

TLV320AIC36EVM-K

This user's guide describes the characteristics, operation, and use of the TLV320AIC36EVM-K. This evaluation module (EVM) features a complete stereo audio codec with several inputs and outputs, extensive audio routing, mixing, and effects capabilities. A complete circuit description, schematic diagram, and bill of materials are also included.

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

EVM-Compatible Device Data Sheets

Device	Literature Number
TLV320AIC36	SBAS387
TAS1020B	SLES025
TPS767D318	SLVS209
SN74LVC125A	SCAS290
SN74LVC1G125	SCES223
SN74LVC1G07	SCES296

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1 EVM Overview

1.1 Features

- Full-featured evaluation board for the TLV320AIC36 stereo audio codec.
- USB connection to PC provides power, control, and streaming audio data for easy evaluation.
- Onboard microphone for ADC evaluation
- Connection points for external control and digital audio signals for quick connection to other circuits/input devices.

The TLV320AIC36EVM-K is a complete evaluation kit, which includes a universal serial bus (USB)-based motherboard and evaluation software for use with a personal computer running Microsoft Windows™ XP.

1.2 Introduction

The TLV320AIC36EVM is in the Texas Instruments (TI) modular EVM form factor, which allows direct evaluation of the device performance and operating characteristics and eases software development and system prototyping.

The TLV320AIC36EVM-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 (PC) running the Microsoft Windows XP operating system.

The TLV320AIC36EVM-K is operational with one USB cable connection to a PC. The USB connection provides power, control, and streaming audio data to the EVM for reduced setup and configuration. The EVM also allows external control signals, audio data, and power for advanced operation, which allows prototyping and connection to the rest of the development or system evaluation.

2 EVM Description and Basics

This section provides information on the analog input and output, digital control, power, and general connection of the TLV320AIC36EVM-K.

2.1 TLV320AIC36EVM-K Block Diagram

The TLV320AIC36EVM-K consists of two separate circuit boards, the USB-MODEVM and the TLV320AIC36EVM. The USB-MODEVM is built around the TAS1020B streaming audio USB controller with an 8051-based core. The motherboard features two positions for modular EVMs, or one double-wide serial modular EVM can be installed. The TLV320AIC36EVM is one of the double-wide modular EVMs that is designed to work with the USB-MODEVM.

The simple diagram of [Figure 1](#) shows how the TLV320AIC36EVM is connected to the USB-MODEVM. 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, etc.) externally. The source of these signals is controlled by SW2 on the USB-MODEVM. See [Table 1](#) for details on the switch settings.

The USB-MODEVM has two EVM positions that allow for the connection of two small evaluation module or one larger evaluation module. The TLV320AIC36EVM is designed to fit over both of the smaller evaluation module slots as shown in [Figure 1](#).

2.1.1.1 USB-MODEVM Interface Board

The simple diagram of [Figure 1](#) shows only the basic features of the USB-MODEVM Interface board.

Because the TLV320AIC36EVM is a double-wide modular EVM, it is installed with connections to both EVM positions, which connects the TLV320AIC36 digital control interface to the I²C port realized using the TAS1020B, as well as the TAS1020B digital audio interface.

In the factory configuration, the board is ready to be used with the USB-MODEVM. To view all the functions and configuration options available on the USB-MODEVM board, see the USB-MODEVM Interface Board schematic in [Appendix G](#).

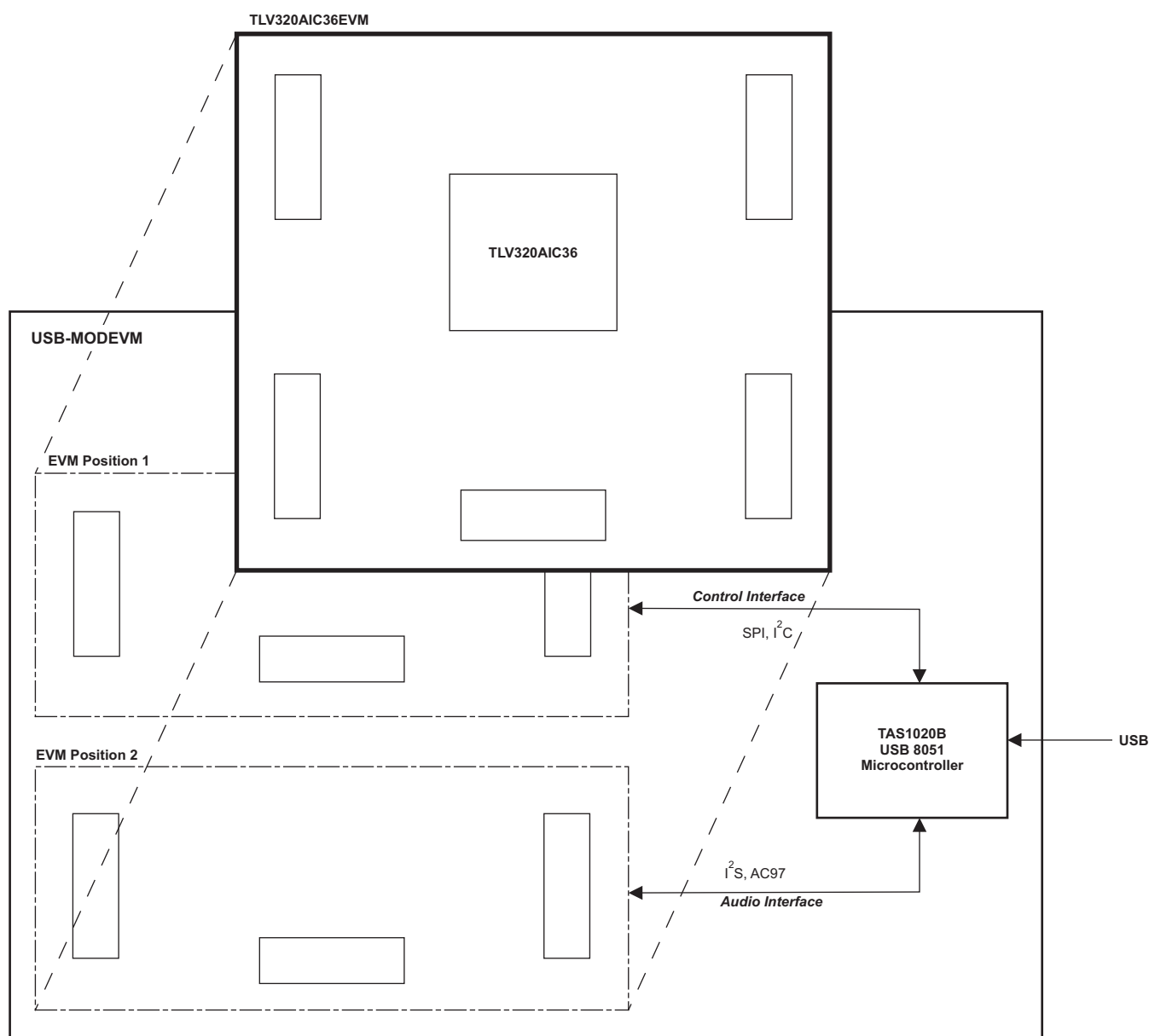


Figure 1. TLV320AIC36EVM-K Block Diagram

2.2 Default Configuration and Connections

2.2.1 USB-MODEVM

Table 1 provides a list of the SW2 settings on the USB-MODEVM. For use with the TLV320AIC36EVM, SW-2 positions 1, 3, 4, 5, 6, and 7 must be set to ON, whereas SW-2.2 and SW-2.8 must be set to OFF. If the TLV320AIC36EVM is to be used with an external audio interface, SW2.4 and SW2.5 also need to be set to OFF and such interface must be connected as explained in [Section 2.4](#)

Table 1. USB-MODEVM SW2 Settings

SW-2 Switch Number	Label	Switch Description
1	A0	USB-MODEVM EEPROM I ² C Address A0 ON: A0 = 0 OFF: A0 = 1
2	A1	USB-MODEVM EEPROM I ² C Address A1 ON: A1 = 0 OFF: A1 = 1
3	A2	USB-MODEVM EEPROM I ² C Address A2 ON: A2 = 0 OFF: A2 = 1
4	USB I ² S	I ² S Bus Source Selection ON: I ² S Bus connects to TAS1020 OFF: I ² S Bus connects to USB-MODEVM J14
5	USB MCK	I ² S 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

2.2.2 TLV320AIC36 Jumper Locations

Table 2 provides a list of jumpers found on the EVM and their factory default conditions.

Table 2. List of Jumpers

Jumper	Default Position	Jumper Description
W1	2-3	When connecting 2-3, microphone bias comes from the EXT_MICBIAS pin on the device; when connecting 1-2, microphone (mic) bias is supplied by the AVDD_BIAS node. The AVDD_BIAS node can be sourced by two different supplies depending on the jumper W13 setting or can be sourced by an external supply through TP34 (with W13 removed).
W2	Installed	Connects onboard Mic negative terminal to the circuit.
W3	Installed	Connects onboard Mic positive terminal to the circuit.
W4	Open	Connects the DETECT pin to J11.2.
W5	Installed	Provides mic bias to J11.2 through a 2.2k Ω equivalent resistance (W6 not installed) or 1k Ω resistor (W6 installed).
W6	Installed	Sets the mic bias resistance to 1 k Ω . Use for differential electret mic configurations.
W7	Installed	Connects J11.3 to the circuit.
W8	2-3	Connects J11.3 to ground or 1-k Ω resistor.
W9	Open	Connects a 1k Ω load to INT_MICBIAS.
W10	Installed	Connects HP_COM to ground.
W11	1-2	Connects AVDD_CP to the on-board regulator (U2) or an external +2.5V supply (through J18.3).
W12	1-2	Connects AVDD_REG to the on-board regulator (U2) or an external +2.5V supply (through J18.3).
W13	1-2	Connects AVDD_BIAS to the on-board regulator (U2) or an external +2.5V supply (through J18.3).

Table 2. List of Jumpers (continued)

Jumper	Default Position	Jumper Description
W14	1-2	Connects AVDD_ADC to AVDD2 or an external +1.8V supply (through J17.3).
W15	Open	Connects AVSS_REG to an external –2.5V supply (through J18.1). Do not connect if the charge pump is enabled.
W16	1-2	Connects AVDD_DAC to AVDD1 or an external +1.8V supply (through J17.3).
W17	1-2	Connects AVSS_DAC to AVSS1 or an external –1.8V supply (through J17.1).
W18	1-2	Connects AVDD_HP to AVDD1 or an external +1.8V supply (through J17.3).
W19	1-2	Connects AVSS_HP to AVSS1 or an external –1.8V supply (through J17.1).
W20	2-3	Connects I2C_ADDR0 to IOVDD or ground.
W21	2-3	Connects I2C_ADDR1 to IOVDD or ground.
W22	Open	Connects GPIO1 to J4.2/P4.2.
W23	Open	Connects GPIO2 to J4.6/P4.6.
W24	Installed	Provides a means of measuring IOVDD current.
W25	Installed	Provides a means of measuring DVDD current.
W26	1-2	Connects DVDD to +1.8VD (provided by P3.7/J3.7) or an external +1.8V supply (through J17.3).
W27	Open	Provides a means to connect IOVDD to +1.8VD (provided by P3.7/J3.7) or an external +1.8V supply (through J17.3).
W28	1-2	Connects IOVDD to +3.3VD (provided by P3.9/J3.9) or the source provided by the W27 setting.
W29	N/A	N/A
W30	Open	When installed, connects J4.8/P4.8 to RESETB.
W31	Installed	When installed, it selects onboard EEPROM as firmware source.

2.3 Analog Signal Connections

2.3.1 Analog Inputs

The analog input sources can be applied directly to terminal blocks J7, J8, J9 and J10 or input jacks J6 and J11. The connection details can be found in [Appendix A](#).

2.3.2 Analog Output

The analog outputs are available from terminal blocks J13, J14, J15 and J16 or output jack J12. The connection details can be found in [Appendix A](#).

2.4 Digital Signal Connections

The digital inputs and outputs of the EVM can be monitored through P4 and P5. If external signals need to be connected to the EVM, digital inputs must be connected via J14 and J15 on the USB-MODEVM and the SW2 switch must be changed accordingly (see [Section 2.2.1](#)). The connector details are available in [Section A.2](#).

2.5 Power Connections

The TLV320AIC36EVM can be powered independently when being used in stand-alone operation or by the USB-MODEVM when it is plugged onto the motherboard.

2.5.1 Stand-Alone Operation

When used as a stand-alone EVM, power is applied to P3/J3 directly, making 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 [TLV320AIC36 data sheet](#) before applying power to the EVM.

P3/J3 provides connection to the common power bus for the TLV320AIC36EVM. Power is supplied on the pins listed in [Table 7](#).

The TLV320AIC36EVM-K motherboard (the USB-MODEVM Interface board) supplies power to J3 of the TLV320AIC36EVM. Power for the motherboard is supplied either through its USB connection or via terminal blocks on that board.

2.5.2 USB-MODEVM Operation

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

- USB
- 6-Vdc to 10-Vdc AC/DC external wall supply (not included)
- Laboratory power supply

When powered from the USB connection, JMP6 must have a shunt from pins 1–2 (this is the default factory configuration). When powered from 6-Vdc to 10-Vdc power supply, either through the J8 terminal block or J9 barrel jack, JMP6 must 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, JMP6 must 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 illuminates when the power supplies are active.

3 TLV320AIC36EVM-K Setup and Installation

The following section provides information on using the TLV320AIC36EVM-K, including setup, program installation, and program usage.

NOTE: If using the EVM in stand-alone mode, the software must be installed per the following instructions, but the hardware configuration may be different.

3.1 Software Installation

1. Download the latest version of the AIC36 Control Software (CS) located in the [TLV320AIC36EVM-K Product Folder](#).
2. Open the self-extracting installation file.
3. Extract the software to a known folder.
4. Install the EVM software by double-clicking the **Setup** executable, and follow the directions. The user may be prompted to restart their computer.

This installs all the TLV320AIC36EVM-K software.

3.2 EVM Connections

1. Ensure that the TLV320AIC36EVM is installed on the USB-MODEVM Interface board, aligning J1, J2, J3, J4, and J5 with the corresponding connectors on the USB-MODEVM.
2. Verify that the jumpers and switches are in their default conditions.
3. Attach a USB cable from the PC to the USB-MODEVM Interface board. The default configuration provides power, control signals, and streaming audio via the USB interface from the PC. On the USB-MODEVM, LEDs D3, D4, D5, and D7 illuminate to indicate that the USB is supplying power.
4. For the first connection, the PC recognizes new hardware and begins an initialization process. The TLV320AIC36EVM-K will enumerate as a "USB Human Interface Device" and as a "USB Audio Device".
5. Once the PC confirms that the hardware is operational, D2 on the USB-MODEVM illuminates to indicate that the firmware has been loaded and the EVM is ready for use. If D2 does not illuminate, verify that the EEPROM jumper and switch settings conform to [Table 1](#) and [Table 2](#).

After the TLV320AIC36EVM-K software installation (described in [Section 3.2](#)) is complete, evaluation and development with the TLV320AIC36 can begin.

The TLV320AIC36EVM-K software can now be launched. The user sees an initial screen that looks similar to [Figure 2](#).

