LMZM33604EVM and LMZM33606EVM User's Guide

These evaluation modules (EVMs) are designed as an easy-to-use platform that facilitates an extensive evaluation of the features and performance of the LMZM33604 and LMZM33606 power module. This guide provides information on the correct usage of the EVMs and an explanation of the numerous test points on the board.

1 Description

These EVMs feature either the LMZM33604 or LMZM33606 synchronous-buck power module configured for operation with typical 3.5-V to 36-V input bus applications. The output voltage is set to one of five popular values by using a configuration jumper. Similarly, the switching frequency is set to one of five values with a jumper. The EVM supplies the full output current rating of the device. Input and output capacitors are included on the board to accommodate the entire range of input voltage and the selectable output voltages on the EVM. 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, PGOOD, BIAS, and SYNC features of the LMZM33606 device. The EVMs use 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 (TB1) is used for connection to the host input supply and the *VOUT Power* terminal block (TB2) is used for connection to the load. These terminal blocks accept up to 16-AWG wire.

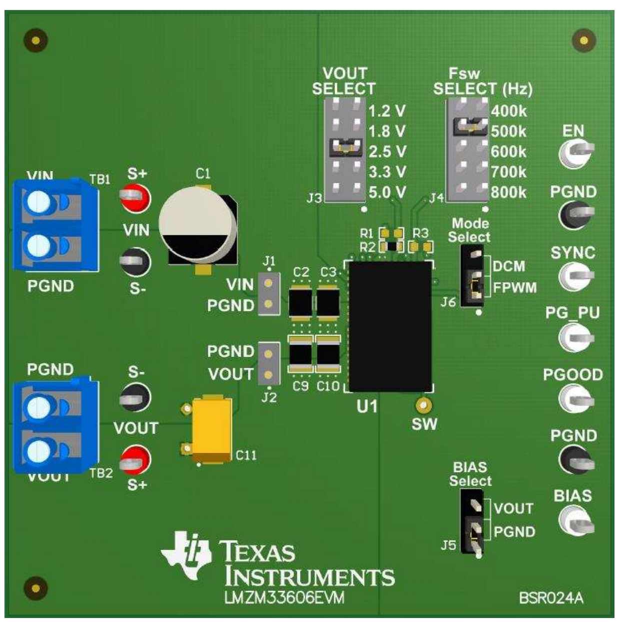

Figure 1. LMZM33606EVM User Interface

Use the S+ and S- test points for both VIN and VOUT, located near the power terminal blocks, 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.

Use the VIN scope (J1) and VOUT scope (J2) test points to monitor VIN and VOUT waveforms with an oscilloscope. These test points are intended to use 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. Connect the scope probe tip to the socket labeled VIN or VOUT, and connect the scope ground lead to the socket labeled PGND.

The control test points located to the right of the EVM 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 (J3) and F_{SW} SELECT jumper (J4) are provided to select the desired output voltage and appropriate switching frequency. Before applying power to the EVM, make sure 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.

To set the output voltage to a voltage other than the five selectable values, remove jumper J3 and solder the required R_{FBT} for the desired voltage in component footprint R1. See the component datasheet for the R_{FBT} value. Output voltages greater than 12V will require the output capacitors to be replaced with higher voltage rated capacitors. See the EVM BOM for component voltage ratings.

Table 1. Output Voltage and Switching Frequency Jumper Settings

VOUT Select	F_{SW} Select
1.2 V	400 kHz
1.8 V	500 kHz
2.5 V	500 kHz
3.3 V	500 kHz
5.0 V	500 kHz

3 Test Point Descriptions

Wire-loop test points and scope probe sockets are included 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.
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.
EN	Enable test point. Connect this test point to PGND to disable the device.
SYNC	Synchronization input test point. When synchronizing to an external clock, connect the clock to this test point.
PG_PU	PGOOD pull-up pin. Apply a voltage to this pin to use as a pull-up voltage for the PGOOD signal. Internal to the device, a 100-kΩ resistor is connected to this pin and the PGOOD pin.
PGOOD	Monitors the power good signal of the device. This is an open-drain signal. Internal to the device, a 100-kΩ resistor is connected to this pin and the PG_PU pin.
BIAS	Bias voltage test point. If using an external bias voltage, apply the voltage to this test point and remove jumper J5.

