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

List of Tables

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 ±VREF. 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 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 ± Vref)
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.

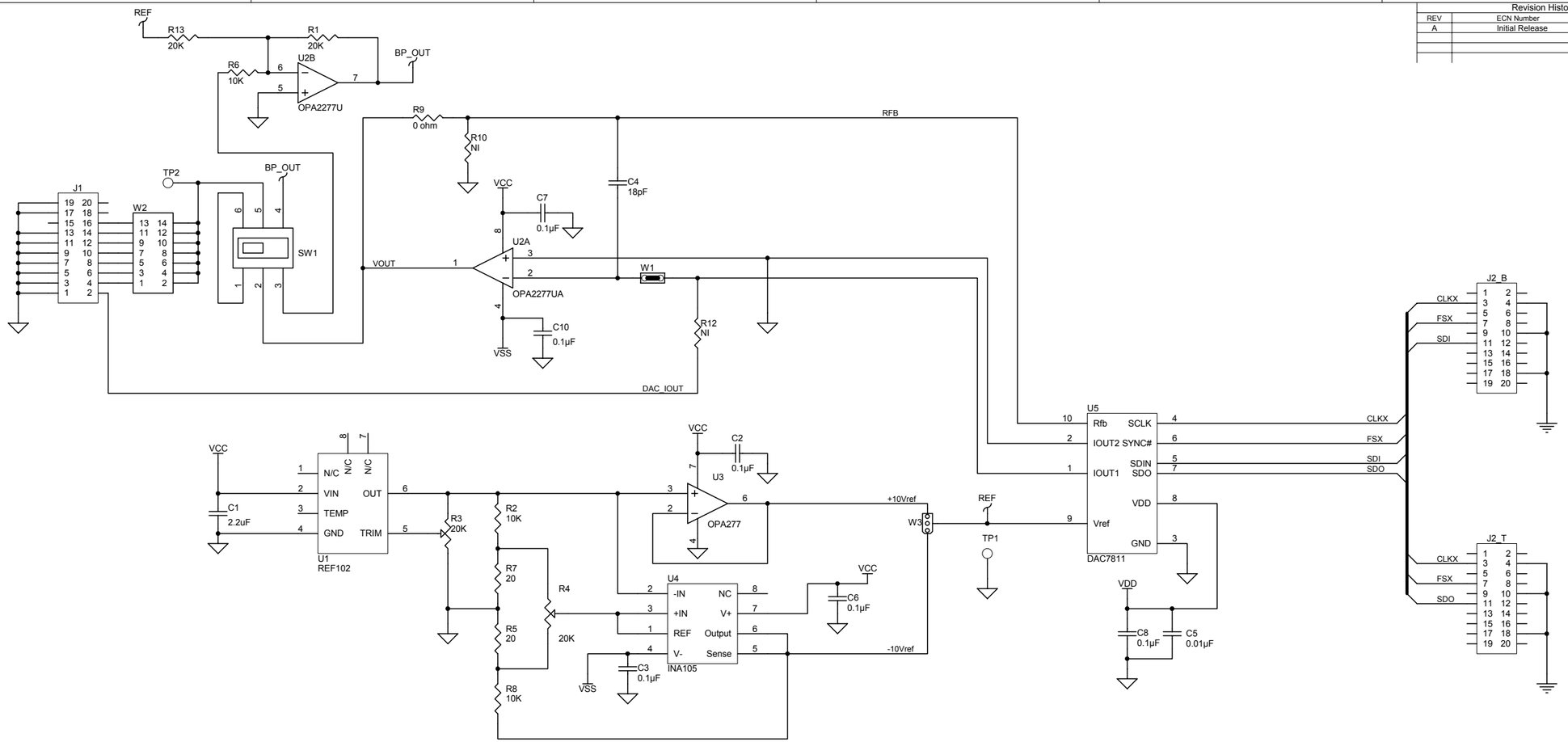
Table 6. Bill of Materials

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	DAC7811IDGST
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

Revision History		
REV	ECN Number	Approved
A	Initial Release	TH



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TEXAS INSTRUMENTS

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Title:	DAC7811 EVM		
DOCUMENTCONTROL #	6473313		REV: A
DATE: 14-Sep-2005	SIZE:	SHEET: 1	OF: 1

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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.

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