EVM User's Guide: CDCLVP111SEPEVM

CDCLVP111-SEP Evaluation Module (CDCLVP111SEPEVM) User's Guide

Description

This user's guide provides an overview of the evaluation module (EVM) including hardware features to be considered while using this module. This manual is applicable to the CDCLVP111-SEP EVM. The EVM provides a platform for evaluating the clock buffer under various voltage and bias configurations.

Features

- Distributes one of two differential input clocks to 10 differential LVPECL output clocks
- Clock input selectable
- Low output skew
- Wide supply range

Get Started

1. Order the EVM.
2. Download the latest libraries.
3. Download the comprehensive reference design files.
4. See the latest applications notes regarding use of the CDCLVP111-SEP.

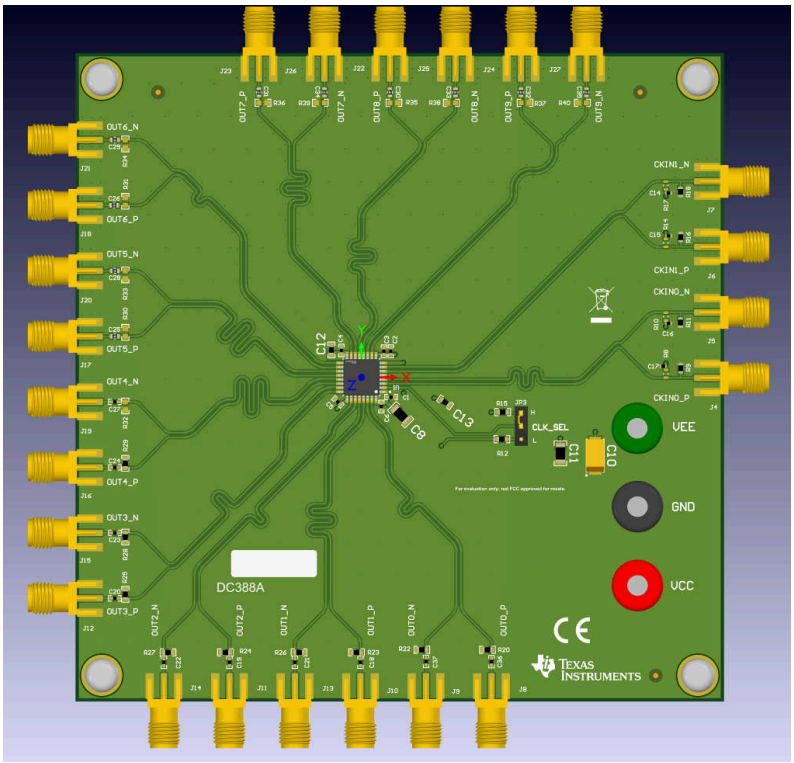

Figure 1-1. CDCLVP111-SEP EVM Hardware Image

1 Evaluation Module Overview

1.1 Introduction

The CDCLVP111-SEP EVM is designed for evaluating the CDCLVP111-SEP. The CDCLVP111-SEP is a 1 to 10 LVPECL buffer with selectable input. The evaluation setup is shown in Figure 1-1. The evaluation setup is essentially a break-out board exposing full functionality of the device with flexible input and output-biasing options.

This user's guide provides an overview of the evaluation module (EVM) including hardware features to be considered while using this module. This manual is applicable to the CDCLVP111-SP EVM which is synonymous with CDCLVP111EVM-CVAL, the orderable part number. The EVM provides a platform for evaluating the clock buffer under various voltage and bias configurations.

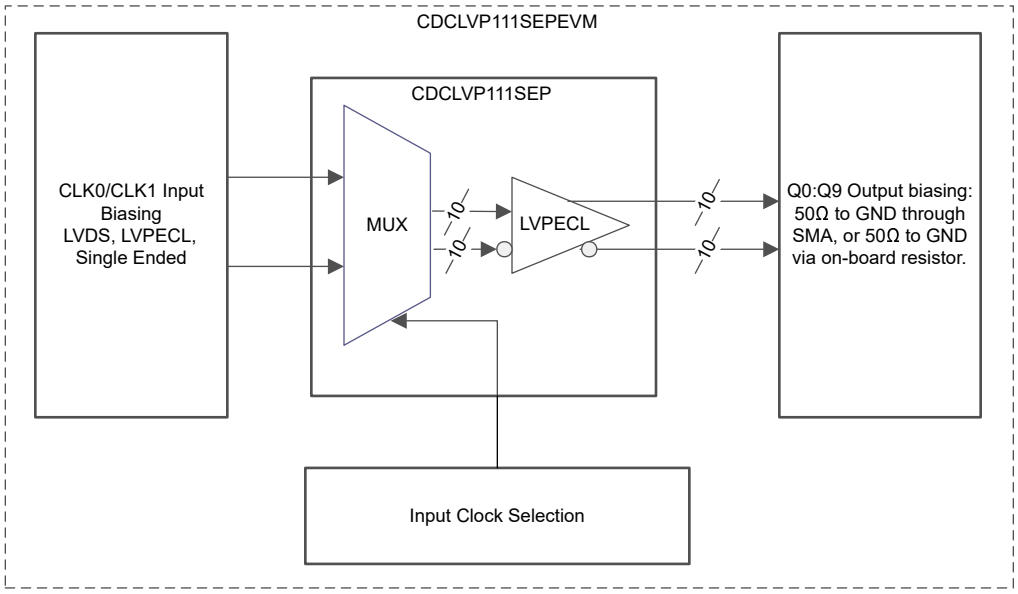

Figure 1-1. CDCLVP111-SEP EVM Block Diagram

1.2 Kit Contents

This box contains

- One CDCLVP111-SEP EVM (DC388)

1.3 Specification

Parameter	Value	Conditions
Supply voltage (relative to VEE)	VCC: 2.375V to 3.8V	VEE = 0V
Supply current	ICC: 385mA to 405mA	All outputs terminated 50Ω to VCC – 2V
Input/output frequency	DC to 3.5GHz	VCM = 1V, VPP = 0.5V

1.4 Device Information

The CDCLVP111-SEP is a high performance, space grade 1 to 10 LVPECL buffer with selectable input. The device runs from 3.3V and 2V supplies to allow for VCC-to-VEE operation. CDCLVP111-SEP has a selectable differential input through CLK_SEL and a reference voltage output that allows for a single-ended input by biasing the unused input pin. The device supports frequencies from DC to 3.5GHz, has additive jitter less than 1ps, and has propagation delay less than 355ps. CDCLVP111-SEP supports defense, aerospace, and medical applications, and is available in a military version that supports temperatures from -55°C to 125°C. This device is fabricated in Texas Instruments' advanced RF-SIGE process and is available in a 36-lead 9.08mm × 9.08mm HFG ceramic package

2 Hardware

2.1 CDCLVP111-SEP Clock Mux Selection

The EVM provides a three-pin jumper, J1, to select CLK0 or CLK1 pairs.

