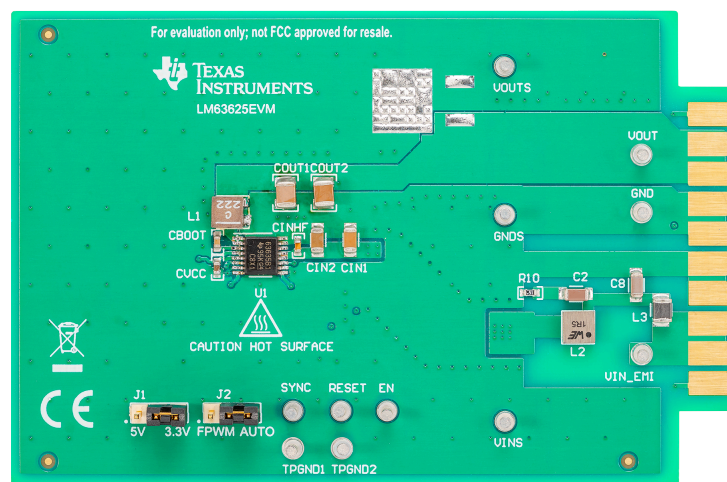![Texas Instruments logo]

LM63635EVM EVM User's Guide

The Texas Instruments LM63635EVM evaluation module (EVM) helps designers evaluate the operation and performance of the LM63635-Q1 buck regulator. The LM63635-Q1 is a family of easy-to-use synchronous step-down DC/DC converters capable of driving up to 3.25 A of load current from an input voltage of 3.5 V to 32 V. The LM63635EVM features a selectable output voltage of 3.3 V or 5 V and a switching frequency of 400 kHz. See the *LM636x5-Q1 3.5-V to 36-V, 1.5-A, and 2.5-A Automotive Step-down Voltage Converter Data Sheet* for additional features, detailed description, and available options.

The EVM options are found in Table 1.

Table 1. Device and Package Configurations

EVM	DEVICE	FREQUENCY/OUTPUT CURRENT
LM63635EVM	LM63635DQPWPRQ1	400 kHz / 3.25 A

Contents

List of Figures

List of Tables

Trademarks

All trademarks are the property of their respective owners.

1 Setup

This section describes the test points and connectors on the EVM and how to properly connect, set up, and use the LM63635EVM. Either the test points on the top of the board or the card edge connector can be used for connections. See Figure 1 for the top of board connections and Figure 2 for the card edge connections. The following lists the functions of the connections:

VIN_EMI— Input supply to EVM. Connect to a suitable input supply. See the *LM636x5-Q1 3.5-V to 36-V, 1.5-A, and 2.5-A Automotive Step-down Voltage Converter Data Sheet* for input supply requirements.

GND— System ground

VOUT— Output of EVM. Connect to desired load.

VOUTS— Output voltage sense connection (do not use for current; sense only)

VINS— Input voltage sense connection (do not use for current; sense only)

