

## **DRV411EVM User's Guide**

This user's guide describes the characteristics, operation, and use of the DRV411 Evaluation Module (EVM). The DRV411 is a signal conditioning and 250-mA full-bridge drive circuit for closed-loop Hall effect sensors. A complete circuit description, schematic diagram, and bill of materials (BOM) are included.

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## 1 EVM Overview

### 1.1 Features

- Full-featured evaluation board for the DRV411
- Pin sockets for easily changing Hall sensor devices
- Built-in reference

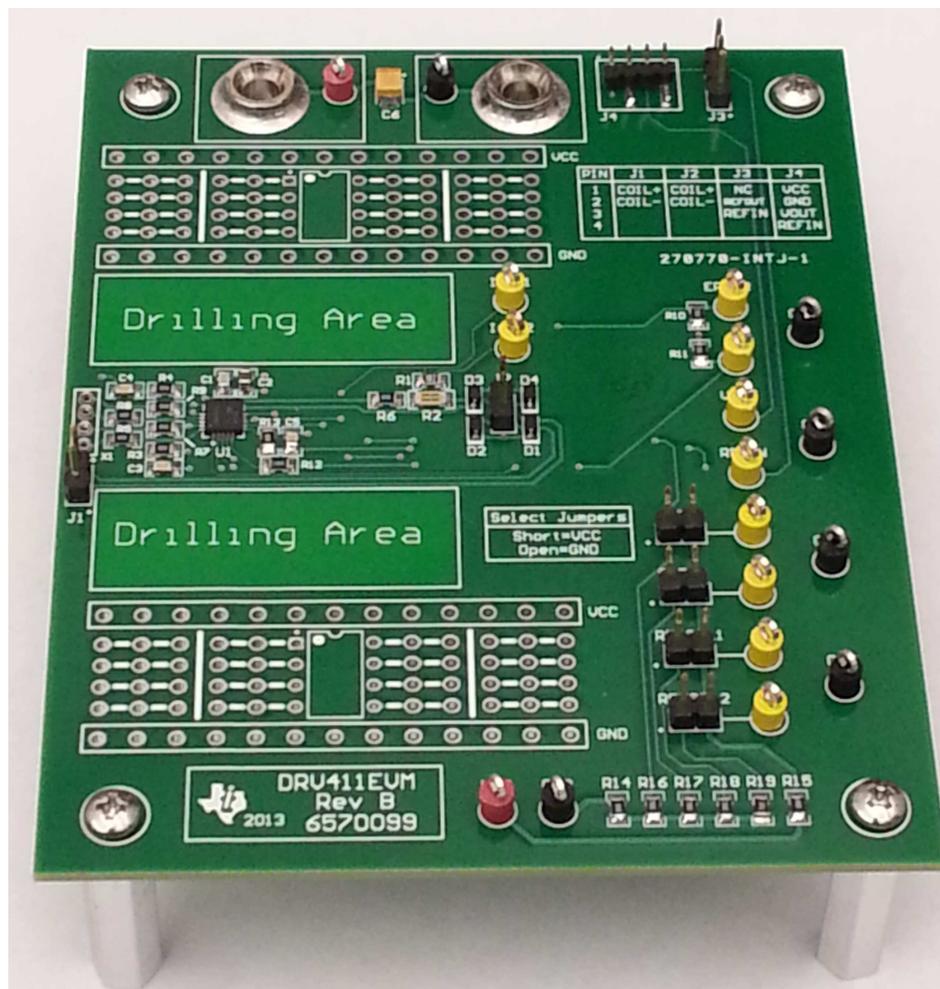
### 1.2 Introduction

This document provides the information needed to set up and operate the DRV411 evaluation module (EVM), a test platform for the DRV411 full-bridge drive integrated circuit for closed loop Hall-sensor devices. For a more detailed description of the DRV411, please refer to the product data sheet, [SBOS693](#). Additional support documents are listed in [Related Documents from Texas Instruments](#).

Throughout this document, the abbreviation EVM and the term evaluation module are synonymous with the DRV411EVM.

## 2 DRV411EVM Hardware

[Figure 1](#) shows the complete DRV411EVM hardware. The evaluation kit consists of a single printed-circuit board with a variety of test points (to monitor supply, reference, and output voltages) and jumpers to enable or disable various features of the DRV411 device.



