TPS62184EVM-581 Evaluation Module

This user's guide describes the characteristics, operation, and use of TI's TPS62184 evaluation module (EVM). The TPS62184EVM-581 (PWR581-002) facilitates the evaluation of the TPS62184 6-A, 2-phase buck converter. The EVM outputs a 1.8-V output voltage from input voltages between 4 V and 17 V. The TPS62184 features Automatic Efficiency Enhancement (AEE™) to deliver efficiencies in excess of 90% across the load current range. The small solution size (99 mm^2) and low profile possible enable a very dense power solution in tablets, Solid State Drives (SSDs), and other portable devices. This user's guide includes setup instructions for the hardware, a printed-circuit board layout for the EVM, a schematic diagram, a bill of materials (BOM), and test results for the EVM.

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1 Introduction

The TPS62184 is a 6-A, dual-phase, synchronous, step-down converter in a 2 × 3-mm, WCSP package.

1.1 Performance Specification

Table 1 provides a summary of the TPS62184EVM-581 performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 1. Performance Specification Summary

Specification	Test Conditions	Min	Typ	Max	Unit
Input voltage		4		17	V
Output voltage setpoint			1.8		V
Output current	V_{OUT} ≤ 1.8 V	0		6	A
	V_{OUT} > 1.8 V and ≤ 2.5 V	0		5.5	A
	V_{OUT} > 2.5 V and ≤ 3.5 V	0		5	A
Soft-start time	Ramp time of V_{OUT}		825		µs

1.2 Modifications

The output voltage of the EVM may be adjusted within the range stated in the device data sheet. Additional input and output capacitors can also be added. A lower profile inductor may also be used to reduce the total solution height. Finally, the input voltage at which the IC turns on can be adjusted with two resistors.

1.2.1 Changing the Output Voltage

The output voltage may be adjusted by changing the values of R1 and R2. Be sure and keep the output voltage within the range specified in the device data sheet. Setting an output voltage above 1.8 V reduces the maximum amount of current which can reliably be delivered, per Table 1. See the data sheet for details.

1.2.2 Input and Output Capacitors

C13 and C14 are provided for additional input capacitors. These capacitors are not required for proper operation but can be used to reduce the input voltage ripple.

C7, C8, C9, C10, C11, and C12 are provided for additional output capacitors. These capacitors are not required for proper operation but can be used to reduce the output voltage ripple and to improve the load transient response. The total output capacitance must remain within the recommended range in the TPS62184 data sheet (SLVSCQ5) for proper operation.

1.2.3 Lower Profile Solutions

The TPS62184EVM-581 supports modifications to achieve a lower total solution profile (height). The current EVM gives a maximum height of 2.1 mm. To obtain a lower profile solution, replace both inductors L1 and L2 with a suitable inductor of lower height. An option is the DFE252012P series from Toko which has a maximum profile of 1.2 mm. These inductors fit well on the existing pads for L1 and L2.

1.2.4 Configurable Enable Threshold Voltage

With JP1 removed, R4 and R5 can be installed to set a user-selectable input voltage at which the IC turns on. See the equations in the data sheet for details of calculating the resistor values.

AEE is a trademark of Texas Instruments.

2 Setup

This section describes how to properly use the TPS62184EVM-581.

2.1 Input/Output Connector Descriptions

J1 – VIN	Positive input connection from the input supply for the EVM
J2 – S+/S–	Input voltage sense connections. Measure the input voltage at this point.
J3 – GND	Return connection from the input supply for the EVM
J4 – VOUT	Output voltage connection
J5 – S+/S–	Output voltage sense connections. Measure the output voltage at this point.
J6 – GND	Output return connection
J7 – PG/GND	The PG output appears on pin 1 of this header with a convenient ground on pin 2
J8 – SS/TR/GND	The SS/TR pin voltage appears on pin 2 of this header with a convenient ground on pin 1
JP1 – EN	EN pin input jumper. Place the supplied jumper across ON and EN to turn on the IC. Place the jumper across OFF and EN to turn off the IC. Remove the jumper to set a configurable enable threshold voltage with R4 and R5.
JP2 – PG Pullup Voltage	PG pin pullup voltage jumper. Place the supplied jumper on JP2 to connect the PG pin pullup resistor to the output voltage. Alternatively, the jumper can be removed and a different voltage can be supplied on pin 1 to pull up the PG pin to a different level. This externally applied voltage must remain below 7 V.

