User's Guide
SLVUB74–September 2017

TPS62097QEVM-891 Evaluation Module

The TPS62097QEVM-891 facilitates the evaluation of the TPS62097-Q1 2-A, automotive buck converter with iDCS-Control, forced PWM mode, and selectable switching frequency. The EVM outputs a 1.8-V output voltage from input voltages between 2.5 V and 6 V. The TPS62097-Q1 features the excellent transient response of DCS-Control with the ability to force the device into PWM mode for constant frequency operation above the AM band. With its wettable flanks, the TPS62097-Q1 is a robust, highly integrated, efficient, and small solution for point-of-load (POL) converters in automotive equipment, such as gateway, head unit, instrumentation cluster, and telematics.

Contents

List of Figures

List of Tables

1 Introduction

The TPS62097-Q1 is a synchronous, step-down converter in a 3- x 3- x 1-mm package with wettable flanks. It contains a selectable switching frequency and has a forced PWM mode option for low noise applications.

1.1 Performance Specification

Table 1 provides a summary of the TPS62097QEVM-891 performance specifications.

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Table 1. Performance Specification Summary

Specification	Test Conditions	Min	Typ	Max	Unit
Input voltage		2.5	5	6	V
Output voltage setpoint			1.8		V
Output current		0		2000	mA

1.2 Modifications

The printed-circuit board (PCB) for this EVM is designed to accommodate both the fixed and adjustable voltage versions of this integrated circuit (IC). Additional input and output capacitors can also be added. Finally, the loop response of the IC can be measured, the soft start time can be changed, and the switching frequency can be selected.

1.2.1 Fixed Output Voltage Operation

U1 can be replaced with the fixed output voltage version of the IC for evaluation. For fixed output voltage version operation, replace R2 with a 0-Ω resistor and remove R1.

1.2.2 Input and Output Capacitors

C5 is provided for an additional input capacitor. This capacitor is not required for proper operation but can be used to reduce the input voltage ripple.

C6, C7, and C8 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 data sheet for proper operation.

1.2.3 Loop Response Measurement

The loop response of the TPS62097QEVM-891 can be measured with two simple changes to the circuitry. First, make two cuts on the back of the PCB to remove shorts across the resistor pads. This change is shown in Figure 1. Second, install a 1-Ω resistor across those pads on the back of the PCB. The pads are spaced to allow installation of an 0603-sized resistor. With these changes, an ac signal (10-mV, peak-to-peak amplitude recommended) can be injected into the control loop across the added resistor. Details of measuring the control loop of DCS-Control devices are found in SLVA465. The results of this test are shown in Figure 3.

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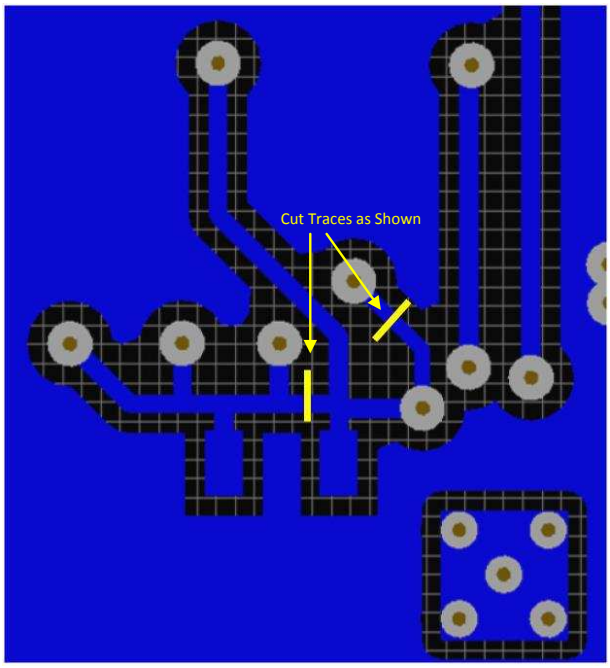

Figure 1. Loop Response Measurement Modification

1.2.4 Soft Start Capacitor

C3 sets a soft start time of about 1 ms. This capacitor can be changed to set other soft-start times. See the device data sheet for details.

1.2.5 MODE Resistor

R4 selects a switching frequency of about 1.5 MHz when the MODE jumper is connected between MODE and PWM. This resistor can be changed to select other switching frequencies. See the device data sheet for details.

2 Setup

This section describes how to properly use the TPS62097QEVM-891.

2.1 Input/Output Connector Descriptions

J1, Pin 1 and 2 – VIN	Positive input connection from the input supply for the EVM.
J1, Pin 3 and 4 – S+/S-	Input voltage sense connections. Measure the input voltage at this point.
J1, Pin 5 and 6 – GND	Input return connection from the input supply for the EVM.
J2, Pin 1 and 2 – VOUT	Output voltage connection.
J2, Pin 3 and 4 – S+/S-	Output voltage sense connections. Measure the output voltage at this point.
J2, Pin 5 and 6 – GND	Output return connection.
J3 – PG/GND	The PG output appears on pin 1 of this header with ground on pin 2.
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.

