LMP91051EVM User's Guide

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1. Introduction

The LMP91051 Design Kit (consisting of the LMP91051 Evaluation Module, the SPIO-4 Digital Controller Board, the Sensor AFE software, and this user's guide) is designed to ease evaluation and design-in of Texas Instrument's LMP91051 Configurable AFE for Nondispersive Infrared (NDIR).

Data capturing and evaluations are simplified by connecting the SPIO-4 Digital Controller Board (SPIO-4 board) to a PC via USB and running the Sensor AFE software. The data capture board will generate the SPI signals to communicate to and capture data from the LMP91051. The user will also have the option to evaluate the LMP91051 without using the SPIO-4 board or the Sensor AFE software.

The on board data converter will digitize the LMP91051's analog output, and the software will display these results in time domain and histogram. The software also allows customers to write to and read from registers, to configure the device's gain, output offset, and common mode voltage, and most importantly, to configure and learn about the LMP91051.

This document describes the connection between the boards and PC, and provides a quick start for voltage measurements. This document also describes how to evaluate the LMP91051 with and without the SPIO-4 board and provides the schematic, board layout, and BOM.

2. Setup

This section describes the jumpers and connectors on the EVM as well and how to properly connect, set up and use the LMP91051EVM.

2.1. Connection Diagram

Figure 1 shows the connection between the LMP91051 Evaluation Module (LMP91051EVM), SPIO-4 board, and a personal computer with the Sensor AFE software. LMP91051 can be powered using external power supplies or from the SPIO-4 board.

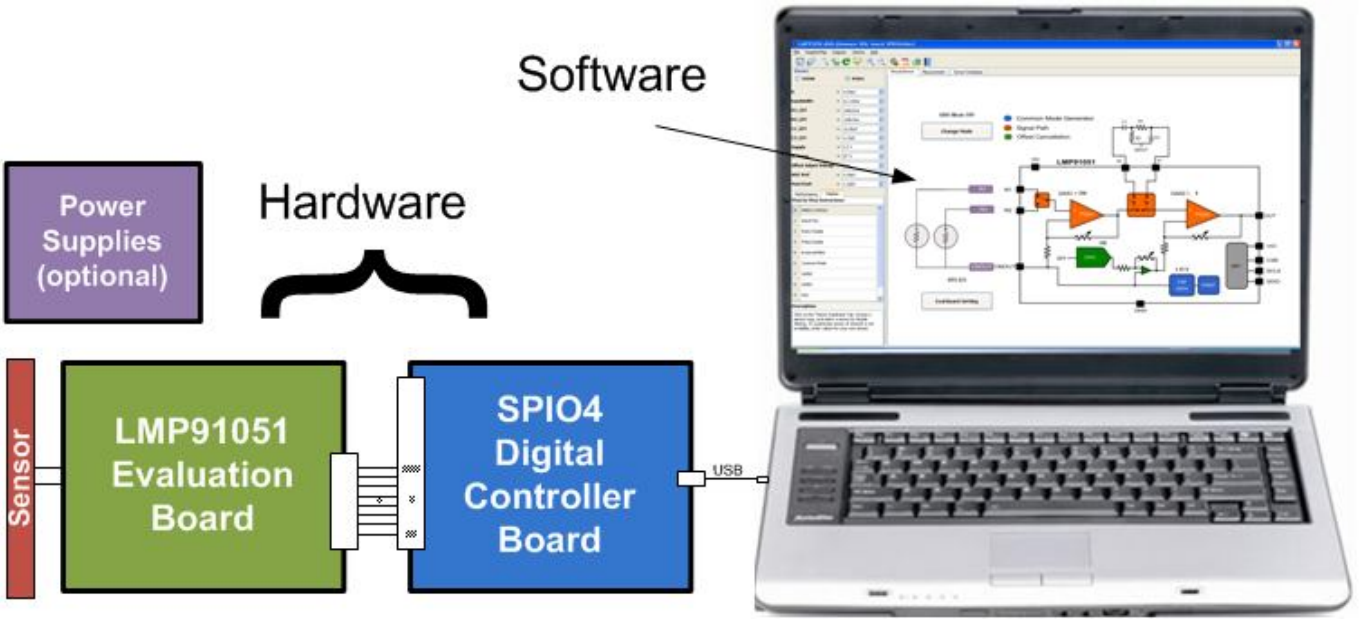

Figure 1: Connection Diagram

2.2. Jumper Connections

1. The jumpers for this example application can be seen in Figure 2 and Table 1.
2. The SPIO-4 board is properly setup out of the box (no assembly required).
3. The schematic for the LMP91051EVM can be seen in Figure 10.

