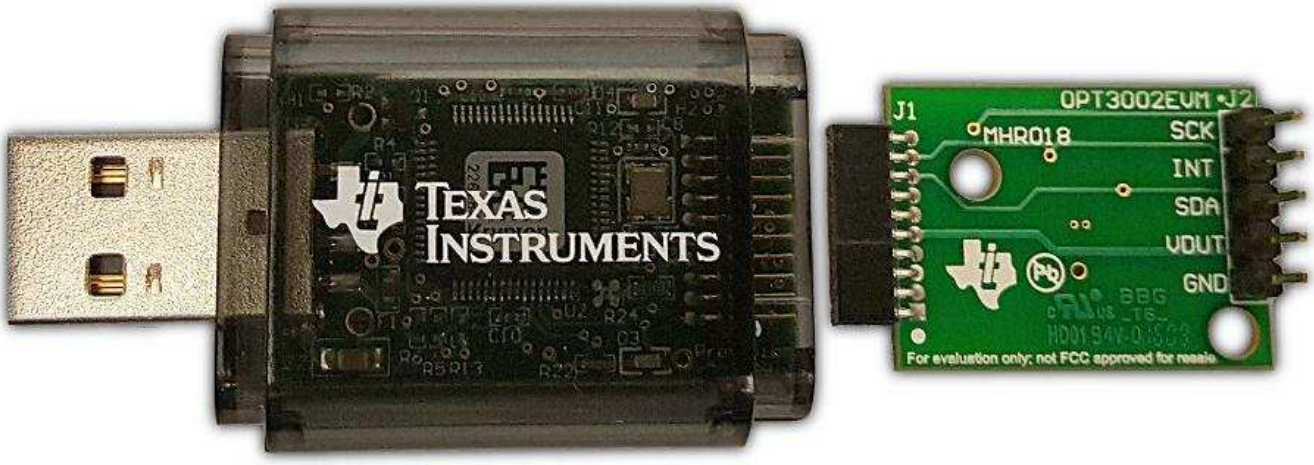
User's Guide
SBOU160–May 2016

OPT3002EVM User's Guide



This user's guide describes the characteristics, operation, and use of the OPT3002 evaluation module (EVM). This user's guide discusses how to set up and configure the software and hardware, and reviews various aspects of the program operation. Throughout this document, the terms evaluation board, evaluation module, and EVM are synonymous with the OPT3002EVM. This document also includes an electrical schematic, printed circuit board (PCB) layout drawings, and a parts list for the EVM.

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1 Overview

The OPT3002 is an ambient light sensor (ALS) with a digital output integrated circuit. The OPT3002 uses a two-wire interface that works with the I^2C protocol, making this device ideal for many applications. The OPT3002EVM is a platform for evaluating the performance of the OPT3002 under various conditions. The OPT3002EVM consists of two PCBs. The first PCB is the SM-USB-DIG board that communicates with the computer, provides power, and sends and receives appropriate digital signals. The second PCB is the OPT3002 test board that contains the OPT3002 device and its support circuitry.

1.1 Kit Contents

Table 1 summarizes the contents of the OPT3002EVM kit. Figure 1 shows the included hardware. Contact the Texas Instruments Worldwide Customer Support Center nearest you if any component is missing. It is highly recommended that you also check the OPT3002 product folder on the TI web site at www.ti.com to verify you have the latest versions of the released software.

Table 1. Kit Contents

Item	Quantity
OPT3002 test board	1
SM-USB-DIG board	1
USB extension cable	1

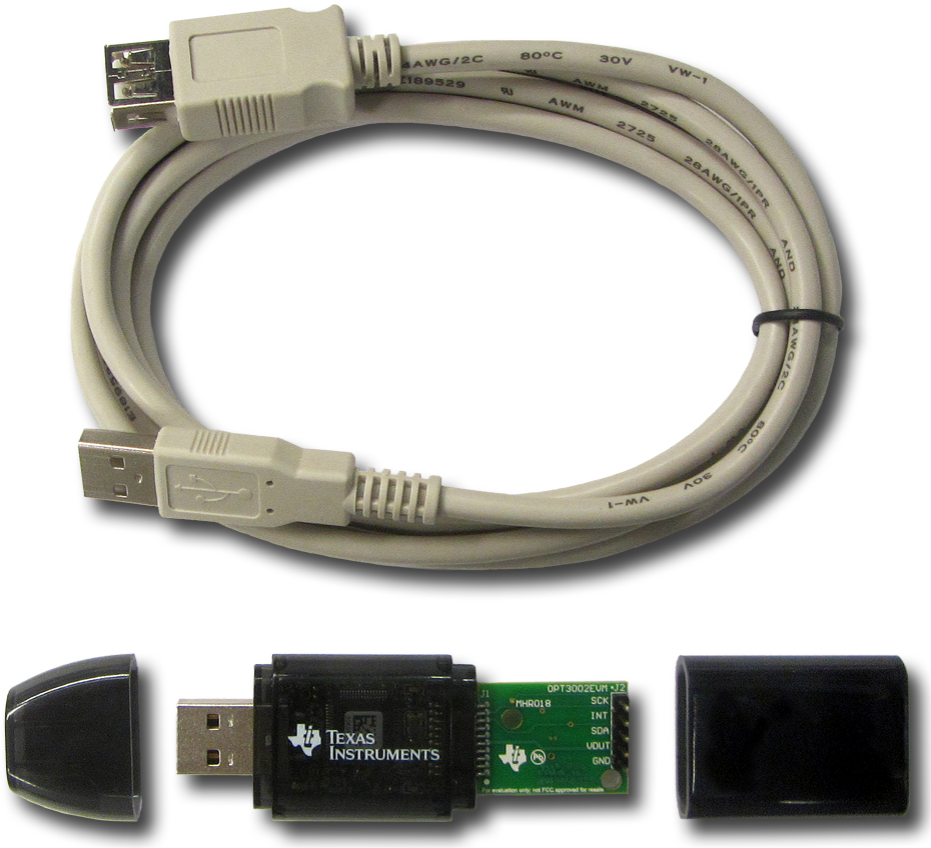


Figure 1. Hardware Included With OPT3002EVM Kit

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1.2 Related Documentation from Texas Instruments

