



ABSTRACT

This user's guide describes the characteristics, operation, and use of the TMP9A00-EP Evaluation Module (EVM). A complete schematic diagram, printed-circuit board layouts, and bill of materials are included in this document.

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1 Overview

The TMP9A00-EP-EVM allows users to evaluate the performance of the TMP9A00-EP analog temperature sensor. The EVM uses a USB interface for control and data logging, and has an onboard MSP430F5528 microcontroller that connects the host computer and the analog interface of the TMP9A00-EP device. The sensor side of the board may be separated from the main section to allow the TMP9A00-EP to be remotely located from the host.

1.1 Features

This EVM has the following features:

- Provides GUI for easy setup
- Perforated PCB allows for placement flexibility
- Software runs online or through offline installation

1.2 EVM Kit Contents

Table 1-1 details the contents of the EVM kit. Contact the nearest Texas Instruments Product Information Center if any components are missing. TI highly recommends that users check the TI website at <https://www.ti.com> to verify that they have the latest versions of the related software.

Table 1-1. EVM Kit Contents

Item	Quantity
TMP9A00-EP-EVM	1

2 EVM Hardware

2.1 Perforations

There are perforations between the USB controller and the TMP9A00-EP sensor, labeled on both sides for pin connections.

2.2 Subregulator

The onboard 3.3-V regulator (U1) is enabled and disabled with switch S1. The subregulator must be enabled for normal operation of the TMP9A00-EP-EVM. The green LED (D3) illuminates when the subregulator is enabled.

2.3 Programming Header

The TMP9A00-EP-EVM comes pre-loaded with firmware that is necessary for correct operation. Header J2 is provided for Spy-Bi-Wire access to the MSP430F5528, but TI does not recommend that users access this header or reprogram the device.

2.4 Pushbutton Switch

Switch SW1 is used for entering USB BSL mode; this can be used for firmware updates.

3 Software Download

The PC GUI Software for TMP9A00-EP-EVM runs on TI's GUI Composer framework. The software is available as a live version that runs in a browser and as a download for offline use. The software is compatible with Microsoft® Windows®, Mac®, and Linux® operating systems.

3.1 Online Software

Access the online version by navigating to <https://dev.ti.com/gallery/search/TMP9A00-EP-EVM>. The online software works with Google Chrome®, Firefox®, and Safari® browsers.

3.2 Offline Software

Access the offline software by navigating to <https://dev.ti.com/gallery/search/TMP9A00-EP-EVM> and downloading the application and runtime for Linux, Mac, or Microsoft Windows, and then follow the on-screen installation instructions.

