SigmaDSP® Evaluation Board

EVAL-ADAU1701EB/EVAL-ADAU1702EB

EVALUATION BOARD OVERVIEW

This evaluation board is a platform that operates all of the ADAU1701/ADAU1702's functions with a full range of analog and digital inputs and outputs. Digital I/O connections are available in both S/PDIF and 3-wire serial data formats. The DSP is controlled by Analog Devices, Inc. SigmaStudio™ software, which interfaces to the board with a USB connection. This evaluation board is powered by a single supply, which is regulated to the proper voltages on the board. The PCB is in a 6-inches × 6-inches 4-layer design, with a single ground plane and a single power plane on the inner layers.

PACKAGE CONTENTS

The EVAL-ADAU1701EB/ADAU1702EB package contains:

- The EVAL-ADAU1701EB/ADAU1702EB evaluation board
- A GPIO control board
- The SigmaStudio software
- A universal power supply
- A USB cable
- A evaluation board/software quick-start guide

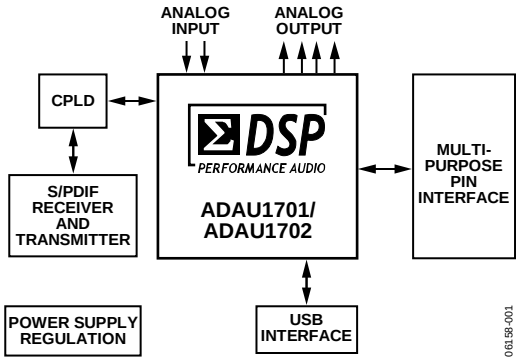

Figure 1. Evaluation Board Block Diagram

ADAU1701/ADAU1702 OVERVIEW

The ADAU1701/ADAU1702 is a standalone 28-/56-bit audio DSP that handles all system processing and control tasks. Processing includes equalization, crossover, bass enhancement, multiband dynamics processing, delay compensation, speaker compensation, and stereo image widening. These algorithms can be used to compensate for the real-world limitations of speakers, amplifiers, and listening environments, resulting in a dramatic improvement of perceived audio quality.

The signal processing used in the ADAU1701/ADAU1702 is comparable to that found in high-end studio equipment. Most of the processing is done in full 56-bit double-precision mode, resulting in very good low-level signal performance. The ADAU1701/ADAU1702 is a fully programmable DSP. The easy-to-use SigmaStudio software allows the user to graphically configure a custom signal processing flow using blocks, such as biquad filters, dynamics processors, level controls, and GPIO interface controls.

The ADAU1701/ADAU1702 programs can be loaded on power-up either from a serial EEPROM though its own self-boot mechanism or from an external microcontroller. On power-down, the current state of the parameters can be written back to the EEPROM from the ADAU1701/ADAU1702 to be recalled the next time the program is run.

Two Σ-Δ ADCs and four Σ-Δ DACs provide a 98.5 dB analog input to analog output dynamic. Each ADC has a THD + N of −83 dB, and each DAC has a THD + N of −90 dB. Digital input and output ports allow for glueless connection to additional ADCs and DACs. The ADAU1701/ADAU1702 communicates through either an I^2C bus or a 4-wire SPI port.

The differences between the ADAU1701 and ADAU1702 are:

- The ADAU1701 has 1024 program RAM locations, while the ADAU1702 has 512.
- The ADAU1701 has 2 k words of data memory, while the ADAU1702 has 0.5 k words.

Rev. 0

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REVISION HISTORY

1/07—Revision 0: Initial Version

SETUP

POWER SUPPLY

The evaluation board is powered by either single supply through Connector J14 or through the USB power. Once the board's driver is properly installed, it can be powered directly from the USB connection with no other power supply needed. If an external power supply is used, the voltage on J14 should be 6 V dc to 9 V dc with the ability to source at least 200 mA. The power supply connector's tip should be the positive voltage. This single supply is regulated to 3.3 V for both the analog and digital planes. The ADAU1701/ADAU1702 generate 1.8 V from the 3.3 V supply using the integrated regulator.

DIGITAL AUDIO INPUTS AND OUTPUTS

Digital I/Os can be connected to the board in two different formats. First, the evaluation board can input or output a standard 2-channel S/PDIF stream. These I/Os can be either electrical (J5 and J4) or optical (U13 and U29). The S/PDIF I/O streams are connected to the SDATA_IN0 and SDATA_OUT0 serial data ports and are active according to specific switch settings on S2. The copy protection bit on the S/PDIF transmitter is set; therefore, audio devices, such as digital recorders, may ignore the data output from the evaluation board.

PCM digital audio data can also be interfaced to the ADAU1701/ADAU1702. This data is connected to the ADAU1701/ADAU1702 through the GPIO interface board connected to J12. Input Header JX1 and Output Header JX3 can connect to external ADCs, DACs, and codecs with an I²S, left-justified, or right-justified data stream. Master clock, left/right clock, and bit clock connections are also on these headers. Up to four stereo audio signals can be input or output on each of these headers. These signals, when selected by the rotary mode switches, interface directly to the serial data ports of the ADAU1701/ADAU1702. These headers also serve as the I/Os for the multichannel TDM streams.

ANALOG AUDIO INPUTS AND OUTPUTS

The evaluation board can input two analog audio signals and can output four signals using the ADAU1701/ADAU1702's converters. The full-scale input voltage is 2.0 V rms and the full-scale output is 0.9 V rms.

RCA jack J9 and mini-jack J11 are the inputs to the ADCs. These two jacks are wired in parallel, so only one should be used at a time.

RCA Jack J6 to Jack J7 and Mini-Jack J1 and Mini-Jack J3 are the DAC output connectors. The output is low-pass filtered with either an active anti-image filter using op amp U3 or a passive R-C filter. The active filters' −3 dB cutoff frequency is 100 kHz and has an approximate third-order Bessel (linear phase) response.

MASTER CLOCK SETTINGS

The ADAU1701/ADAU1702's master clock connection is set with Jumper LK1 to Jumper LK4. These allow the user to select as a source either the on-board oscillator connected to an external crystal (OSC), the S/PDIF receiver's master clock output (DIR), an external clock from J12 (EXT), or a dedicated clock connection on BNC connector J13 (BNC). If any setting other than OSC is chosen, then be sure to disconnect Jumper LK16, which couples the ADAU1701/ADAU1702's oscillator circuit to the crystal. If this jumper is not removed, there could be two clocks on the PCB running at very close frequencies. These clocks could easily cause serious performance degradation on the ADAU1701/ADAU1702's converters.

CONTROL INTERFACE

J16 is the connection for the USB interface. USB Receiver U11 and microcontroller U19 convert the USB data to either SPI or I²C to interface to the ADAU1701/ADAU1702. The software connection is further explained in the SigmaStudio Software Interface section.

