

## Description

The ISL54214EVAL1Z and ISL54217EVAL1Z evaluation boards are designed to provide a quick and easy method for evaluating the ISL54214 and ISL54217 USB 2.0 High Speed x 2 Channels/Stereo Audio Dual SP3T (dual 3-to-1 Multiplexer) Switch ICs.

To get an evaluation board with an ISL54214 IC, order P/N: ISL54214EVAL1Z. To get an evaluation board with ISL54217 IC, order P/N: ISL54217EVAL1Z

The ISL54214 and ISL54217 devices are unique ICs. To use the evaluation board properly requires a thorough knowledge of the operation of the ICs. Refer to the data sheets for an understanding of the functions and features of these devices. Studying the device's truth-table along with its pinout diagram in the ISL54214 and ISL54217 data sheets is the best way to get a quick understanding of how the part works.

A picture of the main evaluation board is shown in Figure 1. The ISL54214 or ISL54217 TQFN IC is soldered onto the evaluation board. It is located in the center of the board and is designated as U1.

The ISL54214 or ISL54217 IC has five states or modes of operation called ALL OFF, USB1, USB2, Audio and Audio Mute. The evaluation board contains standard Audio and USB connectors to allow the user to easily interface with the IC to evaluate its functions, features, and performance in the five modes of operation.

For example, when the board is properly powered, a headphone can be plugged into the headphone jack, (J20) and a stereo source, such as a MP3 player can be connected at the RCA connectors J16 (AUDIO LEFT) and J18 (AUDIO RIGHT). The S2 and S1 toggle switches on the board can be put into the High position to play music through the audio switches of the IC (see Figure 2). You can then turn-off the audio source, remove the headphones, configure the logic for USB1 operation (S1 = Low, S2 = High) and then attach a USB cable from a computer to the USB connector J15 (USB TO HOST). This will establish a connection from the computer through the USB1 switches of the IC to the USB device connected at the USB1 connector J13 (USB TO DEVICE 1), to send and receive data.

This application note will guide the user through the process of configuring and using the evaluation board to evaluate the ISL54214 or ISL54217 device in the five modes of operation.

## Features

- Standard USB Connectors
- RCA Audio Input Jacks and Headphone Speaker Jack
- Convenient Test Points and Connections for Test Equipment

## Picture of Evaluation Board (Top View)

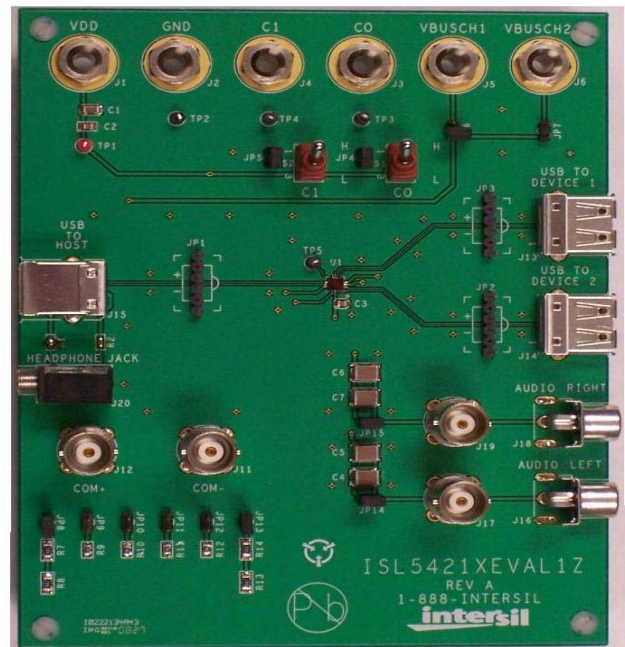


FIGURE 1. ISL54214EVAL1Z/ISL54217EVAL1Z EVALUATION BOARD

## Board Architecture/Layout

### Basic Layout of Evaluation Board

The basic layout of the main board is as follows: Refer to Figure 1.

1. Power and Ground connections are at the top of the board through banana connections labeled VDD and GND (J1 and J2).
2. Logic control connections are at the top of the board either through the banana connections labeled C1 and C0 (J4 and J3) or by the toggle switches S2 and S1. Note: Jumpers JP5 and JP4 must be installed to use the toggle switches and removed to use the banana connections.
3. Audio Source Inputs are at the lower right side of the board (J16 - J19). Audio outputs are at the lower left side of the board (J20, J12, J11). Connector J20 is a standard headphone jack for connecting a 32Ω headphone.
4. USB connection to an upstream host controller (Computer) is made at connector J15, located on left side of the board. USB connections to downstream USB

devices are made at connectors J13 and J14, located on right side of the board.

