DAC8x11 EVM

This document describes the setup and operation of the DAC8x11 Evaluation Module (EVM). It also discusses the DAC eXerciser Program, a software tool used with the DAC8x11 EVM. Included are the EVM schematic, bill of materials, and board layout.

Contents

1 EVM Overview

Features

- Full-featured evaluation board for a variety of single-channel, 6-pin DAC8x11, 6- to 14-bit, serial input, digital-to-analog converters
- Onboard reference and buffer circuits
- High-speed serial interface
- Modular design for use with a variety of DSP and DAC8x11 controller interface boards

1.1 Introduction

The DAC8x11 Evaluation Module is an evaluation board containing all the necessary components to evaluate the 6-pin, SC70 series of high-performance, digital-to-analog converters from Texas Instruments. The EVM is designed so that a single printed-circuit board (PCB) supports the entire family of high-speed, 12- and 16-bit serial DACs.

The modular EVM form factor allows for direct evaluation of the DAC's performance and operating characteristics. This EVM is compatible with the 5-6K Interface Board (SLAU104) from Texas Instruments as well as the HPA-MCU Interface Board (SLAU106). As part of a DAC8x11EVM-PDK kit, this EVM is supported on the DXP Platform using the modular motherboard MMB0.

2 Analog Interface

For maximum flexibility, the DAC8x11 evaluation module (EVM) is designed for easy interfacing to multiple analog sources. Samtec part numbers SSW-110-22-F-D-VS-K and TSM-110-01-T-DV-P provide a convenient 10-pin, dual-row, header/socket combination at J2 (Table 1). This header/socket provides access to the analog input pins of the ADC. Consult Samtec at www.samtec.com, or call 1-800-SAMTEC-9 for a variety of mating connector options.

Features:

- Full-featured evaluation board for a variety of single-channel, 6-pin DAC8x11, 6- to 14-bit, serial input, digital-to-analog converters
- Onboard reference and buffer circuits
- High-speed serial interface
- Modular design for use with a variety of DSP and DAC8x11 controller interface boards

Table 1. Analog Interface

Pin Number	Signal	Description
J2.2	DAC OUT_A12	Single DAC out option via JP3
J2.4	Unused	
J2.6	Unused	
J2.8	DAC OUT_A2	Single DAC out option via JP3
J2.10	Unused	
J2.12	Unused	
J2.14	Unused	
J2.16	Unused	
J2.18	REF(-)	Unused
J2.20	REF(+)	External reference source input (2.5 V nominal, 2.525 V maximum)
J2.15	Unused	
J2.1–J2.19 (odd)	AGND	Analog ground connections (except J2.15)

3 Digital Interface

The DAC8x11 EVM is designed for easy interfacing to multiple control platforms. Samtec part numbers SSW-110-22-F-D-VS-K and TSM-110-01-T-DV-P provide a convenient 10-pin, dual-row, header/socket combination at J1. This header/socket provides access to the digital control and serial data pins of the DAC8x11 EVM. Consult Samtec at www.samtec.com or 1-800-SAMTEC-9 for a variety of mating connector options.

Table 2. Digital Control

Pin Number	Signal	Description
J1.1	$\overline{CS}$	Active-low input to SYNC enables data transfer – jumper configurable (see schematic) via JP1
J1.3	SCLK	Serial clock
J1.5	SCLK(R)	Serial clock return (for DSP host systems)
J1.7	FS	Frame synchronization for DSP host systems – default SYNC input through JP1 (see schematic)
J1.9	FS(R)	Frame synchronization return (for DSP host systems)
J1.11	DX	Serial data input
J1.13	DR	Serial data return (for DSP host systems)
J1.4	GND	System (EVM) ground
J1.10		
J1.18		

4 Power Supplies

The DAC8x11 EVM board requires a single, +5-VDC power supply for proper operation. This 5-V supply powers the voltage reference (U2) and the external reference buffer (U3). When used in combination with one of the DAP interface boards, J3 provides connection to the common power bus described in document SLAA185. Table 3 shows the pinout of J3.

