



LEMO[®]

The Original Push-Pull Connector

Electromagnetic Simulations and Measurements for the LEMO Harsh Environment Connectors

EVENT: CADFEM CONFERENCE 2024

LAUSANNE

DATE 12.09.2024

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Signal Integrity Engineer

CADFEM
CONFERENCE 2024



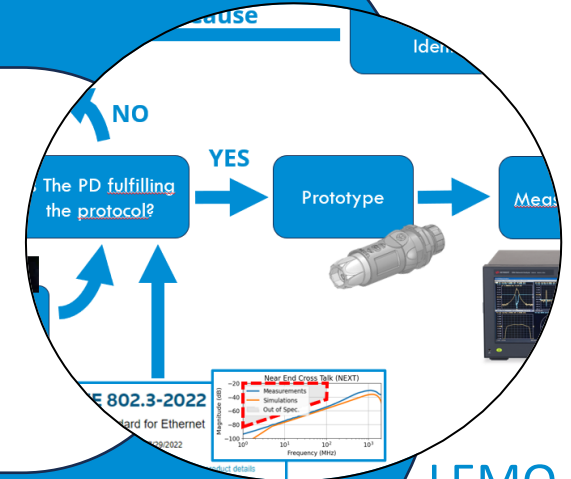
Scope of the Presentation



LEMO connectors



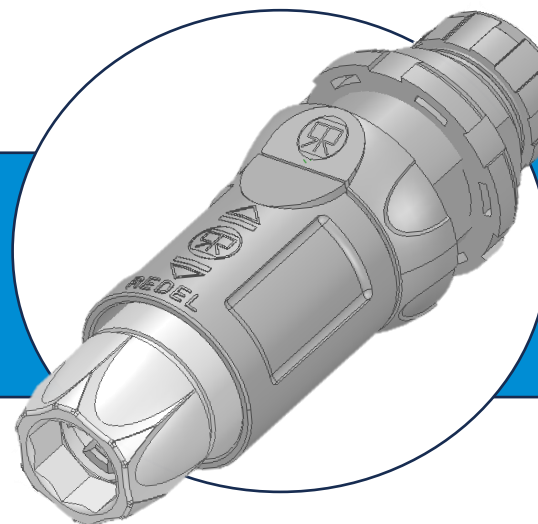
Why Electromagnetic Simulations And Measurements?



LEMO Workflow

- ### Summary
- LEMO Connectors have been presented
 - The need for Electromagnetic Signal Integrity in Industry have been presented
 - The LEMO Approach for The Design of Connectors has been shown as well as the product creation
 - Example of simulation vs measurements
 - An example of design optimization

Summary



Simulations VS Measurements





LEMO

LEMO: The Company and Products



About US: In a Nutshell



- Global leader in **high-quality and performance interconnect solutions** for demanding applications and industries.
- Inventor of the **Push-Pull Connector**.
- A successful and stable **Swiss family-owned company** founded in 1946.
- ~ **2000 employees**, with 55% located outside Switzerland.
- **20 subsidiaries** worldwide selling into 80+ countries.
- Strong **customer centric**, innovation and technical excellence mindset.

“ We are change-makers and innovators. ”



OUR APPLICATIONS

Resistant to the most extreme environments

**-55°
Celsius**

**+250°
Celsius**

**30
G**

IP69

**60+
Bars**

**70
KD DC**

**107
Gy**

**10⁻⁷
mbr.l/s**

Our Applications: Connecting Critical Systems

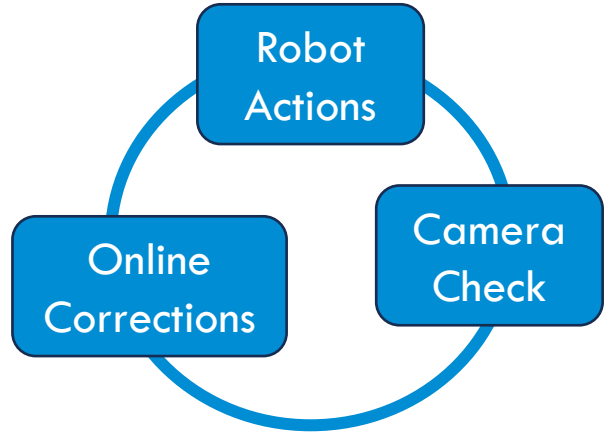
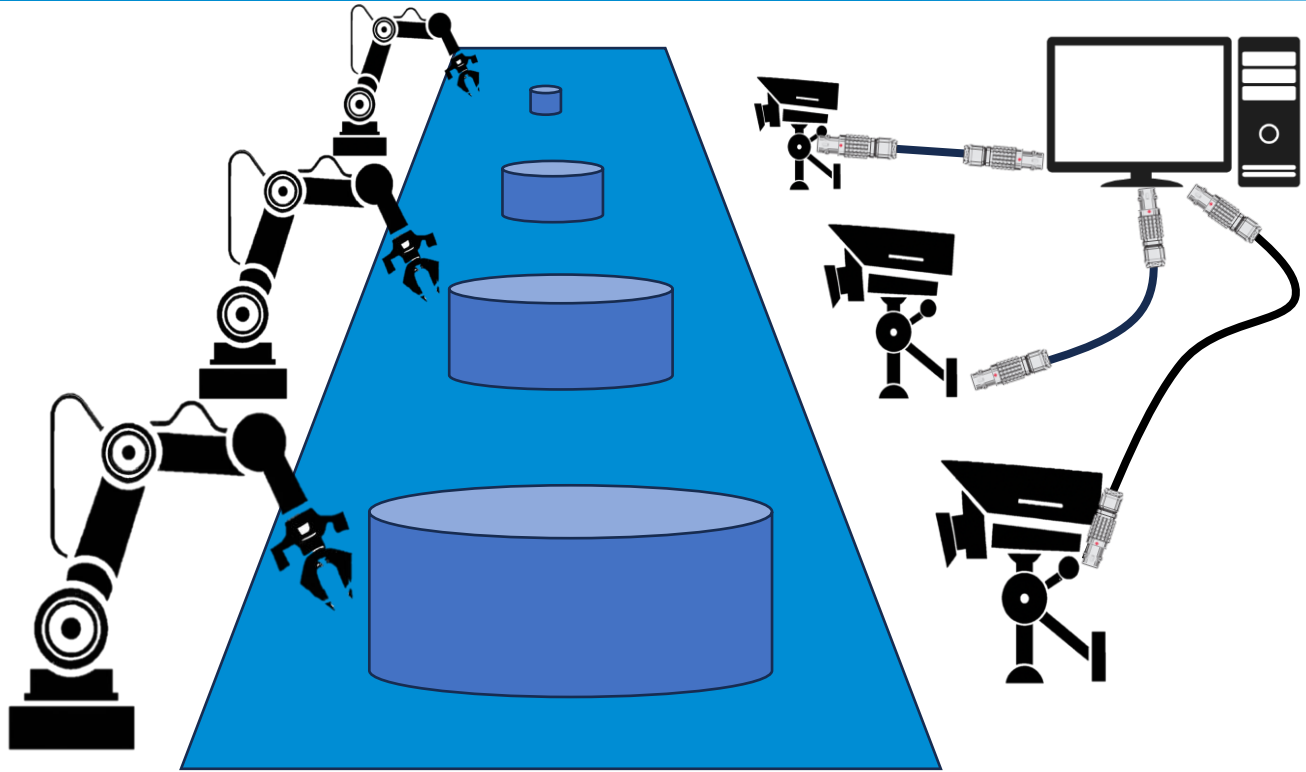




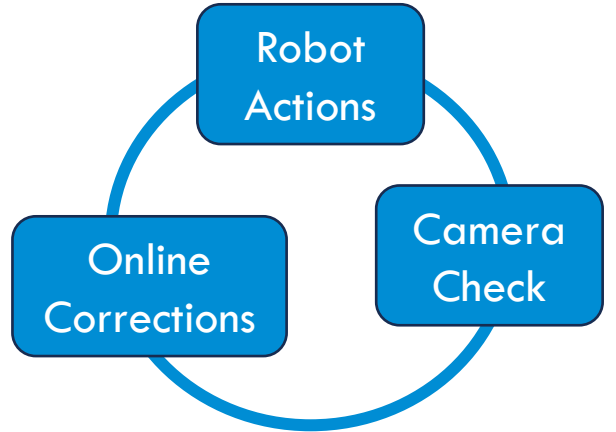
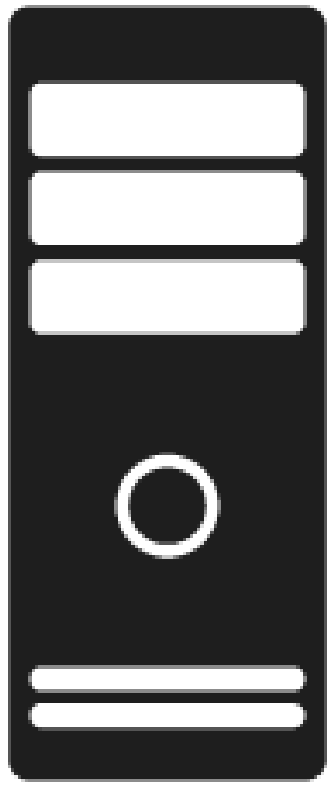
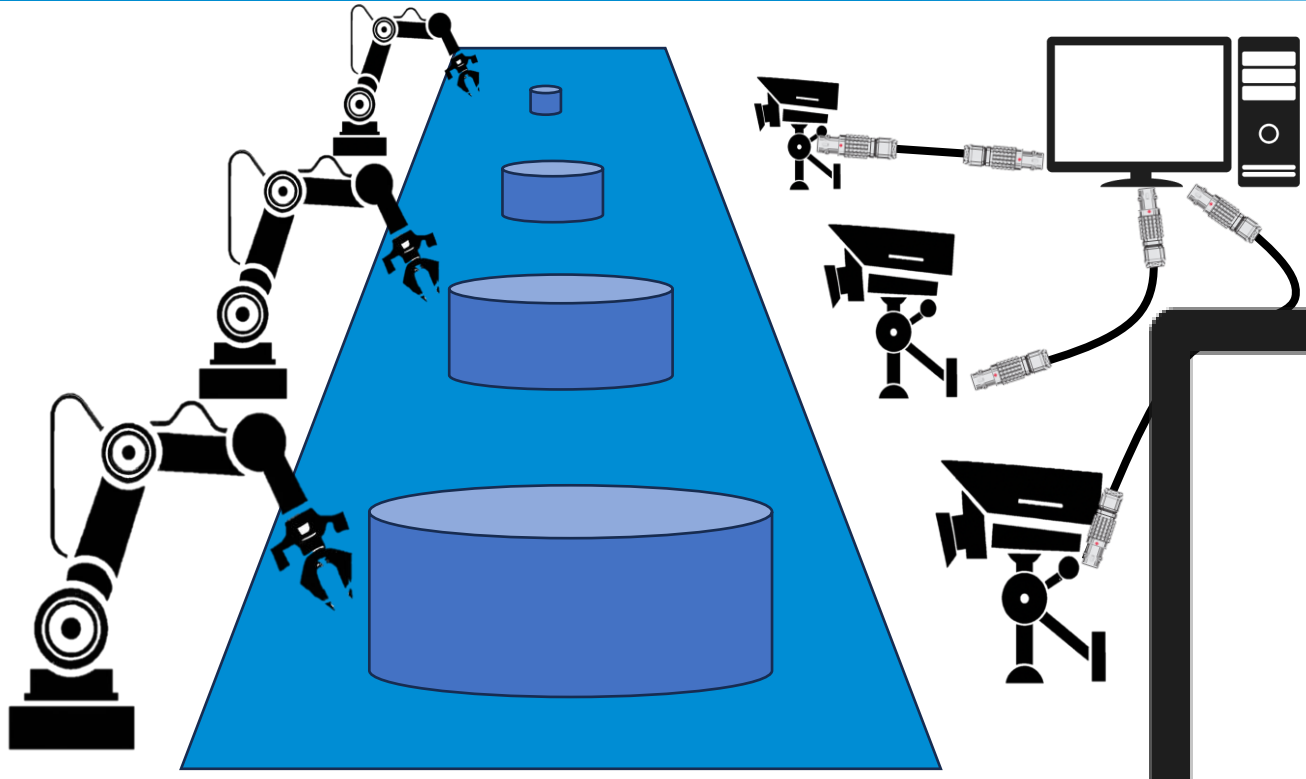
Why Electromagnetic Simulations And Measurements?



