TPS61196EVM-600 User's Guide

This user's guide contains background information for the TPS61196 as well as setup and operation instructions for the TPS61196EVM-600 evaluation module (EVM). Also included are test results, printed-circuit board (PCB) layouts, schematics, and the bill of materials (BOM) for the EVM.

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1 Introduction

TI's TPS61196EVM-600 evaluation module contains the TPS61196 integrated circuit (IC), a six-channel, 400-mA WLED driver. The TPS61196 provides a highly-integrated solution for LCD TV backlight with an independent PWM dimming function for each channel. This EVM helps designers evaluate the operation and performance of the TPS61196. The EVM contains one DC/DC converter as shown in Table 1.

Table 1. Device and Package Configurations

CONVERTER	IC	PACKAGE
U1	TPS61196	HTSSOP

1.1 Performance Specification Summary

The EVM is designed to operate from an input voltage source ranging from 10 V–30 V, and provides a continuous 200-mA output current for each string. The OVP voltage is set to 60 V but can be adjusted for the specific application.

Table 2 provides a summary of the TPS61196EVM-600 performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 2. Typical Performance Specification Summary

	CONDITION	MIN	TYP	MAX	UNITS
V_{IN} supply		10		30	V
I_{OUT}			787		mA

2 Jumper and Connector Setup

This section describes the jumpers and connectors on the EVM as well and how to properly connect, set up and use the TPS61196EVM-600.

2.1 Input/Output Connector Description

J1 – Input: This header is the power input terminals for the converter. The terminal block provides a power (V_{IN}) and ground (GND) connection to allow the user to attach the EVM to a cable harness.

J3 – 8-pin Connector: This header provides connections to the boost converter output (V_{OUT}) and the six current feedback lines (IFBx). With a 8-pin ribbon cable, this header can be connected to six LED strings, to facilitate evaluation.

J4 – FAULT: This header is a fault indicator to indicate abnormal conditions. When the TPS61196 is operating normally, the voltage at the FAULT pin is low. When a fault condition happens, it is in high impedance, which can be pulled to high level through an external resistor.

J5 – PWM Combination: This header provides flexible PWM control, PWM1–PWM6 can be controlled together by one PWM signal or can be controlled by six independent PWM signals.

J6 – GND: This header connects to GND.

JP1, JP3 to JP7 – IFB1 to IFB6: These jumpers are used to enable IFBx channels. Shorting pin 1 and pin 2 enables the IFBx channel and shorting pin 2 and pin 3 disables the corresponding channel.

JP2 – EN: This jumper is used to enable the device. Connecting pin1 and pin2 will toggle the EN high and enable the device. Connecting pin2 and pin3 will toggle the EN low and disable the device.

JP8 – PWM: This jumper is used to send a high or low signal to the J5 jumper. Connecting pin1 and pin2 will send a high signal to J5. Connecting pin2 and pin3 will send a low signal to J5.

2.2 Setup

This EVM requires an external power supply capable of providing 10 V to 30 V at 5 A. To change the default current value (that is, implement dimming), the user can apply either a PWM signal to JP8-pin2 and connect PWM1–PWM6 together, or apply six independent PWM signals to PWM1–PWM6.

The hardware connections of TPS61196EVM-600:

- The DC power supply is connected between J1-pin1 and J1-pin2.
- The LED array is connected to the J3.
- The one single PWM dimming signal can be connected to JP8-pin2, six independent PWM dimming signals can be connected to J5-pin 2, 4, 6, 8, 10, 12.

The range of dimming frequency is 90 Hz to 22 kHz. The output overvoltage protection is set to 60 V, which can be adjusted by R7 in SCH, then can drive different series number of LEDs. To ensure the TPS61196EVM-600 operates properly, the minimum output voltage of the board should be more than input power voltage. This requires selection of the LED array carefully to make sure the total forward voltage of the series LEDs is more than the input voltage.

Figure 1 shows the default configuration of the jumpers.