Table 3. J3 Power Input

Signal	Pin Number		Signal
Unused	1	2	Unused
+5VA	3	4	Unused
GND	5	6	GND
Unused	7	8	Unused
Unused	9	10	Unused

When power is supplied to J3, JP2 allows for one of two different DC voltages to be applied to the DAC installed on the EVM. Review the schematic and PCB silkscreen for details.

4.1 DAC Power

JP2 allows the user to select the power supply used by the DAC installed in position U1 on the EVM. The series of DACs supported on this EVM use a single input as both power and reference voltages. When JP2 is in the default factory position (shunt on pins 1-2), power to the DAC comes from a precision 4.096-V reference. When the shunt on JP2 is moved to pins 2-3, the user may apply an external power/reference source to the DAC via J2 pin 20.

4.2 Stand-Alone Operation

When used as a stand-alone EVM, the analog power can be applied directly to J3 pin 3 referenced to pin 5. Optimal performance of the EVM requires a clean, well-regulated power source.

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CAUTION

The DACs that are compatible with this EVM have a variety of power supply requirements. Check the appropriate data sheets, and verify all power supplies are within the safe operating limits of the converter before applying power to the EVM.

</div>

5 EVM Operation

5.1 Analog Output

The analog output from the EVM is applied directly to J2 (top or bottom side) via jumper JP3. The default condition of the jumper has a shunt placed between pins 1-2, which applies the analog output to J2 pin 2. Moving the shunt on JP3 to cover pins 2-3 applies the analog output to J2 pin 10.

5.2 Digital Control

The digital control signals can be applied directly to J1 (top or bottom side). The DAC8x11 EVM can also be connected directly to a DSP or microcontroller capable of supplying the necessary serial control inputs. Visit the product folder for the EVM or the installed device for a current list of compatible interface and/or accessory boards.

5.3 SYNC

Jumper JP1 is provided to allow the source selection of the signal applied to the SYNC input of the DAC installed on the EVM. The factory default condition for the EVM is to place a shunt jumper between pins 1-2 of JP1. This allows the Frame Sync (FS) signal from DSP host systems to be used as the SYNC input to the DAC. This signal originates from J1.7. When the shunt on JP1 is moved to pins 2-3, a GPIO input applied via J1.1 can be used to control the SYNC input to the DAC. This feature allows the possibility of sharing the SPI bus with up to two DAC8x11 EVMs by stacking the boards together.

5.4 Default Jumper Locations

Table 4 provides a list of jumpers found on the EVM and their factory default conditions.

Table 4. EVM Default Jumper Settings

Jumper	Shunt Position	Jumper Description
JP1	Pins 1-2	Controls SYNC (default is J1.7)
JP2	Pins 1-2	Controls DAC power/reference (default is U2, 4.096 V)
JP3	Pins 1-2	Controls analog output voltage (default is J2.2)

6 Using the DAC8x11 EVM With DXP

The DAC8x11 EVM is compatible with the DAC eXerciser Program (DXP) from Texas Instruments. DXP is a tool that can generate the necessary control signals required to output various signals and waveforms from the device installed on the DAC8x11 EVM. The DAC8x11 EVM-PDK kit combines one of the DAC8411, DAC8311, DAC7311, DAC6311, or the DAC5311 EVM boards with the DSP-based modular motherboard MMB0. The kit includes the DXP software for evaluation using any available USB port on a Microsoft ® Windows® XP-based computer.

DXP is a program for controlling the digital input signals such as the clock, SYNC, and SDI. Wave tables are built into the DSP software to allow Sine, Ramp, Triangle, and Square wave signals to be generated by the DAC8x11. Straight DC outputs can also be obtained.

The DAC8x11 EVM-PDK is controlled by loading a DAC EVM configuration into the MMB0. For complete information about installing and configuring DXP, see the *DXP User's Guide*, available for download from the TI Web site. This section covers the specific operation of the DAC8x11 EVM-PDK.

6.1   Hardware

The hardware consists of two main components: the first is the DAC8x11 EVM itself and the other is a modular motherboard called the MMB0. The MMB0 board houses a TMS320VC5507 DSP which controls the serial interface to the device loaded on the EVM board.

The hardware needs to be configured such that the DAC8x11 EVM is plugged onto the MMB0 aligning female connectors P1, P2, and P3 (bottom side of the DAC8x11 EVM) with male connectors J4, J7, and J5 on the MMB0.

