



Software : by Martin J. King  
e-mail MJKing57@aol.com

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Line Configuration : Near End Open -> Driver in the Line -> Far End Open

**Unit and Constant Definition**

cycle := 2·π·rad     Hz := cycle·sec<sup>-1</sup>

Air Density :     ρ := 1.205·kg·m<sup>-3</sup>

Speed of Sound :     c := 344·m·sec<sup>-1</sup>



**Part 1 : Thiele-Small Consistent Calculation**

**Detailed User Input** (Edit This Section and Input the Parameters for the System to be Analyzed)

Woofer Series Resistance

R<sub>add</sub> := 0.5·Ω

Input Power

Power := 1·watt     (Input Power) Applied Voltage Reference ---> R<sub>ref</sub> := 8·Ω

Extended Range Driver Thiele / Small Parameters : Lowther PM2C

f<sub>d</sub> := 65.4·Hz

V<sub>ad</sub> := 38.1·liter

R<sub>e</sub> := 6.9·Ω + R<sub>add</sub>

Q<sub>ed</sub> := 0.28·(R<sub>e</sub>)·(R<sub>e</sub> - R<sub>add</sub>)<sup>-1</sup>

L<sub>vc</sub> := 0·mH

Q<sub>md</sub> := 2.96

Bl := 9.13· $\frac{\text{newton}}{\text{amp}}$

Q<sub>td</sub> :=  $\left(\frac{1}{Q_{ed}} + \frac{1}{Q_{md}}\right)^{-1}$

S<sub>d</sub> := 206·cm<sup>2</sup>

Q<sub>td</sub> = 0.273



**Bass Driver Thiele / Small Parameters : Two AE OB15 Woofer, Series VC's, in Parallel**

f<sub>d</sub> := 23.286·Hz

V<sub>ad</sub> := 2·495.6·liter

R<sub>e</sub> := 0.5·11.3·Ω + R<sub>add</sub>

Q<sub>ed</sub> := 0.93·(R<sub>e</sub>)·(R<sub>e</sub> - R<sub>add</sub>)<sup>-1</sup>

L<sub>vc</sub> := 0.5·1.499·mH

Q<sub>md</sub> := 6.97

Bl := 13.12· $\frac{\text{newton}}{\text{amp}}$

Q<sub>td</sub> :=  $\left(\frac{1}{Q_{ed}} + \frac{1}{Q_{md}}\right)^{-1}$

S<sub>d</sub> := 2·855·cm<sup>2</sup>

Q<sub>td</sub> = 0.884

## H Frame Enclosure Geometry Definition : Model of Internal Air Volume

$L := 11 \cdot \text{in}$  (Total Length of the H Frame)  
 $\xi := 2 \cdot 11^{-1}$        $\xi \cdot L = 2.000 \text{ in}$  (Fraction of the Total Length of the Front Cavity :  $0.001 < \xi < 0.999$ )  
 $S_0 := 2 \cdot 15.75 \cdot \text{in} \cdot 15.75 \cdot \text{in}$  (Area of the Driver End)  
 $S_L := 2 \cdot 15.75 \cdot \text{in} \cdot 15.75 \cdot \text{in}$  (Area of the Open End)  
 $\text{Density}_F := 0 \cdot \text{lb} \cdot \text{ft}^{-3}$  (Front Stuffing Density :  $0 \text{ lb/ft}^3 < D < 1 \text{ lb/ft}^3$ )  
 $\text{Density}_R := 0 \cdot \text{lb} \cdot \text{ft}^{-3}$  (Rear Stuffing Density :  $0 \text{ lb/ft}^3 < D < 1 \text{ lb/ft}^3$ )

## Crossover Definition

For Even Order Crossovers :    Type 1 = Linkwitz-Riley  
  Type 2 = Bessel  
  Type 3 = BEC  
  Type 4 = Butterworth

### Low Pass Filter

$f_{LP} := 30 \cdot \text{Hz}$

$LP_{\text{order}} := 1$

$LP_{\text{type}} := 4$

### High Pass Filter

$f_{HP} := 200 \cdot \text{Hz}$

$HP_{\text{order}} := 2$

$HP_{\text{type}} := 1$

(Filter Frequency)

(Filter Order : 0, 1, 2, 3, or 4)

(Filter Type : 1, 2, 3, or 4 for even order only, for odd order this entry is ignored)

## Crossover Phase Connection

$LP_{\text{phase}} := 1$

$HP_{\text{phase}} := 1$

(Phase : 1 = in phase, -1 = out of phase)

## Low Frequency Boost

$LP_{\text{boost}} := 18 \text{ dB}$

## Sub High Pass Filter

$f_{\text{sub}} := 20 \cdot \text{Hz}$

$SHP_{\text{order}} := 0$

$SHP_{\text{type}} := 4$

(Filter Frequency)

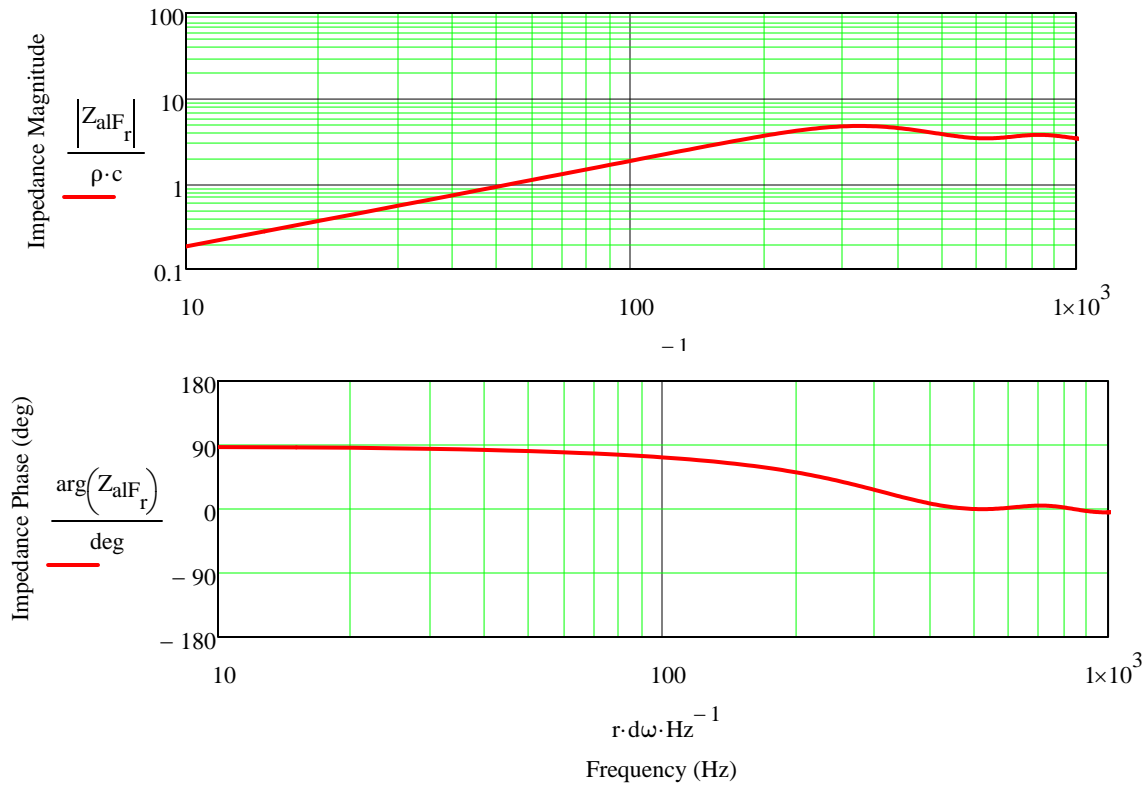
(Filter Order : 0, 1, 2, 3, or 4)

