LMP92064EVM User's Guide

This user's guide describes the characteristics, operation, and use of the LMP92064EVM evaluation board. It also discusses how to set up and configure the software and hardware for a typical operation. Throughout this document, the terms *evaluation board*, *evaluation module*, and *EVM* are synonymous with the LMP92064EVM. This user's guide also includes printed circuit board (PCB) layout drawings, an electrical schematic, and a bill of materials for the EVM.

Contents

1 Overview 3
2 LMP92064EVM Connectors and Components 4
3 LMP92064EVM Software Installation 9
4 LMP92064EVM Setup and Operation 11
5 Other Software Features 16
6 PCB Layout 18
7 Schematic 21
8 Bill of Materials 22

List of Figures

1 LMP92064EVM Picture 3
2 Power Supply Terminals 4
3 Rsense Terminals 4
4 Bus Voltage Divider 5
5 R1, R2, R3 and R4 shorting traces must be cut before use 5
6 Optional Input Filtering Capacitors 6
7 TP4 and TP5 Headers 6
8 Reference test point and reset switch 7
9 Digital Interface Debug Test Point TP8 7
10 Series resistors on digital lines 8
11 GPSI16 Interface Connector 8
12 Update Driver Software 9
13 Driver Authentication Warning 10
14 COM Port Number 10
15 Setup for Current and Voltage Sensing 11
16 Hardware Connection 12
17 Start-up Window 13
18 Connect Successful 13
19 Data Capture 14
20 Registers Tab 16
21 Graph Tab 17
22 Top Components View 18
23 Top Layer Routing 19
24 Bottom Layer Routing 19
25 Mid Layer 1 Routing (Ground) 20
26 Mid Layer 2 Routing (Power) 20

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27 LMP92064EVM Schematic 21

List of Tables

1 LMP92064EVM Kit Contents 3
2 LMP92064EVM Bill of Materials 22

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1 Overview

The Texas Instruments LMP92064EVM evaluation module (EVM) helps designers evaluate the operation and performance of the LMP92064. The LMP92064 is a precision, low-side, digital current sensor and voltage monitor with a digital SPI interface. The LMP92064 features a current sense and a voltage sense channel, which are sampled simultaneously by independent 12-bit ADC converters.

1.1 LMP92064EVM Kit Contents

Table 1 lists the contents of the LMP92064EVM kit and Figure 1 shows all the included hardware. The EVM board contains one LMP92064 device in a low-side configuration for current sensing and voltage monitoring. The EVM comes pre-assembled with a 0.05Ω sense resistor (0.5W), bypass capacitors, test points and connection terminals. The USB2ANY board and the adaptor are required to communicate with the EVM from a PC running the evaluation software.

Table 1. LMP92064EVM Kit Contents

Item	Quantity
LMP92064EVM Evaluation Board	1
USB2ANY Board	1
USB2ANY to GPSI16 Adaptor	1
USB Cable	1

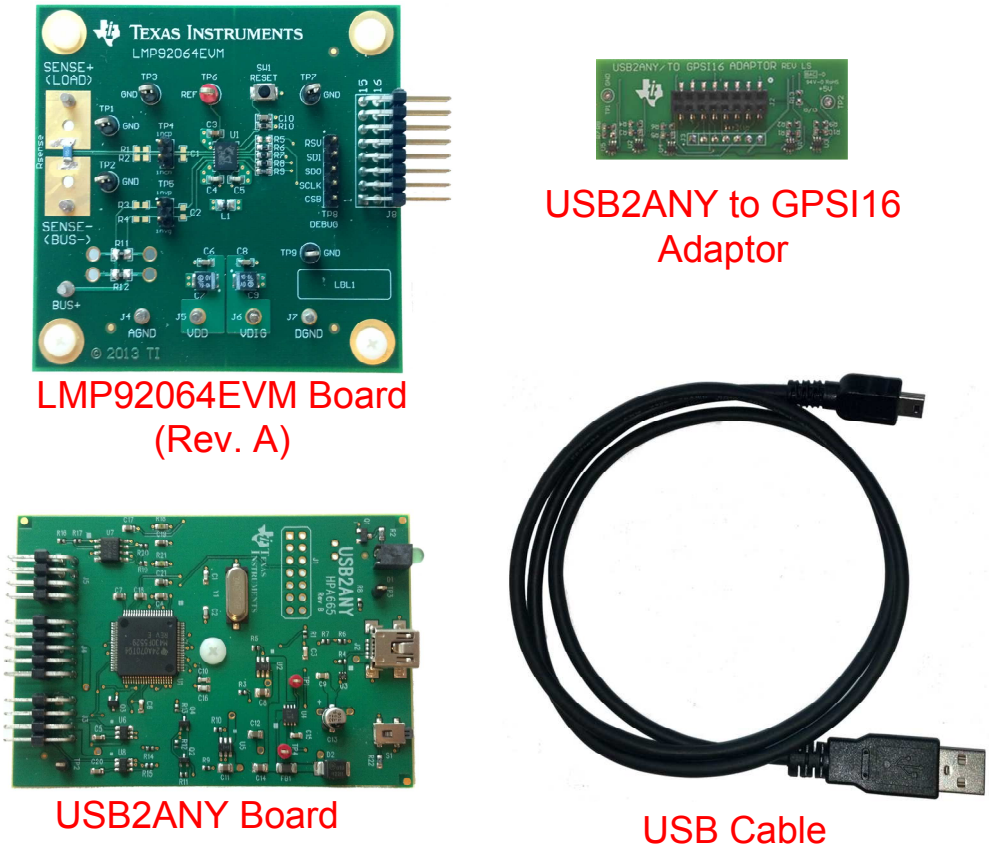


Figure 1. LMP92064EVM Picture

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2 LMP92064EVM Connectors and Components

This section describes the connectors, components and test points used for the proper operation of the LMP92064EVM board.

2.1 Analog Power Supply Input - VDD and AGND

The analog supply pin of the device is connected to the VDD terminal of the EVM and the analog ground plane of the EVM is connected to the AGND terminal. These turrets should be used to connect an external voltage source to power the analog circuitry. There is a 10 µF tantalum capacitor and two ceramic capacitors with values of 0.1 µF and 10 pF on the VDD line. The analog supply should be operated between 4.5V and 5.5V.

2.2 Digital Power Supply Input – VDIG and DGND

The digital supply pin of the device is connected to the VDIG terminal of the EVM and the digital ground plane of the EVM is connected to the DGND terminal. These turrets should be used to connect an external voltage source to power the digital circuitry. There is a 10µF tantalum capacitor and two ceramic capacitors with values of 0.1 µF and 10 pF on the VDIG line. The digital supply should be operated between 4.5V and 5.5V.

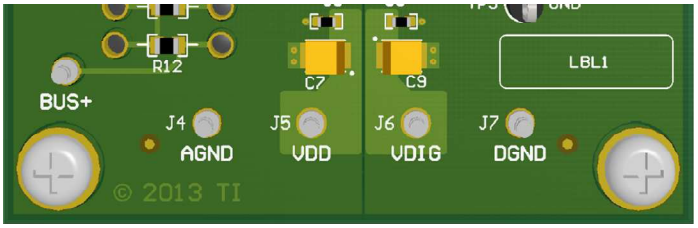


Figure 2. Power Supply Terminals

2.3 Current Sense Resistor and Sense Terminals

The EVM board has placeholders for a current sense resistor, providing options for either through-hole or surface mount resistors. The large pads are bare copper to allow mounting various sizes and shapes of resistor, as well as providing heat dissipation. The board comes pre-assembled with a 0.05Ω sense resistor (0.5W).

