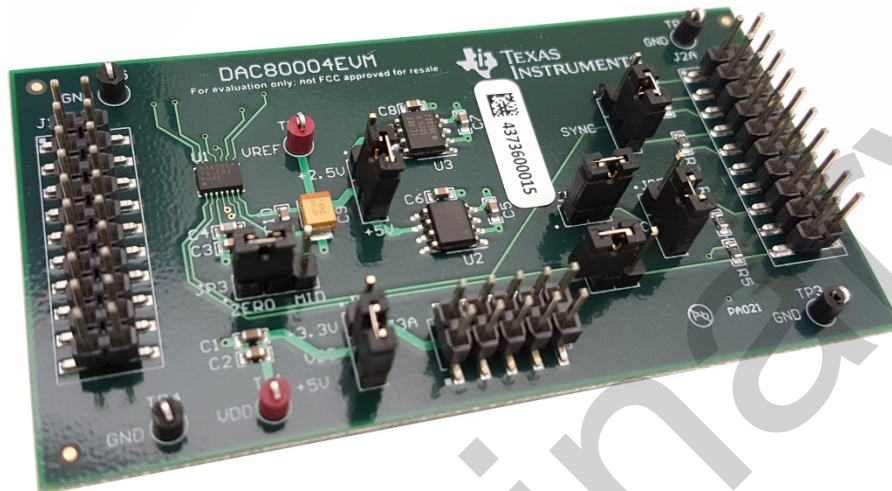


DAC80004EVM User's Guide



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	SLASE44A
REF5025	SBOS410F
REF5050	SBOS410F

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1 EVM Overview

1.1 Features

- Full-featured evaluation board for the DAC80004
- Onboard external reference selection
- Wide selection 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, quad 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 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 & 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: Supply voltage ranges

<i>Signal</i>	<i>Range</i>
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: 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

