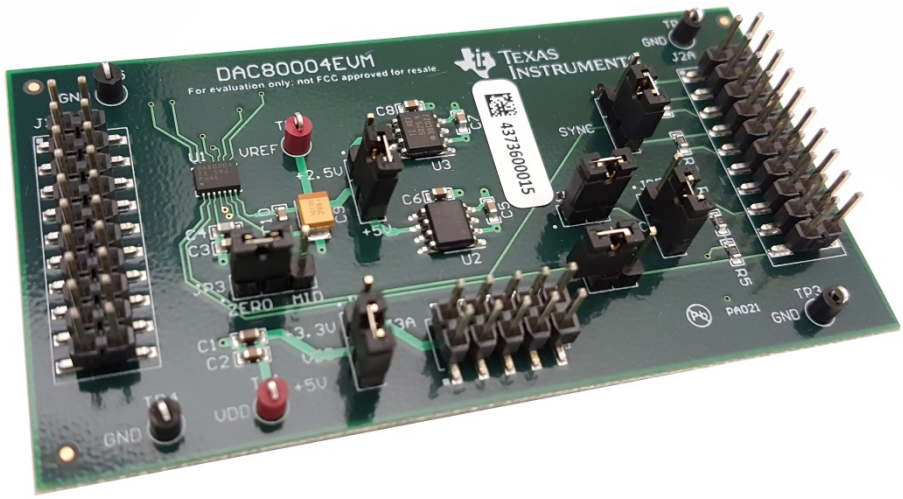
DAC80004EVM



DAC80004EVM

This user's guide describes the characteristics, operation, and use of the DAC80004EVM. The evaluation model (EVM) is an evaluation board for the DAC80004. The DAC80004 is a low-power, buffered voltage-output, 16-bit, quad channel digital-to-analog converter (DAC) with an integrated reference. This converter is controlled through a serial peripheral interface (SPI) that can operate at clock rates of up to 50 MHz. Additionally, the EVM includes a 2.5 V and a 5.5 V external reference voltages, resulting in an output ranges from 0 to 2.5 V and 0 to 5 V. The EVM allows evaluation of all aspects of the device and allows user control over every pin on the DAC80004. Complete circuit descriptions, schematic diagrams, and bill of material are included in this document.

The following related documents are available for download through the Texas Instruments web site at http://www.ti.com.

EVM-Related Device Datasheets

Device	Literature Number
DAC80004	SLASE44
REF5025	SBOS410
REF5050	SBOS410

Contents

List of Figures

List of Tables

Trademarks

1 EVM Overview

1.1 Features

The DAC80004EVM has the following features:

- Full-featured evaluation board for the DAC80004
- Onboard external reference selection
- Wide selection of digital and I/O voltages
- Hardware and software control logic
- Compatible with the TI Modular EVM Motherboard MMB0

This manual covers the operation of the DAC80004EVM. The abbreviation EVM and the term evaluation module are synonymous with the DAC80004EVM.

1.2 Introduction

The DAC80004 is a 16-bit, low-power, buffered voltage-output, dual channel digital-to-analog converter (DAC) that operates from a single 2.7-V to 5.5-V supply. The DAC is controlled through a serial peripheral interface (SPI) that can operate at clock rates of up to 50 MHz. The EVM is designed to highlight the features and the performance of the 16-bit DAC. Additionally, the EVM includes a 2.5-V and 5-V external references, resulting output ranges from 0 to 2.5 V or 5 V.

The DAC80004EVM is designed to give the user easy access to all pins on the DAC80004. The evaluation module allows the user to control the DAC logic using onboard jumpers, or digitally through the J2 header. By default, the evaluation module is configured to be used with an onboard 2.5-V external reference, but can be easily modified to use the other 5-V external reference.

1.3 Power and Motherboard Requirements

This DAC80004EVM board can be used as a standalone board or as a daughter card to the MMB0 Modular EVM motherboard.

1.3.1 Supply Voltage Ranges

Table 1 lists the supply voltage ranges for the EVM.

Table 1. Supply Voltage Ranges

Signal	Range
VDD	2.7 V to 5.5 V
VREF_VIN	2.7 V to 15 V
VREF_EXT	0 V to VDD

1.3.2 Motherboard Supply Mode

The MMB0 motherboard can supply the digital interface as well as the power supply voltage required by the DAC80004EVM. This user's guide focuses on the motherboard supply mode and its software.

