

USB2 Redriver Configuration



TI Precision Labs – USB

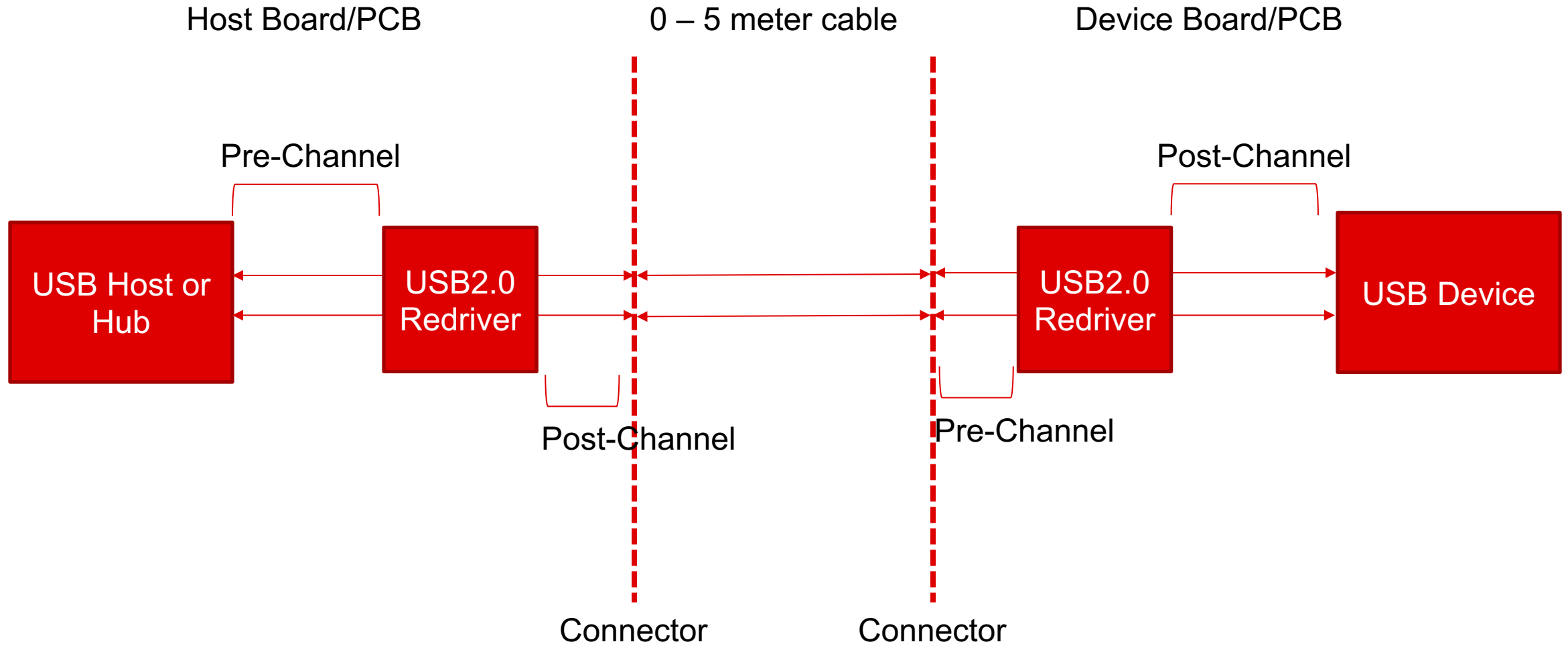
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USB2.0 redriver implementations

- USB2.0 redrivers have been implemented in a variety of systems which make use of USB2.0 signals over long distances for communication between multiple devices.
- These USB2.0 redrivers can come with a variety of settings that can be used to fine tune the amount of compensation that is given to a signal that is boosted, ensuring it is not under or over-boosted.
- Configuring a USB2.0 redriver can be done in many different ways, ranging from placing the redriver at the right location in a system, to configuring certain settings on the redriver to properly match a system's needs.

