# REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188



1. AGENCY USE ONLY (*Leave blank*)

2. REPORT DATE
29 June 95

3. REPORT TYPE AND DATES COVERED
Final 10 Jan 95 - 15 June 95

4. TITLE AND SUBTITLE
Compensation of Free-Space Signal Propagation Errors

5. FUNDING NUMBERS
C - F04611-95-C-0025

6. AUTHOR(S)
Irwin Bardash Hoon Ahn

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Jenter Systems Inc.
8 James Neck Road
St. James, NY 11780-9738

8. PERFORMING ORGANIZATION REPORT NUMBER
3001-1

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
412TW/EWDE
195 Southj Popson Avenue
Edwards AFB, CA 93524-6482

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
None

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Available to Public

12b. DISTRIBUTION CODE

13. ABSTRACT (*Maximum 200 words*)

A methodology for minimizing the deleterious scattering effects of absorber cones in an anechoic chamber was modeled and simulated. The concept involved the use of an absorber block which is placed between the source antenna and the antenna-under-test (AUT) in the anechoic chamber. A calibration run is made that measures and stores the scattered r.f. in the chamber with direct propagation to the AUT blocked. The absorber block is removed and the measurement repeated. The data from the calibration run is vectorially subtracted from the second data run yielding the equivalent free-space characteristics of the AUT. The simulation process involved modeling all elements of an anechoic chamber. For this study the Benefield Anechoic Facility was modeled. This included the source antenna, every absorber cone, and a monitoring "screen" for sensing the E-field at any arbitrary site, or array of sites, in the chamber. The "screen" data was used to calculate the impact on several modeled antennas. These were a 16 element 30 dB Taylor distribution linear array and an interferometer antenna. It was shown that scattered r.f. from absorber cones greatly effects the ability to measure high performance antennas and could compromise the AOA reading of an interferometer antenna.

14. SUBJECT TERMS
Anechoic Chamber Scattering Errors
Absorption Cones Chamber Modeling

15. NUMBER OF PAGES
45

16. PRICE CODE
NTIS

| 17. SECURITY CLASSIFICATION OF REPORT | 18. SECURITY CLASSIFICATION OF THIS PAGE | 19. SECURITY CLASSIFICATION OF ABSTRACT | 20. LIMITATION OF ABSTRACT |
|---|---|---|---|
| UNCLASSIFIED | UNCLASSIFIED | UNCLASSIFIED | UL |

# Compensation of Free-Space Signal Propagation Errors

## Final Report

Contract No.: F04611-95-C-0025

Prepared by: Jenter Systems Inc
8 James Neck Road
St. James, NY 11780-9738

Prepared for: 412TW/EWDE
195 South Popson Avenue
Edwards AFB, CA 93524-6482

## Introduction

The original objective of this program was to generate a methodology for eliminating or minimizing the deleterious effects of scattering produced by absorber cones in an arbitrary anechoic chamber. The proposed methodology involved the measurement of the scattering from the absorber cones through the antenna-under-test (AUT) while direct propagation to the AUT was suppressed by a "to-be-designed" absorber block. The "to-be-designed" absorber block would be removed from the chamber and the characteristics of the AUT would be measured with the scattering from the chamber cones present. The first set of data would be subtracted from the second set of data to yield the "true" characteristics of the AUT. This objective was successfully modeled and the validity of the concept proven.

When it was learned that the originally arbitrary chamber was the Benefield Anechoic Facility (BAF) at Edwards Air Force Base and that r.f. through the AUT would *not* be made available, additional tasks were assumed involving the modeling of the BAF with all of its absorber cones as well as arbitrary scatterers and source antennas to determine the impact of scatterers on the "measured" performance of different types of airborne antennas. A scheme was developed and programmed to calculate the E-field magnitude and phase at any point or set of points in the BAF. This was used to create a "screen" of E-field data which in turn could be used to synthesize the impact on any antenna that could fit within the "screen".

Three antenna types were modeled: (1) a 16 element 30 dB Taylor distribution linear array; (2) a 16 element monopulse linear array difference pattern; and (3) an interferometer D.F. antenna. The characteristics of these antennas were calculated in an error-free environment and that which "exists" in the BAF. The impact of scattering from the BAF's absorber cones clearly shows that the sidelobe levels of the first two antennas are adversely effected as well as the accuracy of the interferometer antenna by the scattering from the chamber's absorber cones. Quantitative data for a number of conditions was computed and the results are presented herein.

A necessary by-product of the chamber and antenna analyses performed, and a major accomplishment for any Phase 1 SBIR program, was the generation of a chamber simulation software system that may be used on any DOS or UNIX platform that has sufficient random access memory (approximately 8 **accessible** megabytes in a single computational array) for storing and manipulating the scattering data from all the specified cones of the BAF. The source code was written using ANSI Standard C++. A logical follow-on to this Phase 1 program would be a Phase 2 effort to add a simple user-friendly interface, incorporate the exact parameters of the BAF's absorber cones and the other scatterers (from existing data or data that must be measured), and to analyze the impact of the BAF's scattering on a host of operational and developmental antenna systems installed on, or planned to be installed on, existing or future aircraft.

## Originally Proposed Concept

The originally proposed approach for achieving a substantial reduction in multipath effects in anechoic chambers involved the measurement and subsequent cancellation of these effects. Figure 1 illustrates the basic concept for measuring the multipath effects.

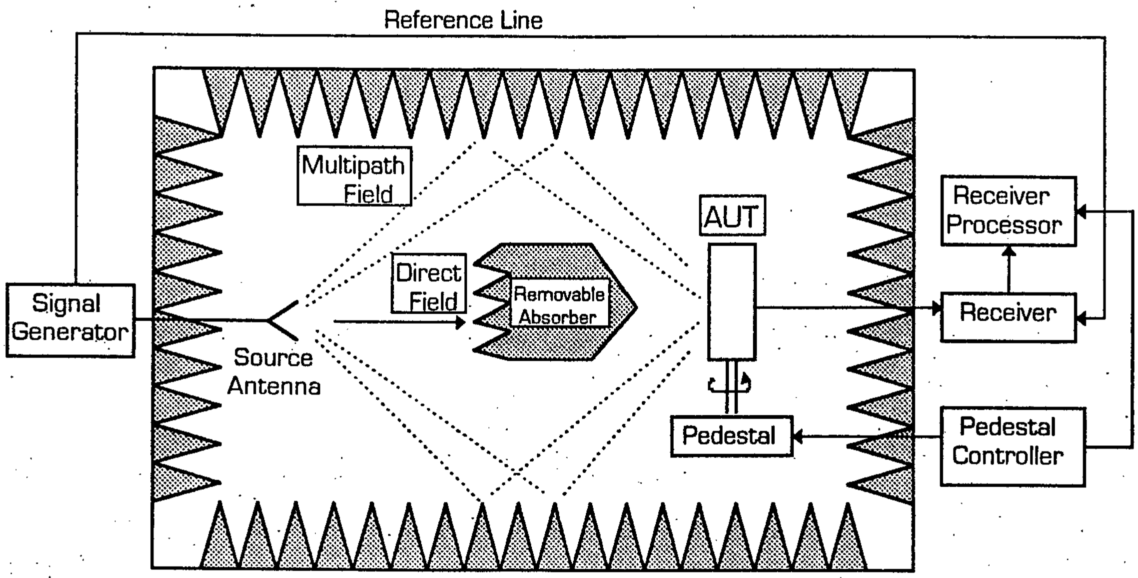



**Figure 1**
**Illustration of Proposed Multipath Cancellation Methodology**

As shown, a removable absorber block is placed in the chamber to absorb all <u>direct</u> r.f. emanating from the source antenna that would normally illuminate the antenna under test (AUT). Several different absorber block configurations were proposed but only the one conceptually illustrated in Figure 2 was modeled. This was done since shortly after the program started it was learned that the r.f. that propagated through the AUT was *not* unavailable.

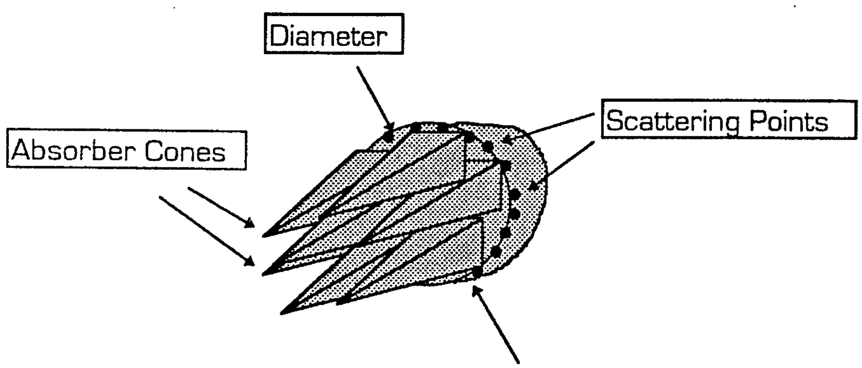



**Figure 2**
**Sketch of a Circular Absorber Block**

The scattering points around the outer diameter of the absorber block were spaced less than a half wavelength apart so that the total scattering from the absorber block could be considered to be almost uniform. Each scattering point was given an attenuation factor relative to the amplitude incident on the absorber block. In general, it was assumed that the absorber block provided at least 60 dB of attenuation to the incident field at each point.

Referring back to Figure 1, with the absorber block in the chamber, theoretically, the only r.f. that reaches the AUT is that created by the scattering from the many absorber cones on the floor and walls of the chamber. The vector sum of all the multipath scattered fields is received by the receiver and the in-phase and quadrature components relative to the signal generator output is measured, processed, and stored in the receiver processor. This would be done for all angles of interest by rotating the antenna under test in 1 degree steps, or any predetermined step angle. The exact angular position at each step is also stored with the associated vector sum data. With an automated system, it would probably not take more than 1 second to make a single measurement so that 180 measurements, to cover a $\pm 90^{\circ}$ sector, would take about 3 minutes.

The absorber block would then be removed and the same exact measurements repeated. This time the direct r.f. is received by the AUT as well as all the multipath scattered r.f. The receiver processor subtracts the vector sum calibration field from the vector sum total field and generates the true characteristics of the AUT. But, as stated earlier, since the r.f. through the AUT could not be made available, this approach was studied more as an academic exercise as opposed to a practical methodology. Considerable effort was expended to simulate any arbitrary anechoic chamber, and in particular, the Benefield Anechoic Facility (BAF) located at Edwards Air Force Base. The balance of this report describes the analyses and simulation methodologies that were accomplished.

**Chamber Scattering Formulation**

The initial approach for simulating the characteristics of an anechoic chamber involved defining the salient elements and propagation phenomena within the chamber. These include: (a) the source antenna; (b) the chamber absorber cones (and/or any other scatterer); and (c) the antenna-under-test (AUT). The equations of concern describe: (1) propagation from the source antenna directly to the AUT; and (2) propagation from the source antenna to all cones in the chamber and then to the AUT.

Figure 3 illustrates these elements and the propagation paths of interest. Equation 1 defines the E-field received directly from the source antenna by the AUT.

$$(1) \qquad E_i = E_{in} G_s(0) \frac{e^{-jkR_D}}{\sqrt{4\Pi (R_D)^2}} \sqrt{\frac{\lambda^2}{4\Pi}} G_r(0 - \Theta_0)$$

Equation 2 defines the scattered E-field received from an arbitrary cone in the chamber by the AUT.

$$(2) \quad E_i(\Theta_o) = E_{in} G_s(\Theta_S^i) e^{-jkR_S^i} S_i(\Theta_S^i, \Theta_r^i) \frac{e^{-jkR_r^i}}{\sqrt{4\Pi \left(R_S^i + R_r^i\right)^2}} \sqrt{\frac{\lambda^2}{4\Pi}} G_r(\Theta_r^i - \Theta_0)$$

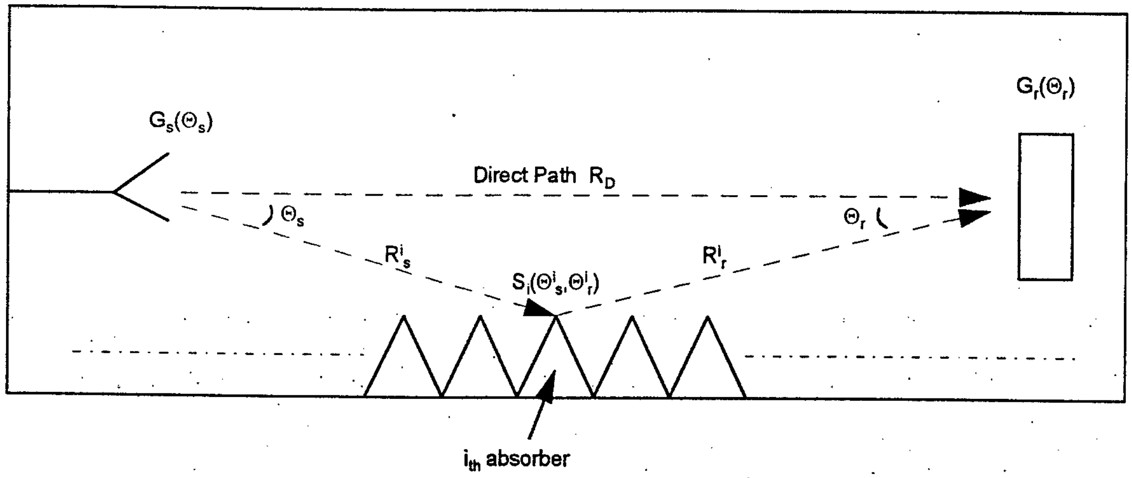



**Figure 3**
**Illustration of Basic Chamber Elements Modeled**

Parameters $G_s(\Theta_s)$ and $G_r(\Theta_r)$ are the arbitrary gain functions of the source and AUT antennas, $\Theta_s$ and $\Theta_r$ are the arbitrary angles from the source antenna and the AUT to the $i_{th}$ absorber cone, and $R_D$, $R_s$ and $R_r$ are the propagation paths from the source antenna to the AUT, to the $i_{th}$ absorber cone, and from the $i_{th}$ absorber cone to the AUT.

## Modeling Approach

The modeling approach involved dividing the simulated scenario into three parts. They are:

- The chamber elements and characteristics
- The "screen" defining the E-field at any arbitrary set of sites in the chamber, and
- The Antenna Under Test.

The chamber elements modeled were its size, its absorber cones heights, and its absorber cones absorption/scattering levels, In addition, the source antenna location, beam widths (Azimuth and Elevation), boresight angle, and input r.f. frequency were modeled. Any arbitrary chamber size can be entered as an input parameter. However, the dimensions that were used during the computer simulations were always set to those of the Benefield Anechoic Chamber (BAF), namely, 250' wide by 70' high by 260' long. For the computed simulations, half the length of the BAF (about 140 feet) was used as the length dimension since all "screen" computations were set to occur in the BAF's quiet zone which occurs in the center of the chamber. A more detailed description of the modeled chamber parameters and the way the user may define them will be discussed in a later section of this report.

An E-field "screen" was used to express the amplitude and phase of the E-field at any arbitrary location in the chamber. Any point or set of points in the chamber may be chosen where the E-field(s) can be computed. For the computer simulations done during this program, a "screen" consisting of 85 (5x17) points was always used. The center of the "screen" was located in the center of the BAF, 35 feet above the floor, 140 feet from the wall with the source antenna, and 125 feet from either sidewall. The "screen" was facing the source antenna, i.e., it was normal to the direct path of propagation from the source antenna. This is portrayed in Figure 4.

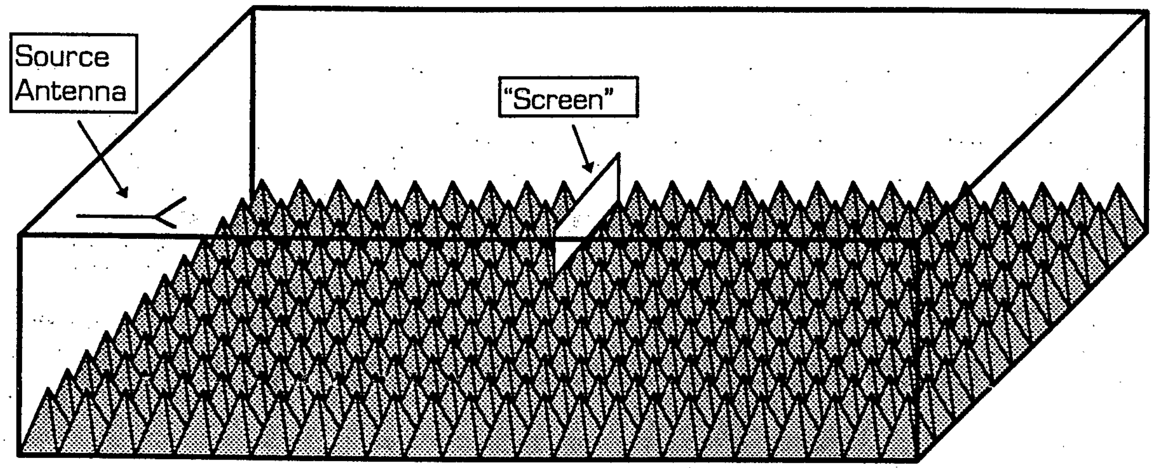



**Figure 4**
**Sketch of Chamber Layout Illustrating Source Antenna, sorber Cones, and "Screen"**

Once the "screen" location and size is fixed, any arbitrary antenna may be selected as the AUT provided its aperture size is not larger than that of the "screen". As an example and as will be described later, the 85 (5x17) points selected for the modeled "screen" were spaced 1 inch apart in both the x and y directions. Hence any antenna with an aperture size 4" by 16" (or less) can be modeled and its "performance" predicted in the chamber. If one wanted to analyze the performance characteristics of a larger antenna in the chamber environment, a larger "screen" would have to be designated.

For the simulations run during the Phase 1 program, three types of antennas were modeled. They are: (1) a 16 element linear array with a 30 dB sidelobe Taylor amplitude distribution; (2) a 16 element linear monopulse array; and (3) an $8\lambda$ interferometer antenna. For each antenna, its free space characteristics and its characteristics "measured" in the chamber are presented. In addition, an absorber block was modeled, as originally proposed, and if the amplitude and phase behind the AUT was available, the proposed calibration methodology was invoked to ascertain if the deleterious effects of the chamber environment could indeed be eliminated or significantly reduced.

## Simulation Approach, User Interface, and Methodology

The source code of the simulation program was written using ANSI Standard C++ and runs properly on both DOS and UNIX platforms. Table 1 is a printout of the menu that appears when the C++ program entitled "CHAMBER" is initiated. It is a list of all commands that can be initiated and all the parameters that may be designated.

Table 1. CHAMBER Menu - List of Program Commands and Parameter Selections

```
a)   Set Chamber Dimensions
b)   Set Source Location
c)   Set Source Angle
d)   Set Frequency
e)   Set Absorber Block Location
f)   Set Absorber Block Radius
g)   Set Absorber Block Angle
h)   Set Absorber Block Attenuation
i)   Take Out Absorber Block
j)   Take Out Direct Contribution
k)   Put Back the Absorber Block  ( undoes j )
l)   Show Current Geometry Parameters
m)   Make Cone Configuration
n)   Clear the Cone Configuration
o)   Set The Screen Location
p)   Set The Screen Configuration
q)   Set Antenna Pattern Exponent
r)   Run the Calculation
rr)   Run the Calculation - include random errors
Chamber Command >
```

Table 2. Display of Parameters Set After Performing Table 1 Operations

```
Chamber Dimensions:  250 70 140
Source Location:  0.0000 0.0000 0.0000
Source Angle:  0.0000
Antenna Pattern Exponent:  100.000
Frequency:  5.8662
Absorber Block Location:  0.0000 0.0000 70.0000
Absorber Block Radius:  0.0000
Absorber Block Angle:  0.0000
Absorber Block Attenuation:  40.0000
Cone Rectangle:  0 125 0 70 for Height 36.0000 and 40
                  dB Attenuation
Screen Location:  0.0000 0.0000 140.0000
Screen  x Grid:  -8.0000 8.0000 1.0000
Screen  y Grid:  -2.0000 2.0000 1.0000
Screen Angle:  0.000
```

Table 2 is displayed when l) is invoked at the "Chamber Command >" prompt shown in Table 1.

As can be seen, Table 2 is a list of a complete set of parameters which was entered by executing each of the commands available in Table 1. The methodology for entering this data will now be described.

Load the CHAMBER program. Enter each parameter at the "Chamber Command >" prompt.

Set the **chamber dimensions** by executing "a↵". Enter the x, y, and z chamber dimensions in *integer* feet. As shown in Table 2, a chamber size of 250' by 70' by 140' was entered. To verify that this has been successfully done, execute "l↵". To return to the main menu hit "↵".

Set the **location of the source antenna** by executing "b↵". Enter the x, y, and z location of the source antenna in *real number* feet. Note that the data entered in Table 2 indicates that the source antenna was located at 0,0,0 which is located in the **center** of the x,y,0 plane, or in the center of the left wall of the chamber. In other words, the origin for this coordinate systems, for the chamber size set in a), is 35 feet above the floor and midway between the two sidewalls. However, the program allows the user to put the source antenna anywhere inside the chamber, but the user must remember where the origin of the coordinate system is located.