The following documents provide information regarding Texas Instruments' integrated circuits used in the assembly of the OPT3002EVM. This user's guide is available from the TI web site under literature number ***SBOU160***. Any letter appended to the literature number corresponds to the document revision that is current at the time of the writing of this document. For the latest revision, click the link in Table 2. The latest revision is also available from the TI website at www.ti.com, the Texas Instruments' Literature Response Center at (800) 477-8924, and the Product Information Center at (972) 644-5580. When ordering, identify the document by both title and literature number.

Table 2. Related Documentation

Document	Literature Number
OPT3002 product data sheet	SBOS745
SM-USB-DIG Platform user's guide	SBOU098

2 Hardware

Figure 2 shows the system setup for the OPT3002EVM. The computer runs the graphical user interface (GUI) software that communicates with the SM-USB-DIG over a USB connection. The SM-USB-DIG translates the USB commands from the computer into power, I^2C, SPI™, and general-purpose input/output (GPIO) commands for the OPT3002 test board. The OPT3002EVM does not require any additional components to operate.



Figure 2. Hardware Setup

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2.1 Theory of Operation

A block diagram of the OPT3002 test board hardware is shown in Figure 3. The OPT3002 test board contains connections for the power, I^2C, and an interrupt signal. For evaluation purposes, the board also has a 5-pin header that allows the OPT3002 test board to be connected to hardware other than the SM-USB-DIG Platform.

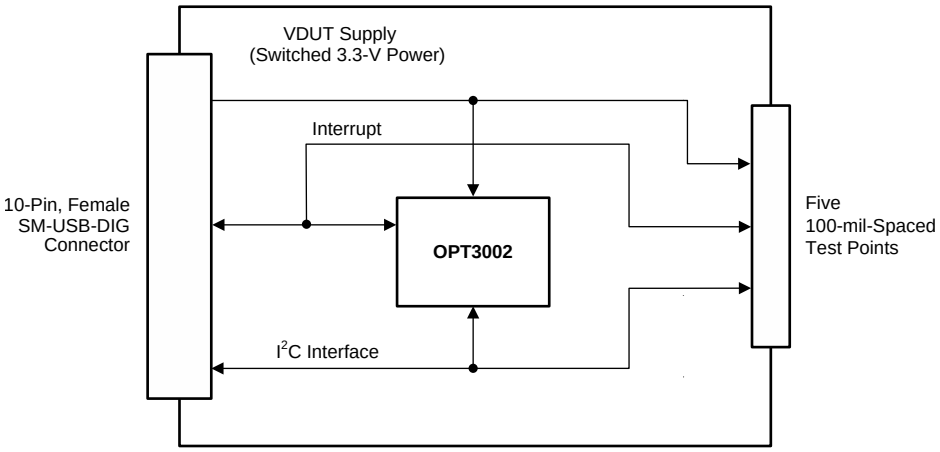


Figure 3. OPT3002 Test Board Block Diagram

2.2 Hardware Overview

If not already assembled, the basic hardware setup for the OPT3002EVM involves connecting the OPT3002 test board to the SM-USB-DIG Platform, and then connecting the USB cable. This section presents the details of this procedure.

CAUTION

Many of the components on the OPT3002EVM are susceptible to damage by electrostatic discharge (ESD). Customers are advised to observe proper ESD handling precautions when unpacking and handling the EVM, including the use of a grounded wrist strap at an approved ESD workstation.

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2.2.1 Typical Hardware Setup

Connect the right-angle female socket on the OPT3002 test board to the right-angle male header on the SM-USB-DIG Platform, as shown in Figure 4. Take special care to make sure that the two 10-pin sockets directly align with each other. Plug the female USB-A cable to the SM-USB-DIG Platform, and then plug the male USB-A cable into the computer.

NOTE: *Always* connect the two boards together before connecting the USB cable to avoid any issues if the connectors are misaligned.

