LMZM33603 and LMZM33602 EVM User's Guide

The LMZM33603 and LMZM33602 evaluation modules (EVM) are designed as easy-to-use platforms that facilitate an extensive evaluation of the features and performance of the LMZM33603 and LMZM33602 power modules. This guide provides information on the correct usage of the EVMs and an explanation of the numerous test points on the board.

1 Description

This EVM features the LMZM33603/LMZM33602 synchronous buck power module configured for operation with typical 4-V to 36-V input bus applications. The output voltage can be set to one of four popular values by using a configuration jumper. Similarly, the switching frequency can be set to one of four values with a jumper. The full output current rating of the device can be supplied by the EVM. Input and output capacitors are included on the board to accommodate the entire range of input and output voltages. Monitoring test points are provided to allow measurement of efficiency, power dissipation, input ripple, output ripple, line and load regulation, and transient response. Control test points and component footprints are provided for use of the EN, UVLO, PGOOD, and SYNC features of the LMZM33603/LMZM33602 device. The EVM uses a recommended PCB layout that maximizes thermal performance and minimizes output ripple and noise.

2 Getting Started

Figure 1 highlights the user interface items associated with the EVM. The *VIN Power* terminal block (J1) is used for connection to the host input supply and the *VOUT Power* terminal block (J2) is used for connection to the load. These terminal blocks can accept up to 16-AWG wire.

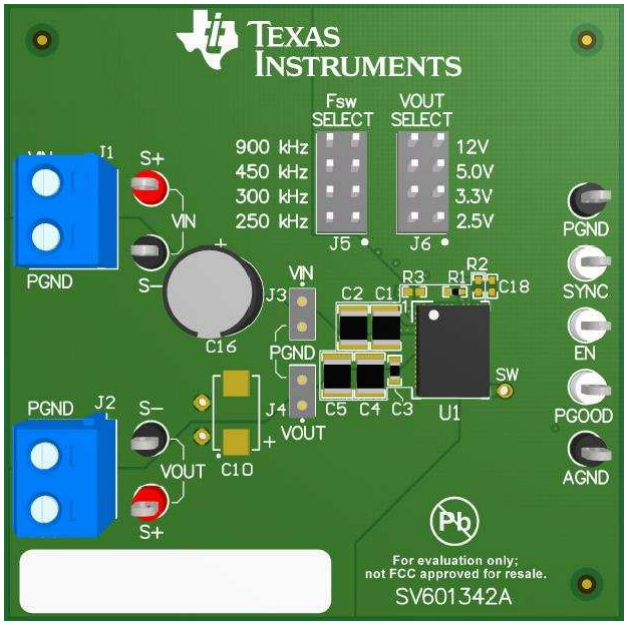

Figure 1. LMZM33603/LMZM33602EVM User Interface

The S+ and S- test points for both VIN and VOUT, located near the power terminal blocks are intended to be used as voltage monitoring points where voltmeters can be connected to measure VIN and VOUT. **Do not use these S+ and S- monitoring test points as the input supply or output load connection points.** The PCB traces connecting to these test points are not designed to support high currents.

The VIN Scope (J3) and VOUT Scope (J4) test points can be used to monitor VIN and VOUT waveforms with an oscilloscope. These test points are intended for use with un-hooded scope probes outfitted with a low-inductance ground lead (ground spring) mounted to the scope probe barrel. The two sockets of each test point are on 0.1 inch centers. The scope probe tip should be connected to the socket labeled VIN or VOUT, and the scope ground lead should be connected to the socket labeled PGND.

The control test points located to the right of the device are made available to test the features of the device. Refer to the Test Points Descriptions section of this guide for more information on the individual control test points.

The VOUT SELECT jumper (J6) and Fsw SELECT jumper (J5) are provided for selecting the desired output voltage and appropriate switching frequency. Before applying power to the EVM, ensure that the jumpers are present and properly positioned for the intended output voltage. Refer to Table 1 for the recommended jumper settings. Always remove input power before changing the jumper settings.

