TEXAS INSTRUMENTS

ADS5440/44/63/74 EVM

User's Guide

November 2006

SLAU194A

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ADS5440/44/63/74 EVM

1 Overview

This user's guide gives a general overview of the ADS5440/44/63/74 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. A breakout board is provided for high-speed logic analyzer touchless probing solutions from both Agilent and Tektronix. Both the Agilent E5405A and Tektronix P6980 probes are supported.

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
J20	ADC	ADS5440/44	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-Ω 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-Ω 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 and can be monitored using the supplied logic analyzer breakout board.

2 Circuit Description

2.1 Schematic Diagram

The schematic diagram for the EVM is attached to the end of this document.

2.2 Circuit Function

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

2.2.1 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

2.2.2 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.

2.2.3 Analog Inputs

The EVM can be configured to use either a balun-coupled input or a TI 9001 amplifier input, both from a single-ended source. The inputs are provided via SMA connectors J11 for a balun coupled input and J10 for the amplifier input. To set up for one of these options, the EVM must be configured as follows:

1. 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-Ω 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-Ω impedance over the first two Nyquist zones. Figure 1 shows the Smith chart of the input impedance over four Nyquist zones.

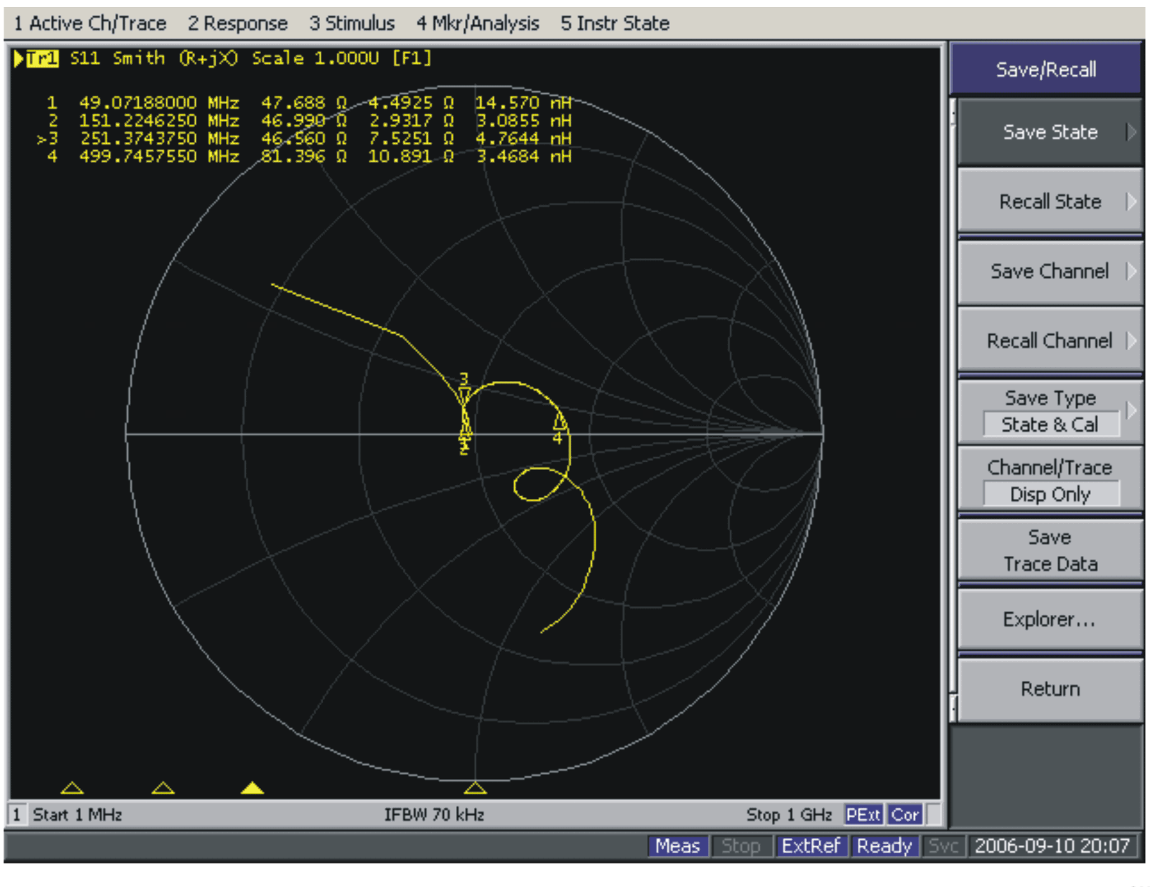


Figure 1. Smith Chart

2. One can use two TI THS9001 IF amplifiers to drive the ADC by applying an input to J10. Reconfigure JP3 and JP4, such that both have pins 1 and 2 shorted. To provide power to the amplifiers, connect 5 Vdc to J18 and connect the ground return to J19. The EVM is configured by default with a 170-MHz band-pass filter. Users can adjust this by tuning L12 abd C75. Figure 2 shows the performance of the EVM when using the THS9001 amplifier path.

