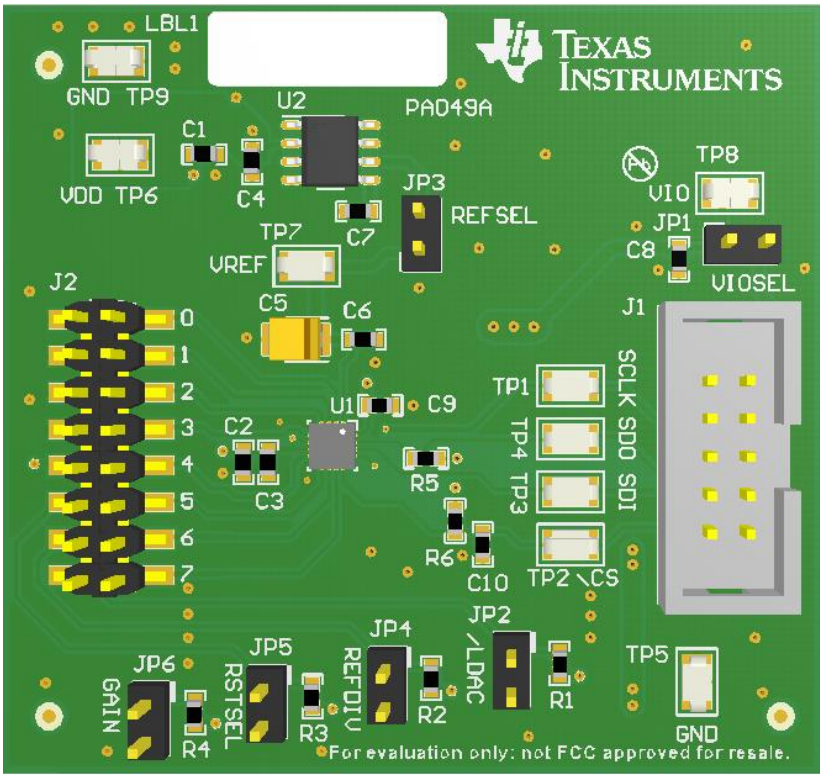
DACx0504 Evaluation Module



This user's guide describes the characteristics, operation, and use of the DACx0504 evaluation boards (EVMs). This user's guide also discusses the proper setup and configuration of both software and hardware, and reviews various aspects of program operation. A complete circuit description, schematic diagram, and bill of materials (BOM) are also included in this document.

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1 Overview

This EVM features the DACx0504 device, a 16-bit/14-bit/12-bit, four-channel, buffered voltage-output digital-to-analog converter (DAC). This device includes a 2.5-V, 5 ppm/°C internal reference giving full scale output voltage ranges of 1.25 V, 2.5 V, or 5 V. These devices are guaranteed monotonic and provide exceptional linearity of ±1 LSB INL in very small package options: WCSP (16), QFN (16), or TSSOP (16). The EVM features the 3-mm × 3-mm QFN package.

1.1 DACx0504EVM Kit Contents

Table 1 details the contents of the EVM kit. Contact the TI Product Information Center nearest you if any component is missing. TI highly recommends that the user verify latest versions of the related software at the TI website, TI.com. The DAC80504EVM works with the USB2ANY interface adapter that must be purchased through ti.com separately.

Table 1. DACx0504EVM Kit Contents

Item	Quantity
DACx0504EVM PCB evaluation board	1

1.2 Related Documentation From Texas Instruments

The following document provides information regarding Texas Instruments integrated circuits used in the assembly of the DACx0504EVM. This user's guide is available from the TI web site under literature number SLAU735. Any letter appended to the literature number corresponds to the document revision that is current at the time of the writing of this document. Newer revisions may be available from the TI web site at TI.com, or call the Texas Instruments Literature Response Center at (800) 477-8924 or the Product Information Center at (972) 644-5580. When ordering, identify the document by both title and literature number.

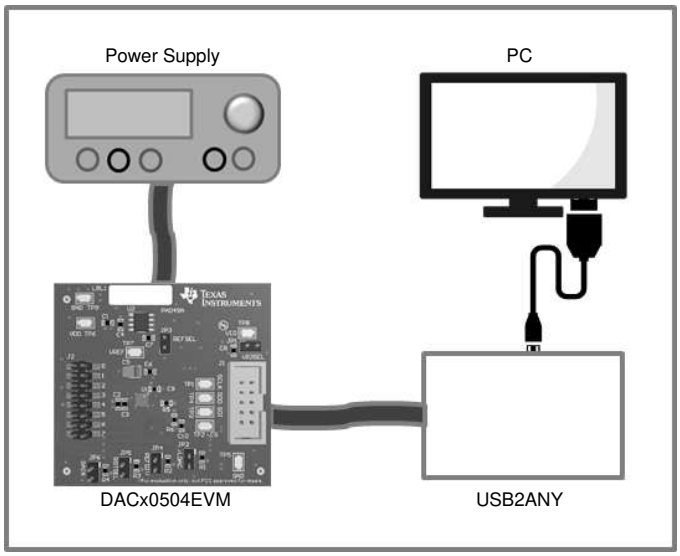
Table 2. Related Documentation

Document	Literature Number
DACx0504 product data sheet	SLASE73

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2 DACx0504EVM Hardware Setup

This section provides the overall system setup for the EVM. A PC runs software that communicates with the USB2ANY platform, which generates the optional VIO power and digital signals used to communicate with the EVM board. Test point connections are included on the EVM board for external power supplies. Figure 1 displays the system setup for the DACx0504EVM.

