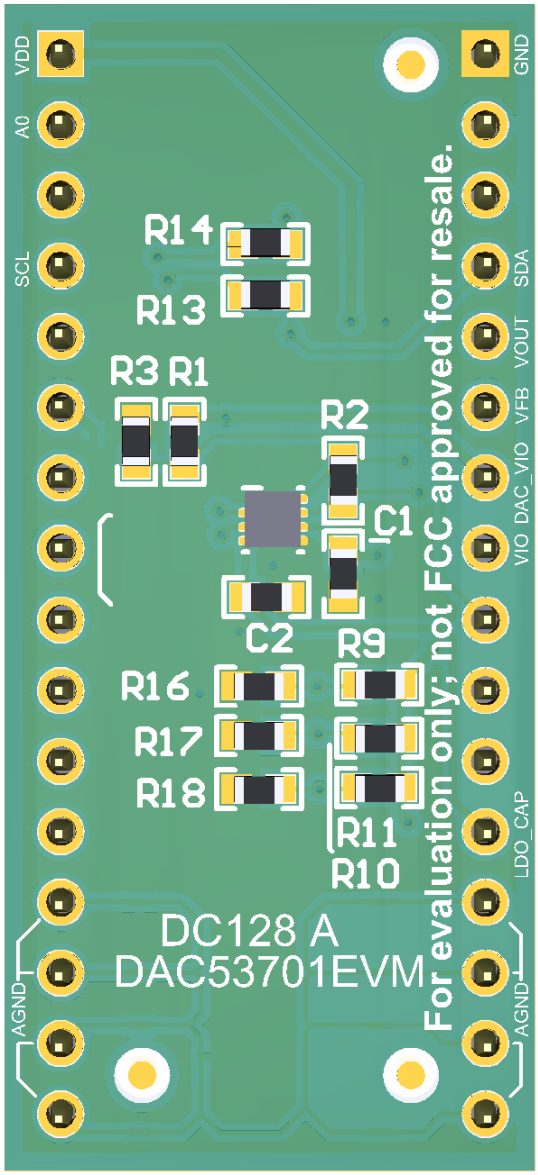
User's Guide

DAC53701EVM

ABSTRACT



This user's guide describes the characteristics, operation, and use of the DAC53701EVM evaluation module (EVM). This EVM is designed to evaluate the performance of the DAC53701 and DAC43701 commercial, buffered voltage output DACs in a variety of configurations. This EVM is also designed to evaluate the automotive version devices, DAC53701-Q1 and DAC43701-Q1. Throughout this document, the terms evaluation board, evaluation module, and EVM are synonymous with the DAC53701EVM. This document includes a schematic, reference printed-circuit board (PCB) layouts, and a complete bill of materials.

Table of Contents

List of Figures

List of Tables

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1 Overview

The DAC53701EVM is an easy-to-use platform to evaluate the functionality and performance of the DAC53701 and DAC43701 commercial devices. This EVM is also designed to evaluate the automotive-version devices, DAC53701-Q1 and DAC43701-Q1.

The 10-bit DAC53701 and 8-bit DAC43701 (DACx3701) are a pin-compatible family of buffered voltage-output digital-to-analog converters (DACs). These devices have nonvolatile memory (NVM), an internal reference, and a PMBus™ compatible I^2C interface. The DACx3701 operate with either an internal reference or the power supply as a reference, and provide full-scale output of 1.8 V to 5.5 V. The devices communicate through the I^2C interface. These devices support I^2C standard mode (100 kbps), fast mode (400 kbps), and fast mode plus (1 Mbps). The DACx3701 are feature rich, and include features such as PMBus voltage margin commands (for example, *turn on/off*, *margin high or low*, and more), digital slew rate control, user-programmable power up to high impedance, a standalone waveform generator (square, ramp, and sawtooth), a medical alarm tone generator (low, medium, and high priority), and a dedicated feedback pin. The EVM provides the GPIO and I^2C programming interface using a PC-based graphical user interface (GUI).

1.1 Kit Contents

Table 1-1 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 1-1. Contents of DAC53701EVM Kit

Item	Quantity
DAC53701EVM evaluation board PCB	1

Table 1-2. Required Components Not Included With Kit

Item	Quantity
BOOSTXL-DAC-PORT	1
MSP-EXP432E401Y Launchpad (TI Launchpad)	1

TI Launchpad can be purchased from the MSP432E401Y tool folder on www.ti.com.

1.2 Related Documentation from Texas Instruments

The following document provides information regarding Texas Instruments integrated circuits used in the assembly of the DAC53701EVM. This user's guide is available from the TI web site under literature number SLAU841. 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 1-3. Related Documentation

Document	Literature Number
DAC53701 product data sheet	SLASEY5
DAC43701 product data sheet	
DAC53701-Q1 product data sheet	SLASEW8
DAC43701-Q1 product data sheet	

2 System Setup

2.1 Software Setup

This section provides the procedure for EVM software installation.

2.1.1 Operating Systems

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

2.1.2 Software Installation

The software is available on the device product folder, and can also be found in the GUI Composer Gallery. Search for *DAC53701EVM* in the GUI Composer Gallery. Use the down arrow symbol to download the software. There are two downloads: *DAC53701EVM GUI* and *GUI Composer Runtime*. Either download both, or just download the EVM GUI; the runtime file can be downloaded through the EVM GUI during installation. The software can also be run online by clicking; however, only after the firmware and driver are upgraded. After the software is downloaded onto the PC, navigate to the download folder, and run the DAC53701EVM software executable, as shown in Figure 2-1.

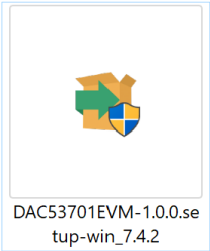

Figure 2-1. DAC53701EVM Software Setup

When the DAC53701EVM 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\DAC53701 EVM* as shown in Figure 2-2. If there is no previous installation of the *GUI Composer Runtime* application, the installer also requests for an automatic download from the web. Select either *Install from Web* to download and install from the web, or *Install from PC* and provide the path to the local file that is already downloaded. The runtime file also installs the USB drivers, unless the drivers are already installed. The software installation automatically copies the required files and drivers to the local machine.

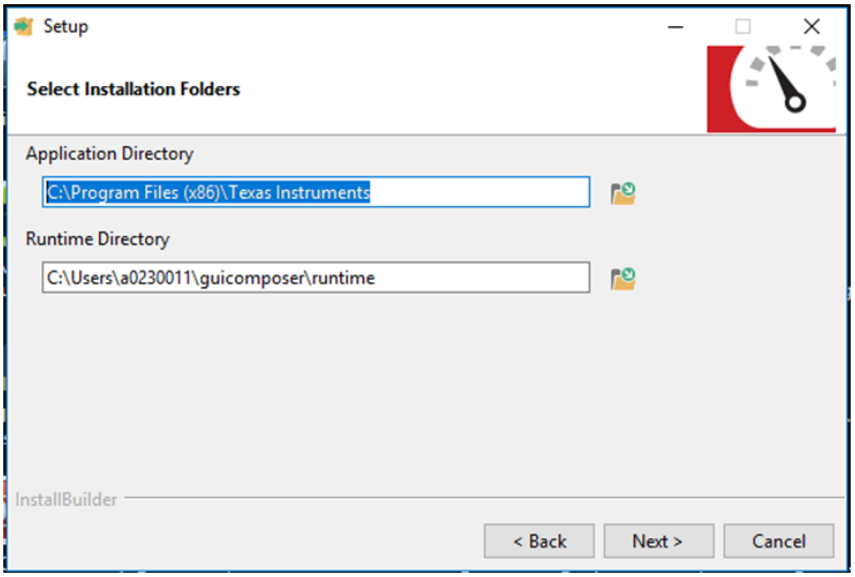

Figure 2-2. Software Installation Path

2.1.3 TI Launchpad Firmware Upgrade

The firmware for the TI Launchpad must be upgraded for the first time before using the software. A jumper must be modified, and the USB cable must be connected to the XDS110 port of the TI Launchpad to download firmware. The firmware can be programmed to the TI Launchpad using the online tool, UniFlash. This link is also provided on the *Setup* page of the GUI. The firmware bin file can be found at *<Download Directory>\DAC53701EVM_1.0.1_installer_win\install_image_DAC53701EVM\DAC53701EVM\firmware\acctrl.0.3.0.3b.bin* after unzipping the file *install_image_DAC53701EVM.zip*.

Follow the step-by-step procedure below to upgrade the firmware and install the device drivers successfully:

1. Remove jumper JP6 on the TI Launchpad, as shown in step 1 of Figure 2-3.

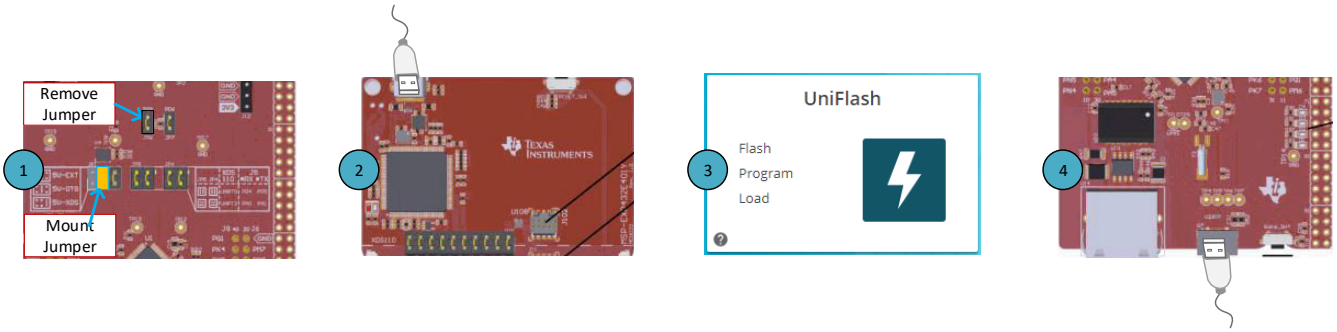

Figure 2-3. MSP-EXP432E401Y Launchpad (TI Launchpad) Setup

2. Mount jumper on 5V-OTG. Retain the jumper on 5V-XDS, as shown in step 1 of Figure 2-3.
3. Connect the USB cable to the port on the XDS110 side of the board, as shown in step 2 of Figure 2-3.
4. Connect the USB cable to the PC and open UniFlash. Click on *Start Now* in the *Detect Device* section.
5. If the GUI Composer framework is being installed for the first time on the PC, the browser extension and the *TI Cloud Agent* must also be installed. Follow the 2-step installation flow prompted on the web page, as shown in Figure 2-4

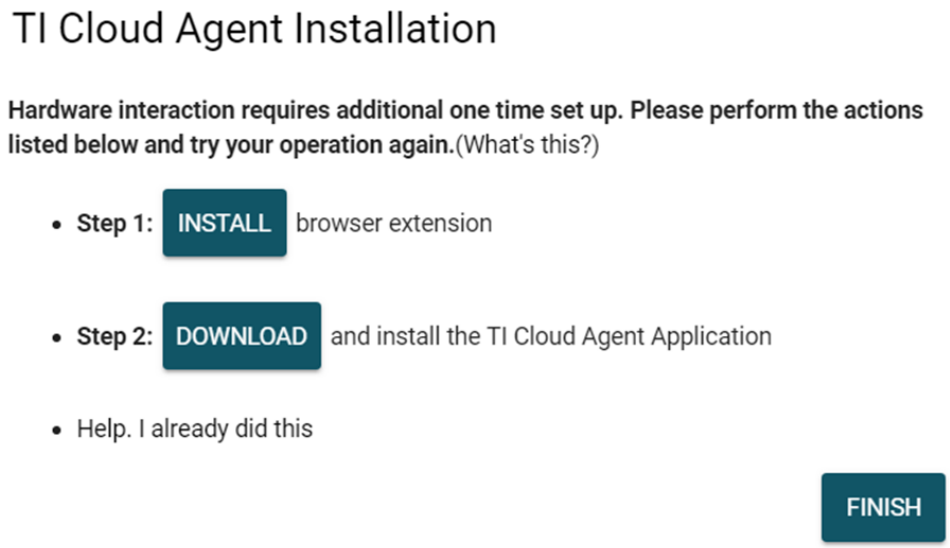

Figure 2-4. TI Cloud Agent Installation

6. Press the *Refresh* or *Finish* button after the installation is complete. This action should detect the Launchpad.
7. Press *Start* and browse for *<Download Directory>\DAC53701EVM_1.0.1_installer_win\install_image_DAC53701EVM.\DAC53701EVM\firmware\acctrl.0.3.0.3b.bin*. Press *Load Image* followed by *Verify Image*.

