The Sensor Hub Booster Pack (BOOSTXL-SENSHUB) is a low-cost extension board for the Tiva™ C Series TM4C LaunchPad EK-TM4C123GXL evaluation platform for ARM® Cortex™-M4F-based microcontrollers (MCUs). This extension board, or BoosterPack, is specifically designed to expand the functionality of the Tiva TM4C LaunchPad. This user’s manual provides an overview of the Sensor Hub BoosterPack software and hardware.

Figure 1 shows a photo of the BOOST-XL-SENSHUB.

---

**Figure 1. BOOSTXL-SENSHUB BoosterPack Extension Board**

---

<table>
<thead>
<tr>
<th>Contents</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Board Overview</td>
<td>2</td>
</tr>
<tr>
<td>2 Hardware Description</td>
<td>3</td>
</tr>
<tr>
<td>3 Software Development</td>
<td>5</td>
</tr>
<tr>
<td>4 References, PCB Layout, and Bill of Materials</td>
<td>6</td>
</tr>
</tbody>
</table>
Board Overview

1 Board Overview

The Sensor Hub BoosterPack is an extension board for the TI MCU LaunchPad evaluation module ecosystem. It was designed specifically to extend the functionality of the Tiva TM4C1233 LaunchPad (EK-TM4C123GXL). The Sensor Hub enables customers to create and model innovative prototype solutions that leverage the processing and floating-point capabilities of the TM4C123GH6PM MCU coupled with motion and environmental sensors. The Sensor Hub BoosterPack plugs in to the BoosterPack XL headers located on the top of the LaunchPad. The BoosterPack also features a TI-standard extension module (EM) connector to further extend customer applications through a variety of wireless extension modules. This board and the available software also highlight the use of the new TivaWare® SensorLib sensor driver library, an easy-to-use, extendable foundation of sensor communication software.

NOTE: The Sensor Hub BoosterPack is fully compatible with both the Tiva™ C Series LaunchPad (EK-TM4C123GXL) and the Stellaris® LM4F120 LaunchPad (EK-LM4F120XL).

1.1 Kit Features

The BOOSTXL-SENSHUB BoosterPack offers the following features:

- **TMP006** infrared object temperature sensor
- 9-axis InvenSense **MPU9150** motion sensor:
  - 3-axis acceleration
  - 3-axis gyroscope
  - 3-axis magnetometer
- Bosch **BMP180** pressure sensor
- Intersil **ISL29023** ambient and infrared light sensor
- Sensirion **SHT21** humidity sensor
- Two user pushbuttons
- One user LED
- One power LED
- EM connector for additional wireless expansion

1.2 Using the Sensor Hub BoosterPack

Follow these recommended steps to quickly configure your Sensor Hub for proper operation.

Step 1. Review the BOOSTXL-SENSHUB BoosterPack Getting Started Guide (literature number SPMU295, available for download at www.ti.com). This document guides you through downloading, installing, and running the associated TivaWare examples that demonstrate the Sensor Hub capabilities and functions.

Step 2. Examine the additional examples that are provided with the downloaded software to understand the capabilities and limitations of each on-board sensor.

Step 3. Create your own application using the Tiva C Series LaunchPad and Sensor Hub BoosterPack. Use the TivaWare for C Series Sensor Library to enable your innovative Tiva TM4C MCU applications.

Step 4. Customize and integrate the hardware to suit a specific end application. This user’s manual is an important reference for understanding circuit operation and completing hardware modifications.
1.3 Specifications

Table 1 summarizes the specifications for the BOOSTXL-SENSHUB BoosterPack.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Board supply voltage</td>
<td>2.7 V to 5.5 V nominally supplied as 3.3 V from the BoosterPack interface</td>
</tr>
<tr>
<td>Dimensions</td>
<td>2.0 x 1.5 x 0.625 (in)</td>
</tr>
<tr>
<td></td>
<td>5.08 x 3.81 x 1.587 (cm)</td>
</tr>
<tr>
<td>RoHS status</td>
<td>Compliant</td>
</tr>
</tbody>
</table>

2 Hardware Description

The Sensor Hub BoosterPack includes five motion and environmental sensors. It also enables RF expansion and access to user LEDs and buttons. The hardware is designed to enable innovative applications that fuse sensor information and Tiva C Series software processing through the functionality of the Tiva C Series LaunchPad.

Figure 2 shows a block diagram of the Sensor Hub BoosterPack.

Figure 2. BOOSTXL-SENSHUB BoosterPack Block Diagram
2.1 Functional Description

This section provides a functional description of the Sensor Hub BoosterPack.

