EVM User's Guide: DAC883xEVM

DAC8831 and DAC8832 Evaluation Module

Description

The DAC8831EVM is an easy-to-use platform to evaluate the functionality and performance of the DAC8831 and DAC8832 devices. The DAC8831EVM has optional circuits and jumpers to configure the device for different applications. The DAC8831 comes installed on the EVM; the DAC8832 does not.

Get Started

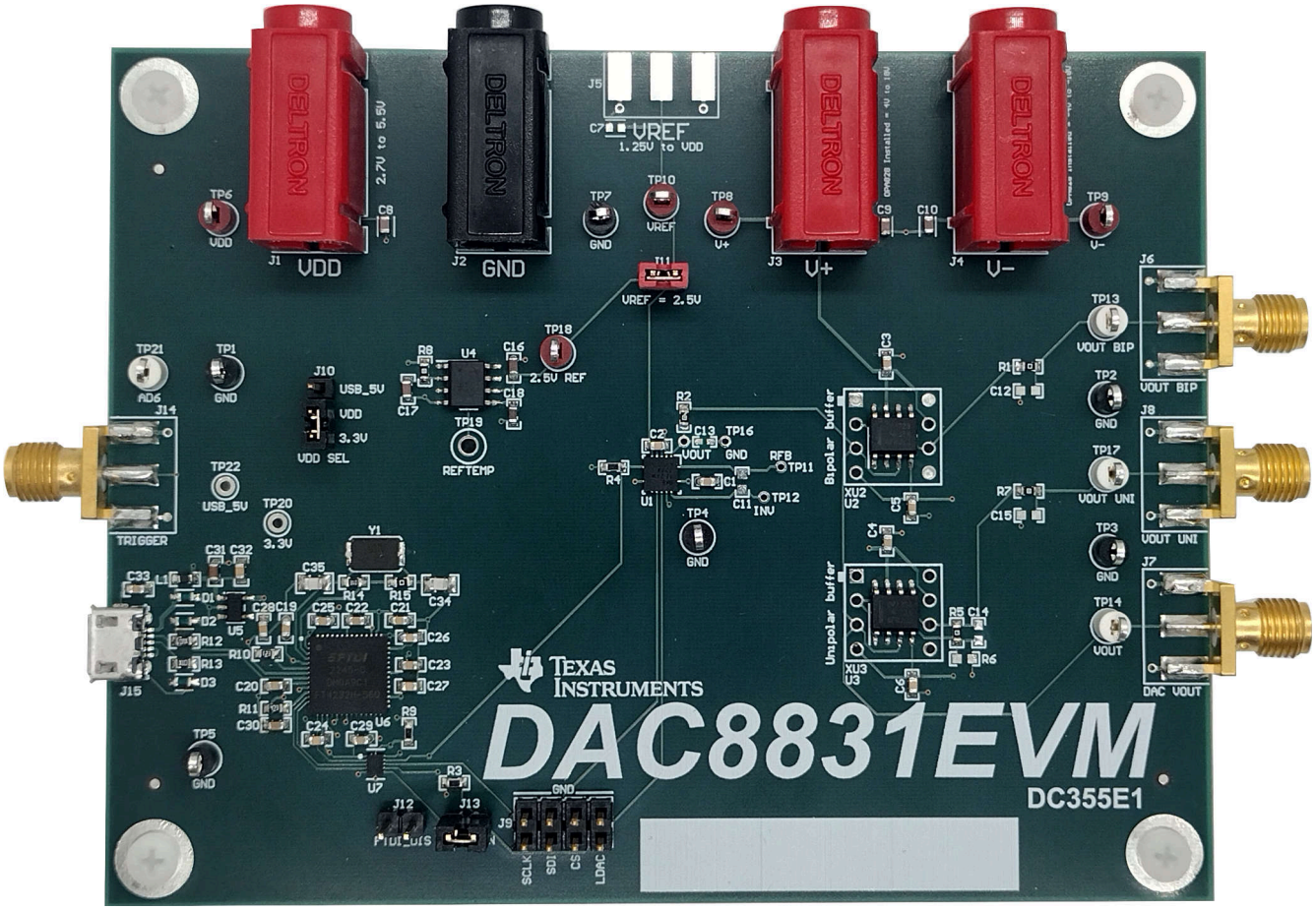
1. Order the EVM.
2. Configure EVM jumpers.
3. Install the DAC8831EVM GUI from ti.com.
4. Connect USB and external power supplies.
5. Launch the DAC8831EVM GUI.

Features

- Configurable circuit to evaluate the DAC8831
- Onboard VDD (5V or 3.3V) support via USB and onboard voltage regulators
- FT4232 easily writes to the DAC using the DAC8831EVM GUI
- Onboard 2.5V VREF support
- Trigger output is available for synchronous measurement
- External SPI connections available
- SOIC-ADAPTER-EVM included for easy op-amp testing

Applications

- Test equipment
- Data acquisition (DAQ)
- Optical networking



1 Evaluation Module Overview

1.1 Introduction

This user's guide describes the characteristics, operation, and recommended use cases of the DAC8831EVM. This document provides examples and instructions on how to use the DAC8831EVM board and included software. Throughout this document, the terms evaluation board, evaluation module, and EVM are synonymous with the DAC8831EVM. This document also includes schematics, the reference printed circuit board (PCB) layouts, and a complete bill of materials (BOM).

1.2 Kit Contents

Table 1-1 details the contents of the EVM kit. Contact the TI Product Information Center at (972) 644-5580 if any component is missing. Download the latest versions of the related software on the TI website, www.ti.com.

Table 1-1. DAC8831EVM Kit Contents

Item	Quantity
DAC8831EVM board	1
USB micro-B plug to USB-A plug cable	1
SOIC-ADAPTER-EVM	1

1.3 Specification

The EVM is intended to provide basic functional evaluation of the device. The layout is not intended to be a model for the target circuit, nor laid out for electromagnetic compatibility (EMC) testing. The EVM consists of a printed-circuit board (PCB), which has the DAC8831 installed.

1.4 Device Information

The DAC8831 and DAC8832 are single, 16-bit, serial-input, voltage-output digital-to-analog converters (DACs) operating from a single 3V to 5V power supply. These converters provide excellent linearity (1LSB INL), low glitch, low noise, and fast settling (1.0µs to 1/2LSB of full-scale output) over the specified temperature range of –40°C to +85°C. The output is unbuffered, which reduces the power consumption and the error introduced by the buffer.

These parts feature a standard high-speed (clock up to 50MHz), 3V or 5V SPI serial interface to communicate with a DSP or microprocessor.

The devices provide bipolar output ($\pm V_{REF}$) when working with an external buffer. The DAC8831 resets to zero code after power up. The DAC8832 resets to midscale code after power up. For optimized performance, a set of Kelvin connections to external reference and analog ground input are provided on the devices.

2 Hardware

2.1 Hardware Setup

This section describes the overall system setup for the EVM. A computer runs software that communicates with the FTDI controller onboard using SPI protocol. External power supplies is required for certain output configurations.