1.3.3 Standalone Supply Mode

The DAC80004EVM can also be used without a motherboard, provided that the digital interface is driven by an external source. The supply voltage must be applied at TP1/VDD according to the specifications in Table 1.

The MMB0 can still be used as a digital interface while using an external power supply. Remember to disconnect any shunt from JP1.

1.3.4 Reference Voltage

The EVM includes an on-board reference as well as the option to provide an external reference voltage. JP2 chooses between the on-board reference and the external reference. TP2 can be used to measure the selected reference, which is the on-board reference by default.

1.4 EVM Default Hardware Setup

Table 2 lists the default jumper settings for the MMB0 modular EVM motherboard and Table 3 lists the default jumper settings for the DAC80004EVM.

Table 2. Default Jumper Settings for the MMB0 Modular EVM Motherboard

Jumper	Position
J12	CLOSED
J13A	OPEN
J13B	CLOSED

Table 3. Default Jumper Settings for the DAC80004EVM

Jumper	Position
JP1	2-3
JP2	1-2
JP3	2-3
JP4	1-2
JP5	2-3
JP6	CLOSED
JP7	OPEN

Figure 1 illustrates the default jumper settings for the DAC80004EVM.

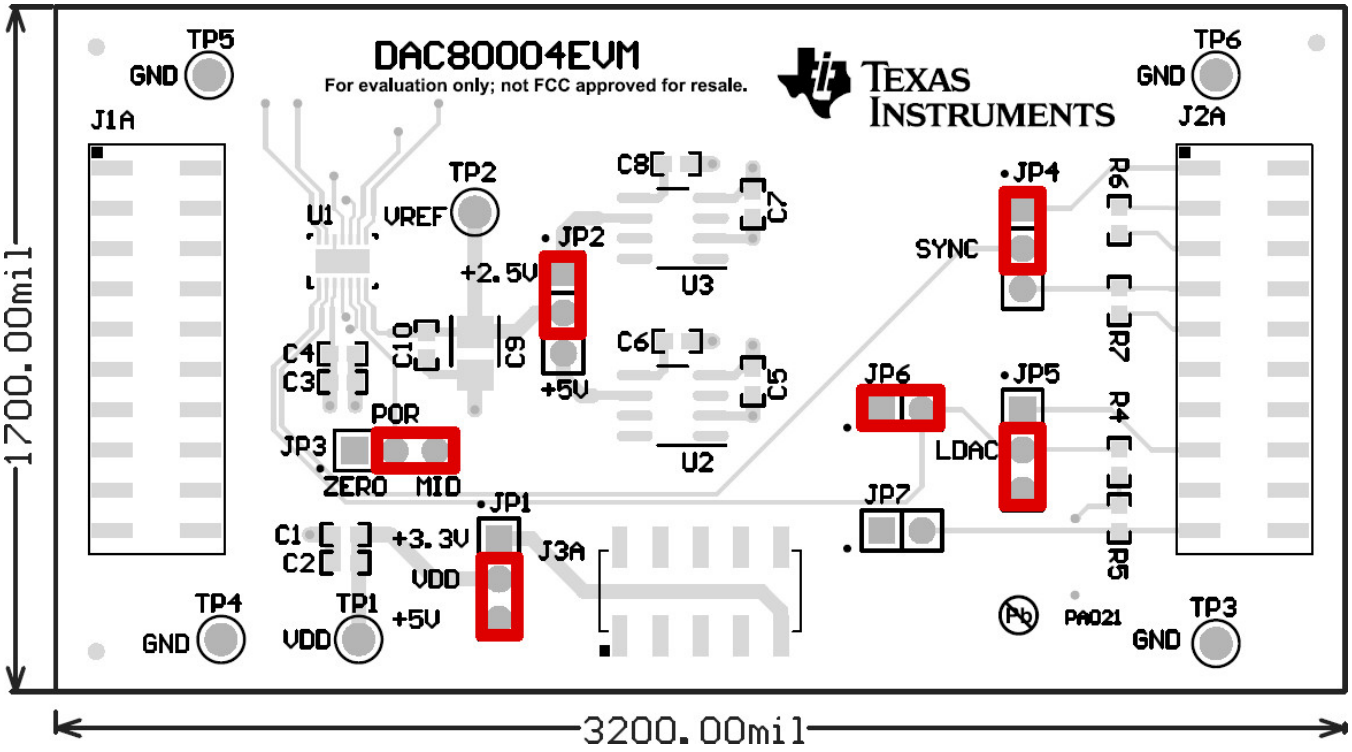


Figure 1. Default Jumper Settings for the DAC80004EVM

1.5 Questions and Support for This or Other Precision Data Converter EVMs

Join TI's E2E precision data converter support forum at
e2e.ti.com/support/data_converters/precision_data_converters

Post your question in the forum and one of our experts will assist you.

