

DXP

DAC Exerciser Program

User's Guide



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DXP User Guide

This user's guide describes the DAC Exerciser Program, or DXP, a software tool that generates a digital signal in order to evaluate digital-to-analog converters (DACs). This tool is provided along with many evaluation modules (EVMs) from Texas Instruments (TI) to assist customers in testing and investigating DAC performance for a range of applications.

1 Introduction

1.1 Features

- Modular design allows for a variety of EVMs to be supported
- Graphical user interface provides easy setup to send signals to a DAC
- Support for both single and multichannel DACs
- Support for I²C™ and Serial interface DACs
- Ability to write arbitrary waveforms for the DAC output
- Ability to send single commands for register configuration

This manual is designed to help you easily configure an evaluation system to generate a digital signal to the DAC.

2 Software Installation and Quick Start

2.1 Minimum Requirements

Before installing the software, please verify that your PC meets the minimum requirements outlined in this section.

2.1.1 Required Setup for DXP Software

- IBM PC-compatible computer with:
 - Pentium III®/ Celeron® 866 MHz or equivalent processor
 - Minimum 256 MB of RAM (512 MB or greater recommended)
 - Hard disk drive with at least 200 MB free space
- Microsoft Windows® XP SP2 operating system or Windows® 7 operating systems supported
- Mouse and Keyboard
- 1024 × 768 display screen resolution

2.1.2 Additional Requirements for Use with Hardware

- TI DACxxx EVM-PDK (evaluation kit that includes MMB0 motherboard and device EVM)
- USB 1.1-compatible input (check requirements of individual EVMs)

2.2 Installing DXP

1. The installation file for the DXP software can be found at www.ti.com/dxp. Navigate to the Download DXP Setup icon found in the “Free Evaluation Tools” section.
2. Once downloaded, double click on the installer executable DXP-setup-x.x.x.exe to begin installation.

NOTE: The x.x.x will be replaced with the current version of the installer

3. The installation will begin with a warning that requires the user to have "Admin Rights" before continuing.
4. After you accept the prompt indicating you have admin rights, the installer will proceed to a Welcome screen shown in [Figure 1](#).



Figure 1. DXP Installation Welcome Screen

5. Two license agreements will be displayed requiring acceptance in order to continue the installation.
6. The installer will continue as shown in [Figure 2](#).

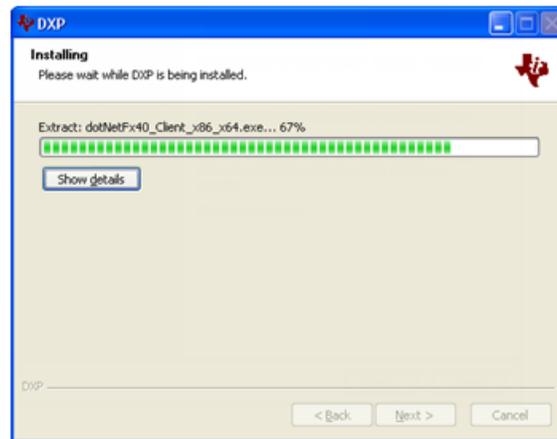


Figure 2. DXP Installation

7. During the installation, there will be a prompt to check the .NET framework. If the framework is not up-to-date, it will begin its installation. Otherwise, a notification box will state that it is OK to proceed, as shown in [Figure 3](#).

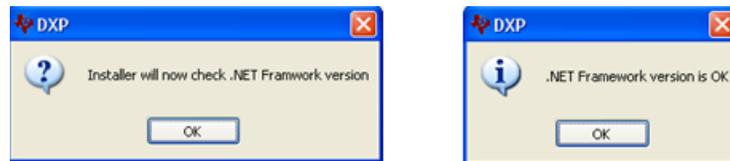


Figure 3. .NET Framework Check

8. Following .NET check, the WINUSB Diver installation will begin.



Figure 4. WINUSB Driver Install

9. Following the WINUSB Driver installation, DXP will be ready for use.

2.3 Hardware Setup/Configuration and Driver Installation

1. After DXP software is installed, connect the DAC EVM under evaluation to the top of the MMB0 motherboard using the J7, J5, and J4 mating connectors. Make sure that the pins are aligned properly to avoid damaging the evaluation system. If using an EVM-PDK, the DAC EVM may already be connected to the MMB0.
2. Connect the USB cable to the J1 connector and the 6 V, 500-mA power supply to the J2 connector.

NOTE: If this is the first time connecting the platform to your PC, perform Steps 3 and 4. Additionally, if the platform is connected to your PC via a different USB port than was previously used, Steps 3 and 4 may need to be repeated. If the drivers have been previously installed and the same USB port is used, you may skip Steps 3 and 4.

3. When using a Windows 7 machine, the DXP driver should automatically complete installation for the NI-VISA driver. A Windows XP machine will prompt the user with a set of instructions to install the NI-VISA driver for the MMB0 motherboard. [Section 2.3.1](#) is included as a reference to illustrate the installation steps when using a Windows XP operating system.
4. After the driver has completed loading, start DXP as detailed in [Section 2.4](#).

2.3.1 NI-VISA USB Device Driver Installation

- The first screen will prompt to install the driver either automatically or manually by pointing to the installation folder as shown in [Figure 5](#). The driver can be found at `C://Program Files/DXP/drivers`.
- For the remaining steps, accept the default settings. Once the NI-VISA driver installation completes, the DXP program will be ready for use.



Figure 5. NI-VISA Driver Installation

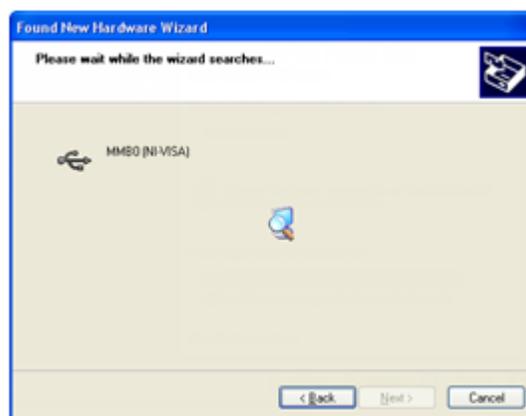


Figure 6. NI-VISA Driver Installation Process



Figure 7. NI-VISA Driver Installation Complete

When the installation of the NI-VISA drivers is complete, you can verify proper installation by opening the Windows Device Manager and locating the device driver as shown in [Figure 8](#)

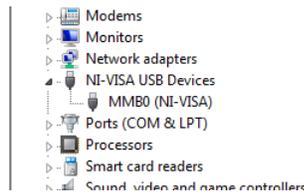


Figure 8. NI-VISA Driver Installation Verification Using Device Manager

When the DXP application is loaded, the driver will change from the NI-VISA to a WINUSB driver that appears as DXP in the Device Manager, shown in [Figure 9](#).