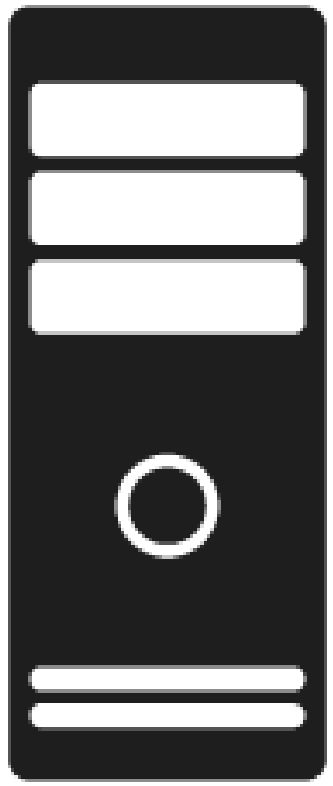
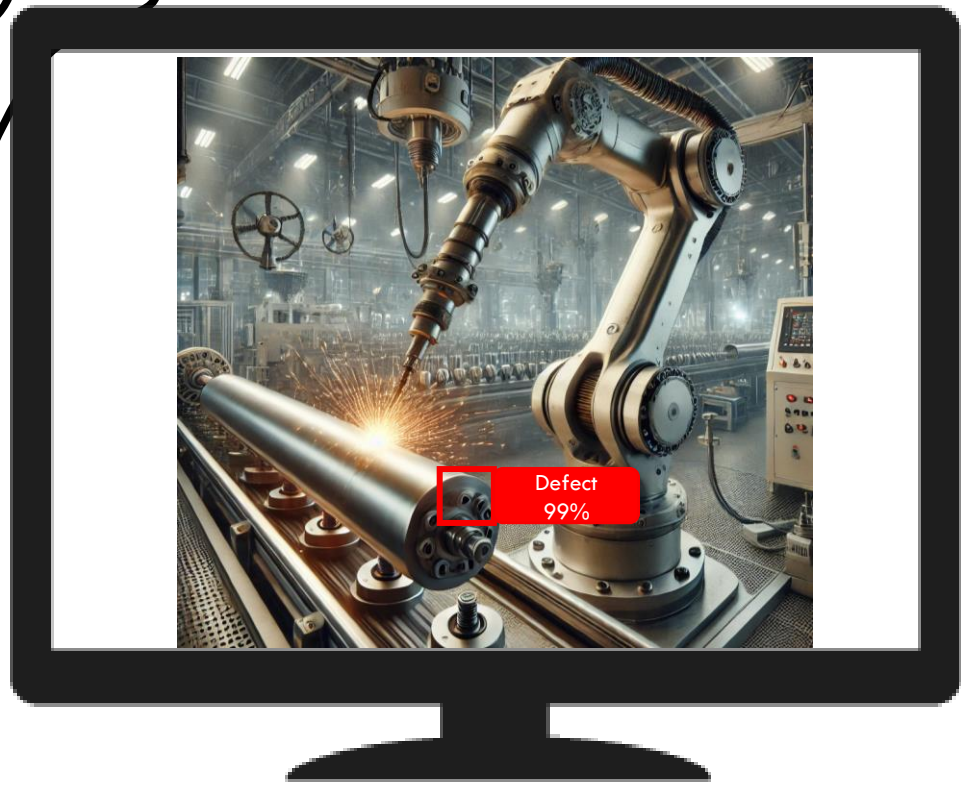
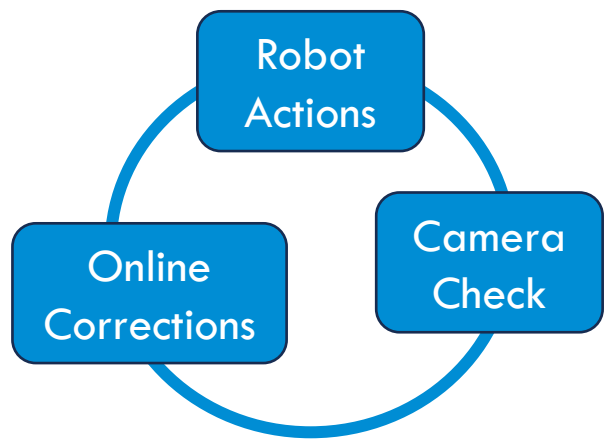
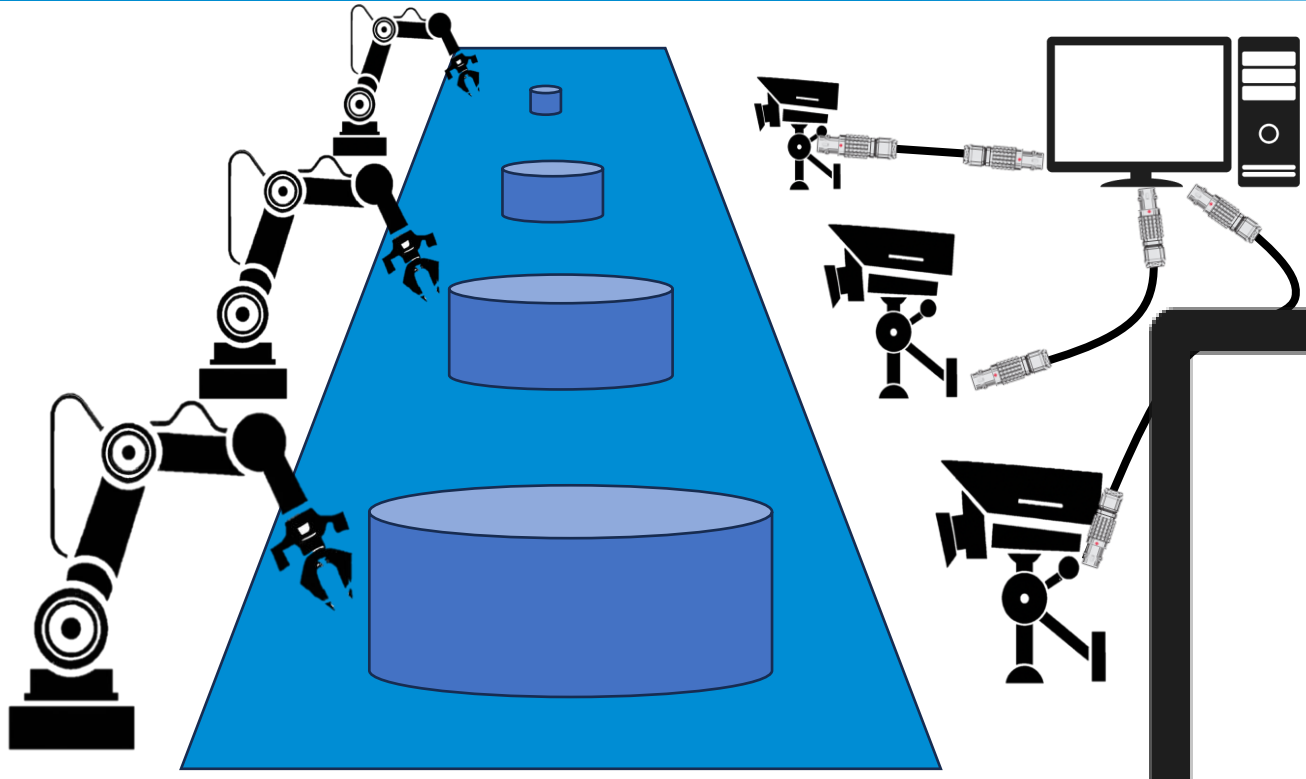
Industrial Example