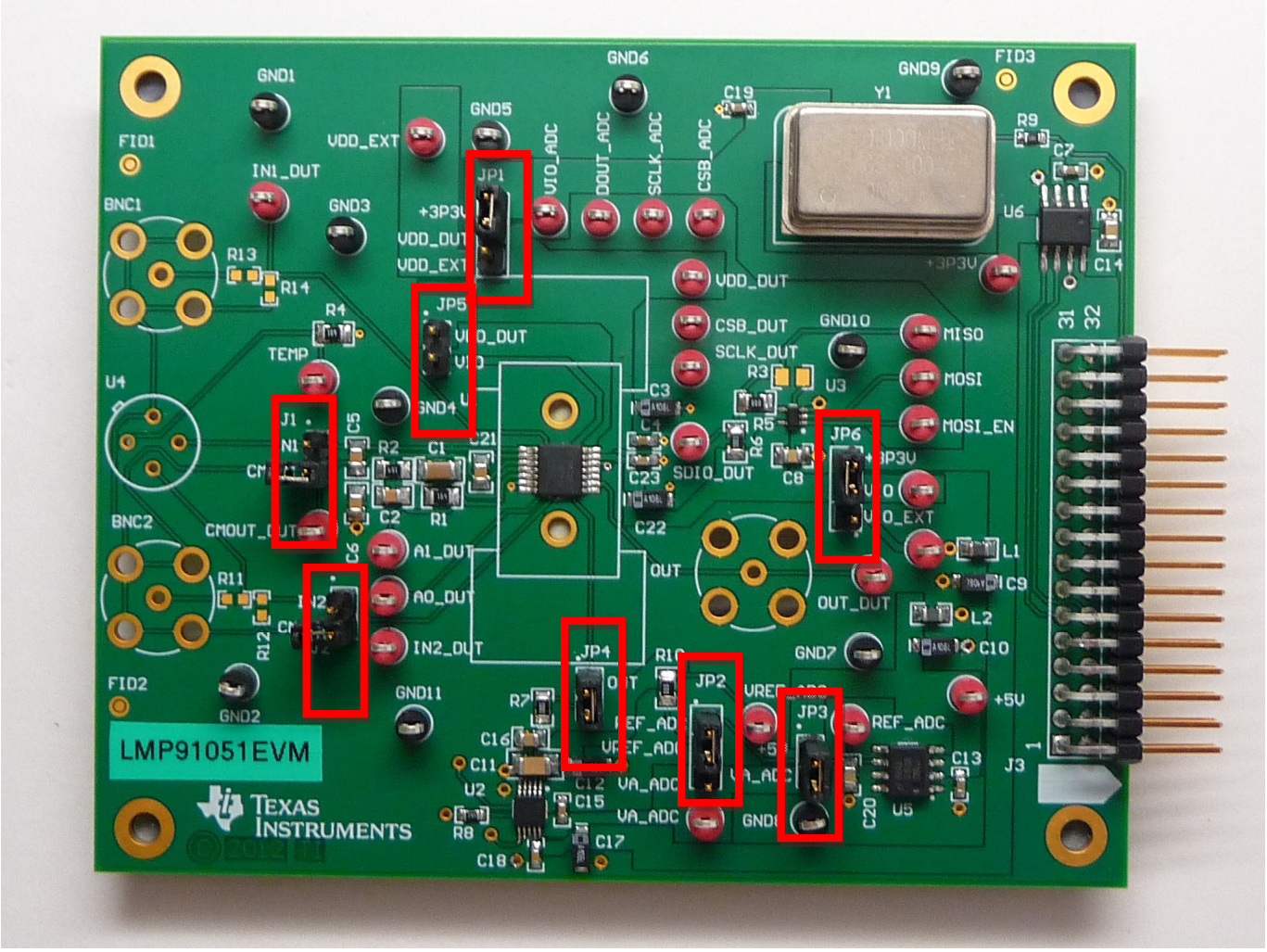

Figure 2: Jumper Setting (Default) for voltage reading

Table 1: Jumpers for Voltage Measurement

Jumpers	Pin	Purpose
JP1: VDD_DUT	P1-P2	Connect LMP91051 VDD to +3.3V from SPIO4
JP2: VREF_ADC	P1-P2	Connect ADC VREF to 4.1V from U5 (LM4140)
JP3: VA_ADC	P1-P2	Connect ADC VA to +5V from SPIO4
JP4: OUT_DUT to ADC	P1-P2	Connect LMP91051 OUT to ADC input RC filter
JP5: VDD to VIO	Open	Connect LMP91051 VDD to VIO
JP6: VIO	P2-P3	Connect LMP91051 VIO to +3.3V from SPIO4
J1: IN1 to CMOUT	Open	Connect LMP91051 IN1 to CMOUT. **Note: Board is provided with this jumper open. Use provided jumper to short IN to CMOUT for easy evaluation.**
J2: IN2 to CMOUT	Open	Connect LMP91051 IN2 to CMOUT. **Note: Board is provided with this jumper open. Use provided jumper to short IN to CMOUT for easy evaluation.**

2.3. Installing/Opening the Software

Follow Section 4 to install and open the Sensor AFE software.

2.4. Connecting and Powering the Boards

These Steps have to be done in this order.

1. Connect the LMP91051EVM's **J3** to SPIO-4 Board's **J6**. See Figure 3.
   .

Figure 3: LMP91051EVM to SPIO-4 Board Connection

2. Connect SPIO-4 board to a PC via **USB.**
3. Use a multimeter to measure LMP91051EVM's +5V test point; it should be approximately 5V. If it is not, check your power supplies and jumpers. Measure test point VREF_ADC; it should be approximately 4.1V. If it's not, check your jumpers and U5.

3. Operation

3.1. Sensor AFE Software Overview

Once connection between the boards and PC is established, you can use the software to communicate to and capture data from the LMP91051. Drag cursor over window icons to get an icon description. Some items of interest are shown in Figure 4.

