

TSC2003EVM and TSC2003EVM-PDK User's Guide

This user's guide describes the characteristics, operation, and use of the TSC2003EVM, both by itself and as part of the TSC2003EVM-PDK. This evaluation module (EVM) is a 4-wire touch screen controller EVM which also has auxiliary inputs and battery 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.

Table 1. EVM-Compatible Device Data Sheets

DEVICE	LITERATURE NUMBER
TSC2003	SBAS162
TAS1020B	SLES025
REG1117-5	SBVS001
TPS767D318	SLVS209
SN74LVC125A	SCAS290
SN74LVC1G125	SCES223
SN74LVC1G07	SCES296

Contents

1	EVM Overview	2
2	Analog Interface.....	2
3	Digital Interface	3
4	Power Supplies	3
5	EVM Operation.....	4
6	Kit Operation	5
7	EVM Bill of Materials.....	10
8	TSC2003EVM Schematic	12
9	USB-MODEVM Schematic.....	12

List of Figures

1	TSC2003EVM-PDK Block Diagram	6
2	Default Software Screen	8

List of Tables

1	EVM-Compatible Device Data Sheets	1
2	Analog Interface Pin Out.....	2
3	Digital Interface Pin Out.....	3
4	Power Supply Pin Out.....	3
5	Power Selection Options - JMP5	3
6	List of Jumpers	5

7	TSC2003EVM Bill of Materials	10
8	USB-MODEVM Bill of Materials	11

1 EVM Overview

1.1 Features

- Full-featured evaluation board for the TSC2003 4-wire resistive touch screen controller (TSC).
- Modular design for use with a variety of DSP and microcontroller interface boards.

The TSC2003EVM-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 TSC2003EVM is in Texas Instruments' modular EVM form factor, which allows direct evaluation of the performance and operating characteristics of the TSC2003, and eases software development and system prototyping. This EVM is compatible with the 5-6K Interface Evaluation Module ([SLAU104](#)) from Texas Instruments and additional third-party boards such as the HPA449 demonstration board from SoftBaugh, Inc. ([www.softbaugh.com](#)) and the Speedy33™ from Hyperception, Inc. ([www.hyperception.com](#))

The TSC2003EVM-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 TSC2003EVM 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 Pin Out

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	VBAT1	Battery Input, 0V to 6V
J1.12	AUX1	Auxiliary Input, 0V to VREF
J1.14	VBAT2	Battery Input, 0V to 6V
J1.16	AUX2	Auxiliary Input, 0V to VREF
J1.18	REF(-)	Tied to analog ground
J1.20	REF(+)	External reference Source Input (2.5V NOM)
J1.15	Unused	
J1.1-J1.19 (odd)	AGND	Analog ground connections (except J1.15)

Speedy33 is a trademark of Hyperception, Inc.
I²C is a trademark of Koninklijke Philips Electronics N.V., The Netherlands.
Windows is a trademark of Microsoft Corporation.
SPI is a trademark of Motorola, Inc.
WinZip is a trademark of WinZip Computing, Inc..

3 Digital Interface

The TSC2003EVM 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 Pin Out

PIN NUMBER	SIGNAL	DESCRIPTION
J2.15	PENIRQ	Pen Interrupt Output from TSC
J2.16	SCL	I ² C™ bus serial clock
J2.4, J2.10, J2.18	DGND	Digital ground
J2.1-J2.19 (odd, except J2.15)	Unused	
J2.20	SDA	I ² C bus data line

4 Power Supplies

J3 provides connection to the common power bus for the TSC2003EVM. Power is supplied on the pins listed in [Table 4](#).

Table 4. Power Supply Pin Out

SIGNAL	PIN NUMBER		SIGNAL
Unused	1	2	Unused
Unused	3	4	Unused
DGND	5	6	AGND
Unused	7	8	+VD1
+3.3VD	9	10	+5VD

When power is supplied to J3, JMP5 allows for one of three different DC voltages to be selected as power for the TSC. See the schematic and PCB silkscreen for details.

