

## Evaluating the **ADF4356** Microwave Wideband Synthesizer with Integrated VCO

### FEATURES

Self contained board, including **ADF4356** frequency synthesizer with integrated VCO, differential, 122.88 MHz, temperature controlled crystal oscillator (TCXO), loop filter (80 kHz), USB interface, and voltage regulators  
 Windows-based software allows control of synthesizer functions from a PC  
 Externally powered by 5.5 V

### EVALUATION KIT CONTENTS

**EV-ADF4356SD1Z**

### EQUIPMENT NEEDED

Windows-based PC with USB port for evaluation software  
 System demonstration platform, serial only (**SDP-S**)  
**EVAL-SDP-CS1Z** controller board  
 USB cable (included with the **EVAL-SDP-CS1Z**)  
 Power supply (5.5 V)  
 Spectrum analyzer  
 50 Ω terminators

### ONLINE RESOURCES

#### Documents Needed

[ADF4356](#) data sheet  
[EV-ADF4356SD1Z](#) user guide  
[PLL Software Installation Guide](#)

#### Required Software

Analog Devices, Inc., [ADF4356](#) software, Version 1.0.10 or higher

### GENERAL DESCRIPTION

The **EV-ADF4356SD1Z** evaluates the performance of the **ADF4356** frequency synthesizer with an integrated voltage control (VCO) for phase-locked loops (PLLs). The evaluation board contains the **ADF4356** frequency synthesizer with an integrated VCO, a differential 122.88 MHz reference (TCXO), a loop filter, a USB interface, power supply connectors, and subminiature Version A (SMA) connectors. A USB cable is included to connect the board to a PC USB port.

This board requires an **SDP-S** (shown in Figure 1, but not supplied with the kit). The **SDP-S** allows software programming of the **EV-ADF4356SD1Z**.

When working with the evaluation board and for full specifications of the device, consult the **ADF4356** frequency synthesizer data sheet. For easy programming of the synthesizer, download the Windows®-based software from the **ADF4356** product page.

### EVALUATION BOARD PHOTOGRAPH

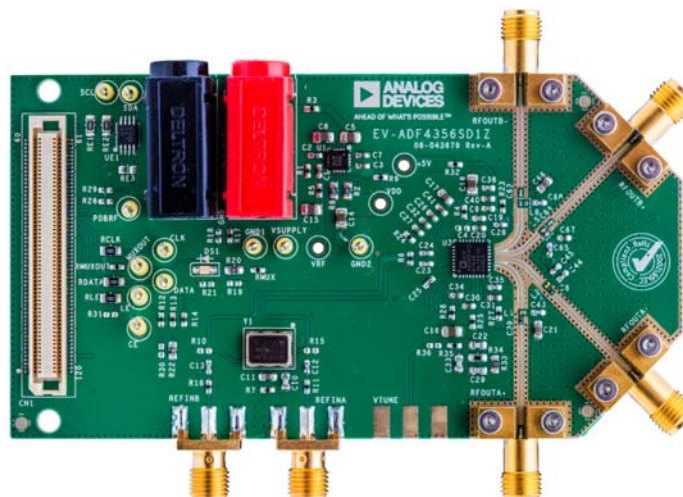


Figure 1.

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## REVISION HISTORY

### 04/2017—Rev. 0 to Rev. A

Changes to Features, Evaluation Kit Contents, Equipment Needed, Online Resources Sections, and Figure 1.....	1
Changes to Figure 2.....	3
Changes to Evaluation Board Hardware Section and Deleted Figure 3, Renumbered Sequentially .....	4
Changes to Figure 3.....	5
Changes to Evaluation Board Software, Step 5 and Figure 5.....	7
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### 10/2016—Revision 0: Initial Version

## GETTING STARTED

### SOFTWARE INSTALLATION PROCEDURES

See the [ADF4356](#) product page for the [EV-ADF4356SD1Z](#) control software. For the software installation procedure, see the [PLL Software Installation Guide](#).

### EVALUATION BOARD SETUP PROCEDURES

To run the software,

1. Click the **ADF4356** file on the desktop or from the **Start** menu.
2. On the **Select Device and Connection** tab, choose **ADF4356** and **SDP board (black)**, and then click **Connect** (see Figure 2).
3. When connecting the board, allow 5 sec to 10 sec for the label on the status bar to change.

