LM5122EVM-2PH Evaluation Module

User's Guide

Literature Number: SNVU205
APRIL 2013

TEXAS INSTRUMENTS

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LM5122EVM-2PH Evaluation Module

1 Introduction

The LM5122EVM-2PH evaluation module (EVM) provides the design engineer with a fully functional dual phase synchronous boost converter to evaluate the Texas Instruments LM5122 synchronous boost controller device. The EVM provides 28 V output at up to 7 A current from a 9 V to 20 V input. The EVM is designed to start up from a single power supply without any additional bias voltage.

2 Features and Electrical Performance

- 9 V to 20 V input voltage range
- 28 V target output voltage
- Up to 7 A output current
- 250 kHz typical switching frequency
- Dual phase interleaved operation

Table 1. Electrical Performance Specifications

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Input Characteristics					
Input Voltage		9	12	20	V
Input Current	V_{SUPPLY} = 12 V, I_{LOAD} = 7A		17		A
Output Characteristics					
Output Voltage	I_{LOAD} = 7A	27.02	28	28.98	V
Output Current				7	A
System Characteristics					
Switching Frequency			250		kHz
Full Load Efficiency	V_{SUPPLY} = 12 V		96%		
	V_{SUPPLY} = 20 V		98%		

3 Test Points

3.1 Test Points

Table 2. Pin Descriptions

PIN NAME	DESCRIPTIONS
TP7, TP8	Power Ground
TP5, TP9, TP10	Analog Ground
TP6	UVLO
J1#1	External Synchronization Pulse Positive Input
J1#2	External Synchronization Pulse Negative Input

4 Test Equipment

4.1 Power Supply

Power Supply should be capable of 20 V / 25 A, current monitoring and remote sensing.

4.2 Electronic Load

Electronic load should be capable of 32 V / 7 A. Use Constant Current (CC) mode.

4.3 Meters

One current meter is required to measure input current accurately. Maximum current rating of the meter should be carefully considered. Input current can be as high as 25 A at full load current and minimum input voltage. Output voltage is monitored by a voltage meter which should be capable of monitoring up to 32 V.

4.4 Oscilloscope

Oscilloscope and 10x probe with at least 20 MHz bandwidth are required.

5 Test Setup and Procedure

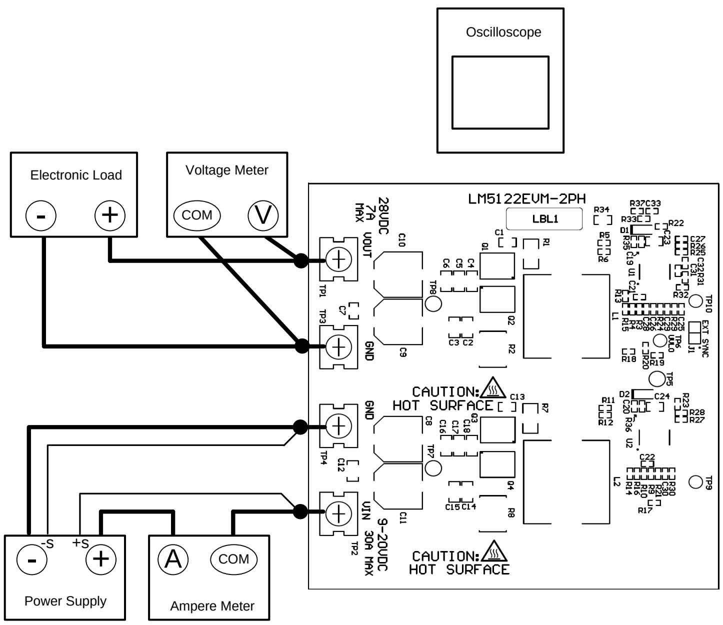

Figure 1. Connection Diagram

5.1 Precaution & Wire Gauge

Prolonged operation with low input voltage at full power will cause heating of the MOSFETs. A fan with a minimum of 200LFM should be always provided.

Wire gauge for the input power supply should be 6-8 AWG minimum and no longer than 1 foot each for VIN and GND. Wire gauge for the output electronic load should be 12 AWG minimum and no longer than 1 foot each for VOUT and GND.

