TLV320AIC1103/1110EVM-K

This user's guide describes the characteristics, operation, and use of evaluation modules TLV320AIC1103/1110EVM-K. A complete circuit description, schematic diagram and bill of materials are also included.

Throughout this document, TLV320AIC11xxEVM refers to TLV320AIC1103/1110EVM-K.

Related documents are available through the Texas Instruments web site at www.ti.com.

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1 EVM Overview

1.1 Features

- Full-featured evaluation board for the TLV320AIC11xx audio codec
- TLV320AIC11xxEVM-K features USB connectivity for quick and easy setup.
- Intuitive evaluation software
- Easy interfacing to multiple analog sources
- Analog output signals from the TLV320AIC11xx are available on top and bottom connectors.
- External microphone jack and electric microphone are included
- Digital control signals can be applied directly to top and bottom connectors.

1.2 Introduction

The TLV320AIC11xxEVM-K 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® XP operating systems only. Provisions are made for connecting all audio inputs and outputs either from the modular connectors or with on-board terminals and external microphone jack. An on-board electret microphone is also provided.

2 Analog Interface

For maximum flexibility, the TLV320AIC11xxEVM 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. These headers/sockets provide access to the analog input and output pins of the device. Consult Samtec at www.samtec.com or call 1-800-SAMTEC-9 for a variety of mating connector options. Table 1 summarizes the analog interface pinout for the TLV320AIC11xxEVM.

Table 1. Analog Interface Pinout

PIN NUMBER	SIGNAL	DESCRIPTION
1.01	EAR1ON	DAC Inverting output
1.02	EAR1OP	DAC Noninverting output
1.03	NC	Not Connected
1.04	EAR2O	DAC Single-Ended Output
1.05	NC	Not Connected
1.06	NC	Not Connected
1.07	NC	Not Connected
1.08	NC	Not Connected
1.09	AGND	Analog Ground
1.10	NC	Not Connected
1.11	AGND	Analog Ground
1.12	NC	Not Connected
1.13	AGND	Analog Ground
1.14	NC	Not Connected
1.15	NC	Not Connected
1.16	NC	Not Connected
1.17	AGND	Analog Ground
1.18	NC	Not Connected
1.19	AGND	Analog Ground
1.20	NC	Not Connected
2.01	MIC2N	ADC Inverting Input
2.02	MIC2P	ADC Noninverting Input
2.03	NC	Not Connected

Table 1. Analog Interface Pinout (continued)

PIN NUMBER	SIGNAL	DESCRIPTION
2.04	NC	Not Connected
2.05	NC	Not Connected
2.06	NC	Not Connected
2.07	MIC1N	ADC Inverting Input
2.08	MIC1P	ADC Noninverting Input
2.09	AGND	Analog Ground
2.10	NC	Not Connected
2.11	AGND	Analog Ground
2.12	NC	Not Connected
2.13	AGND	Analog Ground
2.14	NC	Not Connected
2.15	NC	Not Connected
2.16	NC	Not Connected
2.17	AGND	Analog Ground
2.18	NC	Not Connected
2.19	AGND	Analog Ground
2.20	NC	Not Connected

In addition to the analog headers, the analog inputs and outputs may also be accessed through alternate connectors, either screw terminals or audio jacks. The microphone input is tied to J9. Table 2 summarizes the screw terminals available on the TLV320AIC11xxEVM.

Table 2. Alternate Analog Connectors

DESIGNATOR	PIN 1	PIN 2
J6	EAR1ON	EAR1OP
J7	EAR2O	AGND
J9	MIC1N	MIC1P
J10	MIC2N	MIC2P

3 Digital Interface

The TLV320AIC11xxEVM 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. These headers/sockets provide access to the digital control and serial data pins of the device. Consult Samtec at www.samtec.com or call 1-800- SAMTEC-9 for a variety of mating connector options. Table 3 summarizes the digital interface pinout for the TLV320AIC11xxEVM.

Table 3. Digital Interface Pinout

PIN NUMBER	SIGNAL	DESCRIPTION
J4.1	NC	Not Connected
J4.2	NC	Not Connected
J4.3	NC	Not Connected
J4.4	DGND	Digital Ground
J4.5	NC	Not Connected
J4.6	NC	Not Connected
J4.7	NC	Not Connected
J4.8	$\overline{\text{RESET}}$	Reset signal input
J4.9	NC	Not Connected
J4.10	DGND	Digital Ground

Table 3. Digital Interface Pinout (continued)

PIN NUMBER	SIGNAL	DESCRIPTION
J4.11	NC	Not Connected
J4.12	NC	Not Connected
J4.13	NC	Not Connected
J4.14	$\overline{\text{RESET}}$	Reset signal input
J4.15	NC	Not Connected
J4.16	NC	Not Connected
J4.17	NC	Not Connected
J4.18	DGND	Digital Ground
J4.19	NC	Not Connected
J4.20	NC	Not Connected
J5.1	NC	Not Connected
J5.2	NC	Not Connected
J5.3	SCLK	Audio Serial Data Shift Clock (Input/Output)
J5.4	DGND	Digital Ground
J5.5	NC	Not Connected
J5.6	NC	Not Connected
J5.7	FS_1	Audio Serial Data Bus Frame Sync (Input/Output)
J5.8	NC	Not Connected
J5.9	NC	Not Connected
J5.10	DGND	Digital Ground
J5.11	DIN	Audio Serial Data Bus Data Input (Input)
J5.12	NC	Not Connected
J5.13	DOUT	Audio Serial Data Bus Data Output (Output)
J5.14	NC	Not Connected
J5.15	NC	Not Connected
J5.16	SCL	I^2C Serial Clock
J5.17	MCLK	Master Clock Input
J5.18	DGND	Digital Ground
J5.19	NC	Not Connected
J5.20	SDA	I^2C Serial Data Input/Output

Note that J5 comprises the signals needed for a SMARTDM™ serial digital audio interface and I^2C™ signals. The reset and power down ($\overline{\text{RESET}}$ and $\overline{\text{PWRDN}}$) signals are routed to J4. I^2C™ is actually routed from the USB-MODEVM to both connectors; however, the codec and EEPROM are only connected to J5.

4 Power Supplies

J3 provides connection to the common power bus for the TLV320AIC11xxEVM. Power is supplied on the pins listed in Table 4.

Table 4. Power Supply Pinout

SIGNAL	PIN NUMBER		SIGNAL
NC	J3.1	J3.2	NC
+5VA	J3.3	J3.4	NC
DGND	J3.5	J3.6	AGND
NC	J3.7	J3.8	NC
IOVDD (3.3V)	J3.9	J3.10	NC

The TLV320AIC11xxEVM-K motherboard (the USB-MODEVM Interface board) supplies power to J3 of the TLV320AIC11xxEVM. Power for the motherboard is supplied either through its USB connection or via terminal blocks on that board.

4.1 Stand-Alone Operation

When used as a stand-alone EVM, power can be applied to J3 directly. The user must be sure to reference the supplies to the appropriate grounds on that connector.

CAUTION

Verify that all power supplies are within the safe operating limits shown on the product datasheet before applying power to the EVM.

4.2 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 the 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 configuration, 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) that lights when the power supplies are active.

5 EVM Operation

This section provides information on the analog input and output, digital control, and general operating conditions for the TLV320AIC11xxEVM.

5.1 Analog Input

The analog input sources can be applied directly to J2 (top or bottom side). The analog inputs may also be accessed through J8 and screw terminals J9 and J10.

5.2 Analog Output

The analog outputs from the TLV320AIC11xx are available on J1 (top or bottom). They also may be accessed through J6 or J7.

5.3 Digital Control

The digital control signals can be applied directly to J4 and J5 (top or bottom side). The modular TLV320AIC11xxEVM can also be connected directly to the USB-MODEVM Interface board included as part of the TLV320AIC11xxEVM-K.

5.4 Default Jumper Locations

Table 5 lists the jumpers found on the EVM and their respective factory default conditions.

Table 5. List of Jumpers

JUMPER	DEFAULT POSITION	JUMPER DESCRIPTION
W1	Not Installed	Coupling for EAR1. Either directly or via capacitor
W2	Not Installed	Coupling for EAR2. Either directly or via capacitor
W3	Installed	Provides a means of measuring AVDD and EARVDD current
W4	Installed	Connects MIC1N to MBIAS through a resistor
W5	Installed	Connects MIC2N to MBIAS through a resistor
W6	Installed	Connects on-board microphone to circuit
W7	Installed	Connects J9 to circuit
W8	Installed	Connects external mic source to ground through a resistor
W9	Installed	Selects on-board EEPROM as firmware source (required)
W10	Installed	Provides a means of measuring DVDD current
W11	Installed	Provides a means of measuring PLLVDD current
W12	1-2	Sets PWRUPSEL mode
W13	Installed	When installed, allows the USB-MODEVM to hardware reset the device under user control

6 Kit Operation

This section provides information on using the TLV320AIC11xxEVM-K, including set up, program installation, and program usage.

6.1 TLV320AIC11xxEVM-K Block Diagram

A block diagram of the TLV320AIC11xxEVM-K 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 TLV320AIC11xxEVM described previously in this manual.