Set the **source antenna boresight angle** by executing "c↵". This angle is in the x-z plane and is a *real number* in degrees. For the example listed in Table 2, this angle is 0° and the source antenna is pointing in the +z direction. If the angle were +90°, it would be pointing in the -x direction, and for -90°, it would be pointing in the +x direction.

Set the source antenna **input r.f. frequency** by executing "d↵". The r.f. frequency is expressed in gigahertz (GHz) and is a *real number.*

If an absorber block is to be used, as originally proposed, commands e) through i) must be defined. Otherwise, just set f) to zero.

Set the **absorber block location** by executing "e↵". Enter its x, y, and z location as a *real number* in feet. Remember that the origin, 0,0,0 is as defined earlier.

Set the **absorber block radius** by executing "f↵". Enter its size as a *real number* in feet.

Set the **absorber block angle** by executing "g↵". This angle is also in the x-z plane and is a *real number* in degrees. In general, this angle should be set to match that of the source antenna, i.e., it should face the source antenna.

Set the **absorber block attenuation** by executing "h↵". This figure sets the level of each scattering point located every half wavelength around the diameter of the absorber block, as originally illustrated in Figure 2. Its units are in dB and it is a *real number*.

If an absorber block was inserted in the chamber and the user wants to **remove** it, but without changing its characteristics, execute "i↵".

To **eliminate direct propagation** from the source antenna to the AUT execute "j↵".

To **put back the absorber block**, (which undoes j), execute "k↵".

To **review the current settings** of all parameters, i.e., the type of data shown in Table 2, execute "l↵". To get back to the parameters menu execute "↵".

To initiate **making the chamber cone configuration** execute "m↵". A total of six numbers must be entered for every cone area configuration. They are: $x_{first}$; $x_{last}$; $z_{first}$; $z_{last}$; cone height (in inches); and cone absorption (in dB). A zero value for $x_{first}$ is located at the base of the near wall shown in Figure 4 and a maximum value for $x_{last}$ is located at the far wall. Similarly, the zero value for $z_{first}$ is located at the base of the left wall and the maximum value of $z_{last}$ is located at the right wall. In other words, these dimensions are not the same as the chamber coordinates. This was done this way because commercially available absorber cones usually come in two feet square sections so the dimensions of $x_{first}$, $x_{last}$, $z_{first}$, and $z_{last}$, are two feet per integer. Hence a 100' wide by 200' long chamber would be filled with absorber cones if $x_{first} = 0$, $x_{last} = 50$, $z_{first} = 0$, and $z_{last} = 100$. These values are *integers*. The cone height(s) (in inches) may be selected from the following *integer* values only: 6; 12; 18; 24; 36; and 48. Do not designate any other number for the cone height(s). The absorption characteristic for the cones in the area being configured may be set to any value and is a *real number*.

To eliminate the **chamber cone configuration** execute "n↵".

Before proceeding with subsequent commands, three examples of how to generate three different chamber configurations will be discussed. In all three cases the size of the chamber floor 100' wide by 220' long.

Case1 - All cones on the chamber floor are the same as depicted in Figure 5.

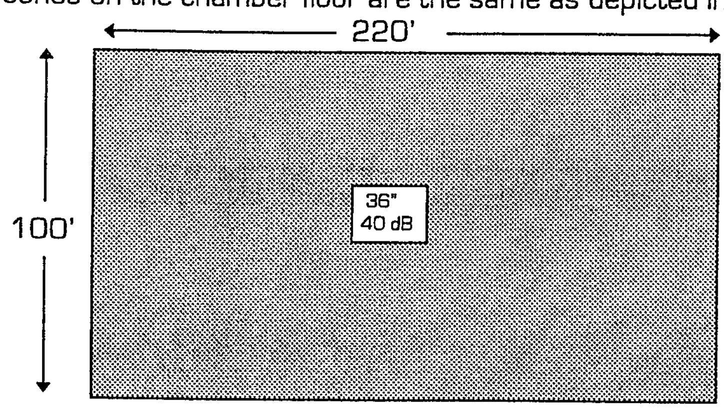



**Figure 5**
**Chamber Floor with All the Same Cones**

It will be assumed that all the cones are 36 inches high and they provide 40 dB of attenuation when illuminated by an arbitrary r.f. frequency. The approach for setting up this case is as follows:

Step 1 - n↵

This erases any previous cone floor layout.

Step 2 - m↵ 0 50 0 110 36 40↵

This initiates the **make cone configuration** command, the six numbers are entered, and they executed with the "enter" command.

Case 2 - Three different cone areas as shown in Figure 6.

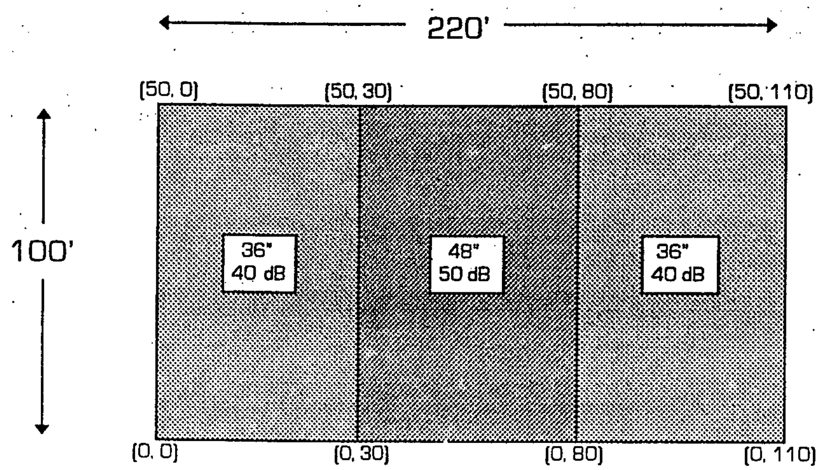



**Figure 6**
**Chamber Floor Layout with Three Different Cone Areas**

Step 1 - n↵

Step 2 - m↵ 0 50 0 30 36 40↵

Step 3 - m↵ 0 50 30 80 48 50↵

Step 4 - m↵ 0 50 80 110 36 40↵

The same comments apply for this case as for case 1. In addition, note that by **not** invoking n↵ after Steps 2 and 3, the second and third cone areas of the floor are **added** to the first.

Case 3 - Nine different cone areas as shown in Figure 7

Step 1 - n↵

Step 2 - m↵ 0 20 0 30 24 30↵

Step 3 - m↵ 20 30 0 30 36 40↵

Step 4 - m↵ 30 50 0 30 24 30↵

Step 5 - m↵ 0 20 30 80 36 40↵

Step 6 - m↵ 20 30 30 80 48 50↵

Step 7 - m↵ 30 50 30 80 36 40↵

Step 8 - m↵ 0 20 80 110 24 30↵

Step 9 - m↵ 20 30 80 110 36 40↵

Step 10 - m↵ 30 50 80 110 24 30↵

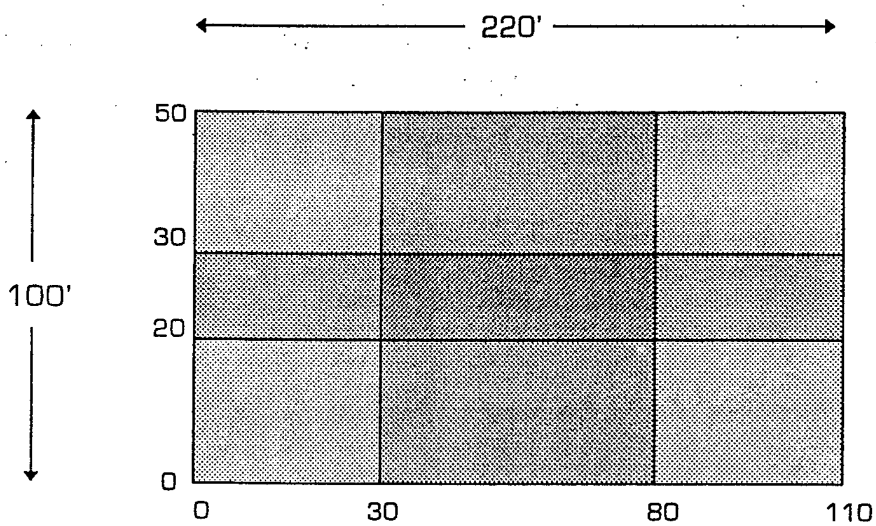



**Figure 7**
**Chamber Floor Layout with Nine Different Cone Areas**

The cone height and absorption figures are not shown in Figure 7 but from Steps 2 through 10 and the shadings in the figure it should be obvious what they are.

It should be pointed out that a single scatterer can be placed anywhere on the chamber floor by adding it the cone configuration. As an example, the following:

Step 11 - m↵ 10 11 15 16 48 50↵

would add a 48 inch cone section with 50 dB of absorption in the middle of the lower left corner area. This can be done at any number of different locations on the chamber floor.

Specifying the cone height is important for two reasons. The first, and obvious one, is to define the distance from the source antenna to the tip of the cone and the distance from the tip of the cone to any arbitrary point in the chamber. The second reason is to establish if shading occurs from higher cones onto lower cones (near the higher cones) if they are located "away" from the source antenna. This shadowing effect was programmed into the simulation software.

To **set the screen location,** execute "o↵". Referring back to Figure 3, the "screen" location may be placed anywhere in the chamber, and the x, y, and z coordinates (in feet) define where center of the "screen" is located. The screen location is a *real number*.

To **set the screen configuration**, execute "p↵". This involve specifying seven number. The units are in inches and they are a *real number*. The seven numbers are: (1) the distance to the left-most position of the "screen" relative to the center; (2) the distance to the right-most position of the "screen" relative to the center; (3) the interval or delta distance between each observation point from the left-most to right-most positions ; (4) the distance to the bottom position of the "screen" relative to the center: (5) the distance to the top position of the "screen" relative to the center; (6) the interval or delta distance between each observation point from the bottom to the top; (7) the orientation angle relative to the z-axis (0° is perpendicular the longitudinal axis). As an example, the following:

p↵-8 8 1 -2 2 1 0↵

would create a "screen" 16 inches wide by 4 inches high with observation points an inch apart in both directions and would be perpendicular to the z direction.

The source antenna has been modeled to generate a pattern governed by the following expression:

$$\text{(3)} \qquad \text{Radiation Pattern} = \cos^{N}\left(\frac{\Theta}{2}\right)$$

where Θ is the solid angle relative to the source antenna boresight. The exponent, N, controls the pattern amplitude taper in space. To **set the antenna pattern exponent** execute "q↵".

To **run the calculation** of the E-fields at the designated "screen" sites, execute "r↵" followed by a filename. As an example:

r↵ screen1↵

would put the calculated "screen" data in a file entitled "screen1". When the calculation is complete, the file may be copied into any word processor program or spreadsheet program to view the computed data and the relevant configuration. The "screen" data can then be used to generate the antenna pattern of any arbitrary antenna by synthesizing the characteristics of the antenna.

To **run the calculation** but with random cone absorption levels and random cone tip locations, execute "rr↵". In addition to a file name, specify the absorption cone maximum variation (in dB) and the maximum cone tip location (in inches). For example:

rr↵ screen1 5 0.5↵

would run the same program as before but each cone would receive a random absorption addition (in dB) ranging from 0 to 5 and random location in an area whose radius is 0.5 inches.

## Simulated "Screen" Cases

In order to evaluate the impact of scattering from the chamber's absorber cones, a number of "screens" were computed for subsequent antenna pattern generation. In all cases the following conditions and parameters were used:

Chamber Dimensions ........................ 250' by 70' by 140'
Source Location ............................ 0, 0, 0
Source Angle ............................... 0 degrees
Antenna Pattern Exponent ................... 100
Frequency .................................. 5.8662 GHz
Cone Height ................................ 36 inches
Cone Attenuation ........................... 40 dB
"Screen" Center Location ................... 0, 0, 140
Horizontal "Screen" Width .................. 16 inches
Horizontal Observation Point Spacing ....... 1 inch
Vertical "Screen" Height ................... 4 inches
Vertical Observation Point Spacing ......... 1 inch
"Screen" Angle ............................. 0 degrees

The frequency of 5.8662 GHz was chosen for convenience since its wavelength is exactly 2 inches. All cone heights and cone attenuations were set to the same values since, at this time, only the *general* impact of scattering was of concern. Specific configurations are deferred to the Phase 2 program. "Screen" observation points were set at 1 inch so that any arbitrary antenna could be simulated within the dimensions of the "screen".

When the absorber block was simulated, it was always sized with a radius of 1.5 feet and located half way between the source antenna and the "screen", specifically, 70 feet to the right of the source antenna. In addition, the absorber block scattering points provided 60 dB of attenuation at each point. Since the scattering from these points is coherent and there are more than 100 points around the circumference of the absorber block, the error contribution of the absorber block was not minimized to make it appear to be benign. If anything, its error-producing-contribution was modeled pessimistically, not optimistically. On the data sheet printouts found in Appendix A, if the absorber block radius is shown as being 0 or -1 inches, it's as if the absorber block is not present, and all of its other specified characteristics are irrelevant.

Eleven different "screens" were simulated. Table 3 is a list of the eleven Microsoft Excel files used to store and plot the data computed by the C++ program.

**Table 3 - List if Excel "CHAMBER" Files**

| File No. | | Description |
|---|---|---|
| R1D_0_0.XLS | - | Direct Propagation Only (0 dB , 0" random error) |
| R1B_0_0.XLS | - | Scattering from Absorber Block Only (0 dB, 0" random error) |
| R1BC0_0.XLS | - | Scattering from Absorber Block and Cones (0 dB, 0" random error) |
| R1BC0_Q.XLS | - | Scattering from Absorber Block and Cones (0 dB, 0.25" rand. error) |
| R1BC0_M.XLS | - | Scattering from Absorber Block and Cones (0 dB, 0.1" rand. error) |
| R1C_0_0.XLS | - | Scattering from Chamber Cones Only (0 dB, 0" random error) |
| R1C_5_0.XLS | - | Scattering from Chamber Cones Only (5 dB, 0" random errors) |
| R1C_0_1.XLS | - | Scattering from Chamber Cones Only (0 dB, 1" random errors) |
| R1C_5_1.XLS | - | Scattering from Chamber Cones Only (5 dB, 1" random errors) |
| R1DC0_0.XLS | - | Direct Propagation+Scattering from Cones (0 dB, 0" random error) |
| R1DC5_1.XLS | - | Direct Propagation+Scattering from Cones (5 dB, 1" random errors) |

Each file printout appears on two pages and is provided in Appendix A. Contained in each file is the configuration and parameters modeled. The title states what was computed and the level of cone absorption and cone position errors when, and if, they were applied. The three sets of numbers are the computed "screen" outputs of the C++ program. The first set is the amplitude of the E-field relative to one volt/meter at the source antenna. The second set is the same data express in dB. The third set is the phase of the E-field relative to that at the source antenna. The latter two number sets are plotted on the second page of each file printout. Full page charts are not provided here so as to save space and paper. They can be made available if requested.

The significance of the "screen" data is essentially self evident. However, a few comments are in order.

For the Direct Contribution Only" (R1D_0_0.XLS) the amplitude is everywhere the same, -80.5 dB, but the phase varies from -0.707° to -4.35°. This is expected and reflects the nature of the spherical wave emanating from the source antenna. However, unless corrected, this spherical aberration could adversely effect the apparent angle-of-arrival data generated by interferometer type D.F. antennas when measured in the BAF.

Another significant point to observe is that the level of the scattering fields produced by the cones in the chamber, as shown in file R1C_O_O.XLS, Cones Contribution Only, is only 10 to 20 dB below that of the direct contribution. It should also be noted that this is occurring with scattering only from the floor (sidewalls and ceiling were not modeled) and with absorber cone scattering at -40dB. Hence, the deleterious effect of the chamber cones is certainly not insignificant. This is apparent from the data illustrated in file R1DCO_O.XLS, Direct Radiation + Cones Scattering, which shows that the amplitude in the screen varies from -78.5 dB to -82.2 dB. This is a variation of just under ±2 dB.

Additional evaluation comments will be made following the presentation of the simulated antenna patterns. The following pages are the printouts of the eleven CHAMBER files.

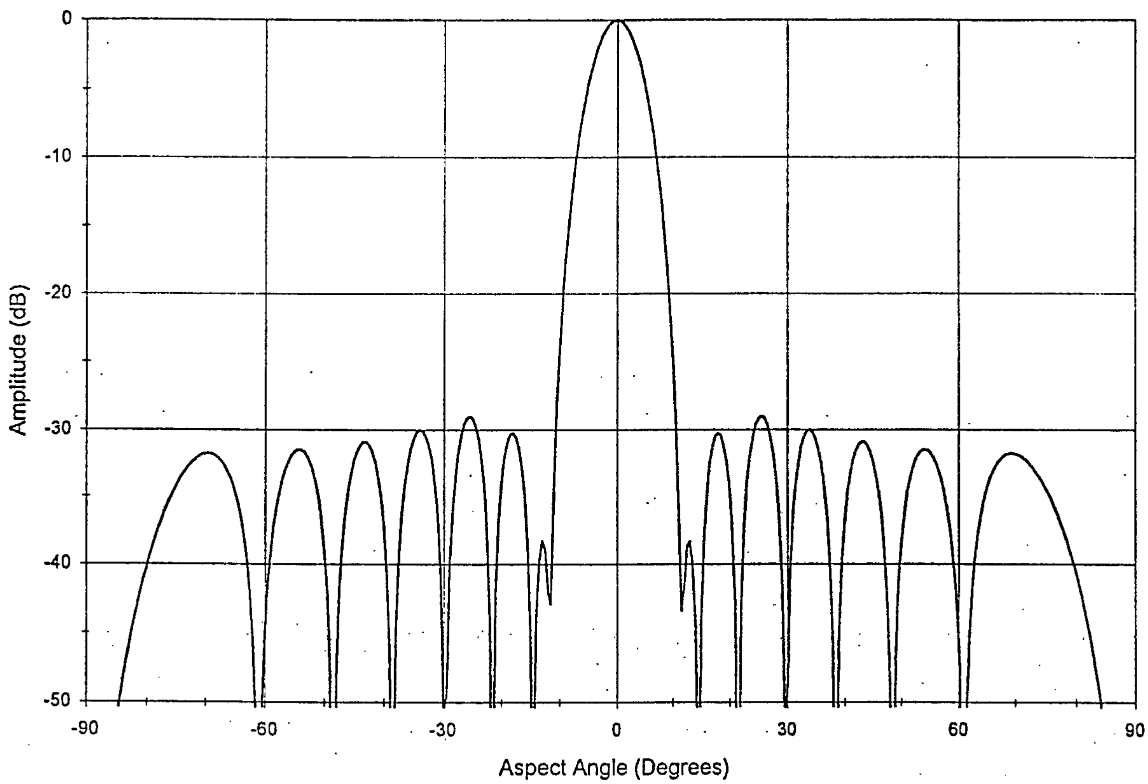
**Impact of Cone Scattering On System Antennas Under Test**

Three antenna patterns were modeled and their characteristics evaluated in the presence of chamber cone scattering. They are: (1) a 30 dB Taylor distribution 16 element linear array $\Sigma$ pattern; (2) a 30 dB Taylor distribution 16 element linear array $\Delta$ pattern; and (3) an $8\lambda$ interferometer pattern.

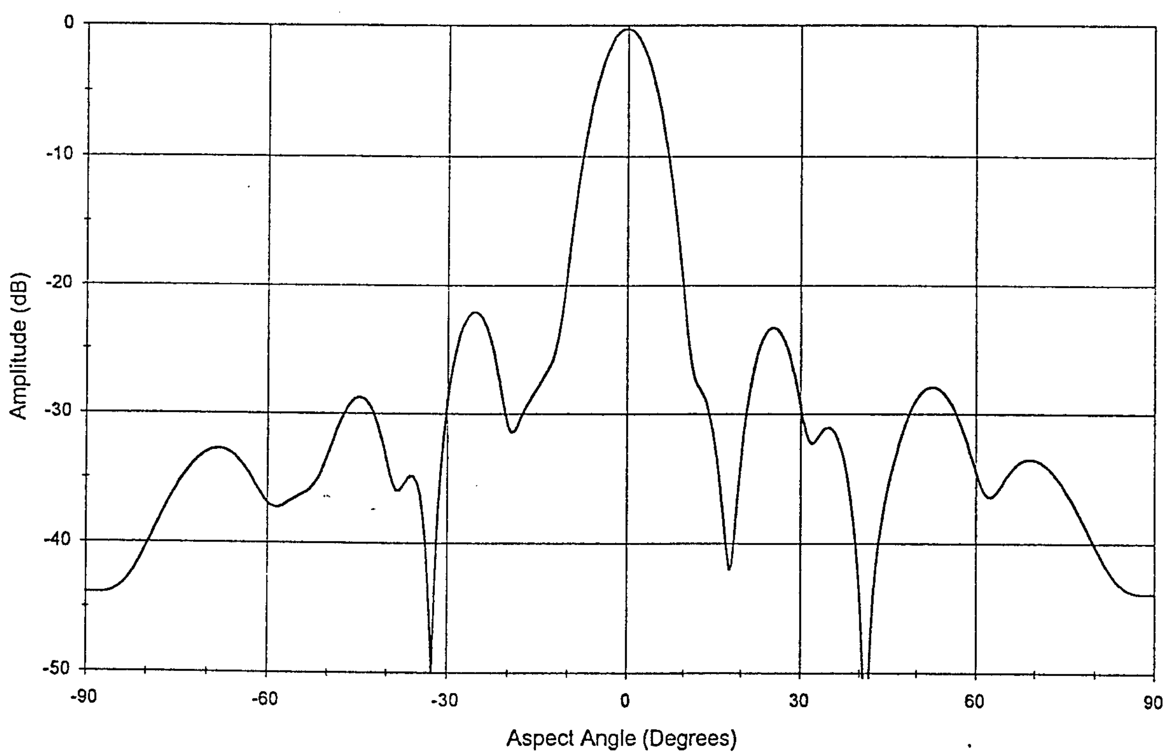
Figure 8a is the free-space pattern of the 30 dB Taylor distribution $\Sigma$ pattern. Figure 8b is the pattern of the same antenna but with the amplitude and phase data of the cones scattering included. Note that the main lobe is relatively unaffected, at least until it is -20dB below its peak, but the sidelobe structure is grossly effected. Every null and sidelobe peak is greatly altered and the peak sidelobe is -22 dB down from the main lobe as opposed to its original -29 dB level. One can conclude from this, that measurement of a medium to high performance radar antenna in the BAF (as modeled) will produce erroneous antenna performance and not indicate the true capabilities of the antenna-under-test.