5.2 Test Setup

5.2.1 Power Supply

Connect the power supply's positive terminal (+) to 'A' terminal of ampere meter and negative terminal (-) to TP4 GND. Connect the power supply's positive remote sense terminal to TP2 VIN and negative remote sense terminal to TP4 GND.

5.2.2 Meter

Connect 'COM' terminal of ampere meter to TP2 VIN. Double check 'A' terminal is connected to the power supply's positive terminal.

Voltage meter is used to measure output voltage. Connect positive terminal (V) of the voltage meter to TP1 VOUT and negative terminal (COM) of the voltage meter to TP3 GND.

5.2.3 Load

Connect electronic load's positive terminal (+) to TP1 VOUT and negative terminal (-) to TP3 GND.

5.3 Quick Test Procedure

5.3.1 Startup

- Set load current to 0 A and turn the load on
- Set power supply current limit to 25 A
- Turn on the power supply and increase voltage slowly up to 20 V
- Increase load current slowly up to 7 A

5.3.2 Shutdown

- Turn off the load
- Decrease the input voltage down to 0 V
- Turn on the load and discharge output capacitor

6 Performance Curves

The following curves are presented for reference, the actual field data may differ from these curves. Actual performance data can be affected by measurement techniques, equipment setting and environmental variables.

6.1 Efficiency

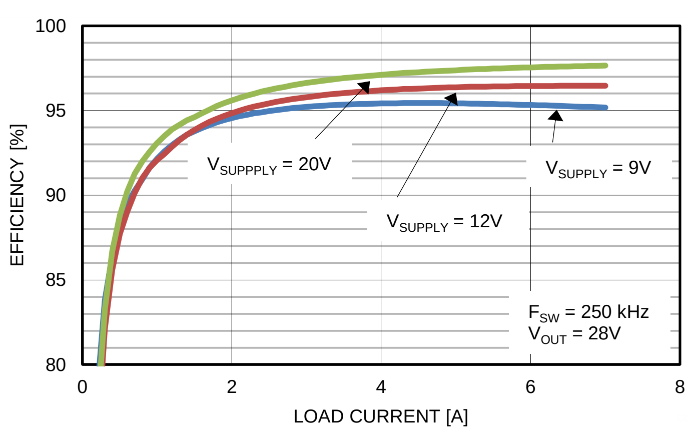

Figure 2. Efficiency

6.2 Load Transient

V_{SUPPLY} = 12 V, 3.5 A to 7 A and 7 A to 3.5 A load transient

C1: V_{OUT}

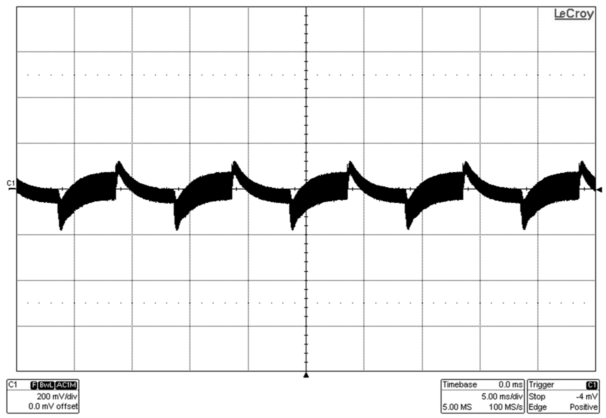

Figure 3. Load Transient

6.3 Interleaving

V_{SUPPLY} = 12 V

C1: SW1, C2: SW2

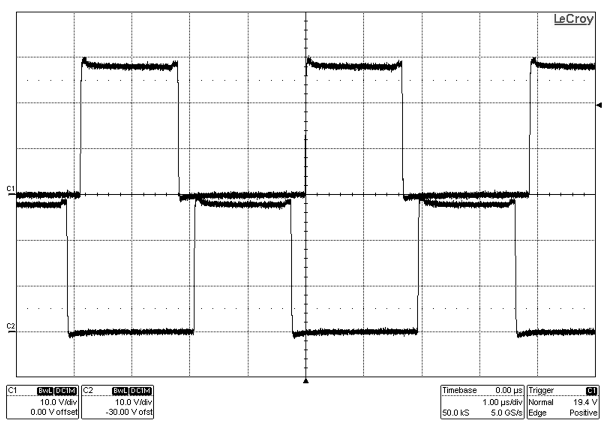

Figure 4. Interleaving

6.4 Light Load Operations

Forced PWM (FPWM) and Skip Cycle mode can be configured by controlling MODE pin voltage.

