User's Guide

LM63635QDRREVM EVM User's Guide

ABSTRACT

The Texas Instruments LM63635QDRREVM 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 LM63635-Q1 features a selectable output voltage of 3.3 V or 5 V and a switching frequency of 2.1 MHz. See the *LM63635-Q1 3.5-V to 32-V, 3.25-A, Automotive Step-down Voltage Converter Data Sheet* for additional features, detailed description, and available options.

The EVM options are found in Table 1-1.

Table 1-1. Device and Package Configurations

EVM	DEVICE	OUTPUT CURRENT	SWITCHING FREQUENCY	PACKAGE
LM63635QDRREVM	LM63635DQDRRQ1	3.25 A	2.1 MHz	DRR0012 (WSON)

Figure 1-1. LM63635QDRREVM Board Image

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1 Setup

This section describes the test points and connectors on the EVM and how to properly connect, set up, and use the LM63635QDRREVM. Either the banana jacks on the top of the board or the card edge connector can be used for connections. See Figure 1-1 for the top of board connections and Figure 1-2 for the card edge connections. 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 details. The following lists the functions of the connections:

VINEMI Input supply to EVM. Connect to a suitable input supply.

GND System ground.

VOUT Output of EVM. Connect to desired load.

VOS Output voltage sense connection (do not use for power; sense only).

VIS Input voltage sense connection (do not use for power; sense only).

GNDS Ground sense point for analog measurements (do not use for power; sense only).