2.2 Hardware Setup

This section provides the overall system setup for the EVM. The hardware setup contains the TI Launchpad (MSP-EXP432E401Y Launchpad), BOOSTXL-DAC-PORT, and DAC53701EVM. A PC runs the software that provides an interface to the DAC53701EVM through the TI Launchpad.

The TI Launchpad generates 5 V of power that can be used as VDD for the DAC. The TI Launchpad also generates 3.3 V of power that can be used for I^2C pullups. The IO ports of the Analog EVM Controller and level translators used on the BOOSTXL-DAC-PORT and DAC53701EVM can withstand a maximum of 3.6-V IO levels. The TI Launchpad also generates digital signals used to communicate with the EVM board.

The BOOSTXL-DAC-PORT is a generic platform used for catalog DACs that provides a predefined interface to connect a DAC evaluation module. The BOOSTXL-DAC-PORT also provides various options for power supply, reference, and digital signals. A connector is provided on the BOOSTXL-DAC-PORT for external power supplies. This platform is designed to host additional boards stacked up on the BOOSTXL-DAC-PORT in order to provide extended functions. Figure 2-5 displays the system hardware setup.

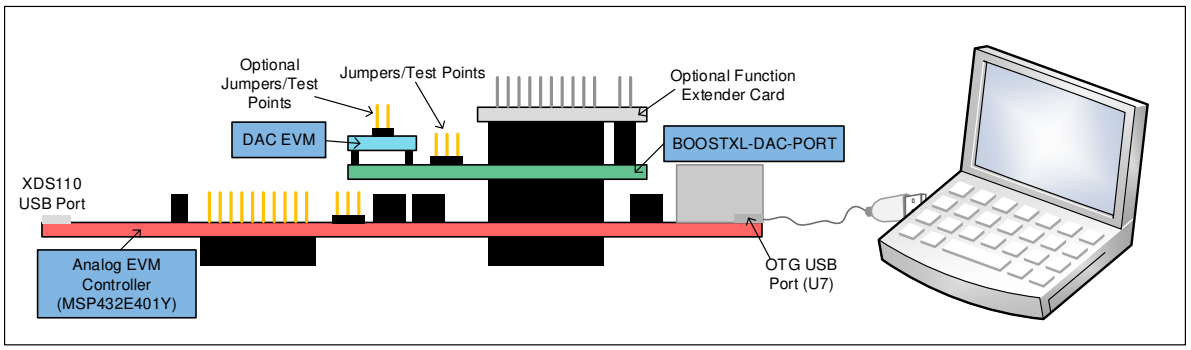

Figure 2-5. Hardware Setup

2.2.1 Power Configurations and Jumper Settings

The DAC53701EVM provides electrical connections to the device supply pins. The connectors and optional configurations are shown in Table 2-1. The jumper settings on the BOOSTXL-DAC-PORT are crucial to the proper functioning of the DAC53701EVM. Table 2-2 provides the details of the possible jumper settings on the BOOSTXL-DAC-PORT.

Table 2-1. DAC53701EVM Power Supply Inputs

DAC53701EVM Connector	Supply Name	Voltage Range
J2.1	VDD	1.8 V to 5.5 V (5 V available on TI Launchpad), jumper J9.1-2 on BOOSTXL-DAC-PORT
J1.8	VIO	1.8 V to 3.6 V (3.3 V available on TI Launchpad), jumper J10.1-2 on BOOSTXL-DAC-PORT
J1.7	DAC_VIO	1.8 V to 3.6 V, jumper J11.1-2 on BOOSTXL-DAC-PORT
J1.1	GND	0 V

Table 2-2. BOOSTXL-DAC-PORT Jumper Settings

Jumper	Default Position	Available Option	Description
J3	1-2: Onboard reference	2-3: External reference	External or onboard reference selection
J6	2-3: Zener reference	1-2: VDD reference	Zener or VDD reference
J7	2-3: 2.5-V reference	1-2: 5-V reference	2.5-V or 5-V reference selection
J8	2-3: Unused on DAC53701	1-2: Unused on DAC53701	External or onboard $\overline{\text{LDAC}}$ selection
J9	1-2: 5 V from TI Launchpad	2-3: External VDD	5-V or external VDD
J10	1-2: 3.3 V from TI Launchpad	2-3: External VIO	3.3-V or external VIO
J11	Closed: DAC_VIO is connected to VIO	Open: DAC_VIO off	DAC_VIO on or off

2.2.2 Connecting the Hardware

After the TI Launchpad firmware is upgraded as described in Section 2.1.3, and power and jumper configurations set up as per Section 2.2.1, the BOOSTXL-DAC-PORT and DAC53701EVM can be connected as shown in Figure 2-6. Connect the USB cable from the TI Launchpad OTG USB Port (U7) to the PC.

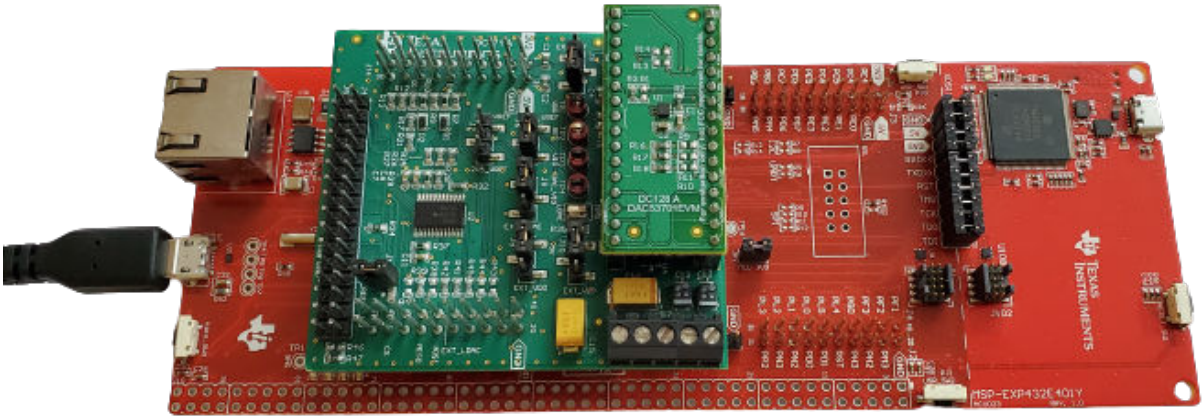

Figure 2-6. Hardware Setup Guidelines

2.2.3 Electrostatic Discharge Warning

Many of the components on the DAC53701EVM 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.

3 Detailed Description

3.1 Hardware Description

The following sections provide detailed information on the EVM hardware and jumper configuration settings.

3.1.1 Theory of Operation for the BOOSTXL-DAC-PORT

The BOOSTXL-DAC-PORT is a generic evaluation platform for catalog DACs that provides various options for power supply, reference, communication interfaces, and GPIO for a DAC EVM. The DAC EVM interfaces with a predefined set of signals common to a precision DAC. The block diagram of this board is shown in Figure 3-1.

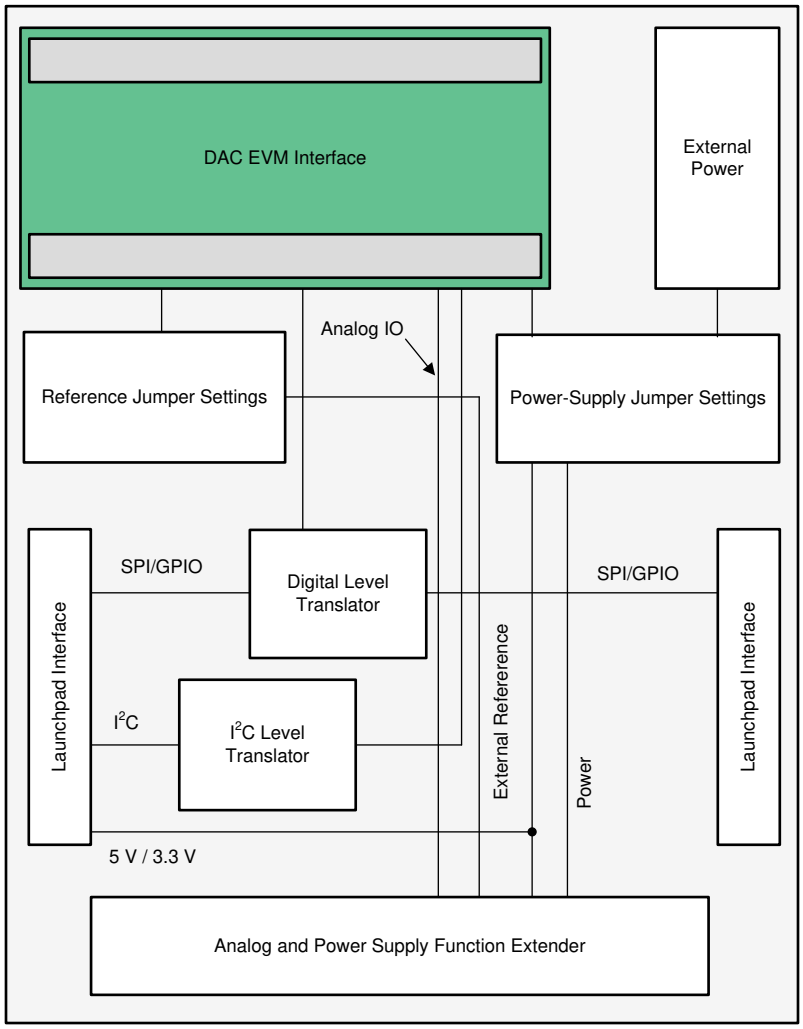

Figure 3-1. BOOSTXL-DAC-PORT Hardware Block Diagram

3.1.1.1 Signal Definition of the BOOSTXL-DAC-PORT

The BOOSTXL-DAC-PORT provides hardware connectors for the TI Launchpad (J13, J14), external power (J12), the DAC53701EVM (J1, J2), and the external function extender (J4, J5). The descriptions are provided in Table 3-1 through Table 3-5.

