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Evaluation Board for the Integer-N PLL Frequency Synthesizer

FEATURES

Self-contained board for generating RF frequencies
Contains the ADF4108—an 8 GHz frequency synthesizer IC
Accompanying software allows complete control of synthesizer functions from a PC

EVALUATION KIT CONTENTS

EV-ADF4108EB1Z board
CD that includes
- Self-installing software that allows users to control the board and exercise all functions of the device
- Electronic version of the ADF4108 data sheet
- Electronic version of the UG-160 user guide
- Electronic version of the UG-476 user guide

ADDITIONAL EQUIPMENT

PC running Windows XP or more recent version
Spectrum analyzer
Oscilloscope (optional)
Power supplies of 5.5 V and 15 V

DOCUMENTS NEEDED

ADF4108 data sheet

REQUIRED SOFTWARE

Analog Devices Int-N software (Version 7 or higher)
ADIsimPLL

GENERAL DESCRIPTION

The EV-ADF4108EB1Z evaluation board allows the user to evaluate the performance of the ADF4108 frequency synthesizer for phase-locked loops (PLLs). Figure 1 shows the board, which contains the ADF4108 synthesizer, an SMA connector for the reference input, the power supplies, a USB interface, and the RF outputs. There is also an active loop filter and a VCO on board. The user has the option of using an alternate loop filter and VCO by connecting the board to the following SMA connectors: VTUNE and CPOUT. The evaluation kit contains software that is compatible with Windows® XP and more recent versions to allow easy programming of the synthesizer.

The USB interface allows software programming of the ADF4108 device. A USB cable is included in the evaluation board kit to allow software programmability.

EVALUATION BOARD

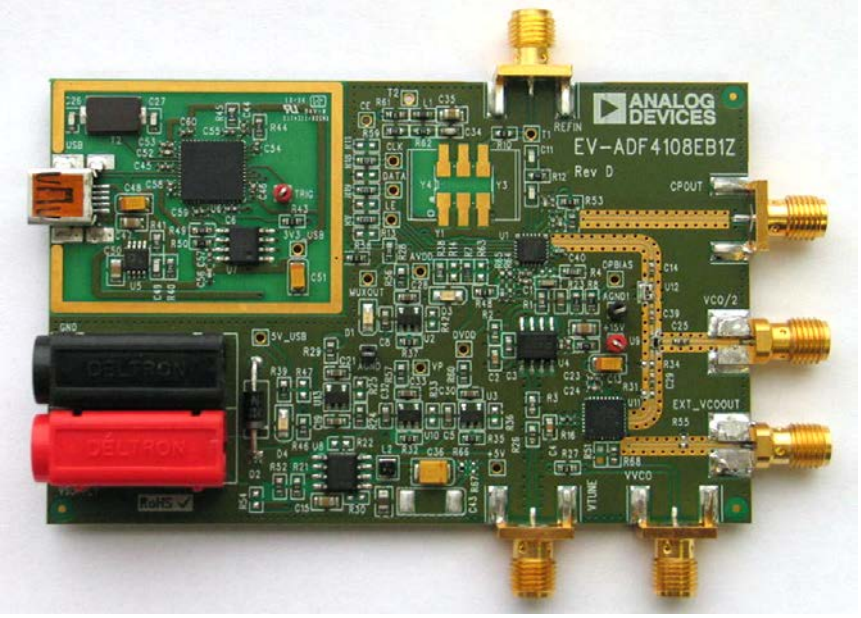

Figure 1. EV-ADF4108EB1Z

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7/11—Revision 0: Initial Version

QUICK START GUIDE

Use the following steps to evaluate the ADF4108 device:

1. Install the Int-N software (see the UG-476 user guide, *PLL Software Installation Guide*).
2. Follow the hardware driver installation procedure.
3. Connect the power supplies to the EV-ADF4108EB1Z:
   a. Connect the 5.5 V power supply to the on-board banana connectors.
   b. Connect the 15 V power supply to the test points labeled +15 V and AGND1.
4. Connect the USB cable to the PC and to the EV-ADF4108EB1Z.
5. Run the Int-N software.
6. Select the ADF4108 device and the USB board in the **Select Device and Connection** tab of the main window.
7. Ensure that **Analog Devices RFG.L Eval Board connected** is displayed at the bottom left of the main window.
8. Connect the reference frequency to REFIN (SMA).
9. Click the **Main Controls** tab to input the RF and other settings.
10. Note that the **Phase Detector Polarity** drop-down box in the **Settings** section should be set to **Negative** to suit the active loop filter in inverting mode.
11. Update all registers.
12. Connect the output to a signal source analyzer. The board offers two outputs.
    a. VCO/2 via the SMA labeled VCO/2.
    b. VCO via the SMA labeled EXT_VCOOUT.
13. Measure the results.

EVALUATION BOARD HARDWARE

The evaluation board comes with a mini-USB cable to connect the evaluation board to the USB port of a PC. The evaluation board silkscreen is shown in Figure 2. The EV-ADF4108EB1Z schematics are shown in Figure 7 to Figure 10.

POWER SUPPLIES

The board is powered via two external supplies, 5.5 V and 15 V, and connected as described in the Quick Start Guide section.

INPUT SIGNALS

The necessary reference input can be supplied from an external generator. A low noise, high slew rate reference source is best for achieving the stated performance of the ADF4108. This reference source is connected to the REFIN SMA connector. A second option is to solder a footprint-compatible TCXO to Footprint Y1.

OUTPUT SIGNALS

The VCO output is available at EXT_VCOOUT through a standard SMA connector. A divide-by-2 option is also available at the VCO/2 SMA connector. To use an alternate loop filter and VCO, the charge pump output (CPOUT) and the VCO tune voltage (VTUNE) are available as outputs via standard SMA connectors.

DEFAULT OPERATION

All components necessary for local oscillation (LO) generation can be inserted on the board. The board is shipped with the ADF4108 synthesizer, an active loop filter, and the VCO.

An active loop filter using standard feedback is inserted between the charge pump output and the VCO input. The design parameters for the loop filter are for a center frequency of 6400 MHz, a PFD frequency of 2500 kHz, and an active loop filter bandwidth of 15 kHz. To design a filter for different frequency setups, use the ADIsimPLL simulation software to generate filter component values and evaluate results.

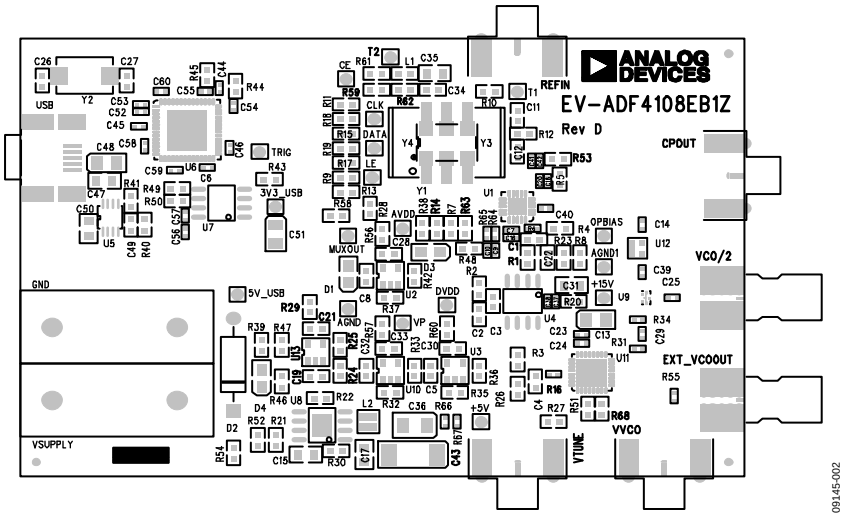

Figure 2. Evaluation Board Silkscreen

EVALUATION BOARD SOFTWARE

The control software for the EV-ADF4108EB1Z is provided on the CD included in the evaluation board kit. To install the software, see the UG-476 user guide, *PLL Software Installation Guide*.

