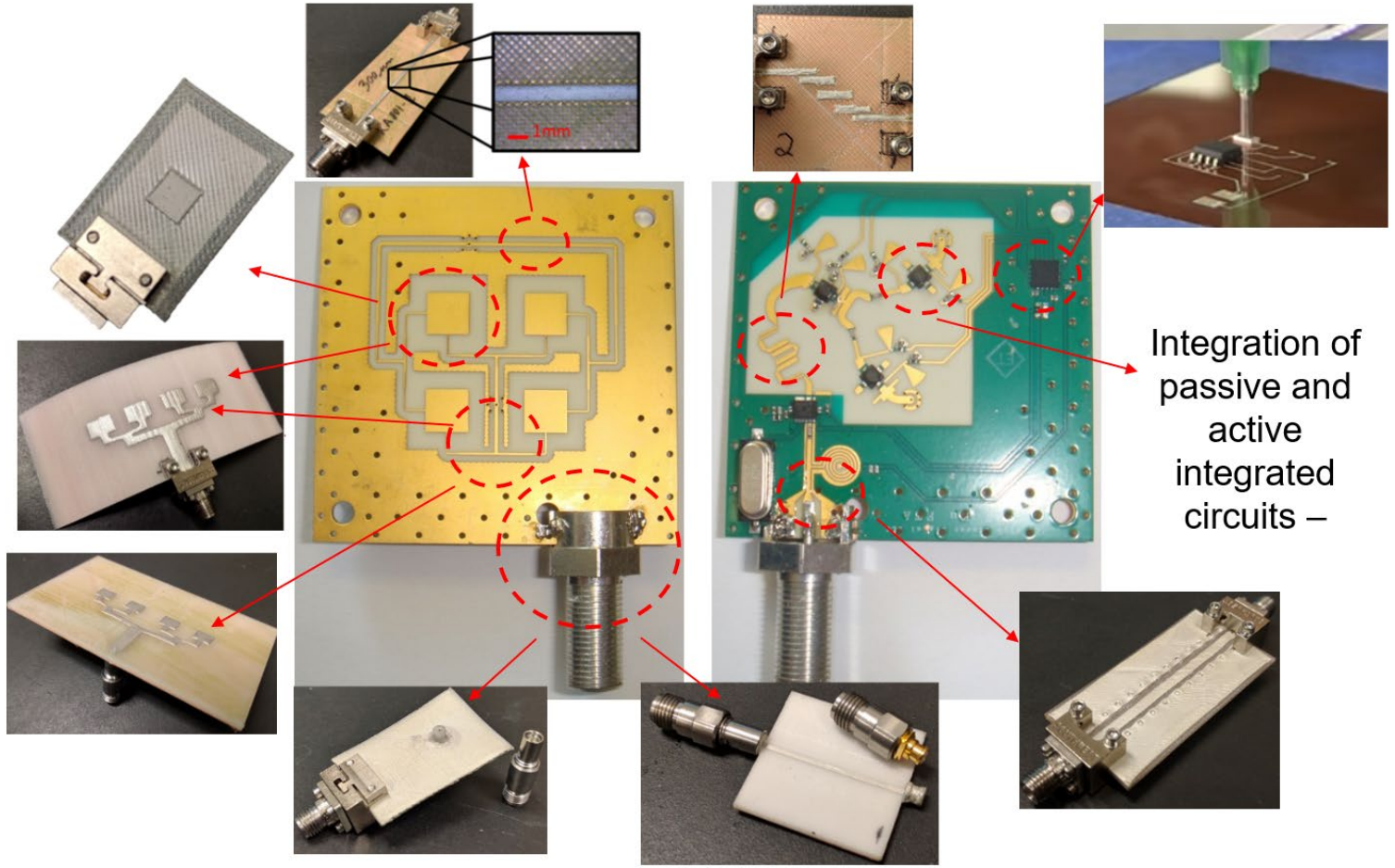
Applications: RF Components and Systems

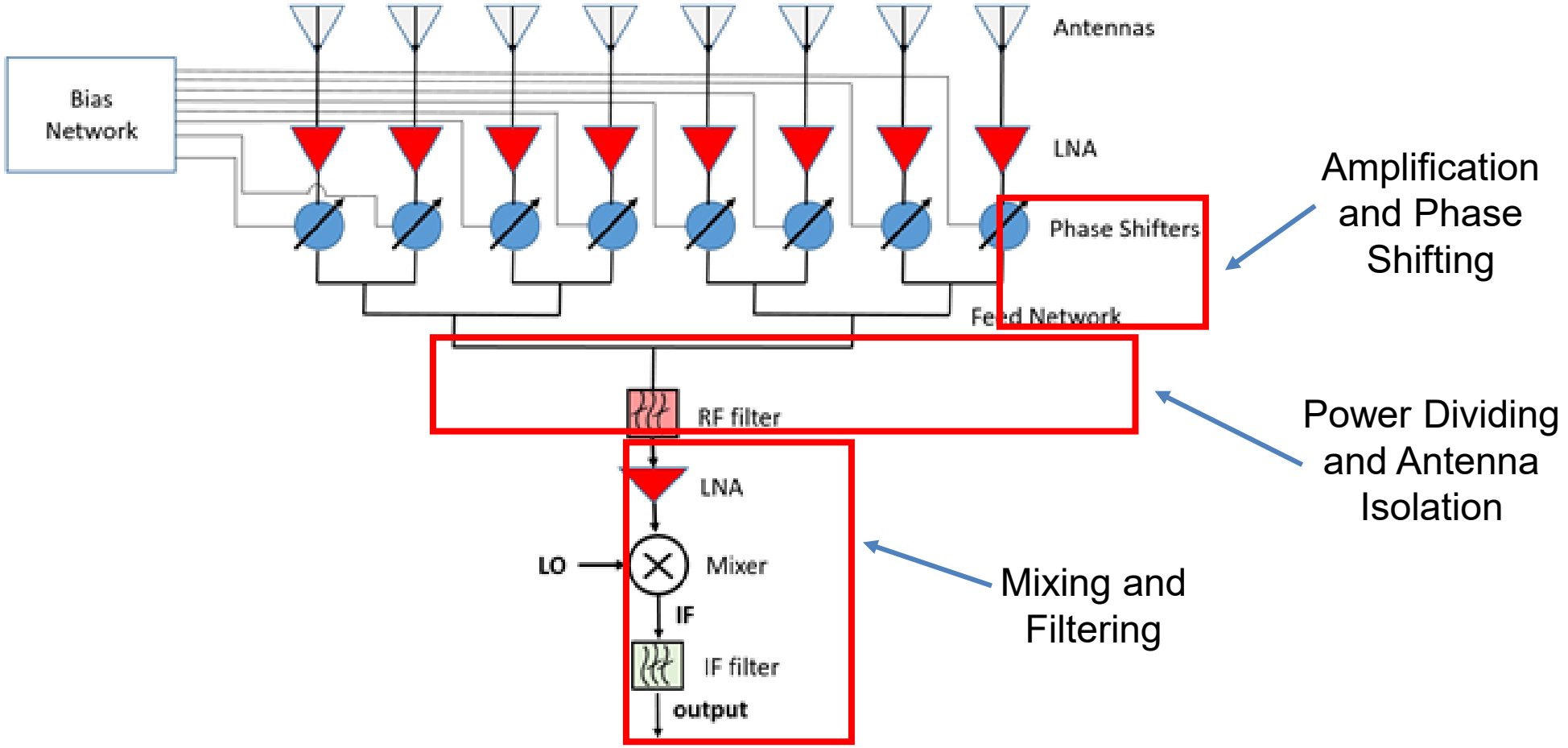
Goal

- Fully printed conformal RF front end (Ku-band) including antennas, transmission lines, filters, connectors