TMP102EVM Evaluation Board and Software Tutorial

This user's guide describes the characteristics, operation, and use of the TMP102EVM 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 TMP102EVM. 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 TMP102 is a digital output temperature sensor capable of reading temperatures to 12 bits of resolution. The TMP102 uses a two-wire I^{2}C™ and SMBus™ interface that allows up to four devices on one bus. The TMP102 is ideal for extended temperature measurement, and is also specified to operate between –40°C and +125°C. The TMP102EVM is a platform for evaluating the performance of the TMP102 under various signal, reference, and supply conditions.

This document gives a general overview of the TMP102EVM and provides a general description of the features and functions to be considered while using this evaluation module.

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1.1 TMP102EVM Kit Contents

Table 1 summarizes the contents of the TMP102EVM kit. Figure 1 shows all of the included hardware. Contact the Texas Instruments Product Information Center nearest you if any component is missing. It is highly recommended that you also check the TMP102 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. TMP102EVM Kit Contents

Item	Quantity
TMP102EVM 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

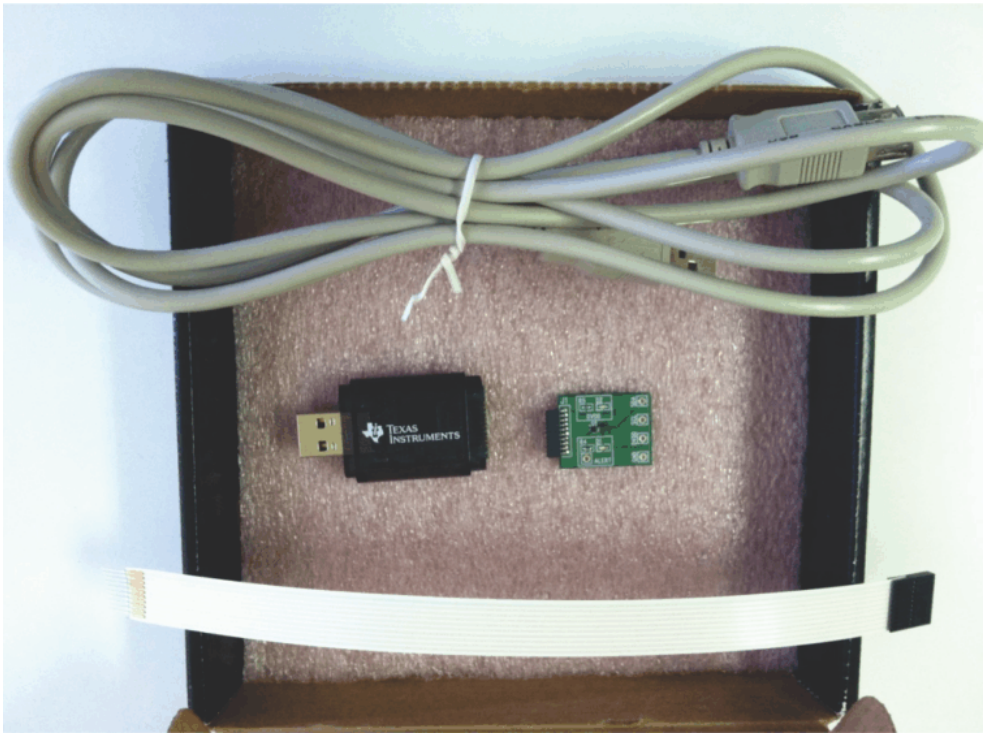


Figure 1. Hardware Included with TMP102EVM Kit

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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 TMP102EVM. This user's guide is available from the TI web site under literature number ***SBOU114***. 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
TMP102 Product Data Sheet	SBOS397B
SM-USB-DIG Platform User Guide	SBOU098

2 TMP102EVM Hardware Setup

Figure 2 shows the overall system setup for the TMP102EVM. The PC runs software that communicates with the SM-USB-DIG platform. The SM-USB-DIG platform generates the digital signals used to communicate with the TMP102 test board. The SM-USB-DIG and TMP102EVM are easily connectable through a 10-pin, board-to-board connector that should be attached to the SM-USB-DIG platform and the TMP102EVM PCBs. Once these two boards are connected, simply plug the USB device from the SM-USB-DIG into the computer as shown in Figure 2.

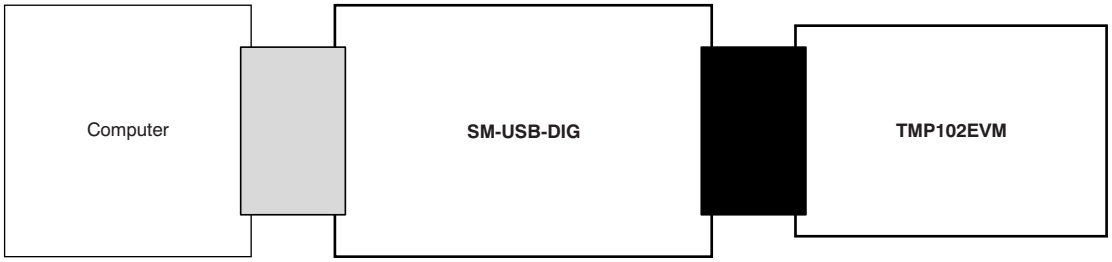


Figure 2. TMP102EVM Hardware Setup

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2.1 Theory of Operation for TMP102 Hardware

The TMP102EVM only requires the two-wire I^2C lines (SDA and SCLK) and V_{DUT}/GND to supply a constant 3.3 V and power return, as shown in Figure 3. The TMP102EVM also has test points to monitor these signal lines and ground, in case users may want to use their own signals or verify successful I^2C communications.

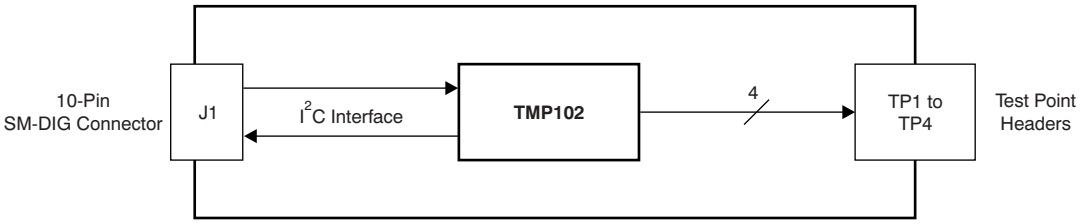


Figure 3. TMP102EVM Board Block Diagram

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 TMP102EVM and the SM-USB-DIG. It should be noted that the TMP102EVM uses only the necessary I^2C communication lines (pins 1 and 3) and the V_{DUT} and GND (pins 6 and 8, respectively) to issue commands to the TMP102 sensors.

