

# TPS62097QEV-891 Evaluation Module

The TPS62097QEV-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.

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## 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 TPS62097QEV-891 performance specifications.

**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.

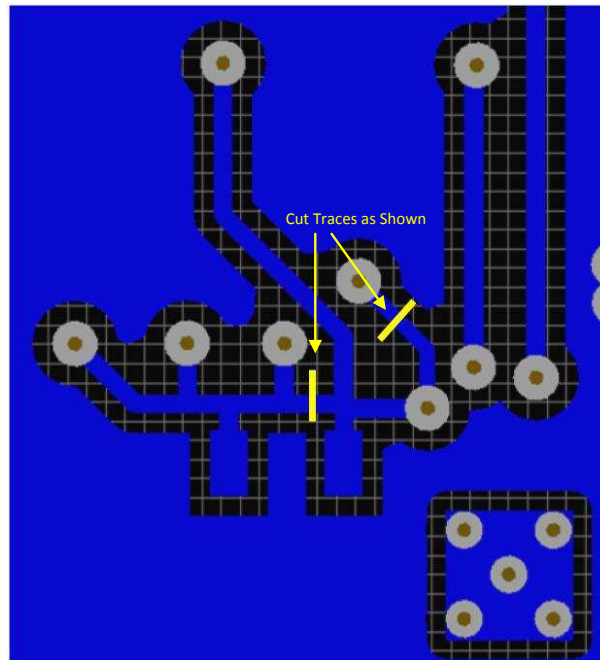
### 1.2.2 Input and Output Capacitors

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](#).



**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 TPS62097QEV-891.

### 2.1 Input/Output Connector Descriptions

<b>J1, Pin 1 and 2 – VIN</b>	Positive input connection from the input supply for the EVM.
<b>J1, Pin 3 and 4 – S+/S-</b>	Input voltage sense connections. Measure the input voltage at this point.
<b>J1, Pin 5 and 6 – GND</b>	Input return connection from the input supply for the EVM.
<b>J2, Pin 1 and 2 – VOUT</b>	Output voltage connection.
<b>J2, Pin 3 and 4 – S+/S-</b>	Output voltage sense connections. Measure the output voltage at this point.
<b>J2, Pin 5 and 6 – GND</b>	Output return connection.
<b>J3 – PG/GND</b>	The PG output appears on pin 1 of this header with ground on pin 2.
<b>JP1 – EN</b>	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.

**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

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**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.

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## 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.

### 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.

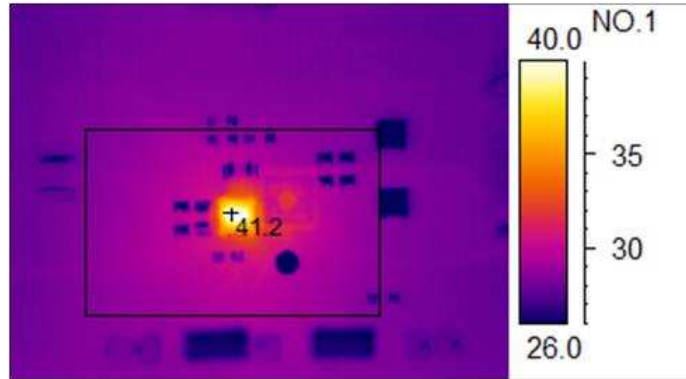


Figure 2. Thermal Performance ( $V_{IN} = 5\text{ V}$ ,  $I_{OUT} = 2000\text{ mA}$ , Mode = PFM/PWM)