USB2.0 redriver placement/block diagram

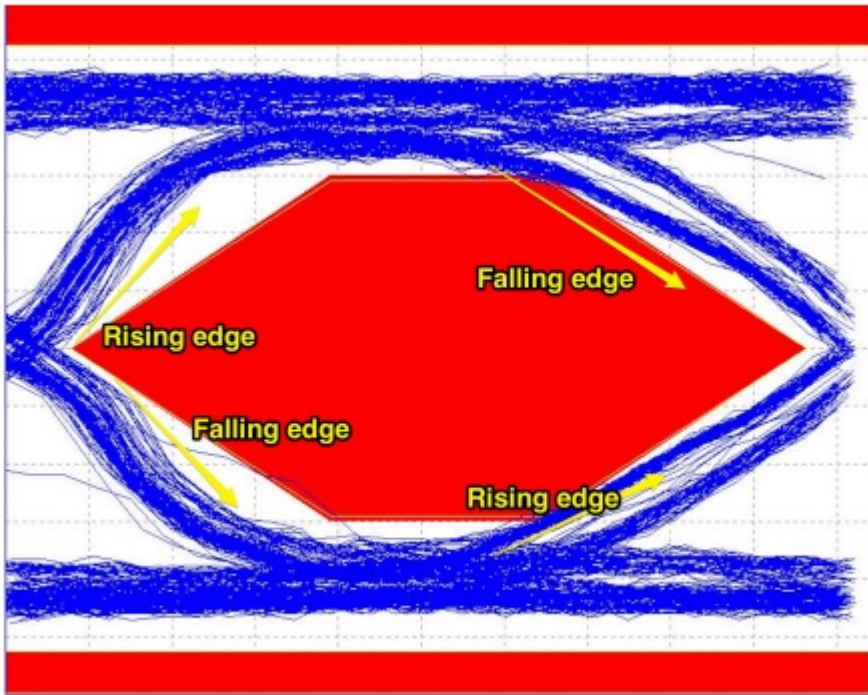


USB2.0 redriver pin settings

- In addition to the placement of the redriver, there are also various settings that can be configured via pin-strap or I2C to fine-tune the amount of loss that is reduced when passing through the redriver, such as:
 - **DC boost (DC_BOOST)** – Broadband gain.
 - **AC boost (EQ)** – High frequency gain or “edge boost”.
 - **Combination boost (BOOST)** – Combination of AC and DC boost
 - **Rx sensitivity (RX_SEN)** – Improves the receiver sensitivity and helps compensate for inter-symbol interference (ISI) jitter in longer applications.

Pin settings: EQ (AC boost)

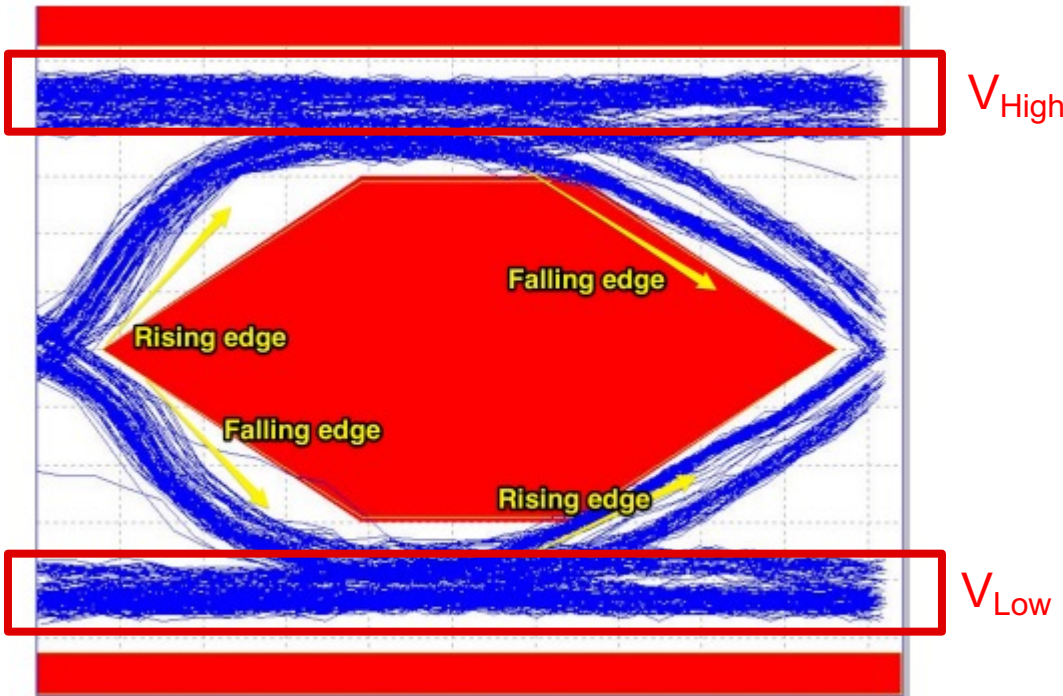
- In some redrivers, AC boost can be controlled via the EQ pin. This pin can be pulled down with a pull-down resistor (R_{eq}) to set the level of AC boost.



