TPS2482 and TPS2483 Evaluation Module

This User's Guide describes the evaluation modules (EVM) for the TPS2482 and TPS2483. The devices are positive voltage, power limiting hot swap controllers with a built in I²C™ current monitor. The TPS2482 operates in a latched fault manner while the TPS2483 operates in an automatic retry manner.

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1 Description

The EVM design allows for several common applications: 12V systems with latched or automatic retry and 24V systems with latched or automatic retry. Both versions feature Texas Instruments new line of high performance power MOSFETs. The EVM also provides a I^2C interface for the current monitor when using the TPS2482 and TPS2483 GUI on a PC

1.1 Features

- General TPS2482, TPS2483 Device Features
  - Programmable Current Limiting and Power Limiting for Complete SOA Protection
  - Programmable Fault Timer to Eliminate Nuisance Shutdowns
  - Programmable Undervoltage Lockout
  - Power Good
  - Latched Operation Mode (TPS2482)
  - Automatic Retry Mode (TPS2483)
  - Shunt Monitor GUI
  - USB-I2C and Cable Provided
  - Design Calculator Tools Available: SLVC033 and SLVC457
- EVM Configurable Options:
  - TPS2482EVM-001 (24V, 325W, Auto Retry)
  - TPS2483EVM-002 (24V, 325W, Latched)
  - High current applications (12V, 40A, 480W, Auto Retry or Latched)

NOTE: The high current version is not orderable. See the high current section for details.

1.2 Applications

- Servers
- Telecom

1.3 Electrical specifications

Table 1. EVM Electrical and Performance Specifications at 25°C

Characteristic	TPS2482EVM-001 TPS2483EVM-002	High Current Application
Maximum input voltage	40 V	40 V
Input voltage (operating)	18-27 V	9-15 V
Turn on voltage (max)	18.5 V	9 V
Turn off voltage (min)	16 V	7.9 V
Maximum operating current	13.5 A	40 A
Trip point current	15-18 A	45-55 A
Circuit operating temperature	-40-50 °C	-40-50°C
TPS2482 fault timer trip time (nom)	752 µs	528 µs
TPS2483 fault timer retry period (nom)	101 ms	71 ms
Program power limit, V_{prog} / (2 x R2)	188 W	203 W

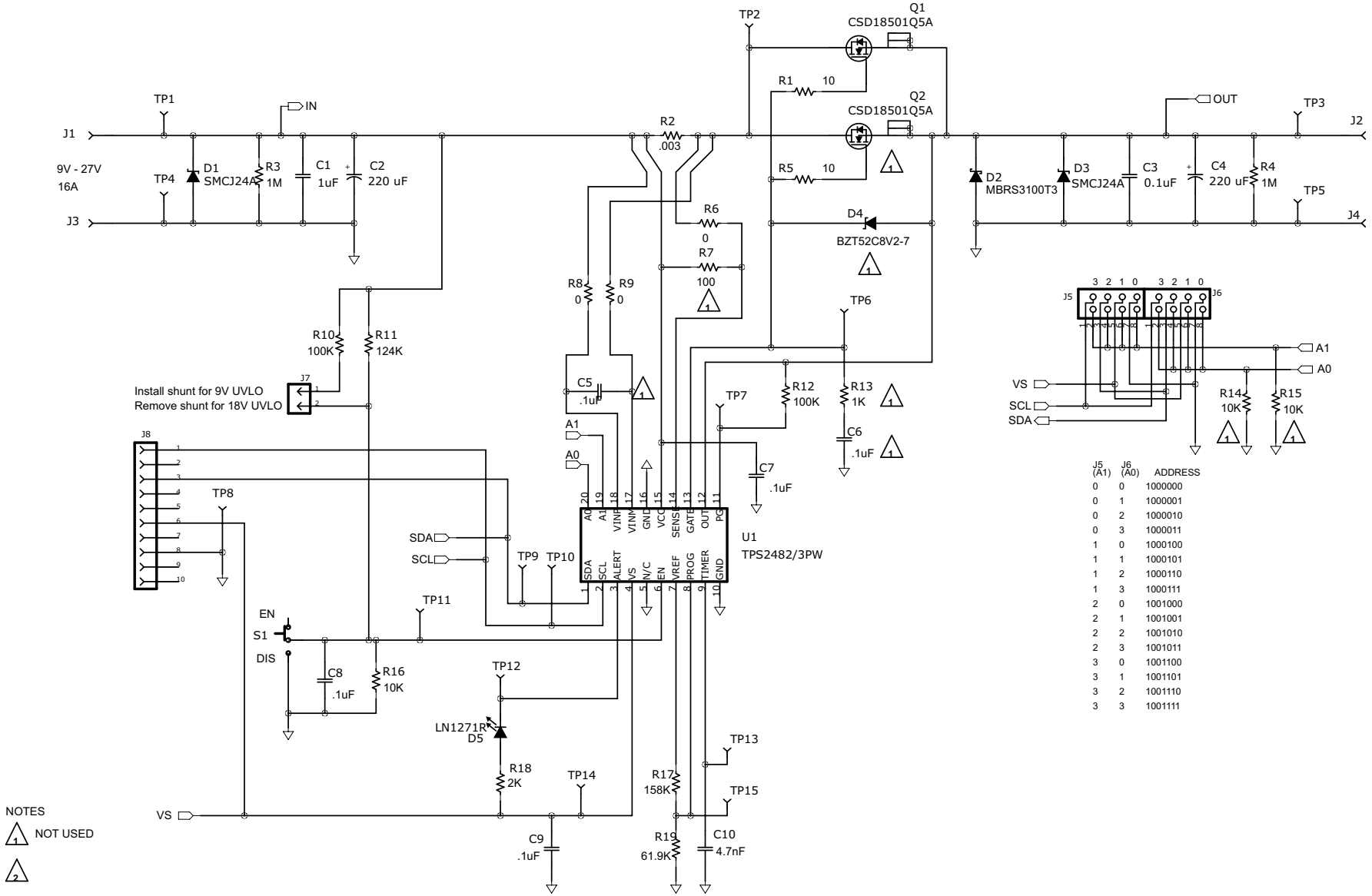
1.4 Circuit Description

See Figure 1 for the following circuit operation description. DC input voltage is applied between J1 and J3 with managed load output voltage being furnished between J2 and J4. TPS2482 and TPS2483 switches input to output by controlling Q1 and Q2. Load current through R2 is measured by both the current monitor and hotswap within TPS2482 and TPS2483. I^2C interface to the current monitor is provided at J8 and address selection is provided by J5 and J6.

