

TWENTY-FOURTH ANNUAL



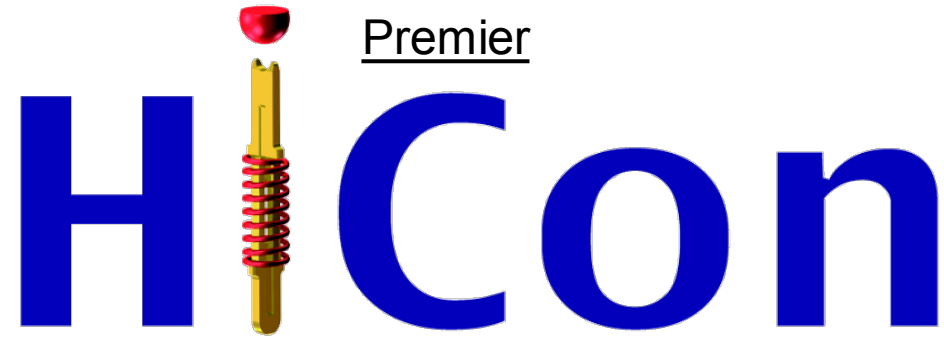
TestConX™

# Archive

DoubleTree by Hilton  
Mesa, Arizona  
March 5-8, 2023

# With Thanks to Our Sponsors!

Premier



Honored



# With Thanks to Our Sponsors!

## Distinguished



## Industry Partners



# COPYRIGHT NOTICE

The presentation(s) / poster(s) in this publication comprise the Proceedings of the TestConX 2023 workshop. The content reflects the opinion of the authors and their respective companies. They are reproduced here as they were presented at the TestConX 2023 workshop. This version of the presentation or poster may differ from the version that was distributed at or prior to the TestConX 2023 workshop.

The inclusion of the presentations/posters in this publication does not constitute an endorsement by TestConX or the workshop's sponsors. There is NO copyright protection claimed on the presentation/poster content by TestConX. However, each presentation / poster is the work of the authors and their respective companies: as such, it is strongly encouraged that any use reflect proper acknowledgement to the appropriate source. Any questions regarding the use of any materials presented should be directed to the author(s) or their companies.

“TestConX”, the TestConX logo, and the TestConX China logo are trademarks of TestConX. All rights reserved.

**[www.testconx.org](http://www.testconx.org)**

# Using Encrypted HFSS Models in HFSS to Determine System Performance

**Jeff Sherry - Johnstech International**



Mesa, Arizona • March 5–8, 2023

The Johnstech logo consists of the word "Johnstech" in a white, bold, sans-serif font with a registered trademark symbol, set against a solid red rectangular background.



# TestConX 2023

## Agenda

- What is an encrypted model and how to use encrypted models
- Process of using encrypted files or S-parameter data from customers to determine system performance
- Devices susceptible to ground inductance
- Using HFSS and ADS with encrypted models
- Comparison of initial design vs. final optimized design
- How Contactor design (GND and materials) impacts system performance
- Encrypted file examples to improve performance (ROL<sup>®</sup>100A)
- Measured repeatability of contactor
- Conclusion



Using Encrypted HFSS Models in HFSS to Determine System Performance

2

**2023**

# TestConX 2023

## What is Encrypted Model and How to Use It

- An encrypted model represents a circuit or device that represents the performance of the circuit or device without showing key information about the circuit or device. Essentially a black box.
- Encrypted model will have an outline of the model or device and interfaces so the model can be used in a system with other components
- Encrypted model of one part of the system can be used with other HFSS models to get system performance. (Example uses an encrypted model of both customer load board and device so can be used with contactor model to gain full system performance of a filter.)

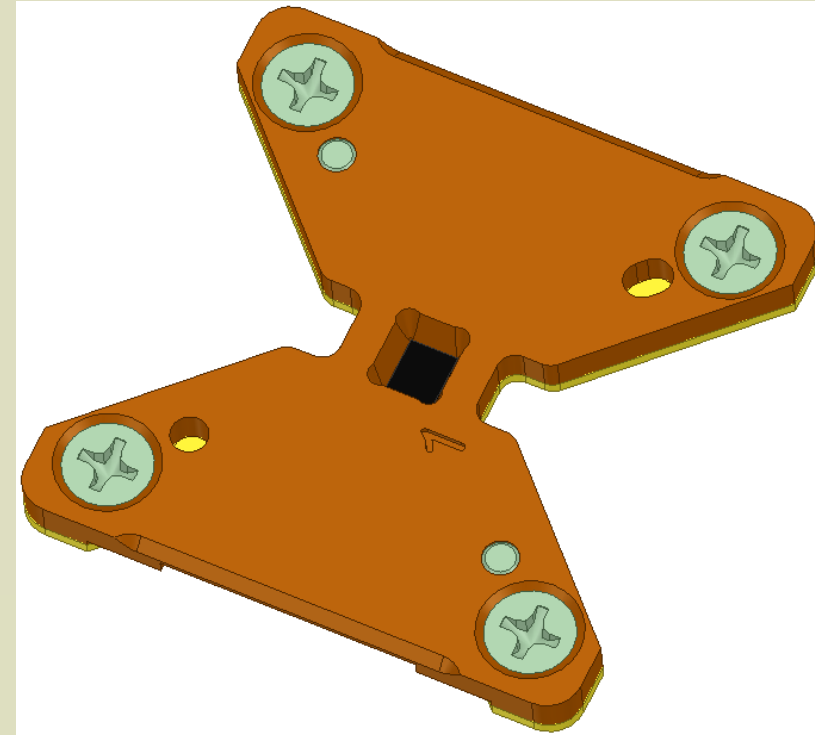
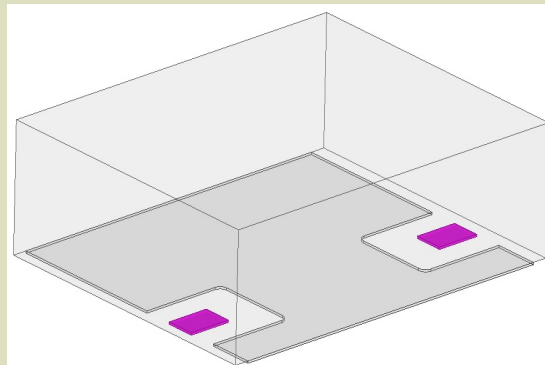


# TestConX 2023

## Process to Generate Encrypted Models for Devices and Generating Performance With Device in Contactor

- Get S-parameters of the device
- Generate device model from samples
- Use HFSS Circuit Elements to generate an encrypted model
- Install a device in the contactor and solve

### Encrypted Model of Device (Filter)



- Contactor Model Based on Manufacturing Build
- Contacts in Compressed /Test Mode



Using Encrypted HFSS Models in HFSS to Determine System Performance

4

# 2023



# TestConX 2023

## Devices that are Susceptible to Ground Inductance in Test System

- Power Amplifiers
- High Gain Amplifiers (Above 20dB)
- Filters Surface Acoustic Wave (SAW) and Bulk Acoustic Wave (BAW)
- High-Frequency Designs – Above 3GHz
- High-Speed Digital Designs – Above 10 GBits/sec
- High Gain Devices like RX and TX Devices (above 20dB)
- Voltage-sensitive devices – (i.e., High BIT count DACs and ADCs - Voltage per BIT small)

If Contactor Can Handle Device Frequency It May Still Have Issues Testing Device



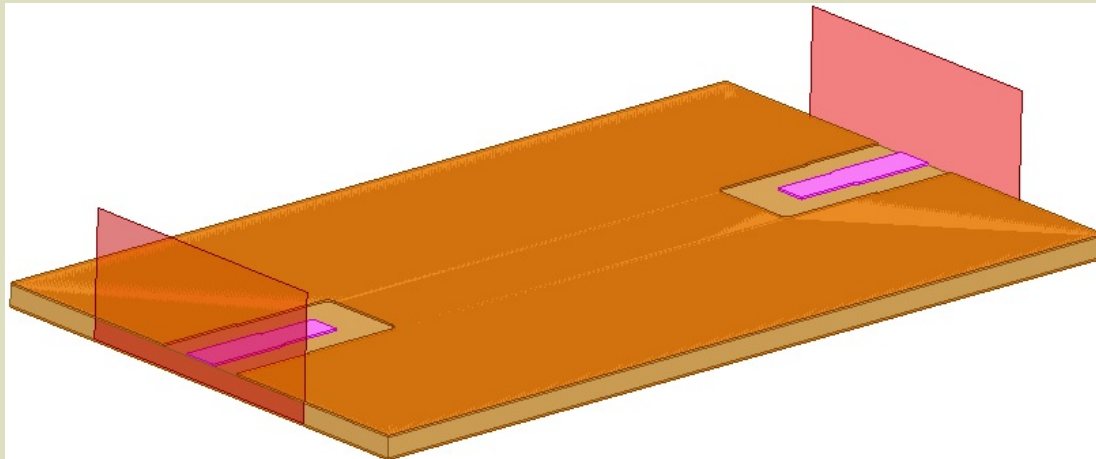
Using Encrypted HFSS Models in HFSS to Determine System Performance

