USB Type-C™
Advanced protection solutions

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Overview information:
Quick start guide

Is this presentation suited for you?

Where do you stand with USB type-C™?

Beginner?

I am not familiar with this subject. I am in the discovery phase and would like an overview and a basic understanding of the technology.

Click here to continue to next slide

Overview

Intermediate?

I have a basic understanding of this subject. I would like to go deeper in details and tackle more aspects of this subject.

Click here to continue to next slide

Fundamentals

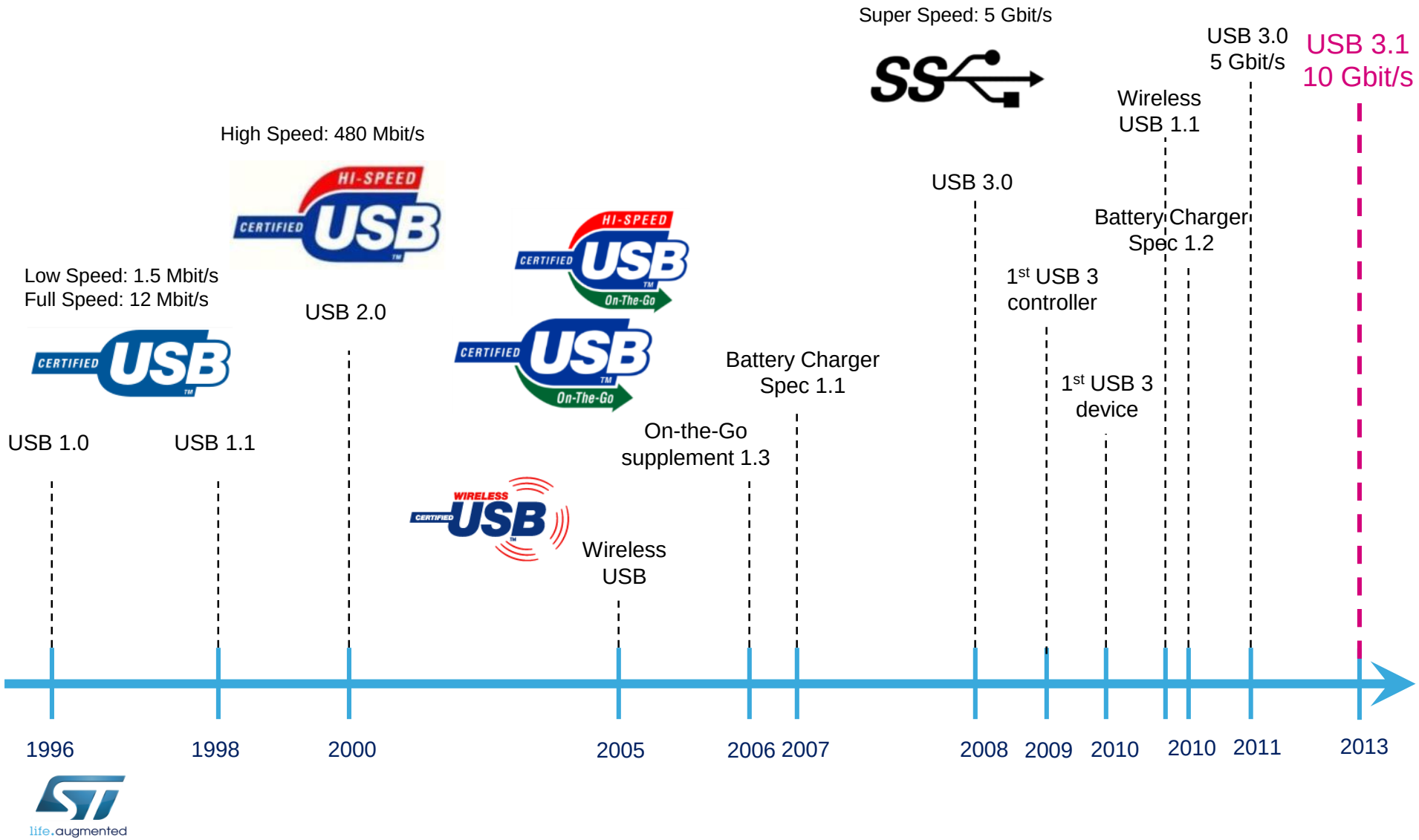
Advanced?

I am very familiar with this subject. I would like to deepen my knowledge and become an expert.

