EVM User's Guide: TMP119EVM
TMP119 Evaluation Module

![Texas Instruments logo]

Description

The TMP119EVM is designed to provide a quick setup to evaluate the TMP119 device and gain familiarity with the device down to the bit-by-bit register level. The EVM allows users to evaluate the performance of the TMP119 digital temperature sensor. The TMP119EVM features a detachable breakable TMP119 sensor board portion to allow flexibility in location of measurement.

Get Started

1. Order the TMP119EVM on ti.com
2. Connect EVM to computer
3. Open GUI link on the TMP119EVM product page
4. Open latest version on GUI on dev.ti.com
5. Install the TI Cloud Agent Setup plug-in
6. Reload GUI
7. Confirm connection with the EVM
8. Monitor temperature change through the Data Capture Tab
9. Detach breakable sensor PCB section and solder connections (optional)
10. Experiment with the GUI tabs using the TMP119 data sheet
11. Visit our E2E forums for support or questions

Features

- Straightforward application to check temperature functionality of TMP119
- Easy to use cloud-based GUI is available on the web or can downloaded for offline use
- Breakable TMP119 sensor board
- Access to data logging, adjusting the I2C frequency, and modifying data in registers
- Software powered by GUI Composer runs in a browser on Windows®, Mac®, and Linux® operating systems

Applications

- Electronic thermometers
- Wireless environmental sensors
- Thermostats
- Automotive test equipment
- Wearable fitness and activity monitors
- Cold chain asset tracking
- Gas meters and heat meters
- Temperature transmitters
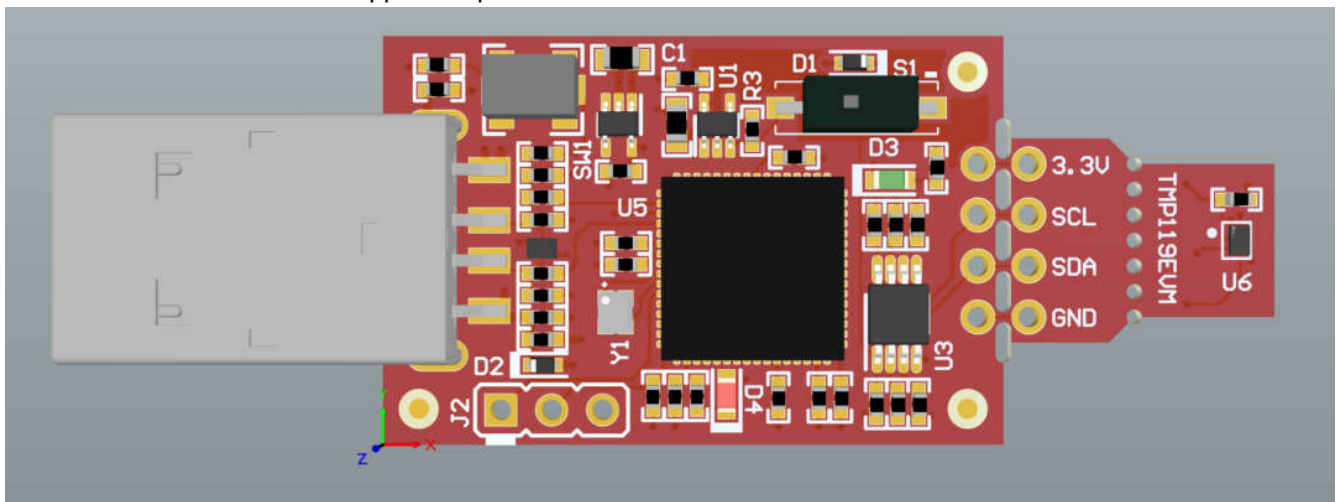
TMP119EVM

1 Evaluation Module Overview

1.1 Introduction

The EVM comes in a USB stick form factor, with an onboard MSP430F5528 microcontroller that interfaces with both the host computer and the TMP119 device. The module is designed with perforations between the sensor and host controller on the EVM board. The perforation allows the user flexibility in their evaluation:

- The user can connect the TMP119 to the user's system or host.
- The user can connect the EVM host and software to the user's system with TMP119 devices.
- Small individual boards allow the user to place sensors in the user's system.
- Hole spacing is compatible with common 0.1" prototyping breadboards.

This user's guide describes the characteristics, operation, and use of the TMP119 Evaluation Module (EVM). A complete schematic diagram, printed-circuit board layouts, and bill of materials are included in this document. This user's guide details through the steps to operate the TMP119 evaluation module.