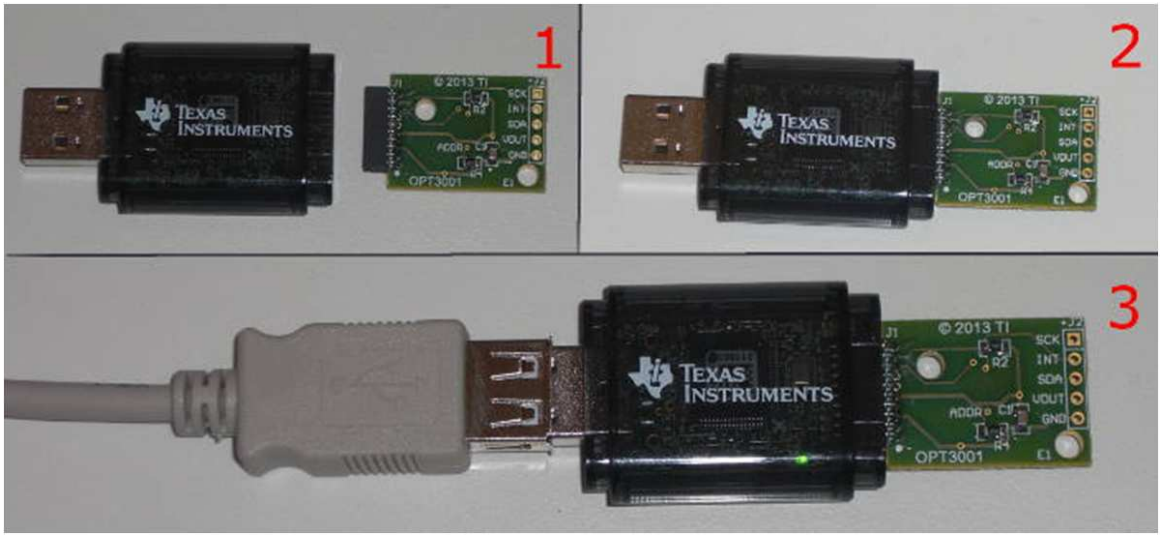


Figure 4. Typical Hardware Connection

Figure 5 shows the typical response when the SM-USB-DIG is plugged into the USB port of the computer for the first time. Typically, the computer responds with a *Found New Hardware, USB Device* pop-up dialog window. The pop-up window then typically changes to *Found New Hardware, USB Human Interface Device*. This pop-up indicates that the device is ready to be used. The SM-USB-DIG Platform uses the human interface device drivers that are part of the Windows® operating system.



Figure 5. Typical Response After Connecting OPT3002EVM to the Computer

In some cases, the *Add Hardware Wizard* appears. If this installation prompt occurs, allow the device manager to install the human interface device drivers by clicking *Yes* at each request to install the drivers.

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3 Software

This section describes the installation and operation of the OPT3002EVM software.

3.1 Hardware Requirements

The OPT3002EVM software has been tested on the Windows 7® operating system (OS) with United States regional settings. The software should function correctly on other Windows operating systems.

3.2 Software Installation

The OPT3002EVM software is available through the OPT3002EVM Product Folder on the TI web site (www.ti.com). To install the software to your computer, launch the OPT3002EVM installation file, *setup_OPT3002_EVM.exe*.

The OPT3002EVM software then begins the installation process, as shown in Figure 6.



Figure 6. OPT3002EVM Software-Installation Launch

Follow the prompts shown in Figure 7 to install the OPT3002EVM software. After the prompts, the OPT3002EVM GUI software completes installation.

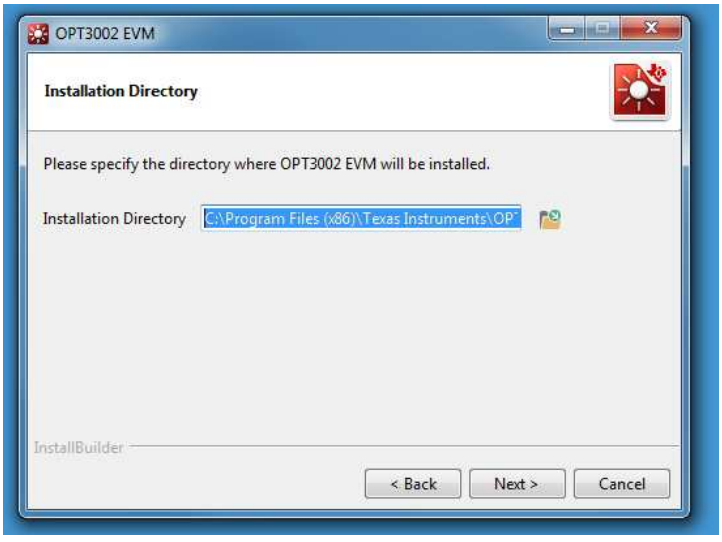


Figure 7. Software-Installation Prompts

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3.3 Launching the Software

With the OPT3002EVM properly connected (see Figure 4), launch the EVM GUI software from the Windows *Start* menu by navigating to the folder titled *Texas Instruments* and clicking on the *OPT3002 EVM* application. The software launches with a screen similar to that shown in Figure 8.

