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A Novel Technique for the Design of High-Speed 10 and 40 Gb/s Compact Modules

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February 19-20 2004

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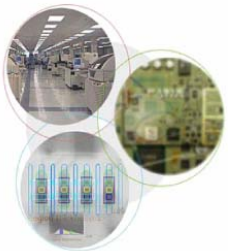
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Outline

- Means of using ANSOFT HFSS to design RF Transmission Line (TL) carriers by the employing a new technique in the 10 Gb/s and 40 Gb/s domain.
- Summary of the ways to change the capacitance and the inductance in a microstrip TL.
- Case studies:
 - Transition between different configurations
 - 50 Ohm resistive termination
 - RF carrier containing a DC block capacitor
 - Ball Grid Arrays (BGA)
- Conclusions



The Design Procedure and Advantages

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- The principle of the technique is to vary the *position of the reference ground* to achieve a step in the *cross-sectional dimension* of the structure.
- In essence, our *main* design variable becomes the *depth of the ground planes* with respect to the signal traces.
- In most cases, exploring the involved effects, allows for decreasing the length of *planar* tapers (step) at the discontinuities and, as such, save real-estate.
- The method leads to *good* dispersion properties and overall electrical performance in broad frequency bands.
- It has been successfully employed to design *volume manufacturability* high speed modules.

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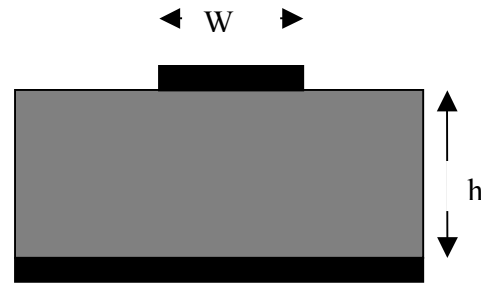


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Summary of the Ways to Change the Capacitance and the Inductance in a Microstrip TL



$C \nearrow \nearrow$	$W \nearrow$	$h \searrow$	$L \nearrow \nearrow$	$W \searrow$	$h \nearrow$
$C \nearrow$	$W \nearrow$	$h =$	$L \nearrow$	$W \searrow$	$h =$
$C \nearrow$	$W =$	$h \searrow$	$L \nearrow$	$W =$	$h \nearrow$
$Z =$	$W \nearrow$	$h \nearrow$	$Z =$	$W \searrow$	$h \searrow$

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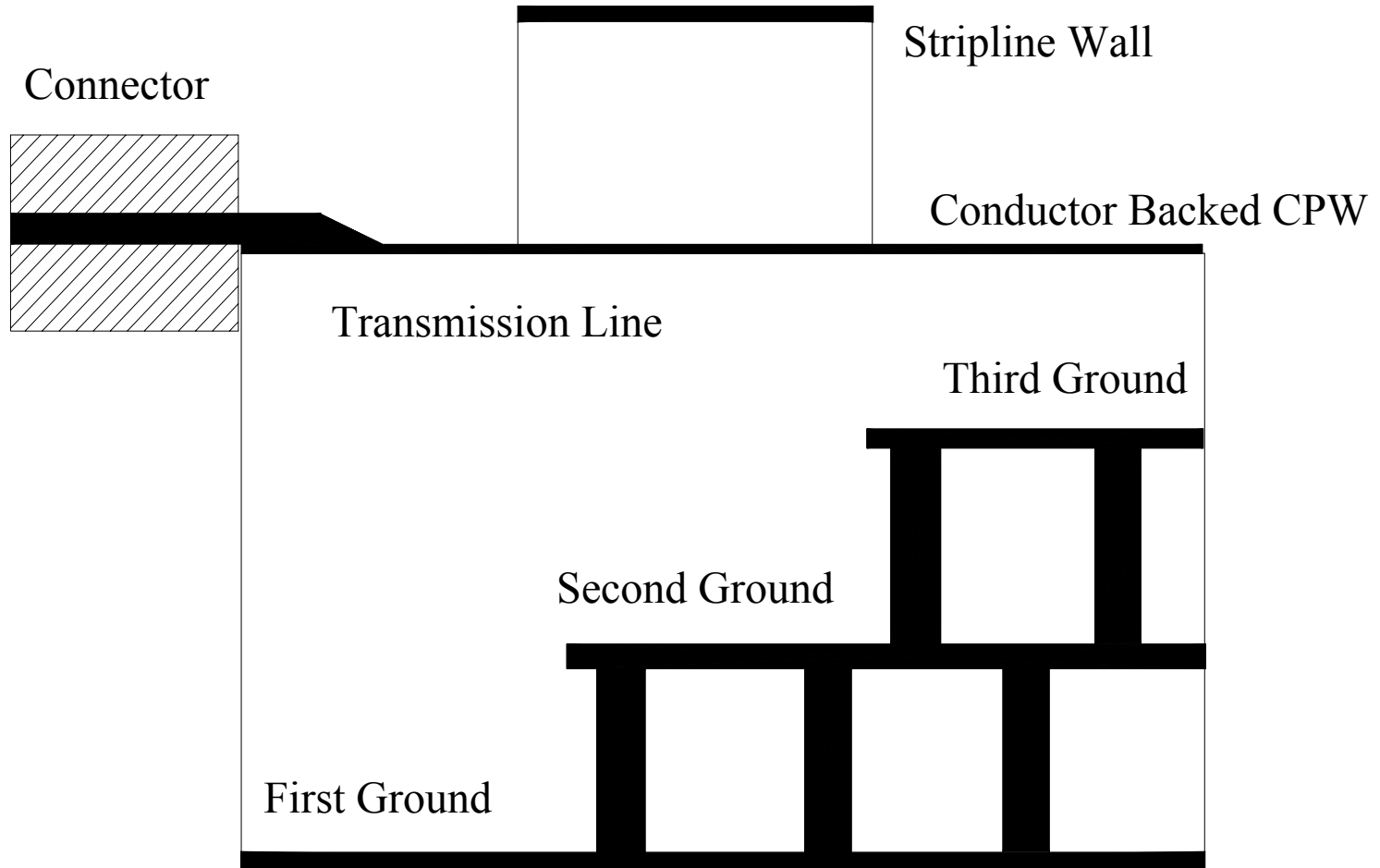
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Transition Between Different Configurations Description