Table 1. Output Voltage and Switching Frequency Jumper Settings

VOUT Select	Fsw Select
2.5 V	250 kHz
3.3 V	300 kHz
5.0 V	450 kHz
12 V	900 kHz

3 Test Point Descriptions

Wire-loop test points and two scope probe test points have been provided as convenient connection points for digital voltmeters (DVM) or oscilloscope probes to aid in the evaluation of the device. A description of each test point follows:

Table 2. Test Point Descriptions(1)

VIN S+	Input voltage monitor. Connect the positive lead of a DVM to this point for measuring efficiency.
VIN S–	Input voltage monitor. Connect the negative lead of a DVM to this point for measuring efficiency.
VOUT S+	Output voltage monitor. Connect the positive lead of a DVM to this point for measuring efficiency, line regulation, and load regulation.
VOUT S–	Output voltage monitor. Connect the negative lead of a DVM to this point for measuring efficiency, line regulation, and load regulation.
AGND	Analog ground test point.
PGND	Power ground test point.
VIN Scope (J1)	Input voltage scope monitor. Connect an oscilloscope to this set of points to measure input ripple voltage.
VOUT Scope (J2)	Output voltage scope monitor. Connect an oscilloscope to this set of points to measure output ripple voltage and transient response.
PGOOD	Monitors the power good signal of the device. This is an open drain signal. A pull-up to a 5.1–V zener diode clamp (D1 & R10) is present on this EVM.
EN	Enable test point. Connect this test point to PGND to disable the device. A 100 kΩ pull-up resistor (R16) to VIN is present on the EVM. Leave this test point open to enable the device.
SYNC	Synchronization input test point. An AC coupling capacitor (C17) is present on the EVM between this test point and the SYNC pin of the device. A 49.9 Ω termination resistor (R17) is present between this test point and PGND. An external clock signal can be applied to this point to synchronize the device to an appropriate frequency.

(1) Refer to the LMZM33603/LMZM33602 datasheet for absolute maximum ratings associated with above features.

4 Operation Notes

In order to operate the EVM, apply an input voltage in the range of 4.0 V to 36 V. The UVLO threshold of the EVM is typically 3.6 V, with 0.3 V of hysteresis. The input voltage must be above the UVLO threshold in order for the device to startup. The UVLO voltage threshold can be adjusted to a higher voltage by adjusting the UVLO resistors on the EVM, R9 and R16. Refer to the LMZM33603/LMZM33602 datasheet for further information on the input voltage range and UVLO operation.

The VOUT SELECT jumper (J6) allows easy evaluation of four common output voltages by simply connecting a jumper. Table 1 lists the VOUT SELECT voltages and the recommended switching frequency selections. The selection of jumper J6 connects the appropriate R_{FBT} resistor and C_{FF} capacitor (if required). If evaluation of another output voltage is desired, jumper J6 should be left open and components R2 and C18 can be populated with the required values. Refer to the LMZM33603 or LMZM33602 datasheet for the R_{FBT} and C_{FF} values.

The F_{SW} SELECT jumper (J5) allows the user to easily change the switching frequency for evaluation. Table 1 lists the recommended switching frequencies for each of the VOUT selections. These recommendations cover operation over a wide range of input voltage and output load conditions. Several factors such as duty cycle, minimum on-time, minimum off-time, and current limit influence selection of the appropriate switching frequency. In some applications, other switching frequencies might be used for particular output voltages, depending on the above factors. Refer to the LMZM33603 or LMZM33602 datasheet for further information on switching frequency selection, including synchronization.

The EVM includes the required amount of input and output capacitors to accommodate most input and output voltage conditions. The actual capacitance required will depend on the input and output voltage conditions of the particular application, along with the desired transient response. If evaluation of the EVM with additional capacitance is desired, additional capacitor footprints are available on the EVM. Refer to the LMZM33603 or LMZM33602 datasheet for further information on the minimum required input and output capacitance.

5 Performance Data

Figure 2 through Figure 5 demonstrate the LMZM33603EVM performance. For more data regarding the LMZM33603 or LMZM33602 please see the product data sheet.