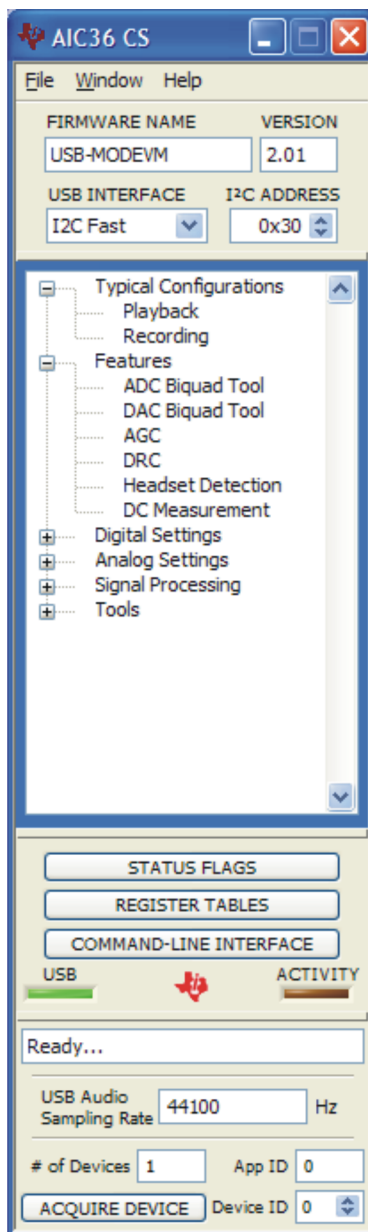


Figure 2. Initial Screen of TLV320AIC36EVM-K Software

If running the software in Windows Vista or Windows 7, right-click the AIC36EVM-K CS shortcut and select *Properties*. Configure the *Compatibility* tab as shown in [Figure 3](#)

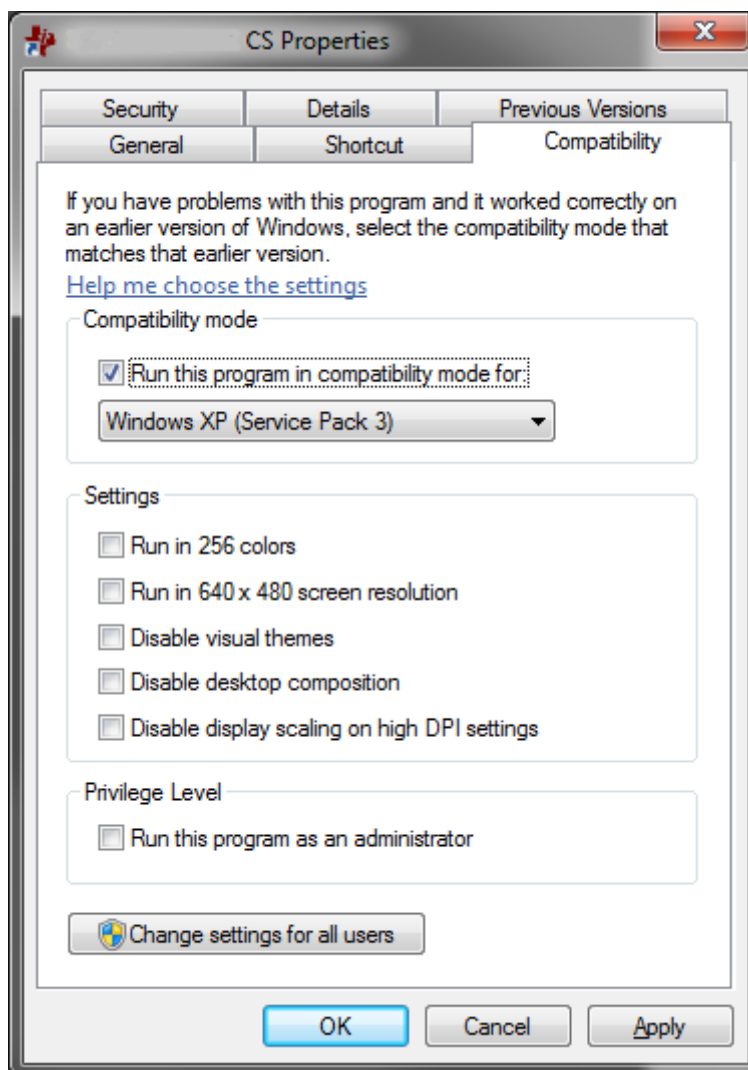


Figure 3. Compatibility Tab

4 AIC36 Control Software

The AIC36 Control Software (CS) is an intuitive, easy-to-use, powerful tool to learn, evaluate, and control the TLV320AIC36. This tool was specifically designed to make learning the TLV320AIC36 easy. The following sections describe the operation of this software.

NOTE: For configuration of the codec, the TLV320AIC36 block diagram located in the [TLV320AIC36](#) data sheet is a good reference to help determine the signal routing.

4.1 Main Panel Window

The Main Panel window, shown in [Figure 2](#), provides easy access to all the features of the AIC36 CS. The Firmware Name and Version boxes provide information about the firmware loaded into the EVM's EEPROM.

The USB Interface drop-down menu allows the user to select which communication protocol the TAS1020B USB Controller uses to communicate with the TLV320AIC36 or to toggle the TAS1020B GPIO pins. The USB-MODEVM Interface selection is global to all panels, including the Command-Line Interface. The I²C Address box sets the global I²C address to be used by controls and indicators. Note that scripts executed in the command line interface and in other panels use the I²C address provided in each command and not the global I²C address.

The Panel Selection Tree provides access to typical configurations, features, and other panels that allow the user to control the TLV320AIC36. The tree is divided into several categories which contain items that pop up panels. A panel can be opened by double-clicking any item inside a category in the Panel Selection Tree.

Below the Panel Selection Tree are three buttons that pop up the following:

- Status Flags - Allows the user to monitor the TLV320AIC36 status flags.
- Register Tables - A tool to monitor register pages.
- Command-Line Interface - A tool to execute/generate scripts and monitor register activity.

The USB LED indicates if the EVM kit is recognized by the software and the ACTIVITY LED illuminates every time a command request is sent.

The dialog box at the bottom of the Main Panel provides feedback of the current status of the software.

For USB-MODEVM firmware versions 2.01 and above, it is possible to update the firmware on-the-fly. This is useful for cases in which different USB Audio sampling rates are desired, or when a new firmware version is released. The "USB Audio Sampling Rate" dialog box displays the current USB audio sampling rate supported by a particular firmware. Details on how to re-program the firmware are available in [Section 4.1.4](#).

4.1.1 Typical Configurations

This category can help users to quickly become familiar with the TLV320AIC36. Each of the panels that can be accessed through this menu have controls relevant to the selected configuration; a tab shows the script that will be loaded for that particular configuration. Each script includes a brief description of the selected configuration, as shown in [Figure 4](#).

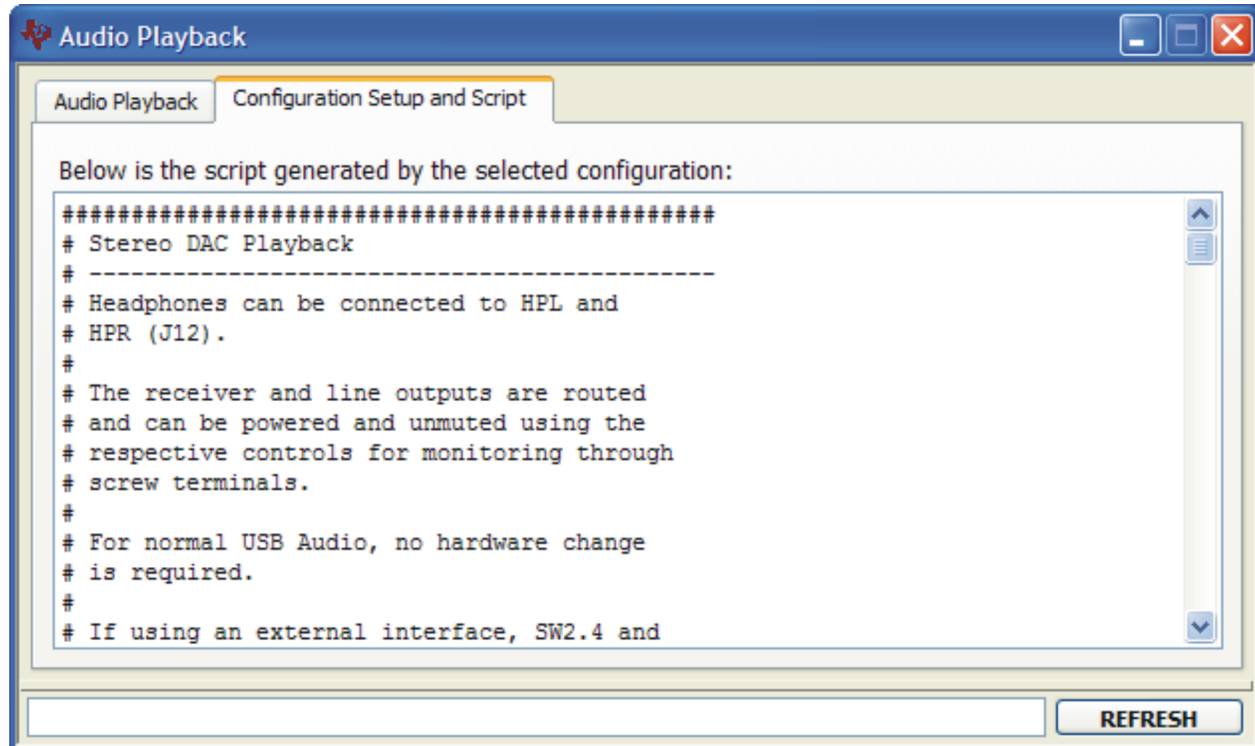


Figure 4. Playback Script Tab

4.1.1.1 Playback

The Playback panel (shown in [Figure 5](#)) has the following configurations:

- Stereo DAC Playback - this configuration programs the TLV320AIC36 for stereo playback through the headphone outputs. The DAC is also connected to the line and receiver driver mixers but are powered down and muted by default.
- Stereo ADC Record and DAC Playback - this configuration is the same as Stereo DAC Playback, but with the LINEIN inputs connected to the ADC.
- LINEIN Analog Bypass - this configuration routes LINEIN to all output mixers. Only the HP outputs are powered and unmuted.
- PGA Analog Bypass - this configuration routes LINEIN to the analog input amplifier (Mic PGA) which is then routed all output mixers. Only the HP outputs are powered and unmuted.

The analog inputs and outputs used for these configurations can be accessed as follows:

1. Line inputs - Jack J6 or terminal block J7.
2. Line outputs - Terminal blocks J14 and J15.
3. Receiver outputs - Terminal block J16.
4. Headphone outputs - Jack J12. A filtered version is available at J13 (for high impedance loads only).

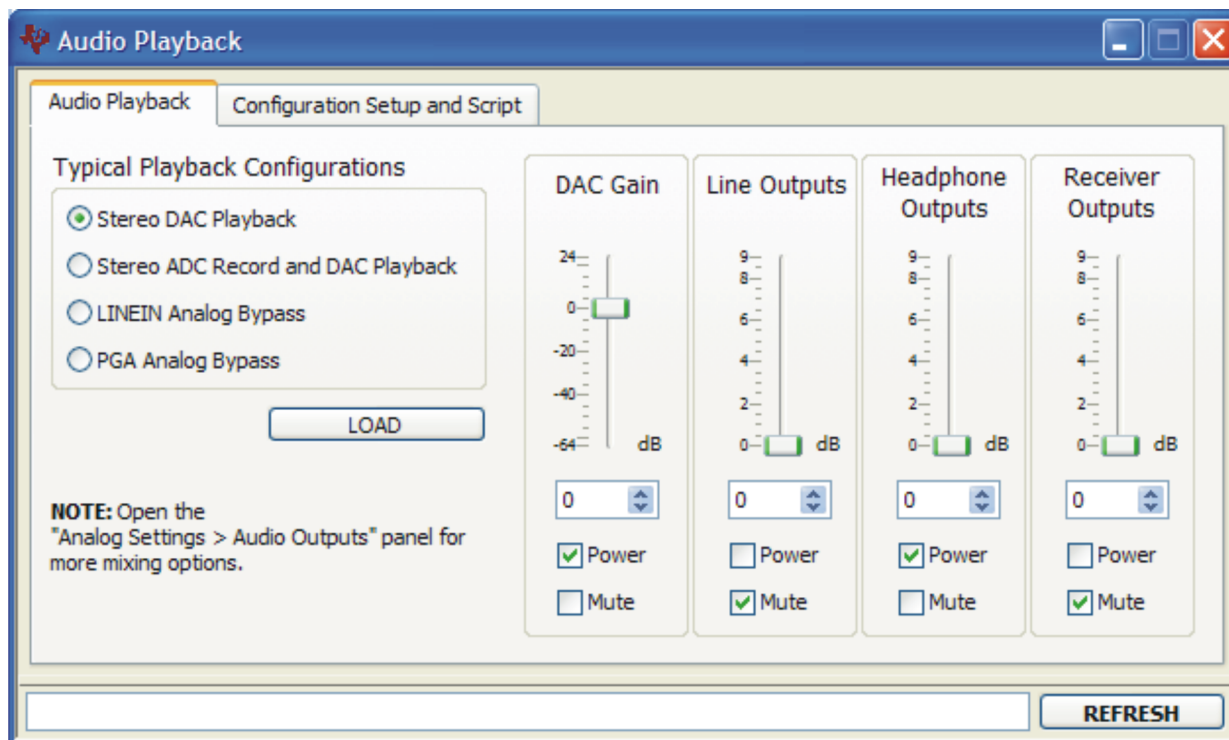


Figure 5. Playback Panel

4.1.1.2 Recording

The Recording panel (shown in [Figure 7](#)) has the following configurations:

- Stereo ADC Recording - LINEIN_L and LINEIN_R are routed to the left ADC and right ADC, respectively, in a single ended fashion.
- Differential On-Board Mic - The on-board microphone is routed to EXTMIC and to the left ADC. The jumper settings for this configuration are shown in [Figure 6](#).

The analog inputs used for these configurations can be accessed as follows:

1. Line inputs - Jack J6 or terminal block J7.

INPUT TYPE		
MODE		DIFFERENTIAL MONO
CODEC INPUTS		EXTMIC_P EXTMIC_M
ONBOARD MIC JUMPERS	W2 W3	IN IN
INPUT CONFIG JUMPER SETTINGS	W5 W6 W7 W8	IN IN IN 2-3

Figure 6. Differential Microphone

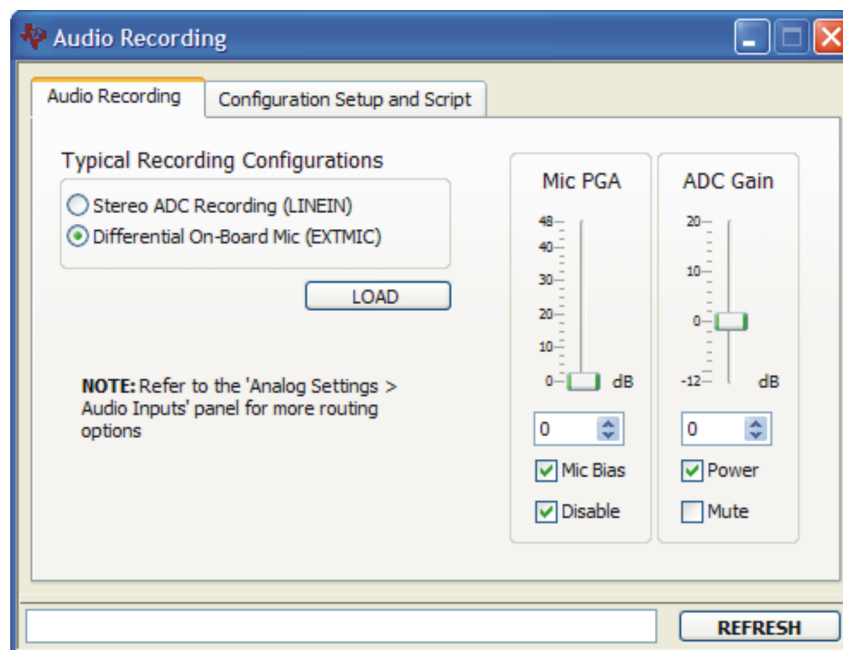


Figure 7. Recording Panel

4.1.2 Features

The **Features** category allows the user to evaluate various features of the TLV320AIC36. Each of the **Features** panels include an **Information** tab that explains the feature and provides hardware setup information for easy evaluation, as seen in [Figure 8](#).

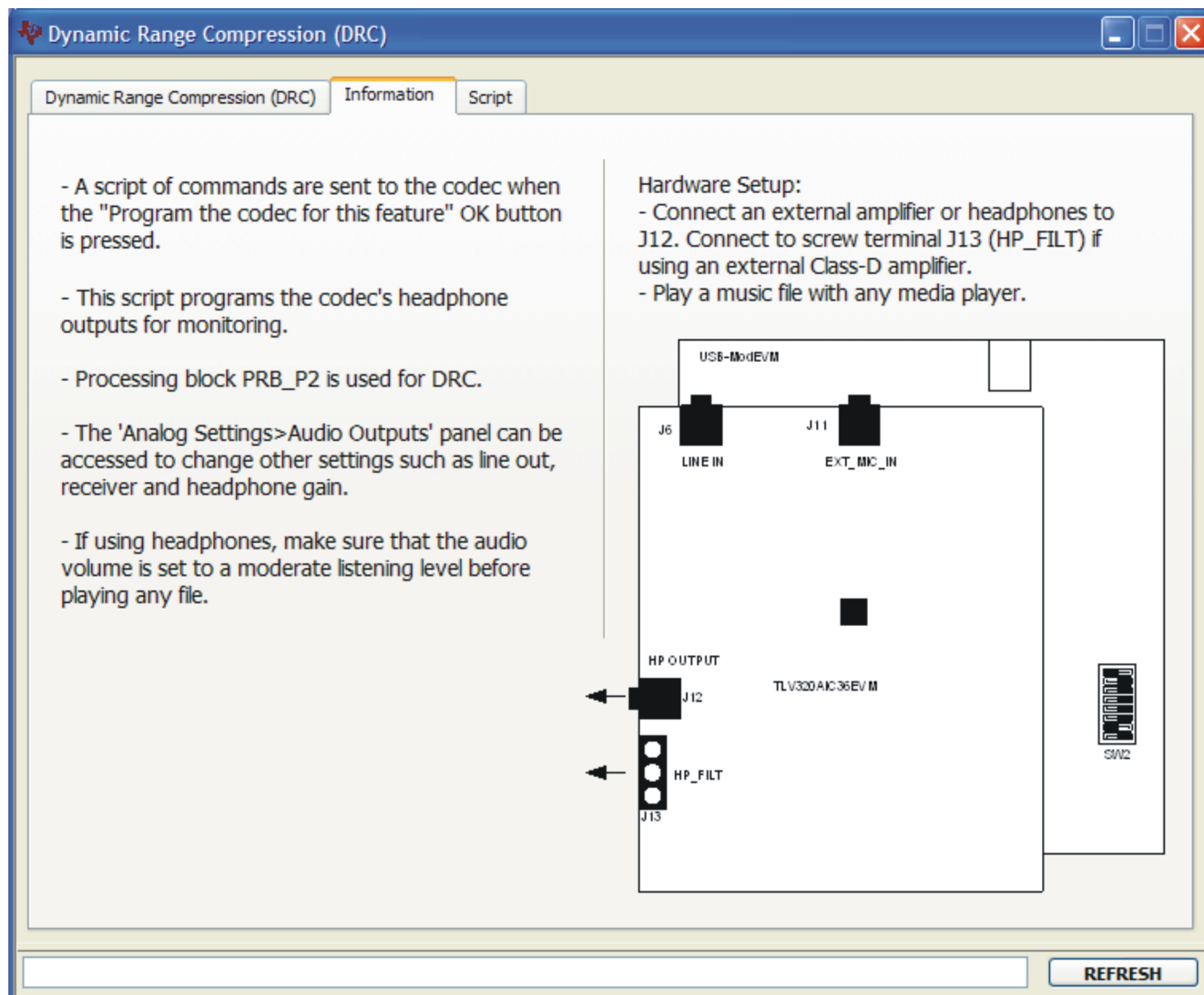


Figure 8. DRC Information Tab

Any item in the **Features** category can be accessed by a double-click. As soon as a **Features** panel opens, a pop-up message appears asking to program the codec for that feature (see Figure 9). A command script is sent to the codec if the **OK** button is clicked. This script programs all registers necessary to evaluate the feature. This can be bypassed by clicking the **Cancel** button.

