TPS62233EVM-574 User's Guide

This user's guide describes the characteristics, operation, and use of the TPS62233EVM-574 evaluation module (EVM). This EVM demonstrates three individual configurations of the Texas Instruments TPS6223x 3-MHz, synchronous step-down converter capable of supplying up to 500 mA of output current. This user's guide includes setup instructions, a schematic diagram, a bill of materials, and printed-circuit board layout drawings for the evaluation module.

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1 Introduction

The Texas Instruments TPS62233EVM-574 evaluation module helps designers evaluate the operation and performance of the TPS6223x family of devices. These devices are high-efficiency, ultra-small size, buck converters that switch at up to 3 MHz.

The EVM contains three independent dc/dc converters. Table 1 lists the default output voltages of the converters.

Table 1. Device and Output Voltage Configurations

Converter	Integrated Circuit	Output Voltage
U11	TPS62233DRY	3.0 V
U21	TPS622310DRY	2.3 V
U31	TPS62237DRY	3.3 V

See the data sheet (SLVS941) for the various fixed output voltage options available in the TPS6223X device family.

2 Setup

This section describes the jumpers and connectors on the EVM and how to properly connect, set up, and use the TPS62233EVM-574.

2.1 Input/Output Connector Descriptions

2.1.1 J11 , J21, and J31 – VIN

This is the positive input connection to the corresponding converter. Twist the leads to the input supply, and keep as short as possible to minimize EMI transmission.

2.1.2 J13 , J23, and J33 – GND

This is the return connection for the input power supply for the corresponding converter.

2.1.3 J12, J22, and J32 – Input Sense

This connection provides monitoring for input voltage using independent traces to the input capacitor.

2.1.4 J14, J24, and J34 – VOUT

This is the positive connection from the output of the corresponding buck power supply.

2.1.5 J16 , J26, and J36 – GND

This is the negative connection from the output of the corresponding buck power supply.

2.1.6 J15, J25, and J35 – Output Sense

This connection provides monitoring for output voltage using independent traces to the output capacitor.

2.1.7 JP11, JP21, JP31 – ENABLE

This jumper enables or disables the converter through the IC EN pin. Connect the shorting jumper from the center (EN) pin to either the ON or OFF position. Never leave EN floating.

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2.1.8 JP12, JP22, and JP32 – Mode

This jumper is used to select the operating mode of the converter. The converter operates in a fixed-frequency, low-noise, PWM mode when a jumper is used to short the MODE pin to the ON pin. Shorting the MODE pin and OFF pin together allows the controller to use the power-saving (PFM) mode for high efficiency at low output currents.

2.2 Converter Configurations

All converters are designed to use an input voltage between 2.05 V and 6 V. But the input voltage must be higher than the output voltage in order to maintain voltage regulation, and U31 requires 3.3-V minimum input. Input voltage requirement may be as high as 1 V above output depending on output current; see the data sheet for additional information. Connect the input voltage power supply and output according to Table 2.

Table 2. Input and Output Connections

Converter No.	Output Voltage	Signal	Connection
U11	3 Vdc Fixed	Positive Input Voltage	J11
		Input Voltage Return	J13
		Positive Output Voltage	J14
		Output Voltage Return	J16
U21	2.3 Vdc Fixed	Positive Input Voltage	J21
		Input Voltage Return	J23
		Positive Output Voltage	J24
		Output Voltage Return	J26
U31	3.3 Vdc Fixed	Positive Input Voltage	J31
		Input Voltage Return	J33
		Positive Output Voltage	J34
		Output Voltage Return	J36

2.3 Operation

The ENABLE jumper and the MODE jumper must be configured for proper operation of the converter.

For ENABLE, the converter enable uses a shorting block to set the JPX1 header to the desired configurations. Each converter has its own header: JP11 for U11, JP21 for U21, and JP31 for U31. The converters are shut down when the EN pin is pulled low; this is the ENABLE-to-OFF connection. The converters are in operate mode when the EN pin is pulled high; this is the ENABLE-to-ON connection. Do not leave the EN pin floating.