To run the software, click the **Int-N v7** file on the desktop or select the file from the **Start** menu.

On the **Select Device and Connection** tab, choose the device and connection method, and then click **Connect.**

Confirm that **Analog Devices RFG.L Eval Board connected** is displayed at the bottom left of the window (see Figure 3). If this message is not displayed, the software cannot connect to the evaluation board.

Note that when the board is connected, there is about a 5 sec to 10 sec delay before the status label changes.

From the **File** menu, the current settings can be saved as and loaded from a text file.

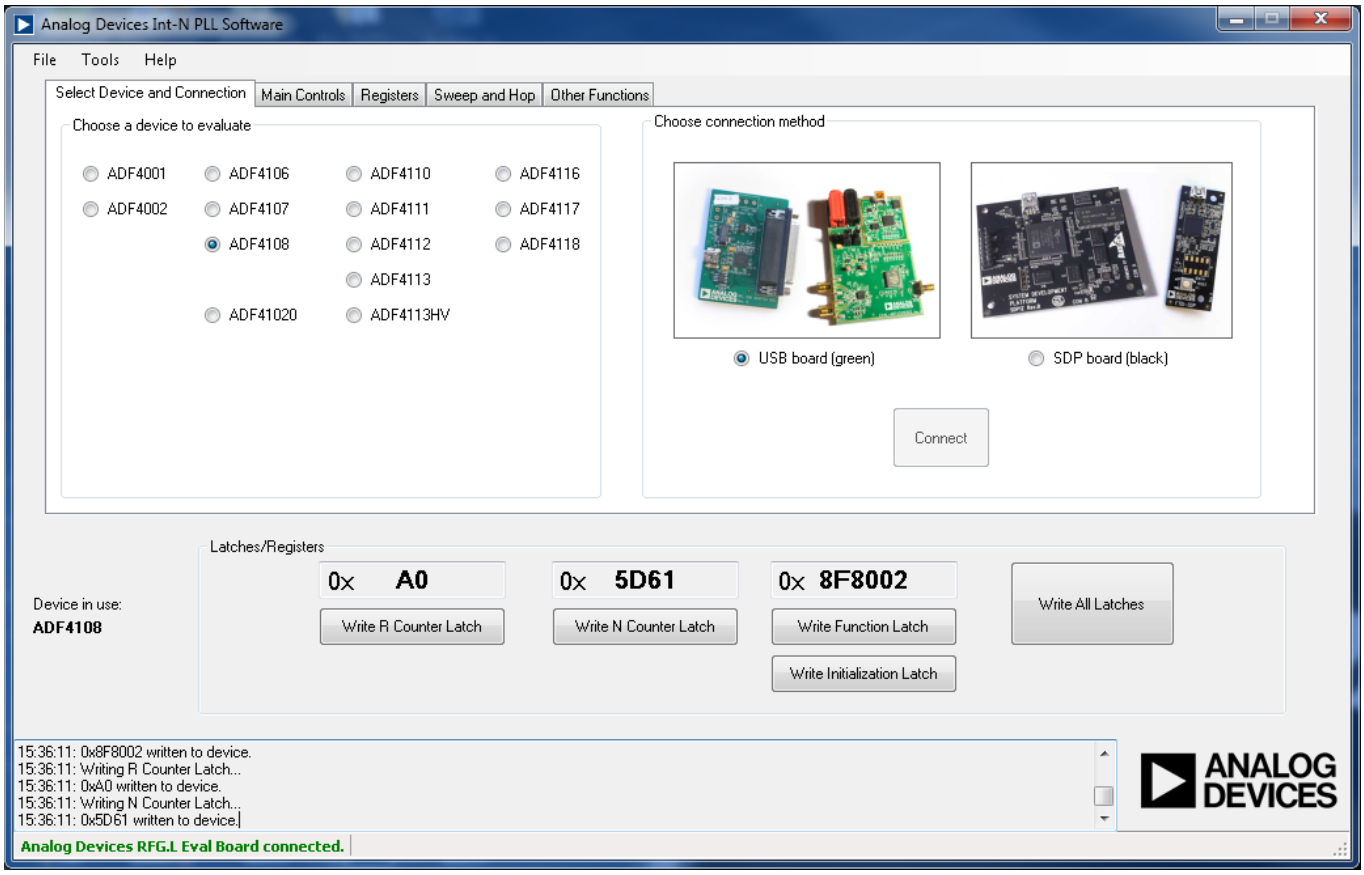

Figure 3. Int-N Software, Main Window—Select Device and Connection

The **Main Controls** tab controls the PLL settings (see Figure 4).

Use the **RF Settings** section to control the output frequency. You can type the desired output frequency in the **RF VCO Output Frequency** text box (in megahertz).

Use the **Reference Frequency** text box to set the correct reference frequency and the reference frequency divider. The default reference on the software window is 100 MHz.

The **Settings** section lets you select general options available for the PLL, including the charge pump current settings and phase detector polarity. The EV-ADF4108EB1Z uses a charge pump setting of 5 mA and a negative phase detector polarity.

In the **Registers** tab, you can manually input the desired value to be written to the registers.

In the **Sweep and Hop** tab, you can make the device sweep a range of frequencies or hop between two set frequencies.

In the **Latches/Registers** section at the bottom of the **Main Controls** tab of the main window, the values to be written to each register are displayed. If the background on the text box is green, the value displayed is different from the value actually on the device. Click **Write R Counter Latch** or **Write N Counter Latch** to write the value displayed to the device. To update all Latches in the correct order, click **Write All Latches.**

