LMH2832EVM-50 Evaluation Module

The LMH2832EVM-50 evaluation module (EVM) is used to evaluate the dual LMH2832, digitally-controlled variable gain amplifier (DVGA) in a 40-pin VQFN package. The EVM is used to easily demonstrate the functionality and performance of LMH2832 across all the gain settings in a 50-Ω input environment. The EVM is ready to connect to power supplies, signal source, USB, and test instruments through the use of onboard connectors. By default, the LMH2832EVM powers up to the 10-dB gain setting with the board supporting only single-supply operation. A USB connector on the EVM facilitates programming of the DVGA gain registers using an FTDI USB-to-SPI bus translator chip.

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1 Features

The key features of this EVM include:

- Configured for 5-V single-supply operation
- Designed for AC-coupled, single-ended, 50-Ω input, and output connection
- Interface to the inputs and outputs using SMA connectors
- USB connector and FTDI USB-to-SPI bus translator chip to successfully program the DVGA gain registers

Figure 1 shows the LMH2832EVM board.

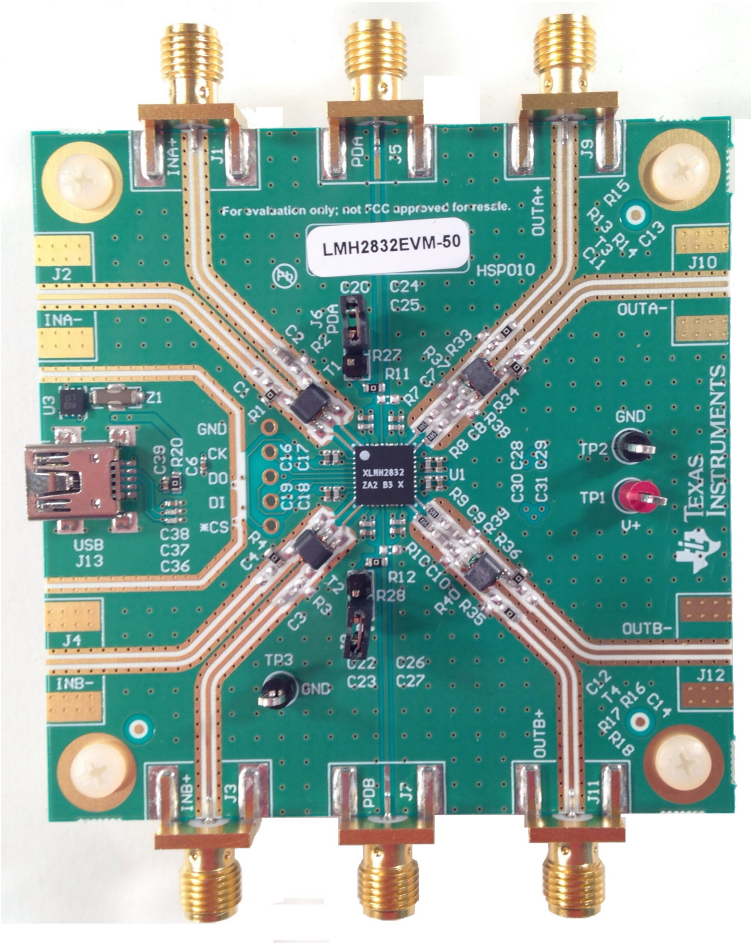


Figure 1. LMH2832EVM Board

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2 EVM Specifications

Table 1 lists the EVM specifications.

Table 1. EVM Specifications

Parameter		Value
V_S	Single-supply voltage range (V– = Ground)	4.5 V to 5.25 V
GND	Ground reference pins	Tied to GND or 0 V
PDA or PDB	Power down (PD) input voltage	GND to V_S
I_S	Supply current with both channels enabled	approximately 204 mA
I_{IN}	Input voltage	V_S±, Max

3 Evaluation Board Setup Block Diagram

The following sections help in setting up the LMH2832 evaluation board hardware and software required to program the internal registers of the LMH2832.

Figure 2 illustrates the LMH2832 evaluation board setup block diagram.

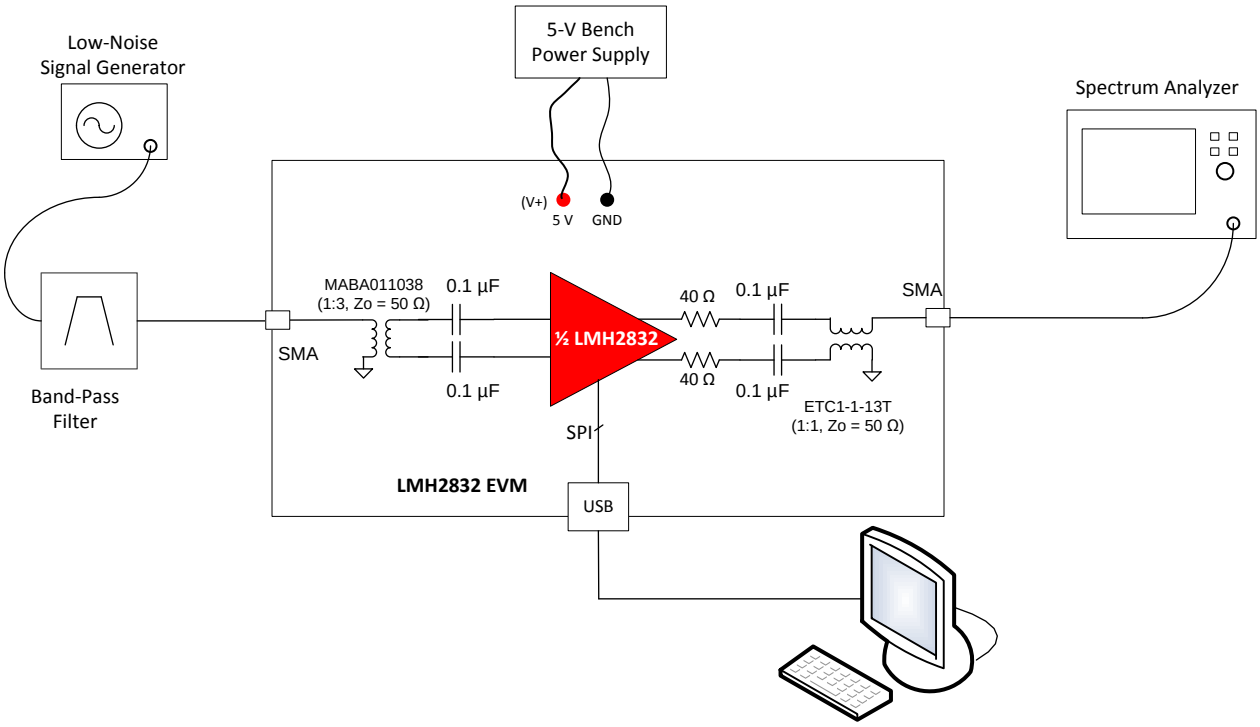


Figure 2. LMH2832 Evaluation Board Setup Block Diagram

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4 Setup Procedure

This section describes the hardware setup procedure and the installation of the software to program the LMH2832 registers.

4.1 Connect EVM to a 5-V Bench Power Supply

1. Before making connections from the bench power supply to the evaluation board supply pin connector, set the bench power supply to 5 V, and switch the bench power supply OFF.
2. While the supplies are turned OFF, connect the evaluation board power supply pins (V+ and GND) to the bench power supply of 5 V and GND, as shown in Figure 2, using a low-noise bench power supply.
3. Turn ON the bench supplies after the power supply connections have been made. The LMH2832 evaluation board should read an approximate DC current of 204 mA for 5-V single supply with both the LMH2832 channels enabled. Input and output pins should be biased to the mid-supplies as specified in the LMH2832 data sheet (SBOS709) for proper operation.

4.2 Connect EVM to the External Signal Source at the Input

1. The LMH2832EVM-50 evaluation board provides the customer flexibility in testing at different input frequencies using on-board input and output baluns as shown in Figure 2.
2. It is recommended to use 6-dB attenuator pads at the input while connecting a 50-Ω signal source to the LMH2832EVM-50 evaluation board SMA inputs.
3. TI recommends using a low pass or band pass filter in-between the signal source and the evaluation board while measuring the harmonic distortion or inter-modulation distortion products.

4.3 Connect EVM to the External Test Equipment at the Output

1. The LMH2832EVM-50 evaluation board has SMA connectors at the output and can be directly connected to 50-Ω test equipment as shown in Figure 2.
2. While connecting the evaluation board output to an oscilloscope, make sure the oscilloscope is set in a 50-Ω termination for the correct voltage reading on the oscilloscope.

