

## Interfacing the **ADL5534** Dual IF Gain Block to the **AD9640** High Speed ADC

### CIRCUIT FUNCTION AND BENEFITS

This circuit uses the **ADL5534** IF amplifier to provide a dual IF gain block for the **AD9640** 14-bit, 150 MSPS dual ADC. The **ADL5534** is a high linearity, dual fixed, 20 dB gain amplifier that can be adapted for use as a driver for a high performance IF sampling ADC. The **ADL5534** provides a simple approach to interfacing the RFIN signal level of 200 mV p-p to the 2 V p-p full scale of the high speed ADC. The low noise (2.5 dB NF at 70 MHz) and low distortion (IP3 of 40 dBm at 70 MHz) of the **ADL5534** ensure that the ADC performance is not compromised.

### CIRCUIT DESCRIPTION

**Table 1. Devices Connected/Referenced**

Product	Description
<b>ADL5534</b>	20 MHz to 500 MHz dual IF amplifier
<b>AD9640</b>	14-bit, 80/105/125/150 MSPS, dual ADC

Figure 1 shows an application circuit where the **ADL5534** drives the **AD9640**, a 150 MSPS, 14-bit ADC. The two 49.9 Ω resistors connected to the **AD9640** CML output establish the 0.9 V dc bias for the **AD9640** inputs and set the **AD9640** differential input impedance to 100 Ω.

When operated as a quasi-differential amplifier, the **ADL5534**'s two amplifiers present 100 Ω differential input and output impedances. The input signal from a 50 Ω RF source is converted to a differential signal with a 1:2 impedance ratio flux-coupled transformer. This matches the 50 Ω source to the 100 Ω differential load of the **ADL5534**. Between the **ADL5534** output and the **AD9640** input, a third-order low-pass filter presenting a 100 Ω differential impedance to the source and load is implemented.

Due to the different common mode voltage levels required by the **ADL5534** and the **AD9640**, the **ADL5534** must be ac-coupled to the **AD9640**. Capacitors of 100 pF were chosen to reduce any low frequency noise coming from the **ADL5534** and to provide dc blocking.

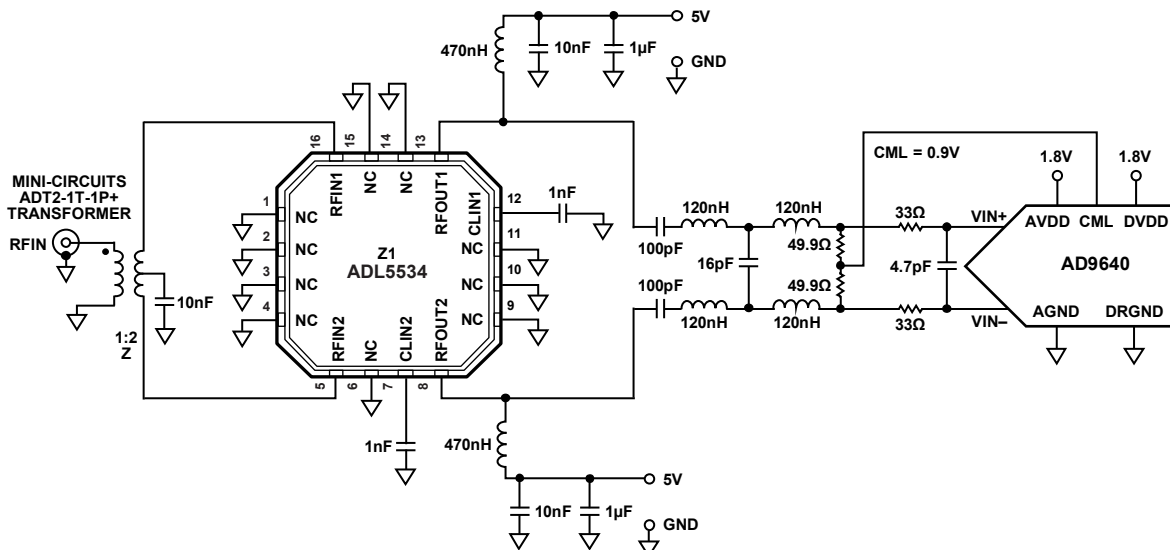


Figure 1. Interface Between the **ADL5534** and **AD9640** with 49.9 Ω Resistors to CML to Establish the 0.9 V DC Bias for the **AD9640** Inputs and Set the **AD9640** Differential Impedance to 100 Ω (Simplified Schematic: Decoupling and All Connections Not Shown)

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The measured results for this filter show 0.5 dB insertion loss for a 20 MHz bandwidth centered around 92 MHz. Figure 2 shows the measured wideband response for the filter.