1.2 Kit Contents

Table 1-1 details the contents of the EVM kit. Contact the nearest Texas Instruments Product Information Center for missing components. TI highly recommends checking the TI website at https://www.ti.com for the latest revision.

Table 1-1. Kit Contents

Item	Quantity
TMP119EVM	1
USB Extension Cable	1

1.3 Specification

Table 1-2 defines the absolute maximum thermal conditions of each section of the EVM. The main two sections are the controller section and the sensor breakable section. These limits must be considered when evaluating the performance of the device at extreme temperatures. In this case, if the setup conditions exceed the controller absolute maximum thermal specifications, then the sensor breakable section must be detached so that only the sensor (and not the MCU) is evaluated at these temperatures.

Table 1-2. TMP119EVM Temperature Limits

BOARD SECTION	CONDITIONS	TEMPERATURE RANGE
Controller board	Recommended operating free-air temperature, T_A	-40°C to 85°C
	Absolute maximum junction temperature, $T_{J\,(MAX)}$	95°C
TMP119 breakable board	Recommended operating free-air temperature, T_A	-55°C to 150°C

1.4 Device Information

The TMP119 is a high-precision digital temperature sensor. The TMP119 provides a 16-bit temperature result with a resolution of 0.0078 °C and an accuracy of up to ±0.08 °C across the temperature range of 0 °C to 45 °C with no calibration. The TMP119 has an interface that is I2C- and SMBus™- compatible, programmable alert functionality, and the device can support up to four devices on a single bus. Integrated EEPROM is included for device programming with an additional 48-bits memory available for general use. TMP119 is NIST traceable. TMP119 is designed to meet ASTM E1112 and ISO 80601 requirements for electronic patient thermometers. For non-medical applications, the TMP119 can serve as a single chip digital alternative to a Platinum RTD. For more information of the IC, please refer to the device data sheet. Table 1-3 includes some of the parameters of interest of the TMP119 to consider when using this EVM.

Table 1-3. Device Specifications

Device Specification	Value
Operating temperature range	-55C to 155C
Temperature accuracy (0°C to 45°C)	0.08
Temperature accuracy (-20°C to 50°C)	0.1
Temperature accuracy (-40°C to 70°C)	0.15
Temperature accuracy (-40°C to 100°C)	0.2
Temperature accuracy (-55°C to 125°C)	0.25
Temperature accuracy (-55°C to 150°C)	0.3
Operating supply range	1.7V to 5.5V

2 Hardware

2.1 Overview

The EVM is divided into two sections: the controller section and the breakable sensor section. The breakable sensor section can be detached to use the sensor in the following scenarios:

- Using the controller section with the sensor section connected by soldered wires/connectors to evaluate the sensor far from the controller and PC at extreme temperatures or other conditions.
- Using the sensor section with the user's system by interfacing through I2C with the TMP119.
- Using the controller section with TMP119 sensors in the user's system.

The figure below highlights the EVM sections as well as some components that must be identified by the user to understand their purpose and use. The components are further explained in detail in the sections below.
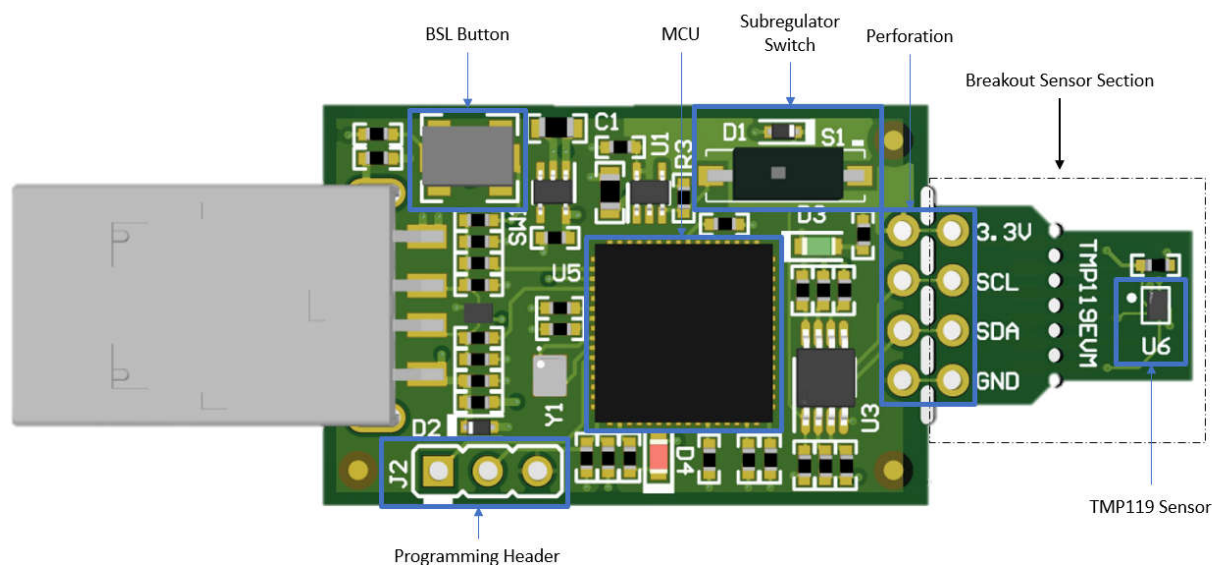
Figure 2-1. TMP119EVM Board Sections

