TPS61176EVM-566

User's Guide

Literature Number: SLVU998
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TPS61176EVM-566 User's Guide

1 Introduction

The TI TPS61176 evaluation module (EVM) helps designers evaluate the operation and performance of the TPS61176 High-Efficiency 6-Channel WLED Driver Supporting Single-Cell Li-Ion Battery Input.

The EVM contains one WLED driver.

2 Connection and Setup of the EVM

This section describes the jumpers and connectors on the EVM and how to properly connect, set up, and use the TPS61176EVM-566.

2.1 Input and Output Connector Description

J1 – VIN: This header is the positive terminal of the input power supply. Twist its leads to the input power supply, and keep them as short as possible.

J2 – PGND: This header is the return terminal of the input power supply.

J3 – 14-pin connector: This header provides connections to the boost converter output (VOUT), the six current feedback lines (IFBx), and return terminal (PGND) of loads. With a 14-pin ribbon cable, this header can be connected to WLEDEVM-260, containing six strings of 12 LEDs, to facilitate evaluation.

J4 and J5 – PGND: These two headers connect to the PGND.

JP1 to JP6 – IFB1 to IFB6: These jumpers are used to enable IFBx channels. Shorting pin 2 and pin 3 enables the IFBx channel and shorting pin 1 and pin 2 disables the corresponding channel.

JP7: This jumper is used to short the isolation FET, when not in fault mode.

JP8: This jumper is used to measure the output load current via connecting a current meter to its leads. When no current is measured, short its leads.

JP9 – EN and PWM : This header is the enable and PWM control of the board. Shorting pin 1 and pin 2 enables the TPS61176 device and shorting pin2 and pin3 disables the device. An external PWM control signal could be delivered between pin 2 and pin 3 for the dimming function.

JP10 – MODE/FAULT: This jumper configures the MODE/FAULT pin of the TPS61176 device. Shorting pin 2 and pin 3 sets the device to run in mode 1. Q1 does not shut off when this is done, so JP7 should be shorted at the same time. Shorting pin 1 and pin 2 sets the device to run in mode 3; Q1 is on, until there is a fault. Q1 can also be shorted by JP7.

2.2 Setup

The minimum hardware equipment to evaluate the TPS61176EVM includes: one DC power supply with 25-V at 1-A capability to power the board, one function generator to generate PWM dimming signal, and an LED array load.

Hardware connections of the TPS61176EVM-566:

- The DC power supply is connected between the J1 and J2.
- The LED array is connected to the J3.
- The PWM dimming signal is connected to the mid-lead of the JP9.

The input voltage range of the DC power supply is 2.7 to 6.5 V. The range of the dimming frequency is 100 Hz to 22 kHz. The maximum OVP threshold of the TPS61176EVM-566 is configured up to 38 V. To ensure the TPS61176EVM-566 operates properly, the minimum output voltage of the board should be more than the input power voltage. This requires the user to select 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 jumpers.