The TSC2003EVM-PDK motherboard (the USB-MODEVM Interface board) supplies power to J3 of the TSC2003EVM. 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 TSC2003 VCC can be supplied either from the +5VD terminal or from the +3.3VD terminal. JMP5 selects which of these voltages is routed to the TSC2003. When JMP5 is in the default factory condition (shunt on pins 3-4), power to the TSC comes from J3.9 (+3.3VD). When the shunt is installed on JMP4 pins 5-6, power comes from J3.10 (+5VD). A shunt on JMP4 pins 1-2 connects power to J3.8, an unspecified voltage level that the user may supply.

Table 5. Power Selection Options - JMP5

SHUNT ON PINS	VDD	VOLTAGE FROM J3 PIN
1-2	+VD1	8
3-4	+3.3VD	9
5-6	+5VD	10

4.2 Stand-Alone Operation

When used as a stand-alone EVM, power can be applied to TP2, referenced to TP1.

CAUTION

Verify that all power supplies are within the safe operating limits shown on the [TSC2003 data sheet](#) 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-10VDC AC/DC external wall supply (not included)
- Lab 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 6V-10VDC, 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 lab supplies are used to provide the individual voltages required by the USB-MODEVM Interface, JMP6 should have no shunt installed. Voltages are then applied to J2 (+5VA), J3 (+5VD), J4 (+1.8VD), and J5 (+3.3VD). The +1.8VD and +3.3VD can also 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 will light when the power supplies are active.

4.4 Reference Voltage

The TSC2003 has an internal voltage reference. An external reference may be supplied through pin 20 of J1 on the TSC2003EVM, referenced to analog ground (pin 18 of J1 on the TSC2003EVM). JMP1 must be installed in order to route this external reference voltage to the TSC2003.

CAUTION

Verify that the external reference voltage is within the safe operating limits shown on the [TSC2003 data sheet](#) before applying power to the EVM. Also, program the TSC2003 to use an external reference, if one is used.

5 EVM Operation

The following section provides information on the analog input, digital control, and general operating conditions of the TSC2003EVM.

5.1 Analog Input

The analog input sources (touch screen, auxiliary inputs, and battery inputs) 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 TSC2003EVM can also 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 TSC2003EVM-PDK. See the product folder for the EVM or the TSC2003 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	OPEN	Connects External reference to TSC2003 (default is disconnected, using internal TSC2003 reference)
JMP2	CLOSED	EEPROM Address Select - when installed and used with the USB-MODEVM, firmware for the motherboard is executed from the EEPROM on the TSC2003EVM. This is the default mode.
JMP3	CLOSED	Sets TSC2003 I ² C address bit A0. Installed A0=0, uninstalled A0=1. Default is jumper installed.
JMP4	CLOSED	Sets TSC2003 I ² C address bit A1. Installed A1=0, uninstalled A1=1. Default is jumper installed.
JMP5	3-4	Analog Power Select (default is +3.3VD)
JMP6	CLOSED	Connects analog ground (AGND) to digital ground (DGND). Default is connected.

6 Kit Operation

The following section provides information on using the TSC2003EVM-PDK, including setup, program installation, and program usage.

6.1 TSC2003EVM-PDK Block Diagram

A block diagram of the TSC2003EVM-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, while the daughtercard is the TSC2003EVM described previously in this manual.

