User's Guide

TPSM8290x Step-Down Converter Evaluation Module User's Guide

TEXAS INSTRUMENTS

ABSTRACT

The TPSM8290xEVM (BSR188) facilitates the evaluation of the TPSM8290x 1-A, 2-A, and 3-A pin-to-pin compatible buck converter modules in a small 3.0-mm by 2.8-mm MicroSiP™ package with integrated inductor. The BSR188-003 uses the 3-A TPSM82903 to output a 1.2-V output voltage from input voltages between 3 V and 17 V. The BSR188-002 uses the 2-A TPSM82902 to output a 1.8-V output voltage from input voltages between 3 V and 17 V. The BSR188-001 uses the 1-A TPSM82901 to output a 3.3-V output voltage from input voltages up to 17 V. The TPSM8290x is a high-efficiency, low I_Q buck converter module for use in a variety of industrial, enterprise, and personal electronics applications, such as the following:

- Factory and building automation
- IP network cameras
- Industrial PC
- Data center switches
- Servo drives
- Mobile and embedded computing
- Any application with a 12-V input voltage or a 1-4 cell lithium battery pack

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Trademarks

MicroSiP™ is a trademark of Texas Instruments.
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1 Introduction

The TPSM8290x are synchronous, step-down converter modules in a small 3.0-mm × 2.8-mm × 1.6-mm MicroSiP package. Three different devices in this family support 1 A, 2 A, or 3 A of output current.

1.1 Performance Specification

Table 1-1, Table 1-2, and Table 1-3 provide a summary of the TPSM8290xEVM performance specifications.

Table 1-1. TPSM82903EVM Performance Specification Summary

Specification	Test Conditions	MIN	TYP	MAX	Unit
Input voltage		3	12	17	V
Output voltage setpoint			1.2		V
Output current		0		3	A
MODE/S-CONF (R7) setting	2.5 MHz, auto PFM/PWM with AEE, external FB, output discharge disabled		7.15		kΩ

Table 1-2. TPSM82902EVM Performance Specification Summary

Specification	Test Conditions	MIN	TYP	MAX	Unit
Input voltage		3	12	17	V
Output voltage setpoint			1.8		V
Output current		0		2	A
MODE/S-CONF (R7) setting	2.5 MHz, auto PFM/PWM with AEE, external FB, output discharge disabled		7.15		kΩ

Table 1-3. TPSM82901EVM Performance Specification Summary

Specification	Test Conditions	MIN	TYP	MAX	Unit
Input voltage		3.4	12	17	V
Output voltage setpoint			3.3		V
Output current		0		1	A
MODE/S-CONF (R7) setting	2.5 MHz, auto PFM/PWM with AEE, external FB, output discharge disabled		7.15		kΩ

1.2 Modifications

The printed-circuit board (PCB) for this EVM is designed to accommodate some modifications by the user. Additionally, the following modifications can be made:

• Input and output capacitors can be added.
• The input voltage at which the IC turns on can be adjusted with two resistors
• The soft-start time can be changed.
• The output voltage can track an applied voltage
• A feedforward capacitor can be added.
• The switching frequency, output discharge setting, MODE setting, and output voltage setting configuration can be changed.

See the *TPSM82903, 3-A, 3-V to 17-V, High Efficiency and Low IQ Buck Converter Module in a MicroSiP Package with an Integrated Inductor Data Sheet* for details of the various settings.

1.2.1 Input and Output Capacitors

C2, C3, and C4 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, and C10 are provided for additional bulk output capacitors. These capacitors are not required for proper operation but can be used to reduce the output voltage ripple. The total output capacitance must remain within the recommended range in the *TPSM82903, 3-A, 3-V to 17-V, High Efficiency and Low IQ Buck Converter Module in a MicroSiPTM Package with an Integrated Inductor Data Sheet* for proper operation.

1.2.2 Configurable Enable Threshold Voltage

With JP2 removed, R3 and R4 can be installed to set a user-selectable input voltage at which the IC turns on.

1.2.3 SS/TR Capacitor

C12 sets the soft-start time. This capacitor can be changed to set other soft-start times.

1.2.4 Feedforward Capacitor

C11 is provided as an optional feedforward capacitor (C_{FF}).