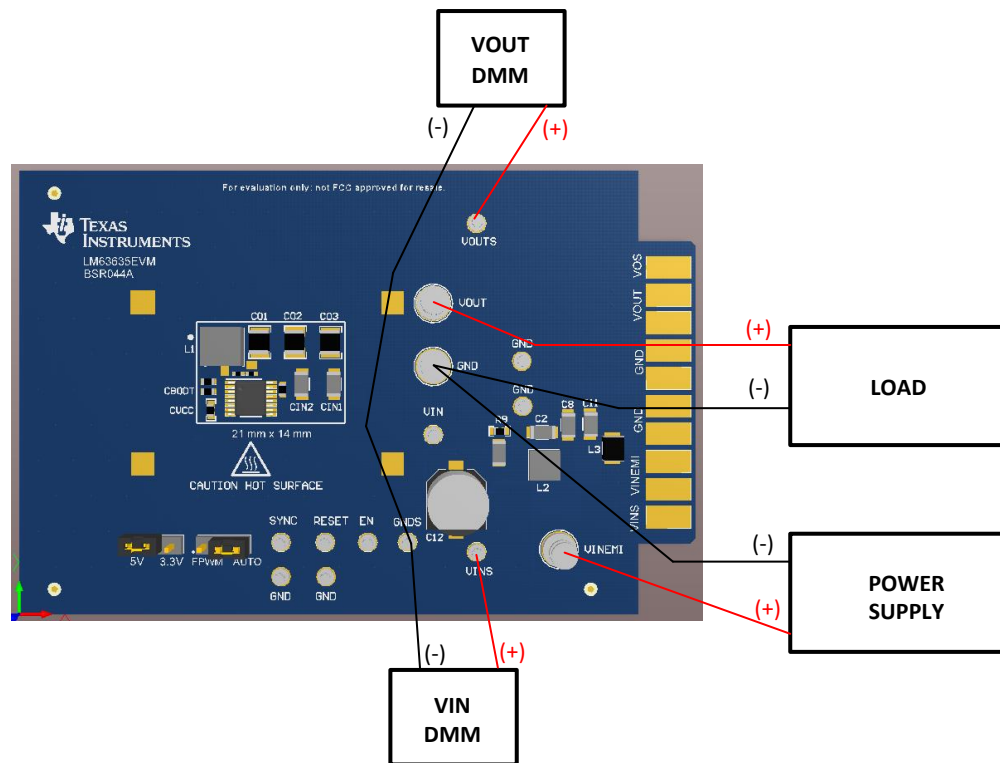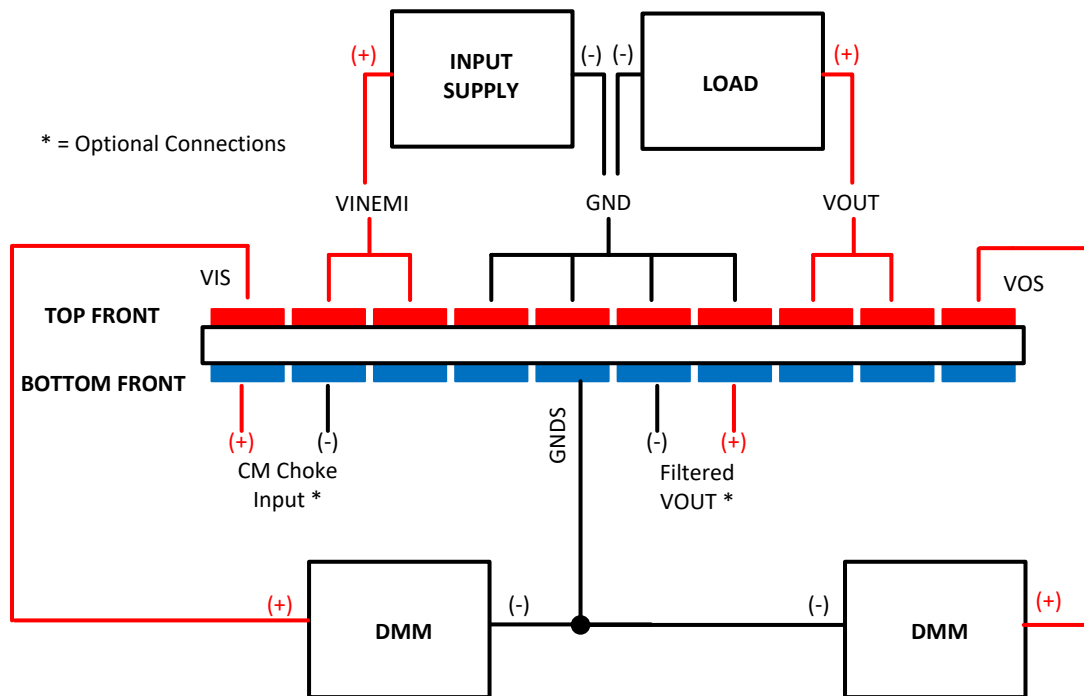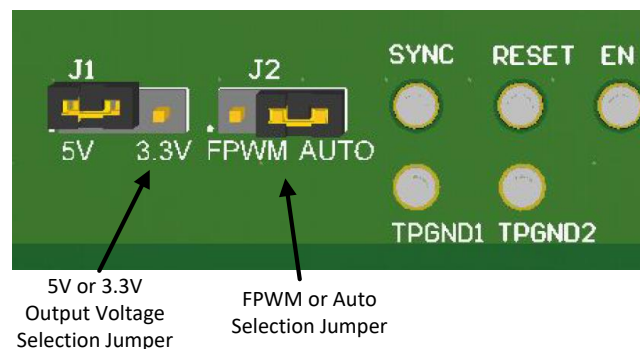**GNDS—** Ground sense point for analog measurements (do not use for current; sense only)

Figure 1. EVM Board Connections

Figure 2. EVM Card Edge Connections

1.1 Jumpers

See Figure 3 for jumper locations.