5. Located in the center of the board is the ISL54214 or ISL54217 IC (U1). The evaluation board has a pin 1 dot, to show how the IC should be oriented onto the evaluation board. The IC pin 1 indicator dot needs to be aligned with the evaluation board pin 1 dot indicator.

### Power Supply

The DC power supply connected at banana jacks J1 (VDD) and J2 (GND) provides power to the part. The IC requires a 2.7V to 4.6V DC power supply for proper operation. The power supply should be capable of delivering 100 $\mu$ A of current.

### Logic Control

The state of the ISL54214 or ISL54217 device is determined by the voltage at the C1 and C0 logic pins.

Access to the C1 pin is through banana jack J4 (C1) when jumper JP5 is not installed, and by the toggle switch S2 (C1) when the JP5 jumper is installed.

Access to the C0 pin is through banana jack J3 (C0) when jumper JP4 is not installed, and by the toggle switch S1 (C0) when the JP4 jumper is installed.

The C1 and C0 logic control pins are 1.8V logic compatible, which allows them to be control via a standard  $\mu$ controller. Logic "0" (LOW) when  $\leq 0.5V$  or floating  
Logic "1" (HIGH) when  $\geq 1.4V$

If C1 and C0 = Logic "0" (LOW), the part will be in the ALL OFF mode. The audio switches, USB1 switches, and the USB2 switches will be OFF.

If C1 = Logic "0" (LOW), and C0 are = Logic "1" (HIGH), the part will be in the USB1 mode. The USB1 switches will be ON and the USB2 and audio switches will be OFF.

If C1 = Logic "1" (HIGH) and C0 are = Logic "0" (LOW), (provided the last mode was not the Audio mode) the part will be in the USB2 mode. The USB2 switches will be ON and the USB1 and audio switches will be OFF.

If C1 and C0 = Logic "1" (HIGH) the part will be in the Audio mode. The audio switches will be ON and the USB switches will be OFF.

If C1 = Logic "1" (HIGH) and C0 are = Logic "0" (LOW), (provided the last mode was the Audio mode) the part will be in the Audio mute mode. The audio switches, USB1 switches and the USB2 switches will be OFF. In this mode, a 1k $\Omega$  shunt is connected on the COM side of the switch for improved isolation when driving 10k $\Omega$  to 20k $\Omega$  amplifier loads.

### Audio Inputs

The evaluation board has two audio inputs labeled AUDIO LEFT (J16 or J17) and AUDIO RIGHT (J18 or J19). Each of these inputs have a BNC connector wired in parallel with a

RCA jack connector. You can connect an audio source/generator at either the BNC connector or the RCA connector.

In a typical application, the left and right outputs of a stereo source, such as an MP3 player, would be connected to the RCA jacks J16 and J18, respectfully.

Over a signal range of  $\pm 1V$  (0.707V<sub>RMS</sub>), these switches have an extremely low  $r_{ON}$  resistance variation. They can pass ground referenced audio signals with very low distortion ( $<0.05\%$  THD+N) when delivering 15.6mW into a 32 $\Omega$  headphone speaker load. A 3V<sub>P-P</sub> signal is acceptable but performance will degrade.

The audio input channels are AC coupled with 200 $\mu$ F capacitors. These capacitors remove any DC voltage from the audio signals and reference them to ground of the device. These capacitors can be shorted out by installing jumpers at JP14 and JP15.

If the audio source being connected to the evaluation board already has internal AC coupling capacitors at the output of its drivers, then the capacitors on the evaluation board should be shorted out by installing jumpers at JP14 and JP15. This will prevent further attenuation of the low frequency content of the audio signal due to the increase of the high-pass corner frequency resulting from the evaluation board capacitor in series with the audio source capacitor.

### Audio Outputs

The evaluation board has a standard headphone jack labeled HEADPHONE JACK (J20). A 32 $\Omega$  stereo headphone should be plugged into this jack.

The BNC connector J11 (COM-) is in parallel with the audio left line of the headphone jack and the D- line of the J15 (USB To HOST) connector. The BNC connector J12 (COM+) is in parallel with the audio right line of the headphone jack and the D+ line of the J15 (USB To DEVICE) connector. These BNC connectors can be used to connect resistive loads and/or test equipment to evaluate the performance of the IC.

