USB Type-C ENGINEERING CHANGE NOTICE

Title: Expansion of Direct Connect Alt Mode Remappable Signals to include A6 and A7
Applied to: USB Type-C™ Cable and Connector Specification Revision 1.3, July 14, 2017

Brief description of the functional changes proposed:

Allow alternate mode remapping of both sides B6/B7 and A6/A7 in docking type (direct connect) applications omitting USB2 signaling where the downstream system is presumed to be a closed ecosystem. Change the requirement to have billboard present while in alternate mode, but still meet requirement to present billboard when alt mode entry fails.

Benefits as a result of the proposed changes:

This modification allows systems that require more functionality than the current pin remapping by gaining access to two additional pins in direct connect applications (e.g. captive cabled devices).

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

No effect as this is an additional host mode not precluding any current host implementation. Only device side would present any interoperability mismatch which would present billboard if mode not supported.

An analysis of the hardware implications:

This change enables new alt mode possibilities, but does not affect standard hardware. A new definition of Alt mode mux would be required for such an application if high integration is desired. Additionally, there are PD phy FW implications for the new messaging and mux control for host systems that implement this.

An analysis of the software implications:

No expected change.

An analysis of the compliance testing implications:

Compliance testing of this closed downstream device would be the responsibility of the direct connection (docked) system OEM. Appropriate host testing for the application is suggested, care should be taken to preserve the signal integrity and function of the base USB functionality and the OEM alt mode.

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Actual Change Requested

Section 5.1.2.1-5.1.2.2

From Text:

5.1.2.1 Alternate Mode Pin Reassignment

Figure 5-1 illustrates the only pins that shall be available for functional reconfiguration in a full-featured cable. The pins highlighted in yellow are the only pins that shall be reconfigured.

Figure 5-1 Pins Available for Reconfiguration over the Full-Featured Cable

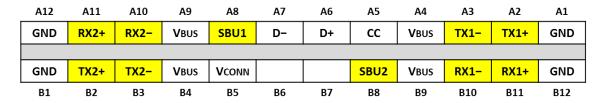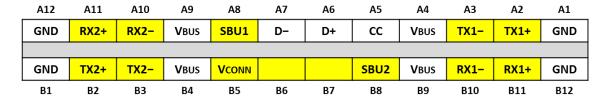| A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
GND	RX2+	RX2−	VBUS	SBU1	D−	D+	CC	VBUS	TX1−	TX1+	GND
GND	TX2+	TX2−	VBUS	VCONN			SBU2	VBUS	RX1−	RX1+	GND
B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12

Figure 5-2 illustrates the only pins that shall be available for functional reconfiguration in direct connect applications such as a cradle dock, captive cable or a detachable notebook. The pins highlighted in yellow are the only pins that shall be reconfigured. Three additional pins are available because this configuration is not limited by the cable wiring.

Figure 5-2 Pins Available for Reconfiguration for Direct Connect Applications

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

The USB 2.0 data pins (A6, A7) shall remain connected to the USB host controller during entry, while in and during exit of an Alternate Mode.

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.

Several 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 and pin pairs A2, A3 (TX1) and B2, B3 (TX2) are used, the DC blocking capacitors in the system used on these pin pairs 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.

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Direct connect applications shall ensure that any stubs introduced by repurposing the extra D+/D− pair do not interfere with USB communication with compliant hosts that short the pairs of pins together on the receptacle. This can be ensured by placing the Alternate Mode switch close to the plug, by adding inductors to eliminate the stubs at USB 2.0 frequencies, by AC-terminating the long stubs to remove reflections at the cost of attenuated signal, or by other means.

To Text:

5.1.2.1 Alternate Mode Pin Reassignment

Figure 5-1 illustrates the only pins that shall be available for functional reconfiguration in a full-featured cable. The pins highlighted in yellow are the only pins that shall be reconfigured.

