EVM User's Guide: LMR43606-Q1

LMR43606MQ3EVM-2M Evaluation Module

Description

The LMR43606-Q1 is an easy-to-use, synchronous, step-down voltage converter. The LMR43606MQ3EVM-2M is a fully assembled and tested circuit for evaluating the LMR43606-Q1 converter. This EVM is designed to be operated with a 3.5V to 36V input and provides a 3.3V output with a load up to 600mA.

Get Started

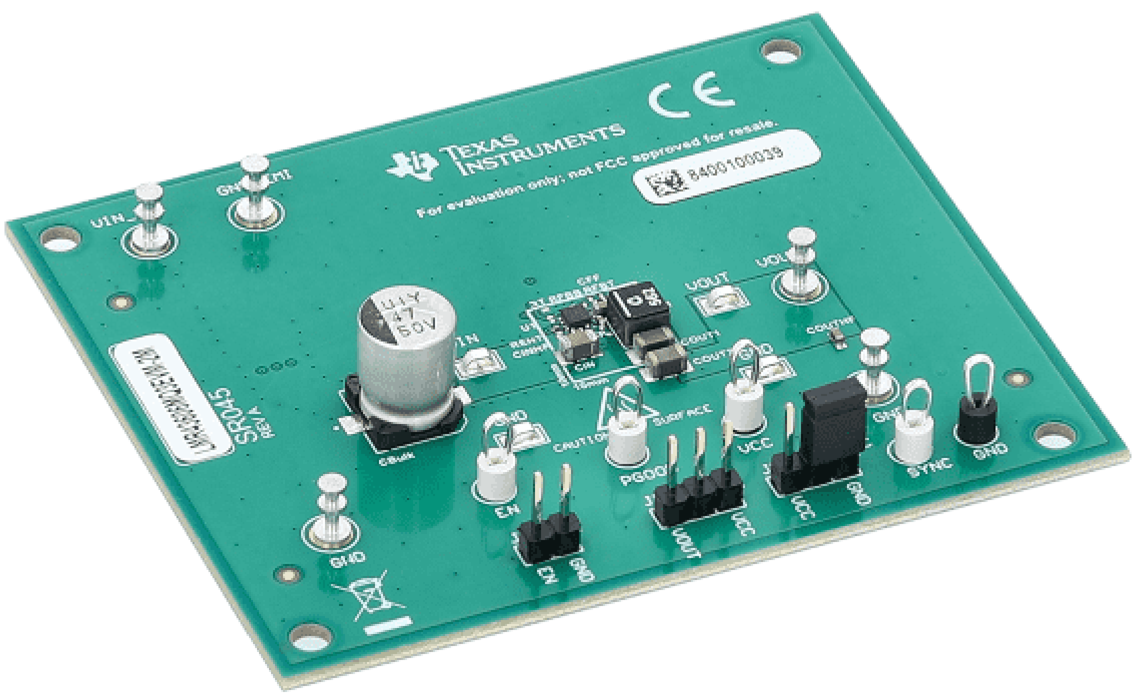
1. Order the LMR43606MQ3EVM-2M.
2. Connect the voltage supply between the VIN_EMI and GND_EMI supply connections.
3. Connect the load between the VOUT and GND test points.
4. Set the supply voltage at an appropriate level between 3.5V to 36V.
5. Turn on the power supply.
6. Monitor the output voltage.

Features

- Included EMI filter connected to VIN_EMI and GND_EMI inputs.
- EMI filter input bypass connected to VIN and GND inputs.
- Easy-to-use test points available for SYNC, PGOOD, EN, VIN, VCC, VOUT, and GND pins.
- Enable input signal available with jumpers.
- PGOOD output signal available with jumpers.
- FPWM/PFM selection available with jumpers.

Applications

- Advanced driver assistance systems: radar ECU
- Infotainment and cluster: head unit, eCall
- Body electronics and lighting



LMR43606MQ3EVM-2M Board

1 Evaluation Module Overview

1.1 Introduction

The LMR43606MQ3EVM-2M is designed to evaluate the performance of the LMR43606-Q1 device. The evaluation module comes with a default 3.3V output and 2.2MHz switching frequency. The device supports input voltages from 3.5V to 36V and is capable of driving a load up to 600mA. Various jumper headers can be used to set the LMR43606-Q1 into different performance modes, as outlined in Section 2.1.2. A dedicated EMI filter is included in the EVM with solder footprints that can be populated for a custom EMI filter design. The EVM also has a dedicated PGOOD test point that can be used as an output when connected to the VCC pin or an appropriate external power supply.

This user's guide reviews the content of the LMR43606MQ3EVM-2M evaluation module and how to quickly get started using the LMR43606-Q1 synchronous buck converter. The information in this user's guide only pertains to the evaluation module of the LMR43606-Q1.

1.2 Kit Contents

The package includes:

1. LMR43606-Q1 Evaluation Module (LMR43606MQ3EVM-2M) that includes the LMR43606MSC3RPERQ1.
2. TI HV EVM User Safety Guidelines
3. EVM Disclaimer Read Me

1.3 Specification

A summary of the LMR43606MQ3EVM-2M performance specifications is provided in Table 1-1. Specifications are given for 13.5V input voltage and 3.3 output voltage from -40°C to 150°C, unless otherwise noted.

