DS90UB933-Q1 Evaluation Module
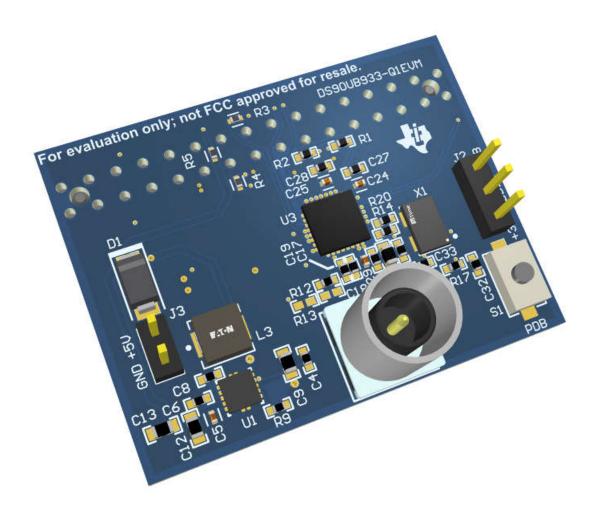
![Texas Instruments logo] TEXAS INSTRUMENTS

Description

The DS90UB933-Q1 evaluation module (EVM) provides an easy way to evaluate the operation and performance of the DS90UB933-Q1 37.5MHz to 100MHz FPD-Link III serializer (SER). The device translates 10 or 12 bits of LVCMOS data into a high-speed serialized FPD-Link III interface transported over a single 50Ω coax cable.

Features

- Supports 10-bit or 12-bit data transmission at up to 100MHz PCLK
- Coax cable support
- Parallel LVCMOS input interface

1 Evaluation Module Overview

1.1 Introduction

The Texas Instruments DS90UB933-Q1EVM is an evaluation module (EVM) for the DS90UB933-Q1 serializer device. Parallel 10/12 bit video data can be inputted into the serializer device through the EVM and then transmitted to a compatible FPD-Link deserializer through a coax cable. The EVM is designed to provide a compact and flexible platform for the evaluation of the DS90UB933-Q1 device with multiple header options for I2C and GPIO access and integrated PoC.

1.2 Kit Contents

Table 1-1 details the content of the EVM kit. Contact the Texas Instruments Product Information Center nearest if any component is missing.

Table 1-1. EVM Kit Contents

ITEM	QUANTITY
DS90UB933-Q1EVM	1

2 Hardware

2.1 Requirements

To use this evaluation module, the following is required:

- Compatible FPD-Link deserializer
- Power supply (12V at 500mA)
- 50Ω coaxial cable[1] [2]
  - **Specification for orderable coax cable:** [3]
    Water Blue, FAKRA Jack to FAKRA Jack Cable, 60-inch length, using RG174 Coax cable.

2.2 Major Components of DS90UB933-Q1EVM

Figure 2-1 shows the DS90UB933-Q1EVM evaluation kit with features and configuration controls as described in this section.
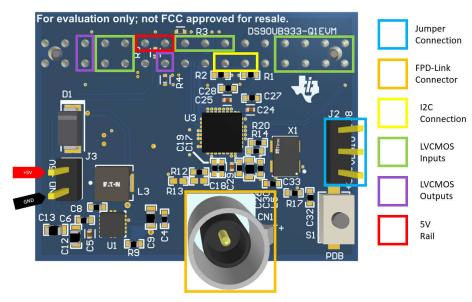

Figure 2-1. DS90UB933-Q1EVM Evaluation Board

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[1] Coax cable is not provided with the EVM.
[2] Boards are configured to transmit power over coax cable, hence connect power to Deserializer board only.
[3] Not a specific recommendation, for evaluation purpose only.

2.3 Board Setup Details

This section describes the connectors and jumpers on the board as well as how to properly connect, set up, and use the DS90UB933-Q1EVM in detail.

2.3.1 Power Connections

1. Connect an external 12V to the deserializer board. (Refer to deserializer user guide for specific pins).
2. Connect ground to deserializer board. (Refer to deserializer user guide for specific pins).
3. Since boards are configured to transmit power over coax cable (PoC), there is no requirement to connect an external power to the serializer, unless PoC is not used.

2.3.2 FPD-Link III Connection

The FPD-Link III serial stream comes out of CN1 on the serializer board as a single-ended signal. Connect to the corresponding connector on the deserializer board. DOUT- on the Serializer and RIN- on the deserializer are terminated to ground through 47nF capacitors in series with 50Ω termination.