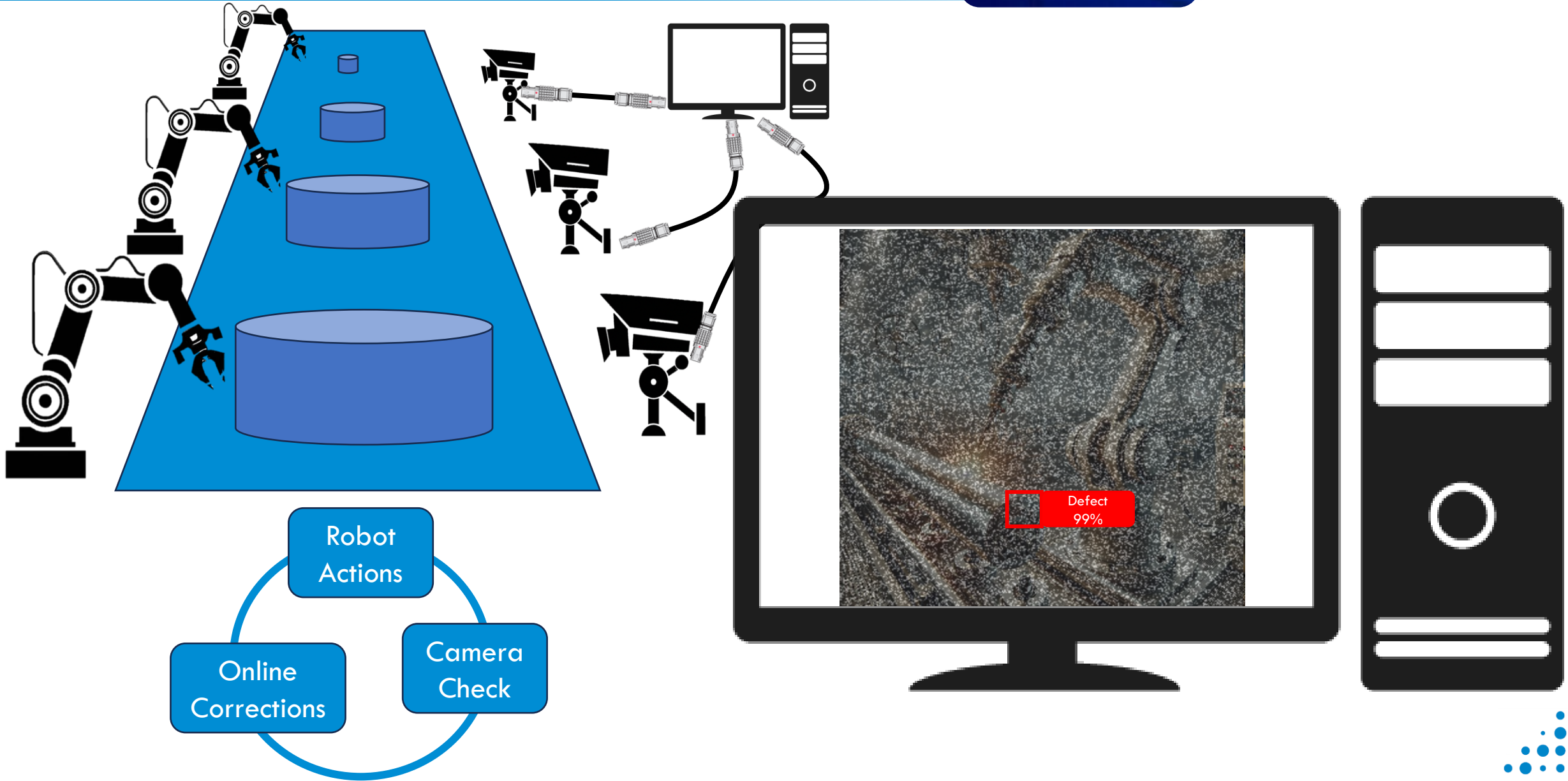
Industrial Example



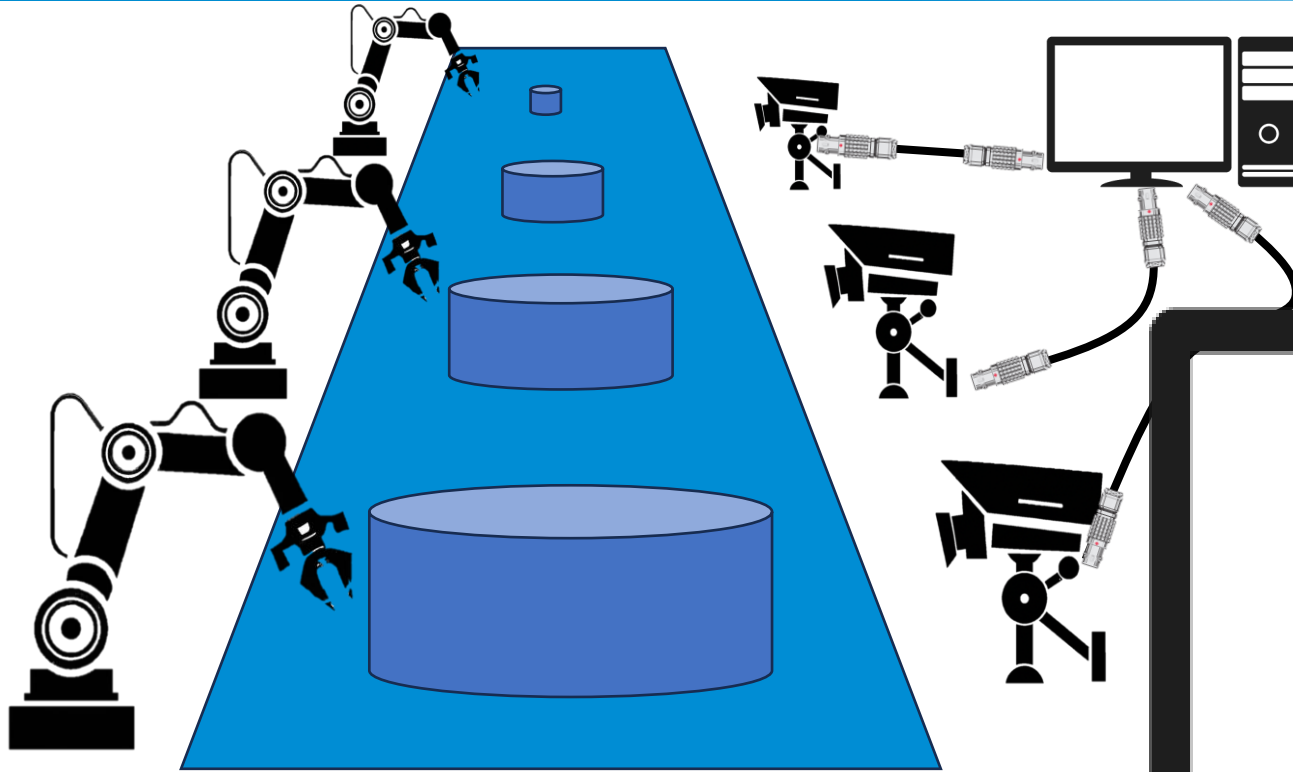
Industrial Example



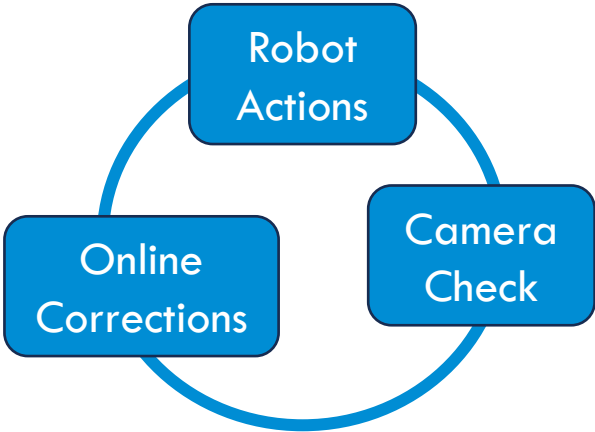
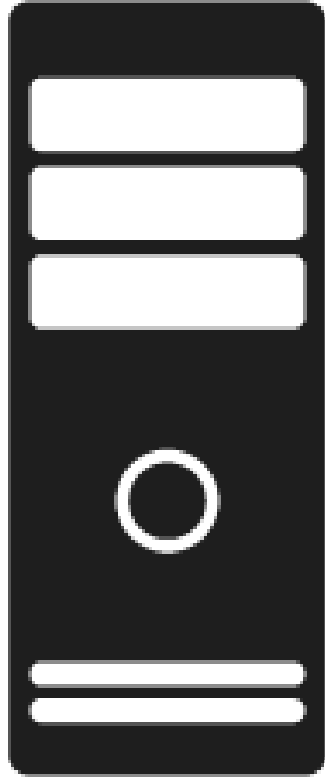
Industrial Example



Industrial Example



Because of signal integrity issues, the video quality system cannot recognize defects on the product



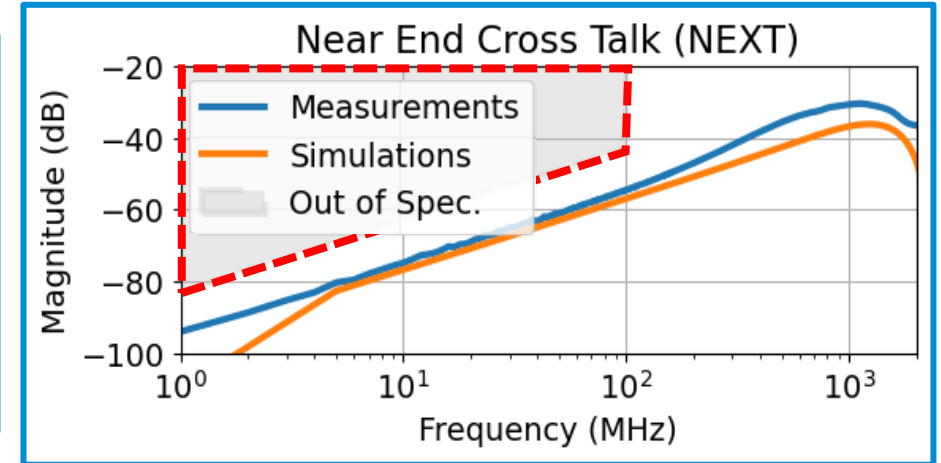
Signal Integrity: In a Nutshell



Collecting the good practices, international organizations for standardization (ISO or SNV for instance), publish standards reporting electromagnetic characteristic limits that a connector and/or a cable should have to avoid signal integrity issues in different applications and for different data rates.



IEEE 802.3-2022
IEEE Standard for Ethernet
STANDARD by IEEE , 07/29/2022
Amendments Available | View all product details



Electromagnetic characteristics obtained by simulations and measurements are benchmarked against the protocol mask to check if the connector is fulfilling the protocol requirements



