ADS5444/63/74-SP Evaluation Module Manual

1 Overview

This user's guide gives a general overview of the ADS5444/63/74 evaluation module (EVM) and provides a general description of the features and functions to be considered while using this module.

1.1 Purpose

The EVM provides a platform for evaluating the analog-to-digital converter (ADC) under various signal, reference, and supply conditions. This document should be used in combination with the EVM schematic diagram supplied.

1.2 EVM Basic Functions

Two analog inputs to the ADC are provided via external SMA connectors. One input path uses a pair of THS9001 amplifiers, while the other input is ac-coupled. In both cases, the user supplies a single-ended input, which is converted into a differential signal.

The EVM provides an external SMA connector for input of the ADC clock. The single-ended input is converted into a differential signal at the input of the device. Digital output from the EVM is via a high-speed, high-density Samtec output header.

Power connections to the EVM are via banana jack sockets. Separate sockets are provided for the ADC analog and digital supplies and for the differential amplifier supply.

1.3 Power Requirements

The EVM can be powered directly with only three supplies: a 3.3-V supply for both ADC analog and digital driver supply, and 5 V for the ADC analog supply.

CAUTION

Voltage Limits: Exceeding the maximum input voltages can damage EVM components. Undervoltage may cause improper operation of some or all of the EVM components.

1.4 ADS5463 EVM Operational Procedure

The ADS5463 EVM provides a flexible means of evaluating the ADS5463 in a number of modes of operation. A basic setup procedure that can be used as a board confidence check is as follows:

1. Verify all jumper settings against the schematic jumper list in Table 1.

Table 1. Three-Pin Jumper List

JUMPER	FUNCTION	LOCATION: PINS 1–2	LOCATION: PINS 2–3	DEFAULT
JP3	Provides AIN+ source to ADS5463	Source provided from differential amplifier	Source provided from T2	2–3
JP4	Provides AIN– source to ADS5463	Source provided from differential amplifier	Source provided from T2	2–3
JP20	ADC	ADS5444	ADS5463/74	2–3
J21	ADS5474 Power Down	ADS5474 Normal Operation	ADS5474 Power Down	1-2

2. Connect supplies to the EVM as follows:
   - 5 V (4.75 V–5.25 V) ADC analog supply to J12 and return to J9
   - 3.3 V (3 V–3.6 V) ADC analog supply to J14 and return to J9
   - 3.3 V (3 V–3.6V) ADC digital buffer supply to J7 and return to J8
3. Switch power supplies on.
4. Using a function generator with 50-W output, generate a 0-V offset, 1.5-Vpp sine-wave clock into J17. The frequency of the clock must be within the specification for the device speed grade.
5. Use a frequency generator with a 50-W output to provide a 15.5-MHz, 0-V offset, –1-dBFS-amplitude sine-wave signal into J11. This provides a transformer-coupled differential input signal to the ADC.
6. The digital pattern on output connector J5 should now represent a sine wave.

2 Circuit Description

2.1 Circuit Function

The following sections describe the function of individual circuits. Refer to the relevant data sheet for device operating characteristics.

2.1.1 Power

Power is supplied to the EVM via banana jack sockets. The EVM offers the capability to supply 5 V, 3.3 V analog, and digital 3.3 V independently. The heat slug is tied to AGND with multiple vias to provide for thermal dissipation. Table 2 offers a snapshot of the power-supply options. All supplies are required for default operation, except J18 and J19.

Table 2. EVM Power Supply Options

EVM BANANA JACK	DESCRIPTION
J7	ADS5463 3.3-V digital supply
J8	AGND
J9	AGND
J12	ADS5463 5-V analog supply
J14	ADS5463 3.3-V analog supply
J18	THS9001 5-V supply
J19	AGND

2.1.2 Clock Input

A single-ended square or sinusoidal clock input should be applied to J17. The clock frequency should not exceed 500 MHz. The clock input is converted to differential signal by a Coilcraft WBC4-1W, which has an impedance ratio of 4. It is important to note that voltage applied to J17 is stepped up by a factor of two.

2.1.3 Analog Inputs

The EVM can be configured to use either a balun-coupled input from a single-ended source. The inputs are provided via SMA connectors J11 for a balun coupled input the EVM must be configured as follows:

- For a 1:1 transformer-coupled input to the ADC, a single-ended source is connected to J11. JP3 has pins 1 and 2 shorted, and JP4 has pins 2 and 3 shorted. This is the default configuration for the EVM. The MACOM ETC1-1-13 forms an inherent band-pass filter with a pass band from 4 MHz to 1 GHz, with no more then 1dB insertion loss. A dual balun configuration has been provided which can improve harmonic distortion performance at higher input frequencies (100 MHz+). It should be noted that excellent results have also been obtained using a single Mini-Circuits JTX4-10T transformer. Transformers can be used in place of the baluns, in which case C58 and C77 can be replaced with 0-W resistors, as the ADC features a self-biased input. When choosing a balun or transformer, it is important to take careful consideration of its amplitude and phase performance. Circuit placeholders L7, C88, and C68 are provided if impedance matching is needed at a specific frequency. By default, these are not populated. The termination resistors have been tuned to represent a broadband 50-W impedance over the first two Nyquist zones.

2.1.4 Digital Outputs

The LVDS digital outputs can be accessed through the J5 output connector. A parallel 100-W termination resistor must be placed at the receiver to properly terminate each LVDS data pair. The supplied logic analyzer breakout board includes the 100-W terminations at the logic analyzer probe point. If using the logic analyzer breakout board, Table 3 use for configuration details. When using a logic analyzer, the ADC DRY clock used to latch in the data must be configured in the DDR mode.

Table 3. Output Connector J5

EVM NET DESCRIPTION	BREAKOUT BOARD SCHEMATIC NET NAME	LOGIC ANALYZER DEFAULT ASSIGNMENTS USING BREAKOUT BOARD
No Connect	D0	D[0] - Ignore
OVR	D1	D[1] - Ignore
MSB	D2	D[2] - MSB
MSB-1	D3	D[3]
MSB-2	D4	D[4]
MSB-3	D5	D[5]
MSB-4	D6	D[6]
MSB-5	D7	D[7]
MSB-6	D8	D[8]
MSB-7	D9	D[9]
MSB-8	D10	D[10]
MSB-9	D11	D[11]
MSB-10	D12	D[12]
MSB-11 (LSB - ADS5463)	D13	D[13]
MSB-12 (LSB - ADS5444)	D14	D[14]
MSB-13 (LSB - ADS5474)	D15	D[15]

2.2 Test Points

The EVM provides access to the ADC VREF voltage through TP1.

2.3 ADC Options

The EVM layout has been designed to showcase the family migration ability. Customers can easily design one layout to accommodate both the ADS5463 and the ADS5444.

- To use the ADS5444 device on this EVM, one must set jumper J20 to short pins 1–2, which connects 5 V to the digital output buffer of the device. To use the ADS5463/74 connect jumper J20 to short pins 2–3.
- The ADS5474 has several modes the ADS5444/63 ADCs do not have. Pin 31 becomes a VCM and pin 35 becomes a power down when asserted high. In the case of the ADS5444/63, these pins can be left unconnected or grounded.

3 Physical Description

This chapter describes the physical characteristics and PCB layout of the EVM.