R6 and R7 are provided for scaling the current trip point to allow use of standard R2 values when non-standard current trip points are required. R8, R9, and C5 are provided if current monitor filtering are required in noisy circuit applications. R13 and C6 are provided when the application requires a linear turn on characteristic.

The 12V, 40A, high current application shown in Table 1 can be achieved with the following BOM changes: Install shunt on J7 for 9V UVLO, change Q1 and Q2 to CSD16401Q5, change R2 to 0.001Ω, change R19 to 17.8k, and change C10 to 3.3nF.

2 Schematic



J5 (A1)	J6 (A0)	ADDRESS
0	0	1000000
0	1	1000001
0	2	1000010
0	3	1000011
1	0	1000100
1	1	1000101
1	2	1000110
1	3	1000111
2	0	1001000
2	1	1001001
2	2	1001010
2	3	1001011
3	0	1001100
3	1	1001101
3	2	1001110
3	3	1001111

Figure 1. TPS2482 and TPS2483 EVM Schematic

3 General Configuration and Description

3.1 Physical Access

Table 2 lists the TPS2482 and TPS2483 EVM connector functionality, and Table 3 describes the test point availability.

Table 2. Table 2. Connector and Jumper Functionality

Connector	Label	Description
J1, J3	+IN, -IN	Power bus input (high current screw down lugs). J1 is +IN and J3 is -IN.
J2, J4	+OUT, -OUT	Switched bus output (high current screw down lugs). J2 is +OUT and J4 is –OUT.
J8	USB	USB Port. Connect furnished SM-USB-DIG and cable to PC when using the TPS2482/3 GUI (see Figure 2).
J5	A1	Allows selection of the A1 I^2C address bit. The EVM default is set to address 1000000. For other address options, see the table in Figure 1.
J6	A0	Allows selection of the A0 I^2C address bit. The EVM default is set to address 1000000.For other address options, see the table in Figure 1.
J7	UVLO	Sets the input voltage turn on point. Install a shunt on J7 for 9V UVLO and remove the shunt for 18V UVLO.
S1	EN	Selecting the S1 EN position allows the TPS2482 and TPS2483 to enable the MOSFET if the power bus input is above the turn on voltage. Setting S1 away from the EN position disables the MOSFET.
D5 (RED)	ALERT	Current monitor ALERT status.

Table 3. Test Points

Test Point	Color	Label	Description
TP1	RED	+IN	Power bus input high.
TP4	BLK	-IN	Power bus input low.
TP3	ORG	+OUT	Switched bus output high.
TP5	BLK	-OUT	Switched bus output low.
TP2	WHT	SNS	SNS pin test point.
TP6	WHT	GATE	GATE pin test point.
TP7	WHT	PG	PG pin (power good) test point.
TP13	WHT	TMR	TMR pin (timer) test point.
TP15	WHT	PRG	PROG pin (power program) test point.
TP11	WHT	EN	EN pin (enable) test point.
TP10	WHT	SCL	SCL pin (serial clock) test point.
TP9	WHT	SDA	SDA pin (serial data) test point.
TP14	RED	VS	VS pin (current monitor supply voltage) test point. The USB source applied at J8 powers the current monitor.
TP8	BLK	GND	GND pin (current monitor ground) test point. The USB source applied at J8 powers the current monitor.
TP12	WHT	ALERT	Current monitor ALERT pin.

4 Test Setup

4.1 5.1 TPS2482 and TPS2483 EVM GUI Installation

- Download the TPS2482 and TPS2483 INSTALLER.ZIP (SLVC454) file from the product page for the devices on www.ti.com.
- Place the TPS2482 and TPS2483 INSTALLER.ZIP file in a known location on the PC. Unzip the TPS2482-3 INSTALLER.ZIP file.
- Double click the unzipped setup.exe file which is located in the TPS2482 and TPS2483 Installer\Volume subdirectory. Proceed through the installation by accepting the prompts.
- Once the GUI completes the installation, the user is prompted to restart the computer.

Figure 2 shows a typical test setup for TPS2482 and TPS2483EVM.

4.2 EVM Hook up

Figure 2 shows a typical test setup for TPS2482 and TPS2483 EVM. Input voltage can be applied as described in Table 2.

