

TSC2008EVM and TSC2008EVM-PDK User's Guide

This user's guide describes the characteristics, operation, and use of the TSC2008EVM, both by itself and as part of the TSC2008EVM-PDK. This evaluation module (EVM) is a 4-wire touch screen controller EVM which also has auxiliary input and temperature measuring 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.

Table 1. EVM-Compatible Device Data Sheets

Device	Literature Number
TSC2008	SBAS406
TAS1020B	SLES025
REG1117-5	SBVS001
TPS767D318	SLVS209
SN74LVC125A	SCAS290
SN74LVC1G125	SCES223
SN74LVC1G07	SCES296

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1 EVM Overview

1.1 Features

- Full-featured evaluation board for the TSC2008 4-wire resistive touch screen controller (TSC).
- Modular design for use with a variety of DSP and microcontroller interface boards.

The TSC2008EVM-PDK is a complete evaluation kit, which includes a USB-based motherboard and evaluation software for use with a personal computer running Microsoft Windows™ operating systems.

1.2 Introduction

The TSC2008EVM is in the Texas Instruments modular EVM form factor, which allows direct evaluation of the performance and operating characteristics of the TSC2008 and eases 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 NI Speedy-33™ from National Instruments Corporation. ([www.ni.com](#))

The TSC2008EVM-PDK is a complete evaluation/demonstration kit, which includes a USB-based motherboard called the USB-MODEVM interface board and evaluation software for use with a personal computer running Microsoft Windows operating systems.

2 Analog Interface

For maximum flexibility, the TSC2008EVM is designed for easy interfacing to multiple analog sources. 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. 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 2. 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
J1.10	Unused	
J1.12	AUX	Auxiliary input, 0 V to VREF
J1.14	Unused	
J1.16	Unused	
J1.18	Unused	
J1.20	Unused	
J1.15	Unused	
J1.1-J1.19 (odd)	AGND	Analog ground connections (except J1.15)

3 Digital Interface

The TSC2008EVM 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. 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 3. Digital Interface Pinout

Pin Number	Signal	Description
J2.1	Unused	
J2.2	Unused	
J2.3	SCLK	SPI serial clock
J2.4	DGND	Digital ground
J2.5	Unused	
J2.6	Unused	
J2.7	$\overline{CS}$	SPI chip selection, active low
J2.8	Unused	
J2.9	Unused	
J2.10	DGND	Digital ground
J2.11	SDI	SPI MOSI - serial data input to TSC from host
J2.12	Unused	
J2.13	SDO	SPI MISO - serial data output from TSC to host
J2.14	Unused	
J2.15	$\overline{PENIRQ}$	PENIRQ Pen interrupt output from TSC, active low
J2.16	SCL	I2C™ bus serial clock
J2.17	Unused	
J2.18	DGND	Digital ground
J2.19	Unused	
J2.20	SDA	I2C bus serial data line

4 Power Supplies

J3 provides connection to the common power bus for the TSC2008EVM. Power is supplied on the pins listed in [Table 4](#).

Table 4. Power Supply Pinout

Signal	Pin Number		Signal
Unused	1	2	Unused
Unused	3	4	Unused
DGND	5	6	AGND
+1.8VD	7	8	Unused
+3.3VD	9	10	Unused

When power is supplied to J3, JMP1 allows for one of two different DC voltages to be selected as power for the TSC. See the schematic and PCB silkscreen for details.

The TSC2008EVM-PDK motherboard (the USB-MODEVM interface board) supplies power to J3 of the TSC2008EVM. Power for the motherboard is supplied either through its USB connection or via terminal blocks on the board.

4.1 TSC Power

Power for the TSC2008 V_{DD} can be supplied either from the +1.8VD terminal or from the +3.3VD terminal. JMP1 selects which of these voltages is routed to the TSC2008. When JMP1 is in the default factory condition (shunt on pins 2-3), power to the TSC comes from J3.9 (+3.3VD). When the shunt is installed on JMP1 pins 1-2, power comes from J3.7 (+1.8VD). Removing the shunt on JMP1, the user can connect any DC power supply between 1.2VD and 3.6VD to VCC by connecting the power to JMP1 pin 2.

Table 5. Power Selection Options - JMP1

SHUNT ON PINS	VDD	VOLTAGE FROM J3 PIN
1-2	+1.8VD	7
2-3	+3.3VD	9
Removed	+1.2VD and +3.6VD	External

4.2 Stand-Alone Operation

When used as a stand-alone EVM, power can be applied to TP6 (V_{DD}), referenced to TP12 (GND).

CAUTION

Verify that all power supplies are within the safe operating limits shown on the TSC2008 data sheet ([SBAS406](#)) before applying power to the EVM.

4.3 USB-MODEVM Interface Power

The USB-MODEVM interface board can be powered from several different sources:

- USB
- 6VDC-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 (this is the default factory configuration). When powered from 6VDC-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 then are applied to J2 (+5VA), J3 (+5VD), J4 (+1.8VD), and J5 (+3.3VD). The +1.8VD and +3.3VD also can be generated on the board by the onboard regulators from the +5VD supply; to enable this supply, the switches on SW1 need to be set to enable the regulators by placing them in the ON position (lower position, looking at the board with text reading right-side up). If +1.8VD and +3.3VD are supplied externally, disable the onboard regulators by placing SW1 switches in the OFF position.

Each power supply voltage has an LED (D1-D7) which lights when the power supplies are active.

5 EVM Operation

The following section provides information on the analog input, digital control, and general operating conditions of the TSC2008EVM.

