Evaluation Module for TPS65217 Power Management IC

This user's guide describes the characteristics, operation, and use of the TPS65217 evaluation module (EVM). The TPS65217EVM is a fully assembled platform for evaluating the performance of the TPS65217 power management integrated circuit (PMIC). The TPS65217 PMIC is used in systems powered from a single cell (1S) lithium-ion (Li-ion) or lithium-polymer (Li-polymer) where size is a concern. The TPS65217 device has an integrated battery charger and white LED (WLED) boost converter for back-lighting LED strings. This document includes schematic diagrams, a printed circuit board (PCB) layout, and bill of materials.

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1 Introduction

The TPS65217 device is a highly integrated power management solution for portable electronics. Features of the TPS65217 include:

- Power path management for Lithium-ion battery, USB, and AC inputs
- Linear battery charger
- 3 DC/DC step-down (buck) converters
- 2 LDOs
- 2 load switches (also configurable as LDOs)
- White LED driver capable of driving up to 20 LEDs

2 Requirements

2.1 Software

The EVM will power-up and operate without the use of software (refer to Note in Section 2.3). However, to execute I^2C read and write commands to examine status bits or change voltage outputs, the required software (refer to Section 8) must be installed.

2.2 Host Computer

A computer with an available USB port is required to make use of the EVM software. The EVM software runs on the computer and communicates with the EVM through the USB2ANY interface adapter hardware.

2.3 Power Supply

A DC power supply capable of delivering up to 5V and 3A is required to operate this EVM.

NOTE: If a ribbon cable is not connected to from a powered USB2ANY adapter to the EVM at connector J8, the user must still supply 3.3V to the 3P3 node.

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2.4 Evaluation Module PCB

Figure 1 shows the TPS65217CEVM printed circuit board (PCB). The TPS65217AEVM, TPS65217BEVM, and TPS65217DEVM used the same PCB with a different IC revision installed. Unless otherwise noted, TPS65217xEVM refers to all four EVM assembly options.