5

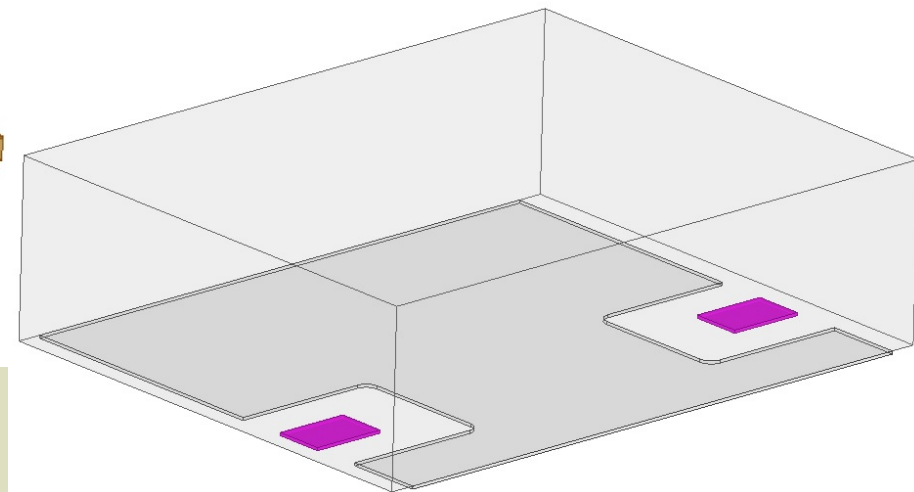
**2023**

## High Frequency Filter Encrypted Models - HFSS

Encrypted Model of Load Board



Encrypted Model of Device (Filter)



