TSC2014EVM and TSC2014EVM-PDK

This user's guide describes the characteristics, operation, and use of the TSC2014EVM, both by itself and as part of the TSC2014EVM-PDK. The TSC2014EVM and TSC2014EVM-PDK are two evaluation fixtures for the TSC2014, an ultra low-power resistive touch screen controller with an I²C™-compatible interface. This evaluation module (EVM) is a four-wire resistive touch screen controller EVM that also has auxiliary input and temperature measurement capabilities. A complete circuit description, schematic diagram, and bill of materials are included.

The following related documents are available through the Texas Instruments web site at www.ti.com.

Related Documentation

Device	Literature Number
TSC2014	SBAS522
TAS1020B	SLES025
REG1117-5	SBVS001
TPS767D318	SLVS209
SN74LVC125A	SCAS290
SN74LVC1G125	SCES223
SN74LVC1G07	SCES296
5-6k Interface Board	SLAU104

Microsoft, Windows are registered trademarks of Microfsoft Corporation.
I²C is a trademark of NXP Semiconductors.
NI Speedy-33 is a trademark of National Instruments.
All other trademarks are the property of their respective owners.

© 2010, Texas Instruments Incorporated

Contents

1 EVM Overview 3
2 Analog Interface 4
3 Digital Interface 4
4 Power Supplies 4
5 EVM Operation 6
6 EVM-PDK Operation 6
7 GUI Software and Operating Descriptions 10
8 EVM Bill of Materials 20
9 TSC2014EVM PCB 23
10 TSC2014EVM Schematic 23

List of Figures

1 TSC2014EVM-PDK Hardware Block Diagram and Connection 7
2 Prompt to Set Up TSC2014 I^2C Slave Address 9
3 TSC2014EVM-PDK Software GUI: Startup Screen with Human Interface Tab 9
4 TSC2014EVM-PDK Software GUI: Configuration Tab 12
5 TSC2014EVM-PDK Software GUI: Command Line Interface Tab 15
6 TSC2014EVM-PDK Software GUI: Read All Threshold Registers Option 16
7 TSC2014EVM PCB Silkscreen (Top View) 23

List of Tables

1 J1: Analog Interface Pinout 4
2 J2: Digital Interface Pinout 4
3 J3: Power-Supply Pinout 4
4 List of Jumpers 6
5 Script Command Types 17
6 TSC2014EVM Bill of Materials 20
7 USB-MODEVM Interface Board Bill of Materials 21

© 2010, Texas Instruments Incorporated

1 EVM Overview

1.1 Features

TSC2014EVM:

- Full-featured evaluation board for the TSC2014 resistive touch screen controller (TSC)
- Modular design for use with a variety of DSP and microcontroller interface boards

TSC2014EVM-PDK:

- Easy-to-use evaluation software for Microsoft® Windows® XP
- Complete control of board settings

For use with a computer, the TSC2014EVM-PDK is a complete evaluation kit. This kit combines the TSC2014EVM with the USB-based USB-MODEVM motherboard and evaluation software for use with a personal computer.

The USB-MODEVM motherboard allows the TSC2014EVM to be connected to the computer via an available USB port. This manual shows how to use the USB-MODEVM as part of the TSC2014EVM-PDK, but does not provide technical details about the USB-MODEVM itself.

This manual covers the operation of both the TSC2014EVM and the TSC2014EVM-PDK. Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the TSC2014EVM.

1.2 Introduction

The TSC2014EVM is manufactured in Texas Instruments' modular EVM System specification. It can be connected to any modular EVM system interface card. The TSC2014EVM allows direct evaluation of the TSC2014 performance and operating characteristics, in addition to rapid software development and system prototyping. This EVM is compatible with the 5-6k Interface Board (SLAU104) from Texas Instruments and additional third-party boards such as the HPA449 demonstration board from SoftBaugh, Inc. (www.softbaugh.com) and the NI Speedy-33™ from National Instruments Corporation.

The TSC2014EVM is available as a stand-alone printed circuit board (PCB) or as part of the TSC2014EVM-PDK, which includes a USB-MODEVM motherboard and software. As a stand-alone PCB, the TSC2014EVM is useful for prototyping designs and firmware.

The TSC2014EVM-PDK is a complete evaluation and demonstration kit that includes a USB-based motherboard, the USB-MODEVM interface board. This kit also contains evaluation software for use with a personal computer equipped with Microsoft Windows operating systems. The TSC2014EVM-PDK is a complete package that includes the following items:

1. TSC2014EVM board
2. USB-MODEVM board
3. TSC2014-EVM-PDK evaluation software installer and related documentation

The EVM software is updated regularly. To check for the latest version, go to the TSC2014EVM software download page on the Texas Instruments' website.

© 2010, Texas Instruments Incorporated

2 Analog Interface

For maximum flexibility, the TSC2014EVM is designed for easy interfacing to multiple analog sources by means of different connection options. Samtec part numbers SSW-110-22-F-D-VS-K and TSM-110-01-T-DV-P provide a convenient 10-pin, dual-row, header/socket combination at J1, described in Table 1. This header/socket provides access to the analog input pins of the TSC. Consult Samtec at www.samtec.com or call 1-800-SAMTEC-9 for a variety of mating connector options.

Table 1. J1: Analog Interface Pinout

Pin Number	Signal	Description
J1.2	X+	Touch screen X+ electrode
J1.4	X–	Touch screen X– electrode
J1.6	Y+	Touch screen Y+ electrode
J1.8	Y–	Touch screen Y– electrode
J1.12	AUX	Auxiliary input, 0 V to VREF
J1.1, J1.3, J1.5, J1.7, J1.10, J1.14 to J1.16, J1.18, J1.20	Unused	—
J1.9, J1.11, J1.13, J1.17, J1.19	AGND	Analog ground connections

3 Digital Interface

The TSC2014EVM is designed to easily interface with multiple control platforms. Samtec part numbers SSW-110-22-F-D-VS-K and TSM-110-01-T-DV-P provide a convenient 10-pin, dual-row, header/socket combination at J2, described in Table 2. This header/socket provides access to the digital control and serial data pins of the TSC. Consult Samtec at www.samtec.com or call 1-800-SAMTEC-9 for a variety of mating connector options.

Table 2. J2: Digital Interface Pinout

Pin Number	Signal	Description
J2.12	$\overline{\text{RESET}}$	Hardware reset to TSC2014
J2.15	$\overline{\text{PINTDAV}}$	Pen interrupt and/or data available output from TSC2014
J2.16	SCL	I^2C bus serial clock
J2.20	SDA	I^2C bus serial data line
J2.1 to J2.3, J2.5 to J2.9, J2.11, J2.13, J2.14, J2.17, J2.19	Unused	—
J2.4, J2.10, J2.18	DGND	Digital ground connections

4 Power Supplies

J3 provides a connection to the common power bus for the TSC2014EVM. Power is supplied on the pins listed in Table 3.

Table 3. J3: Power-Supply Pinout

Signal	Pin Number		Signal
Unused	J3.1	J3.2	Unused
Unused	J3.3	J3.4	Unused
DGND	J3.5	J3.6	AGND
Unused	J3.7	J3.8	+VD1
Unused	J3.9	J3.10	Unused

© 2010, Texas Instruments Incorporated

When power is supplied to J3, JP1 selects power to the TSC2014 VDD/REF, either from the TSC2014EVM-PDK motherboard (that is, the USB-MODEVM Interface Board) or from an external power supply (through the J4 connector). See the schematic and PCB silkscreen for details.

The TSC2014EVM-PDK motherboard (the USB-MODEVM interface board) supplies power to J3 of the TSC2014EVM. Power for the motherboard is supplied either through its USB connection or on terminal blocks on the board.

4.1 TSC Power

Power for the TSC2014 VDD/REF can be supplied either from the motherboard or from an external power source, selected by setting JP1. When the shunt is installed on JP1 pins 1-2, power for VDD/REF comes from J3.8 (+VD1). +VD1 is a power source from the motherboard (the USB-MODEVM) and can be selected in the range of +1.2 VDC to +3.3 VDC. When the shunt is installed on JP1, pins 2-3, power for VDD/REF comes from an external power supply through the J4 terminal block.

CAUTION

Verify that all power supplies are within the safe operating limits shown on the TSC2014 data sheet (SBAS522) before applying power to the EVM. Also, note the power polarity to J4.

4.2 Stand-Alone Operation

When used as a stand-alone EVM, the power can be applied through the J4 terminal block. Note that a shunt must be installed on JP1, pins 2-3 for stand-alone operation

CAUTION

Verify that all power supplies are within the safe operating limits shown on the TSC2014 data sheet (SBAS522) before applying power to the EVM. Also, note the power polarity to J4.

4.3 USB-MODEVM Interface Power

The USB-MODEVM Interface Board can be powered from several different sources:

- Through a USB connection
- 6-VDC to 10-VDC ac/dc external wall supply *(not included)*
- Laboratory power supply

When powered from the USB connection, JMP6 should have a shunt from pins 1-2 (the factory default configuration). When powered from 6 VDC to 10 VDC, either through the J8 terminal block or J9 barrel jack, JMP6 should have a shunt installed on pins 2-3. If power is applied in any of these ways, onboard regulators generate the required supply voltages, and no further power supplies are necessary.

If laboratory supplies are used to provide the individual voltages required by the USB-MODEVM interface board, JMP6 should have no shunt installed. Voltages are then applied to J2 (+5 VA), J3 (+5 VD), J4 (+1.8 VD), and J5 (+3.3 VD). The +1.8 VD and +3.3 VD also can be generated on the board, from the +5-VD supply, by the onboard regulators; to enable this supply, the switches on SW1 must be set to enable the regulators. Move the switches to the *ON* position (higher position, looking at the board with text reading right-side up) to enable the regulators. If +1.8 VD and +3.3 VD are supplied externally, disable the onboard regulators by placing the SW1 switches in the *OFF* position.

