

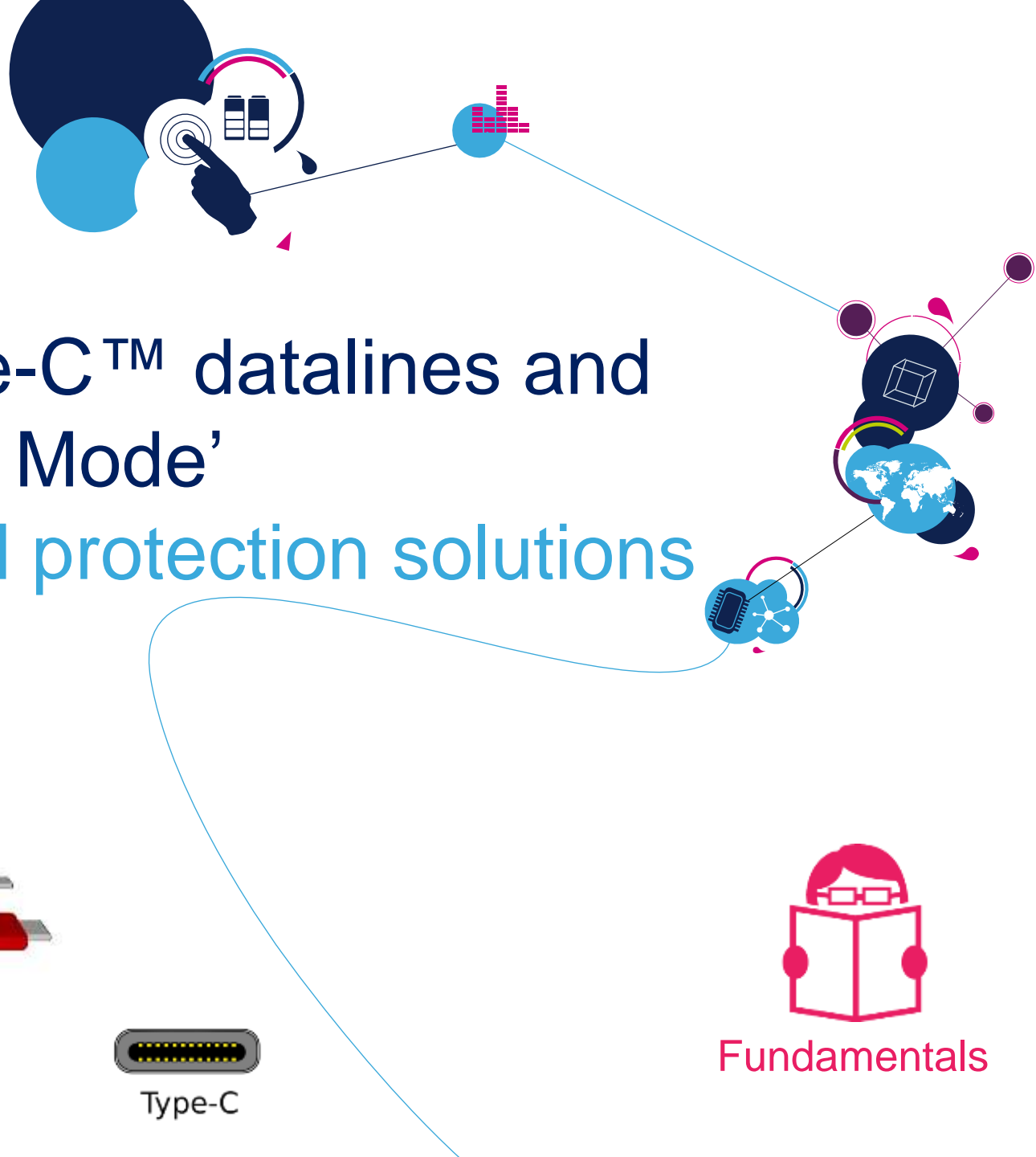
USB Type-C™ datalines and 'Alternate Mode' Advanced protection solutions



Type-C



Fundamentals



Is this presentation suited for you?