HFSS Encrypted Models

Encrypted Models as Minimum Show Interfaces to Rest of System



Using Encrypted HFSS Models in HFSS to Determine System Performance

6

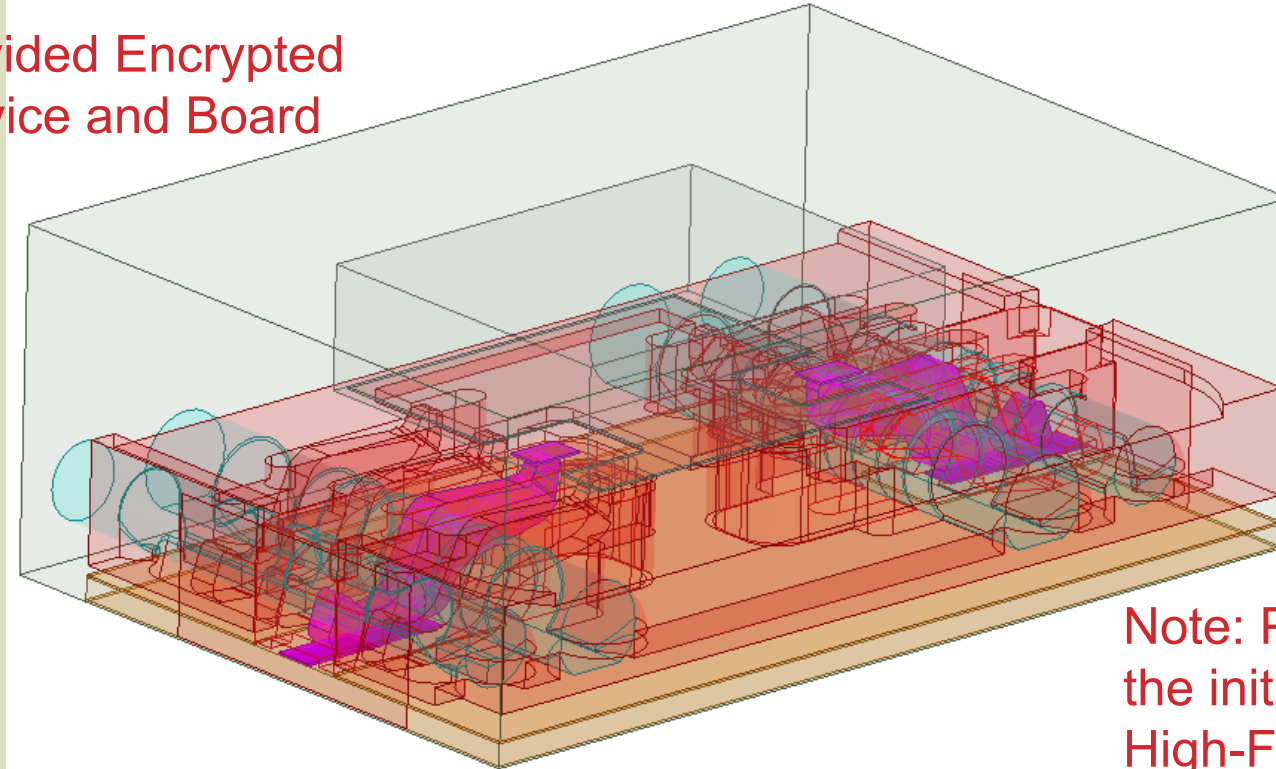
# 2023

# TestConX 2023

## High-Frequency Filter System With Encrypted Models - HFSS

System Model in HFSS With Encrypted Model of Load Board and Device

Customer Provided Encrypted  
models for Device and Board



Note: Picture shows  
the initial contactor for  
High-Frequency Filter



Using Encrypted HFSS Models in HFSS to Determine System Performance

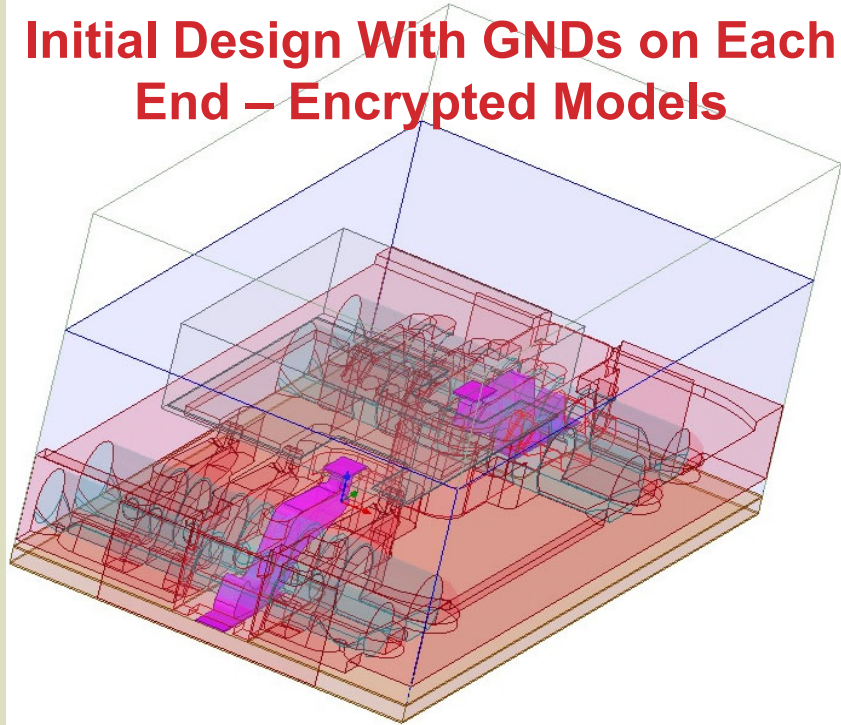
7

**2023**

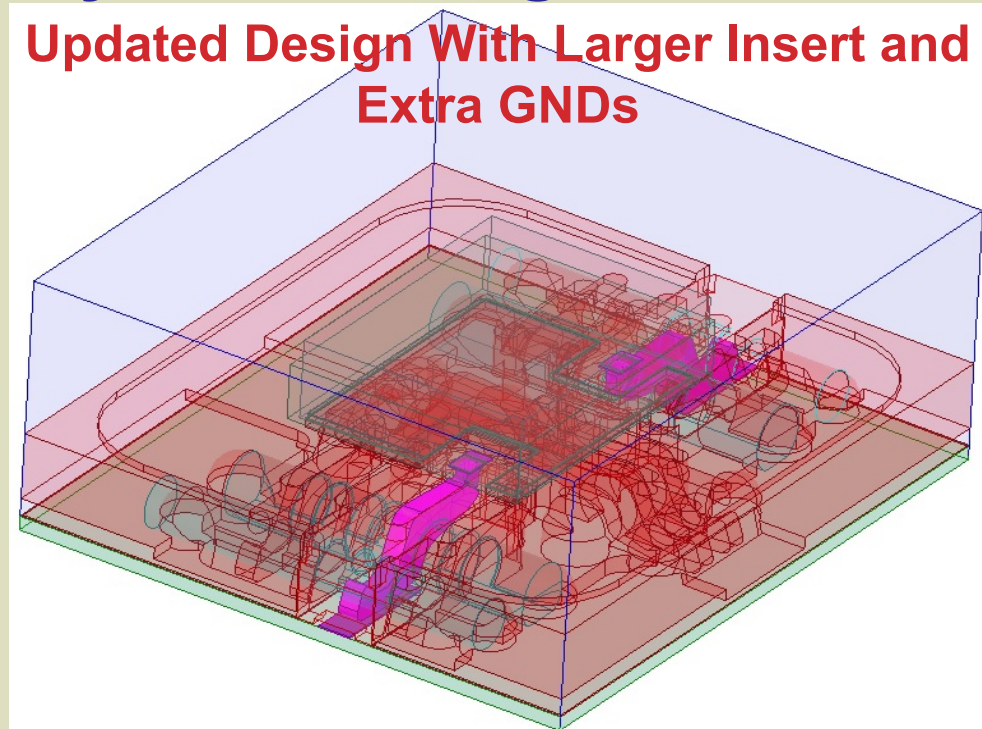
# TestConX 2023

## System Comparison of Initial Design vs. Updated Design for High Frequency Filter Design - HFSS

Initial Design With GNDs on Each End – Encrypted Models



Updated Design With Larger Insert and Extra GNDs



Updated Design Adds Extra Grounds Perpendicular to Signal Flow

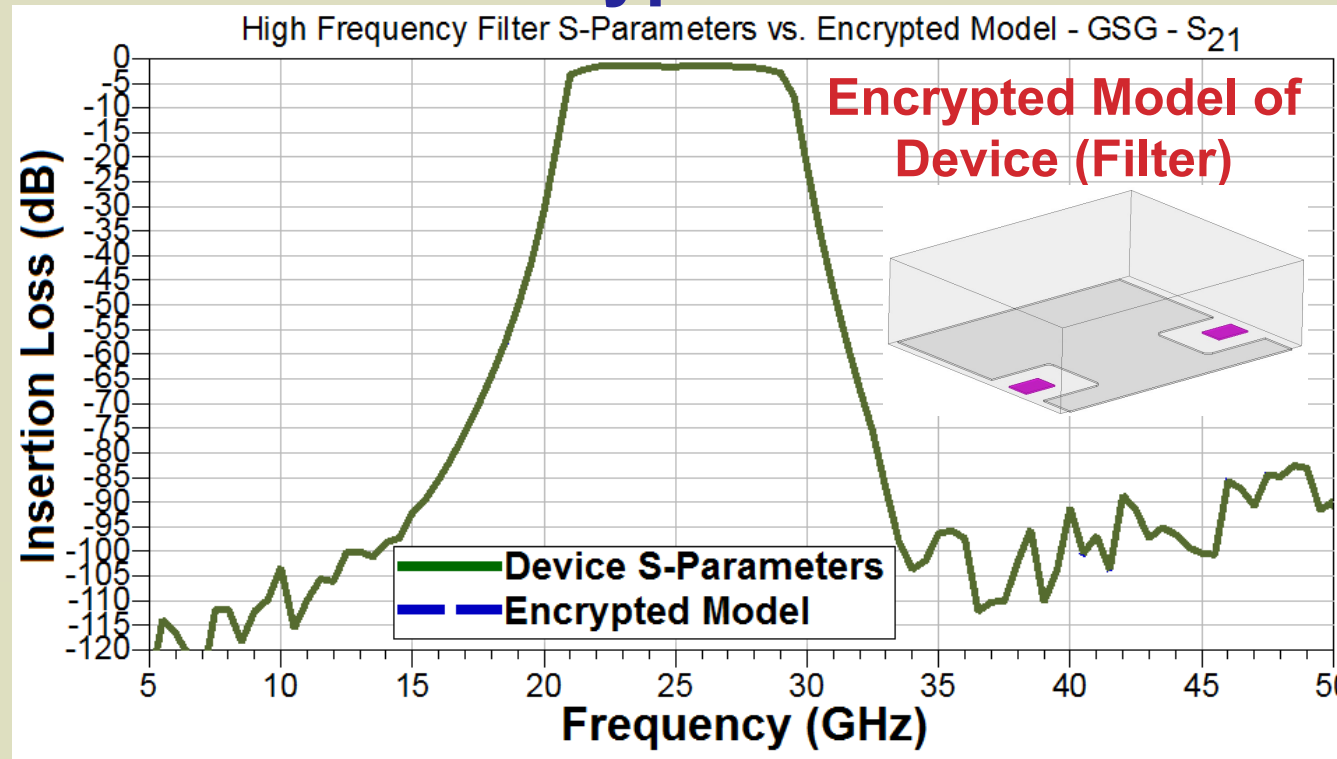


Using Encrypted HFSS Models in HFSS to Determine System Performance

8

**2023**

## S- Parameter File vs. High Frequency Filter Encrypted Model



Encrypted Models if set up Correctly Exactly Mimic S-Parameter Data



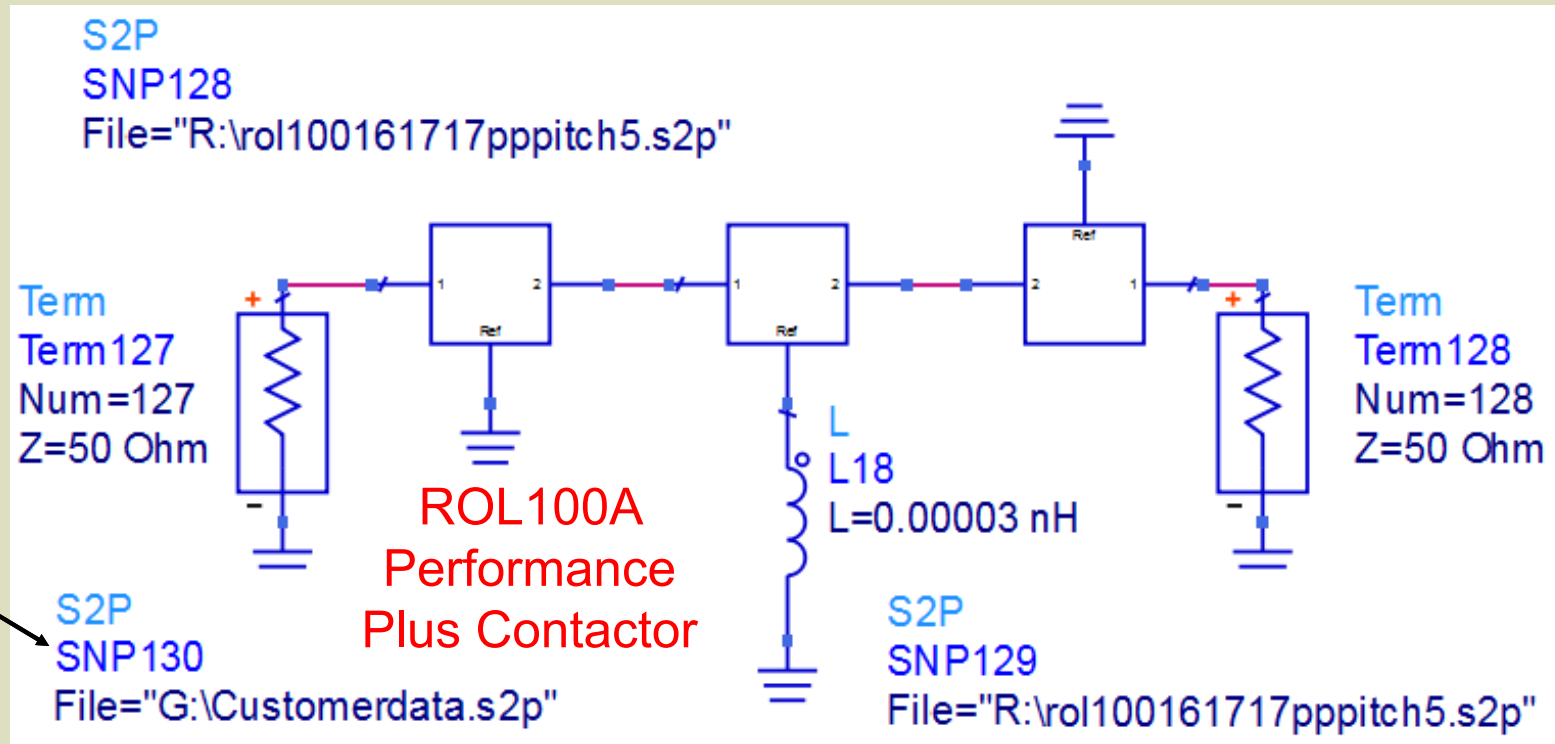
Using Encrypted HFSS Models in HFSS to Determine System Performance

9

# 2023

# TestConX 2023

## 0.5mm Pitch ROL100A<sup>®</sup> Contactor System With Encrypted Device – ADS Final Model Equivalent



Encrypted Model from Customer

Need to Include in Model the Actual Inductance to GND of Design to Predict Performance



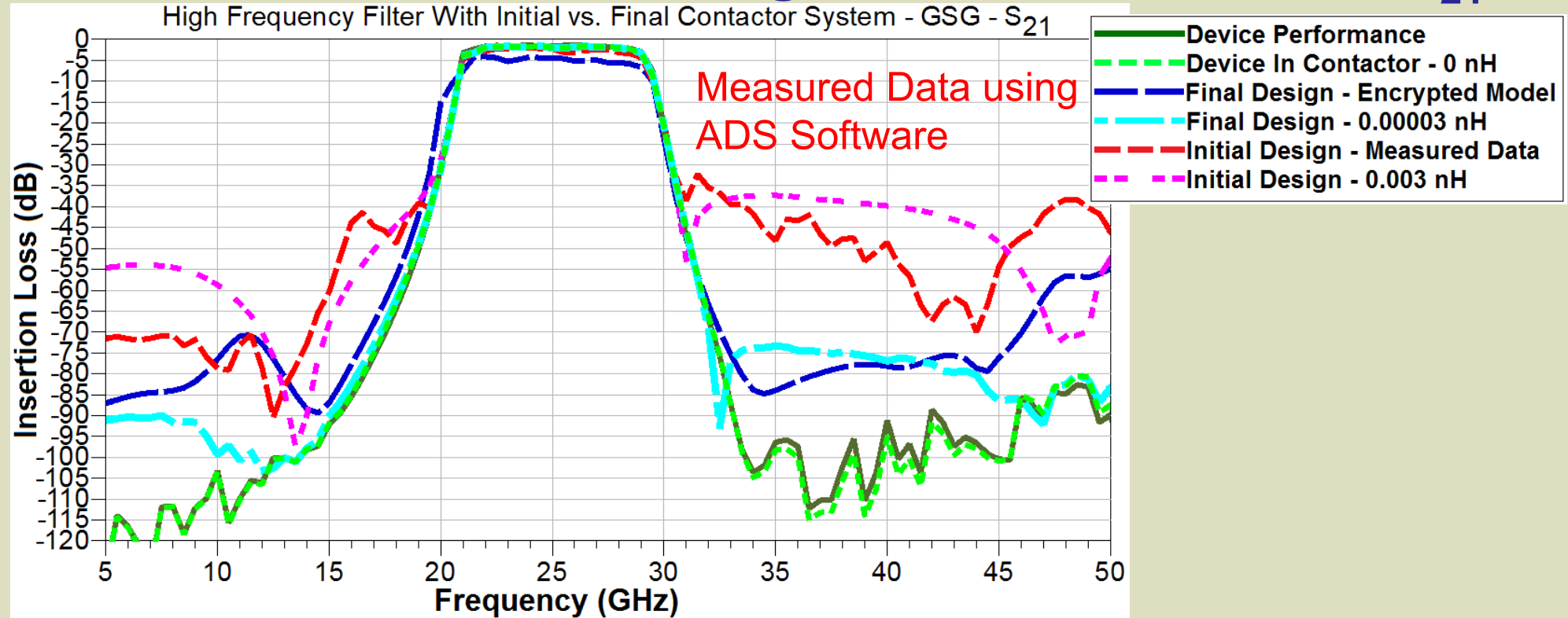
Using Encrypted HFSS Models in HFSS to Determine System Performance