Table 3. Signal Definition of H1 on TMP102EVM 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.

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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.

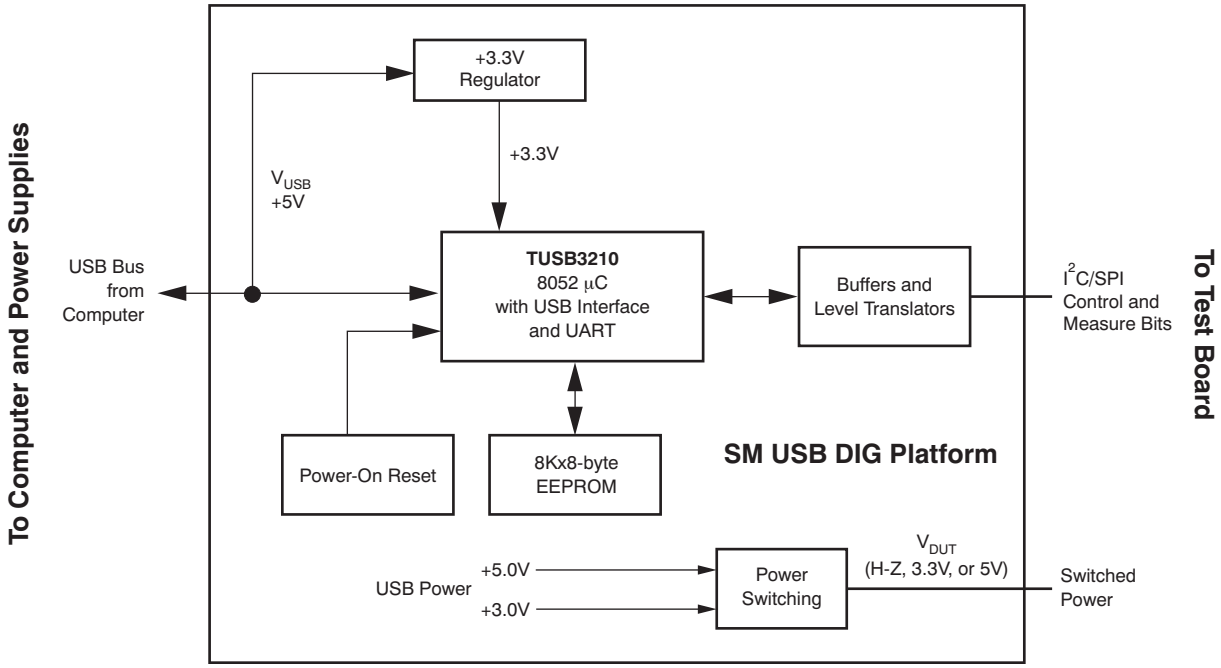


Figure 4. SM-USB-DIG Platform Block Diagram

3 TMP102EVM Hardware

The TMP102EVM hardware overview 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 TMP102EVM 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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3.2 Typical Hardware Connections

To connect the TMP102 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 may cause intermittent operation.

3.3 Connecting the USB Cable to the DIG

Figure 5 shows the typical response to connecting the SM-USB-DIG Platform board to a PC USB port for the first time. Typically, the computer responds with a *Found New Hardware, USB Device* pop-up dialog. The pop-up window then 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 Microsoft® Windows® operating system.

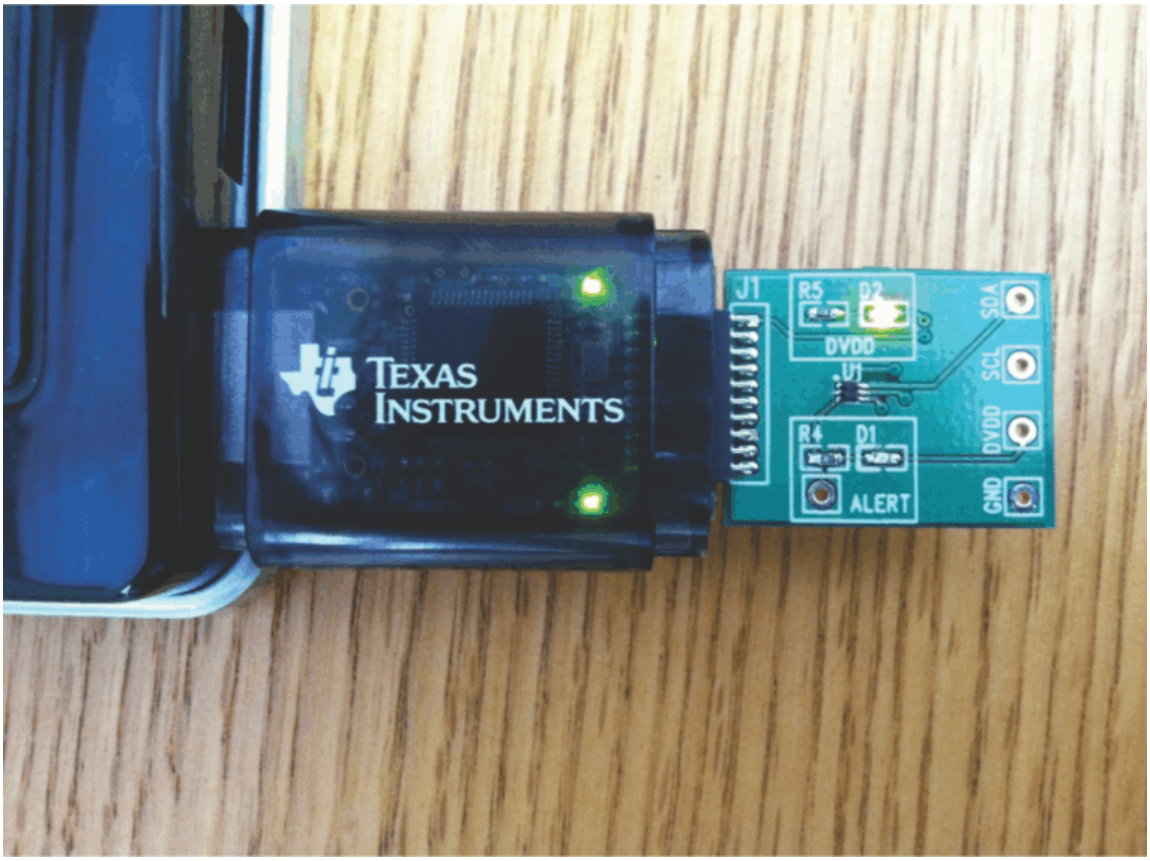


Figure 5. Connecting SM-USB-DIG Platform

In some cases, the Windows *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.