V_{SUPPLY} = 12 V, I_{LOAD} = 0 A

C1:SW1

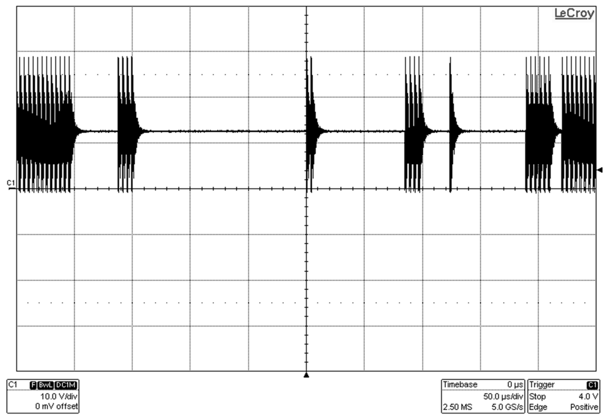

Figure 5. Pulse Skip

C1: SW1

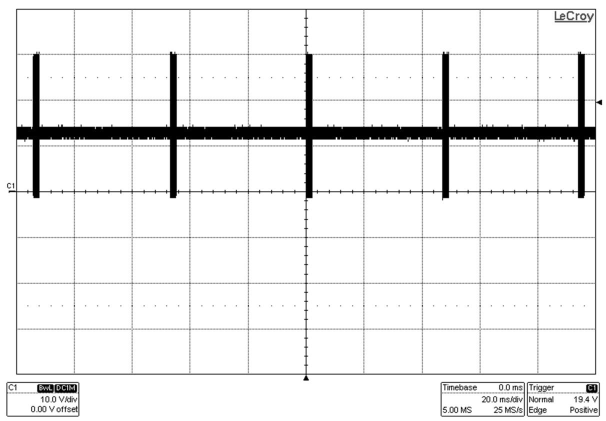

Figure 6. Skip Cycle

C1: SW1

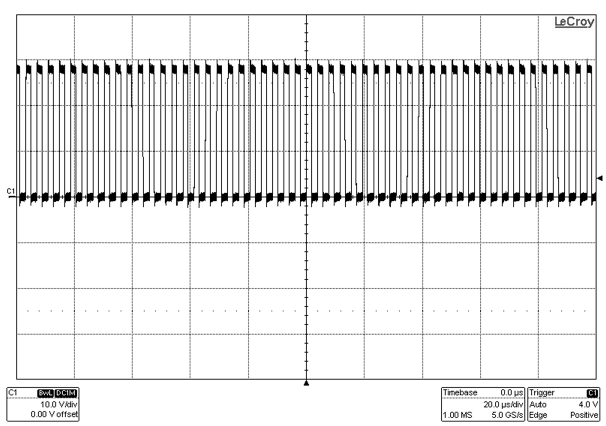

Figure 7. Forced PWM

6.5 Startup

V_{SUPPLY} = 12 V, I_{LOAD} = 0 A

