

## Evaluation Board for the Integer-N PLL Frequency Synthesizer

### FEATURES

General-purpose PLL evaluation board excluding VCO, loop filter, and TCXO

Contains [ADF4002](#) 400 MHz frequency synthesizer IC

Accompanying software allows complete control of synthesizer functions from a PC

### EVALUATION KIT CONTENTS

[EV-ADF4002SD1Z](#) 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 [ADF4002](#) data sheet

Electronic version of the [UG-108](#) user guide

### ADDITIONAL EQUIPMENT

PC running Windows XP or more recent version

SDP-S board (system demonstration platform, serial only)

T-package VCO

0805 resistors and capacitors

Spectrum analyzer

Oscilloscope (optional)

### DOCUMENTS NEEDED

[ADF4002](#) data sheet

### REQUIRED SOFTWARE

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

[ADIsimPLL](#)

### GENERAL DESCRIPTION

This board is designed to allow the user to evaluate the performance of the [ADF4002](#) frequency synthesizer for phase-locked loops (PLLs). Figure 1 shows the board, which contains the footprint for an [ADF4002](#) synthesizer, an SMA connector for the reference input, power supplies, and an RF output. There is also a footprint for a loop filter and a VCO on board.

The evaluation kit also contains software that is compatible with Windows® XP and later versions to allow easy programming of the synthesizer.

This board requires an SDP-S (system demonstration platform-serial) board (shown in Figure 1, but not supplied with the kit). The SDP-S allows software programming of the [ADF4002](#) device.

### EVALUATION BOARD

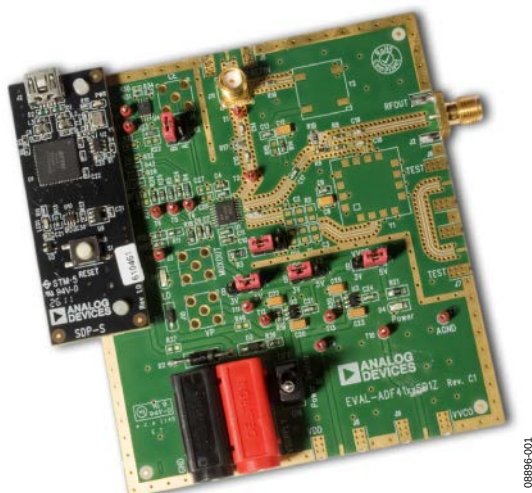


Figure 1. [EV-ADF4002SD1Z](#) with SDP-S

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## REVISION HISTORY

### 12/11—Rev. 0 to Rev. A

|                                                                                                                    |   |
|--------------------------------------------------------------------------------------------------------------------|---|
| Changes to Features and General Description Sections and Figure 1 .....                                            | 1 |
| Added Evaluation Kit Contents, Additional Equipment, Documents Needed, and Required Software Sections .....        | 1 |
| Added Quick Start Guide Section .....                                                                              | 3 |
| Deleted Figure 3; Renumbered Sequentially.....                                                                     | 3 |
| Replaced Hardware Description Section with Evaluation Board Hardware Section .....                                 | 4 |
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| Added Input Signals Section and Output Signals Section .....                                                       | 4 |
| Added Default Operation and Jumper Selection Settings Section and System Demonstration Platform (SDP) Section..... | 5 |
| Added Table 1; Renumbered Sequentially .....                                                                       | 5 |
| Added Evaluation Board Setup Procedure Section.....                                                                | 6 |
| Added Figure 3 and Figure 4; Renumbered Sequentially .....                                                         | 6 |
| Added Figure 5 to Figure 9.....                                                                                    | 7 |
| Added Figure 10 to Figure 14 .....                                                                                 | 8 |
| Added Figure 15 to Figure 16 .....                                                                                 | 9 |

|                                                                                    |    |
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| Replaced Software Description Section with Evaluation Board Software Section ..... | 10 |
| Changes to Figure 17.....                                                          | 10 |
| Added Figure 18 .....                                                              | 11 |
| Added Evaluation and Test Section, Figure 19, and Figure 20.....                   | 12 |
| Changed Schematics Heading to Evaluation Board Schematics and Artwork .....        | 13 |
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| Added Figure 23 .....                                                              | 15 |
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### 9/10—Revision 0: Initial Version

## QUICK START GUIDE

Follow these steps to quickly evaluate the [ADF4002](#) device:

1. Solder the VCO (T-package compatible).
2. Solder the loop filter components (design with ADIsimPLL™).
3. Connect the reference frequency to J11.
4. Install the system development platform (SDP) drivers.
5. Install the Int-N software.
6. Connect the SDP-S motherboard to the PC and to the [EV-ADF4002SD1Z](#).
7. Follow the hardware driver installation procedure.
8. Connect the power supplies to banana connectors (6 V to 12 V).
9. Run the Int-N software.
10. Select the SDP board and the [ADF4002](#) device in the **Select Device and Connection** tab of the software front panel window.
11. Click the **Main Controls** tab. Update all registers.
12. Connect the spectrum analyzer to J2.
13. Measure the results.

## EVALUATION BOARD HARDWARE

The evaluation board requires the use of an SDP-S motherboard to program the device. This is not included and must be purchased separately. The [EV-ADF4002SD1Z](#) schematics are shown in Figure 21, Figure 22, and Figure 23.

### POWER SUPPLIES

The board is powered from external banana connectors. The voltage can vary between 6 V and 12 V. The power supply circuit provides 3.0 V to the [ADF4002](#)  $V_{DD}$  and allows the user to choose either 3.0 V or 5 V for the [ADF4002](#)  $V_P$ . The default settings are 3.0 V for the [ADF4002](#)  $V_{DD}$  and 5 V for the [ADF4002](#)  $V_P$ . Note that  $V_{DD}$  should never exceed 3.3 V. This can damage the device.

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 can be sourced from an external generator. A low noise, high slew rate reference source is best for achieving the stated performance of the [ADF4002](#). This reference source can be connected to Connector J11. If preferred, the edge mount connector, J5, can be inserted and used instead. A third option is to solder a footprint-compatible TCXO to Footprint Y2. To use this option, connect 0  $\Omega$  links to R16 and R14.

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

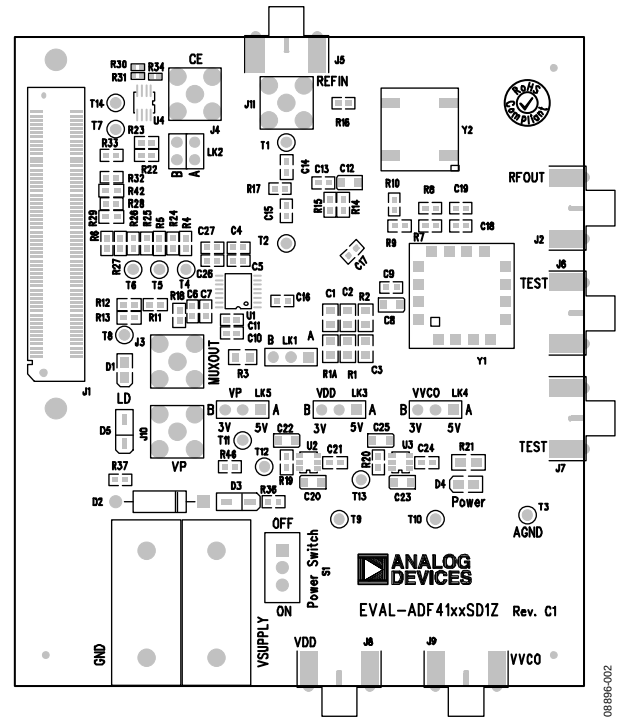


Figure 2. Evaluation Board Silkscreen

### OUTPUT SIGNALS

All components necessary for LO generation can be inserted on board. The PLL is made up of the [ADF4002](#) synthesizer, a passive loop filter, and the VCO. The package containing the VCO must be a T-package (or similar). A low-pass filter must be inserted between the charge pump output and the VCO input. In this case, the user must insert the relevant parts as shown in Figure 2. 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

This board is shipped without a TCXO, low-pass filter, or a VCO. Users must insert suitable components to complete a PLL. Link positions are outlined in Table 1.