Table 3-1. BOOSTXL-DAC-PORT J13 Pin Definitions

Pin#	Signal	Description
11	GPIO	General-purpose I/O
12	$\overline{CS}$	SPI $\overline{CS}$ or general-purpose I/O
13	GPIO	SPI
14	MISO	SPI MISO
15	MOSI	SPI MOSI
16	$\overline{RST}$	MCU reset output
17	GPIO	General-purpose I/O
18	GPIO	General-purpose I/O
19	GPIO	General-purpose I/O
20	GND	Ground
31	GPIO	General-purpose I/O
32	GPIO	General-purpose I/O
33	GPIO	General-purpose I/O
34	GPIO	General-purpose I/O
35	EXT_LDAC	External LDAC I/O
36	EXT_LDAC	External LDAC I/O
37	SPI_BUF_EN	Digital, SPI buffer enable
38	GPIO	General-purpose I/O
39	GPIO	General-purpose I/O
40	GPIO	General-purpose I/O

Table 3-2. BOOSTXL-DAC-PORT J14 Pin Definitions

Pin#	Signal	Description
1	+3.3V	3.3-V power supply
2	GPIO	General-purpose I/O
3	GPIO	General-purpose I/O
4	GPIO	General-purpose I/O
5	GPIO	General-purpose I/O
6	GPIO	General-purpose I/O
7	SCLK_A0	SPI SCLK or I^2C A0
8	GPIO	General-purpose I/O
9	SCL	I^2C SCL
10	SDA	I^2C SDA
21	+5V	5-V power supply
22	GND	Ground
23	GPIO	General-purpose I/O
24	GPIO	General-purpose I/O
25	VDD_SENSE	Sense Input for VDD
26	VIO_SENSE	Sense Input for VIO
27	GPIO	General-purpose I/O
28	GPIO	General-purpose I/O
29	GPIO	General-purpose I/O
30	GPIO	General-purpose I/O

Table 3-3. BOOSTXL-DAC-PORT J4 Pin Definitions

Pin#	Signal	Description
1	AIO0	Analog I/O
2	AGND	Analog ground
3	AIO2	Analog I/O
4	AIO4	Analog I/O
5	AGND	Analog ground
6	AIO6	Analog I/O
7	AIO8	Analog I/O
8	AGND	Analog ground
9	AIO10	Analog I/O
10	AIO12	Analog I/O
11	AGND	Analog ground
12	AIO14	Analog I/O
13	EXT_REF	External reference input
14	GND	Ground
15	VCC	VCC output
16	VDD	VDD output

Table 3-4. BOOSTXL-DAC-PORT J5 Pin Definitions

Pin#	Signal	Description
1	AIO1	Analog I/O
2	AGND	Analog Ground
3	AIO3	Analog I/O
4	AIO5	Analog I/O
5	AGND	Analog Ground
6	AIO7	Analog I/O
7	AIO9	Analog I/O
8	AGND	Analog Ground
9	AIO11	Analog I/O
10	AIO13	Analog I/O
11	AGND	Analog Ground
12	AIO15	Analog I/O
13	REFGND	External Reference Ground
14	GND	Ground
15	VSS	VSS Output
16	VIO or DAC_VIO	VIO or DAC_VIO Output

Table 3-5. BOOSTXL-DAC-PORT J12 Pin Definitions

Pin#	Signal	Description
1	VCC	High-voltage positive power supply
2	VSS	High-voltage negative power supply
3	GND	Ground
4	EXT_VDD	External VDD
5	EXT_VIO	External VIO

3.1.2 Theory of Operation for the DAC53701EVM Hardware

The block diagram of the DAC53701EVM board is displayed in Figure 3-2. The EVM board connects to BOOSTXL-DAC-PORT with two 16-pin connectors. These headers provide access to all DAC pins. The EVM board also houses EEPROM and an I^2C buffer.

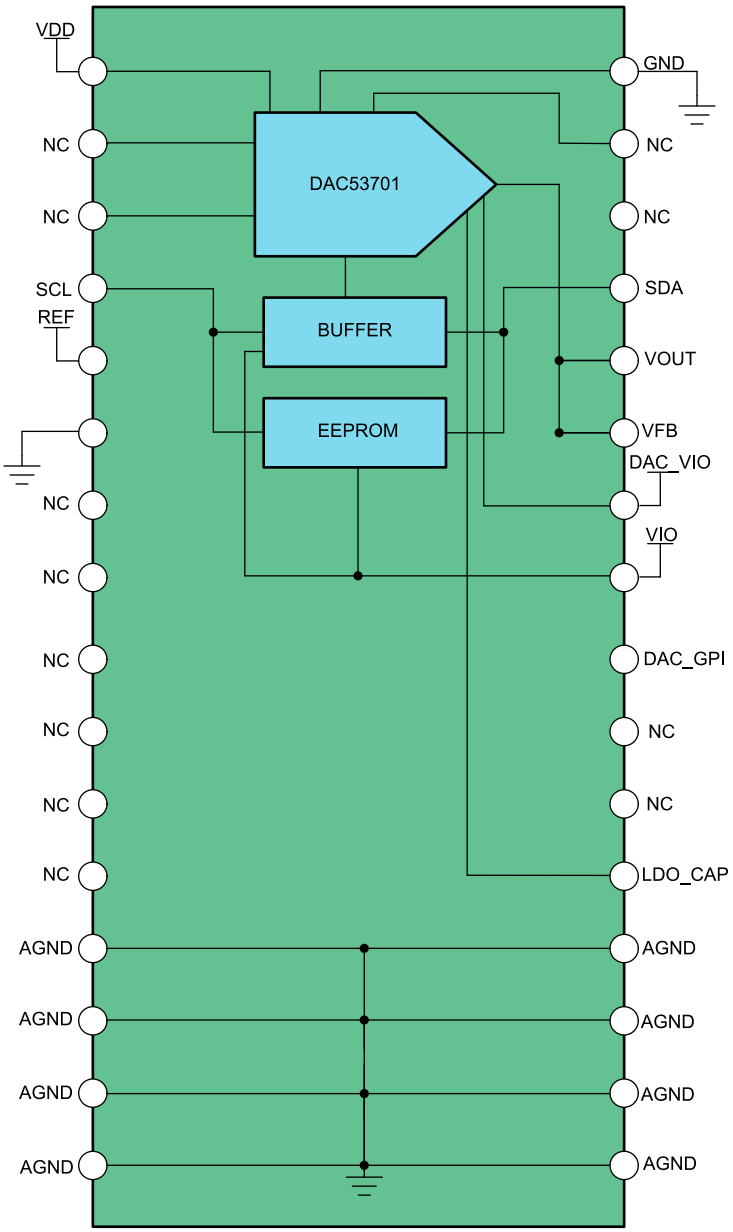

Figure 3-2. DAC53701EVM Hardware Block Diagram

3.1.2.1 Signal Definition of the DAC53701EVM

The DAC53701EVM provides access to all DAC pins through connection J1 and J2, as listed in Table 3-6 and Table 3-7.

Table 3-6. DAC53701EVM J2 Pin Definitions

Pin#	Signal	Description
1	VDD	VDD power supply
2	NC	Not connected
3	NC	Not connected
4	SCL	I^2C SCL
5	REF	Reference input
6	NC	Not connected
7	NC	Not connected
8	NC	Not connected
9	NC	Not connected
10	NC	Not connected
11	NC	Not connected
12	NC	Not connected
13	AGND	Analog ground
14	AGND	Analog ground
15	AGND	Analog ground
16	AGND	Analog ground

Table 3-7. DAC53701EVM J1 Pin Definitions

Pin#	Signal	Description
1	GND	Analog ground
2	NC	Not connected
3	NC	Not connected
4	SDA	I2C SDA
5	VOUT	DAC output
6	VFB	DAC feedback pin
7	DAC_VIO	Pullup for DAC I^2C signals
8	VIO	Power supply for EEPROM
9	DAC_GPI	GPI Input for DAC53701
10	NC	Not connected
11	NC	Not connected
12	LDO_CAP	LDO bypass capacitor
13	AGND	Analog ground
14	AGND	Analog ground
15	AGND	Analog ground
16	AGND	Analog ground

3.2 Software Description

This section describes the features of the DAC53701 EVM software, and discusses how to use these features. The software provides basic control of all the registers and functions to the DAC53701 device.

3.2.1 Starting the Software

To launch the software, locate the Texas Instruments folder in the *All Programs* menu, and select the *DAC53701 EVM* icon.

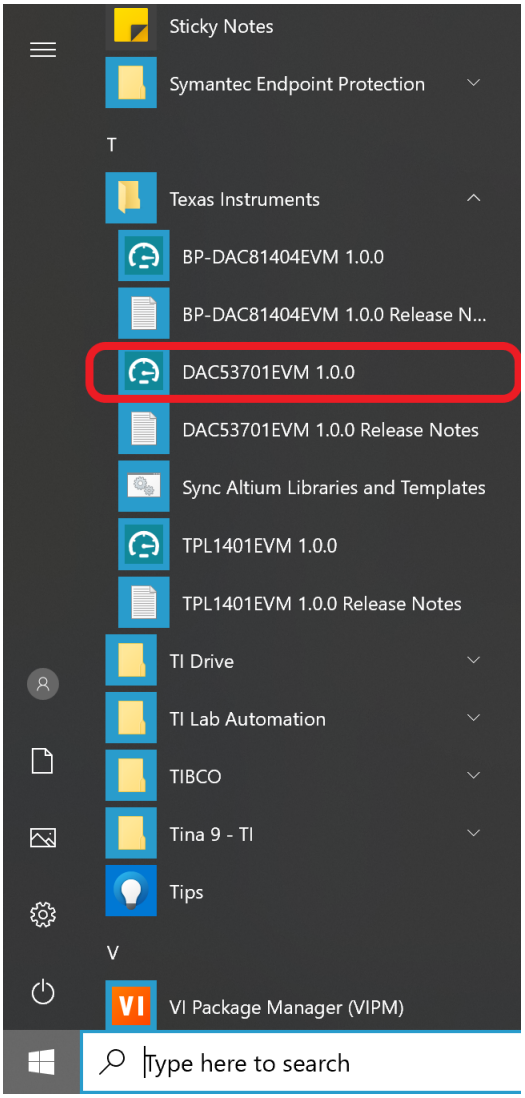

Figure 3-3. DAC53701EVM GUI Location

Figure 3-4 shows that if the Analog EVM Connector is connected correctly, the status bar at the bottom of the screen displays *Hardware Connected*. If the Analog EVM Controller is not properly connected or not connected at all, the status bar displays *Hardware not connected*. In case the *Hardware not connected* status persists even after the hardware is connected, go to *Options* → *Serial Port*, and change the port to the other available port with the *(Texas Instruments)* or *ACCtrl* tag. Out of the two ports with these tags, one port should connect.

Figure 3-4. DAC53701EVM GUI Connection Detection

3.2.2 Software Features

The DAC53701EVM incorporates interactive functions that help configure the DAC53701 device. These functions are built into several GUI pages, as shown in the following subsections. The *Menu* allows the user to switch between pages, with each page representing a feature of the software.

3.2.2.1 Home Page

THe Home page, as shown in Figure 3-5, provides basic information and navigation to other pages. Click on *Learn More...* to get more information on the device.

