted		11		

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 TPS61162AEVM-564 and TPS61163AEVM-564.

2.1   Input and Output Connector Description

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

J3 (USB-to-GPIO Connector) — This connector is for the 10-pin ribbon cable that connects the EVM to the USB-to-GPIO interface box. This connector is only used when the software is used to perform dimming.

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

JP2 (EN) — is the jumper used to enable the device. Connecting pin1 and pin2 toggles the EN high and enables the device. Connecting pin2 and pin3 toggles the EN low and disables the device. A signal from J3 can set the device in EasyScale™ dimming mode.

JP3 (IFB1) — is the jumper used to activate one LED string as the load. The LED string connects in when pin2 and pin3 are shorted. If pin1 and pin2 are shorted, the corresponding channel is disabled and removed from the control loop.

JP4 (IFB2) — is the jumper used to activate one LED string as the load. The LED string connects in when pin1 and pin2 are shorted. If pin2 and pin3 are shorted, the corresponding channel is disabled and removed from the control loop.

JP5 (PWM) — is the jumper used to send PWM dimming signal to the IC. Connecting pin1 and pin2 toggles the PWM high and enables the device. Connecting pin2 and pin3 toggles the PWM low and disables the device. PWM dimming function can be achieved by one PWM signal on pin2.

The other jumpers' functions are described in Table 2.

2.2 Hardware Requirements

This EVM requires an external power supply capable of providing 2.7 V to 6.5 V at 0.5 A. To change the default current value (that is, implement dimming), the user can apply either a PWM signal to JP5-pin2, or digital control signal to JP2-pin2.

2.2.1   Normal Operation Without 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 10-kHz to 100-kHz PWM signal is required for PWM-controlled dimming.

2.2.3   One-Wire Digital EasyScale™ Dimming

The user also can implement dimming by using a digital control signal. The EVM kit includes a PC software CD and USB-to-GPIO interface box, which when installed on a PC and connected to the EVM, allows the user to communicate with the EVM through 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 to 6.5 V. 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 TPS61162A and TPS61163A, properly configure JP1, JP2, JP3, JP4, and JP5. The recommended setting using shorting blocks is shown in Table 3. The configuration for TP6 to TP21 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
JP3	Short pin2 and pin3

Table 3. Final Jumper Settings (continued)

| Reference Designator	Setting on Board
JP4	Short pin1 and pin2
JP5	Short pin1 and pin2

3.2 PWM-Dimming Operation

Remove the jumper on JP5 of default configuration. Connect the appropriately configured function generator output between pin2 and pin3 (for GND connection) of JP5. The device powers up when power is applied. The PWM signal's duty cycle is directly proportional to the regulated current.

3.3 One-Wire Digital EasyScale™ Dimming

Remove the jumper on JP2, prepare a PC running the TPS61162A_63A Controller software and USB-to-GPIO interface box, and perform the following steps in any sequence:

- Connect one end of the USB-to-GPIO box to the PC using the USB cable and the other end to J3 of the TPS61162AEVM-564 or TPS61163AEVM-564 using the supplied 10-pin ribbon cable as shown in Figure 1. The connectors on the ribbon cable are keyed to prevent incorrect installation.
- Connect the power supply between J1 and J2. Turn on the power supply.
- Run the software as explained in Section 3.4.
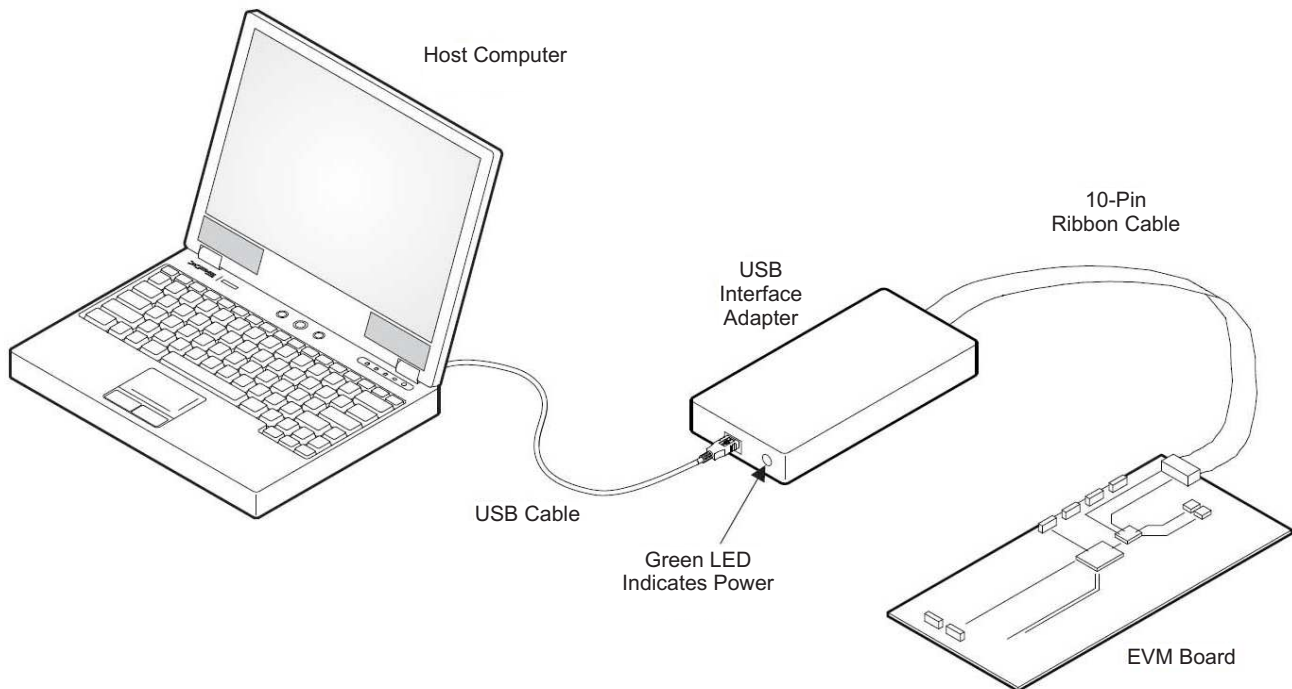
Figure 1. USB Interface Adapter

WARNING

This EVM has white LEDs that shine very brightly. TI recommends to use protective eye wear or a diffuser, or both, to cover the white LED.

3.4   Software Installation and Operation

If a pre-release or beta version of the software is currently installed on the users PC, the user must uninstall this version of the software before installing the final version from either the CD or the TI website.

If installing from a CD, insert the CD and run Setup.exe; follow all of the prompts to install the software. To install from the TI website, go to the TPS61163A product page.

Click the *install* button; the PC shows a security warning and asks whether 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. Immediately following installation, the software automatically runs.

To run the software after installation, go to Start → all programs → Texas Instruments → TPS61162A_63A EVM. 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 it.

NOTE: VeriSign™ Code Signing is used to prevent any malicious code from changing this application. If at any time the binaries are modified, the code no longer attempts to run.

The TPS61162A and TPS61163A IC have a 9-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 through the EN pin to change this register to one of 512 discrete settings, thereby changing the FB voltage and subsequent regulated WLED current. The software provides a GUI interface (see Figure 2) after the software starts up.
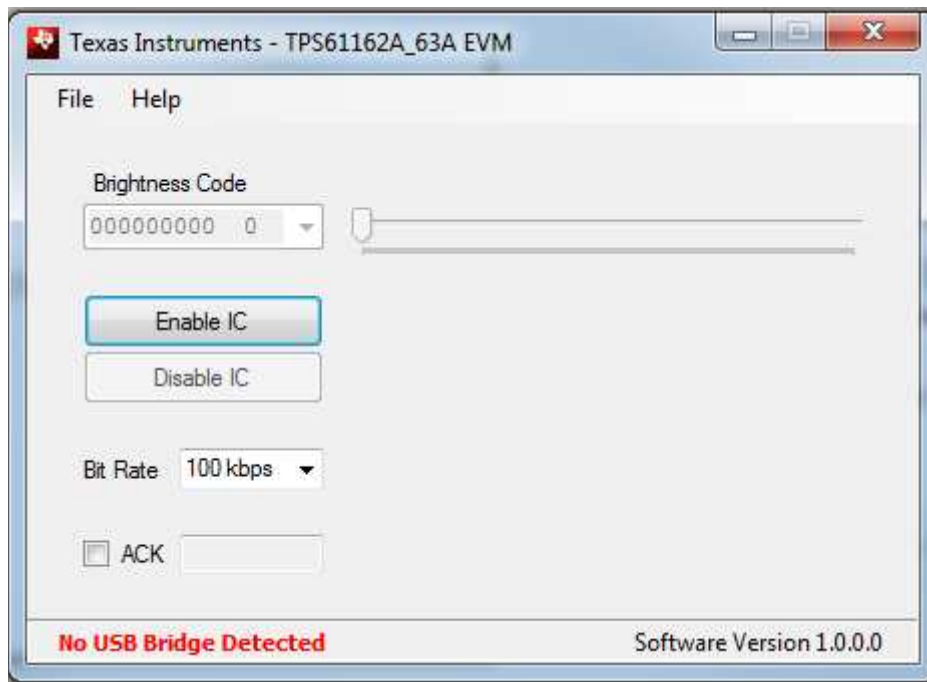