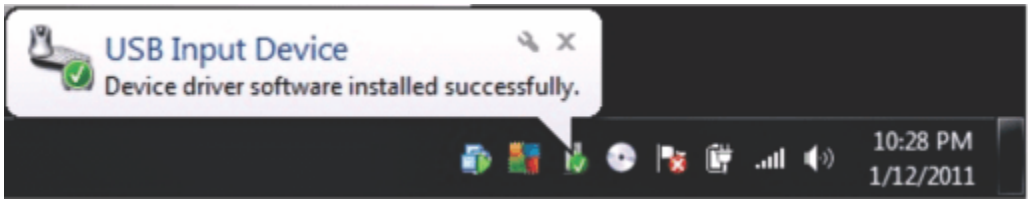


Figure 6. Confirmation of SM-USB-DIG Platform Driver Installation

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3.4 TMP102EVM Features

This section describes some of the hardware features present on the TMP102EVM test board.

3.4.1 I²C Test Points

I²C test points are included on the TMP102 test board for user convenience. These test points can be used to monitor the two-wire lines of the I²C interface or to run the TMP102 test board externally without the use of the SM-USB-DIG.

3.4.2 10-Pin Connector Ribbon Extender (Optional)

The TMP102EVM kit ships with an optional ribbon cable for extending the connection between the SM-USB-DIG and the PCB. This extension cable can be useful if high temperature tests must be run on the test board, because the SM-USB-DIG 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.

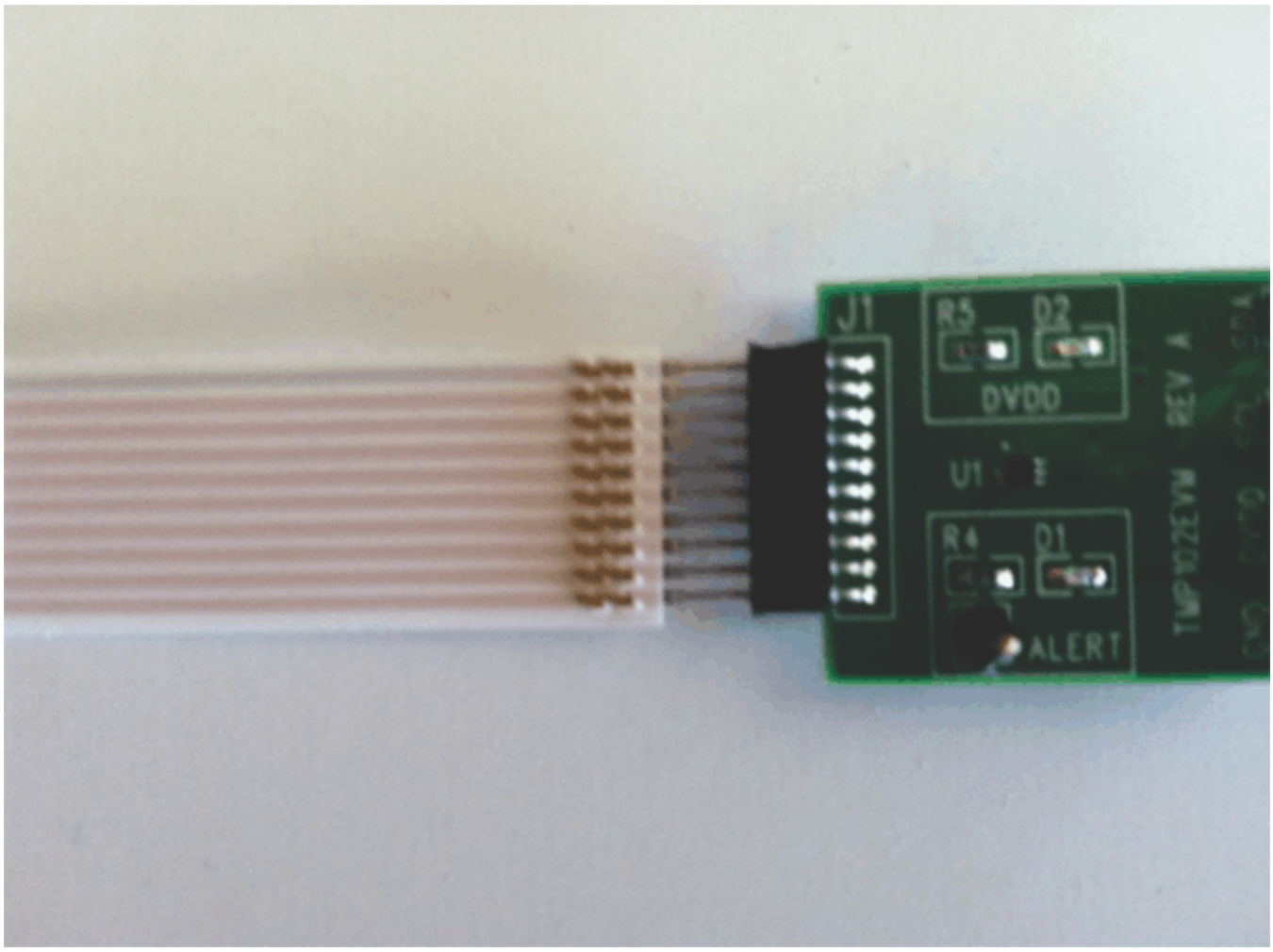


Figure 7. 10-Pin Ribbon Cable Extender

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4 TMP102EVM Software

This section discusses how to install the TMP102EVM software.

4.1 Hardware Requirements

The TMP102EVM 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 OS platforms.

4.2 Software Installation

The TMP102EVM software is included on the CD that is shipped with the EVM kit. It is also available through the TMP102EVM 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 TMP102EVM software folder. Locate the compressed file (*TMP102EVM.zip*) and open it using WinZIP® or a similar file compression program; extract the TMP102EVM files into a specific TMP102EVM folder (for example, *C:\TMP102EVM*) on your hard drive.

Once the files are extracted, navigate to the TMP102EVM folder you created on the hard drive. Locate the *setup.exe* file and execute it to start the installation. The TMP102 software installer file then begins the installation process as shown in Figure 8.