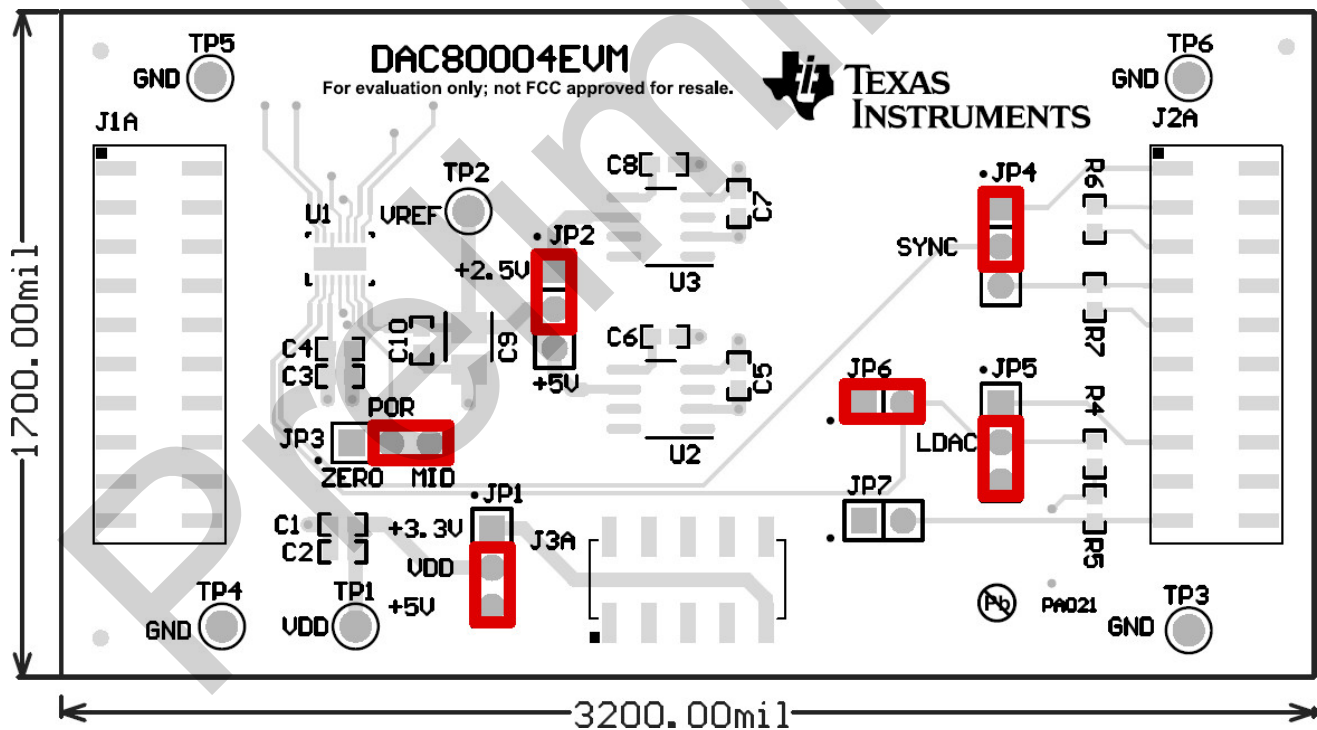


Figure 1: Default Jumper Settings for the DAC80004EVM

1.5 Questions & Support for this or other precision data converter EVMs

Please feel free to join our E2E precision data converter support forum at http://e2e.ti.com/support/data_converters/precision_data_converters

Post your question in the forum and one of our experts will help you answer it.

2 EVM Hardware

2.1 Hardware Interface

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 & 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 please take a look at the **schematic**.

2.2 Quick-start

This section will explain a quick way to test the EVMs functionality without using a motherboard.

The minimum requirements are:

1. An external source to provide the SPI master signals.
2. An external +5 V power supply.
3. A DC digital multimeter.

Follow 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.
 - a. If it does not, something may be wrong. Please check your connections and the jumper settings.
10. Send the SPI code 0x031FFFF0 using the DXP software
11. The DC DMM should display full-scale +5 V. This means that your hardware and software setup are working.
 - a. 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, which is available at www.ti.com/dxp. The software is listed under the “Software” category in this product folder, as shown in Figure 2.

Description

DAC Exerciser Program (DXP) is a software tool from Texas Instruments for evaluating DACs without the requirements of expensive pattern generators or writing complex software. When used with a Texas Instruments DAC EVM and a modular motherboard, it allows for simple and easy digital signal generation for the DAC to produce analog outputs for measurement and evaluation purposes.

Features

- Modular design allows additional EVMs to be supported
- Graphical user interface provides easy setup to send signals to a DAC

Free Evaluation Tool Description

Software:

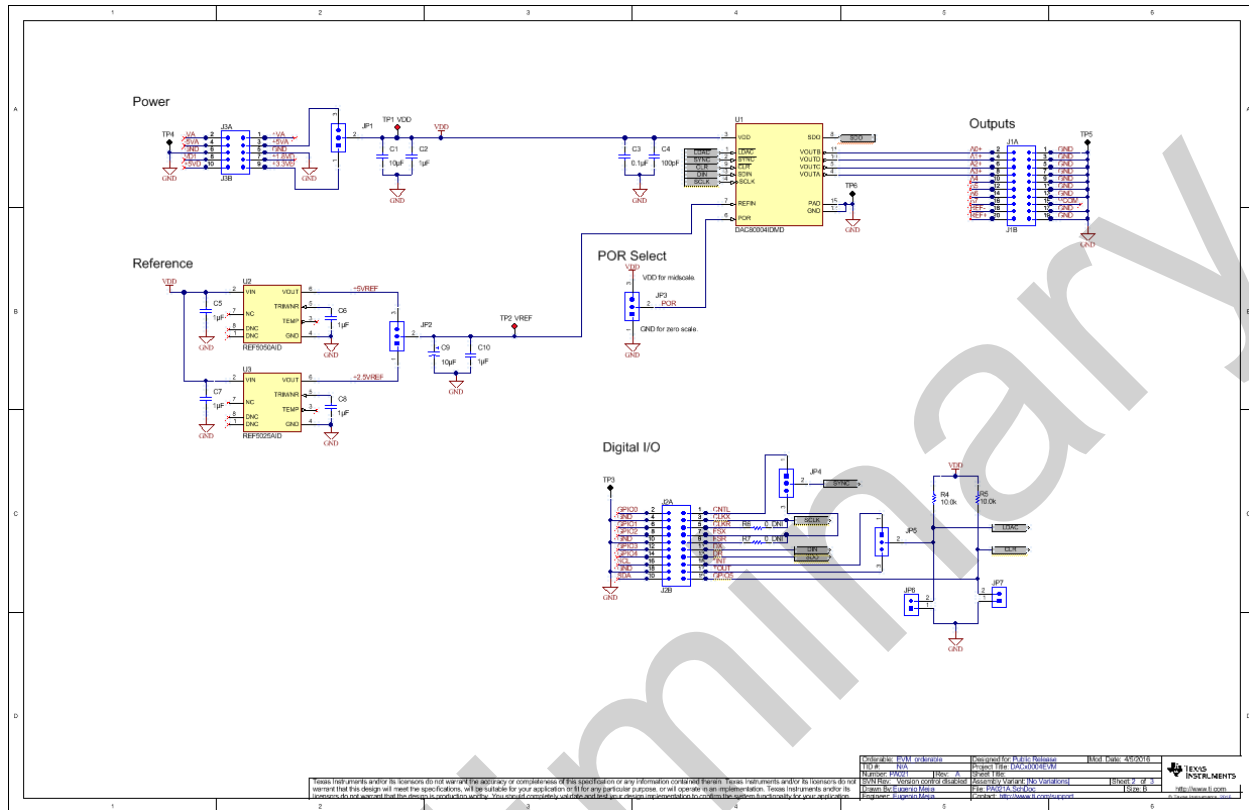
[Download DXP Setup](#)

