

## **DRV3204-Q1 EVM**

This document is a supplement to the DRV3204-Q1 data sheet ([SLVSBT3](#)). It details the hardware implementation of DRV3204-Q1 evaluation module (EVM). This document does not cover the motor-driver application and the software.

[Section 1](#) and [Section 2](#) list the hardware descriptions of the EVM. [Appendix A](#) details getting started with the evaluation, and [Appendix B](#) describes the 3.3-V interface (I/F) board.

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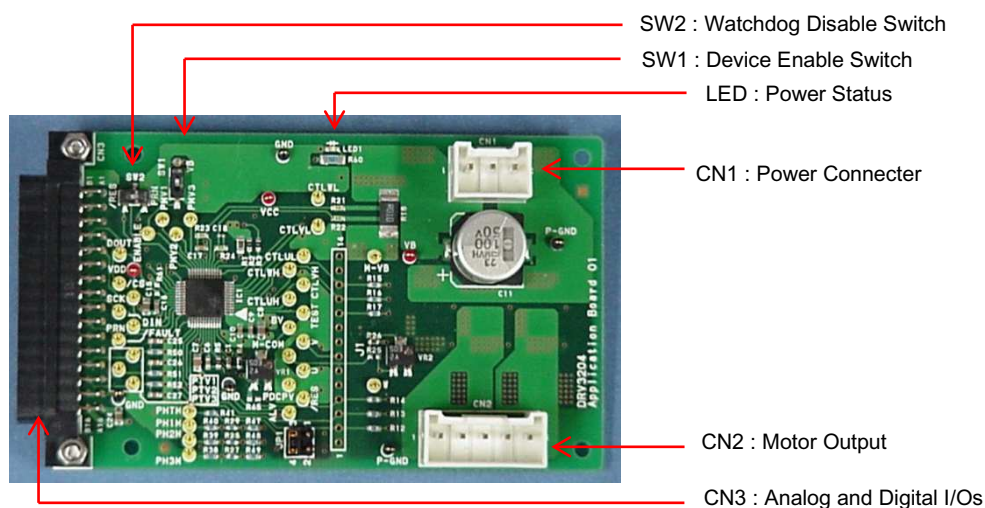
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## **1 Overview**

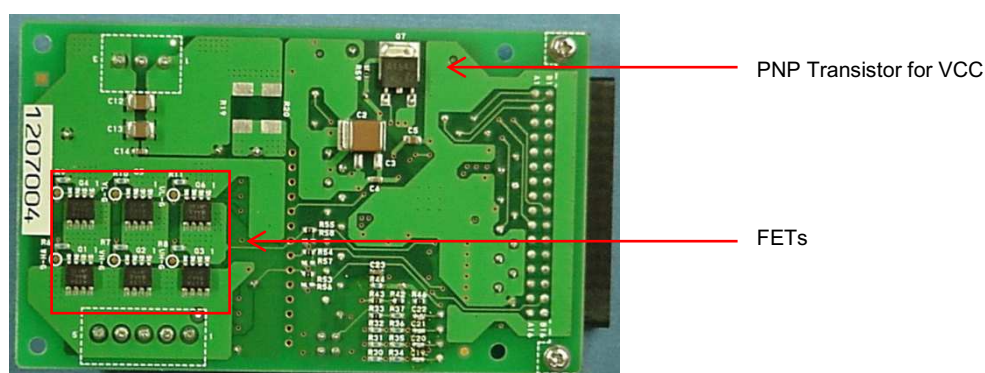
### **1.1 Introduction**

The DRV3204EVM is an application board to evaluate the DRV3204-Q1 device. The DRV3204-Q1 device is a field effect transistor (FET) pre-driver designed for a 3-phase brushless DC motor control. The EVM consists of the DRV3204-Q1 device, six N-channel MOSFETs, and passive devices. The DRV3204EVM has a 5-V level interface to communicate with an external micro-controller unit (MCU). A 3.3-V I/F board is also provided to support the 3.3-V MCU.