3.1 PCB Layout

The EVM is constructed on a 6-layer, 0.062-inch thick PCB using FR-4 material. The individual layers are shown in Figure 1 through Figure 7. The layout features a common ground plane; however, similar performance can be had with careful layout using a split ground plane.

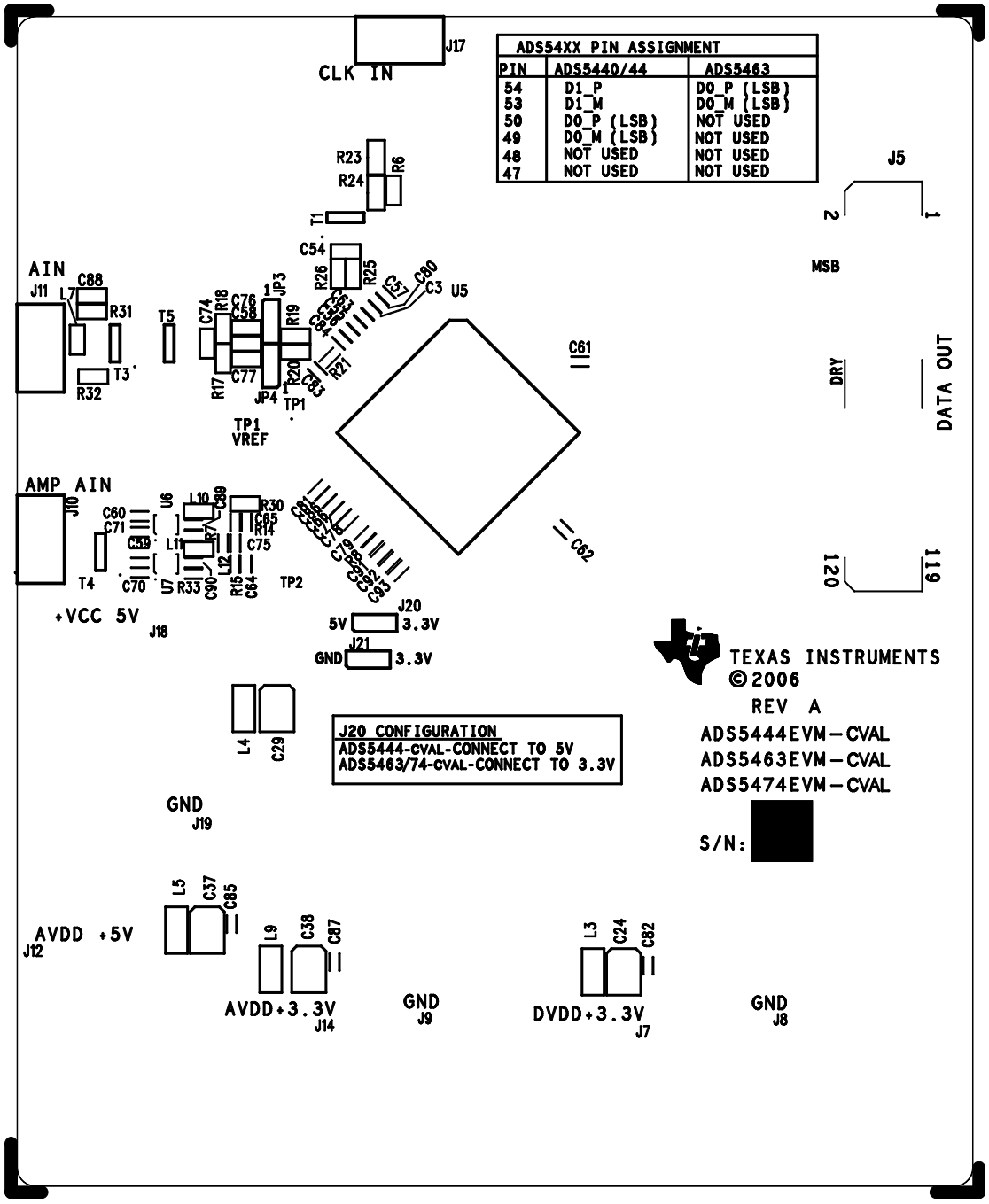


Figure 1. Top Silkscreen

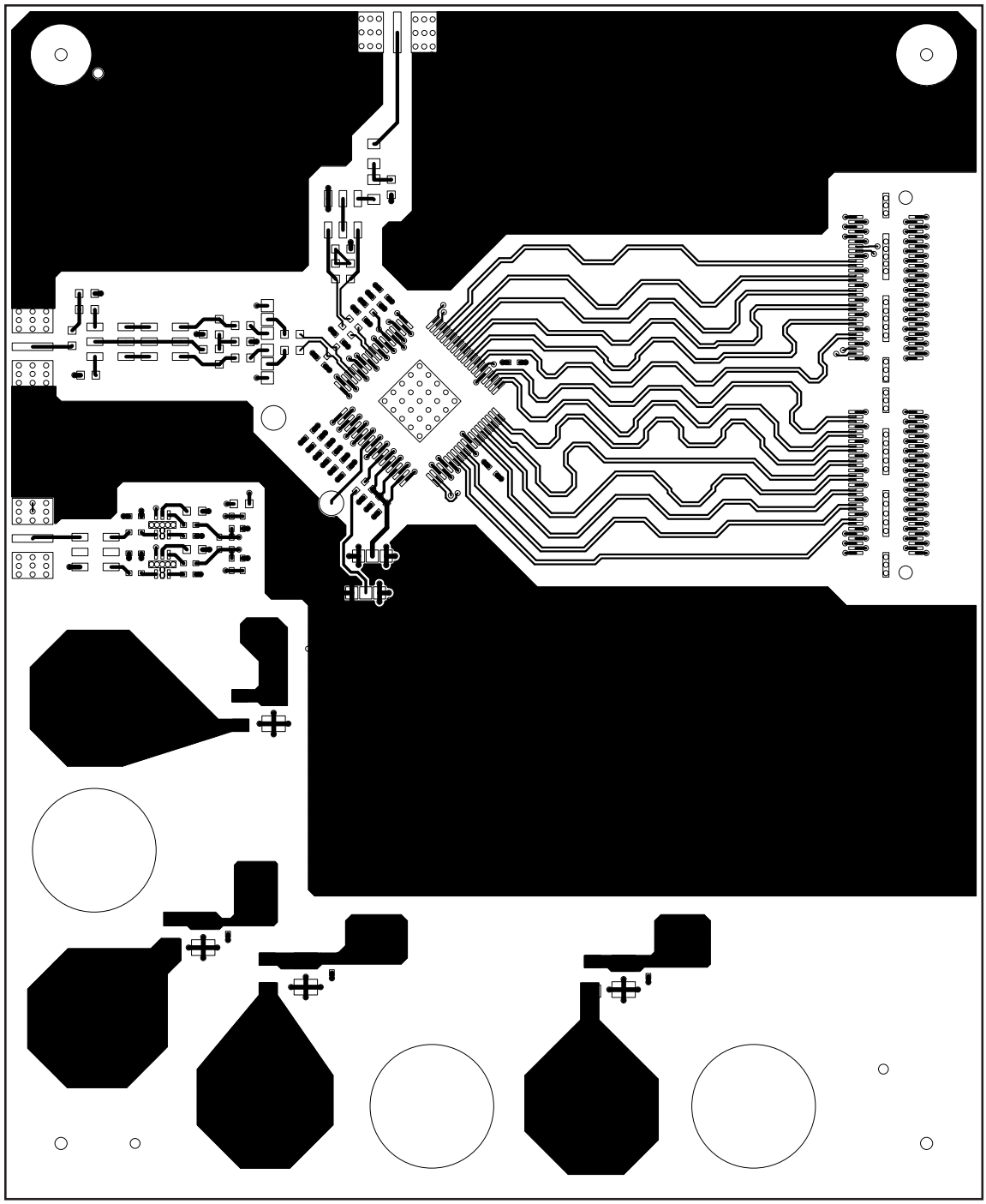