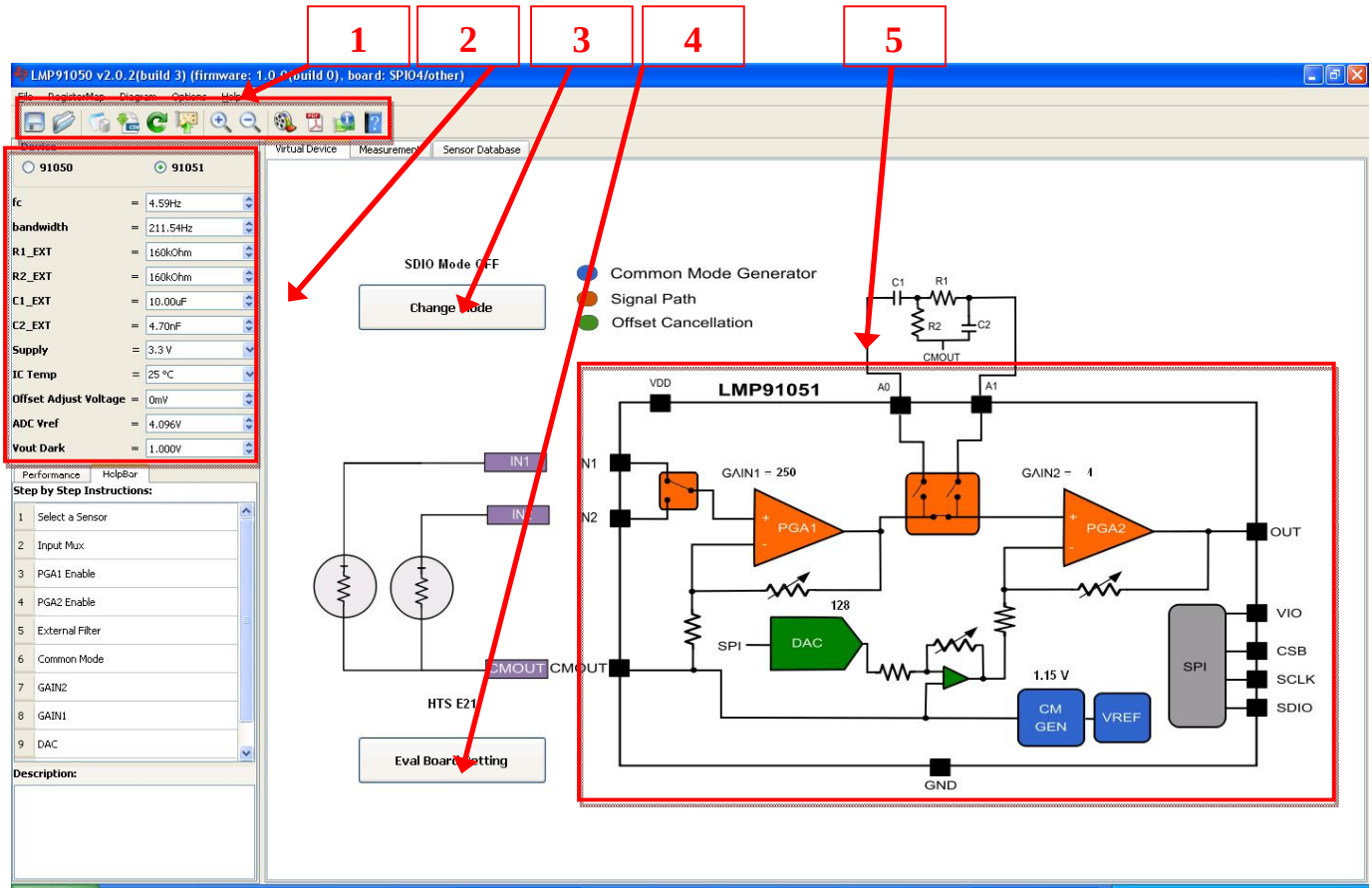

Figure 4: Sensor AFE Items of Interest

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1. Menu Bar Icons (from left to right)
    a. Save Configuration to File: Saves the current configuration settings (register settings) to an .xml file.
    b. Load Configuration File: Loads the selected configuration settings (register settings) .xml file.
    c. Register Map: Opens Register Map window. An alternative to the Virtual Device, for writing and reading the device registers. See datasheet for details on device Register Map.
    d. Save All Registers to File: Saves register contents to a .cvs file.
    e. Read All Register from Board: After configuring the register map, use this button to read all registers. Functional only in SDIO Mode (see Item 3).
    f. Write All Registers To Board: After configuring the register map use this button to write all registers. Registers will not be updated until this step is done.
    g. Zoom In/Out Diagram Image: Zoom in and out of the virtual device image.
    h. Show Tutorial: Takes you to the interactive Software Overview videos.

   i. Documentation: Accesses the LMP91051 Datasheet, SPIO4 User's Guide, or Evaluation Board User's Guide.
2. Device Selection and User Inputs
   a. LMP91050/1 : Toggle between LMP91050 and LMP91051 device.
   b. fc: Center frequency of external bandpass filter.
   c. bandwidth: Pass band bandwidth of external bandpass filter.
   d. R1_EXT, R2_EXT, C1_EXT, C2_EXT: External bandpass filter component values calculated based on user input for center frequency (fc) and pass band (bandwidth) described above.
   e. Supply: LMP91051 supply voltage (VDD).
   f. IC Temp: LMP91051 operating temperature
   g. Offset Adjust Voltage: The tool will calculate the DAC code (decimal) required to achieve this output offset adjust voltage. User must then **Write** to the register to update the value in the NDAC register.
   h. ADC Vref: ADC reference voltage. User should input value measured at VREF_ADC test point. Value used to calculate displayed Output Voltage.
   i. Vout Dark: This value corresponds to the user measured value at the LMP91051 output (OUT) when input is shorted (IN = CMOUT). Tool will use this value to estimate LMP91051 input voltage (IN - CMOUT) on subsequent measurements.
3. Change Mode: Change between device Read Mode OFF (default) and ON. See datasheet for details on SPI Read Mode.
4. Eval Board Setting: Document to show user how to configure jumpers and connect thermopile based on sensor selected.
5. Virtual Device: Drag cursor across color coded blocks and click to configure each block. To update registers **"Write All Registers"** when done.

3.2. Configuring the LMP91051 Using the Sensor AFE Software

Follow the step-by-step instructions under the **"HelpBar"** mini-tab (left hand side of the GUI) to configure the LMP91051 for this example. These step-by-step instructions are discussed in details below, and the recommended configuration should look similar to Figure 5.

