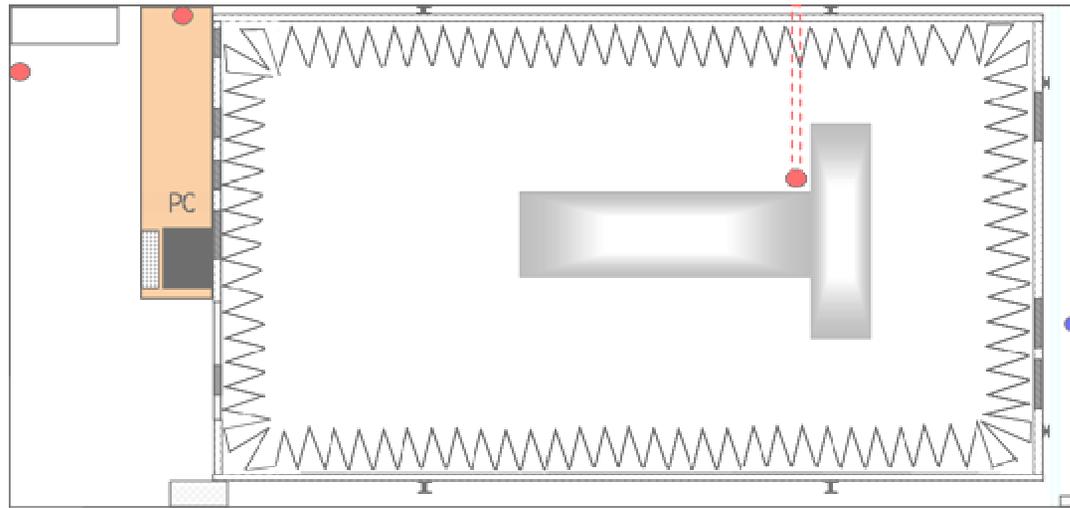


A New Anechoic Chamber for Nearfield Antenna Measurement at Ohio University



FAA/NASA Joint University Program
for Air Transportation Research

Jeff Dickman

Chris Bartone

June 20, 2003



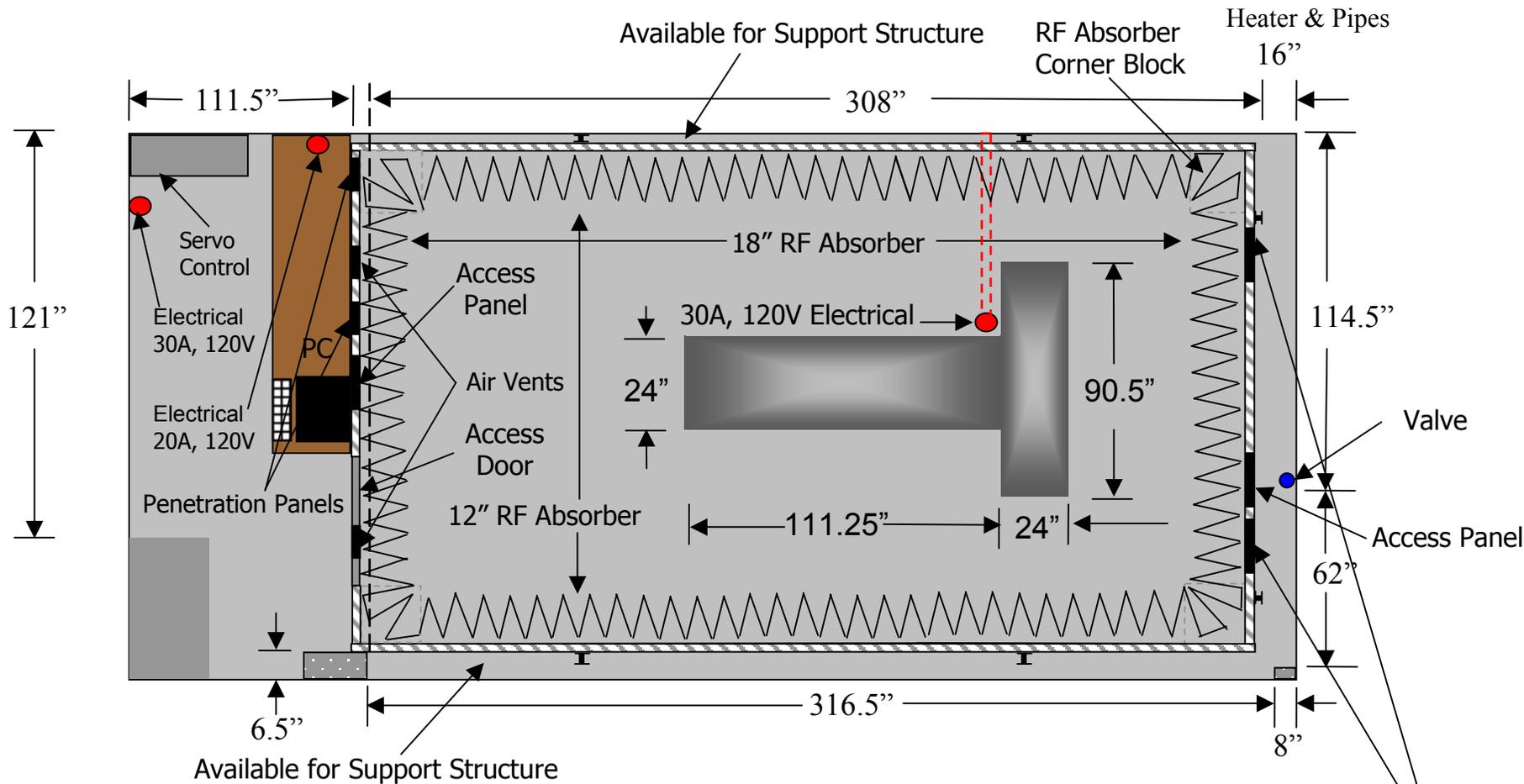
Design Goals

- Planned Uses
 - Sponsored Research (Prototype and Verify In-House Designs)
 - Graduate Education (Research Projects)
 - Undergraduate Education (Senior Design Projects)
- Indoor Antenna Range
 - Ease of Use
 - Year Round Use
- Hybrid Near-Field Scanner
 - Measures Electrically Large Antennas
 - Flexibility to Also Perform Far-Field Measurement for Electrically Small Antennas
- Shielded Chamber To Provide Data Integrity
- Anechoic Chamber To Provide Data Accuracy and Validity
- Establish The Chamber Within an Existing University Facility