J1— This jumper allows the VOUT_SEL pin input to be connected to either VCC or GND for a fixed output voltage selection of 3.3 V or 5 V, respectively. Alternatively, the jumper can be left open and a $R_{VOUTSEL}$ can be populated with 10 kΩ to have the part operate with an adjustable output voltage. See the *LM636x5-Q1 3.5-V to 36-V, 1.5-A, and 2.5-A Automotive Step-down Voltage Converter Data Sheet* for feedback resistor calculation.

J2— This jumper allows SYNC to be connected in this mode to either VCC or GND. When connected to VCC, the part operates in forced pulse width modulation (FPWM) mode and when the SYNC pin is connected to GND, the part operates in auto mode where pulse frequency modulation (PFM) is engaged.

Figure 3. Jumper Locations

1.2 Test Points

- **VIN_EMI -** Input supply to EVM. Connect to a suitable input supply. See the *LM636x5-Q1 3.5-V to 36-V, 1.5-A, and 2.5-A Automotive Step-down Voltage Converter Data Sheet* for input supply requirements.
- **GND -** System power ground
- **VOUT -** Power output of EVM. Connect to desired load.
- **VOUTS -** Output voltage sense connection. Connect to DMM. It is also used for frequency response analyzer connection (do not use for current; sense only).
- **VINS -** Input voltage sense connection. Connect to DMM (do not use for current; sense only).
- **GNDS -** Ground sense point for analog measurements. Connect to DMM (do not use for current; sense only).
- **EN -** Connection for external EN logic input. Connect controlling logic to EN test point for external enable control.
- **RESET -** Connected to the $\overline{\text{RESET}}$ pin of the IC. It is used as a flag output. The reset function can be monitored at this test point. Pullup resistor, R_{PULLUP}, must be populated. A typical value for pullup resistor is 100 kΩ.
- **SYNC -** Connected to the SYNC pin of the IC. Connection to an external clock or synchronization signal enables the IC switching frequency to follow the synchronization signal.
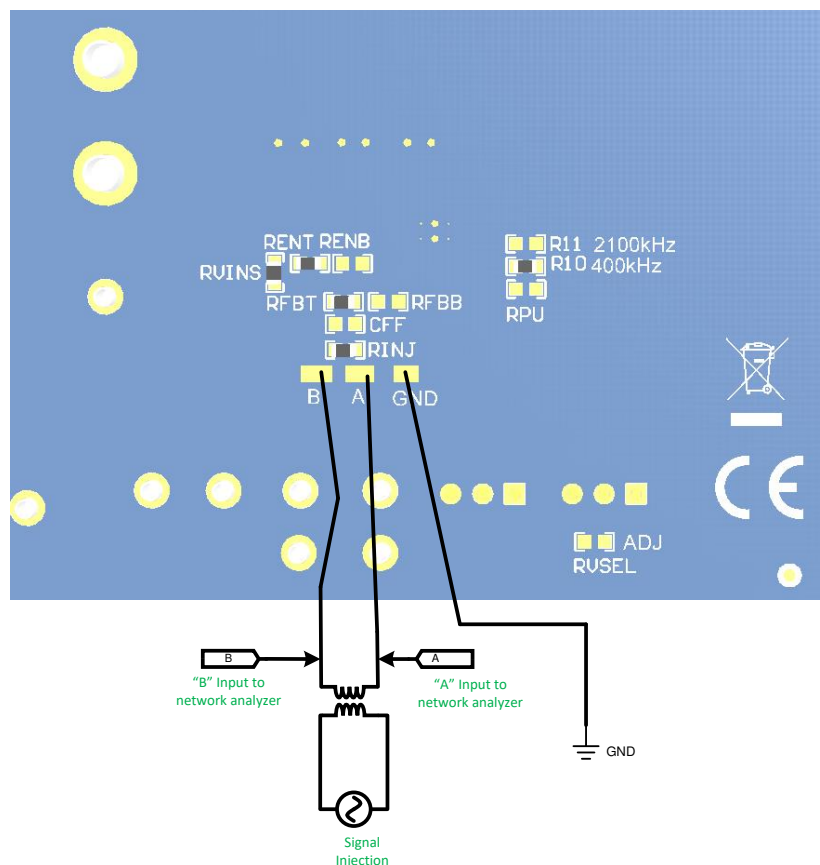- **TPGND1, TPGND2 -** System power ground

