USB Type-C ENGINEERING CHANGE NOTICE

Title: Alt Mode Cable Clarification
Applied to: USB Type-C Specification Release 1.3, July 14, 2017

Brief description of the functional changes proposed:

Mistakes in the cable connections are present in Chapter 5 and need to be fixed. Chapter 3 is correct.

1. Figure 5-3 in the USB Type-C spec has an error. B11/10 are RX1+/- not RX2+/- and A11/10 are RX2+/- not RX1+/-.
2. Figure 5-4 in the USB Type-C spec has an error. B11/10 are RX1+/- not RX2+/- and A11/10 are RX2+/- not RX1+/-.
3. The text in the first bullet in 5.1.2.2 also has an error.

Benefits as a result of the proposed changes:

Consistency in the spec

An assessment of the impact to the existing revision and systems that currently conform to the USB specification:

None

An analysis of the hardware implications:

None

An analysis of the software implications:

None

An analysis of the compliance testing implications:

None

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(a). Section 5.1.2.2, Table/Figure X-XX (if applicable), Page X-XX

From Text:

5.1.2.2 Alternate Mode Electrical Requirements

Signaling during the use of Alternate Modes shall comply with all relevant cable assembly, adapter assembly and electrical requirements of Chapter 3.

Two requirements are specified in order to minimize risk of damage to the USB SuperSpeed transmitters and receivers in a USB host or device:

- When operating in an Alternate Mode and pin pairs A11, A10 (RX1) and B11, B10 (RX2) are used, these shall be AC coupled in or before the USB Type-C plug.
- When operating in an Alternate Mode then the DC blocking capacitors in the system used on pin pairs A2, A3 (TX1) and B2, B3 (TX2) for USB Superspeed signaling shall also be used for Alt Mode signaling.
- Alternate Mode signals being received at the USB Type-C receptacle shall not exceed the value specified for VTX-DIFF-PP in Table 6-17 of the *USB 3.1* specification.

When in an Alternate Mode, activity on the SBU lines shall not interfere with *USB PD* BMC communications or interfere with detach detection.

The AC coupling requirement results from the use of AC coupling in the *USB 3.1* specification. This requires that the TX signals are AC coupled within the system before the physical connector, but that the RX signals are DC coupled within the system. There is thus just one DC blocking capacitor in each connection between the Superspeed transmitter PHY and the Superspeed receiver PHY. Figure 5-XX shows the key components in a typical Alternate Mode implementation using a Type-C to Type-C full featured cable. This implementation meets the AC coupling requirements, as the capacitors required to be in or before the USB Type-C plug are implemented behind the TX pins in the port partner.

It should be noted that the AC capacitor is placed in the system next to the Type-C receptacle, so that the system components (the orientation switch, the Alternate Mode selection multiplexor, and other system components) operate within the common mode limits set by the local PHY. This applies, in the USB Superspeed operation, to both the transmit path and the receive path within the local system. The receive path is isolated from the common mode of the port partner by the AC cap that is implemented on the TX path in the port partner.