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JP2 – MODE MODE pin jumper. This jumper selects the switching frequency and operating mode per Table 2. Set this jumper before the device is enabled. Unless the jumper is installed across MODE and PFM/PWM initially, changes to the jumper position during operation have no effect. If the jumper is installed across MODE and PFM/PWM at startup, a function generator can be installed on MODE (to emulate a GPIO pin in the final application) and drive the pin high to enable forced PWM mode.

JP3 – PG Pullup Voltage PG pin pullup voltage jumper. Place the supplied jumper on JP3 to connect the PG pin pullup resistor to V_{IN}. Alternatively, the jumper can be removed and a different voltage can be supplied on pin 2 to pull up the PG pin to a different level. This externally applied voltage must remain below 6 V.

Table 2. Jumper JP2 Settings

JP2 Setting Before Being Enabled	Nominal Switching Frequency (MHz)	Operating Mode
Between MODE and PWM	1.5 (selectable with R4 value)	Forced PWM
Open	2.5	Forced PWM
Between MODE and PFM/PWM	2.0	Auto Power Save Mode
MODE driven to a logic high with an external function generator, after being installed between MODE and PFM/PWM at enable	2.0	Forced PWM

NOTE: Changes to JP2 during operation have no effect unless JP2 was installed between MODE and PFM/PWM at startup. Only this setting of JP2 allows the user to change between forced PWM and auto power save mode during operation. To achieve a different switching frequency, it is required to disable and re-enable the device.

2.2 Setup

To operate the EVM, set jumpers JP1 through JP3 to the desired position per Section 2.1. Connect the input supply to J1 and connect the load to J2.

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3 TPS62097QEVM-891 Test Results

The TPS62097QEVM-891 was used to take all the data in the TPS62097-Q1 data sheet (SLVSDZ7). See the device data sheet for the performance of this EVM.

Figure 2 shows the thermal performance of the EVM.

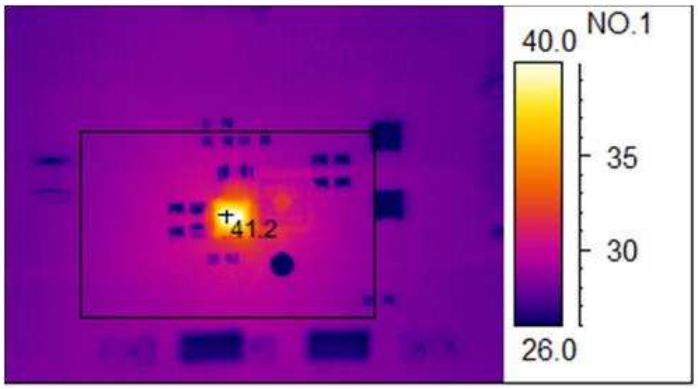

Figure 2. Thermal Performance (V_{IN} = 5 V, I_{OUT} = 2000 mA, Mode = PFM/PWM)

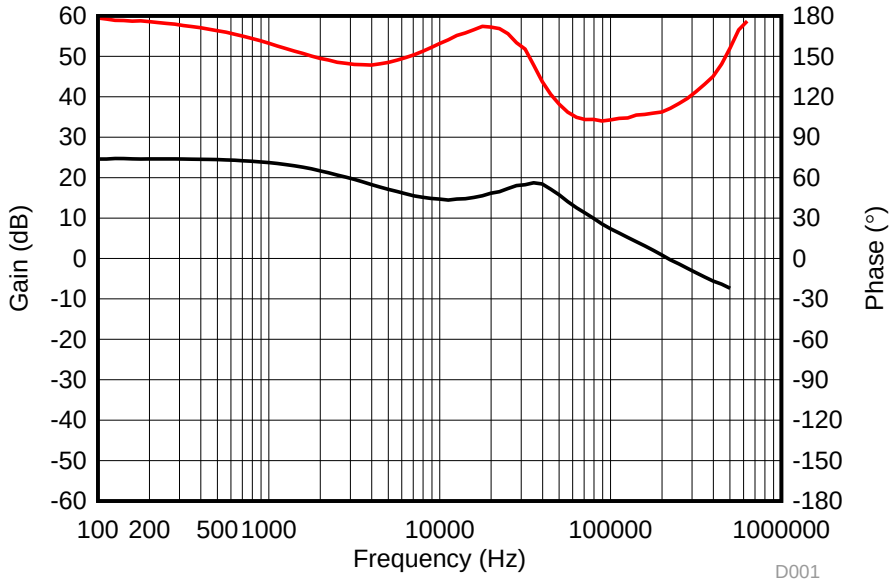

Figure 3. Loop Response Measurement (V_{IN} = 5 V, Load = 2000 mA, Mode = PFM/PWM)

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4 Board Layout

This section provides the TPS62097QEVM-891 board layout and illustrations in Figure 4 through Figure 9. The Gerbers are available on the EVM product page: TPS62097QEVM-891.