1.2.5 MODE/S-CONF Resistor

R7 selects the switching frequency, output discharge, MODE setting, and output voltage setting configuration. When using the VSET configuration for setting the output voltage, remove R2 and change the value of R5. See the *TPSM82903, 3-A, 3-V to 17-V, High Efficiency and Low IQ Buck Converter Module in a MicroSiPTM Package with an Integrated Inductor Data Sheet* for details of the various settings.

2 Setup

This section describes how to properly use the EVM.

2.1 Input/Output Connector Descriptions

J2, Pin 1 and 2 – V$_{IN}$	Positive input connection from the input supply for the EVM
J2, Pin 3 and 4 – S+/S-	Input voltage sense connections. Measure the input voltage at this point.
J2, Pin 5 and 6 – GND	Return connection from the input supply for the EVM
J3, Pin 1 and 2 – V$_{OUT}$	Output voltage connection
J3, Pin 3 and 4 – S+/S-	Output voltage sense connections. Measure the output voltage at this point.
J3, Pin 5 and 6 – GND	Output return connection
J4 – PG/GND	The PG output is on pin 1 of this header with a convenient ground on pin 2.
J5 – TRACK-IN/SS/TR/GND	By removing C12, the IC tracks an externally applied voltage. Apply the voltage on pin 1 to scale the applied voltage through R8 and R9. The SS/TR voltage can be measured on pin 2.
JP1 – PG Pullup Voltage	PG pin pullup voltage jumper. Place the supplied jumper on JP1 to connect the PG pin pullup resistor to V$_{OUT}$. 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 18 V.
JP2 – 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 R3 and R4.
JP3 – MODE/S-CONF	MODE/S-CONF pin input jumper. Place the supplied jumper across PWM and MODE/S-CONF to operate the IC in forced PWM mode. Place the jumper across PFM/PWM and MODE/S-CONF to operate the IC in auto PFM/PWM mode. Remove the jumper to operate the IC with the MODE/S-CONF settings set by R7.

Note

If it is desired to change between PWM and PFM/PWM modes during operation, JP3 must be set to either PWM or PFM/PWM before enabling the IC.

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3 Safety Instructions

WARNING

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

4 Test Results

The TPSM8290xEVM was used to take all the data in the *TPSM82903, 3-A, 3-V to 17-V, High Efficiency and Low IQ Buck Converter Module in a MicroSiPTM Package with an Integrated Inductor Data Sheet*. See the device data sheet for the performance of this EVM.

Figure 4-1 shows the thermal performance of the EVM. "Spot" shows the temperature of the PCB.

Figure 4-1. Thermal Performance (V$_{IN}$ = 12 V, V$_{OUT}$ = 1.2 V, I$_{OUT}$ = 3000 mA, JP3 Open)