10

**2023**

# TestConX 2023

## 0.5mm Pitch System Simulations of High Frequency Filter Performance Using Different Methods – $S_{21}$



Putting Device in Contactor for Test adds Inductance to System



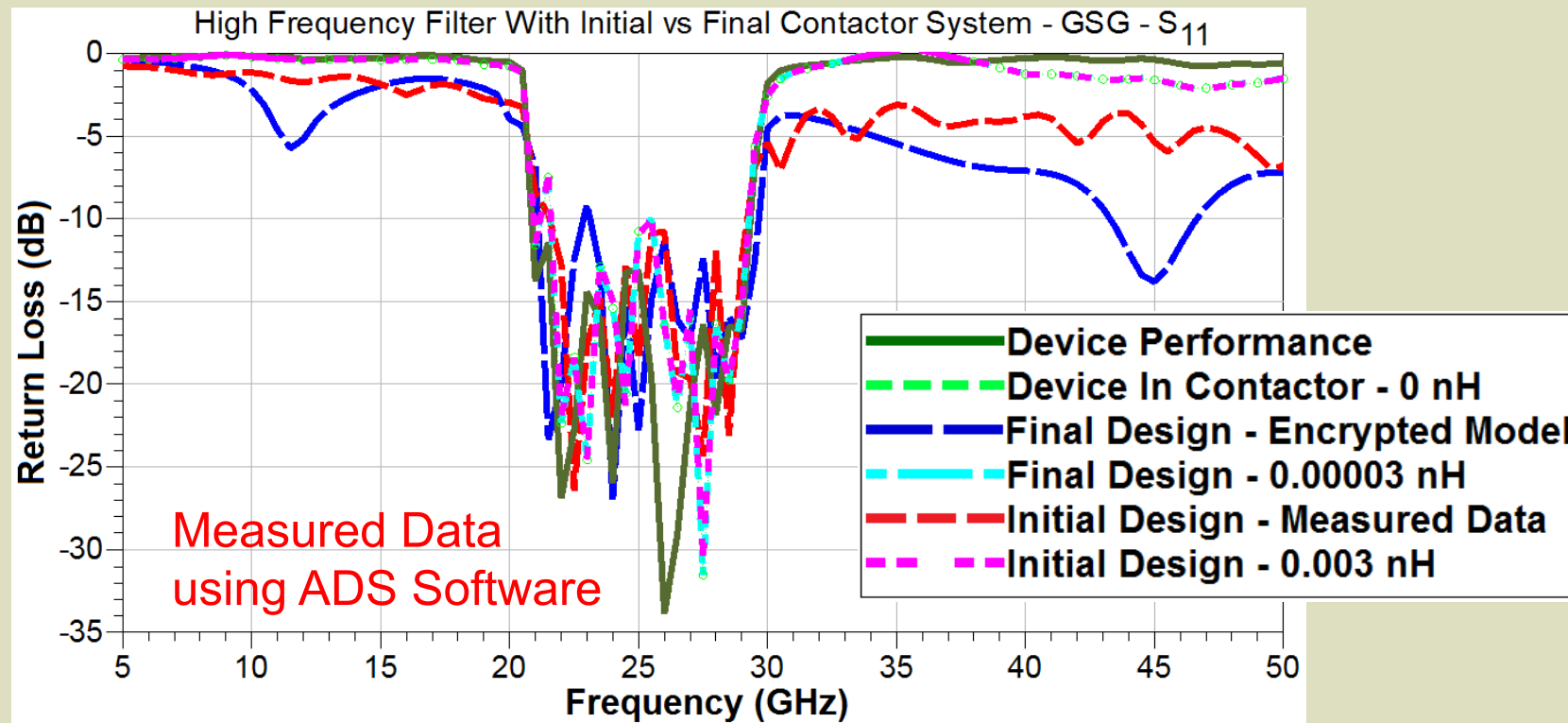
Using Encrypted HFSS Models in HFSS to Determine System Performance

11

**2023**

# TestConX 2023

## 0.5mm Pitch System Simulations of High Frequency Filter Performance Using Different Methods – $S_{11}$



Putting Device in Contactor for Test adds Inductance to System



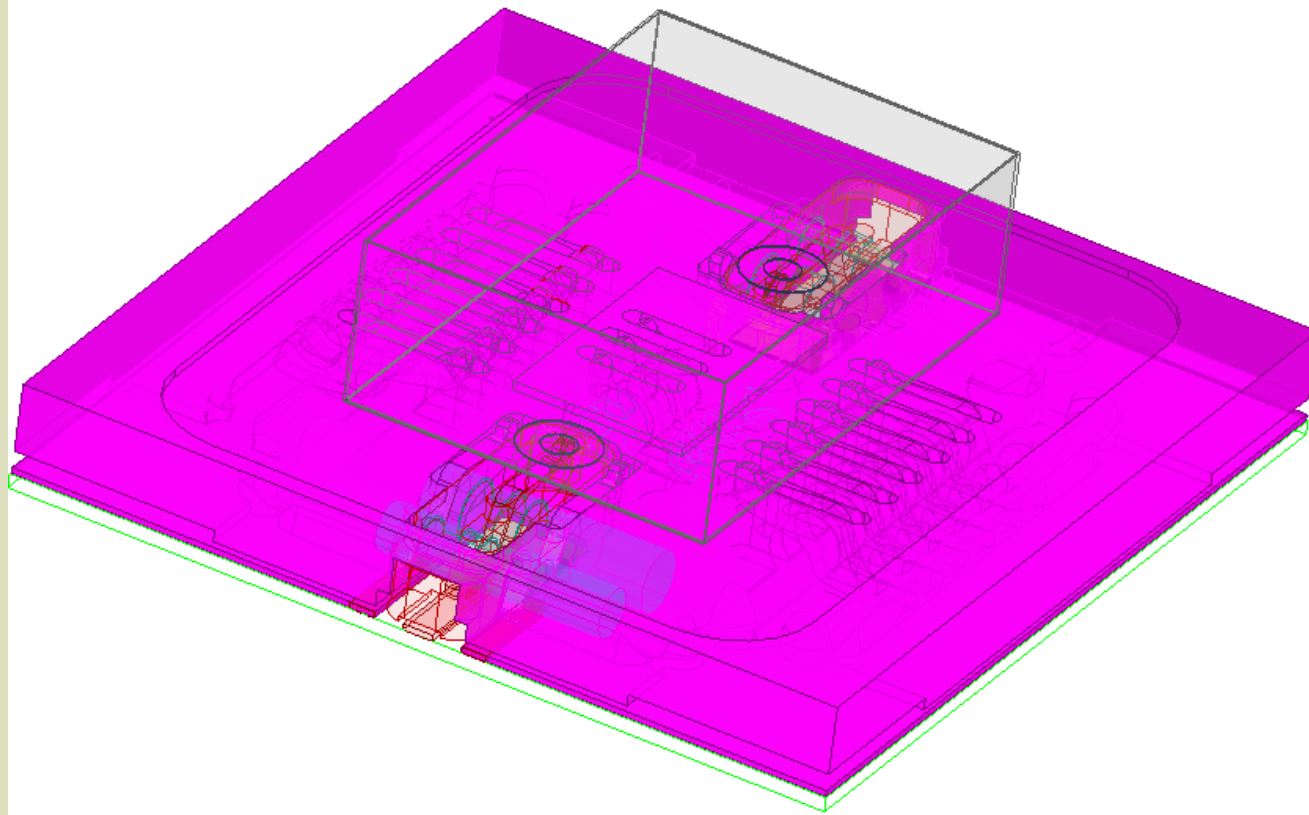
Using Encrypted HFSS Models in HFSS to Determine System Performance