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

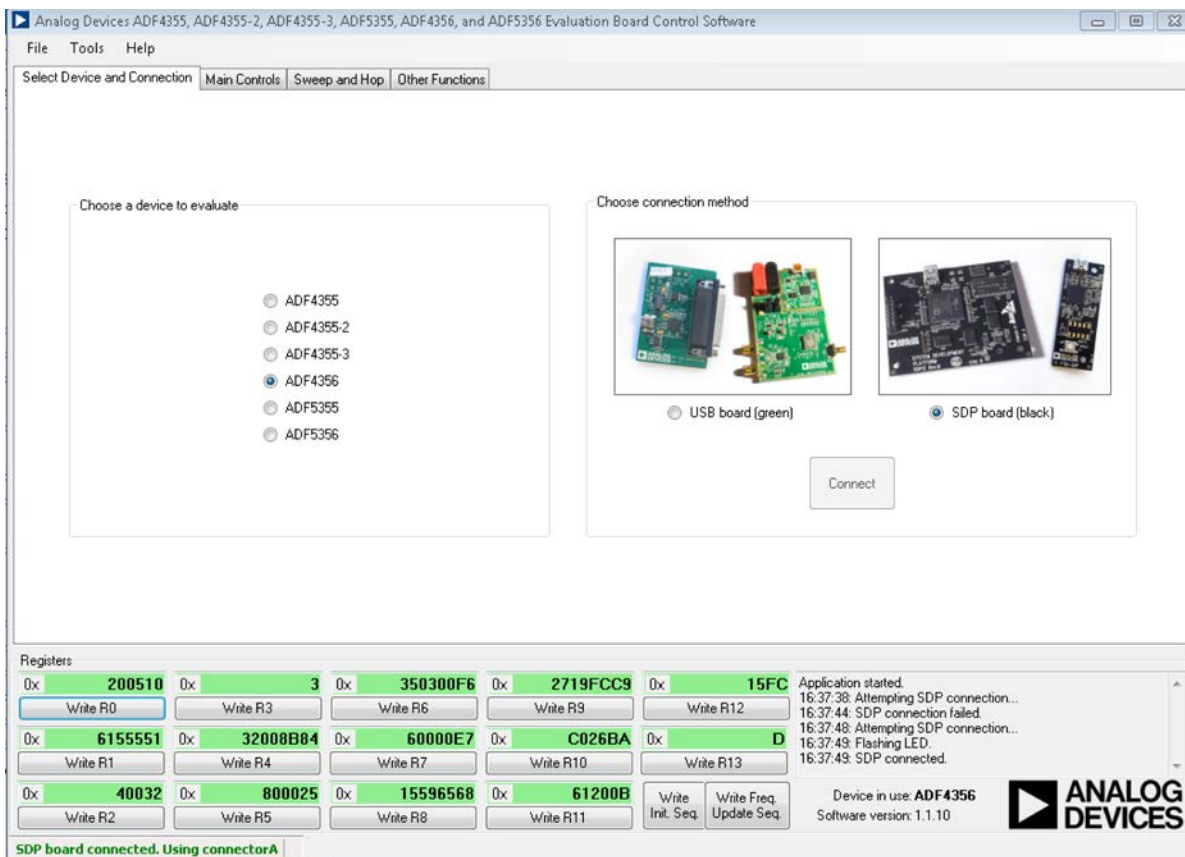


Figure 2. Software Front Panel Display—Select Device and Connection

## EVALUATION BOARD HARDWARE

The [EV-ADF4356SD1Z](#) requires the [SDP-S](#) platform that uses the [EVAL-SDP-CS1Z](#) ([SDP-B](#) is not recommended).

The [EV-ADF4356SD1Z](#) schematics are shown in Figure 6, and Figure 7. The evaluation board silkscreen is shown in Figure 8.

### POWER SUPPLIES

The board is powered by a 5.5 V power supply connected to the red and black banana connectors. Connect the red connector to a 5.5 V power supply and the black connector to ground. Reversal of the connections to the red and black banana connectors can cause catastrophic failure of the HMC1060 low noise regulator.

The [HMC1060](#) low noise regulator is configured to supply 5 V for the charge pump and VCO supply pins, and 3.3 V for the remaining supply pins.

### RF OUTPUT

The [EV-ADF4356SD1Z](#) has two pairs of SMA output connectors: RFOUTA+/RFOUTA– and RFOUTB+/RFOUTB– (differential outputs). Because they are sensitive to impedance mismatch, connect the RF outputs to equal load impedances. If only one port of a differential pair is used, terminate the complementary port with an equal load terminator (in general, a 50  $\Omega$  terminator).

### LOOP FILTER

The loop filter schematic is included in the board schematic in Figure 6. For lowest rms phase noise, use the following components (that are inserted on the evaluation board) with a 0.9 mA charge pump current:

- C22 = 120 pF, C29 = 2700 pF, C33 = 22 pF
- R33 = 2.7 k $\Omega$ , R34 = 10 k $\Omega$

Narrower loop filter bandwidths have lower spurious signals.

### REFERENCE SOURCE

The evaluation board contains a 122.88 MHz differential output TCXO from Vectron International. If preferred, the user may supply either a single-ended or differential reference input to REFINA/REFINB SMA connectors. When using an external reference, remove R7 to disconnect the power rail to the TCXO.

To use a single-ended REFINx, connect a low noise, 122.88 MHz reference source to the REFINA SMA connector. Remove Resistor R6 (100  $\Omega$ ) and insert R10 (50  $\Omega$ ) and R15 (50  $\Omega$ ).

To use a differential REFINx, connect the differential signal to the REFINA and the REFINB SMA connectors. The differential REFINA/REFINB SMA connectors can operate to a 500 MHz input frequency.

### DEFAULT CONFIGURATION

All components necessary for local oscillator (LO) or clock generation are inserted on the board. This board is shipped with the [ADF4356](#) synthesizer with an integrated VCO, a differential 122.88 MHz reference TCXO, and a 80 kHz loop filter ( $I_{CP}$  = 0.9 mA).