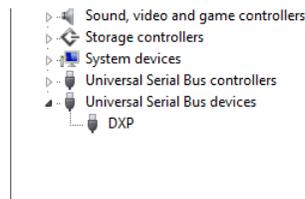


Figure 9. DXP Driver Using Device Manager

2.4 Launching DXP

1. From the Windows **Start** menu, select *All Programs*→*DXP*→*DXP*. On start-up the software will begin loading the resources as shown in [Figure 10](#).

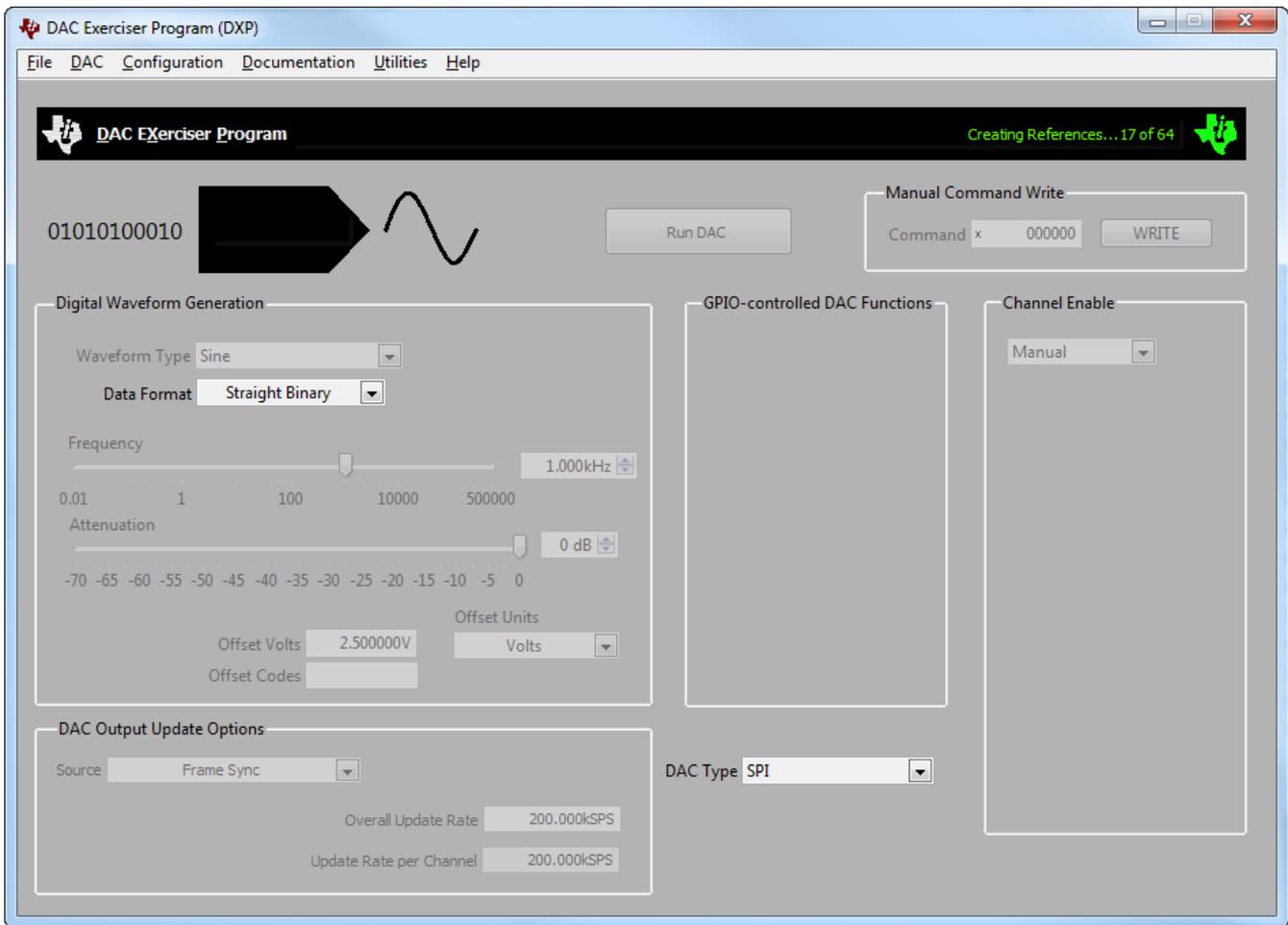


Figure 10. DXP Loading

2. Once loaded, the DXP GUI will state “Ready... Select DAC to load” in the status message box in the top left hand corner shown in the Figure below. Startup may take several seconds to complete.



Figure 11. Select DAC to Load

2.5 DAC EVM Selection

DXP was designed to support TI's expanding catalog of DAC EVMs. The software is designed as a configurable application which uses an individual configuration file for each DAC EVM to set the device properties. These configuration files are available for download within the DXP application or available using the downloadable support package for all supported devices from the DXP homepage. On initial start, if no XML files downloaded, the **DXP DAC Config File Downloader** will open allowing the user to select files for download. The **DXP DAC Config File Downloader** is described in [Section 3.5.2](#).

When the application launches all installed configuration files are populated in the **DAC** menu. Before you can use DXP, a DAC EVM configuration file must be loaded. To load a configuration file, select the desired DAC from the configuration list under the DAC menu. The specific device configuration file that is loaded is shown in **green text** in the DAC symbol near the top left portion of the screen. Once loaded, the status message should change to “Configuration Complete...” as shown in [Figure 12](#).