Table 1-1. LMR43606MQ3EVM-2M Performance Specifications Summary

Specifications		Test Conditions	MIN	TYP	MAX	Unit
V_{OUT}	Output voltage	V_{IN} = 3.6V to 36V, FPWM Mode	3.27	3.3	3.33	V
F_{SW}	Switching frequency			2200		kHz
I_{OUT}	Output current range		0		0.6	A
PGD_{UV}	Pgood upper threshold - falling	% of VOUT/FB	89	91	94.2	%
$V_{EN-WAKE}$	EN Wakeup Threshold		0.5	0.7	1	V

1.4 Device Information

The Texas Instruments' LMR43606MQ3EVM-2M evaluation module (EVM) helps designers evaluate the operation and performance of the LMR43606-Q1 wide-input buck converter. The LMR43606-Q1 is an easy-to-use synchronous step-down voltage converter capable of driving up to 600mA of load current from an input voltage of up to 36V. The EVM also features test points for EN, SYNC, PGOOD, VCC, VOUT, and GND. See the data sheet (SNVSCM5) for additional features, detailed descriptions, and available options.

Table 1-2. Device and Package Configurations

EVM	U1	FREQUENCY	SPREAD SPECTRUM	CURRENT	PIN 1 TRIM
LMR43606MQ3EVM-2M	LMR43606MSC3RPEQ1	2200kHz	Enabled	600mA	MODE/SYNC

2 Hardware

2.1 Setup

This section describes the test points and connectors on the EVM and how to properly connect, set up, and use the LMR43620-Q1 EVM.

2.1.1 Test Points

The test points on the board can be used for connecting to the input of a power supply and output load for the EVM. See Figure 2-1 for typical test setup. The functions of the test points connections are:

- **VIN_EMI —** Input supply to EVM including an EMI filter. Connect to an input supply. Connect at this point for EMI test.
- **GND_EMI —** Ground connection for the input supply
- **VIN —** Input supply to the IC. Can be connected to DMM to measure input voltage after EMI filter.
- **VOUT —** Output voltage test point of EVM. Can be connected to a desired load.
- **GND —** Ground test points
- **EN —** This test point is connected to the EN pin. By default, there is a pullup resistor, R1 (RENT), to VIN to enable the IC. This pin can also be used to enable and disable the device. See Section 2.1.2 for more information.
- **PGOOD —** This test point is connected to the PGOOD pin from the IC. This pin can also be tied to an external supply through a pullup resistor or left open. See Section 2.1.2 for more information.
- **SYNC —** In a **MODE/SYNC** trim part, this test point is connected to the SYNC pin of the IC. This test point can also be connected to an external clock to synchronize the IC. Make sure R9 (RJM) is installed and R8 (RSYNC) is not installed when applying a sync clock input. This pin can also be used to sync the converter to an external clock. See Section 2.1.2 for more information.

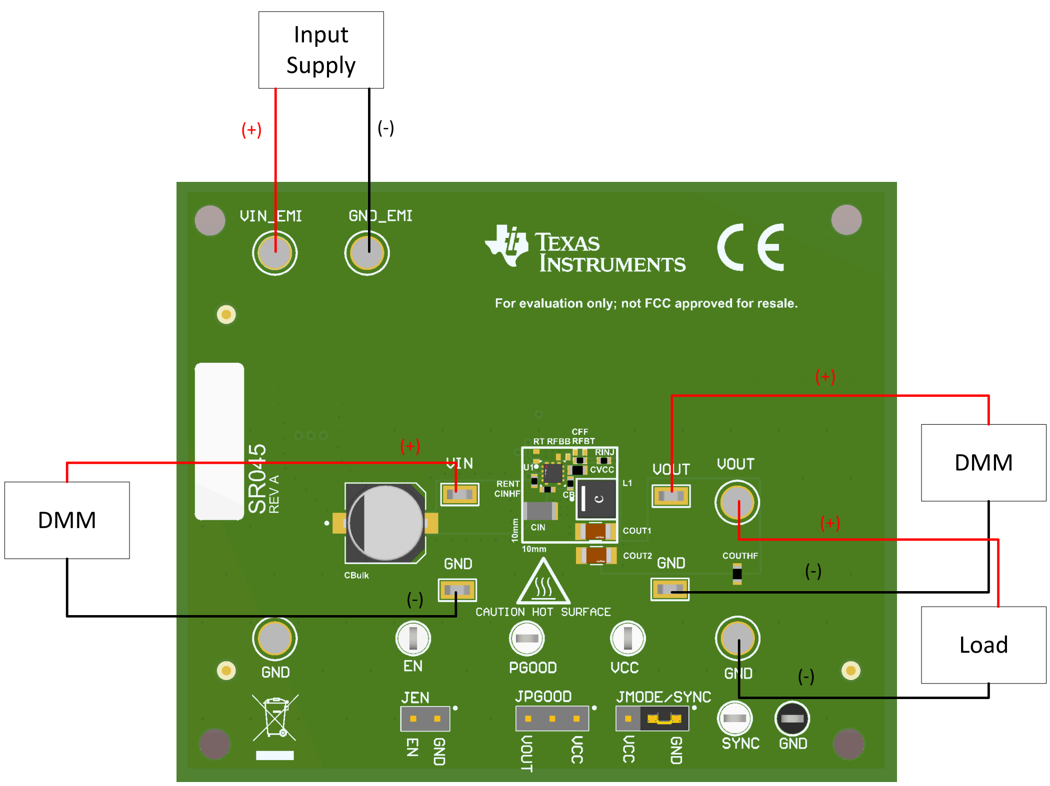


Figure 2-1. EVM Board Connections

2.1.2 Jumpers

See Figure 2-2 for jumper locations.

