Evaluation Board User Guide

EVAL-ADA4356EBZ

Evaluating the ADA4356, Programmable Transimpedance, Current to Bits Receiver µModule

Features and Benefits

- Fully-featured evaluation board for the *ADA4356*, a single-channel, current input, analog-to-digital converter (ADC) µModule in a 12mm × 6mm, 84-ball ball grid array (BGA) package
- *Analysis | Control | Evaluation (ACE) Software* plug-in available for device configuration, data capture, and performance evaluation
- On-board power solution and input current source
- On-board input signal current divider for current range extension
- Provision for TIA gain logic control through 3-pin headers
- Self-debug circuitry for quick diagnostic of the board's supplies
- FMC compatible, configured for ZedBoard but can also be controlled using other FMC-based FPGAs

Evaluation Board Kit Contents

- EVAL-ADA4356EBZ evaluation board (×1, populated)
- Standoffs (×6)
- Screws (×2)
- 2.54mm shunt connectors (×6)

Documents Needed

- ADA4356 data sheet
- EVAL-ADA4356EBZ software resources

Equipment Needed

Hardware

- PC running Windows® 10 operating system or higher
- Digilent ZedBoard with 12V wall adapter power supply
- Function generator

Cables and Components

- SMA cable to connect the EVAL-ADA4356EBZ evaluation board to the signal source
- Ethernet cable to connect the ZedBoard to the PC
- SD card containing system board boot files and Kuiper Linux OS

General Description

The EVAL-ADA4356EBZ evaluation board is designed to evaluate the performance of the ADA4356, a single-channel, low-noise, wide dynamic-range, current input, analog-to-digital converter (ADC) µModule with three programmable gains and two selectable internal analog low-pass filters, offered in a 12mm × 6mm BGA package. It provides access to the ADA4356's features through ADI's Analysis | Control | Evaluation (ACE) software.

The EVAL-ADA4356EBZ evaluation board is designed for use with the Digilent ZedBoard via the field programmable gate array (FPGA) mezzanine card (FMC) connector.

The notable features which the EVAL-ADA4356EBZ evaluation board supports are as follows:

- Low voltage digital signaling (LVDS) data output interface.
- Programmable gain transimpedance amplifier (PGTIA), low-pass filter (LPF), and ADC configuration via serial peripheral interface (SPI) and secure shell (SSH).
- On-board generation of 3.3V regulated supplies that power the board's main circuitry, as well as other regulated supplies: 2.5V, 1.8V.
- Multiple on-board input options for ease of evaluation.
- Level shifters for flexibility on choice of FPGAs.

The EVAL-ADA4356EBZ evaluation board is a 6-layer printed circuit board (PCB) with dimensions of 3.957in × 2.717in. *Figure 1* shows the board's front and back view. The EVAL-ADA4356EBZ evaluation board comes populated with key circuits and components that allow for a straight-forward bench setup, which minimizes the need for additional bench top equipment.

Full specifications on the ADA4356 are available in the ADA4356 data sheet available from Analog Devices, Inc., and must be consulted with this user guide when using the EVAL-ADA4356EBZ evaluation board.

***Ordering Information* appears at end of data sheet.**

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Evaluation Board Photos

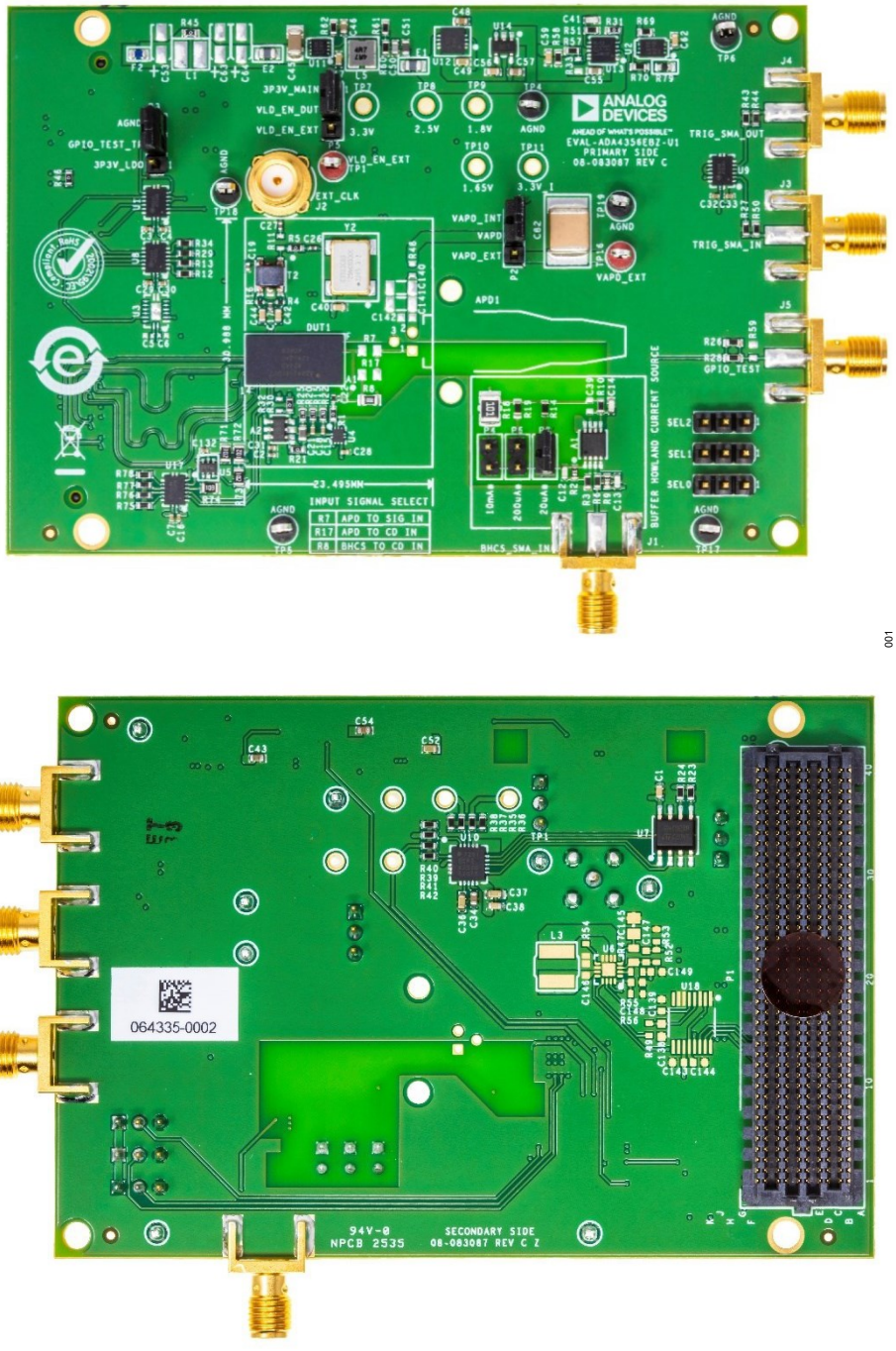

Figure 1. EVAL-ADA4356EBZ Evaluation Board Photography (Front and Back Side View)

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Getting Started

Preparing the SD Card

The EVAL-ADA4356EBZ evaluation kit comes with an SD card preimaged with a version of Kuiper Linux that is compatible with the boot files of EVAL-ADA4356EBZ. To get started, copy the boot files into the SD card by following these steps:

1. Download the assets into the host PC:
   - EVAL-ADA4355/6 boot files: https://wiki.analog.com/resources/eval/eval-ada4356 (10.4MB).
2. Insert the SD card into the host PC's SD card slot. In case the user wants to use their own SD cards or reflash the accompanying SD card, then do the following steps:
   - Download Kuiper Linux: https://swdownloads.analog.com/cse/kuiper/image_2023-12-13-ADI-Kuiper-full.zip (3.8GB).
   - Using a preffered imaging tool, flash the downloaded Kuiper Linux's .iso file into the selected SD card (preferably 16GB or larger, class 10). For more details, refer to the instructions shown in *Formatting and Flashing SD Cards using Windows*.
3. In the host PC's file explorer, access the SD card's BOOT drive and copy the contents of the EVAL-ADA4355/6 boot files folder into it.
4. Safely remove the SD card from the host PC, then install SD card in the card slot under the FMC connector of the ZedBoard.

Caution: Do not use an SD card reader/port that encrypts the SD card. An encrypted SD card does not work on the ZedBoard.

Setting up the ZedBoard and EVAL-ADA4356EBZ

Installing the Spacers and Screws

The EVAL-ADA4356EBZ evaluation kit comes with a set of standoffs and screws that must be installed to secure the connection between the EVAL-ADA4356EBZ and the ZedBoard. For the available standoffs and screws in the kit, see *Table 1*.

Table 1. Standoffs and Screws in the EVAL-ADA4356EBZ Evaluation Kit

QTY	MFG PN	MFG	DESCRIPTION	DESIGNATION
4	971200154	Wurth Elektronik	Spacers, stud, brass, M2.5 × **20mm** length	Standoff (with screw) for the far edge of the EVAL-ADA4356EBZ, away from the FMC port. Top screw for the 10mm standoff between EVAL-ADA4356EBZ and ZedBoard.
4	970050154	Wurth Elektronik	Spacers, stud, brass, M2.5 × **5mm** length	Fastener for the 20mm spacer on the far edge of the EVAL-ADA4356EBZ, away from the FMC port.
2	95947A005	McMaster-Carr	Standoffs, Al, M2.5 × **10mm**, hex female spacer	Standoff between the EVAL-ADA4356EBZ and ZedBoard, on both boards' FMC port side.
2	92005A066	McMaster-Carr	Screws, pan head phillips, M2.5 × **6mm**	Bottom screw for the 10mm standoff between EVAL-ADA4356EBZ and ZedBoard.

Note: Installing the standoffs and screws provides a stable mechanical connection, which is required to ensure proper operation.

To install these, do the following steps:

5. Take the ZedBoard and locate its installed FMC connector. On the ZedBoard's surface beside the FMC connector, there should be two drilled holes (one for each side) for the 10mm spacers installation.
6. Pick out one 10mm spacer and one 6mm screw. On the top side of the ZedBoard, align the spacer on one of the identified drilled holes.
7. From the bottom side of the ZedBoard, install the screw through the drilled hole and into the spacer using a screwdriver. Repeat the steps 6 and 7 for the other plated drilled hole.
8. Take the EVAL-ADA4356EBZ and locate the board's edge opposite to where the FMC connector is installed. On each corner of that edge, there should be two nonplated drilled holes.

