White Paper | USB Type-C

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Content

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1 ABSTRACT

Modern technology and several leading industrial companies have been pushing the boundaries of the universal serial bus (USB) standard. Different markets request smaller, thinner and lighter form-factor designs with better performances and power delivery possibilities. As a result, the USB Type-C connector was born to address this evolving needs all over different industries. Therefore NEUTRIK decided to invent the new mediaCON series.

2 THEORY

2.1 Introduction

You may have heard about the Type-C reversible and its ability to be pluggable in either the right side or upside down direction. However, there is a huge huddle in data and power delivery applications when using the Type-C connector. This white paper should bring some light to this topic.

2.2 About data transmission

First, let us quickly review the evolution of the USB data, starting with USB1.0 through USB 3.1. Table 1 below shows the maximum transfer data rate and length for each USB specification. This standard starts with USB1.0 supporting 1.5 Mbps (low speed) and moves up to 10 Gbps (SuperSpeed+) with USB3.1. Fortunately the USB standard designed the protocols to be backward compatible so that all older versions are workable with the newer one.
Attention: If you combine lower USB Versions with newer ones, you will never achieve the higher defined performance. This software protocol doesn`t interfere with our cable and chassis design of the mediaCON solution. Therefore we are already compatible with higher older versions and the upcoming USB3.2 protocol for 20 Gbps in the future.
Attention: For this 20 Gbps performance, you need a top quality cable like our mediaCON solution.

Version	Speed	Bits/Sec	Max. Length
USB 1.0	Low Speed (LS)	1.5 Mbps	-
USB 1.1	Full Speed (FS)	12 Mbps	-
USB 2.0	High Speed (HS)	480 Mbps	≤ 4 m
USB 3.0 (USB 3.1 Gen. I)	Super Speed (SS)	5 Gbps	≤ 2 m
USB 3.1 (USB 3.1 Gen. II)	Super Speed+ (SS)	10 Gbps	≤ 1 m
US 3.2	Not defined yet	20 Gbps	≤ 1 m

table 1: Data Transmission

In addition to the common USB Protocols, several other protocols work with mediaCON.
This includes:

- DisplayPort 1.4
- MHL (Mobile High-Definition Link)
- super MHL
- Thunderbolt™
- HDMI 1.4b.
- Etc.

2.3 About power transmission

Now, let us also review the evolution of USB power which starts with USB 2.0 through USB PD 3.0. Table 2 shows clearly that the market trend is toward higher power transmission. More and more devices and platforms request power transmission to reduce the amount of connections. In this paper we are going to focus on USB PD 3.0 in combination with USB Type-C connections. Without the PD (Power Delivery) the connection can only support 5 V at 3 A (15 W) maximum. However with the addition of PD you

can go up to 20 V and 5 A (100 W) over the USB Type-C system as shown below in Table 2.

Version	Max. Voltage	Max. Current	Max. Length
USB 2.0	5 V	500 mA	2.5 W
USB 3.0 and USB 3.1	5 V	900 mA	4.5 W
US Type C 1.2	5 V	3 A	15 W
USB PD 3.	20 V	5 A	100 W

table 2: Power Delivery

Even with the suffix of PD there are several different profiles, which can be distinguished in Table 3. Normally, every single device does a handshake between host and device for clarifying the maximum power level which is accepted.

Version	Max. Voltage	Max. Current	Max. Length
Profile 1	5 V	2 A	10 W
Profile 2	12 V	1.5 A	18 W
Profile 3	12 V	3 A	36 W
Profile 4	20 V	3 A	60 W
Profile 5	20 V	5 A	100 W

table 3: Profile Difference in PD

Additionally, the handshake approves the power target categories. This included feature in the USB PD3.0 standard coordinates the voltage increase for the requested power. As shown in Figure 1, it increases the voltage until the device has enough power.

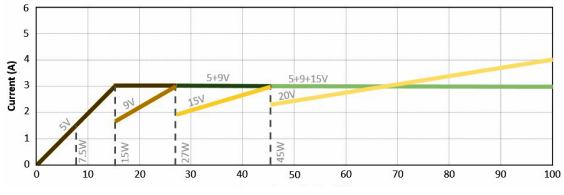

figure 1: Power Target Categories

Fortunately, these power profiles and "power target categories" featured by manufacturers haven't any impact on our mediaCON solution. Therefore Neutrik can guarantee that the mediaCON USB Type-C cable is able to transport power of 100 W and data of 10 Gbps or 20 Gbps in the future.

3 How to pin out the USB Type-C

3.1 Configuration

The pin out of the USB Type-C connector is divided into receptacle and plug and is standardised. In figure 2 and 3 you can find the right configuration.

Plug

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 2: Configuration Plug

Receptacle

A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
GND	TX1+	TX1-	VBUS	CC1	D+	D-	SBU1	VBUS	RX2-	RX2+	GND

GND	RX1+	RX1-	VBUS	SBUS	D-	D+	CC2	VBUS	TX2-	TX2+	GND
B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1

figure 3: Configuration Receptacle

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