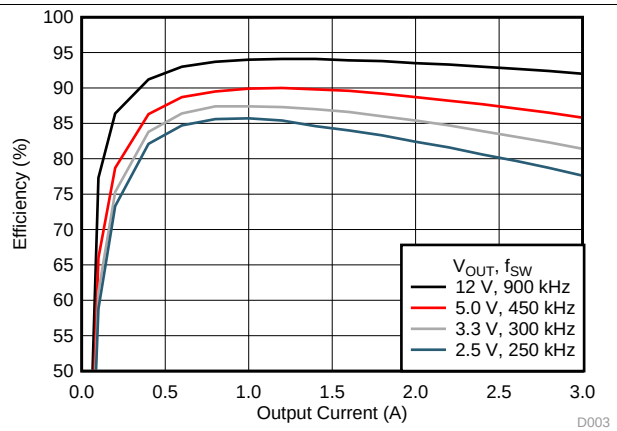

Figure 2. Efficiency (Vin = 24V)

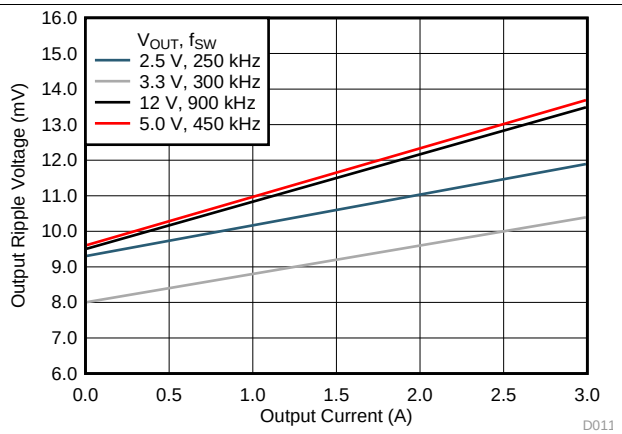

Figure 3. Ripple Voltage (Vin = 24V)

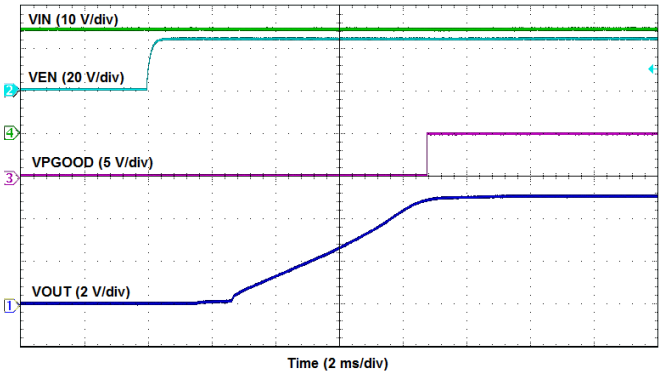

Figure 4. EN Start-up Waveforms

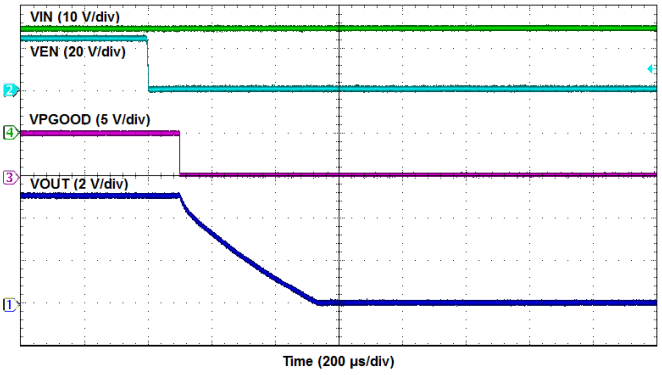

Figure 5. EN Shut-down Waveforms

6 Bill of Materials (BOM)

Table 3 includes the BOM for both the LMZM33602EVM (02) and LMZM33603EVM (03).