Figure 5-1 Pins Available for Reconfiguration over the Full-Featured Cable

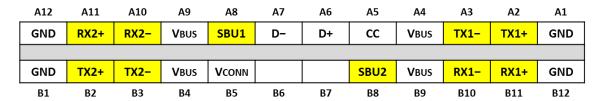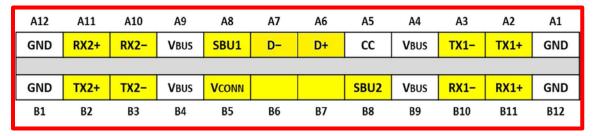| A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
GND	RX2+	RX2−	VBUS	SBU1	D−	D+	CC	VBUS	TX1−	TX1+	GND
GND	TX2+	TX2−	VBUS	VCONN			SBU2	VBUS	RX1−	RX1+	GND
B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12

Figure 5-2 illustrates the only pins that shall be available for functional reconfiguration in direct connect applications such as a cradle dock, captive cable or a detachable notebook. The pins highlighted in yellow are the only pins that shall be reconfigured. Five additional pins are available because this configuration is not limited by the cable wiring.

Figure 5-2 Pins Available for Reconfiguration for Direct Connect Applications

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

The USB 2.0 data pins (A6, A7) shall remain connected to the USB host controller during entry, while in and during exit of an Alternate Mode except in the case of a direct connect application that remaps pins A6 and A7. Direct connection applications that remap pins A6 and A7 through the use of an Alternate Mode shall provide a USB Billboard Class device that is presented if the remapped Alternate Mode is not entered within tAMETimeout.

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.

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• When operating in an Alternate Mode and pin pairs A2, A3 (TX1) and B2, B3 (TX2) are used, the DC blocking capacitors in the system used on these pin pairs 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.

• Direct Connect Applications that remap pins A6 and A7 shall place pins A6 and A7 in a hi-Z state before transmitting the Enter_Mode command to the sink. The source shall not enable the alternate use of the A6 and A7 pins until an ACK has been received by the source. In the event of a failure to enter the alternate mode after transmission of the Enter_Mode command the source shall restore pins A6 and A7 to the normative USB 2.0 operation.

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Table 5-1 USB Safe State Electrical Requirements

From Text:

Table 5-1 USB Safe State Electrical Requirements

	SBU1/2	SSTX$_{1,2}$	SSRX^2	B6/B7[4]
Common-mode voltage	0 to 1.5 V	0 to 1.5 V	0 to 1.5 V	0 to 1.5 V
Impedance to ground[3]	< 4 MΩ	< 4 MΩ	25 KΩ – 4 MΩ	< 4 MΩ

Notes:

1. SSTX common-mode voltage is defined on the integrated circuit side of the AC coupling capacitors.
2. Unused SSTX and SSRX signals should transition to USB Safe State if wired to the connector but not used.
3. The DFP and UFP shall provide a discharge path to ground in USB Safe State when a connection to the USB Type-C receptacle is present.
4. Applies to docking solutions that redefine pins B6 and B7.

To Text:

Table 5-1 USB Safe State Electrical Requirements

	SBU1/2	SSTX$_{1,2}$	SSRX^2	A6/A7/B6/B7[4]
Common-mode voltage	0 to 1.5 V	0 to 1.5 V	0 to 1.5 V	0 to 1.5 V
Impedance to ground[3]	< 4 MΩ	< 4 MΩ	25 KΩ – 4 MΩ	< 4 MΩ

Notes:

1. SSTX common-mode voltage is defined on the integrated circuit side of the AC coupling capacitors.
2. Unused SSTX and SSRX signals should transition to USB Safe State if wired to the connector but not used.
3. The DFP and UFP shall provide a discharge path to ground in USB Safe State when a connection to the USB Type-C receptacle is present.
4. Applies to docking solutions/direct connect applications that redefine pins A6, A7, B6 and B7.