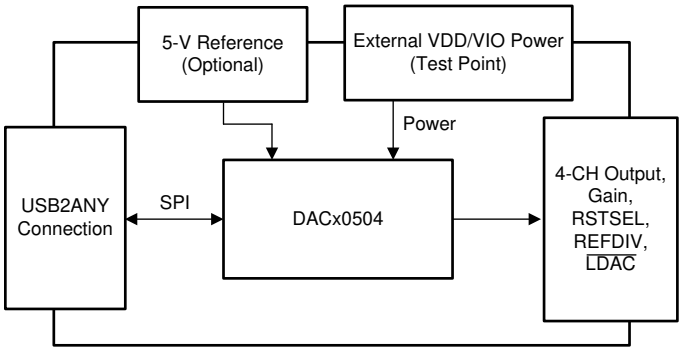


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Figure 1. DACx0504EVM Hardware Setup

2.1 Theory of Operation for DACx0504 Hardware

A block diagram of the DACx0504EVM is displayed in Figure 2. The EVM board connects to the external power supplies VDD and VIO through test points. The 16-pin header provides the four DAC outputs and pullup or pulldown option for GAIN, RSTSEL, REFDIV, and $\overline{\text{LDAC}}$ inputs. The other two headers provide options for external reference connection and VIO input from USB2ANY. The SPI signals can be provided either via the USB2ANY header or test points. The USB2ANY controls the GAIN, RSTSEL, REFDIV and $\overline{\text{LDAC}}$ pins by default.



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Figure 2. DACx0504EVM Block Diagram

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2.2 Signal Definition of USB2ANY

The DACx0504EVM provides a hardware connector (J1) that connects to the USB2ANY interface board, which can supply VIO power and is responsible for providing the SPI commands sent from the PC GUI software. Optionally, the VIO supply can be provided through an external supply, and all digital communication lines can be accessed through their respective digital test points. This information is provided in Table 3.

Table 3. J1 USB2ANY Signal Definition

Pin on J1	Signal	Description
1	GPIO7	General purpose I/O
2	CS, GPIO6	$\overline{CS}$ | General purpose I/O
3	RXD, MISO	SPI MISO
4	TXD, MOSI	SPI MOSI
5	3.3V	3.3-V supply
6	GND	Ground
7	GPIO3	General purpose I/O
8	SCLK, GPIO2	SPI SCLK
9	GPIO1	General purpose I/O
10	GPIO0	General purpose I/O

Table 4. J1 Digital Signal Test Points

Testpoints	SPI Signal
TP1	SCLK
TP2	$\overline{CS}$
TP3	SDI
TP4	SDO

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3 DACx0504EVM Software Setup

This section provides the procedure for EVM software installation.

3.1 Operating Systems for DACx0504EVM Software

The EVM software has been tested on the Microsoft® Windows® XP and Windows 7 operating systems with the United States and European regional settings. The software should also be compatible with other Windows operating systems.

3.2 DACx0504EVM Software Installation

The software is available through the EVM product folder on the TI website. Once the software is downloaded onto the PC, navigate to the DACx0504EVM folder, and run the *Setup_DAC80504_EVM.exe* file, as shown in Figure 3. When the software is launched, an installation dialog will open, and prompt the user to select an installation directory. If left unchanged, the software location defaults to C:\Program Files (x86)\Texas Instruments\DAC80504 EVM as shown in Figure 4.



Figure 3. Launching Software Setup

The software installation will automatically copy the required LabVIEW files and drivers to the local machine. (Note: Please verify that the USB2ANY is not connected before the software installation, as this may affect file or driver installation.)