Also in parallel with the COM - and COM + lines are a bank of common audio load resistors (32 $\Omega$ , 10k $\Omega$ , and 20k $\Omega$ ) that can be connected for testing. To connect a resistor, just install the appropriate jumper. For example, to connect the 32 $\Omega$  load to the COM- and COM + lines, you would install jumpers on JP8 and JP13.

### USB Connections

A "B" type USB receptacle labeled "USB TO HOST" (J15) is located on the left side of the board. This receptacle should be connected using a standard USB cable to the upstream USB host controller which is usually a PC computer or hub. When this connection is made, and the part is put in the USB1 mode, the USB1 switches will be turned ON and will be able to communicate with the USB device connected at

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J13 (USB to DEVICE 1). In the USB2 mode, the USB2 switches will be turned ON and the computer will be able to communicate with the USB device connected at J14 (USB to DEVICE 2).

The board has two "A" type USB receptacles located on the right side of the board, labeled USB TO DEVICE 1 (J13) and USB TO DEVICE 2 (J14). USB devices can be plugged directly into these receptacles or through a standard USB cable.

In USB1 mode, the USB host controller and USB device 1 will be connected through the internal USB1 switches of the IC. In USB2 mode, the USB host controller and USB device 2 will be connected through the internal USB2 switches of the IC. The USB switches are bi-directional, which allow the host (computer) and downstream USB device to both send and receive data.

Note: Before connecting the USB host controller at connector J15, the headphones must be removed from the headphone speaker jack, J20. This will prevent the audio load from interfering with USB signal transmission.

The main purpose of the ISL54214 or ISL54217 device is to allow the use of a common USB and Audio Headphone Connector in Personal Media Players and other portable battery powered equipment. Either a headphone will be in the common connector to play music, or a USB cable from a computer will be in the common connector to transmit digital data into and out of the various transceiver sections of the Media Player.

The BNC connector J11 (COM-) is in parallel with the D- line of the J15 USB connector. The BNC connector J12 (COM+) is in parallel with the D+ line of the J15 USB connector.

These BNC connectors can be used to connect test equipment to evaluate the performance of the IC.

TABLE 1. BOARD COMPONENT DEFINITIONS

DESIGNATOR	DESCRIPTION
U1	ISL54214IRTZ or ISL54217IRTZ IC
J15	"B" type USB Receptacle
J13, J14	"A" type USB Receptacle
J16, J17	Left Stereo Audio Input
J18, J19	Right Stereo Audio Input
J20	Headphone Speaker Jack
J11	COM- BNC Connector
J12	COM+ BNC Connector
J1	VDD Positive Connection
J2	VDD GND Connection
J4	C1 Logic Control
J3	C0 Logic Control
J5	VBUS Connection for USB Device 1
J6	VBUS Connection for USB Device 2
JP1, JP2, JP3	D-/D+ Differential Probe Connection
JP4, JP5	Jumpers to Enable S1 (C0) and S2 (C1) Toggle Switches
JP6	Jumper to Enable VBUS voltage from Computer via J15 Connector to USB Device 1
JP7	Jumper to Enable VBUS voltage from Computer via J15 Connector to USB Device 2

