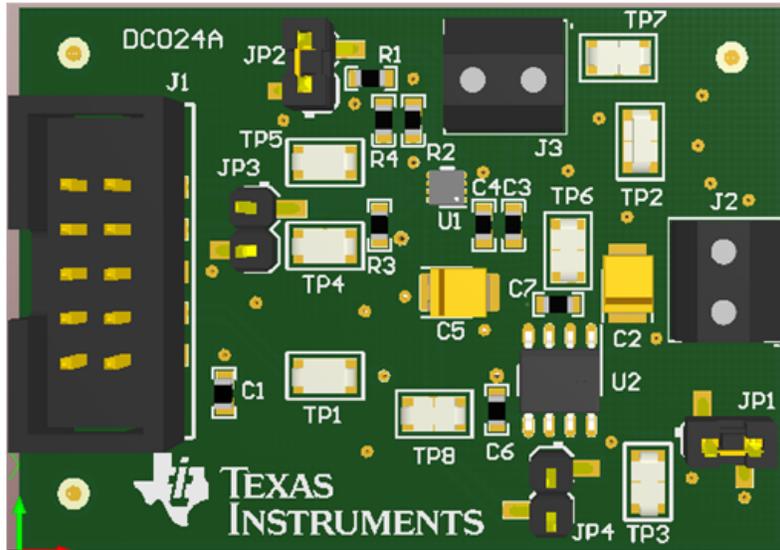


DAC80501EVM

This user's guide describes the characteristics, operation, and use of the DAC80501 evaluation module (EVM). This document also discusses the proper setup and configuration of both software and hardware, and reviews various aspects of program operation. Throughout this document, the terms evaluation board, evaluation module, and EVM are synonymous with the DAC80501EVM. A complete circuit description, schematic diagram, and bill of materials are also included in this document.

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1 Overview

The DAC80501EVM is an easy to use platform for evaluating the functionality and performance of the DAC80501 device. The DAC80501 is a single-channel, buffered, digital-to-analog converter (DAC) in 16-bit resolution with 2.5-V internal reference. This EVM provides output voltage from 0 - 5V. It also provides the SPI programming interface using a PC-based graphical user interface (GUI).

1.1 Kit Contents

Table 1 details the contents of the EVM kit. Contact the TI Product Information Center nearest you if any component is missing. TI highly recommends that the user verify latest versions of the related software at the TI website, www.ti.com.

Table 1. Contents of DAC80501EVM Kit

Item	Quantity
DAC80501EVM evaluation board PCB	1

Table 2. Required Components Not Part of the DAC80501EVM Kit

Item	Quantity
USB2ANY interface adapter	1

1.2 Related Documentation from Texas Instruments

The following document provides information regarding Texas Instruments integrated circuits used in the assembly of the DAC80501EVM. This user's guide is available from the TI web site under literature number SLAU795. 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 may be available from the TI web site at <http://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 3. Related Documentation

Document	Literature Number
DAC80501 product data sheet	SBAS794

2 System Setup

2.1 Hardware Setup

This section provides the overall system setup for the EVM. A PC runs software that provides an interface to the USB2ANY platform. This platform generates the optional 3.3V power and digital signals used to communicate with the EVM board. Connectors are included on the EVM board for external power supplies. [Figure 1](#) displays the system setup for the DAC80501EVM.

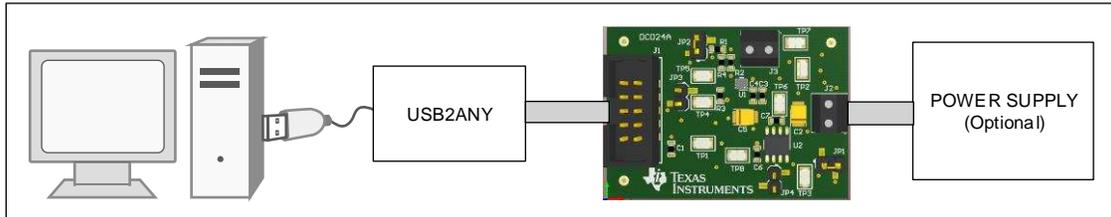


Figure 1. DAC80501EVM Hardware Setup

2.1.1 Connecting the Hardware

Connect the USB cable from the USB2ANY platform to the PC. To connect the USB2ANY to the EVM board, align and firmly connect the keyed ribbon connector to the J8 connector. Verify the connection is snug because loose connections may cause intermittent operation.

