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Line Configuration : Near End Closed -> Offset Driver -> Far End Closed.

Unit and Constant Definition

cycle := 2·π·rad

Hz := cycle·sec⁻¹

Air Density : ρ := 1.205·kg·m⁻³

Speed of Sound : c := 344·m·sec⁻¹



Part 1 : Thiele-Small Consistent Calculation

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

Series Resistance

R_{add} := 0.0·Ω

Driver Thiele / Small Parameters : Focal 8V 4412 Average Driver in Final TL Enclosure

f_d := 33.7·Hz

V_{ad} := 66.9·liter

Adjustments

R_e := 7.7·Ω

Q_{ed} := 0.44

R_e := R_e + R_{add}

L_{vc} := 0.9·mH

Q_{md} := 2.57

Q_{ed} := Q_{ed}·R_e·(R_e - R_{add})⁻¹

Bl := 9.2· $\frac{\text{newton}}{\text{amp}}$

Q_{td} := $\left(\frac{1}{Q_{ed}} + \frac{1}{Q_{md}}\right)^{-1}$

S_d := 221.7·cm²

Q_{td} = 0.376

Enclosure Geometry Definition

L := 15·in

(Length)

Driver Distance

ξ := 0.5

(Driver Position Ratio : 0.001 < ξ < 0.999)

ξ·L = 7.50 in

S₀ := 3·S_d

(Area of the Closed End)

S_L := 3·S_d

(Area of the Open End)

Density := 0.5·lb·ft⁻³

(Stuffing density : 0 lb/ft³ < D < 1 lb/ft³)

Power := 1·watt

(Input Power) Applied Voltage Reference ---> R_{ref} := 8·Ω

End of Abbreviated User Input

Pre Formated Geometry and Stuffing Location Input (Only Edit Details Below to Change Defaults)

Transmission Line Definition (0 lb/ft³ < D < 1 lb/ft³)

$n_{closed} := 4$ (n_closed > 1)

$n_{open} := 4$ (n_open > 1)

Geometry Definition

$TR := (S_L - S_0) \cdot L^{-1}$ TR = 0.000 m

Closed End of Transmission Line (Driver ----> Closed End)

Section Length	Initial Area	Final Area	Stuffing Density
$L_{c_0} := L \cdot \xi \cdot (n_{closed} + 1)^{-1}$	$S_{c_{0,0}} := S_0 + TR \cdot \xi \cdot L$	$S_{c_{0,1}} := S_{c_{0,0}} - TR \cdot L_{c_0}$	$D_{c_0} := \text{Density}$
$L_{c_1} := L \cdot \xi \cdot (n_{closed} + 1)^{-1}$	$S_{c_{1,0}} := S_{c_{0,1}}$	$S_{c_{1,1}} := S_{c_{1,0}} - TR \cdot L_{c_1}$	$D_{c_1} := \text{Density}$
$L_{c_2} := L \cdot \xi \cdot (n_{closed} + 1)^{-1}$	$S_{c_{2,0}} := S_{c_{1,1}}$	$S_{c_{2,1}} := S_{c_{2,0}} - TR \cdot L_{c_2}$	$D_{c_2} := \text{Density}$
$L_{c_3} := L \cdot \xi \cdot (n_{closed} + 1)^{-1}$	$S_{c_{3,0}} := S_{c_{2,1}}$	$S_{c_{3,1}} := S_{c_{3,0}} - TR \cdot L_{c_3}$	$D_{c_3} := \text{Density}$
$L_{c_4} := L \cdot \xi \cdot (n_{closed} + 1)^{-1}$	$S_{c_{4,0}} := S_{c_{3,1}}$	$S_{c_{4,1}} := S_0$	$D_{c_4} := \text{Density}$

Open End of Transmission Line (Driver ----> Open End)

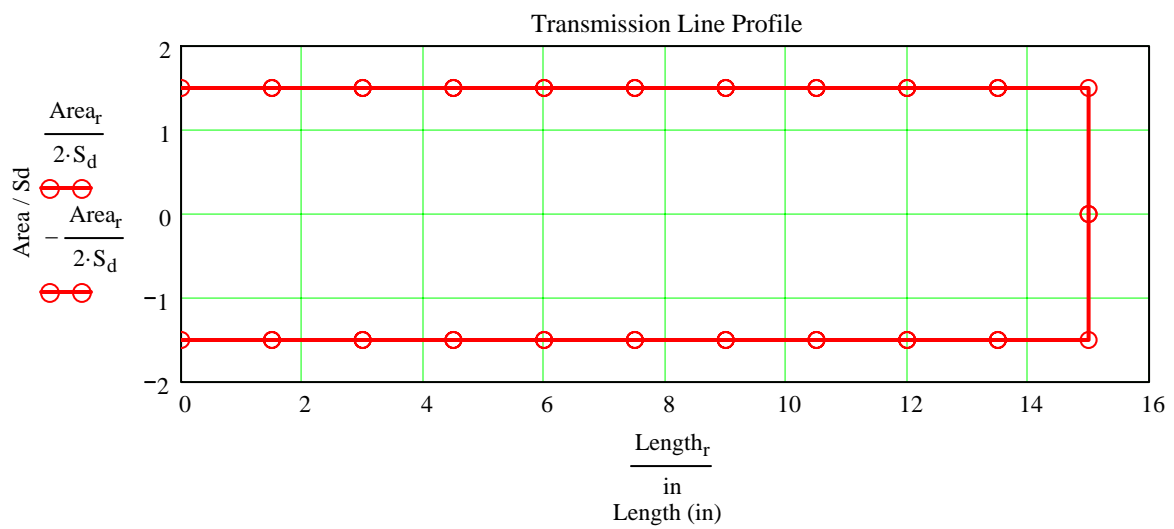
Section Length	Initial Area	Final Area	Stuffing Density
$L_{o_0} := L \cdot (1 - \xi) \cdot (n_{open} + 1)^{-1}$	$S_{o_{0,0}} := S_{c_{0,0}}$	$S_{o_{0,1}} := S_{o_{0,0}} + TR \cdot L_{o_0}$	$D_{o_0} := \text{Density}$
$L_{o_1} := L \cdot (1 - \xi) \cdot (n_{open} + 1)^{-1}$	$S_{o_{1,0}} := S_{o_{0,1}}$	$S_{o_{1,1}} := S_{o_{1,0}} + TR \cdot L_{o_1}$	$D_{o_1} := \text{Density}$
$L_{o_2} := L \cdot (1 - \xi) \cdot (n_{open} + 1)^{-1}$	$S_{o_{2,0}} := S_{o_{1,1}}$	$S_{o_{2,1}} := S_{o_{2,0}} + TR \cdot L_{o_2}$	$D_{o_2} := \text{Density}$
$L_{o_3} := L \cdot (1 - \xi) \cdot (n_{open} + 1)^{-1}$	$S_{o_{3,0}} := S_{o_{2,1}}$	$S_{o_{3,1}} := S_{o_{3,0}} + TR \cdot L_{o_3}$	$D_{o_3} := \text{Density}$
$L_{o_4} := L \cdot (1 - \xi) \cdot (n_{open} + 1)^{-1}$	$S_{o_{4,0}} := S_{o_{3,1}}$	$S_{o_{4,1}} := S_L$	$D_{o_4} := \text{Density}$