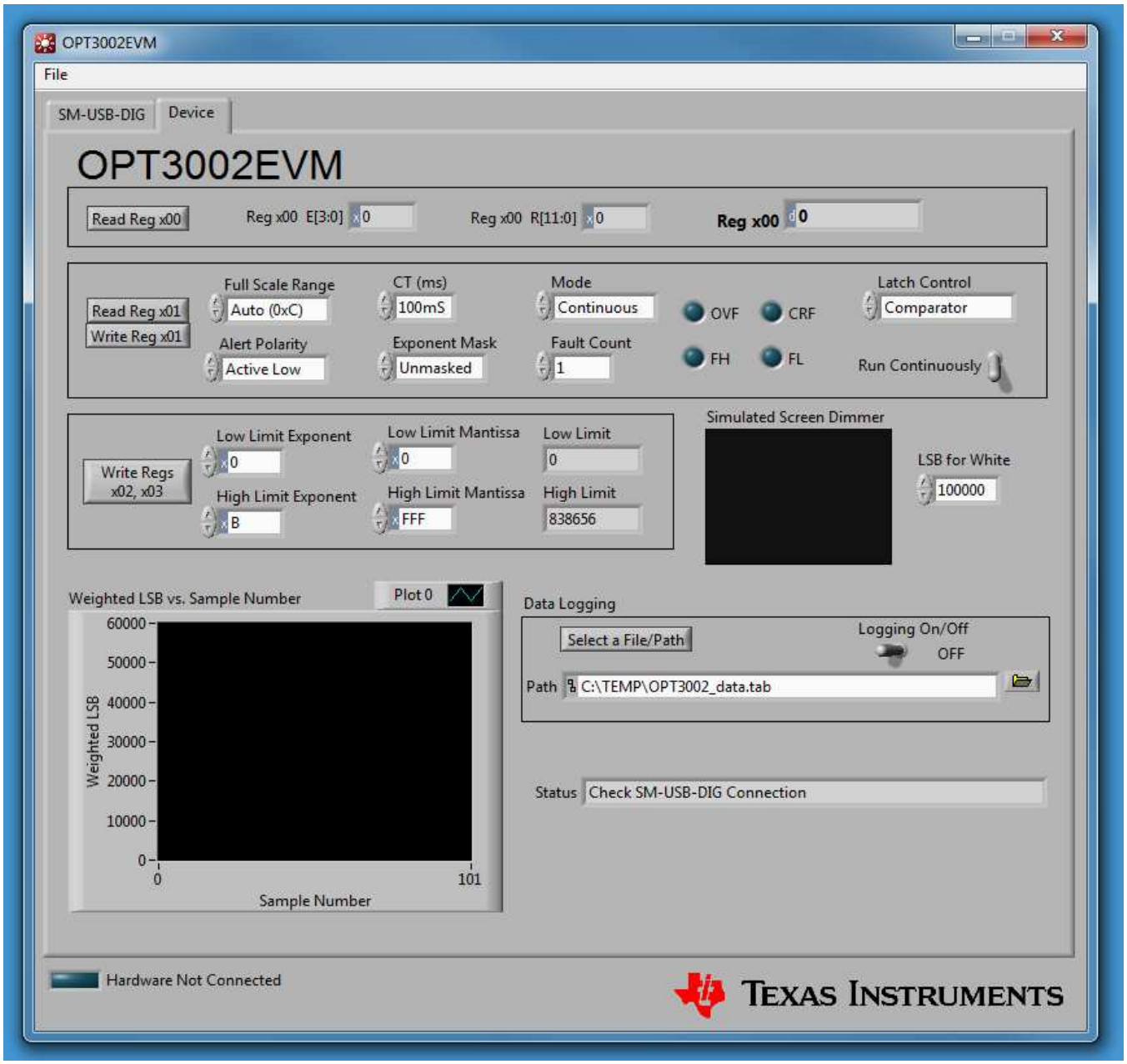


Figure 8. Main Operation Screen

If the message shown in Figure 9 appears when the OPT3002EVM GUI software is launched, disconnect all components of the OPT3002EVM kit, and repeat the hardware assembly and connection instructions.



Figure 9. Hardware Error Message

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3.4 Software Operation

This section primarily discusses software operation and basic GUI functionality, and gives a description of the various tabs.

3.4.1 Getting Started

With the hardware properly connected, and the EVM software installed and operating, make sure that the power to the device is turned on by checking the LED on the SM-USB-DIG board and the VDUT indicator on the SM-USB-DIG tab in the GUI software, as shown in Figure 10. The GUI has a primary window that is used to configure and read from the OPT3002EVM, along with a secondary window used to access different features of the OPT3002EVM.

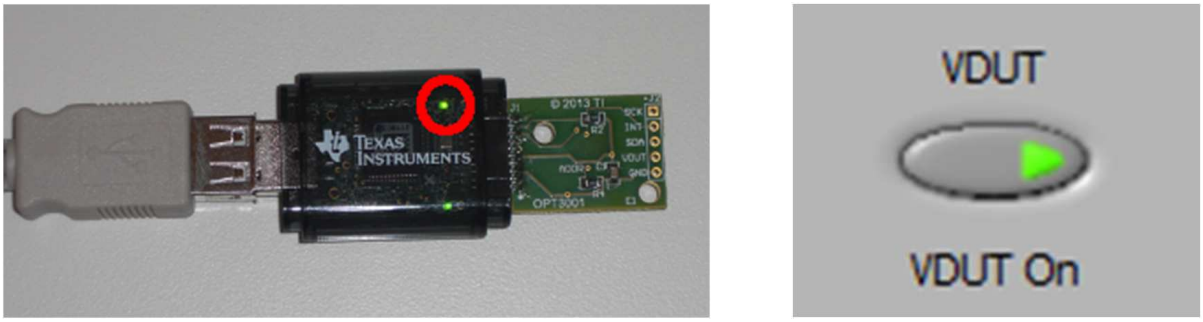


Figure 10. Power Indicators

If the hardware address of the OPT3002EVM on the EVM board has not been reconfigured, then the address fields shown on the SM-USB-DIG tab are set by default, as shown in Figure 11.

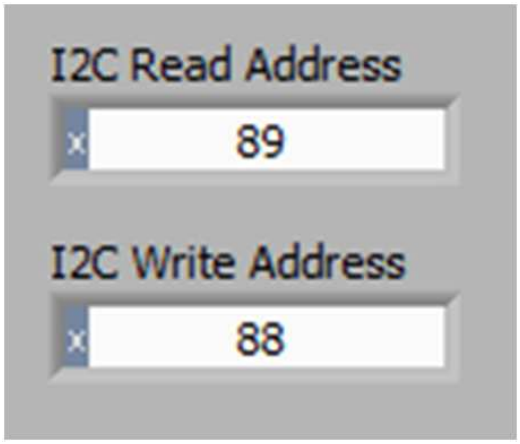


Figure 11. Default I²C Address Selection

To quickly start using the device, leave the default settings selected, click the *Write Reg x01* button, and then click the *Run Continuously* flip switch. The software then begins capturing data from the device. This quick-start procedure is a good test to make sure everything is operational. To stop the computer from capturing data and plotting, click *Run Continuously* again.

