

## Evaluating TxVGAs for Use with RF DACs and Transceivers

### FEATURES

Full featured evaluation board for the or [ADL6316](#)  
SPI control via [SDP-S](#) board  
5.0 V single-supply operation

### EVALUATION KIT CONTENTS

[ADL6316-EVALZ](#) evaluation board

### ADDITIONAL HARDWARE REQUIRED

Analog signal generator  
Analog signal analyzer  
Power supplies (6 V, 5 A)  
PC with Windows® XP, Windows 7, or Windows 10 operating system  
USB 2.0 port, recommended (USB 1.1-compatible)  
[EVAL-SDP-CS1Z \(SDP-S\)](#) controller board  
ADDITIONAL SOFTWARE REQUIRED  
[Analysis | Control | Evaluation \(ACE\)](#) software

### GENERAL DESCRIPTION

The [ADL6316](#) transmit variable gain amplifier (TxVGA) provides an interface for radio frequency (RF) digital-to-analog converters (DACs), transceivers, and systems on a chip (SoC) to power amplifiers (PAs). Integrated balun and hybrid couplers allow high performance RF capability over a frequency range of 0.5 GHz to 1.0 GHz.

To optimize performance vs. power level, the [ADL6316](#) includes a voltage variable attenuator (VVA), high linearity amplifiers, and a digital step attenuator (DSA). The devices integrated into the [ADL6316](#) are programmable via a 4-wire serial port interface (SPI).

This user guide describes the evaluation board and software for the [ADL6316](#). For full details, see the [ADL6316](#) data sheet, which must be consulted when using the evaluation board. The [ADL6316-EVALZ](#) evaluation board is fabricated with FR-370HR, Rogers 4350B in four layers.

### EVALUATION BOARD PHOTOGRAPH

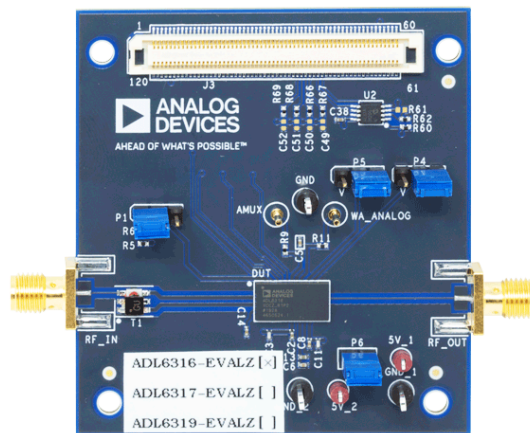


Figure 1. ADL6316-EVALZ

**TABLE OF CONTENTS**

Features .....	1	RF Input.....	3
Evaluation Kit Contents.....	1	RF Outputs .....	3
Additional Hardware Required .....	1	Signal Path Modes Selection.....	3
Additional Software Required .....	1	Evaluation Board Software.....	4
General Description .....	1	Software Requirements and Installation .....	4
Evaluation Board Photograph.....	1	Installing ADL6316 ACE Plugins .....	4
Revision History .....	2	ACE Software Suite .....	4
Evaluation Board Hardware.....	3	Configuration and Programming Sequence.....	5
Power Supply.....	3	Evaluation Board Schematic .....	7

**REVISION HISTORY**

10/2019—Revision 0: Initial Version

## EVALUATION BOARD HARDWARE

The ADL6316-EVALZ evaluation board provides the support circuitry required to operate the ADL6316 in various modes and configurations. Figure 2 shows the typical bench setup to evaluate the performance of the ADL6316.

### POWER SUPPLY

The ADL6316-EVALZ evaluation board requires a single, 5.0 V power supply.

### RF INPUT

The on-board balun enables single-ended driving. The ADL6316 operates the 0.5 GHz to 1.0 GHz frequency range.

### RF OUTPUTS

The RF outputs are available on the evaluation board at the RF\_OUT SMA connectors, which can drive a load of 50 Ω.