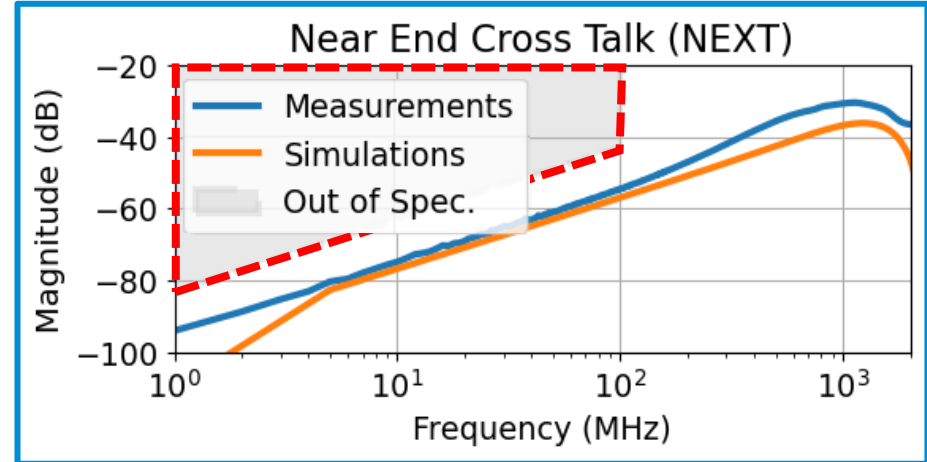
Signal Integrity: In a Nutshell



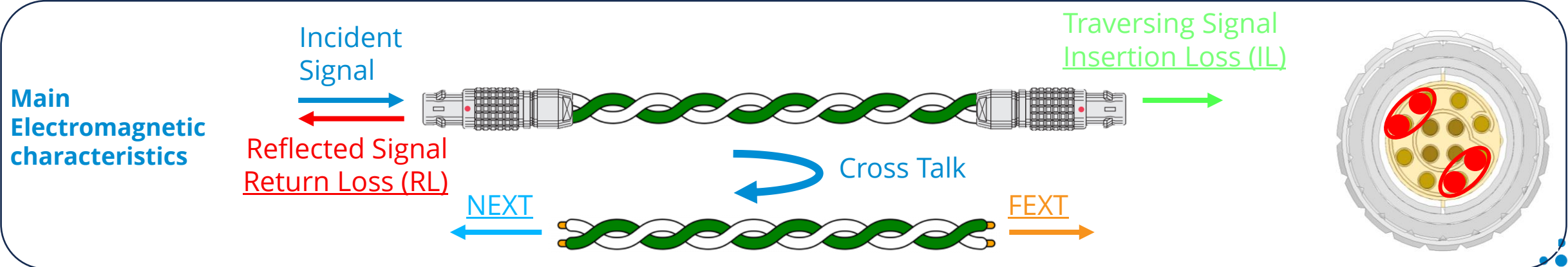
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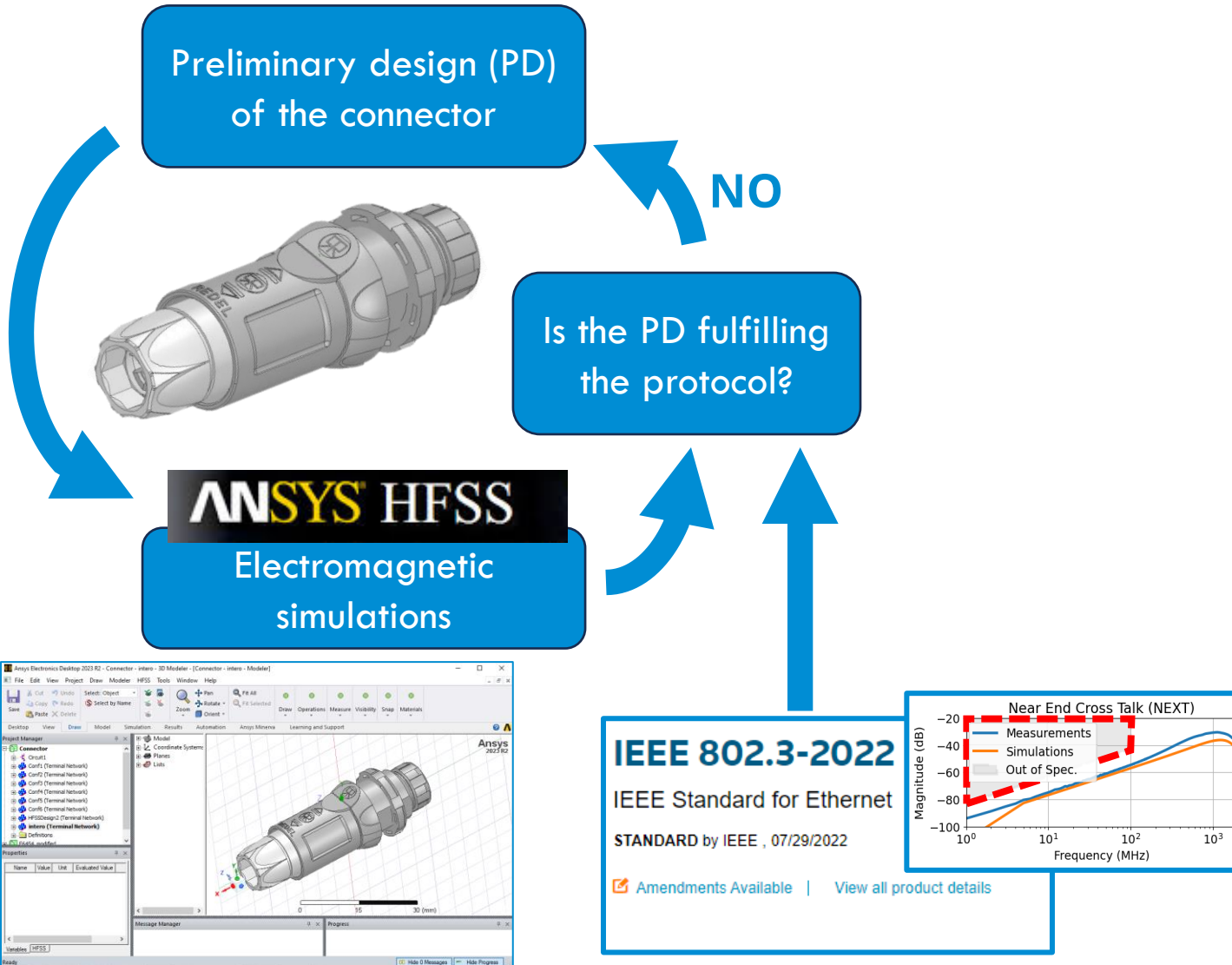




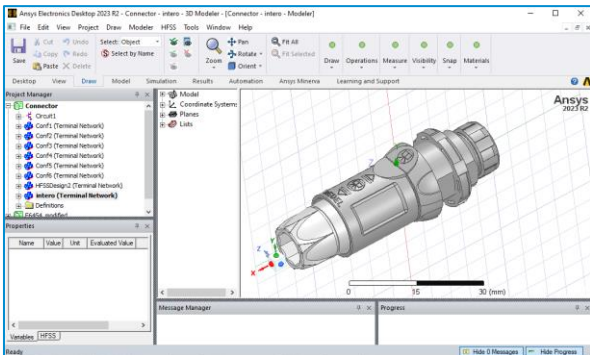
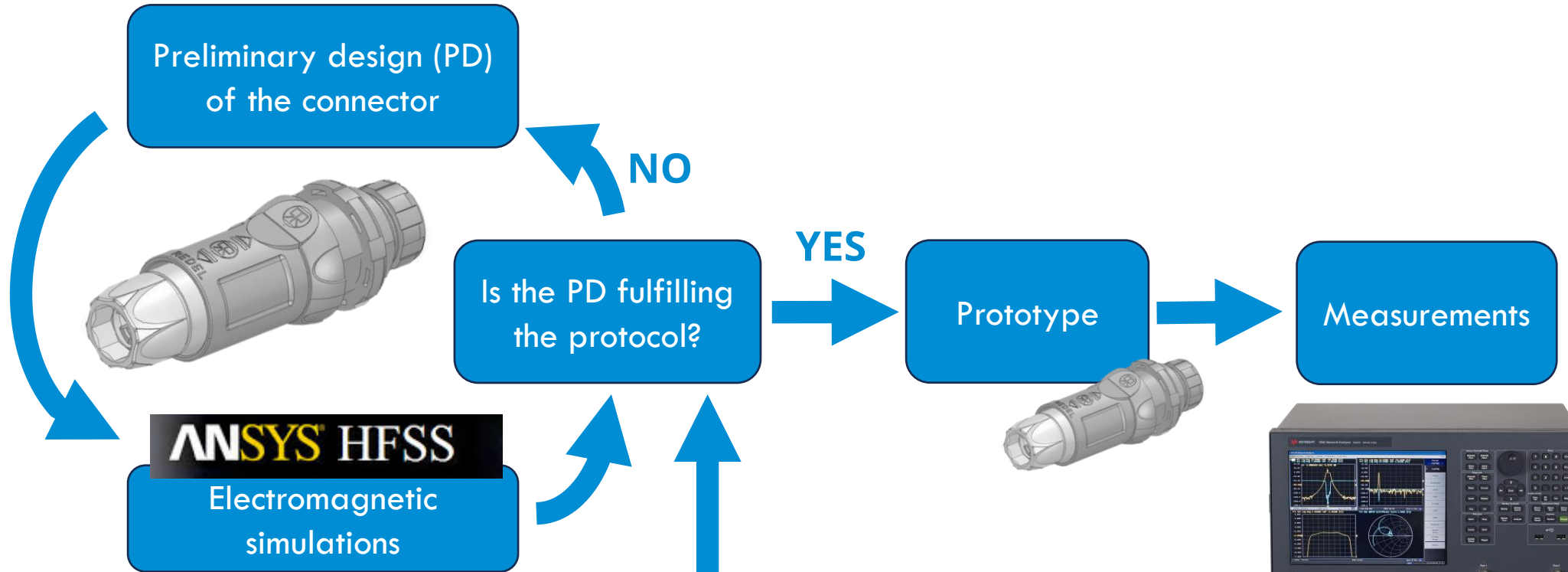
How are Electromagnetic Simulations And Measurements Used at LEMO?