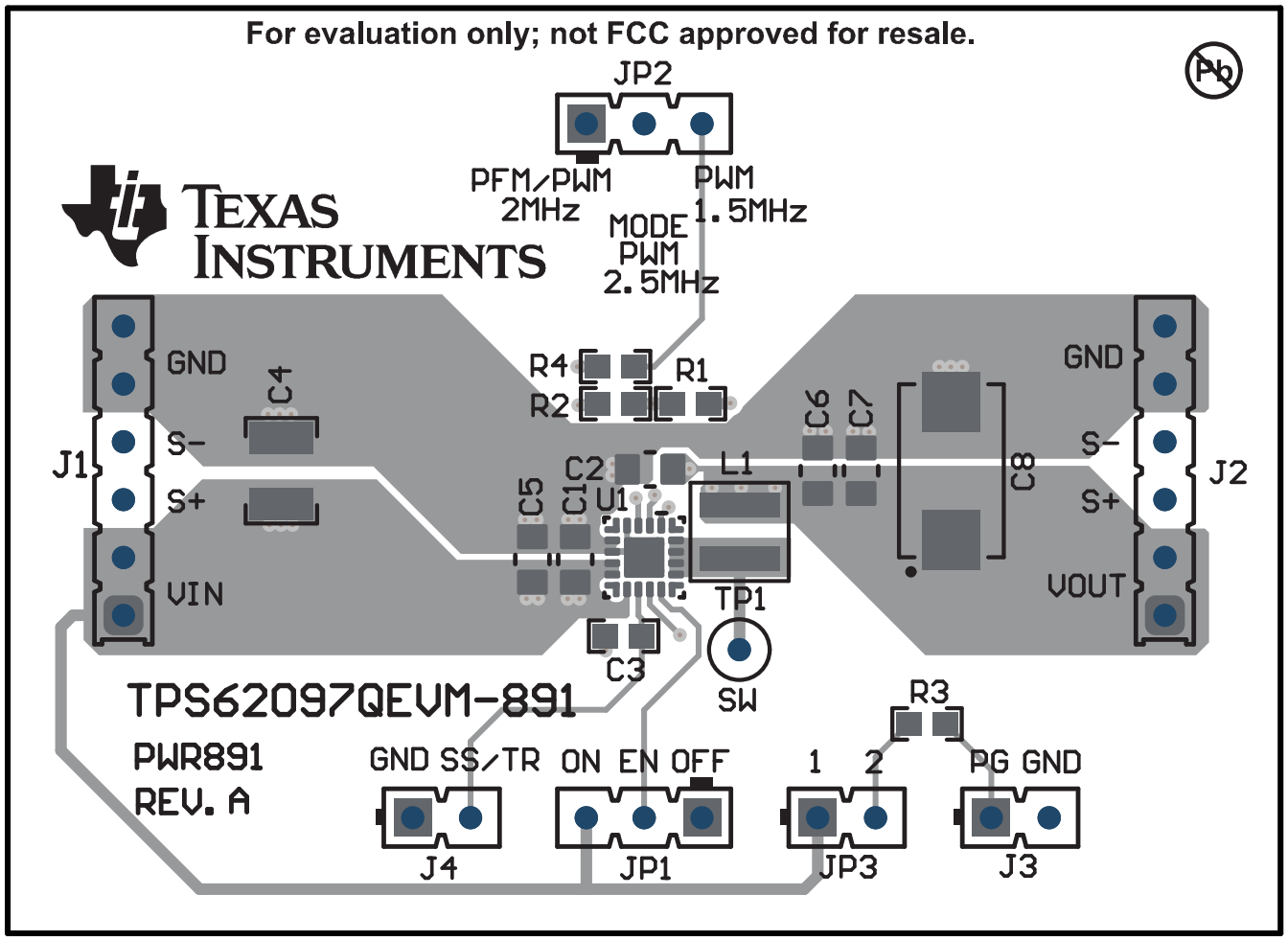

Figure 4. Top Assembly

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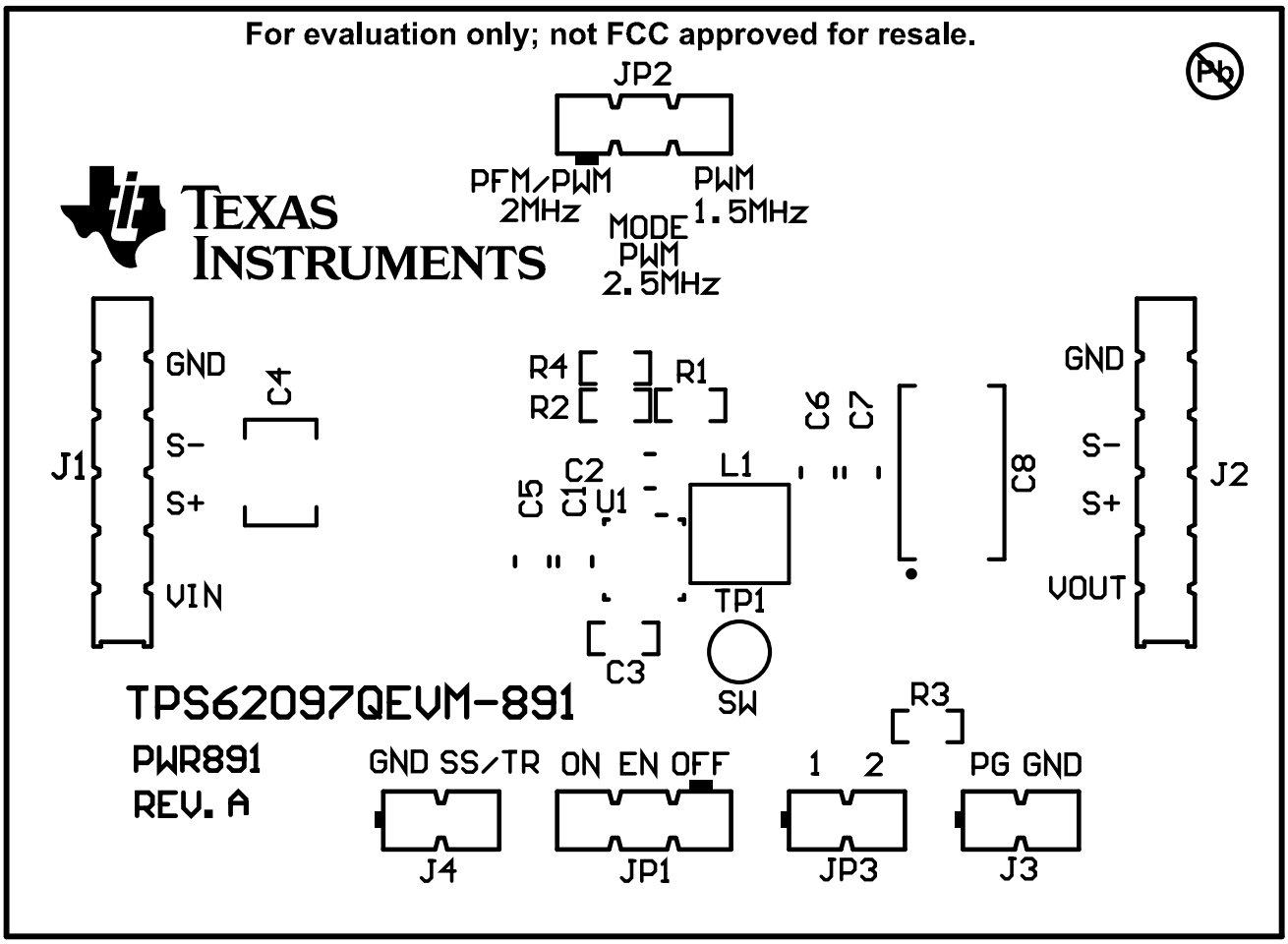

