

## Evaluating the ADAU1442, ADAU1445, and ADAU1446 SigmaDSP Products

### FEATURES

- 8-channel analog input and 16-channel analog output
- Optical and electrical S/PDIF connections directly to the S/PDIF I/O pins on the DSP
- Full access to all digital I/O via digital connectors
- Built-in USB communications interface
- Built-in power regulator with wall supply
- Interface to external GPIO board
- Self-boot capability
- Includes full version of SigmaStudio programming tools
- Compatible with industry-standard communications and audio interfaces

### PACKAGE CONTENTS

- EVAL-ADAU144xEBZ
- Universal power supply
- USB cable
- GPIO daughter board
- EVAL-ADUSB2EBZ
- QuickStart Guide

### GENERAL DESCRIPTION

This document explains the design and setup of the evaluation boards for the [ADAU1442](#), [ADAU1445](#), and [ADAU1446](#) SigmaDSP® products. Two evaluation boards are available: the EVAL-ADAU144xEBZ for evaluation of the ADAU1442 and ADAU1445, and the EVAL-ADAU1446EBZ for evaluation of the ADAU1446. Together, the boards are referred to as the EVAL-ADAU144xEBZ.

The EVAL-ADAU144xEBZ provides a full range of analog and digital inputs and outputs to and from the ADAU144x. The SigmaDSP can connect to analog I/O signals through [AD1938](#) codecs. Digital I/O connections are available in both S/PDIF and 3-wire serial data formats.

### EVALUATION BOARD FUNCTIONAL BLOCK DIAGRAM

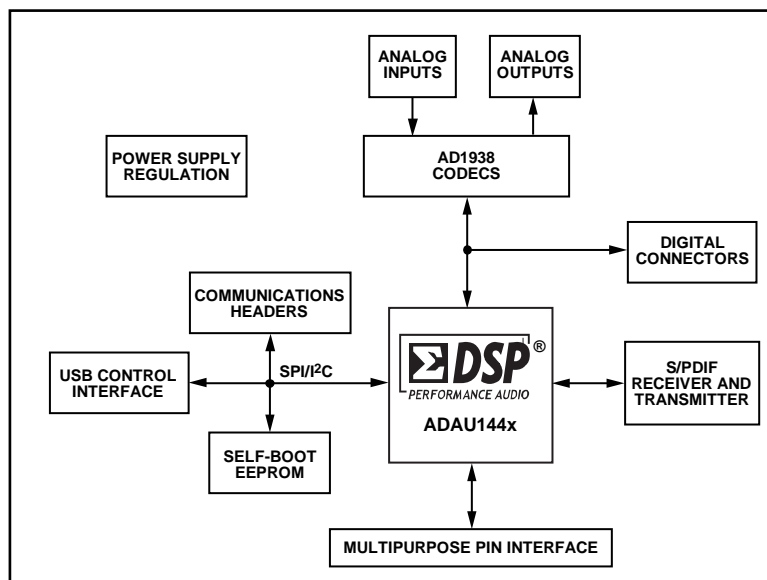


Figure 1.

**TABLE OF CONTENTS**

Features .....	1	Transistors .....	17
Package Contents.....	1	Links.....	18
General Description .....	1	Switches .....	20
Evaluation Board Functional Block Diagram.....	1	Connectors and Jacks.....	22
Revision History .....	2	Circuit Schematics.....	24
Using the EVAL-ADAU144xEBZ with SigmaStudio.....	3	ADAU144x SigmaDSP .....	24
SigmaStudio Software Installation .....	3	S/PDIF Transmitter and Receiver .....	25
Installing the Drivers .....	3	Self-Boot EEPROM.....	25
Connecting the Evaluation Board.....	4	AD1938 Audio Codecs .....	26
Adding the EVAL-ADAU144xEBZ to a SigmaStudio Project	4	Analog Audio Inputs.....	27
Adding an ADAU144x IC.....	5	Analog Audio Outputs.....	30
Adding a Self-Boot EEPROM.....	5	External Connectors .....	34
Programming the Signal Flow .....	5	USB Control Interface .....	37
Monitoring the USB Communications .....	12	Reset Generator .....	38
Programming the Self-Boot EEPROM.....	12	Power Supply.....	38
Hardware Description.....	13	Bill of Materials.....	39
Integrated Circuits (ICs).....	13	ESD Caution.....	43
Crystal Resonators.....	16		

**REVISION HISTORY**

4/10—Revision 0: Initial Version

## USING THE EVAL-ADAU144xEBZ WITH SigmaStudio

### SigmaStudio SOFTWARE INSTALLATION

SigmaStudio™ must be installed to use the EVAL-ADAU144xEBZ. To install the Sigma Studio software, obtain the password from the *QuickStart™ Guide* and follow these steps:

1. If Microsoft® .NET Framework Version 2.0 is not already installed on the PC, install it by downloading the redistributable package from the Microsoft website.
2. Download the SigmaStudio software from <http://www.analog.com/sigmastudiowdownload>.
3. Open the .zip file and extract the files to your PC.
4. Install SigmaStudio by double-clicking **setup.exe** and following the prompts. A computer restart is not required.

### INSTALLING THE DRIVERS

After SigmaStudio is installed, follow these steps to install the drivers:

1. Plug the USBi into the USB port of the PC using the included mini USB cable.
2. If this is the first time the USBi has been connected to the PC, the Windows **Found New Hardware** notification should appear in the taskbar.



Figure 2. Windows Found New Hardware Notification

3. When the Found New Hardware Wizard opens, click **Install from a list or specific location (Advanced)**.
4. Click **Next**.



Figure 3. Windows Found New Hardware Wizard

5. Click **Search for the best driver in these locations** and select **Include this location in the search**.
6. Click **Browse** and select the **USB drivers** subfolder, located in the SigmaStudio install directory.
7. Click **Next**.

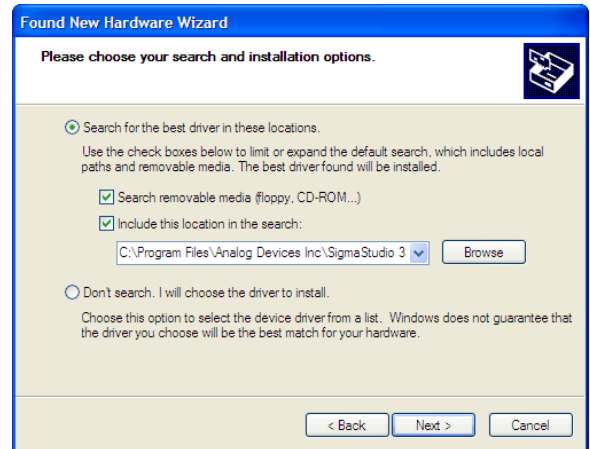


Figure 4. Windows Found New Hardware Wizard Search and Install Options

8. When the warning about Windows logo testing appears, click **Continue Anyway**.



Figure 5. Windows Logo Test Warning

Next, Windows proceeds with the installation of the drivers, as shown in Figure 6.

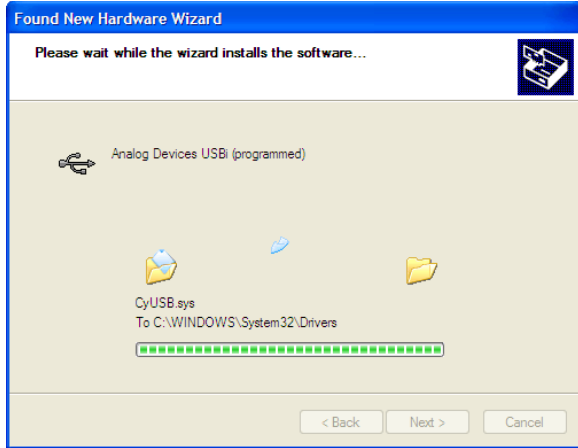


Figure 6. Windows Installation of the USBi Drivers

9. When the installation of the drivers is complete, the window shown in Figure 7 appears. Click **Finish**.

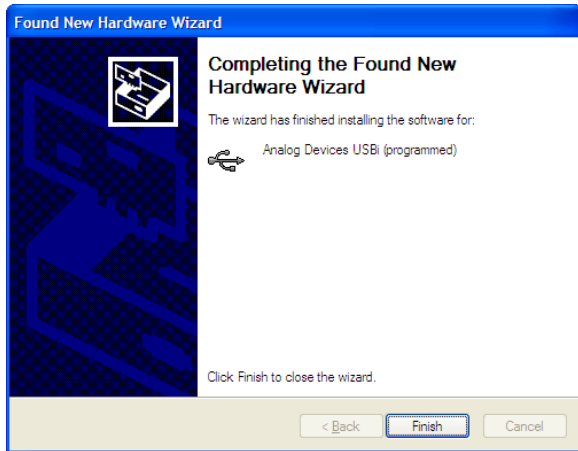


Figure 7. Driver Installation Complete

A notification of successful installation should appear in the taskbar, as shown in Figure 8.

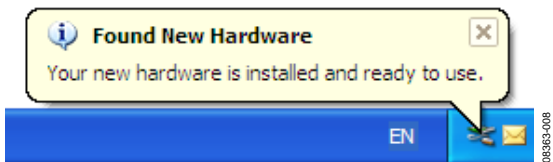


Figure 8. Successful Driver Installation Notification

**CONNECTING THE EVALUATION BOARD**

1. Plug the included dc power supply into the J24 power jack on the board.
2. Connect the USBi 10-pin communication cable to the J18 communications port on the evaluation board.

**ADDING THE EVAL-ADAU144xEBZ TO A SigmaStudio PROJECT**

To use the EVAL-ADAU144xEBZ with SigmaStudio, follow these steps:

1. Start the SigmaStudio software.
2. Begin a new project by opening the **File** menu and selecting **New Project**. (The keyboard shortcut for this operation is **Ctrl + N**.)
3. The default view in SigmaStudio is the **Hardware Configuration** tab.
  - a. On the left side of the screen is the **Tree Toolbox** tab.
  - b. Within the **Tree Toolbox** there is a subsection called **Communication Channels**. From the list of **Communication Channels**, click and hold **USBi** dragging it to the right into the empty white project space. See Figure 9 and Figure 10 for details.

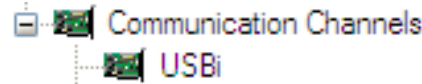


Figure 9. Adding the USBi Communication Channel to the Evaluation Board for the ADAU144x

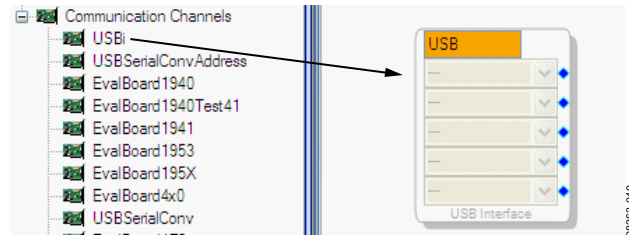


Figure 10. Adding a USBi to the Project

If SigmaStudio cannot detect the USBi on the USB port of the computer, the background of the **USB** label turns red, as shown in Figure 11. This happens if the USBi is not connected or when the drivers are not installed correctly.



Figure 11. EVAL-ADAU144xEBZ Not Detected by SigmaStudio

If SigmaStudio detects the USBi on the USB port, the background of the **USB** label changes to orange, as shown in Figure 12.

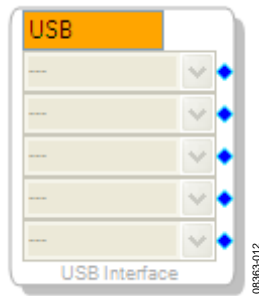


Figure 12. USBi Detected by SigmaStudio

### ADDING AN ADAU144x IC

To communicate with the targeted ADAU144x IC on the evaluation board, add ADAU144x to the processor list in SigmaStudio.

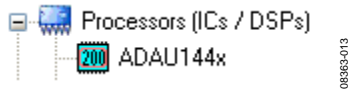


Figure 13. Adding an ADAU144x IC

To use the USBi to communicate with the target ADAU144x IC, click the top blue pin of the **USB** and drag a wire to the green pin of the **ADAU144x IC 1**, as shown in Figure 14. The I<sup>2</sup>C Address 0x70 is assigned automatically.

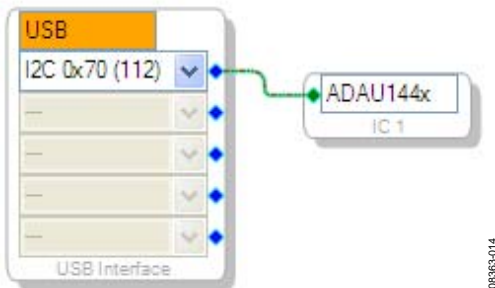


Figure 14. Connecting the EVAL-ADAU144xEBZ to an ADAU144x IC

### ADDING A SELF-BOOT EEPROM

To evaluate the EVAL-ADAU144xEBZ self-boot functionality, an E2Prom IC must be added to the project. This corresponds to the EEPROM U2 device on the evaluation board.

1. Click and drag an **E2Prom** IC into the project space.
2. Drag a wire from the second blue pin on the USBi to the green pin on the E2Prom IC, as shown in Figure 16.

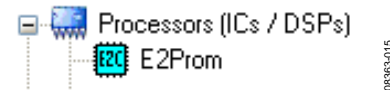


Figure 15. Adding an E2Prom IC

When the second pin on the USBi communication channel is connected to the EEPROM, I<sup>2</sup>C Address 0xA0 is assigned automatically.

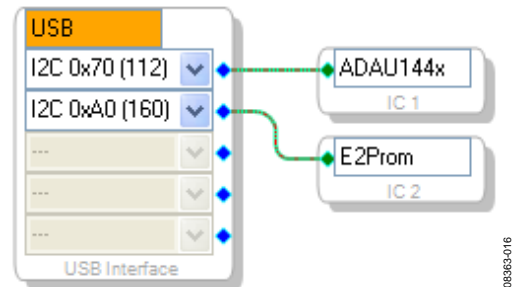


Figure 16. Connecting the EVAL-ADAU144xEBZ to the E2Prom IC

An E2Prom IC does not have to be added unless the self-boot functionality of the board is required.

### PROGRAMMING THE SIGNAL FLOW

To program the signal processing flow, use the **Schematic** tab, located at the top of the window as shown in Figure 17.

1. Click the **Schematic** tab.

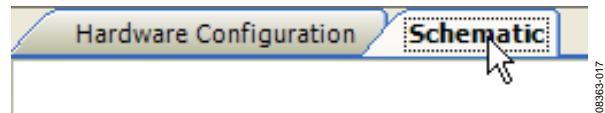


Figure 17. Schematic Tab

The left side of the schematic box shows the **Tree Toolbox**. It contains a list of all signal processing algorithms for use in the ADAU144x, as shown in Figure 18.

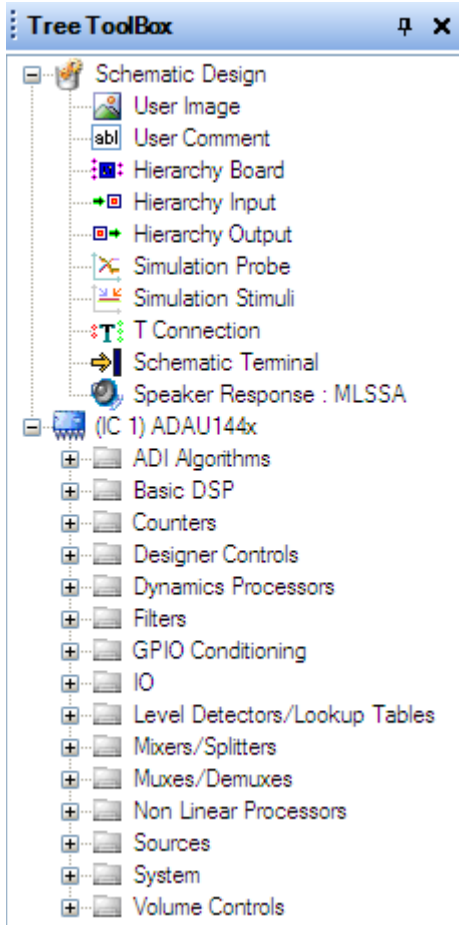


Figure 18. Tree Toolbox

2. Open the **IO** folder.
  - a. Open the **Input** subfolder.
  - b. Locate an **Input** cell, as shown in Figure 19.

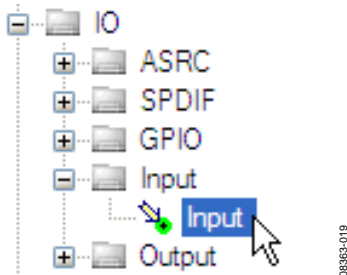


Figure 19. Locating an Input Cell

3. Click and drag the **Input** cell into the project space, as shown in Figure 20.

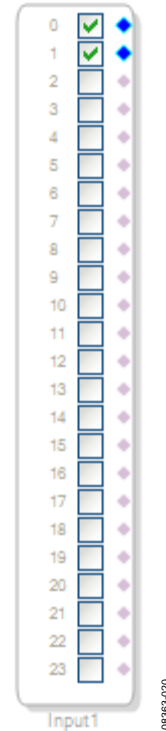


Figure 20. Input Cell

4. Open the **IO** folder.
  - a. Open the **Output** subfolder.
  - b. Locate an **Output** cell, as shown in Figure 21.

