TPS61261EVM-208 Evaluation Module

This user's guide describes the characteristics, operation, and use of the TPS61261EVM-208 evaluation module (EVM). This EVM contains TI's TPS61261 boost converter, configured with external components to regulate current through an LED. This user's guide includes EVM specifications, recommended test setup, test results, bill of materials, and a schematic diagram.

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1 Introduction

This EVM contains the TPS61261 boost converter integrated circuit (IC), supporting components, and one white light-emitting diode (LED). The purpose of this EVM is to facilitate evaluation of the TPS61261 in a typical LED application.

1.1 Performance Specification Summary

Table 1 provides a summary of the EVM performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 1. Typical Performance Specification Summary

Parameter	Test Condition	Min	Typ	Max	Units
V_{IN}		0.8		3	V
V_{OUT}			3.3		V
I_{LED}	$V_{IN} \geq 1.2$ V	10		100	mA

1.2 Modifications

To aid user customization of the EVM, the board was designed with devices having 0603 or larger footprints. Actual implementations may occupy less space. JP2 may be removed to disconnect the LED, then the DC/DC will regulate 3.3-V voltage at the output. The IC also can be replaced with TPS61260 and R1 and R2 installed (to set V_{OUT} higher than Vforward) to drive LEDs with higher forward voltages than 3.3 V.

2 TPS61261EVM-208 Setup

The connection points and jumper positions are described in Section 2.1 through Section 2.9.

2.1 J1 – V_{IN}

This header is the positive connection for the input power supply. Twist the leads to the input supply and keep them as short as possible. The input voltage must remain within the limits specified in Table 1.

2.2 J2 – Sense + and –

This header is the low current sense lines that monitor V_{IN} at the input capacitor.

2.3 J3 – GND

This header is the return connection to the input power supply.

2.4 J4 – VLED

This header is the positive connection for the output.

2.5 J5 – Sense + and –

This header is the low current sense lines that monitor V_{OUT} at the output capacitor.

2.6 J6 – GND

This header is the return connection to the output power supply.

2.7 J7 - Analog Dimming and GND

This header is the analog dimming control signal connector.

2.8 JP1 - Enable

This jumper connects the enable pin of the TPS61261 to either ON (enabling the TPS61261) or OFF (disabling the TPS61261). Enable is default high if JP1 is open.

2.9 JP2 + and –

This jumper connects the LED to the output. Install a shunt on JP2 to drive the onboard LED, D1. Removing the shunt on JP2 drives a user-installed LED between J4 and J6. Connect a test wire across JP2 to measure the current through the onboard LED, D1.

WARNING

This EVM LED shines brightly. Protective eyewear and use of the diffuser cover is recommended.

3 Setting the LED Current

When no LED is connected at the output, the TPS61261 delivers a regulated 3.3-V output voltage that delivers up to 100 mA. When the TPS61261 is used as a LED driver, the forward voltage of the LED should be less than 3.3 V. The average output current regulation function makes the TPS61261 an ideal LED driver. The LED is directly connected between VLED and GND. Since no traditional sense resistor is needed at the FB pin, the TPS61261 saves battery energy by eliminating those losses.

3.1 Analog Dimming

The output current is regulated via RI pin. The typical voltage at RI pin is 400 mV, and the relationship between I_{out} and I_{RI} is shown in Equation 1. R3 and R5 are needed to implement the analog dimming function. When the analog dimming voltage is applied at J7, the current coming out of the RI pin can be calculated as shown in Equation 2. Equation 3 shows I_{out} as a function of the applied dimming voltage. The LED current should be set in the range of 10 mA to 100 mA by applying a dimming voltage from 400 mV to 760 mV at J7.

$$I_{out} = I_{Ri} \times 500 \tag{1}$$

$$I_{Ri} = \frac{400\ mV}{R3} - \frac{V_{dim\ min\ g} - 400\ mV}{R5} \tag{2}$$

$$I_{out} = I_{Ri} \times 500 = \left(\frac{400\ mV}{R3} - \frac{V_{dim\ min\ g} - 400\ mV}{R5} \right) \times 500 \tag{3}$$

