Evaluation Board User Guide
UG-165

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Evaluation Board for the ADF4113HV Integer-N PLL Frequency Synthesizer

FEATURES

Self-contained evaluation board, including synthesizer, VCO, TCXO for reference frequency, and loop filter
Designed for 1 MHz PFD frequency and 50 kHz loop bandwidth
Accompanying software allows complete control of synthesizer functions from a PC

EVALUATION KIT CONTENTS

EV-ADF4113HVSD1Z 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 ADF4113HV data sheet
- Electronic version of the UG-165 user guide

ADDITIONAL EQUIPMENT

PC running Windows XP or more recent version
SDP-S board (system demonstration platform, serial only)
Spectrum analyzer
Oscilloscope (optional)

DOCUMENTS NEEDED

ADF4113HV data sheet

REQUIRED SOFTWARE

Analog Devices Int-N PLL software (Revision 7.3.1 or higher)
ADIsimPLL

GENERAL DESCRIPTION

This evaluation board allows the user to evaluate the performance of the ADF4113HV frequency synthesizer for phase-locked loops (PLLs). Figure 1 shows the board, which contains the ADF4113HV synthesizer, an edge-mounted SMA connector for the RF output signal, power supply connectors, a temperature compensated reference oscillator (TCXO) of 25 MHz frequency, and an SDP connector. There is also a loop filter (50 kHz) and a voltage controlled oscillator (VCO), the Mini-Circuits ROS-2260W+, on board.

The package contains Windows®-based software (XP or later) to allow easy programming of the synthesizer.

This evaluation board requires an SDP-S board (shown in Figure 1, but not supplied with the evaluation board kit). The SDP-S allows software programming of the ADF4113HV device.

EVALUATION BOARD

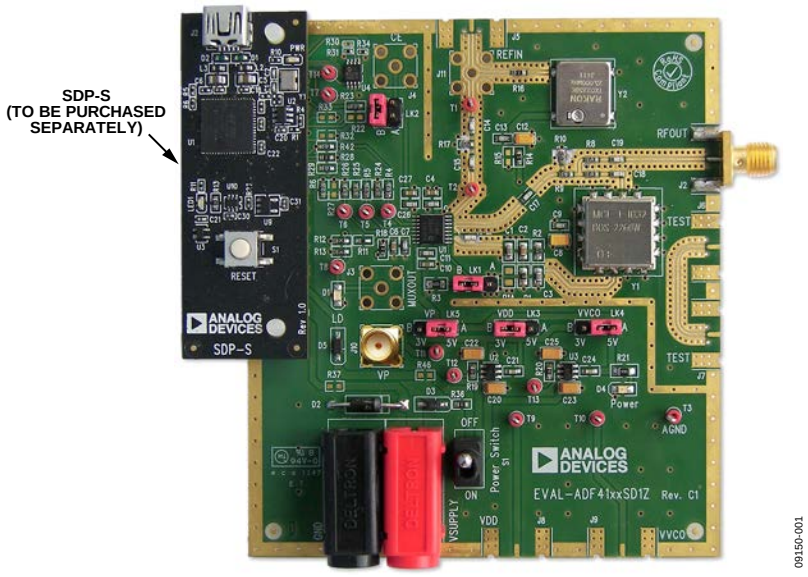

Figure 1. EV-ADF4113HVSD1Z with SDP-S

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REVISION HISTORY

10/12—Rev. 0 to Rev. A

Changed EVAL-ADF4113HVEB1Z to EV-ADF4113HVSD1Z ..... Universal
Replaced All Sections, Tables, and Figures ..... Universal

6/11—Revision 0: Initial Version

QUICK START GUIDE

Follow these steps to quickly evaluate the ADF4113HV device:

1. Install the Analog Devices Int-N PLL software.
2. Connect the SDP-S motherboard to the EV-ADF4113HVSD1Z board and to the PC.
3. Follow the hardware driver installation procedure that appears if you are using Windows XP.
4. Connect the power supplies to banana connectors (6 V to 12 V).
5. Connect 15 V to V_P.
6. Run the Analog Devices Int-N PLL software.
7. Select the SDP board and the ADF4113HV device in the **Select Device and Connection** tab in the main window of the evaluation board software.
8. Click the **Main Controls** tab. Set the correct values for **Reference Frequency** (25 MHz) and **RF VCO Output Frequency** (ranging from 1200 MHz to 2100 MHz), and then click **Write All Latches**.
9. Connect the spectrum analyzer to J2.
10. Measure the results.

EVALUATION BOARD HARDWARE

The evaluation board requires the use of an SDP-S motherboard to program the device. The SDP-S board is not included with the evaluation board and must be purchased separately. The EV-ADF4113HVSD1Z schematics are shown in Figure 21 to Figure 23.

POWER SUPPLIES

The board is powered from external banana connectors and an external 15 V source connected to the VP SMA connector. The supply voltage on the banana connectors can vary between 6 V and 12 V. The power supply circuit provides 3.0 V to V_{DD} on the board (which supplies the ADF4113HV AV_{DD} and DV_{DD} pins) and allows the user to choose either 3.0 V or 5 V for the VCO supply. The default settings are 3.0 V for the ADF4113HV V_{DD} and 5 V for the VCO supply. Note that V_{DD} should never exceed 3.3 V because exceeding this voltage level may damage the device. The supply pin, V_P, must be driven externally via J10 with 15 V.

External power supplies can be used to directly drive the device. In this case, the user must insert SMA connectors as shown in Figure 2.

INPUT SIGNALS

The necessary reference input comes from an on-board temperature compensated crystal oscillator (TCXO) of 25 MHz frequency.

Alternatively, this can be sourced from an external generator. In this case, remove R16 and R14 to disconnect the TCXO from the supply and from the reference path, insert Connector J11 or the J5 edge-mount connector, and connect the external generator to the connector. A low noise, high slew rate reference source is best for achieving the stated performance of the ADF4113HV.

Digital SPI signals are supplied through the SDP connector, J1. Using the SDP-S board is recommended. The SDP-Blackfin (SDP-B) board can also be used, but Resistor R57 must be removed from the SDP-B board. Some additional spurious low frequencies may appear if the SDP-B connector is used.

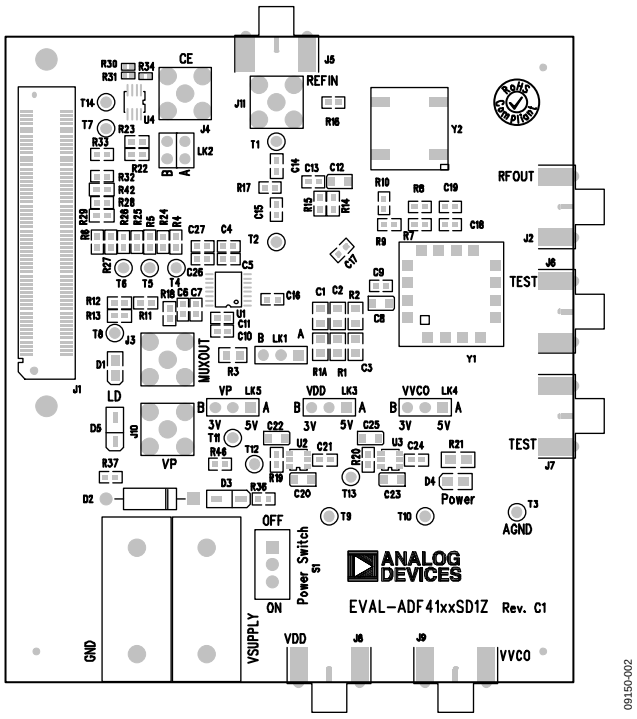

Figure 2. Evaluation Board Silkscreen

OUTPUT SIGNALS

All components necessary for local oscillator (LO) generation are inserted on board. The PLL is made up of the ADF4113HV synthesizer, a passive loop filter, and the VCO. This board is supplied with a VCO ROS-2260W+ from Mini-Circuits, which covers a frequency range from 1290 MHz to 2260 MHz. A low-pass filter of 50 kHz loop bandwidth is inserted between the charge pump output and the VCO input. The VCO output is available at RFOUT through a standard SMA connector, J2. The MUXOUT signal can be monitored at Test Point T8 or at SMA Connector J3.

DEFAULT OPERATION AND JUMPER SELECTION SETTINGS

Link positions and their respective functions are outlined in Table 1.

Table 1. Link Positions and Functions

Link	Position	Options	Description
LK1	A	R1A	Not used
	B	RSET	Normal operation
LK2	A	GND	Not used
	B	VDD	Normal operation
LK3 (V_{DD})	A	5 V	Not used
	B	3 V	Normal operation
LK4 (V_{VCO})	A	5 V	VCO supply (5 V)
	B	3 V	VCO supply (3 V)

SYSTEM DEMONSTRATION PLATFORM (SDP)

The system demonstration platform (SDP) is a series of controller boards, interposer boards, and daughter boards that can be used for easy, low cost evaluation of Analog Devices, Inc., components and reference circuits. It is a reusable platform whereby a single controller board can be reused in various daughter board evaluation systems.