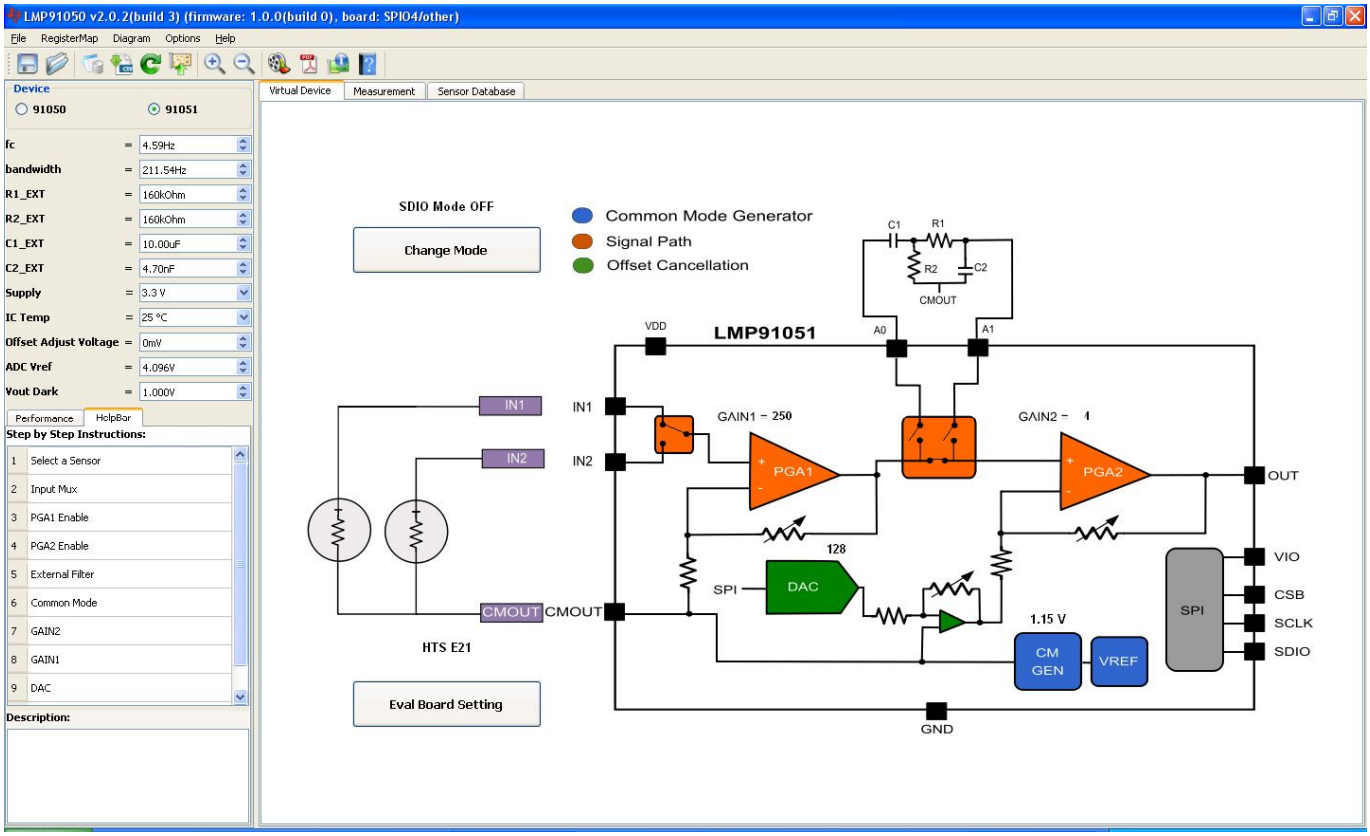

Figure 5: Recommended LMP91051 Configuration for a voltage Reading

1. Step 1: Select a Sensor – Sensor Database window opens. See Figure 6. Step 1: Click sensor type (Thermopile) and the sensors will show in the bottom table. Step 2: Click sensor and then click **"Select"** button on the left to use this sensor.