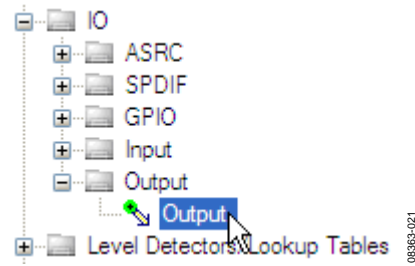


Figure 21. Locating an Output Cell

5. Click and drag the **Output** cell into the project space, as shown in Figure 22.

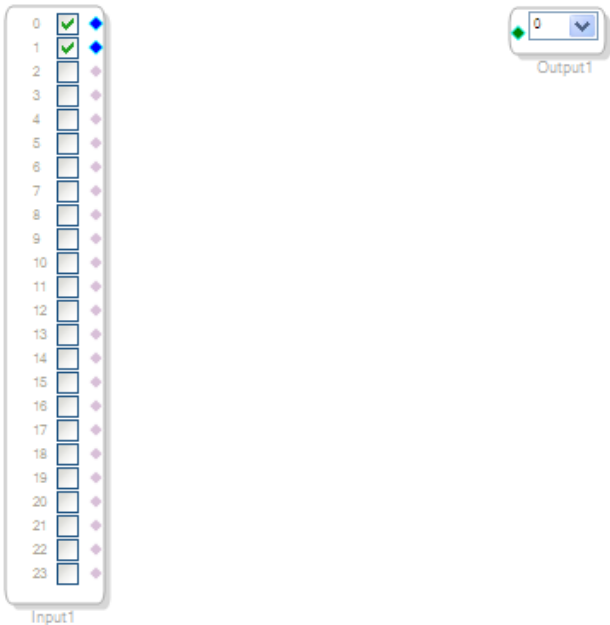


Figure 22. Input Cell and Output Cell

To have stereo inputs and outputs, one additional **Output** cell is required.

6. Select the **Output1** cell.
  - a. Press **Ctrl + C** to copy the cell.
  - b. Then press **Ctrl + V** to paste the copy of the cell. There should now be two output cells, as shown in Figure 23.

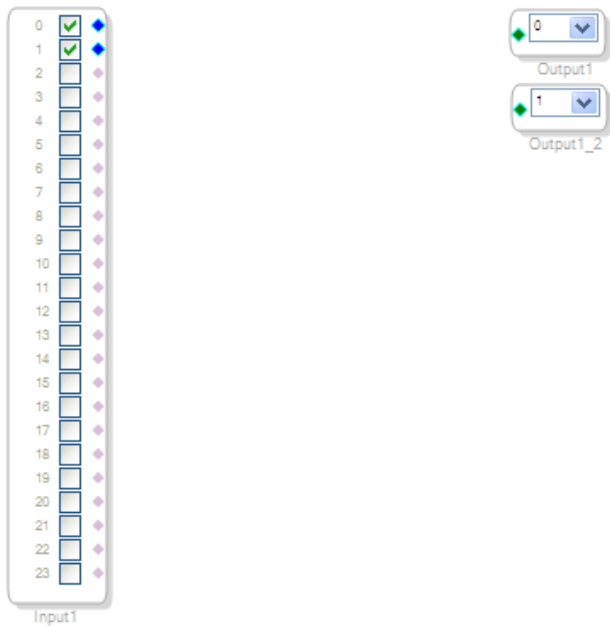


Figure 23. Stereo Input and Output

To control the volume of the output, a volume control is required.

7. Open the **Volume Controls** folder.
  - a. Open the **Adjustable Gain** subfolder.
  - b. Open the **Shared Slider** subfolder.
  - c. Open the **Clickless SW Slew** subfolder.
  - d. Locate the **Single SW slew vol** cell.

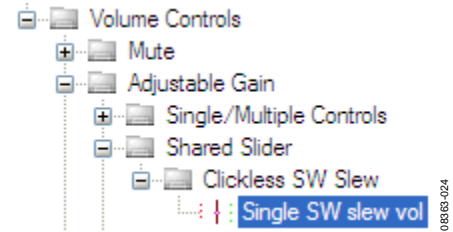


Figure 24. Locating the Single Slew Volume Cell

8. Click and drag the **Single SW slew vol** cell into the project space, as shown in Figure 25.

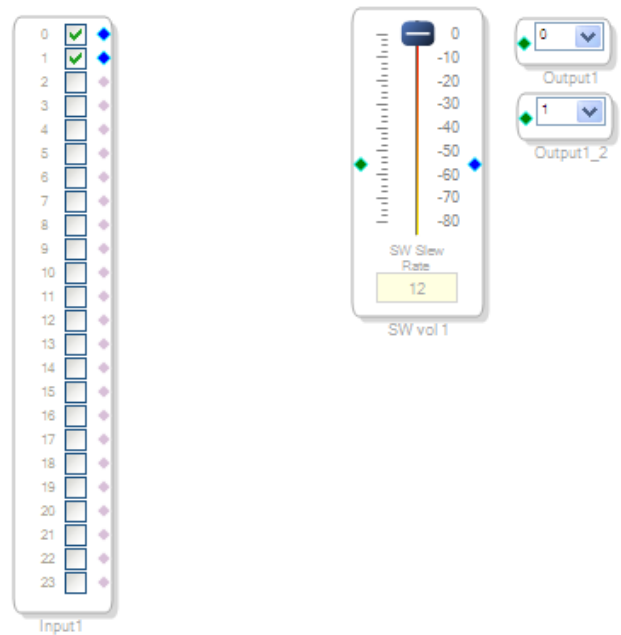


Figure 25. Stereo Input and Output with Slew Volume

To make the volume control stereo, follow these steps as illustrated in Figure 26.

9. Right click **SW\_vol\_1**, the volume control cell.
10. Select **Grow Algorithm, 1. Volume (SW slew)**.
11. Select **1**.

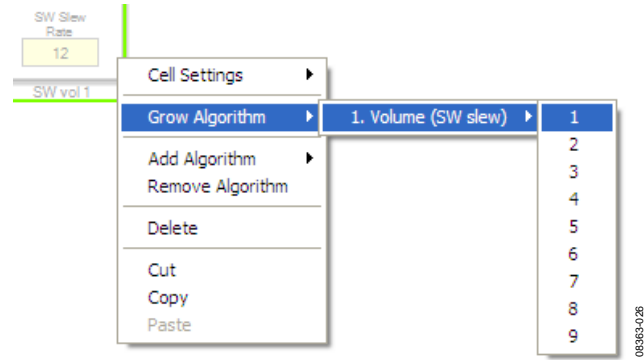


Figure 26. Growing the Volume Control

The resulting volume control cell has two inputs and two outputs marked with the green and blue points in Figure 27.

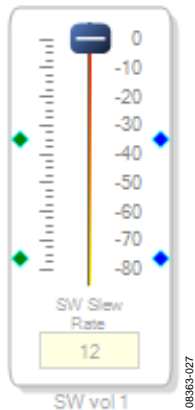


Figure 27. Stereo Volume Control

To add an equalizer, a filter is required. To add a filter, follow these steps (illustrated in Figure 28):

12. Open the **Filters** folder.
  - a. Open **Second Order** subfolder.
  - b. Open the **Single Precision** subfolder.
  - c. Open the **2 Ch** subfolder.
  - d. Locate the **Medium Size Eq** cell.

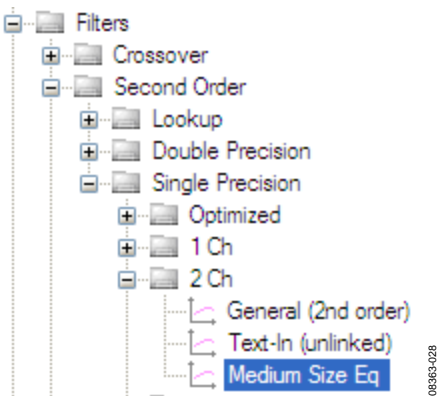


Figure 28. Locating the Medium Size Equalizer Cell

13. Click and drag the **Medium Size Eq** cell into the project space, as shown in Figure 29.

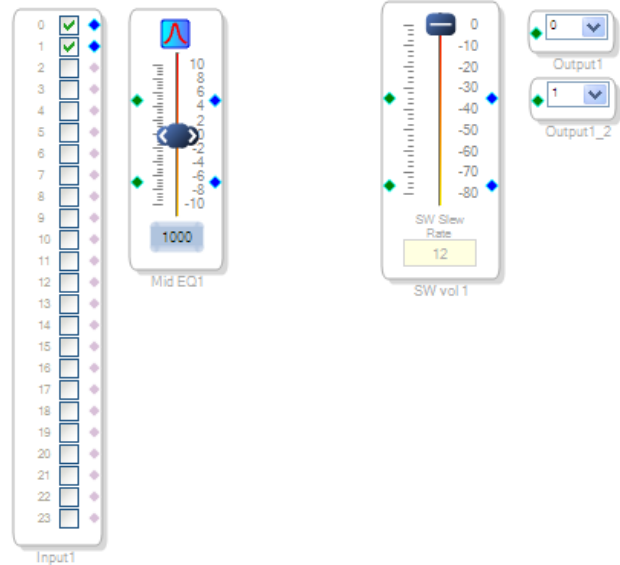


Figure 29. Stereo Audio Flow with Volume Control and Single-Band Equalizer

To add more bands to the equalizer, follow Step 14 through Step 16 (illustrated in Figure 30) and adjust the filter parameters following Step 17 and Step 18.

14. Right-click **Grow Algorithm**.
15. Select **1. 2 Channel – Single Precision**.
16. Select **2**.

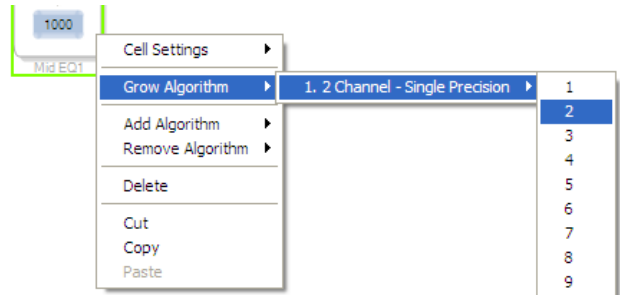


Figure 30. Growing the Equalizer

17. Click the blue equalizer icon to alter filter parameters (see Figure 31).

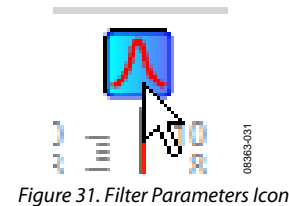


Figure 31. Filter Parameters Icon

- Configure the filter parameters for each band, as desired (see Figure 32).

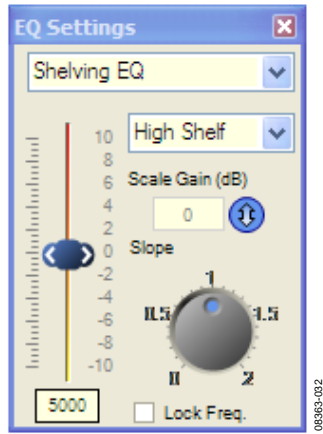


Figure 32. Filter Parameters

- For each cell, click the blue pin and drag a wire to the green pin to create an audio path from the input to the output for each channel, as shown in Figure 33.

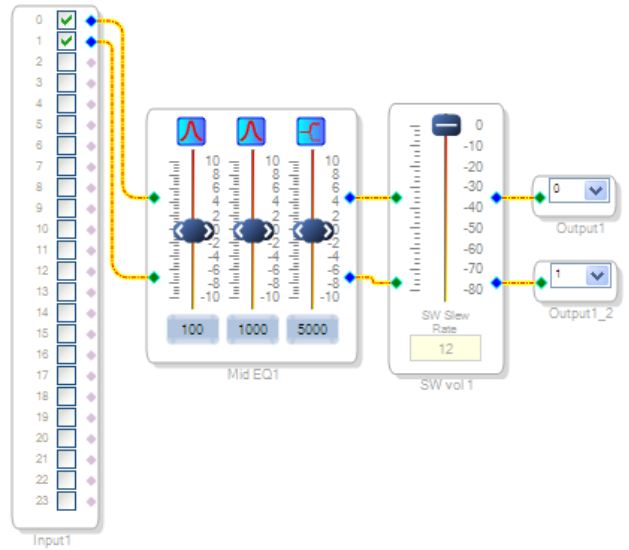


Figure 33. Completed Audio Path

- Set the switches and jumpers to correspond to the default settings in Figure 35. A black rectangle corresponds to the position of a switch or jumper.
- Connect an audio source to the audio input jack, J12, and a pair of headphones or powered speakers to the audio output jack, J4.
- Click the **Link Compile Download** button to download the program to the ADAU144x IC.

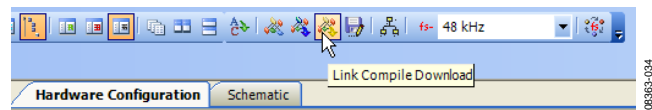


Figure 34. Link Compile Download

The device should now process audio in real time.

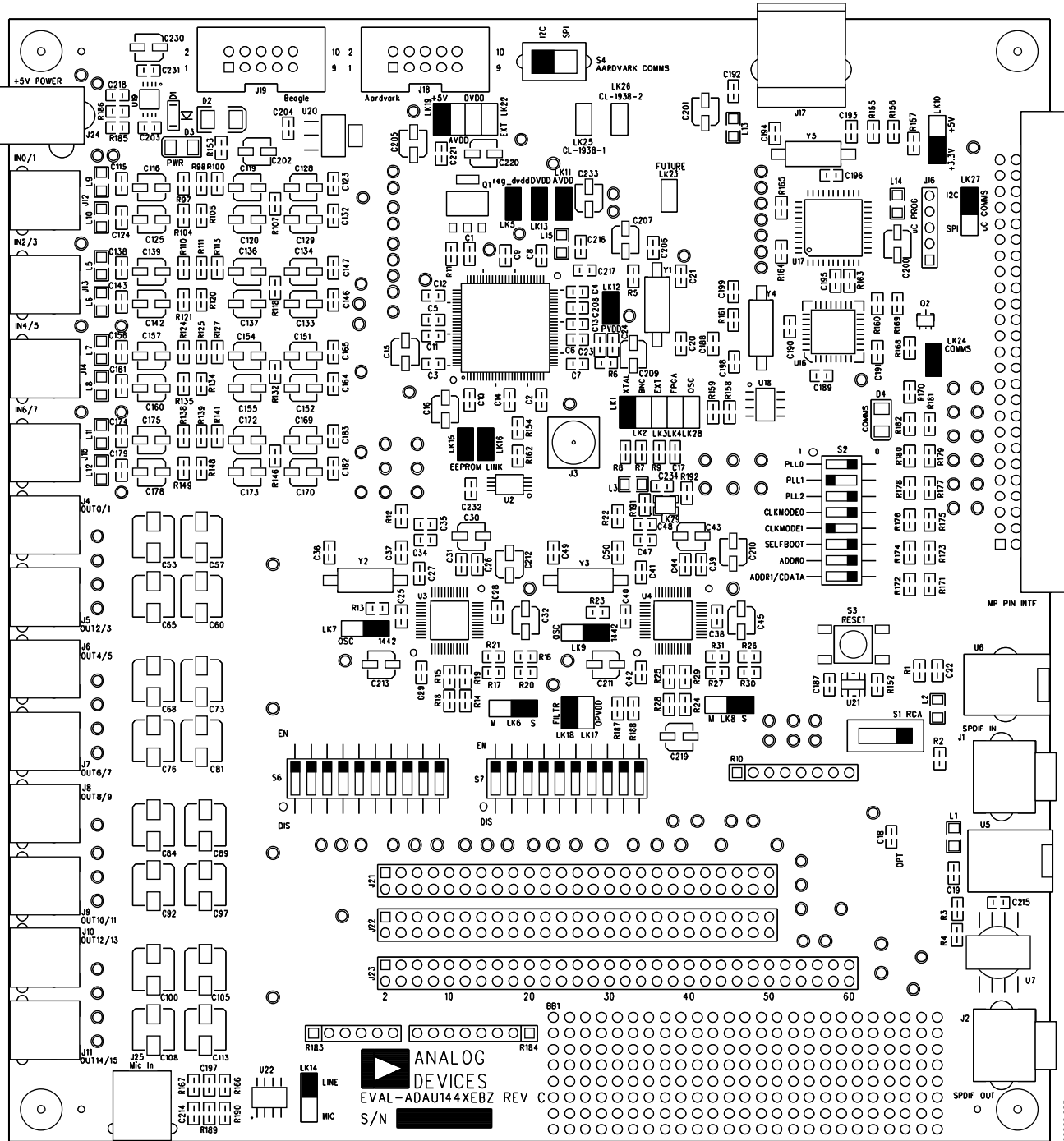


Figure 35. Default Switch and Jumper Settings

## Default Switch and Jumper Setting Descriptions

The default setup represents the state of the board when it leaves the factory. With this configuration, the analog audio is routed from the input connectors to the codecs, in and out of

the DSP, back through the codecs, and to the output connectors. Descriptions with direction references are based on the orientation of the board shown in Figure 35.

**Table 1. Default Switch and Jumper Setting Descriptions**

Board Element	Description
Crystal Oscillator Circuit	Used as a master clock source. LK1 connected.
Regulator DVDD, IOVDD, AVDD PVDD	Active. LK5, LK11, and LK13 connected. Active.
Op Amps	Use a 5 V supply. LK19 connected.
USB Communications	Active and in I <sup>2</sup> C mode. LK27 is in the up position. Note that the SPI functionality of the USB communications interface has not yet been implemented, and users wishing to test SPI functionality should connect the EVAL-ADUSB2 (USBi) to the Aardvark header, J18.
PLLx	Set to 010, 256 × f <sub>s</sub> mode. The S2 Switch 1, S2 Switch 2, and S2 Switch 3 are in the right, left, and right positions, respectively.
CLKMODEx	In Mode 01, with buffered oscillator output. The S2 Switch 4 and S2 Switch 5 are in the right and left positions, respectively.
SELFBOOT	Inactive. The S2 Switch 6 is in the right position.
ADDR0	Set to 0. The S2 Switch 7 is in the right position.
CDATA Line	Active. The S2 Switch 8 is in the right position.
S/PDIF Receiver	Set to RCA/coaxial connector. The S1 switch is in the right position.
Codec 1 and Codec 2	Set as slaves to the ADAU144x. LK7 and LK9 are in the right position.
Serial Ports on Codec 1 and Codec 2	Set as slaves to the ADAU144x. LK6 and LK8 are in the right position.
Connection Between the Codecs and the ADAU144x	Enabled. The S6 and S7 switches are in the up position.
Op Amp Reference	Set to FILTR. LK18 is connected, and LK17 is disconnected.
Microphone Input	Disabled. LK14 is in the up position.
Self-Boot EEPROM	Connected to the ADAU144x IC. LK15 and LK16 are connected.
GPIO Interface Board Supply	Set to 3.3 V. LK10 is set to 3.3 V.
External Communications Interface	Set to I <sup>2</sup> C mode. The S4 switch is set to I <sup>2</sup> C.