(Filter Type : 1, 2, 3, or 4 for even order only, for odd order this entry is ignored)

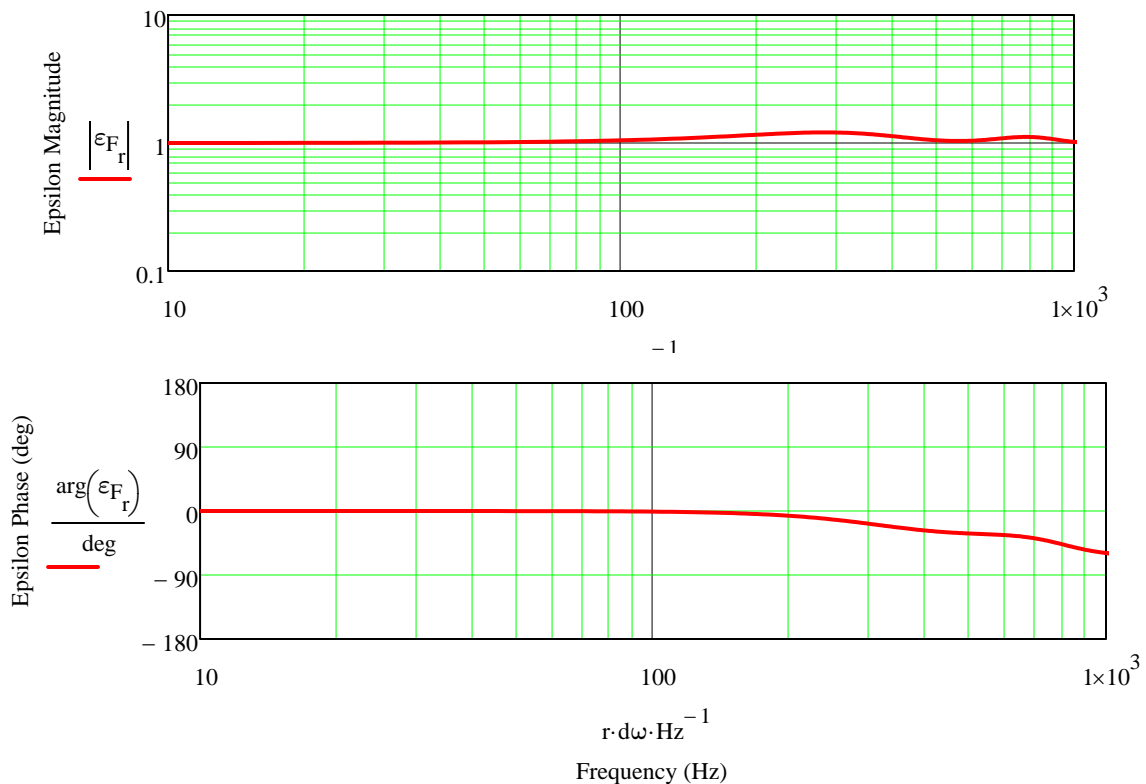
## End of Abbreviated User Input



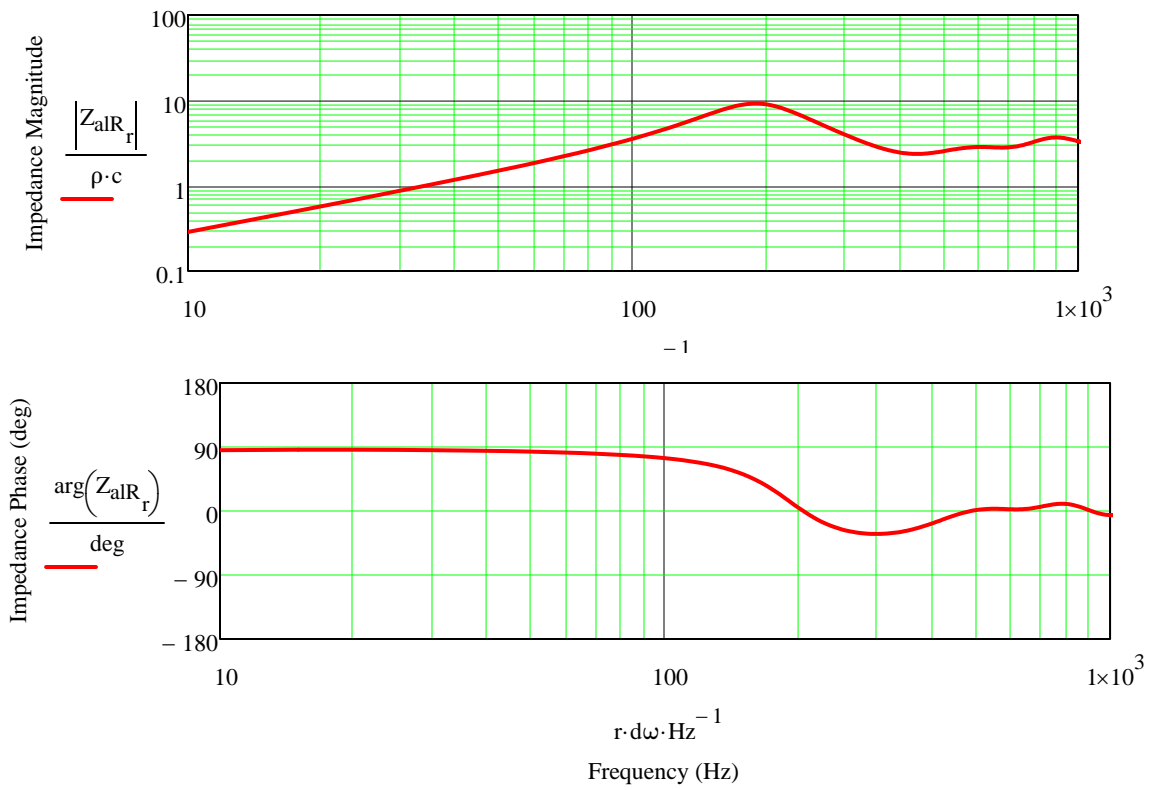
## Resulting Acoustic Impedance for the H Frame - Front Cavity