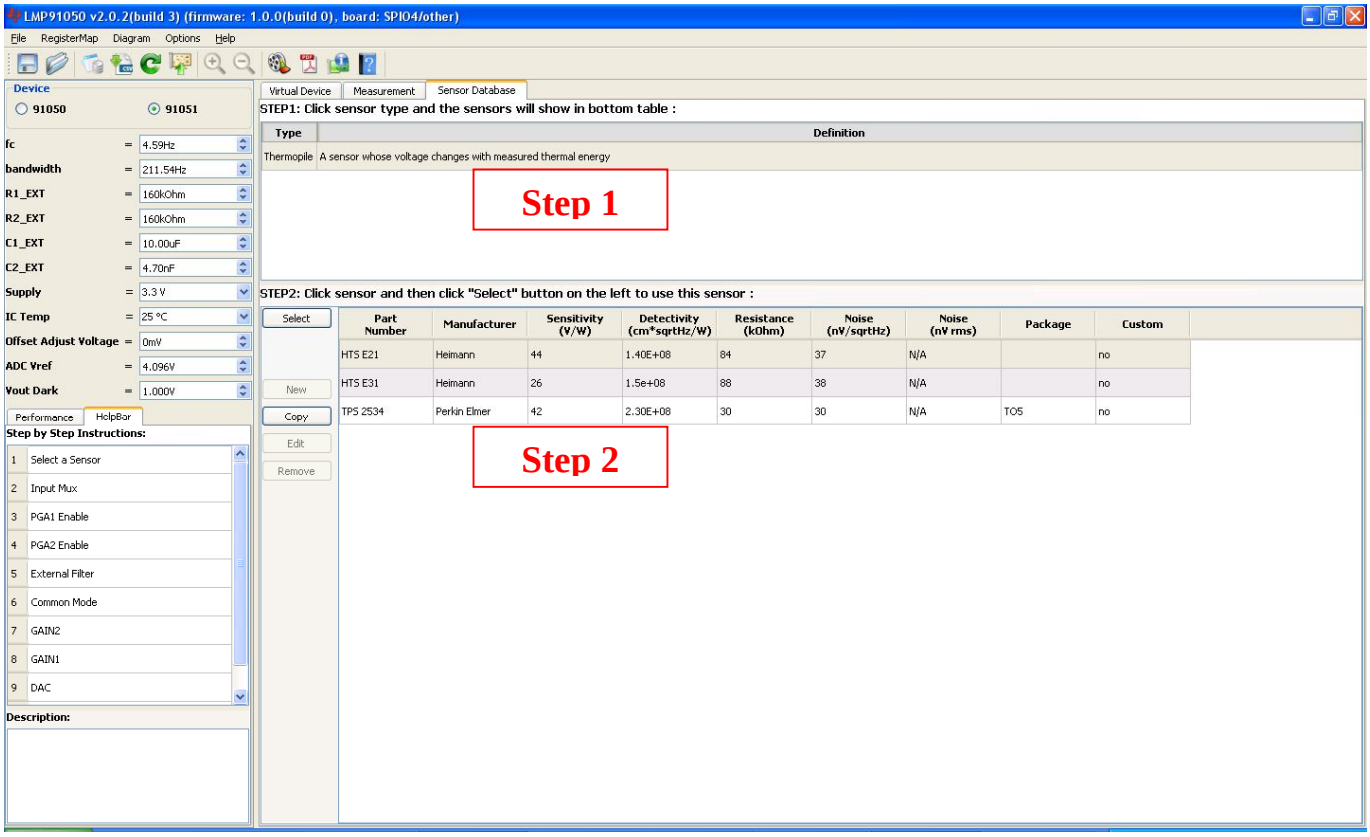

Figure 6: Sensor Database Window

2. Step 2: Input Mux – click on the mux block to set **"1: IN1"** (default).
3. Step 3: PGA1 Enable – click on the **"PGA1"** block to set "**1: PGA1 ON"** . Remember after configuring the register map to use the **Write All Registers** button to update the registers.

4. Step 4: PGA2 Enable – click on the **"PGA2"** block to set "**1: PGA2 ON"** . Note: By default PGA1 and PGA2 are OFF on power up. However the software was designed to automatically power ON PGA1 and PGA2 for ease of use.

5. Step 5: External Filter – click on the switch block to choose **"0: PGA1 to PGA2 direct"** (default).

6. Step 6: Common Mode – click on the "**CM GEN"** block to set **"0: 1.15V"** (default).

7. Step 7: GAIN 2 – click on the "**PGA2"** block to set **"00: 4"** (default).

8. Step 8: GAIN 1 – click on the "**PGA1"** block to set **"0: 250"** (default).

9. Step 8: DAC (Output Offset) – click on the "**DAC"** block to set **"128"** (default) for 0 mV offset. Alternatively, user can also use the Offset Adjust Voltage user input field to input 0 mV.

10. Step 10: Performance - click on the **"Performance"** mini-tab. This tab displays the Estimated Device Performance based on device configuration and user input device Supply and IC Temp .This tab also displays the Measured System Performance if you've connected a board and ran the LMP91051.

3.3. Capturing Data

1. Click on the **"Measurement"** tab.
2. Under the **"Output Format"** field, select Display as "**Output Voltage (V)"**
3. Under the **"Stop Condition"** field, select Run as **"1"** Seconds. Alternatively, select **"Run Continuously"** radio button to run continuously up to 1 hour.
4. Click on the **"Run"** button to view the output voltage results. A reading should be plotted as seen in Figure . Output voltage will vary depending on input voltage across input (IN1/IN2) and CMOUT. If J1/J2 are shorted, IN1/IN2 = CMOUT, output voltage should be about 1V. **Note: Board is provided with jumper J1/J2 open. Use provided jumper to short IN1/IN2 to CMOUT for easy evaluation.**

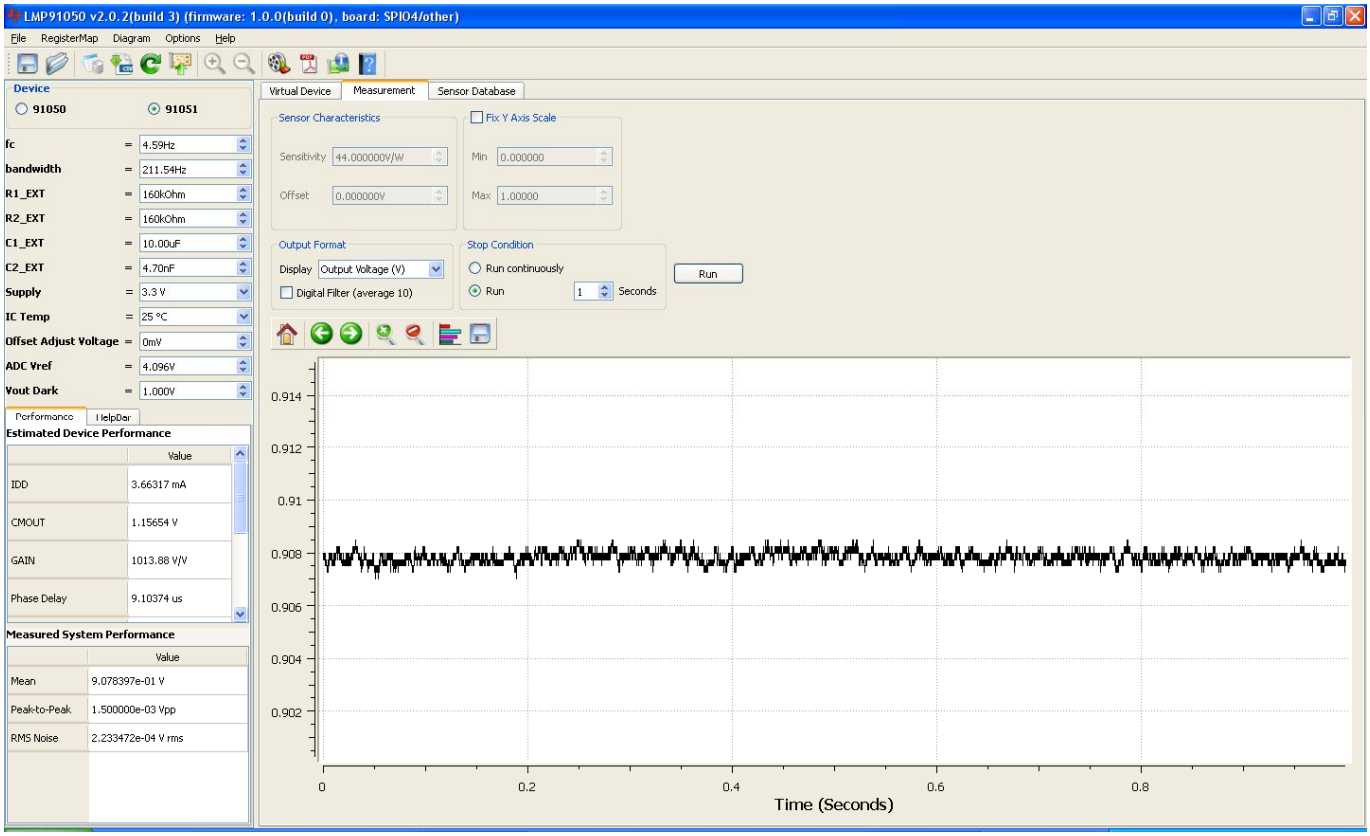

Figure 7: Results of DC Reading

3.4. Powering the LMP91051EVM

There are two ways in which VDD can be sourced: external supply or SPIO-4 power.

