TMP108EVM Evaluation Board and Software Tutorial

This user's guide describes the characteristics, operation, and use of the TMP108EVM evaluation board. It 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 TMP108EVM. This user's guide also includes information regarding operating procedures and input/output connections, an electrical schematic, printed circuit board (PCB) layout drawings, and a parts list for the EVM.

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1 Overview

The TMP108 is a digital output temperature sensor capable of reading temperatures of –40°C to +125°C with 12 bits of resolution. The TMP108 uses a two-wire I^{2}C™ and SMBus™ interface that allows up to four devices on one bus. The TMP108 is ideal for extended temperature measurement, and is specified to operate between –40°C and +125°C. It is also ideal for thermal management optimization in a variety of consumer, computer, and environmental applications.

This document gives a general overview of the TMP108EVM and provides a general description of the features and functions to be considered while using this evaluation module.

1.1 TMP108EVM Kit Contents

Table 1 summarizes the contents of the TMP108EVM kit. Figure 1 shows all of the included hardware. Contact the Texas Instruments Product Information Center if any component is missing. It is highly recommended that you also check the TMP108 product folder on the TI web site at www.ti.com to verify that you have the latest versions of the related software.

Table 1. TMP108EVM Kit Contents

Item	Quantity
TMP108EVM PCB Test Board	1
SM-USB-DIG Platform PCB	1
USB Extender Cable	1
10-pin Connector Ribbon Cable	1
User's Guide CD-ROM	1

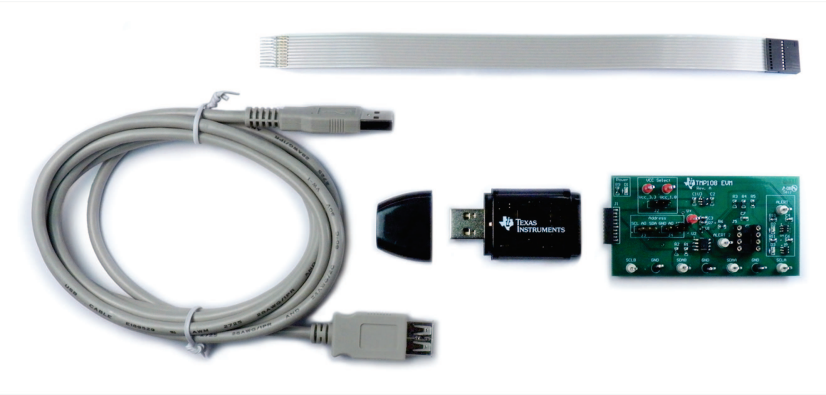


Figure 1. Hardware Included with TMP108EVM Kit

1.2 Related Documentation from Texas Instruments

The following documents provide information regarding Texas Instruments' integrated circuits used in the assembly of the TMP108EVM. This user's guide is available from the TI web site under literature number ***SBOU128***. Any letter appended to the literature number corresponds to the document revision that is current at the time of the writing of this document. Newer revisions may be available from the TI web site, or call the Texas Instruments' Literature Response Center at (800) 477-8924 or 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
TMP108 Product Data Sheet	SBOS663
SM-USB-DIG Platform User Guide	SBOU098

2 Hardware Configuration

Figure 2 shows the overall system configuration for the TMP108EVM. The computer runs the software that communicates with the SM-USB-DIG Platform. The SM-USB-DIG Platform generates the digital signals used to communicate with the TMP108 test board. The SM-USB-DIG and TMP108EVM are easily connected through 10-pin board-to-board connectors on the SM-USB-DIG Platform and the TMP108EVM PCBs. After these two boards are connected, simply plug the assembly into the computer USB port.

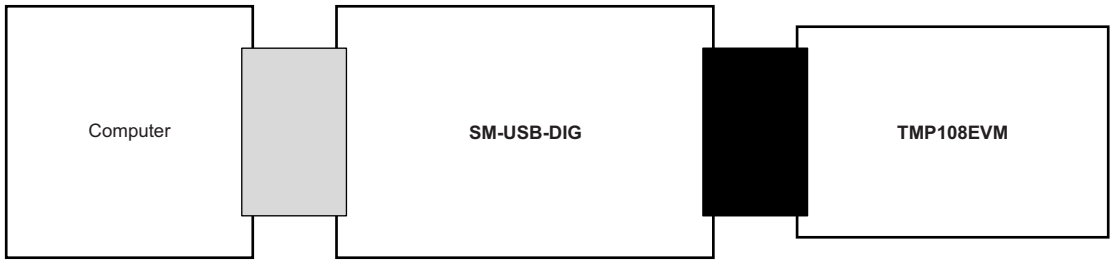


Figure 2. Hardware Configuration

2.1 Theory of Operation for TMP108 Hardware

The TMP108EVM only requires the two-wire I^2C lines (SDA and SCLK) and V_{DUT}/GND, as shown in Figure 3. The TMP108EVM has test points to monitor these signals. If desired, use these test points as external signal inputs. These test points may also be used for external input/output signals.

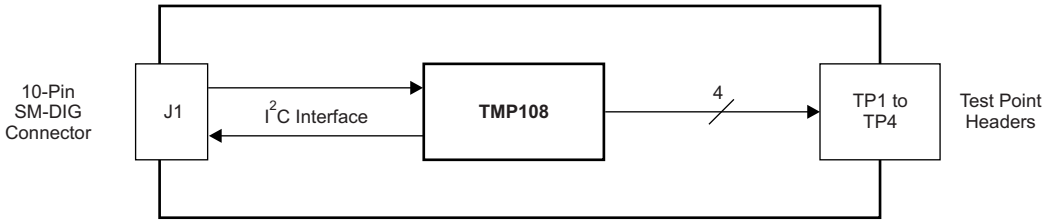


Figure 3. TMP108EVM Board Block Diagram

2.2 Signal Definitions of H1 (10-Pin Male Connector Socket)

Table 3 shows the pinout for the 10-pin connector socket used to communicate between the TMP108EVM and the SM-USB-DIG. Only the I^2C communication lines (pins 1 and 3) and the V_{DUT} and GND (pins 6 and 8, respectively) are used on the TMP108EVM.

Table 3. Signal Definition of H1 on TMP108EVM Board

Pin on U1	Signal	Description
1	I2C_SCL	I^2C clock signal (SCL)
2	CTRL/MEAS4	GPIO: control output or measure input
3	I2C_SDA1	I^2C data signal (SDA)
4	CTRL/MEAS5	GPIO: control output or measure input
5	SPI_DOUT1	SPI data output (MOSI)
6	V_{DUT}	Switchable DUT power supply: +3.3 V, +5 V, Hi-Z (disconnected)(1)
7	SPI_CLK	SPI clock signal (SCLK)
8	GND	Power return (GND)
9	SPI_CS1	SPI chip select signal ($\overline{CS}$)
10	SPI_DIN1	SPI data input (MISO)

(1) When V_{DUT} is Hi-Z, all digital I/O are Hi-Z as well.

2.2.1 Theory of Operation for SM-USB-DIG Platform

Figure 4 shows the block diagram for the SM-USB-DIG Platform. This platform is a general-purpose data acquisition system that is used on several different Texas Instruments evaluation modules. The details of its operation are included in a separate document, SBOU098 (available for download at www.ti.com). The block diagram shown in Figure 4 gives a brief overview of the platform. The primary control device on the SM-USB-DIG Platform is the TUSB3210.