Each power-supply voltage has an LED (D1, D2–D8) that lights when the power supplies are active.

© 2010, Texas Instruments Incorporated

4.4 Reference Voltage

No additional reference is needed for the TSC2014EVM because the reference voltage used for the TSC2014 device is provided from the VDD/REF pin of the TSC2014. A reference is needed only for single-ended input mode when measuring the AUX or temperature. TSC2014 touch screen measurements are operated under differential (ratiometric conversion) mode and, therefore do not need any reference.

5 EVM Operation

This section provides information on the analog input, digital control, and general operating conditions of the TSC2014EVM, both by itself and as part of the TSC2014EVM-PDK.

5.1 Analog Input

The analog input sources (touch screen and auxiliary input) can be applied directly to J1 (top or bottom side; refer to Table 1), or through signal-conditioning modules available for the modular EVM system.

5.2 Digital Control

The digital control signals can be applied directly to J2 (top or bottom side; refer to Table 2). The modular TSC2014EVM also can be connected directly to a DSP or microcontroller interface board, such as the HPA449, or to the USB-MODEVM Interface Board if purchased as part of the TSC2014EVM-PDK. For a current list of compatible interface and/or accessory boards for the EVM or the TSC2014, see the TSC2014 product folder on the TI web site (www.ti.com).

5.3 Default Jumper Locations

Table 4 provides a list of jumpers found on the EVM and the respective factory default conditions for each.

Table 4. List of Jumpers

Jumper	Description	Default Shunt Position
JP1	Power Supply Select: 1-2: from motherboard +VD1 (J3.8) 2-3: from external (J4)	1-2 (from J3.8)
JP2	EEPROM Address Select: Installed: firmware for the motherboard from the EEPROM onboard the TSC2014EVM Removed: firmware for the motherboard from the EEPROM on motherboard	Installed (FW from EEPROM on TSC2014EVM board)
JP3	TSC2014 I2C Address Bit A0: 1-2: A0 = 1 2-3: A0 = 0	2-3 (A0 = 0)

6 EVM-PDK Operation

The following sections of this user guide provide information about operating the TSC2014EVM-PDK, including setup, program installation, and using the software as well as its operational description.

© 2010, Texas Instruments Incorporated

6.1 Block Diagram

Figure 1 shows the hardware block diagram of the TSC2014EVM-PDK. The two PCBs are connected together, and the TSC2014EVM board is seated on top of the USB-MODEVM board.

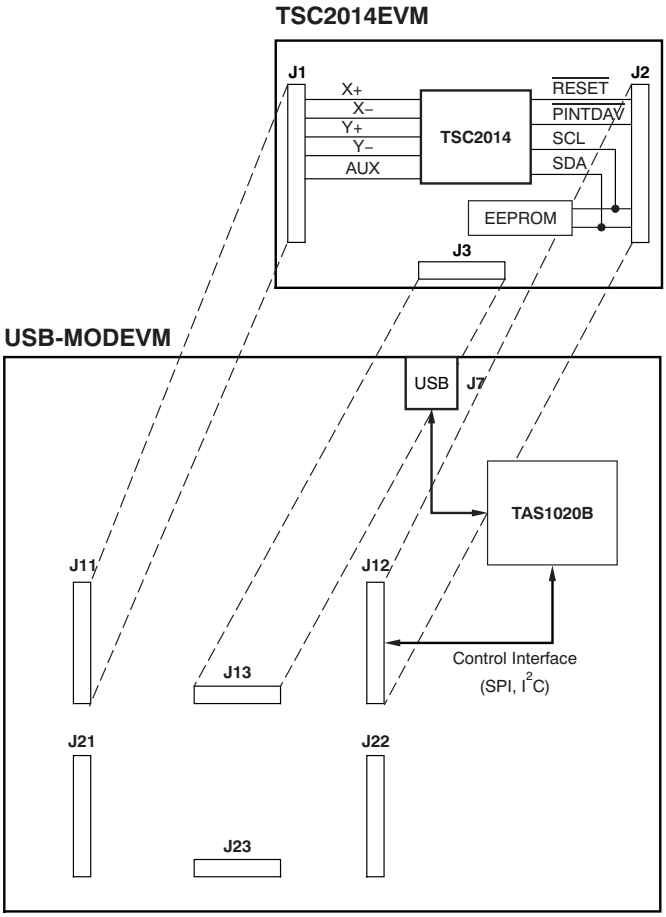


Figure 1. TSC2014EVM-PDK Hardware Block Diagram and Connection

The USB-MODEVM Interface Board is intended to be used in USB mode, where control of the installed EVM is accomplished using the onboard USB controller device. However, provision is made for driving all the buses (I^2C and/or SPI) externally. The source of these signals is controlled by switch SW2 on the USB-MODEVM. For more details, see the USB-MODEVM Interface Board schematic (appended to this document).

© 2010, Texas Instruments Incorporated

6.2 Quick Start

Ensure that the TSC2014EVM is installed on the USB-MODEVM Interface Board. The TSC2014EVM should be installed in the topmost position, using J11, J12, and J13 on the USB-MODEVM, as shown in Figure 1.

CAUTION

Do not connect the EVM-PDK to your PC through a USB cable before you install the software.

Follow these procedures to install the software:

1. Download the TSC2014-EVM-PDK software from the TI website (https://tisps.ext.ti.com/sites/tscevmpdksoftware), and run *Setup.exe*, found in the Installer directory.
2. Accept the license agreement, and continue the installation.
3. Follow the instructions and prompts given. Then click *Finish* in the TSC2014EVM Installer window.
4. Restart your computer. (This step may not be necessary, but is recommended.)
5. When your computer has restarted, connect the TSC2014EVM to the computer via a USB cable. Windows should recognize the new device, and the *Found New Hardware* wizard appears.
6. Select *Install from a list or specific location (Advanced)*, and click on **Next>**.
7. Select *Don't Search. I will choose the driver to install*, and click on **Next>**.
8. If the TSC2014EVM is in the list of available models, click on it to select it. You are done. Otherwise, if it is not shown, your PC *Add Hardware* wizard provides a list of *Common hardware types*; find and click on *NI-VISA USB Devices*.
9. Click on *Have Disk...*
10. Select *Browse ...*,and find the **TSC2014EVM.inf**, which is included with the installer. This file should be (by default) in the directory *C:\Program Files\Texas Instruments\TSC2014EVM\data*.
11. Select the TSC2014EVM.inf, and click on it. Then click on *OK*; your PC searches for and finds *TSC2014EVM*.
12. Select the *TSC2014EVM* in the list of models, and click on **Next>**.
13. Click **Finish** to complete the installation process.

Once the installer has completed its processes, you are done and ready to operate the TSC2014EVM software.

As configured at the factory, the TSC2014EVM board is powered from the USB-MODEVM interface board. Therefore, the power indicator LEDs on the USB-MODEVM should light when connecting the EVM-PDK to your PC through a USB cable. When installation is complete, launch the TSC2014 evaluation software on your PC.

© 2010, Texas Instruments Incorporated

Once the USB-MODEVM powers on, the software should automatically find the TSC2014EVM, and a window similar to the one in Figure 2 should appear.

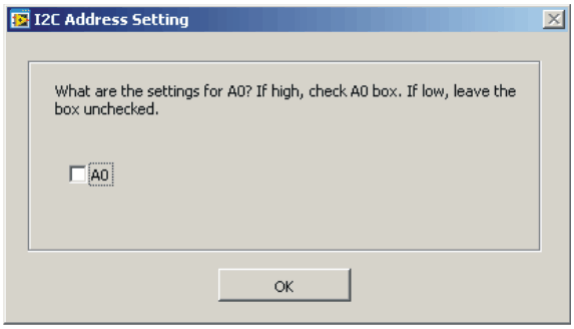


Figure 2. Prompt to Set Up TSC2014 I²C Slave Address

Check the **A0** box if TSC2014EVM jumper JP3 is shunted on 1-2 (that is, set to the high position). By default, A0 should be unchecked with jumper JP3 shunted on 2-3 (low) (refer to Table 4). Click on the *OK* button to continue, and the software graphical user interface (GUI) appears; see Figure 3.