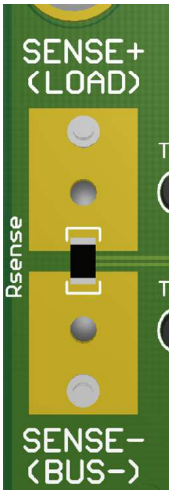


Figure 3. Rsense Terminals

The larger inner holes are for optional pin socket receptacles to allow easy swapping of through-hole resistors for prototyping.

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For off-board current sense resistors, the sense lines can be connected to the SENSE+ and SENSE- terminals (removing the on-board sense resistor). It is recommended for these wires to be twisted to prevent noise and electromagnetic interference (EMI) pickup.

Load ground currents should be kept off the board. Load current should be returned directly to the power supply terminals and not through the evaluation board grounds.

2.4 Voltage Sense Resistors and Terminals

The EVM provides two resistors, R11 and R12, as means of sensing the voltage on a bus connected to the BUS+ terminal. The resistor values of R11 and R12 should be selected according to the voltage on the bus that is to be monitored, considering the maximum input range of the Voltage Sensing Channel, which is 2.048V.

$$(INVP - INVG) = V_{BUS} \times \frac{R11}{R11 + R12} \leq 2.048V \quad (1)$$

The EVM comes pre-assembled with values of R11 = 2kΩ and R12 = 30 kΩ.

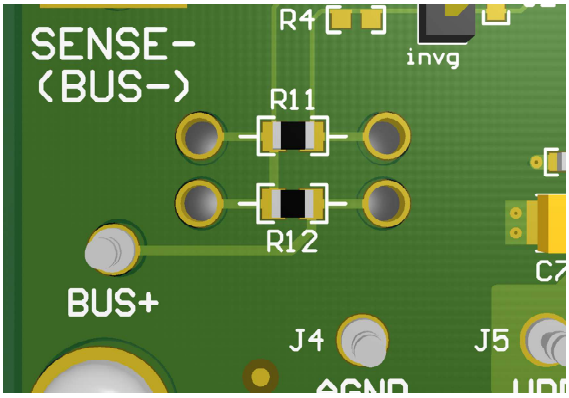


Figure 4. Bus Voltage Divider

2.5 Optional Input Filtering

The optional R1, R2, R3 and R4 resistor pads are provided to add, in conjunction with C1 and C2, EMI/noise filtering to the input. Series resistors or series inductors can optionally be connected to these pads. To maintain a continuous solid copper path between the shunt and the inputs of the amplifier, the resistor pads have shorting traces across them. To use these pads, the shorting traces must be cut before installing the resistors.

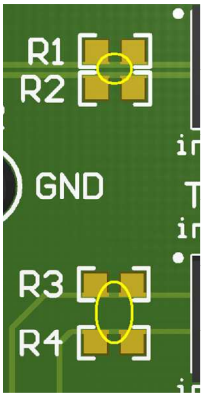


Figure 5. R1, R2, R3 and R4 shorting traces must be cut before use

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To maintain accuracy, these resistors should be of equal value and well matched, as they are in series with the device's internal resistors and will affect the device's specifications. The values of these resistors should be kept as low as possible and should not exceed a few hundred ohms.

Pads C1 and C2 are provided for optional EMI rejection. For RF/EMI protection, values in the 10 pF to 100 pF range are recommended. It is also possible to use the resistor pairs R1/R2 and R3/R4 with the capacitors C1 and C2 to create a first-order low-pass filter in the signal path.

Keep in mind that, creating an AC filter of reasonable cut-off frequency with resistor values below a few hundreds of ohms, the capacitor values will become quite large.

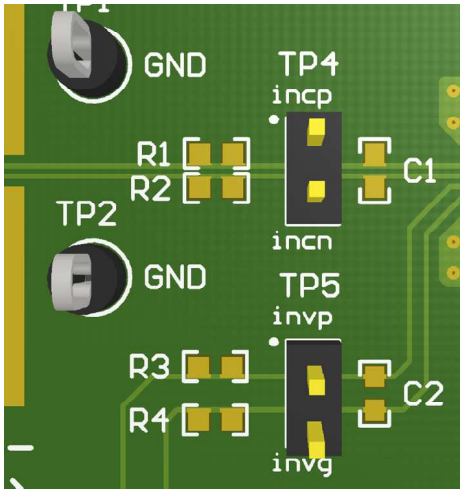


Figure 6. Optional Input Filtering Capacitors

2.6 Input Sense Test Points – TP4 and TP5

These standard 0.1" headers allow probing the input signals or applying test voltages. TP4 is connected to the Current Sensing Channel and TP5 is connected to the Voltage Sensing Channel.

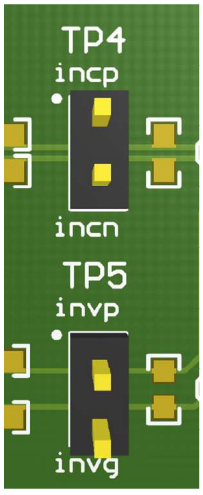


Figure 7. TP4 and TP5 Headers

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2.7 Reference Test Point – REF TP6

There is a test point connected to the reference pin of the LMP92064. The reference pin is not intended to drive other circuitry.

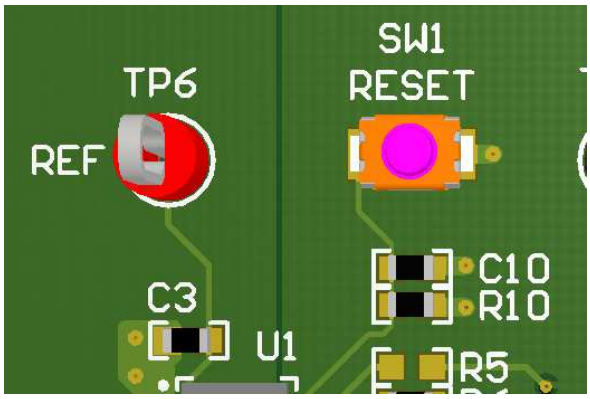


Figure 8. Reference test point and reset switch

2.8 Reset Switch – SW1

This switch is used to perform a hardware reset on the LMP92064. The combination of R10 and C10 is used to smoothen the falling edge of the reset pulse generated when releasing the switch.

2.9 Serial Peripheral Interface (SPI) Bus Test Point – DEBUG TP8

This standard 0.1” header allows probing the SPI bus. The SPI bus consists of an active-low chip select (CSB) line, a serial clock (SCLK) line, a serial data output (SDO) line and a serial data input (SDI) line. There is an additional reserved line (RSV) that is not part of the SPI interface.

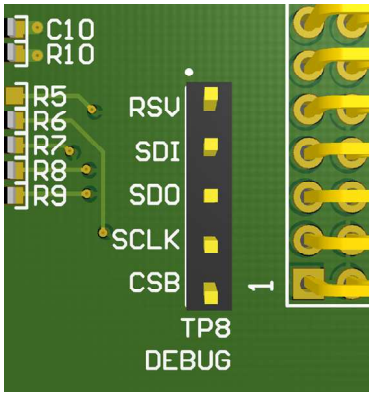


Figure 9. Digital Interface Debug Test Point TP8

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2.10 SPI Series Resistors

Resistors are placed in series with the CSB, SCLK, SDI and SDO digital lines to clean the edges of the fast transitions and prevent the digital signals from creating noise that can affect sensitive internal analog nodes. Refer to the Schematic for the component values. The value of these resistors should be limited to below a few hundred ohms, otherwise the digital communication may become unreliable.