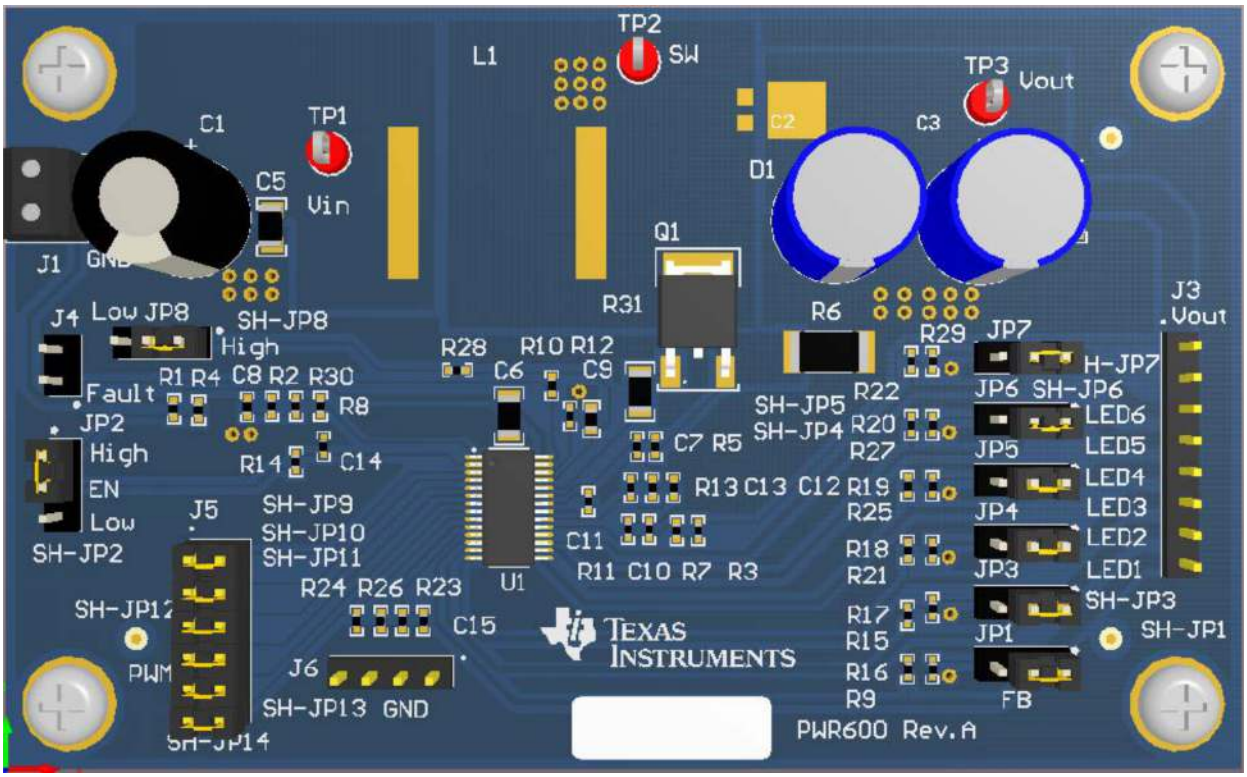

Figure 1. Default Jumper Configuration

3 Operation

This section contains non-dimming and PWM-dimming operation instructions, and EVM test results.

3.1 Non-Dimming Operation (Default Configuration)

For non-dimming operation of the TPS61196EVM-600; J5, JP2, and JP8 should be properly configured as shown in Figure 1. The configuration for JP1 and JP3 to JP7 is determined by the specific application. In this default configuration, the device will power up when power is applied.

3.2 PWM-Dimming Operation

Remove the jumper on JP8 of the default configuration, connect the appropriately configured function generator output between JP8-pin2 and JP8-pin3 (for GND connection) to control PWM1–PWM6 together, or connect six independent PWM signals between J5-pin2, 4, 6, 8, 10, 12 and GND to control PWM1–PWM6. The PWM signal's duty cycle is directly proportional to the regulated current.

3.3 Test Results

Figure 2 and Figure 3 provide typical efficiency for the TPS61196EVM-600 board.