5.1 Analog Input

The analog input sources (touch screen and auxiliary input) can be applied directly to J1 (top or bottom side) 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). The modular TSC2008EVM also can be connected directly to a DSP or microcontroller interface board, such as the USB-MODEVM interface board if purchased as part of the TSC2008EVM-PDK. See the product folder for the TSC2008 for a current list of compatible interface and/or accessory boards.

5.3 Default Jumper Locations

[Table 6](#) provides a list of jumpers found on the EVM and their factory default conditions.

Table 6. List of Jumpers

Jumper	Shunt Position	Jumper Description
JMP1	2-3	Analog power select (default is +3.3VD)
JMP2	Closed	EEPROM address select. When installed and used with the USB-MODEVM, firmware for the motherboard is executed from the EEPROM on the TSC2008EVM. This is the default mode.

6 Kit Operation

The following section provides information on using the TSC2008EVM-PDK, including setup, program installation, and program usage.

6.1 TSC2008EVM-PDK Block Diagram

A block diagram of the TSC2008EVM-PDK is shown in [Figure 1](#). The evaluation kit consists of two circuit boards connected together. The motherboard is designated as the USB-MODEVM interface board; the daughtercard is the TSC2008EVM described previously in this manual.

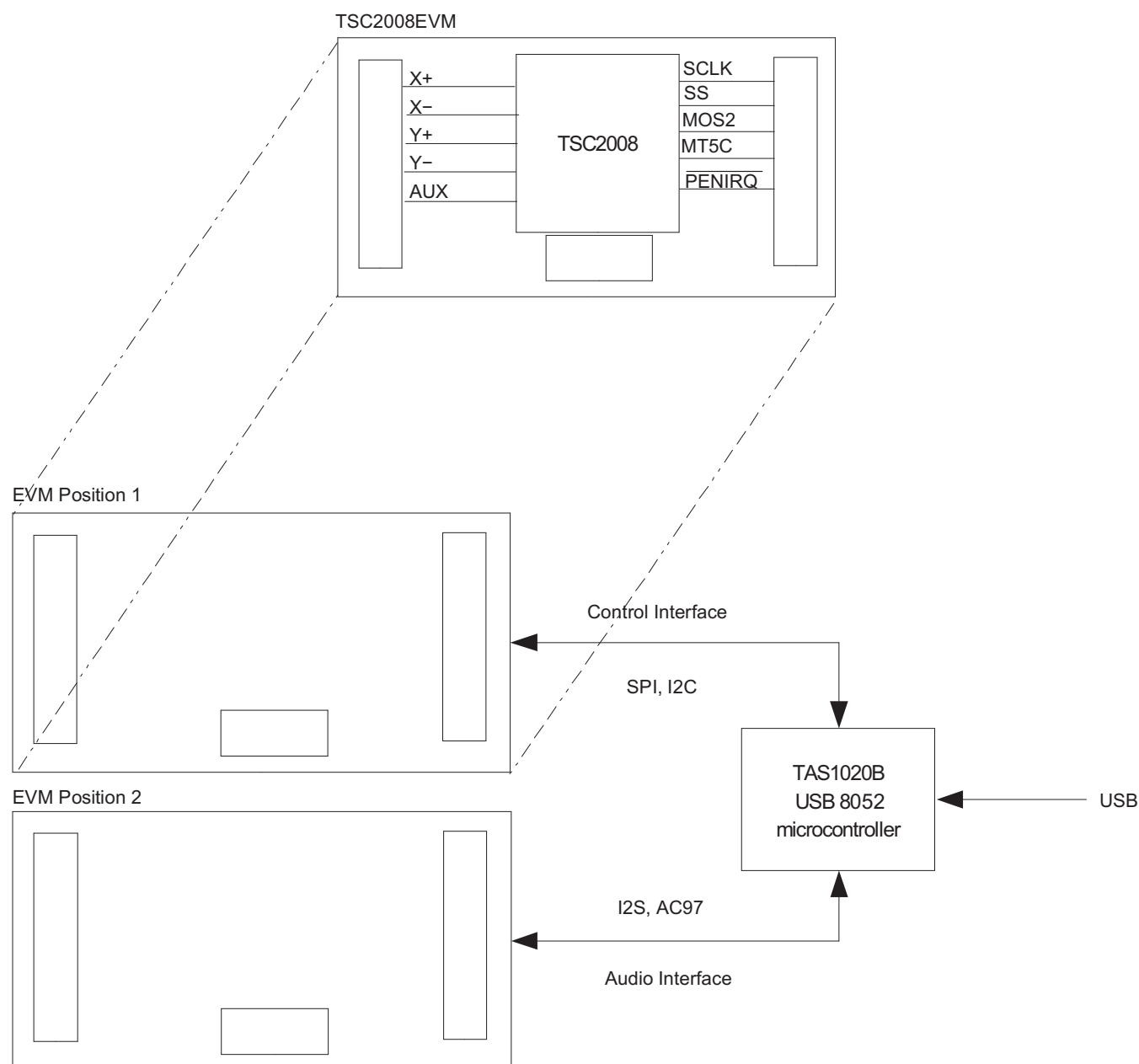


Figure 1. TSC2008EVM-PDK Block Diagram

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 data buses (I²C, SPI™, and I²S/AC97) externally. The source of these signals is controlled by SW2 on the USB-MODEVM.

6.2 Quick Start

Before installing the TSC2008EVM board on top of the USB-MODEVM board, check SW2-1, SW2-2, and SW2-3 on the USB-MODEVM board to ensure that at least one of these three is OFF

Ensure that the TSC2008EVM is installed on the USB-MODEVM interface board. The TSC2008EVM should be installed in the topmost position, using J11, J12, and J13 on the USB-MODEVM.