3.2 PWM Dimming

The EN pin is typically used for disabling and enabling the device. By applying a PWM signal to EN, it can be used to dim the LED. And the analog dimming pin can be left open in PWM dimming mode. With a PWM signal applied directly to the EN pin, the LED current is turned on when the PWM signal is high and off when the PWM signal is pulled low. Changing the PWM duty cycle changes the LED brightness. The PWM signal used must have a high level greater than the minimum V_{IH} level and a low level less than the maximum V V_{IL} level. When dimming with the EN pin, the frequency of the PWM signal is important. It must be kept low enough such that the turnon and turnoff delays of the TPS61261 do not significantly affect the dimming linearity. It also must be high enough to keep the LED flicker from being noticeable to the human eye. A dimming frequency of 100 Hz is recommended. At this low frequency, the turnon and turnoff times, of less than 100 µs total, only slightly impact the dimming linearity. When Vin is above 1.2V, the LED current is typically 100mA when 100% duty cycle is applied.

4 Test Results

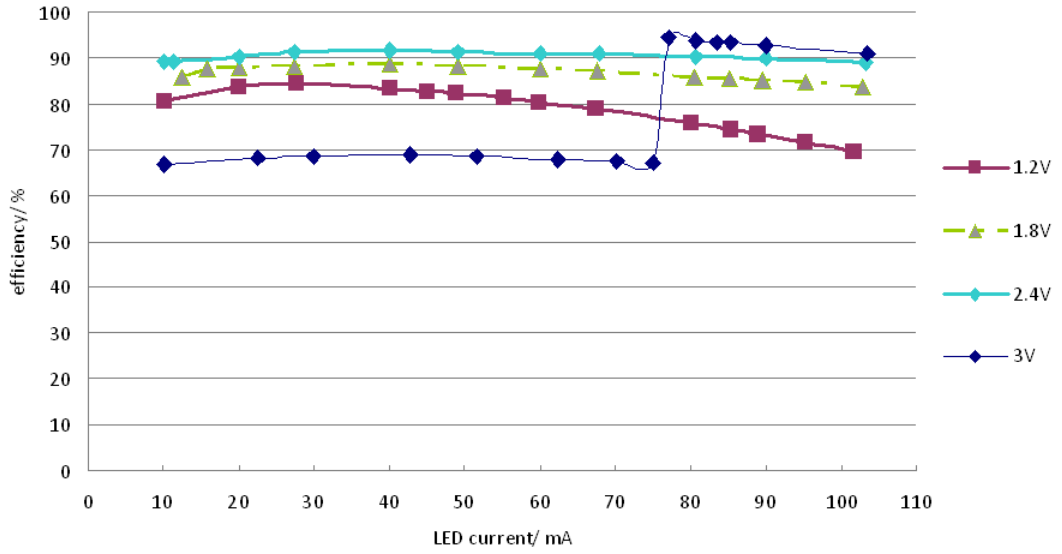


Figure 1. Analog Dimming Efficiency Versus LED Current

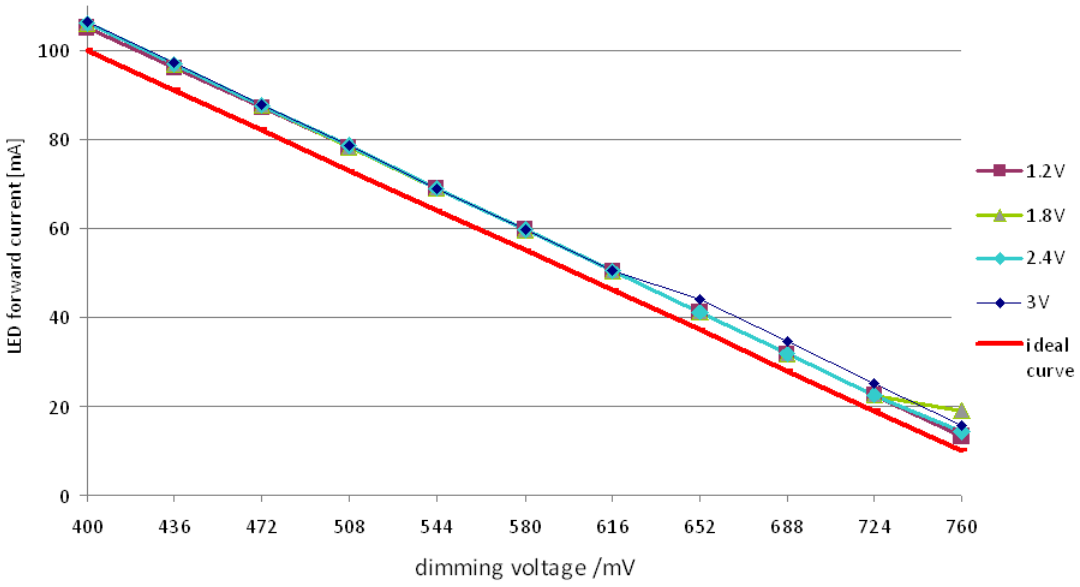


Figure 2. Analog Dimming Voltage Versus LED Current

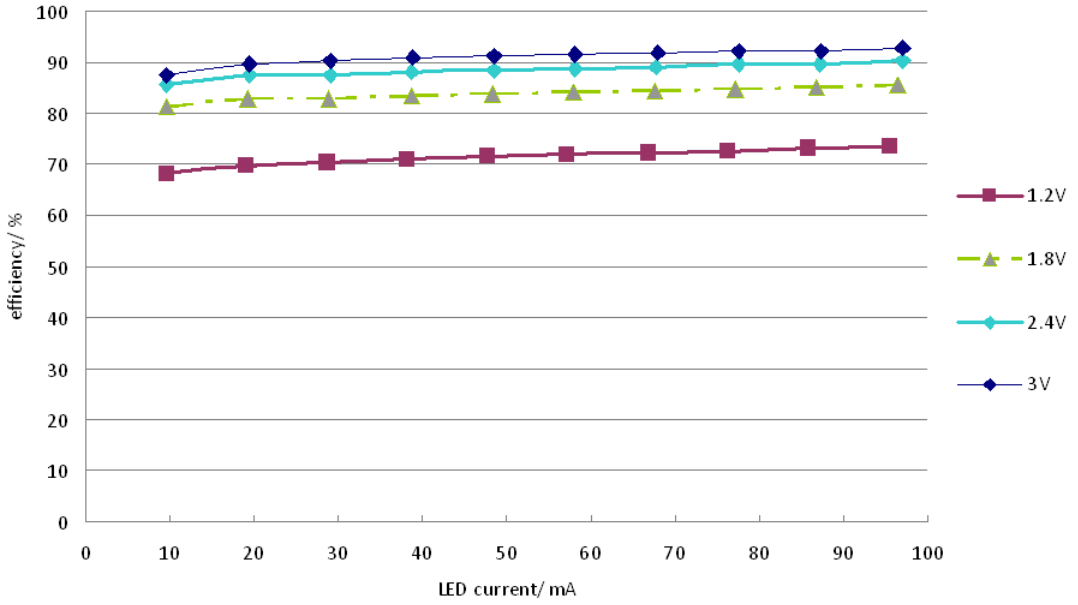


Figure 3. PWM Dimming Efficiency Versus LED Current

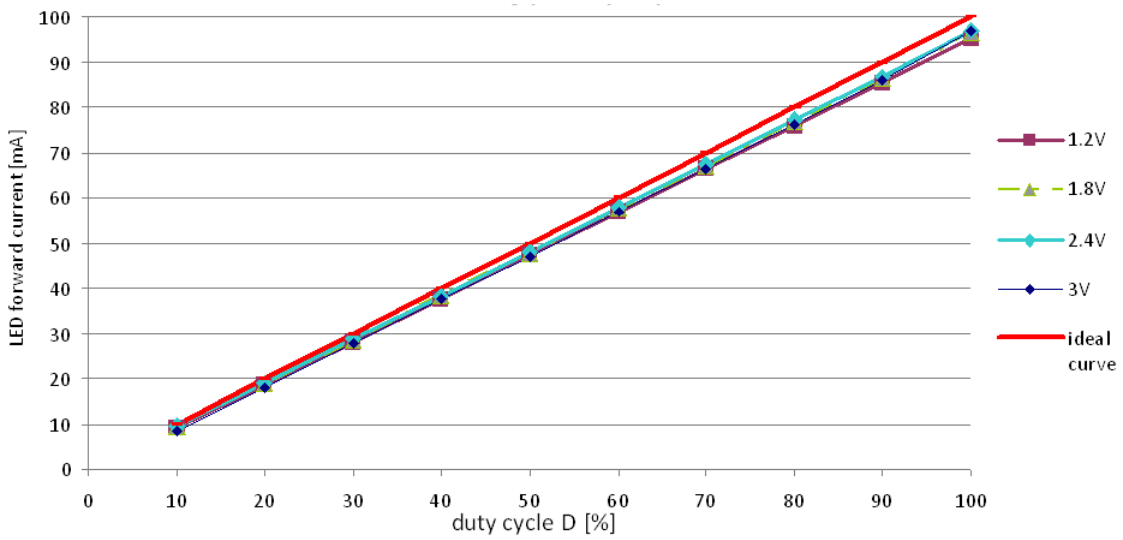


Figure 4. PWM Dimming Duty Cycle Versus LED Current

5 Board Layout

This section provides the board layout of the EVM. A 2-layer PCB with a number of vias near the LED was used to help with the thermal dissipation of the LED. Users must carefully design their system to handle the thermal challenges raised by the LEDs.

Board layout is critical for all switch-mode power supplies. See the data sheet (SLVSA99) for specific layout and routing guidelines.

