AD8460

Evaluating the AD8460 High Power, High Speed Arbitrary Waveform Driver

Features

- Enables easy evaluation of the AD8460
- Easy connection to any controller board
- Robust thermal management

Applications

- Automatic test equipment (ATE)
- Display panel formation and testing
- Piezo drivers
- Programmable power supplies

Evaluation Kit Contents

- EVAL-AD8460SDZ evaluation board
- Aluminum heat sink
- Tubeaxial fan

Hardware and Software Required

- SDP-H1 or SDP-B controller board, must be purchased separately
- ACE software
- EVAL-AD8460SDZ ACE plugin

General Description

This user guide describes the EVAL-AD8460SDZ board, which evaluates the AD8460 offered in a 12 mm × 12 mm, 80-lead thin quad flat package (TQFP) with an exposed pad at the top for a mountable heat sink. The evaluation board provides a platform for quick and easy evaluation of the AD8460 for various user-defined configurations.

The AD8460 is ideally suited for demanding applications such as high-speed arbitrary waveform generation, programmable power supplies, and LCD/OLED panel formation.

The evaluation board hardware and software enable full operation of the AD8460 analog pattern generation (APG) and arbitrary waveform generation (AWG) modes. The AD8460 data sheet provides the full specifications of the AD8460 and details on the device operation. Consult it in conjunction with the user guide.

Evaluation Board Photographs

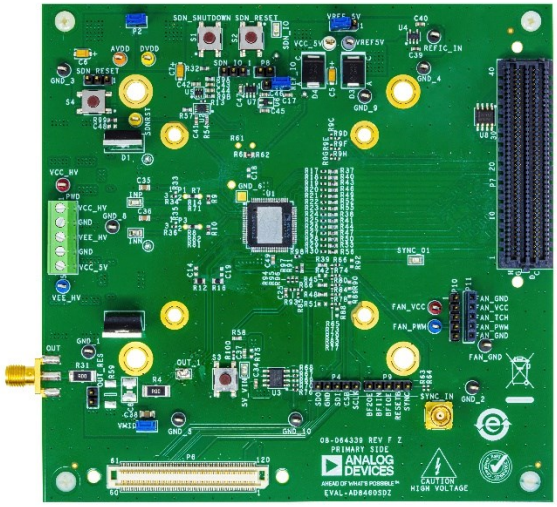

Figure 1. Front of AD8460 Evaluation Board

Warning: This high voltage evaluation board contains exposed metal carrying lethal voltages when under power. Take all necessary steps to protect users during operation. For full precautions when using this high voltage evaluation board, see the *High Voltage Evaluation Board* section.

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Initial Setup

The complete AD8460 evaluation system includes the AD8460 evaluation board, SDP board, and the AD8460 ACE plug-in. Plug-ins are product-specific applications downloaded and run in the analysis/control/evaluation (ACE) software environment. The AD8460 evaluation board communicates with Microsoft Windows 10 and ACE software through the SDP board. The AD8460 evaluation board and SDP controller boards are ordered separately. There are two types of SDP boards that can interface with the AD8460 evaluation board: SDP-B and SDP-H1.

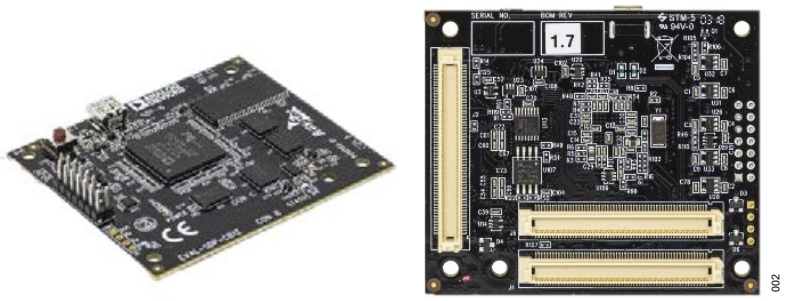

Figure 2. SDP-B Controller Board

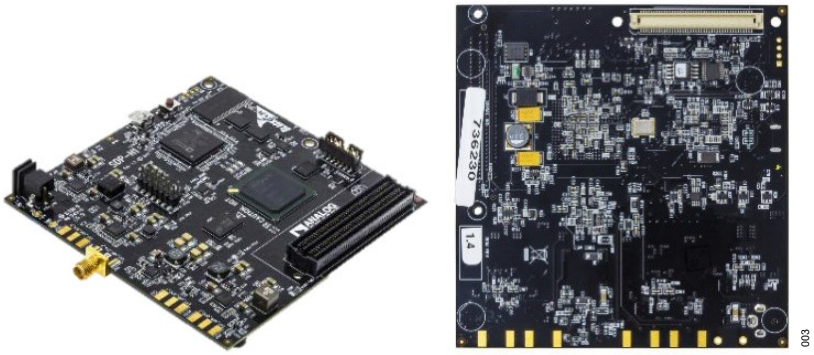

Figure 3. SDP-H1 Controller Board

The SDP-B board (*Figure 2*) has the SDP 120-pin connectors only and enables the evaluation of the APG mode (data inputs through SPI). The board comes populated for this configuration. Connect CON A/J2 of the SDP-B board to the AD8460 evaluation board's 120-pin connector P6.

The SDP-H1 board (*Figure 3*) has both the SDP 120-pin connector at the bottom and high-speed FMC connector on the top. It enables the evaluation of both the APG and AWG modes (data inputs through parallel data bits). Connect the SDP-H1 board to the AD8460 evaluation board's FMC connector P7.

Table 1 below shows the AD8460 input mode vs. SDP controller board.

TABLE 1. AD8460 INPUT MODE VS. SDP CONTROLLER BOARD

SDP Board Model	APG Mode	AWG Mode
SDP-B	YES	NO
SDP-H1	YES	YES

See the *Additional Resources* section for more information on the SDP boards. Refer to the AD8460 data sheet for more information on the APG and AWG input modes.

Alternatively, the 6-pin header P4 allows evaluation of the APG mode using a customized microcontroller.

Evaluation Board Software Installation

1. Download the ACE installer software from *www.analog.com/ace*.
2. Install the ACE application and any other recommendations like SDP drivers.

Note: This might require a system reboot at the end. So, save any open files and close any other running applications beforehand.

3. Open the ACE platform. A successfully installed ACE application displays a list of preinstalled plugins of released ADI products.

Note: Reinstall the software if unable to see existing plugins.

4. Install **Board.AD8460** through the plugin manager in the ACE toolbar. Go to **Start** and locate the AD8460 plugin in the list of installed ACE plugins.

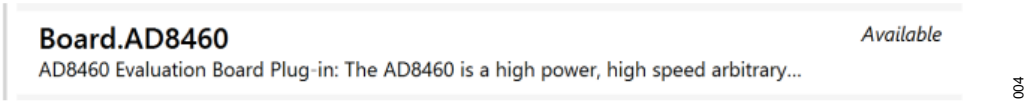

Figure 4. Plugin Available Through ACE Plugin Manager

Updating Installed Plugins

If an earlier version of the AD8460 plugin is already installed, update to the newest version by following these steps.

1. Go to Plugin Manager and select **Available Updates.**
2. Select **Board.AD8460** and click **Update Selected**.

Configuring Hardware

To configure and test the AD8460 evaluation board, the following equipment is recommended:

- N6705B power supply or equivalent
- 34401A DMM or equivalent
- 33250A function generator or equivalent
- Oscilloscope, Tektronix DPO 3014 or equivalent
- 10-8109 Silicone heat sink compound or equivalent
- System development platform (H1 or B)
- Torque screwdriver
- Kapton tape

1. Confirm the jumpers are in the factory default positions, as shown in *Figure 5*.
   a. Connect VMID to GND through the VMID 2-pin header.
   b. Connect AVDD to DVDD through the P2 2-pin header.
   c. Connect VCC_5V to VREF5V through the VREF_5V 3-pin header.
   d. Connect REF_IO to GND with a 0.1 µF capacitor through the REF_IO 3 pin header.

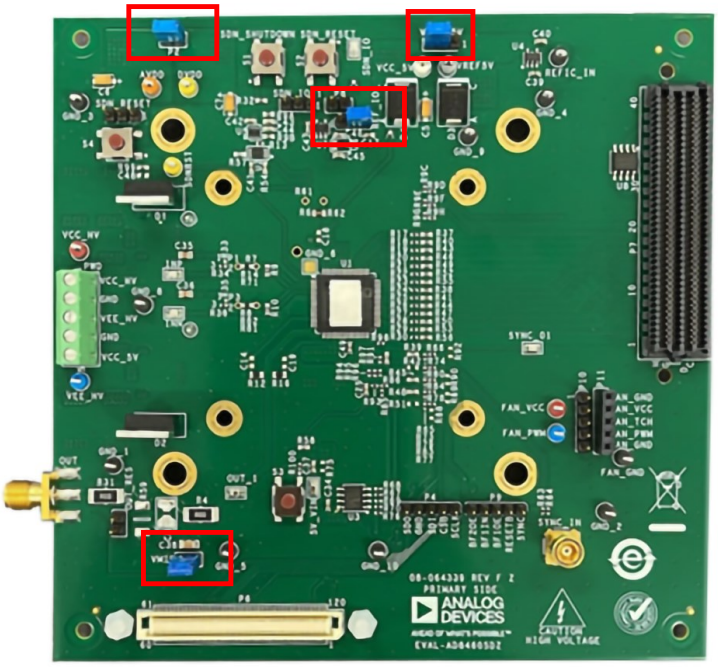

Figure 5. AD8460 Evaluation Board Factory Default Jumper Position

2. Spread a thin layer of low-impedance thermal compound about 1 ml thick on top of the AD8460. Apply Kapton tape to the edges of the heatsink, as seen in *Figure 6*, to not touch the AD8460. This is to prevent the heatsink from contacting some surface mount components, located under the heatsink from becoming shorted, that creates unwanted connections. The heatsink is black anodized. However, black anodize can scratch easily, exposing aluminum as a good conductor.

Figure 6. Back of Heatsink with Kapton Tape

3. Mount the heat sink and secure four screws (PN 9902) onto the board with four hex nuts (PN HNSS440), as shown in *Figure 7*. Use a torque screwdriver to alternatively tighten the four screws, alternating diagonally like tightening lug nuts on a car tire, to 6 in-oz on each.

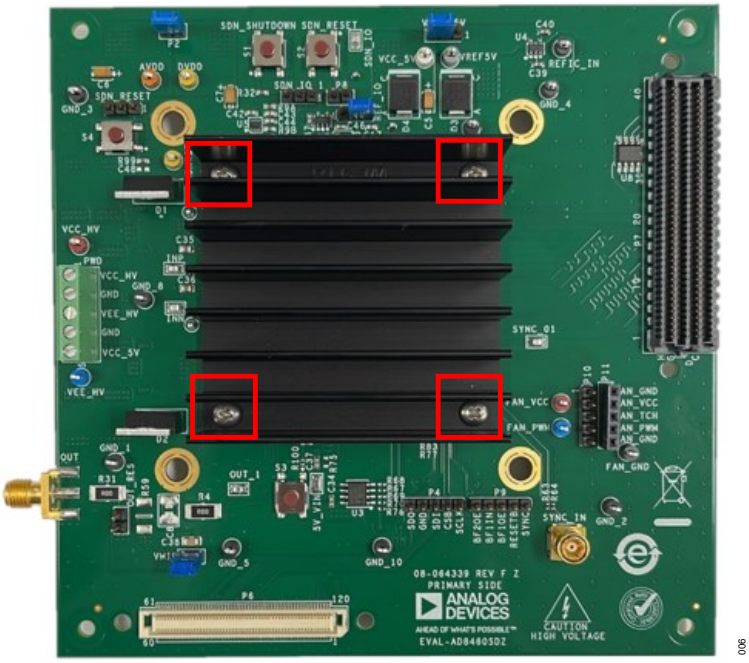

Figure 7. AD8460 Evaluation Board with Heat Sink

4. Secure the four fan standoffs (PN 2114-440-AL) onto the board with four screws (PN 9900) from the bottom of the board, as seen in *Figure 8*.