C1: V_{OUT}, C2: SS, C4: V_{SUPPLY}

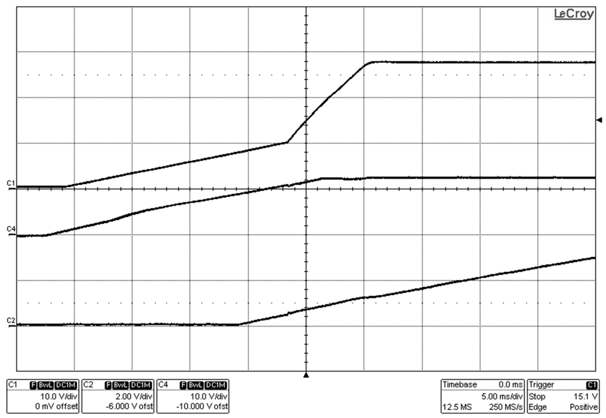

Figure 8. Startup

6.6 Loop Response

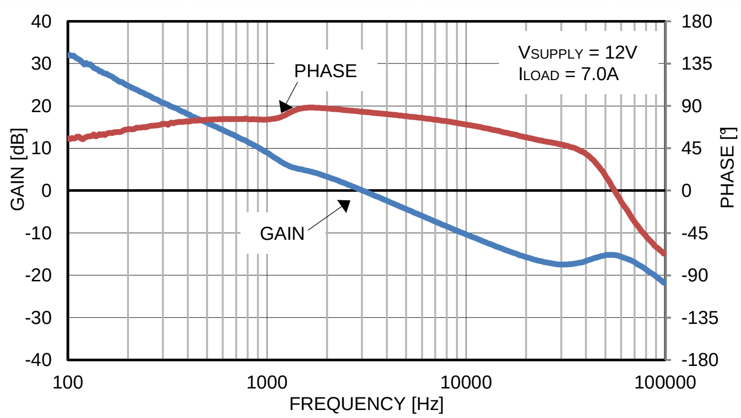

Figure 9. Loop Response

7 Schematic

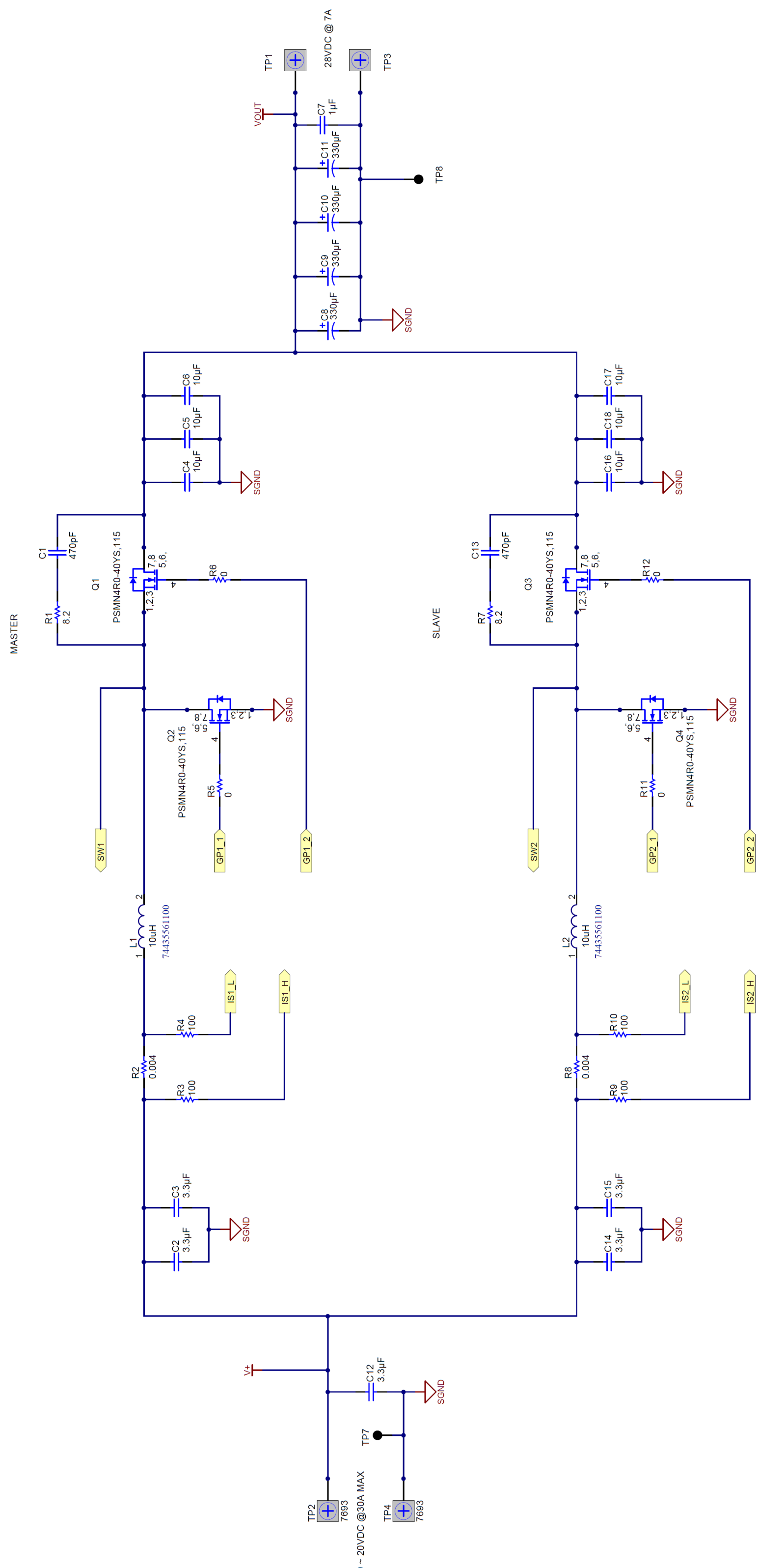

Figure 10. Schematic (Power Block)