Total Length of the Transmission Line

$$\sum_{i=0}^{n_{\text{closed}}} L_{c_i} + \sum_{i=0}^{n_{\text{open}}} L_{o_i} = 15.000 \text{ in}$$

Total Amount of Stuffing

$$\sum_{r=0}^{n_{\text{closed}}} \left(\frac{S_{c_{r,0}} + S_{c_{r,1}}}{2} \cdot L_{c_r} \cdot D_{c_r} \right) + \sum_{r=0}^{n_{\text{open}}} \left(\frac{S_{o_{r,0}} + S_{o_{r,1}}}{2} \cdot L_{o_r} \cdot D_{o_r} \right) = 0.447 \text{ lb}$$

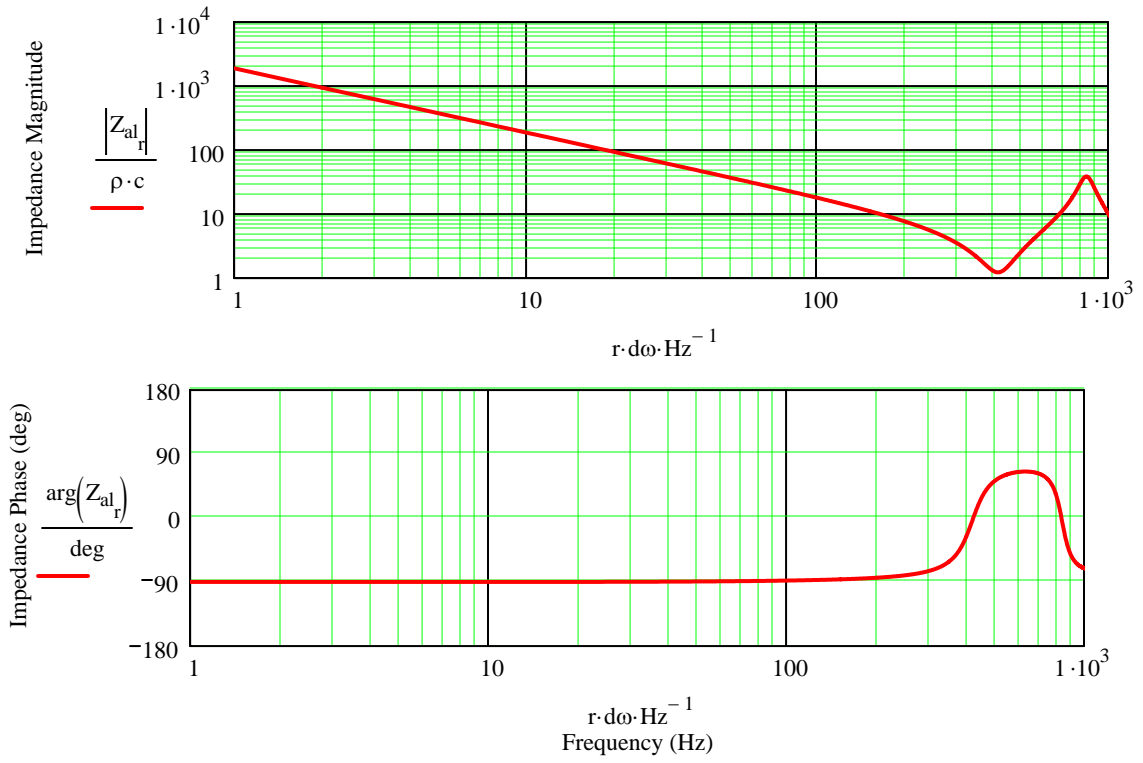


End of Detailed Input

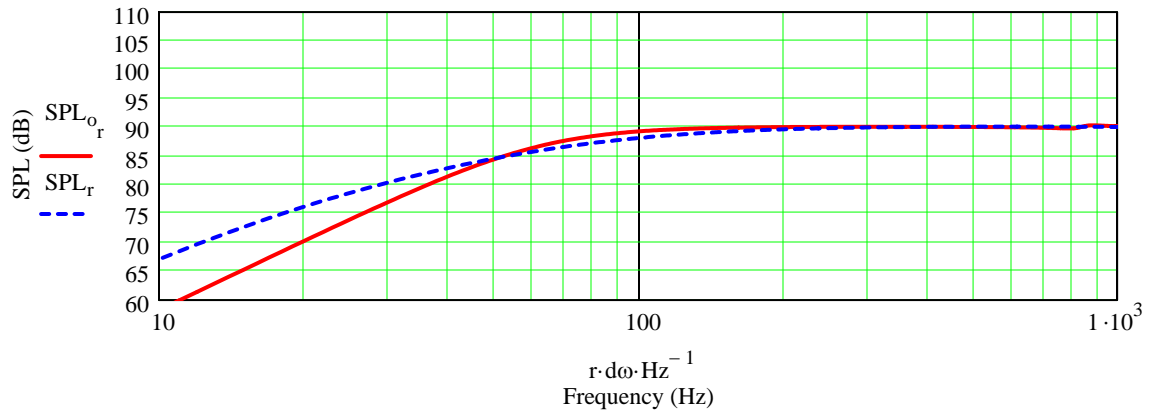
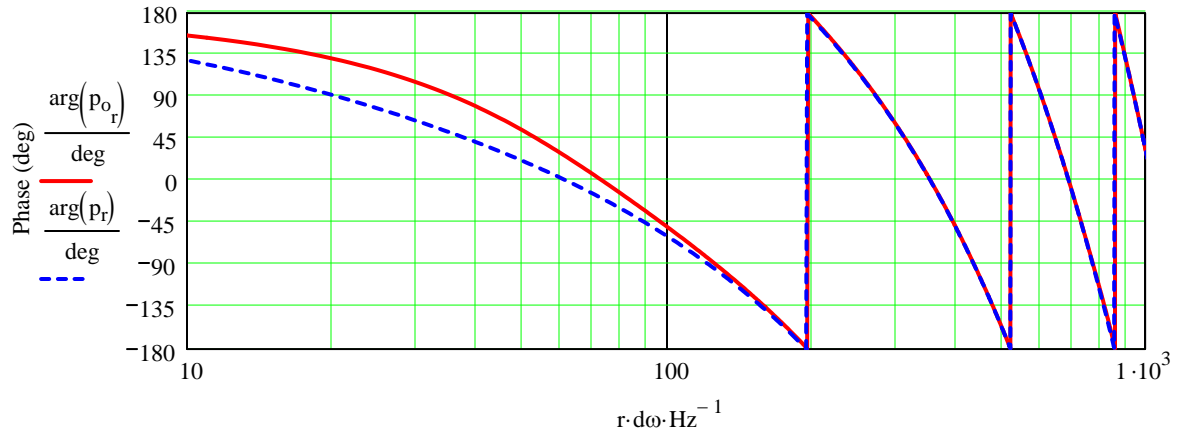
End of Part 1 Input



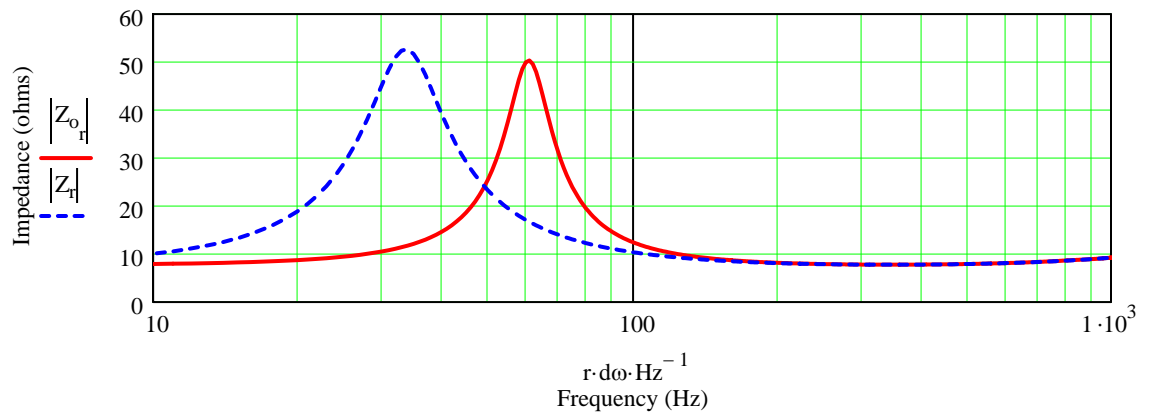
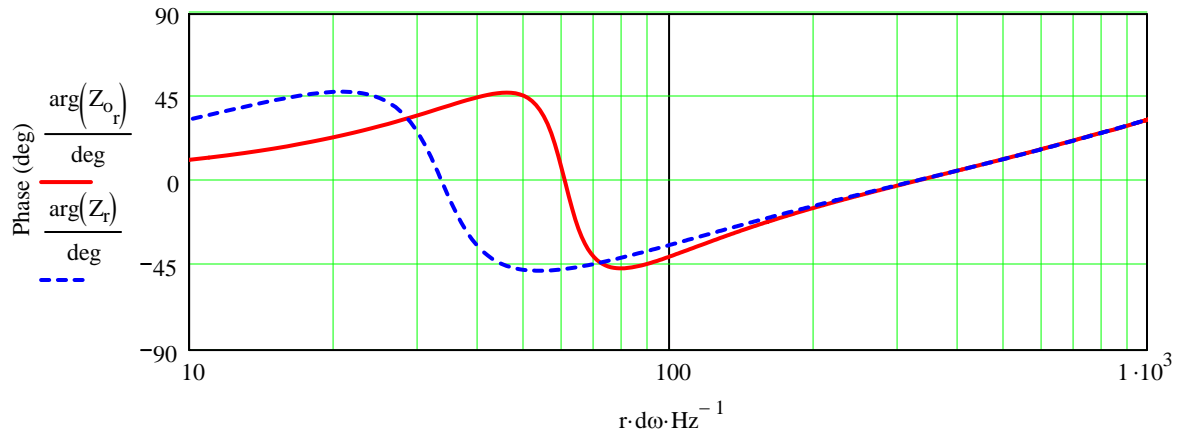
Resulting Acoustic Impedance for the Transmission Line



