Evaluating the ADL5960

FEATURES

- Full featured evaluation board for the ADL5960
- Integrated bi-directional bridge measures forward and reverse coupled signal

EQUIPMENT NEEDED

- Power Supply
- One or two RF Signal Generators
- Spectrum Analyzer or Oscilloscope
- DC2026C "Linduino" Board
- Experimental impedances such as open, short, and load

GENERAL DESCRIPTION

Evaluation Board ADL5960-EVALZ allows evaluation of the ADL5960 network analyzer front end IC.

The ADL5960 with integrated bridge derives inline incident and reflected power samples, up to 20GHz, while maintaining low insertion loss, approximately 1 to 2 dB depending on frequency. Integrated mixers down convert the incident and reflected samples to IF while preserving phase information. SPI port provides access to programmable LO and offset mixer versatility features, plus programmable IF gain and bandwidth.

For best performance, the PCB RF transmission lines are 50Ω controlled impedance on Rogers RO3003 low-loss substrate material.

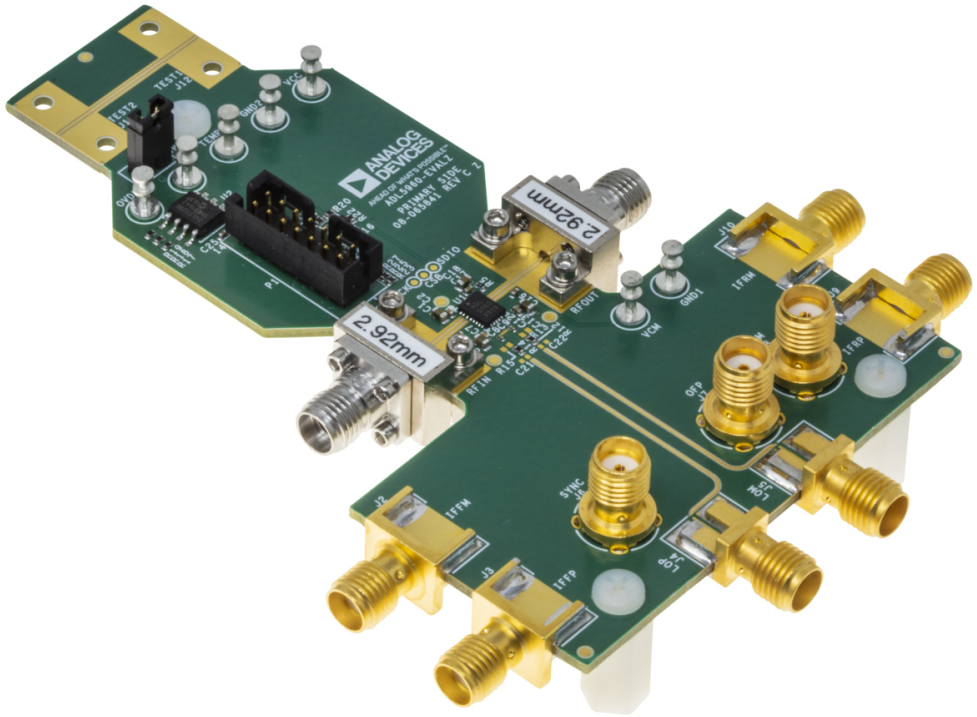

Figure 1. ADL5960-EVALZ

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EVALUATION BOARD TEST SETUP

ADL5960 evaluation board requires a 5V power supply with a recommended minimum current rating of 500mA.

Note: External +3.3V for OVDD need not be supplied, since this is normally supplied by the DC2026C "Linduino" board.

RFIN port requires an RF signal generator capable up to 20GHz for full frequency range demonstration.

RFOUT port can be connected to the spectrum analyzer or various impedance standards for demonstration or device calibration, and also for evaluating the insertion loss and directivity of the ADL5960 device.

LO input port is differential, LOP and LOM. LO drive also functions well when simply driven single-ended, with the unused side terminated with 50Ω SMA termination.

IF outputs are differential, IFFP and IFFM (forward channel), and IFRP and IFRM (reverse channel), for forward and reverse paths respectively. All IF outputs are AC coupled, 50Ω source impedance, and can be directly connected to a 50Ω spectrum analyzer or oscilloscope for single-ended or differential measurement. Unused IF outputs can be either left open or terminated with 50Ω.

A graphical user interface (GUI) program is provided by Analog Devices for ADL5960 test and demonstration purpose. The program is freely available via a link on the ADL5960 product page and runs in a Microsoft Windows environment. If not already installed, this program should be downloaded and installed before proceeding further. Installing the GUI program also installs the USB drivers necessary to support the DC2026C "Linduino" hardware. Be sure to install the GUI program *before* connecting the Linduino board USB to the PC.

A DC2026C "Linduino" is normally shipped with each ADL5960-EVALZ board as a kit. The Linduino board will have custom firmware pre-installed to support the GUI. The custom firmware installation is signified by a "ADL5960" label adhered to the board, on the outer shell of the USB receptacle.

A 14-conductor ribbon cable provides SPI and regulated +3.3V connections between interface board and evaluation board. The +3.3V from Linduino powers the ADL5960 OVDD pin, thus powering the ADL5960 on-chip digital interface. Without this power source, the ADL5960 will not enable or function.

An RF test trace is provided near the top edge of the evaluation board. This transmission line is provided for de-embedding purpose, having the same cross-sectional dimensions as the RFIN and RFOUT printed transmission lines. The RF test trace connectors are not normally supplied but can be 'borrowed' from the RFIN and RFOUT locations for test purpose, or purchased separately (see BOM for component information).