Table 2-1. CDCLVP111-SEP Jumper Configuration

Reference Designator	# of Pins	Default Config	Pin 1 Silkscreen	Pin 2 Silkscreen	Pin 3 Silkscreen
J1	3	Short pins 1-2	VEE	CLK_SEL	VCC

The CDCLVP111-SEP CLK_SEL pin contains a 75kΩ pulldown to VEE. Leaving J1 without jumper selects the CLK0 pair, the same as if J1 has pins 1 and 2 shorted. Shorting J1 pins 2 and 3 selects CLK1 input pair.

2.2 CDCLVP111-SEP EVM Input Biasing

The CDCLVP111-SEP EVM is designed to allow implementation of flexible input biasing. By default, the board is configured with two 50Ω resistors to LVPECL bias level (VCC-2 V, earth ground) for both CLK inputs. This configuration allows for direct use of LVPECL drivers.

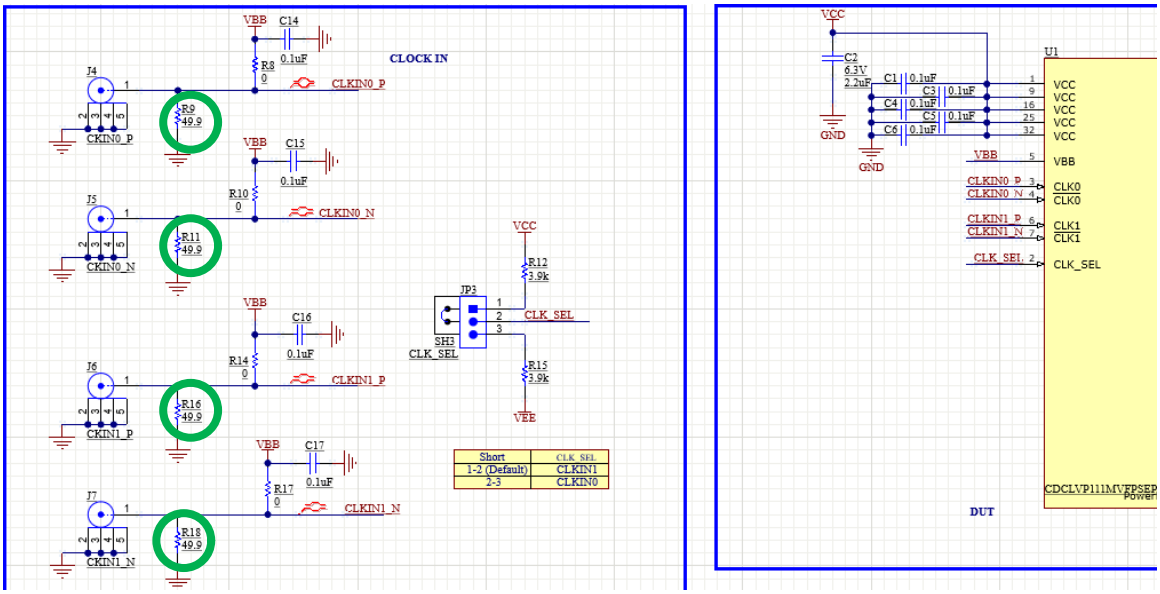

Figure 2-1. Input Biasing Schematic

The board also is designed to allow AC-coupled LVDS inputs. This is accomplished by the by having the LVDS input signal AC coupled with the corresponding 50Ohm to GND termination populated on both intra-pairs of CLKx pins.

The final termination option is to allow single-ended input to drive CLKx. A few 0Ω resistors, R8,R10,R14,R17, can be added to the circuit to connect VBB output to the unused pin of CLKx.

2.3 CDCLVP111-SEP EVM Output Termination

The CDCLVP111-SEP EVM is configured with no on-board output termination installed for CLK[5:0] by default. This allows simple connection to 50Ω terminated test equipment. There are 0402 pads for 50Ω terminations on board. This allows the connection of a high-impedance or differential probe. Simply install the pair of resistors on the pads of the outputs being evaluated. In Figure 2-2, install R30 and R33 for on-board termination. Leave them unconnected for direct termination to 50Ω test equipment. CLK[4:0] have on board 50Ω terminations along with AC coupling capacitors, which can allow for those outputs to be connected directly to a phase noise analyzer.

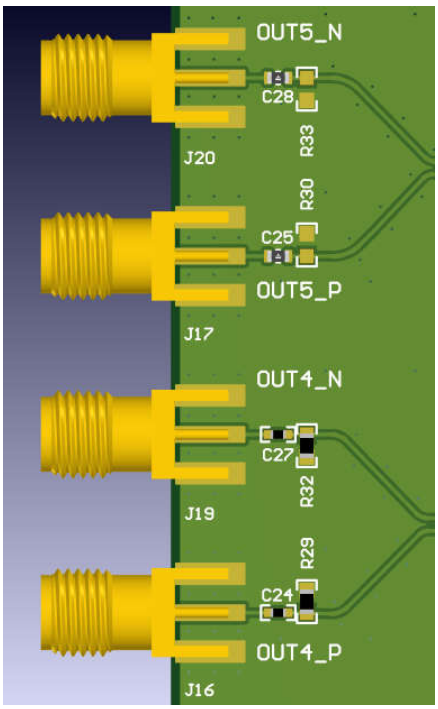

Figure 2-2. On Board Optional Output Termination

2.4 Assembly Instructions

2.4.1 CDCLVP111-SEP Setup and Quick Test

The CDCLVP111-SEP EVM is designed to ease lab-based evaluation by utilizing an offset LVPECL bias point set to earth ground. This allows two power supplies to easily connect the outputs to standard 50Ω terminated test equipment. Utilizing two supplies provides the proper termination for LVPECL drivers. The EVM also provides pads near SMA jacks for on-board 50Ω termination for cases that require using high-impedance probes.

2.4.1.1 Power Supply Setup

Figure 2-3 illustrates the necessary power connections for 3.3V VCC-to-VEE operation.

