INA209 Evaluation Module

This user's guide describes the characteristics, operation, and use of the INA209 evaluation module (EVM). It discusses the processes and procedures required to properly use this EVM board. This document also includes the physical printed circuit board (PCB) layout, schematic diagram, and circuit descriptions.

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1 Overview

This document provides the information needed to set up and operate the INA209EVM evaluation module, a test platform for the INA209 high-side current shunt monitor. For a more detailed description of the INA209 product line, please refer to the product data sheet (SBOS403) available from the Texas Instruments web site at http://www.ti.com. Support documents are listed in the section of this guide entitled *Related Documentation from Texas Instruments* .

The INA209EVM is an evaluation module that is used to fully evaluate the INA209 current shunt monitor. The INA209 is a mixed-signal current shunt monitor. The INA209EVM consists of two PCBs. One board generates the digital signals (USB DIG Platform) required to communicate with the INA209 (INA209_Test_Board), and the second board contains the INA209, as well as support and configuration circuitry.

NOTE: Much of the information contained in this document is also contained in the QuickStart Video, which is included with the EVM kit. It is highly recommended that you watch this video before using this EVM.

Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the INA209EVM.

1.1 INA209EVM Hardware

Figure 1 shows the hardware included with the INA209EVM kit. Contact the factory if any component is missing. It is highly recommended that you check the TI web sit at http://www.ti.com to verify that you have the latest software. It is also recommended that you watch the QuickStart Video (included on the compact disk) before using the INA209EVM.

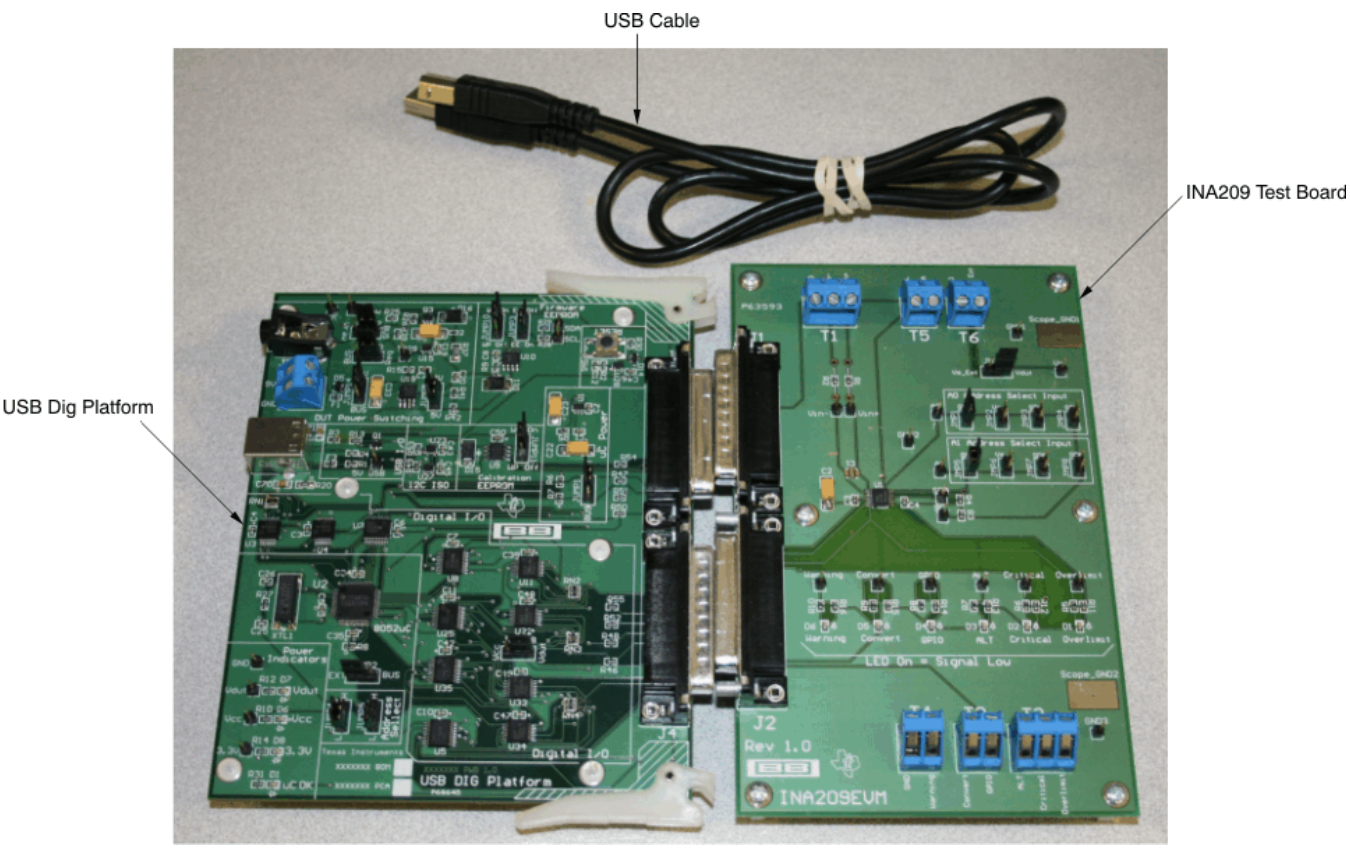

Figure 1. Hardware Included With the INA209EVM

The complete kit includes the following items:

- INA209 test PCB
- USB Dig platform PCB
- USB cable
- QuickStart Video

1.2 Related Documentation from Texas Instruments

The following document provides information regarding Texas Instruments integrated circuits used in the assembly of the INA209EVM. This document is available from the TI web site under literature number SBOU055. Any letter appended to the literature number corresponds to the document revision that is current at the time of the writing of this User's Guide. Newer revisions may be available from the TI web site at http://www.ti.com/, or call the Texas Instruments Literature Response Center at (800) 477-8924 or the Product Information Center at (972) 644-5580. When ordering, identify the document by both title and literature number.

Data Sheet	Literature Number
INA209 Product Data Sheet	SBOS403

1.3 If You Need Assistance

If you have questions about the INA209 evaluation module, send an e-mail to the Linear Application Team at precisionamps@list.ti.com. Include *INA209EVM* as the subject heading.

1.4 Information About Cautions and Warnings

This document contains caution statements.

CAUTION

This is an example of a caution statement. A caution statement describes a situation that could potentially damage your software or equipment.

The information in a caution or a warning is provided for your protection. Please read each caution and warning carefully.

1.5 FCC Warning

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense is required to take whatever measures may be required to correct this interference.

2 System Setup

Figure 2 shows the system setup for the INA209EVM. The PC runs software that communicates with the USB Dig platform. The USB Dig platform generates the digital signals used to communicate with the INA209 test board. Connectors on the INA209 test board allow for connection to the system that will be monitored by the user.