2.2 Perforations and Connectivity

The perforation between the USB controller and TMP119 sensor is labeled on both sides for pin connections. Once the sensor section is detached from the controller section, the user can interface with the sensor section in two different ways:

- Soldering wires or 0.1" header connectors: With this approach, the user has access to all pins of the device.

Note

Pullup resistors and protection diodes are on the controller section. Thus, when interfacing with other controller boards, TI recommends to verify that pullup resistors and protection circuitry are present on any controller board for safe and proper functionality.

2.3 Status LEDs and Subregulator

The switch S1 enables and disables the onboard 3.3-V regulator: U5. When the subregulator is enabled, the green LED D3 illuminates. The subregulator must be enabled for normal operation of TMP119EVM as the subregulator supplies power to the device and pullup voltage of the communication lines.

The red LED D4 is the MSP430F5528 status LED. Table 2-2 shows how the different modes of operation are displayed by the LED status.

D4 LED Status	MSP430F5528 Mode of Operation
Off	EVM is connected to EVM GUI
Blicking in burst of 4 blinks	EVM is plugged into PC, not connected to EVM GUI
Steady blinking	Connected to USB power

2.4 Programming Header

The TMP119EVM comes pre-loaded with firmware that is necessary for the correct operation of the USB interface and PC GUI software. The unpopulated header, J2, is provided for Spy-Bi-Wire access to the MSP430F5528. TI does not recommend that users access this header or reprogram the device.

2.5 BSL Button

The TMP119EVM features push-button SW1 for entering USB BSL mode. This can be used for firmware updates. To enter USB BSL mode, connect the EVM to a PC USB port while holding down SW1.

3 Software

3.1 Software Installation

The PC GUI Software for TMP119EVM runs on TI's GUI Composer framework. The software is available as a live version, which runs in a browser, and is available as a download for offline use. The software is compatible with Windows, Mac, or Linux operating systems.

3.1.1 Live Software on dev.ti.com

The live software currently works on Chrome™, Firefox®, and Safari® browsers. Internet Explorer® is not supported. Users can access the live version through one of the following actions:

- Go to the TMP119EVM Product page on ti.com and click on the View button

- Go to dev.ti.com/gallery, log in with myTI account credentials, and search for TMP119EVM.
- Go to dev.ti.com/gallery/info/THSApps/TMP119EVM/.