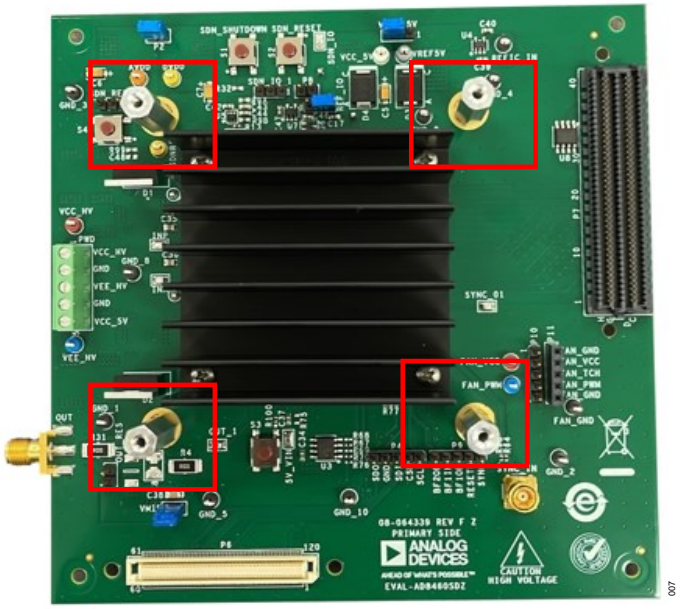

Figure 8. AD8460 Evaluation Board with Fan Standoffs Attached

5. Use four screws (PN 010440CD125) to secure the fan onto the standoffs. Then, attach the black wire of the fan to FAN_GND and attach the red wire of the fan to FAN_VCC of the female connector P11. See *Figure 11*.

Figure 9. AD8460 Evaluation Board with Fan Attached

6. Secure the four plastic standoffs (PN 1902C) to the back of the board with four plastic screws (PN NY PMS 440 0025 PH), as seen in *Figure 10*.

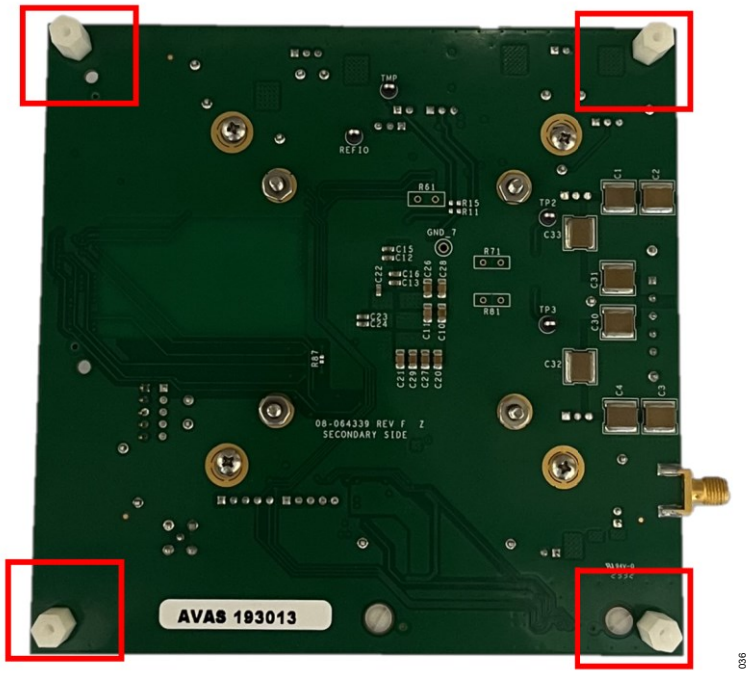

Figure 10. Back of Evaluation Board with Plastic Standoffs

7. A load capacitor can be installed on the board at C8, or an off-board load may be connected through the OUT_RES test point. Use caution when driving a load that the AD8460 does not exceed its maximum allowable temperature of 150°C.
8. Connect the high voltage supply through VEE_HV, VCC_HV, and GND test points. Make sure that the GND test point is connected first before attaching VEE_HV and VCC_HV. The recommended high voltage supplies are −50 V for VEE_HV and +50 V for VCC_HV. Make sure power connections are secure before turning on the power supplies to avoid damaging the board.
9. Connect a 5 V supply to the VCC_5V test point. Make sure the GND connection is connected first.
10. Connect a 12 V supply to FAN_VCC and set the 12 V supply to have a current limit of 100 mA.
11. Turn on the supplies at the same time. If all supplies cannot be turned on simultaneously, turn on the HV supplies first, then the 5 V supply.
12. Check the supply currents. Under normal operation, the VEE_HV and VCC_HV current should be ~18 mA to 23 mA. The 5 V digital supply current should be ~10 mA to 20 mA, with the default state of the DAC being off.

TABLE 2. POWER SUPLLY LIMITS

Supply	Expected Value
VCC_HV	18 mA to 23 mA
VEE_HV	−18 mA to −23 mA
VCC_5V (DAC Off)	10 mA to 20 mA
VCC_5V (DAC On)*	37 mA to 47 mA
TMP	1.7 V to 2.2 V

13. Turn off the supplies.
14. Mate the SDP-H1 board to the AD8460 board through P6, the 120- pin connector at the bottom side of the AD8460 board, if using APG mode only. For a more secure connection, screw the boards together through the connectors' mounting holes.

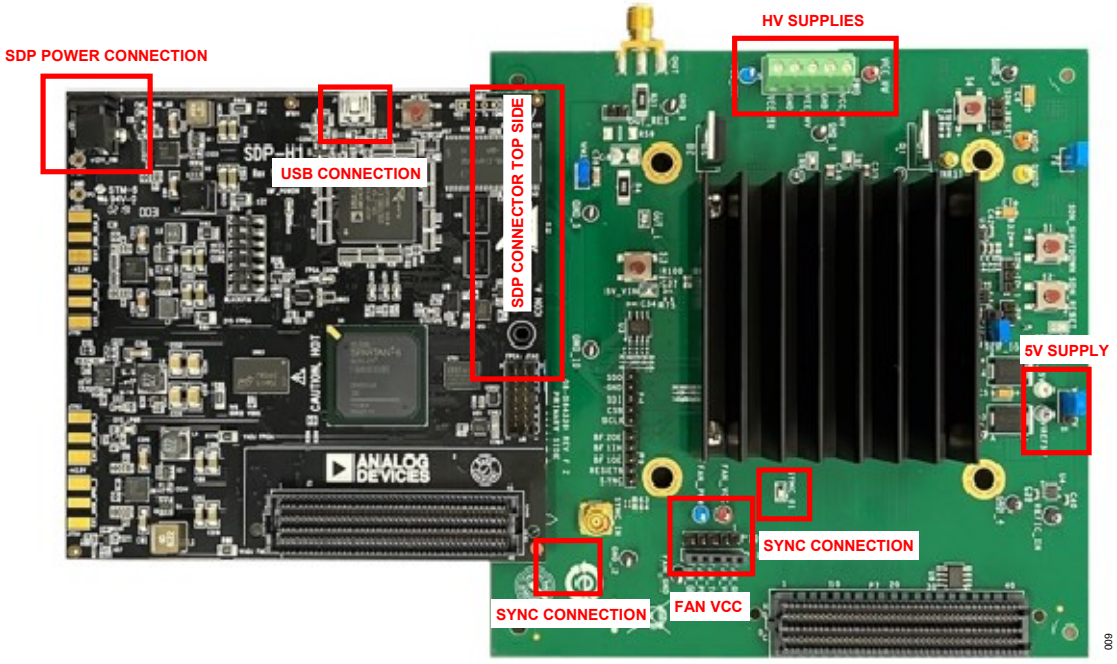

Figure 11. AD8460 and SDP Board Connected to P6 at the Bottom

If AWG mode is also used, connection is through the FMC connector P7.

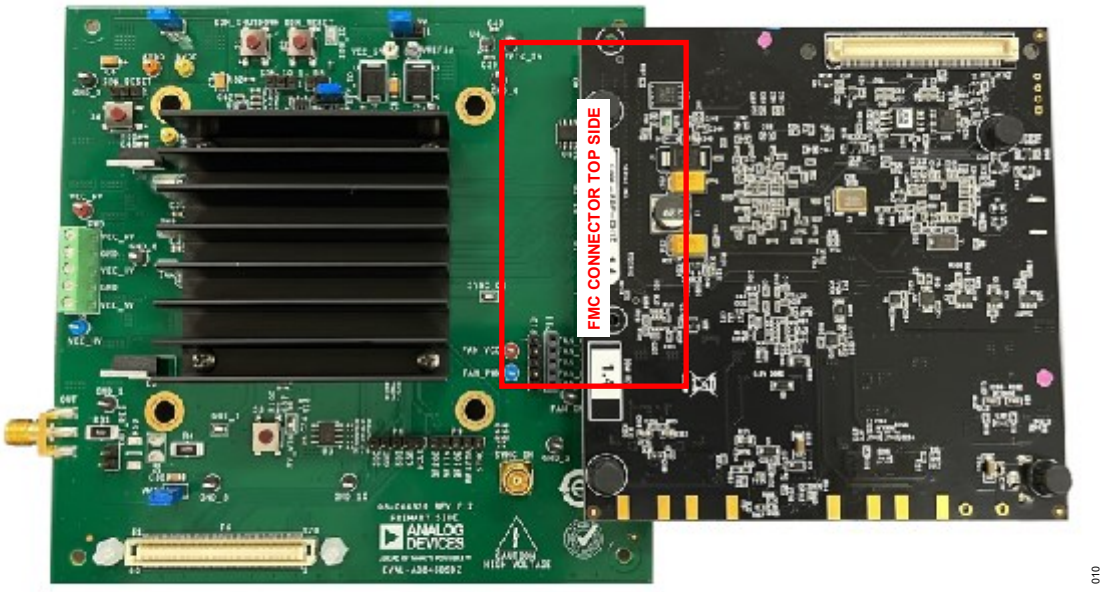

Figure 12. AD8460 and SDP Board Connected to P7 on the Top

15. Connect and plug in the SDP-H1 board power adapter.
16. Connect the SDP-H1 board to the host computer with the USB cable.
17. Turn on the supplies and apply the SYNC clock (3 Vpp, 20 kHz square wave signal centered at 1.5 V) through SYNC_01 test point or SYNC_IN SMB connector using an external function generation. Make sure your function generator is set to High Z.
18. Run the ACE application. The **AD8460 Board** plugin for P6-connected board or the **AD8460 FMC Eval Board** plugin for P-7 connected board appears in the attached hardware section of the **Start** tab. Refer to item 1 in the **Known Issues** section if the board does not appear under the attached hardware section.