The LEMO Workflow For High Datarate Connector From Design to Production

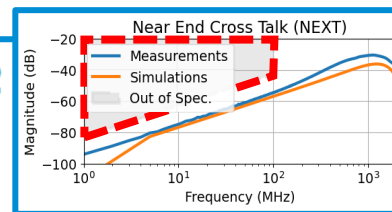


The LEMO Workflow For High Datarate Connector From Design to Production

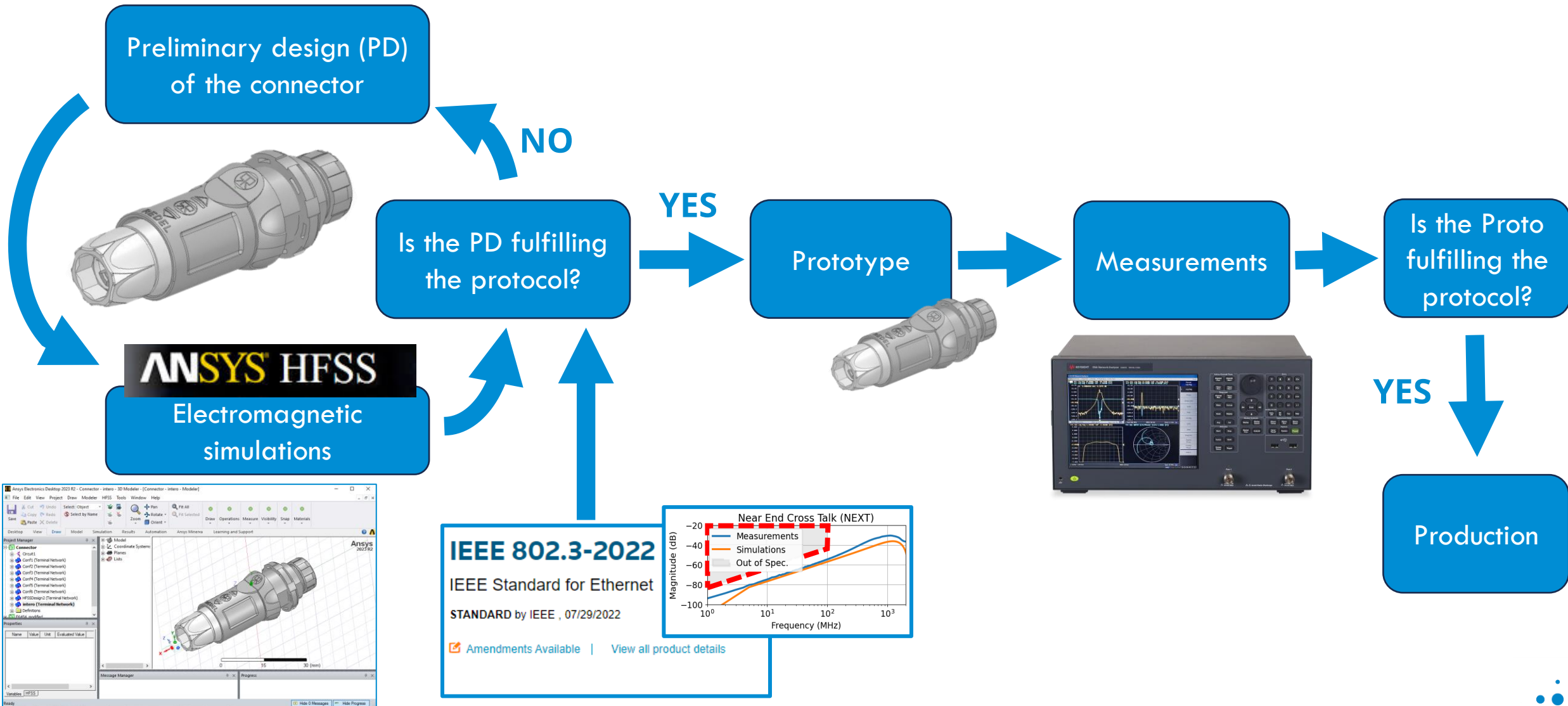


IEEE 802.3-2022
IEEE Standard for Ethernet
STANDARD by IEEE, 07/29/2022

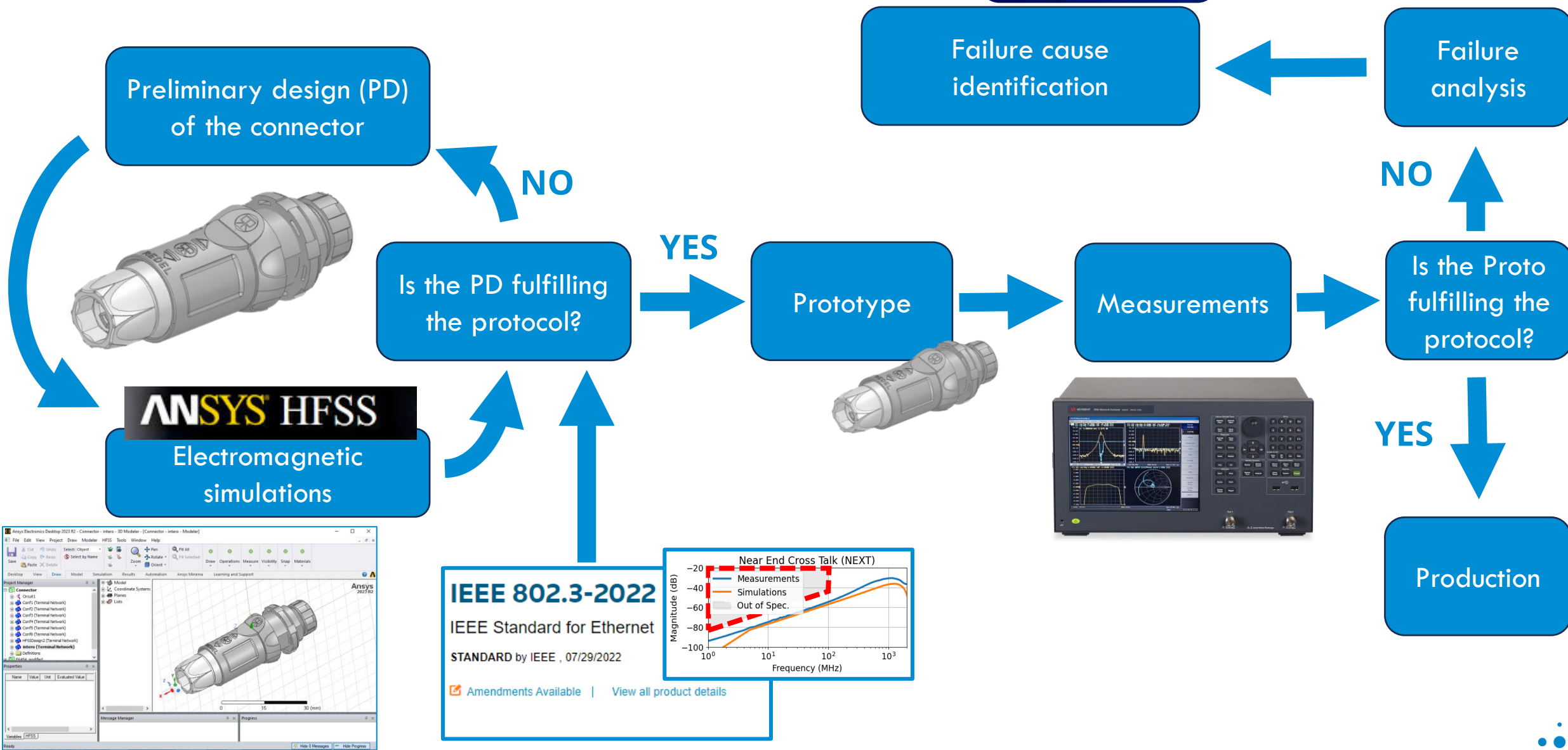
[Amendments Available](#) | [View all product details](#)



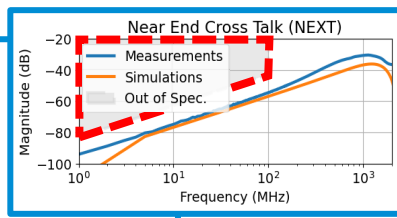
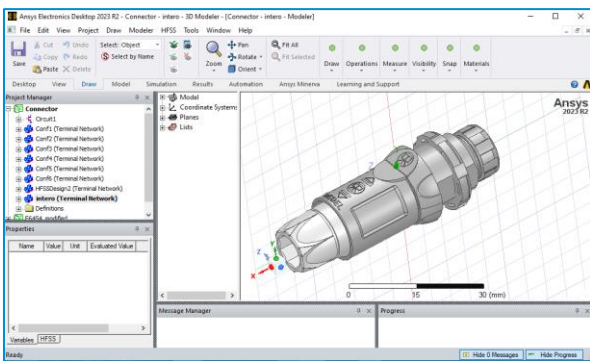
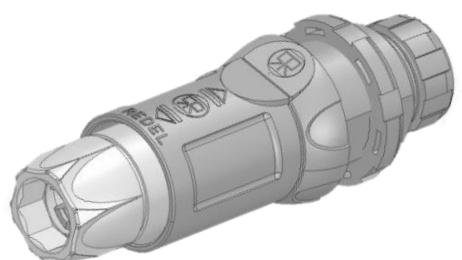
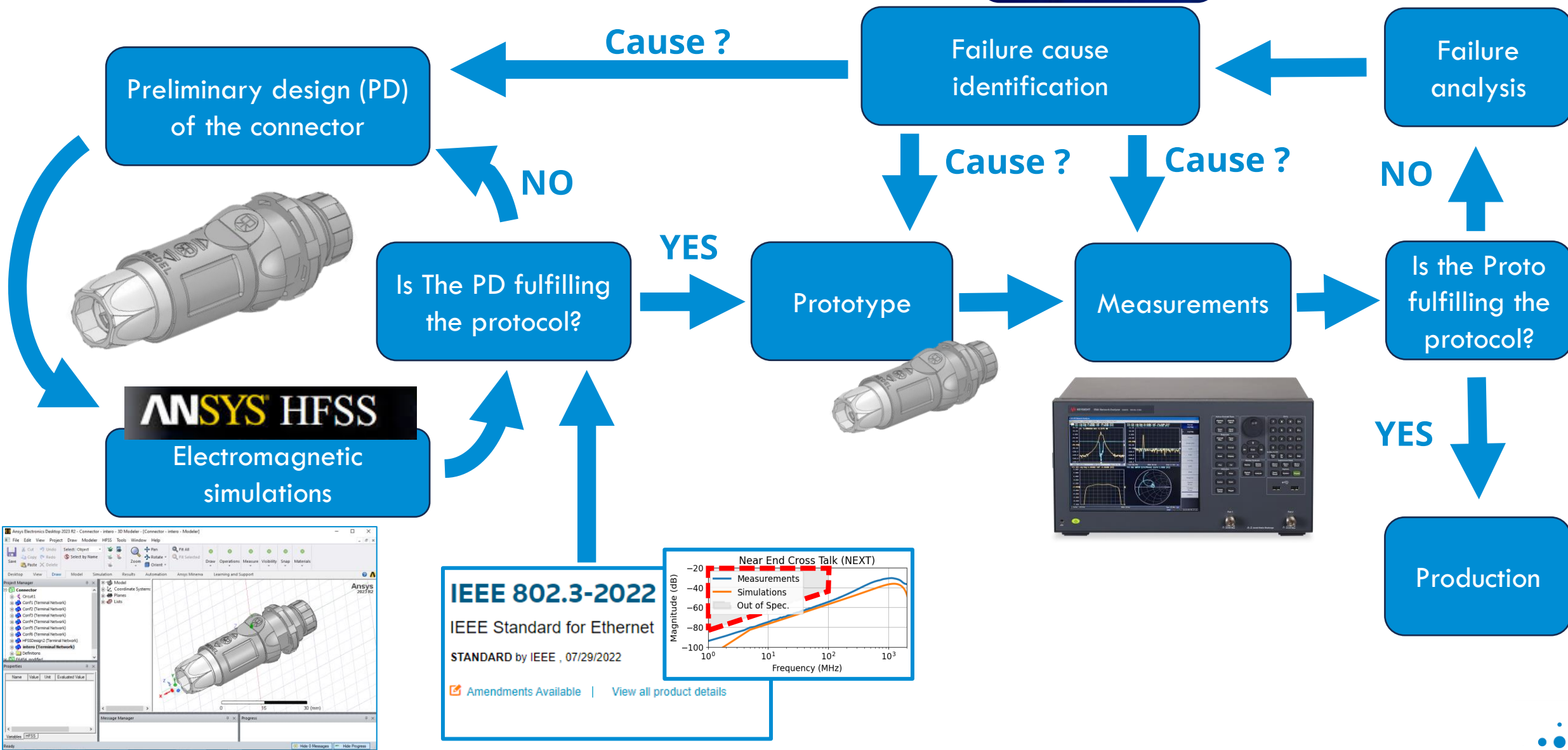
The LEMO Workflow For High Datarate Connector From Design to Production



The LEMO Workflow For High Datarate Connector From Design to Production



The LEMO Workflow For High Datarate Connector From Design to Production



IEEE 802.3-2022
 IEEE Standard for Ethernet
 STANDARD by IEEE , 07/29/2022

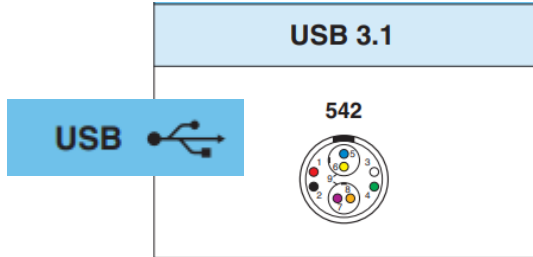
[Amendments Available](#) | [View all product details](#)