Place the CD-ROM into your personal computer (PC) CD-ROM drive. Locate the Setup program on the disk, and run it. The Setup program installs the TSC2008 Evaluation software on your PC.

Accept the license agreement, and continue the installation.

When the installation completes, click *Finish* on the TSC2008EVM installer window. You may be prompted to restart your computer.

When installation is complete, attach a USB cable from your PC to the USB-MODEVM interface board. As configured at the factory, the board is powered from the USB interface; so, the power indicator LEDs on the USB-MODEVM should light. Once this occurs, launch the TSC2008 evaluation software on your PC. It is suggested that users read the *readme_install.txt* file for up-to-date, step-by-step instructions.

The software should automatically find the TSC2008EVM, and a screen similar to the one shown in [Figure 2](#) should appear.

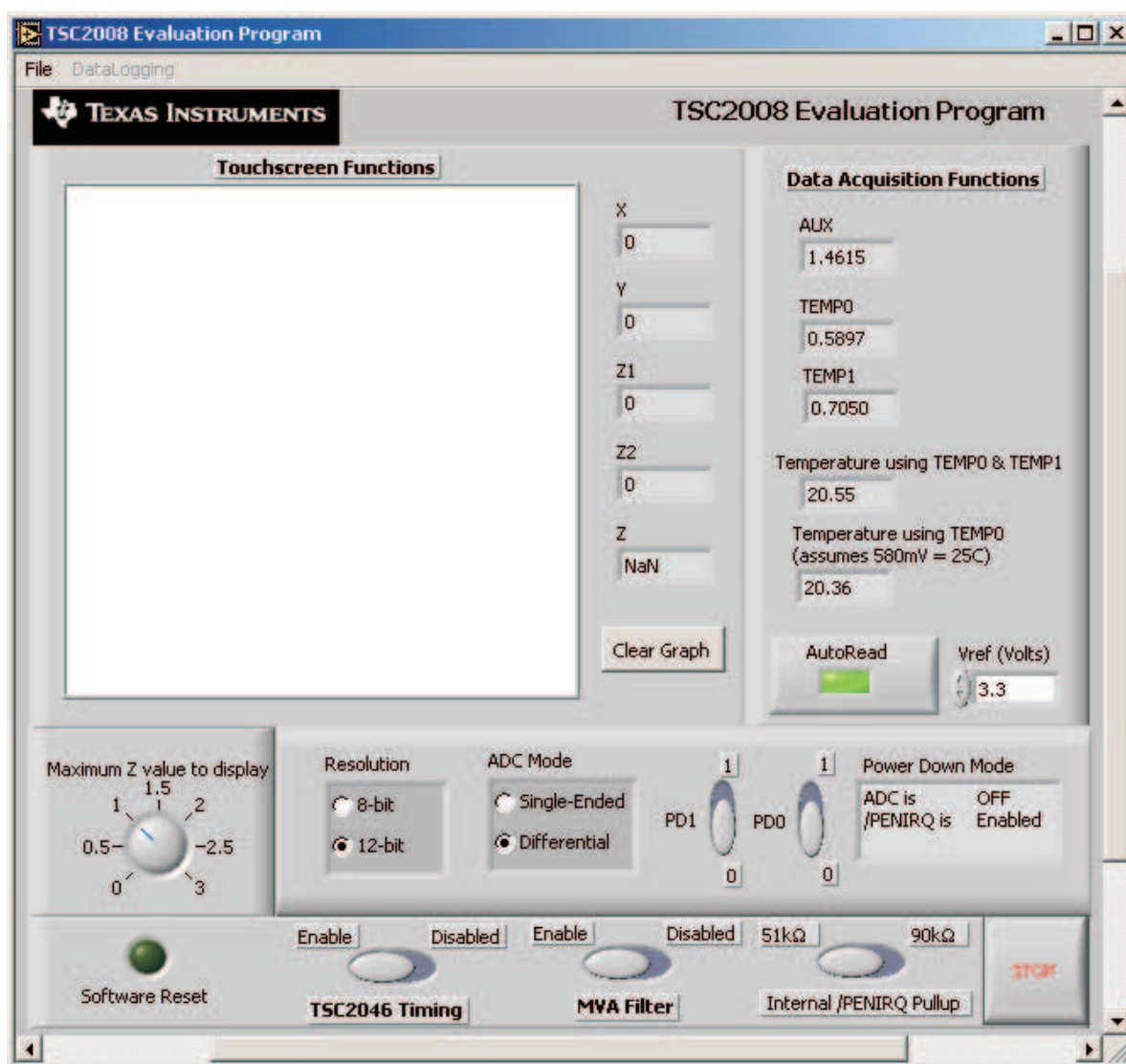


Figure 2. Default Software Screen

In order to use the touch screen features, a user needs to connect a 4-wire resistive touch screen to J1 of the TSC2008EVM, as described previously.

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 built around a TAS1020B streaming audio USB controller with an 8051-based core. The board features two positions for modular EVMs, or one double-wide serial modular EVM may be installed.

For use with the TSC2008, the TSC2008EVM is installed in the topmost EVM slot, which connects the TSC2008 digital control interface to the SP1 port, realized using the TAS1020B. Because the TSC2008 has no audio features, the lower EVM slot, which is connected to the TAS1020B digital audio interface, is not used.

As configured from the factory, the board is ready to use with the TSC2008EVM.

6.4 Program Description

After the TSC2008EVM-PDK software installation (described in [Section 6.2](#)), evaluation and development with the TSC2008 can begin.