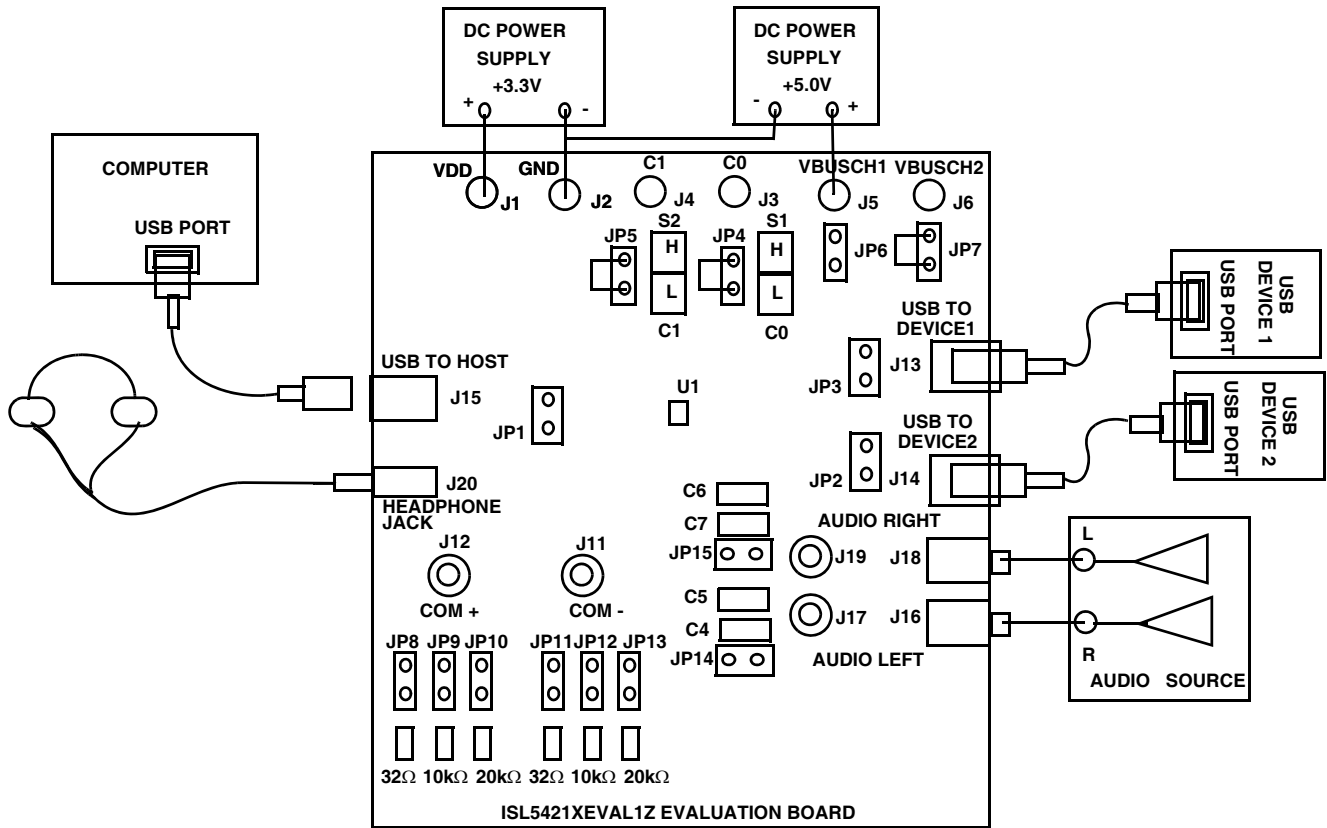


FIGURE 2. BASIC EVALUATION TEST SETUP BLOCK DIAGRAM

## Using The Board (Refer to Figure 2)

### Lab Equipment

The equipment, external supplies and signal sources needed to operate the board are listed in the following:

1. +3V to 5V DC Power Supplies
2. Stereo Audio Source (MP3/Radio/CD Player) or Audio Generator
3. Headphone Set or Audio Analyzer/Oscilloscope
4. Standard USB High-Speed Cables
5. Computer with USB Port
6. Two USB Devices (i.e. USB Memory Stick, MP3 Player with USB Port, etc.)

### Initial Board Setup Procedure

1. Attach the main evaluation board to a DC power supply at J1 (VDD) and J2 (GND). Positive terminal at J1 and negative terminal at J2. The supply should be capable of delivering 3V to 5V and 100mA of current. Set the supply voltage to 3.3V.
2. Connect a DC power supply at J5 (VBUSCH1) and J2 (GND) (positive terminal at J5 and negative terminal at J2). The supply should be capable of delivering 5V and 100mA of current. Set the supply voltage to 5V. This supply provides the required  $V_{BUS}$  voltage for the USB

device connected at J13 (USB TO DEVICE 1). No jumper should be installed on jumper JP6.

3. Install jumpers at JP4, JP5, and JP7. Note: Jumper installed at JP7 will allow the USB device connected at J14 (USB TO DEVICE 2) to get its  $V_{BUS}$  voltage from the computer through connector J15 (USB TO HOST). Jumpers installed at JP4 and JP5 will allow control of the C1 and C0 logic pins by the S2 (C1) and S1 (C0) toggle switches.
4. Connect the stereo audio source left channel to J16 RCA connector or J17 BNC connector and right channel to J18 RCA connector or J19 BNC connector.
5. Connect one USB device to the USB "B" type receptacle, J13 (USB TO DEVICE 1).
6. Connect the other USB device to the USB "B" type receptacle, J14 (USB TO DEVICE 2).