- With supply 1 disabled, program supply 1V to 3.3V with 500mA current limit
- With supply 2 disabled, program supply 2V to 2V with 500mA current limit

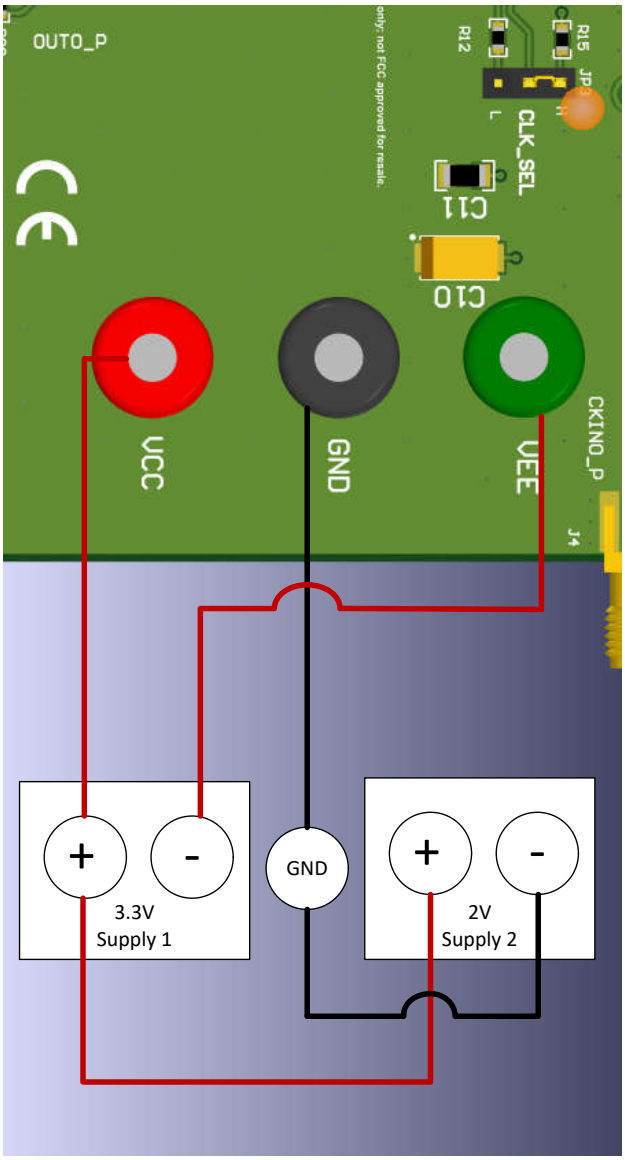

Figure 2-3. Power Supply Connections

1. Connect supplies and board with banana cables as shown. This configuration is for nominal 3.3V testing. To configure other VCC-to-VEE voltages, program supply 1 to the proper range of 2.375V to 3.8V. Supply 2 remains fixed with 2V offset from VCC to earth ground termination.
2. With the signal generator disabled, program according to Table 2-2 based on the supply voltage used. Note, that the amplitudes and offsets are based on a single-ended signal.

Table 2-2. Power Supply Configuration

Voltage	VCC:VEE	VCC-GND	CLK[0:1] amplitude	CLK[0:1] offset
MIN	2.375V	2V	500mV	0.625V
TYP	3.3V	2V	500mV	–0.3 V
MAX	3.8V	2V	500mV	–0.8 V

3. This configuration provides a 1V peak-to-peak differential clock with appropriate offset relative to earth ground (LVPECL termination point).
4. Connect 1 or more output pairs to a 50Ω terminated oscilloscope.
5. Connect signal generator to CLK0 and nCLK0.
6. Verify that JP3 is open or set between pins 2 and 3. This enables CLK0. Jumper pins 1 and 2 are shorted to select CLK1.

a. There is an error with the silkscreen, JP3 'H' side is a resistor to VEE or GND.

7. Enable power supply 1 and 2.
8. Enable signal generator outputs.
9. View outputs on oscilloscope screen.

3 Hardware Design Files

3.1 CDCLVP111-SEP EVM Schematic

Figure 3-2 illustrates the EVM schematic.