Click the application icon within the gallery to launch the software. Agree to the prompts to install or update the TI Cloud Agent browser plug-in. The plug-in is necessary for connection to the USB hardware.
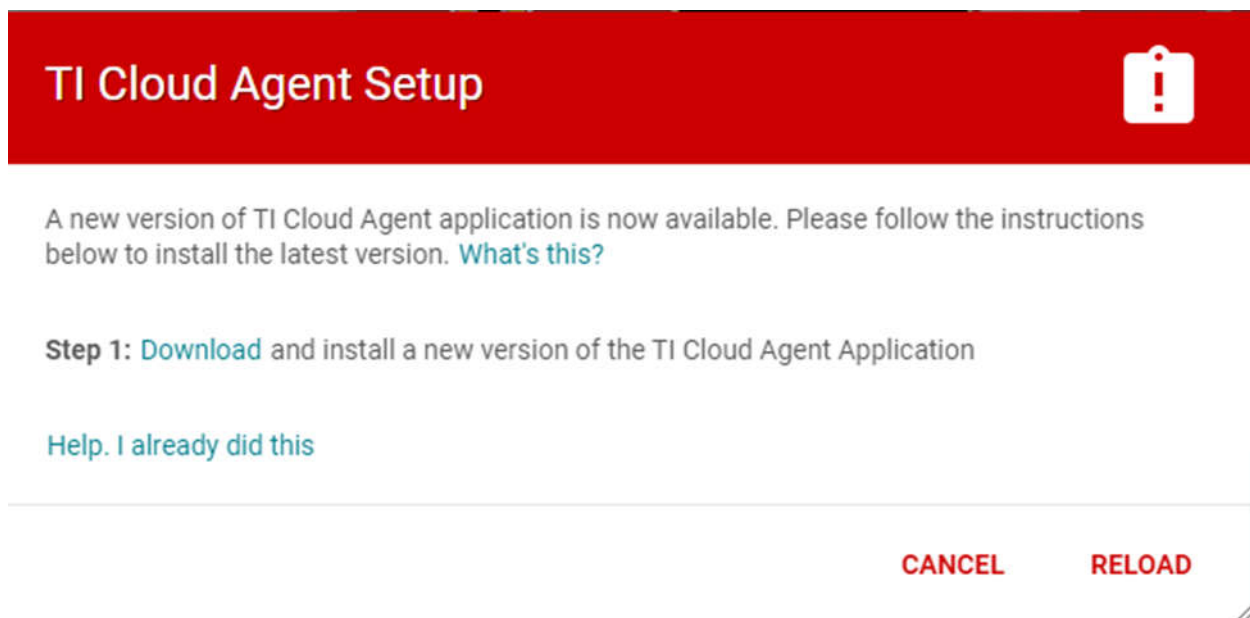
Figure 3-1. Plug-in Setup

3.1.2 Download from dev.ti.com

Users can access the latest version of the offline software by navigating to the live version as noted above. Look for the download icon and download both the application and run time for the operating system as shown in .
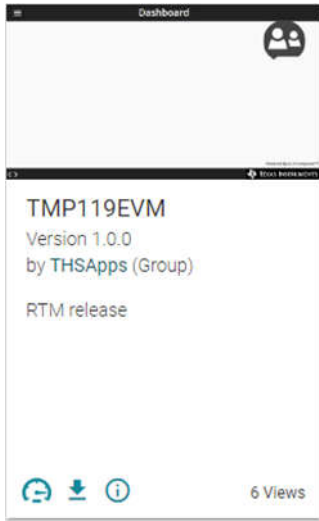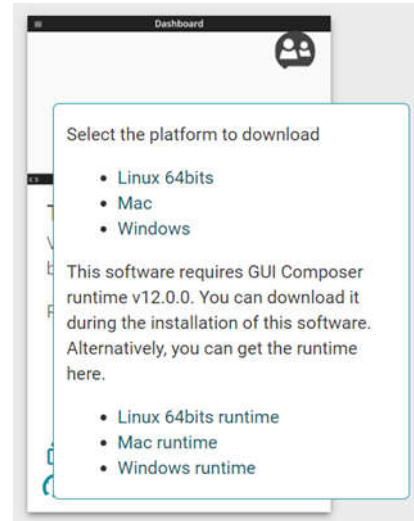

Figure 3-2. Download Pop-Up

Figure 3-3. Download Pop-Up

3.2 Home Tab

The *Home* tab is shown at software launch. The icons on the bottom of this tab are shortcuts to the other functional tabs of the GUI, and correspond to the icons on the left side of the GUI.
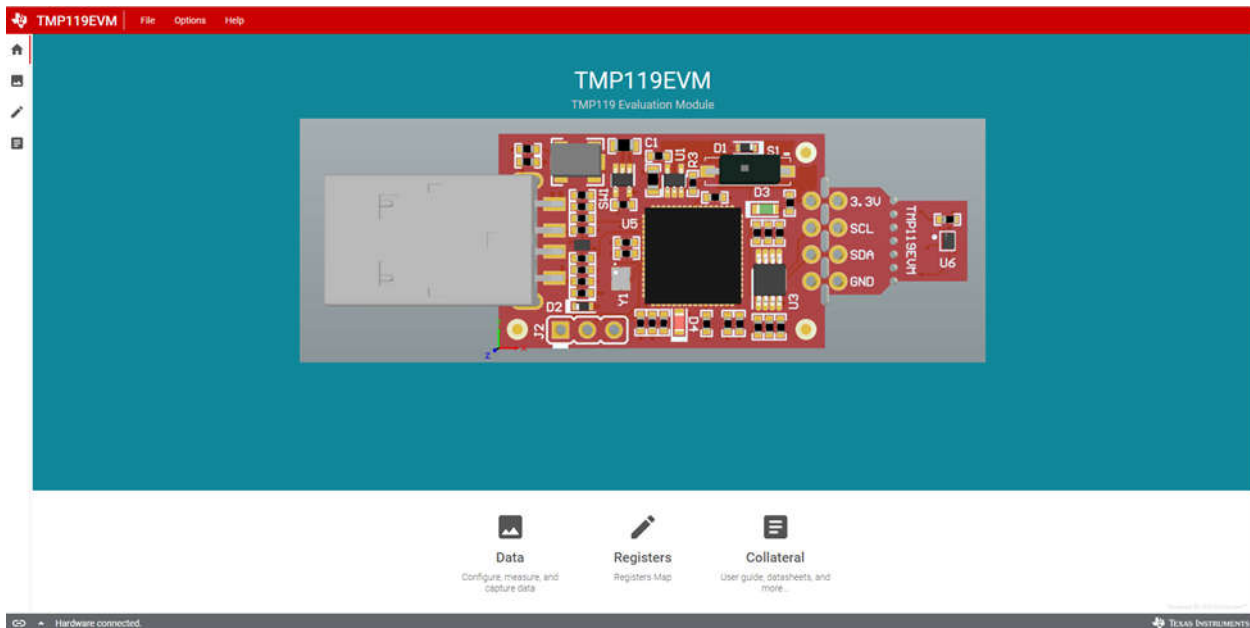
Figure 3-4. Home