2.1.1 BoosterPack XL Connector

The BoosterPack XL connector attaches the BoosterPack to the Tiva TM4C LaunchPad. This BoosterPack is specifically designed to match the pin function with the Tiva TM4C LaunchPad. Basic I²C and UART communication to the sensors and RF expansion connectors are also available when the Sensor Hub is connected to either the C2000 or MSP430 LaunchPad.

Table 2 describes the BoosterPack XL interface connections and the respective uses on the Sensor Hub BoosterPack. It also shows which pins remain available for additional expansion at the user's discretion.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
<th>Pin</th>
<th>Function</th>
<th>Pin</th>
<th>Function</th>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1.1</td>
<td>3.3 V IN</td>
<td>J2.1</td>
<td>Ground</td>
<td>J3.1</td>
<td></td>
<td>J4.1</td>
<td></td>
</tr>
<tr>
<td>J1.2</td>
<td></td>
<td>J2.2</td>
<td>Interrupt</td>
<td>J3.2</td>
<td></td>
<td>J4.2</td>
<td></td>
</tr>
<tr>
<td>J1.3</td>
<td>UART RX</td>
<td>J2.3</td>
<td>Interrupt</td>
<td>J3.3</td>
<td></td>
<td>J4.3</td>
<td>RF GPIO</td>
</tr>
<tr>
<td>J1.4</td>
<td>UART TX</td>
<td>J2.4</td>
<td></td>
<td>J3.4</td>
<td></td>
<td>J4.4</td>
<td>UART RTS</td>
</tr>
<tr>
<td>J1.5</td>
<td></td>
<td>J2.5</td>
<td>Sensor I²C</td>
<td>J3.5</td>
<td>USER LED</td>
<td>J4.5</td>
<td>UART CTS</td>
</tr>
<tr>
<td>J1.6</td>
<td>Interrupt</td>
<td>J2.6</td>
<td>Sensor I²C</td>
<td>J3.6</td>
<td>User Button</td>
<td>J4.6</td>
<td>RF Shutdown</td>
</tr>
<tr>
<td>J1.7</td>
<td></td>
<td>J2.7</td>
<td>Sensor I²C</td>
<td>J3.7</td>
<td>User Button</td>
<td>J4.7</td>
<td>RF Reset</td>
</tr>
<tr>
<td>J1.8</td>
<td>SSI TX</td>
<td>J2.8</td>
<td>SSI RX</td>
<td>J3.8</td>
<td>RF GPIO</td>
<td>J4.8</td>
<td>RF GPIO</td>
</tr>
<tr>
<td>J1.9</td>
<td>RF I²C</td>
<td>J2.9</td>
<td>SSI SS</td>
<td>J3.9</td>
<td>RF GPIO</td>
<td>J4.9</td>
<td></td>
</tr>
<tr>
<td>J1.10</td>
<td>RF I²C</td>
<td>J2.10</td>
<td>SSI CLK</td>
<td>J3.10</td>
<td></td>
<td>J4.10</td>
<td></td>
</tr>
</tbody>
</table>

(1) Shaded cells indicate unused pins that are available for additional expansion.

2.1.2 TMP006 Temperature Sensor

The TMP006 provides both direct and indirect temperature measurements. It contains an on-chip temperature sensor to directly measure ambient temperature conditions. It also allows contactless infrared object temperature measurement.

2.1.3 InvenSense MPU9150 9-Axis Motion Sensor

The MPU9150 is a 3-axis accelerometer, 3-axis gyroscope, and 3-axis magnetometer in a single package. This device is the primary motion sensor on the Sensor Hub. It is used by the demonstration software as the raw motion inputs, which are fused by a direct cosine matrix into roll, pitch, and yaw measurements.

2.1.4 Intersil ISL29023 Ambient and Infrared Light Sensor

The ISL29023 provides sensor measurements of light conditions across both the ambient (human-visible) spectrum and the infrared spectrum.

2.1.5 Sensirion SHT21 Humidity Sensor

The SHT21 provides relative humidity measurements.

2.1.6 Bosch BMP180 Barometric Pressure Sensor

The BMP180 measures barometric pressure conditions. It can be used to enhance the motion sensor by determining relative changes in altitude.

2.1.7 Low-Power RF Expansion Connection

The RF expansion connection provides a wide array of options to the end application.
2.1.8 TPS75118 Voltage Regulator
The TPS75118 regulates the 3.3-V supply from the LaunchPad down to 1.8 V for the input to the RF expansion connector.

