

## 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

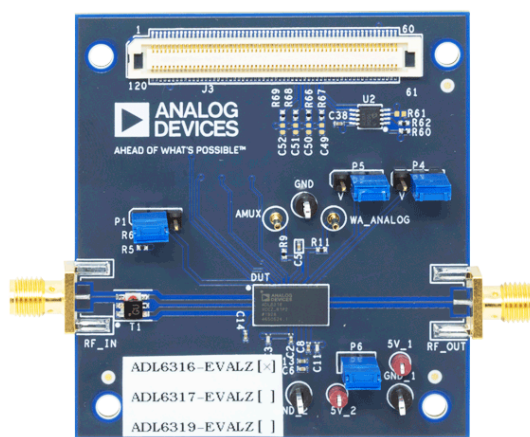


Figure 1. ADL6316-EVALZ

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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  $\Omega$ .

### 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.

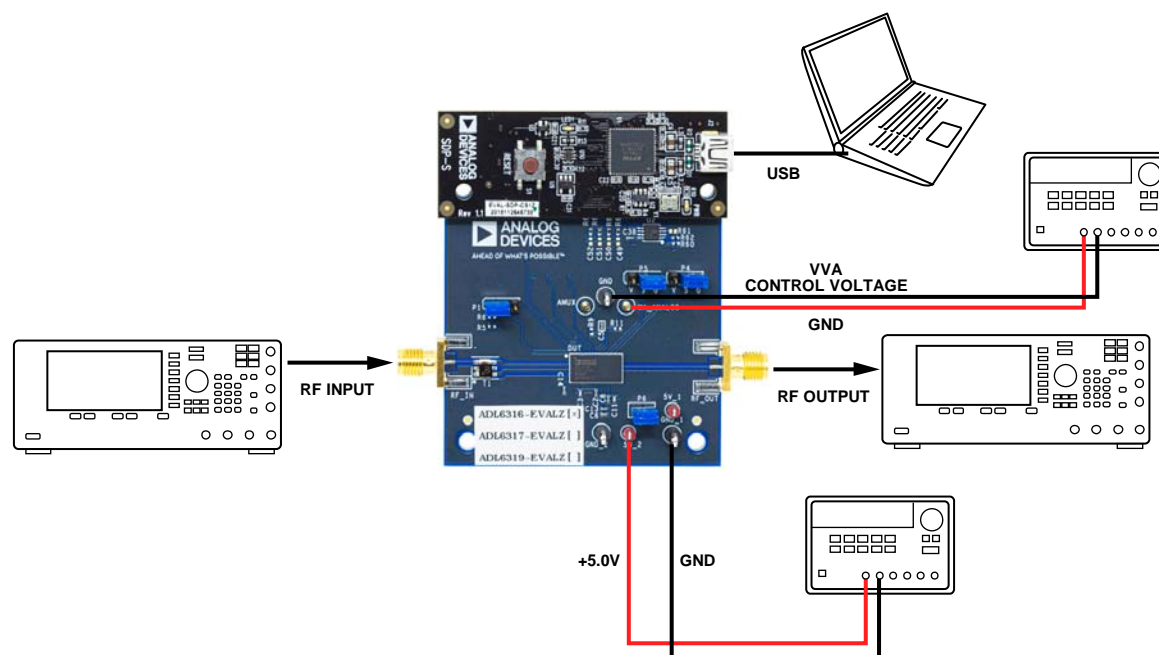


Figure 2. [ADL6316](#) Typical Measurement Setup

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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