Controller boards connect to a PC via a USB 2.0 high speed port and provide a range of communication interfaces on a 120-pin connector. The pinout for this connector is strictly defined. A receptacle for this 120-pin connector is included on all SDP daughter boards, component evaluation boards, and Circuits from the Lab® reference circuit boards. There are two controller boards in the platform: the SDP-B, which is based on the Blackfin® ADSP-BF527, and the SDP-S, which is a serial interface only controller board. The SDP-S has a subset of the SDP-B functionality.

Interposer boards route signals between the SDP 120-pin connector and a second connector. When the second connector is also a 120-pin connector, the interposer can be used for signal monitoring of the 120-pin connector signals. Alternatively, the second connector allows SDP platform elements to be integrated into a second platform, for example, the BeMicro SDK. More information on the SDP can be found at www.analog.com/sdp.

EVALUATION BOARD SETUP PROCEDURE

SOFTWARE INSTALLATION

Use the following steps to install the SDP drivers and Analog Devices Int-N PLL software.

1. Install the Analog Devices Int-N PLL software by double-clicking **ADI_Int-N_Setup.msi**. Note that the version number may be added to the file name.
   If you are using Windows XP, follow the instructions in the Windows XP Software Installation Guide section (see Figure 3 to Figure 7).
   If you are using Windows Vista or Windows 7, follow the instructions in the Windows Vista and Windows 7 Software Installation Guide section (see Figure 8 to Figure 12).
   Note that the software requires Microsoft Windows Installer and Microsoft .NET Framework 3.5 (or higher). The installer connects to the Internet and downloads Microsoft .NET Framework automatically. Alternatively, before running the **ADI_Int-N_Setup.msi**, both the installer and .NET Framework can be installed from the CD provided in the evaluation board kit.
2. Connect your SDP board to EV-ADF4113HVSD1Z and to the USB port of the PC using the supplied USB cable. If you are using Windows XP, follow the steps in the Windows XP Driver Installation Guide section (see Figure 13 to Figure 16). If you are using Windows Vista or Windows 7, the drivers install automatically.

Windows XP Software Installation Guide

1. Click **Next**.

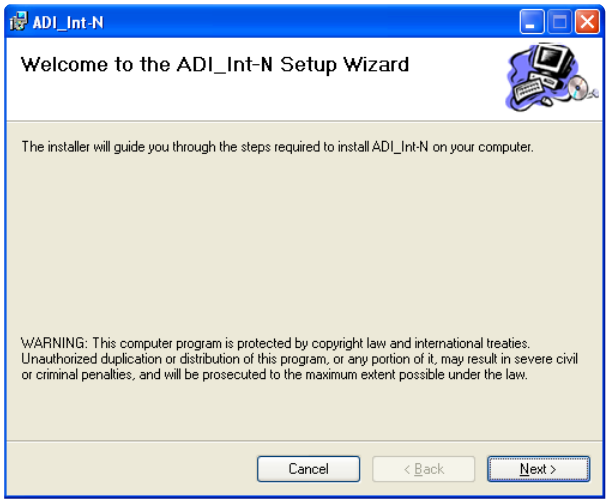

Figure 3. Windows XP Int-N PLL Software Installation, Setup Wizard

2. Choose an installation directory and click **Next**.

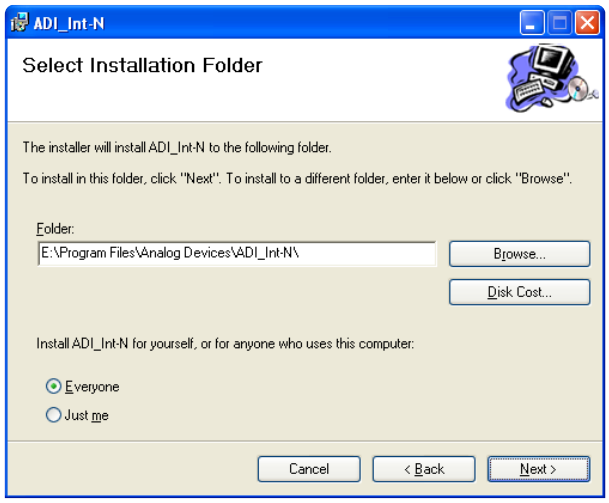

Figure 4. Windows XP Int-N PLL Software Installation, Select Installation Folder

3. Click **Next**.

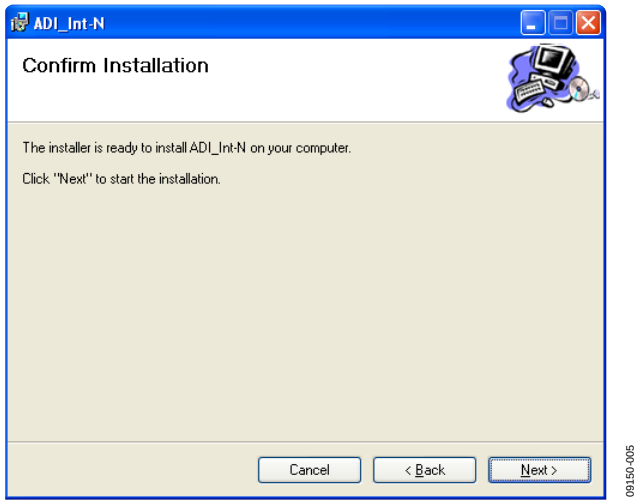

Figure 5. Windows XP Int-N PLL Software Installation, Confirm Installation

4. Click **Continue Anyway**.

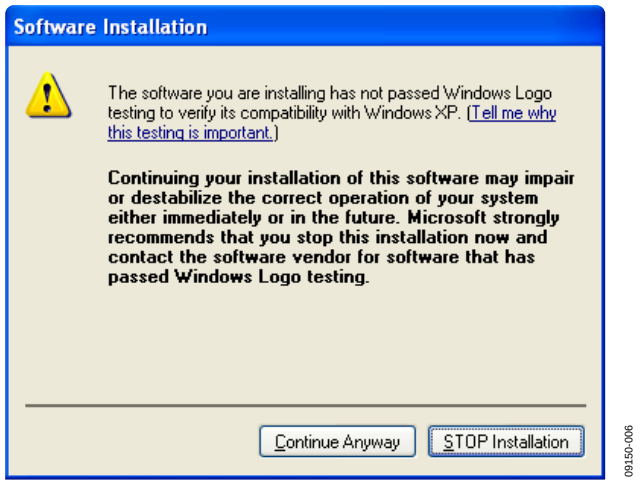

Figure 6. Windows XP Int-N PLL Software Installation, Logo Testing

5. Click **Close**.

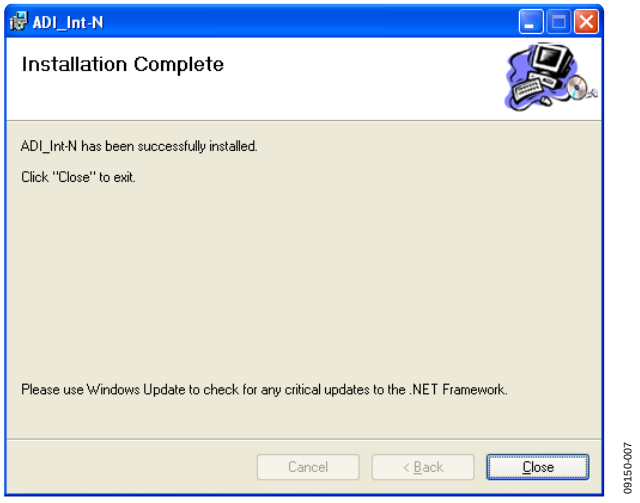

Figure 7. Windows XP Int-N PLL Software Installation, Installation Complete

Windows Vista and Windows 7 Software Installation Guide

1. Click **Next**.

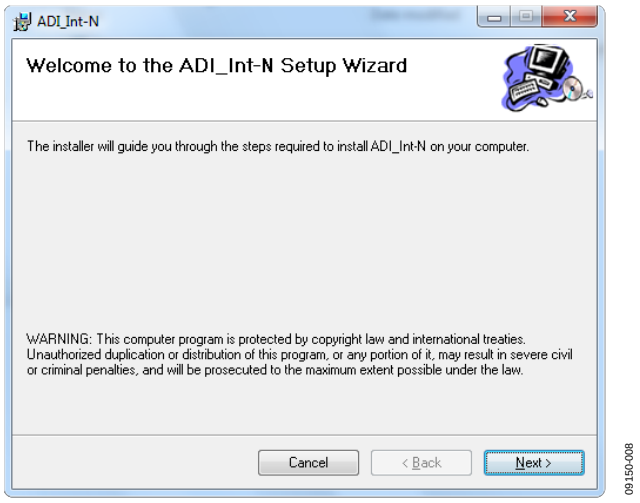

Figure 8. Windows Vista/Windows 7 Int-N PLL Software Installation, Setup Wizard

2. Choose an installation directory and click **Next**.

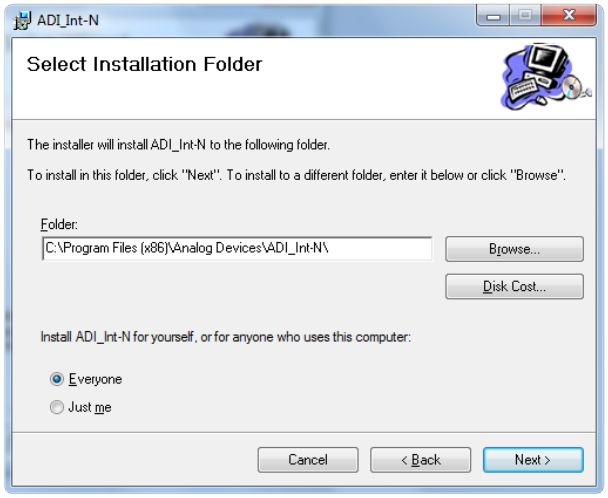

Figure 9. Windows Vista/Windows 7 Int-N PLL Software Installation, Select Installation Folder