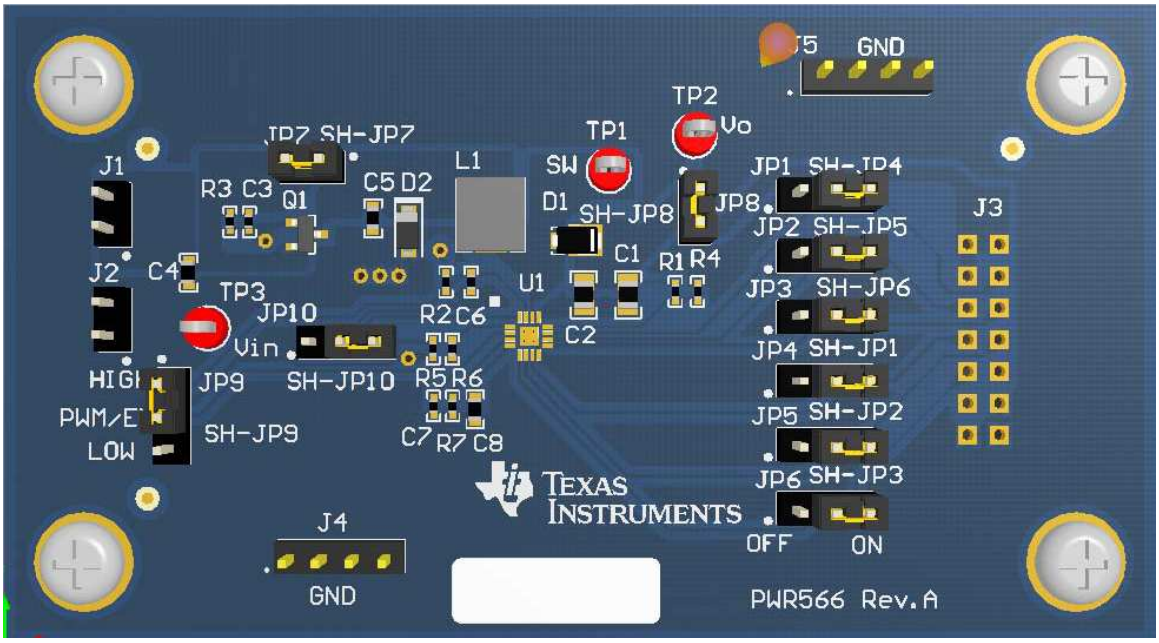

Figure 1. Default Configuration of Jumpers

3 Operation

3.1 Non-Dimming Operation (Default Configuration)

For non-dimming operation of the TPS61176EVM-566, jumpers should be properly configured as in Figure 1. This is the default setting.

3.2 Dimming Operation

Remove the jumper on JP9 of default configuration, connect the appropriately configured function generator output between pin 2 and pin 3 (for GND connection) of JP9. The device powers up when VIN power and the PWM signal are applied. The recommended PWM signal frequency is from 100 Hz to 22 kHz, and the recommended PWM duty is from 1 to 100%. The regulated output current is proportional to the PWM signal duty cycle.

3.3 Dimming Mode Selection

TPS61176 device has four dimming modes. See Table 1.

Table 1. Dimming Mode

MODE	MODE RESISTOR	DIMMING MODE	SWITCH POINT BETWEEN ANALOG AND PWM DIMMING (%)
Mode 1 (default)	1.3 MΩ (5%)	Analog dimming and 22-kHz fixed-frequency PWM dimming	25
Mode 2	620 kΩ (5%)	Analog dimming and direct PWM dimming	25
Mode 3	220 kΩ (5%)	Analog dimming and 22-kHz fixed-frequency PWM dimming	12.5
Mode 4	82 kΩ (5%)	Analog dimming and direct PWM dimming	12.5

Configuration of JP10 sets the TPS61176EVM-566 to operate in mode 1 or mode 3. See Section 2.1 for more information.

3.4 Test Results

This section provides the typical efficiency for the TPS611176EVM-566 board.