If using an external power supply to source VDD, do the following:
1. Connect an external power supply to banana jacks VDD-EXT and GND.
2. Jumper pins 2 and 3 of JP1 to connect the external power to VDD_DUT.

If using the SPIO-4 power to source VDD, then do the following:
1. Jumper pins 1 and 2 of JP1 to connect +3.3V SPIO-4 power to VDD_DUT.

The schematic for the LMP91051EVM can be seen in Figure 10.

3.5. Evaluating the LMP91051 without the SPIO-4 Board

The SPIO-4 digital controller board is used to generate the SPI signals to communicate to the LMP91051. Without the SPIO-4 board, the Sensor AFE software for the LMP91051 cannot be used to capture and analyze data from the LMP91051EVM.

If the SPIO-4 board is not available but LMP91051 evaluation is desirable, then connect your own SPI signals to J1 of the LMP91051EVM as seen below. Reference the LMP91051 datasheet for appropriate SPI timing diagrams. Source LMP91051 VDD with an external power supply per previous section.

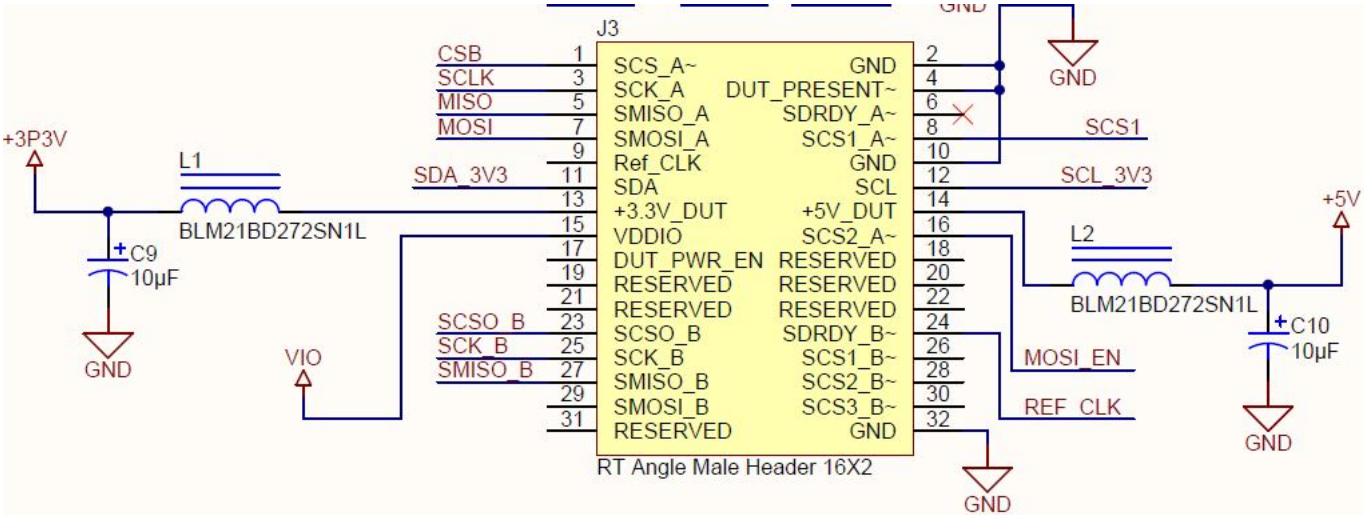

Figure 8: LMP91051EVM's J3 for SPI Signals

Refer to the LMP91051 datasheet for more information on the LMP91051's SPI protocol.

4. Installing the Sensor AFE Software

Each Sensor AFE product will have its own software. To access the Sensor AFE software for LMP91051, follow the steps below.

1. **Getting the Zip Files**
   - **a.** You can find the latest downloadable Sensor AFE software at ti.com/sensorafe
   - **b.** Download the zip file onto your local hard drive. Unzip this folder.

2. **Installing the Driver -** skip this step if you don't have the LMP91051EVM and SPIO4 digital controller board.
   - **a.** See the provided **Installation Guide For SensorAFE Drivers.pdf**.

3. **Installing the Software**
   a. See the provided **Installation Guide for LMP91050 SensorAFE Software.pdf**
      i. Note: If you run the software without the boards, you'll get an error message. Ignore that error message and click "Ok" to continue.