- **JEN —** This jumper allows the ENABLE input to be connected to GND in order to disable the IC. By default, this jumper is left open since there is a pullup resistor, R2 (RENT), to VIN to enable the IC.
- **JPGOOD —** Use this jumper to select how the PGOOD pin is connected. A jumper can be used to connect pin 2 and 3. In this configuration, the PGOOD pin is pulled up to VOUT through R7 (RPGOOD) with a value of 100kΩ. When connecting the jumper between pin 1 and 2, the PGOOD pin is pulled up to VCC through R7 (RPGOOD) with a value of 100kΩ. By default, this jumper is not populated.
- **JMODE/SYNC —** Use this jumper to select the mode of operation in a *MODE/SYNC* trim part. Connecting a jumper between pin 1 and 2 sets the IC operation to PFM (pulse frequency modulation) mode for a higher efficiency at light load. A jumper between pin 2 and pin 3 causes the IC to operate in FPWM (forced pulse width modulation) mode. By default, the jumper is connected between pin 1 and 2. Pin 1 is indicated by the dot on the PCB.

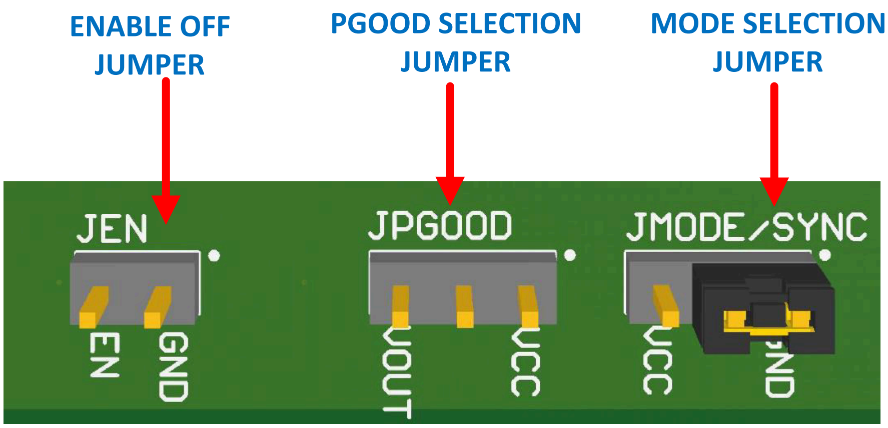


Figure 2-2. Jumper Locations

3 Test Results

3.1 LMR43606MQ3EVM-2M Test Results

The LMR43606MQ3EVM-2M variant is used for the following images.

3.1.1 Efficiency, Load Regulation, and Thermal Picture

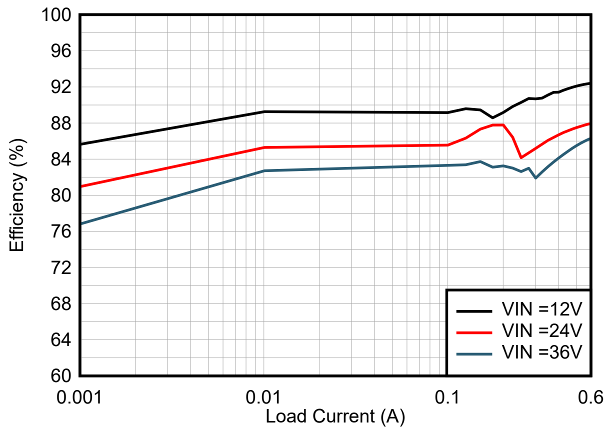


Figure 3-1. $3.3V_{OUT}$, 2.2MHz Efficiency (AUTO)

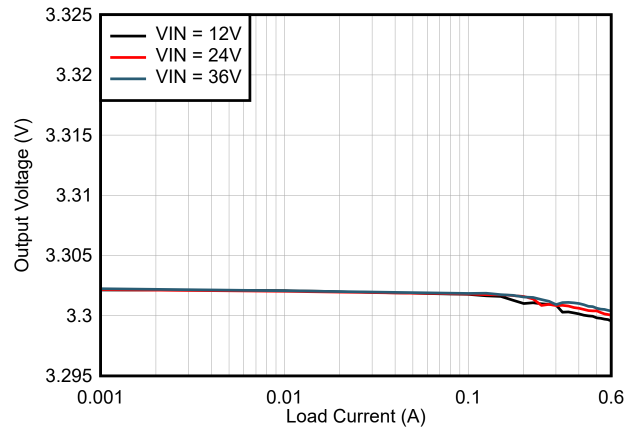


Figure 3-2. $3.3V_{OUT}$, 2.2MHz Load Regulation (AUTO)