Table 3. EVM Bill of Materials

Designator	Quantity		Value	Description	Package Reference	Part Number	Manufacturer
	02	03					
C1, C2	2	2	4.7µF	CAP, CERM, 4.7 µF, 50 V, +/- 10%, X7R, 1210	1210	GRM32ER71H475KA88L	MuRata
C3	1	1	0.1µF	CAP, CERM, 0.1 µF, 50 V, +/- 10%, X7R, 0603	0603	GRM188R71H104KA93D	MuRata
C4, C5, C6, C7	4	4	22µF	CAP, CERM, 22 µF, 25 V, +/- 10%, X7R, 1210	1210	GRM32ER71E226KE15L	MuRata
C11	1	1	220pF	CAP, CERM, 220 pF, 100 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C2A221JA01D	MuRata
C12	1	1	150pF	CAP, CERM, 150 pF, 100 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C2A151JA01D	MuRata
C13	1	1	100pF	CAP, CERM, 100 pF, 100 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C2A101JA01D	MuRata
C16	1	1	47µF	CAP, AL, 47 µF, 100 V, +/- 20%, 0.14 ohm, TH	D8xL15mm	EKZN101ELL470MH15D	Chemi-Con
C17	1	1	1000pF	CAP, CERM, 1000 pF, 50 V, +/- 10%, X7R, 0603	0603	GRM188R71H102KA01D	MuRata
D1	1	1	5.1V	Diode, Zener, 5.1 V, 500 mW, SOD-123	SOD-123	DDZ9689-7	Diodes Inc.
J1, J2	2	2		Socket Strip, 2x1, 100mil, Black, Tin, TH	Socket Strip, 100mil, 2pin	310-43-102-41-001000	Mill-Max
J3, J4	2	2		Header, 100mil, 4x2, Tin, TH	Header, 4x2, 100mil, Tin	PEC04DAAN	Sullins Connector Solutions
R1	1	1	10.0k	RES, 10.0 k, 1%, 0.063 W, 0402	0402	CRCW040210K0FKED	Vishay-Dale
R5	1	1	162k	RES, 162 k, 1%, 0.1 W, 0603	0603	CRCW0603162KFKEA	Vishay-Dale
R6	1	1	133k	RES, 133 k, 1%, 0.1 W, 0603	0603	CRCW0603133KFKEA	Vishay-Dale
R7	1	1	88.7k	RES, 88.7 k, 1%, 0.1 W, 0603	0603	CRCW060388K7FKEA	Vishay-Dale
R8	1	1	44.2k	RES, 44.2 k, 1%, 0.1 W, 0603	0603	CRCW060344K2FKEA	Vishay-Dale
R10	1	1	49.9k	RES, 49.9 k, 1%, 0.063 W, 0402	0402	CRCW040249K9FKED	Vishay-Dale
R11	1	1	15.0k	RES, 15.0 k, 1%, 0.1 W, 0603	0603	CRCW060315K0FKEA	Vishay-Dale
R12	1	1	23.2k	RES, 23.2 k, 1%, 0.1 W, 0603	0603	CRCW060323K2FKEA	Vishay-Dale
R13	1	1	40.2k	RES, 40.2 k, 1%, 0.1 W, 0603	0603	CRCW060340K2FKEA	Vishay-Dale
R14	1	1	110k	RES, 110 k, 1%, 0.1 W, 0603	0603	CRCW0603110KFKEA	Vishay-Dale
R15	1	1	0	RES, 0, 5%, 0.1 W, 0603	0603	CRCW06030000Z0EA	Vishay-Dale
R16	1	1	100k	RES, 100 k, 1%, 0.063 W, 0402	0402	CRCW0402100KFKED	Vishay-Dale
R17 (or R4)	1	1	49.9	RES, 49.9, 1%, 1 W, 2512	2512	CRCW251249R9FKEG	Vishay-Dale
TB1, TB2	2	2		Terminal Block, 5.08 mm, 2x1, Brass, TH	2x1 5.08 mm Terminal Block	ED120/2DS	On-Shore Technology
TP1, TP2	2	2		Test Point, Multipurpose, Red, TH	Multipurpose Testpoint Red	5010	Keystone

Table 3. EVM Bill of Materials (continued)