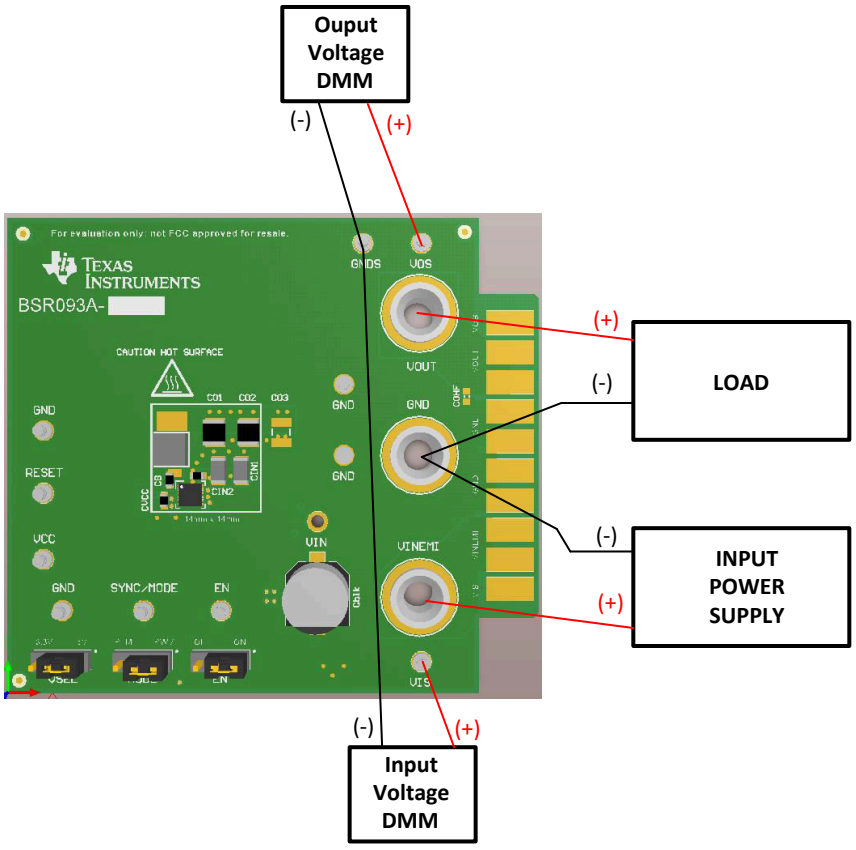

Figure 1-1. EVM Board Connections

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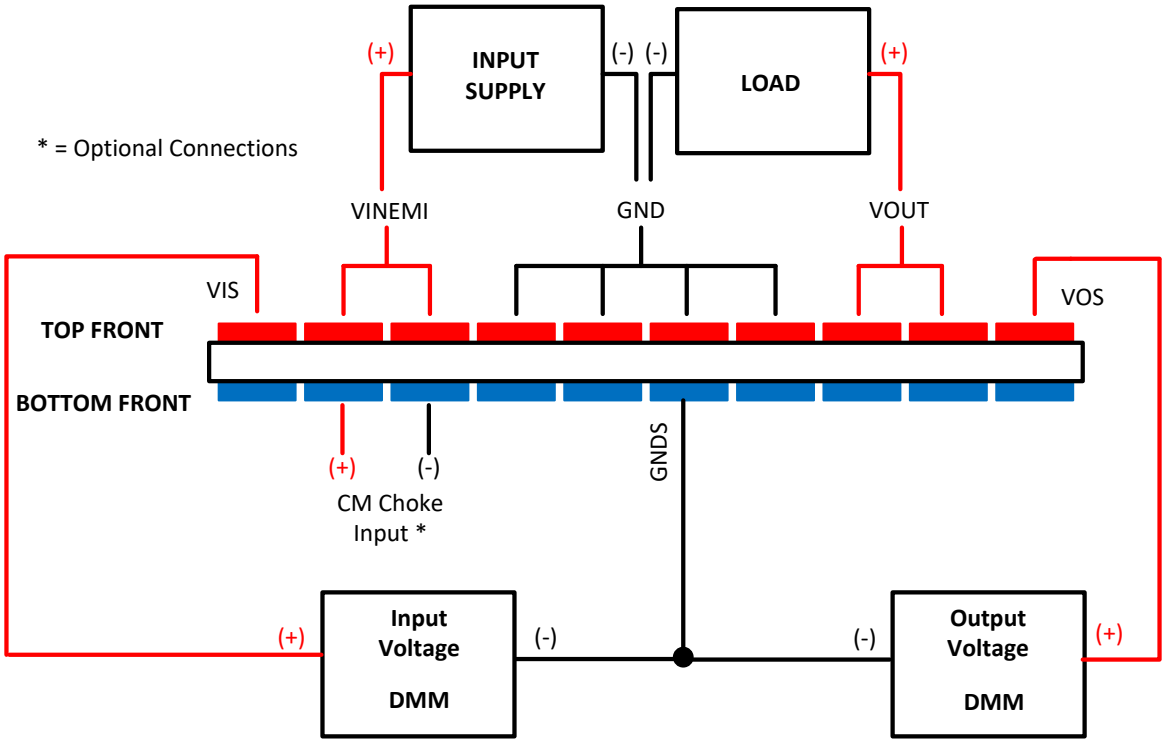

Figure 1-2. EVM Card Edge Connections

1.1 Jumpers

See Figure 1-3 for jumper locations.

VSEL This jumper allows output voltage selection of either 3.3 V or 5 V. See Section 2 for details.

MODE This jumper allows the selection of either AUTO mode or FPWM mode. In addition, by removing this jumper and supplying a clock signal to the SYNC/MODE test point, the device can by synchronized to an external clock.

EN This jumper turns the device on or off. In addition, by removing this jumper and supplying a signal to the EN test point, the device can be controlled externally.