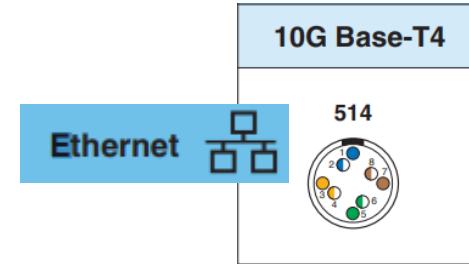
The LEMO Workflow For High Datarate Connector From Design to Production



All the LEMO high speed data transfer connectors have been designed using the previous workflow



Series	B, K, T
Sizes	2
Insert configuration	Proprietary interface
Maximum data transfer speed	10 Gb/s
Contacts	2 SuperSpeed pairs
	1 High speed pair
	2 Low Voltage



Series	B, K, T, W
Sizes	2
IEEE standard	IEEE 802.3an
Maximum data transfer speed	10 Gb/s
Number of twisted pairs	4
Cable category	CAT 6A





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Simulations VS Measurements

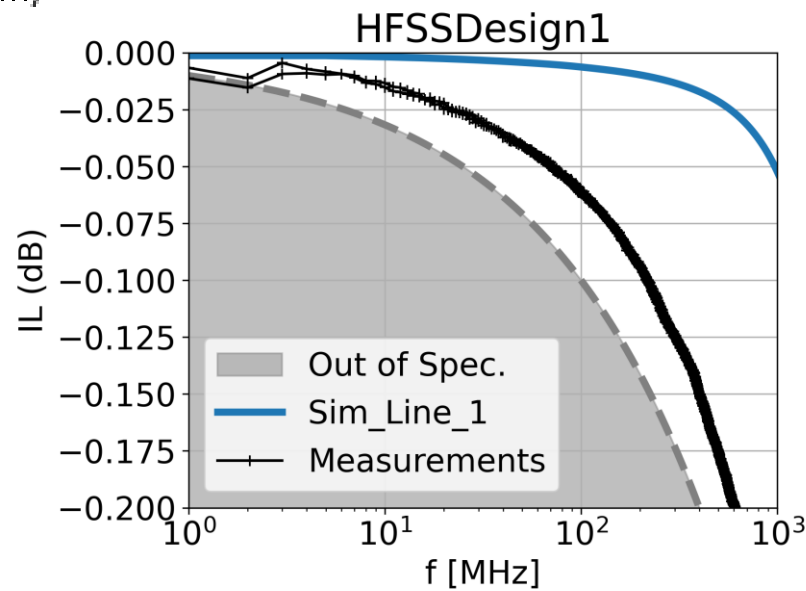
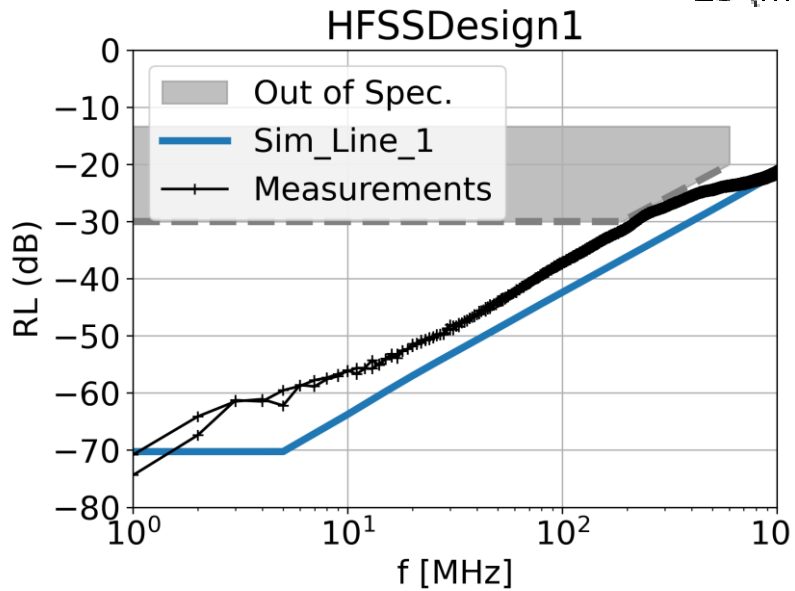
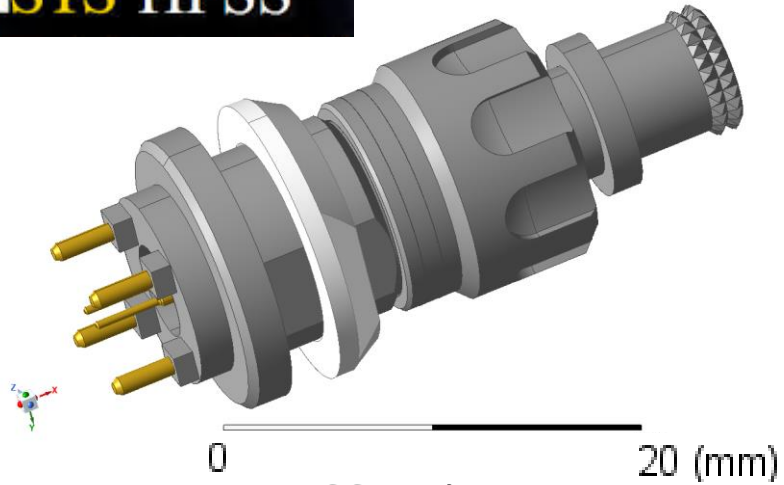


M_{series} (Vibration Proof) - 1000BASE-T1



ANSYS HFSS

Ansys
2024 R2



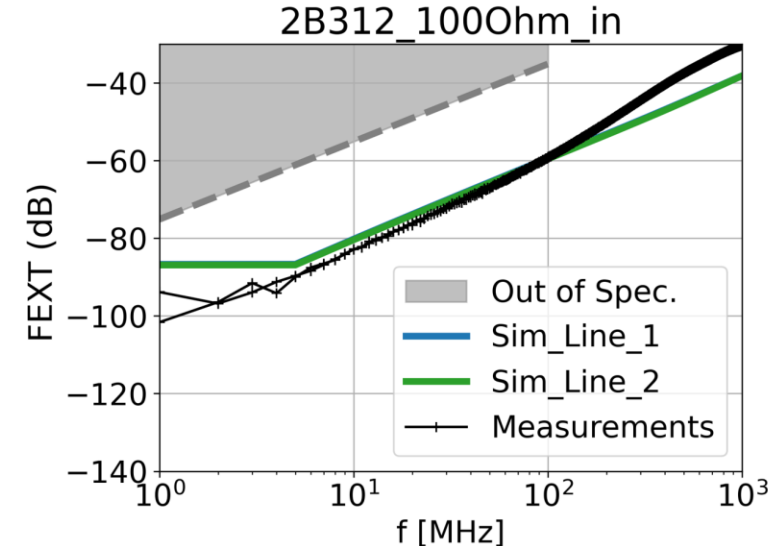
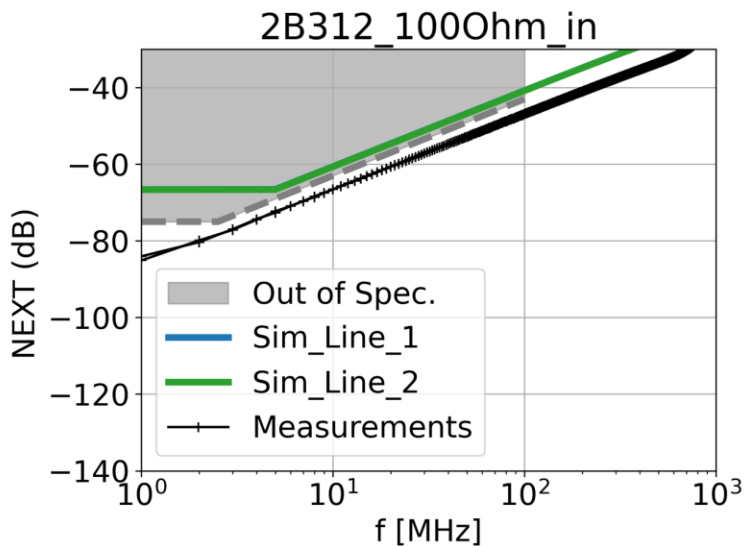
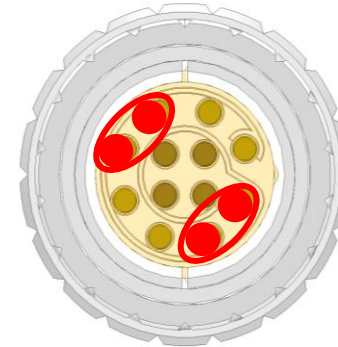
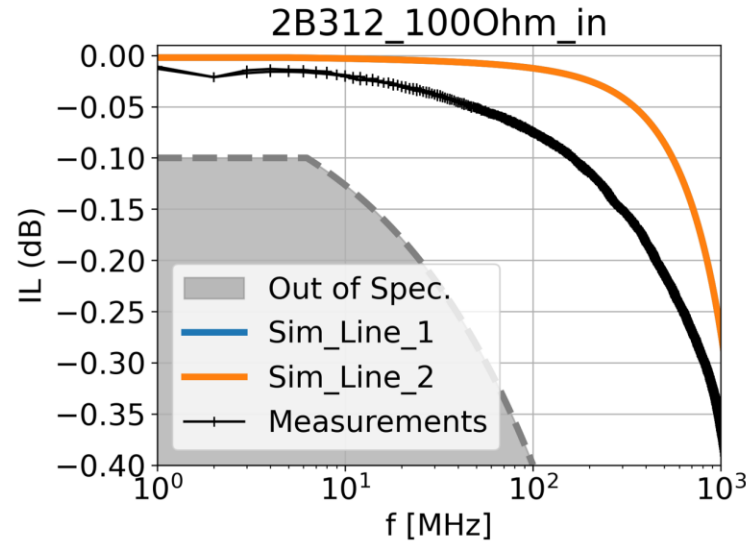
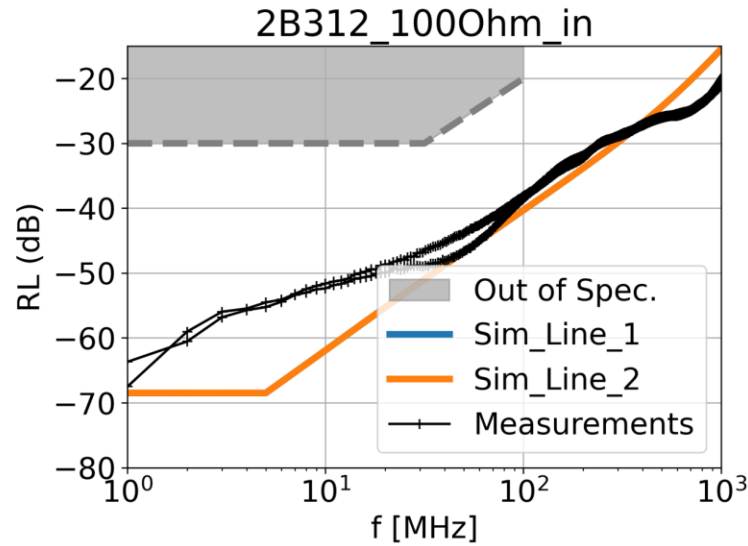
New Connector developed for 1000BASE-T1