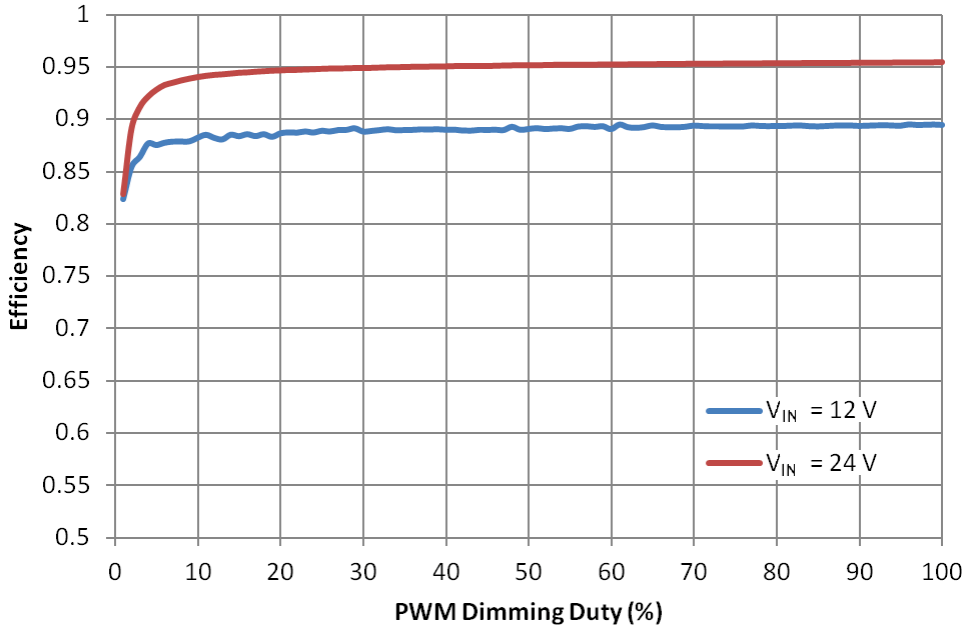

Figure 2. Efficiency Versus Dimming Cycle, 20 LEDs

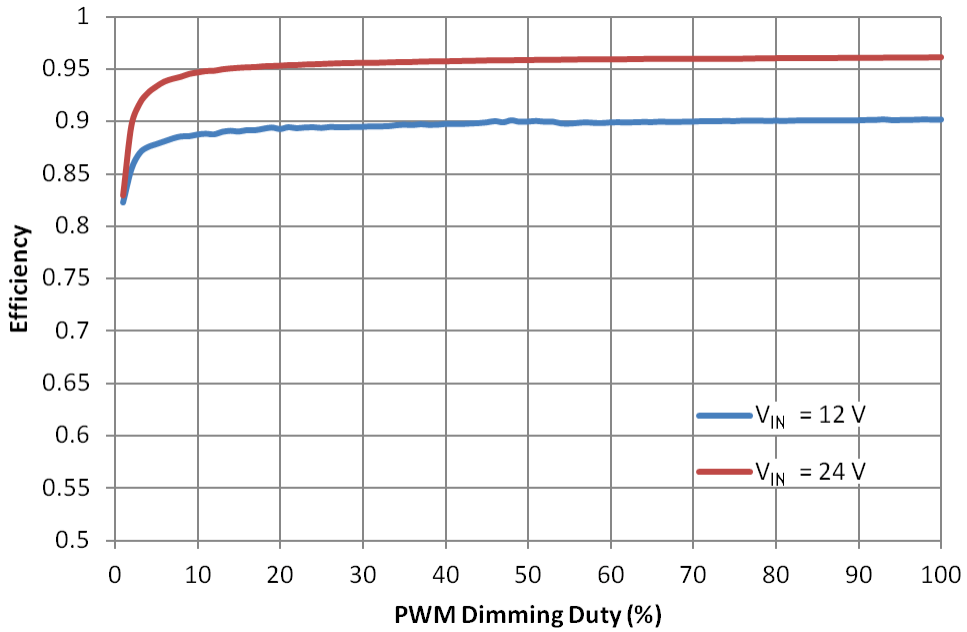

Figure 3. Efficiency Versus Dimming Cycle, 16 LEDs

4 Board Layout

Figure 4, Figure 5, and Figure 6 show the board layout for the TPS61196EVM-600. The EVM offers resistors, capacitors and jumpers. Jumpers are provided to configure the device.