5 Board Layout

This section provides the EVM board layout and illustrations in Figure 5-1 through Figure 5-5. The Gerbers are available on the EVM product page.
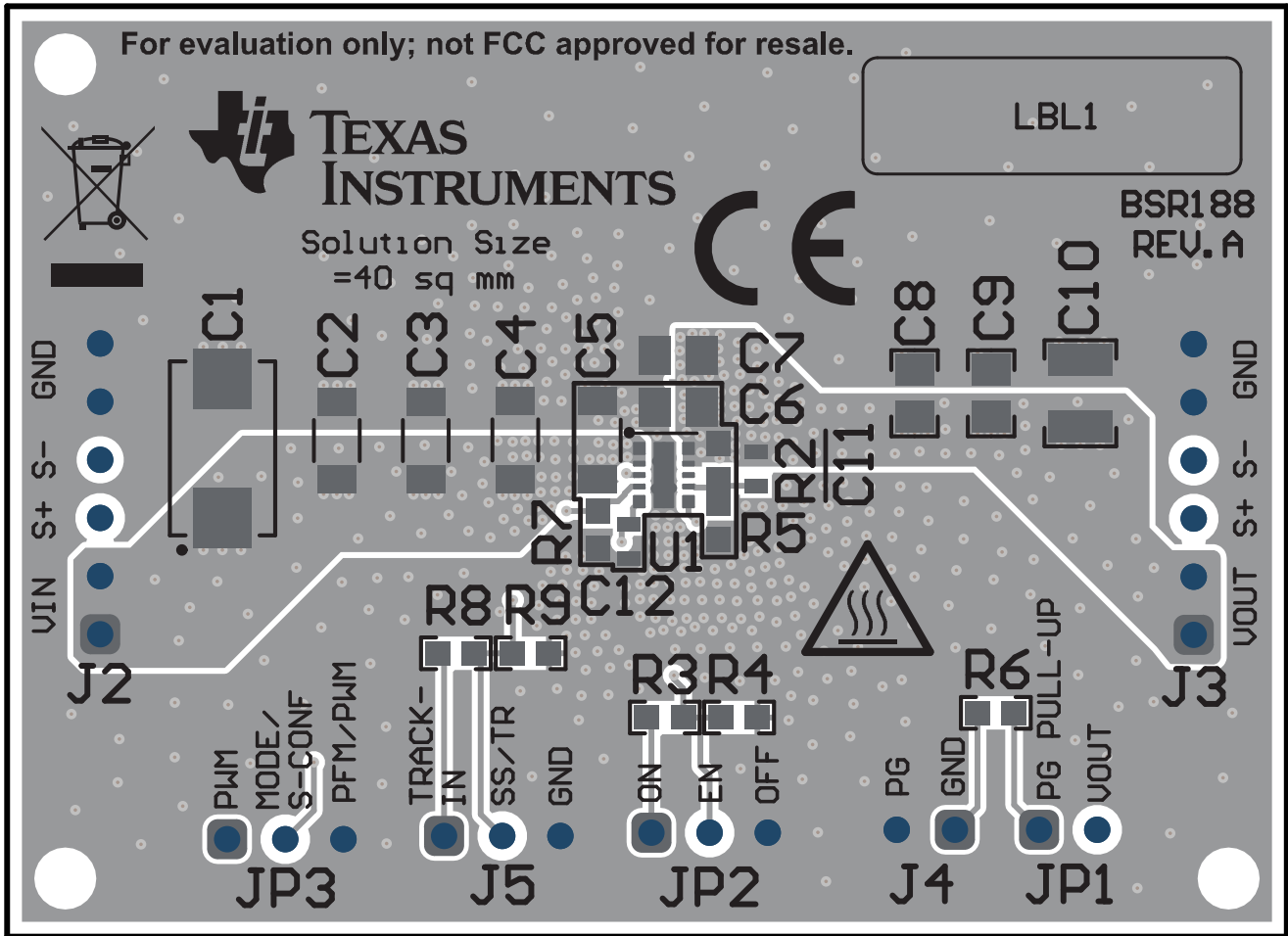
Figure 5-1. Top Assembly
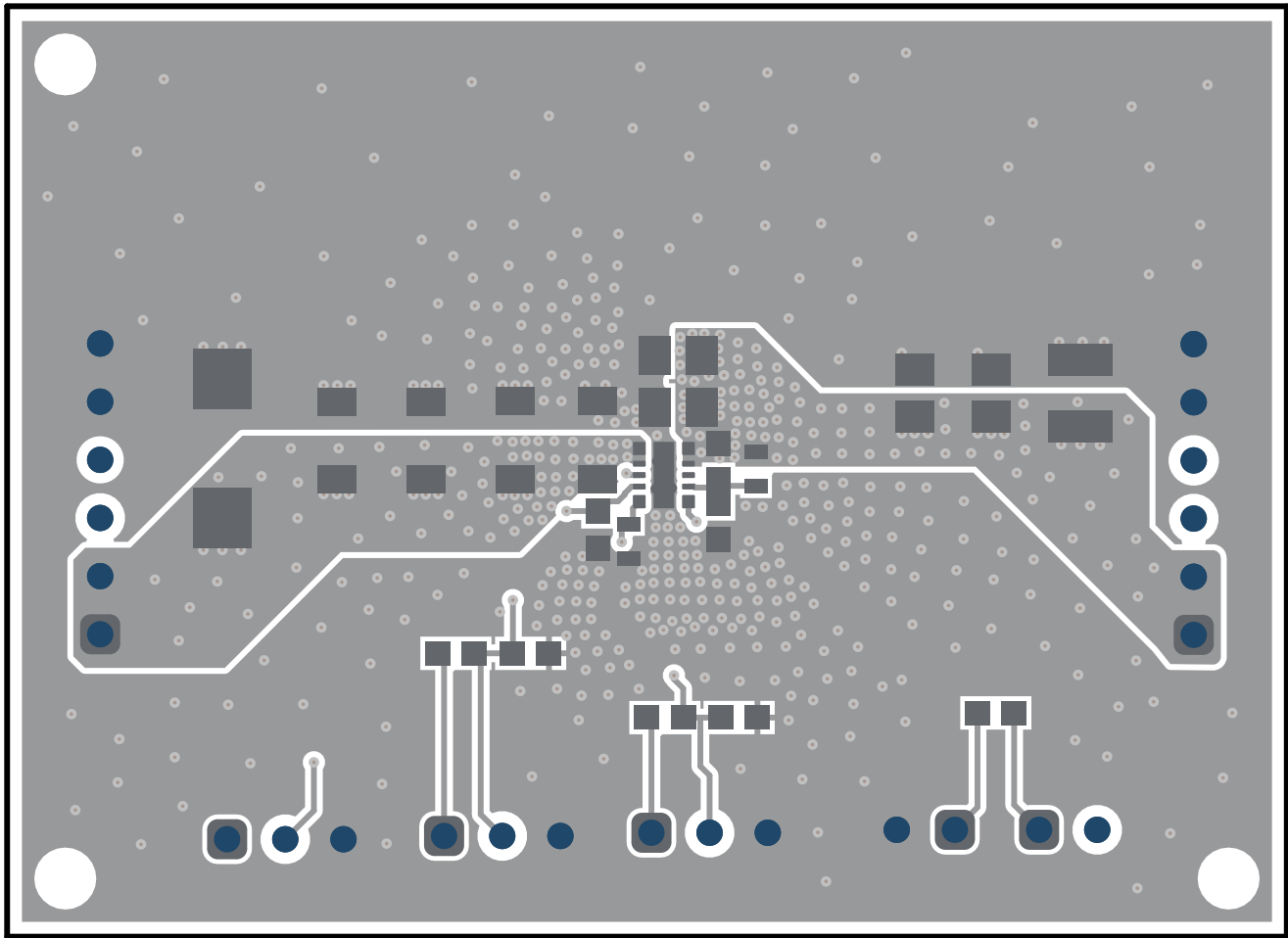