EVALUATION BOARD TEST SETUP

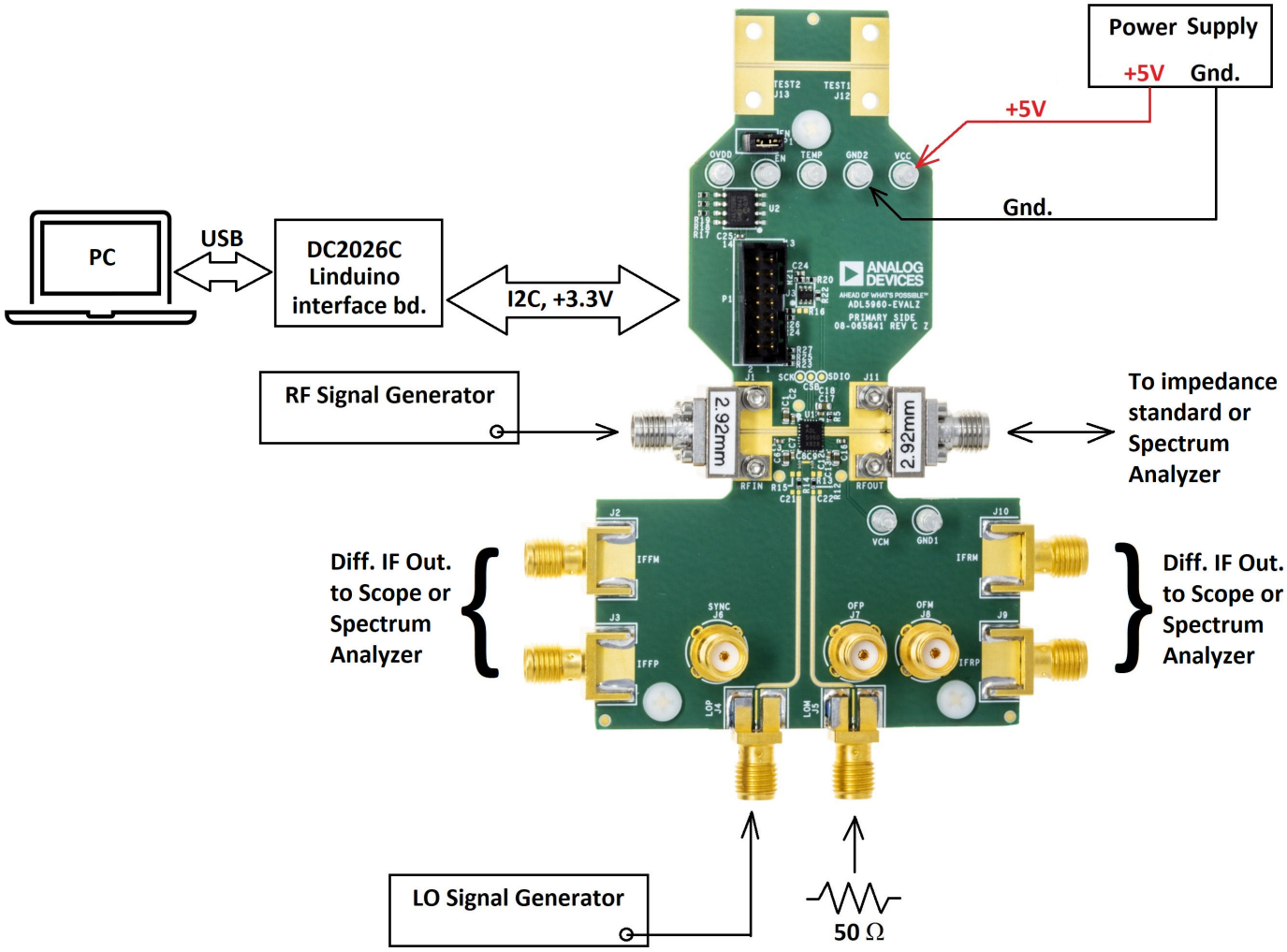

Figure 2. ADL5960-EVALZ Basic Test Setup

TEST PROCEDURE

Test setup and demonstration begins with the basic preparation and power up sequence which establishes SPI communications, then proceeds to a basic RF functional demonstration.

Preparations for Testing

- Connect the DC2026C Linduino board to the ADL5960-EVALZ board using the supplied 14-conductor ribbon cable. Keep the ribbon cable connected for the duration of testing.
- Be sure the DC2026C Linduino board has correct firmware installed, as indicated by a "ADL5960" label affixed to the controller board.
- Verify on the DC2026C Linduino controller board that VCCIO is set to 3.3V, which is the normal configuration.
- Be sure the ADL5960 board's EN jumper is installed, which is how the EVB normally ships. This jumper is seen at the top of the EVB, near the RF test trace.
- Setup +5V power supply for at least 500mA of current capability. Then turn the power source OFF for now. Connect power supply to the VCC turret, along with a ground return path.
- Be sure the demo software has been downloaded and installed on the PC. If not, do so now.

Recommended Power Sequencing

To prevent damage, we recommend the following power-up sequence:

1. Apply +5V power to VCC.
2. Connect the USB cable from Linduino to the PC. Wait for the LEDs to stop blinking. The ADL5960 is now enabled, and +5V current consumption should be approx. 120mA nominal.
3. Launch the GUI program on the PC.

The GUI "Connection" tab should show that the PC automatically discovers the Linduino controller. Click "Connect" to connect to the ADL5960 IC under test. A register viewing and edit screen should now be visible.

To power-down the test setup, reverse the above 3 steps:

1. Close the GUI program.
2. Disconnect the USB cable. The ADL5960 becomes disabled.
3. Turn OFF or disconnect the +5V.

RF Functional Demonstration

The most fundamental ADL5960 demonstration occurs when LO is supplied externally at a frequency offset by the desired IF output frequency:

1. Connect an RF signal generator to drive the RF port. Set power level to 10 dBm, frequency to 1 GHz.
2. Connect 2nd RF signal generator to the LO port. The unused differential LO port should be terminated with 50 Ω SMA termination. Set LO drive power to 0 dBm, and frequency to 1.01 GHz.
3. Leave RFOUT port unconnected for now.
4. Connect both IF port outputs to oscilloscope. If only 2-channel oscilloscope is available, drive each oscilloscope channel single-ended with the down-converted IF incident and reflected signals. If oscilloscope is 4-channel, connect all 4 IF output connectors to oscilloscope, and in this case we recommend configuring the oscilloscope to display two differential signals, incident and reflected.
5. Down-converted incident and reflected output signals should now be observable on the oscilloscope at the difference frequency, 10MHz. Increasing the IF gain register settings to approximately 20 dB will typically give more favorable signal-to-noise ratio at the IF outputs without overdrive problems.
6. With RFOUT port remaining unconnected (**open**), observe that there are large signals at both incident and reflected IF output ports. Reflected IF port signal is expected to be slightly lower than the incident port signal, because of ADL5960 insertion loss.
7. Now install an RF **short** onto the RFOUT port. Observe IF incident and reflected port magnitudes remain relatively constant, while phase of the reflected IF port signal flips 180-degrees, compared to the prior RFOUT= Open test condition.
8. Connect a 50 Ω SMA RF **load** (termination) to the RFOUT port. Observe IF incident port magnitude remains relatively constant, while IF reflected port magnitude drops by a large amount, typically 30 dB, which is the approximate directivity specification of the ADL5960 device at 1GHz. Note that the external SMA 50 Ω load termination on RFOUT should be very high quality for this test. This measurement will always be no better than the directivity of the ADL5960, or the return loss performance of the 50 Ω termination on RFOUT.