In order to evaluate the **originally proposed concept** of using an absorber block to calibrate the scattering from the cones, two additional 30 dB Taylor distribution $\Sigma$ patterns were generated. They are presented in Figures 9a and 9b and are patterns generated by subtracting the "screen" data of the scattering from the absorber block + cone scattering (files R1BCO_Q.XLS and R1BCO_M.XLS) from the "screen" data of the direct propagation + cone scattering (file R1DCO_O.XLS). It should be noted that random errors in the location of the cones were incorporated in both of the calibration "screen" files to simulate slight motion and vibration (from earth tremors, sonic booms, high wind on the walls of the BAF, etc.) which might occur as a function of time between the "measurement" of the calibration data and the "measurement" of the antenna-under test. It should also be noted that the kernel used in generating the random errors was itself a random number so that there is no correlation or coherency from one set of random errors to the next.

From Figure 9a it appears that there is a significant reduction of the deleterious effects of the chamber cone scattering when a 0.25 inch random radius error of the

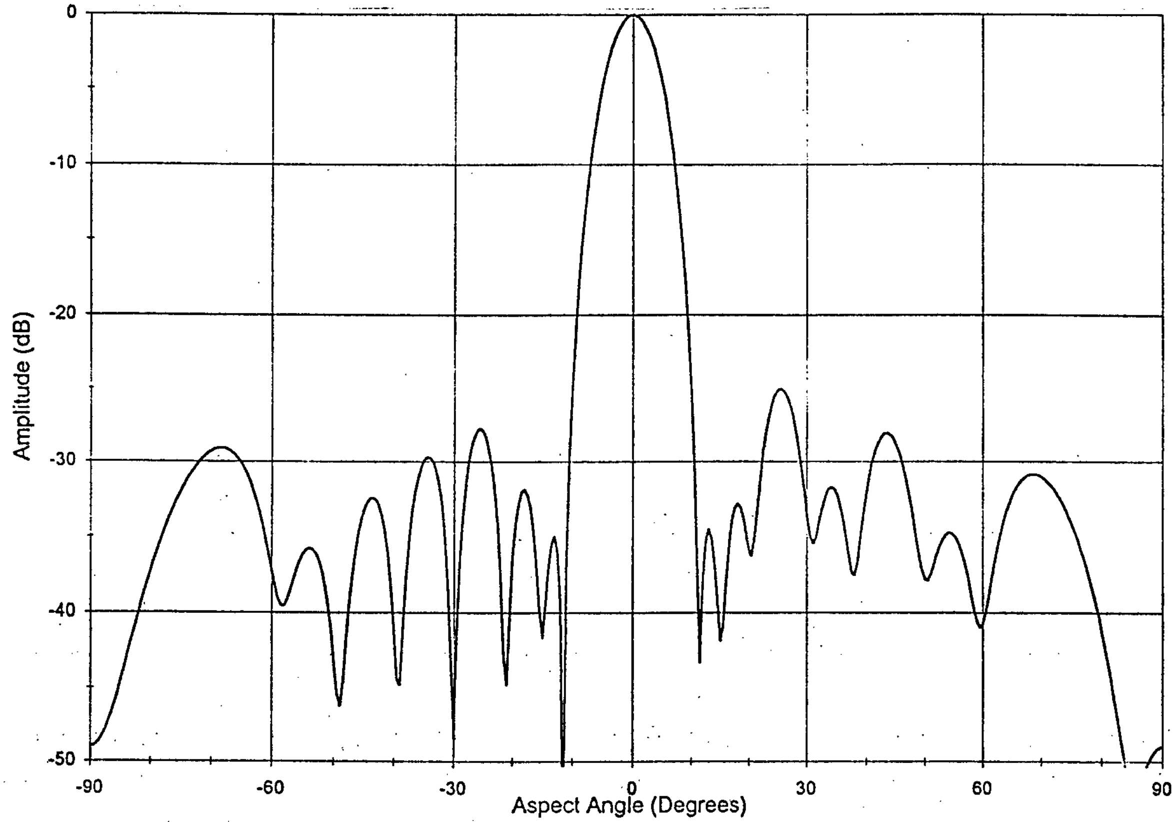



**(a) Free Space Pattern**

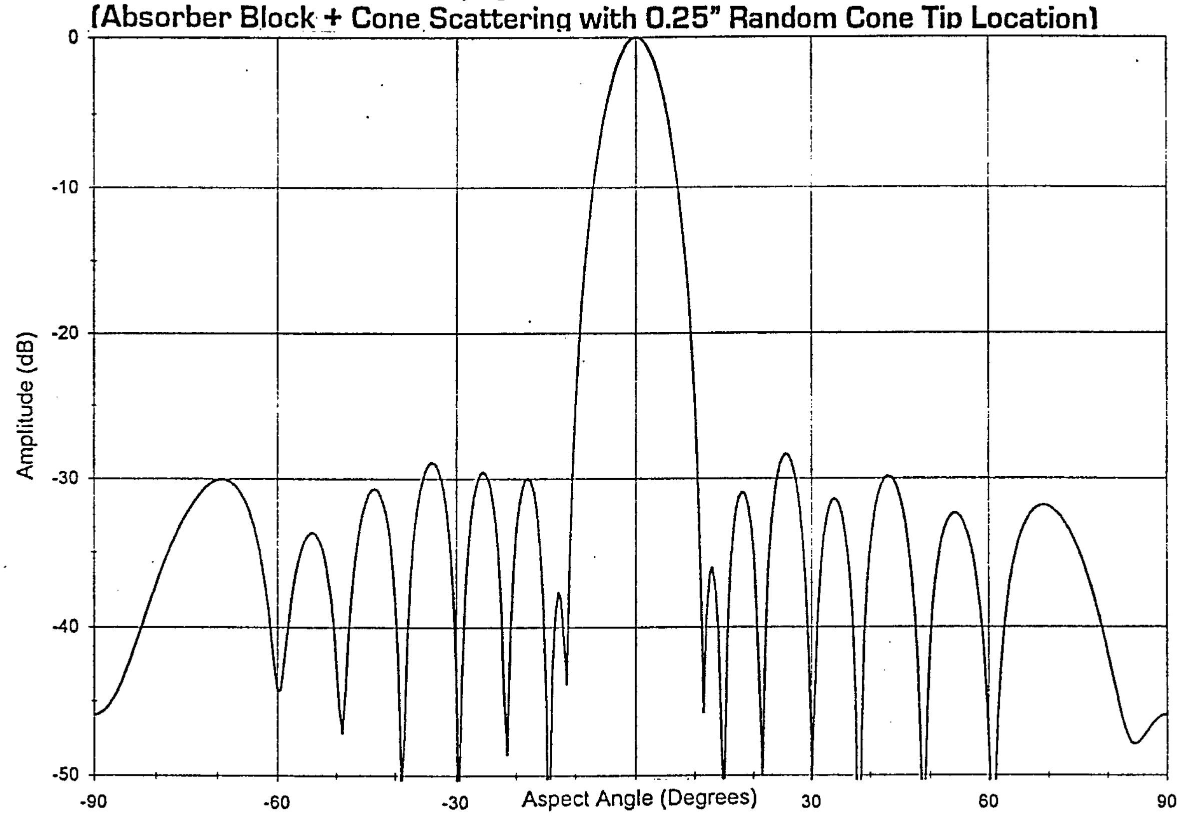



**(b) Direct Propagation and Scattering From Chamber Cones**

**Figure 8**
**16 Element, 30dB Taylor Distribution Linear Array**




(a) (Direct Propagation + Cone Scattering) Minus
(Absorber Block + Cone Scattering with 0.25" Random Cone Tip Location)




(b) (Direct Propagation + Cone Scattering) Minus
(Absorber Block + Cone Scattering with 0.10" Random Cone Tip Location)

Figure 9
16 Element, 30dB Taylor Distribution Linear Array

cone tip location was incorporated into the calibration methodology. This position error represents a random motion over a circle **0.5** inches in diameter.

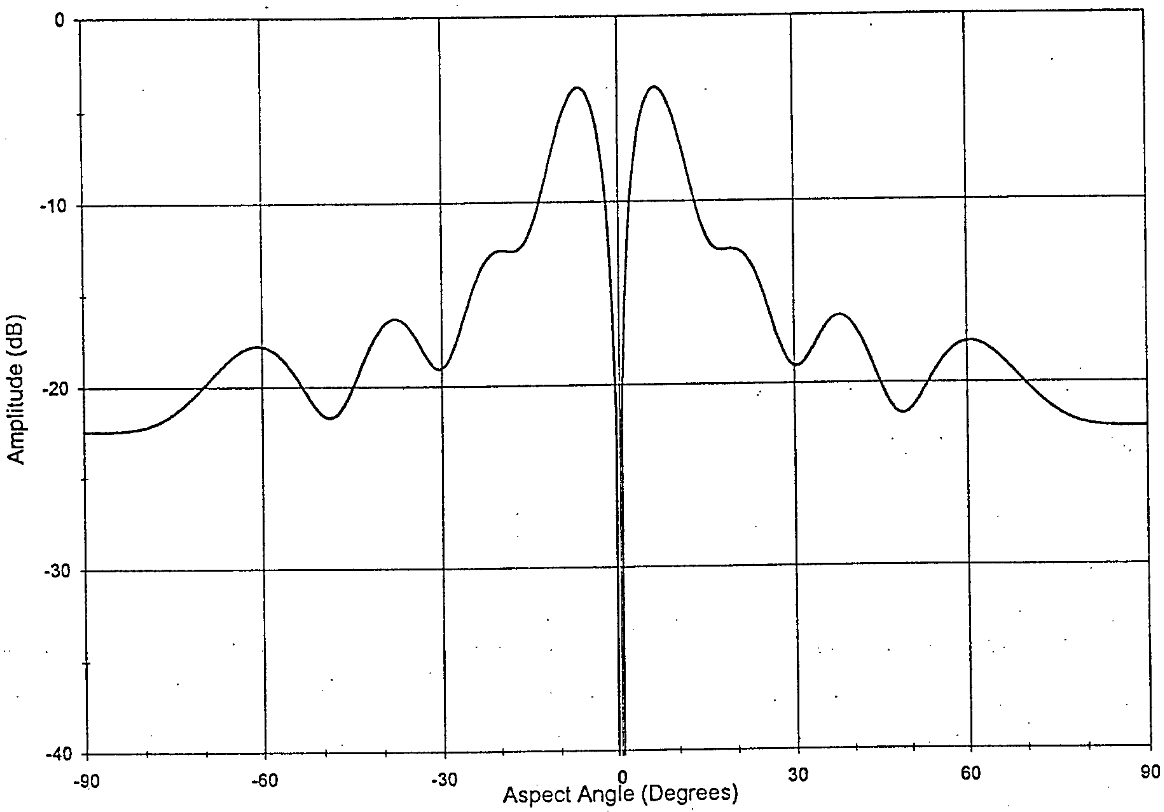
Of even greater significance, and as shown in Figure 9b, when the random cone position error is reduced to 0.1 inches (an area with diameter **0.2** inches) there is essentially total cancellation of the deleterious effect of the chamber cone scattering. Sidelobe peaks are almost identical and sidelobe nulls are in exactly the same location. It is difficult to believe that cone motion caused by earth motion, sonic booms, or wind would cause more than 0.2 inches of motion randomly. Hence, if it were possible to obtain r.f. from behind the AUT, and if an absorber block as modeled could be built, the proposed methodology for eliminating the effects of errors from the cones in the BAF would indeed be valid as originally proposed.

Figures 10a and 10b illustrate the difference patterns of the 16 element 30dB Taylor distribution antenna in free space and in the presence of scattering from the cones in the BAF. It appears that for this type of pattern, the negative effects of cone scattering is minimal. The sidelobe structure is slightly effected (and of little significance) but the null position and null depth are apparently unaffected. Actually, this is not surprising since the errors from the cone scattering are essentially random and at levels between -10 dB and -20 dB below the antenna's mainlobe. If the absorption characteristics of the cones in the BAF are poorer than the -40dB modeled, the performance of this type of monopulse antenna might begin to become compromised. Hence, care should be taken to make sure that cone scattering is never worse than that modeled.

Figures 11a and 11b illustrate the patterns of an 8λ interferometer antenna with no errors and with scattering from the cones in the BAF. For all practical purposes the 8λ interferometer patterns are unaffected by the presence of scattering from the cones with the exception of the null depths between beams. This should pose no problem with regard to the *precision* of a typical interferometer subsystem. However, Figures 12a, 12b, 13a, and 13b illustrate the impact of scattering errors on a 0.5λ spaced interferometer pair of elements. Here the sum patterns shows that chamber cone scattering produces a D.F. error of about 3° and the difference pattern verifies this more dramatically. In fact, phase comparitor processing normally uses the sine and cosine of the two inputs thereby causing the interferometer subsystem to possibly output grossly erroneous D.F. data which, in turn, could indicate a major error in the r,f, angle-of-arrival. This is due to the very shallow null depth as indicated in Figure 13b. Hence, the precision of an interferometer system will be maintained when measured in the BAF but the accuracy could be grossly effected.

## Conclusion

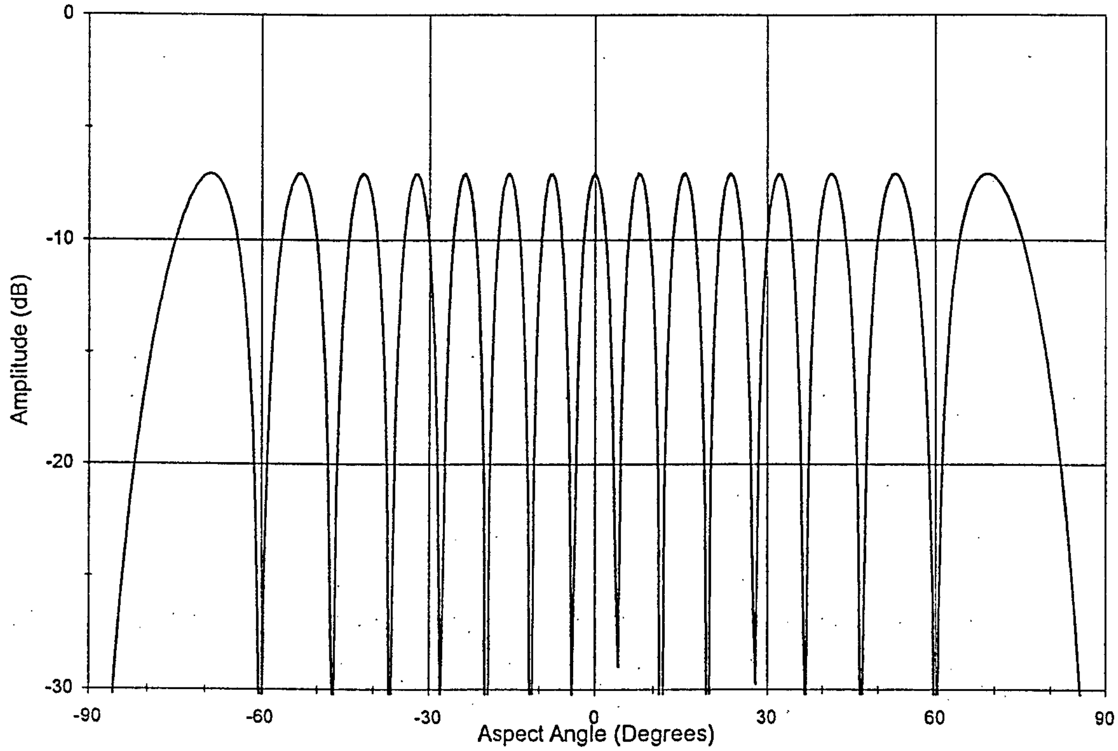
The proposed approach for developing a methodology to reduce the deleterious effects of scattering from absorber cones in a chamber was completed and proven to be successful, as originally proposed. This methodology involved the modeling of an absorber block that absorbs direct radiation from the chamber's source antenna to the antenna-under-test during a calibration measurement of all scatterers in the chamber. The calibration measurement data is vectorially subtracted from the AUT measurements when the AUT performance is taken in the presence of chamber