2.1.2 Power Configurations

The DAC80501EVM provides electrical connections to the device supply pins. The connectors and optional configurations are shown in the [Table 4](#). Note that the headroom between the reference and the power supply needs to be maintained. Refer to datasheet for details.

Table 4. Power Supply Inputs

Connector/Pin	Supply Name	Voltage Range
J2.1	VDD	4.5-V to 5.5-V
J2.2	GND	0-V
J1.5 (Option)	VDD (JP1 needs to be closed)	3.3-V

2.1.3 Electrostatic Discharge Warning

Many of the components on the DAC80501EVM are susceptible to damage by electrostatic discharge (ESD). 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 Software Setup

This section provides the procedure for EVM software installation.

2.2.1 Operating Systems Requirements

The EVM software is compatible with the Windows™ 7, Windows 8, and Windows 10 operating systems.

2.2.2 Software Installation

The software is available through the EVM product folder on the TI website. After the software is downloaded onto the PC, navigate to the *DAC80501EVM* folder, and run the *Setup_DAC80501_EVM.exe* file, as shown in [Figure 2](#). When the software is launched, an installation dialog window opens and prompts the user to select an installation directory. If left unchanged, the software location defaults to *C:\Program Files (x86)\Texas Instruments\DAC80501 EVM* as shown in [Figure 3](#).

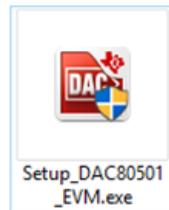


Figure 2. Launching Software Setup

The software installation automatically copies the required LabVIEW files and drivers to the local machine. Make sure to verify that the USB2ANY is not connected before the software, or the file and driver installation may be affected.

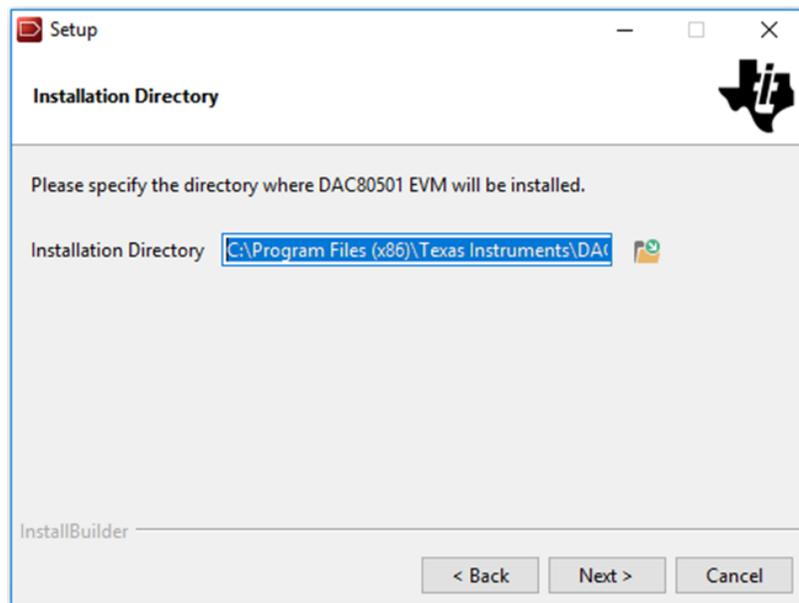


Figure 3. DAC80501EVM Installation Path

3 Detailed Description

3.1 Hardware Description

The following sections provide detailed information on the EVM hardware and jumper configuration settings. [Table 5](#) displays the default configurations of all jumper connections on the DAC80501EVM. Connect the USB cable from the USB2ANY to the PC.

