

ABSTRACT

The Texas Instruments LM63635DNEVM evaluation module (EVM) helps designers evaluate the operation and performance of the LM636x5CAQDRRQ1 buck regulator. The LM636x5CAQDRRQ1 is a family of easy-to-use synchronous step-down DC/DC converters capable of driving up to 3.5 A of load current from an input voltage of 3.5 V to 36 V. 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. Please note that this EVM is designed for the LM636x5CAQDRRQ1. This device has a different pin-out than the other devices in the LM636x5-Q1 product family.

Table 1-1. Device and Package Configurations

EVM	DEVICE	OUTPUT VOLTAGE	OUTPUT CURRENT	SWITCHING FREQUENCY	PACKAGE
LM63635DNEVM	LM63635CAQDRRQ1	5 V	3.25 A	2.1 MHz	DRR0012 (WSON)



Figure 1-1. LM63635DNEVM Board Image

Table of Contents

1 Setup	3
2 Operation	6
3 Performance Curves	6
4 Schematic	7
5 Board Layout	8
6 Bill of Materials	10

List of Figures

Figure 1-1. LM63635DNEVM Board Image.....	1
Figure 1-1. EVM Board Connections.....	3
Figure 1-2. EVM Card Edge Connections.....	4
Figure 1-3. Jumper Locations.....	4
Figure 1-4. FRA Setup.....	5
Figure 3-1. Efficiency: AUTO Mode, $V_{OUT} = 5\text{ V}$, $f_{SW} = 2100\text{ kHz}$	6
Figure 3-2. Line and Load Regulation: AUTO Mode, $V_{OUT} = 5\text{ V}$, $f_{SW} = 2100\text{ kHz}$	6
Figure 4-1. LM63635DNEVM Schematic.....	7
Figure 5-1. Top View of EVM.....	8
Figure 5-2. Bottom View of EVM.....	8
Figure 5-3. EVM Top Copper Layer.....	9
Figure 5-4. EVM Mid Layer One.....	9
Figure 5-5. EVM Mid Layer Two.....	9
Figure 5-6. EVM Bottom Copper Layer.....	9

List of Tables

Table 1-1. Device and Package Configurations.....	1
Table 6-1. BOM for LM63625DNEVM.....	10

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 LM63635DNEVM. 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).