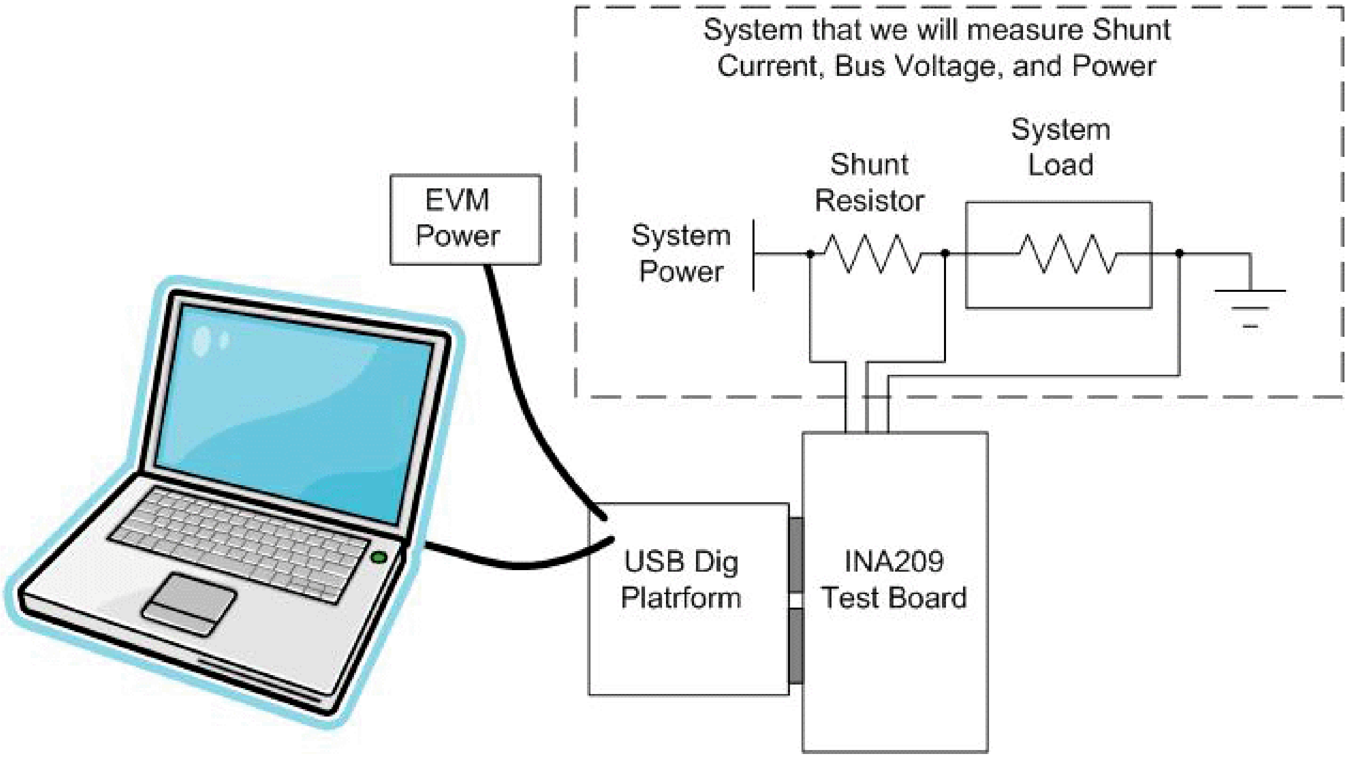

Figure 2. Hardware Setup for the INA209EVM

Minimim PC operating requirements:

- Microsoft Windows® XP or higher
- USB port
- Works on US or European regional settings

2.1 Theory of Operation for the INA209 Test Board Hardware

Figure 3 shows the block diagram of the INA209 test board. The INA209 test board functionality is relatively simple. It provides connections to the I²C™ interface and general-purpose inputs/outputs (GPIOs) on the USB Dig platform. It also provides connection points for external connection of the shunt voltage, bus voltage, and GND on the system being measured.

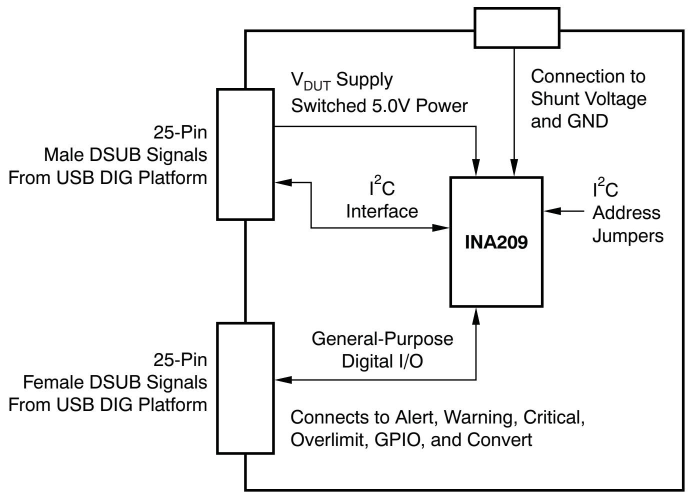

Figure 3. Block Diagram of the INA209 Test Board

Figure 4 illustrates the system setup for the INA209 test board schematic. LEDs D1 through D6 are used as indicators for many of the digital signals (for example, Warning, Critical, GPIO, etc). Jumpers JMP1 through JMP8 allow the configuration of A0 and A1. Connector T1 allows the connection of shunt and bus voltages.

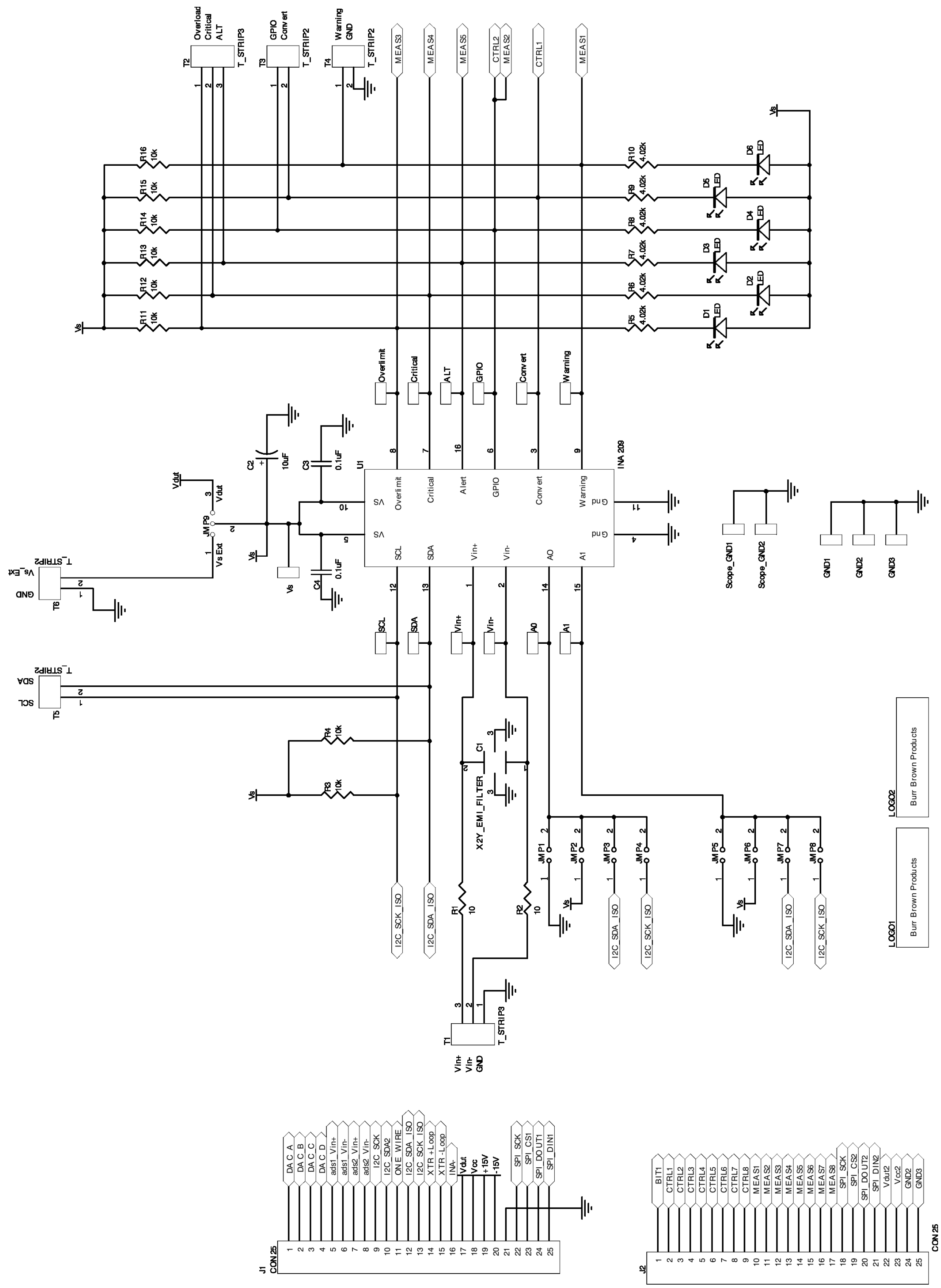

Figure 4. INA209 Test Board Schematic

2.2 Signal Definition of J1 (25-Pin Male DSUB) on the INA209 Test Board

Table 1 shows the different signals connected to J1 on the INA209 test board. Table 1 also identifies signals connected to pins on J1 that are not used on the INA209 test board.