Where do you stand with USB Type-C™ datalines?

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](#)

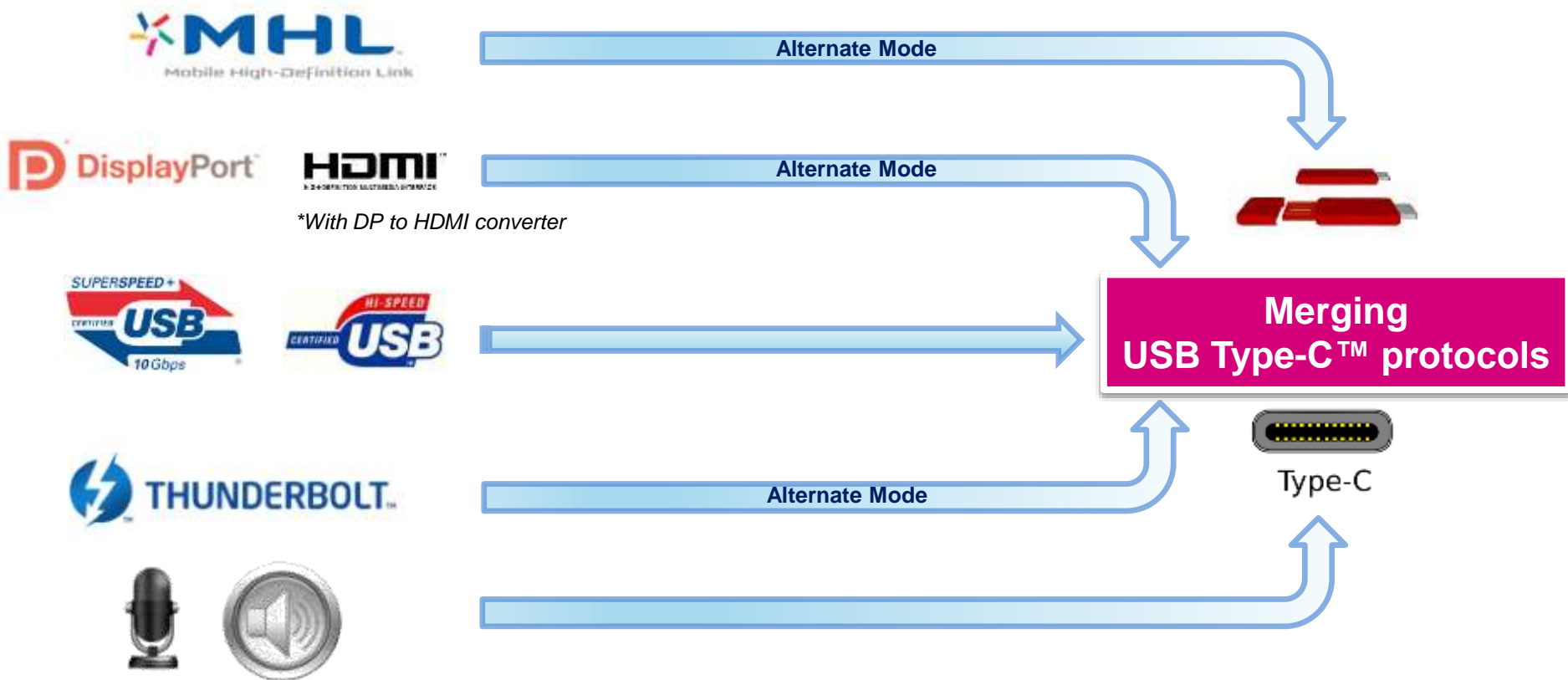
Advanced?