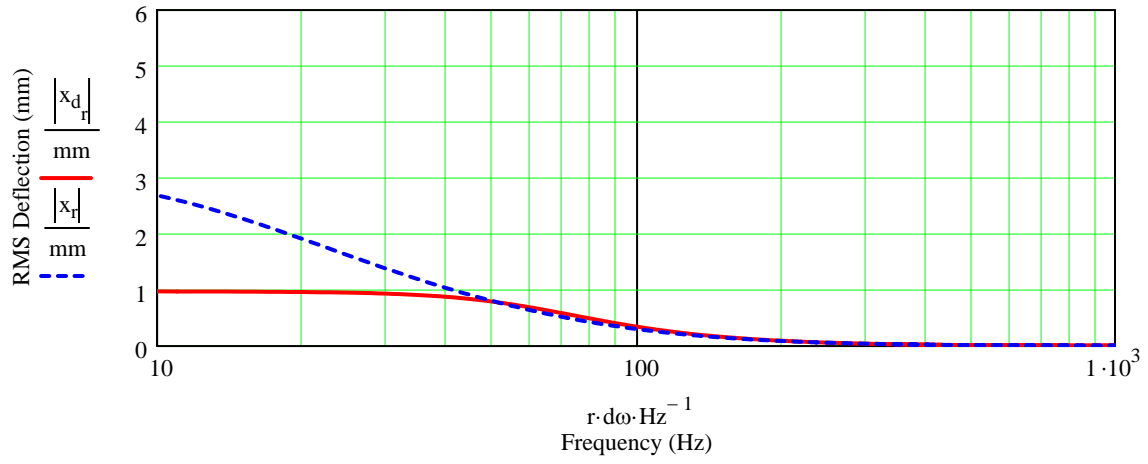
Far Field Transmission Line System and Infinite Baffle Sound Pressure Level Responses



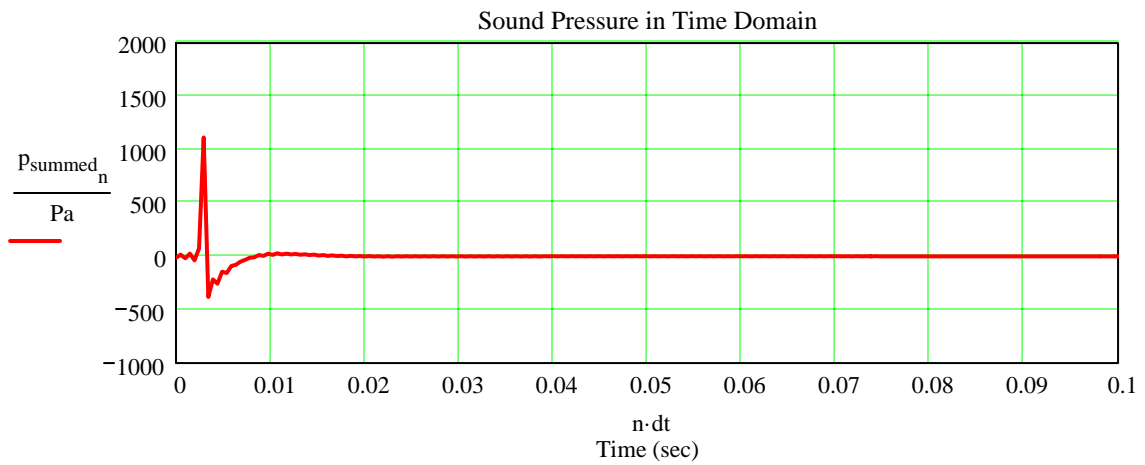
Transmission Line System and Infinite Baffle Impedance