2 EVM Hardware

This section provides descriptions of the hardware interface and a quick-start guide.

2.1 Hardware Interface

Table 4 provides hardware descriptions.

Table 4. Hardware Description

Jumper	Default Position	Description
JP1	2-3	VDD selector. Selects between 5VA on J3A.3 and 3.3VD on J3A.9.
JP2	1-2	VREF selector. Selects between the 2.5 V and 5 V on-board references.
JP3	2-3	POR selector. Selects between the power-on state of the output. Default position powers-on to midscale, position 1-2 powers-on to zero-scale.
JP4	1-2	SYNC selector. Selects the SYNC signal between J2.1 and J2.7.
JP5	2-3	LDAC selector. Selects between an LDAC signal from J2A.15 and J2A.17.
JP6	CLOSED	LDAC GND tie. Selects between an LDAC signal from J2A with a pull-up resistor and GND.
JP7	OPEN	CLR GND tie. Selects between a RST signal from J2A.19 with a pull-up resistor and GND.

NOTE: For more details, view the Section 4.1.

2.2 Quick-Start

This section explains a quick method to test the EVM's functionality without using a motherboard.

The minimum requirements are:

- An external source to provide the SPI master signals
- An external 5-V power supply
- A DC digital multimeter

Use the following steps:

1. Ensure that all of the jumpers are in their default position.
2. Ensure that all the power supplies are switched off.
3. Connect the power supply ground to any of the ground leads on the EVM board.
4. Connect the SPI master ground to any of the ground leads on the EVM board.
5. Connect the DC DMM ground probe to any of the ground leads on the EVM board.
6. Connect 5 V to J3A.3.
7. Connect the DC DMM signal probe to J1A.8.
8. Power on the power supplies.
9. The DC DMM should display mid-scale 1.25 V. This means that the hardware setup is working.
   - If it does not, something may be wrong. Please check your connections and the jumper settings.
10. Send the SPI code 0x19FFFF using the DXP software.
11. The DC DMM should display full-scale 5 V. This means that your hardware and software setup are working.
    - If it does not, something may be wrong. Please check your digital interface implementation by looking at the digital signals on a signal analyzer or an oscilloscope.

3 EVM Operation

3.1 DXP Software Installation

The DXP software required to use the DAC80004EVM with the MMB0 must be downloaded from the Texas Instruments website, available at www.ti.com/dxp. The software is listed under the “Software” category in this product folder, as shown in Figure 2.

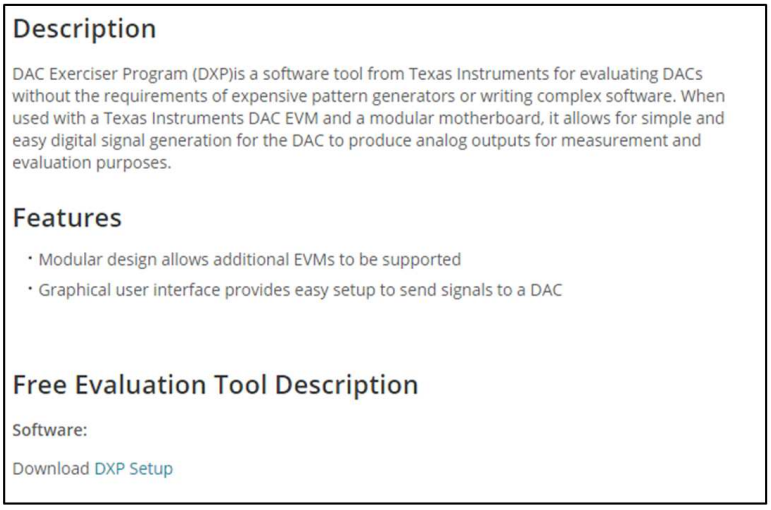


Figure 2. EVM Software Link

Once the download is complete, run the executable file and follow the installer instructions. After the DXP software installs, copy the DAC80004.xml file into the “Devices” directory that the installer created. Typically located in ‘C:\Users\Public\Documents\DXP\Devices’. If you cannot find the “Devices” directory, go to the DXP install directory, typically “C:\Program Files\DXP” and open the file “DXP.ini”. Locate the line that starts with “DXPDevices”; it will contain the location of the “Devices” directory.