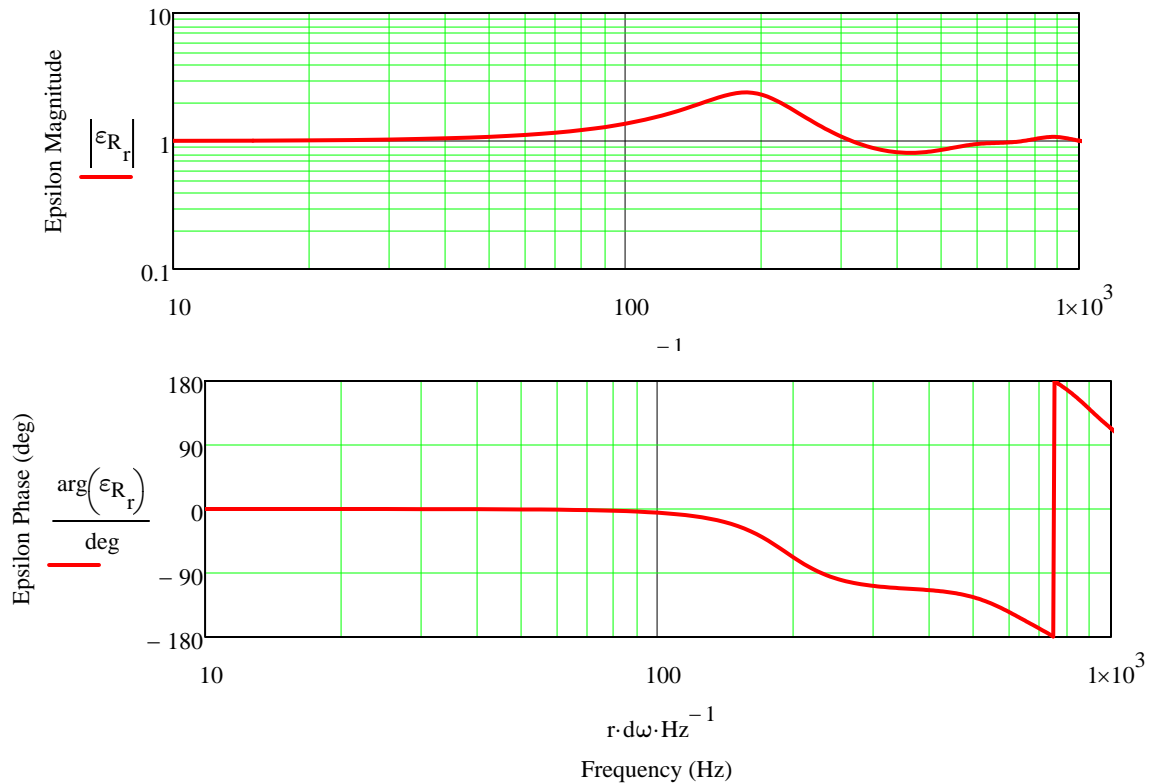
## Velocity at the Terminus of the H Frame for a 1 m/sec Excitation at the Driver - Front Cavity



### Resulting Acoustic Impedance for the H Frame - Rear Cavity



### Velocity at the Terminus of the H Frame for a 1 m/sec Excitation at the Driver - Rear Cavity



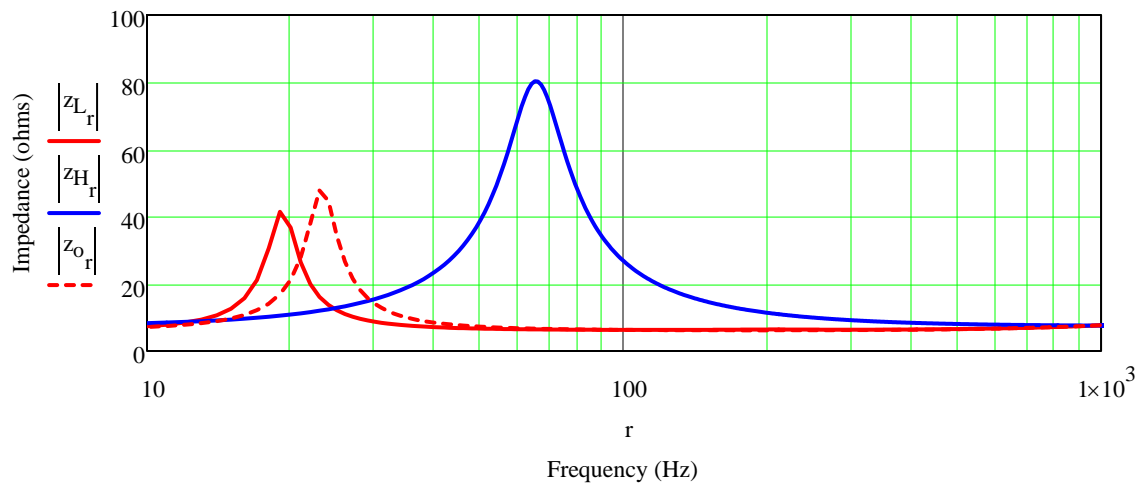
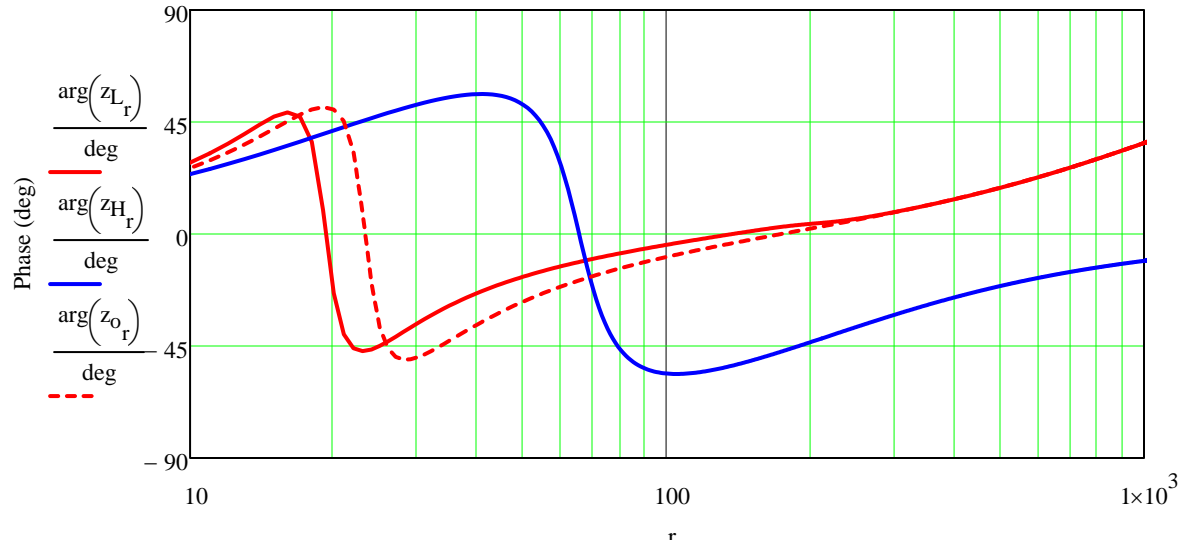


