

DAC7811EVM

This user's guide describes the characteristics, operation, and use of the DAC7811EVM – a 12-bit, synchronous-serial-interface, digital-to-analog converter evaluation module (EVM). A complete circuit description, a schematic diagram, and bill of materials are included.

Contents

1	EVM Overview	1
2	Analog Interface	2
3	Digital Interface	3
4	Power Supplies	3
5	EVM Operation.....	4
6	EVM Bill of Materials and Schematic	5

List of Tables

1	Pinout of J1.....	2
2	Pinout of J2T	3
3	Pinout of J2B	3
4	Pinout of J3.....	4
5	List of Jumpers and Switches.....	5
6	Bill of Materials.....	5

1 EVM Overview

1.1 Features

- Evaluation board for the 12-bit current output DAC7811
- Onboard reference and buffer circuits
- High-speed serial interface
- Modular design for use with a variety of DSP and microcontroller interface boards

1.2 Introduction

The DAC7811 is a single, 12-bit, serial-input, current-output, digital-to-analog (DAC) converter operating from a single 3-V to 5-V power supply. This converter provides excellent 4-quadrant multiplication characteristics, with a large signal multiplying bandwidth of 10 MHz. An integrated feedback resistor provides temperature tracking and full-scale voltage output when combined with an external current-to-voltage (I-to-V) precision amplifier. The EVM provides the external I-to-V amplifier and DPDT switch to allow unipolar and bipolar output operation.

The modular EVM form factor allows direct evaluation of the DAC's performance and operating

characteristics. This EVM is compatible with the Texas Instruments 5-6K Interface Board ([SLAU104](#)), the HPA-MCU Interface Board ([SLAU106](#)) and additional 3rd party boards such as the HPA449 Demonstration Board from SoftBaugh, Inc. (www.softbaugh.com). Field programmable gate array (FPGA) users may also use the DAC7811EVM with a variety of Xilinx FPGAs by obtaining the Texas Instruments Analog Adapter Kit (part number [ADS-TI-AD-DAU](#)) from Avnet Electronics Marketing.

2 Analog Interface

For maximum flexibility, the DAC7811 EVM is designed for easy interfacing to multiple analog sources. [Table 1](#) provides the pinout of connector J1. 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 analog output pins of the DAC through the onboard buffer amplifier. Consult Samtec at www.samtec.com, or call 1-800-SAMTEC-9 for a variety of mating connector options.

Table 1. Pinout of J1

Pin Number	Signal	Description
J1.2	Iout	DAC current output – remove W1 and install R12 using a 0-Ω resistor
J1.4	Vout Option	Pins 4-18 (even) are used with W2. W2 is a dual-row, 7-pin header with a shunt jumper used to apply the output voltage from U2 on various pins of J1. This combination is provided to allow the EVM user the option of daisy-chaining up to a maximum of seven EVMs.
J1.6	Vout Option	
J1.8	Vout Option	
J1.10	Vout Option	
J1.12	Vout Option	
J1.14	Vout Option	
J1.16	Vout Option	
J1.18	REF(-)	Unused
J1.20	REF(+)	Unused
J1.15	Vcom	Unused
J1.1–J1.19 (odd)	AGND	Analog ground connections (except J1.15)

2.1 EVM Output Voltage

Switch SW1 provides a means to allow unipolar or bipolar output operation of the DAC7811EVM. When the slide switch is to the right, the output voltage on J1.4 and TP2 is $\pm V_{REF}$. If the onboard reference is used, this means that the output voltage is –10 Vdc to +10 Vdc. When the switch is to the left, the output voltage from the buffer is dependent on the position of W3. With a negative reference applied (default condition, W3 pins 1-2 shorted), the voltage output from the buffer is 0 V to +10 Vdc. If W3 is located on pins 2-3, a positive 10-V reference is applied to the DAC7811, and the voltage output from the buffer is 0 V to –10 Vdc.

For a wider dynamic output range, the EVM can be configured to use an external reference by removing the shunt at W3 and applying an external source to W3 pin 2 (center pin). In this case, an external reference of ± 15 V may be applied to the DAC7811. For best performance, the external reference must be supplied by a clean ac or dc source.

3 Digital Interface

The DAC7811EVM is designed for easy interfacing to multiple control platforms. [Table 2](#) provides the pinout of connector J2T located on the top side of the EVM; [Table 3](#) provides the pinout of connector J2B located on the bottom side of the EVM. This header/socket combination allows the EVM user to stack up to seven DAC7811EVMs together to demonstrate daisy-chain operation of the converter.

CAUTION

For daisy-chain operation, the shunt jumper at W2 should be moved for each board in the stack so that the output voltages appear on different pins of J1. Output voltages from multiple EVMs applied to the same pin of J1 may cause permanent damage to the output amplifiers found at U2.