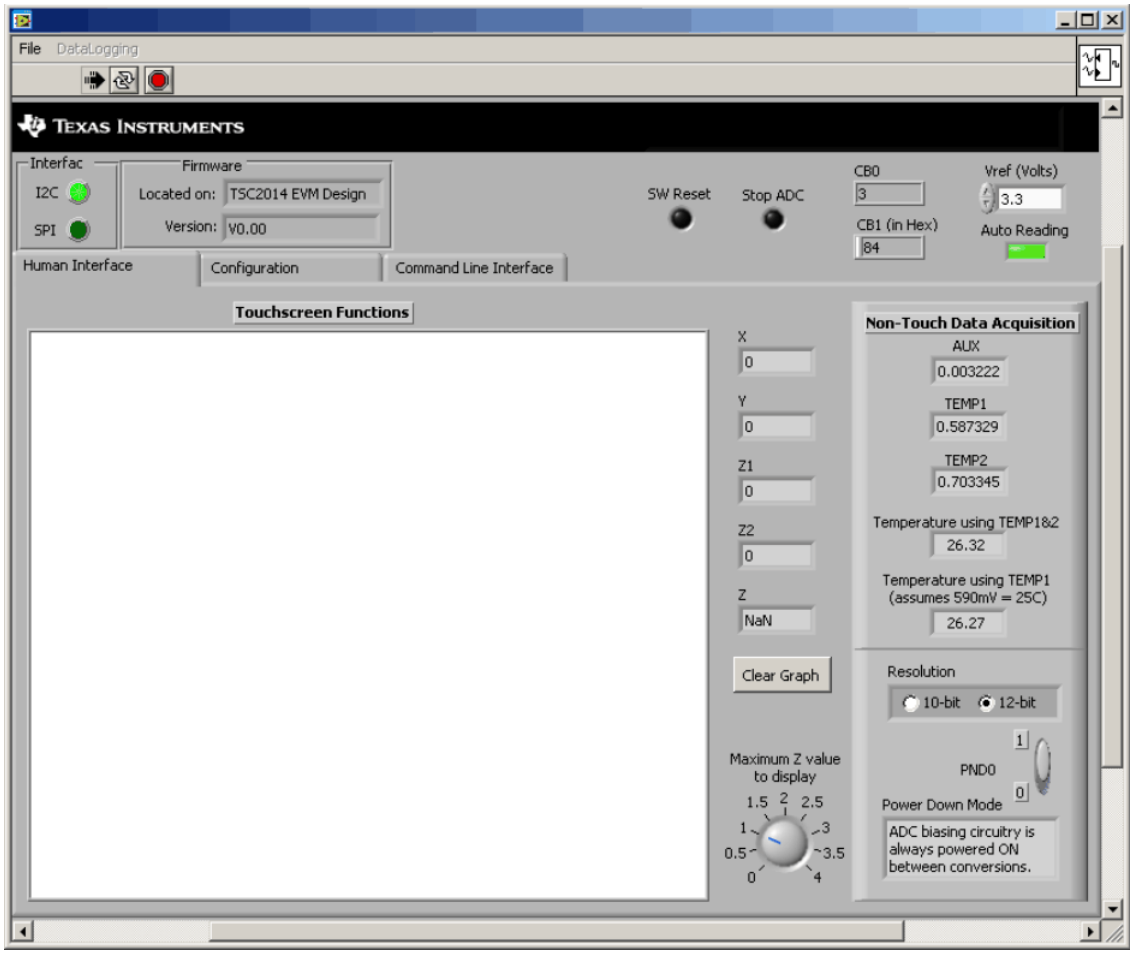


Figure 3. TSC2014EVM-PDK Software GUI: Startup Screen with Human Interface Tab

In order to use the touch screen features, a four-wire resistive touch screen must be connected to J1 of the TSC2014EVM, as discussed previously. The four wires of the touch panel should be connected to the pins 2 (X+), 4 (X–), 6 (Y+), and 8 (Y–) of J1A on the TSC2014EVM board.

© 2010, Texas Instruments Incorporated

6.3 USB-MODEVM Interface Board

The simple diagram shown in Figure 1 shows only the basic features of the USB-MODEVM Interface Board. The board is designed for a TAS1020B USB controller with an 8052-based core. It features two positions for modular EVMs, or one double-wide serial modular EVM can be installed.

For use with the TSC2014, the TSC2014EVM is installed in the topmost EVM slot, which connects the TSC2014 digital control interface to the I^2C port of the TAS1020B. Because the TSC2014 has no audio features, the lower EVM slot (which is connected to the TAS1020B digital audio interface) is not used.

As configured at the factory, the board is ready to use with the TSC2014EVM. However, if external I^2C control is desired, the signals may be applied to J6 on the USB-MODEVM board. To view all the functions and configuration options available on this board, see the USB-MODEVM Interface Board schematic appended to this document.

7 GUI Software and Operating Descriptions

7.1 Program Description

Afteryou complete the TSC2014EVM-PDK software installation (described in Section 6.2), evaluation and development with the TSC2014 can begin.

When the TSC2014EVM-PDK software starts on your PC, the interface GUI is displayed as shown in Figure 3. On the top-left side of the GUI, a lit green LED indicates the digital serial interface type; this indicator should be *I^2C* for the TSC2014EVM-PDK. The next box to the right shows the location and version of the firmware.

The two LEDs near the top center of the GUI can be used to perform a software reset of the TSC2014 and stop the TSC2014 analog-to-digital converter (ADC) operation. Note that the two LEDs reflect the corresponding bits inside the CB1 (see the TSC2014 data sheet).

When the SW Reset LED is lit (blue), bit 1 of CB1 is set to logic '1' and the TSC2014 is in the software reset mode. When the LED is off (black), bit 1 is set to logic '0'; the TSC2014 is not reset and is in normal operating mode.

When the Stop ADC LED is lit (red), bit 0 of CB1 is set to logic '1' and the TSC2014 ADC stops. When this LED is off (black), bit 0 goes to logic '0' and the TSC2014 operates normally.

Next to the SW Reset and Stop ADC LEDS, two boxes labeled CB0 and CB1 display the current/default settings of the TSC2014 control byte mode 0 (CB0) and mode 1 (CB1), respectively. See the TSC2014 data sheet on the control byte and its two modes.

The data in CB0 are written to the TSC2014 while writing to a control register; CB0 is the command byte.

Data in CB1 are written to the TSC2014 when one of the following events occurs:

- Bit 0 (STS or Stop ADC) is set by clicking on the Stop ADC LED.
- Bit 1 (SWREST or SW Reset) is set by clicking on the SW Reset LED.
- Bit 2 (RM or Resolution) is set at the Human Interface tab.
- Bits 3 through 6 (Converter Function Select) can be set at the Configuration tab beneath the CFR1 section.

Most product and design evaluations can be implemented using the three primary tabs on the TSC2014EVM GUI: *Human Interface*, *Configuration*, and *Command Line Interface*. Clicking on a tab accesses the functions that correspond to the specific tab. This section provides a detailed discussion of the functions of these tabs.

© 2010, Texas Instruments Incorporated

7.2 Human Interface Tab

Refer to Figure 3 for a view of the Human Interface tab; this screen is the default (startup) tab of the GUI, and shows both touch data (such as X-, Y-, and Z-coordinates of each touch on the screen) and non-touch data (for example, AUX and temperature).

7.2.1 Touch Screen Control Function

The touch screen box in this tab updates when a touch is detected on the touch screen. As the touch screen is drawn on, the motion on the touch screen is translated into pixels in this box. The software takes X, Y, Z_1, and Z_2 readings which are shown to the right of the touch screen box. As the touch pressure increases, the pixel size increases; a lighter touch results in thinner pixel sizes.

(**NOTE:** The Z-value displayed is not exactly what is described in the TSC2014 data sheet because the data sheet equations are calculated as if there is a known resistance of the touch screen being used.) The value used in the evaluation software is calculated by Equation 1 of the TSC2014 data sheet, but without multiplying the value by the Rx-plate resistance. This raw value is shown as *Z* beneath the measured touch data, X, Y, Z_1, and Z_2; it normally ranges from 0 to 4, with larger numbers representing a more forceful press on the screen. Using the *Maximum Z Value to Display* knob, you can set a threshold so that the program does not display lightly pressed points. This threshold setting helps to eliminate the display of spurious points that may result from touch screen mechanical bouncing or physical jitter.

The display in the touch screen box can be cleared by pressing the **Clear Graph** button on the screen.

7.2.2 Data Acquisition Functions

The TSC2014 provides for measuring an auxiliary input voltage (AUX) and the temperature. A data acquisition function on this tab displays the measured values for these parameters. Measurements are updated only when the touch screen is not being pressed, and the Auto Reading LED is on.

Temperature is displayed using both measurement modes described in the TSC2014 data sheet. Using the TEMP1 and TEMP2 measurements, a temperature reading with 2°C resolution and accuracy is achieved. Using only the TEMP1 measurement, a reading with 0.3°C resolution is possible, but requires that the user know the TEMP1 value at +25°C. This setting normally requests a calibration that the user performs. The evaluation software program presumes that TEMP1 = 590 mV at +25°C.

By default, the software continuously reads non-touch data, AUX, TEMP1, and TEMP2, and automatically updates these values in the *Non-Touch Data Acquisition* section of the GUI display. To stop data acquisition, click on the green LED *Auto Reading* in the top-right corner.

Both AUX and temperature measurements require a reference voltage, which is provided to the TSC2014 VDD/REF pin. The V_{REF} value (in volts) controller box can be written with the corresponding V_{REF} voltage.

7.2.3 Direct Configuration

The TSC2014 parameters (or modes) can be set up or configured in two ways. One approach is to set up the control registers (this procedure is described in the Configuration Tab section). The second method is to write directly to the TSC2014 through control bytes. Most of the device configuration information and status of the TSC2014 can be accessed through writing to or reading from the TSC2014 control registers. Additionally, several parameters or modes can be accessed through the direct configuration, including Resolution, ADC Power-Down, ADC Stop, and SW Reset. See the TSC2014 data sheet for more details.

In the Human Interface tab, two direct configuration modes can be accessed: one is Resolution mode; the second is ADC Power-Down mode.

The TSC2014 ADC can be configured to operate in either 10-bit or 12-bit resolution mode. This option can be directly configured using Control Byte Mode #1 (or CB1), or by writing to bit #13 of Control Register CFR0. Clicking on the resolution option in this tab changes the resolution setting in CB1. Note that the CB1 box at the top of the GUI updates when any of the control bits change. You may also need to change the resolution setting in CFR0 (which is discussed in the Configuration Tab section) to make them consistent.

© 2010, Texas Instruments Incorporated

A Power-Down bit in TSC2014 Control Byte Mode #0 (or CB0) can be set from this tab to power up the ADC biasing circuitry always, or to cycle down the power between conversions. The box under the **PND0** control button shows the brief description.

7.3 Configuration Tab

On the Configuration tab, shown in Figure 4, all of the TSC2014 control registers can be accessed and written to.