### SIGNAL PATH MODES SELECTION

The ADL6316 has two signal path modes. This feature allows two predefined modes of operation to be controlled by the logic level on TXEN, a real-time external pin (Pin 37), without SPI latency. Table 1 shows the hardware configuration to select the desired mode.

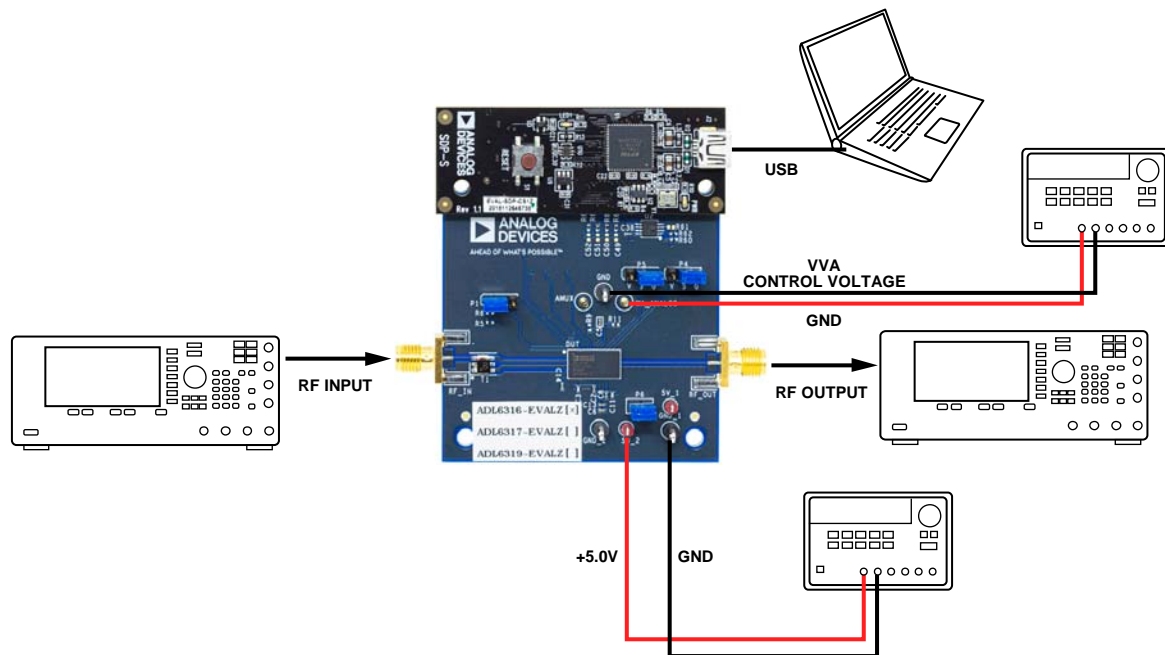


Figure 2. ADL6316 Typical Measurement Setup

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Table 1. Mode Selection and Setup Registers

TXEN (Pin 37) Logic Level	Register	Functional Blocks	Description
0	0x0102	DSA attenuation	0 dB to ~14 dB range, 0.45 dB step
	0x0107	AMP1	Amplifier 1 optimization
	0x0108	AMP1	Amplifier 1 enable
	0x0109	AMP2	Amplifier 2 optimization
	0x010A	AMP2	Amplifier 2 enable
1	0x0112	DSA attenuation	0 dB to ~14 dB range, 0.45 dB step
	0x0117	AMP1	Amplifier 1 optimization
	0x0118	AMP1	Amplifier 1 enable
	0x011A	AMP2	Amplifier 2 enable

## EVALUATION BOARD SOFTWARE

The **ADL6316** on the ADL6316-EVALZ evaluation board and the **SDP-S** controller board are configured with a USB friendly interface to allow programmability of the **ADL6316** registers.

### SOFTWARE REQUIREMENTS AND INSTALLATION

The **Analysis | Control | Evaluation (ACE)** software is required to program and control the **ADL6316** and the ADL6316-EVALZ evaluation board.

