

## Description

The ISL54208EVAL1Z evaluation board is designed to provide a quick and easy method for evaluating the operation of the ISL54208 USB/CVBS/Audio IC.

The ISL54208 device is a unique IC. To use this evaluation board properly, requires a thorough knowledge of the operation of the IC. Refer to the ISL54208 datasheet for an understanding of the functions and features of the device. Studying the device's truth table along with its pinout diagram on page 2 of the ISL54208 datasheet, 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 ISL54208  $\mu$ TQFN IC is soldered onto the evaluation board. It is located in the center of the board and is designated as U1.

The ISL54208 IC is a dual SPDT analog switch that has two modes of operation: Audio/Video mode and USB mode. The evaluation board contains standard RCA, BNC, and USB connectors to allow the user to easily interface with the IC to evaluate its functions, features, and performance in these two modes of operation.

For example, when the board is properly powered, the video/mono audio outputs of a video MP3 player can be connected at RCA connectors J13 (VIDEO IN) and J15 (MONO AUDIO IN) and the USB output of the player can be connected at the USB connector J12 (USB TO DEVICE) on the board. See Figure 2 on page 4. A TV can be connected at RCA jacks J5 (VIDEO OUT) and J7 (MONO AUDIO OUT) to play the video on the TV. You can then turn-off the video, disconnected the TV, and attach a USB cable from a computer to USB connector J4 (USB TO HOST) to load digital video tracks into the player.

This application note will guide the user through the process of configuring and using the evaluation board to evaluate the ISL54208 device in both the Audio/Video mode and the USB mode.

## Key Features

- Standard USB Connectors
- RCA Audio/Video Input Jacks and BNC Connectors
- Convenient Test Points and Connections for Test Equipment
- $V_{BUS}$  from USB Host Logic Drive Capability

## Picture of Evaluation Board (Top View)

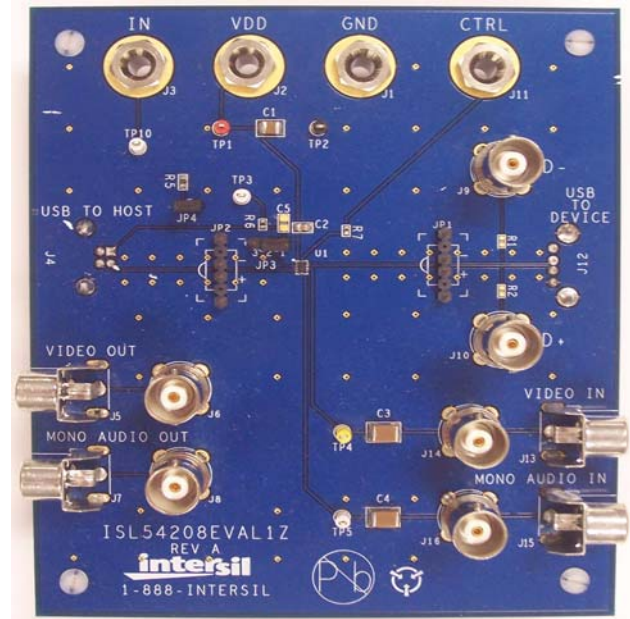


FIGURE 1. ISL54208EVAL1Z EVALUATION BOARD

## Board Architecture/Layout

### Basic Layout of Evaluation Board

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

Power (J2), GND (J1), logic IN (J3) and logic CTRL (J11) banana jack connections are at the top of the board.

Audio/Video Source RCA inputs are at the lower right side of the board (J13 and J15). Audio/Video RCA outputs are at the lower left side of the board (J5 and J7).

A standard “B” type USB connection to an upstream host controller (Computer) is made at connector J4, located on left underside of the board. A standard “A” type USB connection to a downstream USB device is made at connector J12, located on right underside of the board.

Located in the center of the board is the ISL54208 IC (U1). The evaluation board has a pin 1 dot, to show how the IC should be oriented on to the evaluation board. The IC pin 1 indicator dot needs to be aligned with the evaluation board pin 1 dot indicator.