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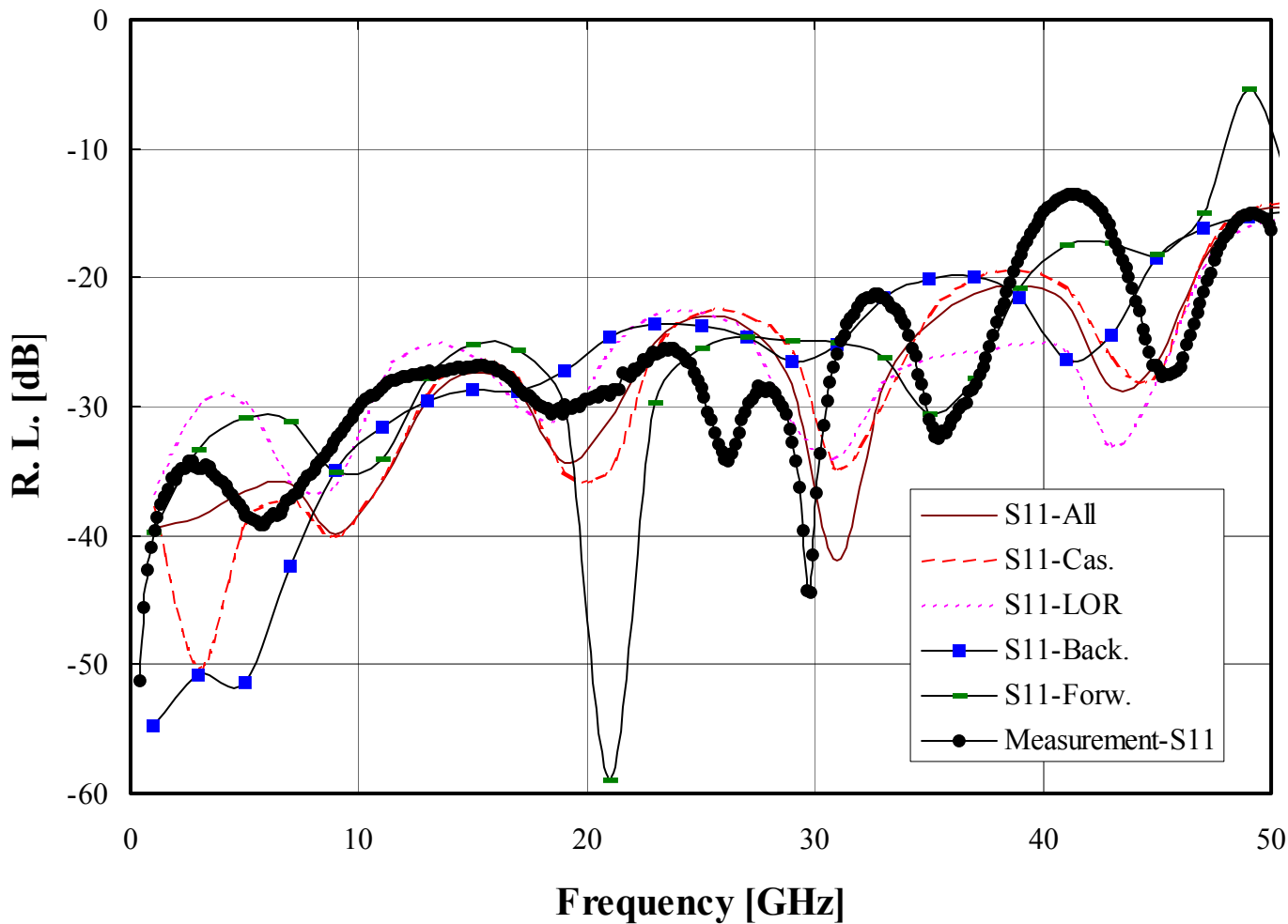