3. Click **Next**.

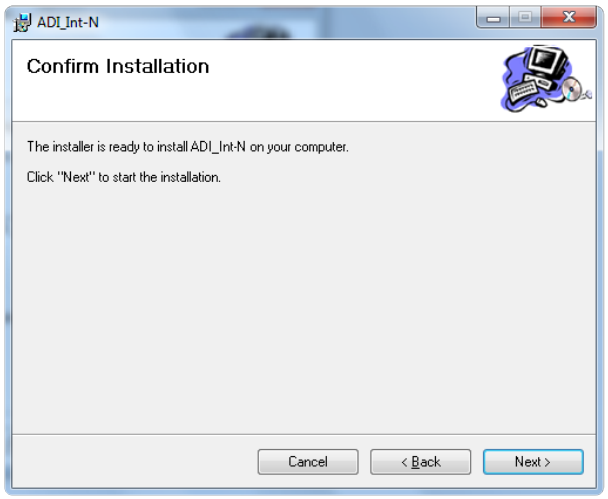

Figure 10. Windows Vista/Windows 7 Int-N PLL Software Installation, Confirm Installation

4. Click **Install**.

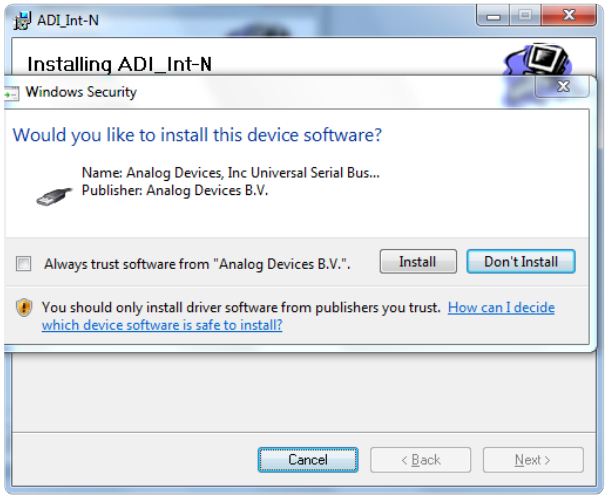

Figure 11. Windows Vista/Windows 7 Int-N PLL Software Installation, Start Installation

5. Click **Close**.

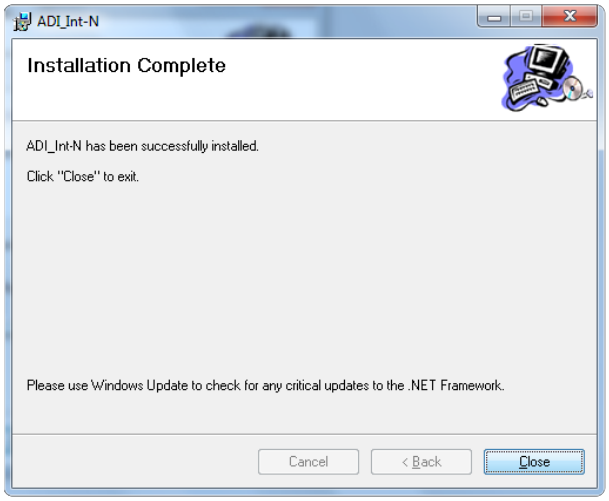

Figure 12. Windows Vista/Windows 7 Int-N PLL Software Installation, Installation Complete

Windows XP Driver Installation Guide

1. Choose **Yes, this time only** and click **Next**.

Figure 13. Windows XP SDP-S Board Driver Installation, Found New Hardware Wizard

2. Click **Next**.

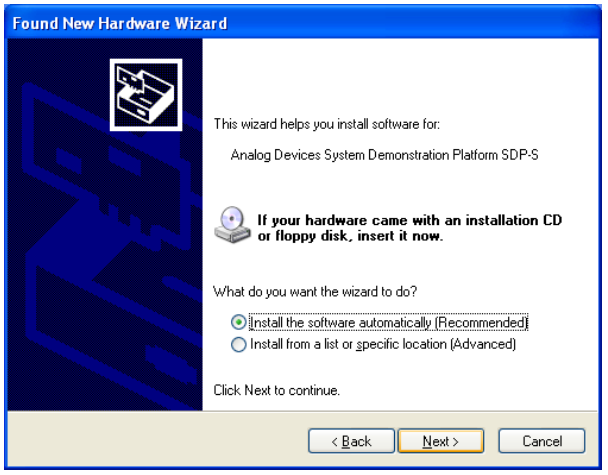

Figure 14. Windows XP SDP-S Board Driver Installation, Installation Options

3. Wait for the installation program to copy all the necessary files.

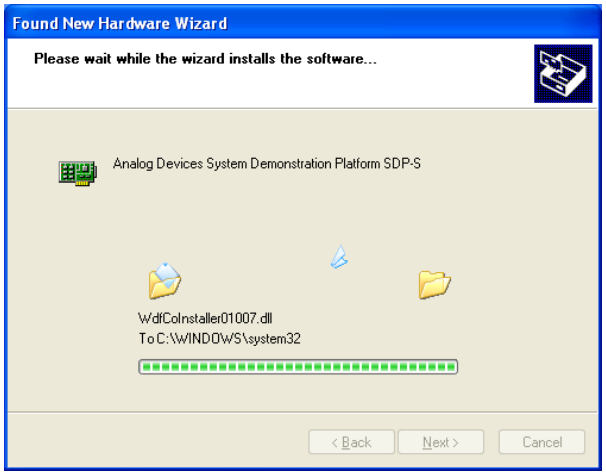

Figure 15. Windows XP SDP-S Board Driver Installation, Progress

4. Click **Finish**.

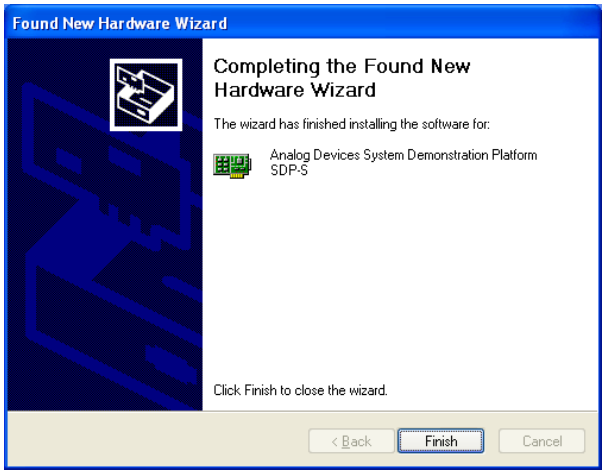

Figure 16. Windows XP SDP-S Board Driver Installation, Complete Installation

EVALUATION BOARD SOFTWARE

The control software for the EV-ADF4113HVSD1Z is provided on a CD included in the evaluation board kit. To install the software, see the Software Installation section.

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

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

Confirm that **SDP board connected** is displayed at the bottom left of the window (see Figure 17). 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 to and loaded from a text file.