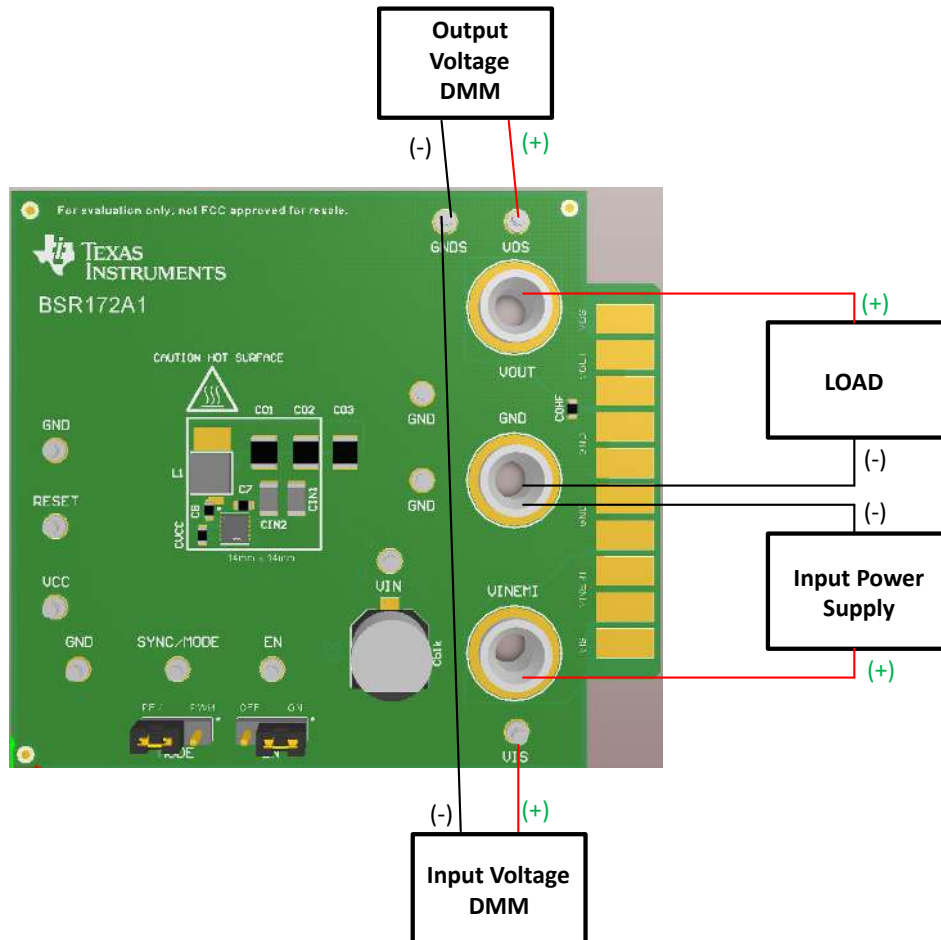


Figure 1-1. EVM Board Connections

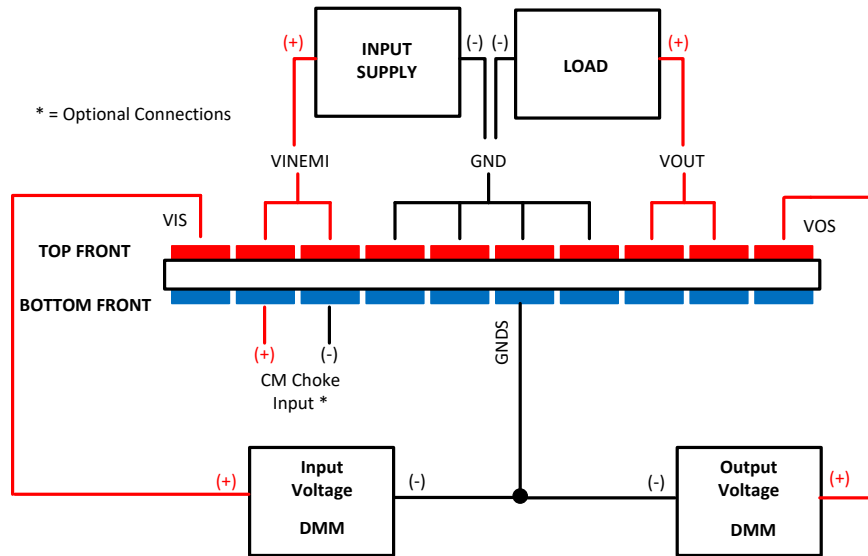


Figure 1-2. EVM Card Edge Connections

1.1 Jumpers

See [Figure 1-3](#) for jumper locations.

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 be 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.

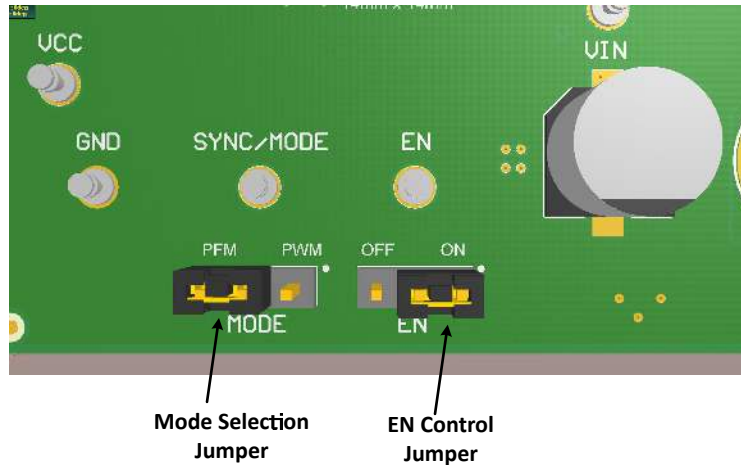


Figure 1-3. Jumper Locations

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.
- **RESET** - Connected to the RESET pin of the IC. It is used as a flag output. The reset function can be monitored at this test point.
- **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.