Note: The connectors J5 (VIDEO OUT) and J7 (MONO AUDIO OUT) are connected in parallel to J4 (USB TO HOST). When driving the USB input, the A/V output should be in a high impedance state (and vice versa).

### Power Supply

The DC power supply connected at banana jacks J2 (VDD) and J1 (GND) provides power to the evaluation board. The IC requires a +2.7V to +3.6V 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 ISL54208 device is determined by the voltage at the IN pin and the CTRL pin. Access to the CTRL pin is through the banana jack J11 (CTRL) and access to the IN pin is through the banana jack J3 (IN) if jumper JP3 is in the 2 to 3 position and through the J4 V<sub>BUS</sub> line if jumper JP3 is in the 1 to 2 position.

The following control pins are 1.8V logic compatible which allows for control via a standard  $\mu$ controller.

IN = Logic "0" (LOW) when  $\leq 0.5V$

IN = Logic "1" (HIGH) when  $\geq 1.4V$

CTRL = Logic "0" (LOW) when  $\leq 0.5V$  or Floating

CTRL = Logic "1" (HIGH) when  $\geq 1.4V$

Note: The ISL54208 on the CTRL pin has an internal 4M $\Omega$  pull down resistor while the IN pin has no internal pull-down. The evaluation board has a external 4.3M $\Omega$  pull-down resistor from the IN pin to ground. This pull-down is required if you want to configure the evaluation board to control the ISL54208 device via the V<sub>BUS</sub> of the USB computer. See the "Modifying The EVAL Board TO USE the Computer V<sub>BUS</sub> Voltage To Drive the "IN" Pin" in following section. You can disconnect this external resistor by simply removing jumper JP4 on the evaluation board.

If IN is driven LOW and CTRL is HIGH the part will be in the Audio/Video mode. The NC switches will be ON and the NO switches will be OFF. There will be a low impedance path from VIDEO IN to VIDEO OUT and from MONO AUDIO IN to MONO AUDIO OUT.

If IN is driven HIGH and CTRL = X (don't care) the part will be in the USB mode. The NO switches will be ON and the NC switches will be OFF. There will be a low impedance path from USB TO DEVICE to USB TO HOST.

If IN = LOW and CTRL = LOW the part will be in the Low Power mode. In Low Power mode all switches are OPEN and the IC will draw around 1nA of current.

### MODIFYING THE EVAL BOARD TO USE THE COMPUTER V<sub>BUS</sub> VOLTAGE TO DRIVE THE "IN" PIN

Rather than using a logic controller to control the IN logic pin, you can directly drive the IN pin using the V<sub>BUS</sub> voltage from the computer. Jumper JP3 enables this function. When JP3 is connected on pins 2 and 3, logic control to the IN pin is through the banana jack J3. When JP3 is connected on pins 1 and 2, logic control to the IN pin is through the V<sub>BUS</sub> connection of the USB connector at J4.

When the USB connector at J4 is not connected to a USB port on a computer, the 4.3M $\Omega$  pull-down will pull the IN pin low putting the ISL54208 in the Audio/Video mode or Low Power mode depending on the condition of the CTRL pin.

When a connection to a computer USB host is present on J4, the voltage at the IN pin will be driven to 5V and the part will automatically go into the USB mode.

Note: The voltage at the IN pin can exceed the V<sub>DD</sub> voltage by as much as 2.55V. This allows the V<sub>BUS</sub> voltage from a computer or USB hub (4.4V to 5.25V) to drive the IN pin while the V<sub>DD</sub> voltage is in the range of 2.7V to 3.6V.

### Audio/Video Inputs

The evaluation board has two audio/video inputs labeled VIDEO IN (J13) and MONO AUDIO IN (J15). Each of these inputs have a BNC connector (J14 and J16 respectively) wired in parallel with the RCA connector. You can connect an audio/video source or generator at either the BNC connector or the RCA connector.