Table 5. Jumper Settings

Jumper	Default Position	Available Option	Description
JP1	Open: VDD is supplied externally through J2	Closed: VDD should be supplied by USB2ANY (the reference headroom must be maintained)	VDD Source Selection
JP2	Closed: SPI Enabled	Open: I2C Enabled (Not supported in the software)	SPI or I2C Interface Selection
JP3	Open: $\overline{\text{SYNC}}/\text{A0}$ HIGH	Closed: $\overline{\text{SYNC}}/\text{A0}$ LOW	$\overline{\text{SYNC}}/\text{A0}$ Level
JP4	Open: Internal Reference	Closed: External On-board Reference	Reference Selection

3.1.1 Theory of Operation for DAC80501 Hardware

The block diagram of the DAC80501EVM board is displayed in [Figure 4](#). The EVM board connects to external power supply VDD either through USB2ANY (3.3V) or through JP2. Note that the headroom for the reference needs to be maintained as specified in the datasheet. The 10-pin wire-to-board connector J1 provides an interface to the USB2ANY platform. The SPI signals are provided either by using the USB2ANY header or the test points. There is an onboard 5-V reference source selected using JP4. JP4 is open by default making the DAC work with the internal reference.

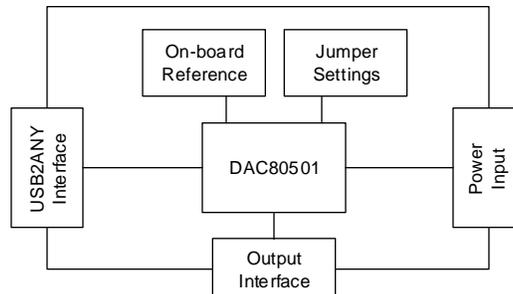


Figure 4. DAC80501EVM Hardware Block Diagram

3.1.2 Signal Definition of USB2ANY

The DAC80501EVM provides a hardware connector (J1) that connects to the USB2ANY interface board. The USB2ANY platform supplies VIO power and is responsible for providing the SPI commands sent from the PC GUI software. Optionally, the VDD supply can be provided through an external supply, and all digital communication lines can be accessed through their respective digital test points. [Table 6](#) provides the pin definitions for this connector. [Table 7](#) provides the corresponding test points for the SPI signals.

Table 6. J8 (USB2ANY) Pin Definitions

Pin#	Signal	Description
1	GPIO7	General purpose I/O
2	CS/GPIO6	/CS General purpose I/O
3	RXD/MISO	SPI MISO
4	TXD/MOSI	SPI MOSI
5	3.3V	3.3V Supply
6	GND	Ground
7	GPIO3	General purpose I/O
8	SCLK/GPIO2	SPI SCLK
9	GPIO1	General purpose I/O
10	GPIO0	General purpose I/O

Table 7. J1 SPI Signal Test Points

Test Points	SPI Signal
TP1	SCLK
TP2, TP3	GND
TP4	MOSI/SDI
TP5	$\overline{\text{SYNC}}$

3.1.3 DAC Signal Pins

The DAC80501EVM provides access to the DAC output through connection J3 as listed in [Table 8](#).

Table 8. J3 Pin Definitions

Connector/Pin	Signal Name
J3-1	VOUTA
J3-2	GND

3.2 Software Description

This section describes the features of the DAC80501 EVM software, and discusses how to use these features. The software provides basic control of all the registers and functions to the DAC80501 device.

3.2.1 Starting the Software

After the DAC80501EVM software is installed, a restart may be required by Windows. To launch the software, locate the Texas Instruments folder in the *All Programs* menu, and select the *DAC80501 EVM* icon.

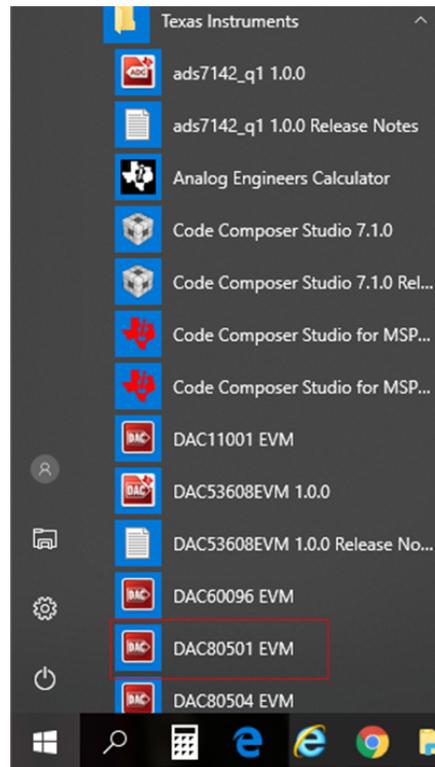


Figure 5. DAC80501EVM GUI Location

Figure 6 shows that If the USB2ANY is correctly connected, the status bar at the bottom of the screen displays *HARDWARE CONNECTED*. If the USB2ANY is not properly connected or not connected at all, the status bar displays *DEMO*. If the GUI is not displaying the *HARDWARE CONNECTED* status while the USB2ANY is connected, unplug and reconnect the USB2ANY and relaunch the GUI software.