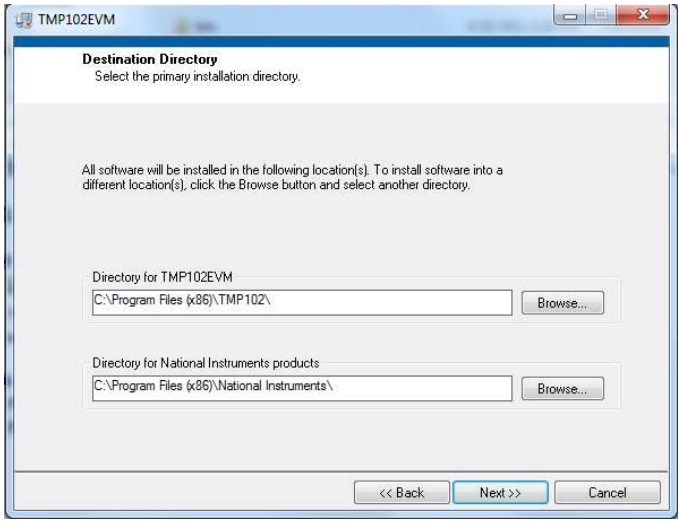


Figure 8. TMP102EVM Software Installation

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After the installation process initializes, the user is given the choice of selecting the directory in which to install the program; the default location is *C:\Program Files\TMP102* 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. Once the installation process is completed, click **Finish**.

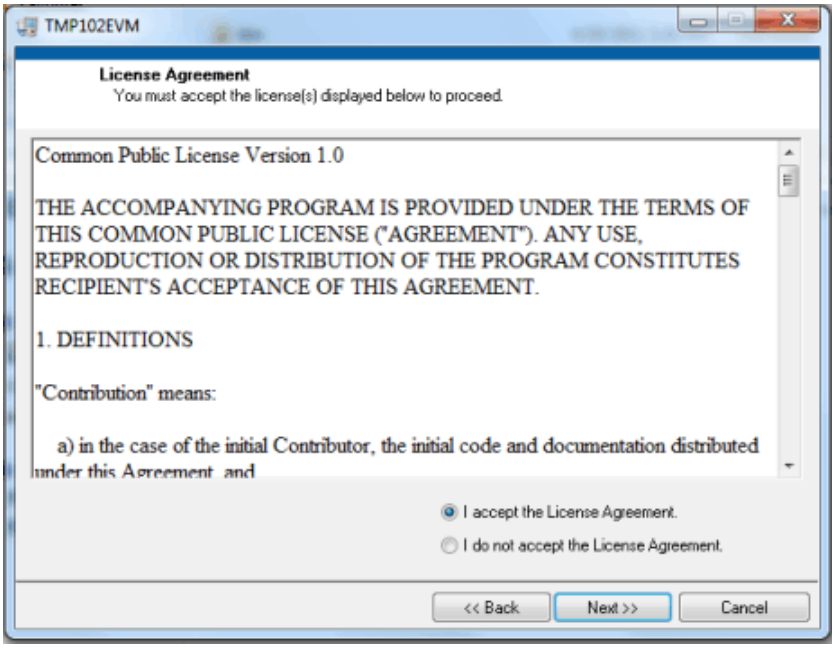


Figure 9. TMP102EVM License Agreements

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5 TMP102EVM Software Overview

This section discusses how to use the TMP102EVM software.

5.1 Starting the TMP102EVM Software

The TMP102 software can be operated through the Windows *Start* menu. From Start, select *All Programs*; then select the *TMP102EVM* program.

Figure 10 illustrates how the software should appear if the TMP102EVM is functioning properly.

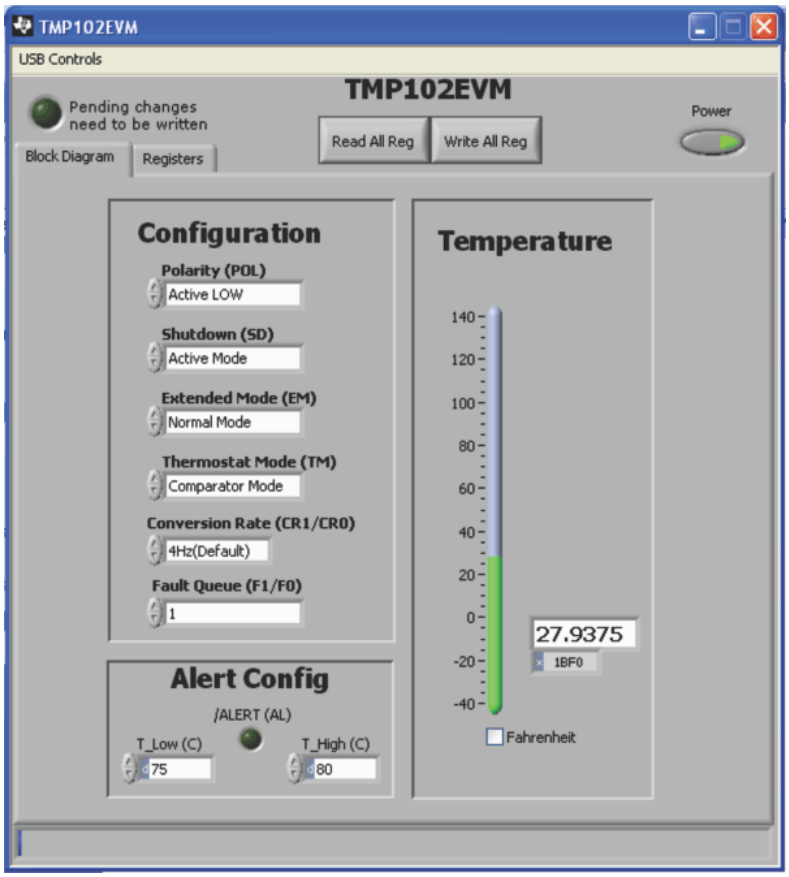


Figure 10. TMP102EVM Software Interface

Figure 11 shows an error message that is displayed if the PC cannot communicate with the SM-USB-DIG platform. If you receive this error message, first check to see that the USB extension cable is properly connected to both the PC USB port and to the SM-USB-DIG platform. Another possible source for this error is a problem with the PC USB Human Interface Device driver. Make sure that the device is recognized when the USB cable is plugged in; recognition is indicated by a Windows-generated confirmation sound.

