

# TMUX7211, TMUX7212, and TMUX7213 Evaluation Modules



## ABSTRACT

This user's guide describes the characteristics, operation, and use of the TMUX7211, TMUX7212, and TMUX7213 evaluation modules (EVM), which is represented by TMUX721xEVM in this user's guide. A complete schematic diagram, printed-circuit board layouts, and bill of materials are included in this document.

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## Trademarks

All trademarks are the property of their respective owners.

## 1 Introduction

The TMUX7211EVM, TMUX7212EVM, and TMUX7213EVM support evaluation of the TMUX7211, TMUX7212, and TMUX7213 devices in the 16-pin TSSOP (PW) package respectively. The TMUX7211, TMUX7212, and TMUX7213 are complementary metal-oxide semiconductor (CMOS) switches with four independently selectable 1:1, single-pole single-throw (SPST) switch channels. These device support dual supplies ( $\pm 4.5$  V to  $\pm 22$  V), a single supply (4.5 V to 44 V), or asymmetric supplies (such as  $V_{DD} = 12$  V,  $V_{SS} = -5$  V). TMUX7211, TMUX7212, and TMUX7213 support bidirectional analog and digital signals on the source (Sx) and drain (Dx) pins ranging from VSS to VDD. All logic control inputs support logic levels from 1.8 V to VDD, ensuring both TTL and CMOS logic compatibility when operating in the valid supply voltage range. The Fail-Safe Logic circuitry allows voltages on the control pins to be applied before the supply pin, protecting the devices from potential damage.

**Table 1-1. Device Comparison Table**

Product	Description
TMUX7211	Low-Leakage-Current, Precision, 4-Channel, 1:1 (SPST) Switches (Normally Closed)
TMUX7212	Low-Leakage-Current, Precision, 4-Channel, 1:1 (SPST) Switches (Normally Open)
TMUX7213	Low-Leakage-Current, Precision, 4-Channel, 1:1 (SPST) Switches (Dual Open and Dual Closed)

## 2 Information About Cautions and Warnings



### CAUTION

This EVM contains components that can potentially be damaged by electrostatic discharge. Always transport and store the EVM in its supplied ESD bag when not in use. Handle using an antistatic wristband. Operate on an antistatic work surface. For more information on proper handling, see [Electrostatic Discharge \(ESD\) application report](#).

## 3 Features of this EVM

The EVM has the following features:

- 35 tests points (including 7 GND test points), which allows easy access for measuring signals
- Quick prototyping and testing setup for the TMUX7211, TMUX7212, and TMUX7213 devices in the 16-pin TSSOP (PW) package
- No specific TMUX721x device is supplied or soldered to the evaluation modules, which allows flexibility to choose the desired IC for evaluation
- Support for both single supply and dual supply operation
- Six power supply decoupling capacitors ( $2 \times 0.1 \mu\text{F}$ ,  $2 \times 1 \mu\text{F}$ , and  $2 \times 10 \mu\text{F}$ )
- Jumpers to eight signal lanes, VDD and VSS power rails, and control signals
- Eight pads are available for placement of SMA connectors
- Pads are available for pull-up or pull-down resistors on control signal pathways
- Pads are available for surge protection diodes
- 0805 capacitor pads are available on all signal pathways referenced to ground