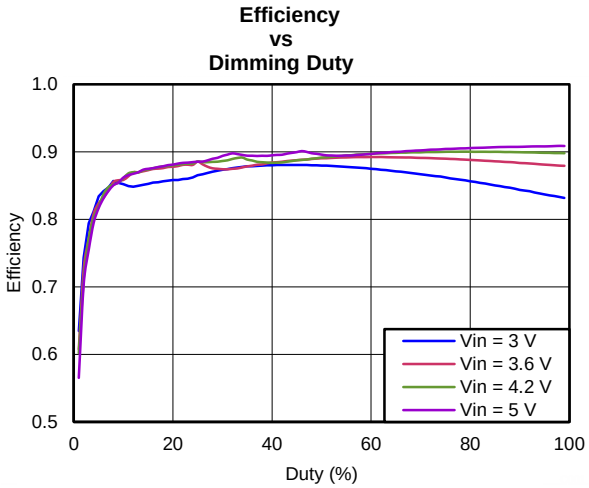

Figure 2. 6s6p, 20 mA/channel

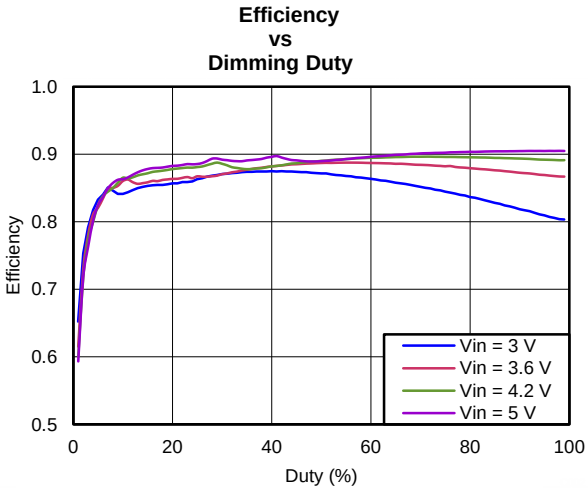

Figure 3. 7s6p, 20 mA/channel

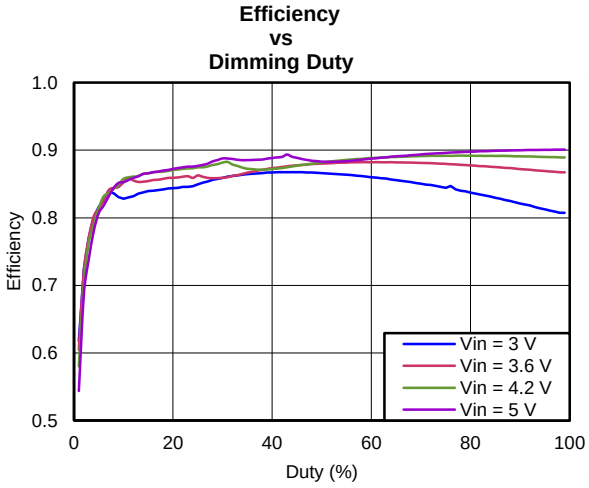

Figure 4. 8s5p, 20 mA/channel

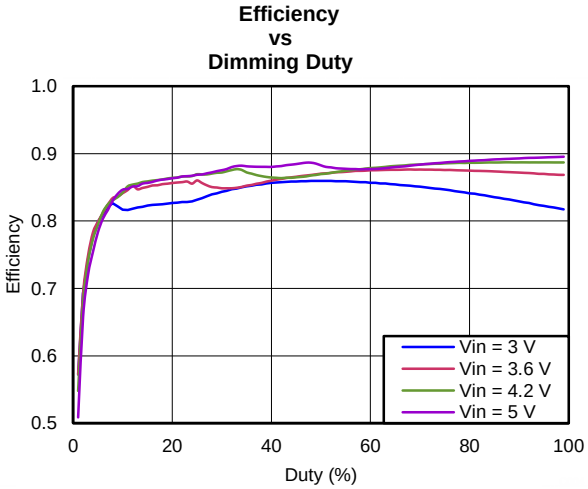

Figure 5. 9s4p, 20 mA/channel

4 Board Layout

Figure 6, Figure 7, and Figure 8 show the board layout for the TPS61176EVM.