6.4.1 Touch Screen Functions Panel

The touch screen box in this panel is updated 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 on this box. The software takes X, Y, and Z readings which are shown to the right of the touch screen box. As the touch pressure is increased, the pixel size increases; a lighter touch results in smaller pixel sizes.

The Z-value displayed is not what is described in the TSC2008 data sheet, because in the data sheet equation, it is assumed that the sheet resistance of the touch screen being used is known. The value used in this program is calculated by Equation 2 of the TSC2008 data sheet, but without multiplying it by the $R_{x-plate}$ resistance. This value ranges from 0 to 3, and larger, 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 display of spurious points that may result from touch screen mechanical bouncing.

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

6.4.2 Data Acquisition Functions Panel

The TSC2008 has provision for measuring one auxiliary input voltages (AUX) and temperature. This panel displays the measured values for these parameters. Measurements are updated only when the touch screen is not being pressed.

Temperature is displayed using both methods described in the TSC2008 data sheet. Using the TEMP0 and TEMP1 measurements, a temperature reading with 2°C resolution and accuracy is achieved. Using only the TEMP0 measurement, a reading with 0.3°C resolution is possible, but this option requires knowing the TEMP0 value at +25°C; this normally is a calibration that the user performs. This program assumes that TEMP0 = 600 mV at +25°C.

6.4.3 Configuration Panel

The TSC2008 can be configured to operate in 8-bit or 12-bit resolution modes. Control over the mode used is selected in this panel.

Touch screen measurements can be made in either single-ended or differential mode; see the TSC2008 data sheet for a discussion of these modes. The touch screen measurement mode can also be selected in this panel. If single-ended mode is used, an external reference is highly recommended; however, single-ended measurements are discouraged for touch screen use because differential mode yields far more accurate results.

The two power-down bits of the TSC2008 can be set from this panel as well. A brief description of the mode selected is shown on the screen when setting these bits; see Table 3 (*Command Byte Definitions*) of the TSC2008 data sheet ([SBAS406](#)) for details on what these bits do.

6.4.4 Setup Panel

TSC2008 has several software programmable features that can be set up by TSC2008 in the setup mode, when $A[2:0] = 2h$.

Software reset can bring TSC2008 to its power-up default condition. When clicking on the LED and it becomes green, the TSC2008 is software reset.

TSC2008 can be totally compatible to TSC2046 on their data protocols, that is: the MSB of MISO signal from the TSC starts at the falling edge of the ninth SCLK, that is: the SDO data is readable from the rising edge of the tenth SCLK. Besides, TSC2008 can have its SDO output readable from the rising edge of the ninth SCLK. This option can be selected by clicking on the *TSC2046 Timing* button. TSC2008 output starting from the tenth SCLK when the TSC2046 Timing is enabled; and TSC2008 outputs starting from the ninth SCLK when the TSC2046 Timing is disabled. TSC2008 is defaulted with the TSC2046 Timing being enabled.

TSC2008 has a built-in MVA filter, which is enabled by default. The MV filter can be disabled/enabled by clicking on the *MVA Filter* button.

The $\overline{PENIRQ}$ can be used as an interrupt to the host and is pulled up by R_{IRQ} internally. The R_{IRQ} is with a programmable value of either 50 k Ω (default) or 90 k Ω . The *Internal $\overline{PENIRQ}$ Pullup* button is used to select the R_{IRQ} .

For more details on the programmable features, see the data sheet.

6.4.5 Datalogging

The software can record the data it takes from the TSC2008 to a tab-delimited file, suitable for importing into spreadsheets. To do this, first go into the *File* menu, and select *Log Data to File...*, which opens a file-select window and allows you to specify a file to which to write the data. At the same time, this enables the Datalogging menu.

When ready to begin recording data to a file, select *Datalogging* $\rightarrow$ *Start Logging*. Data is written to the file until *Datalogging* $\rightarrow$ *Stop Logging* is selected. When the screen is not touched, the AUX and TEMP values are written to the file, and the X, Y, Z1, and Z2 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, Z1, and Z2 parameters are written while the AUX and TEMP values are written to the file as **9999**. Because the program constantly updates at a rate of about 400 readings per second, datalog files can quickly grow large; therefore, log only that data which is necessary.

The format of the data file has the first column as the time in milliseconds (which is just a timer in the program; it can arbitrarily start at any number), then X, Y, Z1, Z2, AUX, TEMP0, and TEMP1 columns. Every new reading is a new row in the file.

7 EVM Bill of Materials

Table 7 and Table 8 contain a complete bill of materials for the modular TSC2008EVM evaluation board and the USB-MODEVM interface board, respectively (included only in the TSC2008EVM-PDK).

Table 7. TSC2008EVM Bill of Materials

Qty	Value	Ref Des	Description	Vendor	Part Number
1	100	R1	1/8W 5% Chip Resistor	Panasonic	ERJ-6GEYJ101V
2	2.7K	R2, R3	1/10W 5% Chip Resistor	Panasonic	ERJ-6GEYJ272V
1	20K	R4	1/10W 5% Chip Resistor	Panasonic	ERJ-6GEYJ203V
1	0.1µF	C1	25V Ceramic Chip Capacitor, ±10%, X7R	TDK	C2012X7R1E104K
2	1µF	C6, C7	16V Ceramic Chip Capacitor, ±10%, X7R	TDK	C2012X7R1C105K
1		U1	Touch Screen Controller	Texas Instruments	TSC2008IRGV
1		U2	I ² C 64K EEPROM, 1.8–5.5V	Microchip	24AA64-I/SN
2		J1A, J2A	20 Pin SMT Plug	Samtec	TSM-110-01-L-DV-P
1		J3A	10 Pin SMT Plug	Samtec	TSM-105-01-L-DV-P
2		J1B, J2B	20 pin SMT Socket	Samtec	SSW-110-22-F-D-VS-K
1		J3B	10 pin SMT Socket	Samtec	SSW-105-22-F-D-VS-K
1		N/A	TSC2008 EVM PWB	Texas Instruments	6495737
1		JMP2	Terminal Strip, 2 pin (2×1)	Samtec	TSW-102-07-G-S
1		JMP1	Terminal Strip, 3 pin (3×1)	Samtec	TSW-103-07-G-S
2		TP6, TP12	Testpoint, Large-Loop	Keystone Electronics	5011
10	Not Installed	TP1–TP5, TP7–TP11	Testpoint, Mini-Loop	Keystone Electronics	5000
2		N/A	Shorting Blocks	Samtec	SNT-100-BK-G-H