12

**2023**



## How Contactor Grounding Impacts System Performance - Modeled ROL100A PP Contactor

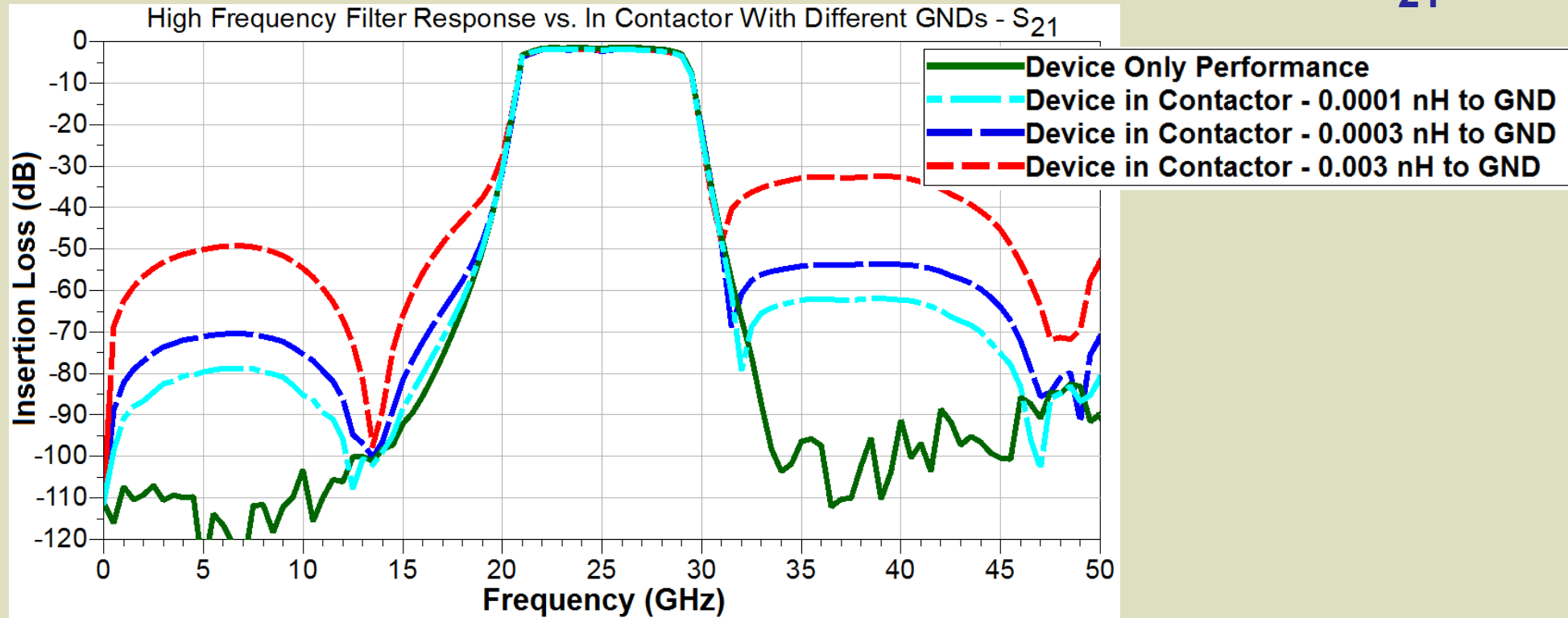


### Contactors Features:

- 19 GND Contacts
- Metal Housing
- 2 Coaxial Inserts
- GND Plane on Top Side of Board
- Thinner Substrate
- Via GND Fences

# TestConX 2023

## Modeled ROL<sup>®</sup>100A PP Contactor System With Different GND Inductances to Match Measured Data – S<sub>21</sub>



Inductance to Ground Plane Affects Out of Band Rejection and Filter Skirt

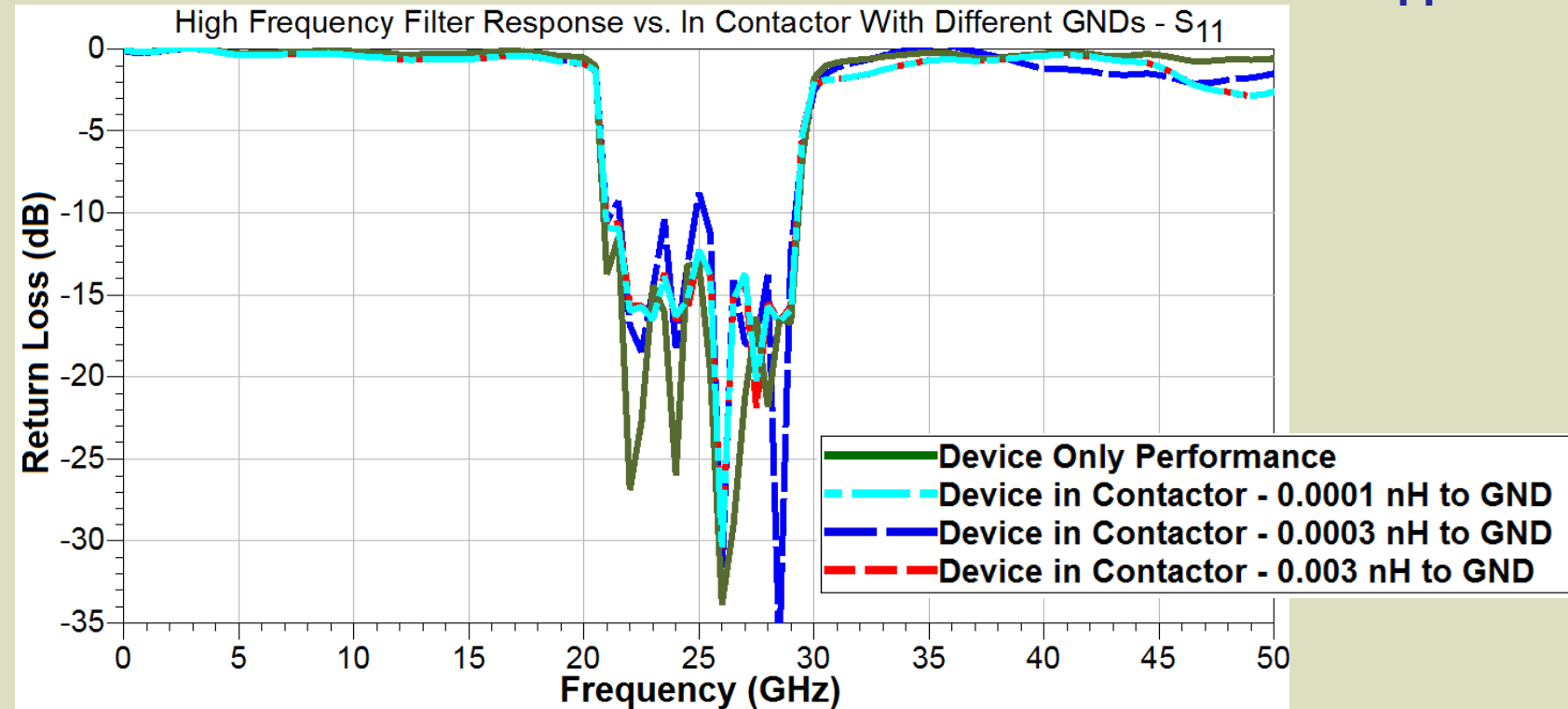


Using Encrypted HFSS Models in HFSS to Determine System Performance

14 **2023**

# TestConX 2023

## Modeled ROL<sup>®</sup> 100A PP Contactor System With Different GND Inductances to Match Measured Data – $S_{11}$



Inductance to Ground Plane Affects In-Band Return Loss



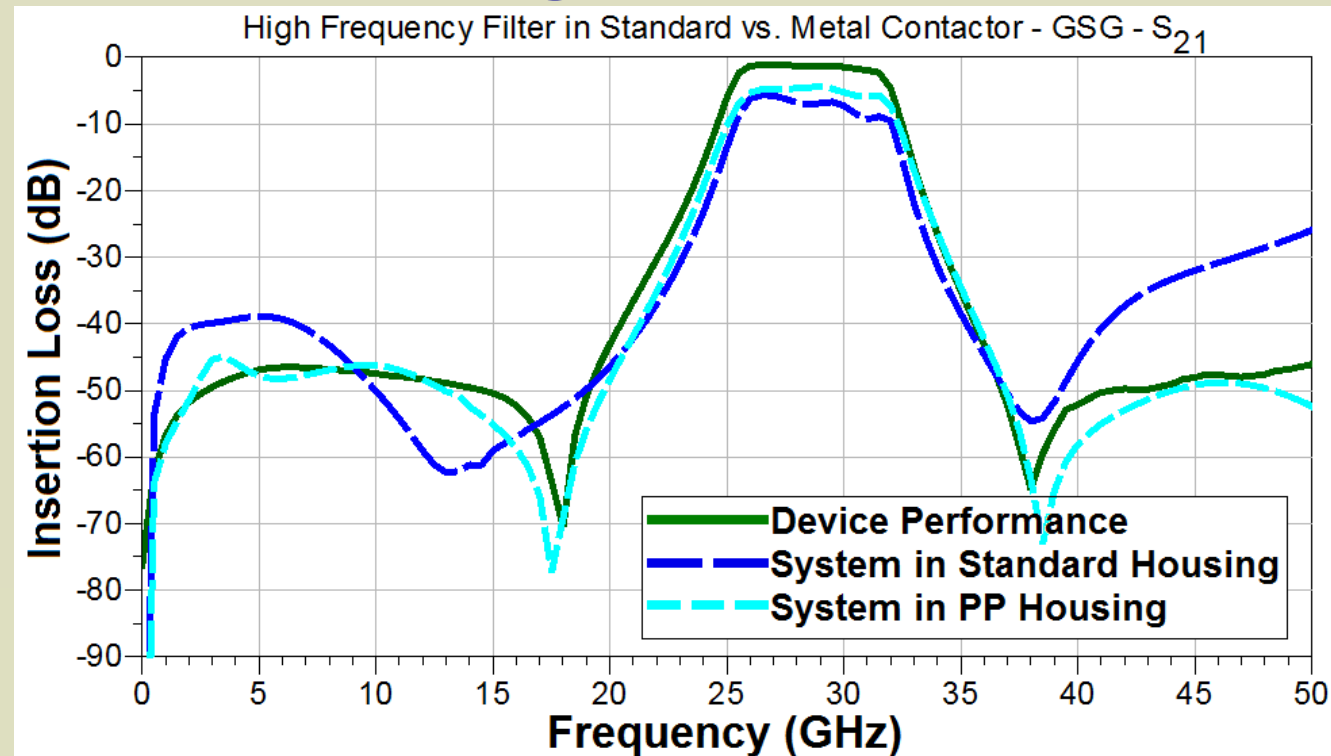
Using Encrypted HFSS Models in HFSS to Determine System Performance