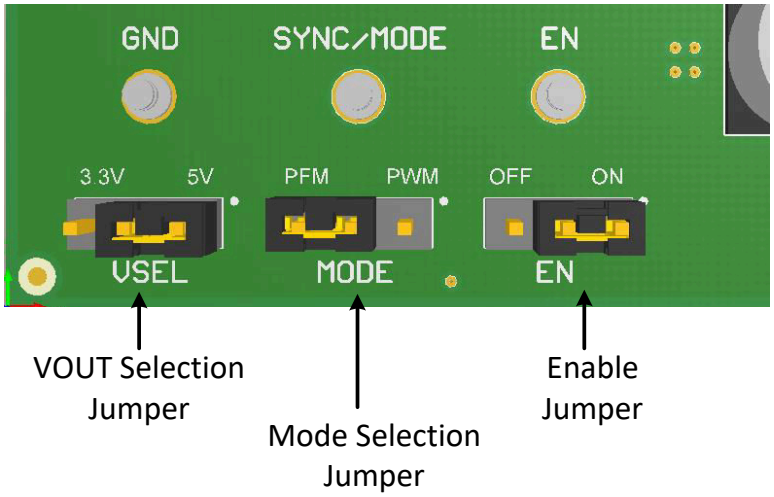

Figure 1-3. Jumper Locations

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1.2 Test Points

- **VINEMI -** Input supply to EVM. Connect to a suitable input supply.
- **GND -** System power ground.
- **VOUT -** Power output of EVM. Connect to desired load.
- **VOS -** Output voltage sense connection. Connect to DMM.
- **VINS -** Input voltage sense connection. Connect to DMM.
- **GNDS -** Ground sense point for analog measurements. Connect to DMM.
- **EN -** Connected to the EN input of the device.
- **$\overline{\text{RESET}}$ -** 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. Pull-up resistor, RPU, must be populated. A typical value for pullup resistor is 100 kΩ.
- **SYNC/MODE -** Connected to the SYNC/MODE pin of the IC.
- **VCC -** Connected to the VCC output of the device. Can be used for logic level pullups, if needed.
- **OPEN PADS -** Connections for frequency response analyzer (on bottom of board) to take Bode plots. See Figure 1-4 for details of connections.

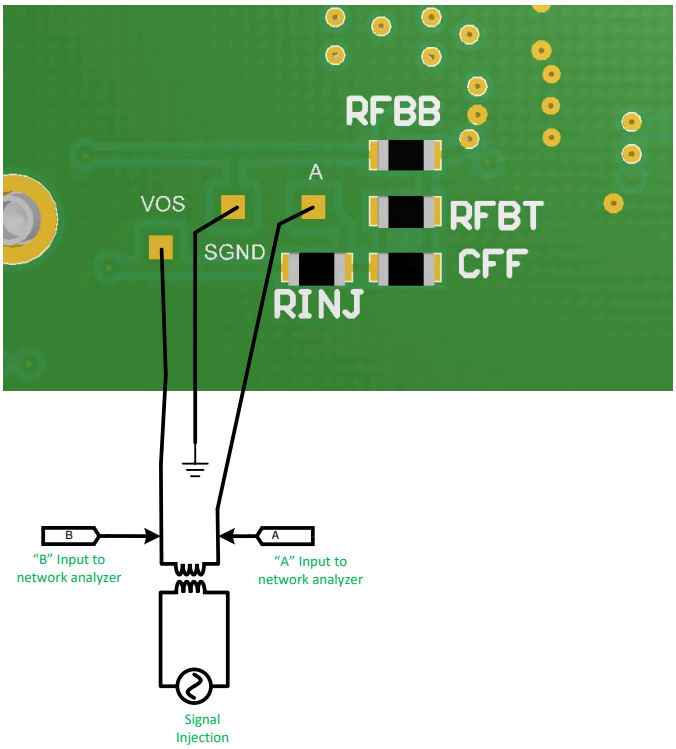

Figure 1-4. FRA Setup

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2 Operation

Once the above connections are made and the appropriate jumpers are set, the EVM is ready to use.

The output voltage of the EVM can be selected by the VSEL jumper to either 3.3 V or 5 V. EN must be cycled when the jumper is changed, in order for the selection to be programmed. Other values of output voltage can be set by removing the VSEL jumper and populating Radj (on bottom) with a 10 kΩ. Values for R_{FBT} and R_{FBB} are then selected and populated in the designated locations. 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.

The switching mode of the EVM can be changed by using the SYNC/MODE jumper; this selection can be made "on-the-fly".

To use the $\overline{\text{RESET}}$ function, a pullup resistor is required. A place for this resistor is provided on the bottom of the PCB (RPU). 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.

Some components in the EMI filter are not populated. The user is free to experiment with different EMI filter components as desired.

Loop gain measurements (Bode plots) can be made using the setup shown in Figure 1-4.

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

Curves showing typical efficiency data are found in Figure 3-1 and Figure 3-2. For other conditions and/or other data, consult the device data sheet.