9. Pick out two 20mm spacers and two 5mm spacers; the 20mm spacer has a screw on one side and a hole on the other, while the 5mm spacers only have holes on both sides. Align one of the 20mm spacers under one of the drilled holes in the board, with its screw side pointing upwards and into the drilled hole.
10. From above the EVAL-ADA4356EBZ, fasten the 5mm spacer into the 20mm spacer's screw. Repeat the steps 9 and 10 for the other nonplated drilled hole. Both boards are now ready to be fastened together.

Connecting the EVAL-ADA4356EBZ to the ZedBoard

11. Flip over the EVAL-ADA4356EBZ and locate the circular Kapton sticker covering part of the FMC connector. Remove this sticker before attempting to connect the boards.
12. Insert the EVAL-ADA4356EBZ's FMC connector into the ZedBoard's FMC connector. On the EVAL-ADA4356EBZ's edge where the FMC connector is installed, the EVAL-ADA4356EBZ's plated drilled holes should now be aligned with the 10mm spacers installed on the ZedBoard in the steps 6 and 7.
13. Take one 20mm spacer; with the screw side pointing downwards, screw the 20mm spacer through one of the plated drilled holes of the EVAL-ADA4356EBZ and into the 10mm spacer installed on the ZedBoard. Repeat this step for the other plated drilled hole. Both boards are now fixed together.

Powering up the ZedBoard and Connecting the Host PC

14. Before powering up the ZedBoard, ensure that the VADJ (JP18) is configured at 2.5V by placing the shunt connector to its correct header. Ensure that the ZedBoard's boot configuration jumpers (J7 to J11) also follow *Figure 2*.

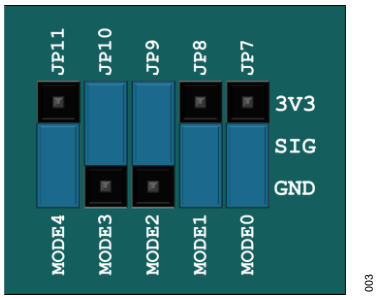


Figure 2. ZedBoard Boot Configuration Jumpers

15. Take the 12V wall wart adapter that comes with the ZedBoard. Plug the adapter into the electrical outlet, then connect its barrel connector into the ZedBoard's power port (J20). Do not turn on the main ZedBoard system power yet.
16. Connect one end of the ethernet cable into the ZedBoard's ethernet port (J11) and the other end into the host PC's ethernet port.
17. Toggle the ZedBoard's power switch (SW8) to ON; this boots up the ZedBoard. This should send power into the ZedBoard, as indicated by a green LED (LD13, POWER) lighting up. A bright blue LED (LD12, DONE) lights up once boot is successful and complete.
18. To validate a successful connection, open Windows PowerShell in the host PC and send in a ping request to the ZedBoard by entering this command: `ping analog.local.`

    When the system is not ready yet, the error appears as: `Ping request could not find host analog.local. Please check the name and try again.`