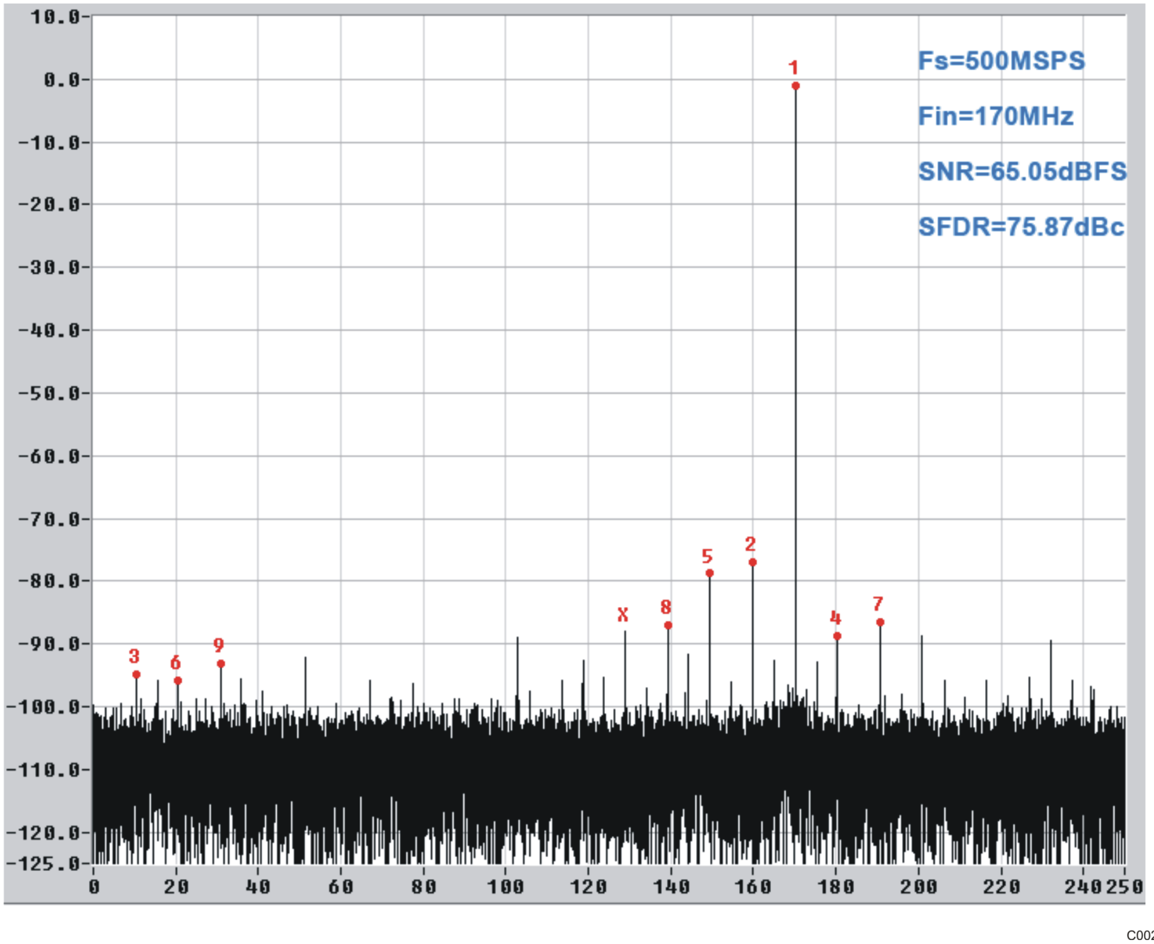


Figure 2. THS9001 + ADS5463 FFT Plot

2.2.4 Digital Outputs

The LVDS digital outputs can be accessed through the J5 output connector. A parallel 100-Ω termination resistor must be placed at the receiver to properly terminate each LVDS data pair. The supplied logic analyzer breakout board includes the 100-Ω 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 - ADS5440\44)	D14	D[14]
MSB-13 (LSB - ADS5474)	D15	D[15]

2.3 Test Points

The EVM provides several different access points to monitor ADC voltages.

- TP1 provides access to the ADC VREF voltage.
- TP2 (ADS5474 only) provides access to the ADS5474 VCM.

2.4 ADC Options

The EVM layout has been designed to showcase the family migration ability. Customers can easily design one layout to accomodate both the ADS5463/74 and the ADS5440/44 family of ADCs.

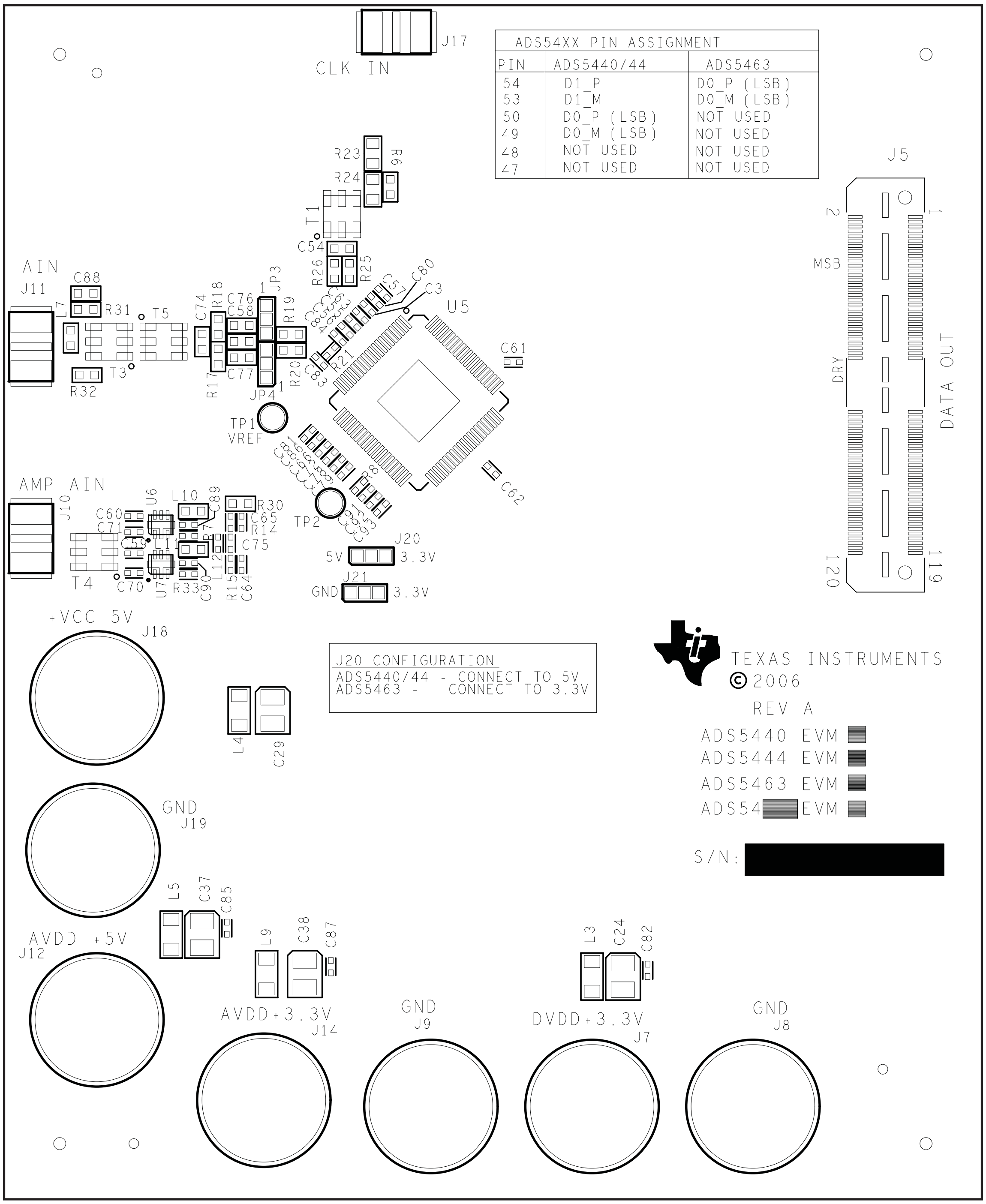
- To use the ADS5440/44 device on this EVM, one must set jumper J20 to short pins 1–2, which connects 5 V to the digital output buffer of the device. To use the ADS5463/74 connect jumper J20 to short pins 2–3.
- The ADS5474 has several modes the ADS5440/44/63 ADCs do not have. Pin 29 becomes a VCM and pin 33 becomes a power down when asserted high. In the case of the ADS5440/44/63 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 3 through Figure 9. The layout features a common ground plane; however, similar performance can be had with careful layout using a split ground plane.