3 Software Development
This section provides general information on software development as well as instructions for Flash memory programming. Note: This information presumes that the Sensor Hub BoosterPack is connected to a Tiva TM4C1233 LaunchPad.

3.1 Software Description
The TivaWare software provided with the Tiva C Series LaunchPad includes functional drivers for all of the peripheral devices supplied in the design. The TivaWare for C Series Peripheral Driver Library is used to configure and operate the on-chip peripherals as part of TivaWare.

The TivaWare package includes a set of example applications that use the TivaWare Peripheral Driver Library. These applications demonstrate the capabilities of the TM4C1233H6 microcontroller, as well as provide a starting point for the user to develop the final application for use on the Tiva C Series LaunchPad evaluation board and the BOOSTXL-SENSHUB BoosterPack.

3.2 Source Code
The complete source code, including the source code installation instructions, are available at www.ti.com/tool/boostxl-senshub. The source code and binary files are installed in the TivaWare for C Series Peripheral Driver Library tree.

3.3 Tool Options
The source code installation includes directories that contain projects and/or makefiles for the following tool chains:
- Keil™ ARM RealView® Microcontroller Development System
- IAR Embedded Workbench for ARM
- Sourcery CodeBench
- Texas Instruments' Code Composer Studio™ IDE

Download evaluation versions of these tools from www.ti.com/tiva-c. As a result of code size restrictions, the evaluation tools may not build all example programs. A full license is necessary to rebuild or debug all examples.

Instructions on installing and using each of the evaluation tools can be found in the Quickstart guides (for example, Quickstart-Keil, Quickstart-IAR), which are available for download from the Evaluation Kit section of our website at www.ti.com/tiva-c.

For detailed information on using each tool, see the documentation included with the respective tool chain installation or visit the website of the respective tool supplier.

3.4 Programming the Tiva TM4C LaunchPad Evaluation Board
The Tiva TM4C LaunchPad software package includes pre-built binaries for each of the example applications. If you installed TivaWare for C Series to the default installation path of C:\tiva\TivaWare_C_Series_<version>, you can find these example applications in C:\tiva\TivaWare_C_Series_<version>/examples/boards/ek-tm4c123gx. The onboard ICDI is used with the LM Flash Programmer tool to program applications on the Tiva C Series LaunchPad.

Follow these steps to program example applications into the Tiva C Series LaunchPad evaluation board using the ICDI:
1. Install the LM Flash Programmer on a PC running Microsoft® Windows® XP, Windows 7, or later Windows OS.
2. Switch the POWER SELECT switch to the right to use Debug mode.
3. Connect the USB-A cable plug to an available port on the PC and the Micro-B plug to the Debug USB port on the board.
4. Verify that the POWER LED D4 on the board is lit.
5. Run the LM Flash Programmer program.
6. In the Configuration tab, use the Quick Set control to select the Tiva C Series LaunchPad evaluation board.
7. Move to the Program tab and click the Browse button. Navigate to the example applications directory (the default location is C:\ti\TivaWare_C_Series_<version>\examples\boards\ek-tm4c123gxl-senshub\). Each example application has its own directory. Navigate to the example directory that you want to load, then navigate to the directory that contains the binary (*.bin) files. Select the desired binary file and click Open.
8. Set the Erase Method to Erase Necessary Pages. Check the Verify After Program box, and check the Reset MCU After Program option.
9. Click the Program button to start the Erase, Download, and Verify process. Program execution starts once the Verify process is complete.

4 References, PCB Layout, and Bill of Materials

Complete schematics for the Sensor Hub BoosterPack are appended to this user's guide.

4.1 References

In addition to this document, the following references are available for download at www.ti.com:
- BOOSTXL-SENSHUB BoosterPack Getting Started Guide (literature number SPMU295)
- Tiva C Series TM4C123GH6PM Microcontroller Data Sheet (literature number SPMS376).
- TivaWare for C Series Driver Library. Available for download at www.ti.com/tool/sw-tm4c-drl.
- TivaWare for C Series Driver Library User’s Manual (literature number SPMU298).
- TPS75118 Fast Transient Response, 1.5-A, Low-Dropout Regulator Data Sheet (literature number SLVS241)
- TMP006 Infrared Thermopile Sensor Data Sheet (literature number SBOS518)
- Texas Instruments’ Code Composer Studio IDE website: www.ti.com/ccs

Additional support:
- RealView MDK (www.keil.com/arm/rvmdkkit.asp)
- IAR Embedded Workbench (www.iar.com)
- Sourcery CodeBench development tools (www.codesourcery.com/gnu_toolchains/arm)
- InvenSense MPU9150 (www.invensense.com/mems/gyro/mpu9150.html)
- Bosch BMP180 (www.bosch-sensortec.com/homepage/products_3/environmental_sensors_1/bmp180_1/bmp180)
4.2 Bill of Materials (BOM)

Table 3 shows the bill of materials for the BOOSTXL-SENSHUB BoosterPack board.