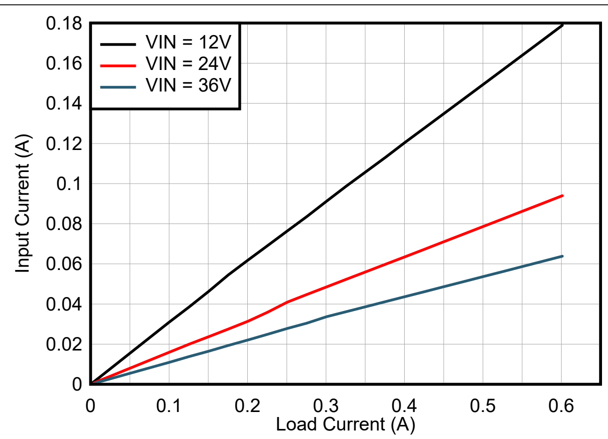


Figure 3-3. Input Current vs Load Current for $3.3V_{OUT}$ (R_{ENB} removed)

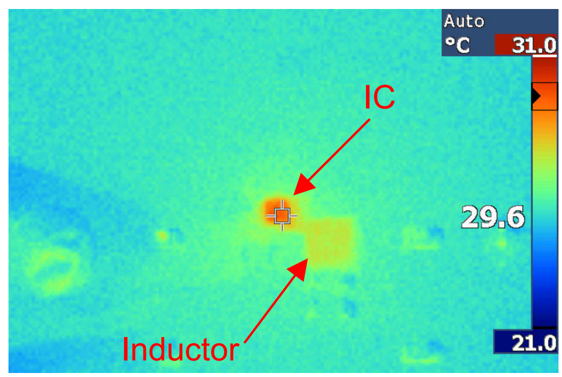


Figure 3-4. Thermal Capture, $12V_{IN}$, $3.3V_{OUT}$, 0.6A Load, 2.2MHz, Θ_{JA}≅ 50°C/W

3.1.2 Load Transients

Figure 3-5. Load Transient $12V_{IN}$, $3.3V_{OUT}$, I_{OUT} = 60mA to 600mA, Slew Rate = 1A/µs (FPWM)

Figure 3-6. Load Transient $12V_{IN}$, $3.3V_{OUT}$, I_{OUT} = 60mA to 600mA, Slew Rate = 1A/µs (AUTO)

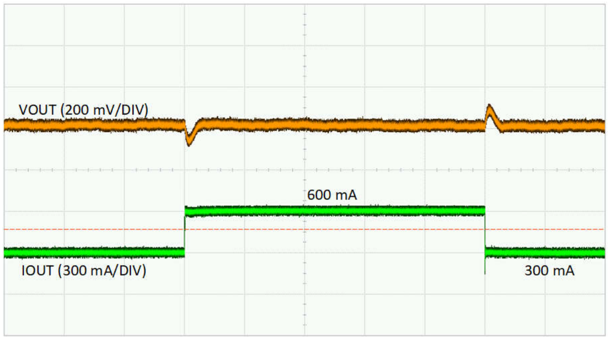


Figure 3-7. Load Transient 12V_{IN}, 3.3V_{OUT}, I_{OUT} = 300mA to 600mA, Slew Rate = 1A/µs (FPWM)

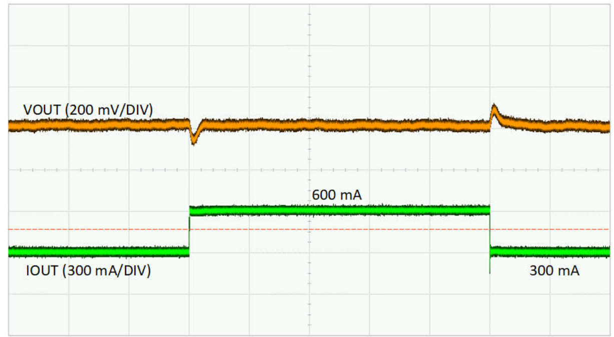


Figure 3-8. Load Transient 12V_{IN}, 3.3V_{OUT}, I_{OUT} = 300mA to 600mA, Slew Rate = 1A/µs (AUTO)

