

LM95235EVAL User's Guide

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1.0 Introduction

The Texas Instruments LM95235EVAL board helps designers evaluate the operation and performance of the LM95235 Precision Remote Diode Temperature Sensor With SMBus Interface and Tru Therm™ Technology. The LM95235EVAL Evaluation Board is used together with the Texas Instruments SensorEval software (downloaded on the web), and with a USB cable (not provided in the kit), and with an external personal computer (PC). Power to the LM95235EVAL/NOPB Evaluation Board is provided by the +5 VDC line from the USB connection. No external power supply or signal sources are required for operation of the LM95235 evaluation board.

Before connecting the PC to the LM95235EVAL evaluation board through the USB cable, the PC is first turned on and allowed to go through its boot-up procedure. The user installs and initiates the SensorEval software after downloading from <http://www.ti.com/tool/sensoreval>.

After the SensorEval software is running, the user can connect the USB cable first to the computer and then to the LM95235EVAL/NOPB Evaluation Board.

The PC should be able to recognize the board, and the user simply selects the LM95235 Evaluation Board radio button.

The block diagram below describes the LM95235EVAL/NOPB Evaluation Board. The USB input provides the +5.0 VDC power to the board, which is regulated down to 3.3 VDC to power the IC's. The EEPROM is programmed at the factory with a unique ID code for this particular board. When the USB cable is plugged in, the PC interrogates the USB devices and can identify this device as the LM95235 Evaluation Board.

The microcontroller on the board provides the serial SMBus clock (SMBCLK), provides the SMBus data (SMBDAT) signal, and relays the information from the LM95235 to the PC via the USB lines.

The block in the lower right of the Block Diagram shows the signals that are available to probe by the user for the LM95235 device on the board.

1.1 Block Diagram

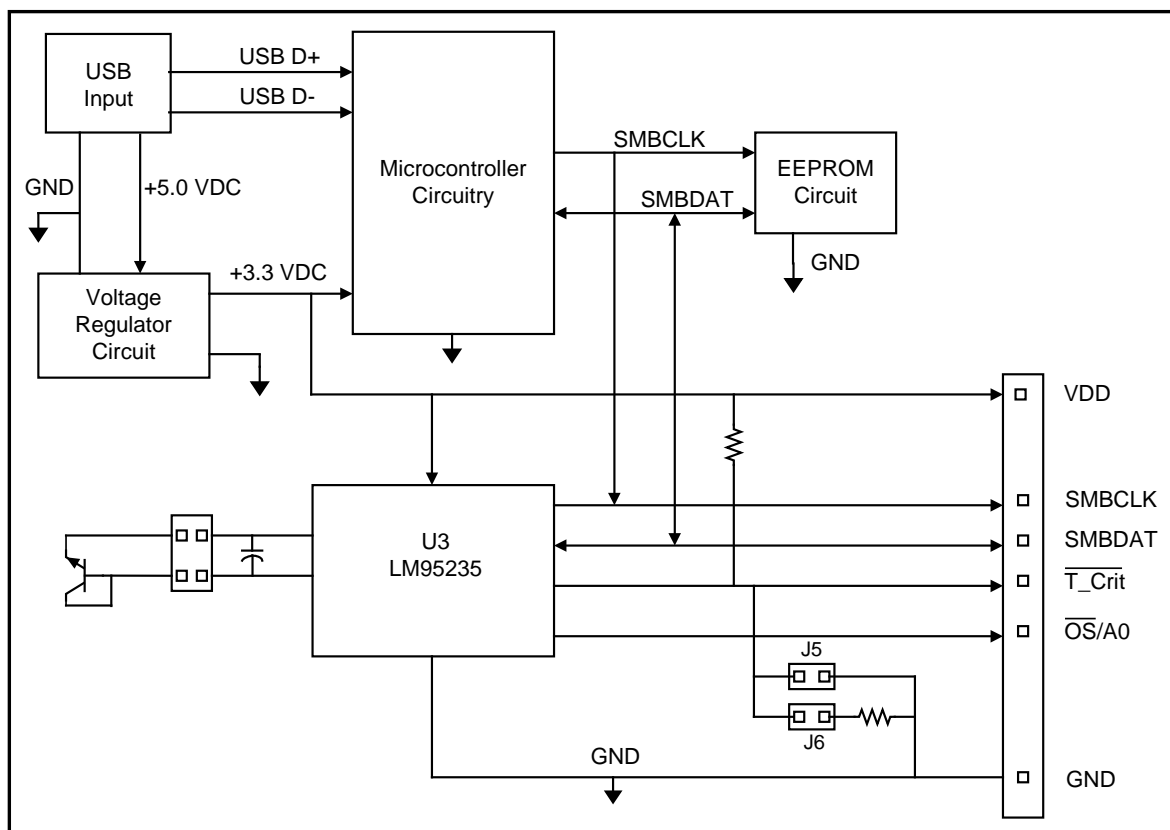


Figure 1: LM95235 Block Diagram

The EVM contains one sensor which is attached to the EVM (See Table 1).

Table 1: Device and Package Configurations

CONVERTER	IC	PACKAGE
U3	LM95235C1MM/NOPB	MINI SOIC-8

2.0 Setup

This section describes the software download, jumpers and connectors on the EVM as well as how to properly connect, set up and use the LM95235EVAL board.