EVALUATION BOARD SETUP

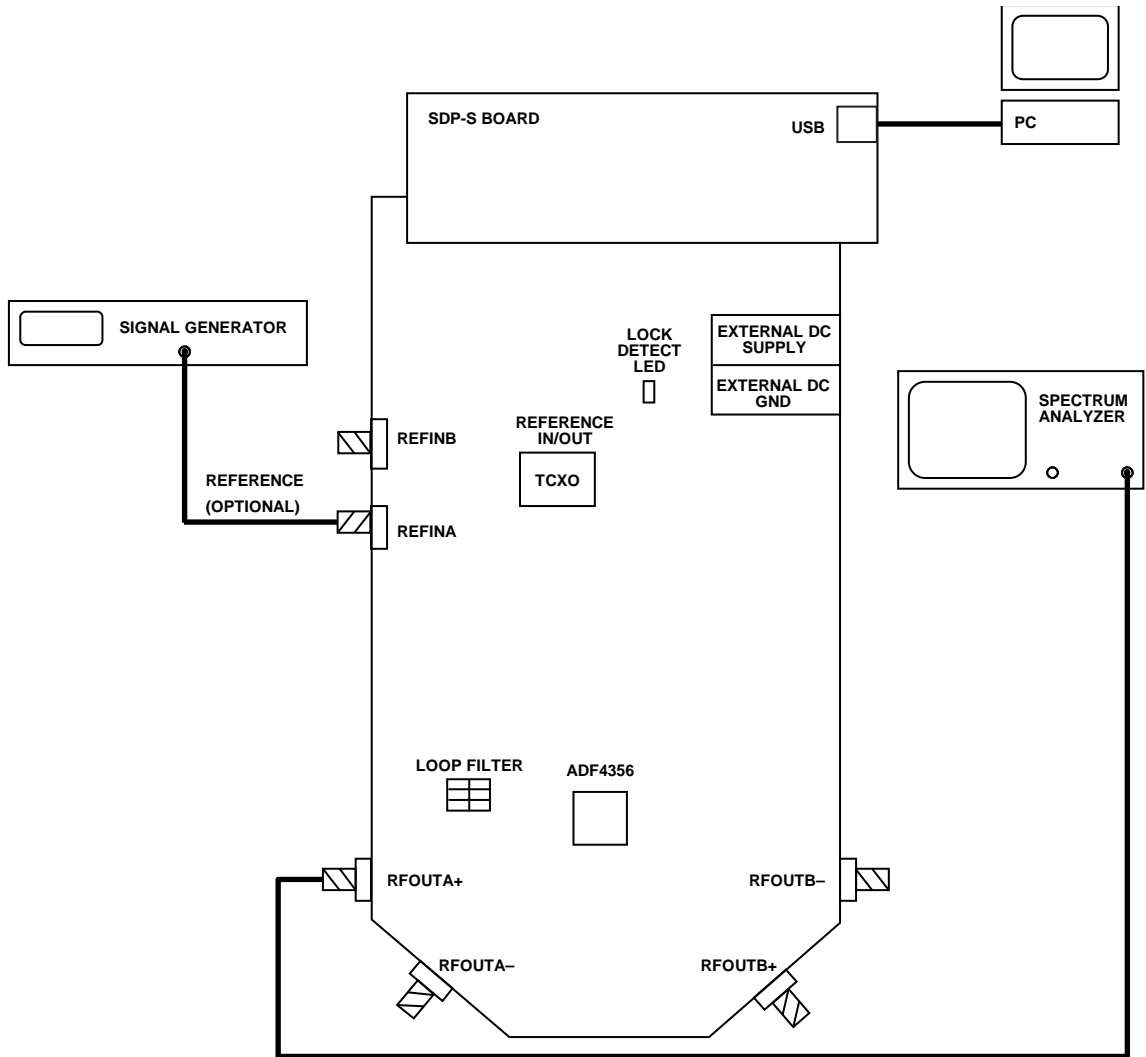


Figure 3. Evaluation Setup Block Diagram

# EVALUATION BOARD SOFTWARE

## MAIN CONTROLS

The **Main Controls** tab (see Figure 4) selects the RF and user configurable register settings. Consult the register descriptions of the **ADF4356** data sheet for details. Default settings are recommended for most registers.

In the **RF Settings** section, ensure that the **VCOout (MHz) box** equals the VCO frequency. Set the **Output divider** dropdown menu to give the required **RFoutA± (MHz)**.

Ensure that the **Reference freq.** value equals the applied reference signal. The PFD frequency is calculated from the reference frequency, the R counter, the reference doubler, and the reference divide by 2. Ensure that the value in **PFD (MHz)** matches the value specified in the loop filter design.

In the **Register 4** section, program the **CP current** dropdown menu to match the value used for the loop filter design.