Figure 5-2. Top Layer
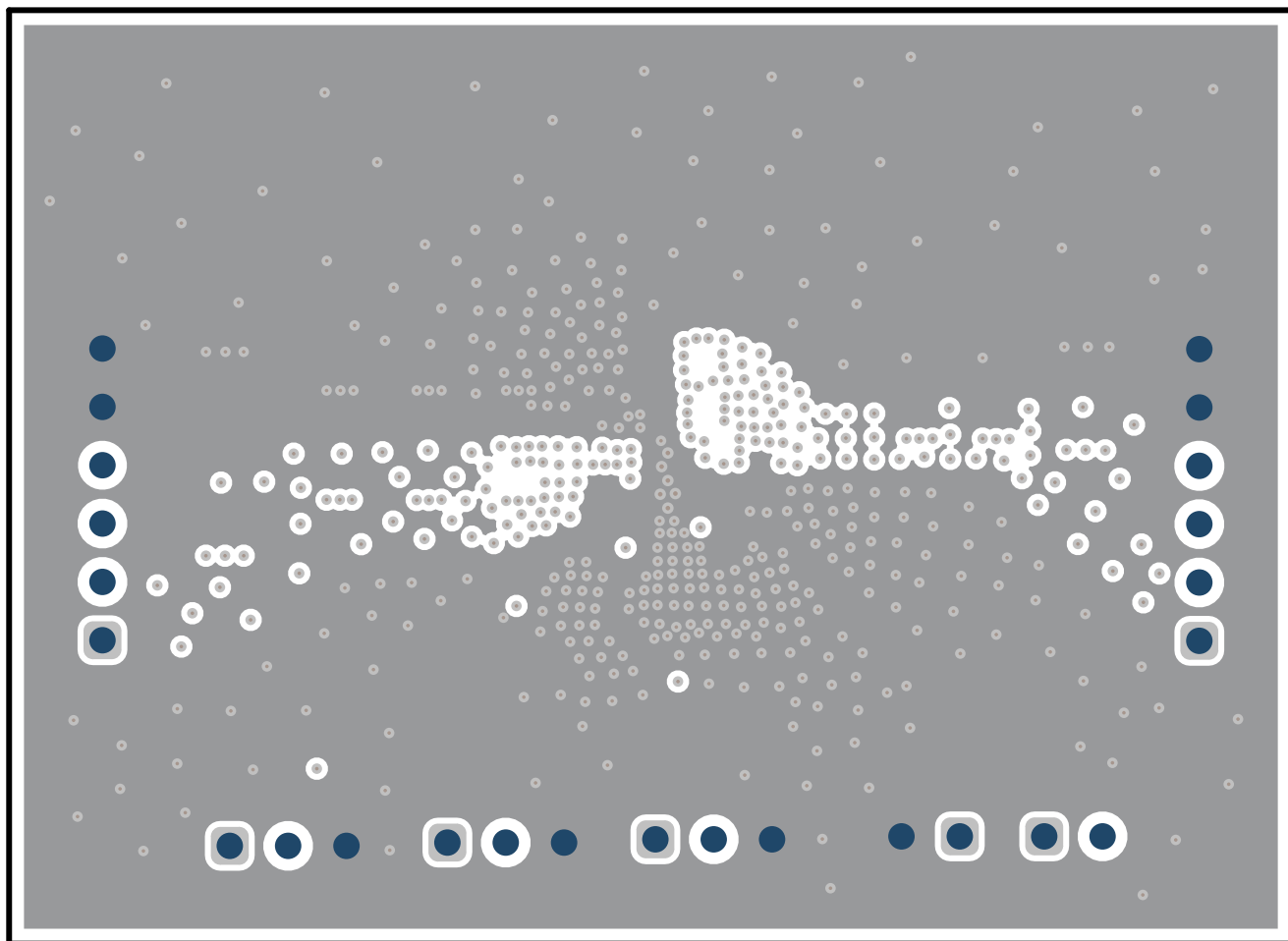
Figure 5-3. Internal Layer 1