2.1 Software Download

1. Download the latest SensorEval software at <http://www.ti.com/tool/sensoreval>
2. Save or run the zip file.
3. Open the file and click on the SensorEval Setup.exe file.
4. Follow the screen instructions.

2.2 Input/Output Connector Description

1. **JP2** – Output header provides the user with signals for test purposes only.
Note: Do not apply any external power or signals to any of these header pins.
2. **J3** – USB cable input. Connect the USB cable to this jack **after** the SensorEval software has been loaded on the PC.
3. **J4** – Connection to the temperature diodes. Pins 1-2 & 3-4 should be shorted.
Note: Do not apply any external power or signals to any of these header pins.
4. **J5, J6**- These are jumpered as indicated if the LM95235 is in the A0 Address Selection function mode.

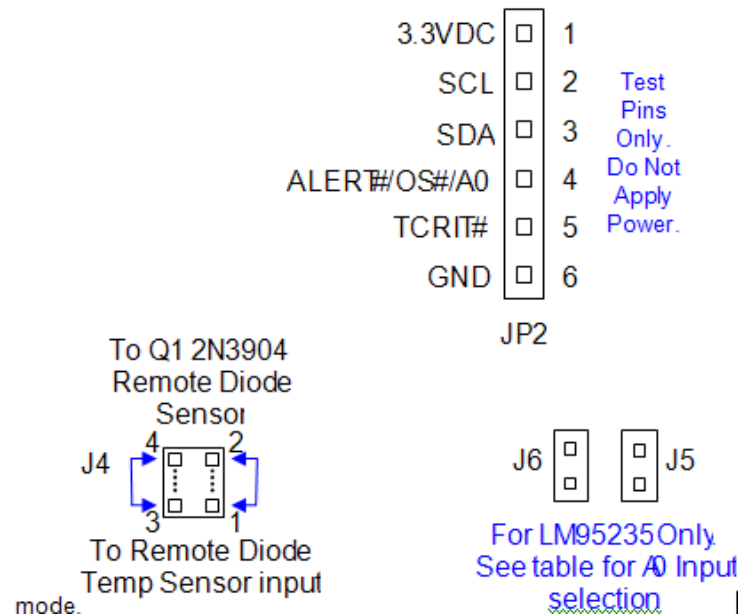


Figure 2: LM95235 Jumper Settings

2.3 Setup

Important! *NO EXTERNAL POWER SUPPLY OR SIGNAL INPUTS ARE REQUIRED!*

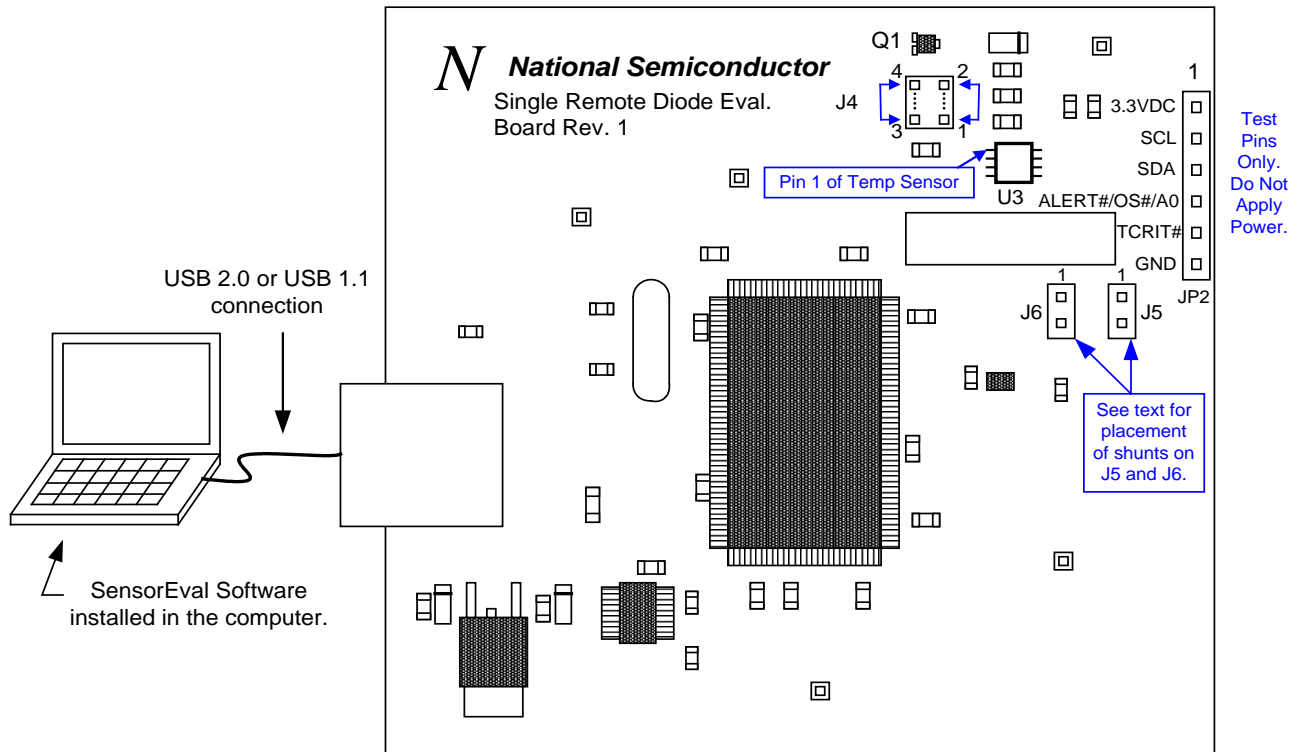


Figure 3: LM95235 Connections

3.0 Operation

3.1 For proper operation of the LM95235EVAL board **J4** pins 1-2 & 3-4 should be shorted. Jumpers **J5** & **J6** normally should be open except if you are in the A0 address function mode.