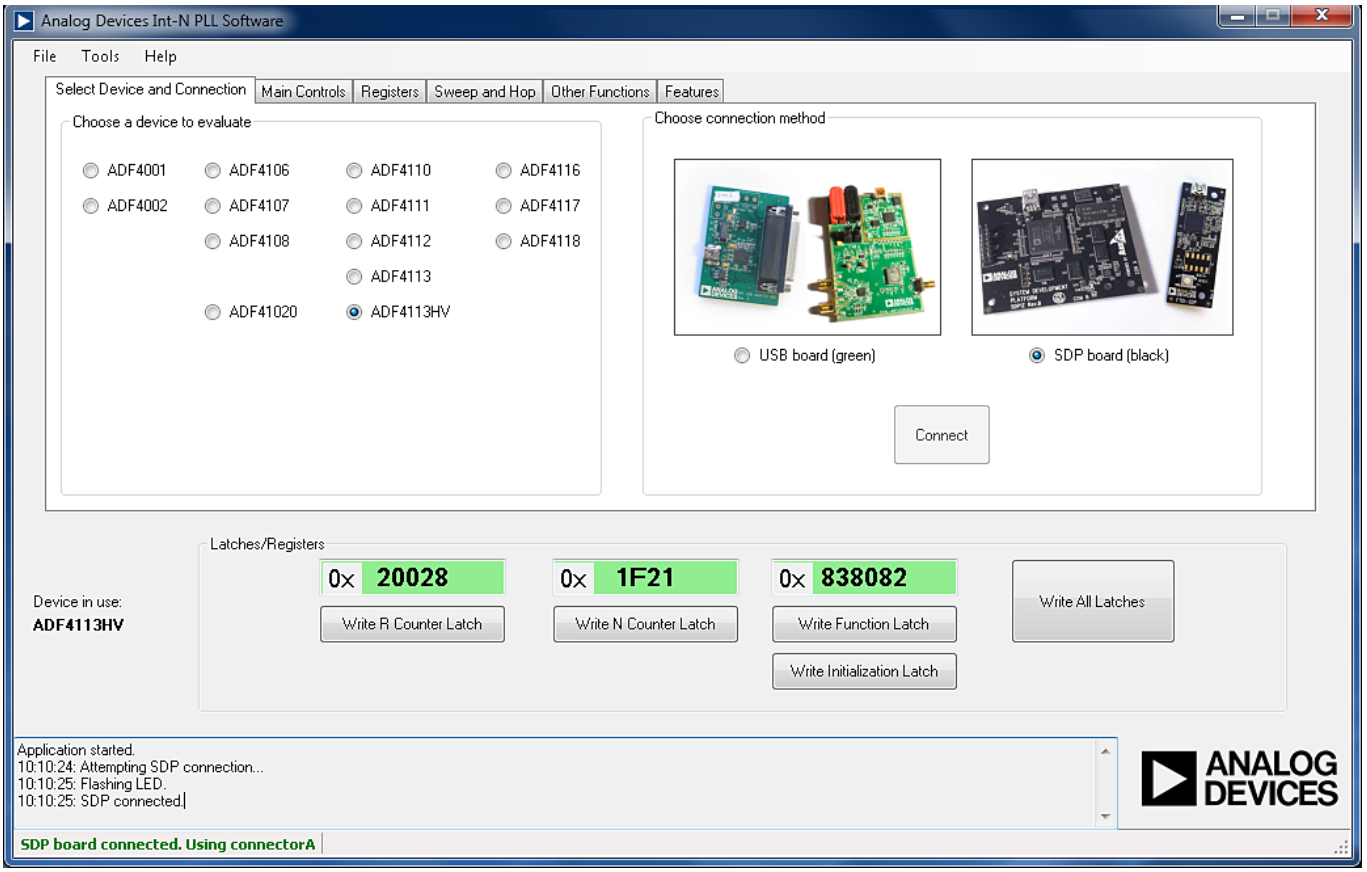

Figure 17. Int-N PLL Software, Main Window—Select Device and Connection

The **Main Controls** tab controls the PLL settings (see Figure 18).

Use the **Reference Frequency** text box to set the correct reference frequency and the reference frequency divider. The default reference frequency in this box is 10 MHz; it must be changed to 25 MHz if the on-board reference oscillator is used.

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).

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**, **Write N Counter Latch**, **Write Function Latch**, or **Write Initialization Latch** to write the value displayed to the device.

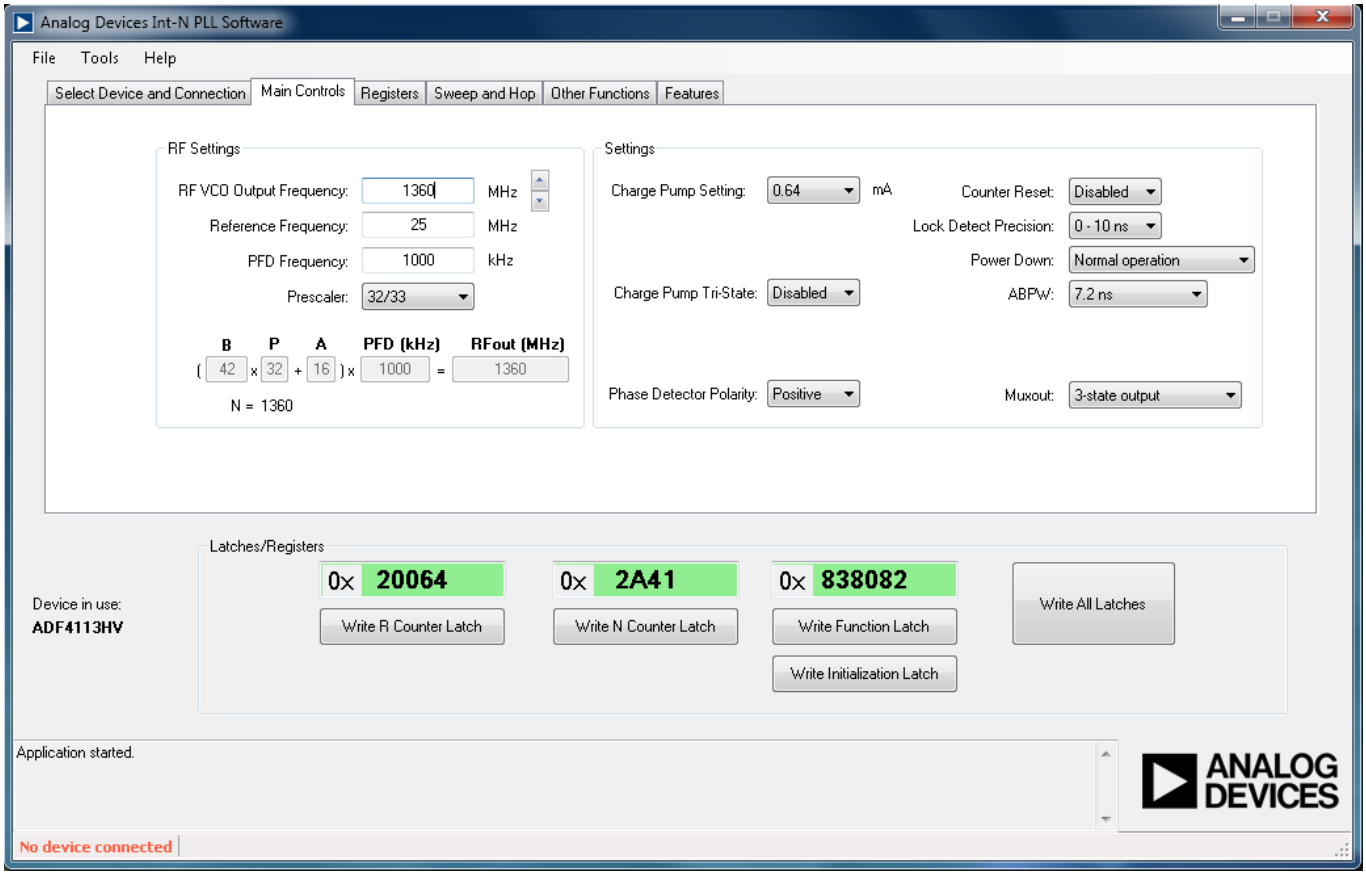

Figure 18. Int-N PLL Software, Main Window—Main Controls

EVALUATION AND TEST

To evaluate and test the performance of the ADF4113HV, use the following procedure:

1. Install the Int-N PLL software.
2. Connect the SDP-S connector to the EV-ADF4113HVSD1Z and to a PC using the supplied USB cable. If you are using Windows XP, follow the hardware driver installation procedure that appears.
3. Connect a spectrum analyzer to Connector J2.
4. Run the Int-N PLL software.
5. Select the SDP board and the ADF4113HV device in the **Select Device and Connection** tab in the main window of the evaluation board software.
6. From the **Main Controls** tab in the main window of the evaluation board software, set the desired frequency in the **RF VCO Output Frequency** text box. Set the **PFD Frequency** text box to 1000 kHz, and program the **Reference Frequency** text box to 25 MHz. See Figure 20 for the suggested measurement setup.
7. Measure the output spectrum. Figure 19 shows a phase noise plot at 1360 MHz output frequency.