Figure 4. FRA Setup

2   Operation

Once the above connections are made and the appropriate jumpers are set, the EVM is ready to use. The EN pin is pulled up to VIN with a 100-kΩ resistor.

The output voltage of the EVM can be selected by the VOUT jumper to either 3.3 V or 5 V. Other values of output voltage can be programmed by removing the jumper on J1 before powering on the device and changing the value of R_{FBT} and R_{FBB} on the EVM. In addition, it is possible that the values of the inductor and the output capacitance need to be changed. See the *LM636x5-Q1 3.5-V to 36-V, 1.5-A, and 2.5-A Automotive Step-down Voltage Converter Data Sheet* for more information.
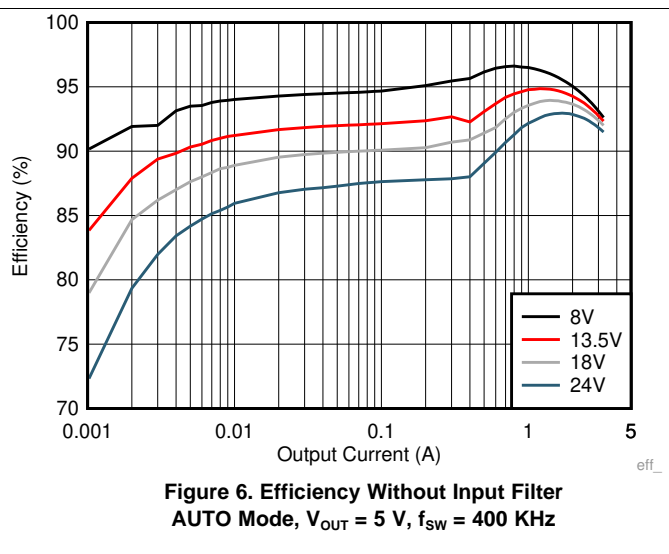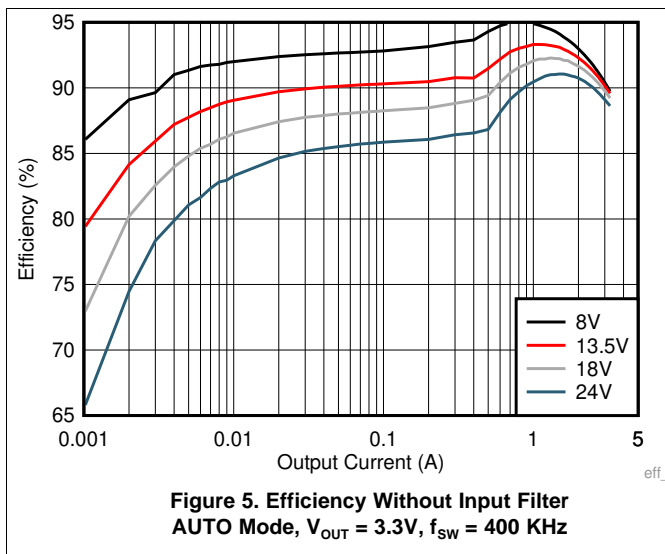
To us the $\overline{\text{RESET}}$ function, a pullup resistor is required. A place for this resistor is provided on the bottom of the PCB. Values of 10 kΩ to 100 kΩ are appropriate. Be sure to limit the voltage on this pullup to less than the specified Abs max for this pin.

The EVM is equipped with several EMI filter options. These are accessed through the edge connector as shown in Figure 2. Refer to Figure 2, Figure 7, and Table 2 for details.