In a typical application the composite video output (NTSC or PAL) and the mono audio output of the video source, (i.e. TV, video MP3 Player, digital camera, cellphone, etc.), would be connected to the RCA jacks J13 for video and J15 for mono audio on the evaluation board.

Over a signal range of  $\pm 1V$  (0.707V<sub>RMS</sub>) these switches have an extremely low r<sub>ON</sub> resistance variation (0.03 $\Omega$ ). They can pass ground referenced audio/video signals up to 0.707V<sub>RMS</sub> with very low distortion and degradation. A 3V<sub>P-P</sub> signal is acceptable but performance will degrade.

The audio/video channels are AC-coupled with 100 $\mu$ F capacitors (C<sub>3</sub> and C<sub>4</sub>). These capacitors remove any DC voltage from the audio/video signals and reference them to ground of the device. If the audio/video 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 (replaced with 0 $\Omega$  resistors). 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/video source capacitor.

Note: When in USB mode the audio/video source needs to be in a high impedance state so it will not interfere with the USB signal. Since the audio/video source inputs are AC-coupled on the evaluation board, simply turning the audio/video source OFF will isolate it from interfering with the USB signal.

### Audio/Video Outputs

The evaluation board has RCA type connectors labeled J5 and J7 for A/V output connections. For video playback, a TV monitor should be connected at these connectors using a standard A/V cable. The video input port of the TV should be

connected to VIDEO OUT (J5) and the audio input port of the TV should be connected to MONO AUDIO OUT (J7).

The BNC connector J6 is in parallel with J5 and the D- line of the J4 (USB TO HOST) connector. The BNC connector J8 is in parallel with J7 and the D+ line of the J4 (USB TO HOST) connector. These BNC connectors can be used to connect resistive loads and/or test equipment to evaluate the performance of the IC.

Note: When in USB mode, devices on the audio/video outputs need to be in a high impedance state so it will not interfere with the USB signal, since the USB and A/V connections on the output/upstream side are all wired in parallel.

### USB Connections

A “B” type USB receptacle labeled “USB TO HOST” (J4) is located on the left underside of the board. This receptacle should be connected, using a standard USB cable, to the up-stream USB host controller which is usually a PC computer or hub. When this connection is made and the IN logic control is driven HIGH, the ISL54208 device will go into USB mode. High Speed USB signals can be passed between J4 and J12.

An “A” type USB receptacle labeled USB TO DEVICE (J12) is located on the right underside of the board. The USB device can be plugged directly into this receptacle or through a standard USB cable.

In USB mode the USB host controller and USB device will be connected through the internal NO switches of the IC. The NO switches are bi-directional which allow the host (computer) and downstream USB device to both send and receive data.

JP1 and JP2 permit the connection of differential probes for monitoring of the USB signals. JP1 is used for monitoring on the device side. JP2 is used for monitoring on the host side. In addition, BNC connectors J9 (D-) and J10 (D+) can be connected in parallel to J12 for monitoring the USB signals on the device side using an oscilloscope. Normally, J9 and J10 are not connected to the USB signal path. If the user requires BNC connections to the USB signals on the device side, then R<sub>1</sub> and R<sub>2</sub> on the evaluation board can be

populated with 0Ω resistors. R<sub>1</sub> and R<sub>2</sub> are located between the J9 and J10 BNC connectors.

Note: Before connecting the USB host controller at connector J4, the A/V connections must be disconnected (or set to high impedance) from the VIDEO OUT and MONO AUDIO OUT connectors (J5-J8). This will prevent the audio/video load from interfering with USB signal transmission.

### Application

The main purpose of the ISL54208 device is to allow the use of a common USB and Audio/Video Connector in Personal Media Players and other portable battery powered equipment. Either a TV monitor will be in the common connector to play video or a USB cable from a computer will be in the common connector to transmit digital data, such as music videos or MP3 songs into the memory of the Media Player.