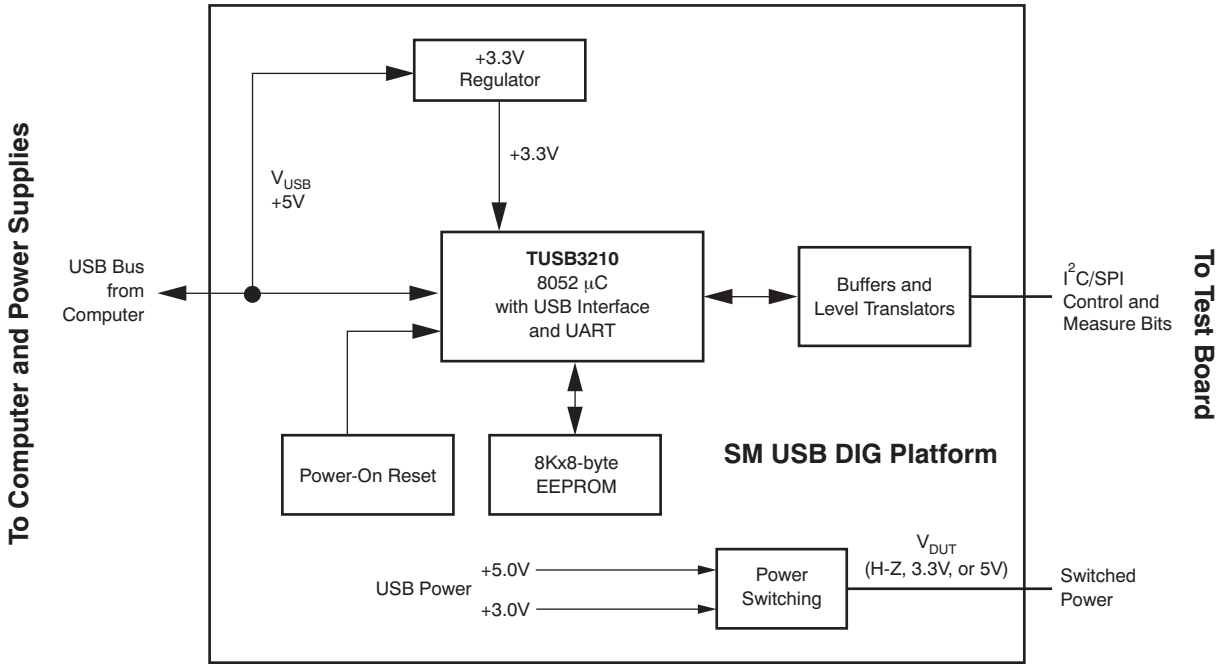


Figure 4. SM-USB-DIG Platform Block Diagram

3 Hardware Installation

The TMP108EVM hardware installation involves connecting the two PCBs of the EVM together, connecting the USB cable, applying power, and setting the jumpers. This section presents the details of this procedure.

3.1 Electrostatic Discharge Warning

CAUTION

Many of the components on the TMP108EVM 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.

3.2 Typical Hardware Connections

To connect the TMP108 test board and the SM-USB-DIG Platform together, gently slide the male and female ends of the 10-pin connectors together. Make sure that the two connectors are completely pushed together; loose connections can cause intermittent operation. Then use the USB extension cable to connect everything to the computer, as shown in Figure 5.

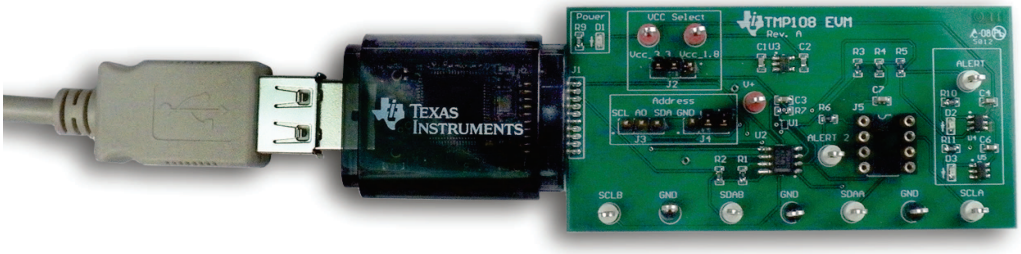


Figure 5. Connecting SM-USB-DIG Platform

3.3 Connecting the USB Cable to the SM-USB-DIG Platform

When the SM-USB-DIG Platform is first connected, the computer typically responds with a *Found New Hardware, USB Device* popup message. The message then changes to *Found New Hardware, USB Human Interface Device*. This prompt indicates that the device is ready to use. Note that the SM-USB-DIG Platform uses the human interface device drivers that are part of the Microsoft Windows® operating systems.

In some cases, the *Add Hardware Wizard* appears. If this prompt pops up, allow the system device manager to install the human interface drivers by clicking *Yes* when requested to install drivers. Windows confirms installation of the drivers with the message shown in Figure 6.

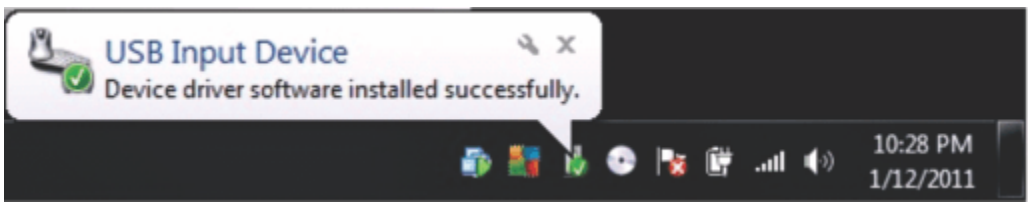


Figure 6. Confirmation of SM-USB-DIG Platform Driver Installation

3.4 Hardware Features

This section describes some of the hardware features present on the TMP108EVM test board.

3.4.1 I²C Translator and Test Points

The TMP108EVM is equipped with an onboard I²C level translator. This allows the TMP108 to be operated at 3.3 V or 1.8 V by changing the jumper position on J2. The I²C test points SDAB and SCLB are connected to the I²C line of the SM-USB-DIG Platform and run to the input of the level translator, U2. The I²C test points, SDAA and SCLA, are connected to the output of the level translator, U2, and run to the clock and data lines of the TMP108.

3.4.2 DIP Adapter Socket, J5

The TMP108EVM provides the option of connecting a second temperature sensor though a DIP adapter socket. The A0 pin on the second temperature sensor is connected to GND. In order to avoid conflicts, make sure that jumper J4 on the first temperature sensor is not set to GND. The socket is not included on the EVM and must be ordered separately. The part number is specified in Table 4, the bill of materials. If using this socket, visit the DIP-Adapter-EVM web page (http://www.ti.com/tool/dip-adapter-evm) for SOIC-to-DIP adapter boards.

3.4.3 10-Pin Connector Ribbon Extender (Optional)

The TMP108EVM kit ships with an optional ribbon cable for extending the connection between the SM-USB-DIG Platform and the PCB. This extension cable is useful if high temperature tests must be run on the test board because the SM-USB-DIG Platform is not rated for high temperatures. To connect the ribbon cable, attach the cable to the EVM and SM-USB-DIG, as shown in Figure 7.

