

# ISL54200EVAL1Z

## Evaluation Board User's Manual

AN1330  
Rev 0.00  
June 13, 2007

### Description

The ISL54200EVAL1Z evaluation board is designed to provide a quick and easy method for evaluating the ISL54200 USB Switch IC.

The ISL54200 device is a unique IC. To use this evaluation board properly requires a thorough knowledge of the operation of the IC. Refer to the data sheet for an understanding of the functions and features of the device. Studying the device's truth-table along with its pin-out diagram on page 2 of the data sheet 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 ISL54200  $\mu$ TQFN IC is soldered onto the evaluation board. It is located in the center of the board and is designated as U1.

The evaluation board contains USB connectors to allow the user to easily interface with the IC to evaluate its functions, features, and performance. For example, with the board properly powered and configured as shown in Figure 2 you can control the logic pins, IN and EN, to switch between a high-speed device and a full-speed device while connected to a single USB host (computer).

In a typical application, the ISL54200 dual SPDT device is used to select between two different USB transceiver sections of a media player. Logic control from a  $\mu$ processor determines which section to connect to the computer. To change channels, the following sequence would possibly be followed:

1. A signal would be sent to take the EN pin Low, to open all switches. The off-isolation of the ISL54200 device would allow the present active channel to properly disconnect from the computer.
2. The IN pin would be set to select the other USB channel.
3. The EN pin would then be taken High to close the switches to make the connection between the computer and the other USB section of the player.

This application note will guide the user through the process of configuring and using the evaluation board to evaluate the ISL54200 device.

### Features

- Standard USB Connectors
- Standard Banana Jacks for Power, Ground,  $V_{BUS}$  and Logic Connections
- Jumpers to allow a device to be powered through the Host Controller
- Convenient Test Points and Connections for Test Equipment

### Picture of Evaluation Board (Top View)

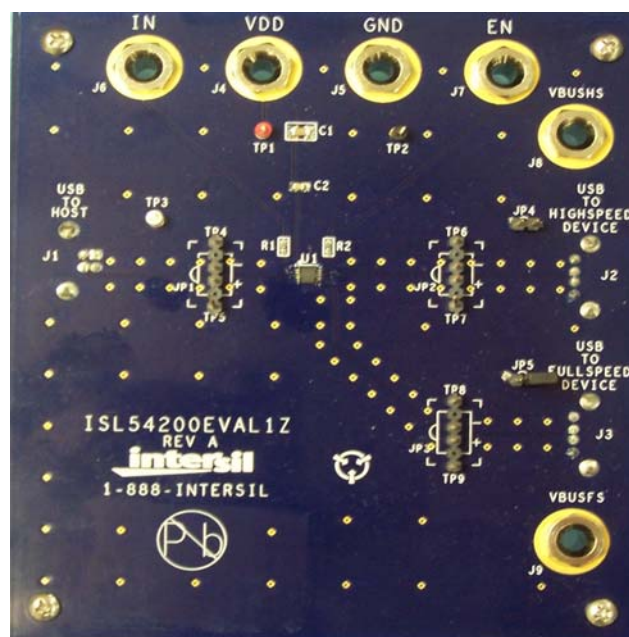


FIGURE 1. ISL54200EVAL1Z EVALUATION BOARD

## Board Architecture/Layout

### Basic Layout of Evaluation Board

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

- Power and Ground connections are at the top of the board at banana jacks (J4 and J5).
- Logic connections, IN and EN, are at the top of the board at banana jacks (J6 and J7).
- USB connection to an upstream host controller (Computer) is made at J1, located on the left under-side of the board.
- USB connections to downstream USB devices are made at connectors J2 and J3, located on right under-side of the board.
- $V_{BUS}$  voltage for the USB devices are made through banana jacks J8 and J9. Optionally,  $V_{BUS}$  for the USB devices can be connected to the Host Controller  $V_{BUS}$  through jumpers JP4 and JP5.
- Located in the center of the board is the ISL54200 IC (U1). The eval 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.