Figure 2. Component Side

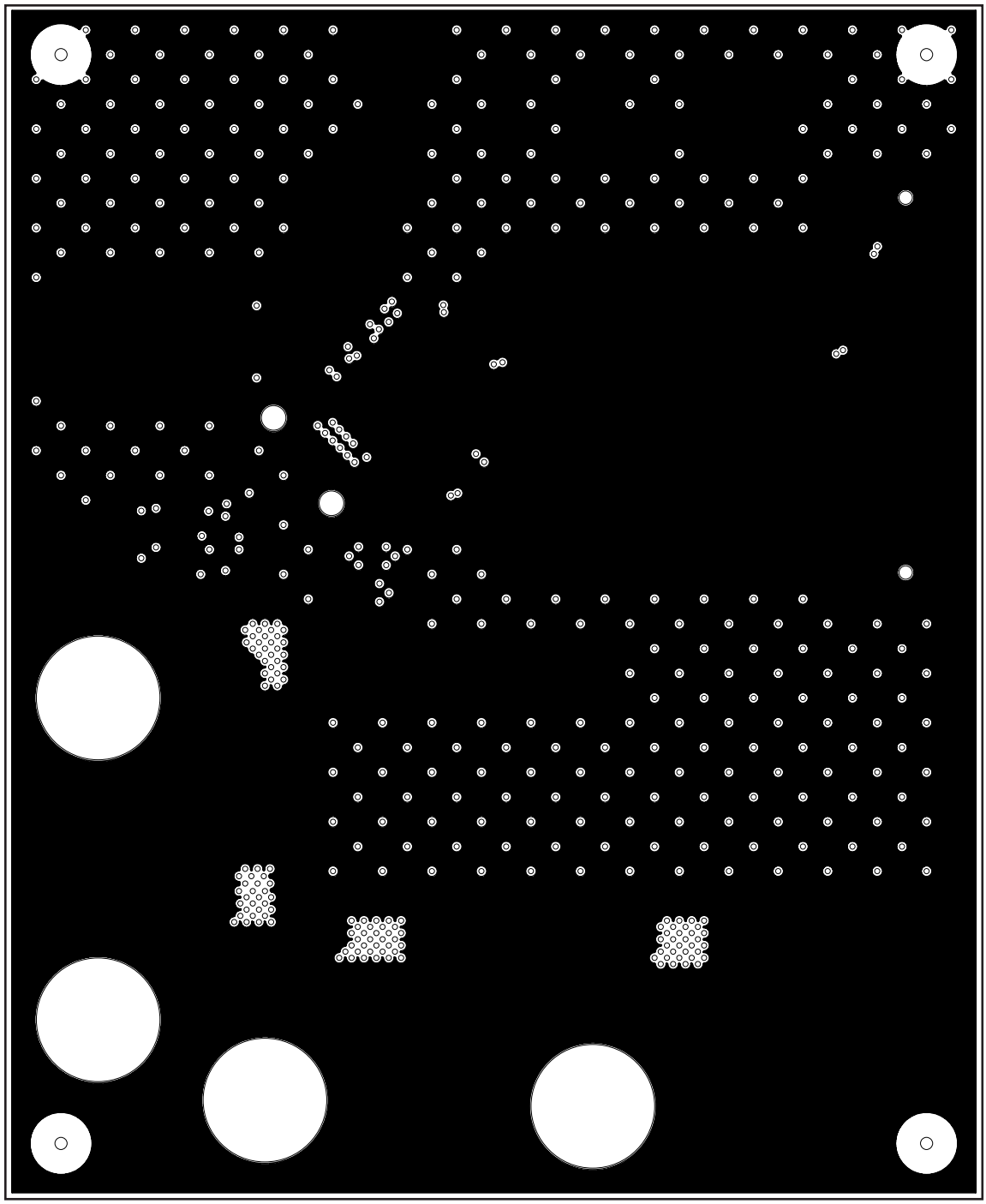


Figure 3. Ground Plane 1

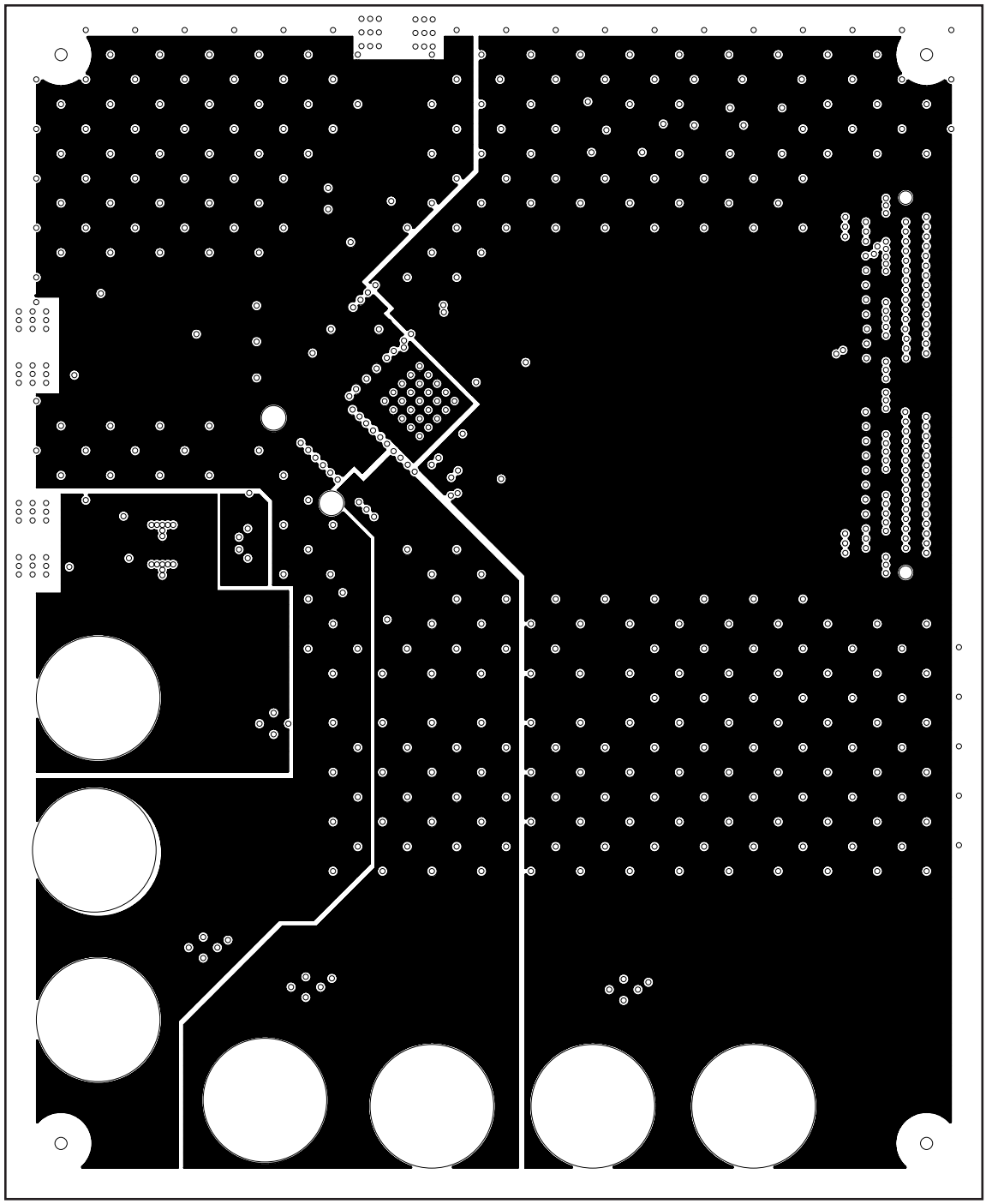


Figure 4. Power Plane 1

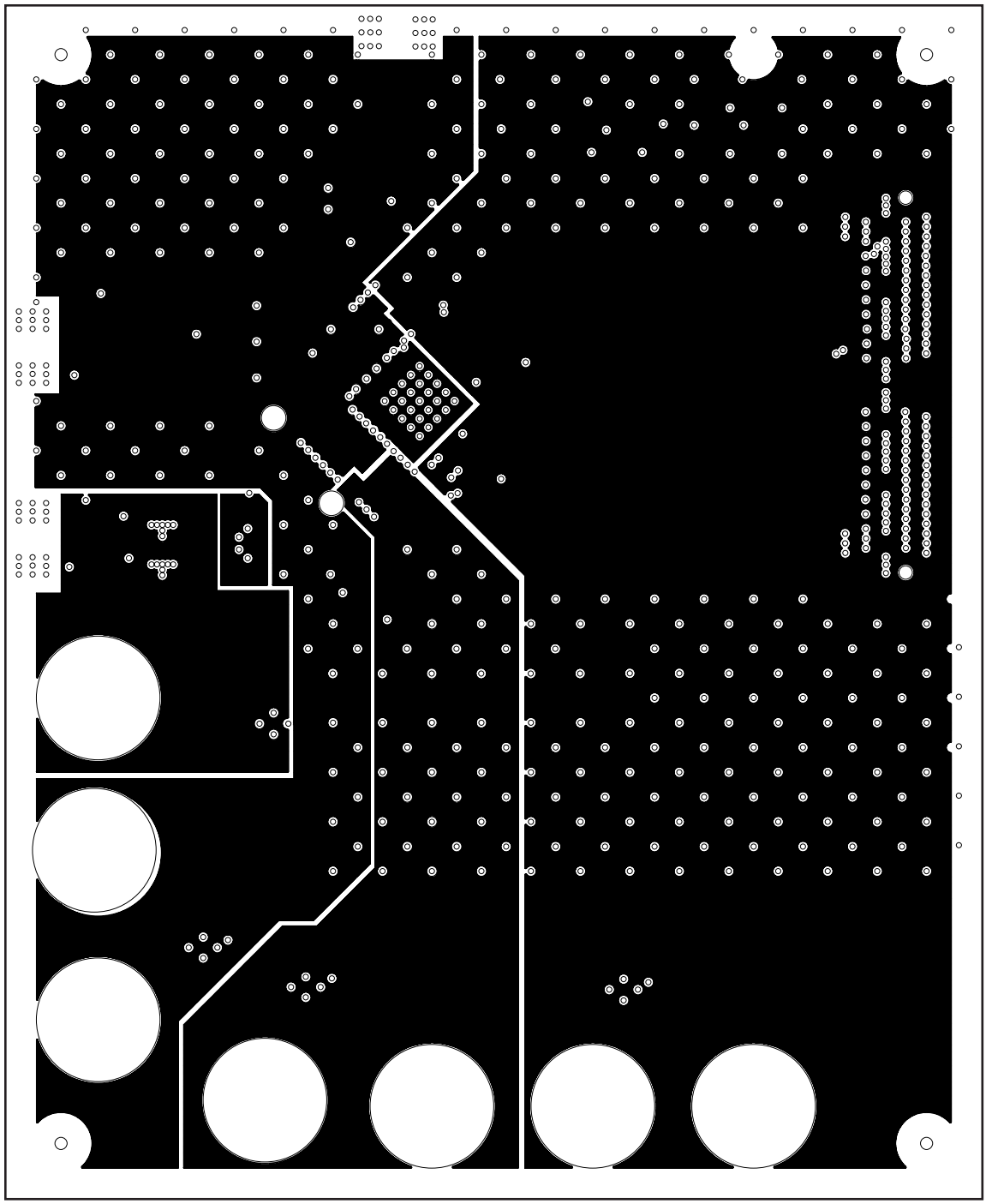