Click here to continue to next slide

In depth

Do you know the USB world ?



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USB Type-C™ connector –
The best of two worlds and more …

"Market perception"

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- -
+++

USB 2.0 Micro-B connector

- Data rate: 0.48 Gbit/s
- V_{BUS}: 0.5 A max
- Connector

USB 3.0 Micro-B connector

- Data rate: 5 Gbit/s
- V_{BUS}: 0.9 A max
- Connector

"Market perception"

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USB 3.1 USB Type-C™ connector

- Data rate: 0.48 to 10 Gbit/s
- V_{BUS}: 3 A max
- Same size as USB 2.0 micro-B connector

"Market perception"

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Click here to know more about common **USB2.0 advanced protection & filtering solutions**

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USB Type-C™

‘One connector to rule them all’

HDMI™ HIGH-DEFINITION MULTIMEDIA INTERFACE

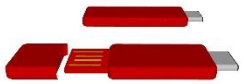
*With HDMI to DP converter

DisplayPort™

SUPERSPEED+ CERTIFIED USB 10Gbps

HI-SPEED CERTIFIED USB™

THUNDERBOLT™



Merging
USB Type-C™ protocols

Type-C

Before, there were **7** connectors for **7** protocols.

Now, with USB Type-C™: **1** single connector for **7** protocols.

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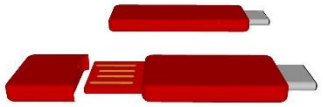
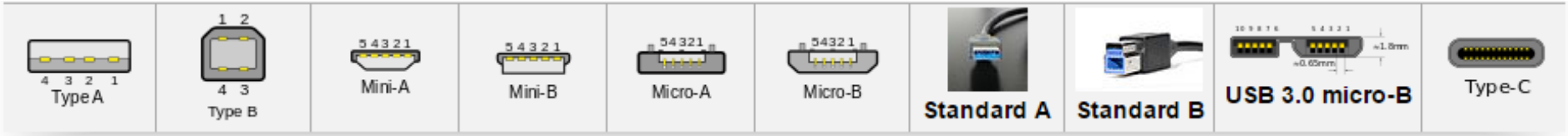
USB Type-C™ features

- Scalable power charging with connectors being able to supply up to 5 A and cables supporting 3 A for up to 100 watts of power
- Certified for USB 3.1 data rates (10 Gbit/s)



- Reversible plug and cable orientation for ease of connection
- Slim enough for mobile devices, but robust enough for laptops and tablets
- Similar to the size of USB 2.0 Micro-B (standard smartphone charging cable)
- Improved EMI and RFI mitigation features

Type-C



Targeted applications for USB Type-C™

Smartphones, tablets, and computers

Dongles

AC/DC power adapters

Set-top boxes

All devices connected with USB port receiver and high-speed data rates.

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USB Type-C™ connector

Plug

High Speed Data Path (RX for USB, or TX for DP Alt Mode)

USB 2.0 Interface

High Speed Data Path (TX for USB, or for DP Alt Mode)

A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
GND	RX2+	RX2-	V_{BUS}	SBU1	D-	D+	CC	V_{BUS}	TX1-	TX1+	GND
GND	TX2+	TX2-	V_{BUS}	V_{CONN}			SBU2	V_{BUS}	RX1-	RX1	GND
B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12

Secondary Bus

Cable Bus Power

Cable Ground

Plug Configuration Detection
- One becomes V_{CONN} cable power
- CC is used for USB – PD Communication

Pins	Total (24)
GND	4
SSTx/ SSRx	8 (4 pairs)
DP/DN	4 (2 pairs)
V_{BUS}	4
CC1/ CC2	2
SBU1/ SBU2	2

Receptacle

High Speed Data Path (RX for USB, or TX for DP Alt Mode)

USB 2.0 Interface

High Speed Data Path (TX for USB, or for DP Alt Mode)

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

Secondary Bus

Cable Bus Power

Cable Ground

Plug Configuration Detection
- One becomes V_{CONN} cable power
- CC is used for USB – PD Communication

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I have 5 problems, what can I do?

Audio and USB/DP* have different speeds !

Greater V_{BUS} EOS & ESD protection for Power Delivery!

USB 2.0 voltages are positive but audio voltages can be negative!!

DP* does not generate 2.4 GHz noise but USB 3.1 generates 2.4 GHz noise!

Multiplexers are not ESD-protected!

Designers need high flexibility to ensure the best compatibility.