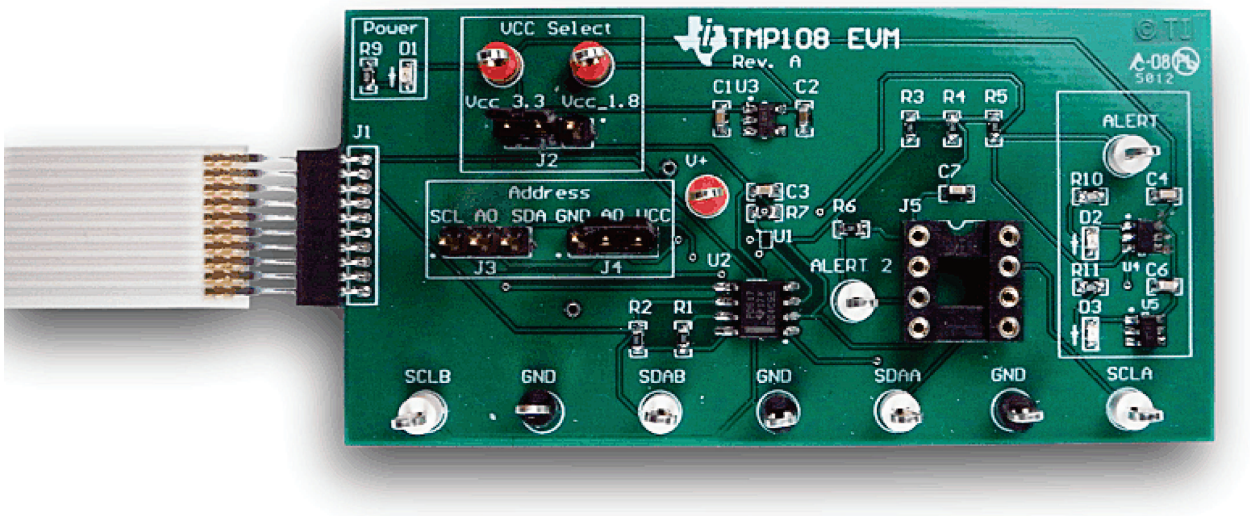


Figure 7. 10-Pin Ribbon Cable Extender

4 Software Installation

This section discusses how to install the TMP108EVM software.

4.1 Operating System Requirements

The TMP108EVM software has been tested on Microsoft Windows XP® operating systems (OS) with United States and European regional settings. The software should also function on other Windows operating systems.

4.2 Installing the Software

The TMP108EVM software is included on the CD that is shipped with the EVM kit. It is also available through the TMP108EVM product folder on the TI website. To install the software to a computer, insert the disc into an available CD-ROM drive. Navigate to the drive contents and open the TMP108EVM software folder. Locate the compressed file (*TMP108EVM.zip*) and extract the TMP108EVM files into a specific TMP108EVM folder (for example, *C:\TMP108EVM*) on your hard drive.

Once the files are extracted, navigate to the TMP108EVM folder you created on the hard drive. Locate the *setup.exe* file and execute it to start the installation. The TMP108 software installer file then begins the installation process as shown in Figure 8.

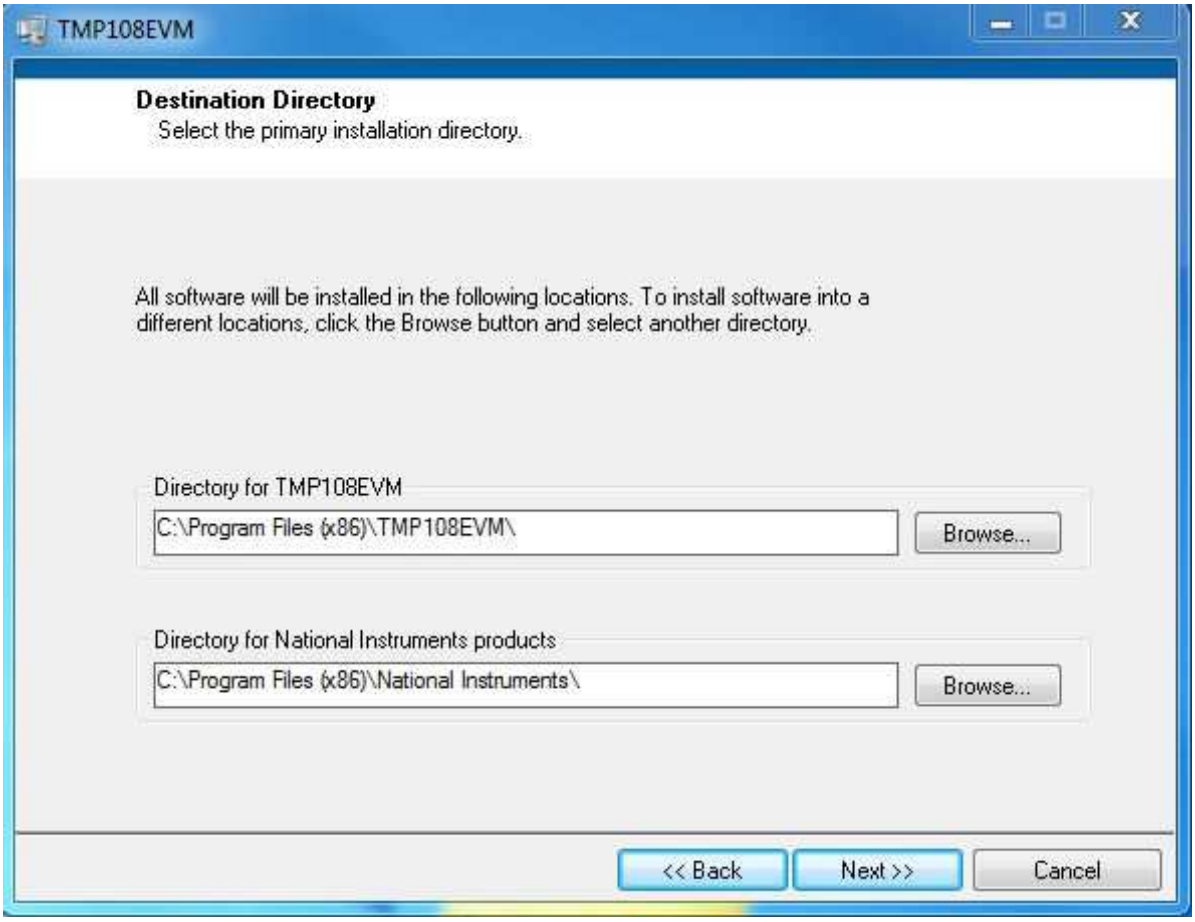


Figure 8. Starting the Software Installation

After the installation process initializes, select the directory in which to install the program; the default location is *C:\Program Files\TMP108* and *C:\Program Files\National Instruments*. Following this option, two license agreements are presented that must be accepted, as shown in Figure 9. After accepting the Texas Instruments and National Instruments license agreements, the progress bar opens and shows the installation of the software. After the installation process is completed, click *Finish*.