Figure 5. Power Plane 2

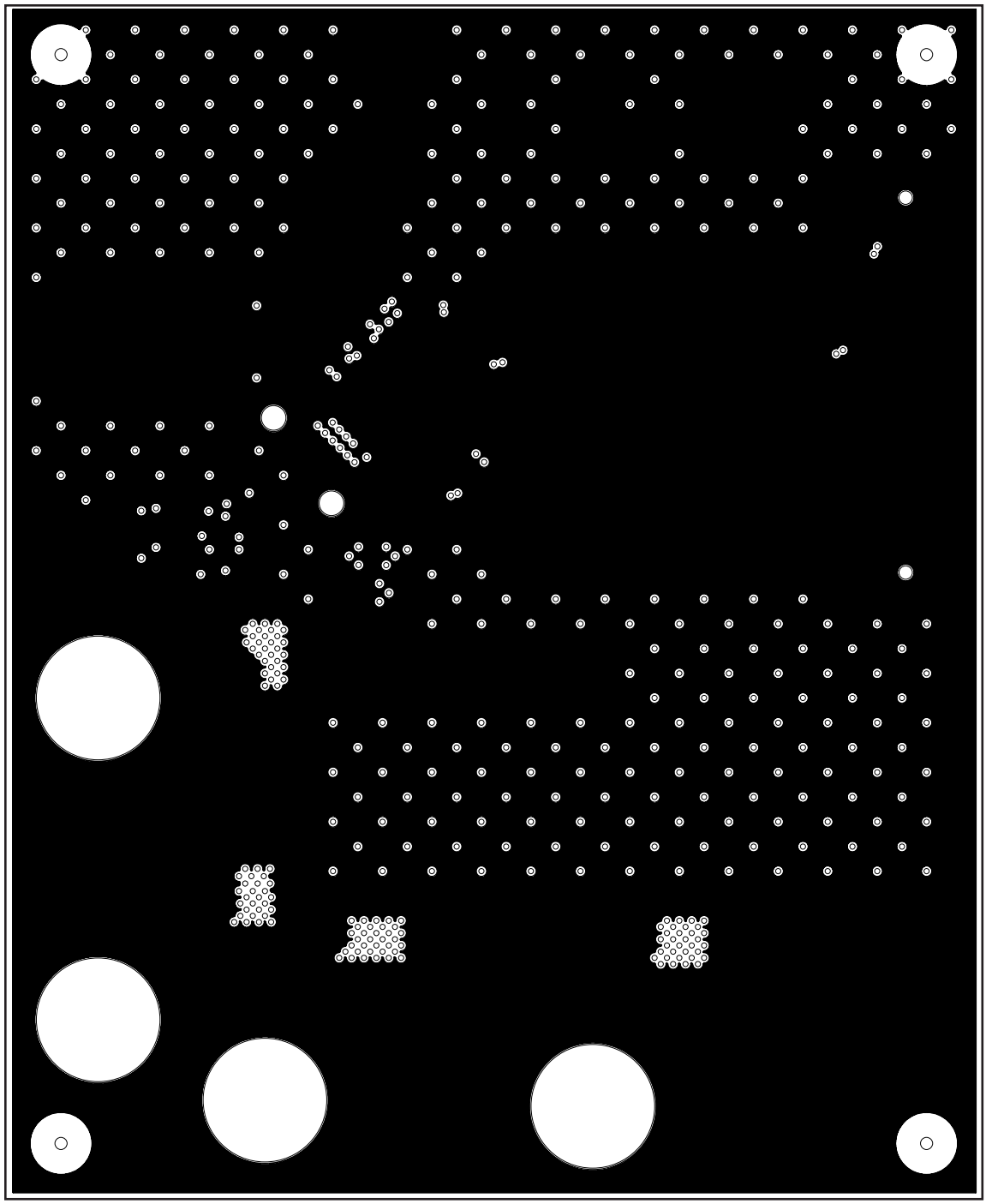


Figure 6. Ground Plane 2

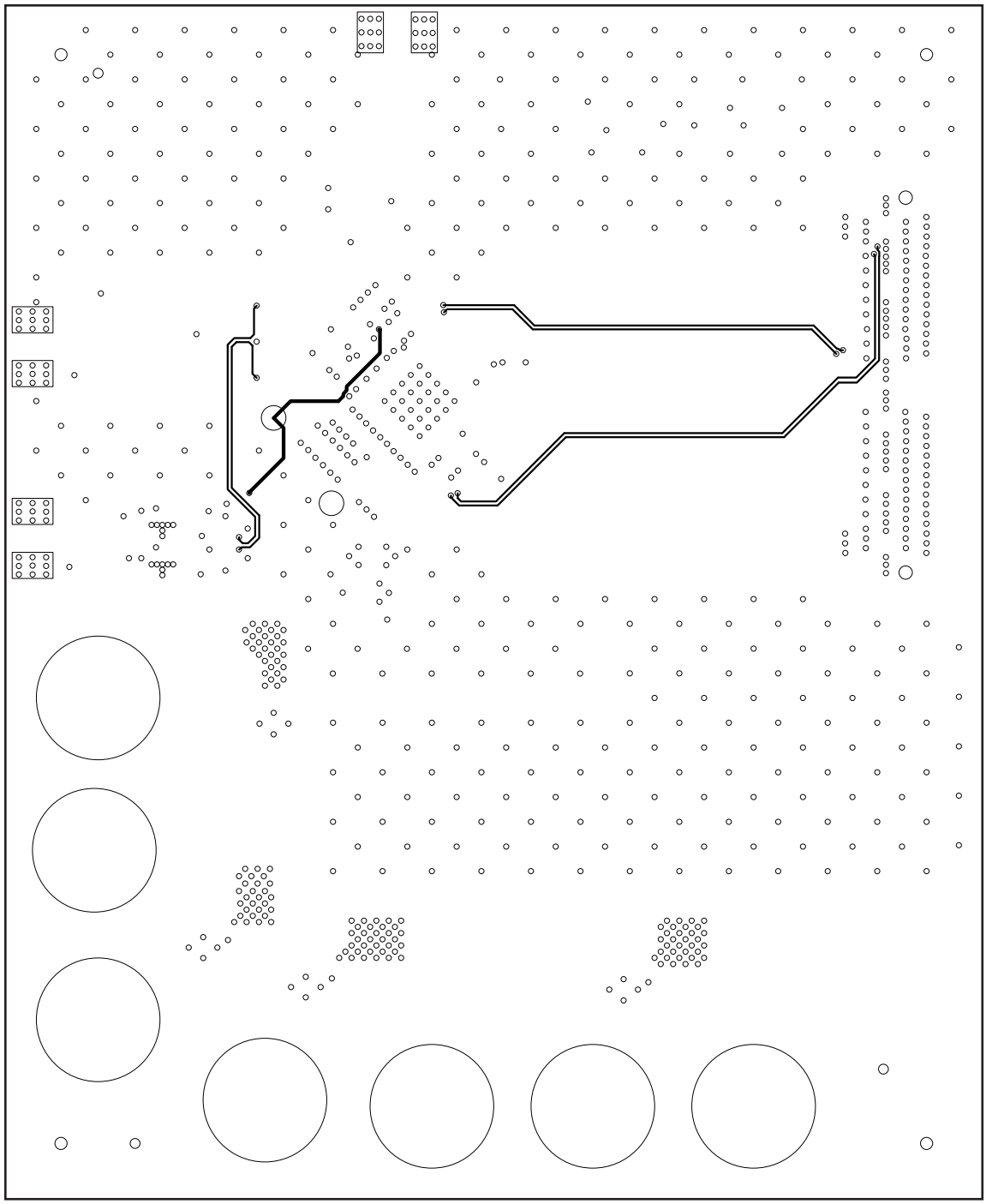
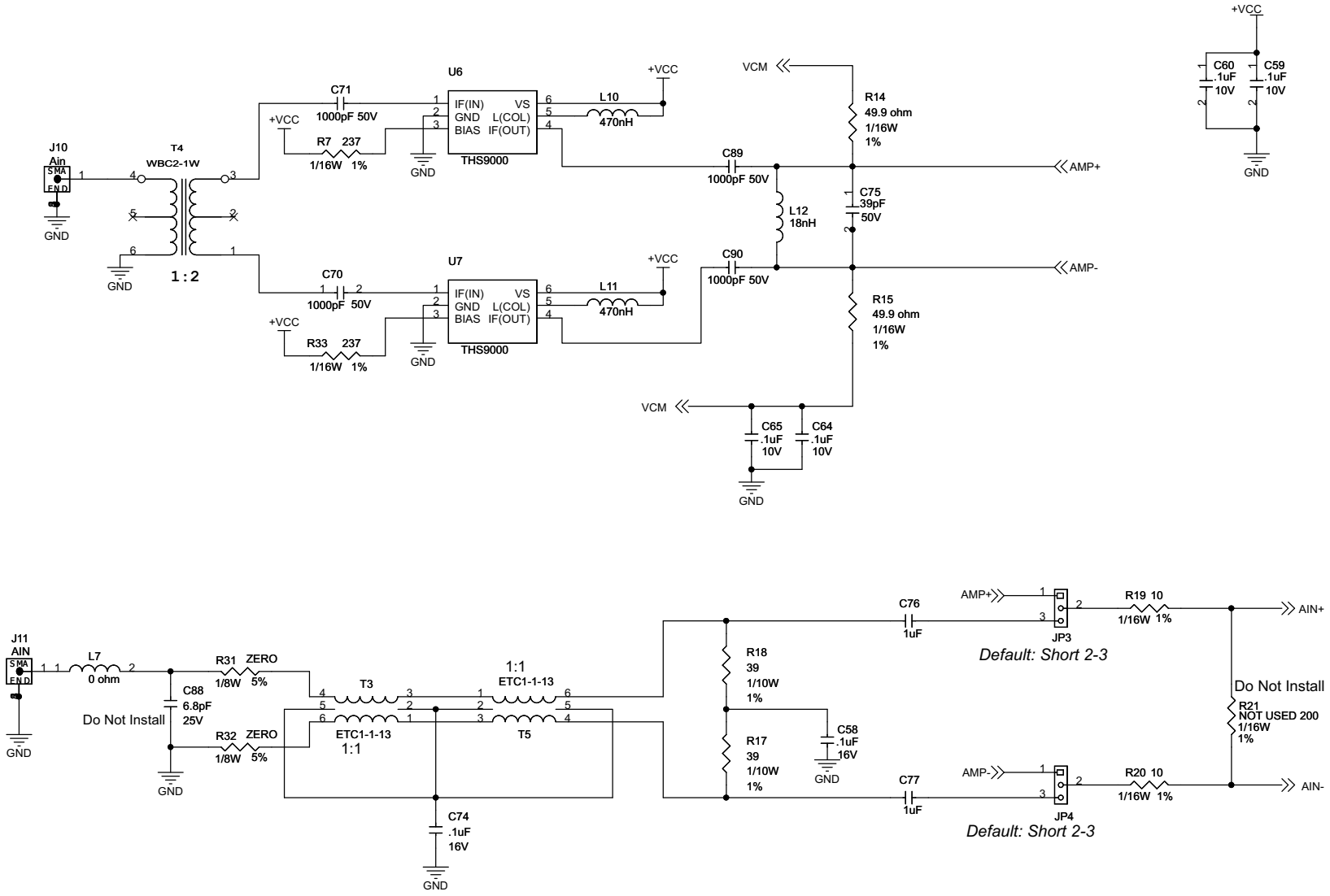