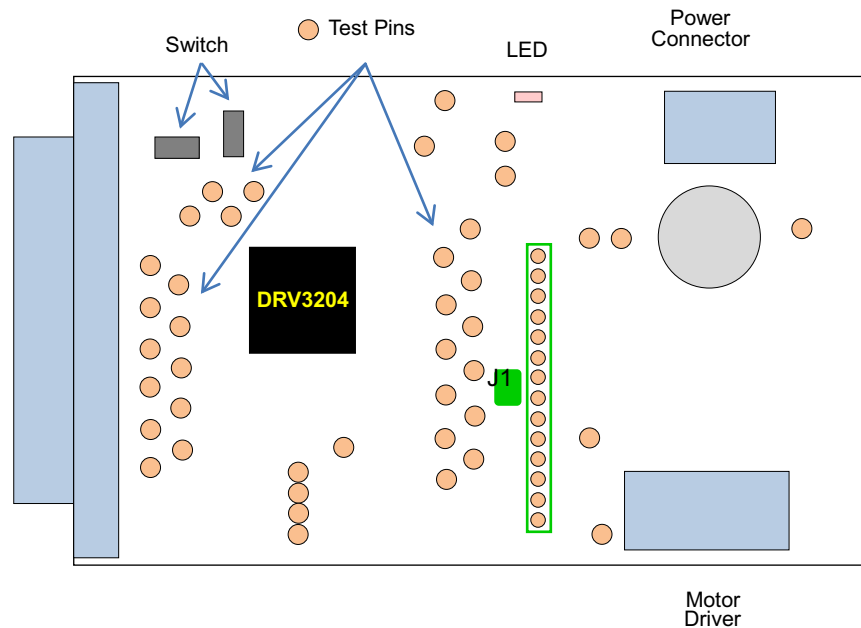
## 1.2 Block Diagram



**Figure 1. DRV3204EVM Board Layout (Front Side)**



**Figure 2. DRV3204EVM Board Layout (Back Side)**



**Figure 3. DRV3204EVM Block Diagram**

### 1.2.1 Power and Communication Connectors

The EVM offers terminal blocks for the application of power and motor outputs, as well as digital input/output (I/O) and communication. This section briefly describes the functions. The pin assignments are described in [Section 2](#).

#### 1.2.1.1 Power Connector

The VB power rail (typically 12 V) must be externally supplied. The power for the external MCU and other analog and digital functions are supplied by the regulator implemented in the DRV3204-Q1 device.

#### 1.2.1.2 Motor Outputs

A brushless DC Motor is connected to the EVM through the motor outputs.

#### 1.2.1.3 Analog and Digital I/O

The analog and digital I/O and SPI communication of the DRV3204-Q1 can be used through the connector.

### 1.2.2 LED

The LED turns on when the DRV3204EVM power is supplied.

### 1.2.3 Switch

Switch1 is connected to the enable input (ENABLE) pin of the DRV3204-Q1. DRV3204-Q1 is enabled by turning this switch ON. Switch3 is for disabling the watchdog function. When you want to disable the watchdog function, this switch must be set to the  $\overline{\text{RES}}$  position.

### 1.2.4 FETs

Six N-channel MOSFETs are implemented on the board to drive the brushless DC motor. A 10-A maximum brushless DC motor can be evaluated using this EVM board.

### 1.2.5 Test Pins

The DRV3204-Q1 pins are brought out to the test pin or test through-hole. For each test pin, a label on the silkscreen identifies the signal. Access the signals by using 14 through-holes, marked as J1.

## 2 Connectors and Switches

This section describes the pin assignment of the connectors and switches.

### 2.1 Connectors

#### 2.1.1 CN1 – B3P-VH-FB-B(LF)(SN) (JST)

**Table 1. Power Connectors**

| Pin# | Name | Description                                |
|------|------|--------------------------------------------|
| 1    | VB   | External power supply (typ 12-V, max 10 A) |
| 2    | NC   | No connection                              |
| 3    | GND  | Base ground (B-GND)                        |

#### 2.1.2 CN2 – B5P-VH-FB-B(LF)(SN) (JST)

**Table 2. Motor Outputs**

| Pin# | Name   | Description      |
|------|--------|------------------|
| 1    | Motor1 | Motor terminal 1 |
| 2    | NC     | No Connection    |
| 3    | Motor2 | Motor terminal 2 |
| 4    | NC     | No Connection    |
| 5    | Motor3 | Motor terminal 3 |