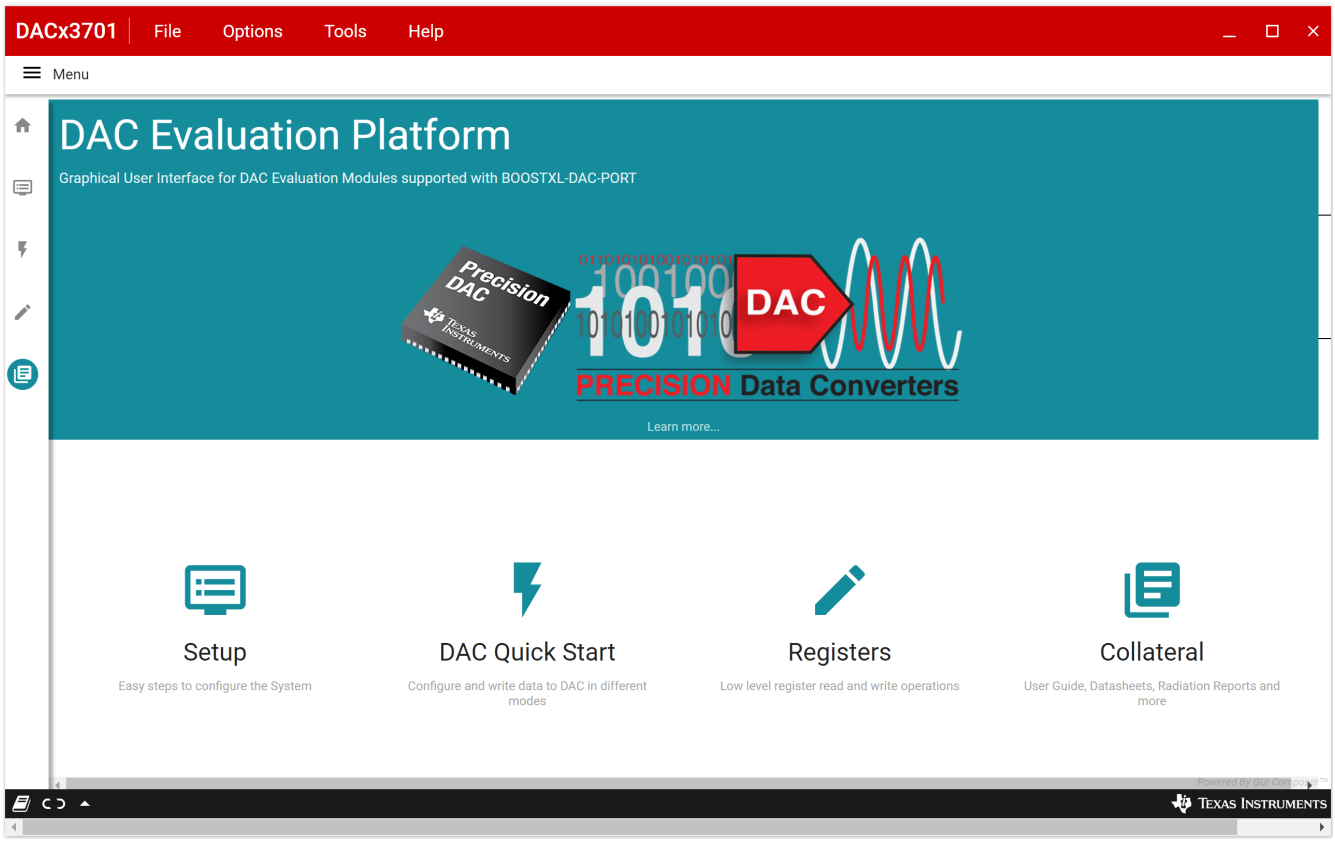

Figure 3-5. Software Home Page

3.2.2.2 Setup Page

The Setup page, as shown in Figure 3-6, guides the user to perform a one-time firmware upgrade for the TI Launchpad, and details how the TI Launchpad, BOOSTXL-DAC-PORT, and DAC53701EVM are stacked. This page also shows the default jumper settings for the BOOSTXL-DAC-PORT.

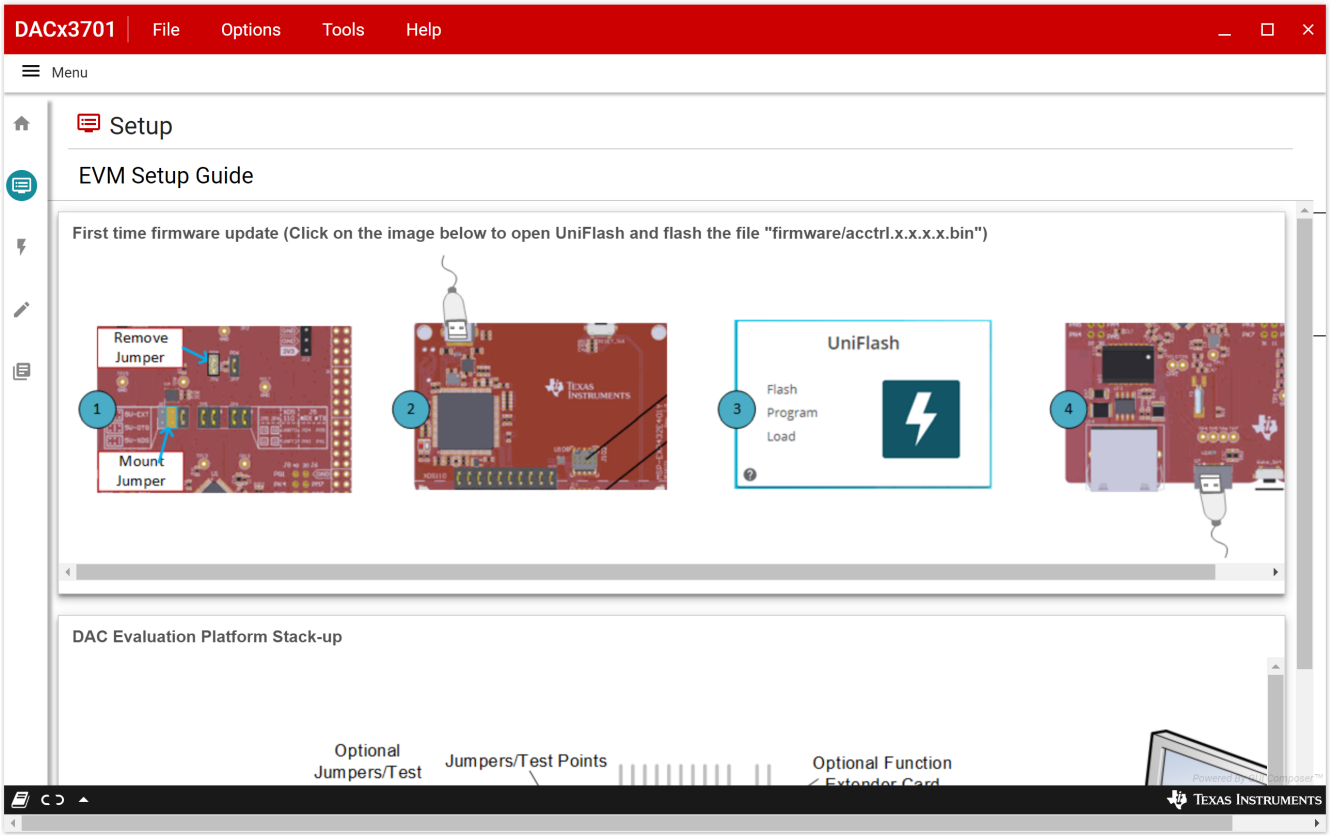

Figure 3-6. Setup Page

3.2.2.3 DAC Quick-Start Page

This page is divided in to four tabs: *Basic DAC*, *Margining*, *Functions*, and *Alarms*. The following subsections describe each tab.

3.2.2.3.1 Basic DAC Tab

The *Basic DAC* quick-start tab is shown in Figure 3-7provides an interface to quickly power up, select the reference and output span, and program the output voltage (decimal) for the DAC53701. The DAC53701 comes in Hi-Z power-down mode by default.

Note

The basic DAC setup for power up, reference selection, and output span selection available in this tab is common to all the tab functions.

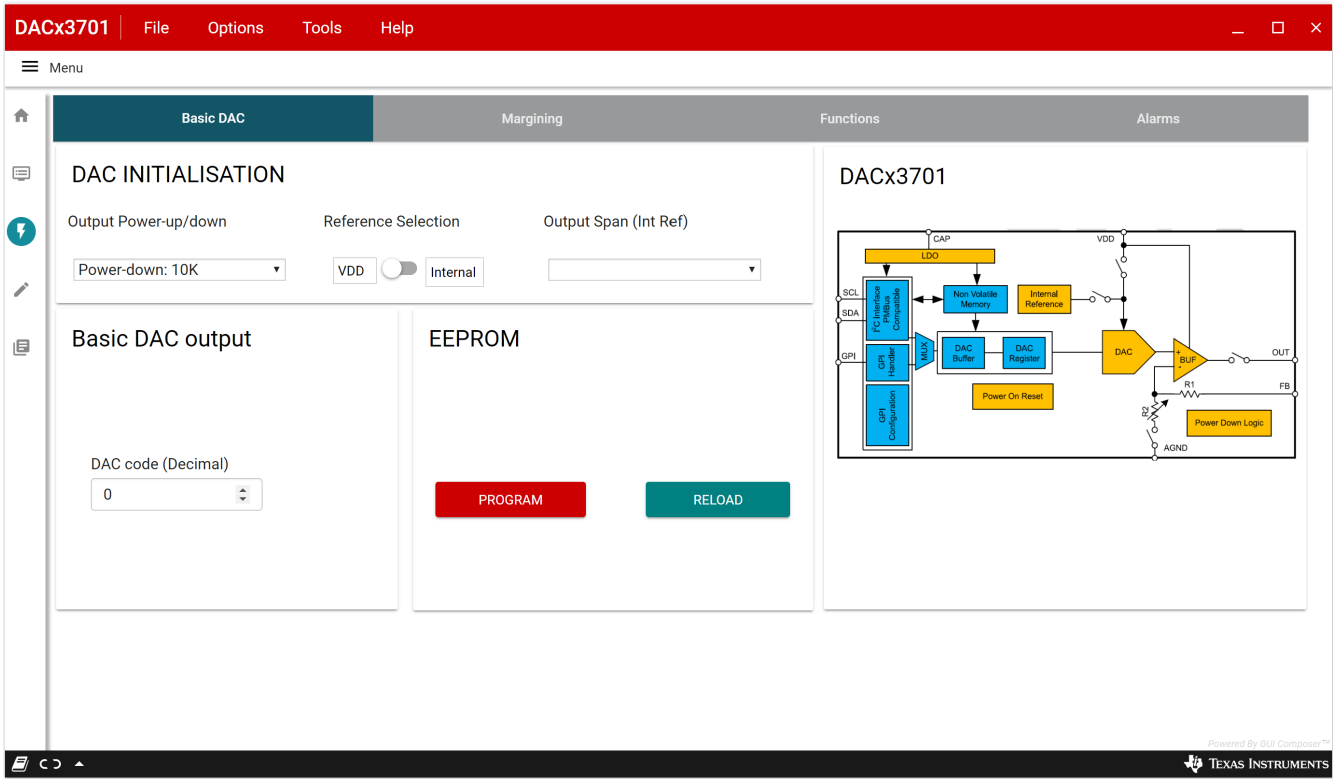

Figure 3-7. DAC Quick-Start Page: Basic DAC Tab

The EEPROM *PROGRAM* button is used to write the latest register settings to the EEPROM.

The *RELOAD* button is used to retrieve the settings stored in the EEPROM.

The GPI pin programming has not been provided in this version of the software, although the EVM hardware has options for providing signals to DAC53701 through header J2

3.2.2.3.2 Margining Tab

The second tab on the *Quick-Start* page is *Margining*, as shown in Figure 3-8. This tab provides the settings for margin-low, margin-high, and nominal DAC outputs, along with code-step and slew-rate for the ramp generation.