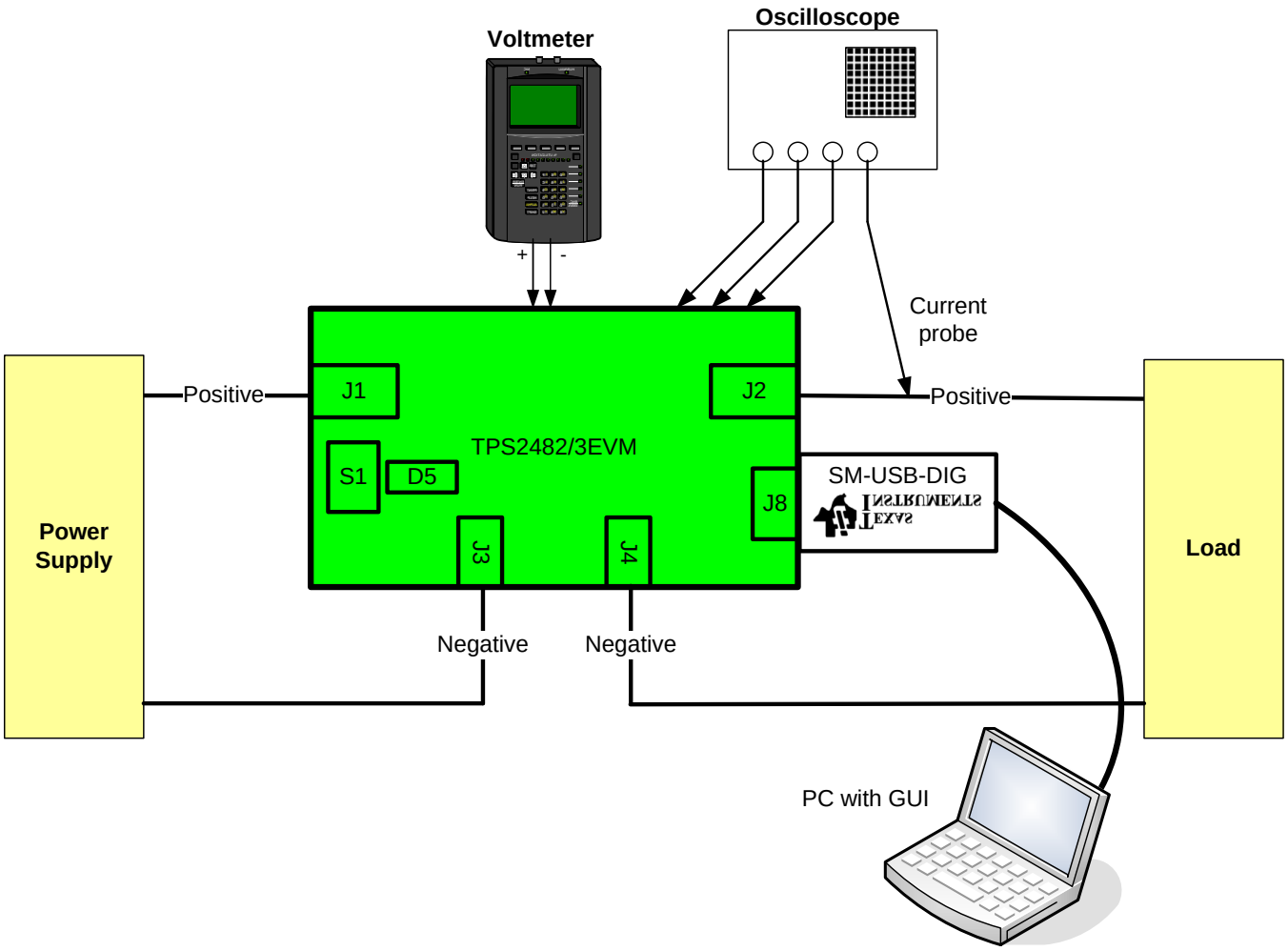


Figure 2. Typical TPS2482 and TPS2483 EVM Test Setup

- Connect the PC to the UUT J8 using the SM-USB-DIG and Type A Male to Type A Female USB v2.0 extension cable. Orient the SM-USB-DIG so that the TI bug is oriented as shown in Figure 2.
- Turn on the input power supply and enable the TPS2482 and TPS2483 EVM using S1. Apply a known load to the circuit.

4.3 TPS2482 TPS2483 EVM GUI Operation

- Navigate to the TPS2482 and TPS2483 shortcut and start the GUI (see Figure 3).

