

Evaluating the **ADRF6612/ADRF6614**, 700 MHz to 3000 MHz Rx Dual Mixer with Integrated Fractional-N PLL and VCO

FEATURES

Full featured evaluation board for the **ADRF6612/ADRF6614**
Single supply: 5 V operation

EQUIPMENT NEEDED

Rohde and Schwarz SMA100 CW generator (3×)
Mini-Circuits® ZFSC-2-2500-S splitter combiner (or equivalent)
Spectrum analyzer, Keysight PSA series or equivalent
Power supply (5.0 V, 1.0 A)
PC running Windows 7 (or Windows XP, or Windows Vista)
USB 2.0 port, recommended (USB 1.1 compatible)
ADRF6612/ADRF6614 evaluation board

SOFTWARE REQUIRED

ADRF6612/ADRF6614 software graphical user interface (GUI)

INTRODUCTION

This user guide allows the user to quickly power up and run the software for the **ADRF6612/ADRF6614** integrated synthesizer and mixers. It complements the **ADRF6612/ADRF6614** data sheet, which should be used in conjunction with this user guide.

POWER, RF, IF, AND USB CONNECTIONS

Figure 1 shows the **ADRF6612/ADRF6614** evaluation board with all required connections for proper operation. All of the connections shown in Figure 2 must be made with the power turned off. When all power, RF, IF, and USB connections are made, the 5 V supply can then be turned on. When the power is turned on initially, the 5 V supply draws approximately 500 mA. When the device is initially programmed via the **ADRF6612/ADRF6614** GUI and USB interface, this current changes as described in the Software GUI Operation, Testing a Number of Evaluation Boards section.

The red and black clips on the evaluation board represent 5 V and GND, respectively. In the upper left of the evaluation board as shown in Figure 2, an SMA cable connects to an external PLL reference source. The dual single-ended RF inputs (RF1 and RF2) are located on the right side of the evaluation board. The IF outputs are located on the top right and bottom right sides of the board. In the default **ADRF6612/ADRF6614** evaluation board configuration, the IF outputs are run single-endedly using the baluns on the board; thus, only one SMA is connected for each IF output.

The USB connector for the software interface is located on the lower left side of the evaluation board. A standard USB cable, PC to mini USB, is required to connect this evaluation board to a PC.

The **ADRF6612/ADRF6614** evaluation board provides all of the support circuitry required to operate the **ADRF6612/ADRF6614** in various modes and configurations. Figure 2 shows the typical bench setup to evaluate the performance of the **ADRF6612/ADRF6614**.

APPLYING POWER

When the 5 V supply is first connected and turned on, the evaluation board draws approximately 500 mA. When the **ADRF6612/ADRF6614** is programmed through the software GUI and the device is fully operational, this current increases to approximately 600 mA.

