

LM9402xEVM Evaluation Module (EVM)

User's Guide



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Introduction

The Texas Instruments LM9402xEVM evaluation module (EVM) helps designers evaluate the operation and performance of the LM94021, LM94022, and LM94023. The LM94021, LM94022, and LM94023 are precision, analog output, CMOS integrated-circuit, temperature sensors. The analog temperature sensors have a gain select pin which allows the user to set the gain of the temperature-to-voltage output transfer function.

The EVM contains three analog temperature sensors. This EVM comes pre-assembled with the devices in [Table 1-1](#), and with all the gain jumpers shorted to GND (the lowest gain setting).

Table 1-1. Device and Package Configurations

SENSOR	IC	PACKAGE
U1	LM94021QBIMG	SC-70
U2	LM94022BIMG	SC-70
U3	LM94023BITME	DSBGA

Board Connectors

This section describes the jumpers and connectors on the EVM, and how to properly connect, set up and use the LM9402xEVM.

2.1 Input/Output Connector Description

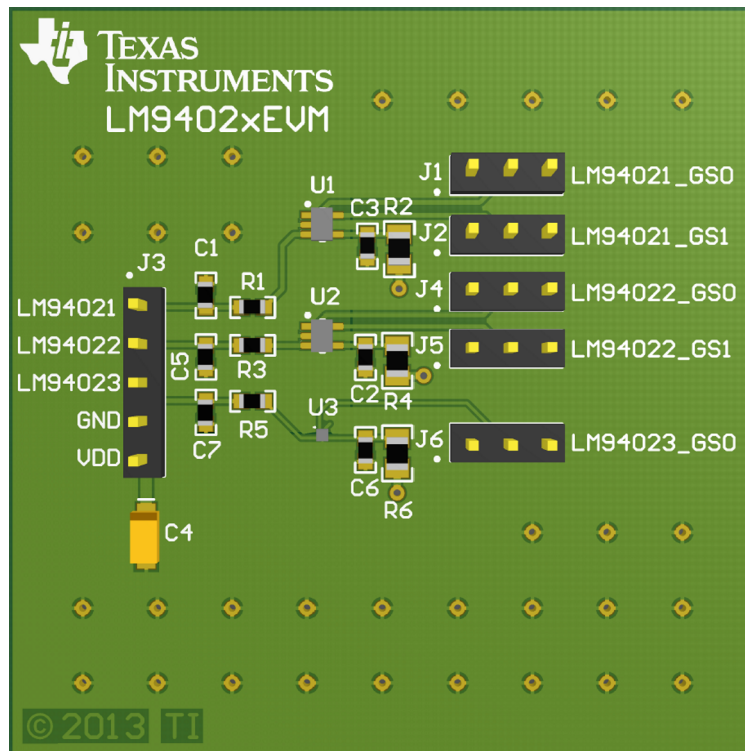


Figure 2-1. LM9402x Evaluation Board

J1 – Input is the gain select (GS0) terminal for the LM94021. The standard 0.1" header allows the user to set the gain of the transfer function to HIGH or LOW.

J2 – Input is the gain select (GS1) terminal for the LM94021. The standard 0.1" header allows the user to set the gain of the transfer function to HIGH or LOW.

J4 – Input is the gain select (GS0) terminal for the LM94022. The standard 0.1" header allows the user to set the gain of the transfer function to HIGH or LOW.

J5 – Input is the gain select (GS1) terminal for the LM94022. The standard 0.1" header allows the user to set the gain of the transfer function to HIGH or LOW.

J6 – Input is the gain select terminal for the LM94023. The standard 0.1" header allows the user to set the gain of the transfer function to HIGH or LOW.

- J3.P1 – Output** is the output of the LM94021 analog temperature sensor.
- J3.P2 – Output** is the output of the LM94022 analog temperature sensor.
- J3.P3 – Output** is the output of the LM94023 analog temperature sensor.
- J3.P5 – GND** is the ground pin.
- J3.P6 – VDD** is the power supply for LM94021, LM94022, and LM94023.



