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Evaluating the AD1940 SigmaDSP Using the EVAL-AD1940MINIBZ

PACKAGE CONTENTS

AD1940 mini evaluation board
EVAL-ADUSB2EBZ (USBi) communications adapter
USB cable with mini-B plug
Evaluation board/software quick start guide

OTHER SUPPORTING DOCUMENTATION

AD1940/AD1941 data sheet
AD1938 data sheet
AN-1006 Application Note, *Using the EVAL-ADUSB2EBZ*

EVALUATION BOARD OVERVIEW

This document explains the design and setup of the AD1940 SigmaDSP® miniature evaluation board.

This evaluation board provides a simple analog input and output setup for the AD1940. The SigmaDSP is controlled by the Analog Devices, Inc., SigmaStudio™ software, which interfaces to the board via a USB connection. This evaluation board may be powered either over the USB or by a single 3.8 V to 6 V supply, which is regulated to the voltages required on the board. The PC board is a 3" × 3" 4-layer design, with a single ground plane and a single power plane on the inner layers. The AD1938 codec handles all signal conversion between the analog and digital domains.

Use the AD1940 evaluation board for AD1941 evaluation also. There is no dedicated AD1941 evaluation board.

EVALUATION BOARD PHOTOGRAPHS

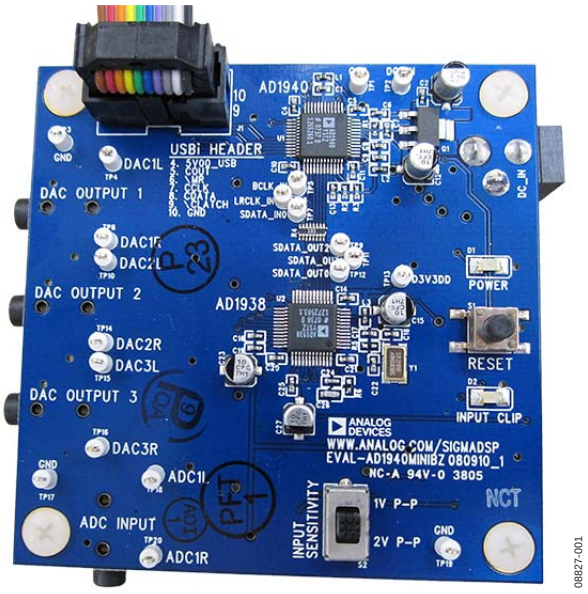

Figure 1. Evaluation Board Top Side

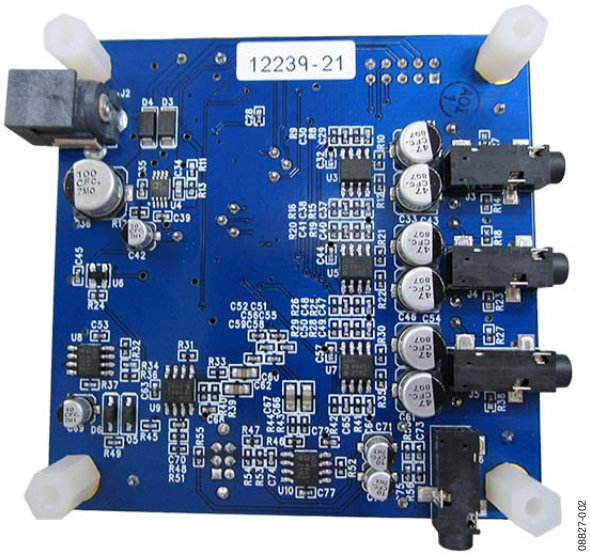

Figure 2. Evaluation Board Bottom Side

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REVISION HISTORY

7/10—Revision 0: Initial Version

FUNCTIONAL BLOCK DIAGRAMS

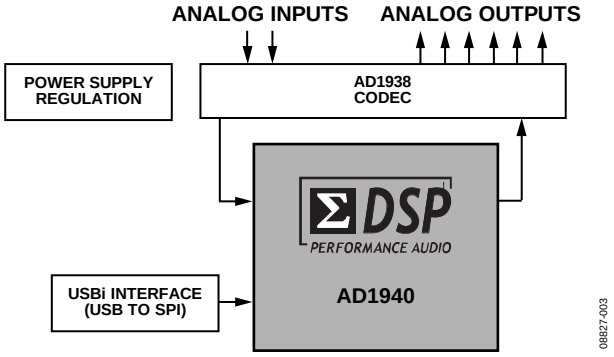

Figure 3. Functional Block Diagram

BOARD LAYOUT BLOCK DIAGRAMS

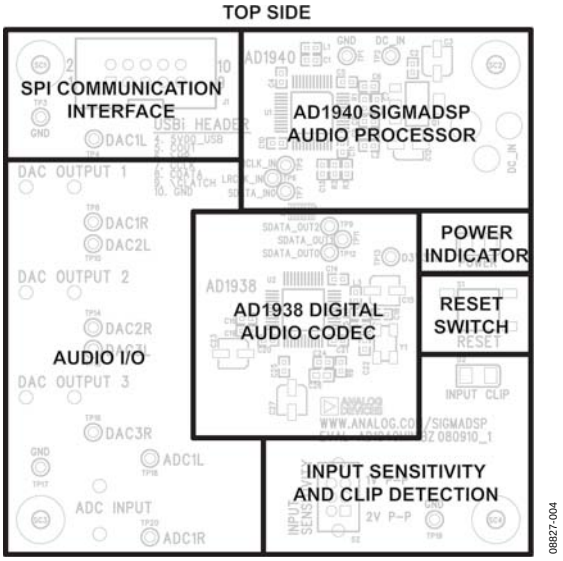

Figure 4. Board Layout Block Diagram (Top Side)

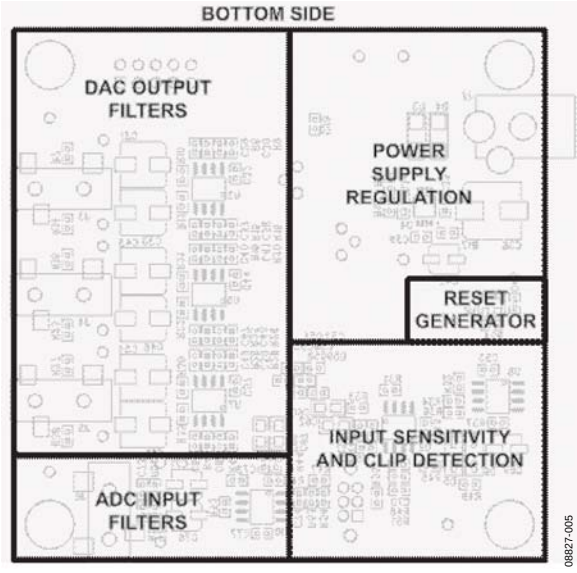

Figure 5. Board Layout Block Diagram (Bottom Side)

SETTING UP THE EVALUATION BOARD

INSTALLING THE SigmaStudio SOFTWARE

Download the latest version of SigmaStudio online at: http://www.analog.com/sigmastudiodownload.

To install, use the following steps:

1. Open the downloaded installer file and extract the files to your PC.
2. Install the Microsoft® .net Framework, if not already installed.
3. Install SigmaStudio by double-clicking **setup.exe**, and following the prompts.