Chamber Interior

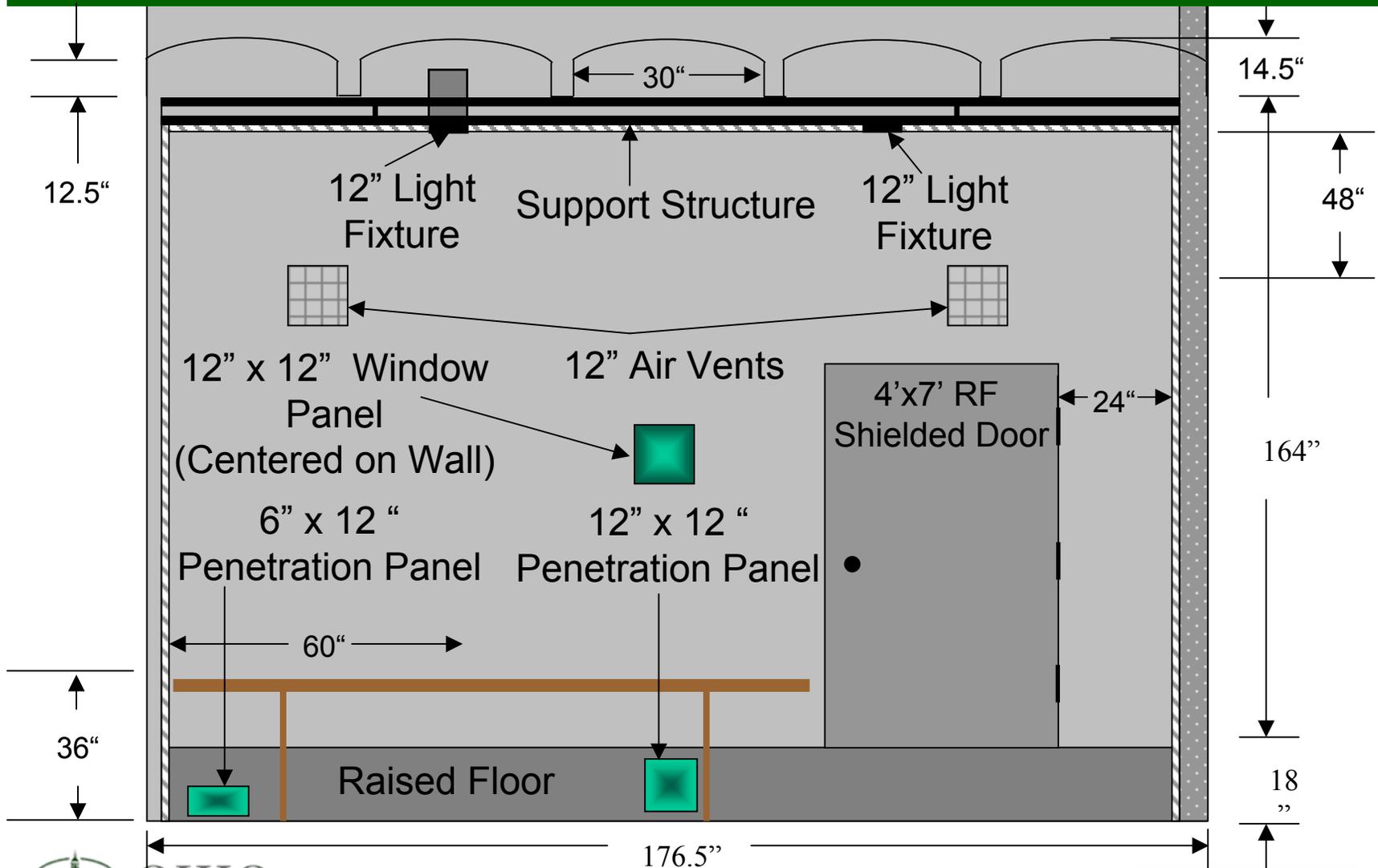


Shielded Chamber Floor Plan



Note: Shown to Approximate Scale

Shielded Chamber Front Wall Layout



Presentation Outline

- Facility Overview and Summary
 - Floorplan
 - Photos
 - Physical Dimensions
- Shielded Chamber
 - Overview
 - Performance
- RF Absorber
 - Overview
 - Performance
- Antenna Measurement Scanner
 - Block Diagram
 - Capabilities
 - Measurement Probes

Pre-Construction



Post-Demolition



Shielding Assembly



Flashing Seams



Completed Shielded Assembly



3 Ghz Leakage Testing



Preparing for the Absorber



Physical Specifications

Frequency Range

Frequency (Primary)

1.2 GHz – 1.6 GHz

Frequency (Secondary)

900 MHz – 2.4 GHz

Exterior Dimensions

Length

26 ft 7 in

Width

14 ft 8 in

Height

13 ft 8 in

Shielded Chamber Interior Dimension

Length

26 ft

Width

13 ft

Height

13 ft

RF Absorber Interior Dimension

Length

23 ft

Width

11 ft

Height

10.5 ft

Presentation Outline

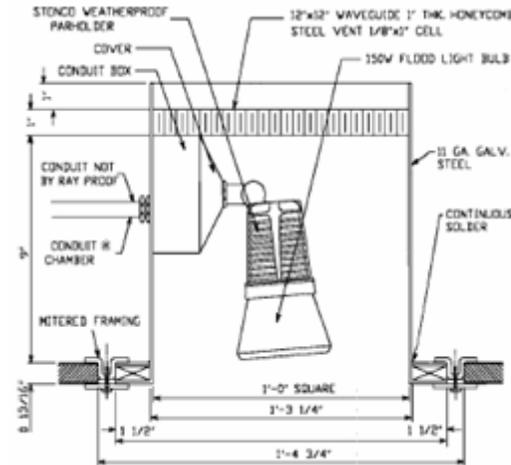
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Shielded Chamber Overview I

- The Free Standing Shielded Chamber Provides at Least 100 dB of Isolation To and From the Outside World.
- Shielding is Provided by a High Density $\frac{3}{4}$ ” Wood Core Laminated by 26-gauge Galvanized Steel Panels on Each Side.