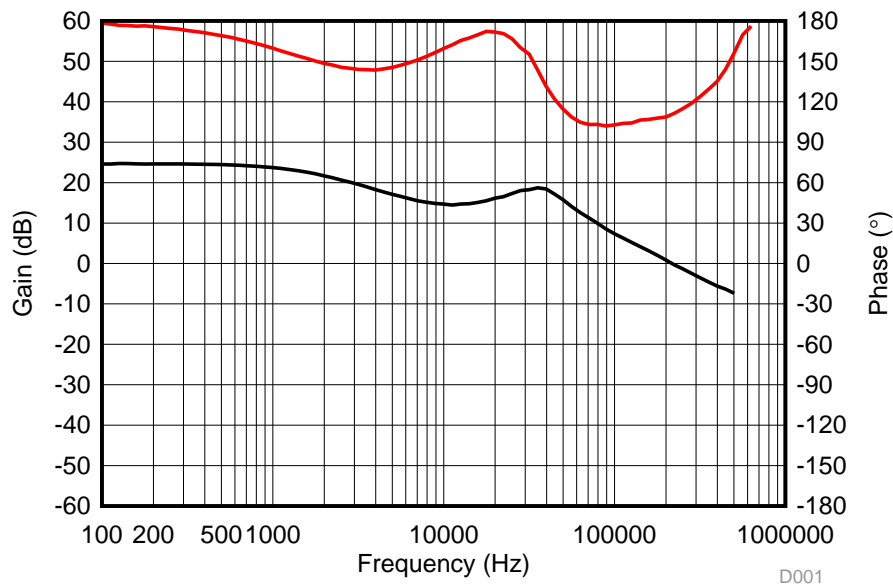


Figure 3. Loop Response Measurement ( $V_{IN} = 5\text{ V}$ , Load = 2000 mA, Mode = PFM/PWM)