4 Schematic, PCB Layout, and Bill of Materials

This section contains the DAC80005EVM schematic, DAC80005EVM PCB layout, and the DAC80005EVM BOM.

4.1 Schematic

Figure 3 illustrates the DAC80004EVM schematic.

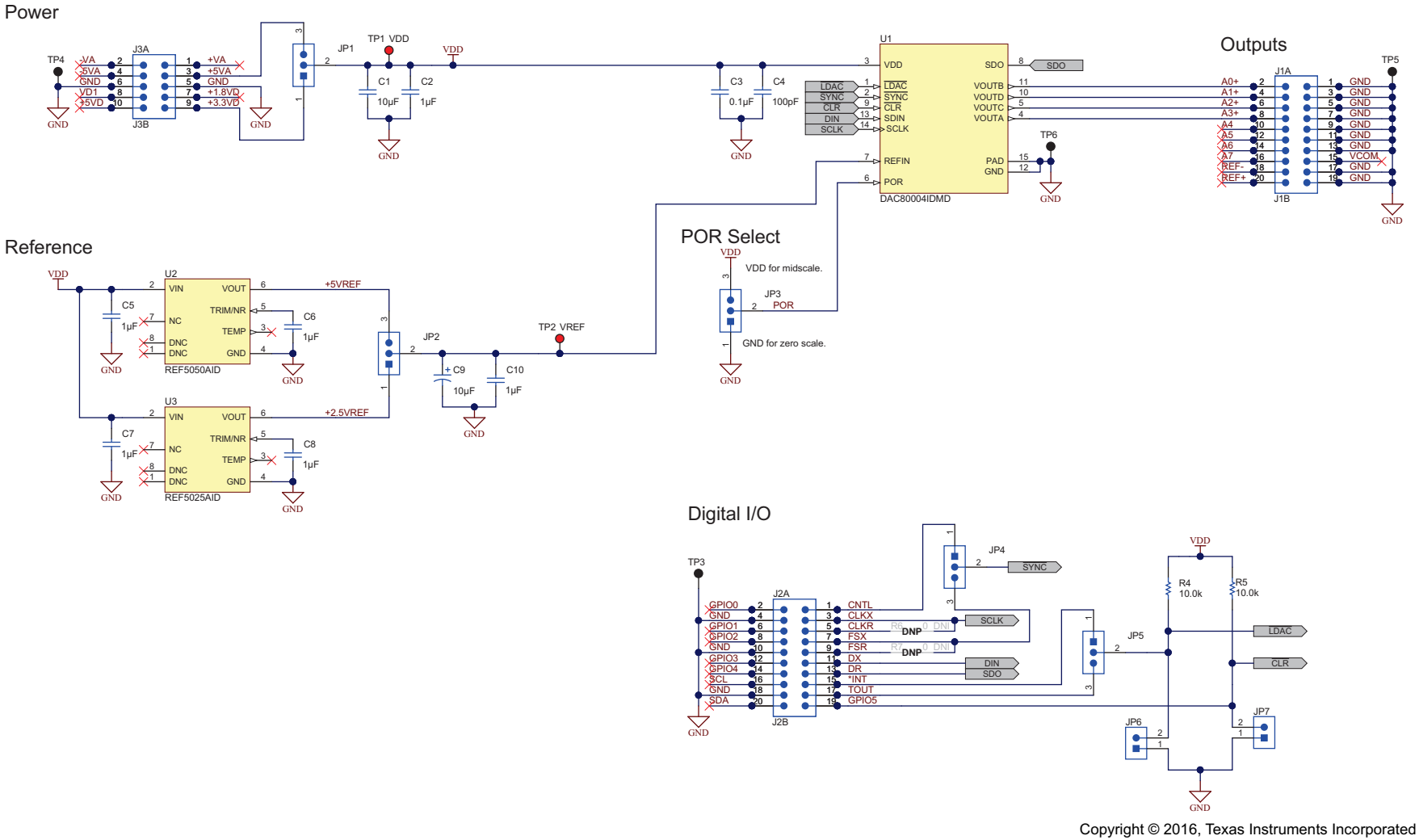


Figure 3. DAC80004EVM Schematic

4.2 PCB Layout

Figure 4 shows the DAC80004EVM PCB layout.