- Penetrations Include RF Connections, Filtered Power, Air Ventilation, and Lighting; All of Which Maintain Isolation in the Desired Frequency Range.

Shielded Chamber Overview II

- Ventilation and Lighting Pass Through Honeycomb Waveguide Openings to Isolate Electromagnetic Radiation.
- A Thirty Amp Power Filter Provides at Least 100 dB of Attenuation at Frequencies above 14 kHz.



Shielded Chamber Performance

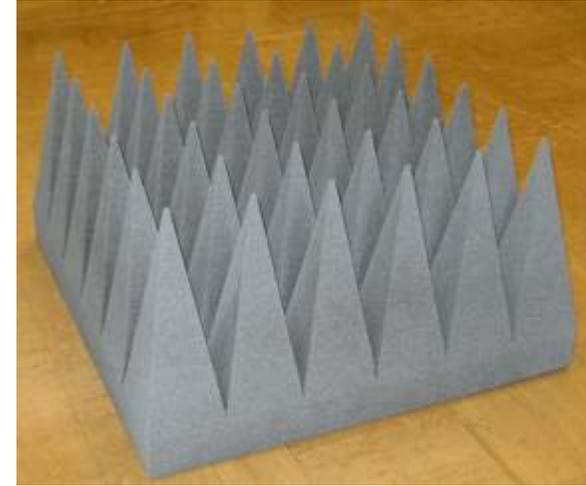
Field Type	Attenuation
Magnetic	20 dB @ 1 kHz 56 dB @ 10 kHz 100 dB @ 200 kHz
Electric	100 dB from 200 kHz – 50 MHz
Plane Wave	100 dB from 50 MHz – 1 GHz
Microwave	100 dB from 1 GHz – 10 GHz

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RF Absorber Overview

- RF Absorber is Applied to the Interior Walls of the Chamber to Prevent RF Reflections Off the Floor and Walls From Entering the Receiver.
- Two Sizes (12" and 18") Are Used to Provide Different Levels of Protection In Critical areas.
 - Most of the Power is Directed at the Back Wall and Floor so 18" is Desired.
 - 12" is Sufficient for the Other Surfaces.
- Walkable Absorber is Used on the Floor to Provide a Pathway to the Antenna Scanner.
- Reflectivity is Constrained to -35 dB for Normally Incident Waves From 1 – 2 GHz.