Loop gain measurements can be made using the setup shown in Figure 4.

The EVM has been designed for maximum flexibility regarding component selection. This allows the user to place preferred components such as the inductor, the capacitors, or both, on the board and test the performance of the regulator. This way the power supply system can be tested before committing the design to production.

3   Performance Curves

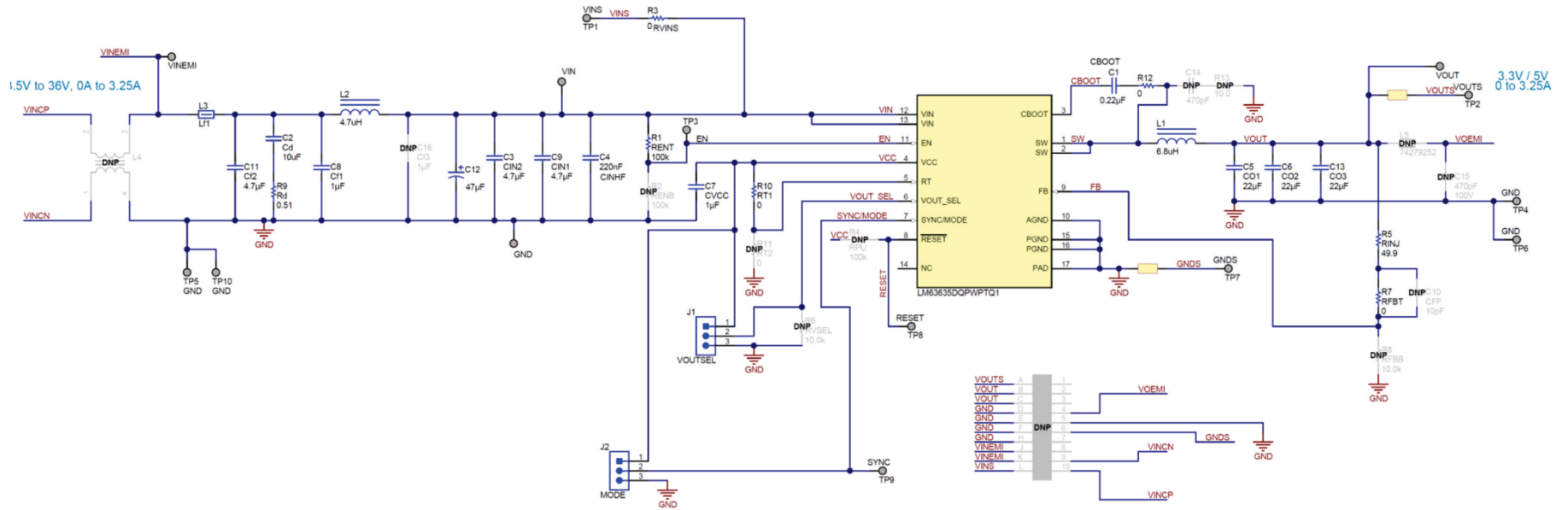**Figure 5. Efficiency Without Input Filter**
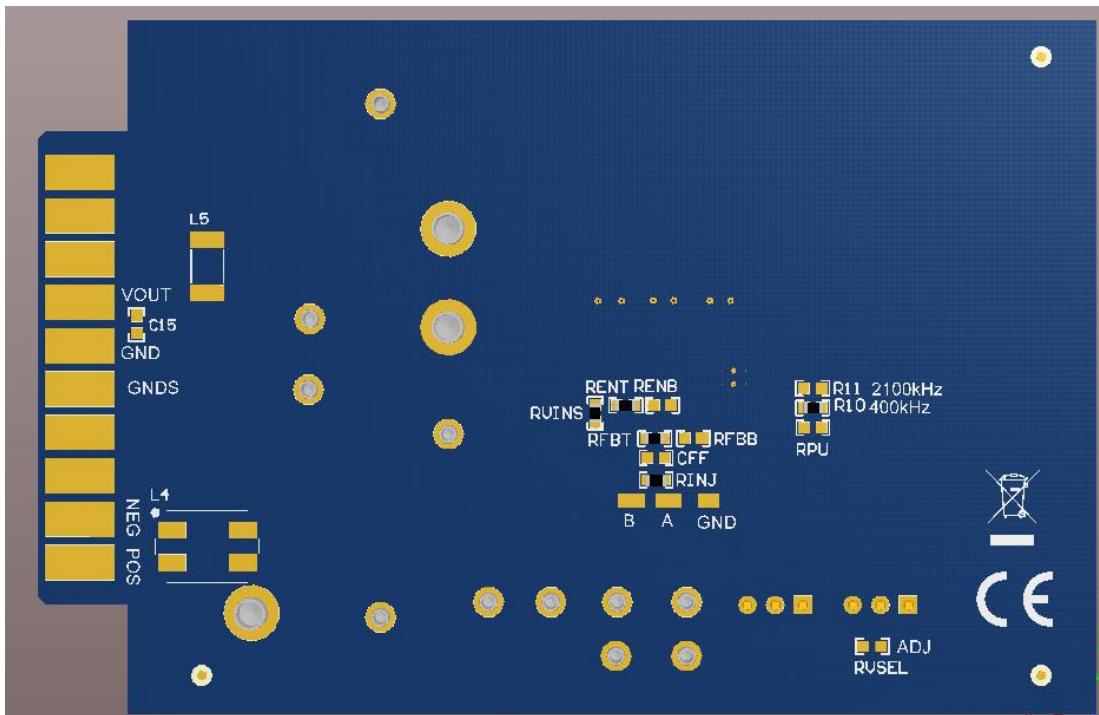**AUTO Mode, V_{OUT} = 3.3V, f_{SW} = 400 KHz**