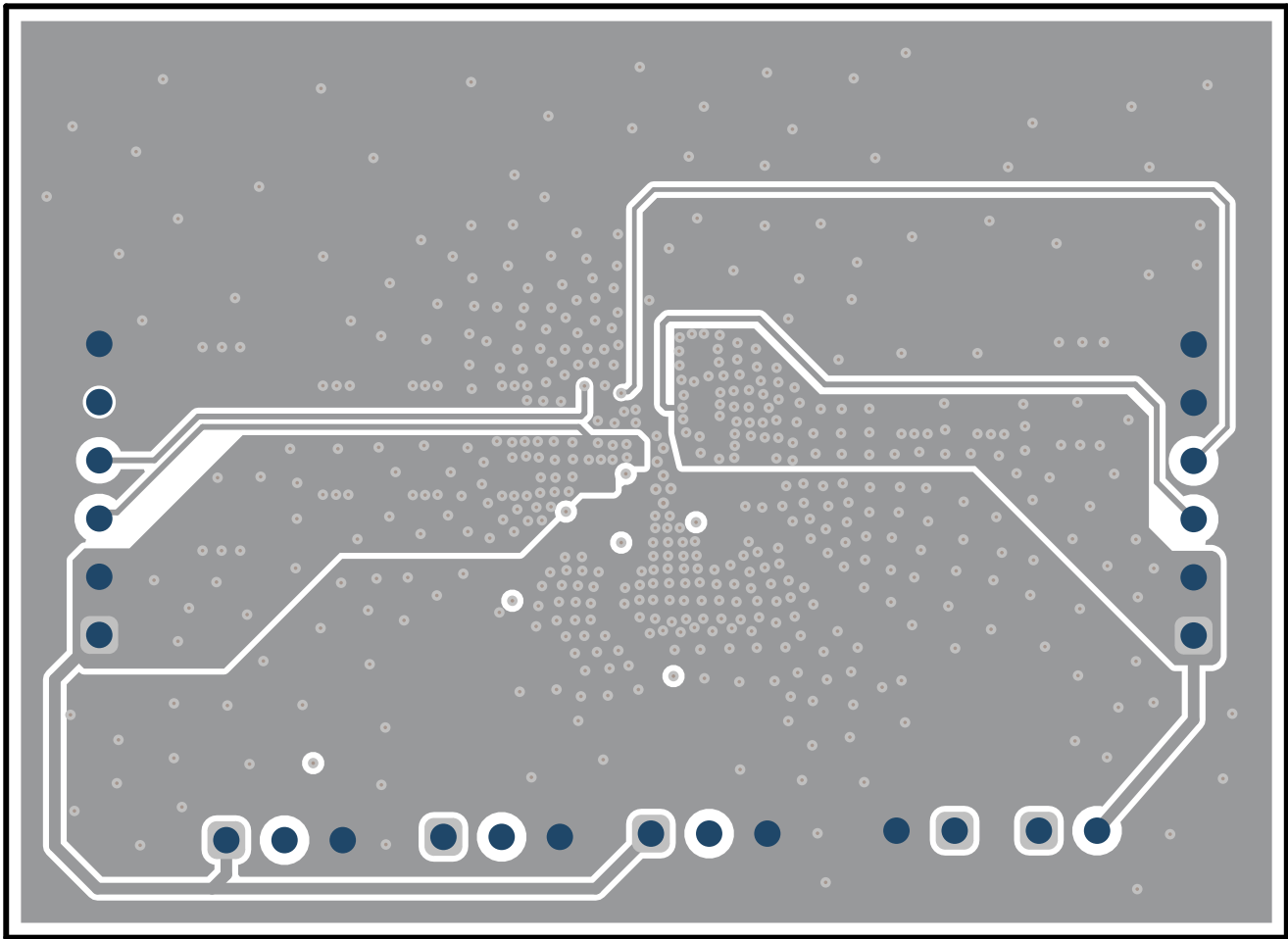
Figure 5-4. Internal Layer 2
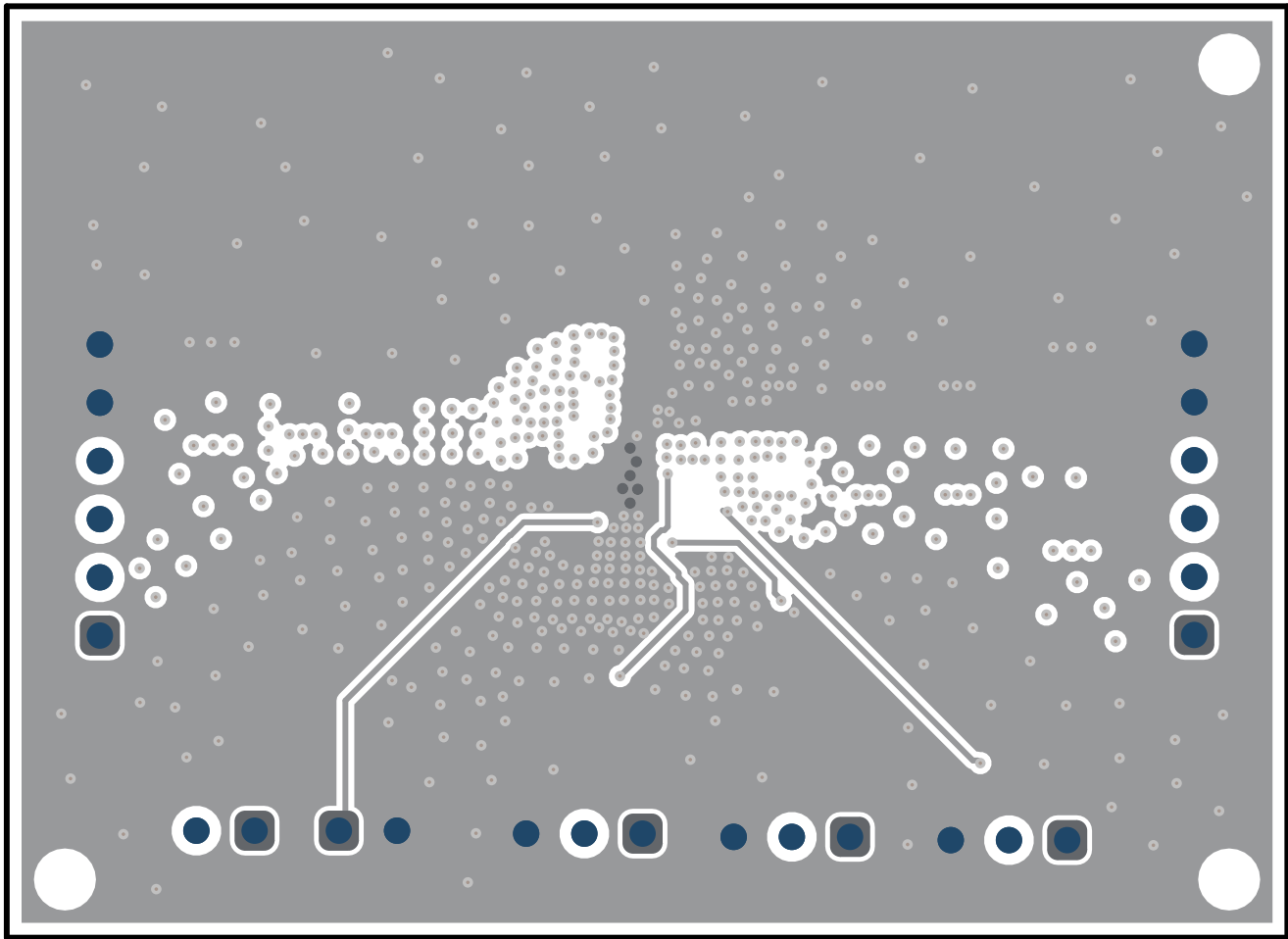
Figure 5-5. Bottom Layer