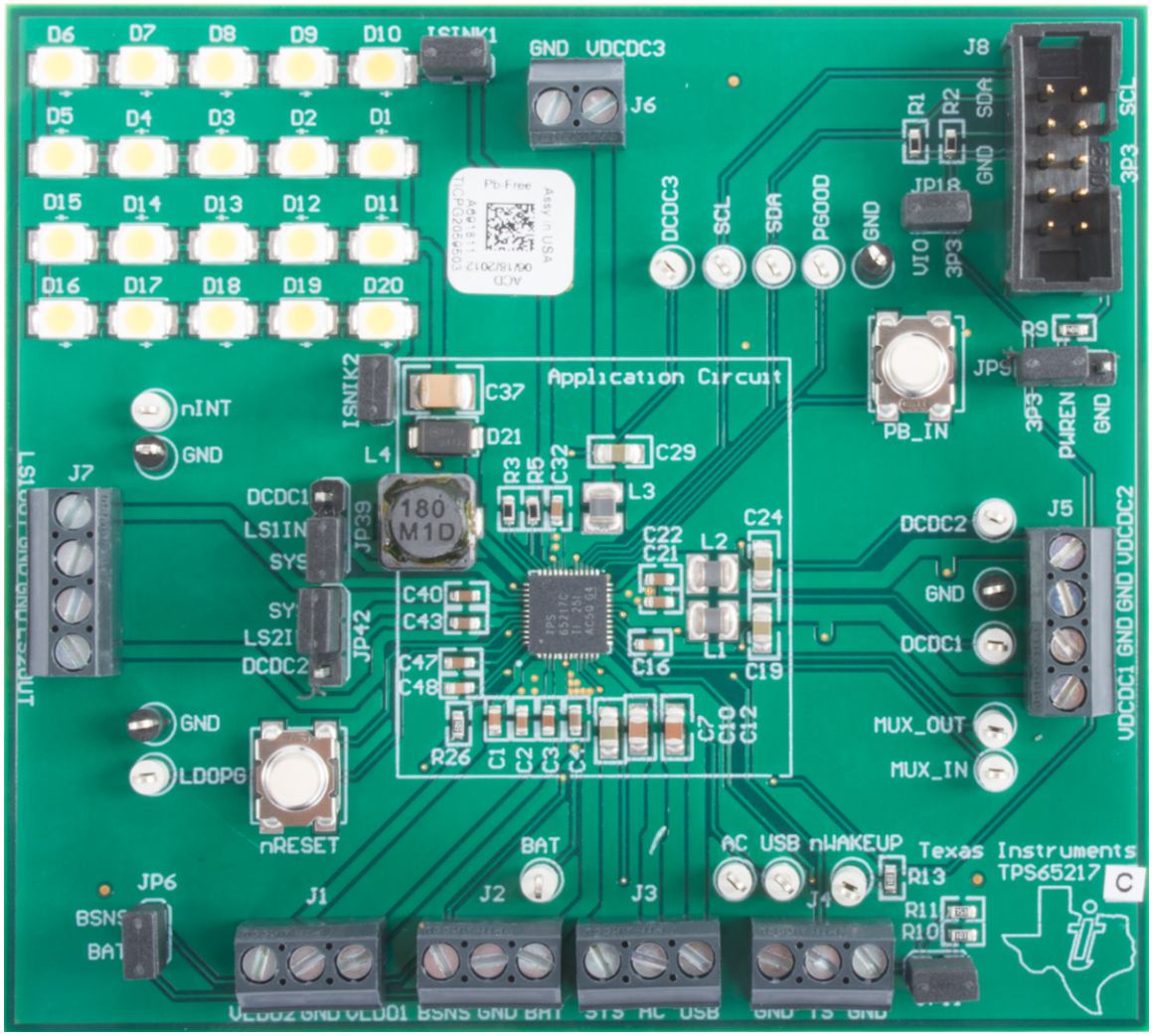


Figure 1. TPS65217xEVM Printed Circuit Board

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3 Schematic

Figure 2 shows the TPS65217 EVM schematic.