Table 1. Switches and Jumpers

Reference Designator	Function
S1	Reset evaluation board.
S2	Signal routing mode select.
S3-1	Set SELFBOOT.
S3-2	Set PLL_MODE0.
S3-3	Set PLL_MODE1.
S3-4	Set ADDR0.
S3-5	Set ADDR1.
S3-6	Reserved—set low.
S4	Sets I²C or SPI mode.
S5	External control connector—I²C (left) or SPI (right).
S6	Select between RCA and optical S/PDIF input.
S7	Unused
S8	Unused
LK1 to LK4	Selects which master clock signal is sent to ADAU1701/ADAU1702's PLL.
LK7	Sets EEPROM write protect pin.
LK8	Selects 3.3 V or 5 V power connected to GPIO control board.
LK5 to LK6, LK9 to LK14	Connect DAC outputs to active (A) or passive (B) filters.
LK15	Connects regulator transistor's 1.8 V output to ADAU1701/ADAU1702 DVDD.
LK16	Connects/disconnects 12.288 MHz crystal from ADAU1701/ADAU1702's oscillator circuit.
LK17	Connects/disconnects MCLK output to external circuits. Connecting this may degrade the board's analog audio performance.
LK18	Connects 3.3 V to ADAU1701/ADAU1702 AVDD.
LK19	Writeback trigger input.
LK20	Connects 3.3 V to AD8608 op amp.
LK21	Connects 3.3 V to ADAU1701/ADAU1702 IOVDD.
LK25	Connects 3.3 V power to serial data buffer.

SWITCH AND JUMPER FUNCTIONS

This evaluation board has many switches and jumpers, but for most applications, many of these need to be set only once and can be ignored after that. Table 1 shows the function of each jumper and switch on the evaluation board. For switch package S3, logic high (1) is left and logic low (0) is right, assuming analog connectors are the top of the board.

ROTARY SWITCH SETTINGS

S2 is a hex rotary switch that controls the input and output signal routing on the evaluation board. The position of this switch controls which serial data signals and clocks will be routed to and from the ADAU1701/ADAU1702.

Table 3 shows rotary switch S2's settings. This switch controls the routing of digital signals to and from the ADAU1701/ADAU1702 (U1) serial input and output ports. The table indicates which serial data signals and clocks will be sent to each of the four serial data inputs, as well as to where the serial port's output signals will be routed. An x in the table indicates that no signal is sent to that input pin on the ADAU1701/ADAU1702 in that mode. Switch Positions 4-F are unused.

The following functions are available for each of these modes:

0. Inputs: S/PDIF, analog
   Outputs: S/PDIF, analog, serial data (slave)
1. Inputs: analog, serial data
   Outputs: analog, serial data (master or slave)
2. Inputs: analog, serial data
   Outputs: S/PDIF, analog, serial data (master)
3. Inputs: S/PDIF, analog
   Outputs: analog

The ADAU1701/ADAU1702's multipurpose pins must be set into serial data I/O modes to use the board's digital I/O.

IC FUNCTIONS

Table 2 explains the function of each IC on the evaluation board. The Lattice CPLD (U2) is only used for routing signals on the board and performs no decoding or signal conditioning.

Table 2. IC Functions

Reference Designator	Function
U1	ADAU1701/ADAU1702 SigmaDSP® audio processor
U2	Lattice M4A3-64/32 CPLD for signal routing
U3	AD8608 quad op amp for analog audio output buffering
U4	CS8416 S/PDIF receiver
U5	74LVC541 for buffering serial output signals
U6	CS8406 S/PDIF transmitter
U8	ADP3336-3 regulator—3.3 V analog supply
U10	ADM811RART reset generator
U11	FT245BM USB receiver
U12	74LVC1G240 inverter
U14	Selfboot EEPROM: 32 kB × 8 (256 kbit)
U18	1 Mb serial EEPROM
U19	PIC16F877 microcontroller
U20	1 kb serial EEPROM for USB device ID

LED FUNCTIONS

The two LEDs on the evaluation board are useful components that can indicate that the board is properly powered and set up.

D11 indicates that the 3.3 V supply is present either through an external supply or through USB.

The Communications Active LED, D5, is dim when the USB connection to the evaluation board is recognized by the PC. This LED blinks when I^2C or SPI communication is active.

RESET

The evaluation board can be reset with Push-Button Switch S1. This active-low reset signal is debounced by the ADM811 (U10). This reset signal affects the ADAU1701/ADAU1702 and S/PDIF receiver and transmitter. The board may also be reset by disconnecting the power. After reset, the ADAU1701/ADAU1702 will not pass audio and a control port write has to be performed so that signals are output again. The Using SigmaStudio section has more specific details about this operation.

Table 3. S2 Settings

SW2 Position	SDATA_IN0	SDATA_IN1 to SDATA_IN3	SDATA_OUT0 to SDATA_OUT3	SPDIF Tx	Clock Master
0	S/PDIF Rx	x	External Out 0 to External Out 3	SDATA_OUT0	S/PDIF Rx
1	x	x	x	x	ADAU1701/ADAU1702 crystal oscillator
2	External In 0	External In 1 to External In 3	External Out 0 to External Out 3	SDATA_OUT0	ADAU1701/ADAU1702 output
3	S/PDIF Rx	x	x	x	S/PDIF Rx
4-F	x	x	x	x	x

SELFBOOT

The ADAU1701/ADAU1702's selfboot function can be set up on the evaluation board. This allows the ADAU1701/ADAU1702 to boot itself from EEPROM U14 when it is brought out of reset. The ADAU1701/ADAU1702 is the master on the I^2C bus during the selfboot operation; however, another bus master device may take control afterwards.

The first step in setting up selfboot mode is to load a program from SigmaStudio into the EEPROM. This is done by using the Load latest compilation to EEPROM function found by right-clicking on the IC in the hardware configuration window. This should be done while Selfboot Switch S3-1 is set low (right). Note that the jumper should not be LK7 for this operation because the EEPROM cannot be write-protected. After the program is saved, this switch can be set high (left), which will set the ADAU1701/ADAU1702 into selfboot mode the next time that it is powered on or reset. To regain SigmaStudio control of the ADAU1701/ADAU1702, Switch S3-1 needs to set low again; SigmaStudio will not communicate with the ADAU1701/ADAU1702 while the selfboot pin is set high.

TYPICAL SETUPS

ALL SETUPS

The switch and jumper settings in Table 4 are common for all typical setups described here.

Table 4. Standard Switch and Jumper Settings

Component	Setting
LK15, LK18, LK20 to LK25	Jumper on
LK7, LK19	Jumper off
S3-4	0 (right)
S3-5	0 (right)
S4	Down (for default I²C communication)
S5	Left (for default I²C communication)

ANALOG INPUT AND ANALOG OUTPUT

Input will come from the stereo analog inputs to Pin ADC0 and Pin ADC1 of the ADAU1701/ADAU1702 and will output on the DACs. Default outputs for the ADC inputs are DAC outputs VOUT2 and VOUT3.

In this setup, the master clock is generated by the ADAU1701/ADAU1702's oscillator connected to a 12.288 MHz crystal. Table 5 explains how the switches and jumpers need to be set up for this mode. Any component setting not mentioned in this table or in Table 4 can be considered don't care.