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REVISION HISTORY

4/16—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

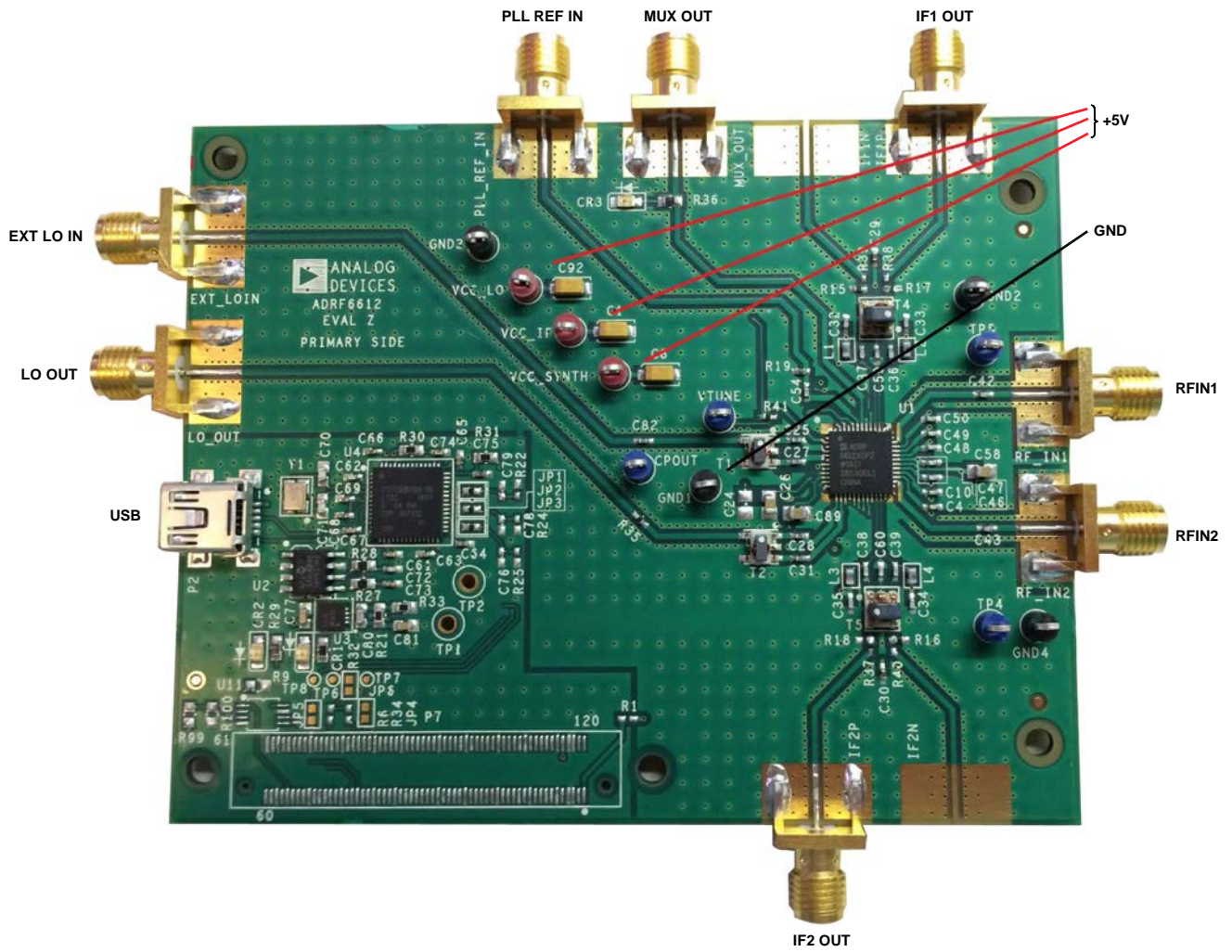


Figure 1. ADRF6612/ADRF6614 Evaluation Board with Connections

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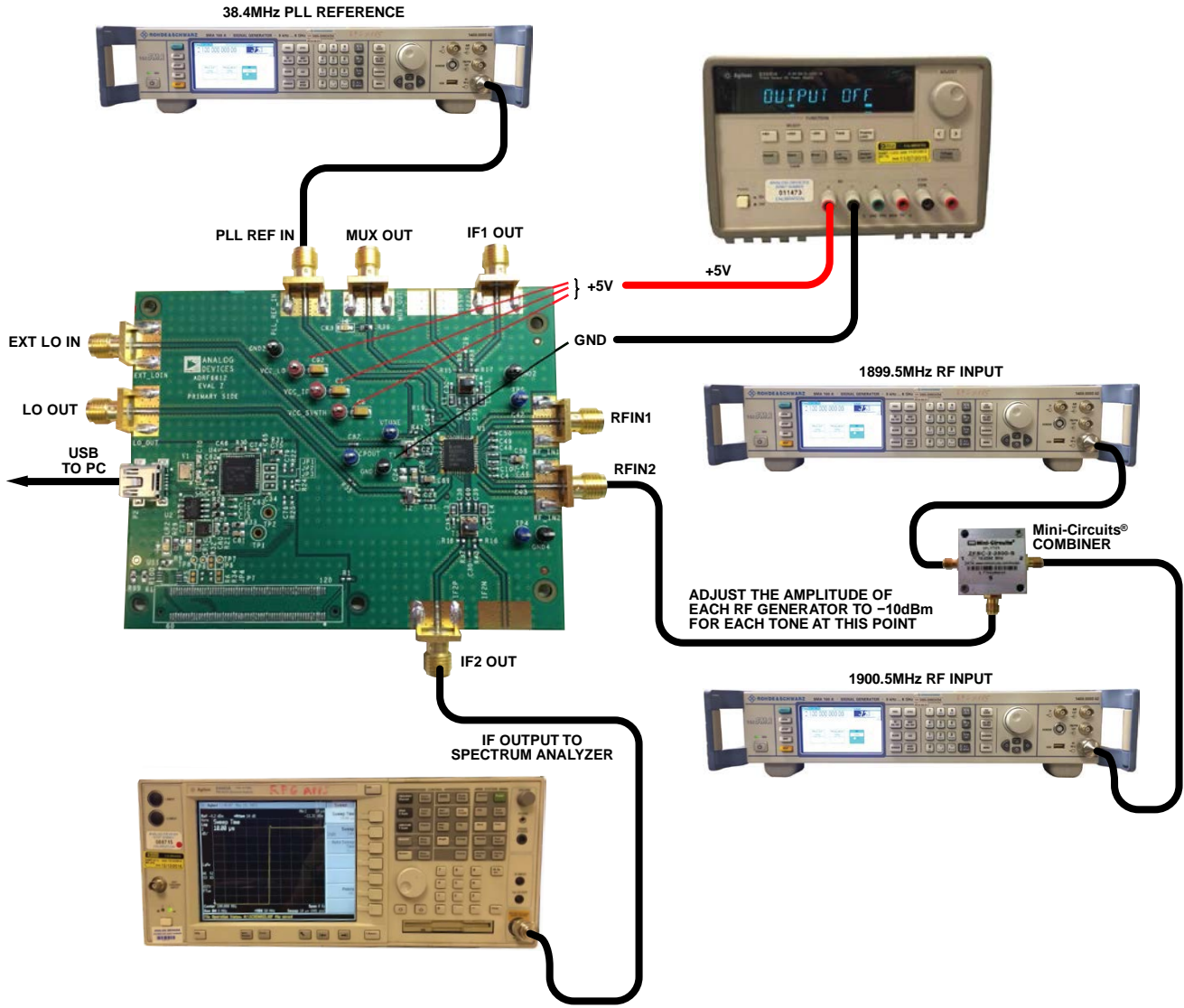


Figure 2. ADRF6612/ADRF6614 Typical Measurement Setup

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SOFTWARE DIRECTORY STRUCTURE

The software is packaged in the following compressed file:
ADRF6612_14_rev_2p0p0_customer_install.zip.

When extracted, the included readme file describes how to install the driver for Windows® XP, Windows Vista™, and Windows 7. This software is compatible with 32-bit and 64-bit systems. When the software installs, the default installation directory opens, as shown in Figure 3.

The GUI itself loads its initial values from a .txt file located in the **device_save_states** subdirectory, as shown in Figure 4. The user can edit this file or save it to a different file name to modify the start-up conditions.