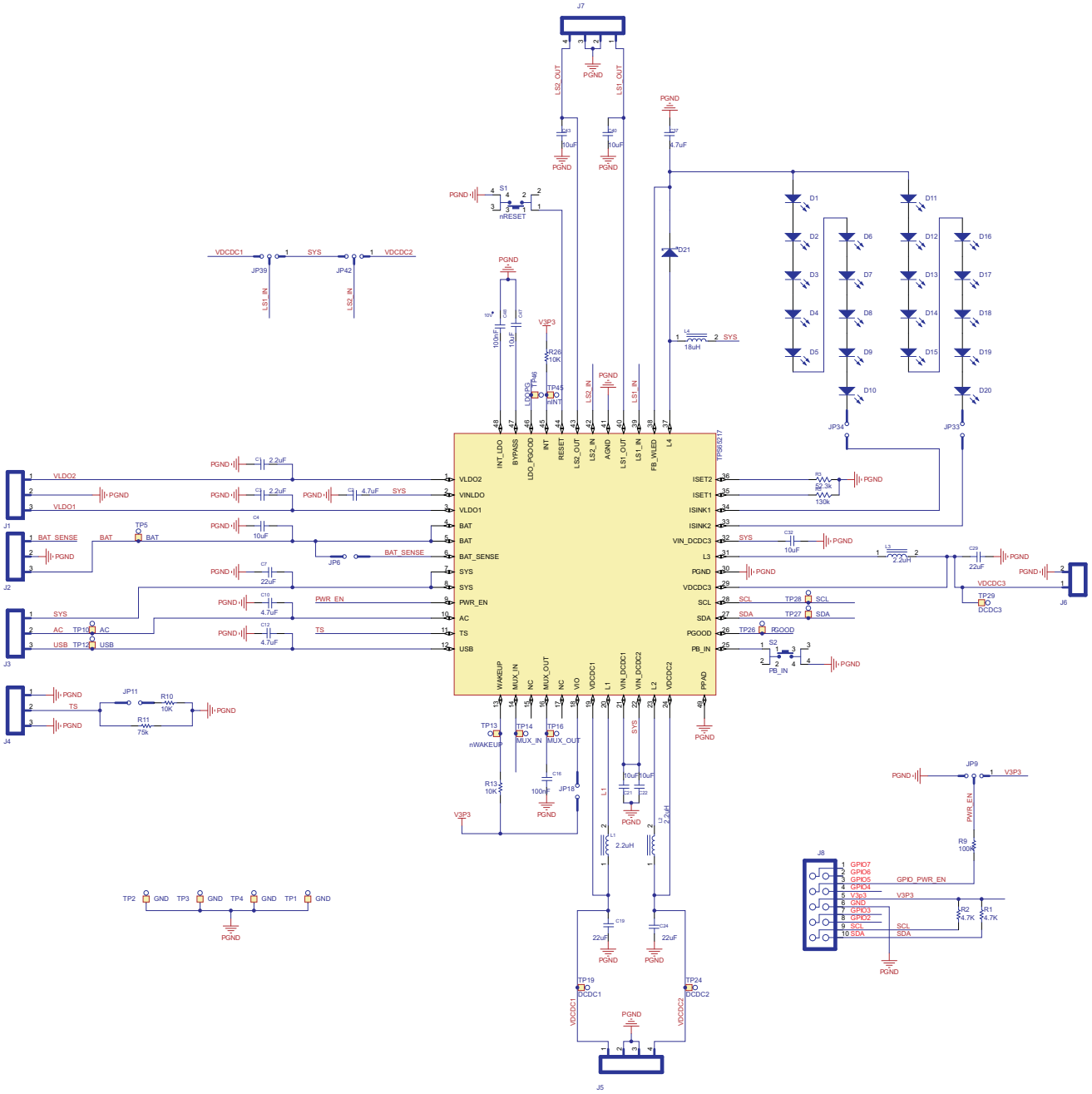


Figure 2. TPS65217 EVM Schematic

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4 Terminal Block Descriptions

Table 1 lists the terminal blocks.

Table 1. Terminal Blocks

Connector		Description
J1	VLDO2	Output voltage of LDO2
	GND	Ground
	VLDO1	Output voltage of LDO1
J2	BSNS	Battery Voltage Sense Input
	GND	Ground
	BAT	Battery
J3	SYS	System Voltage
	AC	AC adapter input
	USB	USB voltage input
J4	GND	Ground
	TS	Temperature sense input
	GND	Ground
J5	VDCDC1	DCDC1 output
	GND	Ground
	GND	Ground
	VDCDC2	DCDC2 output
J6	VDCDC3	DCDC3 output
	GND	Ground
J7	LS1OUT	LS1 / LDO3 Output
	GND	Ground
	GND	Ground
	LS2OUT	LS2 / LDO4 Output
J8	SDA	I2C Data
	SCL	I2C Clock
	GND	Ground
	3P3	3.3V
	GPIO_PWR_EN	Software PWR_EN signal

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5 Test Point Descriptions

Table 2 lists the test points.

Table 2. Test Points(1) (2)

Test Point	Description
BAT	Battery
AC	AC adapter input
USB	USB voltage input
nWAKEUP	Wakeup output signal
MUXI	Input to analog multiplexer
MUXO	Output of analog multiplexer
DCDC1	DCDC1 output voltage
GND	Ground
DCDC2	DCDC2 output voltage
GND	Ground
PGOOD	Power Good
SDA	I2C Data
SCL	I2C Clock
DCDC3	DCDC3 output voltage
nINT	Interrupt Output
GND	Ground
GND	Ground
LDOPG	LDO Power Good

(1) Test points are not designed to carry current. They are intended for measuring voltage.
(2) The test points for high current nodes (BAT, AC, USB, DCDC1, DCDC2, and DCDC3) are designed to measure voltage at their respective input/output capacitor.

6 Jumper Descriptions

Table 3 lists the jumpers.

Table 3. Jumpers

Jumper	Description
JP6	Connects battery to battery voltage sense input. User should only install this jumper if use of the battery charger is desired and the supply connected to BAT is capable of sinking current.
JP9	Used to pull PWREN either high or low. If not installed, the software can control PWR_EN via the GPIO_PWR_EN signal.
JP11	Connects TS input to a 10k resistor to simulate a thermistor. If using a battery pack, do not install this jumper. Instead, use J4 to connect thermistor to TS.
JP18	Connects VIO to 3P3. Do not install if other VIO supply is desired.
JP39	Allows user to select input to LS1
JP42	Allows user to select input to LS2
ISINK1	Connects LED string to ISINK1. Must connect to use LEDs.
ISINK2	Connects LED string to ISINK2. Must connect to use LEDs.