<table>
<thead>
<tr>
<th>Item</th>
<th>Ref Des</th>
<th>Qty</th>
<th>Value</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Manufacturer Part No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>U2</td>
<td>1</td>
<td>BMP180</td>
<td>IC, digital, barometric pressure sensor</td>
<td>Bosch</td>
<td>BMP180</td>
</tr>
<tr>
<td>2</td>
<td>C1-2, C8-9, C11, C13, C15-16</td>
<td>8</td>
<td>100 nF</td>
<td>Capacitor, ceramic, NPO or C0G or X5R, 10 V or higher, 0805 (4)</td>
<td>Murata</td>
<td>GRM21BR71E104KA01L</td>
</tr>
<tr>
<td>3</td>
<td>C4, C6</td>
<td>2</td>
<td>100 nF</td>
<td>Capacitor, ceramic, X7R, ±10%, 10 V or higher, 0805 (4)</td>
<td>Murata</td>
<td>GRM216R71E104KA01L</td>
</tr>
<tr>
<td>4</td>
<td>C5</td>
<td>1</td>
<td>10 nF</td>
<td>Capacitor, ceramic, X7R, ±10%, 10 V or higher, 0805 (4)</td>
<td>Murata</td>
<td>GRM216R71H103KA01D</td>
</tr>
<tr>
<td>5</td>
<td>C3</td>
<td>1</td>
<td>2.2 nF</td>
<td>Capacitor, ceramic, X7R, ±10%, 50 V or higher, 0805 (4)</td>
<td>Murata</td>
<td>GRM216R71H103KA01D</td>
</tr>
<tr>
<td>6</td>
<td>C7, C10, C12, C14</td>
<td>4</td>
<td>1 µF</td>
<td>Capacitor, tantalum, 10 V or higher, Type A</td>
<td>AVX Corp.</td>
<td>TAJA105M020RNJ</td>
</tr>
<tr>
<td>7</td>
<td>C17</td>
<td>1</td>
<td>47 µF</td>
<td>Capacitor, tantalum, 10 V or higher, Type A</td>
<td>Nihicon</td>
<td>F931A476MAA</td>
</tr>
<tr>
<td>8</td>
<td>D1</td>
<td>1</td>
<td>Red</td>
<td>Light emitting diode, 1.7 V forward voltage or less, 0805</td>
<td>Stanley</td>
<td>BR1112H-TR</td>
</tr>
<tr>
<td>9</td>
<td>D2</td>
<td>1</td>
<td>Yellow</td>
<td>Light emitting diode, 0805</td>
<td>Knightbright</td>
<td>APT2012YC</td>
</tr>
<tr>
<td>10</td>
<td>J1-4</td>
<td>4</td>
<td>PEC10SAAN</td>
<td>Header, female, 10-pin, 100-mil spacing, 0.100 inch x 10</td>
<td>Sullins</td>
<td>PPTC101LFBN-RC</td>
</tr>
<tr>
<td>11</td>
<td>RF_PART1-2</td>
<td>2</td>
<td>TFM-110-02-SM-D-A-K-TR</td>
<td>Header, SMT 10x2 pin, shrouded, 0.225 x 0.625 inch</td>
<td>Samtec</td>
<td>TFM-110-02-SM-D-A-K-TR</td>
</tr>
<tr>
<td>12</td>
<td>U4</td>
<td>1</td>
<td>ISL29023</td>
<td>IC, integrated digital light sensor with interrupt</td>
<td>Intersil</td>
<td>ISL29023</td>
</tr>
<tr>
<td>13</td>
<td>U3</td>
<td>1</td>
<td>MPU-9150</td>
<td>IC, nine-axis MEMS motion tracking device</td>
<td>InvenSense</td>
<td>MPU-9150</td>
</tr>
<tr>
<td>14</td>
<td>R1, R4, R9-10</td>
<td>4</td>
<td>10 kΩ</td>
<td>Surface mount resistor, 1/10 W or higher, 0805</td>
<td>Yageo</td>
<td>RC805JR-0710KL</td>
</tr>
<tr>
<td>15</td>
<td>R6</td>
<td>1</td>
<td>5.1 Ω</td>
<td>Surface mount resistor, 1/10 W or higher, 0805</td>
<td>Yageo</td>
<td>RC805JR-075R1L</td>
</tr>
<tr>
<td>16</td>
<td>R7</td>
<td>1</td>
<td>100 Ω</td>
<td>Surface mount resistor, 1/10 W or higher, 0805</td>
<td>Yageo</td>
<td>RC805JR-07100RL</td>
</tr>
<tr>
<td>17</td>
<td>R5, R8</td>
<td>2</td>
<td>0 Ω</td>
<td>Surface mount resistor, 1/10 W or higher, 0805</td>
<td>Yageo</td>
<td>RC805JR-070RL</td>
</tr>
<tr>
<td>18</td>
<td>R3</td>
<td>1</td>
<td>499 kΩ</td>
<td>Surface mount resistor, 1/10 W or higher, 0805</td>
<td>Yageo</td>
<td>RC805FR-07499KL</td>
</tr>
<tr>
<td>19</td>
<td>R11-12</td>
<td>2</td>
<td>3.3 kΩ</td>
<td>Surface mount resistor, 1/10 W or higher, 0805</td>
<td>Yageo</td>
<td>RC805JR-073K3L</td>
</tr>
<tr>
<td>20</td>
<td>U5</td>
<td>1</td>
<td>SHT21</td>
<td>IC, humidity and temperature sensor</td>
<td>Sensirion AG</td>
<td>SHT21</td>
</tr>
<tr>
<td>21</td>
<td>S1-2</td>
<td>2</td>
<td>7914G</td>
<td>Switch, 1P1T, PB momentary, 100 mA, SM, 0.19 x 0.18 inch</td>
<td>Bourns</td>
<td>7914G</td>
</tr>
<tr>
<td>22</td>
<td>U1</td>
<td>1</td>
<td>TMP006AY2FT</td>
<td>IC, infrared thermopile sensor</td>
<td>Texas Instruments</td>
<td>TMP006Y2F</td>
</tr>
<tr>
<td>23</td>
<td>U6</td>
<td>1</td>
<td>TPS75118Q PWP</td>
<td>IC, low dropout voltage regulator, 1.8 V, 1.5 A</td>
<td>Texas Instruments</td>
<td>TPS75118Q PWP</td>
</tr>
</tbody>
</table>