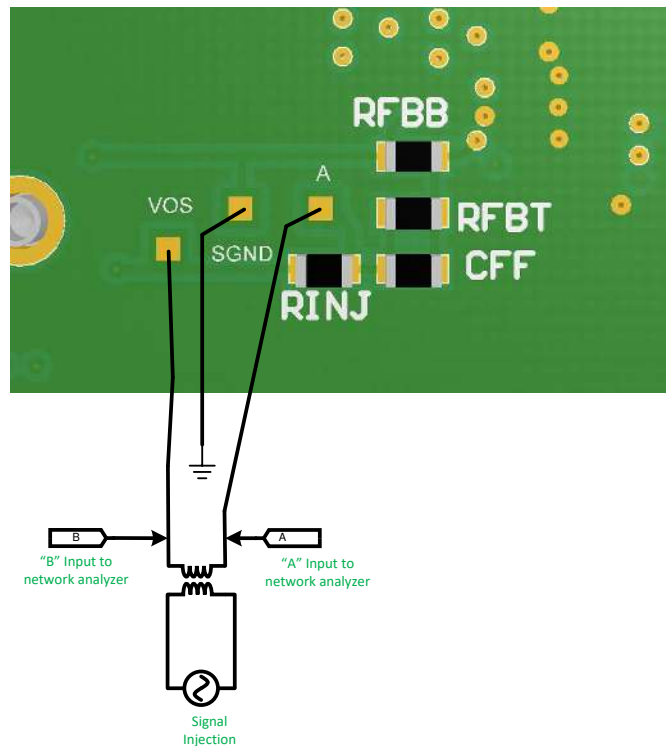


Figure 1-4. FRA Setup

2 Operation

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

The EVM is configured for a 5-V output. The output voltage can be changed by changing the values of resistors R2 (R_{FBT}) and or R3 (R_{FBB}). Depending on the output capacitors and the desired loop performance, a feed-forward capacitor, C5 (C_{FF}) can be desirable. A space is available on the EVM for this optional component. 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 MODE jumper; this selection can be made *on-the-fly*.

The $\overline{\text{RESET}}$ flag is used to indicate when the output voltage is within $\pm 5\%$ of the regulated value. This EVM is configured with a 100 k Ω pull-up resistor from $\overline{\text{RESET}}$ to VCC (about 5V). A low on $\overline{\text{RESET}}$ indicates the output voltage is out of regulation. The pull-up resistor can be removed and the open-drain $\overline{\text{RESET}}$ pin can be used to control a system processor from the EVM. Be sure to limit the voltage on the $\overline{\text{RESET}}$ 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 performance data are found in [Figure 3-1](#) and [Figure 3-2](#). For other conditions and/or other data, consult the device data sheet.

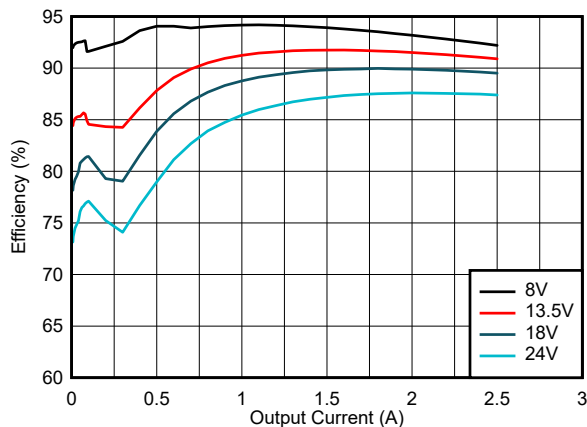


Figure 3-1. Efficiency: AUTO Mode, $V_{OUT} = 5\text{ V}$, $f_{sw} = 2100\text{ kHz}$

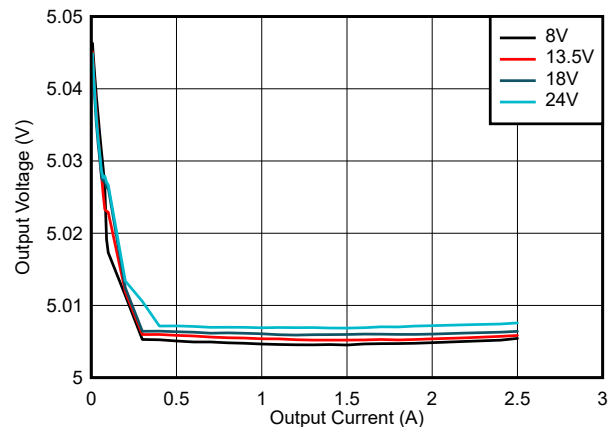


Figure 3-2. Line and Load Regulation: AUTO Mode, $V_{OUT} = 5\text{ V}$, $f_{sw} = 2100\text{ kHz}$