**MONITORING THE USB COMMUNICATIONS**

Use the **Capture Window** to view all communication transfers between the PC and the target IC (see Figure 38). For each write, the write mode, time of write, cell name, parameter name, address, data (in decimal and hexadecimal), and length are shown.

Click the expand/collapse button in the leftmost column to view the full data write. Otherwise, for block writes where more than one memory location is written, only the first location is shown.

**PROGRAMMING THE SELF-BOOT EEPROM**

After compiling a project, the registers and RAM contents of the ADAU144x can be written to a target EEPROM for self-boot. To use this functionality

1. Connect an E2Prom IC to the EVAL-ADAU144xEBZ in the **Hardware Configuration** window.
2. Verify that the EEPROM write protect pin is disabled on the target board.
3. Link-compile-download the project by clicking the **Link Compile Download** button.
4. Right-click the ADAU144x IC, and select **Write Latest Compilation to E2PROM**, as shown in Figure 36.

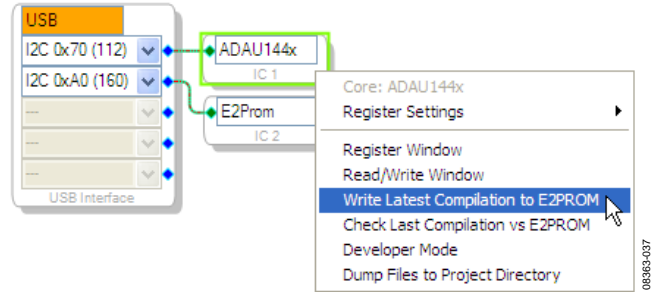


Figure 36. Writing to the Self-Boot EEPROM

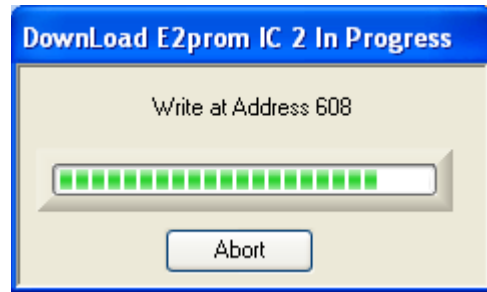


Figure 37. Self-Boot EEPROM Download Progress Bar

Mode	Time	Cell Name	Parameter Name	Address	Value	Data	Bytes
Block Write	16:7:6 - 357ms		IC 1.Routing M...	57472		0x00, 0x3F, 0x00, 0x3F	16
Block Write	16:7:6 - 357ms		IC 1.Routing M...	57480		0x00, 0x3F, 0x00, 0x3F	16
Block Write	16:7:6 - 357ms		IC 1.Routing M...	57488		0x00, 0x10, 0x00, 0x11	24
Block Write	16:7:6 - 357ms		IC 1.5/PDIF Regs	57536		0x00, 0x00, 0x00, 0x01	24
Block Write	16:7:6 - 357ms		IC 1.ASRC1 (0-3)	57600		0x00, 0xE4, 0x0F, 0x00	4
Block Write	16:7:6 - 357ms		IC 1.ASRC2 (4-7)	57664		0x00, 0xE4, 0x0F, 0x00	4
Block Write	16:7:6 - 357ms		IC 1.Serial In Fl...	57728		0x00, 0x00, 0x00, 0x00	48
Block Write	16:7:6 - 357ms		IC 1.Serial Out...	57792		0x00, 0x00, 0x00, 0x00	64
Block Write	16:7:6 - 357ms		IC 1.DSP Regs	57856		0x00, 0x00, 0x00, 0x00	84
Block Write	16:7:6 - 357ms		IC 1.Other DSP...	57920		0x00, 0x02, 0x00, 0x00	26
Block Write	16:7:6 - 357ms		IC 1.Enable Re...	57984		0x01, 0xFF	2
Block Write	16:7:6 - 357ms		Param	0		0x00, 0x00, 0x1F, 0x00	32
Block Write	16:7:6 - 357ms		NonModRamAlloc	0	7936	0x00, 0x00, 0x1F, 0x00	4
Block Write	16:7:6 - 357ms		Non Modulo RAM	24320			0
Block Write	16:7:6 - 357ms		IC 1.Core_Run_...	57896		0x00, 0x01	2

Figure 38. Output Capture Window

# HARDWARE DESCRIPTION

## INTEGRATED CIRCUITS (ICs)

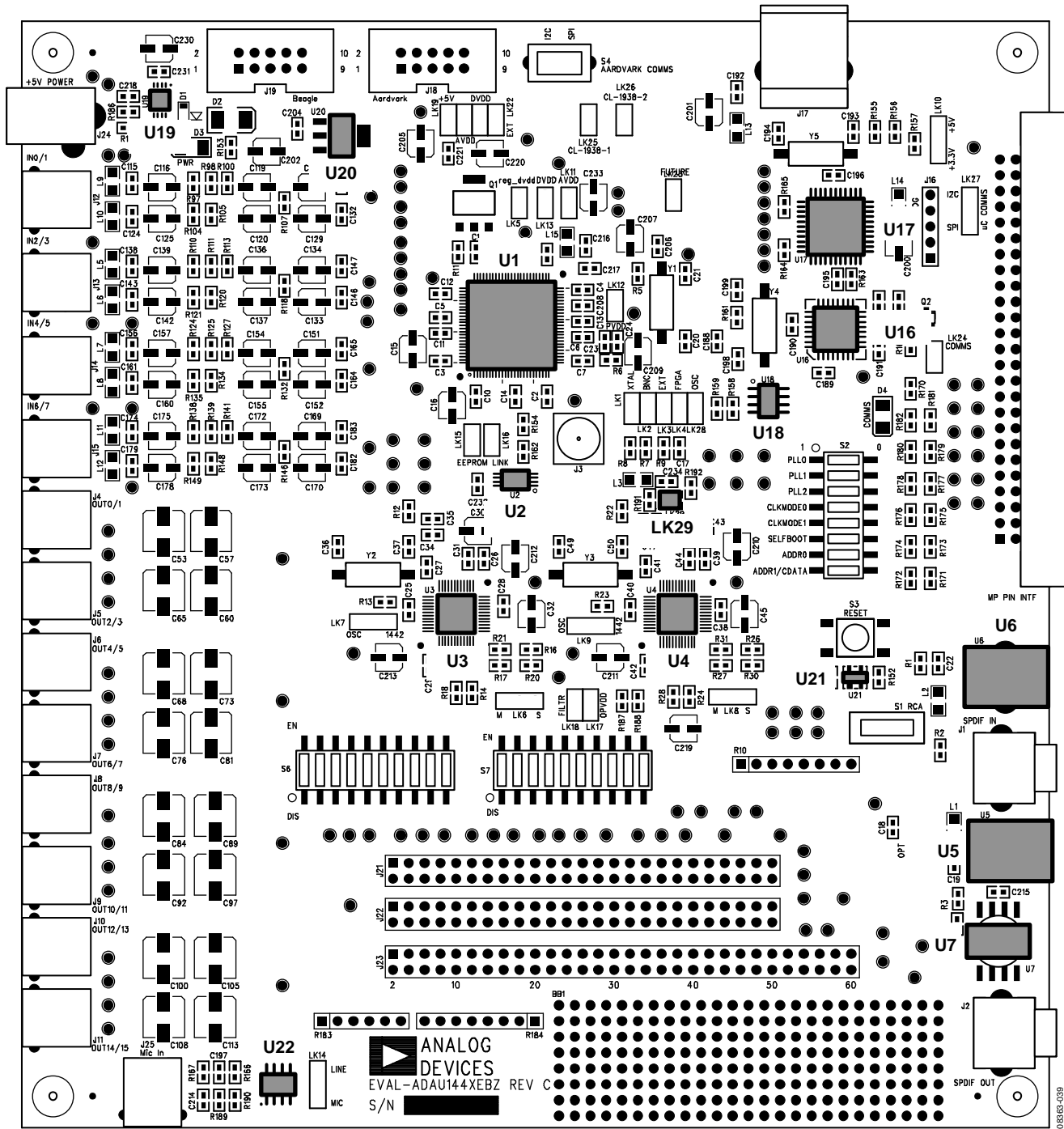


Figure 39. IC Layout

Table 2. IC Descriptions

Reference	Functional Name	Description
U1	ADAU144x SigmaDSP	Digital audio signal processor
U2	24AA256-I/ST 256 kb serial EEPROM	Self-boot memory
U3	AD1938 audio codec	ADC for Input 0 to Input 3; DAC for Output 0 to Output 7
U4	AD1938 audio codec	ADC for Input 4 to Input 7; DAC for Output 8 to Output 15
U5	TOTX141P 15 Mbps optical transmitter	S/PDIF output jack
U6	TORX147L 15 Mbps optical receiver	S/PDIF input jack
U7	SC937-02 110 $\Omega$ AES/EBU transformer	Transformer for electrical S/PDIF output
U8	AD8608ARZ low noise op amp	Filter op amp for Output 0 to Output 3
U9	AD8608ARZ low noise op amp	Filter op amp for Output 4 to Output 7
U10	AD8608ARZ low noise op amp	Filter op amp for Output 8 to Output 11
U11	AD8608ARZ low noise op amp	Filter op amp for Output 12 to Output 15
U12	AD8608ARZ low noise op amp	Filter op amp for Input 0 to Input 1
U13	AD8608ARZ low noise op amp	Filter op amp for Input 2 to Input 3
U14	AD8608ARZ low noise op amp	Filter op amp for Input 4 to Input 5
U15	AD8608ARZ low noise op amp	Filter op amp for Input 6 to Input 7
U16	FT245BL USB to parallel FIFO interface	USB to parallel communications interface
U17	PIC16LF877-04/PT microcontroller	Parallel to SPI/I <sup>2</sup> C communications interface
U18	AT93C46-10SU-2.7 1 kb serial EEPROM	USB vendor ID and product ID memory
U19	ADP3336ARMZ low dropout voltage regulator	Analog supply voltage regulator
U20	ADP3339AKCZ low dropout voltage regulator	Digital supply voltage regulator
U21	ADM811RARTZ logic low reset output	Master reset generator
U22	AD8608ARZ low noise op amp	Microphone balanced-to-unbalanced converter
LK29	ASEP3JL-ND programmable oscillator	Active 12.288 MHz oscillator

### Detailed IC Descriptions

#### U1—ADAU144x SigmaDSP

Main audio signal processor and connectivity hub in the system. It includes nine serial input ports and nine serial output ports, with a total I/O capability of 24 serial audio channels. In addition, two pins are designated as S/PDIF input/output ports.

Inside the DSP are eight asynchronous sample rate converters, each capable of using any available clock domain as an output sample rate. The SigmaDSP core runs at 172 MHz and can be programmed via USB by the SigmaStudio programming tool.

#### U2—24AA256-I/ST 256 kb Serial EEPROM

Self-boot memory. Has enough memory to store an entire program, including program RAM, parameter RAM, and register settings. The ADAU144x can optionally boot from this memory on power-up, reducing the need for a system microcontroller.

#### U3—AD1938 Audio Codec

A four-ADC, eight-DAC audio codec that allows connection of analog audio signals to the board. The U3 handles Input 0 to Input 3 and Output 0 to Output 7. It is capable of running synchronously to the ADAU144x or using its own crystal oscillator circuit. Its serial ports can also act as either master or slave.

#### U4—AD1938 Audio Codec

A four-ADC, eight-DAC audio codec that allows connection of analog audio signals to the board. The U4 handles Input 4 to Input 7 and Output 8 to Output 15. It is capable of running synchronously to the ADAU144x or using its own crystal oscillator circuit. Its serial ports can also act as either master or slave.

#### U5—TOTX141P 15 Mbps Optical Transmitter

Optical transmitter for S/PDIF signals coming from the SPDIFO pin of the ADAU144x. It is always active.

#### U6—TORX147L 15 Mbps Optical Receiver

Optical receiver for S/PDIF signals, which are then routed to the SPDIFI pin of the ADAU144x. It is selected by putting the S3 switch into the left position (opposite the RCA label on the silkscreen).

#### U7—SC937-02 110 $\Omega$ AES/EBU Transformer

Transformer that conditions the S/PDIF output signal from the SPDIFO pin on the ADAU144x and prepares it for output on Connector J2, the electrical S/PDIF output jack.

#### U8—AD8608ARZ Low Noise Op Amp

Operational amplifier used to actively filter the analog outputs of the AD1938 codecs. The U8 handles Output 0 to Output 3.

**U9—AD8608ARZ Low Noise Op Amp**

Operational amplifier used to actively filter the analog outputs of the AD1938 codecs. The U9 handles Output 4 to Output 7.

**U10—AD8608ARZ Low Noise Op Amp**

Operational amplifier used to actively filter the analog outputs of the AD1938 codecs. The U10 handles Output 8 to Output 11.

**U11—AD8608ARZ Low Noise Op Amp**

Operational amplifier used to actively filter the analog outputs of the AD1938 codecs. The U11 handles Output 12 to Output 15.

**U12—AD8608ARZ Low Noise Op Amp**

Operational amplifier used to actively filter the analog inputs of the AD1938 codecs. The U12 handles Input 0 to Input 1.

**U13—AD8608ARZ Low Noise Op Amp**

Operational amplifier used to actively filter the analog inputs of the AD1938 codecs. The U13 handles Input 2 to Input 3.

**U14—AD8608ARZ Low Noise Op Amp**

Operational amplifier used to actively filter the analog inputs to the AD1938 codecs. The U14 handles Input 4 to Input 5.

**U15—AD8608ARZ Low Noise Op Amp**

Operational amplifier used to actively filter the analog inputs of the AD1938 codecs. The U15 handles Input 6 to Input 7.

**U16—FT245BL USB to Parallel FIFO Interface**

Single-chip USB used to parallel the FIFO bidirectional data transfer interface. It enables communication between the ADAU144x and the SigmaStudio programming tool via the PIC16LF877 microcontroller.

Note that in the current revision of the board, this device is disabled. The evaluation kit includes the EVAL-ADUSB2EBZ to be used as a communication interface.

**U17—PIC16LF877-04/PT Microcontroller**

U17 is a microcontroller that serves as a parallel FIFO to the SPI or I<sup>2</sup>C bidirectional communications interface. It enables communication between the ADAU144x and the SigmaStudio programming tool via the FT245BL.

Note that in the current revision of the board, this device is disabled. The evaluation kit includes the EVAL-ADUSB2EBZ to be used as a communication interface.

**U18—AT93C46-10SU-2.7 1 kb Serial EEPROM**

USB device identification memory that contains the USB vendor ID and product ID numbers, allowing the correct driver to be chosen and enabling communications to the USB port of the PC.

**U19—ADP3336ARMZ Low Dropout Voltage Regulator**

U19 is the analog supply voltage regulator; it regulates the dc power supply to a 3.3 V analog supply.

**U20—ADP3339AKCZ Low Dropout Voltage Regulator**

Digital supply voltage regulator; it regulates the dc power supply to a 3.3 V digital supply.

**U21—ADM811RARTZ Logic Low Reset Output**

Debounced reset signal generator that acts as a master reset for the board.

**U22—AD8608ARZ Low Noise Op Amp**

Operational amplifier used to take a balanced analog microphone input signal and convert it to an unbalanced signal.

**LK29—ASEP3JL-ND Programmable Oscillator**

An active oscillator that generates a clock signal at 12.288 MHz; it is useful for simulating an external master clock source in the system.

CRYSTAL RESONATORS

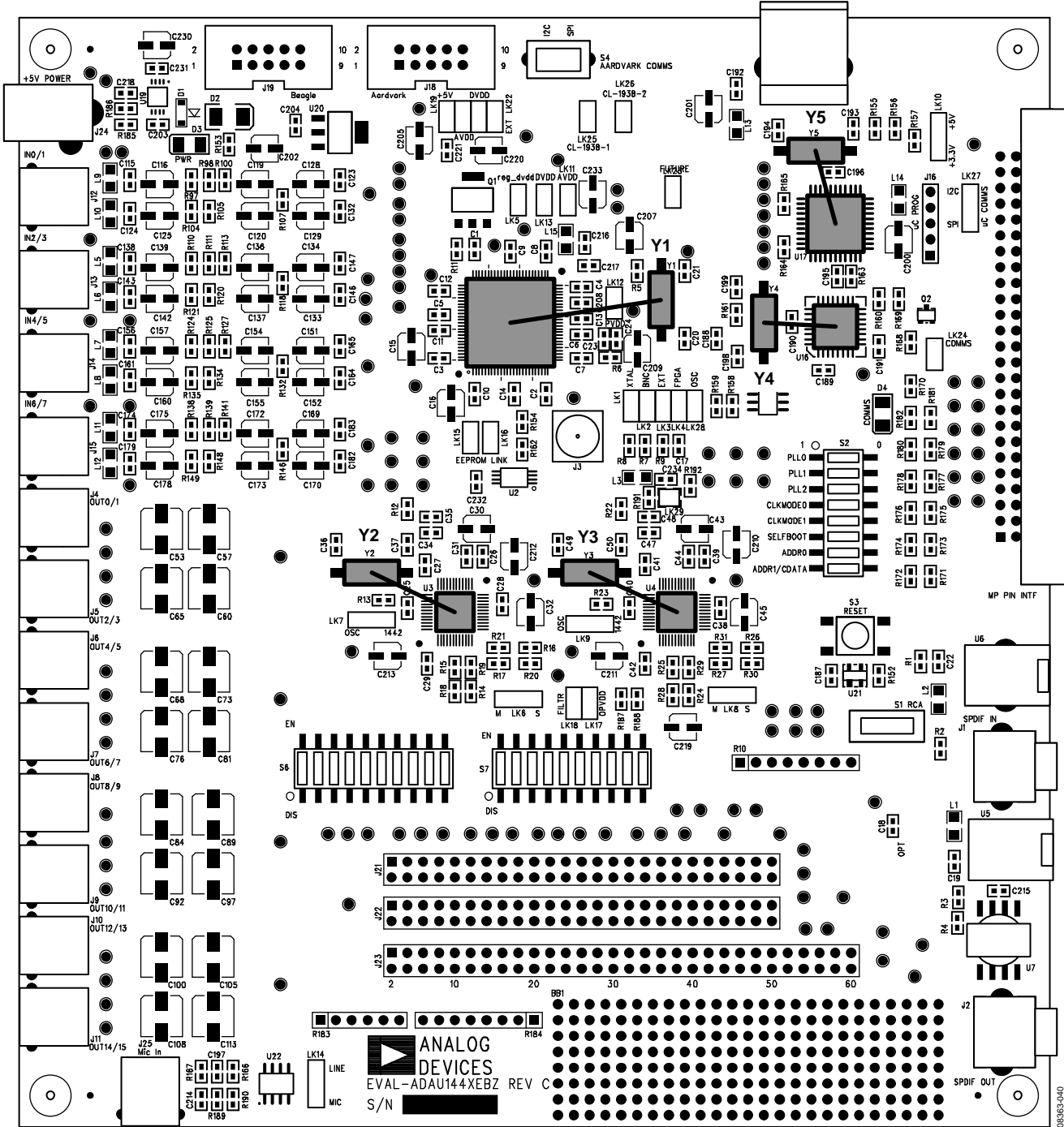


Figure 40. Crystal Resonator Layout

Table 3. Crystal Resonator Descriptions

Reference	Name	Description
Y1	DSP crystal	12.288 MHz crystal for the ADAU144x
Y2	Codec 1 crystal	12.288 MHz crystal for the AD1938 Codec 1
Y3	Codec 2 crystal	12.288 MHz crystal for the AD1938 Codec 2
Y4	Microcontroller crystal	6.000 MHz crystal for the PIC16LF877 microcontroller
Y5	USB interface crystal	10.000 MHz crystal for the FT245BL USB interface