3.1.3 Output Ripple

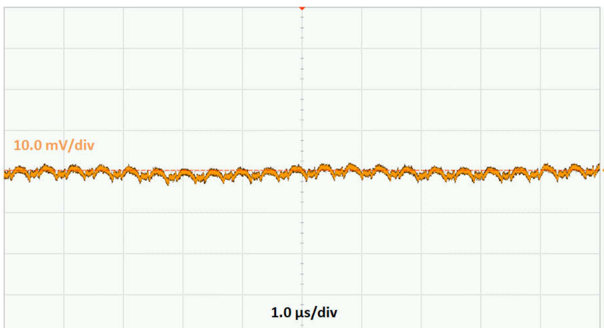


Figure 3-9. Output Ripple at 12V_{IN}, 3.3V_{OUT} (fixed), 600mA Load

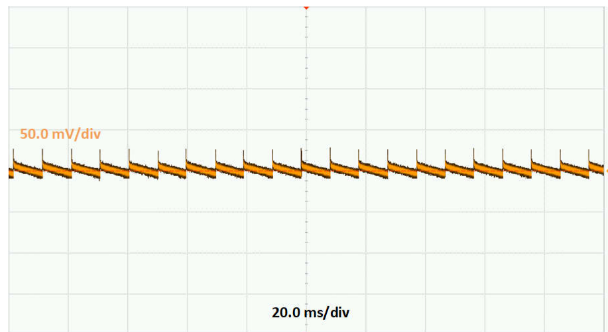


Figure 3-10. Output Ripple at 12V_{IN}, 3.3V_{OUT} (fixed), No Load

3.1.4 Conducted EMI

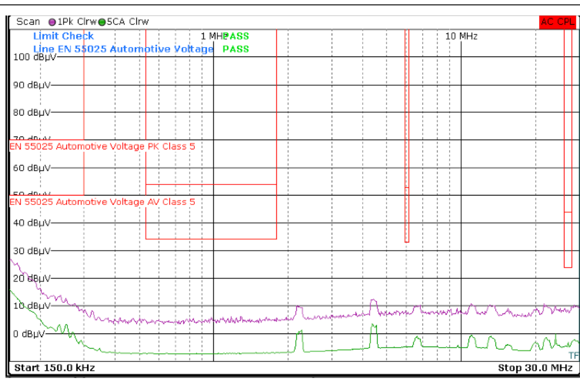


Figure 3-11. LMR43606MQ3EVM-2M Low Frequency Conducted EMI Results 13.5V_{IN}, 3.3V_{OUT}, 0.6A I_{OUT} (Green-Average Scan and Purple-Peak Scan)

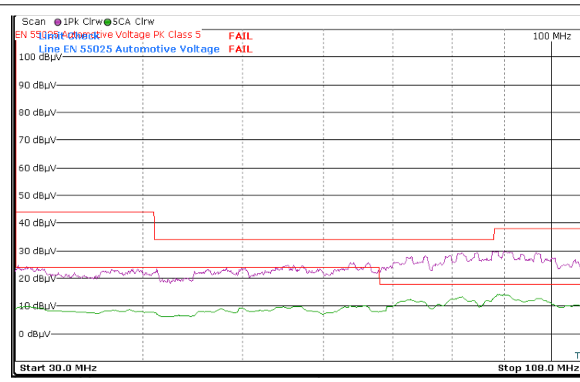


Figure 3-12. LMR43606MQ3EVM-2M High Frequency Conducted EMI Results 13.5V_{IN}, 3.3V_{OUT}, 0.6A I_{OUT} (Green-Average Scan and Purple-Peak Scan)