RF Absorber Performance

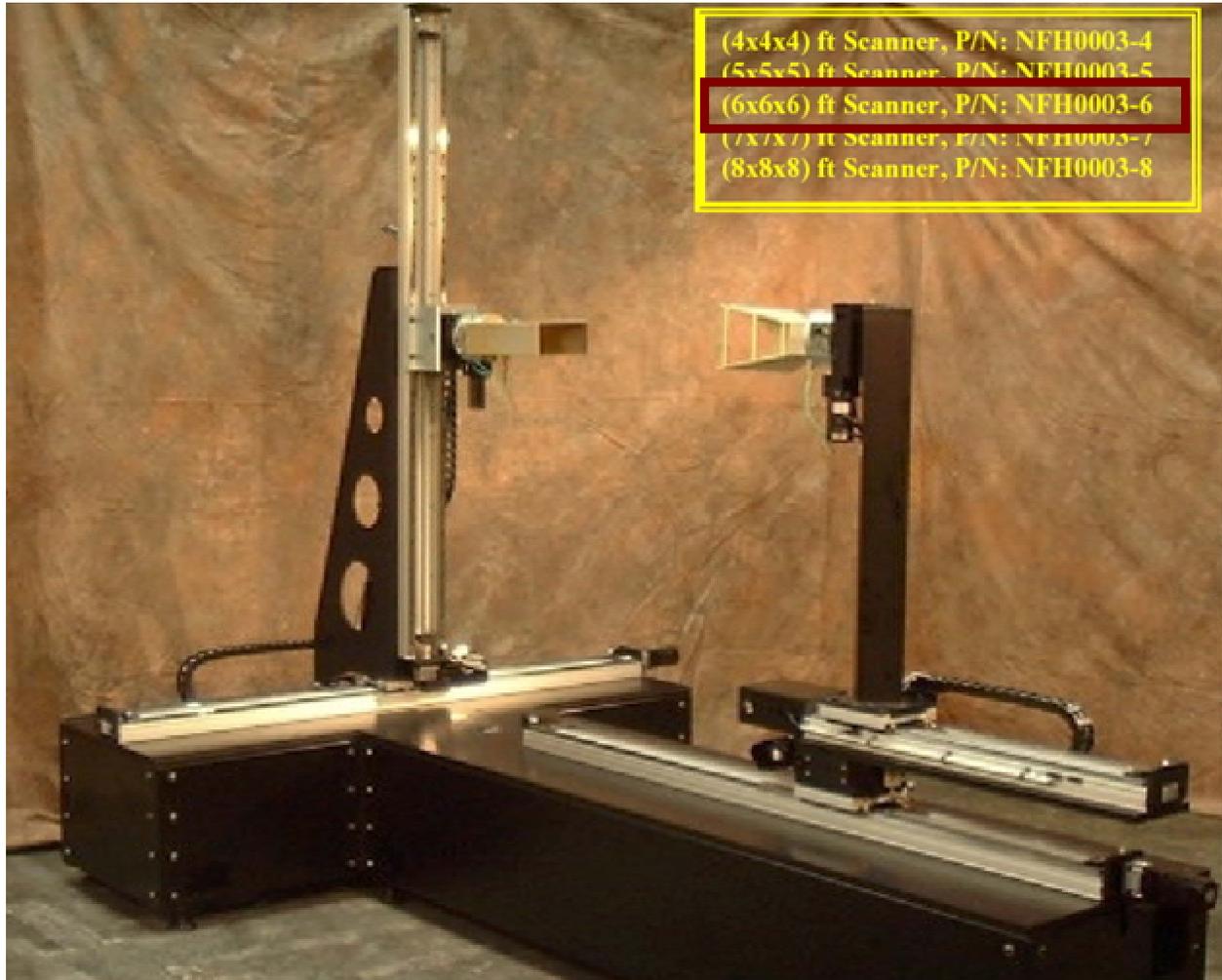
Location	Absorber Type
Both End Walls	18" Thickness (< -40 dB Reflectivity from 1-2 GHz)
Side Walls & Door	12" Thickness (< -35 dB Reflectivity from 1-2 GHz)
Ceiling	12" Thickness (< -40 dB Reflectivity from 1-2 GHz)
Floor	18" Thickness (Unknown Reflectivity from 1-2 GHz)
Walkway (Floor Absorber)	8 Pieces of 12" Walkable (Unknown Reflectivity)
Corners	Lossy Block (Unknown Performance)