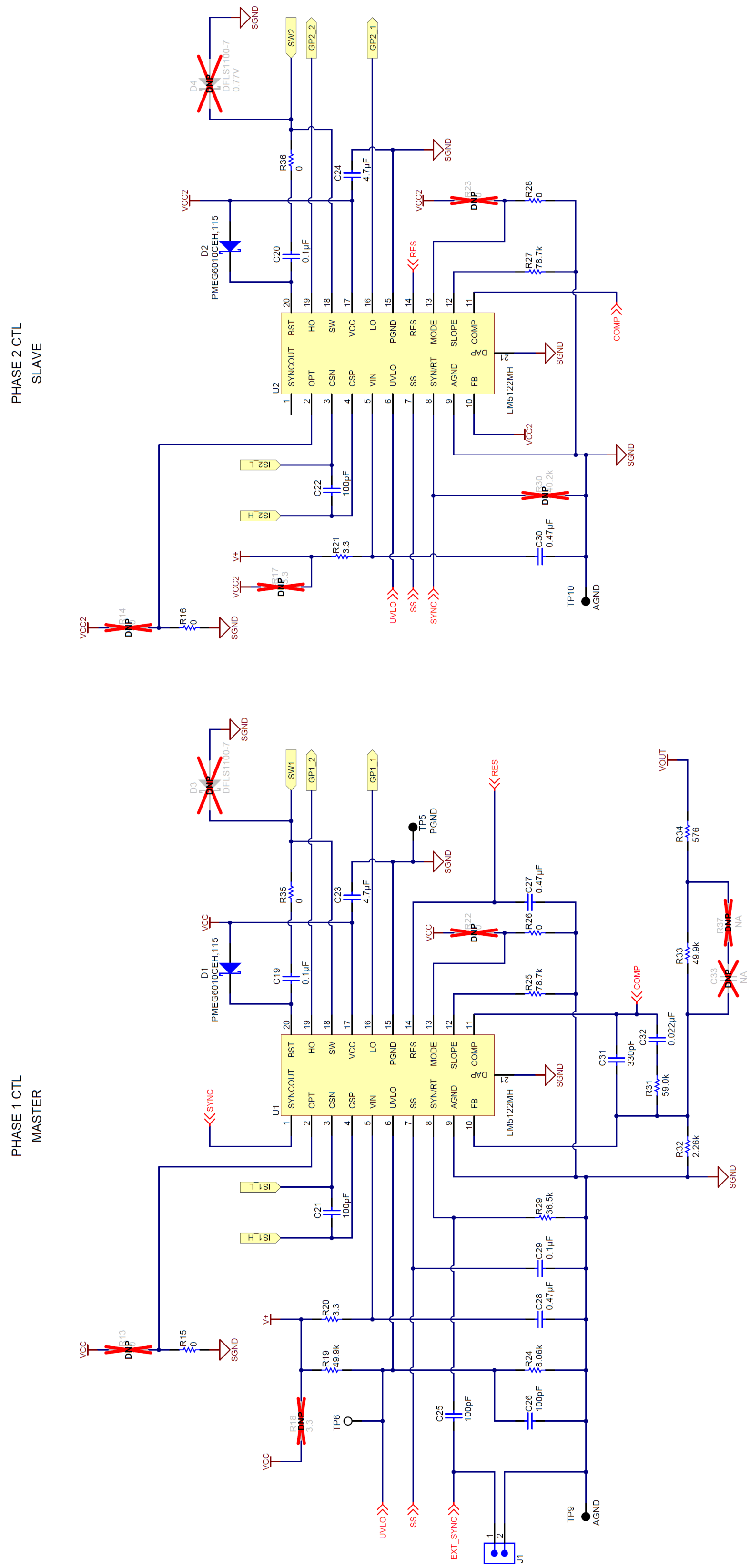

Figure 11. Schematic (Control Block)

8 Layout

The LM5122 2-phase EVM has been designed using a 4-layer board. Most of components are on the top to allow the user to easily view, probe, and evaluate the LM5122 device.