Figure 5. Top Overlay

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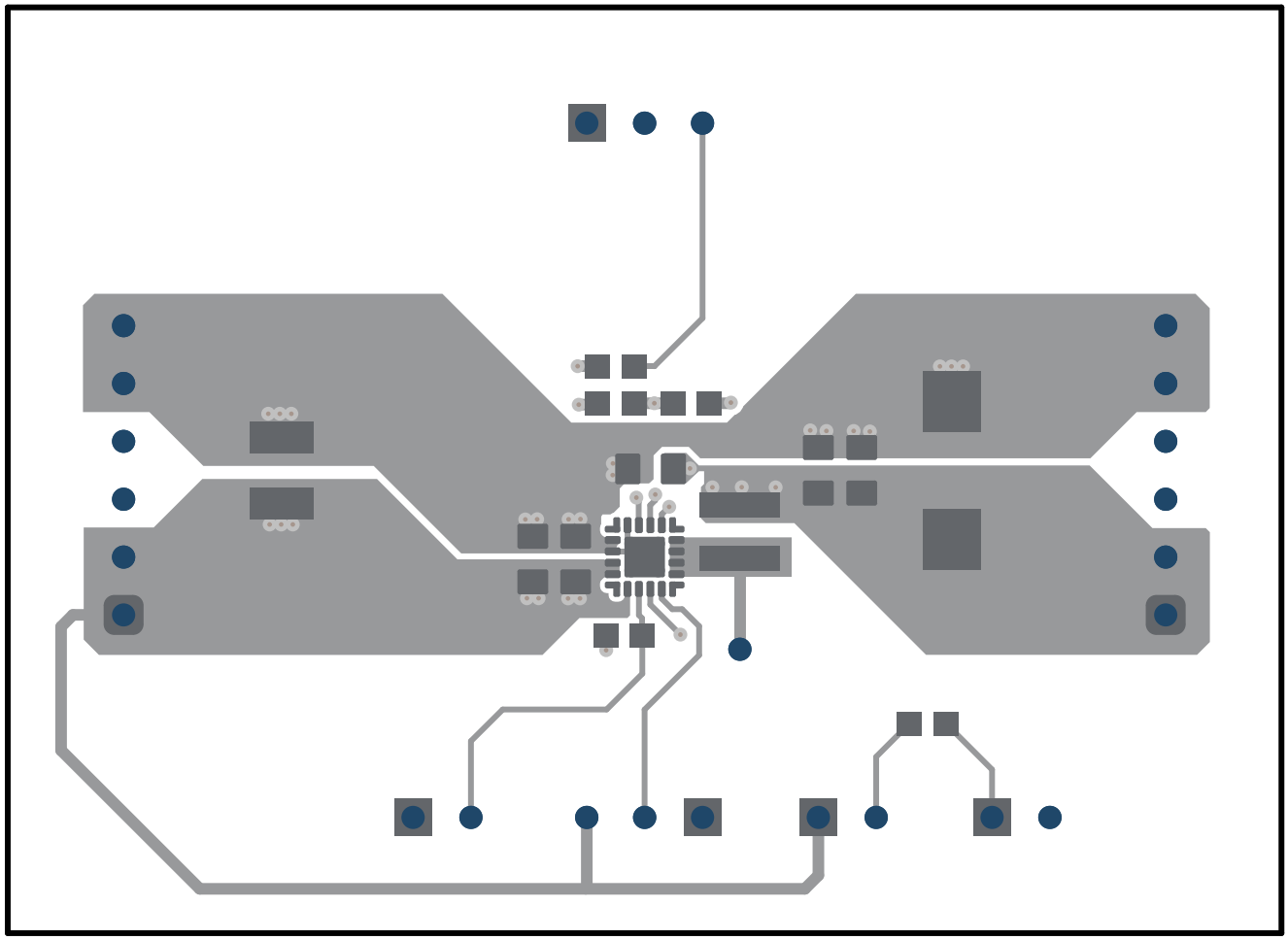