    A successful ping looks similar to this:

```
Pinging analog.local [fe80::dbf5:dc43:5234:970f%20] with 32 bytes of data:
Reply from fe80::dbf5:dc43:5234:970f%20: time=1ms
Reply from fe80::dbf5:dc43:5234:970f%20: time<1ms
Reply from fe80::dbf5:dc43:5234:970f%20: time<1ms
Reply from fe80::dbf5:dc43:5234:970f%20: time<1ms
Ping statistics for fe80::dbf5:dc43:5234:970f%20:
```

```
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

19. Once a ping has succeeded, Kuiper Linux is confirmed to be up and running and ready for the next step.

Communicating to ZedBoard via Secure Shell (SSH)

Some functions of EVAL-ADA4356EBZ, such as shutting down the system, require connecting to Kuiper Linux on the ZedBoard through SSH. Being able to control the board via SSH in can also be useful for debugging. To establish a connection, do the following steps:

20. From Windows PowerShell or the user's preferred terminal software, enter: `ssh analog@analog.local`.
    If it asks to add key, click yes. User may need to delete a previous key if this is not the first Kuiper Linux system that is connected to this particular computer. In Windows, the key files are known_hosts and known_hosts.old at **C:\Users\YOURUSERNAME\.ssh**.
21. Once the system asks for a password, enter `analog`.
22. Following are the useful Linux commands:
    a. `iio_info` – displays information about all ICs on the EVAL-ADA4356EBZ and some ZedBoard properties.
    b. `sudo reboot` – restarts the system.
    c. `sudo shutdown -h now` – shuts down the system completely.

Controlling the EVAL-ADA4356EBZ using ACE

The plug-in for the EVAL-ADA4356EBZ is available in *ACE*. The ACE plug-in allows the user to configure the EVAL-ADA4356EBZ's gain and frequency settings, measure the board supplies, and observe the resulting output waveform.

To control the EVAL-ADA4356EBZ through ACE, the host PC must first be physically connected to the FPGA using an ethernet cable. The following steps must then be followed:

23. Open ACE. Within the software, navigate to **Plug-in Manager**. A user can find and install all the avalable plug-ins for ADI boards in the **Plug-in Manager**.
24. In the **Plug-in Manager**, select the **Available Packages** drop-down menu. This checks for plug-ins that are available for installation. Note that plug-ins which are already installed can be found under the **Installed Plug-ins** drop-down menu instead.
25. Select the check box for **Boards**, search for **ADA4356**, then install. If the plug-in is not available yet, follow the directions shown in *EVAL-ADA4356 Software Documentation*.
26. Once installation is complete, restart ACE. Upon rebooting ACE, the evaluation board hardware should be detected, as shown in *Figure 3*.

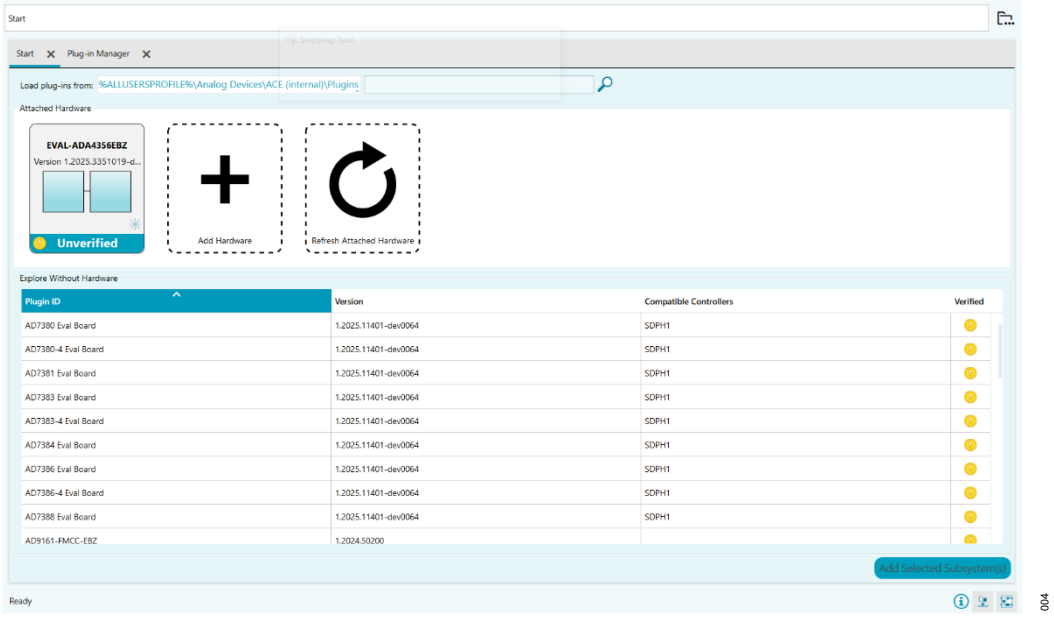


Figure 3. ACE Start Page

Configuring the EVAL-ADA4356EBZ and Outputting a Waveform

27. Before going further, prepare the input signal by configuring the function generator with the following parameters:
    - Signal type: Sine wave
    - Frequency: 1MHz
    - Amplitude: 2.5V
    - DC Offset: 1.1V
    - Output Load: HiZ
28. Connect the output of the function generator to J1 of the EVAL-ADA4356EBZ, which is the SMA input for the BHCS.
    - Do not enable the function generator's output yet.
29. In the *ACE* software, double-click on the detected EVAL-ADA4356EBZ board, then double-click on its subsystem. This brings up the **Board View** window, as shown in *Figure 4*, where a summary of devices available in EVAL-ADA4356EBZ is visually shown. A user can configure the settings of the EVAL-ADA4356EBZ in this window.

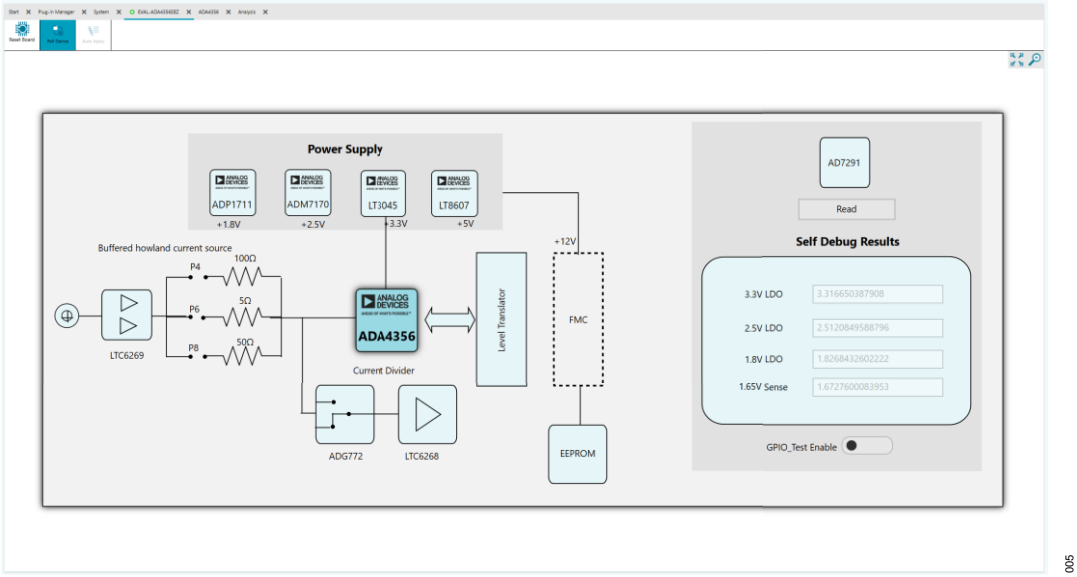


Figure 4. EVAL-ADA4356EBZ ACE Plug-In Board View

Among the components, only the *ADA4356* can be interacted with. Double-clicking on it brings the user to **Chip View**, where the output is accessible by clicking the **Proceed to Analysis** button.

On the right panel is the *AD7291*, the on-board self-debug ADC, and its output. Clicking the **Read** button under the AD7291 chip updates the results.

Below the Self Debug Results is the GPIO_Test Enable switch. Toggle it ON to send a logic HIGH output to J5.

30. Double-click on the **ADA4356** to enter **Chip View**, then click on the **Proceed to Analysis** button. This opens the **Analysis** window, which shows the results, along with the **CAPTURE** pane where capture settings can be configured, as shown in *Figure 5*.
    The **CAPTURE** pane contains controllers that can adjust the number of samples and configure both the TIA and the low-pass filter of the ADA4356.
    In the **Frequency Select** drop-down menu, select the filter setting between two options: (1) 100MHz for a wider bandwidth, and (2) 1MHz for a more restricted bandwidth. In the **Gain Select** drop-down menu, select among three internal gain resistors: 133kΩ, 4.54kΩ, and 11kΩ.