**Table 1. Link Positions and Function**

| Link                    | Position | Options | Description               |
|-------------------------|----------|---------|---------------------------|
| LK1                     | A        | R1A     | Not used                  |
|                         | B        | RSET    | Normal operation          |
| LK2                     | A        | GND     | Hardware power-down       |
|                         | B        | VDD     | Normal operation          |
| LK3 (V <sub>DD</sub> )  | A        | 5V      | Not used                  |
|                         | B        | 3V      | Normal operation          |
| LK4 (V <sub>VCO</sub> ) | A        | 5V      | VCO supply 5 V            |
|                         | B        | 3V      | VCO supply 3 V            |
| LK5 (V <sub>P</sub> )   | A        | 5V      | V <sub>P</sub> supply 5 V |
|                         | B        | 3V      | V <sub>P</sub> 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 the PC via USB 2.0 and provide a range of communication interfaces on a 120-pin connector. The pinout for this connector is strictly defined. This 120-pin connector's receptacle is 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](http://www.analog.com/sdp).

## EVALUATION BOARD SETUP PROCEDURE

### SOFTWARE INSTALLATION

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

1. Install the SDP drivers by double-clicking **SDPDrivers.exe** and following the relevant installation instructions. See the [UG-291](#) for further instructions on installation of the SDP-S platform or the [UG-277](#) if the SDP-B platform is used.
2. Install the Analog Devices Int-N software by double-clicking **ADI\_Int-N\_Setup.msi**.

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.

3. Connect your SDP board (black) or USB adapter board (green) by USB. If you are using an SDP board, the drivers install automatically, and you are ready to run the software. If you are using a USB adapter board on Windows XP, follow the steps in the Windows XP Driver Installation Guide section (see Figure 13 to Figure 16). On Windows Vista or Windows 7, the drivers install automatically.

#### Windows XP Software Installation Guide

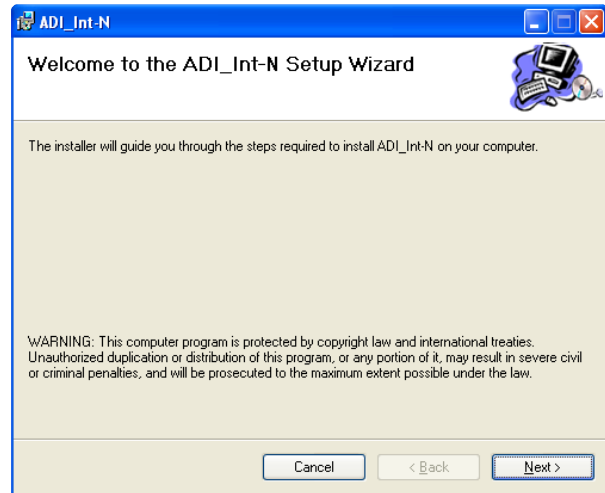


Figure 3. Windows XP Int-N Software Installation, Setup Wizard

1. Click **Next**.

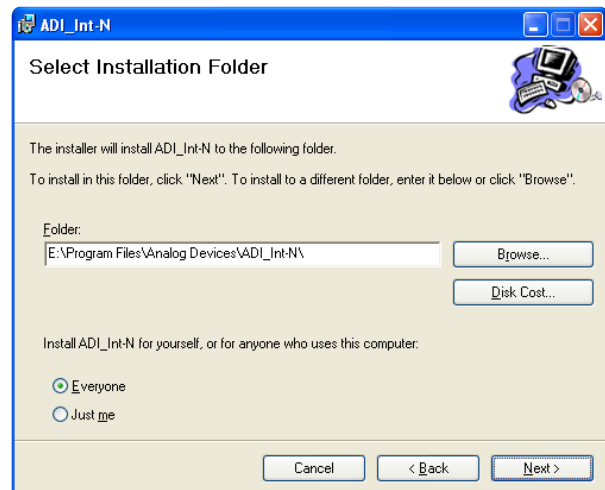


Figure 4. Windows XP Int-N Software Installation, Select Installation Folder

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

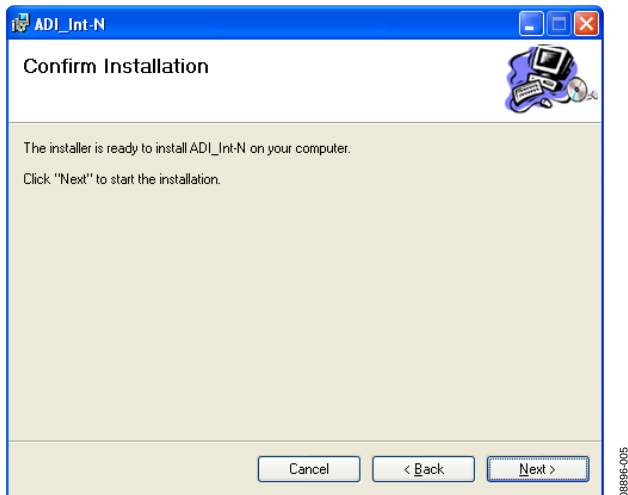


Figure 5. Windows XP Int-N Software Installation, Confirm Installation

3. Click **Next**.



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

4. Click **Continue Anyway**.

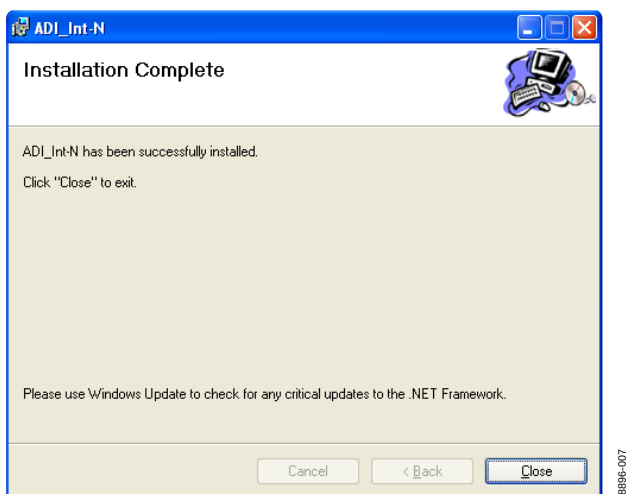


Figure 7. Windows XP Int-N Software Installation, Installation Complete

5. Click **Close**.

## Windows Vista and Windows 7 Software Installation Guide

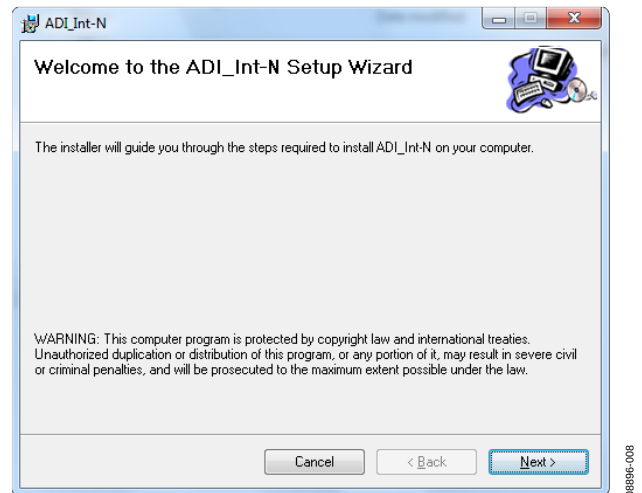


Figure 8. Windows Vista/7 Int-N Software Installation, Setup Wizard

1. Click **Next**.

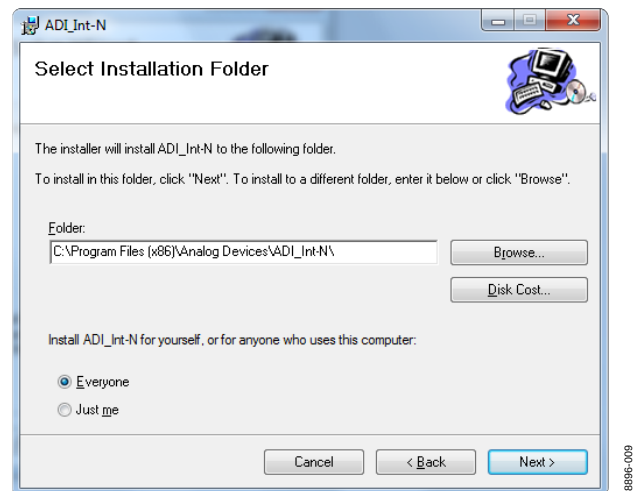


Figure 9. Windows Vista/7 Int-N Software Installation, Select Installation Folder