## 4 EVM Images

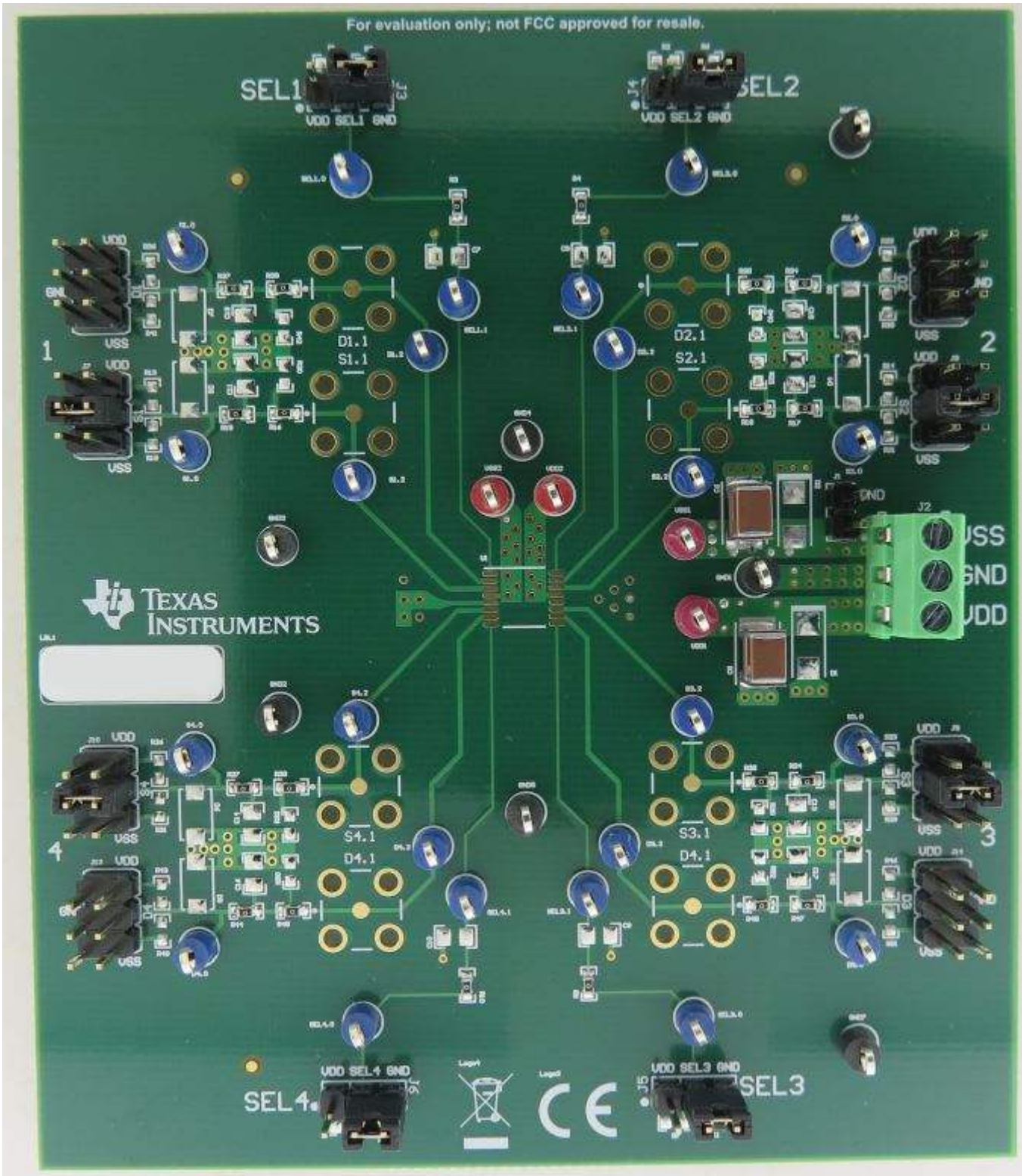


Figure 4-1. TMUX721xEVM Topside View

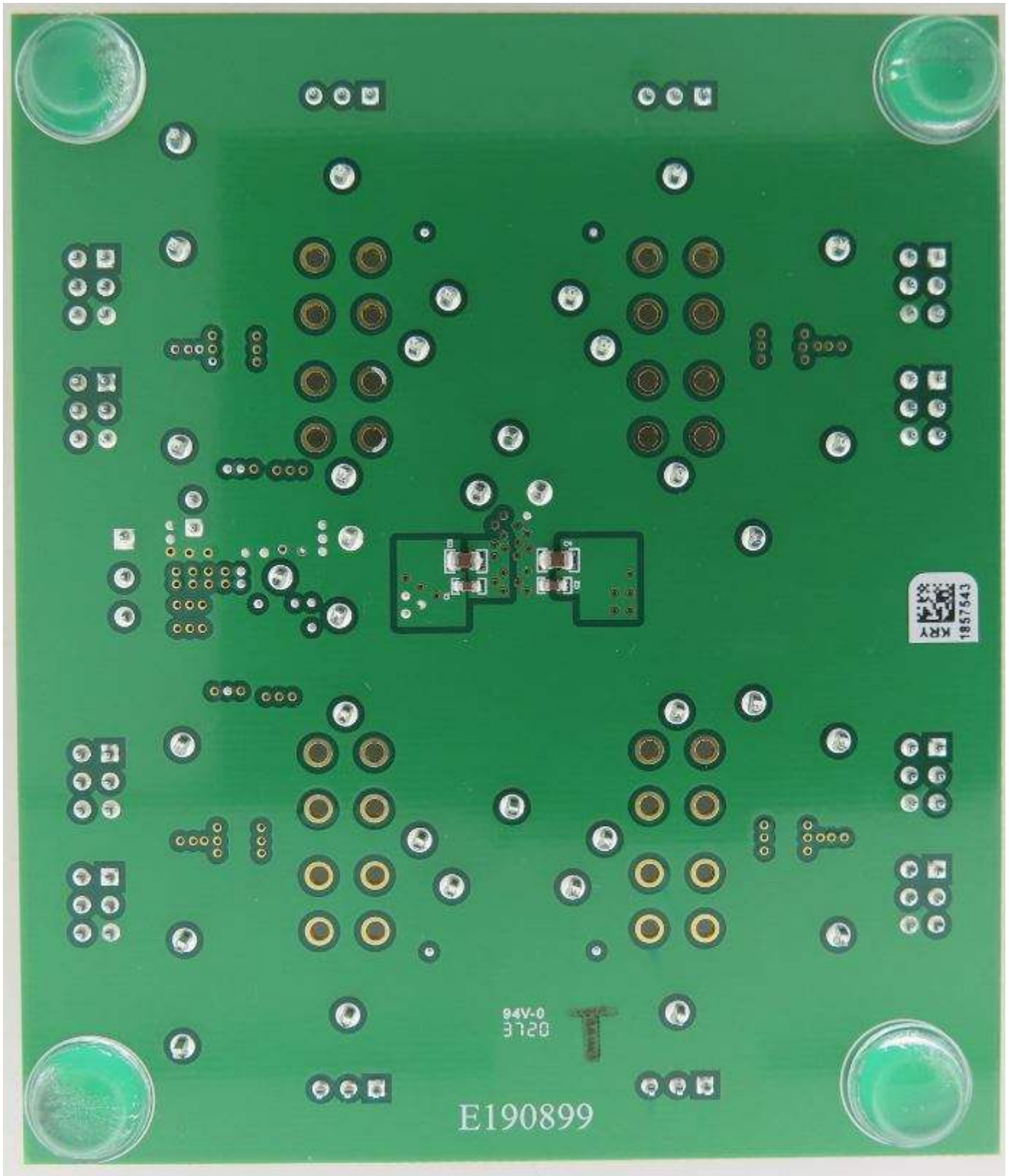


Figure 4-2. TMUX721xEVM Bottom View

## 5 EVM Setup

The following instructions are for setting up the EVM:

- The control inputs and signal lines may be loaded by soldering components to signal path pads as needed. [Table 5-1](#) describes which load pads correspond to what pin on the DUT. SMA connectors can be soldered to corresponding pads accordingly.