The MODE header, JPX2, controls the device power-save mode option. This mode changes the operation at light loads; it has no impact at mid-to-high loads . The device can operate in the low-noise, fixed-frequency PWM mode or high-efficiency, power-saving PFM mode at low power. Each converter has its own mode header: JP12 for U11, JP22 for U21, and JP32 for U31. The converters are in PWM mode when the MODE pin is pulled high; this is the MODE-to-ON connection. The converters operate in PFM mode when the MODE pin is pulled low; this is the MODE-to-OFF connection. Do not leave the MODE pin floating.

2.4 Test Results

See the Typical Characteristics section of the TPS6223x data sheet. This EVM uses the same inductors and similar capacitors as those used for characterization in the data sheet. Performance is consistent with that shown in the data sheet.

3 Board Layout

This section provides the TPS62233EVM-574 board layout and illustrations.

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Board layout is critical for all high-frequency, switch-mode power supplies. Figure 1, Figure 2, and Figure 3 show the board layout for the TPS62233EVM-574 printed-circuit board. The nodes with high-switching frequencies and currents are kept as short as possible to minimize trace inductance. High-impedance inputs to the TPS62233, such as the Vout pin, have traces that are shielded by ground traces and planes. Careful attention has been given to the routing of high-frequency current loops, and a single-point grounding scheme is used. See the data sheet for specific layout guidelines. Input and output capacitors must be kept as close as possible to the device. A large bulk input capacitor (C13, C23, and C33) is provided to compensate for impedance in long input leads.