Figure 2. GUI Interface of EasyScale™ Dimming

The user clicks the *Enable IC* button to enable the IC and enter the EasyScale™ dimming mode. If the hardware is already connected and powered on, moving the slider runs the dimming operation (see Figure 3).
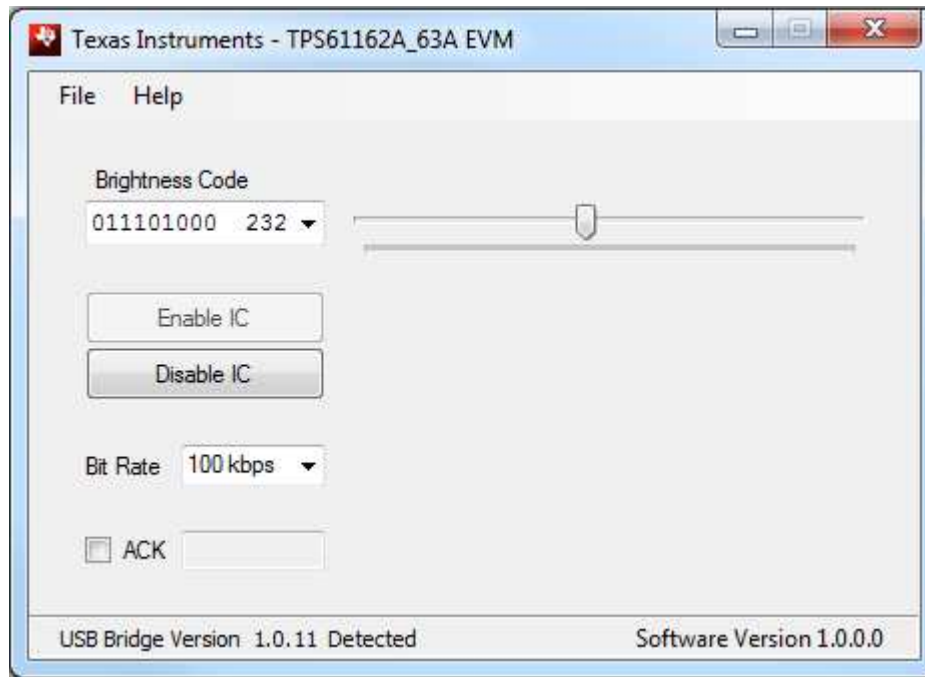

Figure 3. Operation of EasyScale™ Dimming

The default bit transmission rate is 100 kbps, but the software also supports other rate options between 5 kbps to 100 kbps. The user can change the bit rate directly by a drop-down box. See a screen shot of the software in Figure 4.