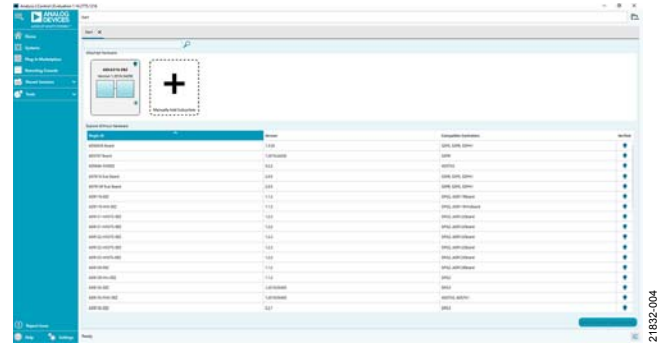


Figure 3. ACE Plugin View

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

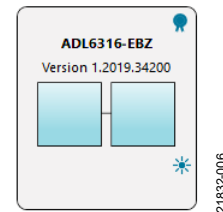


Figure 4. ADL6316-EBZ Board Icon

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

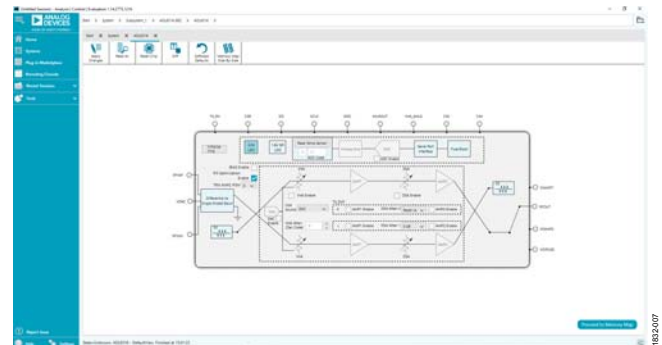


Figure 5. ACE Chip View

## 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](#).

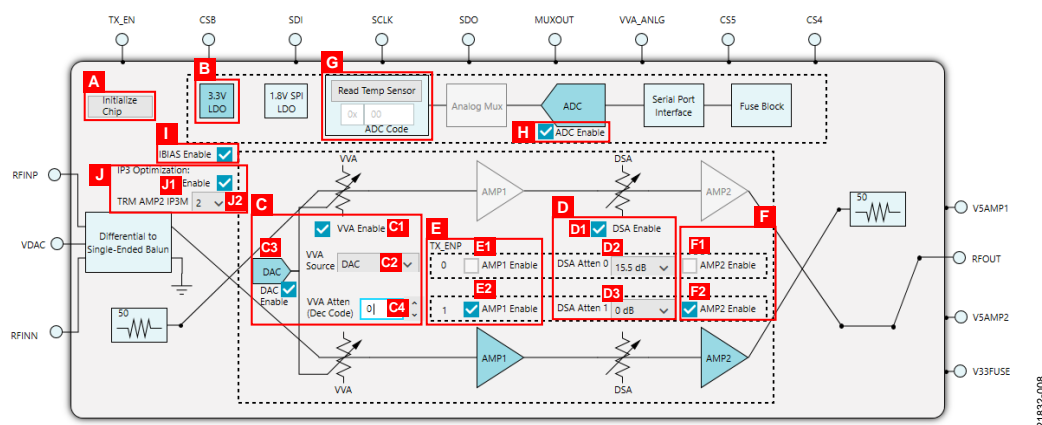


Figure 6. [ADL6316](#) Chip Block Diagram

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.