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7 Setup

Figure 3 shows an example setup for using TPS65217 EVM.

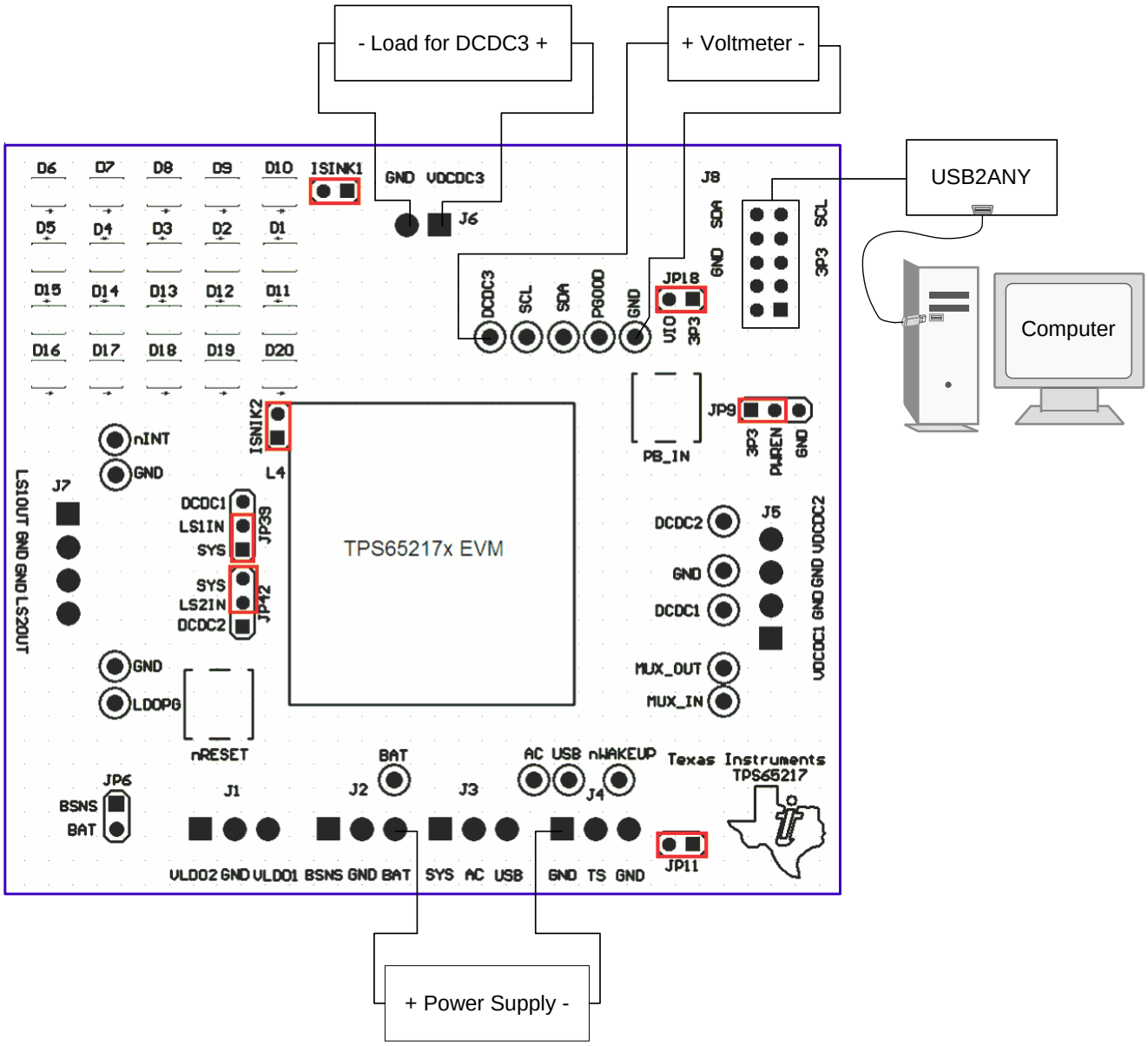


Figure 3. TPS65217 EVM Setup

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8 Software

Software support for controlling the TPS65217 over I^2C using the USB2ANY adapter can be downloaded from www.ti.com/tool/IPG-UI. To install the software and learn how to use the IPG-UI GUI, follow the instructions in the *IPG-UI User's Guide* .