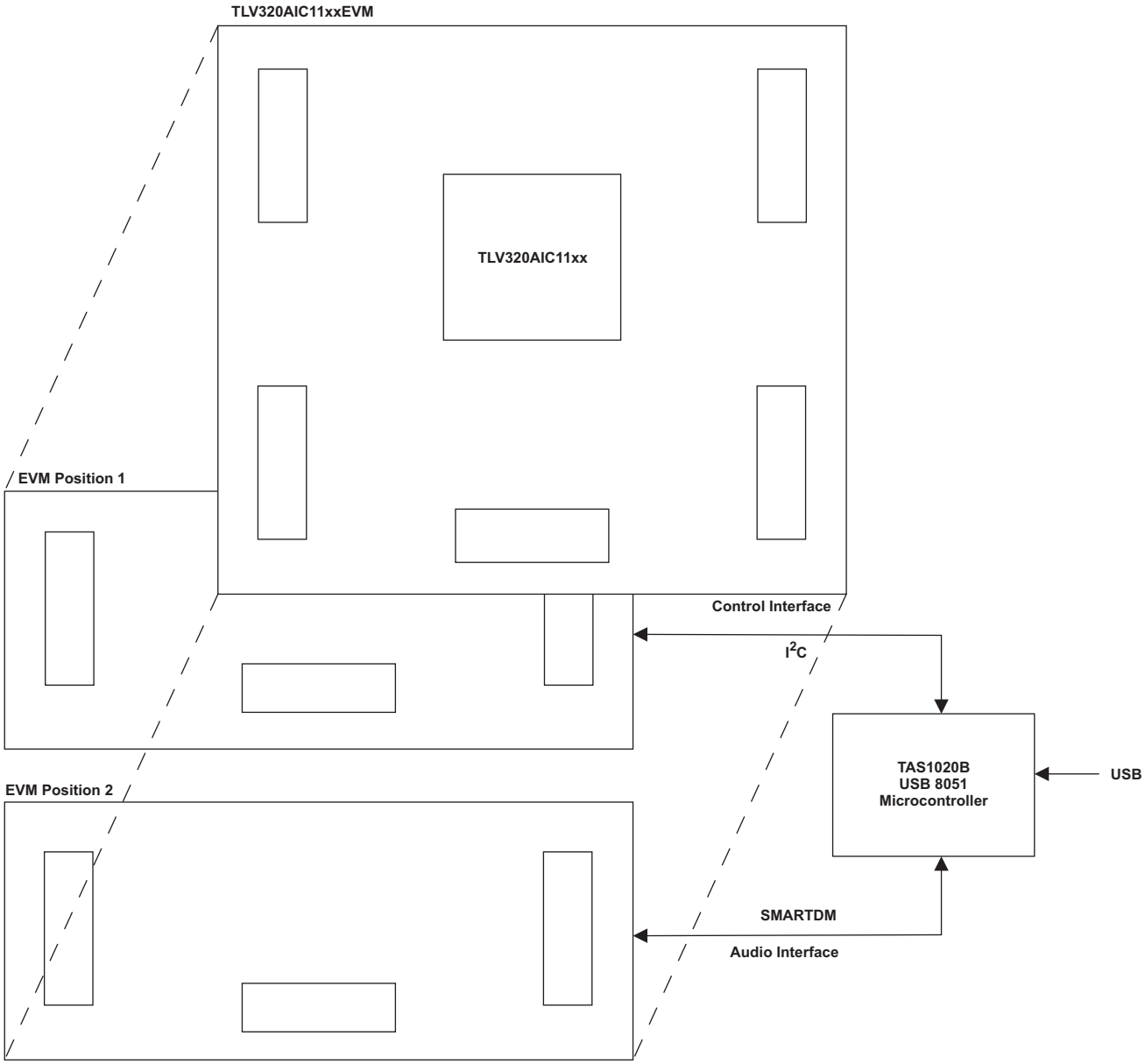


Figure 1. TLV320AIC11xxEVM-K Block Diagram

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 (I^2C, PCM/ SMARTDM™) externally. The source of these signals is controlled by SW2 on the USB-MODEVM. Refer to Table 6 for details on the switch settings.

Additionally, SW3 on the USB-MODEVM (IOVDD SELECT) must be set up to 3.3V (SW3 position 1 on, SW3 positions 2-8 off).

Table 6. USB-MODEVM SW2 Settings

SW-2 SWITCH NUMBER	LABEL	SWITCH DESCRIPTION
1	A0	USB-MODEVM EEPROM I²C Address A0 ON: A0 = 0 OFF: A0 = 1
2	A1	USB-MODEVM EEPROM I²C Address A1 ON: A1 = 0 OFF: A1 = 1
3	A2	USB-MODEVM EEPROM I²C Address A2 ON: A2 = 0 OFF: A2 = 1
4	USB I²S	Digital Audio Bus Source Selection ON: Digital Audio Bus connects to TAS1020 OFF: Digital Audio Bus connects to USB-MODEVM J14
5	USB MCK	Digital Audio Bus MCLK Source Selection ON: MCLK connects to TAS1020 OFF: MCLK connects to USB-MODEVM J14
6	USB SPI	SPI Bus Source Selection ON: SPI Bus connects to TAS1020 OFF: SPI Bus connects to USB-MODEVM J15
7	USB RST	RST Source Selection ON: EVM Reset Signal comes from TAS1020 OFF: EVM Reset Signal comes from USB-MODEVM J15
8	EXT MCK	External MCLK Selection ON: MCLK Signal is provided from USB-MODEVM J10 OFF: MCLK Signal comes from either selection of SW2-5

For use with the TLV320AIC11xxEVM, SW-2 positions 1, 3, 4, 5 and 6 should be set to ON, while SW-2 positions 2, 7 and 8 should be set to OFF.

6.2 Installation

Ensure that the TLV320AIC11xxEVM is installed on the USB-MODEVM Interface board, aligning J1, J2, J3, J4, J5 with the corresponding connectors on the USB-MODEVM.

Go to www.ti.com and type AIC11xx (where xx corresponds to the device under evaluation) on the "Search by Part Number" field. Locate the "EVM-K" product folder and download the software. Once downloaded, unzip and locate the Setup program, and start it. The Setup program will install the TLV320AIC11xx Evaluation Tool software on your PC.

The NI-VISA Runtime installer is embedded to the TLV320AIC11xx Evaluation Tool installer. This software allows the program to communicate with the USB-MODEVM.

When the installation completes, click *Finish* on the TLV320AIC11xx Evaluation Tool 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 and the 'USB ACTIVE' LED on the USB-MODEVM should light.

The **Found New Hardware Wizard** will show up on the screen. Select the '**No, not this time**' radio button and click '**Next >**'. Select '**Install the software automatically (Recommended)**' and click '**Next >**'. If the driver installs correctly the message: '**The wizard has finished installing the software for: USB-MODEVM**' should appear. Click '**Finish**'. The USB-MODEVM driver should now be installed. The device should now appear on the Device Manager as '**NI-VISA USB Devices>USB-MODEVM**' and as '**Sound, video and game controllers>USB Audio Device**'.

Once the device drivers are installed launch the TLV320AIC11xx Evaluation Tool software on your PC, located on the computer's desktop or in 'Start>Programs>Texas Instruments'.

The software should automatically find the TLV320AIC11xx, and a screen similar to the one in Figure 2 should appear. Select the appropriate device in this screen.

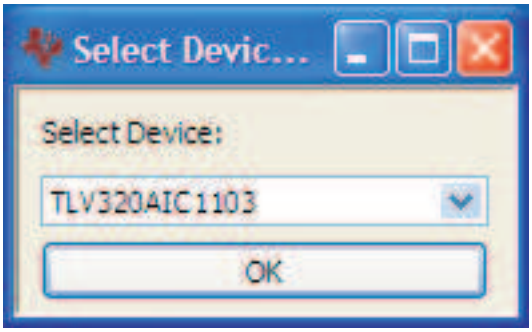


Figure 2. Device Selection Window

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.

Since the TLV320AIC11xxEVM is a double-wide modular EVM, it is installed with connections to both EVM positions, which connects the TLV320AIC11xx digital control interface to the I^2C port realized using the TAS1020B, as well as the TAS1020B digital audio interface.

In the factory configuration, the board is ready to use with the TLV320AIC11xxEVM. To view all the functions and configuration options available on the USB-MODEVM board, see the USB-MODEVM Interface Board schematic in Appendix B.

6.4 Program Description

After the TLV320AIC11xxEVM software installation (described in Section 6.2) is complete, evaluation and development with the TLV320AIC11xx can begin.