Figure 6. Top Layer

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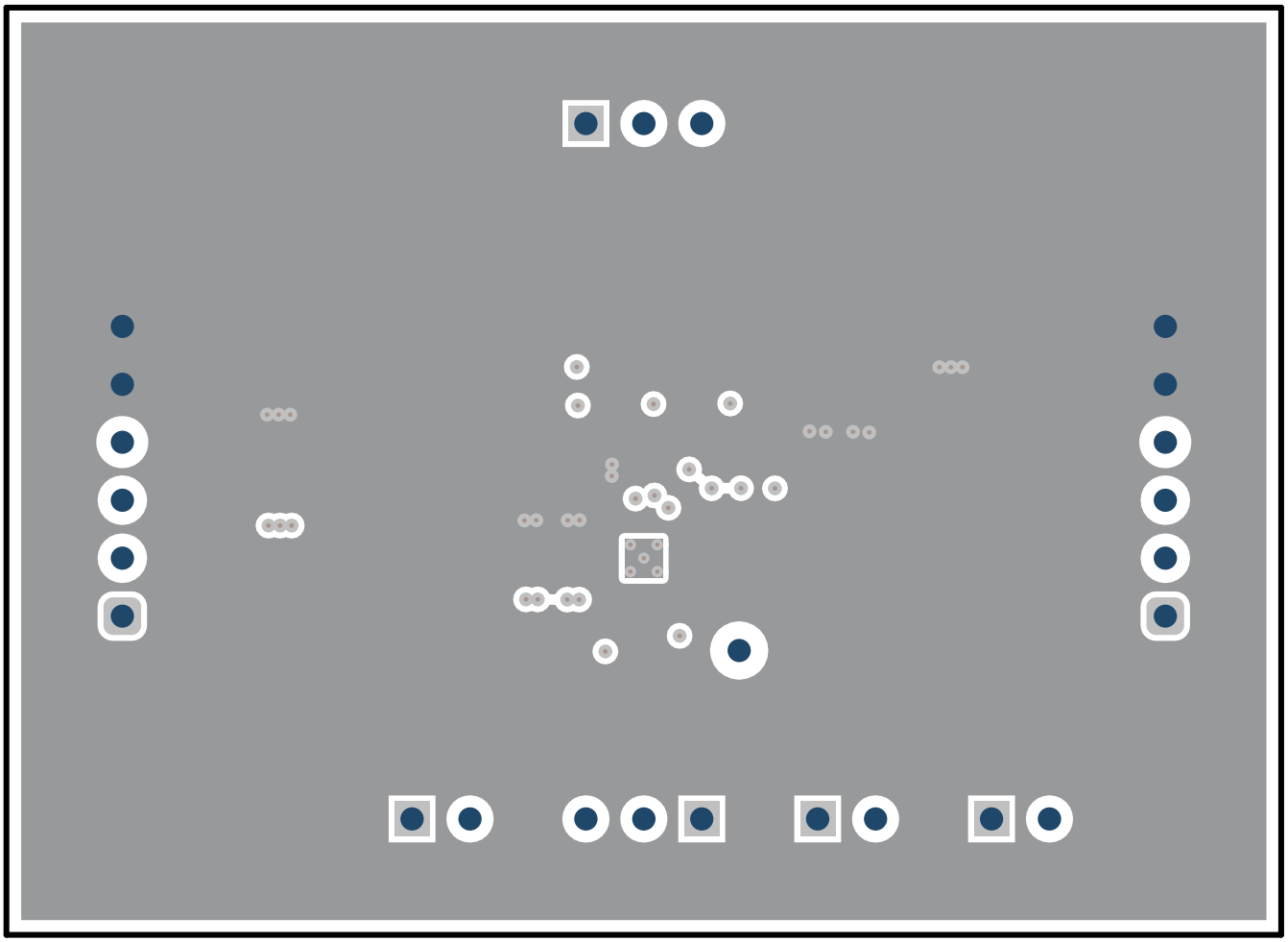