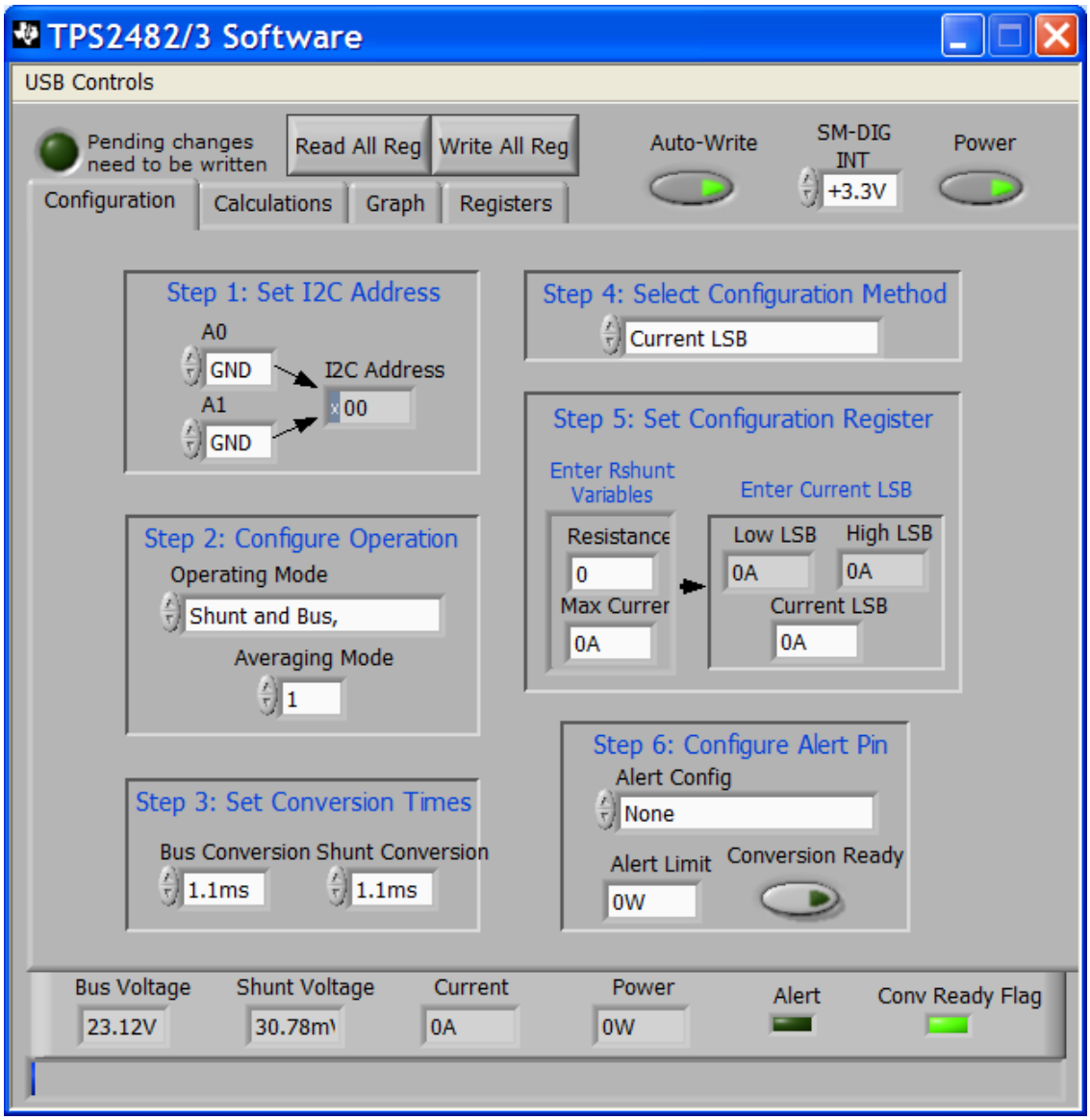


Figure 3. TPS2482 and TPS2483 GUI Overview Form

- Type a value of 0.003 into the Resistance text box
- Type a value of 20 into the Max Current text box.
- Type a value of 0.001 into the Current LSB text box.
- Press the Write All Reg button and then the Read All Reg at the top of the GUI form.
- Verify the GUI Vbus voltage and current are as expected per the EVM loading and power supply.
- In the Configure Alert Pin field, click the Alert Config Up/Down arrow until the appropriate alert pin status is active as shown in Figure 4. In the Alert Limit box, enter the appropriate value and press the PC enter key. Verify that the ALERT LED (D5) on the EVM is ON or OFF as appropriate.

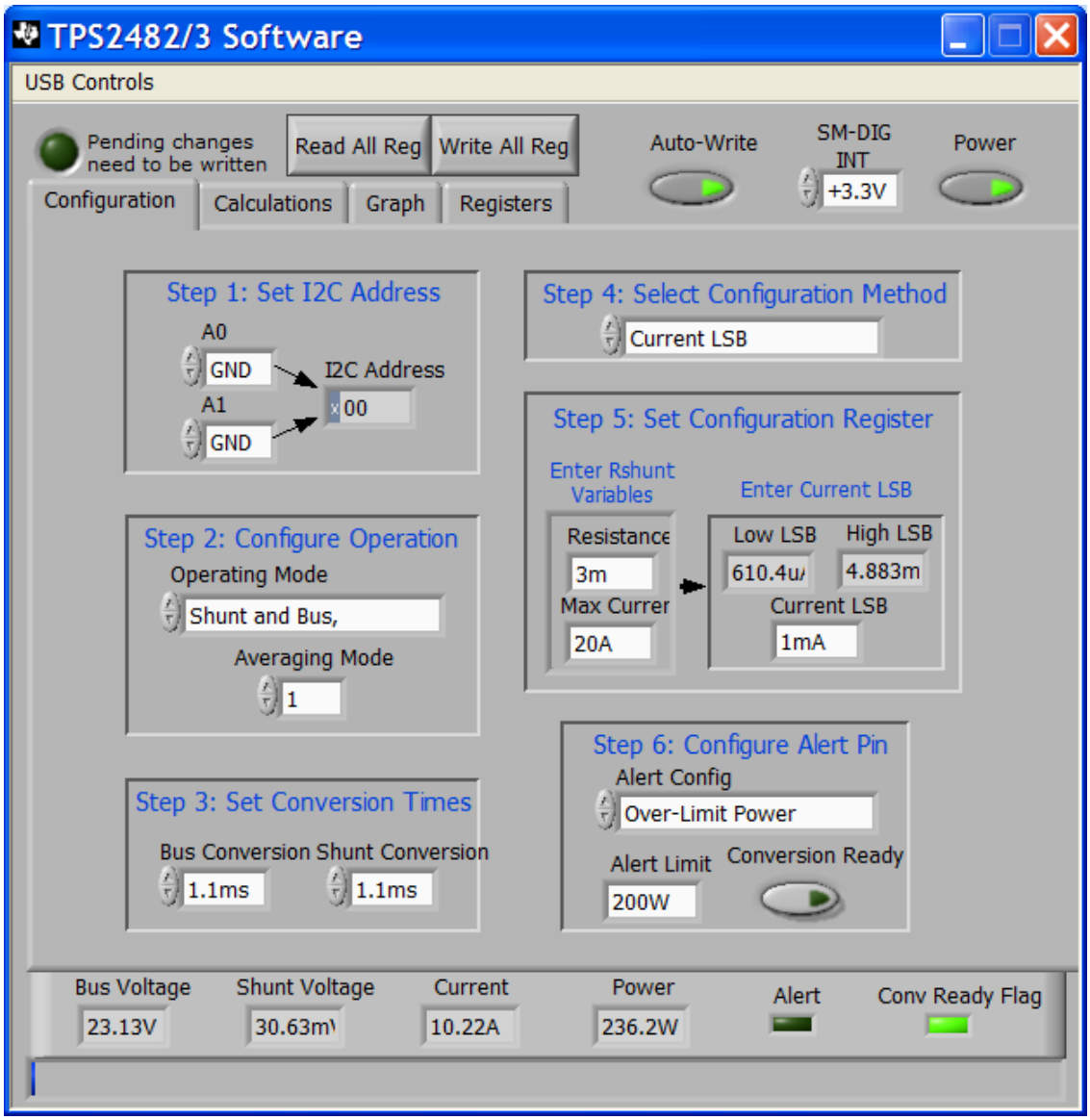


Figure 4. TPS2482 and TPS2483 GUI Calibrate Form

5 TPS2482 and TPS2483 EVM Typical Performance Data

5.1 TPS2482EVM-001 and TPS2483EVM-002 Power Limit Curves

Figure 5 illustrates the current limit vs output voltage curve for TPS2482EVM-001 and TPS2483EVM-002.