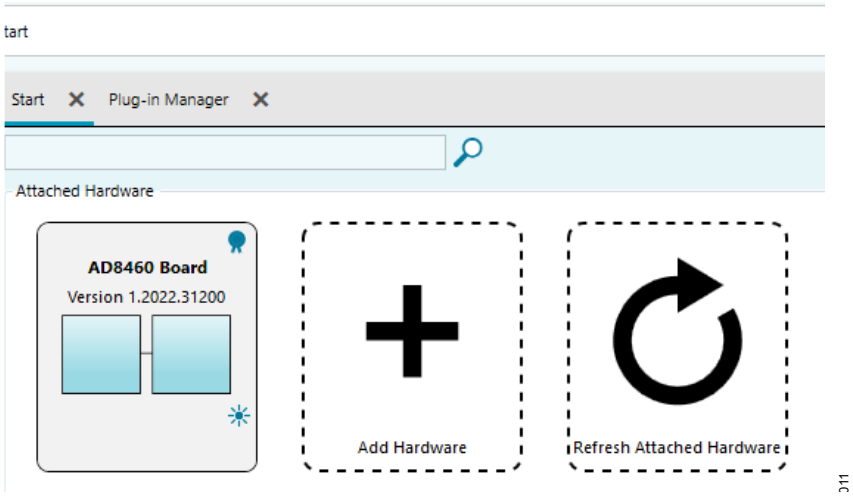

Figure 13. AD8460 Plugin Start Tab for SDP Connected Board

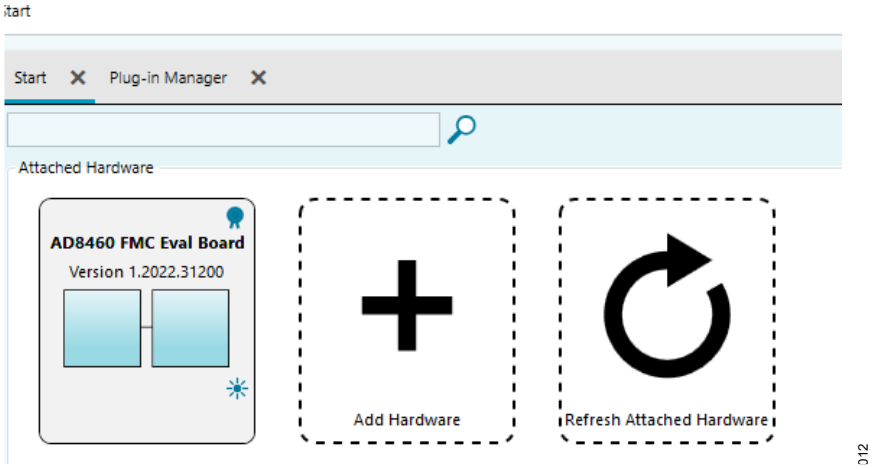

Figure 14. Successful Connection Indicator for FMC Connected Board

19. Double-click the plugin to open the board view. A successful hardware connection is indicated by a green indicator in the **AD8460 Board** or **AD8460 FMC Eval Board** tab.

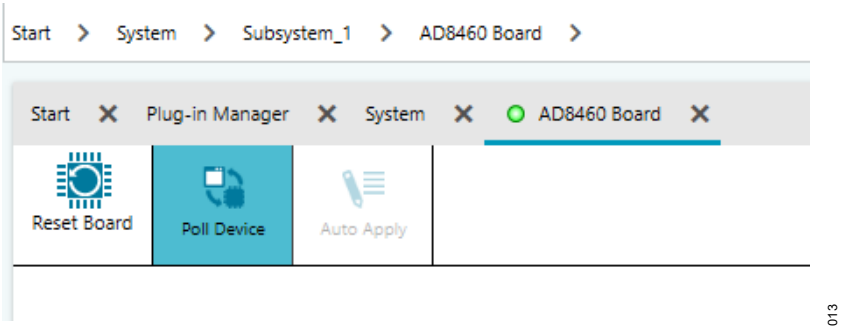

Figure 15. AD8460 Board View for SDP Connected Board

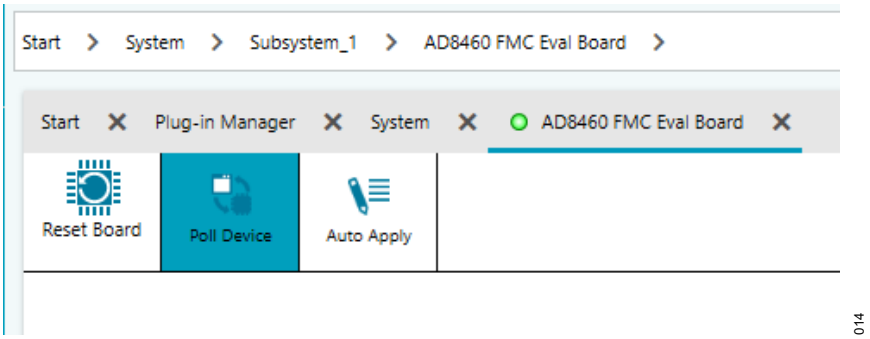

Figure 16. Successful Connection Indicator for FMC Connected Board

20. The AD8460 main functions are labeled in the **Block Diagram View** or **Chip View**. This view can be accessed by double-clicking the AD8460 symbol in the board view. This view provides a basic representation of the board's functionality.

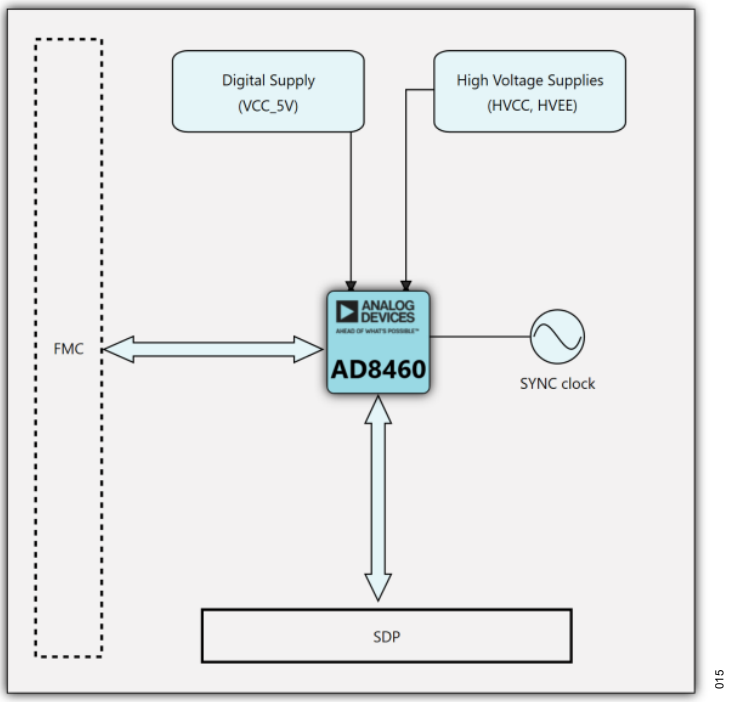

Figure 17. AD8460 ACE Plugin Board View

Block Diagram and Description

This section describes the main functions of the block diagram. The AD8640 data sheet gives a full description of each register and its settings. Some blocks and their functions are described here.

DAC and Input Mode Switch

This block allows to select the input of the MUX and sleep/wake the DAC. Select arbitrary waveform generation (AWG) or analog pattern generation (APG).

Output Voltage Levels

In the APG mode, a pattern of up to 16 discrete DC voltage levels can be loaded serially into the memory through the SPI. The pattern depth parameter indicates the number of levels the AD8460 reads from the memory to create a repeating pattern.

Sleep/Wake

This button toggles the AD8460 in and out of SLEEP mode.

Shutdown Indicator

This button and LED indicator light up green in normal operation and red when the part goes into shutdown.

Shutdown Reset

After a shutdown event due to a fault condition, reset the shutdown feature to turn the AD8460 back on. This button resets the shutdown feature by writing a 1 and then a 0 to bit[7] of 0x00.

Protection Panel

This panel allows to enable individually parameter protection. To enable protection for a given fault type, click the corresponding **Enable Protection** checkbox. Each fault type is mapped to an indicator on the GUI. Also specify the corresponding thresholds in **Desired Value** fields to trigger an alarm and shut down the high voltage driver. To clear alarms, make sure the fault event is gone, and the part's shutdown feature is reset. Click **Clear All Alarms** to clear the alarm registers and indicators.

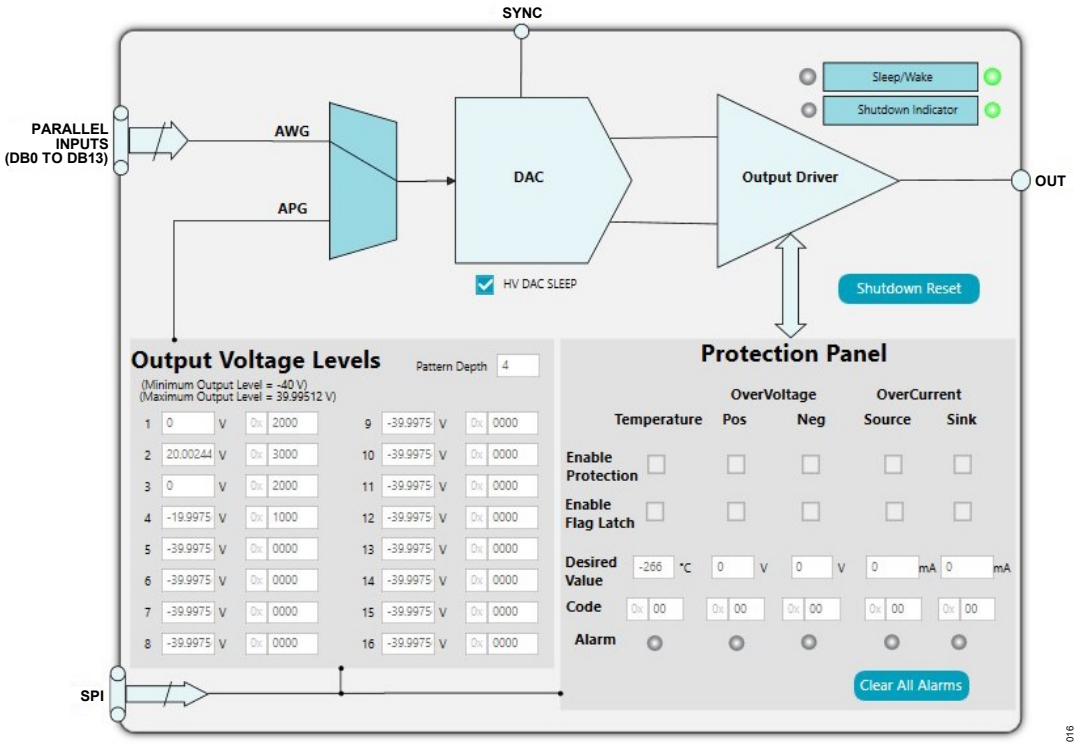

Figure 18. AD8460 Plugin Chip View Block Diagram

Using the Top Bar

Apply Changes: Apply all the values to the device and then read back all the values from the device to ensure consistency with the GUI's indicators.

Read All: Read all hardware registers from the device.

Note that by clicking **Read All**, all software changes not applied to the device are removed.

Reset Chip: Reset the hardware to its default state.

Diff: Performs no action in case of the AD8460 plugin.

Software Defaults: Shows software default values. This can be helpful in reverting to software defaults. These changes can be applied to the hardware by clicking **Apply Changes**.

Note that by clicking **Read All**, all software changes not applied to the device are removed.

Memory Map Side-By-Side: Shows the memory map of the AD8460 side by side with the chip plugin. This can be useful in seeing what changes to the plugin bind with which hardware register.

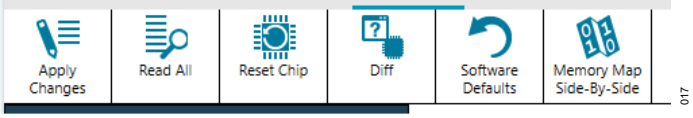

Figure 19. AD8460 Plugin Chip View Top Bar

Using Macros

Use macros to save the previous states of the evaluation process. Access macros from the left sidebar under **Tools** (*Figure 20*). Macros can also be saved as a script and run again.

Perform the following actions from the **Macro Tools:**

(*Figure 21*) Toolbar from left to right:

Record/Stop: Record/stop recording commands.

Play: Playback the recorded commands.