## H Frame and Infinite Baffle Woofer Impedance

Solid Red is the H Frame Impedance

Solid Blue is the Extended Range Driver Impedance

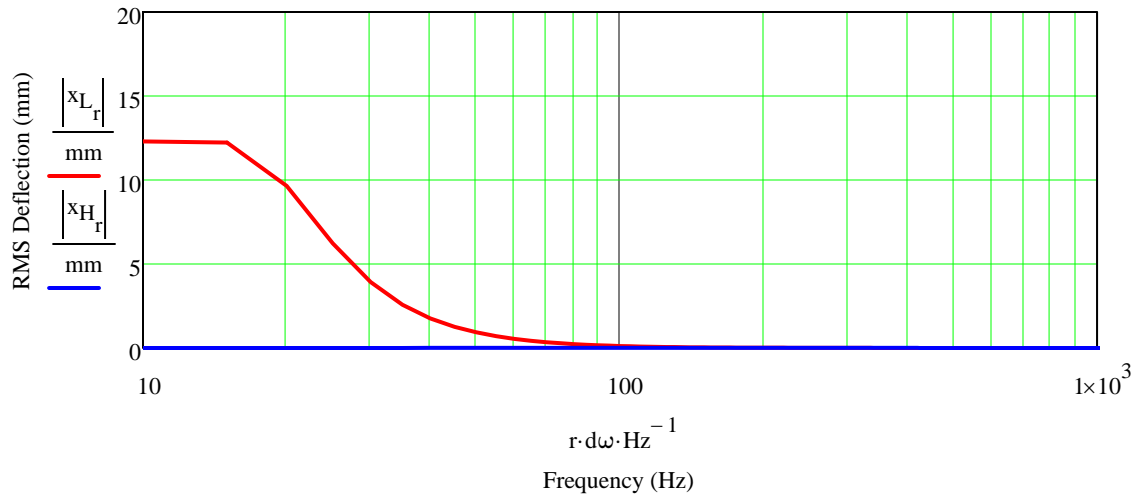
Dashed Red is the Woofer Infinite Baffle Impedance



## Driver RMS Displacements

Solid Red is the H Frame Woofer Response

Solid Blue is the OB Driver Response



## Part 2 : Detailed SPL Response Calculation

Calculation Includes :

- Position of Front Terminus and Rear Terminus on the Baffle.
- Baffle Step Defraction for the Front Terminus and the Rear Terminus.
- Room Reflections for the Front Terminus and the Rear Terminus.

### Geometry

Coordinate System :

- Origin is the lower left corner of the H Frame
- y = horizontal direction
- z = vertical direction

The variables num\_r, n\_drv, and n\_mth control the number of simple sources used in the calculations. Increasing each will improve accuracy at the expense of longer calculation times. Increase each variable until final plotted SPL stops changing at which point the solution has converged.

### Enclosure Geometry Input

- $X_0 := 4.5\text{-ft}$  (Front Baffle Distance from Rear Wall > Depth of Enclosure)
- $Y_0 := 2\text{-ft}$  (Front Baffle Distance from Side Wall)
- $\theta_0 := 30\text{-deg}$  (Rotation Towards Room Center)
- $Z_0 := 8\text{-ft}$  (Floor to Ceiling Distance)
  
- stand := 0·m (Height from Floor to Bottom Edge of Front Baffle)
- num\_r := 20 (Number of Points per Unit Length of Baffle Edge)

### H Frame Geometry Input

- $H_{\text{width}} := 2\cdot 17.25\text{-in}$  (H Frame External Width)
- $H_{\text{height}} := 17.25\text{-in}$  (H Hrame External Height)
- depth := L + 0.75·in (H Frame External Depth)
- $y_c := 17.25\text{-in}$  (Terminus Center y Coordinate)
- $z_c := 8.625\text{-in}$  (Terminus Center z Coordinate)
- $w_{\text{mth}} := 2\cdot 15.75\text{-in}$  (Terminus Width)
- n\_mth := 2·10 (Number of Points Across the Width)

### Extended Range Driver OB Geometry Input

- $OB_{\text{width}} := 20\text{-in}$  (OB panel width)
- $OB_{\text{height}} := 20\text{-in}$  (OB panel height)
- $y_{dc} := 13\text{-in}$  (Driver Center y Coordinate w.r.t. lower left corner of OB)
- $z_{dc} := 12\text{-in}$  (Driver Center z Coordinate w.r.t. lower left corner of OB)
- $\xi_{\text{ob}} := 2\text{-in}\cdot\text{depth}^{-1}$  (Fraction of the Total Depth of the H Frame :  $0.001 < \xi < 0.999$ )
- n\_high := 5 (Number of Points Across Diameter)

## Listening Position

$n\_listen = 0$  (Listening Position Relative to Speaker)  
 $radius := 1 \cdot m$  (Calculation Radius Along Axis of the Extended Range Driver)  
 $\theta := 0 \cdot deg$  (0 deg is along the Driver's Axis,  $-80 \text{ deg} < \theta < 80 \text{ deg}$ )  
 $z_p := 29.25 \cdot in$  (Default Height is Equal to Seated Height)

