TEXAS STATE UNIVERSITY

The rising STAR of Texas

1.03 - Team Guide

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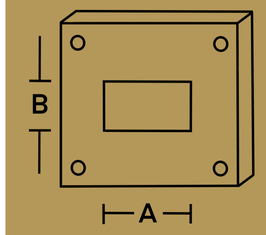
Prototype Waveguide Components

Bulkhead Adapter

Coax-to-Waveguide Adapter

Straight Section

What is the WR-90 Standard?



Features

- 8.2-12.4 GHz range.
- WR-90 flange has the following dimensions:
  A = 22.82 mm
  B = 10.1 mm

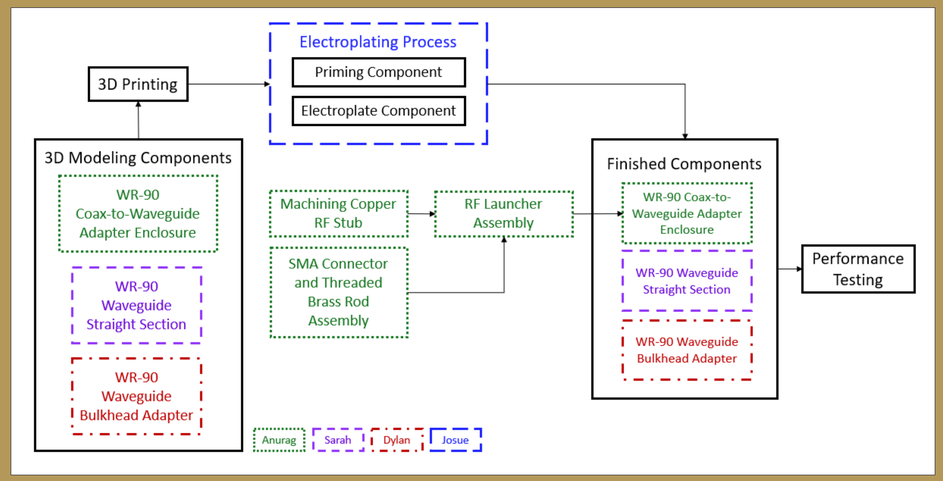
- We are using this standard because this is the standard of the commercial waveguide components that we have access to test.

D2 Plans

Our Plans for D2

- Combine with team 1.02.
- Improve the design of the waveguide components
- Improve the quality of electroplating
- Comprehensively test the waveguide components and electroplating process
- Design and construct the communications demo.

Can commercial WR-90 waveguides' performance be replicated using 3D printing and electroplating?



Waveguide Production Process Flow Diagram

What are Waveguides?

- Structures that transmit waves with low losses using their shape and physical characteristics.
- Focus EM waves in one direction, instead of letting them propagate normally.

Why 3D Print?

- Fabrication time is much lower
- Cost of PETG is much lower
- Iterative design improvements become achievable
- 3D printed components weigh less than commercial components.

Electroplating Process

Why Electroplate?

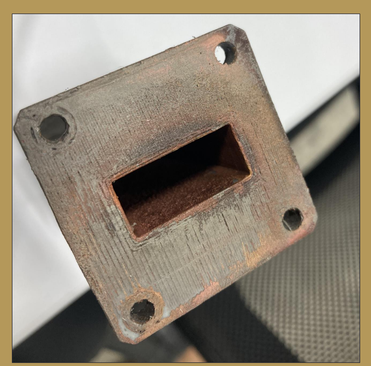
- We are electroplating the components to give them the conducting layer necessary to transmit high-frequency EM waves.

Steps in the electroplating process

- Sanding the printed components
- Cleaning the printed component in acidic solution
- Applying conductive paint to create a seed layer
- Create custom plating anode and fixture
- Electroplating the components in a copper ion solution

Why is Thickness Important?

- Without the electroplated layer reaching a specific level of thickness, there will be significant, measurable losses in transmitted signals due to the skin effect.
- The required electroplating layer thickness is no less than 7µm



Electroplated Flange

Requirements

Insertion Loss
The loss in signal magnitude that happens through the waveguide.

VSWR
A measurement that maps to the power delivery efficiency of the waveguide

Waveguide Straight Section

- Insertion Loss: less than 0.5 dB/m
- VSWR: less than 1.5

Waveguide Bulkhead Adapter

- Insertion Loss: less than 0.5 dB/m
- VSWR: less than 1.5

Coax-to-Waveguide Adapter

- Insertion Loss: less than 1 dB
- VSWR: Less than 1.5

Commercial Components' Performance

Waveguide Straight Section

- Insertion Loss: less than 0.33 dB/m
- VSWR: less than 1.03

Waveguide Bulkhead Adapter

- Insertion Loss: less than 0.33 dB/m
- VSWR: less than 1.03

Coax-to-Waveguide Adapter

- Insertion Loss: less than 0.5 dB
- VSWR: Less than 1.3

**Retrieved from Pasternack Website*

Cost Restrictions

The per-unit cost of the components that we are designing have a limit of being less than 20% of the price of their commercially available counterparts.

Waveguide Straight Section

- Max cost: $44.75

Waveguide Bulkhead Adapter

- Max cost: $190.73

Coax-to-Waveguide Adapter

- Max cost: $72.99

**Retrieved from Pasternack Website*