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3.4.2 Feature Descriptions

Register x00 is a read-only register that holds the range and converted value. These data are used (per the OPT3002 data sheet) to compute the output, labeled *Reg x00* in Figure 12. Click the *Read Reg x00* button to update these fields and the plot with the latest values from the OPT3002EVM.



Figure 12. *Register x00* **Button and Recorded Values**

Register x01 configures the OPT3002 device and provides feedback about the state of the device; the bit names and full descriptions are shown in the OPT3002 data sheet. Figure 13 shows the control and status register bits for register x01. All the configurable read-and-write bits have a drop-down menu to select the appropriate value. All the read-only status bits have an associated small, blue indicator. Two buttons are provided to operate register x01 because some of the bits have read and write capability. The *Full Scale Range* selection field has four identical automatic range modes: 0x0C, 0x0D, 0x0E, and 0x0F. Also, the *Mode* selection field has two identical continuous sampling options: 0x02 and 0x03.

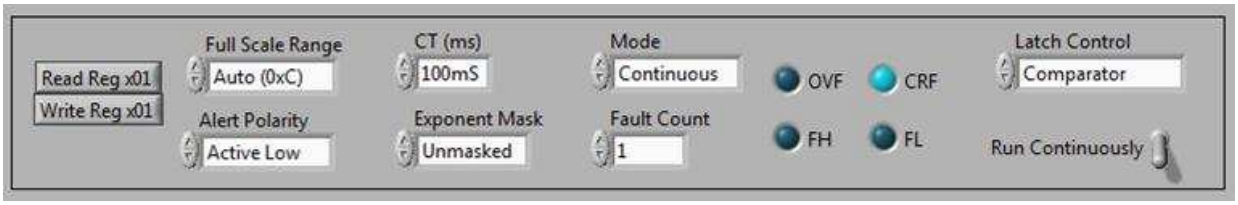


Figure 13. Register x01 Control and Status Register Bits

Registers x02 and x03 enforce low and high limits, respectively, on the output ranges (exponent) and values (mantissa) from the OPT3002. These registers are programmed using the appropriate fields, as shown in Figure 14. Change the values of the data in these fields to write and read the values from the OPT3002. No button press is required; however, make sure to exit the text field for the field to update.

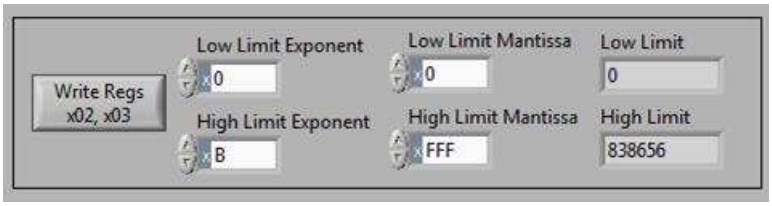


Figure 14. Registers x02 and x03 LSB Limit Controls

There is a simulated screen backlight dimmer represented by a rectangle, shown in Figure 15. This rectangle changes from black, through 254 shades of grey, to white, depending on the value of the output measured by the OPT3002. The rectangle shows a brighter backlight for high-output situations, and a dim backlight for low-output situations. The low limit (darkest backlight) is always 0, and the high limit (brightest backlight) can be adjusted with the *LSB for White* numeric field.

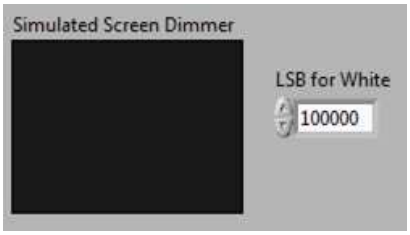


Figure 15. Simulated Screen Backlight Dimmer

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The software provides a plot of the register x01 output labeled *Weighted LSB vs. Sample Number*, as shown in Figure 16. As readings are collected, the plot is updated with those values. The y-axis is autoscaled to show the magnitude of the output value recorded, and has a visible history of 100 samples along the x-axis. To reset the plot, return to the *SM-USB-DIG* tab and click the *Re-Initialize* button, as shown in Figure 17. To access the plot axis range and formatting, right-click the plot.