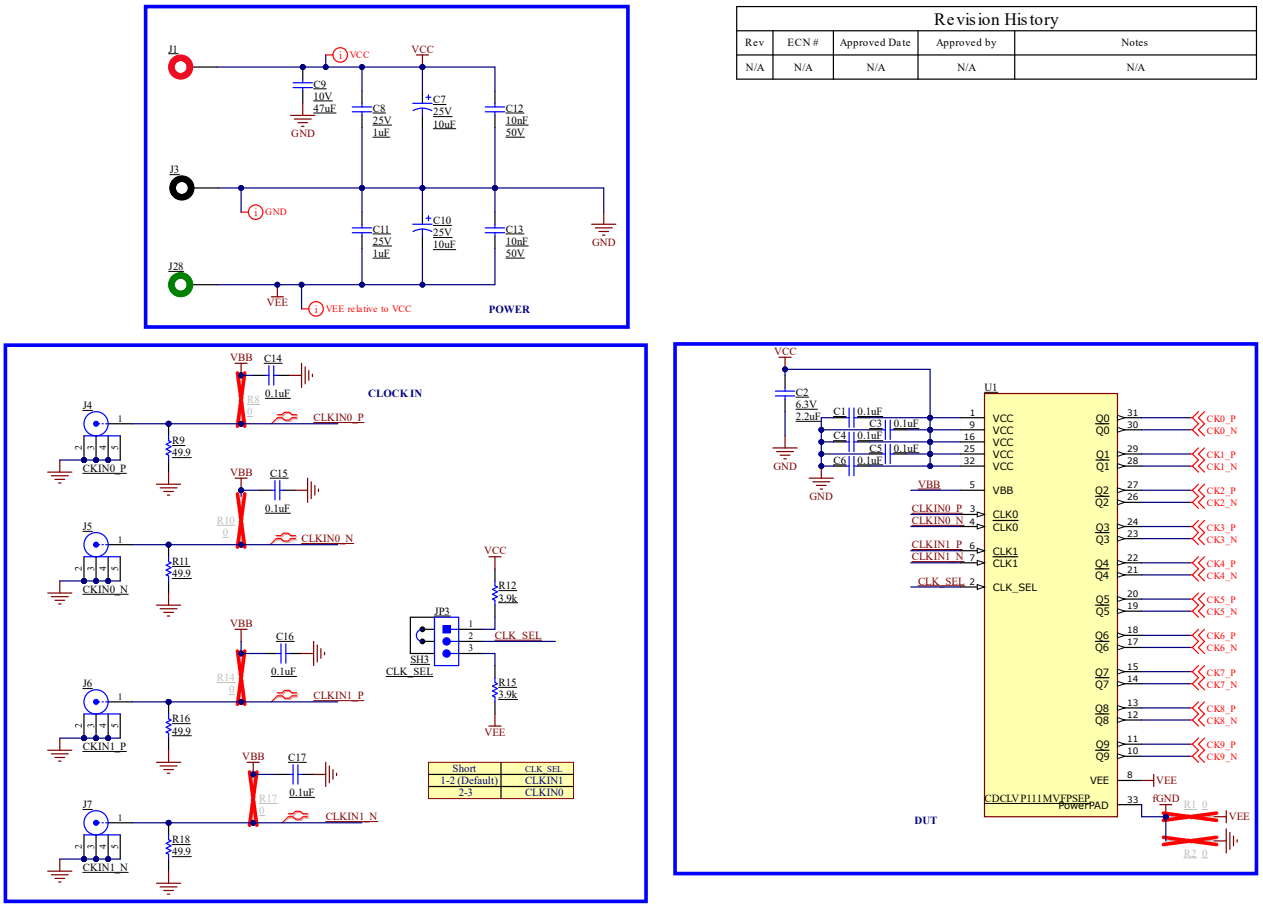

Figure 3-1. CDCLVP111-SEP Main Schematic

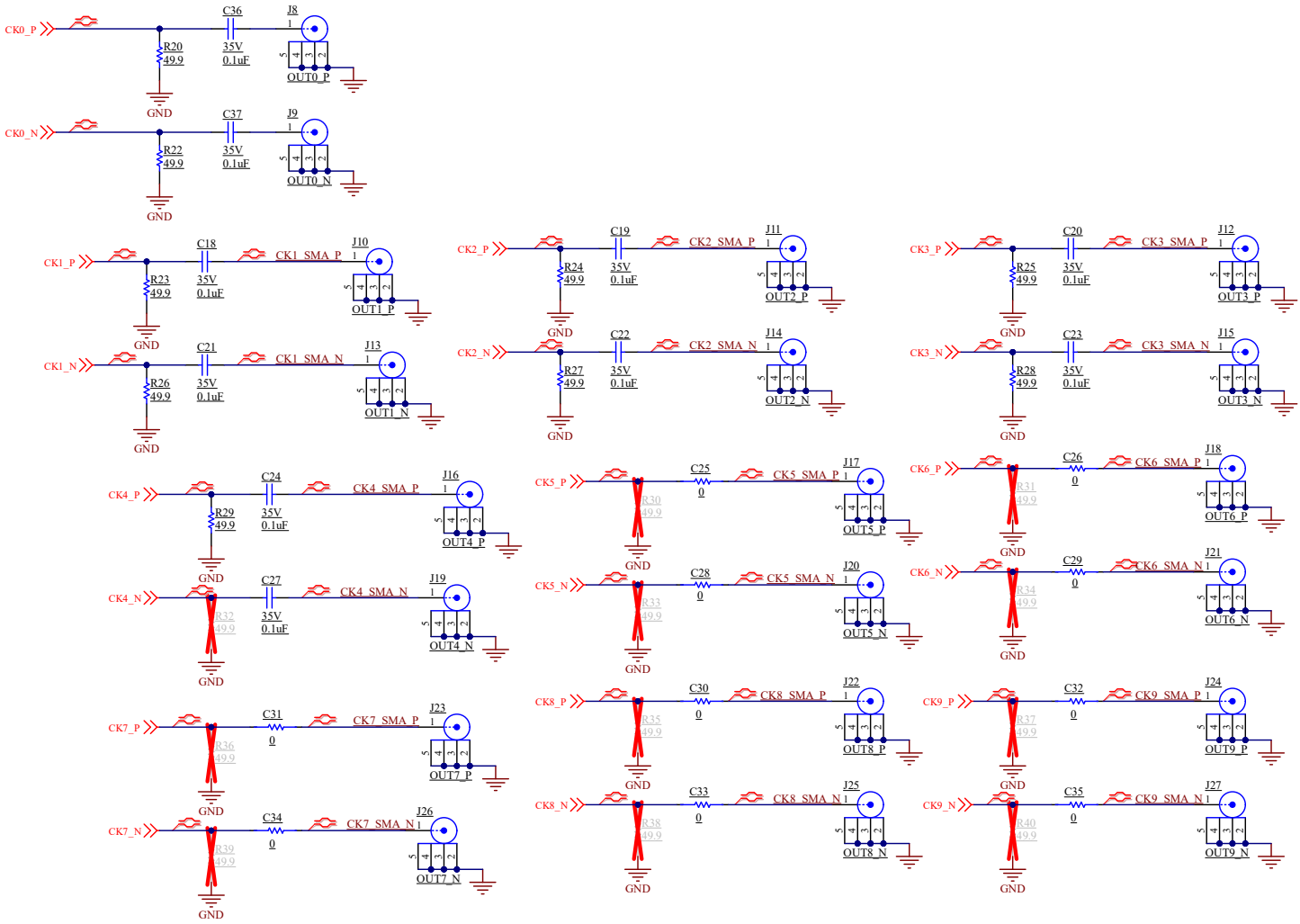

Figure 3-2. CDCLVP111-SEP Output Schematic

3.2 PCB Layouts

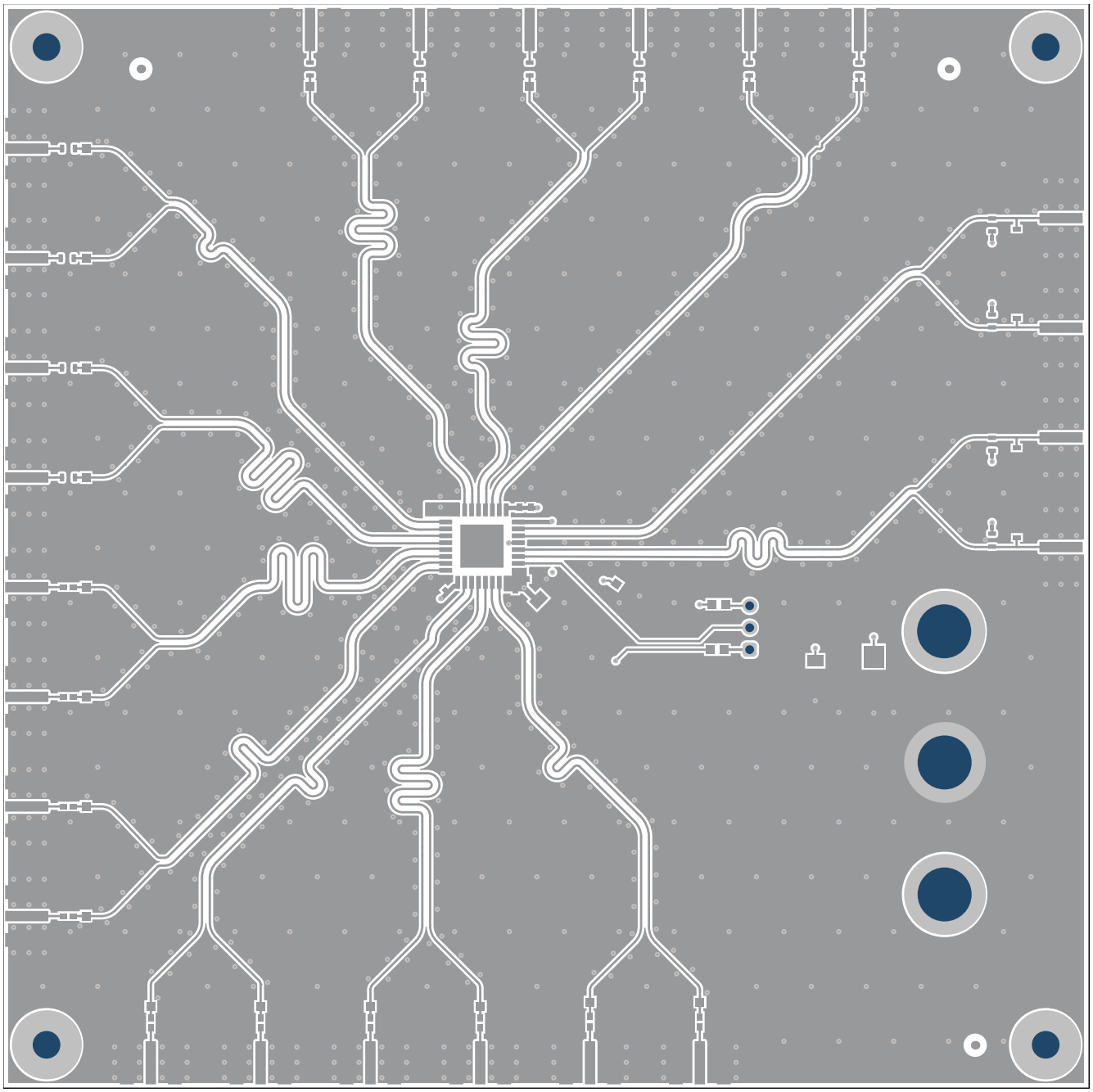

Figure 3-3. Top layer

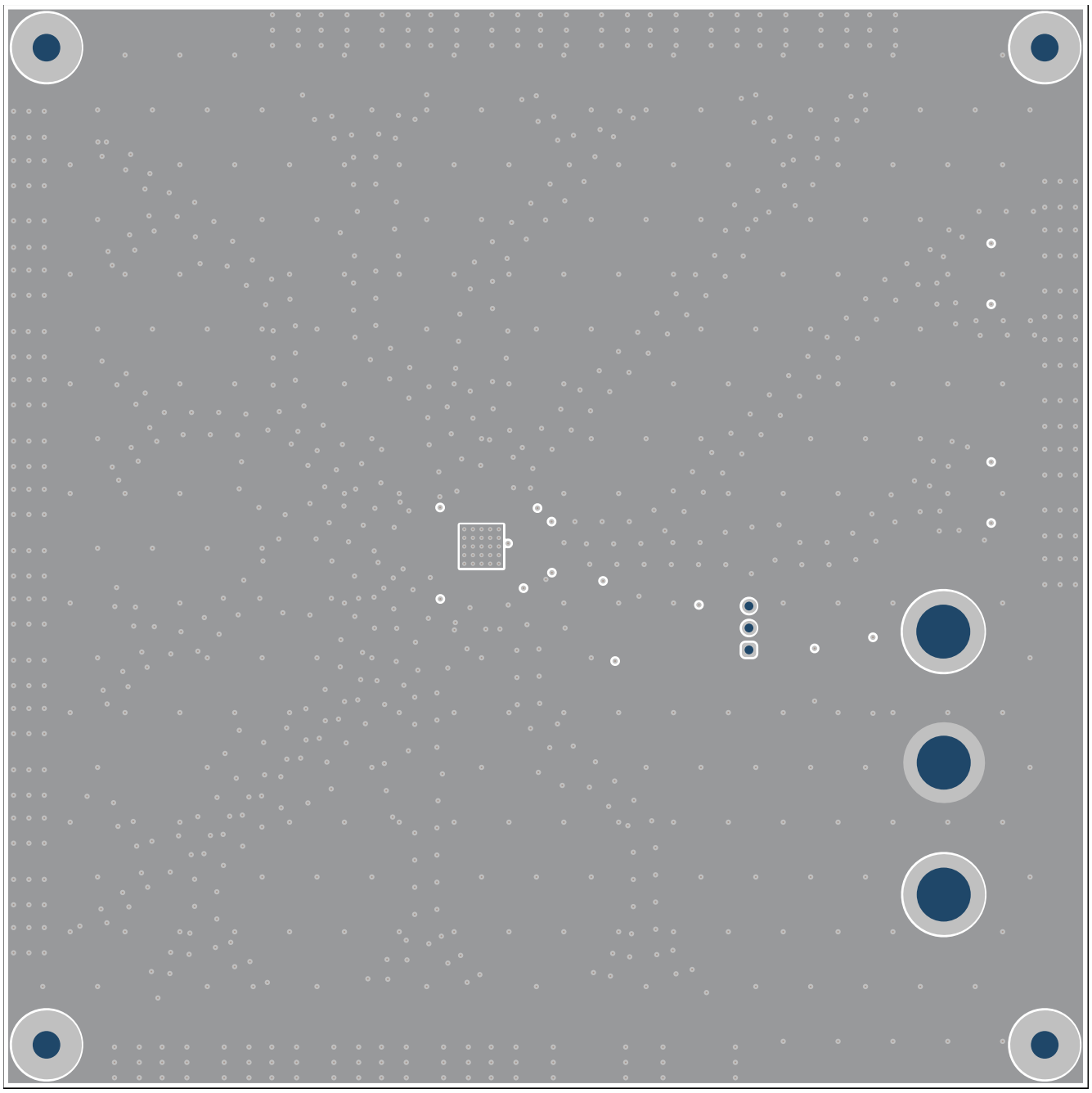

Figure 3-4. 2nd Layer - RF GND

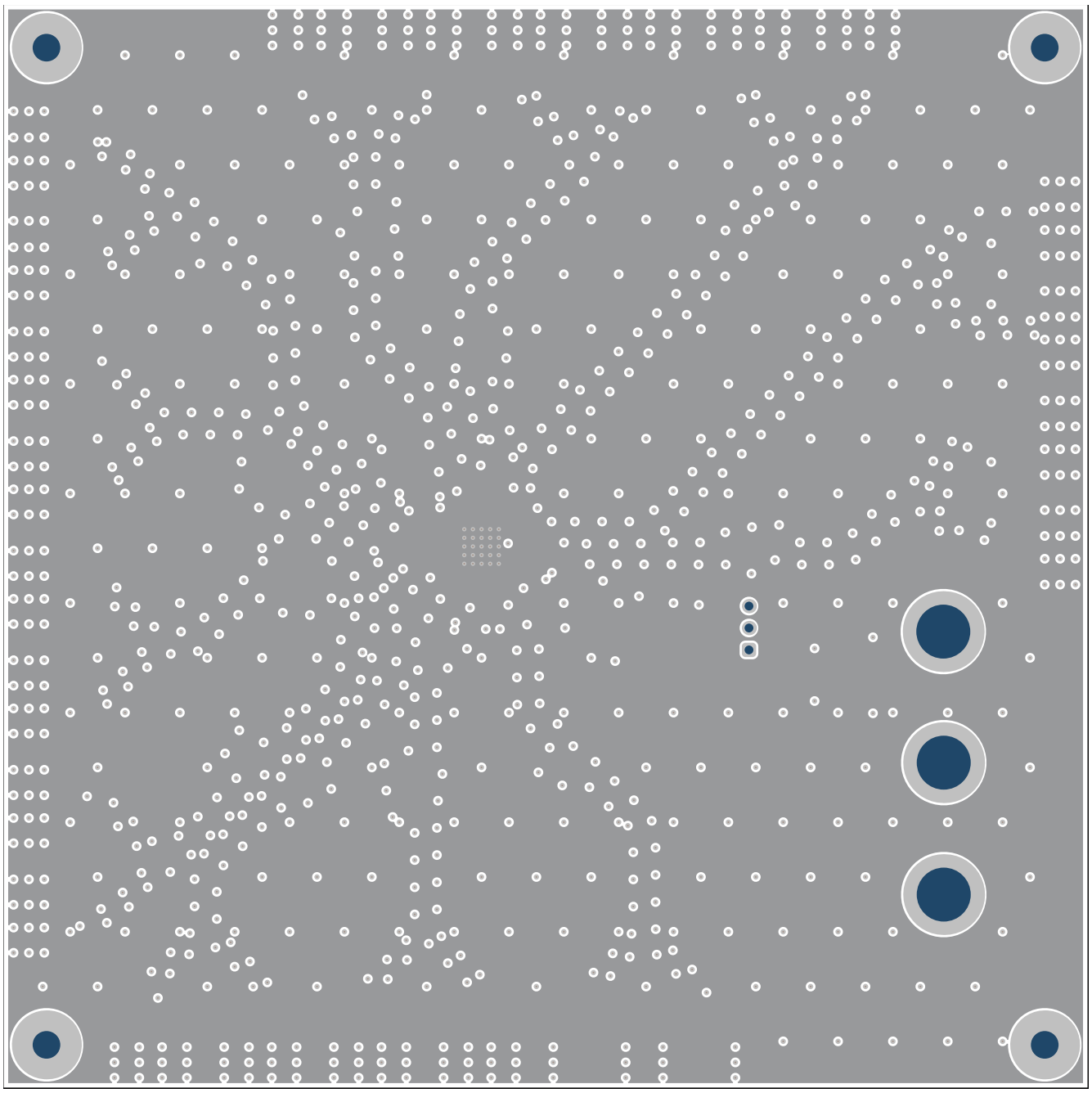

Figure 3-5. 3rd Layer - Heat Sink 1

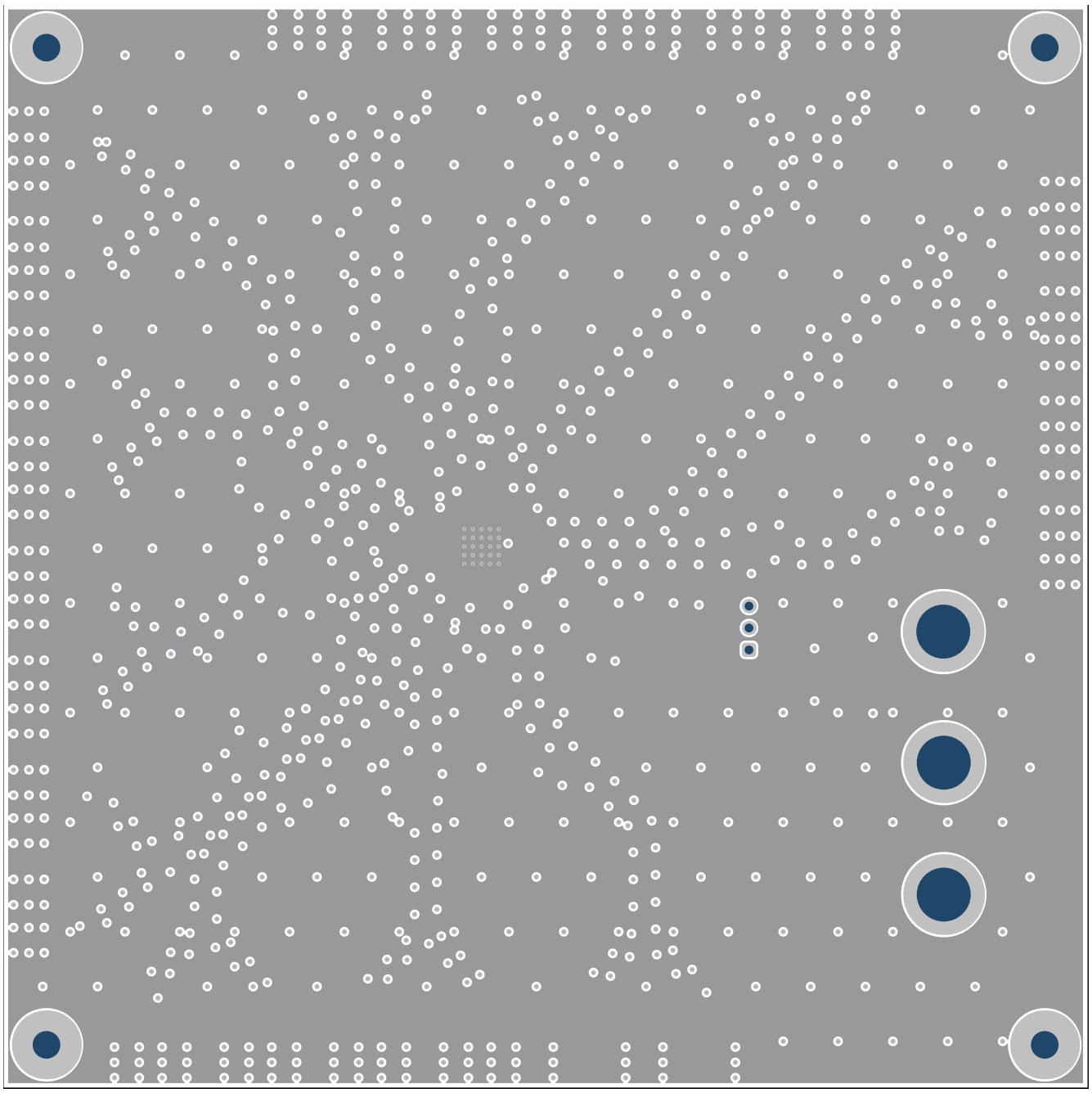

Figure 3-6. 4th Layer - Heat Sink 2

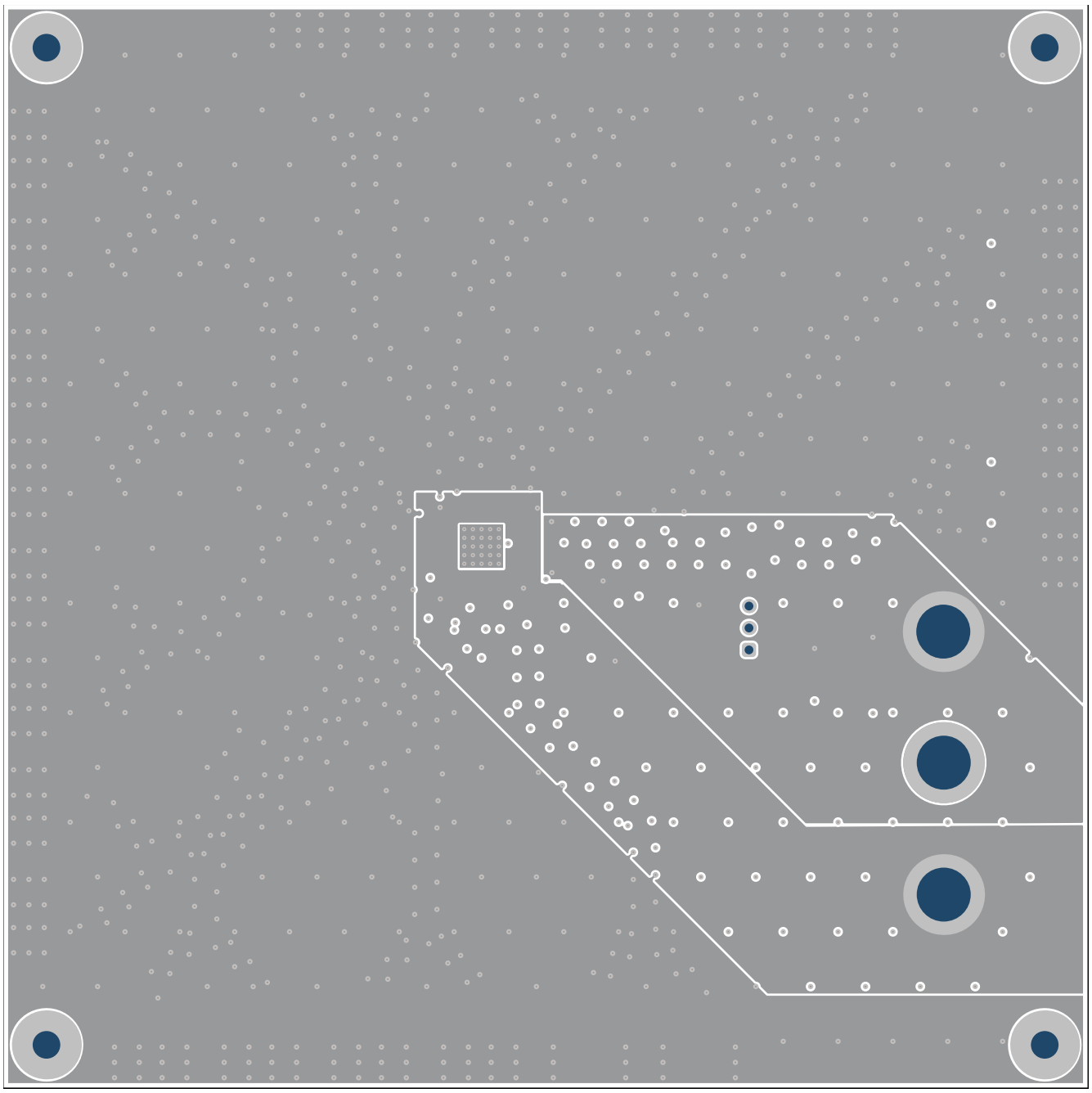

Figure 3-7. 5th Layer - Split Power Supplies

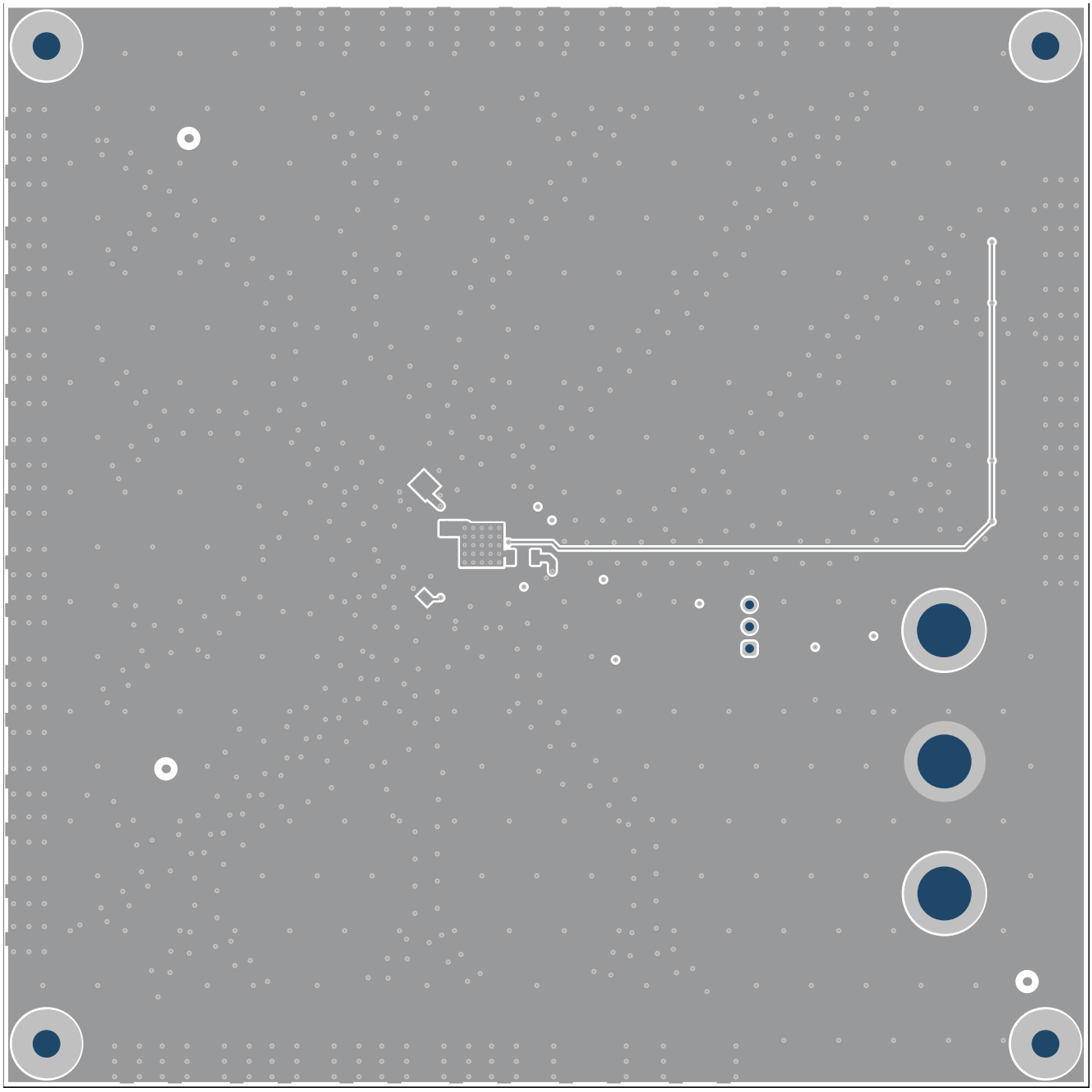

Figure 3-8. Bottom layer

Table 3-1. PCB Stack-up

Layer	Material	Thickness (mil)	ε_r
Top Layer	Copper	1.4	-
Dielectric	FR4	6	4.2
RF Ground	Copper	1.4	-
Dielectric	FR4	8	4.2
Heat Sink 1	Copper	1.4	-
Dielectric	FR4	24.8	4.2
Heat Sink 2	Copper	1.4	-
Dielectric	FR4	8	4.2
Split Power Supplies	Copper	1.4	-

