User's Guide

TLVM23625EVM User's Guide

ABSTRACT

The TLVM23625EVM enables the evaluation of the TLVM23625 power module. The EVM allows for several configurations of the power module. Additionally, electrical test points provide ease in verifying the performance of the power regulator. Lastly, this EVM serves as a basis for optimal TLVM23625 layout and component selection.

CAUTION

Read the user's guide before use.

CAUTION

Hot surface! Contact can cause burns. Do not touch!

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Trademarks

All trademarks are the property of their respective owners.

1 Introduction

The output voltage of the TLVM23625EVM can be configured from 1.8 V to 6 V with a load current up to 2.5 A.

Measurement points are provided to easily measure conversion efficiency and look at other performance metrics. In addition, jumpers and test points are provided to evaluate the features of the TLVM23625, such as programmable enable UVLO, adjustable switching frequency, and power-good flag.

The EVM layout allows the TLVM23625 and its orderable part numbers to be installed, and their specific features to be evaluated. The TLVM23625EVM comes installed with the TLVM23625RDNR, the adjustable switching frequency (RT pin) version of the TLVM23625.

The TLVM23625EVM is configured by default to be enabled with an output voltage of 5 V, and a switching frequency of 2.2 MHz with frequency foldback (auto mode) at light load. The following sections outline the step-by-step procedure to use the TLVM23625 and the performance that is exhibited.

Table 1-1. EVM Overview

EVM	Buck Regulator	Buck Features
TLVM23625EVM	TLVM23625RDNR	Output: ADJ (1-6 V) Fsw: ADJ Mode: Auto

2 Setup Procedure

The following procedure outlines the steps to be taken for using the TLVM23625EVM. Use this section in conjuction with *Test Setup* to correctly setup the EVM.

1. Determine the output voltage that is to be evaluated, then reference *Setup Procedure*. This table provides the recommended jumper configurations.
2. After making any required changes, confirm that the output voltage is within a couple percent of the set output voltage.
3. Verify the performance of the EVM and compare with applicable curves within this user's guide.
4. Consult on e2e if there are concerns in the evaluation of this device.

Table 2-1. Suggested Switching Frequency Settings

V_{OUT} (V)	Suggested Frequency
1.8	300 kHz
2.5	800 kHz
3.3	800 kHz
5	1 MHz (J4: 3 – 4) *2.2 MHz can improve transient response for given output capacitance.

3 Test Setup

Table 3-1. Description of Jumpers, Test Points, and Terminal Blocks

Reference Designator	Description
J1	Input to series, PI filter for EMC compliance testing. Note polarity, which is annotated in the silkscreen. Connect to a terminal block with a short, thick gauge (18AWG) wire.
TP1, TP2	V_{IN} test points that bypass the EMC filter and connect directly to input capacitors. Enables more accurate efficiency measurements as well as potential parasitic minimization and signal integrity of AC measurements. Connect to test points with a short, thick gauge (18AWG) wire.
TP4	PGOOD test point for verifying PGOOD (output) flag feature
TP3, TP6	V_{OUT} test points connected directly to output capacitors. Enables more accurate efficiency measurements, as well, potential parasitic minimization and signal integrity of AC measurements. Connect to test points with a short, thick gauge (18AWG) wire.
J2	Output (V_{OUT}) terminal block. Connect to terminal block with a short, thick gauge (18AWG) wire.
TP11, TP12	EN test point for accurately measuring EN voltage. If EN voltage is to be applied (externally), resistor R2 and R4 potentially can need to be removed.
J5	Disable the regulator by shorting the pins of the jumper.
J4	TLVM23625EVM: Jumper for configuring the switching frequency of the converter. Using the "key" annotated in the schematic and also in the silkscreen. Placing the jumper on the adjacent pins sets the annotated switching frequency.
TP7, TP8	Test points for applying an external signal source to synchronize the regulator to.
J3	Jumper for configuring the output voltage. Set the voltage by using the "key" annotated in the schematic and also in the silkscreen, and by placing the jumper on the pins next to the annotated output voltage.
TP9, TP10	Test points for applying an AC signal source (across an injection resistor) often used in evaluating the loop response in a current mode regulator, such as the TLVM23625.