*DP: DisplayPort™

Possible answers: 6 winning solutions

Audio and USB/DP* have different speeds

Solutions 1, 5, and 6

Greater V_{BUS} EOS & ESD protection for Power Delivery

Solutions 2, 3, 4, 5, and 6

DP* does not generate 2.4 GHz noise but
USB 3.0 generates 2.4 GHz noise

Solutions 5 and 6

USB 2.0 voltages are positive but
audio voltages can be negative

Solutions 1, 5, and 6

Multiplexers are not ESD-protected

All solutions

And more possible solutions or combinations !

Let's take a closer look at all the solutions!

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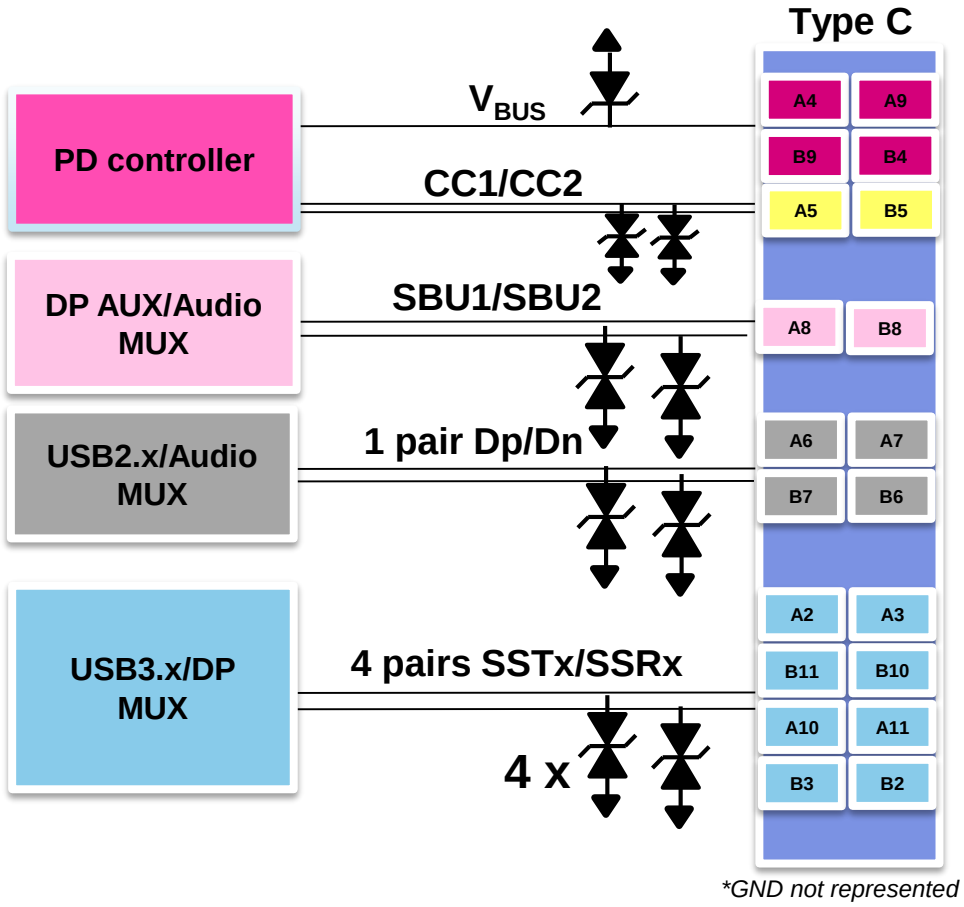
*DP: DisplayPort™

#tab-3

Solution 1:
0201 ESD single-line protection

Pin	P/N	Total
SSTx / SSRx	ESDARF02-1BU2CK	8
V_{BUS}	ESDA5-1BF4	1
CC1	ESDALC5-1BF4	2
CC2		
Dp/Dn	ESDAULC5-1BF4	2
SBU1	ESDALC5-1BF4	2
SBU2		
Audio	Compatible	
USB	Up to USB3.1 Gen 2	
USB PD	No	
DP	Up to DP.1.3	
TBT	Up to TBT Gen 2	



*GND not represented

15 discrete components - housed in 0201 package - for maximum flexibility with audio