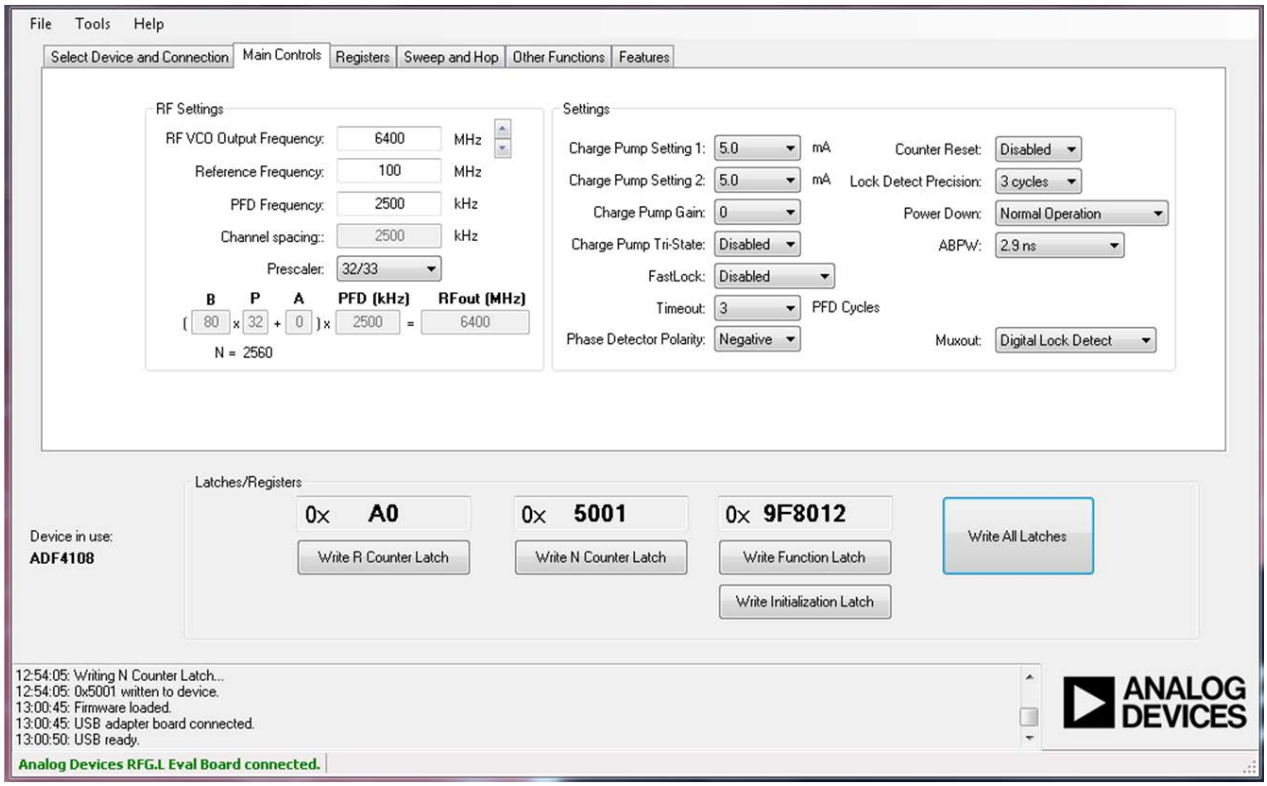

Figure 4. Int-N Software, Main Window—Main Controls

EVALUATION AND TEST

To evaluate and test the performance of the ADF4108, use the following procedure:

1. Install the Analog Devices Int-N software (see the UG-476 user guide, *PLL Software Installation Guide*).
2. Use ADIsimPLL to generate the loop filter component values if a different loop filter is required.
3. Solder new filter components specified by ADIsimPLL.
4. Install the USB software drivers. Connect the evaluation board to a PC using the supplied USB cable. Follow the hardware driver installation procedure that appears.
5. Connect the USB connector to the EV-ADF4108EB1Z.
6. Connect a reference signal to REFIN.
7. Connect a spectrum analyzer to EXT_VCOOUT or VCO/2.
8. Run the Int-N software.
9. Select the USB board and the ADF4108 device in the **Select Device and Connection** tab of the main window of the evaluation board software.
10. In the **Main Controls** tab in the main window of the evaluation board software, set the VCO center frequency in the **RF VCO Output Frequency** text box (the example in Figure 5 uses a 6.4 GHz VCO). Set the **PFD Frequency** text box as specified in ADIsimPLL, and program the **Reference Frequency** value to equal the reference connected to the REFIN SMA Connector (or the TCXO). See Figure 6 for the suggested setup.
11. Measure the output spectrum. Figure 5 shows 6.4 GHz phase noise output.