4.4 PD (Power Down) Input

1. The LMH2832EVM has jumpers (J6 and J8) that allow the individual channels of the amplifier to be manually disabled. The LMH2832 EVM consumes less than 9 mA of supply current with both the LMH2832 channels disabled.
2. The PDA and PDB SMA input connector facilitates driving the LMH2832 PDA and PDB pins with a high-speed signal source. Note that the PD SMA input connector should to be terminated on-board with 50 Ω to GND (R11 and R12) so as to provide high-frequency termination for signals from a 50-Ω pulse generator.

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4.5 Connect EVM to the PC and LMH2832 EVM GUI Installation

The LMH2832 EVM GUI is used to control the LMH2832 EVM. It must be used to properly configure the LMH2832 device.

1. Download the LMH2832 EVM GUI (SLOC338) from the TI website.
2. Extract the files from the zip file.
3. Run setup.exe and follow the installation prompts.
4. Connect the LMH2832EVM to the PC using a mini-USB cable.
5. Open the LMH2832 EVM GUI by going to Start Menu → All Programs → Texas Instruments → LMH2832 EVM GUI.
6. Verify that the green USB Status indicator is lit in the top right corner of the GUI. If it is not lit, click the *Reconnect USB* button and check the USB Status indicator again. If it is still not lit, then verify the EVM is connected to the computer through the included mini-USB cable.
7. Follow the instructions in Section 5: Amplifier Device Register Configuration to correctly use the GUI to program the LMH2832 device registers.
8. The DVGA register address and configuration values are found in the LMH2832 device data sheet (SBOS709).

5 Amplifier Device Register Configuration

The LMH2832 channels are programmable via the serial programming interface (SPI) bus accessible through the FTDI USB-to-SPI converter chip located on the EVM. A GUI is provided to write instructions on the bus and program the registers of the LMH2832.

The LMH2832 individual channel gain can be controlled from –9 dB to 30 dB in 1-dB steps using register address 5h and 7h for channels A and B, respectively. The amplifier is programmed to the maximum gain (30 dB) when a value 0h is written to the gain control registers 5h and 7h, whereas a value 27h written to the gain control registers programs the device to the minimum gain (–9 dB) setting. Table 2 shows the default LMH2832 SPI register map on power up. For more information about the registers in the LMH2832, see the LMH2832 data sheet (SBOS709).

Table 2. LMH2832 Default SPI Register Map

Address (A[6:0], Hex)	R/W	Register	Default
0	R	Revision ID	B3h
1	R	Product ID	23h
2	R/W	Software Reset	00h
3	R/W	Power-down	00h
4	R/W	Channel A Bias Control	20h
5	R/W	Channel A Gain Control	14h
6	R/W	Channel B Bias Control	20h
7	R/W	Channel B Gain Control	14h

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5.1 LMH2832 EVM GUI

The software GUI allows for full register programming control of the LMH2832. Figure 3 shows the front page of the LMH2832 EVM GUI as it should be seen upon opening the GUI. Descriptions for each of the tabs of the GUI are shown in Table 3.

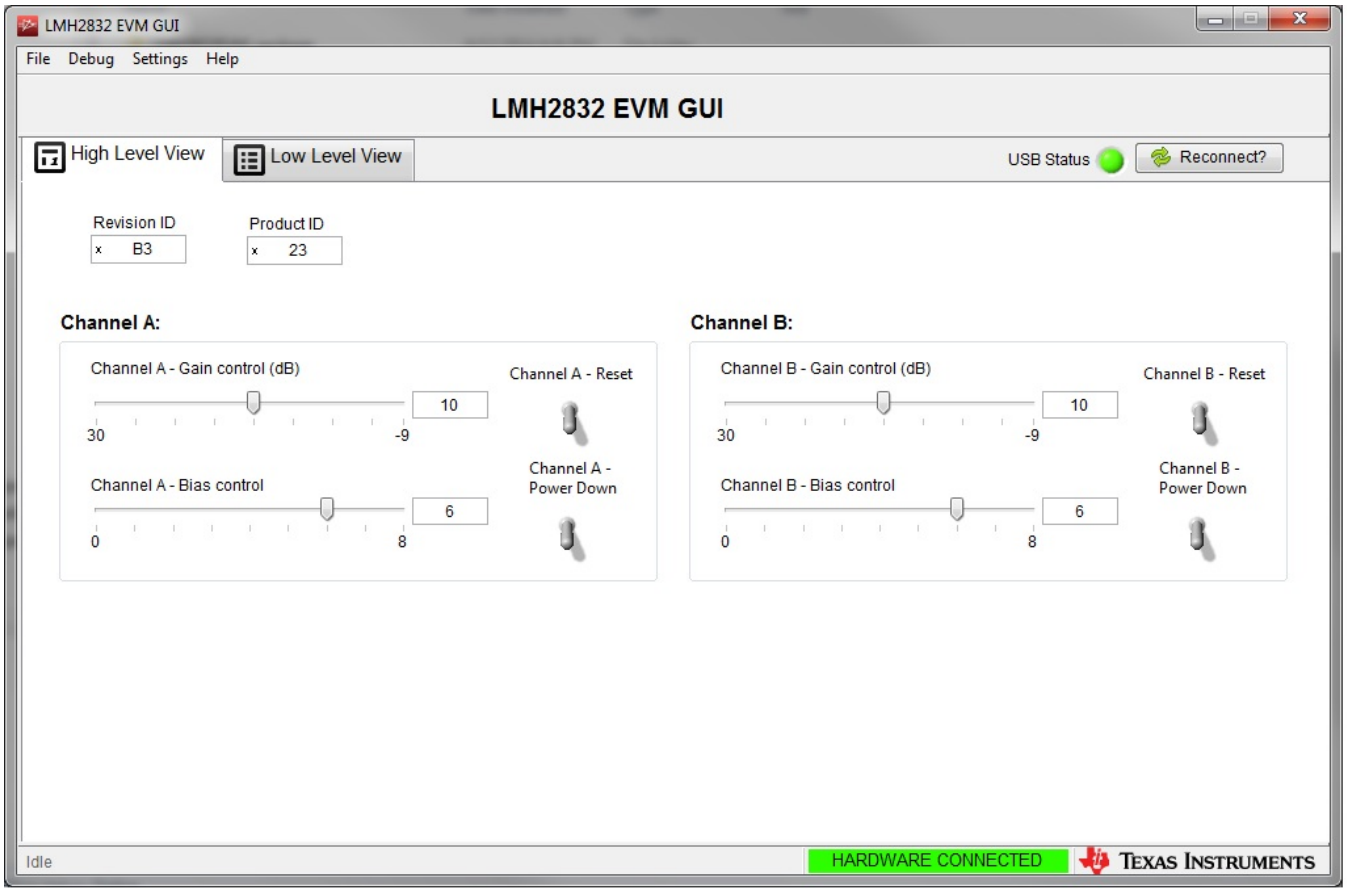


Figure 3. LMH2832 EVM GUI Front Page

Table 3. LMH2832 GUI Tab Descriptions

Tab	Description
High Level View	Enables control of the LMH2832 features. None of these controls need to be touched for basic operation. Instead, use the *Low Level View* tab to load configuration files.
Low Level View	Allows write and read access to all device registers. Also allows loading and saving of configuration files. The device configurations can be saved from this tab for use in the user's system. See Figure 4 for more information.

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5.2 Low Level View

The *Low Level View* tab, shown in Figure 4, allows configuration of the devices at the bit and field level. At any time, the controls described in Table 4 may be used to configure or read from the device.