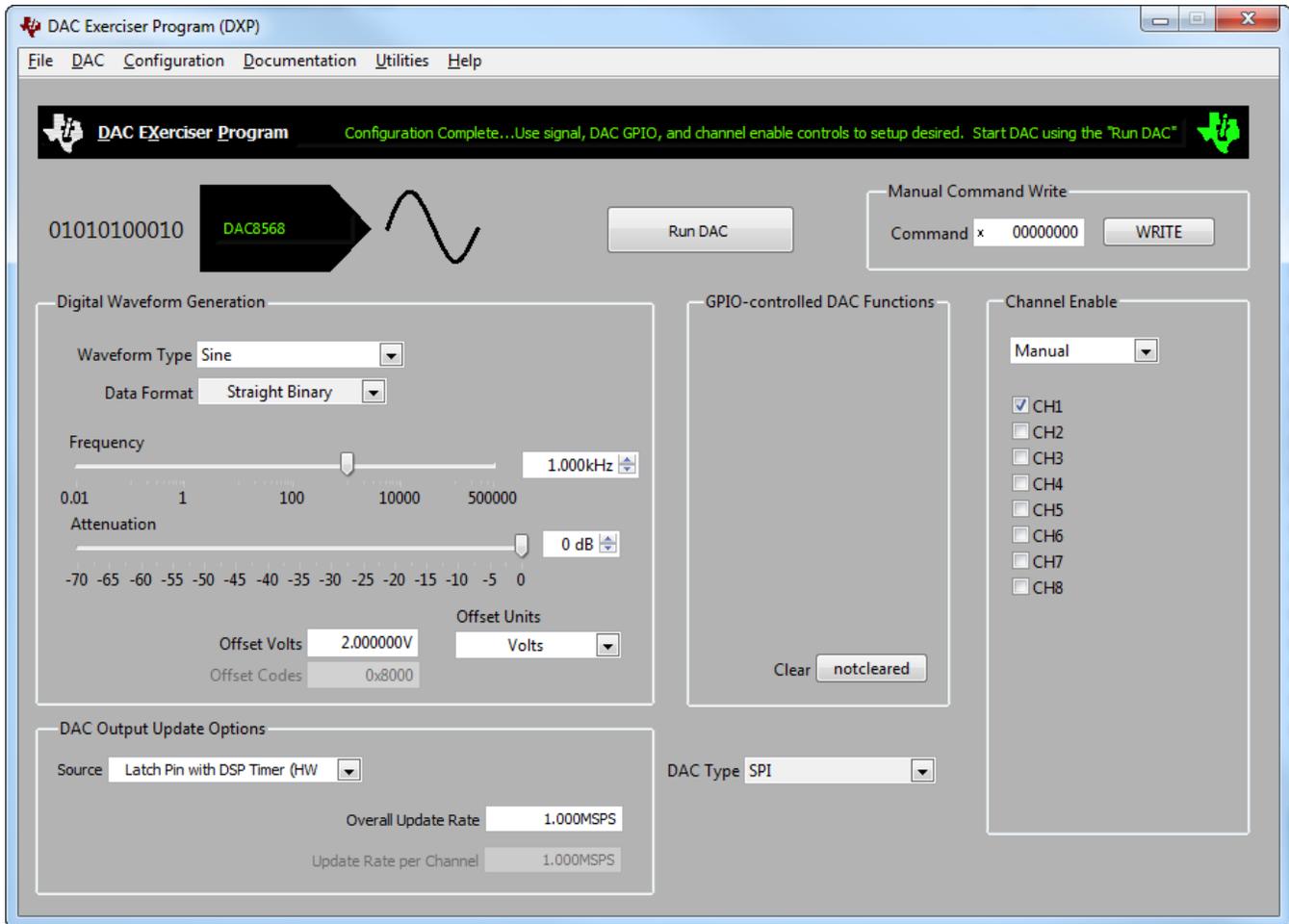


Figure 12. Configuration Complete

Once the configuration file is loaded, all applicable controls are enabled and the **DAC Type** display will read *SPI* or *I²C* indicating the DAC interface. The user can now configure the digital waveform to generate and send to the DAC.

2.6 DXP Overview

DXP is designed to be an easy to use user interface (UI) allowing for evaluation of our single and multichannel digital to analog converters (DACs). Individual configuration files are available for download for all supported DACs to preload DXP with the converters parameters. Once loaded, the software is designed such that options can be manipulated to allow the user to fully evaluate the DAC. The DXP UI consists of the following:

1. DXP User Menu (Section 3)
2. Manual Command Write (Section 4)
3. Digital Waveform Generation (Section 5)
4. DAC Output Update Options (Section 6)
5. GPIO Controlled DAC Functions (Section 7)
6. Channel Enable (Section 8)

Each of the areas are shown in Figure 13 and are described in the following sections.