Figure 7. Signal Layer 1

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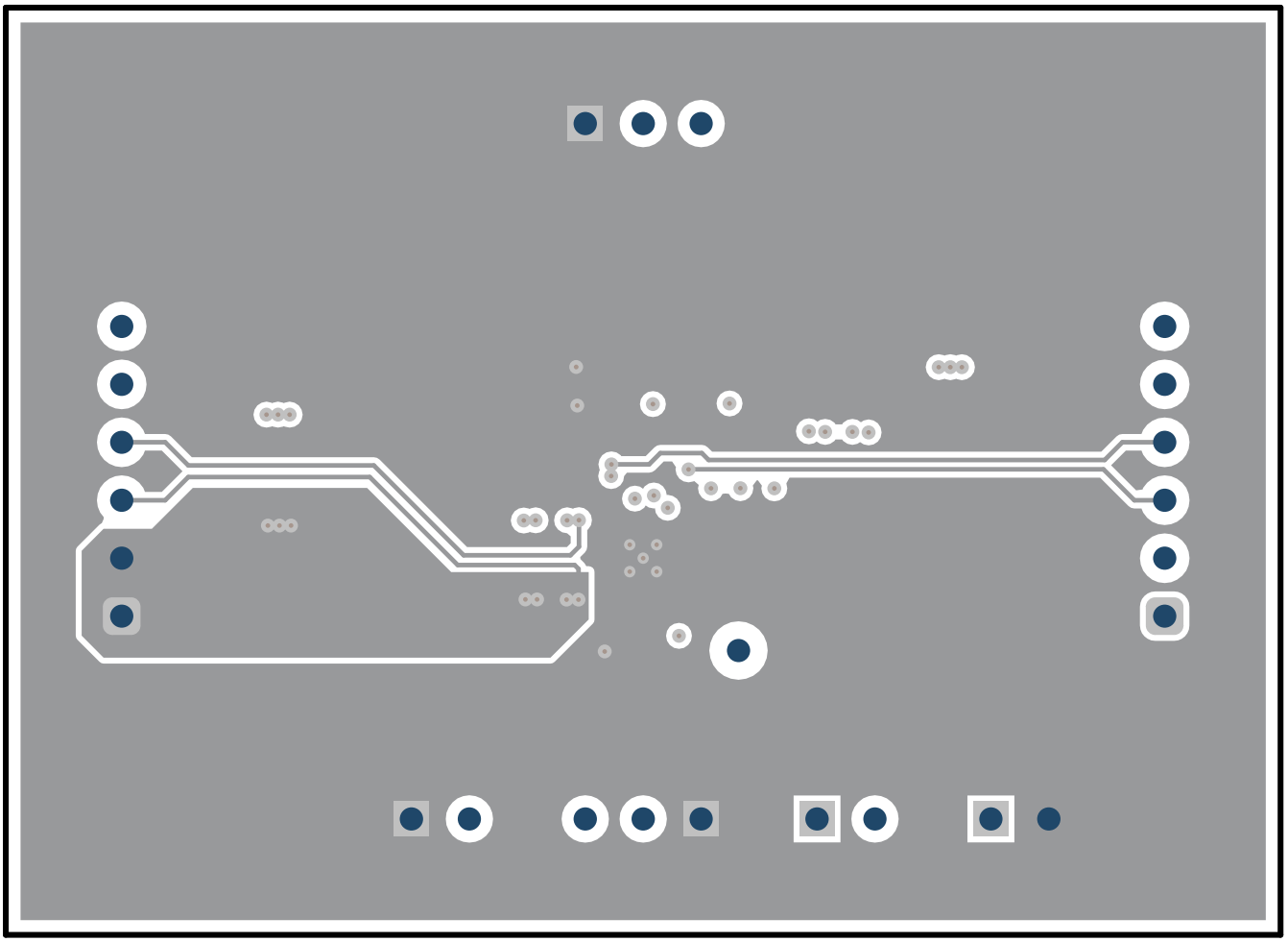