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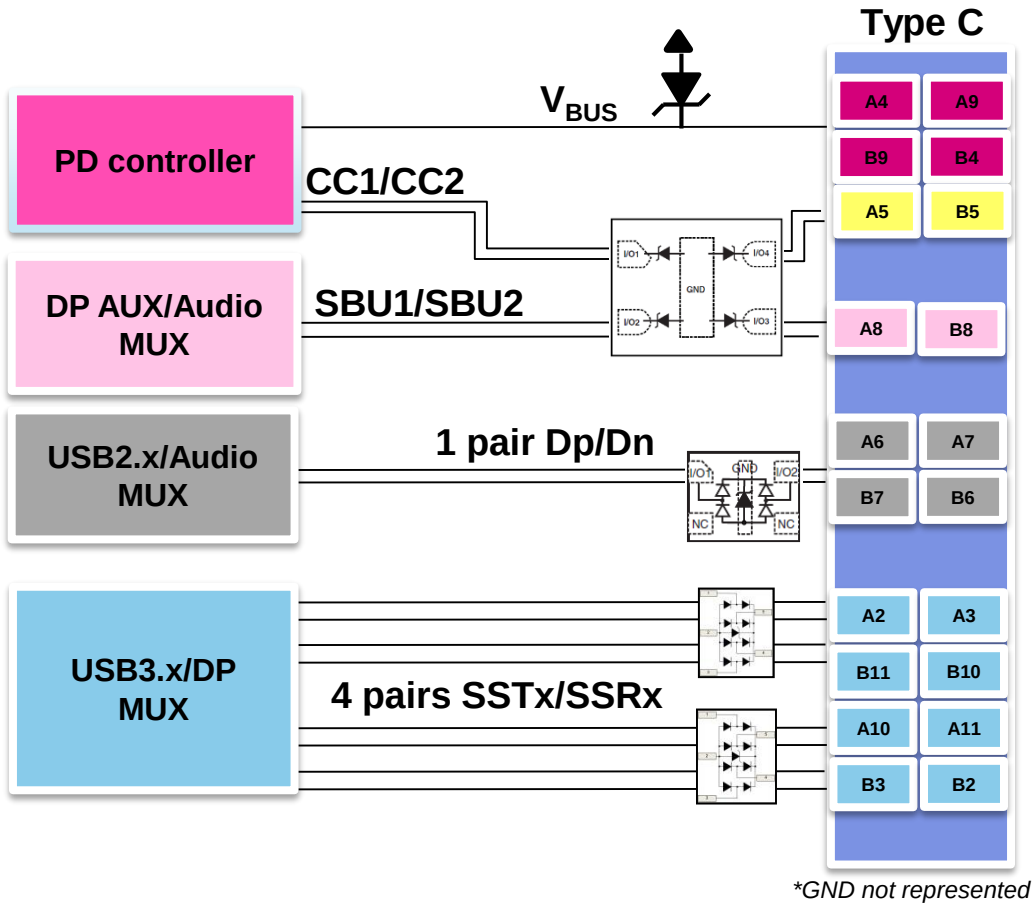
Solution 2:
ESD multi-line protection with new HSP051-4M5

Pin	P/N	Total
SSTx / SSRx	SOON HSP051-4M5	2
V_{BUS}	ESDA13P70-1U1M (for 12 V) ESDA7P60-1U1M (for 5 V)	1
CC1 CC2 SBU1 SBU2	ESDALC6-4N4	1
Dp/Dn	HSP061-2N4	1
Audio	Not compatible	
USB	Up to USB3.1 Gen 2	
USB PD	Yes, 12 V	
DP	Up to DP.1.3	
TBT	Up to TBT Gen 2	



*GND not represented

New, innovative 5-lead package for very compact designs w/out audio for portable applications

