WE2D-2

A Wide-band Millimeter Wave RWG to Air-Filled SIW Transition

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Outline

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Applications & Requirements

Emerging Applications [1],[2]

- High-Speed Communication
- Automotive Radar
- Wireless Power Transmission

Requirements

- Low loss
- Wide Bandwidth
- High Integration Density

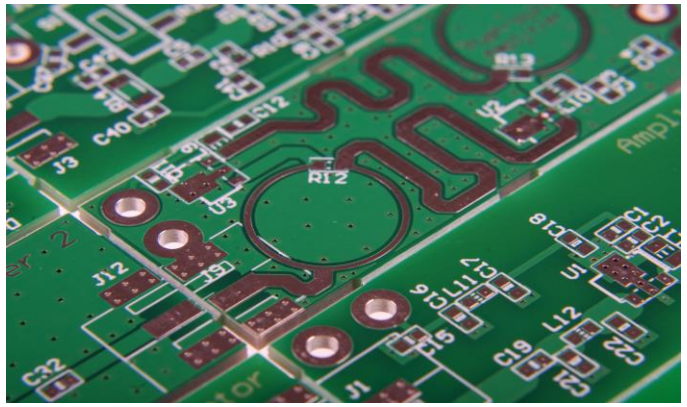
Technology Options

Rectangular Waveguide (Non-planar)

- Low insertion loss
- High Q factor
- Self Shielded
- High power handling

- Expensive
- Difficult Integration
- Heavy
- Tedious to produce

Printed Circuit Board (Planar)

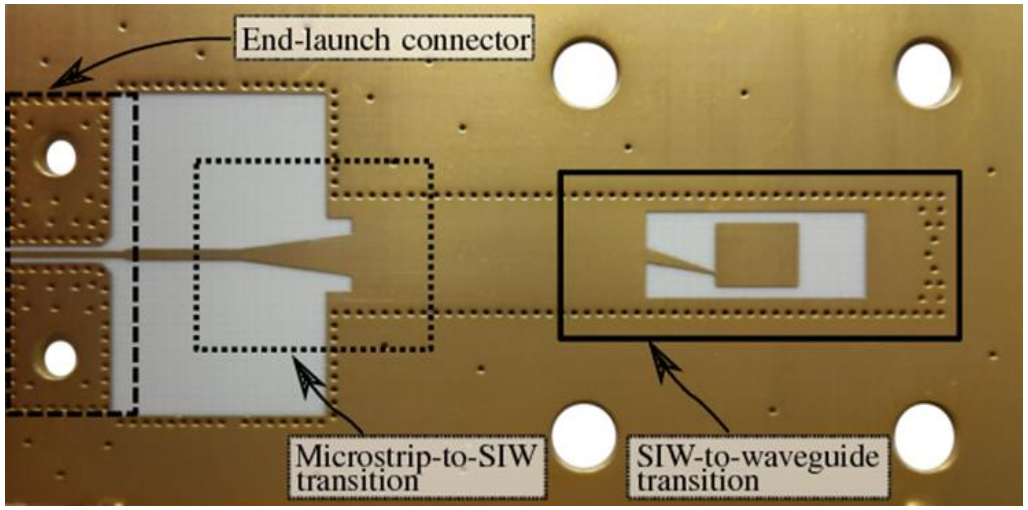


- Low Cost
- Easy Integration
- Light Weight
- Standard Production

- High insertion loss
- Low Q factor
- Not Shielded
- Low power handling

Technology Options

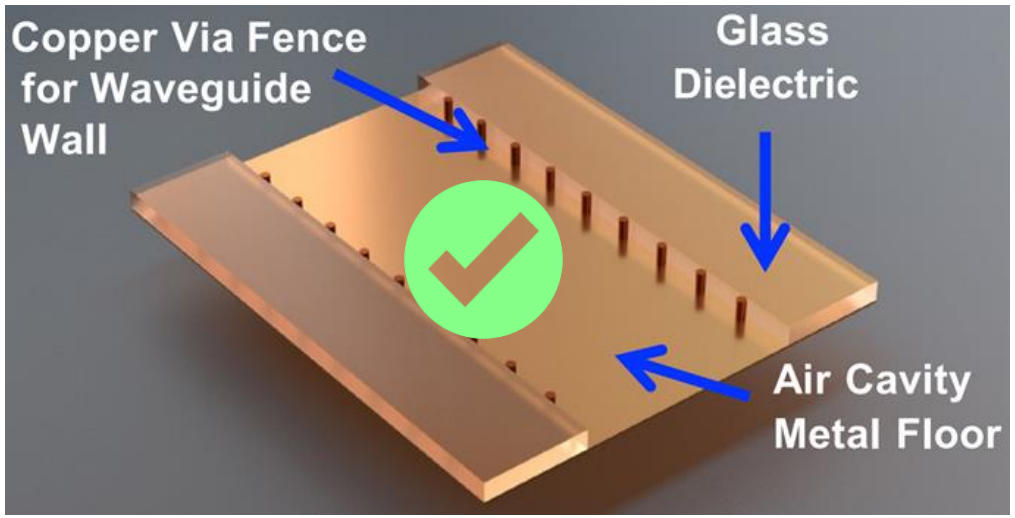
SIW



- Low Cost
- Easy Integration
- Self Shielded
- Compact
- Light Weight

- Medium Insertion Loss
- Medium Q Factor
- Medium Power Handling

AFSIW [4]-[6]