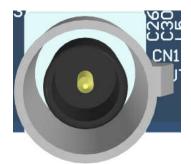**Figure 2-2. Serial Link Connection Using a Single 50Ω Coaxial Cable**

2.3.3 LVCMOS Input Connector Description (on DS90UB933-Q1 Board)

J1 – GPO0, GPO1, CLK OUT, CLK IN, DIN[11:0], HSYNC, VSYNC, PCLK IN are the input pins for the LVCMOS interface on Serializer board. Refer to Figure 2-3 below.
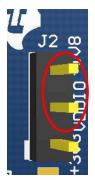

Figure 2-3. Parallel Input Connector on Serializer Board

2.3.4 Factory Set Switch Settings and Jumpers Default Configuration

2.3.4.1 Serializer Board Default Configuration

Figure 2-4. Switch S2: Default Settings on Serializer Board

1. Mode Select Resistor R19 is default set to 4.7kΩ for external oscillator mode. Replace R19 with 100kΩ for PCLK from imager mode.
2. On J2, a 3-pin header is factory placed as shown in Figure 2-4. This selects power from U2 for 1.8V VDDIO and does not have the 3.3V VDDIO option internally.

2.4 Operation with Deserializer

Make sure jumper is placed between positions 2 and 3 (VDDIO and +1V8) on J2.

1. Connect the DS90UB933-Q1 and Deserializer board using a coax cable.
2. Make sure power over coax is configured with $5V <= V_{PoC} <= 9V$.
3. Connect the 12V power supply to deserializer board (recommended current limit is 500mA) and apply power.
4. Look for the LED D2 to light up on the deserializer board (if applicable).
   • If the LED is lit and stable, then the Deserializer is LOCKED to the FPD-Link III serial stream, which means the setup was successful.
   • If not, then continue to the next section.

2.5 Troubleshooting the EVM Setup

1. **Check power supply polarity.**

> **WARNING**
> Reverse supply polarity can damage the board. Verify that the power supply polarity is correct before turning on the power supply.

2. Check power over Coax configuration on deserializer board. Make sure correct voltage is applied ($5V <= V_{PoC} <= 9V$). (Refer to deserializer user's guide for jumper setup).
3. Check to make sure there is sufficient current (500mA) by checking that the voltage (12V) is correctly applied to deserializer using DMM.
4. Check to make sure there is a FPD-Link III signal by probing on both C17 and C19.
5. Monitor the LOCK signal using oscilloscope on DES board. Do not rely on visual inspection of Lock LED present on deserializer board.
6. With no PCLK input applied on SER board, PCLK output frequency on DES board must be 50MHz for the default settings.

Table 2-1. PCLK Output (on DES) without Applying PCLK Input (on SER)

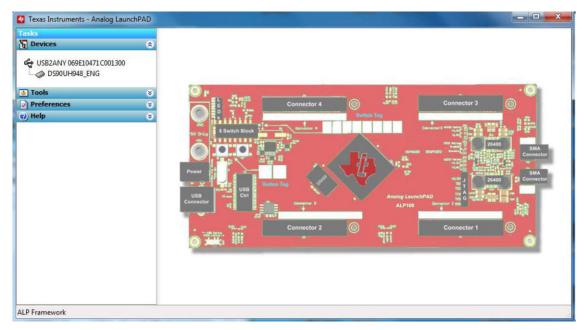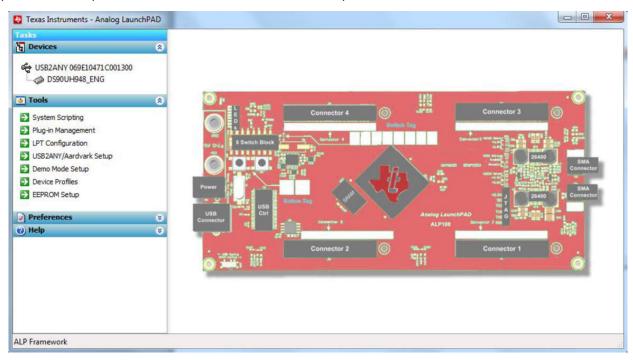| Mode Selected	PCLK Output Expected
10 bit mode (default mode)	50MHz
12 bit high frequency mode	37.5MHz

7. Go back to double check factory settings.

llremore5The

555

Expand the *Tools* panel and select *USB2ANY/Aardvark Setup*.

Figure 3-2. Tools

If there is already a device listed in the menu, then select and click *Remove*.

Figure 3-3. Device Menu

Once the device has been removed (or if there was not one to begin with), select the EVM name from the list on the right and then click *Add*. If users plan on using a deserializer to program the DS90UB933-Q1EVM, then select the deserializer name if the deserializer is connected instead.