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Transition Between Different Configurations Results

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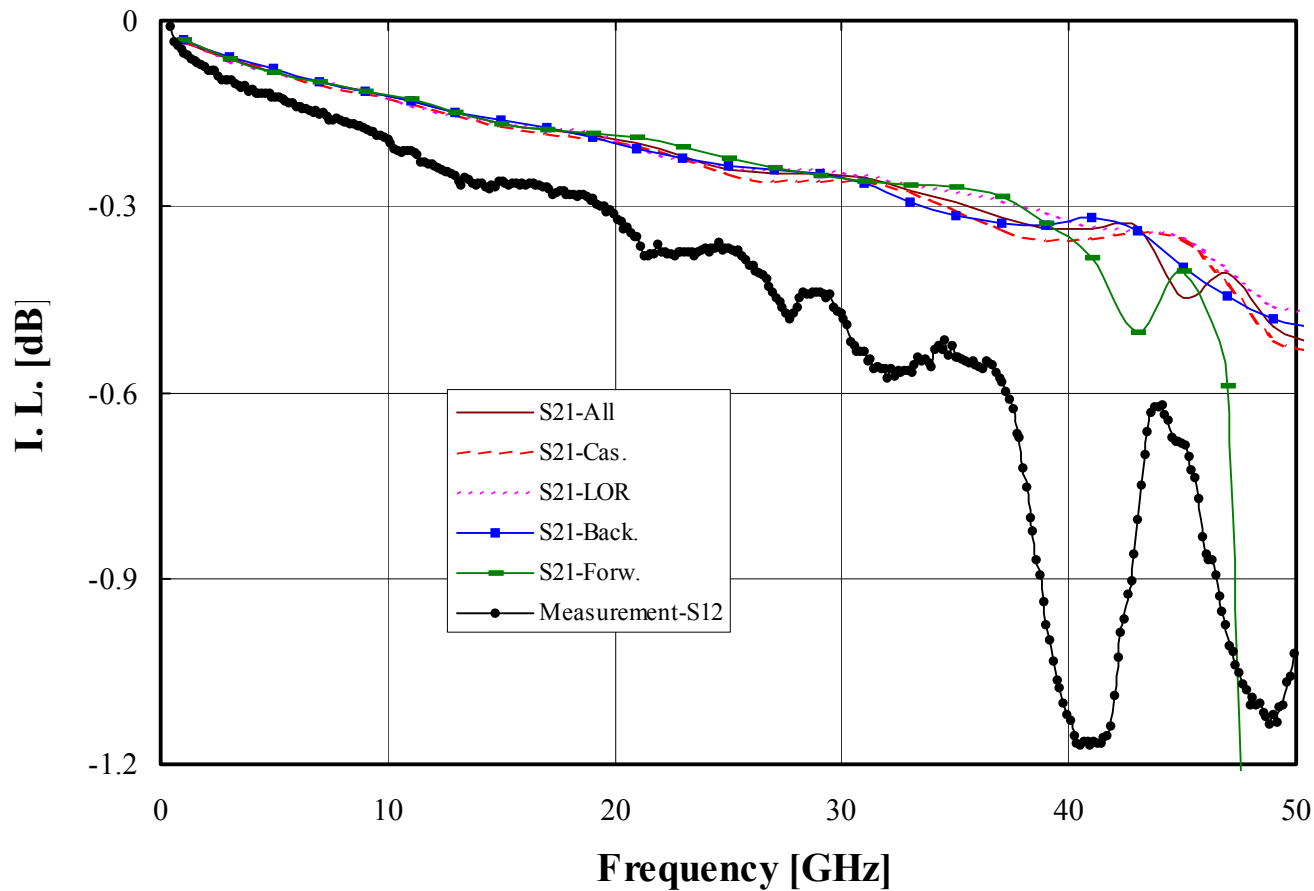
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Transition Between Different Configurations Results Cont'd