### IC Power Supply

A DC power supply connected at banana jacks J4 (VDD) and J5 (GND) provides power to the ISL54200 IC. The IC requires a 3.3VDC to 5VDC power supply for proper operation. The power supply should be capable of delivering 100 $\mu$ A of current.

### $V_{BUS}$ Power Supply

A DC power supply connected at banana jacks J8 (VBUSHS) and J9 (VBUSFS) provides the  $V_{BUS}$  voltage required by the USB devices. The devices require a DC power supply in the range of 4.4V to 5.25V for proper operation. The power supply should be capable of delivering 100 $\mu$ A of current.

The J8 banana jack is connected to the VBUS pin of the J2 "A" type USB receptacle. The J9 banana jack is connected to the VBUS pin of the J3 "A" type receptacle.

The  $V_{BUS}$  voltage can be provide from the USB host controller (computer) by installing a jumper at either JP4 or JP5.

With a jumper at JP4, the  $V_{BUS}$  voltage from J1 gets routed to the J2 connector. With this jumper installed, no DC supply should be connected at the J8 (VBUSHS) banana jack.

With a jumper at JP5, the  $V_{BUS}$  voltage from J1 gets routed to the J3 connector. With this jumper installed, no DC supply should be connected at the J9 (VBUSFS) banana jack.

### Logic Control

The state of the ISL54200 device is determined by the voltage at the IN pin and the EN pin. Access to the IN pin is through the banana jack J6 (IN) and access to the EN pin is through the banana jack J7 (EN).

If IN is driven Low (to ground) and EN = High (>1.4V), the full-speed (FS) switches will be ON. In this state, the USB host controller (computer) connected at J1 will be connected through to the USB device connected at J3 and data will be able to be transmitted between the computer and the device.

If IN is driven High (>1.4V) and EN = High (>1.4V), the high-speed (HS) switches will be ON. In this state, the USB host controller (computer) connected at J1 will be connected through to the USB device connected at J2 and data will be able to be transmitted between the computer and the device.

If EN = Low (driven to ground or floating), all switches will be OFF. Neither device will be connected through to the host controller.

In a typical application, the ISL54200 dual SPDT device is used to select between two different USB transceiver sections of a media player. Logic control from a  $\mu$ processor determines which section to connect to the computer. To change channels, the following sequence would possibly be followed:

1. A signal would be sent to take the EN pin Low, to open all switches. The off-isolation of the ISL54200 device would allow the present active channel to properly disconnect from the computer.
2. Then the IN pin would be set to select the other USB channel.
3. The EN pin would then be taken High to close the switches to make the connection between the computer and the other USB section of the player.

### USB Connections

A "B" type USB receptacle labeled "USB TO HOST" (J1) is located on the left under-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, the ISL54200 device will connect the computer through to the USB device determined by the voltage at the IN logic control pin.

An "A" type USB receptacle labeled "USB TO HIGH SPEED DEVICE" (J2) is located on the right under-side of the board. The USB device can be plugged directly into this receptacle or through a standard USB cable.

An "A" type USB receptacle labeled "USB TO FULL SPEED DEVICE" (J3) is located on the right under-side of the board. The USB device can be plugged directly into this receptacle or through a standard USB cable.

The USB switches are bi-directional, which allows the host (computer) and downstream USB device to both send and receive data.

### Full-Speed Switches

The two FSx switches (FSD1, FSD2) are bi-directional switches that can pass rail-to-rail signals. When powered with a 3.3V supply, these switches have a nominal  $r_{ON}$  resistance of 7 $\Omega$  over the signal range of 0V to 3.3V. They were

specifically designed to pass USB full-speed (12Mbps) differential signals and meet the USB 2.0 full-speed signal quality specifications.

The FSx switches can also pass USB high speed signals (480Mbps) but do not quite meet the USB 2.0 high speed signal quality eye diagram compliance requirement.

The maximum signal range for the FSx switches is from -1.5V to  $V_{DD}$ . The signal voltage should not be allowed to exceed the  $V_{DD}$  voltage rail or go below ground by more than -1.5V.