- Low Cost
- Easy Integration
- Light Weight
- Standard Production
- Low Insertion loss
- High Q Factor
- High Power Handling

- Less Compact

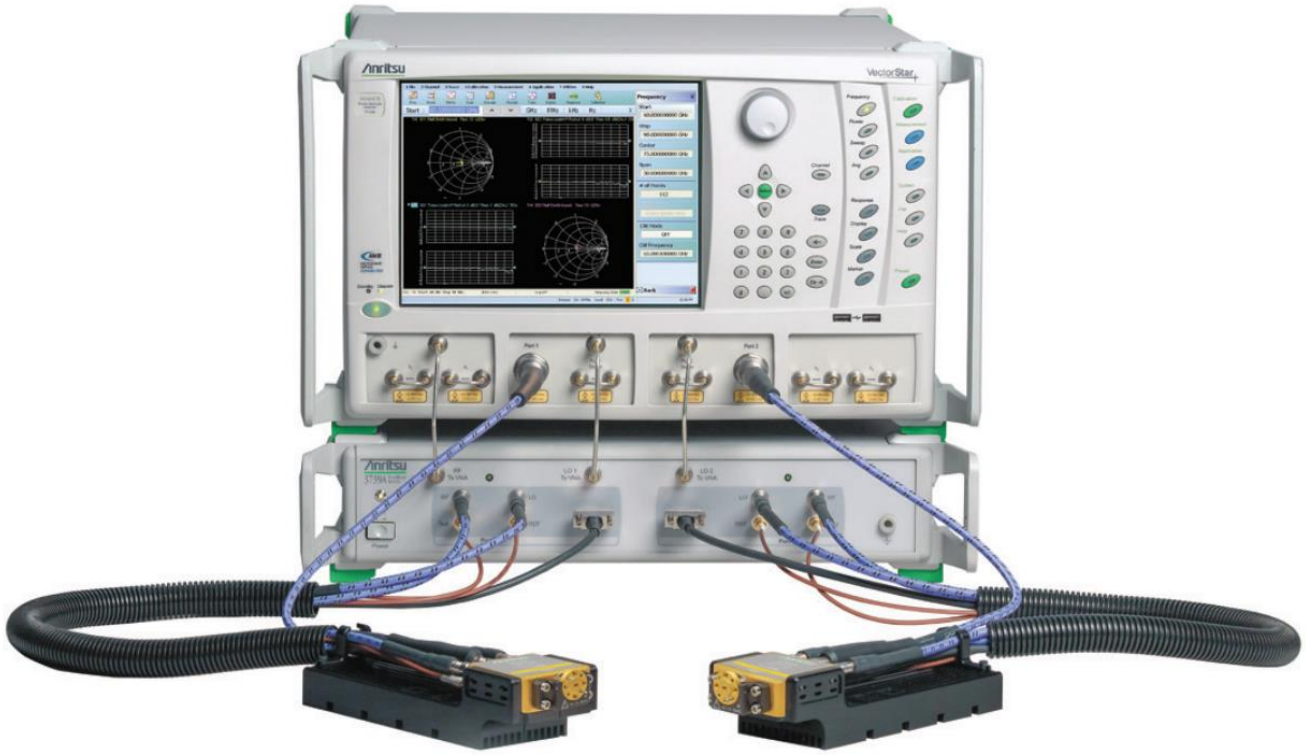
Transition Needs and Challenges

Why Transition? [3]