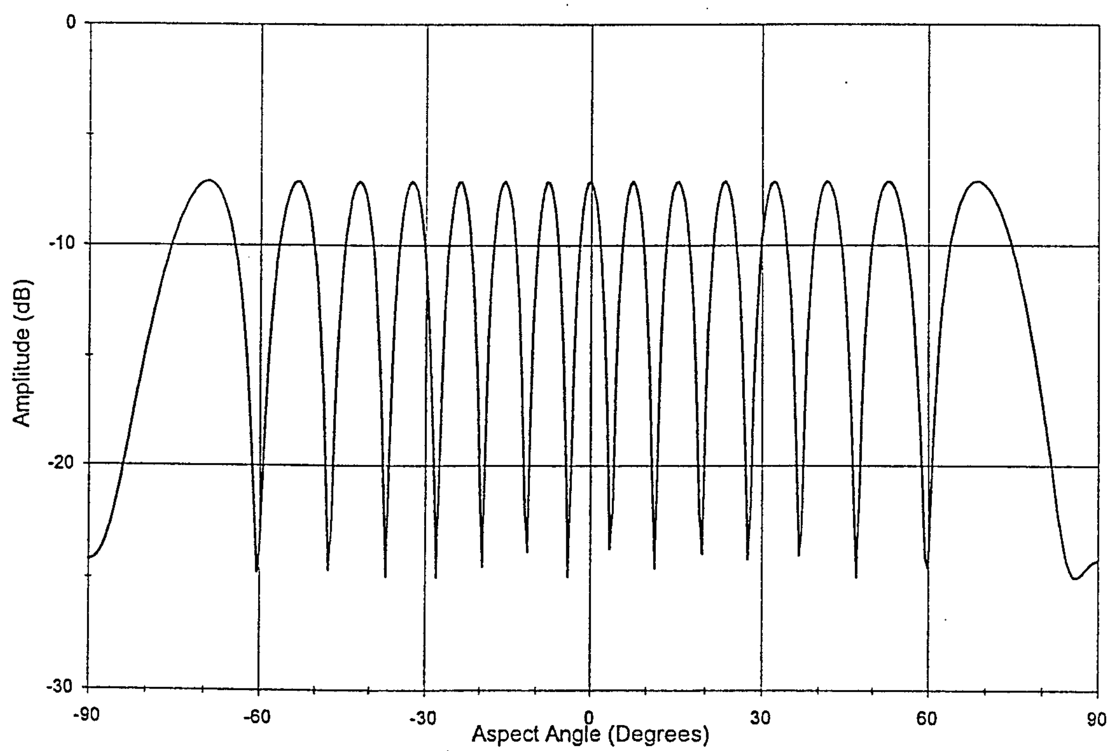

(a) Free Space Δ Pattern


(b) Direct Propagation + Scattering From Chamber Cones Δ Pattern

Figure 10
16 Element, 30dB Taylor Distribution Monopulse Linear Array

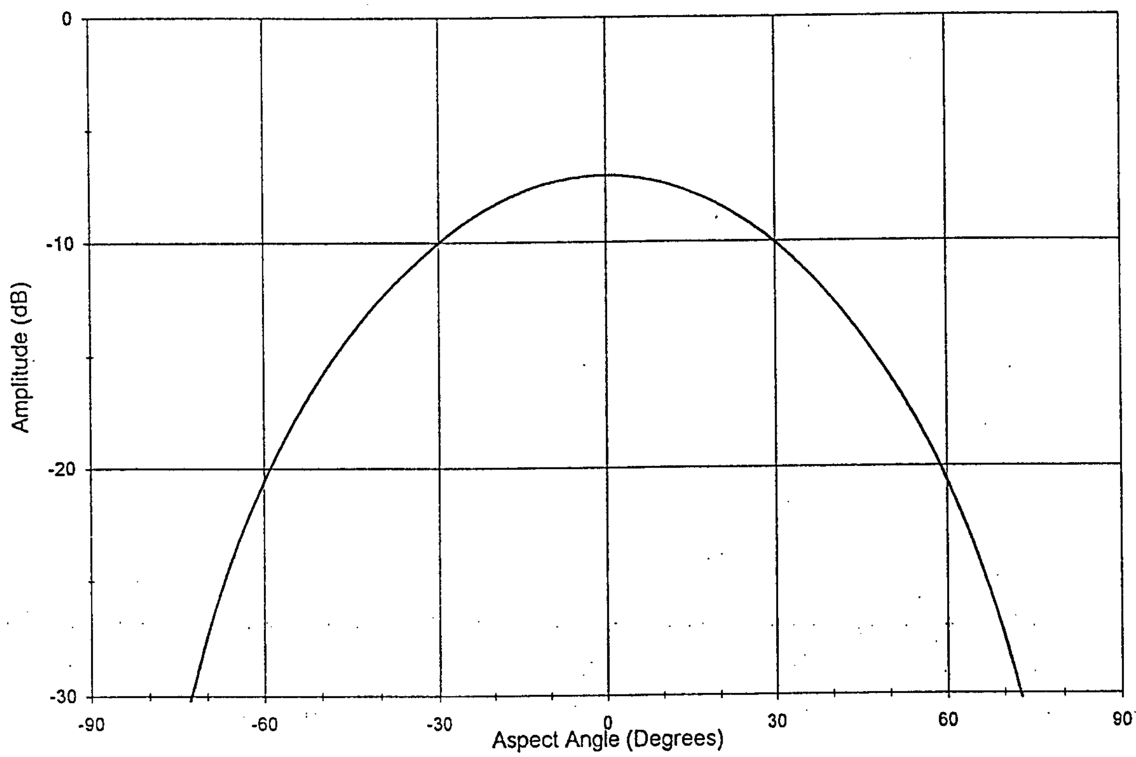



(a) Free Space Pattern

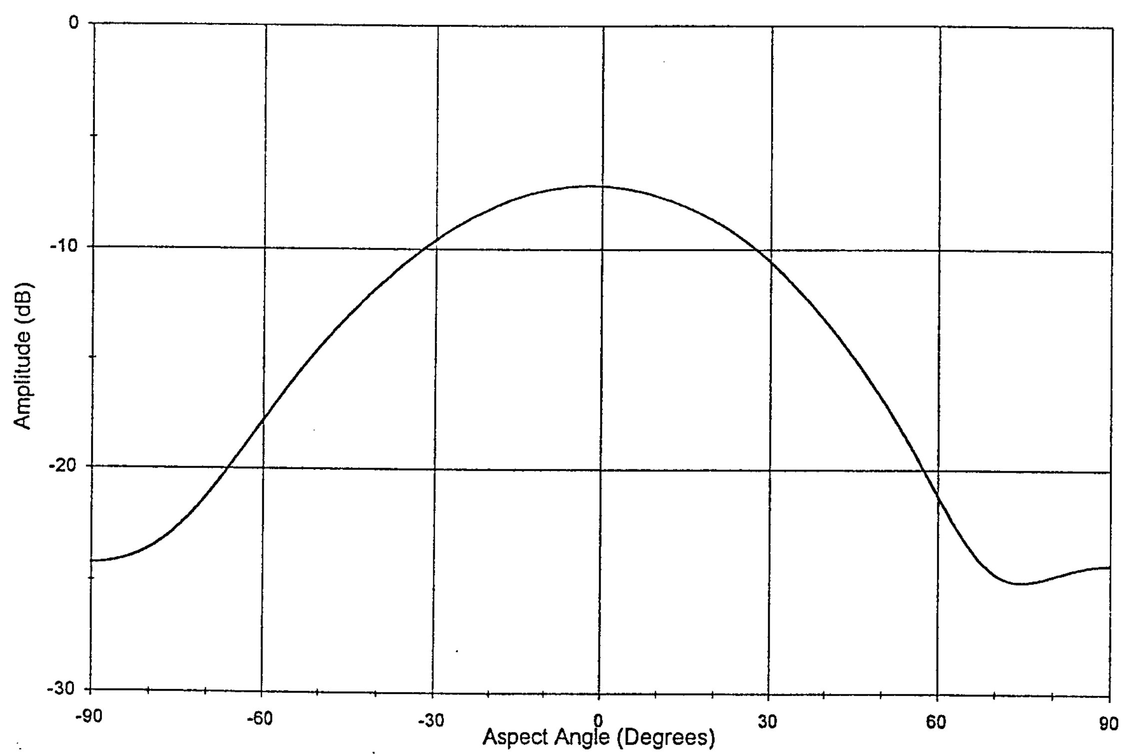



(b) Direct Propagation + Scattering From Chamber Cones

Figure 11
8λ Interferometer Pattern

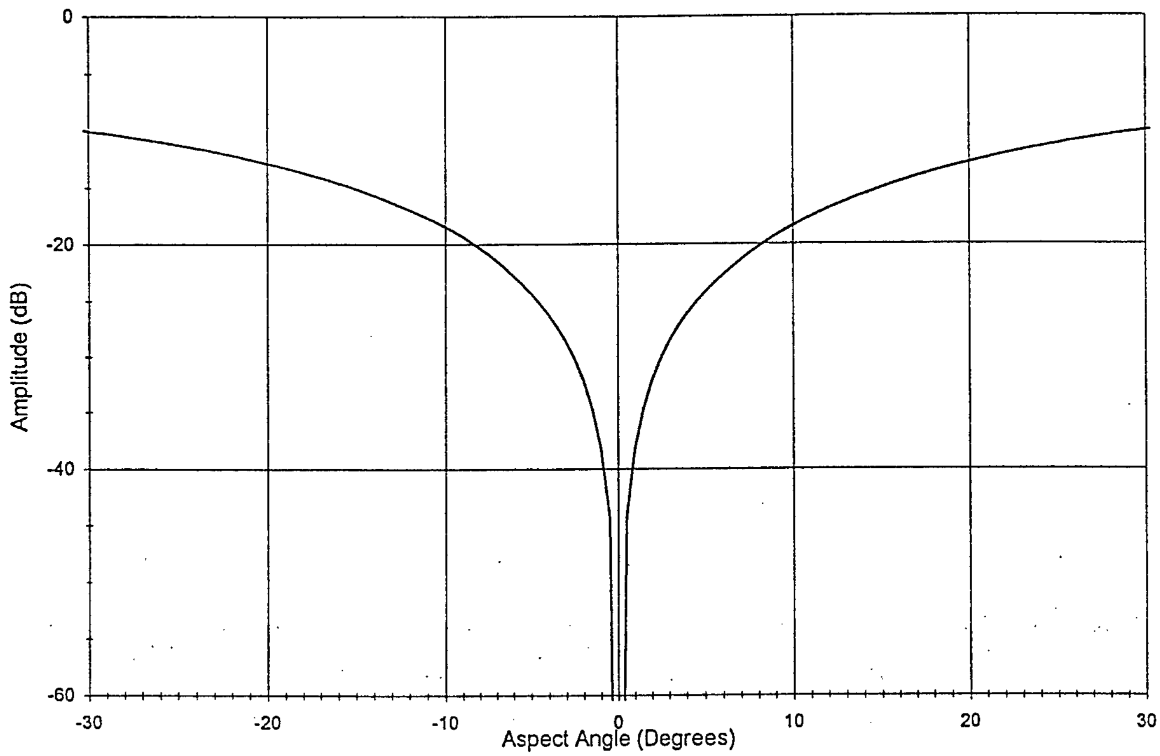



(a) Free Space Pattern

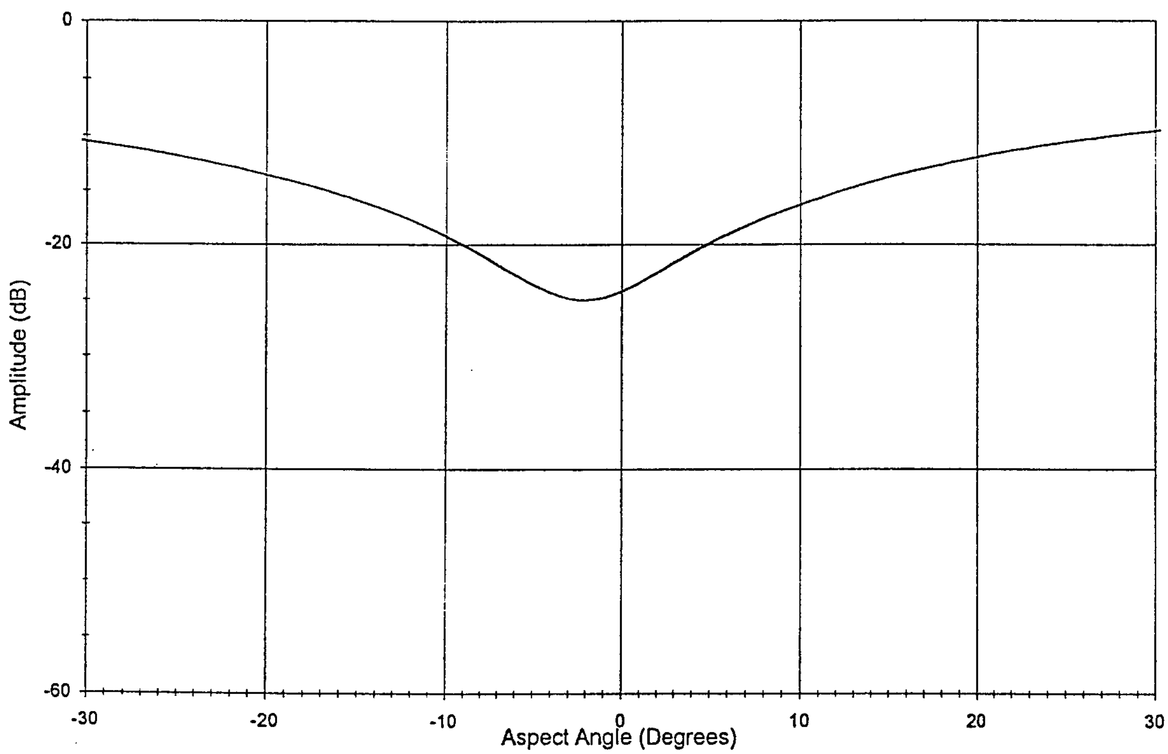



(b) Direct Propagation + Scattering From Chamber Cones

Figure 12
0.5λ Interferometer Pattern




(a) Free Space Δ Pattern




(b) Direct Propagation + Scattering From Chamber Cones Δ Pattern

Figure 13
0.5λ Interferometer Pattern

scattering. It was shown that even in the presence of reasonable random cone positioning errors the proposed methodology would work.

In the process, a simulation software system for modeling the Benefield Anechoic Chamber was developed. In addition to the originally proposed statement of work, analyses were performed on the impact of the chamber characteristics on the performance of a 16 element 30 dB Taylor distribution linear phased array and monopulse antenna and an interferometer antenna. It was shown that the main beam and difference beam of the linear array were relatively unaffected by the chamber characteristics but that the sidelobe performance was greatly effected. The implication of this is that monopulse tracking antennas could be properly tested in the BAF, but high performance, low sidelobe, antennas could not, at least not as the chamber was modeled. As expected, the interferometer antenna calculations indicated that AOA resolution was not hampered by the chamber's characteristics but the data from the closely spaced elements could be compromised by scattering from the cones in the chamber.

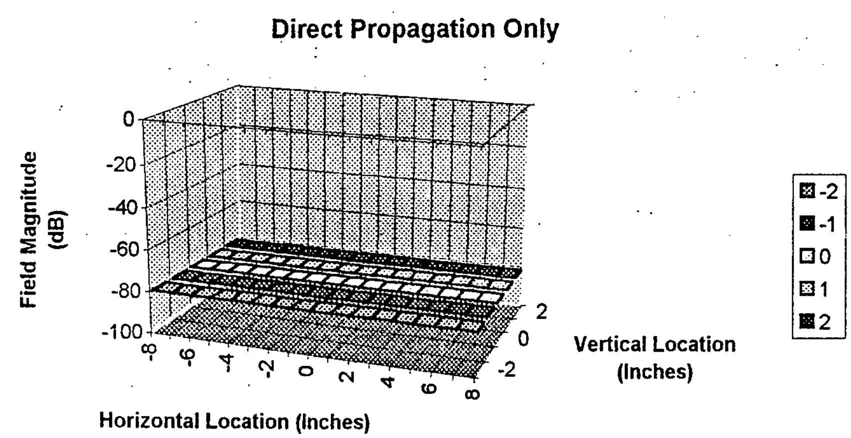
It is recommended that the Phase 2 of this program address upgrading the software so that a flexible and user-friendly simulation system may be used by analysis and test engineering personnel. In addition, during the Phase 2 program, all modeled parameters of the chamber should be measured and updated to truly reflect those characteristics that exist in the BAF.

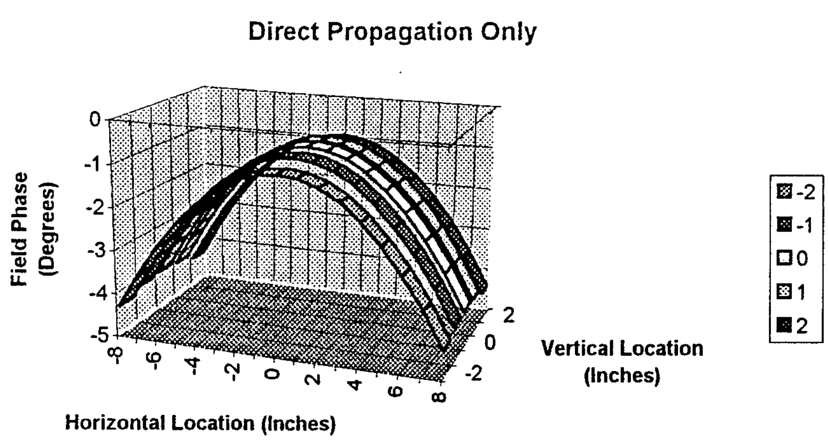
# APPENDIX A

## EXCEL "CHAMBER" FILE PRINTOUTS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CHAMBER - Direct Contribution Only | | | | | | | | | |
| | | | | | | | | | |
| Chamber | Dimensions: | | | 250 ft. | 70 ft. | 140 ft. | | | |
| Source | Location: | | | 0 | 0 | 0 | | | |
| Source | Angle: | | | 0 | | | | | |
| Antenna | Pattern | Exponent: | | 100 | | | | | |
| Frequency: | | | | 5.8662 | GHz | | | | |
| Absorber | Block | Location: | | 0 | 0 | 70 | | | |
| Absorber | Block | Radius: | | 0 | | | | | |
| Absorber | Block | Angle: | | 0 | | | | | |
| Absorber | Block | Atten: | | 40 | | | | | |
| Cone | Rectangle: | | | 0 | 1 | 0 | 1 | Hght=36" | Atn=90dB |
| Screen | Location: | | | 0 | 0 | 140 | | | |
| Screen | x (inches) | Grid: | | -8 | 8 | 1 | | | |
| Screen | y (inches) | Grid: | | -2 | 2 | 1 | | | |
| Screen | Angle: | | | 0 | | | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x | -8 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | | | |
| | -7 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | | | |
| | -6 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | | | |
| | -5 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | | | |
| | -4 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | | | |
| | -3 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | | | |
| | -2 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | | | |
| | -1 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | | | |
| | 0 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | | | |
| | 1 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | | | |
| | 2 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | | | |
| | 3 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | | | |
| | 4 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | | | |
| | 5 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | | | |
| | 6 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | | | |
| | 7 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | | | |
| ↓ | 8 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | 9.47E-05 | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x | -8 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | | | |
| | -7 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | | | |
| | -6 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | | | |
| | -5 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | | | |
| | -4 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | | | |
| | -3 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | | | |
| | -2 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | | | |
| | -1 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | | | |
| | 0 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | | | |
| | 1 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | | | |
| | 2 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | | | |
| | 3 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | | | |
| | 4 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | | | |
| | 5 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | | | |
| | 6 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | | | |
| | 7 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | | | |
| ↓ | 8 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | -80.4702 | | | |

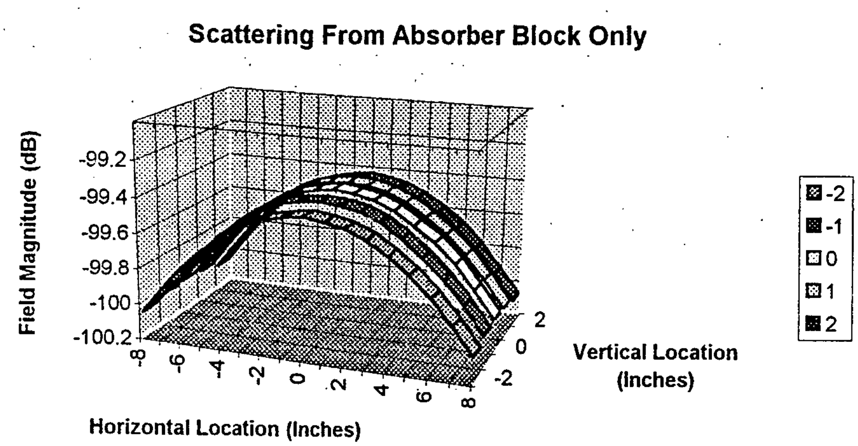
| | y → | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|---|
| x ↓ | -8 | -4.35 | -4.19 | -4.136 | -4.19 | -4.35 |
| | -7 | -3.546 | -3.385 | -3.332 | -3.385 | -3.546 |
| | -6 | -2.85 | -2.689 | -2.636 | -2.689 | -2.85 |
| | -5 | -2.261 | -2.1 | -2.047 | -2.1 | -2.261 |
| | -4 | -1.778 | -1.618 | -1.564 | -1.618 | -1.778 |
| | -3 | -1.404 | -1.243 | -1.189 | -1.243 | -1.404 |
| | -2 | -1.136 | -0.975 | -0.922 | -0.975 | -1.136 |
| | -1 | -0.975 | -0.814 | -0.761 | -0.814 | -0.975 |
| | 0 | -0.922 | -0.761 | -0.707 | -0.761 | -0.922 |
| | 1 | -0.975 | -0.814 | -0.761 | -0.814 | -0.975 |
| | 2 | -1.136 | -0.975 | -0.922 | -0.975 | -1.136 |
| | 3 | -1.404 | -1.243 | -1.189 | -1.243 | -1.404 |
| | 4 | -1.778 | -1.618 | -1.564 | -1.618 | -1.778 |
| | 5 | -2.261 | -2.1 | -2.047 | -2.1 | -2.261 |
| | 6 | -2.85 | -2.689 | -2.636 | -2.689 | -2.85 |
| | 7 | -3.546 | -3.385 | -3.332 | -3.385 | -3.546 |
| | 8 | -4.35 | -4.19 | -4.136 | -4.19 | -4.35 |