#### 2.1.3 CN3 – FCN-365J032-AU (Fujitsu Component)

**Table 3. Analog and Digital I/O**

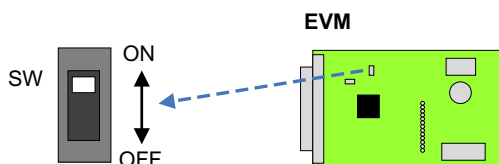
| Pin# | Name            | Description                                       |
|------|-----------------|---------------------------------------------------|
| A1   | PMV1            | Phase comparator output 1                         |
| B1   | PMV2            | Phase comparator output 2                         |
| A2   | PMV3            | Phase comparator output 3                         |
| B2   | PSS1            | Sample and hold control signal input 1 (not used) |
| A3   | PSS2            | Sample and hold control signal input 2 (not used) |
| B3   | PSS3            | Sample and hold control signal input 3 (not used) |
| A4   | $\overline{CS}$ | SPI chip select signal input                      |
| B4   | DOUT            | SPI data signal output                            |
| A5   | SCK             | SPI clock signal input                            |
| B5   | DIN             | SPI data signal input                             |
| A6   | CTLEN           | Pre-driver parallel enable input (not used)       |
| B6   | CTLWL           | Pre-driver parallel input                         |
| A7   | CTLWH           | Pre-driver parallel input                         |
| B7   | CTLVL           | Pre-driver parallel input                         |
| A8   | CTLVH           | Pre-driver parallel input                         |
| B8   | CTLUL           | Pre-driver parallel input                         |

**Table 3. Analog and Digital I/O (continued)**

| Pin# | Name                     | Description                                |
|------|--------------------------|--------------------------------------------|
| A9   | CTLUH                    | Pre-driver parallel input                  |
| B9   | $\overline{\text{RES}}$  | Reset output                               |
| A10  | PRN                      | Watchdog timer pulse input                 |
| B10  | FAULT                    | Diagnosis output                           |
| A11  | $\overline{\text{OVCR}}$ | Overcurrent reset input (not used)         |
| B11  | NC                       | No connection                              |
| A12  | CANRX                    | CAN digital receive data output (not used) |
| B12  | CANTX                    | CAN digital transmit data input (not used) |
| A13  | NC                       | No Connection                              |
| B13  | PTV1                     | Phase output 1                             |
| A14  | PTV2                     | Phase output 2                             |
| B14  | PTV3                     | Phase output 3                             |
| A15  | GND                      | Ground                                     |
| B15  | ALV                      | Motor current sense amp output             |
| A16  | GND                      | Ground                                     |
| B16  | VCC                      | 5-V VCC supply output                      |

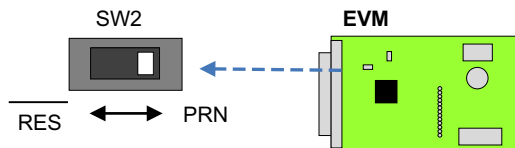
## 2.2 Switches

### 2.2.1 SW1


**Figure 4. Device Enable Switch**
**Table 4. Device Enable Switch**

| Switch | Description                                     |
|--------|-------------------------------------------------|
| ON     | DRV3204 ENABLE = VB<br>DRV3204-Q1 is enabled    |
| OFF    | DRV3204 ENABLE = OPEN<br>DRV3204-Q1 is disabled |

### 2.2.2 SW2


**Figure 5. Watchdog Disable Switch**

**Table 5. Watchdog Disable Switch**

| Switch                  | Description                                                               |
|-------------------------|---------------------------------------------------------------------------|
| PRN                     | Watchdog function is enabled.<br>It is controlled through the CN3 by MCU. |
| $\overline{\text{RES}}$ | Watchdog function is disabled.                                            |

## Appendix A Application Evaluation

This section gives an overview of an application evaluation environment. It uses an F28035 (C2000) Control Card and TI Code Composer Studio (CCS) to control and monitor the DRV3204-Q1 and motor-driver application.

### A.1 Example of Evaluation Environment

Figure 6 shows a typical environment to evaluate the brushless DC motor system, Figure 7 shows the block diagram, and Table 6 lists the components.