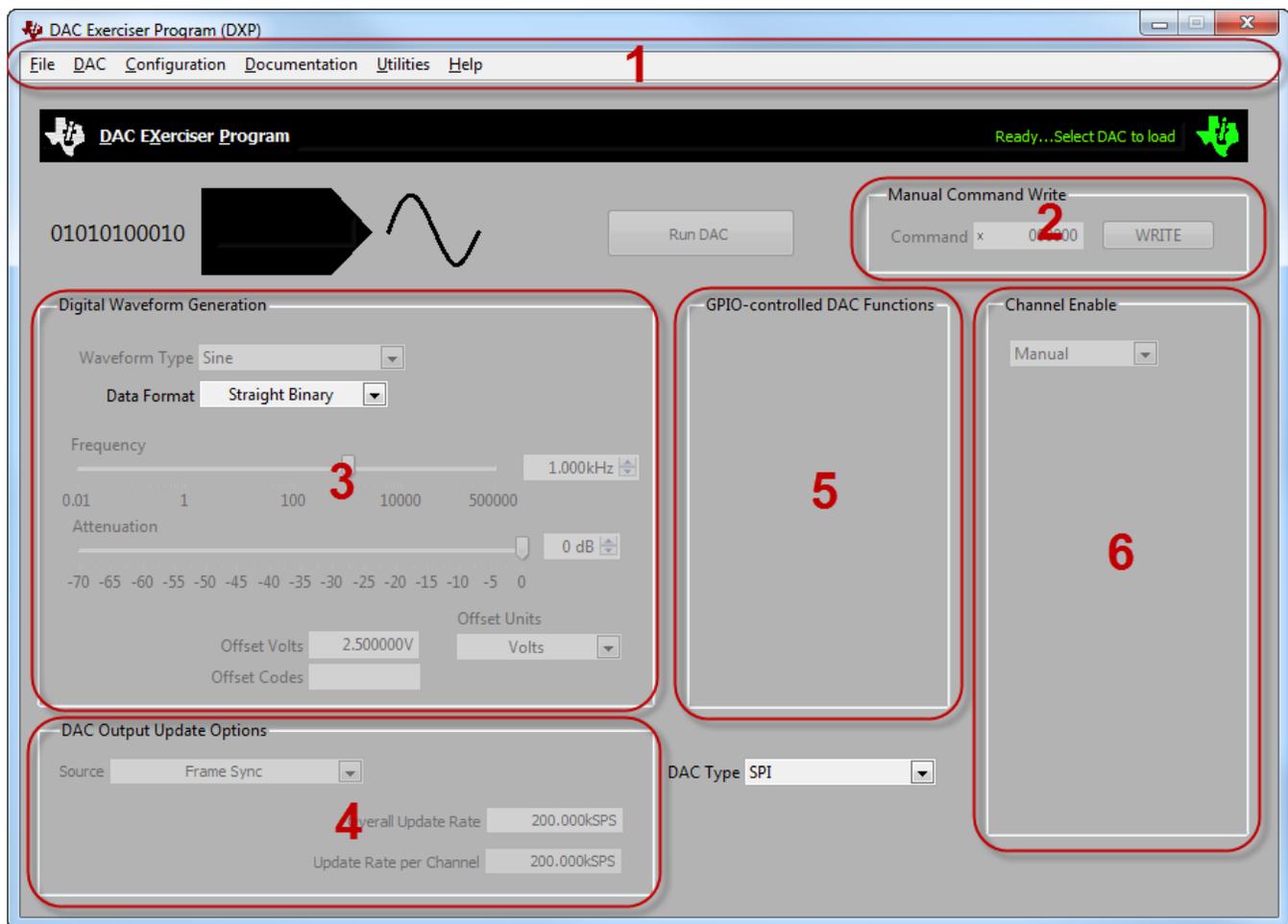


Figure 13. DXP Front Panel Sections

3 DXP User Menu

The User Menu is the grouping along the top of the UI. It consists of six items: **File**, **DAC**, **Configuration**, **Documentation**, **Utilities** and **Help**. Some menu items have shortcut keys; if available, these keys are shown next to the corresponding item in the menu.

3.1 File

The **File** menu contains an item selection entitled *Exit* that closes the DXP software.

3.2 DAC

The **DAC** menu contains a list of all the DAC configuration files that were found when the program started, as shown in [Figure 14](#). The final item in the list, titled *Rescan for Devices* allows the user to rescan the configuration file directory in the event that a support package was added while DXP was running.

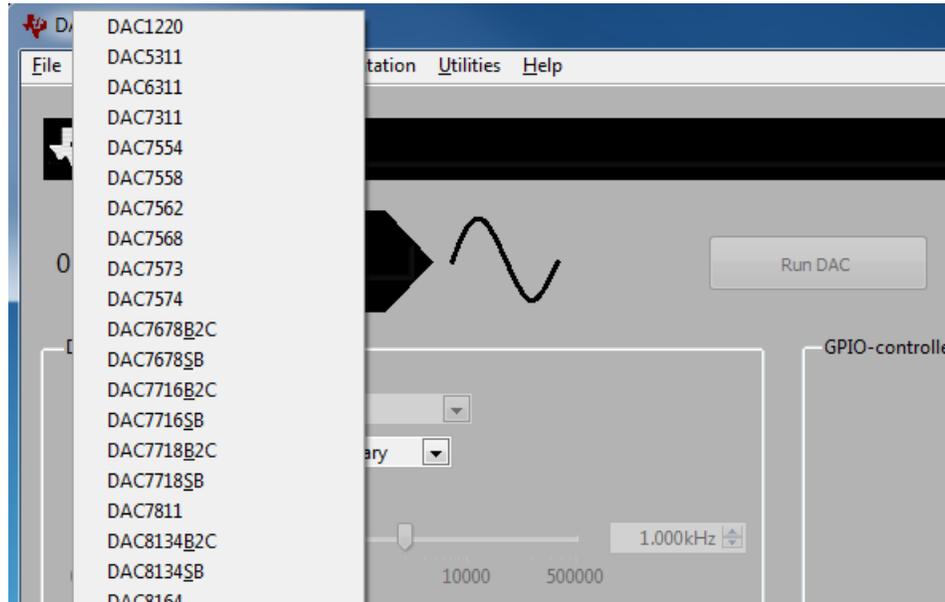


Figure 14. DXP Configuration File List

3.3 Configuration

The **Configuration** menu has options to clear the Communication Logs or the DataDump files whenever DXP is started. These two files are used for debugging if DXP is having operating issues.

3.4 Documentation

The **Documentation** menu, shown in [Figure 15](#), includes links to the TI website for the DXP User's Guide, the data sheet of the currently loaded DAC, and the User's Guide for the currently loaded EVM.

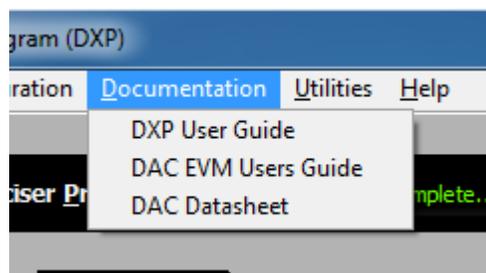


Figure 15. Documentation Menu

3.5 Utilities

The **Utilities** menu, shown in [Figure 16](#), contains four items: *Device Configuration Info*, *Download DAC Devices*, *Waveform File Writer*, and *Waveform File Converter*.

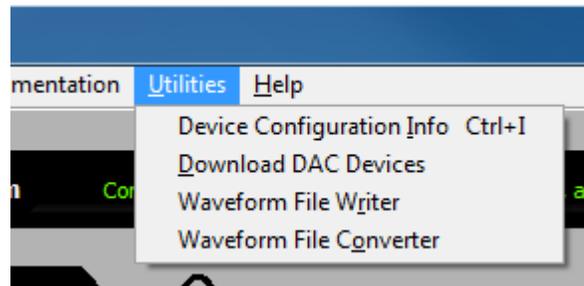


Figure 16. Utilities Menu

3.5.1 Device Configuration Information

The *Device Configuration Info* item within the Utilities menu displays the DAC configuration information related to the selected DAC. The *Device Settings* and *Interface Settings* areas of the panel are the communication settings for the specified DAC under test. The *GPIO Settings* are hardware-specific settings applicable to the DAC EVM hardware; these settings should not be changed in user designs. [Figure 17](#) shows an example configuration for the DAC8568EVM.