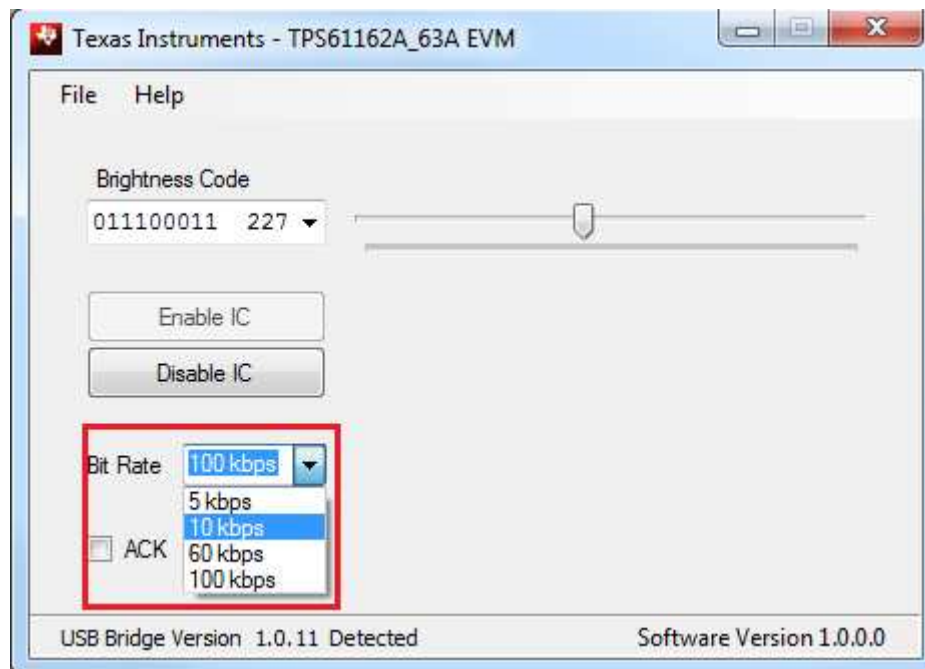**Figure 4. Bit Rate Change**

3.5 Test Results

This section provides the typical efficiency for the TPS61163AEVM-564 board.
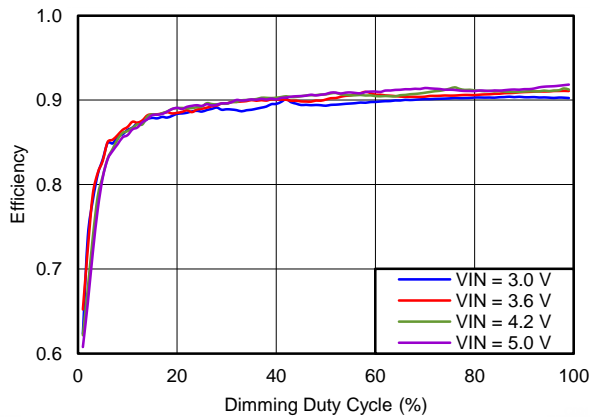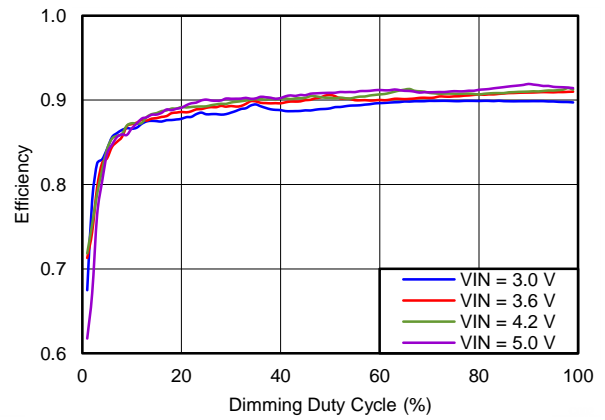

Figure 5. Efficiency versus Dimming Cycle, 5s2p 10 LEDs
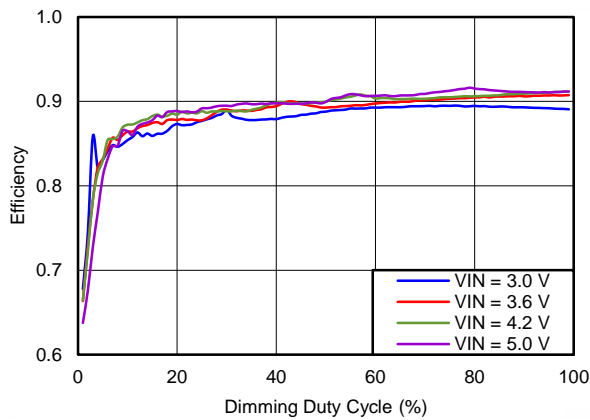

Figure 6. Efficiency versus Dimming Cycle, 6s2p 12 LEDs

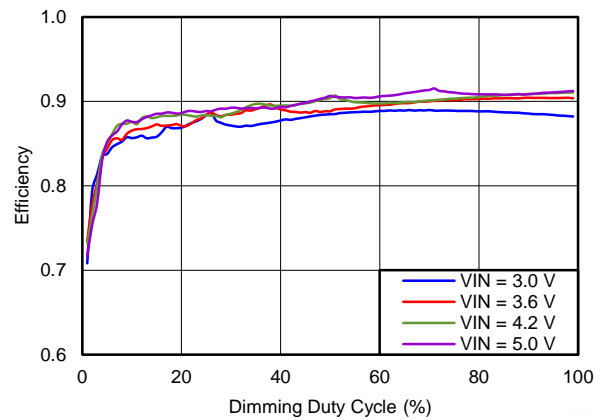**Figure 7. Efficiency versus Dimming Cycle, 7s2p 14 LEDs**