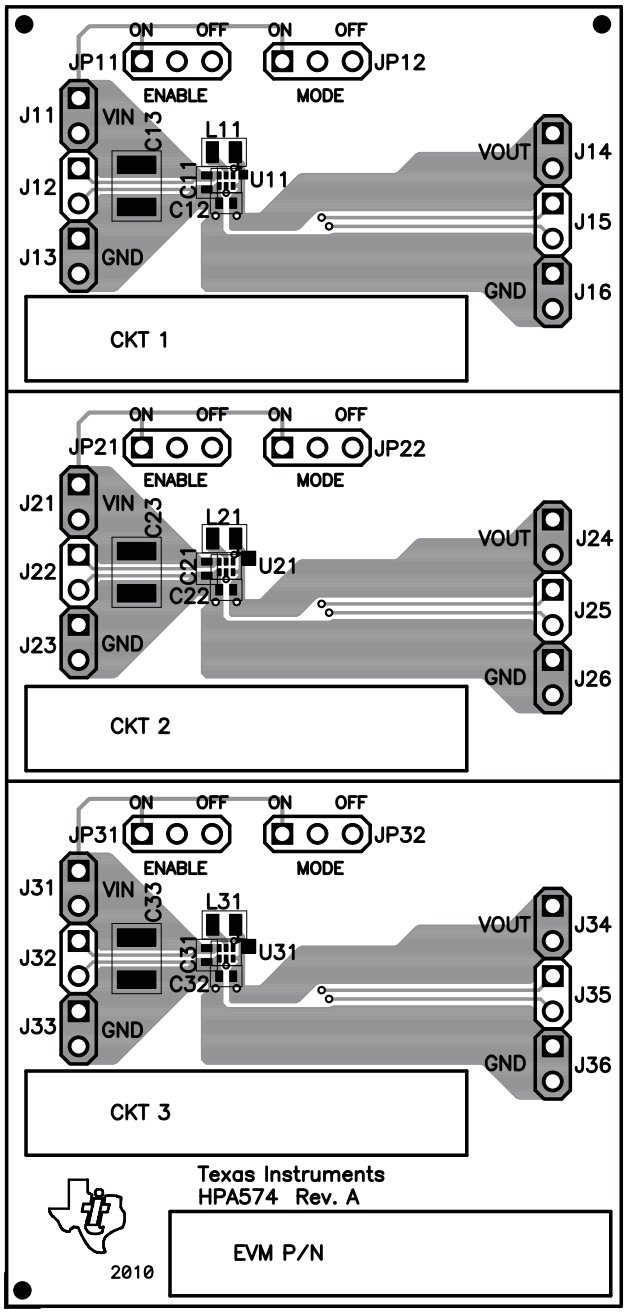


Figure 1. Assembly Layer

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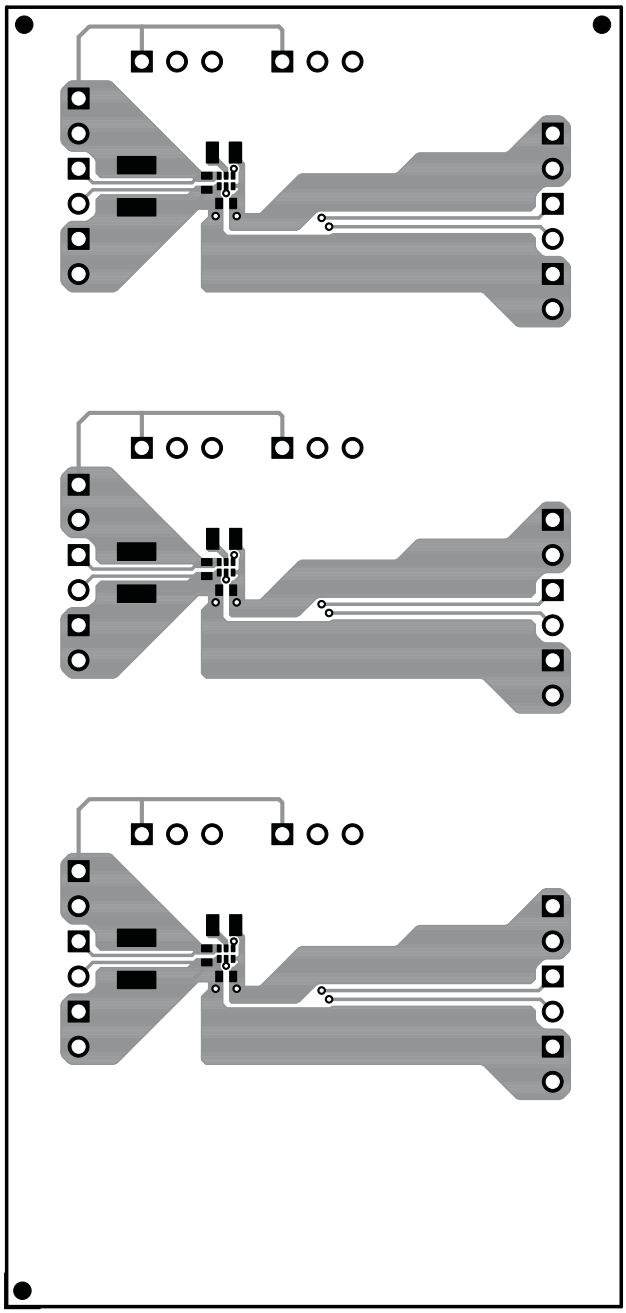