2.2 Setup

To operate the EVM, set jumpers JP1 and JP2 to the desired positions per Section 2.1. Connect the input supply to J1 and J3 and connect the load to J4 and J6.

3 TPS62184EVM-581 Test Results

The TPS62184EVM-581 was used to take the data in the TPS62184 data sheet (SLVSCQ5). See the device data sheet for the performance of this EVM.

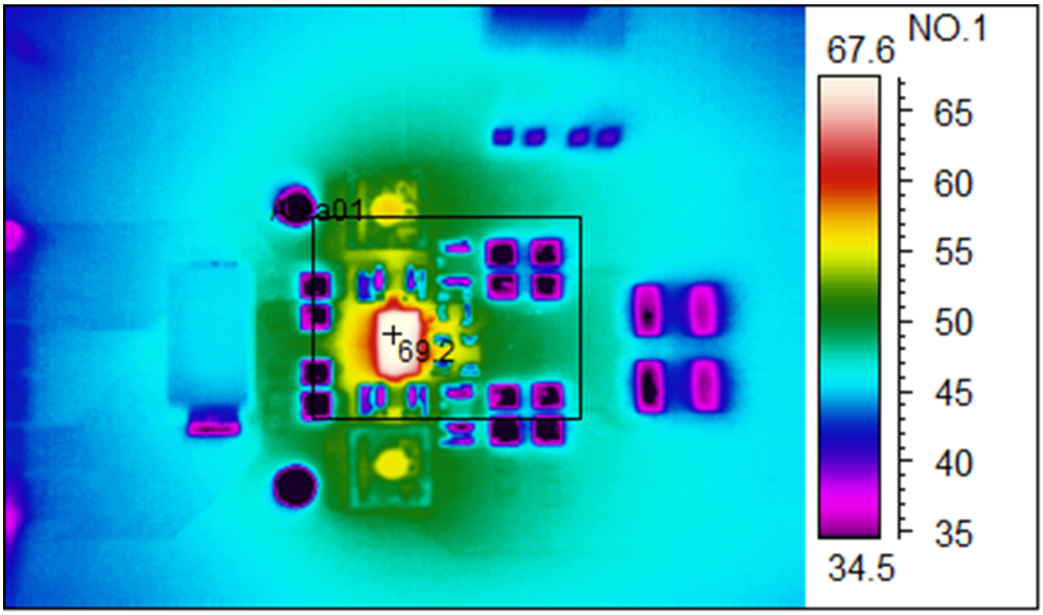

Figure 1. Thermal Performance (V_{IN} = 17 V, Load = 6 A)

WARNING

Hot surface. Contact may cause burns. Do not touch!