K001

Figure 3. Top Silkscreen

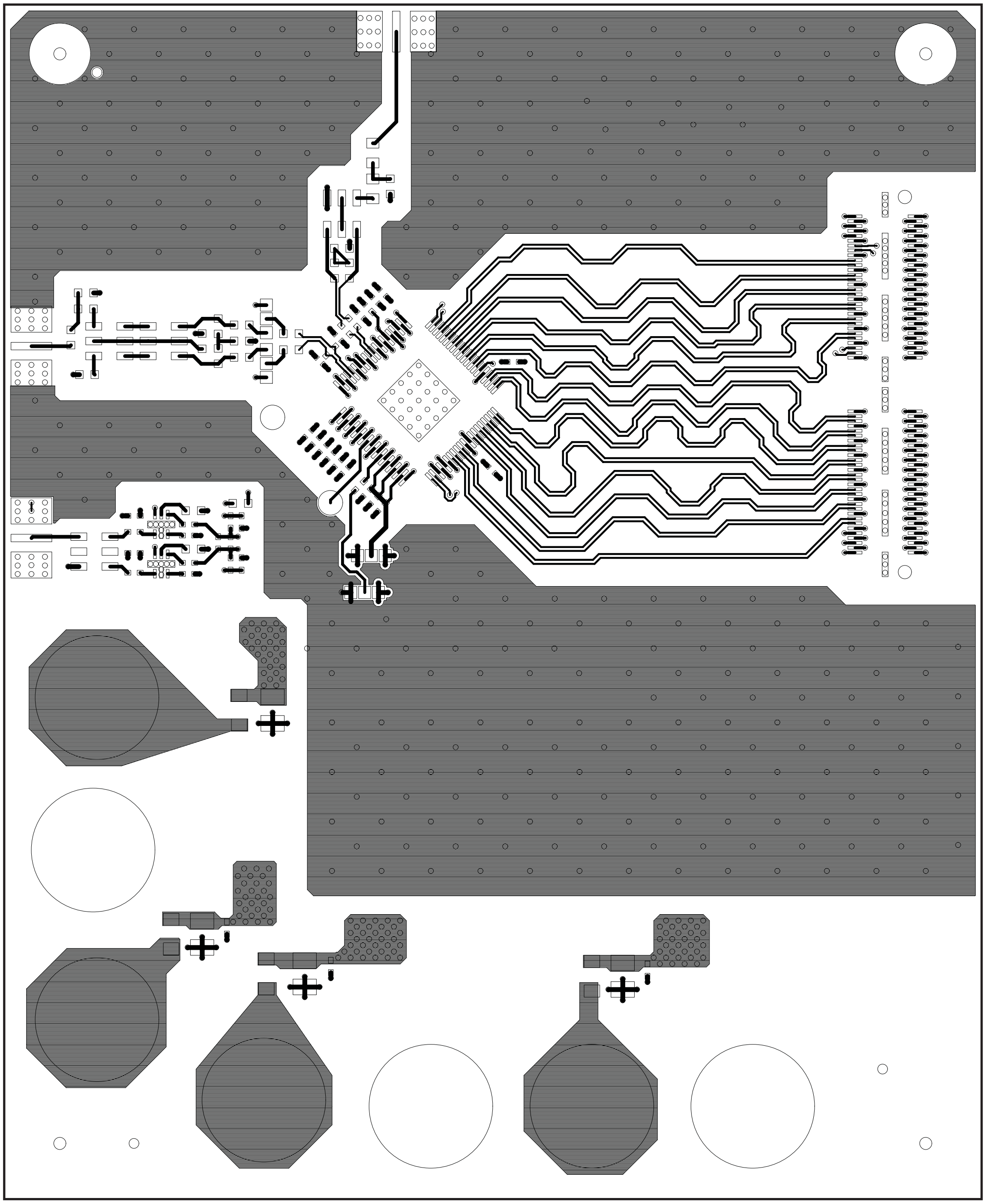
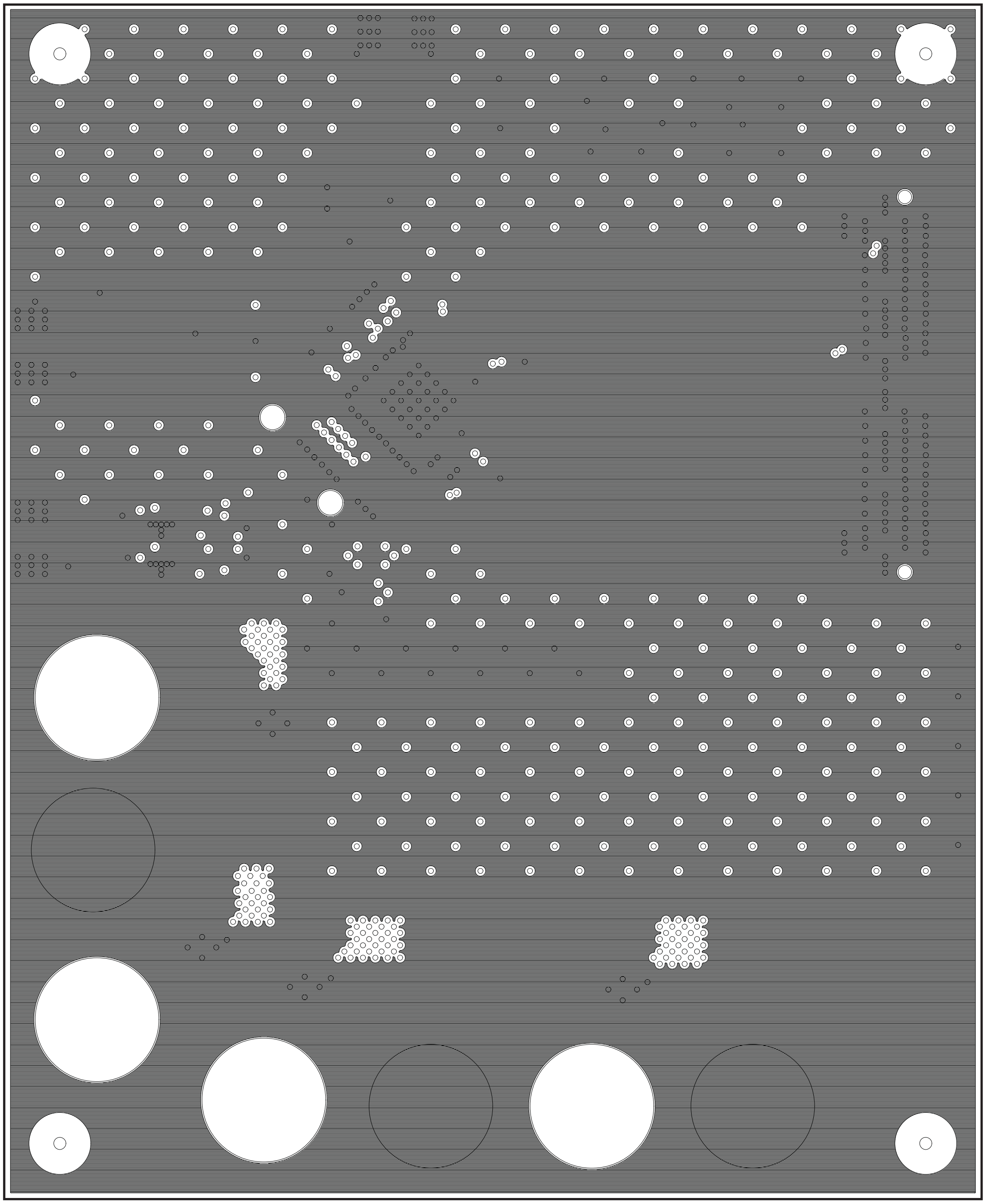