Figure 2. Top Layer Routing

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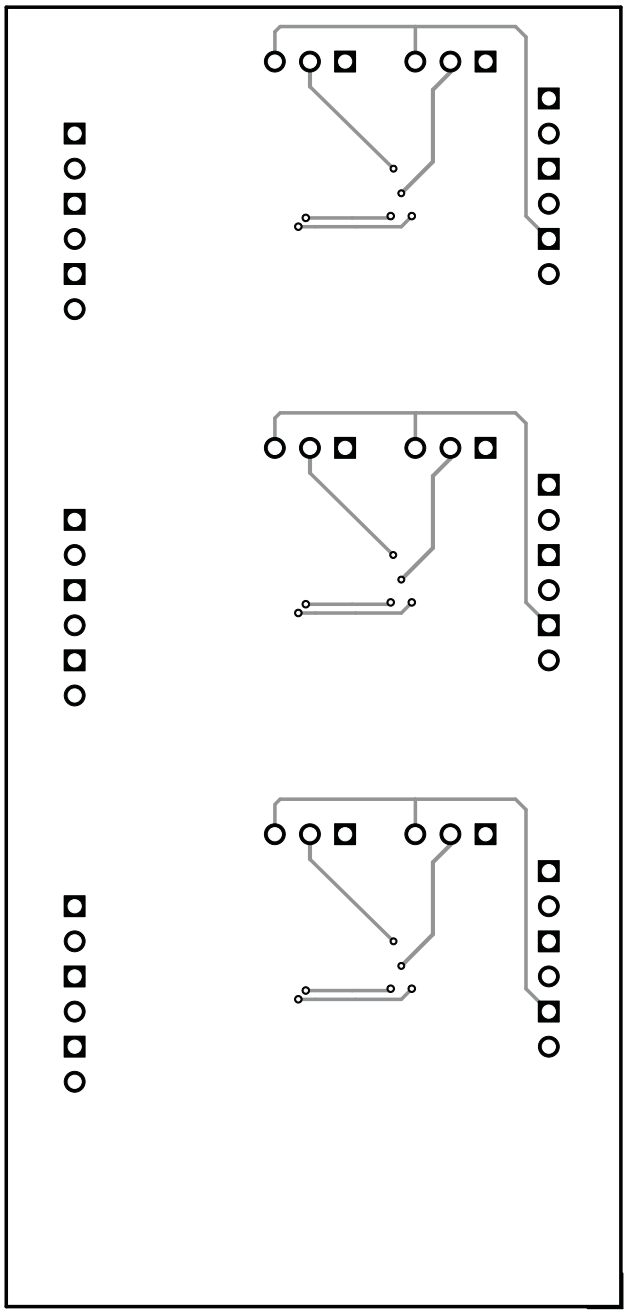


Figure 3. Bottom Layer Routing

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4 Schematic and Bill of Materials

This section provides the TPS62233EVM-574 schematic and bill of materials.