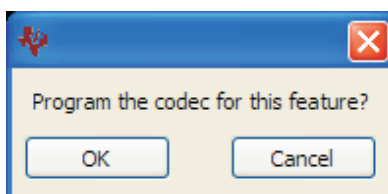


Figure 9. Program Codec Pop-Up Window

The script corresponding to each feature can be accessed at the *[Installation Directory]\DATA\EVM* folder. Also, each script can be manually customized and loaded as the feature's start-up script as long as the file name remains the same.

4.1.2.1 ADC Biquad Filter Tool

The ADC Biquad Filter Tool allows the user to specify the following biquad filters downloadable to the TLV320AIC36:

- All-pass
- High-pass (Butterworth first-order, Butterworth second-order, Bessel second-order, Linkwitz-Riley second-order, and variable-Q second-order)
- Low-pass (Butterworth first-order, Butterworth second-order, Bessel second-order, Linkwitz-Riley second-order, and variable-Q second-order)
- EQ (equalizer)
- Notch
- Treble shelf
- Bass shelf

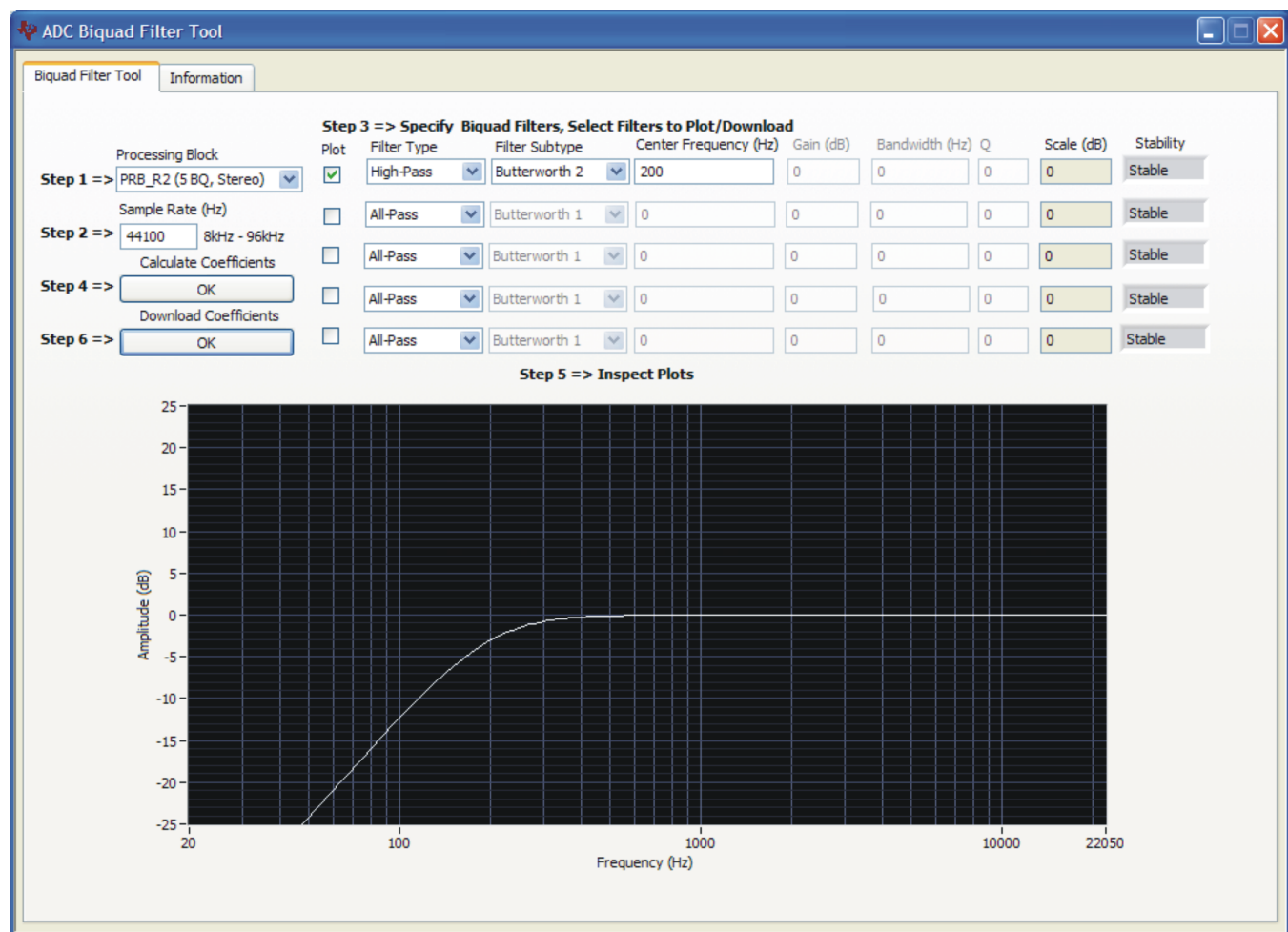


Figure 10. ADC Biquad Filter Tool

To use the default EVM settings with the Biquad Filter Tool click on the "Recording" application and download for example the line-input script to setup EVM for line-in recording then proceed to use the Biquad Filter Tool.

Step 1: Select the Processing Block - This specifies the number of biquads available (3 or 5) and stereo or mono (right). For best results use Processing Block PRB_R2 as this works well with the default EVM setup.

Step 2: Specify the Sample Rate - This is a key design parameter input to the Biquad Tool. The default is 44.1kHz which is the sample rate used on the EVM. The tool will work with any sample rate from 8kHz to 96kHz, however, if a sample rate other than 44.1kHz is selected then the user must go to the clock panel to modify the PLL and/or clock settings so that the desired sample rate is setup properly when used with an external audio interface.

Step 3: Specify the Biquad Filters - Select the filter type and subtype and enter any required parameters. Note that the parameters not used will be grayed out. Use the "Plot" Check-Box to select the filters to plot and/or download.

Step 4: Calculate the Coefficients - Click on the "Calculate Coefficients" OK button. This calculates all the selected filters and plots the combined response of all the checked filters. If a filter is not checked it is treated as an All-Pass filter.

Step 5: Inspect the Plots - Based on the selected filters determine if this is the total desired response. Also, inspect the Scale (dB) display. Some filters may create a negative gain error which is reflected in the scale. For example, if the Scale displays 0.5 there is a - 0.5dB gain error which can be corrected in the analog PGA or the digital Volume. In the last column the stability of the filter is indicated. If the roots of the filter denominator are less than 1 then the filter is stable and this field will display the text "Stable". Otherwise, it will display the text "Unstable" meaning that the unstable filter should be re-specified until it is stable.

Step 6: Download the Coefficients - Click on the "Download Coefficients" OK button. This action will download the filter coefficients to the device. Note that in order to download coefficients into the device, the following register writes are done:

1. Page 0 - Select processing block and Power-Down both ADCs
2. Page 4 - Write filter coefficients to both left and right channels as required
3. Page 0 - Power-Up both ADCs

Note that the filter coefficients can be saved as an I2C script by using the Command-Line Interface Record Button. The I2C commands will be displayed in the Command Buffer which can be selected and copied to a text command file.

4.1.2.2 DAC Biquad Filter Tool

The DAC Biquad Filter Tool allows the user to specify the following biquad filters downloadable to the TLV320AIC36:

- All-pass
- High-pass (Butterworth first-order, Butterworth second-order, Bessel second-order, Linkwitz-Riley second-order, and variable-Q second-order)
- Low-pass (Butterworth first-order, Butterworth second-order, Bessel second-order, Linkwitz-Riley second-order, and variable-Q second-order)
- EQ (equalizer)
- Notch
- Treble shelf
- Bass shelf

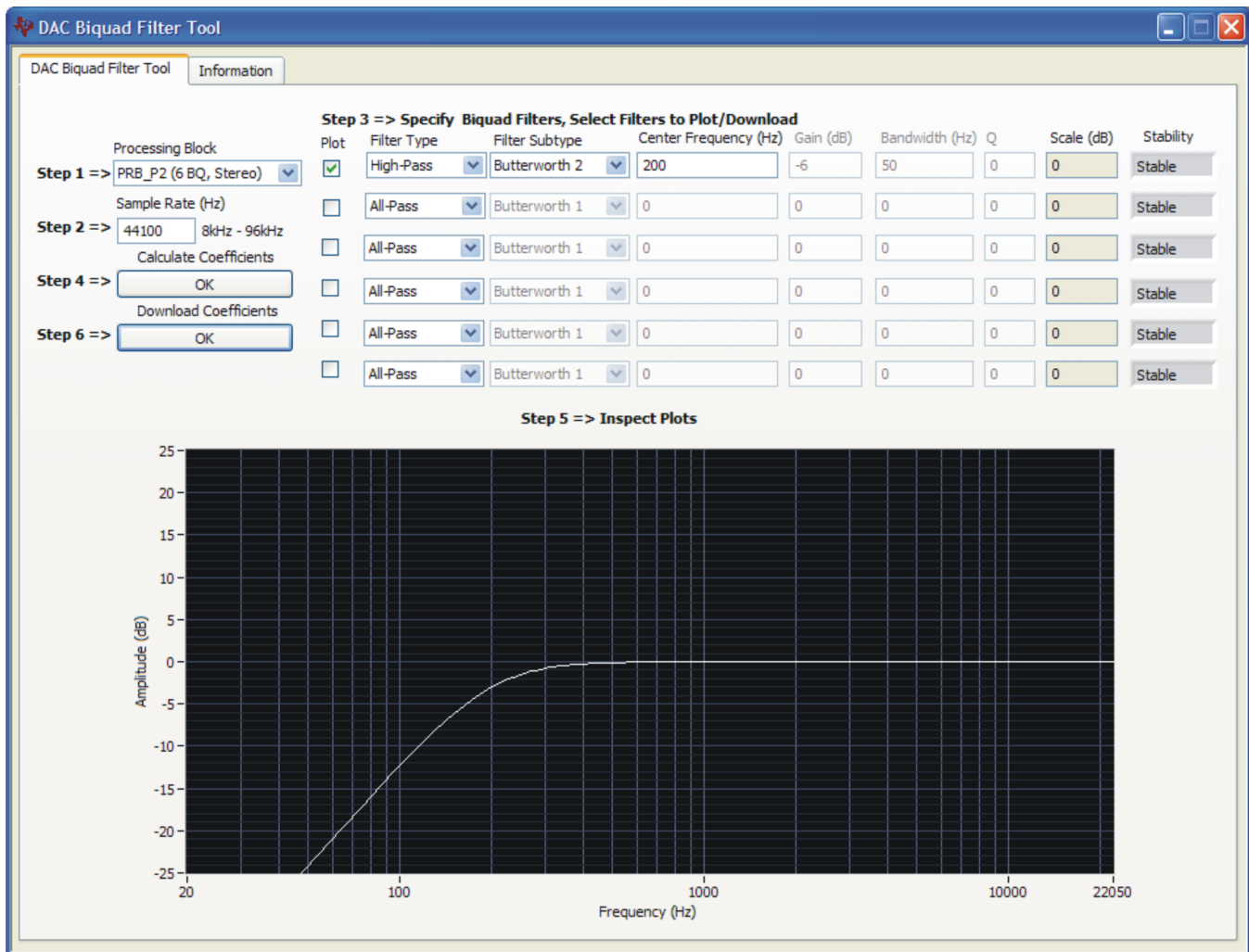


Figure 11. DAC Biquad Filter Tool

To test the filters with USB Audio, select a configuration from the 'Typical Configurations>Playback' panel. The 'Stereo DAC Playback' configuration is optimized for any 'Filter A' processing block. Alternatively, a custom script can be loaded into the Command-Line Interface panel before downloading coefficients. This tool assumes that Adaptive Filtering is enabled for real-time filtering.

Step 1: Select the Processing Block - This specifies the number of biquads available and stereo or mono (left). For best results, use Processing Block PRB_P2 as this works well with the default EVM setup. To change the processing block on the device:

1. Go to the 'Analog Settings>Audio Outputs' panel to uncheck the 'Enable DACs' box.
2. Go to the 'Signal Processing>Processing Blocks' panel to select the DAC processing block.
3. Go to the 'Analog Settings>Audio Outputs' panel to check the 'Enable DACs' box.

Step 2: Specify the Sample Rate - This is a key design parameter input to the Biquad Tool. The default is 44.1kHz which is the sample rate used on the EVM. The tool will work with any sample rate from 8kHz to 96kHz, however, if a sample rate other than 44.1kHz is selected then the user must go to the clock panel to modify the PLL and/or clock settings so that the desired sample rate is setup properly when used with an external audio interface.

Step 3: Specify the Biquad Filters - Select the filter type and subtype and enter any required parameters. Note that the parameters not used will be grayed out. Use the "Plot" Check-Box to select the filters to plot and/or download.

Step 4: Calculate the Coefficients - Click on the "Calculate Coefficients" OK button. This calculates all the selected filters and plots the combined response of all the checked filters. If a filter is not checked it is treated as an All-Pass filter.

Step 5: Inspect the Plots - Based on the selected filters determine if this is the total desired response. Also, inspect the Scale (dB) display. Some filters may create a negative gain error which is reflected in the scale. For example, if the Scale displays 0.5 there is a - 0.5dB gain error which can be corrected with the Digital PGA and amplifier gain. In the last column the stability of the filter is indicated. If the roots of the filter denominator are less than 1 then the filter is stable and this field will display the text "Stable". Otherwise, it will display the text "Unstable" meaning that the unstable filter should be re-specified until it is stable.

Step 6: Download the Coefficients - Click on the "Download Coefficients" OK button. This action will download the filter coefficients to the device. Note that in order to download coefficients into the device, the following register writes are done:

1. Page 8 - Write filter coefficients to both left and right channels as required
2. Page 8 - Switch Buffers and wait for flag to clear.
3. Page 8 - Re-write filter coefficients to both left and right channels as required

Note that the filter coefficients can be saved as an I2C script by using the Command-Line Interface Record Button. The I2C commands will be displayed in the Command Buffer which can be selected and copied to a text command file.

4.1.2.3 Automatic Gain Control

The left-channel Automatic Gain Control (AGC) can be enabled by checking the **Enable Left AGC** box (Figure 12). Pressing the **Capture Audio** button records the left-channel audio. Its corresponding data is displayed in the audio capture graph window. The small white window located at the bottom right of the AGC tab displays the audio waveform of the recorded data. Ensure that the AIC32x4 EVM is selected as the computer's default audio capture device before pressing this button. To set the TLV320AIC36EVM-K as the default audio device, open the Windows™ Control Panel → Sounds and Audio Devices Properties and set the AIC32x4 EVM as the default audio recording device. Also, do not use any other media player or audio recording software while the control software is recording.

The **target level** and **noise threshold** parameters can be modified by dragging the horizontal cursor lines located at the audio capture graph window. Its numeric values are displayed to the right of the graph. Noise threshold can be disabled by unchecking the **Enable Noise Threshold** box. The **AGC Max Gain** control sets the maximum allowed AGC PGA Gain. The **AGC Gain** indicator bar continuously displays the contents of Page 0/Register 93 if the **Enable Polling** box is checked.

Other parameters can be accessed by checking the **Advanced** box. For more information about AGC, see the **Information** tab and the data sheet.

Other flags related to this feature can be accessed at the **Status Flags** panel.