ATTENTION: All components should be RoHS compliant. Some part numbers may be either leaded or RoHS. Verify purchased components are RoHS compliant.

Table 8. USB-MODEVM Bill of Materials

Reference Designator	Description	Manufacturer	Manufacturer's Part No.
R4	10Ω 1/10W 5% Chip Resistor	Panasonic	ERJ-3GEYJ100V
R10, R11	27.4Ω 1/16W 1% Chip Resistor	Panasonic	ERJ-3EKF27R4V
R20	75Ω 1/4W 1% Chip Resistor	Panasonic	ERJ-14NF75R0U
R19	220Ω 1/10W 5% Chip Resistor	Panasonic	ERJ-3GEYJ221V
R14, R21, R22	390Ω 1/10W 5% Chip Resistor	Panasonic	ERJ-3GEYJ391V
R13	649Ω 1/16W 1% Chip Resistor	Panasonic	ERJ-3EKF6490V
R9	1.5KΩ 1/10W 5% , Chip Resistor	Panasonic	ERJ-3GEYJ152V
R1–R3, R5–R8	2.7KΩ 1/10W 5% , Chip Resistor	Panasonic	ERJ-3GEYJ272V
R12	3.09KΩ 1/16W 1% , Chip Resistor	Panasonic	ERJ-3EKF3091V
R15, R16	10KΩ 1/10W 5%, Chip Resistor	Panasonic	ERJ-3GEYJ103V
R17, R18	100KΩ 1/10W 5%, Chip Resistor	Panasonic	ERJ-3GEYJ104V
RA1	10KΩ 1/8W Octal Isolated, Resistor Array	CTS Corporation	742C163103JTR
C18, C19	33pF 50V Ceramic, Chip Capacitor, ±5%, NPO	TDK	C1608C0G1H330J
C13, C14	47pF 50V Ceramic, Chip Capacitor, ±5%, NPO	TDK	C1608C0G1H470J
C20	100pF 50V Ceramic Chip Capacitor, ±5%, NPO	TDK	C1608C0G1H101J
C21	1000pF 50V Ceramic Chip Capacitor, ±5%, NPO	TDK	C1608C0G1H102J
C15	0.1μF 16V Ceramic Chip Capacitor, ±10%,X7R	TDK	C1608X7R1C104K
C16, C17	0.33μF 16V Ceramic Chip Capacitor, ±20%,Y5V	TDK	C1608X5R1C334K
C9–C12–C28	1μF 6.3V Ceramic Chip Capacitor, ±10%, X5R	TDK	C1608X5R0J105K
C1–C8	10μF 6.3V Ceramic Chip Capacitor, ±10%, X5R	TDK	C3216X5R0J106K
D1	50V, 1A, Diode MELF SMD	Micro Commercial Components	DL4001
D2	Yellow Light Emitting Diode	Lumex	SML-LX0603YW-TR
D3, D4, D6, D7	Green Light Emitting Diode	Lumex	SML-LX0603GW-TR
D5	Red Light Emitting Diode	Lumex	SML-LX0603IW-TR
Q1, Q2	N-Channel MOSFET	Zetex	ZXMN6A07F
X1	6MHz Crystal SMD	Epson	MA-505 6.000M-C0
U8	USB Streaming Controller	Texas Instruments	TAS1020BPFB
U2	5V LDO Regulator	Texas Instruments	REG1117-5
U9	3.3V/1.8V Dual Output LDO Regulator	Texas Instruments	TPS767D318PWP
U3, U4	Quad, 3-State Buffers	Texas Instruments	SN74LVC125APW
U5–U7	Single IC Buffer Driver with Open Drain o/p	Texas Instruments	SN74LVC1G07DBVR
U10	Single 3-State Buffer	Texas Instruments	SN74LVC1G125DBVR
U1	64K 2-Wire Serial EEPROM I ² C	Microchip	24LC64I/SN
	USB-MODEVM PCB	Texas Instruments	6463995
TP1–TP6, TP9–TP11	Miniature test point terminal	Keystone Electronics	5000
TP7, TP8	Multipurpose test point terminal	Keystone Electronics	5011
J7	USB Type B Slave Connector Thru-Hole	Mill-Max	897-30-004-90-000000
J1–J5, J8	2-position terminal block	On Shore Technology	ED555/2DS
J9	2.5mm power connector	CUI Stack	PJ-102B
J10	BNC connector, female, PC mount	AMP/Tyco	414305-1
J11A, J12A, J21A, J22A	20-pin SMT plug	Samtec	TSM-110-01-L-DV-P
J11B, J12B, J21B, J22B	20-pin SMT socket	Samtec	SSW-110-22-F-D-VS-K
J13A, J23A	10-pin SMT plug	Samtec	TSM-105-01-L-DV-P
J13B, J23B	10-pin SMT socket	Samtec	SSW-105-22-F-D-VS-K
J6	4-pin double row header (2x2) 0.1"	Samtec	TSW-102-07-L-D
J14, J15	12-pin double row header (2x6) 0.1"	Samtec	TSW-106-07-L-D
JMP1–JMP4	2-position jumper, 0.1" spacing	Samtec	TSW-102-07-L-S

