Maximizing USB 3.0 Data Transmission Speed and Performance

Pushing Performance

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One of the most common problems when implementing USB 3.0 cables and panel feed-through is ensuring that the USB is properly connected to reach USB 3.0 SuperSpeed, instead of slowing down to USB 2.0 speeds. This short article explains what causes the slower speed and how to prevent it.

Unlike other data transmission protocols, such as Ethernet and USB 2.0, USB 3.0 SuperSpeed does not use auto-crossing or bi-directional data transmitting/receiving. Instead, specific pairs on either end must be crossed to ensure SuperSpeed.

To start let's first compare the pin out of a USB 2.0 and USB 3.0 solution.

USB 2.0: 4 pins + shield

- 2 pins for +5V + ground
- 2 pins for full duplex data transmission (bi-directional)

USB 3.0: 9 pins + shield

- 2 pins for +5V and ground
- 2 pins for full duplex USB 2.0 data transmission
- 2 pins for USB 3.0 high speed data transmission (uni-directional)
- 2 pins for USB 3.0 high speed data receiving (uni-directional)
- 1 additional ground

For USB 3.0 data transmission to reach SuperSpeed the two additional high speed pairs have to be crossed once both devices are connected. This means that the "transmission" end of device A must be connected to "receiving" and at device B and vice versa.

If two crossed cables of the SuperSpeed pairs are improperly connected, such as the "transmission" end of device A is connected to "transmission" end of device B, the SuperSpeed (USB 3.0) transmission will not work and reverts to sending data along the USB 2.0 lines.

As USB 2.0 uses bi-directional data transmission this is not an issue.

It is important to note that two pins within a USB 3.0 cable do utalize USB 2.0 bi-directional pins. This allows a mismatched cable and device to still function, although at lower speed.

USB 2.0 Pin-Out				
Pin	**Color**	**Signal Name ("A" Connector)**	**Signal Name ("B" Connector)**	**Description**
Shell	N/A	Shield		Metal housing
1	Red	VBUS		Power
2	White	D-		USB 2.0 differental pair
3	Green	D+		
4	Black	GNC		Ground for power return

USB 2.0 utilizes 4 pins and allows bi-directional data transmission.

USB 3.0 Pin-Out				
Pin	**Color**	**Signal Name ("A" Connector)**	**Signal Name ("B" Connector)**	**Description**
Shell	N/A	Shield		Metal housing
1	Red	VBUS		Power
2	White	D-		USB 2.0 differental pair
3	Green	D+		
4	Black	GNC		Ground for power return
5	Blue	StdA_SSRX-	StdB_SSTX-	SuperSpeed transmitter differential pair
6	Yellow	StdA_SSRX+	StdB_SSTX+	
7	N/A	GND Drain		Ground for signal return
8	Purple	StdA_SSTX-	StdB_SSRX-	SuperSpeed receiver differential pair
9	Orange	StdA_SSTX+	StdB_SSRX+	

USB 3.0 utilizes 9 pins and can only reach SuperSpeed when the SuperSpeed pair are crossed correctly.

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