4 Hardware Design Files

4.1 Schematic

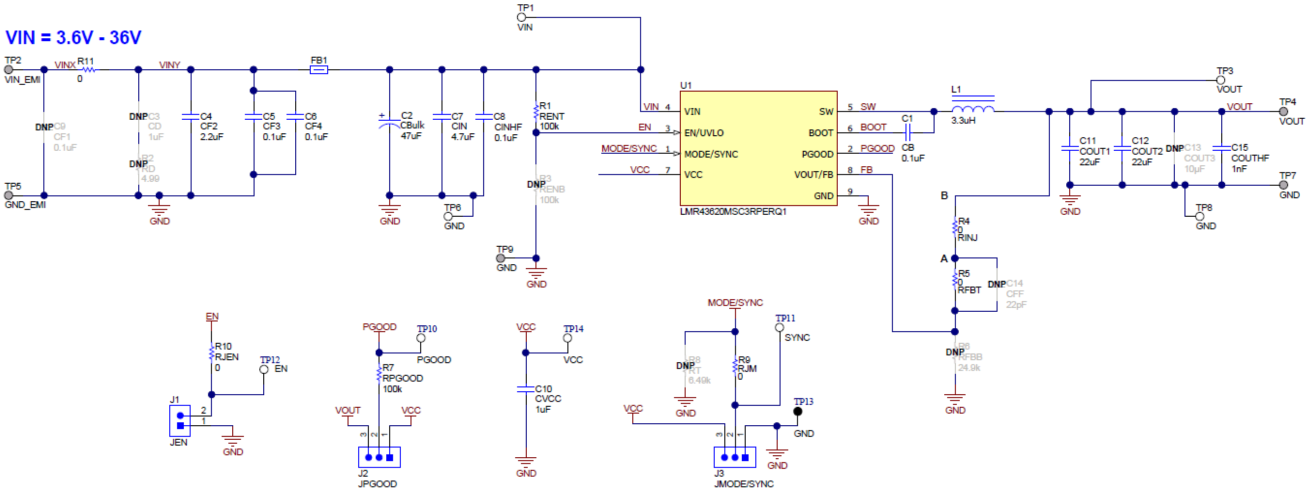


Figure 4-1. LMR43606MQ3EVM -2M Schematic

4.2 PCB Layout

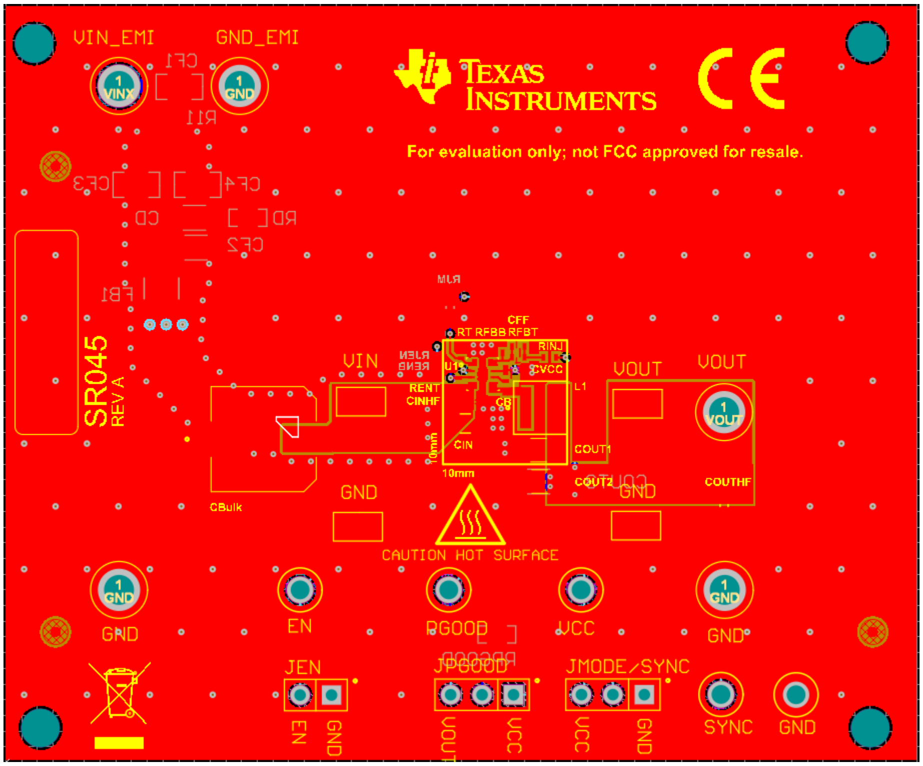


Figure 4-2. Top View of EVM

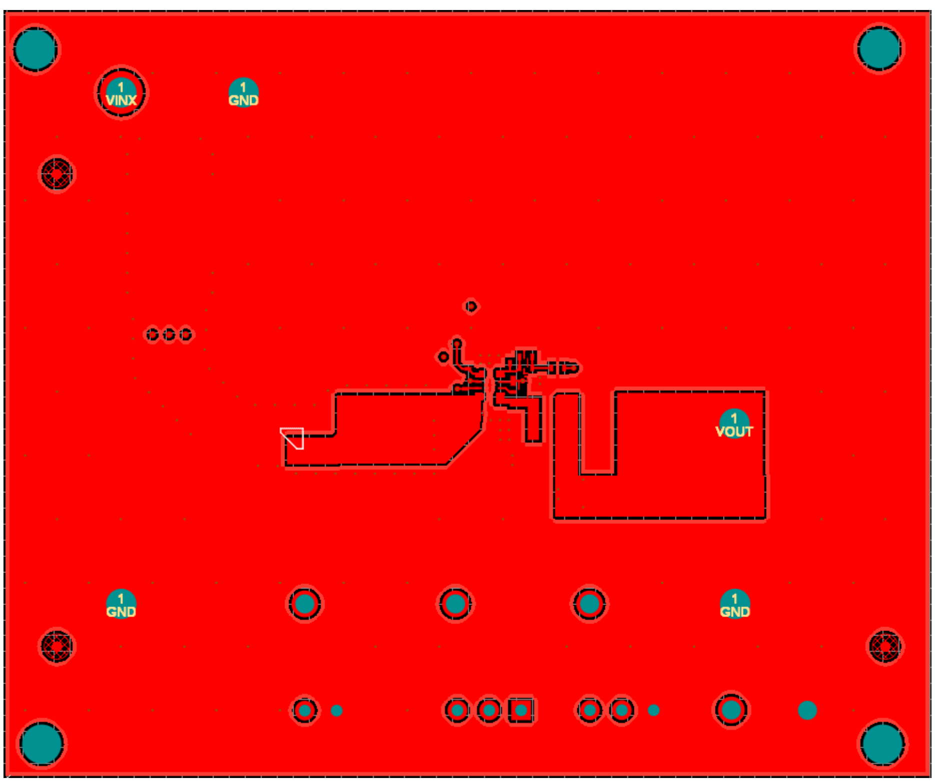


Figure 4-3. EVM Top Copper Layer

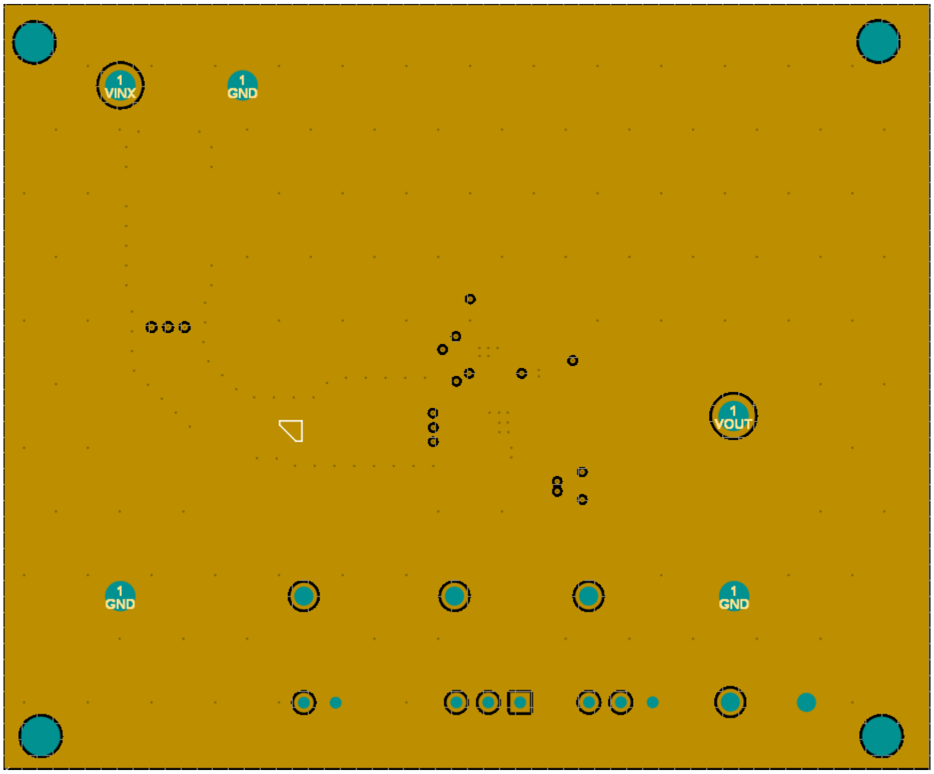


Figure 4-4. Mid-Layer One

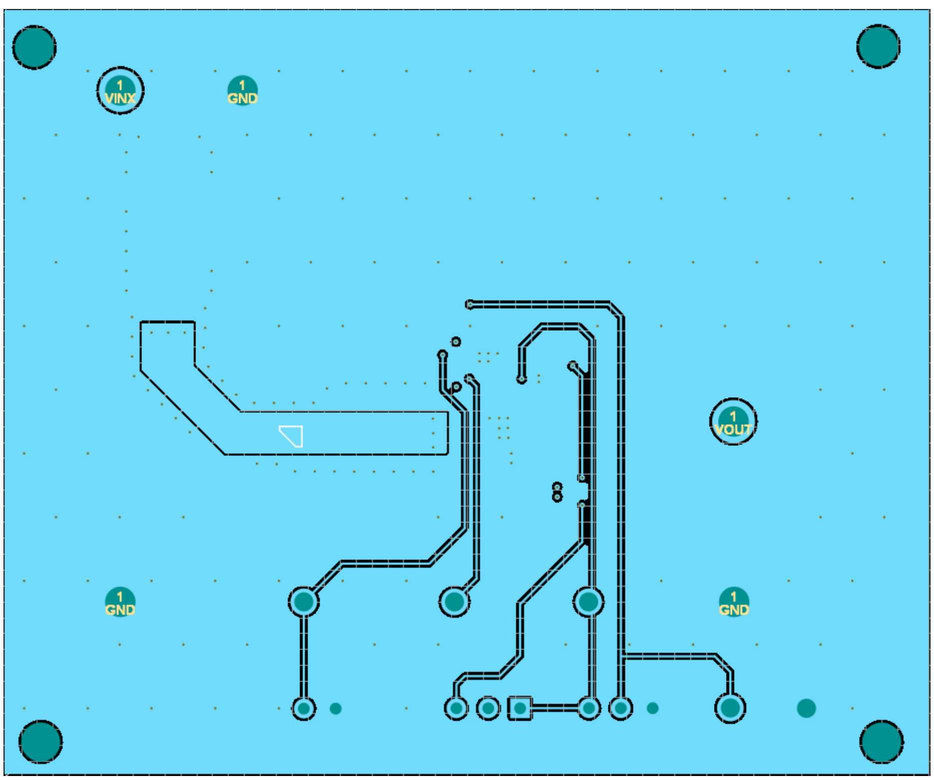


Figure 4-5. Mid-Layer Two

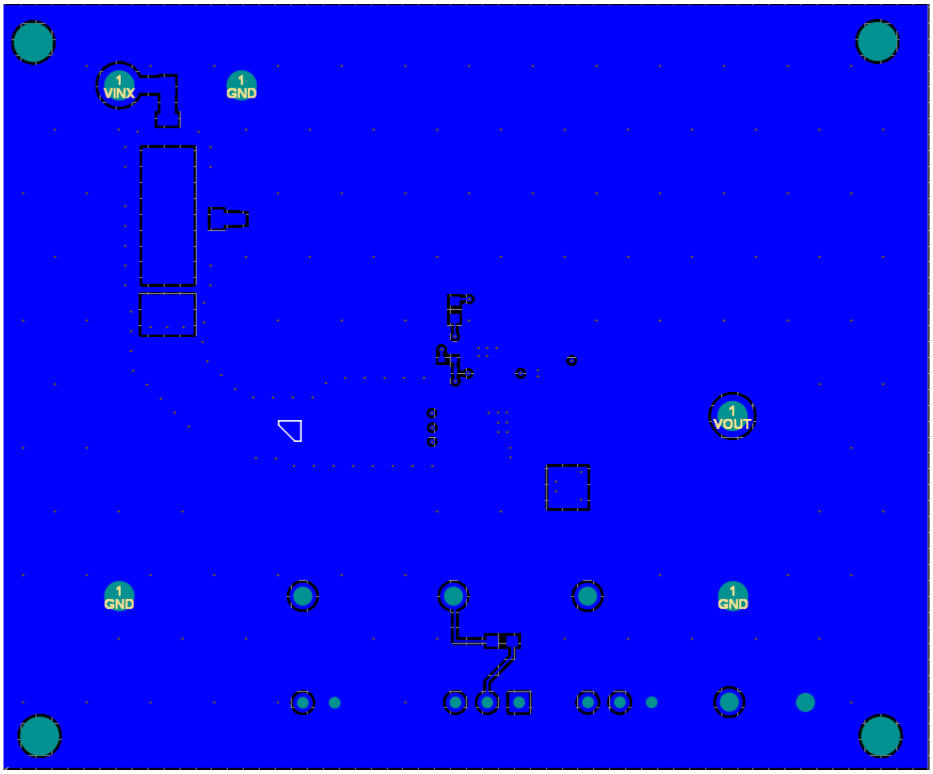


Figure 4-6. EVM Bottom Copper Layer

4.3 Bill of Materials

Table 4-1. Bill of Materials

DESIGNATOR	QTY	DESCRIPTION	COMMENT	MANUFACTURER	PART NUMBER
C1	1	CAP, CERM, 0.1µF, 25V, ±20%, X7R, 0402	CB	TDK	C1005X7R1E104M050BB
C2	1	CAP, AL, 47µF, 80V, ±20%, 1.3Ω, AEC-Q200, SMD	CBulk	Panasonic	EEE-FN1K470UP
C4	1	CAP, CERM, 2.2µF, 100V, ±10%, X7S, AEC-Q200 Grade 1, 1206	CF2	TDK	CGA5L3X7S2A225K160AB
C5, C6	2	CAP, CERM, 0.1µF, 100V, ±10%, X7R, AEC-Q200 Grade 1, 0805	CF3, CF4	TDK	CGA4J2X7R2A104K125AA