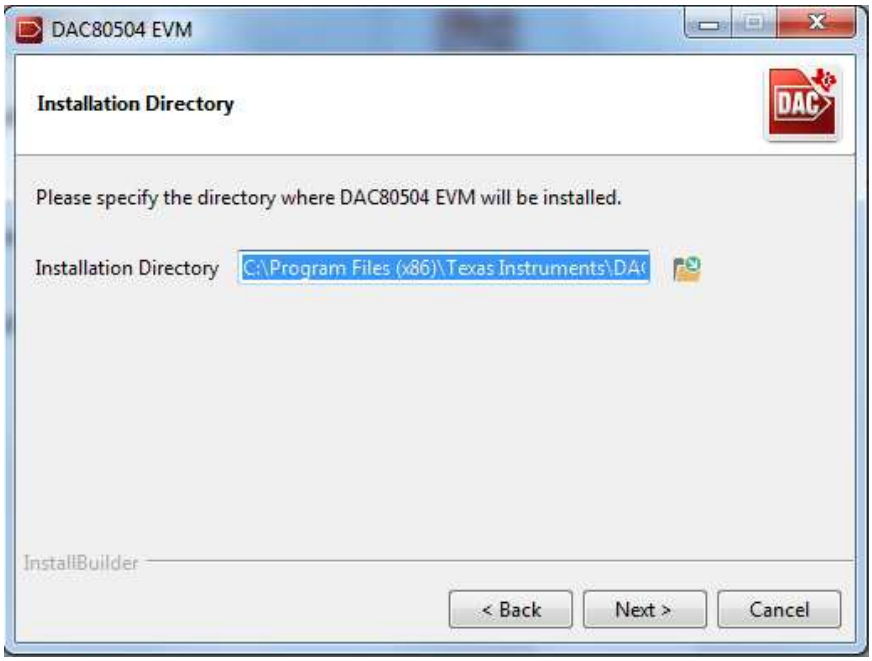


Figure 4. DACx0504EVM Install Path

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4 DACx0504EVM Hardware Overview

The subsequent sections provide detailed information on the EVM hardware, and jumper configuration settings. Table 5 displays the default configurations of all jumper connections on the DACx0504EVM. Connect the USB extender cable from the USB2ANY to the PC.

Table 5. Default Jumper Settings

Jumper	Default Position	Function
JP1	Shunt populated	VIO supply from USB2ANY controller

4.1 Electrostatic Discharge Warning

Many of the components on the DACx0504EVM are susceptible to damage by electrostatic discharge (ESD). Customers are advised to observe proper ESD handling precautions when unpacking and handling the EVM, including the use of a grounded wrist strap at an approved ESD workstation.

4.2 Connecting the Hardware

To connect the USB2ANY to the EVM board, align and firmly connect the keyed ribbon connector to the J1 connector. Verify the connection is snug, as loose connections may cause intermittent operation.

4.3 DACx0504EVM Power Configurations

The DACx0504EVM provides electrical connections to the device supply pins. The connectors and optional configurations are shown in the Table 6.

Table 6. DACx0504EVM Power Supply Configuration

Connector	Connection Type	Description
TP6	Test Point	External VDD connection (2.7 V to 5.5 V)
TP8	Test Point	External VIO connection • JP1 populated (USB2ANY to power VIO) • JP1 unpopulated (VIO powered through TP8)

VIO can be supplied by the USB2ANY by default. If a different source is required, it is possible to separate the USB2ANY supply and VIO by removing the jumper from J1. An external supply can then connect to J5 to power VIO.

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4.4 DAC Signal Pins

The DACx0504EVM provides access to all DAC outputs through connection J2 as shown in Figure 5, and listed in Table 7.

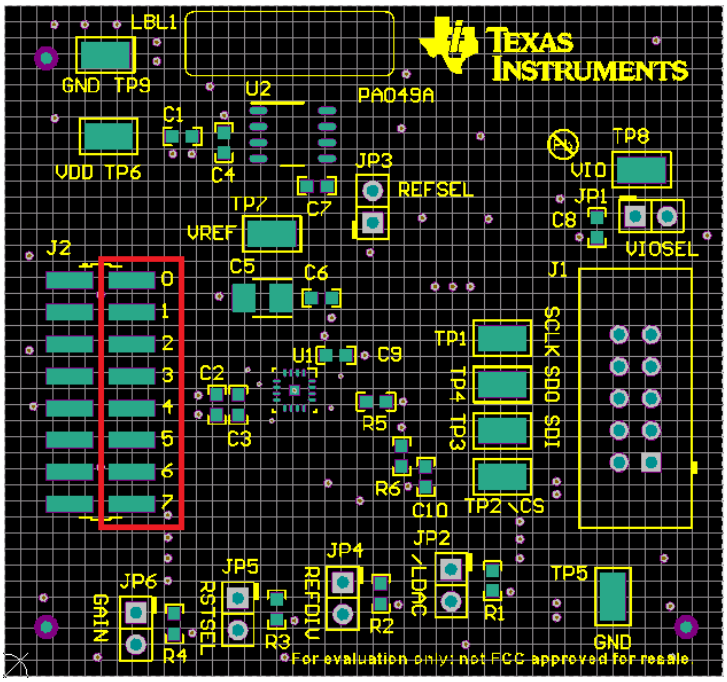


Figure 5. DAC Output Connection Headers

Table 7. DACx0504EVM DAC Signal Connections

Name	Connector	Description
DACOUT0	J2-2	DAC output voltage
DACOUT1	J2-4	DAC output voltage
DACOUT2	J2-6	DAC output voltage
DACOUT3	J2-8	DAC output voltage
GAIN	J2-10	DAC gain
RSTSEL	J2-12	DAC reset select
REFDIV	J2-14	DAC reference divider
$\overline{\text{LDAC}}$	J2-16	DAC Load DAC

4.5 SPI Communication Signals and Digital Inputs

The SPI signals are located on various test points and are described in Table 8, along with the digital input signals of the DACx0504 device.