- Frequency Extenders
- Anechoic Chamber
- Radar Systems

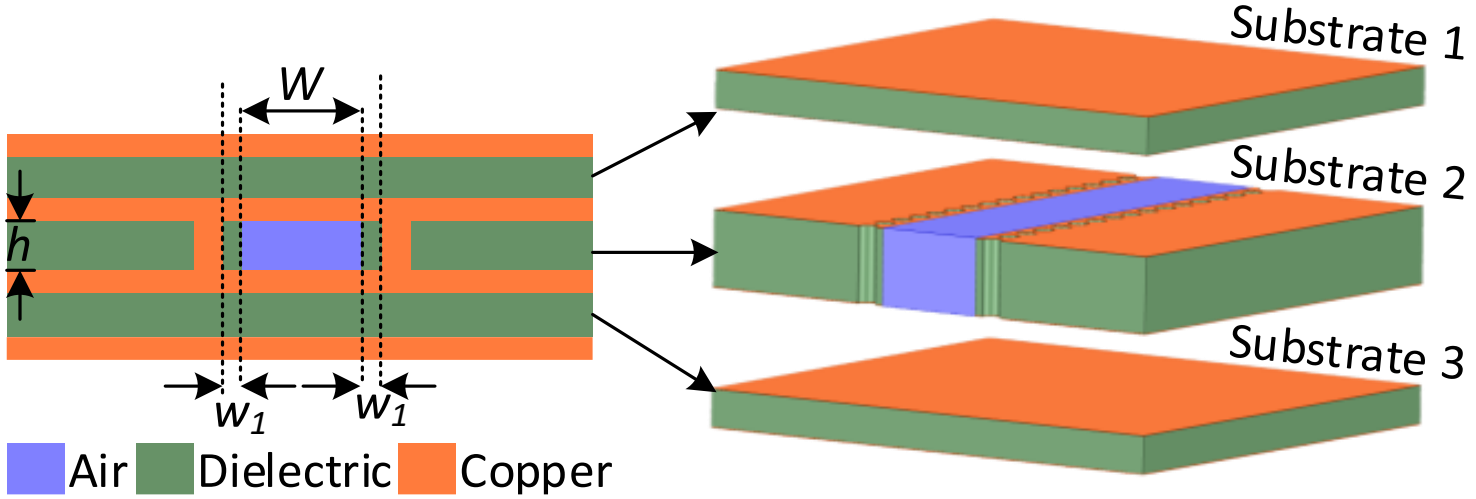
Challenges Involved

- Low insertion loss
- Wide Bandwidth
- Design Flow



AFSIW Structure

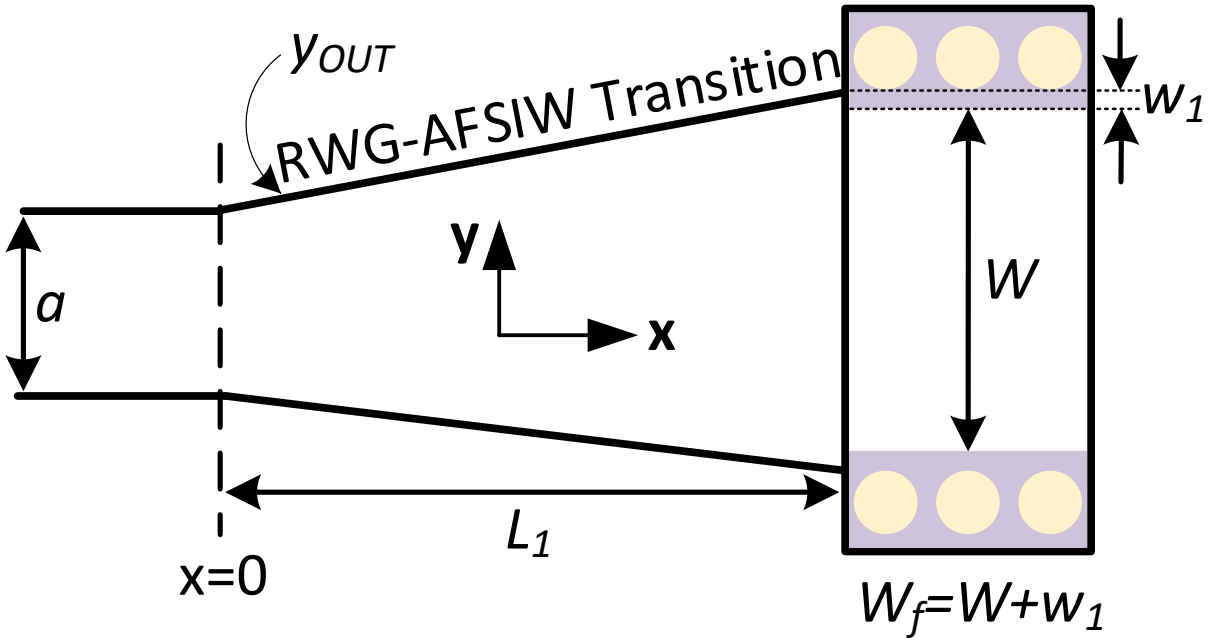
AFSIW structure with discontinuous electric walls [10],[11]



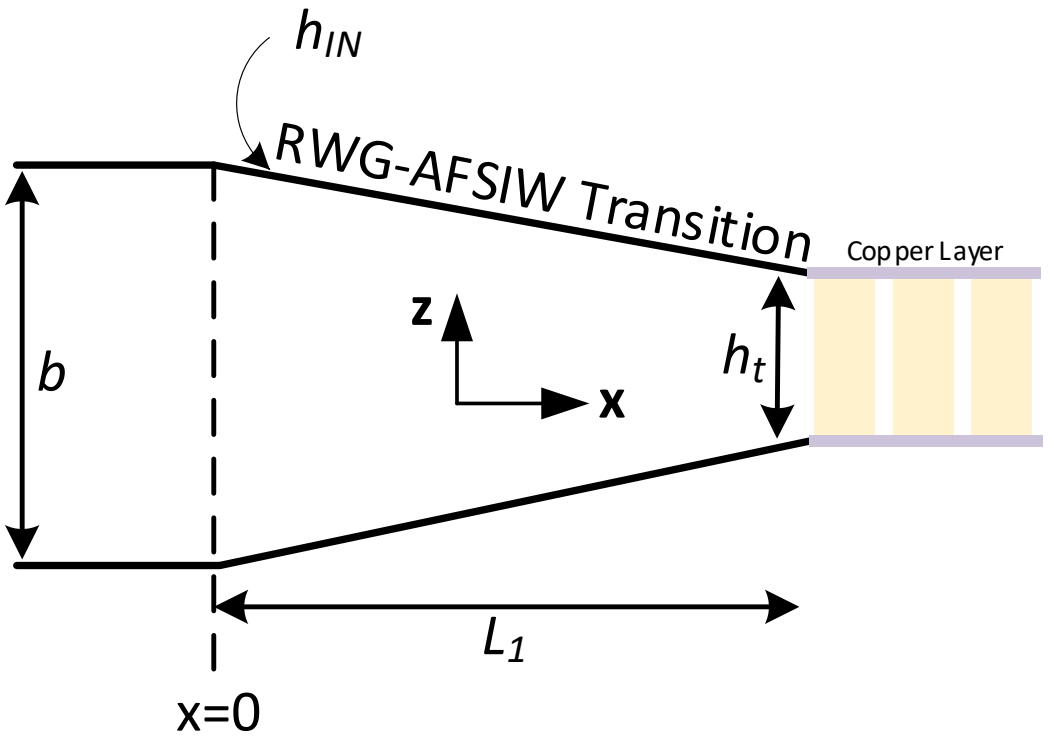
A High degree of design flexibility for next-generation radio circuits at a low cost