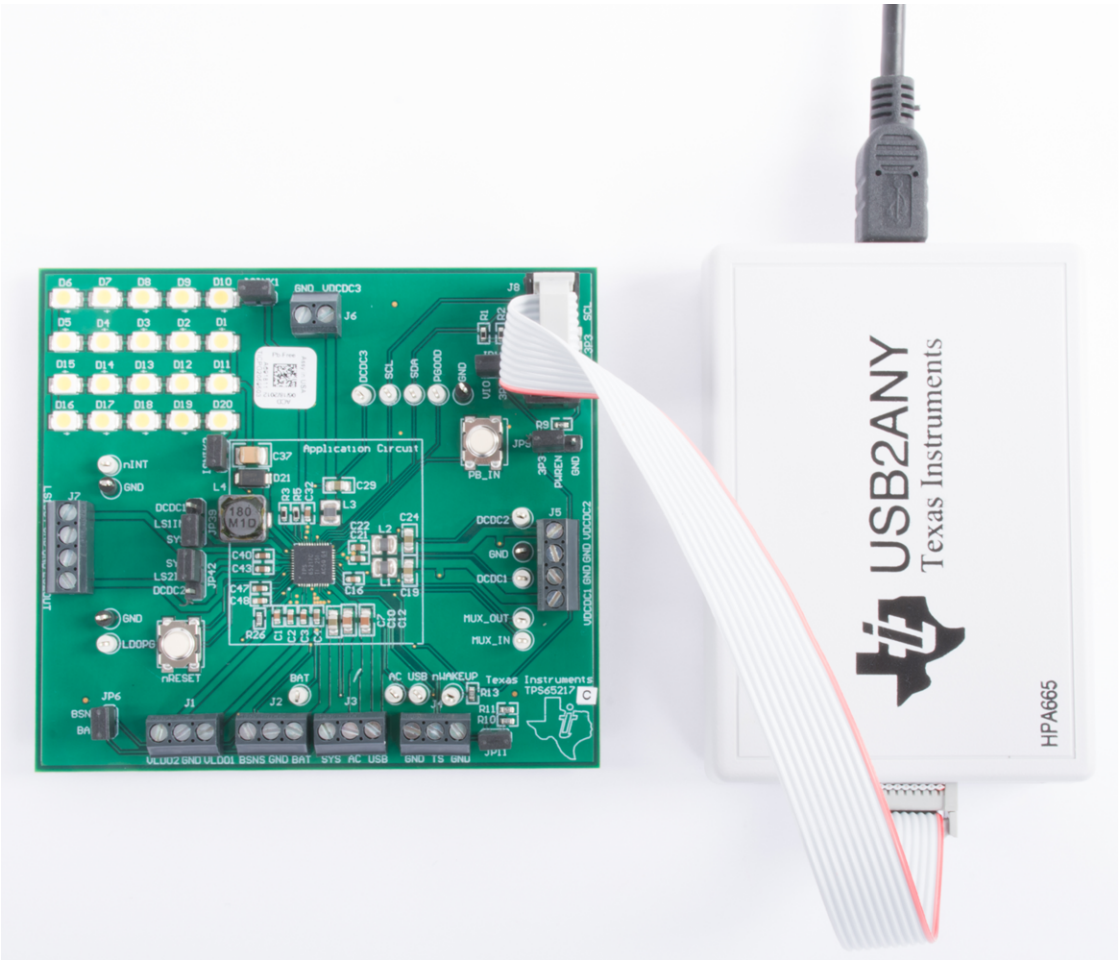


Figure 4. TPS65271 EVM and USB2ANY Connected for Using the IPG-UI Software

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9 Silkscreen Layouts