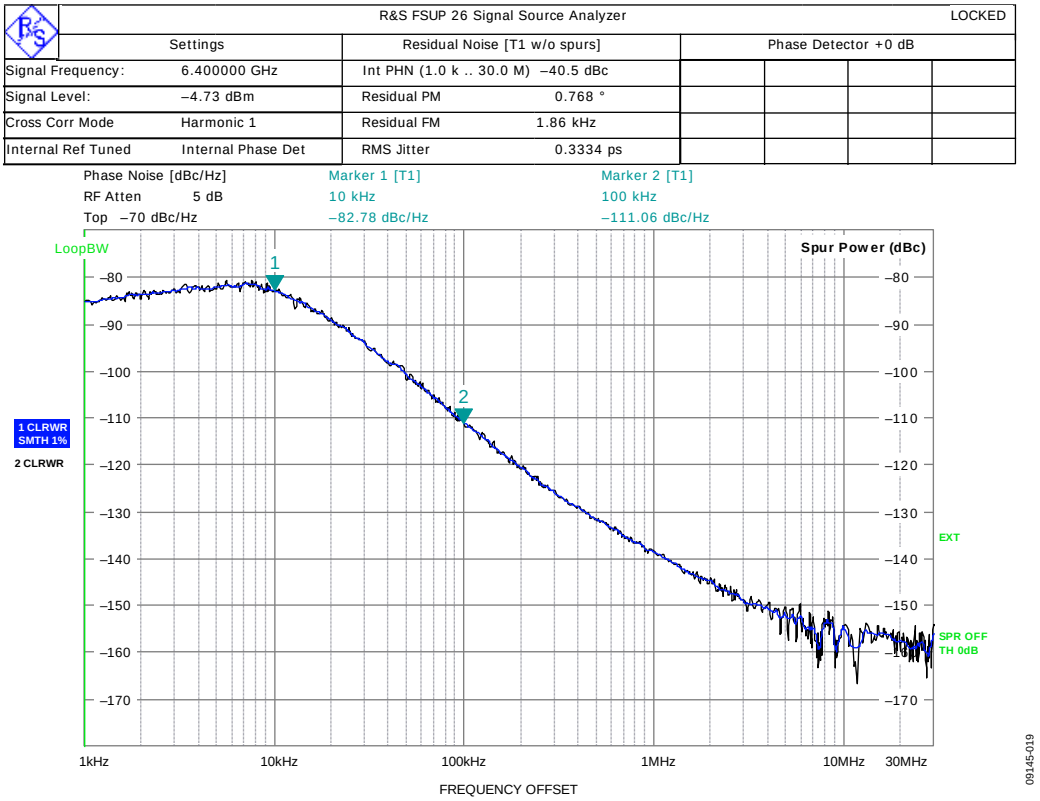

Figure 5. Spectrum Analyzer Display

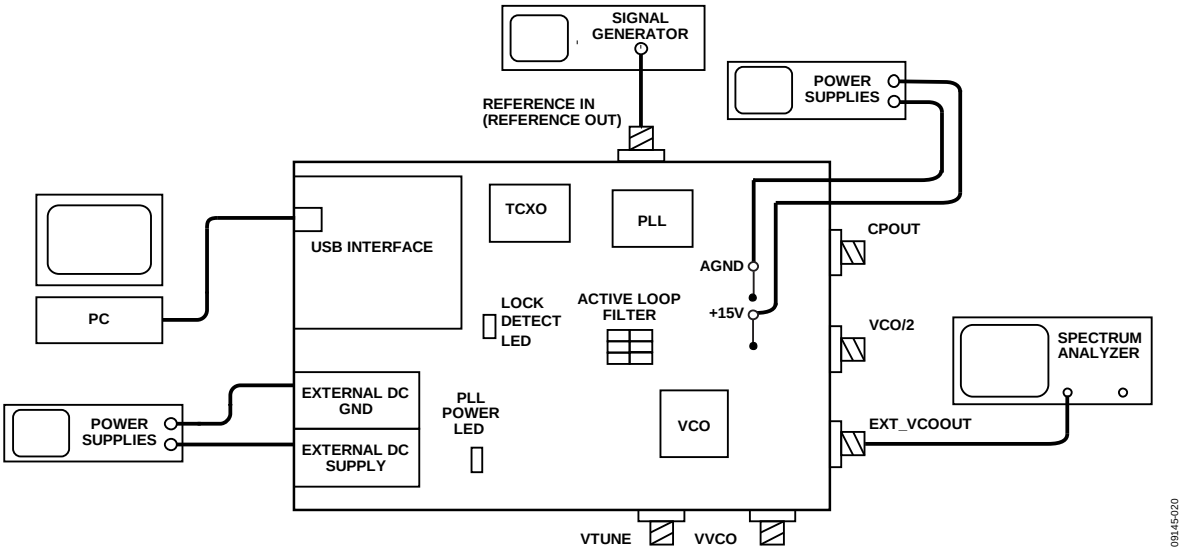

Figure 6. Typical Evaluation Setup

EVALUATION BOARD SCHEMATICS AND ARTWORK

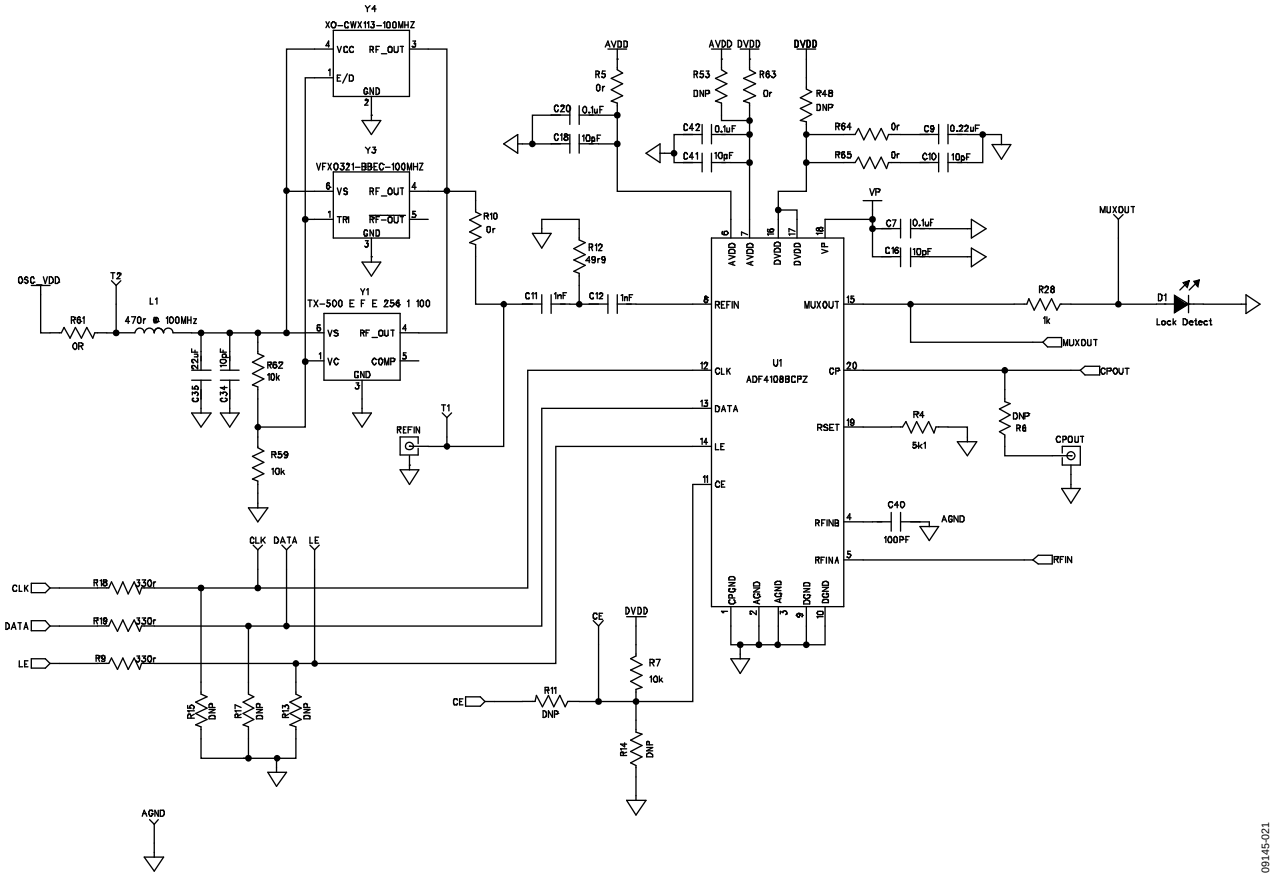

Figure 7. Evaluation Board Schematic (Page 1)