GRAPHICAL USER INTERFACE

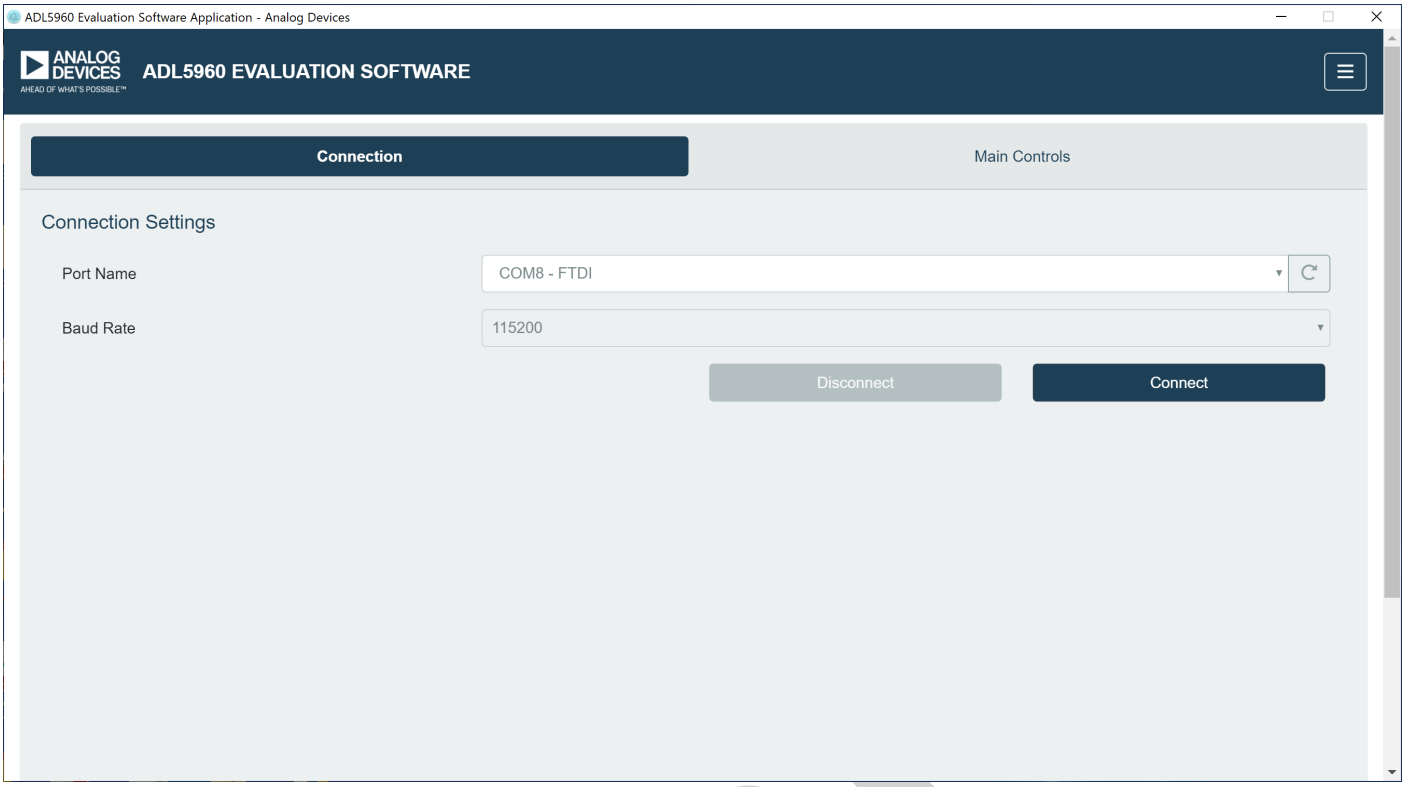

Figure 3. Connection Tab

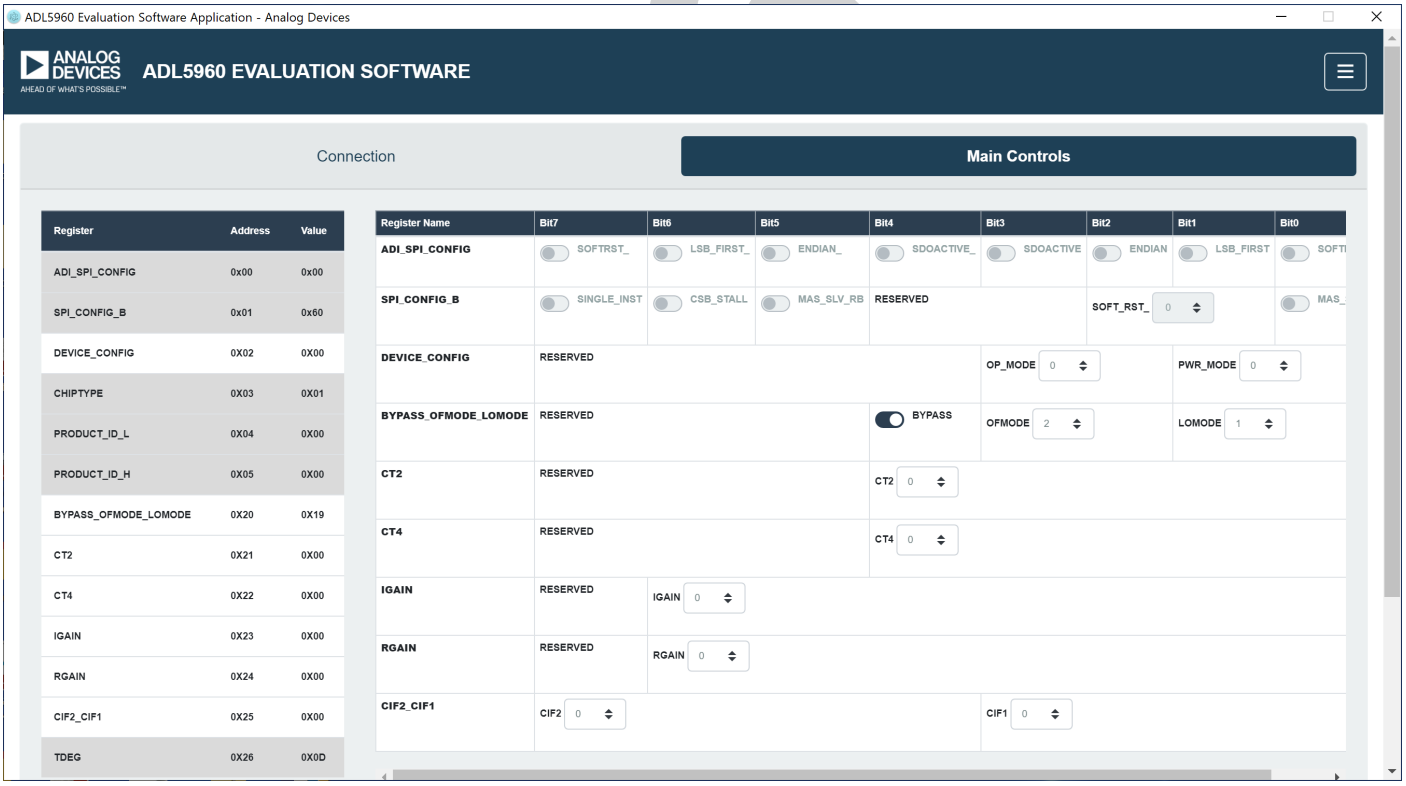

Figure 4. Main Controls Tab

GRAPHICAL USER INTERFACE

Quick Reference

For full and complete information, consult ADL5960 datasheet.