15

# 2023

# TestConX 2023

## How Contactor Materials Impacts Performance in Standard Housing and Metal Contactor – $S_{21}$



Metal Housing Results in Lower Ground Inductance so Better Performance



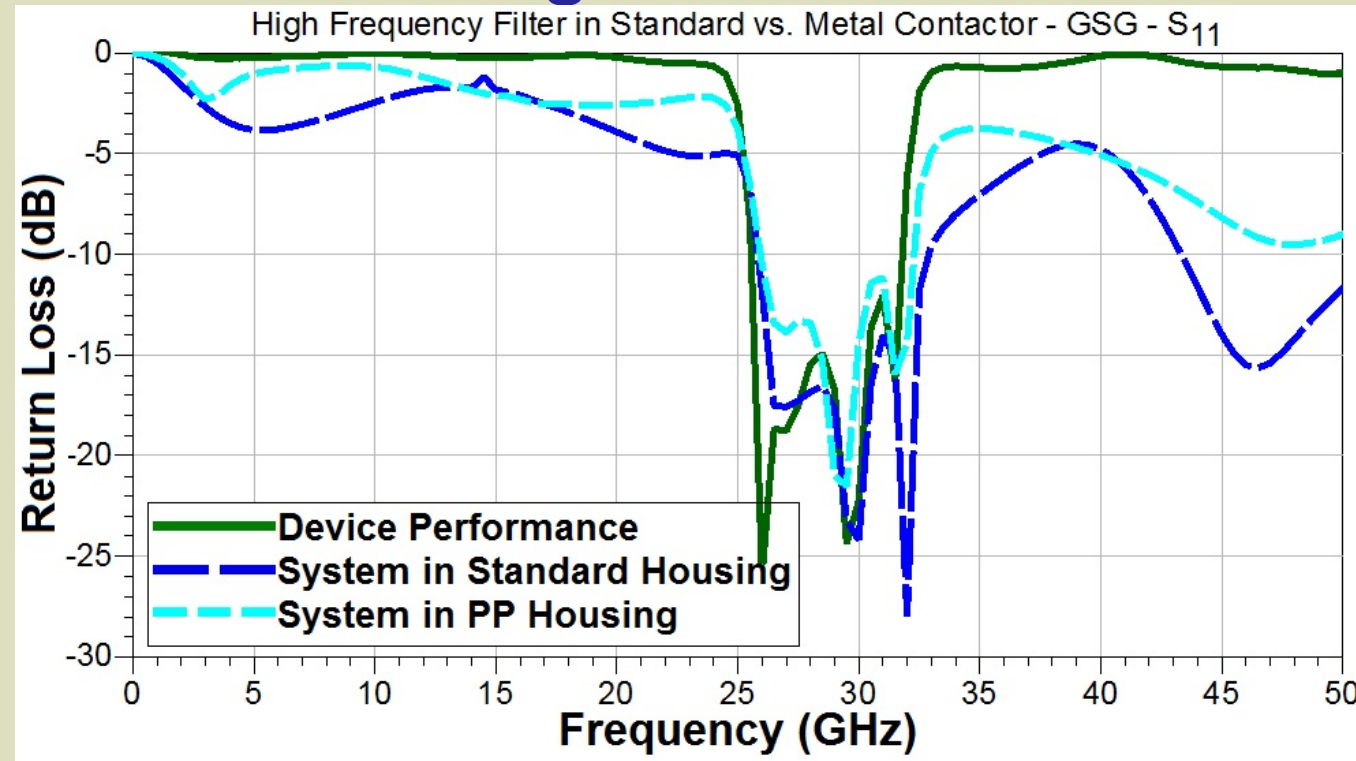
Using Encrypted HFSS Models in HFSS to Determine System Performance

16

**2023**

# TestConX 2023

## How Contactor Materials Impacts Performance in Standard Housing and Metal Contactor – $S_{11}$



Contactor Design and Material Affects Performance by Changing Impedance



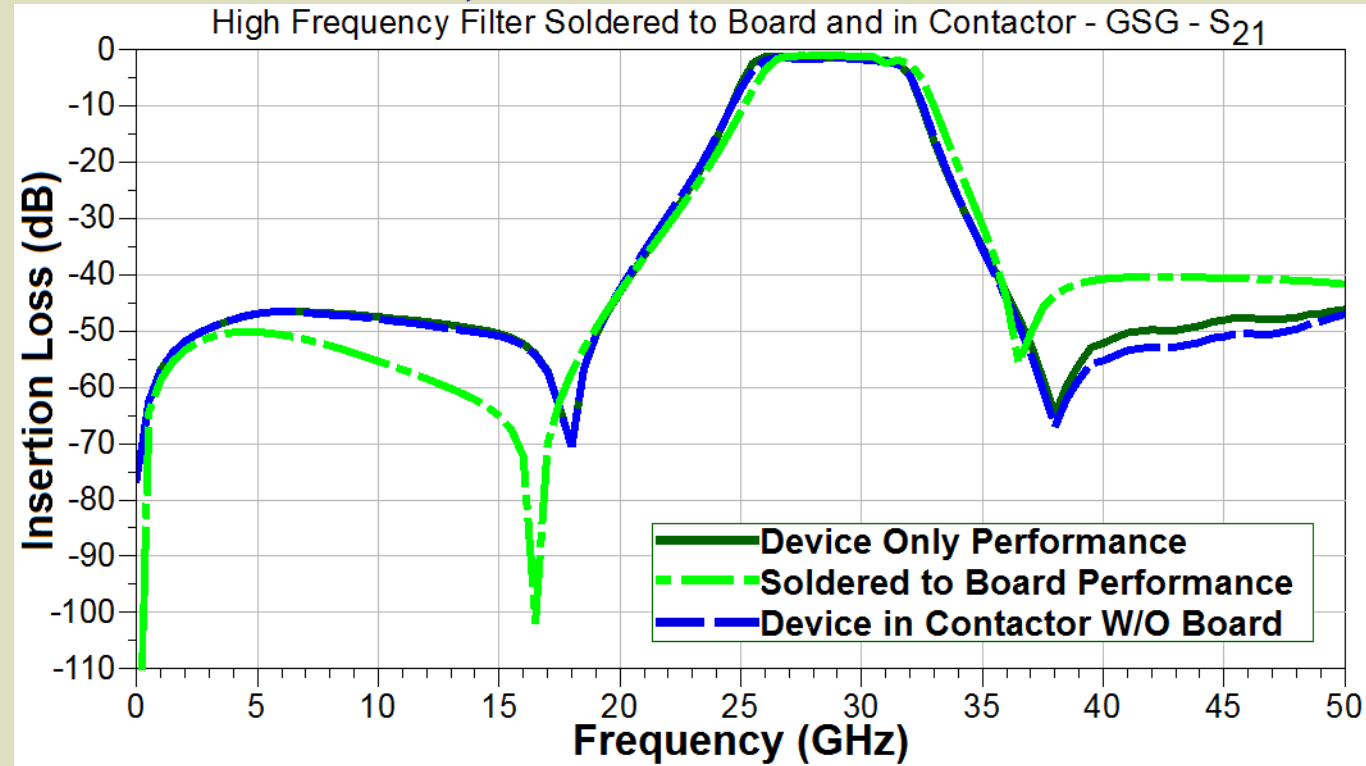
Using Encrypted HFSS Models in HFSS to Determine System Performance

17

# 2023

# TestConX 2023

## HFSS System Performance Comparing Device, Device Soldered to Board, And Device in Contactor – $S_{21}$



Load Board Grounding has Effects on Filter Out-of-Band Rejection



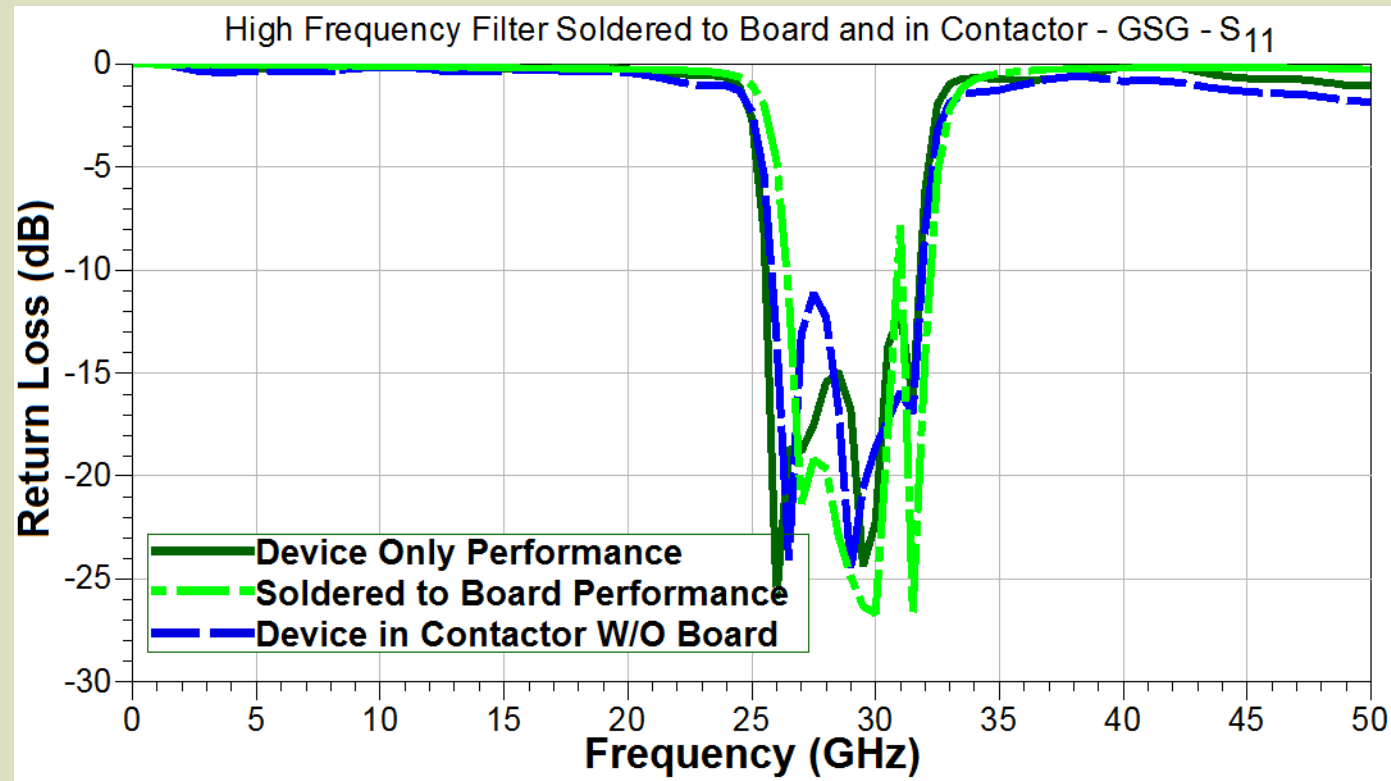
Using Encrypted HFSS Models in HFSS to Determine System Performance