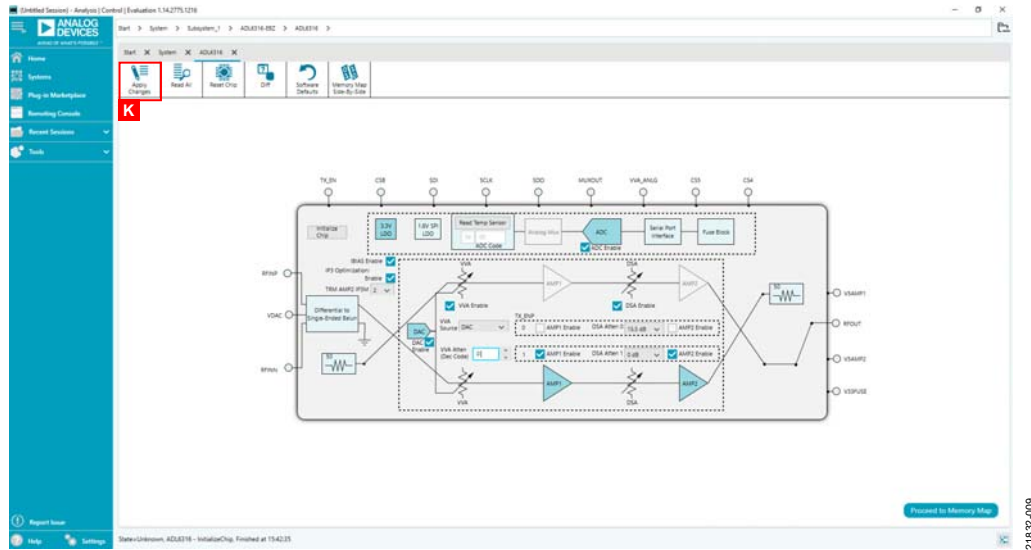


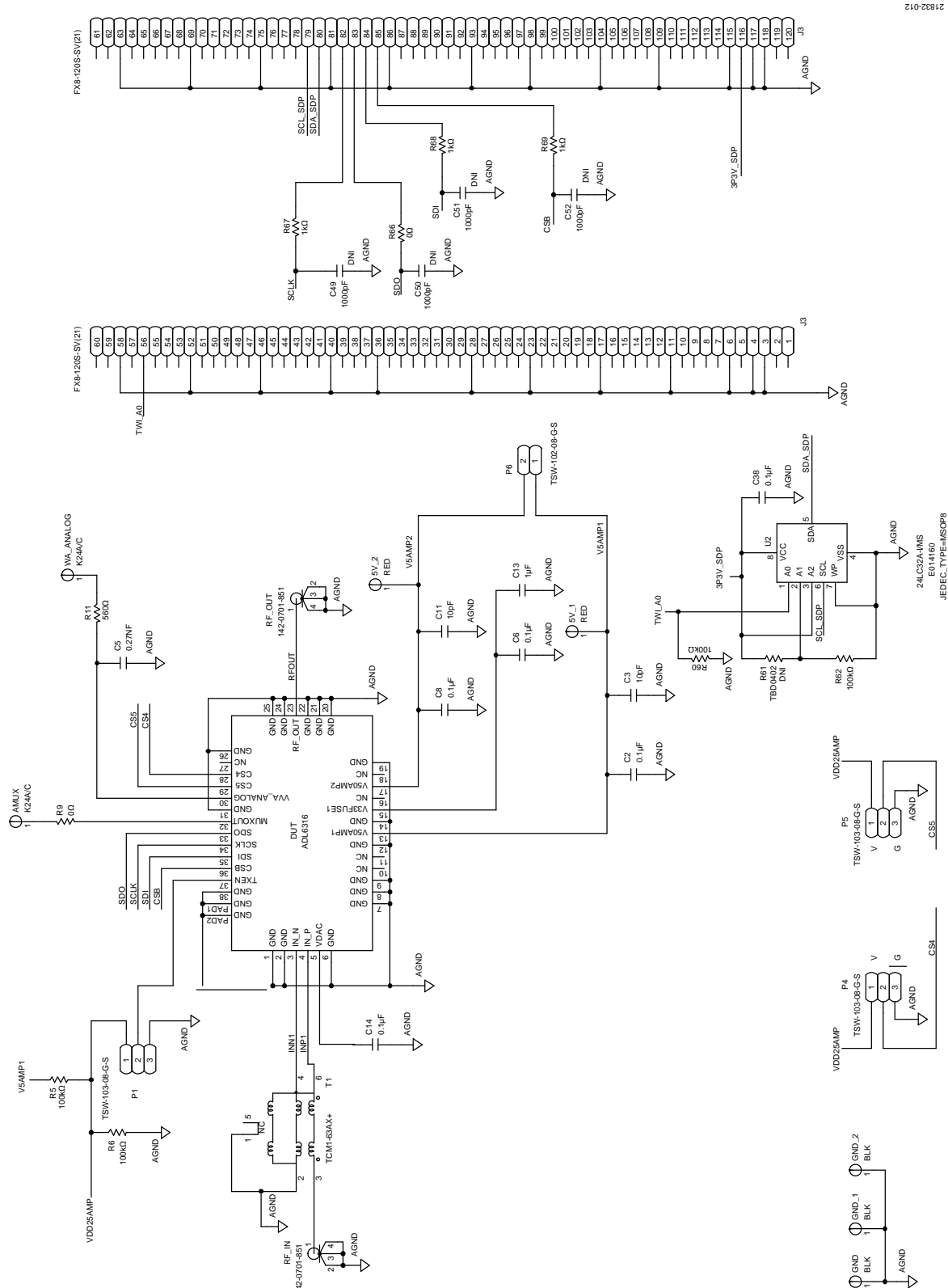
Figure 7. ADL6316-EVALZ ACE Chip View After Chip Initialization