These settings are also appropriate for using the serial data I/Os.

Table 5. Evaluation Board Settings for Analog I/O

Component	Setting
S2	Position 1
S3-2	0 (right)
S3-3	1 (left)
LK1	Connected
LK2 to LK4	Disconnected
LK5 to LK6, LK9 to LK14	A for active filter, and B for passive filter on DAC outputs
LK16	Connected
LK17	Disconnected

S/PDIF INPUT AND S/PDIF OUTPUT

Input will come from the stereo S/PDIF receiver to Pin SDATA_IN0 of the ADAU1701/ADAU1702 and will output on whichever outputs (SDATA_OUTx) are designated in the SigmaStudio software. The default output for the input is SDATA_OUT0.

In this setup, the master clock and serial data clocks are generated by the CS8416. Table 6 explains how the switches and jumpers need to be set up for this mode. Any component setting not mentioned in Table 6 can be considered don't care.

Table 6. Evaluation Board Settings for S/PDIF Input/Analog and S/PDIF Output

Component	Setting
S2	Position 0
S3-2	0 (right)
S3-3	1 (left)
LK2	Connected
LK1, LK3 to LK4	Disconnected
LK5 to LK6, LK9 to LK14	A for active filter, and B for passive filter on DAC outputs
LK16	Disconnected
LK17	Connected

SIGMASTUDIO SOFTWARE INTERFACE

The ADAU1701/ADAU1702 SigmaDSP is controlled by the SigmaStudio software. This software allows the developer to graphically build a fully customized, audio signal processing flow. SigmaStudio generates run-time DSP code that is downloaded to the SigmaDSP through the control port. This connection on the evaluation board is USB Header J16. This board is programmed to work in with I²C communication between SigmaStudio on the USB port and the ADAU1701/ ADAU1702. If SPI communication is required, an external SPI microcontroller can be connected to J8 with S5 set to the right.

SOFTWARE INSTALLATION

The evaluation board cannot be run with a PC until the SigmaStudio software is installed. SigmaStudio must be installed on a PC running Windows® 2000 or Windows XP. The following steps should be taken to properly install the software and drivers.

1. Insert the SigmaStudio CD.
2. Install Microsoft .NET Framework Version 1.1
   Double-Click **dotnetfx.exe**
   Note that the .NET installation can be skipped if Version 1.1 or newer has already been installed from Microsoft®.
3. Install SigmaStudio—double-click **setup.exe** and follow the prompts to install.
4. It is not necessary to restart the PC to use SigmaStudio with the ADAU1701/ADAU1702 evaluation board.

HARDWARE SETUP—USB

The USB receiver circuit on the evaluation board is powered with 5 V through the USB port. The following steps explain how to set up the USB connection on a PC.

1. Use the included USB cable to make a connection between the evaluation board Connector J16 and an available USB port on your PC.
2. Windows should recognize the device, and the **Found New Hardware Wizard** should appear on your screen.
3. **Select Install from a list or specific location (Advanced)**, and click **Next**.
4. Select **Search for the best driver in these locations**, then make sure **Search removable media (floppy, CD…)** is unchecked, and **Include this location in the search** is checked.
5. Click **Browse**.
6. Browse to the USB driver's folder. By default, it should be located at **C:\Program Files\Analog Devices\Sigma Studio\USB Drivers**.
7. Click **OK**.
8. Click **Next** to begin the installation.
9. Windows will tell you that the software has not passed Windows Logo testing. Click **Continue Anyway**.
10. When the installation is complete, click **Finish**. LED D11 should now be illuminated indicating that the board is being supplied with USB power.

USING SIGMASTUDIO

The ADAU1701/ADAU1702 does not pass an audio signal on power-up. First, the user must set Bits 2:4 of the DSP core control register, which will unmute the ADCs and DACs and unclear all internal registers. This procedure can be done manually, but these bits are always set to 1 after the program and parameter loading procedure is completed by clicking the Link-Compile-Download button in SigmaStudio. For more information about using SigmaStudio with the evaluation board, read the software's online help document.

Software updates are provided via Analog Devices FTP site. E-mail SigmaDSP@analog.com for login information.

USING THE GPIO BOARD

The GPIO board is provided with the EVAL-ADAU1701EB/EVAL-ADAU1702EB to connect control and data interfaces to the ADAU1701/ADAU1702's multipurpose pins. These controls are broken out on a separate board from the main evaluation board so that different configurations beyond what is supplied can be connected easily. The functions on this board include potentiometers, LEDs, push buttons, switches, a rotary encoder, an IR receiver, and an analog signal input.

Table 7 shows how the jumpers should be set to properly route the controls to the MPx pins. The settings in Table 7 assume that the board is oriented with the 50-pin Connector JX3 on the left of the board.

The 12 jumpers on JX4 should be left on the pins to connect the MPx pins to the control interfaces. These jumpers should be removed if the GPIO board is being used to interface serial audio data to the ADAU1701/ADAU1702 through Header JX1 and Header JX2. LK13 and LK14 are used to route the serial data ports' master clock signals.

The GPIO board uses a Hirose PCN10C-50S-2.54DS connector to interface to the ADAU1701/ADAU1702 evaluation board. Using this connector and the pinout in Figure 7, any set of controls can be connected to the ADAU1701/ADAU1702's multipurpose pins. The GPIO board is powered through Pin 1 of J12 on the evaluation board. The voltage supplied to the GPIO board is set with LK8—3.3 V in Position A or 5 V in Position B.

Table 7. GPIO Board Jumper Settings and Functions

ADAU1701/ADAU1702 Mnemonic	Jumper	Control Routed to MPx Pin	Jumper Setting	Notes
MP0	LK11	Button S1 Rotary encoder	Up Down	Use debounce Must be set to input GPIO no debounce
MP1	LK10	Button S2 Rotary encoder	Up Down	 Must be set to input GPIO no debounce
MP2	LK1	ADC1 RCA jack	Right Left	Can read back from Register 2058
MP3	LK5	ADC2 IR Receiver	Left Right	Can read back from Register 2059
MP4	LK6	Button S3 Switch 1	Down Up	
MP5	LK4	Button S4 Switch 2	Down Up	
MP6	LK3	Button S5 Switch 4	Up Down	
MP7	LK2	Button S6 Switch 3	Up Down	
MP8	LK7	ADC3 LED D3	Left Right	Can read back from Register 2060
MP9	LK12	ADC0 LED D4	Left Right	Can read back from Register 2057
MP10	LK9	Button S7 LED D1	Down Up	Pushing button causes pin to go low
MP11	LK8	Button S8 LED D2	Down Up	Pushing button causes pin to go low