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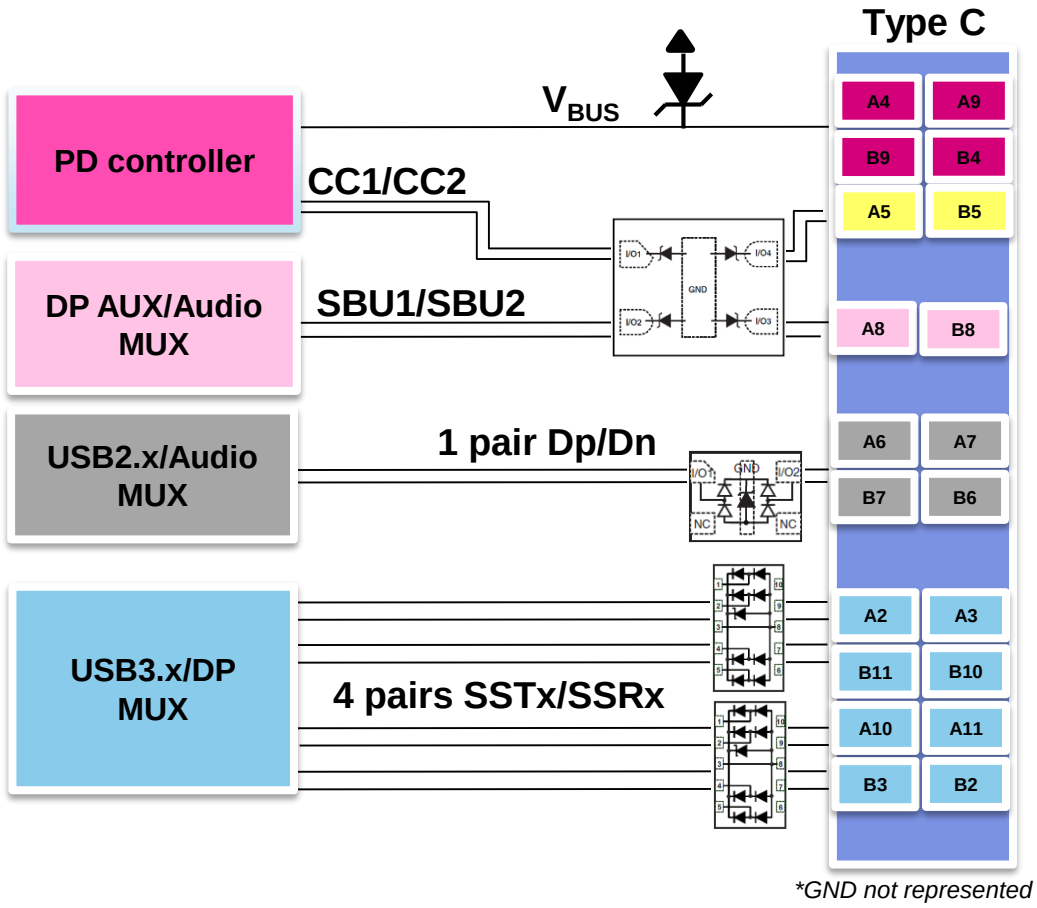
Solution 3:
ESD multi-line 400-µm pitch protection

Pin	P/N	Total
SSTx / SSRx	HSP051-4N10	2
V_{BUS}	ESDA13P70-1U1M (for 12 V) ESDA7P60-1U1M (for 5 V)	1
CC1 CC2 SBU1 SBU2	ESDALC6-4N4	1
Dp/Dn	HSP061-2N4	1
Audio	Not compatible	
USB	Up to USB3.1 Gen 2	
USB PD	Yes, 12 V	
DP	Up to DP.1.3	
TBT	Up to TBT Gen 2	