INSTALLING THE USBi DRIVERS

1. SigmaStudio must be installed to use the USBi. Once SigmaStudio has been properly installed, connect the USBi to an available USB port with the included USB cable. At this point, Windows® Vista recognizes the device and prompts the user to install drivers.

Figure 6. Found New Hardware Notification

2. Select the **Install from a list or specific location (Advanced)** option and click **Next** (see Figure 7).

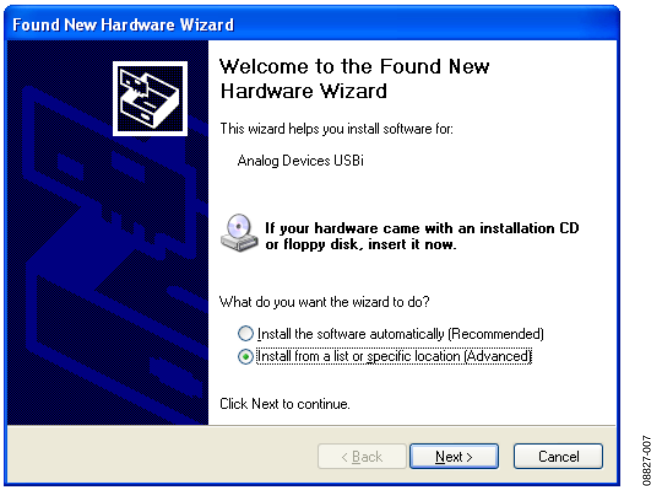

Figure 7. Found New Hardware Wizard—Installation

3. Click **Search for the best driver in these locations**, then select **Include this location in the search**. Click **Browse** to find the SigmaStudio 3.0\USB drivers directory (see Figure 8).

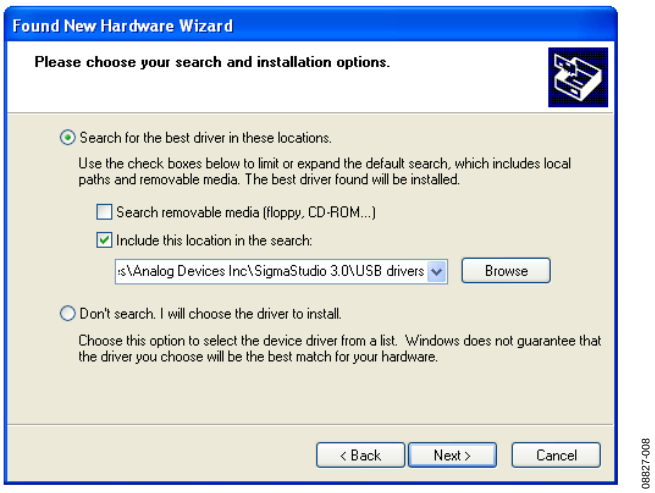

Figure 8. Windows Found New Hardware Wizard—Search and Installation Options

4. When the warning about Windows Logo testing appears on the screen, click **Continue Anyway** (see Figure 9).

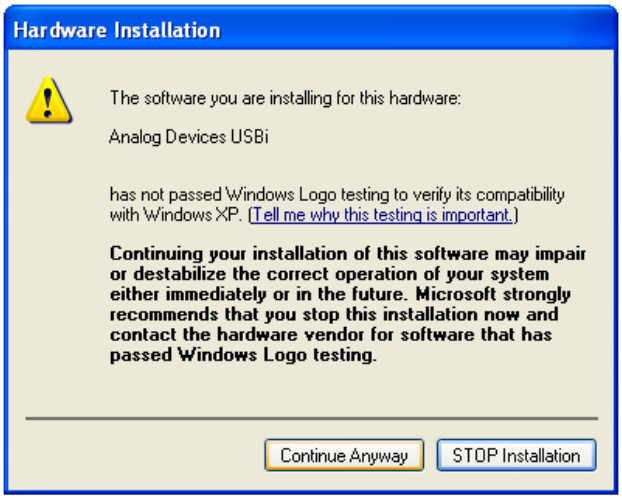

Figure 9. Windows Logo Testing Warning

The USBi drivers should now be successfully installed. Leave the USBi connected to the PC.

CONFIGURING THE DEFAULT SWITCH AND JUMPER SETTINGS

The board is hardwired in a stereo analog input, six channel analog output configuration that cannot be modified. No jumpers exist on this board, but there is one configuration switch, S2. The setting of S2 determines the input gain of the ADC preamp. The switch can be configured in 1 V p-p or 2 V p-p mode to match the input audio source.

POWERING UP THE BOARD

To power up the board, connect the USBi's ribbon cable to the EVAL-AD1940MINIBZ's communications header, J1.

CONNECTING THE AUDIO CABLES

1. Connect a stereo audio source to J6 (ADC input).
2. Connect headphones or powered speakers to J3 (DAC Output 1). The labels for J6 and J3 are only visible on the bottom of the board.

SETTING UP COMMUNICATIONS IN SigmaStudio

1. Start SigmaStudio by double-clicking the shortcut on the desktop.
2. Click **File** > **New Project** or press **Ctrl+N** to create a new project. The default view of the new project is called the **Hardware Configuration** tab.
3. To use the USBi in conjunction with SigmaStudio, first select it in the **Communication Channels** subsection of the toolbox on the left side of the **Hardware Configuration** tab (see Figure 10). Add it to the project space by clicking and dragging it to the right.

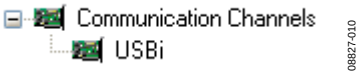

Figure 10. Adding the USBi Communication Channel

If SigmaStudio cannot detect the USBi on the USB port of the computer, then the background of the **USB** label displays red (see Figure 11). This may happen when the USBi is not connected or when the drivers are incorrectly installed.

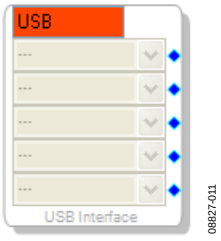

Figure 11. USBi Not Detected by SigmaStudio

If SigmaStudio detects the USBi on the USB port of the computer, the background of the **USB** label changes to orange (see Figure 12).

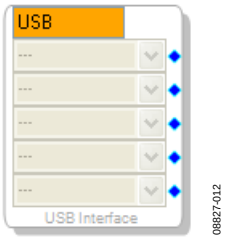

Figure 12. USBi Detected by SigmaStudio

4. To add an AD1940 to the project, select it from the **Processors (ICs / DSPs)** list and drag it to the project space (see Figure 13).

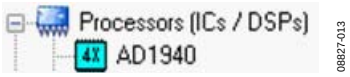

Figure 13. Adding an AD1940

5. To use the USBi to communicate with the target IC, connect it by dragging a wire between the blue pin of the **USB Interface cell** and the green pin of the IC. The corresponding drop-down box of the USBi automatically fills with the default mode and channel for that IC.

Figure 14. Connecting the USBi to an AD940 IC

CREATING A BASIC SIGNAL FLOW

To create a basic signal flow, use the following steps:

1. To access the **Schematic** tab, where a signal processing flow can be created, click the **Schematic** tab at the top of the screen (see Figure 15).