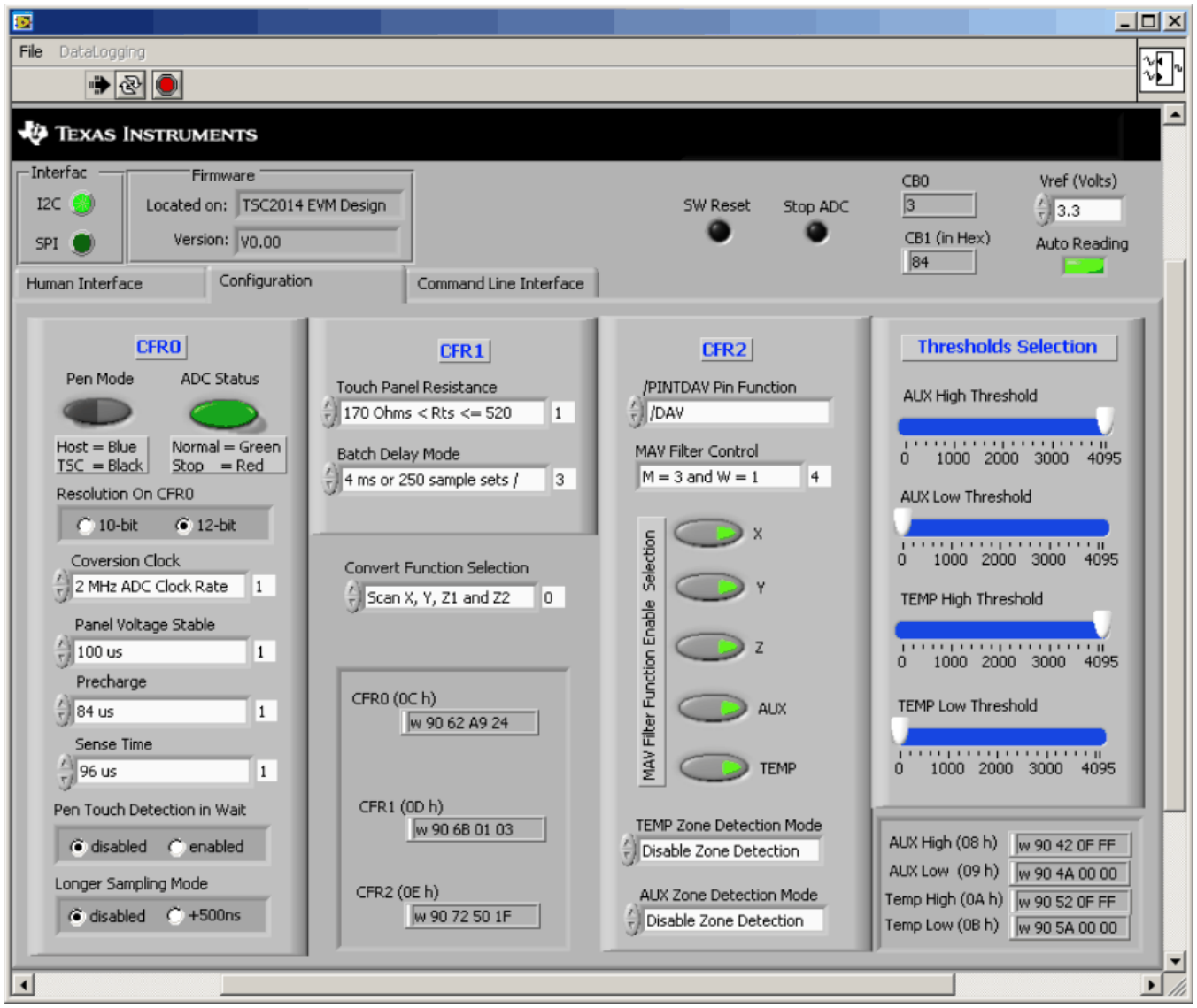


Figure 4. TSC2014EVM-PDK Software GUI: Configuration Tab

The tab has four sections, corresponding to the configuration registers CRF0, CFR1, CFR2, and the four thresholds registers, respectively. The two status boxes, one under the *CFR1* section and the other under the *Threshold Selection* section, display the current values written to these TSC2014 control/configuration registers.

Note that a digital box is next to each of these multiple selectors; clicking on this box sends the data to the corresponding control registers.

© 2010, Texas Instruments Incorporated

7.3.1 ADC Configuration (CFR0)

This section controls the parameters in TSC2014 configuration register CFR0. Each button or selection controls a single parameter.

- Pen Control Mode:

  The button controls whether the touch data acquisition is started or initialized by a host processor command (manually) or by a touch on the screen (automatically). The default option is to start acquisition by touching the screen.
- Stop ADC

  This button can stop the TSC2014 ADC, or put the ADC into normal operating mode; the default is normal operating mode. It has the same function as the *Stop ADC* LED (bit #1 of CB1) at the top center of TSC2014EVM GUI.
- Resolution

  This button selects between 10- and 12-bit resolution. Note that bit #2 of CB1 also controls the resolution; thus, you may need to double-check the settings in both places to make sure they are consistent. The default setting is 12-bit resolution.
- Conversion Clock

  The internal clock that runs the ADC can run at 4 MHz, 2 MHz, or 1 MHz. Note that at 4 MHz, only 10-bit resolution is possible; 12-bit resolution is not. Therefore, you should verify the resolution setting after selecting a 4-MHz conversion clock. By default, the clock runs at 2 MHz.
- Panel Voltage Stabilization Time

  This time is the period that the TSC2014 allows for the touch screen to settle after turning on the drivers.
- Precharge Time
- Sense Time

  These two parameters show the time allowed to precharge the touch panel capacitance and then sense to see if the screen has been touched. For more details about these parameters, see the TSC2014 data sheet.
- Detection of Pen Touch in Wait

  This option is valid when the ADC is put into the host-controlled mode. Enabling this option puts the touch detection in the background and allows the TSC2014 to pull its $\overline{\text{PINTDAV}}$ pin high if no touch is detected while waiting for the host to issue a command, so that the host can decide whether or not a reading touch data command should be issued.
- Longer Sample Mode

  Enabling this option adds an extra 500 ns of sampling time to the normal sampling cycle. It is disabled by default.

© 2010, Texas Instruments Incorporated

7.3.2 Test Mode Configuration (CFR1)

The TSC2014 features a touch screen test function to check if the four-wire touch panel has been properly connected and if there is short-circuitry enabled. To perform the connection test, the resistance range of the touch screen must be entered into CFR1. Select *Short Circuit Panel Test* to perform the short-circuitry test function.

To perform a touch screen test, the *Converter Function Selection* must be set up in CB1 as *X-Axis Connection Test*, *Y-Axis Connection Test*, or *Short-Circuit Test*. The multiple selector under CFR1 provides user access.

The test result returns to the Status Register.

Another TSC2014 feature is the Batch Delay Mode, as shown in the CFR1 section. Under the TSC-controlled ADC mode, this feature adds a delay between ADC samples and thus controls the time/interval between samples. The batch delay ranges from 0 ms to 100 ms.

7.3.3 MAVF Configuration (CFR2)

The preprocessing MAV filter (MAVF) within the TSC2014 reduces sampling noise. See the TSC2014 data sheet for details of the MAVF.

The CFR2 section has five selection buttons that can be used to enable/disable the MAVF on touch data, X, Y, and Z, or nontouch data, AUX and Temperature.

Clicking on the *MAV Filter Control* option box brings up a list of settings on M and W values. Select an eligible option from the list (do not select the *Reserved* option) and the corresponding digital value appears in the next box. Click on the digital box to write the selected value to the CFR2 Register.

7.3.4 Threshold Configuration

Zone detection is one of the new features the TSC2014 offers. The zone detection function was designed to monitor the zone/range of the nontouch inputs, including AUX and TEMP1/TEMP2.

The four control registers on the TSC2014 (used to set up the upper and lower thresholds of AUX and TEMP1/TEMP2) can be accessed through the four moving slides in the *Threshold Selection* section. The zone detection modes can be controlled/selected through the two option boxes at the bottom of the CFR2 section.

© 2010, Texas Instruments Incorporated

7.4 Command Line Interface Tab

Clicking on the *Command Line Interface* tab brings up a screen similar to that shown in Figure 5, which provides a flexible way to read from and write to the TSC2014EVM by the use of scripts.