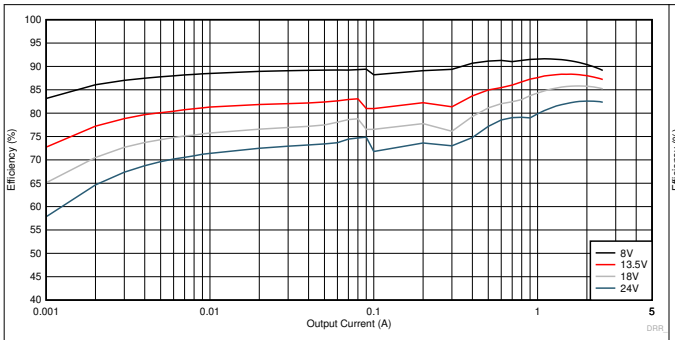

Figure 3-1. Efficiency AUTO Mode, V_{OUT} = 3.3 V, f_{SW} = 2100 KHz

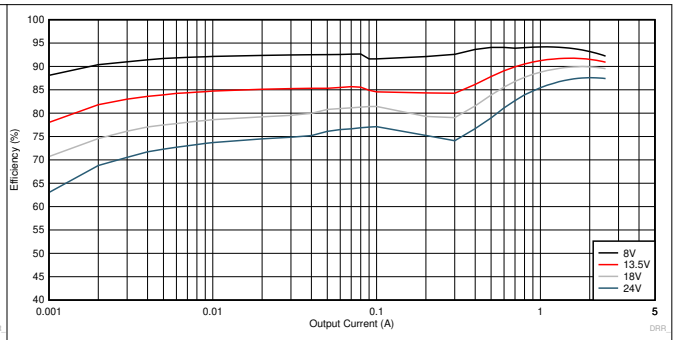

Figure 3-2. Efficiency AUTO Mode, V_{OUT} = 5 V, f_{SW} = 2100 KHz

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4 Schematic

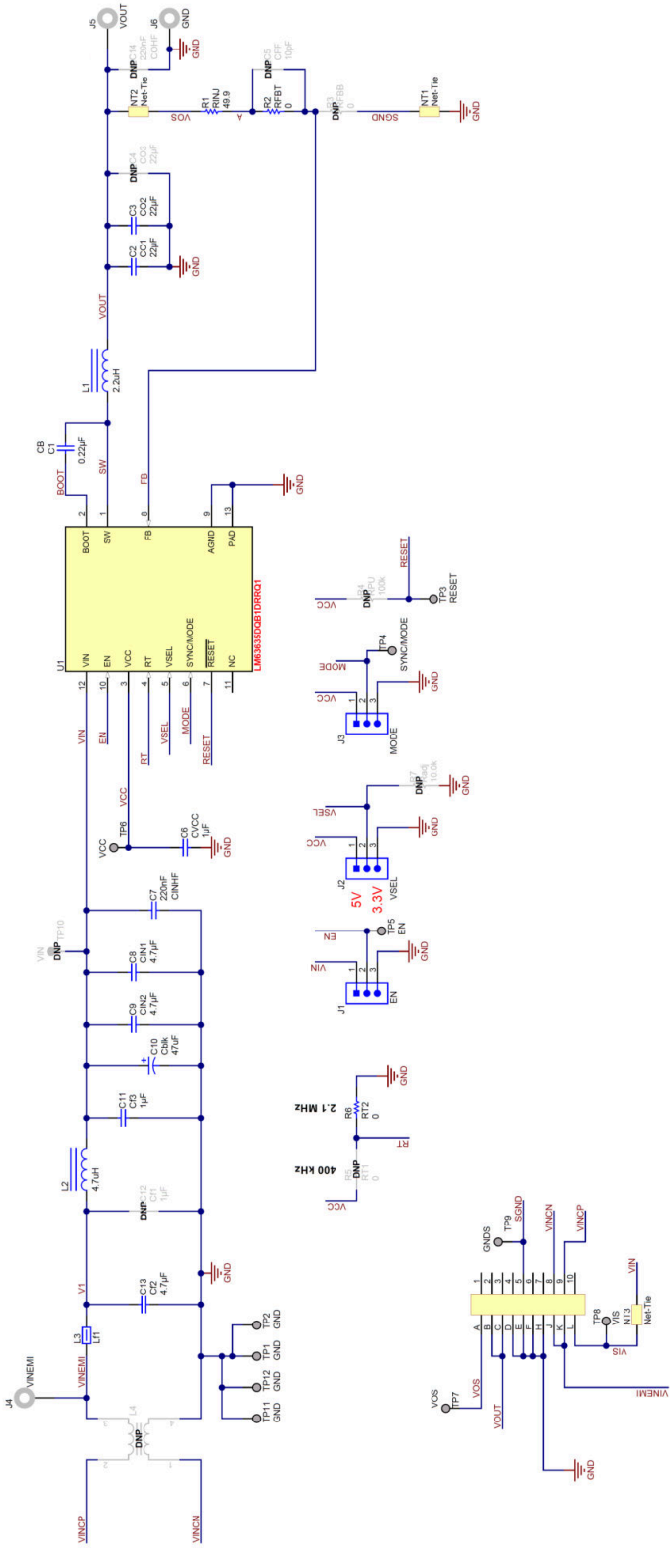

Figure 4-1. LM63635EVM Schematic

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5 Board Layout

CAUTION

Caution Hot surface.
Contact may cause burns.
Do not touch.