EVALUATION BOARD SCHEMATICS

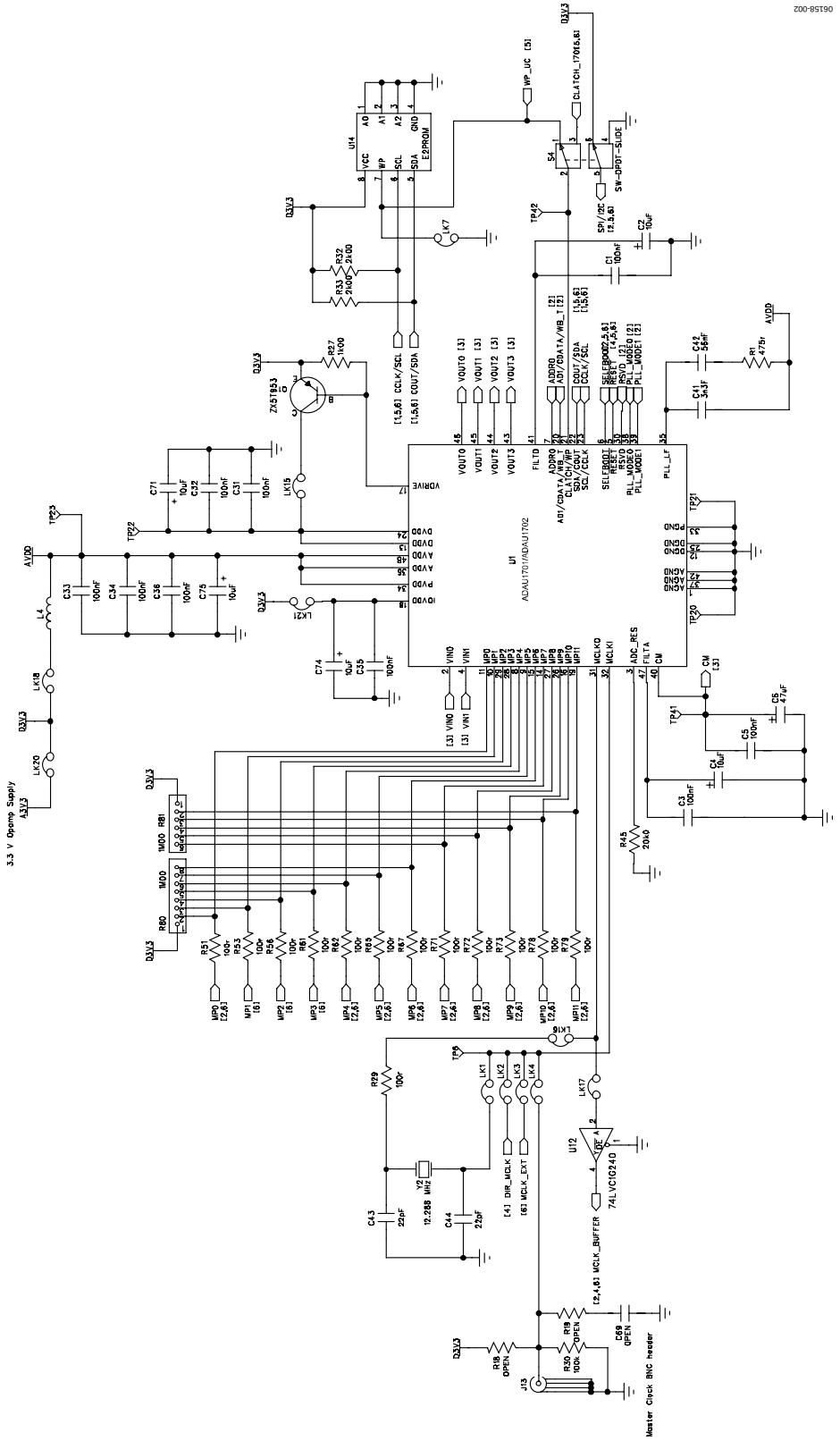

Figure 2. ADAU1701/ADAU1702 Evaluation Board Schematic

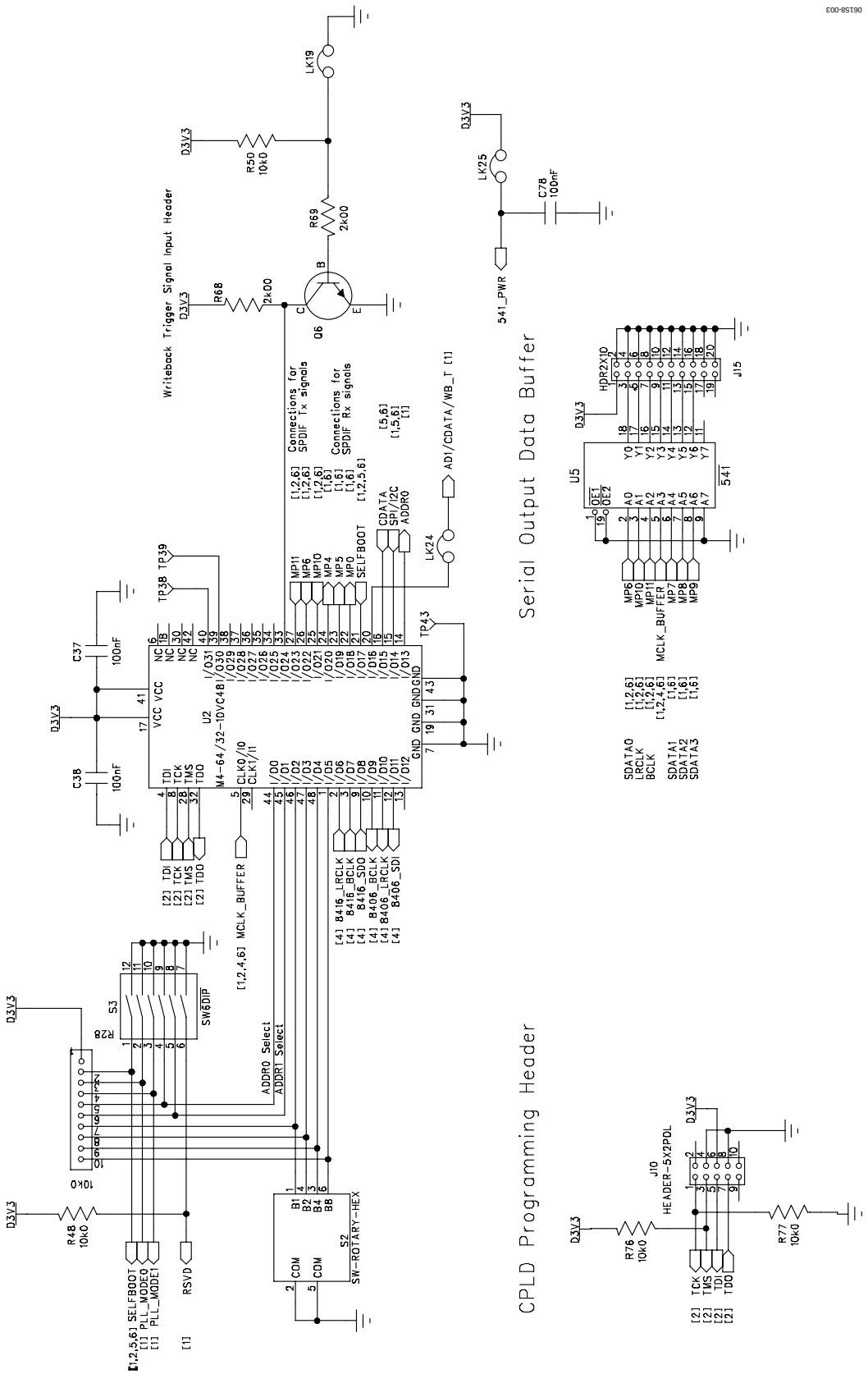

Figure 3. CPLD

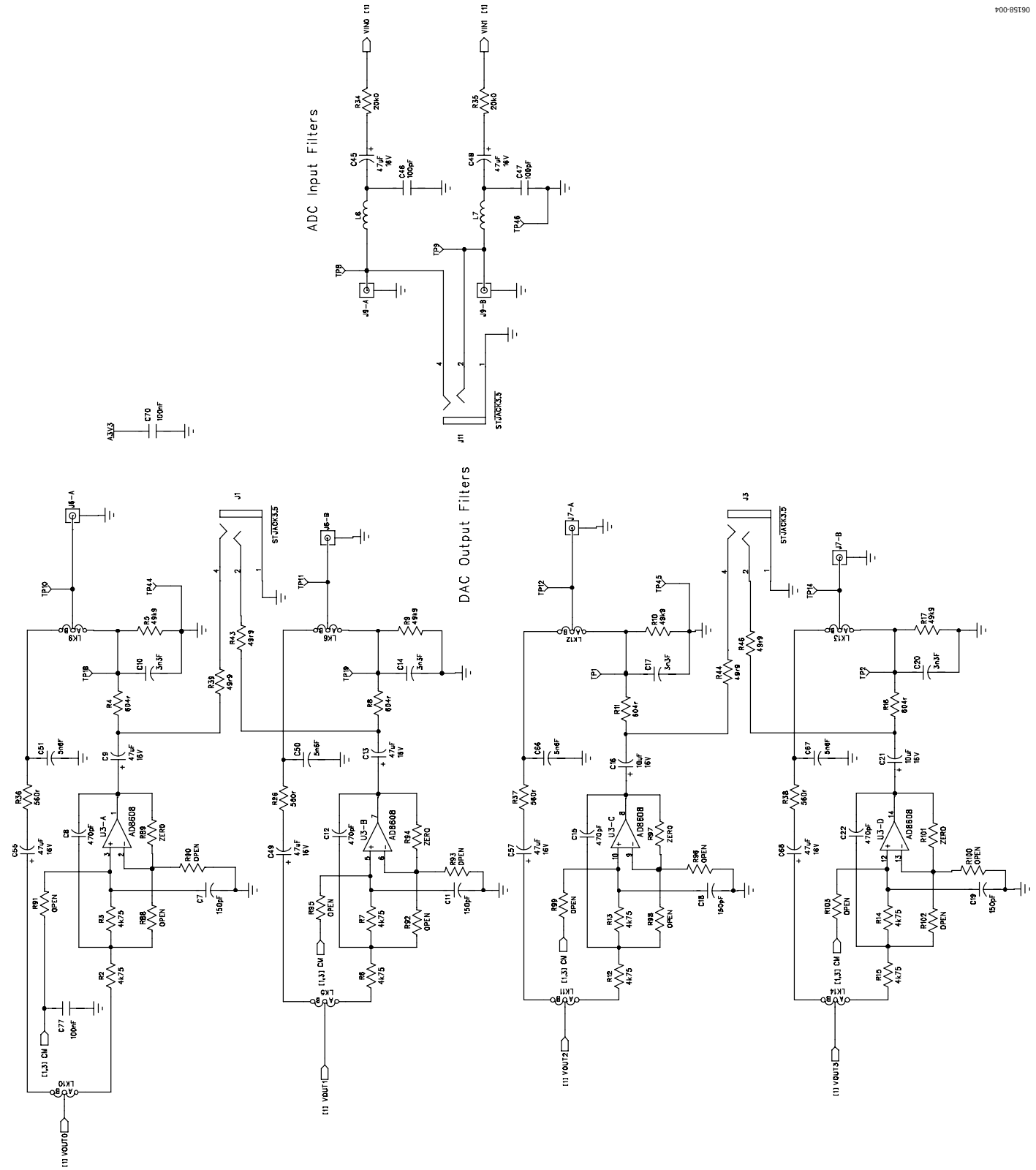