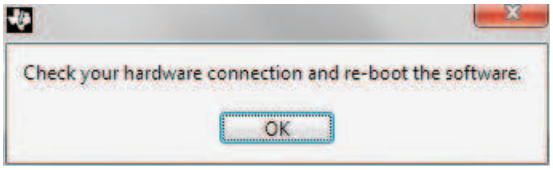


Figure 11. TMP102EVM Software: Communication Error with the SM-USB-DIG Platform

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5.2 Using the TMP102Software

5.2.1 Reading from Registers

When first starting the TMP102EVM software, the user should confirm stable connections to the test board by toggling the **Read All Reg** button (shown in Figure 12). If all devices are communicating correctly, the user should be able to see temperature change over time in the TMP102 Temperature box.

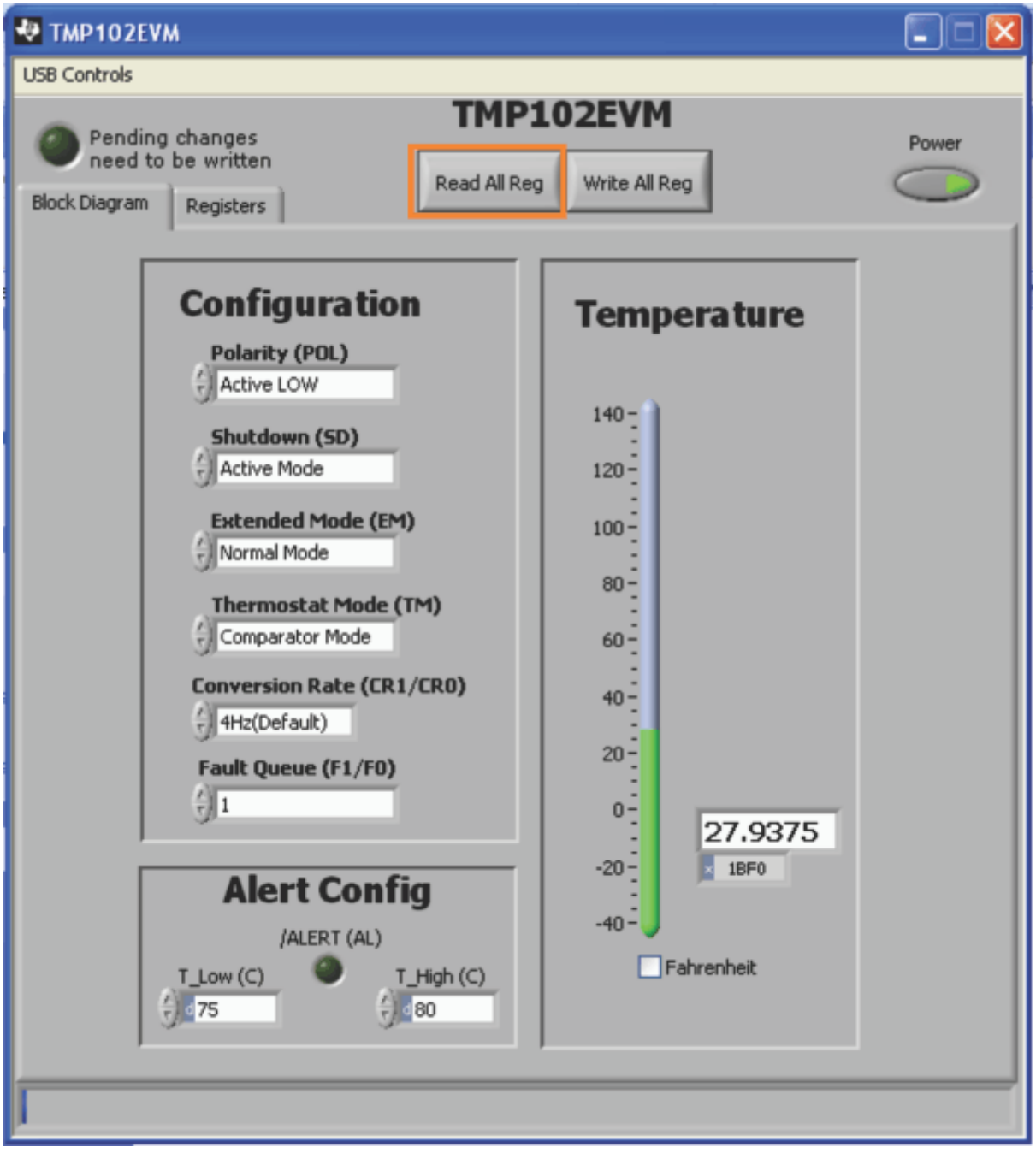


Figure 12. TMP102 Reading from Registers

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5.2.2 Writing to Registers

The TMP102EVM software contains two different methods for writing data: *Write All Reg* and *Auto-Write Reg*. Writing the registers individually without Auto-write can be useful when adjusting large numbers of the configuration registers on the left side of the panel. The Auto-write feature automatically makes changes to the configuration register whenever one of the configuration settings on the left changes, as shown in Figure 13.

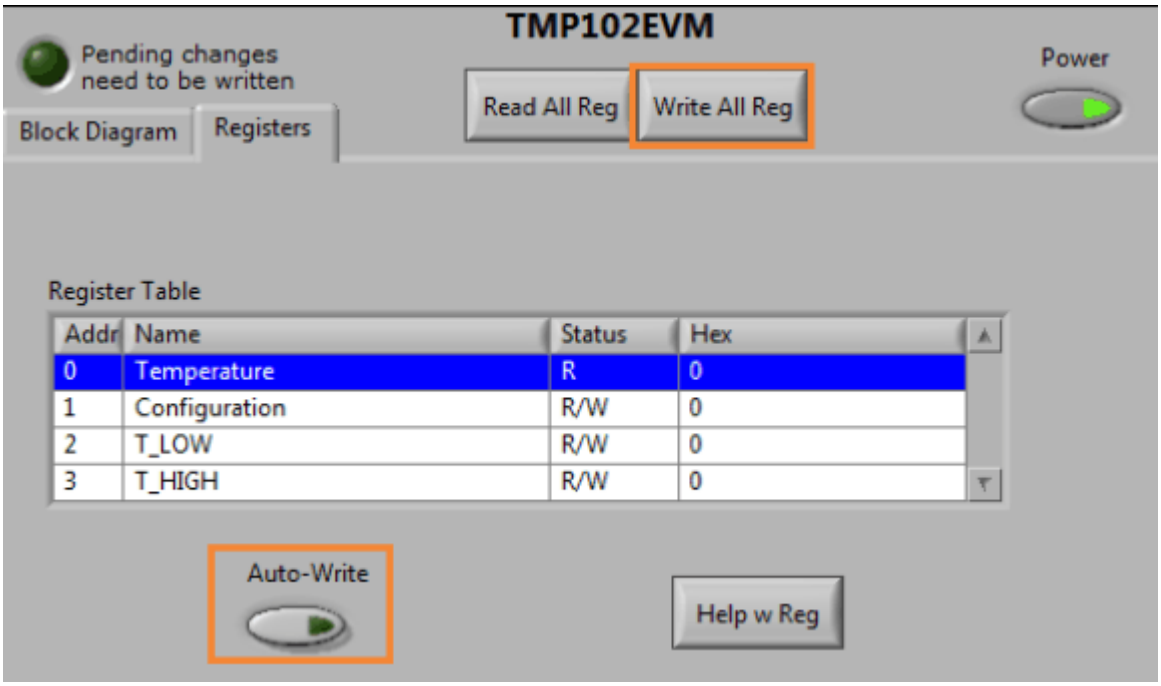


Figure 13. TMP102 Writing to Registers

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5.2.3 Reading the Temperature Gauge