Figure 8 shows the ADL6316-EVALZ ACE Memory Map View. The screenshot displays the memory map of the chip, listing various registers and their addresses. The right pane shows the data values for these registers. A red box highlights the 'BASEBAND\_CONFIG\_0' register at address 0x00000000, which contains the value 0x00000000.

Address (Hex)	Name	Data (Hex)	Data (Binary)
0x00000000	BASEBAND_CONFIG_0	0x00000000	00000000000000000000000000000000
0x00000001	BASEBAND_CONFIG_1	0x00000000	00000000000000000000000000000000
0x00000002	BASEBAND_CONFIG_2	0x00000000	00000000000000000000000000000000
0x00000003	BASEBAND_CONFIG_3	0x00000000	00000000000000000000000000000000
0x00000004	BASEBAND_CONFIG_4	0x00000000	00000000000000000000000000000000
0x00000005	BASEBAND_CONFIG_5	0x00000000	00000000000000000000000000000000
0x00000006	BASEBAND_CONFIG_6	0x00000000	00000000000000000000000000000000
0x00000007	BASEBAND_CONFIG_7	0x00000000	00000000000000000000000000000000
0x00000008	BASEBAND_CONFIG_8	0x00000000	00000000000000000000000000000000
0x00000009	BASEBAND_CONFIG_9	0x00000000	00000000000000000000000000000000
0x0000000A	BASEBAND_CONFIG_10	0x00000000	00000000000000000000000000000000
0x0000000B	BASEBAND_CONFIG_11	0x00000000	00000000000000000000000000000000
0x0000000C	BASEBAND_CONFIG_12	0x00000000	00000000000000000000000000000000
0x0000000D	BASEBAND_CONFIG_13	0x00000000	00000000000000000000000000000000
0x0000000E	BASEBAND_CONFIG_14	0x00000000	00000000000000000000000000000000
0x0000000F	BASEBAND_CONFIG_15	0x00000000	00000000000000000000000000000000
0x00000010	BASEBAND_CONFIG_16	0x00000000	00000000000000000000000000000000
0x00000011	BASEBAND_CONFIG_17	0x00000000	00000000000000000000000000000000
0x00000012	BASEBAND_CONFIG_18	0x00000000	00000000000000000000000000000000
0x00000013	BASEBAND_CONFIG_19	0x00000000	00000000000000000000000000000000
0x00000014	BASEBAND_CONFIG_20	0x00000000	00000000000000000000000000000000
0x00000015	BASEBAND_CONFIG_21	0x00000000	00000000000000000000000000000000
0x00000016	BASEBAND_CONFIG_22	0x00000000	00000000000000000000000000000000
0x00000017	BASEBAND_CONFIG_23	0x00000000	00000000000000000000000000000000
0x00000018	BASEBAND_CONFIG_24	0x00000000	00000000000000000000000000000000
0x00000019	BASEBAND_CONFIG_25	0x00000000	00000000000000000000000000000000
0x0000001A	BASEBAND_CONFIG_26	0x00000000	00000000000000000000000000000000
0x0000001B	BASEBAND_CONFIG_27	0x00000000	00000000000000000000000000000000
0x0000001C	BASEBAND_CONFIG_28	0x00000000	00000000000000000000000000000000
0x0000001D	BASEBAND_CONFIG_29	0x00000000	00000000000000000000000000000000
0x0000001E	BASEBAND_CONFIG_30	0x00000000	00000000000000000000000000000000
0x0000001F	BASEBAND_CONFIG_31	0x00000000	00000000000000000000000000000000

Figure 8. ADL6316-EVALZ ACE Memory Map View

## EVALUATION BOARD SCHEMATIC



## 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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