Table 8. USB-MODEVM Bill of Materials (continued)

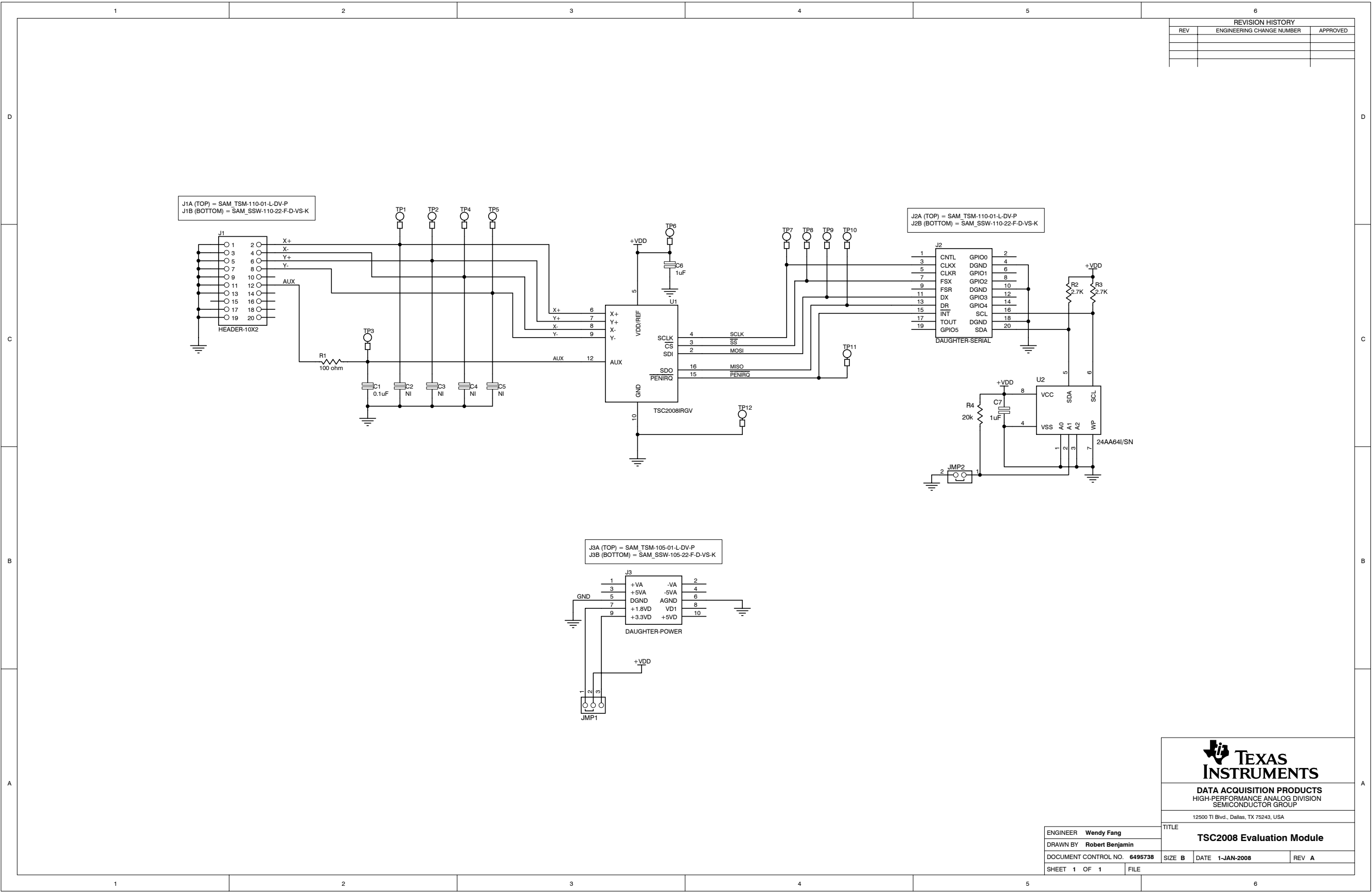
Reference Designator	Description	Manufacturer	Manufacturer's Part No.
JMP8–JMP14	2-position jumper, 0.1" spacing	Samtec	TSW-102-07-L-S
JMP5, JMP6	3-position jumper, 0.1" spacing	Samtec	TSW-103-07-L-S
JMP7	3-position dual row jumper, 0.1" spacing	Samtec	TSW-103-07-L-D
SW1	SMT, half-pitch 2-position switch	C&K Division, ITT	TDA02H0SK1
SW2	SMT, half-pitch 8-position switch	C&K Division, ITT	TDA08H0SK1
	Jumper plug	Samtec	SNT-100-BK-T

8 TSC2008EVM Schematic

The schematic diagram is provided as a reference.

9 USB-MODEVM Schematic

The schematic diagram is provided as a reference.