TRANSISTORS

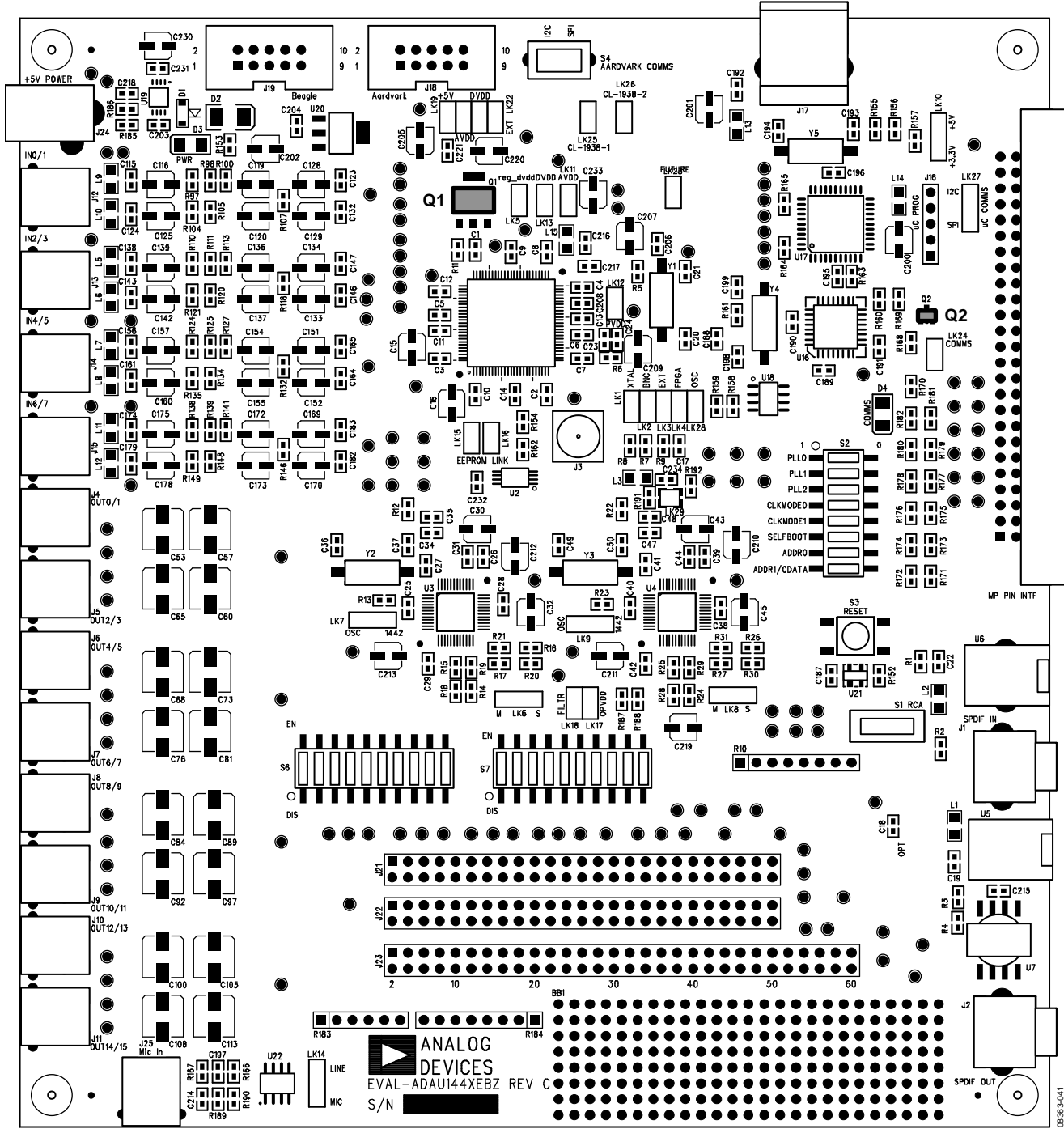


Figure 41. Transistor Layout

Table 4. Transistor Descriptions

Reference	Name	Description
Q1	Voltage regulator transistor	Darlington PNP transistor. Acts as a pass transistor for the DVDD supply.
Q2	Microcontroller JTAG reset transistor	Reset transistor. Required component of the JTAG microcontroller programming circuit.

LINKS

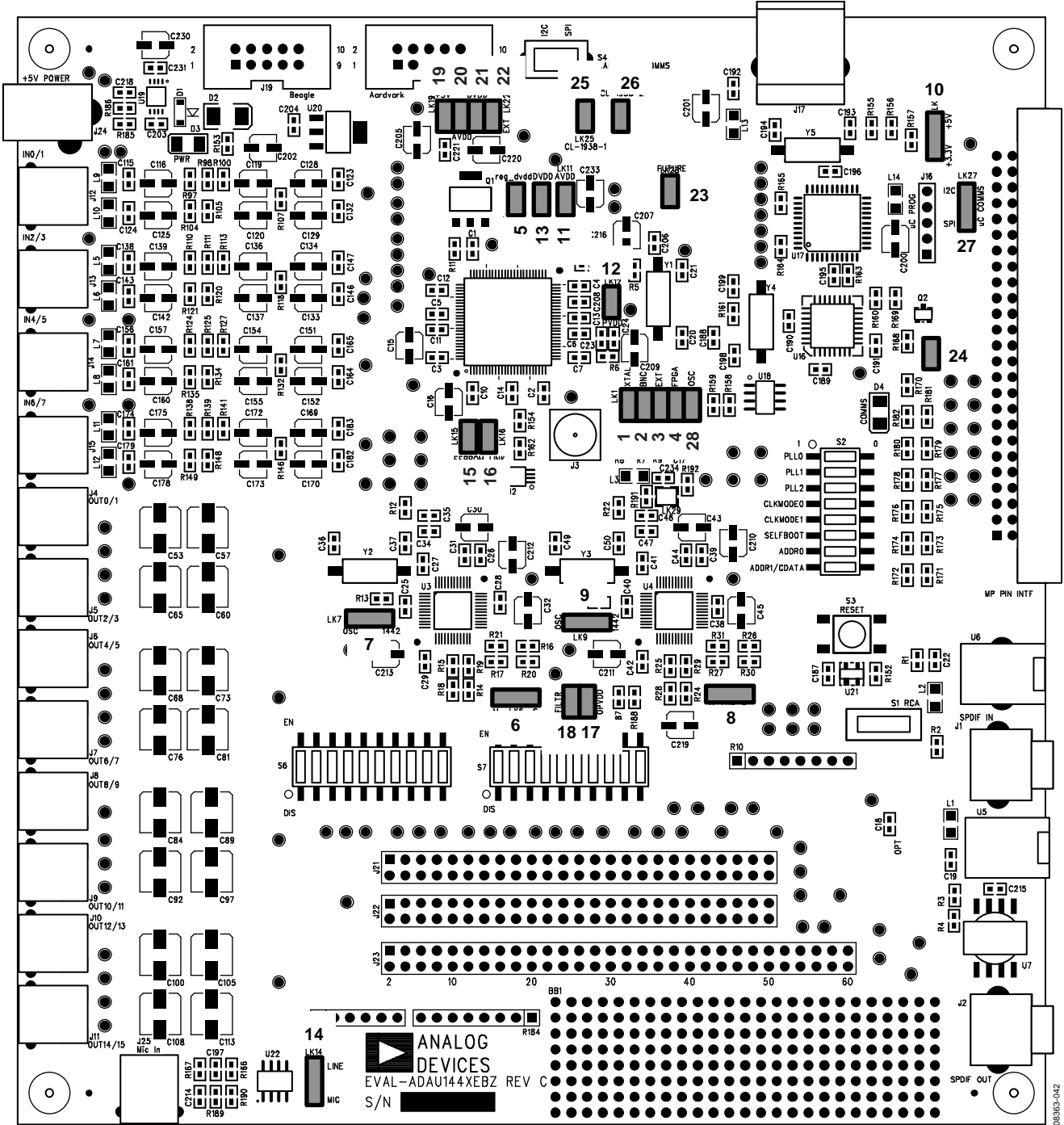


Figure 42. Link Layout

Table 5. Link Descriptions

Reference	Functional Name	Description
LK1	Clock select, crystal oscillator circuit	LK1, LK2, LK3, LK4, and LK28 select the master clock input to the ADAU144x. LK1 connects the ADAU144x to its crystal oscillator circuit.
LK2	Clock select, BNC	LK1, LK2, LK3, LK4, and LK28 select the master clock input to the ADAU144x. LK2 connects the ADAU144x to a master clock signal input on the SMA input header, J3.
LK3	Clock select, external clock input	LK1, LK2, LK3, LK4, and LK28 select the master clock input to the ADAU144x. LK3 connects the ADAU144x to an external MCLK signal from the multipurpose pin interface, J20.
LK4	Clock select, FPGA board	LK1, LK2, LK3, LK4, and LK28 select the master clock input to the ADAU144x. LK4 connects the ADAU144x to an external MCLK signal coming from header, J23.
LK5	DVDD regulator circuit enable	Connects a regulated DVDD supply from the collector of the pass transistor, Q1, to the ADAU144x.
LK6	Codec 1 master/slave	Places the Codec 1 serial ports in either master or slave mode, which are marked by M or S on the silkscreen, respectively.
LK7	Codec 1 clock select	Connects or disconnects Codec 1 from its crystal oscillator circuit. When disconnected, the codec receives a master clock signal from the ADAU144x.
LK8	Codec 2 master/slave	Places the Codec 2 serial ports in either master or slave mode, which are marked by M or S on the silkscreen, respectively.
LK9	Codec 2 clock select	Connects or disconnects Codec 2 from its crystal oscillator circuit. When disconnected, the codec receives a master clock signal from the ADAU144x.
LK10	Multipurpose board supply select	Selects either a 3.3 V (DVDD) or 5 V supply for the optional external multipurpose board, which attaches to the J20 header.
LK11	AVDD enable	Connects the AVDD supply to the ADAU144x.
LK12	PVDD enable	Connects the PVDD supply to the ADAU144x.
LK13	IOVDD enable	Connects the IOVDD supply to the ADAU144x.
LK14	Microphone input select	Allows the microphone to be input to Codec 2. By default, the jumper should be set on LINE, which enables both channels on the J15 input jack. However, when set to MIC, the left channel of J15 is replaced by the microphone signal on J25.
LK15	EEPROM SCL connect	Connects the SCL line of the self-boot EEPROM U2 to the ADAU144x. The jumper must be connected to program and read from the EEPROM.
LK16	EEPROM SDA connect	Connects the SDA line of the self-boot EEPROM U2 to the ADAU144x. The jumper must be connected to program and read from the EEPROM.
LK17	Op amp reference select, VREF	LK17 and LK18 select the reference level for the active filters. Connecting LK17 selects a OPVDD/2 reference from a voltage divider on the OPVDD supply.
LK18	Op amp reference select, FILT	LK17 and LK18 select the reference level for the active filters. Connecting LK18 selects a reference output directly from the AD1938 codec.
LK19	Op amp supply select, 5 V	LK19 to LK22 select the supply for the filter operational amplifiers. LK19 connects a 5 V supply.
LK20	Op amp supply select, DVDD	LK19 to LK22 select the supply for the filter operational amplifiers. LK20 connects the op amps to the DVDD supply.
LK21	Op amp supply select, AVDD	LK19 to LK22 select the supply for the filter operational amplifiers. LK21 connects the op amps to the AVDD supply.
LK22	Op amp supply select, GND	LK19 to LK22 select the supply for the filter operational amplifiers. LK22 disables the op amps by connecting their supplies to ground.
LK23	Futures	Connects a pin on the microcontroller, which is not yet implemented.
LK24	Communication active signal output	Connects the communications active signal to the multipurpose pin interface header, J20.
LK25	Codec 1 external SPI latch connect	Connects the latch signal for Codec 1 to the J18 and J19 external communications headers, allowing the codec to be programmed independently. When using the Aardvark or Beagle communications interface in I <sup>2</sup> C mode, the jumper must be disconnected.
LK26	Codec 2 external SPI latch connect	Connects the latch signal for Codec 1 to the external communications headers (J18 and J19) allowing the codec to be programmed independently. When using the Aardvark or Beagle communications interface in I <sup>2</sup> C mode, the jumper must be disconnected.

Reference	Functional Name	Description
LK27	Microcontroller communication mode select	Selects either I <sup>2</sup> C or SPI communication mode for the microcontroller; however, only I <sup>2</sup> C is supported by the firmware on the EVAL-ADAU144xEB. To communicate with the ADAU144x in I <sup>2</sup> C mode, connect an external I <sup>2</sup> C programmer to J19.
LK28	Clock select, active oscillator	LK1, LK2, LK3, LK4, and LK28 select the master clock input to the ADAU144x. LK28 selects the ASEP3JL-ND programmable oscillator as the MCLK source.

SWITCHES

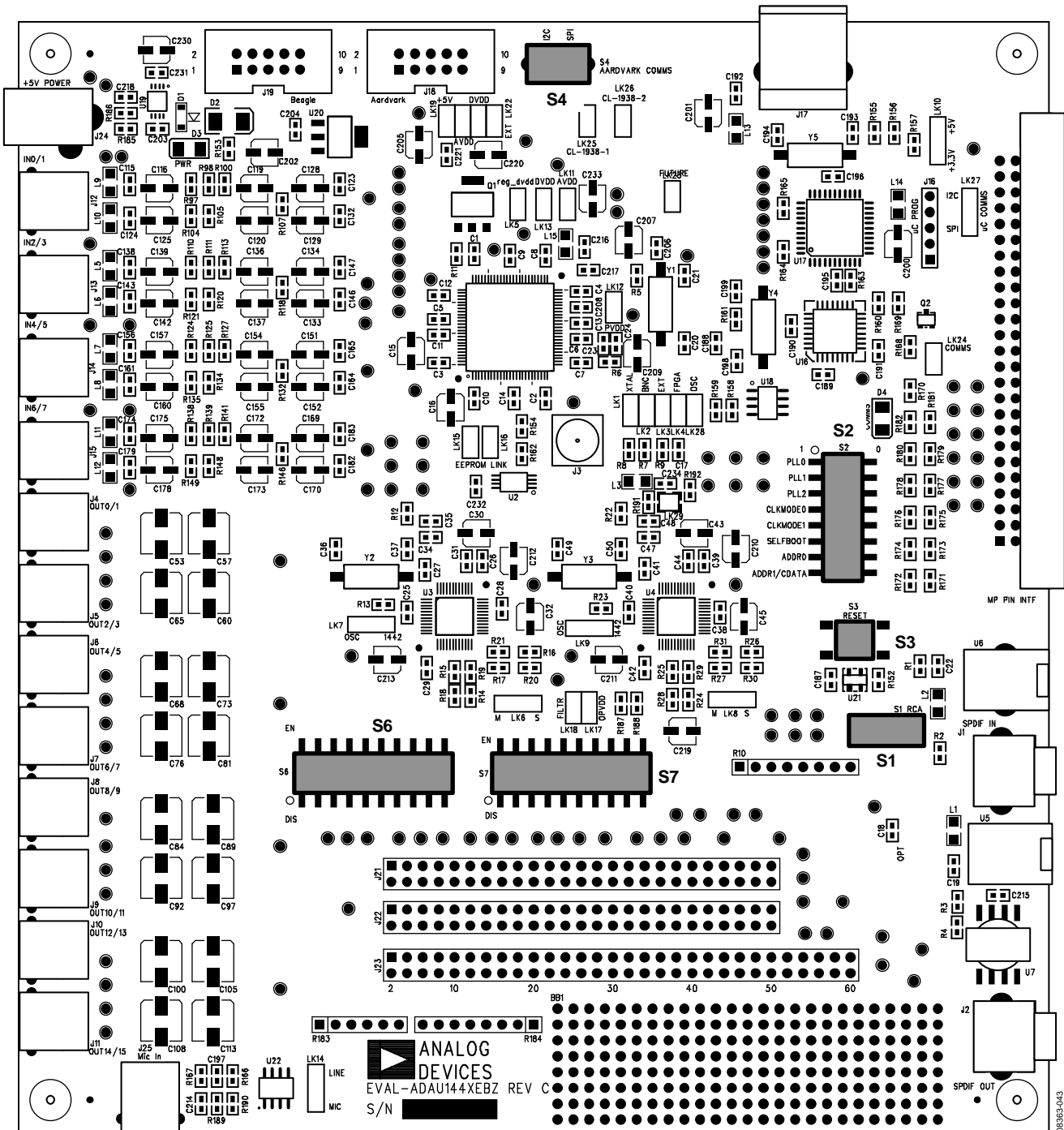


Figure 43. Switch Layout

Table 6. Switch Descriptions

Reference	Functional Name	Description
S1	S/PDIF input format select	Selects between the optical or electrical S/PDIF receiver input. Note that both transmitters are active at all times. When the switch is to the left, the optical receiver is enabled. When to the right, the electrical receiver is enabled.
S2	ADAU144x mode switch	Sets multiple mode pins on the ADAU144x, including PLL mode, CLK mode, self-boot, and address. For more information on these particular modes, refer to the ADAU1442/ADAU1445/ADAU1446 datasheet. For each switch, the right position (the on position) corresponds to a Logic 0. The left position corresponds to a Logic 1.
S3	Master reset	Triggers a single reset pulse from reset generator U21, and resets all major ICs on the board.
S4	Aardvark communication format select	Selects between I <sup>2</sup> C and SPI mode for the Aardvark communication interface. When the switch is in the left position, I <sup>2</sup> C communications are enabled. When to the right, SPI communications are enabled.
S6	Codec Enable 1	Enables communication between the ADAU144x and the AD1938 Codec 1. When the switches are in the on position (up), communications are enabled, and signals travel freely between the two ICs. When in the off position (down), the signals are blocked. To use the J21, J22, and J23 headers to input audio data to the ADAU144x directly, make sure these switches are in the off position.
S7	Codec Enable 2	Enables communication between the ADAU144x and the AD1938 Codec 2. When the switches are in the on position (up), communications are enabled, and signals travel freely between the two ICs. When the switches are in the off position (down), the signals are blocked. To use the J21, J22, and J23 headers to input audio data to the ADAU144x directly, make sure these switches are in the off position.