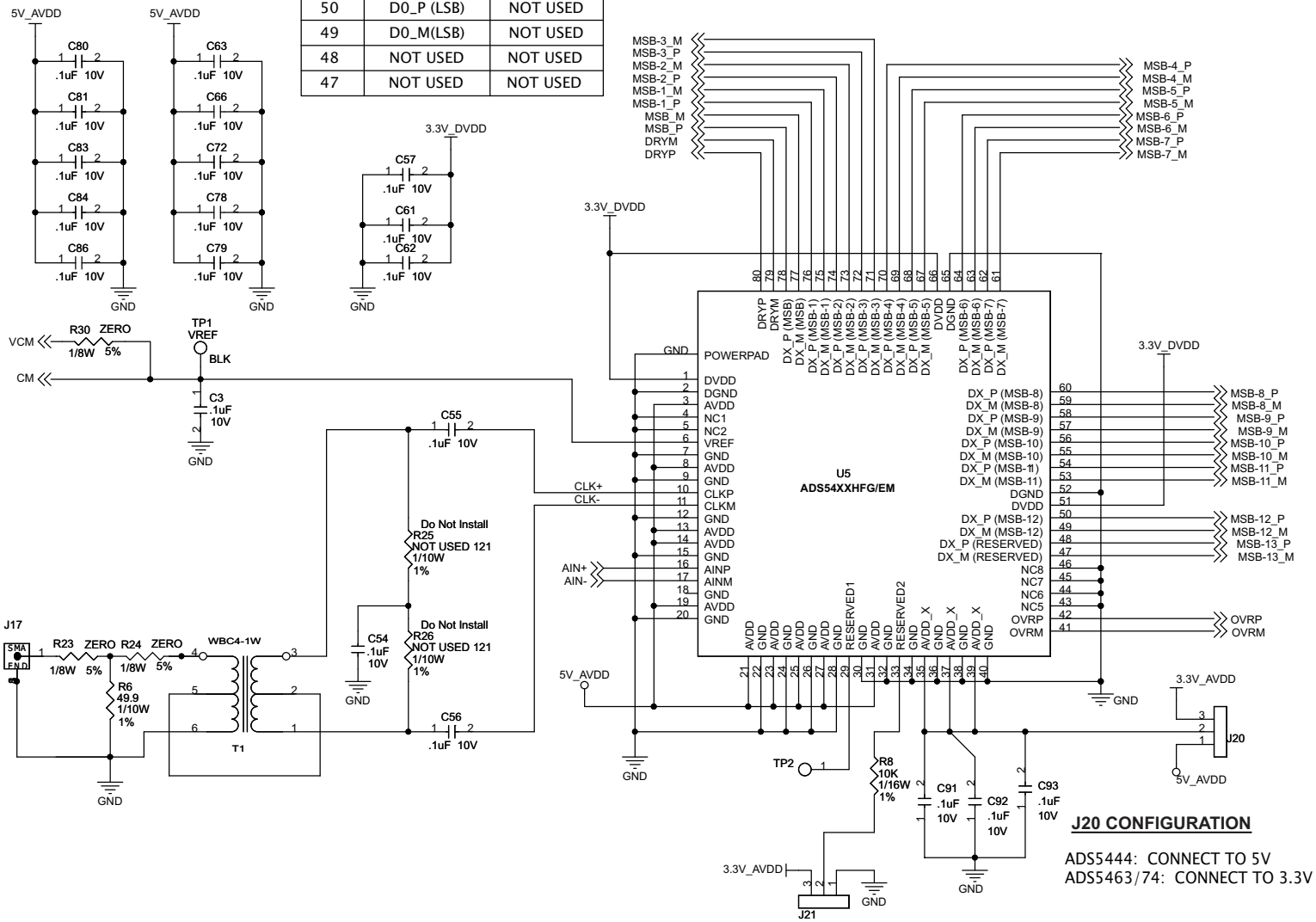
Figure 7. Bottom Side

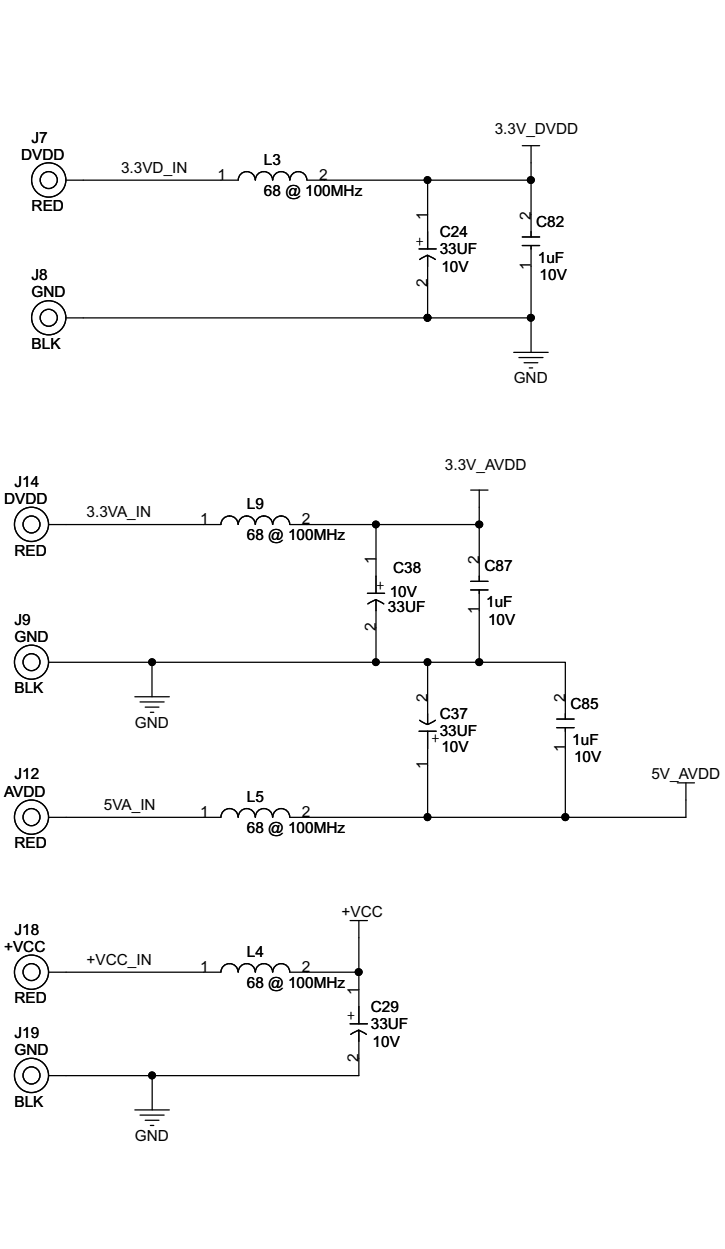
4 Schematics

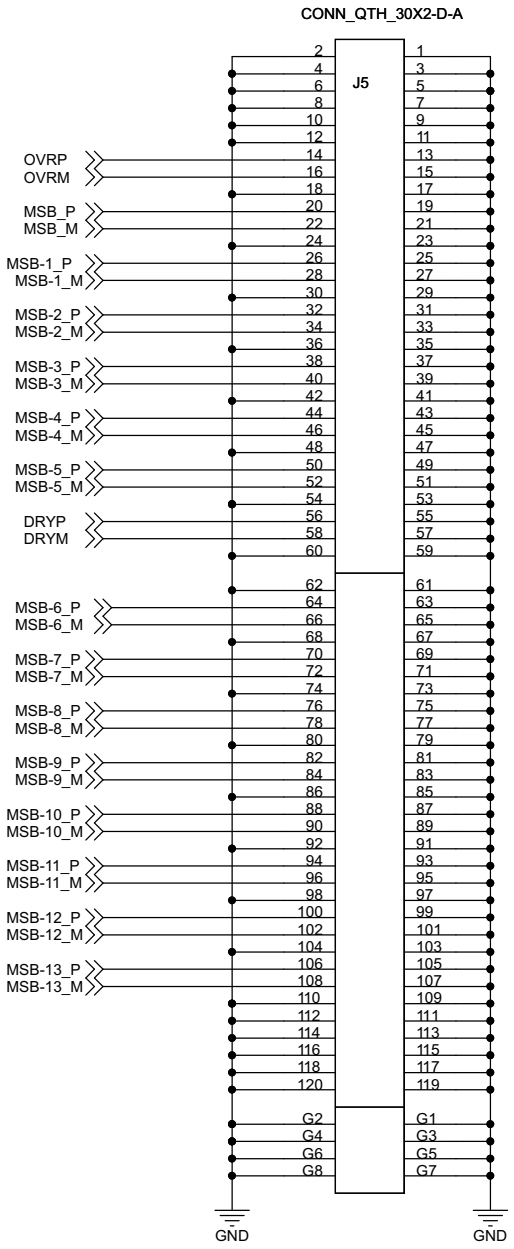
See the following pages for the ADS5444/63/74 schematics.