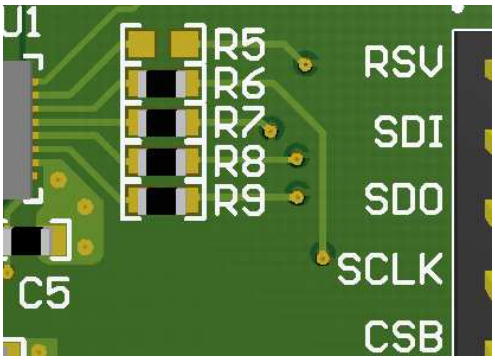


Figure 10. Series resistors on digital lines

2.11 Interface Connector – J8

J8 is used to connect the LMP92064EVM to the USB2ANY board. The interface is used to access the device registers and to read the conversion data from the LMP92064. An adaptor board is required between the EVM and the USB2ANY board.

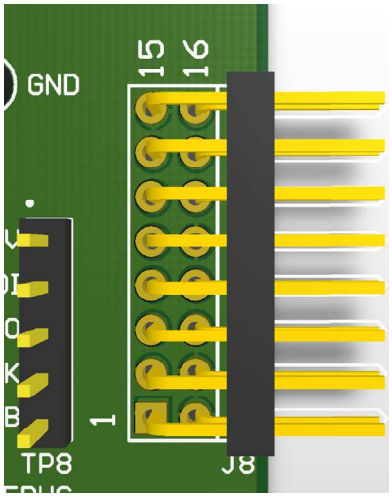


Figure 11. GPSI16 Interface Connector

2.12 Ground Test Points – GND TPx

There are ground (GND) test points distributed around the board for ease of probing: TP1, TP2, TP3, TP7 and TP9.

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3 LMP92064EVM Software Installation

The latest software version for the LMP92064EVM can be downloaded from the Texas Instruments website at http://www.ti.com/product/lmp92064. You must install the software before you connect the LMP92064EVM via the USB2ANY board to your PC.

To install the LMP92064EVM software:

1. Navigate to http://www.ti.com/product/lmp92064, scroll down to the **"Software"** section and download the latest LMP92064 Evaluation Software.
2. Unzip the downloaded file into a known directory and run the "setup.exe" file located in [Unzip location]\LMP92064EVM_Software_vXX\Installer\Volume\
3. Follow the on-screen instructions by clicking the "Next" button to install the software.
4. When the installation is finished, click the "Finish" button.
5. Before launching the LMP92064EVM software, connect the USB2ANY board to a USB port of your PC. Go to your computer's **"Device Manager"** and find **"MSP430-USB Example"** (see Figure 12). Right-click on it and choose **"Update Driver Software"**.

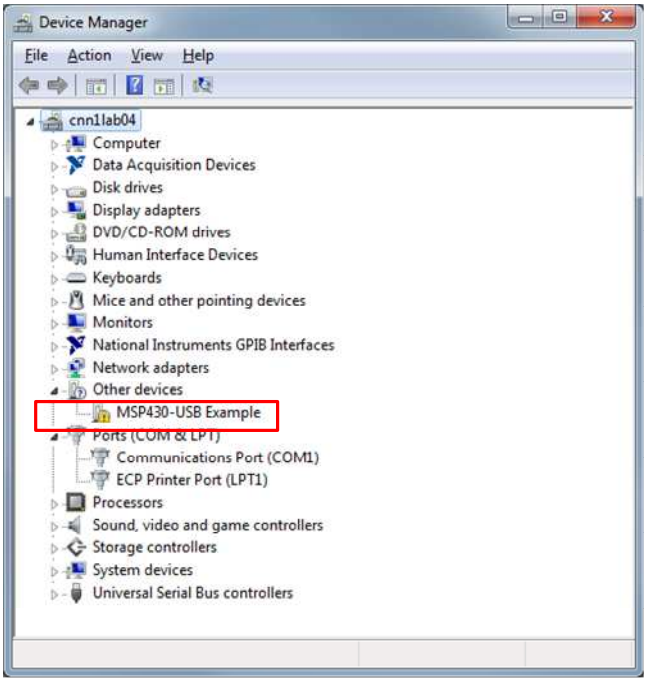


Figure 12. Update Driver Software

6. In the next screen, select the **"Browse my computer for driver software"** option. Navigate and select the **Driver** folder located in the directory where the LMP92064 evaluation software was decompressed.

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7. If prompted with a warning window, select **"Install this driver software anyway"** for Windows to proceed with the installation.

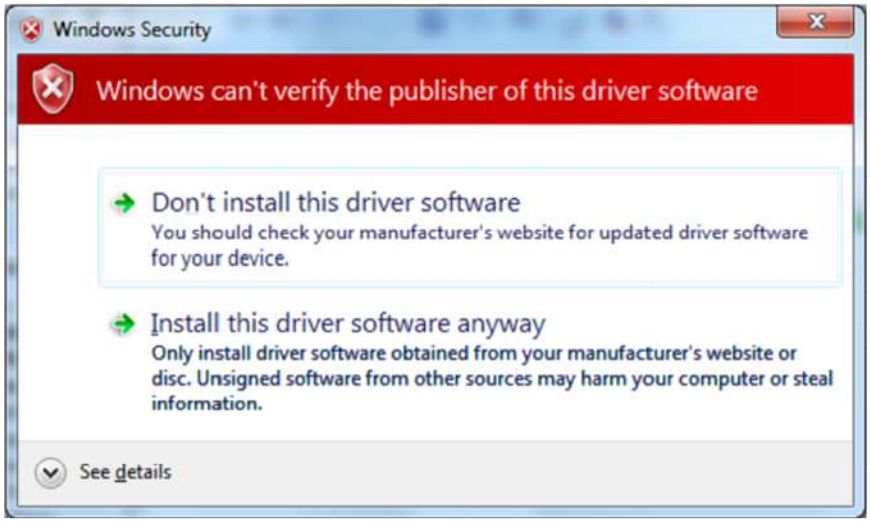


Figure 13. Driver Authentication Warning

8. Close the installation window when it is completed. The device manager should now display an **"MSP430 Virtual COM Port"** item followed by a COM port number. Take note of this port number as it will be required to connect to the device from the LMP92064EVM Software.

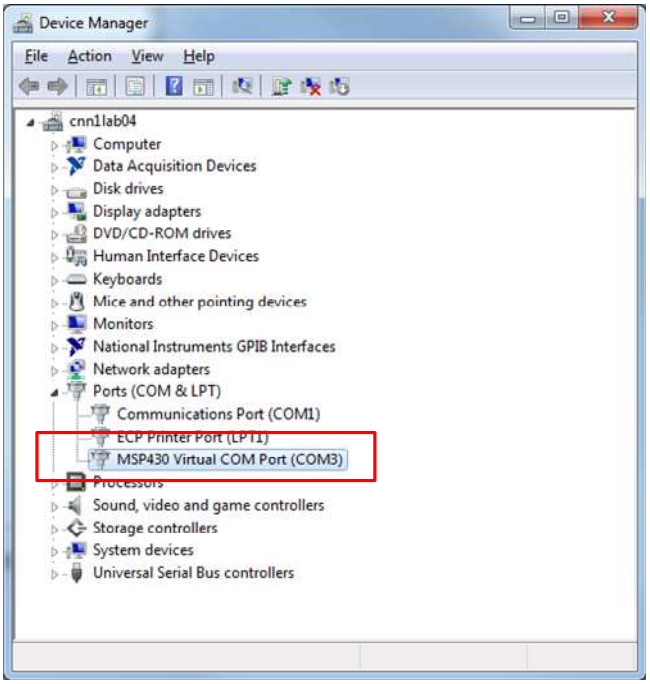


Figure 14. COM Port Number

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4 LMP92064EVM Setup and Operation

CAUTION

Do not exceed the power rating of the sense resistor. For the pre-assembled 0.05Ω sense resistor, keep the load current below 3A at all times.