Table 2. Pinout of J2T

Pin Number	Signal	Description
J2.1	Unused	
J2.3	SCLK	Serial Clock - Signal is common to J2B
J2.5	Unused	
J2.7	$\overline{\text{SYNC}}$	Synchronization input to the DAC. Tied to the Frame Sync for DSP host systems – STE for SPI Host systems - Signal is common to J2B
J2.9	Unused	
J2.11	SDO	Serial Data Output - provides delayed serial data to additional EVMs (user may "stack" up to seven boards together) - the applied signal may be monitored at the SDO test point located beside J2.
J2.13	Unused	
J2.15	Unused	
J2.17	Unused	
J2.19	SPARE	

Table 3. Pinout of J2B

Pin Number	Signal	Description
J2.1	Unused	
J2.3	SCLK	Serial Clock - Signal is common to J2T
J2.5	Unused	
J2.7	$\overline{\text{SYNC}}$	Synchronization input to the DAC. Tied to the Frame Sync for DSP host systems – STE for SPI Host systems - Signal is common to J2T
J2.9	Unused	
J2.11	SDI	Serial Data Input - the applied signal may be monitored at the SDI test point located beside J2.
J2.13	Unused	
J2.15	Unused	
J2.17	Unused	
J2.19	SPARE	

4 Power Supplies

The DAC7811EVM board requires ± 15 Vdc (max) for the analog section. This includes the 10-V reference (U1) and its buffer (U3), an INA105 used to derive the -10 -V reference voltage (U4), and the output buffers (U2). All applied voltages should be from clean dc sources that are current limited to prevent damage caused by accidental short circuits. Before changing the reference configuration or the output voltage selection, it is recommended that the power first be removed from the EVM.

Supply voltages of +2.7 Vdc to +5.5 Vdc for the V_{DD} supply to the DAC7811 are also required. When used with one of the previously mentioned interface boards, J3 provides connection to the common power bus described in the *5-6K Interface Board EVM User's Guide* ([SLAU104](#)).

Table 4 shows the pinout of connector J3.

Table 4. Pinout of J3

Signal	Pin Number		Signal
Unused	1	2	Unused
+5VA	3	4	–5VA
DGND	5	6	AGND
Unused	7	8	Unused
Unused	9	10	+5VD

4.1 Stand-Alone Operation

When used as a stand-alone EVM, the analog power can be applied to J3 pins 3 and 4, referenced to J3 pin 6. Digital power can be applied to J3 pin 10, referenced to J3 pin 5. Optimal performance of the EVM requires a clean, well-regulated power source.

CAUTION

The DAC7811 has a V_{DD} power source requirement of +2.7 Vdc to +5.5 Vdc. If using an external reference source, keep the reference voltage to a level less than or equal to the maximum limits described in the Electrical Characteristics table of the DAC7811 data sheet.

4.2 Reference Voltage

The DAC7811 can be configured to use the onboard reference/buffer circuits (U1, U3, and U4) or an external reference applied to W3, pin 2 (completely remove shunt jumper). Jumper W3 controls the reference source. In the factory default position (shunt on W3 pins 1-2), a –10-V reference is applied to the DAC7811 (U5). Moving the shunt at W3 to pins 2-3 applies a positive 10-V reference to the DAC7811.

The DAC7811, as a 2-quadrant multiplying DAC, can be used to generate a unipolar output. The polarity of the full-scale output IOUT is the inverse of the input reference voltage at VREF. Some applications require full 4-quadrant multiplying capabilities or bipolar output swing. As shown in the schematic, the second half of U2 is added as a summing amplifier and has a gain of 2X that widens the output span to 20 V. A 4-quadrant multiplying circuit is implemented by using a 10-V offset from the reference voltage to bias U4.

5 EVM Operation

5.1 Analog Output

The analog output is applied to J1 pins 4 to 14 (even) by the application of a shunt jumper on W2. The factory default is to apply the voltage output from U2 to J1.4. The analog output range depends on the configuration of the EVM and the reference applied to the DAC7811. See Sections 3 and 4.2 of this user's guide and the DAC7811 data sheet ([SBAS337](#)) to determine the maximum analog output range.

5.2 Digital Control

The digital control signals $\overline{\text{SYNC}}$ and SCLK can be applied directly to J2 (top or bottom side). The serial data input must be applied to J2B pin 11 or the test point labeled SDI found beside J2. The DAC7811 EVM can also be connected directly to a DSP or microcontroller interface board such as the 5-6K Interface Board, the HPA-MCU Interface Board, or the HPA449. See the DAC7811 product folder on the TI Web site (www.ti.com) for a current list of compatible interface and/or accessory boards.

5.3 Frame Synchronization ($\overline{\text{SYNC}}$)

Connector J2 pin 7 applies the frame synchronization control to the DAC7811's $\overline{\text{SYNC}}$ pin. When using a 5-6K Interface or HPA-MCU Interface Board, J2 pin 7 ties the $\overline{\text{SYNC}}$ pin to the Frame Sync pin of the DSP or STE pin of the microcontroller. A 16-bit command+data word is then applied to the SDI input of the DAC7811. Releasing the active low $\overline{\text{SYNC}}$ pin updates the DAC output.