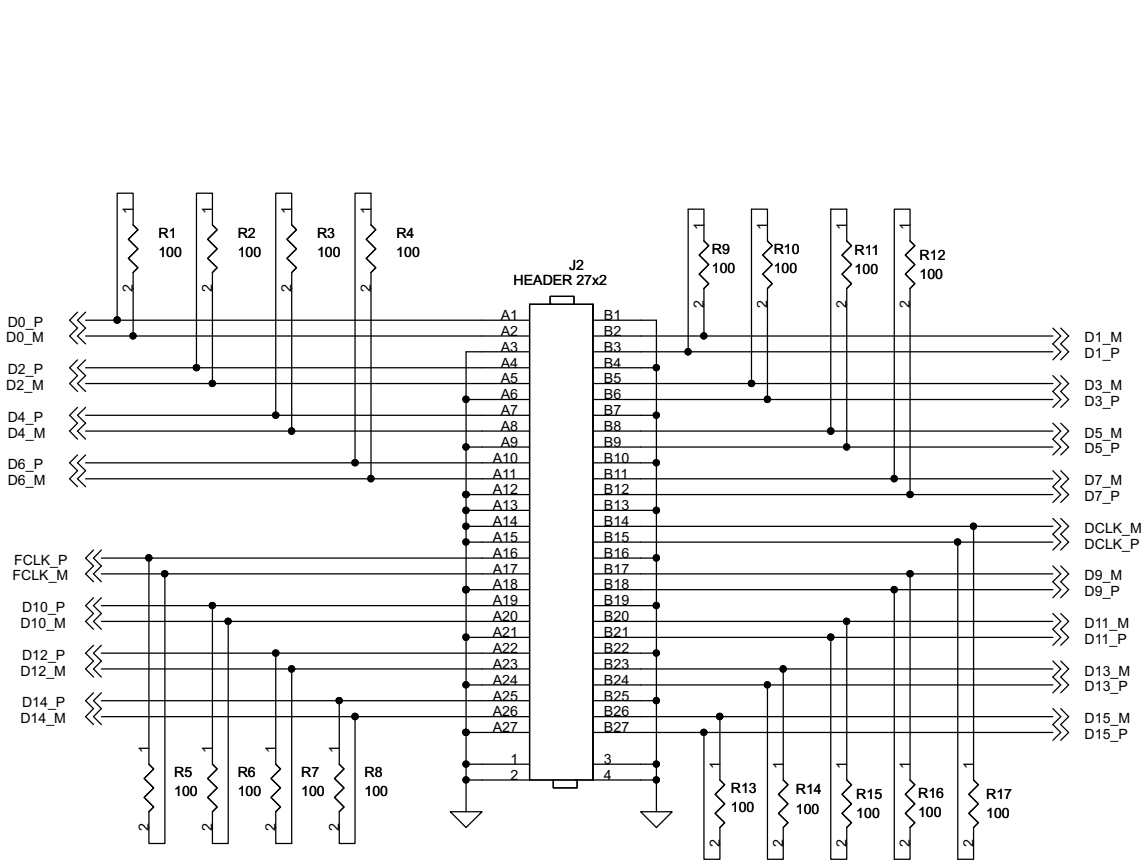


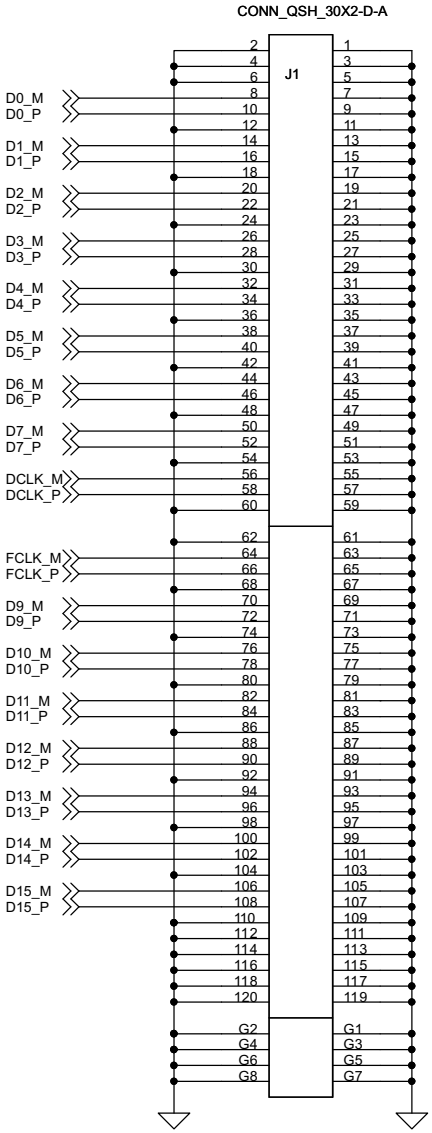
ADS54XX PIN ASSIGNMENT		
PIN #	ADS5444	ADS5463
54	D1_P	D0_P (LSB)
53	D1_M	D0_M(LSB
50	D0_P (LSB)	NOT USED
49	D0_M(LSB)	NOT USED
48	NOT USED	NOT USED
47	NOT USED	NOT USED











5 Bill of Materials

ITEM	QUANTITY	DESIGNATOR	VALUE	DESCRIPTION	PKG/CASE	MANUFACTURER	PART NUMBER
1	23	C3, C55, C56, C57, C59, C60, C61, C62, C63, C64, C65, C66, C72, C78, C79, C80, C81, C83, C84, C86, C91, C92, C93	0.1 uF	10%, 10V	0402	Panasonic	ECJ-0EB1A104K
2	4	C24, C29, C37, C38	33 uF	20%, 10V	TANT_B	Epcos Inc	B45196H2336M209
3	1	C54	0.1 uF	10%, 10V	0603	Kemet	C0603C104K8RACTU
4	2	C58, C74	0.1 uF	10%, 16V	0603	Panasonic	ECJ-1VB1C104K
5	4	C70, C71, C89 ,C90	1000 pF	10%, 50V	0402	Panasonic	ECJ-0EB1H102K
6	1	C75	39 pF	5%, 50V	0402	Panasonic	ECJ-0EC1H390J
7	2	C76, C77	1 uF	10%, 10V	0603	Panasonic	ECJ-1VB1A105K
8	3	C82, C85, C87	1 uF	20%, 10V	0402	Panasonic	ECJ-0EB1A105M
9	2	JP3, JP4	0 Ω	Jumper 1x3 SMT	0603	See (1)	
10	1	J5		Data connector, QTH_30X2-D-A		Samtec	QTH-060-02-F-D-A
11	4	J7, J12, J14, J18		Red banana jack, THVT, 500 dia		Allied Electronics	ST-351A
12	3	J8, J9, J19		Black banana jack, THVT, 500 dia		Allied Electronics	ST-351B
13	3	J10, J11, J17		SMA_END_RND, RECP 250x250		Johnson Components	142-0711-821
14	1	J20	0 Ω	SJP3 jumper	0603	See (2)	
15	1	J21	0 Ω	SJP3 jumper	0603	See (3)	
16	4	L3, L4, L5, L9	68 @ 100MHz		1206	Panasonic	EXC-ML32A680U
17	1	L7	0 Ω	5%, 1/4W	0603	Panasonic	ERJ-3GEY0R00V
18	2	L10, L11	470 nH	5%	0604	Murata	LQW18ANR47J00D
19	1	L12	18 nH	5%	0402	Murata	LQW15AN18NJ00D
20	1	R6	49.9 Ω	1%, 1/10W	0603	Panasonic	ERJ-3EKF49R9V
21	2	R7, R33	237 Ω	1%, 1/16W	0402	Panasonic	ERJ-2RKF2370X
22	1	R8	10 kΩ	1%, 1/16W	0402	Panasonic	ERJ-2RKF1002X
23	2	R14, R15	49.9 Ω	1%, 1/16W	0402	Panasonic	ERJ-2RKF49R9X
24	2	R17, R18	39 Ω	1%, 1/10W	0603	Panasonic	RC0603FR-0739RL
25	2	R19, R20	10 Ω	1%, 1/16W	0603	Panasonic	ERJ-3EKF10R0V
26	2	R23, R24	0 Ω	5%, 1/8W	0805	Panasonic	ERJ-6GEY0R00V
27	3	R30, R31, R32	0 Ω	5%, 1/8W	0603	Panasonic	ERJ-3GEY0R00V
28	1	TP1		Test point, black, THVT 100 RND		Keystone	5001
29	1	TP2		Test point, white, THVT 100 RND		Keystone	5002
30	1	T1	WBC4-1W		XFMR_WBC4-1W	Coilcraft	WBC4-1WL
31	2	T3, T5	ETC1-1-13		XFMR_WBC4-1W	Macom	ETC1-1-13
32	1	T4	WBC2-1W		XFMR_WBC4-1W	Coilcraft	WBC2-1TL

(1) Short pins 2 and 3 for both, JP3 and JP4 using a 0-Ω resistor.
(2) Connect middle pin to 5 V for J20 using a 0-Ω resistor for the ADS5444EVM-CVAL and to 3.3 V for the ADS5463/74EVM-CVAL.