3.3 Data Capture Tab

The *Data Capture* tab reports the temperature from the TMP119 device included on the TMP119EVM. Temperature data is polled and displayed by default. By default, the MCU polls the registers with a 100 ms delay. The CONVERT TEMP command (0x44) is sent automatically while polling. The polling rate setting on the *Data Capture* tab is synchronized with the polling rate setting on the *Registers* tab. The following features of the Data Capture Tab include:

- Reading the current temperature measurement from the TMP119 displayed in the upper right corner.

- Polling Rate drop-down menu is used to disable polling or change the polling rate.
- The *Save Logging* and *Stop Logging* buttons can be used to capture Temperature data and save the data to a CSV format.

When capturing data, please remember the following:

- For the online version of the GUI, a download begins in the browser. This download is lost if the GUI is closed.
- For the offline version of the GUI, the file is appended as data is received. In this case, appended data is not lost if the GUI is closed.

Figure 3-5. Data Capture

3.4 Registers Tab

The *Registers* tab interacts with the registers and the bits within the TMP119 device. For more information on each register/bit, hover over the register name and click on the question mark to see what each bit defines.

By default, the MCU polls the registers with a 100 ms delay and the table shows the current status of the registers and updates the changes in the table every poll. By clicking on the bits in the table, the user has the availability to change the bit to a 1 or 0. The Write Register buttons are grayed and disabled when the button is set to Immediate. Immediate mode triggers a Write operation each time a register is modified. When Deferred mode is selected and the Write Register button is enabled, write operations are not performed unless the Write Register button is clicked.

When Deferred mode is selected, the user can take advantage of the following:

• Write button writes the bit changes in the selected register.
• Write All button is used to write all bit changes in all registers.

When auto read is turned off, the table no longer updates itself and the user can take advantage of the following:

• Read button reads the current status of the selected register.
• Read All button is used to fetch the current contents of all registers at once.