The ACE software suite allows bit control of the **ADL6316** register map via the SPI, and communicates to the **SDP-S** controller board via the USB connection. The **SDP-S** controller board configures the SPI lines (CS, SDI, SDO, and SCLK) accordingly to communicate to the **ADL6316**.

#### Installing the ACE Software Suite

To install the **ACE** software suite, take the following steps:

1. Download the software from the **ACE** product page.
2. Open the downloaded file to begin the installation process. The default installation path is **C:\Program Files (x86)\Analog Devices\ACE**.
3. If desired, the user can create a desktop icon for the **ACE** software. Otherwise, the **ACE** executable can be found by clicking **Start > Analog Devices > ACE**.

### INSTALLING ADL6316 ACE PLUGINS

When the **ACE** software installations are complete, the user must install the evaluation board plugins to the hard drive of the PC.

1. Download the **ADL6316 ACE** plugins (**Board.ADL631x.1.2019.34200.acezip**) from the ADL6316-EVALZ product page.
2. Double-click the **Board.ADL631x.1.2019.34200.acezip** file to install the evaluation board plugins.
3. Ensure that the **Board.ADL631x.1.2019.34200** and **Chip.ADL631x.1.2019.34200** folders are located inside the **C:\ProgramData\Analog Devices\ACE\Plugins** folder.

### ACE SOFTWARE SUITE

Power up the ADL6316-EVALZ evaluation board and connect the USB cable to the PC and to the **SDP-S** board mounted on the ADL6316-EVALZ evaluation board.

1. Double-click the **ACE** shortcut on the PC desktop of the computer (if created). The software automatically detects the ADL6316-EVALZ evaluation board. The software opens the **ACE** plugin view, as shown in Figure 3

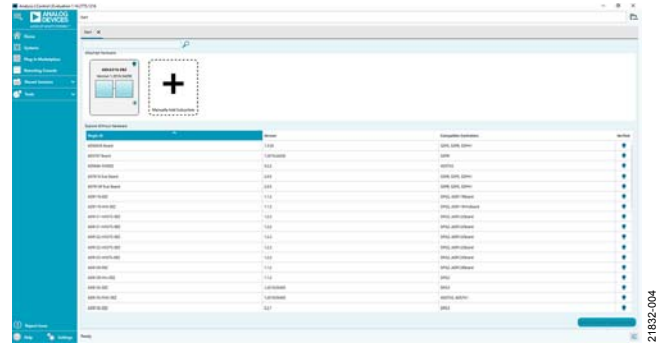


Figure 3. ACE Plugin View

2. Double-click the **ADL6316-EBZ** board icon, as shown in Figure 4.

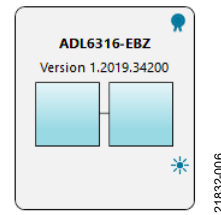


Figure 4. ADL6316-EBZ Board Icon

3. The software opens the **ACE** chip view as shown in Figure 5.

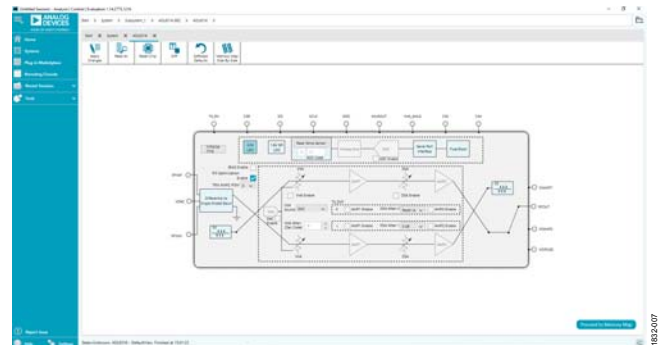


Figure 5. ACE Chip View

**CONFIGURATION AND PROGRAMMING SEQUENCE**

To configure and program the evaluation board, take the following steps:

1. Run the [ACE](#) software as explained in the **Error! Reference source not found.** section.
2. Click **Initialize Chip** (Label A, see Figure 6).
3. Click and adjust the block (Label B to Label H in Figure 6) if necessary.