$n\_listen = 1$  (Listening Position Relative to the Room Corner)  
 $X_p := 10ft$   
 $Y_p := 7 \cdot ft$   
 $Z_p := 33 \cdot in$  (Default Height is Equal to Seated Height)  
 $n\_listen := 0$  (Method Selection)

## Floor Condition

Reflect := 1 (0 = hardwood or concrete, 1 = carpeted)

## Reflective Surface Selections (if 1 reflective surface is included, if 0 reflective surface is removed)

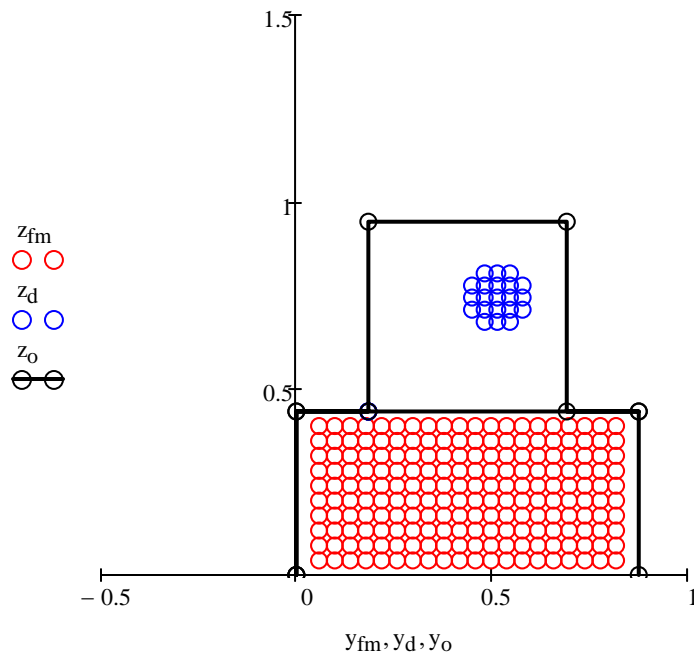
Inc\_floor := 1 (Floor,  $Z = 0$ )  
Inc\_rear := 0 (Rear Wall,  $X = 0$ )  
Inc\_side := 0 (Left Side Wall,  $Y = 0$ )  
Inc\_ceiling := 0 (Ceiling)



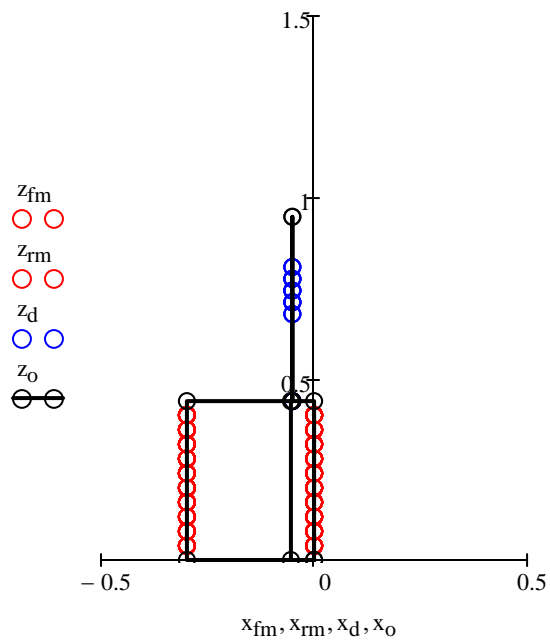


## H Frame and Extended Range Driver Simple Source Pattern with Baffle Edge Outline

Front View



Side View



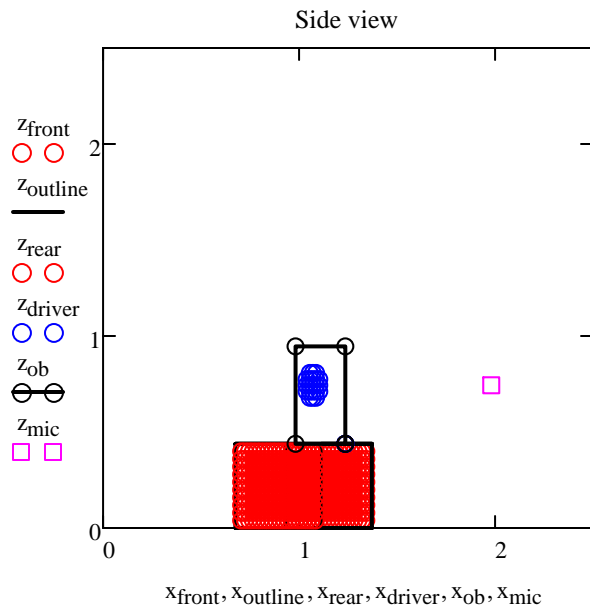
Blue sources represent extended range driver.  
Red sources represent front terminus.  
Red sources represent the rear terminus.  
Black outline represents the baffle edge.  
Origin is at the bottom front left corner of the enclosure.



### Three Dimensional View

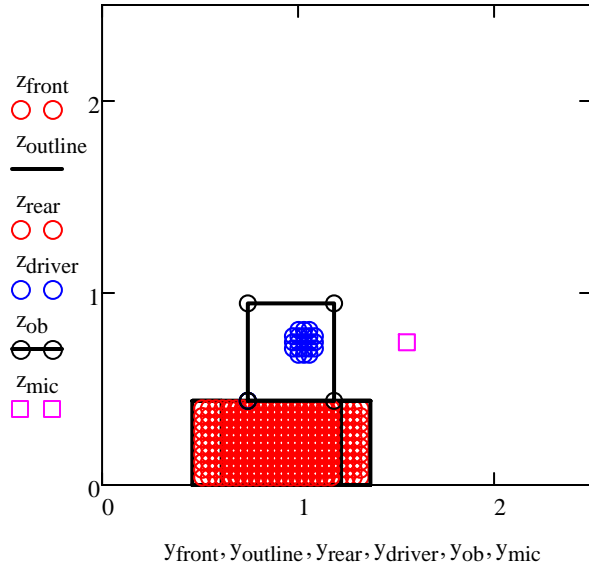
Axis Length (m) axis := 2.5 <---- Change value of "axis" to rescale plots