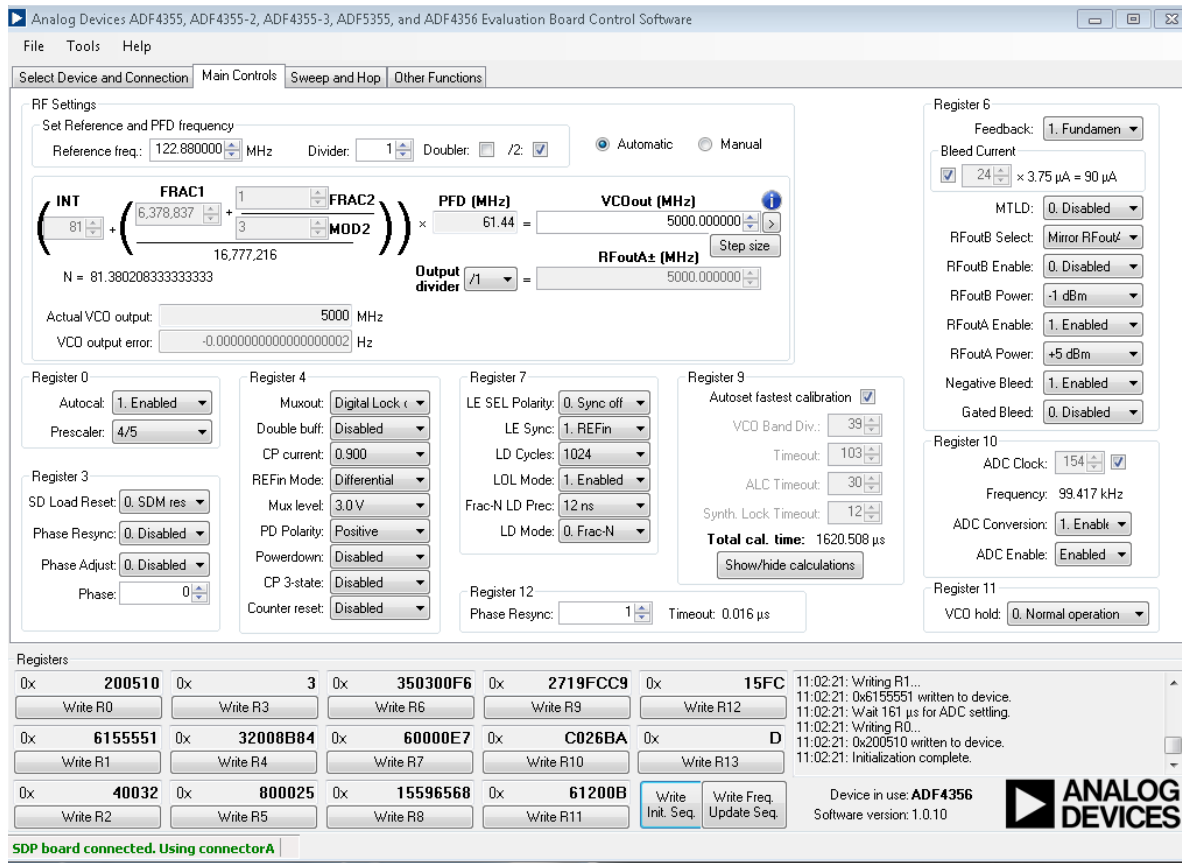


Figure 4. Software Front Panel Display—Main Controls

## EVALUATION AND TEST

To evaluate and test the performance of the [ADF4356](#), use the following procedure:

1. Install the [ADF4356](#) software (see the [PLL Software Installation Guide](#)).
2. Follow the hardware driver installation procedure (Windows XP only).
3. Connect a 50  $\Omega$  terminator to RFOUTA-.
4. Connect the [EV-ADF4356SD1Z](#) board to the [SDP-S](#) board.
5. Connect the 5.5 V power supply to the banana connectors and power on the board.
6. Connect the USB cable from the [SDP-S](#) board to the PC.
7. Run the [ADF4356](#) software.
8. Select **ADF4356** and **SDP board (black)** in the **Select Device and Connection** tab of the software front panel display window (see Figure 2).
9. Click the **Main Controls** tab, and set the **VCOout (MHz)** to a frequency of 5000 MHz.
10. Click **Write Init. Seq.**
11. Connect the spectrum analyzer to SMA connector RFOUTA+, see Figure 3 for a typical evaluation setup.
12. Measure the output spectrum and single-sideband phase noise.

Figure 5 shows a phase noise plot of the SMA RFOUTA+ equal to 5 GHz.