Table 8. SPI Signal Definition

Name	Connector	Description
SCLK	TP1	Serial interface clock
MOSI	TP3	Serial interface data input
MISO	TP4	Serial interface data output
$\overline{\text{CS}}$	TP2	Active-low serial data enable

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5 DACx0504EVM Software Overview

This section discusses how to use the DACx0504EVM software.

5.1 Starting the DACx0504EVM Software

Once the DACx0504EVM software is installed, a restart may be required by Windows. To launch the software, locate the Texas Instruments folder in the *All Programs* menu and select the 'DAC80504 EVM' icon.

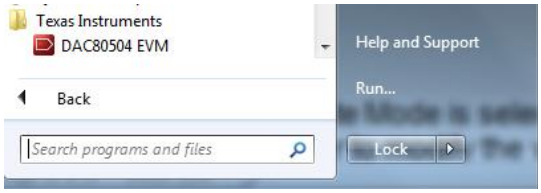


Figure 6. DACx0504EVM GUI Location

This section describes the features of the DACx0504EVM software. The software, as shown in Figure 7, provides basic control of all the registers and functions to the DACx0504 device. If the USB2ANY is correctly connected, the STATUS should display "HARDWARE CONNECTED". If the USB2ANY is not properly connected or not connected at all, the STATUS will display "DEMO". If the GUI is not displaying the "CONNECTED" status while the USB2ANY is connected, unplug and reconnect the USB2ANY and re-launch the GUI software.



Figure 7. DACx0504EVM GUI—Power On

5.2 DACx0504EVM Software Features

The DACx0504EVM incorporates interactive functions that help configure the DACx0504 device. These functions are built into several GUI pages, as shown in Figure 8. The *Page Selection* menu allows the user to switch between the pages; each page representing a feature of the software.

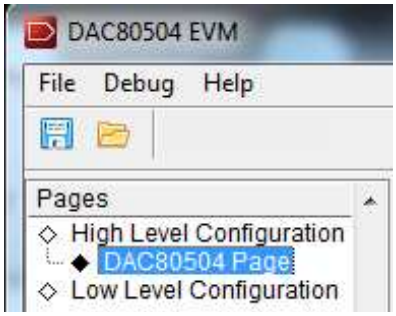


Figure 8. DACx0504EVM Software Page Selection

5.2.1 DACx0504EVM Low Level Configuration Page

The *Register Map* page of the DACx0504EVM allows the user to access low-level communication directly with the registers of the DACx0504. Selecting a register on the *Register Map* list presents a description of the values in that register as well as shows information on the address of the register's, default value, size, and current value. Values can be read and written to the registers by writing to the *Value* or bit field of the GUI.

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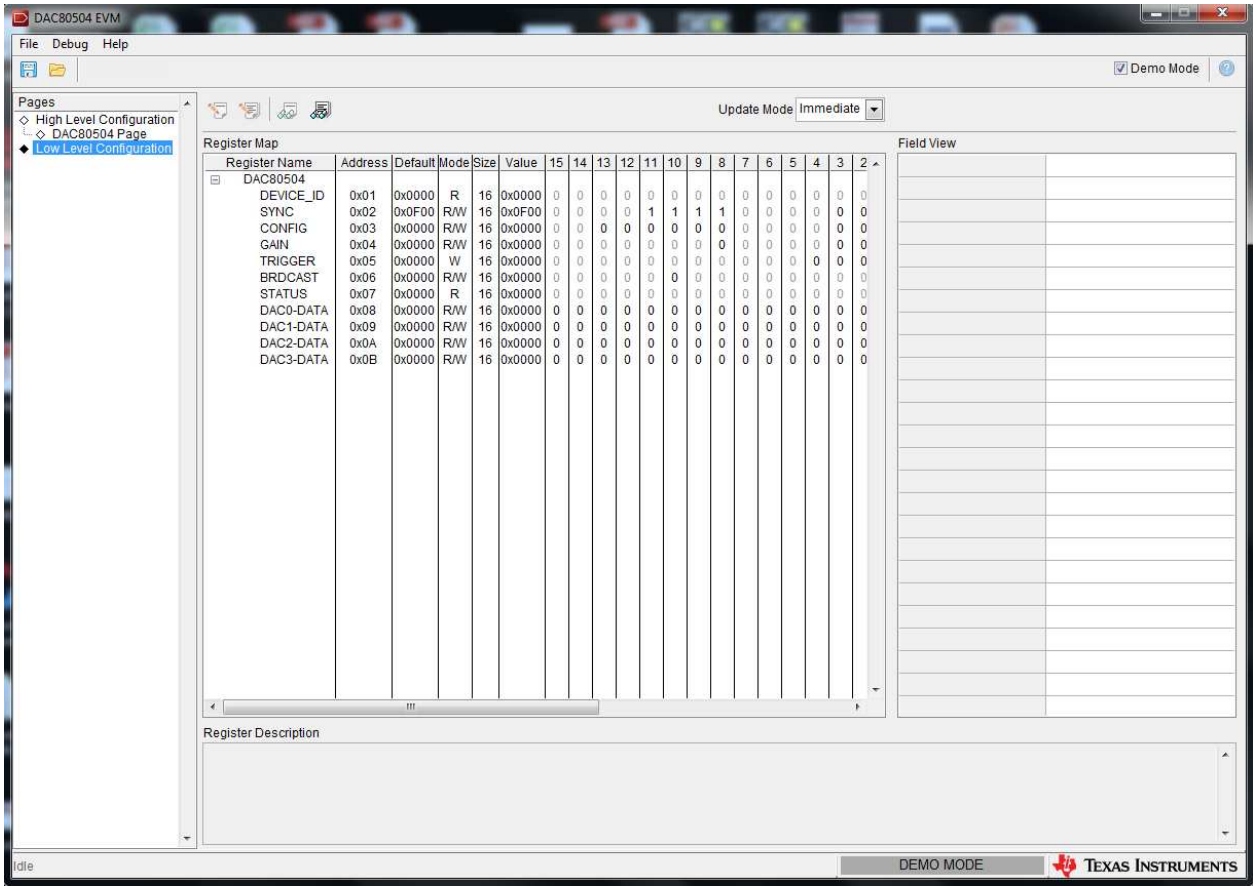