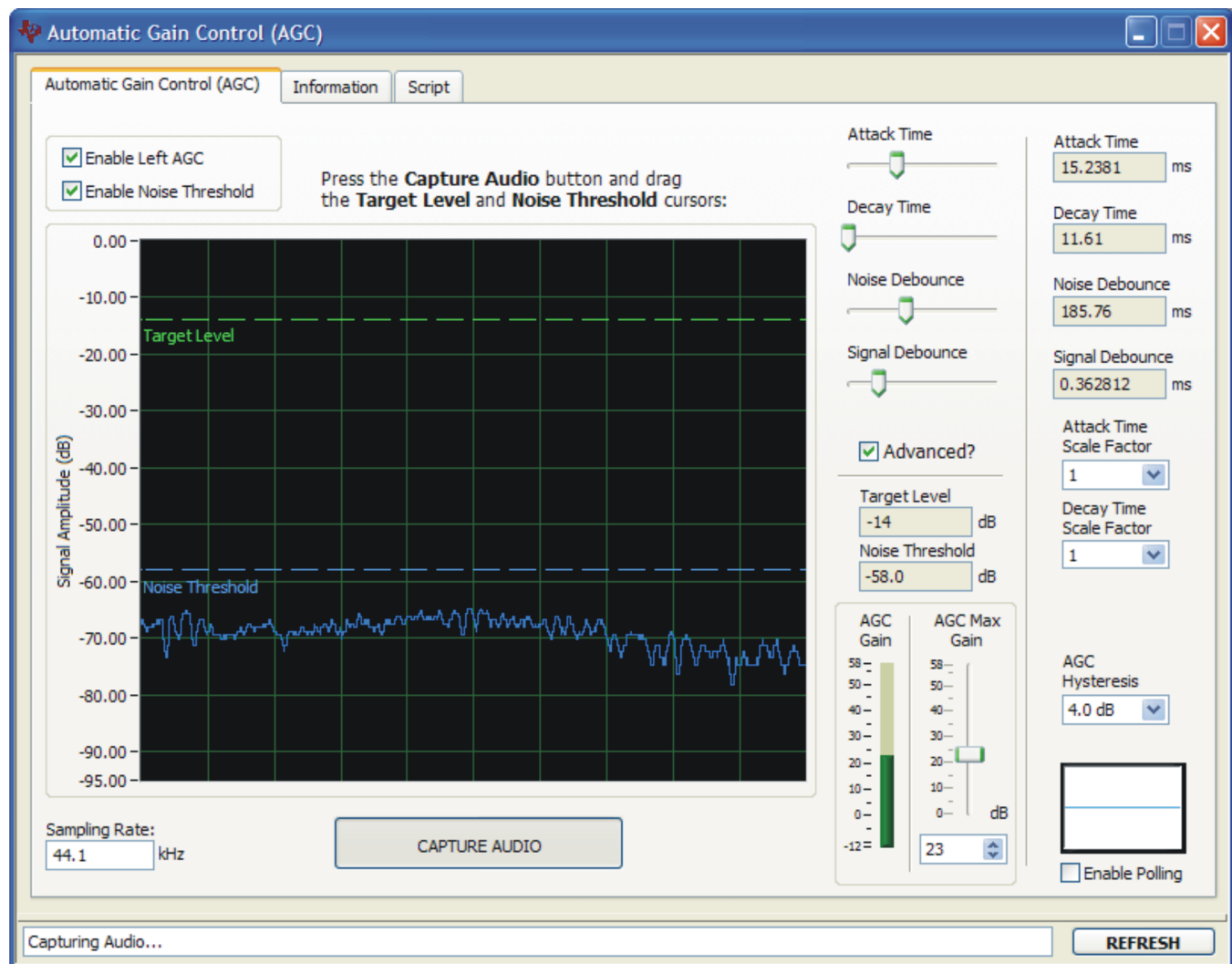


Figure 12. Automatic Gain Control Panel

4.1.2.4 Dynamic Range Compression

Dynamic Range Compression (DRC) can be enabled by checking the **Enable Left DRC** and **Enable Right DRC** boxes.

The level transfer characteristic graph is a function of the applied digital gain and the threshold parameter. The graph line is separated into two piece-wise linear regions where the red line represents the level range in which the DRC attenuation takes place, and the green line represents the level range in which the signal is not affected by DRC. As an example, setting the threshold to -24 dB with a gain to 24 dB implies that an input signal strength variation from -48 dB (threshold - gain) to 0 dB results in an output signal strength variation from -24 dB to 0 dB, or a compression ratio of 2:1. Similarly, a threshold of -3 dB with a gain of 24 dB implies that an input signal strength variation from -27 dB to 0 dB results in an output signal strength variation from -3 dB to 0 dB, or a ratio of 9:1. Note that a gain less than 0 dB does not result in expansion.

The **Attack** and **Decay** are time domain parameters that control the rate in which the applied gain reaches the target gain after the threshold level is crossed. As an example, a fast attack rate quickly reaches the target gain once the output signal crosses the programmed threshold region.

Other flags related to this feature can be accessed at the **Status Flags** panel.

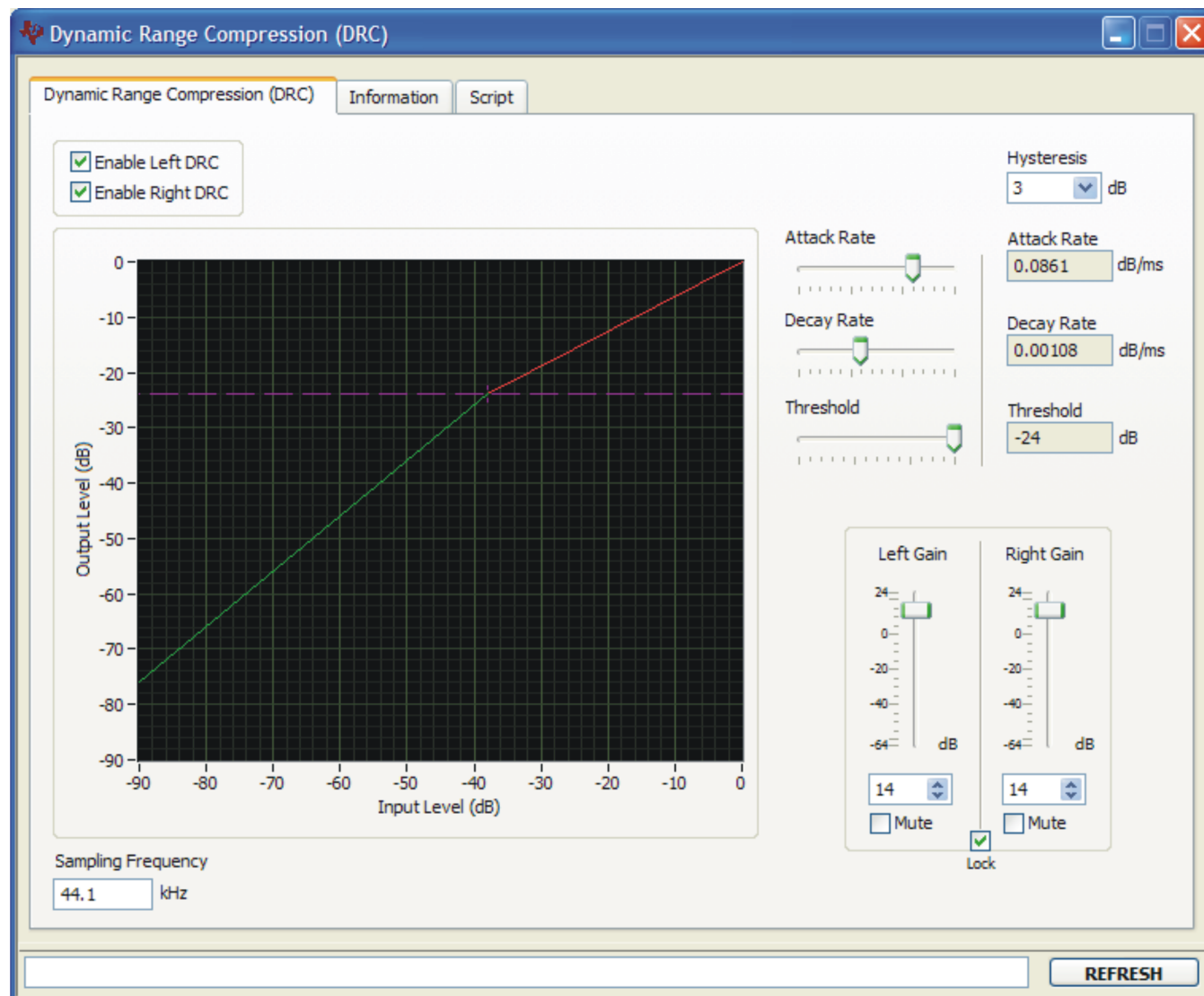


Figure 13. Dynamic Range Compression Panel

4.1.2.5 Headset Detection

Screw terminal J10 (EXT MIC IN) is provided to connect an external microphone, as well as unique push button combinations. As an example, the circuit shown below, connects a push button-resistor combination.

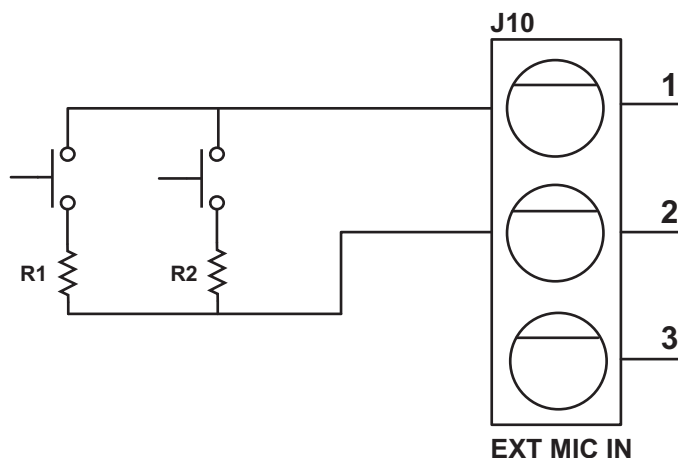


Figure 14. Headset Detection Circuit

This circuit can be used in combination with the on-board differential microphone (MK1) by using the following jumper settings:

Table 3. Jumper Settings for Headset Detection Example

Jumper	Setting
W1	2-3
W2	Inserted
W3	Inserted
W4	Inserted
W5	Inserted
W6	Open
W7	Inserted
W8	1-2

The DETECT SAR section in the image below shows a result of 19 as its Raw detect value. The WINDOW COMPARATOR section is configured for three windows separated by two threshold levels: window 0 (bits 0 to 13), window 1 (bits 14 to 27) and window 2 (bits 28 to 31). The detected window is "window 1" (raw detect value of 19) as shown in the PULSE DETECT sections.

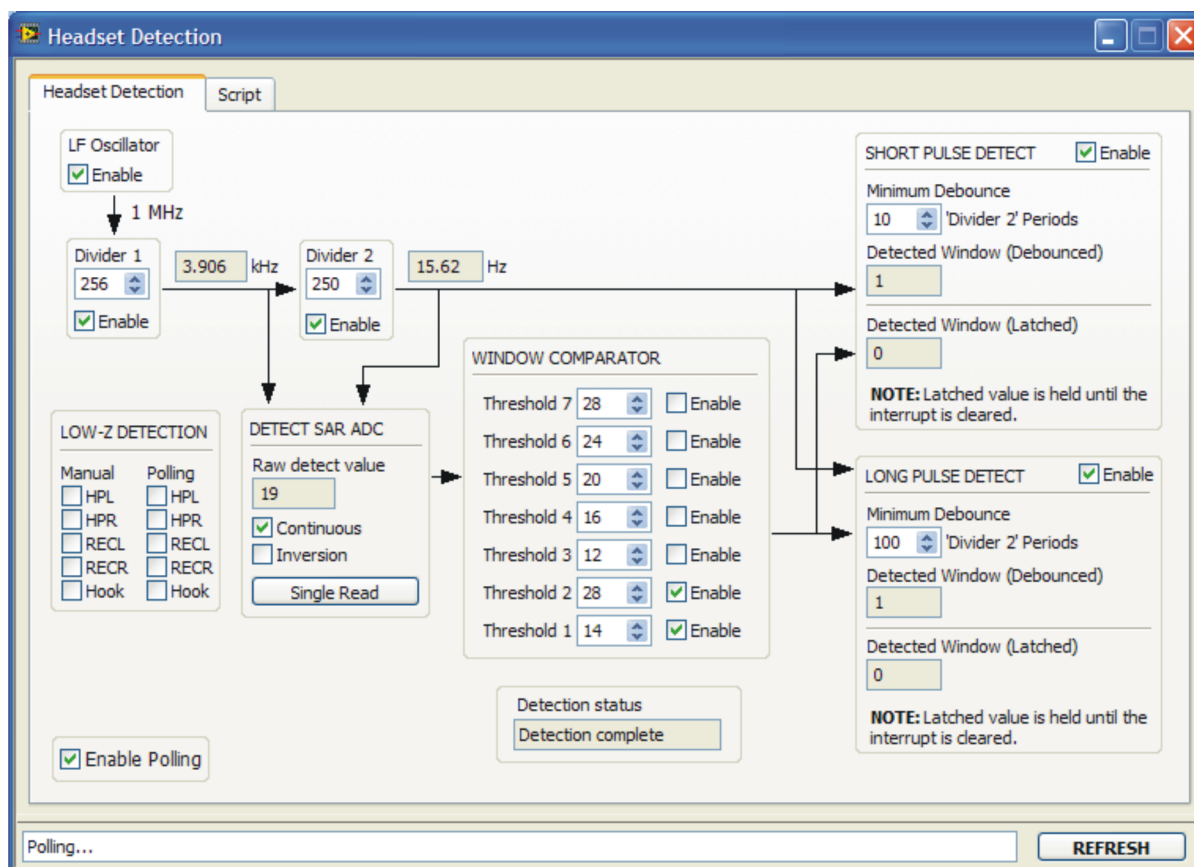


Figure 15. Headset Detection Panel

The Enable Polling button must be checked in order to update all dialog boxes, even if continuous mode or a single read is used.

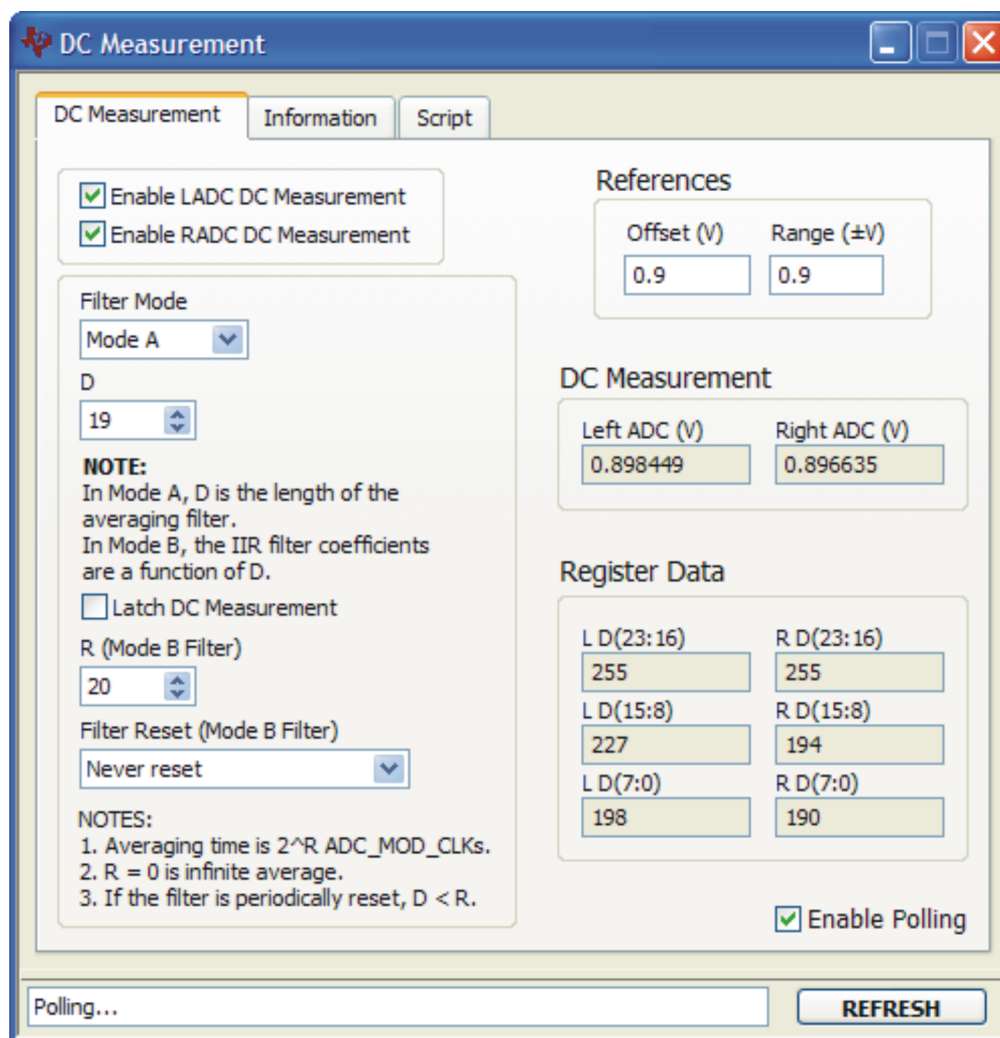
4.1.2.6 DC Measurement

Terminal block J3 on the TLV320AIC36EVM can be used to evaluate the DC measurement feature. The **Information** tab provides the hardware setup information.

The **Left ADC (V)** and **Right ADC (V)** boxes convert the register data to voltage. The voltage is derived from the **References** shown at the upper right corner of the **DC Measurement** tab. The DC measurement register data is in 2.22, 2s complement format.

Checking the **Enable Polling** box displays the DC measurement data.

Other flags related to this feature can be accessed at the **Status Flags** panel.



The screenshot shows the 'DC Measurement' panel with three tabs: 'DC Measurement', 'Information', and 'Script'. The 'DC Measurement' tab is active.

Enable LADC DC Measurement ☒ **Enable RADC DC Measurement** ☒

Filter Mode
Mode A
D: 19

NOTE:
In Mode A, D is the length of the averaging filter.
In Mode B, the IIR filter coefficients are a function of D.

☐ Latch DC Measurement

R (Mode B Filter): 20

Filter Reset (Mode B Filter): Never reset

NOTES:
1. Averaging time is 2^R ADC_MOD_CLKs .
2. R = 0 is infinite average.
3. If the filter is periodically reset, $D < R$.