Figure 2-2. Default Gain Select Jumper Settings

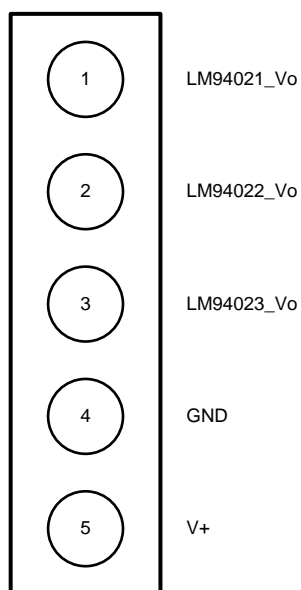


Figure 2-3. Standard 0.1" Header

Board Operation

3.1 Required Equipment

1. 1x Power Supply (5V, >25mA)
2. 1x Digital Multimeter (4.5 digit or better)

3.2 Connections

1. Select desired gain setting.
2. Supply a voltage to VDD (pin 5 of J3) and GND (pin 4 of J3).
3. Measure the output voltage of the temperature sensors at pin 1 to pin 4 of J3.

Board Layout

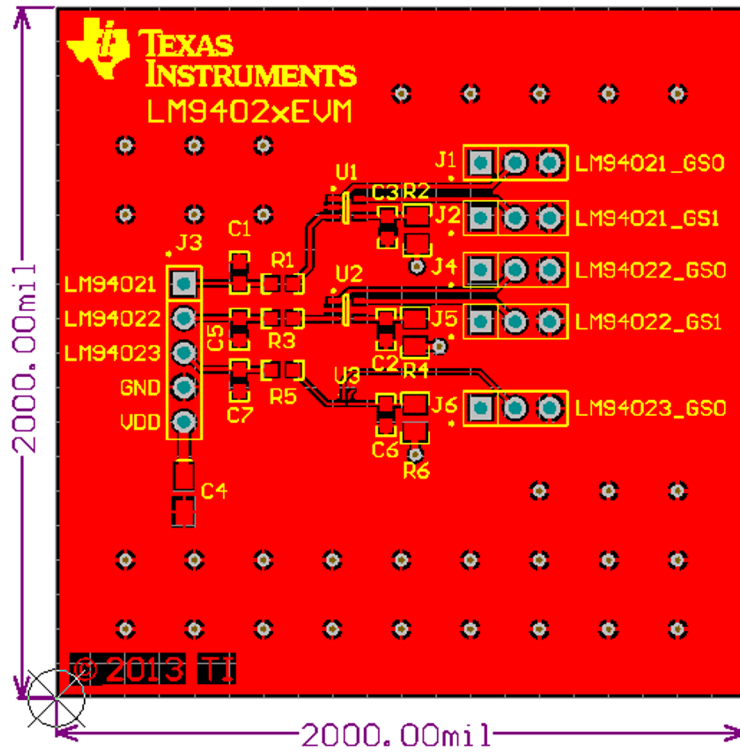


Figure 4-1. Top Assembly Layer

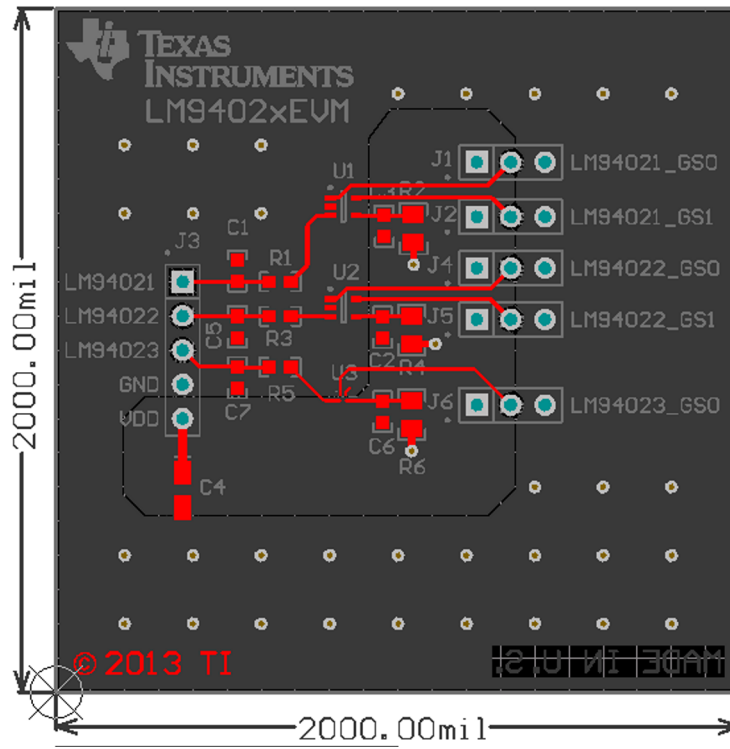


Figure 4-2. Top Layer Routing

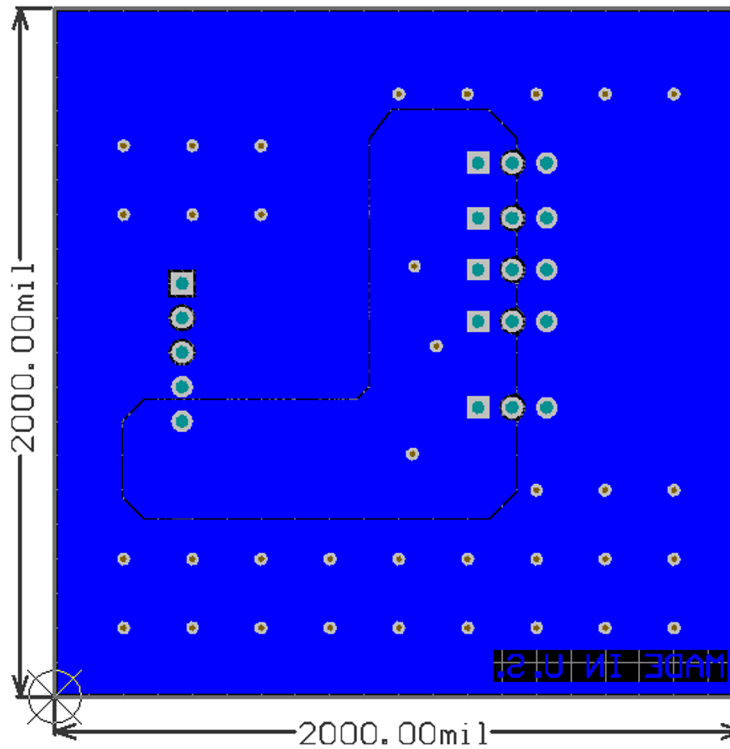


Figure 4-3. Bottom Layer Routing

Bill of Materials

Table 6-1. LM9402xEVM Bill of Materials

Designator	Description	Manufacturer	Part Number
EVM	LM9402xEVM	Texas Instruments	SV600933
C2, C3, C6	CAP, CERM, 0.1uF, 50V, +/- 10%, X7R, 0603	Kemet	C0603C104K5RACTU
C4	CAP, TANT, 10uF, 10V, +/- 20%, 1.8 ohm, 3216-18 SMD	AVX	TPSA106M010R1800
J1, J2, J4, J5, J6	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-103-07-G-S
J3	Header, TH, 100mil, 5x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-105-07-G-S
R1, R3, R5	RES, 0 ohm, 5%, 0.1W, 0603	Vishay-Dale	CRCW06030000Z0EA
R2, R4, R6	RES, 0 ohm, 5%, 0.125W, 0805	Vishay-Dale	CRCW08050000Z0EA
U1	Multi-Gain Analog Temperature Sensor, 5 pin SC-70, Pb-Free	Texas Instruments	LM94021QBIMG/NOPB
U2	1.5V, Multi-Gain Analog Temperature Sensor with Class-AB Output, 5-pin SC-70, Pb-Free	Texas Instruments	LM94022BIMGX/NOPB
U3	1.5V, Dual-Gain Analog Temperature Sensor with Class AB Output, 4-pin Micro SMD, Pb-Free	Texas Instruments	LM94023BITME/NOPB
C1, C5, C7	CAP, CERM, 0.1uF, 50V, +/- 10%, X7R, 0603	Kemet	C0603C104K5RACTU

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

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

Caution

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

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

FCC Interference Statement for Class A EVM devices

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

FCC Interference Statement for Class B EVM devices

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

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

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

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

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs including detachable antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

Concernant les EVMs avec appareils radio

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

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

【Important Notice for Users of EVMs for RF Products in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

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

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4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

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