Figure 8. Signal Layer 2

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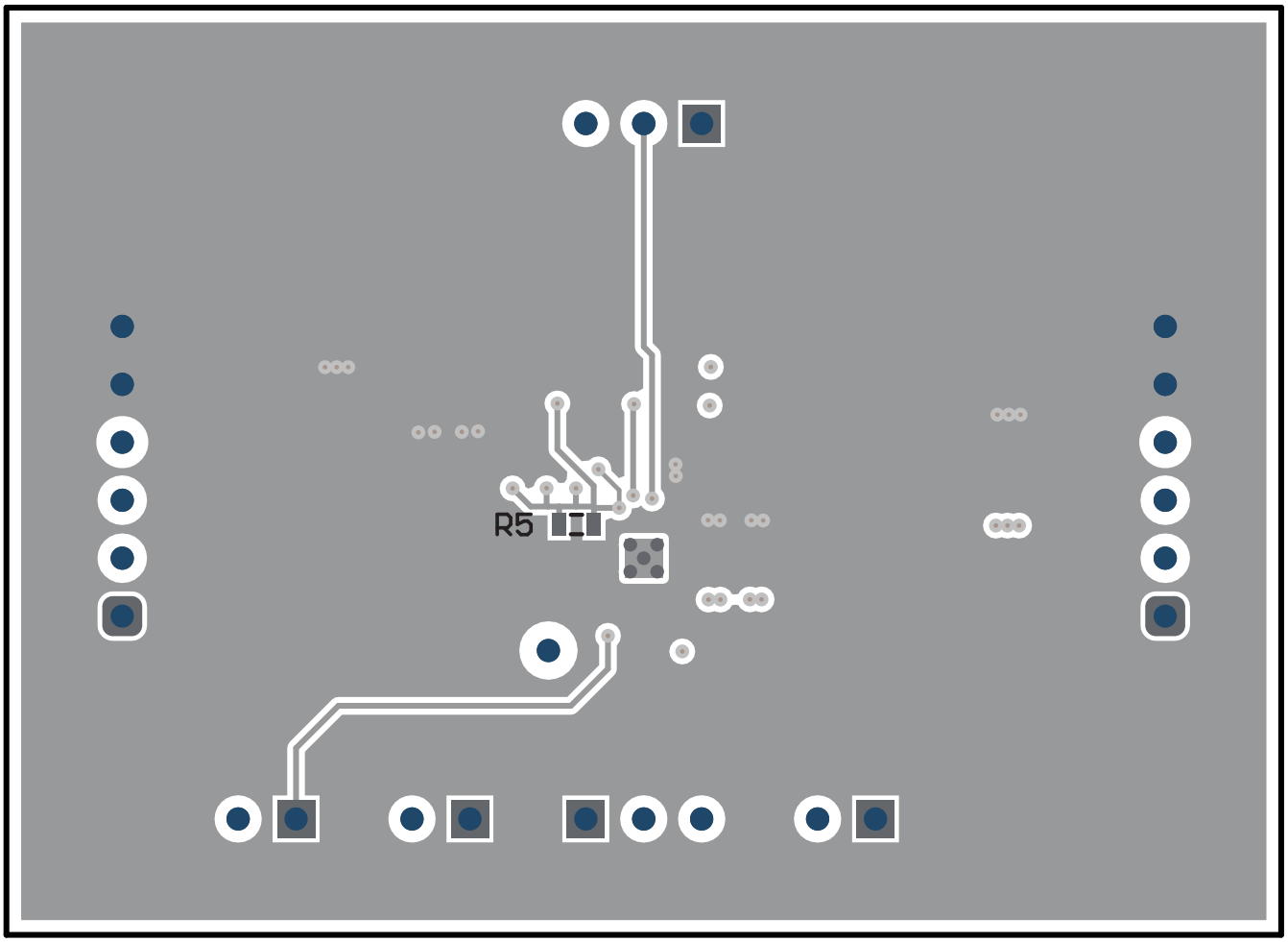

Figure 9. Bottom Layer

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5 Schematic and Bill of Materials

This section provides the TPS62097QEVM-891 schematic and bill of materials (BOM).