Figure 4. Analog Input and Output Filters

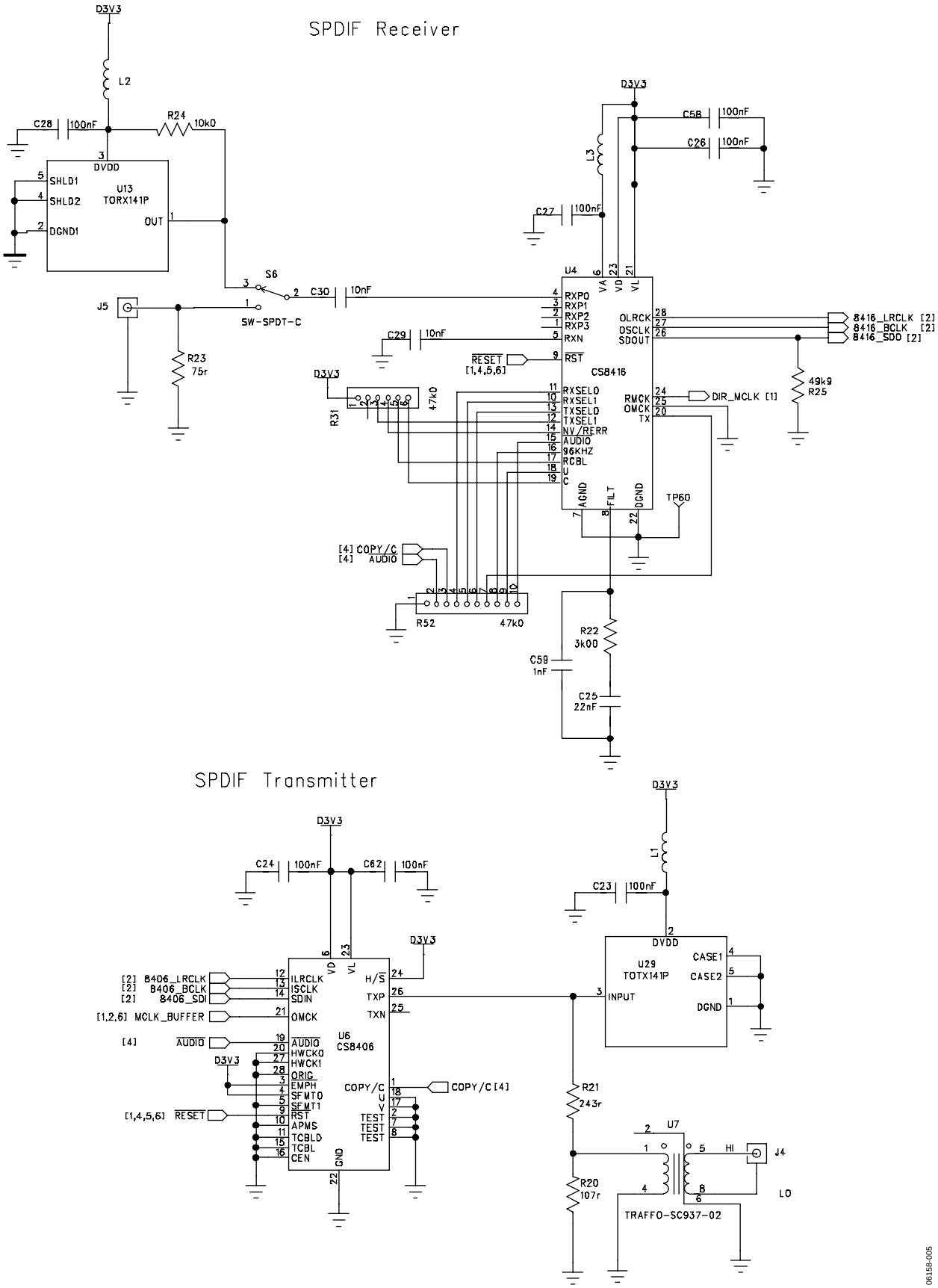

Figure 5. S/PDIF Receiver and Transmitter

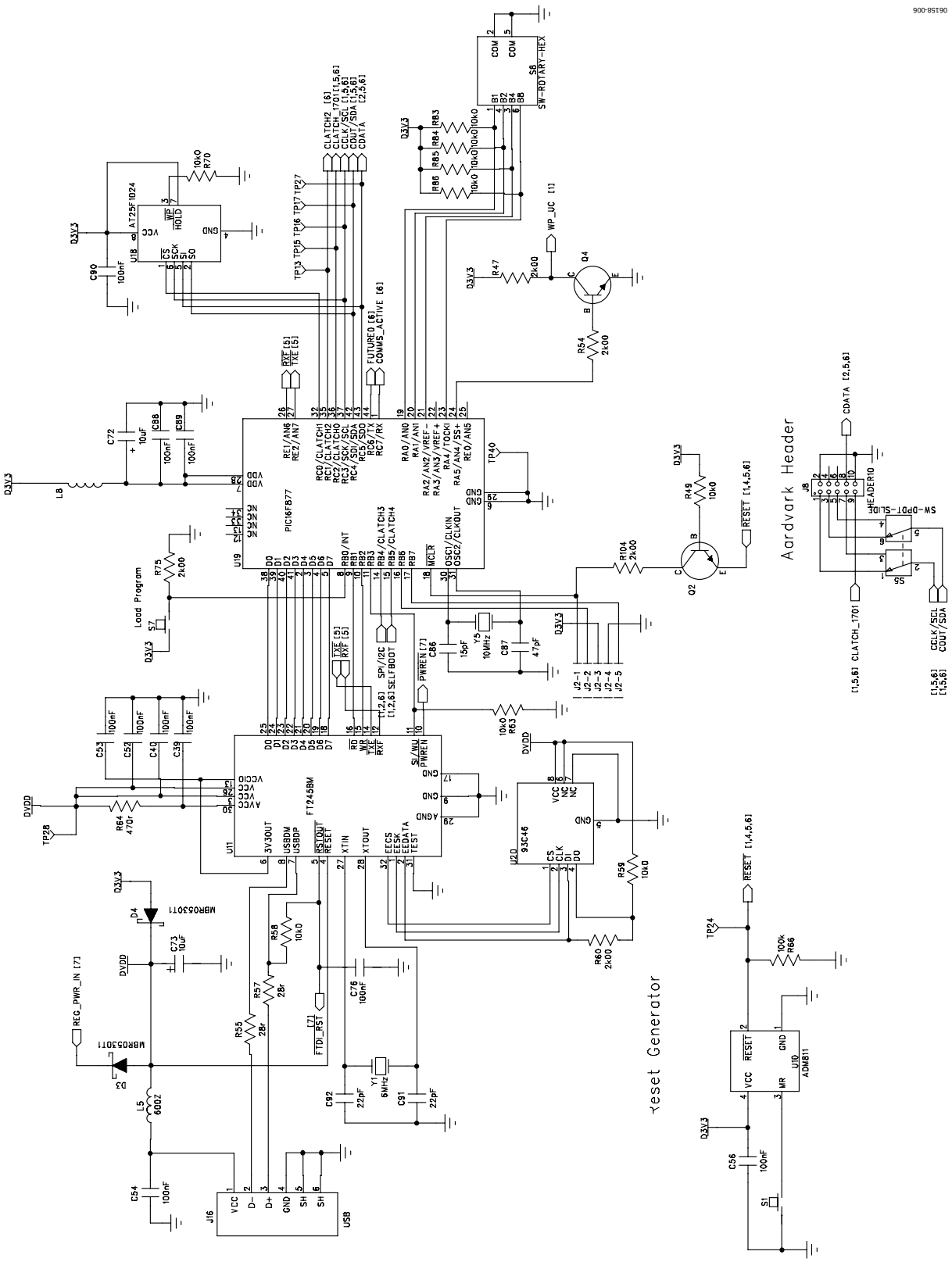

Figure 6. USB Interface