Thanks to simulations, only one iteration design-prototyping-measurements was needed

Good agreement between simulations and measurements



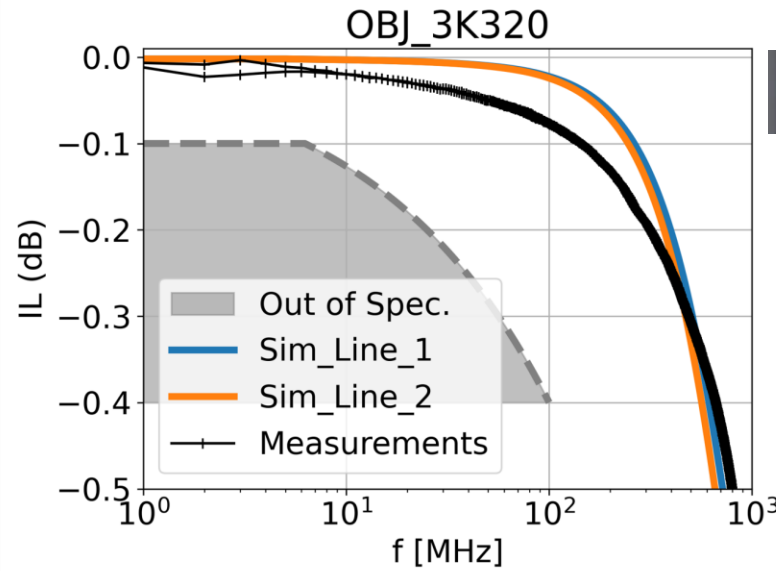
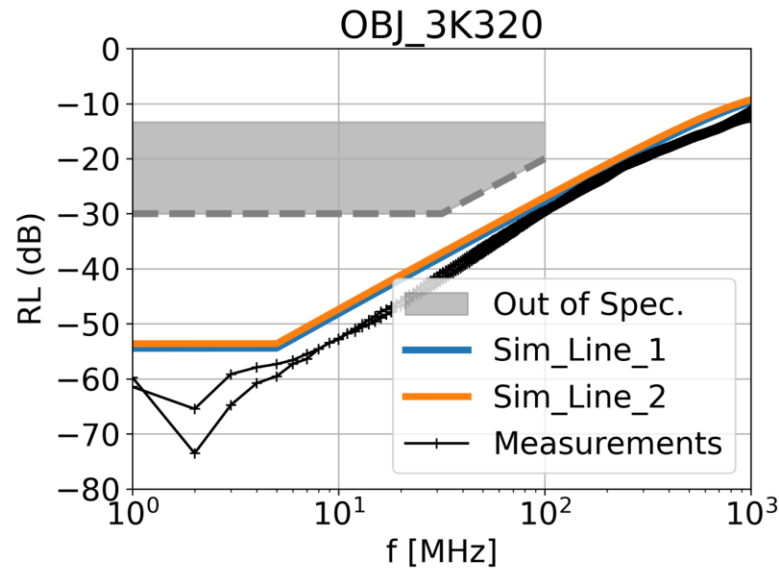
2B.312 – Ethernet CAT5e



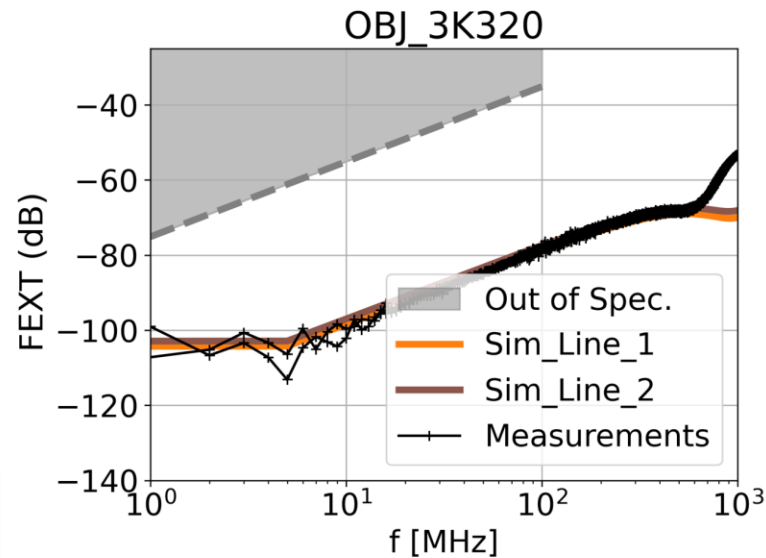
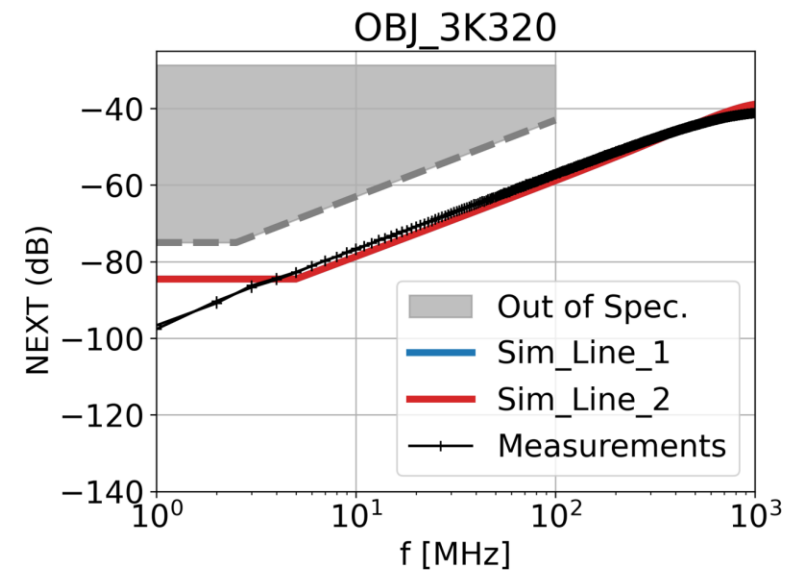
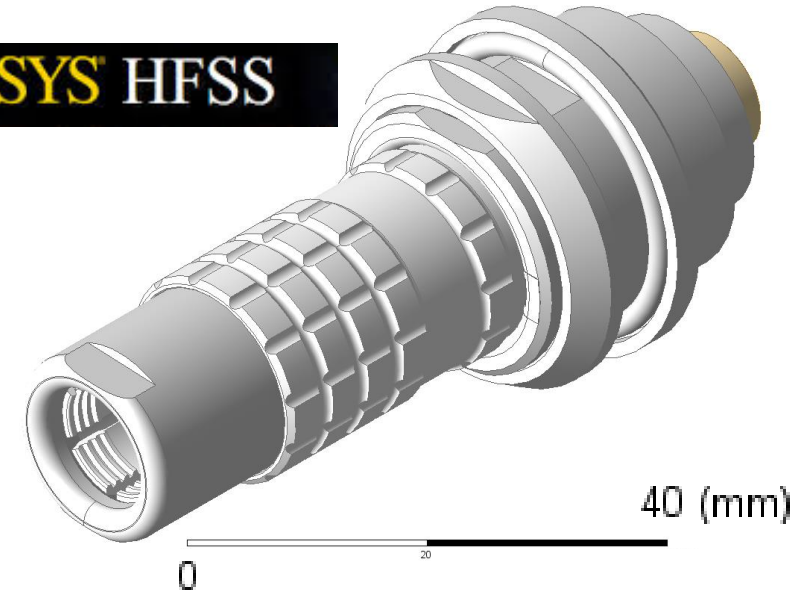
Still some discrepancies between simulations and measurements, however, reality sometimes can be better than simulations.