### Audio Mode Operation

1. Install headphone in the headphone jack, J20. No USB cable should be connected at the J15 (USB TO HOST) connector.
2. Logic Control: Put S2 and S1 toggle switches in the "H" (high) position. You will now be in Audio mode (2.3Ω audio switches are ON).
3. Turn the audio source ON. You should hear the music in the headphones.

4. Toggle S1 to the “L” position to mute the audio signal. Return it to the “H” position to play the music.
5. You can observe the audio signals at the output of the IC on an oscilloscope or audio analyzer by using the J11 and J12 BNC connectors. Connect to J11 for left audio and J12 for right audio.

### USB1 Mode Operation

1. Turn OFF audio stereo source.
2. Remove headphone from J20 Headphone Jack.
3. Logic Control: Put S2 and S1 toggle switches in the “L” (low) position. You will now be in ALL OFF mode (All switches of the device will be OFF).
4. Logic Control: Put S2 toggle switch in the “L” (low) position and the S1 toggle switch in the “H” (high) position. You will now be in USB1 mode (6.2Ω USB channel 1 switches are ON).
5. Connect USB cable from computer USB port to the USB “A” type receptacle, J15 (USB TO HOST) on the evaluation board. The computer should indicate that it is connected to the USB device connected at the J13 (USB TO DEVICE 1) connector.
6. You will now be able to send and receive data between the computer and USB device 1.
7. You can observe the D- and D+ USB digital signals on an oscilloscope or other test equipment by connecting to the JP1 and JP3 test points located on the board.
8. Remove the 0Ω resistors R<sub>1</sub> and R<sub>2</sub> when evaluating the performance (i.e. eye diagram, etc.) of the high speed USB signal. Removal of these resistors disconnects the headphone jack (J20), the BNC connectors (J11, J12) and the bank of load resistors (R7, R8, R9, R10, R11, R12, R13, and R14) from the USB differential lines. These components, when connected will degrade the USB signal. These components will not be there in an actual application.

You can switch between the two USB devices by toggling the S2 and S1 switches. It is recommended when switching between USB devices to take both toggle switches to the “L” (low position) momentarily turning all switch channels OFF and then take the appropriate toggle switch to the “H” position to connect the USB device.

If you disconnect the USB cable from J15 and take the S2 and S1 toggle switches to the “H” position, the IC will return to Audio mode. You can now plug the headphone set into the headphone jack, turn the audio source ON to once again play music.

### USB2 Mode Operation

1. Turn OFF audio stereo source.
2. Remove headphone from J20 Headphone Jack.
3. Logic Control: Put S2 and S1 toggle switches in the “L” (low) position. You will now be in ALL OFF mode (All switches of the device will be OFF).

4. Logic Control: Put S2 toggle switch in the “H” (high) position and the S1 toggle switch in the “L” (low) position. You will now be in USB2 mode (6.2Ω USB channel 2 switches are ON).
5. Connect USB cable from computer USB port to the USB “A” type receptacle, J15 (USB TO HOST) on the evaluation board. The computer should indicate that it is connected to the USB device connected at the J14 (USB TO DEVICE 2) connector.
6. You will now be able to send and receive data between the computer and USB device 2.
7. You can observe the D- and D+ USB digital signals on an oscilloscope or other test equipment by connecting to the JP1 and JP2 test points located on the board.
8. Remove the 0Ω resistors R<sub>1</sub> and R<sub>2</sub> when evaluating the performance (i.e. eye diagram, etc.) of the high speed USB signal. Removal of these resistors disconnects the headphone jack (J20), the BNC connectors (J11, J12) and the bank of load resistors (R7, R8, R9, R10, R11, R12, R13, and R14) from the USB differential lines. These components when connected will degrade the USB signal. These components will not be there in an actual application.

You can switch between the two USB devices by toggling the S2 and S1 switches. It is recommended when switching between USB devices to take both toggle switches to the “L” (low position) momentarily turning all switch channels OFF and then take the appropriate toggle switch to the “H” position to connect the USB device.

If you disconnect the USB cable from J15 and take the S2 and S1 toggle switches to the “H” position, the IC will return to Audio mode. You can now plug the headphone set into the headphone jack, turn the audio source ON to once again play music.