Figure 8. Efficiency versus Dimming Cycle, 8s2p 16 LEDs
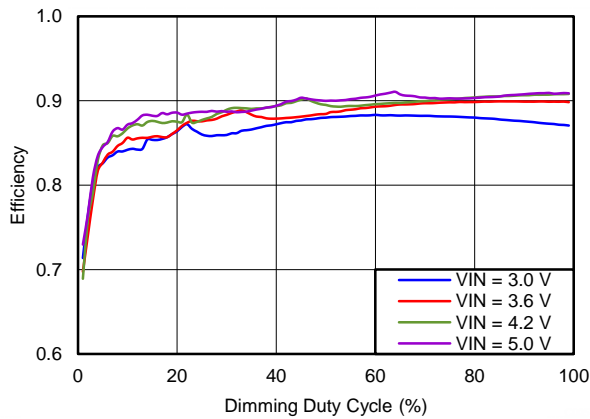

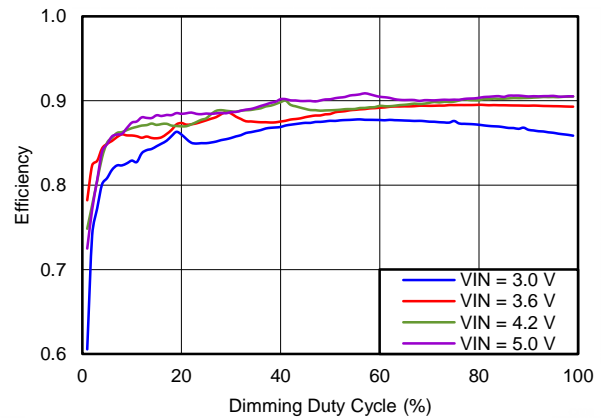**Figure 9. Efficiency versus Dimming Cycle, 9s2p 18 LEDs**