2.1.1 Hardware Theory of Operation

The DAC8831EVM is connected to the computer through the onboard FTDI digital controller using the USB cable that is supplied with the EVM. The evaluation board features connectors and test points for all communication lines, DAC outputs, and supplies. Figure 2-1 shows a block diagram of the DAC8831EVM.

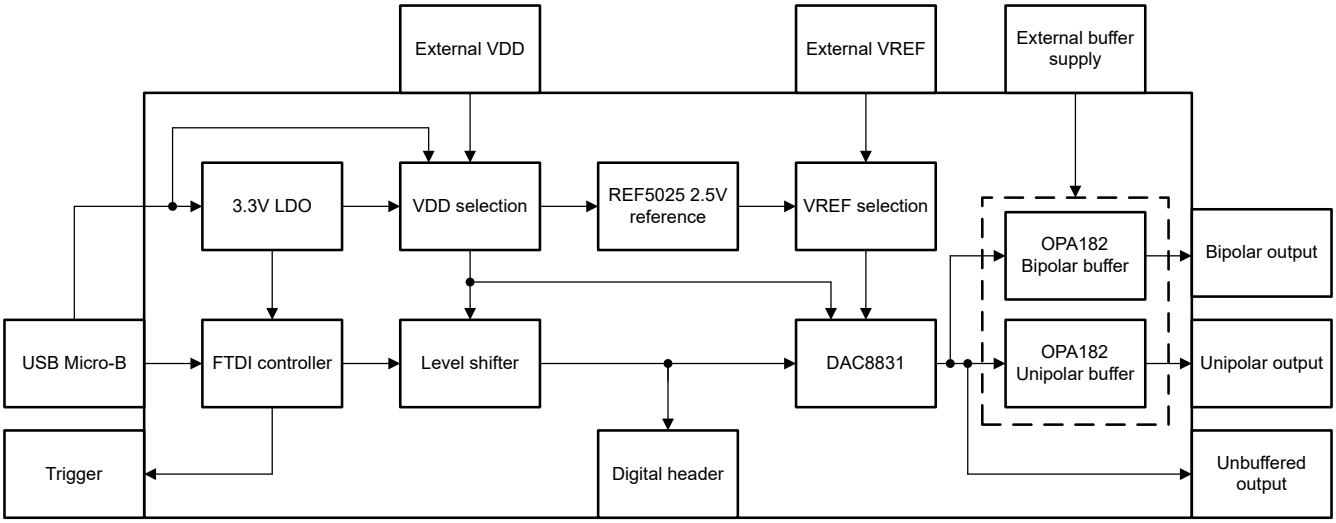


Figure 2-1. Theory of Operation Block Diagram

The USB connection provides the 5V supply to the EVM. Voltage regulators generate 3.3V from the USB 5V supply. This 3.3V supply is used to power the FTDI controller.

The V_{DD} supply can use the onboard 5V or 3.3V supplies depending on the J10 jumper setting. By default, V_{DD} is connected to the onboard 3.3V supply. Alternatively, V_{DD} can be supplied externally through banana jack J1. Remove the jumper connector on J10 before connecting external supplies to V_{DD}.

The device V_{REF} is supplied by the onboard 2.5V voltage regulator (by shorting jumper J11), or from an external supply (with SMA connector J5).

Each of the DAC outputs have footprints available for capacitor and resistor loads that are unpopulated by default.

2.1.2 Jumper Definitions

Table 2-1 provides the details of the configurable jumper settings of the DAC8831EVM. Figure 2-2 shows the default jumper connections on the board.

Table 2-1. DAC8831EVM Jumper Definitions

Designator	Name	Positions
J10	VDD SEL	**SHORT 1-2** – V_{DD} is connected to onboard 3.3V (default). **SHORT 2-3** – V_{DD} is connected to USB 5V. **OPEN** – Open if using external power through J1.
J11	VREF = 2.5V	**SHORT 1-2** – V_{REF} is connected to the onboard 2.5V reference (default). **OPEN** – Open if using external reference through J5.
J12	FTDI_DIS	**SHORT 1-2** – FTDI communication is disabled. **OPEN** – FTDI communication is enabled (default).
J13	LDAC_EN	**SHORT 1-2** – Connects the LDAC pin to the FTDI (default). **OPEN** – Disconnects the LDAC pin from the FTDI.
J16	V+ SEL	**SHORT 1-2** – The positive rail of the op amp is connected to V_{DD}. **SHORT 2-3** – The positive rail of the op amp is connected to GND. **OPEN** – Open if using external power through J3 (default).
J17	V- SEL	**SHORT 1-2** – The negative rail of the op amp is connected to GND. **OPEN** – Open if using external power through J4 (default).