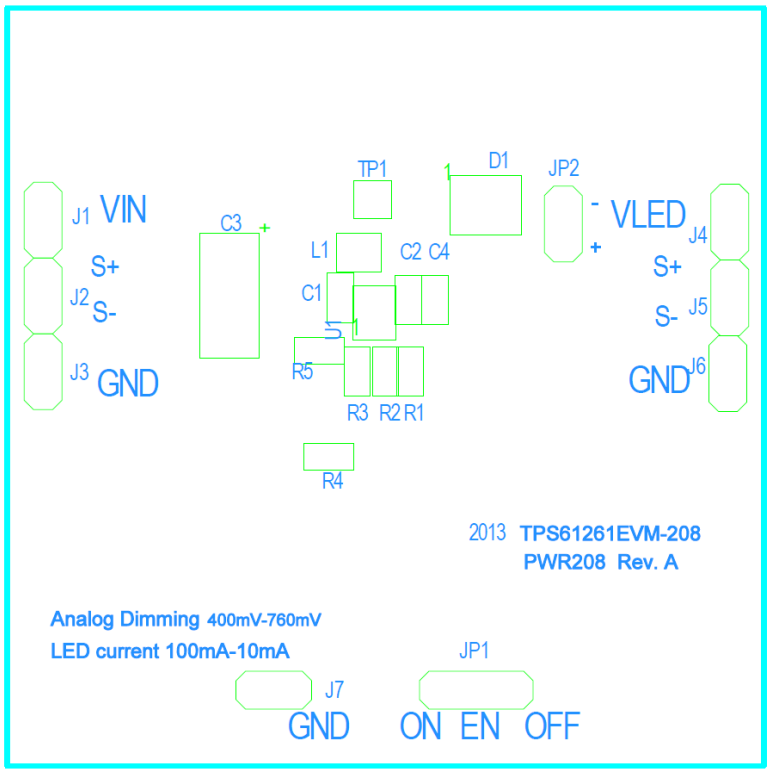


Figure 5. Top Silkscreen Layer

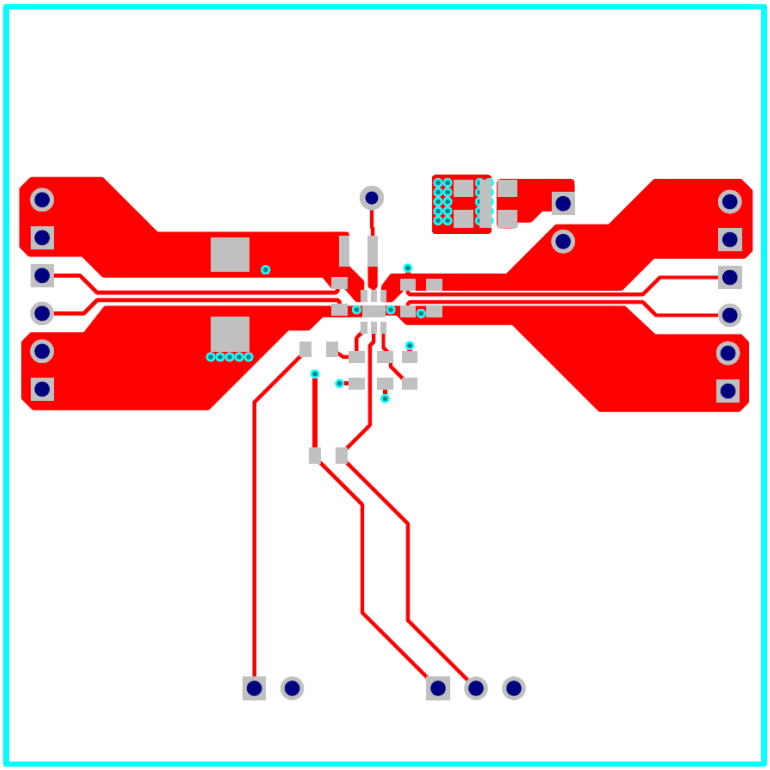


Figure 6. Top Layer

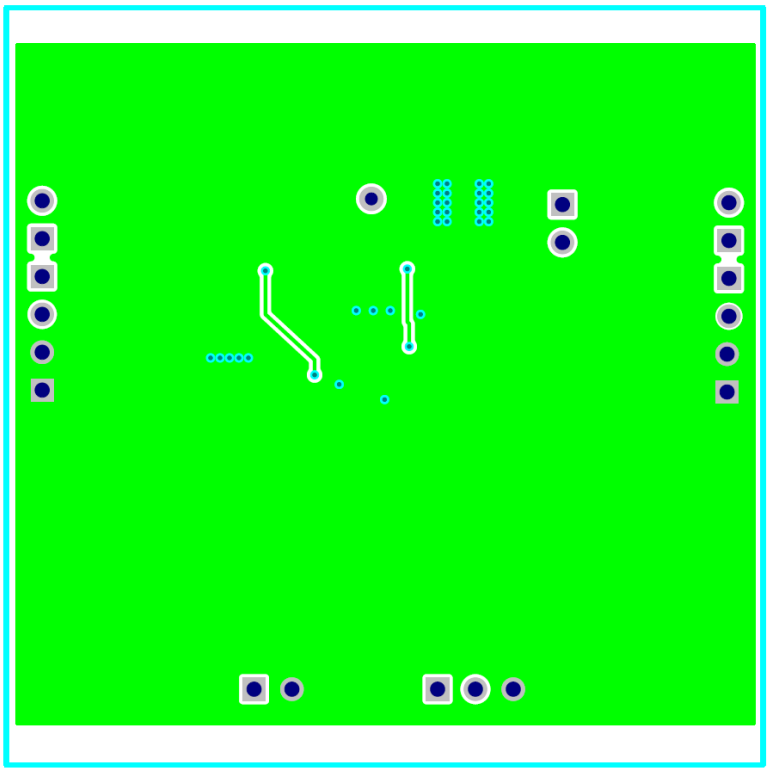


Figure 7. Bottom Layer

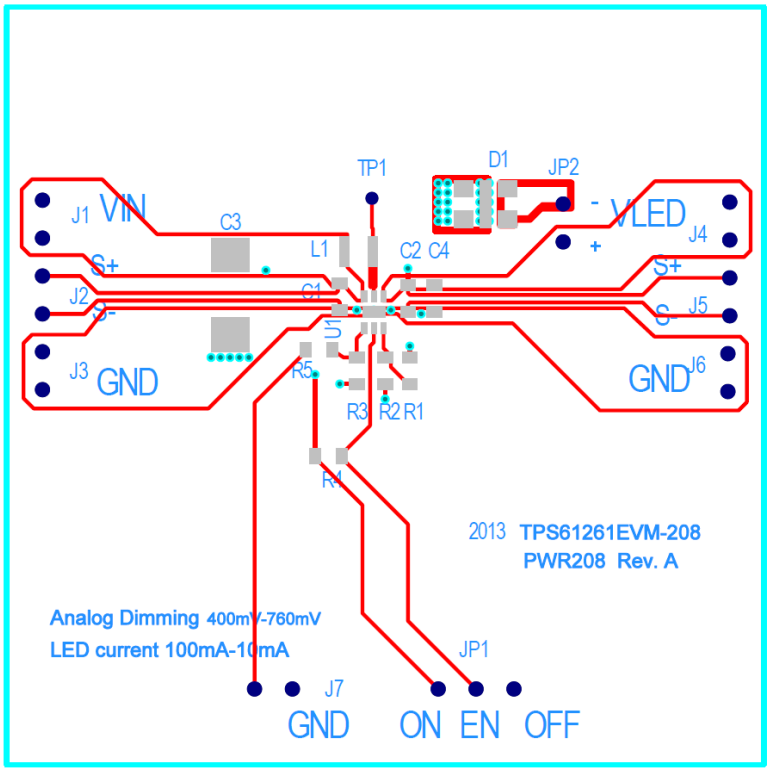
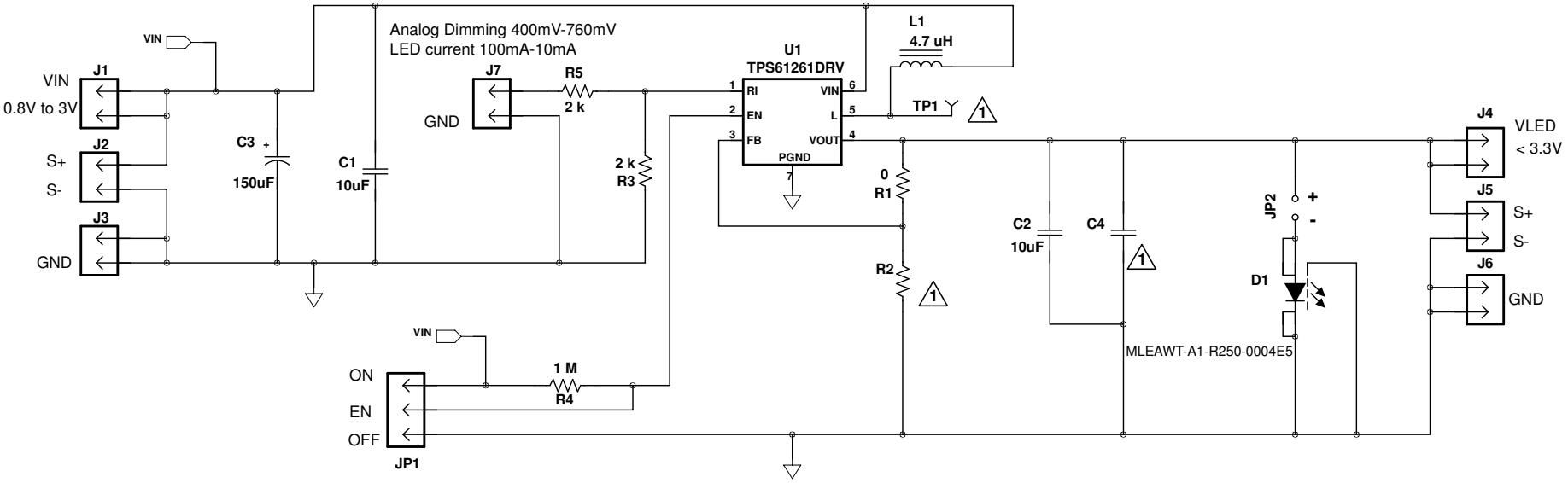


Figure 8. Copper Pour Outline

6 Schematic and Bill of Materials

This section contains a schematic and bill of materials for the EVM.

6.1 TPS61261EVM-208 Schematic



1 Not Installed

6.2 TPS61261EVM-208 Bill of Materials

Table 2. Bill of Materials

Qty	RefDes	Value	Description	Size	Part Number	MFR
1	C3	150uF	Capacitor, Tantal,10V,20%	6032 (C)	T520C157M010ATE055	kemet
2	C1-2	10uF	Capacitor, Ceramic,6.3V,,X5R,20%	0603	GRM188R60J106ME47D	Murata
1	D1		Diode, LED 1/4 W, 175 mA	3.5x3.5 mm	MLEAWT-A1-R250-0004E5	CREE
1	L1	4.7 uH	Inductor, Power,1.1A,138 milliohms	2.5X2.0 mm	LQM2HPN4R7MG0	muRata
1	R1	0	Resistor, Chip, 1/10W, 1%	0603	STD	STD
1	R4	1M	Resistor, Chip, 1/10W, 1%	0603	STD	STD
2	R3 R5	2K	Resistor, Chip, 1/10W, 1%	0603	STD	STD
1	U1	TPS61261DRV	IC, Tiny Low Input Voltage Boost Converter	SON	TPS61261DRV	TI

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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.

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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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