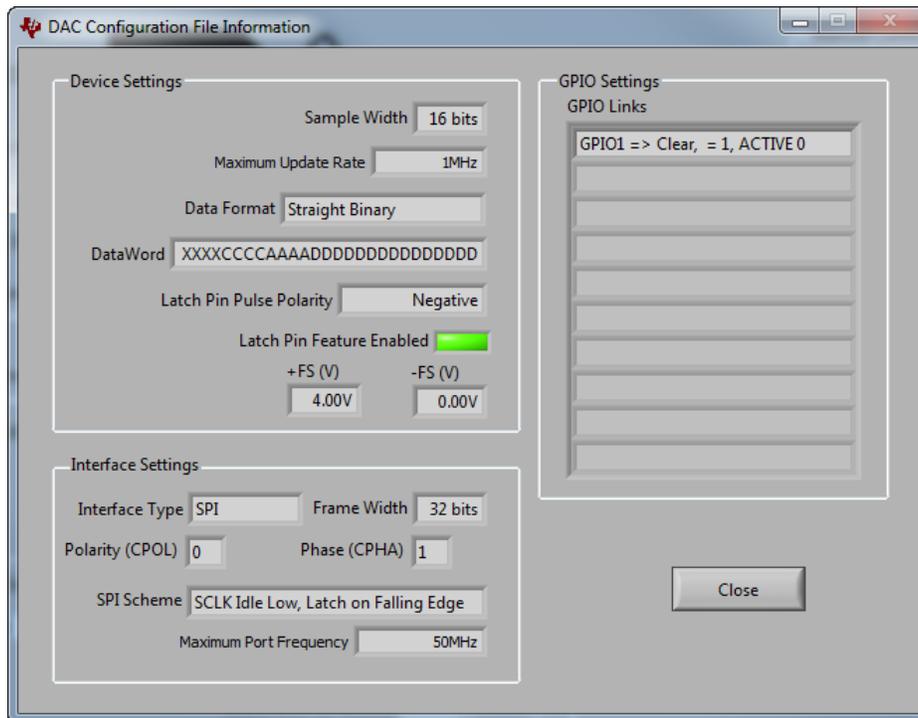


Figure 17. DAC8568EVM Configuration File

3.5.2 Download DAC Devices

The *Download DAC Devices* item opens the **DXP DAC Config File Downloader** pop up, shown in [Figure 18](#), allowing the user to select and download any of the available DAC DXP configuration files. Use the *Get Available Devices* button to populate a list of all the files available from the web. Individual devices can be selected for download or the entire list can be downloaded using the *Download All Devices* checkbox. Once the desired devices are selected, use the *Download Selected* button to have the files downloaded. After exiting the downloader, DXP will automatically rescan for devices and populate the DAC menu accordingly.

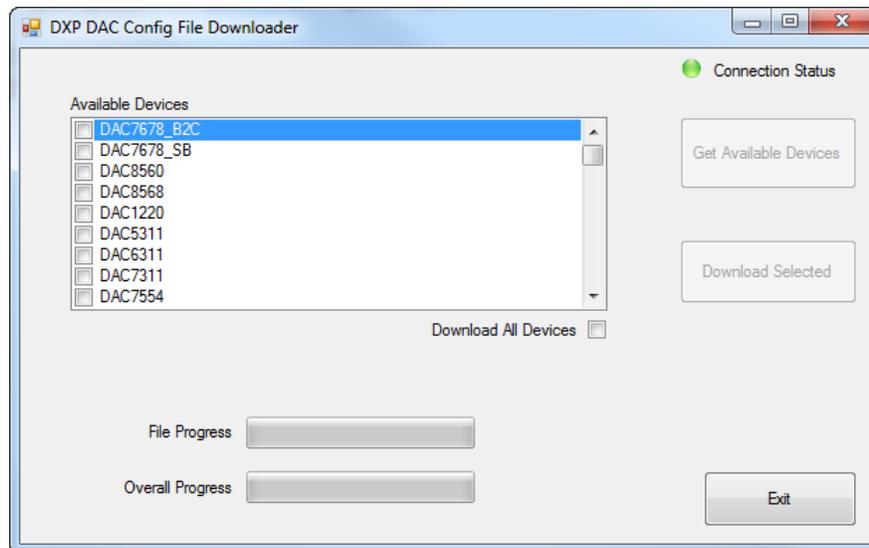


Figure 18. DAC Configuration File Downloader

3.5.3 Waveform File Writer

The *Waveform File Writer* tool is used to create a file for DXP to use for arbitrary waveform generation. The **General DAC Settings** set the global parameters and limits for the file while the **Channel Settings** are used to create waveform. Below is a list and description of the adjustable options in the *Waveform File Utility*, shown in [Figure 19](#).