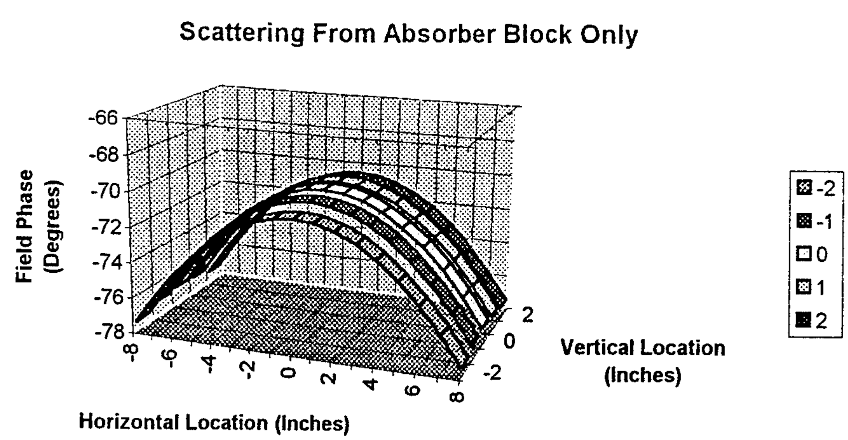


| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CHAMBER - Absorber Block Contribution Only | | | | | | | | | |
| | | | | | | | | | |
| Chamber | Dimensions: | | | 250 ft. | 70 ft. | 140 ft. | | | |
| Source | Location: | | | 0 | 0 | 0 | | | |
| Source | Angle: | | | 0 | | | | | |
| Antenna | Pattern | Exponent: | | 100 | | | | | |
| Frequency: | | | | 5.8662 | GHz | | | | |
| Absorber | Block | Location: | | 0 | 0 | 70 | | | |
| Absorber | Block | Radius: | | 1.5 | ft. | | | | |
| Absorber | Block | Angle: | | 0 | | | | | |
| Absorber | Block | Atten.: | | 60 | dB | | | | |
| Cone | Rectangle: | | | 0 | 1 | 0 | 1 | Hght=36" | Atn=90dB |
| Screen | Location: | | | 0 | 0 | 140 | | | |
| Screen | x (inches) | Grid: | | -8 | 8 | 1 | | | |
| Screen | y (inches) | Grid: | | -2 | 2 | 1 | | | |
| Screen | Angle: | | | 0 | | | | | |
| | | | | | | | | | |
| x | y ⟶ | -2 | -1 | 0 | 1 | 2 | | | |
| | -8 | 9.93E-06 | 9.97E-06 | 9.98E-06 | 9.97E-06 | 9.93E-06 | | | |
| | -7 | 1.01E-05 | 1.01E-05 | 1.02E-05 | 1.01E-05 | 1.01E-05 | | | |
| | -6 | 1.03E-05 | 1.03E-05 | 1.03E-05 | 1.03E-05 | 1.03E-05 | | | |
| | -5 | 1.04E-05 | 1.04E-05 | 1.04E-05 | 1.04E-05 | 1.04E-05 | | | |
| | -4 | 1.05E-05 | 1.05E-05 | 1.05E-05 | 1.05E-05 | 1.05E-05 | | | |
| | -3 | 1.06E-05 | 1.06E-05 | 1.06E-05 | 1.06E-05 | 1.06E-05 | | | |
| | -2 | 1.06E-05 | 1.07E-05 | 1.07E-05 | 1.07E-05 | 1.06E-05 | | | |
| | -1 | 1.07E-05 | 1.07E-05 | 1.07E-05 | 1.07E-05 | 1.07E-05 | | | |
| | 0 | 1.07E-05 | 1.07E-05 | 1.07E-05 | 1.07E-05 | 1.07E-05 | | | |
| | 1 | 1.07E-05 | 1.07E-05 | 1.07E-05 | 1.07E-05 | 1.07E-05 | | | |
| | 2 | 1.06E-05 | 1.07E-05 | 1.07E-05 | 1.07E-05 | 1.06E-05 | | | |
| | 3 | 1.06E-05 | 1.06E-05 | 1.06E-05 | 1.06E-05 | 1.06E-05 | | | |
| | 4 | 1.05E-05 | 1.05E-05 | 1.05E-05 | 1.05E-05 | 1.05E-05 | | | |
| | 5 | 1.04E-05 | 1.04E-05 | 1.04E-05 | 1.04E-05 | 1.04E-05 | | | |
| | 6 | 1.03E-05 | 1.03E-05 | 1.03E-05 | 1.03E-05 | 1.03E-05 | | | |
| | 7 | 1.01E-05 | 1.01E-05 | 1.02E-05 | 1.01E-05 | 1.01E-05 | | | |
| ↓ | 8 | 9.93E-06 | 9.97E-06 | 9.98E-06 | 9.97E-06 | 9.93E-06 | | | |
| | | | | | | | | | |
| | y ⟶ | -2 | -1 | 0 | 1 | 2 | | | |
| x | -8 | -100.061 | -100.03 | -100.02 | -100.03 | -100.061 | | | |
| | -7 | -99.9136 | -99.8792 | -99.8707 | -99.8792 | -99.9136 | | | |
| | -6 | -99.7771 | -99.7517 | -99.7348 | -99.7517 | -99.7771 | | | |
| | -5 | -99.6677 | -99.6426 | -99.626 | -99.6426 | -99.6677 | | | |
| | -4 | -99.5845 | -99.5514 | -99.5432 | -99.5514 | -99.5845 | | | |
| | -3 | -99.5103 | -99.4775 | -99.4693 | -99.4775 | -99.5103 | | | |
| | -2 | -99.4612 | -99.4286 | -99.4204 | -99.4286 | -99.4612 | | | |
| | -1 | -99.4367 | -99.4042 | -99.3961 | -99.4042 | -99.4367 | | | |
| | 0 | -99.4204 | -99.3961 | -99.3799 | -99.3961 | -99.4204 | | | |
| | 1 | -99.4367 | -99.4042 | -99.3961 | -99.4042 | -99.4367 | | | |
| | 2 | -99.4612 | -99.4286 | -99.4204 | -99.4286 | -99.4612 | | | |
| | 3 | -99.5103 | -99.4775 | -99.4693 | -99.4775 | -99.5103 | | | |
| | 4 | -99.5845 | -99.5514 | -99.5432 | -99.5514 | -99.5845 | | | |
| | 5 | -99.6677 | -99.6426 | -99.626 | -99.6426 | -99.6677 | | | |
| | 6 | -99.7771 | -99.7517 | -99.7348 | -99.7517 | -99.7771 | | | |
| | 7 | -99.9136 | -99.8792 | -99.8707 | -99.8792 | -99.9136 | | | |
| ↓ | 8 | -100.061 | -100.03 | -100.02 | -100.03 | -100.061 | | | |

| | y → | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|---|
| x ↓ | -8 | -77.474 | -77.12 | -76.98 | -77.054 | -77.343 |
| | -7 | -75.866 | -75.512 | -75.373 | -75.448 | -75.737 |
| | -6 | -74.474 | -74.121 | -73.982 | -74.057 | -74.346 |
| | -5 | -73.296 | -72.943 | -72.805 | -72.88 | -73.17 |
| | -4 | -72.331 | -71.978 | -71.84 | -71.916 | -72.206 |
| | -3 | -71.581 | -71.229 | -71.091 | -71.167 | -71.458 |
| | -2 | -71.046 | -70.694 | -70.556 | -70.632 | -70.923 |
| | -1 | -70.724 | -70.372 | -70.235 | -70.311 | -70.602 |
| | 0 | -70.617 | -70.265 | -70.128 | -70.204 | -70.495 |
| | 1 | -70.725 | -70.372 | -70.235 | -70.311 | -70.602 |
| | 2 | -71.046 | -70.694 | -70.556 | -70.633 | -70.923 |
| | 3 | -71.582 | -71.229 | -71.092 | -71.168 | -71.458 |
| | 4 | -72.332 | -71.979 | -71.841 | -71.917 | -72.207 |
| | 5 | -73.297 | -72.944 | -72.805 | -72.881 | -73.171 |
| | 6 | -74.475 | -74.121 | -73.983 | -74.058 | -74.347 |
| | 7 | -75.867 | -75.513 | -75.374 | -75.449 | -75.738 |
| | 8 | -77.476 | -77.121 | -76.981 | -77.056 | -77.344 |

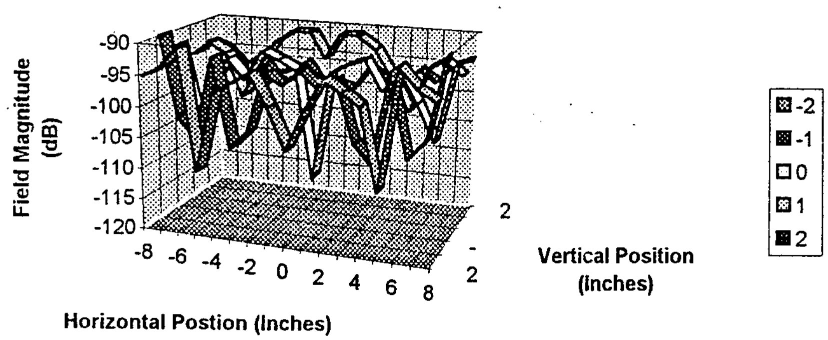


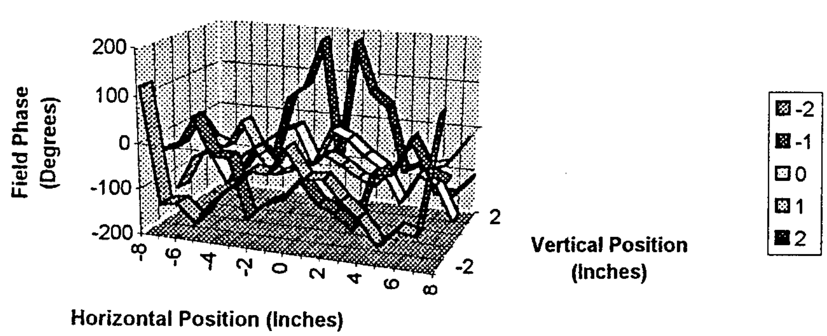
| CHAMBER - Scattering from Absorber Block and Cones (No random errors) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| Chamber | Dimensions: | | | 250 ft. | 70 ft. | 140 ft. | | | |
| Source | Location: | | | 0 | 0 | 0 | | | |
| Source | Angle: | | | 0 | | | | | |
| Antenna | Pattern | Exponent: | | 100 | | | | | |
| Frequency: | | | | 5.8662 | GHz | | | | |
| Absorber | Block | Location: | | 0 | 0 | 70 | | | |
| Absorber | Block | Radius: | | 1.5 | | | | | |
| Absorber | Block | Angle: | | 0 | | | | | |
| Absorber | Block | Atten: | | 60 | | | | | |
| Cone | Rectangle: | | | 0 | 125 | 0 | 70 | Hght=36" | Atn=40dB |
| Screen | Location: | | | 0 | 0 | 140 | | | |
| Screen | x | Grid: | | -8 | 8 | 1 | | | |
| Screen | y | Grid: | | -2 | 2 | 1 | | | |
| Screen | Angle: | | | 0 | | | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x ↓ | -8 | 1.70E-05 | 3.34E-05 | 2.36E-05 | 1.74E-05 | 2.00E-05 | | | |
| | -7 | 2.05E-05 | 7.01E-06 | 5.82E-06 | 2.24E-05 | 1.77E-05 | | | |
| | -6 | 2.94E-05 | 4.97E-06 | 1.14E-05 | 1.88E-05 | 1.26E-05 | | | |
| | -5 | 3.22E-06 | 2.28E-05 | 1.96E-05 | 8.27E-06 | 1.57E-05 | | | |
| | -4 | 1.41E-05 | 4.23E-06 | 1.36E-05 | 1.49E-05 | 1.13E-05 | | | |
| | -3 | 1.74E-05 | 6.02E-06 | 2.33E-05 | 2.48E-05 | 1.22E-05 | | | |
| | -2 | 2.13E-05 | 1.84E-05 | 2.08E-05 | 3.12E-05 | 1.52E-05 | | | |
| | -1 | 1.19E-05 | 1.52E-05 | 1.75E-05 | 3.43E-05 | 9.62E-06 | | | |
| | 0 | 5.64E-06 | 2.02E-05 | 2.31E-06 | 1.98E-05 | 1.06E-05 | | | |
| | 1 | 1.19E-05 | 1.52E-05 | 1.75E-05 | 3.43E-05 | 9.62E-06 | | | |
| | 2 | 2.13E-05 | 1.84E-05 | 2.08E-05 | 3.12E-05 | 1.52E-05 | | | |
| | 3 | 1.74E-05 | 6.02E-06 | 2.33E-05 | 2.48E-05 | 1.22E-05 | | | |
| | 4 | 1.41E-05 | 4.23E-06 | 1.36E-05 | 1.49E-05 | 1.13E-05 | | | |
| | 5 | 3.23E-06 | 2.28E-05 | 1.96E-05 | 8.27E-06 | 1.57E-05 | | | |
| | 6 | 2.94E-05 | 4.97E-06 | 1.14E-05 | 1.88E-05 | 1.26E-05 | | | |
| | 7 | 2.05E-05 | 7.01E-06 | 5.82E-06 | 2.24E-05 | 1.77E-05 | | | |
| | 8 | 1.70E-05 | 3.34E-05 | 2.36E-05 | 1.74E-05 | 2.00E-05 | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x ↓ | -8 | -95.3859 | -89.5173 | -92.5454 | -95.199 | -93.9794 | | | |
| | -7 | -93.7819 | -103.083 | -104.702 | -92.995 | -95.0454 | | | |
| | -6 | -90.636 | -106.075 | -98.8695 | -94.5261 | -97.9651 | | | |
| | -5 | -109.832 | -92.8299 | -94.1771 | -101.653 | -96.1097 | | | |
| | -4 | -97.0279 | -107.471 | -97.3292 | -96.5304 | -98.9692 | | | |
| | -3 | -95.209 | -104.415 | -92.6454 | -92.104 | -98.2942 | | | |
| | -2 | -93.4283 | -94.7225 | -93.6596 | -90.1058 | -96.3631 | | | |
| | -1 | -98.4891 | -96.3574 | -95.1244 | -89.3068 | -100.336 | | | |
| | 0 | -104.977 | -93.893 | -112.713 | -94.0799 | -99.5185 | | | |
| | 1 | -98.4891 | -96.3574 | -95.1244 | -89.3068 | -100.336 | | | |
| | 2 | -93.4283 | -94.7225 | -93.6596 | -90.1058 | -96.3631 | | | |
| | 3 | -95.209 | -104.414 | -92.6454 | -92.104 | -98.2942 | | | |
| | 4 | -97.0279 | -107.471 | -97.3292 | -96.5304 | -98.9692 | | | |
| | 5 | -109.829 | -92.8299 | -94.1726 | -101.653 | -96.1097 | | | |
| | 6 | -90.636 | -106.075 | -98.8695 | -94.5261 | -97.9651 | | | |
| | 7 | -93.7819 | -103.083 | -104.702 | -92.995 | -95.0454 | | | |
| | 8 | -95.3859 | -89.5173 | -92.5454 | -95.199 | -93.9794 | | | |

| | y → | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|---|
| x | -8 | 117.279 | -40.005 | -149.335 | -0.949 | -106.863 |
| | -7 | -133.478 | -27.502 | -72.974 | -53.114 | -147.44 |
| | -6 | -126.541 | 39.37 | -55.692 | -65.034 | -145.362 |
| | -5 | -165.571 | -39.865 | -123.912 | -1.09 | -84.443 |
| | -4 | -112.308 | -40.75 | -52.076 | -75.915 | -104.799 |
| | -3 | -79.252 | -170.444 | -26.875 | -118.398 | 42.336 |
| | -2 | -37.082 | -136.795 | 5.001 | -103.222 | 72.635 |
| | -1 | -40.95 | -119.136 | 20.847 | -78.299 | 178.634 |
| | 0 | 18.84 | -70.046 | -58.581 | -59.917 | -89.429 |
| | 1 | -40.951 | -119.137 | 20.847 | -78.299 | 178.634 |
| | 2 | -37.083 | -136.795 | 5.001 | -103.222 | 72.635 |
| | 3 | -79.252 | -170.444 | -26.875 | -118.398 | 42.336 |
| | 4 | -112.309 | -40.751 | -52.076 | -75.916 | -104.799 |
| | 5 | -165.571 | -39.866 | -123.913 | -1.091 | -84.443 |
| | 6 | -126.541 | 39.371 | -55.693 | -65.035 | -145.363 |
| | 7 | -133.478 | -27.503 | -72.976 | -53.115 | -147.44 |
| ↓ | 8 | 117.28 | -40.005 | -149.335 | -0.95 | -106.863 |

**Scattering From Absorber Block and Cones (No Random Errors)**

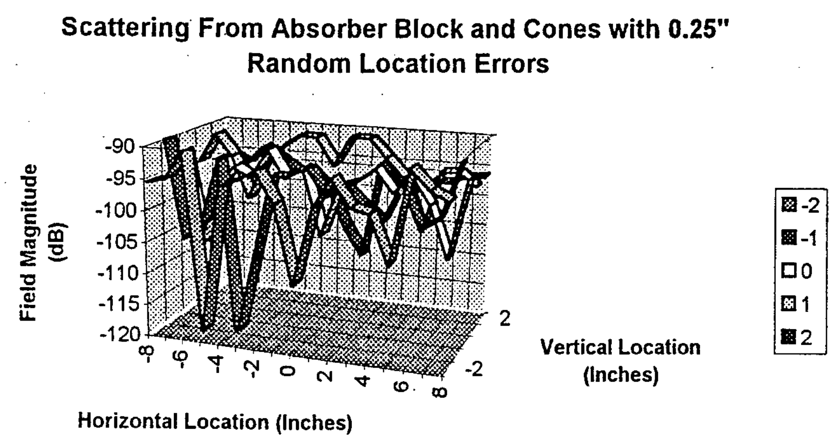


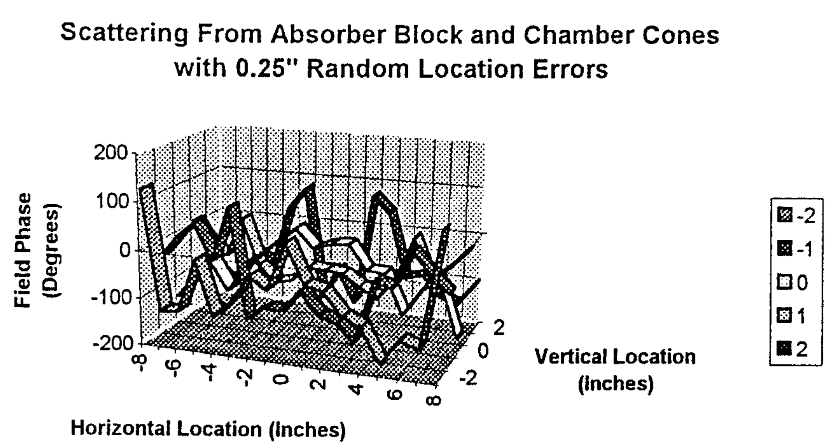

**scattering From Absrober Block and Cones (No Random Errors_**



| CHAMBER - Radiation from Absorber Block and Cones Scattering (0 dB and 0.25" Random Errors) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| Chamber | Dimensions: | | | 250 ft. | 70 ft. | 140 ft. | | | |
| Source | Location: | | | 0 | 0 | 0 | | | |
| Source | Angle: | | | 0 | | | | | |
| Antenna | Pattern | Exponent: | | 100 | | | | | |
| Frequency: | | | | 5.8662 | GHz | | | | |
| Absorber | Block | Location: | | 0 | 0 | 70 | | | |
| Absorber | Block | Radius: | | 1.5 | | | | | |
| Absorber | Block | Angle: | | 0 | | | | | |
| Absorber | Block | Atten: | | 60 | | | | | |
| Cone | Rectangle: | | | 0 | 125 | 0 | 70 | Hght=36" | Atn=40dB |
| Screen | Location: | | | 0 | 0 | 140 | | | |
| Screen | x | Grid: | | -8 | 8 | 1 | | | |
| Screen | y | Grid: | | -2 | 2 | 1 | | | |
| Screen | Angle: | | | 0 | | | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x ↓ | -8 | 1.64E-05 | 3.12E-05 | 2.17E-05 | 1.61E-05 | 1.48E-05 | | | |
| | -7 | 1.77E-05 | 5.05E-06 | 3.85E-06 | 2.82E-05 | 1.64E-05 | | | |
| | -6 | 2.95E-05 | 6.90E-06 | 1.13E-05 | 1.90E-05 | 1.44E-05 | | | |
| | -5 | 1.19E-06 | 2.26E-05 | 1.79E-05 | 8.61E-06 | 2.05E-05 | | | |
| | -4 | 1.70E-05 | 8.62E-07 | 1.49E-05 | 1.90E-05 | 1.67E-05 | | | |
| | -3 | 1.94E-05 | 3.98E-06 | 2.62E-05 | 2.44E-05 | 1.35E-05 | | | |
| | -2 | 2.37E-05 | 1.86E-05 | 1.56E-05 | 3.09E-05 | 1.32E-05 | | | |
| | -1 | 1.34E-05 | 1.93E-05 | 1.93E-05 | 3.04E-05 | 9.79E-06 | | | |
| | 0 | 3.32E-06 | 2.27E-05 | 5.73E-06 | 1.84E-05 | 4.74E-06 | | | |
| | 1 | 1.34E-05 | 1.42E-05 | 1.46E-05 | 3.20E-05 | 2.82E-06 | | | |
| | 2 | 2.29E-05 | 1.68E-05 | 1.63E-05 | 3.25E-05 | 1.72E-05 | | | |
| | 3 | 1.42E-05 | 1.25E-05 | 2.14E-05 | 2.26E-05 | 1.12E-05 | | | |
| | 4 | 1.32E-05 | 9.61E-06 | 1.40E-05 | 1.61E-05 | 1.01E-05 | | | |
| | 5 | 5.67E-06 | 1.96E-05 | 2.00E-05 | 6.19E-06 | 1.36E-05 | | | |
| | 6 | 3.03E-05 | 9.18E-06 | 1.18E-05 | 1.86E-05 | 1.33E-05 | | | |
| | 7 | 2.14E-05 | 1.12E-05 | 4.65E-06 | 1.94E-05 | 1.53E-05 | | | |
| | 8 | 1.84E-05 | 3.00E-05 | 1.97E-05 | 1.51E-05 | 1.57E-05 | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x ↓ | -8 | -95.7296 | -90.1253 | -93.2668 | -95.8581 | -96.5948 | | | |
| | -7 | -95.0209 | -105.934 | -108.291 | -91.0073 | -95.7084 | | | |
| | -6 | -90.5947 | -103.229 | -98.9231 | -94.4478 | -96.8328 | | | |
| | -5 | -118.518 | -92.9101 | -94.9284 | -101.297 | -93.7776 | | | |
| | -4 | -95.4166 | -121.295 | -96.513 | -94.4432 | -95.5301 | | | |
| | -3 | -94.2395 | -108.011 | -91.6506 | -92.2593 | -97.4256 | | | |
| | -2 | -92.505 | -94.6331 | -96.1153 | -90.2036 | -97.5885 | | | |
| | -1 | -97.4709 | -94.3069 | -94.2754 | -90.3311 | -100.186 | | | |
| | 0 | -109.572 | -92.8757 | -104.834 | -94.6942 | -106.49 | | | |
| | 1 | -97.4839 | -96.9849 | -96.6892 | -89.9051 | -111.004 | | | |
| | 2 | -92.7919 | -95.4886 | -95.7669 | -89.7543 | -95.3147 | | | |
| | 3 | -96.9298 | -98.0896 | -93.3917 | -92.914 | -99.0001 | | | |
| | 4 | -97.6149 | -100.347 | -97.0836 | -95.8527 | -99.8792 | | | |
| | 5 | -104.931 | -94.1549 | -93.9751 | -104.173 | -97.3612 | | | |
| | 6 | -90.3826 | -100.744 | -98.5403 | -94.5957 | -97.5295 | | | |
| | 7 | -93.3958 | -99.0312 | -106.649 | -94.2261 | -96.3289 | | | |
| | 8 | -94.7273 | -90.4605 | -94.1151 | -96.432 | -96.0765 | | | |

| | y → | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|---|
| x ↓ | -8 | 123.156 | -36.886 | -146.642 | 3.581 | -113.933 |
| | -7 | -127.381 | 9.201 | -102.275 | -51.861 | -149.107 |
| | -6 | -123.928 | 41.91 | -59.763 | -67.894 | -127.38 |
| | -5 | -10.643 | -33.628 | -119.418 | 18.388 | -81.009 |
| | -4 | -125.025 | 82.965 | -69.338 | -81.122 | -101.905 |
| | -3 | -87.212 | -150.845 | -29.907 | -115.303 | 33.807 |
| | -2 | -31.27 | -121.244 | 0.658 | -106.478 | 78.732 |
| | -1 | -54.116 | -122.402 | 31.965 | -72.204 | -165.661 |
| | 0 | 44.985 | -75.013 | -7.595 | -76.699 | -96.095 |
| | 1 | -36.019 | -121.754 | 5.436 | -79.593 | -167.618 |
| | 2 | -43.939 | -134.726 | 9.001 | -103.648 | 74.677 |
| | 3 | -90.762 | -170.553 | -42.349 | -125.639 | 40.089 |
| | 4 | -107.501 | -38.881 | -44.944 | -75.095 | -99.493 |
| | 5 | -178.181 | -48.377 | -127.271 | 13.586 | -88.306 |
| | 6 | -125.697 | 28.561 | -69.917 | -76.725 | -130.841 |
| | 7 | -138.615 | -12.3 | -48.428 | -42.763 | -147.702 |
| | 8 | 97.879 | -46.776 | -163.033 | -4.544 | -99.082 |