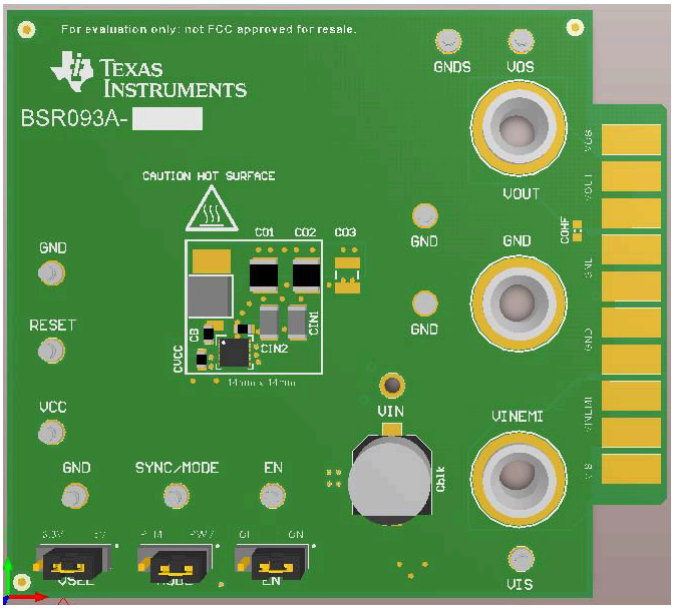

Figure 5-1. Top View of EVM

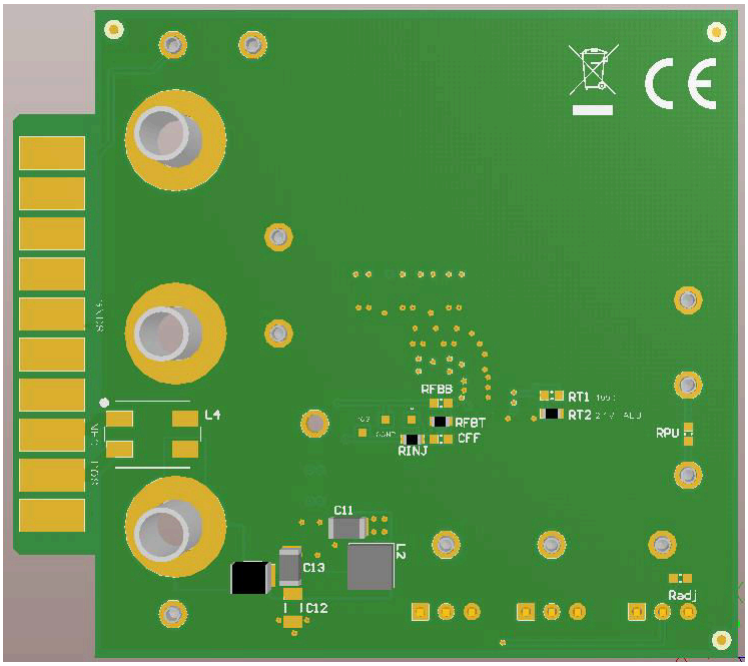

Figure 5-2. Bottom View of EVM

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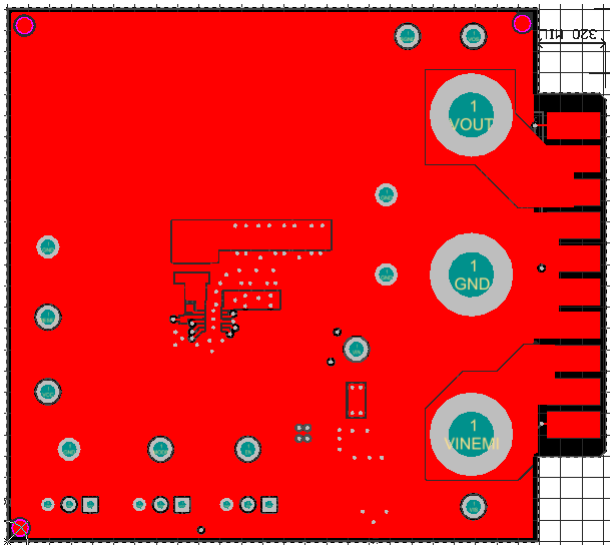