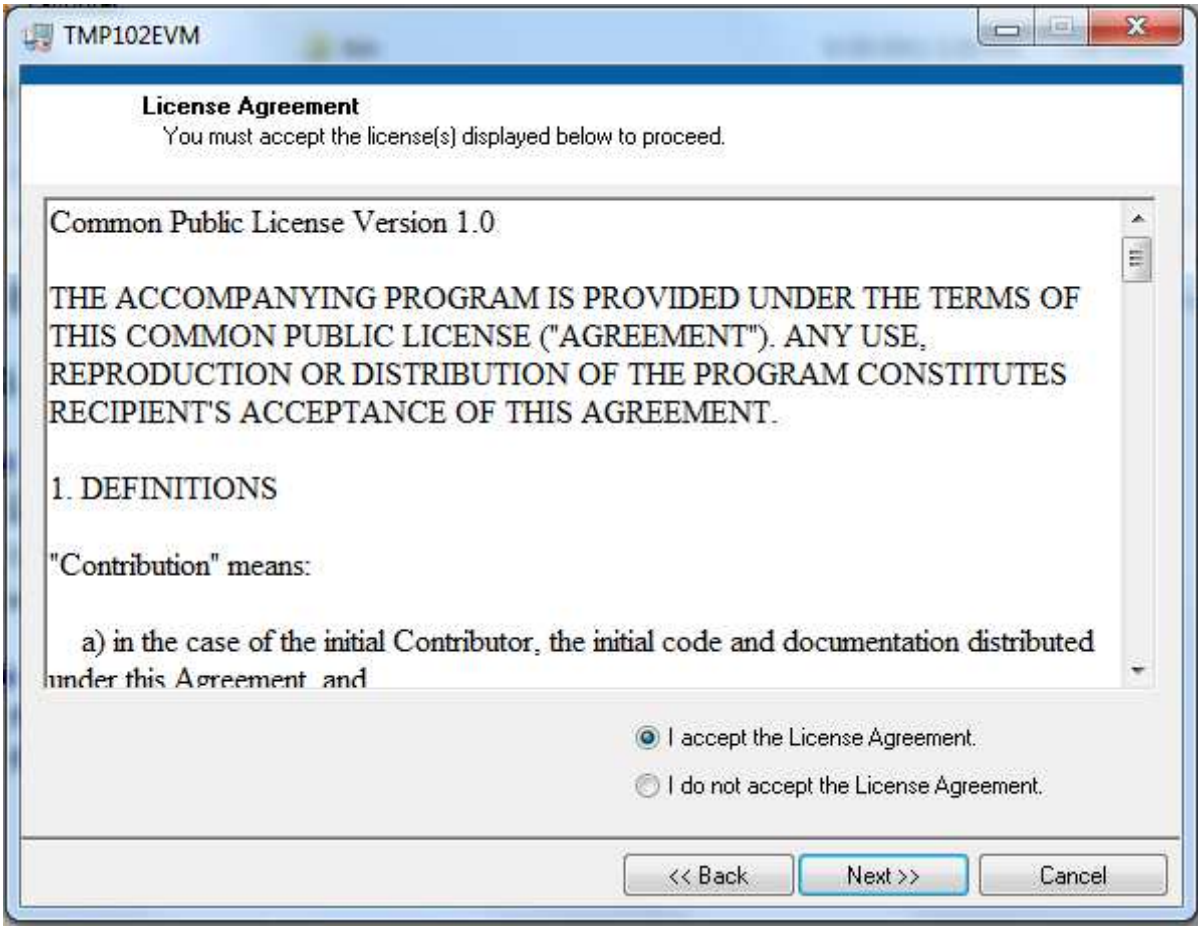


Figure 9. License Agreements

5 Software Operation

This section discusses how to use the TMP108EVM software.

5.1 Starting the Software

To start the TMP108 software, go to the Windows *Start* menu, select *All Programs*, and then select the *TMP108EVM* program.

Figure 10 illustrates how the software appears if the TMP108EVM is functioning properly.

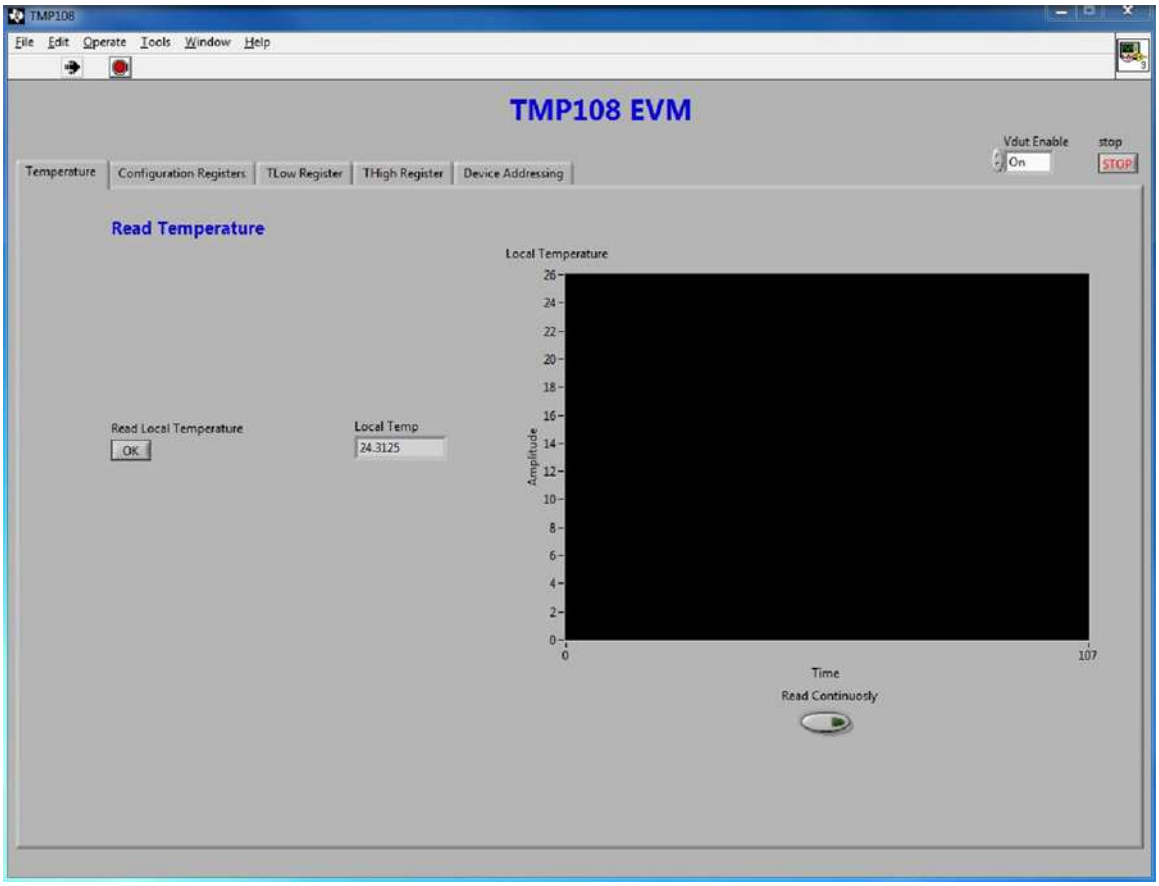


Figure 10. Software Interface

Figure 11 shows the error that pops up if the computer cannot communicate with the EVM. In the event you receive this error, first ensure that the USB cable is properly connected on both ends. Another possible source for this error is a problem with your computer USB human interface device driver. Make sure that the device is recognized when the USB cable is plugged in, indicated by a Windows-generated confirmation sound.