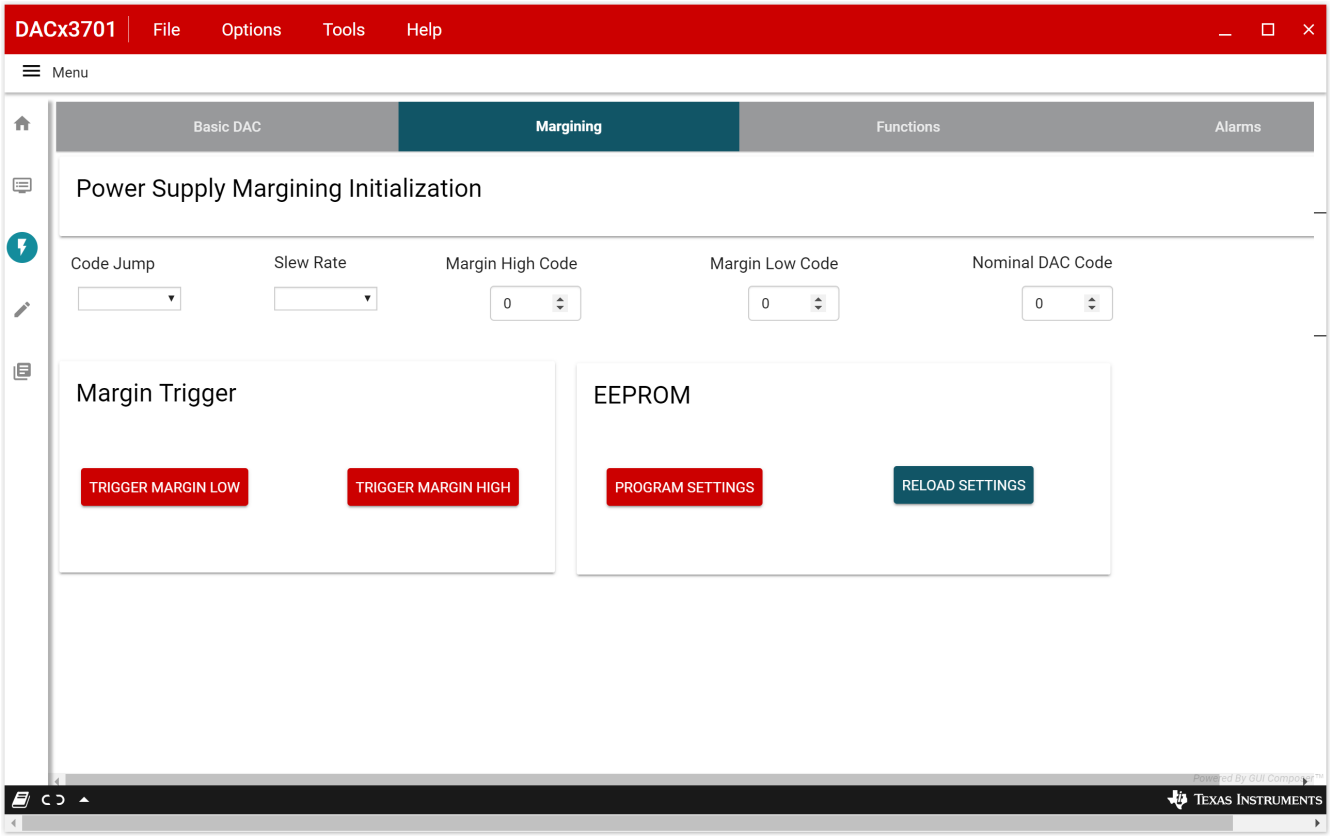

Figure 3-8. DAC Quick-Start Page: Margining Tab

The margin-low and the margin-high triggers are by the respective buttons.

The register settings are programmed or retrieved using the EEPROM *PROGRAM* or *RELOAD* buttons, respectively.

The trigger bits are not loaded to the EEPROM because they are edge sensitive.

3.2.2.3.3 Functions Tab

The next tab on the *Quick-Start* page is *Functions* for function generation, as shown in Figure 3-9. This page provides the ramp programming done through code-step and slew-rate settings.

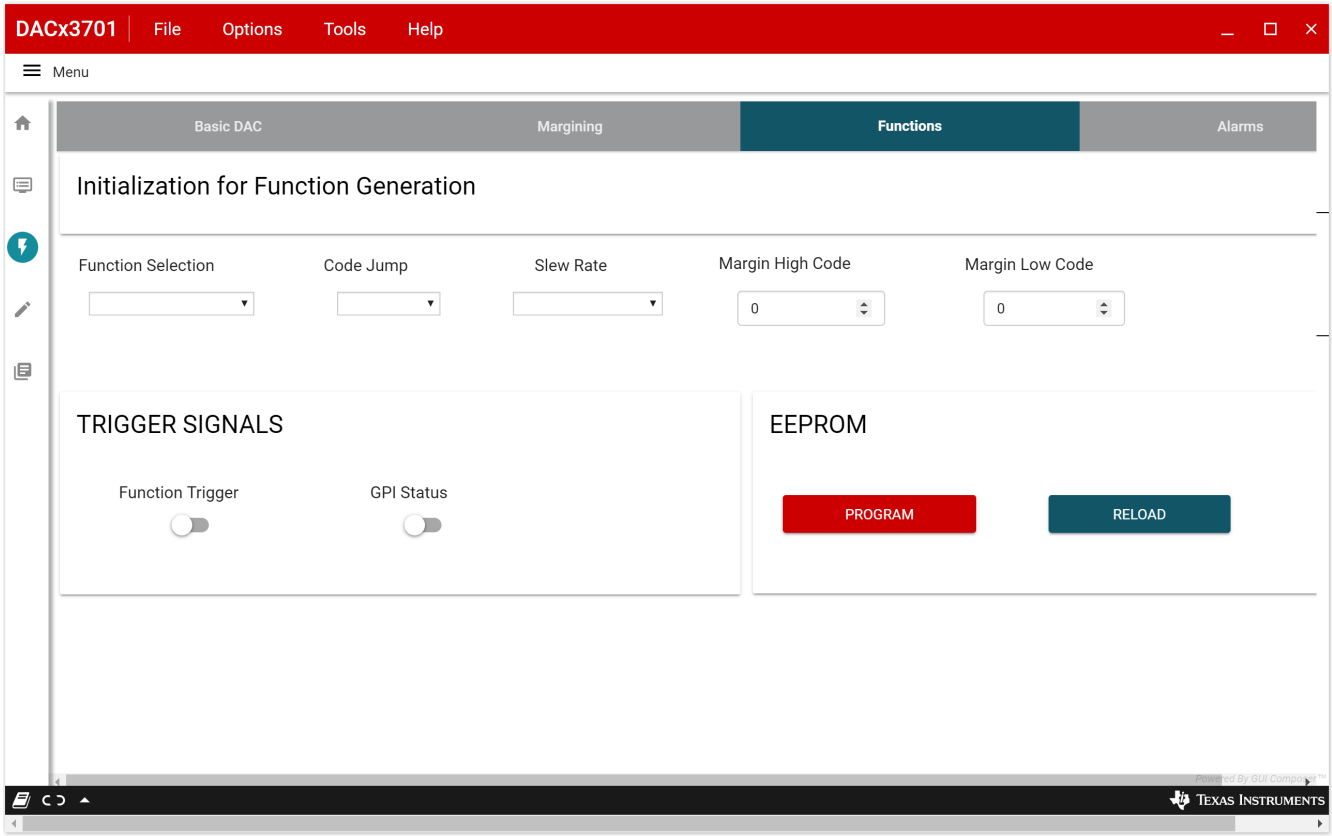

Figure 3-9. DAC Quick Start Page: Function Generation

The most basic setting for this functionality is the function selection: triangular wave, saw-tooth wave, reverse saw-tooth wave, and square wave.

The margin-low and margin-high settings define the lower and the upper bounds of the waveform, respectively.

The toggle button starts or stops the defined function generation.

Any change to the function settings can only be done when the function is off.

The register settings can be programmed or retrieved using the EEPROM *PROGRAM* or *RELOAD* buttons, respectively.

3.2.2.3.4 Alarms Tab

The *Alarm* tab on the *Quick-Start* page is a special medical alarm function provided by the DAC53701. The settings for this function are as shown in Figure 3-10. The ramp generation settings are similar to that of function generation: code-step, slew-rate, margin-low, and margin-high.

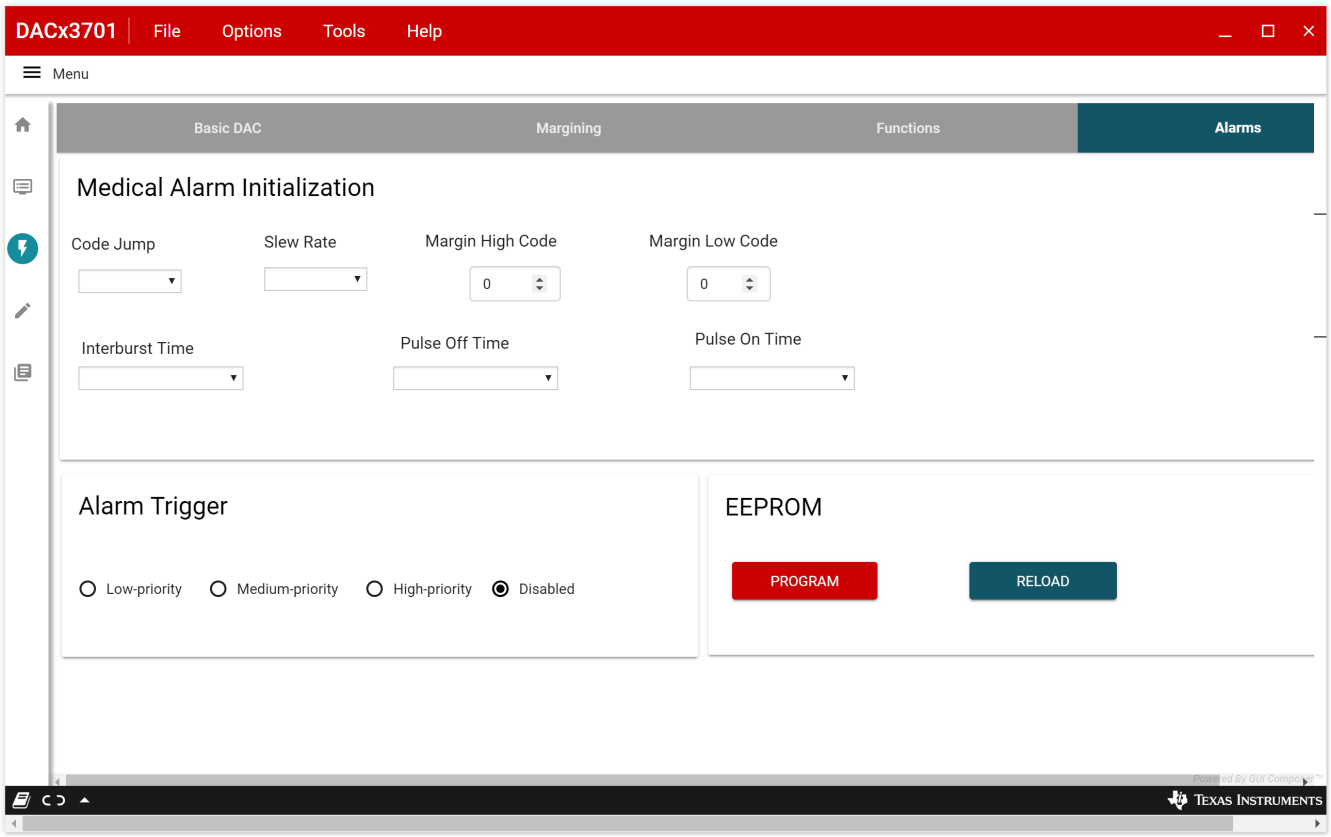

Figure 3-10. DAC Quick-Start Page: Alarms Tab

In addition to these settings, the medical alarms have three more settings: interburst time, pulse-off time, and pulse-on time. These settings have four common settings that take different values depending on the type of alarm selected. Refer to the DAC53701 data sheet for these timing details. There are three types of alarms: low-priority, medium-priority, and high-priority. The radio buttons are used to trigger any one of the alarms. The register settings are programmed or retrieved using the EEPROM *PROGRAM* or *RELOAD* buttons, respectively.