The Temperature box on the TMP102EVM software window displays the measured values of the TMP102 registers in a graphical format, as Figure 14 shows. This value can be toggled to either (degrees) Fahrenheit or Celsius by toggling the checkbox at the bottom of the window. It is important to note that changing to extended mode on the TMP102EVM software also changes the full-scale value of TMP102 thermometer.

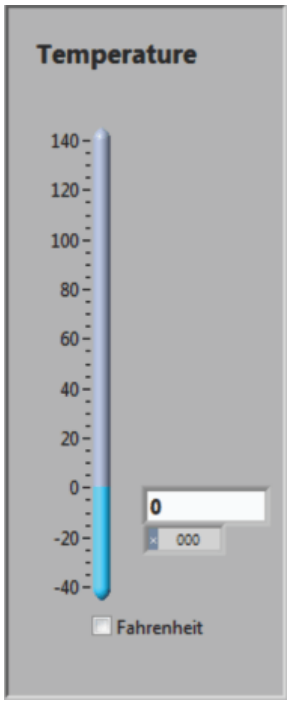


Figure 14. Reading the Temperature Gauge

5.2.4 Polarity (Alert Pin)

The polarity drop-down selection box in the Configuration section allows the user to toggle how the Alert pin behaves when it is triggered. When the polarity box is set to Active Low, as shown in Figure 15, the LED on the TMP102EVM board lights up when triggered and acts as a ground source. When the polarity box is set to Active High, the LED on the TMP102EVM board does not function, and the Alert pin on the TMP102 is set to DVDD when triggered.

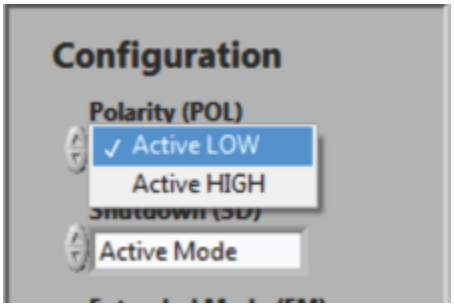


Figure 15. Configuring the Polarity

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5.2.5 Shutdown Mode

The TMP102 has a built-in shutdown mode that allows the device to stop consuming power. The Shutdown mode selection box (illustrated in Figure 16) can also be used to clear the Alert pin when the Interrupt Mode (refer to Section 5.2.7) is selected. It is important to note that the TMP102 EVM cannot perform temperature conversions while in Shutdown mode.

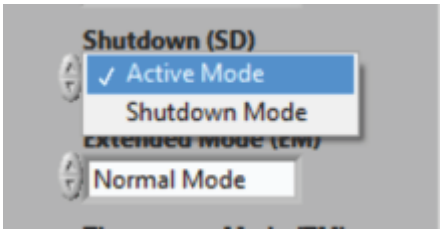


Figure 16. Active and Shutdown Mode

5.2.6 Extended Mode

The TMP102EVM has two modes for storing converted temperature data as shown in Figure 17: Extended Mode and Normal Mode. Normal mode gives the Temperature, T_{LOW}, and T_{HIGH} Registers 12 bits of accuracy. By changing to Extended Mode, the user increases to 13 bits of accuracy and adjusts the full-scale value of the three registers from 120°C to 150°C. It is important to note that adding an additional bit of accuracy also changes the current T_{HIGH} and T_{LOW} values; these values must then be reset to the user's original, intended values after adjusting the Extended Mode drop-down box.

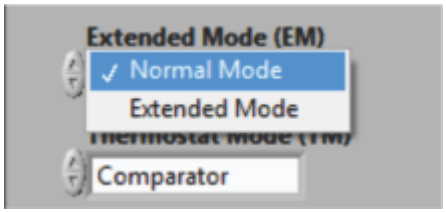


Figure 17. Extended Mode and Normal Mode

5.2.7 Thermostat Mode

Thermostat Mode, in the Configuration box, allows the user to designate how the TMP102 Alert pin behaves when the Temperature Register exceeds the T_{HIGH} Register. When the TMP102EVM software is in Comparator Mode, the Alert pin triggers if the temperature measured by the TMP102 exceeds the T_{HIGH} Register for the set amount of faults, described in the Fault Queue (see Section 5.2.9). Once the Alert pin has been triggered, it remains triggered until the temperature measured by the TMP102 falls below the T_{LOW} Register value for the set amount of faults.

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When the TMP102EVM software is in Interrupt Mode, the Alert pin does not automatically clear after it falls below the T_{LOW} Register limit. Instead, the user must either select the **Read All Reg** button or put the device into Shutdown mode, described in Section 5.2.5. After the **Read All Reg** button is selected, or the device is put into Shutdown Mode, the Alert pin clears when the measured temperature drops down below the T_{LOW} Register. Figure 18 illustrates the Thermostat Mode dialog.

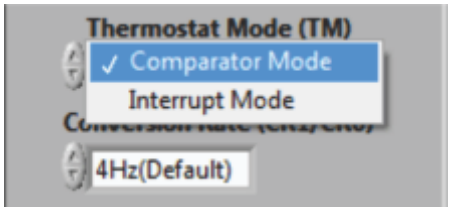


Figure 18. Comparator/Interrupt Mode

5.2.8 Conversion Rate

The Conversion Rate selection box (shown in Figure 19) allows the user to change how long each temperature conversion takes the TMP102 to perform. The user may want to select a slower conversion time, as shown in Figure 19, to make the TMP102 consume less power.