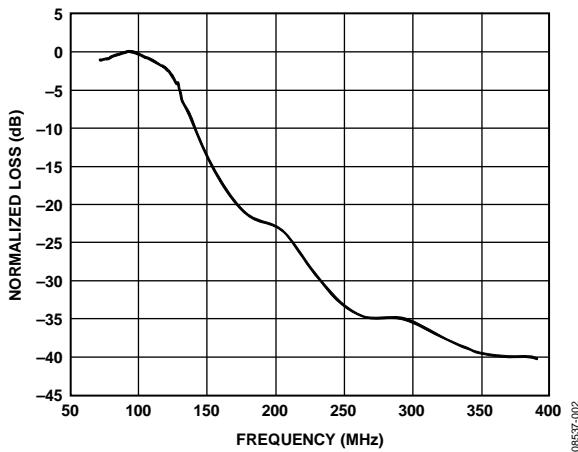


Figure 2. Measured Frequency Response of the LC Filter

The single-tone FFT results shown in Figure 3 for an input signal of approximately 93 MHz show an SNR of 69.3 dB and an SFDR of 82 dBc. Note that because of aliasing, the fundamental frequency in the FFT is at 122.8 MHz – 93 MHz = 31.8 MHz.

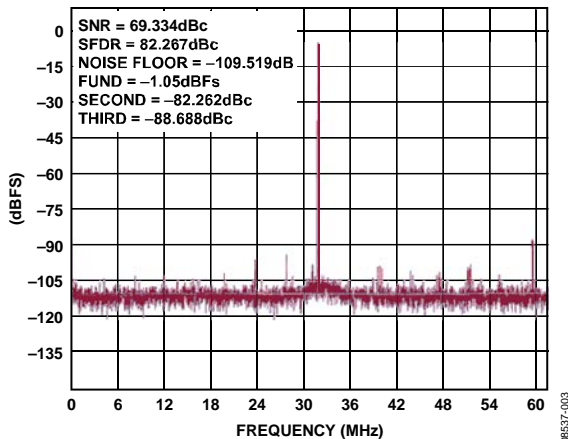


Figure 3. Measured Single-Tone Performance for An Input Frequency of 93 MHz, Sample Rate of 122.8 MSPS

The two-tone results for tones at 91 MHz and 93 MHz are shown in Figure 4 and yield an IMD3 of –80.5 dBc and SFDR of 78 dBc. The AD9640 was clocked at a sample rate of 122.8 MSPS for both single and two-tone tests.

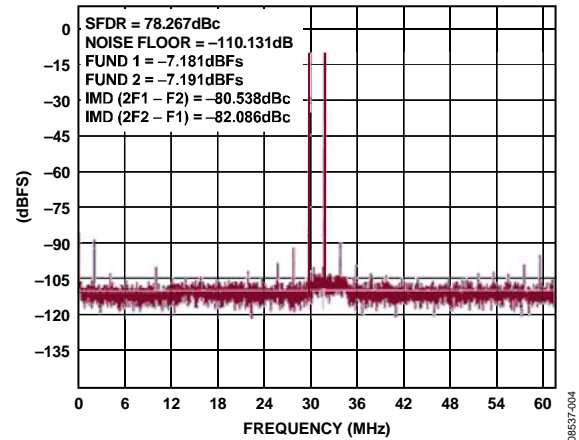


Figure 4. Measured Two-Tone Performance for Input Tones at 93 MHz and 92 MHz, Sample Rate of 122.8 MSPS

## COMMON VARIATIONS

This application circuit can be modified for any IF frequency within the operating range of the ADL5534 and AD9640. As an alternative to the ADL5534, the AD8375, a digitally programmable differential variable gain amplifier, can be used.

Alternatively, the AD8352, a resistor programmable differential amplifier, can be used to convert from single ended to differential without the requirement of an external balun. The AD8352, AD8375, and AD8376 (dual version of the AD8375) are all true differential amplifiers that provide rejection of common-mode signals at their input.

The circuit must be constructed on a multilayer PC board with a large area ground plane. Proper layout, grounding, and decoupling techniques must be used to achieve optimum performance (see MT-031 Tutorial, MT-101 Tutorial, the ADL5534 evaluation board layout, and the AD9640 evaluation board layout). Both the ADL5534 and the AD9640 have exposed thermal pads that should be soldered directly to the low impedance ground plane.

## LEARN MORE

AN-742 Application Note, *Frequency Domain Response of Switched Capacitor ADCs*. Analog Devices.

AN-827 Application Note, *A Resonant Approach to Interfacing Amplifiers to Switched-Capacitor ADCs*. Analog Devices.

Kester, Walt. 2006. *High Speed System Applications*. Analog Devices. Chapter 2, “Optimizing Data Converter Interfaces.”

MT-031 Tutorial, *Grounding Data Converters and Solving the Mystery of “AGND” and “DGND.”* Analog Devices.

MT-073 Tutorial, *High Speed Variable Gain Amplifiers*. Analog Devices.

MT-101 Tutorial, *Decoupling Techniques*. Analog Devices.

**Data Sheets and Evaluation Boards**

- [ADL5534 Data Sheet](#)
- [ADL5534 Evaluation Board](#)
- [AD9640 Data Sheet](#)
- [AD9640 Evaluation Board](#)
- [AD8352 Data Sheet](#)
- [AD8375 Data Sheet](#)

**REVISION HISTORY**

**4/13—Rev. A to Rev. B**  
 Changed Document Title from CN-0049 to AN-1234 ..... Universal

**2/10—Rev. 0 to Rev. A**  
 Updated Format ..... Universal  
 Changes to Circuit Function and Benefits..... 1  
 Changes to Circuit Description..... 1  
 Changes to Common Variations..... 2

**8/08—Revision 0: Initial Version**