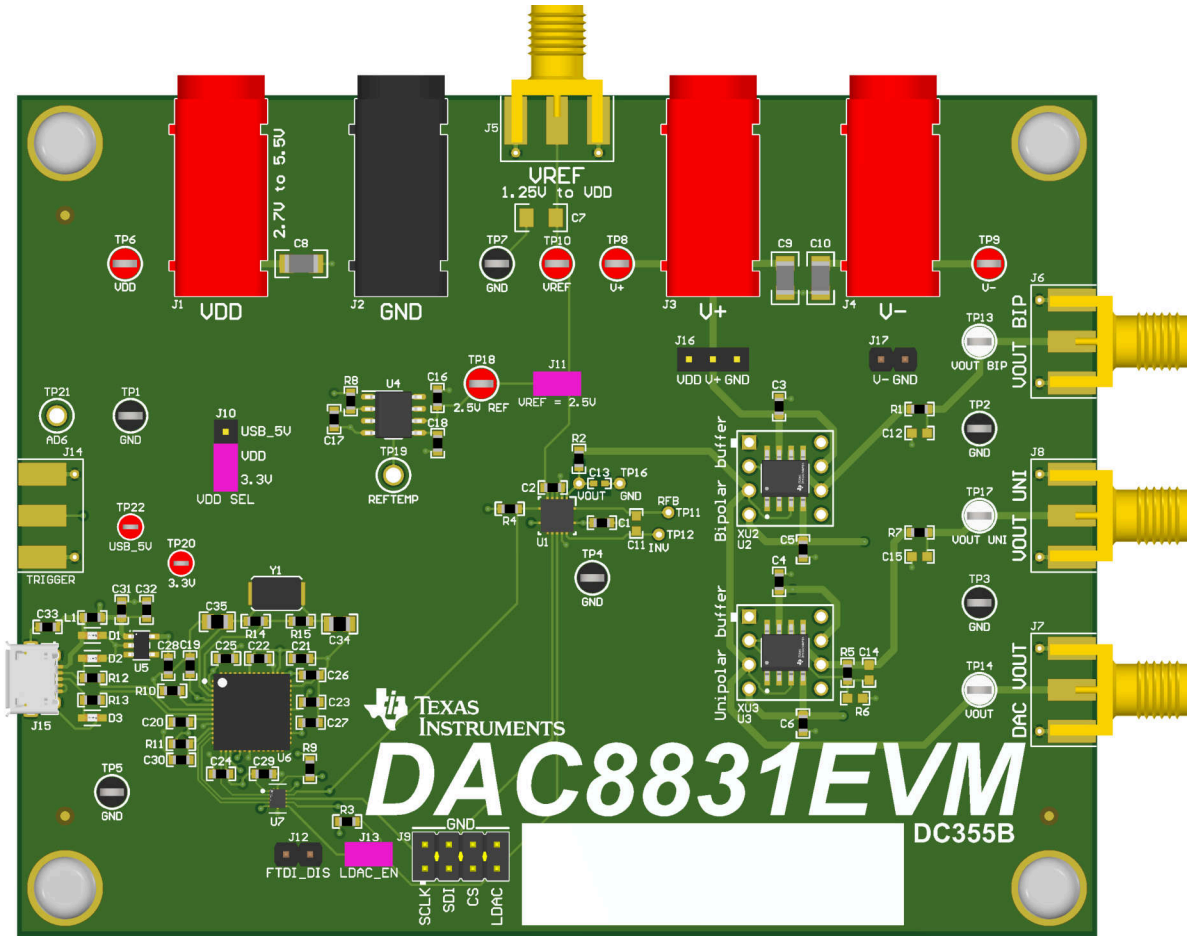


Figure 2-2. DAC8831EVM Default Jumper Settings

2.1.3 Connector Definitions

Table 2-2 shows the power connector definitions of the DAC8831EVM.

Table 2-2. Power Connector Definitions

Designator	Definition
J1	DAC8831 V_{DD} supply (2.7V to 5.5V)
J2	DAC8831 GND supply
J3	Op-amp positive rail (2.25V to 18V)
J4	Op-amp negative rail (–18V to –2.25V)
J5	SMA connector for DAC8831 external reference voltage (1.25V to V_{DD})
J14	SMA connector for FTDI trigger output (unpopulated)
J15	USB connector

Table 2-3 shows output connector definitions for the DAC8831EVM.

Table 2-3. Output Connector Definitions

Designator	Definition
J6	SMA connector for bipolar buffered V_{OUT}
J7	SMA connector for unbuffered V_{OUT}
J8	SMA connector for unipolar buffered V_{OUT}

2.1.4 Test Points

The DAC8831EVM has a variety of test points available for measuring and debugging purposes. Table 2-4 explains the purpose of each test point.

Table 2-4. DAC8831EVM Test Points

Test Point	Net	Description
TP1, TP2, TP3, TP4, TP5, TP7, TP16	GND	Ground test points
TP6	VDD	DAC8831 V_{DD} supply
TP8	V+	V+ supply
TP9	V-	V- supply
TP10	VREF	DAC8831 V_{REF} test point
TP11	RFB	DAC8831 RFB test point
TP12	INV	DAC8831 INV test point
TP13	VOUT BIP	Bipolar output test point
TP14, TP15	VOUT	Unbuffered output test point
TP17	VOUT UNI	Unipolar output test point
TP18	2.5V REF	On-board 2.5V reference test point
TP19	REFTEMP	REF5025 TEMP pin test point (unpopulated)
TP20	3.3V	On-board 3.3V test point (unpopulated)
TP21	AD6	FTDI trigger test point (unpopulated)
TP22	USB 5V	On-board USB 5V test point (unpopulated)

2.2 Hardware Overview

This section details how to configure the EVM for voltage outputs using SPI. The following subsections provide detailed information on the EVM hardware (see also Section 2.1.2).

2.2.1 Electrostatic Discharge Caution

CAUTION

Many of the components on the DAC8831EVM are susceptible to damage by electrostatic discharge (ESD). Customers are advised to observe proper ESD handling precautions when unpacking and handling the EVM, including the use of a grounded wrist strap at an approved ESD workstation.

2.2.2 Connecting the FTDI Digital Controller

To connect the FTDI digital controller on the EVM board to the computer, align and firmly connect the USB connector to the J15 connector. Verify the connection is snug; a loose connection can cause intermittent operation. A 100 mil header (J9) is available for external communication.

Table 2-5 lists the J9 pin definitions. To use external communication, close jumper J12 to disable the connection to the FTDI controller.

Table 2-5. Digital Header J9 Pin Definitions

Pin	Definition
1	DAC8831 SCLK
3	DAC8831 SDI
5	DAC8831 $\overline{CS}$
7	DAC8831 $\overline{LDAC}$
2, 4, 6, 8	Ground

3 Software

3.1 Software Setup

This section provides the procedure for EVM software installation.

3.1.1 Software Installation

Note

Do not connect the EVM to the computer while the software is installing.

Download the latest version of the EVM graphical user interface (GUI) installer from the *Order and start development* subsection of the DAC8831EVM tool folder on TI.com. Run the GUI installer to install the DAC8831EVM GUI software on your computer. The software installation automatically copies the required LabVIEW™ software files and drivers to the computer.

When the DAC8831EVM GUI is launched, an installation dialog window opens and prompts the user to select an installation directory. If left unchanged, Figure 3-1 shows that the software location defaults to *C:\Program Files (x86)\Texas Instruments\DAC8831EVM GUI.*