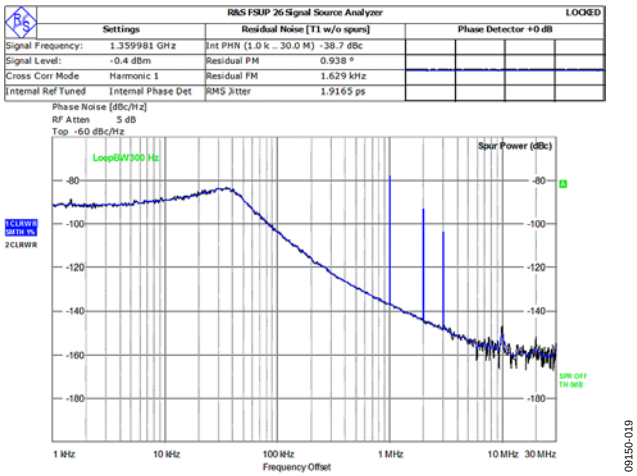

Figure 19. Signal Source Analyzer Display

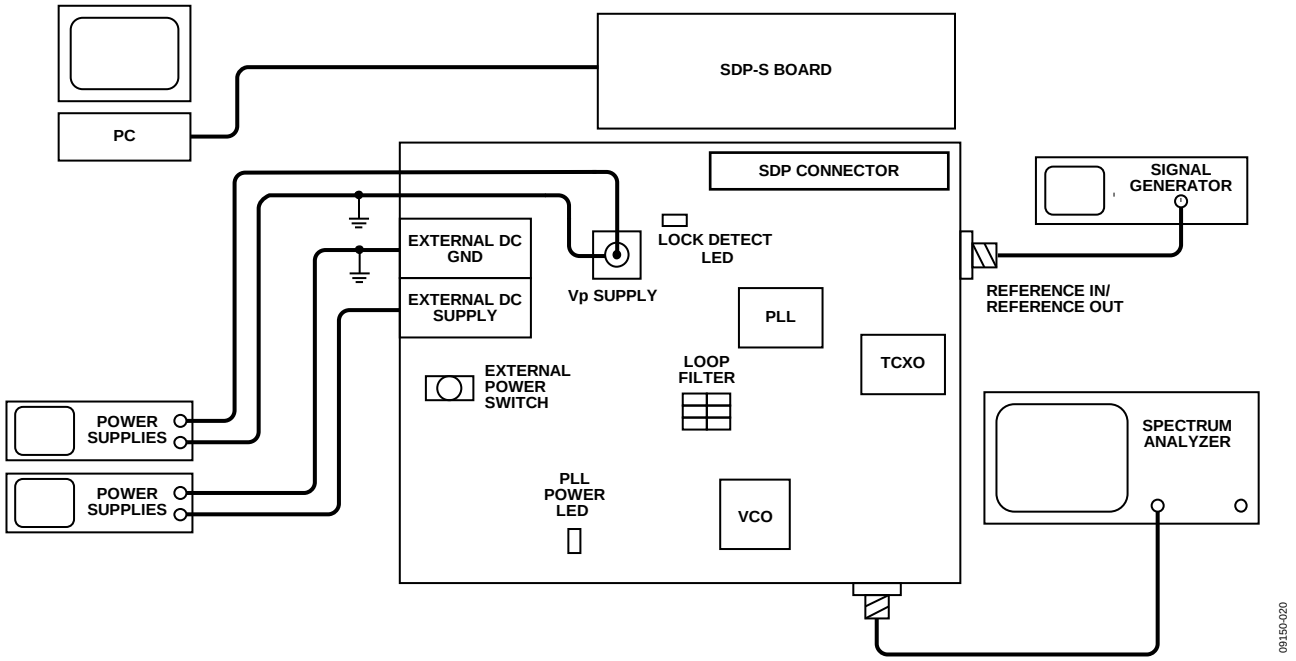

Figure 20. Typical Evaluation Setup

EVALUATION BOARD SCHEMATICS AND ARTWORK

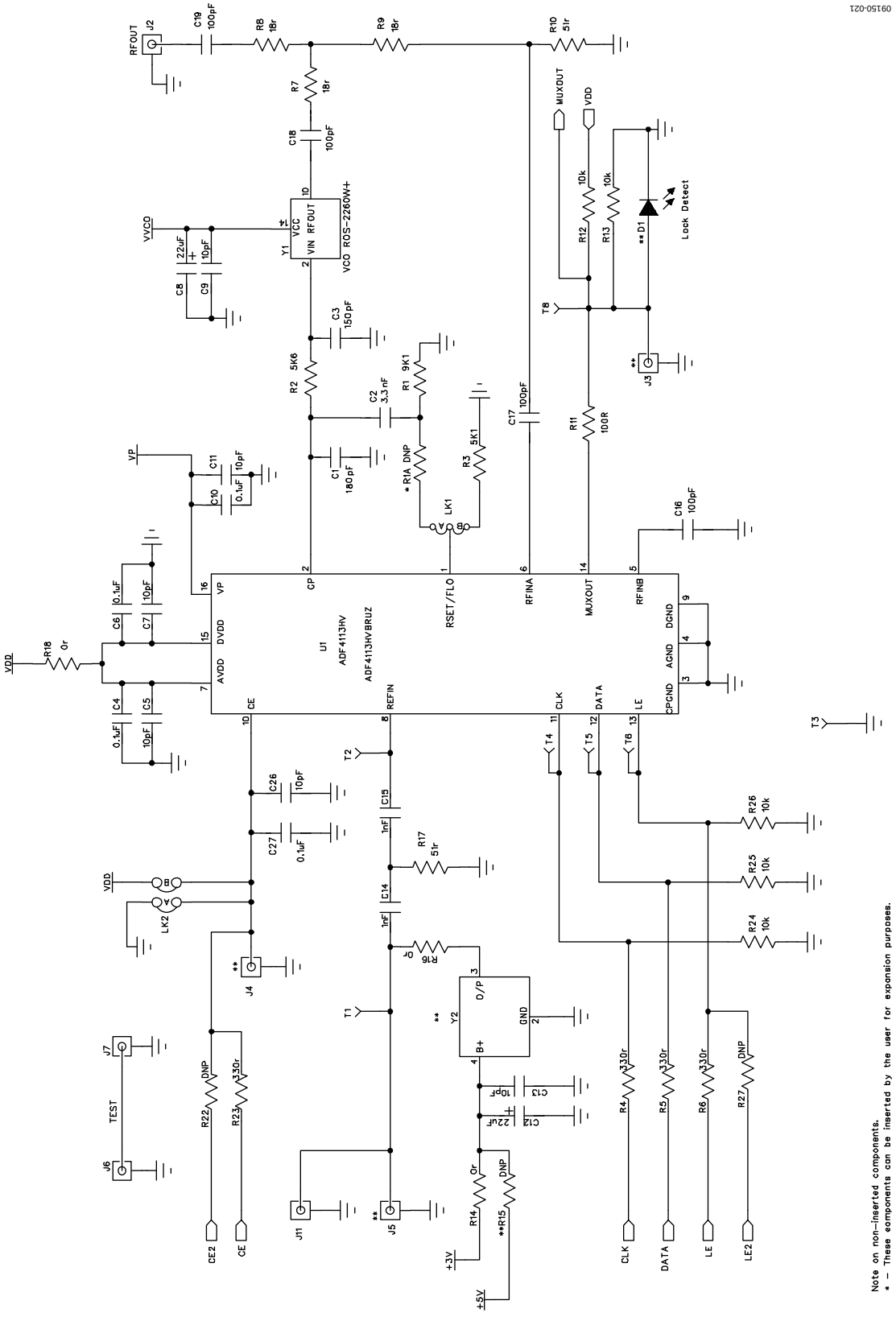

Figure 21. Evaluation Board Schematic (Page 1)