(1) Refer to the LMZM33606 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 3.5 V to 36 V. The turnon threshold of the EVM is typically 3.1 V, with 0.5 V of hysteresis. The input voltage must be above the turnon threshold in order for the device to start-up. Raise the system UVLO voltage by adjusting the UVLO resistors on the EVM, R4 and R5. Refer to the LMZM33604 or LMZM33606 datasheet for further information on the input voltage range and system UVLO operation.

The VOUT SELECT jumper (J3) allows easy evaluation of five 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 J3 connects the appropriate R_{FBT} resistor. If evaluation of another output voltage is desired, leave jumper J3 open, then component R1 can be populated with the required value. Refer to the LMZM33604 or LMZM33606 datasheet for the R_{FBT} value.

The F_{SW} SELECT jumper (J4) allows the user to easily change the switching frequency for evaluation. Table 1 lists the recommended switching frequency 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. Refer to the LMZM33604 or LMZM33606 datasheet for further information on switching frequency selection, including synchronization.

The EVM includes the required input and output capacitors to accommodate most input and output voltage conditions. The specific capacitance required depends on the input and output voltage conditions of the particular application, along with the desired transient response. Additional capacitor footprints are available on the EVM. See the LMZM33604 or LMZM33606 data sheet for further information on the minimum required input and output capacitance.

5 Performance Data

Figure 2 through Figure 5 demonstrate the LMZM33606EVM performance. The LMZM33604EVM performs similarly only with reduced current. See the LMZM33604 or LMZM33606 data sheet for more details.

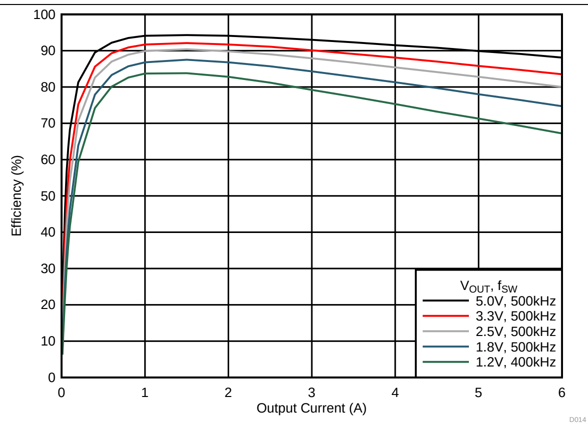

Figure 2. Efficiency (Vin = 12V, FPWM Mode)

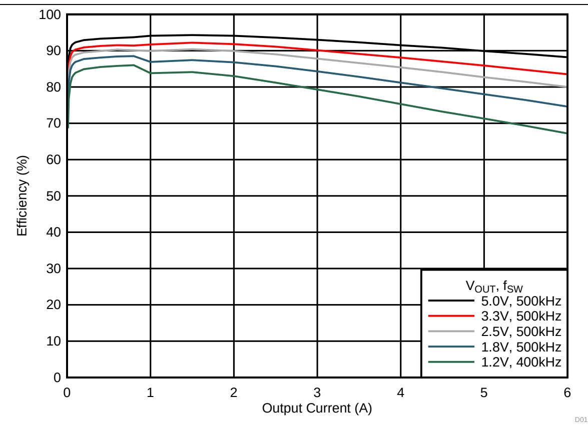

Figure 3. Efficiency (Vin = 12V, Auto Mode)