Figure 4. Component Side



K003

Figure 5. Ground Plane 1

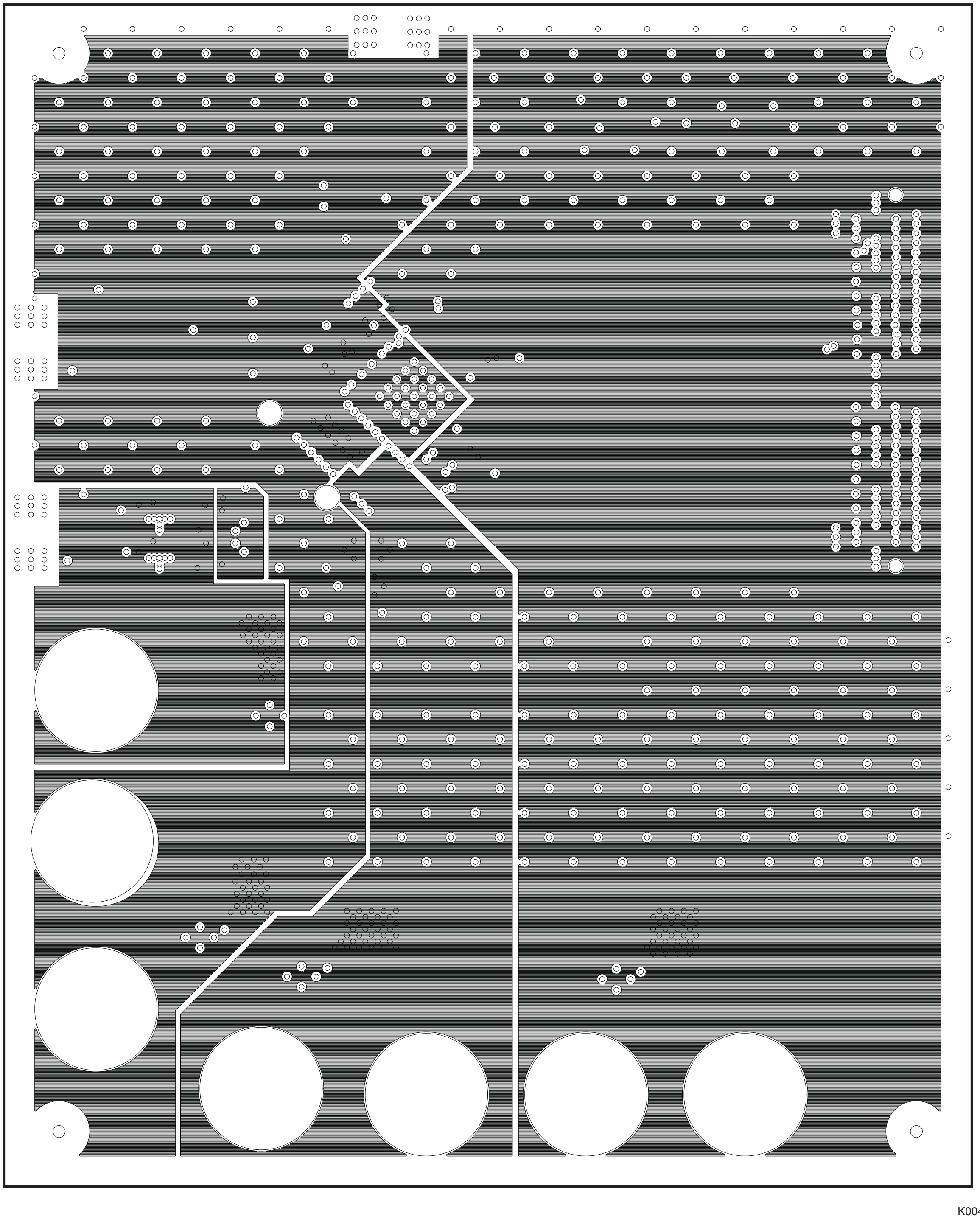


Figure 6. Power Plane 1

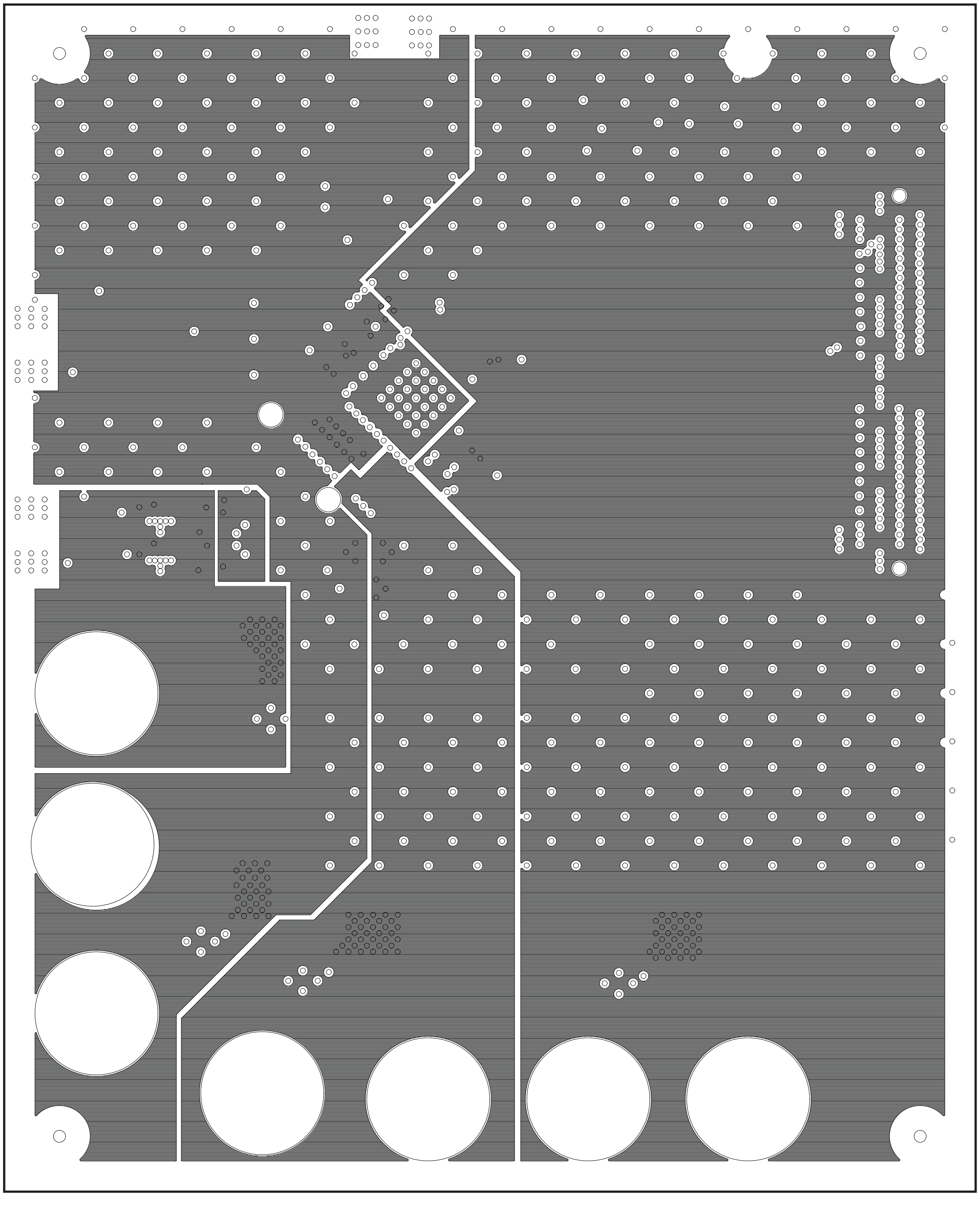


Figure 7. Power Plane 2

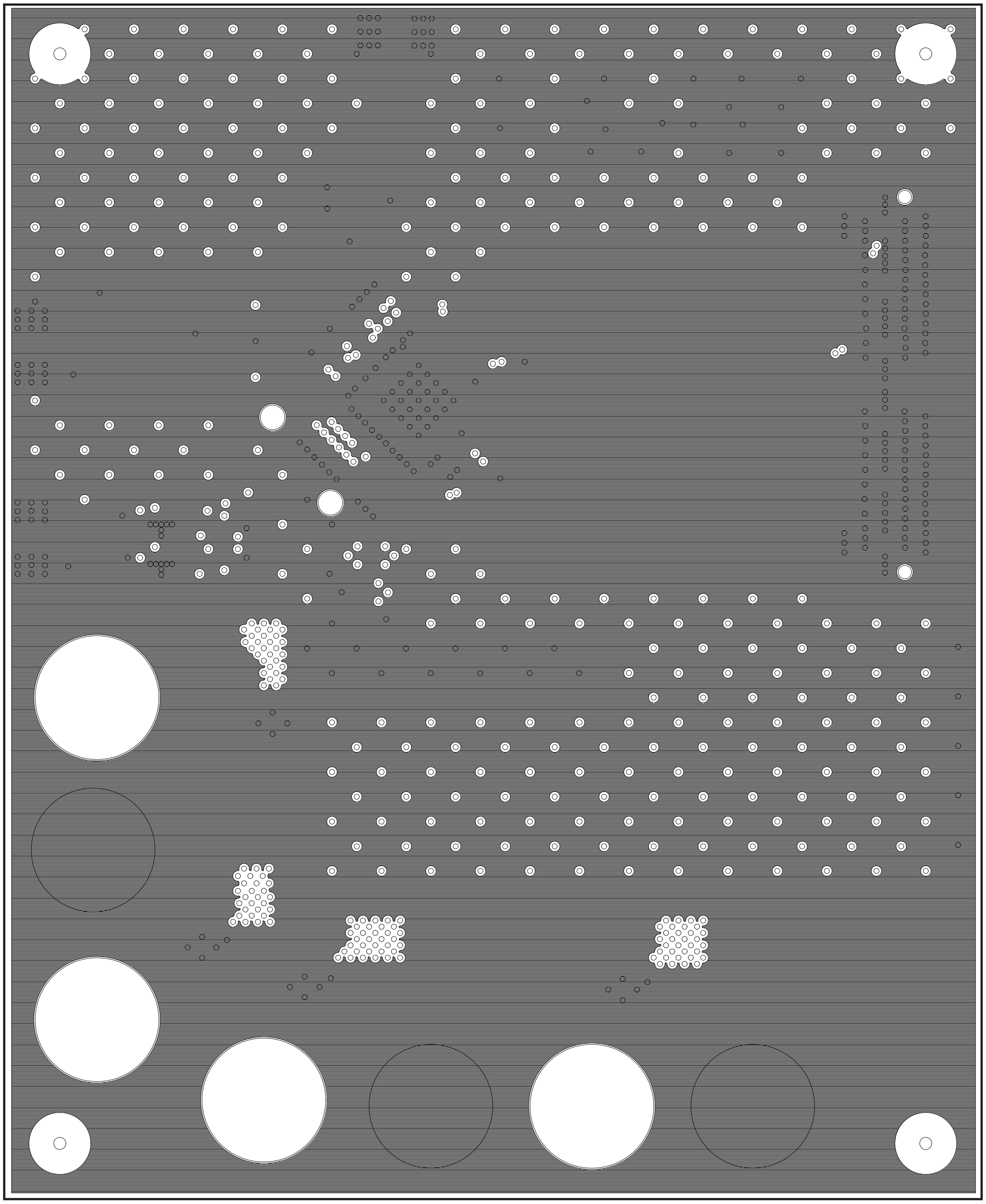


Figure 8. Ground Plane 2

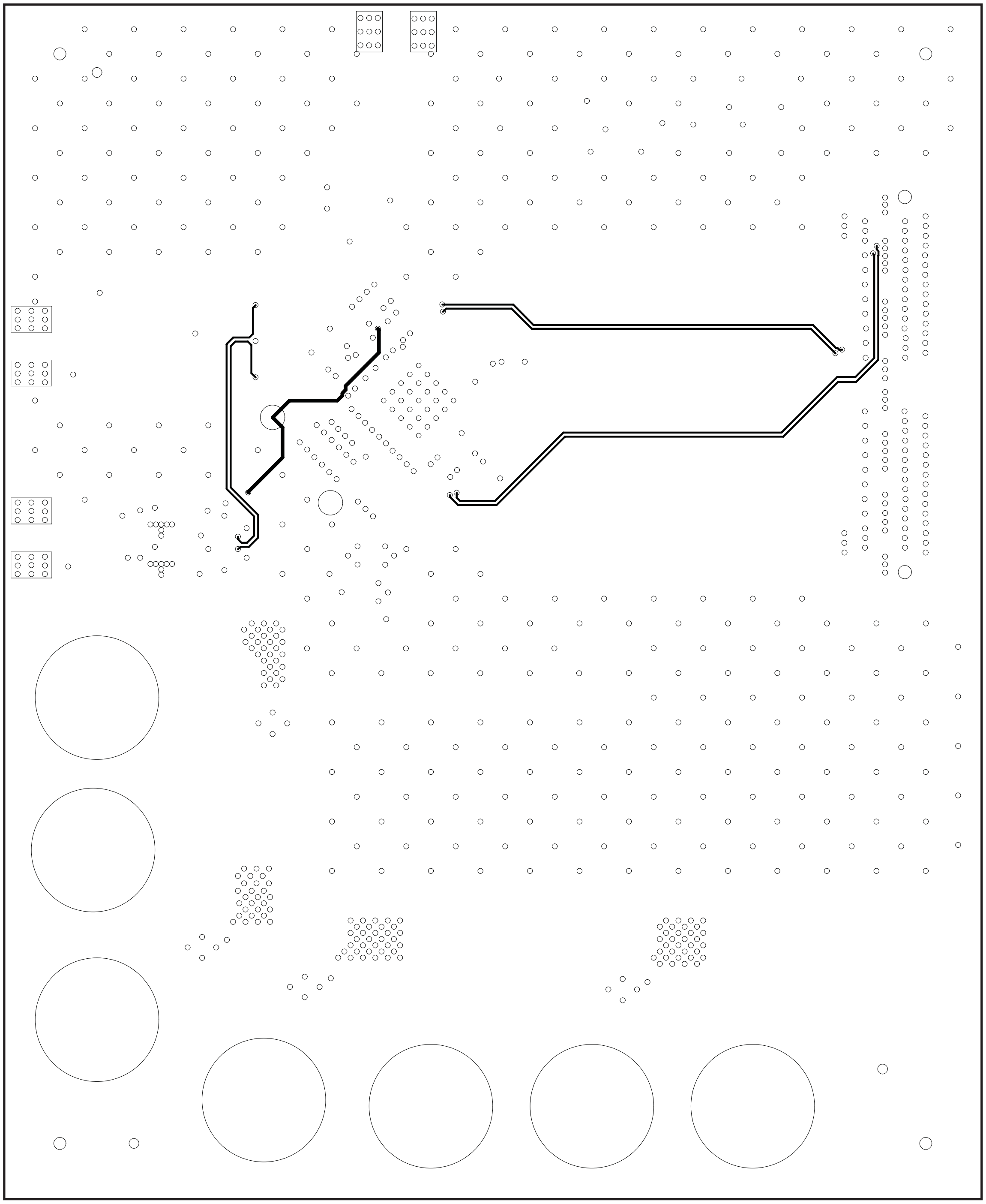


Figure 9. Bottom Side

3.2 Bill of Materials

Table 4. Bill of Materials

QTY	PART REFERENCE	VALUE	PCB FOOTPRINT	MFR NAME	MFR PART NUMBER	NOTE
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 µF	0402	Panasonic	ECJ-0EB1A104K	
4	C24, C29, C37, C38	33 µF	TANT_B	EPCOS, Inc.	B45196H2336M209	
1	C54	0.1 µF	0603	Panasonic	ECJ-0EB1A104K	
2	C58, C74	0.1 µF	0603	Panasonic	ECJ-1VB1C104K	
4	C70, C71, C89, C90	1000 pF	0402	Panasonic	ECJ-0EB1H102K	