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](#)

USB Type-C™ ‘One connector to rule them all’



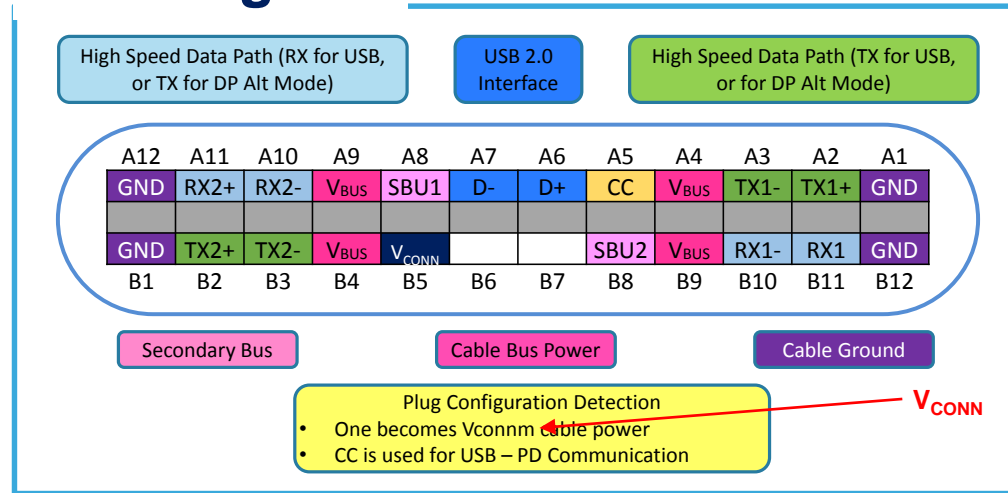
Before, there were **7** connectors for **7** protocols.
Now with USB Type-C™: **1** single connector for **7** protocols.

Alternate Mode through USB Type-C™ connector

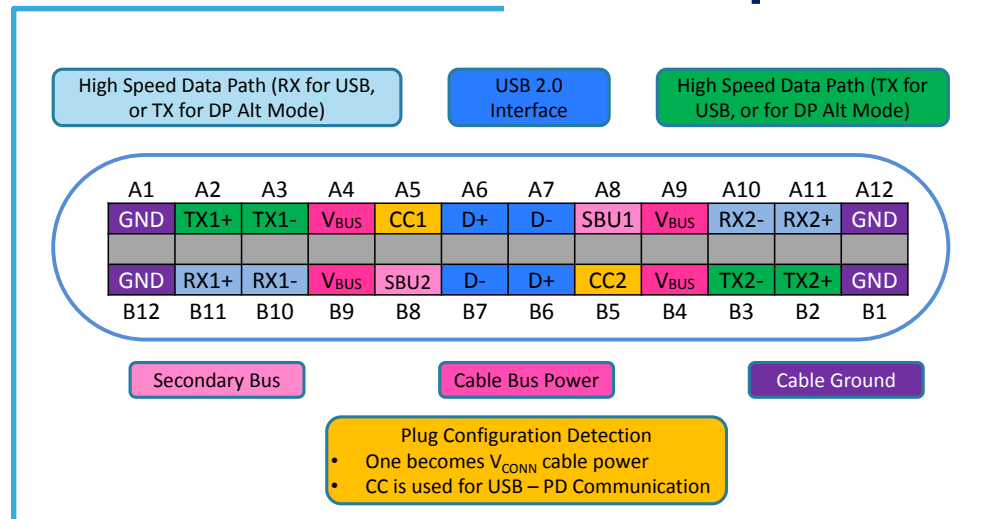
- Alternate Mode dedicates physical wires in the USB Type-C cable for direct device-to-host transmission of alternate data protocols:

- Four high-speed lanes (RX/TX)
- Two sideband pins (SBU)
- Two USB 2.0 pins for dock, detachable device and permanent cable applications only (D+/D-)
- One configuration pin can be used for Alternate Mode transmission (CC1 or CC)

Plug



Receptacle



- **Alternate Mode partner specifications**

The USB-IF is working with its Alternate Mode partners to make sure that ports are properly labeled:

- DisplayPort Alternate Mode on USB Type-C Connector Standard published in September 2014, supporting [DisplayPort 1.3](#)



- MHL Alternate Mode (“Alt Mode”) announced November 2014 supporting [MHL 3.0](#)



- Thunderbolt Alternate Mode supporting [Thunderbolt 3](#)



- Other serial protocols such as [PCI Express](#) and [Base-T Ethernet](#) are possible.