4. After changing the block in the [ACE](#) software as directed in Step 3, click **Apply Changes** (Label K, see Figure 7) to update the [ADL6316](#).
5. To adjust an individual register and bit, click **Proceed to Memory Map**. This button opens the [ADL6316](#) memory map for bit control (see Figure 8). The [ADL6316](#) can be configured by either putting data into **Data(Hex)** column (Label L, see Figure 8) or by clicking a specific bit in the **Data(Binary)** column (Label M, see Figure 8) of the register map (see Figure 8). Click **Apply Changes** (Label N, see Figure 8) to save changes and program the [ADL6316](#).

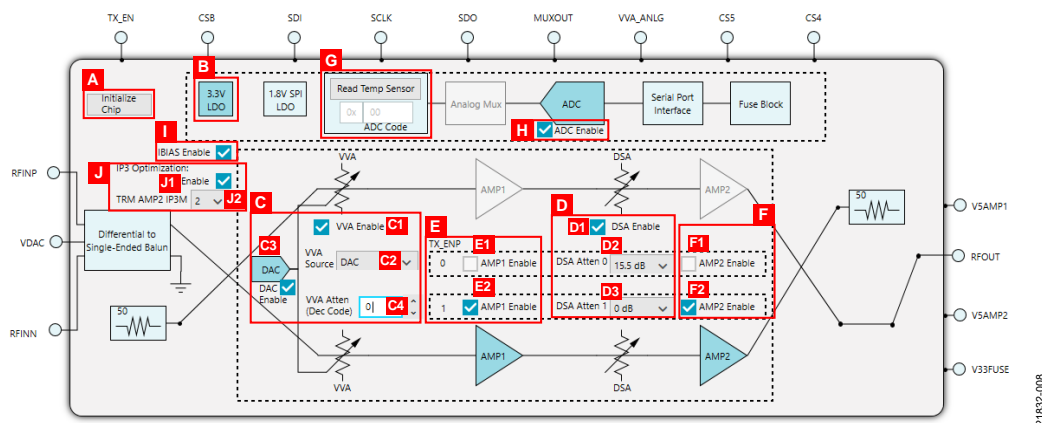


Figure 6. ADL6316 Chip Block Diagram

Table 2. Main Screen Functionality (see Figure 6)

Label	Function
A	Initialize chip button.
B	3.3 V low dropout regulator (LDO) enable.
C	VVA control block.
C1	<b>VVA Enable</b> checkbox.
C2	Selects VVA voltage source: DAC = VVA attenuation set by internal 12-bit DAC, set DAC code (0 to ~4095 range) in <b>VVA Atten (Dec Code)</b> field. VVA_ANALOG = VVA attenuation set by analog voltage applied on ANLG pin.
C3	<b>DAC Enable</b> checkbox for VVA attenuation when the <b>VVA Source</b> field is set to <b>DAC</b> .
C4	<b>VVA Atten (Dec Code)</b> menu. Selects VVA DAC code in decimal (0 to ~4095 range). Higher numbers equal less attenuation.
D	DSA control block, <b>DSA Atten 0</b> and <b>DSA Atten 1</b> are selected by the logic level on TXEN (see Table 1).
D1	<b>DSA Enable</b> checkbox.
D2	Set <b>DSA Atten 0</b> attenuation.
D3	Set <b>DSA Atten 1</b> attenuation.
E	<b>AMP1 Enable</b> checkbox. AMP1 can be set individually by the logic level on TXEN (see Table 1).
F	<b>AMP2 Enable</b> checkbox. AMP2 can be set individually by the logic level on TXEN (see Table 1).
G	<b>Read Temp Sensor</b> button and <b>ADC Code</b> text fields. These functions are for proportional to absolute temperature (PTAT) ADC code readback.
H	<b>ADC Enable</b> checkbox.
I	<b>IBIAS Enable</b> checkbox. This function enables the bias generator.
J	<b>IP3 Optimization</b> control block.
J1	<b>Enable</b> checkbox for IP3 optimization.
J2	<b>TRM AMP2 IP3M</b> dropdown menu. Set TRM_AMP2_IP3 bits value for IP3 optimization.