Figure 5-3 Alternate Mode Implementation using a Type-C to Type-C cable

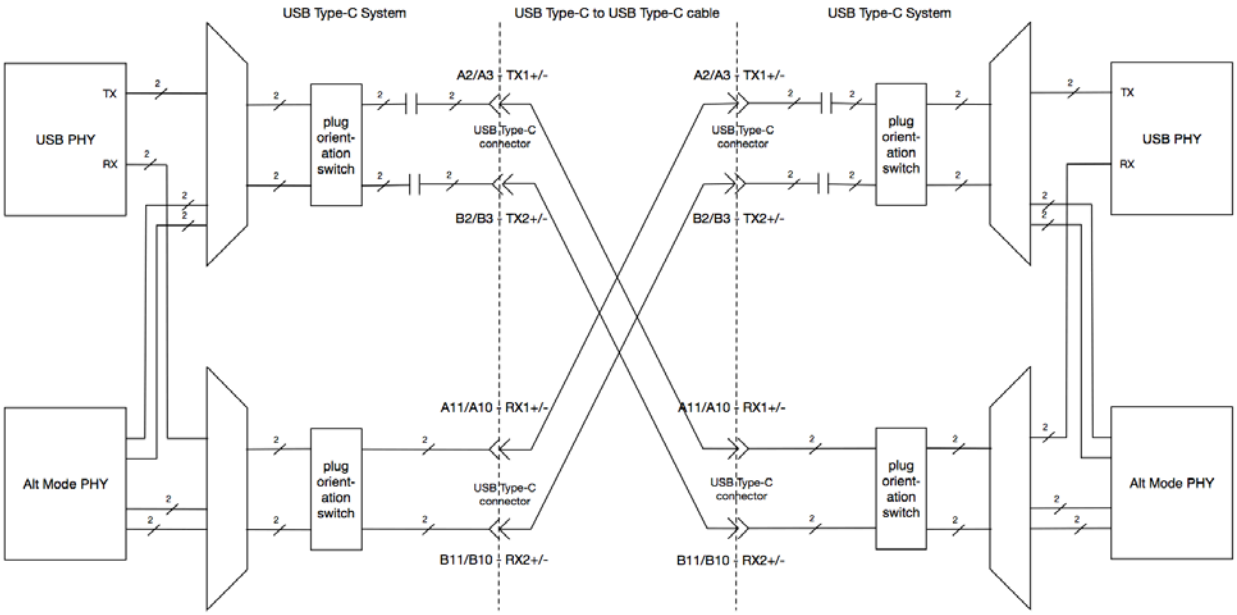
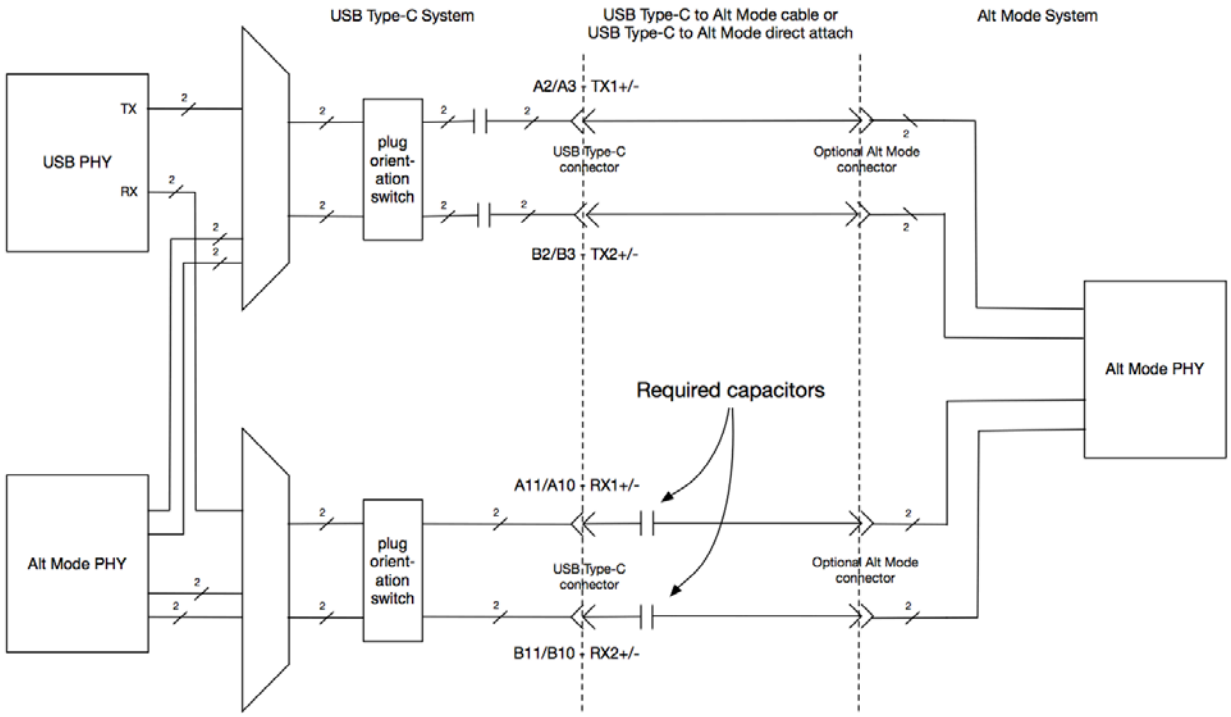