    In the **Number of Samples** drop-down menu, select a preferred value. For example, a lower value 8192 shows a more visually perceivable output waveform.
31. Toggle the function generator's output to ON (or ENABLE) to produce an observable output. By clicking either **Run Once** or **Run Continuously** in the ACE software's **CAPTURE** Pane, an output waveform similar to *Figure 5* should be displayed.
    Along with the regular time-domain output waveform, the FFT and histogram can also be observed by selecting the corresponding option on the left side of the **CAPTURE** pane.

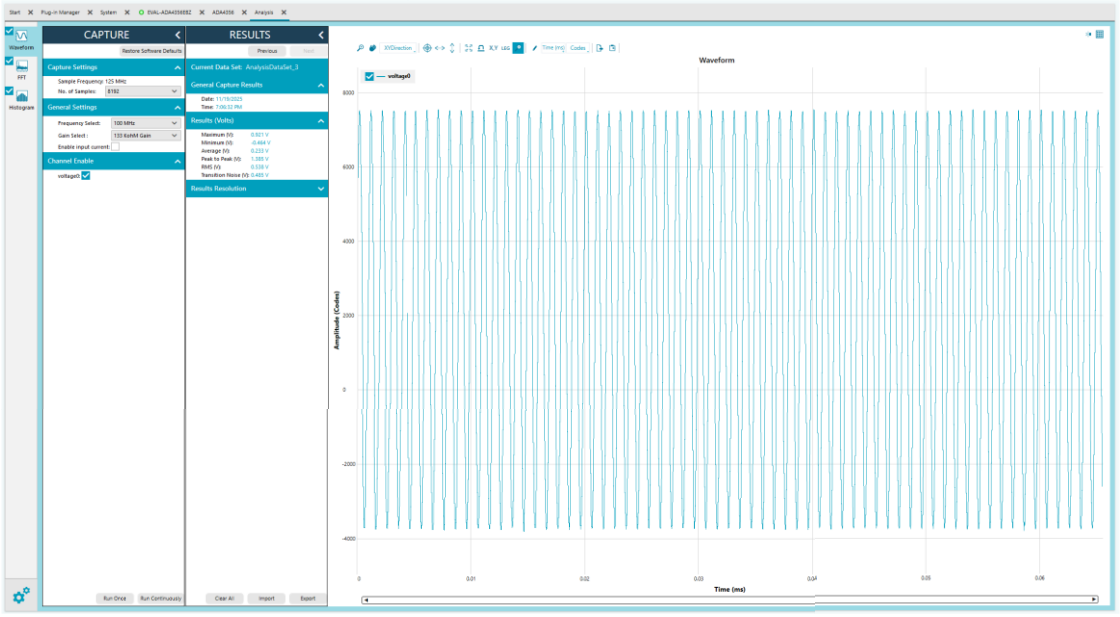


Figure 5. EVAL-ADA4356EBZ ACE Plug-In Analysis Window

Evaluation Board Hardware Guide

The EVAL-ADA4356EBZ evaluation board contains circuits that allow for the evaluation of the ADA4356's key features as well as eliminating the need for complicated test bench setup. Figure 6 shows the components of the EVAL-ADA4356EBZ's key circuits and features, their purpose is briefly described in Table 2 and explained in-depth in each feature's subsection.

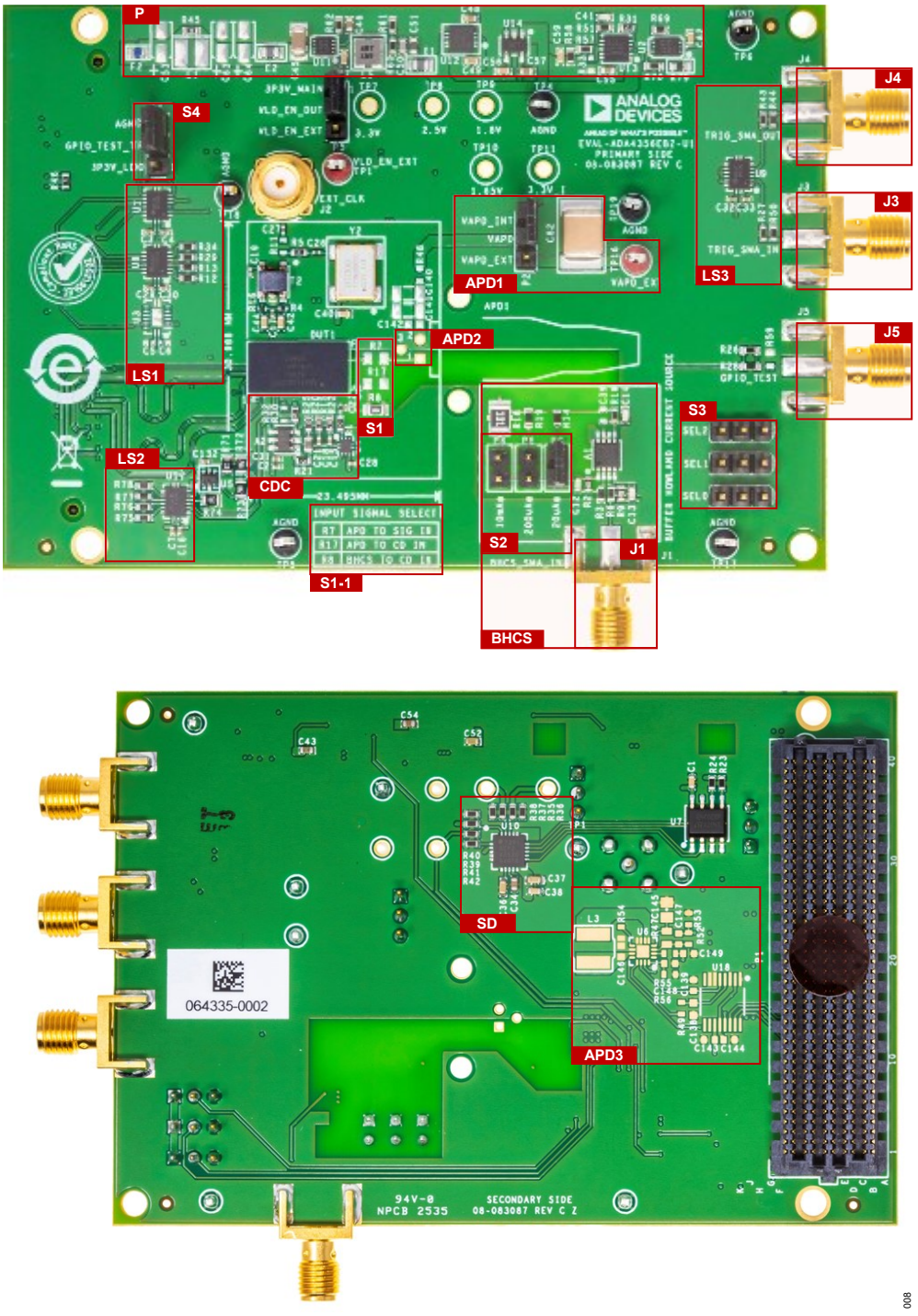


Figure 6. Key Features of the EVAL-ADA4356EBZ Evaluation Board (Front and Back Side View)

Table 2. Short Description of Key Features

DESIGNATOR	DESCRIPTION
P	On-Board Power Solution: 12V to 5V Silent Switcher | 3.3V LDO | 2.5V LDO | 1.8V LDO.
BHCS	On-Board Buffered Howland Input Current Source (BHCS): 20µA | 200µA | 10mA.
CDC	Current Divider Circuit for Current Range Extension.
APD1	APD Voltage Bias Source Selection: External (VAPD_EXT) | Internal (VAPD_INT).
APD2	APD Slot.
APD3	Internal APD Bias Circuit.
SD	Self-Debug Circuit.
LSx	Level Shifters.
S1	Input Signal Selection.
S1-1	Input Signal Selection Truth Table.
S2	Input Current Setting (BHCS).
S3	Control Gain Setting and Enable Current Divider.
S4	GPIO_TEST Mode: Transmit | Receive.
J1	Input to BHCS.
J3	Data Trigger Input.
J4	Data Trigger Output.
J5	Input/Output for GPIO_TEST.

EVAL-ADA4356EBZ Kit Contents

Apart from the board itself, the EVAL-ADA4356EBZ evaluation kit contains mechanical components such as 2.54mm shunt connectors or jumpers, which can be used on headers to activate specific functions and features of the board, and sets of standoffs and screws to fix the EVAL-ADA4356EBZ and ZedBoard in place. The standoffs and screws provided in the EVAL-ADA4356EBZ are listed in *Table 1*. *Table 3* shows the default jumper settings on the board.

Table 3. Default Jumper Connections

JUMPER	DEFAULT CONNECTION	FEATURE
P2	Shunt 3-2 (VAPD_EXT to VAPD)	Sets APD Bias to External Source
P3	Shunt 3-2 (AGND to GPIO_TEST_TR)	Sets GPIO_TEST mode to Transmit
P4	No Shunt (Not Connected)[1]	Max 10mA input current setting (BHCS)
P5	Shunt 1-2 (3P3V_MAIN to VLD_EN_DUT)	Uses internal supply to enable VLD
P6	No Shunt (Not Connected)[1]	Max 200µA input current setting (BHCS)
P8	Install Shunt (Connected)[1]	Max 20µA input current setting (BHCS)
SEL0	No Shunt (Not Connected)[2]	Bit0 of gain selection bootstrap
SEL1	No Shunt (Not Connected)[2]	Bit1 of gain selection bootstrap
SEL2	No Shunt (Not Connected)[2]	Enables current divider

[1] For P4, P6, and P8, only one jumper must be installed at a time.

[2] For SEL0, SEL1, and SEL2, use the jumpers only if analog/manual gain selection is preferred (default is to set this digitally).

Power Supply

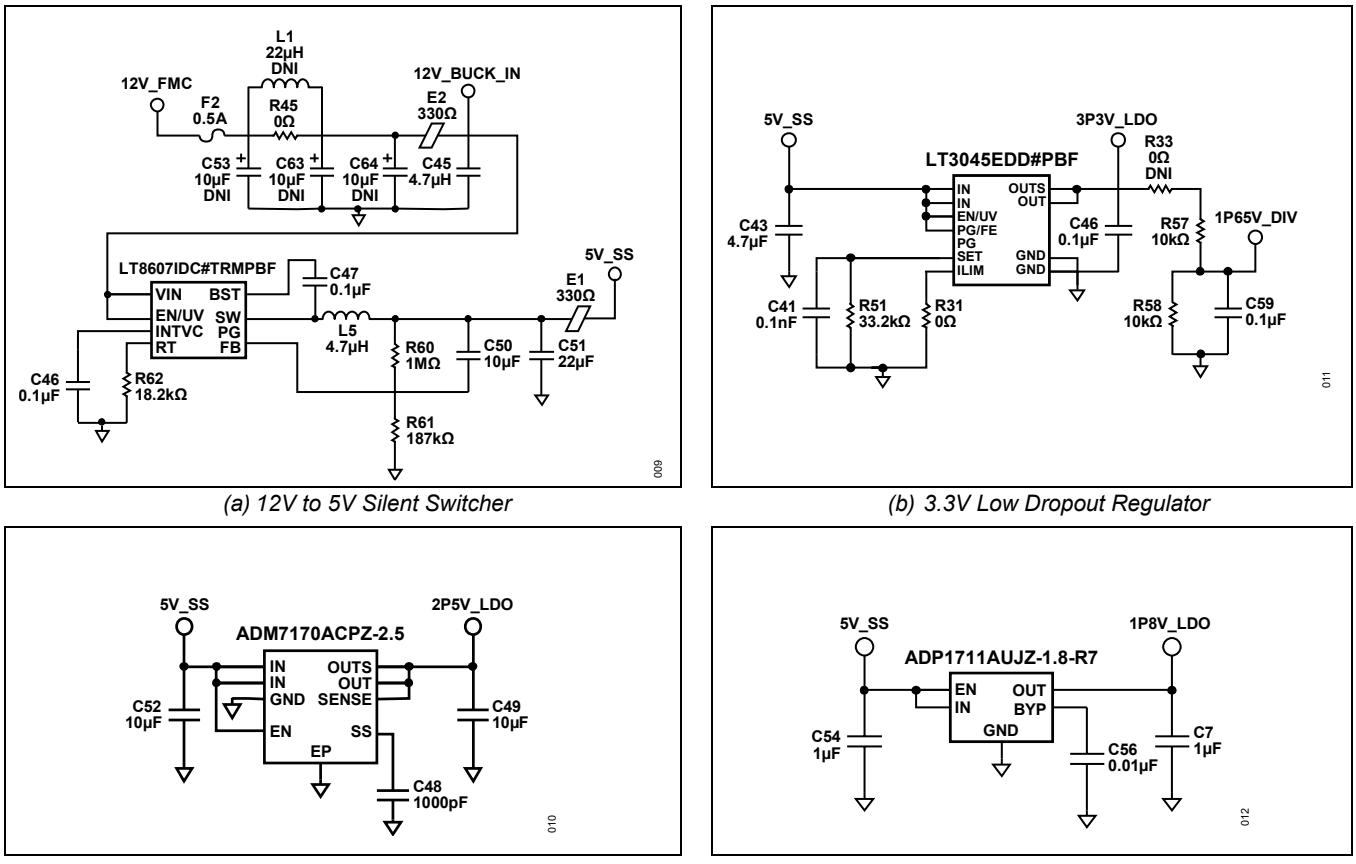
The power supply of the EVAL-ADA4356EBZ comes directly and entirely from ZedBoard's 12V supply pin, passed along through the board's FMC connector. Given this, a stable mechanical connection between the ZedBoard and the EVAL-ADA4356EBZ is required to ensure proper operation.

A fuse is installed between the FMC connector and the rest of the EVAL-ADA4356EBZ's circuitry, serving as the board's primary line of defense against unwanted current surge in an event of unintended disruption in connectivity. The installed fuse, F0603E0R50FSTR, is a fast blow 500mA fuse in a 0603 SMT package, located in the upper corner of the board, designated as F2, as shown in *Figure 6*.

The 12V supply is leveled down to 5V using *LT8607*, a synchronous step-down regulator with more than 93% efficiency at 0.5A, $12V_{IN}$ to $5V_{OUT}$. At the LT8607's output, three LDOs are connected: (1) 3.3V, which powers the main DUT and majority of the circuit, (2) 2.5V, which is used on the APD bias circuit, and (3) 1.8V, which provides for the DUT's digital pins. *Table 4* shows the LDOs used for each voltage level and *Figure 7* shows the circuits.

Table 4. Selected LDOs for On-Board Power Solution

VOLTAGE LEVEL (V)	SIGNAL NAME	LDO USED (MFG PN)
3.3	3P3V_LDO, 3P3V_MAIN	*LT3045EDD#PBF*
2.5	2P5V_LDO	*ADM7170ACPZ-2.5-R7*
1.8	1P8V_LDO	*ADP1711AUJZ-1.8-R7*



(a) 12V to 5V Silent Switcher

(b) 3.3V Low Dropout Regulator

(c) 2.5V Low Dropout Regulator

(d) 1.8V Low Dropout Regulator