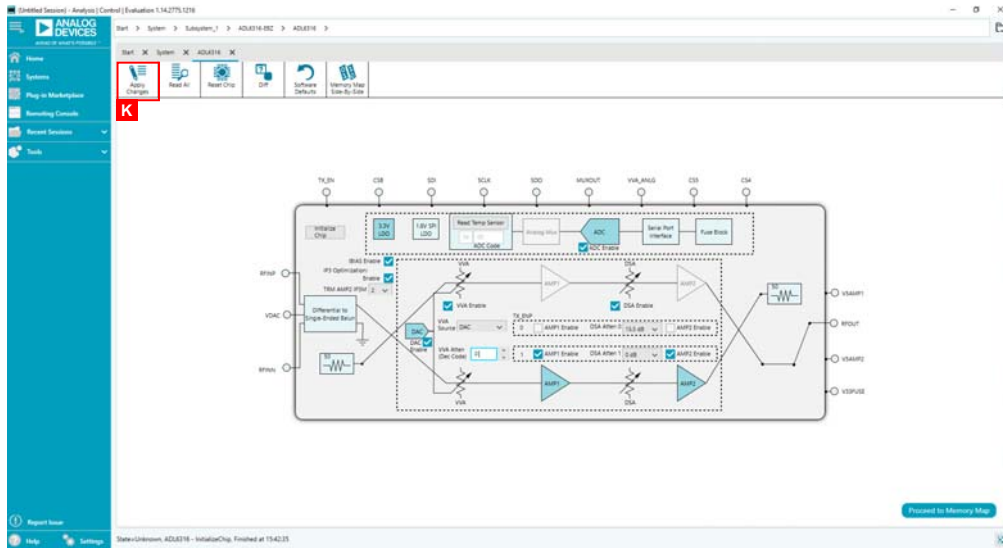


Figure 7. ADL6316-EVALZ ACE Chip View After Chip Initialization

21832-309

Address (Hex)	Name	Data (Hex)	Data (Binary)
00000102	7 SNAKE_0012	...	...
00000103	7 SNAKE_0013	...	...
00000100	SNAKE_CTRL_0	...	...
00000101	SNAKE_CTRL_1	...	...
00000102	SNAKE_CTRL_2	...	...
00000103	SNAKE_CTRL_3	...	...
00000104	SNAKE_CTRL_4	...	...
00000105	SNAKE_CTRL_5	...	...
00000106	SNAKE_CTRL_6	...	...
00000107	SNAKE_CTRL_7	...	...
00000108	SNAKE_CTRL_8	...	...
00000109	SNAKE_CTRL_9	...	...
0000010A	SNAKE_CTRL_10	...	...
0000010B	SNAKE_CTRL_11	...	...
0000010C	SNAKE_CTRL_12	...	...
0000010D	SNAKE_CTRL_13	...	...
0000010E	SNAKE_CTRL_14	...	...
0000010F	SNAKE_CTRL_15	...	...
00000110	SNAKE_CTRL_16	...	...
00000111	SNAKE_CTRL_17	...	...
00000112	SNAKE_CTRL_18	...	...
00000113	SNAKE_CTRL_19	...	...
00000114	SNAKE_CTRL_20	...	...
00000115	SNAKE_CTRL_21	...	...
00000116	SNAKE_CTRL_22	...	...
00000117	SNAKE_CTRL_23	...	...
00000118	SNAKE_CTRL_24	...	...
00000119	SNAKE_CTRL_25	...	...
0000011A	SNAKE_CTRL_26	...	...
0000011B	SNAKE_CTRL_27	...	...
0000011C	SNAKE_CTRL_28	...	...
0000011D	SNAKE_CTRL_29	...	...
0000011E	SNAKE_CTRL_30	...	...
0000011F	SNAKE_CTRL_31	...	...