Figure 5-YY shows the key components in a typical Alternate Mode implementation using either a Type-C to Alternate Mode connector cable, or a Type-C Alternate Mode Direct Attach device. In both cases it is necessary that the system path behind the RX pins on the USB receptacle be isolated from external common mode. This requirement is met by incorporating capacitors in or behind the USB Type-C plug on the Alternate Mode cable or Alternate Mode device.

In the case where the Alt Mode System is required to implement DC blocking capacitors within the system between active system components and the Alt Mode connector, then this provides the necessary isolation and further capacitors in the USB Type-C to Alt Mode adapter cable are not necessary, and may indeed impair signal integrity.

Figure 5-4 Alternate Mode Implementation using a Type-C to Alternate Mode cable or device



To Text:

5.1.2.3 Alternate Mode Electrical Requirements

Signaling during the use of Alternate Modes shall comply with all relevant cable assembly, adapter assembly and electrical requirements of Chapter 3.

~~Two Three~~Four requirements are specified in order to minimize risk of damage to the USB SuperSpeed transmitters and receivers in a USB host or device when operating in an Alternate Mode:

- If ~~When operating in an Alternate Mode and pp~~in pairs B~~A~~11, B~~A~~10 (RX1) and A~~B~~11, A~~B~~10 (RX2) are used on a captive cable, ~~these~~ they shall be AC coupled ~~and discharged per *USB 3.2*~~ either before ~~the USB Type-C receptacle in~~ or ~~before~~ in the USB Type-C plug ~~if the cable is captive~~.
- If pin pairs B11, B10 (RX1) and A11, A10 (RX2) are used on a USB Type-C receptacle, they may be AC coupled and discharged per *USB 3.2* before the receptacle.
- AC coupling on ~~When operating in an Alternate Mode then the DC blocking capacitors in the system used on pp~~in pairs A2, A3 (TX1) and B2, B3 (TX2) as defined for USB Superspeed signaling per *USB 3.2* ~~shall~~ shall ~~also~~ be used for Alt Mode signaling.
- ~~Alternate Mode s~~Signals being received at the USB Type-C receptacle shall not exceed the value specified for VTX-DIFF-PP in Table 6-~~17~~ 18 of the ~~*USB 3.1*~~ *USB 3.2* specification.

When in an Alternate Mode, activity on the SBU lines shall not interfere with *USB PD* BMC communications or interfere with detach detection.

The AC coupling requirement ~~results from the use of AC coupling~~are the same as defined in the ~~*USB 3.1*~~ *USB 3.2* specification. Th~~is requires that~~e ~~the~~ TX signals ~~are~~ shall be AC coupled within the system before the physical connector~~. , but that t~~The RX signals may be ~~are~~ DC coupled or AC coupled and discharged within the system. Figure 5-3 shows the key components in a typical Alternate Mode implementation using a Type-C to Type-C full featured cable. This implementation meets the AC coupling requirements, as the capacitors required to be in or before the USB Type-C plug are implemented behind the TX pins in the port partner.