1	C75	39 pF	0603	Panasonic	ECJ-0EC1H390J	
2	C76, C77	1 µF	0603	Panasonic	ECJ-1VB1A105K	
2	C82, C85, C87	1 µF	0402	Panasonic	ECJ-0EB1A105M	
0	C88	6.8 pF	0603	Panasonic	ECD-G0E6R8C	Do not install
2	JP3, JP4	Jumper_1x3_SMT			NO PART	
1	J5	CONN_QTH_30X2-D-A			QTH-60-02-F-D-A	
4	J7, J12, J14, J18	RED		Allied Electronics	ST-351A	
3	J8, J9, J19	BLK		Allied Electronics	ST-351B	
3	J10, J11, J17	SMA_END_RND		Johnson Components	142-0711-821	
1	J20	HEADER 3			NO PART	
1	J21	HEADER 3			NO PART	
4	L3, L4, L5, L9	68 Ω @ 100 MHz	1206	Panasonic	EXC-ML32A680U	
1	L7	0 Ω	0603	Panasonic	ERJ-8GEY0R00V	
2	L10, L11	470 nH	0603	Murata	LQW18ANR47J00D	
1	L12	18 nH	0402	Murata	LQW15AN18NJ00D	
1	R6	49.9 Ω	0603	Panasonic	ERJ-3EKF49R9V	