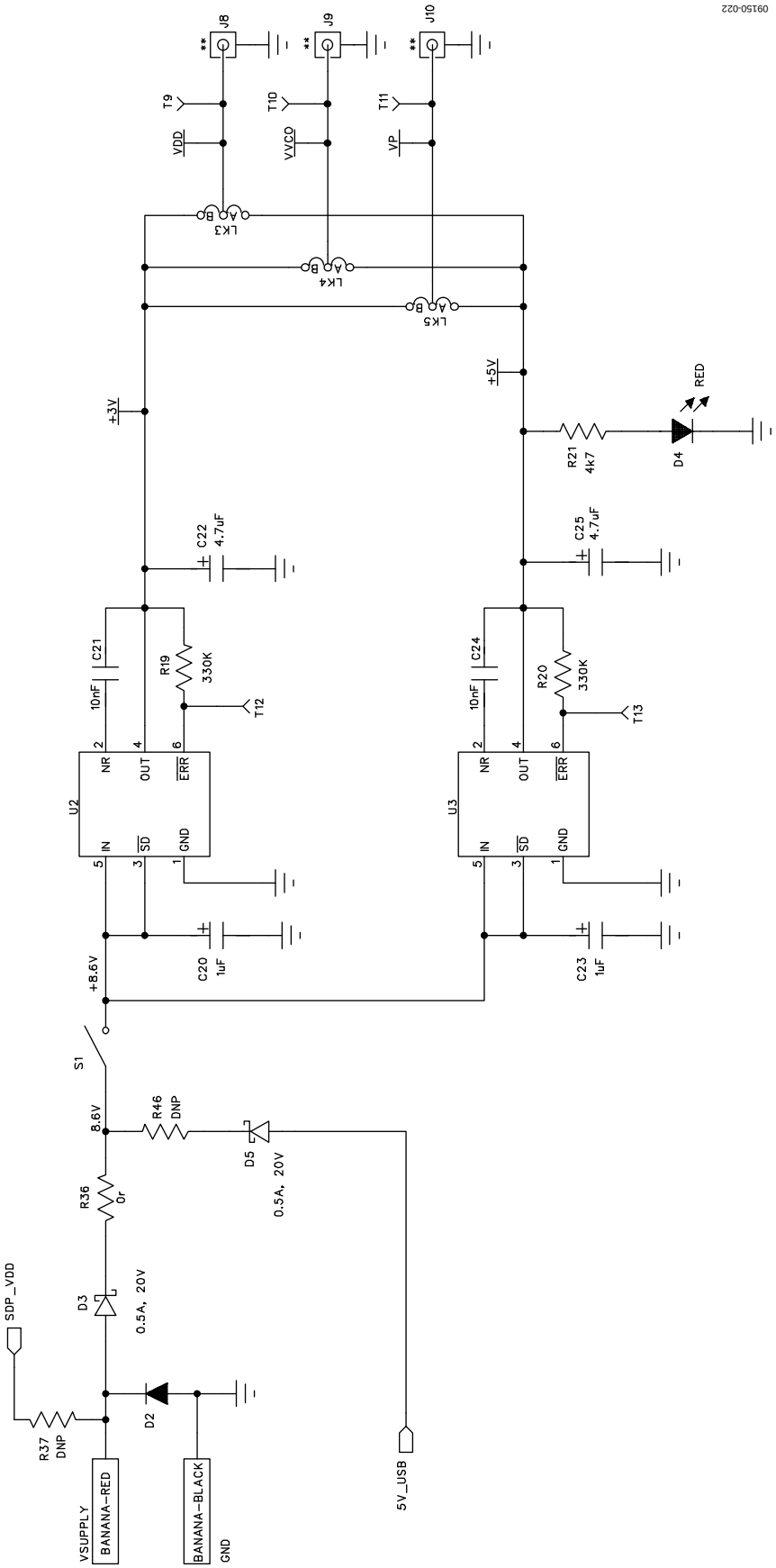

Figure 22. Evaluation Board Schematic (Page 2)

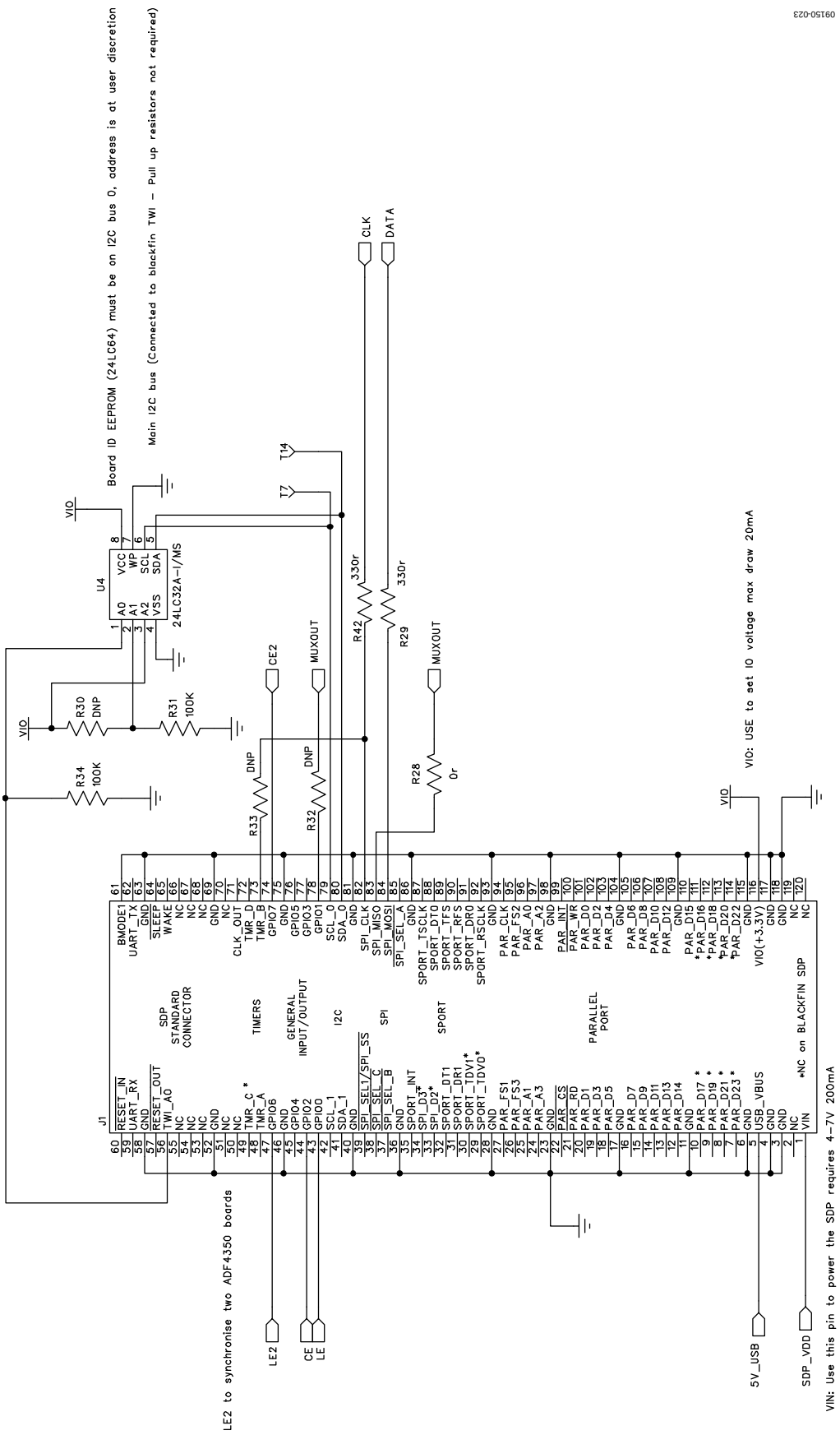

Figure 23. Evaluation Board Schematic (Page 3)

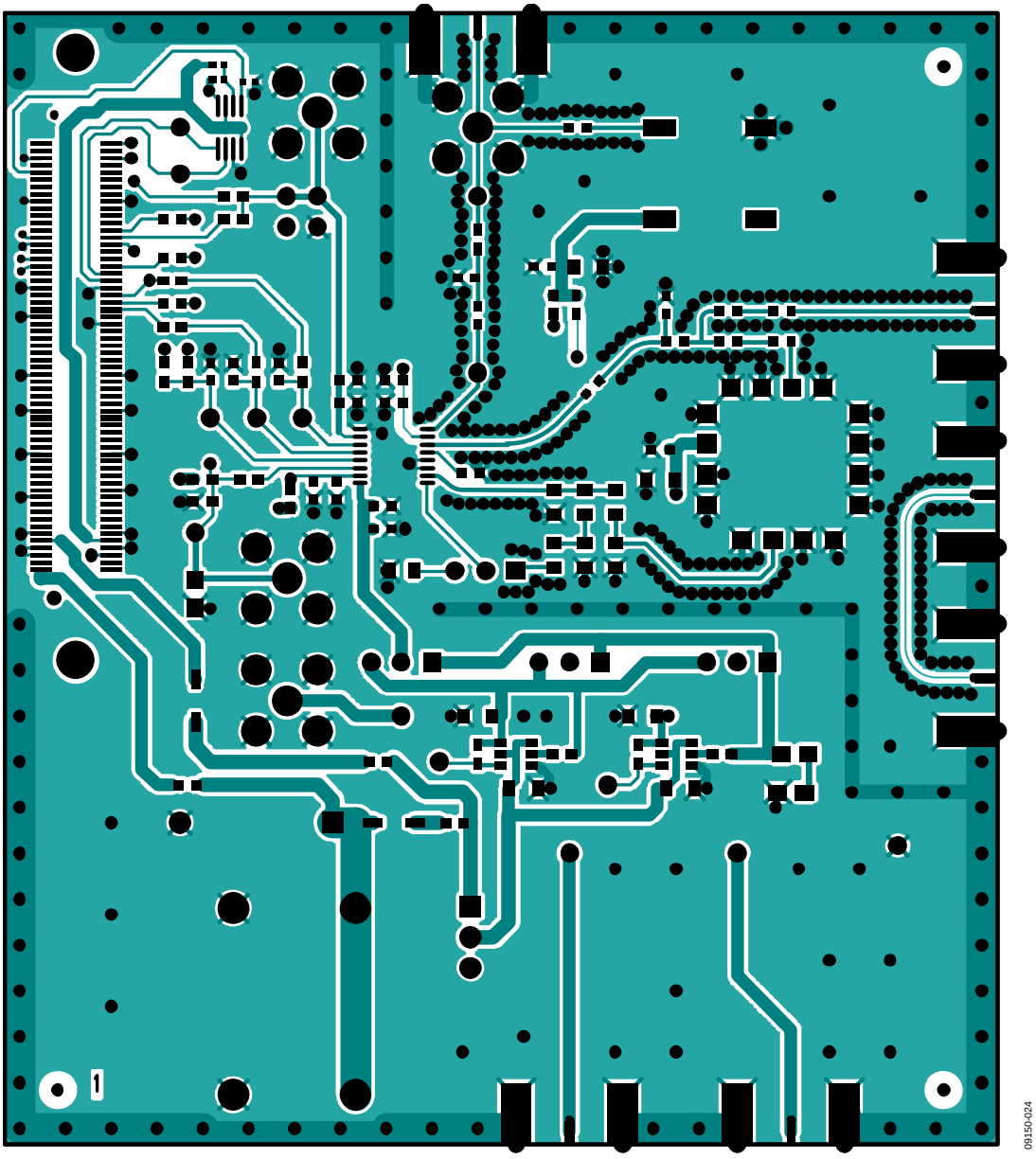

Figure 24. Layer 1 (Component Side)