**Figure 1. DRV411EVM Board**

## 2.1 Default Jumper Settings

Table 1 provides descriptions of the jumpers on the EVM and their function:

**Table 1. Jumper Descriptions**

Jumper	Default State	Description
GSEL1	Open	Gain select options, selects the gain of the Hall amplifier
GSEL2	Open	Gain select options, selects the gain of the Hall amplifier
REFSEL1	Open	Reference select options, selects the reference mode
REFSEL2	Open	Reference select options, selects the reference mode

## 2.2 Available Test Points

Table 2 provides descriptions of the test points on the EVM and their functions:

**Table 2. Test Point (TP) Descriptions**

TP Name	Description
VCC	EVM power, monitor with respect to GND test point
GND	System ground, there are 5 GND test points for ease of monitoring
IAIN1	Inverting input of the differential amplifier
IAIN2	Non-inverting input of the differential amplifier
ERROR	Error flag output (open drain output with 10-kΩ pull-up)
OR	Over Range Indicator (open drain output with 10-kΩ pull-up)
VOOUT	Output of the differential amplifier
REFIN	Input for zero reference to differential amplifier
Other	There are four additional test points for use in monitoring the state of the reference select pins as well as the gain select pins

## 3 Power Supply, Reference, and Gain Options

The EVM requires a single power supply in the range of +2.7-V to +5.5-V DC, for proper operation of the device. The EVM (without a Hall sensor installed) draws less than 10 mA at 5.5 V.

Power can be applied to the EVM via the banana jacks labeled VCC and GND, or through clip leads directly to the VCC and GND test points. When operating the EVM, TI recommends to use a linear DC bench supply, current limited to 50 mA.

### 3.1 Reference Voltage Selection

The EVM provides two jumpers to configure the reference voltage output selection. The reference selection input pins are pulled to ground, or logic '0' by default (jumpers 'open'). Closing the jumpers places the associated REFSEL pin at the applied Vcc potential (logic '1'). Table 3 provides a description of the available options:

**Table 3. Voltage Selection Options**

Mode	REFSEL1	REFSEL2	Description
REF = 2.5 V	Open	Open	Used with Hall-sensor supply of 5 V
REF = 1.65 V	Closed	Open	Used with Hall-sensor supply of 3.3 V
Ratiometric Output	Closed	Closed	Provides a reference output centered on VCC/2

### 3.2 Gain Setting and Compensation Frequency

The DRV411EVM provides two jumpers to configure the gain and sensor excitation frequency selection. The gain selection input pins are pulled to ground, or logic '0' by default (jumpers 'open'). Closing the jumpers places the associated GSEL pin at the applied Vcc potential (logic '1'). [Table 4](#) provides a description of the available options:

**Table 4. Gain and Compensation Frequency Settings**

Mode	GSEL1	GSEL2	Description
Gain_1	Open	Open	G = 250 V/V, Compensation frequency set to 3.8 kHz
Gain_2	Open	Closed	G = 250 V/V, Compensation frequency set to 7.2 kHz
Gain_3	Closed	Open	G = 1000 V/V, Compensation frequency set to 3.8 kHz
External Gain / Compensation	Closed	Closed	Excitation/chopping circuitry switched off. The gain and compensation is set by using external resistors and capacitors (R3/C3 and R4/C4).

## 4 EVM Operation

There are four pin sockets on the left side of the EVM for mounting the user-supplied Hall-sensor. Besides indium antimonide (InSb) Hall elements, the DRV411 can also be connected to symmetrical gallium arsenide (GaAs) Hall elements such as the HG-302C from [AKM Semiconductor](#).

With a Hall sensor mounted to the DRV411, the user is then free to mount their compensation coil to the 'drilling area' noted on the EVM. The area inside the silkscreen is free of any copper and can be used as needed to provide a means of securing the coil to the EVM. Connectors J1 and J2 are provided to terminate the compensation coil. Pins 1 and 2 of both J1 and J2 are connected together and then back to the ICOMP and IAIN pins of the DRV411 (please refer to the [DRV411EVM Schematic](#), for details). The coil can be terminated at either the J1 or the J2 location, or between J1 and J2, if necessary.