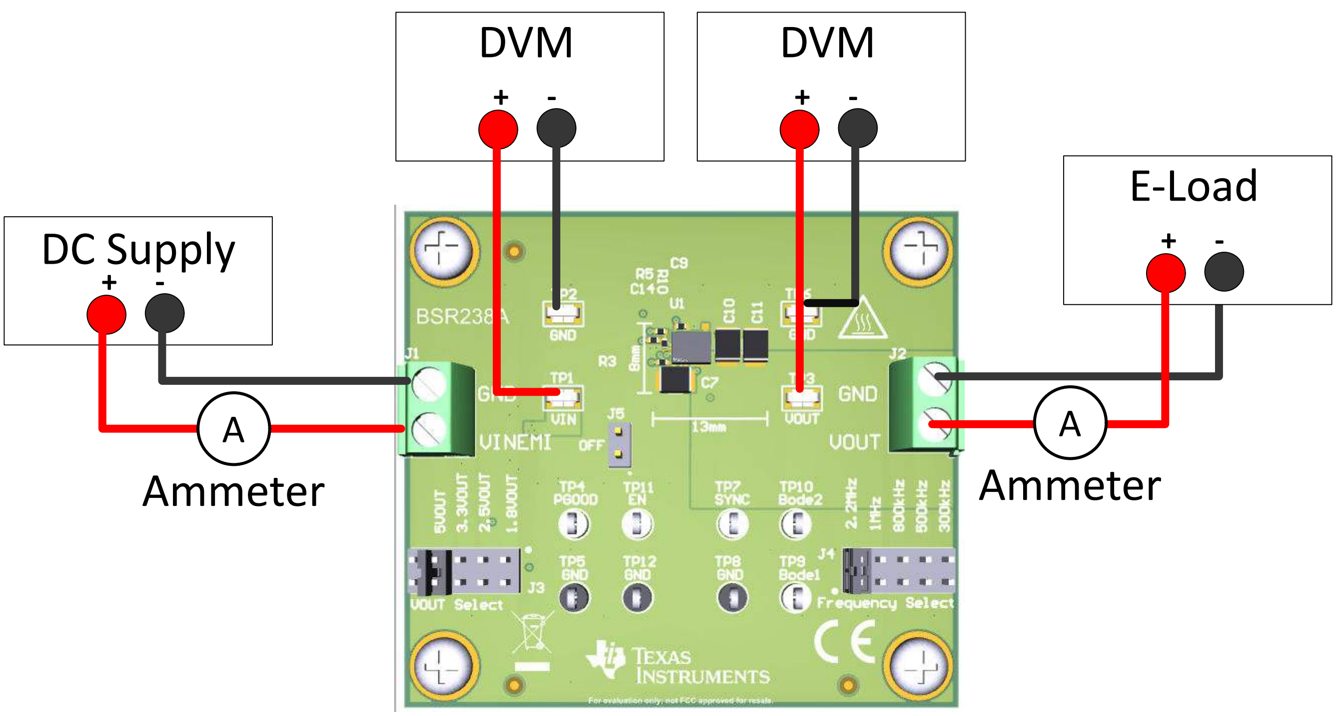

Figure 3-1. Test Setup Diagram

4 Schematic

Customers can choose to implement a PI filter in series with the input of a power regulator, which allows for the differential noise generated to be attenuated, allowing a noise emission regulation to be met. The filter crossover frequency is ideal for 1-MHz switching frequency, attenuating the switching frequency and the corresponding harmonics greatly. A damping capacitor is provided (C5), to damp the high-Q PI filter. For more information on filter damping, see *Reference*.