6 Schematic and Bill of Materials

This section provides the EVM schematic and bill of materials (BOM).

6.1 Schematic

, , and illustrate the EVM schematics.
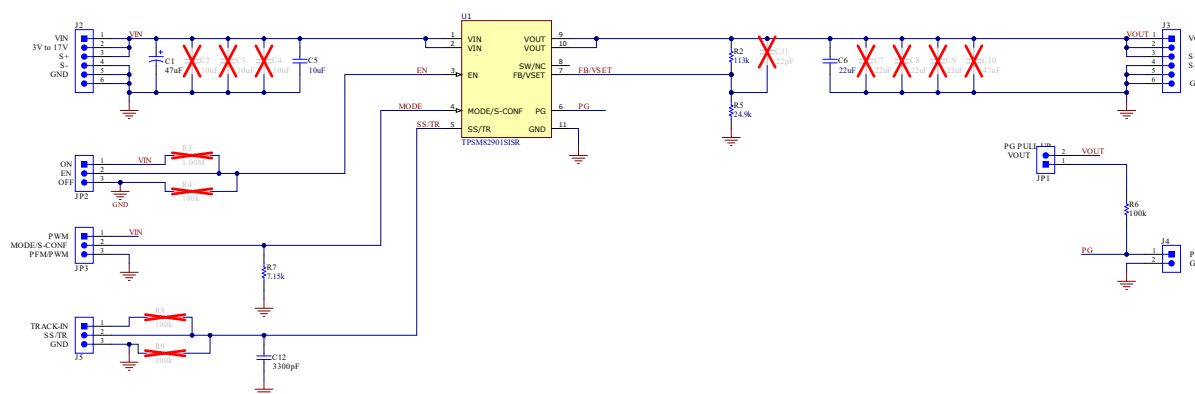
Figure 6-1. TPSM82901EVM Schematic
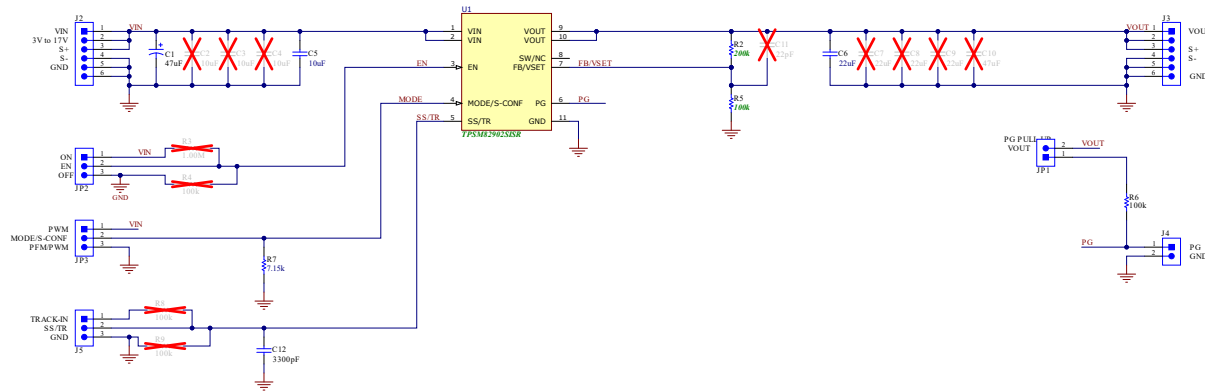
Figure 6-2. TPSM82902EVM Schematic
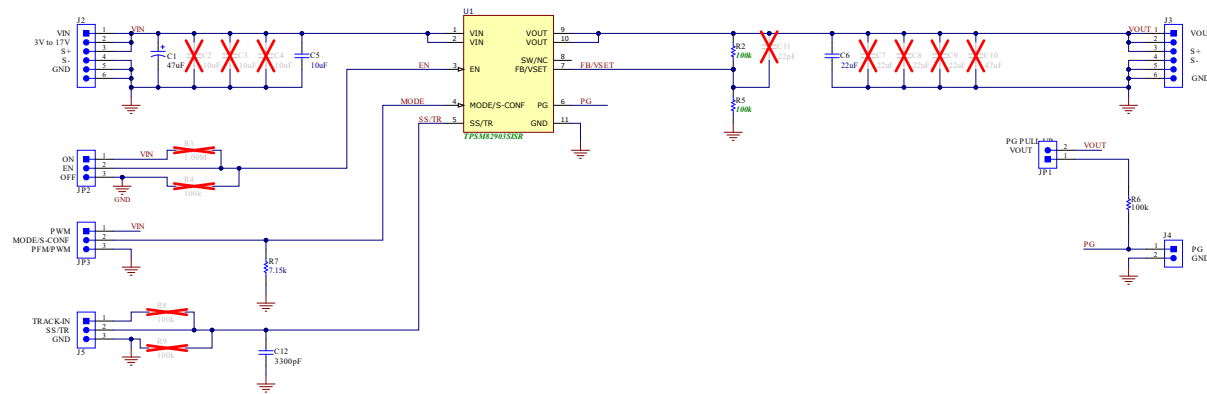
Figure 6-3. TPSM82903EVM Schematic