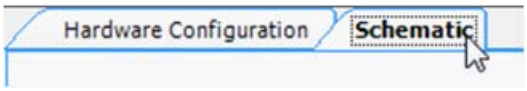

Figure 15. Schematic Tab

2. The left side of the schematic view houses the **Tree Toolbox**, which contains all of the algorithms that can run in the SigmaDSP. Navigate to the **IO** > **Input** folder and select an **Input** cell.

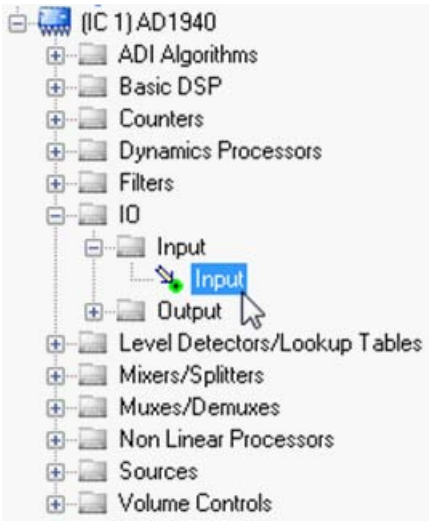

Figure 16. Input Cell Selection

3. Click and drag the input cell into the blank schematic space to the right of the toolbox (see Figure 17).

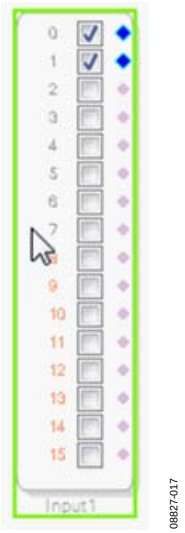

Figure 17. Input Cell

4. In the **Tree Toolbox**, navigate to the **IO** > **Output** folder and select an **Output** cell (see Figure 18).

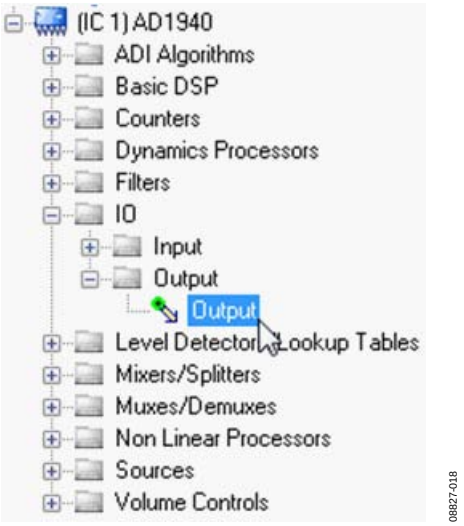

Figure 18. Output Cell Selection

5. Click and drag an output cell to the schematic. Repeat so there will be two outputs (see Figure 19).

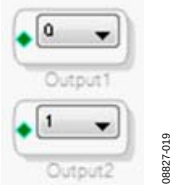

Figure 19. Output Cells

6. In the **Tree Toolbox**, navigate to the **Volume Controls** > **Adjustable Gain** > **Single/Multiple Controls** > **Clickless (RC Type) HW Slew** folder and select a **Single Volume Control** cell (see Figure 20).

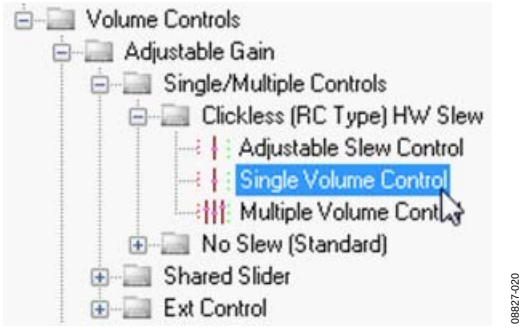

Figure 20. Volume Control Cell Selection

7. Click and drag the **Single Volume Control** cell to the schematic.

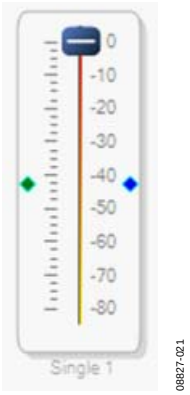

Figure 21. Volume Control Cell

8. By default, this cell only has one input channel and one output channel, as indicated by the green input and blue output dots. To add a channel, right click in the blank white part of the cell and select **Add Algorithm > IC 1 > Gain (slew)** from the menu (see Figure 22).

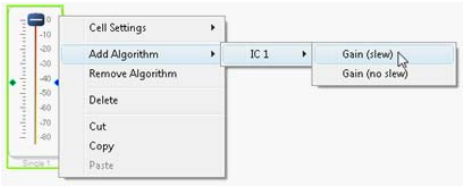

Figure 22. Adding a Channel to the Volume Control

The cell should now have two inputs and two outputs (see Figure 23).

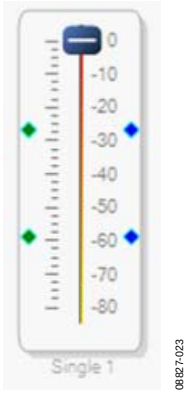

Figure 23. Stereo Volume Control Cell

9. Navigate to the **Filters** > **Second Order** > **Single Precision** > **2 Ch** folder and select a **Medium Size Eq** cell (see Figure 24).

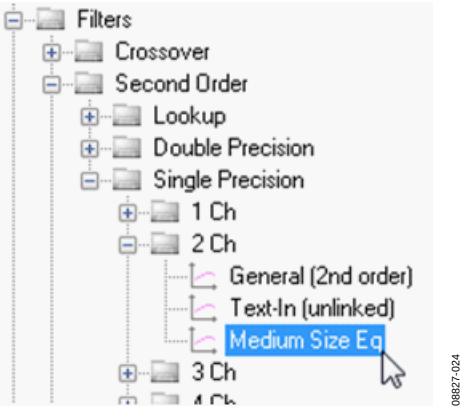

Figure 24. EQ Cell Selection

10. Click and drag the cell to the schematic (see Figure 25).

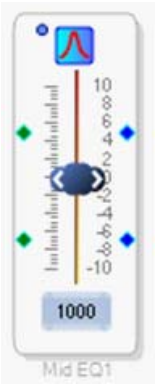

Figure 25. Single-Band Stereo EQ Cell

11. By default, the EQ only has one band. To increase the number of bands, right click in the blank white part of the cell and select **Grow Algorithm** > **1. 2 Channel – Single Precision** > **4** to increase the EQ to 5 bands (see Figure 26).

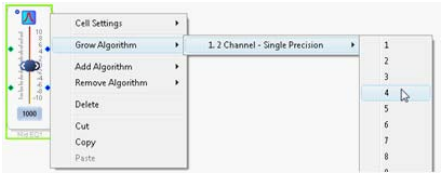

Figure 26. Growing the EQ Cell

The EQ should now have five bands (see Figure 27).

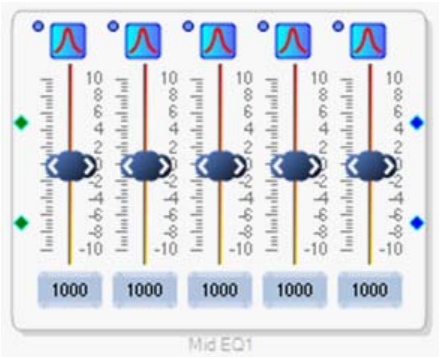

Figure 27. Five-Band Stereo EQ Cell

12. To change the properties of a filter, click once on its corresponding blue filter icon (see Figure 28).

Figure 28. Filter Properties Button

13. Configure each filter as required. As an example, Figure 29 shows a low shelf at 50 Hz, peaking filters at 200 Hz, 500 Hz, and 2000 Hz, and a high shelf at 10 kHz.