Figure 6. Efficiency Without Input Filter
AUTO Mode, V_{OUT} = 5 V, f_{SW} = 400 KHz

4   Schematic

Figure 7. LM63635EVM Schematic

5 Board Layout

<table>
<tr><td colspan="2"><u>CAUTION</u></td></tr>
<tr><td></td><td>Caution Hot surface.
Contact may cause burns.
Do not touch.</td></tr>
</table>

Figure 8. Top View of EVM

Figure 9. Bottom View of EVM

Figure 10. EVM Top Copper Layer

Copyright © 2020, Texas Instruments Incorporated
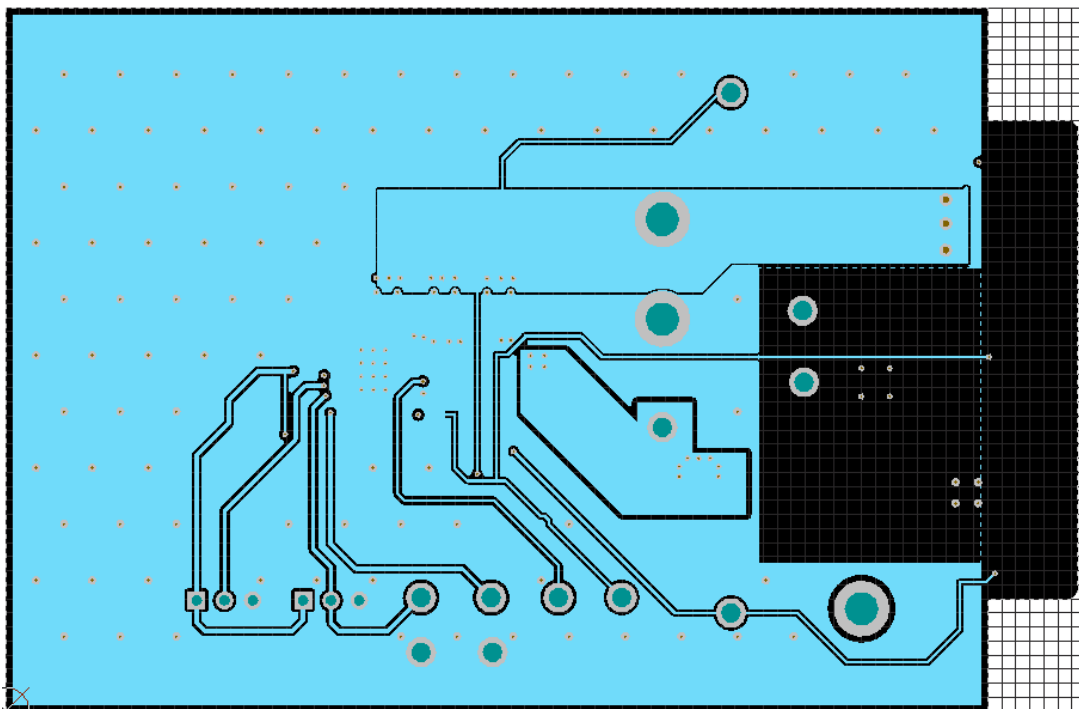
Figure 11. EVM Mid Layer One