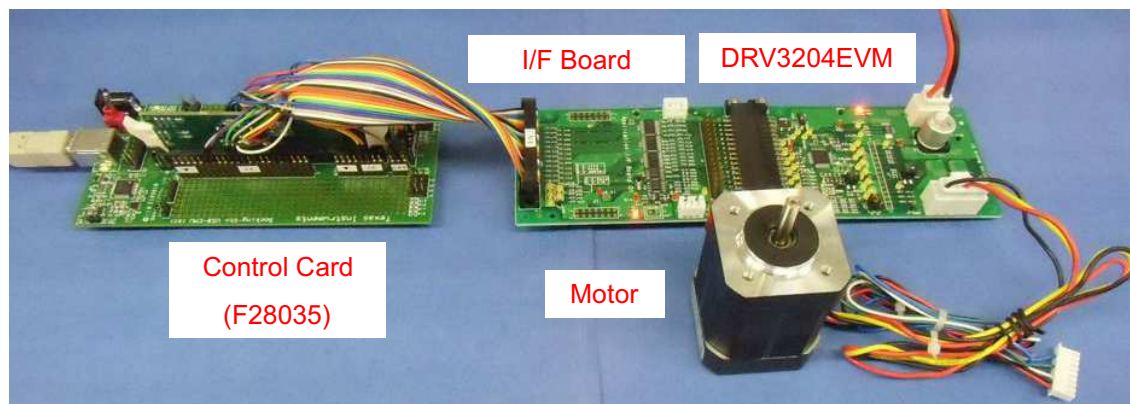


Figure 6. Example of Evaluation Environment

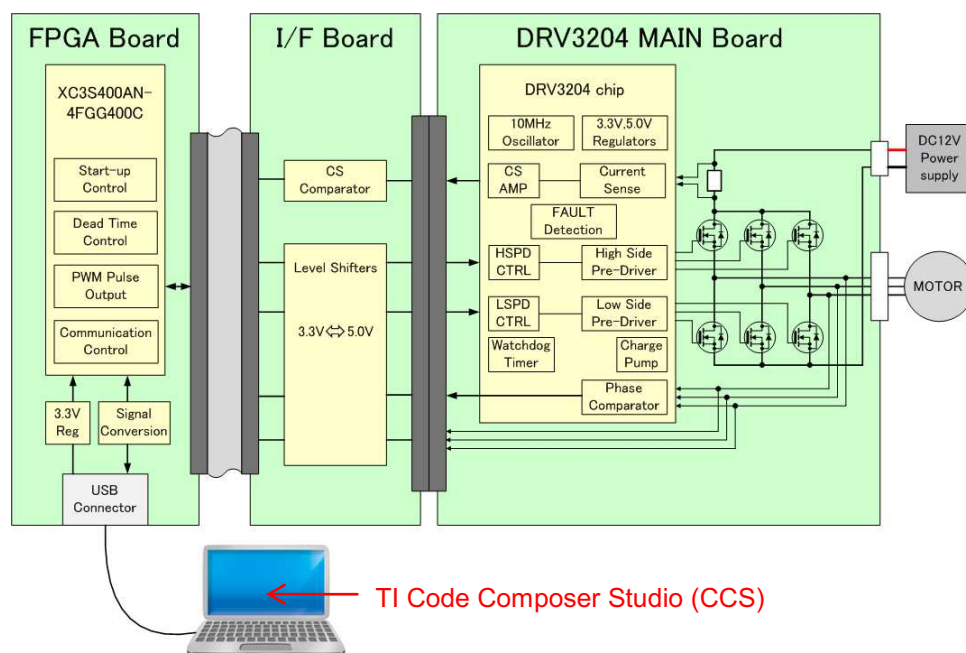


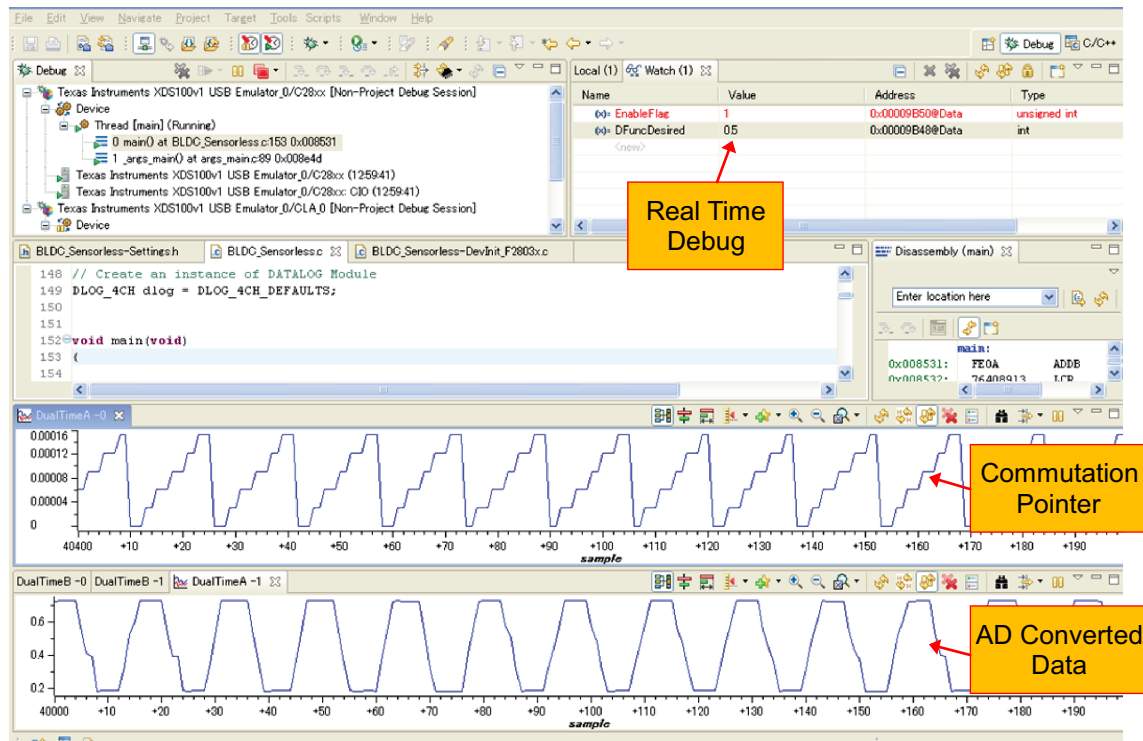
Figure 7. EVM Block Diagram

Table 6. Debugging Environment Example

| Component | Description                                                                                                                                                                                          |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CCS       | CCS is the integrated development environment (IDE) for TI's micro-controllers. It provides a compiler of the user's code, a source code editor, a project build environment and real-time debugger. |

**Table 6. Debugging Environment Example (continued)**

| Component    | Description                                                                                                    |
|--------------|----------------------------------------------------------------------------------------------------------------|
| Control CARD | The Piccolo F28035 Control CARD is a TI 32-bit CPU suitable for motor-driver or power management applications. |
| I/F board    | The I/F board converts the I/O voltage level between the Control CARD (3.3 V) and the DRV3204EVM (5 V).        |
| MOTOR        | A 3-phase brushless DC motor                                                                                   |
| Power supply | A 12-V power supply to EVM board                                                                               |