Edit Script: Make changes, skip commands, set up break points, and make notes for future use to a recorded macro.

Save/Save As: Save the macro for future use.

Open: Close an open macro. Open multiple macros and play with them as needed.

Delete: Delete a macro.

Generate: The tool can generate the scripts in five different languages to port them into various other tools; options are ACE Macro, C#, MATLAB, Python, and Hexadecimal (Hex).

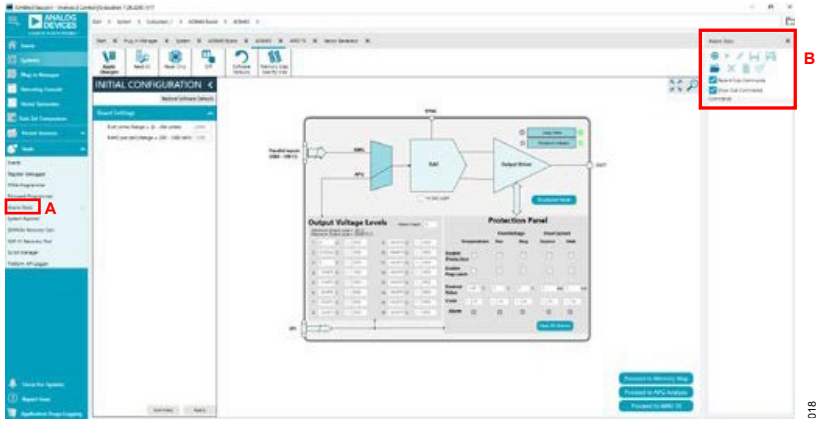

Figure 20. Accessing Macros from Tools

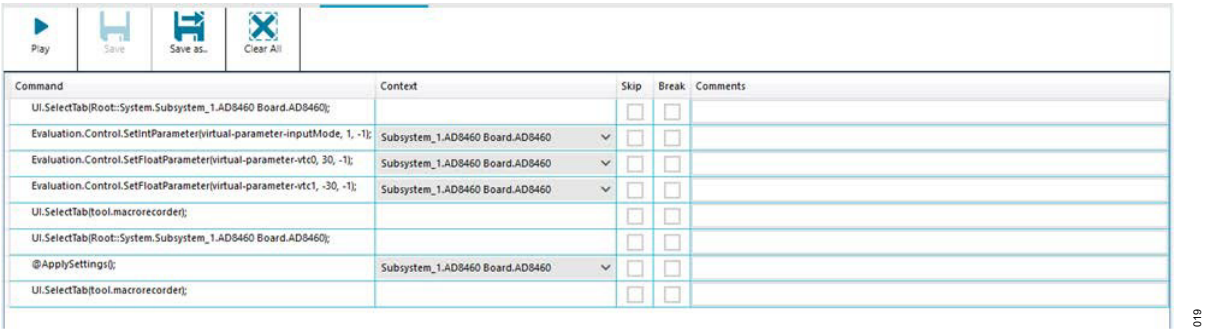

Figure 21. Using Macros

Quick Start

Once the initial setup is complete, the ACE software is loaded, and the plugins are loaded. This section details how to get an example output from both the APG and AWG modes.

Using the Analog Pattern Generation Mode

The APG mode is analogous to the operation of a digital pattern generator. Up to 16 elements may be created, each element containing an analog voltage represented by 14-bit data. This mode is recommended for simple, repetitive waveforms consisting of voltage levels. This mode can be evaluated in both the SDP and FMC connected boards. To get a sample 60 Vp-p square wave, follow these steps:

1. Click **Reset Chip** on the top left of the plugin to reset all the registers in the chip and also ensure to communicate with the device without any errors.

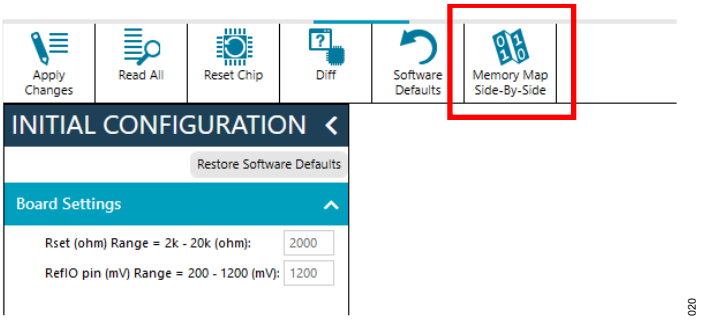

Figure 22. AD8460 Plugin Reset Chip Button

2. Once the chip is reset, use the **Input Mode Switch** to select the APG mode.
3. Make the following changes in the **Output Voltage Levels** block to generate a square wave of +/−30 V amplitude, as a simple example.
    a. **Pattern Depth** indicates the number of output states the analog pattern generates before repeating. A square wave pattern consists of only two voltage levels. So, set the **Pattern Depth** to 2. In this example, the user instructs the DAC to create a repeating pattern from only the first two levels in the list of 16 values.
    b. To create a square wave of 60 Vp-p, set the **Output Voltage Level** box 1 to '30', and Box 2 to '−30'. The corresponding hexadecimal DAC code values automatically reflect this change.
4. To protect the AD8460 from overheating, do the following in the temperature column of the **Protection Panel**:
    a. Check the **Enable Protection** box.
    b. Check the **Enable Flag Latch** box.
    c. Enter '150' in the **Desired Value** box.

    Note: See the *Application Specific Information* section for limitations in this function.

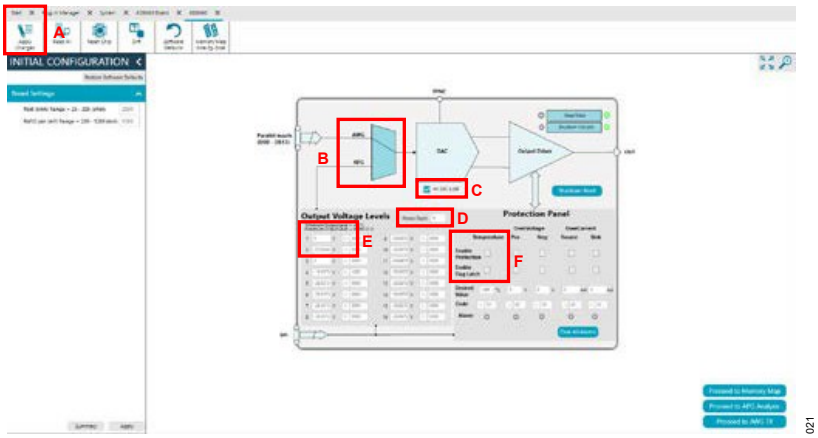

Figure 23. AD8460 APG Mode Setup

5. Wake the AD8460 HVDAC by unticking **HV DAC SLEEP.**
6. Send the entered values to the hardware through SPI by clicking **Apply Changes** on the top left of the plugin.
7. Turn on SYNC signal from an external function generator. Note: SYNC is a 3.3 V square wave signal. Any SYNC frequency up to 20 MHz may be used. Make sure to consider the slew rate limitations of the part when choosing SYNC frequency.
8. The output waveform can be measured at OUT_1 test point using an oscilloscope.

9. If there is no waveform, and the supply current drops to zero, check if **Shutdown Indicator** is lighting up, check which limit is causing the shutdown through the **Protection Panel**, remove the alarm event, and click **Shutdown Reset**.
10. To stop the output waveform, turn off/disable the SYNC clock from the external function generator.

Using the Arbitrary Waveform Generation Mode

The AWG mode is analogous to the operation of an arbitrary waveform generator. This mode is useful in generating waveforms that cannot be achieved from 16 levels. This mode provides versatility of usage and active control of the waveform. This mode is only available for the FMC connected board (*Table 1*). The following are the steps to use this mode of operation.

1. Implement these changes to the AD8460 evaluation board:
    a. Use the SDP-H1 board with the FMC connector.
    b. Set the SYNC frequency from an external function generator to 20 MHz.

       Note: The SYNC signal is also routed to the FPGA on the SDP-H1 board. The minimum frequency for this FPGA operation is 19 MHz.
    c. Supply +/− 25 V or more
2. Plugin steps:
    a. Use the **Input Mode Switch** to select the AWG mode.
    b. Wake the AD8460 HVDAC by unticking the **HV DAC SLEEP** box.
    c. Click **Apply Changes**.
    d. Click on **Proceed to AWG TX** o advance to the vector transmission tab.
    e. Click on **Vectors…** to advance to the **Vector Generator** tab.
    f. A default single tone vector window pops up, as shown in *Figure 24*.

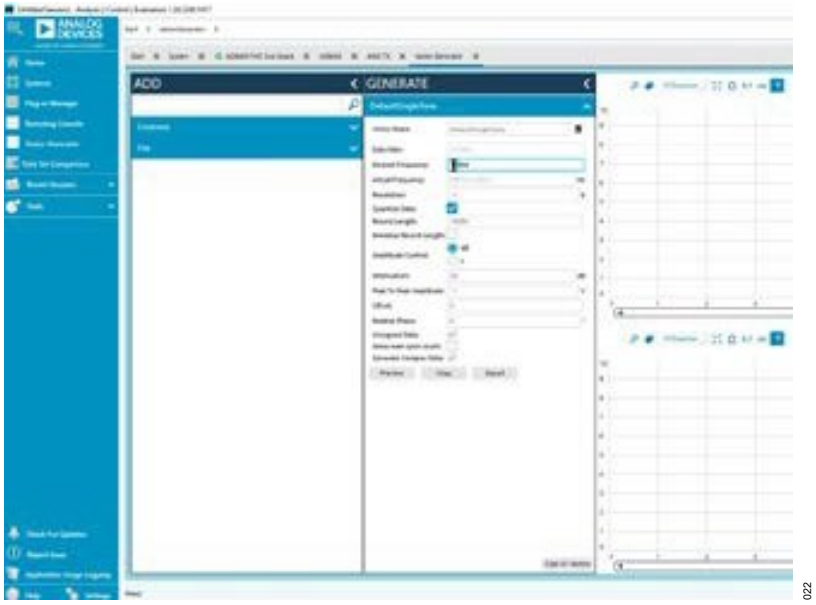

Figure 24. Default Single Tone Vector Setup

3. Generating a 5 kHz 8 Vpp Sine Wave

a. Enter the values for **Desired Frequency** and **Attenuation** (*Figure 25*) of the sine wave. The vector **DefaultSingleTone** shows the values for 8 Vpp sinewave at 5 kHz. Amplitude is 80 Vpp for 0 dB attenuation, 40 Vpp for 6 dB, 20 Vpp signal for 12 dB, 8 Vpp for 20 dB, etc.

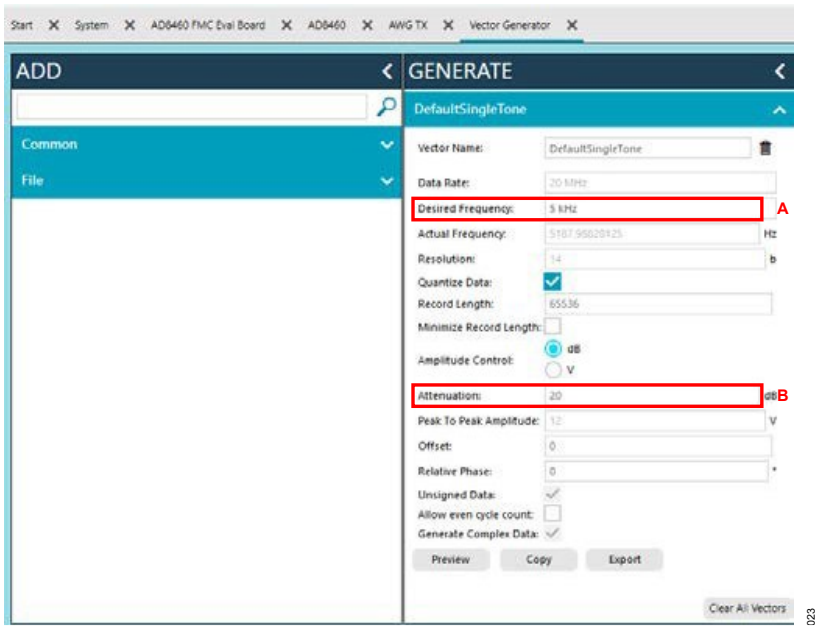

Figure 25. Generating a 5 kHz 8 Vpp Sine Wave

b. **Record Length** decides the accuracy for desired vs. actual frequency. The **Record Length** must be a power of 2.

c. Click **Preview** to review the vector.