6.5 Indicators and Main Screen Controls

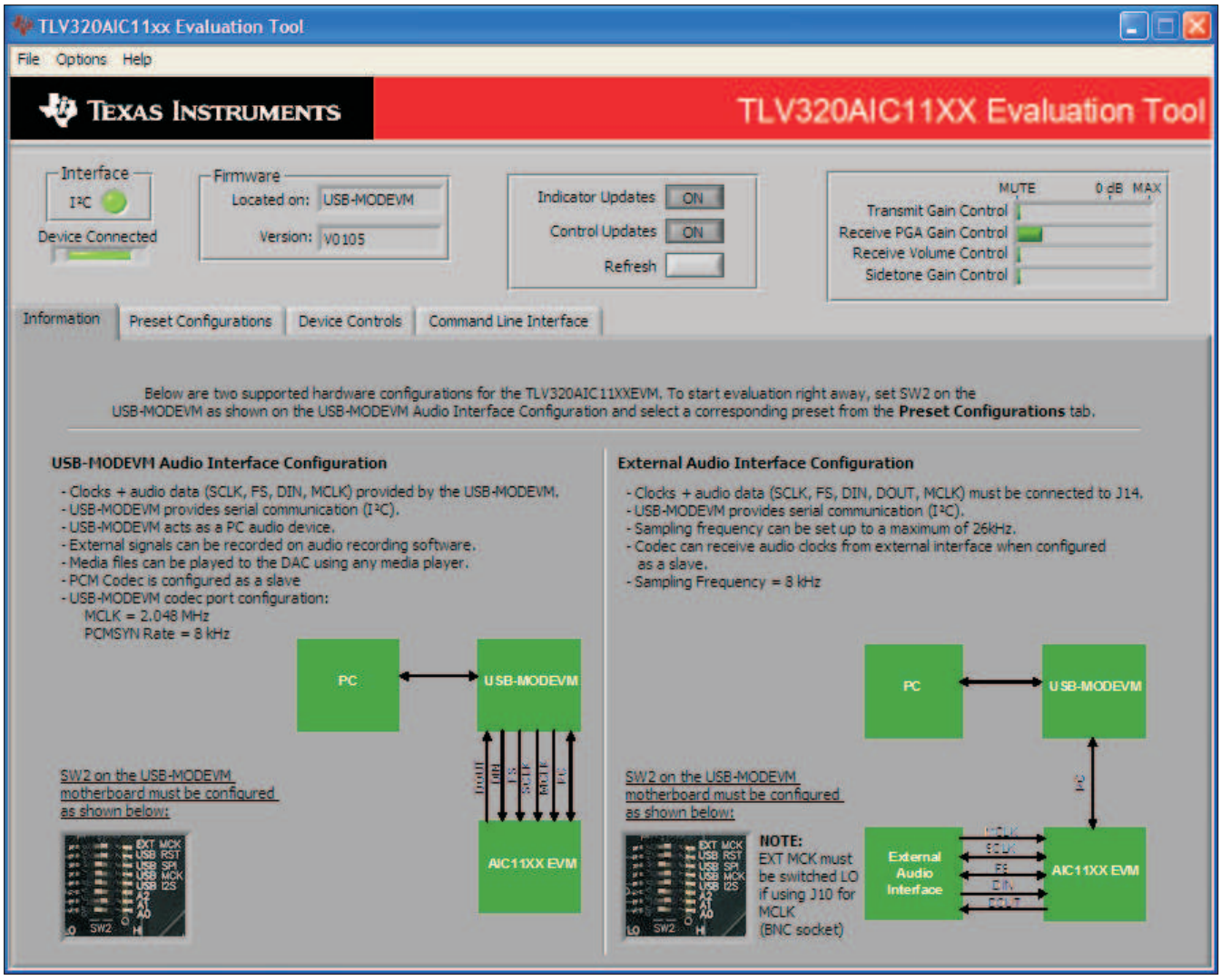


Figure 3. Default Software Screen

Figure 3 illustrates the indicators and the main screen controls near the top of the software screen display, and a large tabbed interface below. This section discusses the controls above this tabbed section.

At the top left of the screen is an **Interface** indicator. The TLV320AIC11xx has an I^{2}C interface. The indicator is lit after the program begins. Below the Interface indicator is the **Device Connected** indicator. The TLV320AIC11xx Evaluation Tool detects whether or not the TLV320AIC11xxEVM-K is present. If the device is unplugged from the USB port or if the device driver is not installed properly, the **Device Connected** indicator will turn red. Otherwise, it will turn green.

To the right of the **Interface** indicator is a group box called **Firmware**. This box indicates the product identification of the USB device, so *USB-MODEVM* should be displayed in the box labeled **Located On:**. The version of the firmware appears in the **Version** box below this.

Indicators on this panel, update only when writing or reading registers, or by pushing the **Refresh** button. The **Indicator Updates** and **Control Updates** buttons enable/disable updates of indicators and controls, respectively.

6.6 Information Tab

The information tab (Figure 4) shows information for two TLV320AIC11xxEVM-K hardware configurations.

The **USB-MODEVM Audio Interface Configuration** allows audio data and I²C communication between the host computer and the TLV320AIC11xx. SW2 on the USB-MODEVM must be configured as shown in the left section of Figure 4.

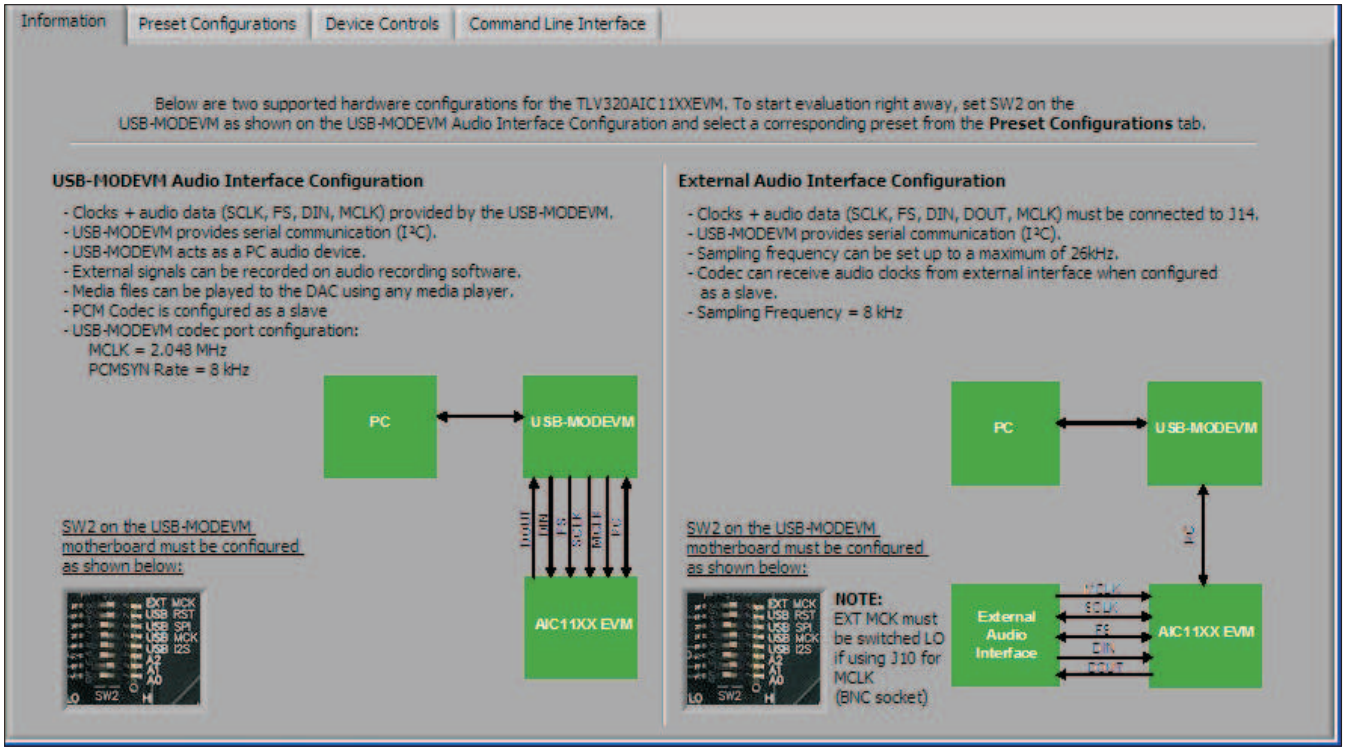


Figure 4. Information Tab

Additionally, the operating system's audio device must be configured as USB-MODEVM (see Figure 5).

The **External Audio Interface Configuration** only allows I²C communication between the host computer and the TLV320AIC11xx. In this configuration, the TLV320AIC11xx can transmit and receive audio data to/from an external PCM device or DSP. SW2 on the USB-MODEVM must be configured as shown in the right section of Figure 4.

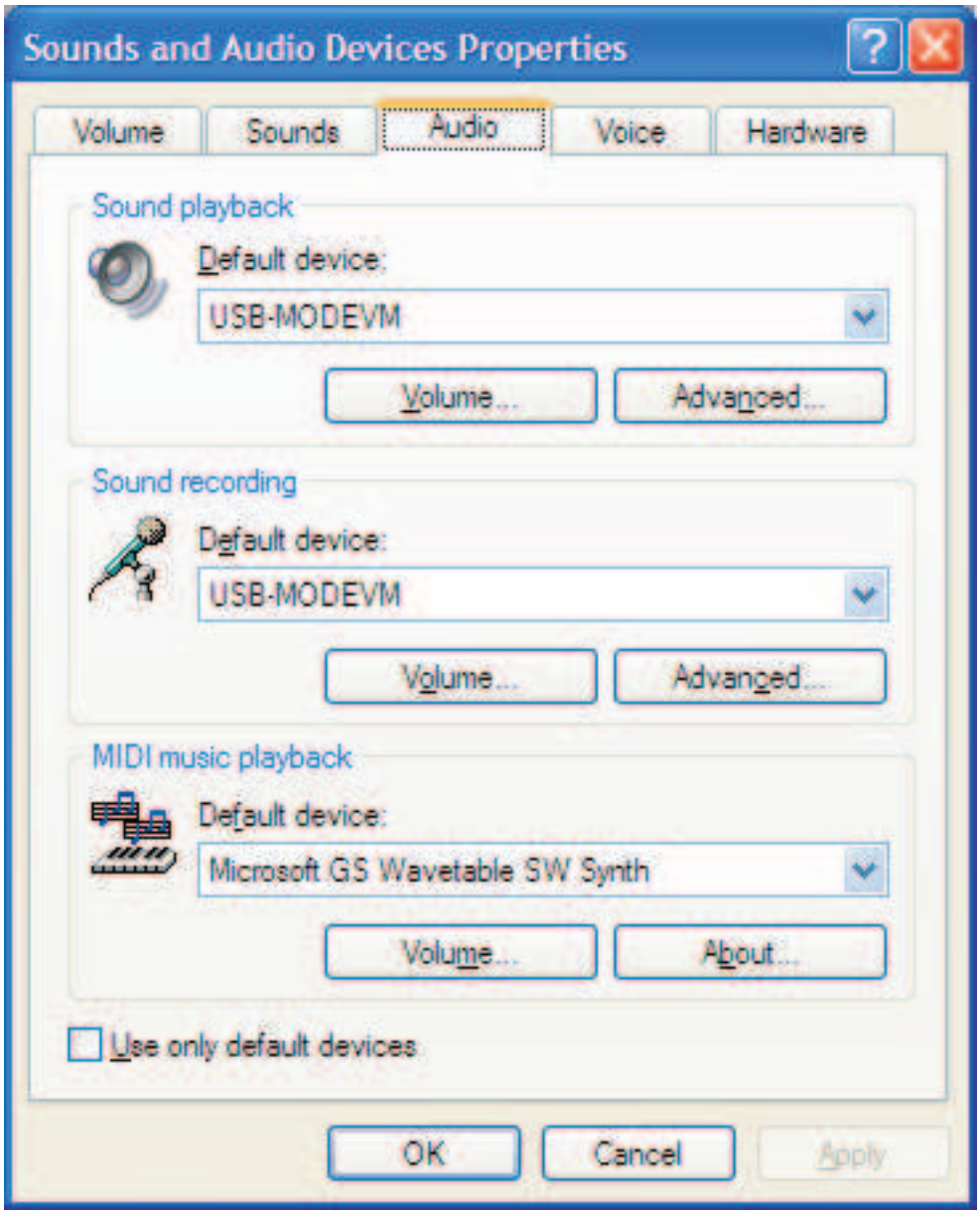


Figure 5. Sounds and Audio Devices Properties

6.7 *Preset Configurations Tab*

The **Preset Configurations** tab (Figure 6) provides several presets for both the **USB-MODEVM Audio Interface Configuration**. Also, there is a **TLV320AIC11xx Defaults** preset which programs the codec's default register settings. When a radio button is selected, a detailed description of the preset will appear on the **Preset Configuration Description** box. To load a preset to the codec, select the desired preset by selecting the corresponding radio button and pushing the **Load** button. At the same time, this will show the preset's executed commands on the **Command Buffer** of the **Command Line Interface** tab (see Figure 8).

