DAC8806/20EVM

This user's guide describes the characteristics, operation, and use of the DAC8806/20 evaluation module (EVM). This EVM features either the DAC8806 (14-bit) or DAC8820 (16-bit) — a current output, multiplying digital-to-analog converter (DAC) with parallel digital inputs in a convenient modular EVM form factor. A complete circuit description, a schematic diagram, and bill of materials are included.

Contents

List of Figures

List of Tables

1 EVM Overview

1.1 Features

- Full-featured evaluation board featuring either the DAC8806 and DAC8820, parallel digital-to-analog converters (DAC)
- Onboard reference selection options for ±10 V or external source
- High-speed parallel interface
- Compatible with the 5-6K and HPA-MCU Interface Boards for use with a variety of Texas Instruments DSP Starter Kits (DSK) and micro controllers such as the TMS470
- Compatible with the TI Analog Interface Board from Avnet for use with Xilinx FPGAs

1.2 Introduction

The DAC8806 and DAC8820 devices are 14-bit and 16-bit, multiplying DACs with a microprocessor and TMS320 DSP-compatible parallel interface. The data bits are double-buffered so that the output can be updated asynchronously using the LDAC pin. During normal operation, the DAC8806 and DAC8820 devices dissipate a mere 25 μW at a 5-V supply and 8.25 μW at a 3-V supply.

Developed for a wide range of supply voltages, these DACs can be operated from 2.7 V to 5.5 V. The full-scale current output for these devices is 1.66 mA with a 10-V reference applied and has a typical settling time of 0.5 μs.

The EVM ships with either the DAC8806 or DAC8820 installed. The chip select function to the installed device is decoded through an SN74AHCT138 address decoder allowing the EVM user to stack multiple EVMs together and address them independently. Up to three DAC8806/20EVM boards can be used together.

2 Analog Interface

For maximum flexibility, the modular DAC8806/20EVM 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. This header/socket provides access to the analog output pins of the DAC. Consult Samtec at www.samtec.com or call 1-800-SAMTEC-9 for a variety of mating connector options. Table 1 shows the pinout of the analog input connector, J2.

Table 1. J2 Pinout

Pin Number	Signal	Description
J2.2 through J2.6 (even)	Analog Output	To accommodate EVM stacking, jumper J3 can be used in combination with J2 to choose the analog output from the evaluation module.
J2.20	REF(+)	External REFP source input (±10 V max), accessible through J4.
J2.9, 11, 13, 17, and 19	AGND	Analog ground connections.

An added feature of the modular DAC8806/20EVM is the use of an operational amplifier component U5 to develop unipolar or bipolar outputs from the EVM. The EVM user can install various jumpers in W2 to provide 2- or 4-quadrant multiplication options. The factory default is 4-quadrant or bipolar output voltage that swings ±10 V. The EVM is designed to provide a unipolar output through the buffer at location U5B when the shunt jumpers at W2 are moved from their default locations (pins 1-2, 5-6, and 7-8 shorted).

To operate the EVM in 2-quadrant mode, the shunt jumpers on W2 needs to be arranged so that pins 3-4, 7-9, and 8-10 are shorted together. See Figure 1 for the 2- and 4-quadrant jumper configurations. In each case, pin 1 is in the lower left corner; the bottom row of pins is numbered 1,3,5,7, and 9.

When operating in 2-quadrant mode, it is important to remember that the analog output polarity is determined by the reference voltage input. For 0-V to +10-V output, the reference must be negative 10 VDC (W1 shorted pins 1-2). For 0-V to –10-V output, the reference must be positive 10 VDC (W1 shorted pins 2-3). For 4-quadrant operation, the shunt on W1 can be in either position.

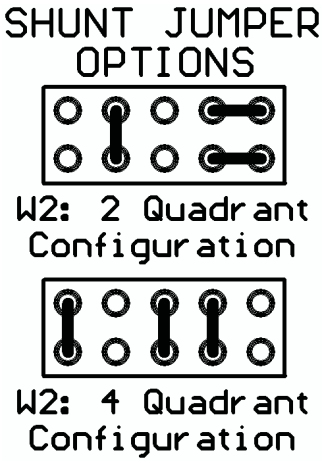


Figure 1. Shunt Jumper Options for 2- and 4-Quadrant Operation

3 Digital Interface

The DAC8806/20EVM is designed for easy interfacing to multiple control platforms. Jumper options are provided on the EVM to allow direct control over the address space to which the DAC responds.