References
Offset (V): 0.9 Range ($\pm V$): 0.9

DC Measurement
Left ADC (V): 0.898449 Right ADC (V): 0.896635

Register Data

L D(23:16)	R D(23:16)
255	255
L D(15:8)	R D(15:8)
227	194
L D(7:0)	R D(7:0)
198	190

☒ Enable Polling

Polling...

Figure 16. DC Measurement Panel

4.1.3 Control Categories

The **Digital Settings**, **Analog Settings**, and **Signal Processing** categories provide control of many registers and other features of the TLV320AIC36. These categories are intended for the advanced user. Hovering the mouse cursor on top of a control displays a tip strip that contains page, register, and bit information. As an example, hovering on top of an input in the Audio Inputs panel, as shown in [Figure 17](#) displays p1_r55_b7-6 which means that this control writes to Page 1/Register 55/Bits D7 to D6.

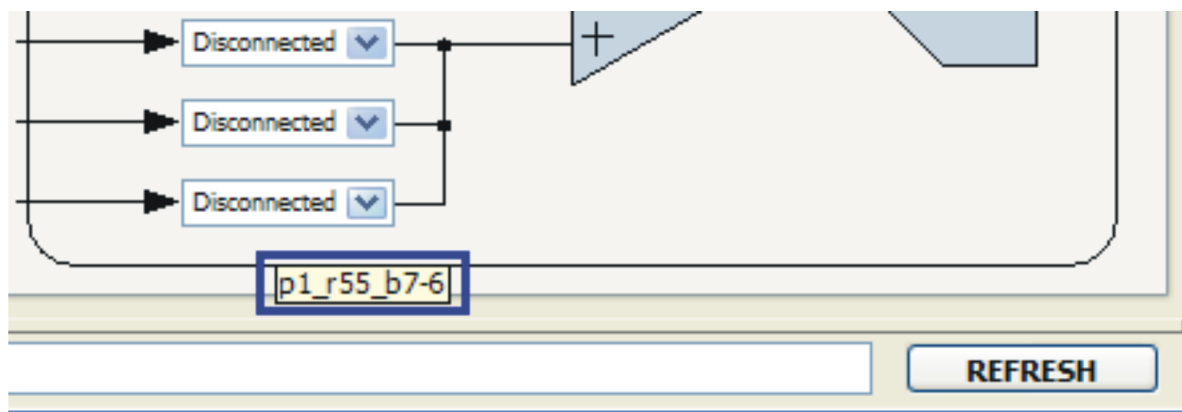


Figure 17. Audio Inputs Panel

All controls update their status with respect to the register contents in the following conditions:

- A panel is opened.
- The **Execute Command Buffer** button in the **Command-Line Interface** is pressed.
- The **Refresh** button at the bottom right of a panel is pressed.

4.1.4 EEPROM Writer

The EEPROM Writer allows the user to upgrade the firmware used by the TAS1020B USB Controller. More information about this panel can be found by double-clicking the "Tools > EEPROM Writer" item, as shown below.

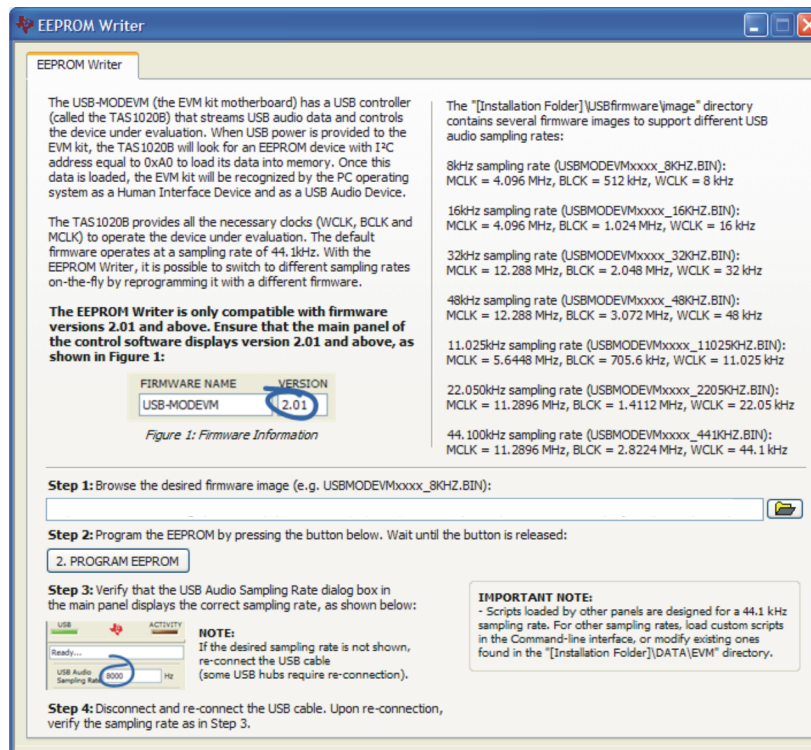


Figure 18. EEPROM Writer Panel

4.2 Status Flags Panel

The TLV320AIC36 status flags can be monitored in the **Status Flags** panel (Figure 19) which is located below the **Panel Selection Tree**. Pressing the **POLL** button continuously reads all the registers relevant to each flag and updates those flags accordingly. The rate at which the registers are read can be modified by changing

the value in the **Polling Interval** numeric control. Note that a smaller interval reduces responsiveness of other controls, especially volume sliders, due to bandwidth limitations. By default, the polling interval is 200 ms and can be set to a minimum of 20 ms.

The **Sticky Flags** tab contains indicators whose corresponding register contents clear every time a read is performed to that register. To read all the sticky flags, click the **Read Sticky Flags** button.

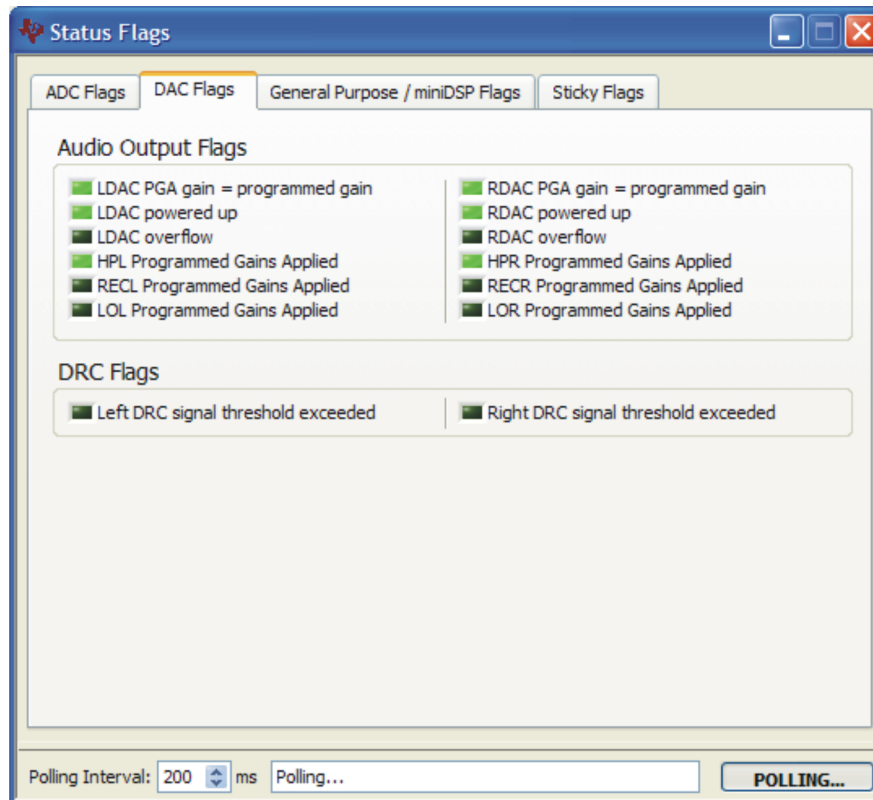


Figure 19. Status Flags Panel

4.3 Register Tables Panel

The contents of configuration and coefficient pages of the TLV320AIC36 can be accessed through the **Register Tables** panel (Figure 20).

The **Page Number** control changes to the page to be displayed in the register table. The register table contains page information such as the register name, reset value, current value, and a bitmap of the current value. The contents of the selected page can be exported into a spreadsheet by clicking the **Dump to Spreadsheet** button.

Register	Hex	Register Name	Reset Value	Current Value	D7	D6	D5	D4	D3	D2	D1	D0
Register 0	0x00	Page Select Register	0x00	0x00	0	0	0	0	0	0	0	0
Register 1	0x01	Software Reset Register	0x00	0x00	0	0	0	0	0	0	0	0
Register 2	0x02	Reserved Register	0x12	0x12	0	0	0	1	0	0	1	0
Register 3	0x03	Reserved Register	0x00	0x00	0	0	0	0	0	0	0	0
Register 4	0x04	Clock Setting Register 1, Multiplexers	0x00	0x08	0	0	0	0	1	0	0	0
Register 5	0x05	Clock Setting Register 2, PLL P&R Values	0x11	0x91	1	0	0	1	0	0	0	1
Register 6	0x06	Clock Setting Register 3, PLL J Values	0x04	0x08	0	0	0	0	1	0	0	0
Register 7	0x07	Clock Setting Register 4, PLL D Values (MSB)	0x00	0x00	0	0	0	0	0	0	0	0
Register 8	0x08	Clock Setting Register 5, PLL D Values (LSB)	0x00	0x00	0	0	0	0	0	0	0	0
Register 9	0x09	Reserved Register	0x00	0x00	0	0	0	0	0	0	0	0
Register 10	0x0A	Reserved Register	0x00	0x00	0	0	0	0	0	0	0	0
Register 11	0x0B	Clock Setting Register 6, NDAC Values	0x01	0x82	1	0	0	0	0	0	1	0
Register 12	0x0C	Clock Setting Register 7, MDAC Values	0x01	0x88	1	0	0	0	1	0	0	0
Register 13	0x0D	DAC OSR Setting Register 1, MSB Value	0x00	0x00	0	0	0	0	0	0	0	0

Figure 20. Register Tables Panel

4.4 Command-Line Interface Panel

The **Command-Line Interface** panel provides a means to communicate with the TLV320AIC36 using a simple scripting language (described in [Section G.1](#)). The TAS1020B USB Controller (located on the USB-MODEVM motherboard) handles all communication between the PC and the TLV320AIC36.

A script is loaded into the command buffer, either by loading a script file using the **File** menu or by pasting text from the clipboard using the Ctrl-V key combination ([Figure 21](#)).

When the command buffer is executed, the return data packets which result from each individual command are displayed in the **Command History** control. This control is an array (with a maximum size of 100 elements) that contains information about each command as well as status. The **Interface** box displays the interface used for a particular command in the **Command History** array. The **Command** box displays the type of command executed (i.e., write, read) for a particular interface. The **Flag Retries** box displays the number of read iterations performed by a **Wait for Flag** command (see [Section G.1](#) for details). The **Register Data** array displays the register number and data bytes that correspond to a particular command.

The **Information** tab provides additional information related to the **Command History** as well as additional settings. The **Syntax** and **Examples** tabs provide useful information related to the scripting language.

The **File** menu provides some options for working with scripts. The first option, *Open Script File...*, loads a command file script into the command buffer. This script can then be executed by pressing the **Execute Command Buffer** button. The contents of the **Command Buffer** can be saved using the *Save Script File...* option.

Both the **Command Buffer** and **Command History** can be cleared by clicking their corresponding **Clear** buttons.

The **Record** button generates script commands based on data written by other panels.

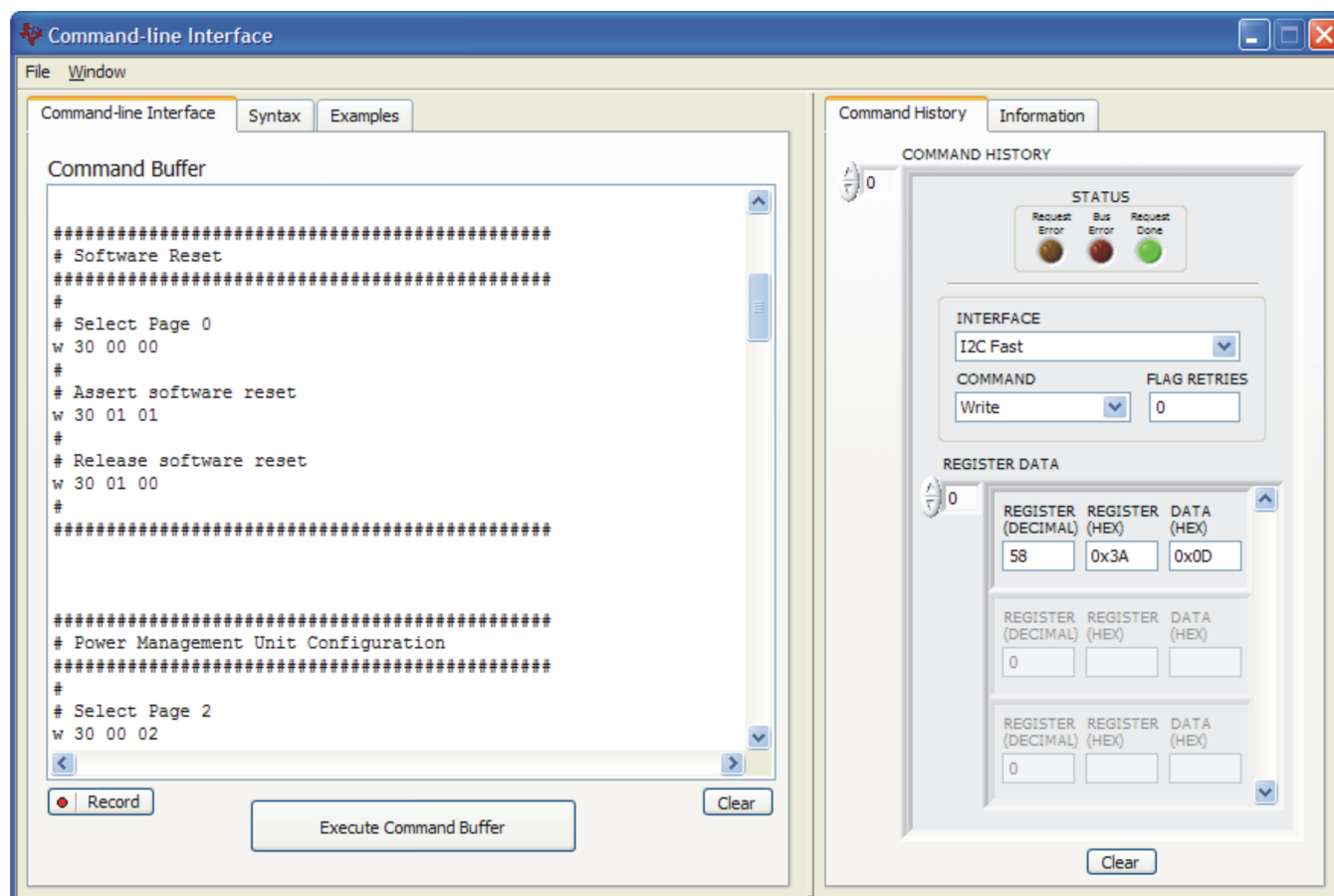


Figure 21. Command-line Interface Panel

Appendix A EVM Connector Descriptions

This appendix contains the connection details for each of the main connectors on the EVM.

A.1 Analog Interface Connectors

A.1.1 Analog Dual-Row Socket Details, J1 and J2

The TLV320AIC36EVM has two analog dual-row sockets located at the bottom of the board. These sockets provide support to the EVM and connect the analog ground plane of the EVM to the USB-MODEVM analog ground. Consult Samtec at www.samtec.com or call 1-800-SAMTEC-9 for a variety of mating connector options. Table 4 summarizes the analog interface pinout for the TLV320AIC36EVM.

Table 4. Analog Interface Pinout

PIN NUMBER	SIGNAL	DESCRIPTION
J1.1	NC	Not Connected
J1.2	NC	Not Connected
J1.3	NC	Not Connected
J1.4	NC	Not Connected
J1.5	NC	Not Connected
J1.6	NC	Not Connected
J1.7	NC	Not Connected
J1.8	NC	Not Connected
J1.9	AGND	Analog Ground
J1.10	NC	Not Connected
J1.11	AGND	Analog Ground
J1.12	NC	Not Connected
J1.13	AGND	Analog Ground
J1.14	NC	Not Connected
J1.15	NC	Not Connected
J1.16	NC	Not Connected
J1.17	AGND	Analog Ground
J1.18	NC	Not Connected
J1.19	AGND	Analog Ground
J1.20	NC	Not Connected
J2.1	NC	Not Connected
J2.2	NC	Not Connected
J2.3	NC	Not Connected
J2.4	NC	Not Connected
J2.5	NC	Not Connected
J2.6	NC	Not Connected
J2.7	NC	Not Connected
J2.8	NC	Not Connected
J2.9	AGND	Analog Ground
J2.10	NC	Not Connected
J2.11	AGND	Analog Ground
J2.12	NC	Not Connected
J2.13	AGND	Analog Ground
J2.14	NC	Not Connected
J2.15	NC	Not Connected
J2.16	NC	Not Connected
J2.17	AGND	Analog Ground
J2.18	NC	Not Connected
J2.19	AGND	Analog Ground

Table 4. Analog Interface Pinout (continued)

PIN NUMBER	SIGNAL	DESCRIPTION
J2.20	NC	Not Connected

A.1.2 Analog Screw Terminal and Audio Jack Details, J6 to J18

The analog inputs and outputs can be accessed through screw terminals or audio jacks. Also, provision is made to connect power supply sources to screw terminals.