4.1 Required Equipment

1. 1x Power supply (20V, >1A)
2. 1x Power supply (5V, >25 mA)
3. 2x Digital multi-meter (4.5 digit or better)
4. 1x 20Ω power resistor (>25W) or a programmable load sinking 1A
5. Misc. test clamps for connections

4.2 Connections

1. With the output disabled, connect the positive terminal (+) of the first power supply (V_{S1}) to the load and the negative terminal (–) to the SENSE- terminal of the EVM. Configure the supply's output to 20V and the current limit to 1.01A.
2. Additionally, connect the positive (+) terminal of the first power supply to the BUS+ terminal of the EVM.
3. Connect the other end of the load to the SENSE+ terminal of the EVM.
4. With the output disabled, connect the positive terminal (+) of the second power supply (V_{S2}) to the VDD and VDIG terminals of the EVM and the negative terminal (–) to AGND and DGND. Configure its output to 5V and the current limit to 20mA.
5. Connect the positive (+) terminal of the first digital multimeter (DMM1) to **incp** on TP4; connect the negative terminal (–) to **incn.**
6. Connect the positive (+) terminal of the second digital multimeter (DMM2) to **invp** on TP5; connect the negative terminal (–) to **invg**.
7. Insert J8 into the adaptor and into the USB2ANY board's connector (do not plug the USB cable to the PC yet). See Figure 16 for reference.

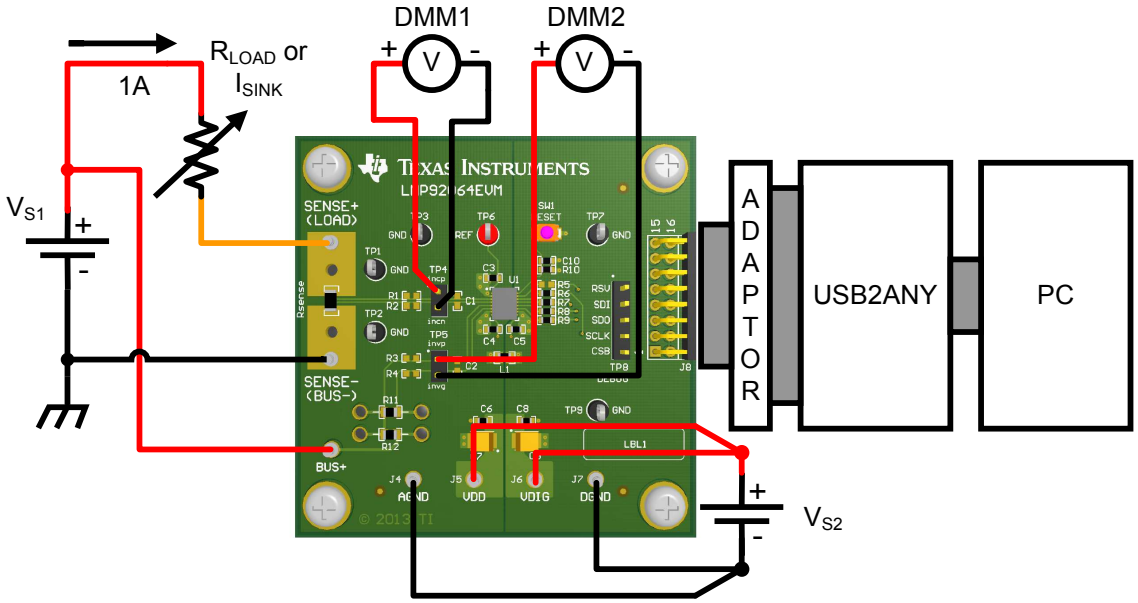


Figure 15. Setup for Current and Voltage Sensing

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The figures below show the connection between the LMP92064EVM, the USB2ANY TO GPSI16 adaptor and the USB2ANY board.

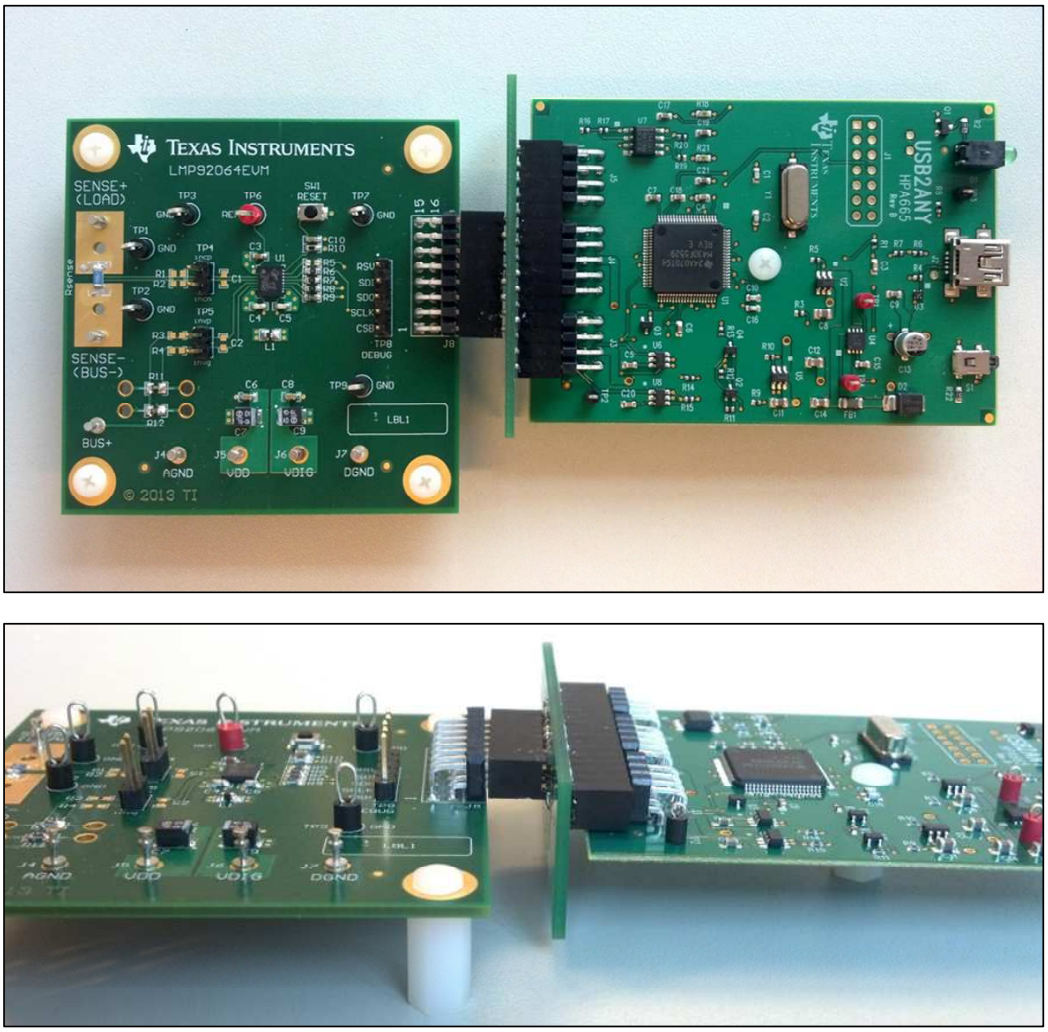


Figure 16. Hardware Connection

4.3 Power-up Sequence

1. Enable the output of V_{S2} (previously configured to 5V).
2. If using a programmable current load, configure it to sink 1A and enable its output.
3. Enable the output of V_{S1} (previously configured to 20V).
4. Connect the USB cable from the USB2ANY board to the PC.