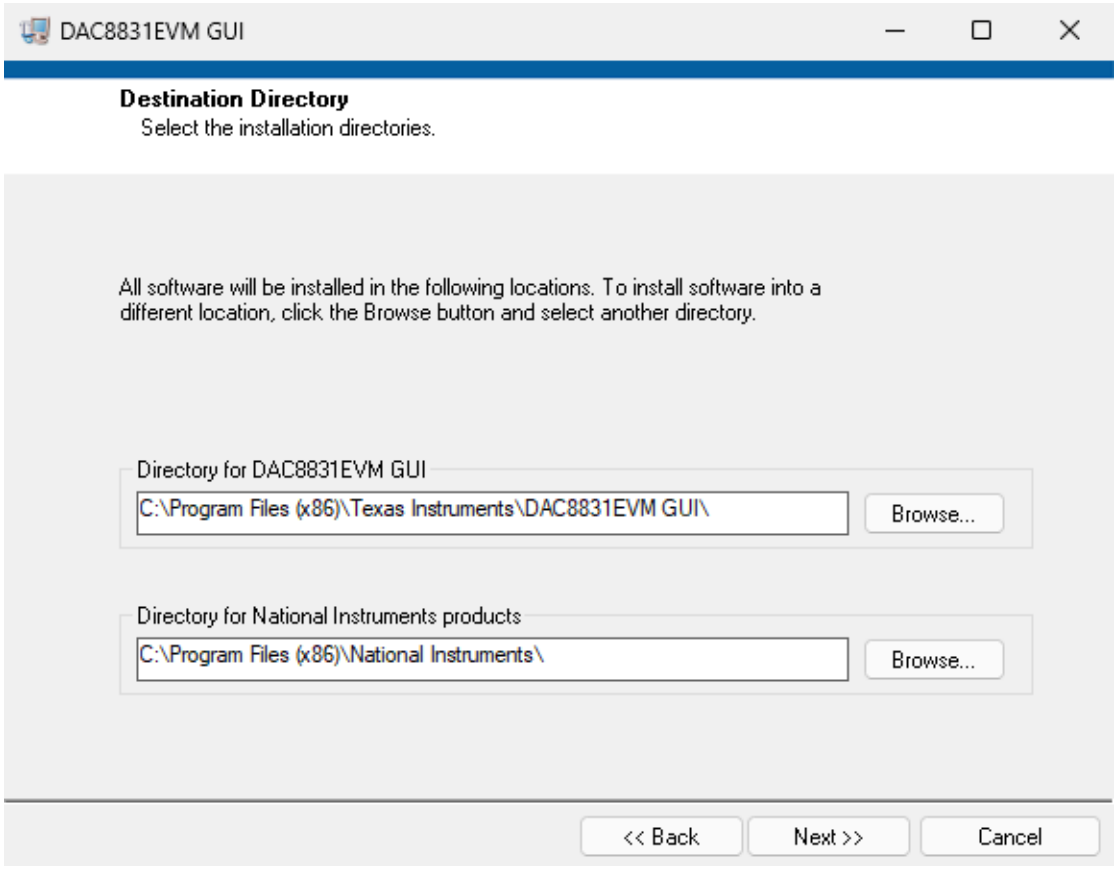


Figure 3-1. Software Installation Path

The EVM software also installs the Future Technology Devices International Limited (FTDI) USB drivers using a separate executable file. Figure 3-2 shows the FTDI USB drivers installation window that is automatically launched after the DAC8831EVM GUI software installation is complete.

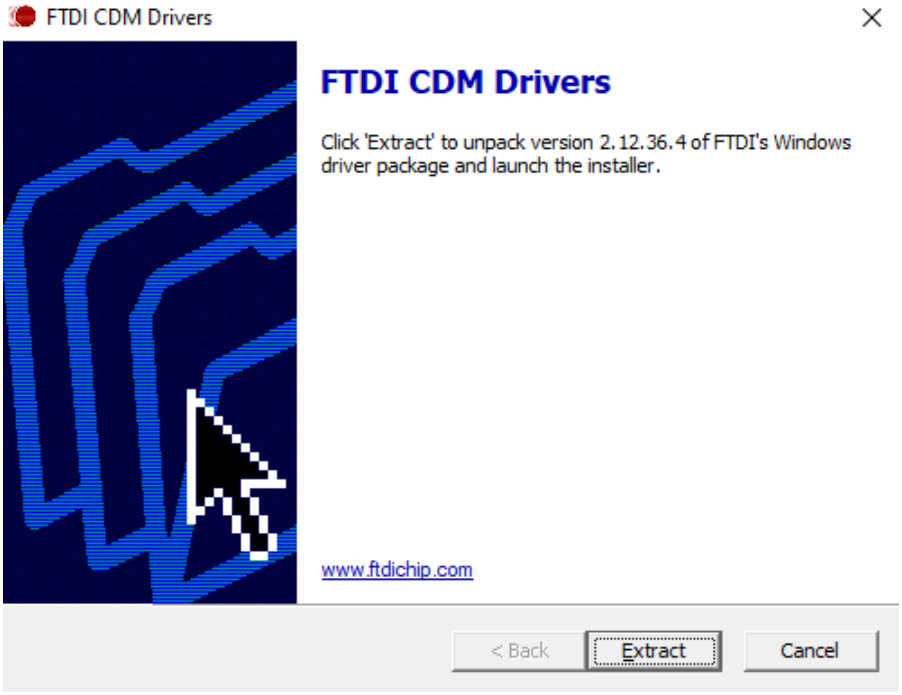


Figure 3-2. FTDI USB Drivers

3.2 Software Overview

This section discusses how to use the DAC8831EVM software.

3.2.1 Launching the Software

If installed in the default directory, launch the DAC8831EVM software by searching for "DAC8831EVM GUI" in the Windows® *Start* menu.

Figure 3-3 shows the GUI after launch.

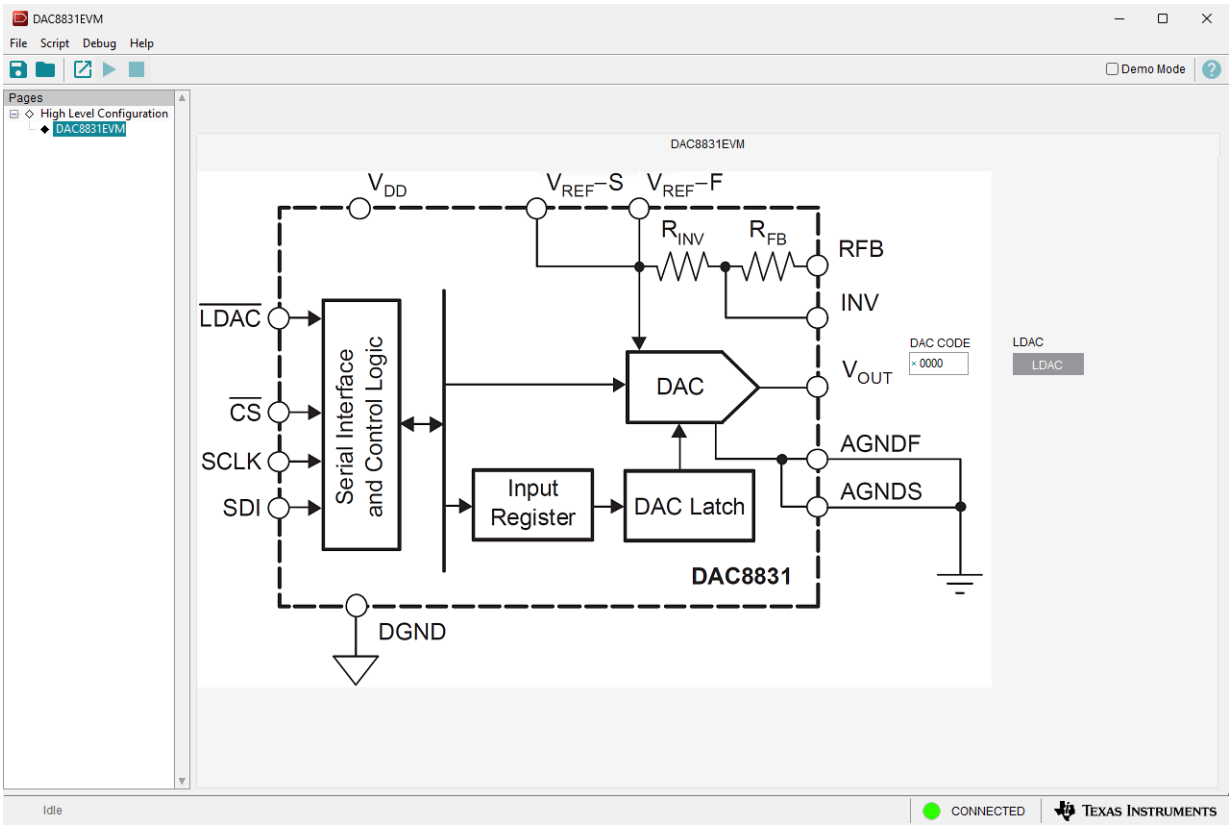


Figure 3-3. DAC8831EVM GUI at Launch

If the FTDI controller is not connected to the computer when the software is launched, the GUI defaults to *demo* mode. Figure 3-4 illustrates the bottom-left corner of the GUI that shows the hardware connection status: DEMO MODE or CONNECTED. After the FTDI controller is properly connected to the computer, uncheck the "Demo Mode" check box on the upper right of the GUI to connect the EVM.