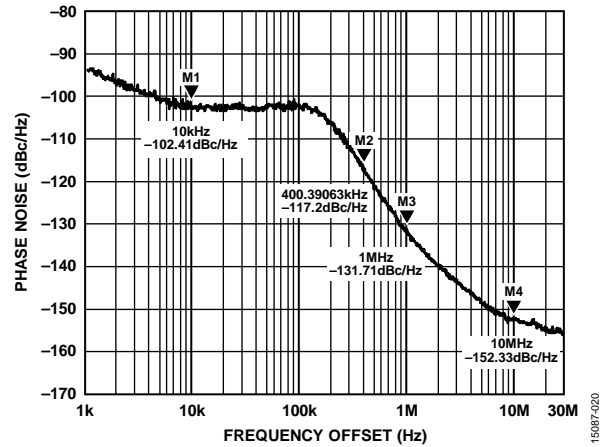
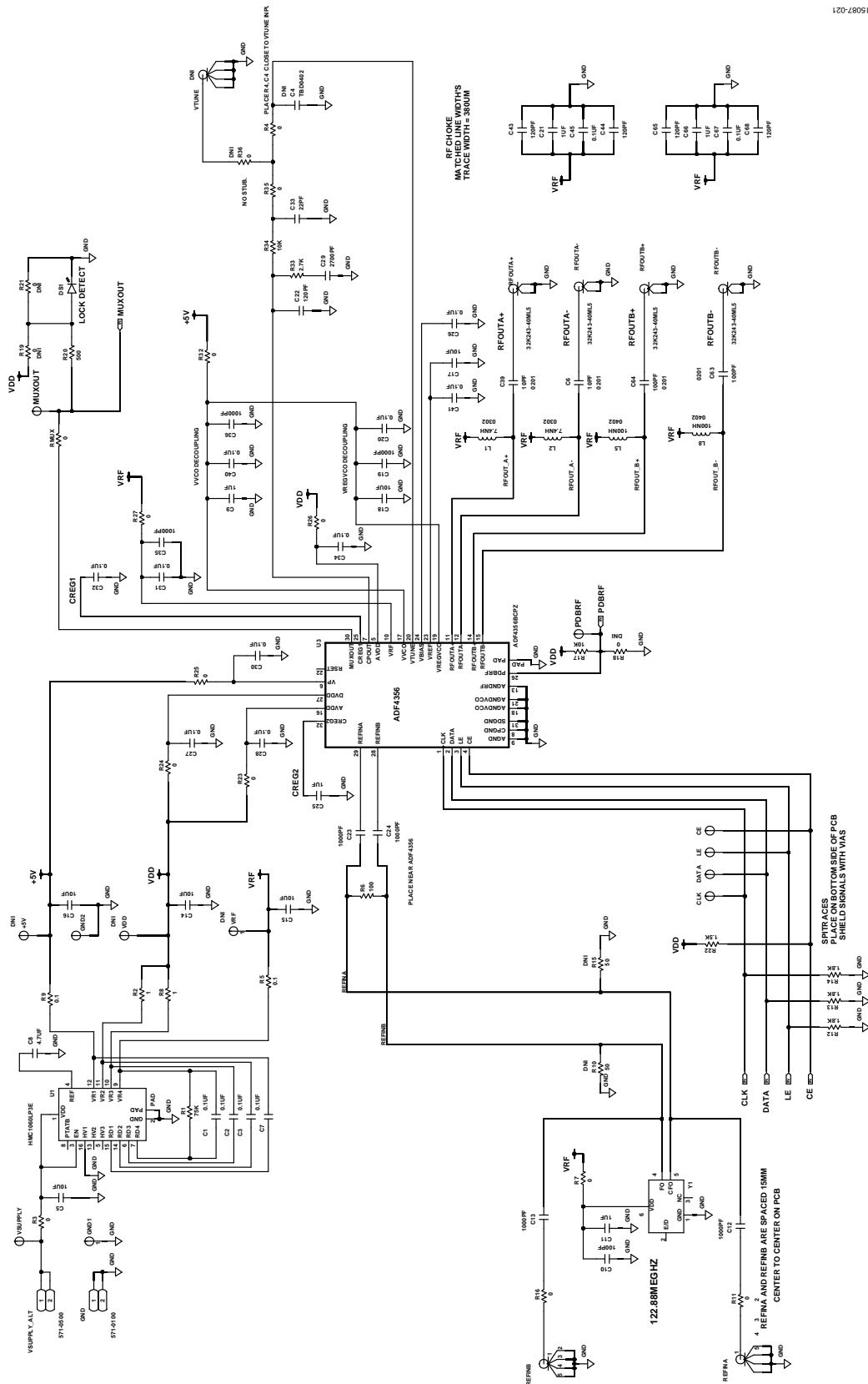