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

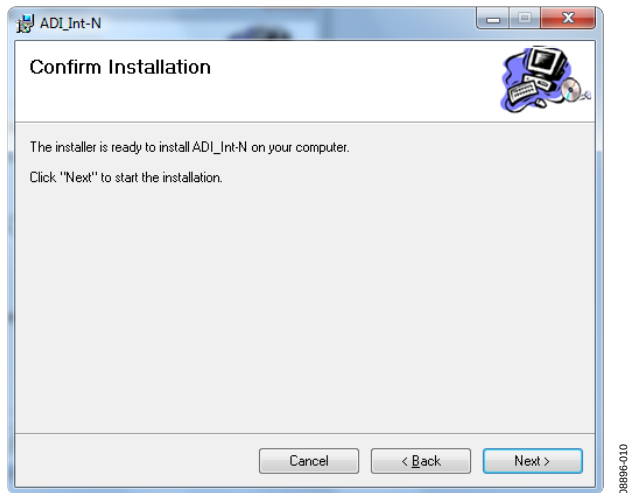


Figure 10. Windows Vista/7 Int-N Software Installation, Confirm Installation

3. Click **Next**.

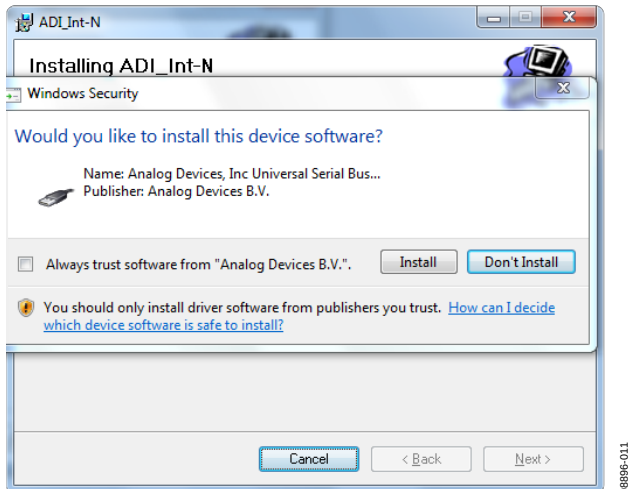


Figure 11. Windows Vista/7 Int-N Software Installation, Start Installation

4. Click **Install**.

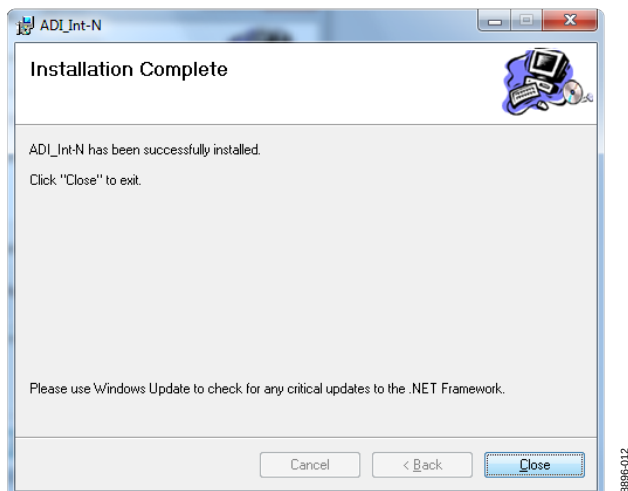


Figure 12. Windows Vista/7 Int-N Software Installation, Installation Complete

5. Click **Close**.

## Windows XP Driver Installation Guide



Figure 13. Windows XP USB Adapter Board Driver Installation, Found New Hardware Wizard

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

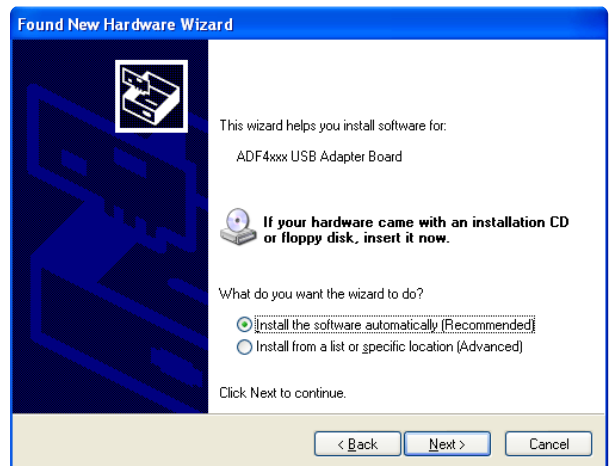


Figure 14. Windows XP USB Adapter Board Driver Installation, Installation Options

2. Click **Next**.

Note that Figure 14 may list **Analog Devices RFG.L Eval Board** instead of **ADF4xxx USB Adapter Board**.



Figure 15. Windows XP USB Adapter Board Driver Installation, Logo Testing

3. Click **Continue Anyway**.

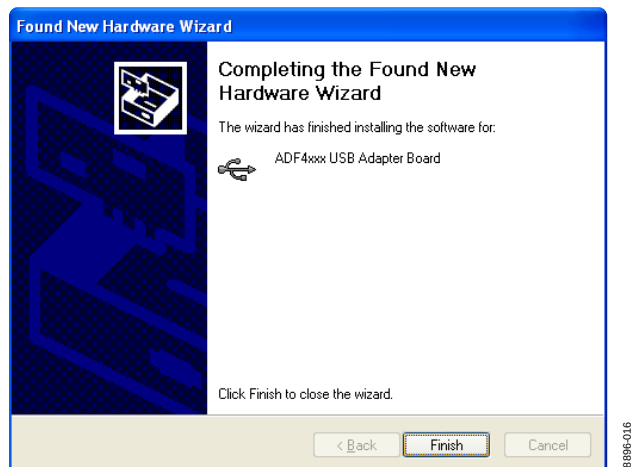


Figure 16. Windows XP USB Adapter Board Driver Installation, Complete Installation

4. Click **Finish**.

## EVALUATION BOARD SOFTWARE

The control software for the [EV-ADF4002SD1Z](#) accompanies the [EV-ADF4002SD1Z](#) on a CD. To install the software, see the Software Installation section.

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

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

Confirm that **SDP board connected, ADF4xxx USB Adapter Board connected**, or **Analog Devices RFG.L Eval Board**

**connected** is displayed at the bottom left of the window (see Figure 17). Otherwise, the software has no connection to the evaluation board.

Note that, when connecting the board, it takes about 5 sec to 10 sec for the status label to change.