#### 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](#).

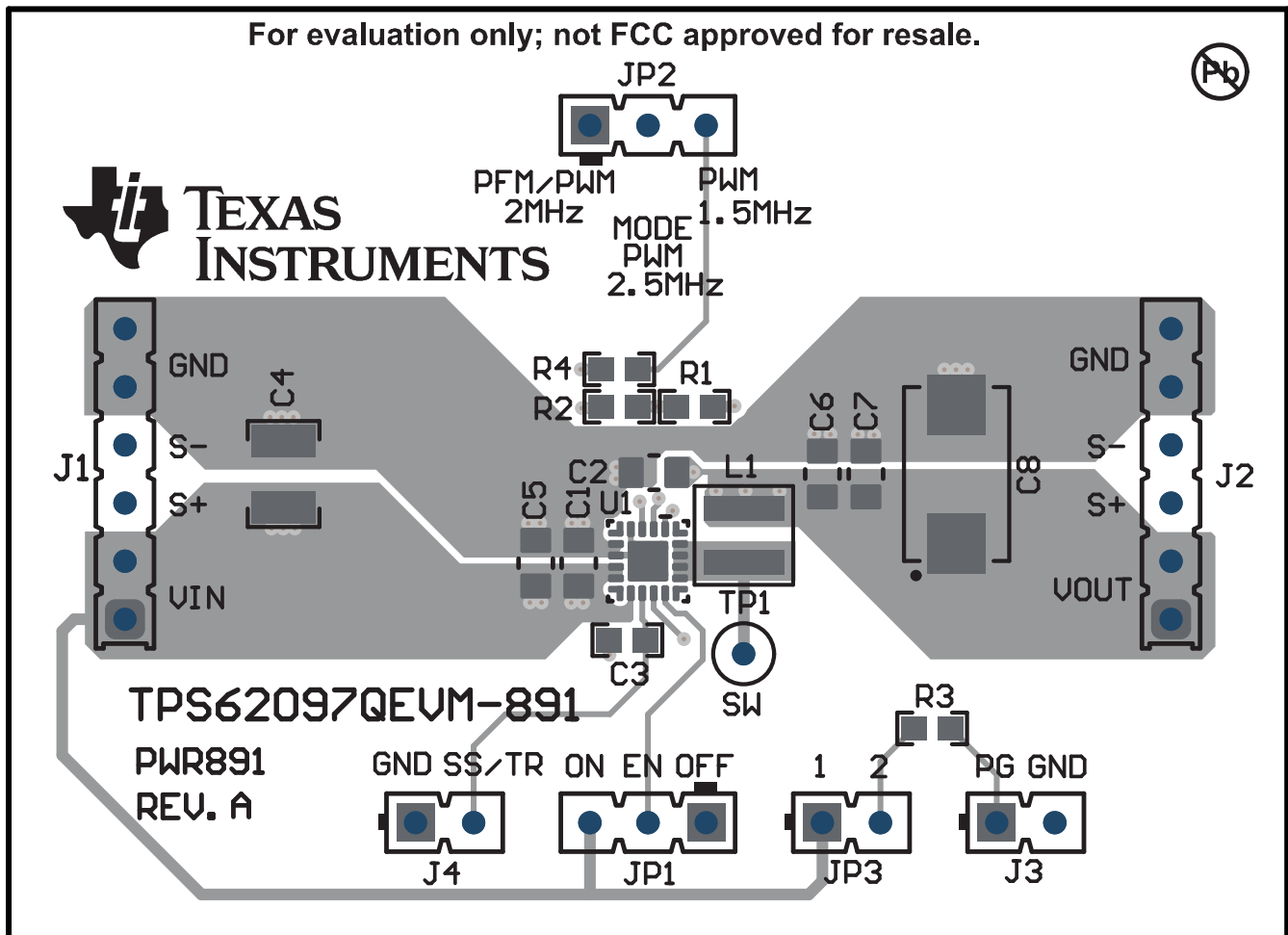


Figure 4. Top Assembly

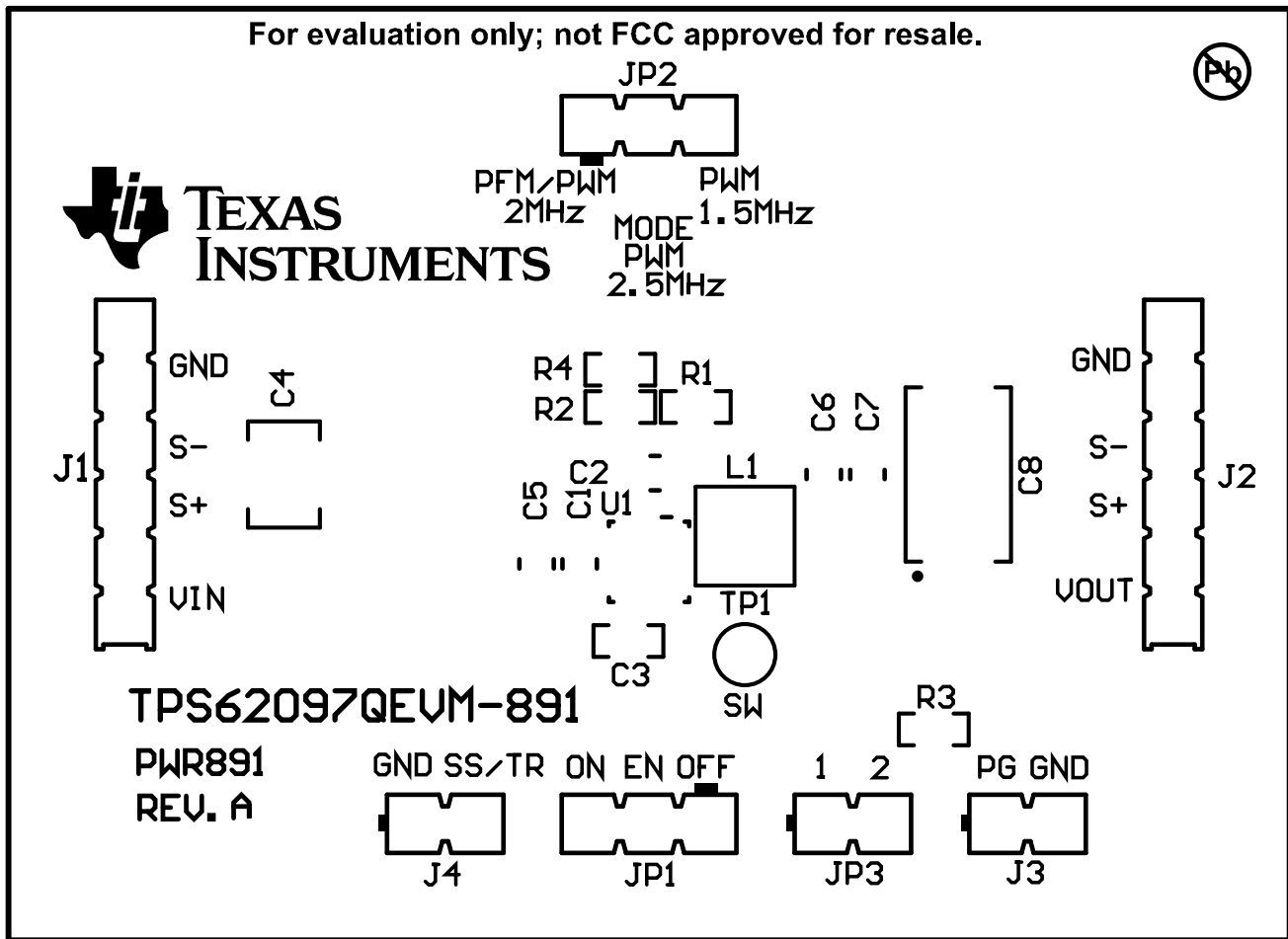


Figure 5. Top Overlay