3.2.2.4 Register Map Page

The DAC53701EVM *Register Map* page, as shown in Figure 3-11, allows the user to access low level communication directly with the DAC53701 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 are read from and written to the registers by writing to the *Value* or bit field of the GUI.

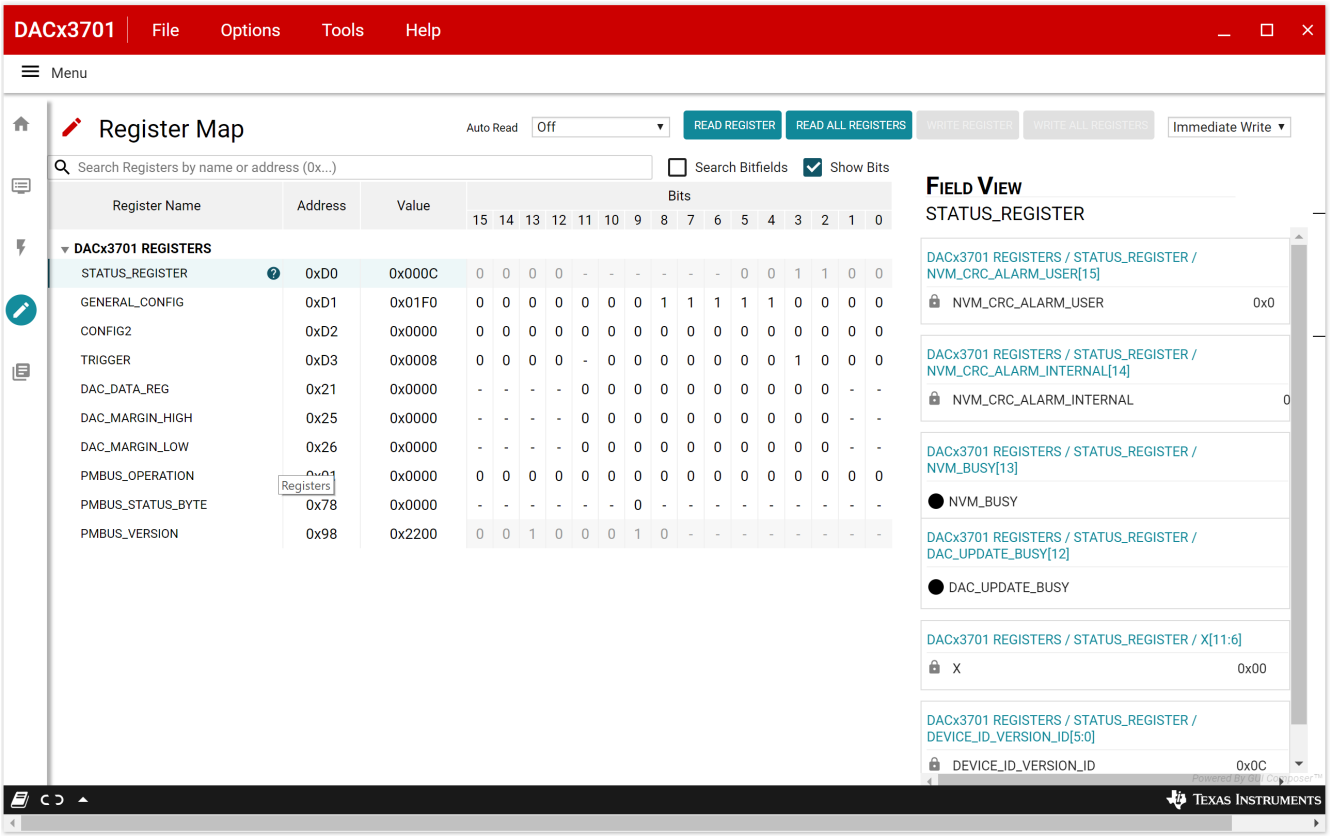

Figure 3-11. Register Map Page

There are some configuration lists and action buttons provided on the *Register Map* page. The values of the register map can be stored locally by pressing the *Save Registers* button under the *File* menu option. Additionally, the stored configuration files can be recalled and loaded through the *Load Registers* button.

Other options selectable by the user are the *Auto Read Interval*,*Read Register*, *Read All Registers*, *Write Register*, *Write All Registers*, and *Update Mode* buttons.

All buttons are displayed in Figure 3-12. The *Write Register* and *Write All Registers* buttons are enabled only with *Deferred* update mode. *Deferred* mode initiates a write operation only when the *Write Register* or the *Write All Registers* button is pressed. By default, the *Immediate* update mode is selected for the *Register Map* page write operations.

Figure 3-12. Register Page Options

3.2.2.5 Collateral Page

This page shown in Figure 3-13 provides links for all the collateral on the DAC53701 device.

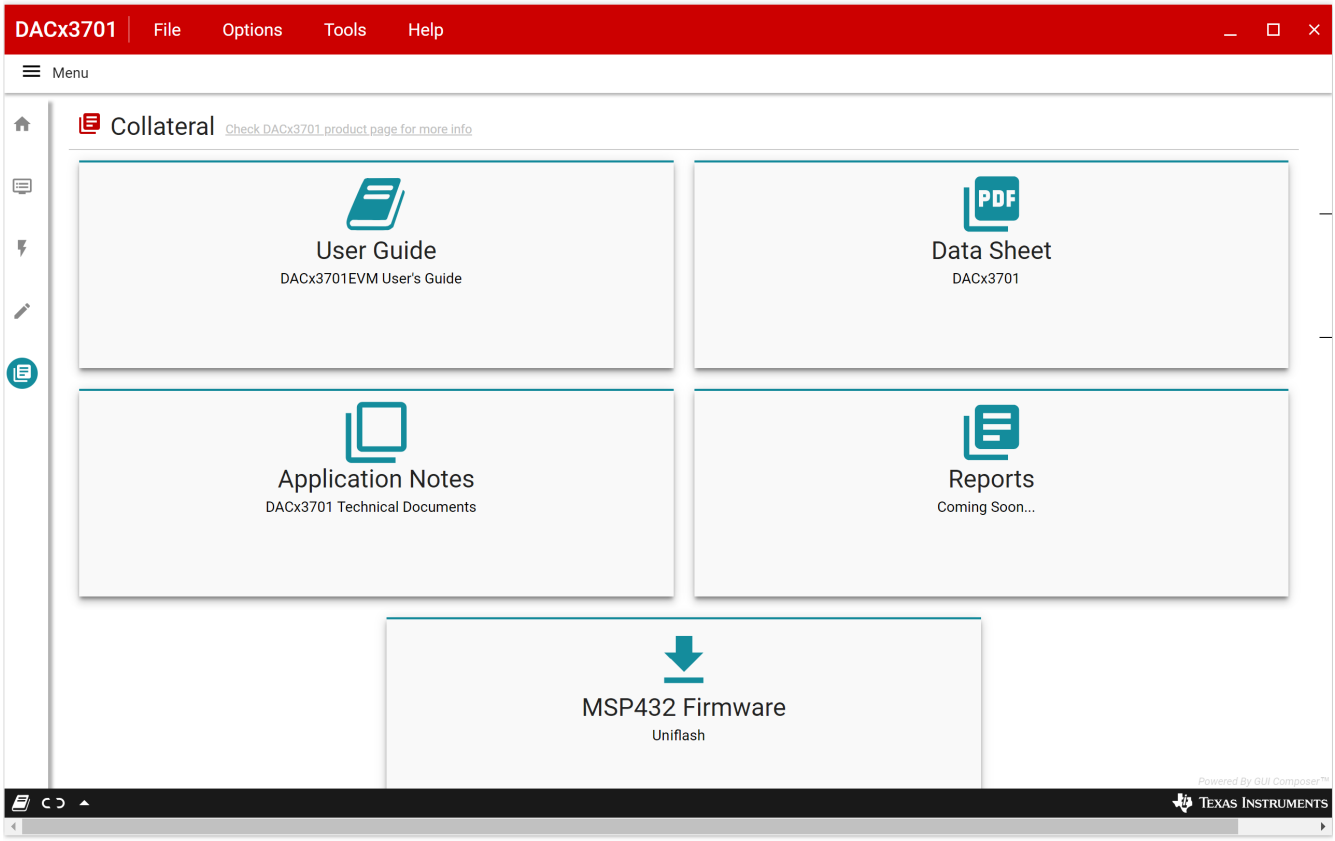

Figure 3-13. Collateral Page

4 Schematic, PCB Layout, and Bill of Materials

This section contains the complete bill of materials and schematic diagram for the BOOSTXL-DAC-PORT and DAC53701EVM.