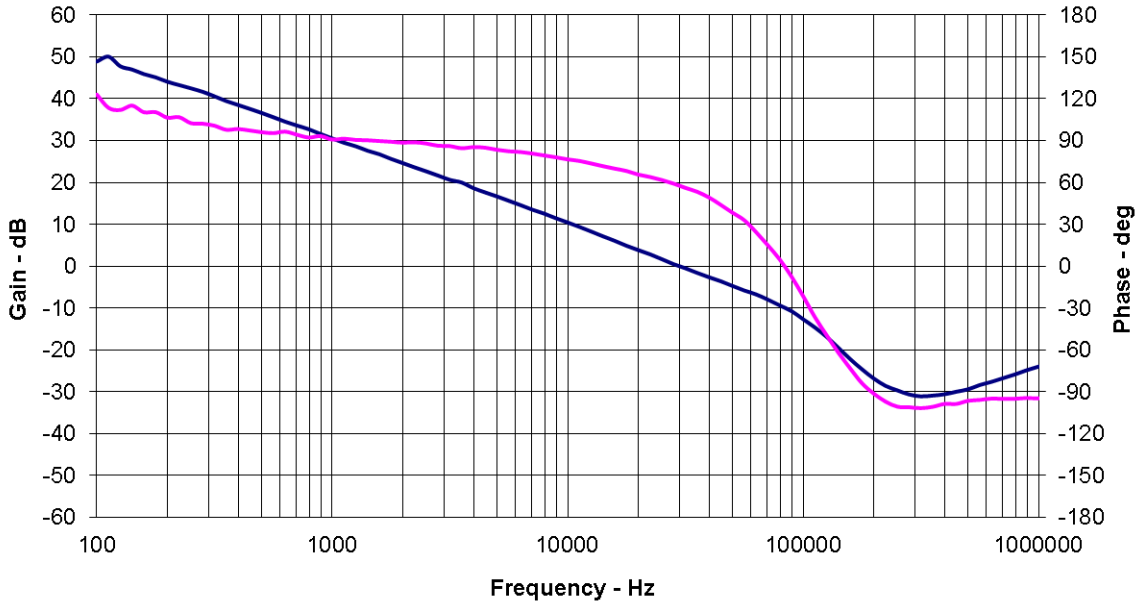

Figure 2. Loop Measurement (V_{IN} = 12 V, Load = 6 A, 50-Ω resistor added in series with R1)

4 Board Layout

This section provides the TPS62184EVM-581 board layout and illustrations. The Gerbers are available on the EVM product page: TPS62184EVM-581. Rev. B of the PCB just filled the vias under U1 to improve manufacturability. No copper changes were made from Rev. A.