Figure 7. On-board Power Solution Circuits

Input Options and Settings

The EVAL-ADA4356EBZ provides two options to produce ADA4356's input: (1) the on-board current source, which is the EVAL-ADA4356EBZ's default input source, and (2) a slot for a 3-pin avalanche photodiode.

Both input options connect to the current divider circuit, which can be enabled to activate range extension, thus bringing down a high input current to the *ADA4356*'s linear input current region. The input can be selected by installing one 0Ω resistor on either R7, R17, or R8; the input source selection table is printed on the board, as shown in *Figure 6*'s S1-1 designation. The input path options are detailed in *Table 5*.

Table 5. Input Source Selection Guide

DESIGNATOR	SELECTED INPUT	CONNECTS TO CURRENT DIVIDER (CD_IN)	PATH
R7	APD	No	Current from APD1 > ADA4356's Input
R17	APD	Yes	Current from APD1 > Current Divider Circuit > ADA4356's Input
R8	Buffered Howland Current Source (BHCS)	Yes	Voltage from external source into J1 > BHCS > Current Divider Circuit > ADA4356's Input

Caution: Only one 0Ω resistor at a time must be installed among these signal paths to ensure correct input source selection.

Buffered Howland Current Source (BHCS)

The current source available in the EVAL-ADA4356EBZ is configured as a BHCS using *LTC6269*, where one channel, amplifier A, is set as a difference amplifier, and the other channel, amplifier B, is set as a buffer. The circuit accepts a voltage input through the J1, an SMA port, as shown in *Figure 6*, and produces a scaled current output based on selected setting.

Figure 8 shows the BHCS circuit used in the EVAL-ADA4356EBZ and the equation 1 shows how the proper resistor is selected given a 5Vpp input signal.

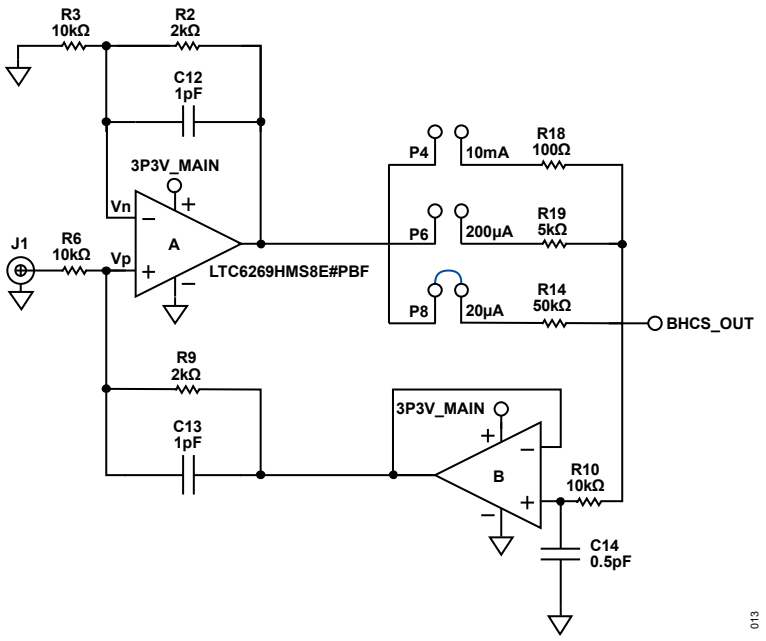


Figure 8. Buffered Howland Current Source Circuit

$$R_s = \frac{G \times (V_p - V_n)}{I_{load}} \qquad (1)$$

where:

R_s is the computed resistor value for R14, R19, and R18.

G is R2/R3.

V_p is the voltage at the positive input pin of amplifier A.

V_n is the voltage at the negative input pin of amplifier A.

I_{load} is the required output current.

Amplifier A balances the input signals from both the IN+ and IN− nodes such that they are both equal. Any imbalance due to incoming signal from J1 causes amplifier A to push or pull current through the selected R_s to balance out the IN+ and IN− nodes again.

As shown in *Figure 6* and *Figure 8*, the EVAL-ADA4356EBZ has three different levels of current that can be selected by installing a jumper on either of these headers: (1) 20µA for P8, (2) 200µA for P6, and (3) 1mA for P4. *Table 6* summarizes the BHCS configuration. These currents assume an input of 5V at J1. Higher or lower voltage inputs produce different output currents than labeled.

Table 6. Current Setting Configuration

CURRENT SETTING	DESIGNATED PIN HEADER	DESIGNATED RESISTOR	RESISTOR VALUE
20µA	P8	R14	50kΩ
200µA	P6	R19	5kΩ
1mA	P4	R18	100Ω

Caution: Only one jumper at a time must be installed among these headers to ensure that correct current is produced.

Avalanche Photodiode (APD)

The EVAL-ADA4356EBZ has a footprint available for a three-pin avalanche photodiode, located at designator APD2 from *Figure 6*, as well as provisions for an internally sourced APD bias based on the footprints and pin configurations of *LT3571* (a boost converter) and *AD5142* (a digital potentiometer), located at designator APD3 in *Figure 6*.

The APD option requires user selected configuration and is not supported by default. It is, however, offered for prototyping beyond initial performance verification using the BHCS.

Current Divider

The current divider circuit divides down a high input current from either the BHCS or the APD within the 300µA linear input current range of the ADA4356. It uses the *ADG772* as its switch (which has an on resistance of 5Ω) and the *LTC6268* as the voltage buffer that charges the capacitors to 1.65V DC bias level using either the 1P65V_DUT (which comes from TIA_{REF} ball F1 of the *ADA4356*) or the 1P65V_DIV (which comes from the voltage divided output of 3P3V_MAIN) as its reference. *Figure 9* shows the current divider circuit.

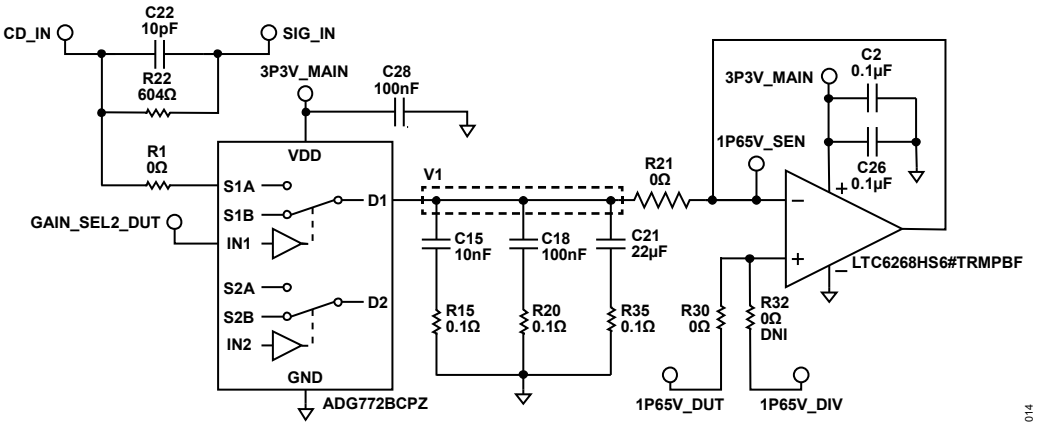


Figure 9. Current Divider Circuit

The input current I1 comes from CD_IN, which is connected to either the BHCS_OUT or the APD_OUT. When S1 closes, I1 is diverted to the AC ground at node V_1, where C15, C18, and C21 are connected. These capacitors shunt this current to ground. The voltage buffer then rapidly charges the capacitors back up to the 1.65V DC bias level provided by 1P65V_DUT. This ensures that V_1 remains at the DC bias of the *ADA4356*'s input ball, which this circuit connects to through the SIG_IN trace.

Gain Selection