[Table 5](#) summarizes the screw terminals and audio jacks available on the TLV320AIC36EVM.

Table 5. Alternate Analog Connectors

DESIGNATOR	PIN 1	PIN 2	PIN3	PIN4	PIN5
J6 (LINE IN)	AGND	LINEIN_L	LINEIN_R	NC	NC
J7 (LINE IN)	LINEIN_R	AGND	LINEIN_L		
J8 (MIC 1 IN)	MIC1_P	AGND	MIC1_M		
J9 (MIC 2 IN)	MIC2_P	AGND	MIC2_M		
J10 (EXT MIC IN)	EXTMIC_P / NC	AGND	EXTMIC_M / NC		
J11 (EXT MIC IN)	AGND	EXTMIC_P	EXTMIC_M	EXTMIC_P / NC	EXTMIC_M / NC
J12 (HEADSET OUTPUT)	HP_COM	HPL	HPR	HPL / NC	HPR / NC
J13 (HP_FILTER)	HPL / NC	HP_COM	HPR / NC		
J14 (LO_LEFT)	LINEOUT_LP	LINEOUT_LM			
J15 (LO_RIGHT)	LINEOUT_RP	LINEOUT_RM			
J16 (REC_OUTPUT)	RECL	AGND	RECR		

A.2 Digital Interface Connectors, P4/J4 and P5/J5

The TLV320AIC36EVM 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 P4/J4 and P5/J5. 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 6 summarizes the digital interface pinout for the TLV320AIC36EVM.

Table 6. Digital Interface Pinout

PIN NUMBER	SIGNAL	DESCRIPTION
P4.1/J4.1	NC	Not Connected
P4.2/J4.2	NC	Not Connected
P4.3/J4.3	NC	Not Connected
P4.4/J4.4	DGND	Digital Ground
P4.5/J4.5	NC	Not Connected
P4.6/J4.6	NC	Not Connected
P4.7/J4.7	NC	Not Connected
P4.8/J4.8	RESET	TAS1020B Reset
P4.9/J4.9	NC	Not Connected
P4.10/J4.10	DGND	Digital Ground
P4.11/J4.11	NC	Not Connected
P4.12/J4.12	NC	Not Connected
P4.13/J4.13	NC	Not Connected
P4.14/J4.14	RESET	TAS1020B Reset
P4.15/J4.15	NC	Not Connected
P4.16/J4.16	NC	Not Connected
P4.17/J4.17	NC	Not Connected
P4.18/J4.18	DGND	Digital Ground
P4.19/J4.19	NC	Not Connected
P4.20/J4.20	NC	Not Connected
P5.1/J5.1	NC	Not Connected
P5.2/J5.2	NC	Not Connected
P5.3/J5.3	BCLK	Audio Serial Data Bus Bit Clock (Input/Output)
P5.4/J5.4	DGND	Digital Ground
P5.5/J5.5	NC	Not Connected
P5.6/J5.6	NC	Not Connected
P5.7/J5.7	WCLK	Audio Serial Data Bus Word Clock (Input/Output)
P5.8/J5.8	NC	Not Connected
P5.9/J5.9	NC	Not Connected
P5.10/J5.10	DGND	Digital Ground
P5.11/J5.11	DIN	Audio Serial Data Bus Data Input (Input)
P5.12/J5.12	NC	Not Connected
P5.13/J5.13	DOUT	Audio Serial Data Bus Data Output (Output)
P5.14/J5.14	NC	Not Connected
P5.15/J5.15	NC	Not Connected
P5.16/J5.16	SCL	I2C Serial Clock
P5.17/J5.17	MCLK	Master Clock Input
P5.18/J5.18	DGND	Digital Ground
P5.19/J5.19	NC	Not Connected
P5.20/J5.20	SDA	I2C Serial Data Input/Output

Note that P5/J5 comprises the signals needed for an I²S™ serial digital audio interface and the control interface (I²C™).

A.3 Power Supply Connector Pin Header, P3/J3

P3/J3 provides connection to the common power bus for the TLV320AIC36EVM. Power is supplied on the pins listed in [Table 7](#).

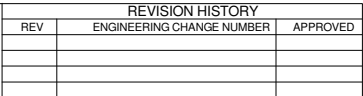
Table 7. Power Supply Pin Out

SIGNAL	PIN NUMBER		SIGNAL
NC	P3.1/J3.1	P3.2/J3.2	NC
+5VA	P3.3/J3.3	P3.4/J3.4	NC
DGND	P3.5/J3.5	P3.6/J3.6	AGND
+1.8VD	P3.7/J3.7	P3.8/J3.8	NC
+3.3VD	P3.9/J3.9	P3.10/J3.10	+5VD

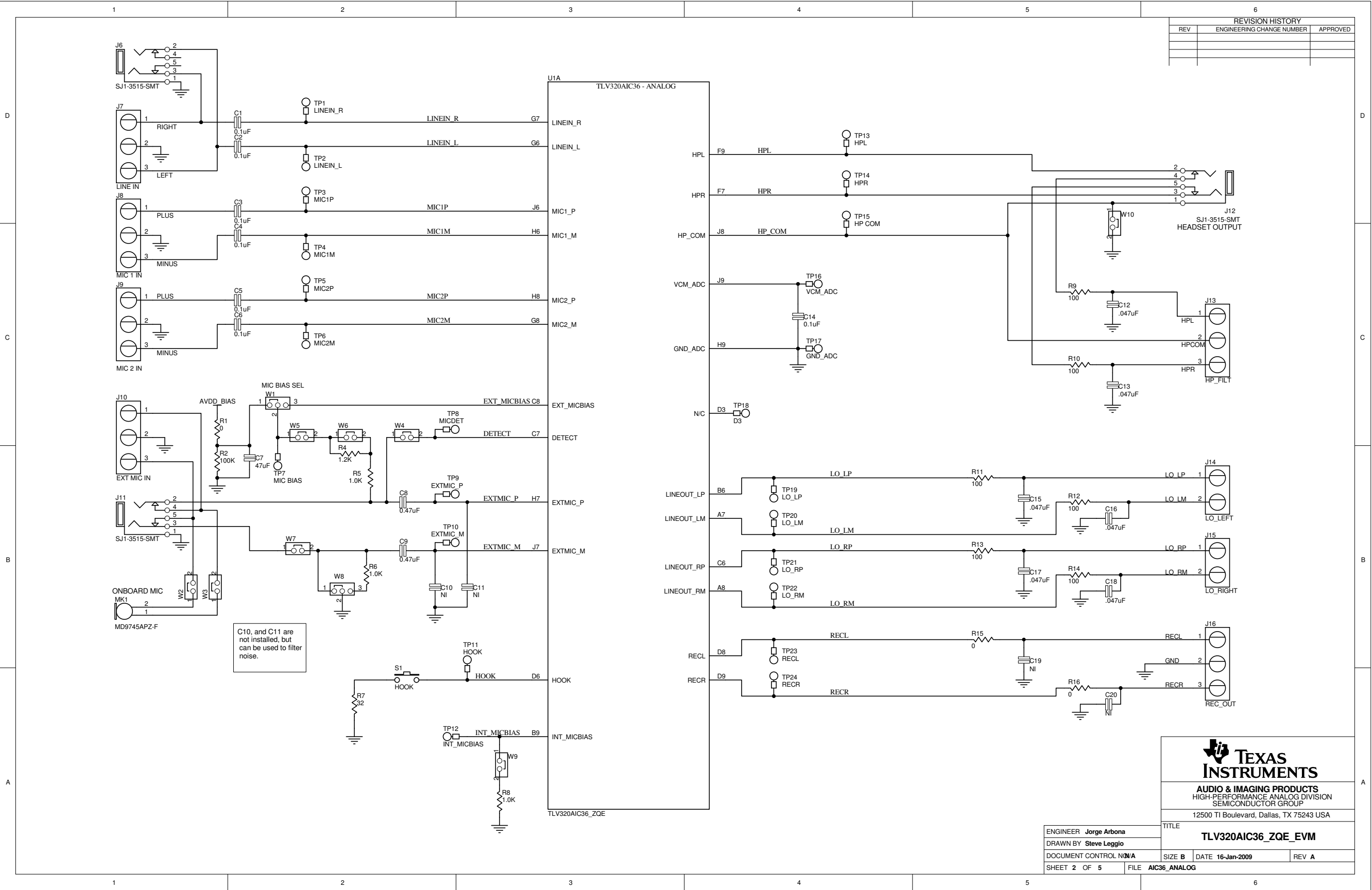
The TLV320AIC36EVM-K motherboard (the USB-MODEVM Interface board) supplies power to P3/J3 of the TLV320AIC36EVM. Power for the motherboard is supplied either through its USB connection or via terminal blocks on that board.

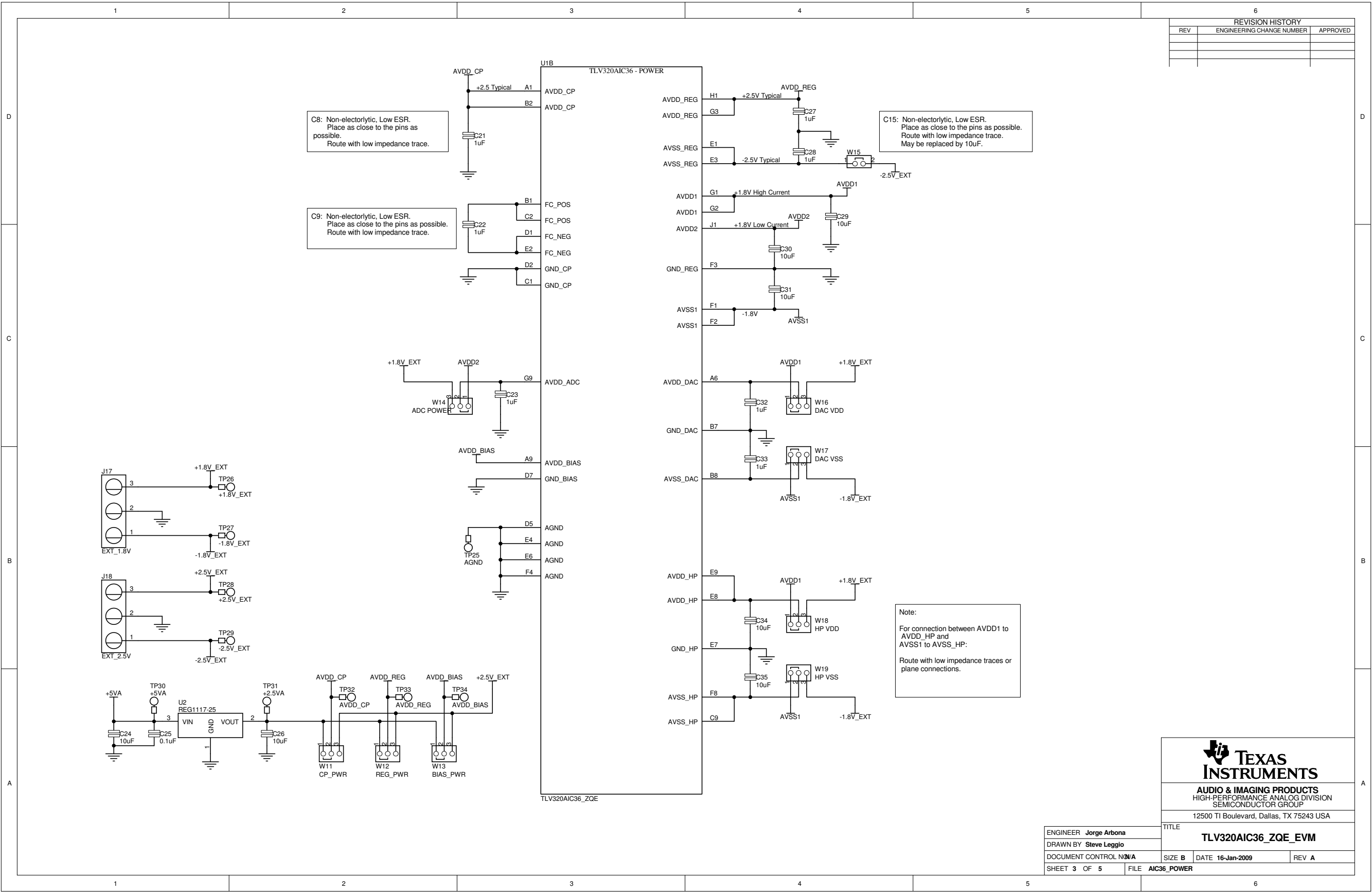
Appendix B TLV320AIC36EVM Schematic

The schematic diagram for the TLV320AIC36EVM is provided as a reference.



 TEXAS INSTRUMENTS		
AUDIO & IMAGING PRODUCTS HIGH-PERFORMANCE ANALOG DIVISION SEMICONDUCTOR GROUP		
12500 TI Boulevard, Dallas, TX 75243 USA		
TITLE		
TLV320AIC36_ZQE_EVM		
SIZE B	DATE 16-Jan-2009	REV A
6_ZQE_EVM_sch.Sch		





**TEXAS
INSTRUMENTS**

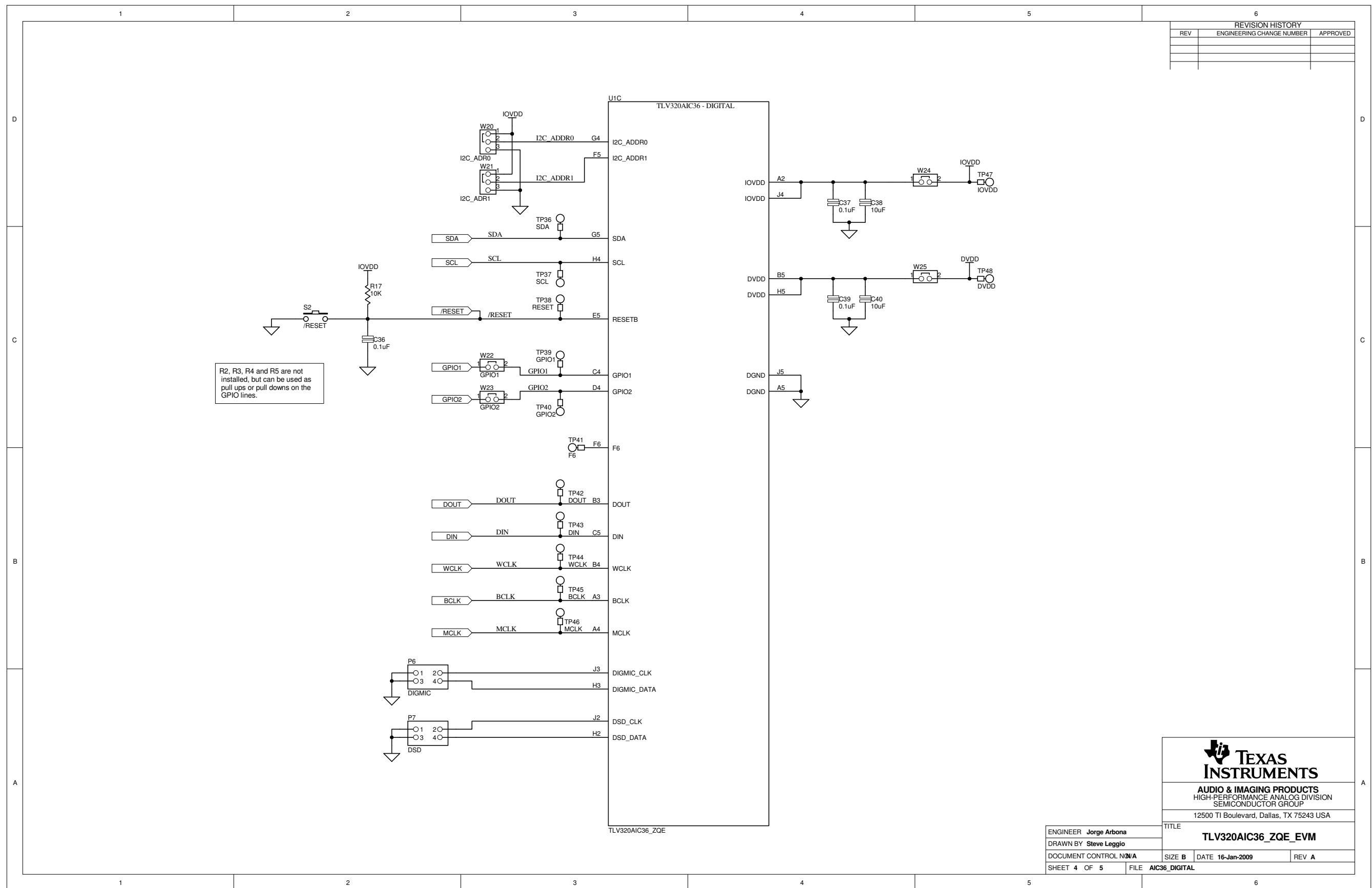
AUDIO & IMAGING PRODUCTS
HIGH-PERFORMANCE ANALOG DIVISION
SEMICONDUCTOR GROUP

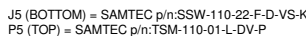
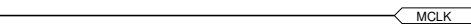
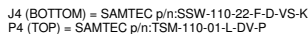
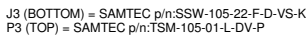
12500 TI Boulevard, Dallas, TX 75243 USA