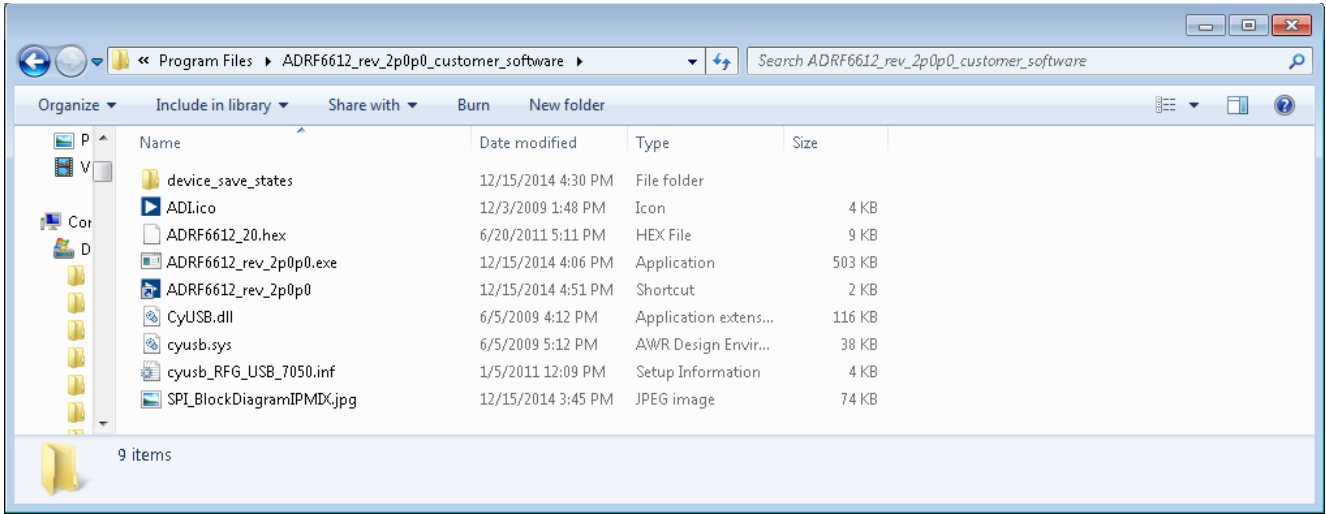


Figure 3. Default Installation Directory for ADRF6612/ADRF6614 Software

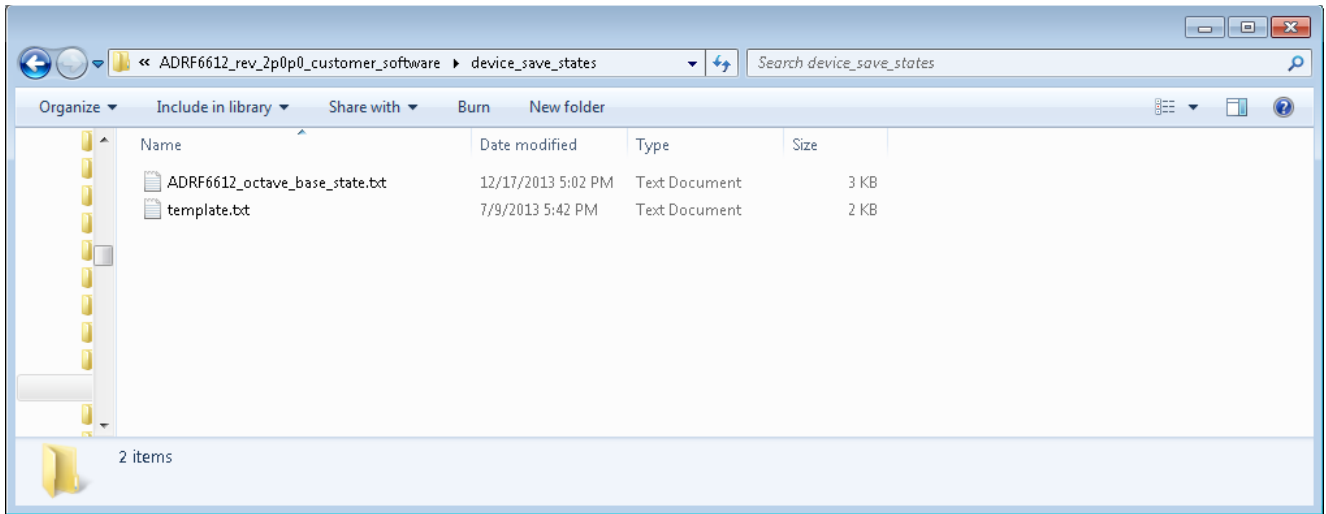


Figure 4. Device Save States Subdirectory

SOFTWARE GUI OPERATION, TESTING A NUMBER OF EVALUATION BOARDS

It is important to note that when entering data into any of the text fields in this GUI, the ENTER key must be pressed when the input is complete. This action updates the variables in the software so that the ADRF6612/ADRF6614 are programmed

with these values during the next programming step (that is, selecting a new value from any of the drop-down menus or clicking INIT).

When the software starts, it loads the initial values from the .txt files described in the Software Directory Structure section. As an example, when the GUI starts, it opens as shown in Figure 5.