Along with the primary digital control for gain selection, the EVAL-ADA4356EBZ also provides an analog way to select the required gain setting. The gain selection section designated as S3 in *Figure 6* allows for manual control once populated with three sets of 3-pin headers. *Table 7* shows how these pins can be configured to enable the required settings.

Table 7. Manual Gain Selection

CONFIGURATION	SEL0 (GAIN_SEL0_DUT)	SEL1 (GAIN_SEL1_DUT)	SEL2 (GAIN_SEL2_DUT)
TIA Gain = 4.54kΩ	Shunt to Pin 1 (3.3V)	Shunt to Pin 3 (GND)	X
TIA Gain = 11kΩ	Shunt to Pin 3 (GND)	Shunt to Pin 1 (3.3V)	X
TIA Gain = 133kΩ	Shunt to Pin 3 (GND)	Shunt to Pin 3 (GND)	X
Enable Current Divider	X	X	Shunt to Pin 1 (3.3V)
Disable Current Divider	X	X	Shunt to Pin 3 (GND)

Each gain select line has a series resistor of 10kΩ between the output of the level shifter (which connects to the FMC) and the ADA4356's gain select input pin. If the gain select pins are toggled both physically and digitally, the analog input's state takes precedence.

Data Clock Generation

The EVAL-ADA4356EBZ has an on-board TTL crystal oscillator, the CB3LV-3I-125M000000. The CB3LV-3I-125M000000 generates a 125MHz clock signal, with two voltage levels, $0.9V_{CC}$ and $0.1V_{CC}$, where V_{CC} is 3.3V. The two voltage levels represent two binary states and are passed through a transformer, the ETC1-1-13. The output of its secondary connects to the ADA4356's CLKP pin and its inverted signal, secondary dot, goes into the ADA4356's CLKN pin, as shown in *Figure 10*.

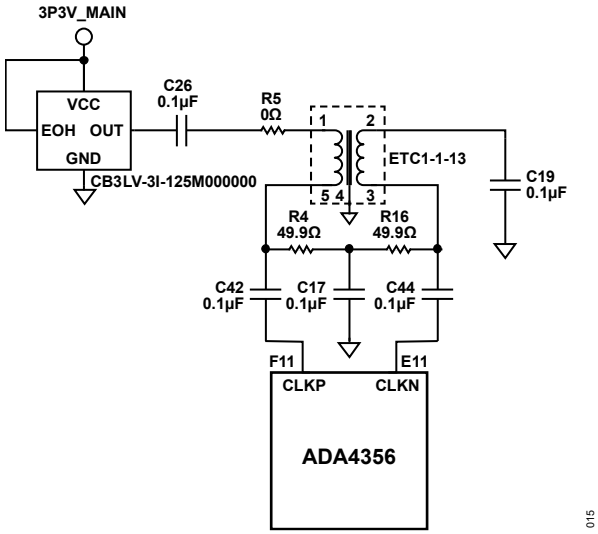


Figure 10. Data Clock Generation Circuit

Self-Debug

The self-debug is a quick, on-demand diagnostic feature that can check for board health with just a couple of clicks in the software. It is powered by the ZedBoard's 3.3V auxiliary pin; it is composed of resistors and *AD7291*, an 8-bit ADC, in which each channel reads the voltage output of on-board and on-chip LDOs.

Since the chosen part has an internal voltage reference of only up to 2.5V, the supply readings are scaled down via voltage divider, using resistors R_{TOP} and R_{BOT}, with the FPGA measuring the voltage drop across R_{BOT}. *Figure 11* shows the self-debug circuit and, for more details on each channel, see *Table 8*.

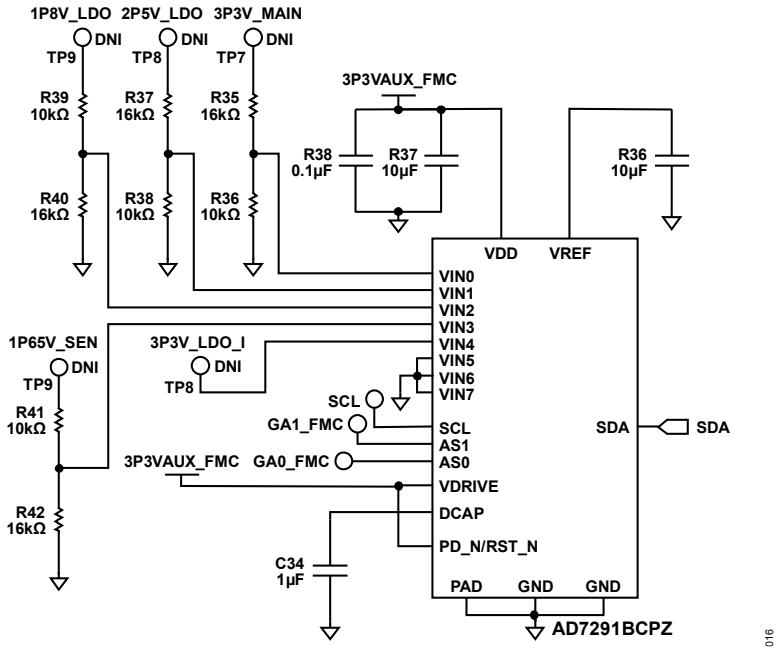


Figure 11. Self-Debug Circuit

Table 8. Self-Debug Circuit Configuration

SUPPLY NAME	TEST POINT	VOLTAGE DIVIDER RESISTORS (R_{TOP} | R_{BOT})	SCALE (V)	SCALED DOWN OUTPUT (V)
3P3V_MAIN	TP7	R35 = 16 kΩ | R36 = 10 kΩ	0.6158	1.2692
2P5V_LDO	TP8	R37 = 16 kΩ | R38 = 10 kΩ	0.6158	0.9615
1P8V_LDO	TP9	R39 = 10 kΩ | R40 = 16 kΩ	0.3846	1.1077
1P65_SEN	TP10	R41 = 10 kΩ | R42 = 16 kΩ	0.3846	1.0150

Note: The ACE plug-in automatically reverts the scaled-down readings back to their actual value by dividing them by their corresponding scale.

Digital Interface

The EVAL-ADA4356EBZ uses the ZedBoard's FMC connector (P3) to configure *ADA4356*'s ADC through the 4-wire SPI in LVDS mode. *Table 9* shows the LVDS connections.

Table 9. LVDS Lines

EVB SIGNAL	DUT PIN	FMC PIN	FMC NAME	ZEDBOARD NAME	ZEDBOARD PKG NUM	ZEDBOARD I/O BANK
DCOP	D14	H4	CLK0-M2C_P	FMC_CLK0_P	L18	34
DCON	D13	H5	CLK0-M2C_N	FMC_CLK0_N	L19	34
FCOP	C14	G6	LA00_P_CC	FMC_LA00_CC_P	M19	34
FCON	C13	G7	LA00_N_CC	FMC_LA00_CC_N	M20	34
D1AP	B14	H10	LA04_P	FMC_LA04_P	M21	34
D1AN	B13	H11	LA04_N	FMC_LA04_N	M22	34
D0AP	A14	G9	LA03_P	FMC_LA03_P	N22	34
D0AN	A13	G10	LA03_N	FMC_LA03_N	P22	34

While the EVAL-ADA4356EBZ's HDL firmware has been developed around the ZedBoard, with its default VADJ set at 2.5V, the EVAL-ADA4356EBZ can be paired with other controller boards as long as an HDL firmware for the preferred controller is created.

Note that the target controller boards must be SOC-based or must have the ability to support SOFT PS (processor subsystem) running linux to be compatible with this hardware.

The EVAL-ADA4356EBZ utilizes an array of bidirectional level shifters, FXL4TD245BQX, that translate the digital interface's voltage levels to the level required by the EVAL-ADA4356EBZ. The supply of one side of the level shifter, side B, comes from the controller board's VADJ, while the other supply, side A, is connected to on-board LDOs, predominantly the 3.3V supply. *Table 10* lists down all the translated digital signals and which level shifter they are connected to.

Table 10. Level Shifted Signals

DIGITAL SIGNAL	FMC PIN	ASSIGNED LEVEL SHIFTER (PIN)	DIRECTION	COUNTERPART VOLTAGE (V)
SCLK_FMC	D8	U17 (14)	B to A	1.8
CSB_DUT_FMC	G13	U17 (13)	B to A	1.8
SDI_FMC	H7	U17 (12)	B to A	1.8
SDO_FMC	H8	U17 (11)	A to B	1.8
GAIN_SEL0_FMC	G21	U8 (14)	B to A	3.3
GAIN_SEL1_FMC	G22	U8 (13)	B to A	3.3
GAIN_SEL2_FMC	G24	U8 (12)	B to A	3.3
FREQ_SEL0_FMC	H25	U1 (14)	B to A	3.3
FREQ _SEL1_FMC	H26	U1 (13)	B to A	3.3
GPIO_TEST_FMC	D23	U1 (12, 11)	B to A | A to B	3.3
TRIG_FMC_IN	C14	U9 (14)	A to B	3.3
TRIG_FMC_OUT	C15	U9 (13, 12, 11)	B to A	3.3
VLOGIC_FMC	D24	U3 (14)	B to A	3.3

Other Features