TITLE

TLV320AIC36_ZQE_EVM

ENGINEER	Jorge Arbona	SIZE	B	DATE	16-Jan-2009	REV	A
DRAWN BY	Steve Leggio						
DOCUMENT CONTROL	N/A						
SHEET	3 OF 5	FILE	AIC36_POWER				





 TEXAS INSTRUMENTS		
AUDIO & IMAGING PRODUCTS HIGH-PERFORMANCE ANALOG DIVISION SEMICONDUCTOR GROUP		
12500 TI Boulevard, Dallas, TX 75243 USA		
TITLE TLV320AIC36_ZQE_EVM		
SIZE B	DATE 16-Jan-2009	REV 02

ughtercard_Interface

Appendix C TLV320AIC36EVM Layout Views

C.1 Layout Views

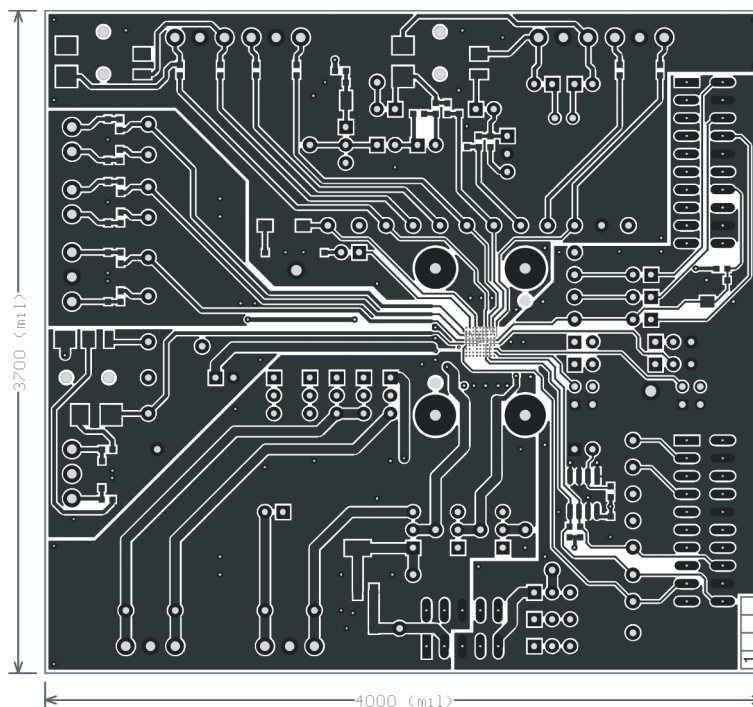


Figure 22. Top Layer

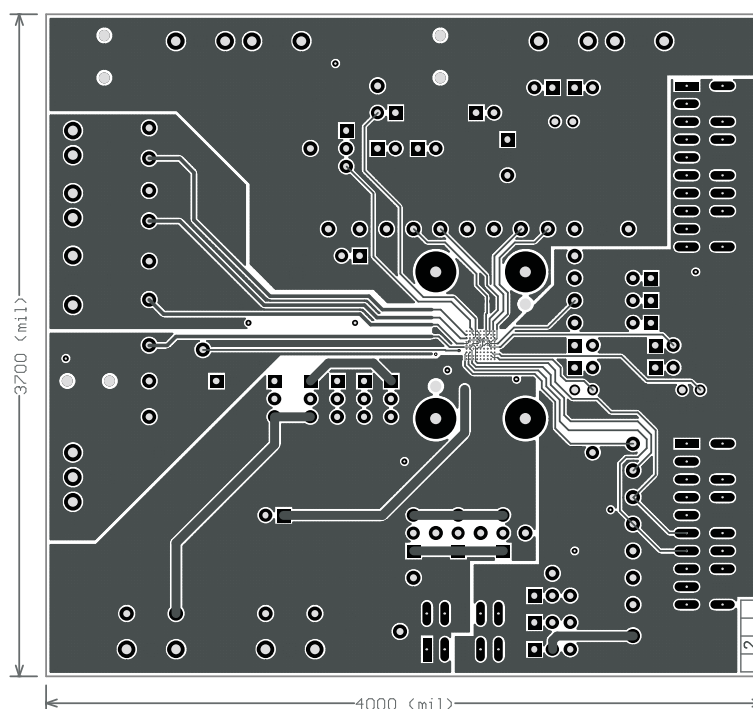


Figure 23. Mid-Layer 1

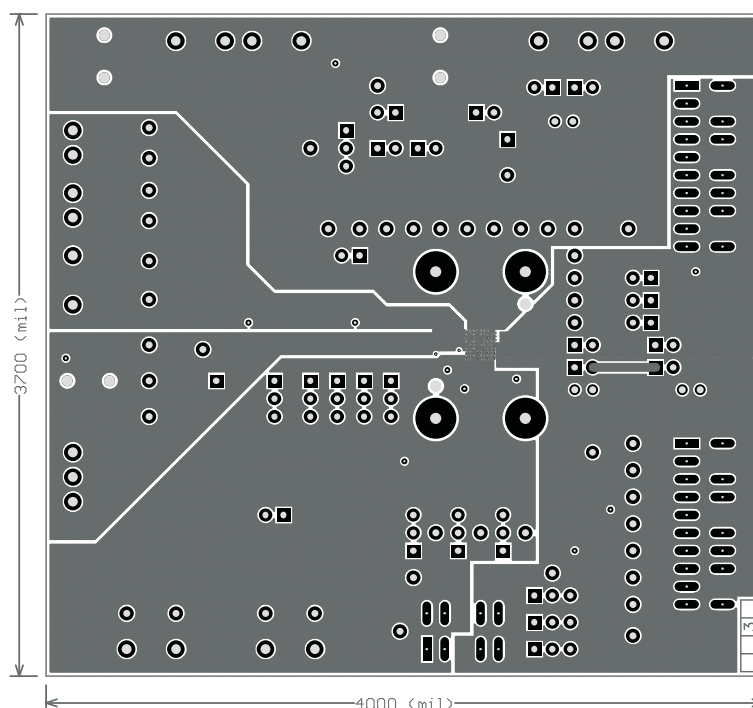


Figure 24. Mid-Layer 2

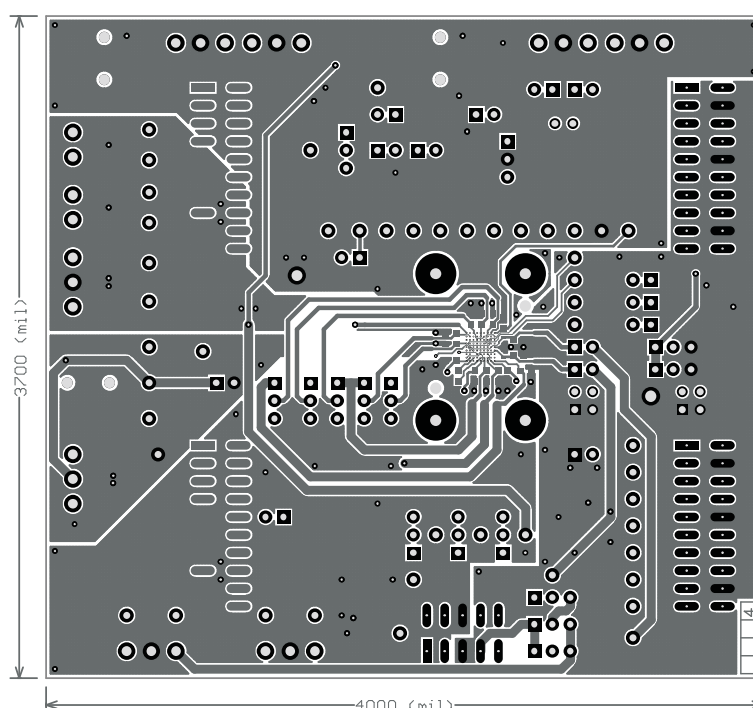


Figure 25. Bottom Layer



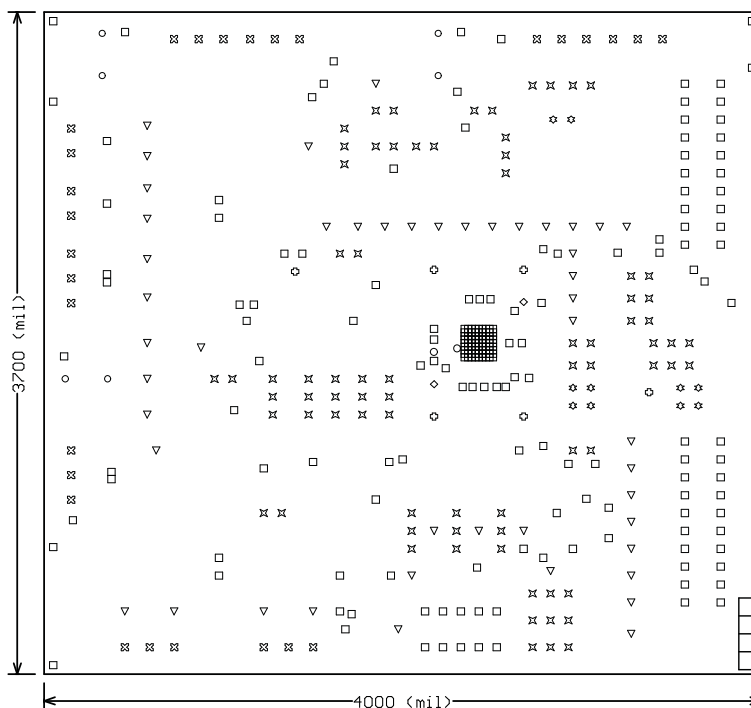


Figure 28. Drill Drawing

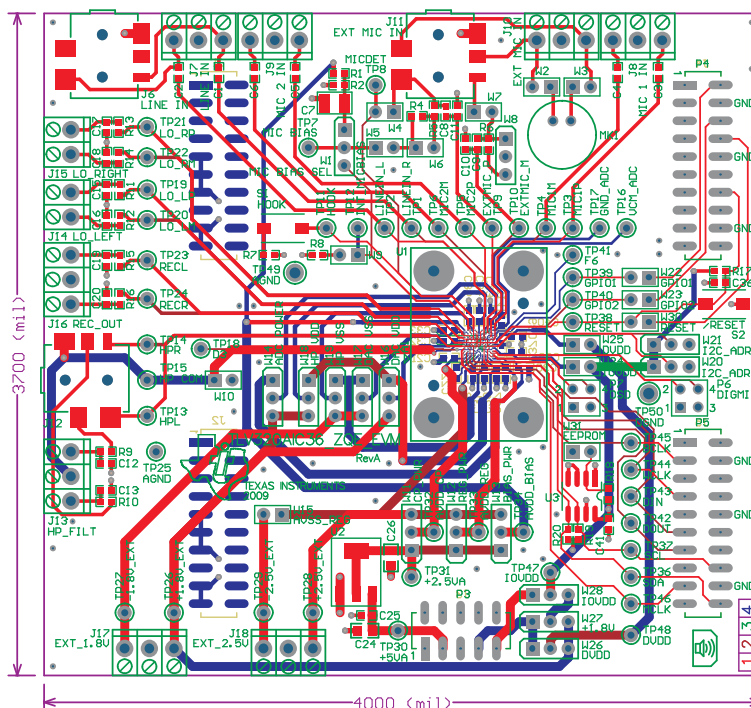


Figure 29. Composite

Appendix D TLV320AIC36EVM Bill of Materials

The complete bill of materials for the TLV320AIC36EVM is provided as a reference.

Table 8. TLV320AIC36EVM Bill of Materials

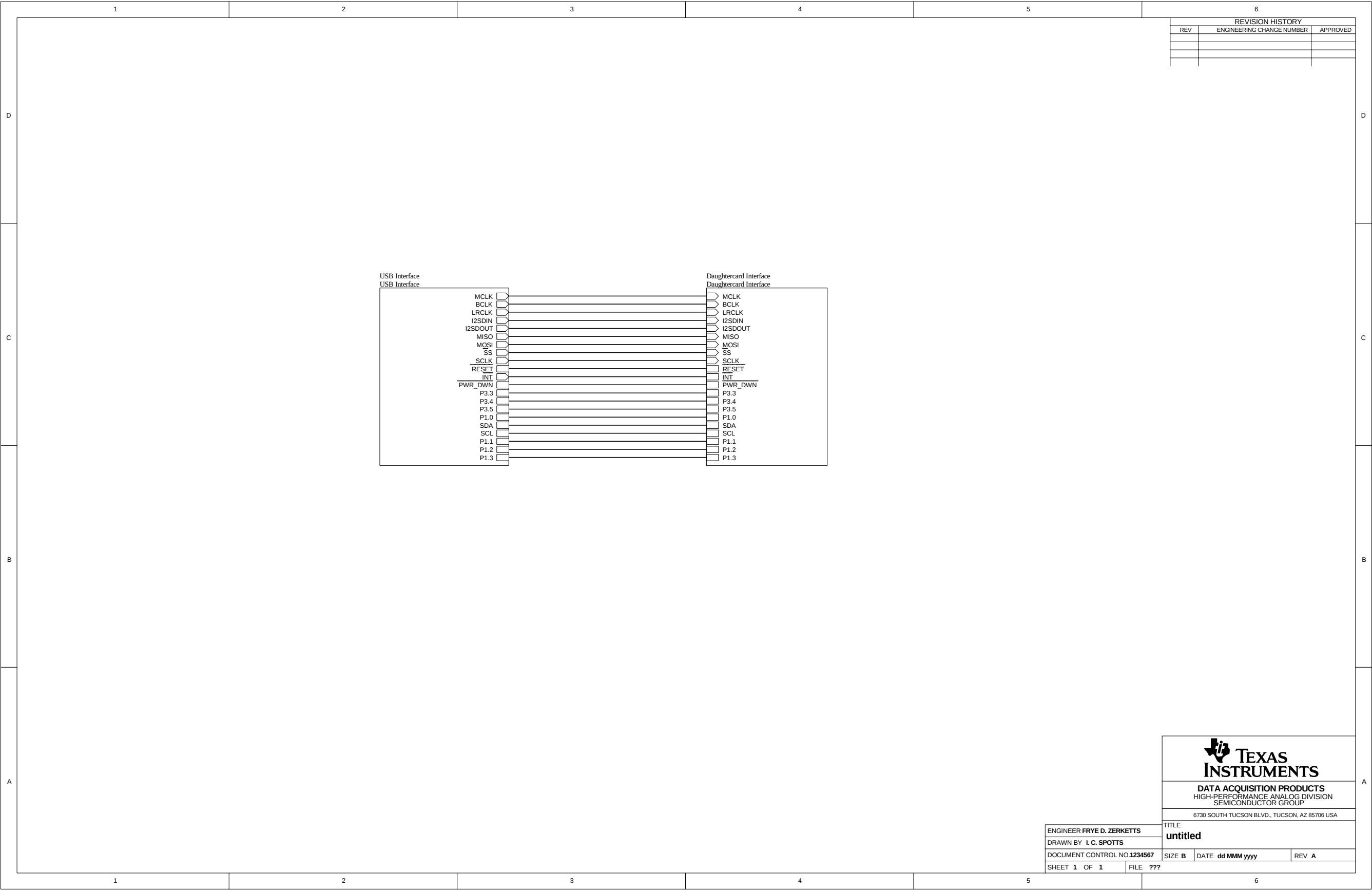
PCB					
Qty	Value	Ref Des	Description	Vendor	Part number
1		N/A	TLV320AIC36_ZQE_EVM_RevA (PWB)	Texas Instruments	
RESISTORS					
Qty	Value	Ref Des	Description	Vendor	Part number
3	0	R1, R15, R16	RES ZERO OHM 1/10W 5% 0603 SMD	Panasonic	ERJ-3GEY0R00V
1	32.4	R7	RES 32.4 OHM 1/10W 1% 0603 SMD	Panasonic	ERJ-3EKF32R4V
6	100	R9, R10, R11, R12, R13, R14	RES 100 OHM 1/10W 1% 0603 SMD	Panasonic	ERJ-3EKF1000V
3	1.0K	R5, R6, R8	RES 1.00K OHM 1/10W 1% 0603 SMD	Panasonic	ERJ-3EKF1001V
1	1.2K	R4	RES 2.2K OHM 1/10W 5% 0603 SMD	Panasonic	ERJ-3GEYJ122V
3	2.7K	R18, R19, R20	RES 2.7K OHM 1/10W 5% 0603 SMD	Panasonic	ERJ-3GEYJ272V
1	10K	R17	RES 10K OHM 1/10W 5% 0603 SMD	Panasonic	ERJ-3GEYJ103V
1	100K	R2	RES 100K OHM 1/10W 1% 0603 SMD	Panasonic	ERJ-3EKF1003V
CAPACITORS					
Qty	Value	Ref Des	Description	Vendor	Part number
6	0.047µF	C12, C13, C15, C16, C17, C18	CAP CER 47000PF 50V X7R 10% 0603	TDK Corporation	C1608X7R1H473K
2	0.1µF	C37, C39	CAP CER .10UF 6.3V X5R 10% 0402	TDK Corporation	C1005X5R0J104K
10	0.1µF	C1, C2, C3, C4, C5, C6, C14, C25, C36, C41	CAP CER .1UF 25V X7R 0603	TDK Corporation	C1608X7R1E104K
2	0.47µF	C8, C9	CAP CER .47UF 10V X5R 10% 0603	Panasonic	C1608X5R1A474K
7	1.0µF	C21, C22, C23, C27, C28, C32, C33	CAP CERAMIC 1UF 10V X5R 0603	Panasonic	ECJ-BVB1A105K
7	10µF	C29, C30, C31, C34, C35, C38, C40	CAP CERAMIC 10UF 6.3V X5R 0603	Panasonic	ECJ-1VB0J106M
2	10µF	C24, C26	CAP CERAMIC 10UF 10V X5R 0805	Panasonic	ECJ-2FB1A106K
1	47µF	C7	CAP CER 47UF 10V X5R 1210 CAP	Murata	GRM32ER61A476KE20L
4	no value - not installed	C10, C11, C19, C20	0603	N/A	N/A
INTEGRATED CIRCUITS					
Qty	Value	Ref Des	Description	Vendor	Part number
1		U1	Low Power Stereo Audio Codec	Texas Instruments	TLV320AIC36IZQE
1		U2	800mA 1A Low Dropout Pos Regulator	Texas Instruments	REG1117A-25
1		U3	IC SERIAL EEPROM 64K 1.7V 8SOIC	MicroChip	24AA64-I/SN
MISCELLANEOUS ITEMS					
Qty	Value	Ref Des	Description	Vendor	Part number
1		MK1	Omnidirectional Microphone Cartridge	Knowles Acoustics	MD9745APZ-F
			or alternate	Knowles Acoustics	MD9745APA-1