Presentation Outline

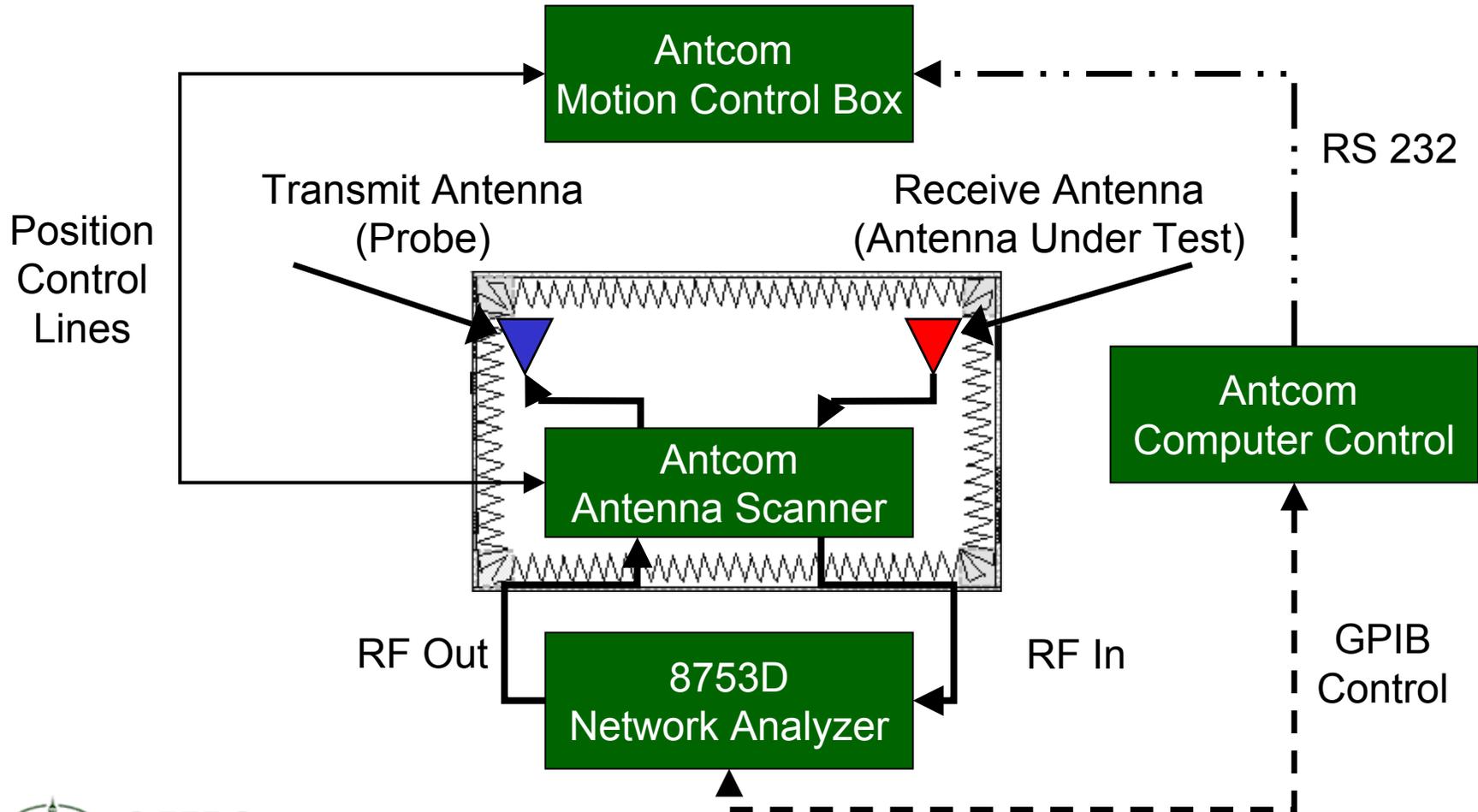
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Antenna Measurement System