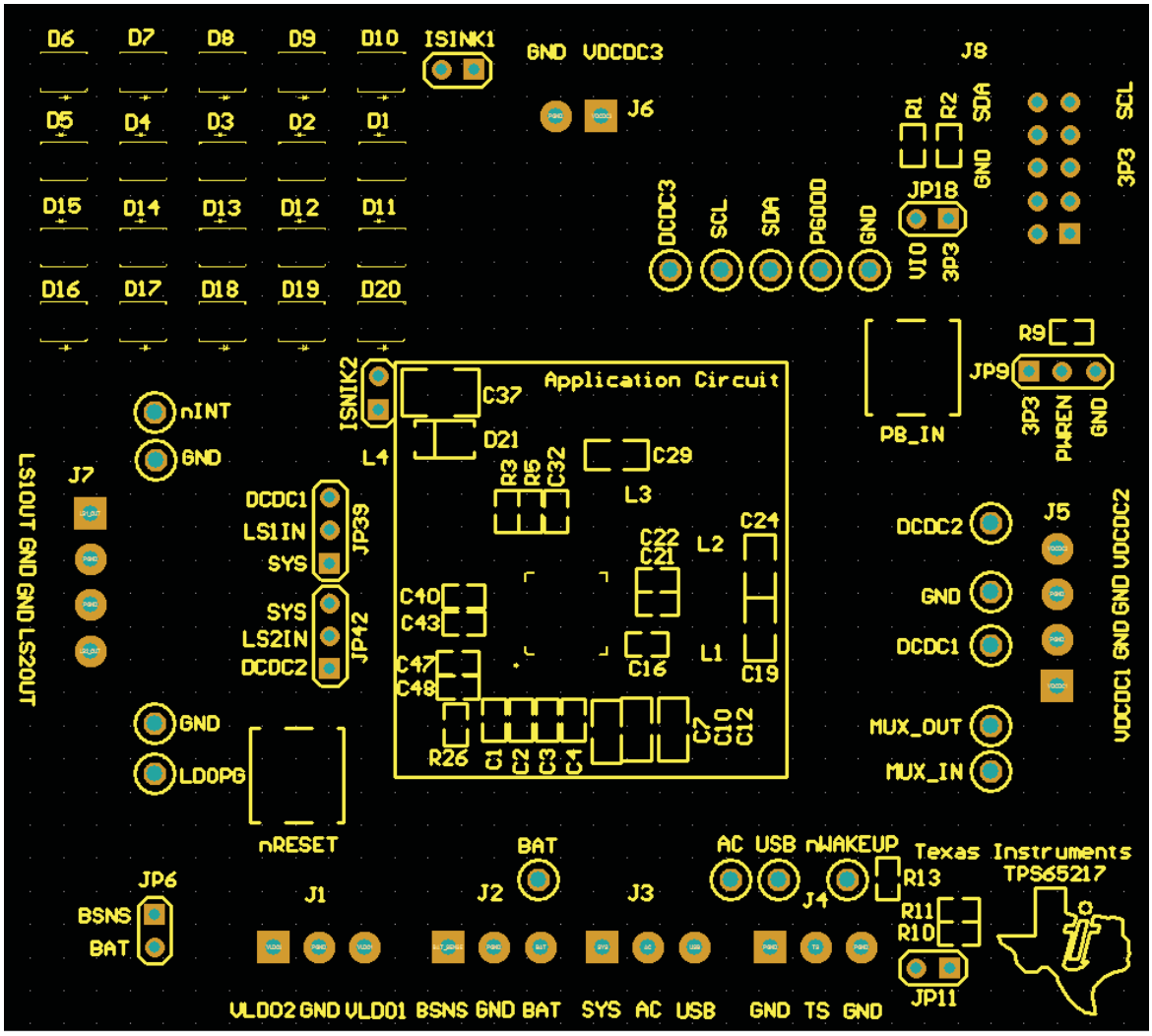


Figure 5. Layout - Silkscreen

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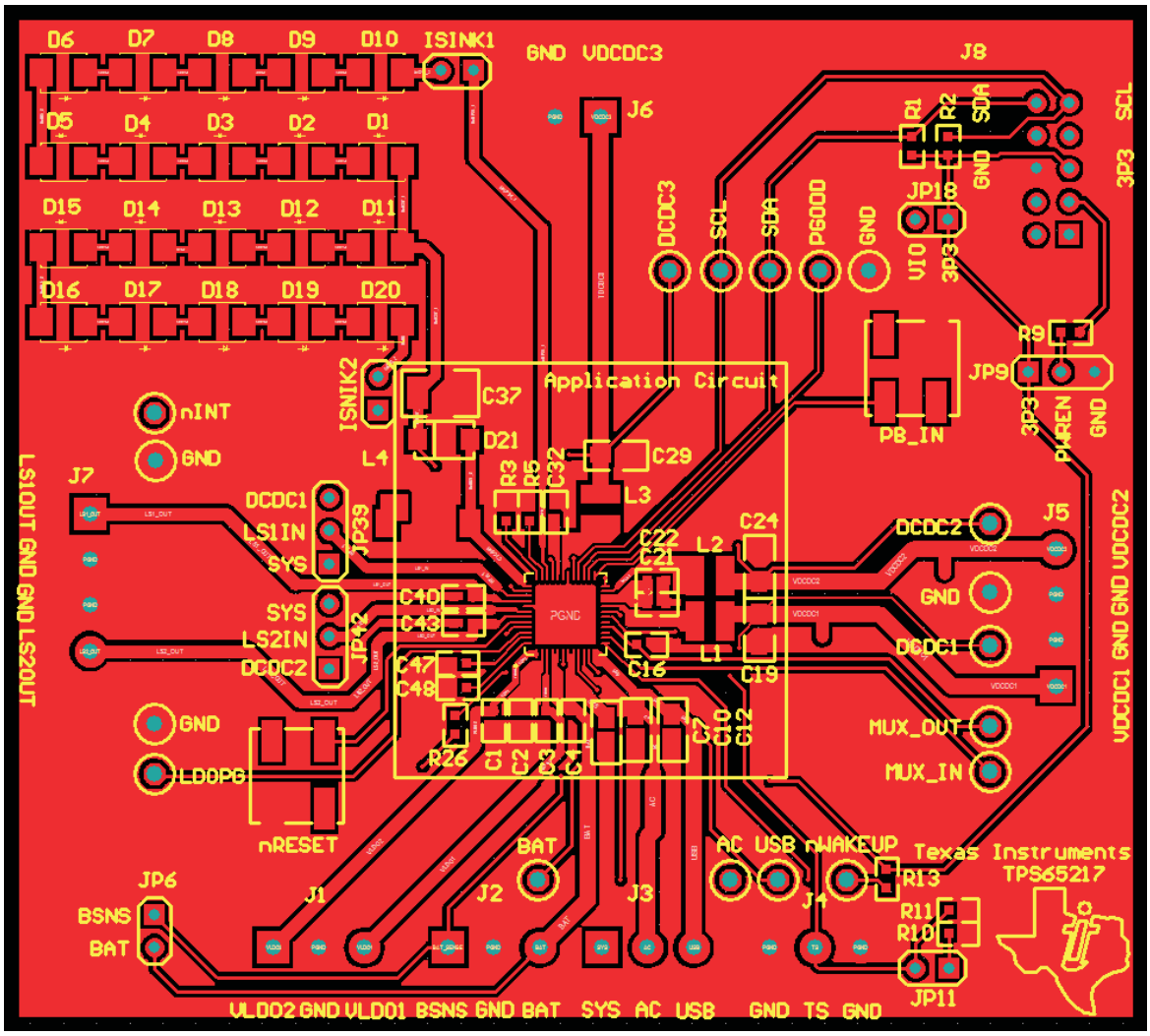


Figure 6. Layout - Top Layer Silkscreen

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10 Bill of Materials

Table 4 lists the bill of materials (BOM) for the EVM.