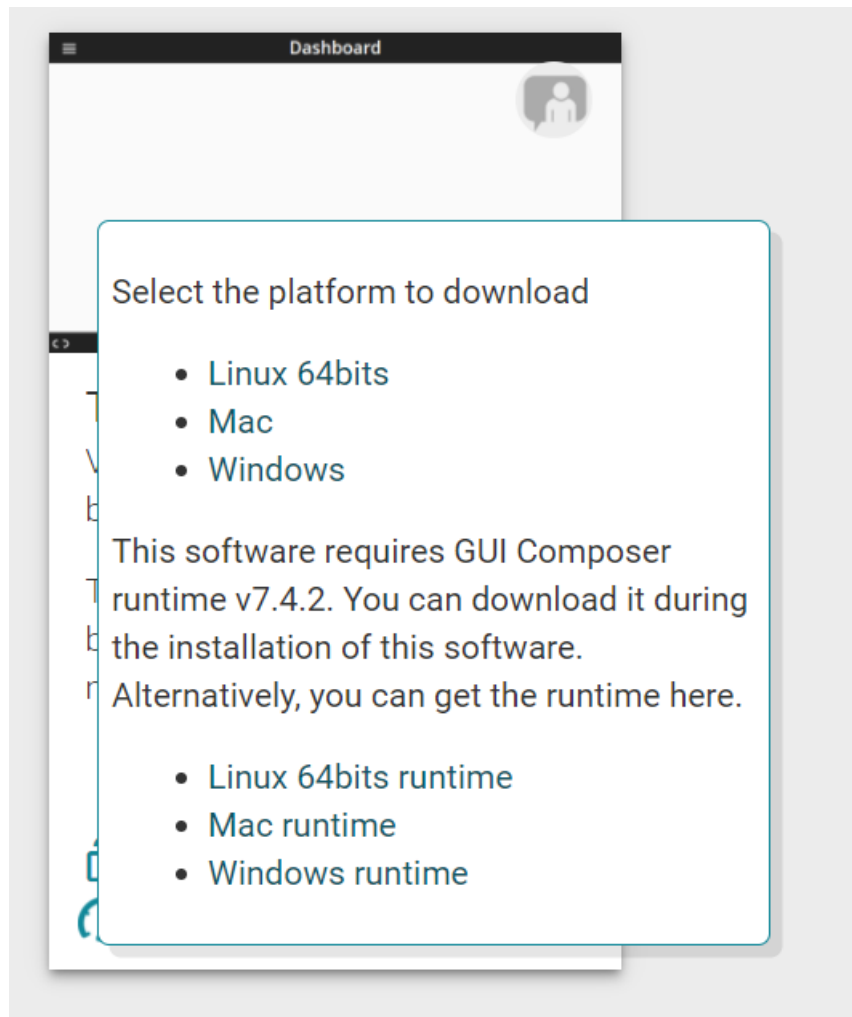


Figure 3-1. Download Pop-Up

4 Software

4.1 Home Tab

At startup the *Home* tab is displayed, see [Figure 4-1](#). To see device features and a pin-out diagram, click the *Learn More* button. The *Home* tab has shortcut icons to the *Data Capture* and *Collateral* tabs for quick access.

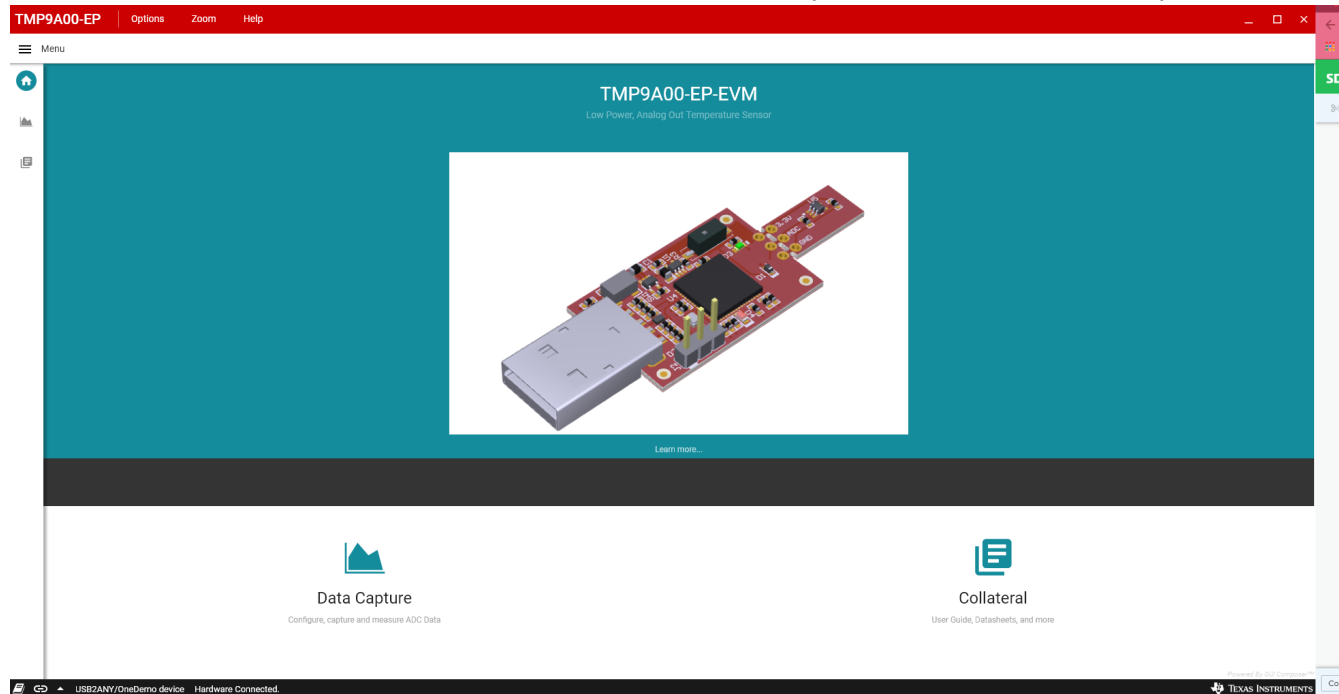


Figure 4-1. Home Tab

4.2 Data Capture Tab

The data capture tab will automatically begin collecting temperature data when the application is launched. The data is displayed in a scalar graph and will default to a refresh rate of 1 second. The drop-down menu allows the user to change the refresh rate for the graph and temperature display. The options are the following:

- Off
- As Fast As Possible
- Every 500 ms
- Every 1 s
- Every 5 s
- Every 10 s
- Every 60 s

The **SAVE START** and **SAVE STOP** buttons (see [Figure 4-2](#)) allow the user to begin recording the temperature data in a .csv file. The file will begin downloading when **SAVE START** is pressed and will end once **SAVE START** and **SAVE STOP** is selected.

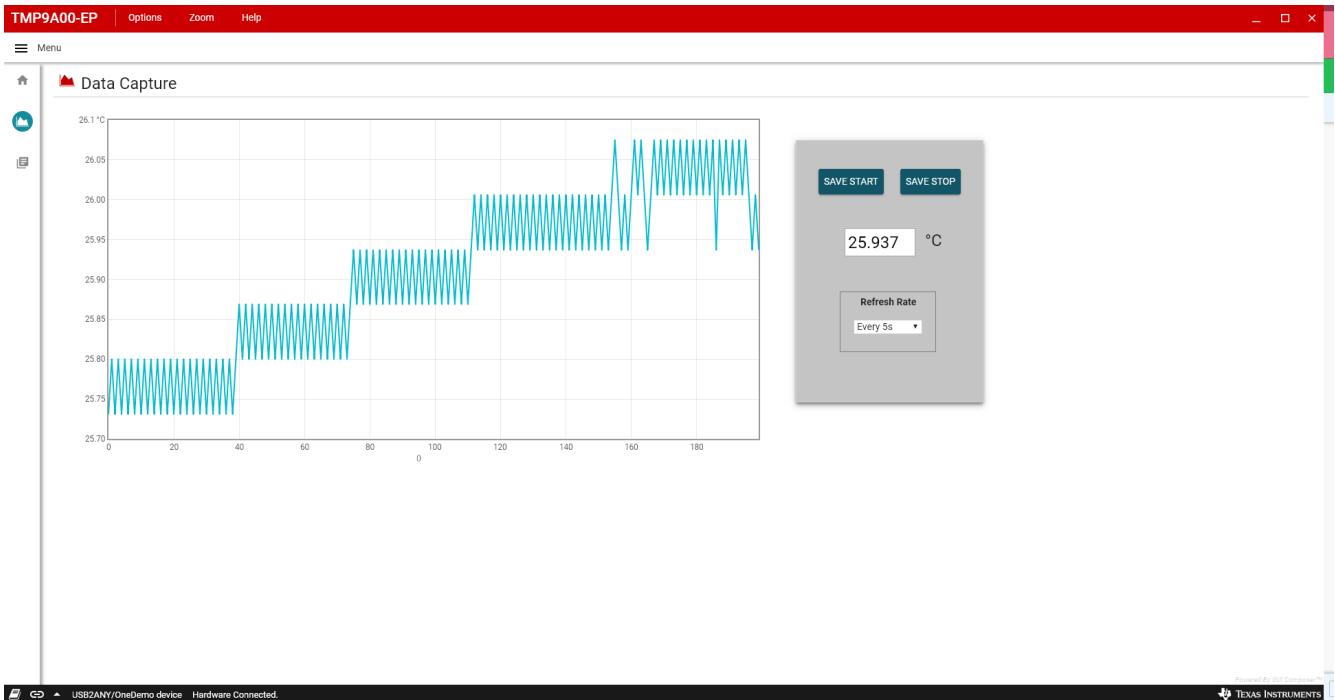


Figure 4-2. Data Capture

4.3 Collateral Tab

As [Figure 4-3](#) shows, the *Collateral* tab includes links to various related literature, including the device data sheet and any corresponding application notes.