Table 1. Signal Definition of J1 (25-Pin Male DSUB) on the INA209 Test Board

J1 Pin	Signal	Used On This EVM?	INA209 Pin
1	DAC A	No	—
2	DAC B	No	—
3	DAC C	No	—
4	DAC D	No	—
5	ADS1+	No	—
6	ADS1–	No	—
7	ADS2+	No	—
8	ADS2–	No	—
9	I2C_SCK	No	—
10	I2C_SDA2	No	—
11	ONE_WIRE	No	—
12	I2C_SCK_ISO	Yes	SCL
13	I2C_SDA_ISO	Yes	SDA
14	XTR_LOOP+	No	—
15	XTR_LOOP–	No	—
16	INA–	No	—
17	V_{DUT}	Yes	V_S
18	V_{CC}	No	—
19	+15V	No	—
20	–15V	No	—
21	GND	Yes	GND
22	SPI_SCK	No	—
23	SPI_CS1	No	—
24	SPI_DOUT	No	—
25	SPI_DIN1	No	—

2.3 Signal Definition of J2 (25-Pin Female DSUB) on the INA209 Test Board

Table 2 shows the different signals connected to J2 on the INA209 test board. Table 2 also identifies signals connected to pins on J2 that are not used on the INA209 test board.

Table 2. Signal Definition of J2 (25-Pin Female DSUB) on the INA209 Test Board

J1 Pin	Signal	Used On This EVM?	INA209 Pin
1	NC	No	—
2	CTRL1	Yes	Convert
3	CTRL2	Yes	GPIO
4	CTRL3	No	—
5	CTRL4	No	—
6	CTRL5	No	—
7	CTRL6	No	—
8	CTRL7	No	—
9	CTRL8	No	—
10	MEAS1	Yes	Warning
11	MEAS2	Yes	GPIO
12	MEAS3	Yes	Overlimit
13	MEAS4	Yes	Critical
14	MEAS5	Yes	ALT
15	MEAS6	No	—
16	MEAS7	No	—
17	MEAS8	No	—
18	SPI_SCK	No	—
19	SPI_CS2	No	—
20	SPI_DOUT2	No	—
21	SPI_DIN2	No	—
22	V_{DUT}	No	V_S
23	V_{CC}	No	—
24	GND	Yes	GND
25	GND	Yes	GND

2.4 Theory of Operation For the USB Dig Platform

Figure 5 shows the block diagram for the USB Dig platform. This platform is a general-purpose data acquisition system that is used on several different Texas Instruments evaluation modules. The block diagram shown in Figure 5 illustrates the general platform outline.

The core component of the USB Dig platform is the TUSB3210.

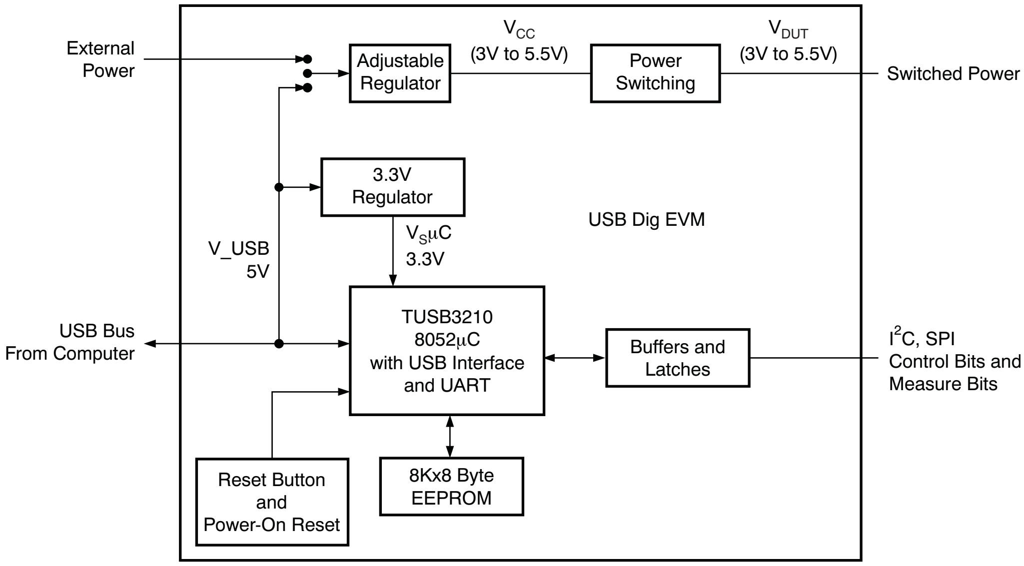

Figure 5. Theory of Operation For the USB Dig Platform

3 INA209EVM Hardware Setup

The INA209EVM hardware setup involves connecting the two halves of the EVM together, applying power, connecting the USB cable, and setting the jumpers. This section covers the details of this procedure.

3.1 Electrostatic Discharge Warning

Many of the components on the INA209EVM are susceptible to damage by electrostatic discharge (ESD). Customers are advised to observe proper ESD handling precautions when unpacking and handling the EVM, including the use of a grounded wrist strap at an approved ESD workstation.

CAUTION

Failure to observe ESD handling procedures may result in damage to EVM components.

3.2 Typical Hardware Connections

A typical INA209EVM hardware setup connects the two EVM PCBs, then supplying power, and connecting an external shunt and load. The external connections may be the real-world system to which the INA209 will be connected. Figure 6 shows the typical hardware connections.