**Table 5-1. Component Pad to TMUX721x Pin Matrix**

	IC Pin #	0805 Capacitor Pad ID	Protection Diode Pad	Protection Diode PN#	0603 Pull-up Pad	0603 Pull-Down Pad	Pad Locations
D1	2	C19	D7	SMAJ36CA	R36	R41	Top Layer
S1	3	C11	D3	SMAJ36CA	R13	R19	Top Layer
S4	6	C14	D6	SMAJ36CA	R26	R31	Top Layer
D4	7	C16	D9	SMAJ36CA	R43	R49	Top Layer
D3	10	C17	D10	SMAJ36CA	R46	R51	Top Layer
S3	11	C13	D5	SMAJ36CA	R23	R29	Top Layer
S2	14	C12	D4	SMAJ36CA	R14	R21	Top Layer
D2	15	C15	D8	SMAJ36CA	R33	R39	Top Layer

- The board is powered by attaching  $\pm 5$  V to  $\pm 22$  V dual power supply or 5 V to 44 V single power supply to the screw terminal J2, with VDD, VSS, and GND oriented as specified in [Table 6-1](#). Jumper J1 should be shorted only when using single sided operation.
- Jumpers should be placed according to the desired functionality. Reference TMUX7211, TMUX7212, and TMUX7213 Truth Tables ([Table 5-2](#) through [Table 5-4](#)) to configure the corresponding control jumpers. Additional signal path jumpers may be configured as shown in [Table 6-1](#).

**Table 5-2. TMUX7211 Truth Table**

SEL x <sup>(1)</sup>	Channel x
0	Channel x ON
1	Channel x OFF

**Table 5-3. TMUX7212 Truth Table**

SEL x	Channel x
0	Channel x OFF
1	Channel x ON

**Table 5-4. TMUX7213 Truth Table**

SEL x	Channel 1 and Channel 4	Channel 2 and Channel 3
0	OFF	ON
1	ON	OFF

(1) X denotes 1, 2, 3, or 4 for the corresponding channel.

## 6 EVM Connectors and Test Points

### 6.1 Connectors

**Table 6-1. Jumper and Header Position Functions**

Jumper ID	Header Pos. 1	Header Pos. 2	Header Pos. 3	Header Pos. 4	Header Pos. 5	Header Pos. 6	Board Function	Fitted (Y/N)
J1	VSS	GND	N/A	N/A	N/A	N/A	Single Supply Short VSS to GND	Y
J2	VSS	GND	VDD	N/A	N/A	N/A	Power Supplies	Y
J3	VDD	SEL 1	GND	N/A	N/A	N/A	Can Short SEL line to VDD or GND	Y
J4	VDD	SEL 2	GND	N/A	N/A	N/A	Can Short SEL line to VDD or GND	Y
J5	VDD	SEL 3	GND	N/A	N/A	N/A	Can Short SEL line to VDD or GND	Y
J6	VDD	SEL 4	GND	N/A	N/A	N/A	Can Short SEL line to VDD or GND	Y
J7	N/A	VDD	GND	I/O (S1)	N/A	VSS	Signal Input—can short to either rail	Y
J8	VDD	N/A	I/O (S2)	GND	VSS	N/A	Signal Input—can Short to either rail	Y
J9	VDD	N/A	I/O (S3)	GND	VSS	N/A	Signal Input—can Short to either rail	Y
J10	N/A	VDD	GND	I/O (S4)	N/A	VSS	Signal Input—can short to either rail	Y
J11	VDD	N/A	I/O (D2)	GND	VSS	N/A	Signal Input—can Short to either rail	Y
J12	N/A	VDD	GND	I/O (D1)	N/A	VSS	Signal Input—can short to either rail	Y
J13	N/A	VDD	GND	I/O (D4)	N/A	VSS	Signal Input—can short to either rail	Y
J14	VDD	N/A	I/O (D3)	GND	VSS	N/A	Signal Input—can Short to either rail	Y
S1.1	I/O (S1)	GND	GND	GND	GND	N/A	SMA Pad	N
D1.1	I/O (D1)	GND	GND	GND	GND	N/A	SMA Pad	N
S2.1	I/O (S2)	GND	GND	GND	GND	N/A	SMA Pad	N
D2.1	I/O (D2)	GND	GND	GND	GND	N/A	SMA Pad	N
S3.1	I/O (S3)	GND	GND	GND	GND	N/A	SMA Pad	N
D3.1	I/O (D3)	GND	GND	GND	GND	N/A	SMA Pad	N
S4.1	I/O (S4)	GND	GND	GND	GND	N/A	SMA Pad	N
D4.1	I/O (D4)	GND	GND	GND	GND	N/A	SMA Pad	N