Table 1. ADL5960 Registers Quick Reference

Field Name	Description
BYPASS	When on, sets the LO path to bypass the LO multipliers/dividers. OFMODE and LOMODE will have no effect. When off, the LO path will be via the selected LO multiplier/divider.
OFMODE	Configures the Offset input dividers.
LOMODE	Configures the LO path multipliers and dividers.
CT2, CT4	Configures the LO chain x2, x4 filter frequency settings respectively.
IGAIN, RGAIN	Configures the forward, reverse path IF gain settings respectively.
CIF1, CIF2	Configures the 1st and 2nd IF filter stage settings respectively.
PWR_MODE	Mode 2 and 3 disable the device.

EVB SCHEMATIC

Note: DNI denotes Do Not Install those components.

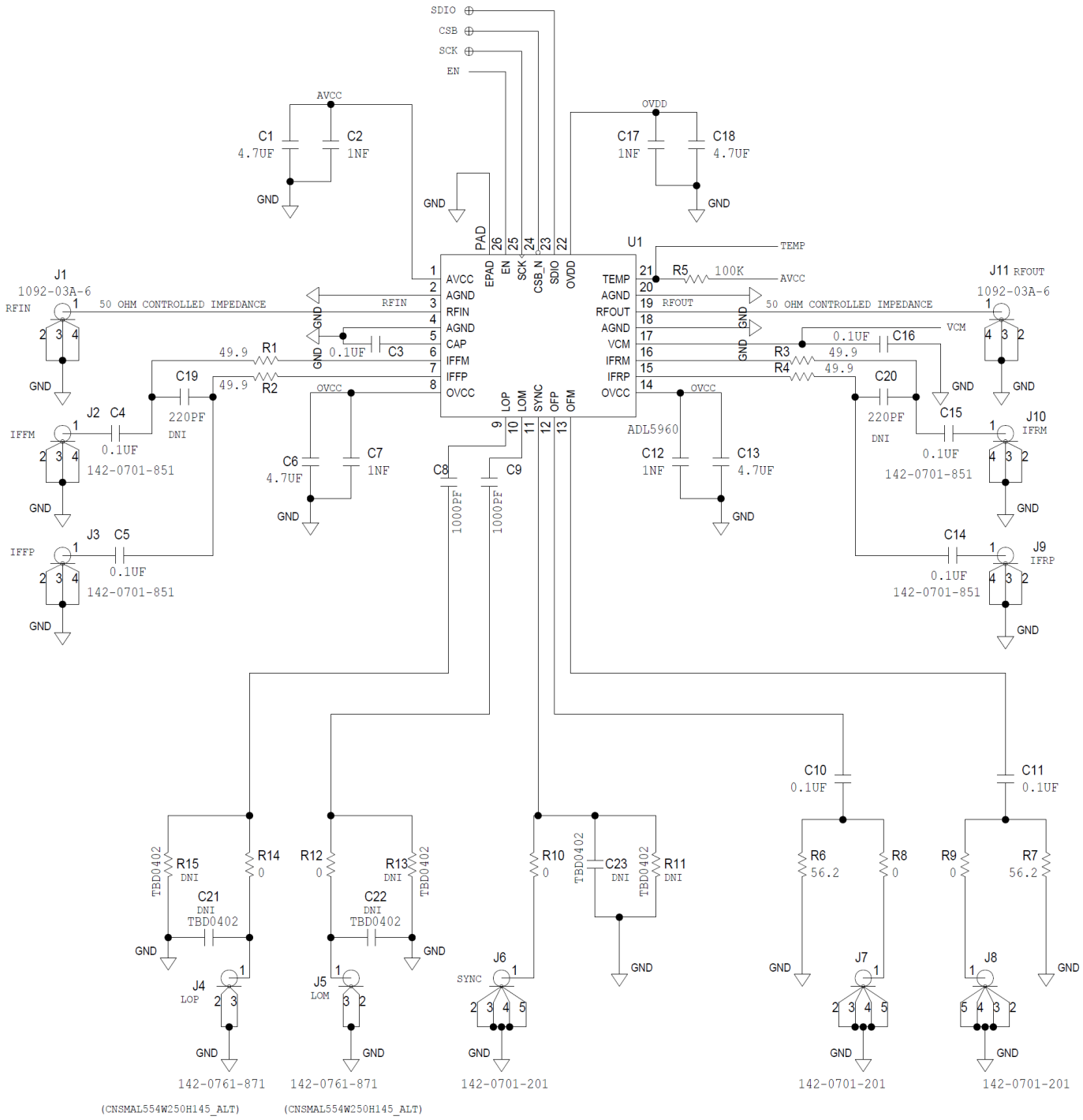

Figure 5. EVB Schematic page 1 of 2

EVB SCHEMATIC

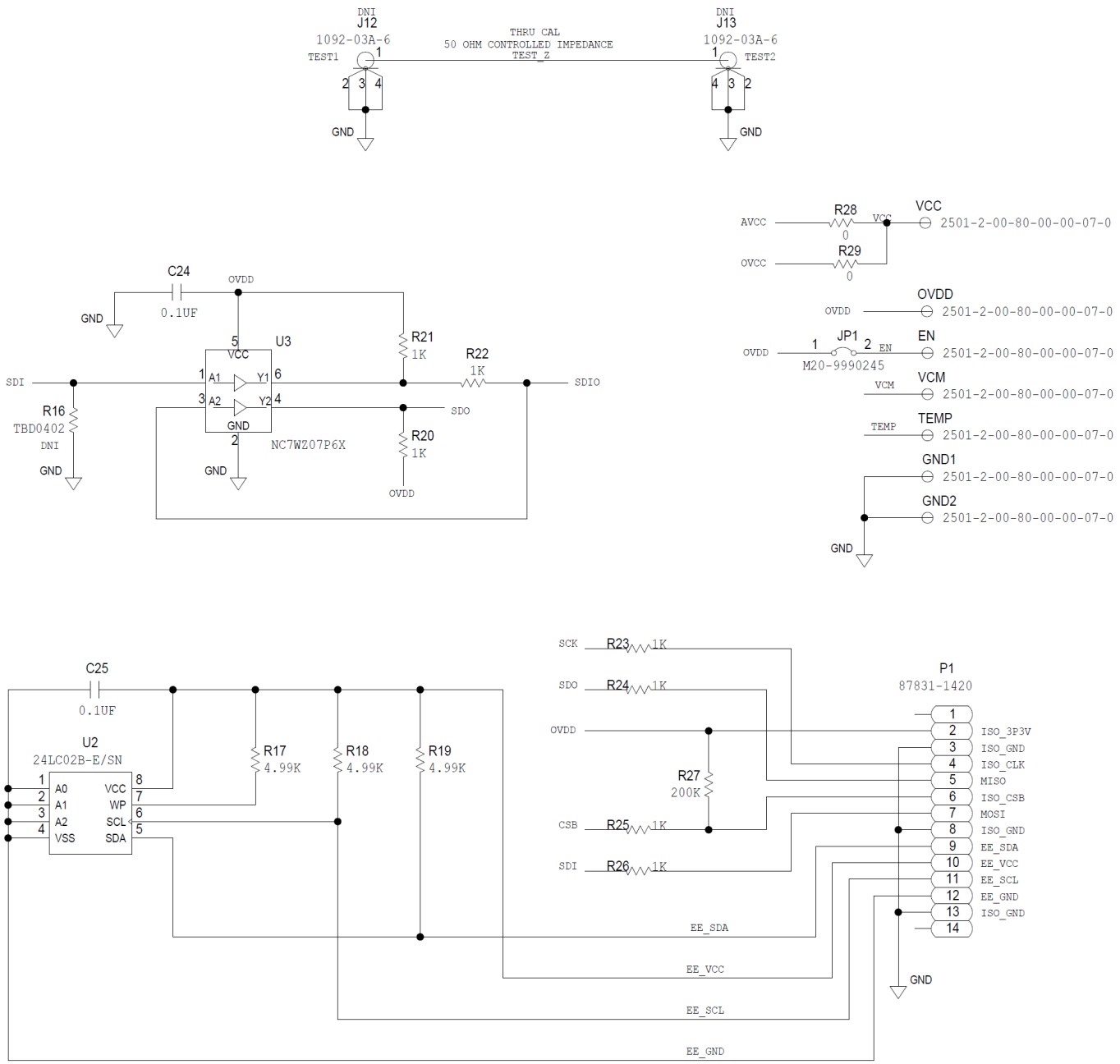

Figure 6. EVB Schematic page 2 of 2

DEMO BOARD ART WORK