Room Corner is the Origin



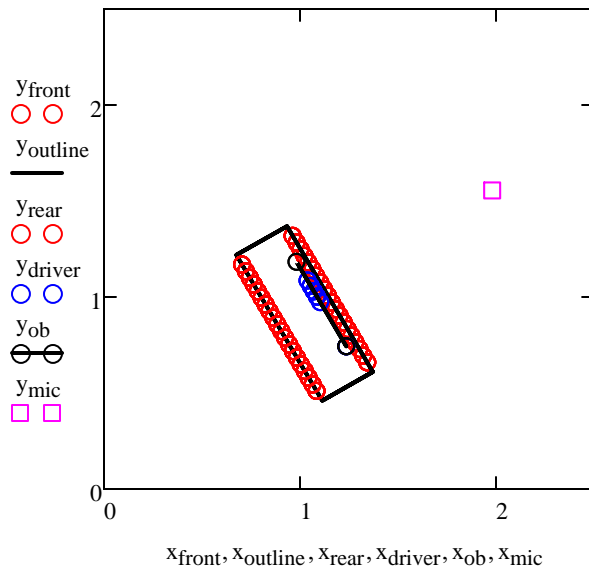
Side View - looking out from side wall

Front View



Front View - looking towards rear wall

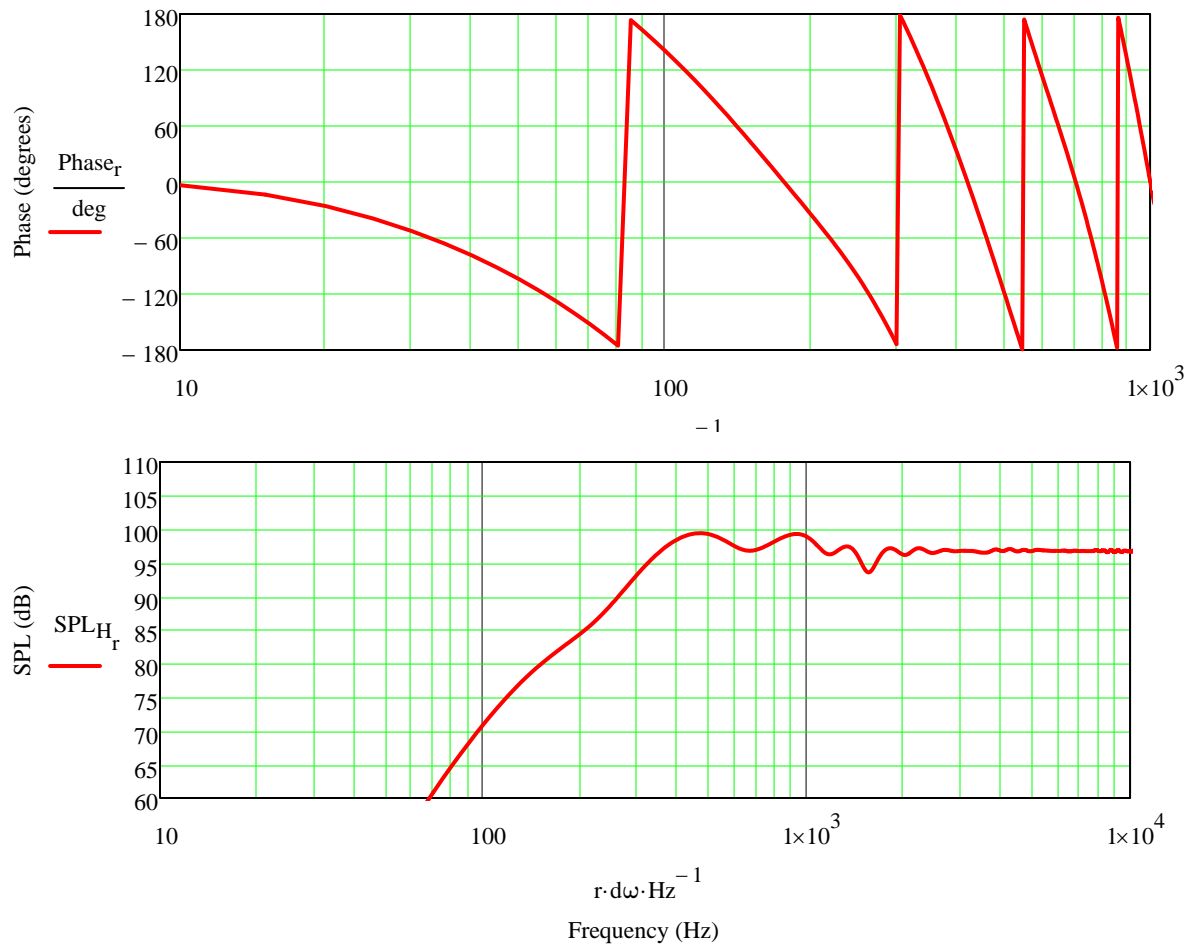
Top View



Top View - looking down from ceiling

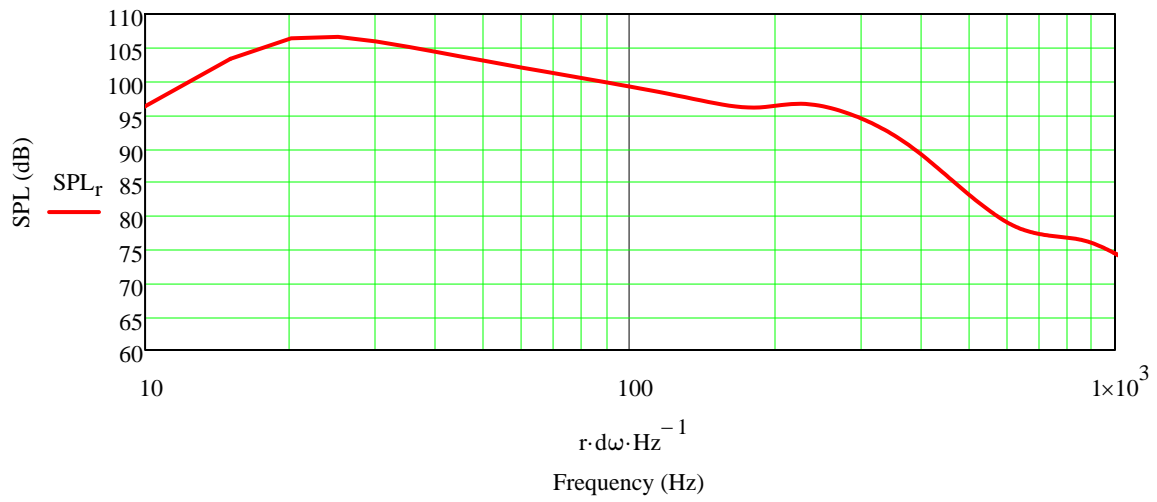
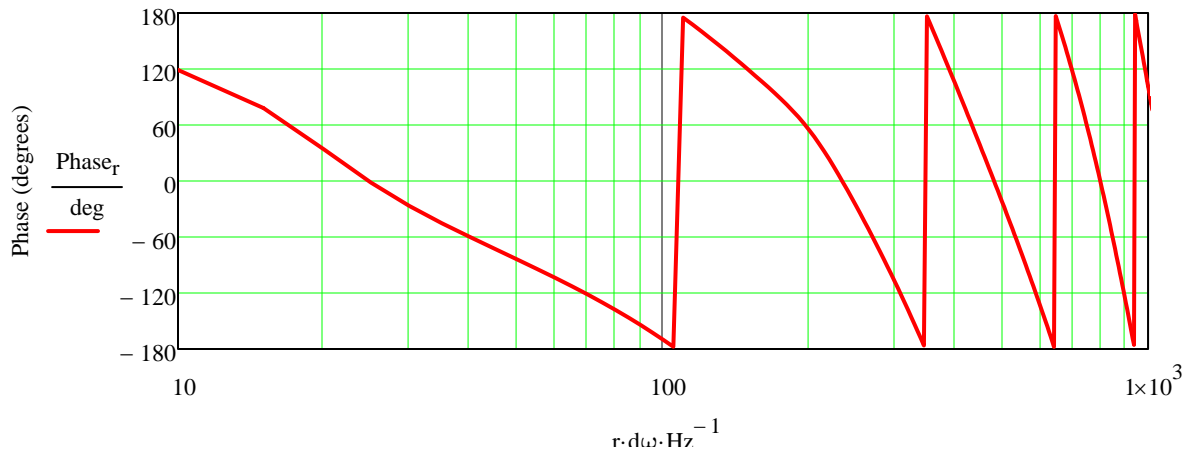