Designator	Quantity		Value	Description	Package Reference	Part Number	Manufacturer
	02	03					
TP3, TP4, TP5, TP6	4	4		Test Point, Multipurpose, Black, TH	Multipurpose Testpoint Black	5011	Keystone
TP9, TP10, TP11	3	3		Test Point, Multipurpose, White, TH	Multipurpose Testpoint White	5012	Keystone
U1	1	0		LMZM33602 RLR0018A (B2QFN-18)	RLR0018A	LMZM33602RLR	Texas Instruments
	0	1		LMZM33603 RLR0018A (B2QFN-18)	RLR0018A	LMZM33603RLR	Texas Instruments
SH-P1, SH-P2	2	2	1x2	Shunt, 2mm, Gold plated, Black	2mm Shunt, Closed Top	2SN-BK-G	Samtec
C8, C9	0	0		CAP, CERM, 1210	1210		
C10	0	0		CAP, Tantalum Polymer, 7343-20 SMD	7343-20		
C14, C15	0	0		CAP, CERM, 1210	1210		
C18	0	0		CAP, CERM, 0402	0402		
R2	0	0		RES, 0402	0402		
R3	0	0		RES, 0402	0402		
R9	0	0		RES, 0402	0402		
TP15	0	0		TEST POINT. No entry in BOM.	N/A		

7 Schematic

Figure 6 is the schematic for this EVM.