1. Run the SensorEval program by either double-clicking on desktop icon or by selecting Start, Program Files, National Semiconductor, National SensorEval.
2. Plug in the cable on the PC then on J3 connector of the LMP5235EVAL board.
3. Follow the register setups shown below. Make sure that you are following the given procedure for the specific evaluation board you are using.
4. Refer to the electrical schematic, layout and connector diagrams for proper connections to the external remote diodes.
5. **3.2** Install the SensorEval software (see Section 2.1).
6. Connect the USB cable between the PC or notebook computer and the LM95235EVAL board as shown if Figure 3 above.
7. Run the SensorEval software by either clicking on the desktop icon or by selecting Start, Programs, National Semiconductor, SensorEval, National SensorEval. The first screen should look like Figure 4 below:

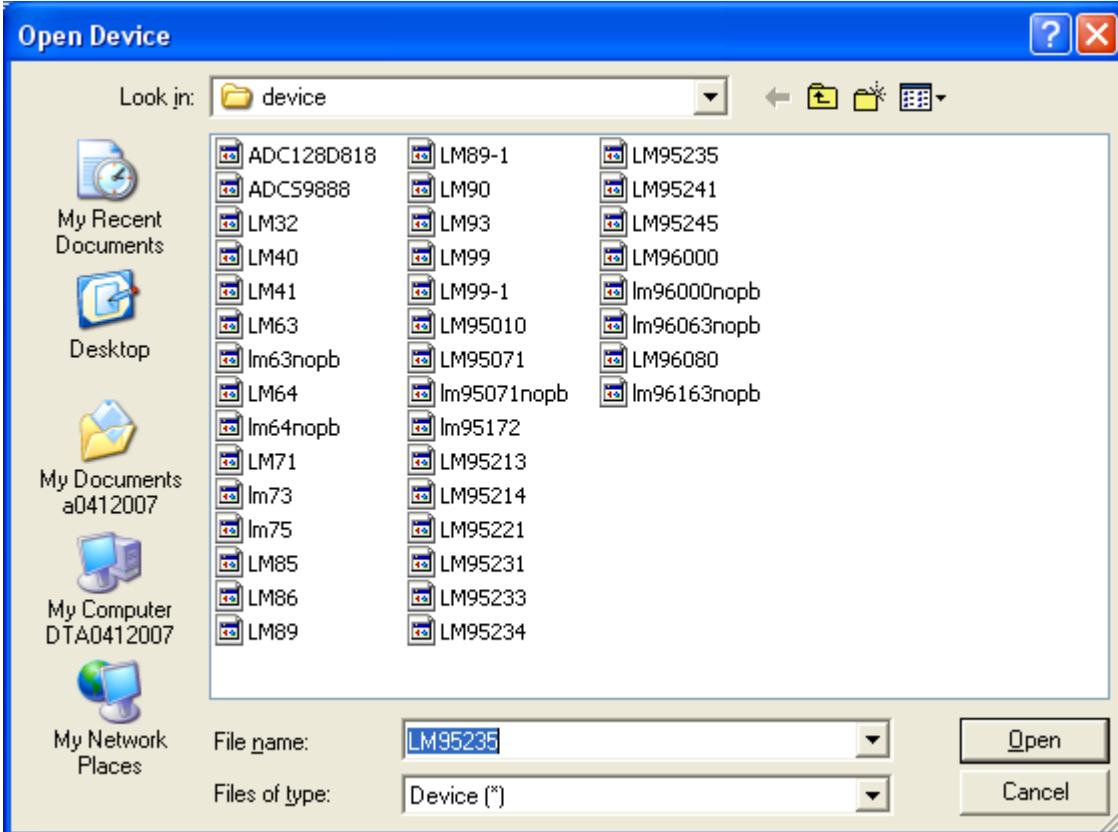


Figure 4

8. Select LM95235 and click on the Open button. The next screen (first screen after the first time you run the program) will look like this Figure 5