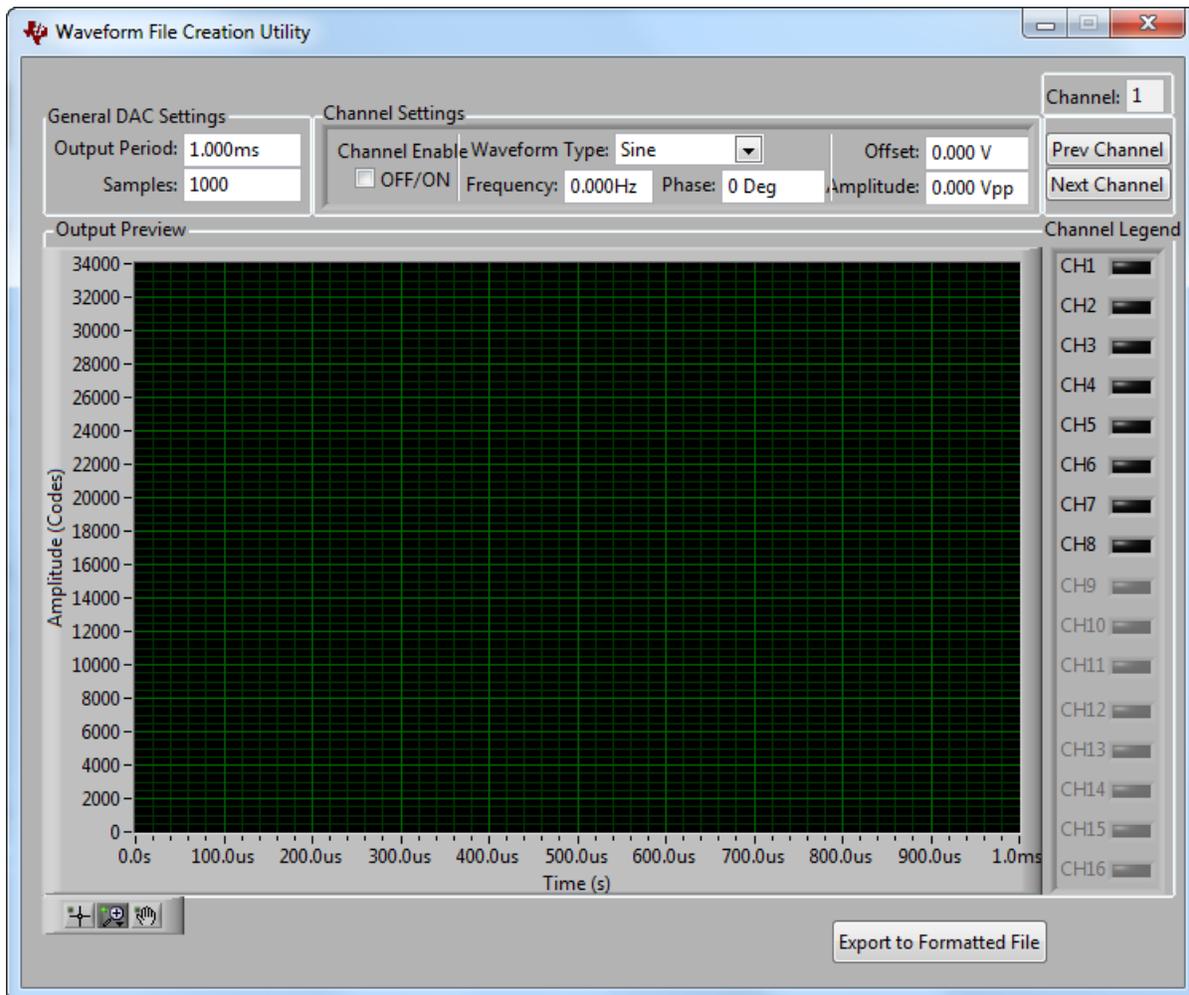


Figure 19. Waveform File Writer

- The **Output Period** sets the minimum period for the generated waveform on all channels. The horizontal display will automatically scale to the period.
- The **Samples** control set the total number of DAC updates per output period. The individual channel update rate can be calculated from the output period, the number of samples per period, and number of enabled channels.
- The **Channel Enable** button enables or disables the current channel.
- The **Waveform Type**, **Frequency**, **Phase**, **Offset**, and **Amplitude** controls are used to build the waveform on the current channel. The designed waveform will be displayed in the **Output Preview** tab whenever the channel is enabled.
- The **Channel** indicator displays the current channel of the *Channels Settings* control. Cycling through the channels can be accomplished a couple of ways: The **Prev Channel** and **Next Channel** buttons can be used, the desired channel can be clicked in the *Channel Legend* grouping, or the channel can be typed into the **Channel** box in the top right corner.

3.5.4 Waveform File Converter

The *Waveform File Converter* tool, shown in [Figure 20](#), is used to import and convert a text file into the proper format for DXP to recognize for either waveform generation, or sending a command list. Click the folder icon to the right of the pop-up box to search for the file to be converted. After the file is selected, set the delimiter used in the source file, the desired output data-rate, the file contents, and the format for the output type. An example text file, which can be used for waveform file conversion, is found in the saved folder under DXP in the documents directory.

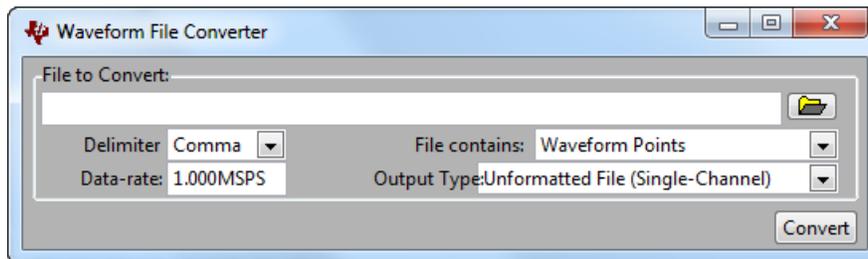


Figure 20. Waveform File Converter

The **File contains** selection box include the options of either *Waveform Points*, if the file is written to generate an arbitrary signal, or *DAC Commands*, if the file is written to have DXP write an array of commands. When *Waveform Points* is selected, the **Output Type** needs to be set as either *Unformatted File (Single-Channel)* or *Formatted File (Single or Multi-Channel)*. The two file types are explained below.

- **Unformatted File (Single-Channel)** - The output file generated is universal and can be used with all DACs supported by DXP.
- **Formatted File (Single or Multi-Channel)** - The output file generated is specific for the DAC which is currently loaded by DXP and cannot be shared with other loaded DACs.

Use the **Convert** button to create the output file that DXP can use for signal generation. DXP requires that the default file format name, **DACxxx_yyySPS_<?user>.tiwu/tiwf**, is kept when the file is saved for the file conversion process. The **x** and **y** parameters will be filled with configuration data while the **?user** field allows the user to add comments. The **tiwu** or **tiwf** file extension delegates between whether it is a unformatted or formatted file.

3.6 Help

The **Help** menu, shown in [Figure 21](#), contains two items: *Contact Us*, and *About*.

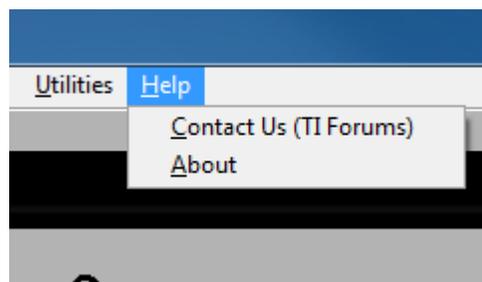


Figure 21. DXP: DAC Help Menu

3.6.1 Contact Us

The *Contact Us* item is a shortcut to the TI e2e forum link for direct support. This function requires internet connection and will use the computer's default internet browser.

3.6.2 About

The *About* item displays information regarding the current version of the DXP software and firmware.

4 Manual Command Write

Once the DAC configuration file is loaded, DXP gives the user the capability to write a custom data word to the DAC. The width of this command is limited to the maximum data word length that the DAC can accept, set in the **DAC Configuration Info** in the *Utilities* menu. The command can be written in either *Decimal, Hex, Octal, Binary, or SI Notation* selectable to the left of the command box, shown in [Figure 22](#). Once the command is written, use the Write button to have the MMB0 update the DAC.