Data on USB 2.0 and 3.1 Gen 1 & Gen 2

Parameters	USB 2.0			SuperSpeed link USB 3.1	
	Low speed	Full speed	High speed	Gen 1	Gen 2
Datarate	Up to 1.5 Mbit/s	Up to 12 Mbit/s	Up to 480 Mbit/s	5 Gbit/s	10 Gbit/s
Termination	Not terminated		90 Ω differential 45 Ω to ground	72 Ω to 120 Ω differential 18 Ω to 30 Ω to ground	
Signaling output low level	$V_{OL} = 0$ to + 0.3 V		$V_{OL} = -10$ to + 10 mV		
Signaling output high level	$V_{OH} = 2.8$ to 3.6 V		$V_{OH} = +360$ to +440 mV		
Signaling Differential voltage swing	6.6 V_{P-P} typ.		800 mV $_{P-P}$ typ.	1 V_{P-P} typ. 0.4V $_{P-P}$ min, 1.2V $_{P-P}$ max	
V_{BUS} voltage	5 V typ. 4.4 V min, 5.5 V max for standard A downstream port				
V_{BUS} max. current	900 mA for standard A downstream port				

2 challenges to overcome

Need for common-mode filtering solution

USB 3.1

Need for ESD protection solution

Signal transmission : @ 5 Gbit/s Gen 1
@ 10 Gbit/s Gen 2

Generation of parasitic harmonics @ 2.4 GHz

Wi-Fi and Bluetooth antenna desense*
(Wi-Fi and Bluetooth frequency carrier = 2.4 GHz)