Figure 2: EVM Software Link

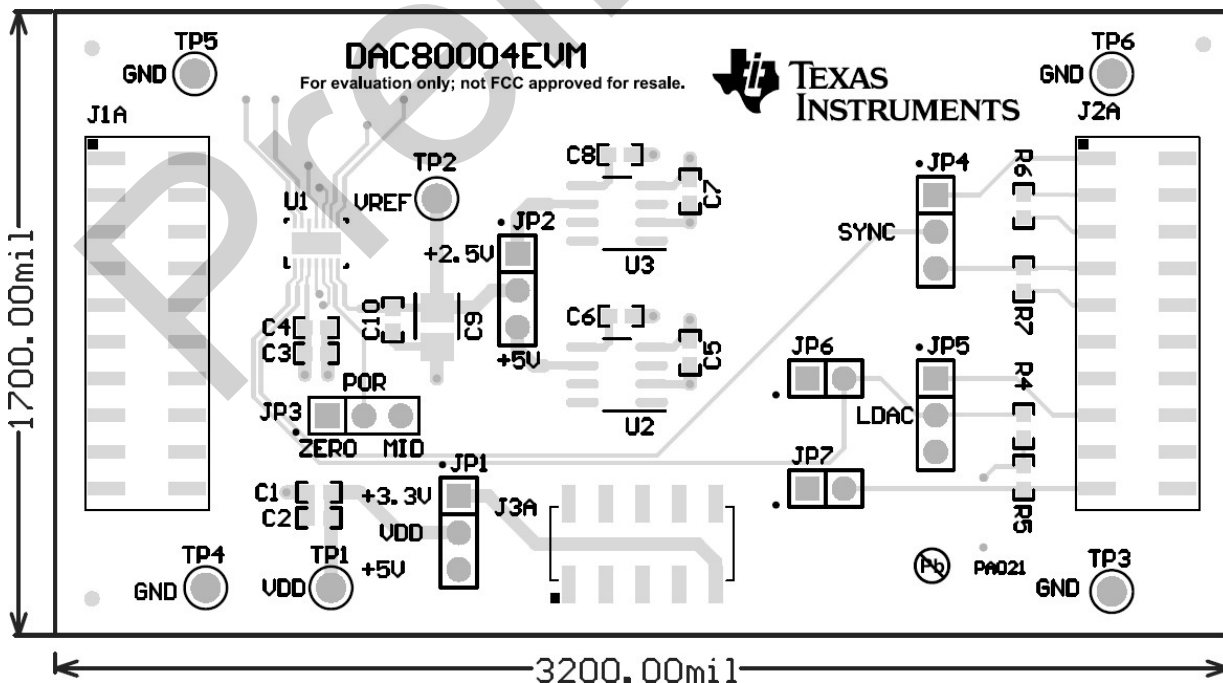
Once the download is complete run the executable file and follow the installer instructions. After the DXP software installs, copy the DAC80004.xml file into the “Devices” directory that the installer created. Typically located in ‘C:\Users\Public\Documents\DXP\Devices’. If you cannot find the “Devices” 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 and Bill of Materials

4.1 Schematic



4.2 PCB



4.3 Bill of Materials

Designator	Quantity	Description	Manufacturer	Part Number
IPCB	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

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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

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). 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:

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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.

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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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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.

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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.

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