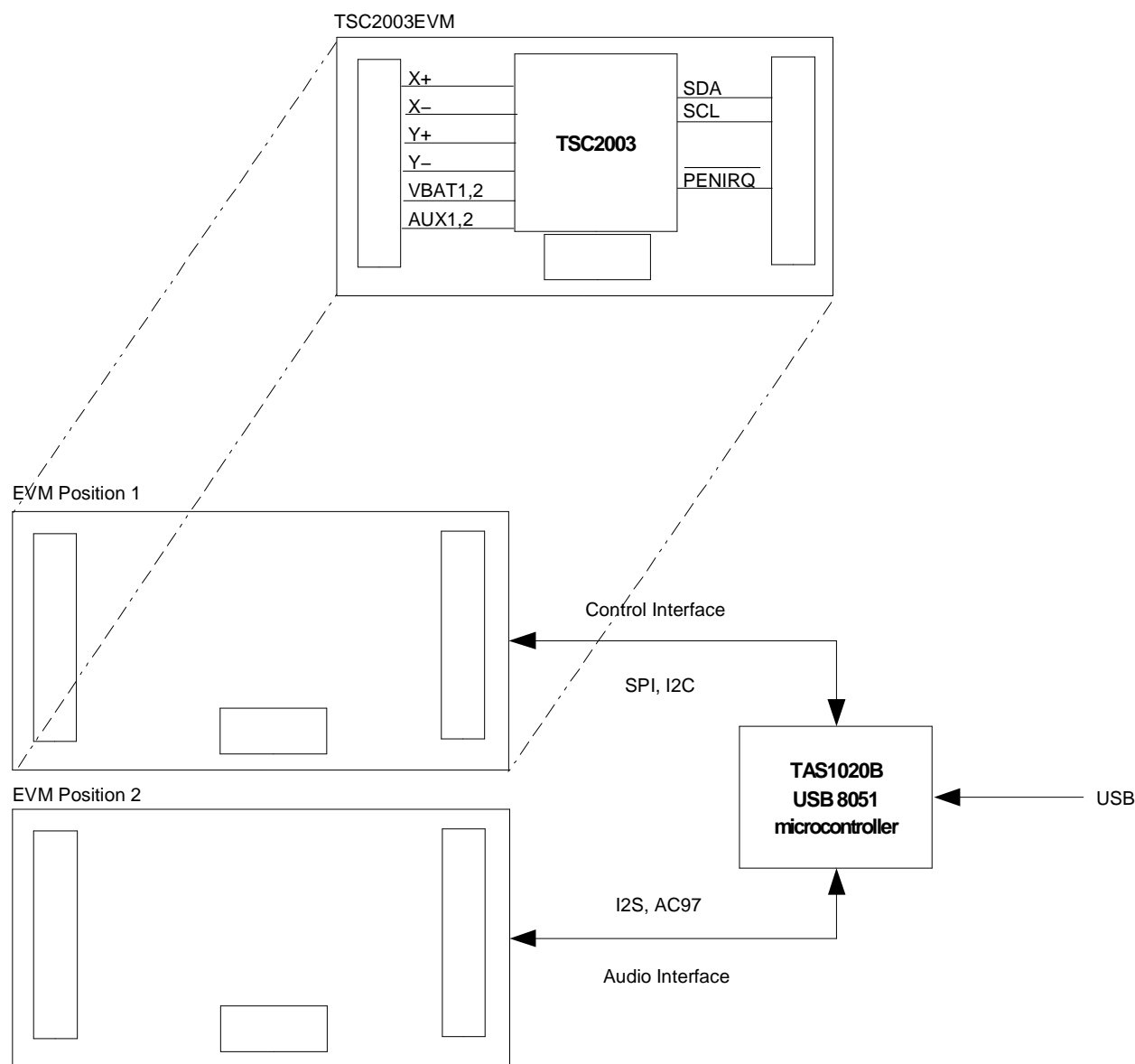


Figure 1. TSC2003EVM-PDK Block Diagram

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. Provision is made, however, for driving all the data buses (I²C, SPI™, I²S/AC97) externally. The source of these signals is controlled by SW2 on the USB-MODEVM.

6.2 Quick Start

Ensure that the TSC2003EVM is installed on the USB-MODEVM Interface board. The TSC2003EVM should be installed in the topmost position, using J11, J12, and J13 on the USB-MODEVM.

Place the CD-ROM into your PC CD-ROM drive. Locate the Setup program on the disk, and run it. The Setup program will install the TSC2003 Evaluation software on your PC.