and active components (pick and place)



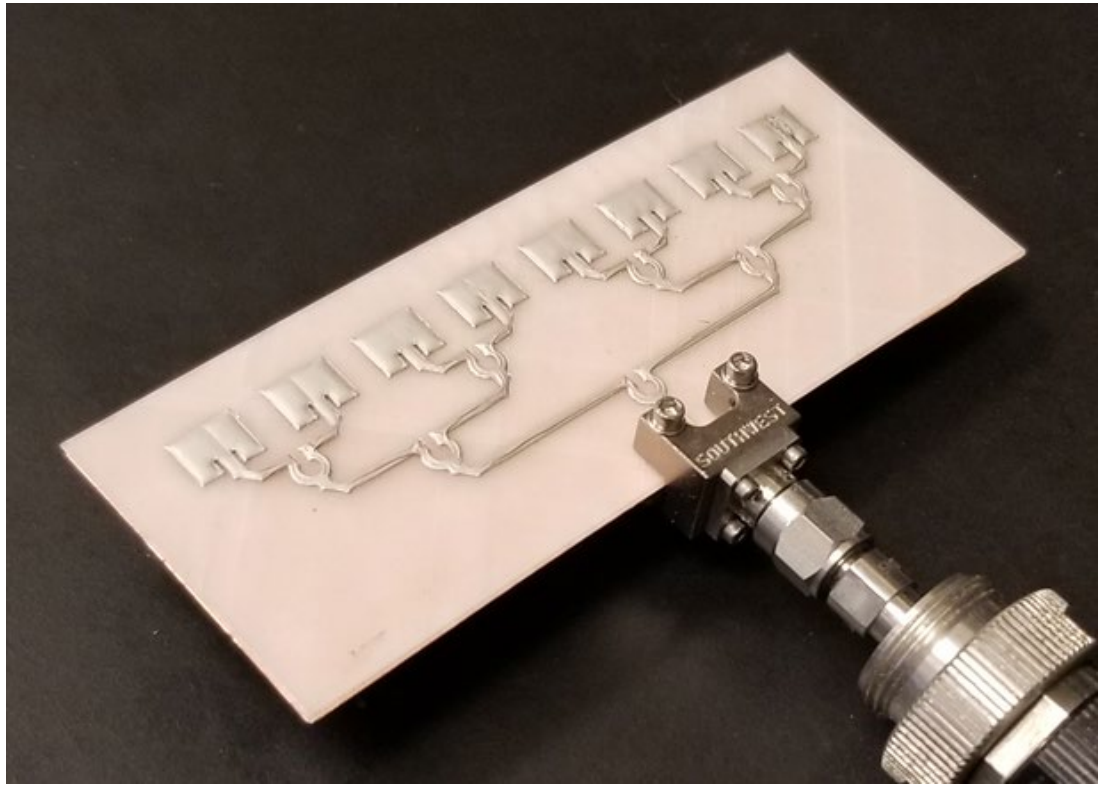
Additive Manufacturing of RF Devices and Systems

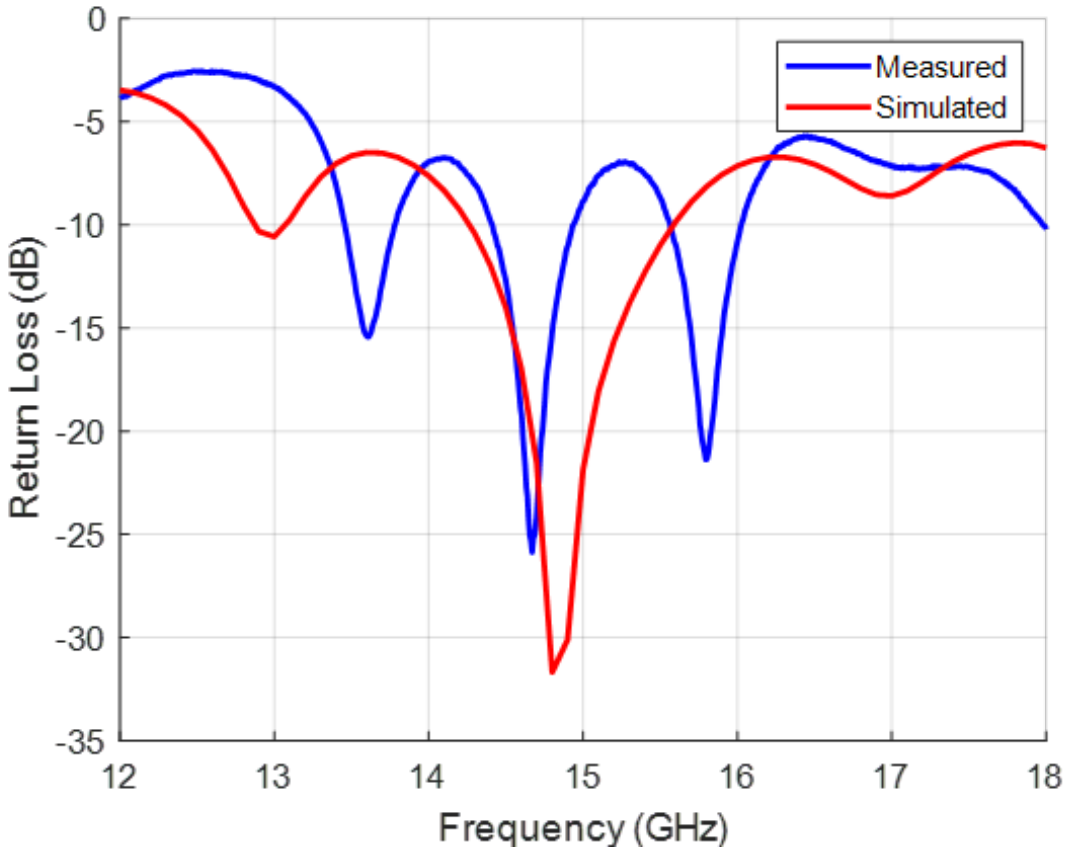
Integration into Active Ku-band 8 x 1 Phased Array