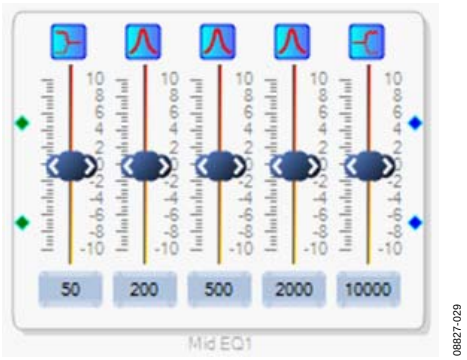

Figure 29. Configured 5-Band EQ Cell

14. Connect the cells together by left clicking a blue output dot and dragging to the green output dot of the next cell. Continue until the signal flow is completed from input to output for each channel.

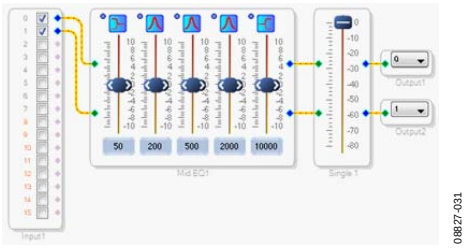

Figure 30. Completed Signal Flow

The basic signal flow is now complete with stereo I/O, a five-band equalizer, and a clickless volume control (see Figure 30).

DOWNLOADING THE PROGRAM TO THE DSP

To compile and download the code to the DSP, click once on the **Link-Compile-Download** button in SigmaStudio's main toolbar (Figure 31). Alternatively, press the **F7** key.

Figure 31. Link-Compile-Download Button

The signal flow should now be running on the evaluation board, and audio should pass from input to output. The controls for filters and volume can be changed in real-time by clicking and dragging them with the mouse.

USING THE EVALUATION BOARD

POWER

Power can be supplied either via the USB bus by connecting the EVAL-ADUSB2EBZ (USBi) to Header J1 or by a tip-positive 3.8 V to 6 V dc power supply on Connector J2. The on-board regulator generates the 3.3 V dc supply for the on-board circuitry. LED D1 lights up when power is supplied to the board.

INPUTS AND OUTPUTS

The board is configured in an analog input-analog output mode. There are two ADC inputs and 6 DAC outputs, each accessible by standard stereo TRS 1/8" mini jacks.

The input and output filters are active, and the outputs can drive passive headphones or active speakers.

The input sensitivity switch sets the preamp gain, and it can be configured as required for various audio input levels. The two gain settings are 1 V rms and 2 V rms.

The input clip LED, D2, lights up when an input signal is close to the full-scale input level of the AD1938.

AD1938 AUDIO CODEC

The audio codec operates in standalone I²S mode. Its serial ports are configured in master mode, so the serial ports of the AD1940 should be configured as slaves.

The audio codec generates a master clock with its on-board oscillator and the 12.288 MHz crystal resonator, Y1. It sends master clock, frame clock, and bit clock signals to the AD1940.

AD1940 SigmaDSP

The AD1940 receives one I²S stream from the AD1938's ADCs and sends three I²S streams to the AD1938's DACs. The registers of the AD1940 and its signal processing flow can be configured in SigmaStudio.

COMMUNICATIONS HEADER

The communications header, J1, connects to the EVAL-ADUSB2EBZ, also called the USBi. More information about the USBi can be found in the AN-1006 Application Note.

The AD1940 uses the SPI communication protocol. The communication port of the AD1938 is not accessible on this evaluation board.

RESET

The reset switch, S1, initiates a reset signal, which is generated by the ADM811. This in turn resets the AD1940 and AD1938. A reset event causes the AD1940 to lose its register settings and RAM contents.