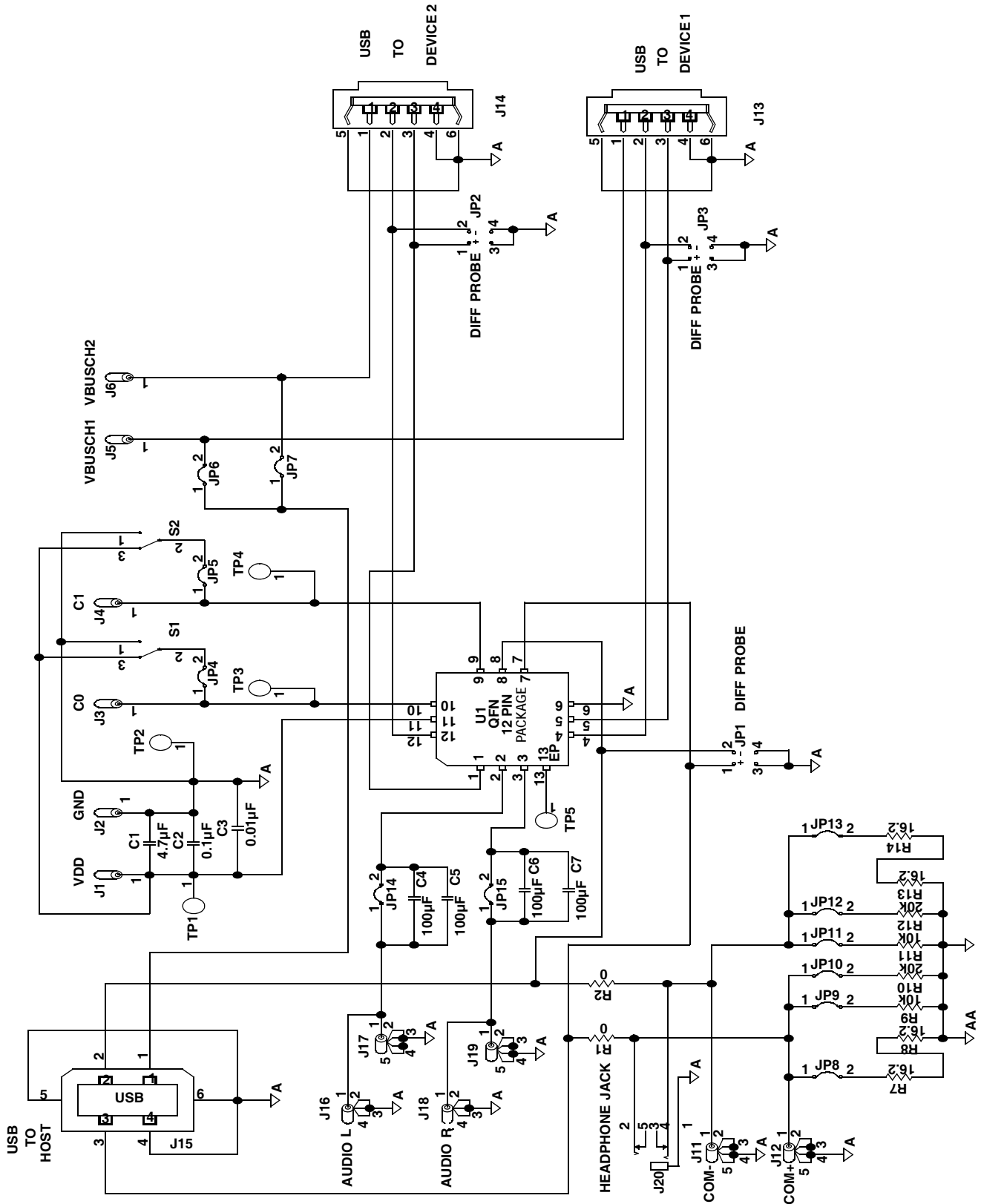
### Test Points

The board has various test points for connecting probes to make measurements. The test points available are described in Table 2.

**TABLE 2. TEST POINT DESCRIPTIONS**

DESIGNATOR	DESCRIPTION
TP1	V <sub>DD</sub> Test Point
TP2	Ground Test Point
TP3	C0 Logic Test Point
TP4	C1 Logic Test Point
TP5	Test Point
JP1	D-/D+ Differential Probe Connection - COM Side of Switch
JP2	D-/D+ Differential Probe Connection - USB Device 2 Side of Switch
JP3	D-/D+ Differential Probe Connection - USB Device 1 Side of Switch

Board Schematic



Intersil Corporation reserves the right to make changes in circuit design, software and/or specifications at any time without notice. Accordingly, the reader is cautioned to verify that the Application Note or Technical Brief is current before proceeding.

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