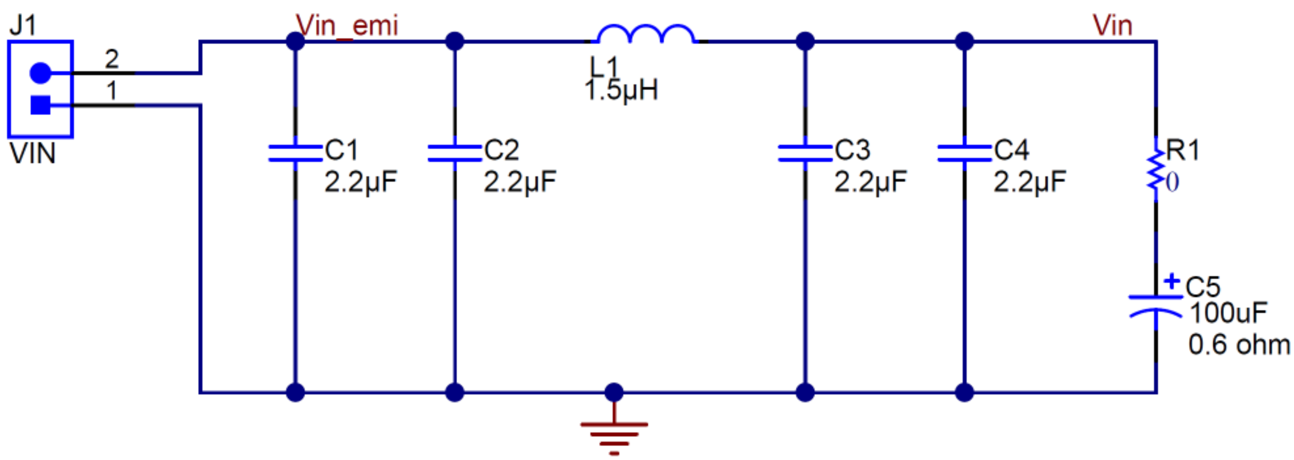

Figure 4-1. Schematic-Compliance Testing Filter

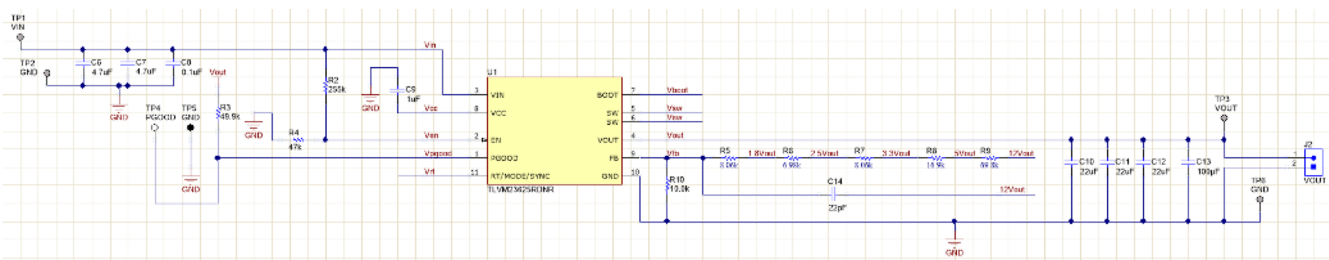

Figure 4-2. Schematic (TLVM23625EVM) – TLVM23625

A disable, frequency select, and output voltage select jumper are provided to aid the evaluation. Additionally, test points to evaluate product features and stability are provided.

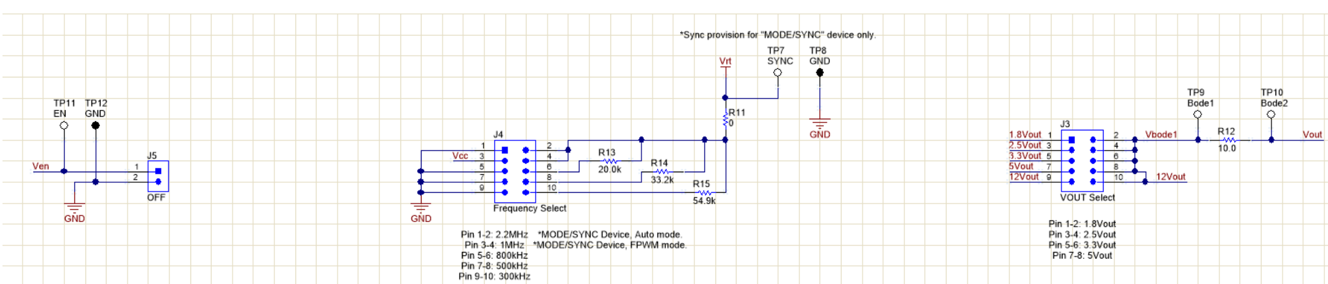

Figure 4-3. Schematic (TLVM23625EVM) – Configuration Jumpers and Evaluation Test Points

A disable, mode select or synchronization, and output voltage select jumper are provided to aid the evaluation. Additionally, test points to evaluate product features and stability are provided.

5 TLVM23625EVM Evaluation

The data was tested on the EVM, with L1 changed to 4.7 uH. The EVM was configured for 1-MHz operation and 5 V_{OUT}, and was measured at 12 V_{IN} and a 2.5-A load.

Figure 5-1. CISPR11/32 Conducted Scan

The data was tested on the EVM, with L1 changed to 4.7 uH. The EVM was configured for 1-MHz operation and 5 V_{OUT}, and was measured at 24 V_{IN} and a 2.5-A load.