3.1 Parallel Control

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 J6. This header/socket provides access to the digital control pins of the EVM. Consult Samtec at www.samtec.com or 1-800-SAMTEC-9 for a variety of mating connector options.

Pin Number	Signal	Description
J6.1	DC_CSa	Daughter Card Chip Select – active-low signal used to access the EVM via U8
J6.3	$\overline{WR}$	Write Strobe – not used on this EVM.
J6.5	$\overline{RD}$	Read Strobe – not used on this EVM.
J6.7	EVM_A0	EVM Address line 0 – used with U8 to control $\overline{RST}$ and $\overline{WR}$
J6.9	EVM_A1	EVM Address line 1 – used with U8 to control $\overline{RST}$ and $\overline{WR}$
J6.11	EVM_A2	EVM Address line 2 – used with U8 to control $\overline{RST}$ and $\overline{WR}$
J6.13	EVM_A3	EVM Address line 3 – not used on this EVM.
J6.15	EVM_A4	EVM Address line 4 – not used on this EVM.
J6.17	TOUT	Timer Output – not used on this EVM.
J6.19	INT	Interrupt Output – not used on this EVM

Jumpers W5 and W6 control the signal applied to the active-low $\overline{RST}$ and $\overline{WR}$ pins, respectively, on the DAC8820 or DAC8806. The absolute address for the installed DAC depends on several factors. When used with the 5-6K Interface Board, the physical address depends on the DSP in use as well as the location of W1 on the 5-6K Interface Board. See the *5-6K Interface Board User's Guide* (SLAU104) and your DSK schematics for details.

When used in combination with U8, an SN74LVC138 address decoder, jumpers W5 and W6 allow the $\overline{RST}$ and $\overline{WR}$ signals to be controlled by one of three different addresses. Having the ability to select the address location of the DAC inputs provides the possibility of stacking additional parallel ADC or DAC boards together with the DAC8806/20EVM.

The Y1, Y2, and Y3 outputs of the address decoder are connected to the DAC Reset pin via jumper W6. The $\overline{RST}$ pin is active when accessed through address locations 0x01, 0x02, or 0x03. Address 0x02 is the default condition on the EVM.

The Load DAC (LDAC) pin is connected via jumper W4 to either the Y4 output of the address decoder U8 (default) or the applied $\overline{WR}$ strobe. When using the LDAC controlled by U8, multiple DAC boards can be stacked together, allowing a single LDAC access to update up to three devices simultaneously. LDAC corresponds to address 0x04.

The Y5, Y6, and Y7 outputs of the address decoder are connected to the DAC Write pin via jumper W5. The $\overline{WR}$ pin is active when accessed through address locations 0x05, 0x06, or 0x07. Address 0x06 is the default condition on the EVM.

3.2 Parallel Data

The modular DAC8806/20EVM uses Samtec part numbers SSW-116-22-F-D-VS-K and TSM-116-01-T-DV-P provide a convenient 16-pin, dual-row, header/socket combination at J7. This header/socket combination provides access to the parallel data pins of the installed DAC. Data line D0 is connected to J7 pin 1. Data lines 1-15 are located on pins 3-31, respectively. Even-numbered pins 2-32 are connected to digital ground. There are no internal connections for D14 and D15 on the DAC8806.

4 Power Supplies

The DAC8806/20EVM board requires a power supply of +2.7 VDC to +5 VDC. Because the EVM is designed to work with the 5-6K Interface Board, J5 provides direct connection to the common power bus described in document SLAU104. When used with the 5-6K Interface Board, power to the installed DAC is controlled by the shunt jumper on W3. The shunt can be placed on W3 pins 1-2 for 5-V operation or 2-3 for 3.3-V operation. The factory default (W3 closed pins 1-2) is 5-V operation. Table 2 shows the pinout of J5.

Table 2. J5 Pinout

Signal	Pin Number		Signal
+VA – Used by U2, U3, and U5, +15 V max	1	2	–VA – Used by U5, -15 V max
+5VA – Unused	3	4	-5VA – Unused
DGND	5	6	AGND
+1.8VD – Unused	7	8	+VD – Unused
+3.3VD – Used with W6 – provides voltage supply to the DAC	9	10	+5VD – Used with W6 – provides voltage supply to the DAC

Alternate power sources can be applied via various test points located on the EVM. See the schematic at the end of this document for details. Completely removing the shorting jumper at W3 allows voltages to be applied from completely independent, variable DC sources via pin 2 (center pin) of W3. The installed DAC can tolerate supplies of +2.7 VDC to +5.5 VDC.