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

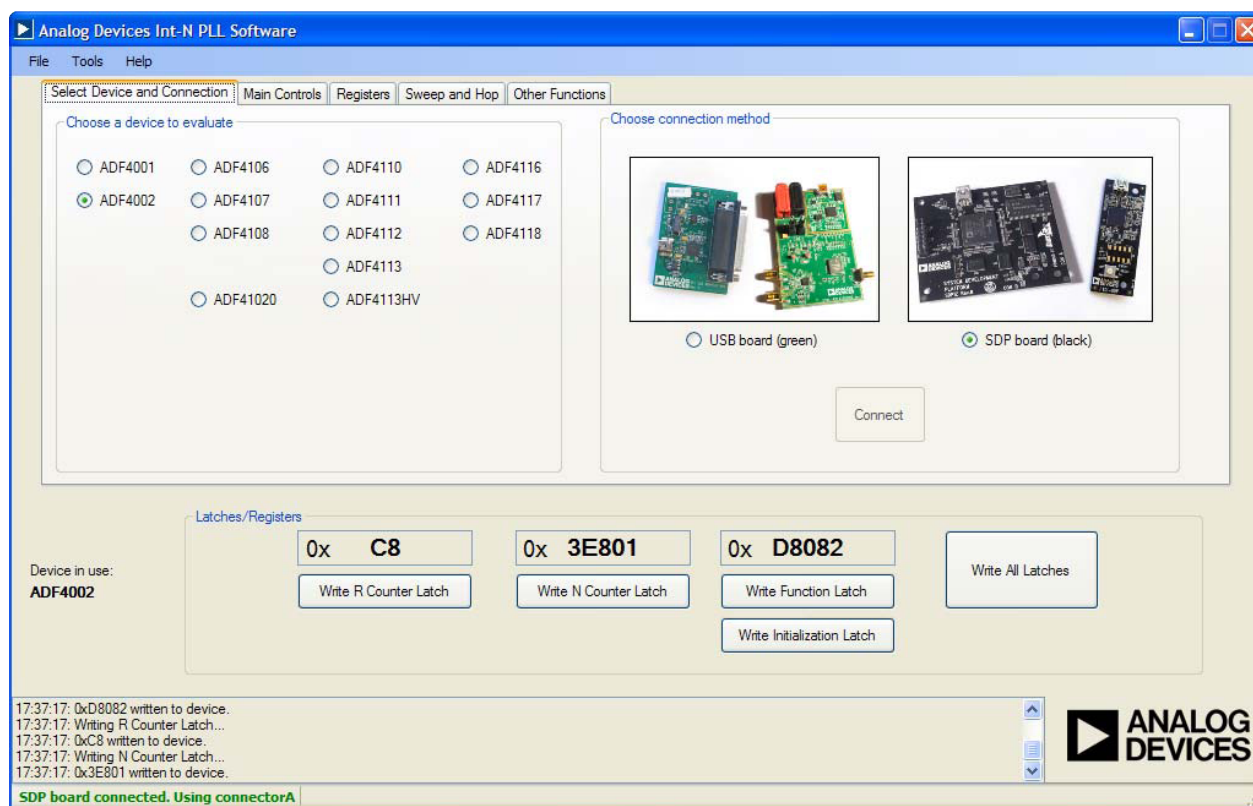


Figure 17. Software Front Panel Display—Select Device and Connection

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 on the software window is at 10 MHz.

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 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 that value to the device.

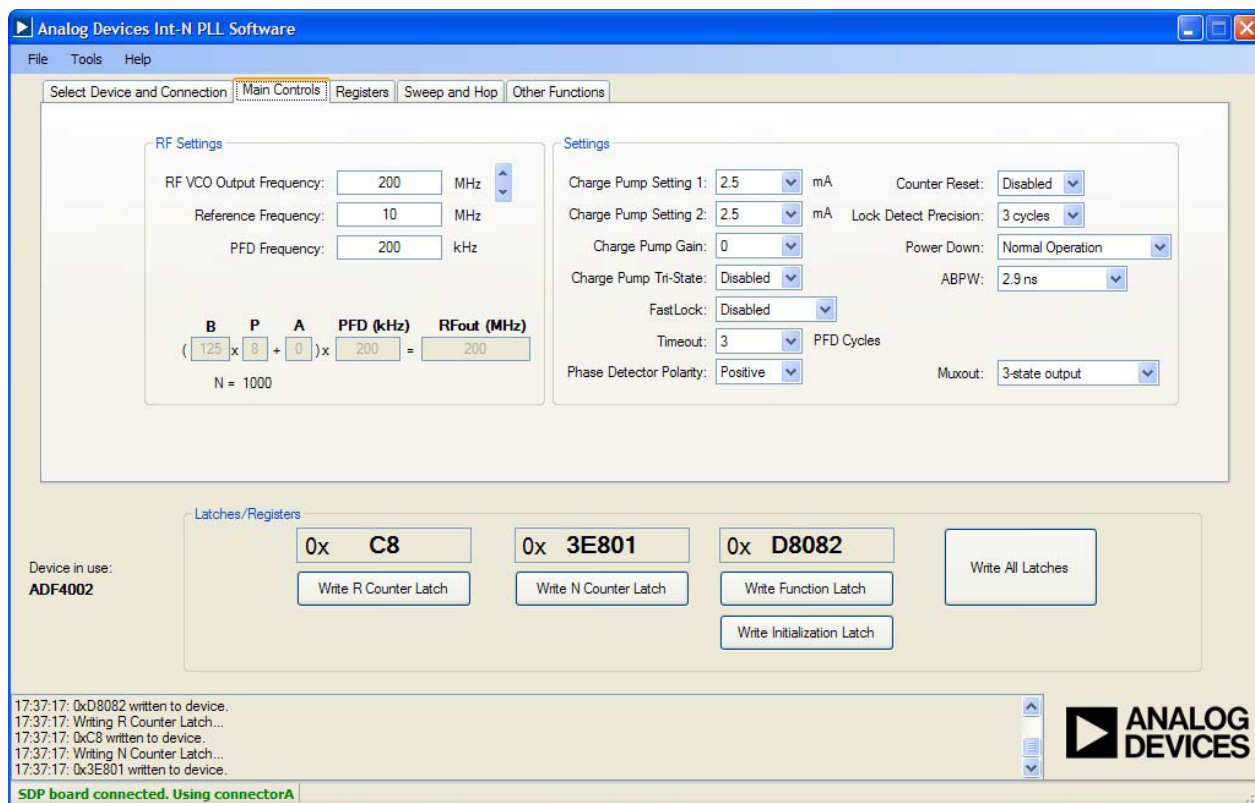


Figure 18. Software Front Panel Display—Main Controls

## EVALUATION AND TEST

To evaluate and test the performance of the ADF4002, use the following procedure:

1. Ensure that a VCO and loop filter are inserted on the board. Use ADIsimPLL to generate the loop filter component values.
2. Install the SDP-S software drivers. Connect the evaluation board to a PC using the supplied USB cable. Follow the hardware driver installation procedure that appears.
3. Connect the SDP-S connector to the [EV-ADF4002SD1Z](#).
4. Connect a reference signal to J11 (or J5, if an edge mount connector is inserted).
5. Connect a spectrum analyzer to Connector J2.
6. Run the Int-N software.
7. Select the SDP board and the [ADF4002](#) device in the **Select Device and Connection** tab of the software front panel window.
8. In the software window, set the VCO center frequency (Figure 19 uses a 400 MHz VCO). Set the PFD frequency as defined in ADIsimPLL, and program the reference frequency to equal that supplied to Connector J11 (or the TCXO). See Figure 20 for the suggested setup.