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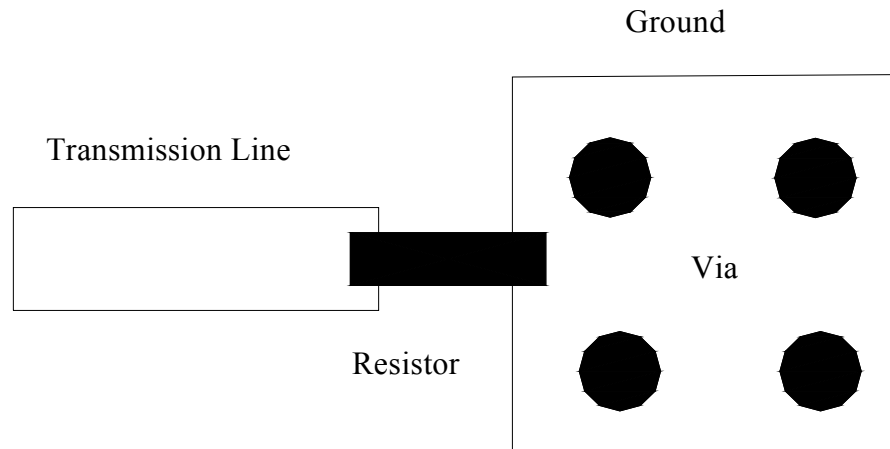
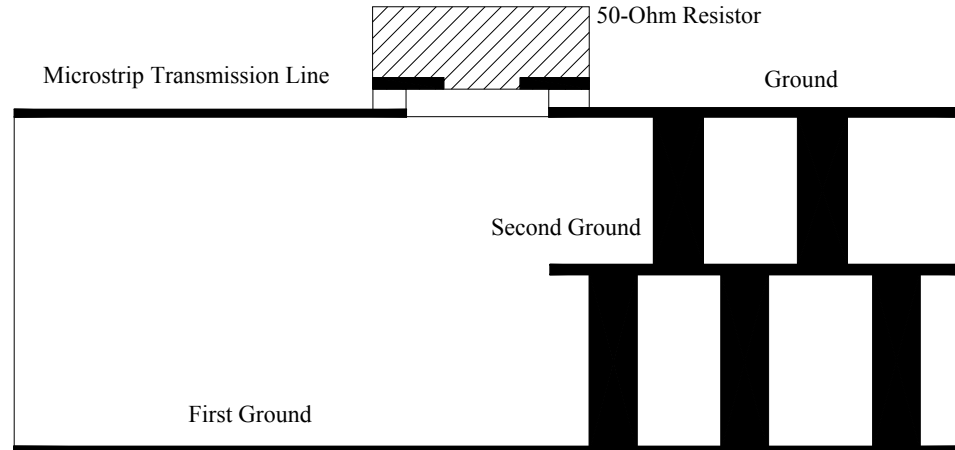
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50 Ohm Resistive Termination Description

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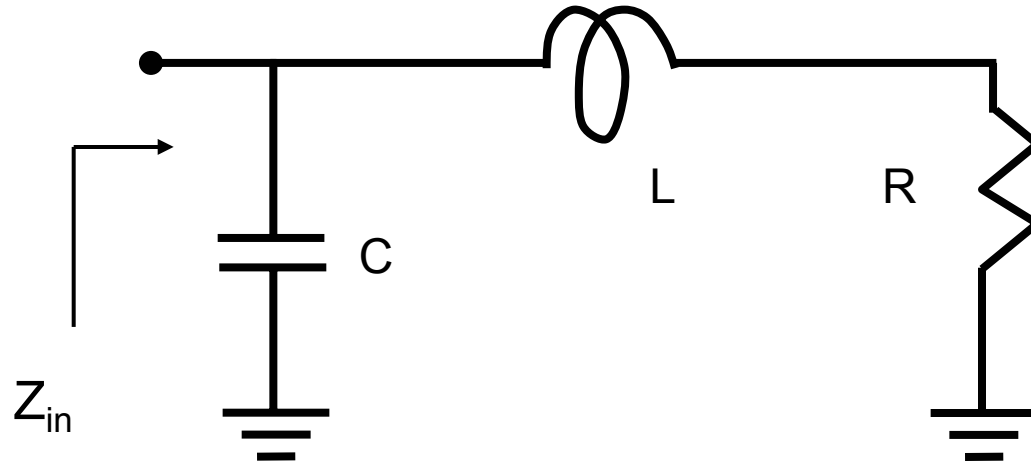


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50 Ohm Resistive Termination Cont'd

Equivalent circuit of the resistive load



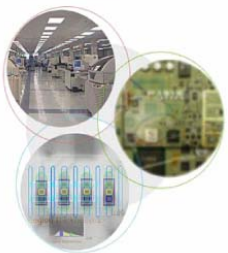
Input impedance of a typical load of resistive impedance

