

# LM95172EVM User's Guide

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## 1. Introduction

The LM95172EVM is used together with TI SensorEval software. The Texas Instruments LM95172EWG evaluation module (EVM) helps designers learn about the operation, and evaluate the performance of the LM95172EWG Temperature Sensor chip. The LM95172EVM is powered directly from the +5V line of the USB connection. The microcontroller on the board provides the SPI (Serial Peripheral Interface) bus, and relays the information from the LM95172EVM to the PC via the USB bus.

The EVM contains one Temperature Sensor (See Table 1).

**Table 1: Device and Package Configurations**

TEMP SENSOR	IC	PACKAGE
U3	LM95172EWG	10-pin Cerpack

## 2. Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, set up the software and hardware, and use the LM95172EVM. There is no external power supply or signal sources are required for operation of the LM95172EVM; however, there is an option allowing the use of external power supply.

### 2.1. Input/Output Connector Description

**J5 – Input** is the power input terminal for the Temperature Sensor. The terminal header provides a power (VDD IO). This header (IDD IO) can be used to insert the ammeter to measure current into VDD IO pin.

**J6 – input** is the VDD IO source for the LM95172EWG. The terminal header is two way jumpers. It can be jumpered either pin 1-2 or 2-3 to use external power or a regulated internal supply +3.3V.

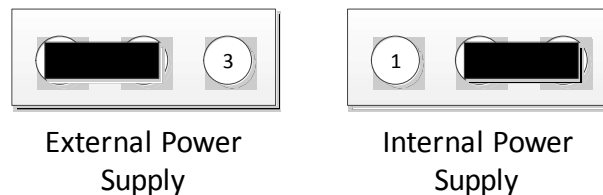


Figure 1: VDD IO Jumper Settings

**J7 – Input** is the input terminal for the external power supply. Pin 1 of J7 is the external VDDA source. Pin 2 of J7 is the GND. Pin 3 of J7 is the external VDD IO source.

**J8 – Input** is the jumper used to enable VDD analog source. The terminal header is two way jumpers. It can be jumpered either pin 1-2 or 2-3 (Figure 1) to use external power or a regulated internal supply +3.3V.

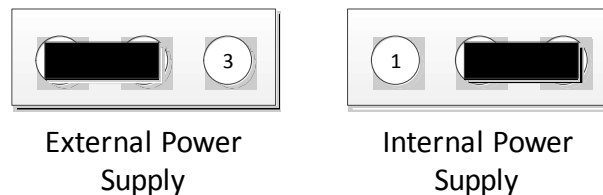


Figure 2: VDDA Analog Source Jumper Settings

**J9 – Input** is the power input terminal for the VDDA analog source. The terminal header provides a power (VDDA analog). This header (IDDA) can be used to insert the ammeter to measure current into VDDA pin.

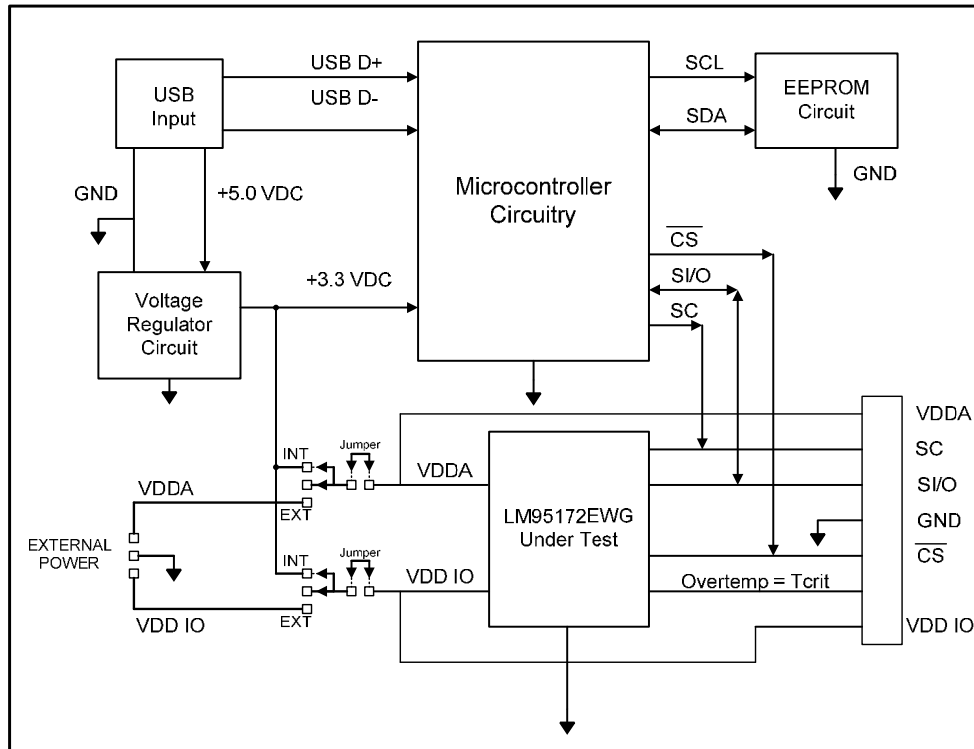
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**J10 – Output** is the testpoint terminal. It provides user with signals for test purposes only. Please do not apply any external power or signal to any of the pins on this header.