These settings give the user total control over bus activity, and enable individual transactions to be easily observed with an oscilloscope, logic analyzer, or bus-sniffing device.
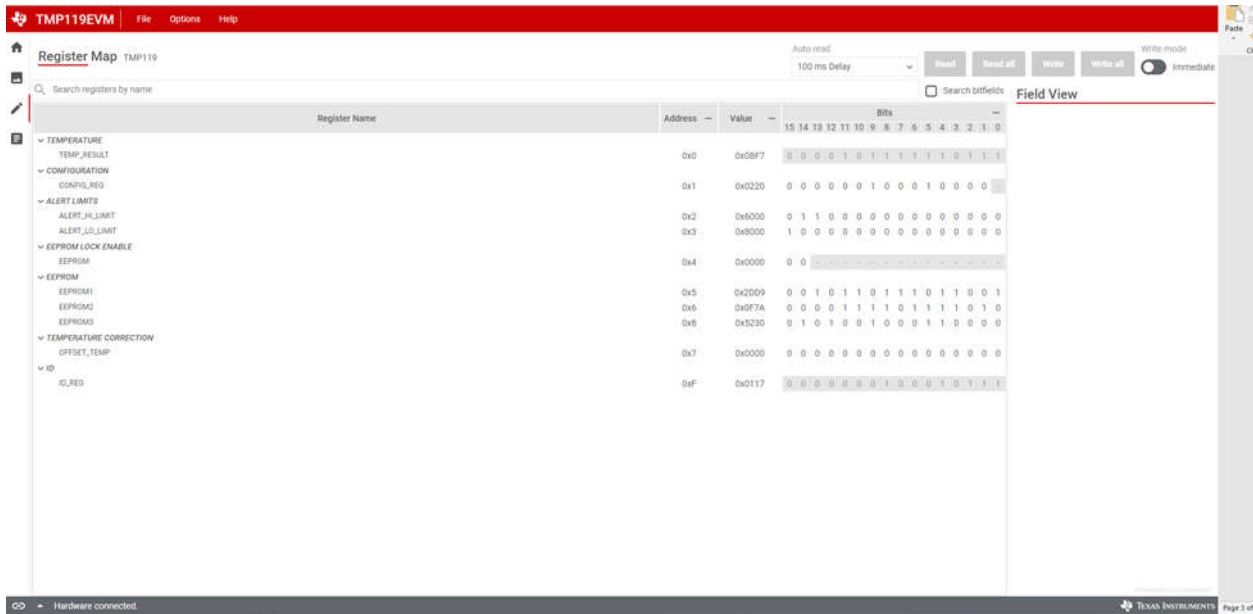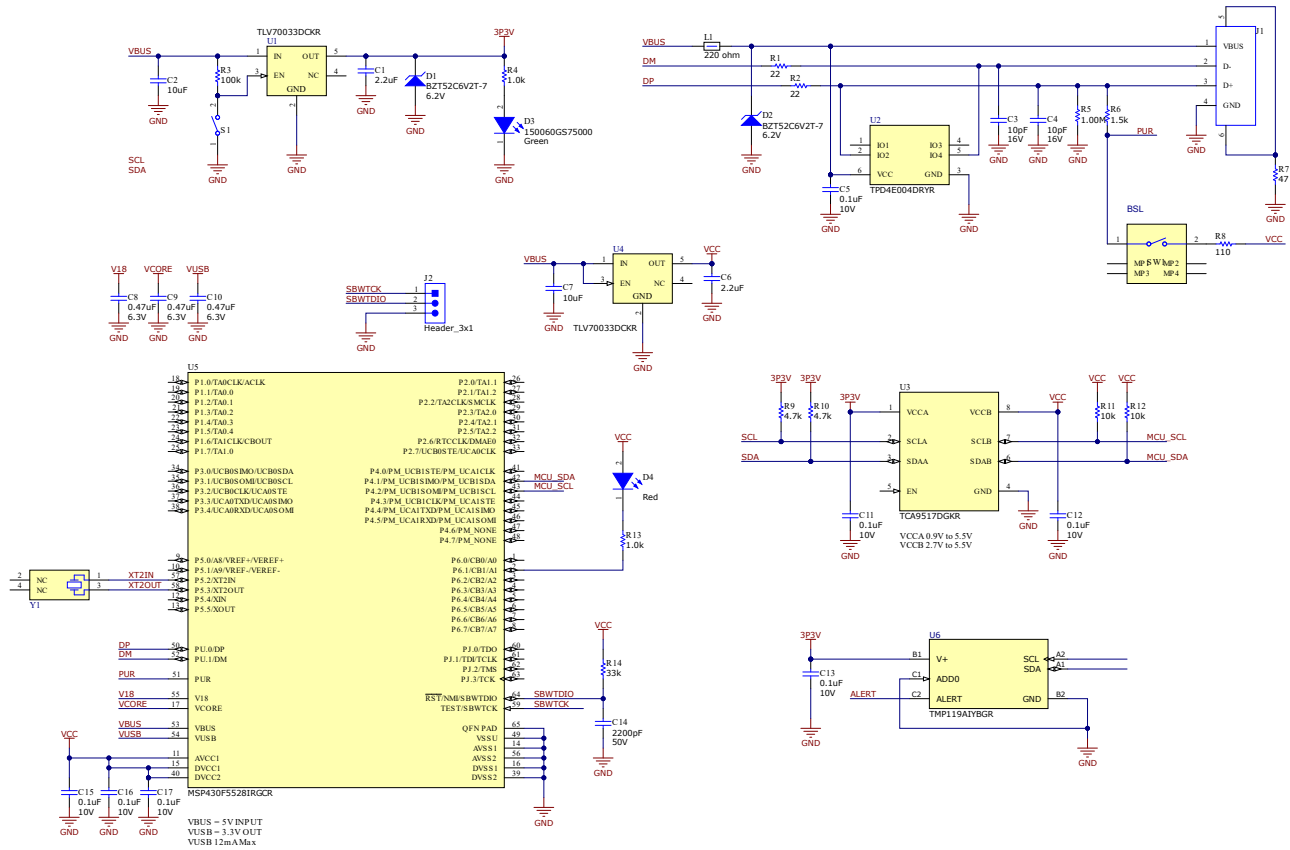