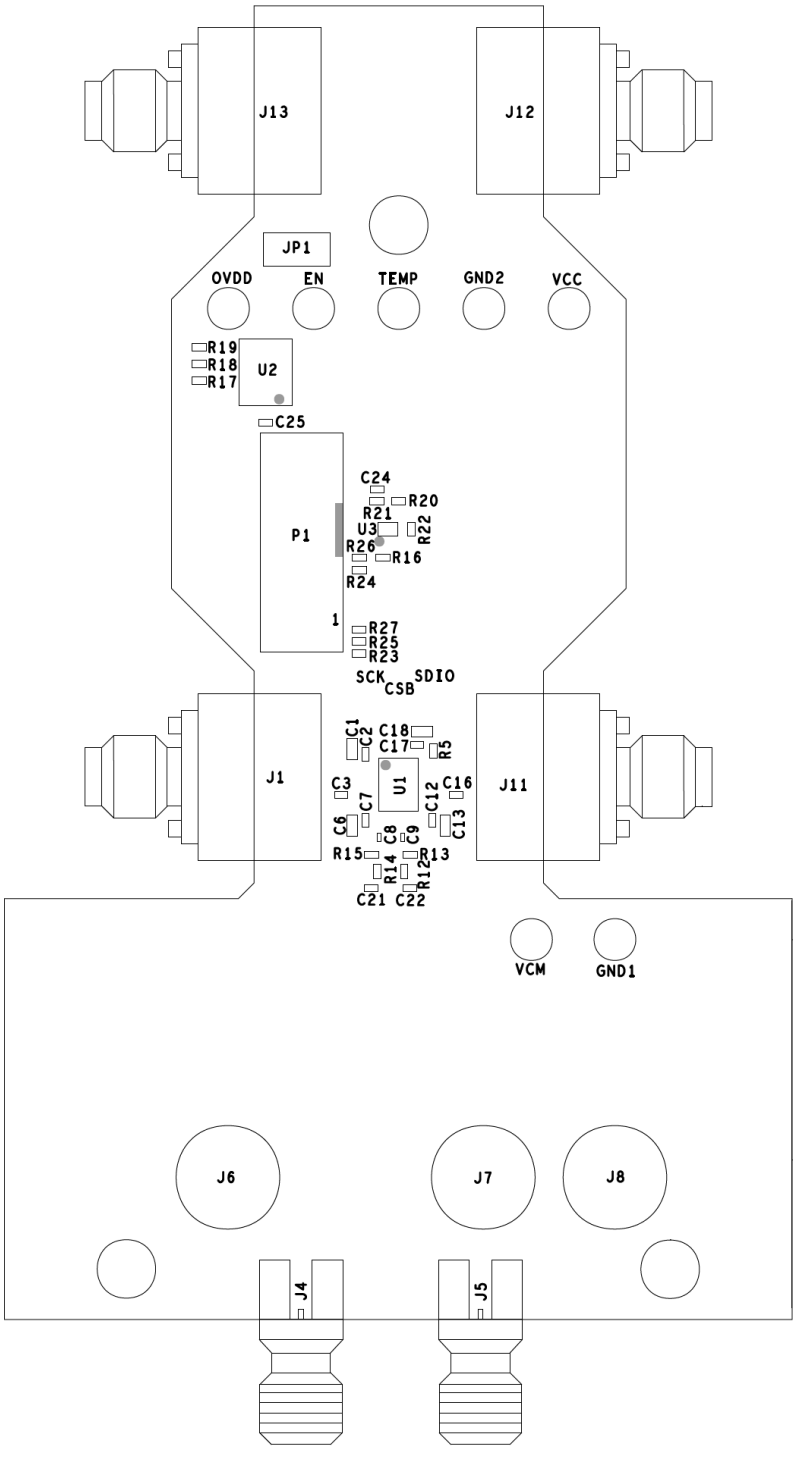

Figure 7. Assembly, primary side

DEMO BOARD ART WORK

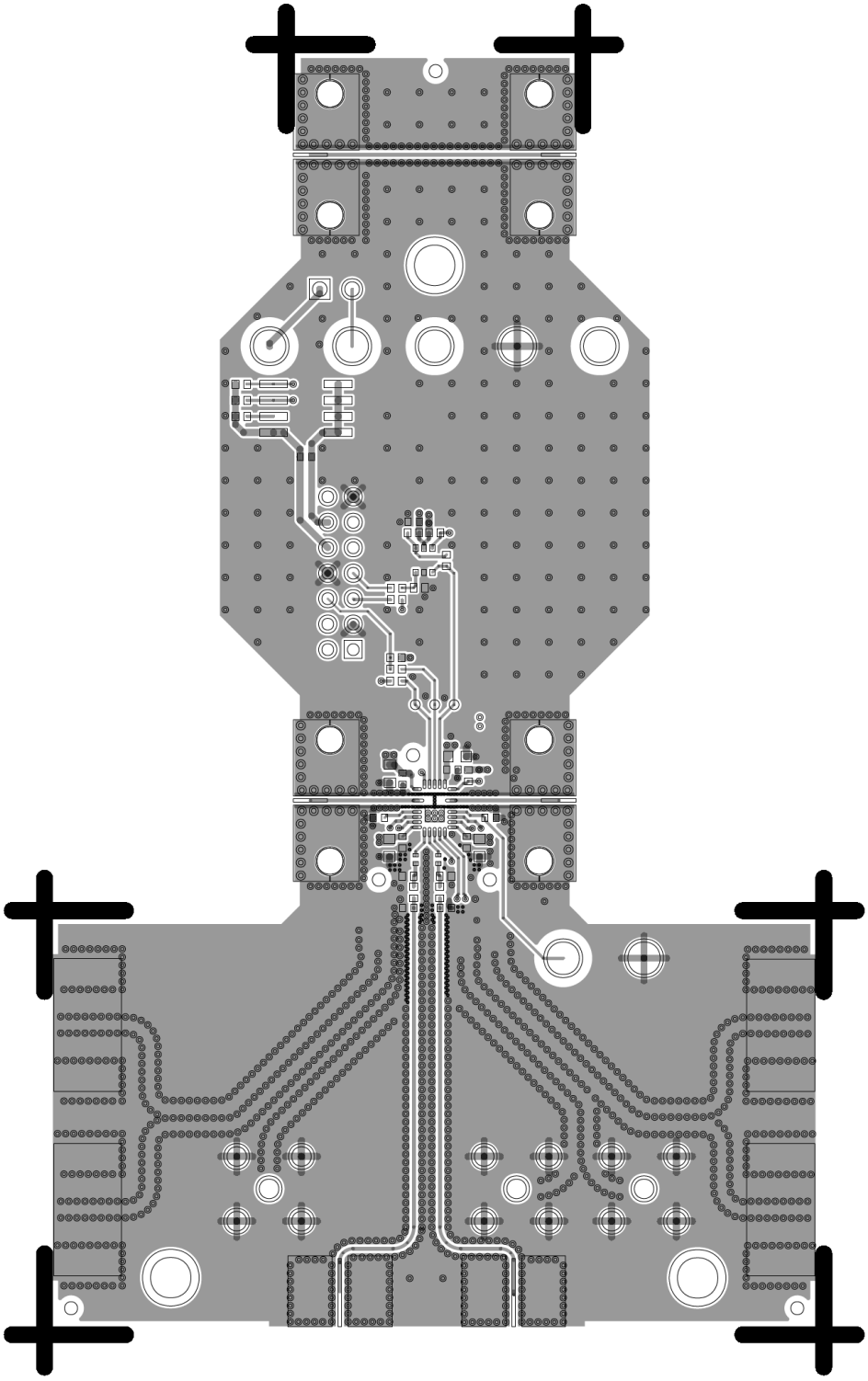

Figure 8. Layer 1

DEMO BOARD ART WORK

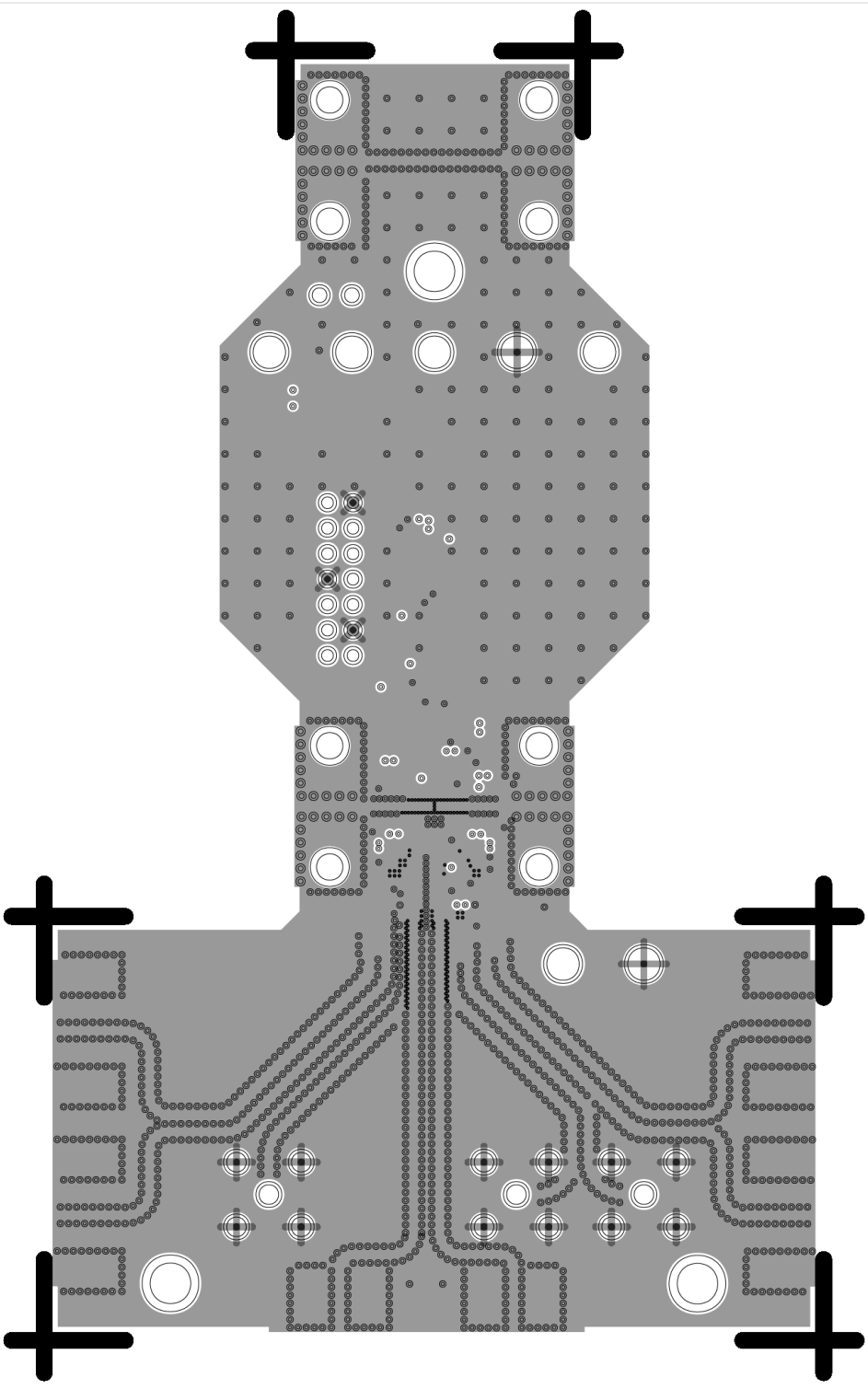

Figure 9. Layer 2

DEMO BOARD ART WORK

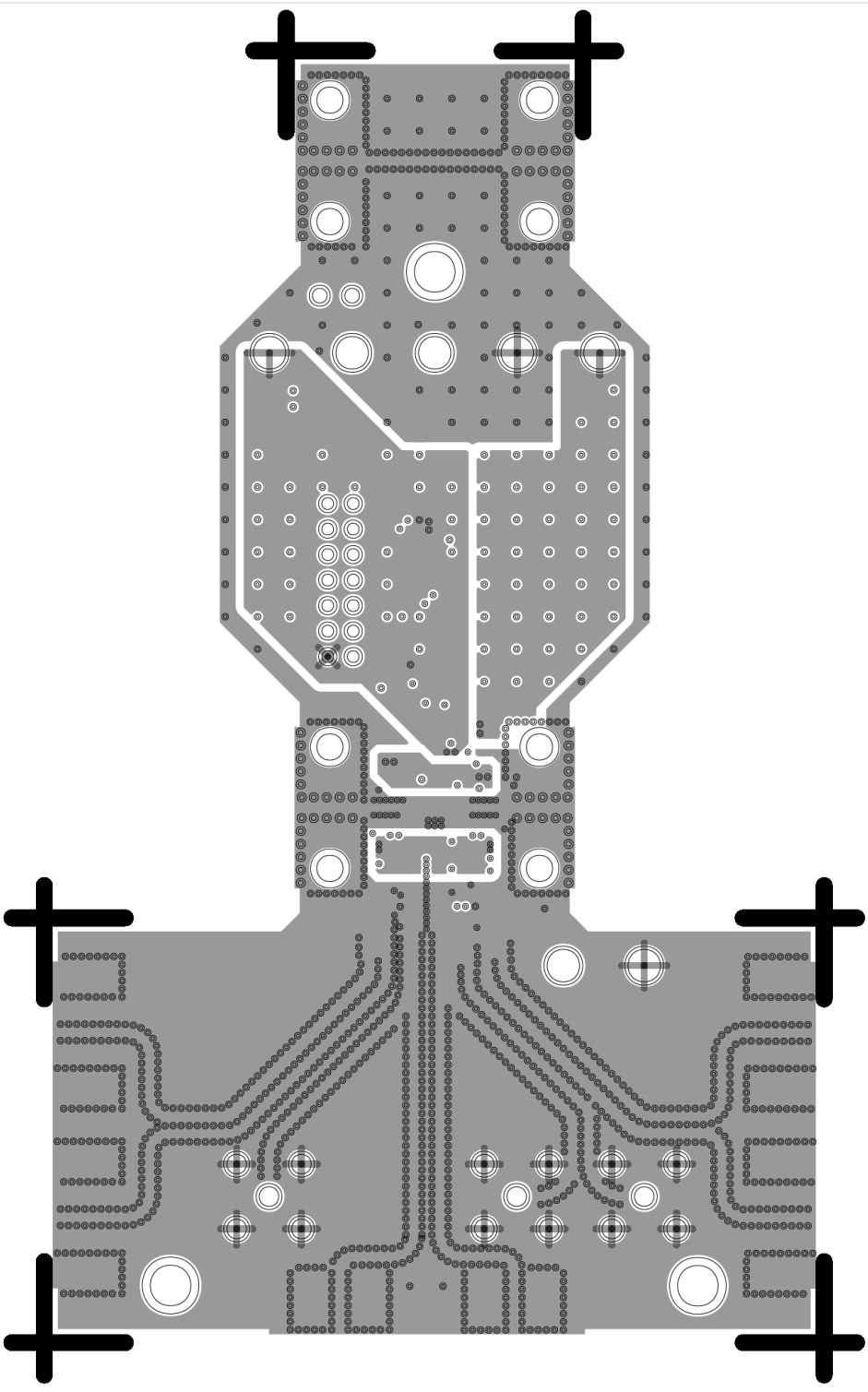