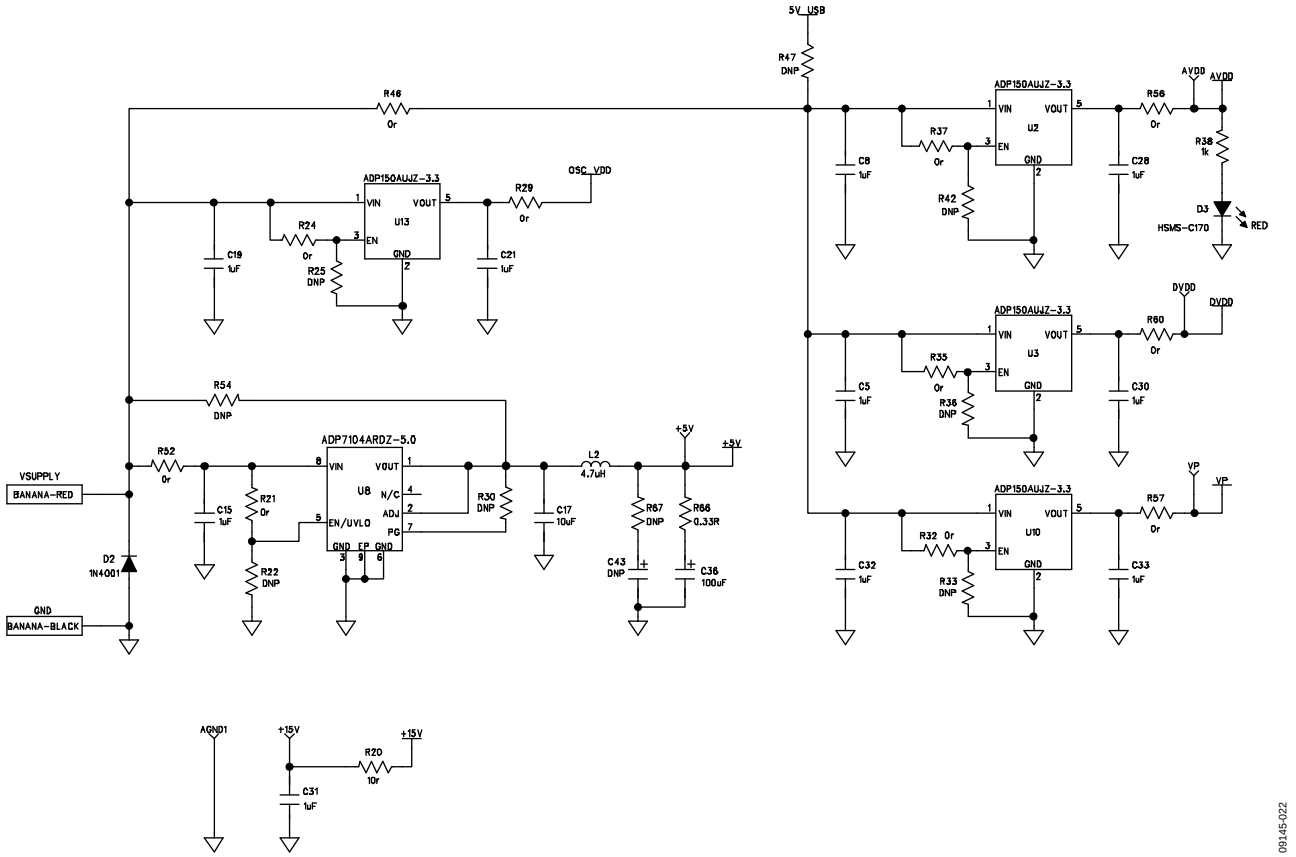

Figure 8. Evaluation Board Schematic (Page 2)

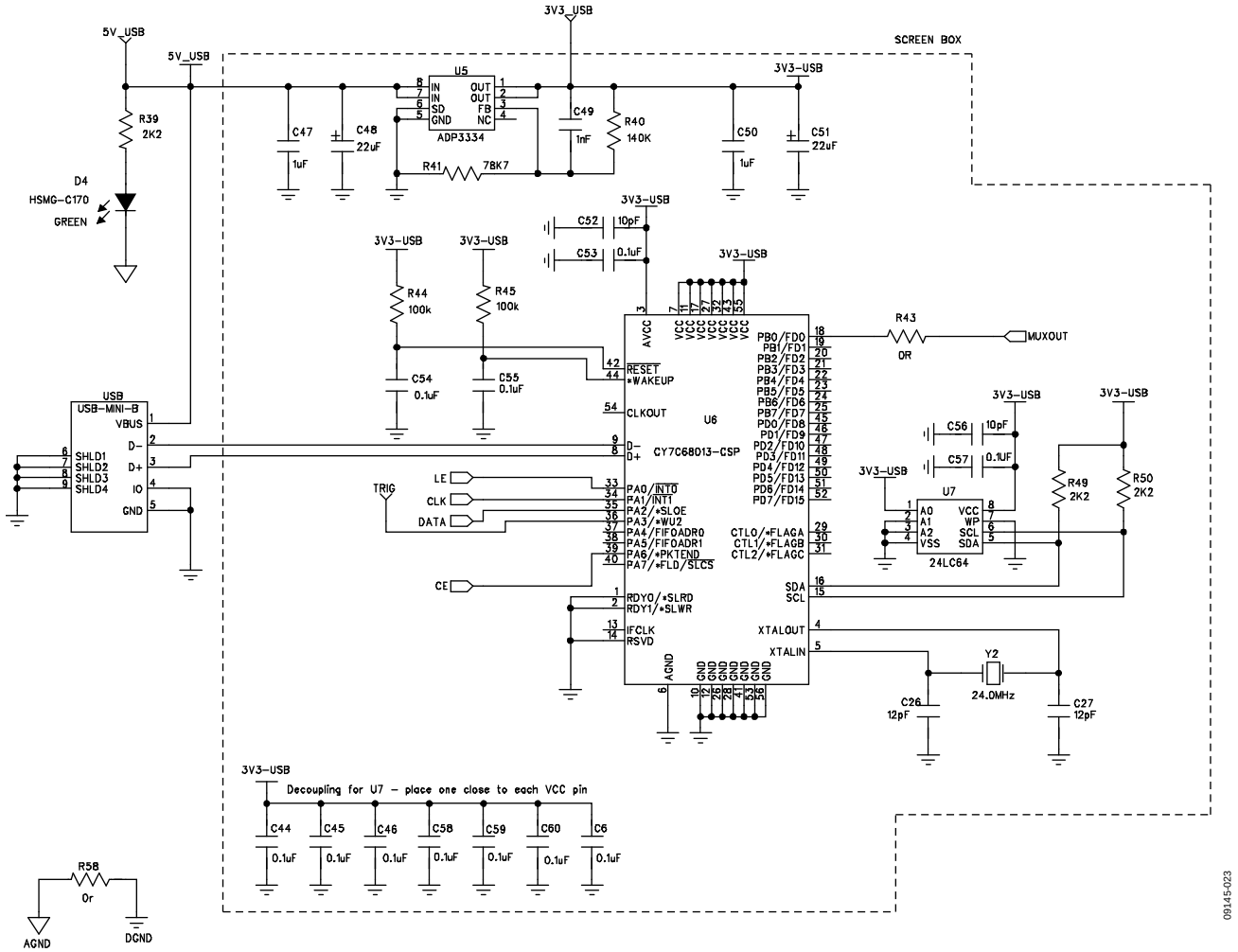

Figure 9. Evaluation Board Schematic (Page 3)