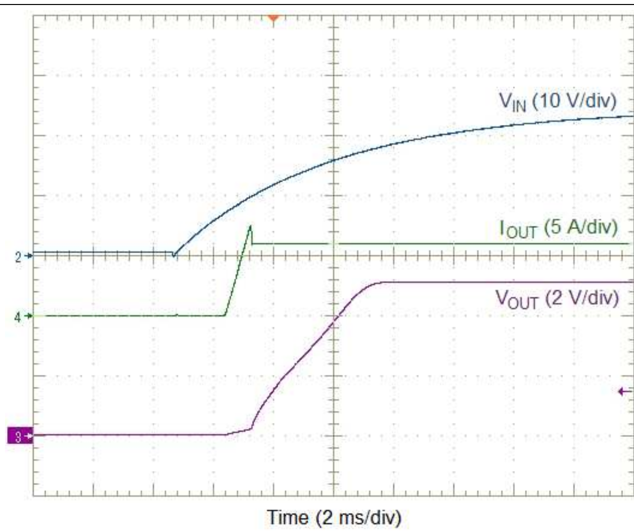

Figure 4. Start-Up Waveforms

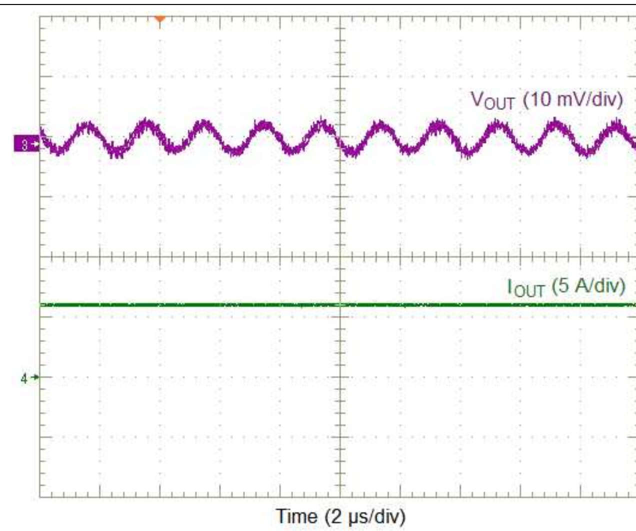

Figure 5. Output Voltage Ripple

6 Bill of Materials (BOM)

Designator	Qnty	Value	Description	Package Reference	Part Number	Manufacturer
C1	1	39µF	CAP, AL, 39 µF, 50 V, +/- 20%, 25 mohm, SMD	D8xL12mm	50SVPF39M	Panasonic
C2, C3	2	4.7µF	CAP, CERM, 4.7 µF, 50 V, +/- 10%, X7R, 1210	1210	C3225X7R1H475K250AB	TDK
C7, C8, C9, C10	4	47µF	CAP, CERM, 47 µF, 16 V, +/- 20%, X5R, 1210	1210	GRM32ER61C476ME15L	MuRata
C11	1	150µF	CAP, Polymer Tantalum, 150 µF, 16 V, +/- 20%, 50 mohm, 7343-31 SMD	7343-31	16TQC150MYF	Panasonic
C12	1	470pF	CAP, CERM, 470 pF, 50 V, +/- 10%, X7R, 0603	0603	885012206081	Wurth Elektronik
J1, J2	2		Socket Strip, 2x1, 100mil, Black, Tin, TH	Socket Strip, 100mil, 2pin	310-43-102-41-001000	Mill-Max
J3, J4	2		Header, 100mil, 5x2, Tin, TH	Header, 5x2, 100mil, Tin	PEC05DAAN	Sullins Connector Solutions
J5, J6	2		Header, 100mil, 3x1, Tin, TH	Header, 3x1, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions
R2	1	10.0k	RES, 10.0 k, 1%, 0.1 W, 0603	0603	CRCW060310K0FKEA	Vishay-Dale
R4, R5, R6	3	100k	RES, 100 k, 1%, 0.1 W, 0603	0603	CRCW0603100KFKEA	Vishay-Dale
R7	1	78.7k	RES, 78.7 k, 1%, 0.1 W, 0603	0603	CRCW060378K7FKEA	Vishay-Dale
R8	2	64.9k	RES, 64.9 k, 1%, 0.1 W, 0603	0603	CRCW060364K9FKEA	Vishay-Dale
R9	1	54.9k	RES, 54.9 k, 1%, 0.1 W, 0603	0603	CRCW060354K9FKEA	Vishay-Dale