Various Configurations

Taper Out - Top View



Taper In – Side View

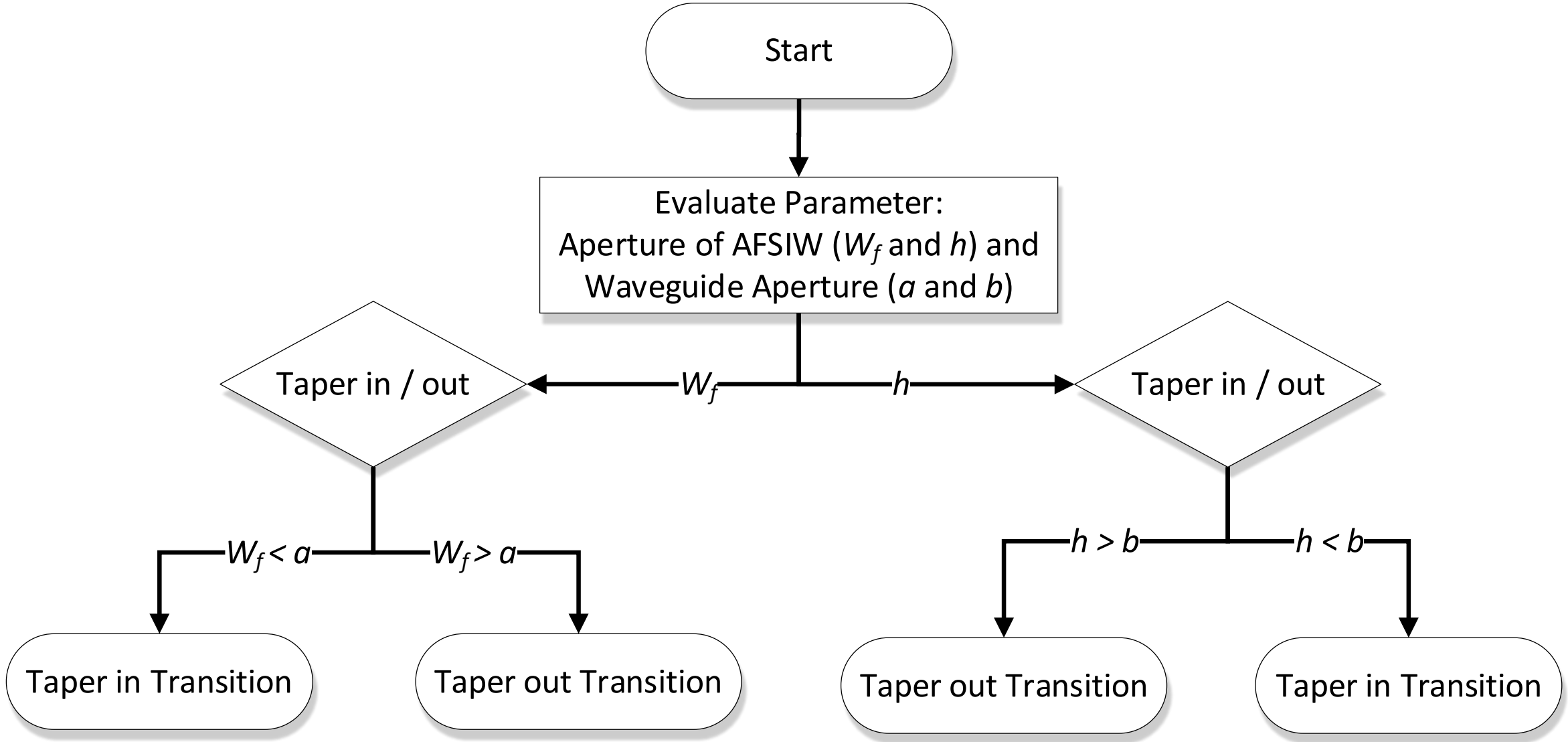


Each configuration is decided by the aperture size of RWG and AFSIW

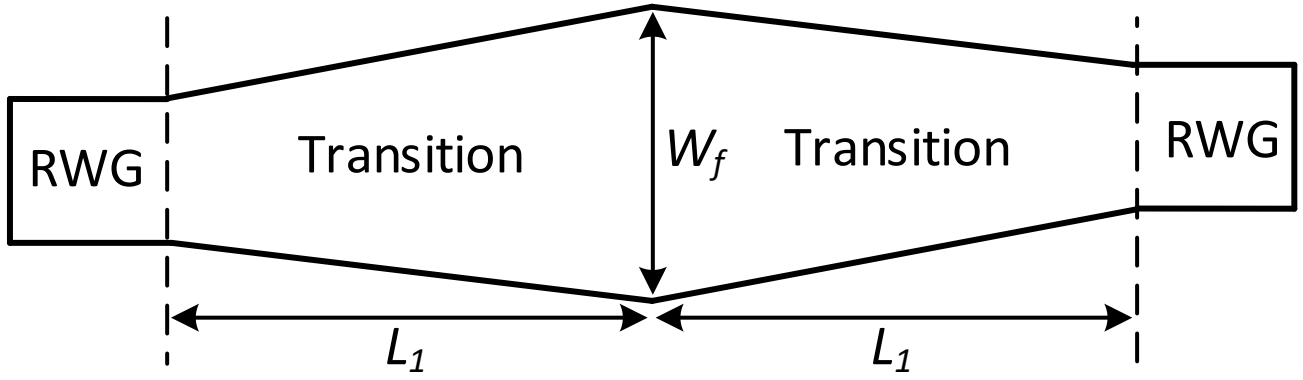
(L_1) is critical design parameter and varies with cutoff Frequency (f_c)

$$L_1 = 8.293 \times e^{-0.01881 \times f_c}$$