Figure 3-6. Registers

4 Hardware Design Files

4.1 Schematic

Figure 4-1. Schematic
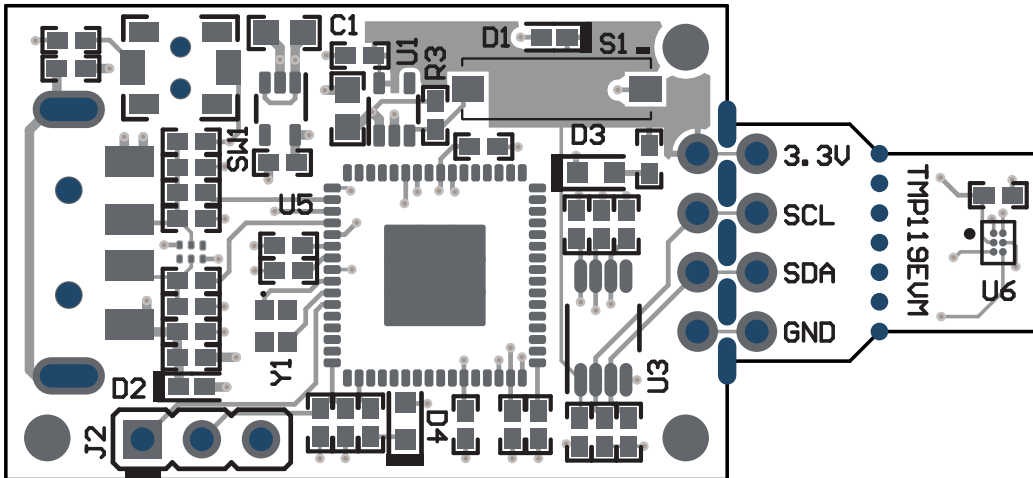
4.2 PCB Layout

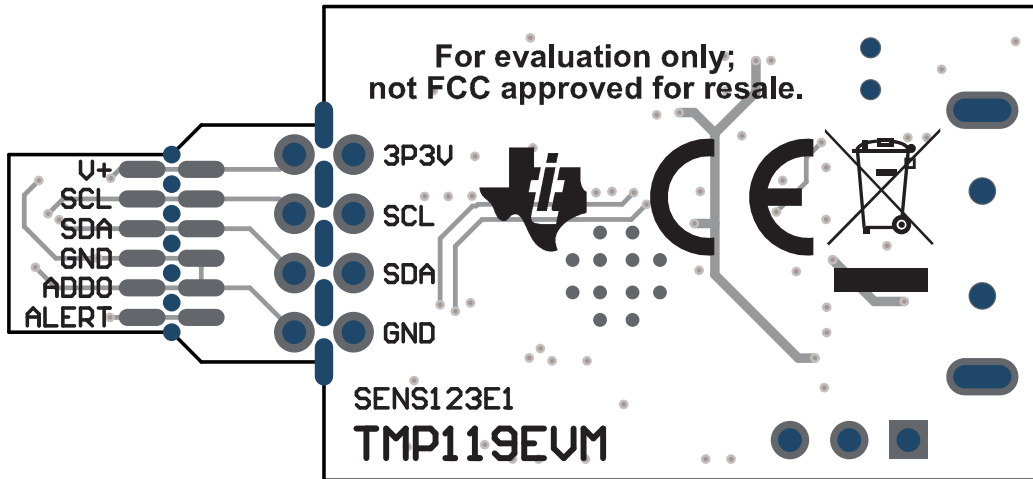**Figure 4-2. PCB Top**

Figure 4-3. PCB Bottom

4.3 Bill of Materials

Table 4-1 lists the bill of materials for TMP1820EVM.