EVALUATION BOARD SCHEMATICS AND ARTWORK

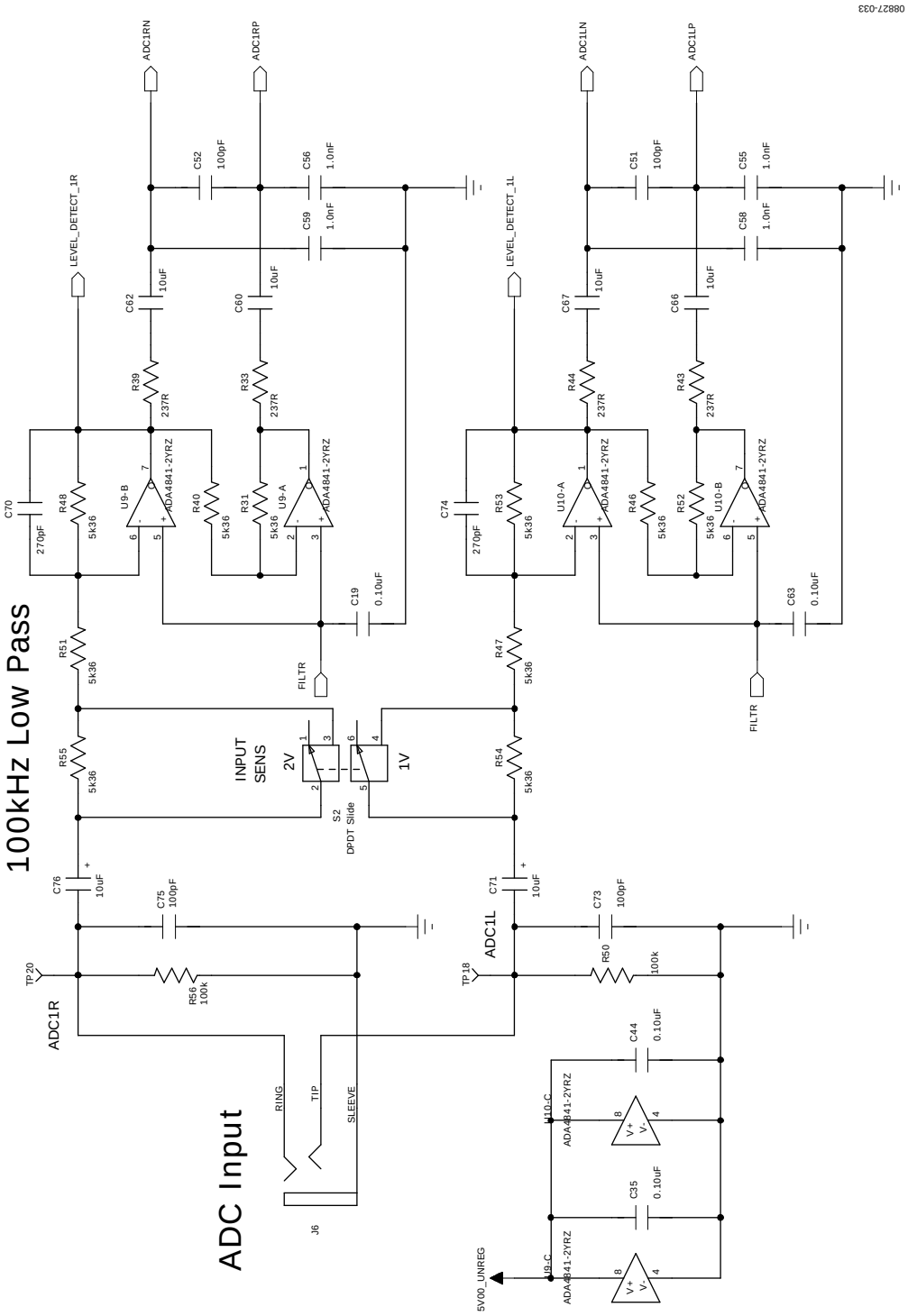

Figure 32. Board Schematics, Page 1—ADC Inputs

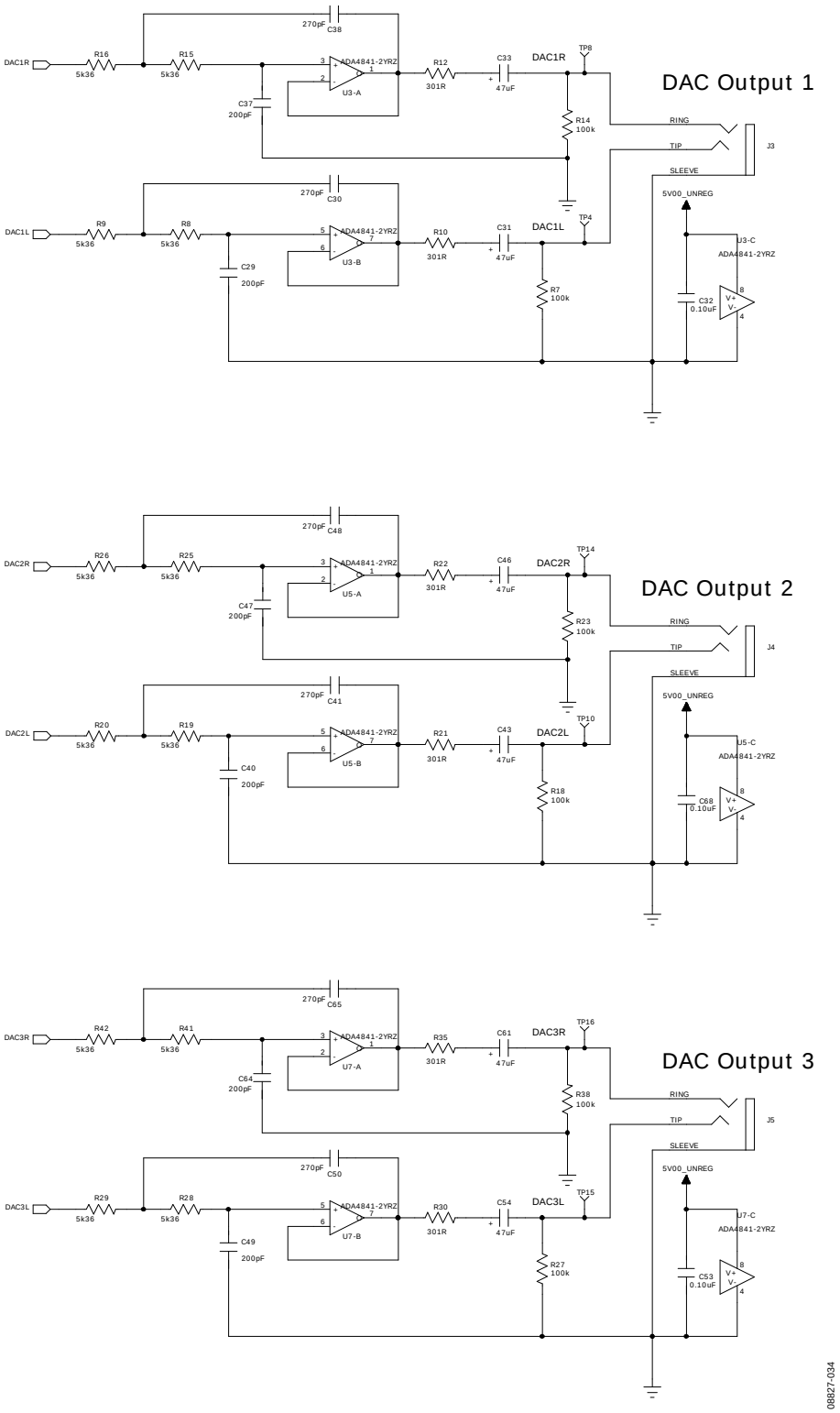

Figure 33. Board Schematics, Page 2—DAC Outputs