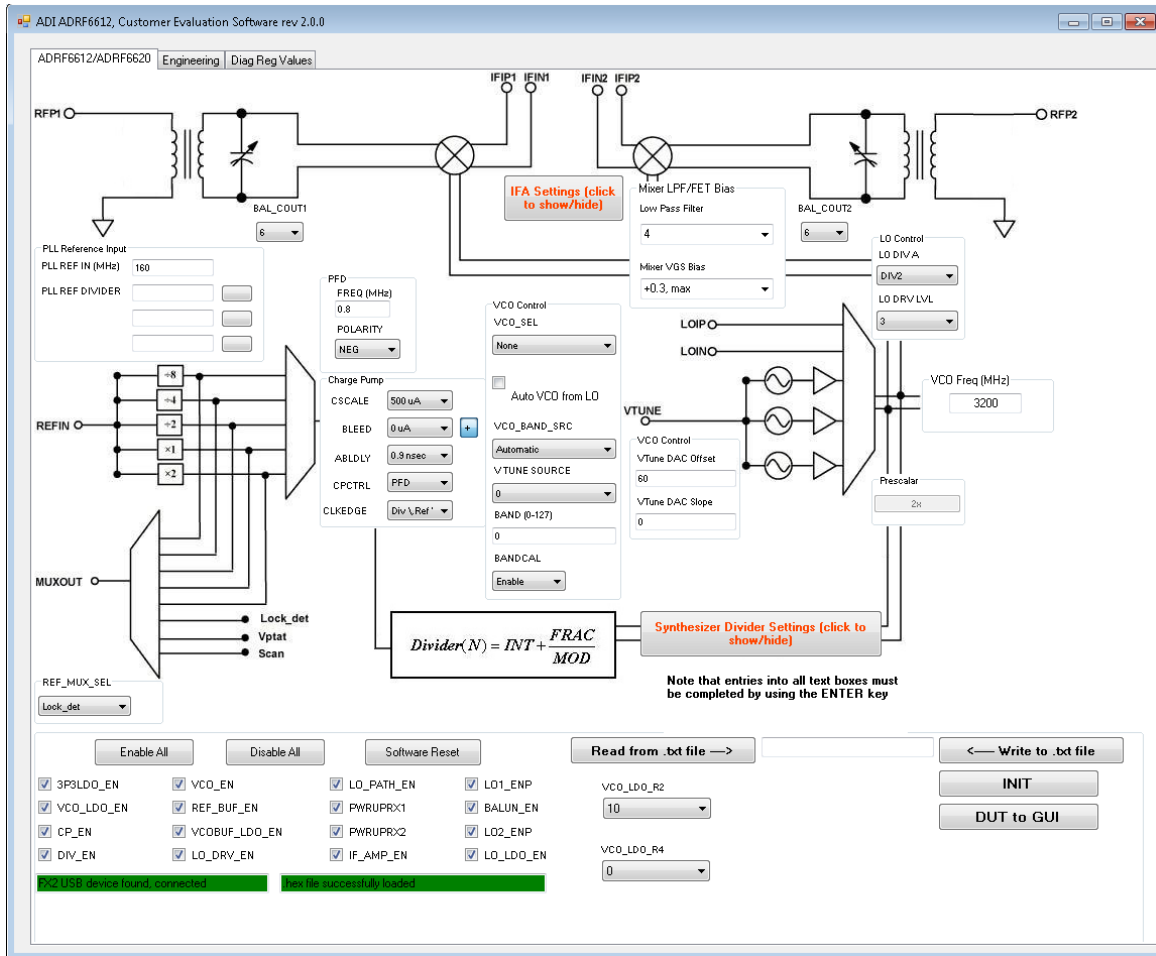


Figure 5. Software GUI for the ADRF6612/ADRF6614 (Note that Green Indicators Show Proper USB Connection)

Test and Programming Sequence

The sequence for setting up the test and programming the [ADRF6612/ADRF6614](#) for proper operation is as follows:

1. Adjust the amplitude of each generator so that each tone on the output of the combiner is at -10 dBm. Ideally, use an SMA barrel to connect the combiner output to the RF input of the [ADRF6612/ADRF6614](#). If this is not possible, use a short as possible cable to minimize cable loss at this point.
2. Set the spectrum analyzer to a center frequency of 203 MHz with a span of 25 MHz, set the input attenuation to 30 dB, and set VBW and RBW to automatic.
3. Click **INIT** (lower right) to load most of the default conditions into the [ADRF6612/ADRF6614](#) registers.
4. Select the **Auto VCO** check box in the center of the **VCO Control** area of the GUI.
5. Enter 38.4 in the **PLL REF IN (MHz)** box in the **PLL Reference Input** area n of the GUI (center left) to set the PLL reference frequency.
6. Enter a value of 1 in the first **PLL REF DIVIDER** box in the **PLL Reference Input** area of the GUI.
7. Click the button to the right of the **PLL REF DIVIDER** box to select the divider value of 1 just entered. The PFD frequency field to the right of the **FREQ (MHz)** button then changes to read 38.4.
8. Click **Synthesizer Divider Settings** in the middle of the GUI to open the Synthesizer Divider Settings dialog box as shown in Figure 7.
9. Select **FRAC** from the **DIV_MODE** drop-down menu. Set the LO output frequency to 1697 MHz by entering 1697 in the **LO OUT FREQ (MHz)** box, and then click **SET**.

At this point, if everything is set up correctly, the spectrum analyzer display appears similar to Figure 6.

These steps complete the testing of Channel 2. To test Channel 1, remove the RF connection from RF Port 2 and connect it to RF Port 1. Additionally, disconnect the IF connection from IF Port 2 and connect it to IF Port 1. The spectrum analyzer display is similar to that in Figure 6.

TESTING THE NEXT EVALUATION BOARD

To test the next evaluation board, disconnect and reconnect all signal, power, and USB connections. It is not necessary to close the software GUI. Reconnect all connections on the next board to be tested. When all connections are made, it is only necessary to click **INIT** to place the next [ADRF6612/ADRF6614](#) evaluation board into a completely operational state. The output spectrum is visible as shown in Figure 6.