Figure 3-4. EVM List

4 Hardware Design Files
4.1 Schematics

Figure 4-1. DS90UB933-Q1 Serializer

Figure 4-2. Power to Serializer Board and Header

4.2 PCB Layout

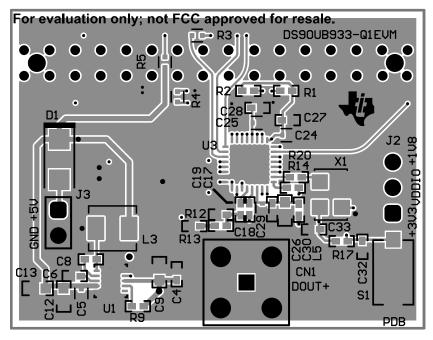### 4.2.1 DS90UB933-Q1EVM Serializer Board Layout

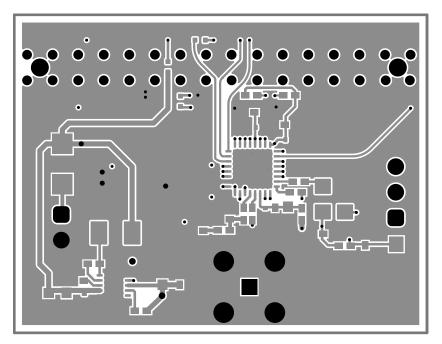**Figure 4-3. Composite (Top View)**

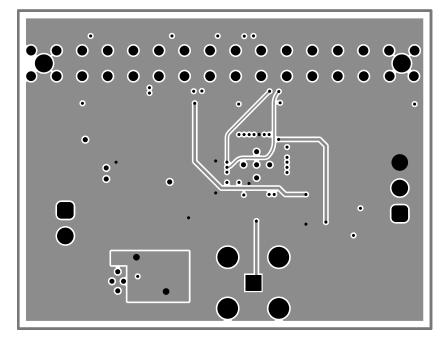**Figure 4-4. Top Layer**

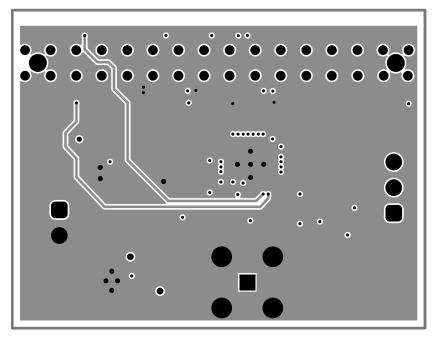**Figure 4-5. Signal 1 Layer**

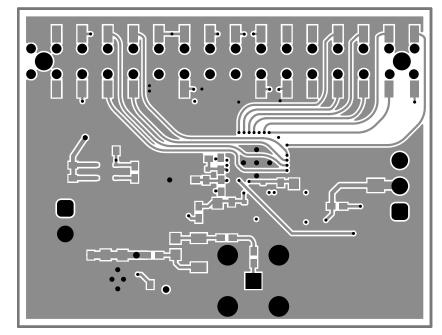**Figure 4-6. Signal 2 Layer**

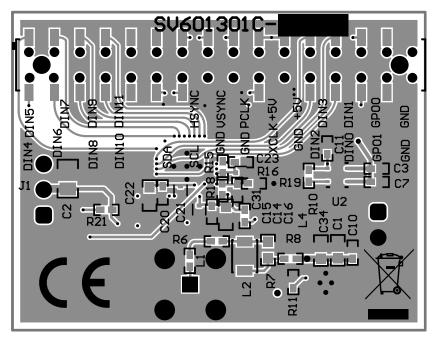**Figure 4-7. Bottom Layer**

Figure 4-8. Composite (Bottom View)