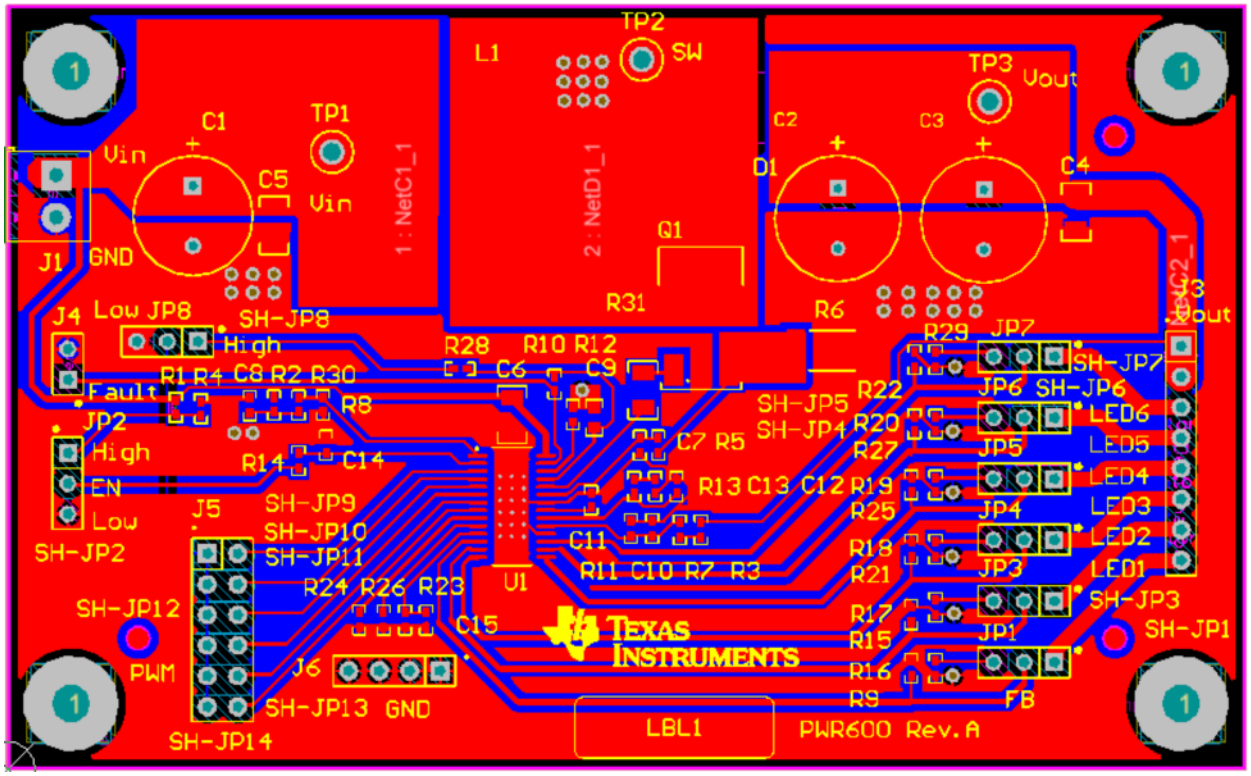

Figure 4. Top Assembly Layer

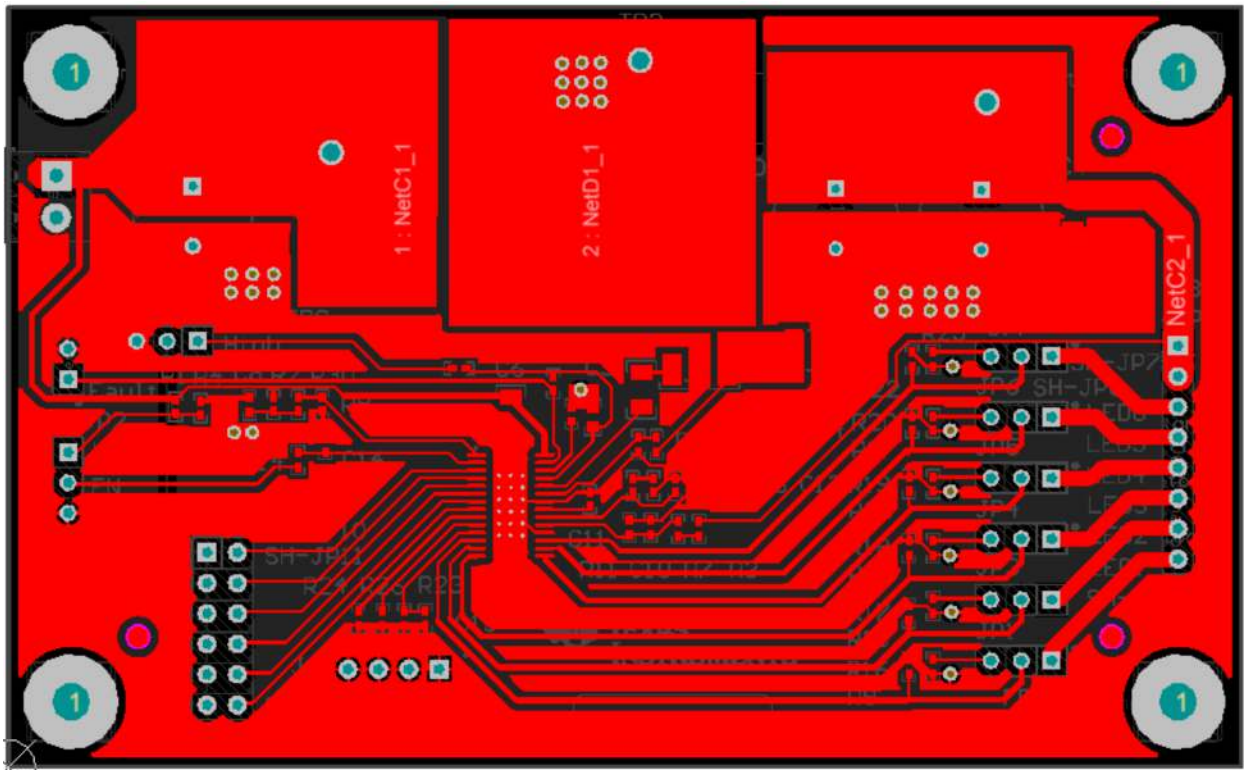

Figure 5. Top Layer Routing