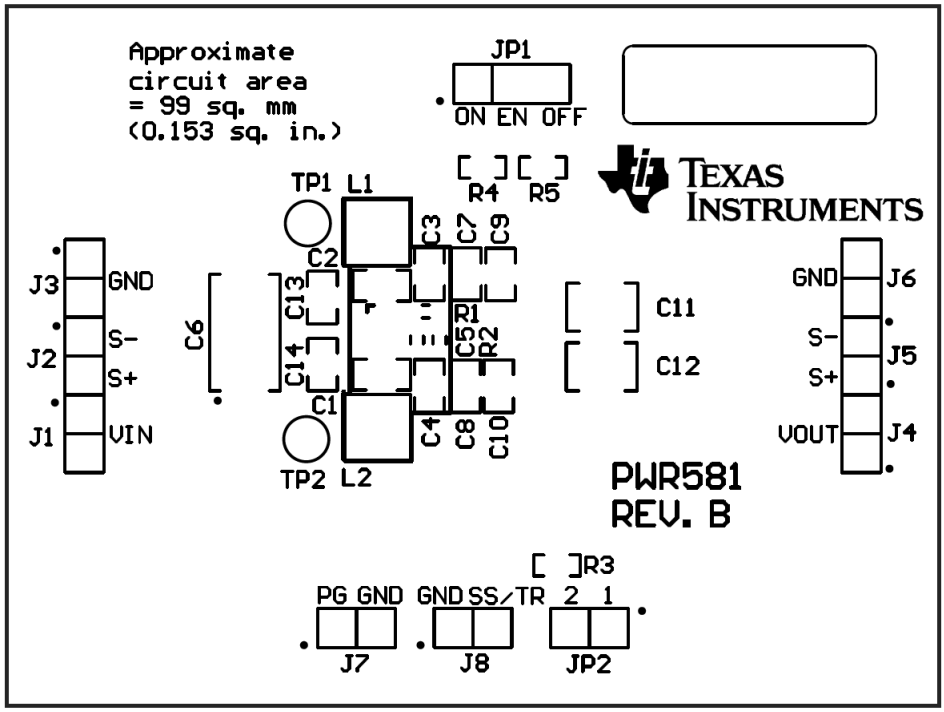

Figure 3. Assembly Layer

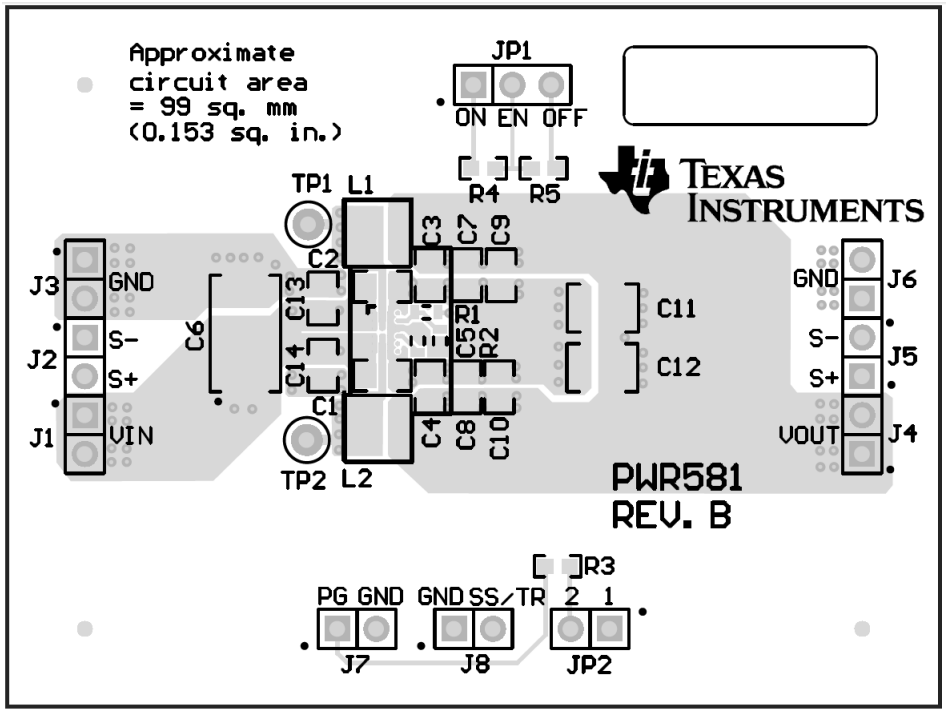

Figure 4. Top Silk Layer

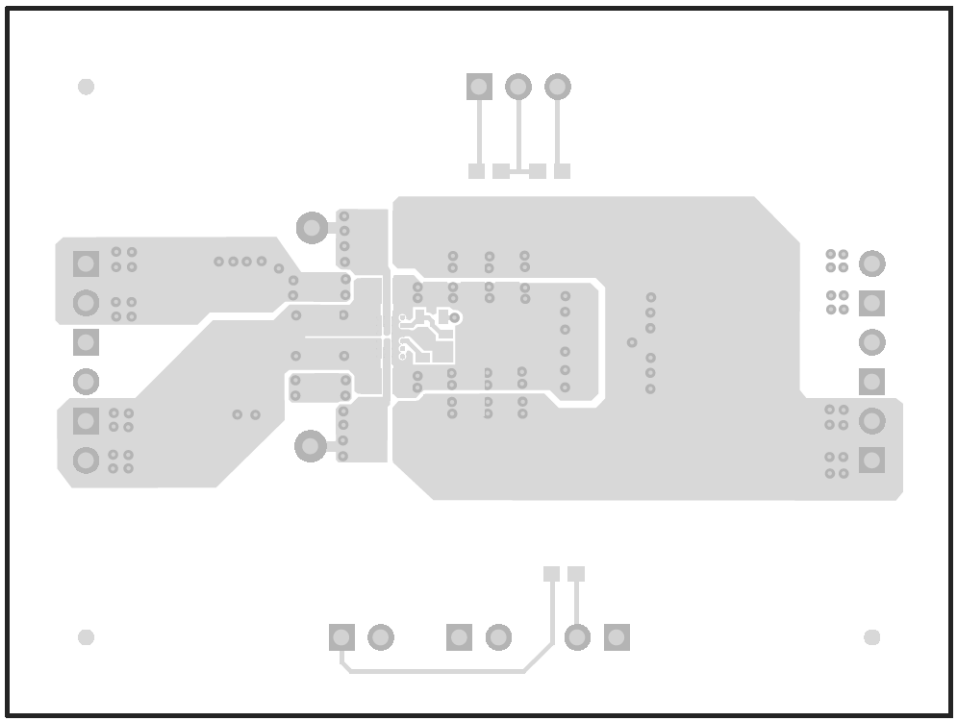

Figure 5. Top Layer