### Plotted Response for the Extended Range Driver

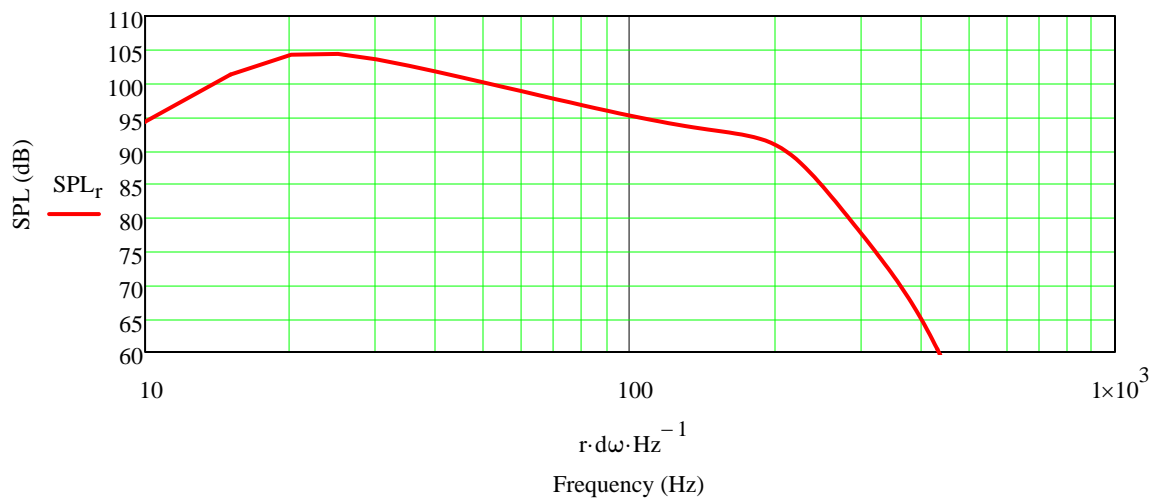
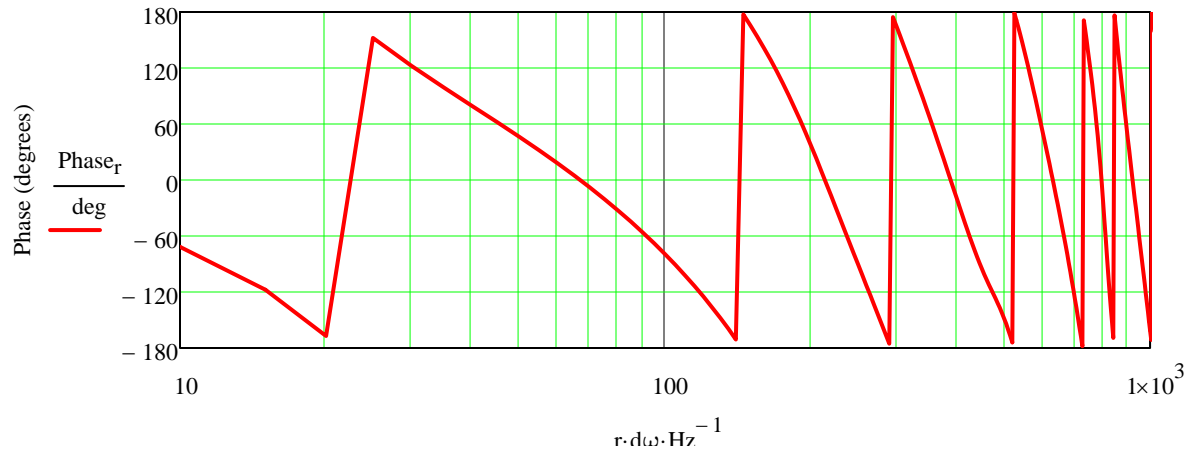