18

# 2023

# TestConX 2023

## HFSS System Performance Comparing Device, Device Soldered to Board, And Device in Contactor – $S_{11}$



Load Board Grounding has Effects on Filter In-Band Return Loss



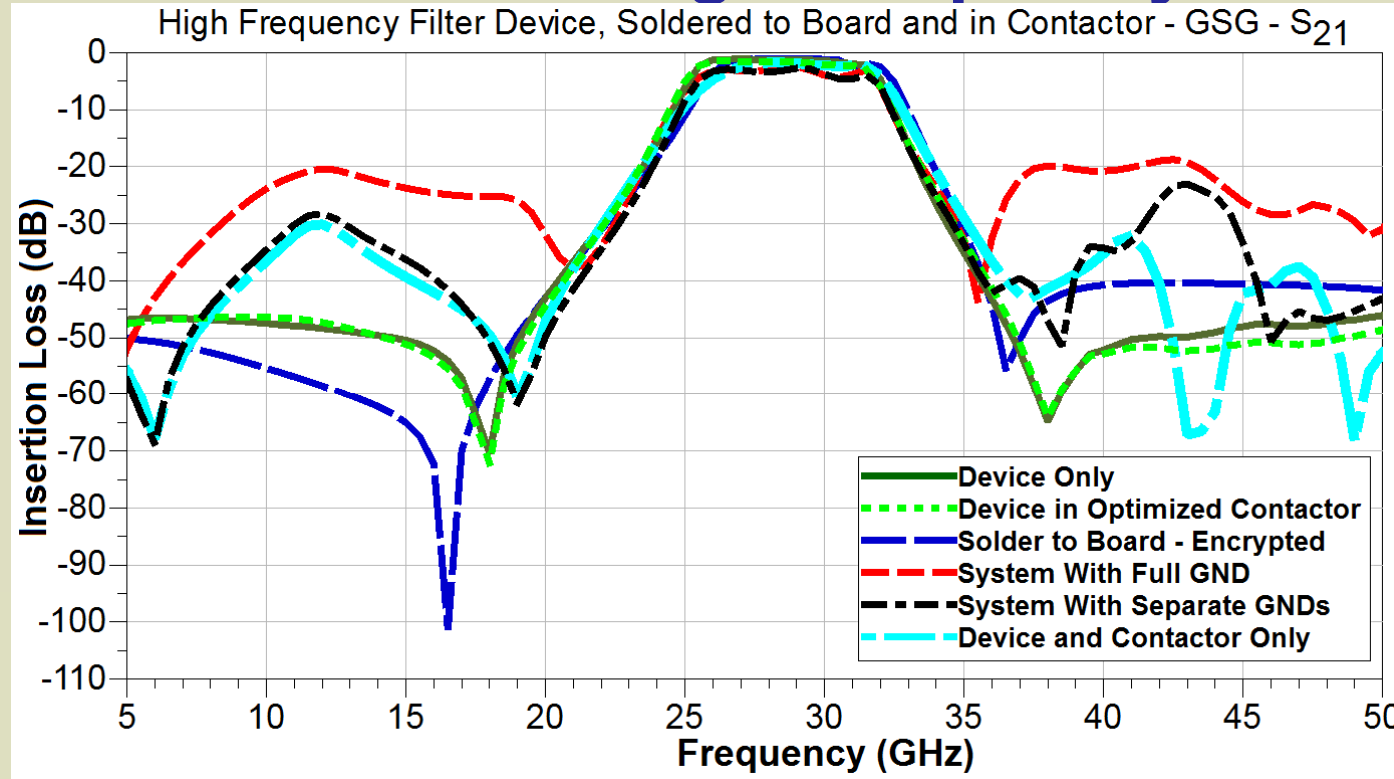
Using Encrypted HFSS Models in HFSS to Determine System Performance

19

# 2023

# TestConX 2023

## Encrypted File Simulations to Improve System Performance for High Frequency Filter Design – $S_{21}$



Used Highest Frequency Filter to Enhance Performance Changes

Load Board and Contactor Grounding has Effect on Filter Out-of-Band Rejection



Using Encrypted HFSS Models in HFSS to Determine System Performance

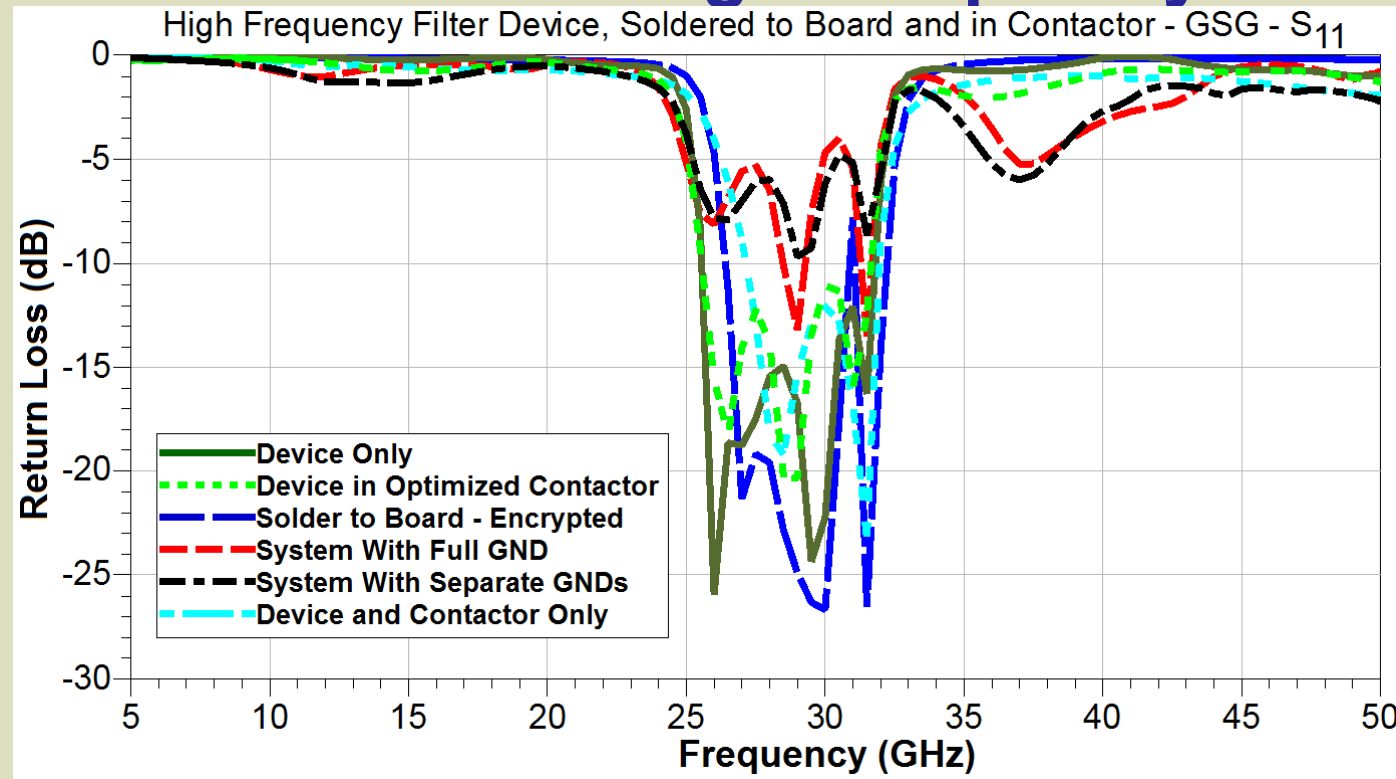
20

**2023**



# TestConX 2023

## Encrypted File Simulations to Improve System Performance for High Frequency Filter Design – $S_{11}$



Used Highest Frequency Filter to Enhance Performance Changes

Load Board and Contactor Matching has Effect on Filter In-of-Band Return Loss



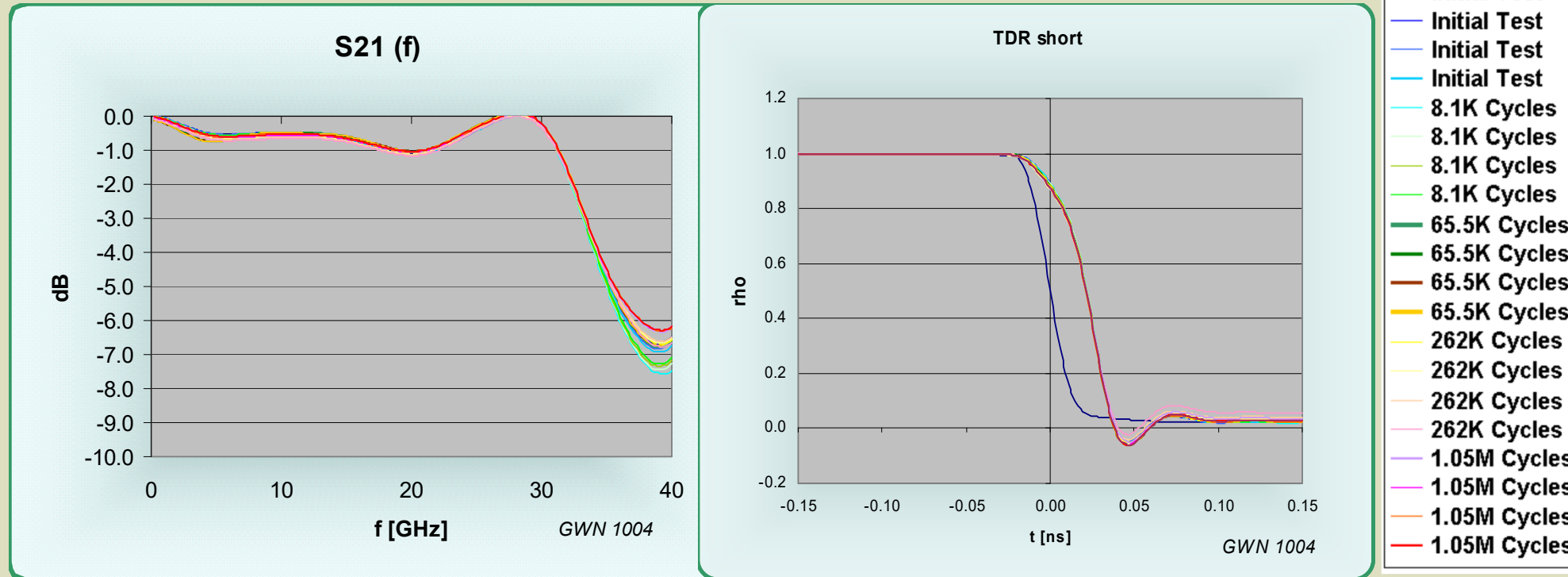
Using Encrypted HFSS Models in HFSS to Determine System Performance