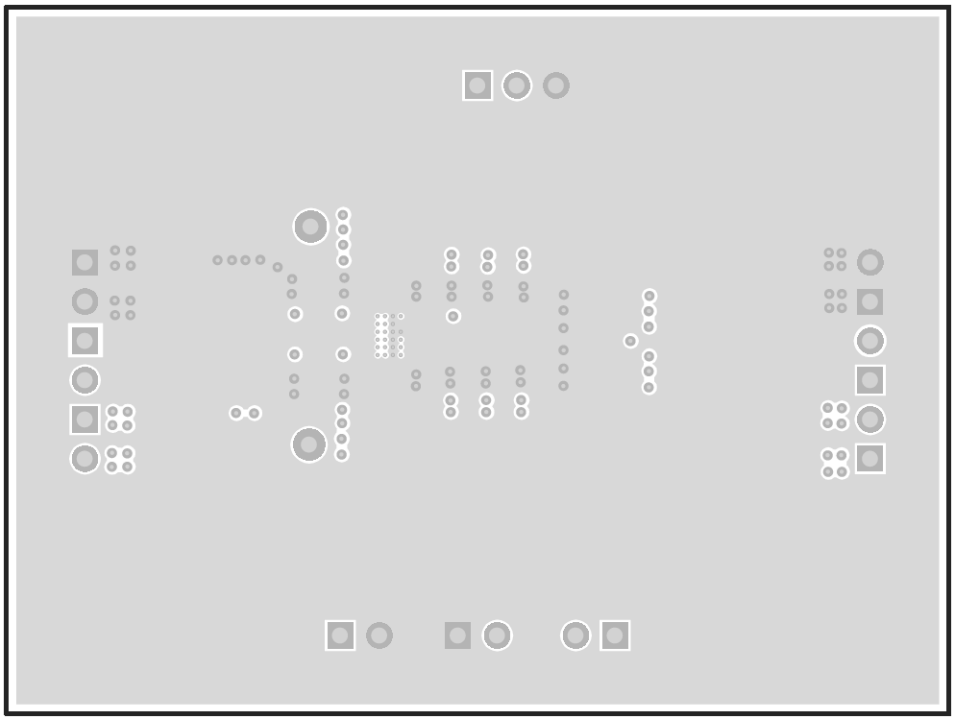

Figure 6. Internal Layer 1

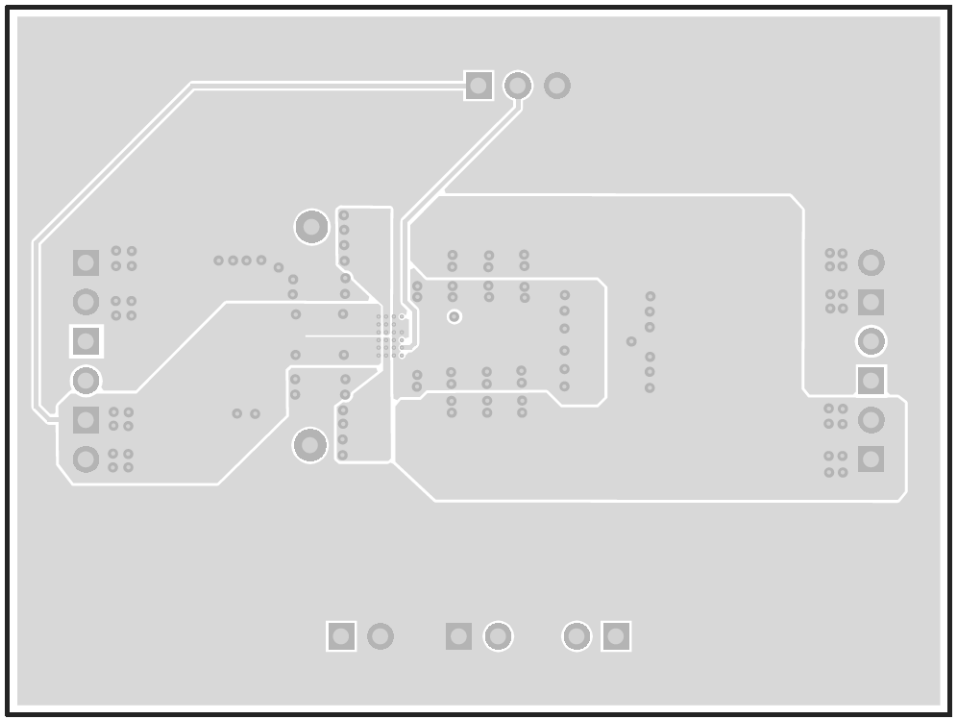

Figure 7. Internal Layer 2

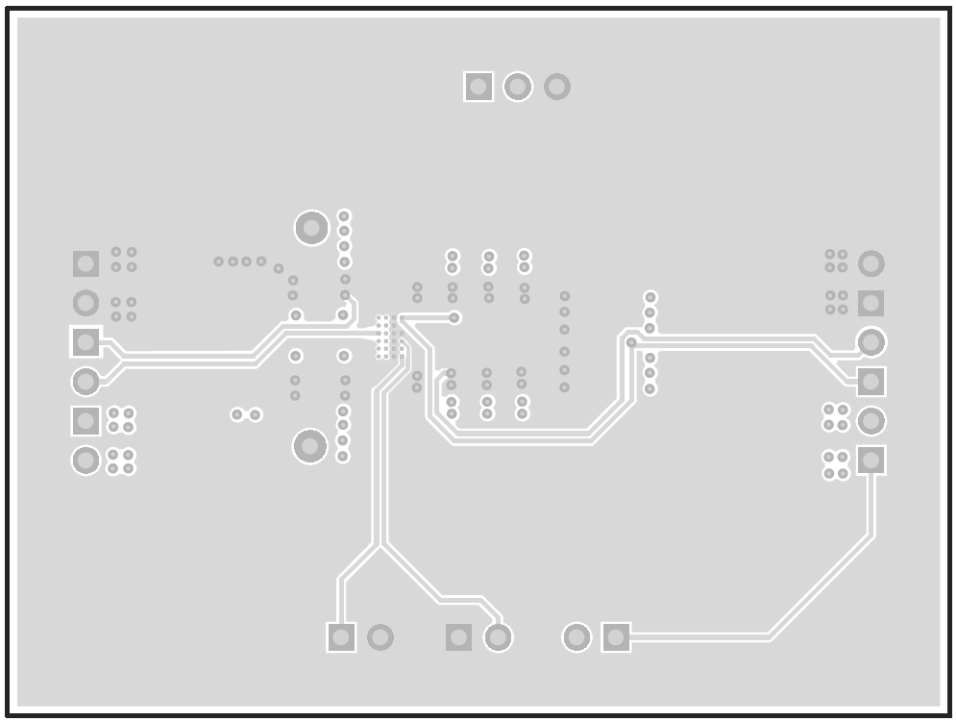

Figure 8. Bottom Layer

5 Schematic and Bill of Materials

This section provides the TPS62184EVM-581 schematic and bill of materials.

5.1 Schematic

Figure 9 illustrates the TPS62184EVM-581 schematic.