2	R7, R33	237 Ω	0402	Panasonic	ERJ-2RKF2370X	
1	R8	10 kΩ	0402	Panasonic	ERJ-2RKF1002X	
2	R14, R15	49.9 Ω	0402	Panasonic	ERJ-2RKF49R9X	
2	R17, R18	39 Ω	0603	Panasonic	RC0603FR-0739RL	
2	R19, R20	10 Ω	0603	Panasonic	ERJ-3EKF10R0V	
0	R21	200 Ω	0402	Panasonic	ERJ-2RKF2000X	Do not install
2	R23, R24	0 Ω	0805	Panasonic	ERJ-6GEY0R00V	
0	R25, R26	121 Ω	0603	Panasonic	ERJ-3EKF1210V	Do not install
0	R30, R3,1 R32	0 Ω	0603	Panasonic	ERJ-3GEY0R00V	Do not install
1	T1	WBC4-1W		Coilcraft	WBC4-1W	
1	T4	WBC2-1W		Coilcraft	WBC2-1W	
2	T3, T5	ETC1-1-13		Macom	ETC1-1-13	
1	TP1	BLK		Keystone	5001K	
1	U6, U7	THS9001		TI	THS9001	
1	U5	ADS5463		TI	ADS5463	See [1]

[1] Populate with ADS5440, ADS5444, ADS5463 depending on build.