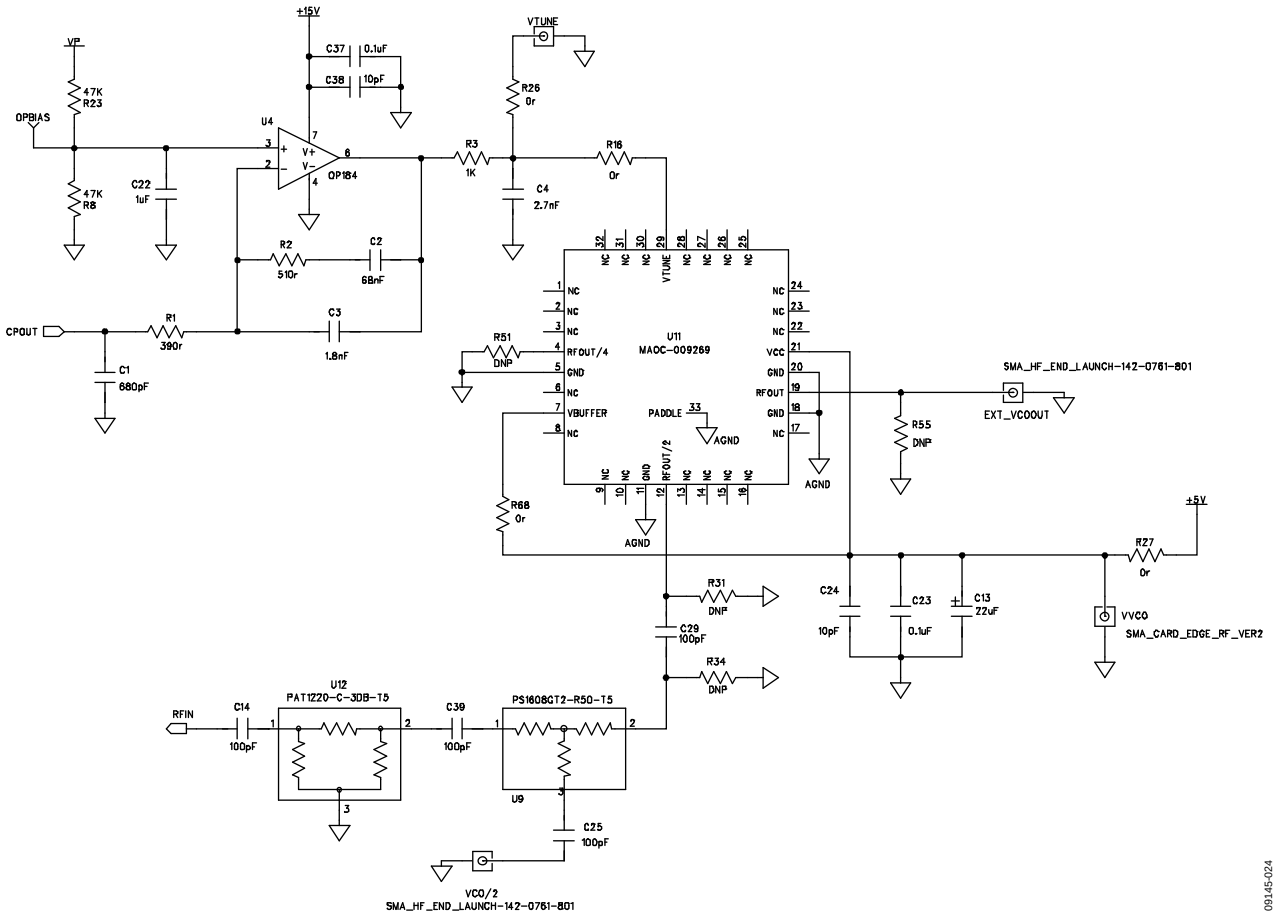

Figure 10. Evaluation Board Schematic (Page 4)

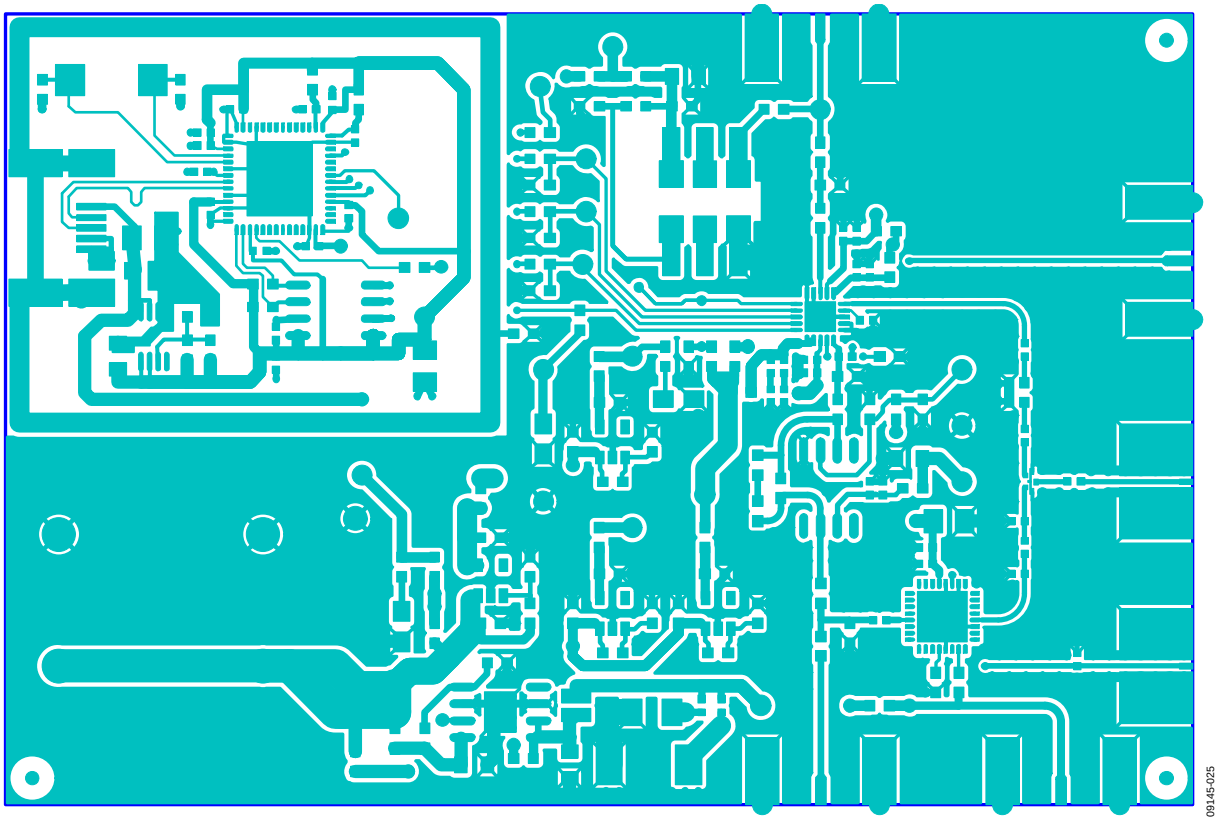

Figure 11. Layer 1 (Component Side)