Figure 6. DAC80501EVM GUI Connection Detection

3.2.2 Software Features

The DAC80501 EVM incorporates interactive functions that help configure the DAC80501 device. These functions are built into several GUI pages, as shown in [Figure 7](#). The *Page Selection* menu allows the user to switch between the pages, with each page representing a feature of the software.

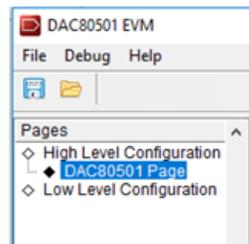


Figure 7. DAC80501EVM Software Page Selection

3.2.2.1 Low Level Configuration Page

The DAC80501 EVM *Register Map* page, shown in [Figure 8](#), allows the user to access low level communication directly with the DAC80501 registers. Selecting a register on the *Register Map* list shows a description of the values in that register, as well as information on the register address, default value, size, and current value. Values can be read and written to the registers by writing to the *Value* or bit field of the GUI.

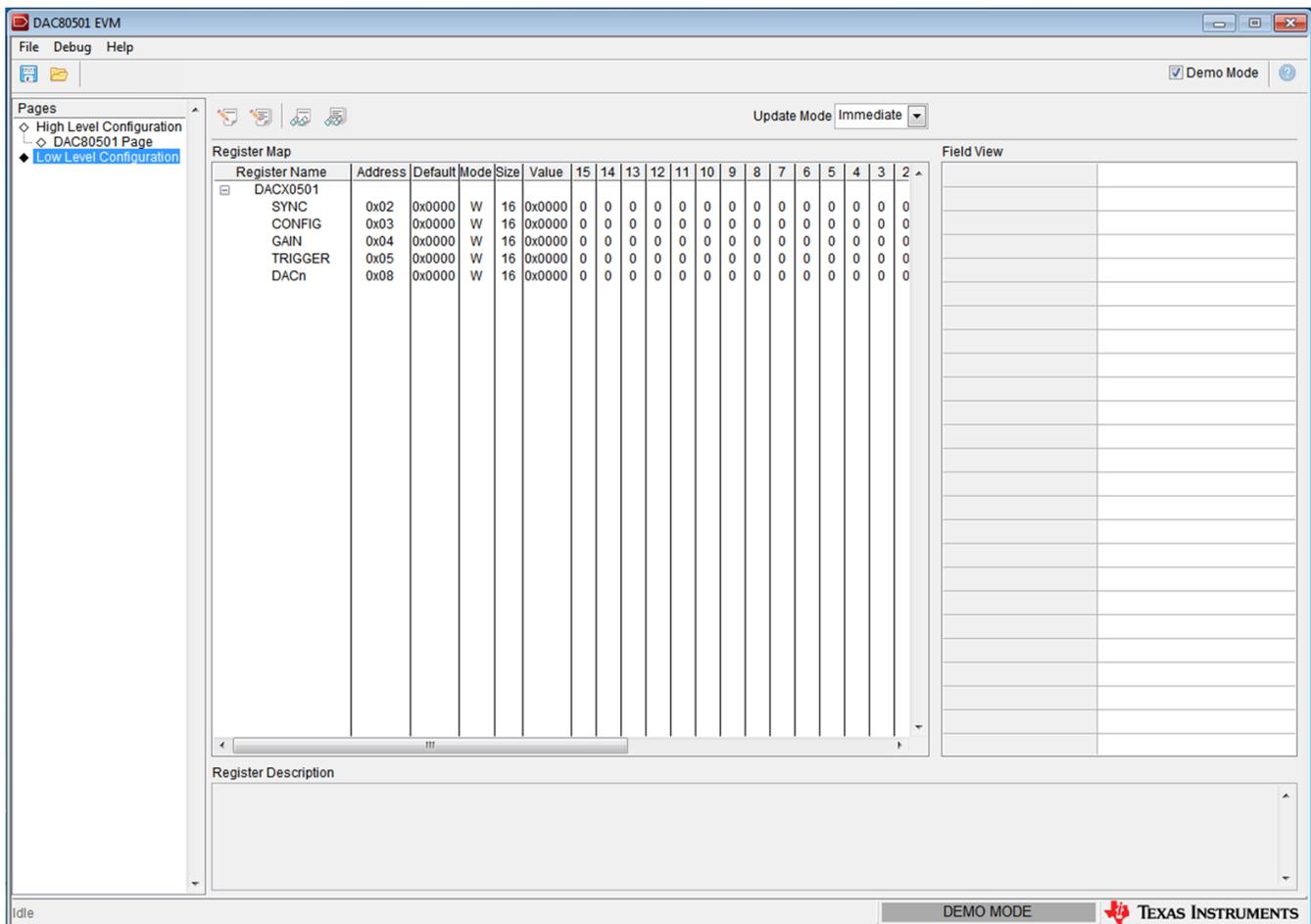


Figure 8. Low Level Configuration Page

The values of the register map can also be saved by pressing the *Save Configuration* button under the *File* menu option. Additionally, the configuration files can be accessed through the *Load Configuration* button. Other options selectable by the user are the *Update Mode*, *Write Selected*, *Read Selected*, *Write Modified*, and *Read All* buttons. All buttons are displayed in [Figure 9](#).

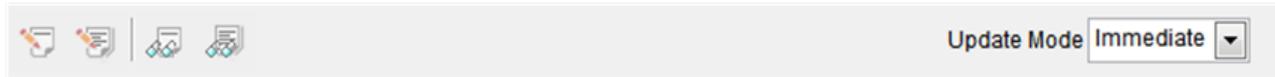


Figure 9. Low Level Configuration Page Options

If *Immediate* is selected under *Update Mode*, all changes to register values update immediately. The *Deferred* option allows the user to modify the value of a register without taking effect until the *Write Selected*, or *Write Modified* button is pressed. The *Read Selected* button allows individual register reads, whereas the *Read All* button reads the status of all registers located in the register map.

3.2.2.2 High Level Configuration Page

The *High Level Configuration* page provides an easy interface to program the output code for the DAC80501 device. This page is displayed in [Figure 10](#).