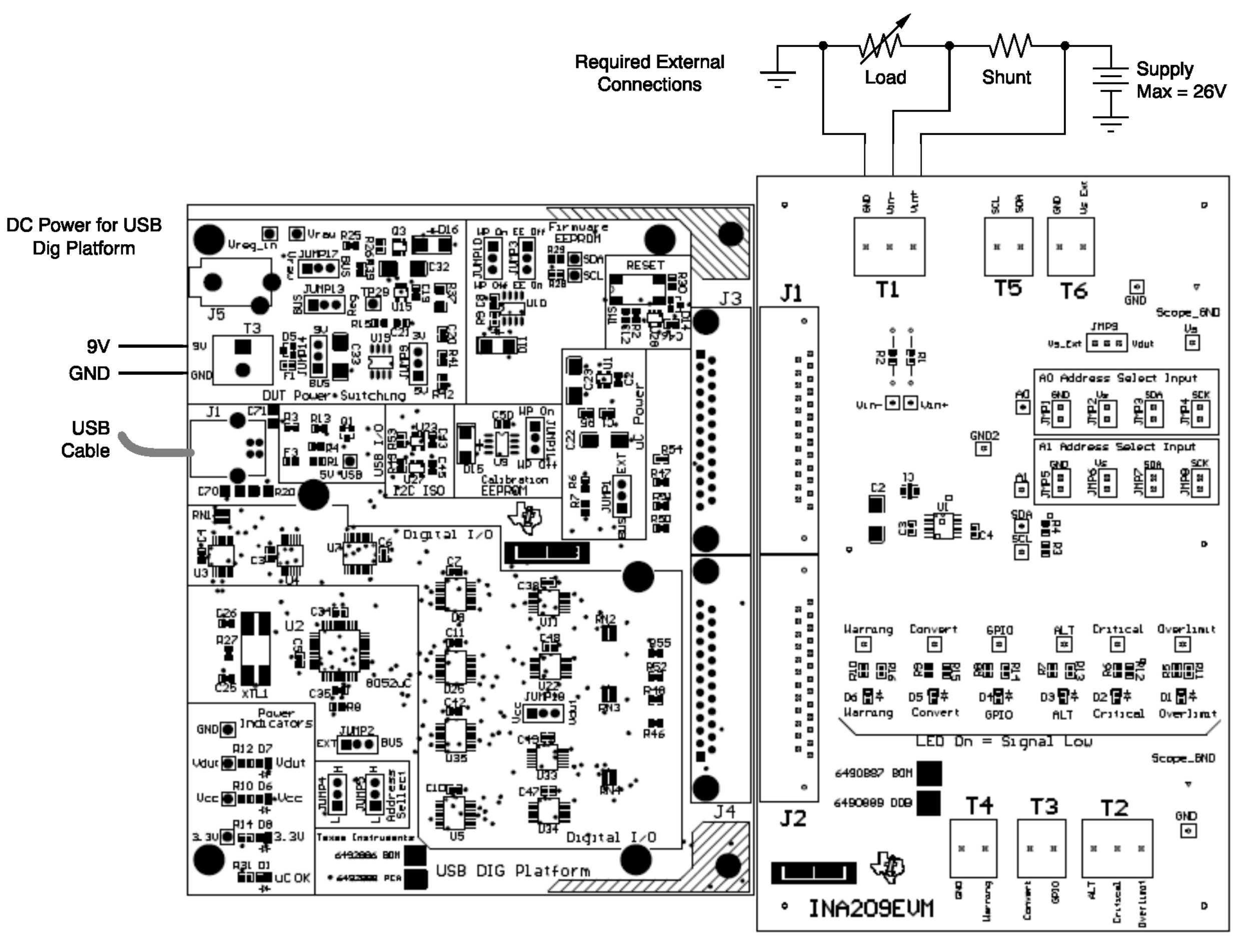

Figure 6. Typical Hardware Connections

3.3 Connecting the Hardware

The best way to connect the two INA209EVM PCBs together is to gently push on both sides of the D-SUB connectors, as shown in Figure 7. Make sure that the two connectors are completely socketed together; loose connections may cause intermittent EVM operation.

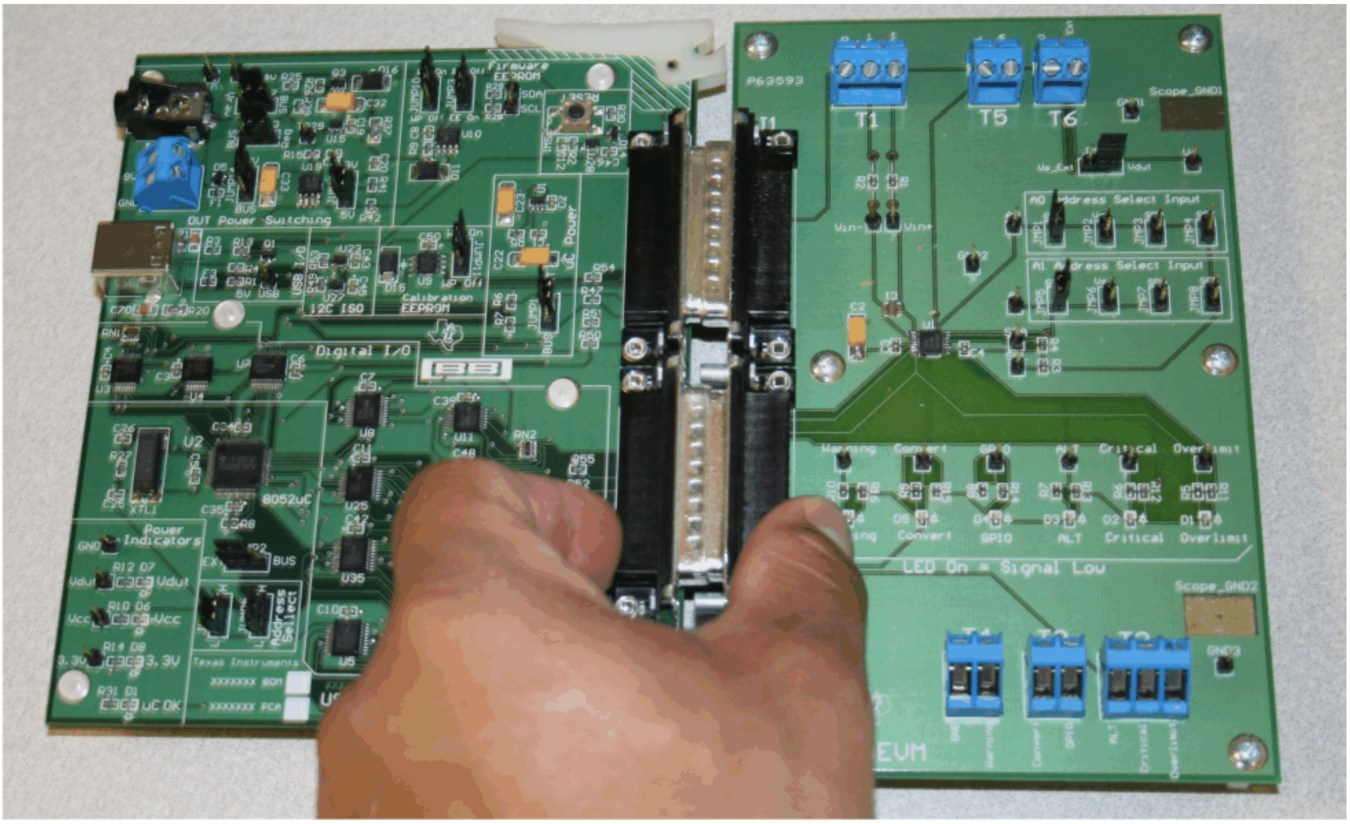

Figure 7. Connecting the Two EVM PCBs

3.4 Connecting Power

Connect the two INA209EVM PCBs prior to connecting a power source, as shown in Figure 8. ***Always connect power before connecting the USB cable.*** If the USB cable is connected before the power is supplied, the computer will attempt to communicate with an unpowered device, and the device will not be able to respond.

