LM43603DSU EVM User's Guide

Introduction

The Texas Instruments LM43603DSUEVM evaluation module (EVM) helps designers evaluate the operation and performance of the LM43603 VSON wide-input voltage Simple Switcher® buck regulator. The device offers configurability in a 1-V to 28-V output voltage, synchronous rectification and a 200-kHz to 2.2-MHz adjustable frequency range. It also offers external frequency synchronization, power good (PG) flag, and a precision enable to program undervoltage lockout (UVLO) and internal compensation. The LM43603DSUEVM is configured for an output voltage of 5 V and a switching frequency of 1 MHz. Refer to the LM43603 datasheet for additional features, detailed description and available options.

The EVM contains one DC-DC converter (See Table 1).

Table 1. Device and Package Configurations

CONVERTER	IC	PACKAGE
U1	LM43603	(DSU) VSON-16

Setup

This section describes the test points and connectors on the EVM and how to properly connect, set up and use the LM43603DSUEVM. Please refer to Figure 1 for a top view of the EVM and relative placement of the different test points and edge connector.

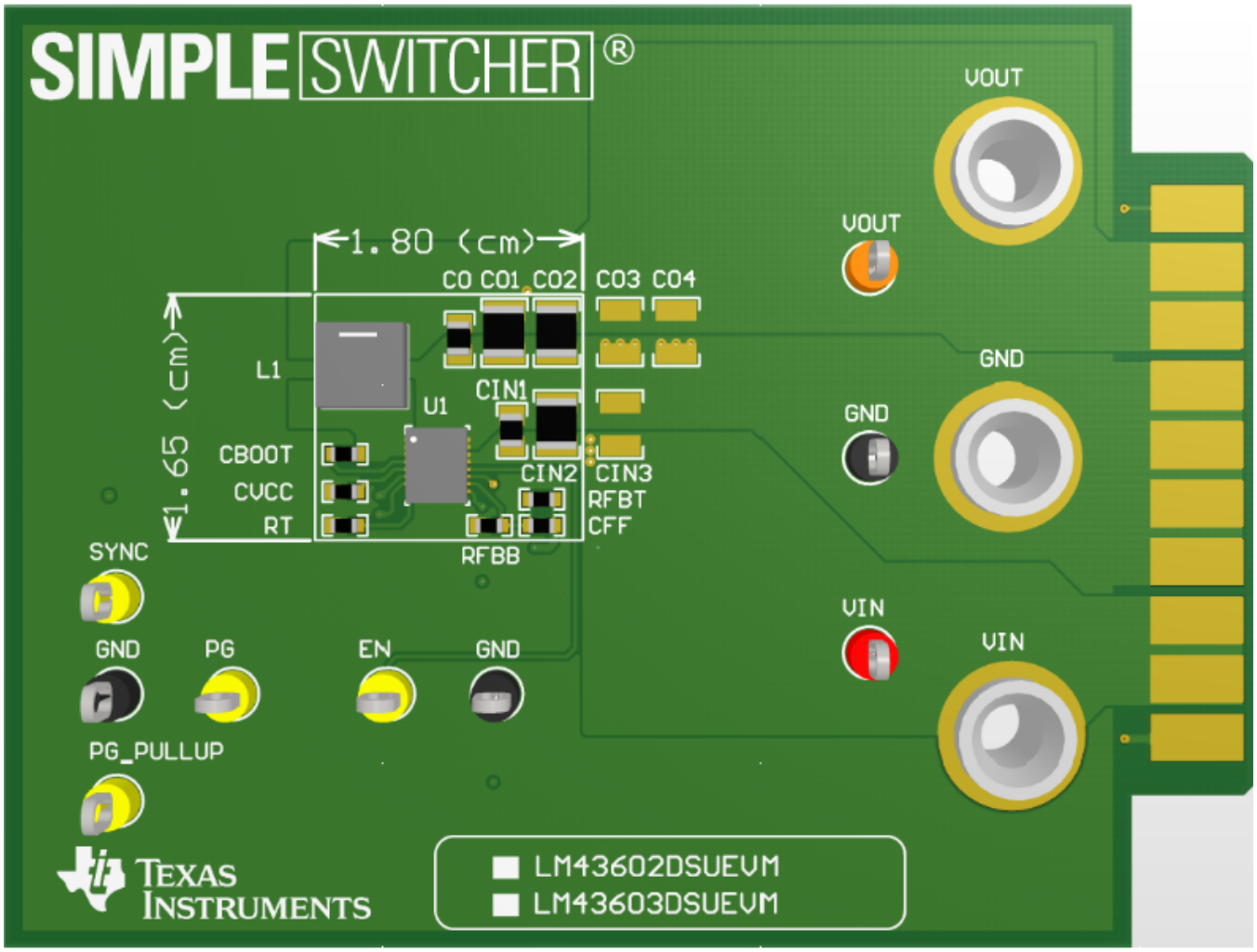

Figure 1. Top View of LM43603DSUEVM

1 Input/Output (I/O) Connector Description

VIN – Terminal—is the power input terminal for the converter. The terminal edge connector also provides a power (VIN) and ground (GND) connection to allow the user to attach the EVM to a cable harness.