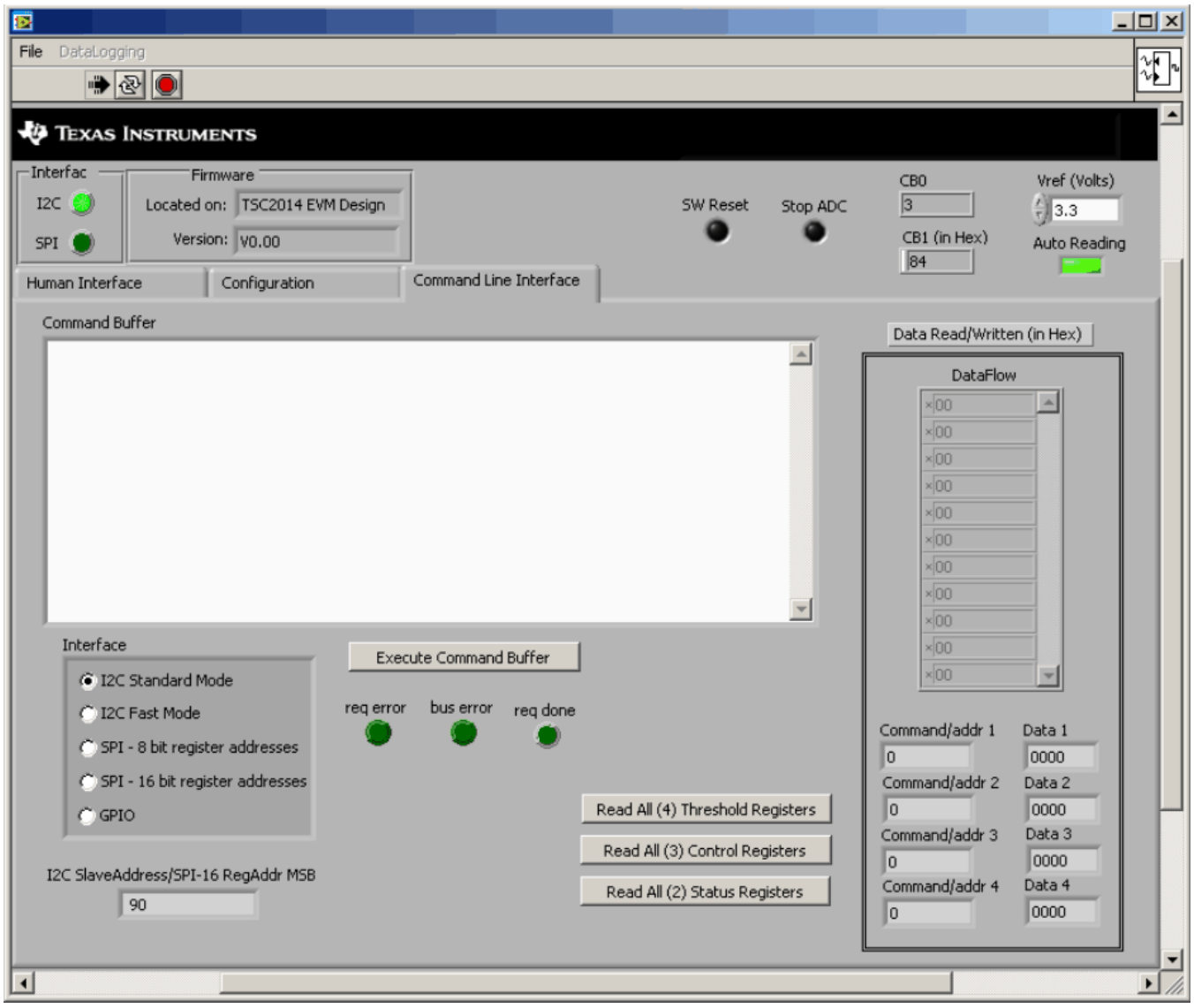


Figure 5. TSC2014EVM-PDK Software GUI: Command Line Interface Tab

The line or lines of the script are typed or loaded into the Command Buffer. Clicking on the **Execute Command Buffer** button runs the script. (The script is discussed in Section 7.4.1.)

There are three LEDs on this tab. The **req done** LED lights up (that is, it turns green) after the script execution finishes. If a line of the script is a reading command, the read data is shown at the *Read Data* section; if the line of the script is a writing command, the written data bytes also are returned to the *Read Data* section.

© 2010, Texas Instruments Incorporated

As Figure 6 shows, three read buttons reveal the contents of the Threshold, Control, and Status Registers of the TSC2014; these contents are also displayed in the *Data Read/Written* section of the screen. The data flow shows at the top of the screen, and is interpreted and listed correspondingly on the button. For example, Figure 5 shows a read result of the four TSC2014 threshold registers after clicking on the **Read All (4) Control Registers** button.

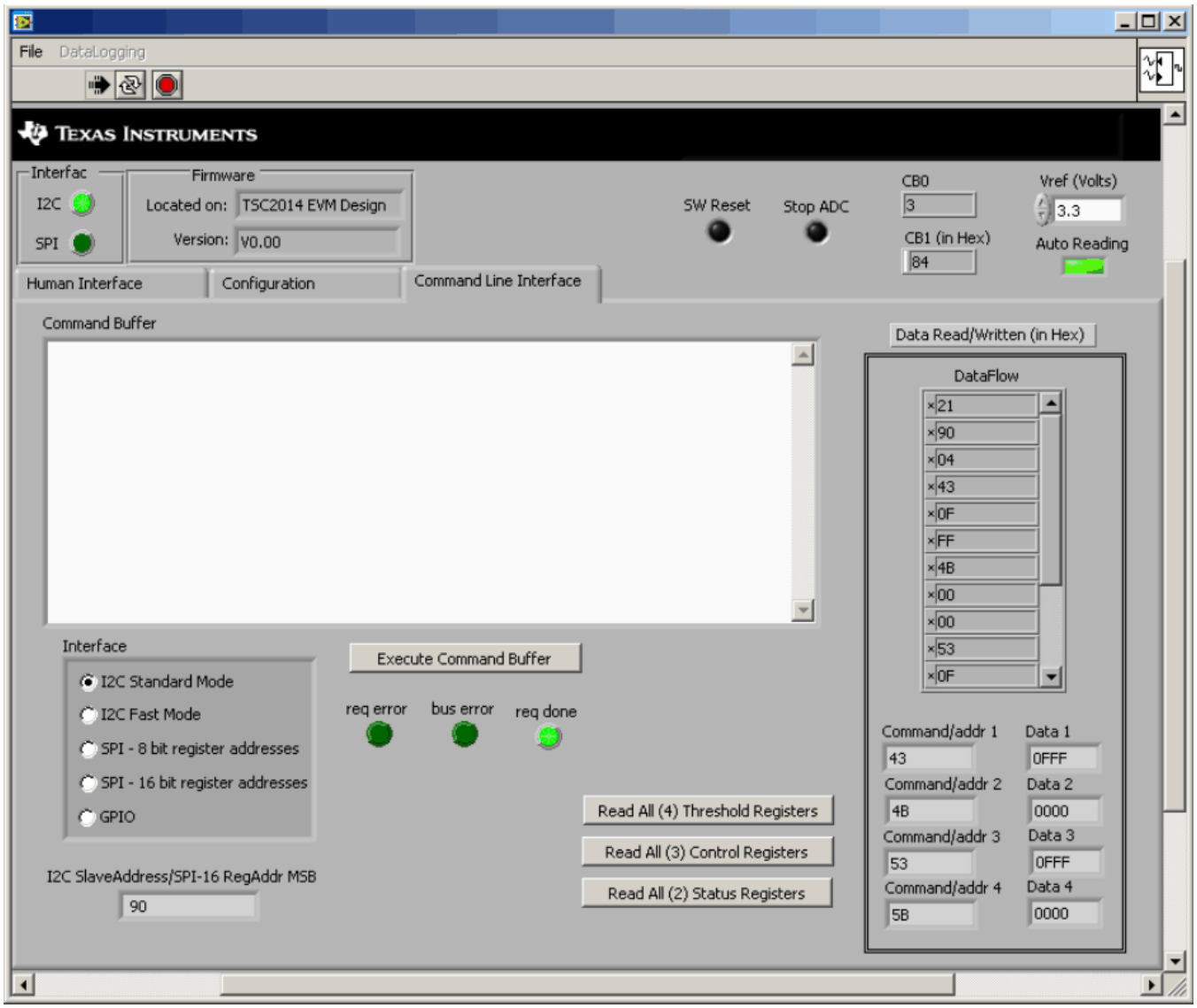


Figure 6. TSC2014EVM-PDK Software GUI: Read All Threshold Registers Option

© 2010, Texas Instruments Incorporated

7.4.1 Software Script

The TSC2014EVM-PDK software was designed to identify and decipher several scripting commands, as described in Table 5.

Table 5. Script Command Types

Command Type	Description
w	Write to TSC through the I^2C serial control bus
r	Read from TSC through the I^2C serial control bus
#	Comment line
b	Break
d	Delay

Each line in a script file is a command, and a line is terminated by a carriage return.

- The first character of a command line indicates the command type. Table 5 lists all the command types that can be recognized and implemented by the TSC2014EVM-PDK software.
- Following the command type *w* or *r*, the byte is the I^2C device address. For the TSC2014, this address is either **[1001 00A0R/W]b** where A0 is 0b by default and can be changed by JP3; the LSB R/W is '1' if a read command or '0' if a write command.

No byte follows a # (comment) or a ***b*** (break) command.

The byte or bytes following a command type ***d*** is the delay time in milliseconds (ms).

- The second byte in a *w* or *r* command line is the address of the TSC2014 configuration register. Refer to the TSC2014 data sheet for details of the register address.

In an *r* command, the byte after the TSC2014 register address indicates the number of registers reading from; the next byte is ignored. If more than one register must be read, the next byte is the address and is followed by two dummy bytes that are ignored.

In a *w* command, the two bytes after the register address are the data written to the 16-bit TSC2014 registers. If more than one registers must be written, the next byte is the register address, followed by two data bytes.

For writing to CB1 of the TSC2014, this byte includes both address and content; thus, there are no further bytes after this address byte.

© 2010, Texas Instruments Incorporated

7.4.2 Software Script Command Line Examples

This section provides several command line script examples for use with the TSC2014EVM evaluation software.

Example 1. Writing to CB1 and Changing to 10-bit Resolution Mode

```
w 90 80
```

Example 2. Writing 0xA924 to Register CFR0 and Writing to CB0 to Set ADC Bias Power Always On

```
w 90 62 A9 24
```

Example 3. Writing 0xA924 to Register CFR0 and Writing to CB0 to Set ADC Bias Power Always Off

```
w 90 60 A9 24
```

Example 4. Writing the Four Threshold Registers to Set Max = 0xFF0 and Min = 0x00F

```
w 90 42 0F F0 4A 00 0F 52 0F F0 5A 00 0F
```

Example 5. Reading the Status Register Contents

```
r 91 38 01 00
```

Example 6. Reading Back the X, Y, Z_1, and Z_2 Data Registers

```
r 91 02 04 00 0A 00 00 12 00 00 1A 00 00
```

7.4.3 Downloading a Script

To download an existing script into the Control Buffer, first go to the *File* menu, then select *Open Command File...*. This menu option opens a file-select window and allows you to browse and find an existing script file. Select the desired file, click on *Open*, and the script is loaded into the command buffer.

7.4.4 Log Script and Data

The software can track and record the script or data used while the TSC2014EVM GUI is active and in use. In the *File* menu, select *Log Script and Results ...* or *Log Data to File ...* to generate the script or data log file.

© 2010, Texas Instruments Incorporated

7.4.4.1 Log Script and Results

Go into the *File* menu and select *Log Script and Results ...*, which opens a file-select window and allows you to specify a log file to write the script and results to. At this point, the script to read/write and the results start to be logged into the file. For example, a written script is logged into the file for any action performed on the Configuration Tab (see Section 7.3); a reading script and the reading results are logged into the file if one of the read buttons on the *Command Line Interface Tab* (refer to Section 7.4) is clicked.

7.4.4.2 Log Data to File

Go into the *File* menu and select *Log Data to File ...*, which opens a file-select window and allows you to specify a log file to write the data to. At the same time, this option enables the Datalogging menu.