Table 4-1. Bill of Materials

Designator	Quantity	Value	Description	Part Number	Package Reference	Manufacturer
!PCB	1		Printed Circuit Board	SENS123		Any
C1, C6	2	2.2uF	CAP, CERM, 2.2 uF, 16 V, +/- 10%, X5R, 0402	GRM155R61C225KE11D	0402	MuRata
C2, C7	2	10uF	CAP, CERM, 10 uF, 10 V, +/- 20%, X5R, 0603	C1608X5R1A106M080AC	0603	TDK
C3, C4	2	10 pF	CAP, CERM, 10 pF, 16 V,+/- 10%, C0G, 0402	C0402C100K4GACTU	0402	Kemet
C5, C11, C12, C13, C15, C16, C17	7	0.1uF	CAP, CERM, 0.1 uF, 10 V,+/- 10%, X5R, 0402	LMK105BJ104KV-F	0402	Taiyo Yuden
C8, C9, C10	3	0.47uF	CAP, CERM, 0.47 uF, 6.3 V, +/- 10%, X7R, 0402	JMK105B7474KVHF	0402	Taiyo Yuden
C14	1	2200 pF	CAP, CERM, 2200 pF, 50 V, +/- 5%, X7R, 0402	CL05B222JB5NNNC	0402	Samsung Electro-Mechanics
D1, D2	2	6.2V	Diode, Zener, 6.2 V, 300 mW, SOD-523	BZT52C6V2T-7	SOD-523	Diodes Inc.
D3	1	Green	LED, Green, SMD	150060GS75000	LED_0603	Wurth Elektronik
D4	1	Red	LED, Red, SMD	150060RS75000	LED_0603	Wurth Elektronik
J1	1		Connector, Plug, USB Type A, R/A, Top Mount SMT	48037-1000	USB Type A right angle	Molex
L1	1	220 ohm	Ferrite Bead, 220 ohm @ 100 MHz, 0.45 A, 0402	BLM15AG221SN1D	0402	MuRata
R1, R2	2	22	RES, 22, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	ERJ-2GEJ220X	0402	Panasonic
R3	1	100k	RES, 100 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	ERJ-2GEJ104X	0402	Panasonic
R4, R13	2	1.0k	RES, 1.0 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	ERJ-2GEJ102X	0402	Panasonic
R5	1	1.00Meg	RES, 1.00 M, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	RMCF0402FT1M00	0402	Stackpole Electronics Inc
R6	1	1.5k	RES, 1.5 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW04021K50JNED	0402	Vishay-Dale
R7	1	47	RES, 47, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	ERJ-2GEJ470X	0402	Panasonic
R8	1	110	RES, 110, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW0402110RJNED	0402	Vishay-Dale
R9, R10	2	4.7k	RES, 4.7 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW04024K70JNED	0402	Vishay-Dale

Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	Part Number	Package Reference	Manufacturer
R11, R12	2	10k	RES, 10 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	ERJ-2GEJ103X	0402	Panasonic
R14	1	33k	RES, 33 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW040233K0JNED	0402	Vishay-Dale
S1	1		Switch, Slide, SPST, Top Slide, SMT	CHS-01TB	Switch, Single Top Slide, 2.5x8x2.5mm	Copal Electronics
SW1	1		Switch, SPST-NO, Off-Mom, 0.05A, 12VDC, SMD	PTS820 J20M SMTR LFS	3.9x2.9mm	C&K Components
U1, U4	2		Single Output LDO, 200 mA, Fixed 3.3 V Output, 2 to 5.5 V Input, with Low IQ, 5-pin SC70 (DCK), -40 to 125 degC, Green (RoHS & no Sb/Br)	TLV70033DCKR	DCK0005A	Texas Instruments
U2	1		4-Channel ESD Protection Array for High-Speed Data Interfaces, DRY0006A (USON-6)	TPD4E004DRYR	DRY0006A	Texas Instruments
U3	1		Level-Shifting I2C Bus Repeater, DGK0008A (VSSOP-8)	TCA9517DGKR	DGK0008A	Texas Instruments
U5	1		16-Bit Ultra-Low-Power Microcontroller, 128KB Flash, 8KB RAM, USB, 12Bit ADC, 2 USCIs, 32Bit HW MPY, RGC0064B (VQFN-64)	MSP430F5528IRGCR	RGC0064B	Texas Instruments
U6	1		High-Accuracy, Low-Power, Digital Temperature Sensor With SMBus™- and I2C-Compatible Interface	TMP119AIYBGR	DSBGA6	Texas Instruments
Y1	1		Crystal, 24 MHz, SMD	XRCGB24M000F2P00R0	2x1.6mm	MuRata
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
J2	0		Header, 2.54 mm, 3x1, Gold, TH	GBC03SAAN	Header, 2.54 mm, 3x1, TH	Sullins Connector Solutions

5 Additional Information

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