VOUT – Terminal—is the regulated output voltage for the converter. The terminal edge connector also provides a power (VOUT) and ground (GND) connection to allow the user to attach the EVM to a cable harness.

GND – Terminal—are the ground reference for the converter. The terminal edge connector also provides a GND connection for attaching the EVM to a cable harness.

EN – Testpoint—is used to enable the converter by supplying a voltage greater than 2.2 V (typ) or just to monitor the voltage on this pin whenever a resistor divider is in place (for precision enable applications). The LM43603DSUEVM is built for a precision enable application with resistors RENT and RENB pre-assembled. The regulator will be enabled when VIN > 3.5 V. This threshold can be calculated by:

$$\text{Enable\_Voltage} = \text{VIH\_EN} \cdot \left(1 + \frac{\text{RENT}}{\text{RENB}}\right) \quad (1)$$

where

- VIH_EN is 2.2 V (typ)

PG – Testpoint—is used to monitor the power good flag. This flag indicates whether the output voltage has reached its regulation point. This pin is an open-drain output that requires a pullup resistor to the appropriate logic voltage (any voltage less than 14 V). A pre-installed resistor RPG1 of 100 kΩ is tied to the PG pin and brought out to the PG_PULL UP test point.

PG_PULL UP – Testpoint—is the top connection of the pre-assembled 100-kΩ RPG1 pullup resistor that ties directly to the open-drain PG pin. Supply an appropriate voltage to this test point, or tie it directly to the VOUT test point to observe the PG flag operation.

SYNC – Testpoint —is the input terminal for an optional external input clock to the converter. The external clock frequency must be between 200 kHz and 2.2 MHz, if used. A pulldown resistor of 100 kΩ (RSYNC) is installed on the EVM.

VIN_EMI – Edge Connector pin #9—is used to supply the input voltage through an on board LC filter (if one is needed for conducted EMI/EMC measurement). The Lin and Cd component pads are located on the bottom side of the EVM. Please refer to the EVM schematic for initial suggestion of component values.

2 Setup

Set the input voltage (VIN) range for the converter between the operating voltage range of 3.5 V to 36 V. If a load is driven, it should be applied to the VOUT terminal and should not exceed the maximum load current of 3 A.

3 Operation

For proper operation of the LM43603, VIN, GND, and VOUT should be properly configured as stated above. In this configuration, the device will start up when power is applied and the output voltage of the regulator (VOUT) will come up to the proper value. The default setting for output voltage of the LM43603DSUEVM is 5V. Other output voltages can be set by replacing the feedback pin resistor dividers RFBT and RFBB; please consult the datasheet for proper selection of these resistor values.

The default frequency for the LM43603DSUEVM is 1 MHz. If other frequencies are desired, within the frequency range of 200 kHz and 2.2 MHz, the RT resistor value can be changed. Please consult the datasheet for proper selection of the RT resistor. You must change inductor (L1) and total output capacitance for proper control loop operation.