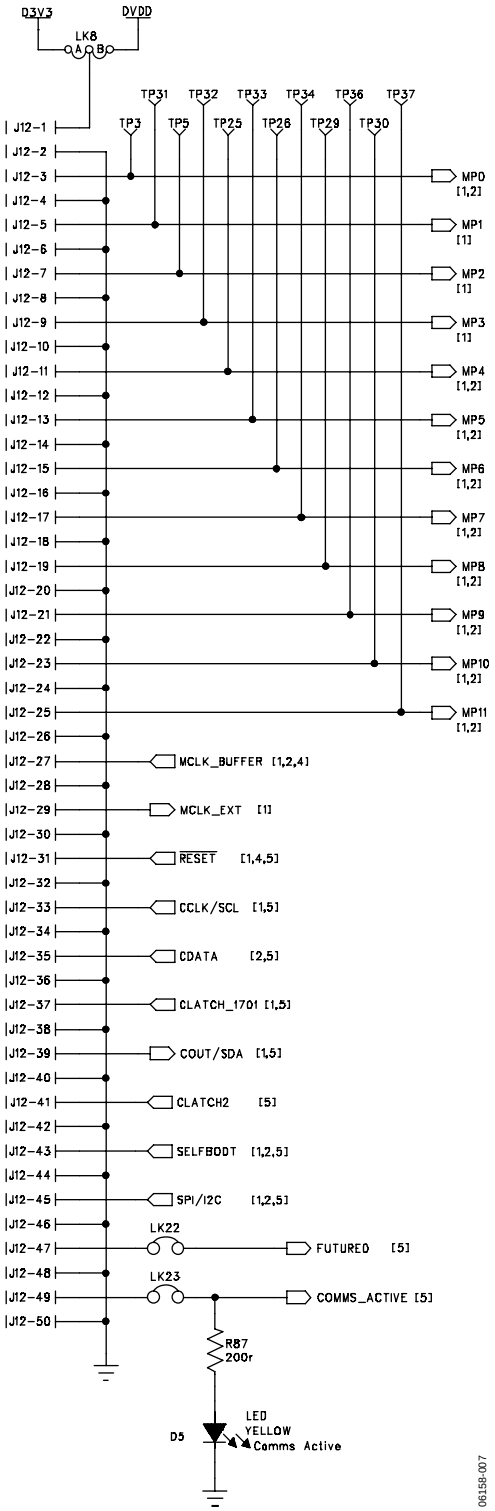

Figure 7. Multipurpose Pin Interface

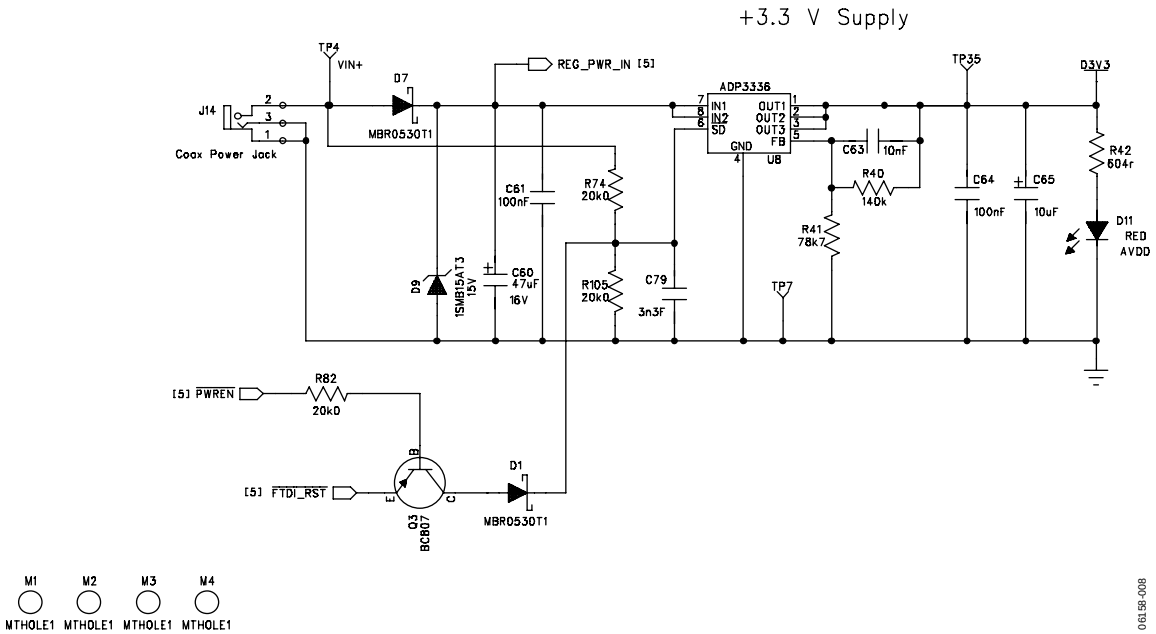

Figure 8. Power Supply

GPIO INTERFACE BOARD SCHEMATICS

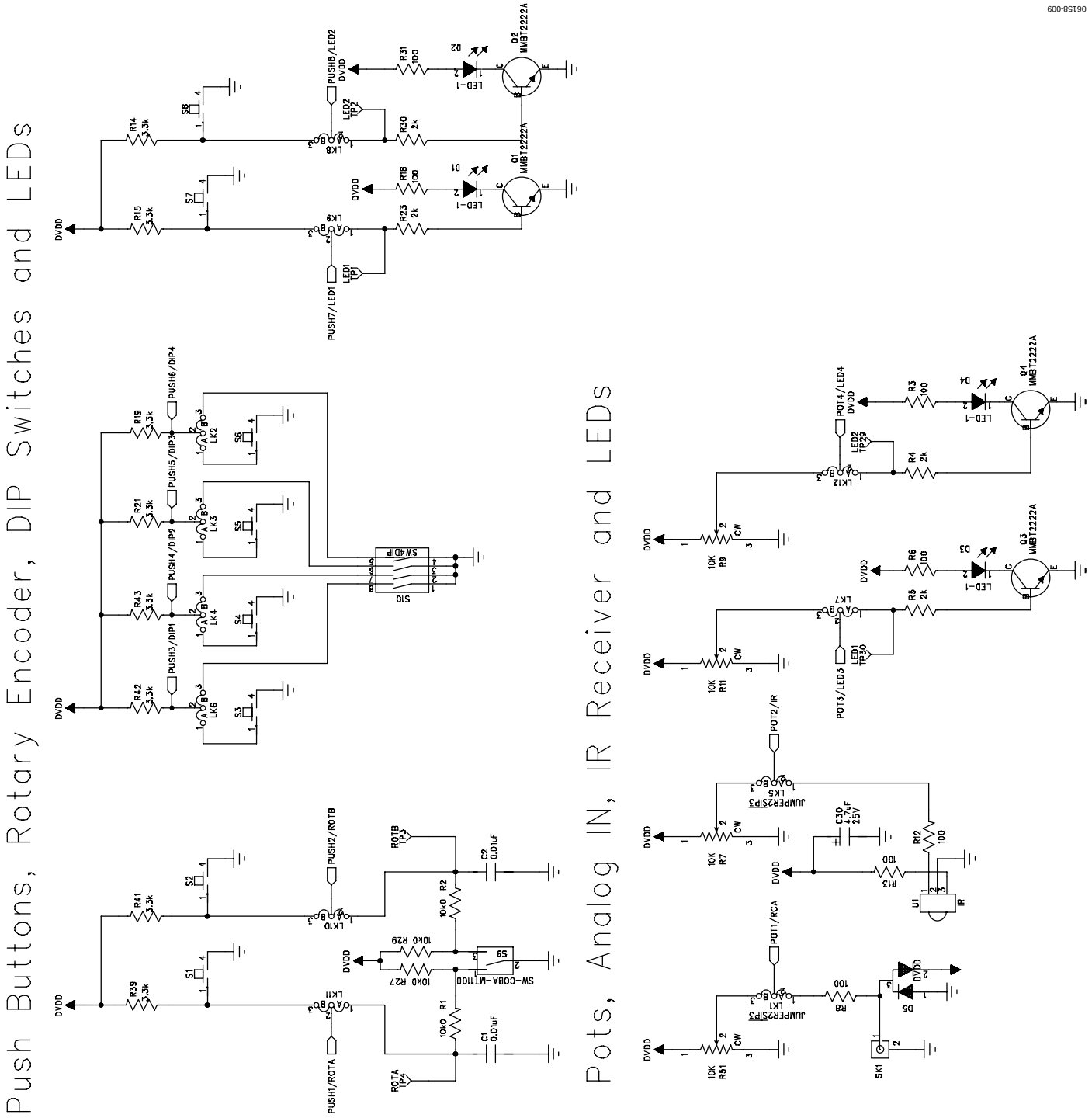