*GND not represented

400-µm pitch multi-line solutions for portable applications w/out audio

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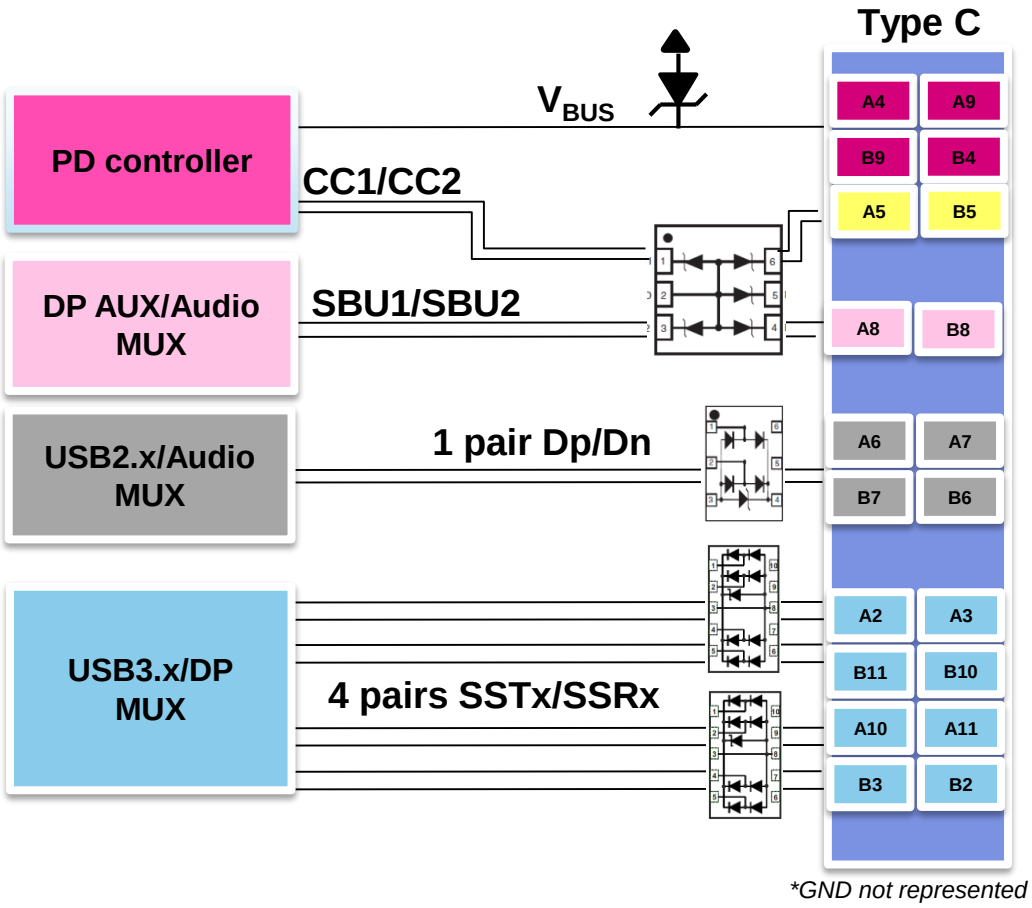
Solution 4:
ESD multi-line 500-µm pitch protection

Pin	P/N	total
SSTx / SSRx	HSP051-4M10	2
V_{BUS}	ESDA13P70-1U1M	1
CC1 CC2 SBU1 SBU2	ESDA6V1-5M6	1
Dp/Dn	HSP062-2M6	1
Audio	Not compatible	
USB	Up to USB3.1 Gen 2	
USB PD	Yes, 12 V	
DP	Up to DP.1.3	
TBT	Up to TBT Gen 2	



*GND not represented

Robust and compact solution for Power Delivery mode w/out audio

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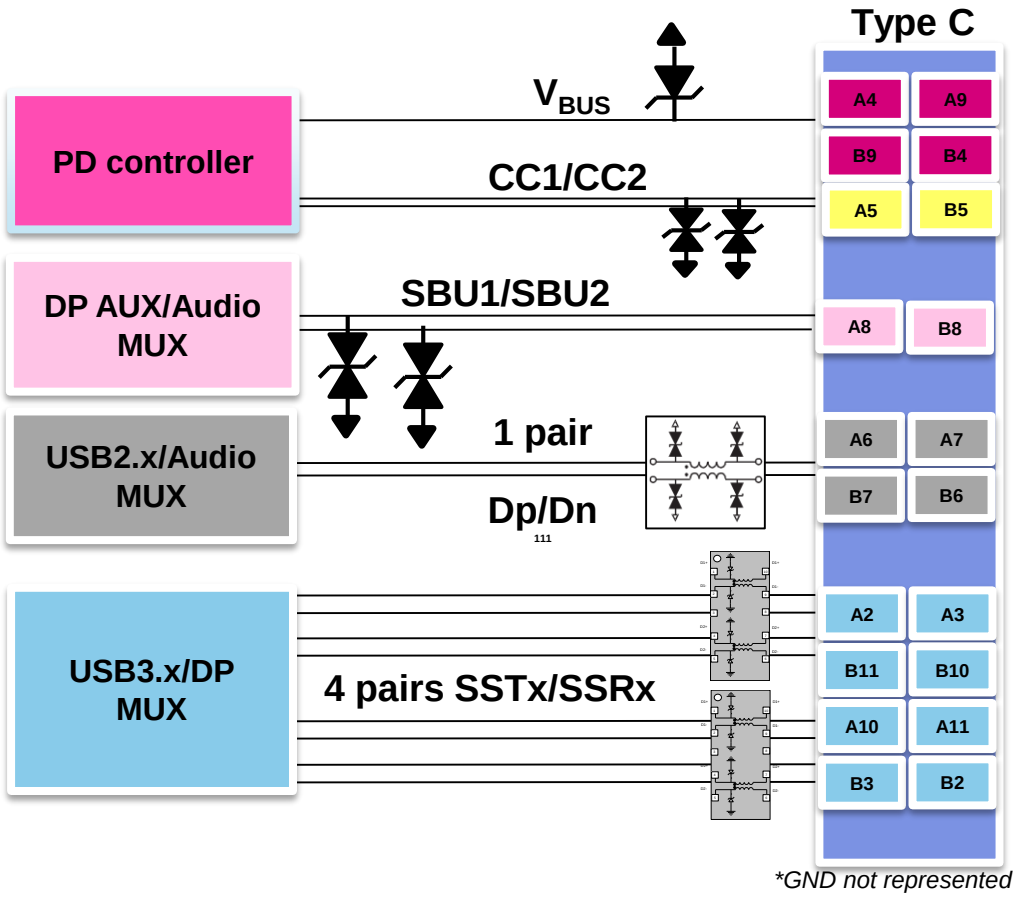
Solution 5:

ECMF™ 400-µm pitch protection and integrated filtering

Pin	P/N	Total
SSTx / SSRx	SOON ECMF4-20A42N10	2
V_{BUS}	ESDA13P70-1U1M (for 12 V) ESDA7P60-1U1M (for 5 V)	1
CC1 CC2 SBU1 SBU2	ESDALC5-1BF4	4
Dp/Dn	ECMF02-2BF3	1
Audio	Compatible	
USB	Up to USB3.1 Gen 1	
USB PD	Yes, 12 V	
DP	Up to DP.1.3	
TBT	Up to TBT Gen 1	



*GND not represented

Best compact and integrated solution to avoid antenna desense
With very wide shape rejection CMF for Dp/Dn

Click here to know more about ECMF™ and antenna desense

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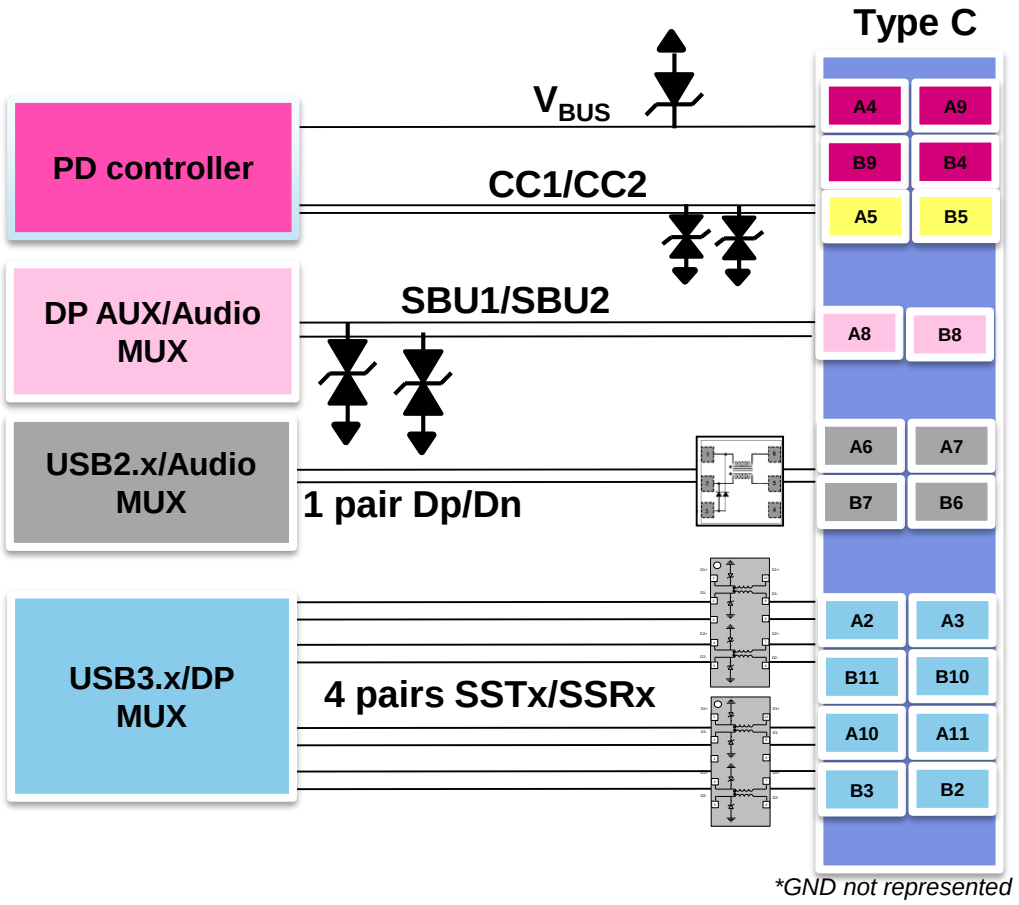
Solution 6:
ECMF 500-µm pitch protection and integrated filtering