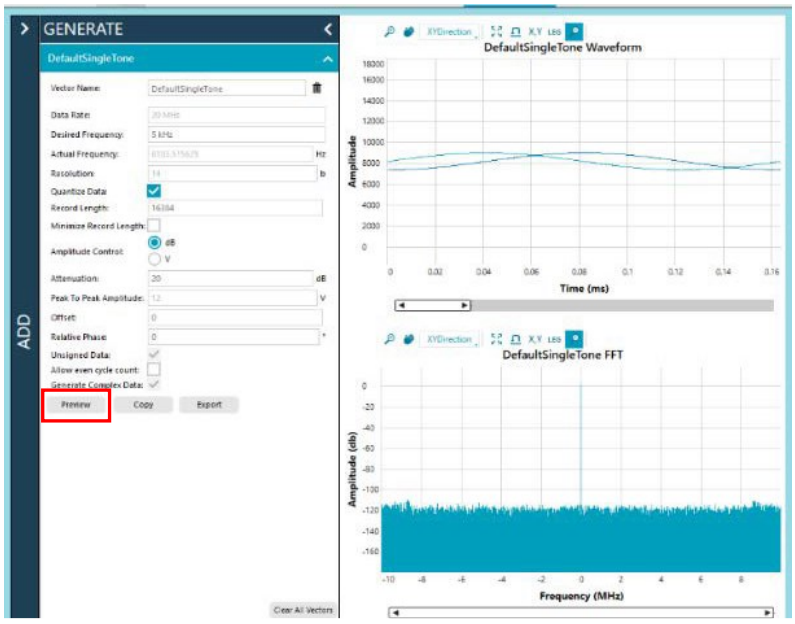

Figure 26. 8 Vpp 5 kHz Sine Wave Setup and Preview

4. Send the generated vector from the **AWG TX** tab.

a. Click the arrow on the right of **Channel0 Data**.

b. Select the desired vector from the **Channel0 Data** dropdown.

c. Click **Preview** to double check the selected vector.

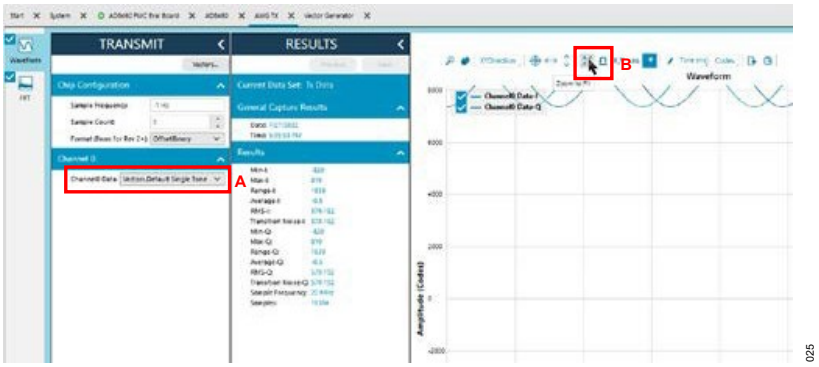

Figure 27. Vector Selection and Default Preview

d. Click **Zoom to Fit** in the waveforms tab so the preview looks like *Figure 28*.

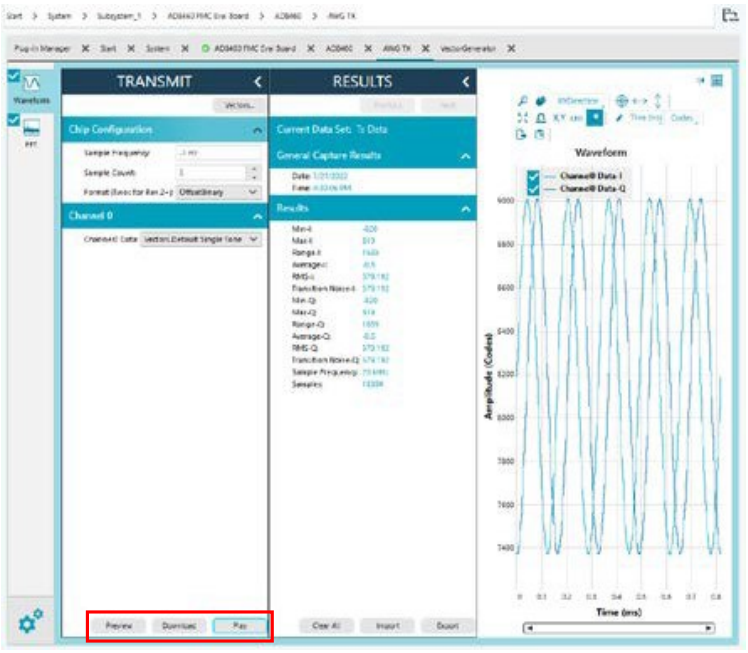

Figure 28. Full Preview of Selected Vector

e. Click **Download** to transmit the vector to the FPGA. Downloading the vector may take a minute. The vector is ready when the waveform reverts to default preview, as in *Figure 28*. Refer to item 2 in the **Known Issues** section if the desired output does not appear. There is a known issue where the vector generator tool only produces a square waveform.

f. Click **Play** to play the downloaded vector. Upon clicking, this changes to a **Stop** to cease the vector output

5. The output waveform can be measured at OUT_1 test point using an oscilloscope.

6. For other waveforms:

a. Review the vector generation tool online for information on how to generate waveforms.

b. Select the preferred waveform under the **Common** dropdown.

c. Set up the desired waveform and see steps 3 to 5 to download and verify the waveform.

Note: It may take multiple **Download → Play** before the output is displayed.

Evaluation Board Hardware Features

A. SPI Connectors

In addition to the FMC and SDP connectors, the EVAL-AD8460SDZ evaluation board includes a SPI breakout jumper for custom controller board operation.

B. Full-Scale Adjustment Through REF_IO Jumper

The EVAL-AD8460SDZ evaluation board includes a REF_IO jumper to reduce the output voltage span by applying an external voltage reference to jumper pin 2, which is connected to REFIO. It can be driven with a voltage in the range of 1.2 V maximum to as low as 0.12 V, reducing the full-scale output span from +/−40 V to as low as +/−4 V. This is the recommended option for applications requiring dynamically adjustable span.

C. Full-Scale Adjustment Through R_{SET}

The EVAL-AD8460SDZ evaluation board has a 2 kΩ 0.01% resistor, R6, that sets the reference current, I_{REF}. The range of this R_{SET} resistor is 2 kΩ to 20 kΩ, corresponding to 600 µA to 60 µA, respectively when REFIO is 1.2 V.

I_{REF} = 1.2 V/2 kΩ = 600 µA

D. Compensation (COMP_H AND COMP_L)

The EVAL-AD8460SDZ evaluation board includes provisions with 0603 footprints for compensation capacitors, COMP_H and COMP_L. These capacitors must be high voltage types to withstand the full-scale range of the output signal; minimum 100 V capacitors are recommended when running on the +/−50 V supplies.

E. Thermal Monitor (TMP) and Thermal Management

The TMP pin can be used to monitor relative changes in die temperature. The typical TMP pin voltage at room temperature is 1.75 V and changes at approximately 6 mV/°C. More precise temperature readings can be achieved through a one-time room temperature calibration.

The TMP pin can be connected to the SDN_IO pin for optional thermal shutdown by installing a 0 Ω resistor at R11. The AD8460's thermal monitoring capability is independent of any overtemperature shutdown threshold and may be used whether TMP is strapped to SDN_IO.

F. Shutdown Feature (SDN_SHUTDOWN, SDN_RESET, and S4 Switch Buttons)

The EVAL-AD8460SDZ evaluation board includes switch buttons SDN_SHUTDOWN and SDN_RESET to pull the SDN_IO pin on the AD8460 to logic high or logic low, respectively. When SDN_IO is pulled high, the AD8460's supply current is reduced to ~100 µA and the internal high voltage driver is disabled.

The S4 switch button toggles the SDN_RESET pin on the AD8460 high. This is an alternative way of exiting a state of shutdown.

G. RESET Feature (S3 Switch Button)

The EVAL-AD8460SDZ evaluation board includes the switch button S3 to manually toggle the RESETB pin to GND to reset all the hardware features to default.