Printed Antennas

8 x 1 Patch Array

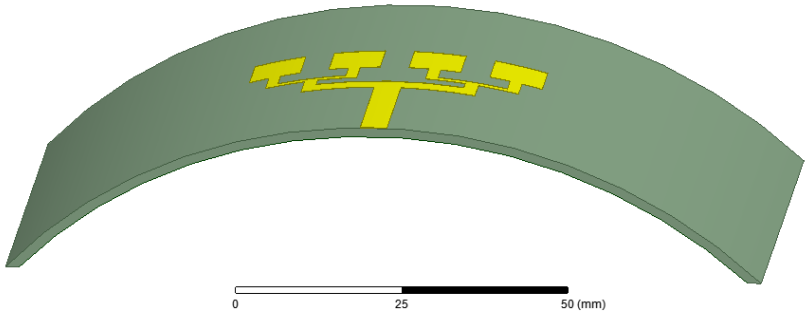


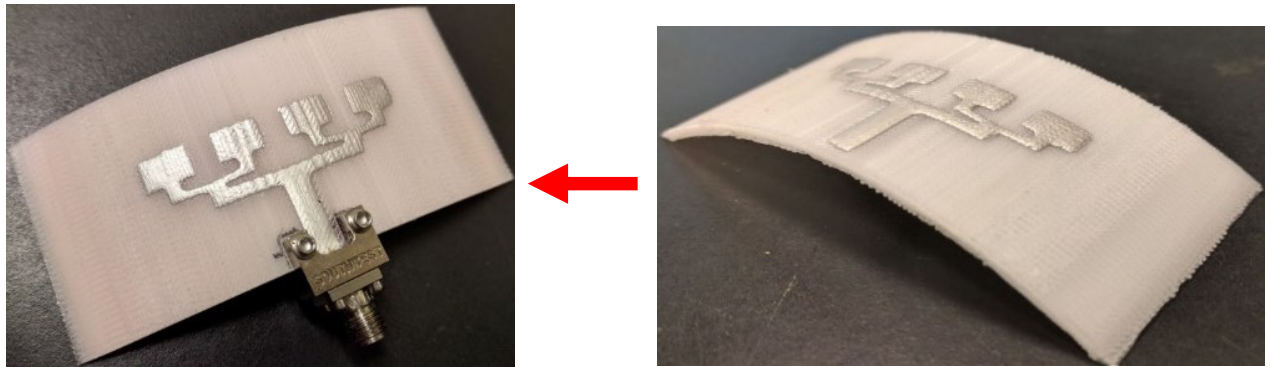


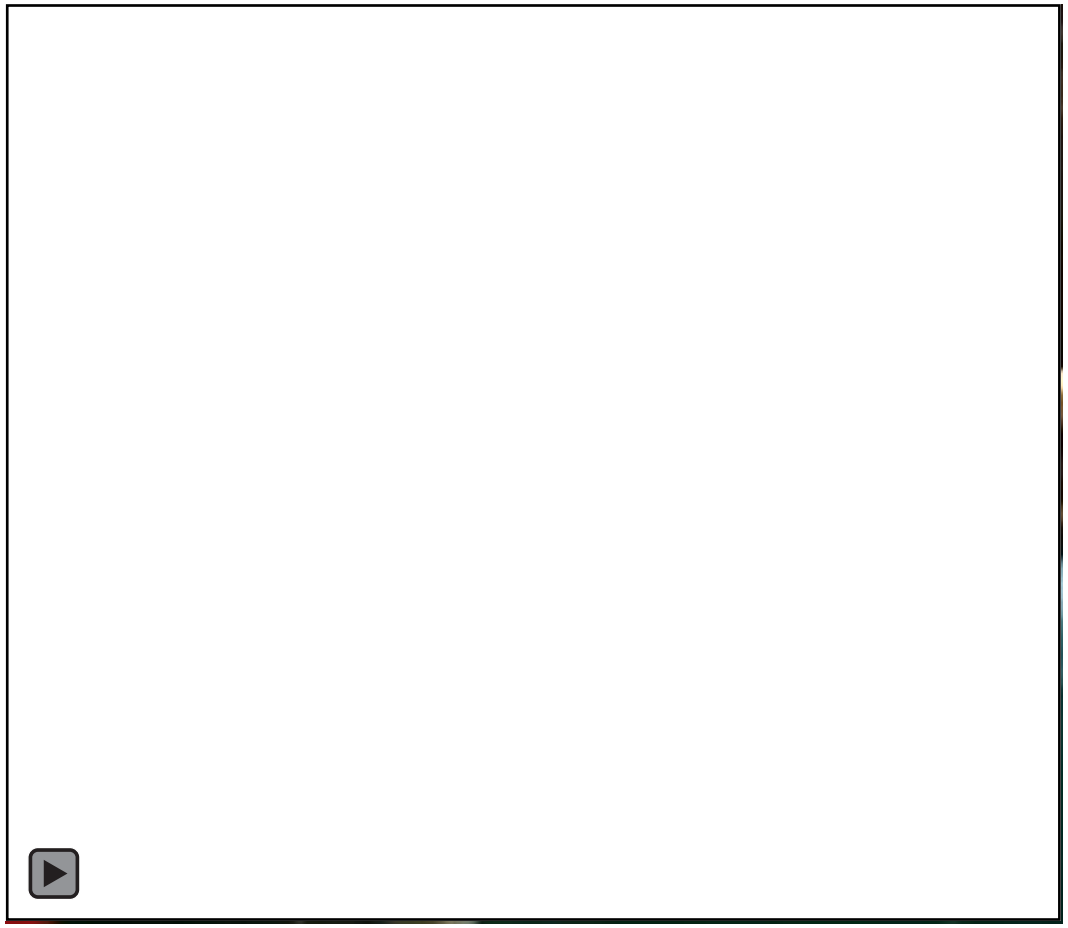
- Ku-band 8 element patch array
- The entire antenna was fully printed using the nScrypt system
- Materials used were silver ink and polycarbonate substrate