Schematic

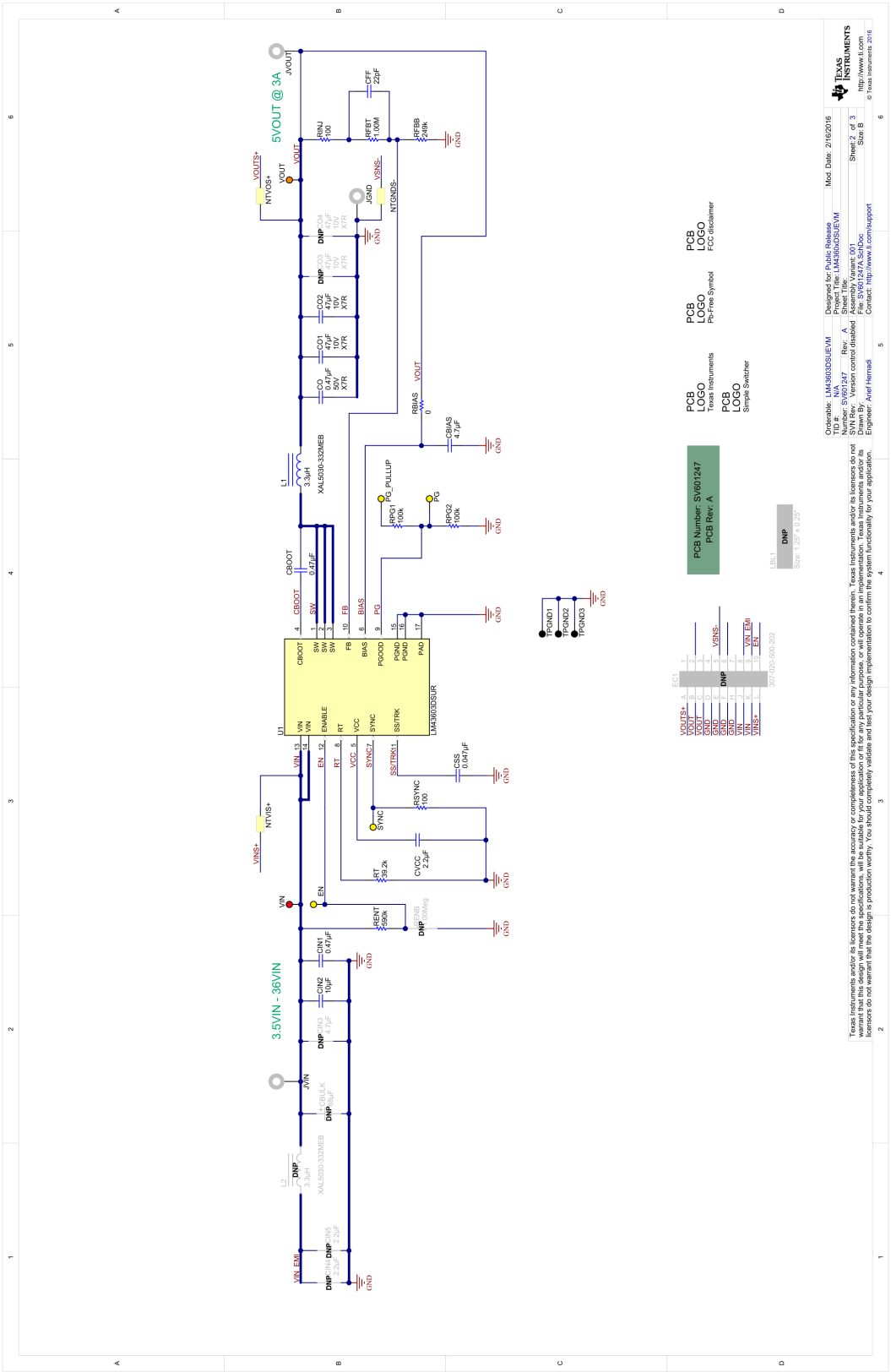

Figure 2. LM43603EVM Schematic

Board Layout

Figure 3 through Figure 7 show the board layout for the LM43603DSUEVM. The EVM offers resistors, capacitors and test points to configure the output voltage, precision enable pin, set frequency and external clock synchronization.

The DSU VSON-16 package offers an exposed thermal pad which must be soldered to the copper landing on the PCB for optimal thermal performance. The PCB consists of a 4-layer design. There are 2-oz copper planes on the top and bottom and 1-oz copper mid-layer planes to dissipate heat with an array of thermal vias under the thermal pad to connect to all four layers.

Test points have been provided for ease of use to connect the power supply, required load and to monitor critical signals. The 12-pin edge connector can also be used to facilitate the use of a cable harness if one is required (refer to the Table 2 section for mating connector part number).