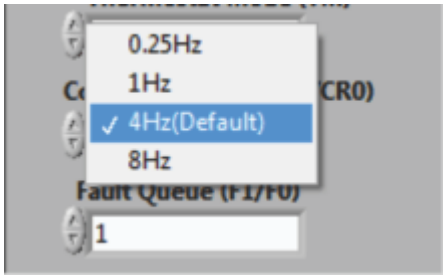


Figure 19. Conversion Rate

5.2.9 Fault Queue

The fault queue drop-down box allows the user to configure how many faults must be triggered before the Alert pin is activated, as shown in Figure 20. A fault is generated whenever the TMP102 T_{HIGH} Register is exceeded by the Temperature Register. This feature can be useful to prevent the TMP102 from triggering on temperature spikes that the user may not want to trigger with the Alert pin.

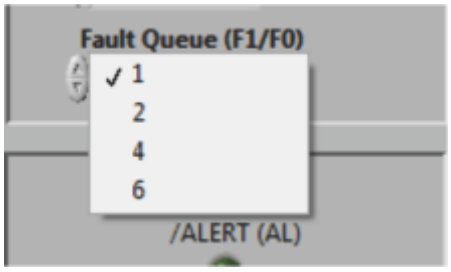


Figure 20. Setting the Fault Queue

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5.2.10 Alert Configuration (T_{LOW} and T_{HIGH})

The Alert Config box has three objects that make up the main functionality of the TMP102 Alert pin, as Figure 21 shows: the Alert bit, T_{LOW} Register, and T_{HIGH} Register. The green LED within the Alert Config box lights up when the T_{HIGH} Register has been exceeded and the Alert pin has been activated. It is denoted as a $\overline{\text{Alert}}$ because of the default configuration. The Alert pin can also be switched to an active high, as shown in Section 5.2.4, if so desired by the user.



Figure 21. Alert Config Box

The T_{LOW} input box allows the user to set when the alert pin is cleared. When the measured value in the temperature register falls below the T_{LOW} threshold, the Alert pin clears, depending on which thermostat mode is selected. For more information on the behavior of the Thermostat mode, see Section 5.2.7.

The T_{HIGH} input box allows the user to set when the Alert pin is triggered. When the measured value in the temperature register exceeds the T_{HIGH} threshold, the Alert pin triggers until the temperature returns to a value below the T_{LOW} threshold, depending on the thermostat mode selected.

5.2.11 Registers Tab

The registers tab displays the individual register setting for the TMP102 sensors. For more information on the individual registers and the bit meanings, simply highlight the desired register and hit the **Help with Reg** button shown in Figure 22.

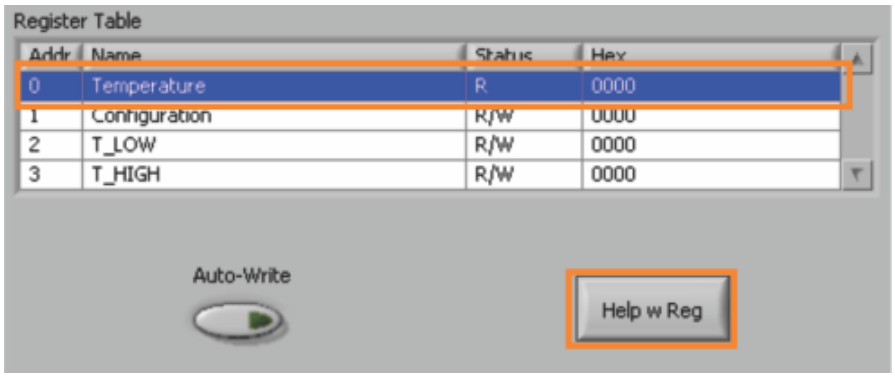


Figure 22. Register Tab

The Registers tab also includes the Dig_Bits table. The Dig_Bits table allows the user to monitor and change individual bits by highlighting the desired register and toggling the bit controls beneath it.

NOTE: Only the bits that can be written within a given register can be toggled.

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6 TMP102 Documentation

This section contains the complete bill of materials and PCB layout for the TMP102EVM.

NOTE: These board layouts are not to scale. These image are intended to show how the board is laid out; they are not intended to be used for manufacturing TMP102EVM PCBs.

6.1 TMP102EVM Board Schematic

Figure 23 shows the schematic for the TMP102EVM board.