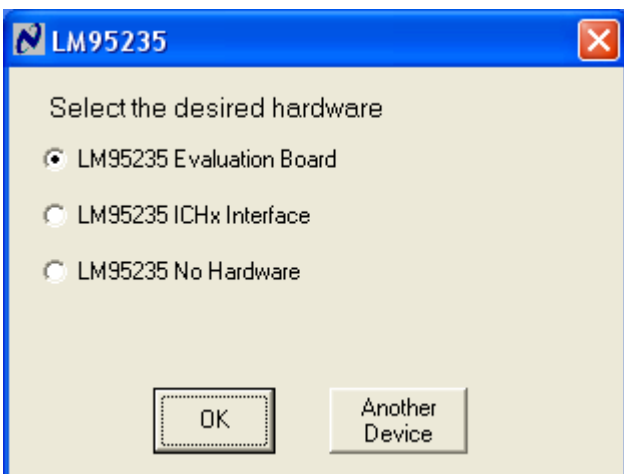


Figure 5

9. Select the LM95235 Evaluation Board then click the OK button.
10. The next screen will look like Figure 6 below.

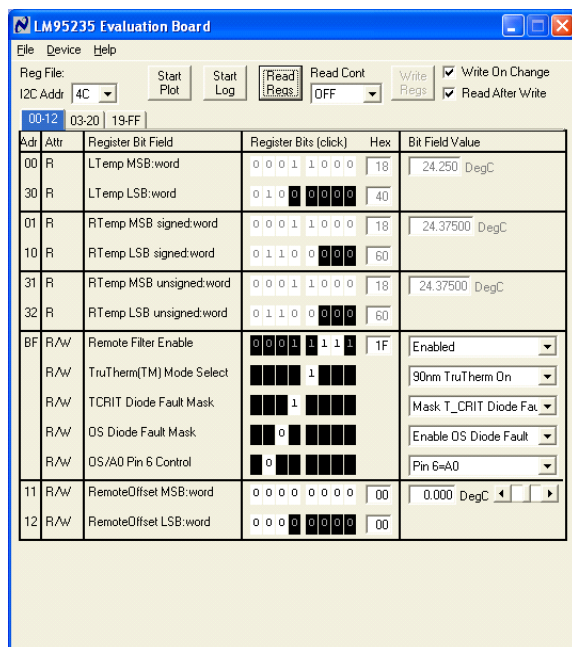


Figure 6

11. Select “Read Cont” down arrow and select “All Regs” from the pull down menu. Click on the “Read Regs” button.
12. The next screen will look like Figure 7.

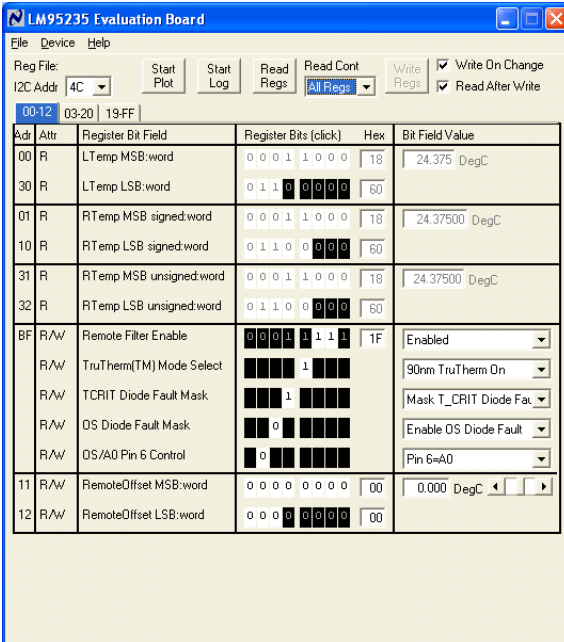


Figure 7

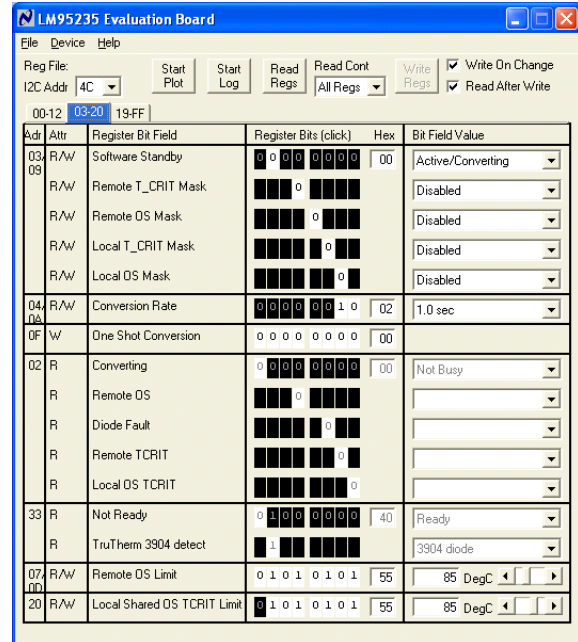


Figure 8

13. Local (on-chip) and remote temperatures should now read continuously.
14. If the user clicks the 03-20 tab the next screen will look like Figure 8. By turning on or off the filters, and/or changing the models, and/or changing the TruTherm controls the user can experiment with the effects of the temperature readings as shown in Figure 9 and Figure 10 below.