CONNECTORS AND JACKS

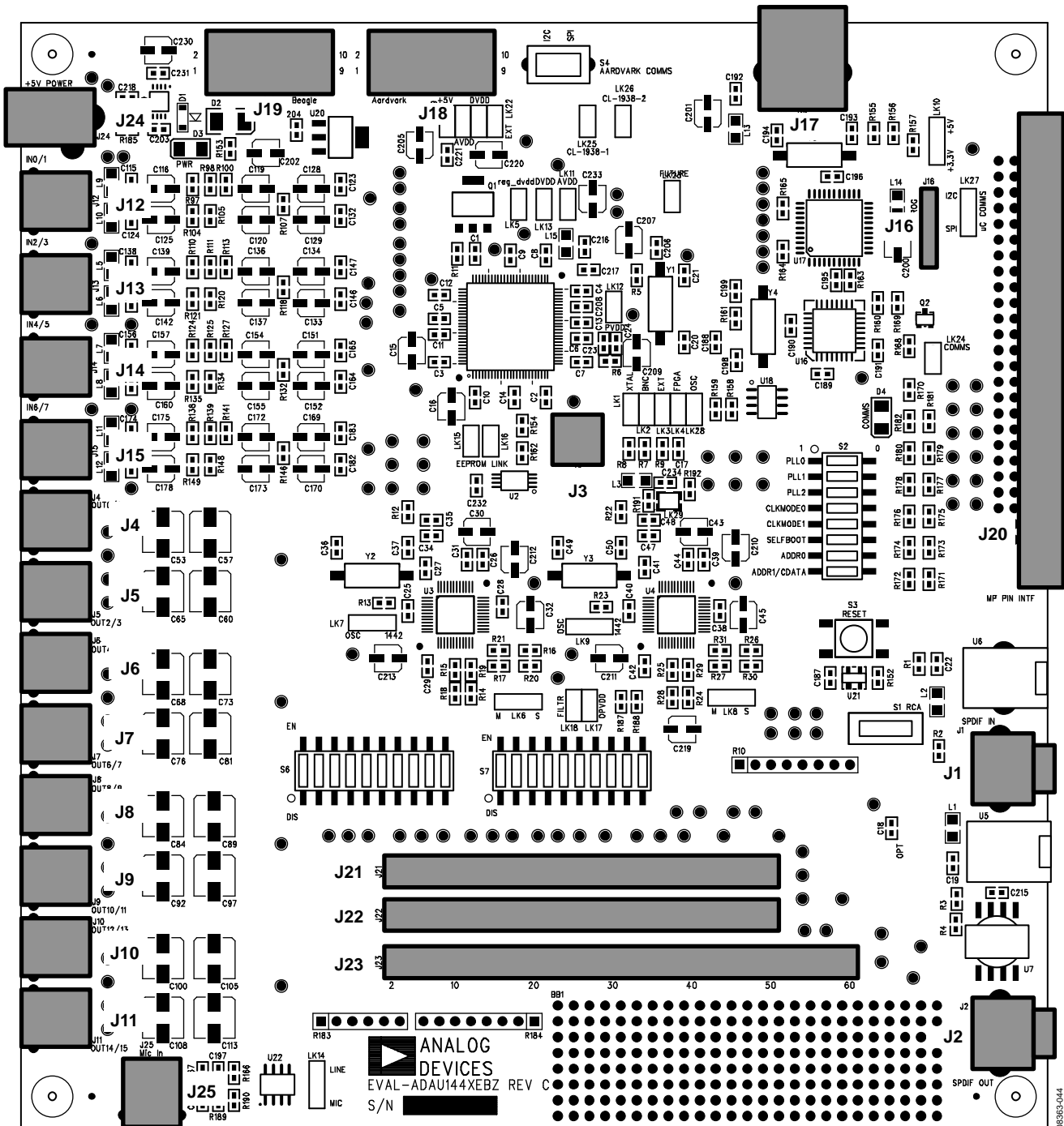


Figure 44. Connectors and Jacks Layout

Table 7. Connector and Jack Descriptions

Reference	Functional Name	Description
J1	S/PDIF electrical coax input jack	Electrical input jack for the S/PDIF signals. To be active, it must first be selected with Switch S1. The signal input on this jack is accessible at the SPDIFI pin on the ADAU144x.
J2	S/PDIF electrical coax output jack	Electrical output jack for S/PDIF signals. This jack always needs to be active; it outputs the signal directly from the SPDIFO jack of the ADAU144x.
J3	Master clock input SMA receptacle	Input jack for external master clock signals to the ADAU144x. It is selected by connecting the jumper on LK2.
J4	Analog Audio Output 0/ Analog Audio Output 1	Stereo audio output from the AD1938 Codec 1, Channel 0 and Channel 1.
J5	Analog Audio Output 2/ Analog Audio Output 3	Stereo audio output from AD1938 Codec 1, Channel 2 and Channel 3.
J6	Analog Audio Output 4/ Analog Audio Output 5	Stereo audio output from AD1938 Codec 1, Channel 4 and Channel 5.
J7	Analog Audio Output 6/ Analog Audio Output 7	Stereo audio output from AD1938 Codec 1, Channel 6 and Channel 7.
J8	Analog Audio Output 8/ Analog Audio Output 9	Stereo audio output from AD1938 Codec 2, Channel 8 and Channel 9.
J9	Analog Audio Output 10/ Analog Audio Output 11	Stereo audio output from AD1938 Codec 2, Channel 10 and Channel 11.
J10	Analog Audio Output 12/ Analog Audio Output 13	Stereo audio output from AD1938 Codec 2, Channel 12 and Channel 13.
J11	Analog Audio Output 14/ Analog Audio Output 15	Stereo audio output from AD1938 Codec 2, Channel 14 and Channel 15.
J12	Analog Audio Input 0/ Analog Audio Input 1	Stereo audio input to AD1938 Codec 1, Channel 0 and Channel 1.
J13	Analog Audio Input 2/ Analog Audio Input 3	Stereo audio input to AD1938 Codec 1, Channel 2 and Channel 3.
J14	Analog Audio Input 4/ Analog Audio Input 5	Stereo audio input to AD1938 Codec 2, Channel 4 and Channel 5.
J15	Analog Audio Input 6/ Analog Audio Input 7	Stereo audio input to AD1938 Codec 2, Channel 6 and Channel 7.
J16	Microcontroller programming header	Connects directly to the programming port on the PIC16LF877 microcontroller.
J17	USB connector	Connects the EVAL-ADAU144xEBZ board to the USB port of a PC.
J18	Aardvark programming header	Allows communication via an Aardvark communication interface instead of the USB connector. An EVAL-ADUSB2EBZ (also known as USBi) can be connected here, as well. When J18 is used, the USB connector of the board, J17, should be disconnected from the USB port of the PC.
J19	Beagle header	Allows communication monitoring via a Beagle sniffer communication interface.
J20	Multipurpose pin interface	Connects to the included external GPIO daughter board, which allows control of the ADAU144x via its MP pins. The GPIO board has several forms of interface circuitry, including potentiometers, pushbuttons, and LEDs.
J21	ADAU144x Interface Connector 1	Header that allows direct access to many of the ADAU144x pins. For more information, see Figure 58.
J22	ADAU144x Interface Connector 2	Header that allows direct access to many of the ADAU144x pins. For more information, see the schematic in Figure 58.
J23	ADAU144x Interface Connector 3	Header that allows direct access to many of the ADAU144x pins. For more information, see the schematic in Figure 58.
J24	Coaxial 5 V power jack	Connector for a standard power supply. The supply should be between 5 V and 6 V, sourcing at least 1.5 A, and have a tip positive polarity.
J25	Microphone input jack	Mono differential microphone input.