C7	1	CAP, CERM, 4.7µF, 50V, ±10%, X7R, 1206	CIN	MuRata	GRM31CR71H475KA12L
C8	1	CAP, CERM, 0.1µF, 50V, ±10%, X7R, AEC-Q200 Grade 1, 0402	CINHF	MuRata	GCM155R71H104KE02D
C10	1	CAP, CERM, 1µF, 16V, ±10%, X7R, 0603	CVCC	Wurth Elektronik	885012206052
C11, C12	2	Chip Multilayer Ceramic Capacitors for General Purpose, 1206, 22µF, X6S, 22%, 10%, 25V	COUT1, COUT2	Murata	GRM31CC81E226KE11L
C15	1	CAP, CERM, 1000pF, 100V, ±10%, X7R, 0603	COUTHF	MuRata	GRM188R72A102KA01D
FB1	1	Ferrite Bead, 600Ω at 100MHz, 3A, 1210	FB1	Taiyo Yuden	FBMH3225HM601NT
J1	1	Header, 100mil, 2x1, Gold, TH	JEN	Samtec	HTSW-102-07-G-S
J2, J3	2	Header, 100 mil, 3x1, Gold, TH	JPGOOD, JMODE/SYNC	Samtec	HTSW-103-07-G-S
L1	1	Inductor, Shielded, Composite, 5.6µH, 2.0A, 0.032Ω, SMD	XGL4030-562MEC	Coilcraft	XGL4030-562MEC
LBL1	1	Thermal Transfer Printable Labels, 0.650" W × 0.200" H - 10,000 per roll	THT-14-423-10	Brady	THT-14-423-10
R1	1	RES, 100 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	RENT	Vishay-Dale	CRCW0402100KFKED