### Board Component Definitions

DESIGNATOR	DESCRIPTION
U1	ISL54208IRUZ IC
J1	Ground Connection
J2	V <sub>DD</sub> Positive Connection
J3	IN Logic Input
J4	“B” type USB Receptacle
J5, J6	VIDEO OUT Outputs
J7, J8	MONO AUDIO OUT Outputs
J9	USB (D-) BNC Connector
J10	USB (D+) BNC Connector
J11	CTRL Logic Input
J12	“A” type USB Receptacle
J13, J14	VIDEO IN Inputs
J15, J16	MONO AUDIO IN Inputs
JP1, JP2	D-/D+ Differential Probe Connection
JP3	V <sub>BUS</sub> Logic Control Connection
JP4	4.3MΩ Pull-Down Disconnect

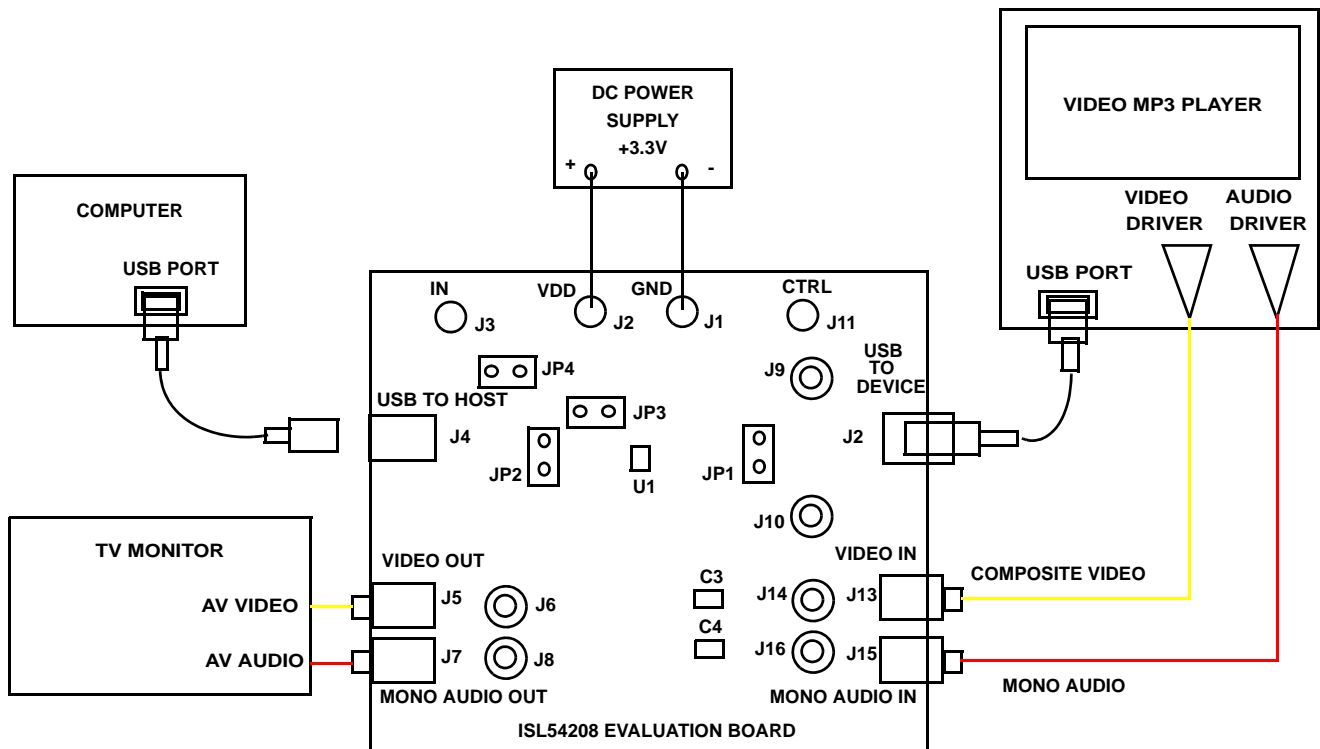


FIGURE 2. BASIC EVALUATION TEST SETUP BLOCK DIAGRAM

## Using The Board (Refer to Figure 2)

### Lab Equipment

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

1. +3V to 5V DC Power Supply
2. Audio/Video Media Player with USB connector (video MP3, digital camera, camcorder) or Audio/Video Generator
3. TV Monitor or Audio/Video Analyzer/Oscilloscope
4. Two standard USB cables
5. Computer with USB port

### Initial Board Setup Procedure

1. Attach the main evaluation board to the DC power supply at J2 ( $V_{DD}$ ) and J1 (GND). Positive terminal at J2 and negative terminal at J1. The supply should be capable of delivering 3V to 5V and 100 $\mu$ A of current. Set the supply voltage to 3.3V.
2. Connect the media player's composite video source to the J13 RCA connector or the J14 BNC connector and the mono audio source to the J15 RCA connector or J16 BNC connector. Set the media player to output either NTSC or PAL composite video signal.
3. Connect the USB port of the media player to the USB "A" type receptacle, J12 (USB TO DEVICE).

### Audio/Video Mode Operation

1. Connect the TV monitor AV video input at J5 (VIDEO OUT) and the AV audio input at J7 (MONO AUDIO OUT). No USB cable should be connected at the J4 (USB TO HOST) connector.
2. Set the TV to receive the video signal through its AV input and set to the appropriate channel.