Figure 11. Communication Error with the SM-USB-DIG Platform

5.2 Using the Software

5.2.1 Reading from Registers

When first starting the TMP108EVM software, confirm there are stable connections to the test board by toggling the *Read Continuously* button, as shown in Figure 12. If all devices are communicating correctly, the temperature is seen to change over time in the TMP108 *Local Temperature* box. If communication with the deivce cannot be established, select the *Device Addressing* Tab to verify the correct device address.

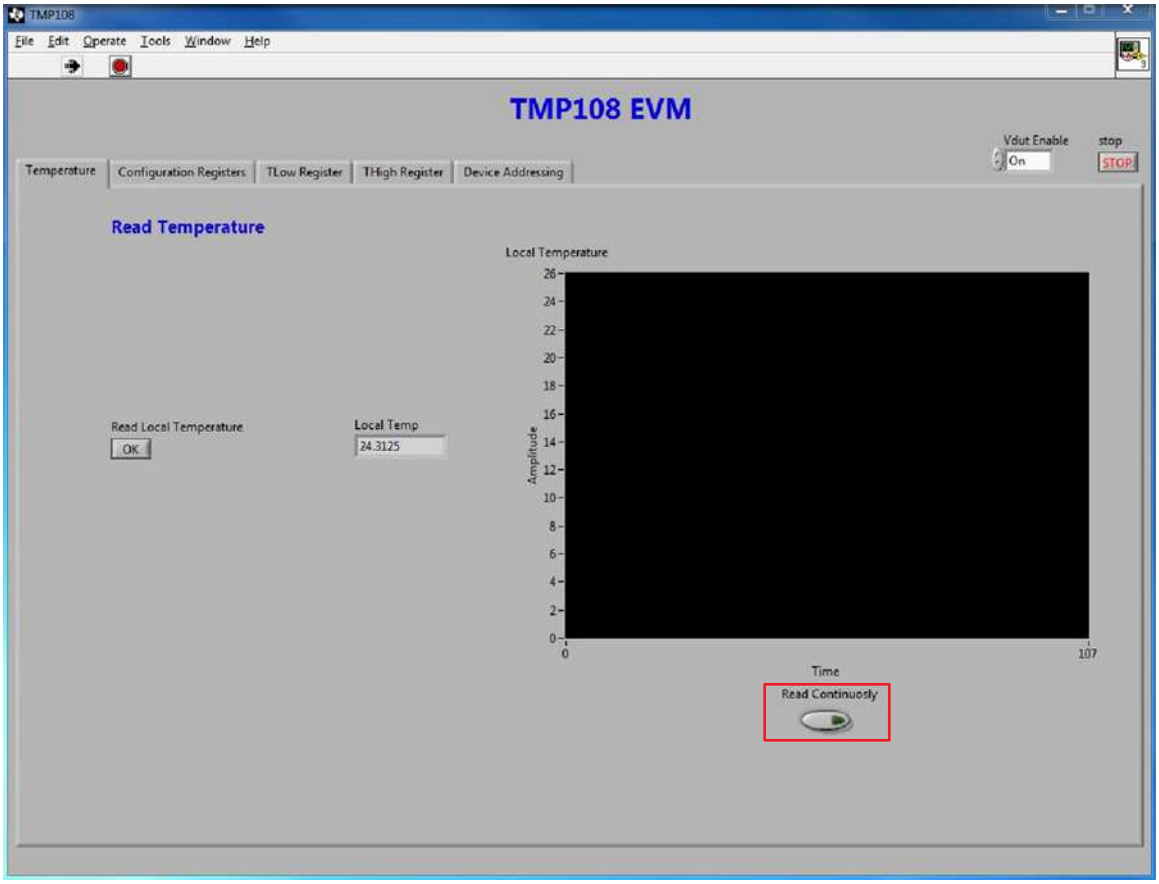


Figure 12. Read Continuously

5.2.2 Configuration Register

The TMP108EVM software contains a tab for the configuration register. Changing values in this register automatically writes them. Bits CR1 and CR0 set the conversion rate of the TMP108. Bits FH and FL denote if the temperature has exceeded the limits set by the THigh and TLow registers. Bit TM indicates to the device whether to operate in comparator mode or interrupt mode. Bits M1 and M0 enable different measurement modes including One-Shot Temperature Measurement mode and Continuous Conversion mode. Bit POL adjusts the polarity of the ALERT pin output. Bits HYS1 and HYS0 configure the hysteresis for the limit comparison of the TMP108 when operating in Comparator mode. See the TMP108 data sheet (SBOS663) for more information. Figure 13shows the Configuration Register tab in the TMP108EVM software.