$$Z_{in} = \frac{R + j\omega L}{1 + j\omega CR - \omega^2 CL}$$

$$L \ll$$

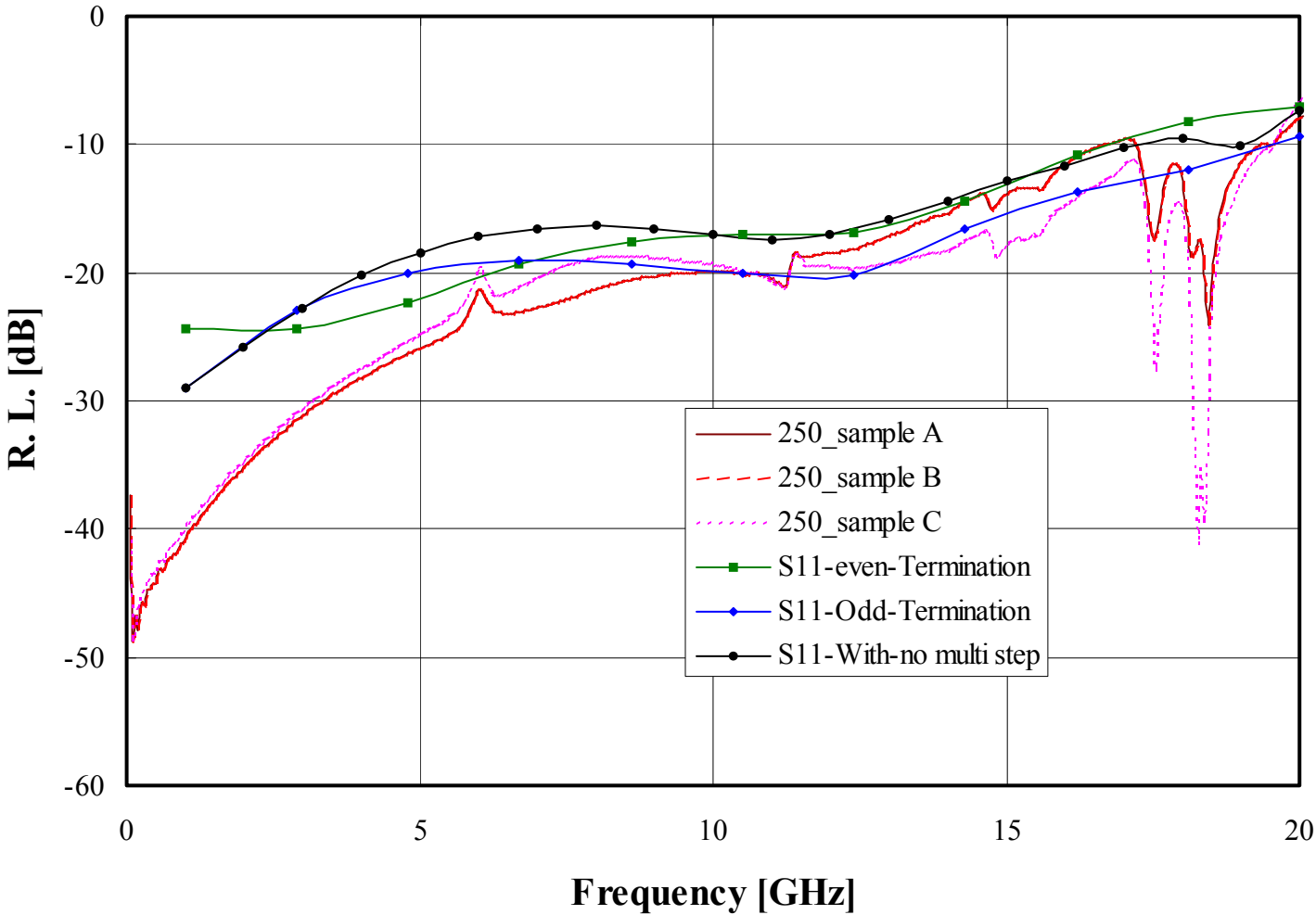
$$\omega^2 CL \ll 1$$

$$j\omega CR = j\omega L/R$$



50 Ohm Resistive Termination Results

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