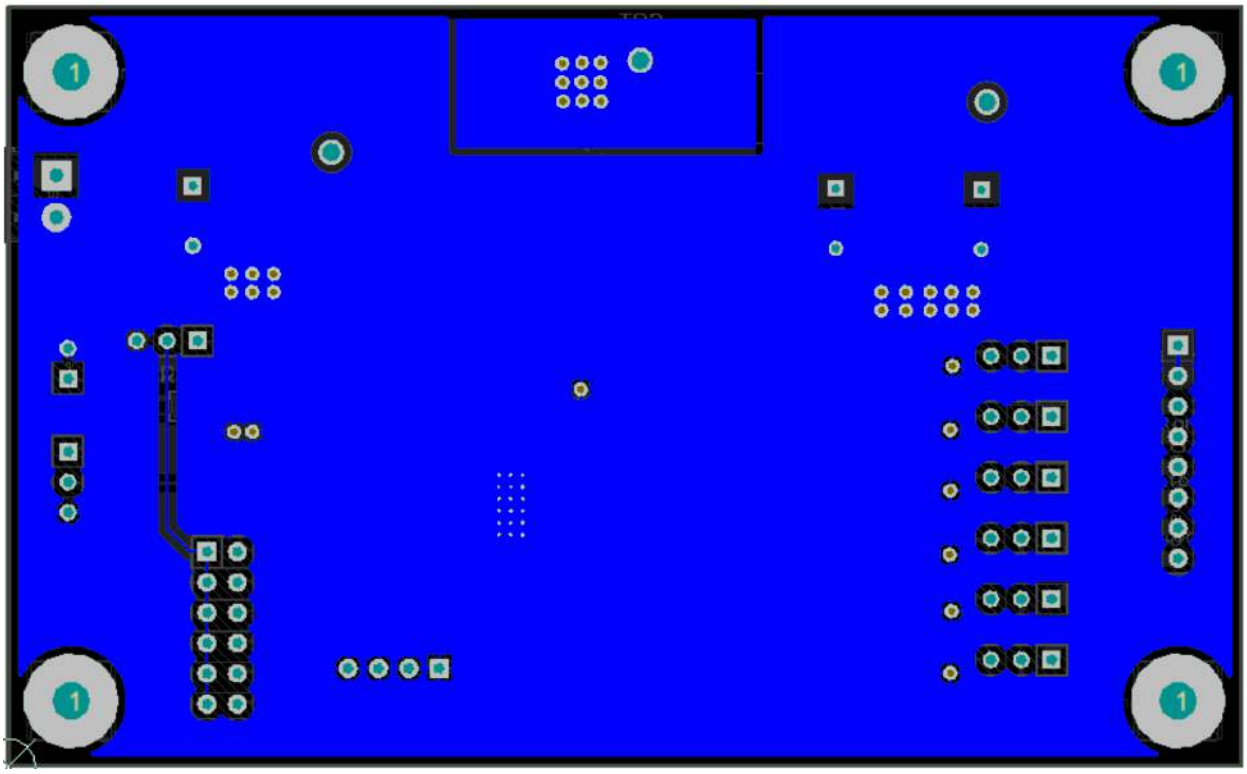

Figure 6. Bottom Layer Routing

5 Schematics

Figure 7 illustrates the schematic for this EVM.