Once the sensor and compensation coil are mounted to the EVM, apply a current limited (50 mA max) 5-V DC source to the banana jacks or test points labeled VCC and GND. The current to be monitored by the DRV411 can then be applied through the compensation coil primary winding.

## 5 DRV411EVM Schematic and Bill of Materials

[Section 5.1](#) contains the schematic for this EVM and [Section 5.2](#) presents the BOM for this EVM.

### 5.1 DRV411EVM Schematic

[Figure 2](#) illustrates the EVM schematic.

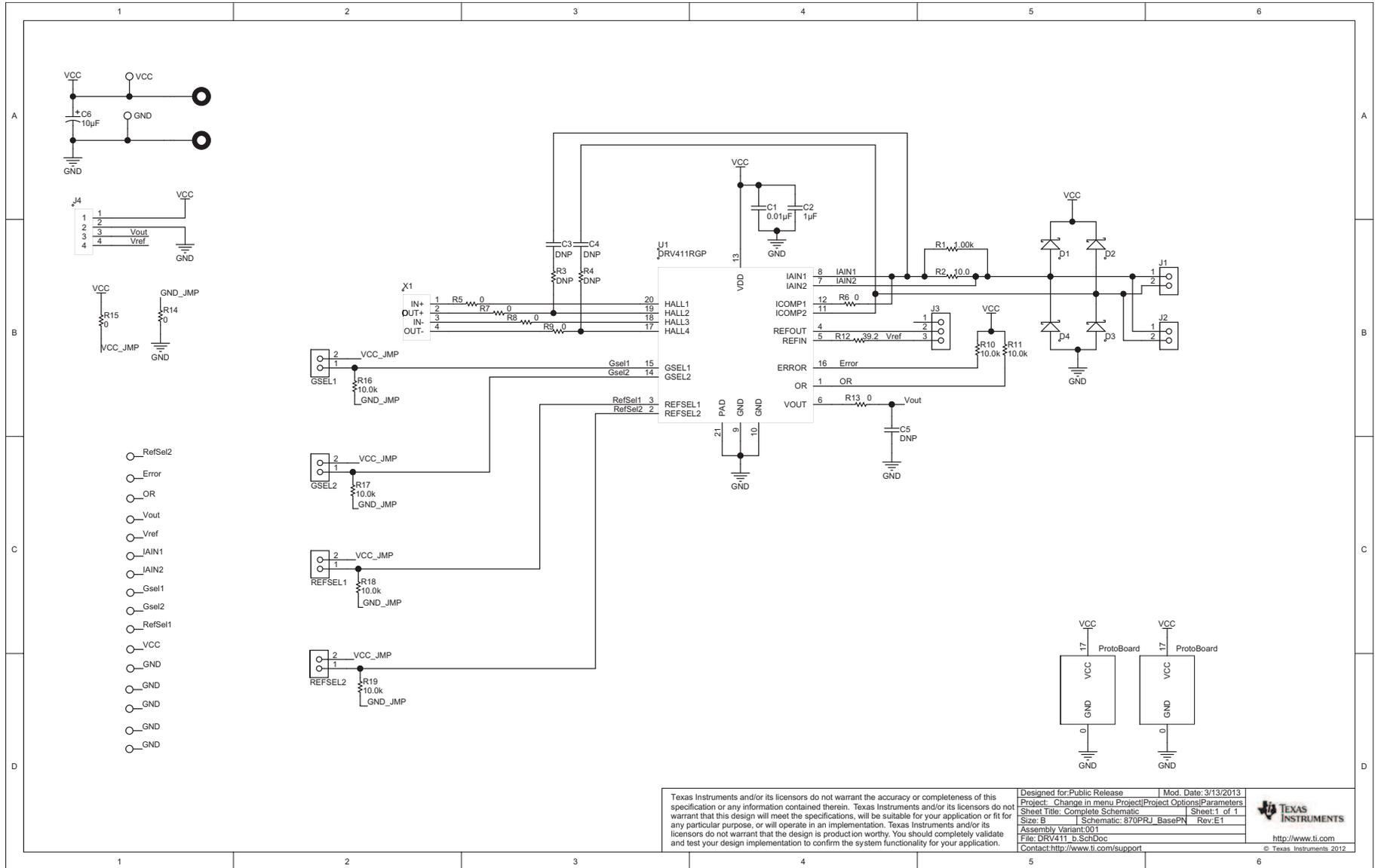


Figure 2. DRV411EVM Schematic

## 5.2 DRV411EVM Bill of Materials

Table 5 is the complete BOM for this EVM.