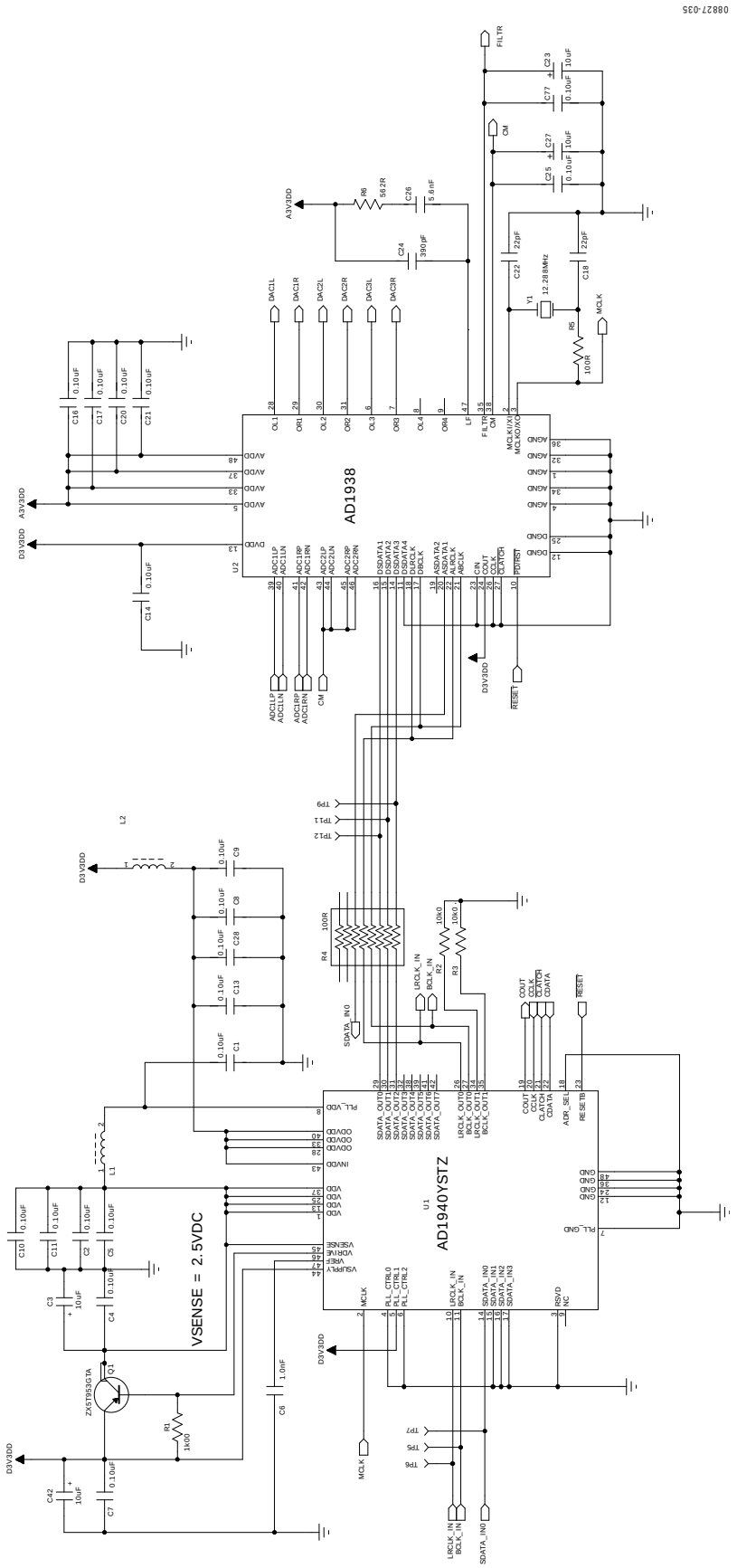

Figure 34. Board Schematics, Page 3—SigmaDSP and Audio Codec

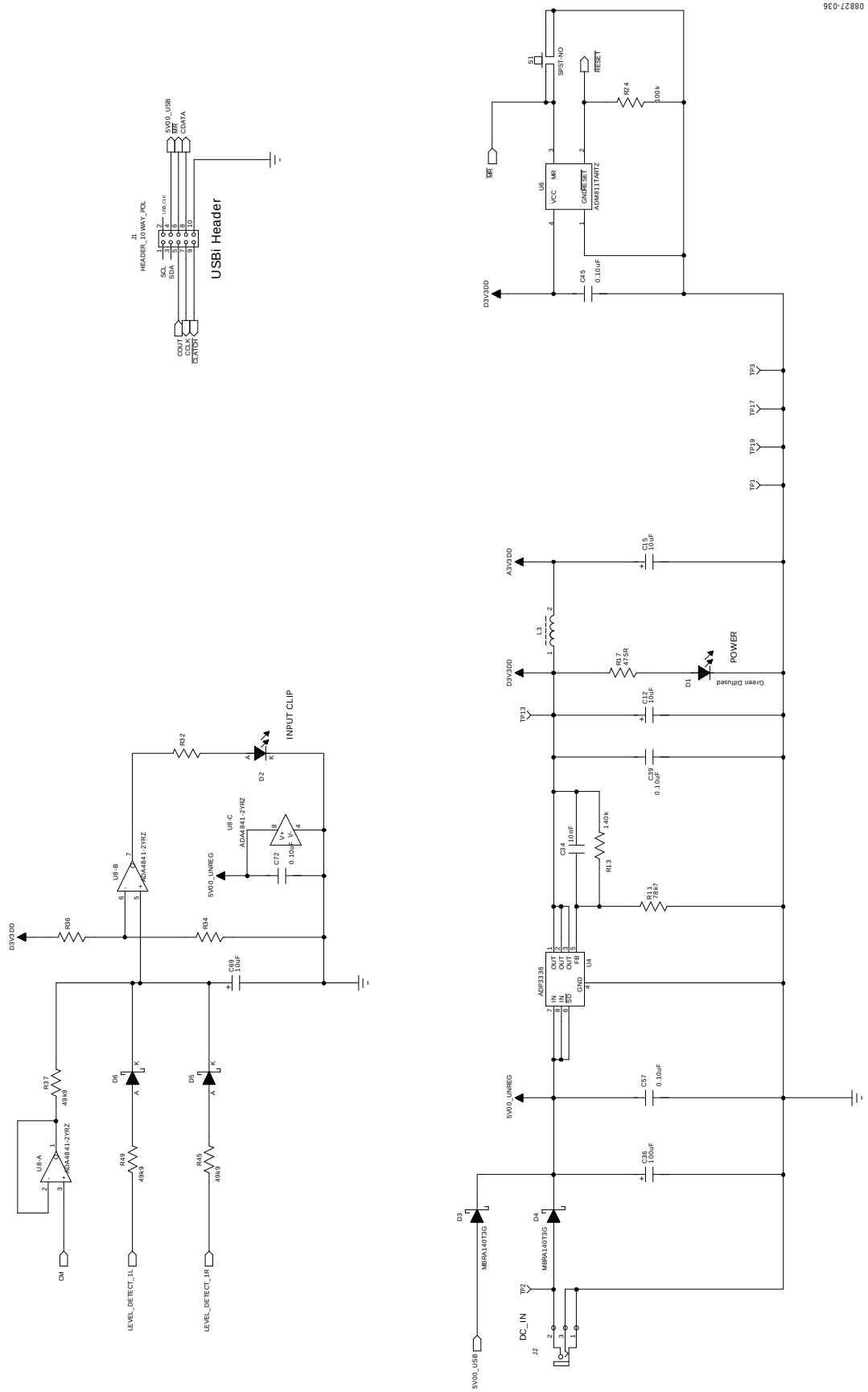

Figure 35. Board Schematics, Page 4—Clip Detection, Power Supply, Reset, Communications