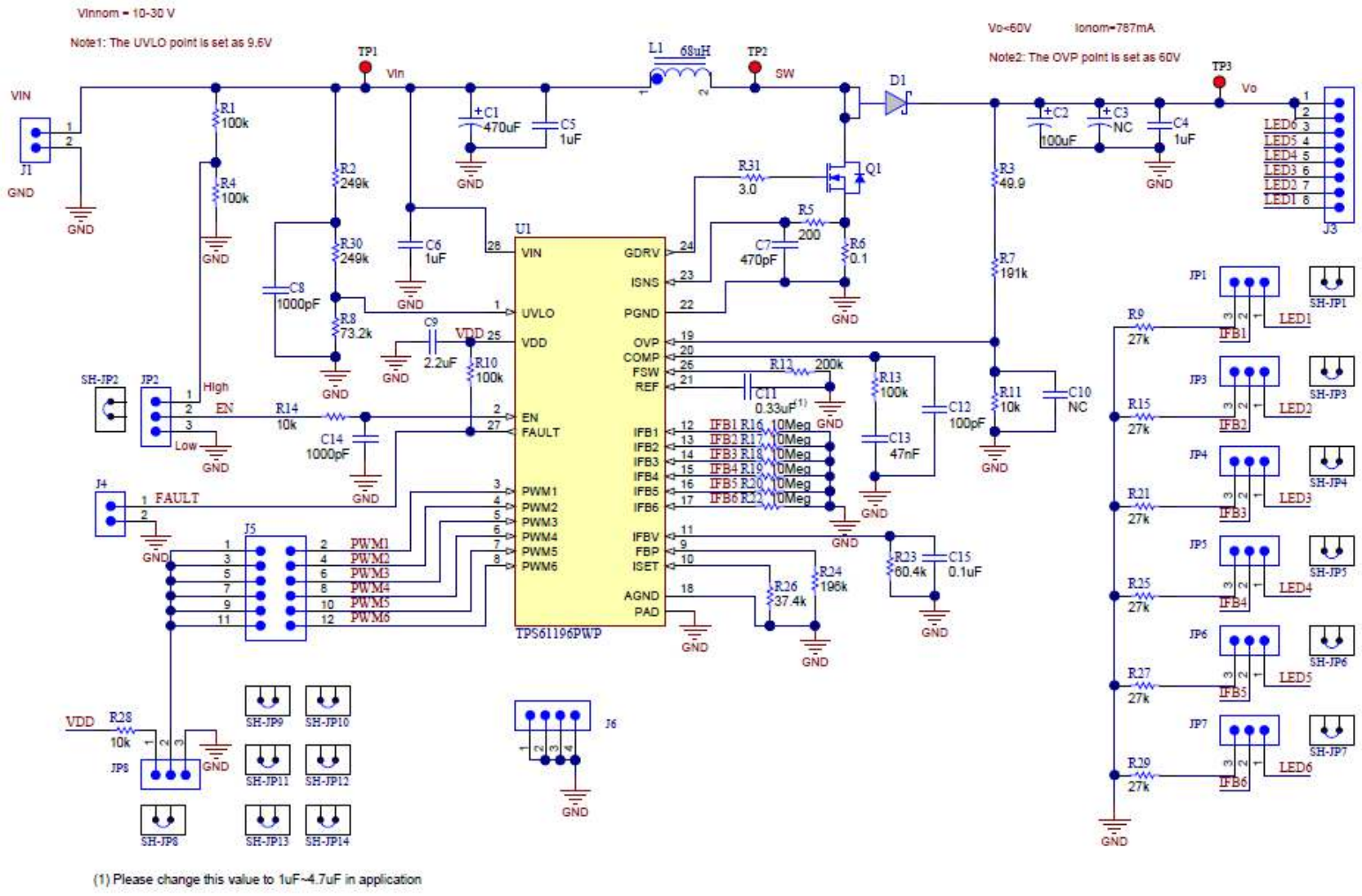

Figure 7. TPS61196EVM-600 Schematic

6 Bill of Materials

Table 3 contains the BOM for the TPS61196EVM-600.