CIRCUIT SCHEMATICS

ADAU144x SigmaDSP

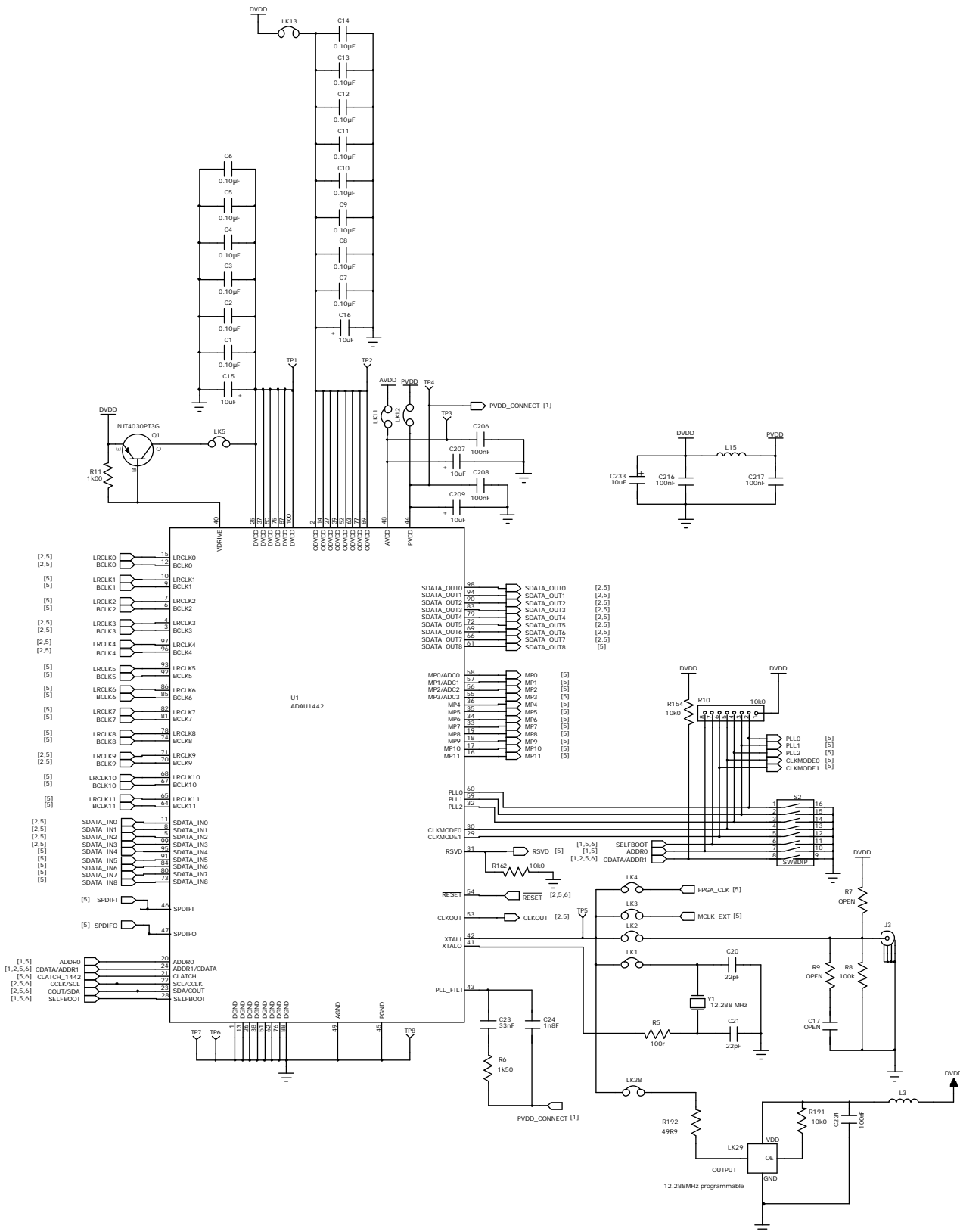


Figure 45. ADAU144x Circuit Schematic

**S/PDIF TRANSMITTER AND RECEIVER**

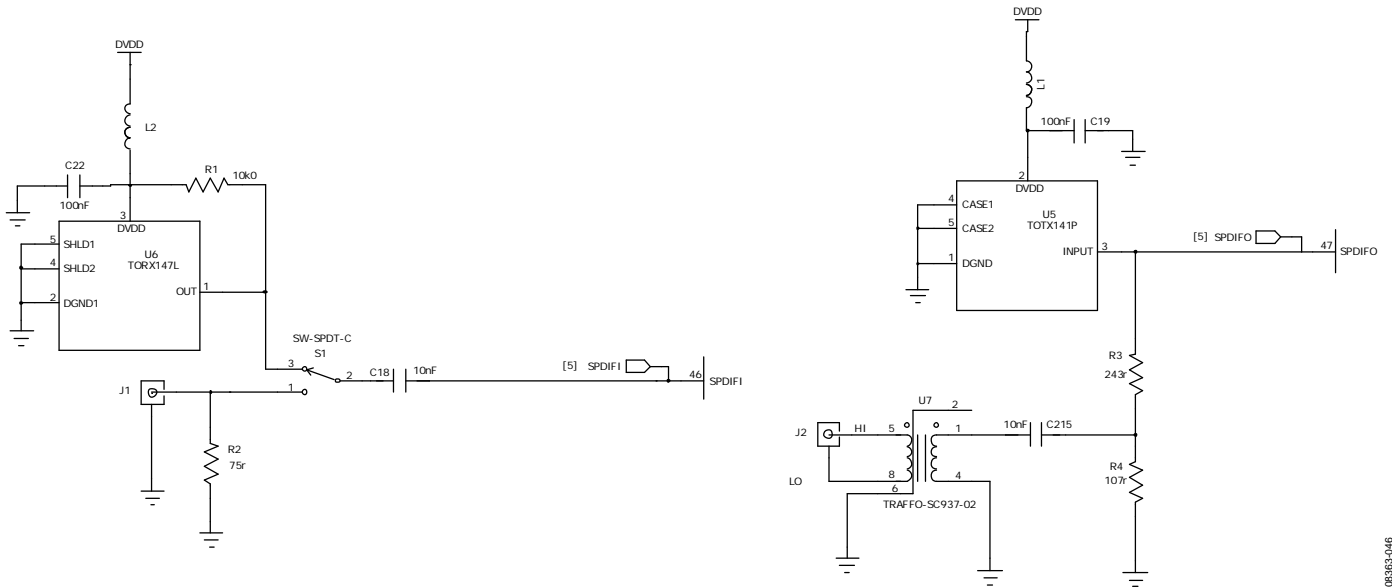


Figure 46. S/PDIF Transmitter and Receiver Circuit Schematics

**SELF-BOOT EEPROM**

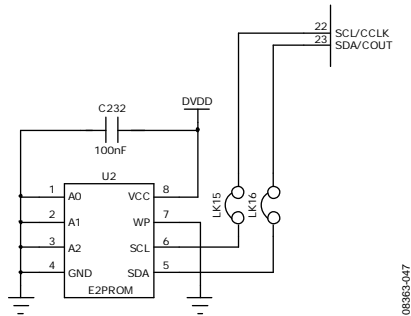


Figure 47. Self-Boot EEPROM Circuit Schematic

AD1938 AUDIO CODECS

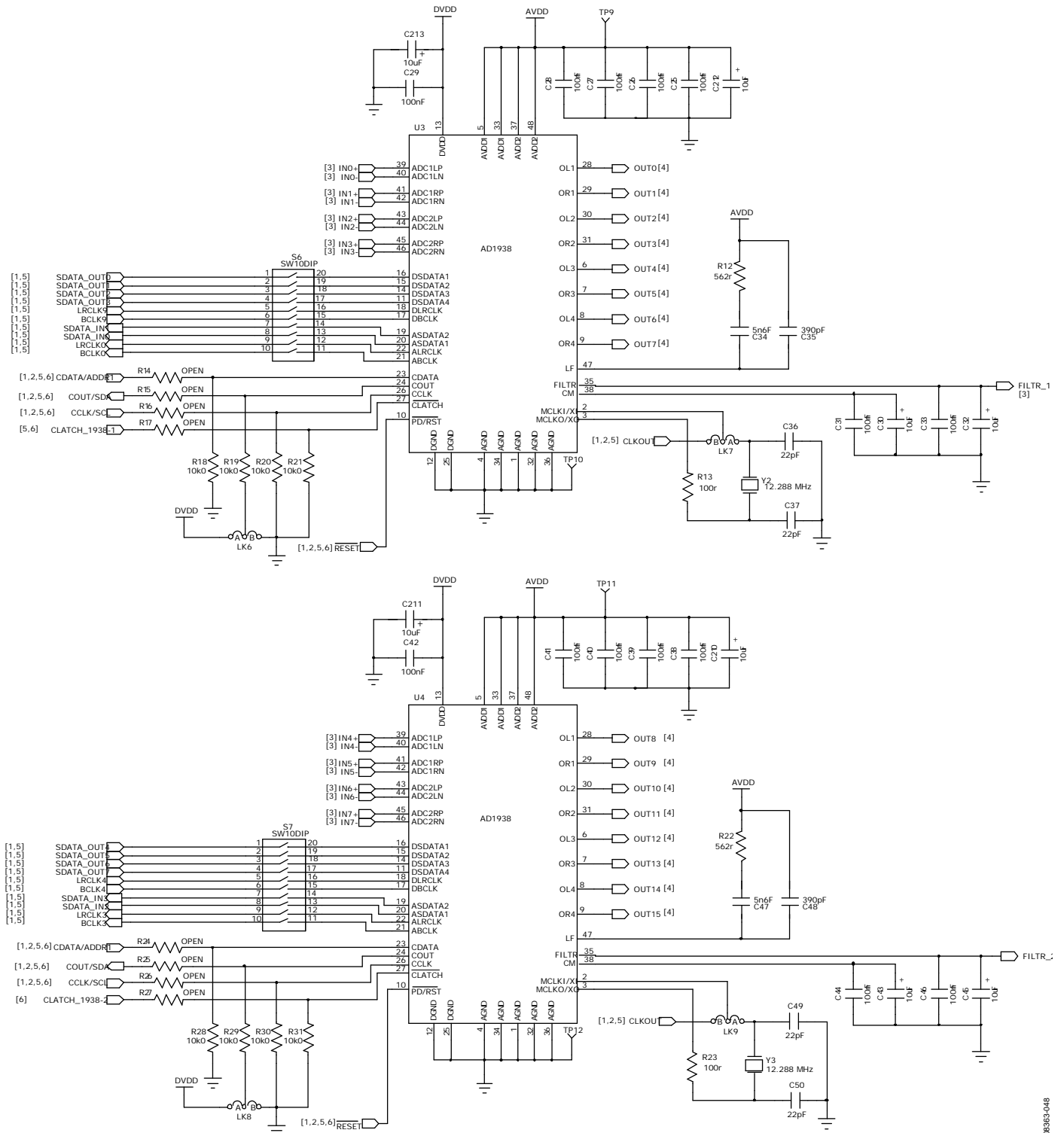
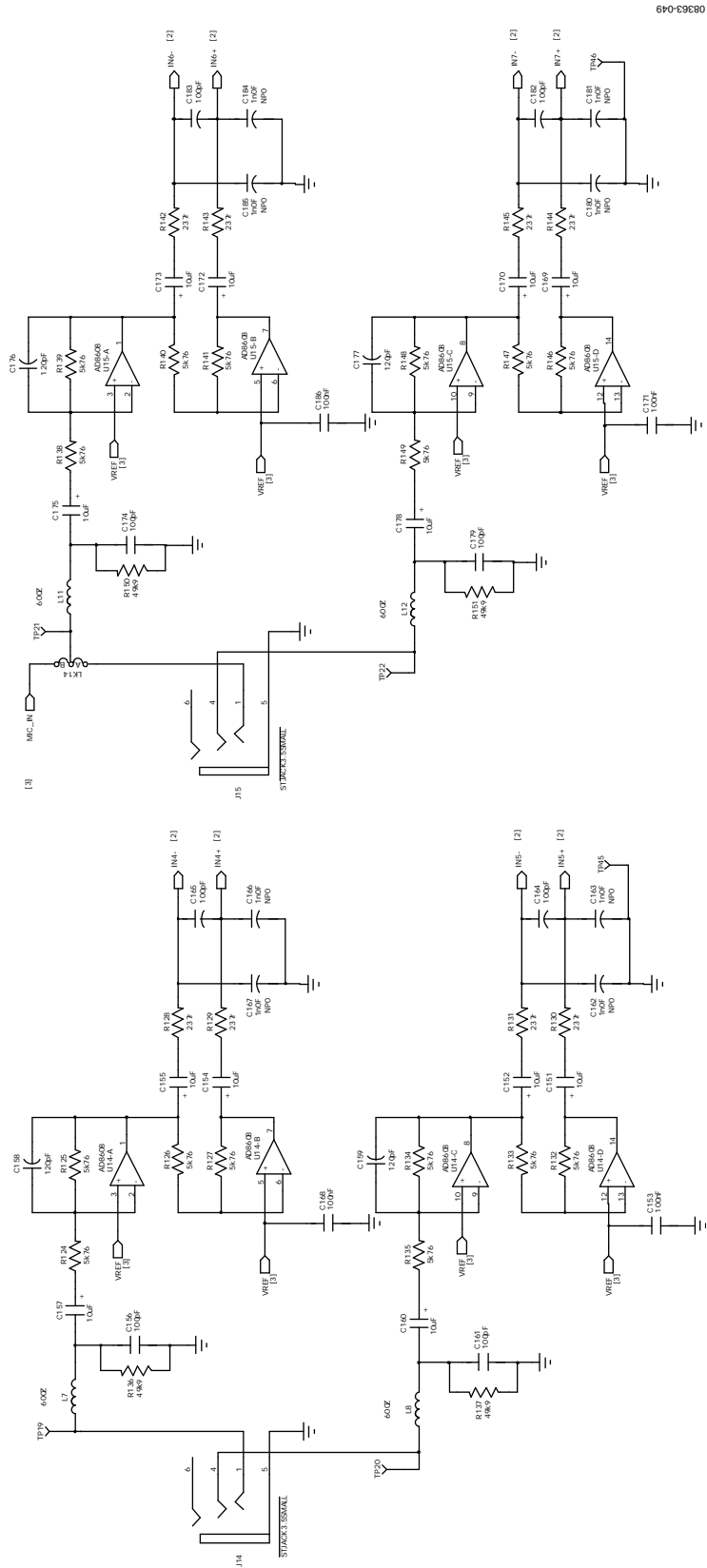


Figure 48. AD1938 Codecs Circuit Schematics

06883-048

ANALOG AUDIO INPUTS



03963-049

Figure 49. Audio Input 0 to Audio Input 3 Circuit Schematics

050-69690

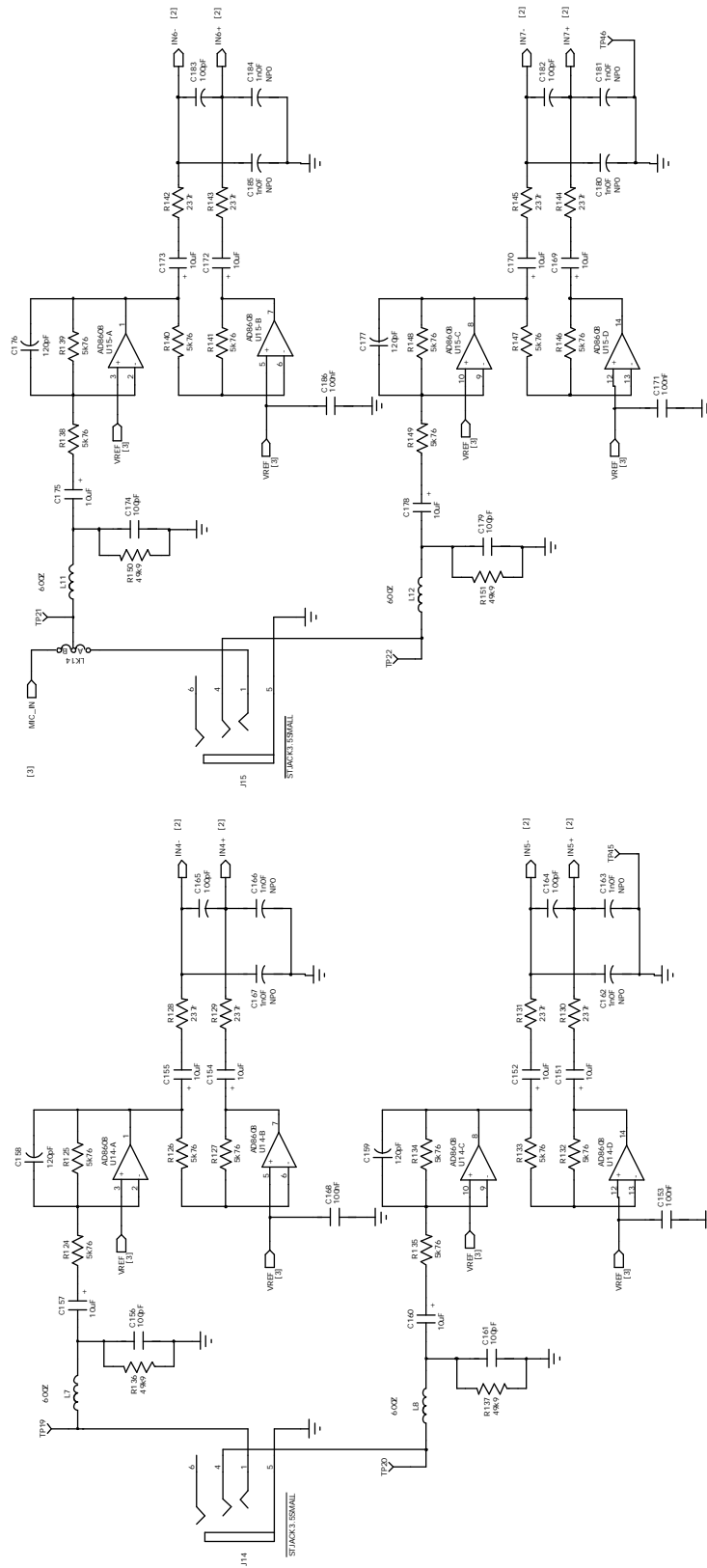


Figure 50. Audio Input 4 to Audio Input 7 Circuit Schematics

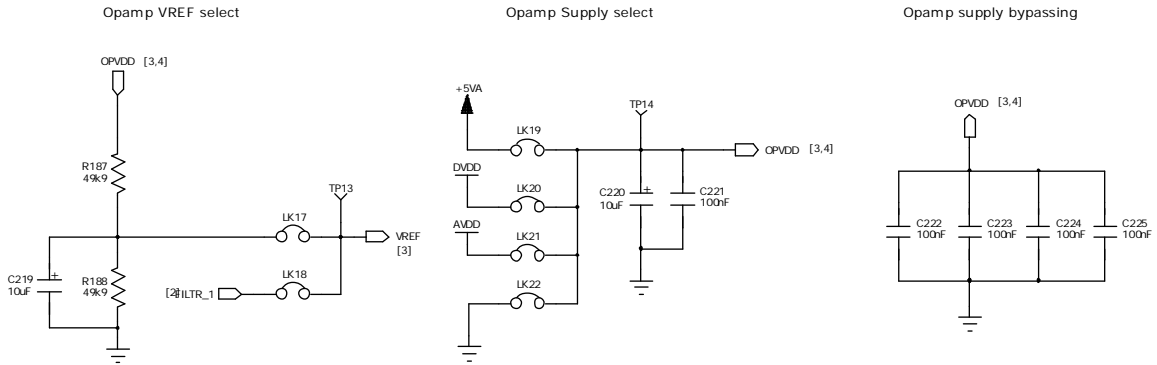


Figure 51. Audio I/O Filter Supply Circuit Schematics

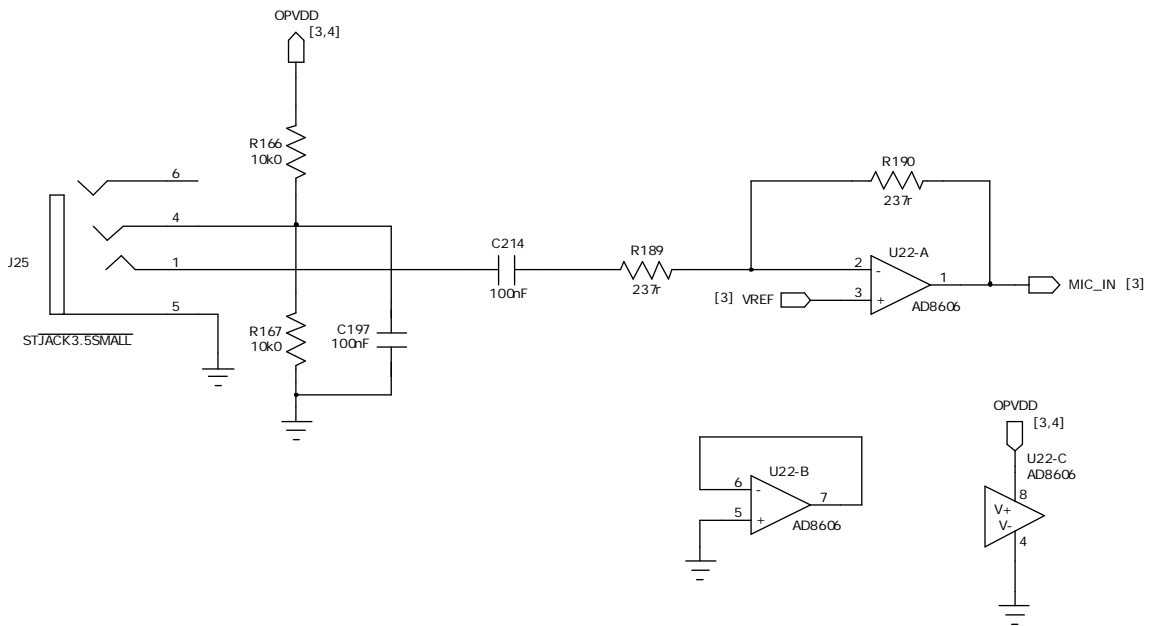


Figure 52. Microphone Input Circuit Schematic

ANALOG AUDIO OUTPUTS

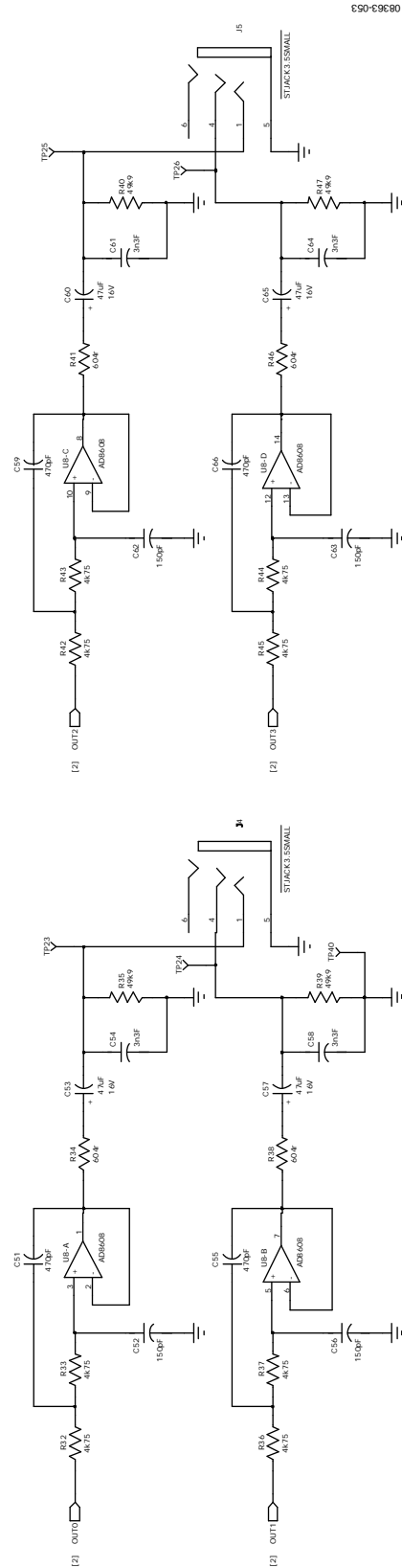
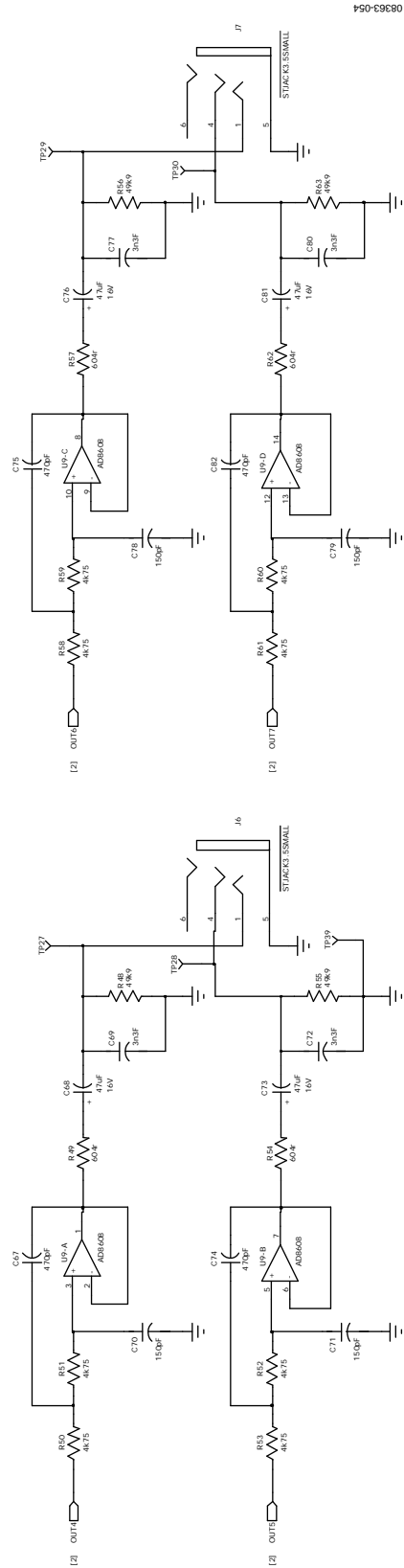