NOTE: Heating of the load and sense resistors may cause drift between measurements.

5. Read the voltage from DMM1; ideally the voltage should be around 50mV, depending on the accuracy of the load and the tolerance of the 0.05Ω sense resistor.
6. Read the voltage from DMM2; ideally the voltage should be around 1.25V, depending on the accuracy of the voltage divider of R11 and R12.

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4.4 Launching and Running the Software

The LMP92064EVM GUI can be run from the Start Menu; by default, it is located in a folder called LMP92064. Launching the software will take you to the main window of the GUI.

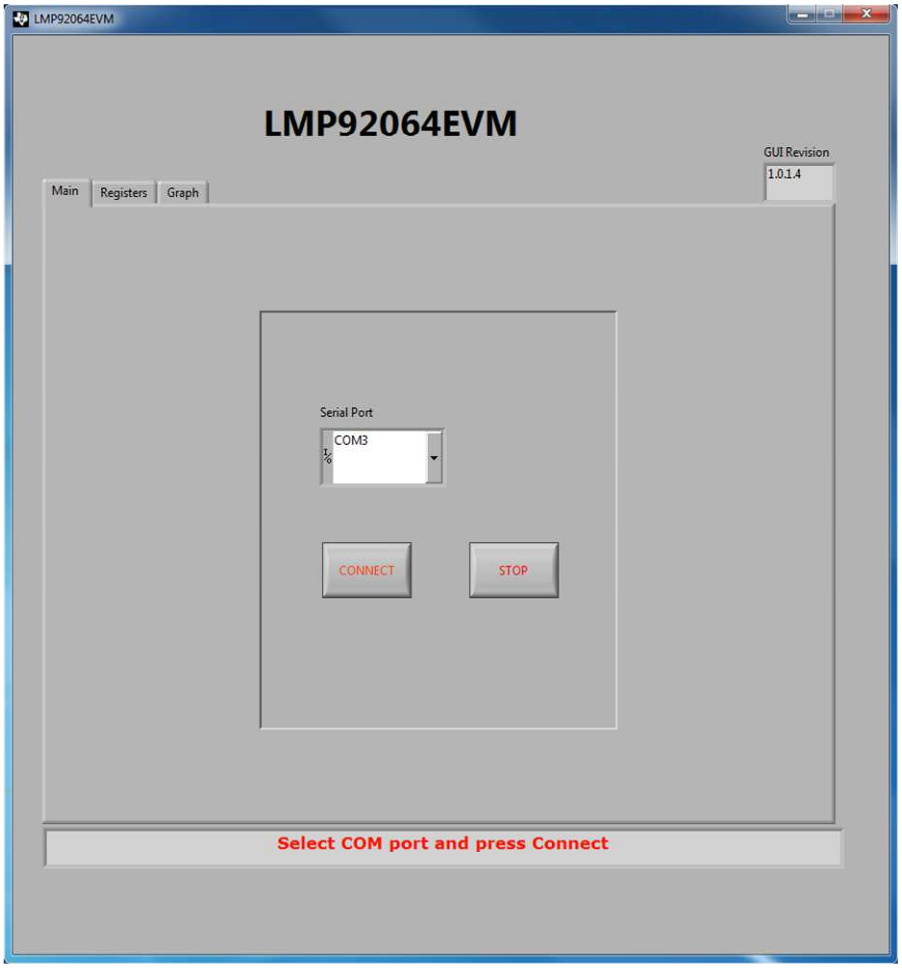


Figure 17. Start-up Window

1. Enter the serial port number found previously in the **"Device Manager"** (e.g. COM3) and click on the **CONNECT** button. If the EVM is found, the GUI returns a **"Connect Successful!"** message.

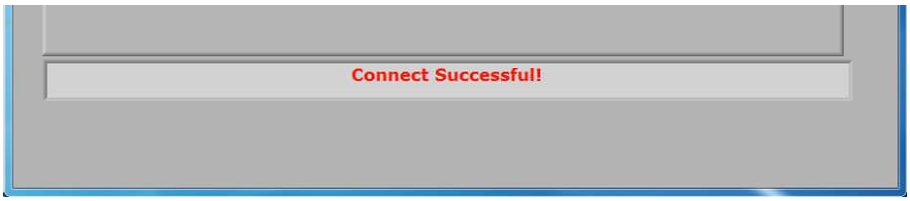


Figure 18. Connect Successful

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2. Go to the **"Graph"** tab and click on the **"Start Graph"** button to begin capturing and plotting data. By default, the Y-axis units are set to Output Code.

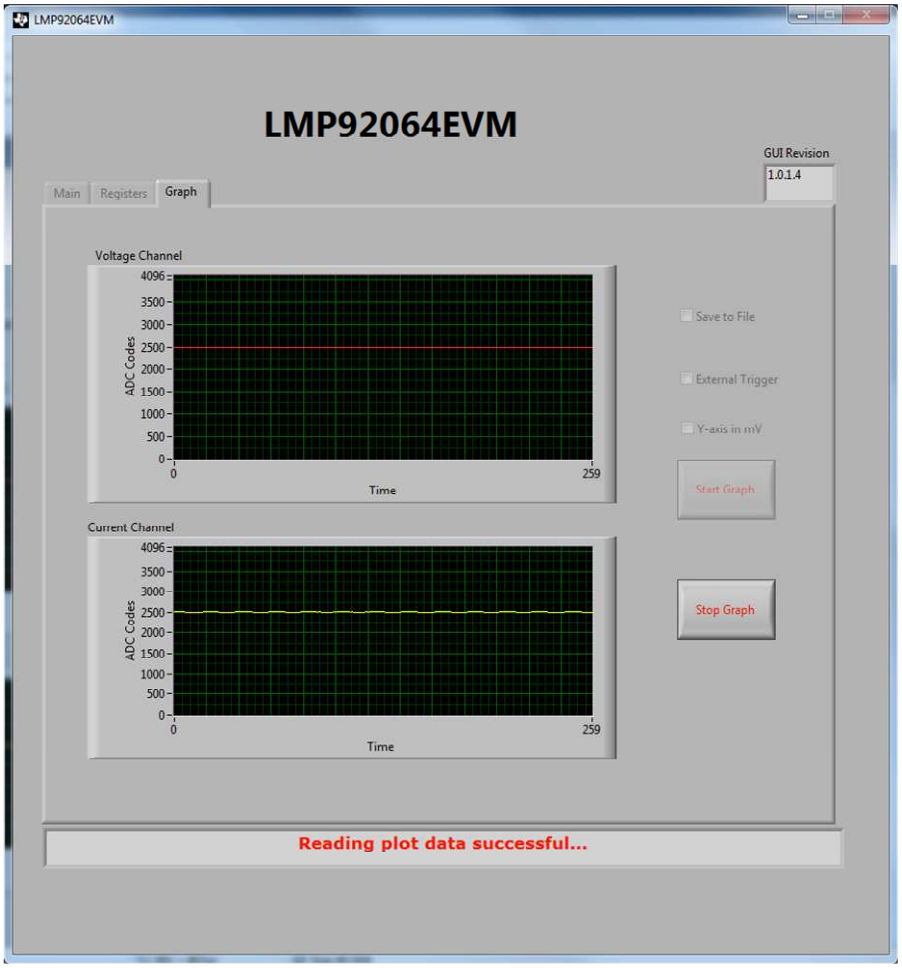


Figure 19. Data Capture

3. Click on **"Stop Graph"** to stop capturing and plotting data.

   (a) Voltage Channel: For a 1.25V input, the ideal output code of the Voltage Channel is 2500 (decimal). The output code of the voltage channel can be calculated as:

$$INV_{CODE} = (invp - invg) \times \frac{4096}{V_{REF}} \quad (2)$$

   Where V_{REF} = 2.048V.