Pin	P/N	Total
SSTx / SSRx	ECMF04-4HSWM10	2
V_{BUS}	ESDA13P70-1U1M (for 12 V) ESDA7P60-1U1M (for 5 V)	1
CC1 CC2 SBU1 SBU2	ESDALC5-1BF4	4
Dp/Dn	ECMF02-2HSMX6	1
Audio	Compatible	
USB	Up to USB3.1 Gen 1	
USB PD	Yes, 12 V	
DP	Up to DP.1.3	
TBT	Up to TBT Gen 1	



Best integrated solution to avoid antenna desense

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Click here to know more about ECMF™ and antenna desense

Let's go further

Overview information

- USB2.0 protection and IPAD™ solutions presentation

Fundamentals

- USB type-C™ dataline advanced protection presentation
- USB type-C™ power delivery advanced protection presentation
- IEC 61000-4-5 standard overview *Application note #AN4275*

In-depth information

- ESD - IEC 61000-4-2 standard testing *Application note #AN3353*
- TVS short pulse dynamic resistance measurement ... *Application note #AN4022*

Selection & sampling

- Protection devices & integrated EMI filtering selection guide
- USB port protection web product selector
- USB IPAD™ (including ECMF™) web product selector

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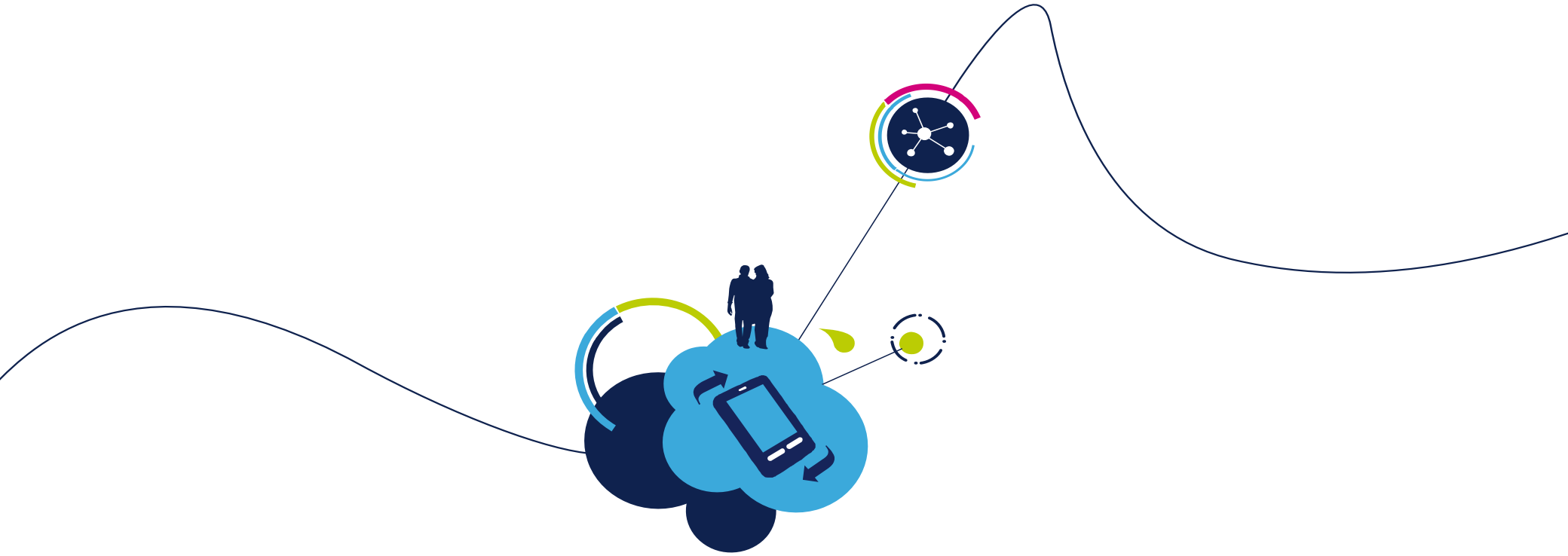

Thank you

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