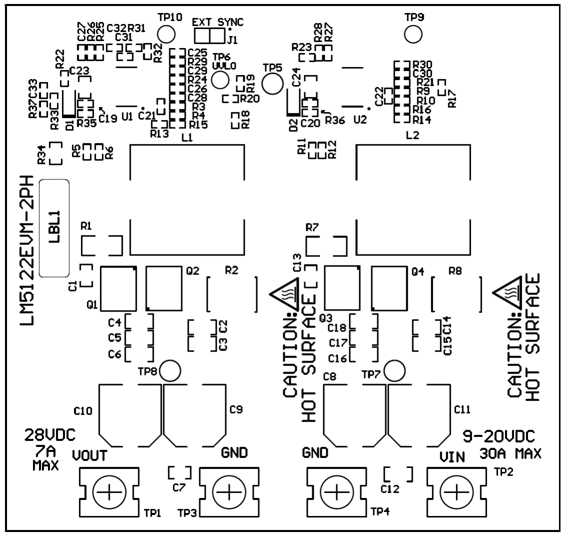

Figure 12. Top Silk (Top View)

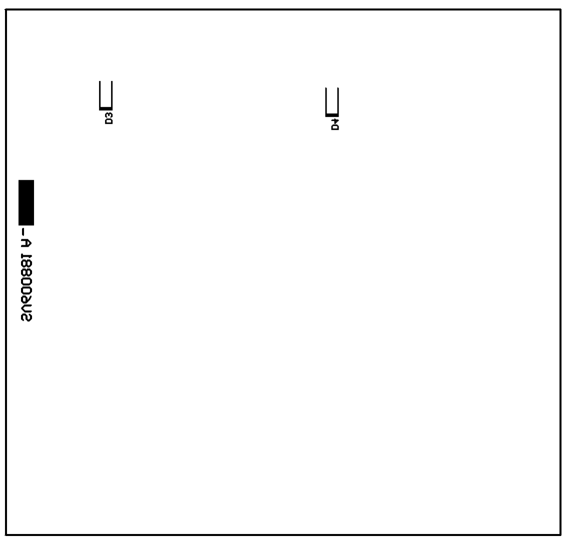

Figure 13. Bottom Silk (X-Ray View)

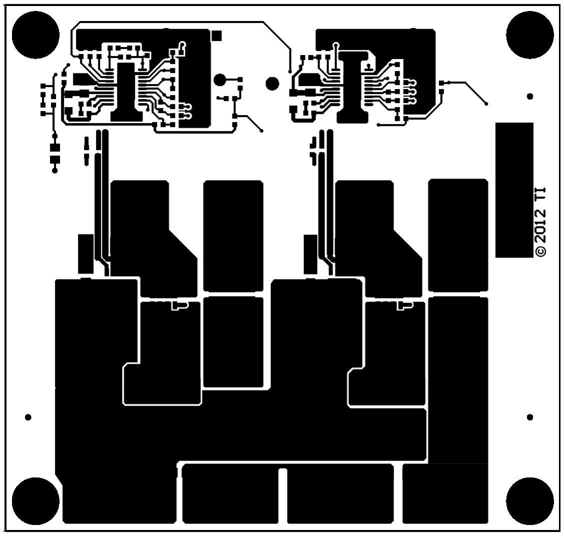

Figure 14. Top Copper (Top View)