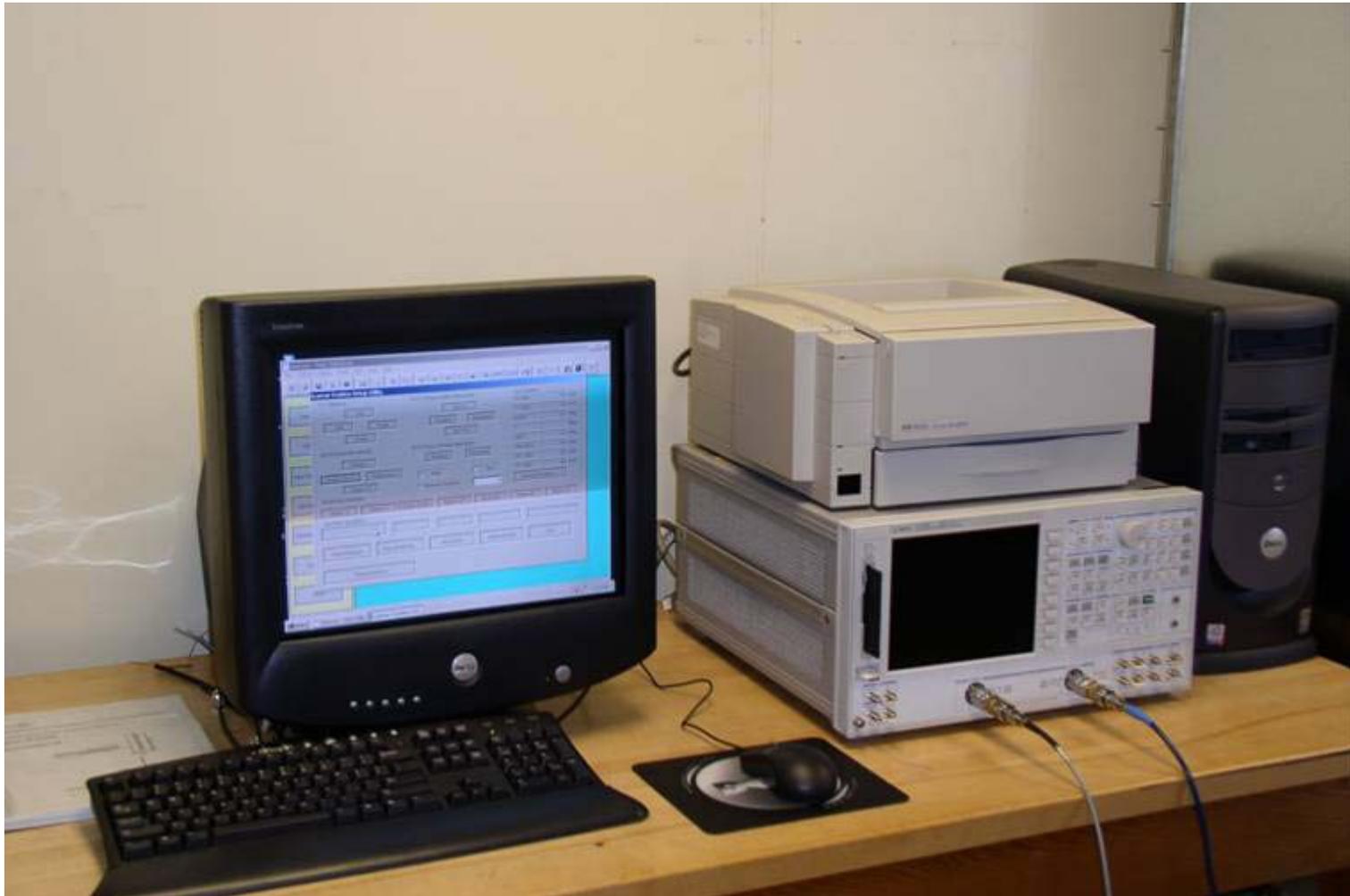
6'x6'x6' Nearfield Antenna Scanner



Antenna Measurement System Block Diagram



Control Room



Antenna Measurement System Capabilities

- 7 Axis Scanner Provides:
- Planar (76''x76'')
 - For High Gain/Narrow Beam Antennas, Reflectors, and Phased Arrays.
- Spherical (360°x360°)
 - For Low Gain/Broad Beam Antennas.
- Cylindrical (360°x76'')
 - For Fan Beams and Linear Arrays.
- Hybrid Configuration
 - For Combinations of the Planar, Spherical, and Cylindrical.
- Automated Phase Center Determination and Adjustment.

Data Visualization Capabilities

- Radiation Patterns
 - Co-Polarization
 - Cross Polarization
 - Axial Ratio
- Amplitude and Phase Patterns
- Rectangular, Polar, Contour, and 3D
- Elevation and Azimuth Cuts for Fixed φ
- Holography Visualization

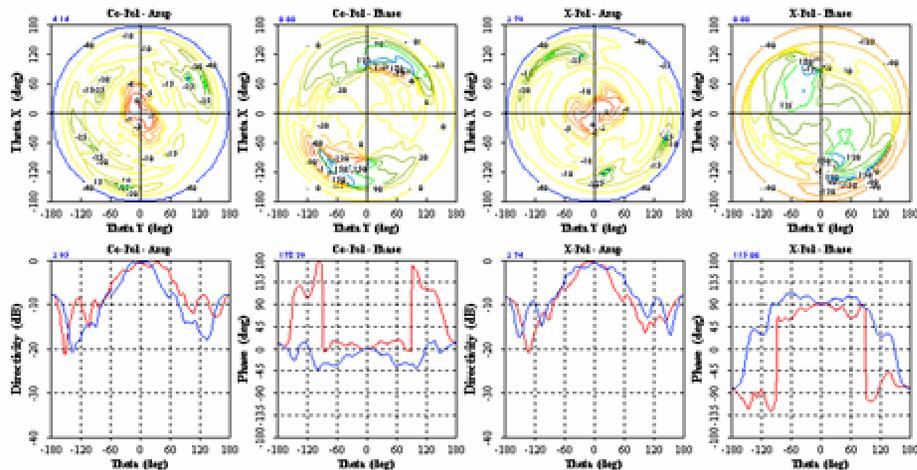
Far Field Patterns – Linear and Polar



Scanner System

Far Field Patterns
Frequency: 1.5750

Scan Surface: Spherical	Freq.: 1.575 - 1.575 GHz
No. of Theta: 201	Polarization: Linear
No. of Phi: 32	AUT Probe Separation: 30.00
Theta (2-way): 360 deg	Reference Power: -47.54 dB
Psi (1/2-way): 180 deg	



