OPT8241 Evaluation Module

This document explains the details of the hardware and its usage and provides a basic introduction to the accompanying software. Throughout this document, camera development kit, evaluation module, and the abbreviations CDK and EVM are used interchangeably and are synonymous with the term OPT8241-CDK-EVM.

Contents

1 Introduction

The OPT8241-CDK-EVM showcases TI's high-performance 3D Time-of-Flight (ToF) sensor OPT8241 and the ToF controller OPT9221 (TFC). The EVM is designed to be reconfigurable and modular in order to enable evaluation at a wide range of operating points and is not optimized for any specific application, by default. The accompanying software is designed to enable evaluation of the TI 3D ToF technology at various levels of detail.

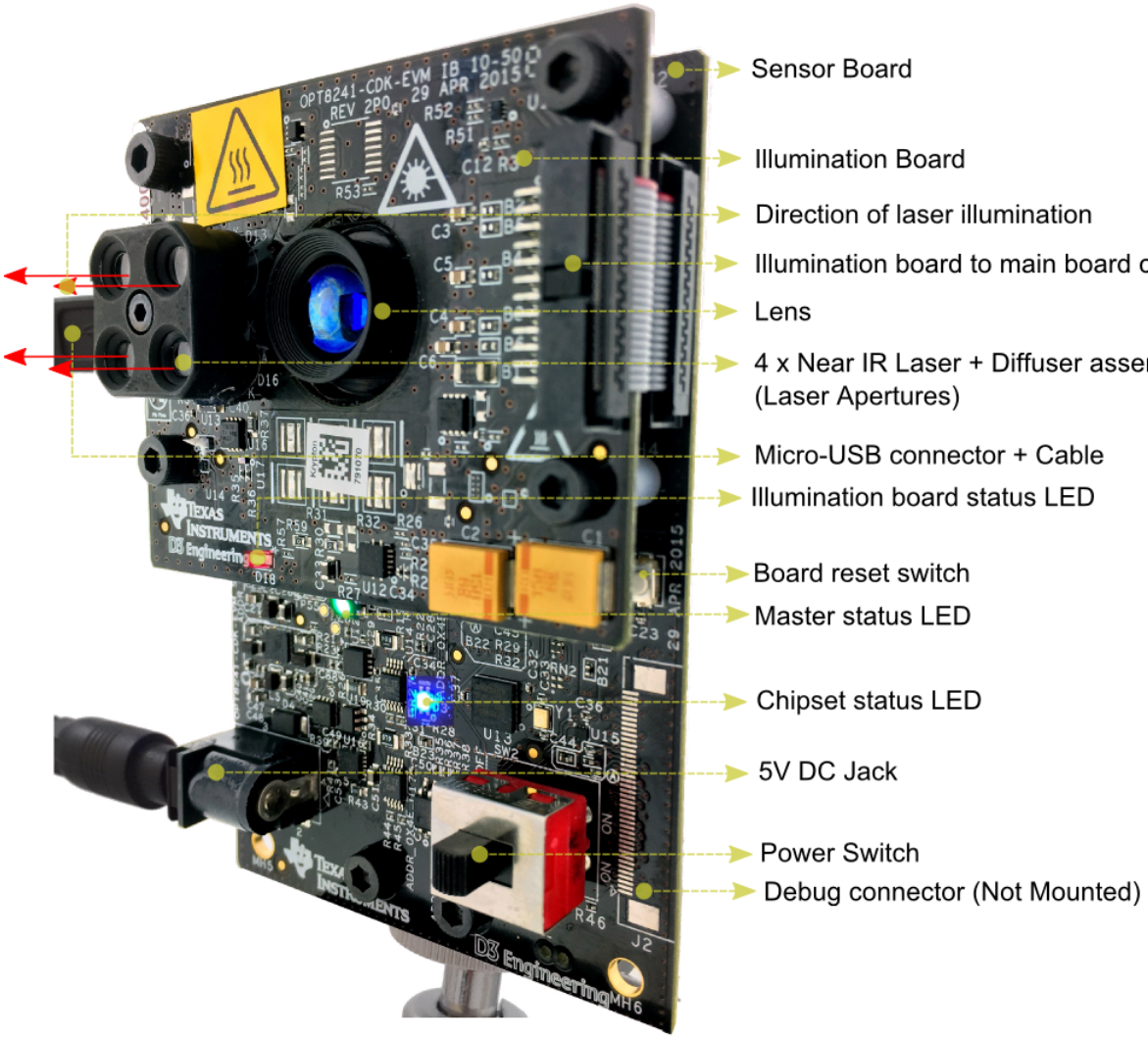

Figure 1. Components of the EVM

2 SAFETY

This Laser Device is designed at Class 1 during normal operation. While the OPT8241-CDK-EVM development boards meet the Class 1 classification requirements under EN/IEC60825-1 2007, users are advised to take the necessary safety caution when using the OPT8241-CDK-EVM. First, examine the board for any damage before the board is powered. Check that the diffusers and diffuser mounts are properly secured on the laser diodes. If there is any damage, stop operating by removing power from the CDK immediately. Opening the laser diffuser assembly may lead to hazardous radiation exposure. Any kind of circuit modification to the board or use of software or firmware other than the recommended EVM tools and firmware provided by TI may lead to violation of class 1 safety limits. Due to the small size and unsuitability for labeling, laser safety related labels are included herein, rather than on the product. Additional safety and manufacturer labels are included in the safety section of the OPT8241-EVM Quick Start Guide.