Setup

**2.2. Setup**

The LM95172EVM along with the SensorEval software provides the designer with a convenient way to learn about the operation of the EVM. The user simply installs the SensorEval software on the PC, connects the USB cable from the PC to the EVM, connects the hardware setting, and it is ready to read the temperature. In figure 3 is the block diagram that describes the EVM itself.



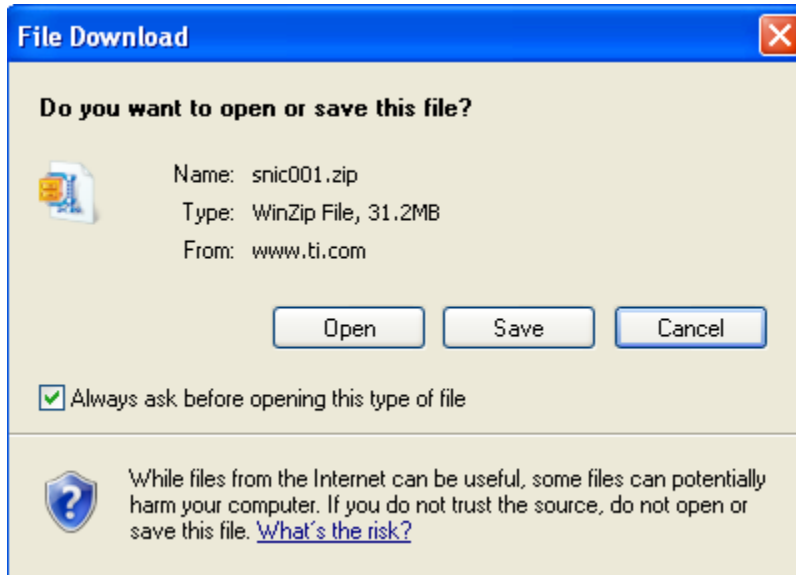
**Figure 3: LM95172EVM Block Diagram**

### 2.3. Software Installation

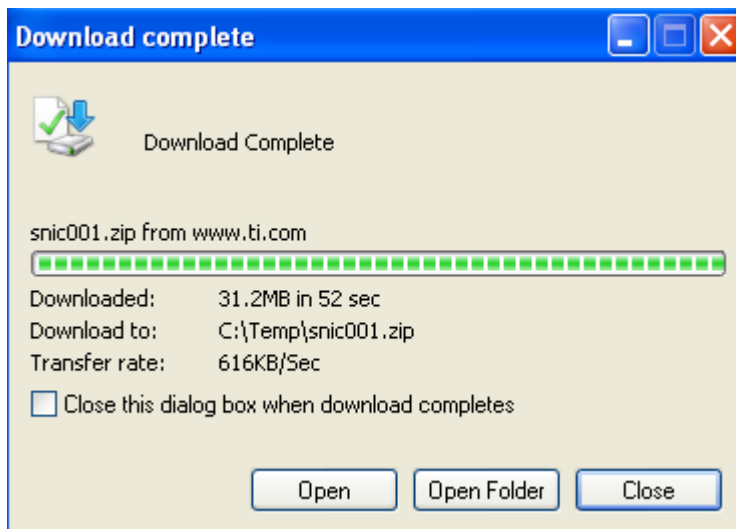
To ensure that you are using the latest version of SensorEval software, you can download from our website at <http://www.ti.com/tool/sensoreval>. You must install the SensorEval software, before you connect the LM95172EVM to your PC.