Figure 53. Audio Output 0 to Audio Output 3 Circuit Schematics



08363-054

Figure 54. Audio Output 4 to Audio Output 7 Circuit Schematics

08363-055

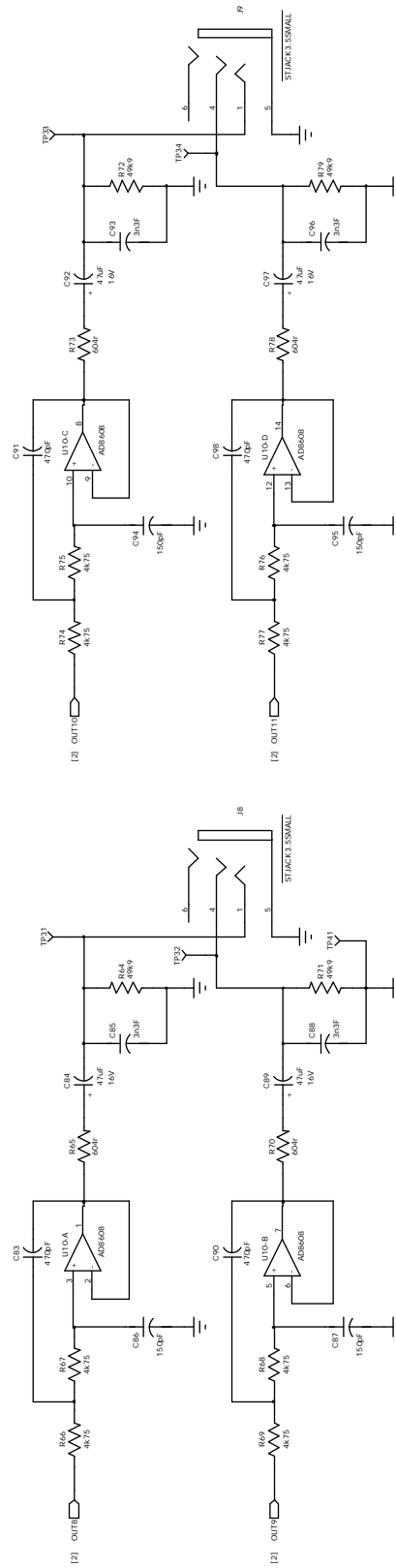


Figure 55. Audio Output 8 to Audio Output 11 Circuit Schematics

950-03680

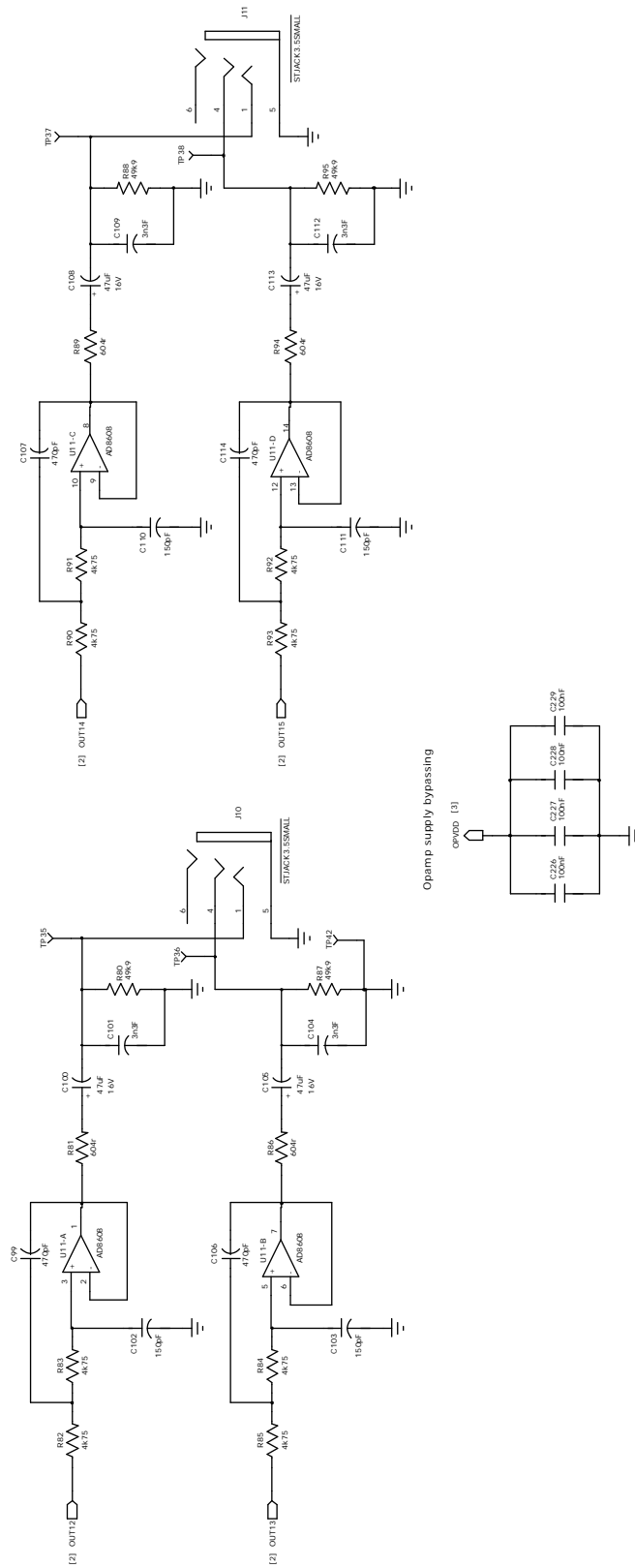


Figure 56. Audio Output 12 to Audio Output 15 Circuit Schematics

EXTERNAL CONNECTORS

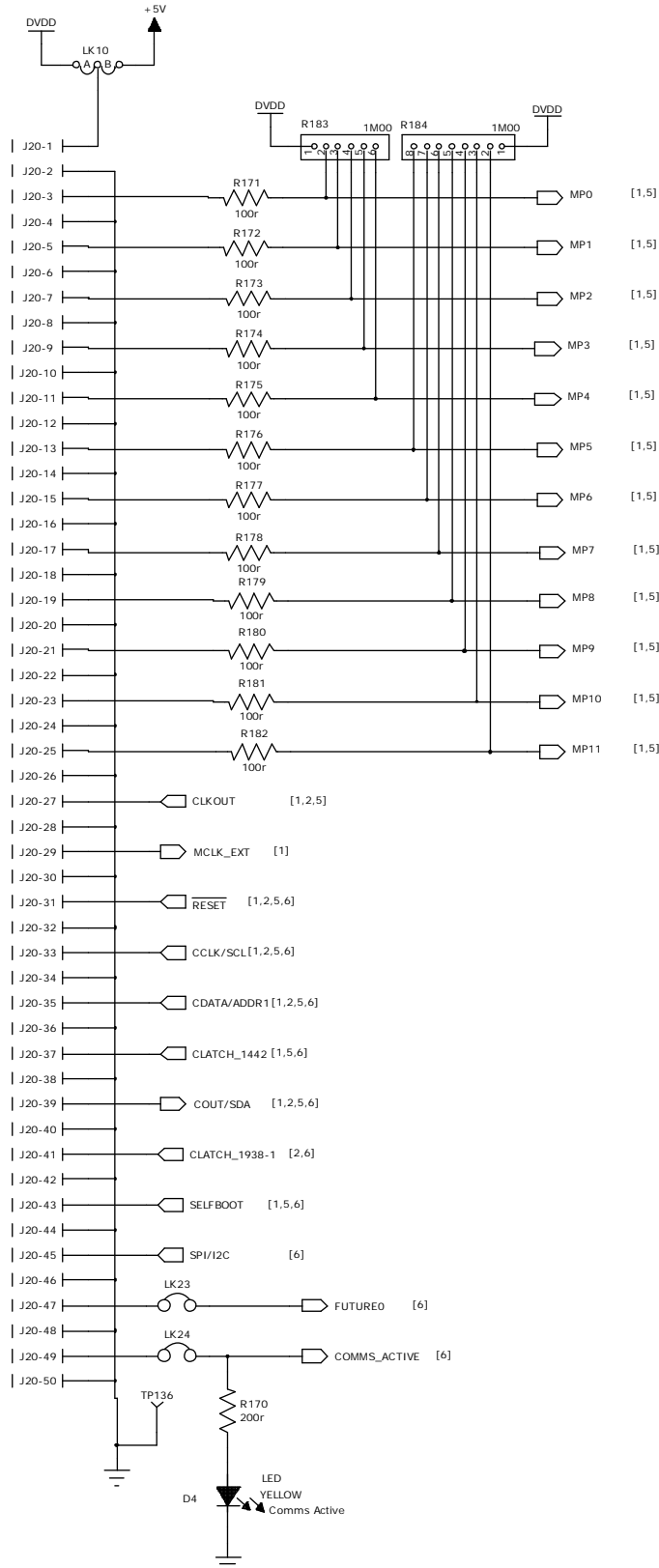


Figure 57. Multipurpose Pin Interface Schematic

08363-067

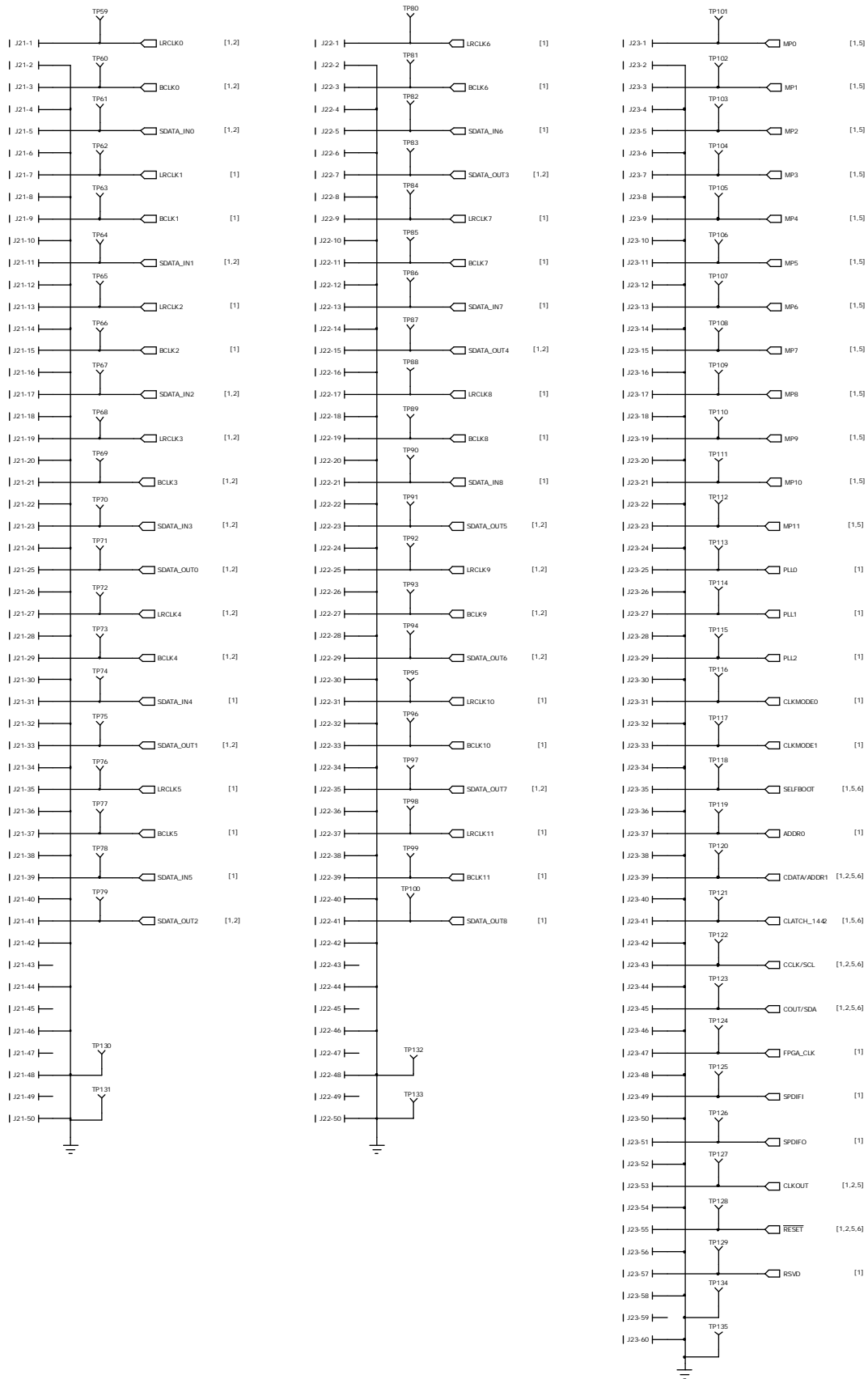


Figure 58. ADAU144x Interface Connector Schematic  
Rev. 0 | Page 35 of 44

09283-005B

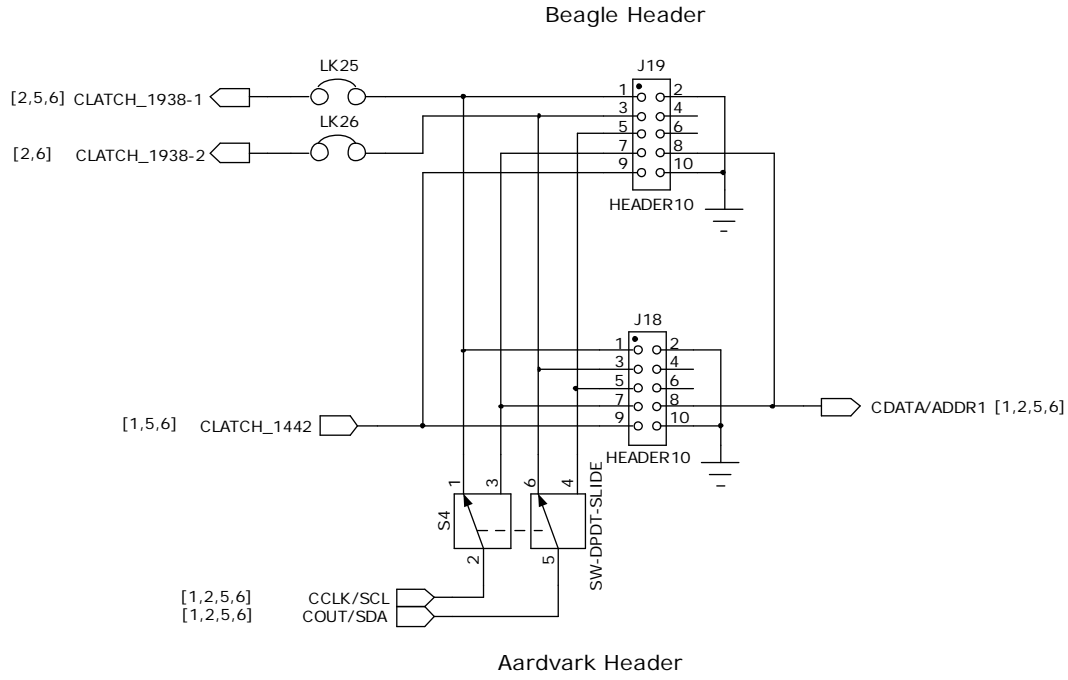


Figure 59. Aardvark and Beagle I<sup>2</sup>C and SPI Communications Headers Circuit Schematics

08383-059



RESET GENERATOR

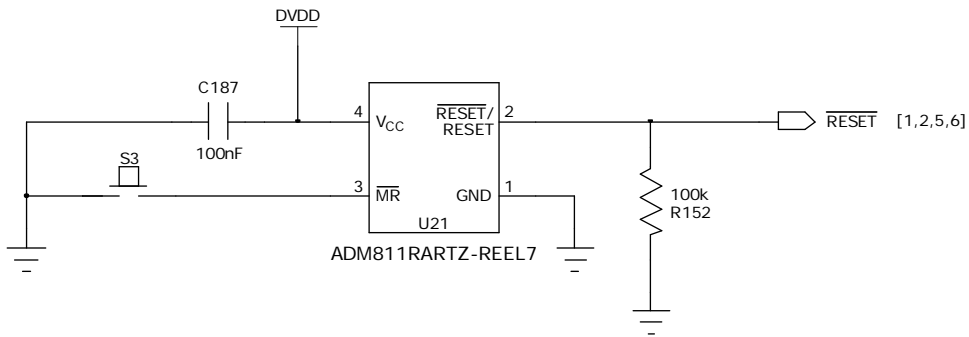


Figure 61. Reset Generator Circuit Schematic

08363-061

POWER SUPPLY

3.3 V Regulated Supplies

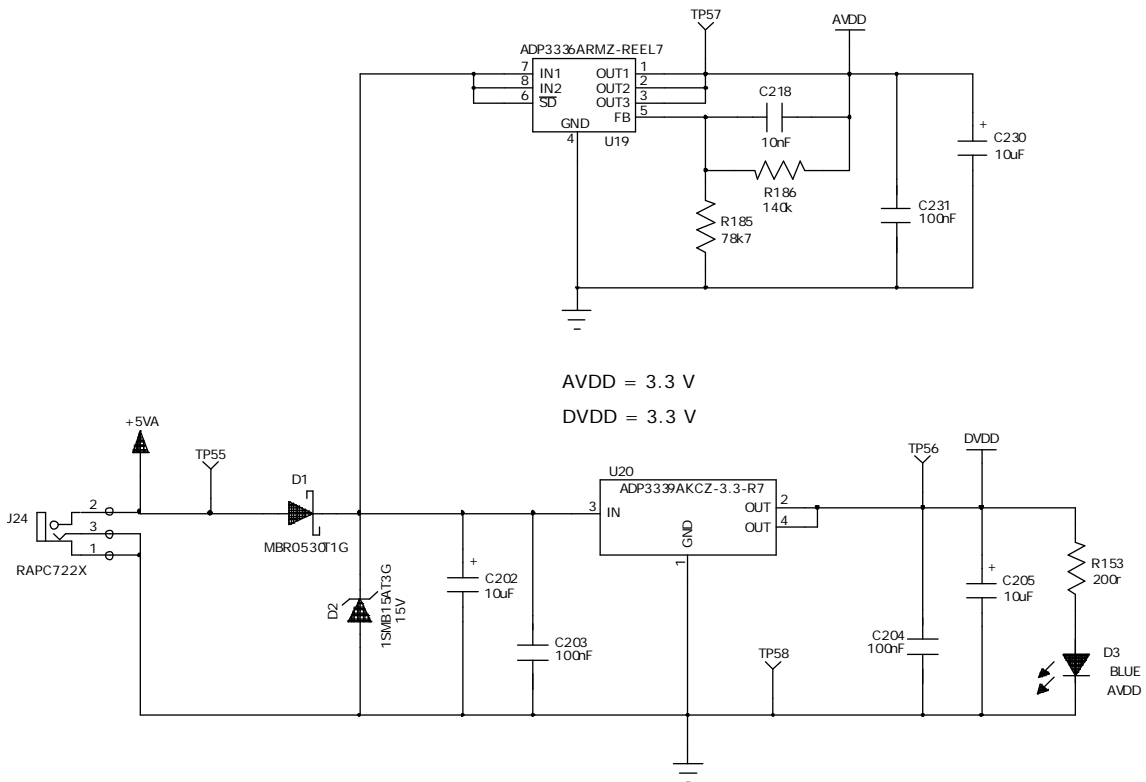


Figure 62. Voltage Regulator Circuit Schematic

08363-062

## ORDERING INFORMATION

### BILL OF MATERIALS

Table 8. Bill of Materials (BOM)