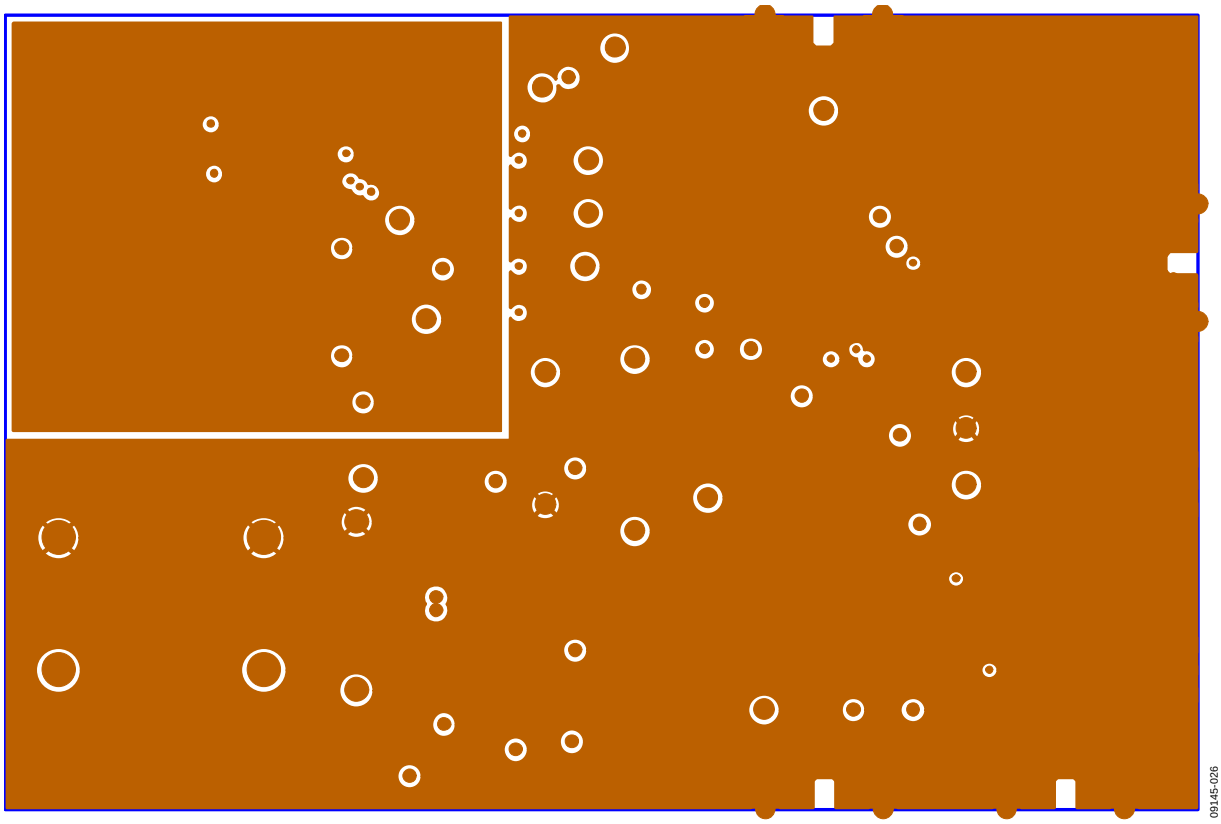

Figure 12. Layer 2 (Ground Plane)

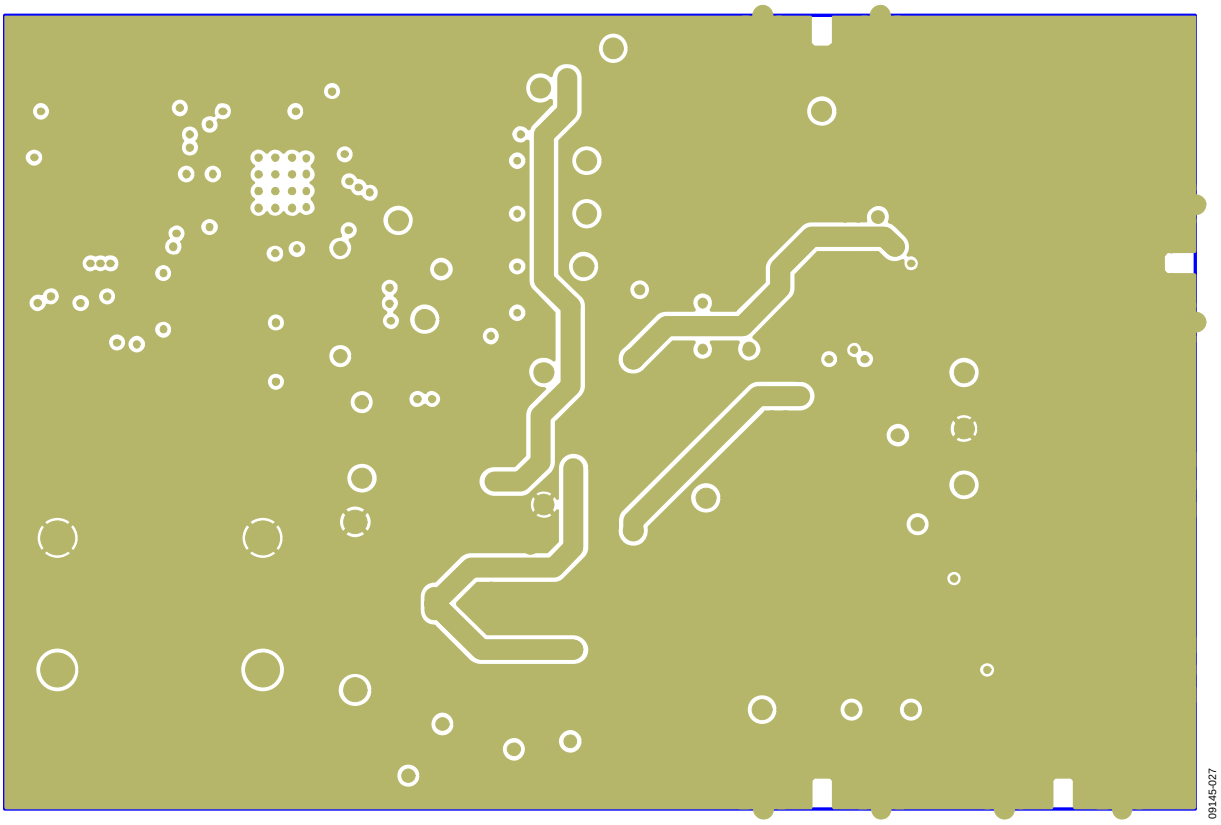

Figure 13. Layer 3 (Power/Ground Plane)