When ready to begin recording data to a file, select *Datalogging→Start Logging*. Data are written to the file until *Datalogging→Stop Logging* is selected. When the screen is not touched, the AUX, TEMP1, and TEMP2 values are written to the file; the X, Y, Z_1, and Z_2 parameters are written to the file with values of *9999*, to indicate that they are not updated. When the screen is touched, the X, Y, Z_1, and Z_2 parameters are written while the AUX, TEMP1, and TEMP2 values are written to the file as *9999*.

The format of the data file has the first column as the time in milliseconds (this value is only a timer in the program, and can arbitrarily start at any number); then X, Y, Z_1, Z_2, AUX, TEMP1, and TEMP2 columns follow. Every new reading is a new row in the file.

After selecting the *Start Logging* option , the data are constantly updated, and the datalog file can quickly grow large. Therefore, log only necessary data.

© 2010, Texas Instruments Incorporated

8 EVM Bill of Materials

Table 6 and Table 7 provide a complete bill of materials for the modular TSC2014EVM evaluation board and the USB-MODEVM Interface Board (included only with the TSC2014EVM-PDK), respectively..

Table 6. TSC2014EVM Bill of Materials

Item	Count	RefDes	Description	MFR (1)	Part Number (1)
1	1	NA	Printed wiring board	TI	6518506
1	1	C1	Capacitor, ceramic 10 µF, 10 V 10% X5R 0805	Murata	GRM219R61A106 KE44D
2	3	C2, C3, C8	Capacitor, ceramic 0.1 µF 50 V 10% X7R 0603	Murata	GRM188R71H104 KA93D
3	0	C4, C5, C6, C7	Not installed		
4	2	J1, J2	10-pin, dual row, SM header (20-position)	Samtec	TSM-110-01-T-DV-P
5	2	J1B, J2B (2)	10-pin, dual row, SM header (20-position)	Samtec	SSW-110-22-F-D-VS-K
6	1	J3	5-pin, dual row, SM header (10-position)	Samtec	TSM-105-01-T-DV-P
7	1	J3B (2)	5-pin, dual row, SM header (10-position)	Samtec	SSW-105-22-F-D-VS-K
8	0	J4	Not installed		
9	2	JP1, JP3	3-position header	Samtec	TSW-103-22-T-S
10	1	JP2	2-position header	Samtec	TSW-102-22-T-S
11	1	R1	Resistor, 0.0 Ω 1/10W 5% 0603 SMD	Yageo	RC0603JR-070RL
12	1	R2	Resistor, 100 Ω 1/10W 1% 0603 SMD	Yageo	RC0603FR-07100RL
13	2	R3, R6	Resistor, 20.0 kΩ 1/10W 1% 0603 SMD	Yageo	RC0603FR-0720KL
14	2	R4, R5	Resistor, 2.74 kΩ 1/10W 1% 0603 SMD	Yageo	RC0603FR-072K74L
15	1	TP1	Test point PC Mini .040"D red	Keystone	5000
16	1	TP2 - TP5	Test point PC Mini .040"D black	Keystone	5001
17	0	TP6 - TP14	Not installed		
18	1	U1	TSC2014IYZG, Touch Screen Controller with I^2C Interface	TI	TSC2014IZZZ
19	1	U2	IC, EEPROM 256Kbit 400 kHz 8-TSSOP	Microchip	24AA256-I/ST
Additional Components					
20	3	N/A	0.100 Shunt - Black Shunts	Samtec	SNT-100-BK-T

(1) Manufacturer and part numbers for items may be substituted with electrically equivalent items.

(2) J1B, J2B, J3B bottom side parts are not shown in the schematic diagram.
- J1B is installed on the bottom side of the PCB opposite J1.
- J2B is installed on the bottom side of the PCB opposite J2.
- J3B is installed on the bottom side of the PCB opposite J3.

© 2010, Texas Instruments Incorporated

Table 7. USB-MODEVM Interface Board Bill of Materials

Item	Count	Value	Ref Des	Description	Mfr	Part Number
1	1	10	R4	1/10W 5% Chip Resistor	Panasonic	ERJ-3GEYJ100V
2	2	27.4	R10, R11	1/16W 1% Chip Resistor	Panasonic	ERJ-3EKF27R4V
3	1	75	R20	1/4W 1% Chip Resistor	Panasonic	ERJ-14NF75R0U
4	2	220	R19, R24	1/10W 5% Chip Resistor	Panasonic	ERJ-3GEYJ221V
5	3	390	R14, R21, R22	1/10W 5% Chip Resistor	Panasonic	ERJ-3GEYJ391V
6	1	649	R13	1/16W 1% Chip Resistor	Panasonic	ERJ-3EKF6490V
7	1	1.5k	R9	1/10W 5% Chip Resistor	Panasonic	ERJ-3GEYJ152V
8	4	2.7k	R1, R2, R3, R5	1/10W 5% Chip Resistor	Panasonic	ERJ-3GEYJ272V
9	1	3.09k	R12	1/16W 1% Chip Resistor	Panasonic	ERJ-3EKF3091V
10	2	10k	R15, R16	1/10W 5% Chip Resistor	Panasonic	ERJ-3GEYJ103V
11	1	22.1k	R25	1/16W 1% Chip Resistor	Panasonic	ERJ-3EKF2212V
12	1	25.5k	R27	1/16W 1% Chip Resistor	Panasonic	ERJ-3EKF2552V
13	1	28k	R29	1/16W 1% Chip Resistor	Panasonic	ERJ-3EKF2802V
14	1	30.1k	R18	1/16W 1% Chip Resistor	Panasonic	ERJ-3EKF3012V
15	1	30.9k	R36	1/16W 1% Chip Resistor	Panasonic	ERJ-3EKF3092V
16	1	32.4k	R31	1/16W 1% Chip Resistor	Panasonic	ERJ-3EKF3242V
17	1	36.5k	R34	1/16W 1% Chip Resistor	Panasonic	ERJ-3EKF3652V
18	1	39.2k	R33	1/16W 1% Chip Resistor	Panasonic	ERJ-3EKF3922V
19	1	46.4k	R35	1/16W 1% Chip Resistor	Panasonic	ERJ-3EKF4642V
20	1	48.7k	R32	1/16W 1% Chip Resistor	Panasonic	ERJ-3EKF4872V
21	1	52.3k	R37	1/16W 1% Chip Resistor	Panasonic	ERJ-3EKF5232V
22	1	56.2k	R30	1/16W 1% Chip Resistor	Panasonic	ERJ-3EKF5622V
23	1	76.8k	R28	1/16W 1% Chip Resistor	Panasonic	ERJ-3EKF7682V
24	1	100k	R17	1/10W 5% Chip Resistor	Panasonic	ERJ-3GEYJ104V
25	1	137k	R26	1/16W 1% Chip Resistor	Panasonic	ERJ-3EKF1373V
26	4	200k	R6 through R8, R23	1/10W 5% Chip Resistor	Panasonic	ERJ-3GEYJ204V
27	1	10M	R38	1/10W 5% Chip Resistor	Panasonic	ERJ-3GEYJ106V
28	2	10k	RA1, RA2	1/8W Octal Isolated Resistor Array	CTS Corporation	742C163103JPTR
29	2	33pF	C18, C19	50V Ceramic Chip Capacitor, ±5%, NPO	TDK	C1608C0G1H330J
30	2	47pF	C13, C14	50V Ceramic Chip Capacitor, ±5%, NPO	TDK	C1608C0G1H470J
31	1	100pF	C20	50V Ceramic Chip Capacitor, ±5%, NPO	TDK	C1608C0G1H101J
32	1	1000pF	C21	50V Ceramic Chip Capacitor, ±5%, NPO	TDK	C1608C0G1H102J
33	26	0.1µF	C9 through C12, C15, C22 through C24, C26-43	16V Ceramic Chip Capacitor, ±10%,X7R	TDK	C1608X7R1C104K
34	2	0.33µF	C16, C17	16V Ceramic Chip Capacitor, ±10%,X5R	TDK	C1608X5R1C334K
35	1	1µF	C44	6.3V Ceramic Chip Capacitor, ±10%, X5R	TDK	C1608X5R0J105K
36	9	10µF	C1 through C8, C25	6.3V Ceramic Chip Capacitor, +/ - 10%, X5R	TDK	C3216X5R0J106K
37	1		U1	64K 2-Wire Serial EEPROM I^2C	Microchip	24LC64I/SN
38	1		U11	I^2C Voltage Level Translator	Texas Instruments	PCA9306DCT
39	1		U2	5V LDO Regulator	Texas Instruments	REG1117-5
40	1		U17	Single 3-State Buffer	Texas Instruments	SN74AUP1G125DBV
41	3		U5, U7, U13	1-bit Dual Supply Bus Transceiver	Texas Instruments	SN74AVC1T45DBV
42	3		U3, U4, U12	4-bit Dual Supply Bus Transceiver	Texas Instruments	SN74AVC4T245PW
43	1		U16	Single Open Drain Buffer	Texas Instruments	SN74LVC1G06DBV
44	1		U10	Single 3-State Buffer	Texas Instruments	SN74LVC1G125DBV
45	1		U15	Single 3-State Buffer	Texas Instruments	SN74LVC1G126DBV

© 2010, Texas Instruments Incorporated

Table 7. USB-MODEVM Interface Board Bill of Materials (continued)