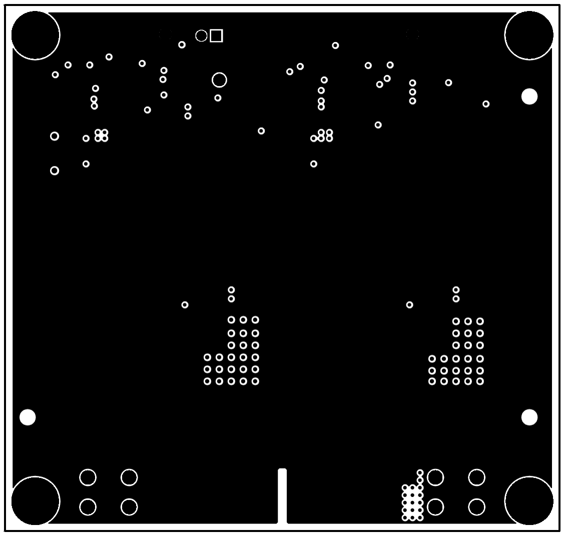

Figure 15. Mid1 Copper (X-Ray View)

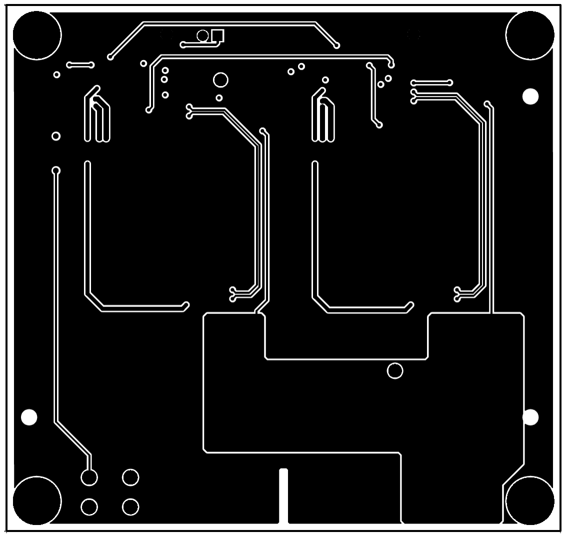

Figure 16. Mid2 Copper (X-Ray View)

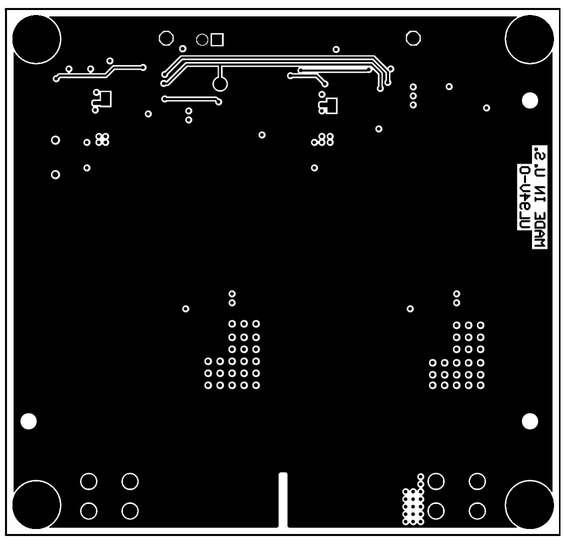

Figure 17. Bottom Copper (X-Ray View)

9 Bill of Materials

The EVM components are list according to the schematic shown in Figure 10 and Figure 11 .