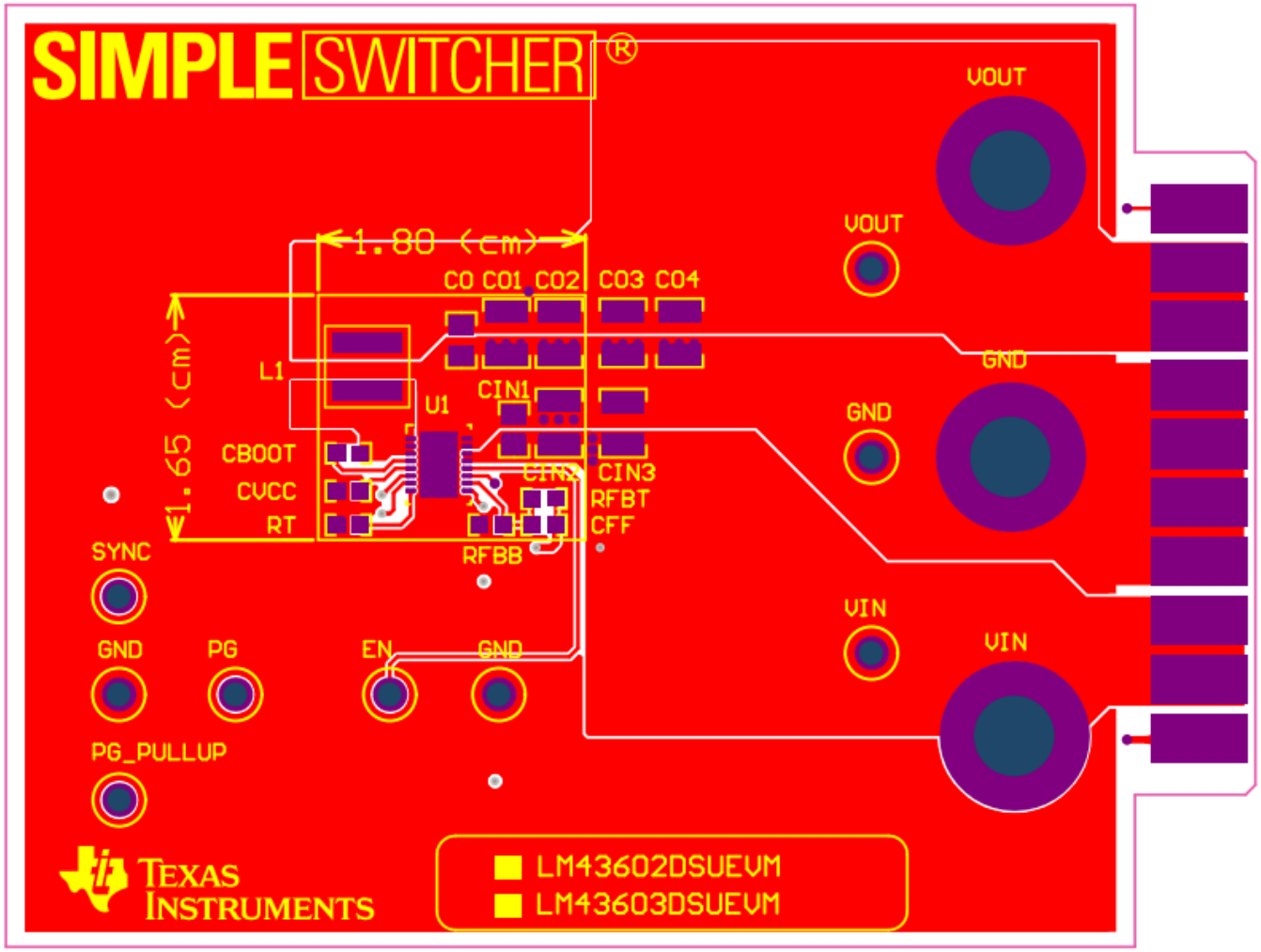

Figure 3. Top Assembly Layer

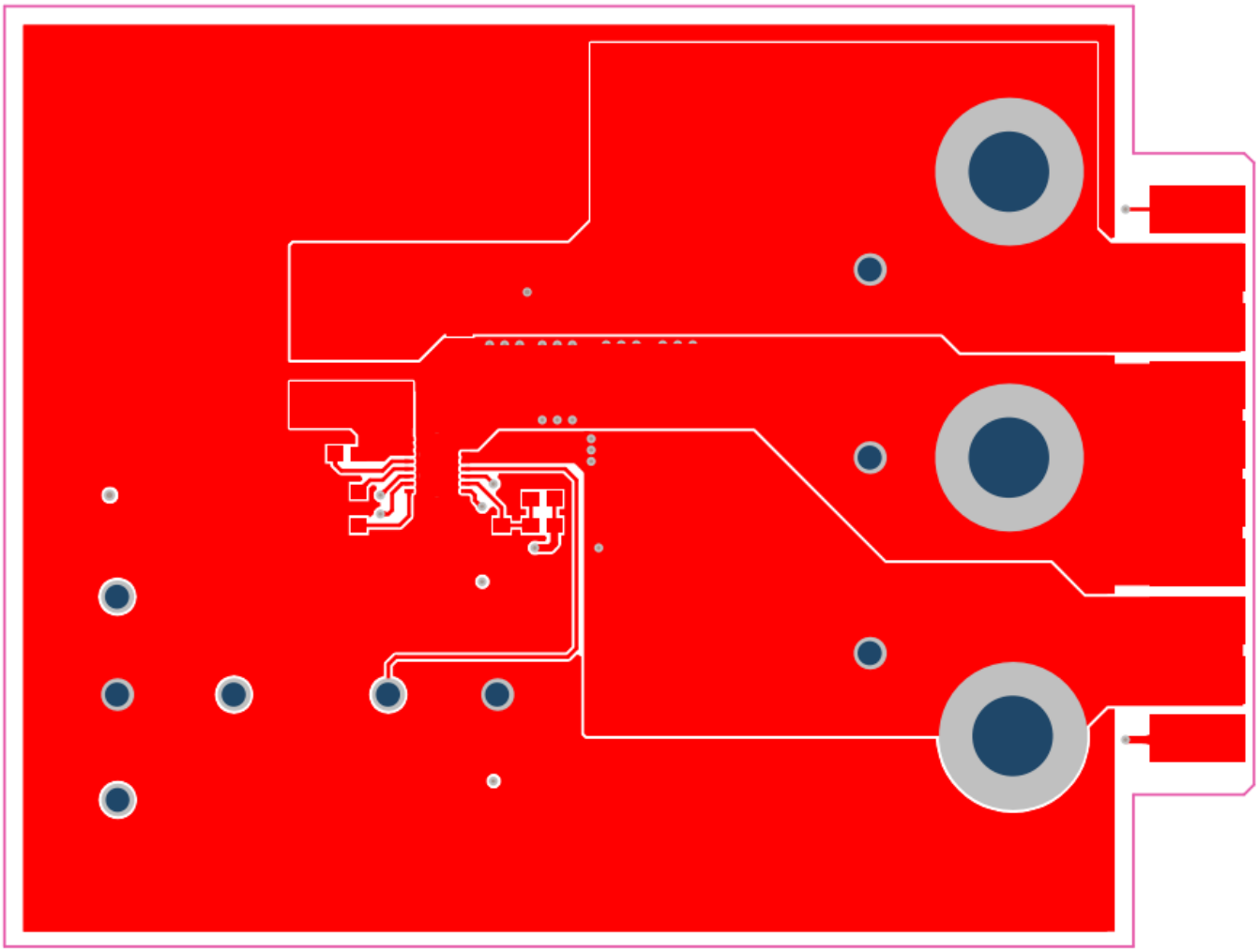

Figure 4. Top Layer Routing

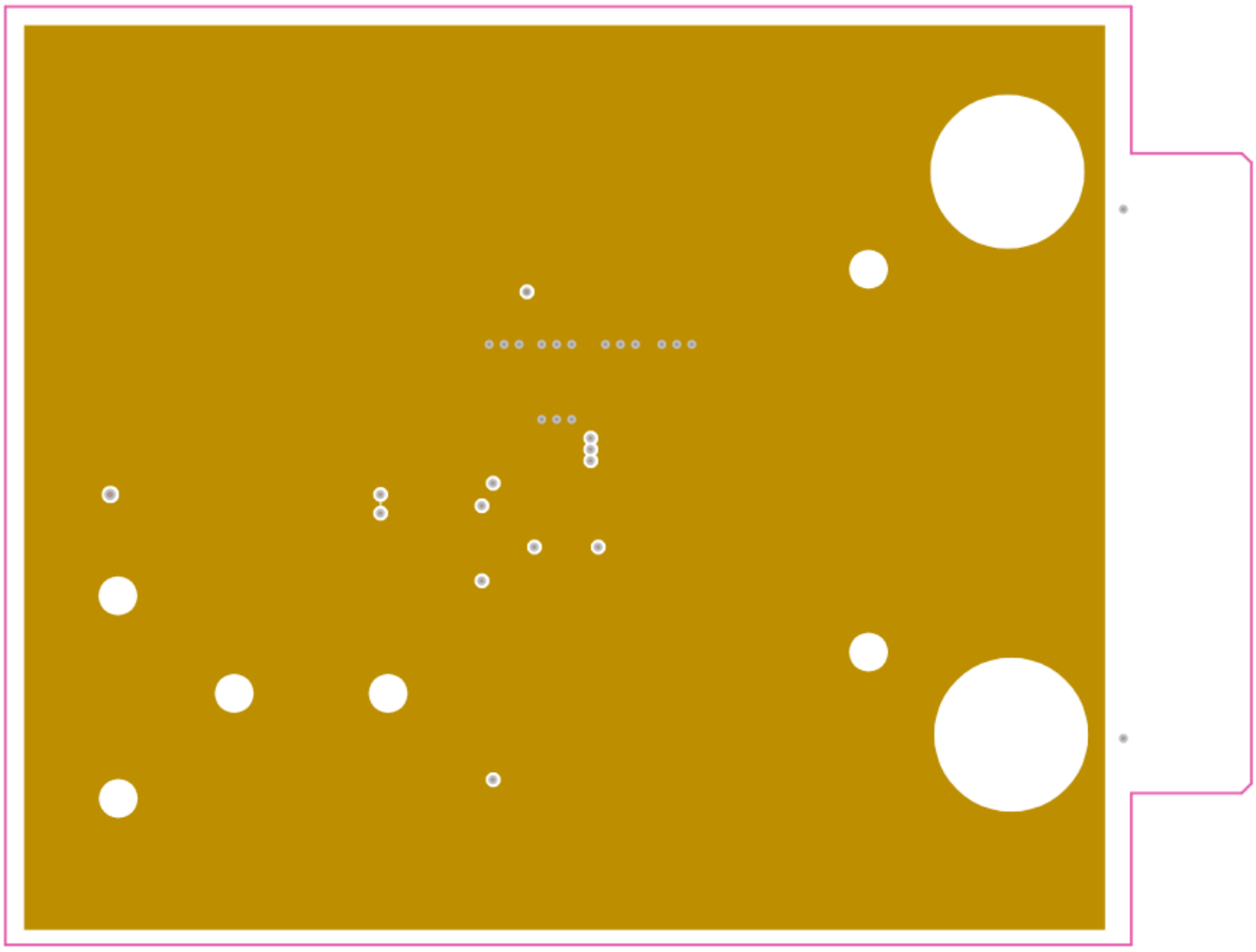

Figure 5. Mid Layer 1 Ground Plane

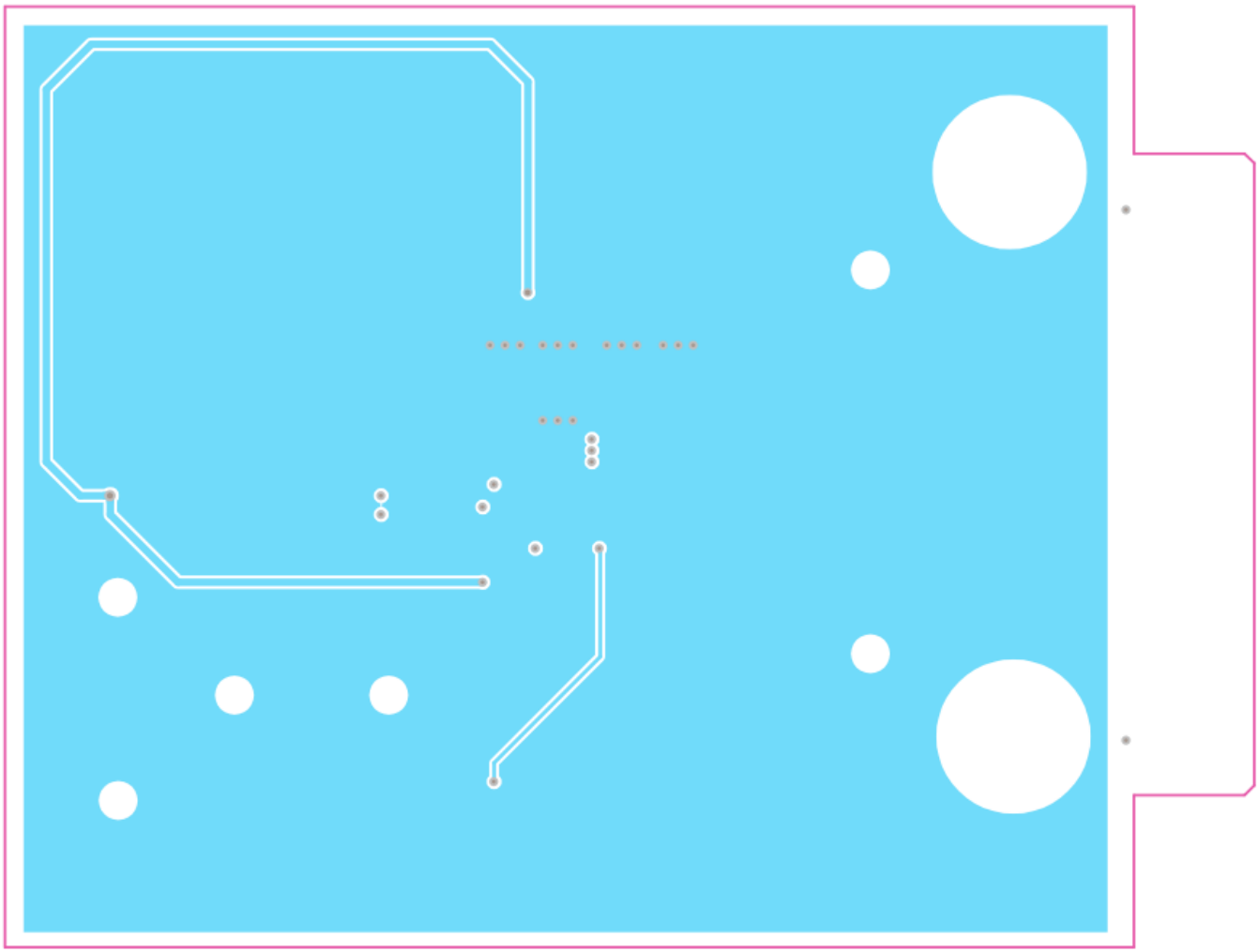

Figure 6. Mid Layer 2 Routing

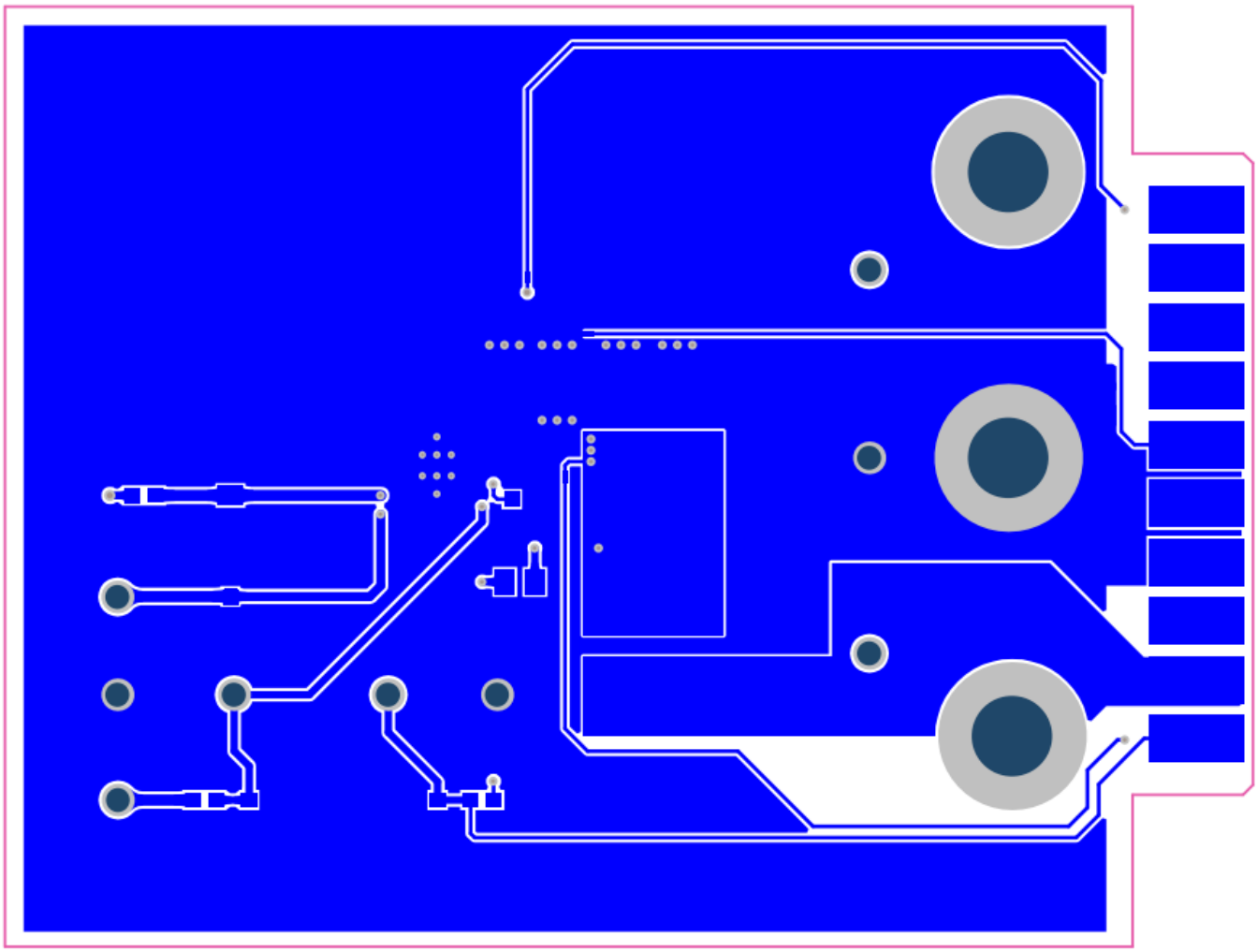

Figure 7. Bottom Layer Routing

Table 2. LM43603DSUEVM Bill of Materials (BOM) for 500 kHz Configuration

Designator	Description	Manufacturer	PartNumber	Quantity
!PCB	Printed Circuit Board	-	SV601247	1
CBIAS	CAP, CERM, 4.7uF, 50V, +/-10%, X5R, 0805	TDK	C2012X5R1H475K125AB	1
CBOOT	CAP, CERM, 0.47uF, 25V, +/-10%, X5R, 0603	MuRata	GRM188R61E474KA12D	1