5. Board Layout

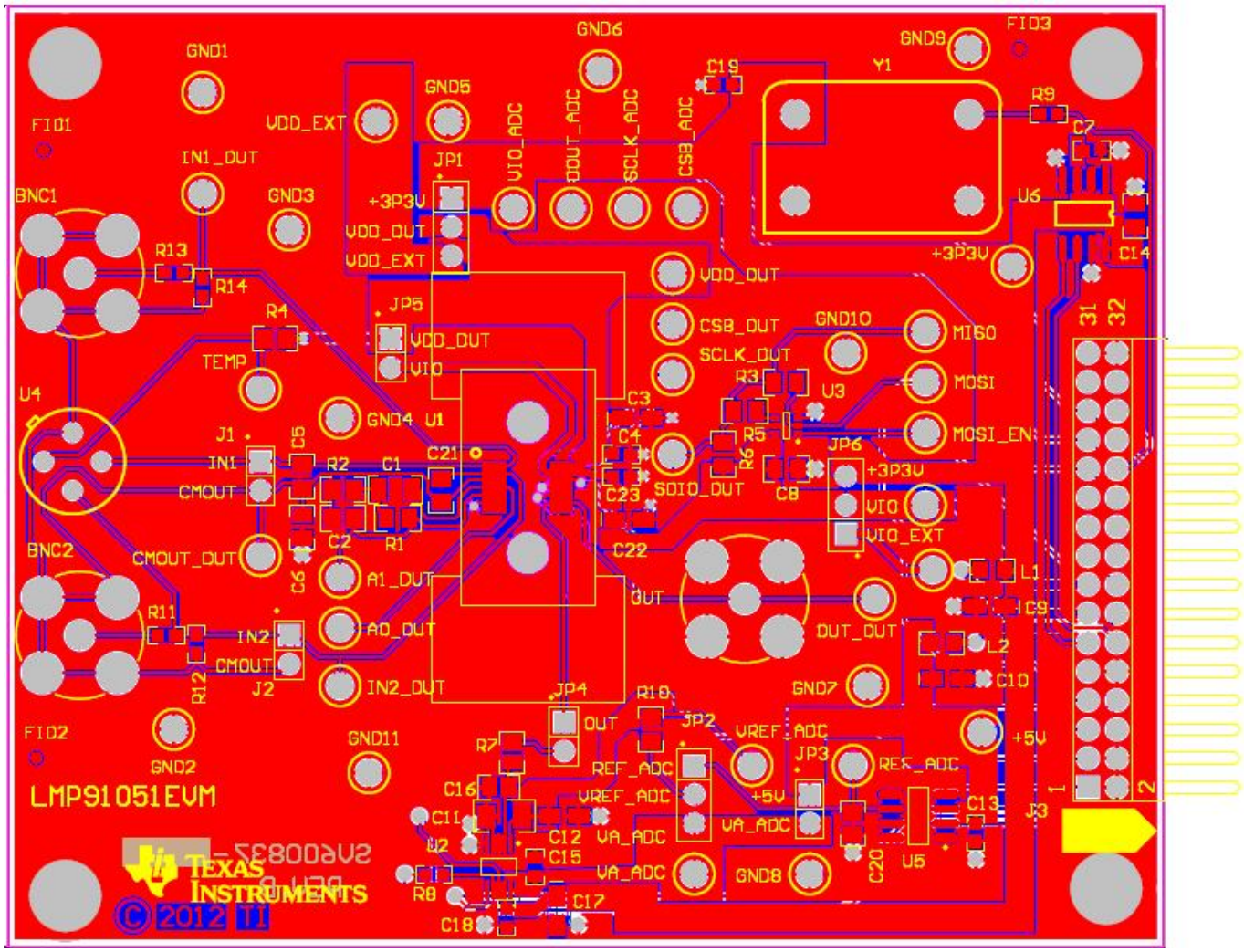

Figure 9: LMP91051EVM Layout

6. Schematic

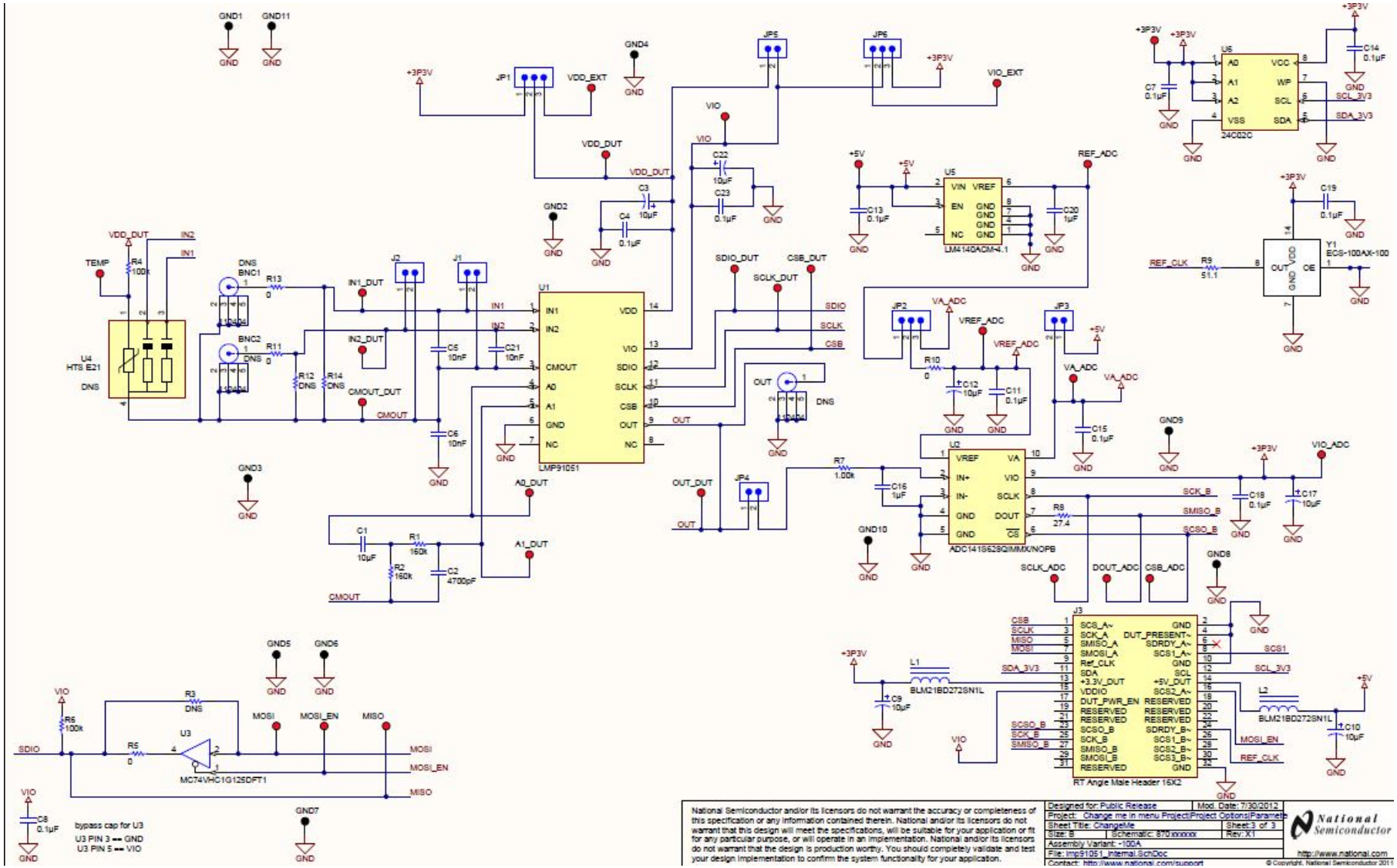

Figure 10: LMP91051EVM Schematic

7. BOM

LMP91051EVM Bill of Materials

Item	Designator	Description	Manufacturer	PartNumber	Quantity
1	+3P3V, +5V, A0_DUT, A1_DUT, CMOUT_DUT, CSB_ADC, CSB_DUT, DOUT_ADC, IN1_DUT, IN2_DUT, MISO, MOSI, MOSI_EN, OUT_DUT, REF_ADC, SCLK_ADC, SCLK_DUT, SDIO_DUT, TEMP, VA_ADC, VDD_DUT, VDD_EXT, VIO, VIO_ADC, VIO_EXT, VREF_ADC	Test Point, TH, Compact, Red	Keystone Electronics	5005	26
2	AA1	Printed Circuit Board	TBD by TI	551xxxxxx-001 REV A	1
3	BNC1, BNC2, OUT	DNS	Amphenol Connex	112404	3
4	C1	CAP, CERM, 10uF, 6.3V, +/- 20%, X5R, 1206	TDK	C3216X5R0J106M	1
5	C2	CAP CER 4700PF 250V X7R 10% 0805	TDK	C2012X7R2E472K	1
6	C3, C9, C10, C12, C17, C22	CAP, TANT, 10uF, 10V, +/- 20%, 3.4 ohm, 3216-18 SMD	Vishay-Sprague	293D106X0010A2TE3	6
7	C4, C7, C13, C15, C18, C19, C23	CAP, CERM, 0.1uF, 16V, +/- 5%, X7R, 0603	AVX	0603YC104JAT2A	7
8	C5, C6, C21	CAP, CERM, 10nF, 50V, +/-5%, C0G/NP0, 0805	MuRata	GRM2195C1H103JA01D	3
9	C8, C14	CAP, CERM, 0.1uF, 25V, +/- 10%, X7R, 0805	AVX	08053C104KAT2A	2
10	C11	CAP, CERM, 0.1uF, 100V, +/- 5%, X7R, 1206	AVX	12061C104JAT2A	1
11	C16, C20	CAP, CERM, 1uF, 10V, +/-10%, X7R, 0805	AVX	0805ZC105KAT2A	2
12	FID1, FID2, FID3	Fiducial mark. There is nothing to buy or mount.	N/A	N/A	3
13	GND1, GND2, GND3, GND4, GND5, GND6, GND7, GND8, GND9, GND10, GND11	Test Point, TH, Compact, Black	Keystone Electronics	5006	11
14	H1, H2, H3, H4	Bump Hemisphere	B&F Fastener Supply	NY PMS 440 0025 PH	4
15	J1, J2, JP3, JP4, JP5	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec Inc.	TSW-102-07-G-S	5
16	J3	SPIO-GPSI16 Header, 16-Pin, Dual row, Right Angle	Sullins Connector Solutions	PBC36DGAN	1