Figure 5. Single-Sideband Phase Noise

EVALUATION BOARD SCHEMATICS AND ARTWORK

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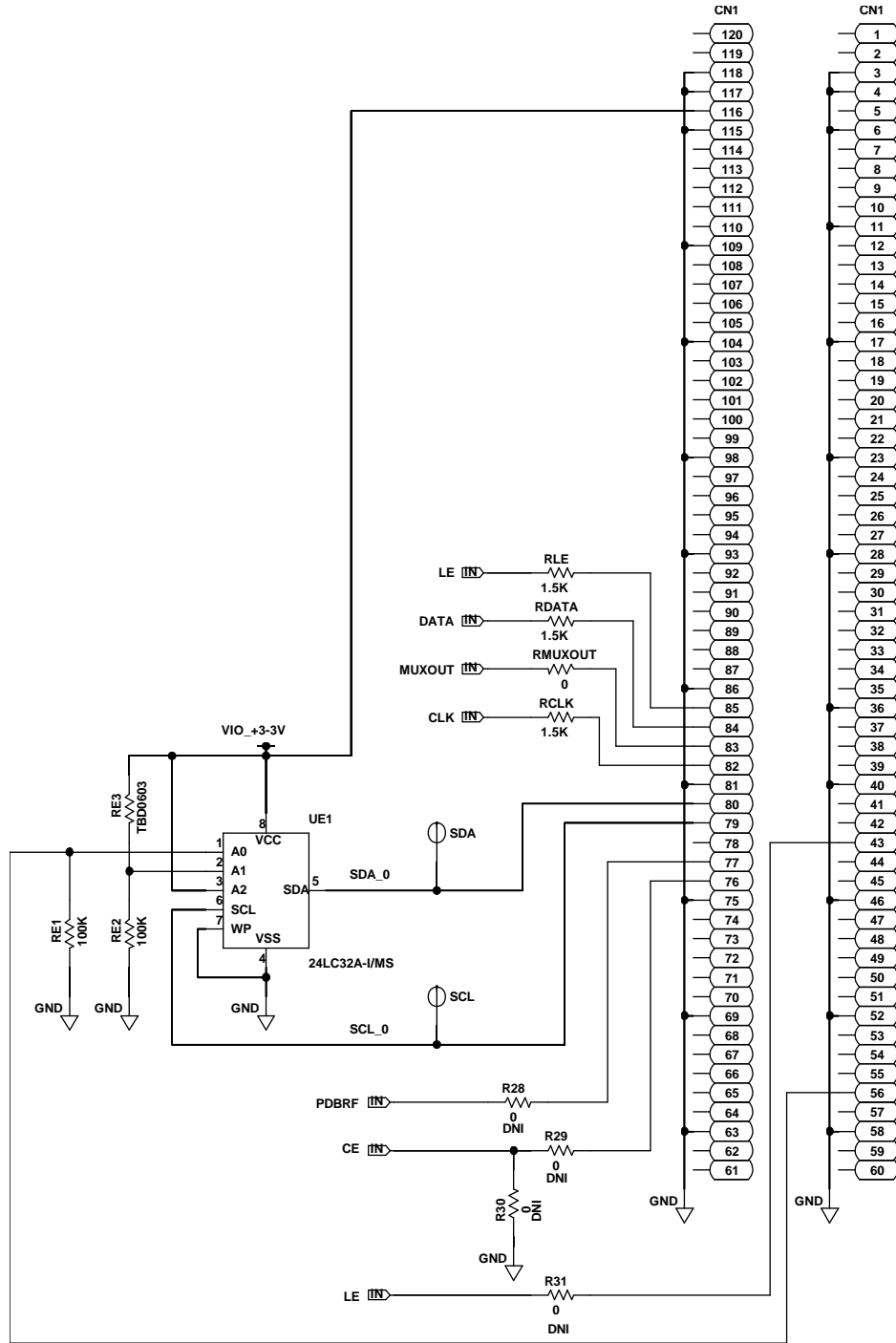


Figure 7. Evaluation Board Schematic—Page 2

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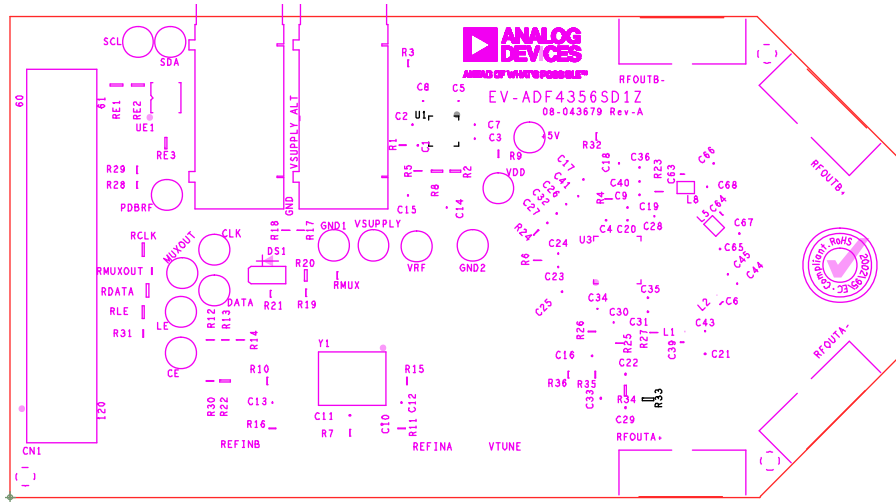


Figure 8. Evaluation Board Silk Screen

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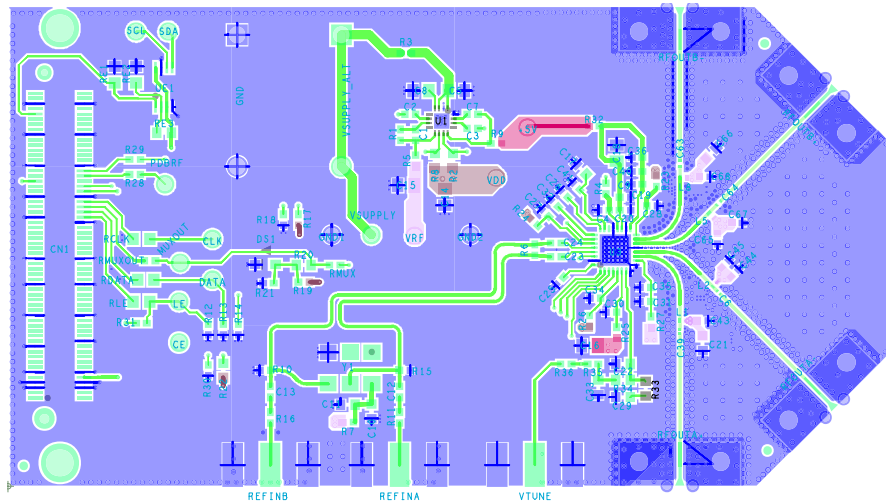