REVISION HISTORY		
REV	ENGINEERING CHANGE NUMBER	APPROVED



**TEXAS
INSTRUMENTS**

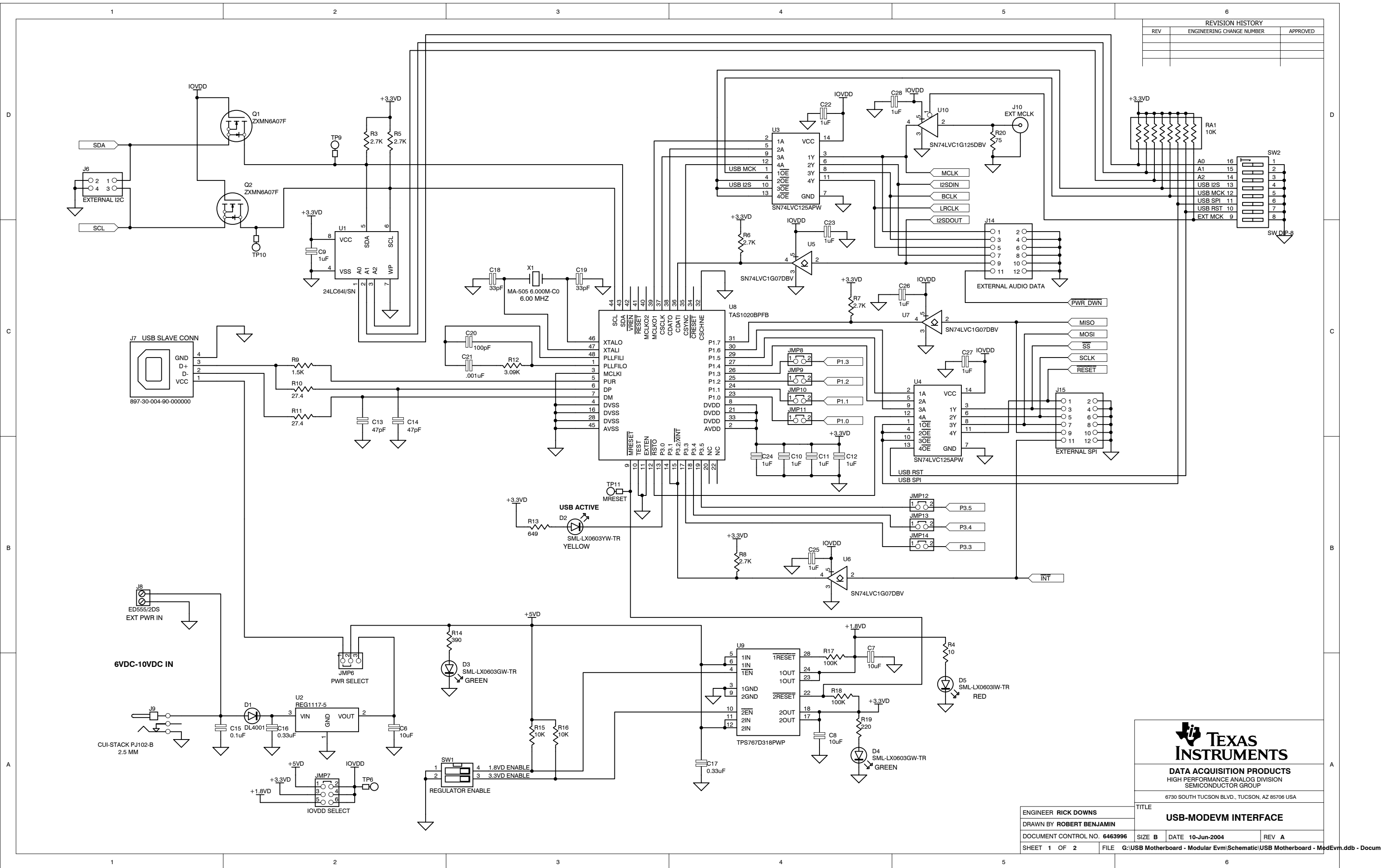
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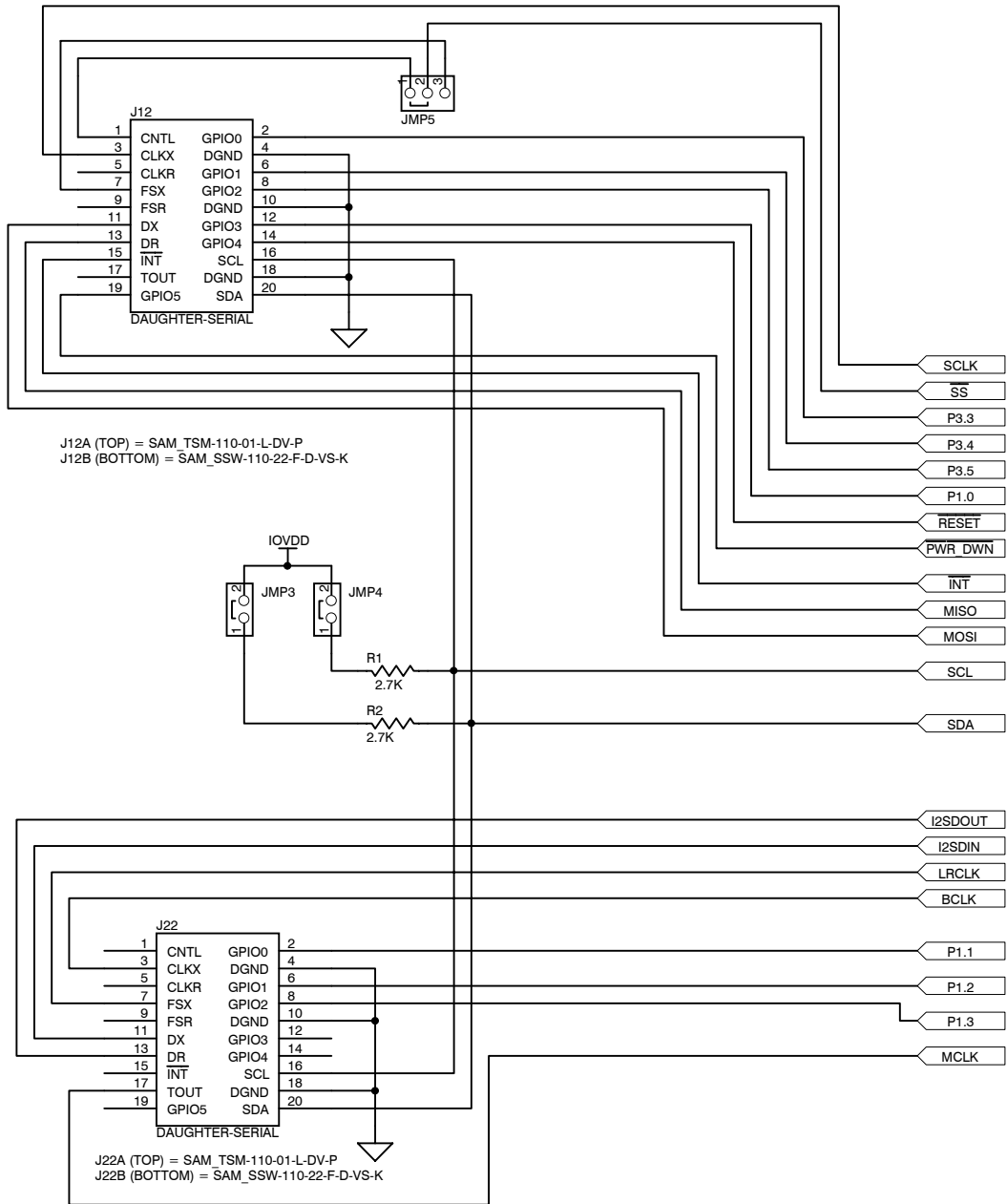
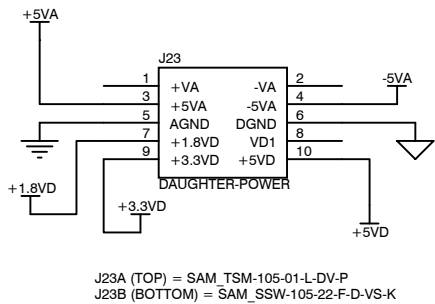
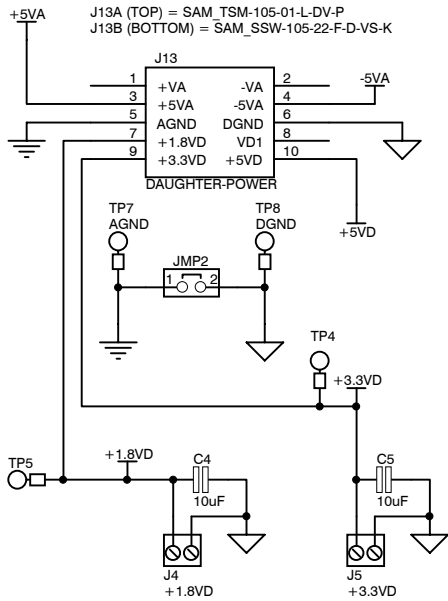
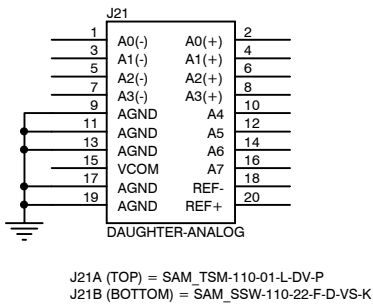
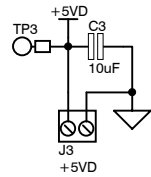
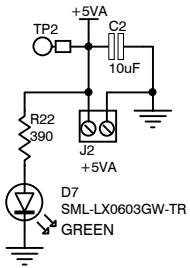
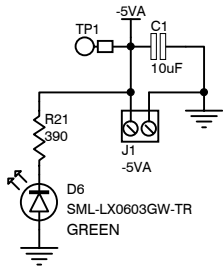
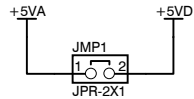
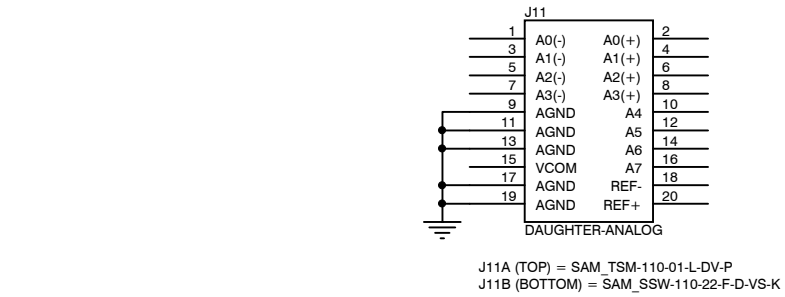
TITLE
TSC2008 Evaluation Module

ENGINEER	Wendy Fang
DRAWN BY	Robert Benjamin
DOCUMENT CONTROL NO.	6495738
SHEET	1 OF 1
SIZE	B
DATE	1-JAN-2008
REV	A

ENGINEER	Wendy Fang
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SHEET	1 OF 1
SIZE	B
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REV	A



REVISION HISTORY		
REV	ENGINEERING CHANGE NUMBER	APPROVED



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 10-Jun-2004

REV A

SHEET 2 OF 2

FILE G:\USB Motherboard - Modular Evm\Schematic\USB Motherboard - ModEvm.ddb - Document

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