3.3 PCB Schematics

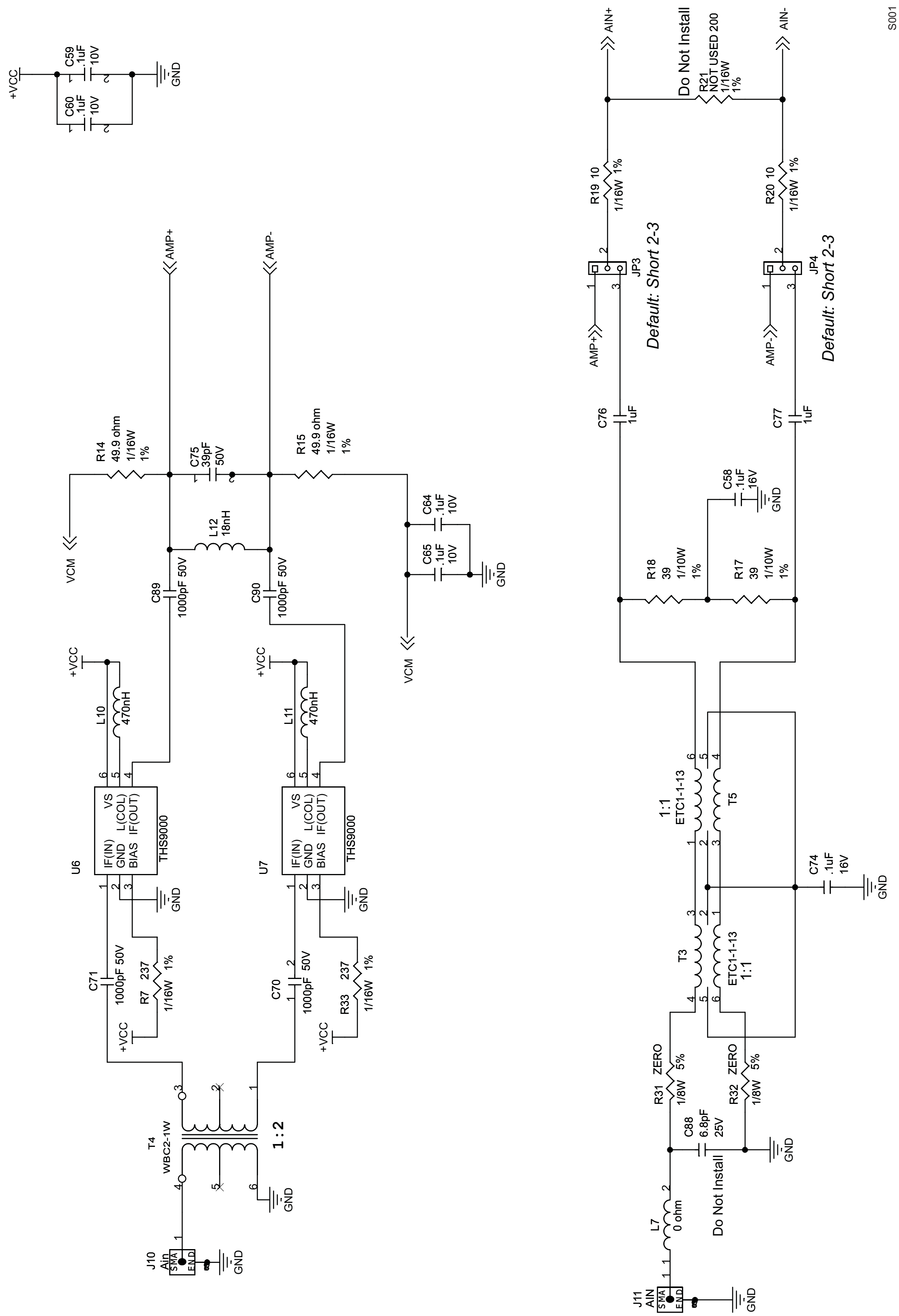
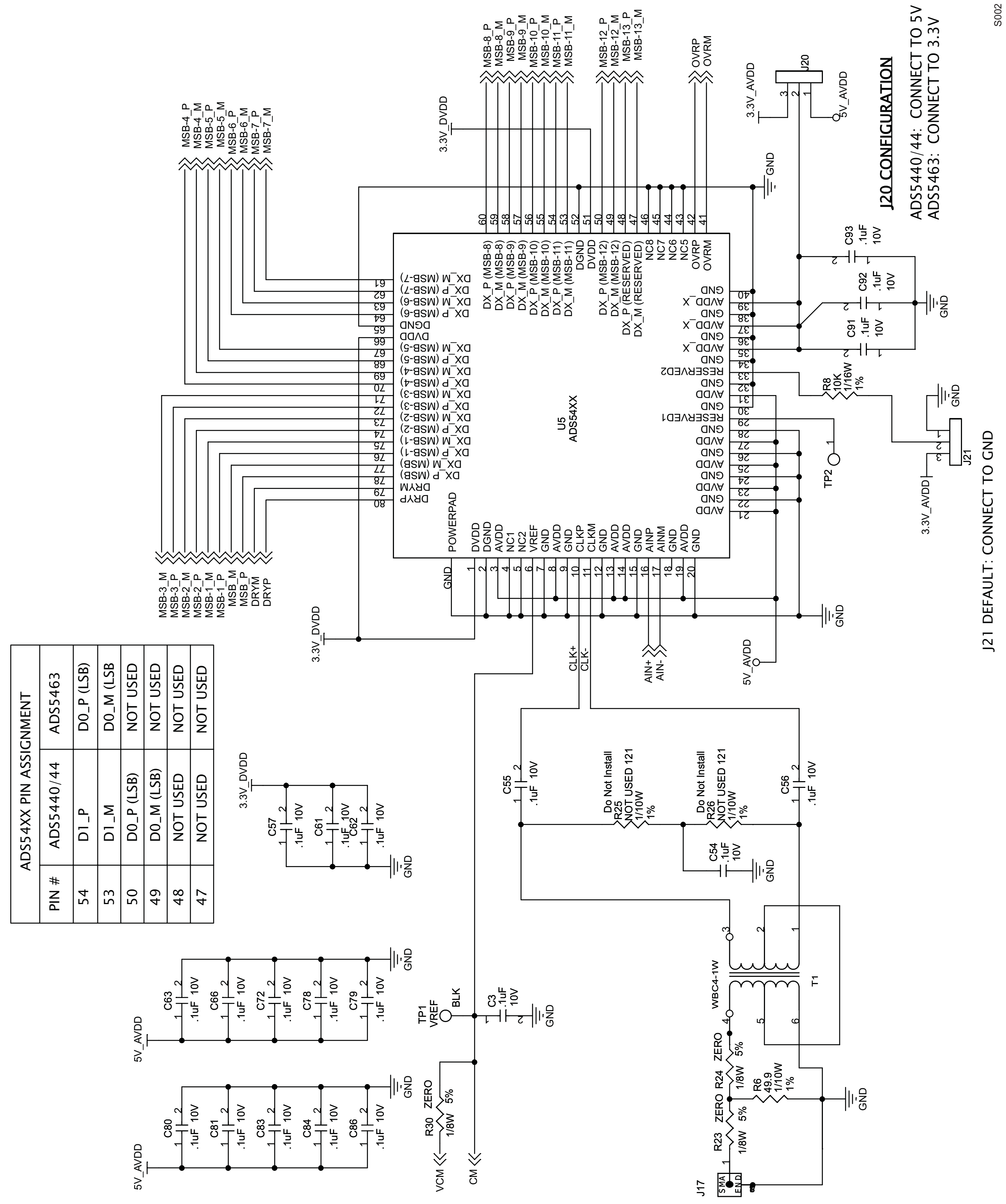


Figure 10. EVM Schematics



ADS54XX PIN ASSIGNMENT		
PIN #	ADS5440/44	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