3. Connect J3 (IN) to J1 (GND) or leave floating if JP4 is connected. Connect J11 (CTRL) to J2 ( $V_{DD}$ ). You will now be in Audio/Video mode (3 $\Omega$  NC switches are ON).
4. Turn the audio/video media player ON. You should hear and see the video on the TV screen.
5. You can observe the audio/video signals at the output of the IC on an oscilloscope or audio/video analyzer by using the J6 and J8 BNC connectors or appropriate test points.

### USB Mode Operation

1. Turn OFF the audio/video from the media player.
2. Disconnect the TV monitor from J5 and J7 RCA or J6 and J8 BNC connectors.
3. Connect J3 (IN) to J2 ( $V_{DD}$ ) or leave floating if JP3 is connected to pins 1 and 2.
4. Connect a USB cable from host (PC computer) to the USB "B" type receptacle, J4 (USB TO HOST). You will now be in USB mode (5 $\Omega$  NO switches are ON).
5. You should now be able to send and receive data between the host and USB device.

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6. You can observe the D- and D+ USB signals on an oscilloscope or other test equipment by connecting to the J6 and J8 BNC connectors. Connect to J6 for D- signal and to J8 for D+ signal.
7. Remove the 0Ω resistors R<sub>3</sub> and R<sub>4</sub> when evaluating the performance (i.e. eye diagram, etc.) of the high speed USB signal. Removal of these resistors disconnects the RCA connectors (J5 and J7) and the BNC connectors (J6 and J8) from the USB differential lines. These components when connected will degrade the USB signal. These components will not be there in an actual application. Note: R<sub>3</sub> and R<sub>4</sub> are located on the underside of the board.

If you disconnect the USB cable from J4 and take the IN pin LOW, the IC will return to Audio mode. You can now plug the TV monitor into J5 and J7, turn the audio/video of the player ON to once again play the music video or movie.

