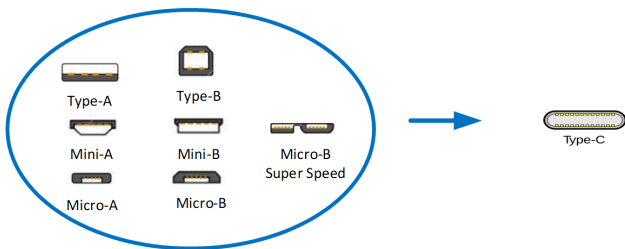


# Enabling USB Type-C Downstream Ports for USB3.1/3.2 Hubs



Over the last two decades, USB has become the most ubiquitous PC connectivity standard for a wide range of devices with ever increasing data rates. Traditionally, USB hosts are equipped with standard Type-A connectors while devices have any one of several Type-B connectors. Some applications will see the need to expand their USB host signals to multiple ports, so a USB hub will be necessary. USB Type-C is a cable and connector standard featuring a reversible cable and flippable, small form-factor connector with enhanced power delivery capability. It was designed to be future-proof and replace all existing Type-A and Type-B connectors for improved ease of use.

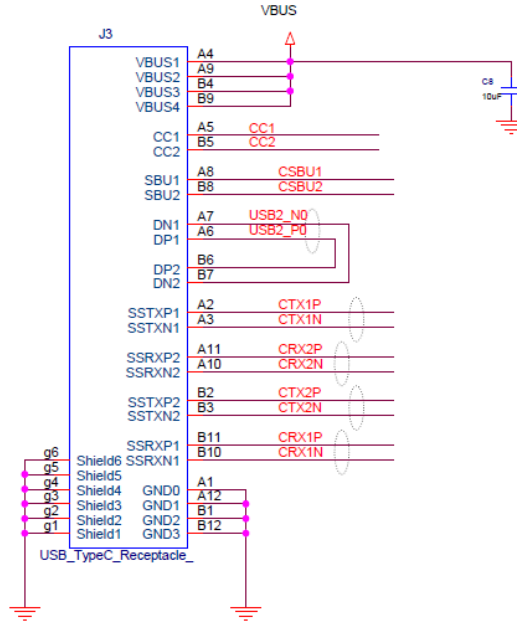


**Figure 1. Standard USB Connectors Are Replaceable With a USB Type-C Connector**

Support for USB 3.1 or USB3.2 Gen 1 (5 or 10 Gbps) is included while maintaining backward compatibility with USB 3.0 and USB 2.0. The 24-pin Type-C connector has two Configuration Channel (CC) pins to support detection of the port attach/detach, connector orientation, port role (host or device), and Type-C VBUS current advertisement mode (500/900mA, 1.5A, and 3.0A). Only a single CC pin is connected through the cable, while the other pin is repurposed after CC detection to supply power (VCONN) to any electronics within the local plug. At a minimum, a Type-C port must support port attach/detach detection, VCONN power, and USB 2.0 data.

To support flippability, the connector has two sets of USB 2.0 data signals and two sets of USB SuperSpeed Tx/Rx signals as shown in Figure 3. The USB 2.0 differential pairs can be connected together with stubs at the receptacle since only one signal pair is physically present in the cable (see Figure 2). Keep in mind that the stub length should not exceed 2.5 mm; otherwise, signal integrity issues may be observed on the USB 2.0 interface. However, the SuperSpeed signals have more stringent signal

integrity requirements and a mux is needed to select the proper connector pins based on the connector orientation detected on the CC pins. Note that a 1 – 2 Mohm pull-down resistor is recommended for the SBU pins.



**Figure 2. USB Type-C Receptacle Schematic**

A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
GND	TX1+	TX1-	VBUS	CC1	D+	D-	SBU1	VBUS	RX2-	RX2+	GND
B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1
GND	RX1+	RX1-	VBUS	SBU2	D-	D+	CC2	VBUS	TX2-	TX2+	GND

**Figure 3. USB Type-C Receptacle Pin Map**  
Source: Courtesy of Type-C Specifications

Because the Type-C connector is common to both host and device applications, there is no mechanical mechanism to prevent two hosts from being connected to each other. To prevent contention, the host must not provide VBUS or VCONN until a device has been detected via the CC pins and must turn off VBUS and VCONN when the device is disconnected. The connection detection scheme is relies on the downstream facing port (i.e. the host) sensing the CC pin voltage level resulting from the pull-down resistor (Rd) on the device CC pin in conjunction with the pull-up resistor or current source on the host.

The building blocks for enabling Type-C on a USB3.0/3.1 downstream port are:

- USB 3.1 capable 2:1 mux.
- VBUS power switch.
- VCONN power switch.
- CC controller/logic to control the mux and power switches.