**Table 5. DRV411EVM Bill of Materials**

Item	Qty	Ref Des	Value	Description	Manufacturer	Part Number
1	1	C1	0.01uF	CAP CER 10000PF 50V 5% NP0 0805	Murata	GRM2195C1H103JA01D
2	1	C2	1uF	CAP CER 1UF 25V 10% X7R 0805	Taiyo Yuden	TMK212B7105KG-T
3	0	C3, C4, C5		Not Installed		
4	1	C6	10uF	CAP TANT 10UF 20V 20% 1210	AVX	TPSB106M020R1000
5	4	D1, D2, D3, D4		DIODE SCHOTTKY 350MA SGL SOD-323, 40V	ST Micro.	BAT48JFILM
6	6	J1, J2, GSEL1, GSEL2, REFSEL1, REFSEL2		CONN HEADER VERT SGL 2POS GOLD	3M	961102-6404-AR
7	1	J3		CONN HEADER VERT SGL 3POS GOLD	3M	961103-6404-AR
8	1	J4		CONN HEADER 4POS 2MM VERT SMD	3M	951104-2530-AR-PR
9	2	VCC, GND		JACK NON-INSULATED .218"	Keystone	575-4
10	1	R1	1.00kohm	RES 1.0K OHM 1/8W .1% 0805 SMD	Susumu	RG2012P-102-B-T5
11	1	R2	10.0 ohm	RES 10.0 OHM 1W .1% 1206	Vishay	PHP01206E10R0BST5
12	0	R3, R4		Not Installed		
13	8	R5, R6, R7, R8, R9, R13, R14, R15	0ohm	RES 0.0 OHM 1/8W 0805 SMD	Vishay-Dale	CRCW08050000Z0EA
14	6	R10, R11, R16, R17, R18, R19	10.0kohm	RES 10.0K OHM 1/8W 1% 0805 SMD	Vishay-Dale	CRCW080510K0FKEA
15	1	R12	39.2 ohm	RES 39.2 OHM 1/8W 1% 0805 SMD	Vishay-Dale	CRCW080539R2FKEA
16	10	IAIN1, IAIN2, ERROR, OR, VOUT, REFIN, GSEL1, GSEL2, REFSEL1, REFSEL2		TEST POINT PC COMPACT .063"D YLW	Keystone	5009
17	2	VCC		TEST POINT PC COMPACT .063"D RED	Keystone	5005
18	6	GND		TEST POINT PC COMPACT .063"D BLK	Keystone	5006
19	1	U1		Hall Effect IC, QFN-20	Texas Instruments	DRV411RGP
20	4	X1-pin sockets		CONN SOCKET MINI SPRING TIN	TE Connectivity	5050935-2
21	0	X1-device		Not Installed		
22	5	NA		SHUNT LP W/HANDLE 2 POS 30AU	TE Connectivity	881545-2
23	4	NA		STANDOFF HEX 4-40THR ALUM 1"L	Keystone	2205
24	4	NA		MACHINE SCREW PAN PHILLIPS 4-40	B&F Fastener Supply	PMSSS 440 0025 PH
25	1	NA		Printed Circuit Board	TI	6570099

## **6 Related Documentation from Texas Instruments**

DRV411 product data sheet, [SBOS693](#)

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## Revision History

Changes from Original (August 2013) to A Revision	Page
• Added link for the DRV411 data sheet .....	2
• Updated Gain_1, Gain_2, and Gain_3 descriptions .....	4

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

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For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

### General Statement for EVMs including a radio

*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.

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**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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Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

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2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure 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.
3. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards (such as UL, CSA, VDE, CE, RoHS and WEEE) which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

**Certain Instructions.** It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please 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 result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

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Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

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