CFF	CAP, CERM, 22 pF, 50 V, +/- 5%, C0G/NP0, 0603	AVX	06035A220JAT2A	1
CIN1, CO	CAP, CERM, 0.47 µF, 50 V, +/- 10%, X7R, 0805	MuRata	GRM21BR71H474KA88L	2
CIN2	CAP, CERM, 10 µF, 50 V, +/- 10%, X7R, 1210	MuRata	GRM32ER71H106KA12L	1
CO1, CO2	CAP, CERM, 47 µF, 10 V, +/- 10%, X7R, 1210	MuRata	GRM32ER71A476KE15L	2
CSS	CAP, CERM, 0.047uF, 50V, +/-10%, X7R, 0603	TDK	C1608X7R1H473K	1
CVCC	CAP, CERM, 2.2uF, 10V, +/-10%, X7R, 0603	MuRata	GRM188R71A225KE15D	1
EN, PG, PG_PULLUP, SYNC	Test Point, TH Multipurpose, Yellow	Keystone	5014	4
JGND, JVIN, JVOUT	Standard Banana Jack, Uninsulated, 8.9mm	Keystone	575-8	3
L1	Inductor, Shielded, Composite, 3.3 µH, 8.1 A, 0.02 ohm, SMD	Coilcraft	XAL5030-332MEB	1