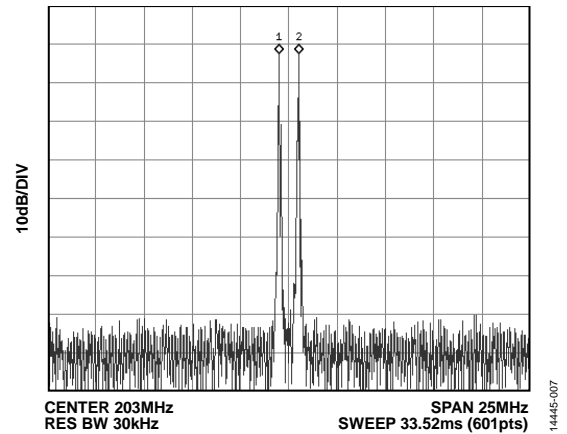


Figure 6. [ADRF6612/ADRF6614](#) Two-Tone Spectral Output

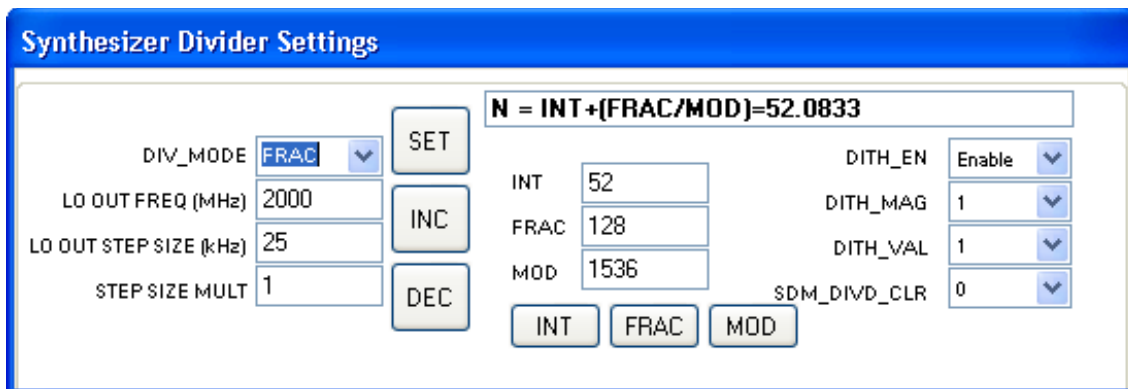
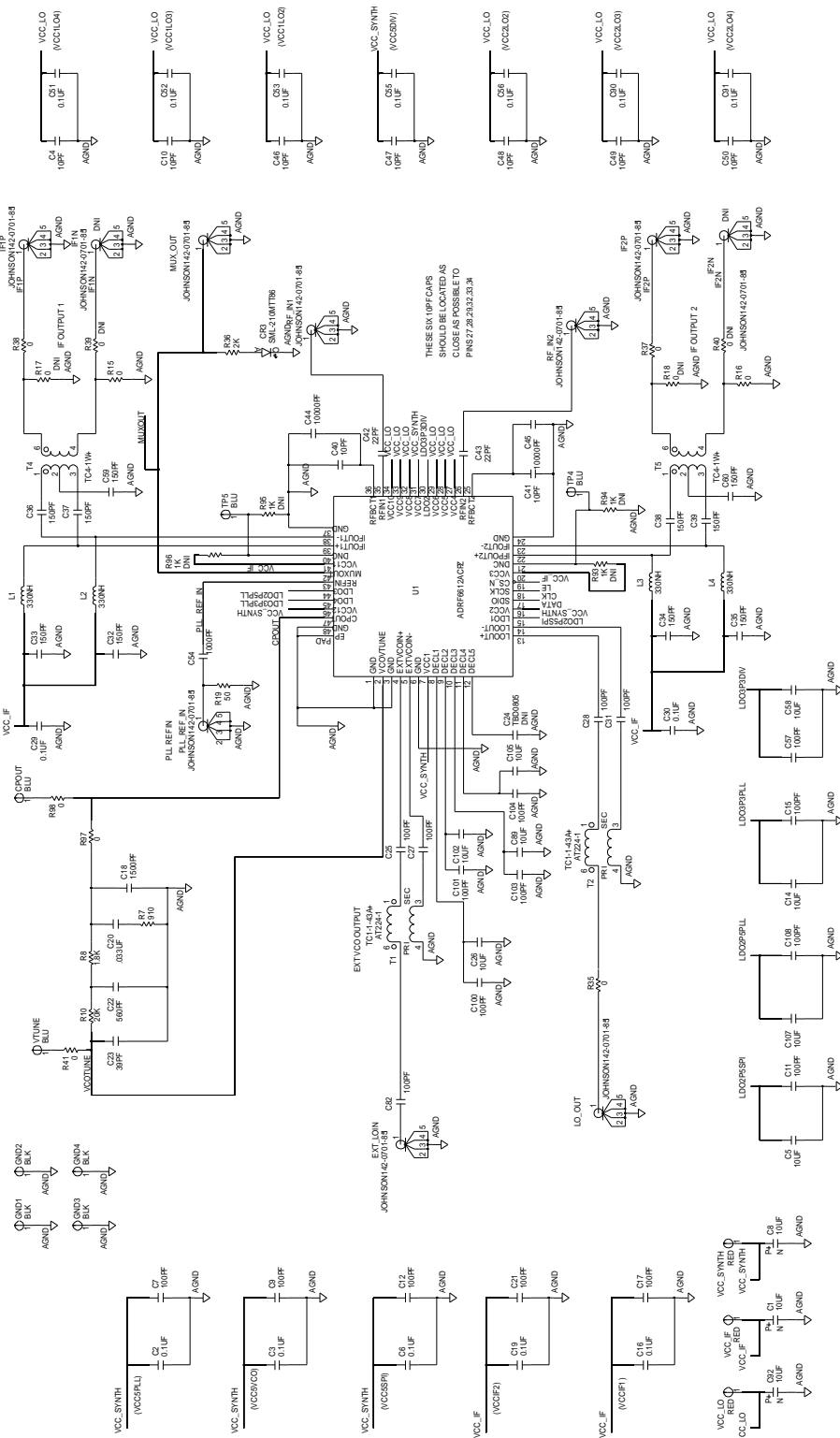