17	JP1, JP2, JP6	Header, TH, 100mil, 1x3, Gold plated, 230 mil above insulator	Samtec Inc.	TSW-103-07-G-S	3
18	L1, L2	Ferrite, Chip, 200mA, .080 ohm, SMD	Wurth Elektronik eiSos	BLM21BD272SN1L	2
19	R1, R2	RES, 160k ohm, 5%, 0.125W, 0805	Vishay-Dale	CRCW0805160KJNEA	2
20	R3	DNS	Vishay-Dale	DNS	1
21	R4	RES, 100k ohm, 5%, 0.125W, 0805	Vishay-Dale	CRCW0805100KJNEA	1
22	R5, R10	RES, 0 ohm, 5%, 0.125W, 0805	Vishay-Dale	CRCW08050000Z0EA	2

23	R6	RES, 100k ohm, 1%, 0.125W, 0805	Vishay-Dale	CRCW0805100KFKEA	1
24	R7	RES, 1.00k ohm, 1%, 0.125W, 0805	Vishay-Dale	CRCW08051K00FKEA	1
25	R8	RES, 27.4 ohm, 1%, 0.1W, 0603	Vishay-Dale	CRCW060327R4FKEA	1
26	R9	**RES, 51.1 ohm, 1%, 0.1W, 0603**	Vishay-Dale	CRCW060351R1FKEA	1
27	R11, R12, R13, R14	DNS	Vishay-Dale	CRCW06031R00JNEA	4
28	U1	LMP91051	Texas Instruments	LMP91051	1
29	U2	16-Bit, 50 to 250 kSPS, Differential Input, MicroPower ADC, 10-pin Mini SOIC, Pb-Free	Texas Instruments	ADC141S628QIMMX/NOPB	1
30	U3	Non-Inverting 3-State Buffer	Texas Instruments	SN74AHC1G125DCKR	1
31	U4	DNS	Heimann	HMS J21	1
32	U5	Precision Micropower Low Dropout Voltage Reference, 8-pin Narrow SOIC	Texas Instruments	LM4140ACM-4.1	1
33	U6	2K 5.0V I2C Serial EEPROM	On Semiconductor	CAT24C02WI-GT3	1
34	Y1	Osc 4.000Mhz 5.0V Full Size	ECS Inc	ECS-100AX-100	1
35	Y1A	Oscllator Socket	Aires Electronics	A462-ND	1

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions: The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

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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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
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EVALUATION BOARD/KIT/MODULE (EVM)
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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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