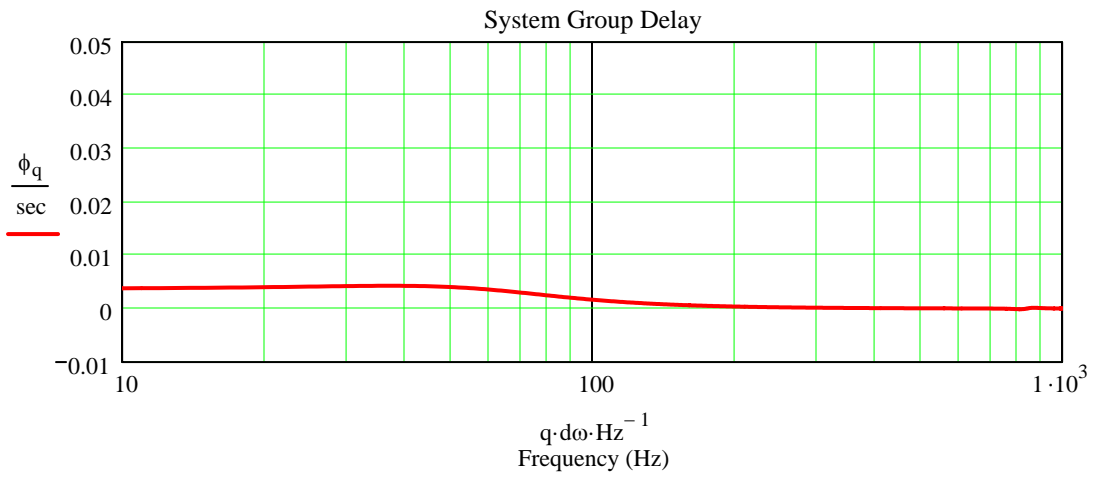
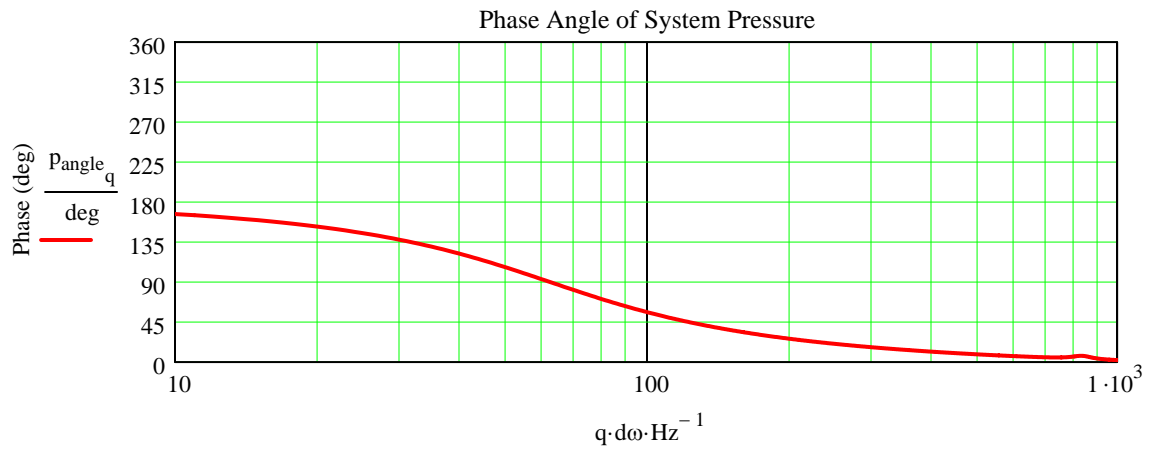
Woofer RMS Displacement



System Time Response for an Impulse Input



System Group Delay



Part 2 : Detailed SPL Response Calculation

Calculation Includes :

- Position of Driver on the Baffle.
- Baffle Step Defraction for the Driver.
- Room Reflections for the Driver.

Geometry

Baffle Coordinate System :

- Origin is the lower left corner of the front baffle
- y = horizontal direction
- z = vertical direction

The variables num_r, n_drv, and n_mth control the number of simple sources that are used in the calculations. Increasing each will improve accuracy at the expense of longer calculation times. Increase each variable until plotted SPL stops changing at which point the solution has converged.

Enclosure Geometry Input

- $X_0 := 2 \cdot \text{ft}$ (Front Baffle Distance from Rear Wall > Depth of Enclosure)
- $Y_0 := 2 \cdot \text{ft}$ (Front Baffle Distance from Side Wall)
- $\theta_0 := 45 \cdot \text{deg}$ (Rotation Towards Room Center)
- $Z_0 := 8 \cdot \text{ft}$ (Floor to Ceiling Distance)

- stand := 12-in (Height from Floor to Bottom Edge of Front Baffle)
- num_r := 10 (Number of Points per Unit Length of Baffle Edge)

Corner Coordinates

- | Y coordinate | Z coordinate | |
|-----------------------------------|-----------------------------------|-----------------------|
| $y_{o_0} := 11.5 \cdot \text{in}$ | | (Bottom Right Corner) |
| $y_{o_1} := 11.5 \cdot \text{in}$ | $z_{o_1} := 16.5 \cdot \text{in}$ | (Top Right Corner) |
| $y_{o_2} := 0 \cdot \text{in}$ | $z_{o_2} := 16.5 \cdot \text{in}$ | (Top Left Corner) |
| $y_{o_3} := 0 \cdot \text{in}$ | | (Bottom Left Corner) |
| depth := 11.5-in | | (Depth of Enclosure) |

Driver Geometry Input

$y_{dc} := 5.75 \cdot \text{in}$ (Driver Center y Coordinate)
 $z_{dc} := 8.25 \cdot \text{in}$ (Driver Center z Coordinate)
 $n_{dvr} := 5$ (Number of Points Across Diameter)

Listening Position (Default Location is at 1 m Distance Along the Driver's Axis)

$n_{listen} = 0$ (Listening Position Relative to Speaker)
 $\text{radius} := 1 \cdot \text{m}$ (Calculation Radius, Effective Radius is Greater if y_p is Changed from Default)
 $\theta := 0 \cdot \text{deg}$ (0 deg is along the Driver's Axis, $-80 \text{ deg} < \theta < 80 \text{ deg}$)
 $z_p := z_{dc} + \text{stand}$ (Default Height is Equal to Driver Height)

$n_{listen} = 1$ (Listening Position Relative to the Room Corner)
 $X_p := 10 \text{ft}$
 $Y_p := 7 \cdot \text{ft}$
 $Z_p := z_{dc} + \text{stand}$ (Default Height is Equal to Driver Height)
 $n_{listen} := 0$ (Method Selection)

Floor Condition

$\text{Reflect} := 1$ (0 = hardwood or concrete, 1 = carpeted)