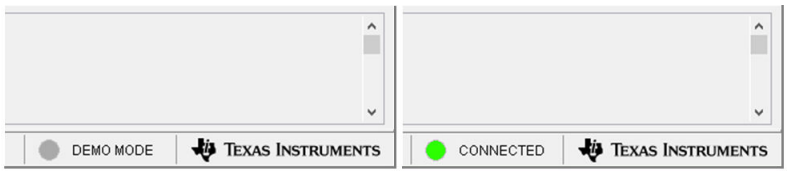


Figure 3-4. FTDI Digital Controller Connection Status

3.2.2 Software Features

The DAC8831EVM GUI allows for SPI communication to the DAC8831. The DAC output is easily controlled through commands in the *High-Level Configuration* Page.

3.2.2.1 High Level Configuration Page

The *High Level Configuration* page is used to set the configuration of the DAC8831EVM GUI. The page is comprised of one tab: *DAC8831EVM*. This tabs act as a shortcut to configure the DAC8831 for basic functionality and testing.

Figure 3-5 shows the *DAC8831EVM* tab of the *High Level Configuration* page. This tab is used to set the output for the DAC. The $\overline{\text{LDAC}}$ pin is also toggleable through the FTDI here.

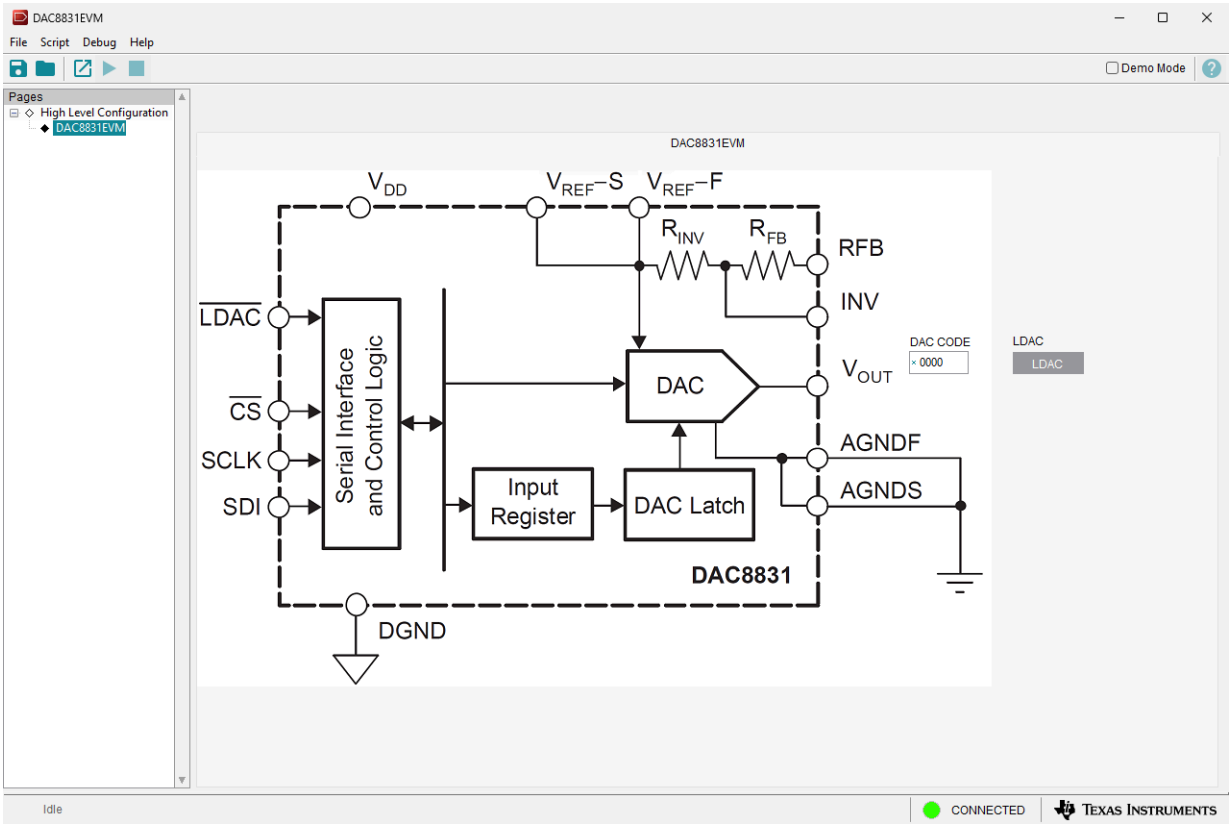


Figure 3-5. DAC8831EVM Tab of the High Level Configuration Page

4 Hardware Design Files

4.1 Schematics

The DAC8831EVM schematics are shown in Figure 4-1 and Figure 4-2.