Table 3. Bill of Materials

REFERENCE DESIGNATOR	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
C1, C13	CAP, CER, 470 pF, 100 V, +/-5%, C0G, 0805	MURATA	GRM2165C2A471JA01D	2
C2, C3, C12, C14, C15	CAP CER 3.3 uF 50 V 10% X7R 1206	TDK	C3216X7R1H335K160AC	5
C4, C5, C6, C16, C17, C18	CAP CER 10 uF 35 V 10% X7R 1206	Taiyo Yuden	GMK316AB7106KL	6
C7	CAP, CER, 1 uF, 50 V, +/-10%, X7R, 0805	MURATA	GRM21BR71H105KA12L	1
C8, C9, C10, C11	CAP ALUM 330 uF 35 V 20% SMD	Panasonic	EEE-FP1V331AP	4
C19, C20, C29	CAP, CER, 0.1 uF, 25 V, +/-10%, X7R, 0603	MURATA	GRM188R71E104KA01D	3
C21, C22, C25, C26	CAP, CER, 100 pF, 50 V, +/-5%, C0G/NP0, 0603	MURATA	GRM1885C1H101JA01D	4
C23, C24	CAP, CER, 4.7 uF, 16 V, +/-10%, X7R, 0805	MURATA	GRM21BR71C475KA73L	2
C27, C28, C30	CAP, CER, 0.47 uF, 25 V, +/-10%, X7R, 0603	MURATA	GRM188R71E474KA12D	3
C31	CAP, CER, 330 pF, 50 V, +/-10%, X7R, 0603	KEMET	C0603C331K5RACTU	1
C32	CAP, CER, 0.022 uF, 50 V, +/-10%, X7R, 0603	KEMET	C0603C223K5RACTU	1
R1, R7	RES 8.2 Ω 3/4W 5% 2010 SMD	Vishay	CRCW20108R20JNEF	2
R2, R8	RES, 0.004 Ω, 3 W, 1%, 3015, WIDE	Susumu	KRL7638-C-R004-F-T1	2
R3, R4, R9, R10	RES, 100 Ω, 1%, 0.1 W, 0603	Vishay	CRCW0603100RFKEA	4
R5, R6, R11, R12, R15, R16, R26, R28, R35, R36	RES, 0 Ω, 5%, 0.1 W, 0603	Panasonic	ERJ-3GEY0R00V	10
R19, R33	RES, 49.9k Ω, 1%, 0.1 W, 0603	Vishay	CRCW060349K9FKEA	2
R20, R21	RES, 3.3 Ω, 5%, 0.1 W, 0603	Vishay	CRCW06033R30JNEA	2
R24	RES, 8.06k Ω, 1%, 0.1 W, 0603	Vishay	CRCW06038K06FKEA	1
R25, R27	RES, 78.7k Ω, 1%, 0.1 W, 0603	Vishay	CRCW060378K7FKEA	2
R29	RES, 36.5k Ω, 1%, 0.1 W, 0603	Vishay	CRCW060336K5FKEA	1
R31	RES, 59.0k Ω, 1%, 0.1 W, 0603	Vishay	CRCW060359K0FKEA	1
R32	RES, 2.26k Ω, 1%, 0.1 W, 0603	Vishay	CRCW06032K26FKEA	1
R34	RES, 576 Ω, 1%, 0.125 W, 0805	Vishay	CRCW0805576RFKEA	1
D1, D2	Diode, Schottky, 60 V, 1 A, SOD-123F	NXP	PMEG6010CEH	2
Q1, Q2, Q3, Q4	MOSFET N-CH 40 V 100 A LFPAK	NXP	PSMN4R0-40YS	4
	MOSFET N-CH 40 V 100 A SON 5x6	Texas Instruments	CSD18501Q5A	ALT
L1, L2	SMD Flat Wire WE-HCI, L Ω = 10.0 µH	WURTH	74435561100	2
TP1, TP2, TP3, TP4	Terminal screw, vertical, snap-in	Keystone	7693	4
TP5, TP7, TP8	Test Point, TH, Multipurpose, Black	Keystone	5011	3
TP6	Test Point, TH, Miniature, White	Keystone	5002	1
TP9, TP10	Test Point, TH, Miniature, Black	Keystone	5001	2
H1, H2, H5, H6	Standoff, Hex, 0.5"L #4-40 Nylon	Keystone	1902C	4
H3, H4, H7, H8	Machine Screw, Round, #4-40 x 1/4, Nylon	B&F	NY PMS 440 0025 PH	4
J1	Header, TH, 100mil, 2x1, Gold plated	SAMTEC	TSW-102-07-G-S	1
U1, U2	Synchronous Boost Controller	Texas Instruments	LM5122MH	2

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