Figure 9. Low Level Configuration Page

The values of the register map can also be saved by pressing the **Save Configuration** button under the *File* menu option. Additionally, the configuration files can be accessed through the **Load Configuration** button.

Other options selectable by the user are the *Update Mode*, *Write Selected (red box)*, *Read Selected (orange box)*, *Write Modified (gray box)*, and *Read All (yellow box)* buttons. All buttons are displayed in Figure 10.

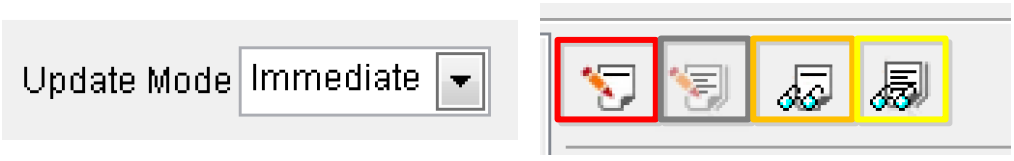


Figure 10. Low Level Configuration Page Available Options

If *Update Mode* is selected to “Immediate”, all changes to register values will update immediately, while “Deferred” allows the user to modify the value of a register without taking effect until the *Write Selected*, or *Write Modified* button is pressed.

The *Read Selected* button allows individual register reads, while the *Read All* button reads the status of all registers located in the register map.

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5.2.2 DACx0504EVM High Level Configuration Page

The *High Level Configuration* page provides an interface to observe and control the different data registers, modes, and configurations available for the DACx0504 device. This page is displayed in Figure 11.