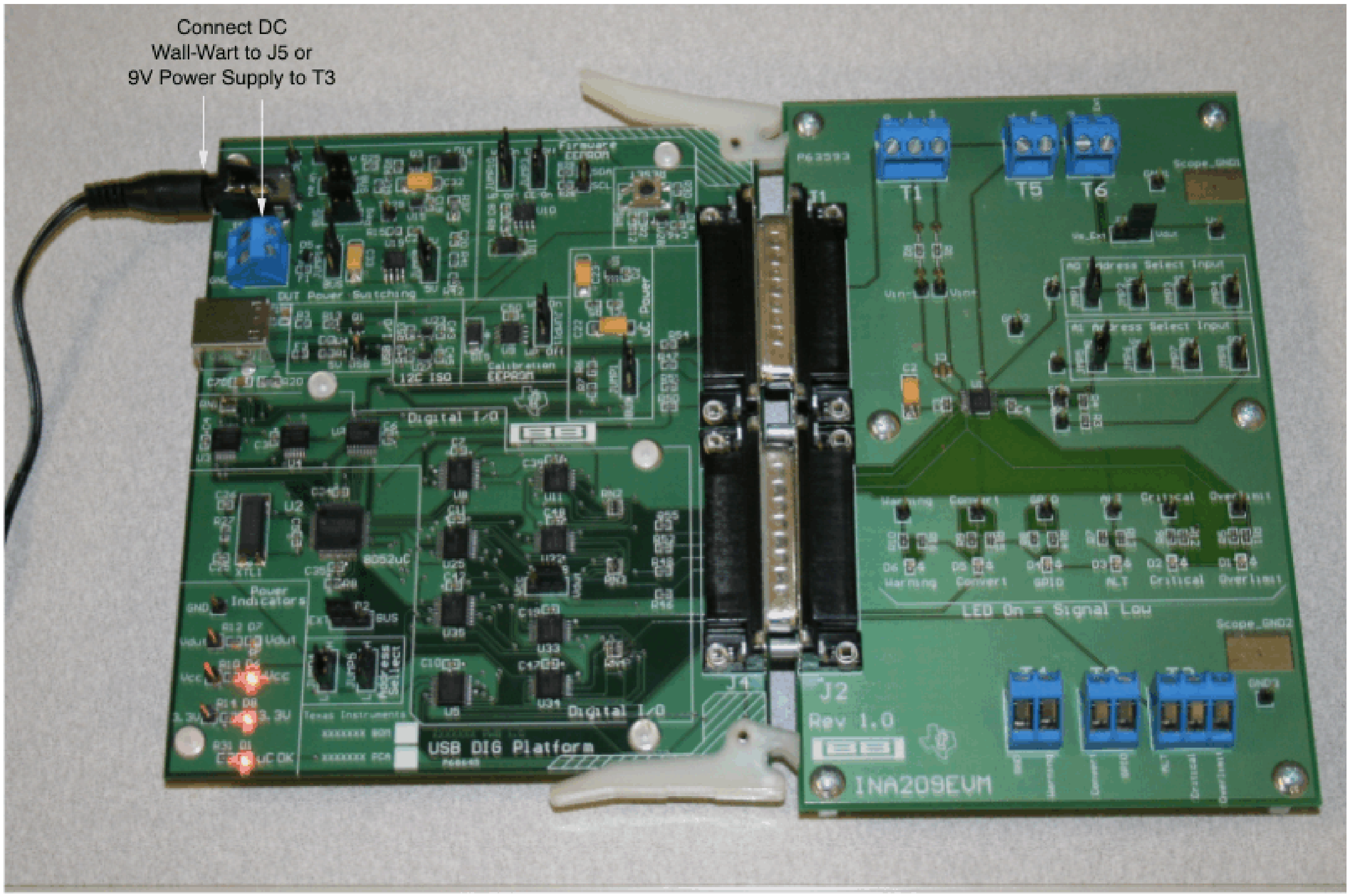

Figure 8. Connecting Power to the EVM

3.5 Connecting the USB Cable to the INA209EVM

Figure 9 shows the typical response to connecting the USB Dig platform to a PC USB port for the first time. Note that the EVM must be powered prior to connecting the USB cable. Typically, the computer will respond with a *Found New Hardware, USB Device* pop-up. The pop-up typically changes to *Found New Hardware, USB Human Interface Device*. This pop-up indicates that the device is ready to be used. The USB Dig platform uses the *Human Interface Device Drivers* that are part of the Microsoft Windows operating system.

In some cases, the Windows *Add Hardware Wizard* will pop-up. If this prompt occurs, allow the system device manager to install the *Human Interface Drivers* by clicking ***Yes*** when requested to install drivers.

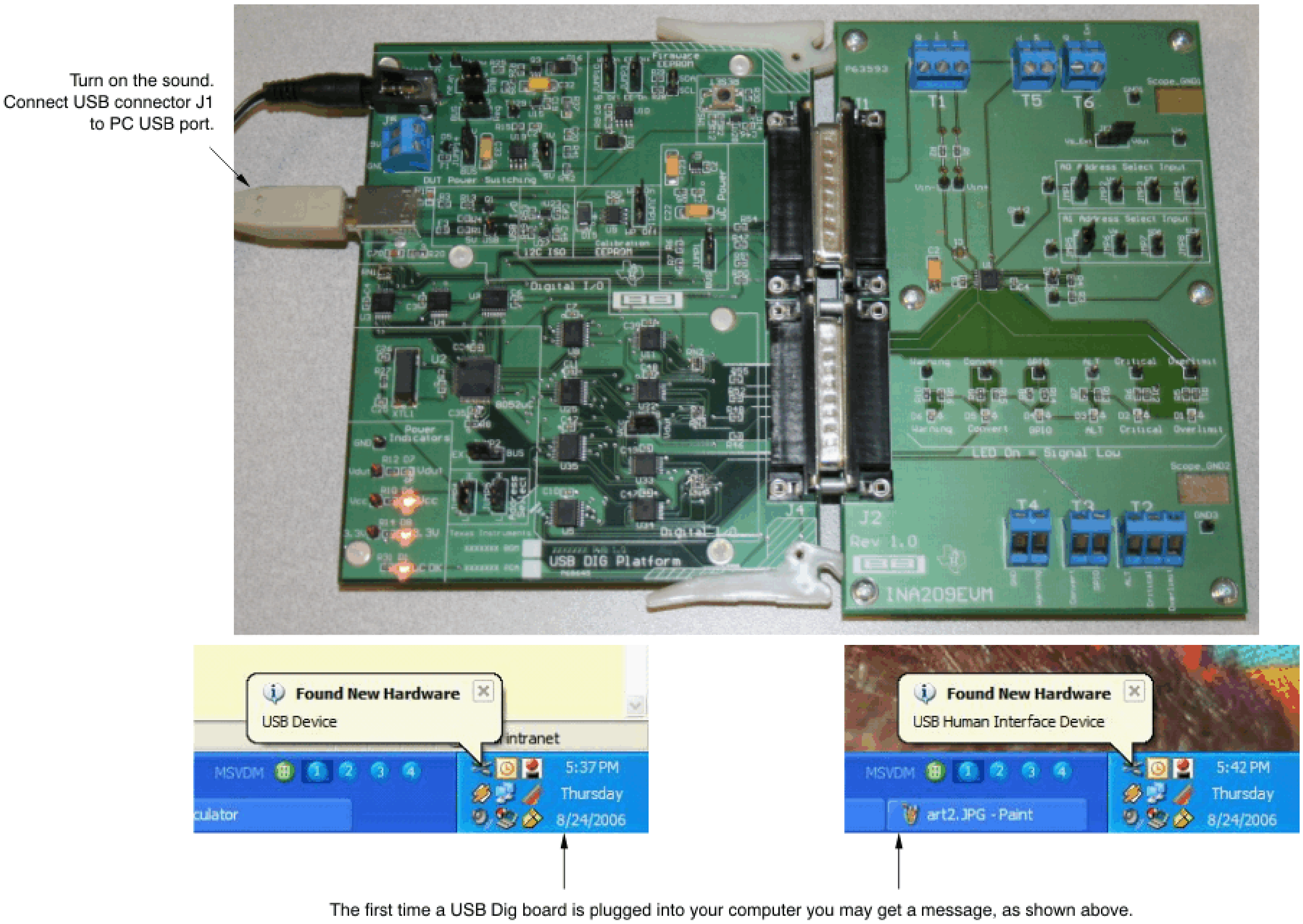

Figure 9. Connecting the USB Cable

3.6 INA209 Jumper Settings

Figure 10 shows the default jumper configuration for the INA209EVM. In general, the jumper settings of the USB Dig platform do not need to be changed. However, you may want to change some of the jumpers on the INA209 test board to match your specific device configuration (for example, to change the I^2C address).