### 6.2 Test Points

**Table 6-2. Test Point Signal Connections**

Signal	Test Point ID
VDD	VDD1 and VDD2
GND	GND1, GND2, GND3, GND4, GND5, GND6, and GND7
VSS	VSS1 and VSS2
S1	S1.0 and S1.2
D1	D1.0 and D1.2
S2	S2.0 and S2.2
D2	D2.0 and D2.2
S3	S3.0 and S3.2
D3	D3.0 and D3.2
S4	S4.0 and S4.2
D4	D4.0 and D4.2
SEL1	SEL1.0 and SEL1.1
SEL2	SEL2.0 and SEL2.1
SEL3	SEL3.0 and SEL3.1
SEL4	SEL4.0 and SEL4.1

## 7 PCB Layouts

Figure 7-1 and Figure 7-2 show the EVM PCB layout images.

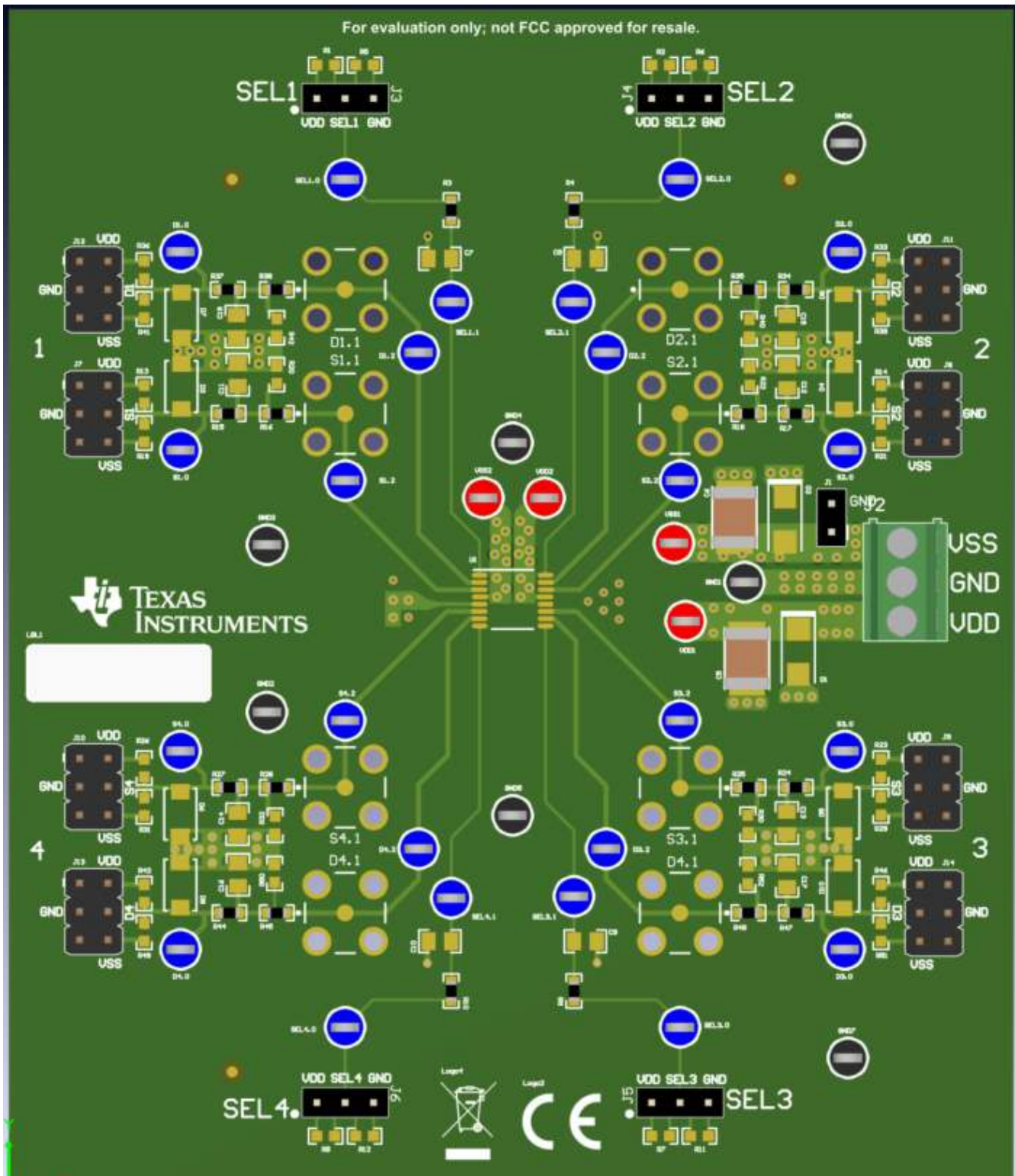
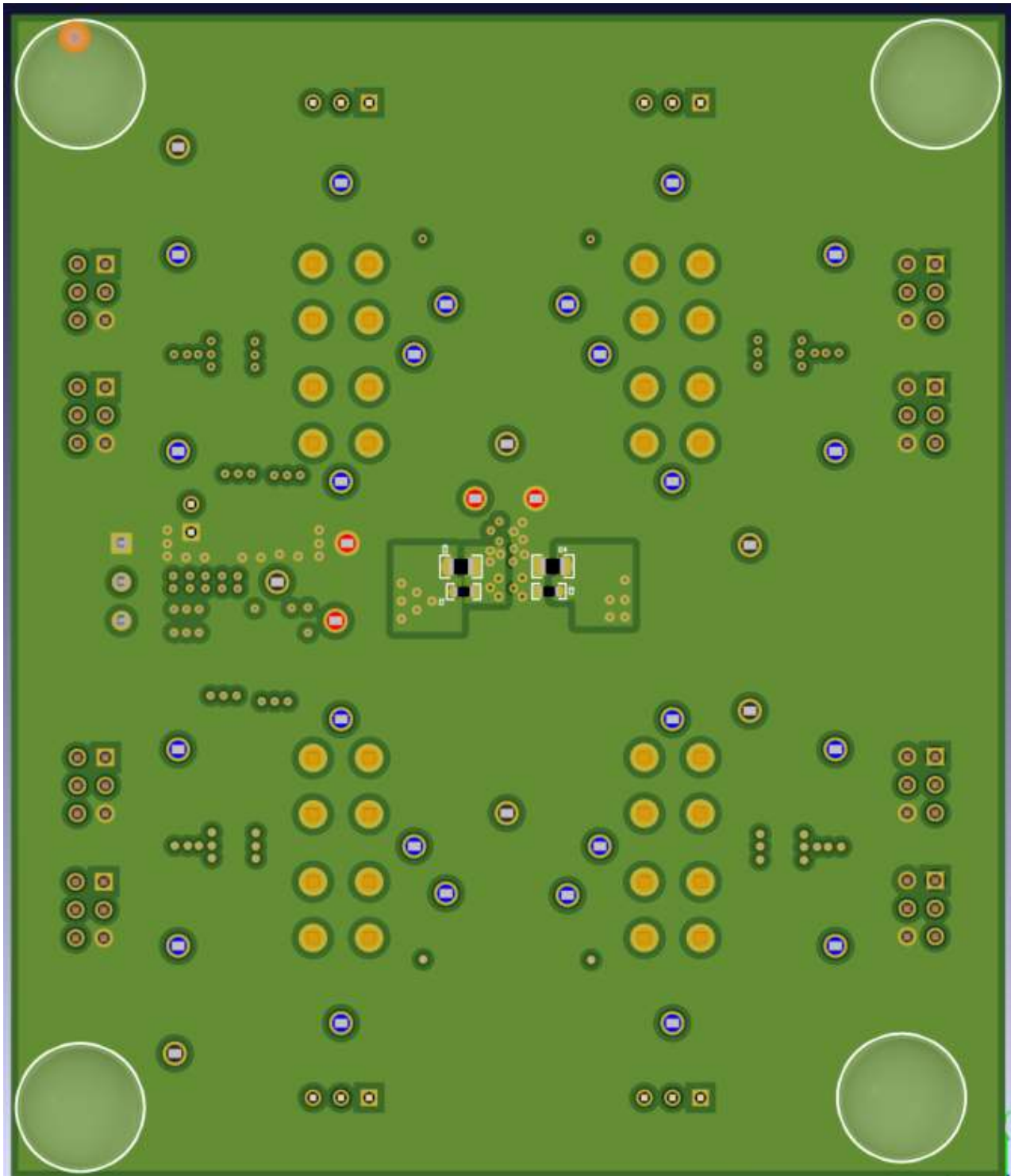