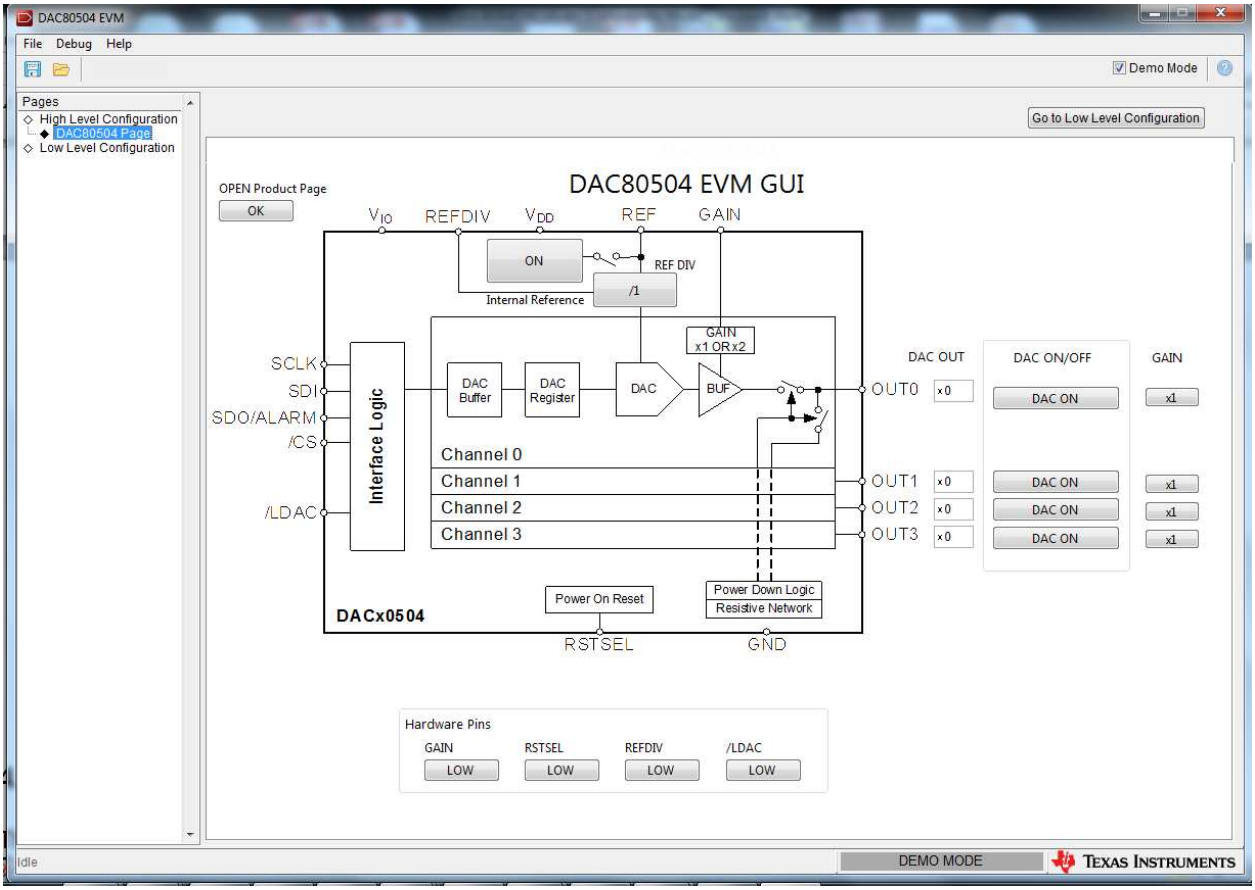


Figure 11. High Level Configuration Page

Internal Reference: By default, the internal reference is “ON”, which is displayed on the *Internal Reference* button. The reference divider bit is also disabled at startup with a division denominator of “1”. When pressed, the reference divider bit is set to “1”, which changes the denominator value to “2” – this essentially halves the reference supply. This reference division provides flexibility when achieving specific DAC output ranges; however, the reference and DAC output should be configured to ensure there is sufficient headroom for VDD during normal operation. More information related to the reference divider is shown in the DACx0504 data sheet.

Gain: The *Gain* buttons set the gain for the corresponding DAC outputs. At startup, the gain bit is cleared to “0”, which sets the gain to 1. When this bit is set, the corresponding DAC has a gain of 2.

DAC Outputs: The DAC outputs can be enabled or disabled via the *DAC ON* button. The DAC outputs are enabled by default. To write to the DACx Register, type the 16-bit hexadecimal value into the corresponding DAC OUT Hex input field.

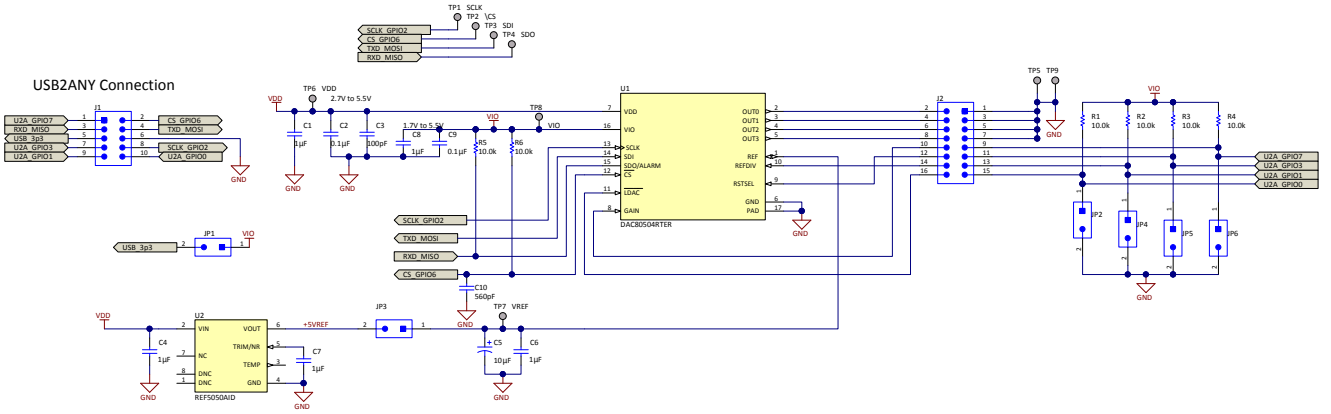
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6 DACx0504EVM Documentation

This section contains the complete bill of materials and schematic diagram for the DACx0504EVM.

6.1 DACx0504EVM Board Schematic

Figure 12 illustrates the DACx0504EVM board schematic.



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Figure 12. DACx0504EVM Board Schematic

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6.2 DACx0504EVM PCB Components Layout

Figure 13 shows the layout of the components for the DACx0504EVM board.