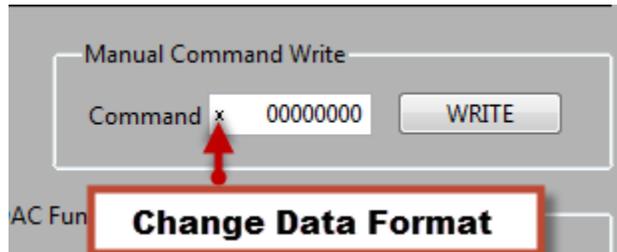


Figure 22. Manual Command Write

When DXP is running to create a digital waveform, the **Manual Command Write** will be unavailable.

5 Digital Waveform Generation

[Figure 23](#) shows the location of the DXP controls that permit the manipulation of the digital signals that are sent to the DAC. The parameters in this section create the waveform on all enabled channels in the [Section 8](#).

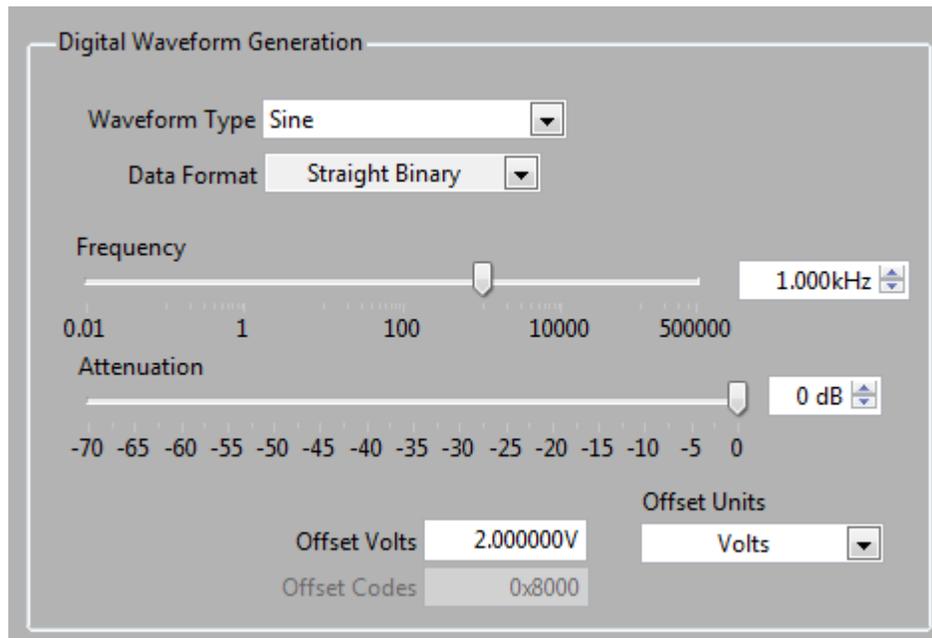


Figure 23. Digital Waveform Generation Block

[Figure 23](#) shows an enlargement of the available controls used to generate the signal. The digital signal has four parameters which can be manipulated:

- Waveform Type ([Section 5.1](#))
- Frequency ([Section 5.2](#))
- Attenuation ([Section 5.3](#))
- Offset ([Section 5.4](#))

5.1 Waveform Type

The **Waveform Type** control selects the type of digital signal to be generated and sent to the DAC. Available options, as shown in [Figure 24](#) are:

- Sine
- Square
- Sawtooth
- Triangle
- DC Continuous
- DC Single
- User

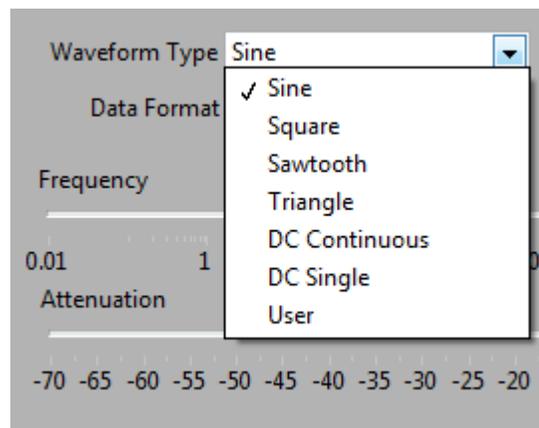


Figure 24. Available Waveform Signals

Sine, *Square*, *Sawtooth*, and *Triangle* waveform options use internal lookup tables to write the continuous data word to the DAC to produce the appropriate signal. The *DC Continuous* signal continuously sends a dc code value to the DAC until the Run DAC button is deselected. The *DC Single* option sends a single data block to the DAC and then halts. When either of the dc waveforms are selected, the **Frequency** and **Attenuation** controls are disabled while the **Offset** fields are used to set the single code.

The **User** control allows DXP to import a written file to have the DAC generate a pre-designed arbitrary waveform. This file can either be written using the **Waveform File Writer** or converted to the proper format using the **Waveform File Converter** in the *Utilities* menu.

5.2 Frequency Control

Frequency control allows the frequency of the digital signal to be set. The available frequency range is from 1 Hz to one-half the update rate in steps of 1 Hz. All of the frequencies within the range may not be available, but the control will automatically update to the closest frequency that can be output.

5.3 Attenuation Control

The **Attenuation** control allows the amplitude of the digital signal to be set. The attenuation range is from –70 dB to 0 dB in steps of 1 dB with respect to full scale value.

5.4 Offset Control

The offset controls allow the offset voltage/code to be set for the digital signal. Using the **Offset Units** (see [Figure 25](#)), you can enter the offset in either Volts, Codes (hex), or Codes (decimal).

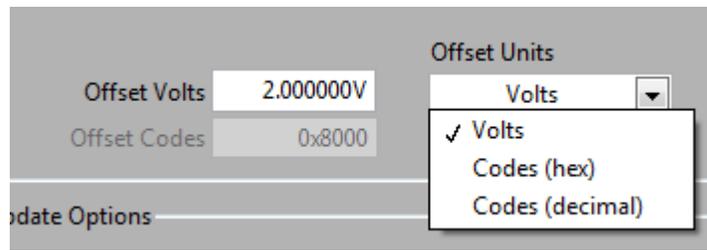


Figure 25. DXP: Waveform Offset Units

The corresponding offset control (**Offset Volts** or **Offset Codes**) will be enabled to allow user input. The **Offset Volts** control has units of volts and allows offset within the range of positive full-scale (+FS) voltage to negative full-scale (–FS) voltage.

The **Offset Codes** control has units of hexadecimal or decimal, depending on the **Offset Units** control. The hexadecimal codes accept an input in either `0000` or `0x0000` formats for valid hexadecimal characters (0-9, A-F). The decimal codes accept an input of decimal characters (0-9).

Both offset fields (volts and codes) restrict the input value to the respective DAC maximums and minimums. Values that are entered above or below the limits result in the input being changed to the corresponding limit automatically.