To install the SensorEval Software:

- Click this link <http://www.ti.com/tool/sensoreval> then click on the red “download” button and click the “Save” button to save the file to the known directory.

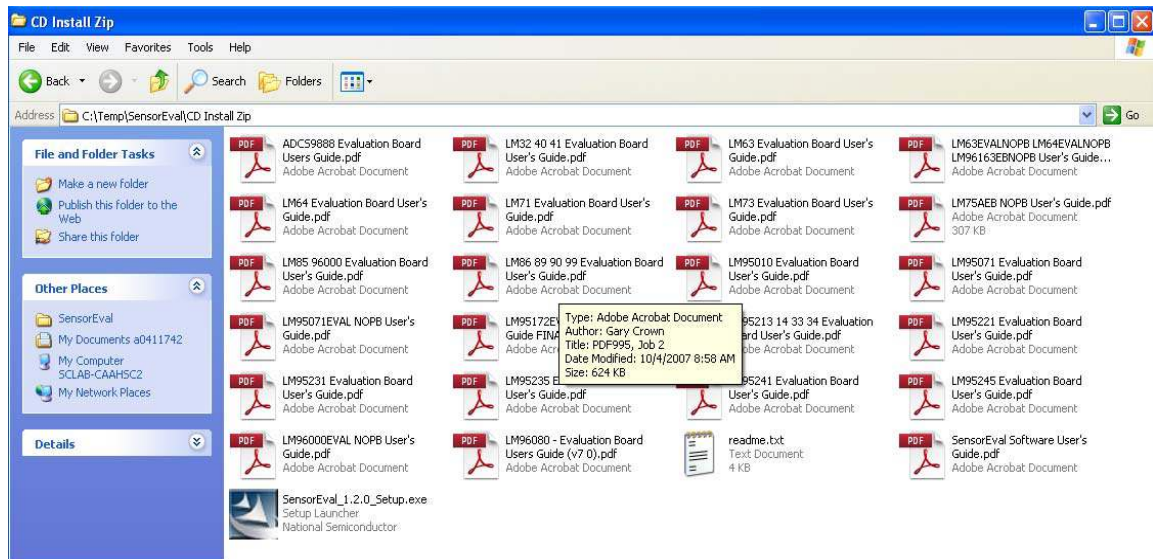


- To open the ZIP file you just download click on the “Open” button.



## Setup

- Uncompress the file that you downloaded into a known directory, and run the SensorEval\_1.2.0\_Setup.exe file.



- When you see the Welcome screen as shown below, follow the instructions by clicking the “Next” button on the screen to install the software.
- When you finish the installation, please click “Finish” button.



- Before you launch the SensorEval software, connect LM95172EVM device to one free USB port of your PC. The “New Hardware” screen appears and click the “Next” button.
- A warning sign appears. Click “Continue Anyway” button.



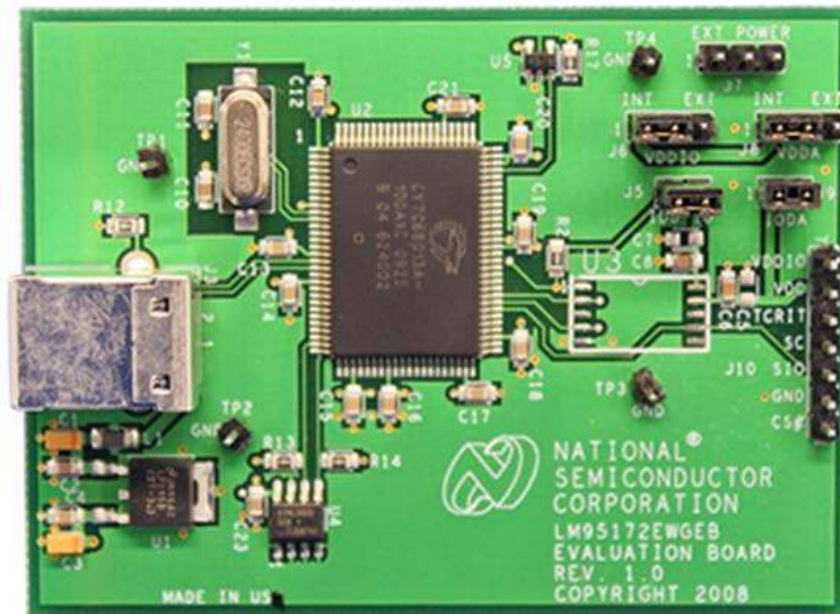
*Setup*

## 2.4. Operation

For proper operation of the LM95172EVM, J5, J6, J8 and J9 should be properly configured. The recommended setting, using shorting blocks, is shown in Figure 4. If U3 of the LM95172EVM is not populated, Finger board must be connected to J10. Fingerboard has a temperature range up to 200°C. One of the best features of this board is that it allows user to insert the board itself into the high temperature.