Additive Manufacturing of RF Devices and Systems

Printed Antennas



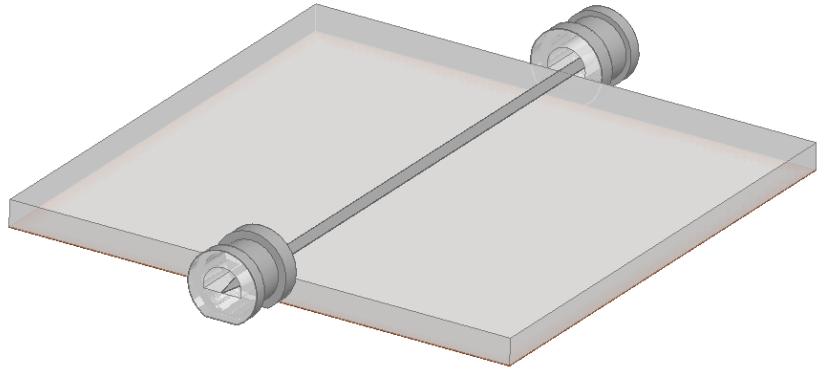


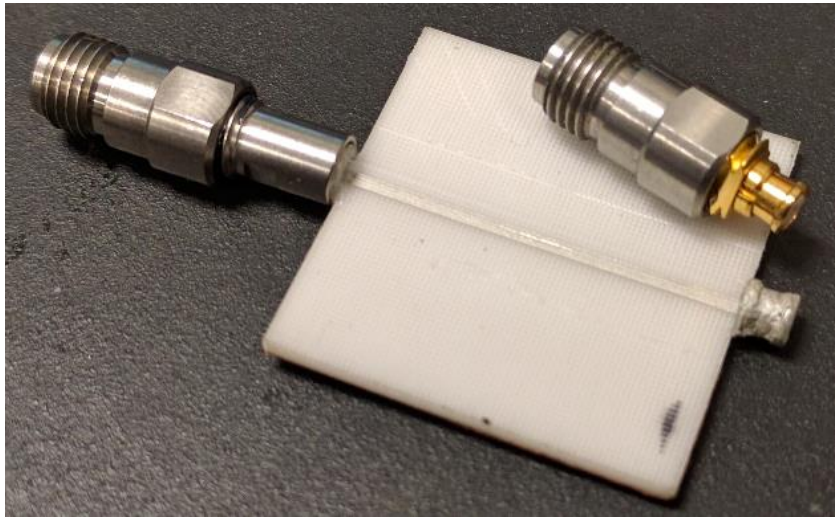


Additive Manufacturing of RF Devices and Systems

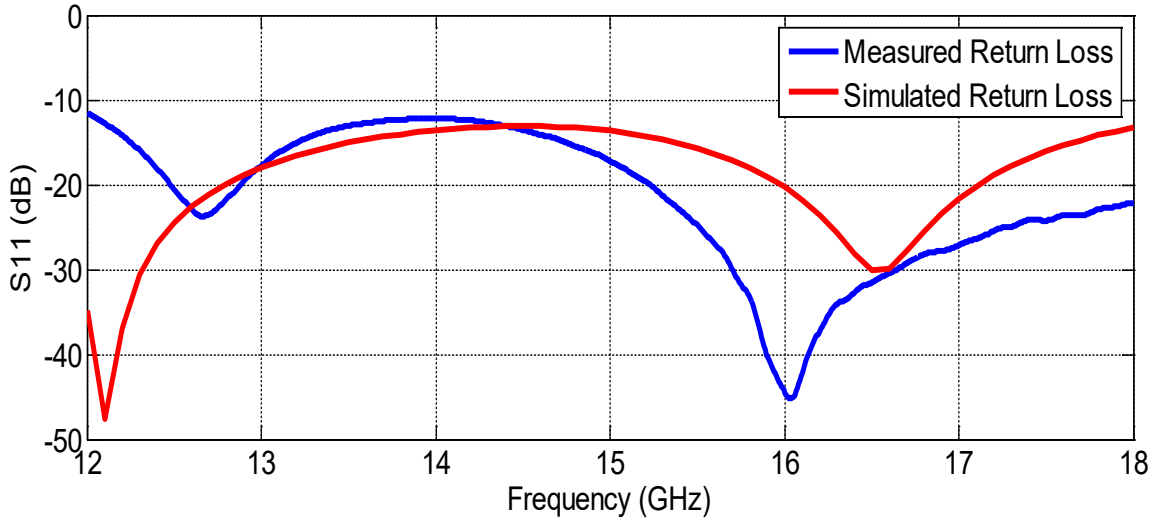
Printed RF Connectors

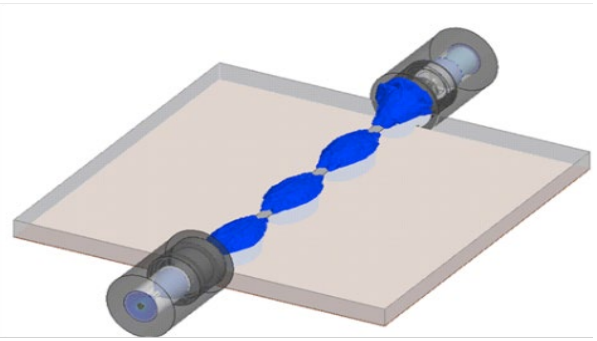
Edge Mount Connectors