R10	1	47.5k	RES, 47.5 k, 1%, 0.1 W, 0603	0603	CRCW060347K5FKEA	Vishay-Dale
R11, R12	2	0	RES, 0, 5%, 0.1 W, 0603	0603	CRCW06030000Z0EA	Vishay-Dale
R13	1	40.2k	RES, 40.2 k, 1%, 0.1 W, 0603	0603	CRCW060340K2FKEA	Vishay-Dale
R14	1	22.6k	RES, 22.6 k, 1%, 0.1 W, 0603	0603	CRCW060322K6FKEA	Vishay-Dale
R15	1	15.0k	RES, 15.0 k, 1%, 0.1 W, 0603	0603	CRCW060315K0FKEA	Vishay-Dale
R16	1	7.87k	RES, 7.87 k, 1%, 0.1 W, 0603	0603	CRCW06037K87FKEA	Vishay-Dale
R17	1	1.91k	RES, 1.91 k, 1%, 0.1 W, 0603	0603	CRCW06031K91FKEA	Vishay-Dale
TB1, TB2	2		Terminal Block, 5.08 mm, 2x1, Brass, TH	2x1 5.08 mm Terminal Block	ED120/2DS	On-Shore Technology
TP1, TP8	2		Test Point, Multipurpose, Red, TH	Multipurpose Testpoint Red	5010	Keystone
TP2, TP7, TP9, TP12	4		Test Point, Multipurpose, Black, TH	Multipurpose Testpoint Black	5011	Keystone
TP3, TP4, TP5, TP6, TP11	5		Test Point, Multipurpose, White, TH	Multipurpose Testpoint White	5012	Keystone
U1	1		LMZM33606 RLX0041A (B2QFN-41)	RLX0041A	LMZM33606RLX	Texas Instruments
			LMZM33604 RLX0041A (B2QFN-41)		LMZM33604RLX	
SH-J1 - J4	4	1x2	Shunt, 2mm, Gold plated, Black	2mm Shunt, Closed Top	2SN-BK-G	Samtec
C4, C5	0		CAP, CERM, 1210	1210		
C6, C14, C15	0		CAP, CERM, 0603	0603		
C13	0		CAP, Polymer Aluminum, TH	D10xL13mm		
R1, R3	0		RES, 0603	0603		

7 Schematic

Figure 6 is the schematic for the LMZM33604EVM and the LMZM33606EVM.