Figure 7. Synthesizer Divider Settings Dialog Box

EVALUATION BOARD SCHEMATICS



ALL 100PF DECOUPLING CAPS SHOULD BE AS CLOSE AS POSSIBLE TO THE PINS ON THE CHIP

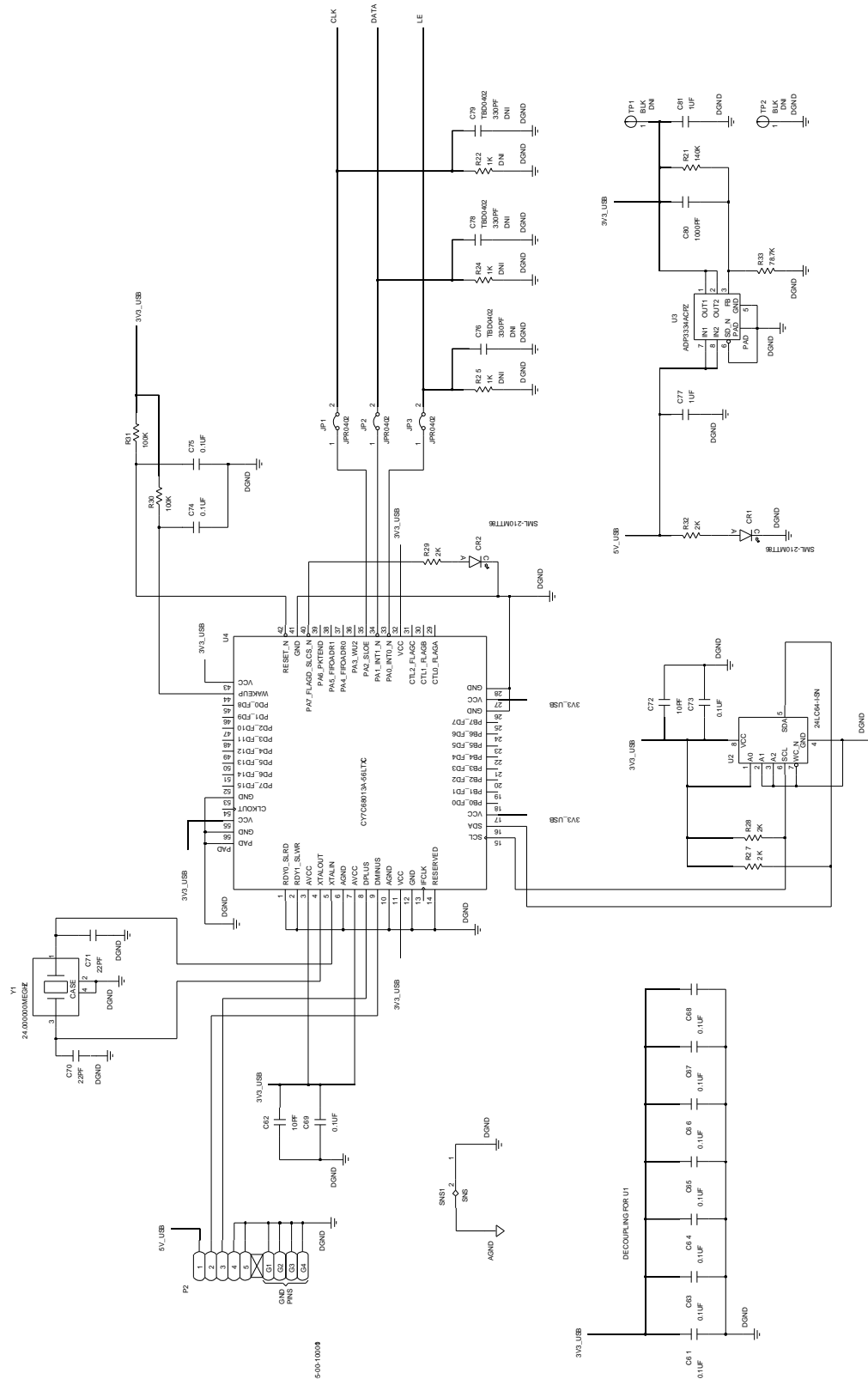


Figure 9. ADRF6612/ADRF6614 Evaluation Board Schematic, Cypress USB Interface

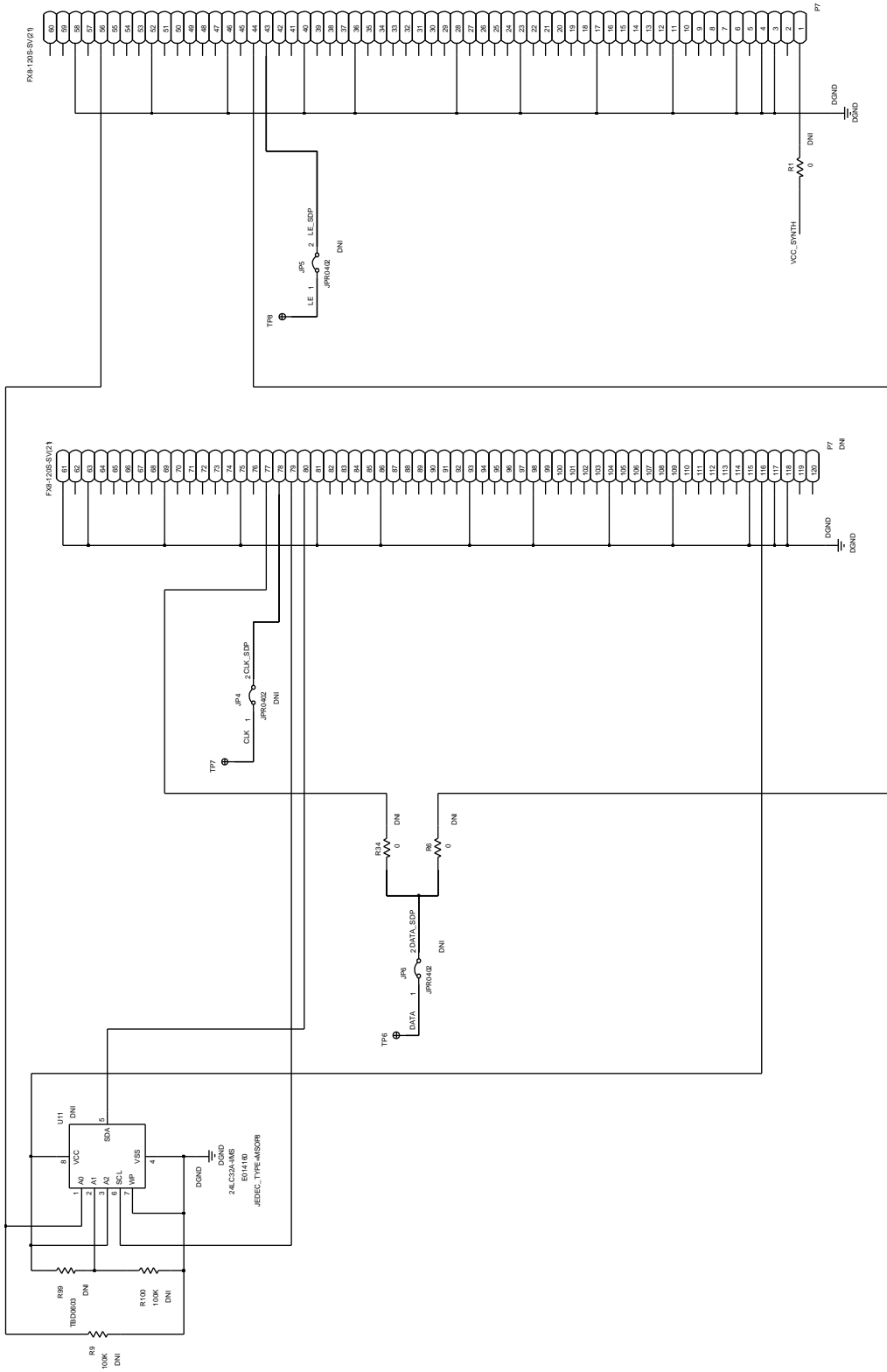


Figure 10. ADRF6612/ADRF6614 Evaluation Board Schematic, SDP Interface (Not Presently Used)

