Evaluating the ADF5355 Frequency Synthesizer for Phase-Locked Loops

FEATURES
Self contained board, including ADF5355 frequency synthesizer with integrated voltage controlled oscillator (VCO), differential 122.88 MHz temperature controlled crystal oscillator (TCXO), loop filter (5 kHz), USB interface, and voltage regulators
Windows-based software allows control of synthesizer functions from a PC
Externally powered by 6 V

EQUIPMENT NEEDED
Windows-based PC with USB port for evaluation software
System demonstration platform, serial only (SDP-S)
EVAL-SDP-CS1Z controller board
Power supply (6 V)
Spectrum analyzer
50 Ω terminators

EVALUATION KIT CONTENTS
EV-ADF5355SD1Z
USB cable

ONLINE RESOURCES
Documents Needed
  ADF5355 data sheet
  EV-ADF5355SD1Z user guide
  PLL Software Installation Guide
Required Software
Analog Devices, Inc., ADF5355 software, Version 0.46.1 or higher (available for download at www.analog.com/ADF5355)

GENERAL DESCRIPTION
The EV-ADF5355SD1Z evaluates the performance of the ADF5355 frequency synthesizer with integrated VCO for phase-locked loops (PLLs). A photograph of the evaluation board is shown in Figure 1. The evaluation board contains the ADF5355 synthesizer with 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.

For easy programming of the synthesizer, download the Windows®-based software from www.analog.com/ADF5355.

This board requires an SDP-S (shown in Figure 1, but not supplied with the kit). The SDP-S allows software programming of the ADF5355 device.

EVALUATION BOARD PHOTOGRAPH

Figure 1. EV-ADF5355SD1Z
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REVISION HISTORY

5/15—Rev. A to Rev. B
   Moved Software Installation Procedures Section and Evaluation
   Board Setup Procedures Section .................................................... 3
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4/15—Rev. 0 to Rev. A
   Change to Figure 2 ........................................................................ 3
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4/15—Revision 0: Initial Version
GETTING STARTED
SOFTWARE INSTALLATION PROCEDURES
See the ADF5355 product page for the EV-ADF5355SD1Z control software. For the software installation procedure, see the PLL Software Installation Guide.

EVALUATION BOARD SETUP PROCEDURES
To run the software,

1. Click the ADF5355 file on the desktop or from the Start menu.
2. On the Select Device and Connection tab, choose ADF5355 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-ADF5355SD1Z requires an SDP-S platform that uses the EVAL-SDP-CS1Z (SDP-B is not recommended).

The EV-ADF5355SD1Z schematics are shown in Figure 7, Figure 8, and Figure 9. The silkscreens for the evaluation board are shown in Figure 10 and Figure 11.

POWER SUPPLIES

The board is powered by a 6 V power supply connected to the red and black banana connectors. Connect the red connector to a 6 V power supply and the black connector to ground.

The power supply circuitry allows the user two or three separate low dropout (LDO) regulators to feed the ADF5355 (using fewer LDO regulators increases the risk of spur contaminated dc feeds).

The charge pump and VCO supply pins are powered from a 5 V ADM7150 high performance, low noise regulator. The remaining supplies are powered from a 3.3 V ADM7150 high performance, low noise regulator.

LED1 indicates when the ADF5355 is powered on. Use Switch S1 to switch the 6 V power to the board on and off.

RF OUTPUT

The EV-ADF5355SD1Z has one pair of SMA output connectors: RFOUTA+ and RFOUTA− (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 Ω terminator).

SMA RFOUTB is a single-ended RF output that operates from 6.8 GHz to 13.6 GHz. If only RFOUTB is used, power off RFOUTA+ and RFOUTA−. If left on, terminate both RFOUTA+ and RFOUTA− SMA connectors with 50 Ω terminators.

LOOP FILTER

The loop filter schematic is included in the board schematic in Figure 7. Figure 3 shows the loop filter component placements. For lowest noise at 100 kHz offset, use the following components (that are inserted on the evaluation board) with a 0.9 mA charge pump current:

- C60 = 22 nF, C59 = 0.47 μF, C61 = 10 nF, C73 = 10 pF
- R14 = 220 Ω, R1 = 470 Ω

For lowest rms phase noise, use the following components with 0.9 mA charge pump current:

- C60 = 1.2 nF, C59 = 33 nF, C61 = 390 pF, C73 = 10 pF
- R14 = 1 kΩ, R17 = 3.3 kΩ

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 the REFINA/REFINB SMA connectors. When using an external reference, remove R12 to disconnect the power rail from the TCXO.

To use a single-ended REFINx, connect a low noise 122.88 MHz reference source to SMA REFINB, and connect a 50 Ω terminator to SMA REFINA. Remove Resistor R27 (100 Ω). To use a differential REFINx, connect the differential signal to SMA REFINA and SMA REFINB. The differential REFINA/REFINB SMA connectors can operate to a 500 MHz input frequency.

In the schematic shown in Figure 7, the REFINA pin of U1 (ADF5355) is connected to SMA REFINB, and the REFINB pin of U1 (ADF5355) is connected to SMA REFINA. This schematic matches the evaluation board connections.

DEFAULT CONFIGURATION

All components necessary for local oscillator generation are inserted on the board. This board is shipped with the ADF5355 synthesizer with an integrated VCO, a differential 122.88 MHz reference TCXO, and a 5 kHz loop filter (I<sub>CP</sub> = 0.9 mA).
EVALUATION BOARD SETUP

Figure 4. Evaluation Setup Block Diagram
EVALUATION BOARD SOFTWARE

MAIN CONTROLS

The Main Controls tab (see Figure 5) selects the RF and user configurable register settings. Consult the register descriptions in the ADF5355 data sheet for details. Default settings are recommended for most registers.

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

Ensure that Reference freq 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 Register 4, program CP current to match the value used for the loop filter design.

![Figure 5. Software Front Panel Display—Main Controls](image-url)
EVALUATION AND TEST

To evaluate and test the performance of the ADF5355, use the following procedure:

1. Install the ADF5355 software (see the PLL Software Installation Guide).
2. Follow the hardware driver installation procedure (Windows XP only).
3. Connect a 50 Ω terminator to RFOUTA−.
4. Connect the EV-ADF5355SD1Z board to the SDP-S board.
5. Connect the 6 V power supply to the banana connectors and power up the board using S1 (check that LED1 is on).
6. Connect the USB cable from the SDP-S board to the PC.
7. Run the ADF5355 software.
8. Select ADF5355 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 6800 MHz and then click Write All Registers.
10. Connect the spectrum analyzer to SMA Connector RFOUTA+. See Figure 4 for a typical evaluation setup.
11. Measure the output spectrum and single sideband phase noise.

Figure 6 shows a phase noise plot of the SMA RFOUTA+ equal to 6.8 GHz.
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 Silkscreen—Top Side
Figure 11. Evaluation Board Silkscreen—Reverse Side
Figure 12. Evaluation Board Layer 1—Primary
Figure 13. Evaluation Board Layer 2—Ground
Figure 15. Evaluation Board Layer 4—Secondary
### ORDERING INFORMATION

#### BILL OF MATERIALS

<table>
<thead>
<tr>
<th>Reference Designator</th>
<th>Description</th>
<th>Value</th>
<th>Manufacturer</th>
<th>Part Number</th>
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<td>C1, C2, C7, C8, C10, C11, C16, C20, C22</td>
<td>Ceramic multilayer capacitor, X5R</td>
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1 TBD means no value assigned; component not inserted.
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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