CAUTION

Exercise caution when assembling the DAC8x11 EVM and MMB0 boards as it is possible to misalign the connectors.

Do not connect the MMB0 to your PC before installing the DXP software as described in the DXP User's Guide. Installing the software ensures that the necessary drivers are properly loaded to run the hardware.
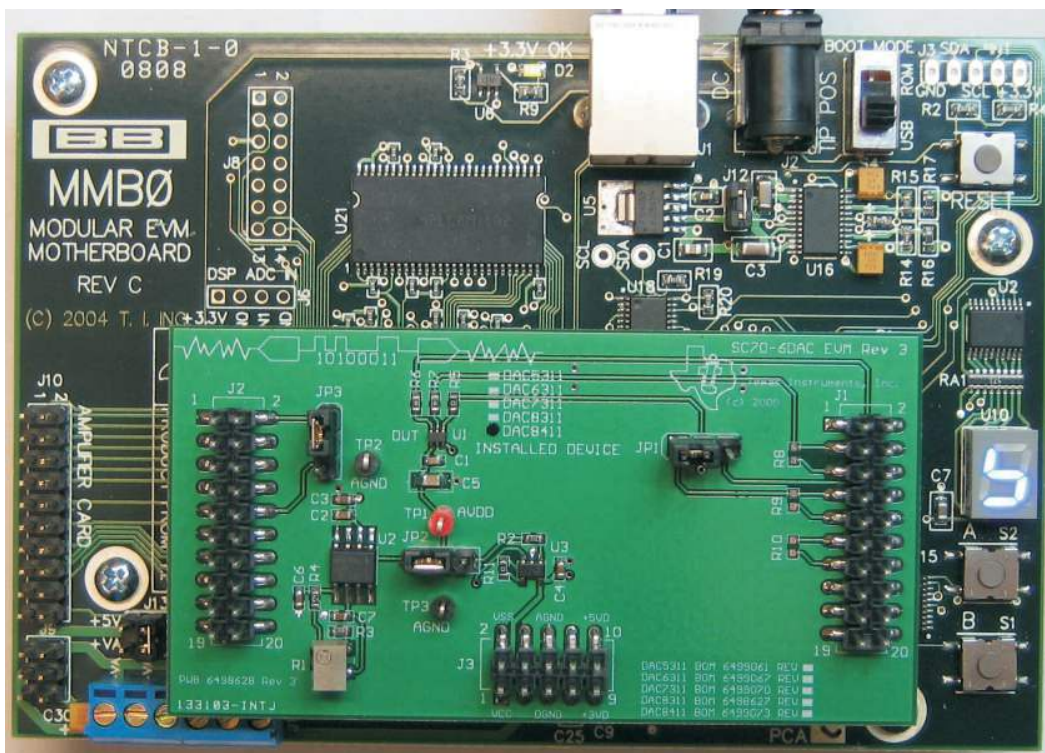
Figure 1. MMB0 With DAC8x11 EVM Installed

6.2   MMB0 Power Supplies

Several power connections are required for the hardware to work properly. For the MMB0, a 6-V AC/DC converter is all that is necessary. Ensure that J12 on the MMB0 board is closed before connecting the AC/DC adapter to the DC In connector of the MMB0. This supply provides all power to the digital portion of the DAC8x11 EVM as well as all necessary power for the DSP. Clean, well-regulated analog power for the DAC8x11 EVM must be supplied externally via J14 – a 6-position screw terminal mounted in the lower left corner of the MMB0 board.

CAUTION

When using external power supplies applied to J14 on the MMB0, ensure that all shorting blocks from J13 are completely removed. Permanent damage to the MMB0 may occur otherwise.


From left to right, the J14 screw terminal connections are –VA, +VA, +5VA, -5VA, +5VD, and GND. The DAC8x11 board has power requirements as described in Section 4. The analog +5VA may be applied directly to the screw terminals at J14 on the MMB0 (referenced to the GND terminal).

For convenience to the DAC8x11 EVM user, the +5VA required for the analog power to the EVM may be provided through the MMB0. This can be accomplished by placing a shunt jumper on J13B (+5 to +5VA), which connects the digital 5-V supply to the analog supply input. Due to switching noise, overall performance of the device installed on the EVM may be compromised.