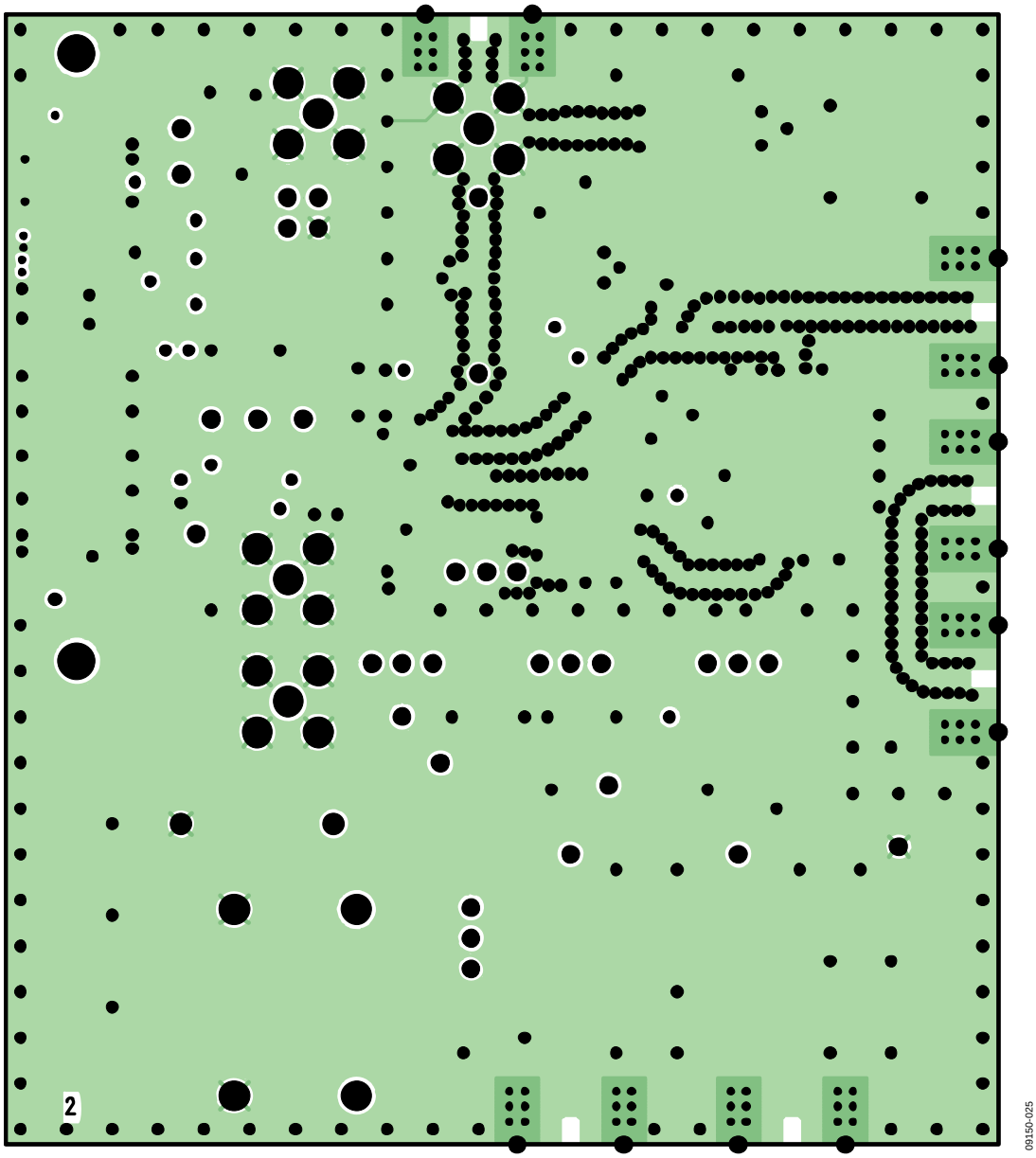

Figure 25. Layer 2 (Ground Plane)

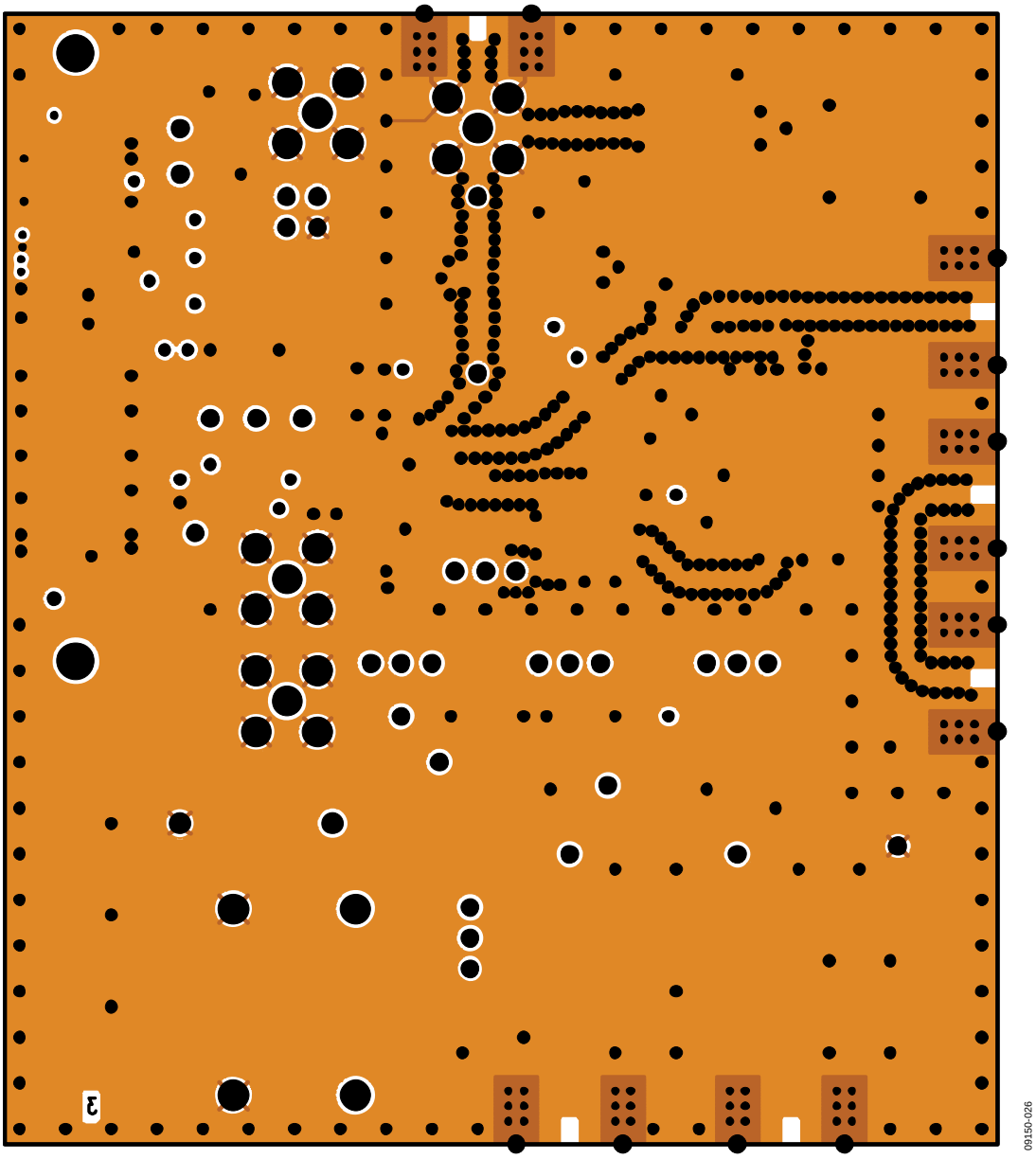

Figure 26. Layer 3 (Power Plane)