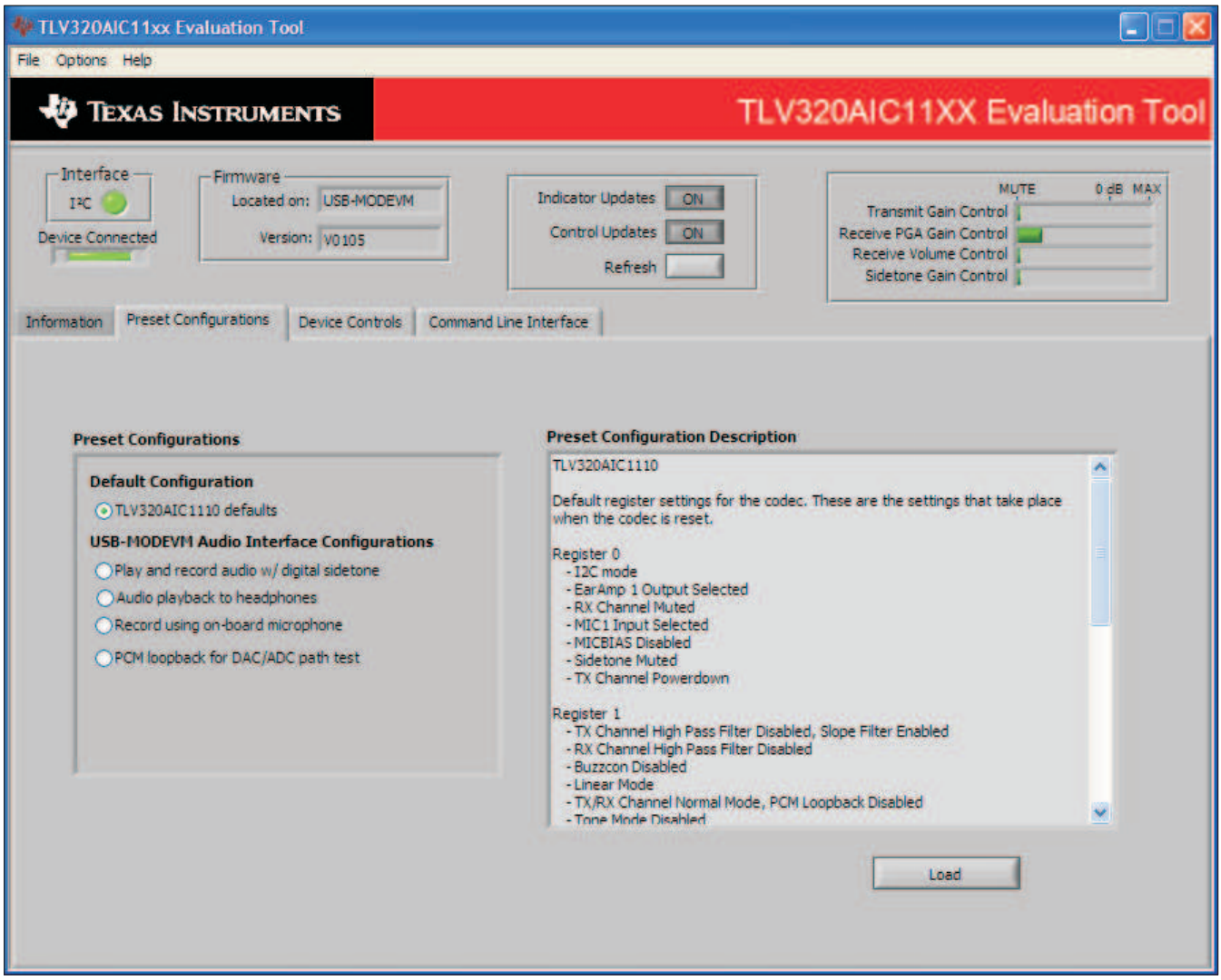


Figure 6. Preset Configurations

6.8 Device Controls Tab

The **Device Controls Tab** (Figure 7) contains seven enumerated **Control Registers** sub tabs with controls for all registers of the TLV320AIC11xx, a register table at the bottom of the tab, several controls and an indicator at the right of the tab. The **8-bit I²C Address** indicator shows the current I²C address. The **Program Device** button, when pushed, programs the register corresponding *only* to the selected **Control Registers** sub tab. The register table holds the current register values in hexadecimal and binary format. The **Register Dump to File** button dumps the current register values to a spreadsheet. Please refer to the respective datasheet for further details on control register content.

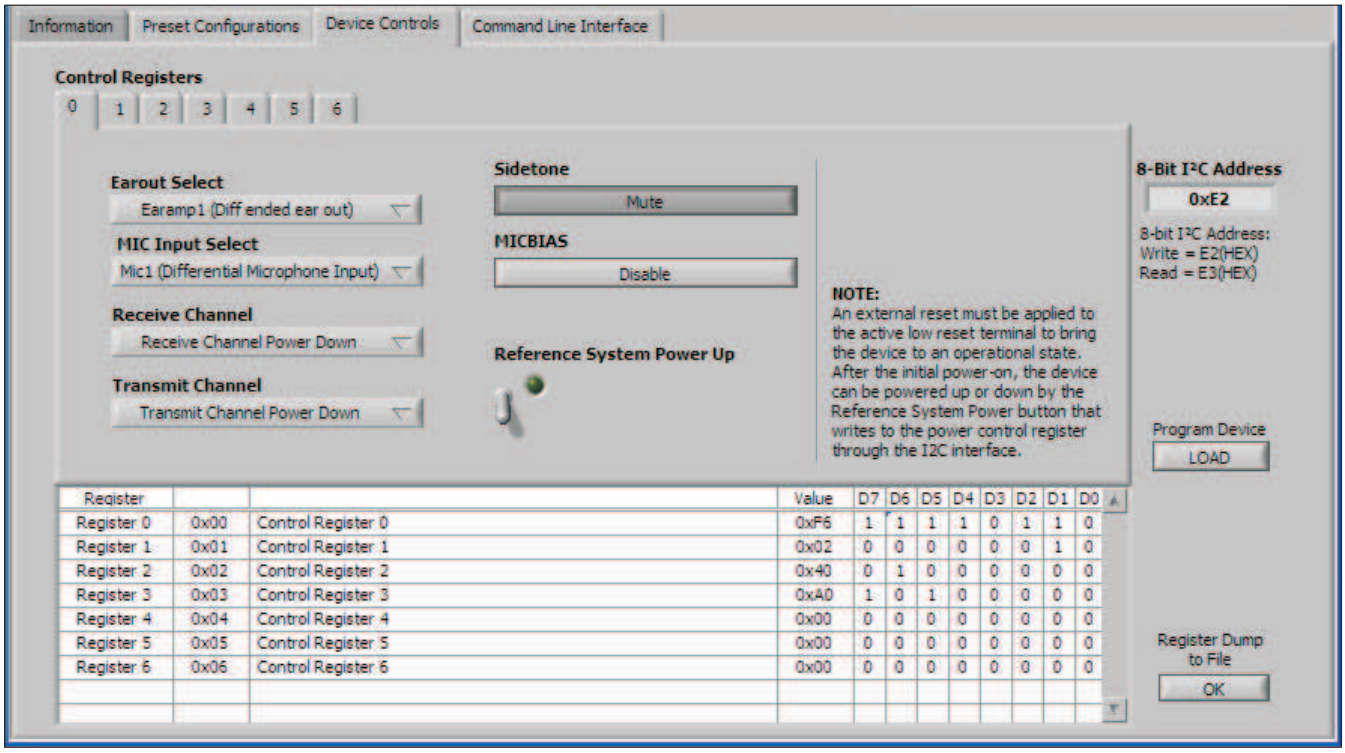


Figure 7. Device Controls Tab

6.9 Command Line Interface Tab

A simple scripting language controls the TAS1020 on the USB-MODEVM from the LabView™-based PC software. The main program controls, described previously, do nothing more than write a script which is then handed off to an interpreter that sends the appropriate data to the correct USB endpoint. Because this system is script-based, provision is made in this tab for the user to view the scripting commands that are created as the controls are manipulated, as well as load and execute other scripts that have been written and saved (see Figure 8). This design allows the software to be used as a quick test tool or to help provide troubleshooting information in the rare event that the user encounters a problem with this EVM.