Design Flow

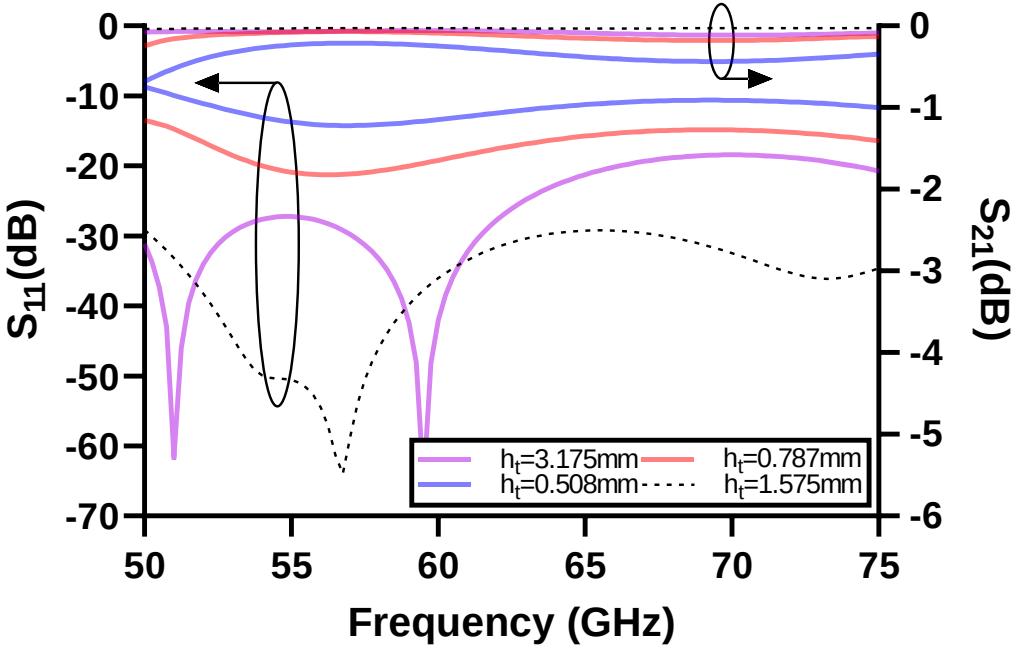

Start
Evaluate Parameter:
Aperture of AFSIW (W_f and h) and
Waveguide Aperture (a and b)
Taper in / out
W_f
h
Taper in / out
$W_f < a$
$W_f > a$
$h > b$
$h < b$
Taper in Transition
Taper out Transition
Taper out Transition
Taper in Transition