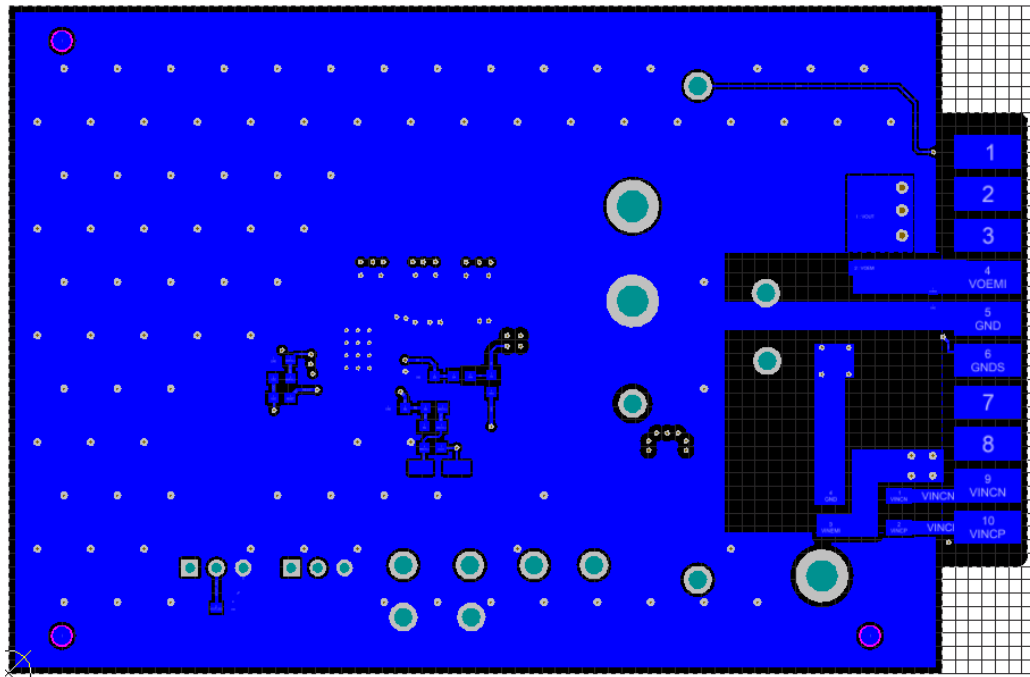**Figure 12. EVM Mid Layer Two**

Figure 13. EVM Bottom Copper Layer

6   Bill of Materials

Table 2. BOM for LM63635EVM

DESIGNATOR	COMMENT	DESCRIPTION	MANUFACTURER	PART NUMBER	QUANTITY
C1	CBOOT	CAP, CERM, 0.22 µF, 16 V, ±10%, X7R, AEC-Q200 Grade 1, 0603	Samsung	CL10B224KO8VPNC	1
C2	Cd	CAP, CERM, 10 µF, 50 V, ±10%, X5R, AEC-Q200 Grade 1, 1206	MuRata	GRT31CR61H106KE01L	1
C3, C9, C11	CIN2, CIN1, Cf2	CAP, CERM, 4.7 µF, 50 V, ±10%, X7R, AEC-Q200 Grade 1, 1206	TDK	CGA5L3X7R1H475K160AE	3
C4	CINHF	CAP, CERM, 0.22 uF, 50 V, ±10%, X7R, AEC-Q200 Grade 1, 0603	TDK	CGA3E3X7R1H224K080AB	1
C5, C6, C13	CO1, CO2, CO3	CAP, CERM, 22 µF, 16 V, ±20%, X7R, AEC-Q200 Grade 1, 1210	Taiyo Yuden	EMK325B7226MMHT	3
C7	CVCC	CAP, CERM, 1 µF, 16 V, ±10%, X7R, AEC-Q200 Grade 1, 0603	Taiyo Yuden	EMK107B7105KAHT	1
C8	Cf1	CAP, CERM, 1 µF, 50 V, ±10%, X7R, AEC-Q200 Grade 1, 1206	Taiyo Yuden	UMK316B7105KLHT	1
J1, J2	VOUTSEL, MODE	Header, 100 mil, 3x1, Gold, TH	Samtec	HTSW-103-07-G-S	2
L1	XAL5050-682MEB	Inductor, Shielded, Composite, 6.8 µH, 6 A, 0.03 Ω, SMD	Coilcraft	XAL5050-682MEB	1
L2	74438356047	Inductor, Shielded, Metal Composite, 4.7 µH, 2.9 A, 0.076 Ω, SMD	Wurth Elektronik	74438356047	1
L3	Lf1	Ferrite Bead, 600 Ω at 100 MHz, 3 A, 1210	Taiyo Yuden	FBMH3225HM601NT	1
R1	RENT	RES, 100 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW0603100KFKEA	1
R3, R7, R10	RVINS, RFBT, RT1	RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Stackpole Electronics Inc	RMCF0603ZT0R00	3
R5	RINJ	RES, 49.9, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW060349R9FKEA	1
R9	Rd	RES, 0.51, 1%, 0.1 W, AEC-Q200 Grade 1, 0603	Panasonic	ERJ-3RQFR51V	1