(3) Connect middle pin to ground for J21 using a 0-Ω resistor.

ITEM	QUANTITY	DESIGNATOR	VALUE	DESCRIPTION	PKG/CASE	MANUFACTURER	PART NUMBER
33	1	U5	ADS54xxHFG/EM		CQFP_84_0.25Mil	Texas Instruments	ADS54xxHFG/EM
34	2	U6, U7	THS9000DRDR	RF amp IC	SON_DRD6	Texas Instruments	THS9000DRDT
35	1		HREL003	PCB board		Texas Instruments	ADS5474EVM-CVAL
36	4			Legs, spacer, 5/8", #8-32, 0.187" thru		Keystone Electronics	1827
37	4			Leg fastener screw, #8-32 panhead, 0.187" thru		B&F Fastener Supply	PMS 832 0038 PH
38	0	C88	6.8 pF	0.25pF, 25V	0603	Panasonic	ECD-G0E6R8C
39	0	R21	200 Ω	1%, 1/16W	0402	Panasonic	ERJ-2RKF2000X
40	0	R25, R26	121 Ω	1%, 1/10W	0603	Panasonic	ERJ-3EKF1210V

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

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REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

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

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

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.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

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

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-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.

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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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.

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.

【Important Notice for Users of EVMs for RF Products in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product 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 this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

Texas Instruments Japan Limited
(address) 24-1, Nishi-Shinjuku 6 chome, Shinjuku-ku, Tokyo, Japan

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日本テキサス・インスツルメンツ株式会社
東京都新宿区西新宿６丁目２４番１号
西新宿三井ビル
http://www.tij.co.jp

EVALUATION BOARD/KIT/MODULE (EVM)
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For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure 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.
3. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards (such as UL, CSA, VDE, CE, RoHS and WEEE) which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please 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 result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

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