RBIAS	RES, 0 ohm, 5%, 0.1W, 0603	Vishay-Dale	CRCW06030000Z0EA	1
RENT	RES, 590k ohm, 1%, 0.1W, 0603	Vishay-Dale	CRCW0603590KFKEA	1
RFBB	RES, 249 k, 1%, 0.1 W, 0603	Vishay-Dale	CRCW0603249KFKEA	1
RFBT	RES, 1.00 M, 1%, 0.1 W, 0603	Vishay-Dale	CRCW06031M00FKEA	1
RINJ	RES, 100, 1%, 0.125 W, 0805	Vishay-Dale	CRCW0805100RFKEA	1
RPG1, RPG2	RES, 100k ohm, 1%, 0.1W, 0603	Vishay-Dale	CRCW0603100KFKEA	2
RSYNC	RES, 100, 1%, 0.1 W, 0603	Vishay-Dale	CRCW0603100RFKEA	1
RT	RES, 39.2 k, 1%, 0.1 W, 0603	Vishay-Dale	CRCW060339K2FKEA	1
TPGND1, TPGND2, TPGND3	Test Point, Multipurpose, Black, TH	Keystone	5011	3
U1	3.5 - 36V 2A, 3A Step-Down Converters with Low Quiescent Current, DSU0016A	Texas Instruments	LM43603DSUR	1