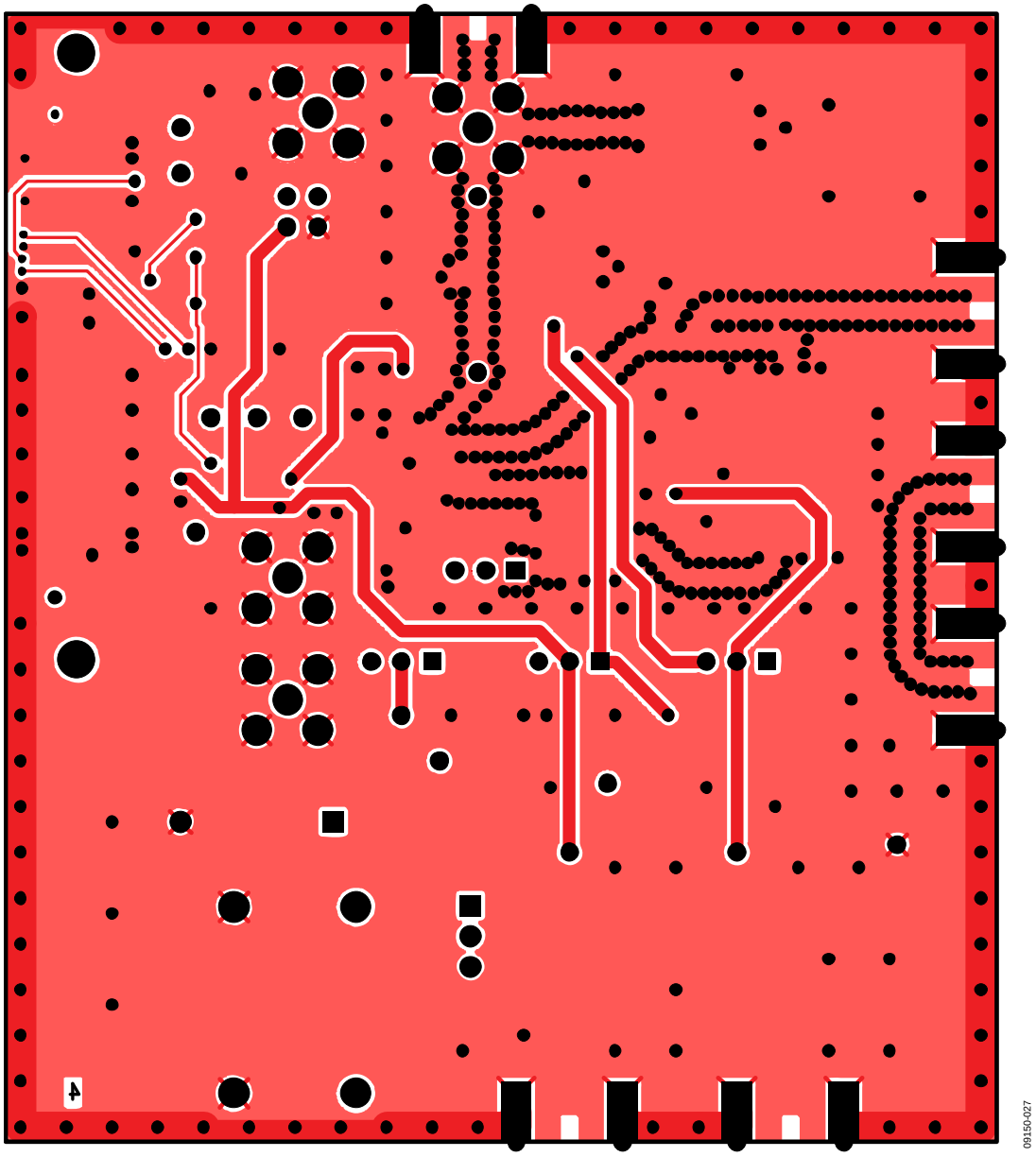

Figure 27. Layer 4 (Solder Side)

BILL OF MATERIALS

Table 2.

Reference Designator	Part Description	Manufacturer/Part No.
C1	Capacitor, 0603, 180 pF, 50 V, COG	Kemet C0603C181J5GAC
C2	Capacitor, 0603, 3.3 nF, 50 V, COG	TDK C1608C0G1H332J
C3	Capacitor, 0603, 150 pF, 50 V, COG	Kemet C0603C151J5GAC AUTO
C4, C6, C10, C27	Capacitor, 0603, 0.1 µF, 16 V	AVX CM105X7R104K16AT
C5, C7, C9, C11, C13, C26	Capacitor, 0603, 10 pF, 50 V	AVX 06035A100JAT2A
C8, C12	Capacitor, Case A, 22 µF, 6.3 V	AVX TAJA226K006RNJ
C14, C15	Capacitor, 0603, 1 nF, 50 V	AVX 06035A102JAT2A
C16, C17, C18, C19	Capacitor, 0603, 100 pF, 50 V	AVX 06035A101JAT2A
C20, C23	Capacitor, Case A, 1 µF, 16 V	AVX TAJA105K016RNJ
C21, C24	Capacitor, 0603, 10 nF, 50 V	AVX 06035C103JAT2A
C22, C25	Capacitor, Case A, 4.7 µF, 10 V	AVX TAJA475K010RNJ
D1	LED, green	OSRAM LGR971-Z
D2	Diode, DO41, 1 A, 50 V	Multicomp 1N4001
D3, D5	SD103C, 6.2 V	ON Semiconductor MBR0520LT1G
D4	LED, red	Avago HSMS-C170
J1	120-way connector, 0.6 mm pitch	Hirose FX8-120S-SV(21)
J2	Jack, SMA, SMA_EDGE	Emerson 142-0701-851
J3, J4, J11	Jack, SMA, receptacle straight PCB	Not inserted
J5, J6, J7, J8, J9	Jack, SMA, SMA_EDGE	Not inserted
J10	Jack, SMA, receptacle straight PCB	Pomona 72963
LK1, LK3, LK4	Jumper-2\SIP3, 3-pin link	Harwin M20-9990345 and M7566-05
LK2	Jumper-2	Harwin M20-9990245 and M7566-05
LK5	Jumper-2\SIP3, 3-pin link	Not inserted
GND	Black 4 mm banana socket	Deltron 571-0100-01
VSUPPLY	Red 4 mm banana socket	Deltron 571-0500-01
R1A	Resistor, 0805	Not inserted
R1	Resistor, 0603, 5.6 kΩ	Multicomp MC 0.063 0603 1% 5k6
R2	Resistor, 0603, 9.1 kΩ	Multicomp MC 0.063 0603 1% 9k1
R3	Resistor, 0805, 5.1 kΩ, ±1%, 0.1 W	Multicomp MC 0.1 0805 1% 5K1
R4, R5, R6, R23, R29, R42	Resistor, 0603, 330 Ω	Multicomp MC 0.063W 0603 1% 330R
R7, R8, R9	Resistor, 0603, 18 Ω	Multicomp MC 0.063W 0603 1% 18R
R10, R17	Resistor, 0603, 51 Ω	Multicomp MC 0.063W 0603 1% 51R
R11	Resistor, 0603, 100 Ω	Multicomp MC 0.0625W 0402 1% 100R
R12, R13, R24, R25, R26	Resistor, 0603, 10 kΩ	Multicomp MC 0.063W 0603 1% 10K
R14, R16, R18, R28, R36	Resistor, 0603, 0 Ω	Multicomp MC 0.063W 0603 1% 0R
R15, R22, R27, R32, R33, R37, R46	Resistor, 0603	Not inserted
R19, R20	Resistor, 0603, 330 kΩ, ±1%, 0.063 W	Multicomp MC 0.063W 0603 1% 330K
R21	Resistor, 0603, 4.7 kΩ, ±1%, 0.063 W	Multicomp MC 0.063W 0603 1% 4K7
R30	Resistor, 0402	Not inserted
R31, R34	Resistor, RC31, 0402, 100 kΩ	YAGEO (Phycomp) RC0402JR-07100KL
S1	Switch, PCB, SPDT, 20 V	APEM TL36P0050
T1 to T14	Test point, PCB, red PK_100	Vero 20-313137
U1	ADF4113HV, 16-lead TSSOP	ADF4113HVBRUZ
U3	ADP3300, 6-lead SOT-23	ADP3300ARTZ-5REEL7
U2	ADP3300, 6-lead SOT-23	ADP3300ARTZ-3-RL7
U4	32k I^2C serial EEPROM, MSOP8	Microchip 24LC32A-I/MS
Y1	1290 MHz to 2260 MHz VCO	Mini-Circuits ROS-2260W+
Y2	25 MHz, SMD, temperature compensated crystal oscillator	Rakon TXO225B

RELATED LINKS

Resource	Description
ADF4113HV	Product Page, Fractional-N Frequency Synthesizer
ADP3300	Product Page, High Accuracy anyCAP® 50 mA Low Dropout Linear Regulator
ADSP-BF527	Product Page, Low Power Blackfin Processor with Advanced Peripherals
SDP-S	Product Page, System Demonstration Platform-Serial (SDP-S)
SDP-B	Product Page, System Demonstration Platform-Blackfin (SDP-B)
UG-291	User Guide, SDP-S Controller Board
UG-277	User Guide, SDP-B Controller Board

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

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.

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