Increase Bit Error Rate and/or increase the
power consumption of the RF chain

Common Mode filter needed

External connector

Vulnerable to ESD

Connector controller internal ESD HBM
protection are not enough

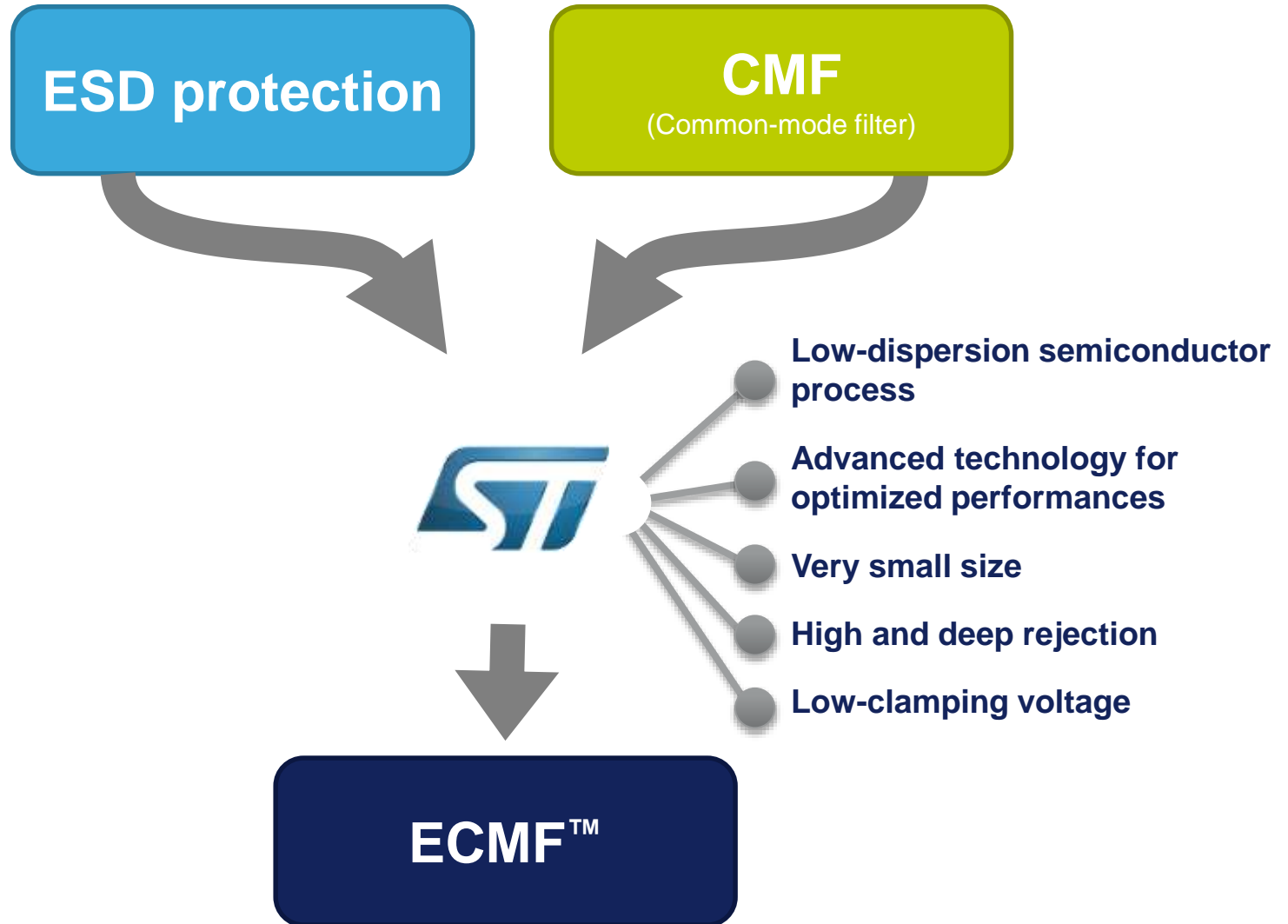
External ESD protection solution needed
(IEC 61000-4-2)