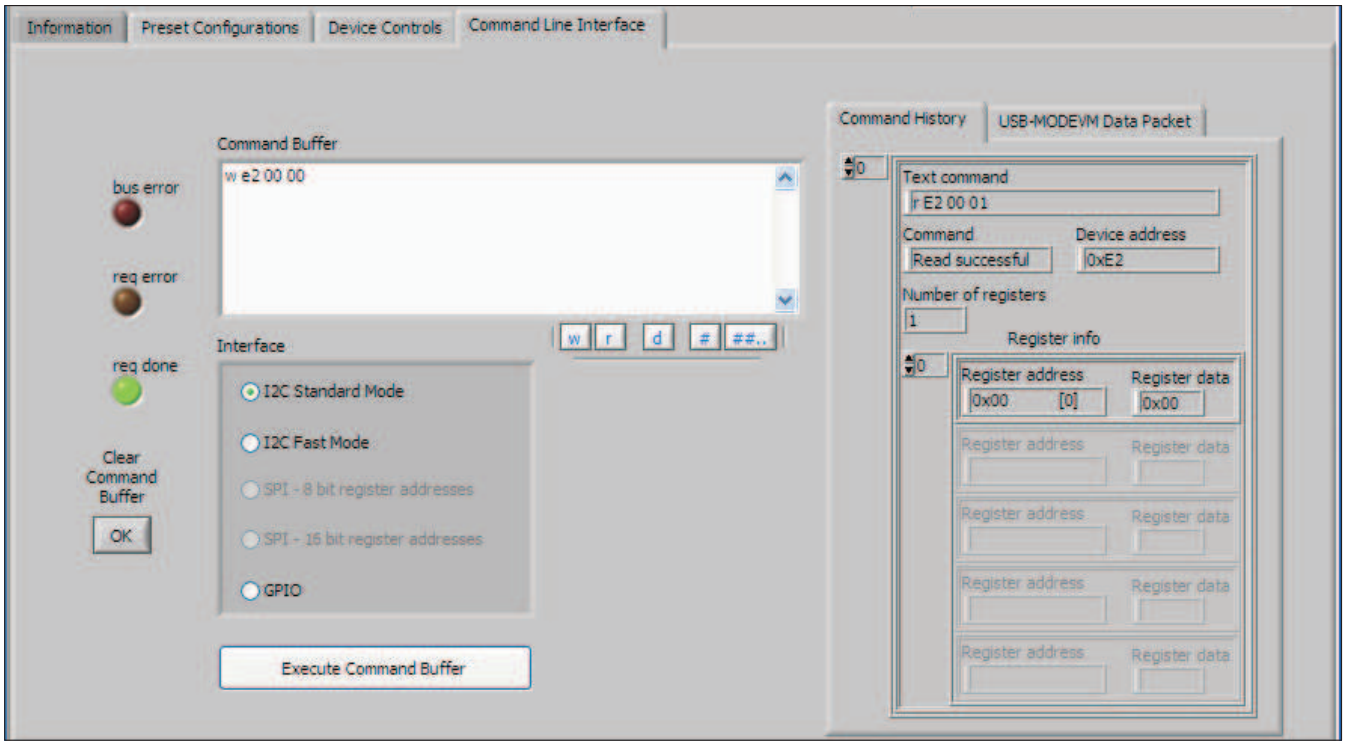


Figure 8. Command Line Interface Tab

A script is loaded into the command buffer, either by operating the controls on the other tabs or by loading a script file or preset.

When executed, either by loading commands from other tabs, loading a preset or pushing the Execute Command Buffer button, an array containing executed commands will be displayed on the **Command History** tab. Additionally, the return packet of data which results from the last command executed will be displayed in the **USB-MODEVM Data Packet** tab. The logging function, described below, can be used to see the results after every executed command.

The File menu (Figure 9) provides some options for working with scripts. The first option, *Open Command File...*, loads a command file script into the command buffer. This script can then be executed by pressing the **Execute Command Buffer** button.

The second option, *Save Command File...*, saves the contents of the command buffer into a file.

The third option is *Log Script and Results...*, which opens a file save dialog box. The user can choose a location for a log file to be written using the file save dialog. When the Execute Command Buffer button is pressed, the script will run and the script, along with resulting data read back during the script, will be saved to the file specified. The log file is a standard text file which can be opened with any text editor, and looks much like the source script file, but with the additional information of the result of each script command executed.

The third menu item is a submenu of *Recently Opened Files*. This list is simply a list of script files that have previously been opened, allowing fast access to commonly-used script files. The final menu item is *Exit*, which terminates the TLV320AIC11xx Evaluation Tool software.

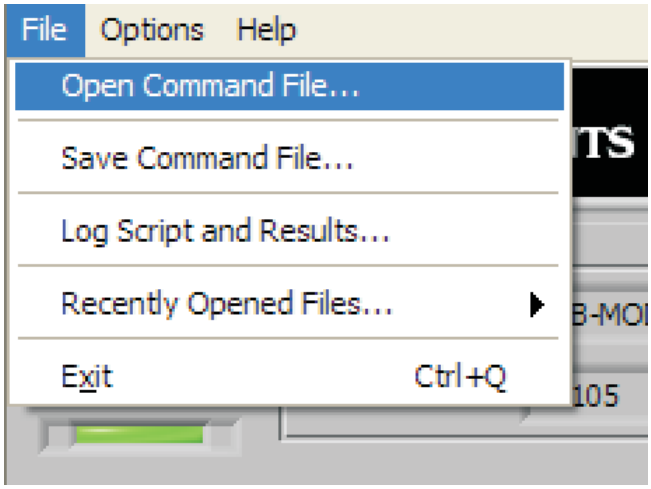


Figure 9. File Menu

The Options menu provides two settings suitable for command line interface users and for troubleshooting. These settings allows the user to evaluate the device in its most basic form.

Under the Help menu is an *About...* menu item (Figure 10) which displays information about the TLV320AIC11xxEVM software.

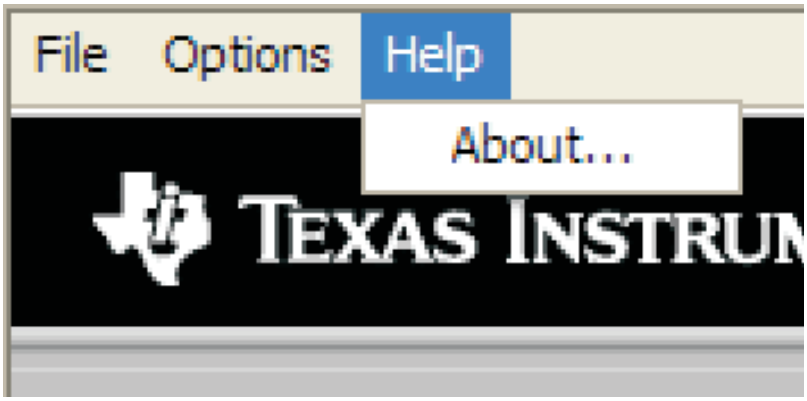


Figure 10. Help

The actual USB protocol used as well as instructions on writing scripts are detailed in the following subsections. While it is not necessary to understand or use either the protocol or the scripts directly, understanding them may be helpful to some users.

6.9.1 USB-MODEVM Protocol

The USB-MODEVM is defined to be a Vendor-Specific class, and is identified on the PC system as an NI-VISA device. Because the TAS1020 has several routines in its ROM which are designed for use with HID-class devices, HID-like structures are used, even though the USB-MODEVM is not an HID-class device. Data passes from the PC to the TAS1020 using the control endpoint.

Data is sent in an HIDSETREPORT (see Table 7):

Table 7. USB Control Endpoint HIDSETREPORT Request

PART	VALUE	DESCRIPTION
bmRequestType	0x21	00100001
bRequest	0x09	SET_REPORT

Table 7. USB Control Endpoint HIDSETREPORT Request (continued)

PART	VALUE	DESCRIPTION
wValue	0x00	don't care
wIndex	0x03	HID interface is index 3
wLength	calculated by host	
Data		Data packet as described below

The data packet consists of the following bytes, shown in Table 8:

Table 8. Data Packet Configuration

BYTE NUMBER	TYPE	DESCRIPTION
0	Interface	Specifies serial interface and operation. The two values are logically OR'd. Operation: READ 0x00 WRITE 0x10 Interface: GPIO 0x08 SPI_16 0x04 I2C_FAST 0x02 I2C_STD 0x01 SPI_8 0x00
1	I^2C Slave Address	Slave address of I^2C device or MSB of 16-bit reg addr for SPI
2	Length	Length of data to write/read (number of bytes)
3	Register address	Address of register for I^2C or 8-bit SPI; LSB of 16-bit address for SPI
4..64	Data	Up to 60 data bytes could be written at a time. EP0 maximum length is 64. The return packet is limited to 42 bytes, so advise only sending 32 bytes at any one time.

Example usage:
Write two bytes (45, A0) to device starting at register 1 of an I^2C device with address 80:

```
[0] 0x11
[1] 0x80
[2] 0x02
[3] 0x01
[4] 0x45
[5] 0xA0
```

Do the same with a fast mode I^2C device:

```
[0] 0x12
[1] 0x80
[2] 0x02
[3] 0x01
[4] 0x45
[5] 0xA0
```

In each case, the TAS1020 will return, in an HID interrupt packet, the following:

[0] interface byte | status

status:

```
REQ_ERROR 0x80
INTF_ERROR 0x40
REQ_DONE 0x20
```

[1] for I^2C interfaces, the I^2C address as sent
for SPI interfaces, the read back data from SPI line for transmission of the corresponding byte

[2] length as sent

[3] for I^2C interfaces, the reg address as sent
for SPI interfaces, the read back data from SPI line for transmission of the corresponding byte

[4..60] echo of data packet sent

If the command is sent with no problem, the returning byte [0] should be the same as the sent one logically or'd with 0x20 - in the second example above (fast mode), the returning packet should be:

```
[0] 0x32
[1] 0x80
[2] 0x02
[3] 0x01
[4] 0x45
[5] 0xA0
```

If for some reason the interface fails (for example, the I^2C device does not acknowledge), it would come back as:

```
[0] 0x52 --> interface | INTF_ERROR
[1] 0x80
[2] 0x02
[3] 0x01
[4] 0x45
[5] 0xA0
```

If the request is malformed, that is, the interface byte (byte [0]) takes on a value which is not described above, the return packet would be:

```
[0] 0x93 --> 0x13 was sent, which is not valid, so 0x93 is returned
[1] 0x80
[2] 0x02
[3] 0x01
[4] 0x45
[5] 0xA0
```

Examples above used writes. Reading is similar:
Read two bytes from device starting at register 1 of an I^2C device with address A0:

```
[0] 0x01
[1] 0x80
[2] 0x02
[3] 0x01
```

The return packet should be

```
[0] 0x21
[1] 0x80
[2] 0x02
[3] 0x01
[4] 0x45
[5] 0xA0
```

assuming that the values we wrote above starting at Register 5 were actually written to the device.