4.1 BOOSTXL-DAC-PORT Schematic

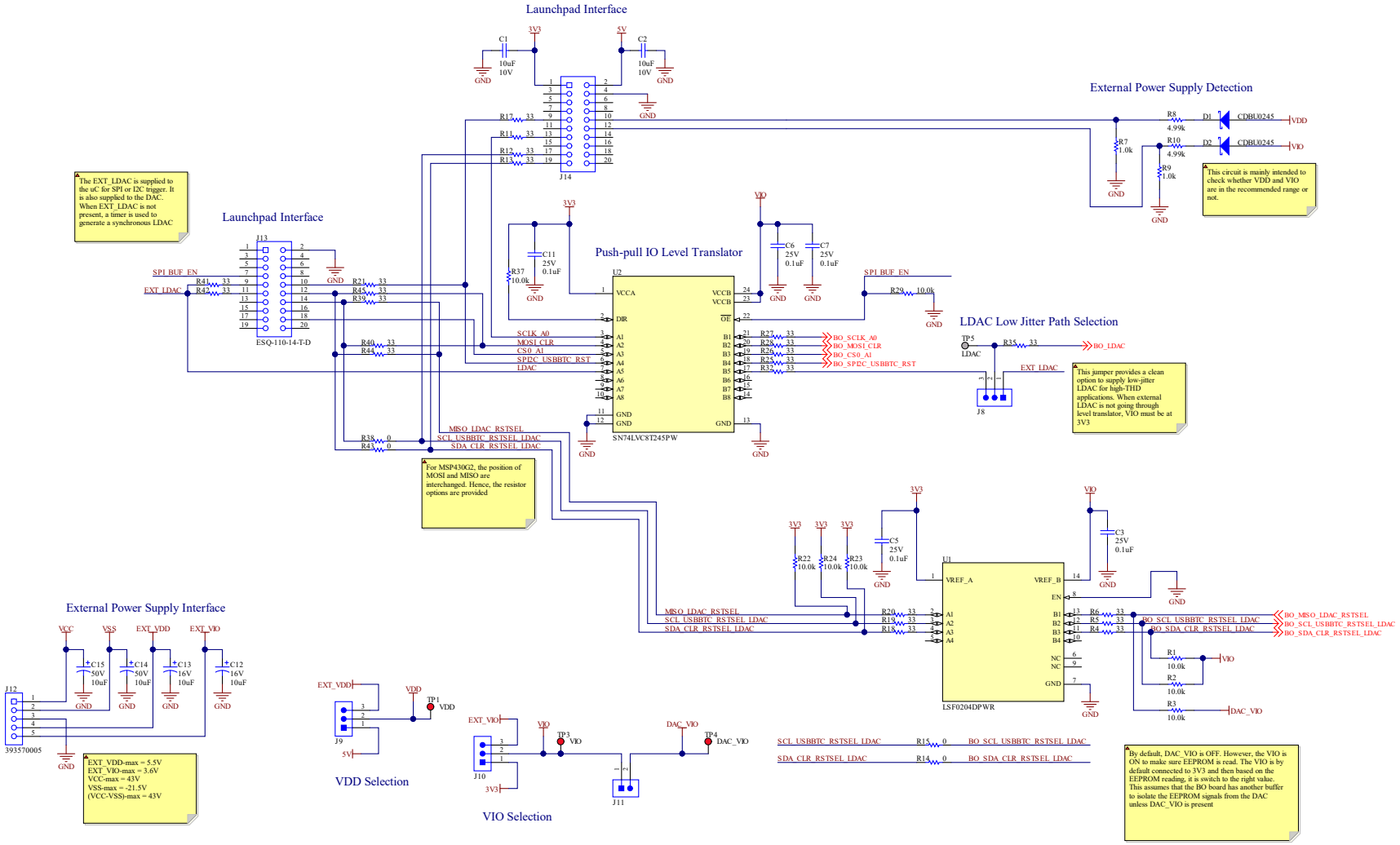

Figure 4-1. BOOSTXL-DAC-PORT Schematic Page 1

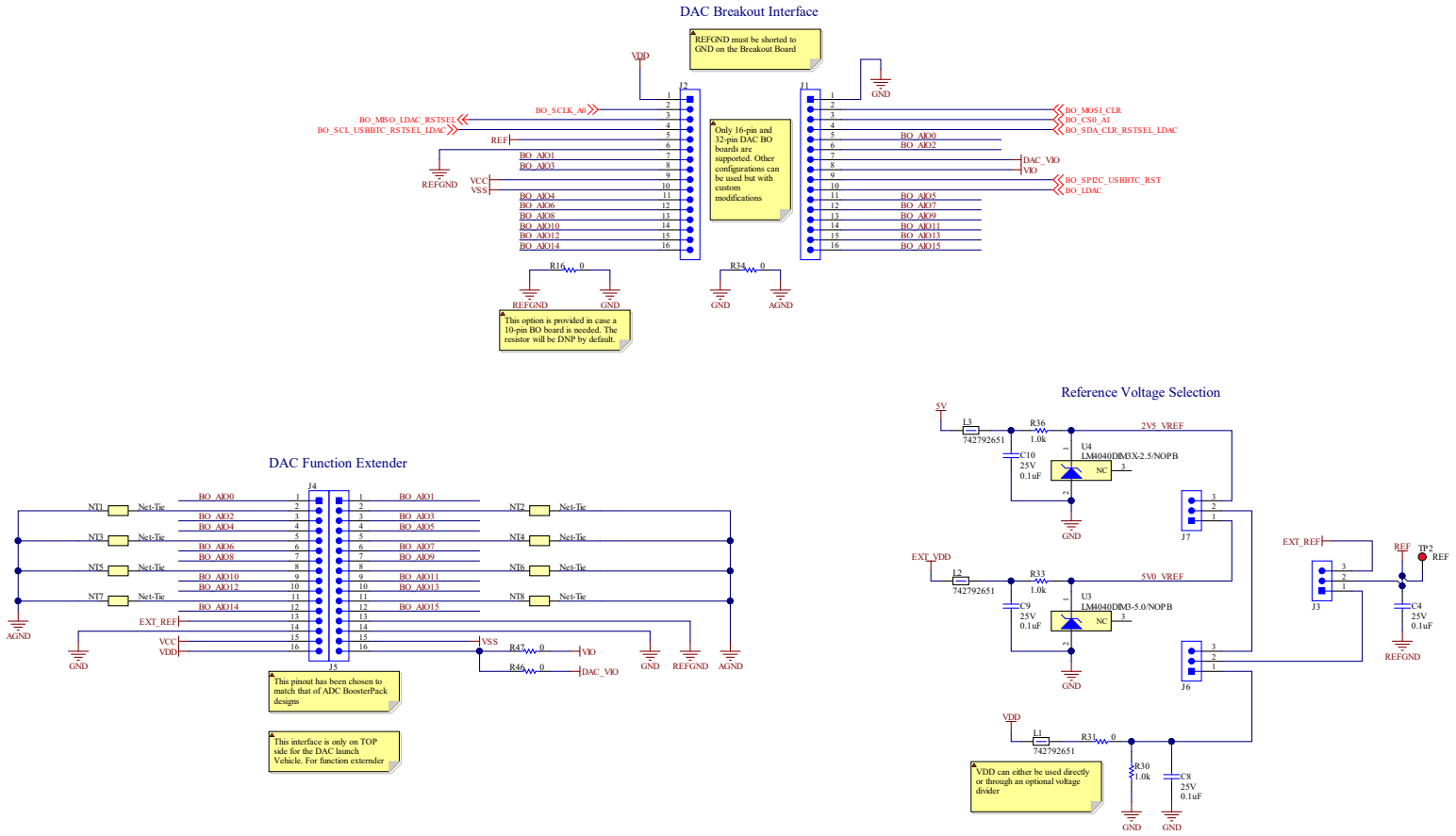

Figure 4-2. BOOSTXL-DAC-PORT Schematic Page 2

4.2 DAC53701EVM Schematic

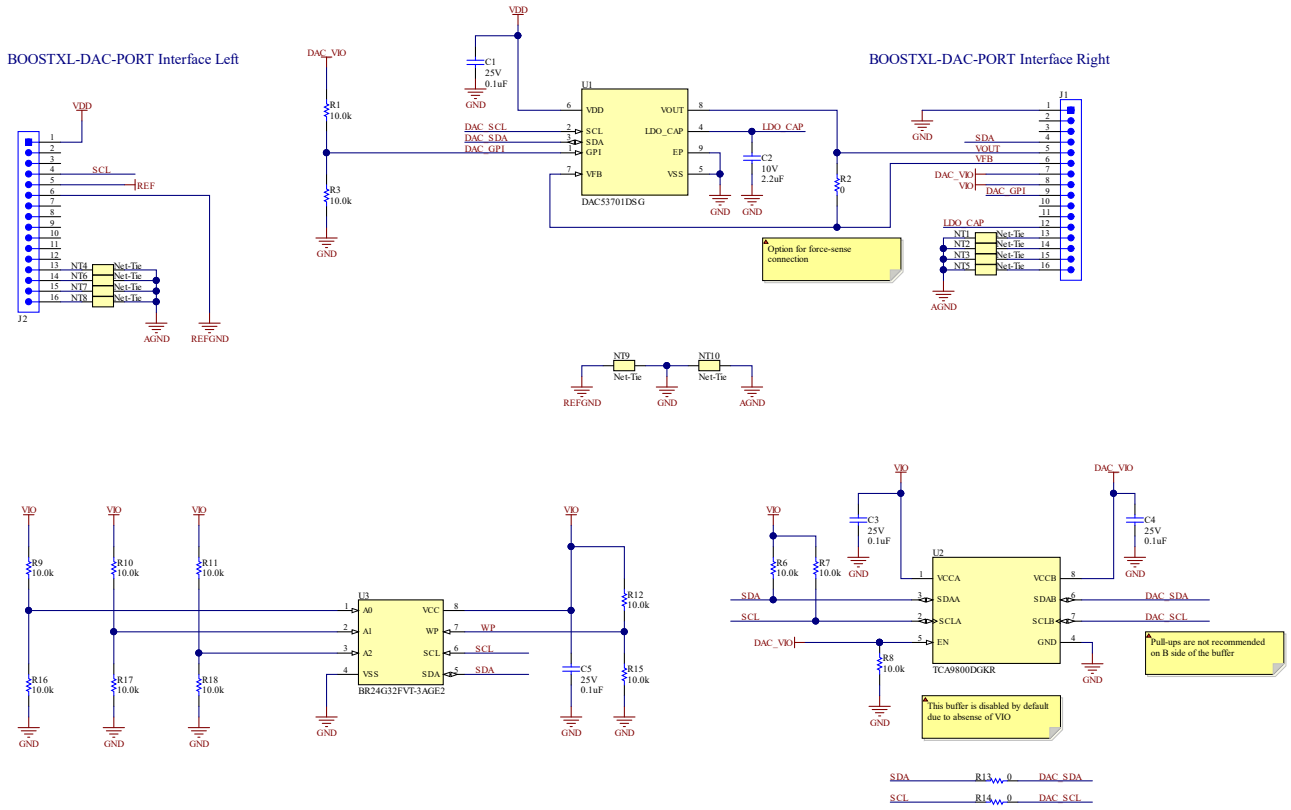

Figure 4-3. DAC53701EVM Schematic

4.3 PCB Components Layout

Figure 4-4 through Figure 4-8 show the layout of the components for the DAC53701EVM board.