6.3 Software – Running DXP

Install DXP on a laptop or personal computer running Windows XP or Windows 7 as per the detailed instruction in the DXP User's Guide (SBAU146). Run the DXP program by clicking on the DXP icon on your desktop, or by browsing to your installation directory.

Before you can generate signals with 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. Choose the DAC configuration file for the device installed on the EVM as shown in Figure 2.
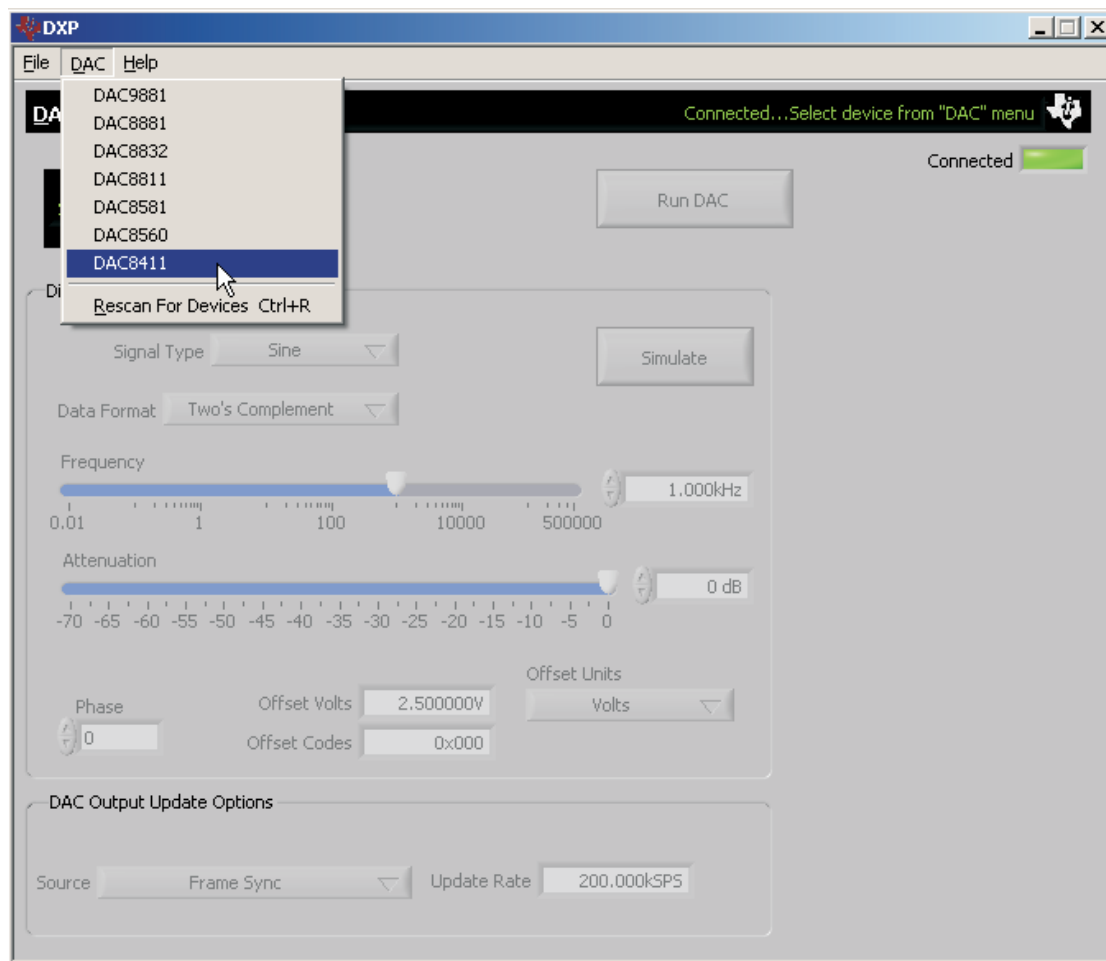
Figure 2. Loading a DAC8x11 EVM Configuration