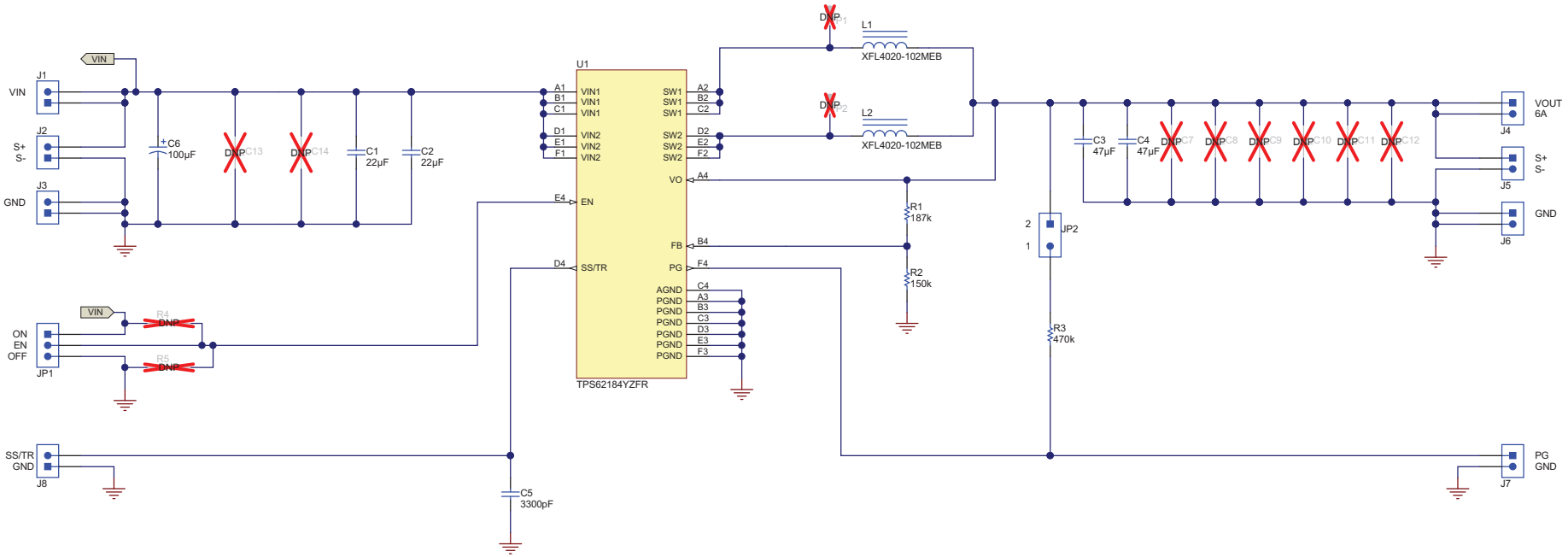

Figure 9. TPS62184EVM-581 Schematic

5.2 Bill of Materials

Table 2 lists the BOM for this EVM.

Table 2. TPS62184EVM-581 Bill of Materials

Quantity	Ref Des	Value	Description	Size	Part Number	Manufacturer
2	C1, C2	22uF	CAP, CERM, 22uF, 25V, +/-20%, X5R, 0805	0805	GRM21BR61E226ME44L	MuRata
2	C3, C4	47uF	CAP, CERM, 47uF, 10V, +/-20%, X5R, 0805	0805	GRM21BR61A476ME15L	MuRata
1	C5	3300pF	CAP, CERM, 3300pF, 25V, +/-10%, X7R, 0603	0603	GRM188R71E332KA01D	MuRata
1	C6	100uF	CAP, TA, 100uF, 20V, +/-10%, 0.5 ohm, SMD	7343-43	293D107X9020E2TE3	Vishay-Sprague
2	L1, L2	1uH	Inductor, Shielded, Composite, 1uH, SMD	4x2x4mm	XFL4020-102ME or XAL4020-102ME	Coilcraft
1	R1	187k	RES, 187k ohm, 1%, 0.1W, 0603	0603	RC0603FR-07187KL	Yageo America
1	R2	150k	RES, 150k ohm, 1%, 0.1W, 0603	0603	RC0603FR-07150KL	Yageo America
1	R3	470k	RES, 470k ohm, 1%, 0.1W, 0603	0603	RC0603FR-07470KL	Yageo America
1	U1	TPS62184	4 - 17V, 6A, 2-Phase Step-Down Converter	2x3mm	TPS62184YZF	Texas Instruments

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3 *Regulatory Notices:*

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

      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*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-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.

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

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http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

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If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

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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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.

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10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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