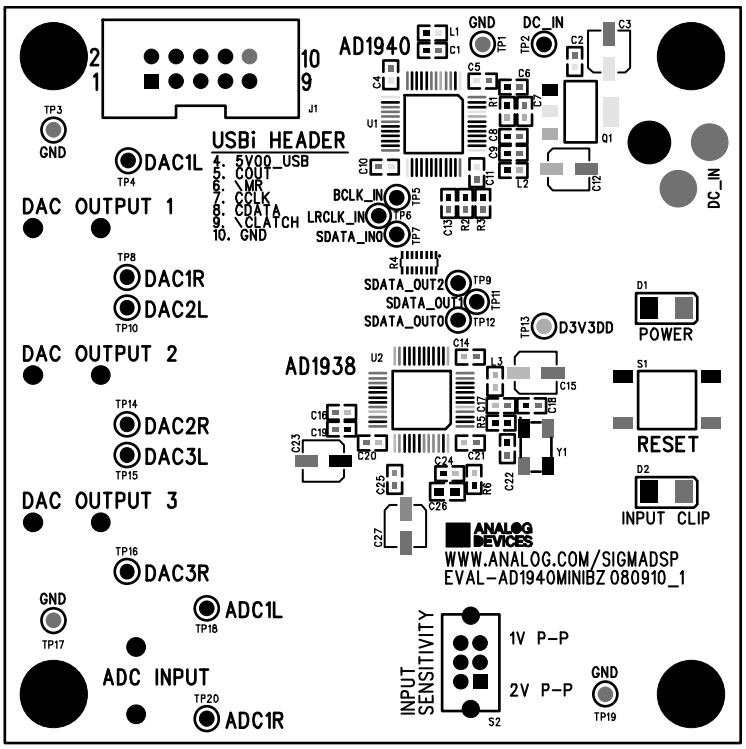

Figure 36. Board Layout, Page 1—Top Assembly

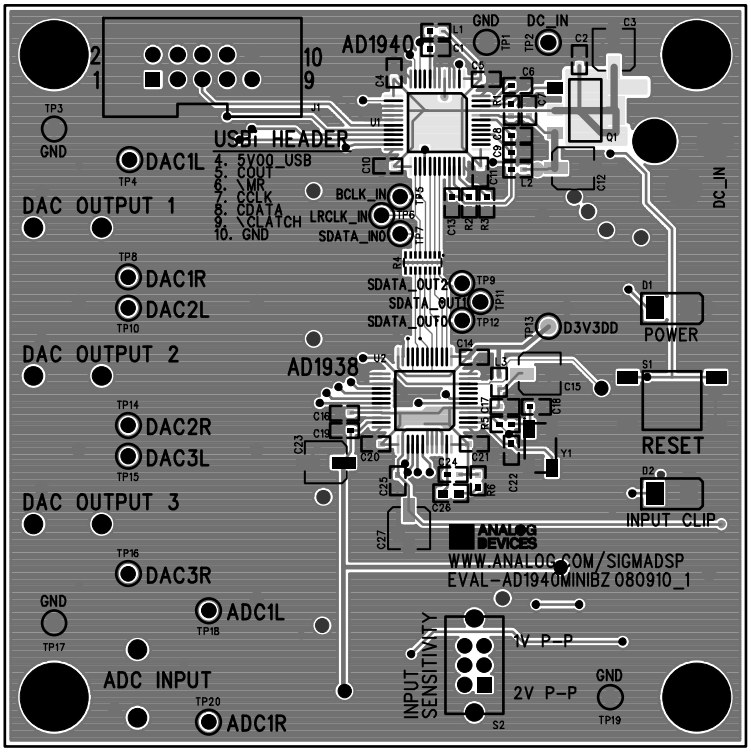

Figure 37. Board Layout, Page 2—Top Layout and Screen

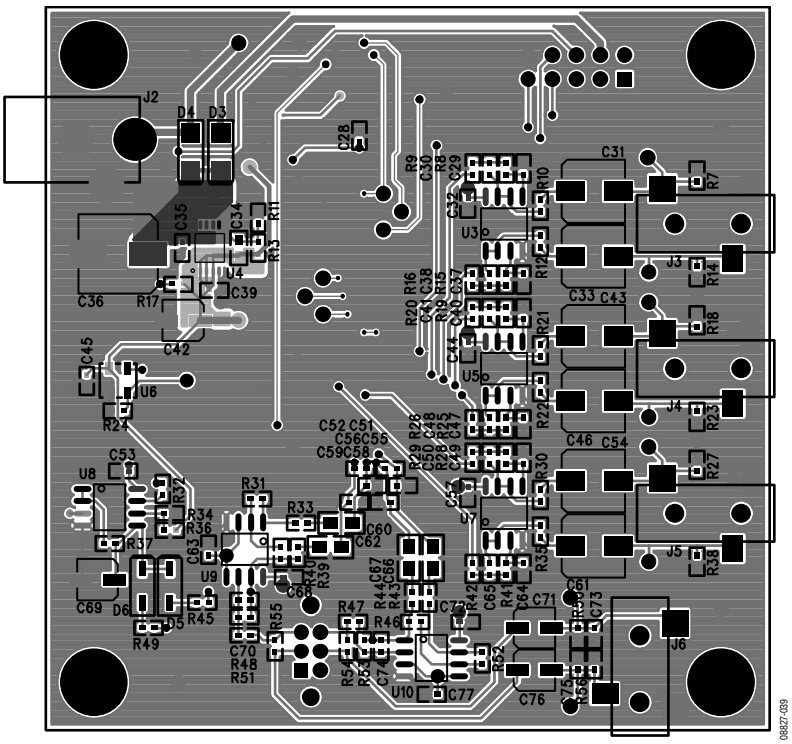

Figure 38. Board Layout, Page 3—Bottom Layout and Screen

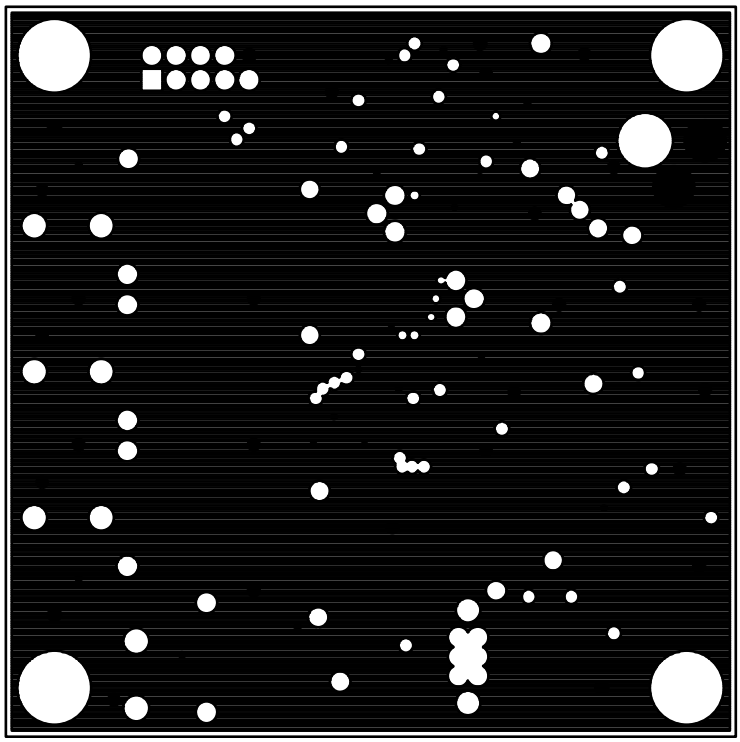

Figure 39. Board Layout, Page 4—Ground Plane

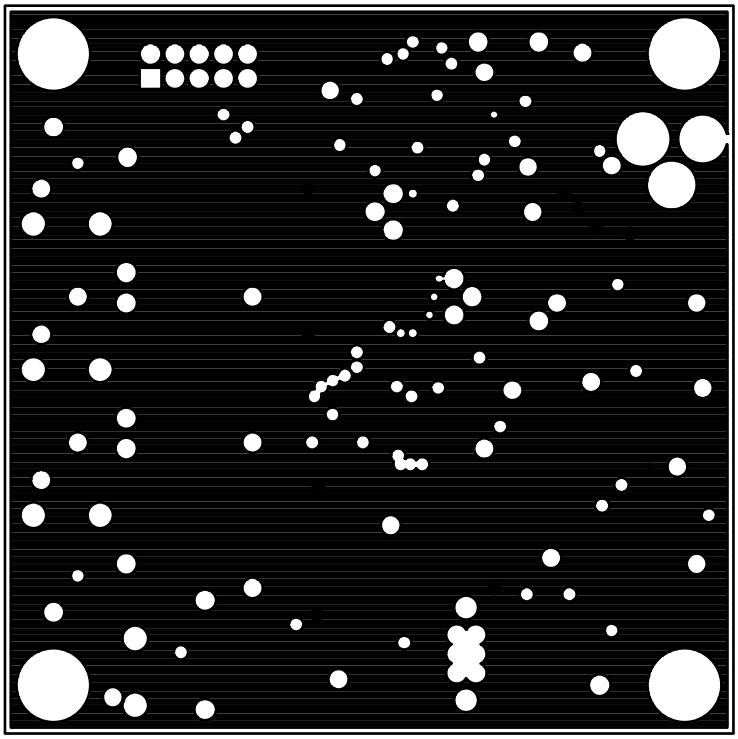

Figure 40. Board Layout, Page 5—Power Plane

ORDERING INFORMATION

BILL OF MATERIALS

Table 1.