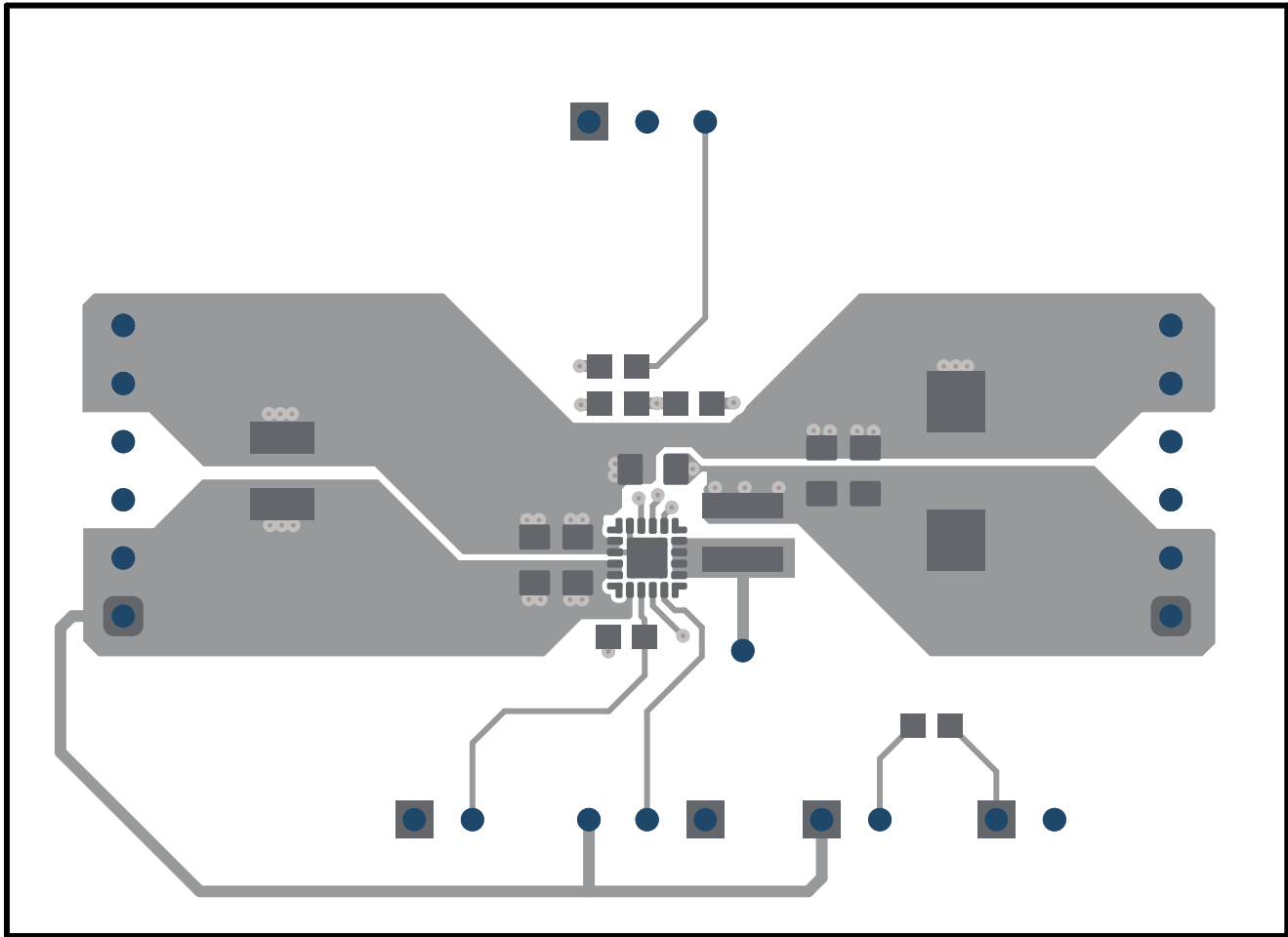


Figure 6. Top Layer



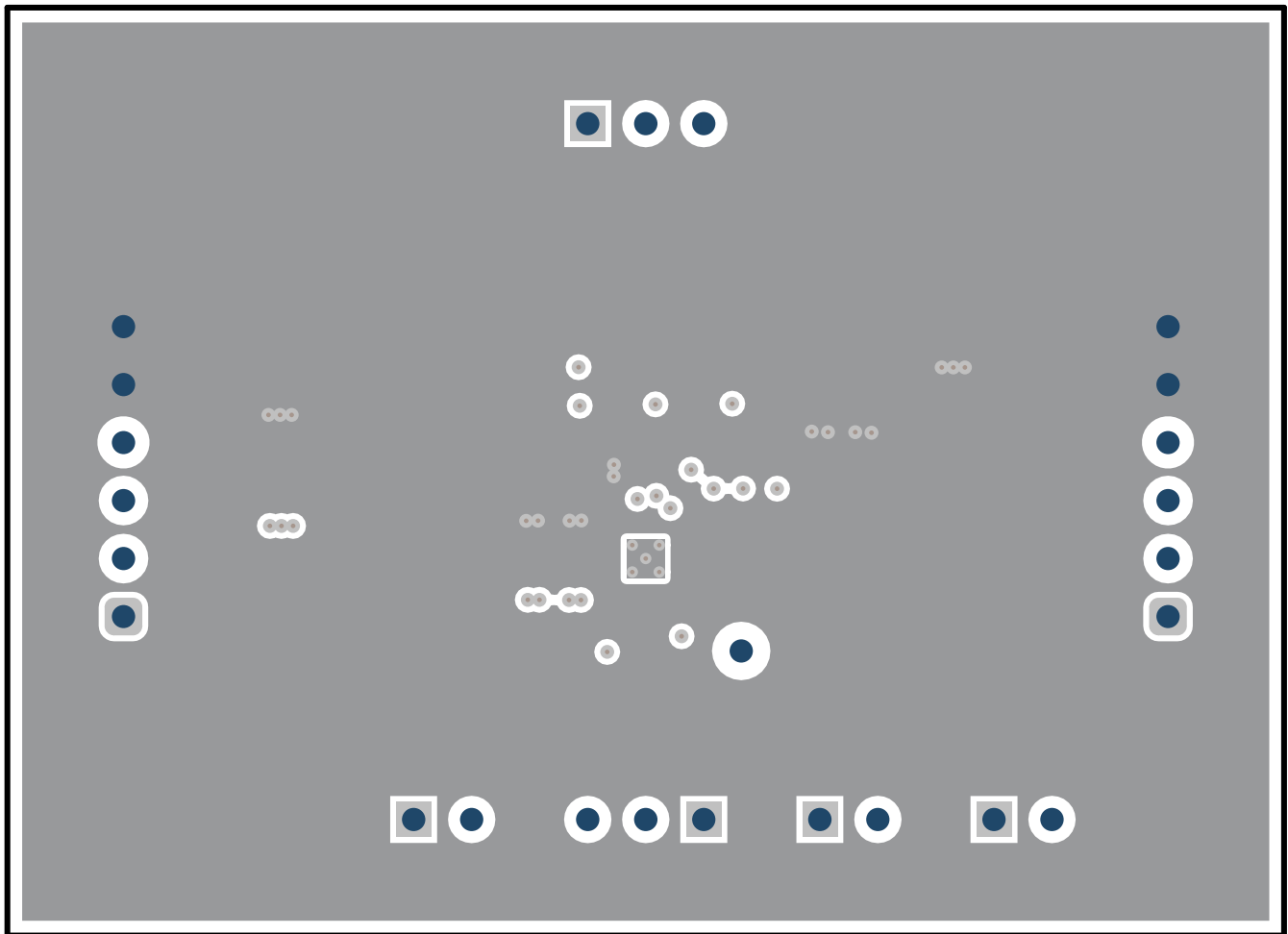


Figure 7. Signal Layer 1

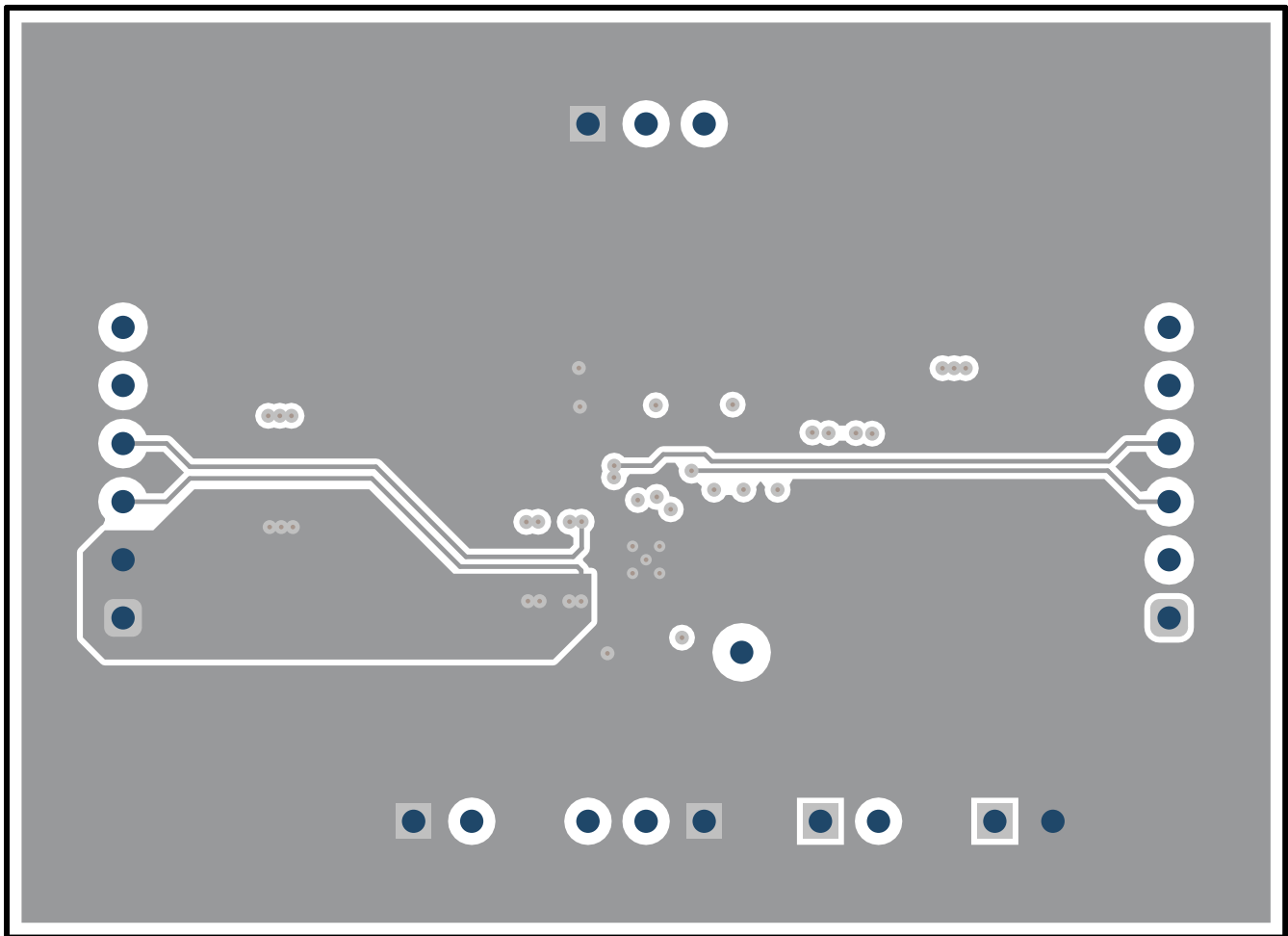


Figure 8. Signal Layer 2

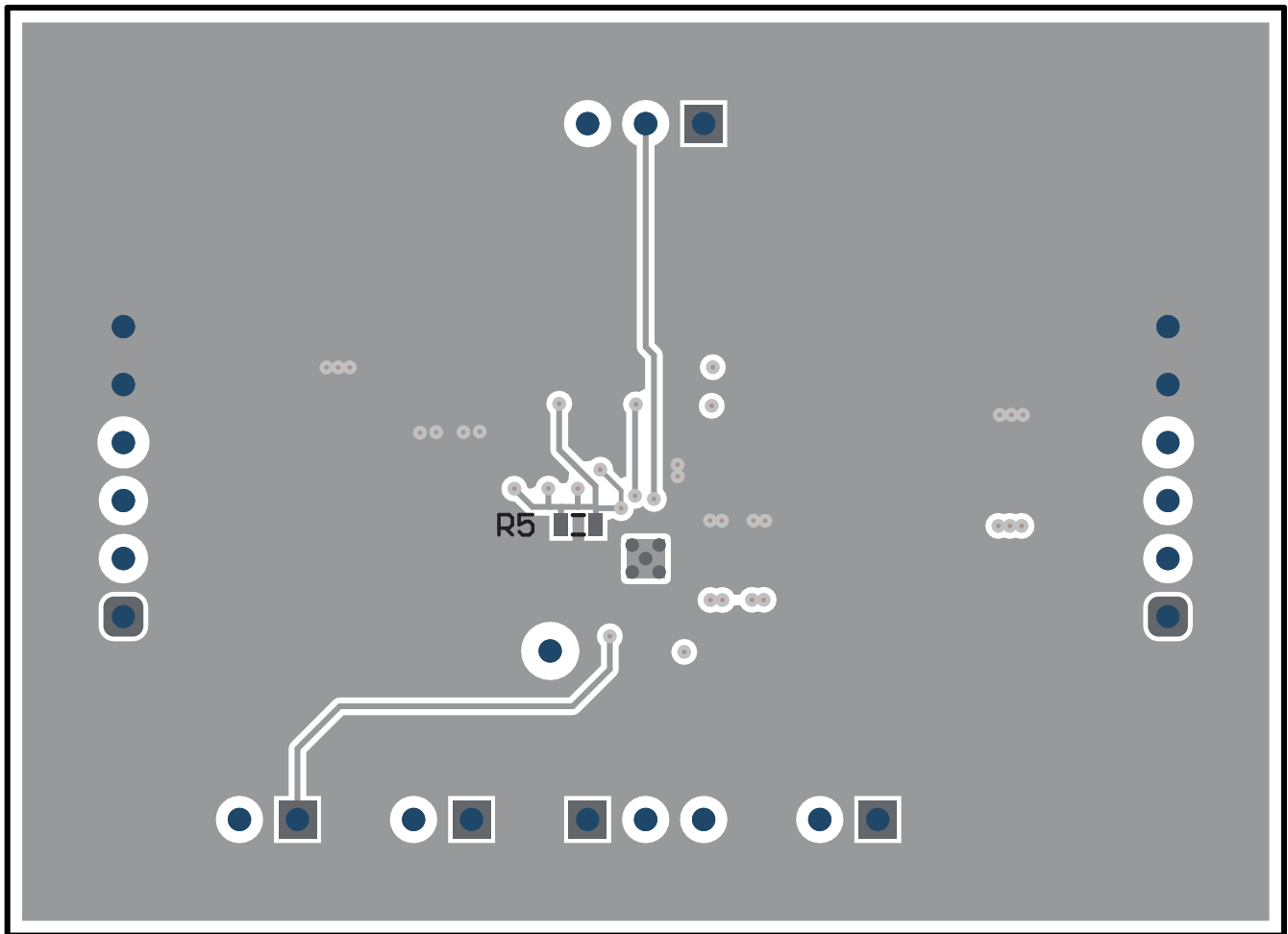