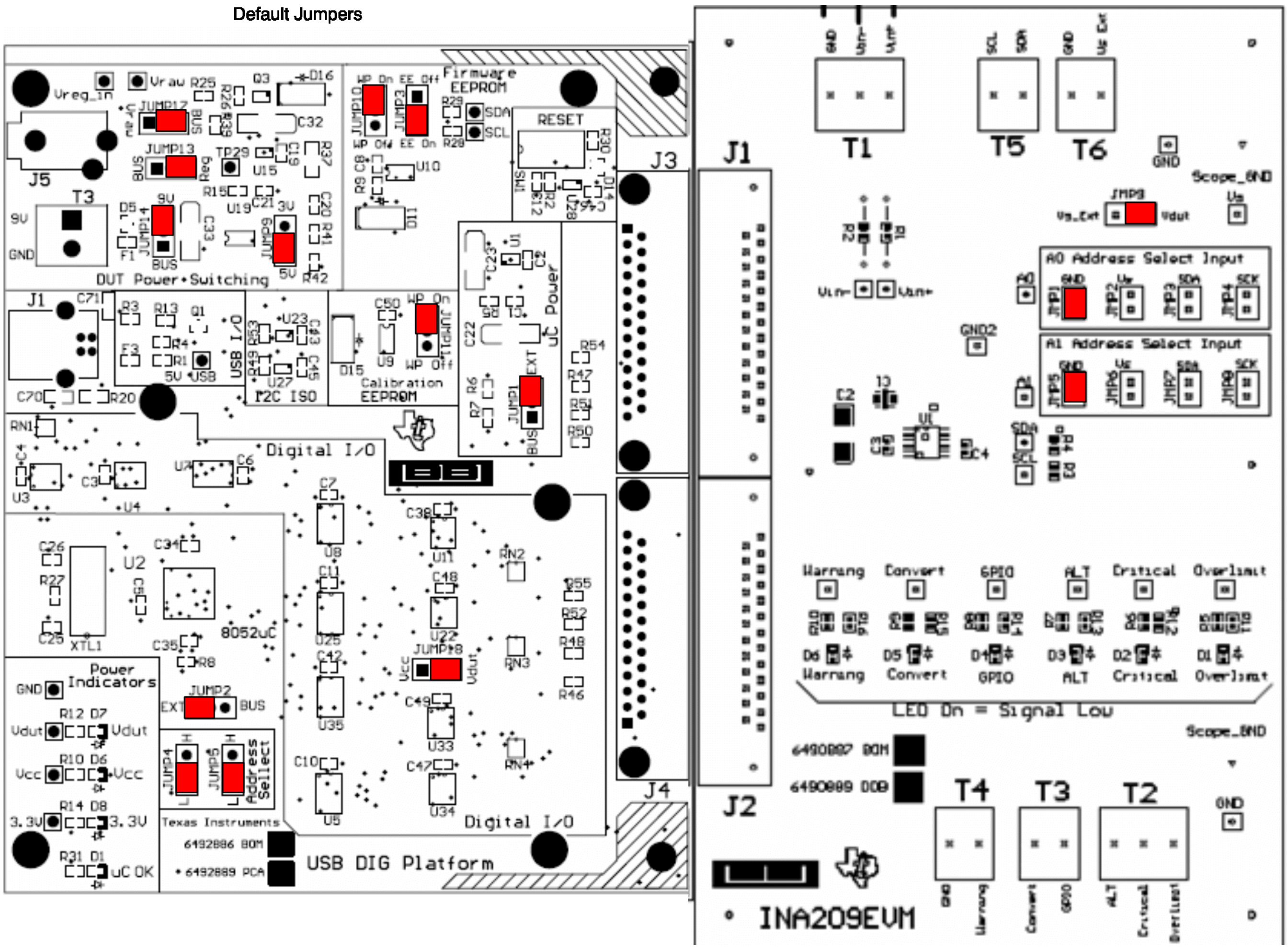

Figure 10. Default Jumper Settings

Table 3 explains the function of the jumpers on the INA209 test board.

Table 3. INA209 Test Board Jumper Function

Jumper	Default	Purpose
JMP1–JMP4	JMP1	A0 address select input. These jumpers determine where the address select pin is connected. This setting connects A0 to GND.
JMP5–JMP8	JMP5	A1 address select input. These jumpers determine where the address select pin is connected. This setting connects A1 to GND.
JMP9	V_{DUT}	This jumper determines where the INA209 gets its power supply. In the V_{DUT} position, the EVM provides power. In the *Vs_Ext* position, the power is connected externally.

Table 4 indicates the function and default position of the USB-DIG-Platform jumpers. For most applications, the default jumper position should be used. Table 5 and Table 6 describe the options for the power-supply configuration. For example, the logic power supply can be changed from the default of 5V to 3V. A separate document (SBOU058) gives details regarding the operation and design of the USB Dig platform.

Table 4. USB DIG Platform Jumper Settings

Jumper	Default	Purpose
JUMP1	EXT	This jumper selects external power or bus power. External power is applied on J5 or T3 (9V dc). Bus power is 5V from the USB bus. External power is typically used because the USB bus power is noisy.
JUMP2	EXT	This jumper selects external power or bus power. External power is applied on J5 or T3 (9V dc). Bus power is 5V from the USB bus. External power is typically used because the USB bus power is noisy.
JUMP3	EE ON	This jumper determines where the INA209 gets its power supply. In the V_{DUT} position, the EVM provides power. The default is the V_{DUT} position. In the *Vs_Ext* position, the power is connected externally.
JUMP4	L	This sets the address for the USB board. The only reason to change from the default is if multiple boards are being used.
JUMP5	L	This sets the address for the USB board. The only reason to change from the default is if multiple boards are being used.
JUMP9	5V	This selects the voltage of the device under test supply (V_{DUT} = 5V or 3V)
JUMP10	WP ON	This write protects the firmware EEPROM.
JUMP11	WP ON	This write protects the calibration EEPROM.
JUMP13	Reg	Uses the regulator output to generate the V_{DUT} supply. The USB bus can be used as the V_{DUT} supply.
JUMP14	9V	Uses external power (9V as apposed to the bus).
JUMP17	BUS	While in the BUS position, V_{DUT} operation is normal. While in the V_{RAW} position, the V_{DUT} supply is connected to an external source. This allows for any value of V_{DUT} between 3V and 5V. **CAUTION** When JUMP17 is in the V_{RAW} position, adjusting the V_{DUT} voltage beyond the 3V to 5V range will damage the EVM.
JUMP18	V_{DUT}	Connects the pull-up resistor on the GPIO to the V_{DUT} supply or the V_{CC} supply.

Table 5. Power-Supply Jumper Configuration #1

Mode	Jumper	Comment
External Power—5V (default jumper settings)	JUMP17 = BUS (not used) JUMP13 = REG JUMP14 = 9V JUMP1 = EXT JUMP2 = EXT JUMP6 = 5V JUMP7 = REF	In this mode, all power is supplied to the EVM via J5 or T3. The external supply must be between 5.8V and 10.4V for proper operation. All digital I/Os are regulated to 5V using U19 (REG101).
External Power—3V (typical jumper settings)	JUMP17 = BUS (not used) JUMP13 = REG JUMP14 = 9V JUMP1 = EXT JUMP2 = EXT JUMP6 = 3V JUMP7 = REF	In this mode, all power is supplied to the EVM via J5 or T3. The external supply must be between 5.8V and 10.4V for proper operation. All digital I/Os are regulated to 3V using U19 (REG101).
External Power—Variable Supply	JUMP17 = Vraw JUMP13 = BUS JUMP14 = 9V (not used) JUMP1 = EXT JUMP2 = EXT JUMP6 = 5V (not used) JUMP7 = REG (ratiometric mode)	In this mode, all the digital I/Os are referenced to the supply that is attached to either J5 or T3. **CAUTION** It is absolutely critical that the supply voltage does not exceed 5.5V in this mode. The supply is directly applied to devices with 5.5V absolute maximum ratings. This mode of operation is useful when a device supply other then 3.0V or 5.0V is required.

Table 6. Power-Supply Jumper Configuration #2

Mode	Jumper	Comment
Bus Power—5V	JUMP17 = BUS JUMP13 = BUS JUMP14 = 9V (not used) JUMP1 = BUS JUMP2 = BUS JUMP6 = 5V (not used) JUMP7 = REG (ratiometric mode, 5V supply)	In this mode, the USB bus completely powers the EVM. The USB bus is regulated by the master (computer) to be 5V. This mode relies upon external regulation. This mode is recommended only when an external 9V supply is not available. If an external 9V supply is available, use either *External Power 5V* mode or *External Power 3V* mode.
Bus Power—3V	JUMP17 = BUS (not used) JUMP13 = REG JUMP14 = BUS JUMP1 = BUS JUMP2 = BUS JUMP6 = 3V JUMP7 = REG (ratiometric mode, 5V supply)	In this mode, the USB bus completely powers the EVM. The regulator (U19, REG101) is used to generate a 3V supply for all digital I/O.

3.7 Connecting External Power to the INA209EVM

The INA209 power supply (V_S) operates over the range of 3V to 5.5V (see the INA209 product data sheet). The default jumper position provides 5V to the INA209 from the USB-DIG-Platform. The power from the USB-DIG-Platform can be changed to 3V using JUMP9.

Another option is to connect power to the INA209 power supply (V_S) using an external power supply. In this case, connect power to the T3 terminal block and set JMP1 to the Vs_EXT positon. The INA209 power supply (V_S) operates over the range of 3V to 5.5V, so be careful to not exceed this range.

3.8 Connecting External Signals to the INA209EVM

The INA209 shunt and bus voltages are applied via terminal block T4. The T4 terminal block is a direct connection to V_{IN+} and V_{IN-} of the INA209. The bus voltage is monitored on V_{IN-} (26V max). The shunt voltage is the difference between V_{IN-} and V_{IN+} (320mV max). Refer to the INA209 data sheet for more details

4 INA209 Software Overview

This section explains how to install and use the INA209 software.

4.1 Operating Systems for the INA209 Software

The INA209 software has been tested on Windows XP with United States and European regional settings. The software should also function on other Windows operating systems. Please report any compatibility issues to precisionamps@list.ti.com.