For this quick start, connect the following jumpers:

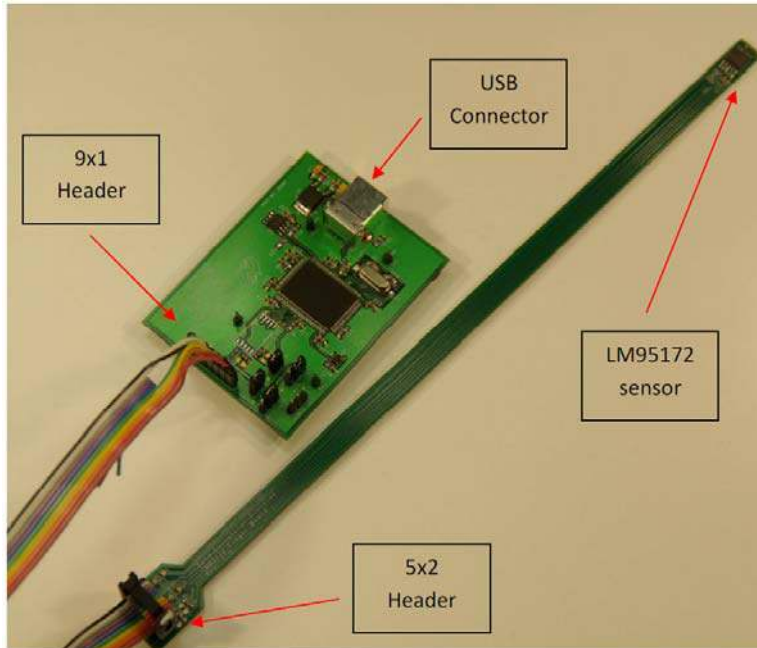
1. J5 to short
2. J9 to short
3. J6 pin 2-3 to short
4. J8 pin 2-3 to short