To begin sending the digital waveform to the DAC, click the **Run DAC** button. For all of the **Signal Type** options except *DC Single*, the DAC continuously receives the digital waveform until the **Run DAC** button (text changes to **Stop DAC**) is clicked again. For a signal type of *DC Single*, the DAC receives one set of digital data; the software automatically stops after this data is sent.

6 DAC Output Update Options

The **DAC Output Update Options** for DXP controls the interface configuration between the DAC and the digital signal processor (DSP) on the motherboard. Two controls, **Source** and **Update Rate**, are provided for customizing the interface. The remaining interface settings are fixed using the configuration file settings and cannot be changed in the user interface.

The **Source** control allows selection for the method used to update the DAC, as Figure 26 shows. *Frame Sync*, *Latch Pin with DSP Timer*, *Latch Pin with External Source*, and *Latch on Write (SW LDAC)* are the allowable configuration settings for this control.

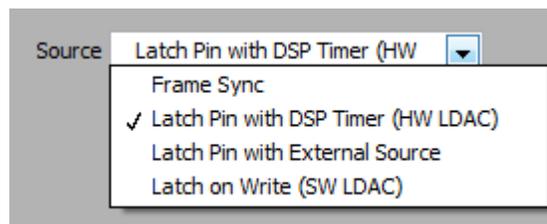


Figure 26. DAC Output Update Source Options

The *Frame Sync* setting functions by using the McBSP frame sync (FS) to load the data into the DAC.

The *Latch Pin with DSP Timer* setting functions by providing a sync signal to the DAC via the DSP timer pin. This option is automatically configured with the appropriate timing needed for the specific DAC.

The *Latch Pin with External Source* setting allows the user to provide an external sync signal to the DAC. The external latch signal must be provided to the hardware and meet the following requirements for the system to operate properly.

- The latch signal must be a pulse with the proper polarity.
- The **Overall Update Rate** control must be set to the exact frequency of the external signal.
- The hardware settings are configured for an external latch signal. These settings will be detailed in the

user guide for the individual DAC EVM.

The *Latch Pin on Write (SW LDAC)* setting changes the DAC command word used for Waveform Generation to have the DAC update using the software load DAC command.

The **Overall Update Rate** control allows the update rate of the DAC to be set. The maximum update rate is the default value shown in the **Update Rate** control upon loading the DAC configuration file. The maximum update rate can also be found by viewing the configuration file settings via the **Utilities** menu (see DAC Utilities Menu [Figure 21](#)).

7 GPIO-Controlled DAC Functions

In addition to the power, ground, digital interface and output pins, DACs may have additional pins for user control. Depending on the DAC EVM design, these pins may be controlled via hardware jumpers and switches or the general-purpose inputs or outputs (GPIOs) from the DSP on the MMB0. Six GPIOs are available via the EVM control interface for this functionality.

For each DAC that uses DXP, the GPIO-controlled functions supported by the software are manipulated via controls that appear when the configuration file is loaded. The section of the GUI which is used to control the GPIO lines, as well as an example device, is shown in [Figure 27](#)

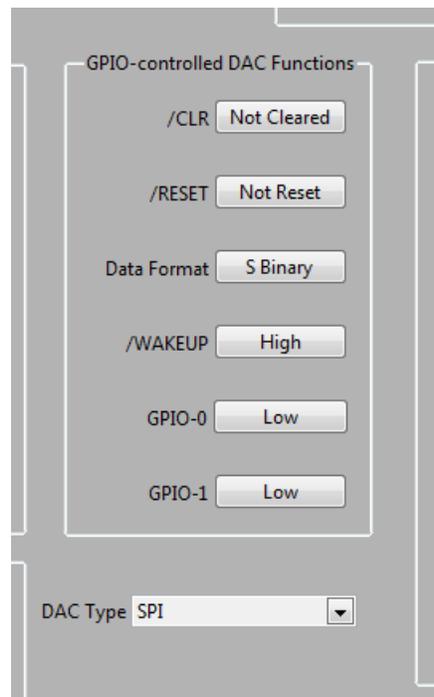


Figure 27. GPIO-Controlled DAC Functions

These functions vary from device to device and therefore, the GPIO controls may or may not be present. If the DAC has such GPIO-controlled functions, the controls for each function are visible on the **GPIO-controlled DAC Functions** section in the DXP window. When a "/" prefix is used, the static line is active low. If no GPIO-controlled functions are available, the DXP functions grouping window will be empty.

Each function has its own control, which is labeled according to the function. The controls operate such that the current status of the function is written in the control button. When the button is pressed, the appropriate active level value is set, whether it is active high or active low.

8 Channel Enable Options

DXP is designed to support both single-channel and multichannel DACs. When a configuration file is loaded, the **Channel Enable** section is populated with the available channels for the specific DAC EVM loaded. The user can select from three choices in the drop-down menu shown in [Figure 28](#): All ON, All OFF, and Manual. Manual channel-select mode allows the user to individually select which channels they would like enabled and disabled. As channels are enabled, the update rate per channel is decreased as the MMB0 needs to write to the channels sequentially.

The signal set in the **Waveform Generation Section** (See [Section 5](#)) will be written to all the enabled channels. The **Waveform File Writer**, discussed above (See [Section 3.5.3](#)), can be used to have different signals generated on the enabled channels.

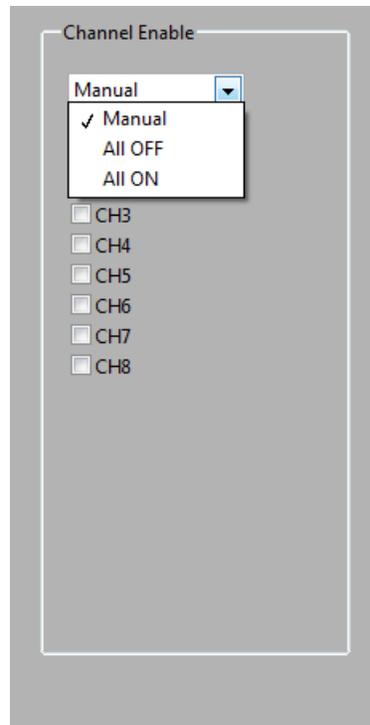


Figure 28. Channel Enable Section

9 Frequently Asked Questions

For DXP Frequently asked questions, visit the [Texas Instruments E2E DXP FAQ](#) page or send us a post directly in the public [Precision Data Converters Forum](#).

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