It should be noted that the AC coupling capacitor is placed in the system next to the Type-C receptacle, so that the system components (the orientation switch, the Alternate Mode selection multiplexor, and other system components) operate within the common mode limits set by the local PHY. This applies, in the USB Superspeed operation, to both the transmit path and the receive path within the local system. The receive path is isolated from the common mode of the port partner by the AC coupling capacitors that ~~is~~ are implemented on the TX path in the port partner.

Figure 5-3 Alternate Mode Implementation using a Type-C to Type-C cable

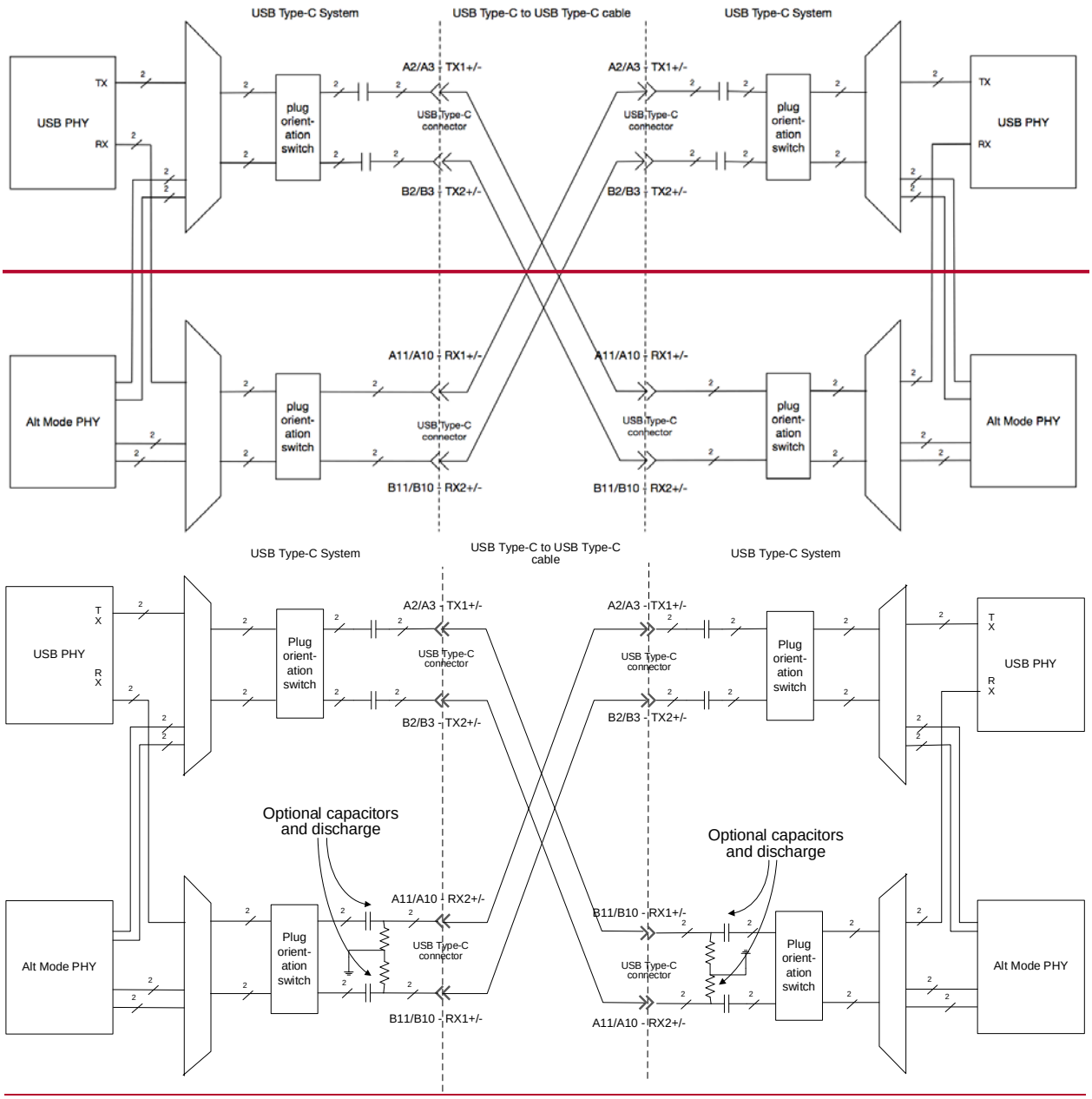
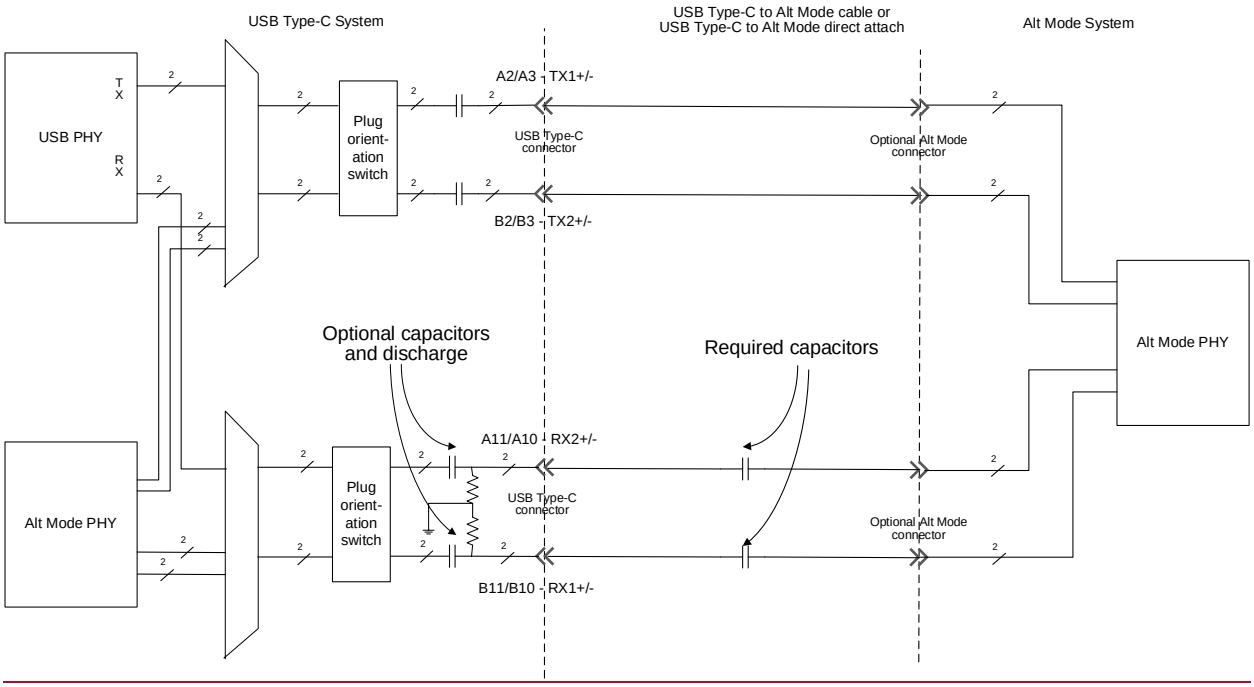
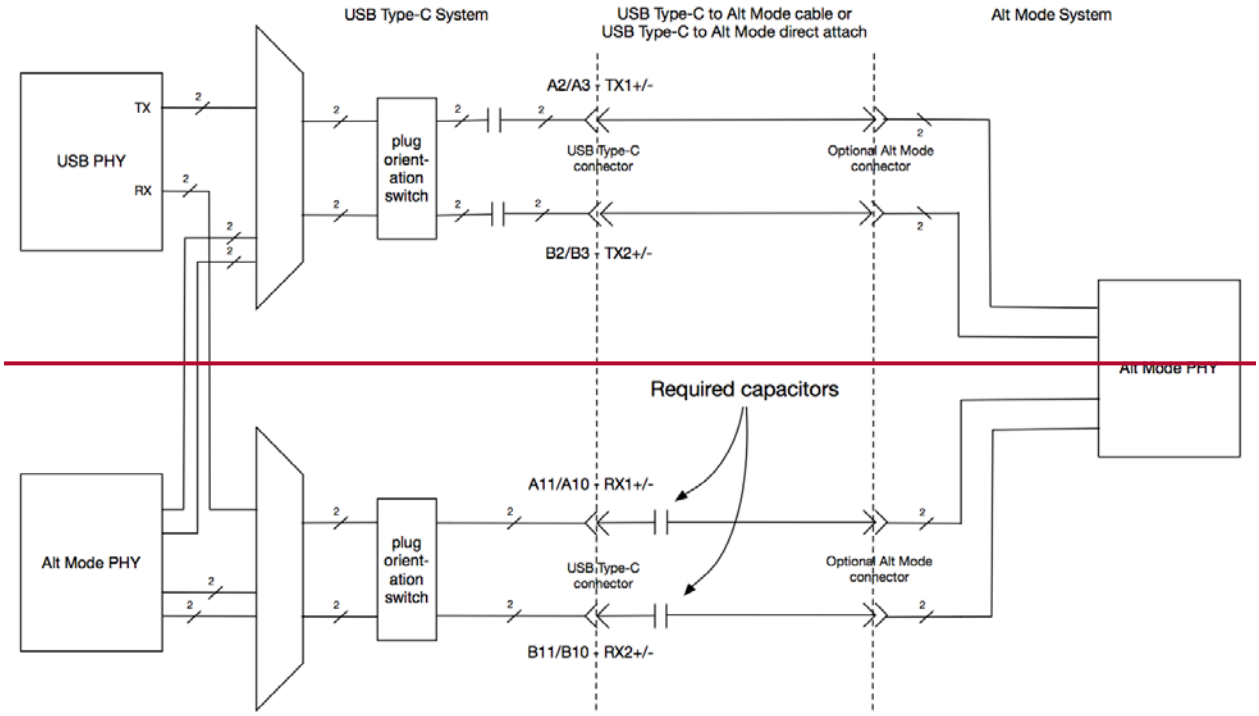