Figure 5-3. EVM Top Copper Layer

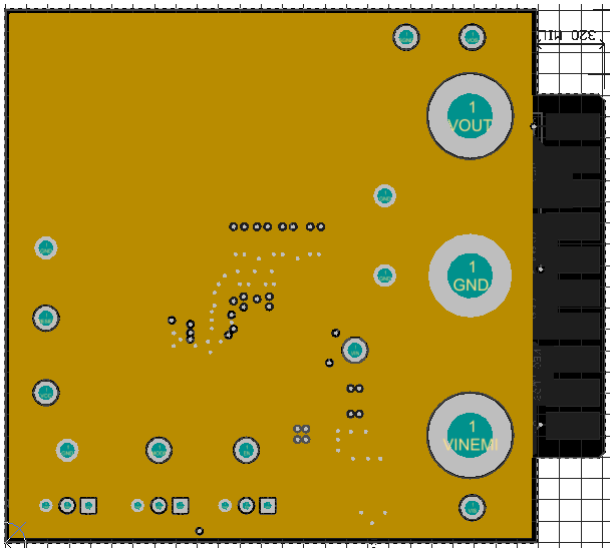

Figure 5-4. EVM Mid Layer One

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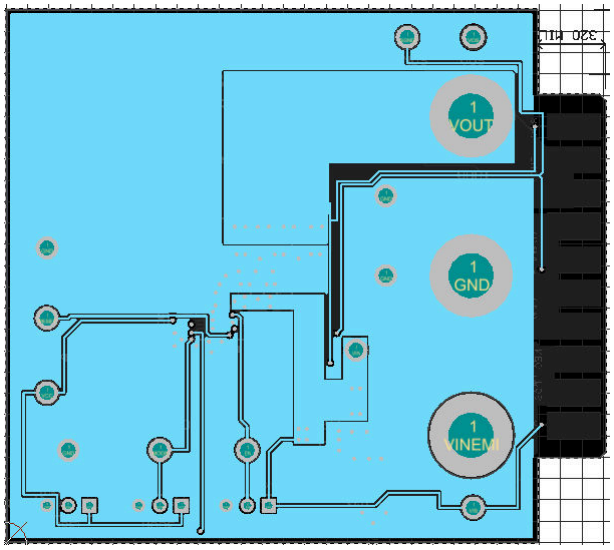