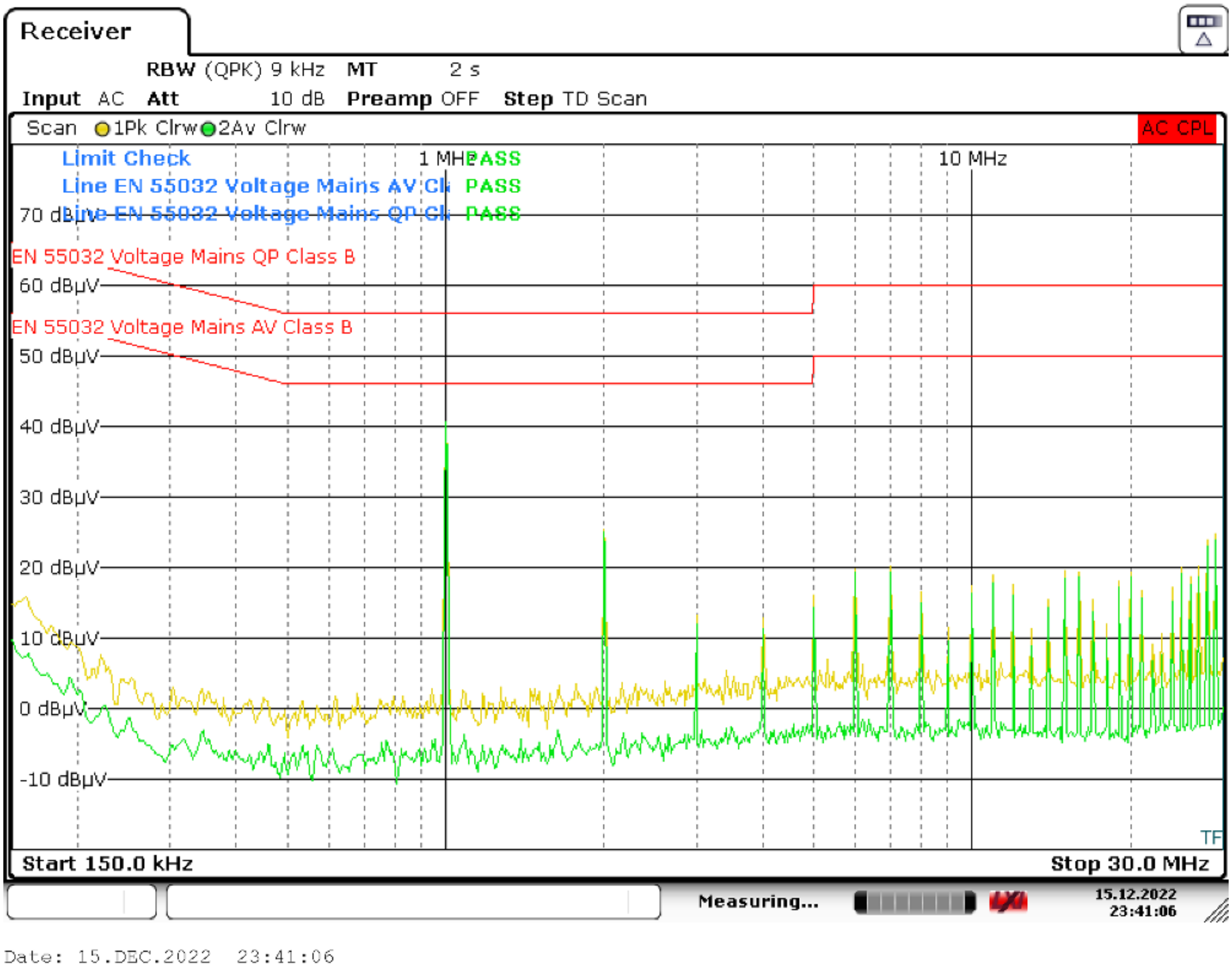

Figure 5-2. CISPR11/32 Conducted Scan

12 V_{IN}, 2.2 MHz, 2-A load (continuous)

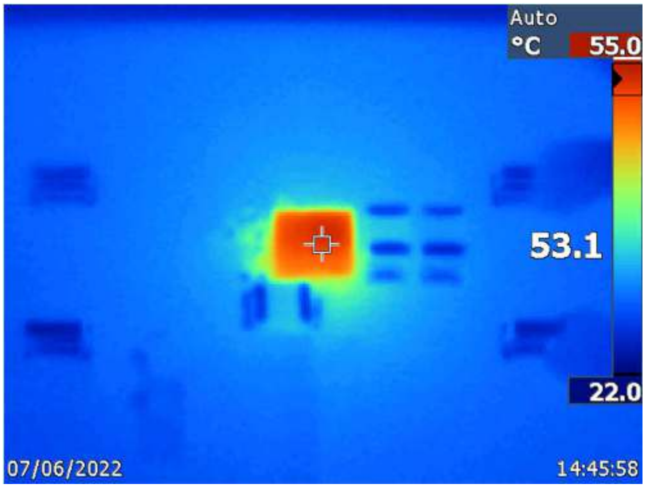

Figure 5-3. IR Top Case Measurement

12 V_{IN}, 1 MHz, 2-A load (continuous)

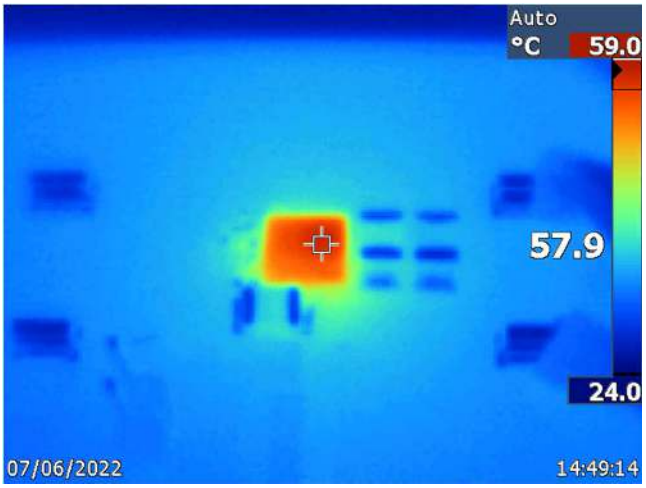

Figure 5-4. IR Top Case Measurement

12 V_{IN}, 500 kHz, 2-A load (continuous)