9. Measure the output spectrum. Figure 19 shows a 400 MHz output.

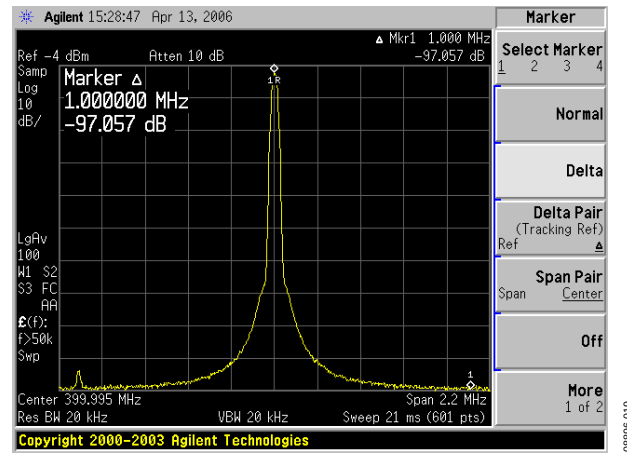


Figure 19. Spectrum Analyzer Display

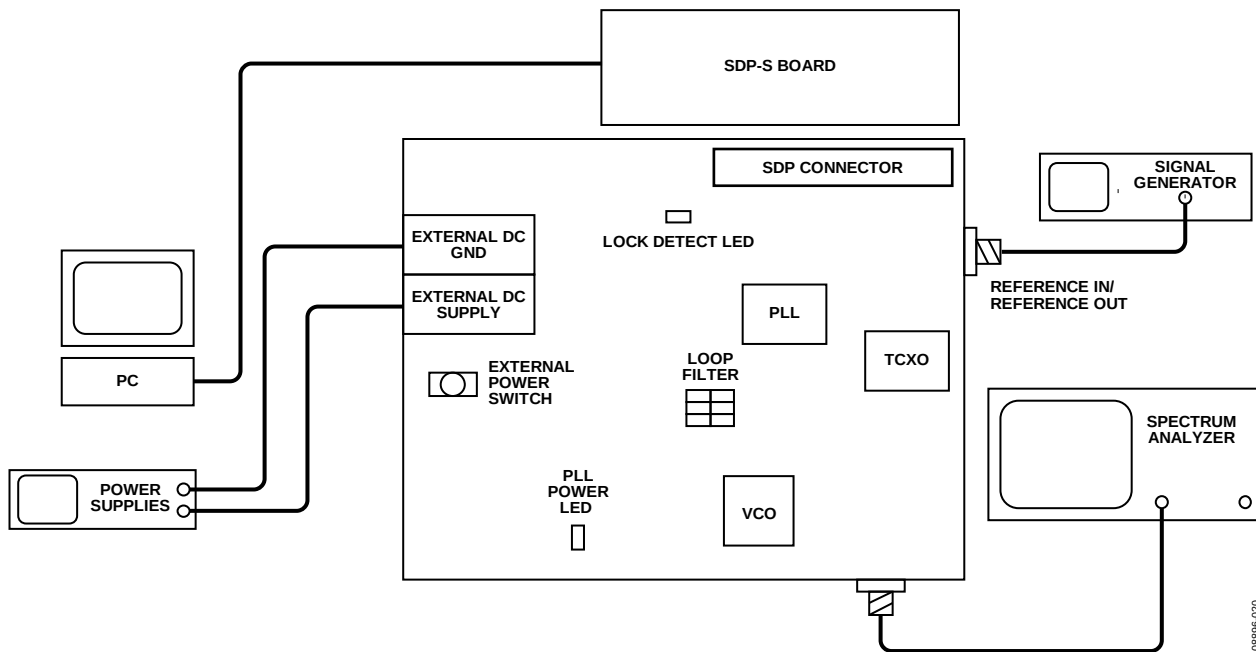
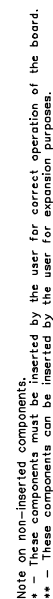
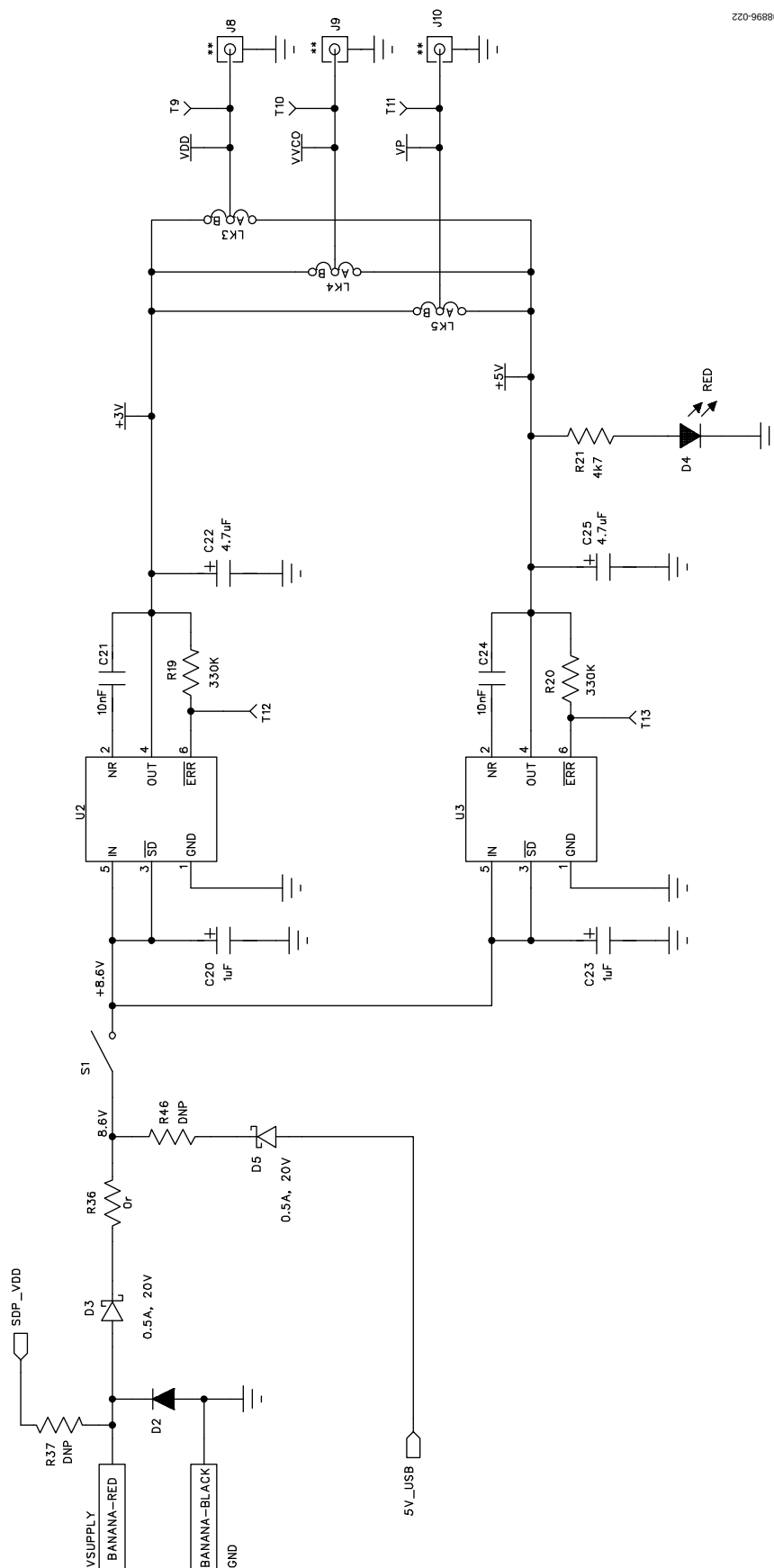


Figure 20. Typical Evaluation Setup

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Figure 22. Evaluation Board Schematic (Page 2)