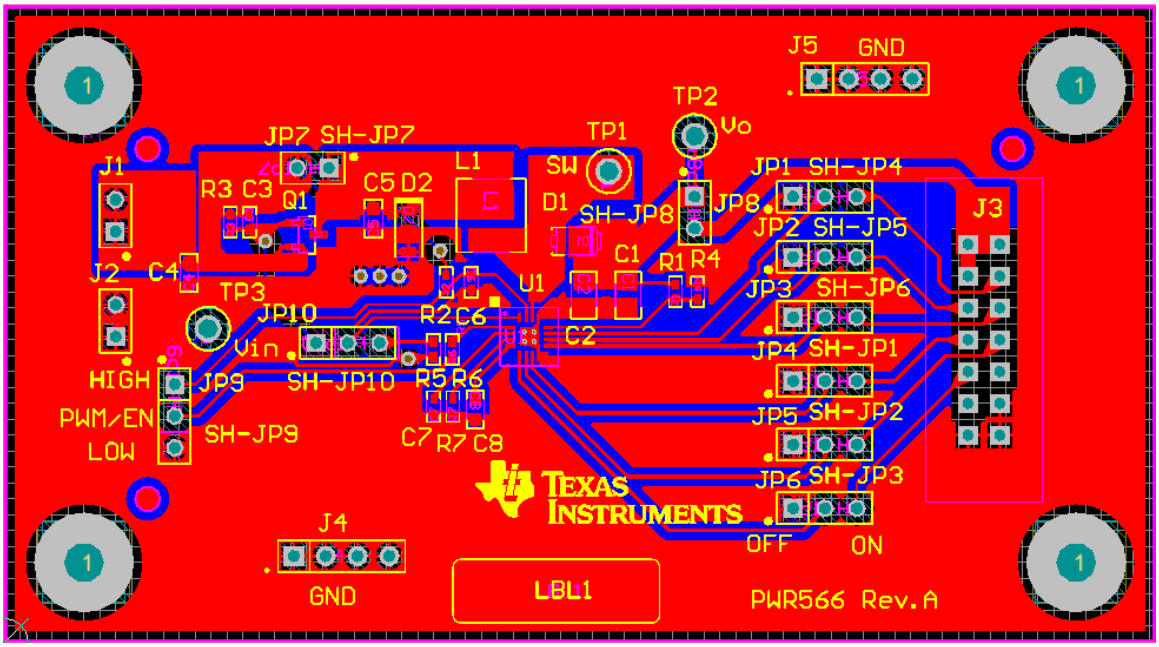

Figure 6. Overview of the Top Layer

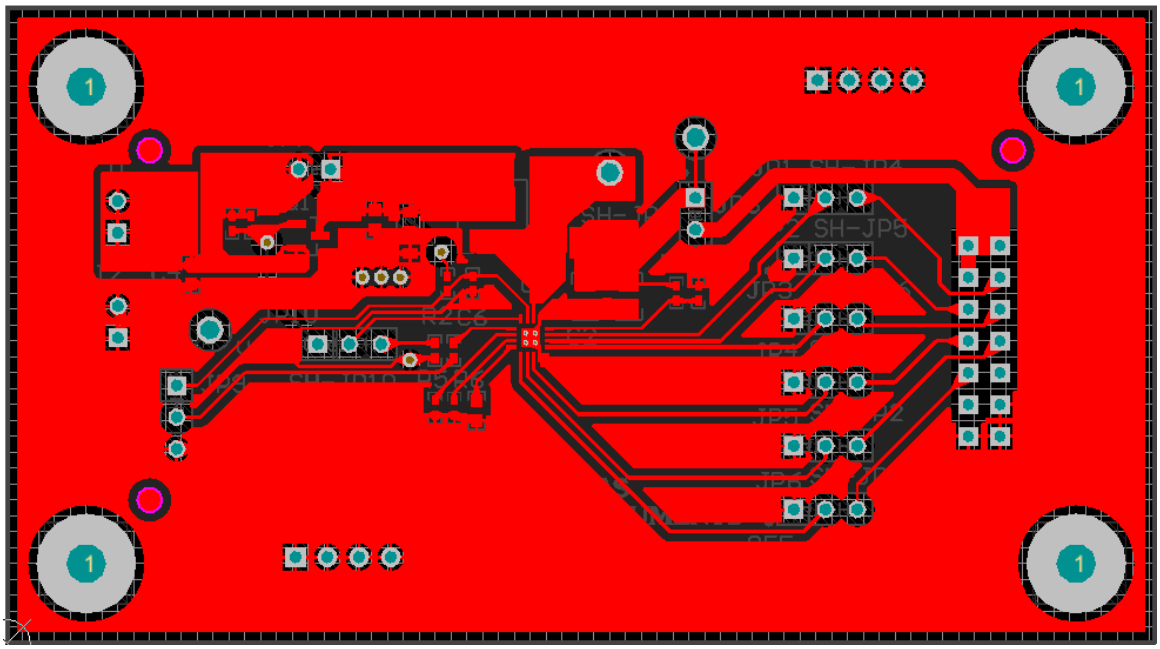

Figure 7. Top-Layer Routing