Figure 5-~~YY~~ 4 shows the key components in a typical Alternate Mode implementation using either a Type-C to Alternate Mode connector cable, or a Type-C Alternate Mode Direct Attach device. In both cases it is necessary that the system path behind the RX pins on the USB receptacle be isolated from external common mode. This requirement is met by incorporating capacitors in or behind the USB Type-C plug on the Alternate Mode cable or Alternate Mode device.

In the case where the Alt Mode System is required to implement DC blocking capacitors within the system between active system components and the Alt Mode connector, then this provides the necessary isolation and further capacitors in the USB Type-C to Alt Mode adapter cable are not necessary, and may indeed impair signal integrity.

Figure 5-4 Alternate Mode Implementation using a Type-C to Alternate Mode cable or device


USB Type-C System
USB Type-C to Alt Mode cable or
USB Type-C to Alt Mode direct attach
Alt Mode System
USB PHY
TX
RX
Plug orient-ation switch
A2/A3 - TX1+/-
USB Type-C connector
Optional Alt Mode connector
B2/B3 - TX2+/-
Alt Mode PHY
Optional capacitors and discharge
Required capacitors
A11/A10 - RX2+/-
B11/B10 - RX1+/-


USB Type-C System
USB Type-C to Alt Mode cable or
USB Type-C to Alt Mode direct attach
Alt Mode System
USB PHY
TX
RX
plug orient-ation switch
A2/A3 - TX1+/-
USB Type-C connector
Optional Alt Mode connector
B2/B3 - TX2+/-
Alt Mode PHY
Required capacitors
A11/A10 - RX1+/-
B11/B10 - RX2+/-