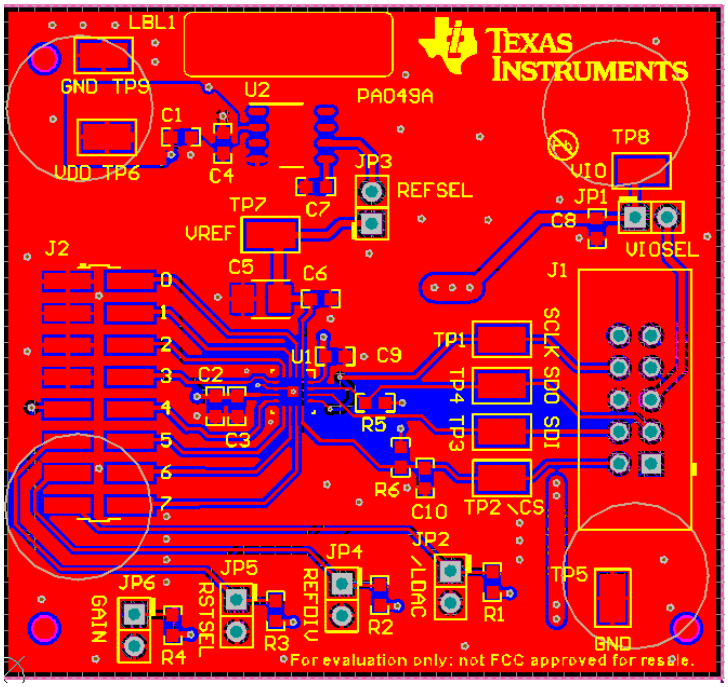


Figure 13. DACx0504EVM PCB Components Layout

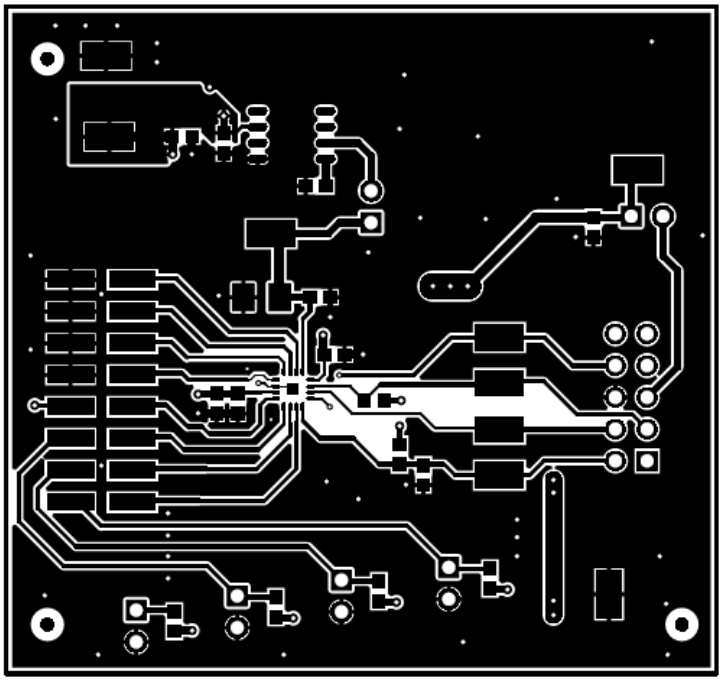


Figure 14. Top Layer

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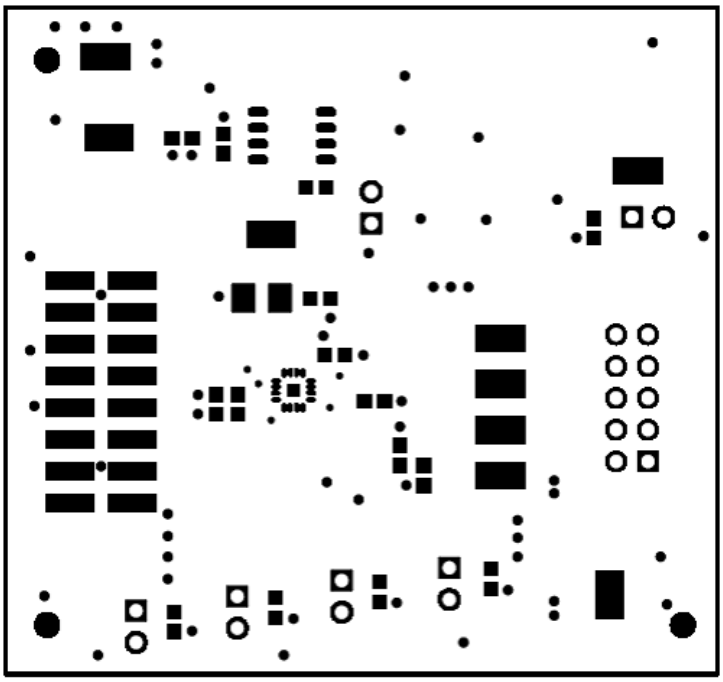


