Driver in a H Frame Transmission Line - Acoustic and Electrical Response 1/30/10

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

Unit and Constant Definition

$cycle := 2 \cdot \pi \cdot rad$ $\quad Hz := cycle \cdot sec^{-1}$

Air Density : $\rho := 1.205 \cdot kg \cdot m^{-3}$

Speed of Sound : $c := 344 \cdot m \cdot sec^{-1}$

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

$R_{add} := 0 \cdot \Omega$

Input Power

$Power := 1 \cdot watt$ (Input Power) Applied Voltage Reference ---> $R_{ref} := 8 \cdot \Omega$

Extended Range Driver Thiele / Small Parameters : Jordan JX92S

$f_d := 49.746 \cdot Hz$ $\quad V_{ad} := 15.53 \cdot liter$

$R_e := 5.3 \cdot \Omega$ $\quad Q_{ed} := 0.706$

$L_{vc} := 0.125 \cdot mH$ $\quad Q_{md} := 2.029$

$Bl := 3.659 \cdot \frac{newton}{amp}$ $\quad Q_{td} := \left(\frac{1}{Q_{ed}} + \frac{1}{Q_{md}} \right)^{-1}$

$S_d := \frac{\pi}{4} \cdot (100 \cdot mm)^2$ $\quad Q_{td} = 0.524$

Bass Driver Thiele / Small Parameters : Goldwood GW1858 18" Woofer

$f_d := 30 \cdot Hz$ $\quad V_{ad} := 497.2 \cdot liter$

$R_e := 5.5 \cdot \Omega$ $\quad Q_{ed} := 1.15$

$L_{vc} := 0.976 \cdot mH$ $\quad Q_{md} := 4.241$

$Bl := 10.8 \cdot \frac{newton}{amp}$ $\quad Q_{td} := \left(\frac{1}{Q_{ed}} + \frac{1}{Q_{md}} \right)^{-1}$

$S_d := \frac{\pi}{4} \cdot (403.2 \cdot mm)^2$ $\quad Q_{td} = 0.905$

Adjustments

$R_e := R_e + R_{add}$

$Q_{ed} := Q_{ed} \cdot R_e \cdot \left(R_e - R_{add} \right)^{-1}$

H Frame Enclosure Geometry Definition : Model of Internal Air Volume

$L := 15 \cdot in$	(Total Length of the H Frame)
$\xi := 0.5$	(Fraction of the Total Length of the Front Cavity : $0.001 < \xi < 0.999$)
$S_0 := 20 \cdot in \cdot 20 \cdot in$	(Area of the Driver End)
$S_L := 20 \cdot in \cdot 20 \cdot in$	(Area of the Open End)
$Density_F := 0 \cdot lb \cdot ft^{-3}$	(Front Stuffing Density : 0 lb/ft^3 < D < 1 lb/ft^3)
$Density_R := 0 \cdot lb \cdot ft^{-3}$	(Rear Stuffing Density : 0 lb/ft^3 < D < 1 lb/ft^3)

Instructions :

1. If a Zobel is used, set L_{vc} equal to zero in driver inputs above. If no Zobel is used, enter a value for L_{vc}.
2. Select the crossover frequencies, orders, and types below.
3. Scroll down to the applicable crossover sections below and fill in the values of the circuit components.
    a. The theoretical values are shown to the right of each schematic.
    b, Theoretical values are calculated using only the driver's DC resistance, a textbook solution.
    c. Enter the actual component values, these should correspond to available components.
    d. Iterate the actual component values to optimize the crossover responses.
    e. You can mix the crossover orders and types by using only half of each pair of schematics.
4. Purchase the optimized actual component values and construct the crossover per the schematics.

Crossover Definition

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

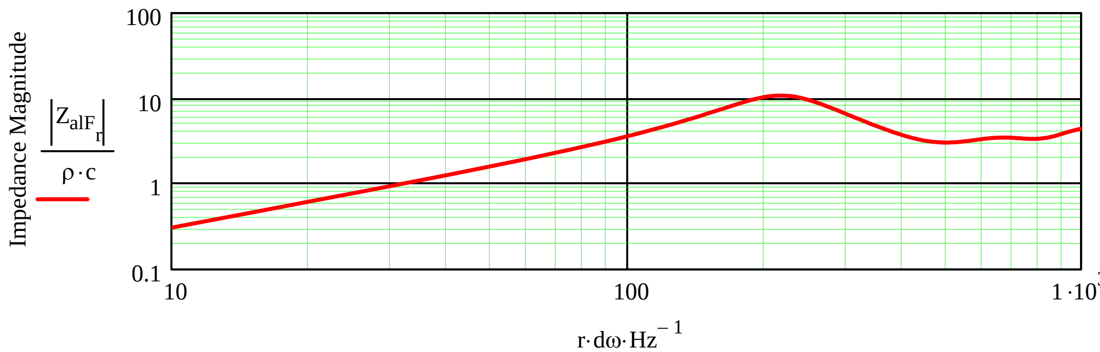
Low Pass Filter	High Pass Filter	
$f_{LP} := 100 \cdot Hz$	$f_{HP} := 250 \cdot Hz$	(Filter Frequency)
$LP_{order} := 2$	$HP_{order} := 2$	(Filter Order : 0, 1, 2, 3, or 4)
$LP_{type} := 1$	$HP_{type} := 2$	(Filter Type : 1, 2, 3, or 4 for even order only, for odd order this entry is ignored)