Figure 10. Layer 3

DEMO BOARD ART WORK

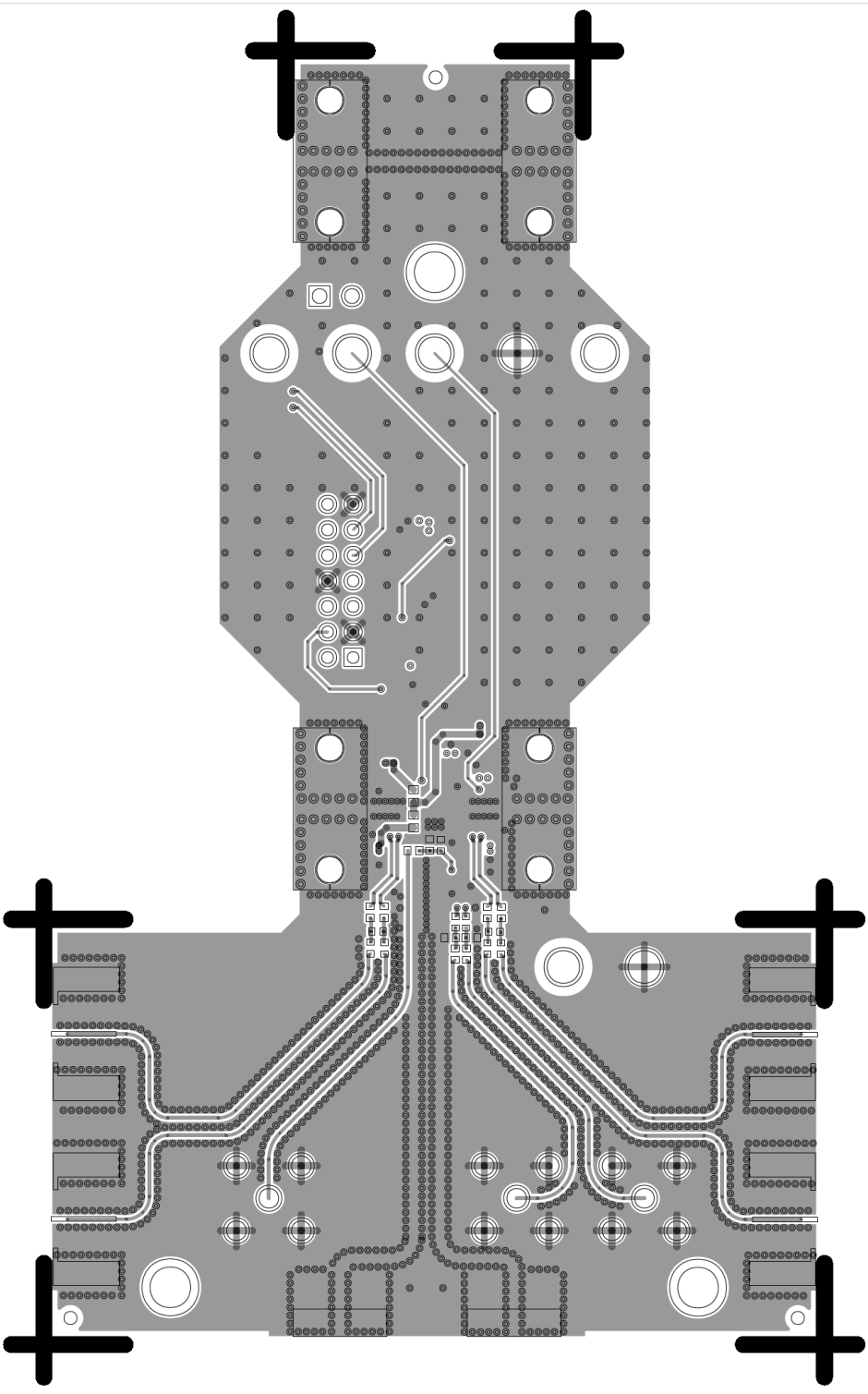

Figure 11. Layer 4

DEMO BOARD ART WORK

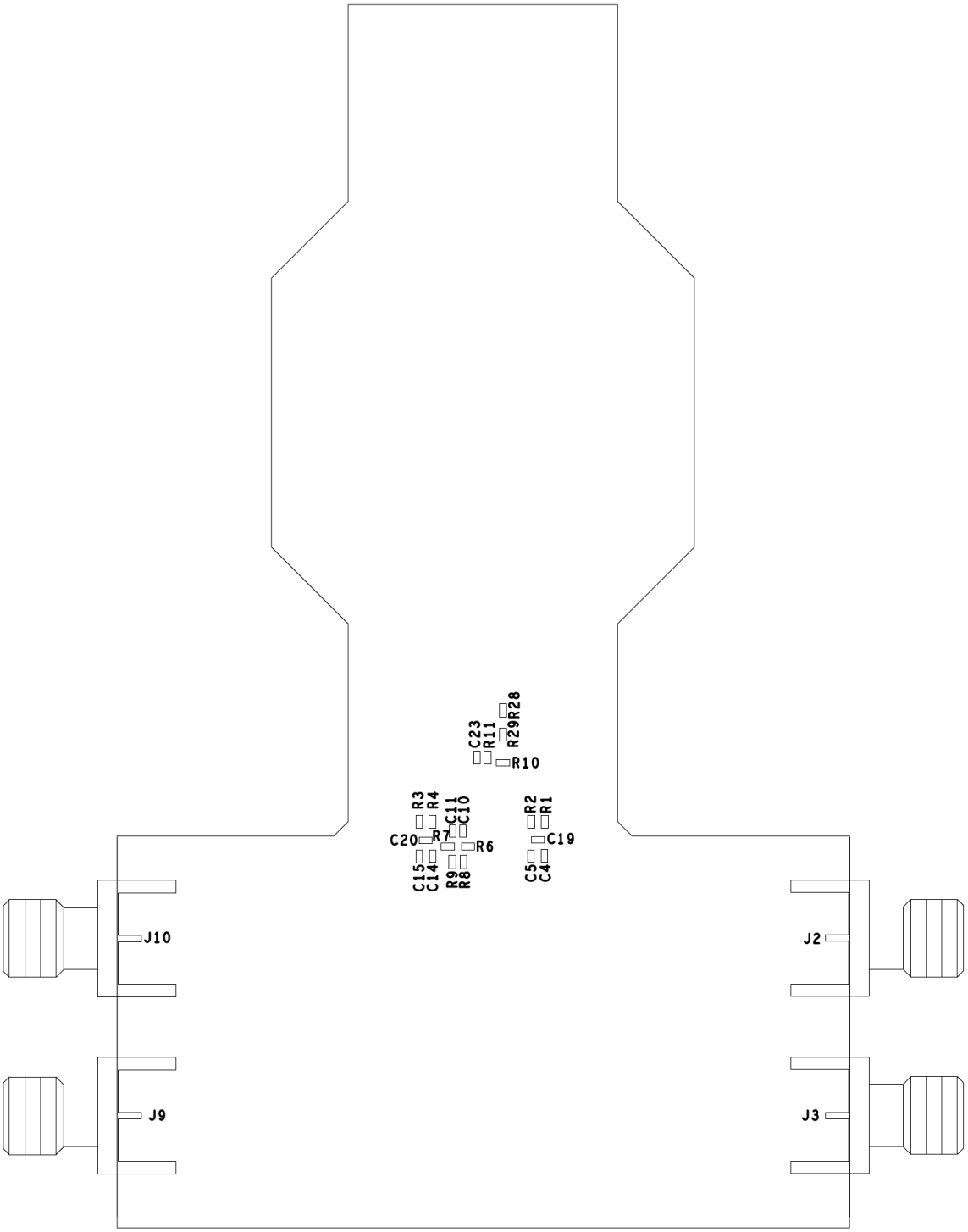

Figure 12. Assembly, secondary side (flipped)

NOTES

ESD Caution
ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.