4 Schematic

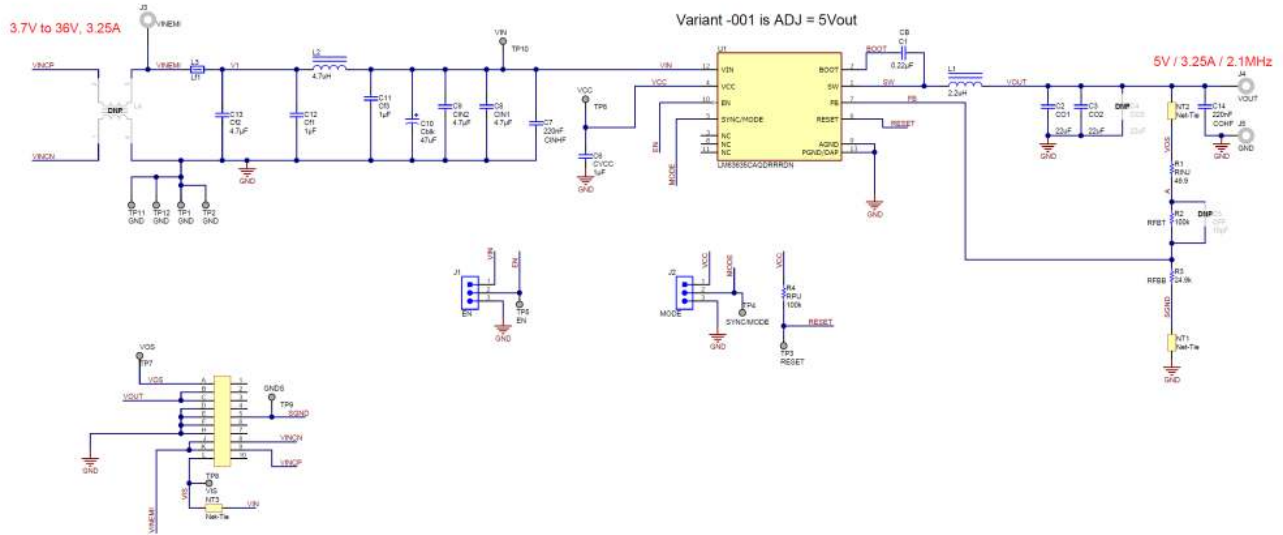



Figure 4-1. LM63635DNEVM Schematic

5 Board Layout



CAUTION

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

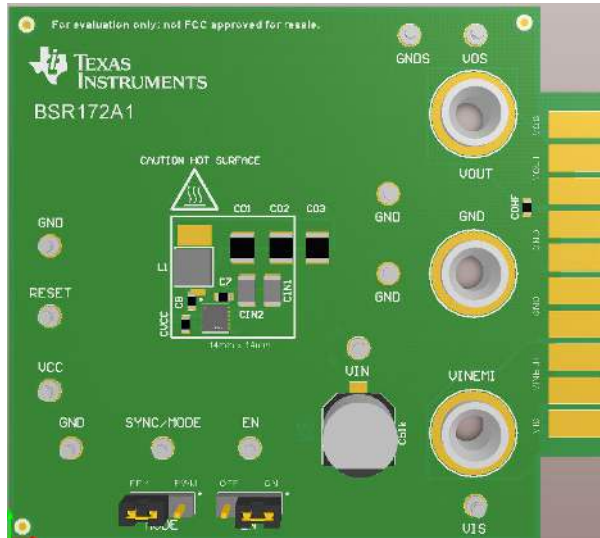


Figure 5-1. Top View of EVM

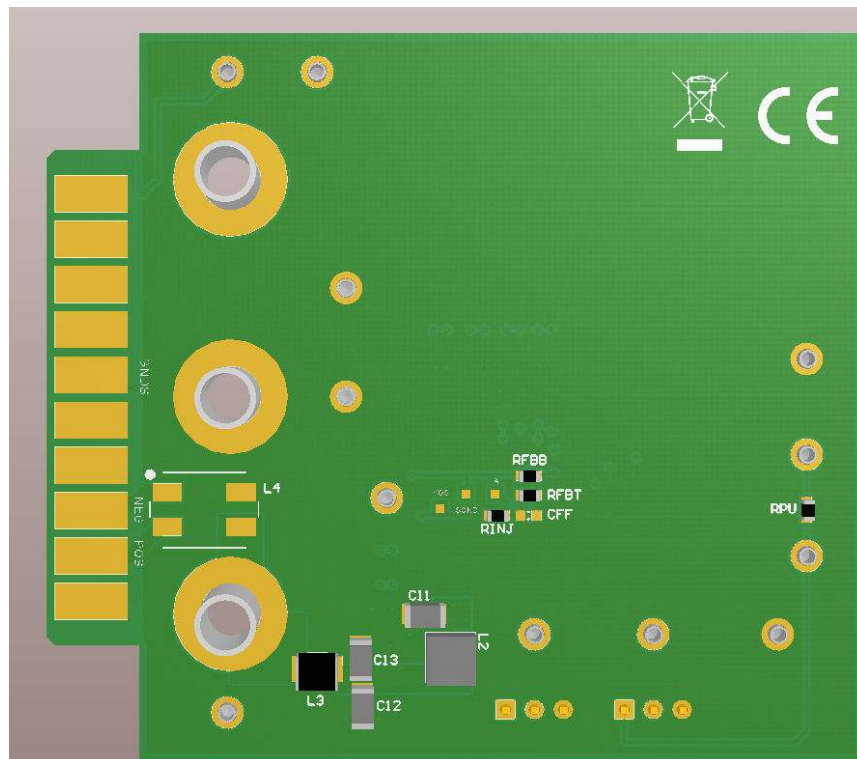


Figure 5-2. Bottom View of EVM

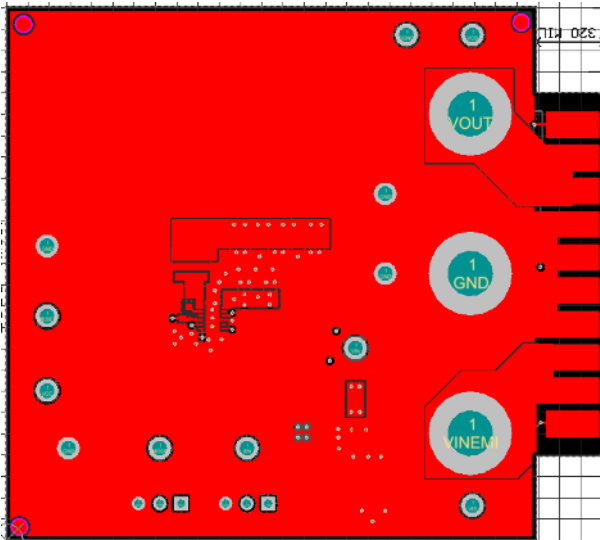


Figure 5-3. EVM Top Copper Layer

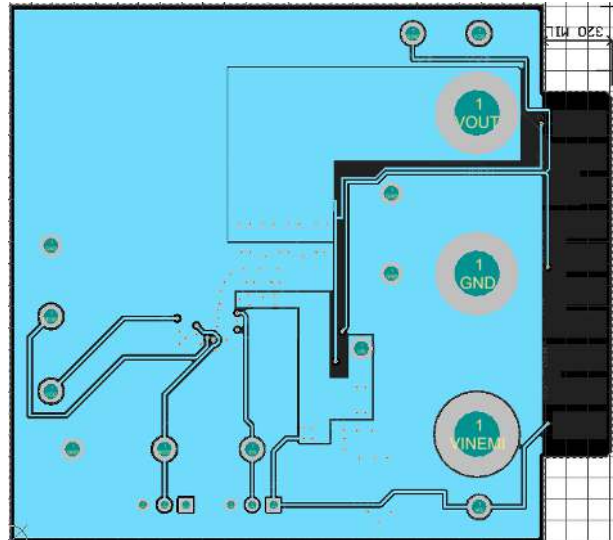


Figure 5-4. EVM Mid Layer One

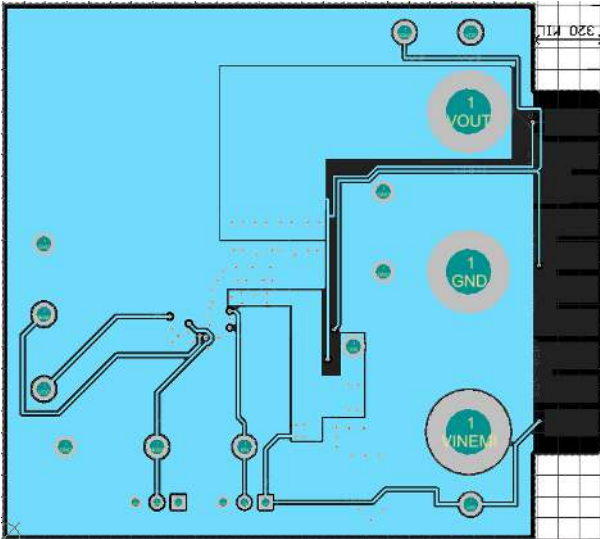


Figure 5-5. EVM Mid Layer Two

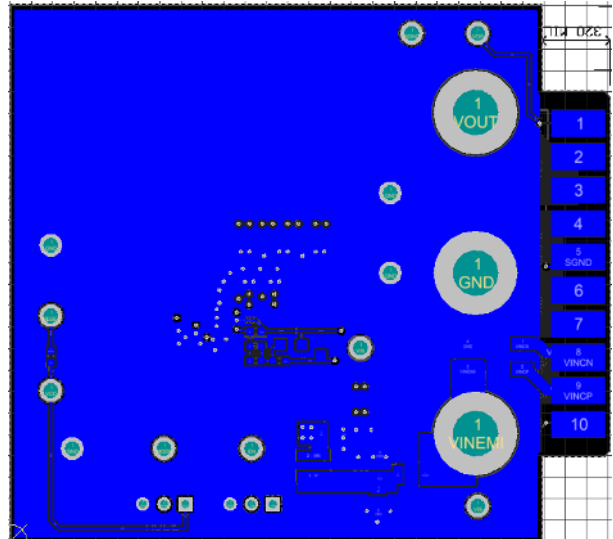


Figure 5-6. EVM Bottom Copper Layer

6 Bill of Materials

Table 6-1. BOM for LM63625DNEVM

DESIGNATOR	COMMENT	DESCRIPTION	MANUFACTURER	PART NUMBER	QUANTITY
C1	CB	CAP, CERM, 0.22 μ F, 16 V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	Samsung	CL10B224K08VPNC	1
C2,C3	CO1,CO2	CAP, CERM, 22 μ F, 25 V, +/- 20%, X7R, 1210	Taiyo Yuden	TMK325B7226MM-TR	2