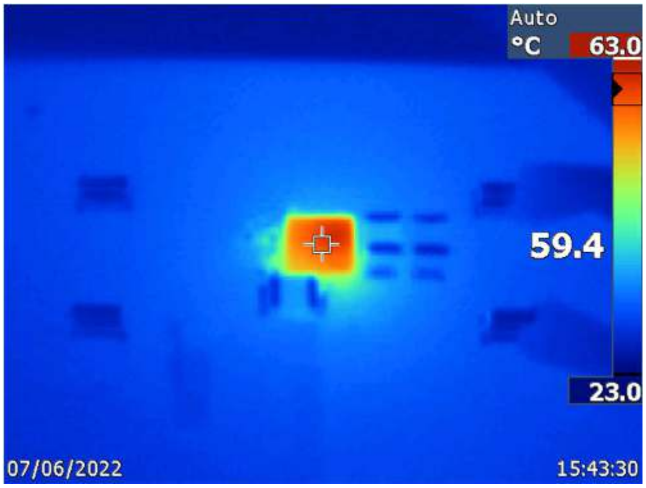

Figure 5-5. IR Top Case Measurement

24 V_{IN}, 2.2 MHz, 2-A load (continuous)

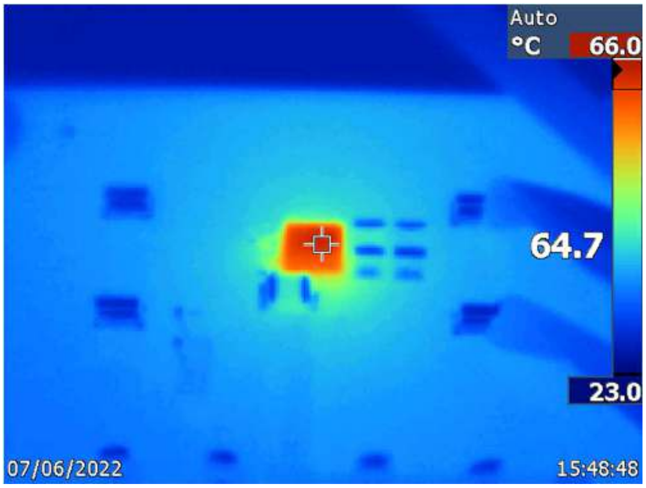

Figure 5-6. IR Top Case Measurement

24 V_{IN}, 1 MHz, 2-A load (continuous)

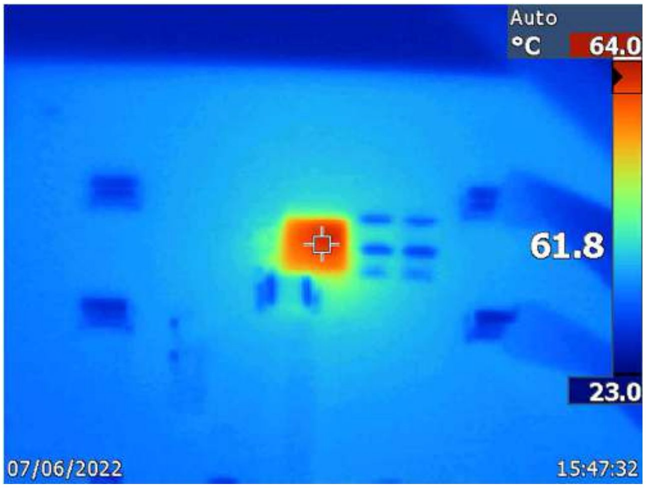

Figure 5-7. IR Top Case Measurement

24 V_{IN}, 500 kHz, 2-A load (continuous)