4.3 DS90UB933-Q1EVM Serializer Board Bill of Materials

Table 4-1. DS90UB933-Q1EVM BOM

DESIGNATOR	DESCRIPTION	MANUFACTURER	PART NUMBER	QUANTITY
C1, C9, C12, C13, C22, C30, C34	CAP, CERM, 10uF, 25V, +/- 20%, X5R, 0603	MuRata	GRM188R61E106MA73D	7
C2	CAP, CERM, 1uF, 50V, +/- 10%, X7R, 0805	AVX	08055C105KAT2A	1
C3, C8, C10, C17, C23, C31	CAP, CERM, 0.1uF, 50V, +/- 10%, X7R, 0402	TDK	C1005X7R1H104K050BB	6
C4	CAP, CERM, 2.2uF, 25V, +/- 10%, X5R, AEC-Q200 Grade 3, 0402	MuRata	GRT155R61E225KE13D	1
C5, C15, C21, C24, C25, C29	Ceramic Capacitor for Automotive 10nF ±10% 50VDC X7R 0402 Paper T/R	Murata	GCM155R71H103KA55D	6
C6, C11, C32	CAP, CERM, 1uF, 25V, +/- 10%, X5R, 0402	TDK	C1005X5R1E105K050BC	3
C7	CAP, CERM, 1uF, 10V, +/- 10%, X5R, 0402	MuRata	GRM155R61A105KE15D	1
C14, C20, C26, C27, C28, C33	CAP, CERM, 0.1uF, 16V, +/- 10%, X7R, 0402	MuRata	GRM155R71C104KA88D	6
C16	CAP, CERM, 4.7uF, 25V, +/- 10%, X5R, 0603	MuRata	GRM188R61E475KE11D	1
C18	CAP, CERM, 240pF, 50V, +/- 5%, C0G/NP0, 0402	MuRata	GRM1555C1H241JA01D	1
C19	CAP, CERM, 0.047uF, 50V, +/- 10%, X7R, 0402	TDK	C1005X7R1H473K050BB	1
CN1	Connector, HF, 50 Ohm, TH	Rosenberger	59S10H-40ML5-Z	1
D1	Diode, Schottky, 20V, 1A, SMA	Diodes Inc.	B120-13-F	1
J1	Receptacle, 2.54mm, 16x2, Gold, SMT	Samtec	HLE-116-02-F-DV-BE-A	1
J2	Header, 100mil, 3x1, Gold, TH	Samtec	TSW-103-07-G-S	1
J3	Header, 100mil, 2x1, Gold, TH	Samtec	TSW-102-07-G-S	1
L1, L4, L5	Ferrite Bead, 1000 ohm @ 100MHz, 0.25A, 0402	MuRata	BLM15HD102SN1D	3
L2	Inductor, Wirewound, 47uH, 0.35A, 1.3 ohm, SMD	TDK	ADL3225V-470M-2P	1
L3	4.7µH Shielded Drum Core, Wirewound Inductor 2.7A 118mOhm Max Nonstandard, 2 Lead	Eaton	MPI4020V2-4R7-R	1
R1, R2	RES, 4.7 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	Vishay-Dale	CRCW04024K70JNED	2
R3, R4, R5, R16	0 Ohms Jumper Chip Resistor 0402 (1005 Metric) Automotive AEC-Q200 Thick Film	Panasonic	ERJ-2GE0R00X	4
R6, R8, R20	RES, 0, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	Vishay-Dale	CRCW04020000Z0ED	3
R7	RES, 2.00 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW06032K00FKEA	1
R9, R11	RES, 100 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	Vishay-Dale	CRCW0402100KFKED	2
R10	RES, 51.1 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0402	Panasonic	ERJ-2RKF5112X	1
R12	RES, 49.9, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	Vishay-Dale	CRCW040249R9FKED	1
R13	RES, 200, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	Vishay-Dale	CRCW0402200RJNED	1
R14	RES, 33, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	Vishay-Dale	CRCW040233R0JNED	1
R15, R17, R18, R21	RES, 10.0 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	Vishay-Dale	CRCW040210K0FKED	4

Table 4-1. DS90UB933-Q1EVM BOM (continued)

DESIGNATOR	DESCRIPTION	MANUFACTURER	PART NUMBER	QUANTITY
R19	RES, 4.70 k, 1%, 0.1 W, 0402	Panasonic	ERJ-2RKF4701X	1
S1	Switch, Normally open, 2.3N force, 200k operations, SMD	C&K Components	KSR221GLFS	1
U1	3.5V to 36V, 1A Synchronous 2.1MHz Step-Down Converter for Automotive Applications, DSX0010A (WSON-10)	Texas Instruments	LM53601LQDSXRQ1	1
U2	500mA Low-Noise, Low-IQ LDO, DRV0006A (WSON-6)	Texas Instruments	LP5912-1.8DRVR	1
U3	12-bit 100MHz FPD-Link III Serializer for 1MP/60fps and 2MP/30fps Cameras, RTV0032A (WQFN-32)	Texas Instruments	DS90UB933TRTVRQ1	1
X1	66.666666MHz XO (Standard) LVCMOS, LVTTL Oscillator 1.8V Enable/Disable 4-SMD, No Lead	SiTime	SiT8924BA-33-18E-66.666666	1

5 Additional Information

5.1 Trademarks
All trademarks are the property of their respective owners.

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

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。

https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

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.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けて

いないものがあります。 技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの

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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。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。
　　　　上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・イ
ンスツルメンツ株式会社
東京都新宿区西新宿６丁目２４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。https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

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.

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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.