Note: Although filters are provided for all power supply inputs, optimal performance of the EVM requires a clean, well-regulated power source.

4.1 Reference Voltages

The DAC8806/20 is configured to use the onboard reference through jumper J4 (see schematic for details). A shunt jumper is installed at J4 pins 3-4 (factory default) to provide a precision +10-V reference to U2 and U4. The outputs of U2 and U4 along with the shunt jumper on W1 determine the polarity of the reference applied to the DAC. U2 is a noninverting buffer and applies positive 10 V to the DAC when the shunt on W1 covers pins 2-3. U4 is an inverting buffer and applies negative 10 V to the DAC when the shunt on W1 covers pins 1-2 (default condition).

If an alternate reference source is desired, the shunt jumper on J4 can be moved to cover pins 1-2. An external reference then can be applied through J2 pin 20 and still take advantage of the buffer circuits associated with U2 and U4. An alternative solution is to completely remove the shunt jumper on W1 and apply a clean external reference directly to W1 pin 2 (center pin).

5 EVM Operation

The analog output swing is ±10 Vpp by default. The OPA2277 installed at position U5 is configured for 4-quadrant output via the jumper arrangement on W2. See section 2 and the EVM silkscreen for 2-quadrant operation configurations.

Once power is applied to the EVM, the analog output source is connected to J2 pin 2 (top and bottom side) by means of a 3-position jumper J3 and buffer U5. The output can be applied to a variety of signal-conditioning modules using the 5-6K Interface Board or HPA-MCU Interface Board.

The digital control signals can be applied directly to J6 (top or bottom side). The DAC8806/20EVM also can be connected directly to the 5-6K Interface Board for use with a variety of C5000™ and C6000™ series DSP Starter Kits (DSK). The Parallel Control and Data connectors are designed to allow pattern generators and/or logic analyzers to be connected to the EVM using standard ribbon-type cables on 0.1-inch centers.

No specific evaluation software is provided with this EVM; however, various code examples are available that show how to use this EVM with a variety of digital signal processors from Texas Instruments. Check the product folders or send an e-mail to dataconvapps@list.ti.com for a listing of available code examples. The EVM Gerber files are available on request.

6 EVM Bill of Materials and Schematic

Table 3 contains a complete bill of materials for the modular DAC8806/20EVM. The schematic diagram also is provided for reference.