Data Trigger

A data trigger signal is provided in the EVAL-ADA4356EBZ to allow for a more efficient data capture. The input trigger in SMA, J3, tells the *ADA4356* that a pulse is expected to come, thereby toggling the device to capture mode. If a data trigger signal is being generated via software or on the ZedBoard, the output trigger SMA, J4, allows monitoring of the trigger signal being sent into ADA4356 for debugging purposes.

Note that the data trigger feature is not included in Rev. 0 release of the EVAL-ADA4356EBZ's HDL. The feature is under development and implemented in a future revision.

GPIO Test

The GPIO test, accessible through J5, is provided to allow for quick testing of a digitally controlled I/O node; the node can be set to either WRITE, in which the FPGA transmits a voltage that can be detected and measured through J5, or READ, where in the software can receive an incoming signal from an external source into J5.

Apart from the digital toggles, there is also a need to physically transfer a jumper to a different position. S4 from *Figure 6* shows the 3-pin header that controls the direction of the signal within the level shifter. The *Table 11* shows the proper configuration.

Table 11. GPIO Configurations

CONFIGURATION	P3 SETTING	DESCRIPTION
WRITE	B to A	Generates a 3.3V output into GPIO_TEST_SMA.
READ	A to B	Reads an input coming into GPIO_TEST_SMA.

Note: The READ setting has not been configured in Rev. 0 release of the EVAL-ADA4356EBZ's HDL.

Evaluation Board Software Guide

Evaluation Software

The EVAL-ADA4356EBZ hardware is controlled and configured through the *ACE* Software. ACE is a desktop software application that allows the evaluation and control of multiple evaluation systems from across the Analog Devices product portfolio. The application consists of a common framework and individual component specific plug-ins.

The controller board supported by ACE for the evaluation of EVAL-ADA4356EBZ is the ZedBoard. For ACE installation and documentation instructions, refer to the *ACE Software User Guides*. Once ACE is installed, open the ACE application and search for the EVAL-ADA4356EBZ board plug-in in ACE's **Plug-in Manager**, then install or update. The **Installing the EVAL-ADA4356EBZ plug-in** subsection under the **Getting Started** section goes over this process.

For the additional software resources, refer to the *EVAL-ADA4356 Software Documentation*.

For the product specific documentation for the evaluation software, refer to the ACE plug-in.

Host PC Software

The embedded Linux stack is based on the IIO (Industrial I/O) architecture, this enables the host PC to communicate with the EVAL-ADA4356EBZ and the controller board with tools such as Python, through the pyadi-iio package, or MATLAB with the precision toolbox.

Additional software resources are compiled and linked under the software section of the EVAL-ADA4356EBZ's product page. Generic, non-specific IIO tools such as IIO oscilloscope, scopy, and IIO command line tools can also be used to evaluate the EVAL-ADA4356EBZ's basic functionality.

Ordering Information

PART	TYPE
EVAL-ADA4356EBZ	EV Kit

Z = RoHS Compliant Part.

EVAL-ADA4356EBZ Bill of Materials

Table 12. Passive Components

QTY	DESIGNATOR	DESCRIPTION	MANUFACTURER AND PART NUMBER
8	C1, C38, C40, C42, C44, C47, C59, C62	Capacitors, 0.1µF, 0603	Kemet, C0603C104K3RACTU
1	C2	Capacitor, 1µF, 0402	Murata, GRT155R70J105KE01D
9	C3, C4, C7, C16, C29, C30, C32, C33, C132	Capacitors, 0.1µF, 0402	Kyocera AVX, 530L104KT16T
2	C12, C13	Capacitors, 1pF, 0603	AVX, 06031A1R0BAT2A
1	C14	Capacitor, 0.5pF, 0603	AVX Corporation, 06035A0R5BAT2A
1	C15	Capacitor, 10nF, 0402	TDK, CGA2B2X7R1E103K050BA
4	C17, C19, C26, C27	Capacitors, 0.1µF, 0402	Taiyo Yuden, TMK105BJ104KVHF
3	C18, C28, C31	Capacitors, 100nF, 0402	Wurth Elektronik, 885012205085
2	C21, C51	Capacitors, 22µF, 0603	TDK, C1608X5R1A226M080AC
4	C34, C46, C54, C57	Capacitors, 1µF, 0603	AVX, 0603YC105KAT2A
4	C36, C37, C49, C52	Capacitors, 10µF, 0603	Murata, GRT188R61A106KE13D
1	C41	Capacitor, 0.1nF, 0603	AVX Corporation, 06033C101KAT2A
2	C43, C55	Capacitors, 4.7µF, 0603	Taiyo Yuden, LMK107BJ475KAHT
1	C45	Capacitor, 4.7µF, 1206	Murata, GCJ31CR71E475KA12L
1	C48	Capacitor, 1000pF, 0603	Kemet, C0603C102K4RECAUTO
1	C50	Capacitor, 10pF, 0603	AVX Corporation, 06033A100FAT2A
7	R1, R5, R21, R30, R31, R45, R46	Resistors, 0Ω, 0603	Panasonic, ERJ-3GEY0R00V
2	R2, R9	Resistors, 2kΩ, 0603	Yageo, RC0603FR-072KL
15	R3, R6, R10, R12, R13, R23, R24, R29, R34, R36, R38, R39, R41, R57, R58	Resistors, 10kΩ, 0603	Panasonic, ERJ-3EKF1002V
2	R4, R16	Resistors, 49.9Ω, 0402	Panasonic, ERJ-2RKF49R9X
1	R8	Resistor, 0Ω, 0805	Panasonic, ERJ-6GEY0R00V
1	R14	Resistor, 50kΩ, 0603	Yageo, RT0603BRD0750KL
3	R15, R20, R25	Resistors, 0.1Ω, 0603	Panasonic, ERJ-3RSFR10V
1	R18	Resistor, 100Ω, 1210	Panasonic, ERJ-14YJ101U