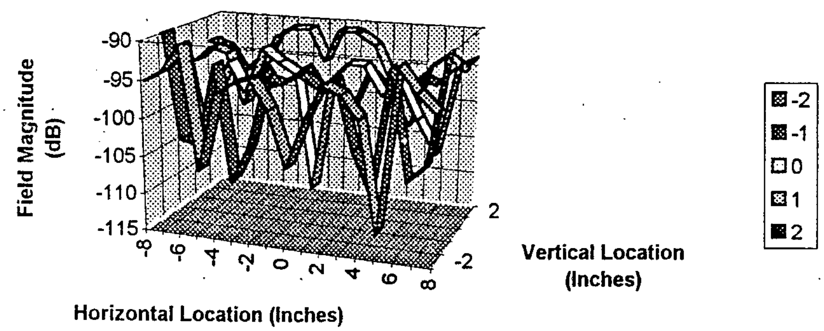


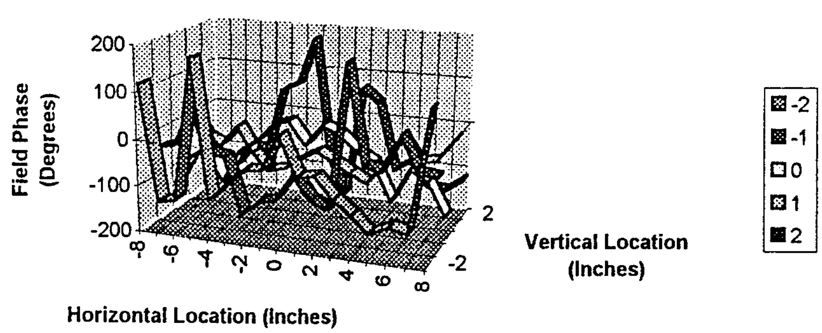
| CHAMBER - Radiation from Absorber Block and Cones Scattering (0dB and 0.1" Random Errors) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| Chamber | Dimensions: | | | 250 ft. | 70 ft. | 140 ft. | | | |
| Source | Location: | | | 0 | 0 | 0 | | | |
| Source | Angle: | | | 0 | | | | | |
| Antenna | Pattern | Exponent: | | 100 | | | | | |
| Frequency: | | | | 5.8662 | GHz | | | | |
| Absorber | Block | Location: | | 0 | 0 | 70 | | | |
| Absorber | Block | Radius: | | 1.5 | | | | | |
| Absorber | Block | Angle: | | 0 | | | | | |
| Absorber | Block | Attenuation: | | 60 | | | | | |
| Cone | Rectangle: | | | 0 | 125 | 0 | 70 | Hght=36" | Atn=40dB |
| Screen | Location: | | | 0 | 0 | 140 | | | |
| Screen | x | Grid: | | -8 | 8 | 1 | | | |
| Screen | y | Grid: | | -2 | 2 | 1 | | | |
| Screen | Angle: | | | 0 | | | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x | -8 | 1.73E-05 | 3.57E-05 | 2.32E-05 | 1.67E-05 | 2.10E-05 | | | |
| | -7 | 2.03E-05 | 6.35E-06 | 6.24E-06 | 2.12E-05 | 1.91E-05 | | | |
| | -6 | 3.04E-05 | 5.95E-06 | 1.08E-05 | 1.97E-05 | 1.29E-05 | | | |
| | -5 | 4.82E-06 | 2.08E-05 | 1.96E-05 | 8.85E-06 | 1.62E-05 | | | |
| | -4 | 1.55E-05 | 3.53E-06 | 1.25E-05 | 1.59E-05 | 1.07E-05 | | | |
| | -3 | 1.88E-05 | 6.18E-06 | 2.49E-05 | 2.68E-05 | 1.23E-05 | | | |
| | -2 | 2.03E-05 | 1.80E-05 | 2.07E-05 | 3.21E-05 | 1.52E-05 | | | |
| | -1 | 1.32E-05 | 1.70E-05 | 1.77E-05 | 3.32E-05 | 1.05E-05 | | | |
| | 0 | 5.81E-06 | 1.99E-05 | 3.09E-06 | 1.97E-05 | 1.13E-05 | | | |
| | 1 | 1.21E-05 | 1.70E-05 | 1.68E-05 | 3.52E-05 | 8.33E-06 | | | |
| | 2 | 2.04E-05 | 1.91E-05 | 2.18E-05 | 3.09E-05 | 1.54E-05 | | | |
| | 3 | 1.81E-05 | 6.97E-06 | 2.17E-05 | 2.63E-05 | 1.19E-05 | | | |
| | 4 | 1.29E-05 | 3.91E-06 | 1.43E-05 | 1.47E-05 | 9.01E-06 | | | |
| | 5 | 2.52E-06 | 2.44E-05 | 1.79E-05 | 8.10E-06 | 1.50E-05 | | | |
| | 6 | 2.85E-05 | 4.77E-06 | 1.04E-05 | 1.98E-05 | 1.37E-05 | | | |
| | 7 | 2.03E-05 | 6.07E-06 | 6.36E-06 | 2.42E-05 | 1.81E-05 | | | |
| ↓ | 8 | 1.56E-05 | 3.41E-05 | 2.34E-05 | 1.96E-05 | 2.05E-05 | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x | -8 | -95.2441 | -88.9564 | -92.7052 | -95.5301 | -93.5763 | | | |
| | -7 | -93.8501 | -103.949 | -104.1 | -93.4938 | -94.393 | | | |
| | -6 | -90.354 | -104.508 | -99.3396 | -94.1063 | -97.7882 | | | |
| | -5 | -106.337 | -93.6304 | -94.1637 | -101.057 | -95.7883 | | | |
| | -4 | -96.1878 | -109.052 | -98.0688 | -95.9666 | -99.453 | | | |
| | -3 | -94.5215 | -104.18 | -92.0725 | -91.4341 | -98.2373 | | | |
| | -2 | -93.8501 | -94.8849 | -93.7016 | -89.8807 | -96.3688 | | | |
| | -1 | -97.6083 | -95.4064 | -95.0454 | -89.5668 | -99.5762 | | | |
| | 0 | -104.721 | -94.0186 | -110.206 | -94.1239 | -98.9769 | | | |
| | 1 | -98.3156 | -95.4166 | -95.5042 | -89.0617 | -101.591 | | | |
| | 2 | -93.8074 | -94.3975 | -93.2468 | -90.1952 | -96.2383 | | | |
| | 3 | -94.8368 | -103.133 | -93.2868 | -91.6075 | -98.4891 | | | |
| | 4 | -97.8152 | -108.165 | -96.9176 | -96.6596 | -100.902 | | | |
| | 5 | -111.982 | -92.2558 | -94.9526 | -101.832 | -96.4898 | | | |
| | 6 | -90.897 | -106.439 | -99.6844 | -94.0799 | -97.2783 | | | |
| | 7 | -93.8715 | -104.335 | -103.936 | -92.3129 | -94.8656 | | | |
| ↓ | 8 | -96.1264 | -89.3449 | -92.6083 | -94.1416 | -93.748 | | | |

| | y → | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|---|
| x ↓ | -8 | 114.674 | -40.835 | -144.789 | -4.396 | -107.536 |
| | -7 | -135.728 | -32.702 | -79.274 | -54.361 | -144.786 |
| | -6 | -126.17 | 49.586 | -58.519 | -67.929 | -140.184 |
| | -5 | 179.012 | -40.572 | -126.728 | -20.857 | -87.28 |
| | -4 | -116.212 | -46.142 | -52.905 | -78.589 | -97.519 |
| | -3 | -78.009 | -170.853 | -29.101 | -114.704 | 52.421 |
| | -2 | -42.409 | -136.955 | 12.244 | -105.666 | 67.907 |
| | -1 | -39.494 | -125.474 | 24.941 | -78.612 | 174.074 |
| | 0 | 37.608 | -66.689 | -24.149 | -59.554 | -92.088 |
| | 1 | -45.359 | -119.081 | 22.573 | -80.109 | -177.854 |
| | 2 | -37.706 | -134.085 | 6.294 | -101.471 | 69.724 |
| | 3 | -81.934 | 176.958 | -25.721 | -120.535 | 38.642 |
| | 4 | -111.084 | -31.686 | -48.769 | -70.678 | -108.829 |
| | 5 | -146.474 | -40.704 | -127.417 | -6.393 | -85.293 |
| | 6 | -126.634 | 39.178 | -53.141 | -61.996 | -138.996 |
| | 7 | -136.943 | -35.036 | -75.285 | -52.112 | -143.895 |
| | 8 | 119.008 | -40.122 | -146.351 | -0.538 | -116.218 |

**Scattering From Absorber Block and Cones with 0.1" Random Location Errors**

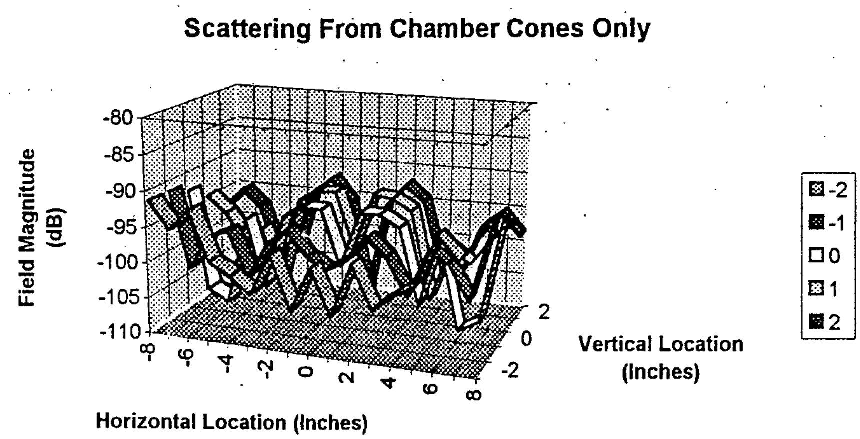


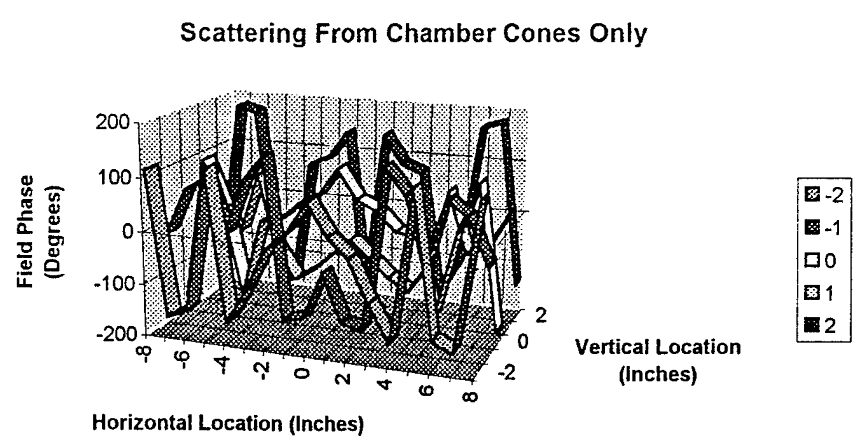

**Scattering From Absorber Block and chamber cones with 0.1" Random Location Errors**



| CHAMBER - Cones Contribution Only | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| Chamber | Dimensions: | | | 250 | 70 | 140 | | | |
| Source | Location: | | | 0 | 0 | 0 | | | |
| Source | Angle: | | | 0 | | | | | |
| Antenna | Pattern | Exponent: | | 100 | | | | | |
| Frequency: | | | | 5.8662 | GHz | | | | |
| Absorber | Block | Location: | | 0 | 0 | 70 | | | |
| Absorber | Block | Radius: | | -1 | | | | | |
| Absorber | Block | Angle: | | 0 | | | | | |
| Absorber | Block | Atten: | | 40 | | | | | |
| Cone | Rectangle: | | | 0 | 125 | 0 | 70 | Hght=36" | Atn=40dB |
| Screen | Location: | | | 0 | 0 | 140 | | | |
| Screen | x (inches) | Grid: | | -8 | 8 | 1 | | | |
| Screen | y (inches) | Grid: | | -2 | 2 | 1 | | | |
| Screen | Angle: | | | 0 | | | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x | -8 | 2.67E-05 | 2.62E-05 | 2.27E-05 | 1.78E-05 | 1.24E-05 | | | |
| | -7 | 1.73E-05 | 7.54E-06 | 4.35E-06 | 1.36E-05 | 1.74E-05 | | | |
| | -6 | 2.45E-05 | 1.31E-05 | 3.61E-06 | 8.77E-06 | 1.34E-05 | | | |
| | -5 | 1.10E-05 | 1.52E-05 | 1.53E-05 | 1.11E-05 | 5.83E-06 | | | |
| | -4 | 9.05E-06 | 7.25E-06 | 5.12E-06 | 4.47E-06 | 6.15E-06 | | | |
| | -3 | 7.02E-06 | 1.30E-05 | 1.74E-05 | 1.93E-05 | 1.91E-05 | | | |
| | -2 | 1.38E-05 | 1.71E-05 | 2.08E-05 | 2.30E-05 | 2.46E-05 | | | |
| | -1 | 5.92E-06 | 1.15E-05 | 2.07E-05 | 2.37E-05 | 1.67E-05 | | | |
| | 0 | 1.20E-05 | 9.47E-06 | 8.48E-06 | 9.42E-06 | 3.50E-06 | | | |
| | 1 | 5.92E-06 | 1.15E-05 | 2.07E-05 | 2.37E-05 | 1.67E-05 | | | |
| | 2 | 1.38E-05 | 1.71E-05 | 2.08E-05 | 2.30E-05 | 2.46E-05 | | | |
| | 3 | 7.02E-06 | 1.30E-05 | 1.74E-05 | 1.93E-05 | 1.91E-05 | | | |
| | 4 | 9.05E-06 | 7.25E-06 | 5.12E-06 | 4.47E-06 | 6.15E-06 | | | |
| | 5 | 1.10E-05 | 1.52E-05 | 1.53E-05 | 1.11E-05 | 5.83E-06 | | | |
| | 6 | 2.45E-05 | 1.31E-05 | 3.61E-06 | 8.77E-06 | 1.34E-05 | | | |
| | 7 | 1.73E-05 | 7.54E-06 | 4.35E-06 | 1.36E-05 | 1.74E-05 | | | |
| ↓ | 8 | 2.67E-05 | 2.62E-05 | 2.27E-05 | 1.78E-05 | 1.24E-05 | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x | -8 | -91.4568 | -91.6373 | -92.8948 | -94.977 | -98.1526 | | | |
| | -7 | -95.2391 | -102.451 | -107.24 | -97.342 | -95.184 | | | |
| | -6 | -92.2309 | -97.6612 | -108.845 | -101.144 | -97.432 | | | |
| | -5 | -99.1721 | -96.3631 | -96.2892 | -99.0935 | -104.693 | | | |
| | -4 | -100.864 | -102.79 | -105.815 | -106.998 | -104.227 | | | |
| | -3 | -103.079 | -97.7145 | -95.209 | -94.3069 | -94.3884 | | | |
| | -2 | -97.1836 | -95.3401 | -93.6262 | -92.773 | -92.1884 | | | |
| | -1 | -104.552 | -98.8163 | -93.668 | -92.5087 | -95.5405 | | | |
| | 0 | -98.3875 | -100.469 | -101.431 | -100.521 | -109.124 | | | |
| | 1 | -104.552 | -98.8163 | -93.668 | -92.5087 | -95.5405 | | | |
| | 2 | -97.1836 | -95.3401 | -93.6262 | -92.773 | -92.1884 | | | |
| | 3 | -103.079 | -97.7145 | -95.209 | -94.3069 | -94.3884 | | | |
| | 4 | -100.864 | -102.79 | -105.815 | -106.998 | -104.227 | | | |
| | 5 | -99.1721 | -96.3631 | -96.2892 | -99.0935 | -104.693 | | | |
| | 6 | -92.2309 | -97.6612 | -108.845 | -101.144 | -97.432 | | | |
| | 7 | -95.2391 | -102.451 | -107.24 | -97.342 | -95.184 | | | |
| ↓ | 8 | -91.4568 | -91.6373 | -92.8948 | -94.977 | -98.1526 | | | |

| | y → | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|---|
| x | -8 | 111.852 | -26.729 | -174.145 | 31.899 | -130.161 |
| | -7 | -163.038 | 60.768 | 101.412 | -36.629 | 179.108 |
| | -6 | -145.857 | 85.51 | 7.88 | -54.422 | 168.455 |
| | -5 | 123.738 | -17.881 | -155.905 | 62.073 | -104.841 |
| | -4 | -160.454 | 90.417 | -7.941 | -85.377 | -171.671 |
| | -3 | -90.863 | 135.921 | -1.604 | -142.264 | 72.827 |
| | -2 | -11.625 | -171.602 | 34.789 | -117.714 | 87.532 |
| | -1 | 22.594 | -163.809 | 52 | -81.902 | 141.962 |
| | 0 | 81.451 | -69.798 | 106.742 | -48.185 | -171.855 |
| | 1 | 22.594 | -163.809 | 52 | -81.902 | 141.962 |
| | 2 | -11.625 | -171.602 | 34.789 | -117.714 | 87.532 |
| | 3 | -90.863 | 135.921 | -1.604 | -142.264 | 72.827 |
| | 4 | -160.454 | 90.417 | -7.941 | -85.377 | -171.671 |
| | 5 | 123.738 | -17.881 | -155.905 | 62.073 | -104.841 |
| | 6 | -145.857 | 85.51 | 7.88 | -54.422 | 168.455 |
| | 7 | -163.038 | 60.768 | 101.412 | -36.629 | 179.108 |
| ↓ | 8 | 111.852 | -26.729 | -174.145 | 31.899 | -130.161 |