Return Loss

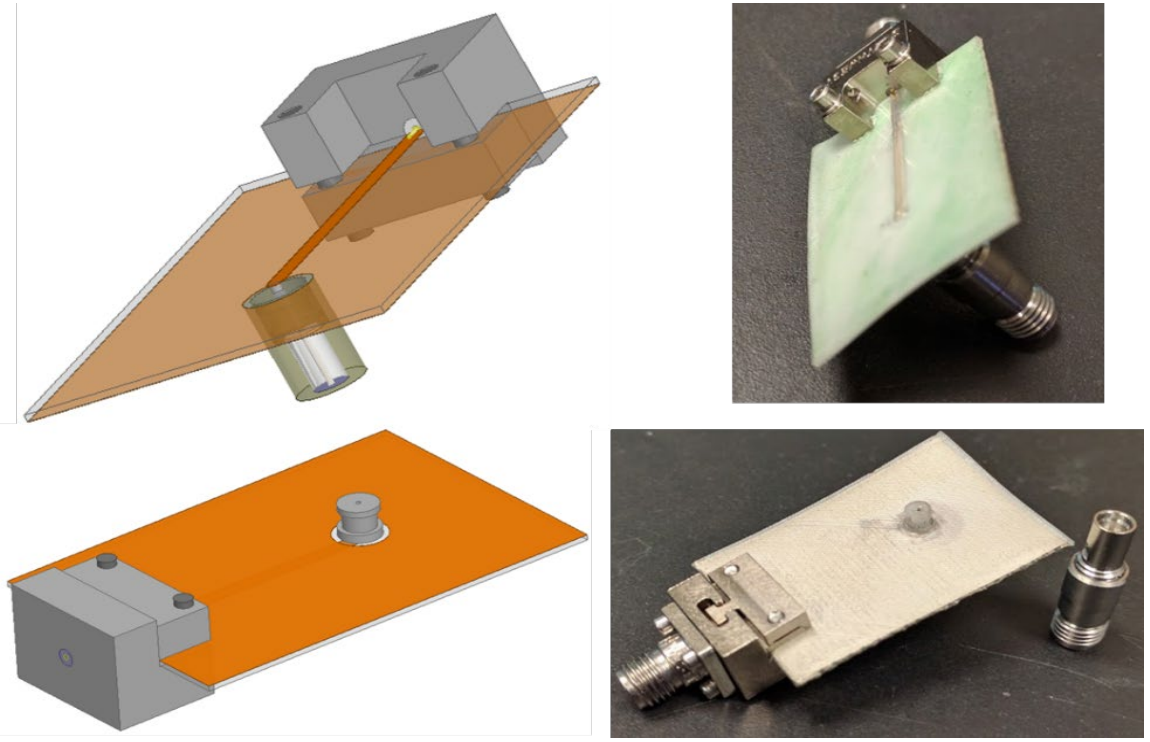




Additive Manufacturing of RF Devices and Systems

Printed RF Connectors

Face Mount Connectors



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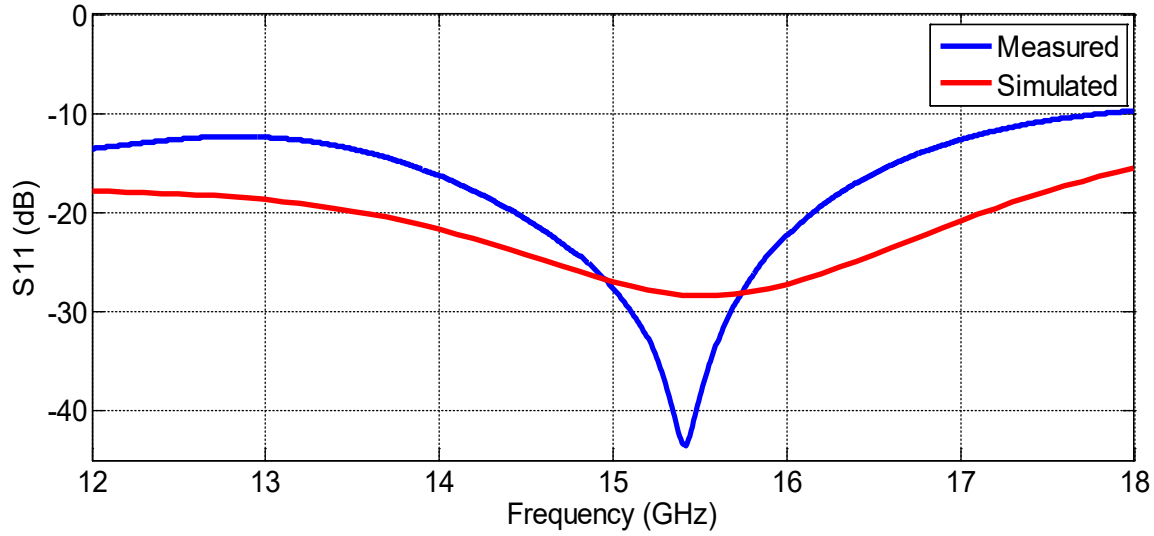
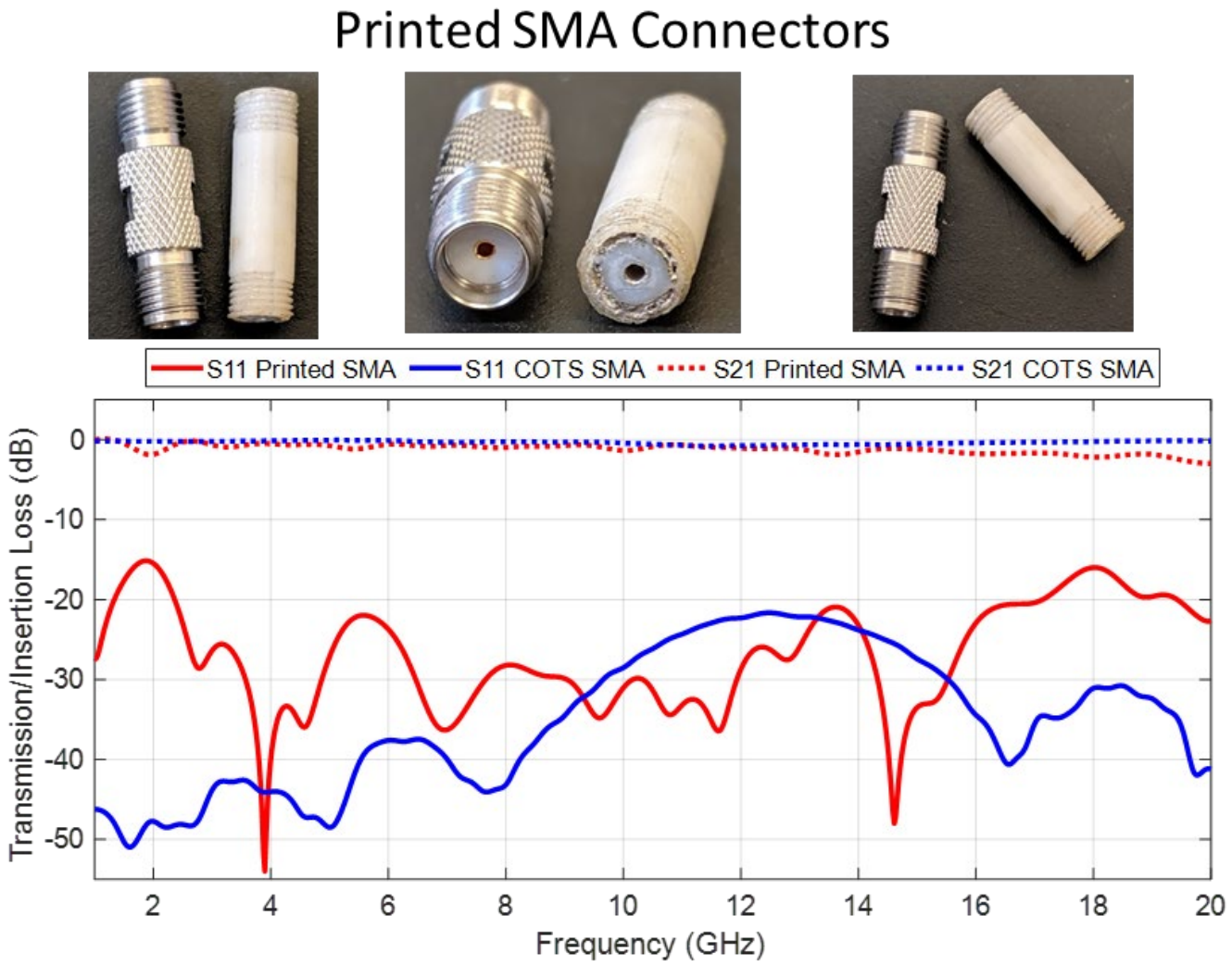
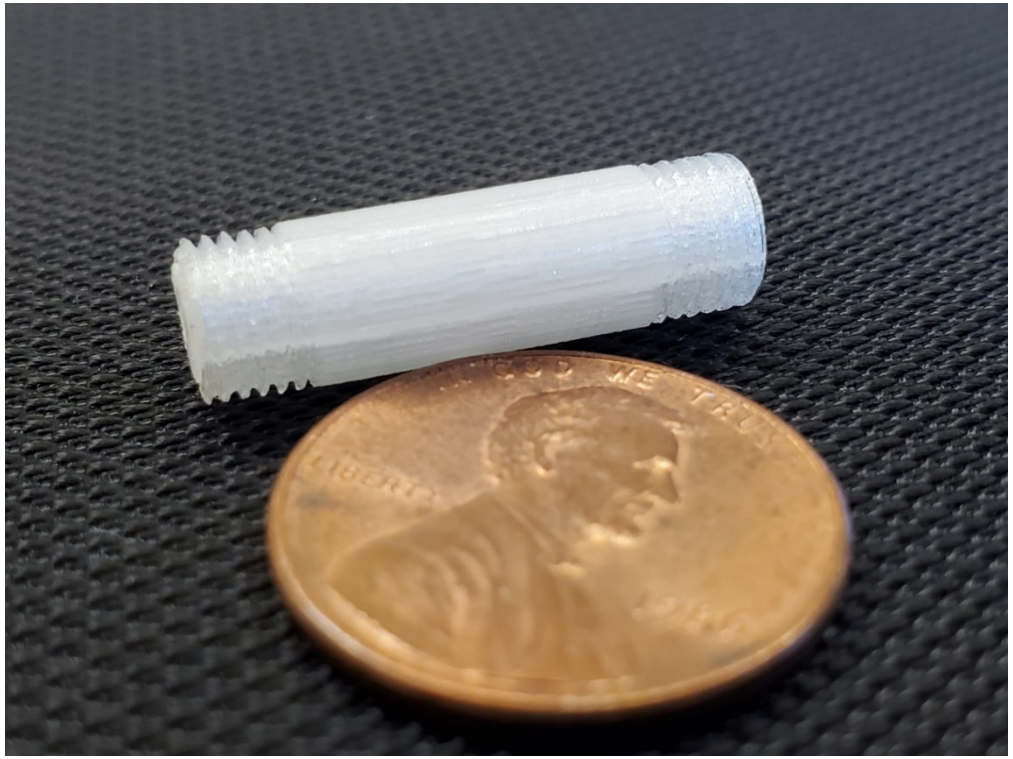