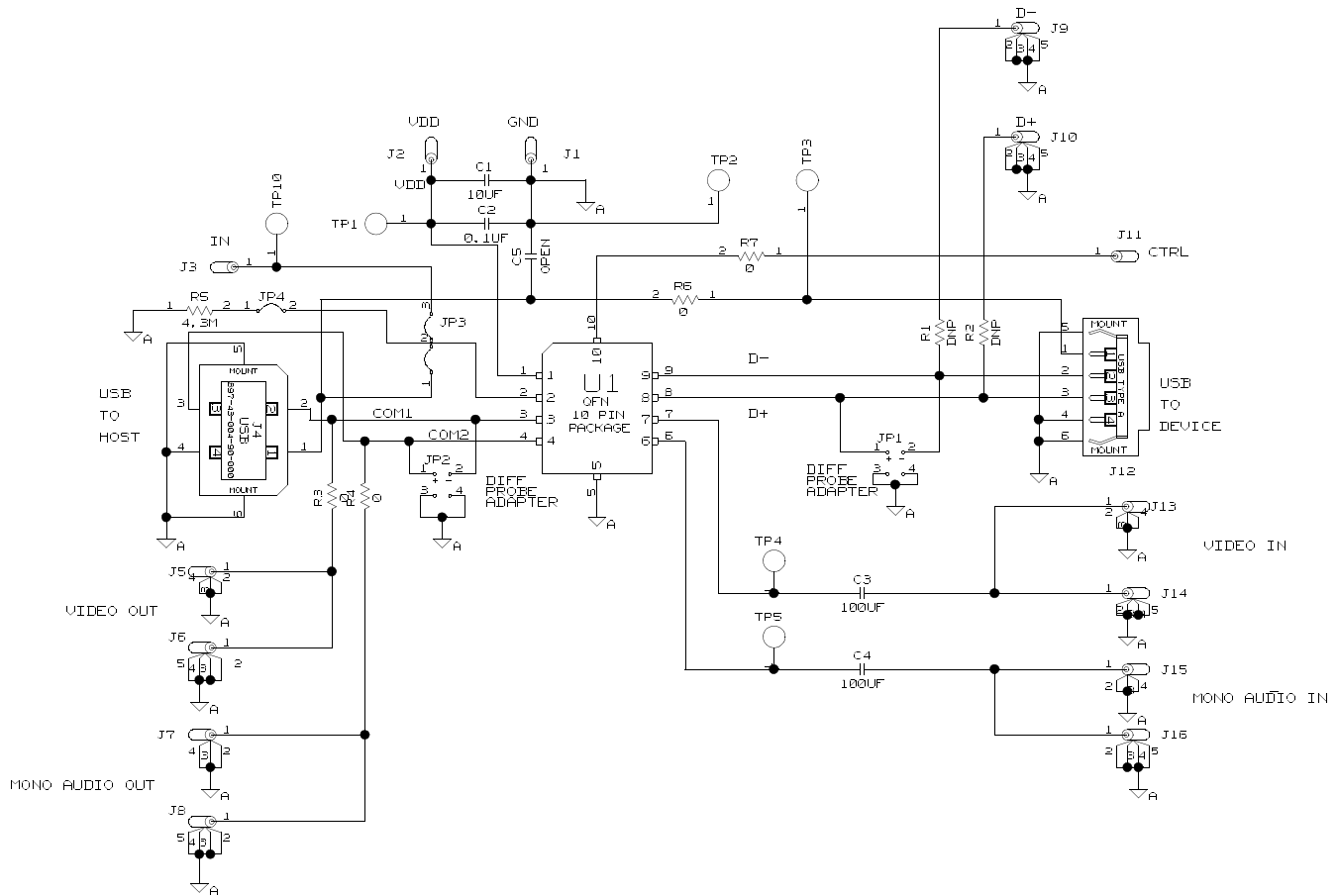
### Test Points

The board has various test points for ease of connecting probes to make measurements. The test points available are described in Table 1.

**TABLE 1. TEST POINTS DESCRIPTIONS**

DESIGNATOR	DESCRIPTION
TP1	V <sub>DD</sub> Test Point
TP2	Ground Test Point
TP3	V <sub>BUS</sub> Test Point
TP4	VIDEO IN Test Point
TP5	MONO AUDIO IN Test Point
JP1	D-/D+ Differential Probe Connection - USB Device Side of Switch
JP2	D-/D+ Differential Probe Connection - HOST 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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