Table 8. TLV320AIC36EVM Bill of Materials (continued)

2		S1, S2	SWITCH LT TOUCH 6X3.5 240GF SMD	Panasonic	EVQ-5PN04K
3		J6, J11, J12	3.5mm Audio Jack, T-R-S, SMD	CUI Inc.	SJ1-3515-SMT
2		J14, J15	Screw Terminal Block, 2 Position	On Shore Technology	ED555/2DS
8		J7, J8, J9, J10, J13, J16, J17, J18	Screw Terminal Block, 3 Position	On Shore Technology	ED555/3DS
2		P6, P7	4 Pin SMT Plug Header	Samtec	TSM-102-01-L-DV-P
1		P3	10 Pin SMT Plug Header	Samtec	TSM-105-01-L-DV-P
1		J3	10 pin SMT Socket Header	Samtec	SSW-105-22-F-D-VS-K
2		P4, P5	20 Pin SMT Plug Header	Samtec	TSM-110-01-L-DV-P
4		J1, J2, J4, J5	20 pin SMT Socket Header	Samtec	SSW-110-22-F-D-VS-K
11	not installed	TP26, TP27, TP28, TP29, TP30, TP31, TP32, TP33, TP34, TP47, TP48	TEST POINT PC MINI .040"D RED	Keystone Electronics	5000
34	not installed	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP18, TP19, TP20, TP21, TP22, TP23, TP24, TP36, TP37, TP38, TP39, TP40, TP41, TP42, TP43, TP44, TP45, TP46	TEST POINT PC MINI .040"D WHITE	Keystone Electronics	5002
2		TP17, TP25	TEST POINT PC MINI .040"D BLACK	Keystone Electronics	5001
2		TP49, TP50	TEST POINT PC MULTI PURPOSE BLK	Keystone Electronics	5011
0			Bus Wire (18-22 Gauge)		TSW-102-07-L-S
15		W2, W3, W4, W5, W6, W7, W9, W10, W15, W22, W23, W24, W25, W30, W31	2 Pin Thru-hole Plug Header (Jumper), 0 .1" spacing	Samtec	TSW-103-07-L-S
15		W1, W8, W11, W12, W13, W14, W16, W17, W18, W19, W20, W21, W26, W27, W28	3 Position Jumper , 0 .1" spacing	Samtec	SNT-100-BK-T
	Installed per test procedure.	Installed per test procedure.	Header Shorting Block	Samtec	
ATTENTION: All components must be Rhos compliant. Some part numbers may be either leaded or Rhos. Verify that purchased components are Rhos compliant.					

Appendix E USB-MODEVM Schematic

The schematic diagram for USB-MODEVM Interface Board is provided as a reference.



ENGINEER FRYE D. ZERKETTS

DRAWN BY I.C. SPOTTS

DOCUMENT CONTROL NO.1234567

SHEET 1 OF 1

FILE ???

TITLE

untitled

SIZE B

DATE dd MMM yyyy

REV A

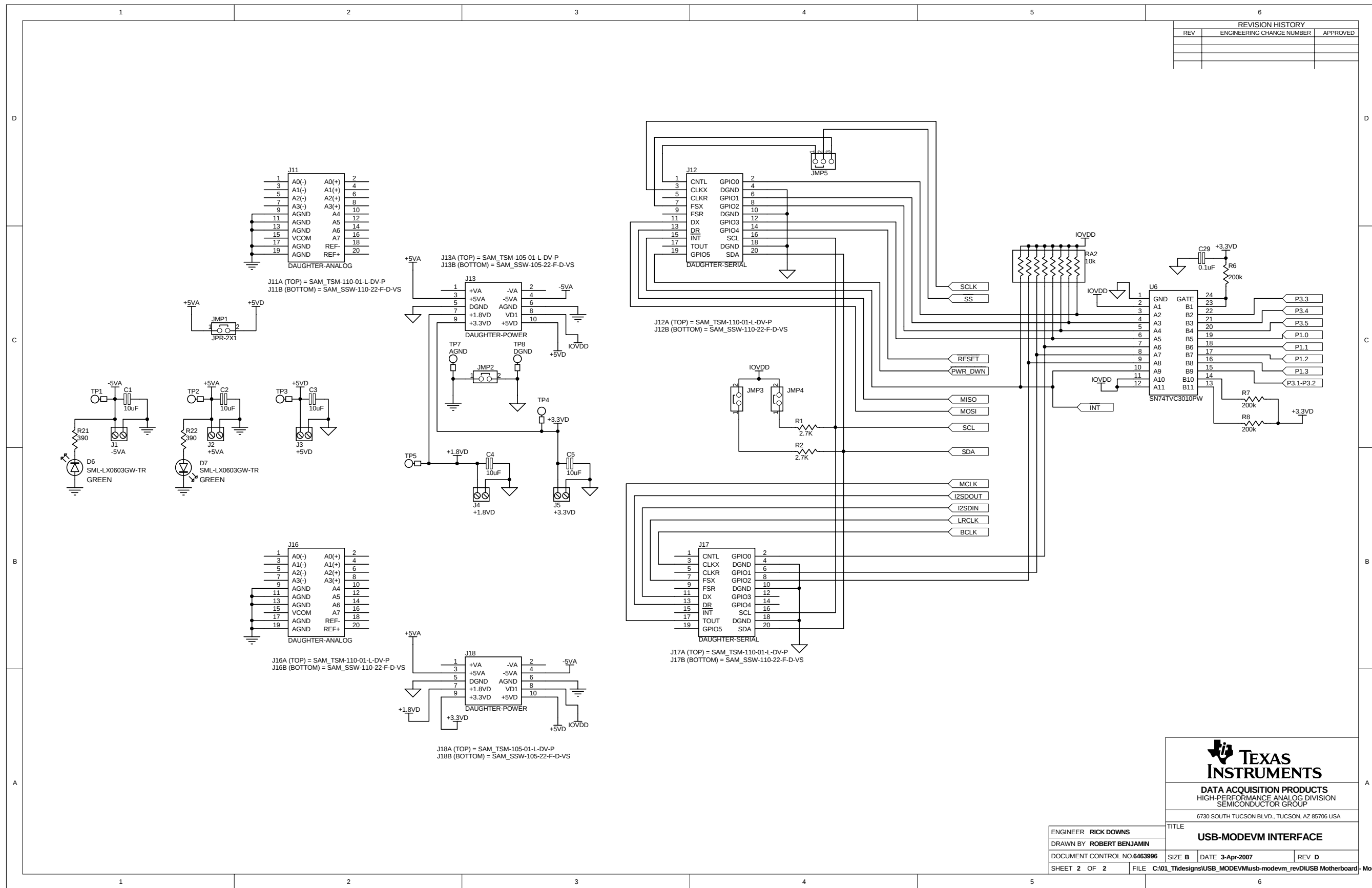
TEXAS INSTRUMENTS

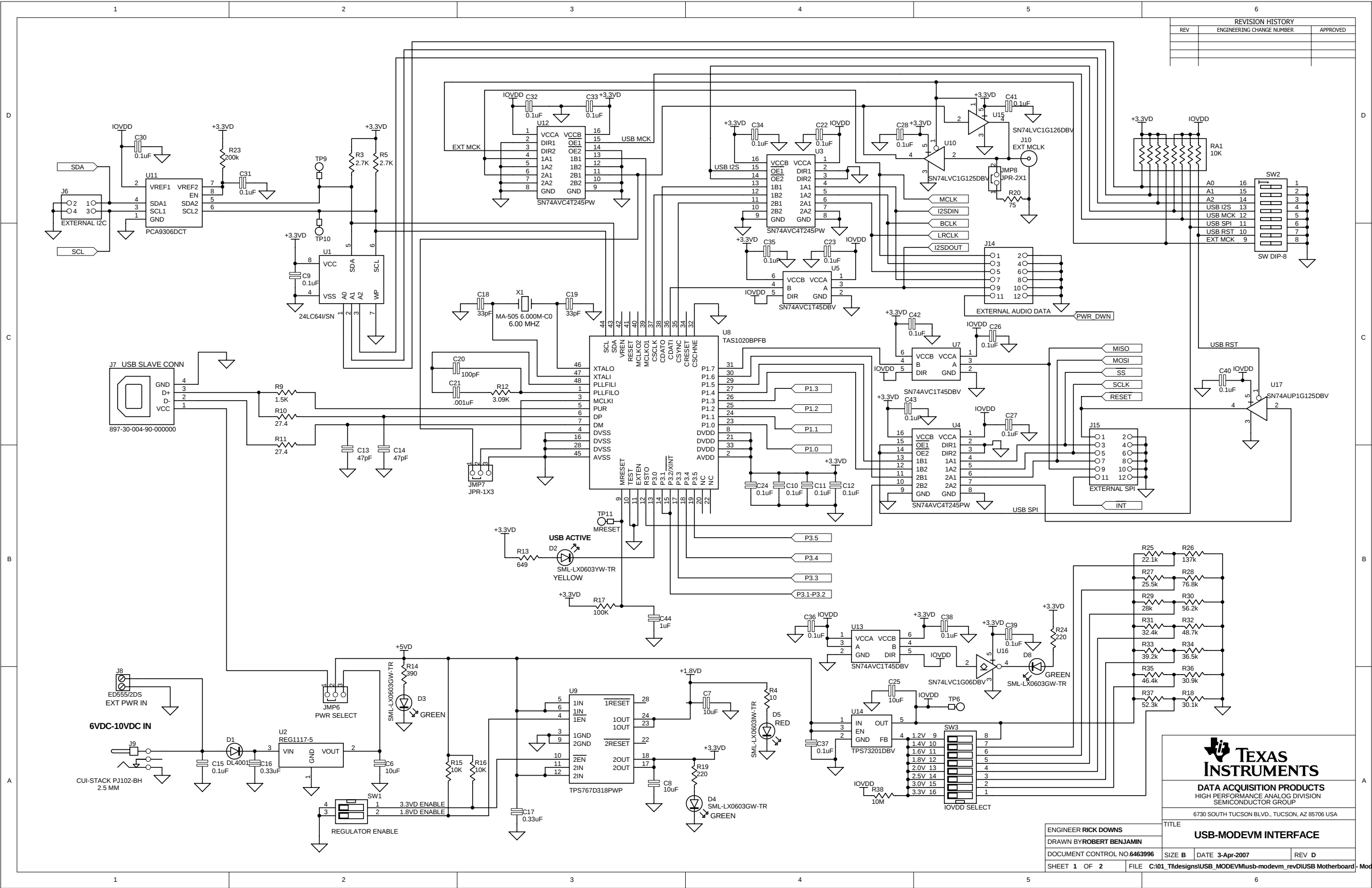
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HIGH-PERFORMANCE ANALOG DIVISION

SEMICONDUCTOR GROUP

6730 SOUTH TUCSON BLVD., TUCSON, AZ 85706 USA





Appendix F USB-MODEVM Bill of Materials

The complete bill of materials for USB-MODEVM Interface Board is provided as a reference.

Table 9. USB-MODEVM Bill of Materials

Designators	Description	Manufacturer	Mfg. Part Number
R4	10Ω 1/10W 5% Chip Resistor	Panasonic	ERJ-3GEYJ1300V
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-3GEYJ1352V
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-3GEYJ1303V
R17, R18	100kΩ 1/10W 5% Chip Resistor	Panasonic	ERJ-3GEYJ1304V
RA1	10KΩ 1/8W Octal Isolated Resistor Array	CTS Corporation	742C163103JTJR
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, C22–C28	1μF 6.3V Ceramic Chip Capacitor, ±10%, X5R	TDK	C1608X5R0J1305K
C1–C8	10μF 6.3V Ceramic Chip Capacitor, ±10%, X5R	TDK	C3216X5R0J1306K
D1	50V, 1A, Diode MELF SMD	Micro Commercial Components	DL4001
D2	Yellow Light Emitting Diode	Lumex	SML-LX0603YW-TR
D3–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
J13, J2–J5, J8	2-position terminal block	On Shore Technology	ED555/2DS
J9	2.5mm power connector	CUI Stack	PJ-102B
J130	BNC connector, female, PC mount	AMP/Tyco	414305-1
J131A, J132A, J21A, J22A	20-pin SMT plug	Samtec	TSM-110-01-L-DV-P
J131B, J132B, J21B, J22B	20-pin SMT socket	Samtec	SSW-110-22-F-D-VS-K
J133A, J23A	10-pin SMT plug	Samtec	TSM-105-01-L-DV-P
J133B, 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
J134, J135	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 9. USB-MODEVM Bill of Materials (continued)

Designators	Description	Manufacturer	Mfg. Part Number
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 G USB-MODEVM Protocol

G.1 Writing Scripts

A script is simply a text file that contains data to send to the serial control buses.

Each line in a script file is one command. No provision is made for extending lines beyond one line, except for the **>** command. A line is terminated by a carriage return.

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

- i** Set interface bus to use
- r** Read from the serial control bus
- w** Write to the serial control bus
- >** Extend repeated write commands to lines below a **w**
- #** Comment
- b** Break
- d** Delay
- f** Wait for Flag

The first command, **i**, 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 ² C bus
i2cfast	Fast mode I ² C 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 I²C bus is to be used, the script begins with:

i i2cfast

A double quoted string of characters following the **b** command can be added to provide information to the user about each breakpoint. When the script is executed, the software's command handler halts as soon as a breakpoint is detected and displays the string of characters within the double quotes.

The Wait for Flag command, **f**, reads a specified register and verifies if the bitmap provided with the command matches the data being read. If the data does not match, the command handler retries for up to 200 times. This feature is useful when switching buffers in parts that support the adaptive filtering mode.

The command **f** syntax follows:

f [i2c address] [register] [D7][D6][D5][D4][D3][D2][D1][D0] where 'i2c address' and 'register' are in hexadecimal format and 'D7' through 'D0' are in binary format with values of 0, 1 or X for don't care.

Anything following a comment command **#** is ignored by the parser, provided that it is on the same line.

The delay command **d** allows the user to specify a time, in milliseconds, that the script pauses before proceeding. **The delay time is entered in decimal format.**

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 TAS1020B by the program.

The first byte following an **r** (read) or **w** (write) command is the I²C slave address of the device (if I²C 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 varies 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 I²C; SPI varies). 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 0xAA 0x55 to an I²C device with a slave address of 0x30, starting at a register address of 0x03, the user writes:

```
#example script i i2cfast w 30 03 AA 55 r 30 03 02
```

This script begins with a comment, specifies that a fast I²C bus will be used, then writes 0xAA 0x55 to the I²C slave device at address 0x30, writing the values into registers 0x03 and 0x04. The script then reads back two bytes from the same device starting at register address 0x03. Note that the slave device value does not change. It is unnecessary to set the R/W bit for I²C devices in the script; the read or write commands does that.

If extensive repeated write commands are sent and commenting is desired for a group of bytes, the > command can be used to extend the bytes to other lines that follow. A usage example for the > command follows:

```
#example script for '>' command i i2cfast # Write AA and BB to registers 3 and 4, respectively w
30 03 AA BB # Write CC, DD, EE and FF to registers 5, 6, 7 and 8, respectively > CC DD EE FF #
Place a commented breakpoint b "AA BB CC DD EE FF was written, starting at register 3" # Read
back all six registers, starting at register 3 r 30 03 06
```

The following example demonstrates usage of the Wait for Flag command, f:

```
#example script for 'wait for flag' command i i2cfast # Switch to Page 8 w 30 00 08 # Switch
buffers w 30 01 05 # Wait for bit D0 to clear. 'x' denotes a don't care. f 30 01 xxxxxx0
```

Any text editor can 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 Script File...* from the File menu. Locate the script and open it. The script is then displayed in the command buffer. The user can also edit the script once it is in the buffer and save it by selecting *Save Script File...* from the File menu.

Once the script is in the command buffer, it can be executed by pressing the *Execute Command Buffer* button. If there are breakpoints in the script, the script executes to that point, and the user is presented with a dialog box with a button to press to continue executing the script. When ready to proceed, push that button and the script continues.

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EVM WARNINGS AND RESTRICTIONS

It is important to operate the EVM daughterboard within the input voltage range specified in Table A-4 and the EVM motherboard within the input voltage range of 6 Vdc to 10 Vdc when using an external ac/dc power source. See the USB-MODEVM Interface Power section of this manual when using laboratory 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 85°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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