6.9.1.1 GPIO Capability

The USB-MODEVM has seven GPIO lines. The user can access them by specifying the interface to be 0x08, and then using the standard format for packets—but addresses are unnecessary. The GPIO lines are mapped into one byte (see Table 9):

Table 9. GPIO Pin Assignments

7	6	5	4	3	2	1	0
x	P3.5	P3.4	P3.3	P1.3	P1.2	P1.1	P1.0

Example: write P3.5 to a 0, all others to 1:

`[0] 0x18` --> write, GPIO
`[1] 0x00` --> this value is ignored
`[2] 0x01` --> length - ALWAYS a 1
`[3] 0x00` --> this value is ignored
`[4] 0x3F` --> 00111111

The user may also read back from the GPIO to see the state of the pins. Suppose the port pins were written as in the previous example.

Example: read the GPIO

`[0] 0x08` --> read, GPIO
`[1] 0x00` --> this value is ignored
`[2] 0x01` --> length - ALWAYS a 1
`[3] 0x00` --> this value is ignored

The return packet should be:

```
[0] 0x28
[1] 0x00
[2] 0x01
[3] 0x00
[4] 0x3F
```

6.9.2 Writing Scripts

A script is simply a text file that contains data to send to the serial control buses. The scripting language is quite simple, as is the parser for the language. Therefore, the program is not very forgiving about mistakes made in the source script file, but the formatting of the file is simple. Consequently, mistakes should be rare.

Each line in a script file is one command. There is no provision for extending lines beyond one line. A line is terminated by a carriage return.

The first character of a line is the command. Commands are:

l = = = = = = =	Set interface bus to use
r = = = = = = =	Read from the serial control bus
w = = = = = = =	Write to the serial control bus
# = = = = = = =	Comment
b = = = = = = =	Break
d = = = = = = =	Delay

The first command, **l**, sets the interface to use for the commands to follow. This command must be followed by one of the following parameters:

i2cstd	Standard mode I^2C Bus
i2cfast	Fast mode I^2C bus
spi8	SPI bus with 8-bit register addressing
spi16	SPI bus with 16-bit register addressing
gpio	Use the USB-MODEVM GPIO capability

For example, if a fast mode I^2C bus is to be used, the script would begin with:

l i2cfast

No data follows the break command. Anything following a comment command is ignored by the parser, provided that it is on the same line. The delay command allows the user to specify a time, in milliseconds, that the script will pause before proceeding.

NOTE: UNLIKE ALL OTHER NUMBERS USED IN THE SCRIPT COMMANDS, THE DELAY TIME IS ENTERED IN A DECIMAL FORMAT. Also, note that because of latency in the USB bus as well as the time it takes the processor on the USB-MODEVM to handle requests, the delay time may not be precise.

A series of byte values follows either a read or write command. Each byte value is expressed in hexadecimal, and each byte must be separated by a space. Commands are interpreted and sent to the TAS1020 by the program using the protocol described in Section 6.9.1.

The first byte following a read or write command is the I^2C slave address of the device (if I^2C is used) or the first data byte to write (if SPI is used—note that SPI interfaces are not standardized on protocols, so the meaning of this byte will vary with the device being addressed on the SPI bus). The second byte is the starting register address that data will be written to (again, with I^2C; SPI varies—see Section 6.9.1 for additional information about what variations may be necessary for a particular SPI mode). Following these two bytes are data, if writing; if reading, the third byte value is the number of bytes to read, (expressed in hexadecimal).

For example, to write the values 0x45 0xA0 to an I²C device with a slave address of 0x80, starting at a register address of 0x01, one would write:

```
#example script
I i2cfast
w 80 01 45 A0
r 80 01 02
```

This script begins with a comment, specifies that a fast I²C bus will be used, then writes *0x45 0xA0* to the I²C slave device at address 0x80, writing the values into registers 0x01 and 0x02. The script then reads back two bytes from the same device starting at register address 0x01. Note that the slave device value does not change. **It is not necessary to set the R/$\overline{W}$ bit for I²C devices in the script**; the read or write commands will do that for the user.

Any text editor may be used to write these scripts; Jedit is an editor that is highly recommended for general usage. For more information, go to: http://www.jedit.org.

Once the script is written, it can be used in the command window by running the program, and then selecting *Open Command File...* from the File menu. Locate the script and open it. The script will then be displayed in the command buffer. The user may also edit the script once it is in the buffer and save it as specified in Section 6.9.

Once the script is in the command buffer, it may be executed by pressing the *Execute Command Buffer* button. If the user has placed breakpoints in the script, it will execute to that point, and a dialog box will show up with a continue button to continue executing the script.

Please refer to sections 3.1 (Power Down and Reset) and section 3.2 (AIC12 Control Register Programming Procedures) on the TLV320AIC12/13/14/15 Codec Operating In Stand-Alone Slave Mode application note for important details on programming the codec.

Special care must be taken when writing subregisters (4A-4B and 5A-5D).

```
Example: w 80 01 45 A0 01 20 B8 00
```

The previous command writes registers 1, 2, 3, 4A, 5C and 6. **It will not increment from 3 to 4A and then to 4B**. The subregister to be written will depend on the data.

7 EVM Bill of Materials

Table 10 and Table 11 contain a complete bill of materials for the modular TLV320AIC11xxEVM and the USB-MODEVM Interface Board.

Table 10. TLV320AIC11xxEVM Bill of Materials

REFERENCE DESIGNATOR	DESCRIPTION	MANUFACTURER	MFG PART NUMBER
R9	RES ZERO OHM 1/10W 5% 0603 SMD	Panasonic	ERJ-3GEY0R00V
R5, R6, R7, R10	RES 10K OHM 1/10W 5% 0603 SMD	Panasonic	ERJ-3GEYJ103V
R8	RES 47K OHM 1/10W 5% 0603 SMD	Panasonic	ERJ-6GEYJ473V
R2	RES 100K OHM 1/10W 5% 0603 SMD	Panasonic	ERJ-3GEYJ104V
R1, R3, R4	RES 2K OHM 1/10W 5% 0603 SMD	Panasonic	ERJ-3GEYJ202V
C4, C9, C11	CAP CER .10µF 6.3V X5R 10% 0402	TDK Corporation	C1005X5R0J104K
C1, C2, C13, C14, C15, C17	CAP CER .1µF 25V X7R 0603	TDK Corporation	C1608X7R1E104K
C3, C10, C12	CAP CERAMIC 10µF 6.3V X5R 0603	Panasonic	ECJ-1VB0J106M
C16, C18	CAP CER 10µF 16V X5R 20% 1206	TDK Corporation	C3216X5R0J106M
C5, C6, C7, C8	CAP CER 47µF 10V X5R 1210	Murata	GRM32ER61A476KE20L
U1	Audio Codec 3.3V	Texas Instruments	TLV320AIC1110
U2	LDO Voltage Regulator	Texas Instruments	REG1117-3.3
U3	64K I2C EEPROM	MicroChip	24AA64-I/SN
U4	D-Type Flip-Flop	Texas Instruments	SN74AUP1G74
J6, J7, J8, J10	Screw Terminal Block, 2 Position	On Shore Technology	ED555/2DS
J9	3.5mm Audio Jack, T-R-S, SMD	CUI Inc. / KobiConn	SJ1-3515-SMT / 161-3335-E
J1A, J2A, J4A, J5A	20 Pin SMT Plug	Samtec	TSM-110-01-L-DV-P
J1B, J2B, J4B, J5B	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
W1, W2, W4, W5, W6-W9, W13	2 Position Jumper , 0 .1" spacing	Samtec	TSW-102-07-L-S
W3, W10, W11	Bus Wire (18-22 Gauge)		
W12	3 Position Jumper , 0 .1" spacing	Samtec	TSW-103-07-L-S
MK1	Omnidirectional Microphone Cartridge or alternate	Knowles Acoustics / Knowles Acoustics	MD9745APZ-F / MD9745APA-1
SW1	SWITCH LT TOUCH 6X3.5 240GF SMD	Panasonic	EVQ-PJU04K
TP1 -TP17	TEST POINT PC MINI .040"D RED	Keystone Electronics	5000
TP18-TP21	TEST POINT PC MINI .040"D BLACK	Keystone Electronics	5001

Table 11. USB-MODEVM Bill of Materials

Designators	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, 3-state buffers	Texas Instruments	SN74LVC125APW
U5, U6, 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^2C	Microchip	24LC64I/SN
	USB-MODEVM PCB	Texas Instruments	6463995
TP1, TP2, TP3, TP4, TP5, TP6, TP9, TP10, TP11	Miniature test point terminal	Keystone Electronics	5000

Table 11. USB-MODEVM Bill of Materials (continued)

Designators	Description	Manufacturer	Mfg. Part Number
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

Appendix A TLV320AIC11xxEVM Schematic

The schematic diagram is provided as a reference.