After the main program is installed, a dialog box appears with instructions for installing NI-VISA 3.2 Runtime, a self-extracting archive. Click *OK* to proceed. A WinZip™ dialog appears. Click *Unzip*, and the archive extracts itself and automatically runs the NI-VISA 3.2 Runtime installer.

Follow the instructions in the NI-VISA 3.2 Runtime Installer. When prompted for which features to install, do the following:

1. Click on the disk icon next to NI-VISA 3.2
2. Select, ***Do not install this feature.***
3. Click on the disk icon next to *USB*.
4. Select the option which installs this feature.
5. Click *Next*.

Accept the license agreement, and continue the installation.

When the installation completes, click *Finish* on the TSC2003EVM 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 will be powered from the USB interface, so the power indicator LEDs on the USB-MODEVM should light. Once this occurs, launch the TSC2003 Evaluation software on your PC.

The software should automatically find the TSC2003EVM, and a screen similar to the one shown in [Figure 2](#) should appear.

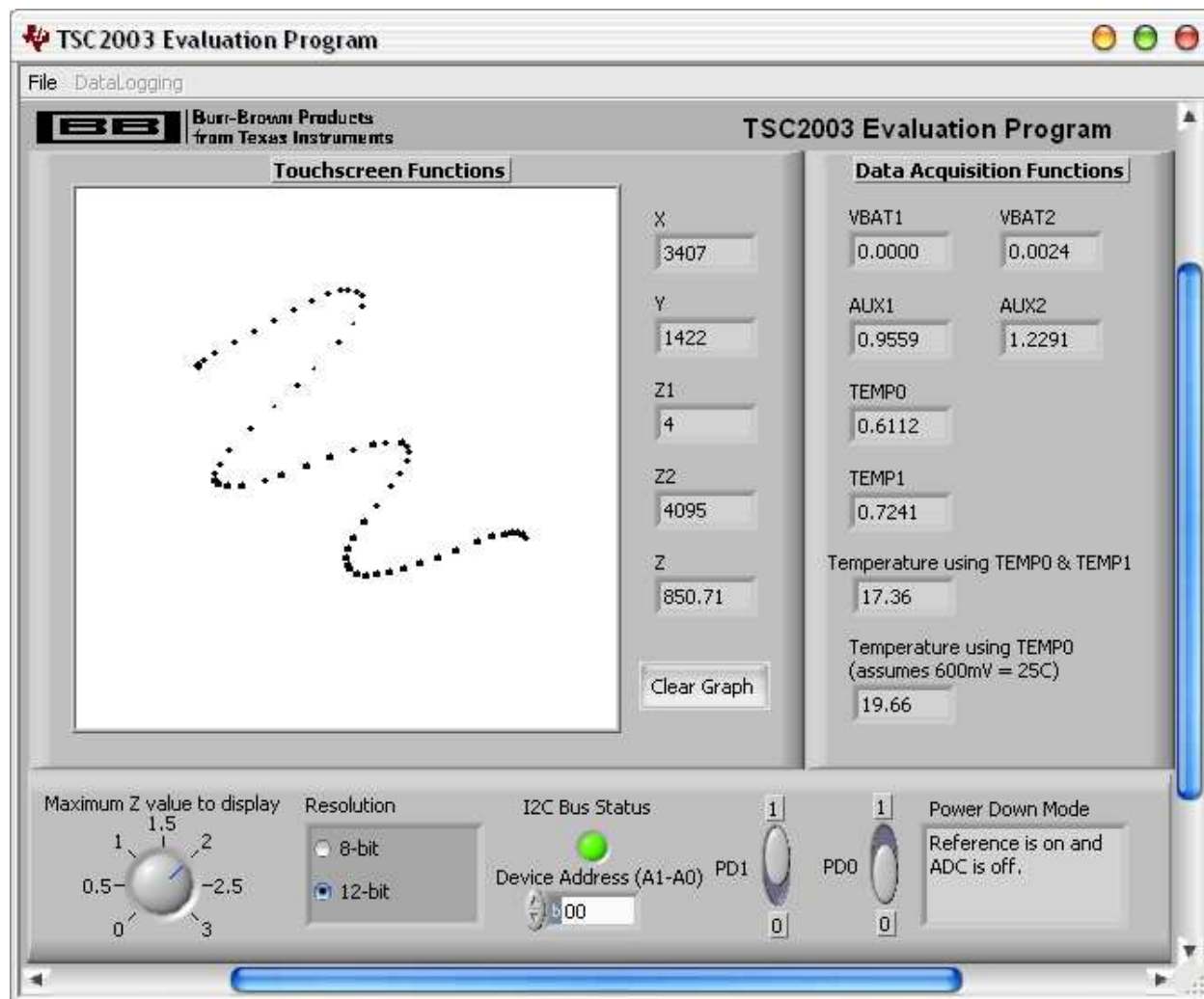


Figure 2. Default Software Screen

In order to use the touch screen features, a 4-wire resistive touch screen will need to be connected to J1 of the TSC2003EVM, as described earlier.

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 TSC2003, the TSC2003EVM is installed in the topmost EVM slot, which connects the TSC2003 digital control interface to the I²C port realized using the TAS1020B. Since the TSC2003 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 TSC2003EVM. However, if external SPI control is desired, the signals may be applied to J15, as long as the SW2 is set so that USB SPI control is disabled. To view all the functions and configuration options available on this board, see the USB-MODEVM Interface Board schematic in [Section 9](#).

6.4 Program Description

After the TSC2003EVM-PDK software installation (described in [Section 6.2](#)), evaluation and development with the TSC2003 can begin.

6.4.1 Touch Screen Functions Panel