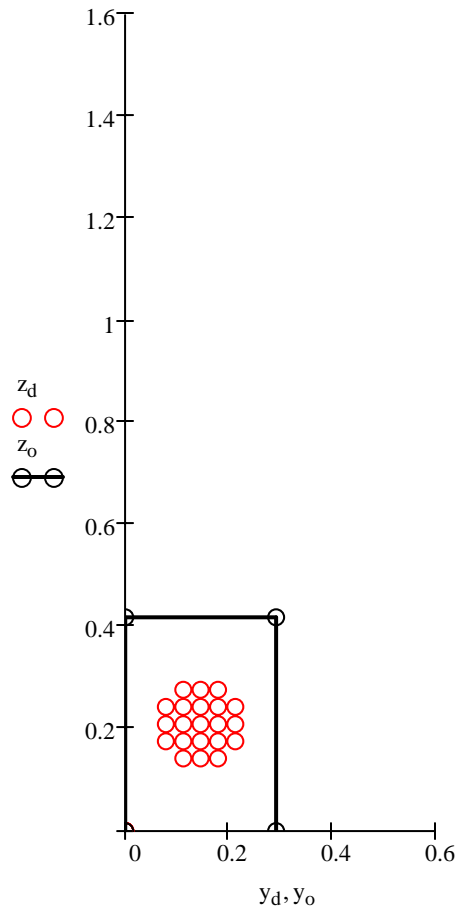
Reflective Surface Selections (if 1 reflective surface is included, if 0 reflective surface is removed)

$\text{Inc}_{\text{floor}} := 1$ (Floor, $Z = 0$)
 $\text{Inc}_{\text{rear}} := 1$ (Rear Wall, $X = 0$)
 $\text{Inc}_{\text{side}} := 1$ (Left Side Wall, $Y = 0$)
 $\text{Inc}_{\text{ceiling}} := 1$ (Ceiling)

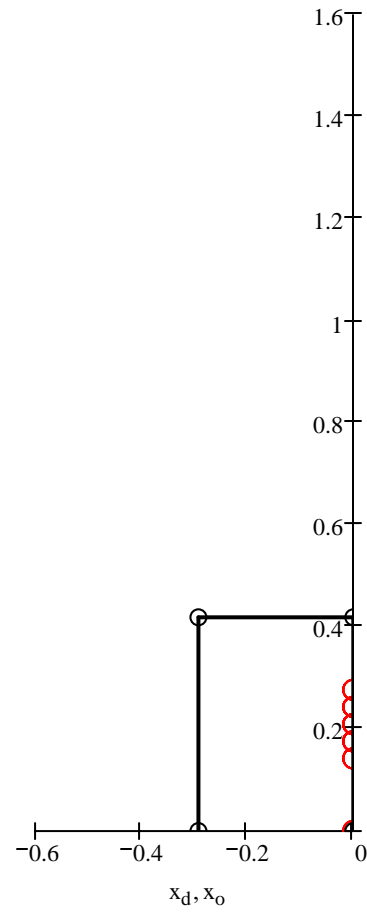


Circular Driver Simple Source Pattern with Baffle Edge Outline

Front View



Side View



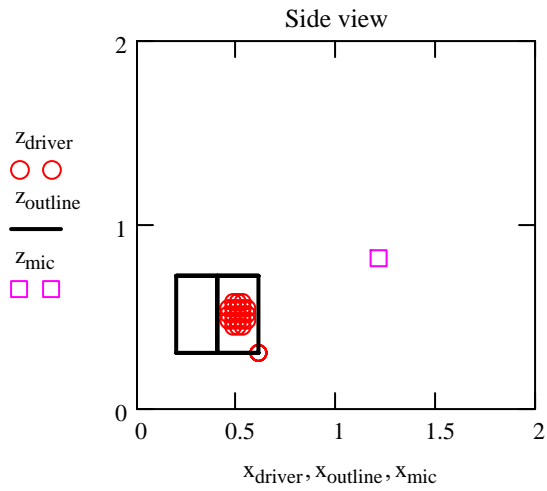
Red sources represent the driver.
Blue sources represent the terminus.
Black outline represents the baffle edge.
Origin is at the bottom front left corner of the enclosure.