There is no scheduled maintenance required for the OPT8241-CDK-EVM; any servicing and maintenance of this EVM shall be performed only by trained Texas Instruments or TI-appointed trained personnel. Any modification or significant damage to the CDK could potentially cause the CDK to operate outside of the EN/IEC60825 2007 Class 1 classification limits.

WARNING

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Figure 2. Explanatory Label

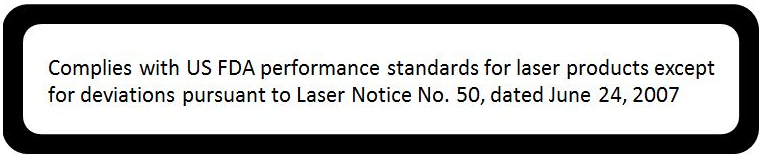

Figure 3. Certification Label

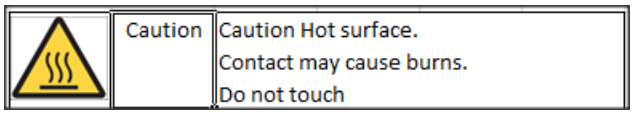

Figure 4. Hot To Touch

3 Hardware

3.1 Block Diagram

The OPT8241 sensor provides the modulation for the internal pixel array as well as for the external illumination drivers. The illumination drivers in-turn drive the laser illumination on the illumination board. The receiver light is focused using a lens on to the OPT8241 sensor. The depth correlation data obtained by the OPT8241 sensor is digitized and provided to the OPT9221 ToF Controller (TFC), the TFC then processes and provides the distance output for each pixel. A Cypress FX2 chip is used as a USB transceiver to enable PC-based acquisition of data and to control the configuration of the CDK dynamically.

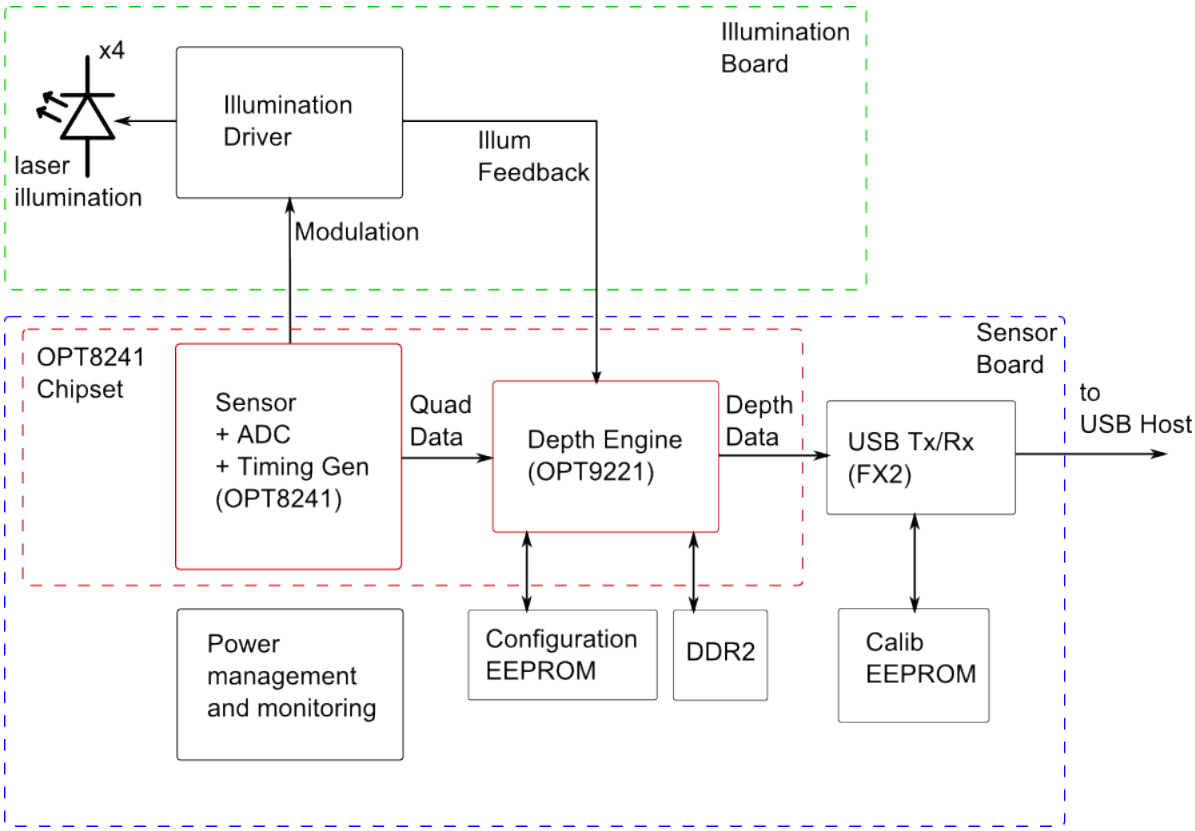

Figure 5. CDK Diagram

3.2 Design Specifications

The hardware consists of an assembly of customizable boards. The hardware comes assembled by default and it is not recommended to disassemble the hardware. The individual boards are listed below with their main constituents:

- Sensor board
  - Sensor, lens holder, lens
  - TFC, DDR2 memory
  - USB transceiver
- Illumination board
  - Lasers , diffuser, diffuser holder
  - Laser driver

The overall specifications of the CDK hardware are listed in Table 1.

Table 1. Specifications

Item	Specification
Time of Flight Sensor	OPT8241
Time of Flight Controller	OPT9221
Sensor resolution	320 x 240 (QVGA)
Field of view	74.4 (H) x 59.3 (V)
Frame-rate	12 … 60 fps
Illumination source wavelength	850 nm
Operating range	Up to 4 m
Connectivity	USB 2.0, micro connector
Cable	1.8 m, Micro USB B-type and standard Male A type
Operating Conditions	0°C to 40°C (Ambient)
CDK Power supply max power	15 Watt
Size	88.8 mm (L) x 60 mm (W) x 24.3 mm (H)

3.3 Sensor Board

The sensor board consists of all interconnects and the corresponding connectors. The illumination board is mechanically held to the sensor board using spacers. The electrical connections between illumination board and sensor board are achieved using a flex cable. The sensor board also provides an extension connector for connecting the boards to an external connector.

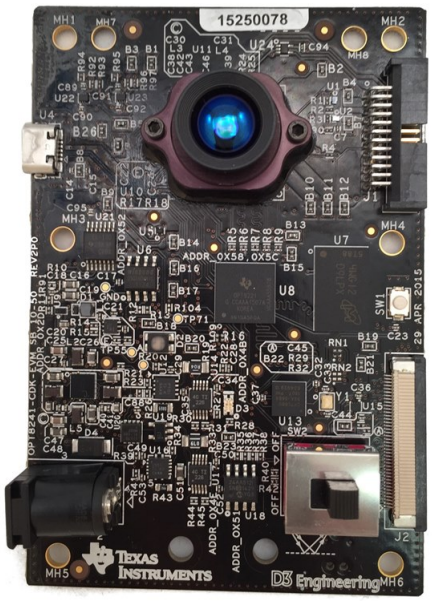

Figure 6. Sensor Board

The specifications for the sensor board are listed in Table 2.

Table 2. Sensor Board Specifications

Item	Specification(*)
Size	88.8 mm (L) x 60 mm (W) x 18.9 mm (H)
Modulation frequency	up to 100 MHz

3.3.1 Indicator LEDs

The sensor board has 2 LEDs for indicating various operating states of the board. The master LED indicates the overall status of the board and the TFC LED indicates the status of the Time-of-Flight chipset. The various states of the board are listed in Table 3.

Table 3. LED Indicator States

State	Master LED	TFC LED	Status Type
All OK, Streaming OFF	Bright Green	Blue	Info
All OK, Streaming On	Cyan	X	Info
TFC Test Mode Enabled	X	Off	Info
Firmware Upgrade in progress	Blink (Magenta)	X	Info
Firmware Upgrade done	Magenta	X	Info
DC Jack unplugged	Dimmed colors	X	Info
Overtemperature	X	Magenta	Warning
TFC booted, but status failed	X	Red	Error
TFC did not boot	Blink (Red)	Off	Error

In usual operating conditions, the master LED should be green/cyan and the TFC LED should be blue.

3.3.2 Power Switch

The power switch controls the power to both the sensor and the illumination board. The switch controls are shown in Figure 7.

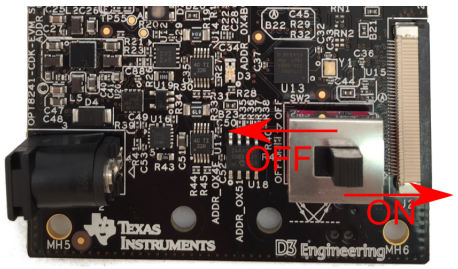

Figure 7. Power Switch

3.3.3 Reset Switch

The reset switch resets the entire board without the need to power-cycle the board. As part of the reset process, the reset triggers a USB connect and disconnect on the USB and output data streaming will stop. This may cause the evaluation software on the PC to misbehave if the software is in connected state. Disconnect and connect operations on the software should restore the CDK operation with reset parameters. Figure 8 shows the location of the reset switch.