Table 4. BOM

QTY	Value	Designator	MFR	MFR Part Number	Description
1	–	–	Texas Instruments	TPS65217C	Power Management IC
2	2.2uF	C1, C3	TDK Corporation	C1608X5R1C225K	CAP CER 2.2UF 16V X5R 0603
2	4.7uF	C10, C12	TDK Corporation	C2012X5R1E475K	CAP CER 4.7UF 25V X5R 0805
1	100nF	C16, C48	TDK Corporation	C1608X7R1C104K	CAP CER 0.10UF 16V X7R 10% 0603
1	4.7uF	C2	TDK Corporation	C1608X5R1A475K	CAP CER 4.7UF 10V X5R 0603
1	4.7uF	C37	AVX Corporation	12105C475KAT2A	CAP CER 4.7UF 50V X7R 10% 1210
7	10uF	C4, C21, C22, C32, C40, C43, C47	TDK Corporation	C1608X5R1A106M	CAP CERAMIC 10UF 10V 0603 X5R
4	22uF	C7, C19, C24, C29	Taiyo Yuden	LMK212BJ226MG-T	CAP CERAMIC 22UF 10V 0805 X5R
20	–	D1 - D20	Lumex Opto/Components Inc	SML-LX2832UWC-TR	LED WHITE 2.8X3.2MM 150 MCD SMD
1	–	D21	On Semiconductor	MBRA140T3G	DIODE SCHOTTKY 40V 1A SMA
4	–	J1, J2, J3, J4	On Shore Technology Inc	ED555/3DS	TBLK_6A_3X3.5MM
2	–	J5, J7	On Shore Technology Inc	ED555/4DS	TBLK_6A_4X3.5MM
1	–	J6	On Shore Technology Inc	ED555/2DS	TBLK_6A_2X3.5MM
1	N2510-6002-RB	J8	3M	N2510-6002-RB	CONN HEADER 10 POS STRGHT GOLD
5	PEC02SAAN	JP34, JP33, JP18, JP11, JP6	Sullins Connector Solutions	PEC02SAAN	CONN HEADER 0.100 SINGL STR 2POS
3	PEC03SAAN	JP9, JP39, JP42	Sullins Connector Solutions	PEC03SAAN	CONN HEADER 0.100 SINGL STR 3POS
3	2.2uH	L1, L2, L3	Murata Electronics North America	LQM2HPN2R2MG0L	INDUCTOR 2.2UH 20% 1300MA 1008
1	18uH	L4	Sumida America Components Inc	CDRH74NP-180MC	POWER INDUCTOR 18UH 1.31A SMD
2	4.7K	R1, R2	Panasonic -ECG	ERJ-3EKF4701V	RES 4.70K OHM 1/10W 1% 0603 SMD
1	75k	R11	Panasonic-ECG	ERJ-3GEYJ753V	RES 75K OHM 1/10W 5% 0603 SMD
3	10K	R26, R13, R10	Panasonic-ECG	ERJ-3GEYJ103V	RES 10K OHM 1/10W 5% 0603 SMD
1	52.3k	R3	Panasonic-ECG	ERJ-3EKF5232V	RES 52.3K OHM 1/10W 1% 0603 SMD
1	130k	R5	Panasonic-ECG	ERJ-3EKF1303V	RES 130K OHM 1/10W 1% 0603 SMD
1	100k	R9	Panasonic-ECG	ERJ-3GEYJ104V	RES 100K OHM 1/10W 5% 0603 SMD
2	–	S1, S2	C&K Components	KT11P2JM34LFS	SWITCH TACT 2.36MM SILV J-LEAD
4	Black	TP1, TP2, TP3, TP4	Keystone Electronics	5001	TEST POINT PC MINI .040"D BLACK
14	White	TP5, TP10, TP12, TP13, TP14, TP16, TP19, TP24, TP26, TP27, TP28, TP29, TP45, TP46	Keystone Electronics	5002	TEST POINT PC MINI 0.040"D WHITE

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Revision History

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

Changes from C Revision (January 2017) to D Revision	Page
• Added the *TPS65271 EVM and USB2ANY Connected for Using the IPG-UI Software* figure	8

Changes from B Revision (June 2012) to C Revision	Page
• Replaced *Software Installation Instruction* with software support paragraph in the *Software* section.	8

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STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

3 *Regulatory Notices:*

   3.1 *United States*

      3.1.1 *Notice applicable to EVMs not FCC-Approved:*

      FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

      3.1.2 *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

      NOTE: 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

NOTE: 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.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. 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.

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.

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.

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

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs 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 EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should 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 also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user 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, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure 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. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

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