VIN	Test Point, Multipurpose, Red, TH	Keystone	5010	1
VOUT	Test Point, Multipurpose, Orange, TH	Keystone	5013	1
CBULK	CAP, AL, 68 µF, 63 V, +/- 20%, 0.65 ohm, AEC-Q200 Grade 2, SMD	Panasonic	EEE-FK1J680UP	0
CIN3	CAP, CERM, 4.7 µF, 100 V, +/- 10%, X7S, 1210	TDK	C3225X7S2A475K200AE	0
CIN4, CIN5	CAP, CERM, 2.2 µF, 50 V, +/- 10%, X5R, 1206	MuRata	GRM31CR61H225KA88L	0
CO3, CO4	CAP, CERM, 47 µF, 10 V, +/- 10%, X7R, 1210	MuRata	GRM32ER71A476KE15L	0
L2	Inductor, Shielded, Composite, 3.3 µH, 8.1 A, 0.02 ohm, SMD	Coilcraft	XAL5030-332MEB	0
LBL1	Thermal Transfer Printable Labels, 1.250" W x 0.250" H - 10,000 per roll	Brady	THT-13-457-10	0
RENB	RES, 1.00Meg ohm, 1%, 0.1W, 0603	Vishay-Dale	CRCW06031M00FKEA	0

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

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      3.1.1 *Notice applicable to EVMs not FCC-Approved:*

      This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

      3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

      CAUTION

      This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

      Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

      FCC Interference Statement for Class A EVM devices

      NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

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1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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