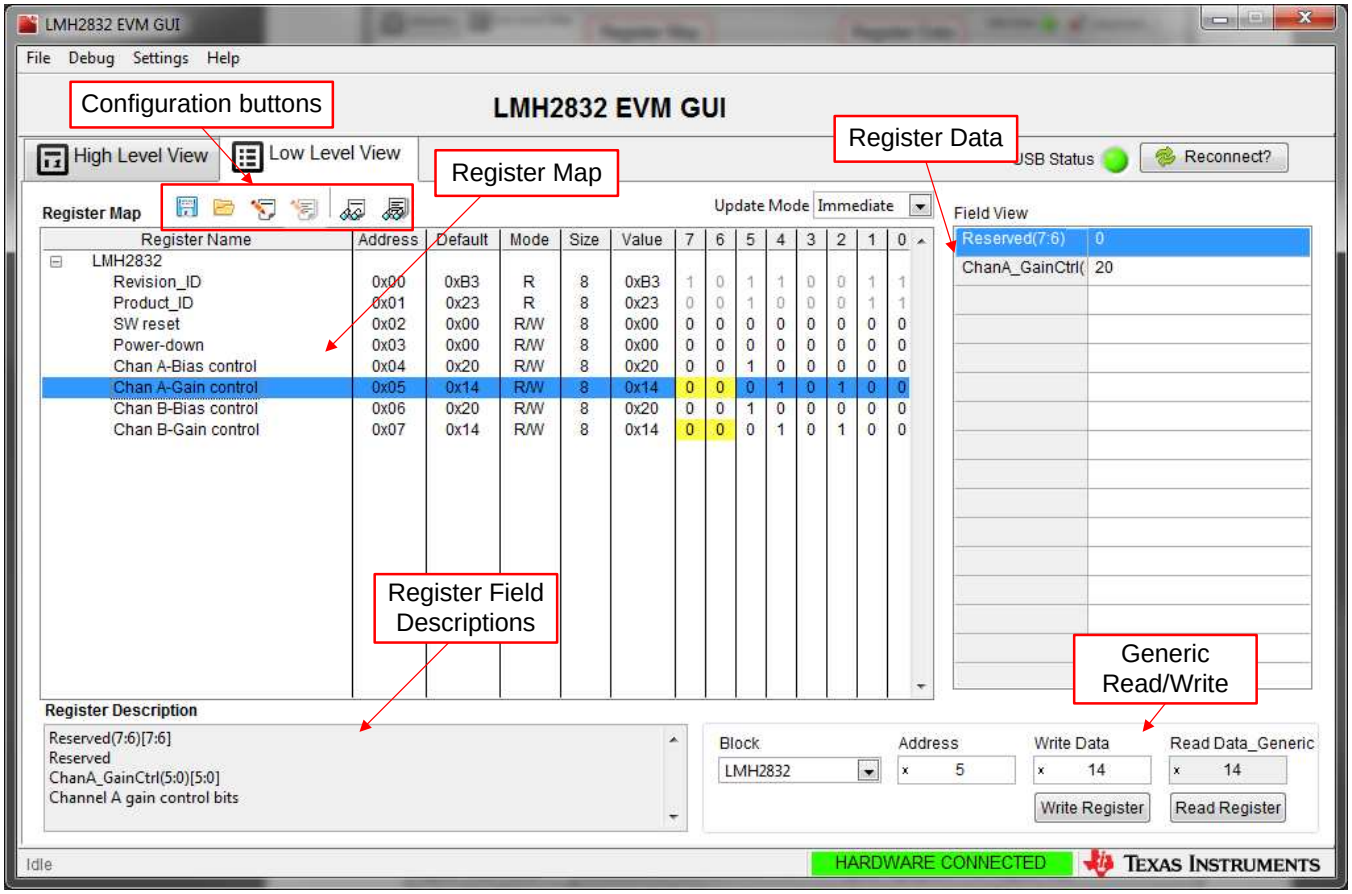


Figure 4. Low Level View Tab

Table 4. Low Level View Controls

Control	Description
Register Map	Displays the devices on the EVM, registers for those devices, and the states of the registers: • Selecting a register field allows bit manipulation in the *Register Data* section. • The *Value* column shows the value of the register at the time the GUI was last updated due to a read or write event.
Write Register button	Write to the register highlighted in the *Register Map* with the value in the *Write Data* field. This button must be clicked after changing bits in the register data section.
Read Register button	Read from the register highlighted in the *Register Map* and display the results in the *Value* column.
Read All button	Read from all registers in the *Register Map* and display the current state of hardware. Also updates the controls in the other tabs.
Load Config button	Load a configuration file from disk and write the registers in the file.
Save Config button	Save a configuration file to disk that contains the current register configuration.
Register Data Cluster	Manipulate individual accessible bits of the register highlighted in the *Register Map*.
Generic Read/Write Register buttons	Perform a generic read or write command to the device shown in the Block drop-down box using the *Address* and *Write Data* information.

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6 Evaluation Troubleshooting

Issue	Troubleshoot
Problem reading or writing the LMH2832 device using the LMH2832 EVM GUI:	Verify that the green USB Status indicator is lit in the top right corner of the GUI. If it is not lit, click the *Reconnect USB* button and check the *USB Status* indicator again. If it is still not lit, then verify the EVM is connected to the computer through the included mini-USB cable.
	Check to see whether the connectors to power supply pins of the LMH2832 EVM are connected properly and turned ON. The nominal supply current for the LMH2832EVM for 5-V supply is approx 204-mA with both the channels enabled.
Low supply current:	See if one of the device channels is disabled by the PDA or PDB jumper. Also, check to see if the power supply is set to the right voltage.
No supply current:	See if the power supply cable connections are connected and the power switch of the source is turned ON.
High supply current:	The reverse supply protection diodes may be conducting. Turn off the power switch and make sure the positive supply is connected to the proper pin. Turn the power back on to see if the correct supply current is recorded.

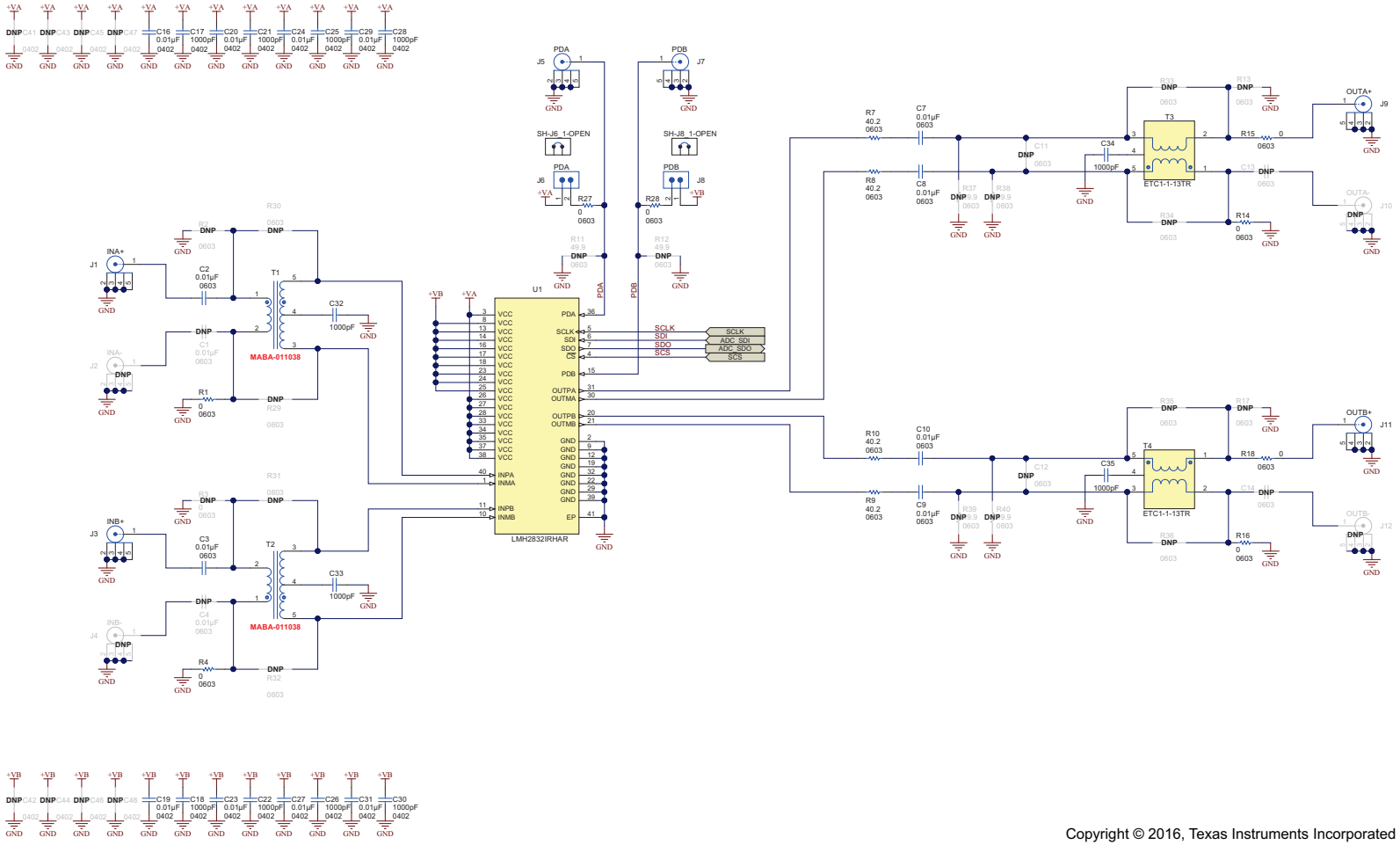
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7 LMH2832 EVM Schematic, Layer Prints, and Bill of Materials

This section contains the EVM schematic, PCB layouts, and the bill of materials (BOM).