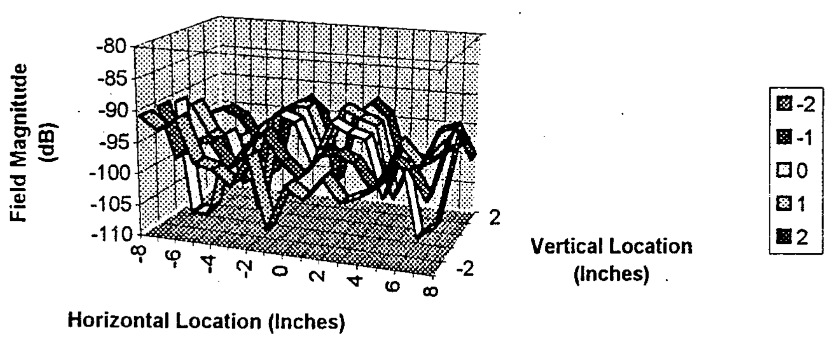


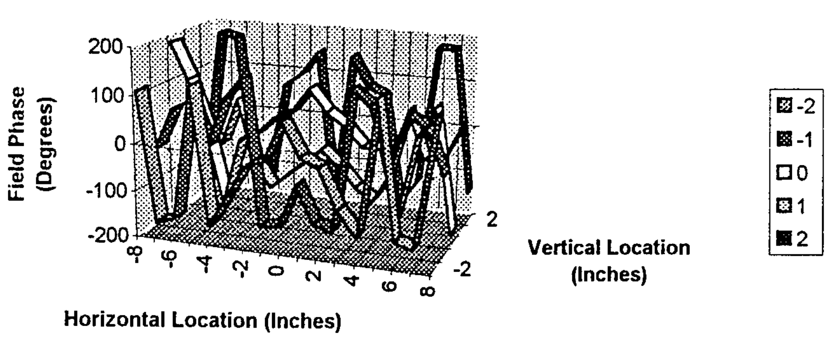
| CHAMBER - Cones Only with 5 dB Random Errors | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| Chamber | Dimensions: | | | 250 ft. | 70 ft. | 140 ft. | | | |
| Source | Location: | | | 0 | 0 | 0 | | | |
| Source | Angle: | | | 0 | | | | | |
| Antenna | Pattern | Exponent: | | 100 | | | | | |
| Frequency: | | | | 5.8662 | GHz | | | | |
| Absorber | Block | Location: | | 0 | 0 | 70 | | | |
| Absorber | Block | Radius: | | -1 | | | | | |
| Absorber | Block | Angle: | | 0 | | | | | |
| Absorber | Block | Atten: | | 40 | | | | | |
| Cone | Rectangle: | | | 0 | 125 | 0 | 70 | Hght=36" | Atn=37dB |
| Screen | Location: | | | 0 | 0 | 140 | | | |
| Screen | x (inches) | Grid: | | -8 | 8 | 1 | | | |
| Screen | y (inches) | Grid: | | -2 | 2 | 1 | | | |
| Screen | Angle: | | | 0 | | | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x | -8 | 2.79E-05 | 2.86E-05 | 2.65E-05 | 2.20E-05 | 1.52E-05 | | | |
| | -7 | 2.22E-05 | 1.11E-05 | 2.23E-06 | 1.26E-05 | 1.73E-05 | | | |
| | -6 | 2.82E-05 | 1.53E-05 | 3.61E-06 | 9.37E-06 | 1.51E-05 | | | |
| | -5 | 1.31E-05 | 1.60E-05 | 1.59E-05 | 1.29E-05 | 9.55E-06 | | | |
| | -4 | 1.20E-05 | 9.98E-06 | 6.27E-06 | 3.11E-06 | 5.06E-06 | | | |
| | -3 | 9.33E-06 | 1.62E-05 | 2.01E-05 | 2.07E-05 | 1.97E-05 | | | |
| | -2 | 1.66E-05 | 2.14E-05 | 2.52E-05 | 2.56E-05 | 2.46E-05 | | | |
| | -1 | 4.63E-06 | 1.27E-05 | 2.24E-05 | 2.54E-05 | 1.82E-05 | | | |
| | 0 | 1.06E-05 | 9.78E-06 | 1.06E-05 | 1.16E-05 | 5.06E-06 | | | |
| | 1 | 8.45E-06 | 1.50E-05 | 2.38E-05 | 2.64E-05 | 1.89E-05 | | | |
| | 2 | 1.29E-05 | 1.65E-05 | 2.01E-05 | 2.25E-05 | 2.58E-05 | | | |
| | 3 | 8.70E-06 | 1.45E-05 | 1.84E-05 | 2.01E-05 | 2.04E-05 | | | |
| | 4 | 1.01E-05 | 9.08E-06 | 6.43E-06 | 5.25E-06 | 7.34E-06 | | | |
| | 5 | 1.26E-05 | 1.60E-05 | 1.58E-05 | 1.15E-05 | 7.56E-06 | | | |
| | 6 | 2.74E-05 | 1.43E-05 | 3.33E-06 | 1.08E-05 | 1.65E-05 | | | |
| | 7 | 1.87E-05 | 8.47E-06 | 4.24E-06 | 1.39E-05 | 1.85E-05 | | | |
| | 8 | 2.76E-05 | 2.69E-05 | 2.28E-05 | 1.69E-05 | 1.04E-05 | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x | -8 | -91.091 | -90.8757 | -91.5253 | -93.1674 | -96.3517 | | | |
| | -7 | -93.0847 | -99.1249 | -113.053 | -98.0064 | -95.2441 | | | |
| | -6 | -90.9889 | -96.2835 | -108.843 | -100.564 | -96.432 | | | |
| | -5 | -97.6347 | -95.9448 | -95.9557 | -97.7815 | -100.404 | | | |
| | -4 | -98.4236 | -100.017 | -104.052 | -110.148 | -105.922 | | | |
| | -3 | -100.605 | -95.7936 | -93.9231 | -93.689 | -94.1327 | | | |
| | -2 | -95.5978 | -93.3877 | -91.9754 | -91.842 | -92.199 | | | |
| | -1 | -106.692 | -97.9308 | -92.995 | -91.8931 | -94.7843 | | | |
| | 0 | -99.535 | -100.19 | -99.4775 | -98.7408 | -105.922 | | | |
| | 1 | -101.461 | -96.4956 | -92.4794 | -91.5745 | -94.4892 | | | |
| | 2 | -97.7949 | -95.6398 | -93.9274 | -92.9448 | -91.7777 | | | |
| | 3 | -101.209 | -96.7846 | -94.7084 | -93.9188 | -93.8244 | | | |
| | 4 | -99.905 | -100.838 | -103.84 | -105.602 | -102.688 | | | |
| | 5 | -97.9857 | -95.9013 | -96.0104 | -98.7936 | -102.43 | | | |
| | 6 | -91.2355 | -96.9115 | -109.562 | -99.2994 | -95.6661 | | | |
| | 7 | -94.5632 | -101.443 | -107.457 | -97.1585 | -94.6801 | | | |
| | 8 | -91.1976 | -91.4211 | -92.8604 | -95.4269 | -99.651 | | | |

| | y → | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|---|
| x | -8 | 106.467 | -34.16 | 179.317 | 29.707 | -125.396 |
| | -7 | -169.455 | 54.503 | 101.668 | -39.803 | 176.156 |
| | -6 | -155.702 | 75.271 | -8.989 | -56.264 | 167.193 |
| | -5 | 127.478 | -18.877 | -163.573 | 47.478 | -115.684 |
| | -4 | -161.37 | 87.197 | -19.743 | -89.372 | -147.817 |
| | -3 | -92.789 | 132.204 | -4.076 | -144.308 | 69.495 |
| | -2 | -25.543 | -179.029 | 35.044 | -111.416 | 96.177 |
| | -1 | -10.887 | -175.861 | 49.694 | -80.089 | 147.426 |
| | 0 | 73.498 | -80.367 | 105.039 | -45.275 | -177.389 |
| | 1 | 4.742 | -158.841 | 57.858 | -77.739 | 143.333 |
| | 2 | -13.944 | -174.123 | 32.027 | -122.772 | 80.291 |
| | 3 | -95.527 | 129.555 | -8.57 | -149.748 | 64.927 |
| | 4 | -148.377 | 98.331 | -6.804 | -85.998 | -174.766 |
| | 5 | 135.532 | -10.921 | -154.398 | 55.478 | -123.39 |
| | 6 | -145.643 | 85.296 | 21.127 | -45.657 | 175.94 |
| | 7 | -157.808 | 69.109 | 87.242 | -42.005 | 173.086 |
| | 8 | 111.96 | -26.231 | -173.161 | 33.106 | -132.918 |

**Scattering From Chamber Cones with +/- 2.5 dB Random Absorption**

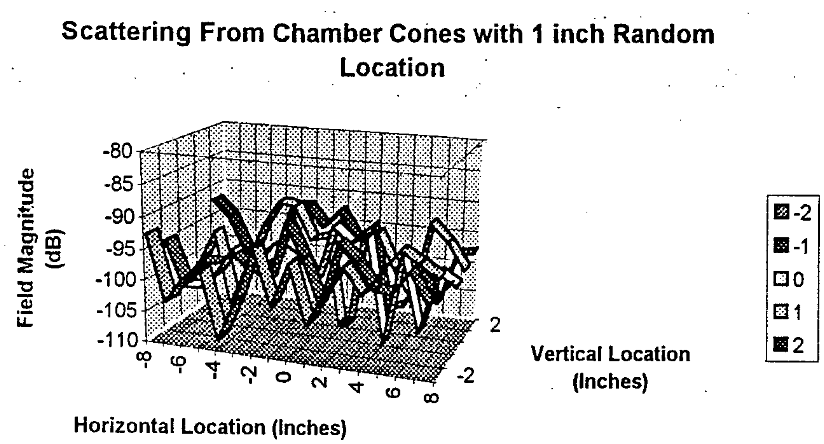


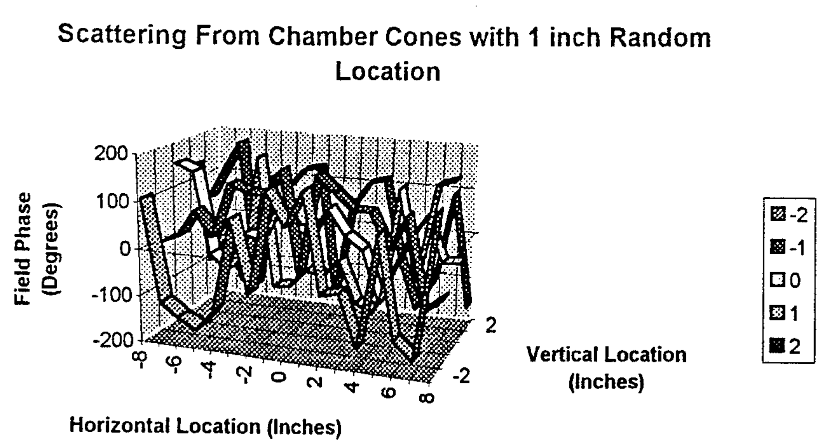

**Scattering from Chamber Cones with +/- 2.5 dB Random Absorption**



| CHAMBER - Cones Only with 1 inch Random errors | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| Chamber | Dimensions: | | | 250 ft. | 70 ft. | 140 ft. | | | |
| Source | Location: | | | 0 | 0 | 0 | | | |
| Source | Angle: | | | 0 | | | | | |
| Antenna | Pattern | Exponent: | | 100 | | | | | |
| Frequency: | | | | 5.8662 | GHz | | | | |
| Absorber | Block | Location: | | 0 | 0 | 70 | | | |
| Absorber | Block | Radius: | | -1 | | | | | |
| Absorber | Block | Angle: | | 0 | | | | | |
| Absorber | Block | Atten: | | 40 | | | | | |
| Cone | Rectangle: | | | 0 | 125 | 0 | 70 | Hght=36" | Atn=40dB |
| Screen | Location: | | | 0 | 0 | 140 | | | |
| Screen | x (inches) | Grid: | | -8 | 8 | 1 | | | |
| Screen | y (inches) | Grid: | | -2 | 2 | 1 | | | |
| Screen | Angle: | | | 0 | | | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x | -8 | 2.26E-05 | 1.69E-05 | 5.84E-06 | 7.82E-06 | 2.33E-05 | | | |
| | -7 | 6.70E-06 | 7.51E-06 | 5.91E-06 | 1.49E-05 | 1.71E-05 | | | |
| | -6 | 1.07E-05 | 1.23E-05 | 7.94E-06 | 3.65E-06 | 8.97E-06 | | | |
| | -5 | 1.29E-05 | 1.22E-05 | 1.33E-05 | 7.99E-06 | 6.62E-06 | | | |
| | -4 | 3.71E-06 | 1.49E-05 | 9.29E-06 | 1.81E-05 | 8.15E-06 | | | |
| | -3 | 8.14E-06 | 1.24E-05 | 1.42E-05 | 2.98E-05 | 2.41E-05 | | | |
| | -2 | 2.19E-05 | 9.89E-06 | 1.78E-05 | 2.87E-05 | 2.47E-05 | | | |
| | -1 | 7.95E-06 | 2.96E-05 | 1.43E-05 | 1.55E-05 | 1.68E-05 | | | |
| | 0 | 1.78E-05 | 1.62E-05 | 8.67E-06 | 1.69E-05 | 2.38E-05 | | | |
| | 1 | 6.09E-06 | 7.03E-06 | 2.52E-05 | 1.67E-06 | 1.43E-05 | | | |
| | 2 | 1.12E-05 | 2.26E-05 | 1.91E-05 | 1.66E-05 | 1.88E-05 | | | |
| | 3 | 1.89E-05 | 1.67E-05 | 2.20E-05 | 2.02E-05 | 3.70E-06 | | | |
| | 4 | 1.17E-05 | 1.05E-05 | 3.21E-06 | 1.03E-05 | 4.12E-06 | | | |
| | 5 | 1.86E-05 | 1.01E-05 | 1.80E-05 | 6.42E-06 | 8.32E-06 | | | |
| | 6 | 2.73E-05 | 1.59E-05 | 4.15E-06 | 2.64E-05 | 4.69E-06 | | | |
| | 7 | 2.26E-05 | 8.88E-06 | 1.32E-05 | 1.92E-05 | 1.27E-05 | | | |
| ↓ | 8 | 1.84E-05 | 1.29E-05 | 1.07E-05 | 1.19E-05 | 1.37E-05 | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x | -8 | -92.9063 | -95.4217 | -104.676 | -102.14 | -92.6641 | | | |
| | -7 | -103.473 | -102.486 | -104.564 | -96.5363 | -95.3249 | | | |
| | -6 | -99.453 | -98.2302 | -101.999 | -108.745 | -100.947 | | | |
| | -5 | -97.7747 | -98.2444 | -97.4969 | -101.949 | -103.585 | | | |
| | -4 | -108.606 | -96.5421 | -100.643 | -94.8512 | -101.779 | | | |
| | -3 | -101.793 | -98.1316 | -96.9604 | -90.5186 | -92.3705 | | | |
| | -2 | -93.211 | -100.097 | -95.016 | -90.8484 | -92.1425 | | | |
| | -1 | -101.989 | -90.5742 | -96.869 | -96.2046 | -95.4835 | | | |
| | 0 | -95.0063 | -95.8043 | -101.238 | -95.4217 | -92.4831 | | | |
| | 1 | -104.312 | -103.066 | -91.9858 | -115.567 | -96.9115 | | | |
| | 2 | -99.0156 | -92.9063 | -94.4021 | -95.5822 | -94.5076 | | | |
| | 3 | -94.4662 | -95.5301 | -93.1555 | -93.9016 | -108.631 | | | |
| | 4 | -98.6735 | -99.5432 | -109.867 | -99.7686 | -107.713 | | | |
| | 5 | -94.6004 | -99.9222 | -94.9187 | -103.856 | -101.593 | | | |
| | 6 | -91.2704 | -95.9939 | -107.633 | -91.5679 | -106.578 | | | |
| | 7 | -92.9371 | -101.037 | -97.5754 | -94.334 | -97.9376 | | | |
| ↓ | 8 | -94.7225 | -97.7613 | -99.4123 | -98.5183 | -97.291 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | y → | -2 | -1 | 0 | 1 | 2 |
| x ↓ | -8 | 103.745 | -9.257 | 149.697 | 130.848 | 38.258 |
| | -7 | -115.065 | 7.587 | 134.196 | -85.965 | 109.063 |
| | -6 | -142.13 | 67.458 | -45.779 | 8.429 | 174.813 |
| | -5 | -164.266 | 13.459 | -78.68 | -123.586 | -160.123 |
| | -4 | -119.232 | 132.516 | 5.966 | 159.393 | 101.034 |
| | -3 | 80.311 | 117.883 | -3.198 | -129.728 | 78.087 |
| | -2 | -72.943 | 114.649 | 73.893 | -123.487 | 123.205 |
| | -1 | 144.722 | 170.259 | 27.902 | -83.347 | 131.544 |
| | 0 | 74.227 | -44.187 | 18.56 | -93.528 | -154.906 |
| | 1 | 150.831 | 166.358 | 79.707 | -53.847 | 46.241 |
| | 2 | -57.989 | 135.051 | 25.223 | -146.844 | 103.801 |
| | 3 | -47.703 | 100.775 | -2.034 | -161.204 | 115.287 |
| | 4 | -155.916 | 99.228 | -112.847 | -76.164 | -61.377 |
| | 5 | 77.023 | 22.852 | 133.591 | 3.467 | -170.277 |
| | 6 | -132.91 | 98.676 | -55.518 | 61.873 | -103.479 |
| | 7 | -167.989 | -94.285 | 146.944 | -34.243 | 95.564 |
| | 8 | 129.627 | -62.633 | 160.171 | -29.244 | -153.016 |

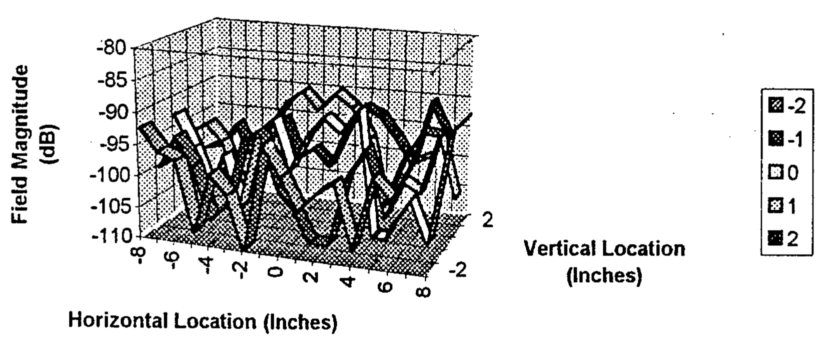


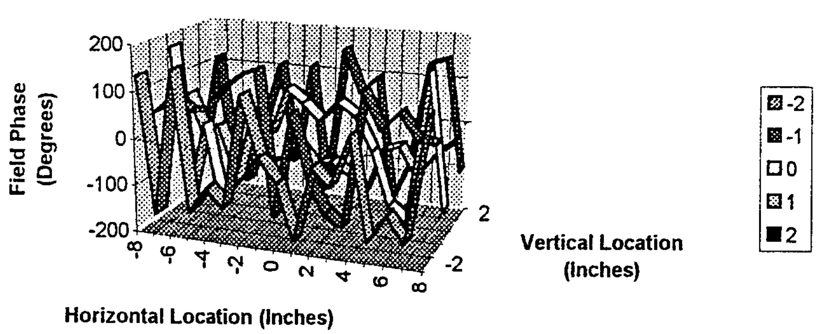
| CHAMBER - Cones Only with 5dB Random Errors and 1 inch Random Errors | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| Chamber | Dimensions: | | | 250 ft. | 70 ft. | 140 ft. | | | |
| Source | Location: | | | 0 | 0 | 0 | | | |
| Source | Angle: | | | 0 | | | | | |
| Antenna | Pattern | Exponent: | | 100 | | | | | |
| Frequency: | | | | 5.8662 | GHz | | | | |
| Absorber | Block | Location: | | 0 | 0 | 70 | | | |
| Absorber | Block | Radius: | | -1 | | | | | |
| Absorber | Block | Angle: | | 0 | | | | | |
| Absorber | Block | Attenuation: | | 40 | | | | | |
| Cone | Rectangle: | | | 0 | 125 | 0 | 70 | Hght=36" | Atn=37dB |
| Screen | Location: | | | 0 | 0 | 140 | | | |
| Screen | x (inches) | Grid: | | -8 | 8 | 1 | | | |
| Screen | y (inches) | Grid: | | -2 | 2 | 1 | | | |
| Screen | Angle: | | | 0 | | | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x | -8 | 2:33E-05 | 9.35E-06 | 2.16E-05 | 1.29E-05 | 7.91E-06 | | | |
| | -7 | 1.57E-05 | 1.72E-05 | 1.15E-05 | 1.58E-05 | 8.59E-06 | | | |
| | -6 | 1.37E-05 | 1.03E-05 | 5.21E-06 | 1.15E-05 | 1.36E-05 | | | |
| | -5 | 3.79E-06 | 3.82E-06 | 1.08E-05 | 4.89E-06 | 7.52E-06 | | | |
| | -4 | 1.16E-05 | 5.10E-06 | 4.14E-06 | 4.10E-06 | 1.05E-05 | | | |
| | -3 | 8.19E-06 | 1.79E-05 | 1.76E-05 | 1.72E-05 | 1.68E-05 | | | |
| | -2 | 2.83E-06 | 2.28E-05 | 2.38E-05 | 2.81E-05 | 7.81E-06 | | | |
| | -1 | 2.19E-05 | 8.31E-06 | 9.43E-06 | 3.56E-05 | 9.86E-06 | | | |
| | 0 | 1.29E-05 | 5.68E-06 | 1.82E-05 | 2.59E-05 | 7.22E-06 | | | |
| | 1 | 7.21E-06 | 2.96E-06 | 2.71E-05 | 3.63E-05 | 1.52E-05 | | | |
| | 2 | 1.02E-05 | 3.05E-06 | 2.08E-05 | 2.83E-05 | 2.43E-05 | | | |
| | 3 | 1.28E-05 | 1.17E-05 | 3.35E-05 | 1.62E-05 | 2.11E-05 | | | |
| | 4 | 4.13E-06 | 1.96E-05 | 1.96E-06 | 3.81E-06 | 1.42E-05 | | | |
| | 5 | 1.51E-05 | 7.35E-06 | 4.25E-06 | 7.76E-06 | 8.78E-06 | | | |
| | 6 | 1.06E-05 | 1.71E-05 | 6.94E-06 | 6.38E-06 | 2.98E-05 | | | |
| | 7 | 2.05E-05 | 2.90E-05 | 3.04E-06 | 2.01E-05 | 1.60E-05 | | | |
| ↓ | 8 | 2.41E-05 | 2.83E-05 | 2.34E-05 | 6.37E-06 | 2.31E-05 | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x | -8 | -92.6492 | -100.583 | -93.3311 | -97.7882 | -102.032 | | | |
| | -7 | -96.0875 | -95.2743 | -98.7634 | -96.0104 | -101.318 | | | |
| | -6 | -97.2466 | -99.7601 | -105.667 | -98.7559 | -97.3292 | | | |
| | -5 | -108.43 | -108.363 | -99.3396 | -106.223 | -102.471 | | | |
| | -4 | -98.7258 | -105.845 | -107.664 | -107.736 | -99.5928 | | | |
| | -3 | -101.738 | -94.9478 | -95.0897 | -95.3046 | -95.5145 | | | |
| | -2 | -110.952 | -92.8261 | -92.4758 | -91.0166 | -102.148 | | | |
| | -1 | -93.207 | -101.61 | -100.506 | -88.9808 | -100.125 | | | |
| | 0 | -97.8084 | -104.915 | -94.8081 | -91.7307 | -102.83 | | | |
| | 1 | -102.846 | -110.565 | -91.331 | -88.8138 | -96.3803 | | | |
| | 2 | -99.8195 | -110.317 | -93.6513 | -90.952 | -92.2914 | | | |
| | 3 | -97.8287 | -98.6289 | -89.4965 | -95.8365 | -93.5061 | | | |
| | 4 | -107.677 | -94.1416 | -114.164 | -108.391 | -96.9298 | | | |
| | 5 | -96.4147 | -102.673 | -107.432 | -102.208 | -101.134 | | | |
| | 6 | -99.4693 | -95.3299 | -103.177 | -103.908 | -90.5244 | | | |
| | 7 | -93.748 | -90.7431 | -110.354 | -93.9577 | -95.9393 | | | |
| ↓ | 8 | -92.3633 | -90.9673 | -92.6046 | -103.92 | -92.7127 | | | |