When operated with a 3.3V to 3.6V supply, the FSx switches are active (turned ON) whenever the IN logic control voltage is  $\leq 0.5V$  and the EN logic voltage is  $\geq 1.4V$ .

### High-Speed Switches

The two HSx switches (HSD2, HSD1) are bi-directional switches that can pass rail-to-rail signals. When powered with a 3.3V supply, these switches have a nominal  $r_{ON}$  of  $4.5\Omega$  over the signal range of 0V to 400mV with a  $r_{ON}$  flatness of  $0.4\Omega$ . The  $r_{ON}$  matching between the HSD1 and HSD2 switches over this signal range is only  $0.01\Omega$  ensuring minimal impact by the switches to USB high speed signal transitions. As the signal level increases, the  $r_{ON}$  switch resistance increases. At signal level of 3.3V the switch resistance is nominally  $20\Omega$ .

The HSx switches were specifically designed to pass USB 2.0 high-speed (480Mbps) differential signals typically in the range of 0V to 400mV. They have low capacitance and high bandwidth to pass the USB high-speed signals with minimum edge and phase distortion to meet USB 2.0 high speed signal quality specifications.

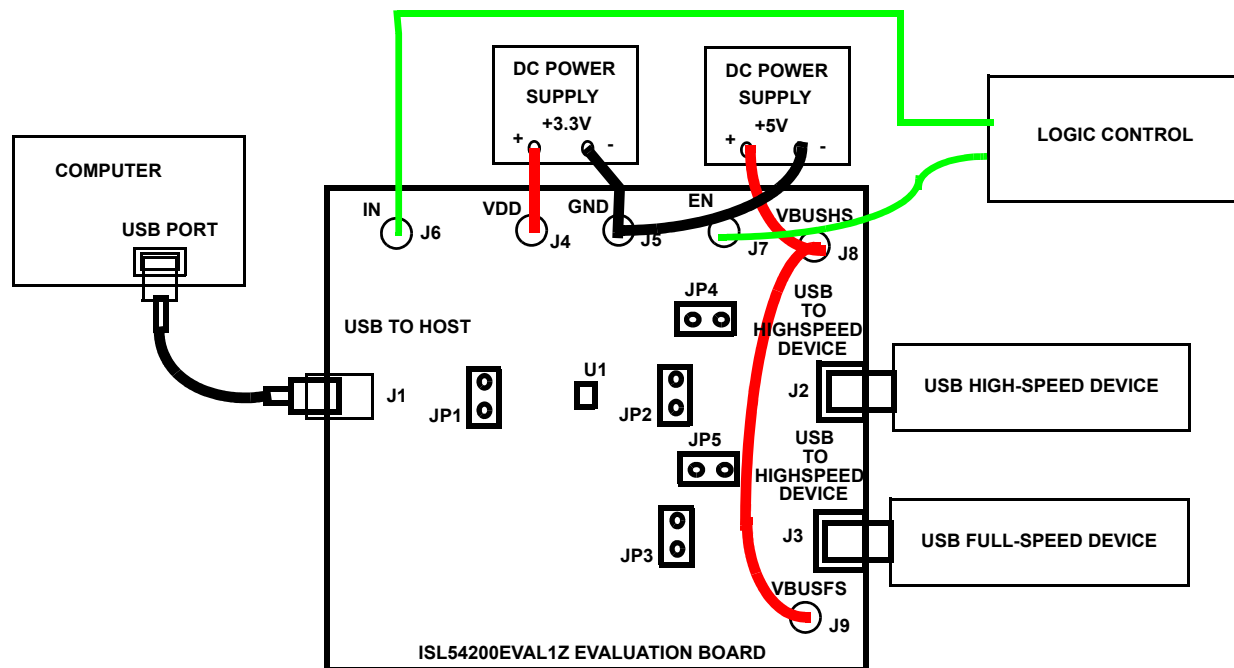
The HSx switches can also pass USB full-speed signals (12Mbps) with minimal distortion and meet all the USB requirements for USB 2.0 full-speed signaling.

The maximum signal range for the HSx switches is from -1.5V to  $V_{DD}$ . The signal voltage should not exceed the  $V_{DD}$  voltage rail or go below ground by more than -1.5V.