C6	CVCC	CAP, CERM, 1 μ F, 16 V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	Taiyo Yuden	EMK107B7105KAHT	1
C7,C14	CINHF,COUTHF	CAP, CERM, 0.22 μ F, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	TDK	CGA3E3X7R1H224K080AB	2
C8,C9,C13	CIN1,CIN2,CF2	CAP, CERM, 4.7 μ F, 50 V,+/- 10%, X7R, AEC-Q200 Grade 1, 1206	TDK	CGA5L3X7R1H475K160AE	3
C10	CBLK	CAP, AL, 47 μ F, 63 V, +/- 20%, AEC-Q200 Grade 2, SMD	Panasonic	EEE-HA1J470UP	1
C11,C12	CF1,CF3	CAP, CERM, 1 μ F, 50 V,+/- 10%, X7R, AEC-Q200 Grade 1, 1206	Taiyo Yuden	UMK316B7105KLHT	2
J1, J2	EN, SYNC/MODE	Header, 100mil, 3x1, Gold, TH	Samtec	HTSW-103-07-G-S	2
J3, J4, J5	VOUT, VIN, GND	Standard Banana Jack, Uninsulated, 8.9mm	Keystone	575-8	3
L1	L1	Inductor, Shielded, Composite, 2.2 μ H, 6.1 A, 0.0201 ohm, AEC-Q200 Grade 1, SMD	Coilcraft	XEL4030-222MEB	1
L2	Lf2	Inductor, Shielded, Metal Composite, 4.7 μ H, 2.9 A, 0.076 ohm, SMD	Würth Elektronik	74438356047	1
L3	Lf1	Ferrite Bead, 600 Ω at 100 MHz, 3 A, 1210	Taiyo Yuden	FBMH3225HM601NT	1
L4	L4	Coupled inductor, 0.015 Ω , AEC-Q200 Grade 1, SMD	TDK	ACM70V-701-2PL-TL00	0
R1	RINJ	RES, 49.9, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW060349R9FKEA	1
R2,R4	RFBT,RPU	RES, 100 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW0603100KFKEA	2
R3	RFBB	RES, 24.9 k, 1%, 0.1 W, 0603	Yageo	RC0603FR-0724K9L	1
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12	VINS, VOUTS, VIN_EMI, EN, VOUT, GND, TPGND2, TPGND1, GNDS, RESET, SYNC	Terminal, Turret, TH, Double	Keystone	1593-2	12
SH-J1, SH-J2	EN, SYNC/MODE	Shunt, 100mil, Gold plated, Black	Samtec	SNT-100-BK-G	2
U1	LM63635CAQDRRRDN	3.5-V to 36-V, Automotive Step-down Voltage Converter	Texas Instruments	LM63635CAQDRRRDN	1

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2022, Texas Instruments Incorporated