4.2 INA209EVM Software Install

Install the INA209EVM software by following these steps:

1. Software can be downloaded from the INA209EVM web page, or from the disk included with the INA209EVM, which contains a folder called *Install_software/*.
2. Find the file called *setup.exe*. Double-click the file to start the installation process.
3. Follow the on-screen prompts to install the software.
4. To remove the application, use the Windows Control Panel utility, *Add/Remove Software*.
5. The INA209 Quickstart Video (included on the CD), or available at www.ti.com, gives more details regarding the initialization of the software.

4.3 Starting the INA209EVM Software

Use the Windows *Start* menu to start the INA209 software. From Start, select *All Programs*, then select the *INA209EVM* program. Figure 11 shows the software display if the EVM is functioning properly.

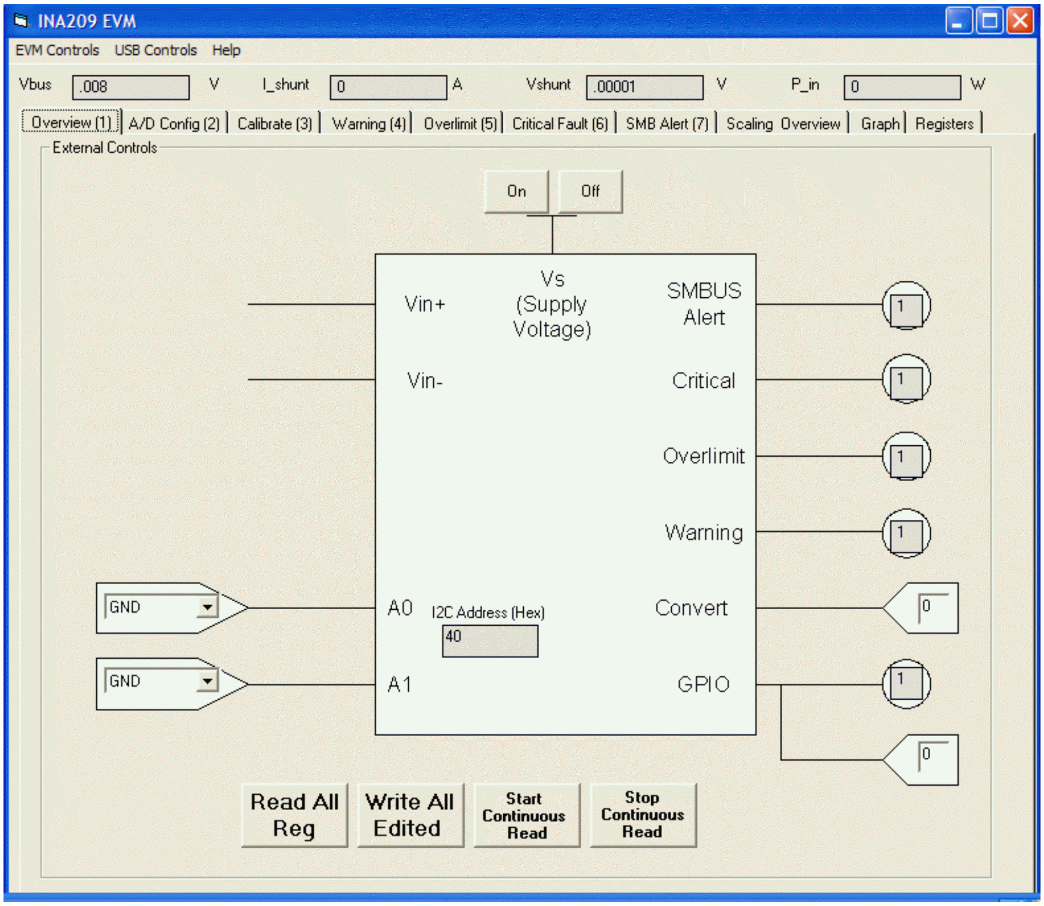

Figure 11. INA209EVM Software—Functioning Properly

Figure 12 shows an error that appears if the computer cannot communicate with the EVM. If this error occurs, check to see that the USB cable is connected. This error can also happen if the USB cable is connected prior to connecting the USB Dig platform 9V power. Another possible reason for this error message is a problem with the USB human interface device driver of the computer. Make sure that the computer recognizes the device when the USB cable is plugged in. If the sound is on, you will hear the distinctive sound that you expect when a USB device is properly connected to a PC with the Windows operating system.

Figure 12. INA209EVM Software—No Communication With the USB Dig Platform

See Figure 13 for an error that will occur if the INA209 test board is not communicating with the USB Dig platform. If you get this error, check the connectors between the two boards; make sure the two 25-pin D-sub connectors are completely pushed together. Another possible cause for this error is it that the INA209 test board jumpers are set in the wrong positions.

4.4 Using the INA209 Software

The INA209EVM software has 10 different tabs that allow you to access different features of the INA209. The first seven tabs were designed for complete configuration of the device by stepping through these tabs in order. Each of these tabs are intended to have an intuitive graphical interface that allows users to develop a better understanding of the INA209.

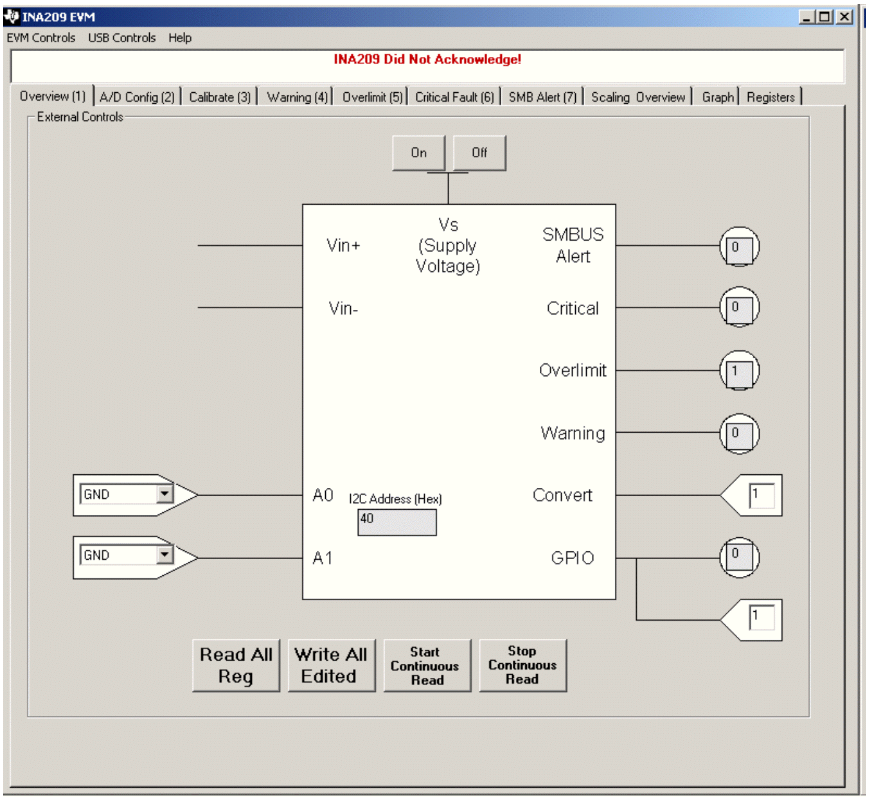

Figure 13. INA209EVM Software—No Communication Between the USB Dig Platform and the INA209

4.4.1 Software Overview Tab

This tab has the following controls:

- Turn on and off the power supply
- Set the I^{2}C address
- Set the logic value on the GPIO and Convert pins
- Read the logic values on the Alert, Critical, Overlimit, and Warning pins

4.4.2 A/D Config Tab

Controls on this tab:

- Shunt voltage attenuator range (smallest range is 40mV, largest range is 320mV).
- Shunt voltage configuration—Resolution and number averages. Note that increasing the number of averages will decrease noise, but will slow down the conversion rate.
- Bus voltage attenuator range (16V and 32V)—Note that the maximum bus voltage for the INA209 is 26V. Therefore, the 32V range cannot be fully used.
- Bus voltage configuration—Resolution and number averages. Note that increasing the number of averages will decrease noise but will slow down the conversion rate.
- A/D converter mode—This control determines how the converters work. The most commonly used mode is the shunt and bus continuous conversion mode. This mode causes both converters to run continuously.

NOTE: More details on these options are explained in the INA209 data sheet and the data sheet sections *Register Details* and *Data Output Registers*.