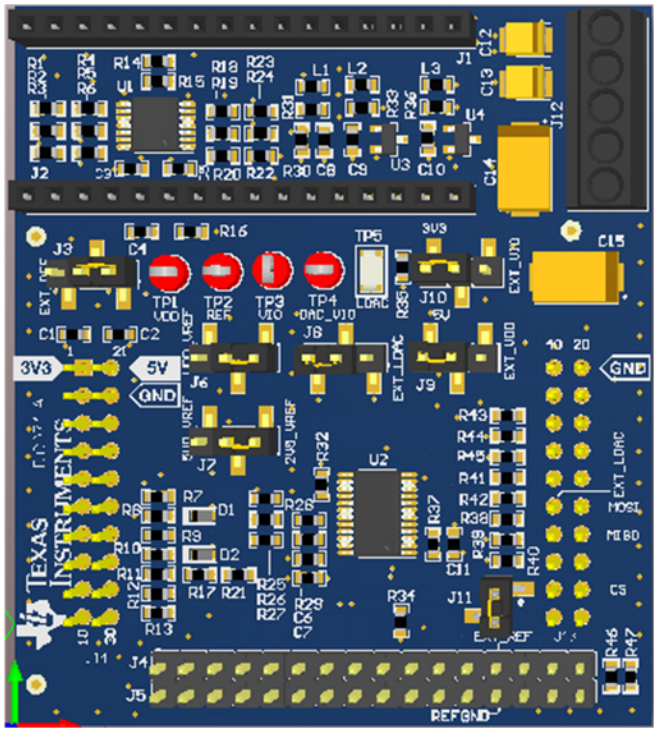

Figure 4-4. BOOSTXL-DAC-PORT PCB Components Layout

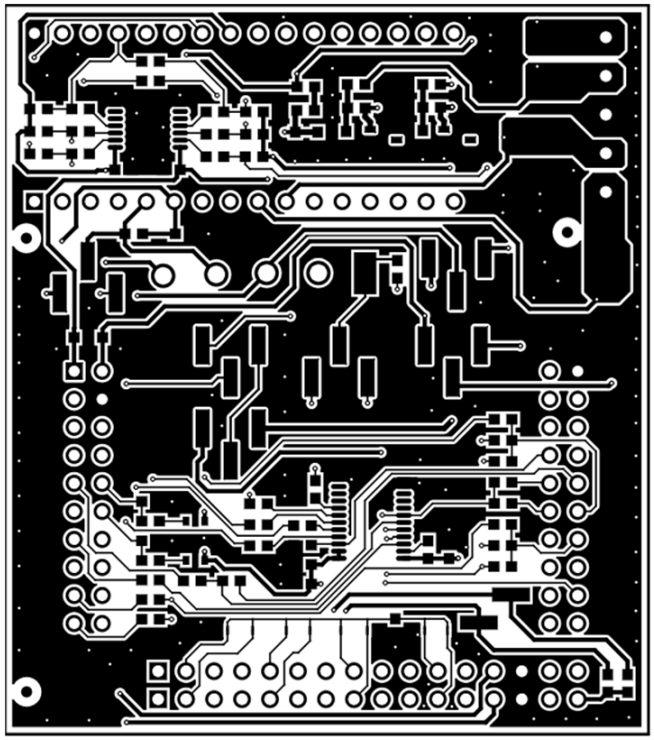

Figure 4-5. BOOSTXL-DAC-PORT Top Layer

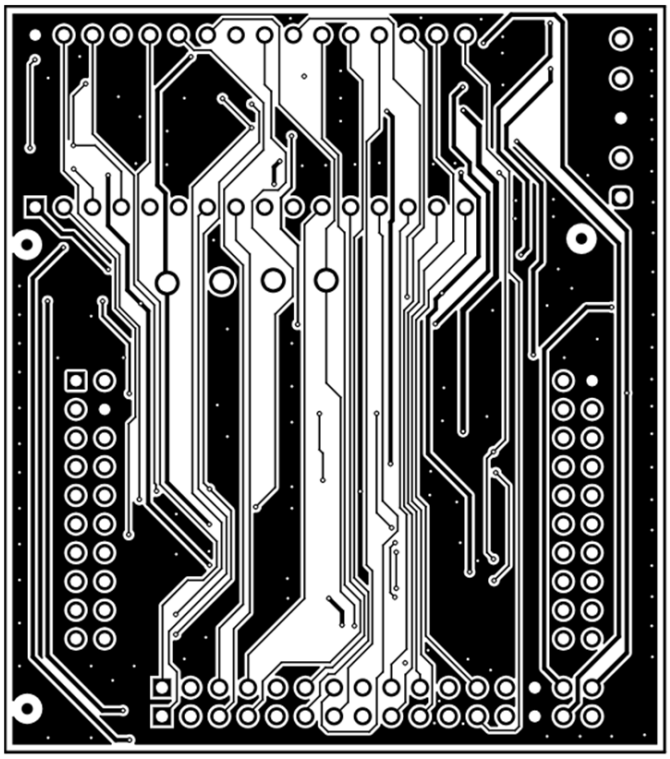

Figure 4-6. BOOSTXL-DAC-PORT Bottom Layer

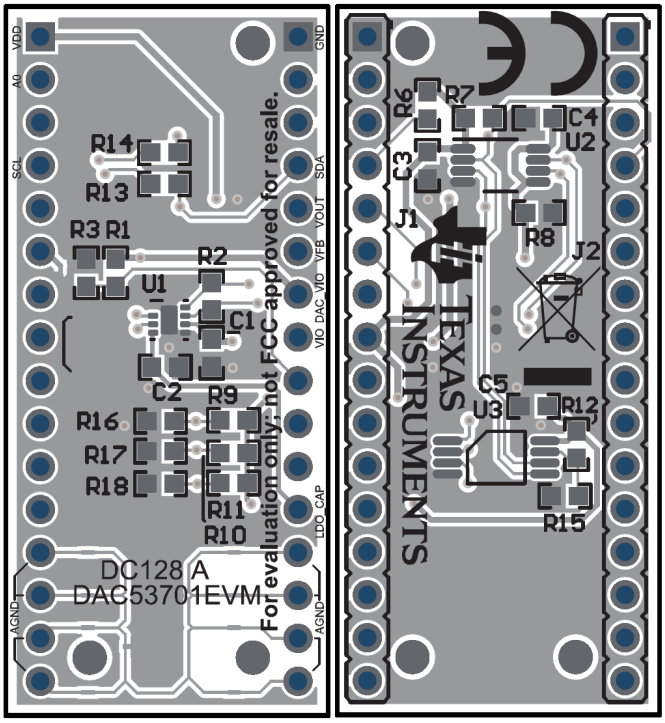

Figure 4-7. DAC53701EVM PCB Components Layout

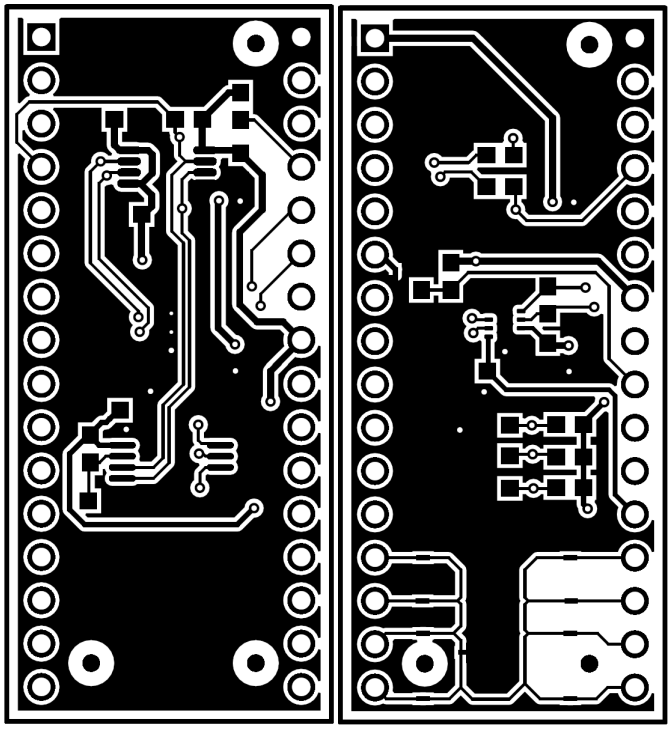

Figure 4-8. DAC53701EVM Layers

4.4 BOOSTXL-DAC-PORT Bill of Materials

Table 4-1. BOOSTXL-DAC-PORT Bill of Materials

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
!PCB1	1		Printed Circuit Board		DC071	Any
C1, C2	2	10uF	CAP, CERM, 10 uF, 10 V, +/- 20%, X7R, 0603	0603	GRM188Z71A106MA73D	MuRata
C3, C4, C5, C6, C7, C8, C9, C10, C11	9	0.1uF	CAP, CERM, 0.1 uF, 25 V, +/- 10%, X7R, 0603	0603	C1608X7R1E104K080AA	TDK
C12, C13	2	10uF	CAP, TA, 10 uF, 16 V, +/- 10%, 2 ohm, SMD	3528-21	293D106X9016B2TE3	Vishay-Sprague
C14, C15	2	10uF	CAP, TA, 10 uF, 50 V, +/- 10%, 0.5 ohm, SMD	7343-43	TPSE106K050R0500	AVX
D1, D2	2	50V	Diode, Schottky, 50 V, 0.2 A, SOD-523F	SOD-523F	CDBU0245	Comchip Technology
J1, J2	2		Receptacle, 2.54mm, 16x1, Tin, TH	Receptacle, 2.54mm, 16x1, TH	PPTC161LFBN-RC	Sullins Connector Solutions
J3, J6, J7, J8, J9, J10	6		Header, 2.54mm, 3x1, Gold, SMT	Header, 2.54mm, 3x1, SMT	TSM-103-01-L-SV-P-TR	Samtec
J4, J5	2		Header, 2.54mm, 16x1, TH	Header, 2.54mm, 16x1, TH	22284160	Molex
J11	1		Header, 100mil, 2x1, Gold with Tin Tail, SMT	2x1 Header	TSM-102-01-L-SV	Samtec
J12	1		Terminal Block, 3.5mm, 5x1, Tin, TH	Terminal Block, 3.5mm, 5x1, TH	393570005	Molex
J13, J14	2		Receptacle, 2.54mm, 10x2, Tin, TH	10x2 Receptacle	SSQ-110-03-T-D	Samtec
L1, L2, L3	3	600 ohm	Ferrite Bead, 600 ohm @ 100 MHz, 1 A, 0603	0603	742792651	Wurth Elektronik
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, R22, R23, R24, R29, R37	8	10.0k	RES, 10.0 k, 1%, 0.1 W, 0603	0603	RC0603FR-0710KL	Yageo America
R4, R5, R6, R11, R12, R13, R17, R18, R19, R20, R21, R25, R26, R27, R28, R32, R35, R39, R41, R42, R45	21	33	RES, 33, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060333R0JNEA	Vishay-Dale
R7, R9, R30, R33, R36	5	1.0k	RES, 1.0 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06031K00JNEA	Vishay-Dale
R8, R10	2	4.99k	RES, 4.99 k, 1%, 0.1 W, 0603	0603	CR0603-FX-4991ELF	Bourns

Table 4-1. BOOSTXL-DAC-PORT Bill of Materials (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
R14, R31, R34, R47	4	0	RES, 0, 5%, 0.1 W, 0603	0603	RC0603JR-070RL	Yageo America
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7	7	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec
TP1, TP2, TP3, TP4	4		Test Point, Compact, Red, TH	Red Compact Testpoint	5005	Keystone
TP5	1		Test Point, Miniature, SMT	Test Point, Miniature, SMT	5019	Keystone
U1	1		4-Bit Bidirectional Multi-Voltage Level Translator for Open-Drain & Push-Pull, PW0014A (TSSOP-14)	PW0014A	LSF0204DPWR	Texas Instruments
U2	1		8-Bit Dual-Supply Bus Transceiver with Configurable Voltage-Level Shifting and Three-State Outputs, PW0024A (TSSOP-24)	PW0024A	SN74LVC8T245PW	Texas Instruments
U3	1		Precision Micropower Shunt Voltage Reference, DBZ0003A (SOT-23-3)	DBZ0003A	LM4040DIM3-5.0/NOPB	Texas Instruments
U4	1		Precision Micropower Shunt Voltage Reference, DBZ0003A (SOT-23-3)	DBZ0003A	LM4040DIM3X-2.5/NOPB	Texas Instruments
R15, R16, R38, R43, R46	0	0	RES, 0, 5%, 0.1 W, 0603	0603	RC0603JR-070RL	Yageo America
R40, R44	0	33	RES, 33, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060333R0JNEA	Vishay-Dale

4.5 DAC53701EVM Bill of Materials

Table 4-2. DAC53701EVM Bill of Materials

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
!PCB	1		Printed Circuit Board		DC128	Any
C1, C3, C4, C5	4	0.1uF	CAP, CERM, 0.1 uF, 25 V, +/- 10%, X7R, 0603	0603	C1608X7R1E104K080AA	TDK
J1, J2	2		Header, 2.54mm, 16x1, TH	Header, 2.54mm, 16x1, TH	22284160	Molex
R1,R3, R6, R7, R8, R15, R16, R17, R18	9	10.0k	RES, 10.0 k, 1%, 0.1 W, 0603	0603	RC0603FR-0710KL	Yageo America
U1	1		10-Bit, I2C Interface, Buffered Voltage Output DAC, DSG0008A (WSON-8)	DSG0008A	DAC53701DSGR	Texas Instruments
U2	1		I2C BUS EEPROM (2-Wire), TSSOP-B8	TSSOP-8	BR24G32FVT-3AGE2	Rohm
U3	1		I2C Level-Translation I2C Bus Repeater, DGK0008A (VSSOP-8)	DGK0008A	TCA9800DGKR	Texas Instruments
C2	1	2.2uF	CAP, CERM, 2.2 uF, 10 V, +/- 10%, X7R, 0603	0603	C1608X7R1A225K080AC	TDK
R2, R13, R14	0	0	RES, 0, 5%, 0.1 W, 0603	0603	RC0603JR-070RL	Yageo America
R9, R10, R11, R12	0	10.0k	RES, 10.0 k, 1%, 0.1 W, 0603	0603	RC0603FR-0710KL	Yageo America

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   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

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   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits 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 shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 *Regulatory Notices:*

3.1 *United States*

3.1.1 *Notice applicable to EVMs not FCC-Approved:*

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

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

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

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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西新宿三井ビル

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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.

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