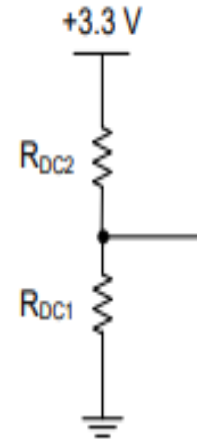
AC Boost Level	R_{eq}
0	0K Ω
1	1.69K Ω
2	3.83K Ω
3	DNI

Pin settings: DC boost (DC_BOOST)

- In some redrivers, DC boost can be controlled via the DC_BOOST pin. This pin samples the voltage coming into it from a voltage divider to determine the DC Boost level.



DC Boost Level	R_{dc1}	R_{dc2}
Low (40mV)	22 k Ω – 47 k Ω	DNI
Mid (60mV)	DNI	DNI
High (80mV)	DNI	22 k Ω – 47 k Ω



Pin setting: combination boost (BOOST)

- The BOOST pin controls both the AC and DC boost aspects of the redriver, and is configured in GPIO mode by pulling the pin down to ground with varying values of a pull-down resistor (R_{boost}).

BOOST level	R_{boost}
0	0 Ω
1	1.8k Ω
2	3.6k Ω
3	DNI/FLOAT

Pin settings: RX sensitivity

- RX sensitivity is used to increase the vertical eye-heights of eyes at longer cable distances or with greater ISI jitter.

R_{rxsen1}	R_{rxsen2}	RX_SEN level
22 K Ω – 40 K Ω	DNI	Low
DNI	DNI	Medium
DNI	22 K Ω – 40 K Ω	High

Recommended practice for Boost/RX_SEN settings

- Appropriate boost setting values are dependent on the systems constraints, such as cable length, trace length, and number of connectors between the host and the device.
- It is best to follow a recommended starting point for boost settings on a redriver, and then adjusting based on system needs.

Pre-channel Cable Length	AC/DC Boost	RX_SEN
0-3 meters	Level 0	Medium or High
2-5 meters	Level 1	Medium or High
Post-channel Cable Length	AC/DC Boost	RX_SEN
0-2 meters	Level 0	Medium or High
1-4 meters	Level 1	Medium or High

Additional features

- There are also various additional features increase the functionality of your USB2.0 redriver, such as:
 - **Connection Detection (CD)** – Output that indicates a USB device is attached.
 - **USB high-speed detection (ENA_HS)** – Output indicating USB high-speed handshake is complete.
 - **Charging Downstream Port (CDP)** – Enables downstream charging and data transmission with the port. Has a higher charging capacity
 - **Dedicated Charging Port (DCP)** – Same functionality as CDP, but with no data transmission.

Short quiz

- AC boost affects the rising and falling edge of the signal, while DC boost affects the V_{high} and V_{low} levels of the signal.
- The section before the signal goes through the redriver is called the pre-channel, and the section after the redriver is called the post-channel.
- RX sensitivity is used to increase the horizontal eye-width of the signal as compensation at longer distances.

Short quiz

- AC boost affects the rising and falling edge of the signal, while DC boost affects the V_{high} and V_{low} levels of the signal.
 - True
- The section before the signal goes through the redriver is called the pre-channel, and the section after the redriver is called the post-channel.
 - True
- RX sensitivity is used to increase the horizontal eye-width of the signal as compensation at longer distances.
 - False



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