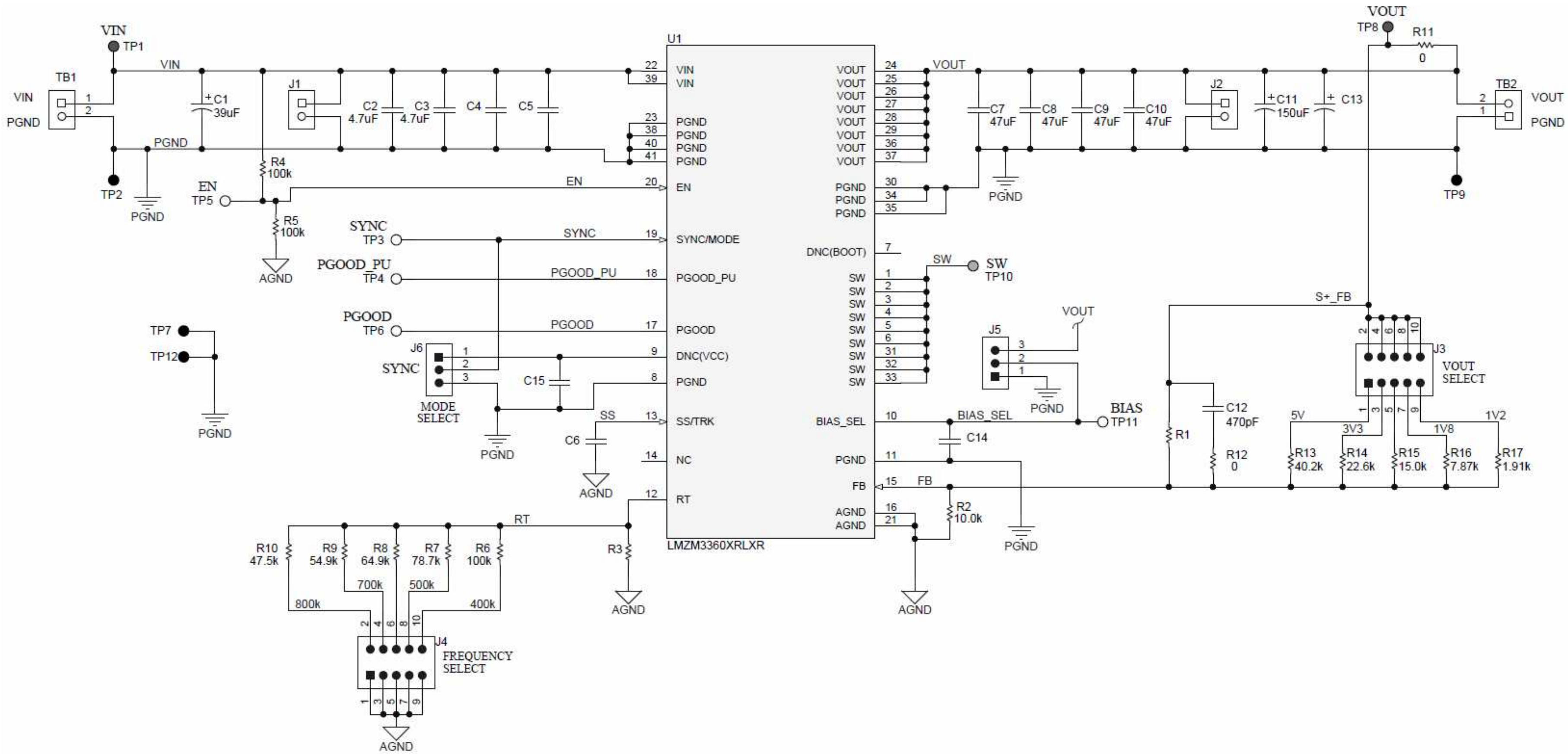

Figure 6. LMZM3360XEVM Schematic

8 PCB Layout

Figure 7 through Figure 12 show the PCB layers of the LMZM33606EVM. The PCB layers of the LMZM33604EVM are identical other than the board name and number on the top side silk screen.

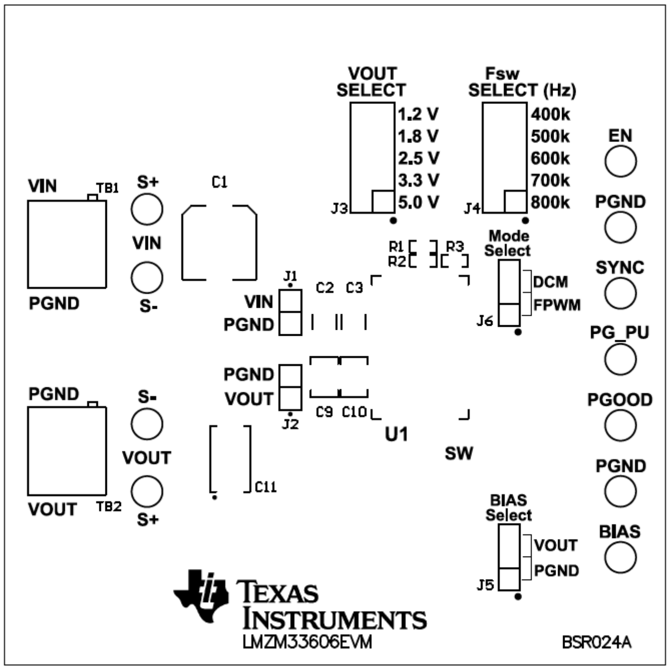

Figure 7. Topside Component Layout (Top View)