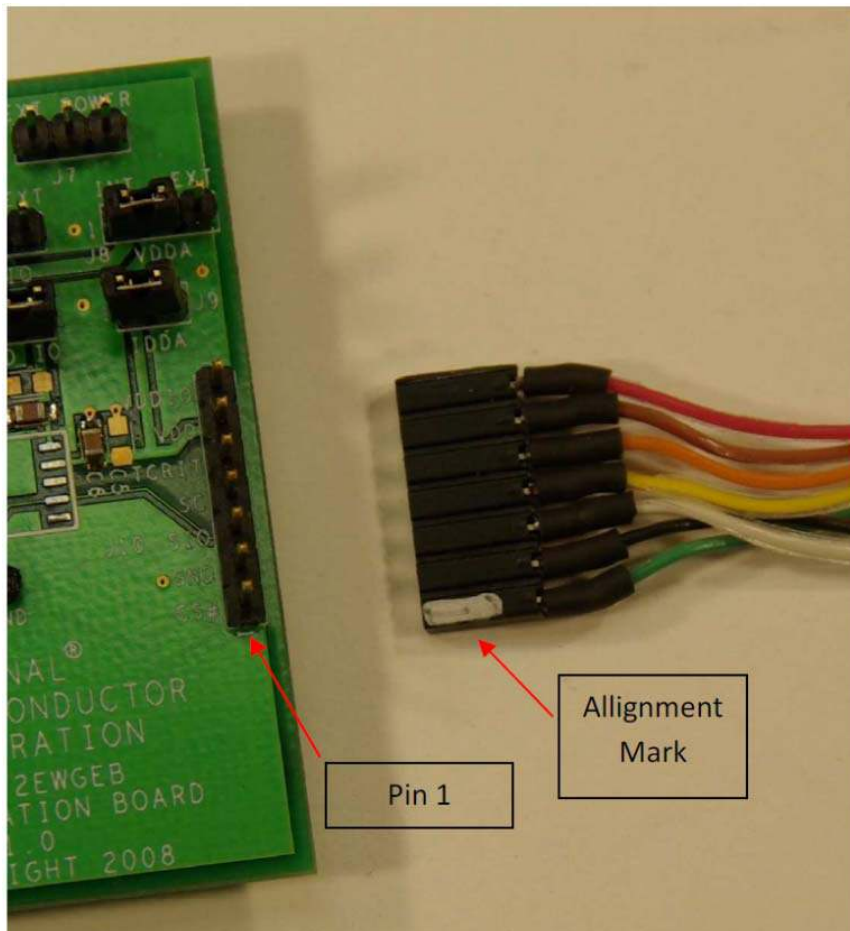
**Figure 4: LM95172EVM**



- Below snapshot is the overview of the setup.

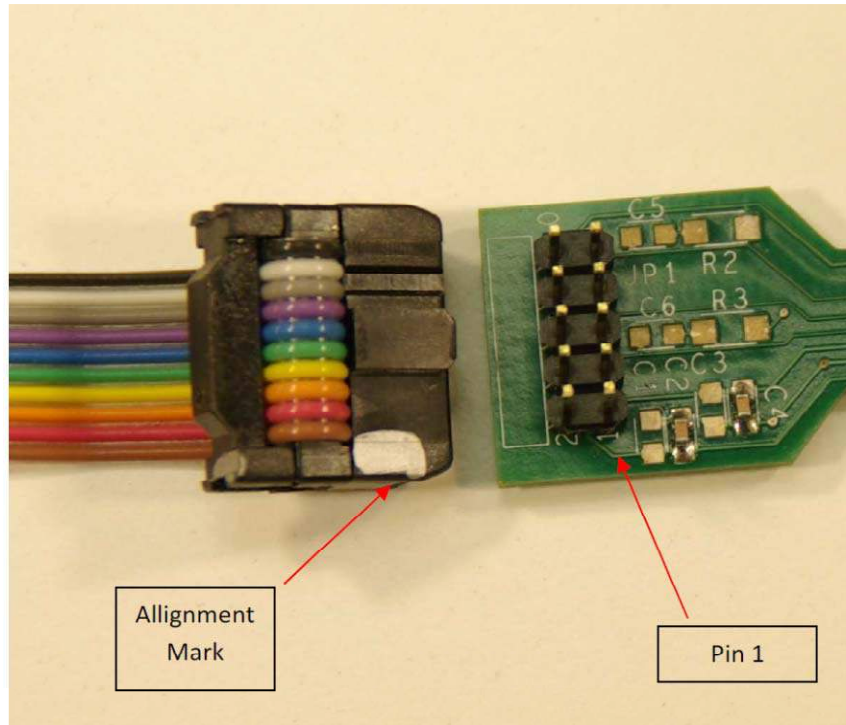


- Align the polarity mark pin 1 of J10 with the ribbon cable alignment mark.

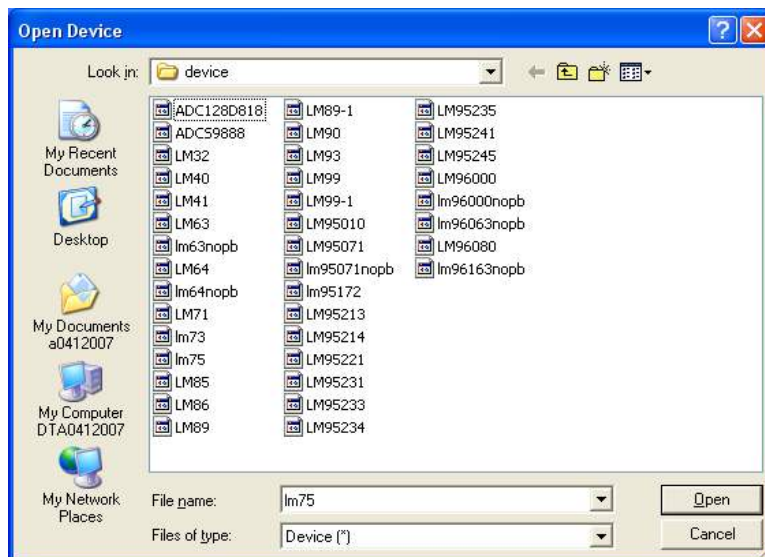


## Setup

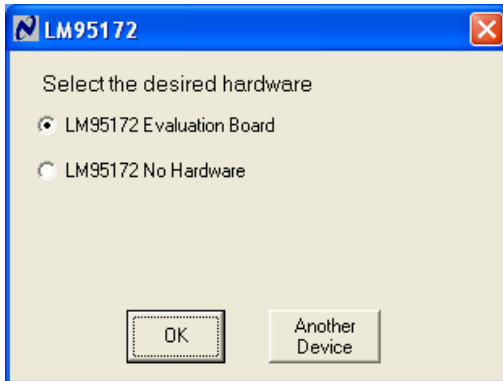
- Also align the polarity mark of the ribbon cable alignment with pin 1 of the Fingerboard.