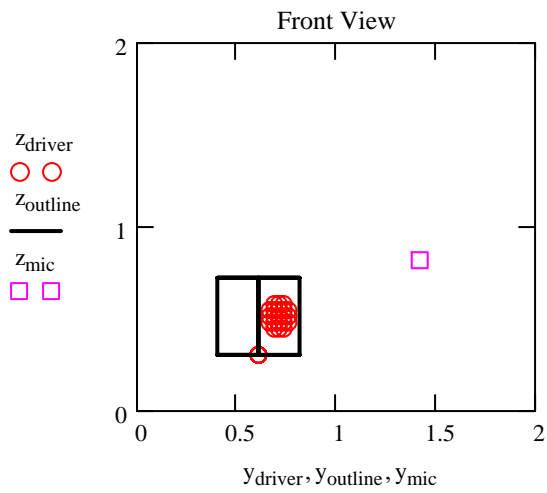
Three Dimensional View

Axis Length (m) axis := 2 <---- Change value of "axis" to rescale plots

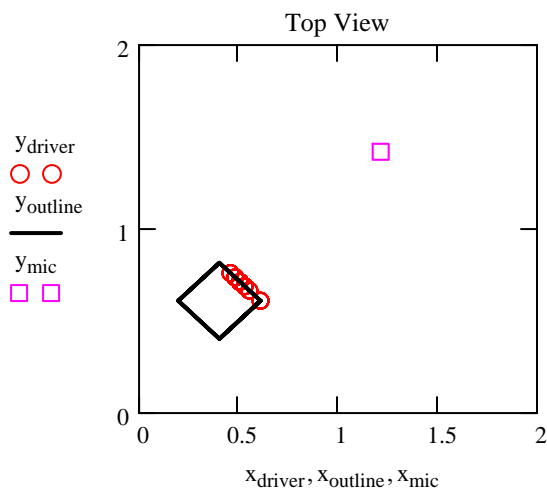
Room Corner is the Origin



Side View - looking out from side wall



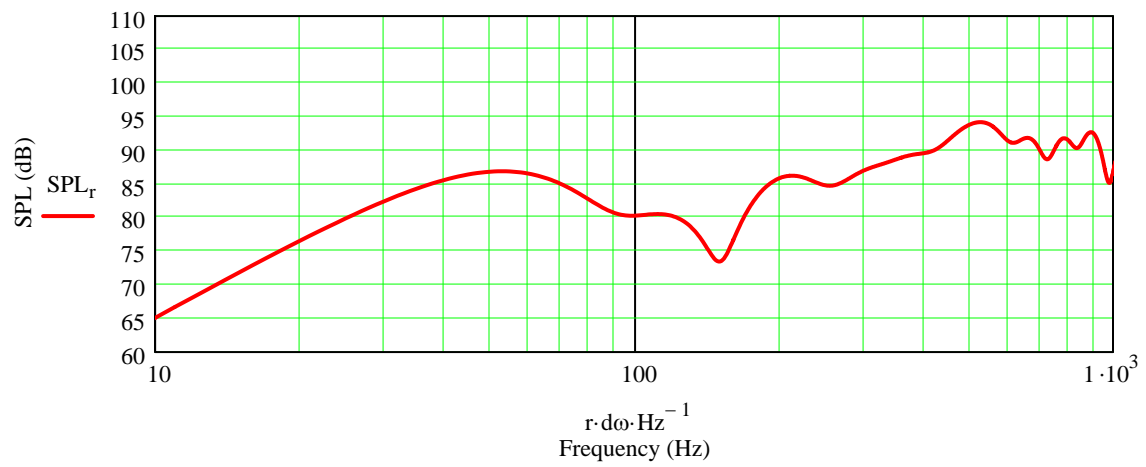
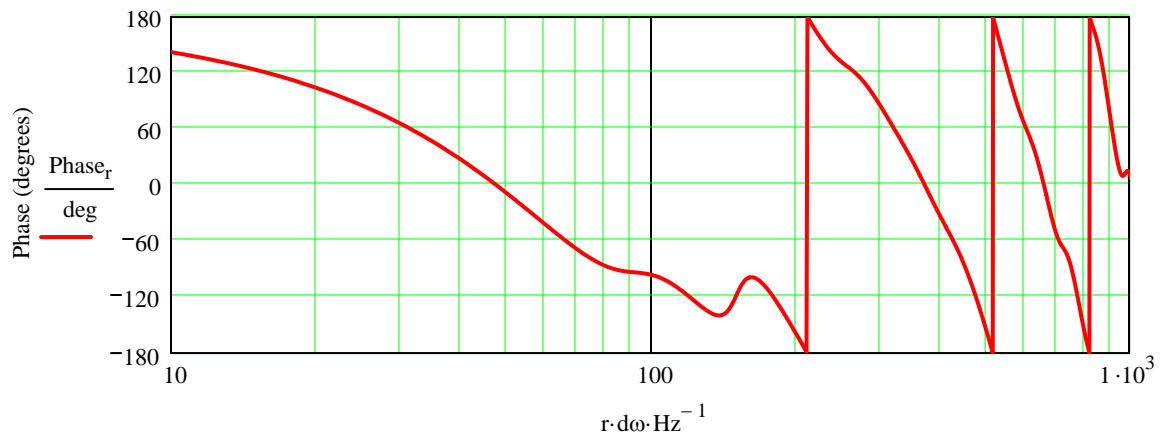
Front View - looking towards rear wall



Top View - looking down from ceiling



Plotted SPL Response for the System



Part 3 : Baffle Step Correction Circuit Design

Input Center Frequency of the Baffle Step and the desired dB of Attenuation.