Table 3-1. PCB Stack-up (continued)

Layer	Material	Thickness (mil)	ε_r
Dielectric	FR4	1.4	4.2
Bottom Layer	Copper	1.4	-

3.3 Bill of Materials (BOM)

Table 3-2 displays the BOM.

Table 3-2. Bill of Materials (BOM)

Designator	Description	Manufacturer	PartNumber
!PCB1	Printed Circuit Board	Any	DC388
C1, C3, C4, C5, C6, C14, C15, C16, C17	CAP, CERM, 0.1 uF, 10 V, +/- 10%, X7R, 0402	MuRata	GRM155R71A104KA01D
C2	CAP, CERM, 2.2 uF, 6.3 V, +/- 20%, X5R, 0402	MuRata	GRM155R60J225ME15D
C7, C10	CAP, TA, 10 uF, 25 V, +/- 20%, 1.5 ohm, SMD	Vishay-Sprague	293D106X0025C2TE3
C8, C11	CAP, CERM, 1 uF, 25 V, +/- 10%, X7R, 1206	TDK	C3216X7R1E105K085AA
C9	CAP, CERM, 47 uF, 10 V, +/- 10%, X5R, AEC-Q200 Grade 1, 1206	MuRata	GRT31CR61A476KE13L
C12, C13	CAP, CERM, 0.01 uF, 50 V, +/- 5%, X7R, 0603	Kemet	C0603C103J5RACTU
C18, C19, C20, C21, C22, C23, C24, C27, C36, C37	CAP, CERM, 0.1 uF, 35 V, +/- 10%, X5R, 0402	Taiyo Yuden	GMK105BJ104KV-F