Best solution ECMF™



*More on antenna desense and ECMF™ here

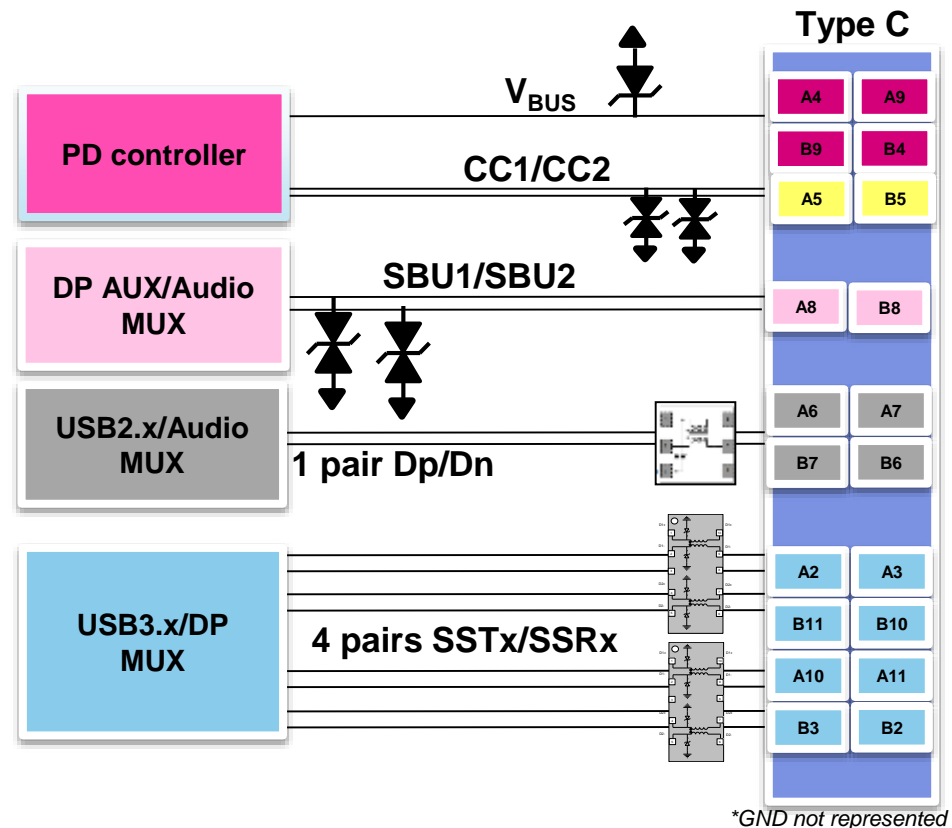
Embedded ESD protection



ECMF™ for USB Type C Alternate Mode

Compatible with USB-PD*

Pin	P/N	Total
SSTx / SSRx	ECMF04-4HSWM10	2
V _{BUS}	ESDA13P70-1U1M	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, 12V	
Display Port	Up to DP.1.3	
Thunderbolt	Up to TBT Gen 1	

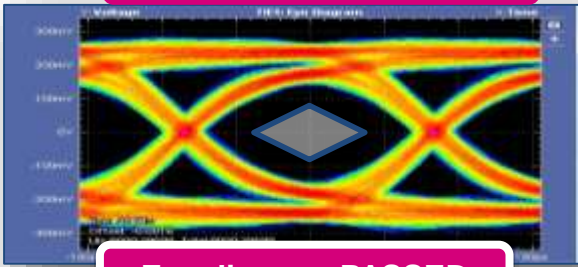


Best integrated solution to avoid antenna desense

Zoom on ECMF04-4HSWM10

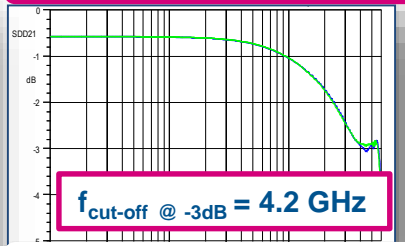
No impact on the signal integrity of USB 3.1, Display Port and more