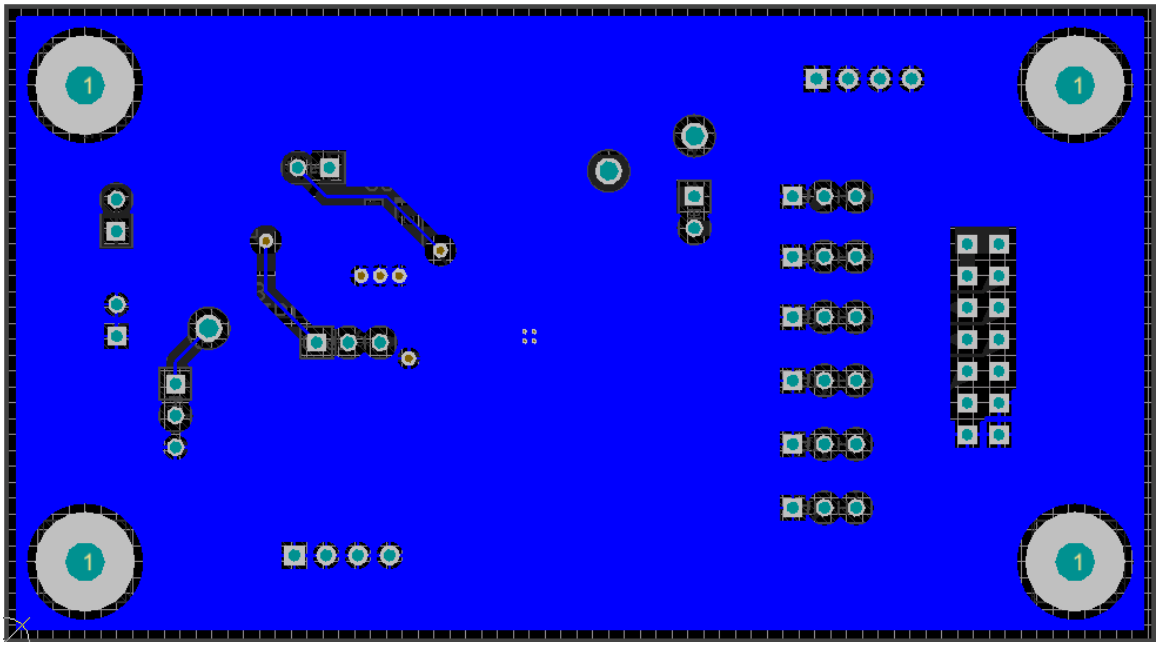

Figure 8. Bottom-Layer Routing

5 Schematic

Figure 9 shows the schematic of the TPS61176EVM-566.