R4, R5, R10	3	RES, 0, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	RINJ, RFBT, RJEN	Vishay-Dale	CRCW04020000Z0ED
R7	1	RES, 100 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	RPGOOD	Vishay-Dale	CRCW0603100KFKEA
R9	1	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	RJM	Vishay-Dale	CRCW06030000Z0EA
R11	1	RES, 0, 1%, 0.5 W, 1206	RFILTJ	Keystone	5108
SH-J1	1	Shunt, 100 mil, Gold plated, Black	SNT-100-BK-G	Samtec	SNT-100-BK-G
TP1, TP3, TP6, TP8	4	Test Point, Miniature, SMT	VIN, VOUT, GND, GND	Keystone	5015
TP2, TP4, TP5, TP7, TP9	5	Terminal, Turret, TH, Double	VIN_EMI, VOUT, GND_EMI, GND, GND	Keystone	1502-2
TP10, TP11, TP12, TP14	4	Test Point, Multipurpose, White, TH	PGOOD, SYNC, EN, VCC	Keystone	5012
TP13	1	Test Point, Multipurpose, Black, TH	GND	Keystone	5011
U1	1	36V, 600mA Buck Converter with 1.5µA IQ in 2mm × 2mm HotRod QFN	LMR43606MSC3RPERQ1	Texas Instruments	LMR43606MSC3RPERQ1

5 Additional Information

5.1 Trademarks

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