7.1 Schematic

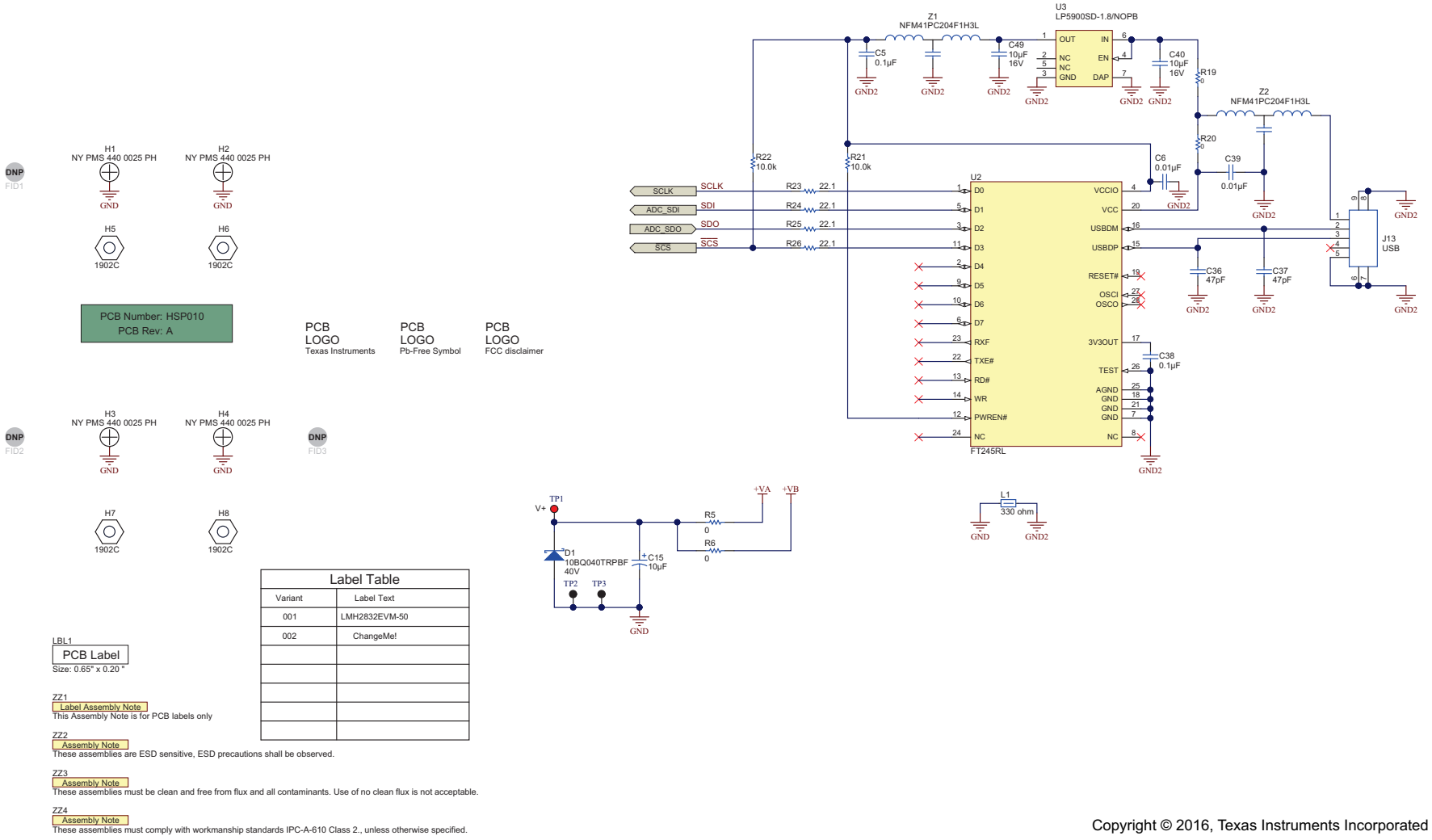
Figure 5 and Figure 6 illustrate the LMH2832EVM schematic



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Figure 5. Schematic - Analog

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Figure 6. Schematic - Digital

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7.2 Layer Prints

Figure 7 through Figure 14 illustrate the LMH2832EVM layer prints.