| | y → | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|---|
| x ↓ | -8 | 132.036 | 35.209 | 165.474 | 41.461 | -91.433 |
| | -7 | -161.468 | 71.703 | -169.997 | -44.33 | 115.997 |
| | -6 | 150.266 | 42.898 | -2.543 | -25.568 | -123.193 |
| | -5 | -148.388 | 49.99 | -174.62 | -121.301 | -172.992 |
| | -4 | -92.111 | 99.056 | -128.408 | -91.641 | -21.399 |
| | -3 | -130.664 | 131.416 | 41.253 | -108.333 | 109.963 |
| | -2 | 111.973 | 148.159 | -12.189 | -83.527 | -113.031 |
| | -1 | -14.571 | -164.247 | 95.039 | -51.274 | 112.221 |
| | 0 | -63.449 | 60.492 | 67.213 | -92.42 | -170.385 |
| | 1 | -178.37 | -68.911 | 31.476 | -79.48 | 155.633 |
| | 2 | -21.338 | -146.087 | 75.408 | -105.207 | 60.662 |
| | 3 | -57.812 | -168.437 | 49.006 | -143.795 | 98.369 |
| | 4 | 52.068 | 120.708 | -24.402 | -43.222 | -179.78 |
| | 5 | -162.259 | 43.323 | -138.49 | -30.637 | -96.688 |
| | 6 | -102.702 | 84.619 | -168.309 | -94.764 | 137.102 |
| | 7 | -156.074 | 30.087 | 156 | -41.94 | 148.818 |
| | 8 | 104.209 | 26.326 | -136.825 | -13.555 | -96.951 |

Scattering From Chamber Cones with +/- 2.5 dB and 1 Inch Random Amplitude and Location



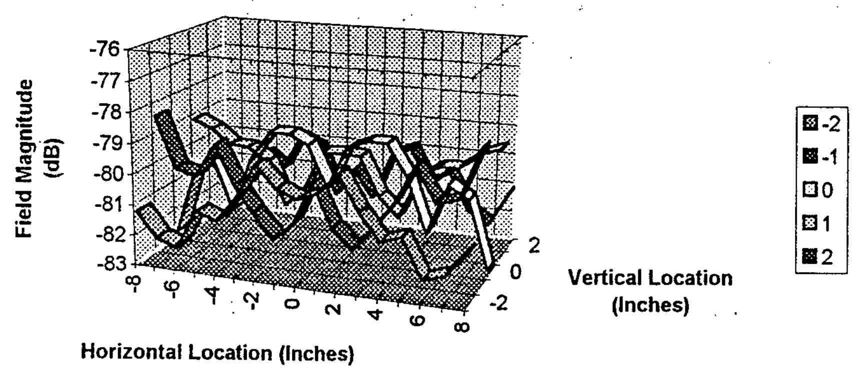

Scattering From Chamber Cones with +/- 2.5 dB and 1 Inch Random Amplitude and Location



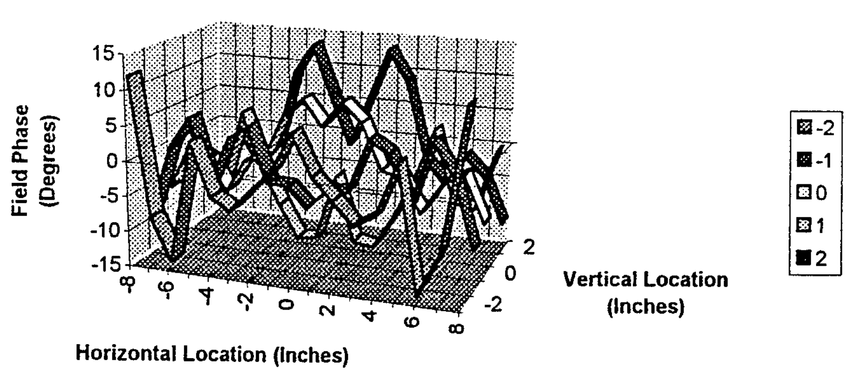
| CHAMBER - Direct Radiation + Cones Scattering | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| Chamber | Dimensions: | | | 250 ft. | 70 ft. | 140 ft. | | | |
| Source | Location: | | | 0 | 0 | 0 | | | |
| Source | Angle: | | | 0 | | | | | |
| Antenna | Pattern | Exponent: | | 100 | | | | | |
| Frequency: | | | | 5.8662 | GHz | | | | |
| Absorber | Block | Location: | | 0 | 0 | 70 | | | |
| Absorber | Block | Radius: | | 0 | | | | | |
| Absorber | Block | Angle: | | 0 | | | | | |
| Absorber | Block | Atten: | | 40 | | | | | |
| Cone | Rectangle: | | | 0 | 125 | 0 | 70 | Hght=36" | Atn=40dB |
| Screen | Location: | | | 0 | 0 | 140 | | | |
| Screen | x (inches) | Grid: | | -8 | 8 | 1 | | | |
| Screen | y (inches) | Grid: | | -2 | 2 | 1 | | | |
| Screen | Angle: | | | 0 | | | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x | -8 | 8.63E-05 | 1.19E-04 | 7.25E-05 | 1.10E-04 | 8.81E-05 | | | |
| | -7 | 7.88E-05 | 9.83E-05 | 9.37E-05 | 1.06E-04 | 7.74E-05 | | | |
| | -6 | 7.66E-05 | 9.60E-05 | 9.83E-05 | 1.00E-04 | 8.15E-05 | | | |
| | -5 | 8.87E-05 | 1.09E-04 | 8.13E-05 | 1.00E-04 | 9.36E-05 | | | |
| | -4 | 8.64E-05 | 9.48E-05 | 9.98E-05 | 9.53E-05 | 8.87E-05 | | | |
| | -3 | 9.51E-05 | 8.57E-05 | 1.12E-04 | 8.07E-05 | 1.02E-04 | | | |
| | -2 | 1.08E-04 | 7.79E-05 | 1.12E-04 | 8.69E-05 | 9.84E-05 | | | |
| | -1 | 1.00E-04 | 8.39E-05 | 1.09E-04 | 1.01E-04 | 8.20E-05 | | | |
| | 0 | 9.71E-05 | 9.85E-05 | 9.26E-05 | 1.01E-04 | 9.13E-05 | | | |
| | 1 | 1.00E-04 | 8.39E-05 | 1.09E-04 | 1.01E-04 | 8.20E-05 | | | |
| | 2 | 1.08E-04 | 7.79E-05 | 1.12E-04 | 8.69E-05 | 9.84E-05 | | | |
| | 3 | 9.51E-05 | 8.57E-05 | 1.12E-04 | 8.07E-05 | 1.02E-04 | | | |
| | 4 | 8.64E-05 | 9.48E-05 | 9.98E-05 | 9.53E-05 | 8.87E-05 | | | |
| | 5 | 8.87E-05 | 1.09E-04 | 8.13E-05 | 1.00E-04 | 9.36E-05 | | | |
| | 6 | 7.66E-05 | 9.60E-05 | 9.83E-05 | 1.00E-04 | 8.15E-05 | | | |
| | 7 | 7.88E-05 | 9.83E-05 | 9.37E-05 | 1.06E-04 | 7.74E-05 | | | |
| ↓ | 8 | 8.63E-05 | 1.19E-04 | 7.25E-05 | 1.10E-04 | 8.81E-05 | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x | -8 | -81.2768 | -78.4672 | -82.7896 | -79.2038 | -81.1034 | | | |
| | -7 | -82.0728 | -80.1525 | -80.5634 | -79.4612 | -82.2308 | | | |
| | -6 | -82.312 | -80.351 | -80.1498 | -79.9653 | -81.78 | | | |
| | -5 | -81.0396 | -79.2197 | -81.8035 | -79.9913 | -80.5708 | | | |
| | -4 | -81.2737 | -80.4684 | -80.0156 | -80.4163 | -81.0425 | | | |
| | -3 | -80.44 | -81.3455 | -79.0079 | -81.8647 | -79.8621 | | | |
| | -2 | -79.2994 | -82.167 | -78.9924 | -81.2236 | -80.1383 | | | |
| | -1 | -79.9826 | -81.5299 | -79.2914 | -79.905 | -81.7216 | | | |
| | 0 | -80.2583 | -80.1295 | -80.6725 | -79.8878 | -80.7925 | | | |
| | 1 | -79.9826 | -81.5299 | -79.2914 | -79.905 | -81.7216 | | | |
| | 2 | -79.2994 | -82.167 | -78.9924 | -81.2236 | -80.1383 | | | |
| | 3 | -80.44 | -81.3455 | -79.0079 | -81.8647 | -79.8621 | | | |
| | 4 | -81.2737 | -80.4684 | -80.0156 | -80.4163 | -81.0425 | | | |
| | 5 | -81.0396 | -79.2197 | -81.8035 | -79.9913 | -80.5708 | | | |
| | 6 | -82.312 | -80.351 | -80.1498 | -79.9653 | -81.78 | | | |
| | 7 | -82.0728 | -80.1525 | -80.5634 | -79.4612 | -82.2308 | | | |
| ↓ | 8 | -81.2768 | -78.4672 | -82.7896 | -79.2038 | -81.1034 | | | |

| | y → | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|---|
| x ↓ | -8 | 11.784 | -9.014 | -7.243 | 1.308 | -10.891 |
| | -7 | -7.958 | 0.575 | -0.762 | -7.399 | -4.143 |
| | -6 | -13.923 | 5.142 | -2.251 | -6.62 | -1.421 |
| | -5 | 3.495 | -4.265 | -6.815 | 3.628 | -5.742 |
| | -4 | -3.963 | 2.77 | -1.89 | -4.288 | -2.475 |
| | -3 | -5.635 | 4.686 | -1.254 | -9.879 | 9.007 |
| | -2 | -2.467 | -3.023 | 5.294 | -14.641 | 13.322 |
| | -1 | 0.379 | -3.104 | 7.983 | -14.191 | 6.079 |
| | 0 | 6.137 | -5.912 | 4.309 | -4.684 | -1.267 |
| | 1 | 0.379 | -3.104 | 7.983 | -14.191 | 6.079 |
| | 2 | -2.467 | -3.023 | 5.294 | -14.641 | 13.322 |
| | 3 | -5.635 | 4.686 | -1.254 | -9.879 | 9.007 |
| | 4 | -3.963 | 2.77 | -1.89 | -4.288 | -2.475 |
| | 5 | 3.495 | -4.265 | -6.815 | 3.628 | -5.742 |
| | 6 | -13.923 | 5.142 | -2.251 | -6.62 | -1.421 |
| | 7 | -7.958 | 0.575 | -0.762 | -7.399 | -4.143 |
| | 8 | 11.784 | -9.014 | -7.243 | 1.308 | -10.891 |

Direct Propagation and Scattering From Cones



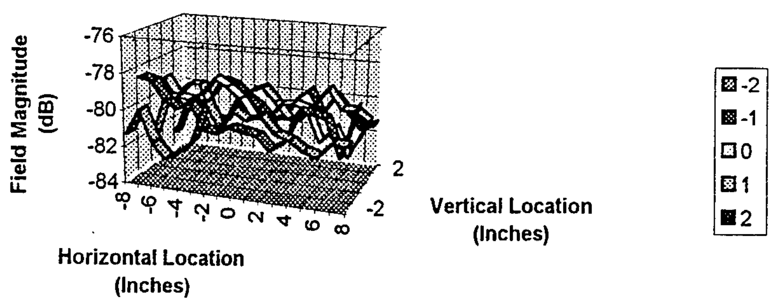

Direct Propagation and Cone Scattering



| CHAMBER - Direct Radiation + Cones Scattering with 5 dB and 1 inch Errors | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| Chamber | Dimensions: | | | 250 ft. | 70 ft. | 140 ft. | | | |
| Source | Location: | | | 0 | 0 | 0 | | | |
| Source | Angle: | | | 0 | | | | | |
| Antenna | Pattern | Exponent: | | 100 | | | | | |
| Frequency: | | | | 5.8662 | GHz | | | | |
| Absorber | Block | Location: | | 0 | 0 | 70 | | | |
| Absorber | Block | Radius: | | 0 | | | | | |
| Absorber | Block | Angle: | | 0 | | | | | |
| Absorber | Block | Atten: | | 40 | | | | | |
| Cone | Rectangle: | | | 0 | 125 | 0 | 70 | Hght=36" | Atn=37dB |
| Screen | Location: | | | 0 | 0 | 140 | | | |
| Screen | x (inches) | Grid: | | -8 | 8 | 1 | | | |
| Screen | y (inches) | Grid: | | -2 | 2 | 1 | | | |
| Screen | Angle: | | | 0 | | | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x ↓ | -8 | 8.52E-05 | 1.18E-04 | 7.61E-05 | 1.08E-04 | 7.04E-05 | | | |
| | -7 | 1.00E-04 | 1.15E-04 | 9.89E-05 | 9.54E-05 | 8.88E-05 | | | |
| | -6 | 8.18E-05 | 1.02E-04 | 1.01E-04 | 1.05E-04 | 8.61E-05 | | | |
| | -5 | 7.50E-05 | 9.81E-05 | 9.96E-05 | 1.06E-04 | 9.29E-05 | | | |
| | -4 | 7.86E-05 | 1.03E-04 | 1.04E-04 | 8.46E-05 | 1.05E-04 | | | |
| | -3 | 8.55E-05 | 8.74E-05 | 1.16E-04 | 8.29E-05 | 1.03E-04 | | | |
| | -2 | 1.10E-04 | 8.62E-05 | 1.11E-04 | 9.77E-05 | 9.48E-05 | | | |
| | -1 | 9.49E-05 | 9.02E-05 | 1.04E-04 | 1.04E-04 | 8.93E-05 | | | |
| | 0 | 1.07E-04 | 8.86E-05 | 9.20E-05 | 1.08E-04 | 8.13E-05 | | | |
| | 1 | 1.01E-04 | 8.73E-05 | 9.21E-05 | 9.84E-05 | 8.45E-05 | | | |
| | 2 | 1.05E-04 | 8.04E-05 | 1.02E-04 | 8.85E-05 | 9.67E-05 | | | |
| | 3 | 9.48E-05 | 8.51E-05 | 1.04E-04 | 8.92E-05 | 1.04E-04 | | | |
| | 4 | 9.22E-05 | 1.05E-04 | 1.01E-04 | 9.97E-05 | 8.82E-05 | | | |
| | 5 | 8.74E-05 | 1.04E-04 | 8.24E-05 | 1.11E-04 | 1.02E-04 | | | |
| | 6 | 8.49E-05 | 1.01E-04 | 9.08E-05 | 9.79E-05 | 9.15E-05 | | | |
| | 7 | 9.32E-05 | 8.07E-05 | 7.69E-05 | 9.82E-05 | 8.26E-05 | | | |
| | 8 | 9.24E-05 | 1.11E-04 | 9.03E-05 | 9.21E-05 | 8.58E-05 | | | |
| | | | | | | | | | |
| | y → | -2 | -1 | 0 | 1 | 2 | | | |
| x ↓ | -8 | -81.3871 | -78.5992 | -82.3746 | -79.3235 | -83.0473 | | | |
| | -7 | -79.9826 | -78.7634 | -80.0987 | -80.4109 | -81.0347 | | | |
| | -6 | -81.7407 | -79.811 | -79.9567 | -79.5845 | -81.304 | | | |
| | -5 | -82.4999 | -80.171 | -80.0383 | -79.5103 | -80.6397 | | | |
| | -4 | -82.0927 | -79.7517 | -79.6426 | -81.4516 | -79.5432 | | | |
| | -3 | -81.3607 | -81.1678 | -78.6809 | -81.6341 | -79.7855 | | | |
| | -2 | -79.18 | -81.2878 | -79.0935 | -80.2066 | -80.4647 | | | |
| | -1 | -80.4556 | -80.9007 | -79.6928 | -79.6844 | -80.982 | | | |
| | 0 | -79.453 | -81.0533 | -80.7214 | -79.3557 | -81.8025 | | | |
| | 1 | -79.9222 | -81.1797 | -80.7195 | -80.1445 | -81.4618 | | | |
| | 2 | -79.6094 | -81.8916 | -79.811 | -81.0602 | -80.2906 | | | |
| | 3 | -80.4611 | -81.4014 | -79.6844 | -80.9908 | -79.7012 | | | |
| | 4 | -80.7016 | -79.6011 | -79.905 | -80.0244 | -81.0956 | | | |
| | 5 | -81.1698 | -79.6844 | -81.6804 | -79.0779 | -79.845 | | | |
| | 6 | -81.4259 | -79.8792 | -80.8345 | -80.1852 | -80.7697 | | | |
| | 7 | -80.6145 | -81.8625 | -82.2849 | -80.1604 | -81.6593 | | | |
| | 8 | -80.6828 | -79.1249 | -80.8872 | -80.7158 | -81.3272 | | | |

| | y → | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|---|
| x ↓ | -8 | 5.158 | -4.358 | -10.063 | -2.863 | -19.314 |
| | -7 | -10.897 | -6.284 | -0.606 | -8.738 | 0.45 |
| | -6 | -9.009 | 7.242 | -11.224 | -12.834 | 5.913 |
| | -5 | 5.357 | -0.542 | -7.685 | 3.262 | -0.869 |
| | -4 | -12.491 | 8.15 | -8.356 | -7.443 | -1.453 |
| | -3 | -12.505 | -0.371 | -1.838 | -14.887 | 8.456 |
| | -2 | -6.738 | 6.71 | 5.487 | -15.971 | 5.062 |
| | -1 | 4.361 | 0.072 | 12.93 | -6.589 | -2.771 |
| | 0 | 2.366 | -15.344 | 8.186 | -12.043 | 2.224 |
| | 1 | -0.281 | 5.505 | 5.662 | -11.782 | 2.884 |
| | 2 | -11.074 | -4.144 | 4.045 | -16.635 | 11.864 |
| | 3 | -2.433 | -11.833 | -7.11 | -3.224 | 6.377 |
| | 4 | -8.162 | 4.577 | -1.569 | -4.885 | 3.227 |
| | 5 | -3.029 | -3.699 | -8.166 | -3.314 | -8.354 |
| | 6 | -8.203 | 6.22 | -5.046 | -8.449 | 1.382 |
| | 7 | -15.005 | -6.31 | -1.385 | -11.356 | -5.351 |
| | 8 | 9.361 | -6.636 | -5.458 | 0.614 | -10.178 |

**Direct Propagation and Scattering From Cones with +/- 2.5 dB and 1 Inch Random Absorption and Location Errors**




**Direct Propagation and Cone Scattering with +/- 2.5 dB and 1 Inch Random Amplitude and Position Errors**