The HSx switches are active (turned ON) whenever the IN voltage is  $\geq 1.4V$  and the EN logic voltage  $\geq 1.4V$  when operated with a 3.3V to 3.6V supply.

### Board Component Definitions

DESIGNATOR	DESCRIPTION
U1	ISL54200IRUZ IC
J1	"B" type USB Receptacle
J2, J3	"A" type USB Receptacle
J4	VDD Positive Connection
J5	VDD Negative Connection
J6	IN Logic Control
J7	EN Logic Control
J8	VBUS Voltage for Highspeed Device
J9	VBUS Voltage for Fullspeed Device
JP1, JP2, JP3	D-/D+ Differential Probe Connection
JP4, JP5	Host Controller VBUS Jumper



Note: Disconnect the +5V power supply connected to J8 and J9 when powering through Host Controller Bus.

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 below:

1. +3.3V to +5V DC Power Supply
2. +5V DC Power Supply
3. High-Speed USB device (i.e. USB memory stick, MP3 Player, etc.)
4. Full-Speed USB device (i.e. USB memory stick, Mouse, etc.)
5. Computer with 2.0 High-Speed USB port
6. Standard USB cable
7. Logic Controller

### Initial Board Setup Procedure

1. Attach the main evaluation board to a DC power supply at J4 (VDD) and J5 (GND). Positive terminal at J4 and negative terminal at J5. The supply should be capable of delivering 3.3V to 5V and 100 $\mu$ A of current. Set the supply voltage to 3.3V.
2. Connect a DC power supply at J8 (VBUSHS) and J9 (VBUSFS). Positive terminal at J8 and J9 and negative terminal at J5 (GND). The supply should be capable of delivering 5V and 100mA of current. Set the supply voltage to 5V. This supply will provide 5V at the V<sub>BUS</sub> pin of the USB "A" type connectors, J8 and J9.

3. Connect a high-speed USB device at USB connector J2 and connect a full-speed USB device at USB connector J3. These connectors are located on the right under-side of the evaluation board.
4. Drive the EN control pin LOW to open all switches of the ISL54200 IC.
5. Connect USB cable from host (PC computer) to the USB "B" type receptacle, J1 (USB TO HOST).

### Full-Speed Device Operation

1. Apply a logic LOW to the IN pin.
2. Apply a logic HIGH to the EN pin.
3. You should now be able to send and receive data between the computer and the full-speed USB device.
4. To disconnect the full-speed device from the computer take the EN pin LOW.

### High-Speed Device Operation

1. Apply a logic HIGH to the IN pin.
2. Apply a logic HIGH to the EN pin
3. You should now be able to send and receive data between the computer and high-speed USB device.