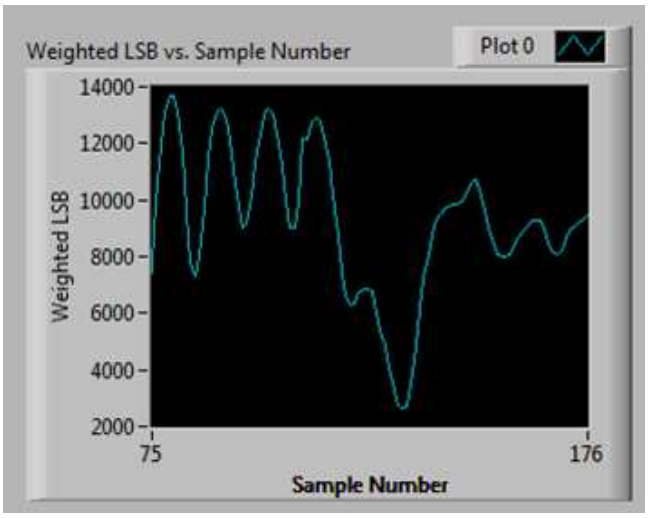


Figure 16. Weighted LSB vs. Sample Number Plot

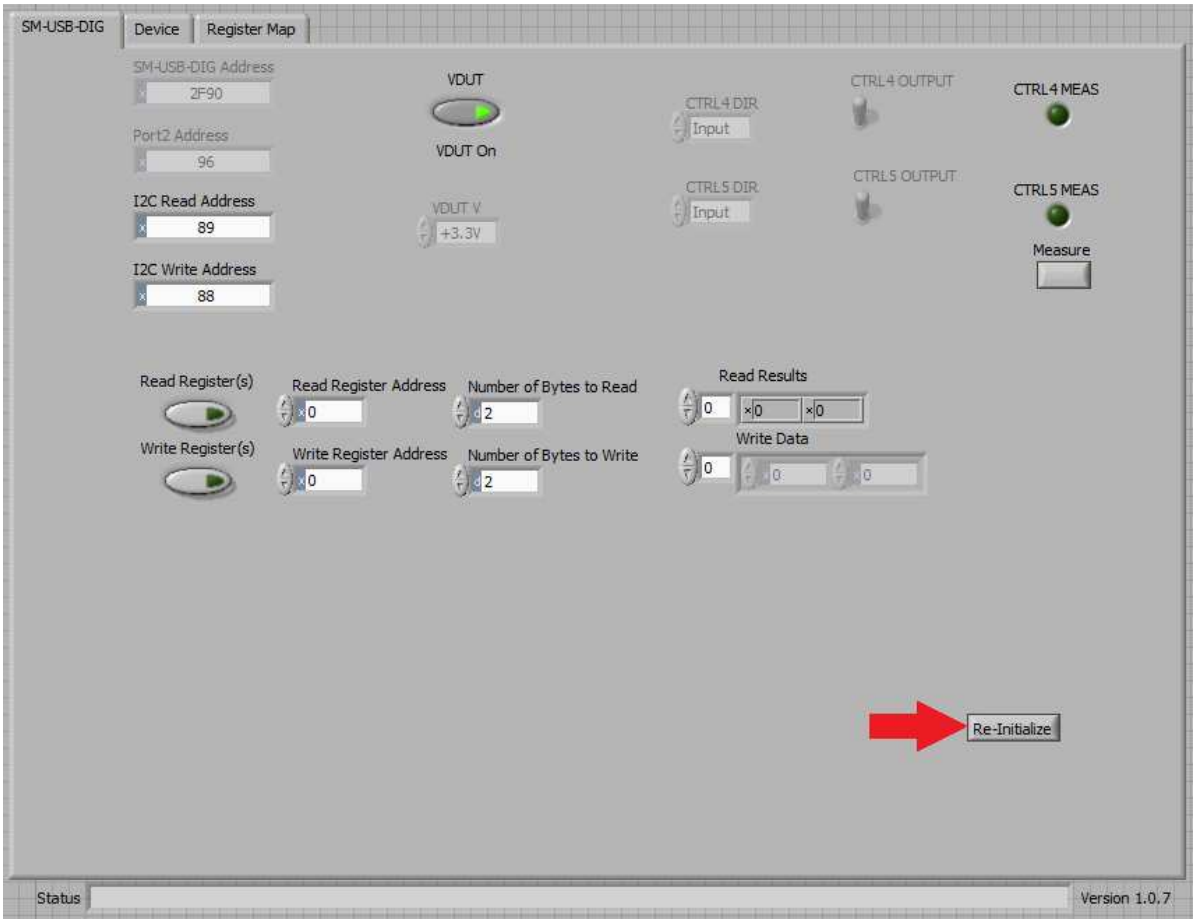


Figure 17. Re-Initialize Button

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There is a data logging feature included in the software that recorda the date and time from the host computer, along with the measured value reported by the device. After a destination file is selected by clicking *Select a File/Path*, as shown in Figure 18, turn on the *Logging On/Off* selector switch to append data to that file in .tab format.

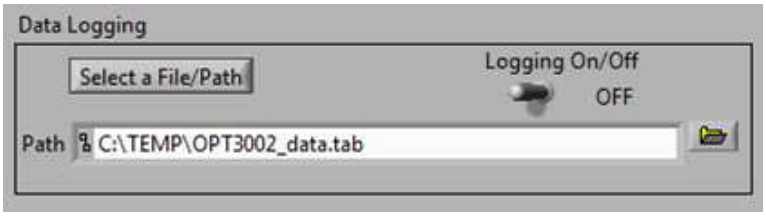


Figure 18. Data Logging Setup and Enable

4 Schematic, PCB Layout, and Bill of Materials

4.1 Schematic

Figure 19 shows the complete schematic of the OPT3002 test board. SDA and SCK are pulled up by the SM-USB-DIG Platform; therefore, there are no pull-up resistors present on the board. R2 is a pull-up resistor for the interrupt signal, C1 is a bypass capacitor for VDUT, and R4 is a jumper to tie the address pin to ground. If another address is desired, remove R4 and install a wire to the pad or via, and then to the appropriate signal source.