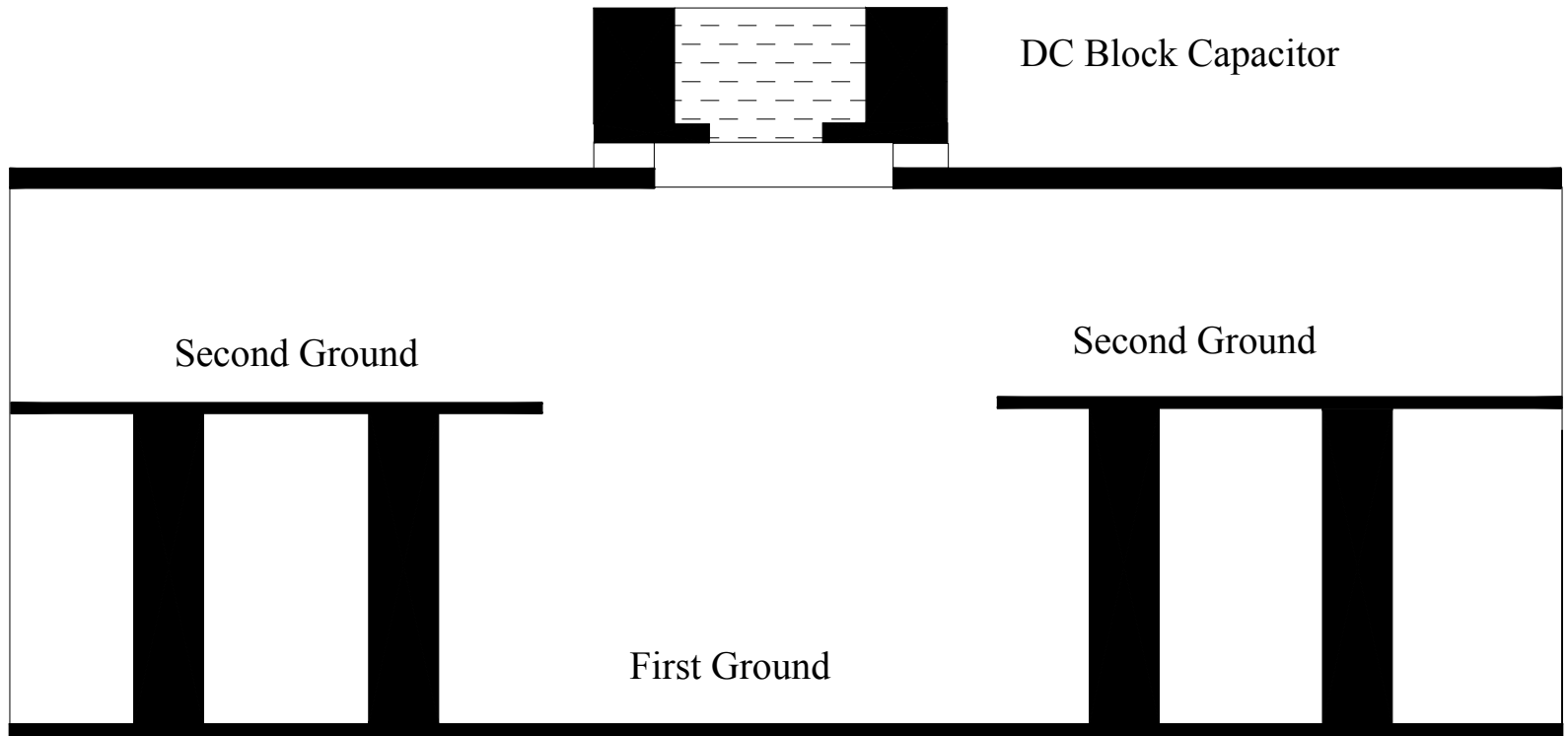
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RF Carrier Containing a DC Block Capacitor

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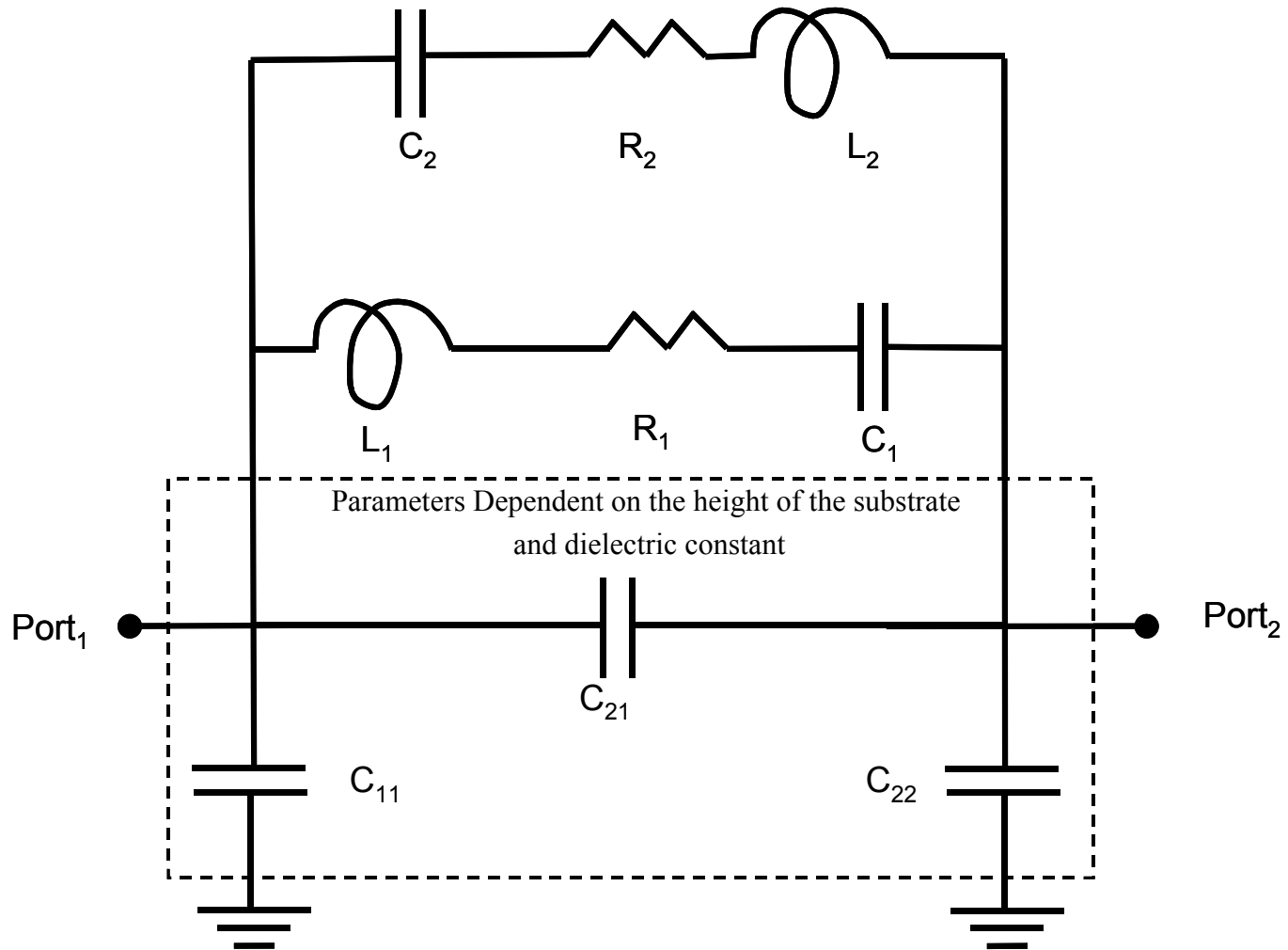