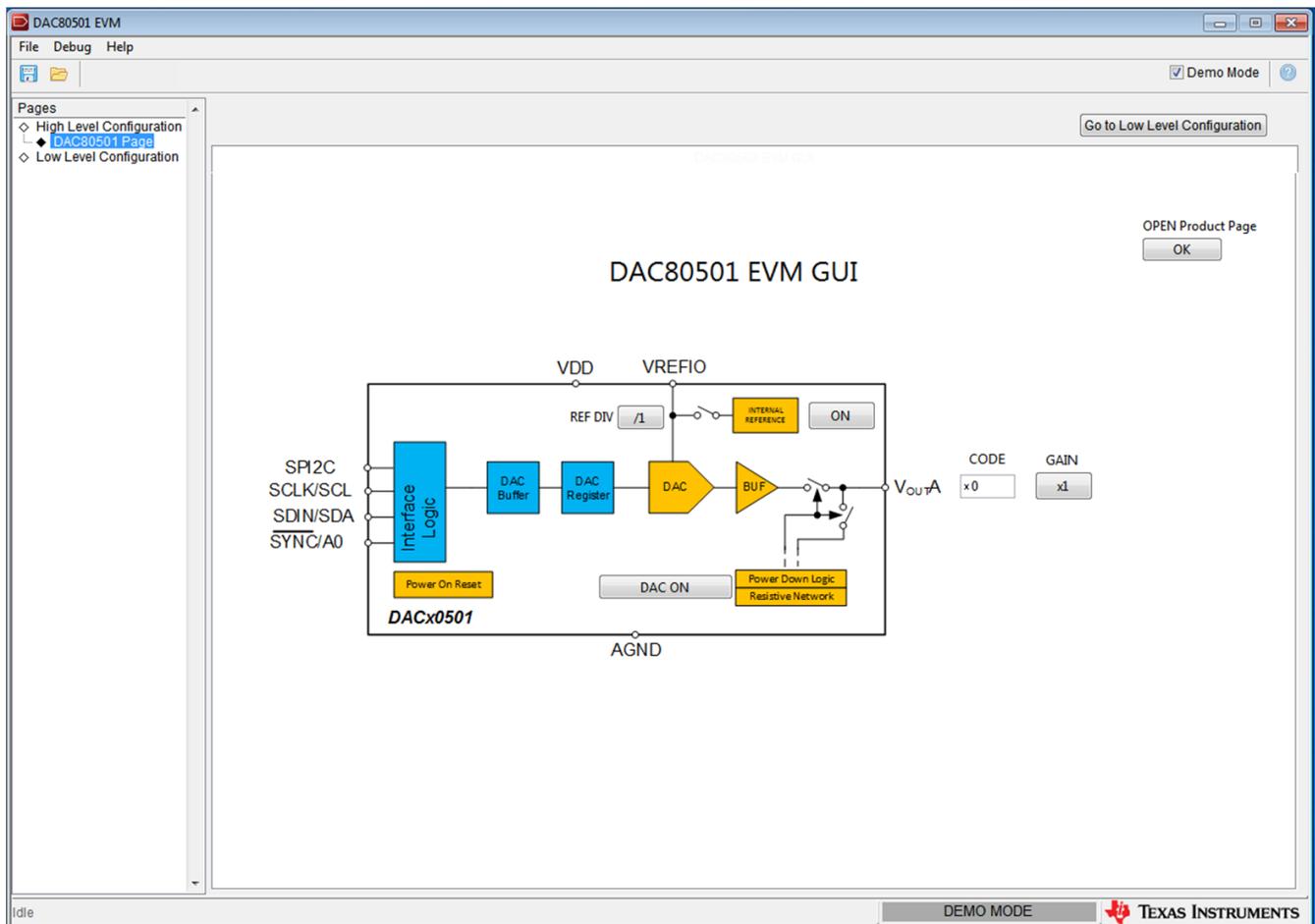


Figure 10. High Level Configuration Page

4 Schematic, PCB Layout, and Bill of Materials

This section contains the complete bill of materials and schematic diagram for the DAC80501EVM.