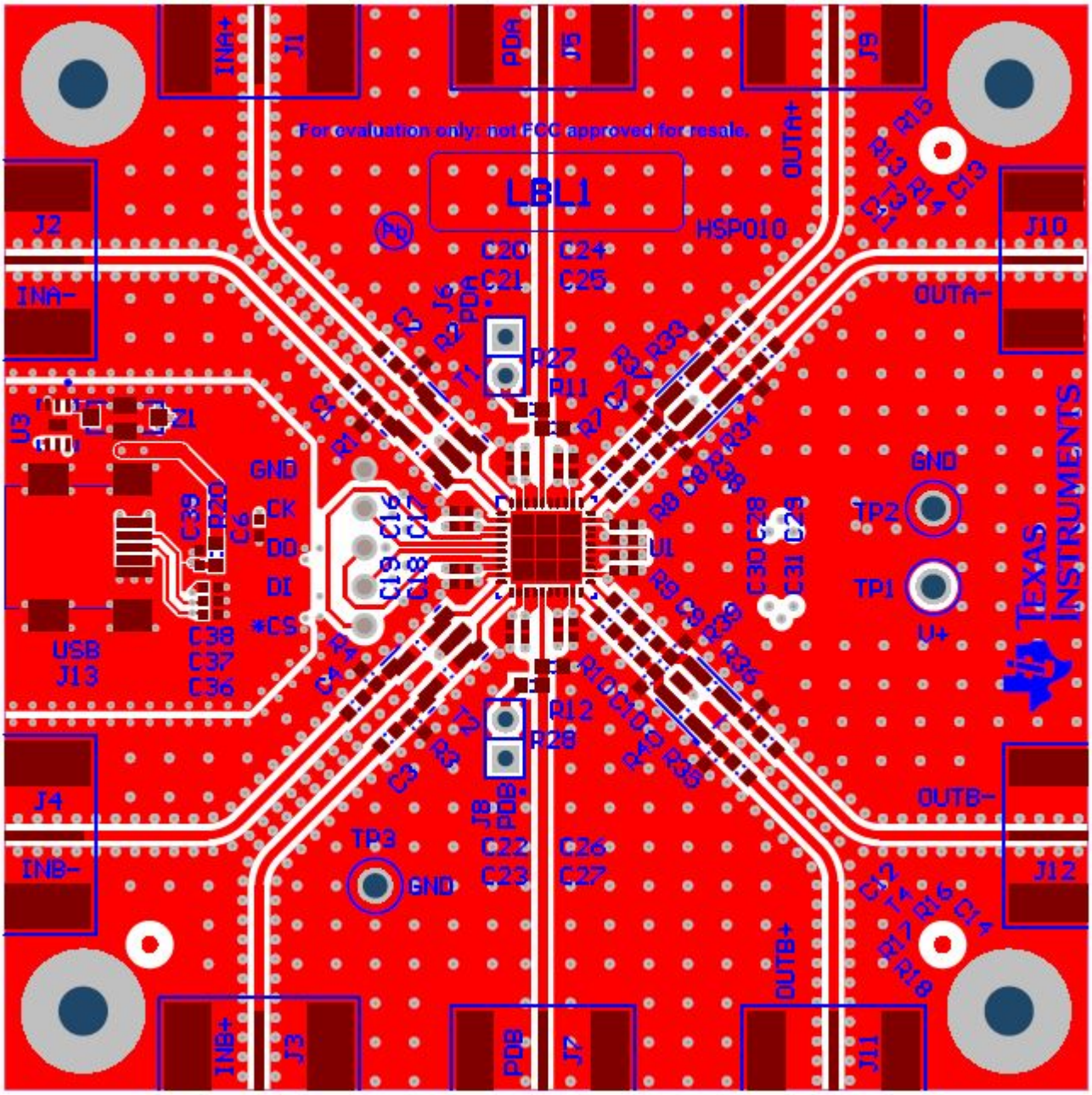


Figure 7. Top Layer

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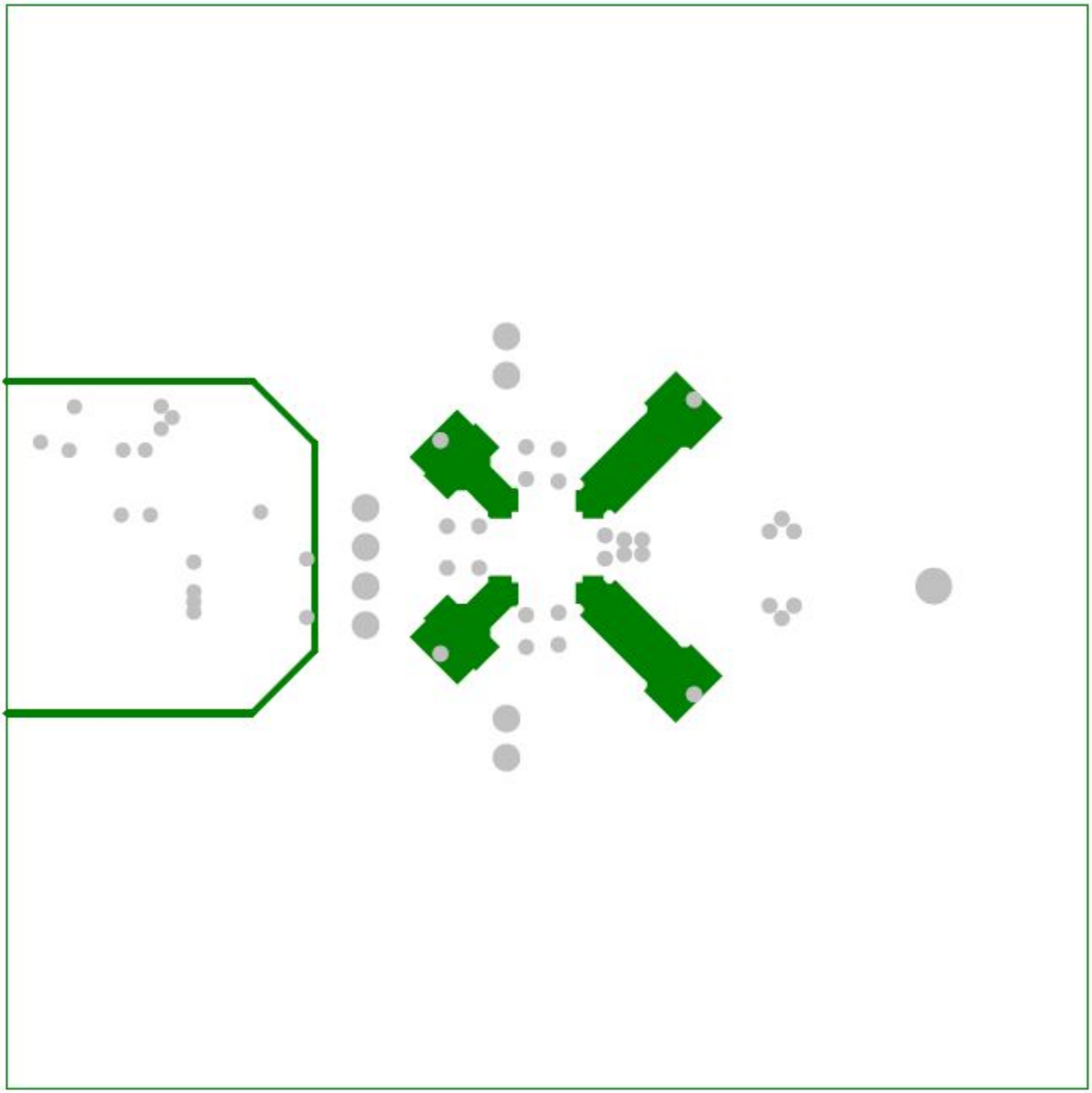


Figure 8. Layer 2 Ground Plane

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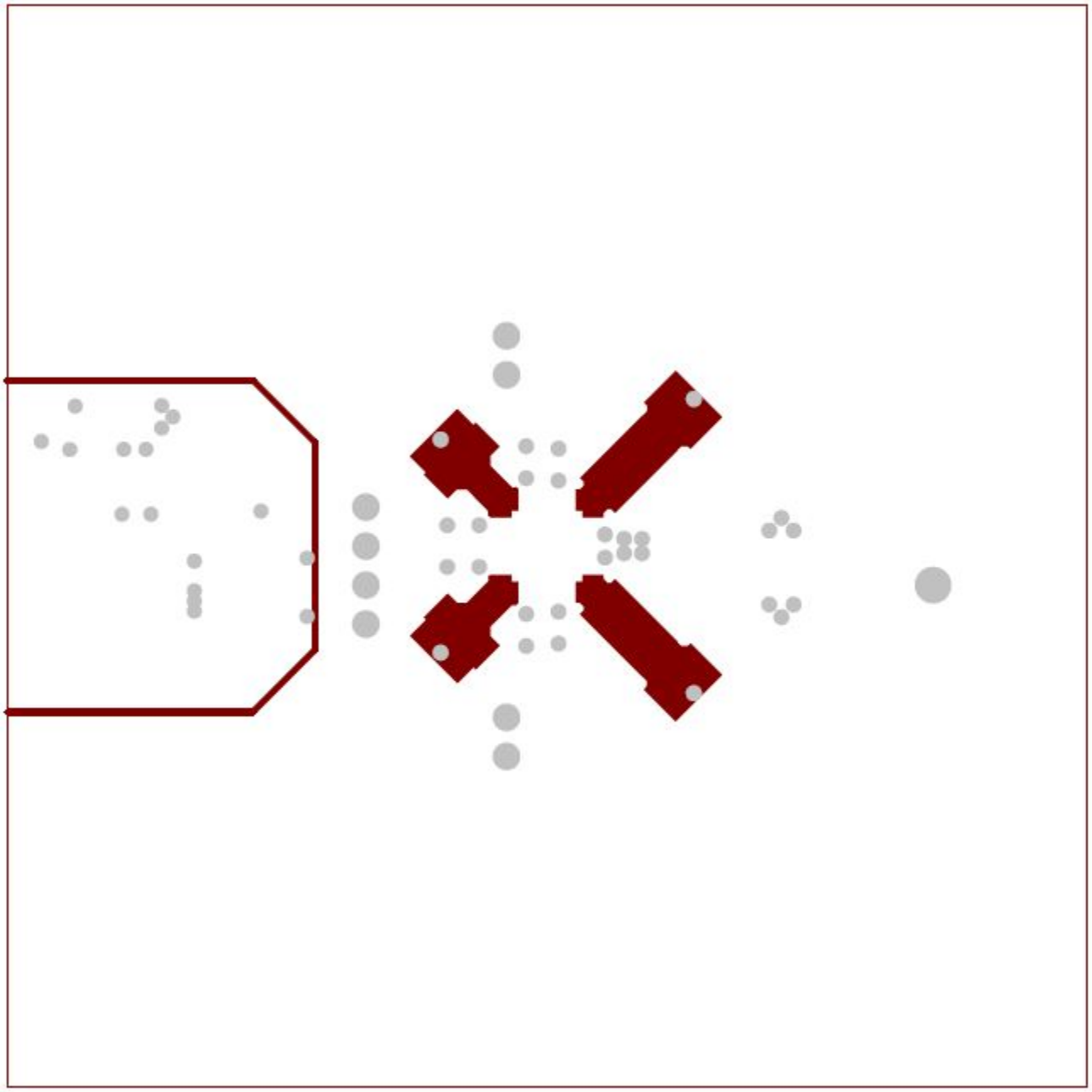