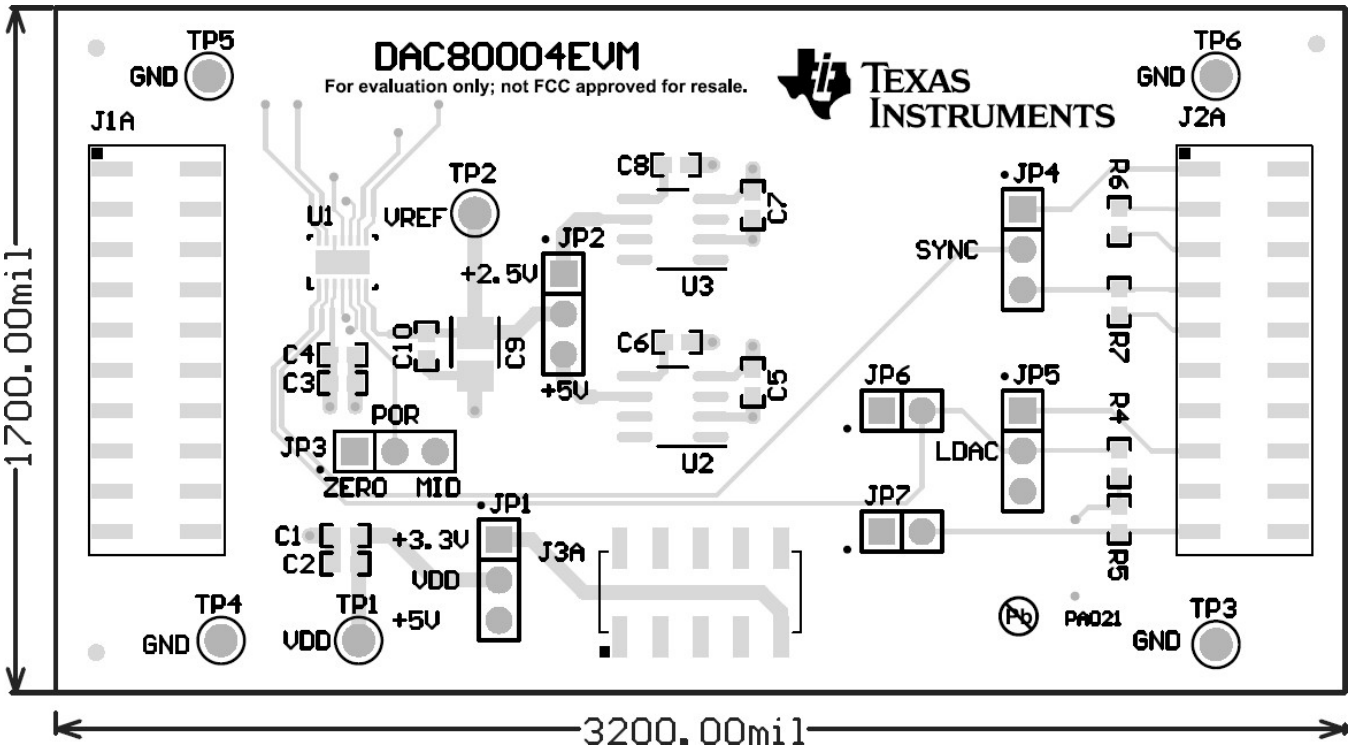


Figure 4. PCB Layout

4.3 Bill of Materials

Table 5 lists the BOM for the DAC80004EVM.