4.1 Board Schematic

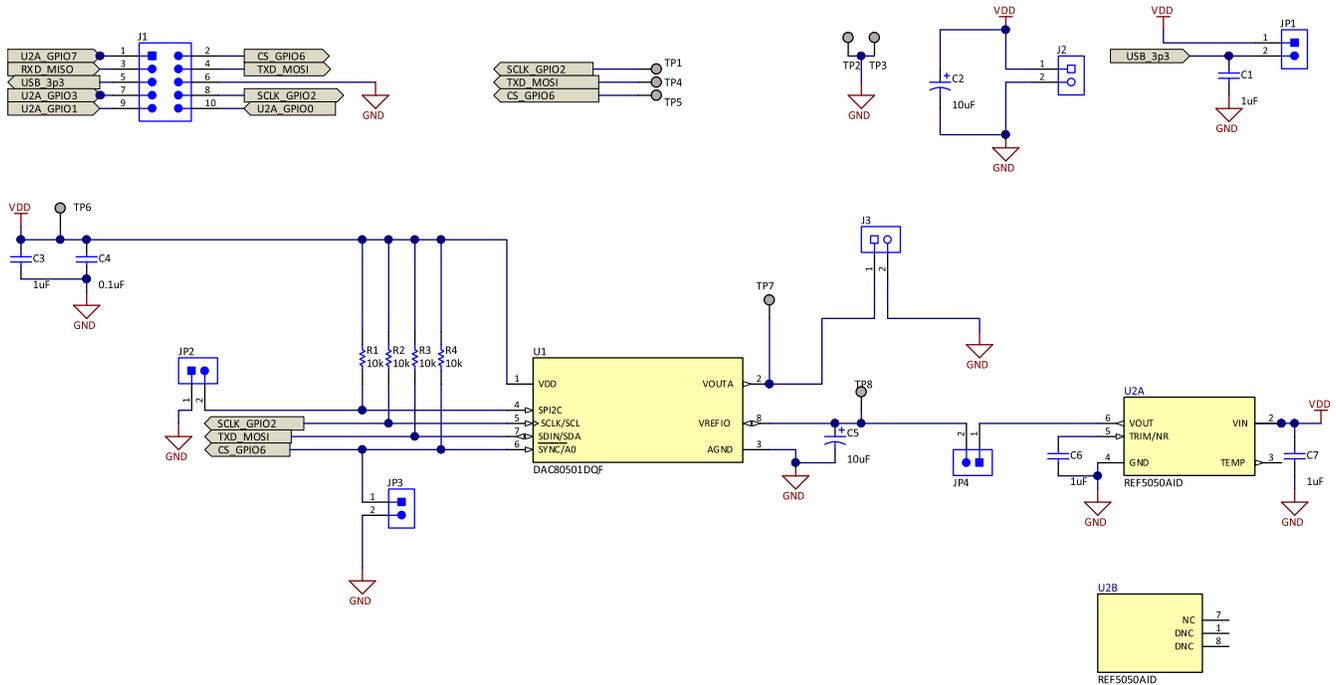


Figure 11. DAC80501EVM Board Schematic

4.2 PCB Components Layout

Figure 12 through Figure 14 show the layout of the components for the DAC80501EVM board.