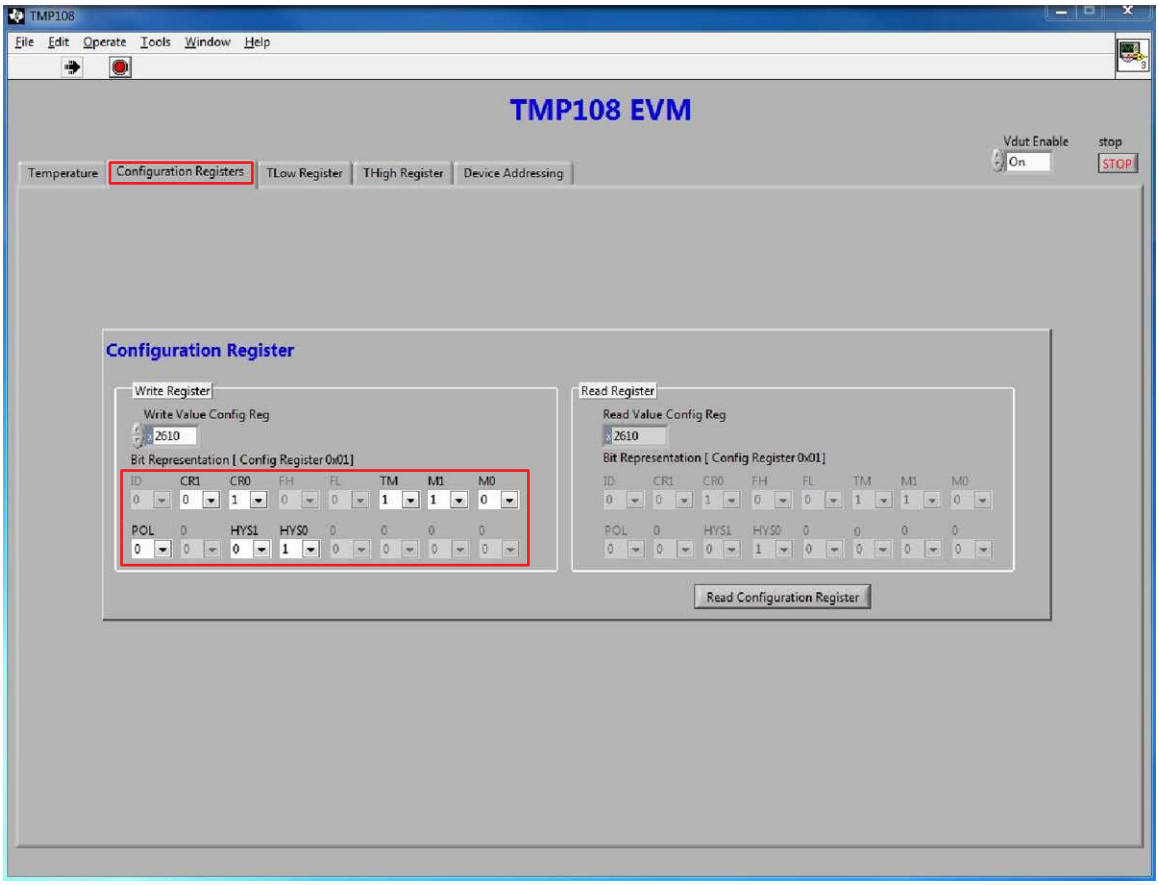


Figure 13. Configuration Register

5.2.3 Reading the Temperature Gauge

The *Local Temperature* box on the TMP108EVM software displays the measured values of the TMP108 registers in a graphical format, as shown in Figure 14 . This value is displayed in degrees Celsius. A continuous reading can be displayed by toggling the *Read Continuously* button.

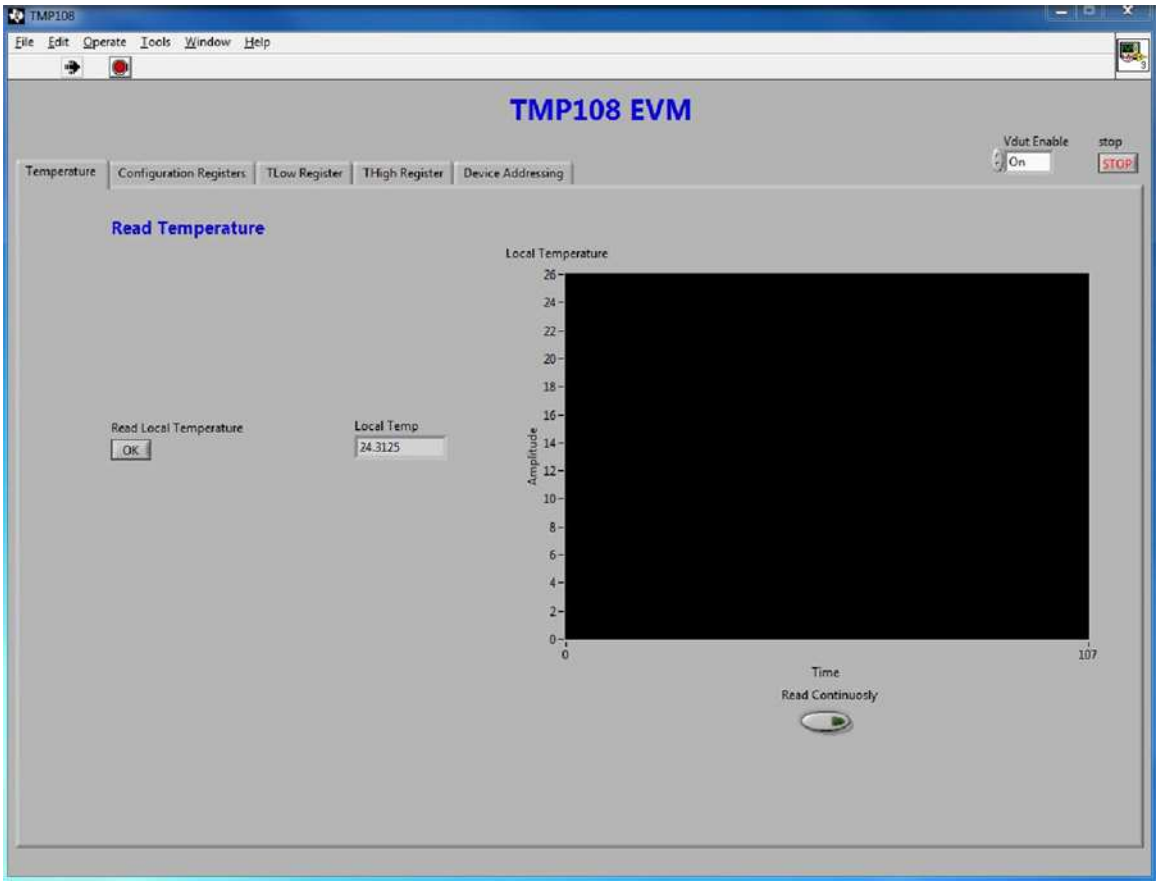


Figure 14. Reading the Temperature Gauge

5.2.4 Alert Configuration (Tlow and Thigh)

The TLow Register tab and the THigh Register tab set the limits of the TLow and THigh register, as shown in Figure 15 and Figure 16, respectively. This setting is made by entering the temperature in the *Write TLow Limit* or *Write THigh Limit* field. Confirm the limit by clicking the *Read TLow Register* or *Read THigh Register* button. When the temperature crosses the TLow or THigh limit, the alert pin is tripped, causing D2 to turn off and D3 to turn on. Note that if the POL bit in the Configuration Register is high, D3 is always on because the comparator looks for the ALERT pin to be active low. To reset the alert pin after it has been triggered, read the Configuration Register again.