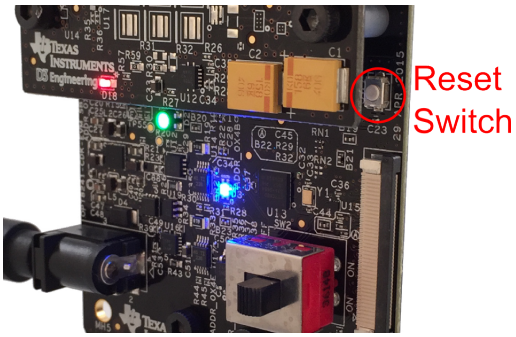

Figure 8. Reset Switch

3.3.4 Lens Assembly

The lens and the lens mount are both custom parts. To allow the use of standard off-the-shelf lenses, a standard M12 lens mount footprint has been provided.

3.3.5 Tripod Mount

A tripod mount comes assembled with the hardware. The tripod mount can be unscrewed from the assembly, if necessary. Figure 9 shows the tripod mount location and the screws that hold the tripod mount to the rest of the assembly.

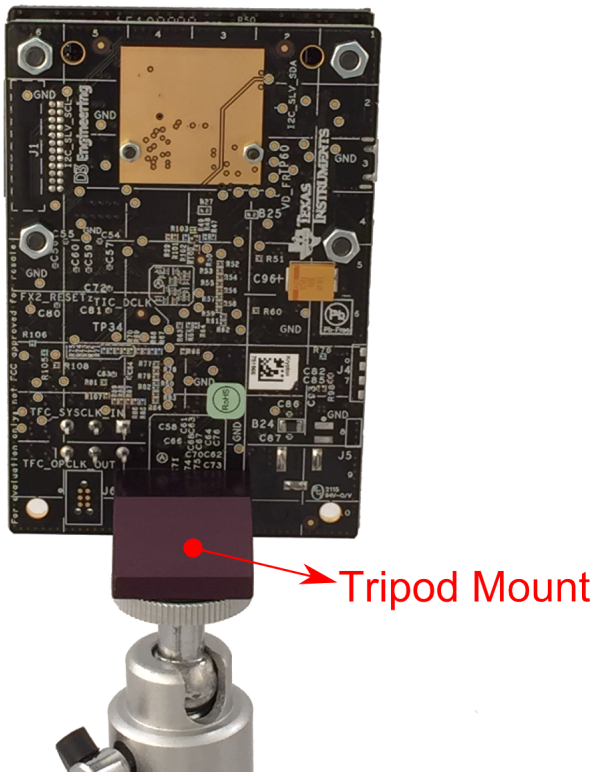

Figure 9. Tripod Mount

3.4 Illumination Board

The illumination board consists of 4 IR lasers mounted with diffusers and the laser driver ckt. The optical output power of the illumination board is controlled using an I^2C interface-based digital potentiometer. The voxel viewer software can be used to configure the digital potentiometer. The modulation control of the illumination is done by the OPT8241 sensor and the corresponding signals from the sensor board to the Illumination board via a flex cable.

Table 4 lists the specifications of the illumination boards.

Table 4. Illumination Board Specifications

Item	Specification[1]
Size	60 mm (W) x 48.5 mm (L) x 12.1 mm (H)
Illumination type	4 x Near IR Laser
Average Output Power(^)	1.5 W
Peak optical output power	10 W
Modulation frequency	12-MHz to 80-MHz square wave at 50% duty cycle
Pulse train width	18 µs–28 ms
Wavelength	850 nm
Laser Beam Divergence	80° at 90% power relative to the center
Laser Beam Shape	Circular
Transverse Beam Mode	Diffused
Diffuser Material	EDC-80, RPC photonics

(1) All values are typical.

The illumination power can be changed only between 40% to 100% of the total power. Values below 40% of the maximum power are not supported. Since each board's maximum power is individually tuned to make sure that the 100% power setting meets the laser safety requirements, the valid steps between 40% to 100% power can differ across CDKs.

3.5 Power Supply

The image of the power supply recommended for use with the CDK along with all the blade options is shown in Figure 10.