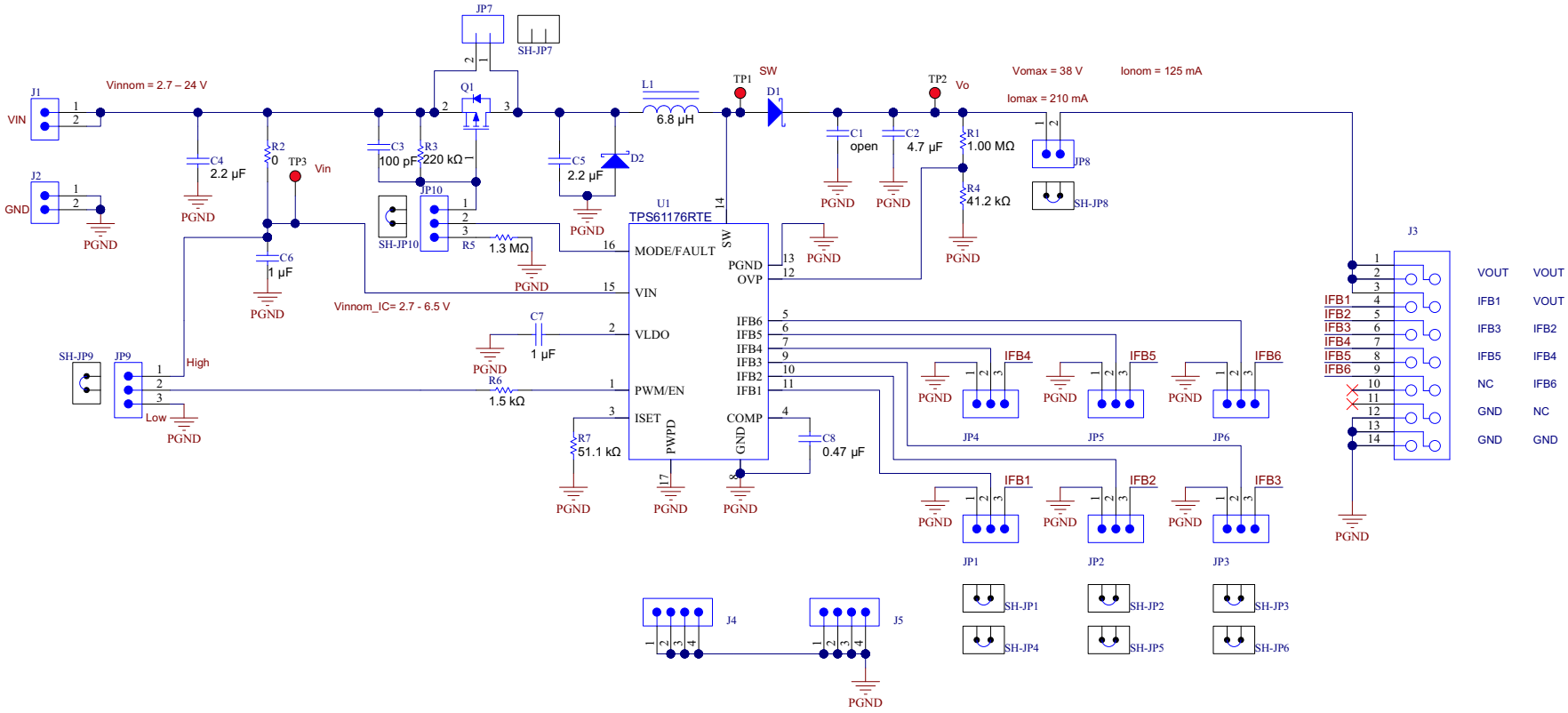

Figure 9. TPS61176EVM Schematic

6 Bill of Materials

Designator	Quantity	Description	Part Number	Manufacturer
C2	1	CAP, CERM, 4.7 µF, 50 V, ±10%, X5R, 0805	C2012X5R1H475K125AB	TDK
C3	1	CAP, CERM, 100 pF, 50 V, ±5%, C0G/NP0, 0402	GRM1555C1H101JA01D	MuRata
C4, C5	2	CAP, CERM, 2.2 µF, 10 V, ±10%, X5R, 0603	C0603C225K8PACTU	Kemet
C6, C7	2	CAP, CERM, 1 µF, 10 V, ±10%, X5R, 0402	GRM155R61A105KE15D	MuRata
C8	1	CAP, CERM, 0.47 µF, 16 V, ±10%, X7R, 0603	C0603C474K4RACTU	Kemet
D1	1	Diode, Schottky, 50 V, 2 A, DO-220AA	SS2P5-M3	Vishay-Semiconductor
D2	1	Diode, Schottky, 30 V, 0.2 A, SOD-123	BAT42W-7-F	Diodes Inc.
H1, H2, H5, H6	4	Standoff, Hex, 0.5"L #4-40 Nylon	1902C	Keystone
H3, H4, H7, H8	4	Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	NY PMS 440 0025 PH	B&F Fastener Supply
J1, J2, JP7, JP8	4	Header, 100 mil, 2 × 1, Tin plated, TH	PEC02SAAN	Sullins Connector Solutions
J3	1	Connector, Male Straight 2 × 7 pin, 100 mil spacing, 4 Wall	2514-6002RB	3M
J4, J5	2	Header, TH, 100mil, 4 × 1, Gold plated, 230 mil above insulator	TSW-104-07-G-S	Samtec, Inc.
JP1, JP2, JP3, JP4, JP5, JP6, JP9, JP10	8	Header, 100mil, 3 × 1, Tin plated, TH	PEC03SAAN	Sullins Connector Solutions
L1	1	Inductor, Powdered Iron, 6.8uH, 2.8A, 0.107 ohm, SMD	PCMB051H-6R8MS	Cyntec
LBL1	1	Thermal Transfer Printable Labels, 0.650" W x 0.200" H – 10,000 per roll	THT-14-423-10	Brady
Q1	1	MOSFET, P-CH, –20 V, –2.4 A, SOT-23	FDN302P	Fairchild Semiconductor
R1	1	RES, 1.00 Meg ohm, 1%, 0.063 W, 0402	CRCW04021M00FKED	Vishay-Dale
R2	1	RES, 0 ohm, 5%, 0.063W, 0402	MCR01MZPJ000	Rohm
R3	1	RES, 220 k ohm, 5%, 0.063W, 0402	CRCW0402220KJNED	Vishay-Dale
R4	1	RES, 41.2 k ohm, 1%, 0.063W, 0402	CRCW040241K2FKED	Vishay-Dale
R5	1	RES, 1.3 Meg ohm, 5%, 0.063W, 0402	CRCW04021M30JNED	Vishay-Dale
R6	1	RES, 1.5 k ohm, 5%, 0.063W, 0402	CRCW04021K50JNED	Vishay-Dale
R7	1	RES, 51.1 k ohm, 1%, 0.063W, 0402	CRCW040251K1FKED	Vishay-Dale
SH-JP1, SH-JP2, SH-JP3, SH-JP4, SH-JP5, SH-JP6, SH-JP7, SH-JP8, SH-JP9, SH-JP10	10	Shunt, 100 mil, Gold plated, Black	969102-0000-DA	3M
TP1, TP2, TP3	3	Test Point, TH, Multipurpose, Red	5010	Keystone
U1	1	IC, High Efficient 6-Channel WLED Driver	TPS61176RTE	TI
PCB	1			
C1	0	CAP, CERM, 4.7 µF, 50 V, ±10%, X5R, 0805	C2012X5R1H475K125AB	TDK
FID1, FID2, FID3	0	Fiducial mark. There is nothing to buy or mount.	N/A	N/A

7 Reference

See the TPS61176RTE data sheet for more information.

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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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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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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.

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