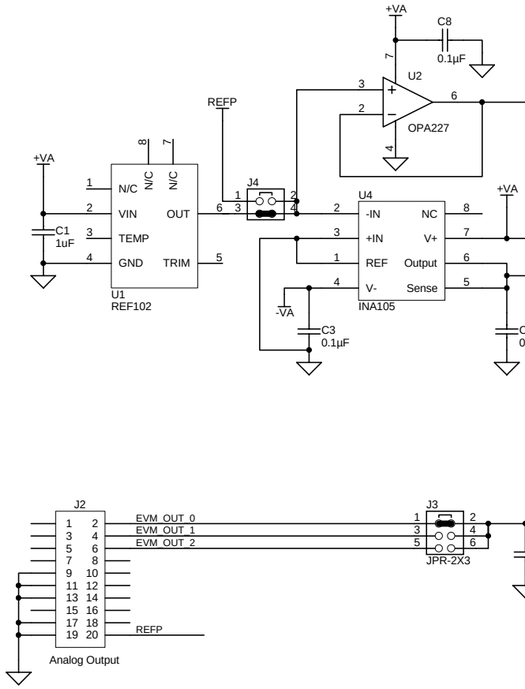
Table 3. Bill of Materials

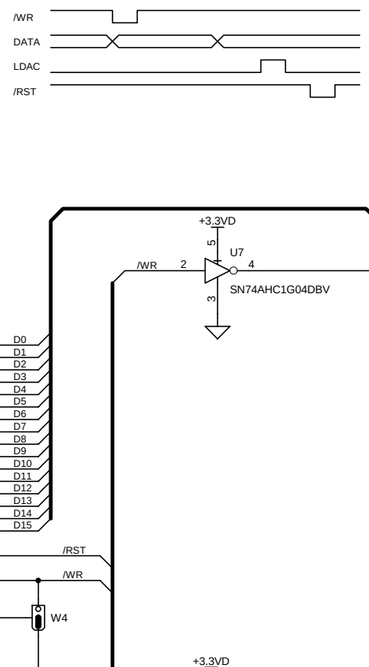
Designators	Description	Manufacturer	Mfg. Part Number
C1	1.0µF, 0603, Ceramic, X5R, 10V	TDK	C1608X5R1A105K
C2	100pF Ceramic, 0805, COG, 50V	TDK	C2012C0G1H101J
C3–C5, C7–C9, C13–C15	0.1uF Ceramic, 0603, X7R, 25V	TDK	C1608X7R1E104K
C6, C10	Not Installed		
C11, C12	10µF, 1206, Ceramic, X5R, 10V	TDK	C3216X5R1A106M
J1 J2 J6 (top side)	10 Pin, Dual Row, SMT Header (20 Pos)	Samtec	TSM-110-01-T-DV-P
J1 J2 J6 (bottom side)	10 Pin, Dual Row, SMT Socket (20 Pos)	Samtec	SSW-110-22-F-D-VS-K
J3	3 Pin, dual row header (6 pos)	Samtec	TSW-103-07-L-D
J4	2 Pin, dual row header (4 pos)	Samtec	TSW-102-07-L-D
J5 (top side)	5 Pin, Dual Row, SMT Header (10 Pos.)	Samtec	TSM-105-01-T-DV-P
J5 (bottom side)	5 Pin, Dual Row, SMT Socket (10 Pos.)	Samtec	SSW-105-22-F-D-VS-K
J7 (top side)	16 Pin, Dual Row, SMT Header (32 Pos.)	Samtec	TSM-116-01-T-DV-P
J7 (bottom side)	16 Pin, Dual Row, SMT Socket (32 Pos.)	Samtec	SSW-116-22-F-D-VS-K
R1	100 ohm, 0603, 5%	Yageo America	9C06031A1000JLHFT
R2 R3	10K ohm, 0603, 5%	Yageo America	9C06031A1002JLHFT
DGND	Black Test Point Loop	Keystone	5001
+3.3VD +5VD REFTEST	Red Test Point Loop	Keystone	5000
U1	REF102	Texas Instruments	REF102BU
U2	OPA227	Texas Instruments	OPA227U
U3	DAC8806	Texas Instruments	DAC8806IDB
U4	INA105	Texas Instruments	INA105KU
U5	OPA2227	Texas Instruments	OPA2227U
U6	SN74LVC16373A	Texas Instruments	SN74LVC16373ADGGRG4
U7 U9	SN74AHC1G04	Texas Instruments	SN74AHC1G04DBVRG4
U8	SN74LVC138	Texas Instruments	SN74LVC138ADG4
W1 W3 W4	3 Pin, single row header	Samtec	TSW-103-07-L-S
W2	5 Pin, dual row header (10 pos)	Samtec	TSW-105-07-L-D
W5 W6	3 Pin, dual row header (6 pos)	Samtec	TSW-103-07-L-D

6.1 Schematic

The schematic diagram appears on the following page.

Revision History		
REV	ECN Number	Approved
A	Initial Release	TH





Engineer:	Nick Trombly
Drawn By:	Tom Hendrick
FILE:	DAC8820_A.sch

TEXAS INSTRUMENTS

12500 TI Boulevard. Dallas, Texas 75243

Title: DAC8806/07/20 EVM			
DOCUMENTCONTROL # 6483546			REV: A
DATE: 8-Dec-2006	SIZE:	SHEET: 1	OF: 1

EVALUATION BOARD/KIT IMPORTANT NOTICE

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and therefore may not meet the technical requirements of these directives or other related directives.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

TI currently deals with a variety of customers for products, and therefore our arrangement with the user **is not exclusive.**

TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.**

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please contact the TI application engineer or visit www.ti.com/esh.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used.

FCC Warning

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 2.7 V to 5.5 V and the output voltage range of -10 V to +10 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 60°C. The EVM is designed to operate properly with certain components above 60°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
RFID	www.ti-rfid.com	Telephony	www.ti.com/telephony
Low Power Wireless	www.ti.com/lpw	Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

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