The DAC7811 powers up in the daisy-chain mode which must be used when two or more devices are connected in tandem. The SCLK and $\overline{\text{SYNC}}$ signals are shared across all devices while the SDO output of the first device connects to the SDIN input of the following device, and so forth. In this configuration, 16 SCLK cycles for each DAC7811 in the chain are required. For n devices in a daisy-chain configuration, $16n$ SCLK cycles are required to shift in the entire input data stream. After $16n$ active SCLK edges are received following a falling $\overline{\text{SYNC}}$, the data stream becomes complete, and $\overline{\text{SYNC}}$ can be brought high to update the DAC outputs. Up to seven DAC7811EVMs can be used in this mode simultaneously.

5.4 Default Jumper Locations

Table 5 provides a list of jumpers and switches found on the EVM and their factory default conditions.

Table 5. List of Jumpers and Switches

Jumper	Shunt	Position Jumper Description
W1	closed	Applies the DAC7811 current output to U2. W1 is fixed with a 0- Ω resistor.
W2	Pins 1-2	Controls which pin on J1 the output voltage from U2 is applied to. Default is pin 4. Output voltage from the EVM can also be monitored on TP2, which is useful for daisy-chain operating mode.
SW1	RIGHT	Controls analog output voltage (default is $\pm V_{\text{ref}}$)
R12	OPEN	R12 can be replaced by removing the 0- Ω resistor found at W1 to provide the current output directly from the DAC7811 to J1 pin 2.

6 EVM Bill of Materials and Schematic

Table 6 contains a complete bill of materials for the modular DAC7811 EVM. The schematic diagram is also provided for reference.

Table 6. Bill of Materials

Designators	Description	Manufacturer	Mfg. Part Number
C1	2.2 μF , 0805, Ceramic	TDK	C2012X5R1A225K
C2 C3 C6 C7 C8 C10	0.1 μF , 0603, Ceramic, X7R, 50V	TDK	C1608X7R1H104K
C4	18 pF, 0603, Ceramic, COG	TDK	C1608COG1H180J
C9	10 μF , 1206, Ceramic, Y5V	TDK	C3216Y5V1C106Z
J1 J2 (top side)	10 Pin, Dual Row, SMT Header (20 Pos.)	Samtec	TSM-110-01-T-DV-P
J1B J2B(bottom side)	10 Pin, Dual Row, SMT Socket (20 Pos.)	Samtec	SSW-110-22-F-D-VS-K
J3 (top side)	5 Pin, Dual Row, SMT Header (10 Pos.)	Samtec	TSM-105-01-T-DV-P
J3B (bottom side)	5 Pin, Dual Row, SMT socket (10 Pos.)	Samtec	SSW-105-22-F-D-VS-K
R1 R13	20K Ω , 0603, 5%, 0.1 W resistor	Yageo America	9C06031A2002JLHFT
R3 R4	20K Ω , 4mm POT	Bourns	3214W-1-203E

Table 6. Bill of Materials (continued)

Designators	Description	Manufacturer	Mfg. Part Number
R5 R7	20 Ω , 0603, 5%, 0.1 W resistor	Yageo America	9C06031A20R0JLHFT
R2 R6 R8	10K Ω , 0603, 5%, 0.1 W resistor	Yageo America	9C06031A1002JLHFT
R9 R11 W1	0 Ω , 0603, 5%, 0.1 W resistor	Yageo America	9C06031A0R00JLHFT
SW1	DPDT Slide Switch	E Switch	EG2209
TP1 TP2	Turret Type Test Point	MillMax	2348-2-00-01-00-00-07
U1	REF102	TI	REF102AU
U2	OPA2277	TI	OPA2277U
U3	OPA277	TI	OPA277U
U4	INA105	TI	INA105KU
U5	DAC7811	TI	DAC7811DGST
W2	7 Pin, Dual Row, 2mm Header	Samtec	TMM-107-03-T-D
W3	3 Pin, Single Row, 2mm Header	Samtec	TMM-103-03-T-S

FCC Warnings

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of 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 IMPORTANT NOTICE

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

This evaluation kit being sold by TI is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not considered by TI to be fit for commercial use. As such, the goods being provided may not be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety measures typically found in the end product incorporating the goods. As a prototype, this product does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may not meet the technical requirements of the directive.

Should this evaluation kit not meet the specifications indicated in the EVM User's Guide, the 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. Please be aware that the products received may not be regulatory compliant or agency certified (FCC, UL, CE, etc.). 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 EVM User's Guide and, specifically, the EVM Warnings and Restrictions notice in the EVM User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact the TI application engineer.

Persons handling the product must have electronics training and observe good laboratory practice standards.

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.

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 0 Vdc to 15 Vdc and the output voltage range of -10 Vdc to 10 Vdc.

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 30°C. The EVM is designed to operate properly with certain components above 30°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
Copyright © 2005, Texas Instruments Incorporated

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 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.

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

Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DSP	dsp.ti.com
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
Low Power Wireless	www.ti.com/lpw

Applications

Audio	www.ti.com/audio
Automotive	www.ti.com/automotive
Broadband	www.ti.com/broadband
Digital Control	www.ti.com/digitalcontrol
Military	www.ti.com/military
Optical Networking	www.ti.com/opticalnetwork
Security	www.ti.com/security
Telephony	www.ti.com/telephony
Video & Imaging	www.ti.com/video
Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2007, Texas Instruments Incorporated