Figure 9. Layer 3 GND Plane

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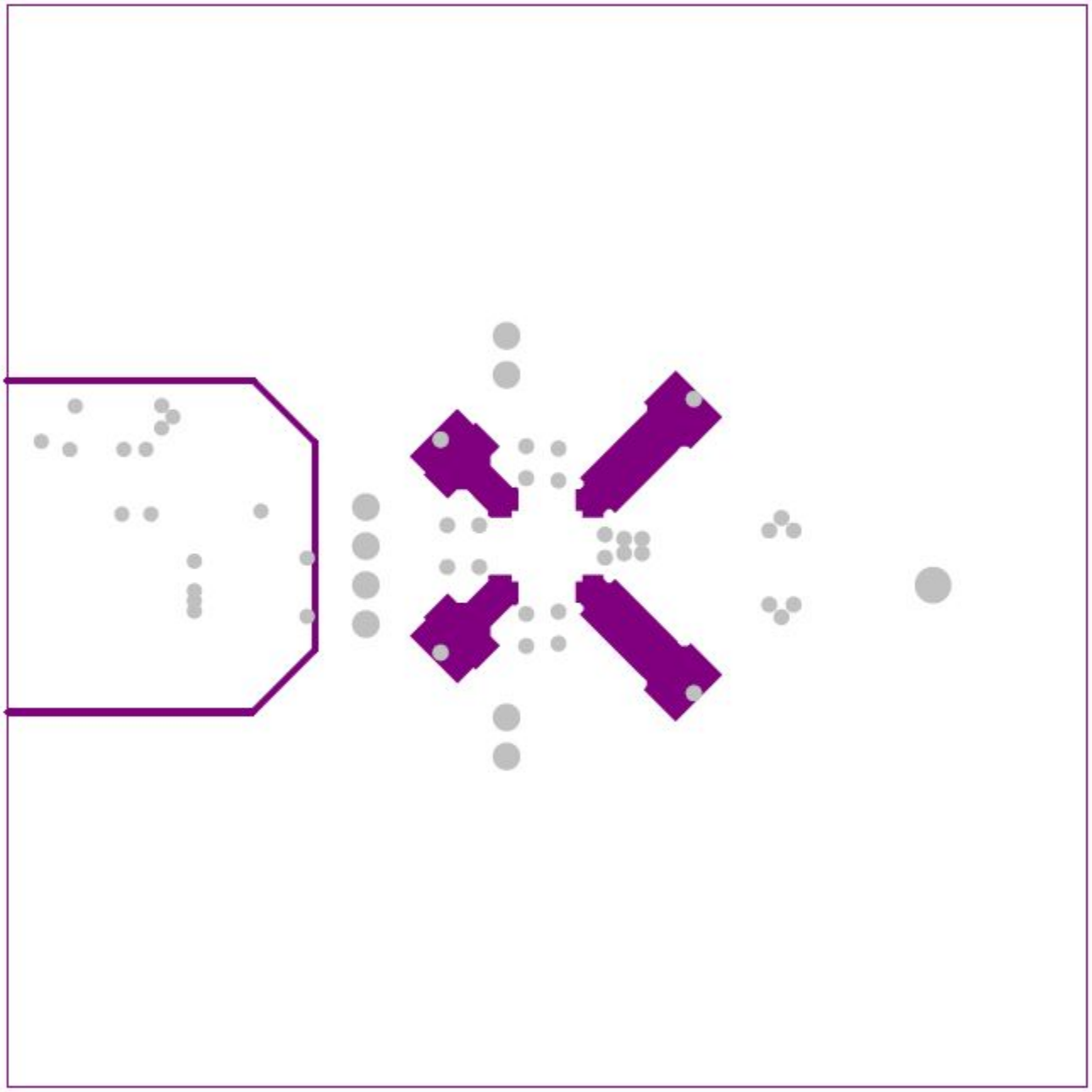


Figure 10. Layer 4 GND Plane

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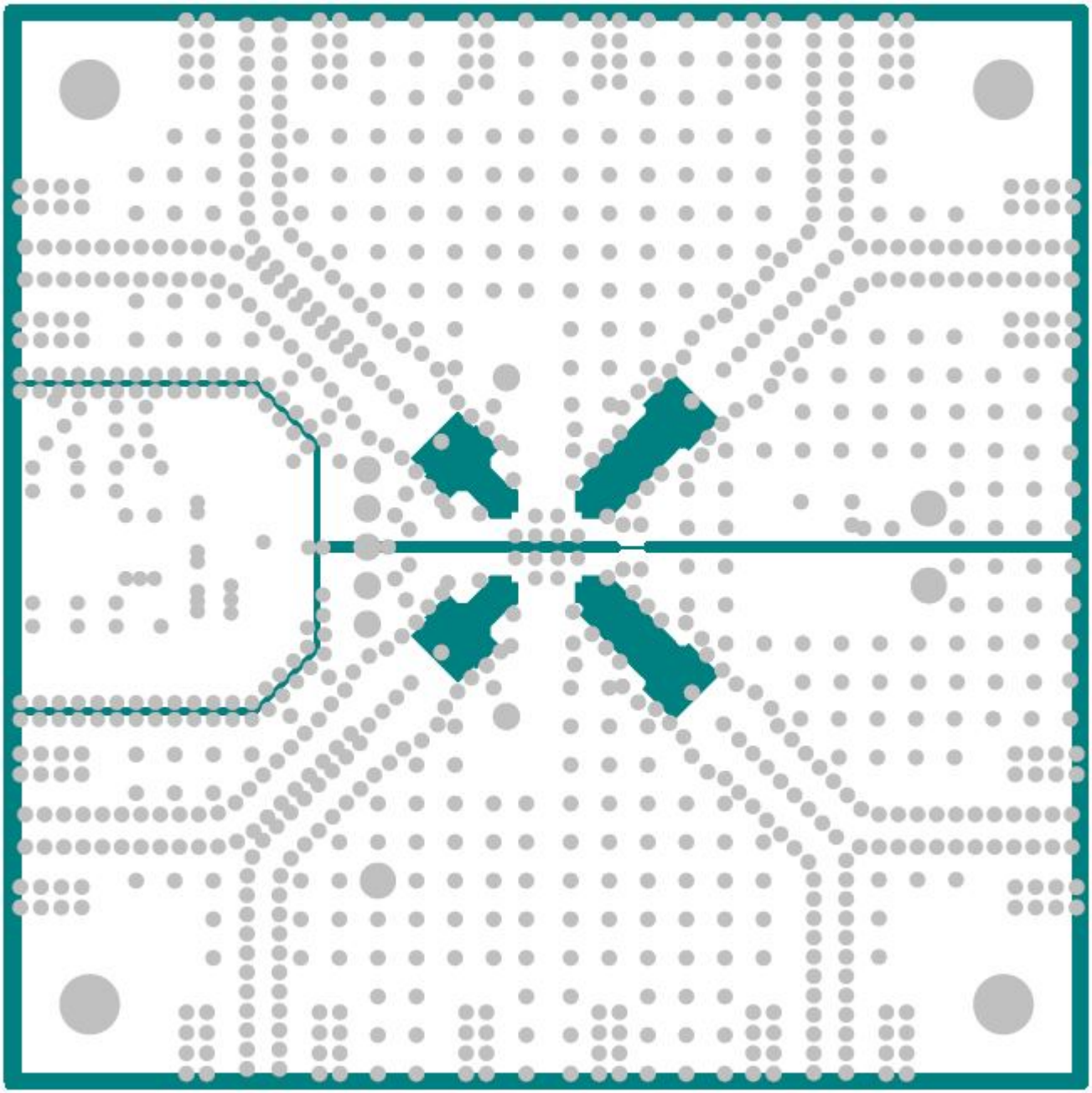