Figure 5-5. EVM Mid Layer Two

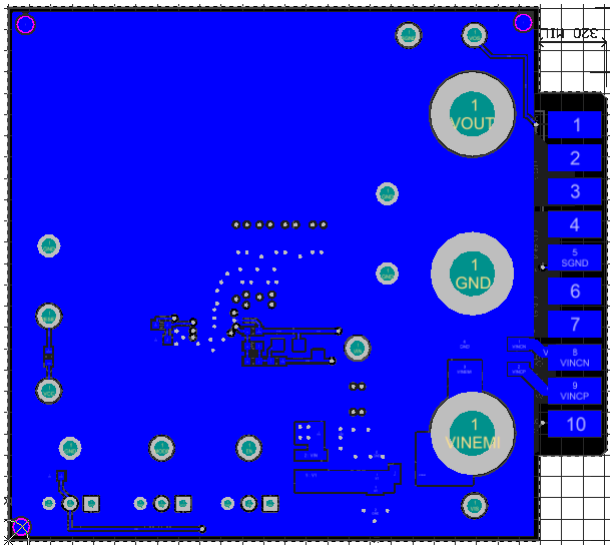

Figure 5-6. EVM Bottom Copper Layer

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6 Bill of Materials

Table 6-1. BOM for LM63635EVM

DESIGNATOR	COMMENT	DESCRIPTION	MANUFACTURER	PART NUMBER	QUANTITY
C1	CB	CAP, CERM, 0.22 µF, 16 V, ±10%, X7R, AEC-Q200 Grade 1, 0603	Samsung	CL10B224KO8VPNC	1
C2,C3	CO1,CO2	CAP, CERM, 22 µF, 16 V, ±20%, X7R, AEC-Q200 Grade 1, 1210	Taiyo Yuden	EMK325B7226MMHT	2
C6	CVCC	CAP, CERM, 1 µF, 16 V, ±10%, X7R, AEC-Q200 Grade 1, 0603	Taiyo Yuden	EMK107B7105KAHT	1
C7	CINHF	CAP, CERM, 0.22 µF, 50 V, ±10%, X7R, AEC-Q200 Grade 1, 0603	Kemet	CGA3E3X7R1H224K080AB	1
C8,C9,C13	CIN1, Cin2, Cf2	CAP, CERM, 4.7 µF, 50 V, ±10%, X7R, AEC-Q200 Grade 1, 1206	TDK	CGA5L3X7R1H475K160AE	3
C7	CVCC	CAP, CERM, 1 µF, 16 V, ±10%, X7R, AEC-Q200 Grade 1, 0603	TDK	EMK107B7105KAHT	1
C10	Cblk	CAP, AL, 47 µF, 63 V, ±20%, AEC-Q200 Grade 2, SMD	Panasonic	EEE-HA1J470UP	1
C11	Cf3	CAP, CERM, 1 µF, 50 V, ±10%, X7R, AEC-Q200 Grade 1, 1206	Taiyo Yuden	UMK316B7105KLHT	1
J1, J2, J3	EN, VSEL, SYNC/MODE	Header, 100 mil, 3x1, Gold, TH	Samtec	HTSW-103-07-G-S	3
L1	L1	Inductor, Shielded, Composite, 2.2 µH, 6.1 A, 0.0201 Ω, AEC-Q200 Grade 1, SMD	Coilcraft	XEL4030-222MEB	1
L2	Lf2	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	RINJ	RES, 49.9, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW060349R9FKEA	1
R2, R6	RT2, RFBT	RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Stackpole Electronics Inc	RMCF0603ZT0R00	2
R6	RINJ	RES, 49.9, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW060349R9FKEA	1
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP11	VINS, VOUTS, VIN_EMI, EN, VOUT, GND, TPGND2, TPGND1, GNDS, RESET, SYNC	Terminal, Turret, TH, Double	Keystone	1593-2	10
U1	LM63635DQB1DRRQ1	3.5-V to 32-V, 3.25-A, Automotive Step-down Voltage Converter, DRR0012E (WSON-12)	Texas Instruments	LM63635DQB1DRRQ1	1
C4	CO3	CAP, CERM, 22 µF, 16 V, ±20%, X7R, AEC-Q200 Grade 1, 1210	Taiyo Yuden	EMK325B7226MMHT	0
C5	CFF	CAP, CERM, 10 pF, 50 V, ±5%, C0G/NP0, 0603	MuRata	GRM1885C1H100JA01D	0
C12	Cf1	CAP, CERM, 1 µF, 50 V, ±10%, X7R, AEC-Q200 Grade 1, 1206	Taiyo Yuden	UMK316B7105KLHT	0
C14	COHF	CAP, CERM, 0.22 µF, 50 V, ±10%, X7R, AEC-Q200 Grade 1, 0603	TDK	CGA3E3X7R1H224K080AB	0
L4	L4	Coupled inductor, 0.015 Ω, AEC-Q200 Grade 1, SMD	TDK	ACM70V-701-2PL-TL00	0
R3, R5	RFFB, RT1	RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Stackpole Electronics Inc	RMCF0603ZT0R00	0
R4	RPU	RES, 100 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW0603100KFKEA	0
R7	Radj	RES, 10.0 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW060310K0FKEA	0

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