4.4.3 Calibrate Tab

The calibration tab allows users to enter some information regarding a specific INA209 configuration. This information is used to compute the *Full Scale Cal Register*. The Full Scale Cal Register converts shunt voltage to current voltage. The detailed mathematics behind this calibration feature are given in the INA209 data sheet section, Calibration Register Scaling . Also, this feature is explained in a step-by-step manner in the QuickStart Video.

4.4.4 Warning Tab

The warning tab allows you to completely configure the warning feature on the INA209. Specifically, there are warning limit registers for Power, Bus Overvoltage, Bus Undervoltage, Shunt Voltage Positive, and Shunt Voltage Negative. If an INA209 reading exceeds the value in a warning limit register, the INA209 warning will trip. Other options on the warning feature are also set on this tab (for instance, the delay, polarity, latch enable, and output enable). See the Warning/Watchdog Registers section of the INA209 data sheet.

4.4.5 Overlimit Tab

The overlimit tab allows you to completely configure the overlimit feature on the INA209. Specifically, there are overlimit limit registers for Power, Bus Overvoltage, and Bus Undervoltage. If an INA209 reading exceeds the value in a overlimit limit register, the INA209 overlimit will trip. Other options on the warning feature are also set on this tab (for example, the delay, polarity, latch enable, and output enable). See the Over-Limit/Critical Watchdog Registers section of the INA209 data sheet.

4.4.6 Critical Fault Tab

The Critical Fault tab allows complete configuration of the Critical Fault feature on the INA209. The Critical Fault feature is an analog path that will trigger when the shunt voltage exceeds a specific level. The level is set by the *Critical DAC+* and the *Critical DAC–* controls. Hysteresis, polarity, latch enable, and output enable options can also be set. See the Over-Limit/Critical Watchdog Registers section of the INA209 data sheet.

4.4.7 SMB Alert Tab

The SMB Alert tab sets the Alert mask register. This register configures the INA209 to allow some events to cause an SMB Alert, while preventing (or masking) other events from causing an Alert. This tab allows the Alert output to be enabled or disabled.

4.4.8 Scaling Overview Tab

This tab allows you to see how the mathematics work in the INA209. Specifically, this tab shows how the current and power values are computed using the full-scale calibration register.

4.4.9 Graph Tab

The graph tab displays bus voltage, shunt current, and power versus time when the software is in continuous convert mode.

4.4.10 Registers Tab

This tab allows reading and editing of all the registers in the INA209. All the previous tabs will affect the register listing. For example, changing the A/D configuration in tab 2 will affect Register 0 in the register list. It is also true that changing Register 0 will update the A/D configuration on tab 2. Thus, the graphical representation and register representation affect each other.

4.5 EVM Controls Pull-Down Menu

The INA209 configuration (such as register settings) can be saved or loaded using the *EVM Controls* pull-down menu, as shown in Figure 14. The file that the configuration is saved into is a simple text file and can be viewed with any text editor.

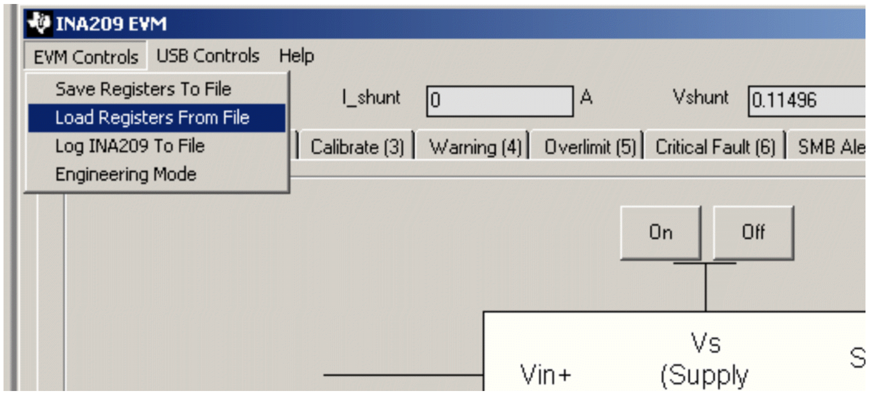

Figure 14. EVM Controls Pull-Down Menu

4.6 Help Pull-Down Menu

The *About* feature can be used to check the current revision. This document is based on revision 1.0.9, as shown in Figure 15.

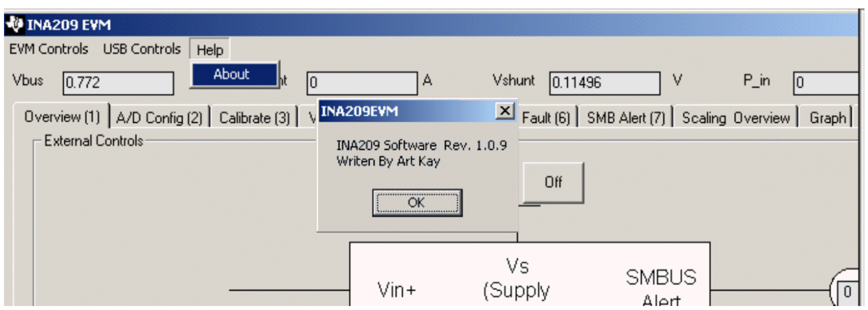

Figure 15. Current Revision of Software

5 Bill of Materials

Table 7 shows the parts list for the INA209 test board.

Table 7. Parts List for the INA209 Test Board

Quantity	Value	RefDes	Description	Vendor	Part Number
6	4.02kΩ	R5–R10	Resistor, 4.02kΩ, 603	ROHM	MCR03EZPFX4021
8	10kΩ	R3, R4, R11–R16	Resistor, 10kΩ, 603	Yageo Corporation	RC0603FR-0710KL
2	10Ω	R1, R2	RES 10.0Ω 1/10W 1% 0603 SMD	Yageo Corporation	RC0603FR-0710RL
1	10μF	C2	Capacitor, Tantalum, 10μF, 16V, 6032	Kemet	T491C106M016AT
2	0.1μF	C3, C4	Capacitor, Ceramic, 0.1μF, 1206, X7R	Yaego Electric	CC1206KRX7R9BB104
1	1000pF	C1	X2Y® Cap	Johanson	500X18N102MV4
6	LED	D1–D6	Diode, LED, Ultra Bright Diff, 603	Panasonic	LNJ208R8ARA
1	DSUB25M	J1	Conn D-Sub Plug R/A 25pos 30gold (with threaded inserts and board locks)	AMP/Tyco Electronics	5747842-4
1	DSUB25F	J2	Conn D-Sub Rcpt R/A 25pos 30gold (with threaded inserts and board locks)	AMP/Tyco Electronics	5747846-4
8	JUMP2 Cut to Size	JMP1–JMP8	Conn, Header, 0.100, 36pos (18 jumpers/strip)	3M/ESD	929647-09-36-I
1	JUMP3 Cut to Size	JMP9	Conn, Header, 0.100, 36pos (12 jumpers/strip)	3M/ESD	929647-09-36-I
16	TP Cut to Size	All Test Points	Conn, Header, 0.100, 36pos (36 test points/strip)	3M/ESD	929647-09-36-I
6	Standoff	None	Standoffs, Hex , 4-40 Threaded, 0.500" Length, 0.250" OD, Aluminum Iridite Finish	Keystone	2203
6	Screw	None	Screw, Machine, Phil 4-40X1/4 SS	Building Fasteners	PMSSS 440 0025 PH
4	2-Pin Connector	T3–T6	2-Position Terminal Strip, Cage Clamp, 45°, 15A, Dove-tailed	On-Shore Technology Inc	ED300/2
2	3-Pin Connector	T1, T2	3-Position Terminal Strip, Cage Clamp, 45°, 15A, Dove-tailed	On-Shore Technology Inc	ED300/3
1	INA209	U1	IC Curr/Pwr Mon Bi-Dir 16-TSSOP	Texas Instruments	INA209AIPWR

Revision History

Changes from Original (February, 2008) to A Revision — **Page**

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 5.7V (min) to 9V (max) and the output voltage range of 0V (min) to 5V (max).

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. 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 +25°C. The EVM is designed to operate properly with certain components above +25°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265