Figure 9. Evaluation Board Layer 1—Primary

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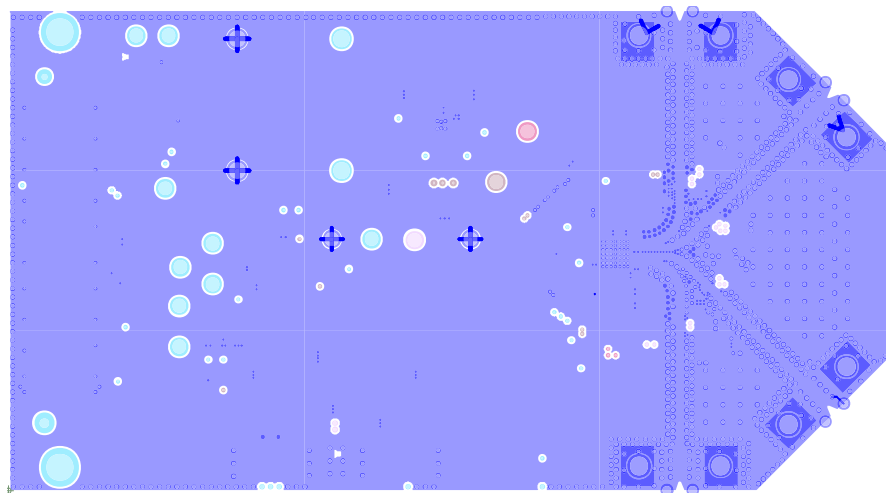
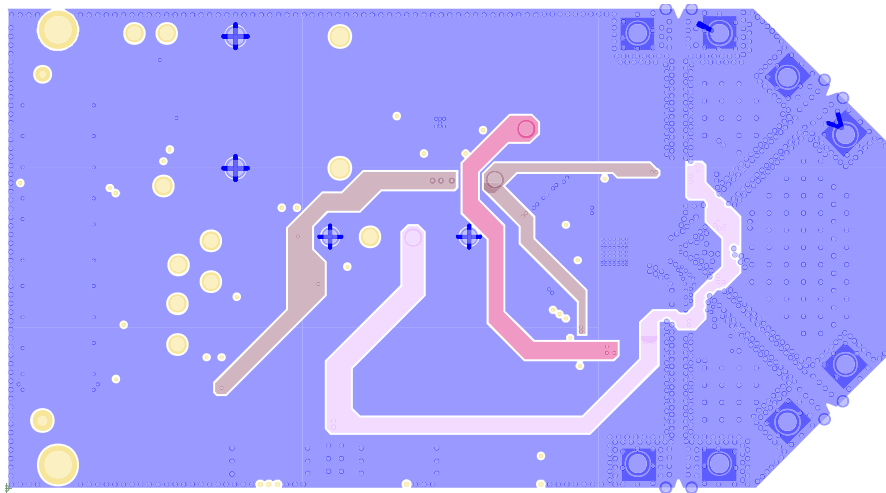


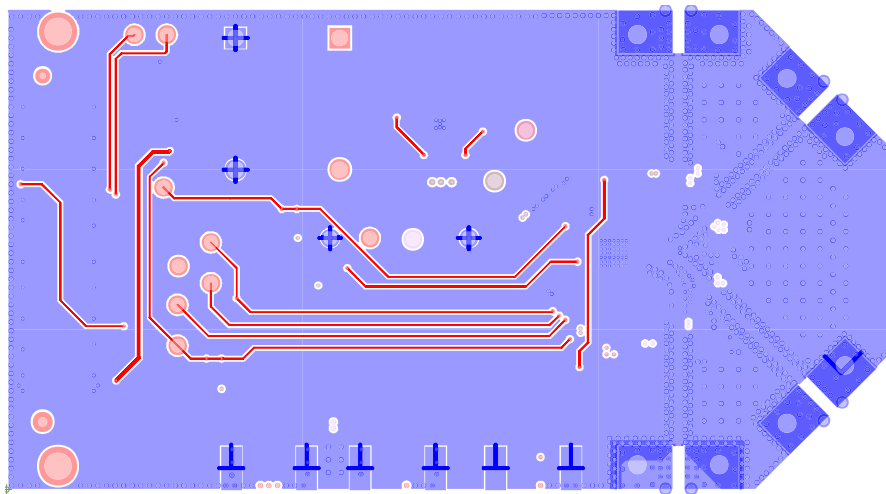
Figure 10. Evaluation Board Layer 2—Ground

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Figure 11. Evaluation Board Layer 3—Power



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Figure 12. Evaluation Board Layer 4—Secondary

## ORDERING INFORMATION

## BILL OF MATERIALS

Table 1.