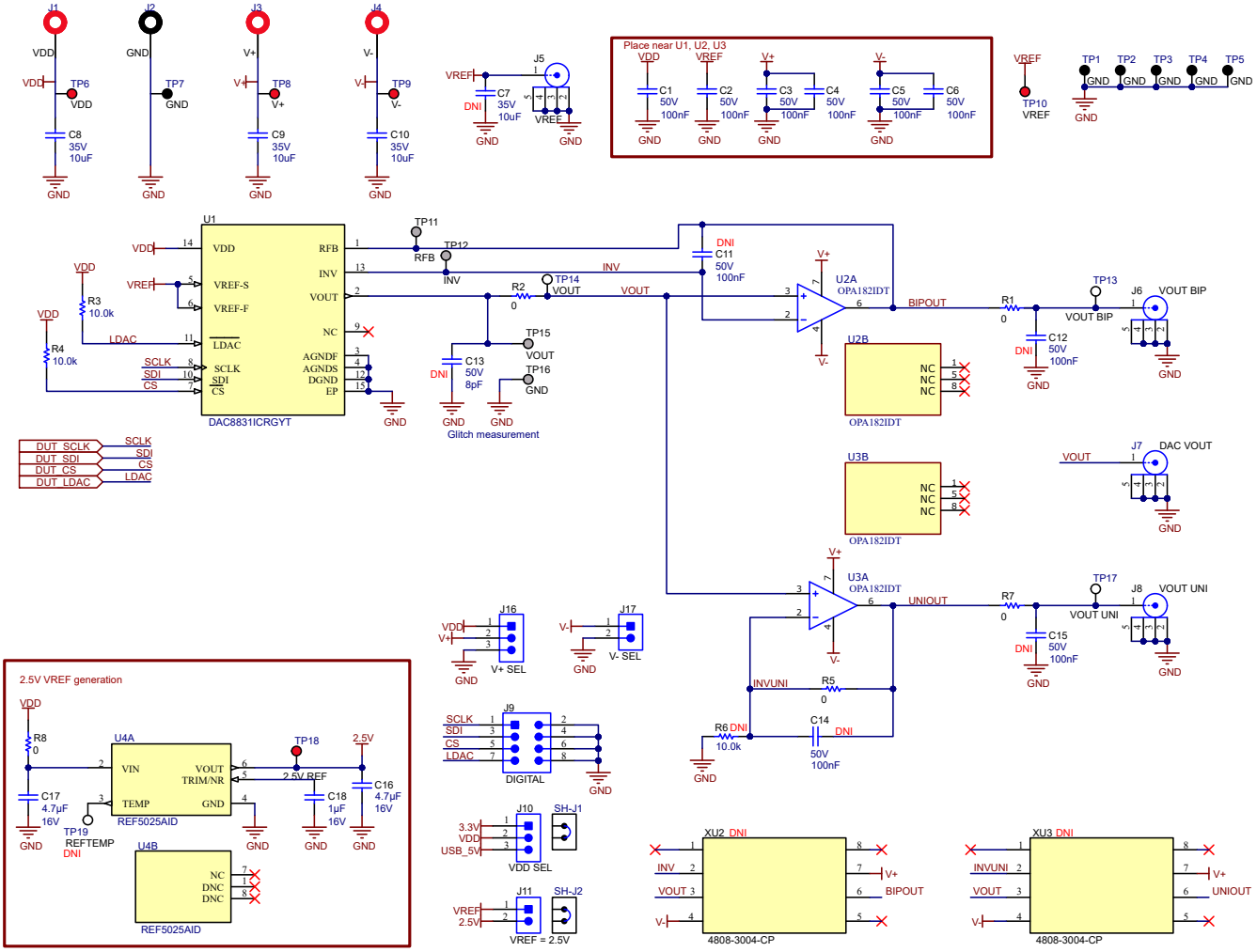


Figure 4-1. DAC8831EVM DUT Schematic

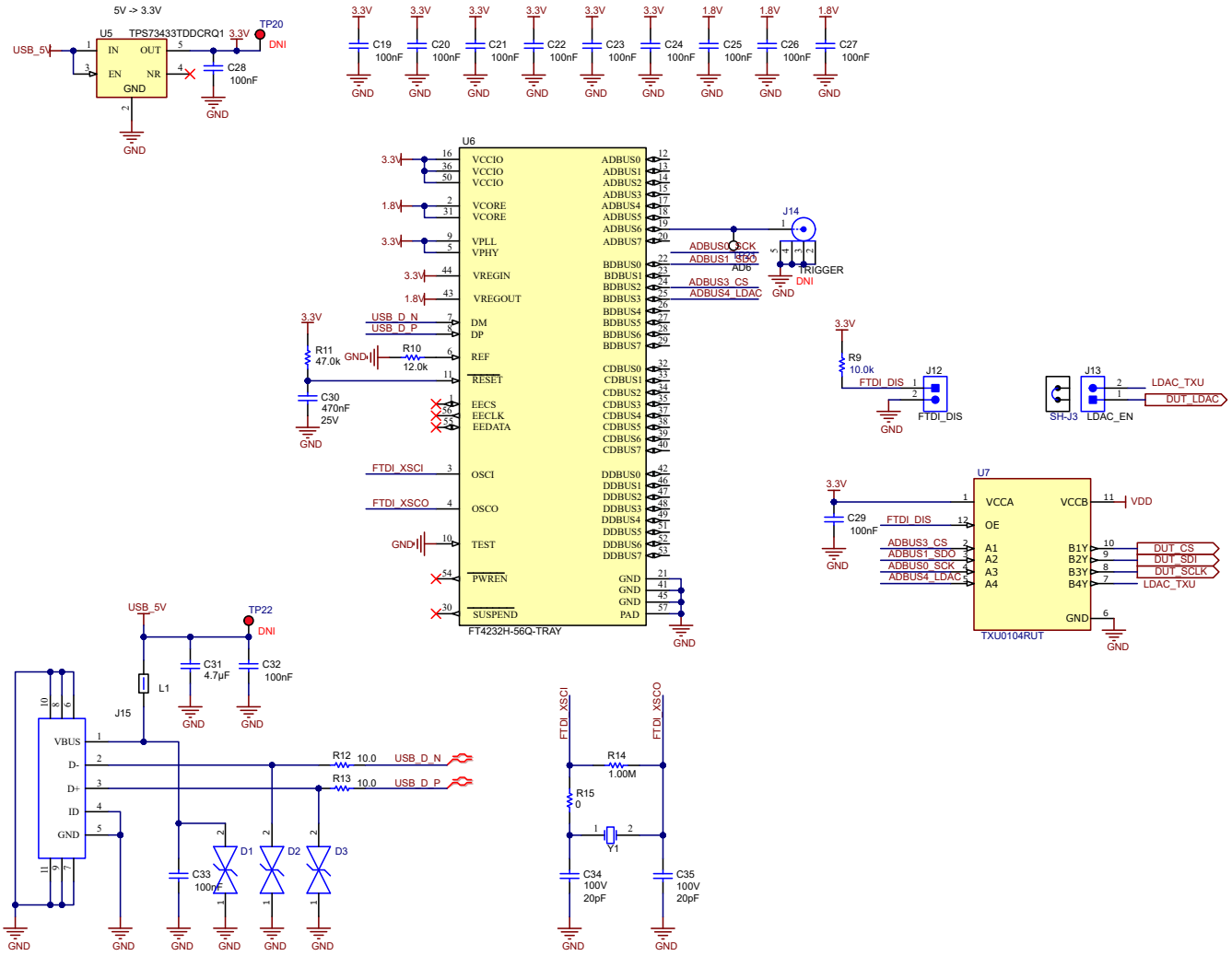


Figure 4-2. DAC8831EVM FTDI Schematic

4.2 PCB Layout

Figure 4-3 through Figure 4-6 show the board layout for the DAC8831EVM.