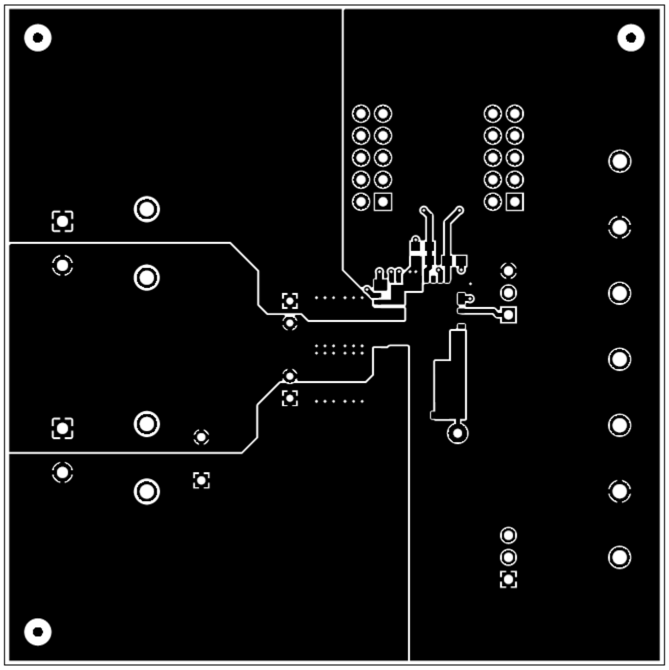

Figure 8. Topside Copper (Top View)

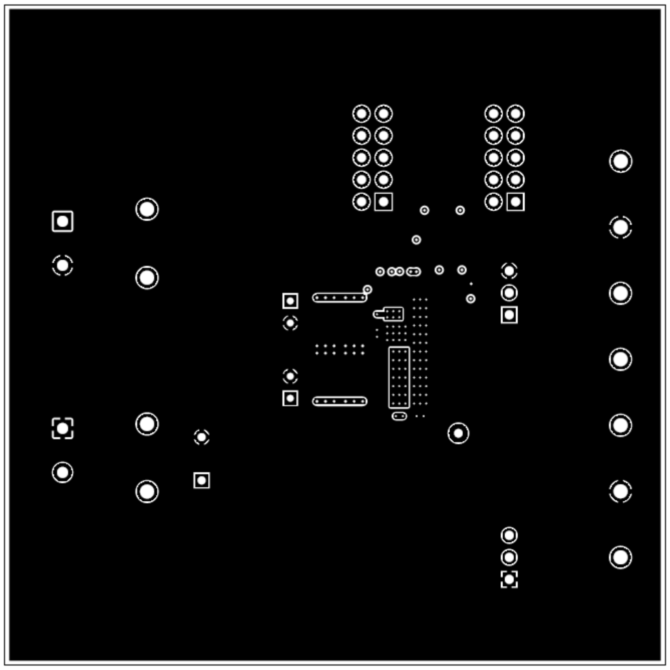

Figure 9. Layer 2 Copper (Top View)