Additive Manufacturing of RF Devices and Systems

Printed RF Connectors: SMA Connectors

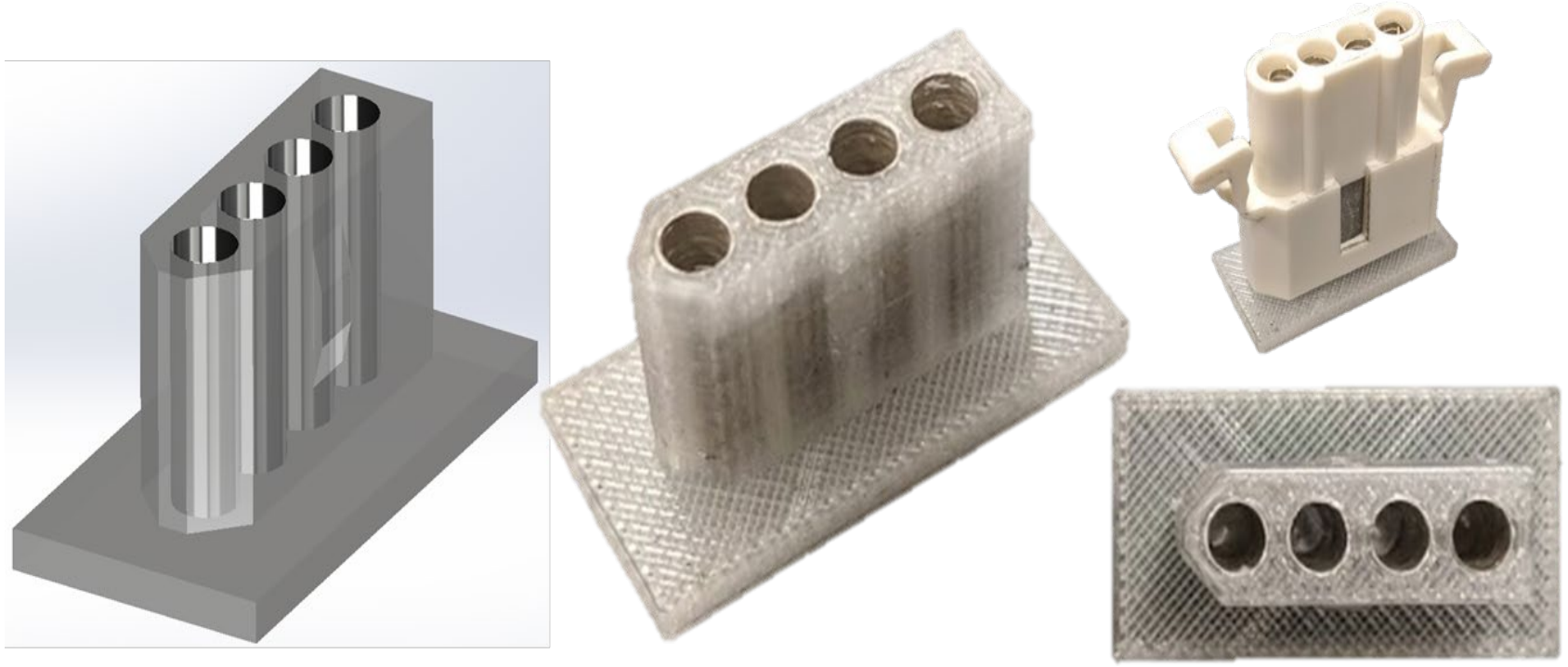




Additive Manufacturing of RF Devices and Systems

Printed Connectors

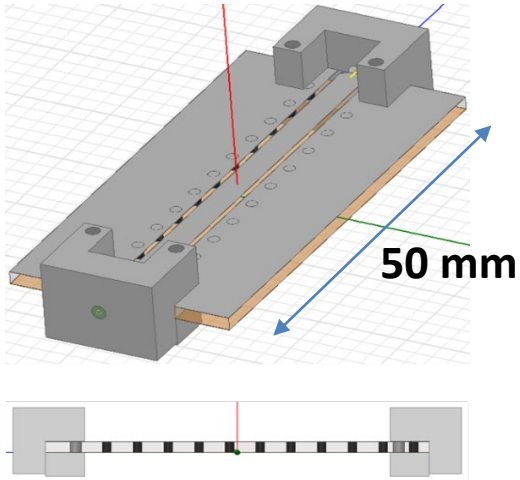
Fully FDM printed 4 channel Molex type connector, in the upper right the printed connector can be seen mating with its COTS interface.