14445-010

BILL OF MATERIALS

Table 1. Bill of Materials

| Qty. | Reference Designator | Description | Value | Manufacturer | Part No. |
|------|---|--|----------------------|----------------------------|----------------------|
| 1 | PCB | PCB | PCB | Analog Devices, Inc. | 08_035817C |
| 3 | C1, C8, C92 | Capacitors, tantalum | 10 μ F | AVX | TAJA106K010RNJ |
| 11 | C4, C10, C40, C41, C46 to C50, C62, C72 | Capacitors, multilayer ceramic, NP0 0402 | 10 pF | Phycomp (Yageo) | CC0402JRNPO9BN100 |
| 18 | C7, C9, C11, C12, C15, C17, C21, C25, C27, C28, C31, C57, C82, C100, C101, C103, C104, C108 | Capacitors, Chip monolithic ceramic, COG 0402 | 100 pF | Murata | GRM1555C1H101JD01D |
| 8 | C5, C14, C26, C58, C89, C102, C105, C107 | Capacitors, ceramic monolithic | 10 μ F | Murata | GRM21BR61C106KE15L |
| 25 | C2, C3, C6, C16, C19, C29, C30, C51 to C53, C55, C56, C61, C63 to C69, C73 to C75, C90, C91 | Capacitors, ceramic, X7R 0402 | 0.1 μ F | Murata | GRM155R71C104KA88D |
| 1 | C18 | Capacitor, ceramic, X7R | 1500 pF | Phycomp (Yageo) | 2238 586 15625 |
| 1 | C20 | Capacitor, ceramic | 0.033 μ F | KEMET | C0603C333J3RACTU |
| 1 | C22 | Capacitor, monolithic ceramic, NP0 | 560 pF | Murata | GRM1885C1H561JA01D |
| 1 | C23 | Capacitor, ceramic, NP0 | 39 pF | Phycomp (Yageo) | 2238 867 15399 |
| 10 | C32 to C39, C59, C60 | Capacitors, ceramic, COG 0402 | 150 pF | Murata | GRM1555C1H151JA01D |
| 2 | C42, C43 | Capacitors, ceramic | 22 pF | Phycomp (Yageo) | 0402CG220J9B200 |
| 2 | C44, C45 | Capacitors, ceramic chip, X7R 0402 | 10,000 pF | TDK | C1005X7R1E103K |
| 1 | C54 | Capacitor, ceramic, COG 0402 | 1000 pF | Murata | GRM1555C1H102JA01 |
| 2 | C70, C71 | Capacitor, ceramic, NP0 | 22 pF | Phycomp (Yageo) | CC0603JRNPO9BN220 |
| 2 | C77, C81 | Capacitor, monolithic ceramic, X5R | 1 μ F | Murata | GRM188R61E105KA12D |
| 1 | C80 | Capacitor, chip monolithic ceramic, COG 0603 | 1000 pF | Murata | GRM1885C1H102JA01D |
| 4 | TP4, TP5, CPOUT, VTUNE | Connector, PCB test point, blue | Blue | Components Corporation | TP104-01-06 |
| 3 | CR1 to CR3 | LED, 570NM WTR, CLR 0805, SMD (green) | SML-210MTT86 | Rohm | SML-210MTT86 |
| 8 | IF1P, IF2P, LO_OUT, RF_IN1, RF_IN2, MUX_OUT, EXT_LOIN, PLL_REF_IN | Connector, PCB coaxial SMA, end launch | 142-0701-851 | Johnson | 142-0701-851 |
| 4 | GND1 to GND4 | Connector, PCB test point, black | Black | Components Corporation | TP-104-01-00 |
| 4 | L1 to L4 | Inductors, SM | 330 nH | Coilcraft | 0603CS-R33XJLW |
| 1 | P2 | Connector, PCB receptacle mini USB, Type B SMT | 897-43-005-00-100001 | Mill-Max | 897-43-005-00-100001 |
| 1 | R10 | Resistor, precision thick film chip, R0402 | 20 k Ω | Panasonic | ERJ-2RKF2002X |
| 9 | R15 to R17, R35, R37, R38, R41, R97, R98 | Use E003438 from cell Resistor JMPROPEN or Resistor JMPRSHRT | 0 Ω | Panasonic | ERJ-2GE0R00X |
| 1 | R19 | Resistor, high frequency chip, 0402 | 50 Ω | VISHAY | FC0402E50R0FST1 |
| 1 | R21 | Resistor, film chip thick | 140 k Ω | NIC Components Corporation | NRC06F1403TRF |
| 5 | R27 to R29, R32, R36 | Resistors, film, SMD 0603 | 2 k Ω | Phycomp (Yageo) | 9C06031A2001FKHFT |

| Qty. | Reference Designator | Description | Value | Manufacturer | Part No. |
|------|----------------------------------|--|---|------------------------|---|
| 2 | R30, R31 | Resistors, precision thick film chip | 100 k Ω | Panasonic | ERJ-3EKF1003V |
| 1 | R33 | Resistor, precision thick film chip, 0603 | 78.7 k Ω | Panasonic | ERJ-3EKF7872V |
| 1 | R7 | Resistor, chip, SMD 0603 | 910 Ω | Panasonic | ERA-3YEB911V |
| 1 | R8 | Resistor, thick film chip | 1.8 k Ω | Panasonic | ERJ-2GEJ182X |
| 2 | T1, T2 | XFMR RF SMT | TC1-1-43A+ | Mini Circuits | TC1-1-43A+ |
| 2 | T4, T5 | XFMR RF with customized pad | TC4-1W+ | Mini Circuits | TC4-1W+ |
| 1 | U1 | IC, dual passive receive mixer, PREL | ADRF6612ACPZ/ ADRF6614ACPZ | Analog Devices | ADRF6612ACPZ/ ADRF6614ACPZ |
| 1 | U2 | IC, 64 kb EEPROM | 24LC64-I-SN | Microchip | 24LC64-I-SN |
| 1 | U3 | IC, high accuracy, low I _Q , adjustable low dropout regulator | ADP3334ACPZ | Analog Devices | ADP3334ACPZ |
| 1 | U4 | IC, HS USB peripheral | CY7C68013A-56LTXC | Cypress Semiconductor | CY7C68013A-56LTXC |
| 3 | VCC_IF, VCC_LO, VCC_SYNTH | Connectors, PCB test point, red | Red | Components Corporation | TP-104-01-02 |
| 1 | Y1 | IC, crystal SMD | 24.000000MEGHZ | NDK | NX3225SA-24.000000MHZ |
| 2 | IF1N, IF2N (DNI) | Connectors, PCB coaxial SMA, end launch | Johnson 142-0701-851 | Johnson | 142-0701-851 |
| 1 | P7 (DNI) | Connector, PCB vertical type receptacle SMD | FX8-120S-SV(21) | HRS | FX8-120S-SV(21) |
| 6 | R1, R6, R18, R34, R39, R40 (DNI) | Use E003438 from cell Resistor JMPROPEN or Resistor JMPRSHRT | 0 Ω | Panasonic | ERJ-2GE0R00X |
| 2 | R9, R100 (DNI) | Resistor precision thick film chip | 100 k Ω | Panasonic | ERJ-3EKF1003V |
| 7 | R22, R24, R25, R93 to R96 (DNI) | Resistor precision thick film chip, R0402 | 1 k Ω | Panasonic | ERJ-2RKF1001X |
| 2 | TP1, TP2 (DNI) | Connectors, PCB test point, black | Black | Components Corporation | TP-104-01-00 |
| 1 | U11 (DNI) | IC, 32 kb serial EEPROM | 24LC32A-I/MS | Microchip | 24LC32A-I/MS |

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.

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