The touch screen box in this panel will be updated when a touch is detected on the touch screen. As the touch screen is drawn upon, the motion on the touch screen will be 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 TSC2003 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 TSC2003 data sheet, but without multiplying it by the $R_{X\text{-plate}}$ resistance. This value ranges from 0 to 3, and larger, with smaller 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 TSC2003 has provision for measuring two battery voltages (VBAT1 and VBAT2), two auxiliary input voltages (AUX1 and AUX2), 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 TSC2003 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 would normally be a calibration that the user would perform. This program assumes that TEMP0 = 600mV at +25°C.

6.4.3 Configuration Panel

The TSC2003 can be configured to operate in 8-bit or 12-bit resolution modes. Control over the mode used is selected in this panel.

In the middle of this panel is an indicator light that shows the I²C Bus Status. If the TSC2003 is acknowledging the address sent, the light is green; if the TSC2003 cannot acknowledge, the light is red. The address that the TSC2003 is set to is shown in binary format in the box labeled, *Device Address A1-A0*. The address set here should correspond to the bit settings determined by JMP3 and JMP4 on the TSC2003EVM.

The two power-down bits of the TSC2003 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 II (*Power-Down Bit Functions*) of the TSC2003 data sheet for details on what these bits do.

6.4.4 Datalogging

The software can record the data it takes from the TSC2003 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* → *Start Logging*. Data is written to the file until *Datalogging* → *Stop Logging* is selected. When the screen is not touched, the VBAT1, VBAT2, AUX1, AUX2 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 VBAT1, VBAT2, AUX1, AUX2 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.

EVM Bill of Materials

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, VBAT1, VBAT2, AUX1, AUX2, 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 TSC2003EVM and the USB-MODEVM Interface Board (included only in the TSC2003EVM-PDK).