   (b) Current Channel: For a 50 mV input, the ideal output code of the Current Channel is 2500 (decimal). The output code of the current channel can be calculated as:

$$INC_{CODE} = (incp - incn) \times \frac{4096 \times Gain}{V_{REF}} \quad (3)$$

   Where Gain = 25 and V_{REF} = 2.048V.

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4.5 Power-down

1. Go back to the **"Main"** tab and click on the **"STOP"** button to disconnect the COM port and stop the execution of the GUI. Close the application. Disconnect the USB cable from the PC (or from the USB2ANY board).
2. Disable the output of V_{S1} (the 20V power supply).
3. If using a programmable load, disable its output.
4. Disable the output of V_{S2} (the 5V power supply).

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5 Other Software Features

5.1 Registers Tab

The **"Registers"** tab provides access to the registers of the LMP92064 to execute read and write commands. Refer to the latest datasheet for details about each register.

Note that register 0x0000 - CONFIG_A is a buffered register. Writing a value to this register moves the data into a buffer, and in order to move this data to the real register location, a write to the 0x000F - REG_UPDATE register is required.



Figure 20. Registers Tab

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5.2 Graph Tab

The **"Graph"** tab allows capturing and displaying data from the Voltage and the Current channel simultaneously. By default, the Y-axis scale is set to ADC Codes, but it can be configured to display the data in milli-volts (mV) by enabling the **"Y-axis in mV"** check-box. This is an ideal analog-to-digital conversion assuming no accuracy errors.

A data capture is started clicking on the "**Start Graph"** button and is stopped by clicking on the **"Stop Graph"** button. The data can be saved into a comma-separated value (CSV) file by enabling the **"Save to File"** check-box. When starting the data capture, you will be prompted to select a location and filename to save the data. Data is always saved as ADC output codes in HEX format.

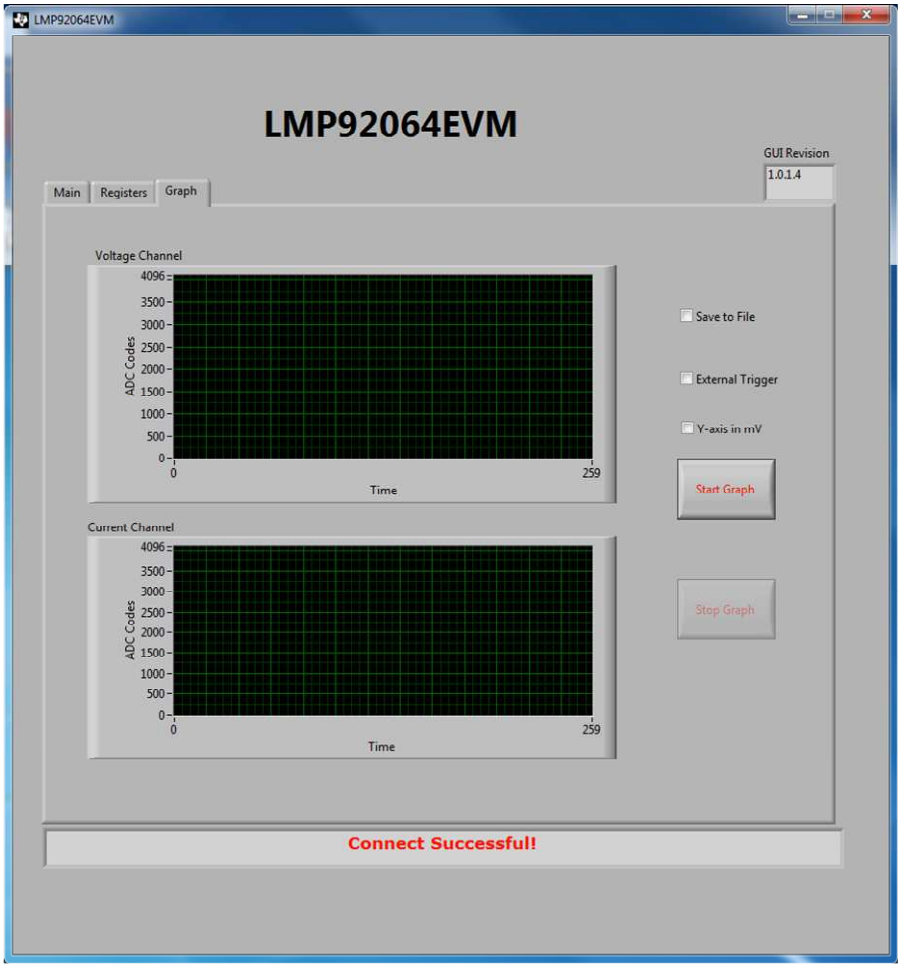


Figure 21. Graph Tab

The data capture software uses an internal time trigger, collecting blocks of 10 current and voltage data samples every 500µs. An external trigger can be used with a slight modification:

1. Connect a 2 kHz or slower clock (3.3V compliant) on the RSV pin of TP8.
2. Enable the **"External Trigger"** check-box and start the data capture.

Data is captured at every falling edge of the trigger pulse.

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6 PCB Layout

NOTE: The board layout is not to scale. The following figures are intended to show how the board is laid out; it is not intended to be used for manufacturing LMP92064EVM PCBs.