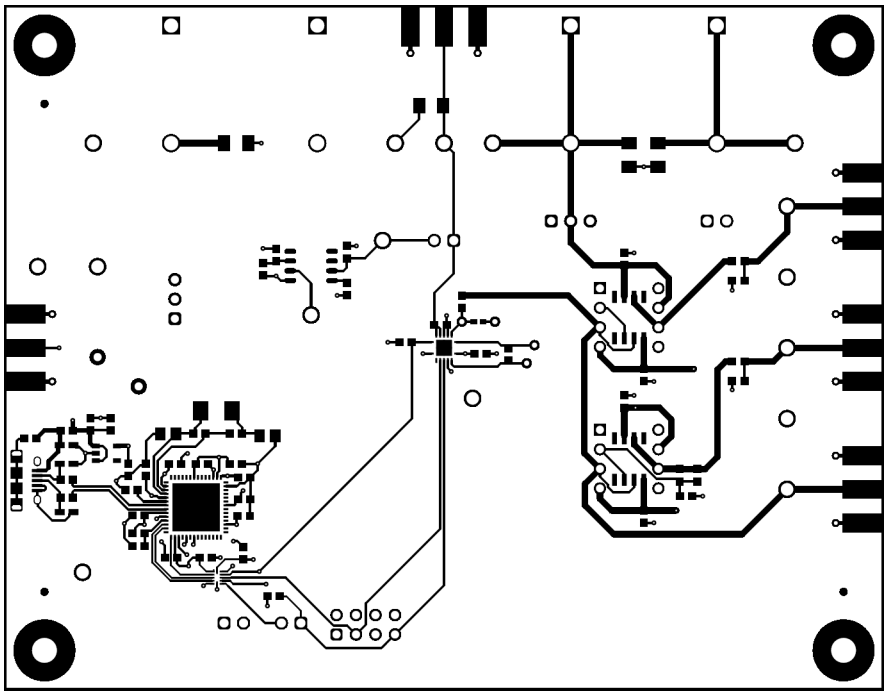


Figure 4-3. DAC8831EVM PCB Top Layer Layout

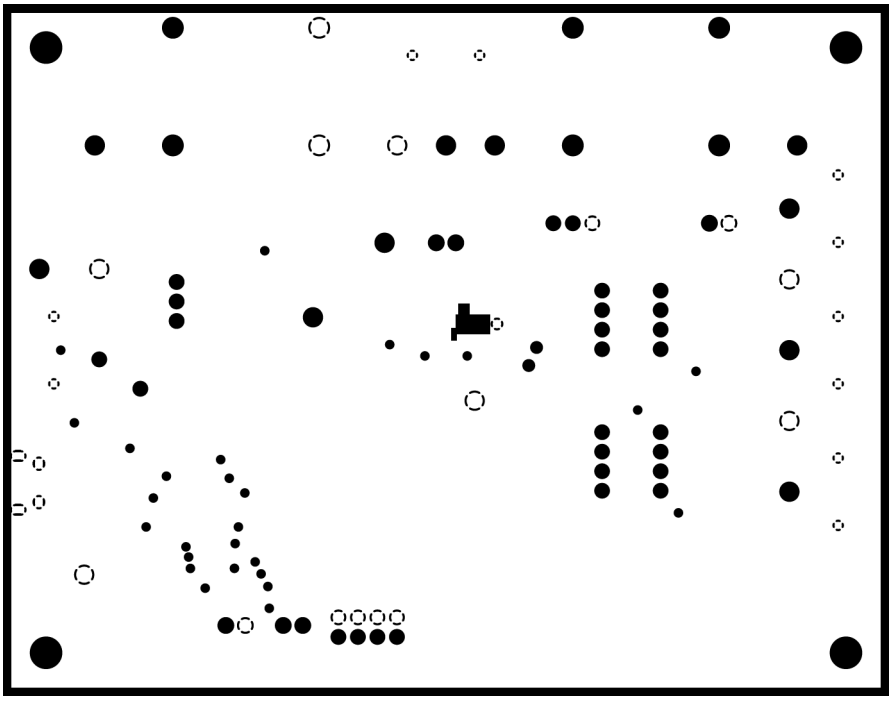


Figure 4-4. DAC8831EVM PCB Mid Layer 1 Layout (Ground Plane)

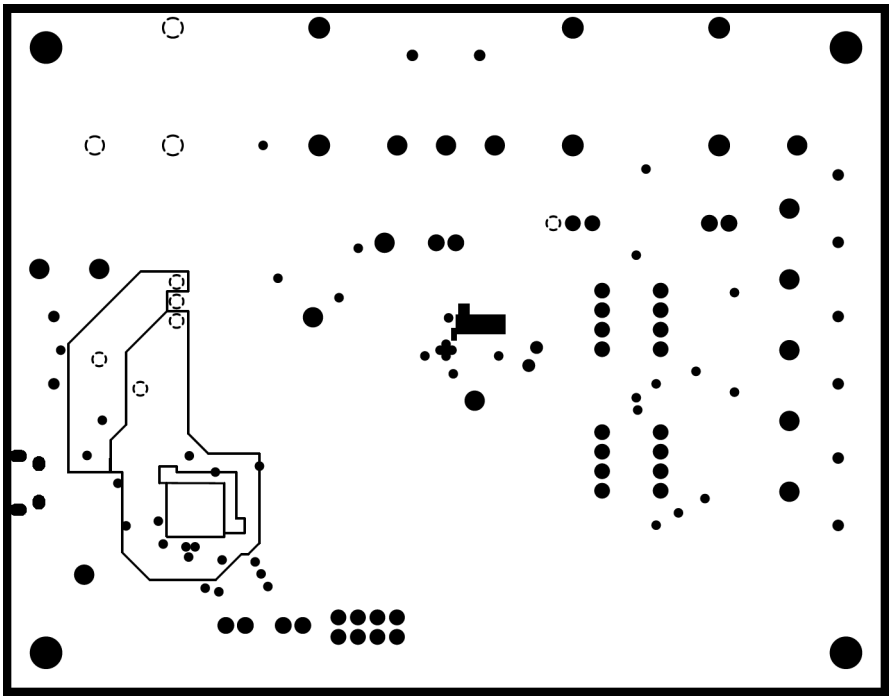


Figure 4-5. DAC8831EVM PCB Mid Layer 2 Layout (Power Plane)

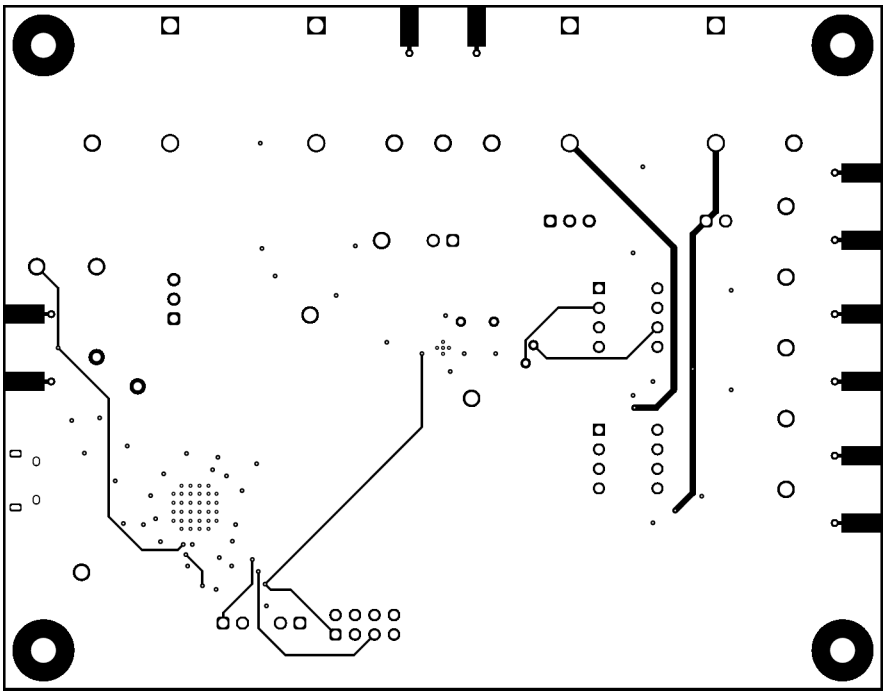


Figure 4-6. DAC8831EVM PCB Bottom Layer Layout

4.3 Bill of Materials

Table 4-1 lists the DAC8831EVM BOM.