REV	REVISIONS
A	ECR XXXX 07/28/08, MPK

Daughtercard_sch
Daughtercard_sch.sch

AIC12K_14K_sch
AIC12K_14K_sch.sch

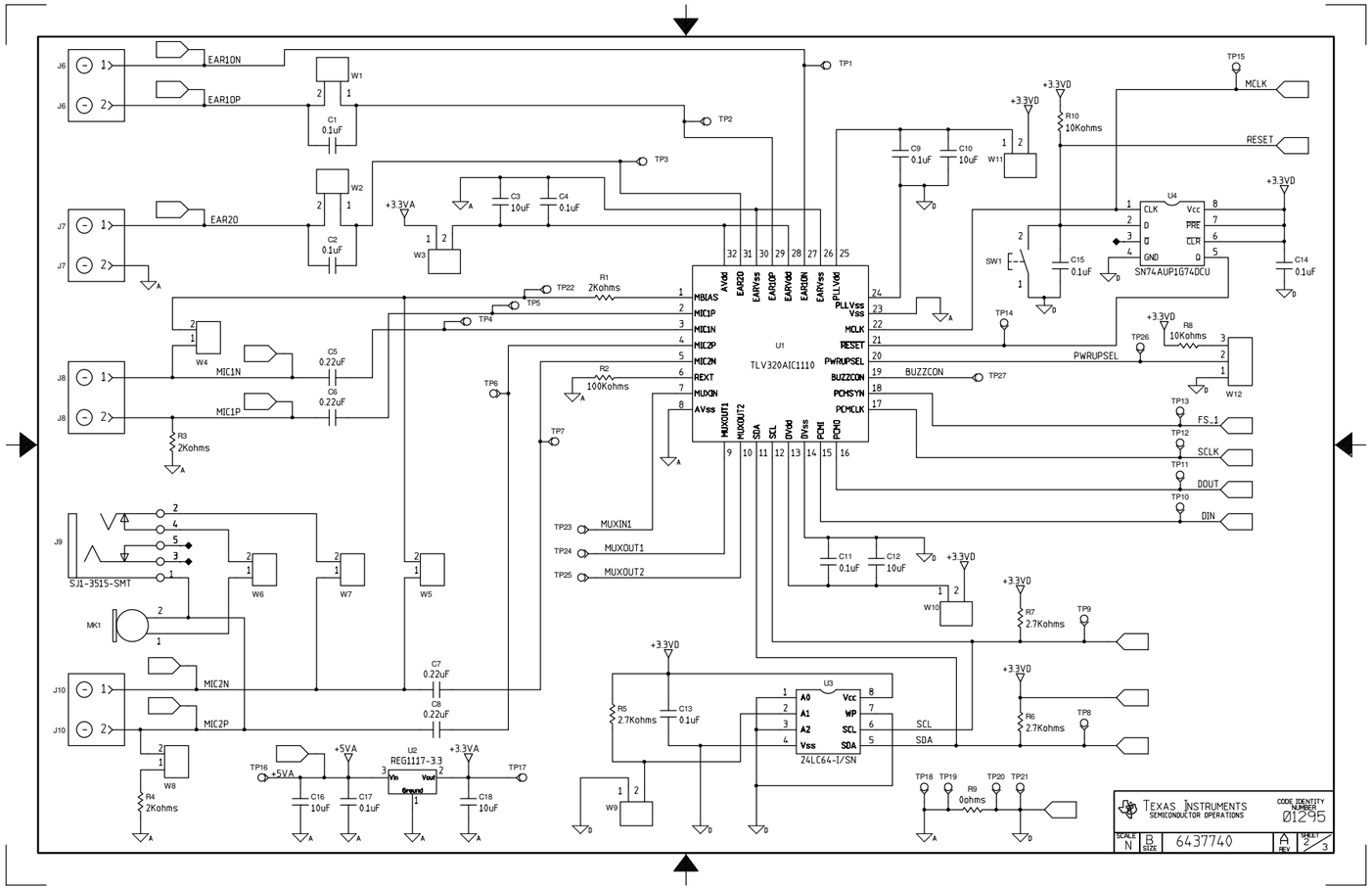
DRAFTSMAN: B Kinney	DATE 07/28/08	
DESIGNER: S Leggio	DATE 07/28/08	
CHECKER: S Leggio	DATE 07/28/08	
ENGINEER: F Shariff	DATE 07/28/08	
APPROVED: S Leggio	DATE 07/28/08	
RELEASED: S Leggio	DATE 07/28/08	

Texas Instruments
SEMICONDUCTOR OPERATIONS

CODE IDENTITY NUMBER 01295

TITLE:
SCHEMATIC,
TLV320AIC1110/09/03_PBS_EVM

SCALE	SIZE		REV	SHEET
N	B	6437740	A	01 / 3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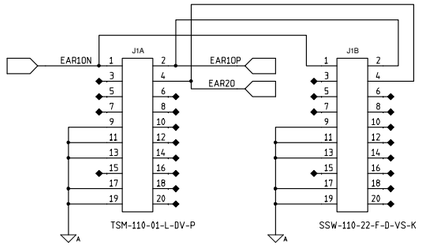
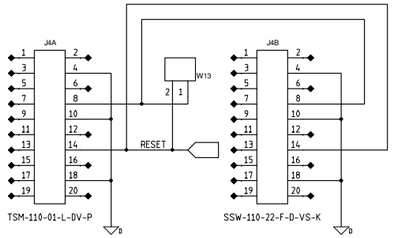
TLV320AIC1110
AVdd
EAR2O
EARVss
EARDP
EARVdd
EARDN
EARVss
PLLVdd
PLLVss
Vss
MCLK
RESET
PWRUPSEL
BUZZCON
PCMSYN
PCMCLK
MBIAS
MIC1P
MIC1N
MIC2P
MIC2N
REXT
MUXIN
AVss
MUXOUT1
MUXOUT2
SDA
SCL
DVdd
DVss
PCMI
PCMO
U4
SN74AUP1G74DCU
CLK
D
PRE
CLR
GND
Vcc
Q
U3
24LC64-I/SN
A0
A1
A2
Vss
Vcc
WP
SCL
SDA
U2
REG1117-3.3
Vin
Vout
Ground
J6
J7
J8
J9
J10
SJ1-3515-SMT
MK1
W1
W2
W3
W4
W5
W6
W7
W8
W9
W10
W11
W12
SW1
TP1
TP2
TP3
TP4
TP5
TP6
TP7
TP10
TP11
TP12
TP13
TP14
TP15
TP16
TP17
TP18
TP19
TP20
TP21
TP22
TP23
TP24
TP25
TP26
TP27
EAR1ON
EAR1OP
EAR2O
MIC1N
MIC1P
MIC2N
MIC2P
MCLK
RESET
PWRUPSEL
BUZZCON
FS_1
SCLK
DOUT
DIN
MUXIN1
MUXOUT1
MUXOUT2
SCL
SDA
+3.3VD
+3.3VA
+5VA
R1 2Kohms
R2 100Kohms
R3 2Kohms
R4 2Kohms
R5 2.7Kohms
R6 2.7Kohms
R7 2.7Kohms
R8 10Kohms
R9 0ohms
R10 10Kohms
C1 0.1uF
C2 0.1uF
C3 10uF
C4 0.1uF
C5 0.22uF
C6 0.22uF
C7 0.22uF
C8 0.22uF
C9 0.1uF
C10 10uF
C11 0.1uF
C12 10uF
C13 0.1uF
C14 0.1uF
C15 0.1uF
C16 10uF
C17 0.1uF
C18 10uF
TEXAS INSTRUMENTS
SEMICONDUCTOR OPERATIONS
CODE IDENTITY NUMBER
Ø1295
SCALE N
B SIZE
6437740
A REV
SHEET 3 / 3



J1A (TOP) = SAMTEC - P/N: TSM-110-01-L-DV-P
J1B (BOTTOM) = SAMTEC - P/N: SSW-110-22-F-D-VS



J4A (TOP) = SAMTEC - P/N: TSM-110-01-L-DV-P
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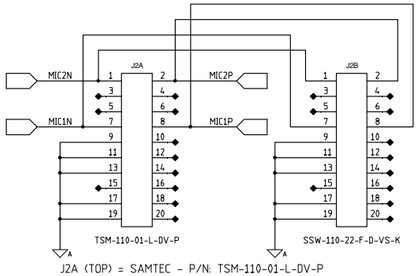

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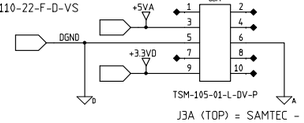

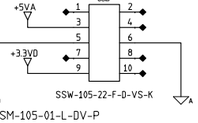

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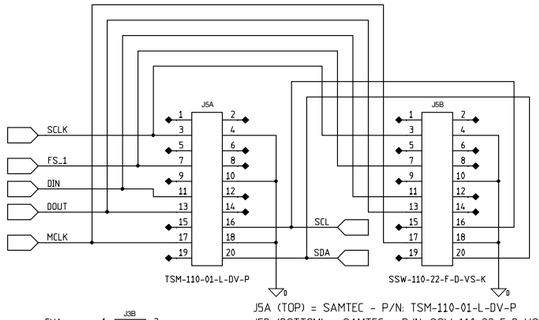
J3B (BOTTOM) = SAMTEC - P/N: SSW-105-22-F-D-VS



J5A (TOP) = SAMTEC - P/N: TSM-110-01-L-DV-P
J5B (BOTTOM) = SAMTEC - P/N: SSW-110-22-F-D-VS

TEXAS INSTRUMENTS
SEMICONDUCTOR OPERATIONS

CODE IDENTITY NUMBER 01295

SCALE	SIZE		REV	SHEET
N	B	6437740	A	03 of 3

Appendix B USB-MODEVM Schematic

The schematic diagram is provided as a reference.

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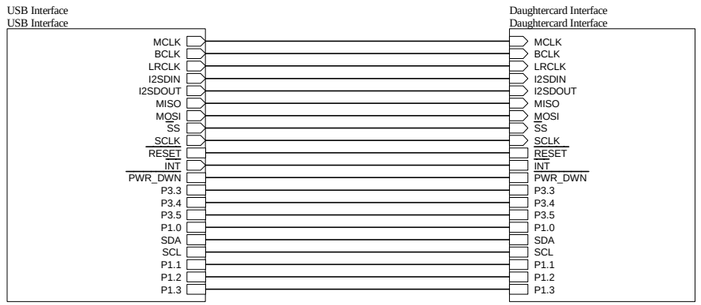

TEXAS INSTRUMENTS

DATA ACQUISITION PRODUCTS
HIGH-PERFORMANCE ANALOG DIVISION
SEMICONDUCTOR GROUP

6730 SOUTH TUCSON BLVD., TUCSON, AZ 85706 USA

ENGINEER **FRYE D. ZERKETTS**	TITLE **untitled**		
DRAWN BY **I. C. SPOTTS**			
DOCUMENT CONTROL NO.**1234567**	SIZE **B**	DATE **dd MMM yyyy**	REV **A**
SHEET **1** OF **1**	FILE **???**		