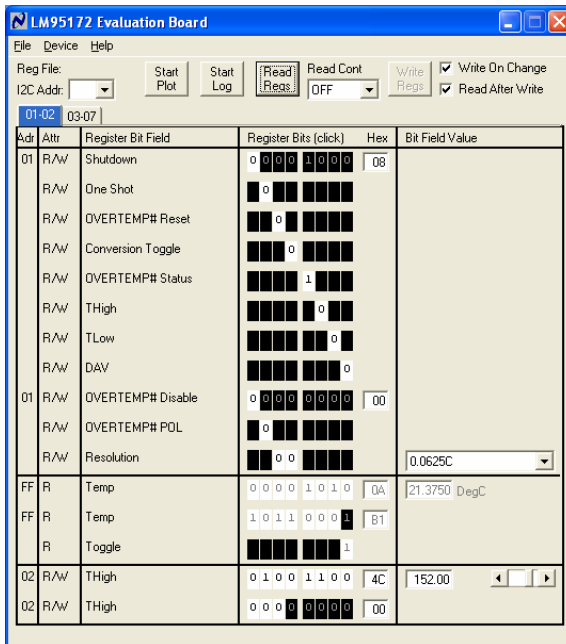
- Once the SensorEval software is installed, and the hardware is setup. You can launch them by clicking the icon on the desktop. The dialog box appears to select the definition file of LM95172.



- A confirm screen appears. Click “OK” button.



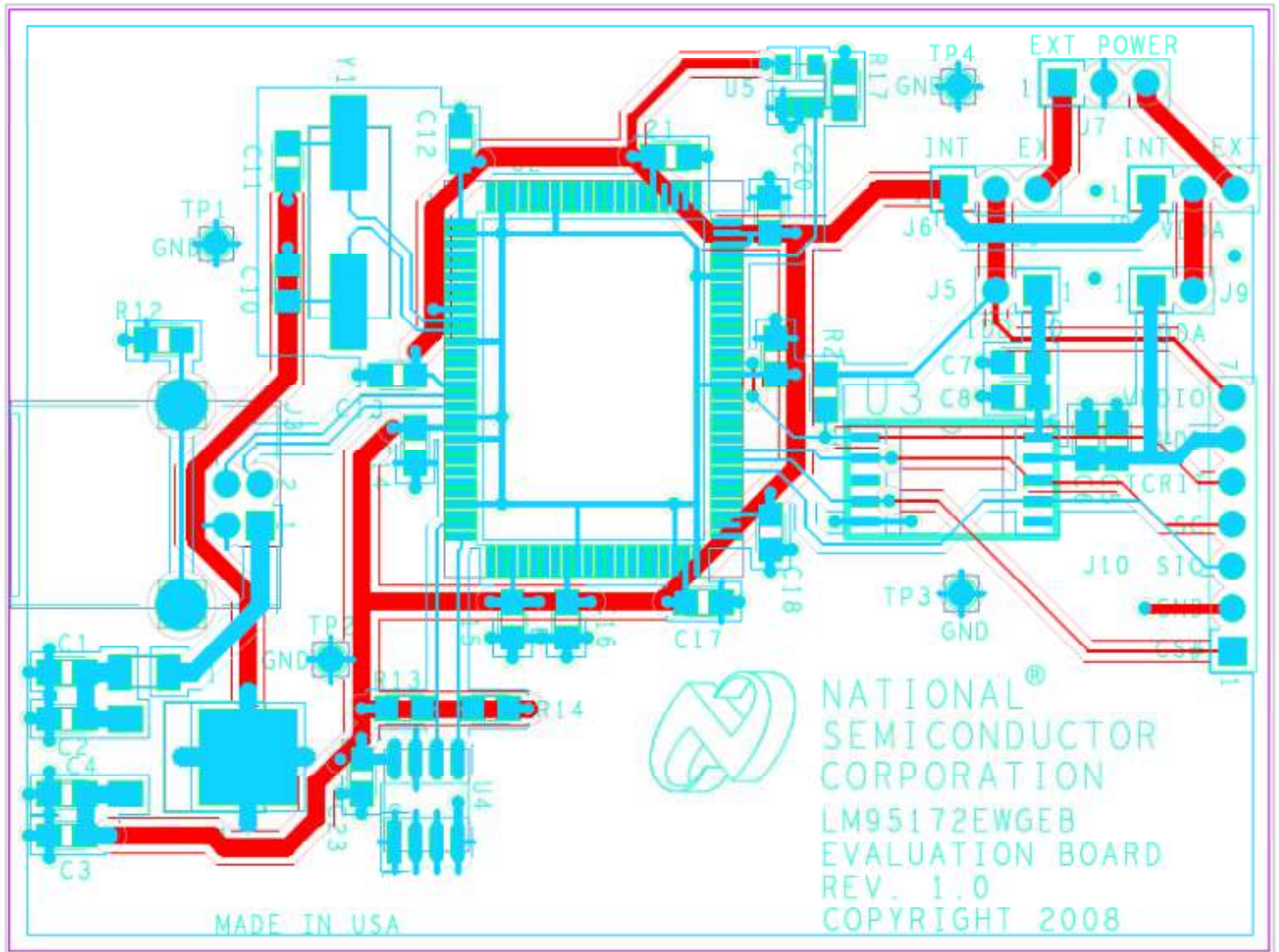
- The SensorEval software will be populated based on the LM95172’s definition file.