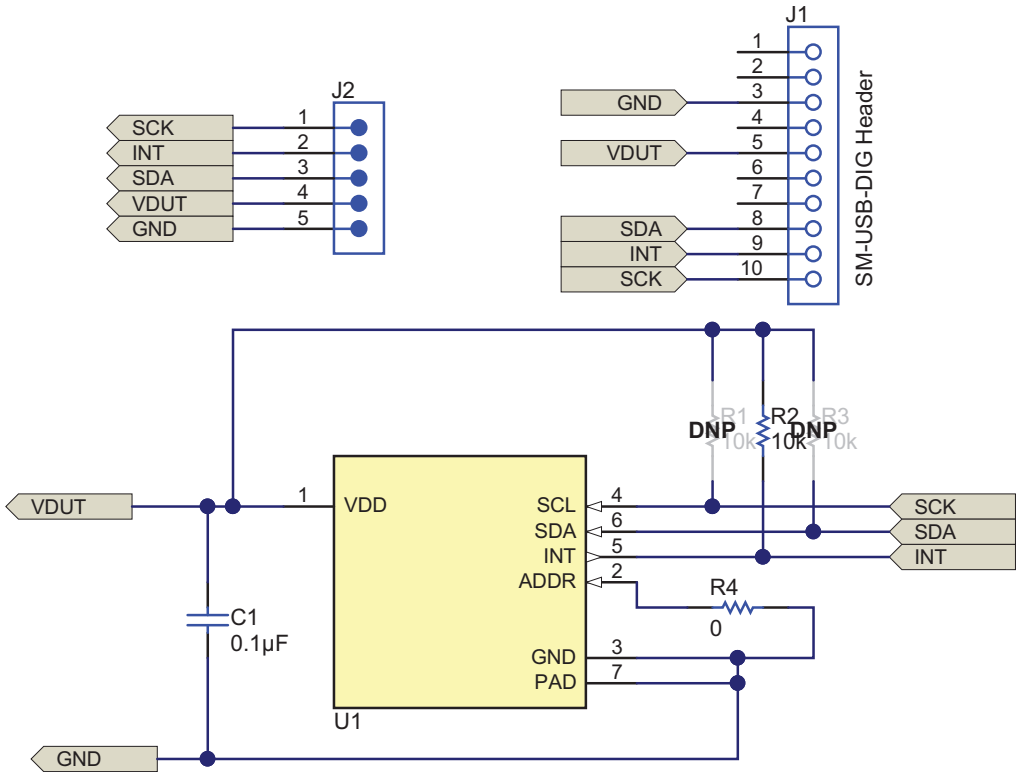


Figure 19. OPT3002 Test-Board Schematic

The OPT3002 is mounted on the back side of the board; therefore, the LED light from the SM-USB-DIG is directed away from the device. Also, no additional LEDs are installed on the test board in order to reduce total ambient light around the device. The back side of the board is mostly planar; mounting holes are included to accommodate evaluation.

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4.2 PCB Layout

Figure 20 and Figure 21 show the top and bottom PCB layers of the test board, respectively. Figure 22 and Figure 23 show the assembly drawings of the top and bottom PCB layers, respectively.