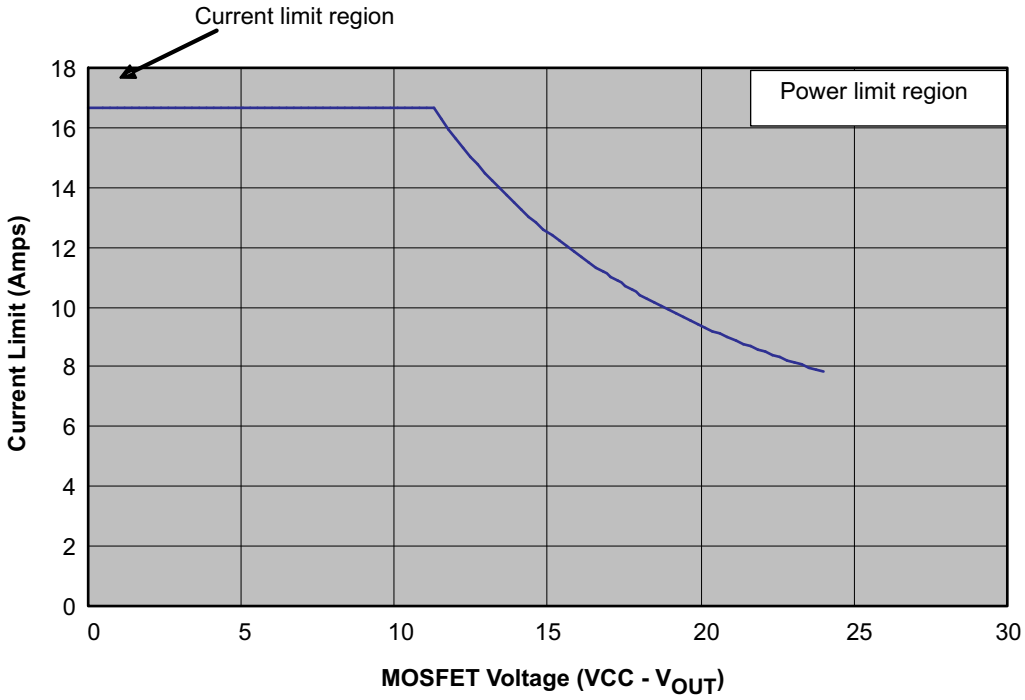


Figure 5. TPS2482EVM-001 and TPS2483EVM-002 Current and Power Limit Curve

6 EVM Assembly Drawings and Layout Guidelines

6.1 PCB Drawings

The Figure 6 through Figure 8 show component placement and layout of the EVM.