Avionics Engineering Center

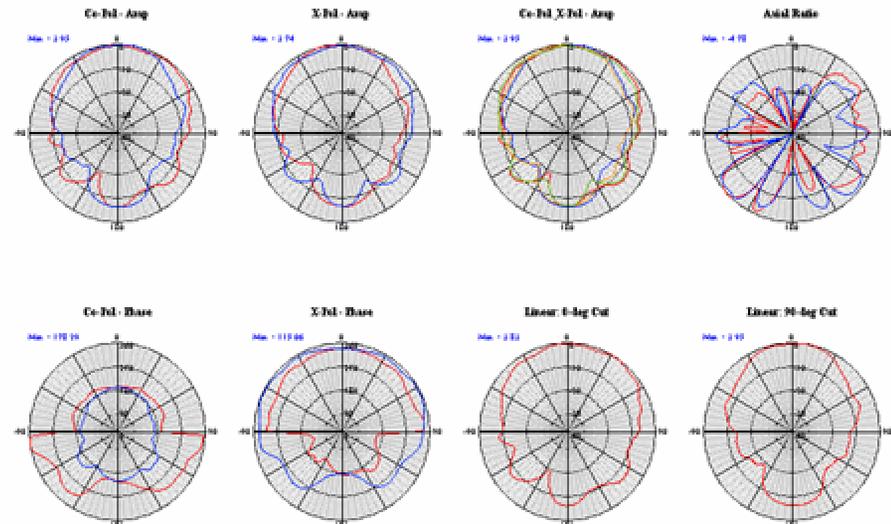
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Scanner System

Far Field Patterns
Frequency: 1.5750

Scan Surface: Spherical	Freq.: 1.575 - 1.575 GHz
No. of Theta: 201	Polarization: Linear
No. of Phi: 32	AUT Probe Separation: 30.00
Theta (2-way): 360 deg	Reference Power: -47.54 dB
Psi (1/2-way): 180 deg	



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3D Visualization



Scanner System

Far Field Patterns : Co - pol, Amp
Frequency: 1.5750

Scan Surface **Spherical**

No. of Theta: 201

No. of Phi: 32

Theta (2-way): 360 deg

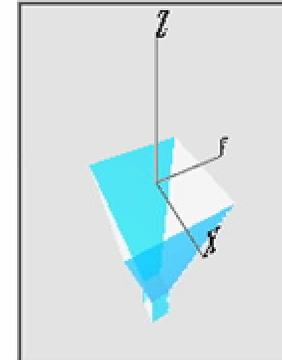
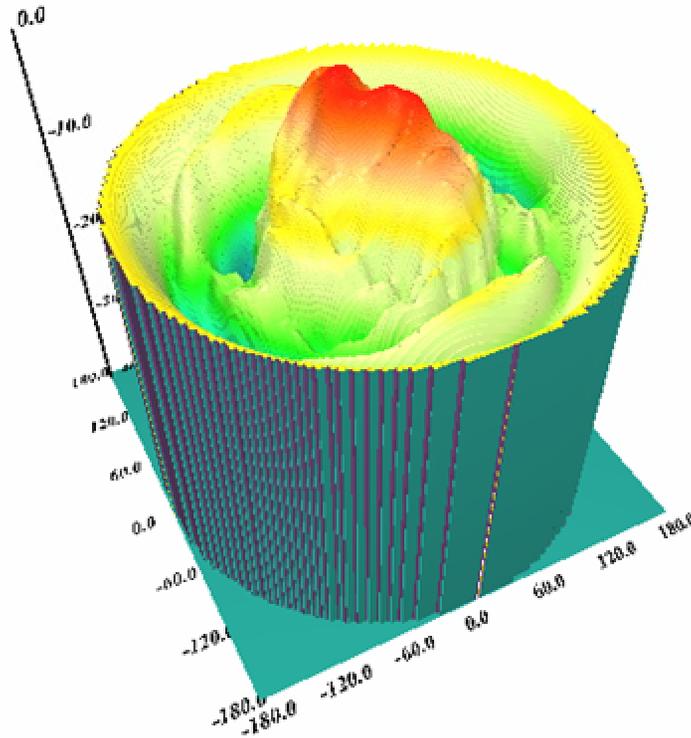
Psi (1/2-way): 180 deg