The DXP software defaults to output a 1-kHz sine wave from the DAC; other waveform options include Square, Saw tooth, Triangle, and DC output options as described in the DXP User's Guide. The frequency and amplitude of the output waveform is controlled by sliders on the DXP interface. The DAC update rate can also be modified as shown in Figure 3.
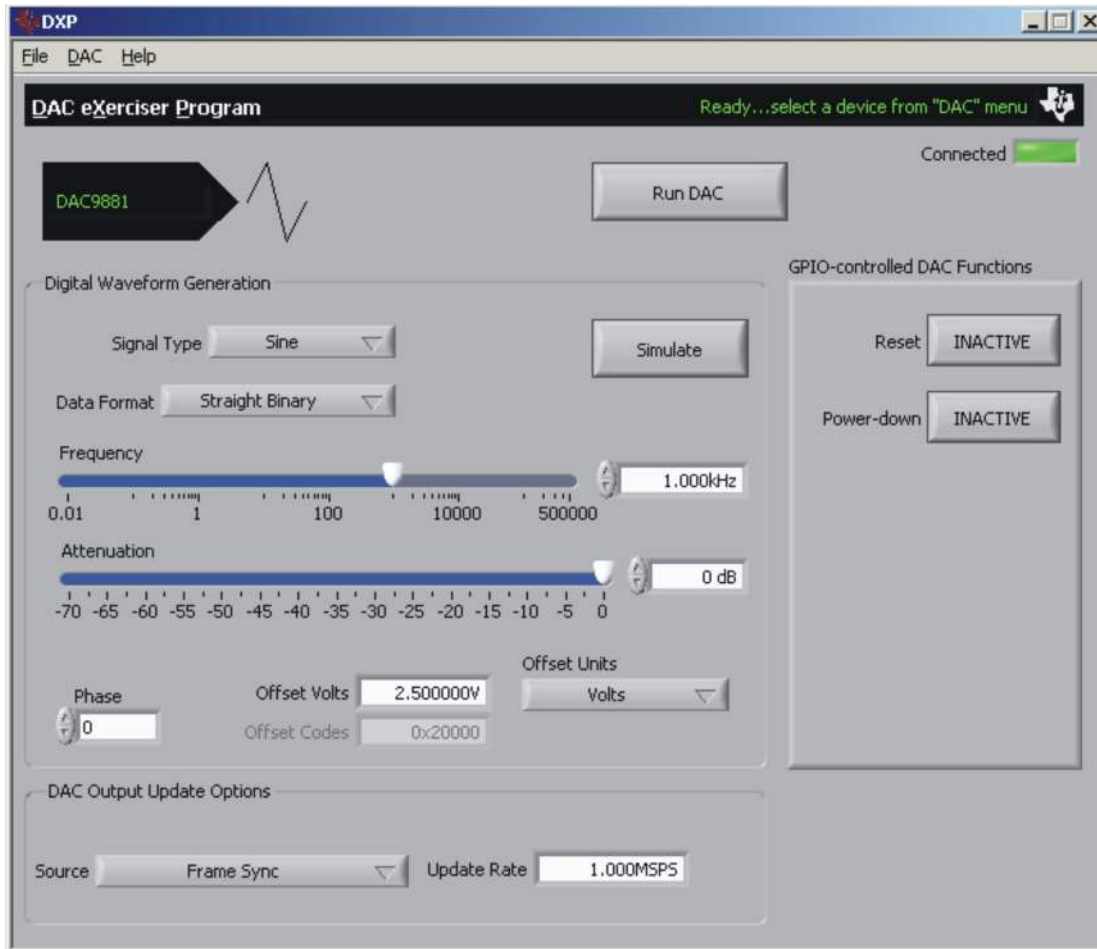

Figure 3. DAC8x11 EVM – Frequency/Amplitude and Update Rate Adjustments

6.4   DAC Output Update Options

The DXP software also allows the user to choose several DAC output update options. These are shown in Figure 4.
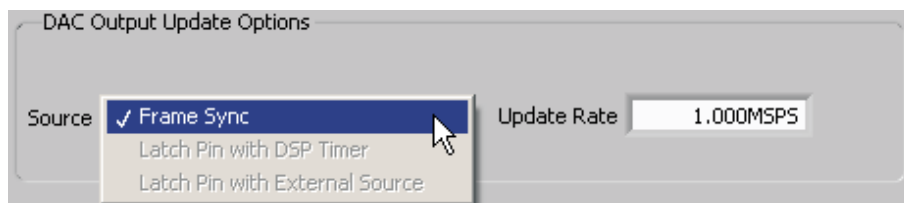
Figure 4. DAC Output Update Options

Details on these options are shown in Table 5.