SH-J1, SH-J2	SNT-100-BK-G	Shunt, 100 mil, Gold plated, Black	Samtec	SNT-100-BK-G	2
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP8, TP9, TP10, TP11	VINS, VOUTS, VIN_EMI, EN, VOUT, GND, GND, GND, GND, GNDS, RESET, SYNC	Terminal, Turret, TH, Double	Keystone	1593-2	12
U1	LM63635DQPWPTQ1	3.5-V to 36-V, 3.5-A Synchronous Step-Down Voltage Regulator with Spread Spectrum, PWP0016D (TSSOP-16)	Texas Instruments	LM63635DQPWPTQ1	1
C10	CFF	CAP, CERM, 10 pF, 50 V, ±5%, C0G/NP0, 0603	MuRata	GRM1885C1H100JA01D	0
C12	CBULK1	CAP, AL, 47 µF, 63 V, ±20%, 1 Ω, AEC-Q200 Grade 1, SMD	Panasonic	EEETG1J470UP	1
FID1, FID2, FID3, FID4, FID5, FID6	Fiducial	Fiducial mark. There is nothing to buy or mount.	N/A	N/A	0
R2, R4	RENB, RPULLUP	RES, 100 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW0603100KFKEA	0
R6, R8	RVOUTSEL, RFBB	RES, 10.0 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW060310K0FKEA	0
R11	RT2	RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Stackpole Electronics Inc	RMCF0603ZT0R00	0
L4	Common Mode Choke	Coupled inductor, 0.015 Ω, AEC-Q200 Grade 1, SMD	TDK	ACM70V-701-2PL-TL00	0

Table 2. BOM for LM63635EVM (continued)

DESIGNATOR	COMMENT	DESCRIPTION	MANUFACTURER	PART NUMBER	QUANTITY
C16	Cf3	CAP, CERM, 1 µF, 50 V, ±10%, X7R, AEC-Q200 Grade 1, 1206	Taiyo Yuden	UMK316B7105KLHT	0
C14	CS	CAP, CERM, 470 pF, 50 V, ±10%, X7R, 0402	MuRata	GRM155R71H471KA01D	0
R13	RS	RES, 10.0, 1%, 0.063 W, 0402	KOA Speer	RK73H1ETTP10R0F	0
L5	Output filter L	Ferrite Bead, 880 Ω at 100 MHz, 4 A, 1812	Wurth Elektronik	74279252	0
C15	Output filter C	CAP, CERM, 470 pF, 100 V, ±10%, X7R, 0603	MuRata	GRM188R72A471KA01D	0

IMPORTANT NOTICE AND DISCLAIMER