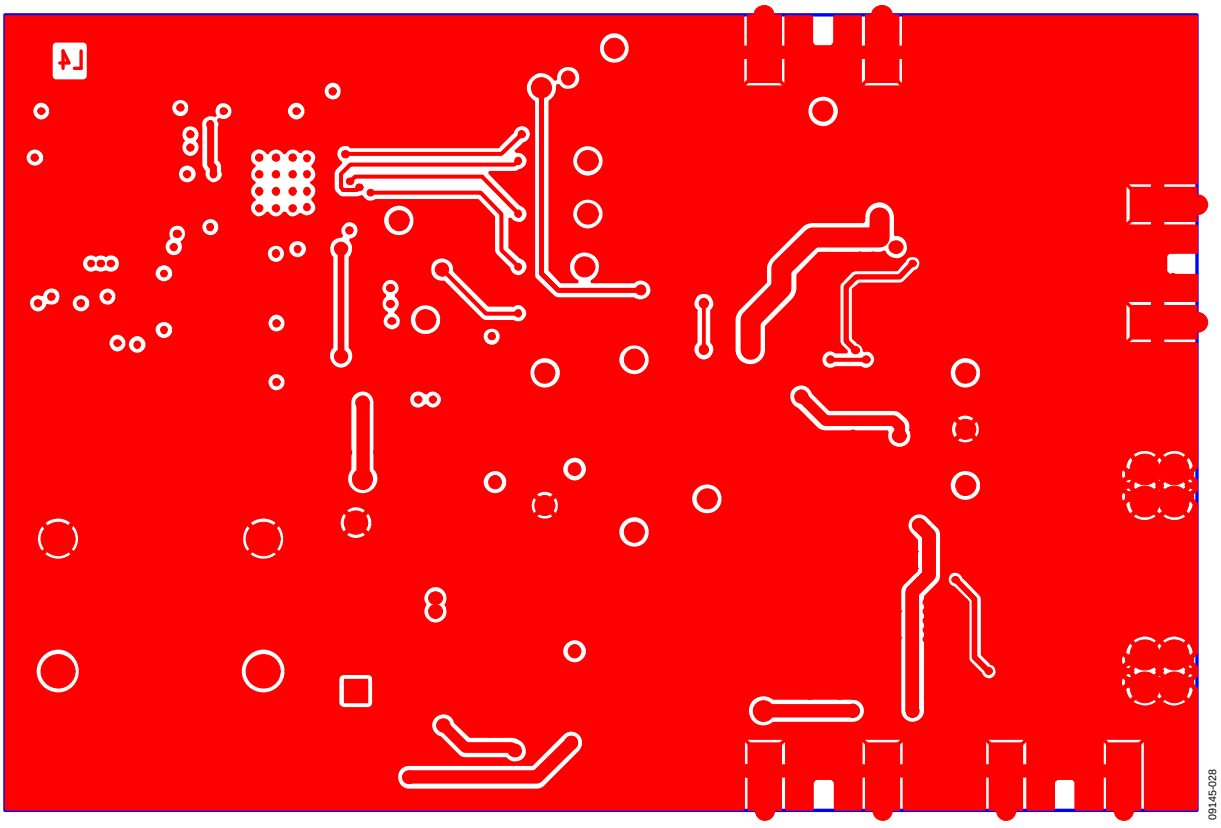

Figure 14. Layer 4 (Solder Side)

BILL OF MATERIALS

Table 1.

Reference Designator	Part Description
+5V, +15V, 3V3_USB,[1] 5V_USB,[1] AVDD,[1] CE,[1] CLK,[1] DATA,[1] DVDD,[1] LE,[1] MUXOUT,[1] OPBIAS,[1] T1,[1] T2,[1] RIG, VP[1]	Red test point
AGND, AGND1	Black test point
C1	Capacitor, 0603, 50 V, 680 pF, COG/NPO
C2	Capacitor, 0603, X7R, 50 V, 68 nF
C3	Capacitor, 0603, X7R, 50 V, 1.8 nF
C4	Capacitor, 0603, X7R, 50 V, 2.7 nF
C5, C8, C19, C21, C22, C28, C30, C32, C33	Capacitor, 0603, 1 µF, 10 V, X5R
C6, C7, C20, C42, C44, C45, C46, C53, C54, C55, C57, C58, C59, C60	X7R ceramic capacitor, 0402,16 V, 0.1 µF
C9	X5R ceramic capacitor, 0402, 6.3 V, 0.22 µF
C10, C16, C18, C24, C38, C41, C52, C56	NP0 ceramic capacitor, 0402, 50 V, 10 pF
C11, C12, C49	NP0 ceramic capacitor, 0603, 50 V, 1 nF
C13, C48, C51	Tantalum capacitor (TAJ-A case), RTAJ_A, 6.3 V, 22 µF
C14, C25, C29, C39	COG ceramic capacitor, 0402, 50 V, 100 pF
C15, C31, C47, C50	Capacitor, X5R, 0805, 1.0 µF, 50 V
C17	Capacitor, X5R, 0805, 10 V, 10 µF, 10%
C23, C37	X5R ceramic capacitor, 0402, 25 V, 0.1 µF
C26, C27	NPO SMD ceramic capacitor, 0603, 50 V, 10 pF
C34	Multilayer ceramic capacitor, 0603, 10 pF
C35	X5R ceramic capacitor, 0805, 6.3 V, 22 µF
C36	Capacitor, CASE B, 100 µF, 6.3 V, RTAJ_B
C40	Capacitor, 0402, 100 pF, 50 V, NP0
C43[1]	Capacitor, RTAJ_D
CPOUT, REFIN, VTUNE, VVCO	Conn jack end launch PC gold SMA
D1, D4	LED, green
D2	Diode, standard, 1 A, 50 V
D3	LED, red
EXT_VCOOUT, VCO/2	High frequency SMA end launch connector—142-0761-801
GND	Black 4 mm banana socket
L1	Ferrite bead, 470 Ω at 100 MHz
L2	Inductor, SMT Power EPL2014 Series, 4.7 µH
R1	Resistor, 0603, 390 Ω
R2	Resistor, 0603, 510 Ω
R3, R28, R38	Resistor, 0603, 1 kΩ
R4	Resistor, 0603, 5.1 kΩ
R5, R10, R21, R24, R26, R27, R29, R32, R35, R37, R43, R46, R48, R52, R53, R56, R57, R58, R60, R61, R68	Resistor, 0603, 0 Ω
R6,[1] R31,[1] R34,[1] R55,[1] R67[1]	Resistor, 0402
R7, R59, R62	Resistor, 0603, 10 kΩ
R8, R23	Resistor, 0603, 47 kΩ
R9, R18, R19	Resistor, 0603, 330 Ω
R11,[1] R13,[1] R14,[1] R15,[1] R17,[1] R22,[1] R25,[1] R30,[1] R33,[1] R36,[1] R42,[1] R47,[1] R51,[1] R54,[1] R63[1]	Resistor, 0603
R12	Resistor, 0603, 49.9 Ω
R16, R64, R65	Resistor, 0402, 0 Ω
R20	Resistor, 0603, 10 Ω
R39, R49, R50	Resistor, 0603, 2.2 kΩ
R40	Resistor, 0603, 140 kΩ

Reference Designator	Part Description
R41	Resistor, 0603, 78.7 kΩ
R44, R45	Resistor, 0603, 100 kΩ
R66	Resistor, 0402, 0.33 Ω
U1	ADF4108, PLL frequency synthesizer
U2, U3, U10, U13	ADP150AUJZ-3.3, 3.3 V linear regulator
U4	OP184, single op amp
U5	ADP3334, adjustable LDO regulator
U6	USB microcontroller
U7	64k, I²C serial EEPROM
U8	ADP7104ARDZ-5.0, linear regulator
U9	Power divider, 6 dB, 1 W, 0603 SMD
U11	VCO, dual output and divide-by-2 prescaler
U12	Attenuator, 3 dB, 50 Ω, 0805 SMD
VSUPPLY	Red 4 mm banana socket
Y1[1]	TX-500 temperature compensated crystal oscillator, 100.0 MHz
Y2	SMD crystal, 24.0 MHz

[1] Do not insert.

RELATED LINKS

Resource	Description
ADF4108	Product Page: PLL Frequency Synthesizer
ADP150	Product Page: Ultralow Noise, 150 mA CMOS Linear Regulator
OP184	Product Page: Single-Supply Rail-to-Rail Input/Output Operational Amplifier
ADP3334	Product Page: High Accuracy Low I_Q, 500 mA anyCAP® Adjustable Low Dropout Regulator
ADP7104	Product Page: 20 V, 500 mA, Low Noise, CMOS LDO
UG-476	User Guide: PLL Software Installation Guide

I²C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).

EEB Caution
EEB (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 EEB. Therefore, proper EEB precautions should be taken to avoid performance degradation or loss of functionality.

UG09145-0-12/12(B)