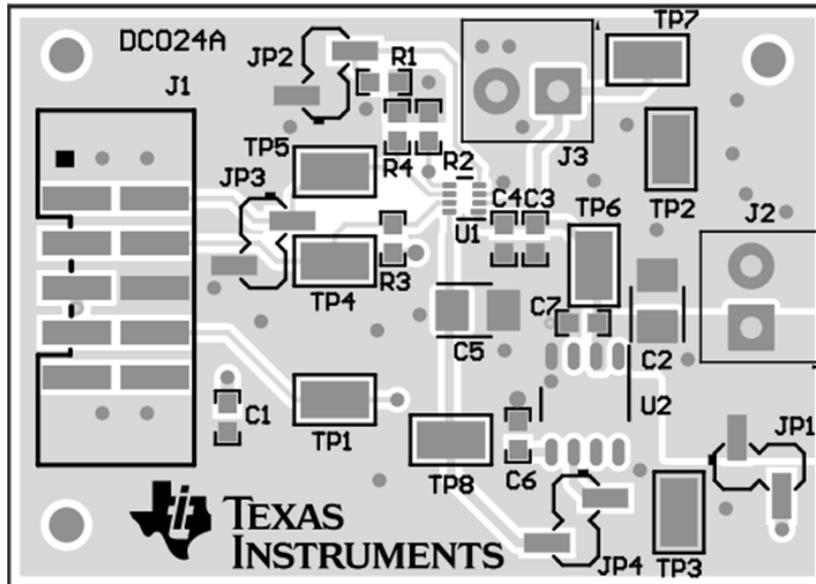


Figure 12. DAC80501EVM PCB Components Layout

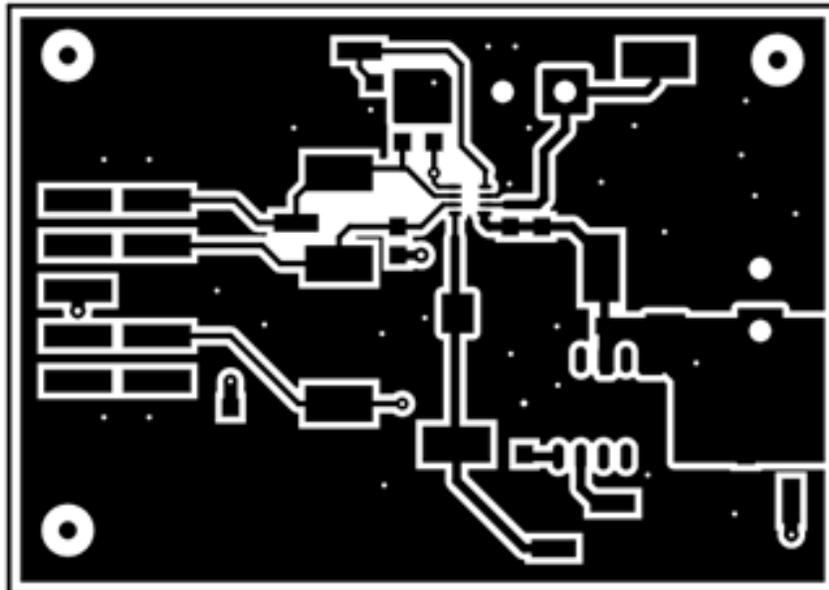


Figure 13. Top Layer

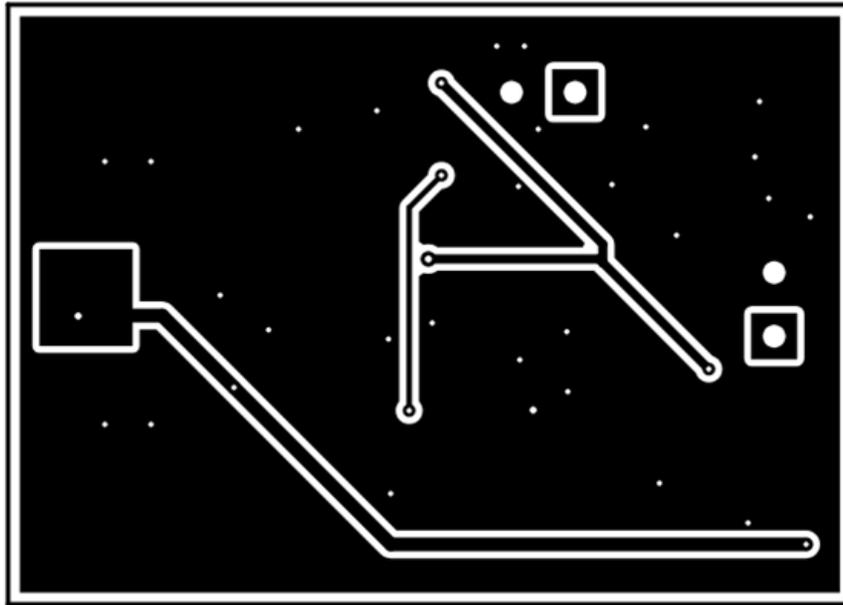


Figure 14. Bottom Layer

4.3 Bill of Materials

Table 9. DAC80501 EVM Bill of Materials

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
!PCB	1		Printed Circuit Board		DC024	Any
C1, C3, C6, C7	4	1uF	CAP, CERM, 1 uF, 25 V, +/- 10%, X7R, 0603	0603	C1608X7R1E105K080AB	TDK
C2	1	10uF	CAP, TA, 10 uF, 16 V, +/- 20%, 2 ohm, SMD	3528-21	293D106X0016B2TE3	Vishay-Sprague
C4	1	0.1uF	CAP, CERM, 0.1 uF, 25 V, +/- 10%, X7R, 0603	0603	06033C104KAT2A	AVX
C5	1	10uF	CAP, TA, 10 uF, 16 V, +/- 10%, 0.8 ohm, SMD	3528-21	TPSB106K016R0800	AVX
H1, H2, H3, H4	4		Bumpon, Hemisphere, 0.44 X 0.20, Clear	Transparent Bumpon	SJ-5303 (CLEAR)	3M
J1	1		Header (shrouded), 100mil, 5x2, Gold, SMT	SMT Header	52601-S10-8LF	FCI
J2, J3	2		Terminal Block, 3.5mm Pitch, 2x1, TH	7.0x8.2x6.5mm	ED555/2DS	On-Shore Technology
JP1, JP2, JP3, JP4	4		Header, 2.54mm, 2x1, Tin, SMT	Header, 2.54mm, 2x1, SMT	M20-8770246	Harwin
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650 x 0.200 inch	THT-14-423-10	Brady
R1, R2, R3, R4	4	10k	RES, 10 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060310K0JNEA	Vishay-Dale
SH-JP1, SH-JP2	2	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8	8		Test Point, Miniature, SMT	Test Point, Miniature, SMT	5019	Keystone
U1	1		16-Bit, 1-LSB INL, Voltage-Output Digital-to-Analog Converters with Precision Internal Reference, DQF0008A (WSON-8)	DQF0008A	DAC80501DQF	Texas Instruments
U2	1		Low Noise, Very Low Drift, Precision Voltage Reference, -40 to 125 degC, 8-pin SOIC (D), Green (RoHS & no Sb/Br)	D0008A	REF5050AID	Texas Instruments

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 - 3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

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1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive):*

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM 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. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

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