Table 5. DAC80004EVM Bill of Materials

Designator	Qty	Description	Manufacturer	Part Number
!PCB	1	Printed Circuit Board	Any	xxxxxxx
C1	1	CAP, CERM, 10uF, 25V, +/-20%, X5R, 0603	Murata	GRM188R61E106MA73
C2, C5, C6, C7, C8, C10	6	CAP, CERM, 1uF, 25V, +/-10%, X5R, 0603	TDK	C1608X5R1E105K080AC
C3	1	CAP, CERM, 0.1uF, 50V, +/-10%, X7R, 0603	Kemet	C0603C104K5RACTU
C4	1	CAP, CERM, 100pF, 50V, +/-5%, C0G/NP0, 0603	Murata	GRM1885C1H101JA01D
C9	1	CAP, TA, 10 µF, 16 V, +/- 10%, 0.8 ohm, SMD	AVX	TPSB106K016R0800
J1A, J2A	2	Header, 100mil, 10x2, SMD	Samtec, Inc.	TSM-110-01-T-DV-P
J1B, J2B	2	Connector, Receptacle, 100mil, 10x2, Gold plated, SMD	Samtec, Inc.	SSW-110-22-F-D-VS-K
J3A	1	Header, 100mil, 5x2, SMD	Samtec, Inc.	TSM-105-01-T-DV-P
J3B	1	Connector, Header, 10-Pos (10x2), Receptacle, 100x100-mil Pitch	Samtec, Inc.	SSW-105-22-F-D-VS-K
JP1, JP2, JP3, JP4, JP5	5	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-103-07-G-S
JP6, JP7	2	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec	TSW-102-07-G-S
R4, R5	2	RES, 10.0k ohm, 1%, 0.1W, 0603	Yageo America	RC0603FR-0710KL
R6, R7	2	RES, 0 ohm, 5%, 0.1W, 0603	Yageo America	RC0603JR-070RL
TP1, TP2	2	Test Point, Miniature, Red, TH	Keystone	5000
TP3, TP4, TP5, TP6	4	Test Point, Miniature, Black, TH	Keystone	5001
U1	1	QUAD 16-BIT, 1LSB INL, BUFFERED, VOLTAGE-OUTPUT DIGITAL-to-ANALOG CONVERTERS, DMD0014A	Texas Instruments	DAC80004IDMD
U2	1	Low-Noise, Very Low Drift, Precision VOLTAGE REFERENCE, D0008A	Texas Instruments	REF5050AID
U3	1	Low-Noise, Very Low Drift, Precision VOLTAGE REFERENCE, 2.5V, D008A	Texas Instruments	REF5025AID

IMPORTANT NOTICE FOR TI DESIGN INFORMATION AND RESOURCES

Texas Instruments Incorporated ('TI") technical, application or other design advice, services or information, including, but not limited to, reference designs and materials relating to evaluation modules, (collectively, "TI Resources") are intended to assist designers who are developing applications that incorporate TI products; by downloading, accessing or using any particular TI Resource in any way, you (individually or, if you are acting on behalf of a company, your company) agree to use it solely for this purpose and subject to the terms of this Notice.

TI's provision of TI Resources does not expand or otherwise alter TI's applicable published warranties or warranty disclaimers for TI products, and no additional obligations or liabilities arise from TI providing such TI Resources. TI reserves the right to make corrections, enhancements, improvements and other changes to its TI Resources.

You understand and agree that you remain responsible for using your independent analysis, evaluation and judgment in designing your applications and that you have full and exclusive responsibility to assure the safety of your applications and compliance of your applications (and of all TI products used in or for your applications) with all applicable regulations, laws and other applicable requirements. You represent that, with respect to your applications, you have all the necessary expertise to create and implement safeguards that (1) anticipate dangerous consequences of failures, (2) monitor failures and their consequences, and (3) lessen the likelihood of failures that might cause harm and take appropriate actions. You agree that prior to using or distributing any applications that include TI products, you will thoroughly test such applications and the functionality of such TI products as used in such applications. TI has not conducted any testing other than that specifically described in the published documentation for a particular TI Resource.

You are authorized to use, copy and modify any individual TI Resource only in connection with the development of applications that include the TI product(s) identified in such TI Resource. NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER TI INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT OF TI OR ANY THIRD PARTY IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information regarding or referencing third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of TI Resources 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.

TI RESOURCES ARE PROVIDED "AS IS" AND WITH ALL FAULTS. TI DISCLAIMS ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING TI RESOURCES OR USE THEREOF, INCLUDING BUT NOT LIMITED TO ACCURACY OR COMPLETENESS, TITLE, ANY EPIDEMIC FAILURE WARRANTY AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

TI SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY YOU AGAINST ANY CLAIM, INCLUDING BUT NOT LIMITED TO ANY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON ANY COMBINATION OF PRODUCTS EVEN IF DESCRIBED IN TI RESOURCES OR OTHERWISE. IN NO EVENT SHALL TI BE LIABLE FOR ANY ACTUAL, DIRECT, SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF TI RESOURCES OR USE THEREOF, AND REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

You agree to fully indemnify TI and its representatives against any damages, costs, losses, and/or liabilities arising out of your non-compliance with the terms and provisions of this Notice.

This Notice applies to TI Resources. Additional terms apply to the use and purchase of certain types of materials, TI products and services. These include; without limitation, TI's standard terms for semiconductor products http://www.ti.com/sc/docs/stdterms.htm), evaluation modules, and samples (http://www.ti.com/sc/docs/sampterms.htm).

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