5.1 Schematic

Figure 10 illustrates the EVM schematic.

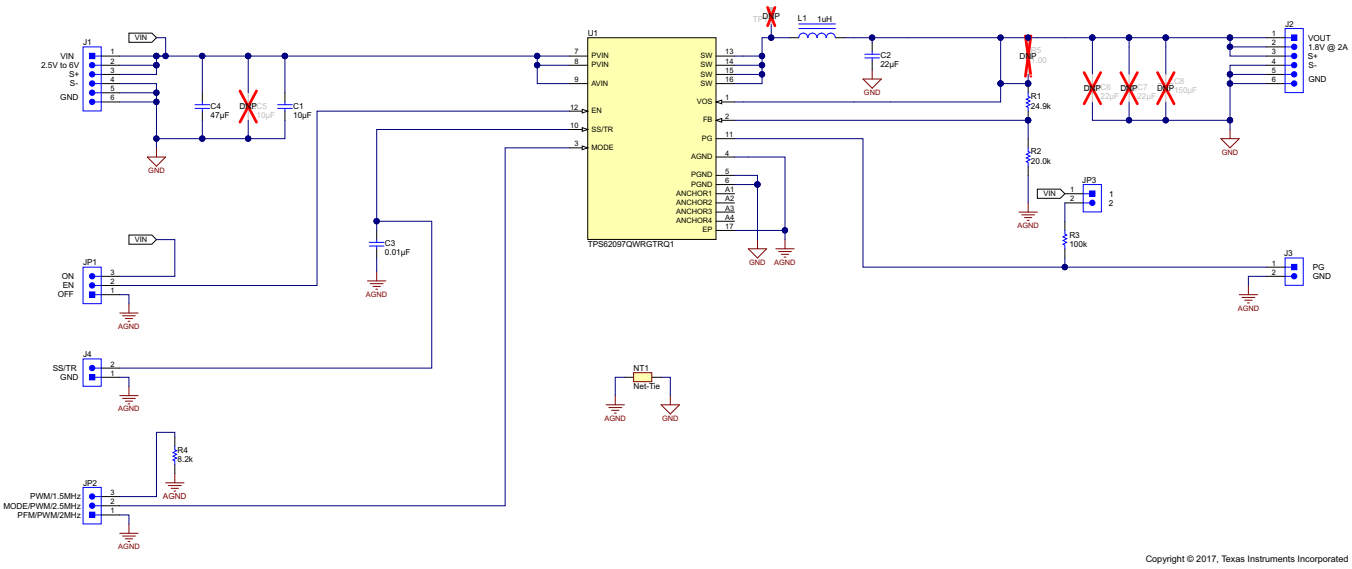

Figure 10. TPS62097QEVM-891 Schematic

5.2 Bill of Materials

Table 3 lists the BOM for this EVM.

Table 3. TPS62097QEVM-891 Bill of Materials

Ref Des	Qty	Value	Description	Size	Part Number	Manufacturer
C1	1	10µF	CAP, CERM, 10 µF, 6.3 V, +/- 20%, X7R	0805	C2012X7R0J106M125AB	TDK
C2	1	22µF	CAP, CERM, 22 µF, 10V, +/- 20%, X7S	0805	C2012X7S1A226M125AC	TDK
C3	1	0.01µF	CAP, CERM, 0.01 µF, 6.3 V, +/- 10%, X7R	0603	GRM188R70J103KA01D	Murata
C4	1	100µF	CAP, CERM, 100 µF, 6.3V, +/- 20%, X5R	1210	GRM32ER60J107ME20L	Murata
L1	1	1µH	Inductor, Shielded, Composite, 1µH, 5.4A, 0.01 ohm, SMD	4 x 4 mm	XFL4020-102MEB	Coilcraft
R1	1	24.9k	RES, 24.9 k, 1%, 0.1 W, 0603	0603	Std	Std
R2	1	20.0k	RES, 20.0 k, 1%, 0.1 W, 0603	0603	Std	Std
R3	1	100k	RES, 100 k, 1%, 0.1 W, 0603	0603	Std	Std
R4	1	8.2k	RES, 8.2 k, 5%, 0.1 W, 0603	0603	Std	Std
U1	1	TPS62097-Q1	2A, High Efficiency Step-Down Converter with wettable flanks	3 x 3 mm	TPS62097QWRGT	Texas Instruments

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      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

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- *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*

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(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

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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.

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Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. 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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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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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.

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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.

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