Simulation Results

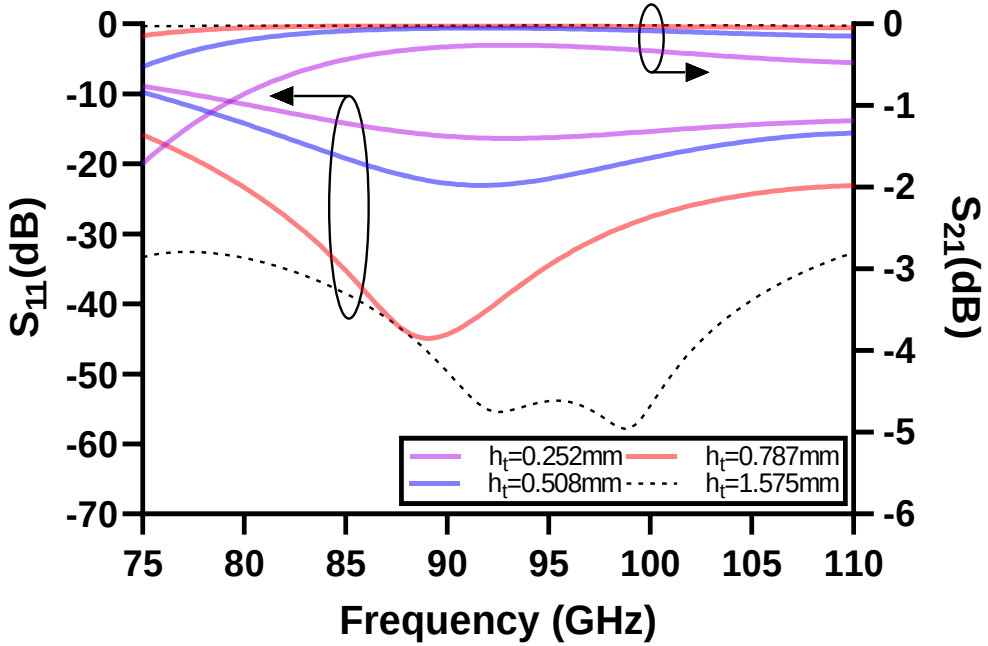


Back-to-Back Transition

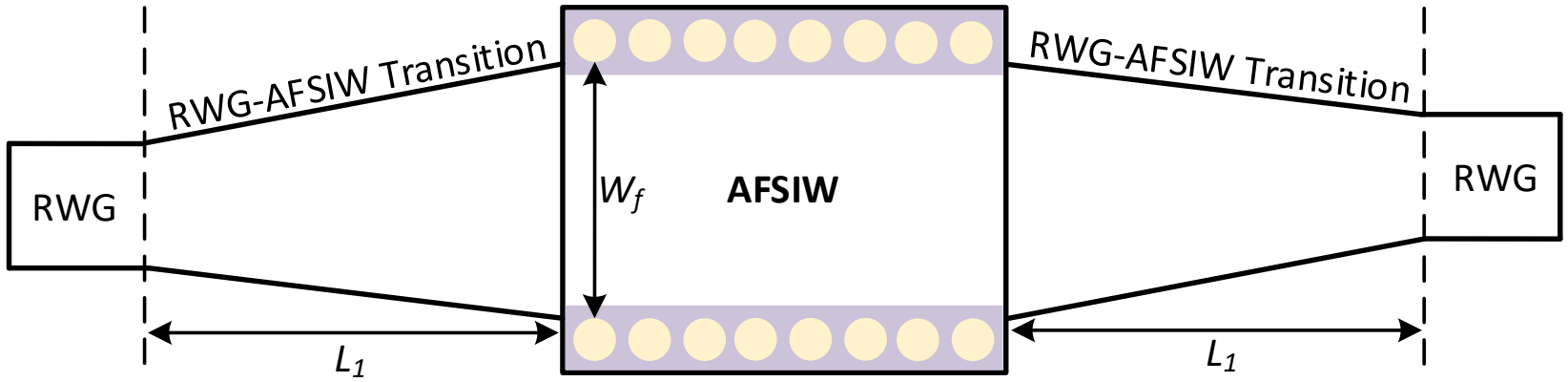
WR-15



WR-10

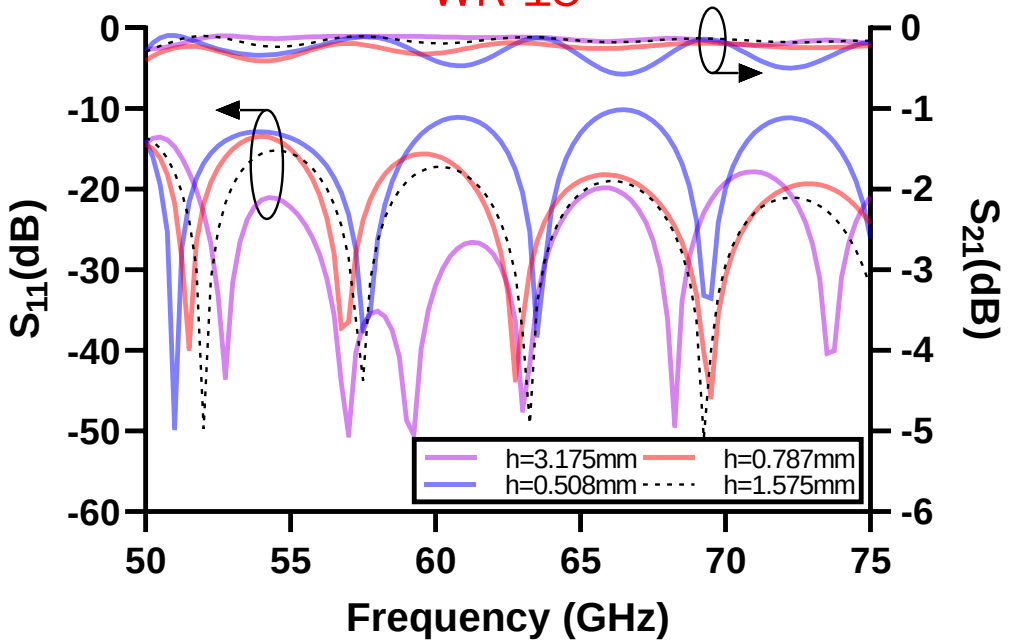


Simulation Results

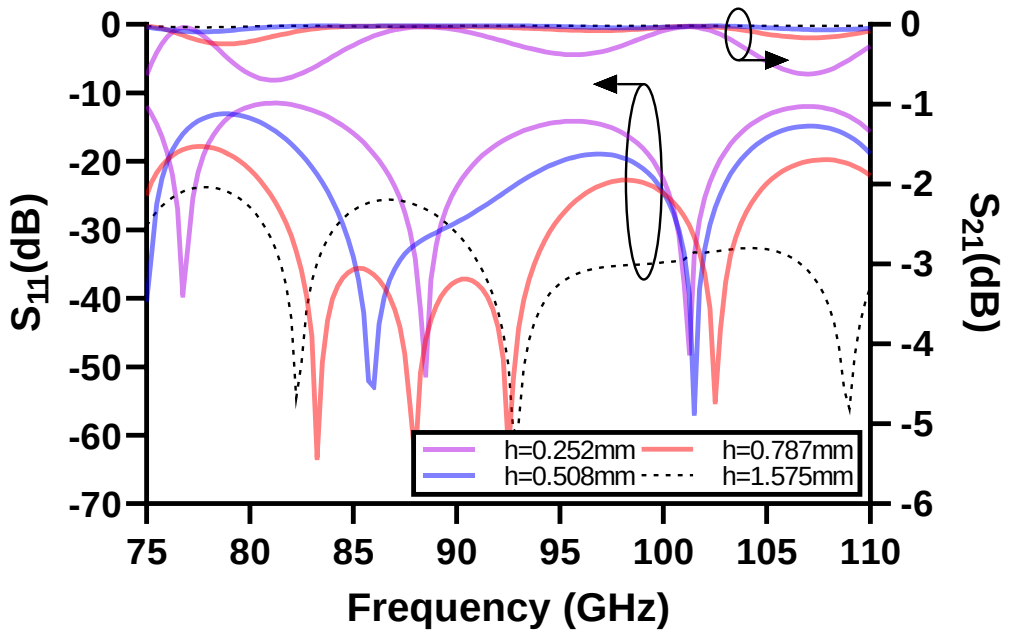


Transmission System

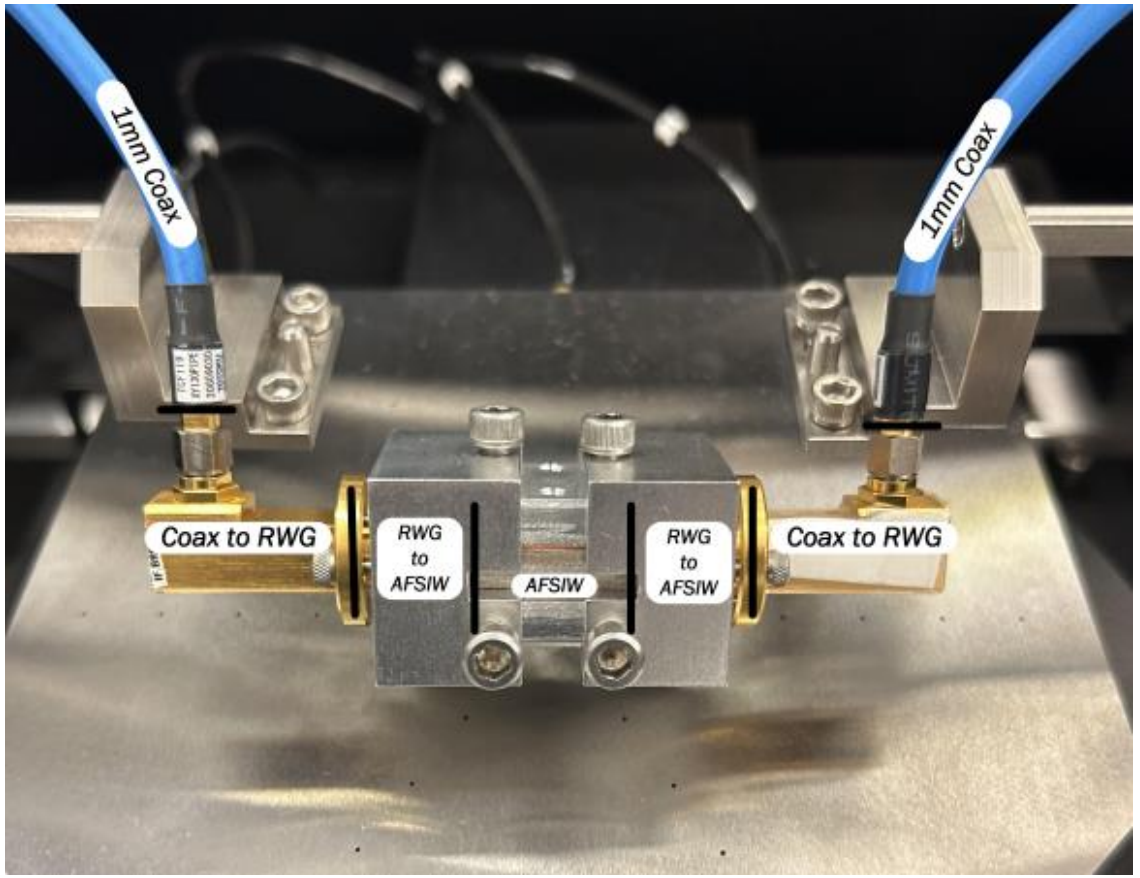
WR-15

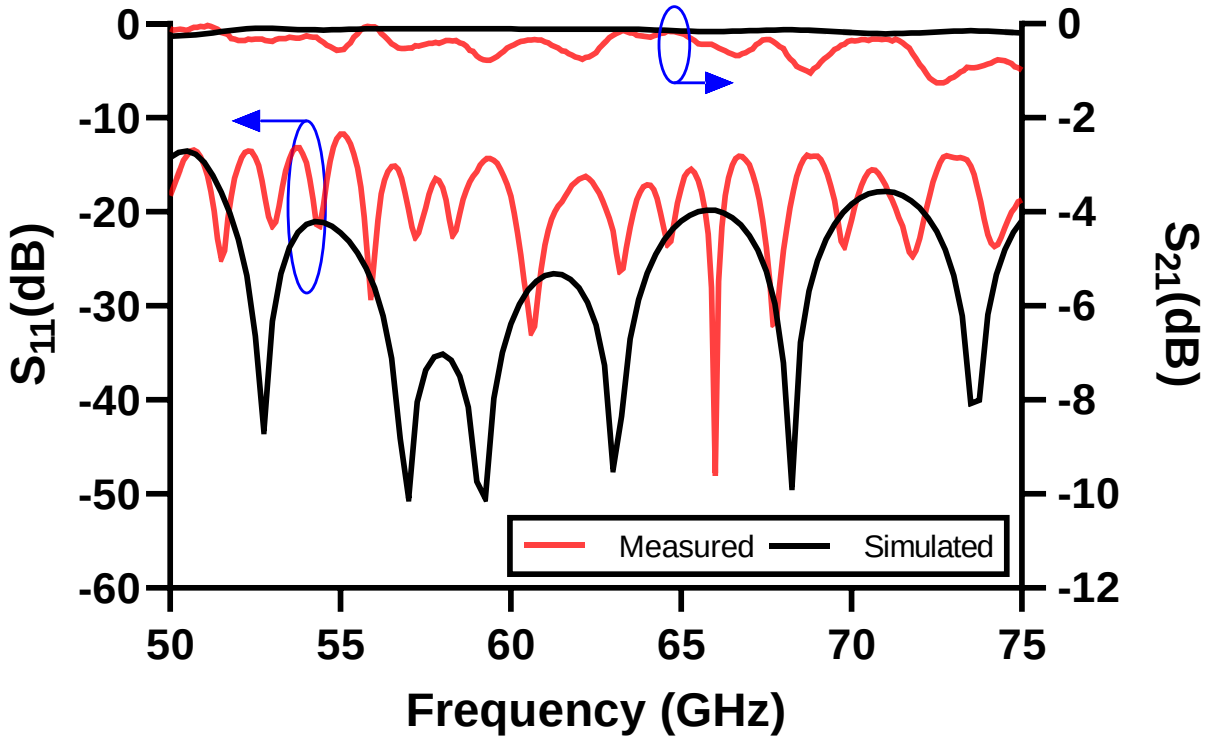


WR-10



Measurement Results





Prototype

Measured Results

Performance Comparison

Ref.	Transition Structure	S_{11} (dB)	S_{21} (dB)	10-dB BW (GHz)
[10]	RWG-SIW	≤-10	>-0.58	50.5-75.3
[11]	SIW-RWG	≤-10	>-0.50	47.2 to 77.5
[12]	SIW-RWG	≤-10	>-0.40	40-65
[This Work]	RWG-AFSIW	≤-10	>-0.35	50-75

As evident from earlier reported work, the paper presents a simple transition design, along with improved performances

Conclusion

- A generalized transition design approach from RWG to AFSIW is presented, and its transition length is analytically determined, which balances the impedance matching and insertion loss.

- The measured S_{11} <-10 dB and S_{21}>-0.35 dB over 50-75 GHz are achieved, which are in close agreement with simulated results, demonstrating the superiority of the developed transition.

- The advantages of extremely low insertion loss, low cost, and improved power handling capacity are the attractive features of the proposed transition to develop next-generation mm-Wave wireless systems.

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Deanship of Academic Research

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Thanks for joining !

Questions?