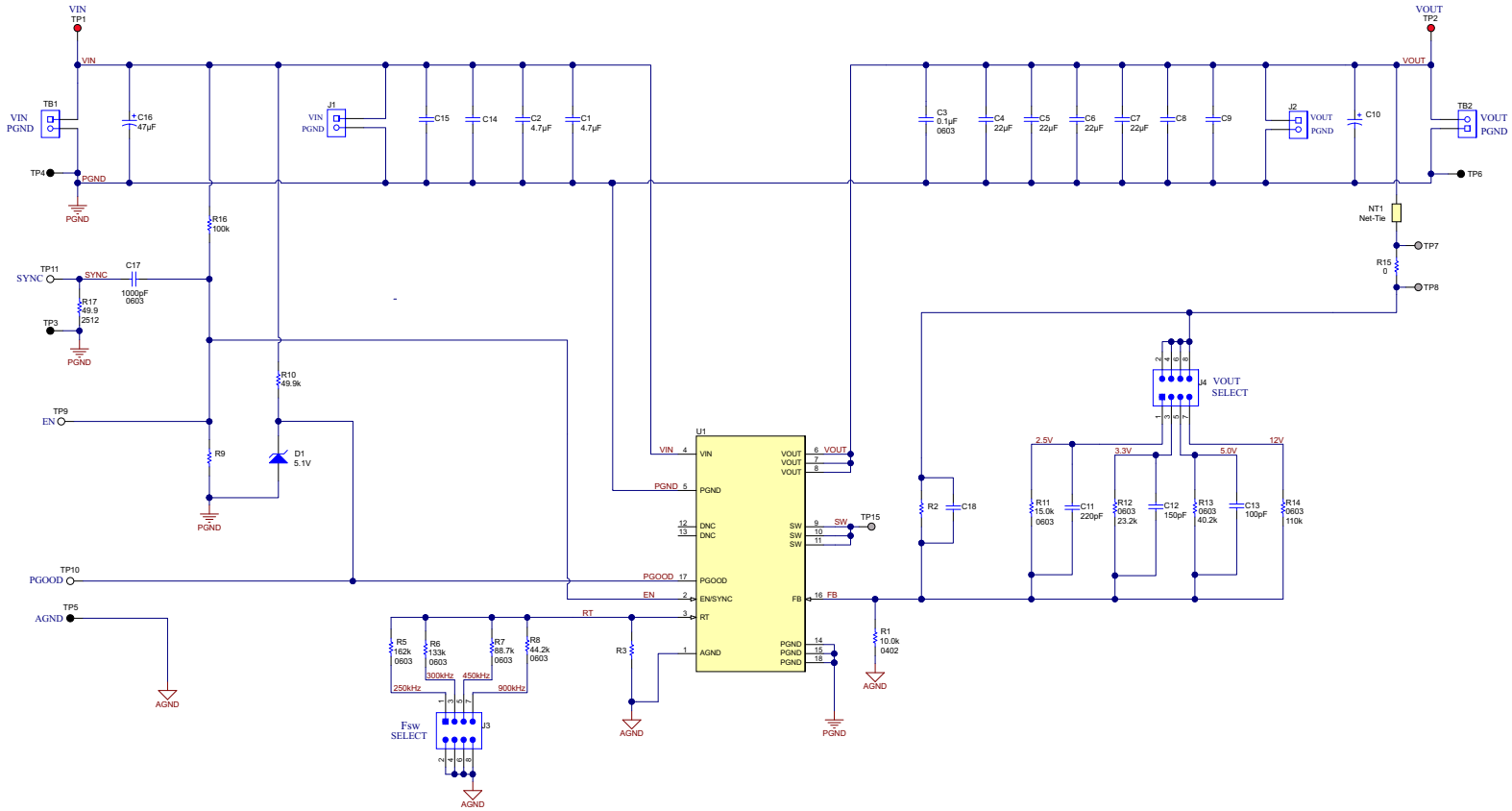

Figure 6. LMZM33603/LMZM33602EVM Schematic

8 PCB Layout

Figure 7 through Figure 12 show the PCB layers of the LMZM33603/LMZM33602EVM.

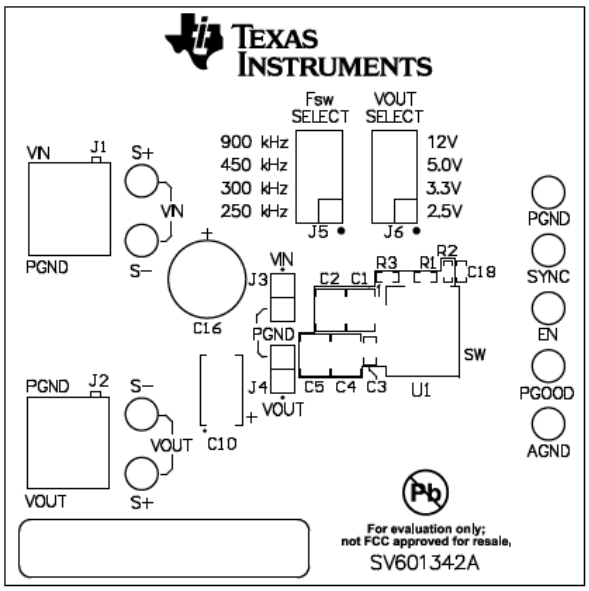

Figure 7. Topside Component Layout (Top View)

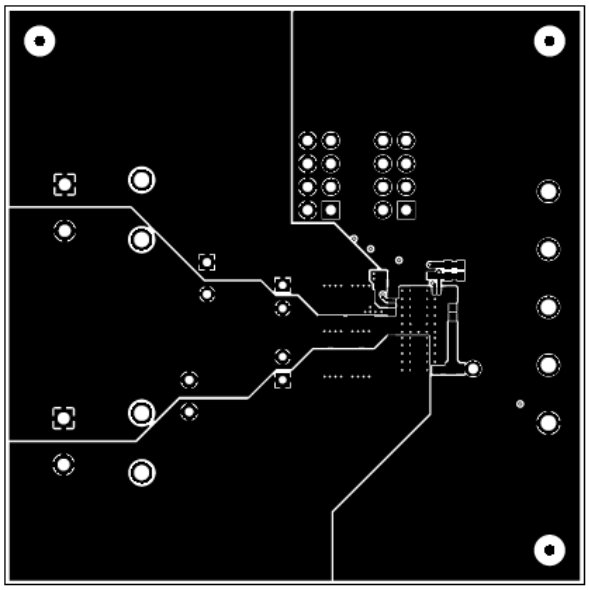

Figure 8. Topside Copper (Top View)

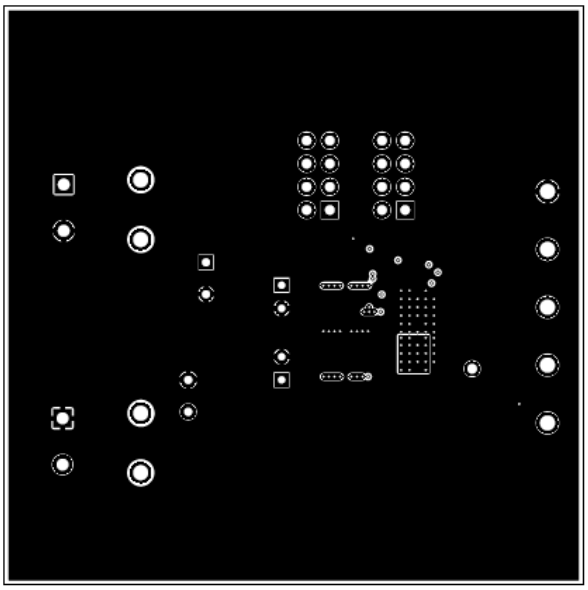

Figure 9. Layer 2 Copper (Top View)