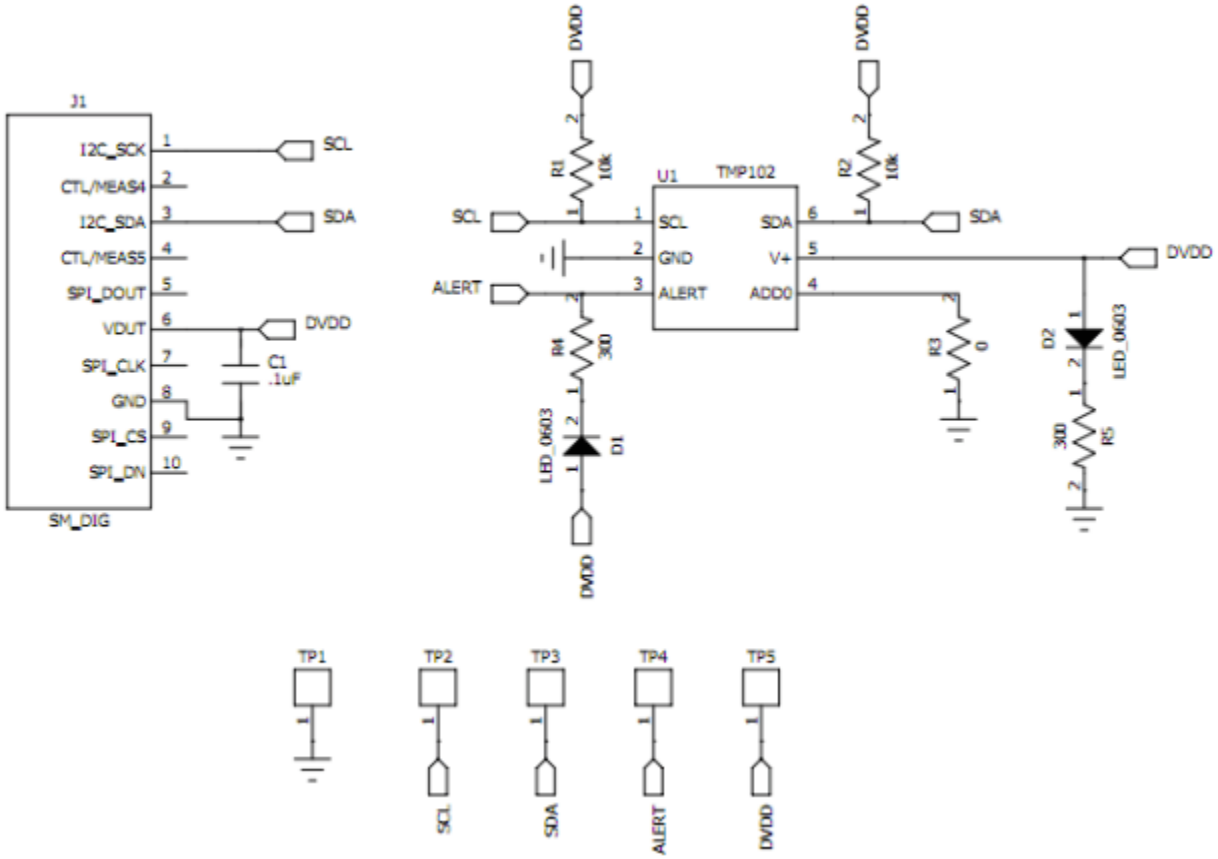


Figure 23. TMP102EVM Board Schematic

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6.2 PCB Layout

Figure 24 and Figure 25 show the PCB layout of the TMP102EVM.

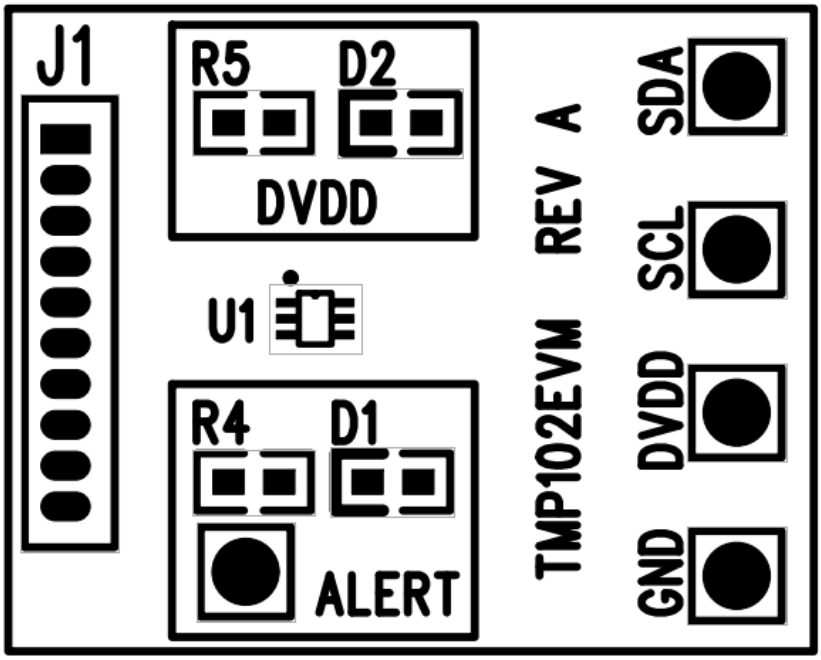


Figure 24. TMP102EVM PCB Top Layer (Component Side)

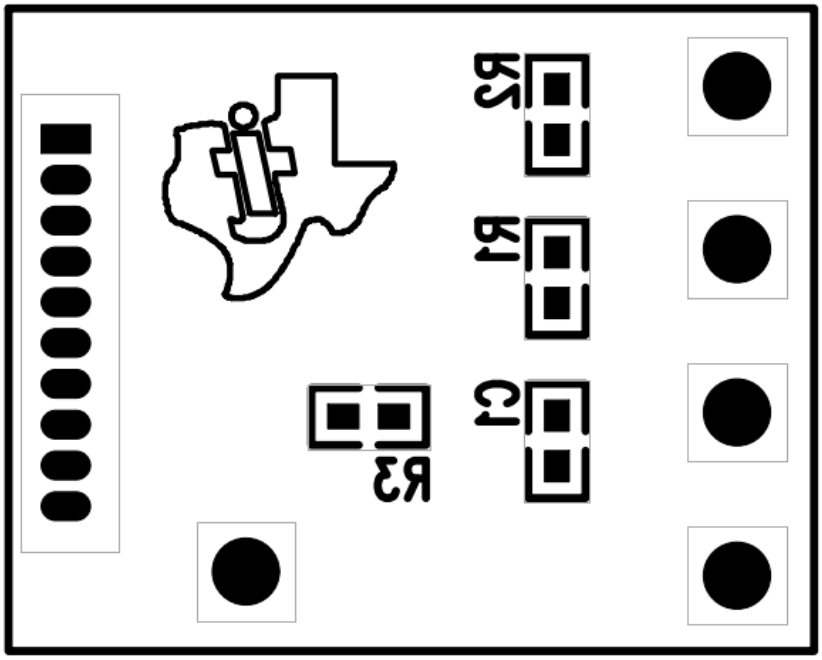


Figure 25. TMP102EVM PCB Bottom Layer

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6.3 Bill of Materials

Table 4 lists the bill of materials for the TMP102EVM.

Table 4. Bill of Materials

Item No.	Qty	Value	Ref Des	Description	Vendor/Mfr	Part Number
1	2	10 kΩ	R1, R2	Resistor, 10 kΩ 1/10W 5% 0603 SMD	Stackpole Electronics	RMCF0603JT10K0
2	1	300 Ω	R4, R5	Resistor, 300 Ω 1/10W 5% 0603 SMD	Panasonic	ERJ-3GEYJ301V
3	1	0 Ω	R3	Resistor, 0.0 Ω 1/10W 0603 SMD	Stackpole Electronics	RMCF0603ZT0R00
4	1	0.1 µF	C1	Capacitor, Ceramic, 0.10-µF 25-V Y5V 0603	TDK Corporation	C1608Y5V1E104Z
5	2	2 V, 5 mA	D1, D2	LED Green Wide Angle 0603 SMD	Panasonic	LNJ3W0C83RA
6	1	—	U1	TMP102	Texas Instruments	
7	1	Jumper TP cut to size (See Note 3xx)	Jumpers, All	Connector, Header 50-Pos .100-in. SGL Gold	Samtec	TSW-150-07-G-S
8	1	Super MiniDIG connector Socket (See Note 2xx)	J1	Connector, Socket 50-Pin .050 R/A Sngl	Mill-Max Manufacturing	851-43-050-20- 001000

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 1.4 V to 3.6 V and the output voltage range of 1.4 V to 3.6 V .

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. 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 +25°C. The EVM is designed to operate properly with certain components above +25°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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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.

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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.

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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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