EZO-96880

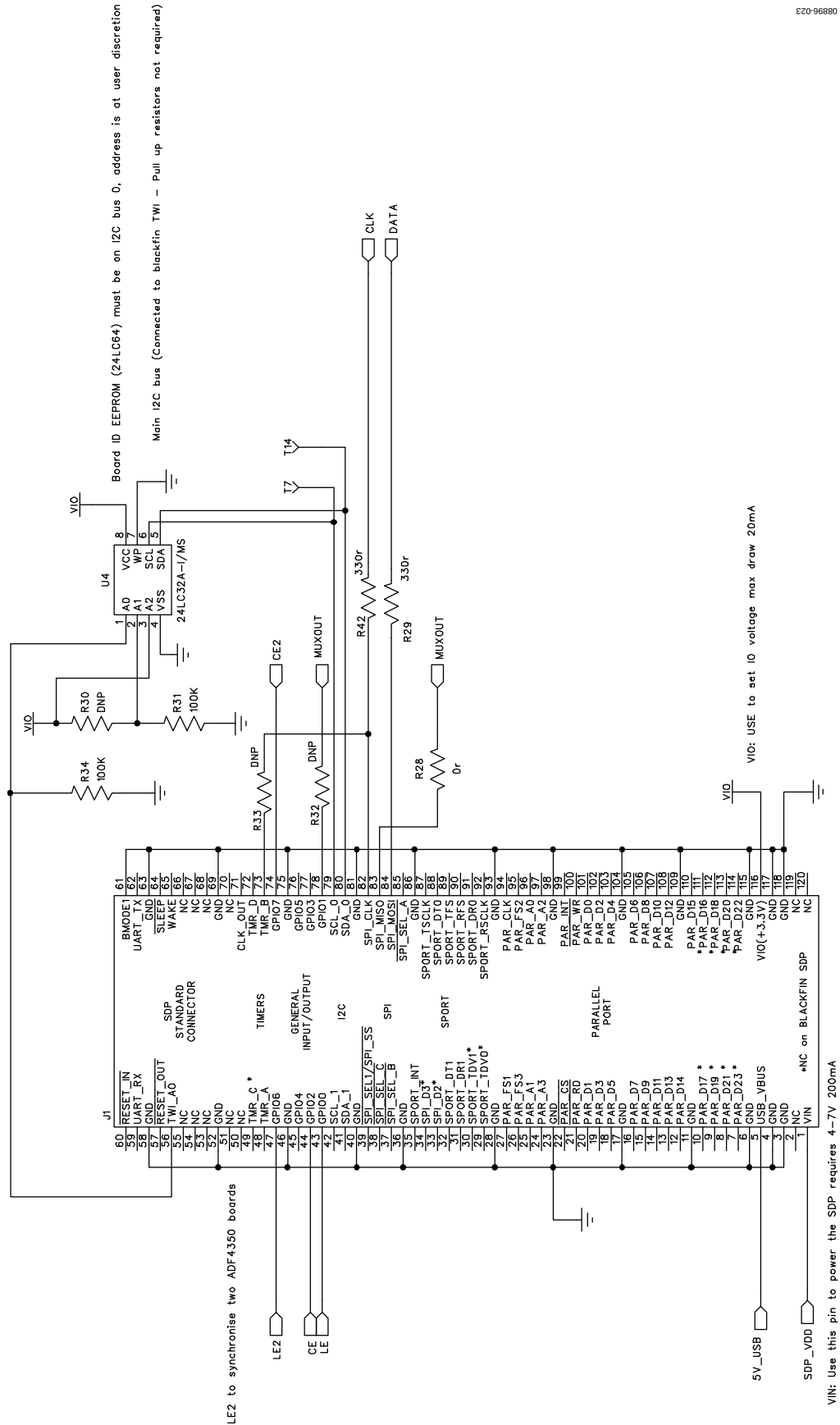


Figure 23. Evaluation Board Schematic (Page 3)

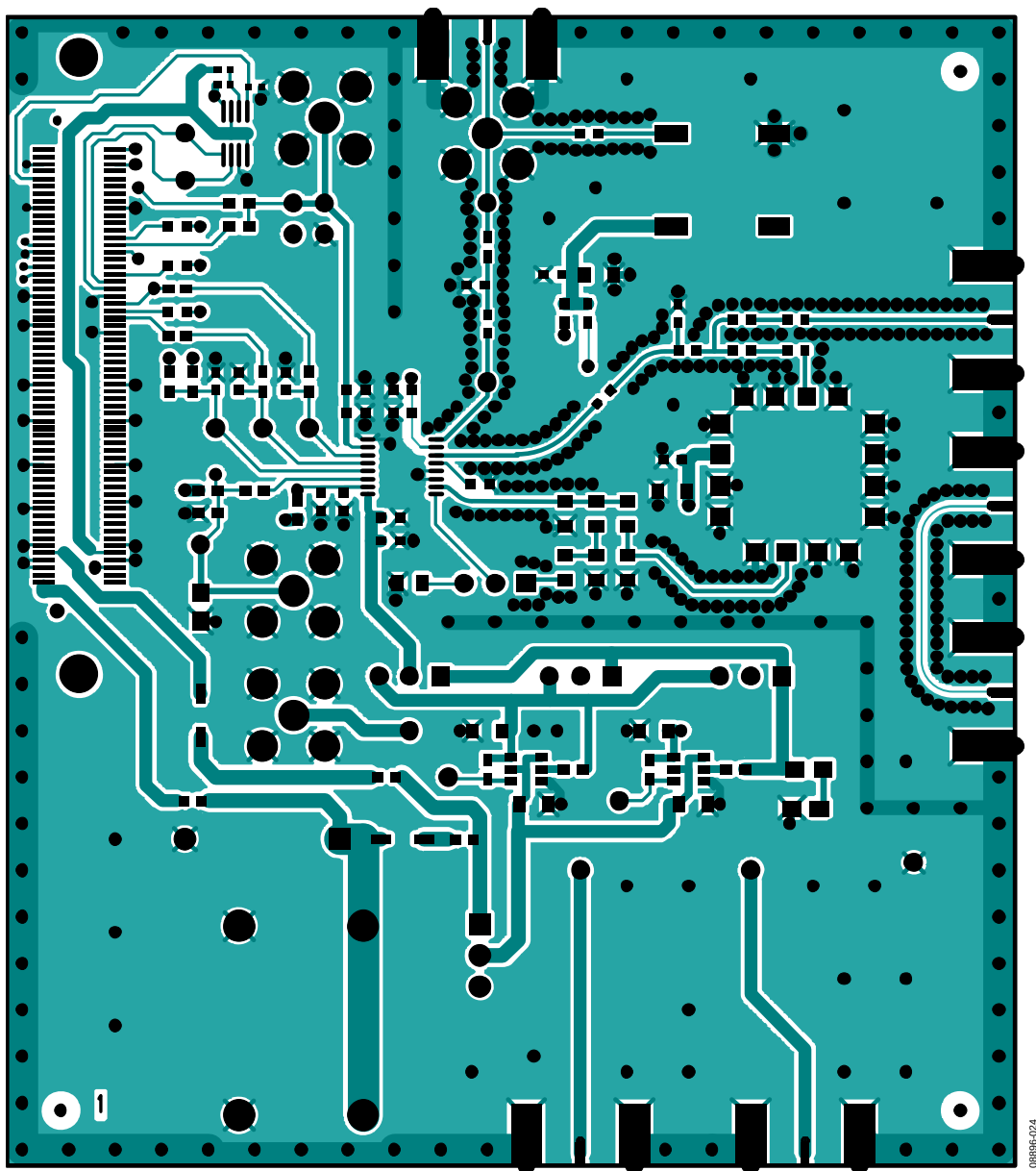


Figure 24. Layer 1 (Component Side)