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RF Carrier Containing a DC block Capacitor Cont'd

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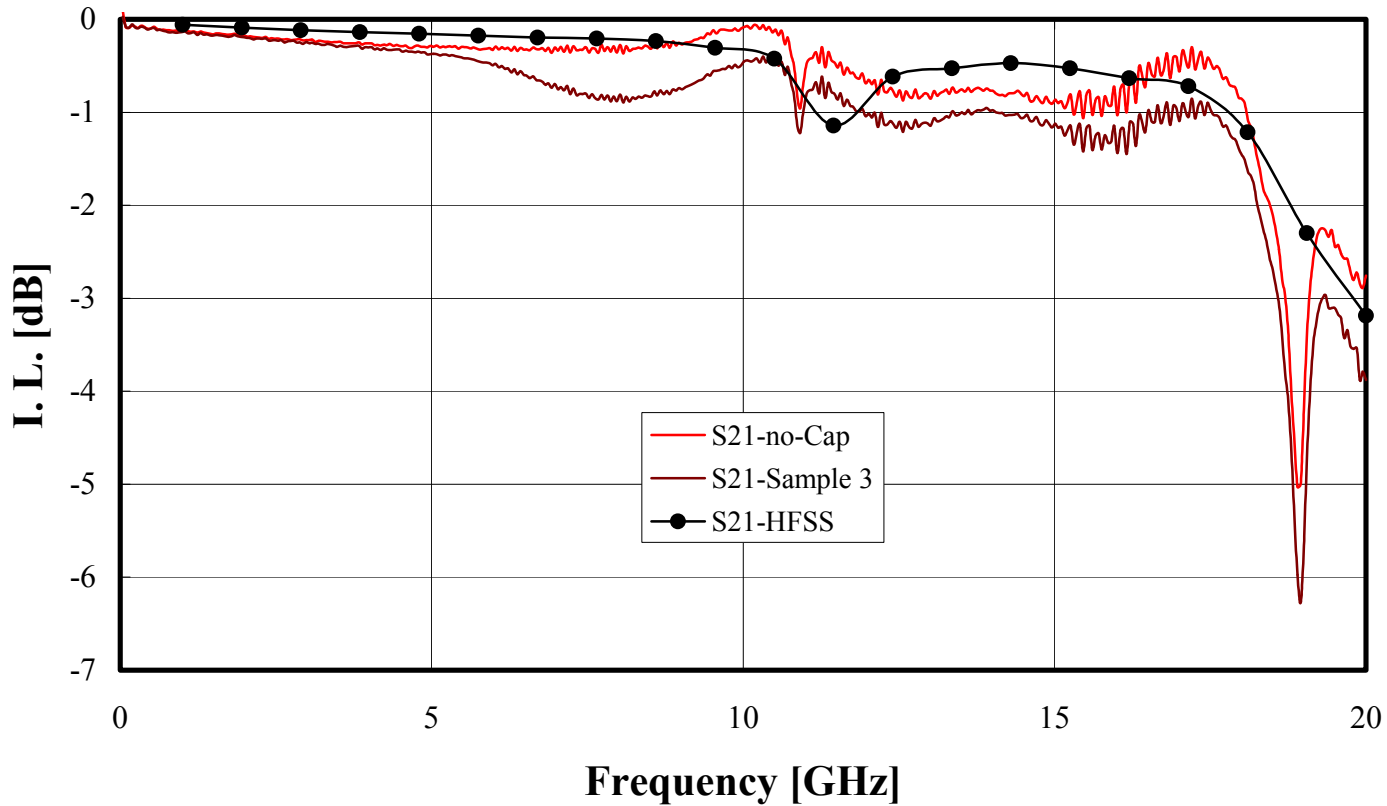
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RF Carrier Containing a DC Block Capacitor Results