- Select the Read Cont dropdown menu as “All Regs”. This will read the values continuously.
- Changing the value of LM95172’s registers by clicking the white textbox on the Register Bits column

### 3. Board Layout

Figure 5 shows the board layout for the LM95172EVM. The EVM offers quick jumpers setting to read the temperature sensor. It uses the +5V and GND lines from the USB connection. This +5V voltage is regulated down to +3.3V to power the board. If the internal +3.3V is selected for both supply voltages then there is no required for external power. However, the user may select the EXT external power inputs at J7.



**Figure 5: LM95172EVM Layout Diagram**

4. Schematic

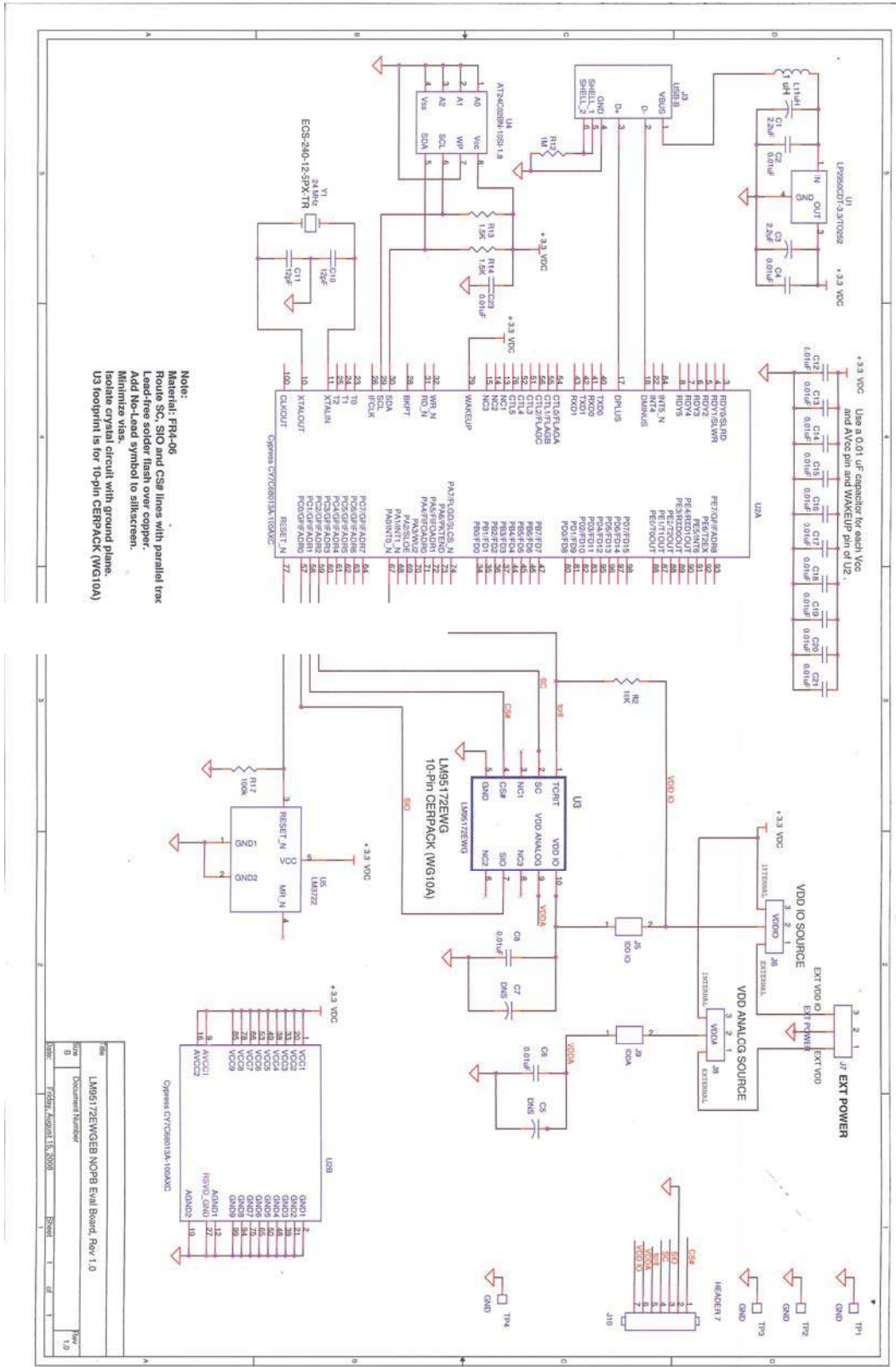


Figure 6: LM95172EVM Schematic



**Table 2: LM95172EVM Bill of Materials**

Item	Qty	Part Reference	Value	Footprint	Description
1	14	C2,C4,C6,C13,C14, C15,C16,C17,C18, C19,C20,C21,C22, C23	10 nF	c0603	
2	2	C1, C3	2.2 uF	c3216	
3	2	C10, C11	12 pF	c0805	
5	1	J3	Connector, USB-B	usb-jack-b	USB Connector Type B, Single Through Hole
6	3	J5, J7, J9	CONN, 1X2Header, 0.1 in centers	TP40	CONN 1 PIN 0.1 TH SINGL ROW HEADER
7	1	J6,J8	CONN, 1X3 Header, 0.1 in centers	TP40	CONN 1 PIN 0.1 TH SINGL ROW HEADER
8	4	TP1,TP2,TP3,TP4	CONN, 1X1 Header, 0.1 in centers	TP40	CONN 1 PIN 0.1 TH SINGL ROW HEADER