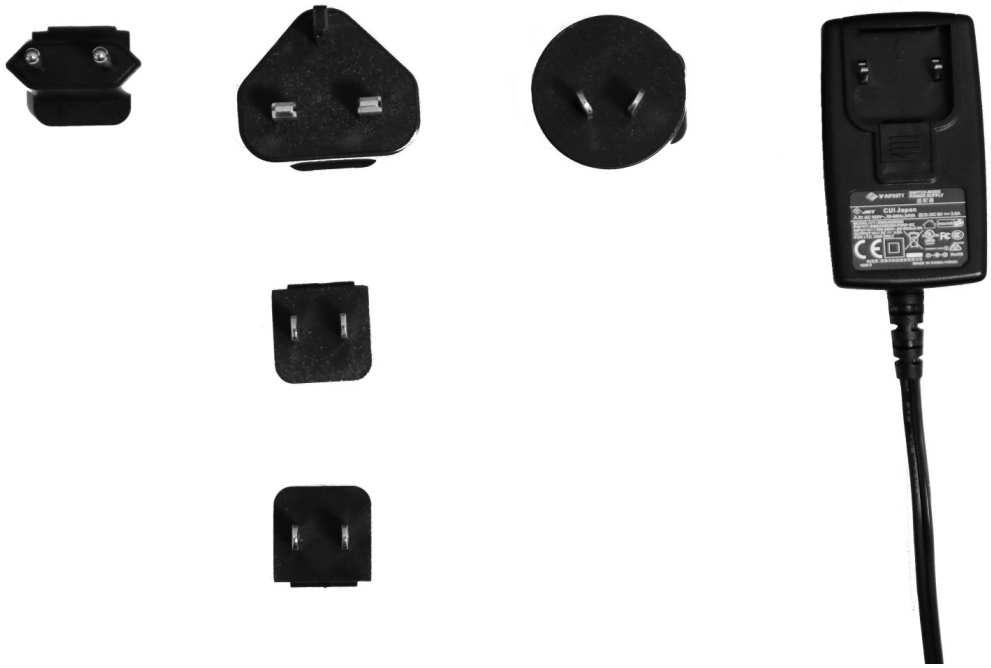

Figure 10. Power Supply

The power supply specifications are shown in Table 5.

Table 5. Power Supply Specifications

Item	Specification[1]
Part Number	EMSA050300-P5RP-SZ
Output Voltage	5 V
Output Current	Up to 3 A
Input Voltage	90 ≈ 264 VAC
Frequency	47 to 63 Hz
Efficiency	Level V
Blade options	US, UK, Europe, Australia, China

(1) All values are typical.

NOTE: TI recommends using an external power supply that complies with applicable regional safety standards such as (by example) UL, CSA, VDE, CCC, PSE, and so forth.

4 Calibration

The CDK is factory-calibrated. The calibration on the CDK is for demonstration purposes only and is not meant to be treated as the most accurate calibration possible. Since the CDK can be configured dynamically using the software, the CDK goes out of calibration whenever a critical parameter is changed. Three default profiles are provided in the hardware to serve as templates. Table 6 lists the default calibration profiles.

Table 6. Calibration Profiles

Parameter	Long Range	Short Range	High Ambient
Parent Profile	Lens Only	Long Range	Long Range
Frame rate (fps)	30	60	30
Sub-Frames	4	2	4
Quads	6	6	6
Integration Duty Cycle (%)	30	10	5
De-aliasing	Enabled	Enabled	Enabled
Illumination Power (%)	100	40	100
Unambiguous Range (m)	10	5	5
Base Frequency (MHz)	60	60	60
De-aliasing Frequency (MHz)	40	40	40
Usable Range	4 m	1.5 m	1.5 m
Calibrations performed	Temperature, Common phase offset, Pixel to Pixel, Pixel cross-talk (1)	Common phase offset(2)	Common phase offset(2)

(1) Since Long range profile derives from lens calibration profile, lens calibration is not redone in long range profile.
(2) Profiles that have a parent derive all the calibrations from the parent. Calibrations in a child override the calibrations derived from the parent.

Calibration is very sensitive to system parameter changes. Any change in a parameter value could put the CDK in a non-calibrated state. The most common parameter changes that mandate re-calibration are listed in Table 7.

Table 7. Calibration Sensitivity Table

Parameter Changed	Re-Calibration Required?		
	Common phase offset	Pixel-to-Pixel Differences	Non-Linearity Calibration, Pixel Cross-Talk Calibration
Unambiguous range (any change in modulation frequency)	Yes	Yes	Yes
Frame rate, number of quads, number of sub-frames (any change in quad timing)	Yes, but to a small extent	No	No
Integration duty cycle	Yes, but to a small extent	No	No
Illumination power	Yes	No	No

5 Software

The CDK is supported by the open source 3D Camera software development kit – Voxel-SDK. To make the evaluation easier, Voxel Viewer, a closed source viewer built on top of Voxel SDK is provided by TI. The viewer supports the following functionality:

- View the following streamed data real-time:
  - Phase
  - Amplitude
  - Ambient
  - Distance
  - Depth
  - Point cloud
- Configure the camera settings
- Basic statistics:
  - Temporal and spatial averaging
  - Temporal and spatial standard deviation
  - Histogram
- Filters (Spatial and temporal):
  - Filter addition/deletion/insertion
  - Configuration of filter coefficients
- Calibrate the camera
- OPT9221 firmware update

The details of the viewer are covered in the Voxel Viewer User's Guide.

5.1 Firmware upgrade

The CDK has two firmware. The FX2 firmware and the TFC (OPT9221) firmware. Both the firmware are stored in separate EEPROMs. Firmware upgrade is a critical activity and the following precautions must be adhered to:

- The CDK should be adequately powered using the recommended power adapter.
- Only the recommended software should be used for firmware upgrade.
- Loading firmware other than the firmware provided by TI is not recommended and could lead to hardware failure.