Table 5. Output Update Features

Options	Detailed Description
Frame Sync	The DXP software defaults to Frame Sync update mode. In this mode, the SYNC input of the DAC loaded on the EVM is controlled by the Frame Sync output of the MMB0. JP1 on the DAC8x11 EVM must be shorted pins 1-2 to use this option.
Latch with DSP Timer	N/A
Latch with External Timer	N/A
Update Rate	User Input – enter the desired DAC update rate, 1MSPS is the default

7 Bill of Materials and EVM Schematic

The following table contains a complete bill of materials for the DAC8x11 EVM. The schematic diagram is also provided for reference.

7.1 Bill of Materials

Designators	Description	Manufacturer	Mfg. Part Number
C1, C2	0.1 µF, 0603, Ceramic, 50V, X7R, 10%	Murata	GRM188R71H104KA93D
C3	0.47 µF, 0603, Ceramic, 25V, X7R, 10%	Murata	GRM188R71E474KA12D
C4, C6	1 µF, 0603, Ceramic, 16V, X5R, 10%	TDK	C1608X5R1C105K
C5	10 µF, 0805, Ceramic, 10V, X5R, 10%	Taiyo Yuden	LMK212BJ106KD-T
C7	10 µF, 0603, Ceramic, 6.3V, X5R, 20%	TDK	C1608X5R0J106M
J1 J2 (Top Side)	10 Pin, Dual Row, SM Header (20 Pos.)	Samtec	TSM-110-01-T-DV-P
J3 (Top Side)	5 Pin, Dual Row, SM Header (10 Pos.)	Samtec	TSM-105-01-T-DV-P
J1 J2 (Bottom Side)	10 Pin, Dual Row, SM Header (20 Pos.)	Samtec	SSW-110-22-F-D-VS-K
J3 (Bottom Side)	5 Pin, Dual Row, SM Header (10 Pos.)	Samtec	SSW-105-22-F-D-VS-K
JP1, JP2, JP3	3 Pin 0.1inch, Header	Samtec	TSW-103-07-T-S
R1	NI		
R2	10 kΩ, 0603, 1/10W, 1%	Yageo	RC0603FR-0710KL
R3, R4, R8, R9, R10	NI		
R5, R6, R7, R11	0 Ω, 0603, 1/10W, 5%	Yageo	RC0603JR-070RL
R12	1.5 Ω, 0603, 1/10W, 5%	Yageo	RC0603JR-071R5L
TP1	TEST POINT PC MINI 0.040" D RED	Keystone	5000
TP2, TP3	TEST POINT PC MINI 0.040" D BLACK	Keystone	5001
U1	Various – See [1]	TI	Various
U2	IC PREC V-REF 4.096V LN 8-SOIC	TI	REF5040AID
U3	IC OPAMP GP R-R 44MHZ SOT23-5	TI	OPA353NA/250

[1] The device installed at location U1 is dependent on the EVM ordered. This device is soldered to the board for best performance. U1 may be replaced with any device listed in the EVM Compatible Device Data Sheets table found at the end of this document.

7.2 EVM Schematic

Figure 5 illustrates the DAC8x11 EVM schematic.