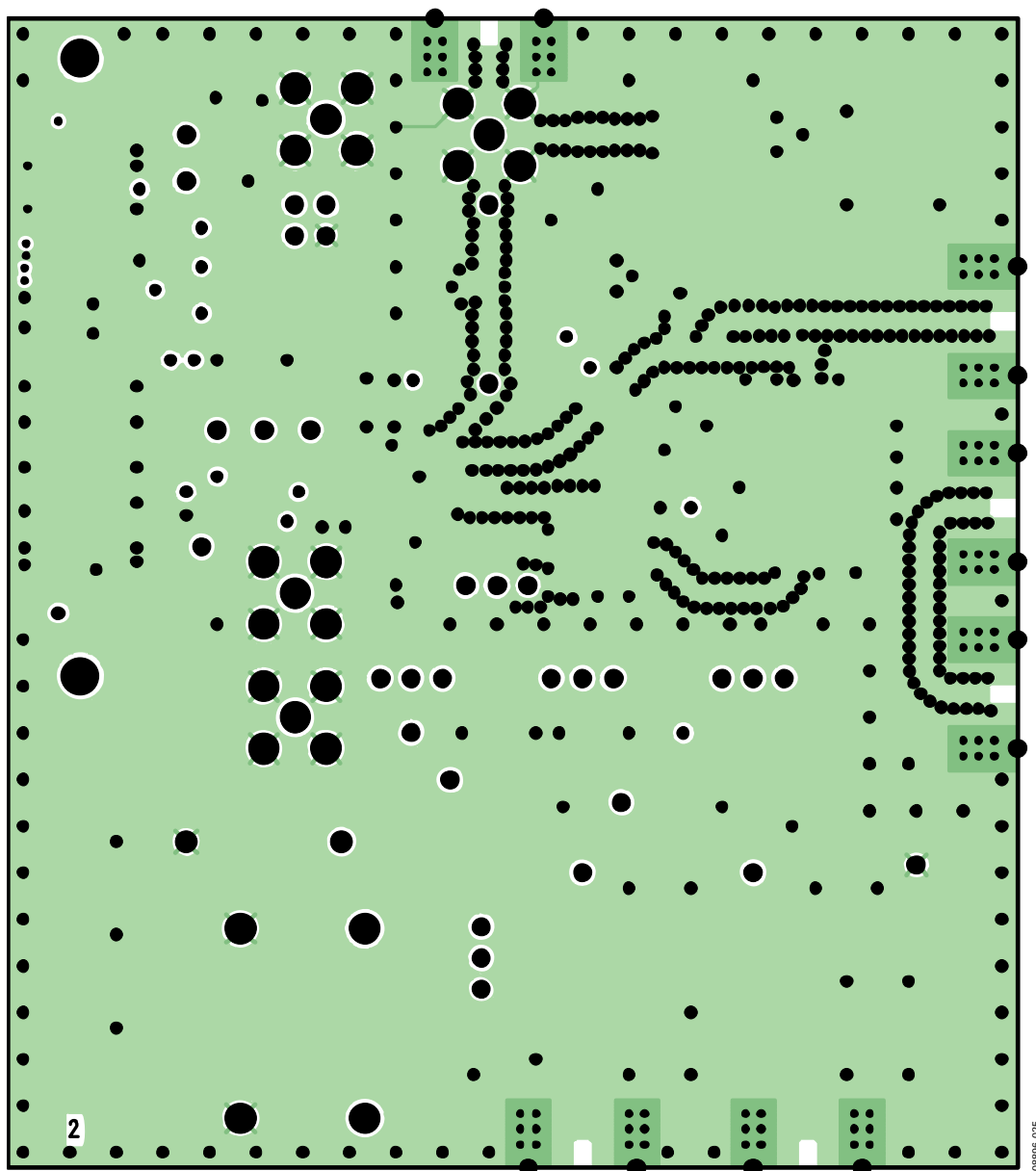
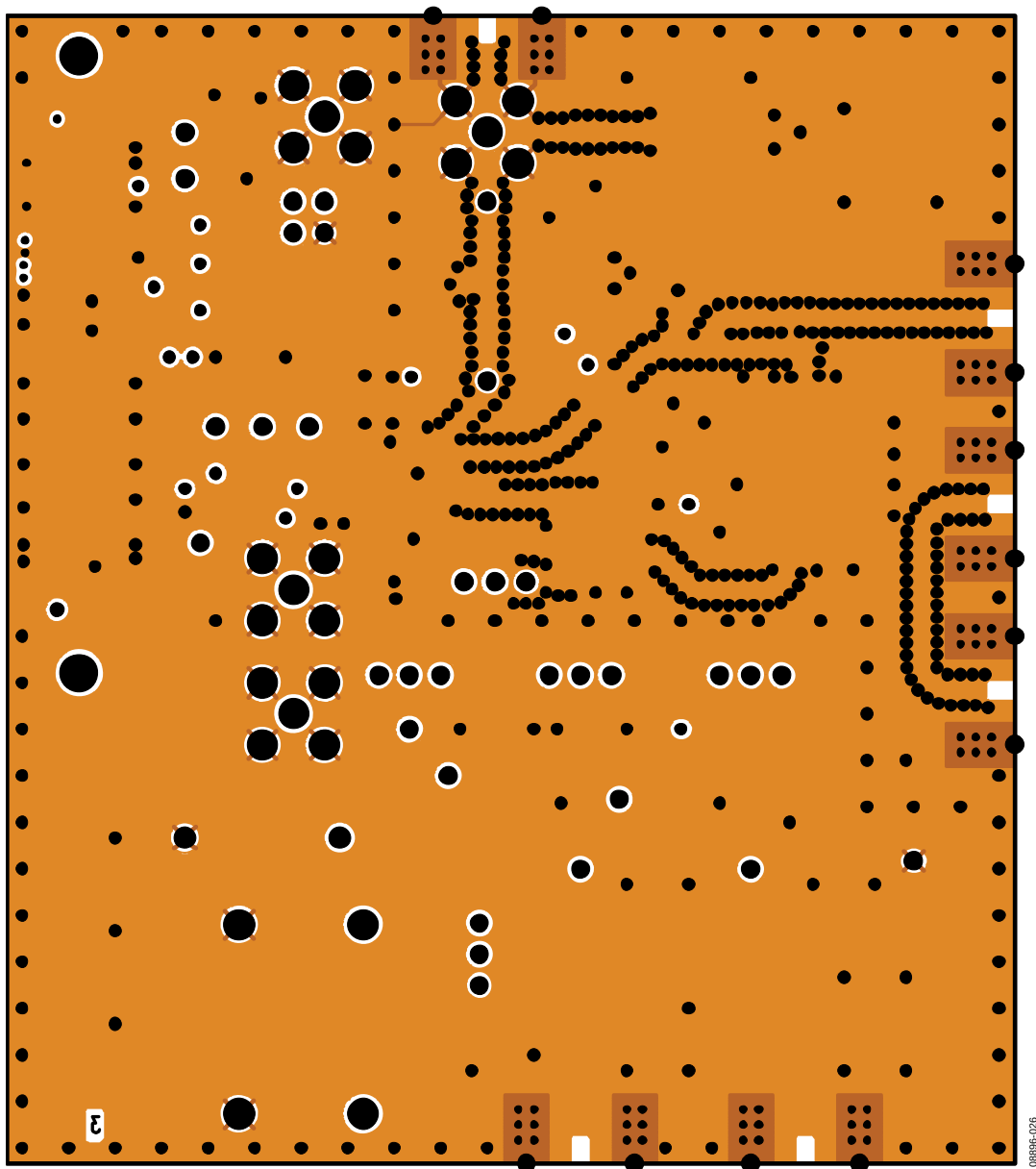


Figure 25. Layer 2 (Ground Plane)