C25, C26, C28, C29, C30, C31, C32, C33, C34, C35, R8, R10, R14, R17	CRCW Series 0603 0.1 W 0 Ohm Jumper Surface Mount Thick Film Chip Resistor	Vishay	CRCW06030000Z0EAC
FID1, FID2, FID3, FID4, FID5, FID6	Fiducial mark. There is nothing to buy or mount.	N/A	N/A
H1, H2, H3, H4	Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	B&F Fastener Supply	NY PMS 440 0025 PH
H5, H6, H7, H8	Standoff, Hex, 0.5"L #4-40 Nylon	Keystone	1902C
J1	Banana Jack BIL 20 Red, TH	Hirschmann	930 176-101
J3	Banana Jack BIL 20 Black, TH	Hirschmann	930 176-100
J4, J5, J6, J7, J8, J9, J10, J11, J12, J13, J14, J15, J16, J17, J18, J19, J20, J21, J22, J23, J24, J25, J26, J27	CONN SMA JACK STR EDGE MNT	RF Solutions Ltd.	CON-SMA-EDGE-S
J28	Banana Jack BIL 20 Green, TH	Hirschmann	930 176-104
JP3	Header, 100mil, 3x1, Gold, TH	Samtec	TSW-103-07-G-S
LBL1	Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	Brady	THT-14-423-10
R1, R2	0 Ohms Jumper 0.5W, 1/2W Chip Resistor 1206 (3216 Metric) - Metal Element	Keystone	5108

Table 3-2. Bill of Materials (BOM) (continued)

Designator	Description	Manufacturer	PartNumber
R9, R11, R16, R18	RES, 49.9, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW060349R9FKEA
R12, R15	RES, 3.9 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW06033K90JNEA
R20, R22, R23, R24, R25, R26, R27, R28, R29, R30, R31, R32, R33, R34, R35, R36, R37, R38, R39, R40	RES, 49.9, 0.1%, 0.1 W, 0603	Yageo America	RT0603BRD0749R9L
SH3	Shunt, 100mil, Gold plated, Black	Samtec	SNT-100-BK-G
U1	CDCLVP111MVFPSEP	Texas Instruments	CDCLVP111MVFPSEP

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   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, 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.

WARNING

Evaluation Kits 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 shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 *Regulatory Notices:*

3.1 *United States*

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

FCC NOTICE: 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 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. 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。

https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

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 to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

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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3. 技術基準適合証明を取得後ご使用いただく。

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上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・インスツルメンツ株式会社

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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。https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

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.

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