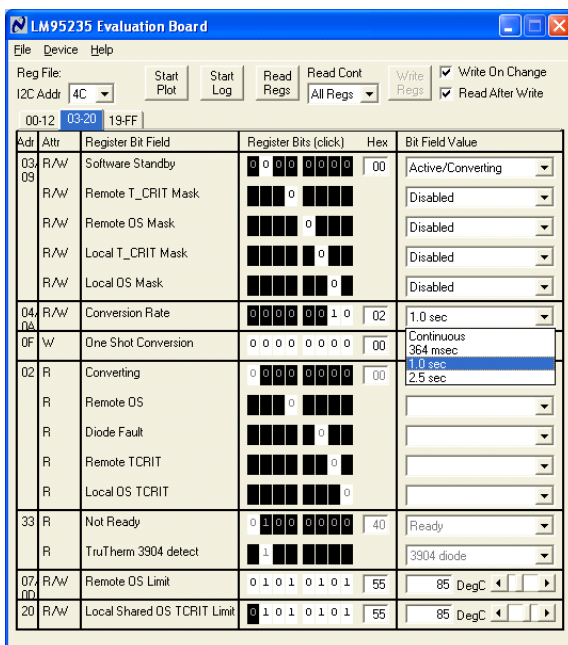


Figure 9

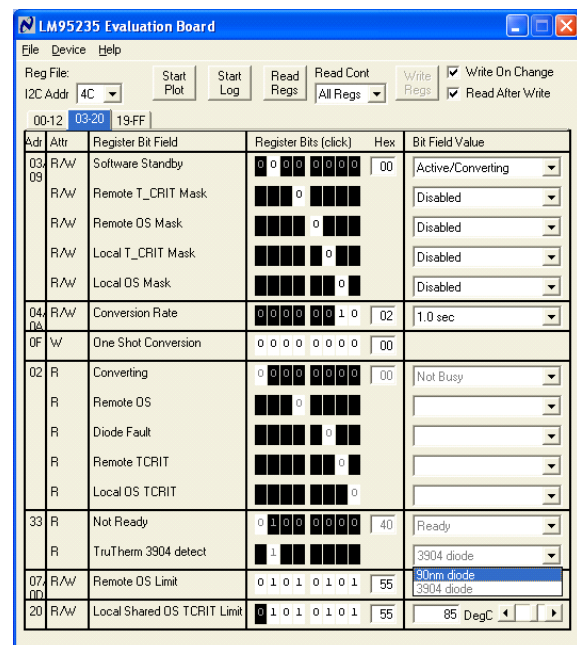


Figure 10

Setup

15. If the user clicks on the Start Plot button, a graph will appear and will graph the temperature as shown in Figure 11 below.

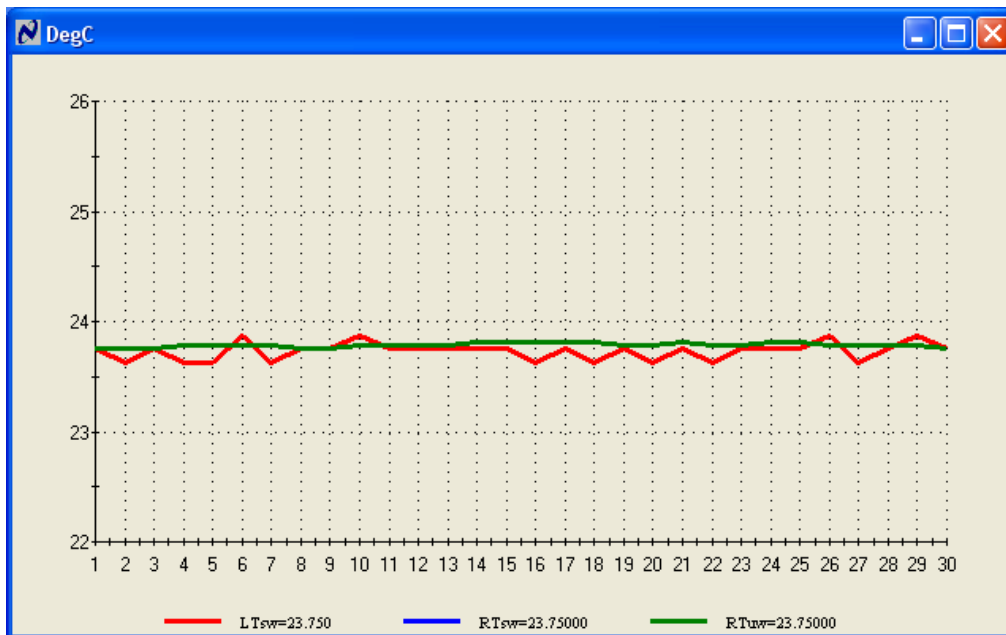


Figure 11

16. The graph will run continuously until you press the “Stop Plot” button.
17. At the same time you can also press the “Start Log” button to capture temperature data in a log file. Press the “Stop Log” button to stop data logging and capture the file. Press the “File” then “View Log” in the pull down menu to see the log file as shown in Figure 12 below.