Qty	Reference Designator	Description	Manufacturer	Part Number
29	C1, C2, C4, C5, C7 to C11, C13, C14, C16, C17, C19 to C21, C25, C28, C32, C35, C39, C44, C45, C53, C57, C63, C68, C72, C77	Multilayer ceramic 16 V, X7R (0402), 0.10 µF capacitor	Panasonic EC	ECJ-0EX1C104K
9	C3, C12, C15, C23, C27, C42, C69, C71, C76	Aluminum electrolytic 10 µF capacitor, FC 105°, SMD_B	Panasonic EC	EEE-FC1C100R
5	C6, C55, C56, C58, C59	Multilayer ceramic 50 V, NP0 (0402), 1.0 nF capacitor	Murata Manufacturing Co., Ltd.	GRM1555C1H102JA01D
2	C18, C22	Multilayer ceramic 50 V, NP0 (0402), 22 pF capacitor	Murata Manufacturing Co., Ltd.	GRM1555C1H220JZ01D
1	C24	Multilayer ceramic 50 V, NP0 (0402), 390 pF capacitor	Murata Manufacturing Co., Ltd.	GRM1555C1H391JA01D
6	C29, C37, C40, C47, C49, C64	Multilayer ceramic 50 V, NP0 (0402), 200 pF capacitor	Murata Manufacturing Co., Ltd.	GRM1555C1H201JA01D
1	C26	Multilayer ceramic 25 V, NP0 (0603), 5.6 nF capacitor	TDK Corporation	C1608C0G1E562J
8	C30, C38, C41, C48, C50, C65, C70, C74	Multilayer ceramic 50 V, NP0 (0402), 270 pF capacitor	Murata Manufacturing Co., Ltd.	GRM1555C1H271JA01D
6	C31, C33, C43, C46, C54, C61	Aluminum electrolytic 47 µF capacitor, FC 105°, SMD_D	Panasonic EC	EEE-FC1C470P
1	C34	Multilayer ceramic 25 V, NP0 (0603), 10 nF capacitor	TDK Corporation	C1608C0G1E103J
1	C36	Aluminum electrolytic 100 µF capacitor, FC 105°, SMD_E	Panasonic EC	EEE-FC1C101P
4	C51, C52, C73, C75	Multilayer ceramic 50 V, NP0 (0402), 100 pF capacitor	Murata Manufacturing Co., Ltd.	GCM1555C1H101JZ13D
4	C60, C62, C66, C67	Multilayer ceramic 10 V, X7R (0805), 10 µF capacitor	Murata Manufacturing Co., Ltd.	GRM21BR71A106KE51L
1	D1	Green diffused 10 millicandela 565 nm (1206)	Lumex Opto/Components, Inc.	SML-LX1206GW-TR
1	D2	Red diffused 6.0 millicandela 635 nm (1206)	Lumex Opto/Components, Inc.	SML-LX1206IW-TR
2	D3, D4	Schottky diode 40 V 1 A	On Semiconductor	MBRA140T3G
2	D5, D6	Schottky 30 V 0.5 A SOD123 diode	On Semiconductor	MBR0530T1G
1	J1	10-way 2 × 5 shroud polarized header	3M	N2510-6002RB
1	J2	Mini power jack 0.08" R/A TH	Switchcraft, Inc.	RAPC722X
4	J3, J4, J5, J6	Sterero Mini Jack SMT, SJ-3523-SMT	Digi-Key	CP-3523SJCT-ND
3	L1 to L3	Chip ferrite bead 600 Ω @ 100 MHz	TDK Corporation	MMZ1005S601C
1	Q1	PNP transistor	Zetex, Inc.	ZX5T953GTA
1	R1	1 kΩ chip resistor 1% 63 mW thick film (0402)	Panasonic EC	ERJ-2RKF1001X
2	R2, R3	10 kΩ chip resistor 1% 63 mW thick film (0402)	ROHM Semiconductor	MCR01MZPF1002
1	R4	100 Ω resistor network isolated 8-resistor (pack	CTS Corporation	741X163101JP
1	R5	100 Ω chip resistor 1% 63 mW thick film (0402)	ROHM Semiconductor	MCR01MZPF1000
2	R6, R32	562 Ω chip resistor 1% 63 mW thick film (0402)	Vishay/Dale	CRCW0402562RFKED
9	R7, R14, R18, R23, R24, R27, R38, R50, R56	100 kΩ chip resistor 1% 63 mW thick film (0402)	ROHM Semiconductor	MCR01MZPF1003
22	R8, R9, R15, R16, R19, R20, R25, R26, R28, R29, R31, R40 to R42, R46 to R48, R51 to R55	5.36 kΩ chip resistor 1% 63 mW thick film (0402)	ROHM Semiconductor	MCR01MZPF5361
6	R10, R12, R21, R22, R30, R35	301 Ω chip resistor 1% 63 mW thick film (0402)	ROHM Semiconductor	MCR01MZPF3010
1	R11	78.7 kΩ chip resistor 1% 63 mW thick film (0402)	Vishay/Dale	CRCW040278K7FKED
1	R13	140 kΩ chip resistor 1% 63 mW thick film (0402)	Panasonic EC	ERJ-2RKF1403X
1	R17	475 Ω chip resistor 1% 63 mW thick film (0402)	Vishay/Dale	CRCW0402475RFKED
4	R33, R39, R43, R44	237 Ω chip resistor 1% 63 mW thick film (0402)	Vishay/Dale	CRCW0402237RFKED
1	R34	20 kΩ chip resistor 1% 63 mW thick film (0402)	ROHM Semiconductor	MCR01MZPF2002
1	R36	18.2 kΩ chip resistor 1% 63 mW thick film (0402)	Vishay/Dale	CRCW040218K2FKED
3	R37, R45, R49	49.9 kΩ chip resistor 1% 63 mW thick film (0402)	Vishay/Dale	CRCW040249K9FKED
1	S1	Tact switch 6 mm gull wing SPST-NO	Tyco/Alcoswitch	FSM6JSMA
1	S2	DPDT slide switch vertical	E-Switch, Inc.	EG2207

Qty	Reference Designator	Description	Manufacturer	Part Number
20	TP1 to TP20	Mini test point white, .1" OD	Keystone Electronics, Corporation	5002
1	U1	SigmaDSP multichannel, 28-bit audio processor	Analog Devices	AD1940YSTZ
1	U2	4 ADC 8 DAC with PLL 192 kHz 24-bit codec	Analog Devices	AD1938YSTZ
6	U3, U5, U7 to U10	Dual, low power, low noise, and distortion rail-to-rail output amplifier	Analog Devices	ADA4841-2YRZ
1	U4	Adjustable low-dropout voltage regulator	Analog Devices	ADP3336ARMZ-REEL7
1	U6	Microprocessor voltage supervisor logic low reset output	Analog Devices	ADM811TARTZ-REEL7
1	Y1	Crystal 12.288 MHZ, SMT, 18 pF	Abracon Corporation	ABM3B-12.288MHZ-10-1-U-T

NOTES

NOTES

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.

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