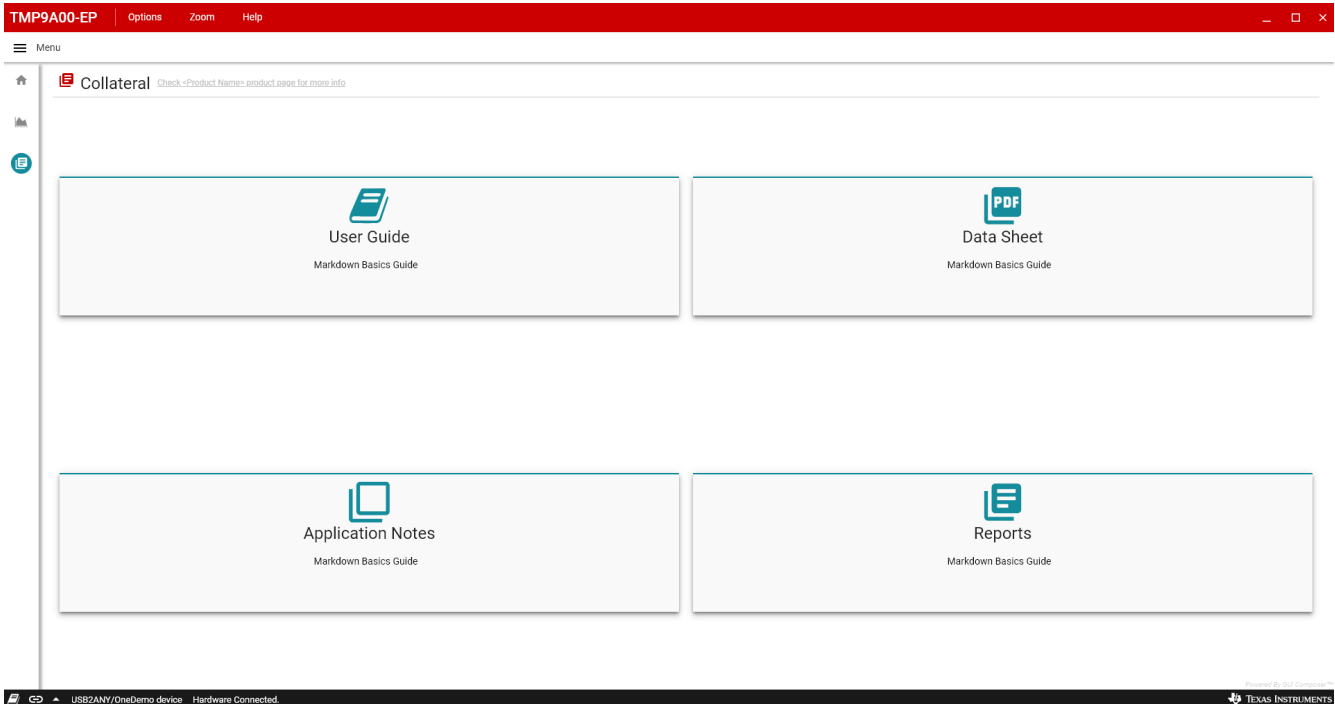


Figure 4-3. Collateral

5 PCB Layout

Figure 5-1 and Figure 5-2 show the EVM PCB layout images.