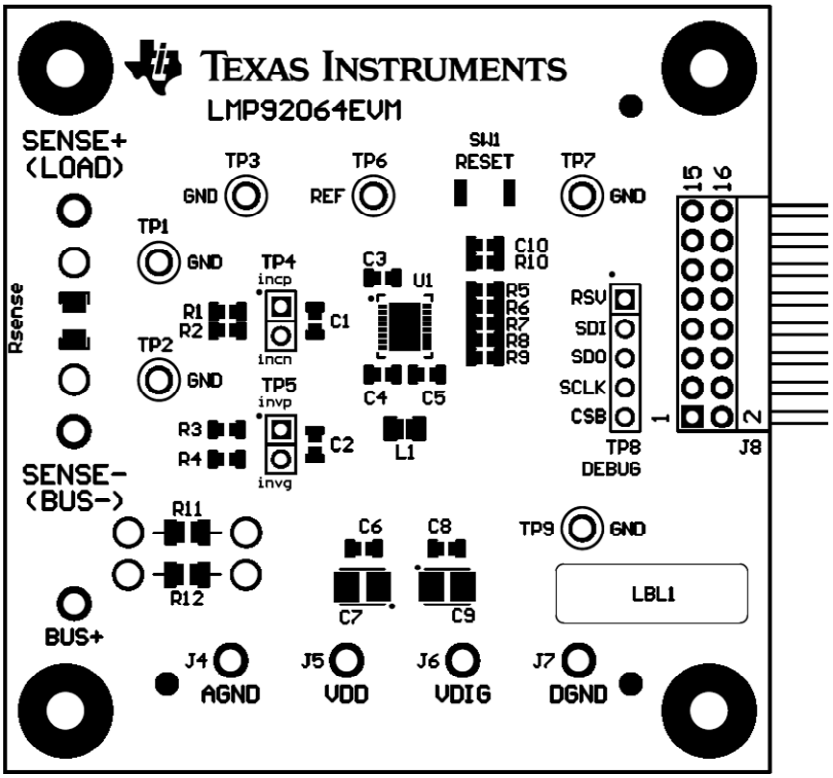


Figure 22. Top Components View

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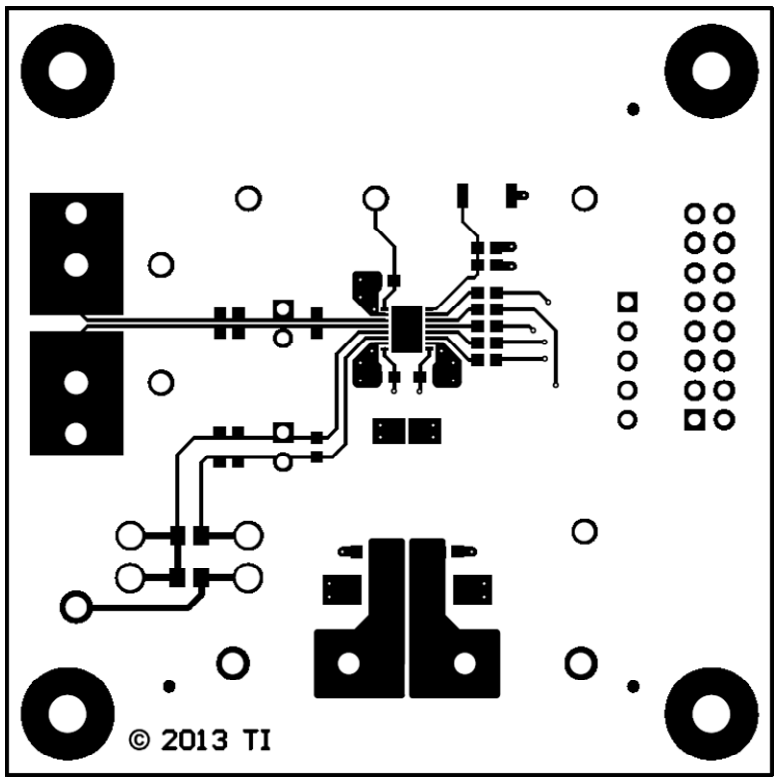


Figure 23. Top Layer Routing

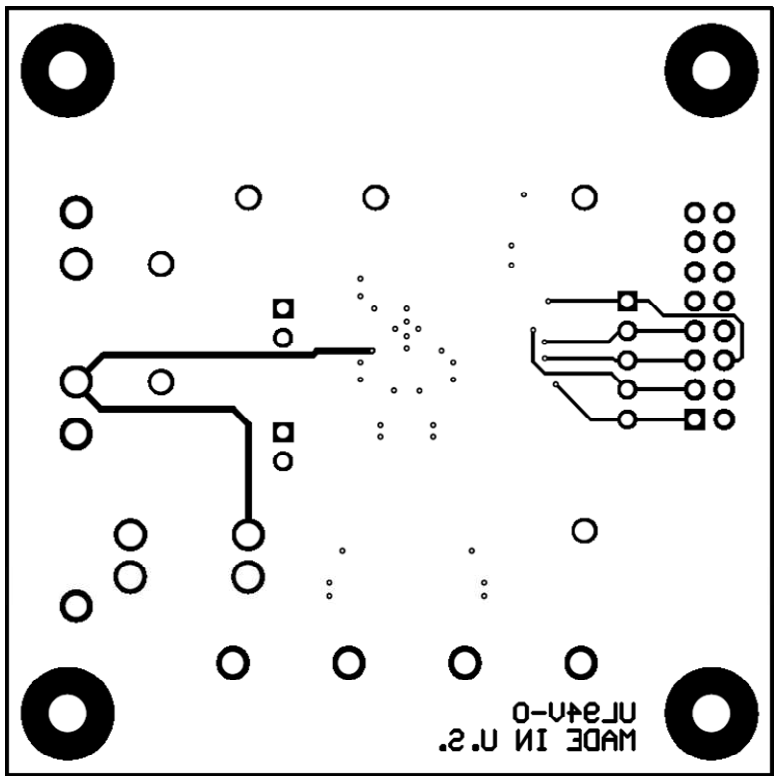


Figure 24. Bottom Layer Routing

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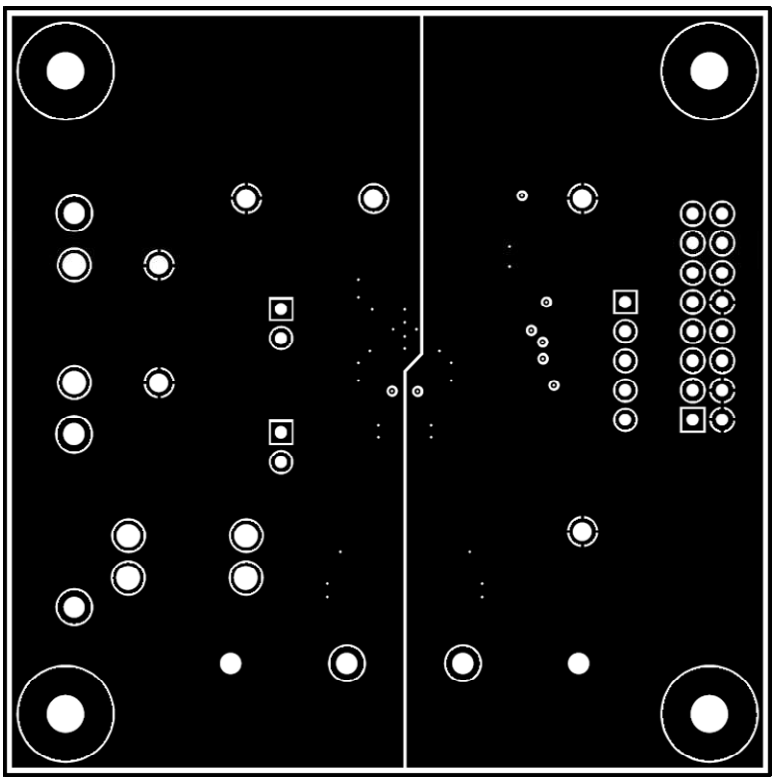


Figure 25. Mid Layer 1 Routing (Ground)

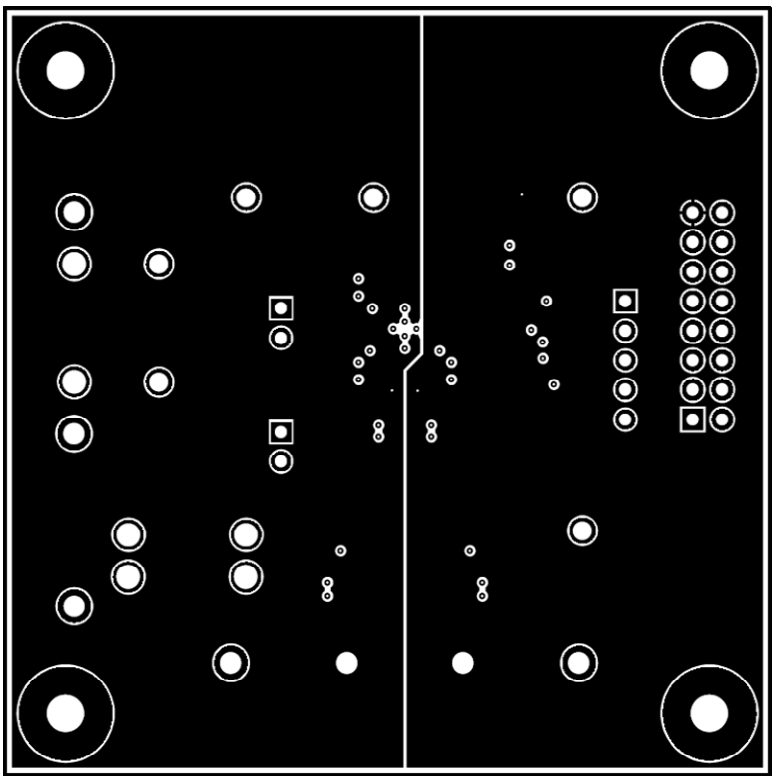


Figure 26. Mid Layer 2 Routing (Power)