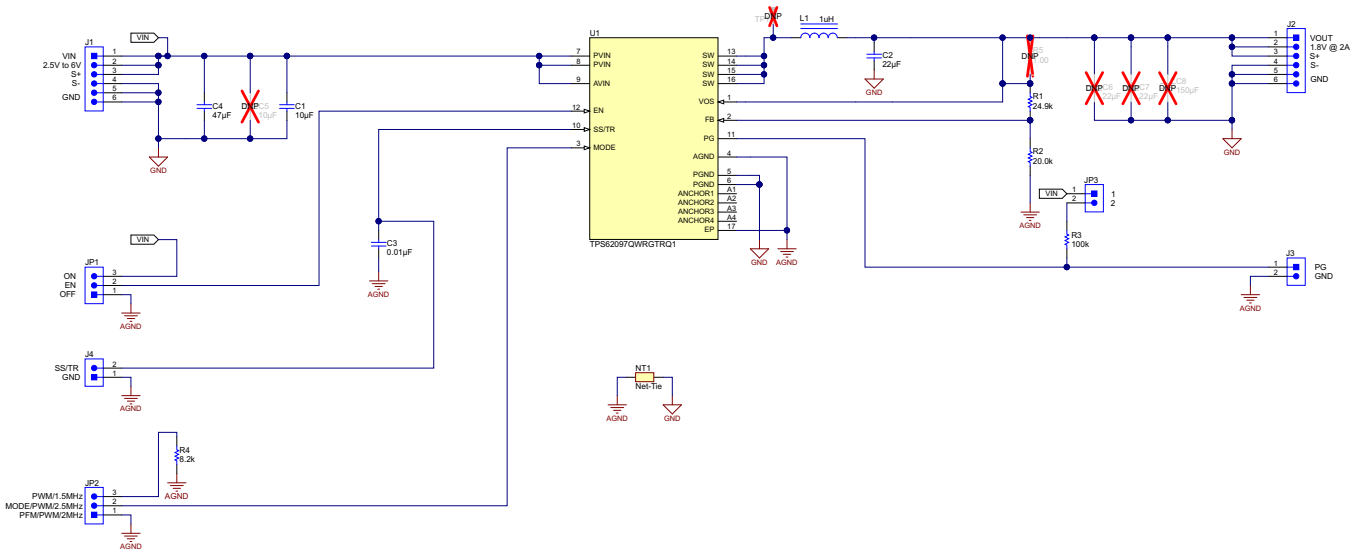
Figure 9. Bottom Layer

## 5 Schematic and Bill of Materials

This section provides the TPS62097QEV-891 schematic and bill of materials (BOM).

### 5.1 Schematic

Figure 10 illustrates the EVM schematic.



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Figure 10. TPS62097QEV-891 Schematic

### 5.2 Bill of Materials

Table 3 lists the BOM for this EVM.

Table 3. TPS62097QEV-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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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.

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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.*

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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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