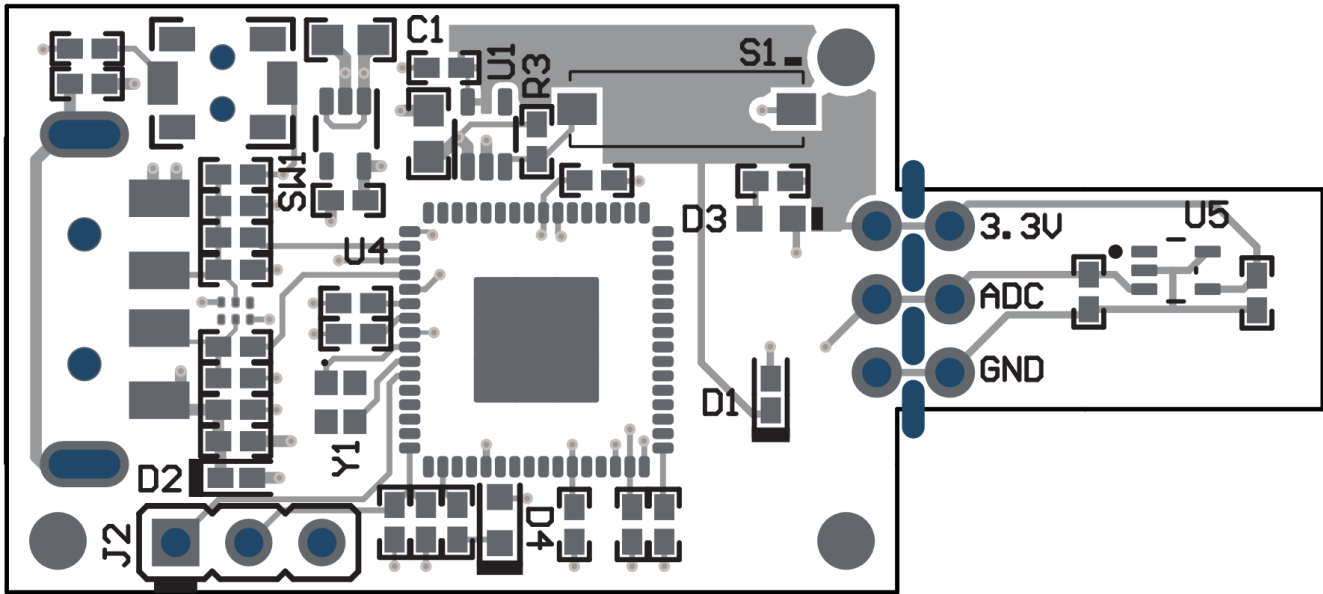


Figure 5-1. Top View

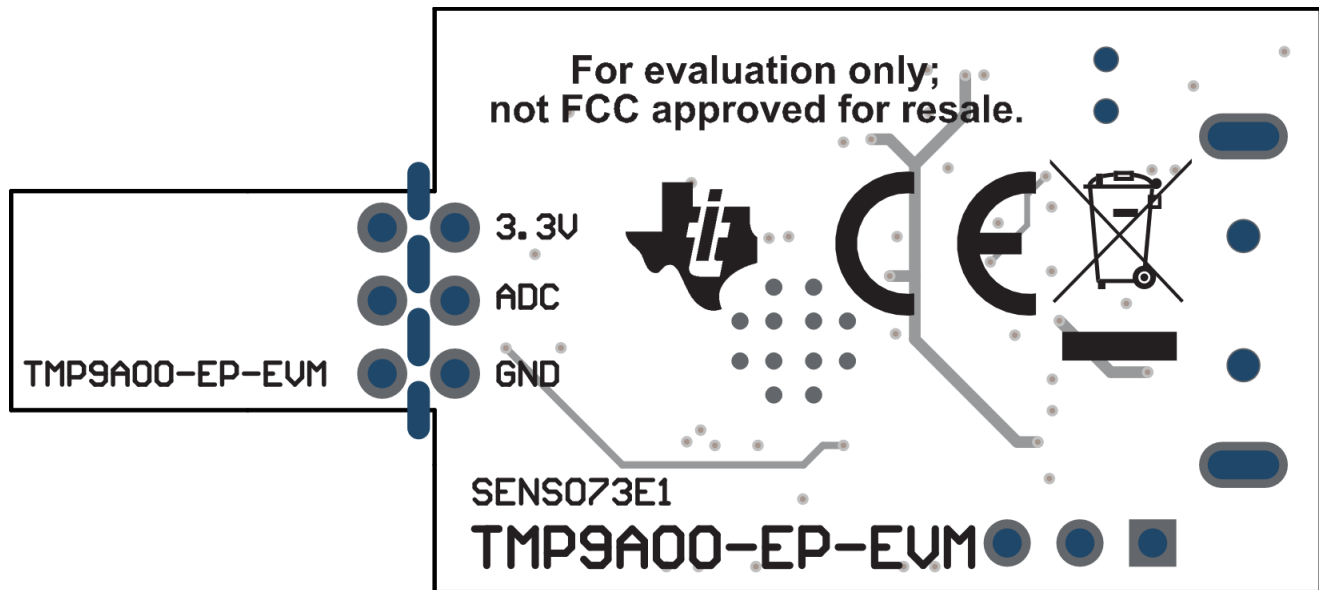


Figure 5-2. Bottom View

6 TMP9A00-EP Schematic

Figure 6-1 shows the EVM schematic.