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7 Schematic

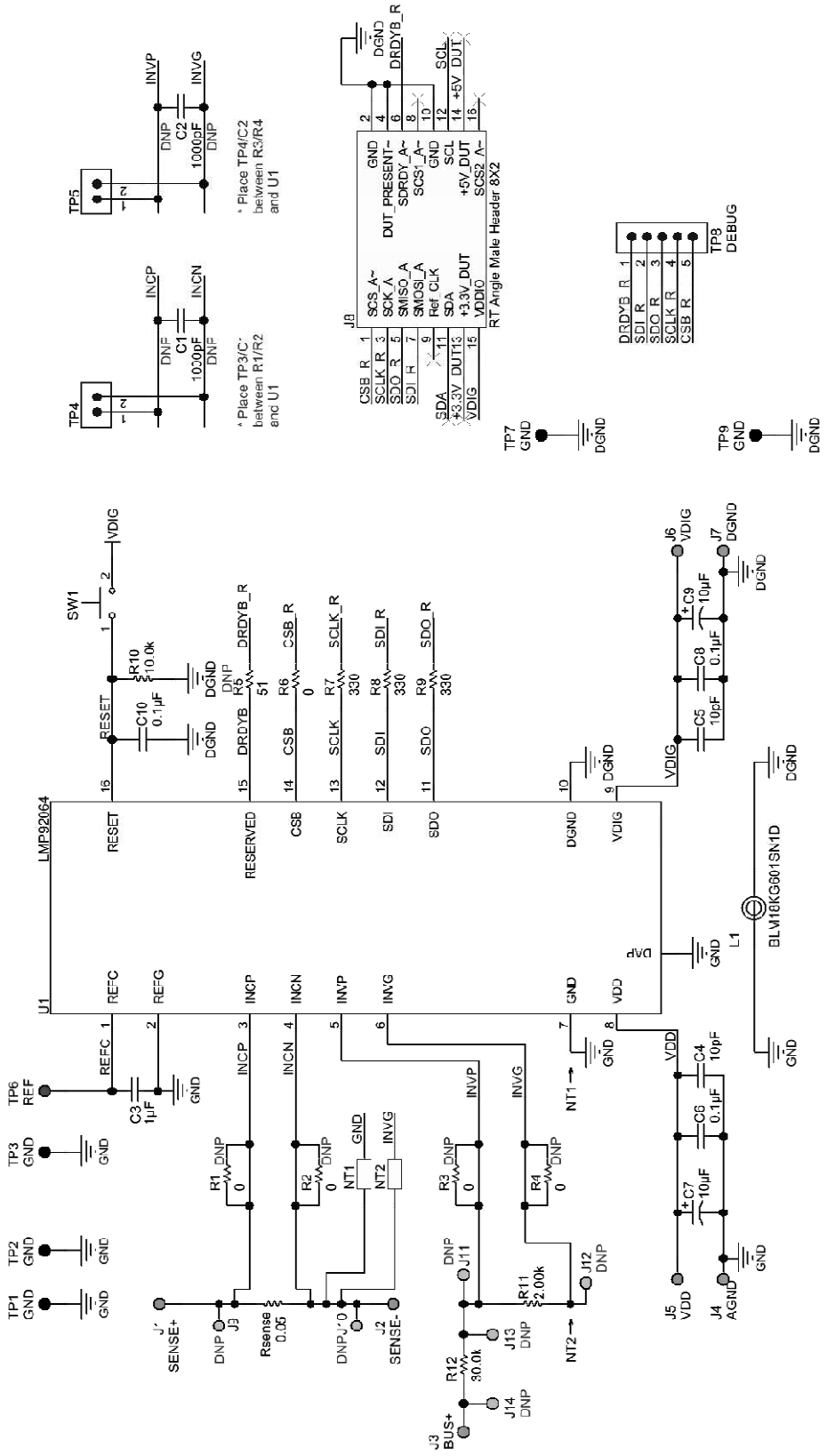


Figure 27. LMP92064EVM Schematic

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8 Bill of Materials

Table 2. LMP92064EVM Bill of Materials

Item No.	Ref Des	Description	Vendor/Mfr	Part Number
1	EVM	LMP92064 EVALUATION BOARD	Texas Instruments	SV600870
2	C3	CAP CER 1UF 25V X7R 10% 0603	MuRata	GRM188R71E105KA12D
3	C4, C5	CAP CER 10PF 50V 5% NP0 0603	AVX	06035A100JAT2A
4	C6, C8, C10	CAP CER 0.1UF 25V 5% X7R 0603	AVX	06033C104JAT2A
5	C7, C9	CAP TANT 10UF 6.3V 10% 1411	Vishay-Sprague	293D106X96R3B2TE3
6	J1, J2, J3, J4, J5, J6, J7	TERMINAL TURRET DBL .084	Keystone	1593-2
7	J8	CONN HEADER .100 DUAL R/A 72POS	Sullins Connector Solutions	PBC36DGAN
8	L1	FERRITE CHIP 600 OHM 1300MA 0603	muRata	BLM18KG601SN1D
9	R6	RES 0.0 OHM 1/10W JUMP 0603 SMD	Vishay-Dale	CRCW06030000Z0EA
10	R7, R8, R9	RES 330 OHM 1/10W 5% 0603 SMD	Vishay-Dale	CRCW0603330RJNEA
11	R10	RES 10.0K OHM 1/10W 1% 0603 SMD	Vishay-Dale	CRCW060310K0FKEA
12	R11	RES 2K OHM 1/10W 0.1% 0805	TE Connectivity	1614914-2
13	R12	RES 30.0K OHM 1/10W 0.1% 0805	TE Connectivity	9-1614884-3
14	Rsense	RES .050 OHM 0.5W 1% 1206 SMD	TT Electronics/IRC	LRC-LR1206LF-01-R050-F
15	SW1	TACTILE SWITCHES 3.9x2.9x2.0MM 160GF	Alps	SKRKAEE010
16	TP1, TP2, TP3, TP7, TP9	TEST POINT PC MULTI PURPOSE BLK	Keystone	5011
17	TP4, TP5	CONN HEADER 2POS .100	Samtec, Inc.	TSW-102-07-G-S
18	TP6	TEST POINT PC MULTI PURPOSE RED	Keystone	5010
19	TP8	CONN HEADER 5POS .100	Samtec, Inc.	TSW-105-07-G-S
20	U1	PRECISION LOW-SIDE DIGITAL CURRENT SENSOR AND VOLTAGE MONITOR	Texas Instruments	LMP92064

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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.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

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REGULATORY COMPLIANCE INFORMATION

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 this Product 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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http://www.tij.co.jp

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.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

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TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

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