9	1	J10	CONN, 1X7 Header, 0.1 in centers	TP41	CONN 1 PIN 0.1 TH SINGL ROW HEADER
8	1	L1	CM CHOKE		CHOKES 90 OHMS PCB
9	1	R2	10k	r0805	RES 10k OHM 1/8W 1% 0805 SMD
9	1	R12	1 Meg	r0805	RES 1.0Meg OHM 1/8W 1% 0805 SMD
10	2	R13,R14	1.5K	r0805	RES 1.5K OHM 1/8W 1% 0805 SMD
11	1	R17	100K	r0805	RES 100K OHM 1/8W 1% 0805 SMD
12	1	U3	Device Under Test (DUT)	10-pin CERPACK	LM95172EWG NOPB High Temp Chip
13	1	U1	LP2950CDT-3.3/TO252	TO263 7P	IC REG Low Dropout
14	1	U2	Cypress CY7C68013A-100AXC	100tqfp	USB MICROCONTROLLER FX2LP 100 PIN
15	1	U4	24C02	soic8	IC SRL EEPROM 2K (256 x 8) 1.8V 8SOIC 2 WIRE
16	1	U5	LM3722	SOT23-stx	5-pin uP reset ckt, sot23-5 pkg, LM3722EM5-3.08
17	1	BOARD	LM95172EWGEB, Rev 1.0		PCB FR4-06 2LYR 62MILS THICK
18	1	Y1	24 MHz	hc49us	CRYSTAL 24.000MHZ

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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.

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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.

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 is strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.



## **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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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.

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