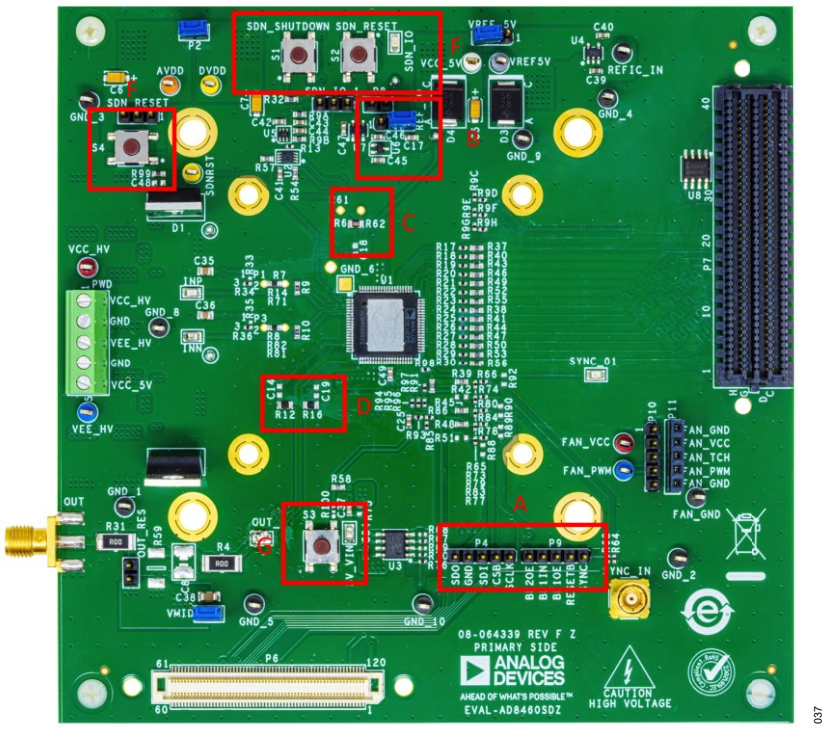

Figure 29. Front of AD8460 Evaluation Board with Highlighted Hardware Features

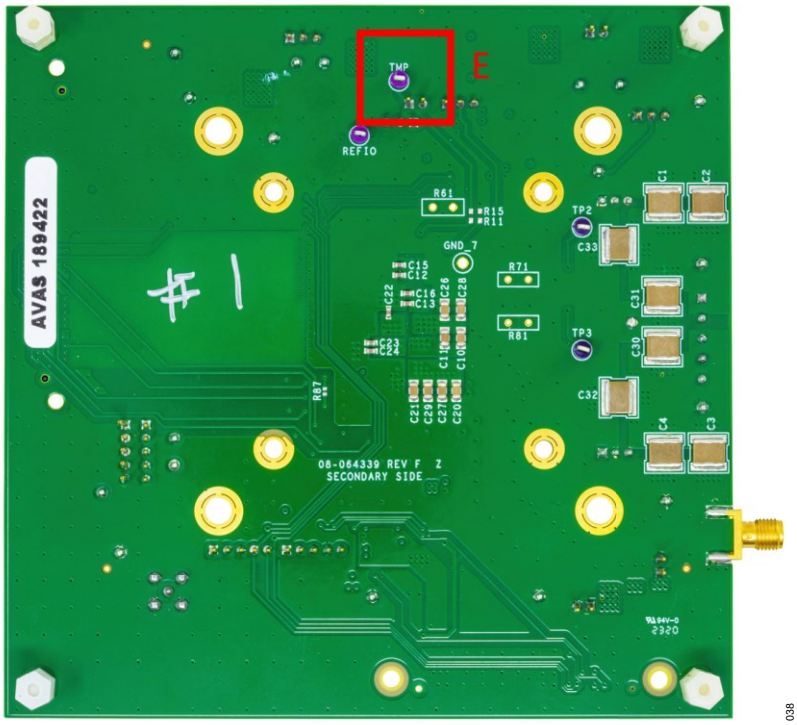

Figure 30. Back of AD8460 Evaluation Board, TMP Monitor is Highlighted

Troubleshooting Errors

1. AD8460 board does not appear in the attached hardware section:
    a. Check for a firm connection between the SDP board and evaluation board.
    b. Check the power of the SDP board and reconnect the USB.
    c. If still not working, try to reset the SDP board through the red reset button switch.
2. AWG mode output does not update.
    a. Sometimes one **Download → Play** sequence is not enough to display the results. Monitor the output on an oscilloscope and repeat the steps until the output is displayed correctly.
    b. If the output is repeatedly updating to a square waveform, generate a **Copy** of the desired vector in the vector generator tool and repeat the **Download → Play** sequence until the output is displayed correctly.
3. Transaction error pops up at start-up.
    a. This is a known issue in the FMC plugin only. Click on **Reset Board** to remove the pop-up. The indicator on the status bar still shows up as red but this does not affect the plugin functions and status now shows up as **Good**.

Application Specific Information

1. When using the fault monitoring and protection:
    a. Triggering the alarm requires the desired threshold to be met for a minimum duration before a shutdown is initiated. When operating at higher SYNC frequencies (>1 MHz), depending on the waveform, the threshold value may not be met for a long enough duration to trigger an alarm.
    b. Programming a desired threshold of 0 always causes the alarms flags to be in a high state since the protection circuitry inherently senses any noise on the output node, causing the alarm to constantly retrigger.

Ordering Information

Bill of Materials

Item	Qty.	Reference Designator	Part Description	Manufacturer, Part No.
1	1	U1	IC, high-voltage, high-current amplifier	Analog Devices, AD8460BSVZ
2	8	C1, C2, C3, C4, C30, C31, C32, C33	Capacitor, ceramic, 1.2 µF, 250 V, 10%, X7R, 2225	Kemet, C2225C125KARACTU
3	9	C10, C11, C20, C21, C26, C27, C28, C29, C38	Capacitor, ceramic, 0.1 µF, 250 V, 10%, X7R, 1206	Kemet, C1206X104KARACTU
4	21	C12, C13, C15, C16, C17, C22, C23, C24, C25, C34, C37, C39, C40, C41, C42, C43, C44, C45, C46, C47, C49	Capacitor, ceramic, 0.1 µF, 16 V, 10%, X7R, 0603	Yageo, CC0603KRX7R7BB104
5	6	5V_VIN, INN, INP, OUT_1, SDN_IO, SYNC_01	Connector-PCB, SMT test point	Keystone Electronics, 5015
6	1	AVDD	Connector-PCB, test point orange	Components Corporation, TP104-01-03
7	2	C35, C36	Capacitor, ceramic, 1.2 µF,10 V,10%,X5R, 0805	Kemet, C0805C125K8PACTU
8	3	C5, C6, C7	Capacitor, tantalum, 10 µF,16 V,10%, 3216 to 3218	Kemet, T491A106K016AT
9	2	D1, D2	Diode, Schottky rectifier, 20 A, 150 V	On Semiconductor/MBR20H150CTG
10	2	D3, D4	Diode, Schottky rectifier, 3 A, 60V	Vishay/SS36-E3/57T
11	2	DVDD, SDNRST	Connector-PCB, test point yellow	Components Corporation, TP-104-01-04
12	10	FAN_GND, GND_1, GND_2, GND_3, GND_4, GND_5, GND_8, GND_9, GND_10, REFIC_IN	Connector-PCB, test point black	Components Corporation, TP-104-01-00
13	2	FAN_PWM, VEE_HV	Connector-PCB, test point blue	Components Corporation, TP104-01-06
14	2	FAN_VCC, VCC_HV	Connector-PCB, test point red	Components Corporation, TP-104-01-02
15	1	OUT	Connector-PCB, surface mount assembly (SMA) end launch	Cinch Connectivity Solutions, 142-0701-801
16	4	OUT_RES, P2, P8, VMID	Connector-PCB, 2 position header	Samtec, TSW-102-09-G-S

17	3	P4, P9, P10	Connector-PCB, 5 position header	Samtec, TSW-105-08-G-S
18	1	P11	Connector-PCB, 5 position female header, 10 mm solder tail	Samtec, SSQ-105-03-G-S
19	1	P6	Connector-PCB, board to board connector	Hirose Electric, FX8-120S-SV(21)
20	1	P7	Connector-PCB, 160 position connector array	Samtec, ASP-134604-01
21	1	PWD	Connector-PCB 5 position terminal block	Phoenix Contact, 1727049
22	2	R9, R10	Resistors, surface-mount device (SMD), 0 Ω, 1/10 W, 0603	Yageo, RC0603JR-070RL
23	1	R100	Resistors, surface-mount device (SMD), 1 kΩ, 1%, 1/10 W, 0402, AEC-Q200	Panasonic, ERJ-2RKF1001X
24	2	R12, R16	Resistors, surface-mount device (SMD), 0 Ω, 1/10 W, 0805	Multicomp (SPC), MC01W08050R
25	23	R9C, R9D, R9E, R9F, R9G, R9H, R13, R34, R36, R63, R64, R65, R66, R73, R74, R77, R78, R79, R80, R83, R84, R85, R86	Resistors, surface-mount device (SMD), 0 Ω, 1/10 W, 0402, AEC-Q200	Panasonic, ERJ-2GE0R00X
26	20	R17, R18, R19, R20, R21, R22, R23, R24, R25, R26, R27, R28, R29, R30, R93, R94, R95, R96, R97, R98	Resistors, surface-mount device (SMD), 0 Ω, 1/16 W, 0402	Yageo, RC0402JR-070RL
27	2	R4, R31	Resistor, surface-mount device (SMD), 0 Ω, 1 W, 2512, AEC-Q200	Vishay, CRCW25120000Z0EG
28	18	R9A, R9B, R32, R37, R38, R40, R41, R43, R44, R46, R47, R49, R50, R52, R53, R55, R56, R99	Resistors, surface-mount device (SMD), 10 kΩ, 1%, 1/10 W, 0603, AEC-Q200	Panasonic, ERJ-3EKF1002V
29	7	R39, R45, R48, R54, R57, R58, R91	Resistors, surface-mount device (SMD), 49.9 kΩ, 1%, 1/10 W, 0603, AEC-Q200	Panasonic, ERJ-3EKF4992V
30	1	R6	Resistor, surface-mount device (SMD), 2 kΩ, 0.01%, 1/8 W, 0805, AEC-Q200	Stackpole Electronics, Inc., RNCF0805TKY2K00
31	2	R67, R70	Resistors, surface-mount device (SMD),	Panasonic, ERJ-2GEJ104X

			100 kΩ, 5%, 1/10 W, 0402, AEC-Q200	
32	2	R7, R8	Resistors, surface-mount device (SMD), 50 Ω, 1%, 1/10 W, 0603 AEC-Q200	Vishay, CRCW060350R0FKEA
33	1	R76	Resistor, surface-mount device (SMD), 1 MΩ, 1%, 1/10 W, 0402, AEC-Q200	Panasonic, ERJ-2RKF1004X
34	2	REFIO, TMP	Connector-PCB, test point violet	Components Corporation, TP104-01-07
35	4	REF_IO, SDN_IO_1, SDN_RESET, VREF_5V	Connector-PCB, 3 position header	Samtec, TSW-103-08-G-S
36	4	S1, S2, S3, S4	Switch, surface mount, mechanical	Omron, B3S1000
37	1	SYNC_IN	Connector-PCB, SMB connector plug, 50 Ω, through hole solder	Amphenol, 142134
38	2	TP2, TP3	Connector-PCB, test point purple	Keystone, 5124
39	1	U2	IC, dual Buffer with 3-state outputs	On Semiconductor, NL27WZ125USG
40	1	U3	IC, 32 kb serial electrically erasable programmable read-only memory (EEPROM)	Microchip Technology, 24LC32A/SN
41	1	U4	IC, low power, low noise V_{REF} with sink/source capability	Analog Devices, ADR365BUJZ
42	1	U5	IC-ADI, rail-to-rail, fast, low power transistor-transistor (TTL)/componentized metal-oxide semiconductor (CMOS) components	Analog Devices, ADCMP608BKSZ
43	1	U6	IC-ADI, 1.2 V ultralow power high power supply rejection ratio (PSRR) voltage reference	Analog Devices, ADR280AKSZ-REEL7
44	1	U7	IC-ADI 8 MHz rail-to-rail operational amplifier	Analog Devices, AD8519ARTZ
45	1	U8	IC 2 kb soft error rate (SER) I^2C bus,	STMicroelectronics, M24C02-RMN6TP

			EEPROM, 1.8 V to 5.5 V	
46	1	VCC_5V	Connector-PCB test point white	Components Corporation, TP-104-01-09
47	1	VREF_5V	Connector-PCB test point grey	Components Corporation, TP104-01-08
48	2	C14, C19	Capacitor, ceramic, 2 pF 250 V, 0.1 pF, C0G 0603	MURATA, GQM1875C2E2R0BB12
49	2	C18, C48	Capacitor, ceramic, 100 pF, 50 V, 10%, X7R 0603	KEMET, C0603C101K5RAC
50	1	C8	Non-preferable, do not install (DNI), use SYM_3 and/or SYM_4	N/A
51	1	GND_7	Connector-PCB test point, black	Components Corporation, TP-104-01-00
52	2	R11, R15	Do not install (DNI) (TBD_R0603), use SYM_3 and/or SYM_4	TBD0603
53	2	R14, R82	Resistor, surface-mount device (SMD), 50 Ω, 1%, 1/20 W, 0402, high frequency	Vishay, FC0402E50R0FST1
54	3	R33, R35, R87	Resistor, surface-mount device (SMD), 0 Ω, jumper 1/10 W, 0402, AEC-Q200	Panasonic, ERJ-2GE0R00X
55	2	R42, R51	Resistor, surface-mount device (SMD), 49.9 kΩ, 1% 1/10 W, 0603, AEC-Q200	Panasonic, ERJ-3EKF4992V
56	1	R59	Resistor, surface-mount device (SMD), 49.9 Ω, 1%, 1 W, 2512, AEC-Q200	Vishay, CRCW251249R9FKEG
57	1	R61	Resistor, through hole, 2 kΩ, 0.005% 0.6 W, 7.62 mm x 2.67 mm x 8.53 mm x 3.81 mm, high precision	Vishay, Y00622K00000V9L
58	1	R62	Resistor, surface-mount device (SMD) 2 kΩ 0.1% 0.15 W, 0603, AEC-Q200, sulfur resistant	Vishay, PAT0603E2001BST1