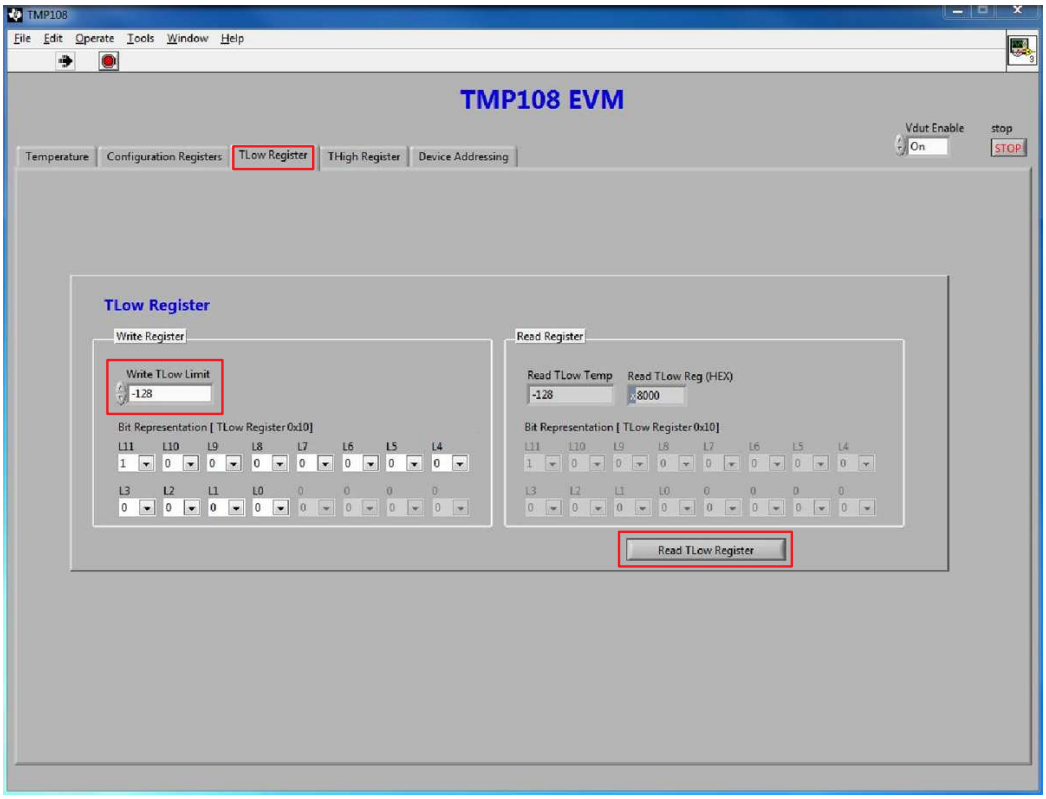


Figure 15. TLow Register

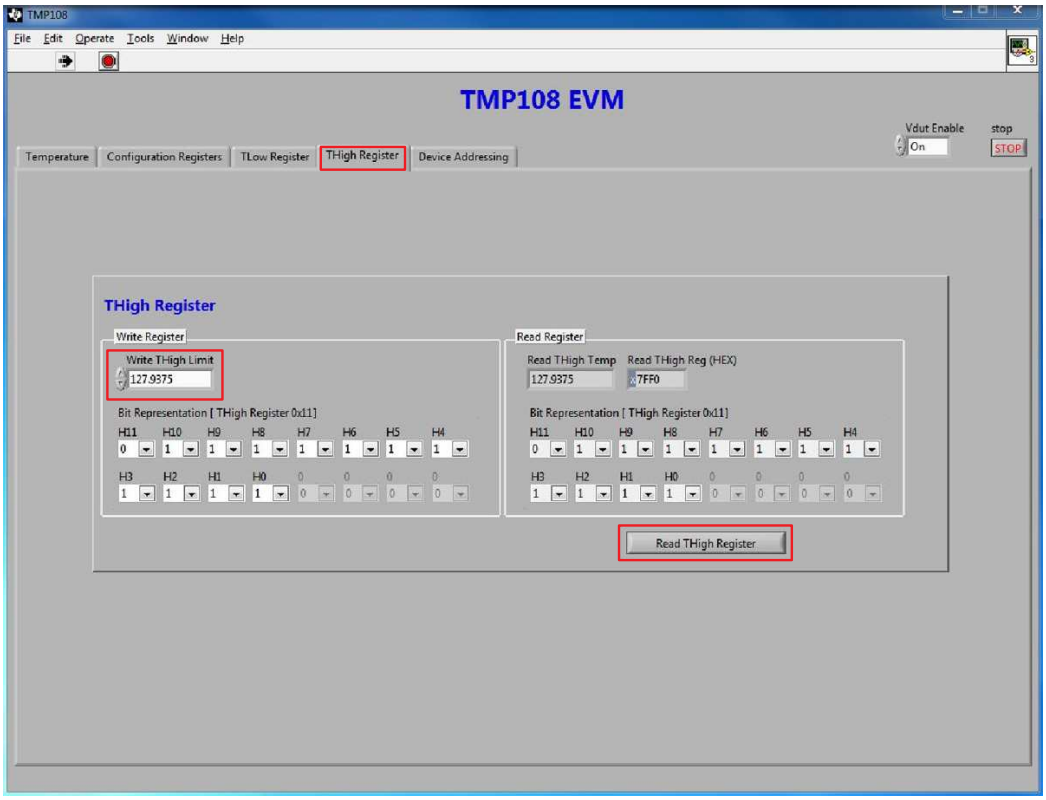


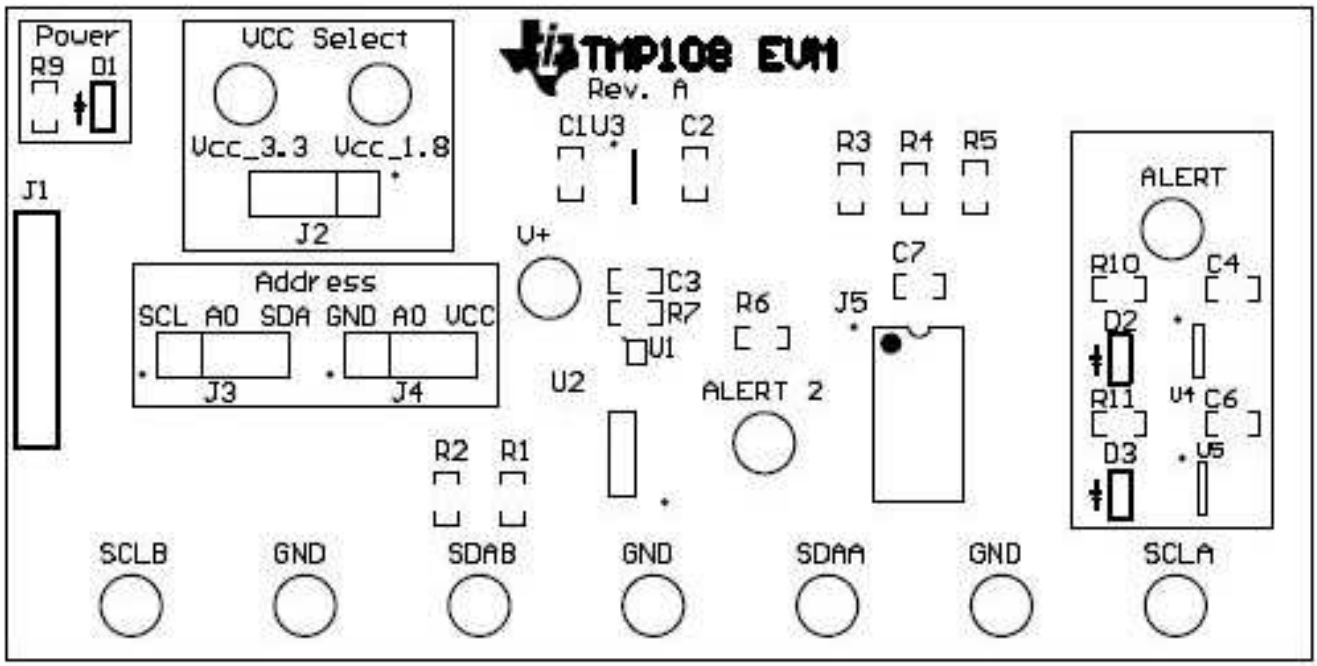
Figure 16. THigh Register

6 Documentation

This section contains the component layout, schematic diagram, and bill of materials for the TMP108EVM. Documentation information for the SM-USB-DIG Platform can be found in SBOU098, the SM-USB-DIG Platform User's Guide, available at the TI web site at http://www.ti.com.

6.1 PCB Layout

Figure 17 shows the PCB layout of the TMP108EVM.



NOTE: This image is not to scale; it is intended to show location of important parts and not for manufacturing.

Figure 17. PCB Layout

6.2 Board Schematic

Figure 18 shows the schematic for the TMP108EVM board.