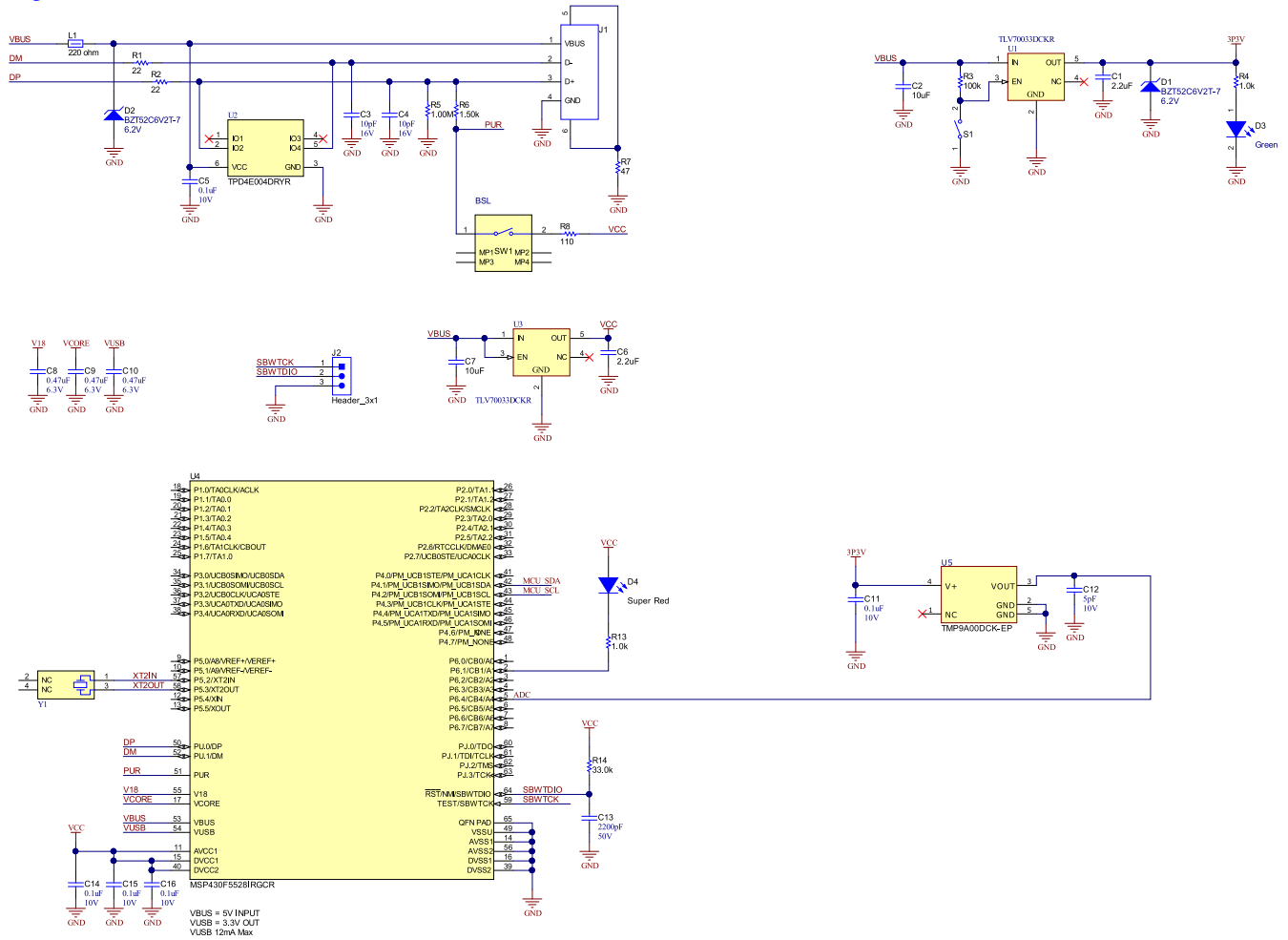


Figure 6-1. TMP9A00-EP Schematic

7 Bill of Materials

Table 7-1 shows the EVM bill of materials.