Figure 11. Layer 5 V+ Plane

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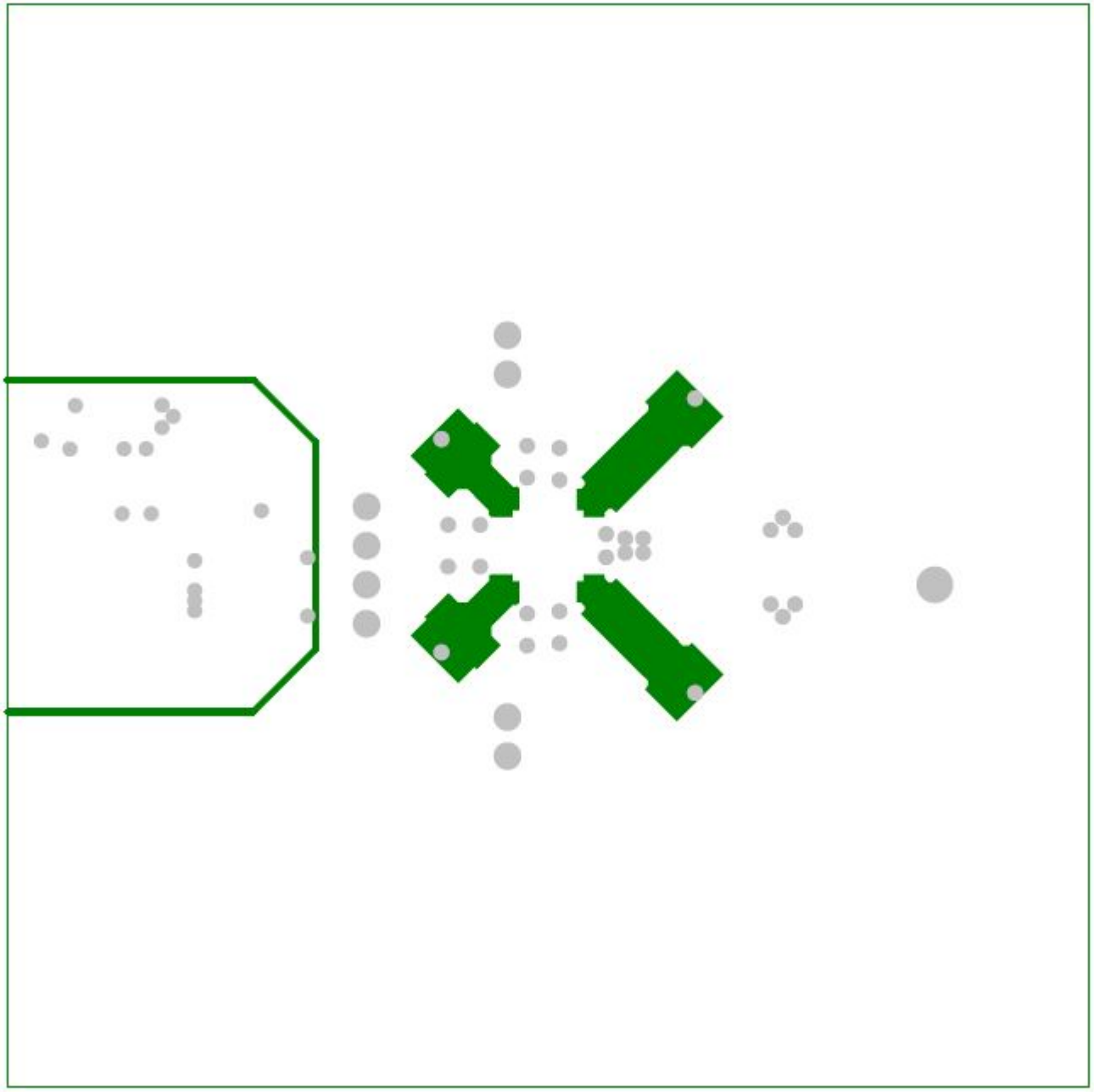


Figure 12. Layer 6 Ground Plane

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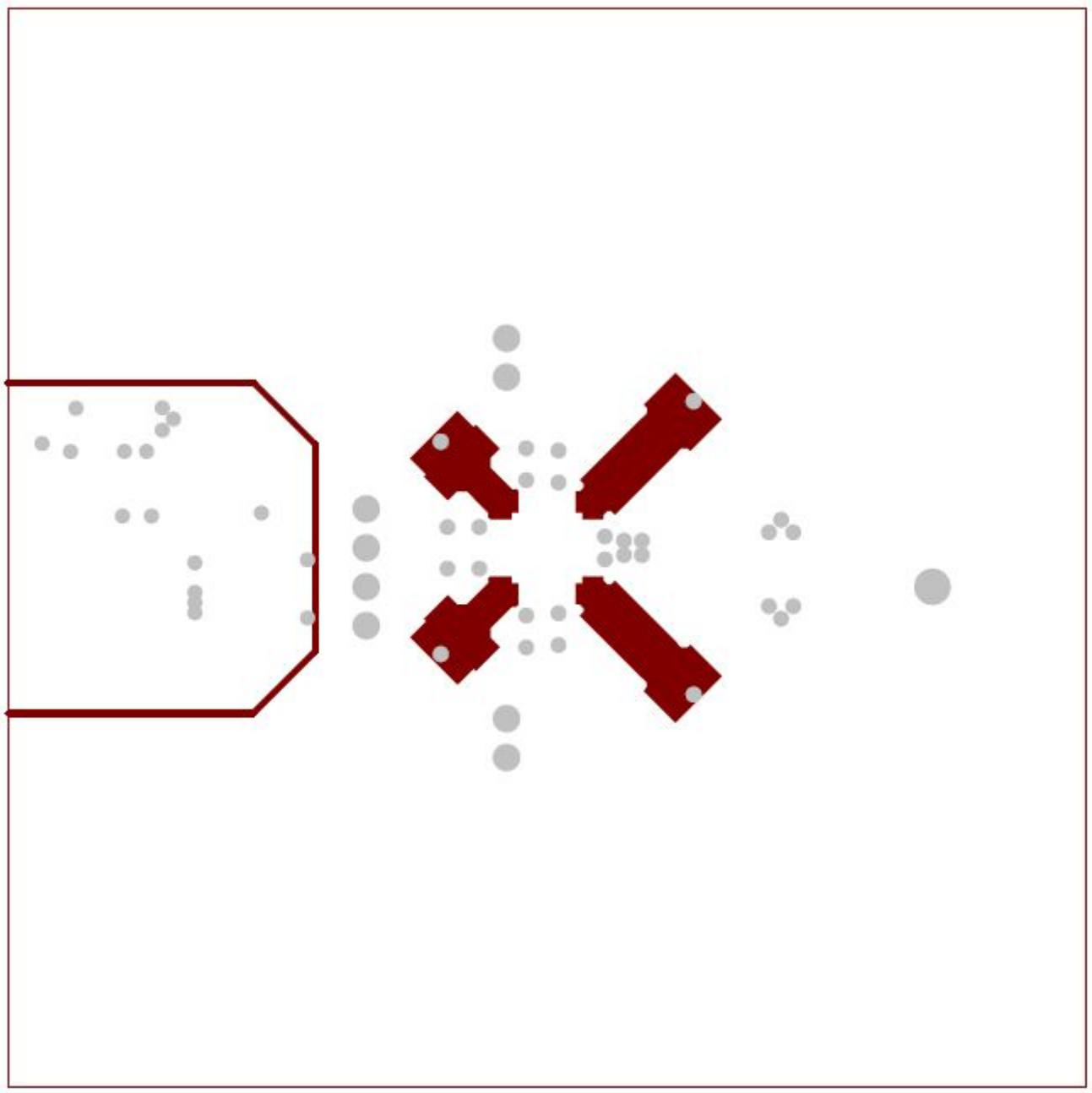


Figure 13. Layer 7 GND Plane

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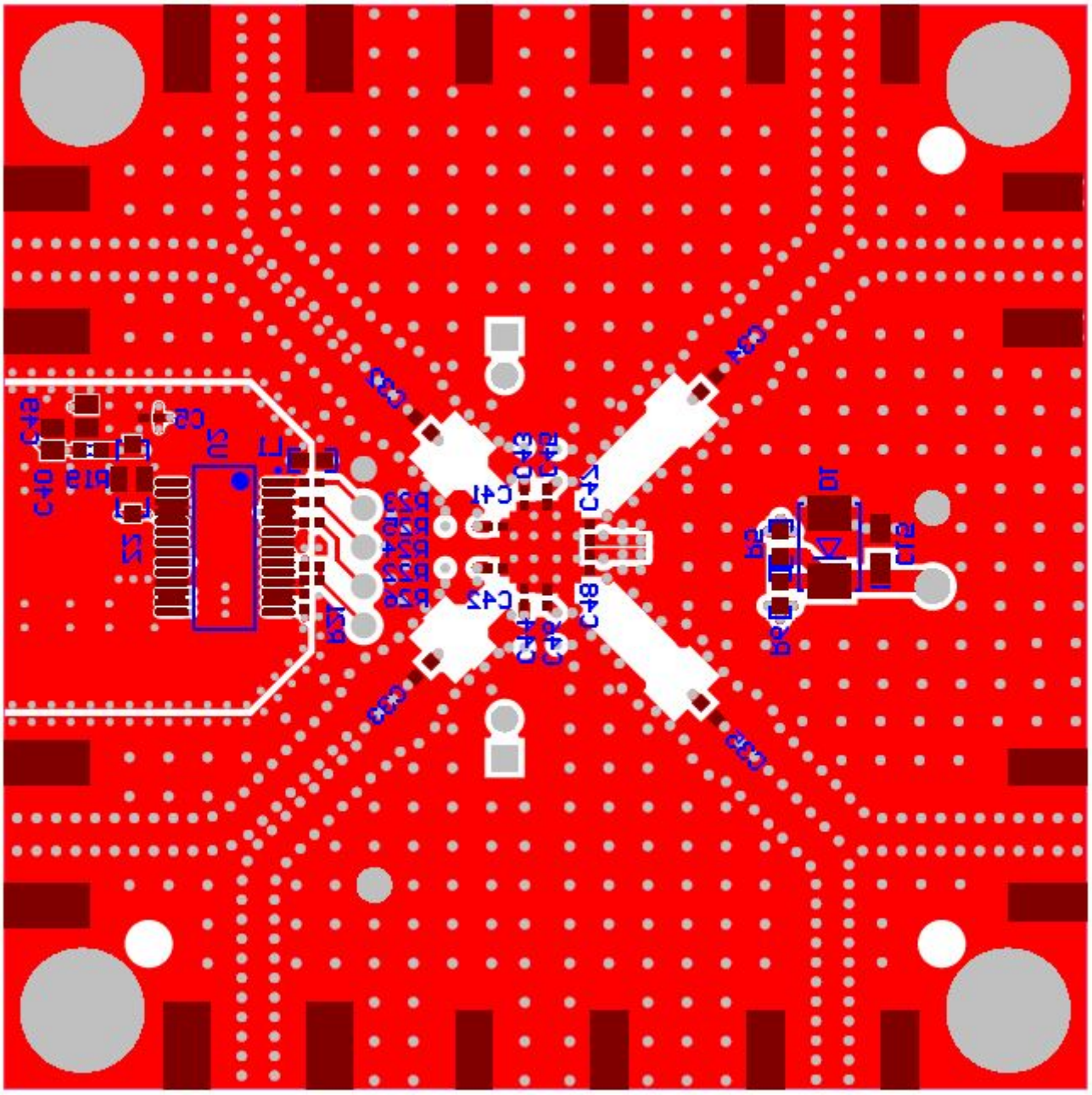