Figure 11. EVM Schematics

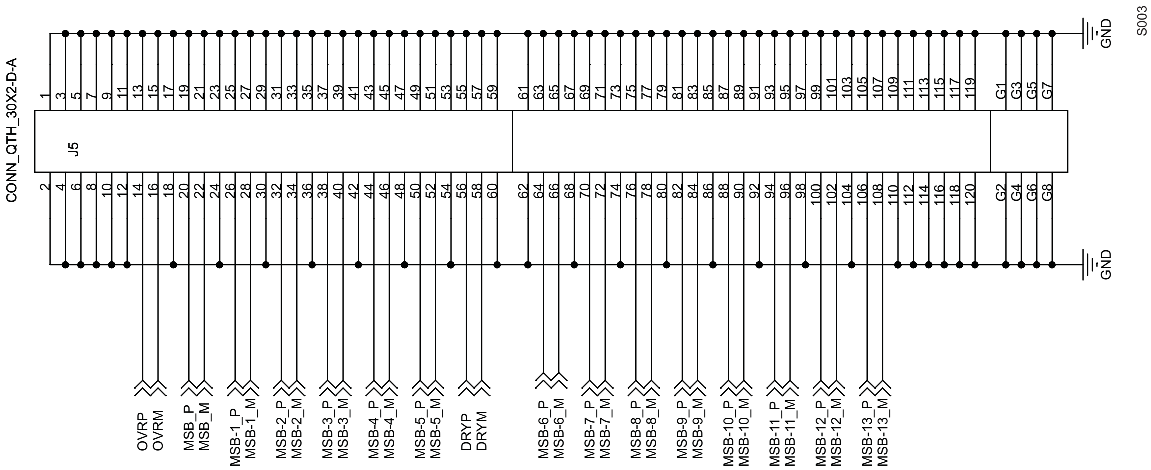


Figure 12. EVM Schematics

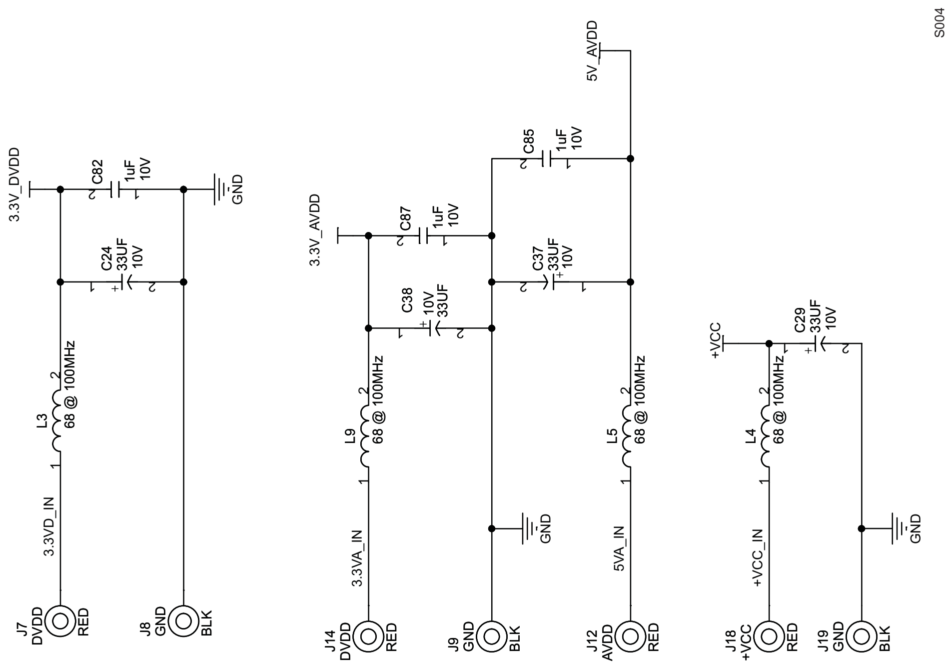


Figure 13. EVM Schematics

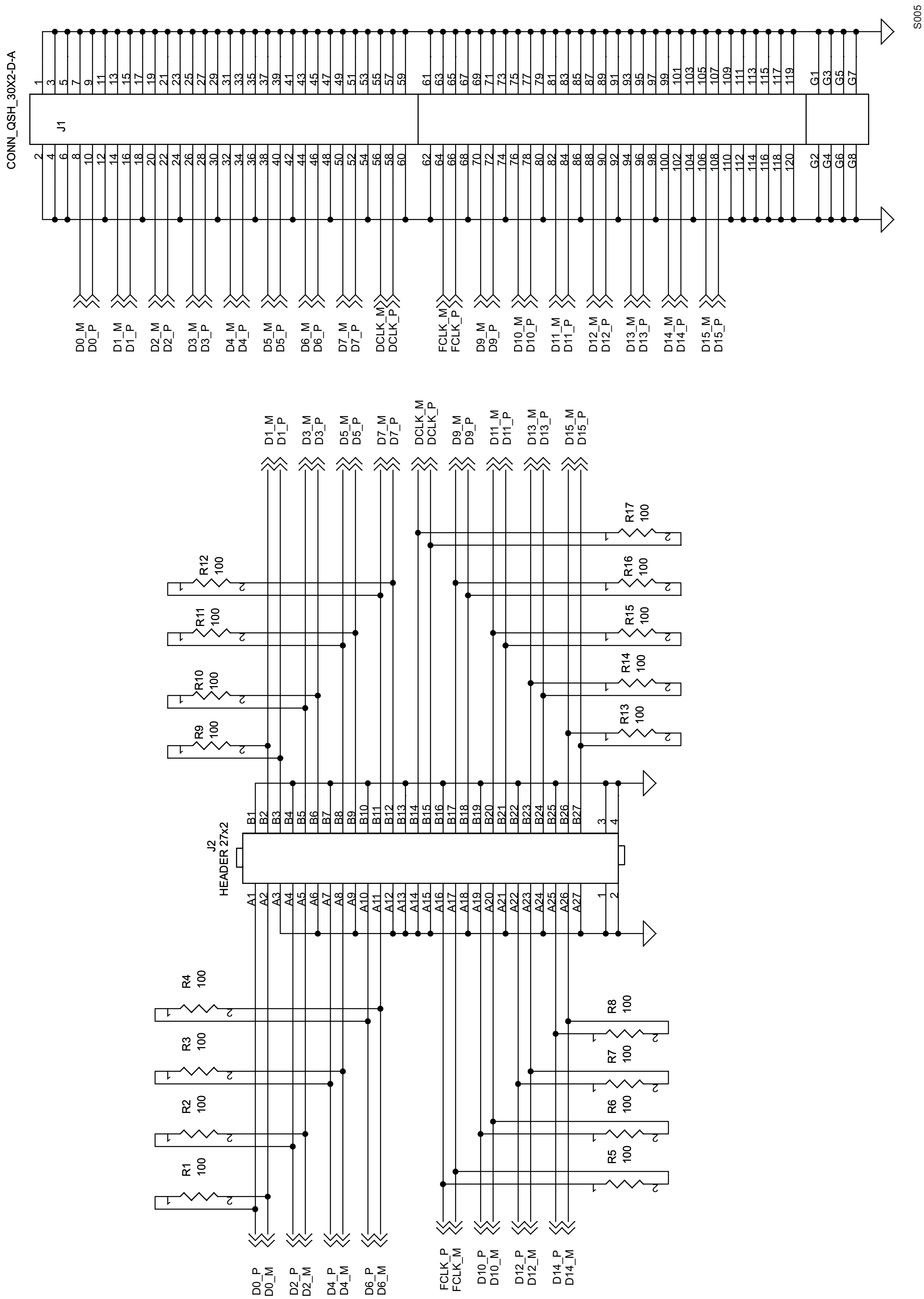


Figure 14. Touchless Probe Breakout Board Schematic

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of –0.3V to +3.6V and the output voltage range of –0.3V to +3.6V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. 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 +25°C. The EVM is designed to operate properly with certain components above +50°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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