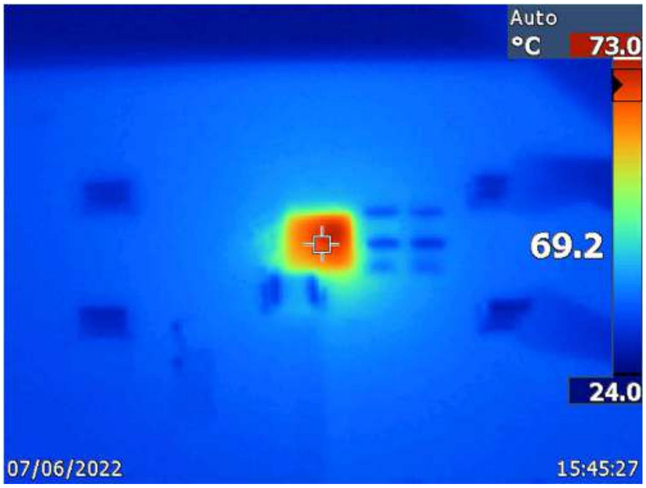

Figure 5-8. IR Top Case Measurement

6 Layout

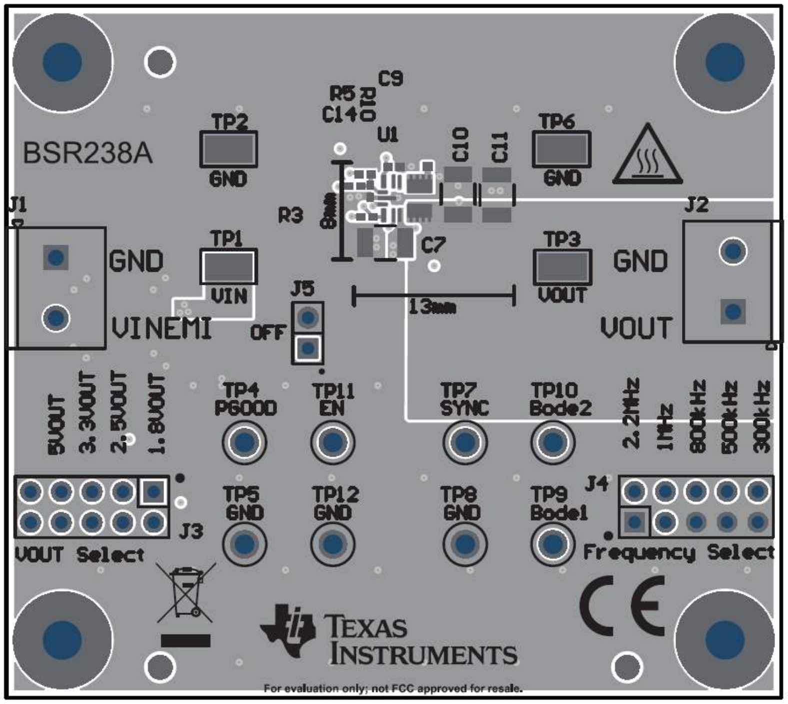

Figure 6-1. PCB Top 2-D (TLVM23625EVM)

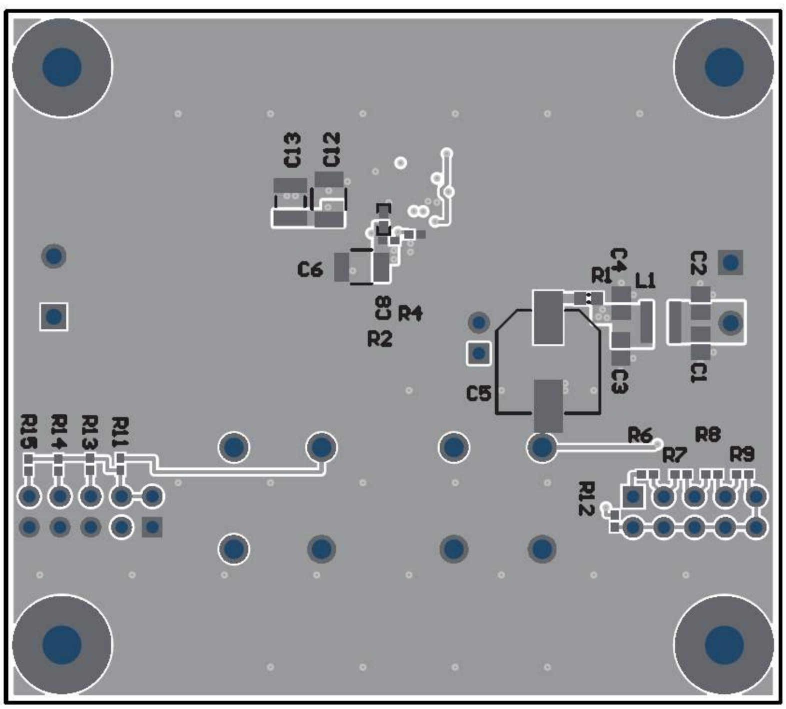

Figure 6-2. PCB Bottom 2-D

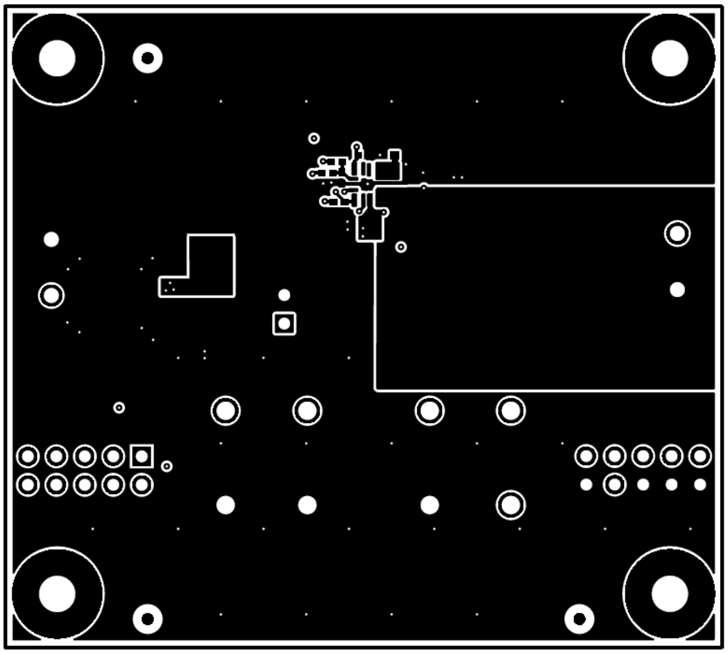

Figure 6-3. Top Layer

Reserved for solid ground plane for low-noise and optimized thermal design.