Figure 15. Top Solder

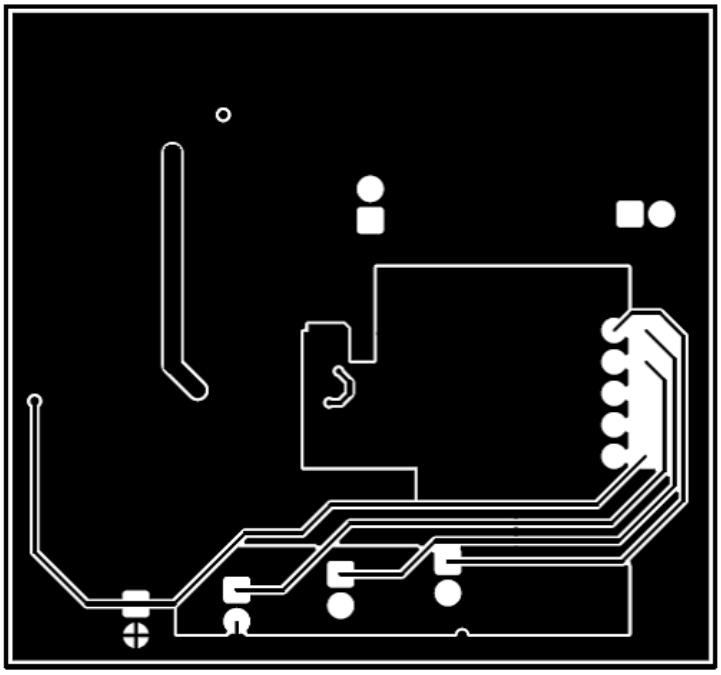


Figure 16. Bottom Layer

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6.3 DACx0504EVM Bill of Materials

Table 9 lists the DACx0504 BOM.

Table 9. DACx0504EVM Bill of Materials(1)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
!PCB	1		Printed Circuit Board		PA049	Any	-	-
C1, C4, C6, C7, C8	5	1uF	CAP, CERM, 1uF, 25V, +/-10%, X5R, 0603	0603	C1608X5R1E105K080AC	TDK		
C2, C9	2	0.1uF	CAP, CERM, 0.1uF, 50V, +/-10%, X7R, 0603	0603	C0603C104K5RACTU	Kemet		
C3	1	100pF	CAP, CERM, 100pF, 50V, +/-5%, C0G/NP0, 0603	0603	GRM1885C1H101JA01D	Murata		
C5	1	10uF	CAP, TA, 10 µF, 16 V, +/- 10%, 0.8 ohm, SMD	3528-21	TPSB106K016R0800	AVX		
C10	1	560pF	CAP, CERM, 560 pF, 25 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C1E561JA01D	Murata		
H9, H10, H11, H12	4		Bumpon, Hemisphere, 0.44 X 0.20, Clear	Transparent Bumpon	SJ-5303 (CLEAR)	3M		
J1	1		Header(Shrouded), 2.54mm, 5x2, Gold, TH	Header, 2.54mm, 5x2, TH	AWHW-10G-0202-T	Assman WSW		
J2	1		Header, 2.54mm, 8x2, Gold, SMT	Header, 2.54mm, 8x2, SMT	TSM-108-01-L-DV	Samtec		
JP1, JP2, JP3, JP4, JP5, JP6	6		Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	2x1 Header	TSW-102-07-G-S	Samtec		
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650 x 0.200 inch	THT-14-423-10	Brady		
R1, R2, R3, R4, R5, R6	6	10.0k	RES, 10.0k ohm, 1%, 0.1W, 0603	0603	RC0603FR-0710KP	Yageo America		
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8, SH-J9, SH-J10	10		Shunt, 100mil, Gold plated, Black	Shunt 2 pos. 100 mil	881545-2	TE Connectivity		
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9	9		Test Point, Miniature, SMT	Test Point, Miniature, SMT	5019	Keystone		
U1	1		Quad, True 16-/14-/12-Bit, SPI Voltage Output DAC with Precision Internal Reference, RTE0016D (WQFN-16)	RTE0016D	DAC80504RTER, DAC70504RTER, DAC60504RTER	Texas Instruments	DAC80504RTET, DAC70504RTET, DAC60504RTET	Texas Instruments
U2	1		Low-Noise, Very Low Drift, Precision VOLTAGE REFERENCE, D0008A	D0008A	REF5050AID	Texas Instruments		
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A		

(1) Unless otherwise noted in the *Alternate Part Number* or *Alternate Manufacturer* columns, all parts may be substituted with equivalents.

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Revision History

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

Changes from A Revision (October 2017) to B Revision **Page**

- Clarified availability of the USB2ANY adapter in the *DACx0504EVM Kit Contents* section and *Table 1*..... 3

Changes from Original (July 2017) to A Revision **Page**

- Changed all instances of DAC80504 to DACx0504. 1
- Changed the DAC from eight-channel to four-channel. 3
- Changed part number from RC0603FR-0710KL to RC0603FR-0710KP in *Table 9*. 15
- Added part numbers DAC70504RTER and DAC60504RTER to designator U1 in *Table 9*. 15
- Added alternate part numbers DAC70504RTET and DAC60504RTET to designator U1 in *Table 9*. 15

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STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits 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 shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 *Regulatory Notices:*

3.1 *United States*

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

FCC NOTICE: 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 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. 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 to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

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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1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

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東京都新宿区西新宿 6 丁目 2 4 番 1 号
西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page
電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

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.

6. *Disclaimers:*

6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

   8.1 *General Limitations*. IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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