Qty.	Reference	Value	Description	Manufacturer	Part No.	Vendor	Vendor No.
66	C1 to C14, C19, C22, C25 to C29, C31, C33, C38 to C42, C44, C46, C118, C127, C135, C150, C153, C168, C171, C186 to C192, C195 to C197, C203, C204, C206, C208, C214, C216, C217, C221 to C229, C231, C232, C234	0.10 $\mu$ F	Multilayer ceramic, 50 V, X7R (0603)	Panasonic EC	ECJ-1VB1H104K	Digi-Key	PCC2398CT-ND
16	C121, C122, C130, C131, C144, C145, C148, C149, C162, C163, C166, C167, C180, C181, C184, C185	1.0 nF	Multilayer ceramic, 50 V, NP0 (0603)	Panasonic EC	ECJ-1VC1H102J	Digi-Key	PCC2151CT-ND
1	C24	1.8 nF	Multilayer ceramic, 50 V, NP0 (0603)	TDK Corporation	C1608C0G1H182J	Digi-Key	445-1296-1-ND
2	R8, R152	100 k $\Omega$	Chip resistor, 1%, 125 mW thick film (0603)	Panasonic EC	ERJ-3EKF1003V	Digi-Key	P100KHCT-ND
16	C11, C123, C124, C132, C138, C143, C146, C147, C156, C161, C164, C165, C174, C179, C182, C183	100 pF	Multilayer ceramic, 50 V, NP0 (0603)	Panasonic EC	ECJ-1VC1H101J	Digi-Key	PCC101ACVCT-ND
15	R5, R13, R23, R171 to R182	100 $\Omega$	Chip resistor, 1%, 100 mW thick film (0603)	Panasonic EC	ERJ-3EKF1000V	Digi-Key	P100HCT-ND
1	R4	107 $\Omega$	Chip resistor, 1%, 100 mW thick film (0603)	Panasonic EC	ERJ-3EKF1070V	Digi-Key	P107HCT-ND
18	R1, R18 to R21, R28 to R31, R154, R157, R158, R160, R162, R166 to R168, R191	10.0 k $\Omega$	Chip resistor, 1%, 125 mW thick film (0603)	Panasonic EC	ERJ-3EKF1002V	Digi-Key	P10.0KHCT-ND
3	C18, C215, C218	10 nF	Multilayer ceramic, 50 V, X7R (0603)	Panasonic EC	ECJ-1VB1H103K	Digi-Key	PCC1784CT-ND

Qty.	Reference	Value	Description	Manufacturer	Part No.	Vendor	Vendor No.
43	C15, C16, C30, C32, C43, C45, C116, C119, C120, C125, C128, C129, C133, C134, C136, C137, C139, C142, C151, C152, C154, C155, C157, C160, C169, C170, C172, C173, C175, C178, C200, C202, C205, C207, C209 to C213, C219, C220, C230, C233	10 $\mu$ F	Alum electrolytic capacitor FC, 105°C, SMD_B	Panasonic EC	EEE-FC1C100R	Digi-Key	PCE3995CT-ND
8	C117, C126, C140, C141, C158, C159, C176, C177	120 pF	Multilayer ceramic, 50 V, NP0 (0603)	Panasonic EC	ECJ-1VC1H121J	Digi-Key	PCC121ACVCT-ND
1	R186	140 k $\Omega$	Chip resistor, 1%, 100 mW thick film (0603)	Panasonic EC	ERJ-3EKF1403V	Digi-Key	P140KHCT-ND
16	C52, C56, C62, C63, C70, C71, C78, C79, C86, C87, C94, C95, C102, C103, C110, C111	150 pF	Multilayer ceramic, 50 V, NP0 (0603)	Panasonic EC	ECJ-1VC1H151J	Digi-Key	PCC151ACVCT-ND
1	R11	1.00 k $\Omega$	Chip resistor, 1%, 125 mW thick film (0603)	Panasonic EC	ERJ-3EKF1001V	Digi-Key	P1.00KHCT-ND
1	R6	1.50 k $\Omega$	Chip resistor, 1%, 100 mW thick film (0603)	Panasonic EC	ERJ-3EKF1501V	Digi-Key	P1.50KHCT-ND
1	D2	15 V	TVS Zener 15 V, 600 W, SMB	ON Semiconductor	1SMB15AT3G	Digi-Key	1SMB15AT3GOSCT-ND
2	R170, R153	200 $\Omega$	Chip resistor, 1%, 100 mW thick film (08603)	Panasonic EC	ERJ-3EKF2000V	Digi-Key	P200HCT-ND
10	C20, C21, C36, C37, C49, C50, C193, C194, C198, C199	22 pF	Multilayer ceramic, 50 V, NP0 (0603)	Panasonic EC	ECJ-1VC1H220J	Digi-Key	PCC220ACVCT-ND
18	R101, R102, R108, R109, R114 to R117, R128 to R131, R142 to R145, R189, R190	237 $\Omega$	Chip resistor, 1%, 125 mW thick film (0603)	Panasonic EC	ERJ-3EKF2370V	Digi-Key	P237HCT-ND
1	R3	243 $\Omega$	Chip resistor, 1%, 100 mW thick film (0603)	Panasonic EC	ERJ-3EKF2430V	Digi-Key	P243HCT-ND
1	U2		256 kb <sup>1</sup> C CMOS serial EEPROM	Microchip	24AA256-I/ST	Digi-Key	24AA256-I/ST-ND
2	R155, R156	28.0 $\Omega$	Chip resistor, 1%, 125 mW thick film (0603)	Panasonic EC	ERJ-3EKF28R0V	Digi-Key	P28.0HCT-ND
5	R159, R163 to R165, R169	2.00 k $\Omega$	Chip resistor, 1%, 100 mW thick film (0603)	Panasonic EC	ERJ-3EKF2001V	Digi-Key	P2.00KHCT-ND

Qty.	Reference	Value	Description	Manufacturer	Part No.	Vendor	Vendor No.
16	C54, C58, C61, C64, C69, C72, C77, C80, C85, C88, C93, C96, C101, C104, C109, C112	3.3 nF	Multilayer ceramic, 50 V, X7R (0603)	Panasonic EC	ECJ-1VB1H332K	Digi-Key	PCC1778CT-ND
1	C23	33 nF	Multilayer ceramic, 50 V, X7R (0603)	Panasonic EC	ECJ-1VB1H333K	Digi-Key	PCC2284CT-ND
2	C35, C48	390 pF	Multilayer ceramic, 50 V, NP0 (0603)	Panasonic EC	ECJ-1VC1H391J	Digi-Key	PCC391ACVCT-ND
16	C51, C55, C59, C66, C67, C74, C75, C82, C83, C90, C91, C98, C99, C106, C107, C114	470 pF	Multilayer ceramic, 50 V, NP0 (0603)	Panasonic EC	ECJ-1VC1H471J	Digi-Key	PCC2147CT-ND
1	R161	475 Ω	Chip resistor, 1%, 125 mW thick film (0603)	Panasonic EC	ERJ-3EKF4750V	Digi-Key	P475HCT-ND
16	C53, C57, C60, C65, C68, C73, C76, C81, C84, C89, C92, C97, C100, C105, C108, C113	47 μF	Alum electrolytic capacitor, FC, 105°C, SMD_D	Panasonic EC	EEE-FC1C470P	Digi-Key	PCE4000CT-ND
22	R35, R39, R40, R47, R48, R55, R56, R63, R64, R71, R72, R79, R80, R87, R88, R95, R136, R137, R150, R151, R187, R188	49.9 kΩ	Chip resistor, 1%, 100 mW thick film (0603)	Panasonic EC	ERJ-3EKF4992V	Digi-Key	P49.9KHCT-ND
32	R32, R33, R36, R37, R42 to R45, R50 to R53, R58 to R61, R66 to R69, R74 to R77, R82 to R85, R90 to R93	4.75 kΩ	Chip resistor, 1%, 100 mW thick film (0603)	Panasonic EC	ERJ-3EKF4751V	Digi-Key	P4.75KHCT-ND
2	C34, C47	5.6 nF	Multilayer ceramic, 50 V, X7R (0603)	Panasonic EC	ECJ-1VB1H562K	Digi-Key	PCC1781CT-ND
2	R12, R22	562 Ω	Chip resistor, 1%, 125 mW thick film (0603)	Panasonic EC	ERJ-3EKF5620V	Digi-Key	P562HCT-ND
16	R124 to R127, R132 to R135, R138 to R141, R146 to R149	5.76 kΩ	Chip resistor, 1%, 125 mW thick film (0603)	Panasonic EC	ERJ-3EKF5761V	Digi-Key	P5.76KHCT-ND
16	R34, R38, R41, R46, R49, R54, R57, R62, R65, R70, R73, R78, R81, R86, R89, R94	604 Ω	Chip resistor, 1%, 100 mW thick film (0603)	Panasonic EC	ERJ-3EKF6040V	Digi-Key	P604HCT-ND
1	R2	75.0 Ω	Chip resistor, 1%, 100 mW thick film (0603)	Panasonic EC	ERJ-3EKF75R0V	Digi-Key	P75.0HCT-ND
1	R185	78.7 kΩ	Chip resistor, 1%, 100 mW thick film (0603)	Panasonic EC	ERJ-3EKF7872V	Digi-Key	P78.7KHCT-ND
2	U3, U4	AD1938YSTZ	Four-ADC, eight-DAC with PLL, 192 kHz, 24-bit CODEC	Analog Devices, Inc.	AD1938YSTZ	Analog Devices	AD1938YSTZ

Qty.	Reference	Value	Description	Manufacturer	Part No.	Vendor	Vendor No.
1	U22		Low noise rail-to-rail CMOS op amp	Analog Devices	AD8606ARZ	Analog Devices	AD8606ARZ
8	U8 to U15		Low noise rail-to-rail CMOS op amp	Analog Devices	AD8608ARZ	Analog Devices	AD8608ARZ
1	U1		SigmaDSP	Analog Devices	ADAU144x	Analog Devices	ADAU144x
1	U21		Microprocessor voltage supervisor, logic low reset output	Analog Devices	ADM811RARTZ-REEL7	Analog Devices	ADM811RARTZ-REEL7
1	U19		Adjustable low dropout voltage regulator	Analog Devices	ADP3336ARMZ-REEL7	Analog Devices	ADP3336ARMZ-REEL7
1	U20		High accuracy, low dropout, 3.3 V dc voltage regulator	Analog Devices	ADP3339AKCZ-3.3-R7	Analog Devices	ADP3339AKCZ-3.3-R7
1	U18	1 kb (128 × 8 bits or 64 × 16 bits)	Serial EEPROM, 1 kb, 2.7 V	Atmel	AT93C46-10SU-2.7	Digi-Key	AT93C46-10SU-2.7-ND
1	C17	Open	Do not stuff	N/A <sup>1</sup>	N/A <sup>1</sup>	N/A <sup>1</sup>	N/A <sup>1</sup>
1	J3		SMA receptacle straight PCB mount	Amp-RF Division	901-144-8RFX	Digi-Key	ARFX1231-ND
1	S4	DPDT slide	DPDT slide switch vertical	E-Switch	EG2207	Digi-Key	EG1940-ND
3	L1 to L3		Chip ferrite bead, 600 Ω @ 100 MHz	Steward	HZ0805E601R-10	Digi-Key	240-2399-1-ND
1	U16		USB to parallel FIFO interface	FTDI	FT245BL	Mouser Electronics	895-FT245BL
1	Q1	TRANS PNP, BIPO 3 A, 40 V, SOT-223	PNP Darlington transistor	ON Semiconductor	NJT4030PT3G	Digi-Key	NJT4030PT3GOSCT-ND
1	Y5	10.000 MHz	Crystal 10.000 MHz, SMT, 18 pF	Citizen America Corp	HCM49-10.000MABJ-UT	Digi-Key	300-8543-1-ND
3	Y1 to Y3	12.288 MHz	Crystal 12.288 MHz, SMT, 18 pF	Citizen America Corp	HCM49-12.288MABJ-UT	Digi-Key	300-8550-1-ND
1	Y4	6.000 MHz	Crystal 6.000 MHz, SMT, 18 pF	Citizen America Corp	HCM49-6.000MABJ-UT	Digi-Key	300-8535-1-ND
2	J18, J19	2 × 5	10-way shroud polarized header	3M	N2510-6002RB	Digi-Key	MHC10K-ND
2	J21, J22	50-pin (2 rows × 25 columns)	50-pin header unshrouded, 0.10" dual row	Sullins Electronics Corp	PBC25DAAN	Digi-Key	S2011E-25-ND
1	J16	1 × 5	5-way unshrouded header single row	Sullins Electronics Corp	PBC05SAAN; also cut PBC36SAAN	Digi-Key	S1011E-05-ND
1	J23	60-pin (2 rows × 30 columns)	60-pin header unshrouded, 0.10" dual row	Sullins Electronics Corp	PBC30DAAN	Digi-Key	S2011E-30-ND
21	LK1 to LK5, LK11 to LK13, LK15 to LK26, LK28		2-pin header unshrouded jumper, 0.10"; use shunt Tyco 881545-2	Sullins Electronics Corp	PBC02SAAN; or cut PBC36SAAN	Digi-Key	S1011E-02-ND
7	LK6 to LK10, LK14, LK27		3-position SIP header	Sullins	PBC03SAAN; or cut PBC36SAAN	Digi-Key	S1011E-03-ND
1	D3	Blue clear	Blue clear, 25 millicandela, 470 nm (1206)	Lumex Opto	SML-LX1206USBC-TR	Digi-Key	67-1701-1-ND
1	D4	Yellow diffused	Yellow clear, 6.0 millicandela, 585 nm (1206)	Lumex Opto	SML-LX1206YC-TR	Digi-Key	67-1358-1-ND
1	D1	Schottky	Schottky 30 V, 0.5 A, SOD123 diode	On Semiconductor	MBR0530T1G	Digi-Key	MBR0530T1GOSCT-ND
1	U17	8 kb × 14	MCU Flash 4 MHz, 8 kb × 14 TQFP44	Microchip Technology	PIC16LF877-04/PT	Digi-Key	PIC16LF877-04/PT-ND
13	J4 to J15, J25		Stereo mini jack, TH	CUI, Inc.	SJ-43514	Digi-Key	CP-43514-ND
1	Q2		NPN general-purpose transistor	ON Semiconductor	MMBT3904LT1G	Digi-Key	MMBT3904LT1GOSCT-ND
1	R183	1.00 MΩ	Resistor network bussed seven resistors	Bourns, Inc.	4606X-101-105LF	Digi-Key	4606X-1-105LF-ND

Qty.	Reference	Value	Description	Manufacturer	Part No.	Vendor	Vendor No.
1	R10	10.0 $\Omega$	Resistor network bussed seven resistors	Bourns, Inc.	4608X-101-103LF	Digi-Key	4608X-1-103LF-ND
1	R184	1.00 M $\Omega$	Resistor network bussed seven resistors	Bourns, Inc.	4608X-101-105LF	Digi-Key	4608X-1-105LF-ND
10	R7, R9, R14 to R17, R24 to R27	Open	Do not stuff				
1	J20 <sup>2</sup>	50-pin	50-pin plug right angle DIN dual row	Hirose Electronic Co., Ltd	PCN10-50P-2.54DS(72)	Digi-Key	H11159-ND
2	J1, J2		RCA jack PCB TH mount right angle orange	Connect-Tech Products Corp.	CTP-021A-S-ORANGE	Connect- Tech Products Corp.	CTP-021A-S-ORANGE
1	J24		Mini power jack, 0.08" right angle through hole	Switchcraft, Inc.	RAPC722X	Digi-Key	SC1313-ND
1	U7		110 $\Omega$ AES/EBU transformer	Scientific Conversion, Inc.	SC937-02	Scientific Conversion	SC937-02
1	S1	SPDT	SPDT slide switch PC mount	E-Switch	EG1218	Digi-Key	EG1903-ND
2	S6, S7	10-position	10-position tape seal DIP switch	CTS Corp	219-10LPST	Digi-Key	CT21910LPST-ND
1	S2	8 $\times$ SPST	eight-section SPST SMD switch raised act	CTS Corp	219-8LPST	Digi-Key	CT2198LPST-ND
1	S3	SPST-NO	Tact switch 6 mm gull wing	Tyco/Alcoswitch	FSM6JSMA	Digi-Key	450-1133-ND
1	U6	15 Mbps	15 Mbps fiber optic receiving module with shutter	Toshiba	TORX147L(F,T)	Digi-Key	TORX147LFT-ND
1	U5		15 Mbps optical transmitter	Toshiba	TOTX141P(F,T)	Digi-Key	TOTX141PFT-ND
1	J17		USB 4-pin B-type receptacle	Tyco Electronics/AMP	292304-1	Mouser Electronics	571-292304-1
1	LK29	12.288 MHz oscillator	ASEP series oscillator	Abracon	ASEP3JL-ND	Digi-Key	ASEP3JL-ND
1	R192	49.9 $\Omega$	Chip resistor, 1%, 100 mW thick film (0603)	Panasonic EC	ERJ-3EKF49R9V	Digi-Key	P49.9HCT-ND
4	6-32 thread size $\times$ 1/4" screw					Digi-Key	H554-ND
4	6-32 thread size $\times$ 1/4" standoff					Digi-Key	1903CK-ND
17	Shunt		Shunt LP	Tyco	881545-2	Digi-Key	A26242-ND

<sup>1</sup> N/A means not applicable.

<sup>2</sup> Install in top of board backwards.

## ESD CAUTION



### ESD (electrostatic discharge) sensitive device.

Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

## NOTES

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