Table 3. TPS61196EVM-600 Bill of Materials

RefDes	Qty	Value	Package	PN
C1	1	470uF	10x20	35ZL470MEFC10X20
C2	1	100uF	10x23	100ZL100MEFC10X23
C4	1	1uF	1206	C3216X7R2A105M
C5, C6	2	1uF	1206	C3216X7R1H105K
C7	1	470pF	0402	C1005C0G1H471J
C8, C14	2	1000pF	0402	C1005C0G1E102J
C9	1	2.2uF	0603	C0603C225K8PACTU
C12	1	100pF	0402	GRM1555C1H101JA01D
C11	1	0.33uF(1)	0402	GRM155C80J334KE01D
C13	1	0.047uF	0402	GRM155R60J473KA01D
C15	1	0.1uF	0402	C1005X5R0J104K
D1	1	SS5P10-M3/86A	TO-277	SS5P10-M3
H1, H2, H5, H6	4		Standoff	1902C
H3, H4, H7, H8	4		Screw	NY PMS 440 0025 PH
J1	1		7.0x8.2x6.5mm	ED555/2DS
J3	1		8x1 Header	TSW-108-07-G-S
J4	1		Header, 2 PIN, 100mil, Tin	PEC02SAAN
J5	1		6x2 Header	TSW-106-07-G-D
J6	1		4x1 Header	TSW-104-07-G-S
JP1, JP2, JP3, JP4, JP5, JP6, JP7, JP8	8		Header, 3 PIN, 100mil, Tin	PEC03SAAN
L1	1	68uH	0.675 x 0.675 inch	IHLP6767GZER680M1
LBL1	1		PCB Label 0.650"H x 0.200"W	THT-14-423-10
Q1	1	100V	DPAK	SUD40N10-25-E3
R1, R4, R10, R13	4	100k	0402	CRCW0402100KJNED
R2, R30	2	249k	0402	CRCW0402249KFKED
R3	1	49.9	0402	CRCW040249R9FKED
R5	1	200	0402	CRCW0402200RFKED
R6	1	0.1	2512	CRA2512-FZ-R100ELF
R7	1	191k	0402	CRCW0402191KFKED
R8	1	73.2k	0402	CRCW040273K2FKED
R9, R15, R21, R25, R27, R29	6	27k	0402	CRCW040227K0JNED
R11, R14, R28	3	10k	0402	CRCW040210K0JNED
R12	1	200k	0402	CRCW0402200KFKED
R16, R17, R18, R19, R20, R22	6	10Meg	0402	CRCW040210M0JNED
R23	1	60.4k	0402	CRCW040260K4FKED
R24	1	196k	0402	CRCW0402196KFKED
R26	1	37.4k	0402	CRCW040237K4FKED
R31	1	3.0	1206	CRCW12063R00JNEA
SH-JP1, SH-JP2, SH-JP3, SH-JP4, SH-JP5, SH-JP6, SH-JP7, SH-JP8, SH-JP9, SH-JP10, SH-JP11, SH-JP12, SH-JP13, SH-JP14	14	1x2	Shunt	969102-0000-DA
TP1, TP2, TP3	3	Red	Keystone5010	5010
U1	1		PWP0028D	TPS61196PWP
PCB	1			PWR600
FID1, FID2, FID3	0		Fiducial	N/A
C3	0	100uF	10x23mm	100ZL100MEFC10X23
C10	0	100pF	0402	GRM1555C1H101JA01D

(1) Please change this value to 1 µF–4.7 µF in the application.

7 Related Documentation From Texas Instruments

See the TPS61196 datasheet (SLVSBG1C) for more information.

Revision History

Changes from Original (January 2014) to A Revision	Page
• Changed schematic image.	7
• Added note to BOM on row that begins with C11.	8

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

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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.

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

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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.

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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.

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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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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
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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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

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Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

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