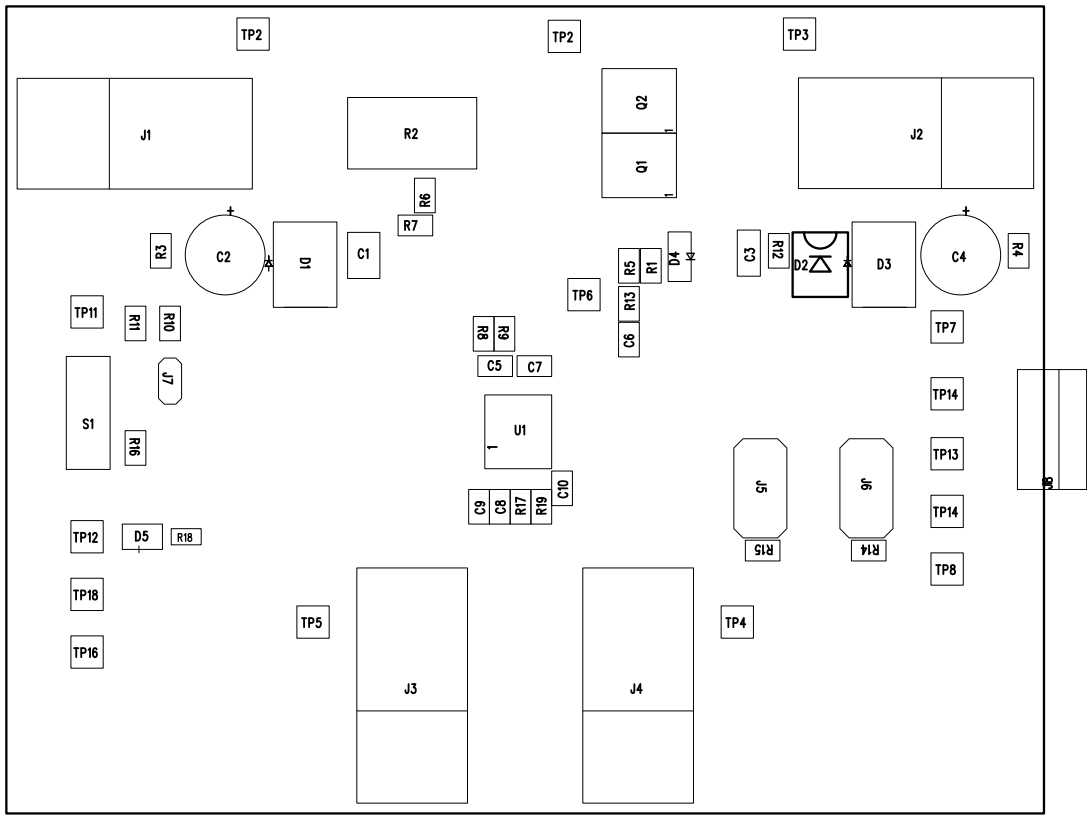


Figure 6. Top Assembly

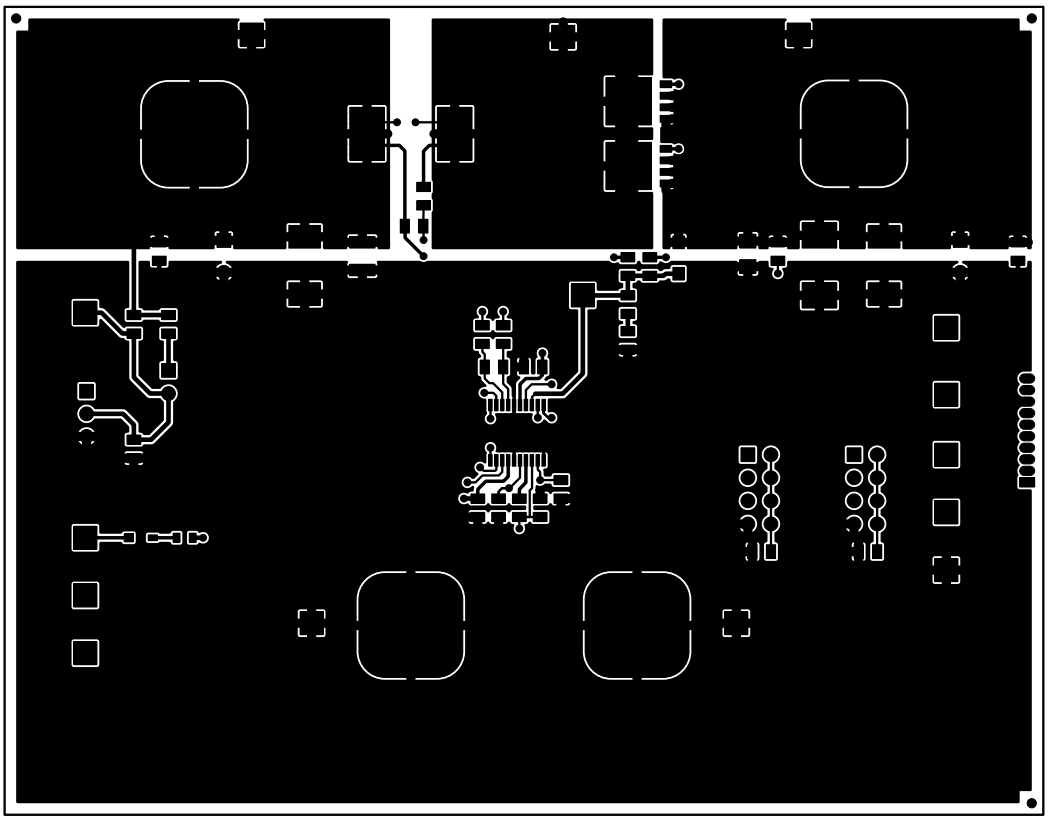


Figure 7. Top Layout

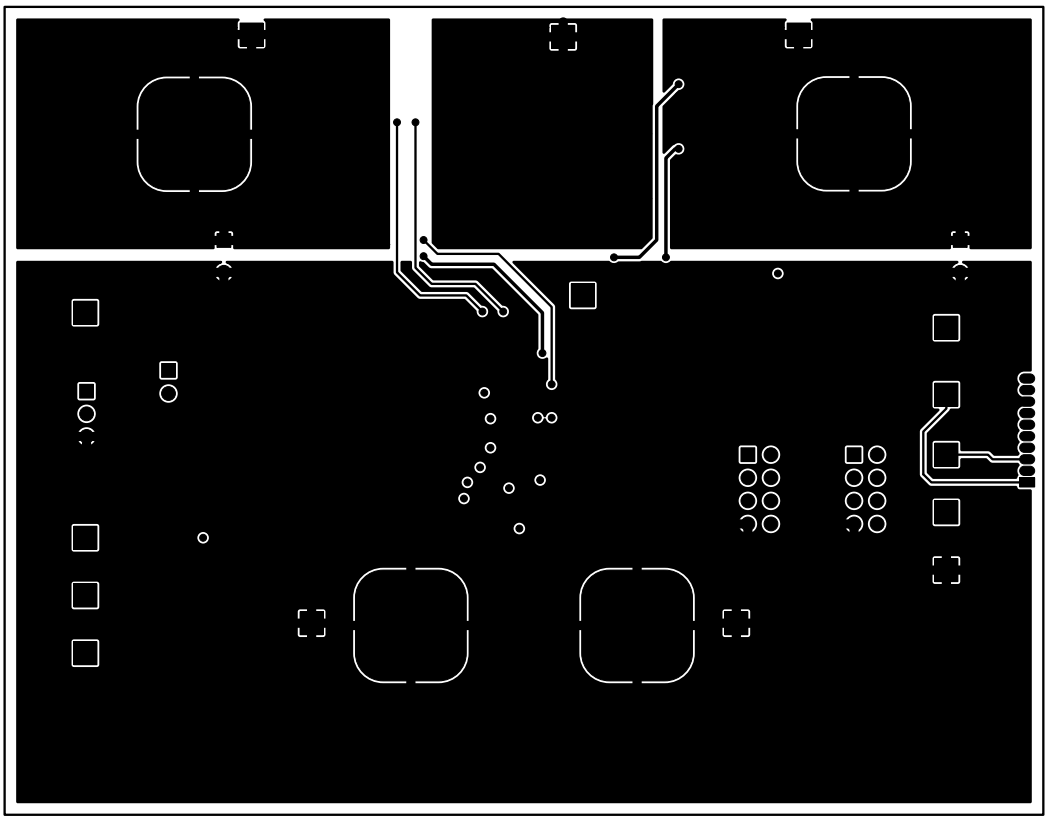


Figure 8. Internal Layer 1

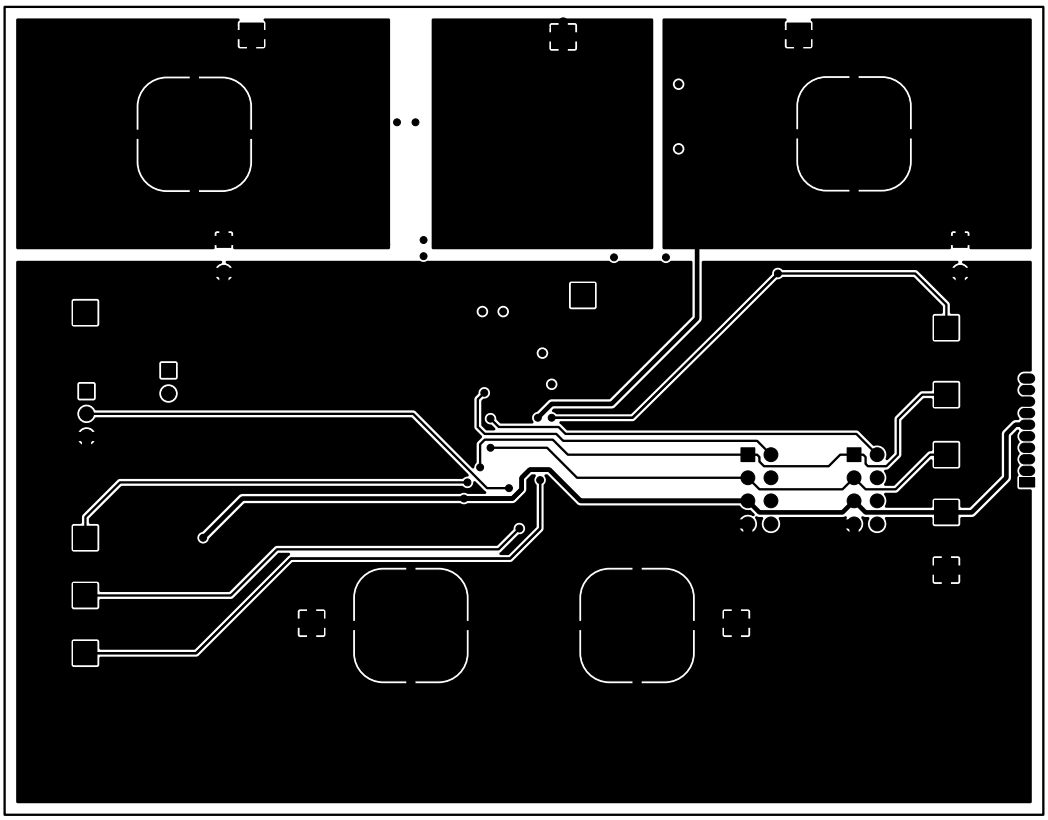