Figure 5. DAC8x11 EVM
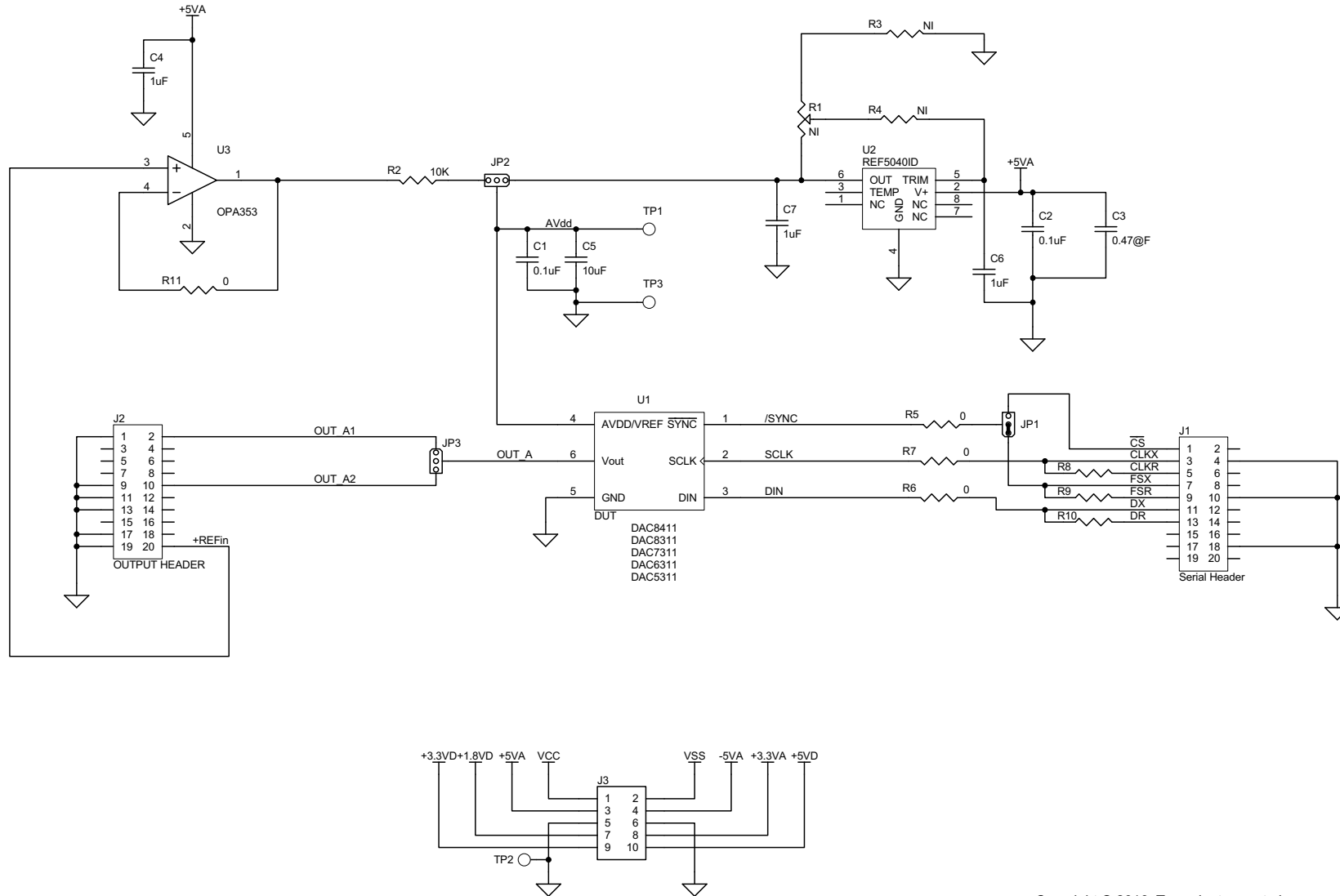
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8   Related Documentation from Texas Instruments

To obtain a copy of any of the following TI documents, call the Texas Instruments Literature Response Center at (800) 477-8924 or the Product Information Center (PIC) at (972) 644-5580. When ordering, identify this booklet by its title and literature number. Updated documents can also be obtained through the TI Web site at www.ti.com

EVM-Compatible Device Data Sheets:

1. DAC5311, DAC6311, DAC7311, 1.8V to 5.5V, 80µA, 8-, 10-, 10-, and 12-Bit, Low-Power, Single-Channel, Digital-to-Analog Converters in SC70 Package (SBAS442)

2. DAC8311, 1.8V to 5.5V, 80µA, DAC8411, 14- and 16-Bit, Low-Power, Single-Channel, Digital-to-Analog Converters in SC70 Package (SBAS439)

Revision History

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

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3 *Regulatory Notices:*

    3.1 *United States*

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

        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

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). 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 by Radio Law of Japan to follow the instructions below with respect to EVMs:

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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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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