21

# 2023

# TestConX 2023

## Contactor RF and Digital Repeatability – Rigid ROL Technology



RF and Digital Repeatability is Important Across Life of Contactor

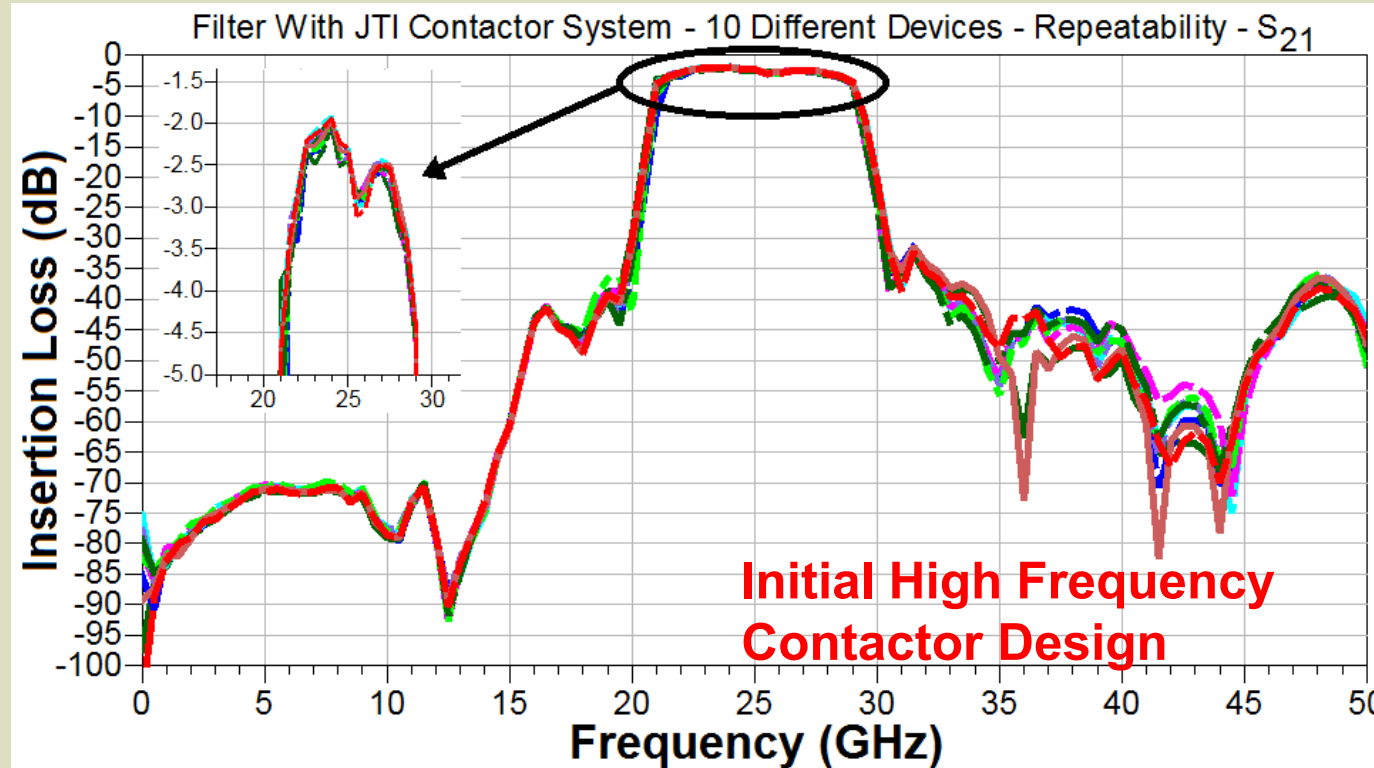


Using Encrypted HFSS Models in HFSS to Determine System Performance

22 **2023**

# TestConX 2023

## Repeatability of High-Frequency Filter in Contactor With 10 Different Devices – $S_{21}$



With Solid ROL<sup>®</sup>100 Technology Repeatability Between Devices is Good



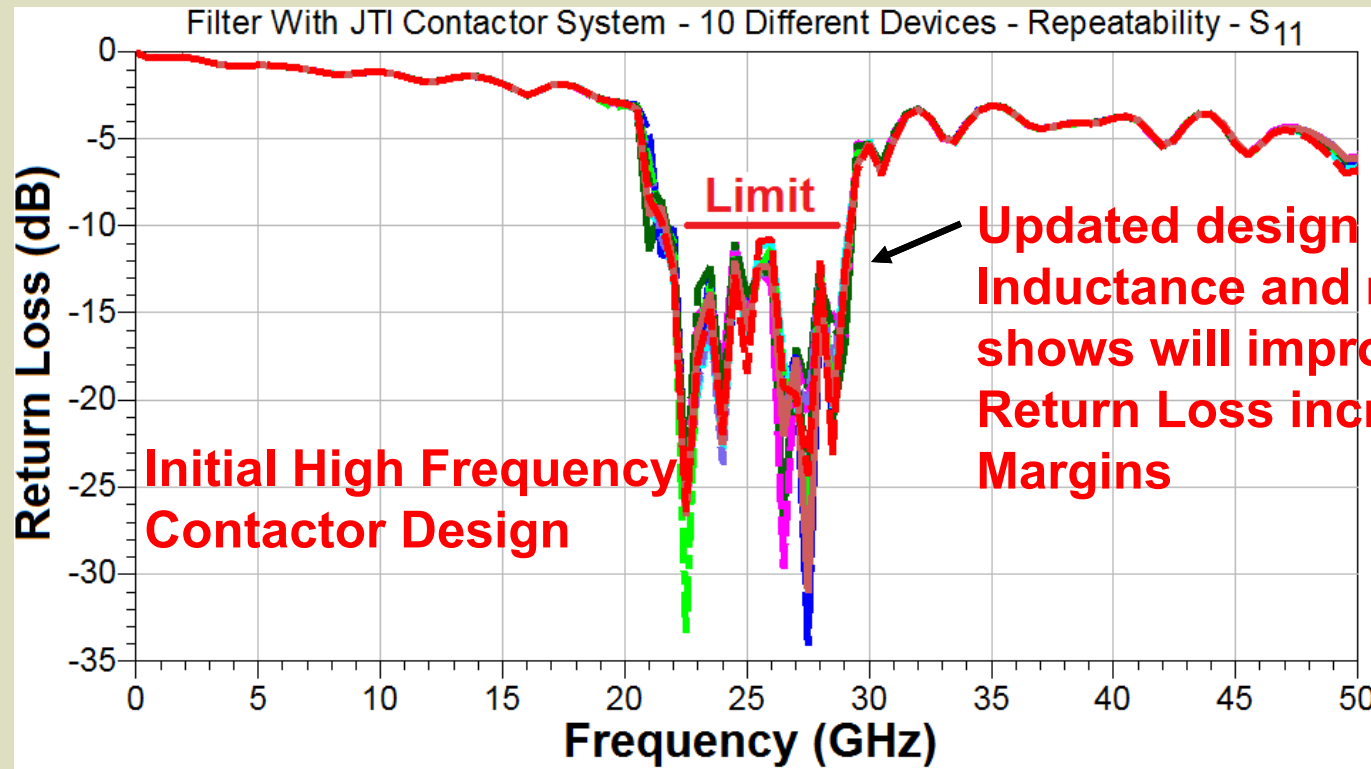
Using Encrypted HFSS Models in HFSS to Determine System Performance

23

# 2023

# TestConX 2023

## Repeatability of High-Frequency Filter in Contactor With 10 Different Devices – $S_{11}$



With Solid ROL<sup>®</sup> 100 Technology Variability is Reduced Which Reduces False Failures



Using Encrypted HFSS Models in HFSS to Determine System Performance

24

**2023**

# TestConX 2023

## Conclusion

- Encrypted models can be used to fill in for missing parts of the system
- S-parameters of a device can be encrypted to get system performance
- For ground-sensitive parts, the GND inductance affects the performance
- Ground inductance becomes more important the higher the frequency of the device, the more gain the device exhibits, or in passive devices
- Device pads affect test technology and test performance
- With the same package, a high-frequency contactor can test multiple devices
- Repeatability of contacts can improve test results and reduce false failures



Using Encrypted HFSS Models in HFSS to Determine System Performance

25

**2023**

## Special Thanks

- Engineers at Mini-Circuits that provided some data and encrypted models of High-Frequency filter



Using Encrypted HFSS Models in HFSS to Determine System Performance

26

**2023**