5.1.1 FX2 Firmware upgrade

FX2 firmware upgrade is accomplished using the Cypress Control Center tool. The procedure follows:

- Launch the cypress control center tool. If the CDK is connected, the CDK is listed in the control center tool.
- Choose "TI 3DTOF CDK OPT8241" among the devices listed.
- Click on the menu option – **Program → FX2 → 64KB EEPROM**.
- Choose the provided firmware file and click on open to start the programming.
- If the programming goes through, the status bar shows "Programming Succeeded".

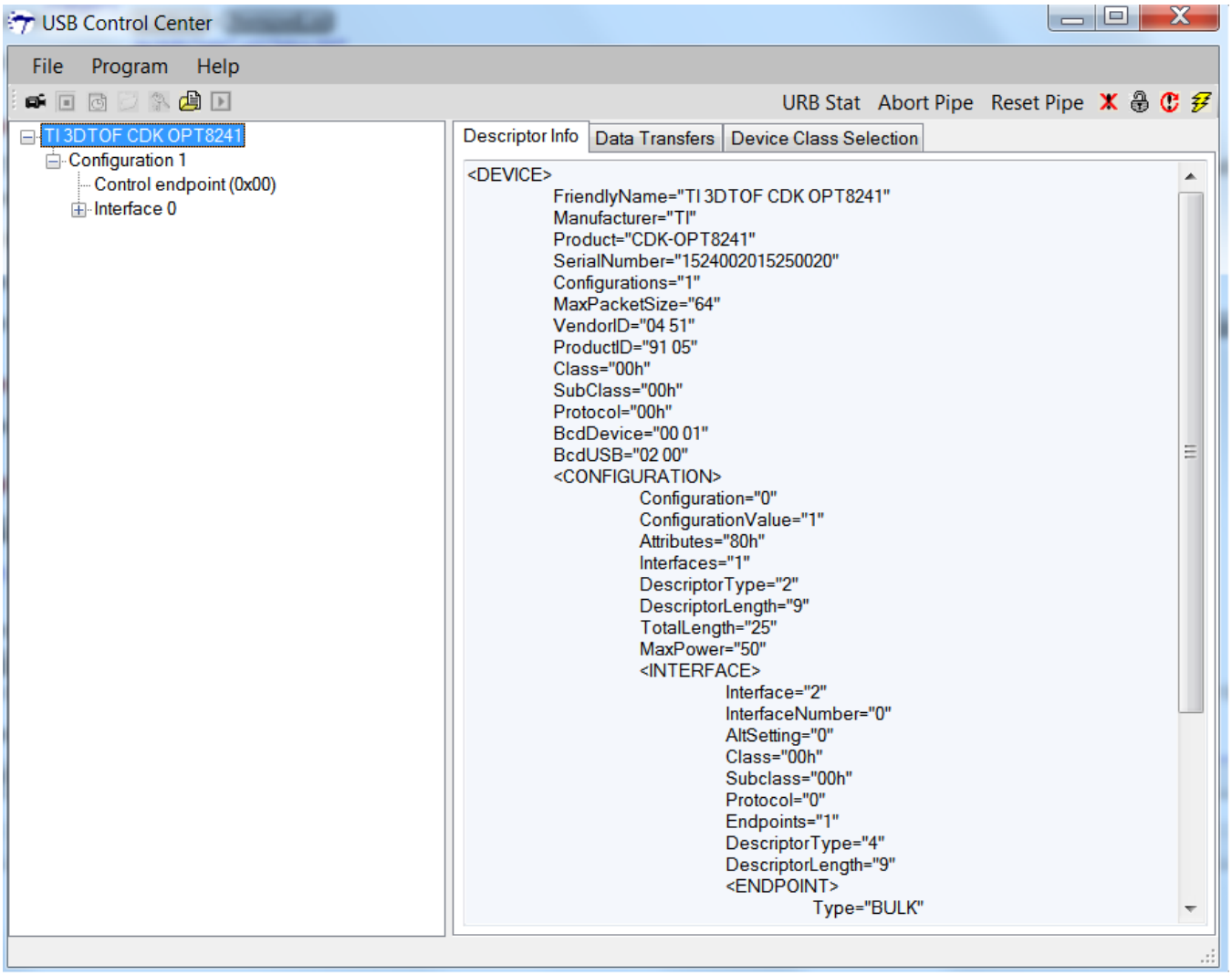

Figure 11. Cypress Control Center

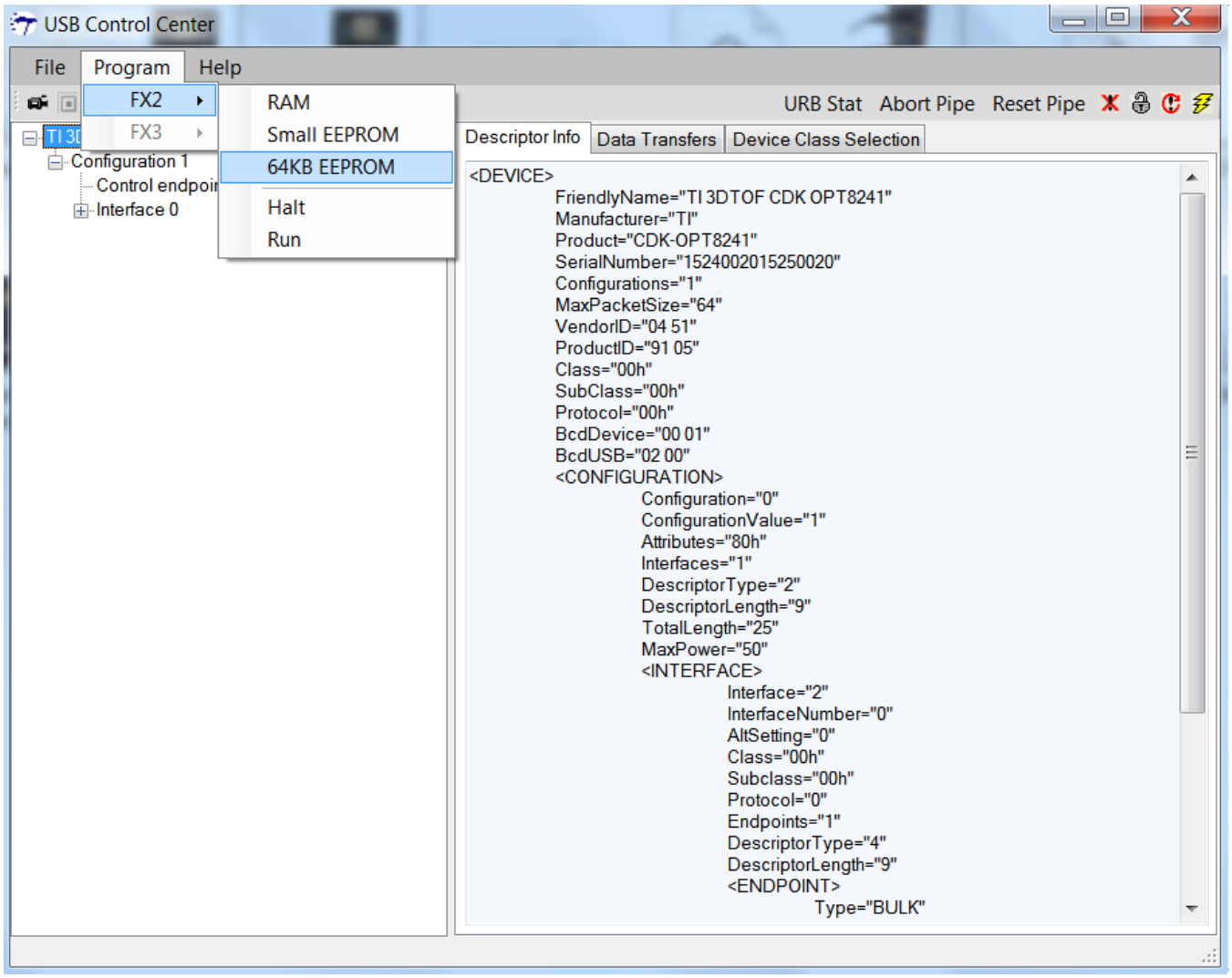

Figure 12. Program Menu

5.1.2 TFC (OPT9221) Firmware Upgrade

The OPT9221 firmware can be updated using the Voxel-Viewer tool. The procedure follows:

- If the Voxel Viewer application is already running and connected to the CDK, launch the "Voxel Programmer" utility from the menu – **File → Open Programmer**
- If the Voxel Viewer application is not running, the "Voxel Programmer" utility can be directly launched from the start menu in Microsoft® Windows® or from a terminal in Linux®.
- Once the programmer is open and is connected to the CDK, choose the provided OPT9221 firmware file and click on the download button.