Table 7. TSC2003EVM Bill of Materials

REFERENCE DESIGNATOR	DESCRIPTION	MANUFACTURER	MFG. PART NUMBER
R1, R2, R3, R4	0Ω 1/8W 5% Chip Resistor	Panasonic	ERJ-6GEY0R00V
R5, R6, R7, R8	100Ω 1/8W 5% Chip Resistor	Panasonic	ERJ-6GEYJ101V
R9, R10, R11, R12, R13	2.7KΩ 1/10W 5% Chip Resistor	Panasonic	ERJ-3GEYJ272V
R14	51KΩ 1/10W 5% Chip Resistor	Panasonic	ERJ-3GEYJ272V
C11	1μF 16V Ceramic Chip Capacitor, +/- 10%, X7R	TDK	C1608X7R1C105K
C9, C10	10μF 16V Ceramic Chip Capacitor, +/- 20%, X5R	TDK	C3216X5R1C106M
C1, C2, C3, C4, C5, C6, C7, C8	Ceramic Chip Capacitor - Not installed		
U1	I ² C Touch Screen Controller	Texas Instruments	TSC2003IPW
U2	64K I ² C EEPROM	MicroChip	24LC64-I/SN
	TSC2003EVM PCB	Texas Instruments	6437755
J1A, J2A	20-pin SMT plug	Samtec	TSM-110-01-L-DV-P
J1B, J2B	20-pin SMT socket	Samtec	SSW-110-22-F-D-VS-K
J3A	10-pin SMT plug	Samtec	TSM-105-01-L-DV-P
J3B	10-pin SMT socket	Samtec	SSW-105-22-F-D-VS-K
JMP1, JMP2, JMP3, JMP4	2-position jumper , 0.1" spacing	Samtec	TSW-102-07-L-S
JMP5	2 X 3 position header , 0.1" spacing	Samtec	TSW-103-07-L-D
TP1	Multipurpose test point terminal	Keystone Electronics	5011
TP2	Miniature test point terminal	Keystone Electronics	5000
	Header shorting block	Samtec	SNT-100-BK-T

Table 8. USB-MODEVM Bill of Materials

REFERENCE DESIGNATOR	DESCRIPTION	MANUFACTURER	MFG. PART NUMBER
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, R2, R3, R5, R6, R7, 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, C10, C11, C12, C22, C23, C24, C25, C26, C27, C28	1μF 6.3V Ceramic Chip Capacitor, ±10%, X5R	TDK	C1608X5R0J105K
C1, C2, C3, C4, C5, C6, C7, 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, Tri-State Buffers	Texas Instruments	SN74LVC125APW
U5, U6, U7	Single IC Buffer Driver with Open Drain o/p	Texas Instruments	SN74LVC1G07DBVR
U10	Single Tri-State Buffer	Texas Instruments	SN74LVC1G125DBVR
U1	64K 2-Wire Serial EEPROM I ² C	Microchip	24LC64I/SN
	USB-MODEVM PCB	Texas Instruments	6463995