Reference Designator	Description	Value	Manufacturer	Product No.
C1 to C3, C7, C27, C28, C30 to C32, C34, C45, C67	Ceramic capacitor, X7R	0.1 $\mu$ F	Kemet	C0402C104K4RACTU
C10	Ceramic capacitor, NPO	100 pF	PHYCOMP (Yageo)	2238 867 15101
C11, C21, C66	Ceramic capacitor, X7R	1 $\mu$ F	AVX Corporation	0603YC105KAT2A
C12, C13, C19, C23, C24, C35, C36	Ceramic capacitor, COG (NPO), general-purpose	1000 pF	Murata	GRM1555C1H102JA01
C5, C14 to C16, C18	Ceramic capacitor, multilayer, X5R	10 $\mu$ F	TDK	C2012X5R1E106K085AC
C17	Ceramic capacitor, X5R	10 $\mu$ F	TDK	C1608X5R1A106M080AC
C20, C26, C40, C41	Ceramic capacitor, X5R, general-purpose	0.1 $\mu$ F	Murata	GRM155R61A104KA01D
C22	Ceramic capacitor, NPO	120 pF	PHYCOMP (Yageo)	CC0603JRNPO9BN121
C9, C25	Ceramic capacitor, X5R, general-purpose	1 $\mu$ F	Murata	GRM155R60J105KE19D
C29	Ceramic capacitor, COG (NPO), general-purpose	2700 pF	Murata	GRM188C1H272JA01D
C33	Ceramic capacitor, X7R	22 pF	AVX Corporation	06035C220JAT2A
C6, C39	Ceramic chip capacitor, 10 pF RF	10 pF	AVX Corporation	0201ZK100GBSTR
C43, C44, C65, C68	Ceramic capacitor, COG (NPO), general-purpose	120 pF	Murata	GRM1555C1H121JA01
C63, C64	Ceramic capacitor, X7R, general-purpose	100 pF	Murata	GRM033R71E101KA01D
C8	Ceramic capacitor, multilayer, X7R	4.7 $\mu$ F	Taiyo Yuden	LMK212B7475KG-T
CE, CLK, DATA, GND1, GND2, LE, MUXOUT, PDBRF, SCL, SDA, VSUPPLY	PCB connectors, test point yellow (TP-104-01-04-YE)	N/A <sup>1</sup>	Components Corporation	TP-104-01-04
CN1	PCB connector, board-to-board receptacle, 0.6 mm pitch	N/A <sup>1</sup>	Hirose Electrical	FX8-1205-5V(21)
DS1	LED, SMD (green)	N/A <sup>1</sup>	Broadcom Limited	HSMG-C170
GND	PCB connector, single socket, black	N/A <sup>1</sup>	Deltron	571-0100
L1, L2	Inductor chip	7.4 nH	Coilcraft	0302CS-7N4XJLU
L5, L8	Inductor chip	100 nH	Coilcraft	0402CS-R10XJLU
R1	Precision resistor, thick film chip	75 k $\Omega$	Panasonic	ERJ-2RKF7502X
R3, R4, R7, R11, R16, R23 to R27, R32, R35, RMUX, RMUXOUT	Resistor, thick film chip	0 $\Omega$	MULTICOMP	MC00625W040210R
R12 to R14	Precision resistor, thick film chip	1.8 k $\Omega$	Panasonic	ERJ-2RKF1801X
R17	Precision resistor, thick film chip	10 k $\Omega$	Panasonic	ERJ-2RKF1002X
R2, R8	Resistor, general-purpose film	1 $\Omega$	Yageo	RC0603FR-071RL
R20	Resistor, thick film chip, 0603	500 $\Omega$	Vishay Precision Group	CRCW0603500RFKEA
R22	Resistor, thick film chip, 0603, 1%	1.5 k $\Omega$	MULTICOMP	MC0063W060311K5
R33	Resistor, thick film, SMD, 0603, 1%	2.7 k $\Omega$	MULTICOMP	MC0063W060312K7
R34	Precision resistor, thick film, chip, R0603	10 k $\Omega$	Panasonic	ERJ-3EKF1002V
R5, R9	Resistor, thick film	0.1 $\Omega$	Panasonic	ERJ-2BSFR10X
R6	Resistor, film, SMD, 0402	100 $\Omega$	Venkel	CR0402-16W-1000FPT
R10, R15	Do not install	50 $\Omega$	Vishay Thin Film	FC0402E50R0FST1
RCLK, RDATA, RLE	Precision resistor, thick film, chip	1.5 k $\Omega$	Panasonic	ERJ-6ENF1501V
RE1, RE2	Precision resistor, thick film, chip	100 k $\Omega$	Panasonic	ERJ-6ENF1003V

Reference Designator	Description	Value	Manufacturer	Product No.
RE3	Do not install	N/A <sup>1</sup>	N/A <sup>1</sup>	N/A <sup>1</sup>
REFINA, REFINB	PCB connector, coaxial SMA end launch	N/A <sup>1</sup>	Cinch Connectivity Solutions	142-0701-801
RFOUTA+, RFOUTA-, RFOUTB+, RFOUTB-	PCB connector, SMA RA jack connectors	N/A <sup>1</sup>	Rosenberger Hochfrequenztechnik GMBH & Co.	32K243-4OML5
U1	IC, Analog Devices, quad, low noise, high PSRR, linear voltage regulator	N/A <sup>1</sup>	Analog Devices	HMC1060LP3E
U3	IC, Analog Devices, microwave wideband synthesizer with integrated VCO	N/A <sup>1</sup>	Analog Devices	ADF4356BCPZ
UE1	32 kB serial EEPROM	N/A <sup>1</sup>	Microchip Technology	24LC32A-I/M5
VSUPPLY_ALT	PCB connector, single socket, red	N/A <sup>1</sup>	Deltron	571-0500
Y1	IC crystal LVPECL, LVDS oscillator	122.88 MHz	Vectron International	VCC6-LAB-122M880000

<sup>1</sup> N/A means not applicable.



#### 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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