Table 7-1. TMP9A00-EP EVM BOM

Designator	QTY	Value	Descriptor	Package Reference	Part Number	Manufacturer
!PCB1	1		Printed Circuit Board		SENS073	Any
C1, C6	2	2.2uF	CAP, CERM, 2.2uF, 16 V, ±10%, X5R, 0402	0402	GRM155R61C225KE11D	MuRata
C2, C7	2	10 uF	CAP, CERM, 10 uF, 10 V, ±20%, X5R, 0603	0603	C1608X5R1A106M080AC	TDK
C3, C4	2	10 pF	CAP, CERM, 10 pF, 16 V, ±10%, C0G, 0402	0402	C0402C100K4GACTU	Kemet
C5, C11, C12, C14, C15, C16	6	0.1uF	CAP, CERM, 0.1 uF, 10 V, ±10%, X5R, 0402	0402	LMK105BJ104KV-F	Taiyo Yuden
C8, C9, C10	3	0.47uF	CAP, CERM, 0.47 uF, 6.3 V, ±10%, X7R, 0402	0402	JMK105B7474KVHF	Taiyo Yuden
C13	1	2200pF	CAP, CERM, 2200 pF, 50 V, ±5%, X7R, 0402	0402	CL05B222JB5NNNC	Samsung Electro-Mechanics
D1, D2	2	6.2V	Diode, Zener, 6.2 V, 330 mW, SOD-523	SOD-523	BZT52C6V2T-7	Diodes Inc.
D3	1	Green	LED, Green, SMD	LED, GREEN, 0603	SML-LX0603GW-TR	Lumex
D4	1	Super Red	LED, Super Red, SMD	LED_0603	150060SS75000	Würth Elektronik
J1	1		Connector, Plug, USB Type A, R/A, Top Mount SMT	USB Type A right angle	48037-1000	Molex
J2	1		Header, 2.54 mm, 3x1, Gold, TH	Header, 2.54mm, 3x1, TH	GBC03SAAN	Sullins Connector Solutions
L1	1	220 ohm	Ferrite Bead, 220 ohm @ 100 MHz, 0.45 A, 0402	0402	BLM15AG221SN1D	MuRata
R1, R2	2	22	RES, 22, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	0402	ERJ-2GEJ220X	Panasonic
R3	1	100k	RES, 100 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	0402	ERJ-2GEJ104X	Panasonic
R4, R13	2	1.0k	RES, 1.0 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	0402	ERJ-2GEJ102X	Panasonic
R5	1	1.00Meg	RES, 1.00 M, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	RMCF0402FT1M00	Stackpole Electronics Inc
R6	1	1.50k	RES, 1.50 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	RMCF0402FT1K50	Stackpole Electronics Inc
R7	1	47	RES, 47, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	0402	ERJ-2GEJ470X	Panasonic
R8	1	110	RES, 110, 1%, 0.1 W, AEC-Q200 Grade 0, 0402	0402	ERJ-2RKF1100X	Panasonic
R14	1	33.0k	RES, 33.0 k, 1%, 0.063 W, 0402	0402	RC0402FR-0733KL	Yageo America
S1	1		Switch, Slide, SPST, Top Slide, SMT	Switch, Single Top Slide, 2.5x8x2.5mm	CHS-01TB	Copal Electronics
SW1	1		Switch, SPST-NO, Off-Mom, 0.05A, 12VDC, SMD	3.9x2.9mm	PTS820 J20M SMTR LFS	C&K Components
U1, U3	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)	DCK0005A	TLV70033DCKR	Texas Instruments
U2	1		4-Channel ESD Protection Array for High-Speed Data Interfaces, DRY0006A (USON-6)	DRY0006A	TPD4E004DRYR	Texas Instruments
U4	1		16-Bit Ultra-Low-Power Microcontroller, 128KB Flash, 8KB RAM, USB, 12Bit ADC, 2 USCIs, 32Bit HW MPY, RGC0064B (VQFN-64)	RGC0064B	MSP430F5528IRGCR	Texas Instruments
U5	1		TMP9A00DCK-EP	SC70-5	TMP9A00DCK-EP	Texas Instruments
Y1	1		Crystal, 24 MHz, SMD	2x1.6mm	XRCGB24M000F2P00R0	MuRata

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User shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

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3.1.1 Notice applicable to EVMs not FCC-Approved:

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:

CAUTION

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

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

FCC Interference Statement for Class A EVM devices

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

FCC Interference Statement for Class B EVM devices

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

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

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

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

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

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3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page

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If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

-
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 - 4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.
 - 4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.
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 - 4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.
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8. *Limitations on Damages and Liability:*

8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMNITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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