Figure 7-1. Top View Illustration of the TMUX721xEVM Layout

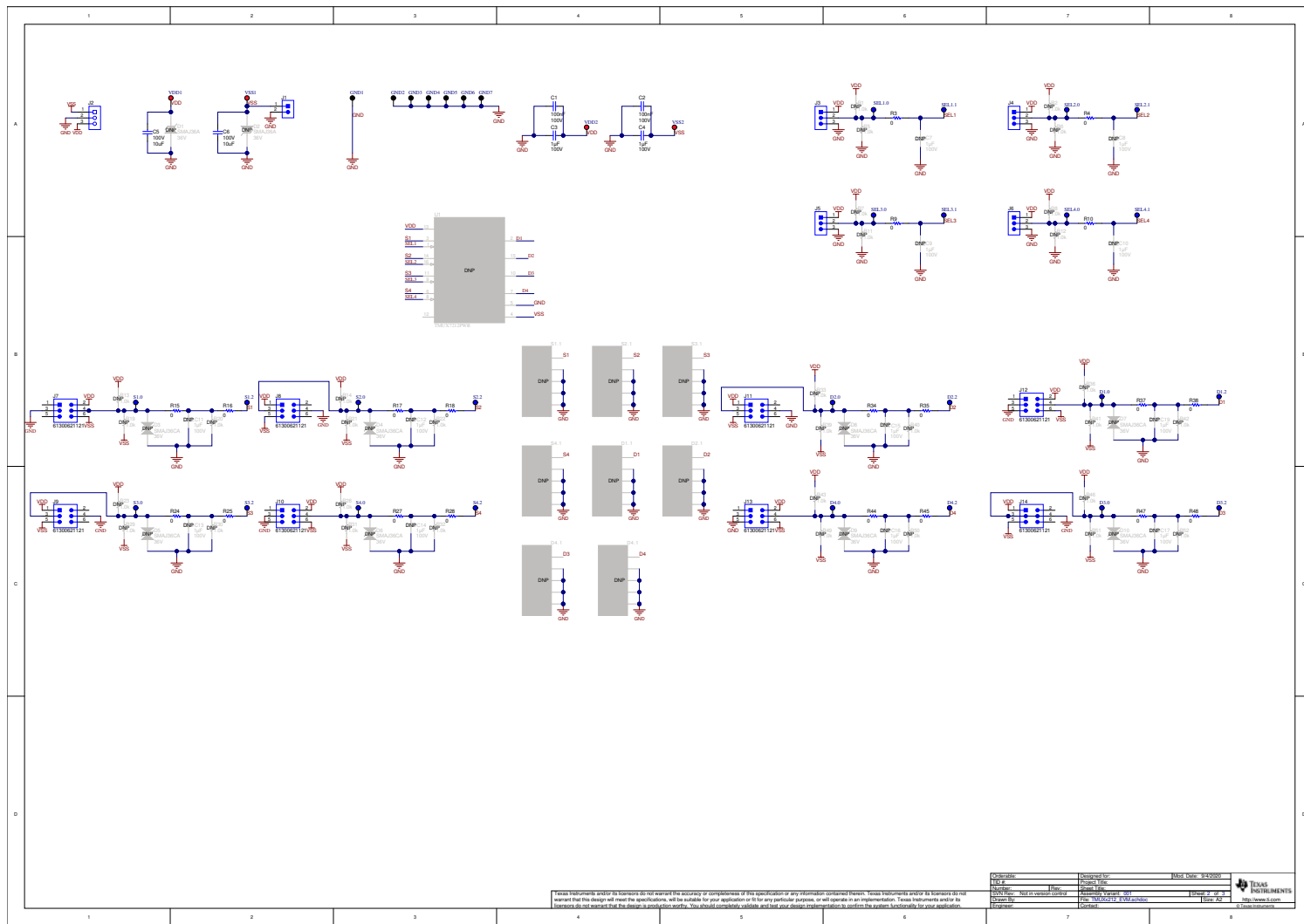


**Figure 7-2. Bottom View Illustration of the TMUX721xEVM Layout**



## 8 Schematics

Schematic views of the TMUX721xEVM. **Figure 8-1** shows DNI view, removing DNI parts which are not included on the evaluation model out-of-the-box.



**Figure 8-1. Schematic of the TMUX721xEVM (DNI View)**

## 9 Bill of Materials

Table 9-1 details the EVM bill of materials.

**Table 9-1. TMUX721xEVM Bill of Materials**

Designator	Component	Manufacturer	Description	Quantity
H9, H10, H11, H12	SJ-5303 (CLEAR)	3M	Bumpon, Hemisphere, 0.44 X 0.20, Clear	4
C1, C2	C1608X7S2A104K080AB	TDK	CAP, CERM, 0.1 $\mu$ F, 100 V, $\pm$ 10%, X7S, 0603	2
C3, C4	C2012X7S2A105K125AB	TDK	CAP, CERM, 1 $\mu$ F, 100 V, $\pm$ 10%, X7S, 0805	2
C5, C6	CKG45NX7S2A106M500JJ	TDK	CAP, CERM, 10 $\mu$ F, 100 V, $\pm$ 20%, X7S, AEC-Q200 Grade 1, 1812	2
J1	PEC02SAAN	Sullins Connector Solutions	Header, 100 mil, 2 $\times$ 1, Tin, TH	1
J3, J4, J5, J6	PEC03SAAN	Sullins Connector Solutions	Header, 100 mil, 3 $\times$ 1, Tin, TH	4
J7, J8, J9, J10, J11, J12, J13, J14	61300621121	Würth Elektronik	Header, 2.54 mm, 3 $\times$ 2, Gold, TH	8
J2	691214110003	Würth Elektronik	Terminal Block, 3.5 mm, 3 $\times$ 1, TH	1
R3, R4, R9, R10, R15, R16, R17, R18, R24, R25, R27, R28, R34, R35, R37, R38, R44, R45, R47, R48	RMCF0603ZT0R00	Stackpole Electronics Inc	RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	20
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8	SNT-100-BK-G	Samtec	Shunt, 100 mil, Gold plated, Black	8
VDD1, VDD2, VSS1, VSS2	5005	Keystone	Test Point, Compact, Red, TH	4
D1.0, D1.2, D2.0, D2.2, D3.0, D3.2, D4.0, D4.2, S1.0, S1.2, S2.0, S2.2, S3.0, S3.2, S4.0, S4.2, SEL1.0, SEL1.1, SEL2.0, SEL2.1, SEL3.0, SEL3.1, SEL4.0, SEL4.1	5122	Keystone	Test Point, Compact, Blue, TH	24
GND1, GND2, GND3, GND4, GND5, GND6, GND7	5006	Keystone	Test Point, Compact, Black, TH	7

## 10 Related Documentation

- Texas Instruments, [Electrostatic Discharge \(ESD\) application report](#)

## 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.
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  - 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 DEGRADATION 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/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/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/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/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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#### 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:*
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- 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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