## 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.

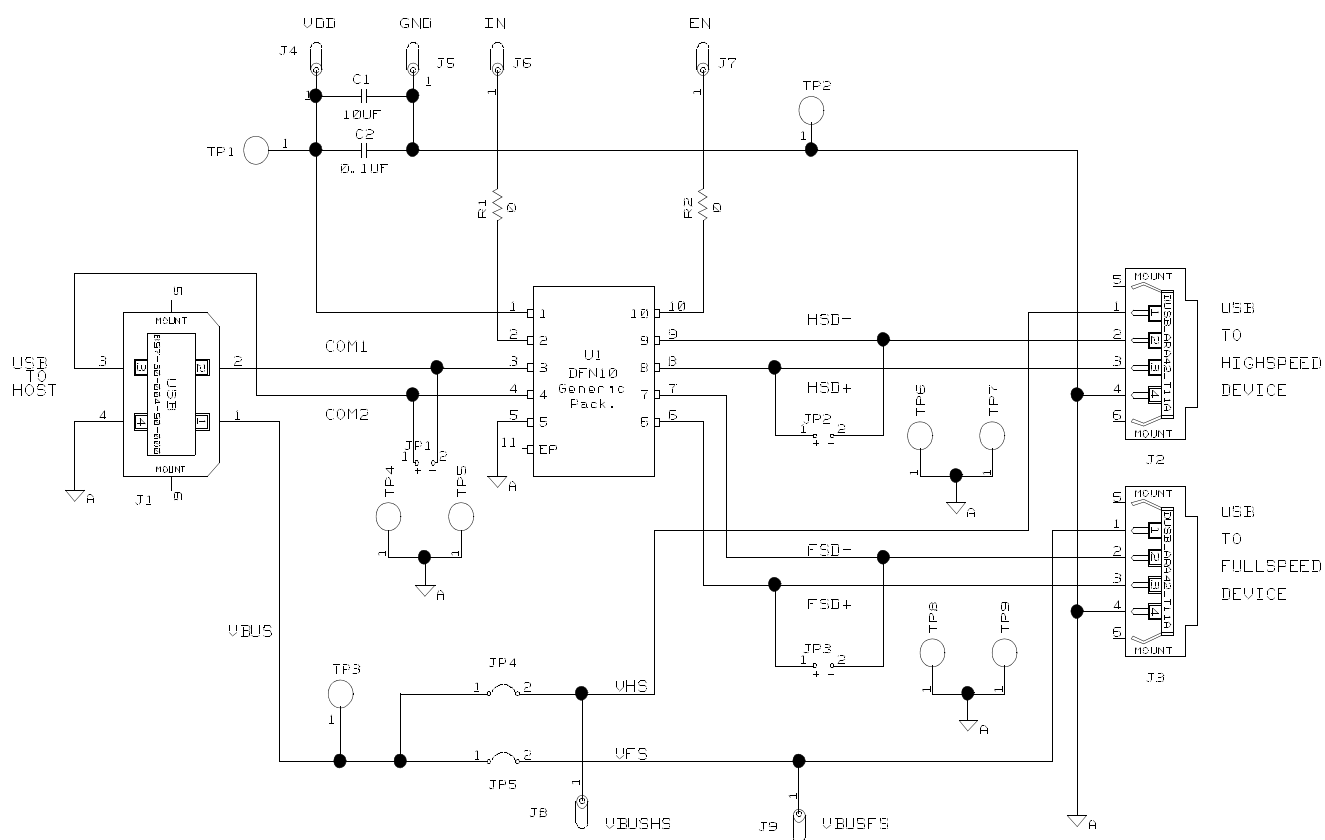
DESIGNATOR	DESCRIPTION
TP1	V <sub>DD</sub> test point
TP2, TP4, TP5, TP6, TP7, TP8, TP9	Ground Test Point
TP3	VBUS Test Point From Computer
JP1	D-/D+ Differential Probe Connection - COM Side of Switch
JP2	D-/D+ Differential Probe Connection - High-Speed Device Side of Switch
JP3	D-/D+ Differential Probe Connection - Full-speed Device Side of Switch

You can observe the D- and D+ USB signal of the full-speed channel on an oscilloscope or other test equipment by connecting a differential probe at JP3.

You can observe the D- and D+ USB signal of the high-speed channel on an oscilloscope or other test equipment by connecting a differential probe at JP2.

You can observe the D- and D+ USB signal at the COM side of the switch on an oscilloscope or other test equipment by connecting a differential probe at JP1.

## ISL54200EVAL1Z Board Schematic



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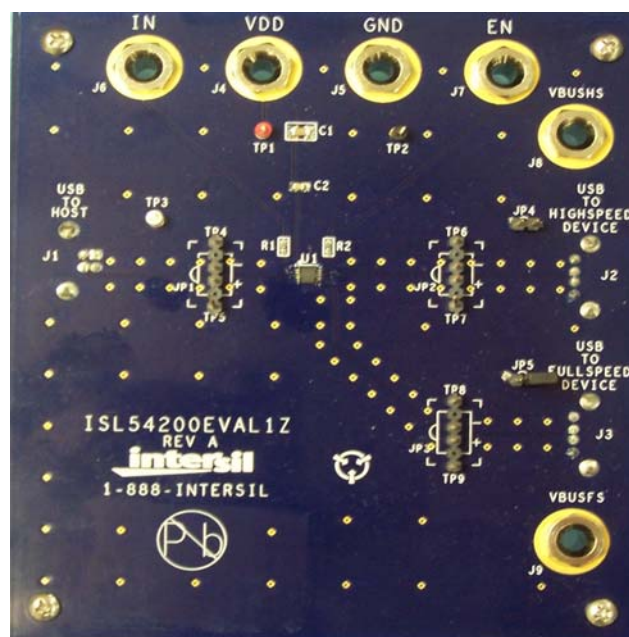