Table 4-1. Bill of Materials for the DAC8831EVM

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
C1, C2, C3, C4, C5, C6, C19, C20, C21, C22, C23, C24, C25, C26, C27, C28, C29, C32, C33	19	0.1µF	CAP, CERM, 0.1µF, 50V, ±10%, X7R, AEC-Q200 Grade 0, 0603	0603	06035C104K4Z4A	AVX
C8, C9, C10	3	10µF	CAP, CERM, 10µF, 35V, ±10%, X7R, 1206_190	1206_190	CL31B106KLHNNNE	Samsung Electro-Mechanics
C16, C17, C31	3	4.7µF	CAP, CERM, 4.7µF, 16V, ±10%, X7R, 0603	0603	GRM188Z71C475KE21D	MuRata
C18	1	1µF	CAP, CERM, 1µF, 16V, ±10%, X5R, 0603	0603	0603YD105KAT2A	AVX
C30	1	0.47µF	CAP, CERM, 0.47µF, 25V, ±10%, X7R, 0603	0603	GRM188R71E474KA12D	MuRata
C34, C35	2	20pF	CAP, CERM, 20pF, 100V, ±5%, C0G/NP0, 0805	0805	08051A200JAT2A	AVX
D1, D2, D3	3		150V (Typ) Clamp Ipp TVS Diode Surface Mount 0603 (1608 Metric)	0603	PGB1010603MRHF	Littelfuse Inc
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 × 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone
J1, J3, J4	3		Standard Banana Jack, insulated, 10A, red	571-0500	571-0500	DEM Manufacturing
J2	1		Standard Banana Jack, insulated, 10A, black	571-0100	571-0100	DEM Manufacturing
J5, J6, J7, J8	4		Connector, End launch SMA, 50Ω, SMT	End Launch SMA	142-0701-801	Cinch Connectivity
J9	1		Header, 2.54mm, 4 × 2, Gold, TH	Header, 2.54mm, 4x2, TH	TSW-104-08-L-D	Samtec
J10, J16	2		Header, 100mil, 3 × 1, Gold, TH	3x1 Header	TSW-103-07-G-S	Samtec
J11, J12, J13, J17	4		Header, 2.54mm, 2 × 1, Gold, TH	Header, 2.54mm, 2x1, TH	61300211121	Wurth Elektronik
J15	1		Receptacle, USB 2.0, Micro-USB Type B, R/A, SMT	USB-micro B USB 2.0, 0.65mm, 5 Pos, R/A, SMT	10118194-0001LF	FCI
L1	1	600Ω	Ferrite Bead, 600Ω at 100MHz, 1A, 0603	0603	782633601	Wurth Elektronik
R1, R2, R5, R7, R8, R15	6	0Ω	RES, 0Ω, 5%, 0.1W, 0603	0603	RC0603JR-070RL	Yageo
R3, R4, R9	3	10.0kΩ	RES, 10kΩ, 1%, 0.1W, 0603	0603	ERJ-3EKF1002V	Panasonic
R10	1	12.0kΩ	RES, 12kΩ, 1%, 0.1W, 0603	0603	RC0603FR-0712KL	Yageo

Table 4-1. Bill of Materials for the DAC8831EVM (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
R11	1	47.0kΩ	RES, 47kΩ, 1%, 0.1W, 0603	0603	RC0603FR-0747KL	Yageo
R12, R13	2	10Ω	RES, 10Ω, 1%, 0.1W, 0603	0603	RC0603FR-0710RL	Yageo
R14	1	1.00MΩ	RES, 1.00MΩ, 1%, 0.1W, AEC-Q200 Grade 0, 0603	0603	RMCF0603FG1M00	Stackpole Electronics Inc
SH-J1, SH-J2, SH-J3	3		Shunt, 2.54mm, Gold, Black	Shunt, 2.54mm, Black	60900213421	Wurth Elektronik
TP1, TP2, TP3, TP4, TP5, TP7	6		Test Point, Compact, Black, TH	Black Compact Testpoint	5006	Keystone Electronics
TP6, TP8, TP9, TP10, TP18	5		Test Point, Compact, Red, TH	Red Compact Testpoint	5005	Keystone Electronics
TP13, TP14, TP17	3		Test Point, Compact, White, TH	White Compact Testpoint	5007	Keystone Electronics
TP20, TP22	2		Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone Electronics
U1	1		16-Bit, Ultra-Low Power, Voltage Output Digital to Analog Converter, RGY0014A (VQFN-14)	RGY0014A	DAC8831ICRGYT	Texas Instruments
U2, U3	2		36V, 5MHz, Low-Noise, Zero-Drift, MUX-Friendly, Precision Op Amps	SOIC8	OPA182IDT	Texas Instruments
U4	1		Low Noise, Very Low Drift, Precision Voltage Reference, –40°C to +125°C, 8-pin SOIC (D), Green (RoHS & no Sb/Br)	D0008A	REF5025AID	Texas Instruments
U5	1		Single Output High PSRR LDO, 250mA, Fixed 3.3V Output, 2.7V to 6.5V Input, with Low IQ, 5-pin SOT (DDC), –40°C to +105°C, Green (RoHS & no Sb/Br)	DDC0005A	TPS73433TDDCRQ1	Texas Instruments
U6	1		Future Technology Devices International Ltd FT4232H Quad High Speed USB to Multipurpose UART/MPSSE IC, VQFN-56	VQFN-56	FT4232H-56Q-TRAY	FTDI
U7	1		4-Bit Fixed Direction Voltage-Level Translator with Schmitt Trigger Inputs, and Tri-State Outputs	UQFN12	TXU0104RUT	Texas Instruments
Y1	1		Crystal, 12MHz, 18pF, SMD	ABM3	ABM3-12.000MHZ-B2-T	Abracon Corporation

5 Additional Information

5.1 Trademarks

LabVIEW™ is a trademark of National Instruments Corporation.
Windows® is a registered trademark of Microsoft Corporation.
All trademarks are the property of their respective owners.

6 Related Documentation

The documents in Table 6-1 provide information regarding Texas Instruments integrated circuits used in the assembly of the DAC8831EVM. This user's guide is available from the TI web site under literature number SLAU202. Any letter appended to the literature number corresponds to the document revision that is current at the time of the writing of this document. Newer revisions are available from the TI web site at www.ti.com, or call the Texas Instruments Literature Response Center at (800) 477-8924 or the Product Information Center at (972) 644-5580. When ordering, identify the document by both title and literature number.

Table 6-1. Related Device Documentation

Document	Literature Number
DAC8831 product data sheet	SLAS449
DAC8832 product data sheet	SBAS380

7 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision A (November 2009) to Revision B (October 2024)	Page
• Updated board image	1
• Updated *Hardware* section	3
• Updated *Software* section	7
• Updated *Hardware Design Files* section	11

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265