4.1 Schematic

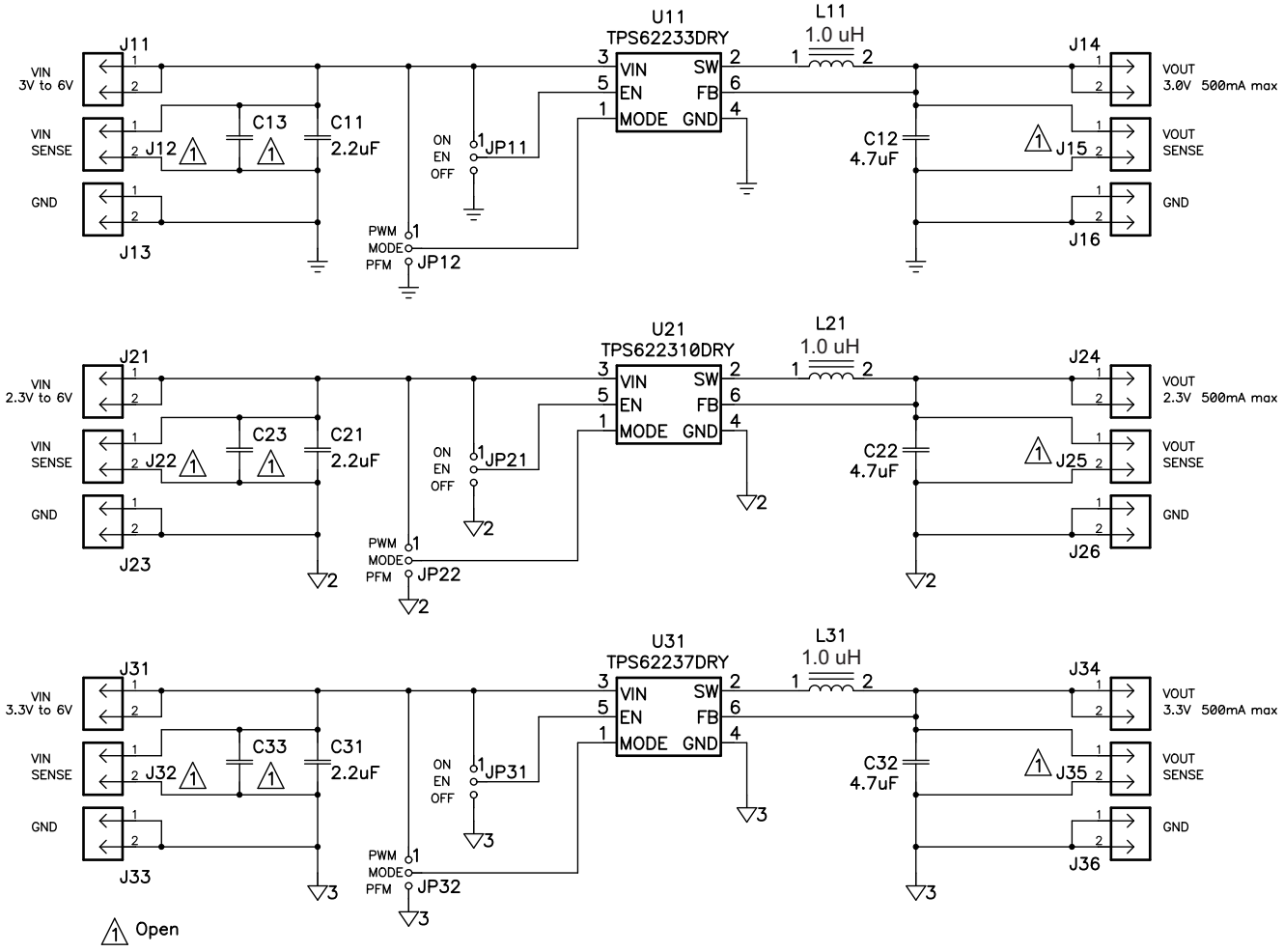


Figure 4. TPS62233/310/37EVM-574 Schematic

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4.2 Bill of Materials

Table 3. TPS62233EVM-574 Bill of Materials

Count -001	RefDes	Value	Description	Size	Part Number	MFR
3	C11,C21,C31	2.2µF	Capacitor, Ceramic, 6.3V, X5R, 20%	0402	JMK105BJ225MV-F CL05A225MQ5NNNC GRM155R60J225ME15D	Taiyo Yuden Samsung Murata
3	C12,C22,C32	4.7µF	Capacitor, Ceramic, 6.3V, X5R, 20%	0402	JMK105BJ475MV-F CL05A475MQ5NRNC GRM155R60J475ME87D	Taiyo Yuden Samsung Murata
0	C13, C23, C33	Open	Capacitor, Ceramic	1210	Std	Std
3	L11,L21,L31	1µH	Inductor, SMT	0805	MDT2012-CH1R0AN MIPS2012D1R0-X2 LQM21PN1R0MC0	TOKO FDK Murata
1	U11	TPS62233DRY	IC, 3MHz Ultra Small Step Down Converter, 3.0 V	SON	TPS62233DRY	TI
1	U21	TPS622310DRY	IC, 3MHz Ultra Small Step Down Converter, 2.3 V	SON	TPS622310DRY	TI
1	U31	TPS62237DRY	IC, 3MHz Ultra Small Step Down Converter, 3.3 V	SON	TPS62237DRY	TI

5 Related Documentation From Texas Instruments

TPS62233, TPS622310, TPS62237, 3 MHz Ultra Small Step Down Converter in 1x1.5 SON Package data sheet (SLVS941)

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User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

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

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

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.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-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.

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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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.

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.

【Important Notice for Users of EVMs for RF Products in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product 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 this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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