Figure 9. Internal Layer 2

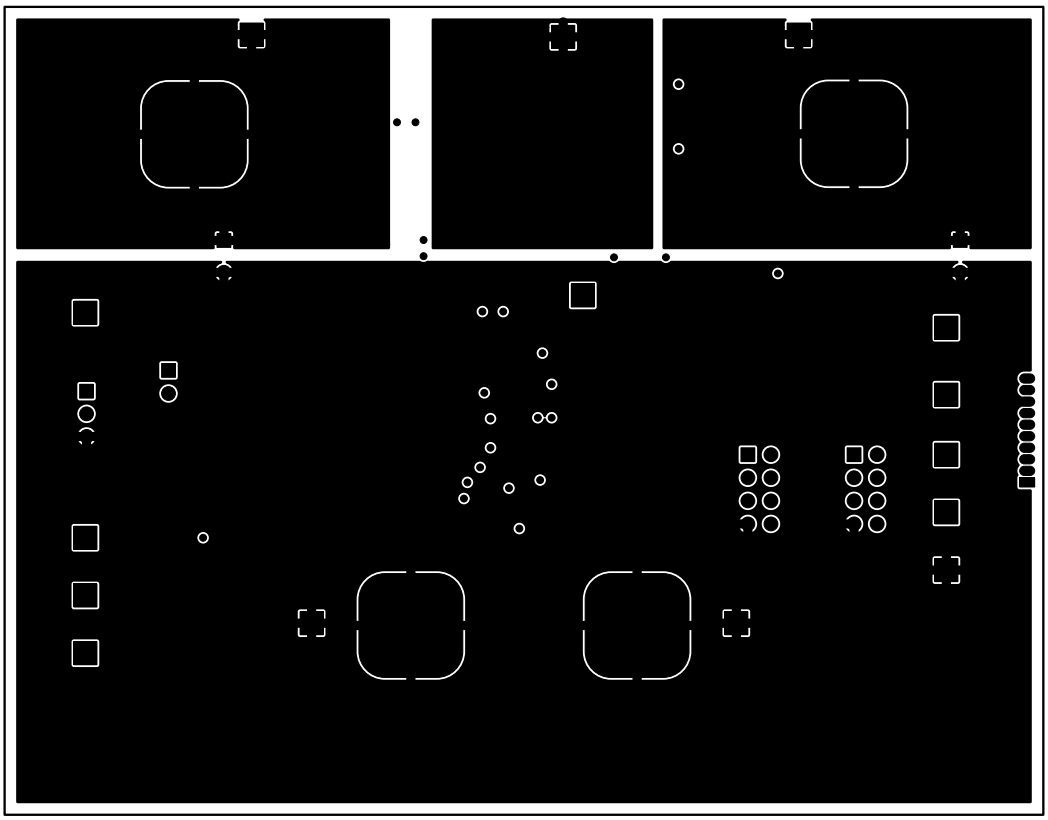


Figure 10. Bottom Layout

6.2 Layout Guidelines

The TPS2482 and TPS2483 circuit layout should follow power and EMI, ESD best practice guidelines. A basic set of recommendations include:

- Arrange the power devices so power flows in a sequential, linear fashion.
- The TPS2482 and TPS2483 should be placed close to the sense resistor and MOSFET using a Kelvin type connection to achieve accurate current sensing.
- A low-impedance GND connection is required because the TPS2482 and TPS2483 can momentarily sink upwards of 100 mA from the gate of the MOSFET. The GATE amplifier has high bandwidth while active, so keep the GATE trace length short.
- Large copper fills and traces should be used on SMT power-dissipating devices, and wide traces or overlay copper fills should be used in the power path.
- The PROG, TIMER, and EN pins have high input impedances; therefore, their input lead length should be minimized.
- Oversize power traces and power device connections assuring low voltage drop and good thermal performance.

7 Bill of Materials

Table 4. EVM Bill of Materials

COUNT	RefDes	Value	Description	Size	Part Number	Mfr
1	C1	1uF	Capacitor, Ceramic, 100V, X7R, 10%	1210	Std	Std
1	C10	4.7nF	Capacitor, Ceramic, 100V, X7R, 10%	805	Std	Std
2	C2 C4	220 uF	Capacitor, Alum Electrolytic 35 V, ±20%	8.00 mm Dia	ECA-1VM221	Panasonic
1	C3	0.1uF	Capacitor, Ceramic, 100-V, X7R, 10%	1206	Std	Std
4	C6-9	.1uF	Capacitor, Ceramic, 100V, X7R, 10%	805	Std	Std
0	C5	.1uF	Capacitor, Ceramic, 100V, X7R, 10%	805	Std	Std
2	D1 D3	SMCJ24A	Diode, [Uni-]Directional TVS, 1500W, 24-V	SMC	SMCJ24A	Littlefuse
1	D2	MBRS3100T3	Diode, Schottky 3-A 100-V	SMC	MBRS3100T3G	On Semi
0	D4	BZT52C8V2-7	Diode, Zener, Planar Power, 500mW, 8.2V	SOD-123	BZT52C8V2-7-F	Diodes
1	D5	LN1271R	Diode, LED, Red, 10-mA, 0.4-mcd	0.114 X 0.049 inch	LN1271RTR	Panasonic
4	J1-4	CX35-36-CY	Lug, Copper, 35A,	0.380 x 1.020 inch	CX35-36-CY	Panduit
2	J5-6	PEC04DAAN	Header, Male 2x4-pin, 100mil spacing	0.20 x 0.40 inch	PEC04DAAN	Sullins
1	J7	PEC02SAAN	Header, Male 2-pin, 100mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
1	J8	851-43-010-20-001000	Connector, 10 pin RA, 50 mil spacing, 3A	0.220 x 0.230 inch	851-43-010-20-001000	Mill-Max
1	Q1	CSD18501Q5A	MOSFET, N-Chan, 40V, 25 A, 3.3 mOhm	QFN-8 POWER	CSD18501Q5A	TI
0	Q2	CSD18501Q5A	MOSFET, N-Chan, 40V, 25 A, 3.3 mOhm	QFN-8 POWER	CSD18501Q5A	TI
2	R1 R5	10	Resistor, Chip, 1/10W, 1%	805	Std	Std
2	R10 R12	100K	Resistor, Chip, 1/10W, 1%	805	Std	Std
1	R11	124K	Resistor, Chip, 1/10W, 1%	805	Std	Std
0	R13	1K	Resistor, Chip, 1/10W, 1%	805	Std	Std
0	R14 R15	10K	Resistor, Chip, 1/10W, 1%	806	Std	Std
1	R16	10K	Resistor, Chip, 1/10W, 1%	805	Std	Std
1	R17	158K	Resistor, Chip, 1/10W, 1%	805	Std	Std
1	R18	2K	Resistor, Chip, 1/16W, 1%	603	STD	Std
1	R19	61.9K	Resistor, Chip, 1/10W, 1%	805	Std	Std
1	R2	0.003	Res, Power Metal Strip, 5W, ±1%	4527	WSR53L000FEA	Vishay Dale
2	R3-4	1M	Resistor, Chip, 1/10W, 1%	805	Std	Std
3	R6 R8-9	0	Resistor, Chip, 1/10W, 5%	805	Std	Std
0	R7	100	Resistor, Chip, 1/10W, 5%	805	Std	Std
1	S1	EG1218	Switch, SPDT, Slide, PC-mount,	0.457 x 0.157 inch	EG1218	E_Switch
2	TP1 TP14	5010	Test Point, Red, Thru Hole	0.125 x 0.125 inch	5010	Keystone

Table 4. EVM Bill of Materials (continued)

COUNT	RefDes	Value	Description	Size	Part Number	Mfr
9	TP2 TP6-7 TP9-13 TP15	5012	Test Point, White, Thru Hole	0.125 x 0.125 inch	5012	Keystone
1	TP3	5013	Test Point, Orange, Thru Hole	0.125 x 0.125 inch	5013	Keystone
3	TP4-5 TP8	5011	Test Point, Black, Thru Hole	0.125 x 0.125 inch	5011	Keystone
1	U1	TPS2483PW or TPS2482PW	IC, 36-V Hotswap Controller with Digital Power Monitoring (Retry for TPS2483, Latched for TPS2482)	TSSOP	TPS2483PW or TPS2482PW	TI
3	See Note 5		Shunt, Black	100-mil	929950-00	3M
4		SJ-5003	BUMPON HEMISPHERE .44X.20 BLACK		SJ-5003	3M
1	—		PCB, 3.5 In x 1.7 In x 0.062 In		PWR157	Any

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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 this Product 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. 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.

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