Figure 8. ADL6316-EVALZ ACE Memory Map View

21832-011

# EVALUATION BOARD SCHEMATIC

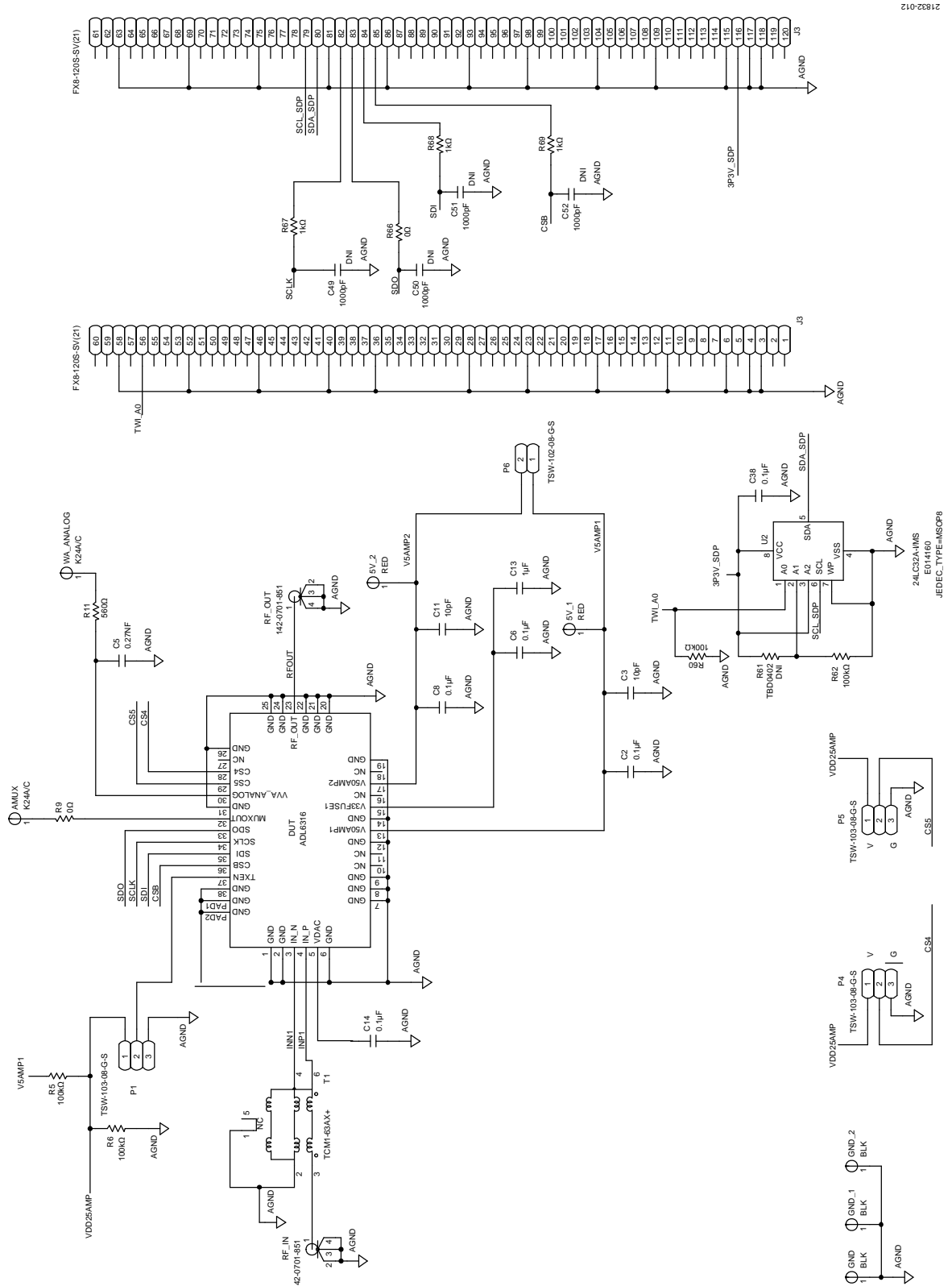


Figure 9. ADL6316-EVALZ Evaluation Board Schematic

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JEDEC\_TYPE=MSCP8  
E014160  
24LC32A-I/M5

## 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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