$f_{\text{center}} := 400 \cdot \text{Hz}$ <--- Input Center Frequency

$\text{dB} := 4$ <--- Input dB of Attenuation

Calculated Component Values

User Assigned Component Values
Based on Calculated Values at Left

$$R_e \cdot \left(10^{\frac{\text{dB}}{20}} - 1 \right) = 4.504 \Omega$$

Parallel Resistor

Input Value --->

$$R_{\text{parallel}} := 4.5 \Omega$$

$$\frac{R_{\text{parallel}}}{f_{\text{center}}} = 1.790 \text{ mH}$$

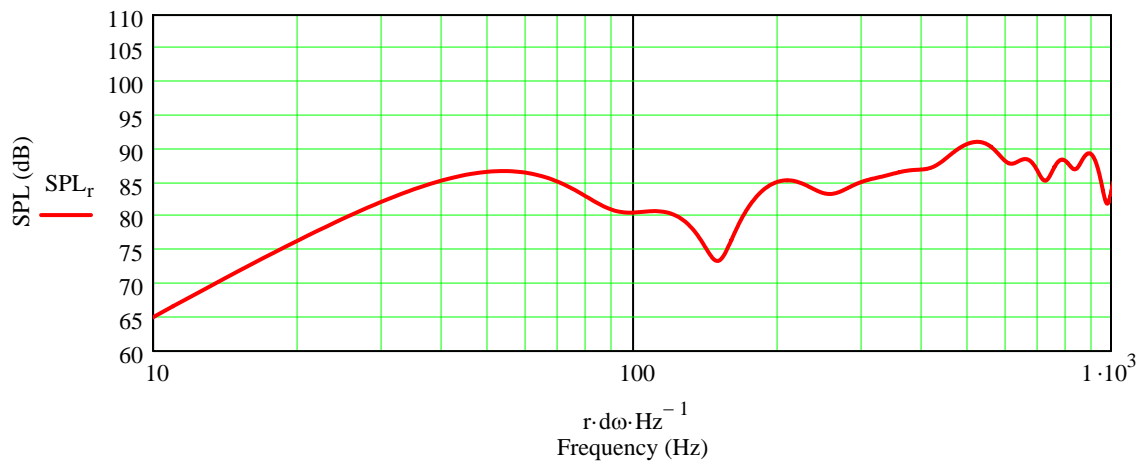
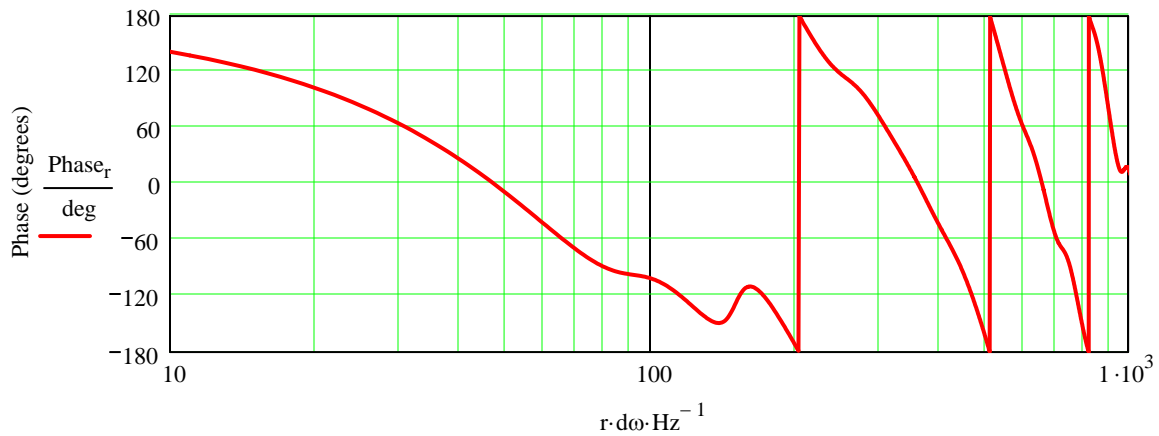
BSC Inductor

Input Value --->

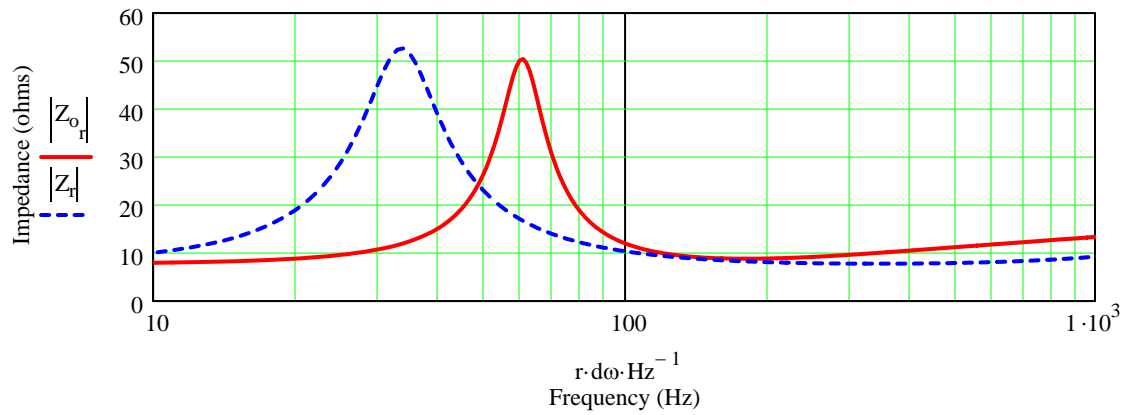
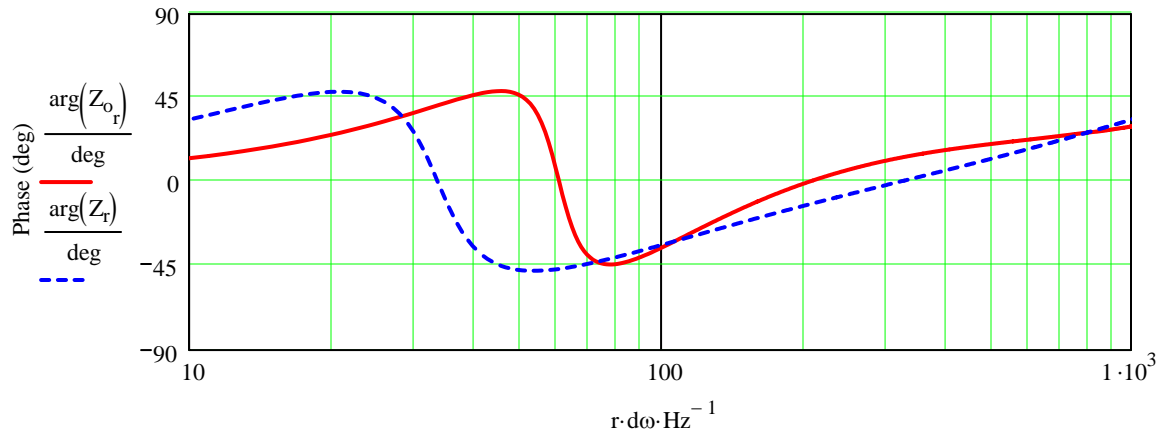
$$L_{\text{BSC}} := 1.8 \text{ mH}$$



Plotted Corrected SPL Response for the System



Transmission Line Corrected System and Infinite Baffle Impedance



System Time Response for an Impulse Input