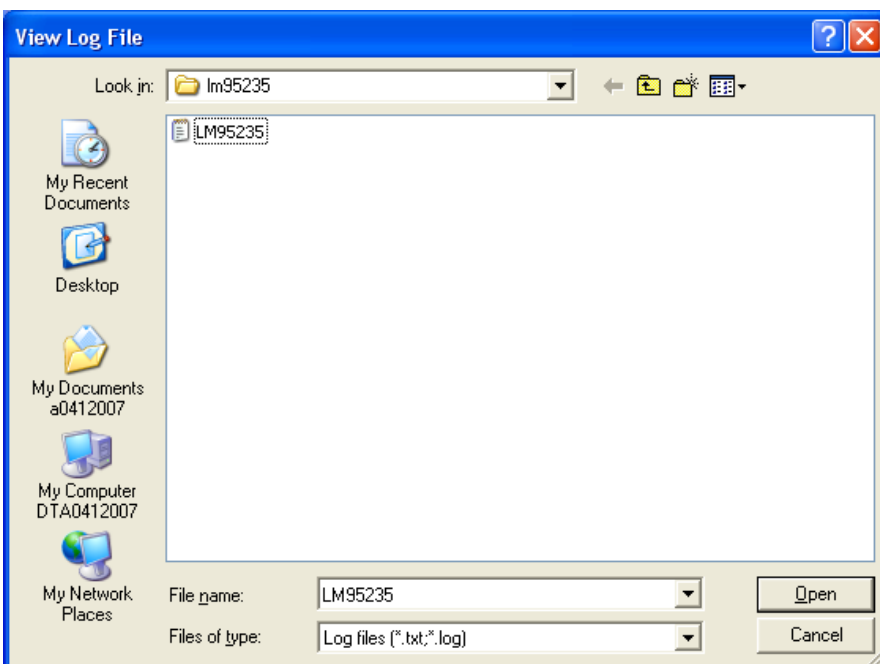


Figure 12

Table 2: Jumper Configurations and Header Pin Output Signals

Connector Label	Pin Number	Description		
J3	N/A	USB Cable Input. Connect the USB cable to this jack <i>after</i> the SensorEval software has been loaded on the PC.		
JP2 Output header provides user with signals for test purposes only. <i>Do not apply any external power or signals to any of the pins on these headers!</i>	1	V _{DD} . The +3.3 VDC voltage supplied by the on-board voltage regulator to the LM95235 V _{DD} input pin. Do not connect an external power supply to this pin!		
	2	SMBCLK. Clock signal for SMBus.		
	3	SMBDAT. Data signal for the SMBus.		
	4	ALERT#/OS#/A0 For the LM95235 this pin can be set to either the ALERT# function or the AO Address Select function.		
	5	TCrit#. This is the Active Low Open Drain pin which indicates that the Temperature limit has been exceeded.		
	6	GND. System ground.		
J4 Connection to temperature diodes <i>Do not apply any external power or signals to any of the pins on these headers!</i>	1,2	Connect for D+ connection		
	3,4	Connect for D- connection		
J5, J6 These are jumpered as indicated if the LM95235 is in the A0 Address Select function mode.		J5 Jumper	J6 Jumper	A0 Address Select, Hex
		NO	NO	Hi = 4C
		NO	YES	Mid = 29
		YES	Don't Care	Low = 18

Figure 13, Figure 14 and Figure 15 shows the board layout for the LM95235EVAL. The Eval Board offers resistors, capacitors and jumpers to display the temperatures.