Figure 10. Efficiency versus Dimming Cycle, 10s2p 20 LEDs

4 Board Layout

Figure 11, Figure 12, and Figure 13 show the board layout for the TPS61162AEVM-564 and TPS61163AEVM-564. 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.
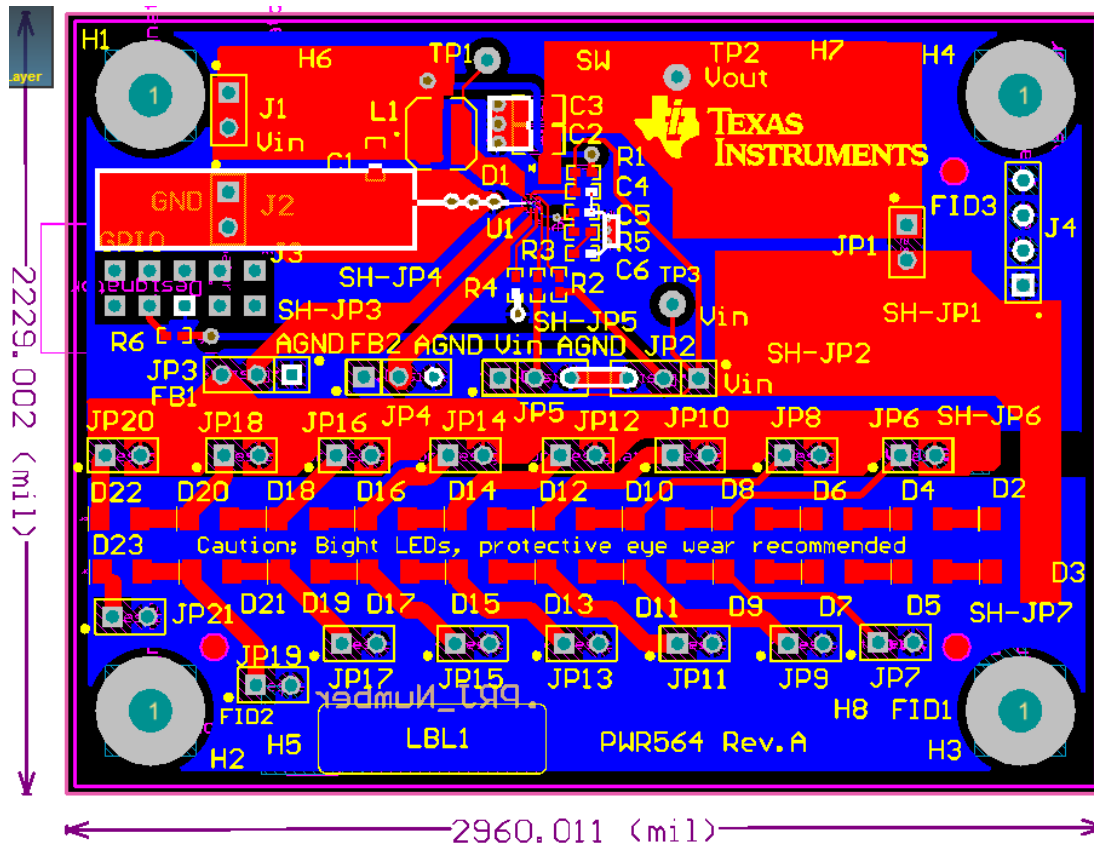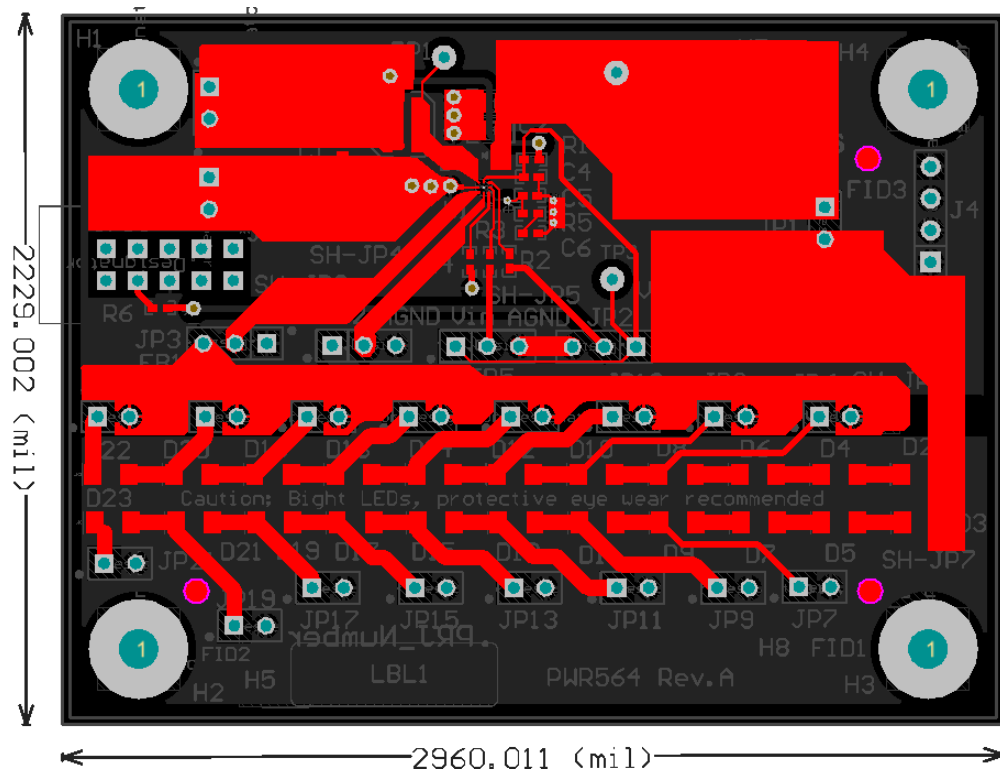