Figure 14. Bottom Layer

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7.3 Bill of Materials

Table 5 lists the EVM bill of materials.

Table 5. LMH2832EVM Bill of Materials

Designator	Qty	Value	Description	PackageReference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
!PCB	1		Printed Circuit Board		HSP010	Any	-	-
C2, C3, C7, C8, C9, C10	6	0.01uF	CAP, CERM, 0.01uF, 25V, +/-5%, C0G/NP0, 0603	0603	C1608C0G1E103J	TDK		
C5, C38	2	0.1uF	CAP, CERM, 0.1uF, 10V, +/-10%, X5R, 0402	0402	C1005X5R1A104K	TDK	-	-
C6, C39	2	0.01uF	CAP, CERM, 0.01uF, 16V, +/-10%, X7R, 0402	0402	C1005X7R1C103K	TDK		
C15	1	10uF	CAP, TANT, 10uF, 10V, +/-10%, 0.9 ohm, 3216-18 SMD	3216-18	TPSA106K010R0900	AVX		
C16, C19, C20, C23, C24, C27, C29, C31	8	0.01uF	CAP, CERM, 0.01uF, 25V, +/-10%, X7R, 0402	0402	C1005X7R1E103K	TDK		
C17, C18, C21, C22, C25, C26, C28, C30	8	1000pF	CAP, CERM, 1000pF, 25V, +/-5%, C0G/NP0, 0402	0402	C1005C0G1E102J	TDK		
C32, C33, C34, C35	4	1000pF	CAP, CERM, 1000pF, 50V, +/-10%, X7R, 0603	0603	C0603C102K5RACTU	Kemet		
C36, C37	2	47pF	CAP, CERM, 47 pF, 50 V, +/- 5%, C0G/NP0, 0402	0402	GRM1555C1H470JA01D	MuRata		
C40, C49	2	10uF	CAP, CERM, 10uF, 16V, +/-10%, X5R, 0805	0805	EMK212BJ106KG-T	Taiyo Yuden		
D1	1	40V	Diode, Schottky, 40V, 1A, SMB	SMB	10BQ040TRPBF	International Rectifier		
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply		
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone	-	-
J1, J3, J5, J7, J9, J11	6		Connector, SMT, End launch SMA 50 ohm	SMA End Launch	142-0701-851	Emerson Network Power	-	-
J6, J8	2		Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	TSW-102-07-G-S	TSW-102-07-G-S	Samtec, Inc.	-	-
J13	1		MINI USB 2.0 SMT TYPE AB 5 CONTACTS R/A, SMD	9.2x9.9x4 mm	651305142821	Wurth Elektronik eiSos		
L1	1	330 ohm	1.5A Ferrite Bead, 330 ohm @ 100MHz, SMD	0603	BLM18SG331TN1D	MuRata		
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650"H x 0.200"W	THT-14-423-10	Brady	-	-
R1, R4, R5, R6, R14, R15, R16, R18, R19, R20, R27, R28	12	0	RES, 0 ohm, 5%, 0.1W, 0603	0603	CRCW06030000Z0EA	Vishay-Dale		
R7, R8, R9, R10	4	40.2	RES, 40.2, 1%, 0.1 W, 0603	0603	CRCW060340R2FKEA	Vishay-Dale		
R21, R22	2	10.0k	RES, 10.0k ohm, 1%, 0.063W, 0402	0402	CRCW040210K0FKED	Vishay-Dale		
R23, R24, R25, R26	4	22.1	RES, 22.1 ohm, 1%, 0.063W, 0402	0402	CRCW040222R1FKED	Vishay-Dale		
SH-J6_1-OPEN, SH-J8_1-OPEN	2	1x2	Shunt, 100mil, Gold plated, Black		382811-6	AMP		
T1, T2	2		Transformer, SMT	4.26x3.8mm	MABA-011038	MACOM		
T3, T4	2		Transformer, SMT	3.94x3.83mm	ETC1-1-13TR	MACOM		
TP1	1	Red	Test Point, TH, Multipurpose, Red		5010	Keystone Electronics		
TP2, TP3	2	Black	Test Point, TH, Multipurpose, Black		5011	Keystone Electronics		
U1	1		Fully-Differential, Dual DVGA, DOCSIS 3.x Return Path ADC Driver, RHA0040A	RHA0040A	LMH2832IRHAR	Texas Instruments	LMH2832IRHAT	Texas Instruments
U2	1		USB FIFO IC, 28SSOP	SSOP28	FT245RL	FTDI		
U3	1		Ultra Low Noise, 150mA Linear Regulator for RF/Analog Circuits Requires No Bypass Capacitor, 6-pin LLP, Pb-Free	SDB06A	LP5900SD-1.8/NOPB	Texas Instruments		

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Table 5. LMH2832EVM Bill of Materials (continued)

Designator	Qty	Value	Description	PackageReference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
Z1, Z2	2	0.2uF	Filter, LC, 0.2uF, 1806, SMT	1806	NFM41PC204F1H3L	MuRata		
C1, C4	0	0.01uF	CAP, CERM, 0.01uF, 25V, +/-5%, C0G/NP0, 0603	0603	C1608C0G1E103J	TDK		
C11, C12, C13, C14	0		CAP, CERM, xxxF, xxV, [TempCo], xx%, [PackageReference]	0603	Used in BOM report	Used in BOM report	-	-
C41, C42, C43, C44, C45, C46, C47, C48	0		CAP, CERM, xxxF, xxV, [TempCo], xx%, [PackageReference]	0402	Used in BOM report	Used in BOM report	-	-
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A		
J2, J4, J10, J12	0		Connector, SMT, End launch SMA 50 ohm	SMA End Launch	142-0701-851	Emerson Network Power	-	-
R2, R13, R17, R29, R30, R31, R32, R33, R34, R35, R36	0		RES, xxx ohm, x%, xW, [PackageReference]	0603	Used in BOM report	Used in BOM report	-	-
R3	0	0	RES, 0 ohm, 5%, 0.1W, 0603	0603	CRCW06030000Z0EA	Vishay-Dale		
R11, R12, R37, R38, R39, R40	0	49.9	RES, 49.9 ohm, 1%, 0.1W, 0603	0603	CRCW060349R9FKEA	Vishay-Dale		
Notes:			Unless otherwise noted in the Alternate PartNumber and/or Alternate Manufacturer columns, all parts may be substituted with equivalents.					

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STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, or documentation (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms and conditions that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms and conditions do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for any defects that are caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.

   2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

3 *Regulatory Notices:*

   3.1 *United States*

      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.

Concerning EVMs Including Detachable Antennas:

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

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

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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2. 実験局の免許を取得後ご使用いただく。
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西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*

   6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY WRITTEN DESIGN MATERIALS PROVIDED WITH THE EVM (AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

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8. *Limitations on Damages and Liability:*

   8.1 *General Limitations*. IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS ANDCONDITIONS OR THE USE OF THE EVMS PROVIDED HEREUNDER, REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN ONE YEAR AFTER THE RELATED CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY WARRANTY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS AND CONDITIONS, OR ANY USE OF ANY TI EVM PROVIDED HEREUNDER, EXCEED THE TOTAL AMOUNT PAID TO TI FOR THE PARTICULAR UNITS SOLD UNDER THESE TERMS AND CONDITIONS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM AGAINST THE PARTICULAR UNITS SOLD TO USER UNDER THESE TERMS AND CONDITIONS SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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