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

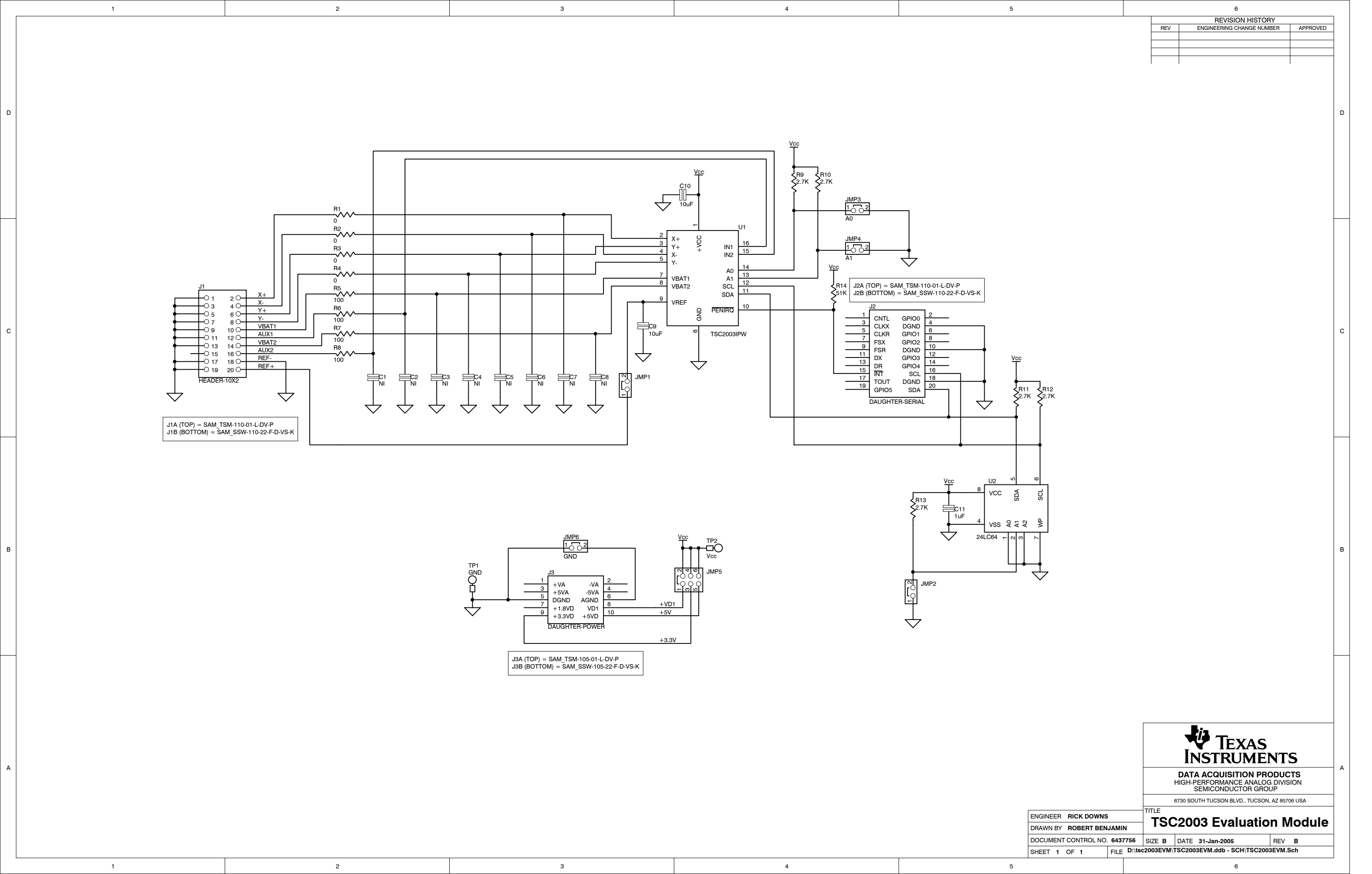
REFERENCE DESIGNATOR	DESCRIPTION	MANUFACTURER	MFG. PART NUMBER
TP1, TP2, TP3, TP4, TP5, TP6, TP9, TP10, TP11	Miniature test point terminal	Keystone Electronics	5000
TP7, TP8	Multipurpose test point terminal	Keystone Electronics	5011
J7	USB Type B Slave Connector Thru-Hole	Mill-Max	897-30-004-90-000000
J1, J2, J3, J4, 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
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