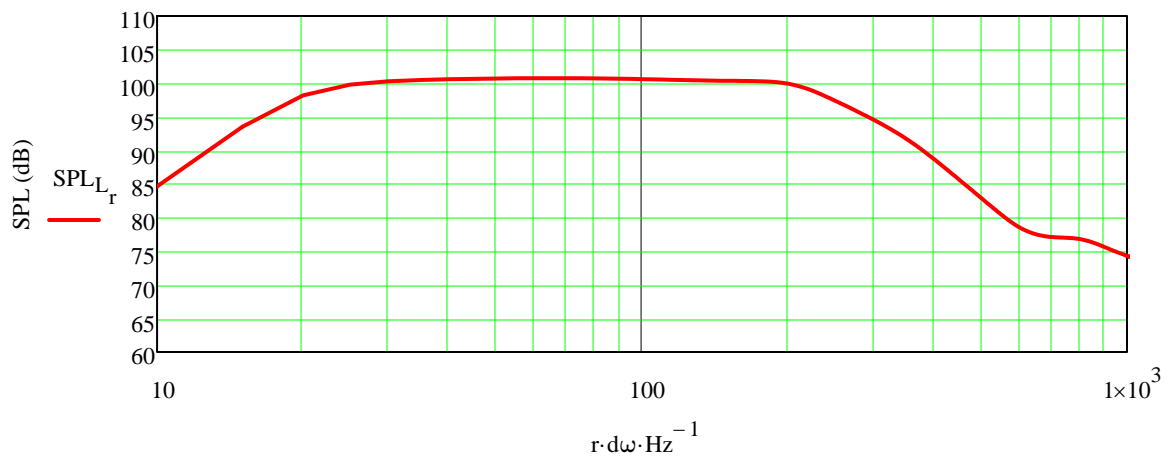
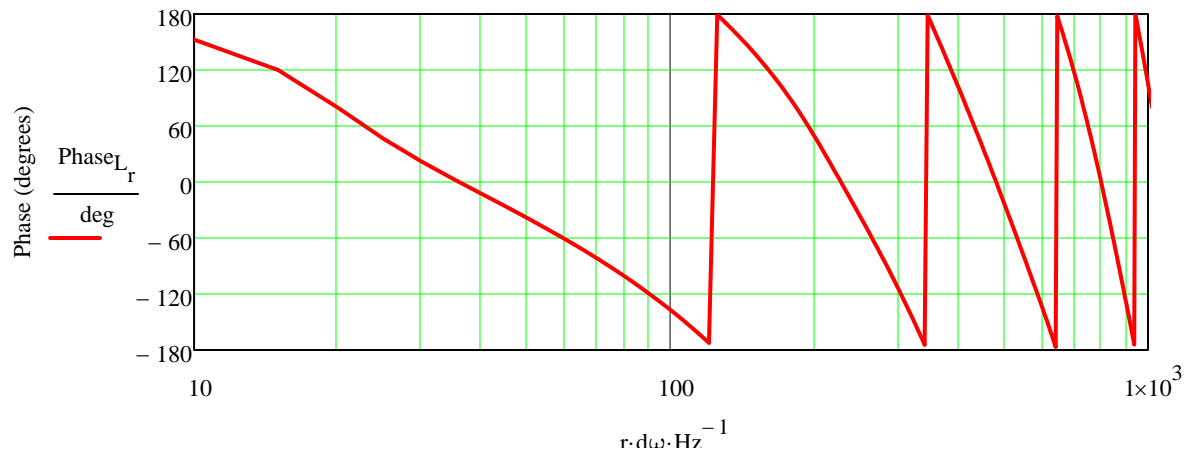
### Plotted Baffle Step and Reflection SPL Response for the Front Terminus



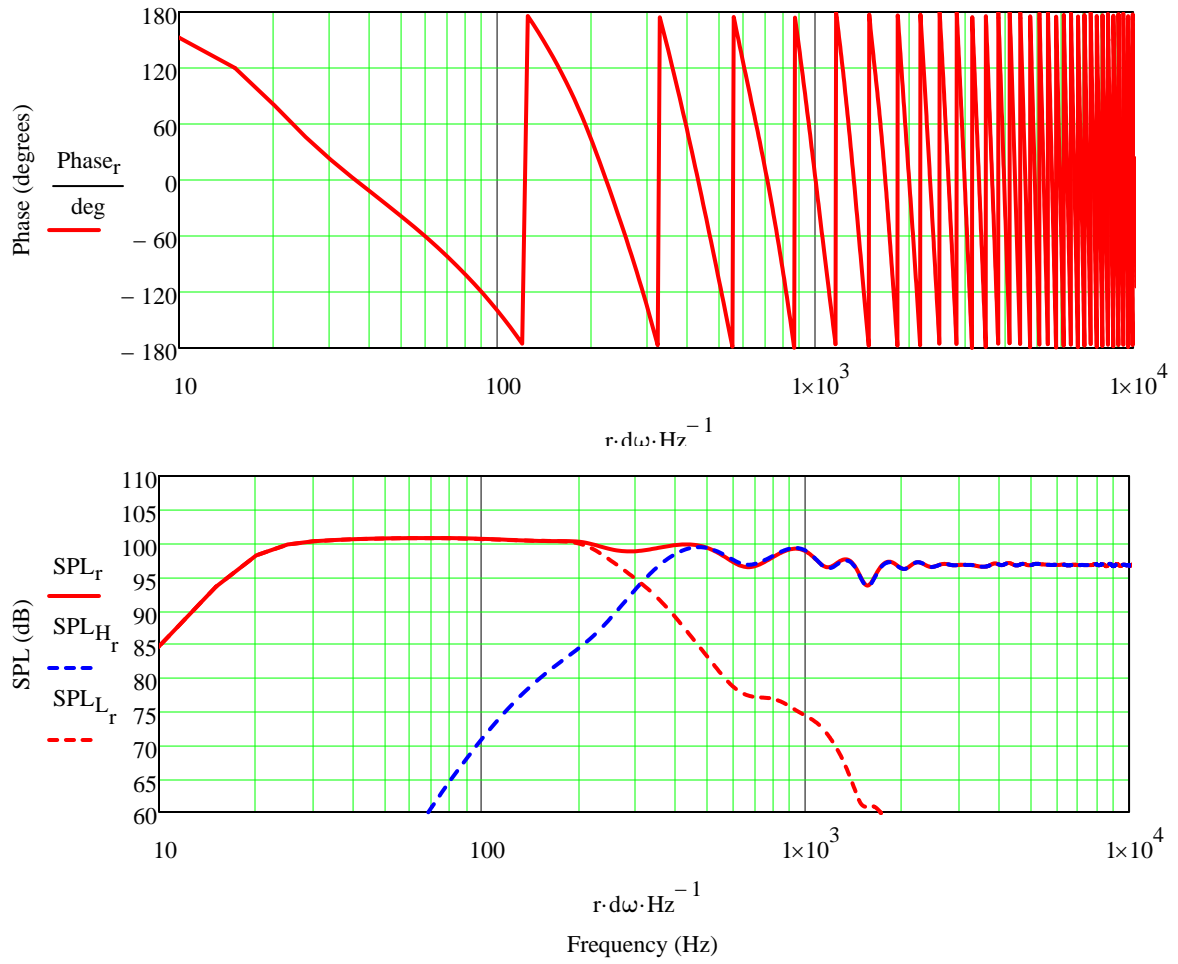
### Plotted Baffle Step and Reflection SPL Response for the Rear Terminus



### Plotted SPL Response for the H Frame



### Plotted SPL Response for the System





## System Time Response for an Impulse Input