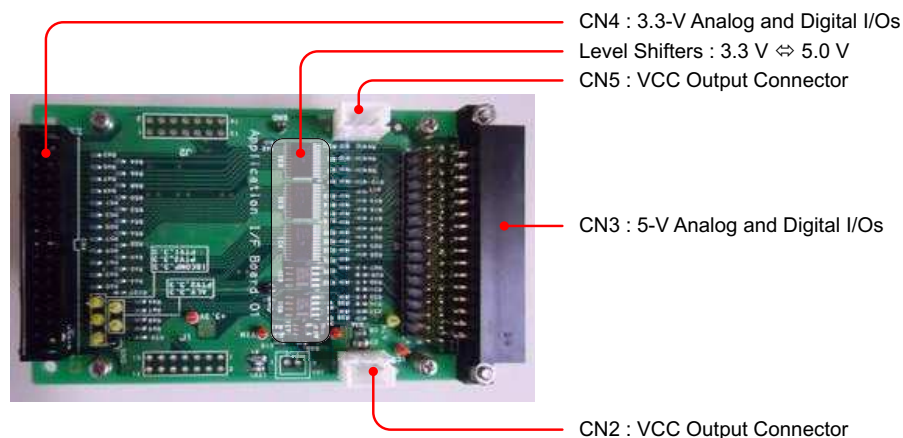


**Figure 8. TI Code Composer Studio Screen Capture**

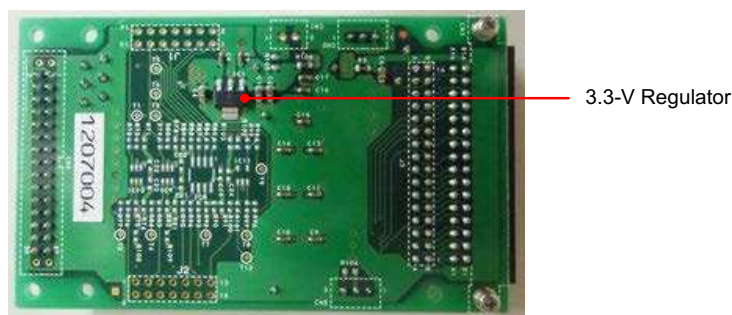
The TI CCS offers real-time debugging with a C2000 MCU. It controls C2000 parameters or displays a motor-control status.

## Appendix B I/F Board

### B.1 I/F Board Overview



**Figure 9. Board Layout (Front Side)**



**Figure 10. Board Layout (Back Side)**

### B.2 Connectors

#### B.2.1 CN1

Not used

#### B.2.2 CN2 and CN5 – B3B-XH-A(LF)(SN) (JST)

CN2 and CN5 are 5-V power supplies to components on the board or external devices.

**Table 7. VCC Output Connector**

| Pin# | Name | Description             |
|------|------|-------------------------|
| 1    | VCC  | VCC power supply output |
| 2    | NC   | No connection           |
| 3    | GND  | Ground                  |

#### B.2.3 CN3 – FCN-365P032-AU (Fujitsu Component)

CN3 is a 5-V voltage level I/F connector, and It is connected on the DRV3204EVM.

Refer to [Table 3](#).

### B.2.4 CN4 – XG4C-3031 (omron)

CN4 is a 3.3-V voltage level I/F connector, and it is used on the C2000 Control CARD.

**Table 8. 3.3-V Analog and Digital I/O**

| Pin# | Name              | Description                                       |
|------|-------------------|---------------------------------------------------|
| 1    | GND               | Ground                                            |
| 2    | ISCOMP            | Current comparator output                         |
| 3    | ALV               | Motor current sense amp output                    |
| 4    | PTV3              | Phase amplifier output 3                          |
| 5    | PTV2              | Phase amplifier output 2                          |
| 6    | PTV1              | Phase amplifier output 1                          |
| 7    | NC                | No connection                                     |
| 8    | PRN               | Pulse input                                       |
| 9    | CTLUH             | Pre-driver parallel input                         |
| 10   | CTLUL             | Pre-driver parallel input                         |
| 11   | CTLVH             | Pre-driver parallel input                         |
| 12   | CTLVL             | Pre-driver parallel input                         |
| 13   | CTLWH             | Pre-driver parallel input                         |
| 14   | CTLWL             | Pre-driver parallel input                         |
| 15   | CTLEN             | Pre-driver parallel enable input                  |
| 16   | DIN               | SPI data signal input                             |
| 17   | SCK               | SPI clock signal input                            |
| 18   | $\overline{CS}$   | SPI chip select signal input                      |
| 19   | PSS3              | Sample and hold control signal input 3 (not used) |
| 20   | PSS2              | Sample and hold control signal input 2 (not used) |
| 21   | PSS1              | Sample and hold control signal input 1 (not used) |
| 22   | $\overline{OVCR}$ | Overcurrent reset input (not used)                |
| 23   | CANTX             | CAN digital input (not used)                      |
| 24   | CANRX             | CAN digital output (not used)                     |
| 25   | FAULT             | Diagnosis output                                  |
| 26   | $\overline{RES}$  | Reset output                                      |
| 27   | DOUT              | SPI data signal output                            |
| 28   | PMV3              | Phase comparator output 3                         |
| 29   | PMV2              | Phase comparator output 2                         |
| 30   | PMV1              | Phase comparator output 1                         |

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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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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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**For Feasibility Evaluation Only, in Laboratory/Development Environments.** Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

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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. 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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