3K.320 – Ethernet CAT5e



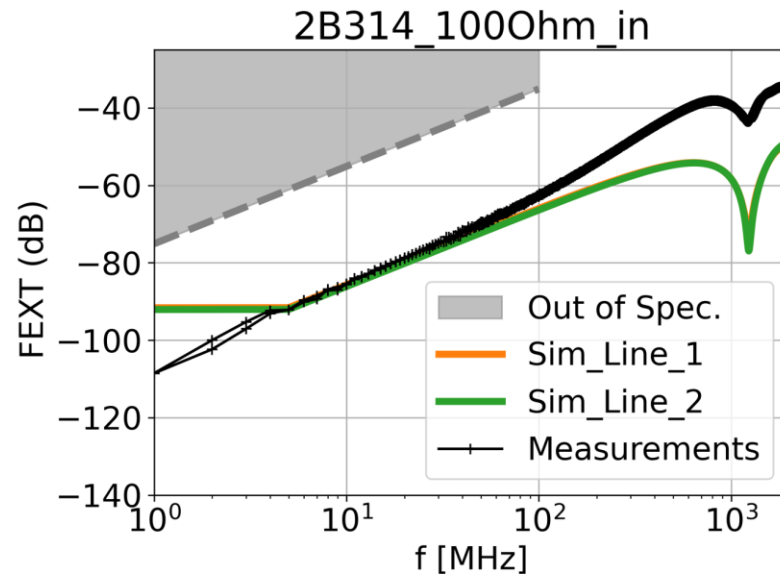
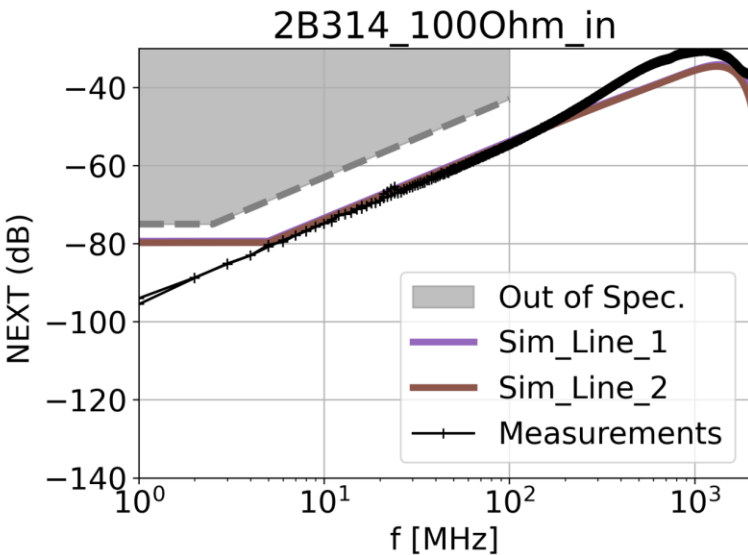
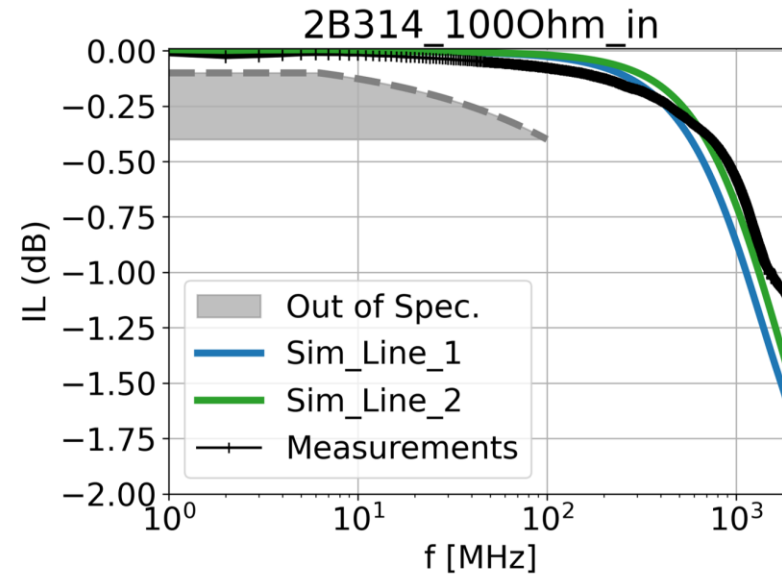
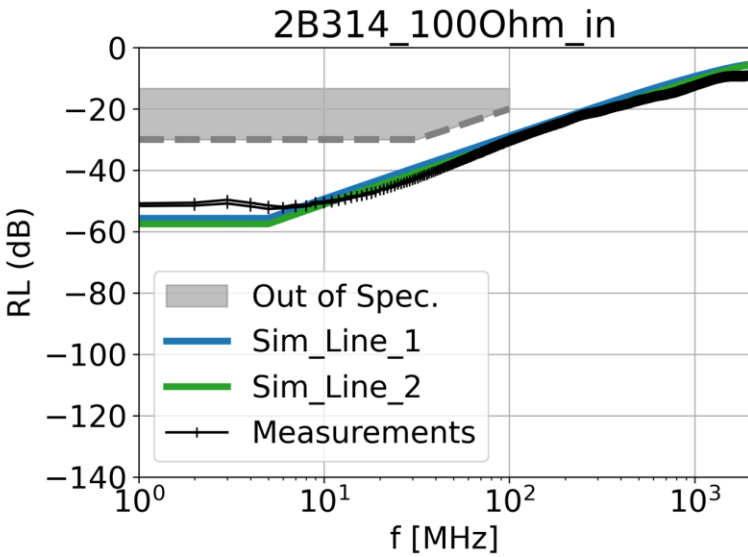
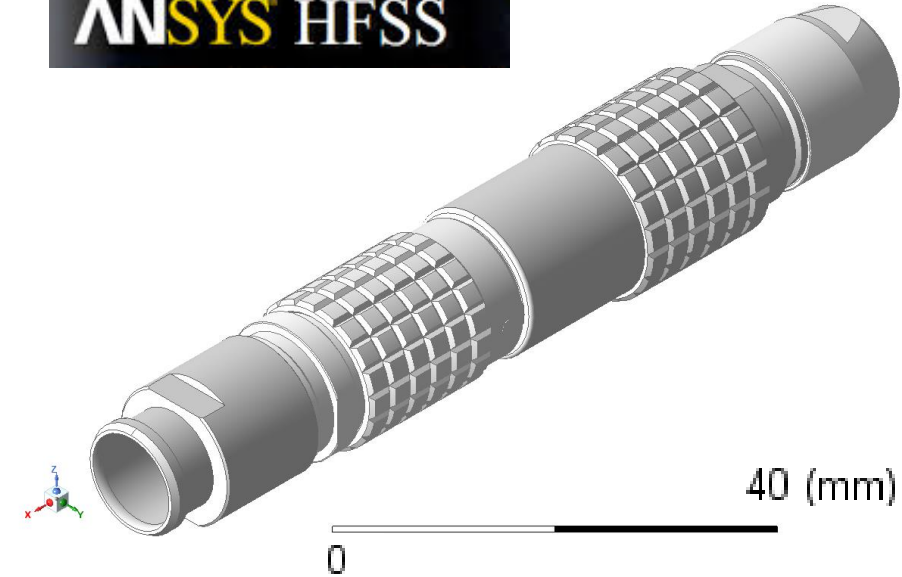
ANSYS HFSS



One of the last measurement campaign, very good agreement between measurements and simulations



2B.314 – Ethernet CAT5e

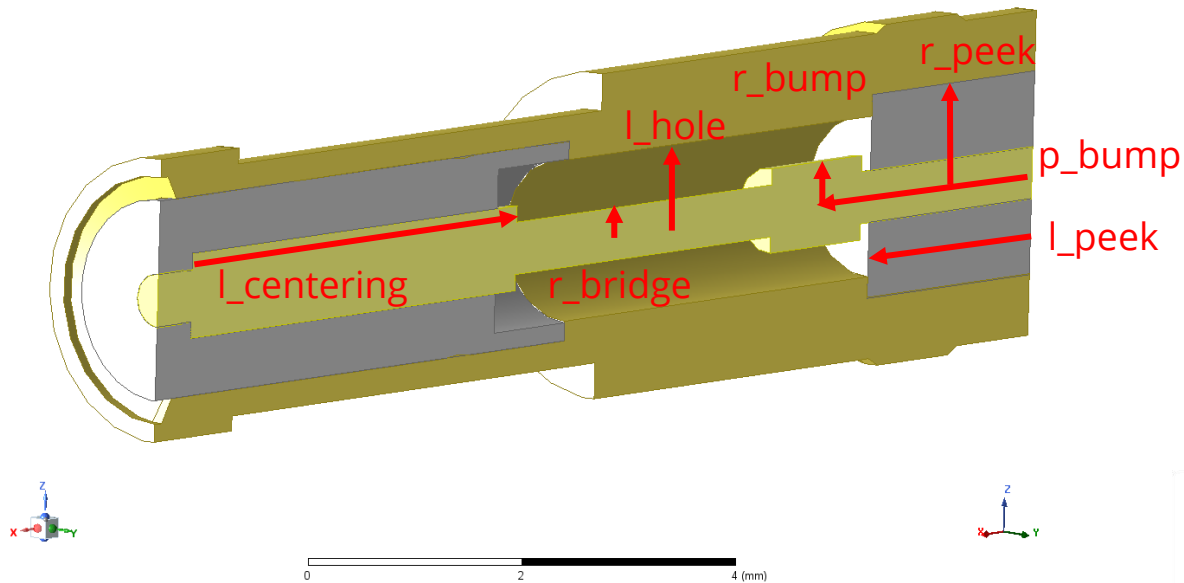


Very good agreement between simulations and measurement. For the AFEX also the resonant mode is taken.

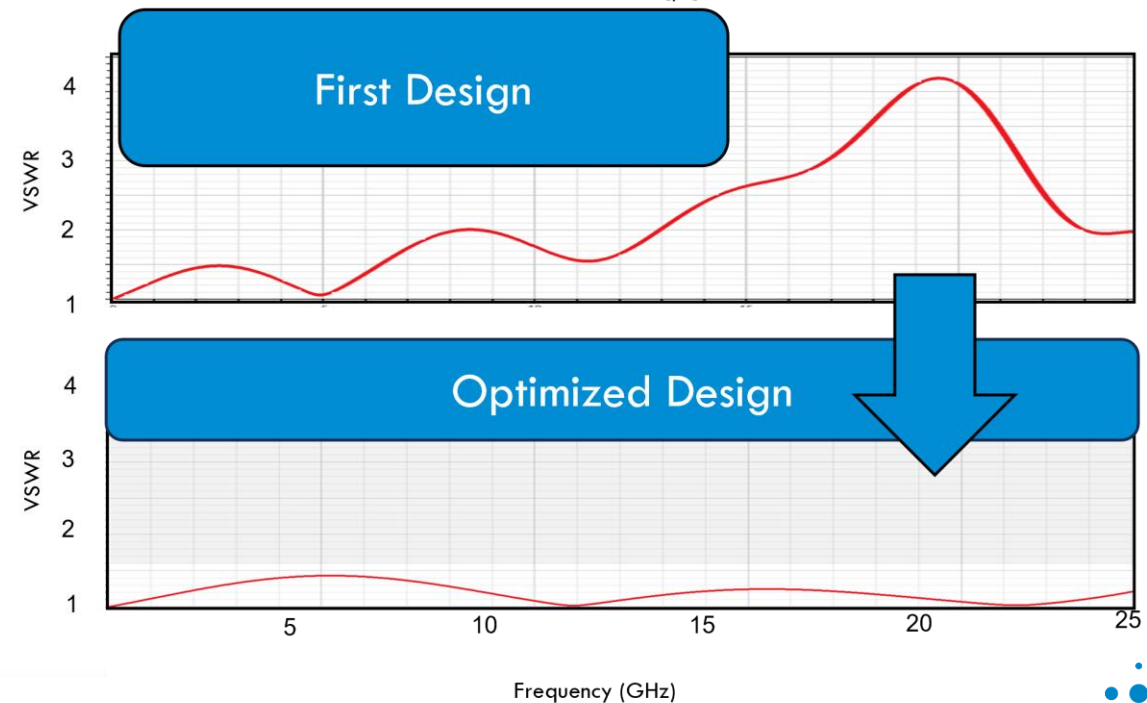
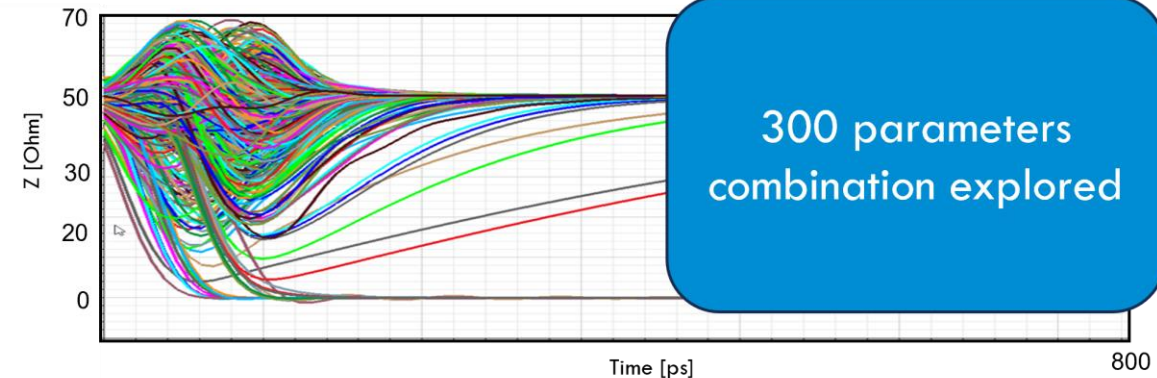


Coaxial Connector To Optimize

Ansys
2023 R2



- Optimization of a coaxial connector (Goal VSWR < 2 between 0 and 20 GHz)
 - 7+ parameters to be optimized
 - 300 designs tested
 - Final result VSWR < 1.5



Summary



- LEMO and its connectors have been presented.
- The need for electromagnetic signal integrity simulations and measurements in the connector industry has been outlined.
- LEMO's approach to the design of high-speed data exchange connectors has been shown, along with the products created using this approach.
- Examples of simulation versus measurement benchmarks have been provided. An example of design optimization has also been shown





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THANK YOU FOR YOUR ATTENTION