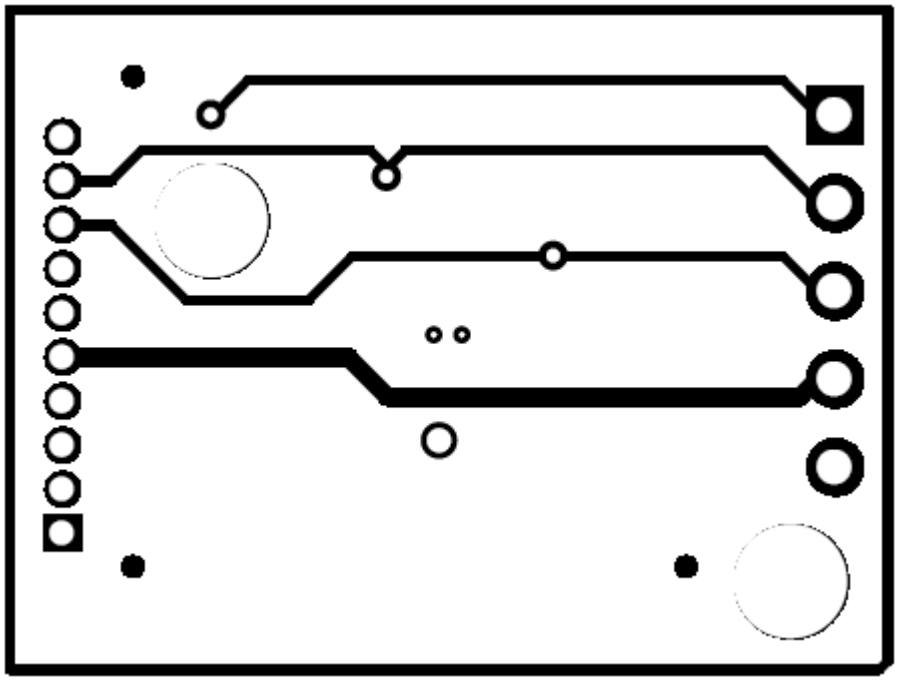


Figure 20. PCB Top Layer

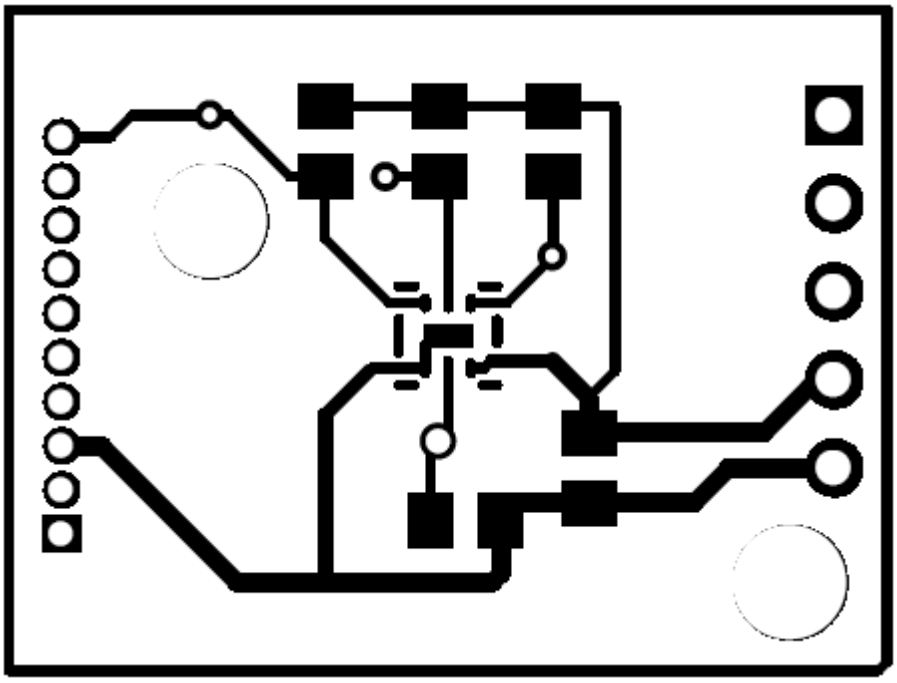


Figure 21. PCB Bottom Layer

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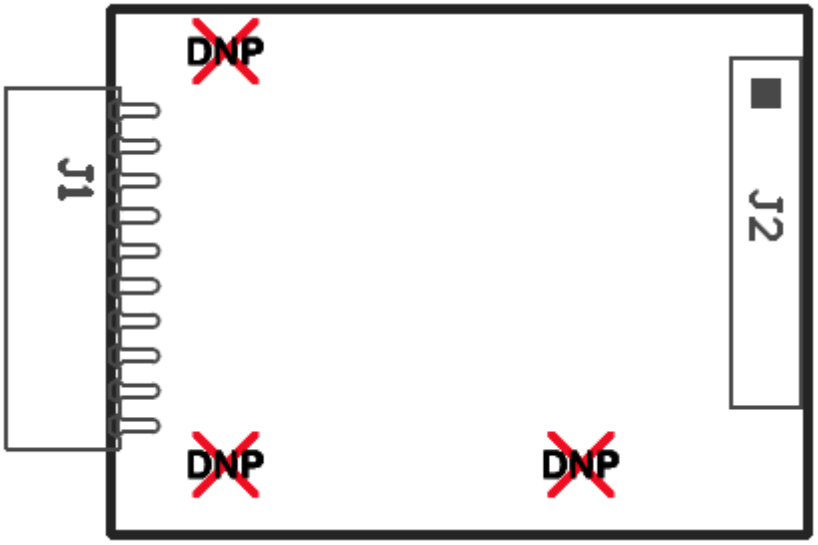


Figure 22. PCB Top-Layer Assembly Drawing

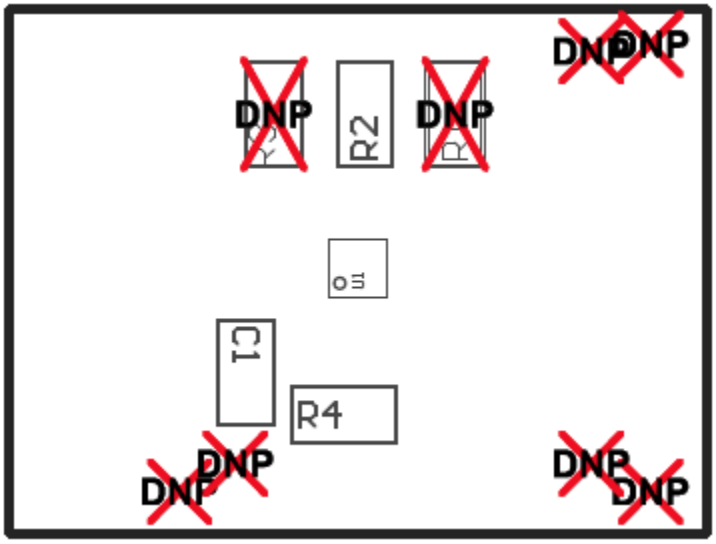


Figure 23. PCB Bottom-Layer Assembly Drawing

4.3 Bill of Materials

Table 3 lists the bill of materials for the OPT3002 test board.

Table 3. OPT3002 Test Board Parts List

Qty	RefDes	Description	Part Number	MFR
1	C1	CAP, CERM, 0.1uF, 50V, +/-10%, X7R, 0805	08055C104KAT2A	AVX Corp.
1	J1	Receptacle, 50mil 10x1, R/A, TH	851-43-010-20-001000	Mill-Max
1	R2	RES, 10k ohm, 5%, 0.125W, 0805	CRCW080510K0JNEA	Vishay Dale
1	R4	RES, 0 ohm, 5%, 0.125W, 0805	CRCW08050000Z0EA	Vishay Dale
1	U1	Light Sensor, DNP0006A	OPT3002DNP	Texas Instruments

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STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, or documentation (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms and conditions that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms and conditions do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for any defects that are caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.

   2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

3 *Regulatory Notices:*

   3.1 *United States*

      3.1.1 *Notice applicable to EVMs not FCC-Approved:*

      This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

      3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

      CAUTION

      This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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

      FCC Interference Statement for Class A EVM devices

      NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-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.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

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4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

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