6.2 Bill of Materials

Table 6-1 lists the BOM for this EVM.

Table 6-1. TPSM8290xEVM Bill of Materials

-001	-002	-003	Reference Designator	Value	Description	Package	Part Number	Manufacturer
1	1	1	C1	47 µF	CAP, TA, 47 µF, 35 V, ±10%, 0.3 Ω	7343-43	T495X476K035ATE300	Kemet
1	1	1	C5	10 µF	CAP, CERM, 10 µF, 25 V, ±10%, X7R	1206	C3216X7R1E106K160AE	TDK
1	1	1	C6	22 µF	CAP, CERM, 22 µF, 10 V, ±20%, X7S	0805	C2012X7S1A226M125AC	TDK
1	1	1	C12	3300 pF	CAP, CERM, 3300 pF, 50 V, ±5%, C0G/NP0	0603	GRM1885C1H332JA01D	muRata
1	0	0	R2	113 kΩ	RES, 113 k, 1%, 0.1 W, 0603	0603	Std	Std
0	1	0	R2	200 kΩ	RES, 200 kΩ, 1%, 0.1 W	0603	Std	Std
0	0	1	R2	100 kΩ	RES, 100 kΩ, 1%, 0.1 W	0603	Std	Std
0	1	1	R5	100 kΩ	RES, 100 kΩ, 1%, 0.1 W	0603	Std	Std
1	0	0	R5	24.5 kΩ	RES, 24.9 k, 1%, 0.1 W, 0603	0603	Std	Std
1	1	1	R6	100 kΩ	RES, 100 k, 1%, 0.1 W, 0603	0603	Std	Std
1	1	1	R7	7.15 kΩ	RES, 7.15 kΩ, 1%, 0.1 W	0603	Std	Std
1	0	0	U1	TPSM82901[1]	3-V to 17-V, Low I_Q Buck Converter Module in MicroSiP Package with Integrated Inductor	3 × 2.8 mm	TPSM82901SISR	Texas Instruments
0	1	0	U1	TPSM82902[1]	3-V to 17-V, Low I_Q Buck Converter Module in MicroSiP Package with Integrated Inductor	3 × 2.8 mm	TPSM82902SISR	Texas Instruments
0	0	1	U1	TPSM82903[1]	3-V to 17-V, Low I_Q Buck Converter Module in MicroSiP Package with Integrated Inductor	3 × 2.8 mm	TPSM82903SISR	Texas Instruments

(1)   The TPSM8290xEVM may be populated with TPSM8290x (U1) devices that do not contain the correct top-side markings on the top of the device itself. These devices are still fully tested TPSM8290x devices.

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