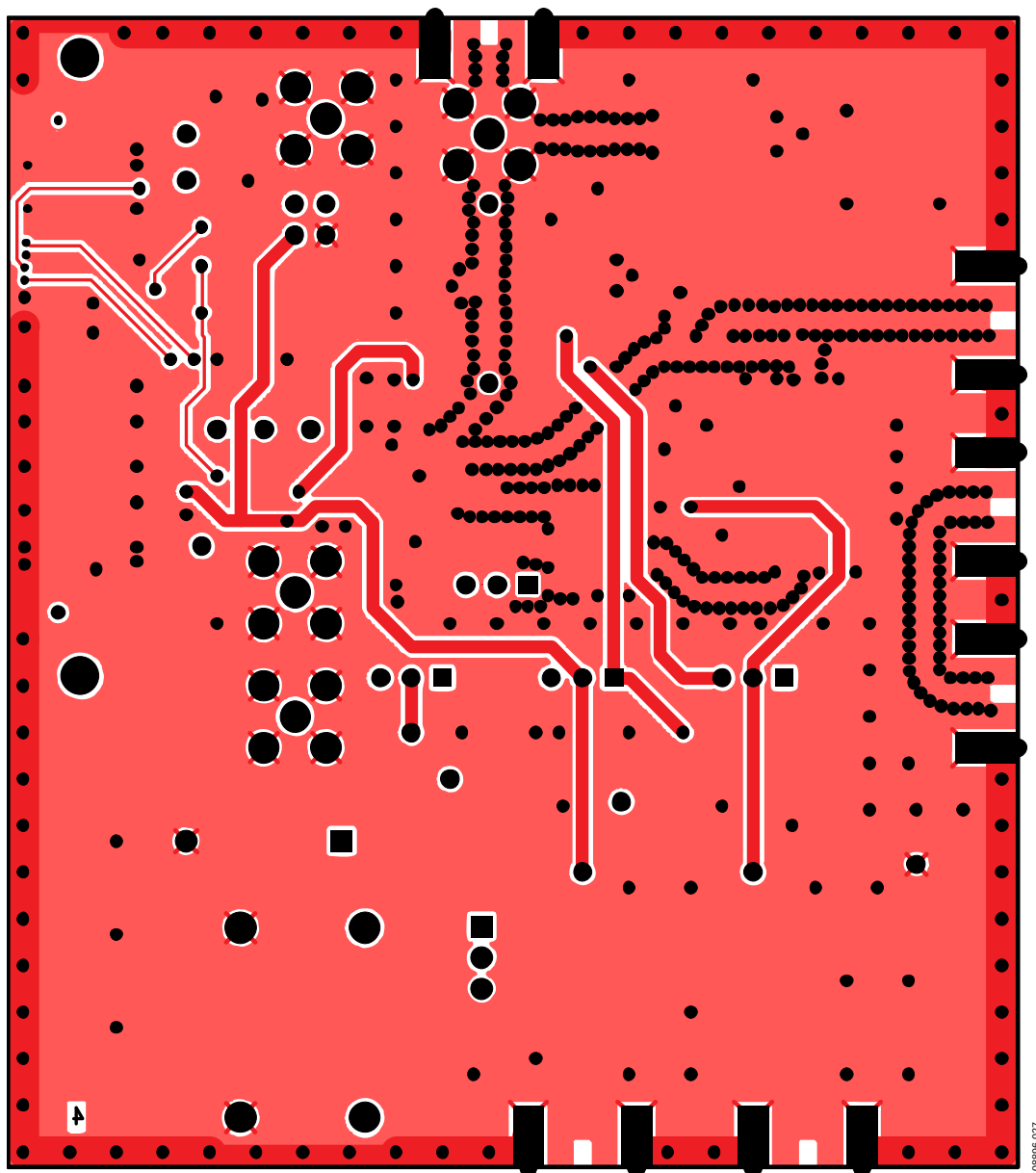


Figure 27. Layer 4 (Solder Side)

## ORDERING INFORMATION

## BILL OF MATERIALS

Table 2.

| Reference Designator              | Part Description                                                       | Manufacturer/Part No.             |
|-----------------------------------|------------------------------------------------------------------------|-----------------------------------|
| C1, C2, C3                        | Capacitor, 0805                                                        | User supplied                     |
| C4, C6, C10                       | Capacitor, 0402, 0.1 $\mu$ F, 16 V                                     | AVX CM105X7R104K16AT              |
| C5, C7, C9, C11, C13              | Capacitor, 0603, 10 pF, 50 V, SMD                                      | AVX 06035A100JAT2A                |
| C8, C12                           | Capacitor, Case A, 22 $\mu$ F, 6.3 V                                   | AVX TAJA226K006R                  |
| 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 $\mu$ F, 16 V                                     | AVX TAJA105K016R                  |
| C21, C24                          | Capacitor, 0603, 10 nF, 50 V                                           | AVX 06035C103JAT2A                |
| C22, C25                          | Capacitor, Case A, 4.7 $\mu$ F, 10 V                                   | AVX TAJA475K010R                  |
| C26, C27                          | Capacitor, 0603, 10 nF, 50 V                                           | Not inserted                      |
| 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                                                    | Johnson Components 142-0701-851   |
| J3, J4, J10                       | Jack, SMA, receptacle straight PCB                                     | Not inserted                      |
| J5, J6, J7, J8, J9                | Jack, SMA, SMA_EDGE                                                    | Not inserted                      |
| J11                               | Jack, SMA, receptacle straight PCB                                     | Pomona 72963                      |
| LK1, LK3, LK4, LK5                | Jumper-2\SIP3, Link-3P                                                 | Harwin M20-9990345 and M7566-05   |
| LK2                               | Jumper-2                                                               | Harwin M20-9990245 and M7566-05   |
| GND                               | Black 4 mm banana socket                                               | Deltron 571-0100-01               |
| VSUPPLY                           | Red 4 mm banana socket                                                 | Deltron 571-0500-01               |
| R1A                               | Resistor, 0805                                                         | User supplied                     |
| R1                                | Resistor, 0805                                                         | User supplied                     |
| R2                                | Resistor, 0805                                                         | User supplied                     |
| R3                                | Resistor, 0805, 5.1 k $\Omega$ , $\pm$ 1%, 0.1 W                       | Multicomp MC 0.1 0805 1% 5K1      |
| R4, R5, R6, R23, R29, R42         | Resistor, 0603, 330 $\Omega$                                           | Multicomp MC 0.063W 0603 1% 330R  |
| R7, R8, R9                        | Resistor, 0603, 18 $\Omega$                                            | Multicomp MC 0.063W 0603 1% 18R   |
| R10, R17                          | Resistor, 0603, 51 $\Omega$                                            | Multicomp MC 0.063W 0603 1% 51R   |
| R11                               | Resistor, 0603 100 $\Omega$                                            | Multicomp MC 0.0625W 0402 1% 100R |
| R12, R13, R24, R25, R26           | Resistor, 0603, 10 k $\Omega$                                          | Multicomp MC 0.063W 0603 1% 10K   |
| R14, R16, R18, R28, R36           | Resistor, 0603, 0 $\Omega$                                             | Multicomp MC 0.063W 0603 1% 0R    |
| R15, R22, R27, R32, R33, R37, R46 | Resistor, 0603, 0 $\Omega$                                             | Not inserted                      |
| R19, R20                          | Resistor, 0603, 330 k $\Omega$ , $\pm$ 1%, 0.063 W                     | Multicomp MC 0.063W 0603 1% 330K  |
| R21                               | Resistor, 0603, 4.7 k $\Omega$ , $\pm$ 1%, 0.063 W                     | Multicomp MC 0.063W 0603 1% 4K7   |
| R30                               | Resistor, 0402                                                         | Not inserted                      |
| R31, R34                          | Resistor, RC31 0402 100 k $\Omega$                                     | 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                                | <a href="#">ADF4002</a> , TSSOP-16                                     | <a href="#">ADF4002BRUZ</a>       |
| U3                                | <a href="#">ADP3300</a> , SOT23-6                                      | <a href="#">ADP3300ART-5</a>      |
| U2                                | <a href="#">ADP3300</a> , SOT23-6                                      | <a href="#">ADP3300ART-3</a>      |
| U4                                | 32k I <sup>2</sup> C serial EEPROM, MSOP8                              | Microchip 24LC32A-I/MS            |
| Y1                                | VCO19V-XXXXT                                                           | Not inserted                      |
| Y2                                | Low profile/temperature compensated crystal oscillator, OSC_TCXO, 10 W | Not inserted                      |

**RELATED LINKS**

| Resource                | Description                                                            |
|-------------------------|------------------------------------------------------------------------|
| <a href="#">ADF4002</a> | Product Page, Phase Detector / PLL Frequency Synthesizer               |
| <a href="#">ADP3300</a> | Product Page, High Accuracy anyCAP® 50 mA Low Dropout Linear Regulator |

**NOTES**

## NOTES

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I<sup>2</sup>C 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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