Freq.: 1.575 - 1.575 GHz

Polarization: **Linear**

AUT Probe Separation: 30.00

Reference Power: -47.54 dB



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OHIO
UNIVERSITY

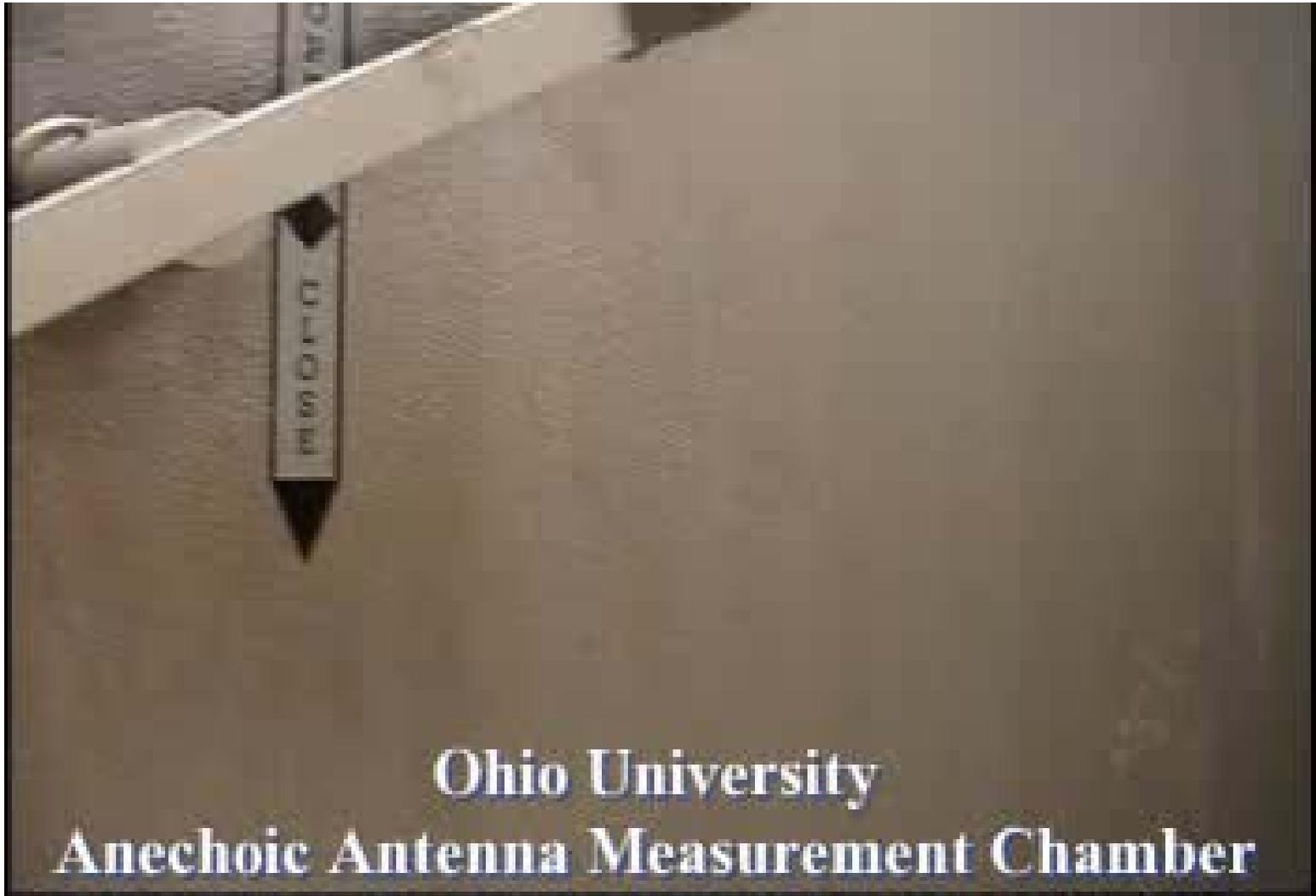
Avionics Engineering Center, Ohio University, Athens



Measurement Probes

- Standard Gain Horn
 - Reference Antenna for Gain Measurement
 - Can Be Used as a Broadband Probe
 - 1.0 to 18 GHz
- Near Field Measurement Probe
 - Signal Transmission
 - Narrowband Probe
 - 1.12 to 1.7 GHz

Scanner Video



Ohio University
Anechoic Antenna Measurement Chamber

Summary

- Construction of a New Shielded Antenna Measurement Facility is Nearing Completion.
- Shielded Chamber Has been Certified to Provide at Least 100 dB of Isolation at 3 GHz.
- Indoor Antenna Anechoic Chamber Provides a New Capability to Prototype and Verify In-House Antenna Designs
- Antenna Measurement Scanner Has a Wide Variety of Measurement and Visualization Capabilities.
- Facility To Be Used For:
 - Sponsored Research
 - Graduate Education
 - Undergraduate Education

Questions