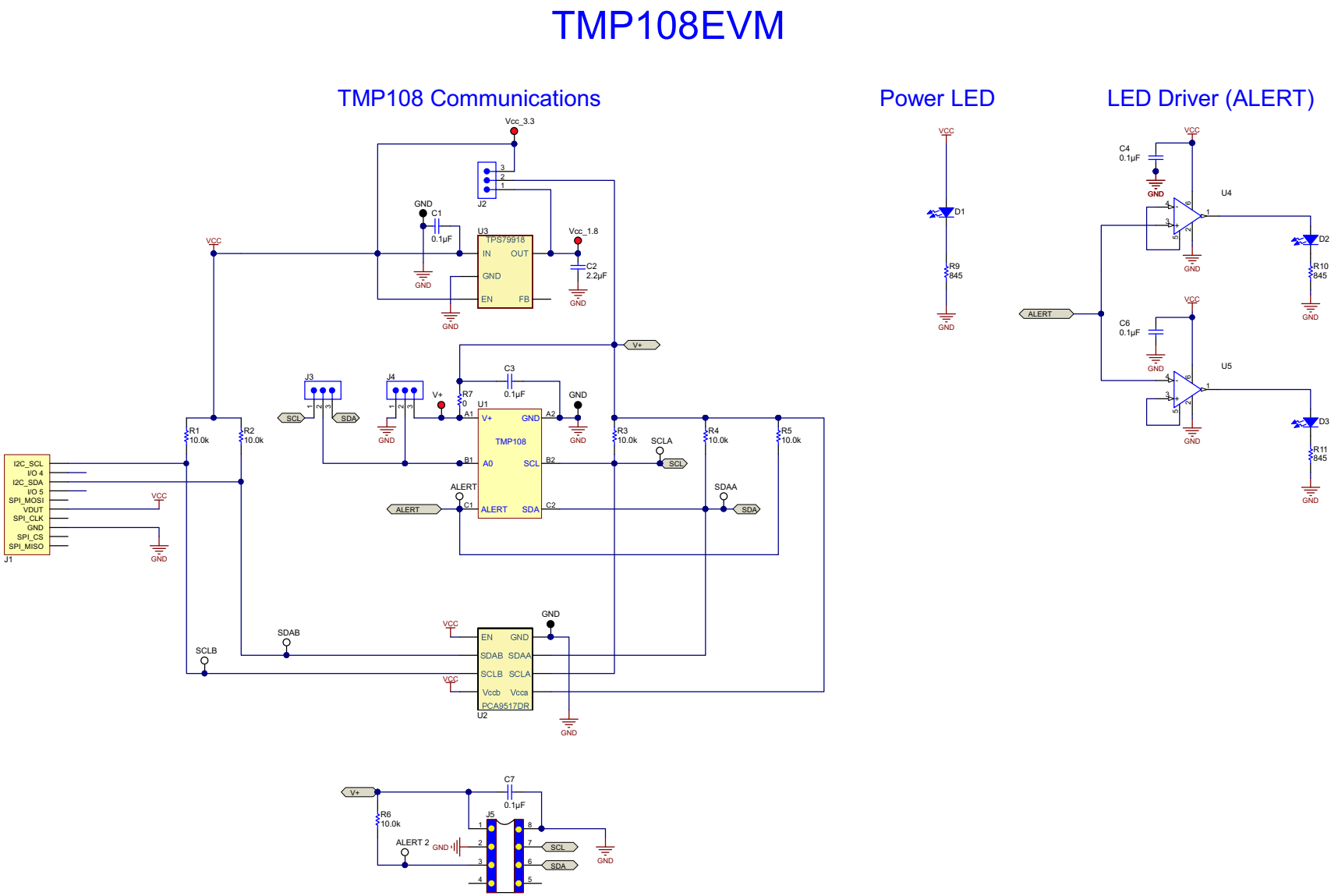


Figure 18. Board Schematic

6.3 Bill of Materials

Table 4 lists the bill of materials for the TMP108EVM.

Table 4. Bill of Materials

Item No.	Qty	Value	Ref Des	Description	Manufacturer	Digi-Key Part Number	Manufacturer Part Number
1	5	0.1 µF	C1, C3, C4, C6, C7	CAP, CERM, 0.1 µF, 16 V, ±5%, X7R, 0603	AVX	478-3726-1-ND	0603YC104JAT2A
2	1	2.2 µF	C2	CAP, CERM, 2.2 µF, 6.3 V, ±10%, X5R, 0603	Kemet	399-3362-1-ND	C0603C225K9PACTU
3	2	Red LED	D1,D3	Red LED LTST-C190EKT	Lite-On Inc	160-1182-6-ND	LTST-C190EKT
4	1	Green LED	D2	LTST-C190GKT	Lite-On Inc	160-1183-1-ND	LTST-C190GKT
5	6	White Test Point	ALERT, ALERT 2, SCLA, SCLB, SDAA, SDAB	Test Point, TH, Multipurpose, White	Keystone	5012K-ND	5012
6	3	Black Test Point	GND	Test Point, TH, Multipurpose, Black	Keystone	5011K-ND	5011
7	3	Red Test Point	V+, Vcc_1.8, Vcc_3.3	Test Point, TH, Multipurpose, Red	Keystone	5010K-ND	5010
8	4	Bumpon	H1, H2, H3, H4	Bumpon, Hemisphere, 0.44 × 0.20, Clear	3M	SJ5303-7-ND	SJ-5303 (CLEAR)
9	1	Super Mini DIG Connector Socket	J1	CONN SOCKET RT ANG 1POS .050	Mill-Max Manufacturing Corp.	ED8850-ND	851-43-010-20-001000
10	3	Pin Jumper	J2, J3, J4	CONN HEADER 3POS .100" SGL GOLD	Samtec Inc	SAM1029-03-ND	TSW-103-07-G-S
11	DNP	Socket	J5	IC SOCKET MACH PIN ST 8POS TIN	Assmann WSW Components	AE10011-ND	AR08-HZL-TT-R
12	1	0	R7	RES, 0 Ω, 5%, 0.1W, 0603	Rohm	RHM0.0GCT-ND	MCR03EZPJ000
13	6	10 kΩ	R1, R2, R3, R4, R5, R6	RES, 10.0 kΩ, 1%, 0.1W, 0603	Vishay-Dale	541-10.0KHCT-ND	CRCW060310K0FKEA
14	3	845	R9, R10, R11	RES, 845 Ω, 1%, 0.1W, 0603	Yageo America	311-845HRCT-ND	RC0603FR-07845RL
15	1	Temperature Sensor	U1	IC TEMP SENSR	Texas Instruments	NA	NA
16	1	I^2C Translator	U2	IC LVL-TRANSL I2C BUS REP 8-SOIC	Texas Instruments	296-23734-1-ND	PCA9517DR
17	1	LDO	U3	IC REG LDO 1.8 V .2 A TSOT-23-5	Texas Instruments	296-17778-1-ND	TPS79918DDCR
18	4	Comparator	U4, U5	IC COMPARATOR 1.8 V W/REF SOT23-6	Texas Instruments	296-16830-1-ND	TLV3012AIDBVR
19	2	Shunt	J2, J4	CONN JUMPER SHORTING .100" GOLD	Sullins Connector Solutions	S9341-ND	NPC02SXON-RC

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.

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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 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.

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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.

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