1	R19	Resistor, 5kΩ, 0603	Yageo, RT0603BRE075KL
1	R22	Resistor, 604Ω, 0402	Panasonic, ERJ-2RKF6040X
5	R26, R27, R28, R43, R44	Resistors, 100Ω, 0603	Panasonic, ERJ-3EKF1000V
4	R35, R37, R40, R42	Resistors, 16kΩ, 0603	Panasonic, ERJ-3EKF1602V
5	R50, R75, R76, R77, R78	Resistors, 49.9Ω, 0603	Panasonic, ERJ-3EKF49R9V
1	R51	Resistor, 33.2kΩ, 0603	Panasonic, ERJ-3EKF3322V
1	R60	Resistor, 1MΩ, 0603	Panasonic, ERJ-3EKF1004V
1	R61	Resistor, 187kΩ, 0603	Panasonic, ERJ-3EKF1873V
1	R62	Resistor, 18.2kΩ, 0603	Panasonic, ERJ-3EKF1822V
1	R69	Resistor, 1.5kΩ, 0603	Panasonic, ERJ-3EKF1501V
1	R70	Resistor, 10Ω, 0603	Panasonic, ERJ-3EKF10R0V
3	R71, R72, R73	Resistors, 1kΩ, 0805	Yageo, RC0805JR-071KL
1	R74	Resistor, 10kΩ, 0805	Yageo, RC0805JR-0710KL
1	R79	Resistor, 0.02Ω, 0603	Vishay, WSL0603R0200FEA
1	L5	Inductor, 4.7µH, 1.9A 158mΩ max, 1212	Wurth Elektronik, 74438336047
2	E1, E2	Ferrite beads, 1 PL, 330Ω at 100 MHz, 0805	TDK, MPZ2012S331A
1	F2	Fast acting fuse, 0.5A, 32V, 0603	Kyocera AVX, F0603E0R50FSTR
1	T2	XFMR RF 1:1 transmission line 4.5MHz to 3000MHz	Macom Technology Solutions, ETC1-1-13TR

EVAL-ADA4356EBZ Bill of Materials (continued)

Table 13. Active Components

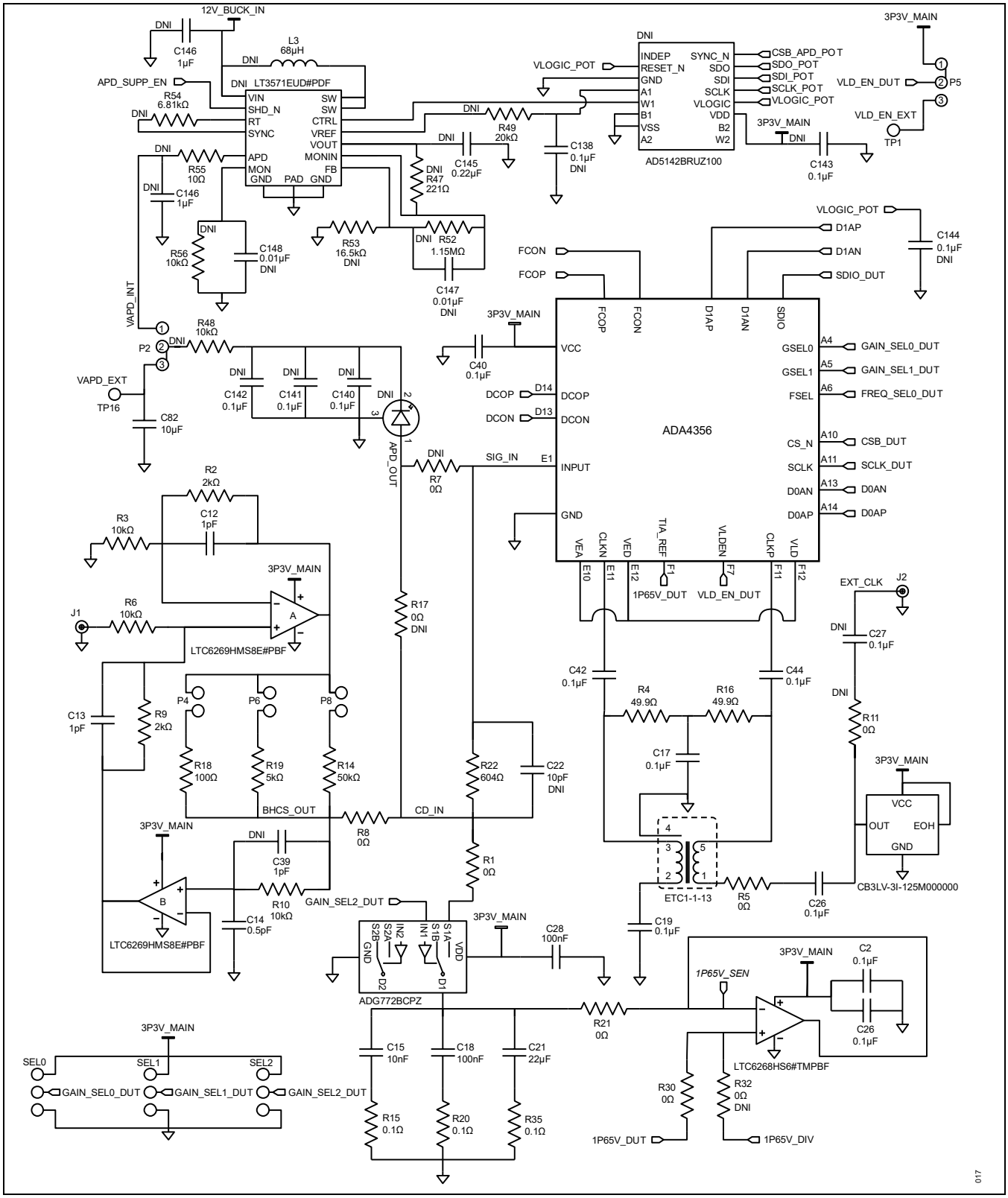
QTY	DESIGNATOR	DESCRIPTION	MANUFACTURER AND PART NUMBER
1	DUT1	Programmable TIA, current to bits receiver µModule	Analog Devices, Inc., ADA4356
1	A1	Ultra low bias current FET input op amp, 500MHz	Analog Devices, Inc., LTC6269HMS8E#PBF
1	A2	Ultra low bias current FET input op amp, 500MHz	Analog Devices, Inc., LTC6268HS6#TRMPBF
1	U2	Precision, extended input range current sense amp	Analog Devices, Inc., LT6105HDCB#TRMPBF
1	U4	Low power dual 2:1 MUX/DEMUX USB 2.0/USB 1.1	Analog Devices, Inc., ADG772BCPZ-REEL7
1	U10	8-channel I^2C 12-bit SAR ADC	Analog Devices, Inc., AD7291BCPZ
1	U11	Synchronous step-down regulator, 42V, 0.75A	Analog Devices, Inc., LT8607IDC#TRMPBF
1	U12	Ultra low noise, high PSRR, fast transient response CMOS LDO	Analog Devices, Inc., ADM7170ACPZ-2.5-R7
1	U13	Ultra low noise, ultra high PSRR linear regulator, 20V, 500mA,	Analog Devices, Inc., LT3045EDD#PBF
1	U14	Low dropout CMOS linear regulator	Analog Devices, Inc., ADP1711AUJZ-1.8-R7
4	U1, U8, U9, U17	Low voltage dual supply 4-bit translator	Fairchild Semiconductor, FXL4TD245BQX
1	U5	TinyLogic UHS dual buffer	Fairchild Semiconductor, NC7WZ07P6X
1	U7	2k-bit serial I^2C bus EEPROM 1.8V to 5.5V	STMicroelectronics, M24C02-RMN6TP
1	Y2	Crystal HCMOS/TTL clock oscillator	CTS Corporation, CB3LV-3I-125M000000

Table 14. PCB Connectors and Mechanical Parts

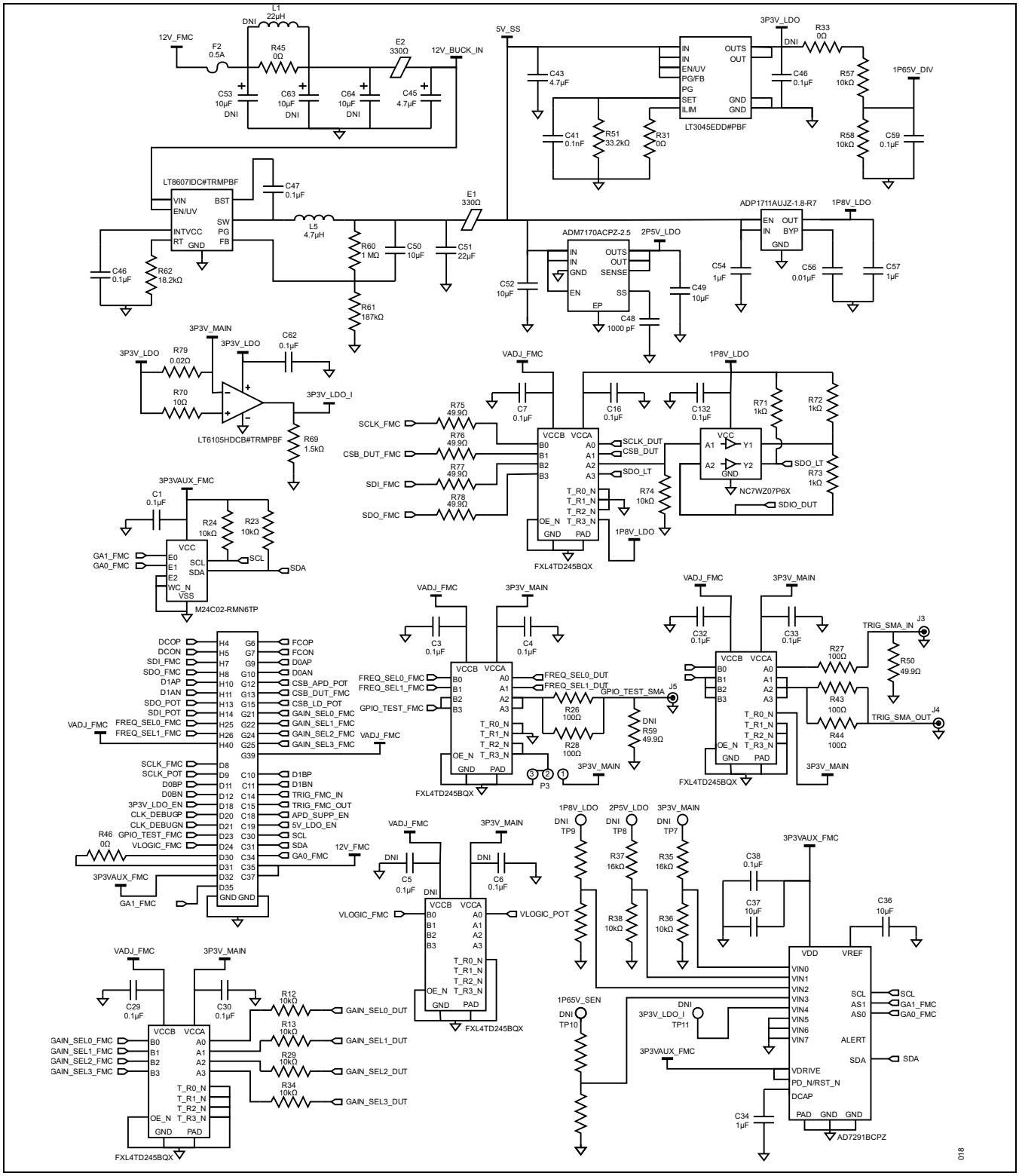
QTY	DESIGNATOR	DESCRIPTION	MANUFACTURER AND PART NUMBER
4	J1, J3, J4, J5	SMA connectors, jack, female socket, 50Ω, end launch solder	Johnson, 142-0701-851
1	J2	SMA connector, jack, female socket, 50Ω, through hole solder	Cinch Connectivity Solutions, 142-0701-201
1	P1	400-position connector, array, male pins, surface mount	Samtec, ASP-134488-01
6	P2, P3, P5, SEL0, SEL1, SEL2	3-position connectors, header, through hole (2.54mm)	Samtec, TSW-103-08-G-S
3	P4, P6, P8	2-position connectors, header, through hole (2.54mm)	Amphenol FCI, 69157-102HLF
2	TP1, TP16	Red PC test points, through hole	Keystone Electronics, 5010
6	TP4, TP5, TP6, TP17, TP18, TP19	Black PC test points, through hole	Keystone Electronics, 5011
4	N/A[1]	2-position shunt connector, closed top (2.54mm)	TE Connectivity, 880584-4
4	N/A[1]	Hex standoff, threaded M2.5 brass (20.00mm)	Wurth Elektronik, 971200154
4	N/A[1]	Hex standoff, threaded M2.5, brass (5.00mm)	Wurth Elektronik, 970050154
2	N/A[1]	Hex standoff, female, threaded M2.5 × 0.45mm, aluminum (10.00mm)	McMaster-Carr, 95947A005
2	N/A[1]	Pan head phillips screw, threaded M2.5 × 0.45mm, steel (6.00mm)	McMaster-Carr, 92005A066
1	N/A[1]	ADA4356 evaluation board PCB	Analog Devices, Inc., EVAL-ADA4356EBZ

[1] *N/A means not applicable.*

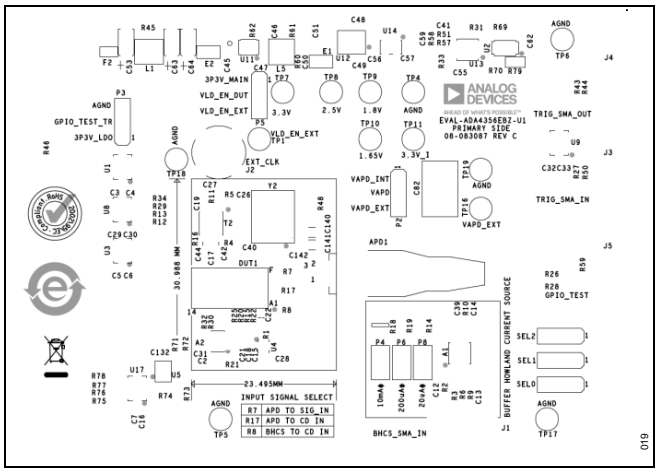
EVAL-ADA4356EBZ PCB Schematic



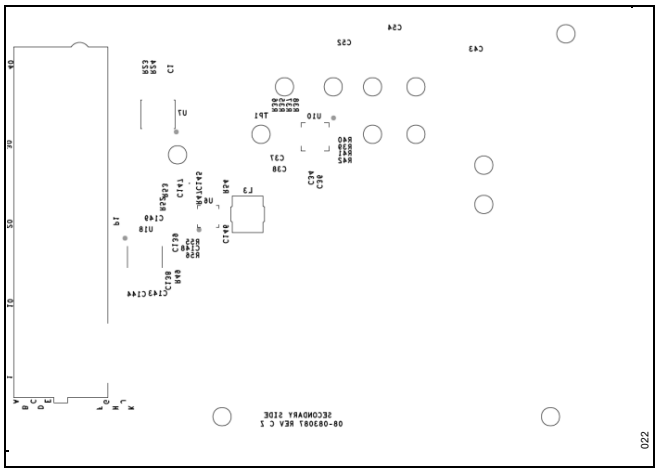
EVAL-ADA4356EBZ PCB Schematic (continued)



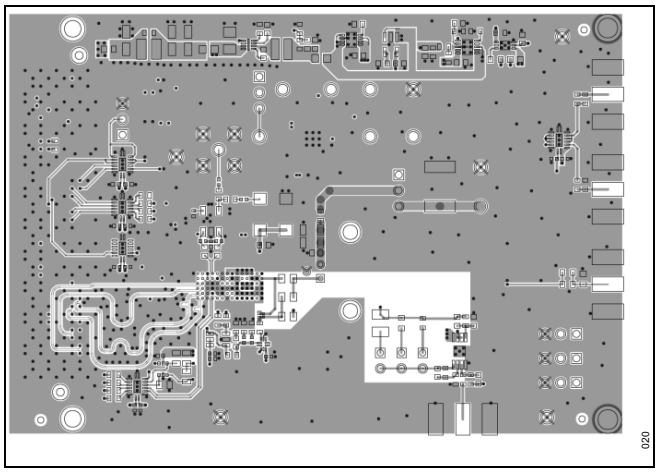
EVAL-ADA4356EBZ PCB Layout



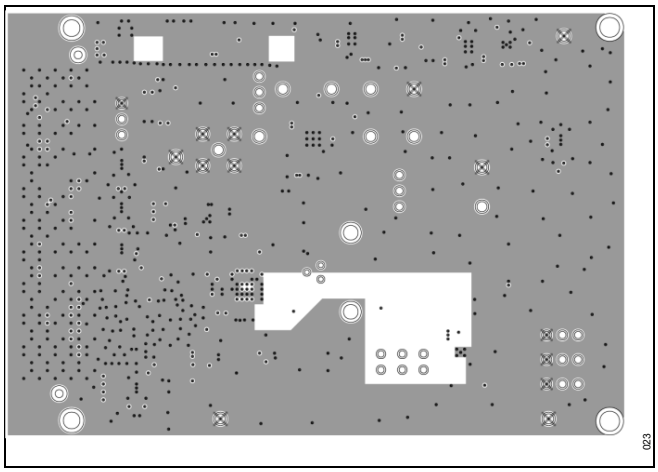
EVAL-ADA4356EBZ Component Placement Guide—Primary Silkscreen



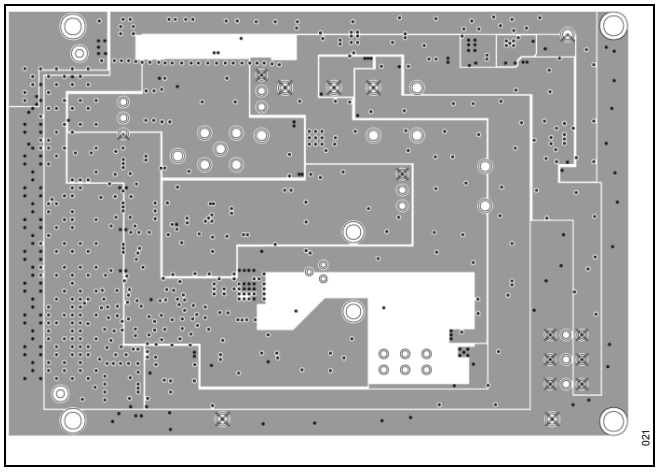
EVAL-ADA4356EBZ Component Placement Guide—Secondary Silkscreen



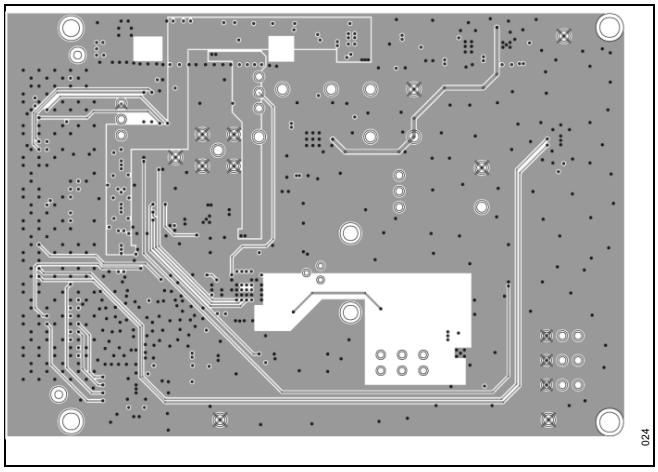
EVAL-ADA4356EBZ PCB Layout—Layer 1 (Primary)



EVAL-ADA4356EBZ PCB Layout—Layer 2 (Ground)

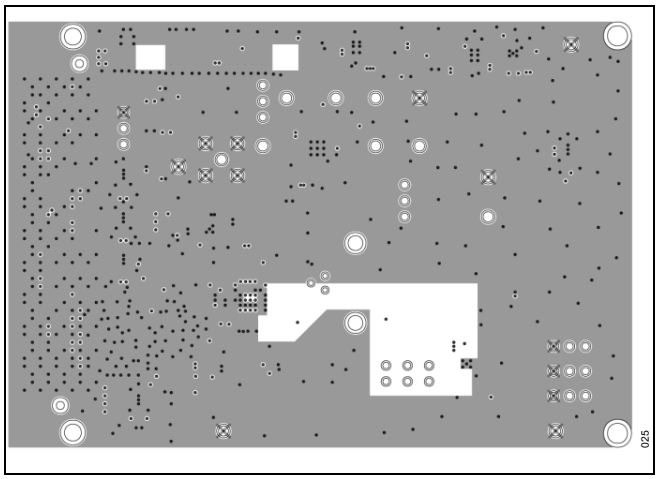


EVAL-ADA4356EBZ PCB Layout—Layer 3 (Power)

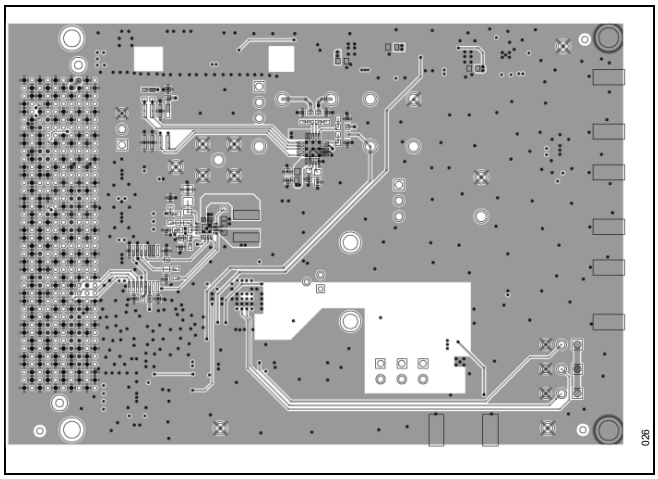


EVAL-ADA4356EBZ PCB Layout—Layer 4 (Power)

EVAL-ADA4356EBZ PCB Layout (continued)



EVAL-ADA4356EBZ PCB Layout—Layer 5 (Ground)



EVAL-ADA4356EBZ PCB Layout—Layer 6 (Secondary)

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	11/25	Initial release	—

Notes

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