Figure 9. GPIO Board Controls

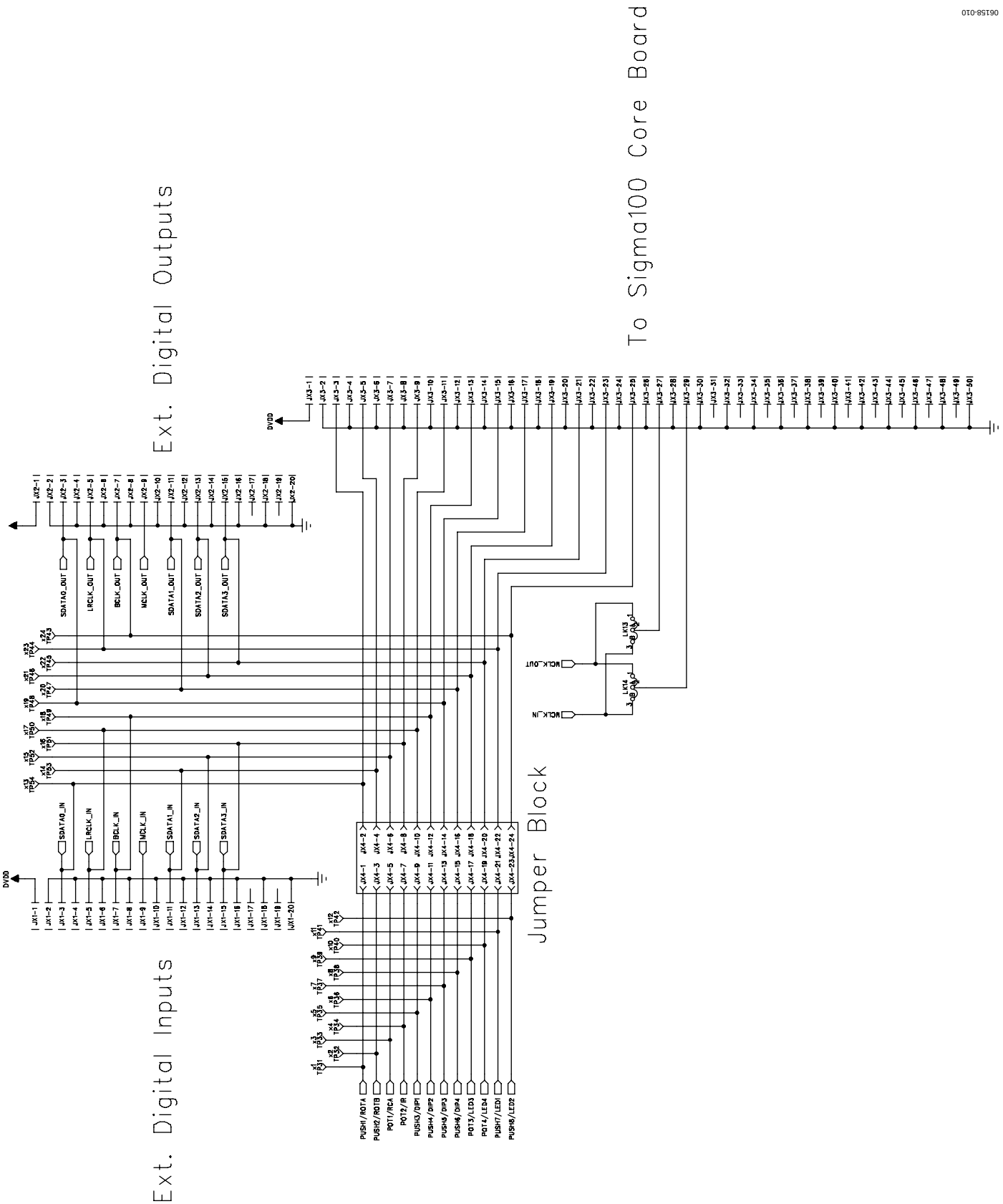

Figure 10. GPIO Board Connector

EVALUATION BOARD PCB SILKSCREEN DRAWING

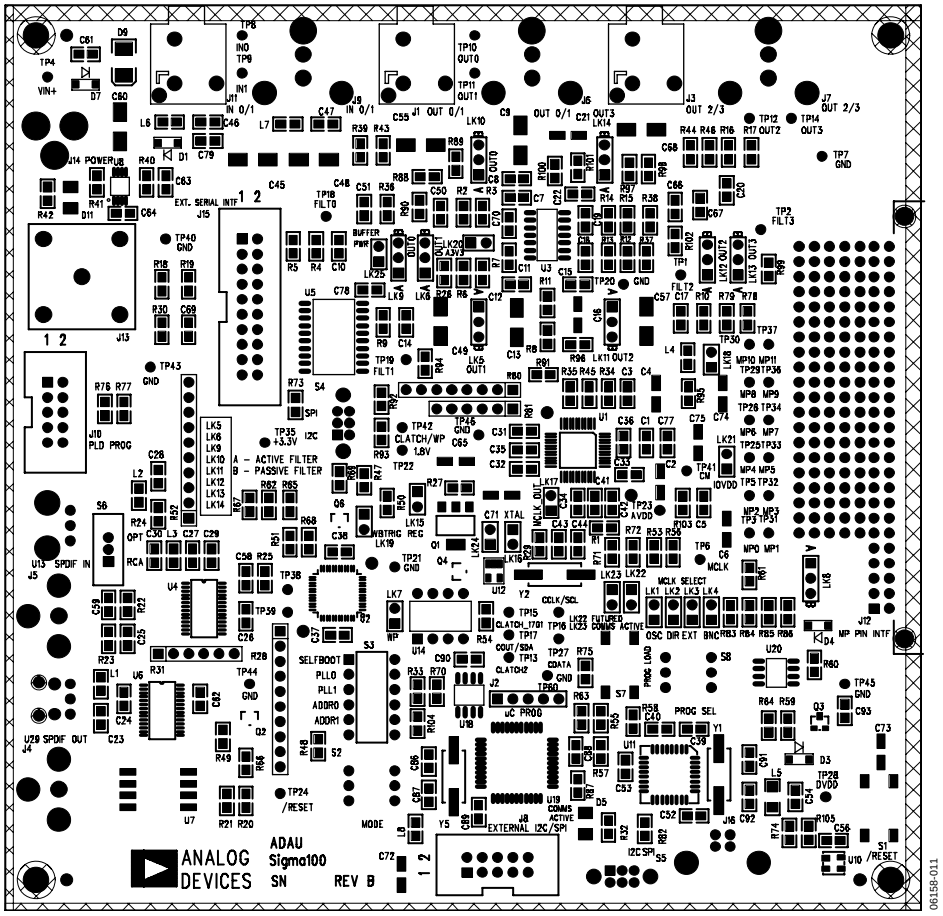

Figure 11. Top Layer Silkscreen

ORDERING INFORMATION

ORDERING GUIDE

Model	Description
EVAL-ADAU1701EB	Evaluation Board
EVAL-ADAU1702EB	Evaluation Board

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