(1) These assemblies are ESD sensitive. ESD precautions shall be observed.
(2) These assemblies must be clean and free from flux and all contaminants. Use of no clean flux is not acceptable.
(3) These assemblies must comply with workmanship standards IPC-A-610 Class 2.
(4) A dielectric with a higher thermal range and/or lower capacitance variation is also permitted (for example, X7R, X9R).
EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User’s Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used. TI currently deals with a variety of customers for products, and therefore our arrangement with the user is not exclusive. TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.

REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User’s Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

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 détaichables

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 this Product 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.

Texas Instruments Japan Limited
(address) 24-1, Nishi-Shinjuku 6 chome, Shinjuku-ku, Tokyo, Japan

http://www.tij.co.jp

【ご使用にあたっての注】

本開発キットは技術基準適合証明を受けておりません。
本製品のご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。
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
http://www.tij.co.jp
EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

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.

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

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.

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.

Agreement to Defend, Indemnify and Hold Harmless. You agree to 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 use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2013, Texas Instruments Incorporated
IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have not been so designated is solely at the Buyer’s risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

<table>
<thead>
<tr>
<th>Products</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio</td>
<td>Automotive and Transportation</td>
</tr>
<tr>
<td>Amplifiers</td>
<td>Communications and Telecom</td>
</tr>
<tr>
<td>Data Converters</td>
<td>Computers and Peripherals</td>
</tr>
<tr>
<td>DLP® Products</td>
<td>Consumer Electronics</td>
</tr>
<tr>
<td>DSP</td>
<td>Energy and Lighting</td>
</tr>
<tr>
<td>Clocks and Timers</td>
<td>Industrial</td>
</tr>
<tr>
<td>Interface</td>
<td>Medical</td>
</tr>
<tr>
<td>Logic</td>
<td>Security</td>
</tr>
<tr>
<td>Power Mgmt</td>
<td>Space, Avionics and Defense</td>
</tr>
<tr>
<td>Microcontrollers</td>
<td>Video and Imaging</td>
</tr>
<tr>
<td>RFID</td>
<td></td>
</tr>
<tr>
<td>OMAP Applications Processors</td>
<td>TI E2E Community</td>
</tr>
<tr>
<td>Wireless Connectivity</td>
<td>e2e.ti.com</td>
</tr>
</tbody>
</table>