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### USB Connections

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An "A" type USB receptacle labeled "USB TO HIGH SPEED DEVICE" (J2) is located on the right under-side of the board. The USB device can be plugged directly into this receptacle or through a standard USB cable.

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When operated with a 3.3V to 3.6V supply, the FSx switches are active (turned ON) whenever the IN logic control voltage is  $\leq 0.5V$  and the EN logic voltage is  $\geq 1.4V$ .

### High-Speed Switches

The two HSx switches (HSD2, HSD1) are bi-directional switches that can pass rail-to-rail signals. When powered with a 3.3V supply, these switches have a nominal  $r_{ON}$  of  $4.5\Omega$  over the signal range of 0V to 400mV with a  $r_{ON}$  flatness of  $0.4\Omega$ . The  $r_{ON}$  matching between the HSD1 and HSD2 switches over this signal range is only  $0.01\Omega$  ensuring minimal impact by the switches to USB high speed signal transitions. As the signal level increases, the  $r_{ON}$  switch resistance increases. At signal level of 3.3V the switch resistance is nominally  $20\Omega$ .

The HSx switches were specifically designed to pass USB 2.0 high-speed (480Mbps) differential signals typically in the range of 0V to 400mV. They have low capacitance and high bandwidth to pass the USB high-speed signals with minimum edge and phase distortion to meet USB 2.0 high speed signal quality specifications.

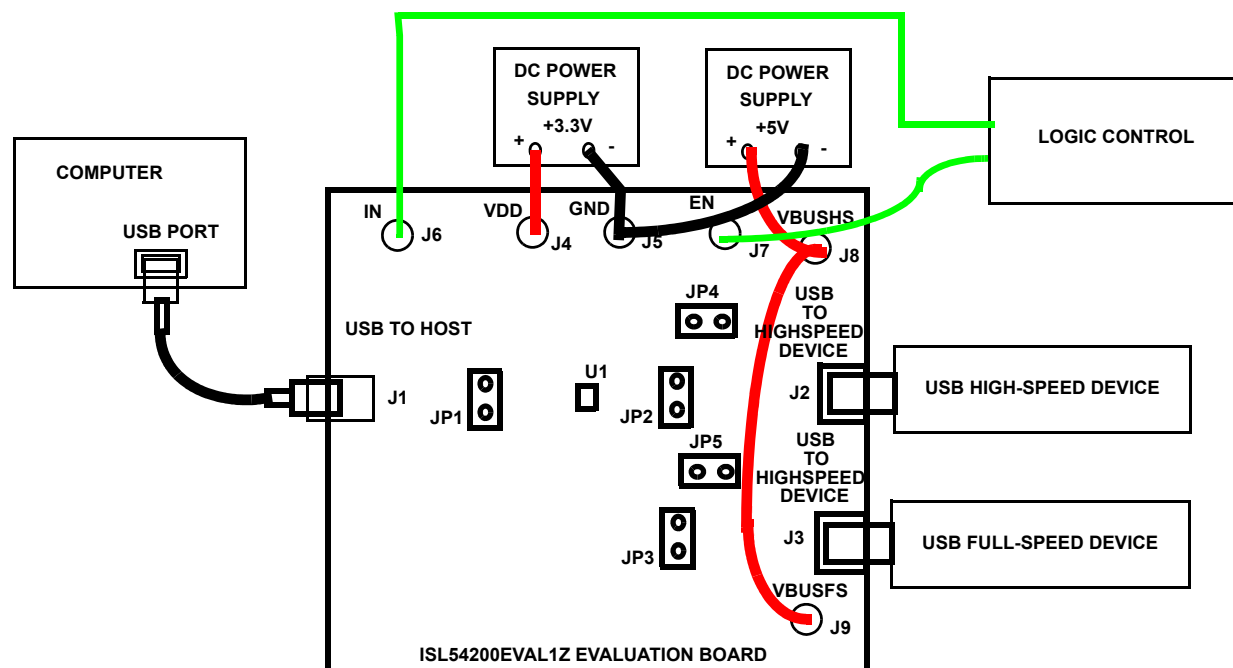
The HSx switches can also pass USB full-speed signals (12Mbps) with minimal distortion and meet all the USB requirements for USB 2.0 full-speed signaling.