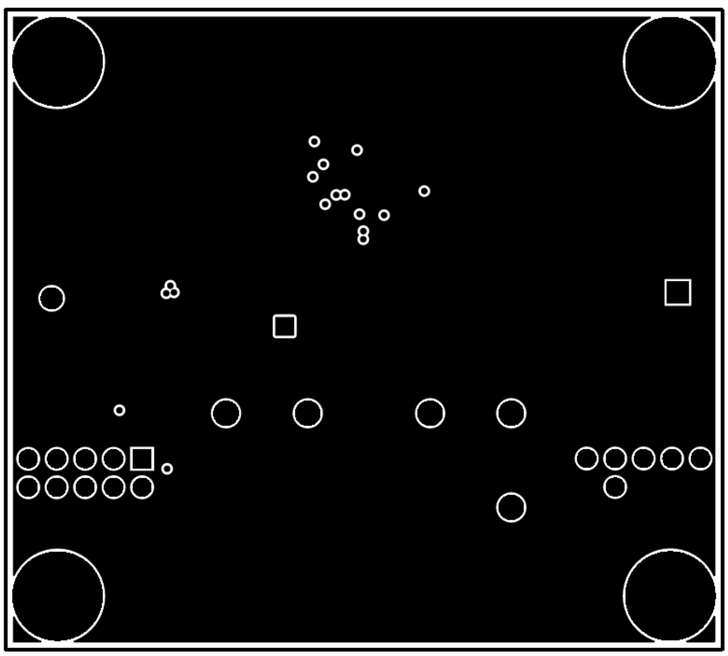

Figure 6-4. Mid Layer 1

Primary routing layer

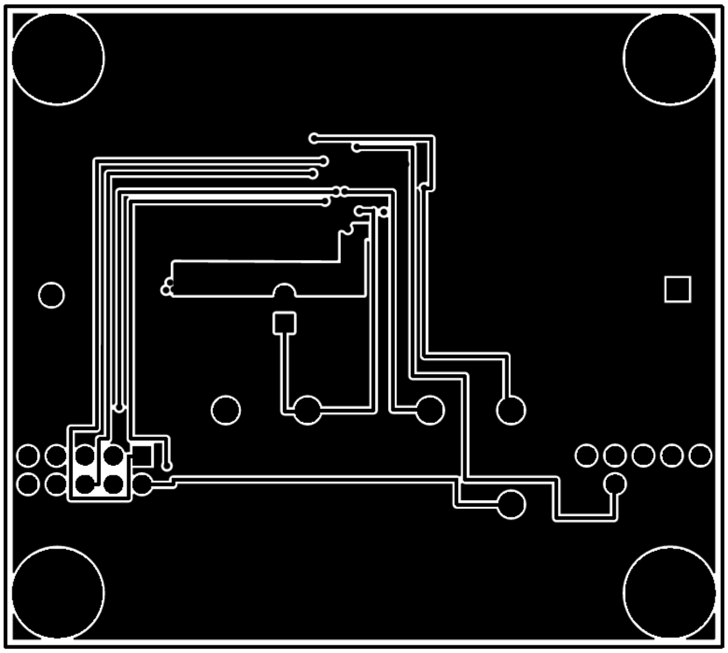

Figure 6-5. Mid Layer 2

Reserved for PI filter and non-critical passive component placement (minus input capacitor). An input capacitor is placed on the bottom side of the PCB as it provides a slightly lower input loop inductance. A single layer implementation is satisfactory as well.