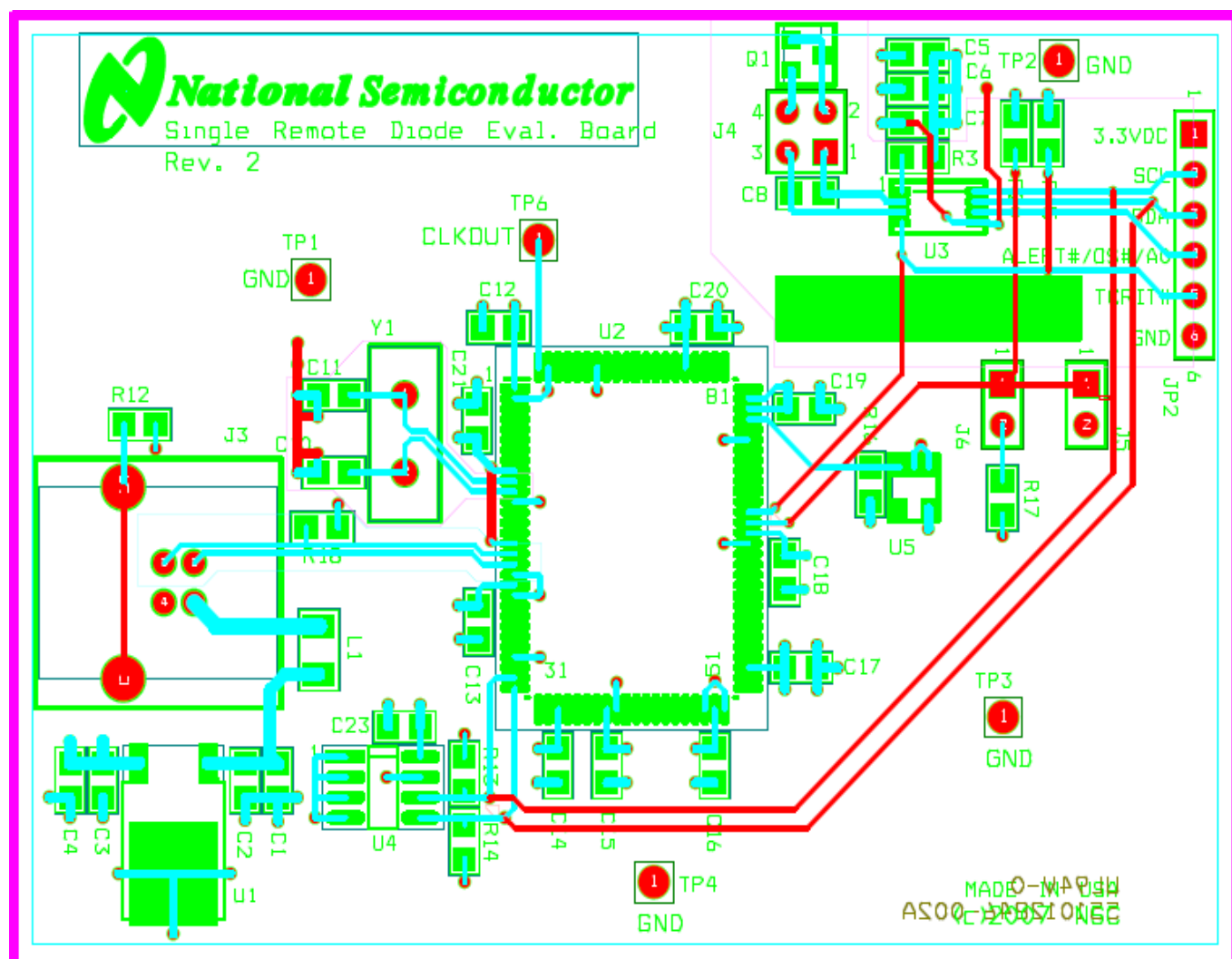


Figure 13: Top Assembly Layer

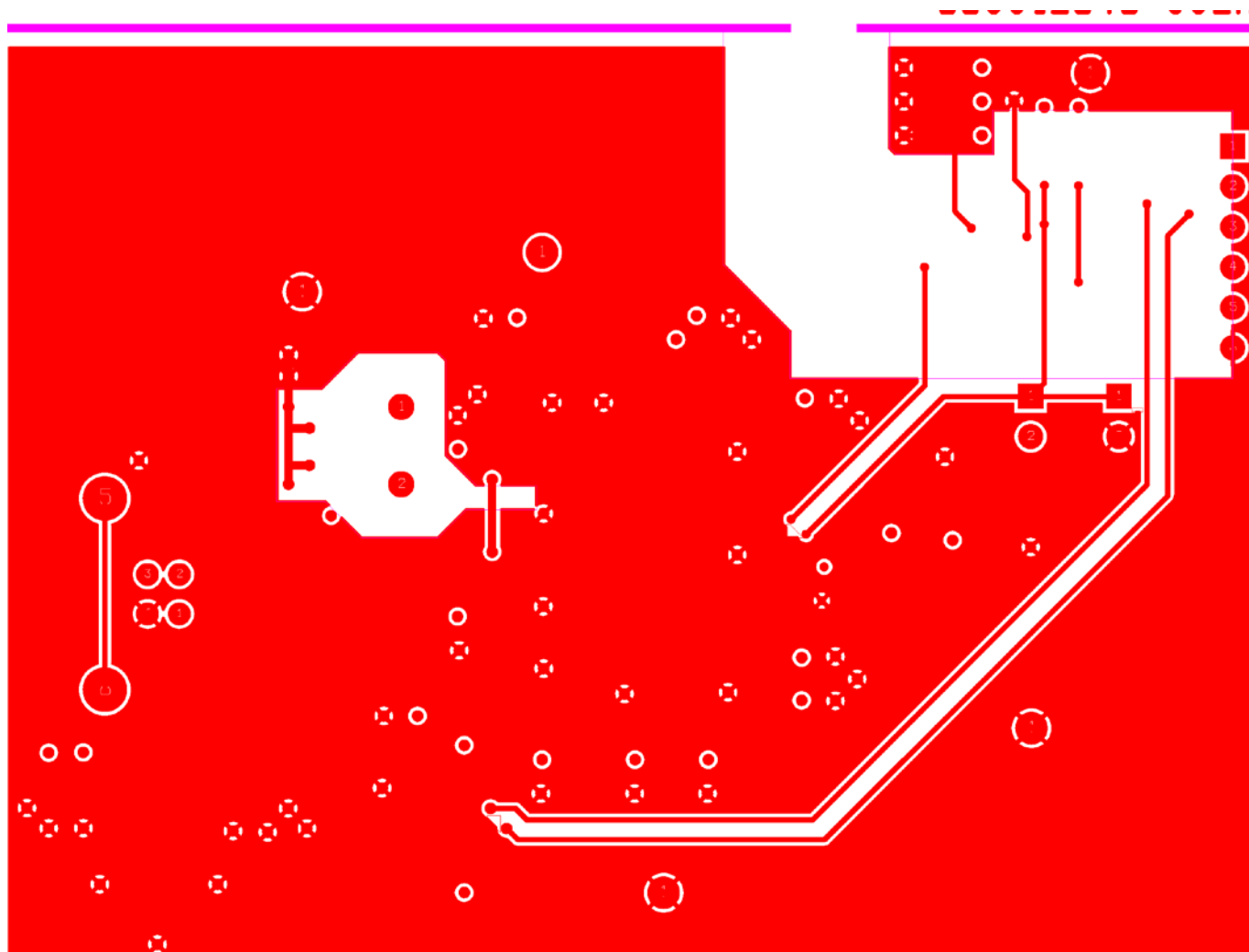


Figure 14: Top Layer Routing

Board Layout

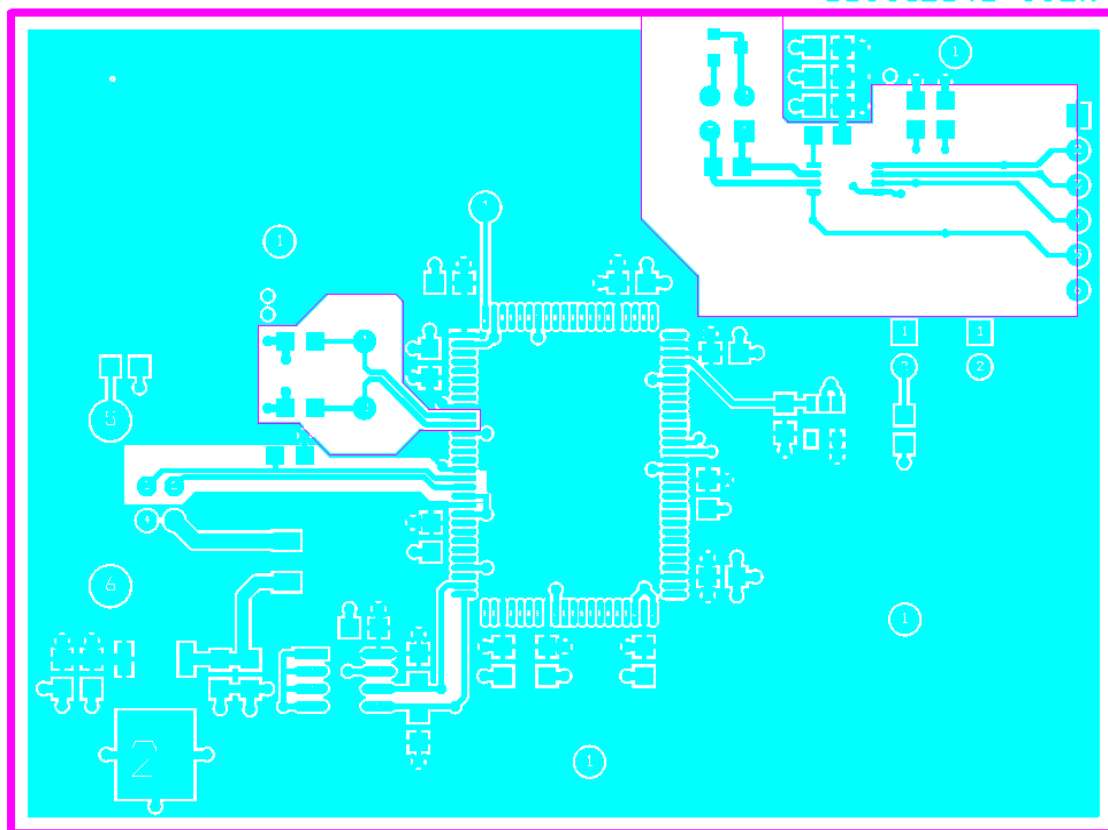


Figure 15: Bottom Layer Routing

Table 3: LM95235EVAL Bill of Materials

TEXAS INSTRUMENTS

				Single Remote Diode Temperature Sensor Eval Board		Created: March 23, 2007 Last Updated: August 21, 2012	Board Layout Revision:1.0 Schematic Revision: 1.0
Item	NSC	Qty	Build	Part Reference	Value	Footprint	Manufacturer
SMT Capacitors							
1		3		C1,C3, C5	2.2 uF	c3216	Kemet
2		14		C2,C4,C6,C12,C13,C14,C15,C16	10 nF	c0805	Panasonic
				C17,C18,C19,C20,C21,C23			
3		1		C7	100 pF	c0805	
4a		1		C8 (for LM95235 only)	100 pF	c0805	
4b		1		C8 (For all others)	2.2 nF	c0805	
5		2		C10,C11	12 pF	c1206	Kemet
Connectors							
6		1		J3	Connector, USB-B	usb-jack-b	Mill-Max
7		1		J4	CONN, 2X2 Headers, 0.1 in centers	th 4_hdr1x4_m_str 100	Sullins
8		2		J5, J6	CONN, 1X2 Headers, 0.1 in centers	TP40	Sullins
9		1		JP2	CONN, 1X6 Headers, 0.1 in centers	TP40	Sullins
10		4		TP1, TP2, TP3, TP4, TP6	CONN, 1X1 Headers, 0.1 in centers	TP40	Sullins
Ferrites							
11		1	10	L1	CM CHOKE		Steward
Resistors							
12		3		R2,R15,R17	3.3K	r0805	Panasonic
13		1		R3	0	r0805	Susumu Co Ltd
14		1		R12	1 Meg	r0805	Panasonic
15		2		R13,R14	1.5K	r0805	Panasonic
IC's							
18		1		U1	LP2950CDT-3.3/TO252	TO263_7P	National Semiconductor
19		1		U2	Cypress CY7C68013A-100AXC	100tqfp	Cypress
20		1		U3	Device Under Test (DUT)	msop8	National Semiconductor
21		1		U4	24C02	soic8	Atmel
22		1		U5	LM3722	SOT23-stx	National Semiconductor
Transistors							
22		1		Q1	MMBT3904/SOT	SOT23-stx	On Electronics
Misc							
23		1		BOARD	Single Remote Diode Temp Sensor Eval Board Rev 1.0	4400	Advanced Circuits
24		1		Y2	24 MHz	hc49us	ECS Inc.
DO NOT SOLDER THE FOLLOWING TO BOARD							
25		1		R18 (for USB 1.1 only)	1.5K	r0805	Panasonic
25		1		R16	10K	r0805	Panasonic

NOTES

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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 is 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.

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Caution

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

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

FCC Interference Statement for Class A EVM devices

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

FCC Interference Statement for Class B EVM devices

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

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

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

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

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs including detachable antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

~

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

Concernant les EVMs avec appareils radio

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

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

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

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EVALUATION BOARD/KIT/MODULE (EVM)

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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.

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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.

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