The maximum signal range for the HSx switches is from -1.5V to  $V_{DD}$ . The signal voltage should not exceed the  $V_{DD}$  voltage rail or go below ground by more than -1.5V.

The HSx switches are active (turned ON) whenever the IN voltage is  $\geq 1.4V$  and the EN logic voltage  $\geq 1.4V$  when operated with a 3.3V to 3.6V supply.

### Board Component Definitions

DESIGNATOR	DESCRIPTION
U1	ISL54200IRUZ IC
J1	"B" type USB Receptacle
J2, J3	"A" type USB Receptacle
J4	VDD Positive Connection
J5	VDD Negative Connection
J6	IN Logic Control
J7	EN Logic Control
J8	VBUS Voltage for Highspeed Device
J9	VBUS Voltage for Fullspeed Device
JP1, JP2, JP3	D-/D+ Differential Probe Connection
JP4, JP5	Host Controller VBUS Jumper



Note: Disconnect the +5V power supply connected to J8 and J9 when powering through Host Controller Bus.

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 below:

1. +3.3V to +5V DC Power Supply
2. +5V DC Power Supply
3. High-Speed USB device (i.e. USB memory stick, MP3 Player, etc.)
4. Full-Speed USB device (i.e. USB memory stick, Mouse, etc.)
5. Computer with 2.0 High-Speed USB port
6. Standard USB cable
7. Logic Controller

### Initial Board Setup Procedure

1. Attach the main evaluation board to a DC power supply at J4 (VDD) and J5 (GND). Positive terminal at J4 and negative terminal at J5. The supply should be capable of delivering 3.3V to 5V and 100 $\mu$ A of current. Set the supply voltage to 3.3V.
2. Connect a DC power supply at J8 (VBUSHS) and J9 (VBUSFS). Positive terminal at J8 and J9 and negative terminal at J5 (GND). The supply should be capable of delivering 5V and 100mA of current. Set the supply voltage to 5V. This supply will provide 5V at the V<sub>BUS</sub> pin of the USB "A" type connectors, J8 and J9.

3. Connect a high-speed USB device at USB connector J2 and connect a full-speed USB device at USB connector J3. These connectors are located on the right under-side of the evaluation board.
4. Drive the EN control pin LOW to open all switches of the ISL54200 IC.
5. Connect USB cable from host (PC computer) to the USB "B" type receptacle, J1 (USB TO HOST).

### Full-Speed Device Operation

1. Apply a logic LOW to the IN pin.
2. Apply a logic HIGH to the EN pin.
3. You should now be able to send and receive data between the computer and the full-speed USB device.
4. To disconnect the full-speed device from the computer take the EN pin LOW.

### High-Speed Device Operation

1. Apply a logic HIGH to the IN pin.
2. Apply a logic HIGH to the EN pin
3. You should now be able to send and receive data between the computer and high-speed USB device.