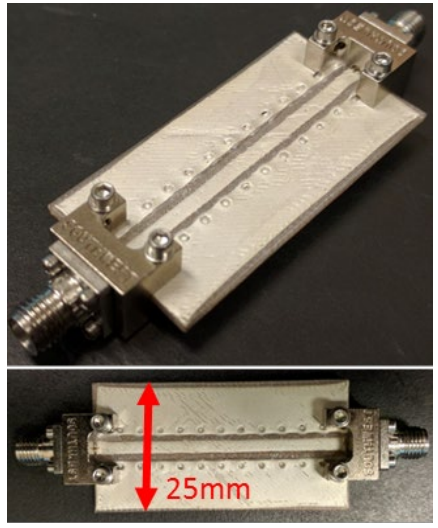


Additive Manufacturing of RF Devices and Systems

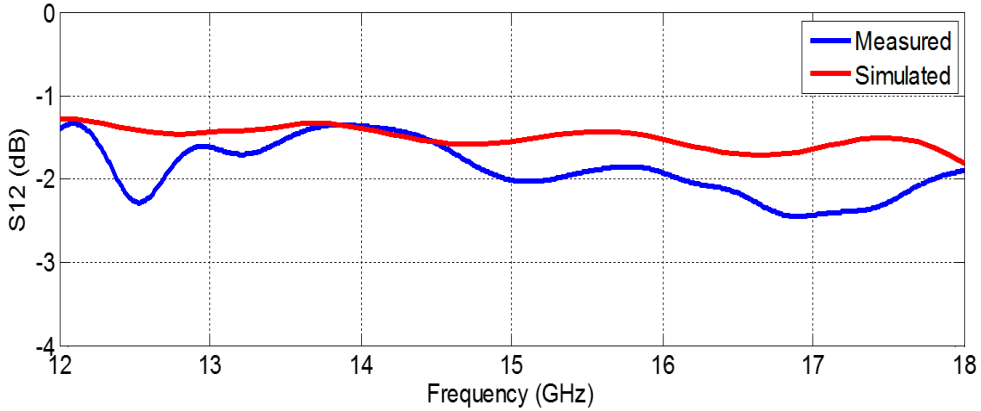
Applications: RF Components and Systems

Grounded co-planar transmission line





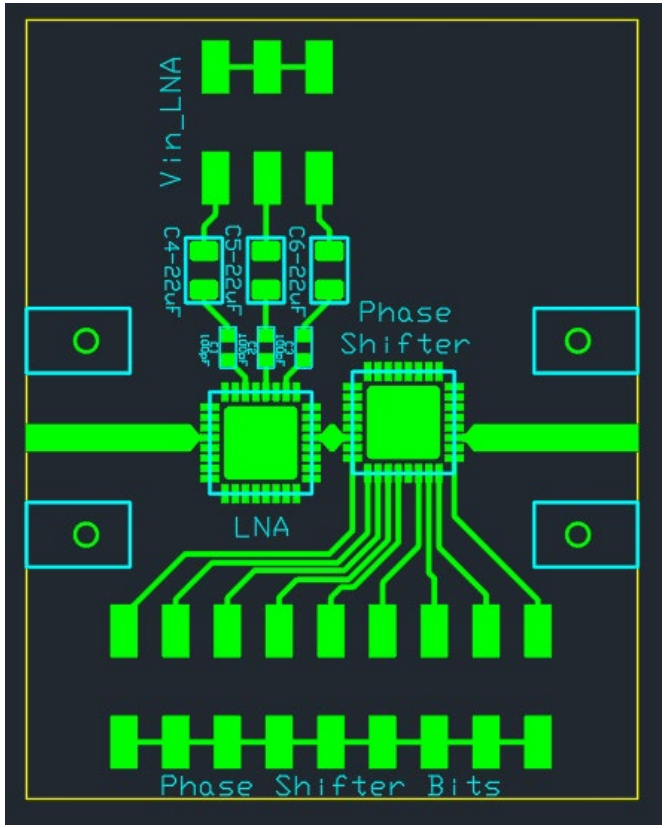
Transmission Coefficient

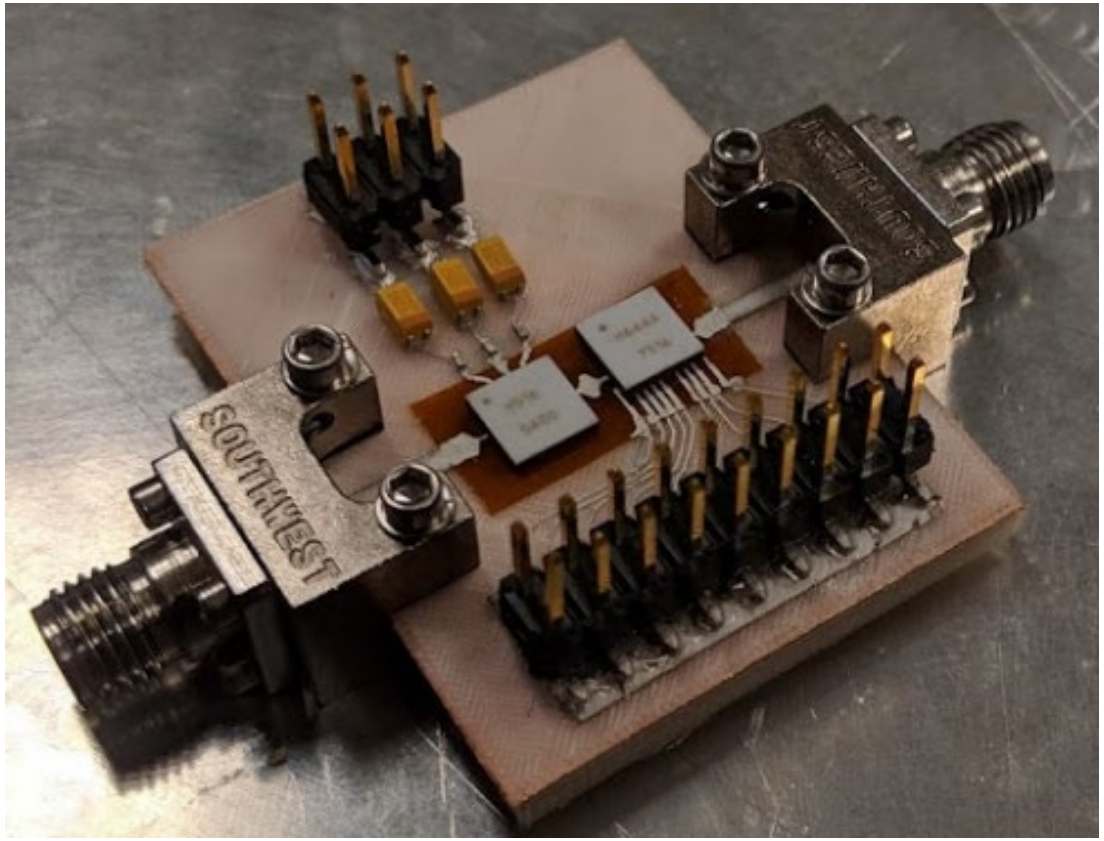


Attenuation coefficient (dB/cm)	f=12 GHz	f=15 GHz	f=18 GHz
Printed grounded co-planar waveguide	0.29	0.34	0.36
Printed microstrip transmission line	0.32	0.36	0.37

Additive Manufacturing of RF Devices and Systems

Integration into Active Components





Printed subassembly

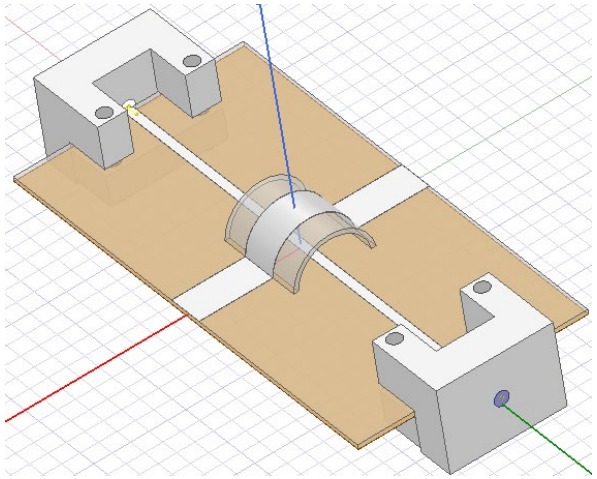