Item	Count	Value	Ref Des	Description	Mfr	Part Number
46	1		U6	10-bit Voltage Clamp	Texas Instruments	SN74TVC3010PW
47	1		U8	USB Streaming Controller	Texas Instruments	TAS1020BPFB
48	1		U14	250 mA Adjustable Output LDO Regulator	Texas Instruments	TPS73201DBV
49	1		U9	3.3V/1.8V Dual Output LDO Regulator	Texas Instruments	TPS767D318PWP
50	1		J7	USB Type B Slave Connector Thru-Hole	Mill-Max	897-43-004-90-000000
51	6		J1, J2, J3, J4, J5, J8	2 Position Terminal Block	On Shore Technology	ED555/2DS
52	1		J9	2.5mm Power Connector	CUI Stack	PJ-102BH
53	1		J10	BNC Connector, Female, PC Mount, RA	AMP/Tyco	5413631-2
54	4		J11A, J12A, J16A, J17A	20-pin SMT Plug	Samtec	TSM-110-01-L-DV-P
Not installed	4		J11B, J12B, J16B, J17B	20-pin SMT Socket	Samtec	SSW-110-22-F-D-VS-K
55	2		J13A, J18A	10-pin SMT Plug	Samtec	TSM-105-01-L-DV-P
Not installed	2		J13B, J18B	10-pin SMT Socket	Samtec	SSW-105-22-F-D-VS-K
56	1		J6	4-pin Double Row Header (2x2) .1"	Samtec	TSW-102-07-L-D
57	2		J14, J15	12-pin Double Row Header (2x6) .1"	Samtec	TSW-106-07-L-D
58	1		NA	USB-MODEVM PWB	Texas Instruments	6463995
59	1		D1	50V, 1A, Diode MELF SMD	Micro Commercial Components	DL4001-TP
60	1		D2	Yellow Light Emitting Diode	Lumex	SML-LX0603YW-TR
61	5		D3, D4, D6 to D8	Green Light Emitting Diode	Lumex	SML-LX0603GW-TR
62	1		D5	Red Light Emitting Diode	Lumex	SML-LX0603IW-TR
63	5		JMP1 to JMP4, JMP8	2 Position Jumper, 0 .1-in spacing	Samtec	TSW-102-07-L-S
64	3		JMP5 to JMP7	3 Position Jumper, 0 .1-in spacing	Samtec	TSW-103-07-L-S
65	1		SW1	SMT, Half-Pitch 2 Position Switch	C & K Division, ITT	TDA02H0SB1
66	2		SW2, SW3	SMT, Half-Pitch 8 Position Switch	C & K Division, ITT	TDA08H0SB1
Not installed	9		TP1, TP2, TP3, TP4, TP5, TP6, TP9, TP10, TP11	Miniature Test Point Terminal	Keystone Electronics	5000
67	9		TP7, TP8	Multipurpose Test Point Terminal	Keystone Electronics	5011
68	1		X1	6MHz Crystal SMD	Epson	MA-505 6.0000M-C0:ROHS
					Citizen	HCM49-6.000MABJ-UT
					CTS	ATS060SM-T
69	8		NA	Jumper Plug	Samtec	SNT-100-BK-T
70	4		NA	Rubber Feet, Adhesive Backed	3M Bumpon	SJ-5003

© 2010, Texas Instruments Incorporated

9 TSC2014EVM PCB

The TSC2014EVM PCB silkscreen image is shown in Figure 7.

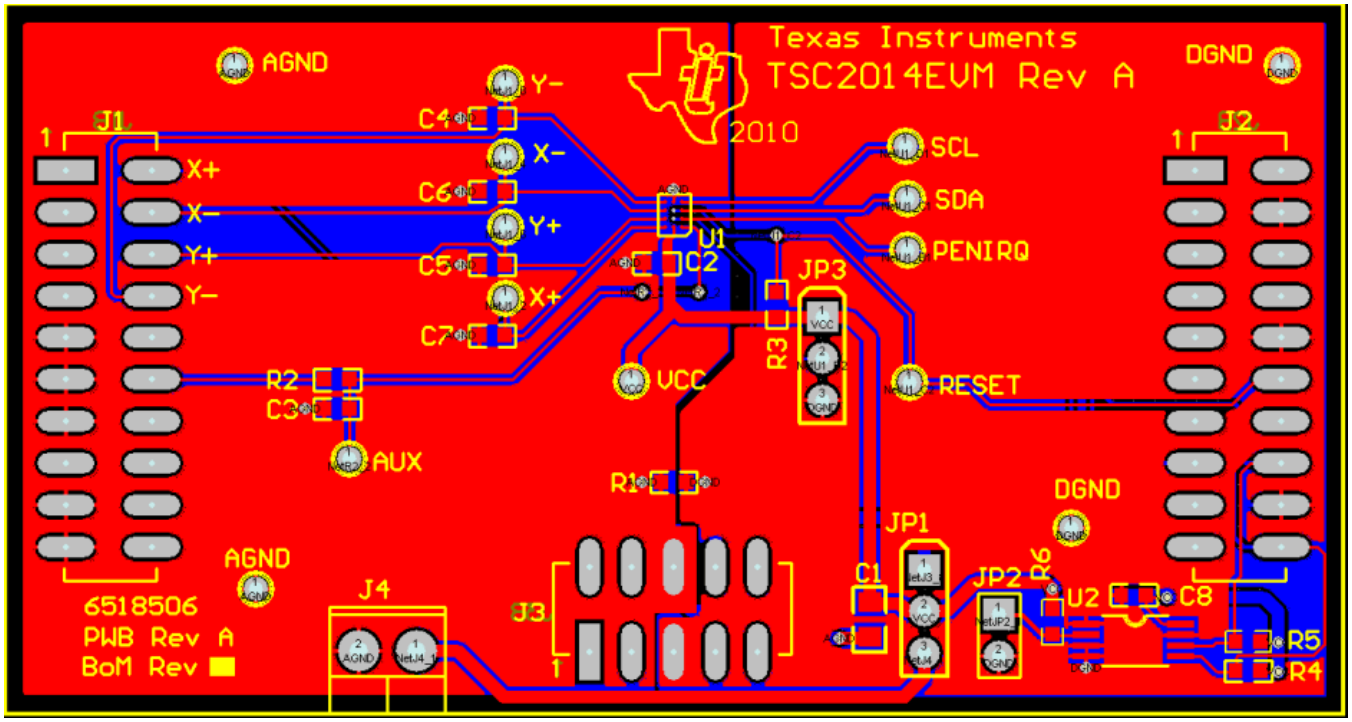
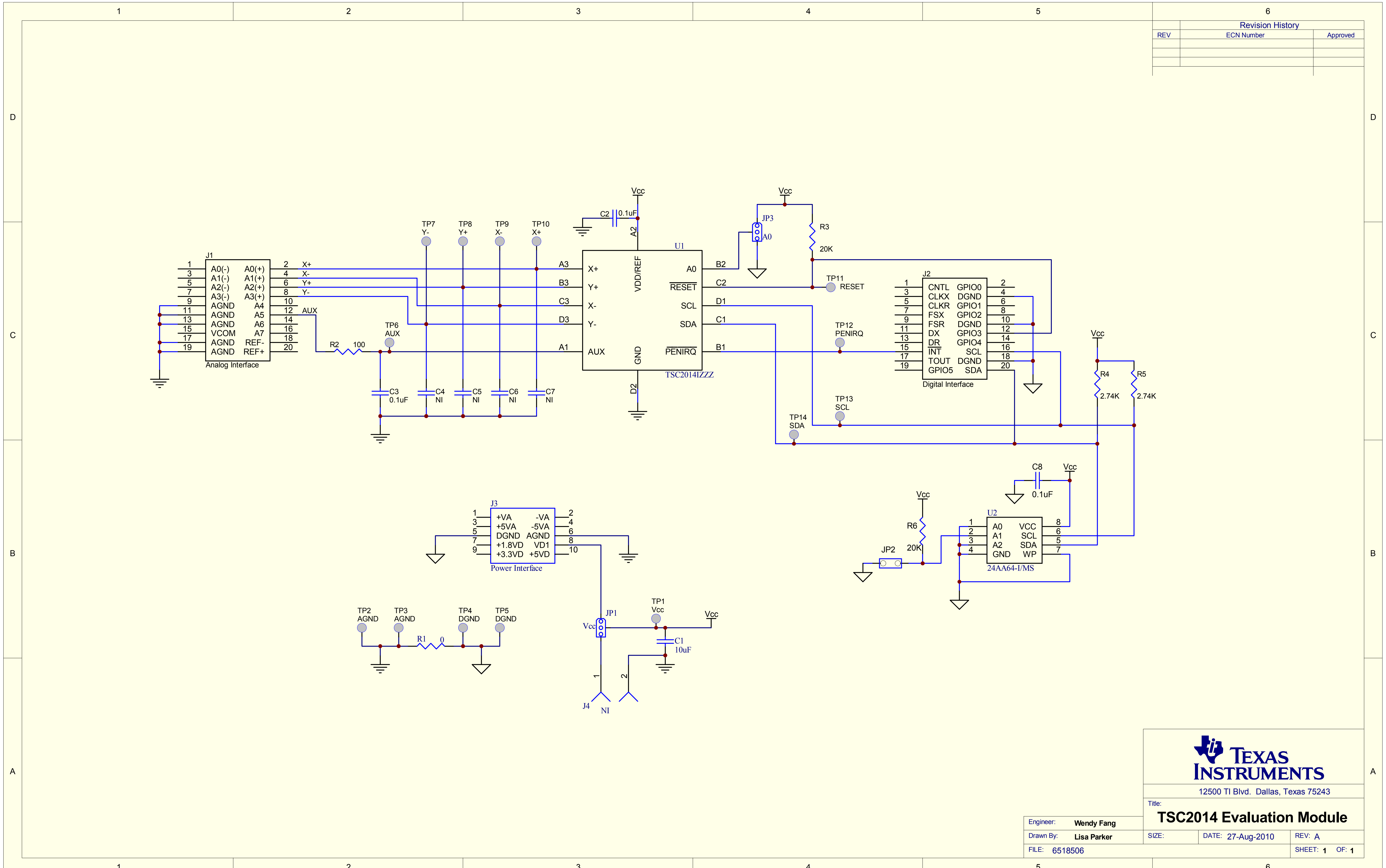


Figure 7. TSC2014EVM PCB Silkscreen (Top View)

10 TSC2014EVM Schematic

The schematic for the TSC2014EVM is appended to this user's guide.