59	2	R68, R69	Resistor, surface-mount device (SMD), 0 Ω, jumper 1/16 W, 0402	Yageo, RC0402JR-070RL
60	2	R71, R81	Resistor, through hole, 50 Ω 0.01%, 3/5 W, 7.62 mm x 2.67 mm x 8.53 mm x 3.81 mm, high precision	Vishay, Y006250R0000T9L
61	1	R75	Resistor, surface-mount device (SMD), 0 Ω, jumper, 1/10 W, 0603 AEC-Q200, precision power	Vishay, CRCW06030000Z0EA
62	4	R88, R89, R90, R92	Resistor, surface-mount device (SMD), 0 Ω, jumper, 1/10 W, 0603, AEC-Q200	Panasonic, ERJ-3GEY0R00V

AD8460 Evaluation Board Schematic

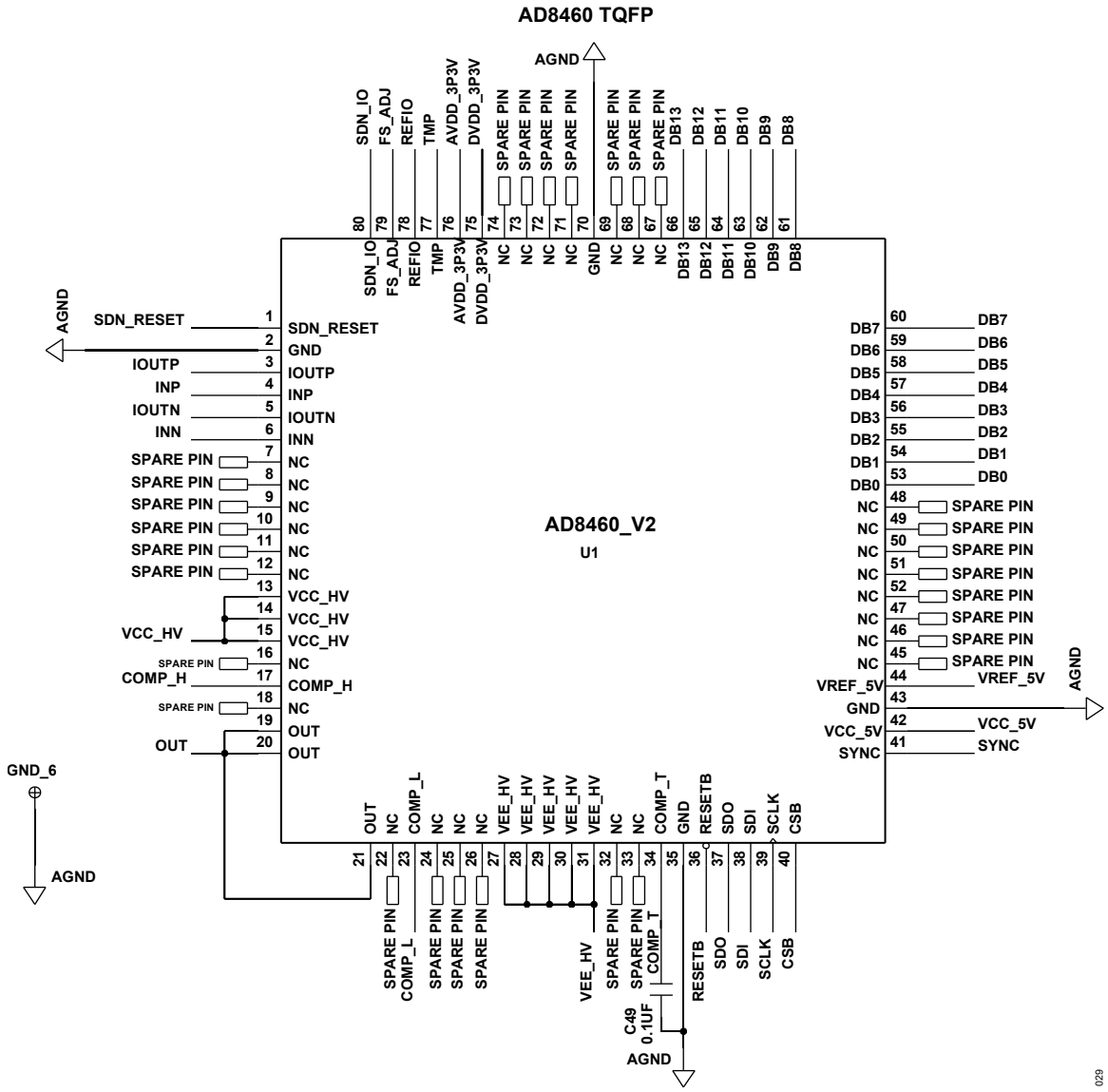

Figure 31. AD8460 Pinout

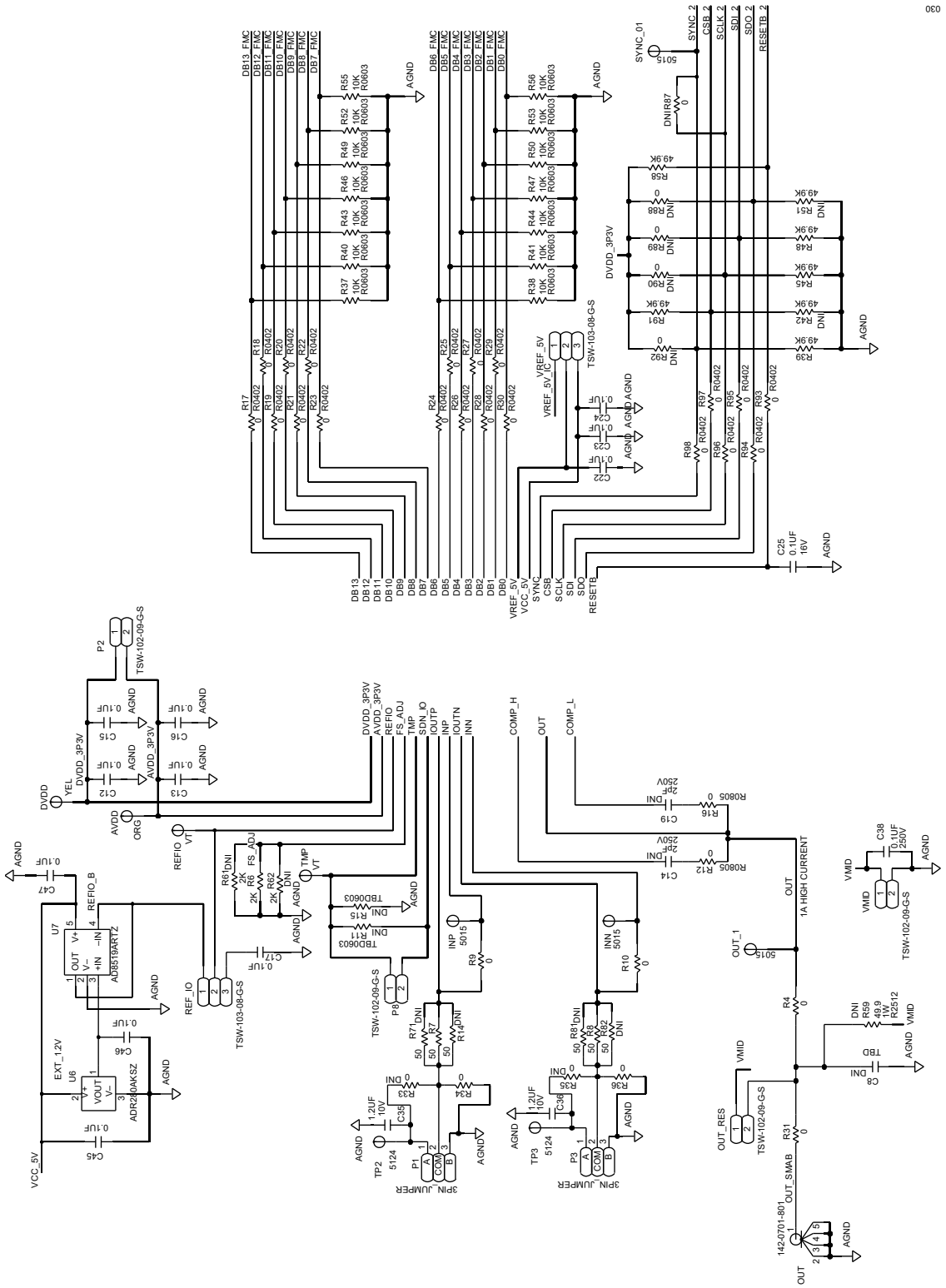

Figure 32. AD8460 Evaluation Board Connections

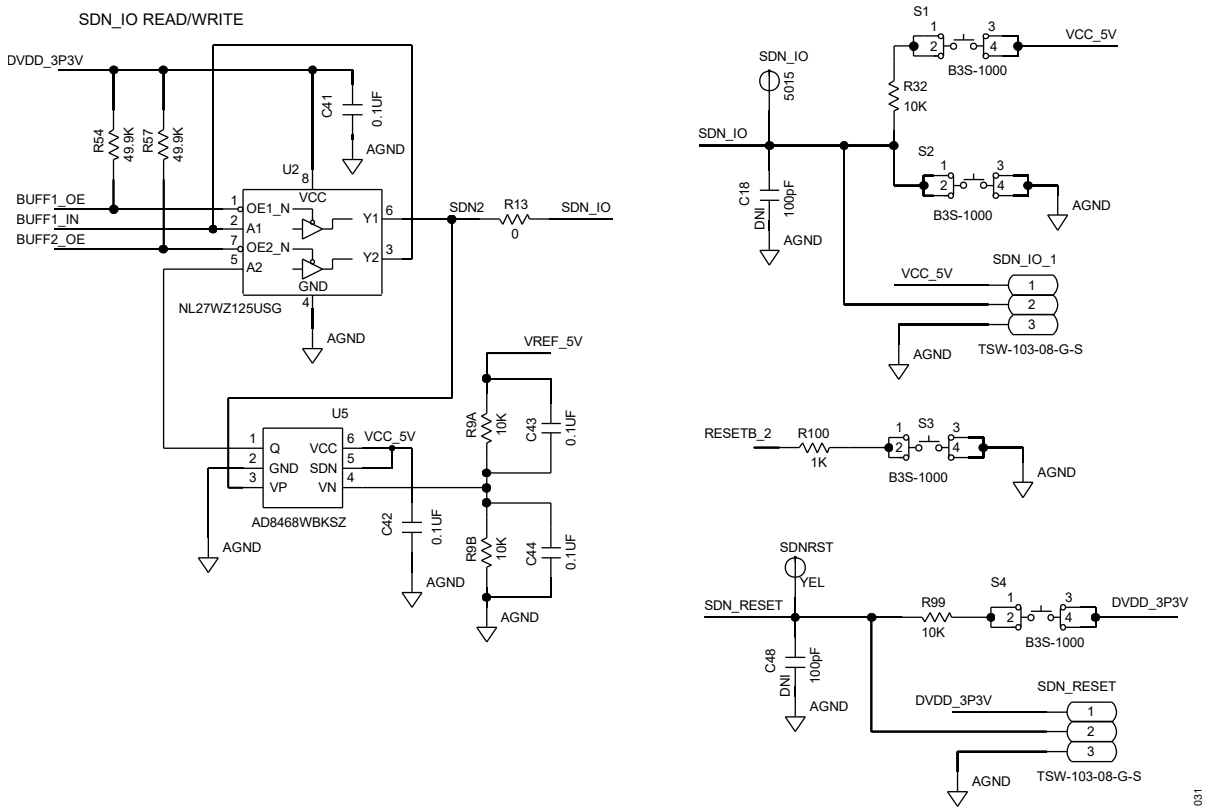

Figure 33. On-Board Switch Button Connections and Shutdown Read/Write

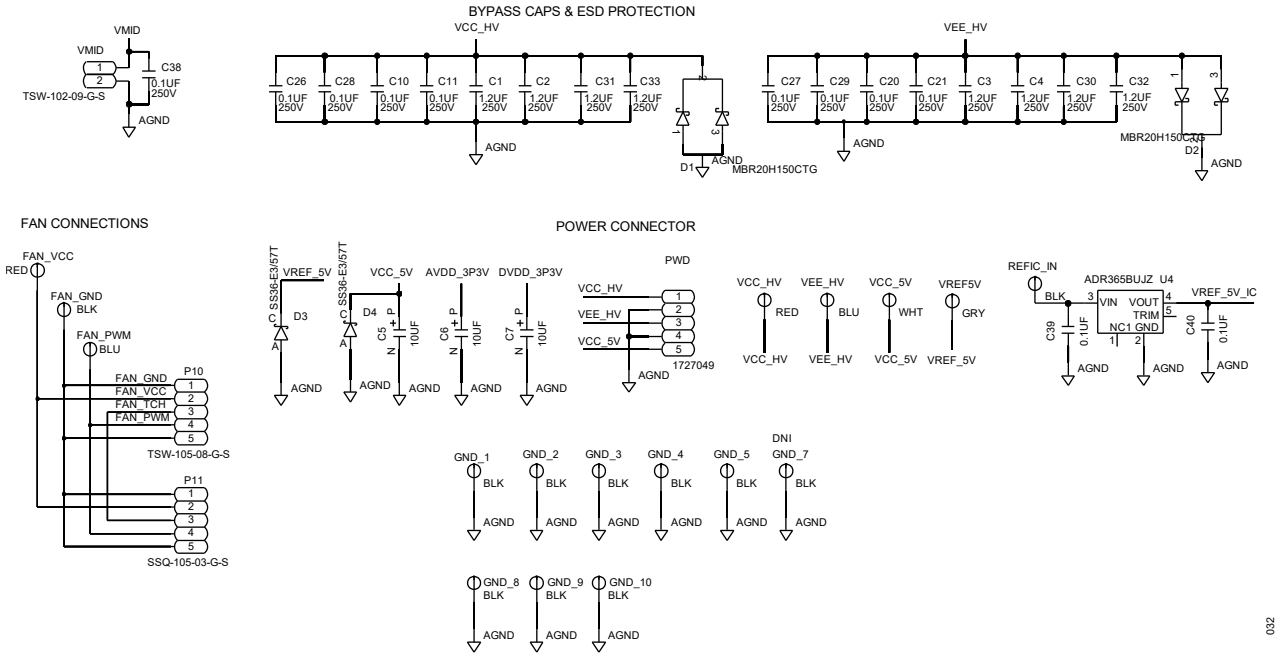

Figure 34. Power Connections and Voltage Reference

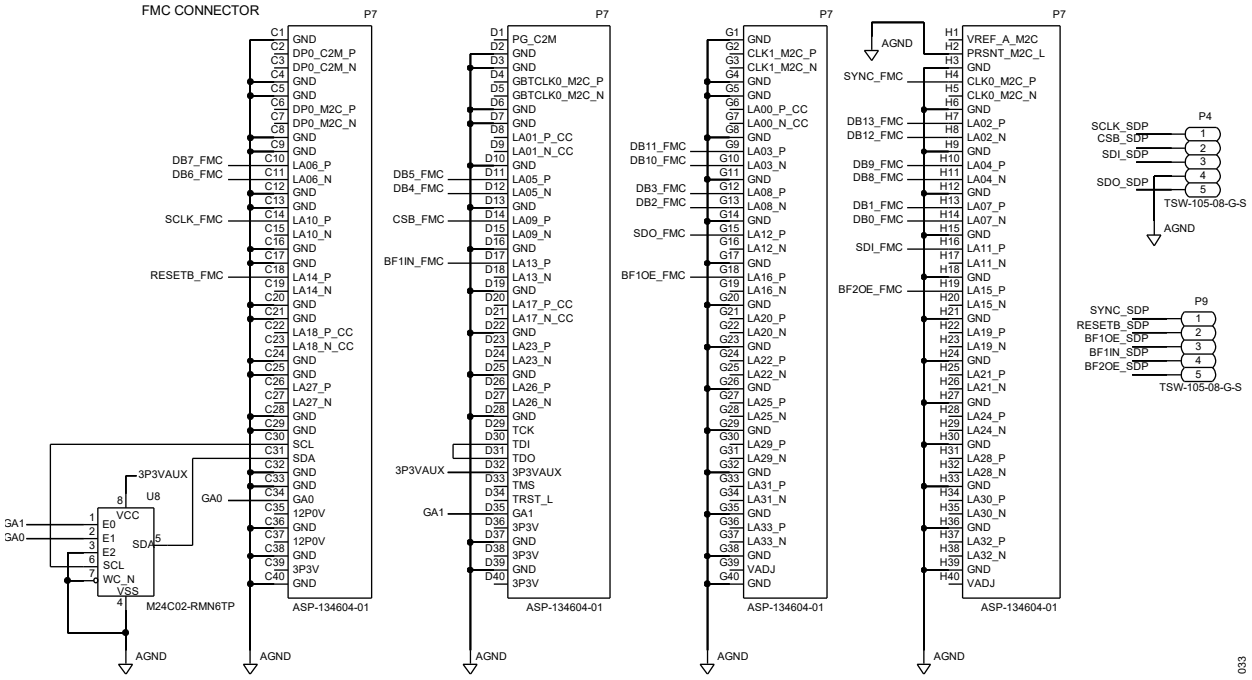

Figure 35. FMC and Connections

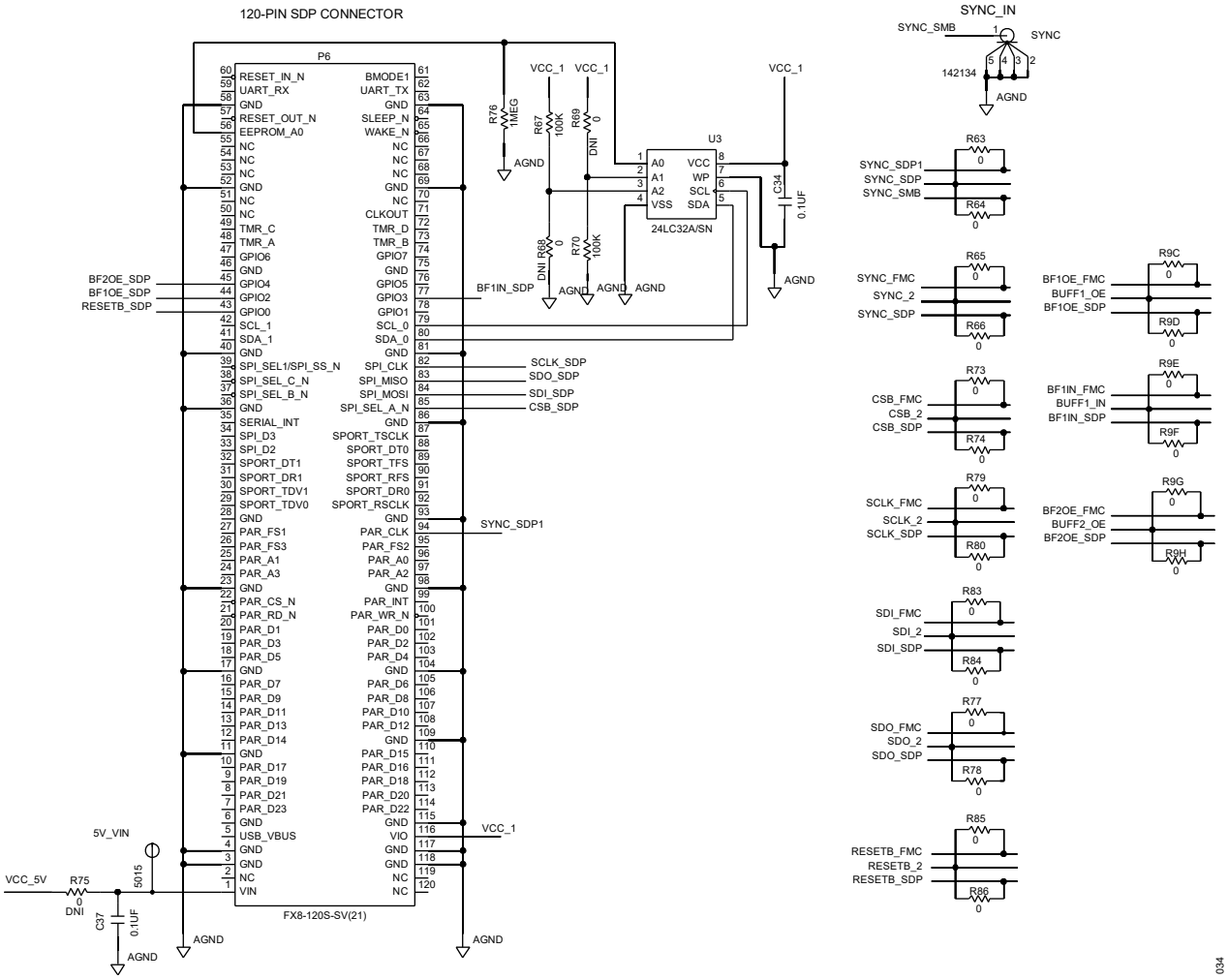

Figure 36. SYNC, SDP, and SPI Connections

High Voltage Evaluation Board

Warning: This high voltage evaluation board contains exposed metal carrying lethal voltages when under power. Take all necessary steps to protect users during operation.

Warnings, Restrictions, and Disclaimers

For evaluation only, in laboratory or development environments, by professionals trained to handle high voltage devices. This evaluation board is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory or development environments by technically qualified electronics experts familiar with the dangers and application risks associated with handling high voltage electrical components, systems, and subsystems. It is not to be used as all or part of a finished end product.

Your Responsibility and Risk. You acknowledge, represent, and agree that:

You have knowledge of all federal, state, and local regulatory requirements that relate to your products and that relate to your use (and/or that of your employees, affiliates, contractors, or designees) of the evaluation board for evaluation, testing, and other purposes.

You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors, or designees, using the evaluation board. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the evaluation board and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.