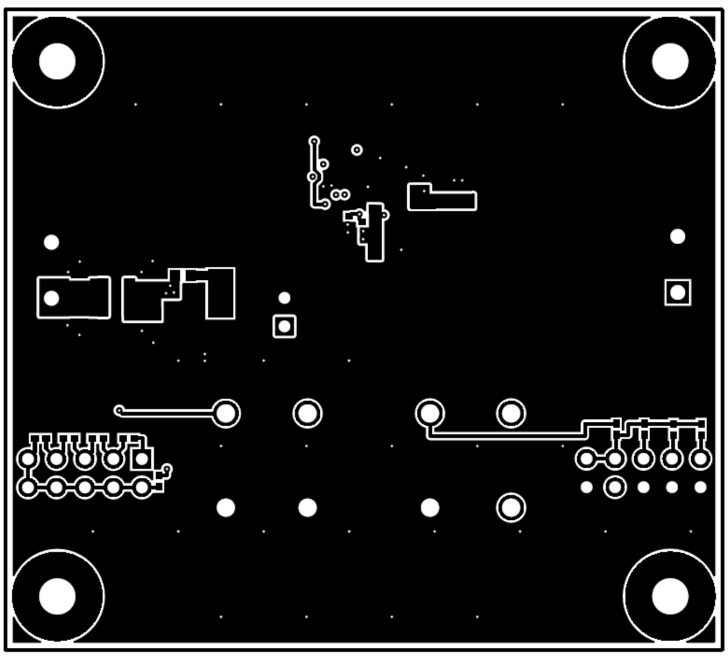

Figure 6-6. Bottom Layer

7 Bill of Materials

Table 7-1. Bill of Materials

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
C1, C2, C3, C4	4	2.2 µF	CAP, CERM, 2.2 µF, 50 V, ±10%, X7R, AEC-Q200 Grade 1, 0805	0805	CGA4J3X7R1H225K125AB	TDK
C5	1	100 µF	CAP, AL, 100 µF, 50 V, ±20%, 0.6 Ω, SMD	HA0	EMVY500ADA101MHA0G	Chemi-Con
C6, C7	2	4.7 µF	CAP, CERM, 4.7 µF, 50 V, ±10%, X7R, 1210	1210	C3225X7R1H475K250AB	TDK
C8	1	0.1 µF	CAP, CERM, 0.1 µF, 50 V, ±20%, X5R, 0402	0402	GRM155R61H104ME14D	MuRata
C9	1	1 µF	CAP, CERM, 1 µF, 16 V, ±10%, X5R, 0402	0402	EMK105BJ105KVHF	Taiyo Yuden
C10, C11	2	22 µF	CAP, CERM, 22 µF, 16 V, ±20%, X7R, AEC-Q200 Grade 1, 1210	1210	CGA6P1X7R1C226M250AC	TDK
C14	1	22 pF	CAP, CERM, 22 pF, 50 V, ±5%, C0G/NP0, AEC-Q200 Grade 1, 0402	0402	CGA2B2NP01H220J050BA	TDK
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 × 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone
J1, J2	2		TERM BLOCK 2POS 5 mm, TH	10x10x8.1 mm	1729018	Phoenix Contact
J3, J4	2		Header, 100 mil, 5 × 2, Tin, TH	Header, 5 × 2, 100 mil, Tin	PEC05DAAN	Sullins Connector Solutions
J5	1		Header, 100 mil, 2 × 1, Gold, TH	Header, 100 mil, 2 × 1, TH	HTSW-102-07-G-S	Samtec
L1	1		Shielded Power Inductors	SMD2	XGL4020-152MEC	Coilcraft
R1	1	0	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06030000Z0EA	Vishay-Dale
R2	1	255 k	RES, 255 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402255KFKED	Vishay-Dale
R3	1	49.9 k	RES, 49.9 k, 1%, 0.063 W, 0402	0402	CRCW040249K9FKED	Vishay-Dale
R4	1	47 k	RES, 47 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040247K0JNED	Vishay-Dale
R5, R7	2	8.06 k	RES, 8.06 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04028K06FKED	Vishay-Dale
R6	1	6.98 k	RES, 6.98 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04026K98FKED	Vishay-Dale
R8	1	16.9 k	RES, 16.9 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040216K9FKED	Vishay-Dale
R9	1	69.8 k	RES, 69.8 k, 1%, 0.063 W, 0402	0402	CRCW040269K8FKED	Vishay-Dale
R10	1	10.0 k	RES, 10.0 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040210K0FKED	Vishay-Dale
R11	1	0	RES, 0, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04020000Z0ED	Vishay-Dale

Table 7-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
R12	1	10.0	RES, 10.0, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040210R0F KED	Vishay-Dale
R13	1	20.0 k	RES, 20.0 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040220K0F KED	Vishay-Dale
R14	1	33.2 k	RES, 33.2 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040233K2F KED	Vishay-Dale
R15	1	54.9 k	RES, 54.9 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040254K9F KED	Vishay-Dale
SH-J1, SH-J2	2		Shunt, 100 mil, Gold plated, Black	Shunt 2 pos. 100 mil	881545-2	TE Connectivity
TP1, TP2, TP3, TP6	4		Test Point, Miniature, SMT	Test Point, Miniature, SMT	5019	Keystone
TP4, TP7, TP9, TP10, TP11	5		Test Point, Multipurpose, White, TH	White Multipurpose Testpoint	5012	Keystone Electronics
TP5, TP8, TP12	3		Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint	5011	Keystone Electronics
U1	1		36-V Input, 1-V to 6-V Output, 2.5-A DC-DC Power Module	QFN-FCMOD11	TLVM23625RDNR	Texas Instruments

8 Reference

Texas Instruments, *Input Filter Design for Switching Power Supplies* application report

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