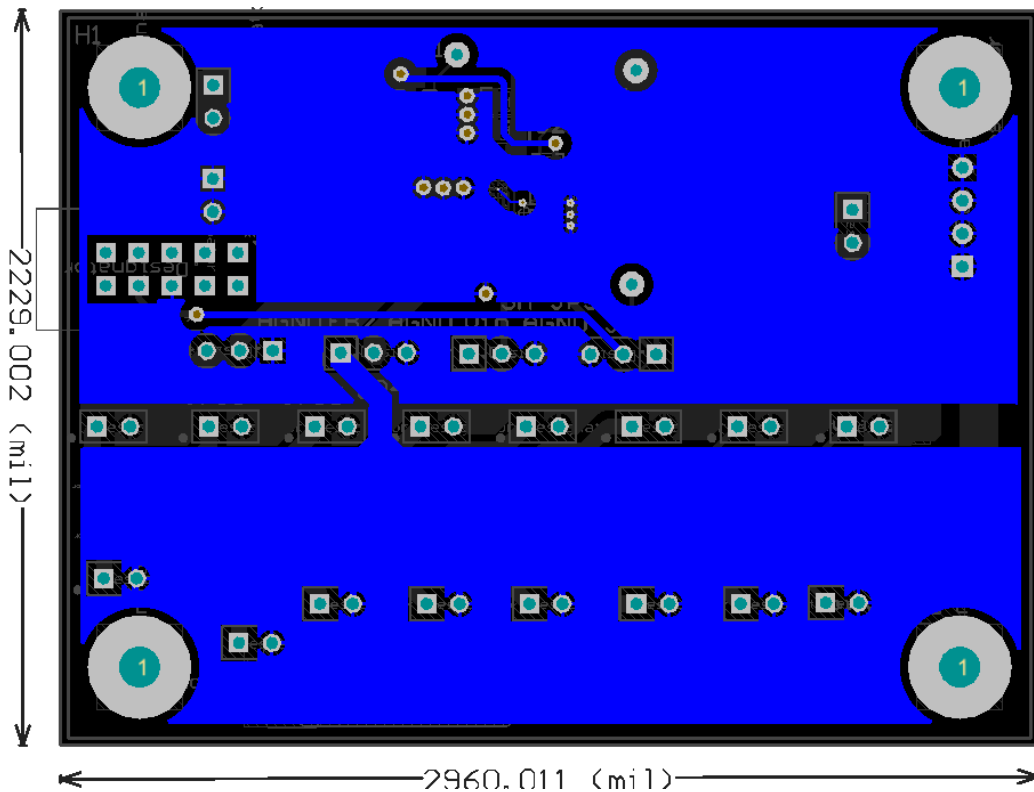**Figure 11. Top Assembly Layer**

Figure 12. Top Layer Routing

Figure 13. Bottom Layer Routing

5 Schematic
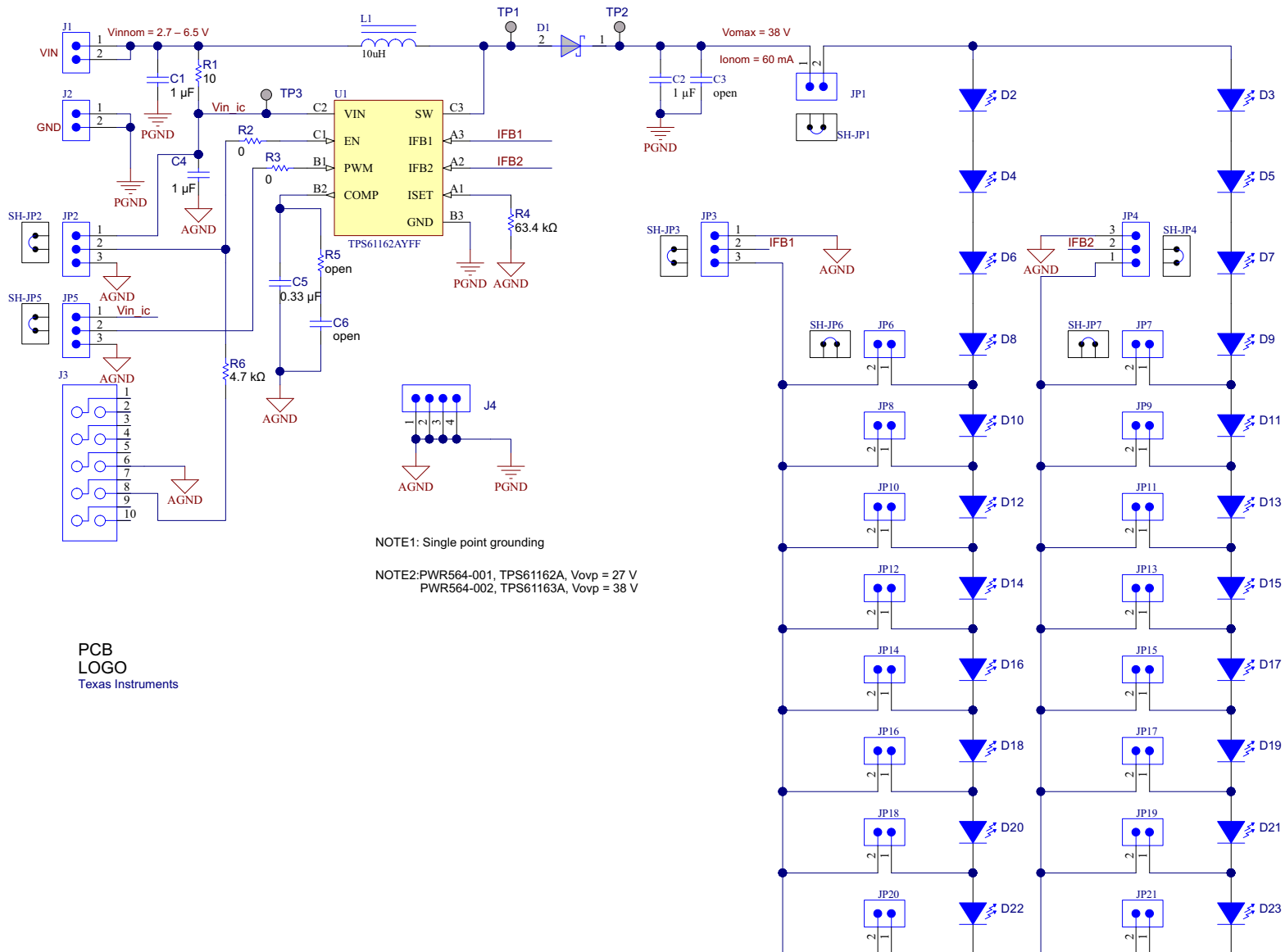
Figure 14. TPS61162AEVM-564 and TPS61163AEVM-564 Schematic

NOTE1: Single point grounding

NOTE2: PWR564-001, TPS61162A, Vovp = 27 V
PWR564-002, TPS61163A, Vovp = 38 V

6 Bill of Materials

RefDes	Quantity		Value	Package	PN
	62	63			
C1	1	1	1µF	0603	C1608X5R1A105K
C2	2	2	1µF	0805	GRM21BR71H105KA12L
C4	1	1	1µF	0402	GRM155R61A105KE15D
C5	1	1	0.33µF	0402	GRM155R60J334KE01D
D1	1	1	NSR0340V2T1G	SOD-523	NSR0340V2T1G
D2-D23	22	22	White	2x1.3x3 mm	ZSM-T3020-W
J1, J2, JP1, JP6-JP21	19	19		Header, 2 PIN, 100mil, Tin	PEC02SAAN
J3	1	1	N2510-6002RB	0.338 x 0.788 inch	N2510-6002RB
J4	1	1		4x1 Header	TSW-104-07-G-S
JP2-JP5	4	4		Header, 3 PIN, 100mil, Tin	PEC03SAAN
L1	1	1	10uH	LPS4018	LPS4018-103MLB
R1	1	1	10	0402	CRCW040210R0JNED
R2, R3	2	2	0	0402	RC0402JR-070RL
R4	1	1	63.4k	0402	CRCW040263K4FKED
R6	1	1	4.7k	0402	CRCW04024K70JNED
SH-JP1-SH-JP7	7	7	1x2	Shunt	969102-0000-DA
TP1, TP2, TP3	3	3	Red	Keystone5010	5010
U1	0	1		WCSP	TPS61163AYFF
	1	0		WCSP	TPS61162AYFF
C6	0	0	open	0402	GRM155R61A105KE15D
C3	0	0	open	0805	GRM21BR71H105KA12L
R5	0	0	open	0402	CRCW04024K70JNED
LBL1	1	1	'PCB Label 0.650"H x 0.200"W		
PCB	1	1			

7 Related Documentation from Texas Instruments

"Dual-Channel WLED Drivers for Smart Phone" data sheet, SLVSC26

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

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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.

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.

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.

【Important Notice for Users of EVMs for RF Products in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

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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EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.

2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.

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.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. 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 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

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.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible 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, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

IMPORTANT NOTICE

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