REVISION HISTORY		
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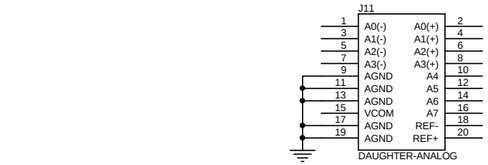
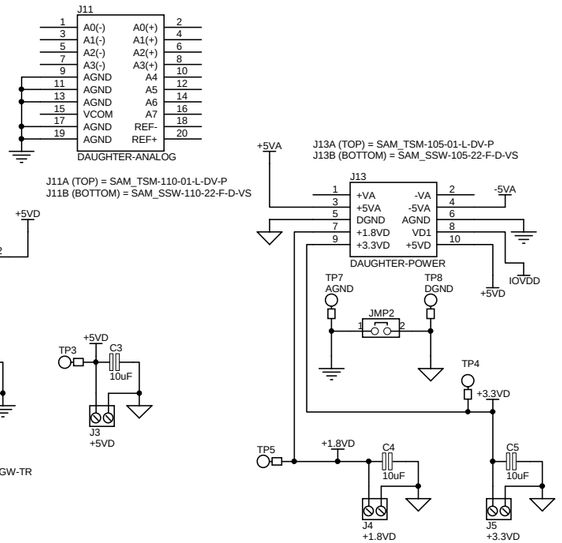
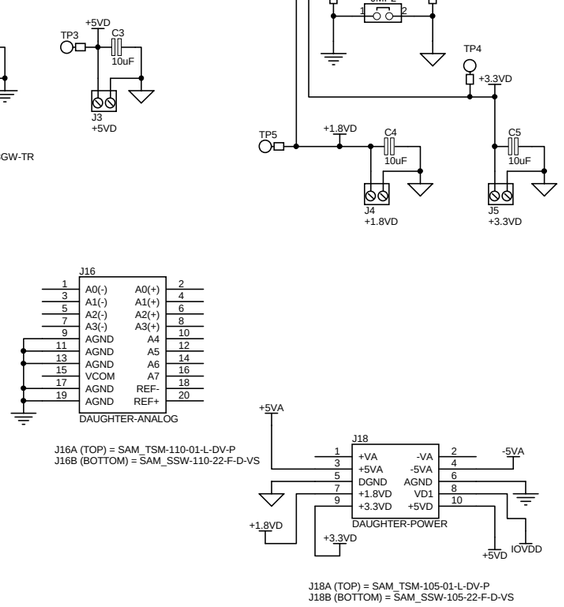
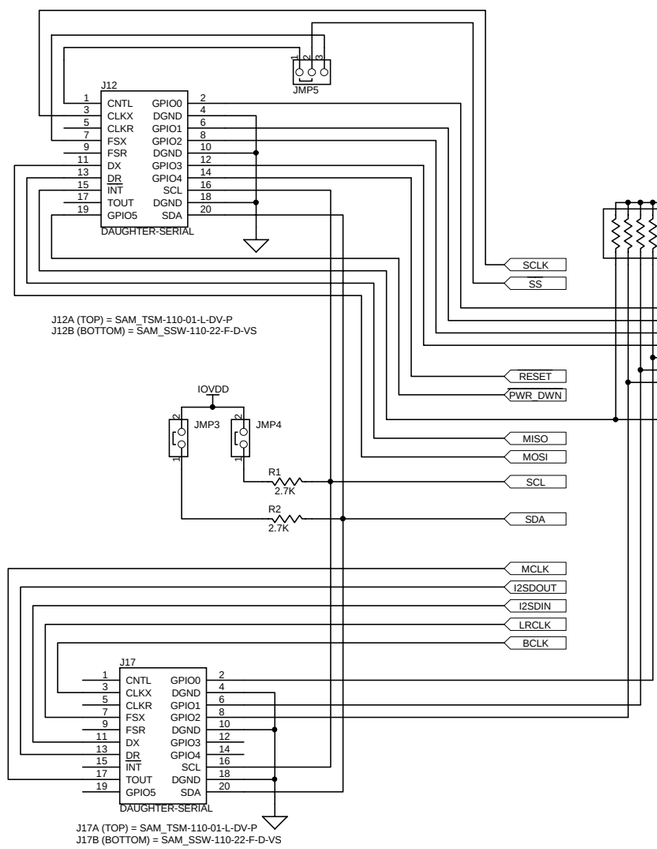
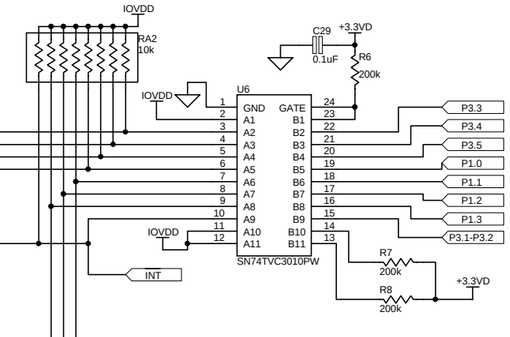




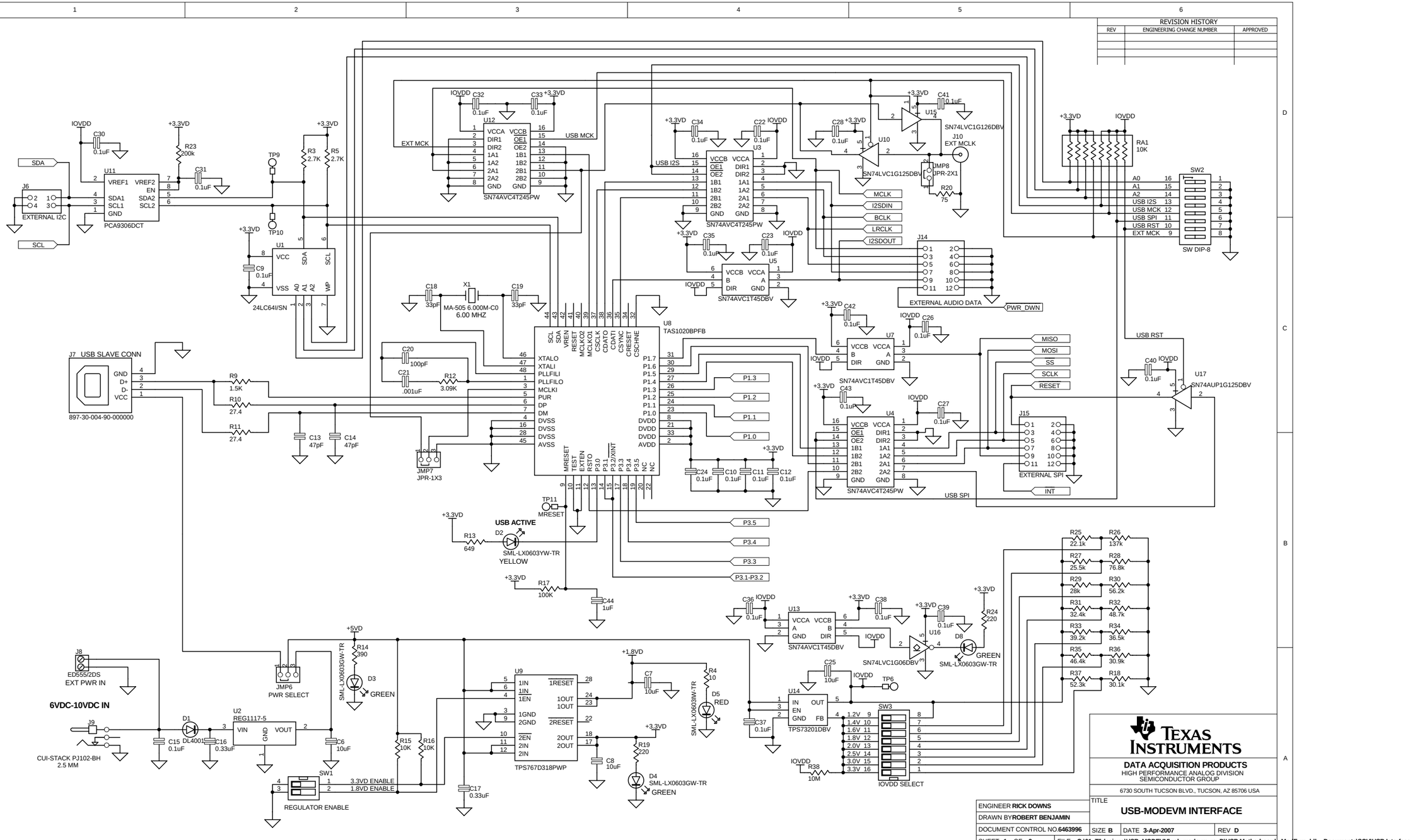






TEXAS INSTRUMENTS	
DATA ACQUISITION PRODUCTS HIGH-PERFORMANCE ANALOG DIVISION SEMICONDUCTOR GROUP	
6730 SOUTH TUCSON BLVD., TUCSON, AZ 85706 USA	
ENGINEER **RICK DOWNS**	TITLE **USB-MODEVM INTERFACE**
DRAWN BY **ROBERT BENJAMIN**	
DOCUMENT CONTROL NO. **6463996**	SIZE **B** DATE **3-Apr-2007** REV **D**
SHEET **2** OF **2**	FILE **C:\01_TI\designs\USB_MODEVM\usb-modevm_revD\USB Motherboard - ModEvm.ddb - Documents\SCH\Daughtercard Interface**

REVISION HISTORY		
REV	ENGINEERING CHANGE NUMBER	APPROVED



ENGINEER **RICK DOWNS**	
DRAWN BY **ROBERT BENJAMIN**	
DOCUMENT CONTROL NO. **6463996**	SIZE **B** DATE **3-Apr-2007** REV **D**
SHEET **1** OF **2**	FILE **C:\01_TI\designs\USB_MODEVM\usb-modevm_revD\USB Motherboard - ModEvm.ddb - Documents\SCH\USB Interface**

TEXAS INSTRUMENTS

DATA ACQUISITION PRODUCTS
HIGH PERFORMANCE ANALOG DIVISION
SEMICONDUCTOR GROUP

6730 SOUTH TUCSON BLVD., TUCSON, AZ 85706 USA

TITLE
USB-MODEVM INTERFACE

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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 and the EVM motherboard within the input voltage range of 6 VDC to 10 VDC when using an external AC/DC power supply. Refer to the USB-MODEVM Interface Power section of this manual when using lab power supplies..

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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