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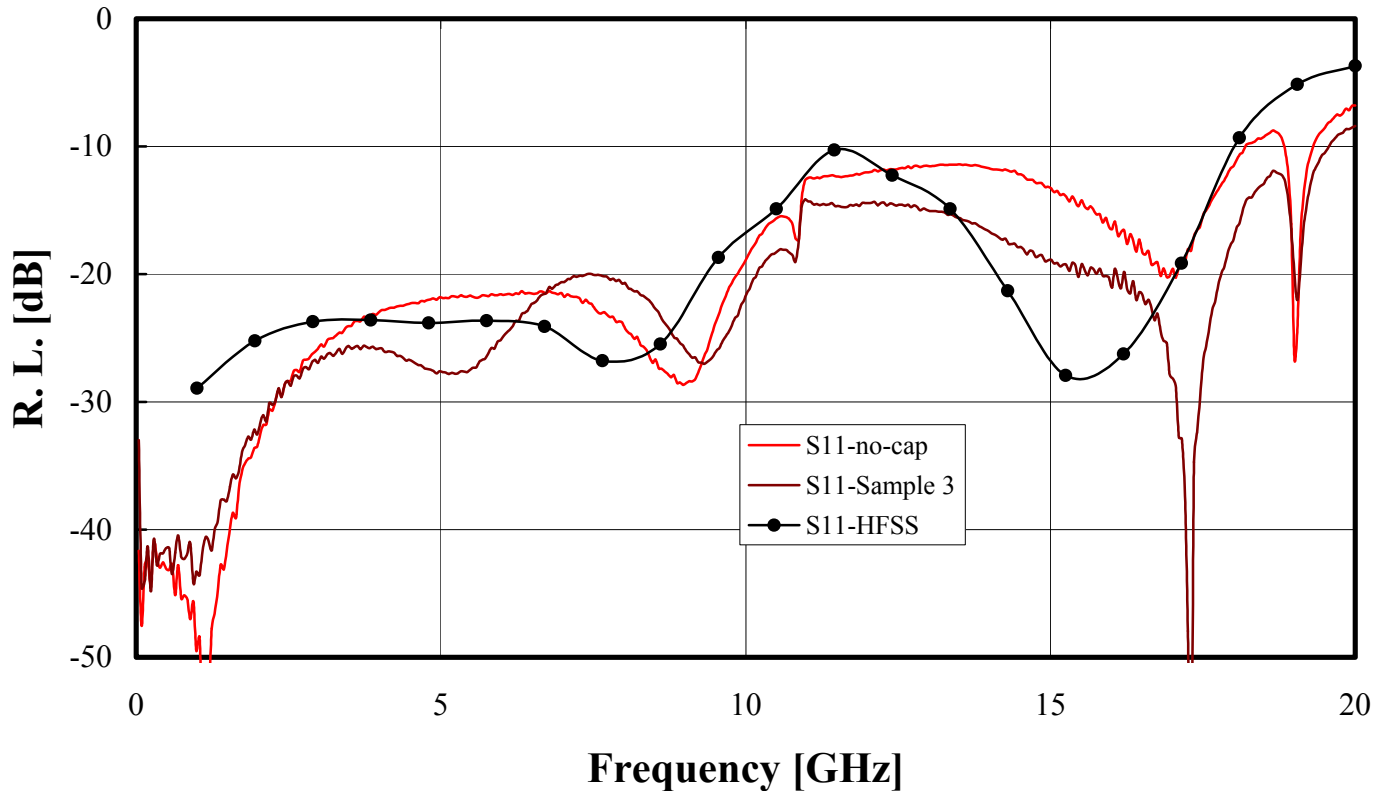


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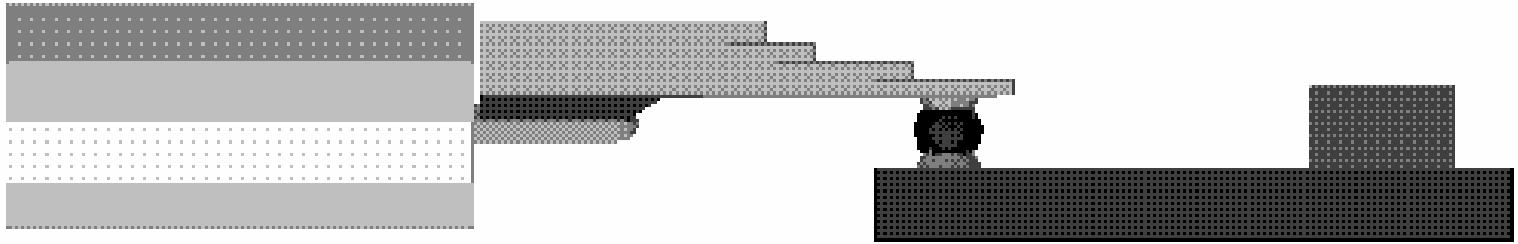


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Ball Grid Arrays (BGA)

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Conclusions

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- We presented a practical approach suitable for use in the design of high speed 10 and 40 Gb/s modules for sub-system applications.
- We demonstrated that stepping (tapering) the buried ground improves the electrical performance and reduced the size of the high speed modules.
- We employed this technique for different transitions.

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