© 2010, Texas Instruments Incorporated


Revision History
REV
ECN Number
Approved
J1
A0(-) A0(+)
A1(-) A1(+)
A2(-) A2(+)
A3(-) A3(+)
AGND A4
AGND A5
AGND A6
VCOM A7
AGND REF-
AGND REF+
Analog Interface
X+
X-
Y+
Y-
AUX
R2 100
TP6 AUX
TP7 Y-
TP8 Y+
TP9 X-
TP10 X+
C3 0.1uF
C4 NI
C5 NI
C6 NI
C7 NI
Vcc
C2 0.1uF
U1
VDD/REF
X+
Y+
X-
Y-
AUX
A0
RESET
SCL
SDA
PENIRQ
GND
TSC2014IZZZ
JP3
A0
R3 20K
TP11 RESET
TP12 PENIRQ
TP13 SCL
TP14 SDA
J2
CNTL GPIO0
CLKX DGND
CLKR GPIO1
FSX GPIO2
FSR DGND
DX GPIO3
DR GPIO4
INT SCL
TOUT DGND
GPIO5 SDA
Digital Interface
R4 2.74K
R5 2.74K
C8 0.1uF
U2
A0 VCC
A1 SCL
A2 SDA
GND WP
24AA64-I/MS
R6 20K
JP2
J3
+VA -VA
+5VA -5VA
DGND AGND
+1.8VD VD1
+3.3VD +5VD
Power Interface
JP1
TP1 Vcc
C1 10uF
J4
NI
TP2 AGND
TP3 AGND
TP4 DGND
TP5 DGND
R1 0
TEXAS INSTRUMENTS
12500 TI Blvd. Dallas, Texas 75243
Title:
TSC2014 Evaluation Module
Engineer: Wendy Fang
Drawn By: Lisa Parker
SIZE:
DATE: 27-Aug-2010
REV: A
FILE: 6518506
SHEET: 1 OF: 1

REVISION HISTORY		
REV	ENGINEERING CHANGE NUMBER	APPROVED

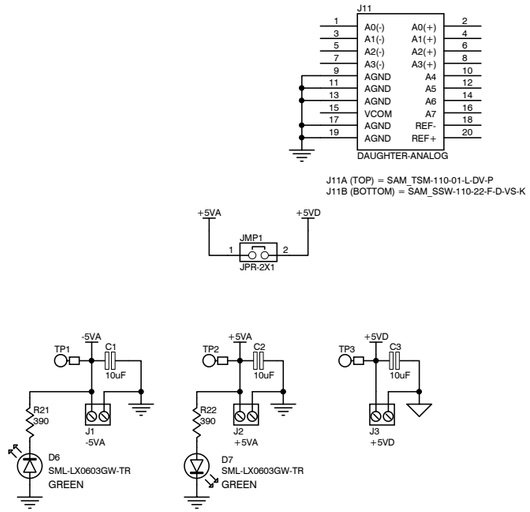
TEXAS INSTRUMENTS

DATA ACQUISITION PRODUCTS
HIGH PERFORMANCE ANALOG DIVISION
SEMICONDUCTOR GROUP

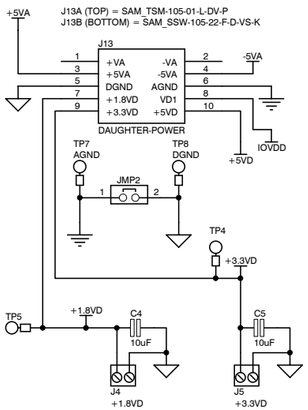
6730 SOUTH TUCSON BLVD., TUCSON, AZ 85706 USA

ENGINEER **RICK DOWNS**	TITLE **USB-MODEVM INTERFACE**		
DRAWN BY **ROBERT BENJAMIN**			
DOCUMENT CONTROL NO. **6463996**	SIZE **B**	DATE **3-Apr-2007**	REV **D**
SHEET **1** OF **2**	FILE **C:\Work\USB-MODEVM\USB Motherboard - ModEvm.ddb - Documents\SCH\USB Interface**		

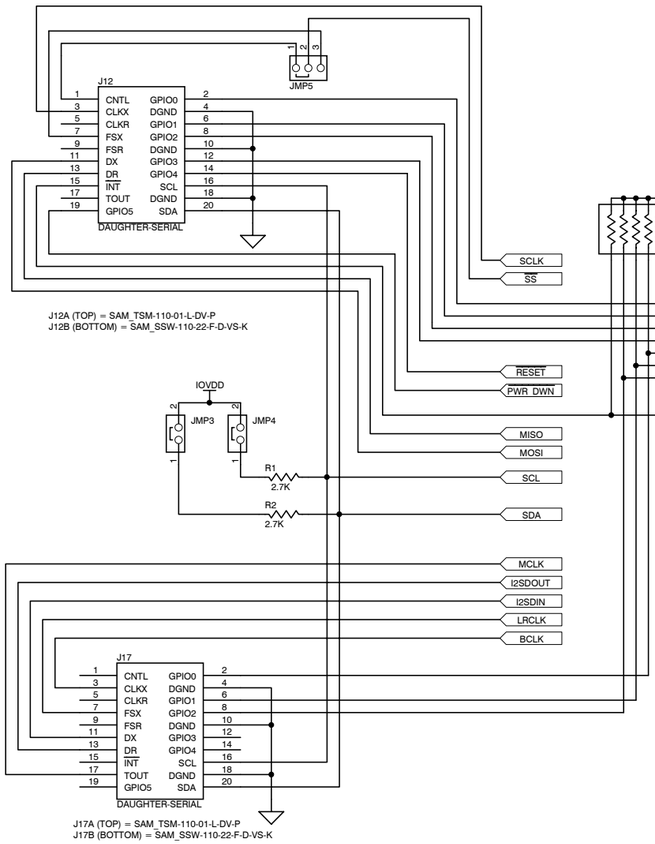
REVISION HISTORY		
REV	ENGINEERING CHANGE NUMBER	APPROVED



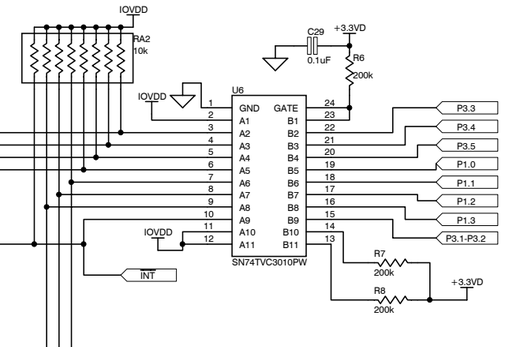
J11A (TOP) = SAM_TSM-110-01-L-DV-P
J11B (BOTTOM) = SAM_SSW-110-22-F-D-VS-K

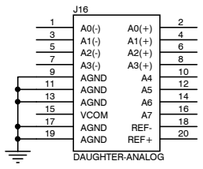


J13A (TOP) = SAM_TSM-105-01-L-DV-P
J13B (BOTTOM) = SAM_SSW-105-22-F-D-VS-K

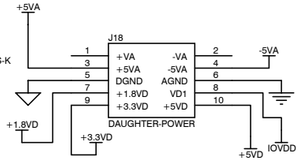


J12A (TOP) = SAM_TSM-110-01-L-DV-P
J12B (BOTTOM) = SAM_SSW-110-22-F-D-VS-K





J16A (TOP) = SAM_TSM-110-01-L-DV-P
J16B (BOTTOM) = SAM_SSW-110-22-F-D-VS-K



J18A (TOP) = SAM_TSM-105-01-L-DV-P
J18B (BOTTOM) = SAM_SSW-105-22-F-D-VS-K

J17A (TOP) = SAM_TSM-110-01-L-DV-P
J17B (BOTTOM) = SAM_SSW-110-22-F-D-VS-K

TEXAS INSTRUMENTS

DATA ACQUISITION PRODUCTS
HIGH-PERFORMANCE ANALOG DIVISION
SEMICONDUCTOR GROUP

6730 SOUTH TUCSON BLVD., TUCSON, AZ 85706 USA

TITLE: **USB-MODEVM INTERFACE**

ENGINEER **RICK DOWNS**			
DRAWN BY **ROBERT BENJAMIN**			
DOCUMENT CONTROL NO. **6463996**	SIZE **B**	DATE **3-Apr-2007**	REV **D**
SHEET **2** OF **2**	FILE **C:\Work\USB-MODEVM\USB Motherboard - ModEvm.ddb - Documents\SCH\Daughtercard Interface**		

Evaluation Board/Kit Important Notice

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation board/kit 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. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and therefore may not meet the technical requirements of these directives or other related directives.

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 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.

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. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

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.

TI currently deals with a variety of customers for products, and therefore our arrangement with the user **is not exclusive.**

TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.**

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 contact the TI application engineer or visit www.ti.com/esh.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used.

FCC Warning

This evaluation board/kit 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 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 will be required to take whatever measures may be required to correct this interference.

EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 0V to +3.6V and the output voltage range of 0V to +3.6V.

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 +30° C. The EVM is designed to operate properly with certain components above +85° 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
Copyright © 2011, Texas Instruments Incorporated

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.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used. TI currently deals with a variety of customers for products, and therefore our arrangement with the user is not exclusive. TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.

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.

Texas Instruments Japan Limited
(address) 24-1, Nishi-Shinjuku 6 chome, Shinjuku-ku, Tokyo, Japan

http://www.tij.co.jp

【ご使用にあたっての注】

本開発キットは技術基準適合証明を受けておりません。

本製品のご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。

日本テキサス・インスツルメンツ株式会社
東京都新宿区西新宿６丁目２４番１号
西新宿三井ビル
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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2012, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components which meet ISO/TS16949 requirements, mainly for automotive use. Components which have not been so designated are neither designed nor intended for automotive use; and TI will not be responsible for any failure of such components to meet such requirements.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2012, Texas Instruments Incorporated