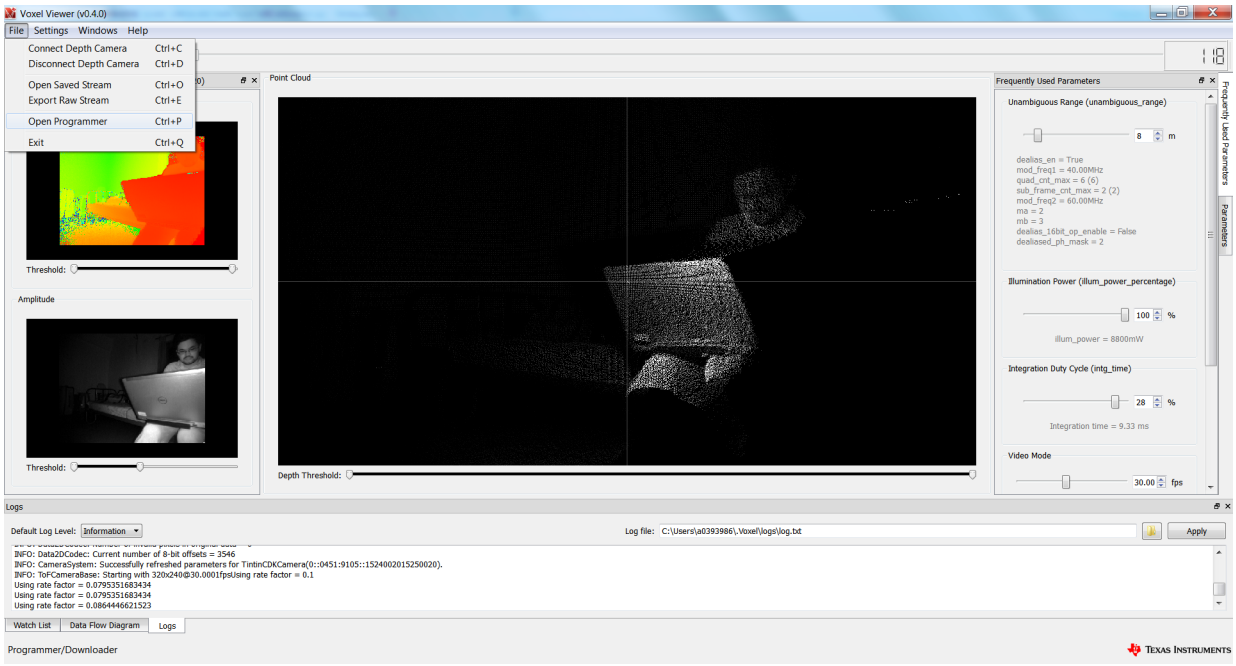

Figure 13. Launching the Programmer From the Voxel Viewer

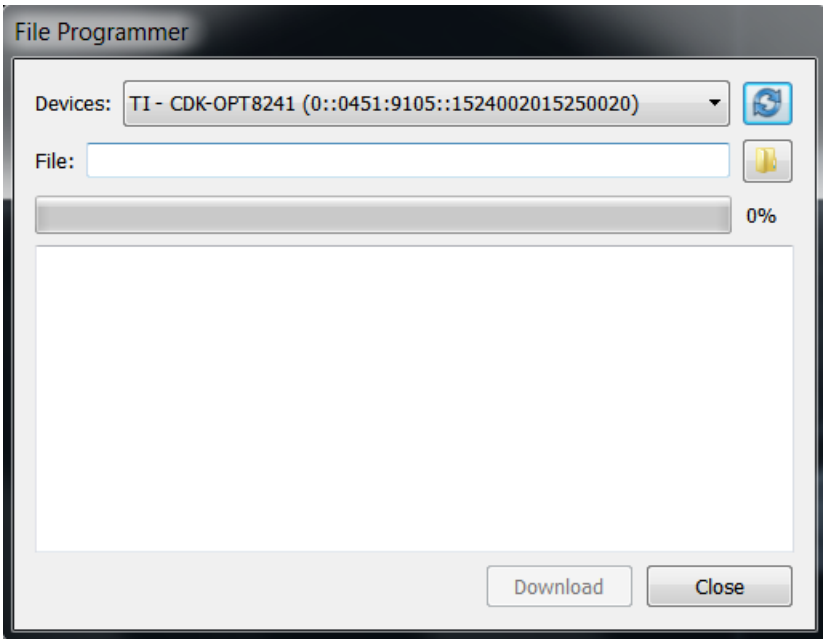

Figure 14. OPT9221 Firmware Download

6 Known Issues

List of known issues for the hardware revision Rev2P0:

- Hardware issues:
  - When the USB cable is connected, the red LED on the illumination board turns on even when the power switch is in the off position. This is behavior is not harmful and the rest of the circuit is indeed powered off. Occasional blinking may also be observed.
  - The lens mount has no alignment tabs. This results into incorrect centering and hence noticeable vignetting near the corners of the image.
  - Hot unplug of power supply DC jack may lead to power failure and board reset.
  - The OPT8241 LVDS data capture on the TFC has latency issues and will be fixed in a future OPT9221 firmware. As of firmware version 0.23, the latency issue is not resolved. The issue manifests itself as a 1-in-8 column pattern both in phase and amplitude images and disappears when "data_latency" parameter is adjusted by ±1.
- Calibration issues:
  - Frequency calibration is not performed on the boards. This may lead to gain errors in distance measurement.
  - Non-linearity calibration is not performed on the boards. This may lead to varying phase slopes versus distance.

7 Related Documentation From Texas Instruments

Related documentation regarding the EVM is available here: http://www.ti.com/tool/opt8241-cdk-evm. The documentation related to the ToF chipset used in the EVM is available in the following:

- Sensor - http://www.ti.com/product/OPT8241
- Time-of-Flight Controller - http://www.ti.com/product/OPT9221

Revision History

Changes from Original (October 2015) to A Revision	Page
• Removed reference to tripod in the *Components of the EVM* image.	2
• Deleted *Tripod* section.	9

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

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.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

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