## 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.

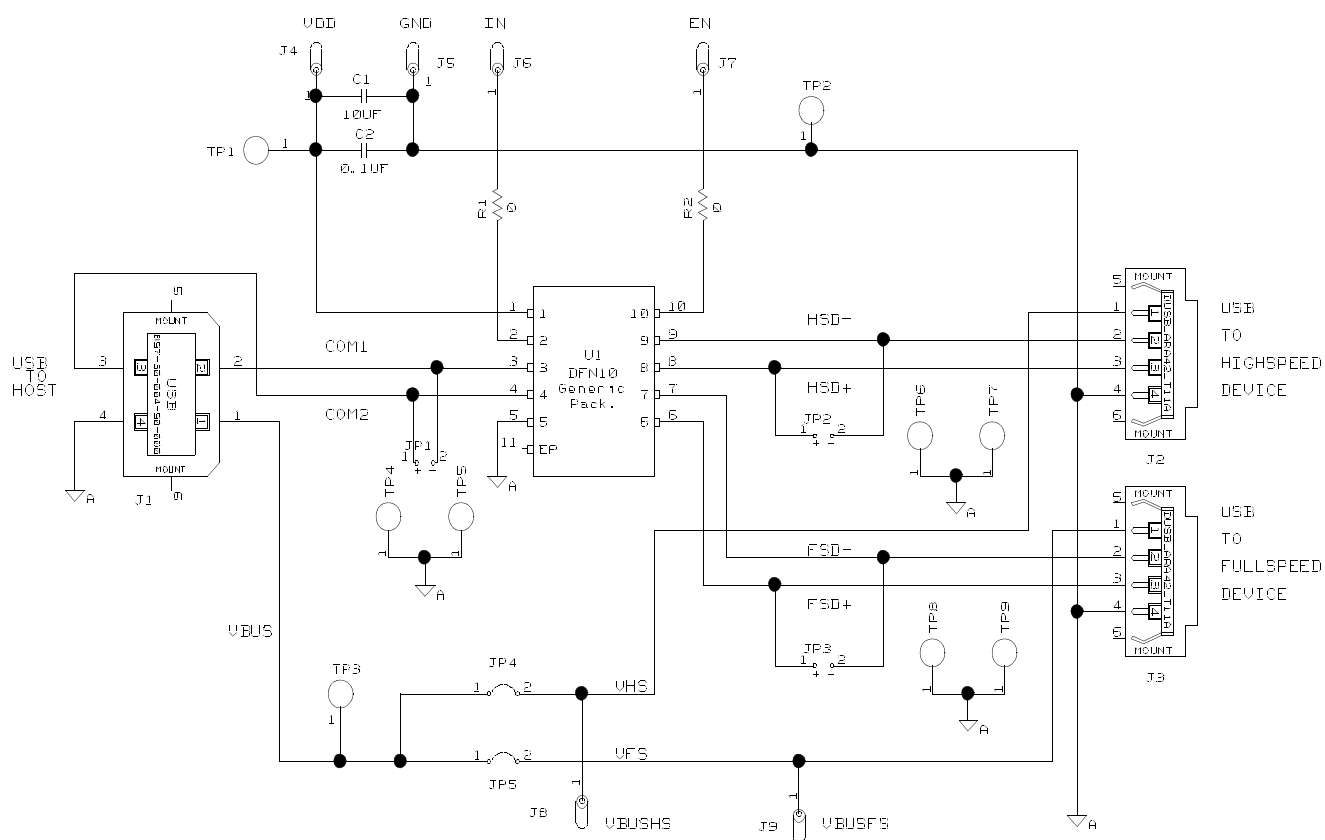
DESIGNATOR	DESCRIPTION
TP1	V <sub>DD</sub> test point
TP2, TP4, TP5, TP6, TP7, TP8, TP9	Ground Test Point
TP3	VBUS Test Point From Computer
JP1	D-/D+ Differential Probe Connection - COM Side of Switch
JP2	D-/D+ Differential Probe Connection - High-Speed Device Side of Switch
JP3	D-/D+ Differential Probe Connection - Full-speed Device Side of Switch

You can observe the D- and D+ USB signal of the full-speed channel on an oscilloscope or other test equipment by connecting a differential probe at JP3.

You can observe the D- and D+ USB signal of the high-speed channel on an oscilloscope or other test equipment by connecting a differential probe at JP2.

You can observe the D- and D+ USB signal at the COM side of the switch on an oscilloscope or other test equipment by connecting a differential probe at JP1.

## ISL54200EVAL1Z Board Schematic



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