You must employ reasonable safeguards to ensure that your use of the evaluation board does not result in any property damage, injury, or death, even if the evaluation board fails to perform as described or expected.

You must properly dispose of or recycle the electronic components of the evaluation board to avoid injury to any other person.

Key Instructions. It is important to operate this evaluation board within Analog Devices recommended specifications and environmental considerations per the user guidelines. **Exceeding the specified evaluation board ratings (including but not limited to input and output voltage, current, power, temperature, and environmental ranges) may cause property damage, personal injury, or death.** If there are questions conceramicning these ratings, contact an Analog Devices representative prior to connecting interface electronics or loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the evaluation board and/or interface electronics. Consult the evaluation board user guide prior to connecting any load to the evaluation board output. If there is unceramictainty as to the load specification, contact an Analog Devices representative. During normal operation, some circuit components may generate significant heat, which may cause fire, melting, or burns. When placing measurement probes near these devices during normal operation, be aware that these devices may be hot. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics are to use the evaluation board.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify, and hold Analog Devices, its directors, officeramics, employees, and their representatives harmless from and against any and all claims, damages, losses, expenses, costs, and liabilities (collectively, "Claims") arising out of or in connection with any use of the evaluation board that is not in accordance with the terms of the agreement. This obligation applies whether Claims arise under law of tort or contract or any other legal theory, and even if the evaluation board fails to perform as described or expected

Additional Resources

- *ACE Glossary*
- *ACE Getting Started*
- *ACE Vector Generation Tool*
- *System Development Platform (SDP) – Homepage*