### 1 One Chip Solution: HD3SS2522 USB Type-C SuperSpeed Mux With DFP Controller

The HD3SS2522 simplifies the addition of Type-C downstream ports by integrating a 2:1 USB 3.1 (up to 10 Gbps) mux with a DFP controller to monitor the Type-C configuration channel (CC) pins to determine plug orientation for mux selection and device attachment for controlling VCONN and VBUS power switches.

Key Features:

- Compliant to USB Type-C Specification v1.1
- Firmware upgradable via I2C Integrated
- Type-C Downstream Facing Port (DFP) controller
- Default, 1.5A, and 3.0A VBUS current mode support. (non-dynamic)
- VCONN support
- 2:1 mux for USB 3.1 signaling.
  - Up to 10 Gbps with wide -3 dB BW of 8 GHz
  - Excellent Dynamic Characteristics at 2.5 GHz
    - Crosstalk: -39 dB
    - Off Isolation: -22 dB

### 2 HD3SS3212 USB Type-C SuperSpeed Mux

The HD3SS3212 is a bidirectional 2:1 USB 3.1 (up to 10 Gbps) mux or demux suited for USB Type-C applications which helps route the SuperSpeed USB data based on the plug orientation.

Key Features:

- 2:1 mux for USB 3.1 signaling.

### 3 TUSB322 USB Type-C CC Logic And Port Control With VCONN

The TUSB322 is dual role port (DRP) controller to monitor the Type-C configuration channel (CC) pins which help determine plug orientation for mux selection and device attachment for controlling VCONN and VBUS power.

Key Features:

- Compliant to USB Type-C Specification v1.1
- Features a Type-C Downstream Facing Port (DFP) as well as Upstream Facing Port (UFP) controller

Legacy designs should already have a VBUS power switch which may be reused for the Type-C application if it meets the advertised VBUS power rating for the port. Likewise, the port's 5V power supply must be able to supply the advertised current for VBUS. Additionally, 1W of power for VCONN is required with a voltage range of 3.0 – 5.5V.

- Insertion Loss: -1.2 dB Input
- Return Loss: -12dB
- Low Active (2 mW) and Standby Power (50 μW) consumption
- Supply Voltage: 3.3V +/- 10%

A typical block diagram showing a HD3SS2522 implementation is shown in Figure 2. The implementation can be duplicated to enable additional Type-C ports.

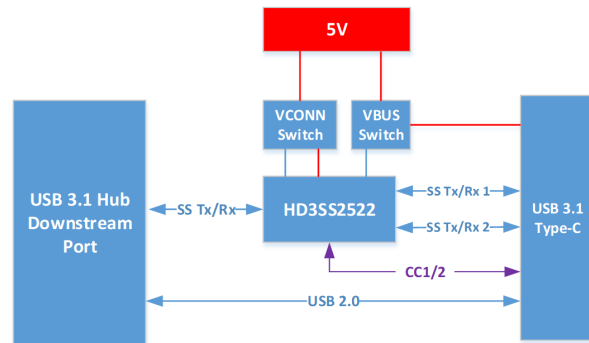
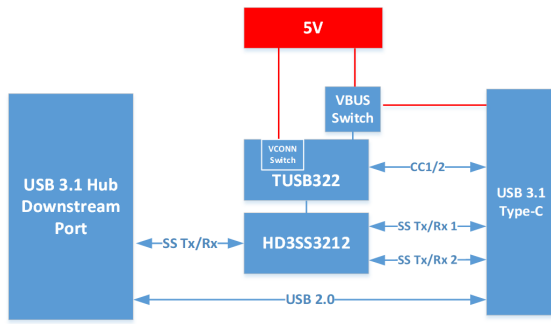


Figure 4. USB Type-C Application Using HD3SS2522

- Up to 10 Gbps with wide -3 dB BW of 8 GHz
- Excellent Dynamic Characteristics at 2.5 GHz
  - Crosstalk: -35 dB
  - Off Isolation: -23 dB
  - Insertion Loss: -0.8 dB Input
  - Return Loss: -13dB
- Low Active (<2 mW) and Standby Power (50 μW) consumption
- Supply Voltage: 3.3V +/- 10% commonly known as dual role port (DRP)
- Default, 1.5A, and 3.0A VBUS current mode support. (non-dynamic)
- VCONN support (integrated VCONN switch)
- Supply Voltage: 4.5V to 5.5V
- Additional features accessed through I2C

An alternate discrete solution of a block diagram showing the TUSB322 + HD3SS3212 implementation is shown in Figure 3. The implementation can be duplicated to enable additional Type-C ports.



**Figure 5. USB Type-C Application Using HD3SS3212 and TUSB322**

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