HDMI 2.0 4K/2K Eye Diagram



Eye diagram PASSED

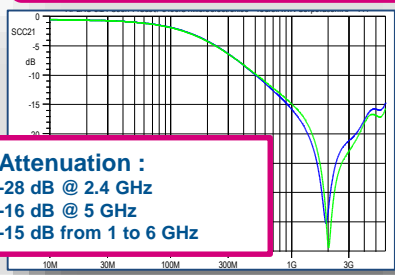
S21dd Measurement



Large bandwidth

Improve antenna sensibility

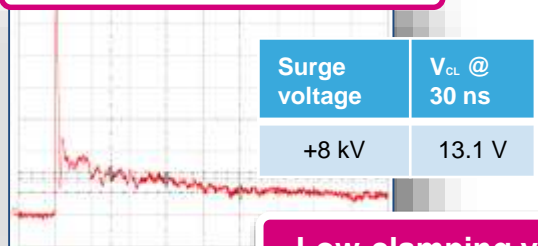
S21cc Measurement



Wide rejection from 1 to 6 GHz

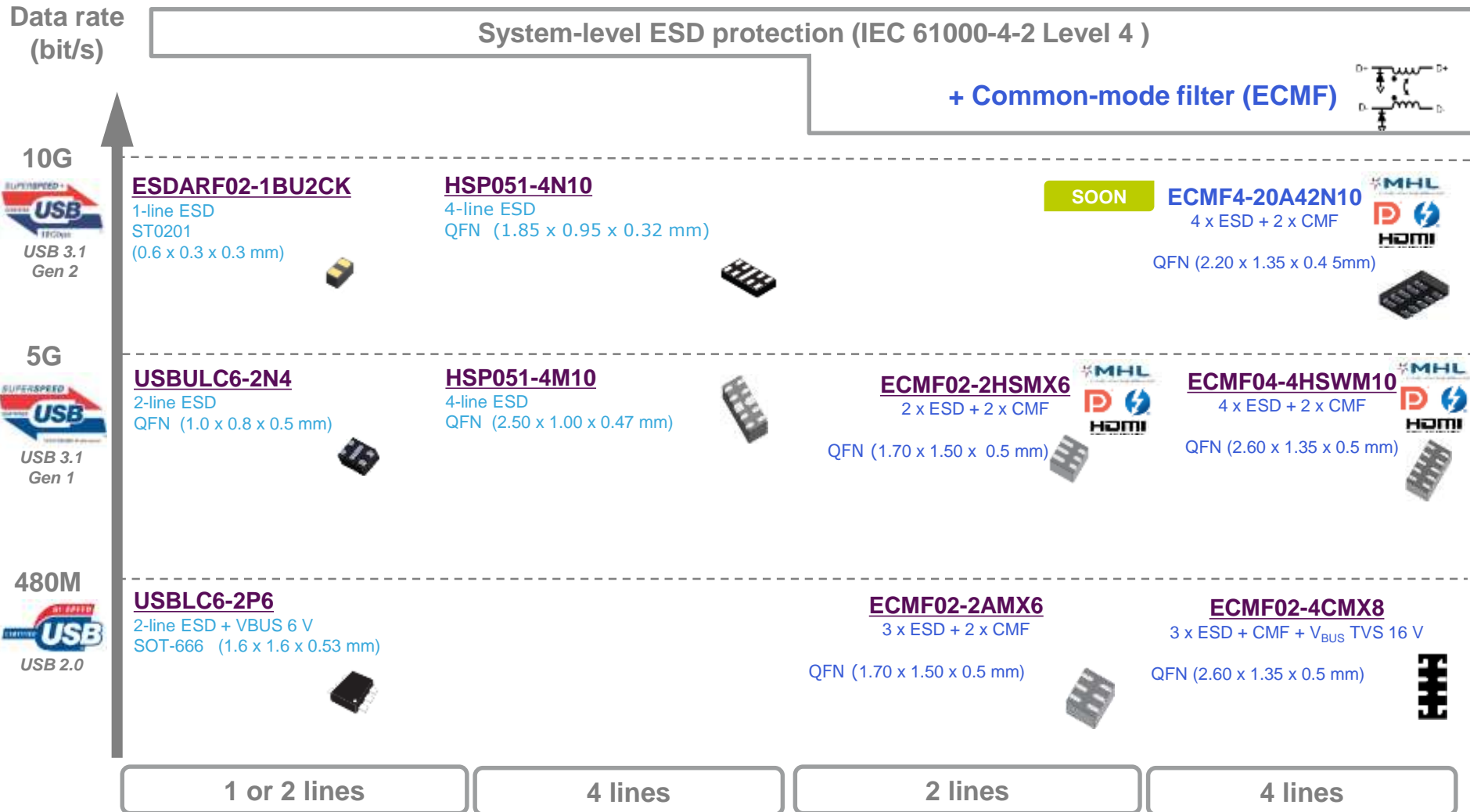
Protect transceivers against overvoltages

ESD measurement +8 kV contact



Low-clamping voltage

EMI filtering & ESD protection for USB datalines



ECMF = Common-mode filter with integrated ESD protection

[Click here to know more about ECMF™](#)

Overview information

- [USB type-C™ advanced protection quick start guide](#)
- [USB 2.0 protection and IPAD™ solutions presentation](#)

Fundamentals

- [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](#)



Thank you