Additive Manufacturing of RF Devices and Systems

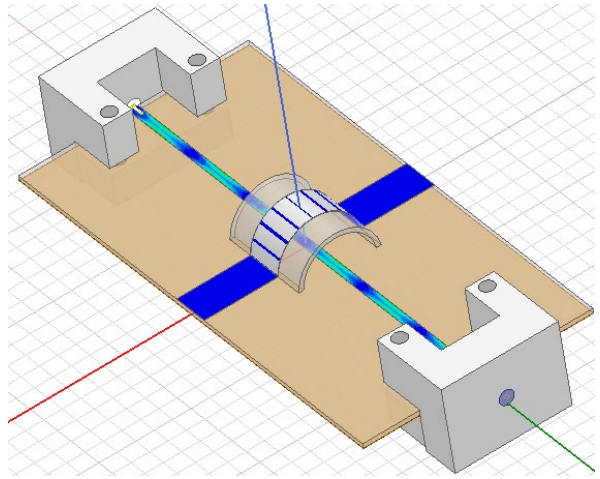
3D Printed Bias Bridges

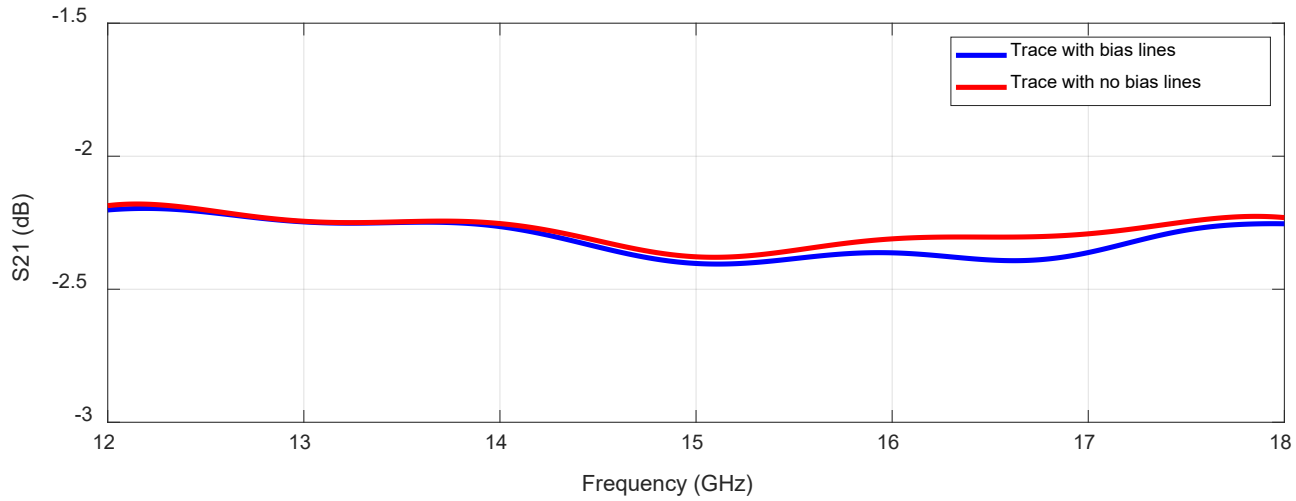
Typically this is done with multi-layer boards and vias to prevent overlapping of lines.

With AM though we can take a different approach. We can route all of the lines on a single 'layer' but place dielectric bridges/spacers over the RF lines.

Modeling shows that we can place bridges over RF transmission lines with no effect as long as the spacing is large enough.







Additive Manufacturing of RF Devices and Systems

3D Printed Bias Bridges