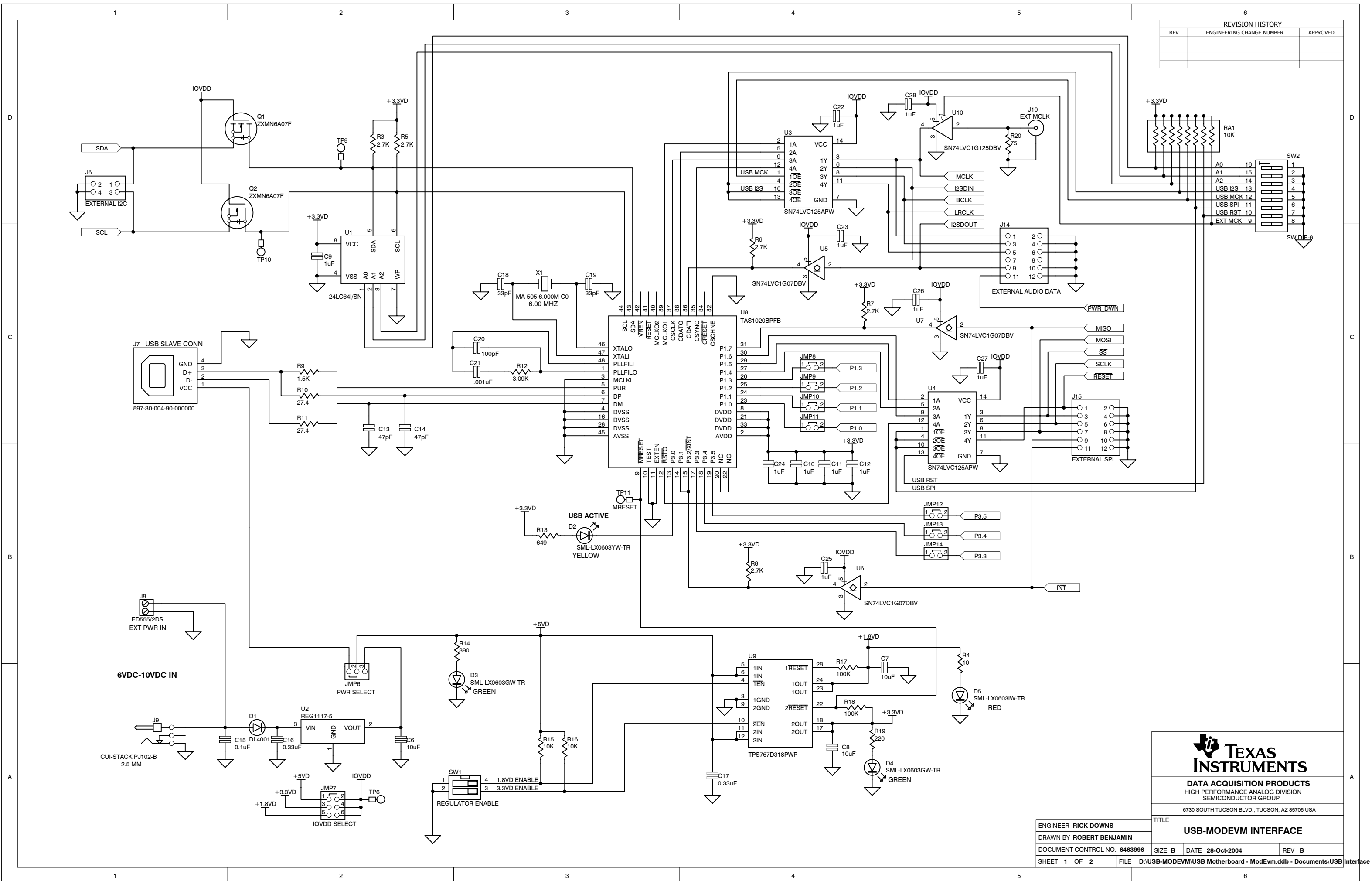
8 TSC2003EVM Schematic

The schematic diagram is provided as a reference.

9 USB-MODEVM Schematic

The schematic diagram is provided as a reference.





FCC Warnings

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

EVM IMPORTANT NOTICE

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

This evaluation kit being sold by TI is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not considered by TI to be fit for commercial use. As such, the goods being provided may not be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety measures typically found in the end product incorporating the goods. As a prototype, this product does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may not meet the technical requirements of the directive.

Should this evaluation kit not meet the specifications indicated in the EVM User's Guide, the 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.**

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Persons handling the product must have electronics training and observe good laboratory practice standards.

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 3.3 V to 5 V and the output voltage range of 0 V to 5 V.

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.

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