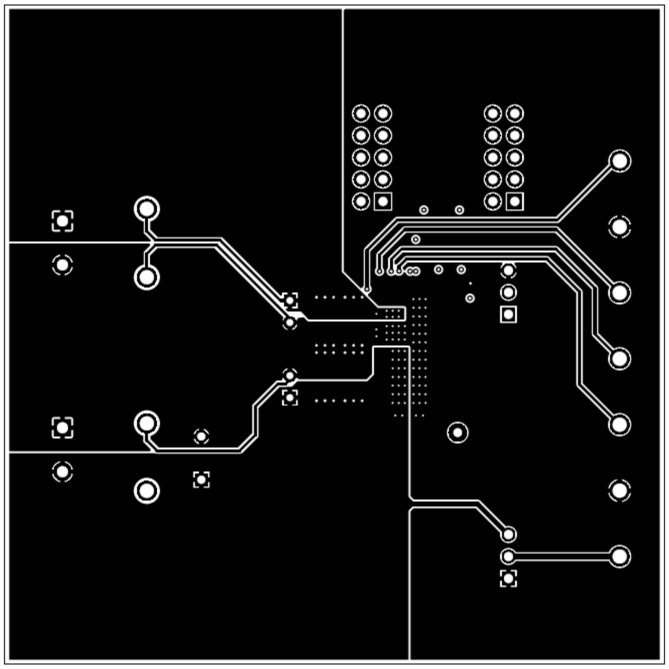

Figure 10. Layer 3 Copper (Top View)

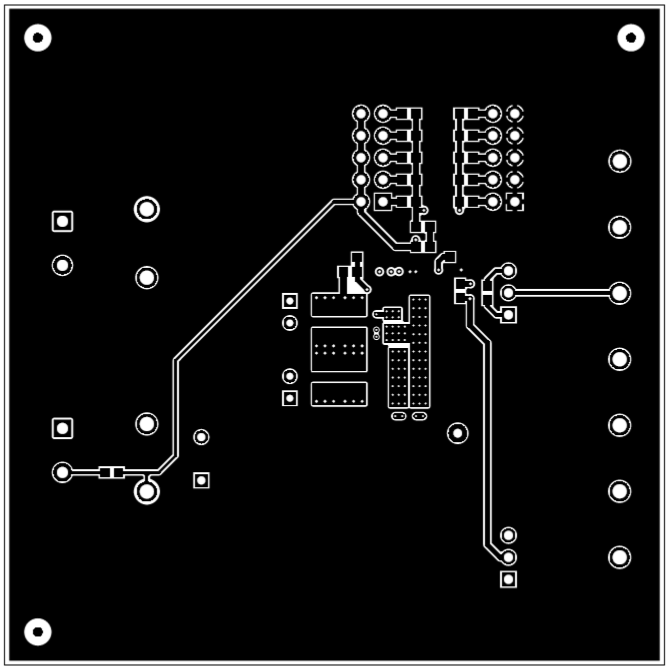

Figure 11. Bottom-Side Copper (Top View)

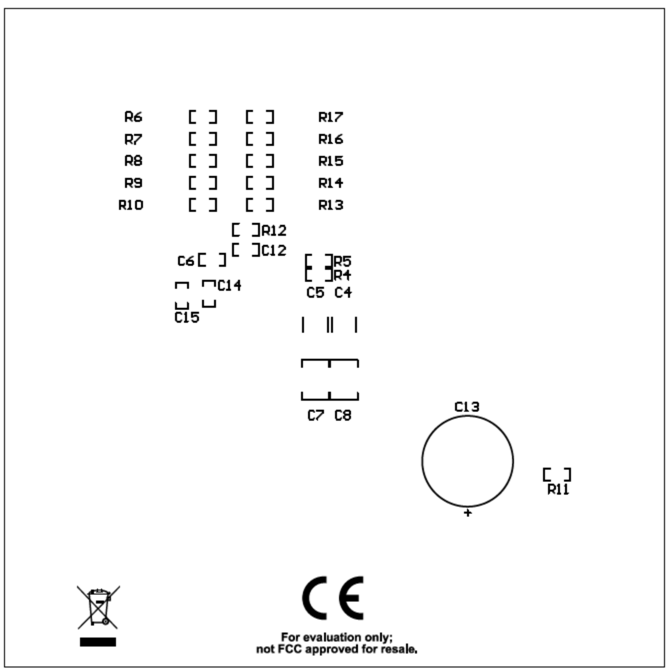

Figure 12. Bottom-Side Component Layout (Bottom View)

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from A Revision (June 2018) to B Revision	Page
• Added paragraph describing how to configure the EVM for non-standard values	2
• Corrected component values in the schematic	6

Changes from Original (June 2018) to A Revision	Page
• Added LMZM33604EVM to User's Guide	1