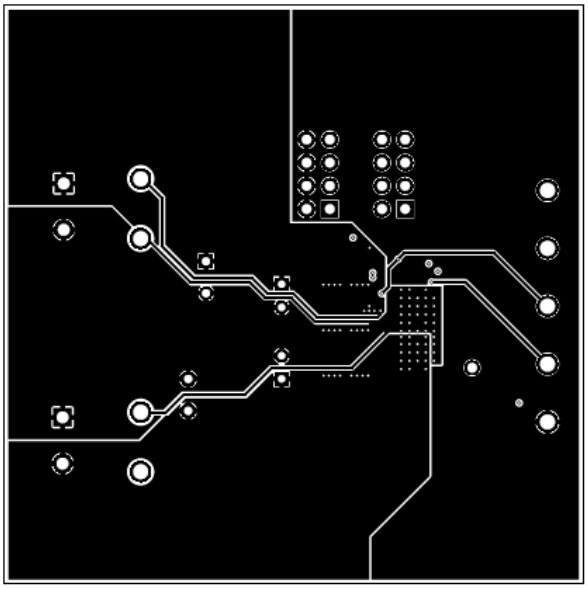

Figure 10. Layer 3 Copper (Top View)

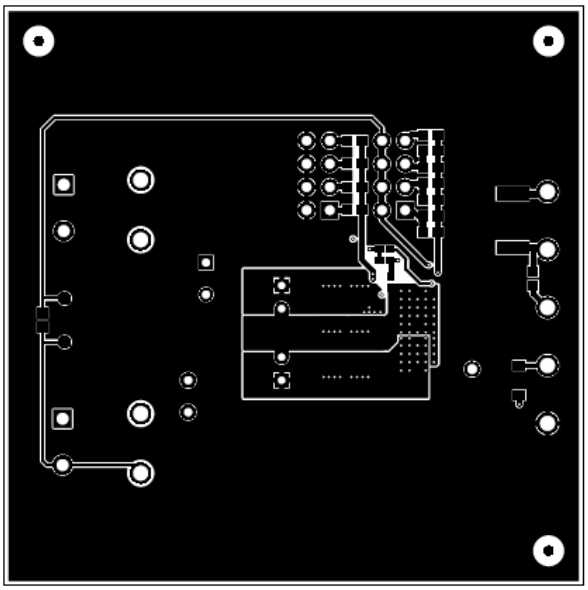

Figure 11. Bottom-Side Copper (Top View)

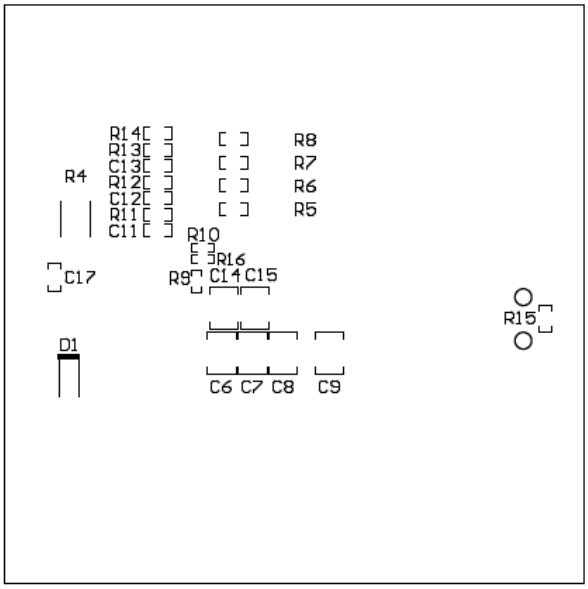

Figure 12. Bottom-Side Component Layout (Bottom View)

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265