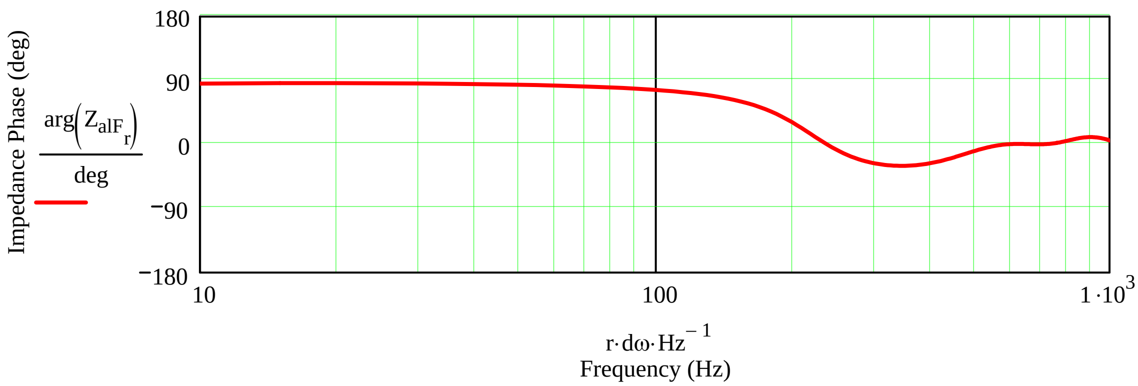
Crossover Phase Connection

$LP_{phase} := 1$	$HP_{phase} := 1$	(Phase : 1 = in phase, -1 = out of phase)

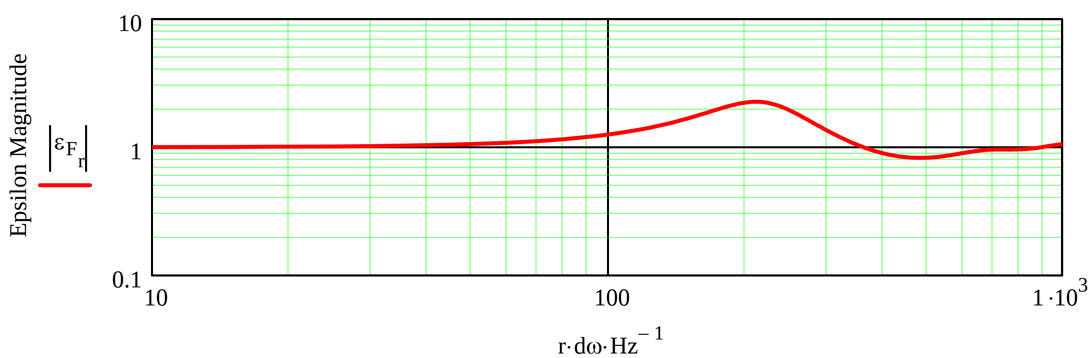
End of Abbreviated User Input

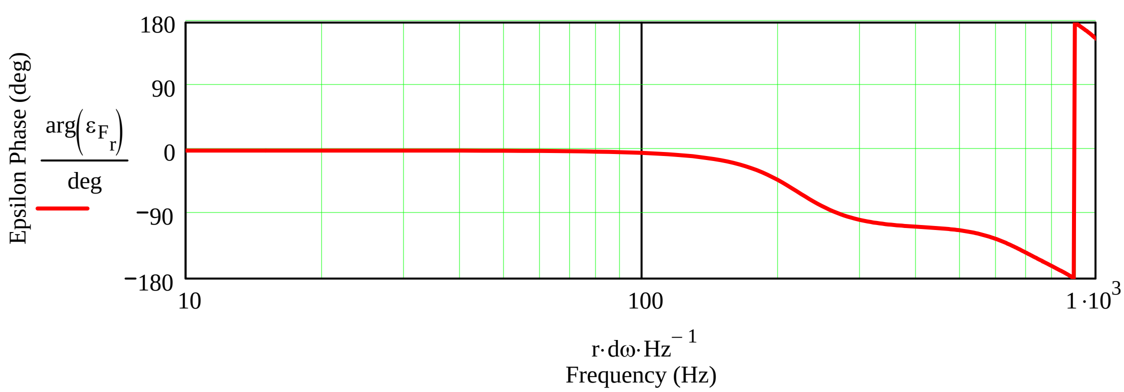
Resulting Acoustic Impedance for the H Frame - Front Cavity



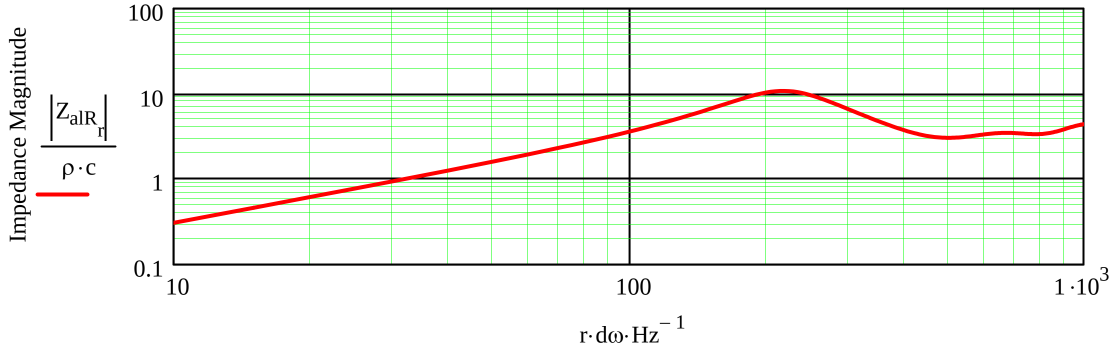


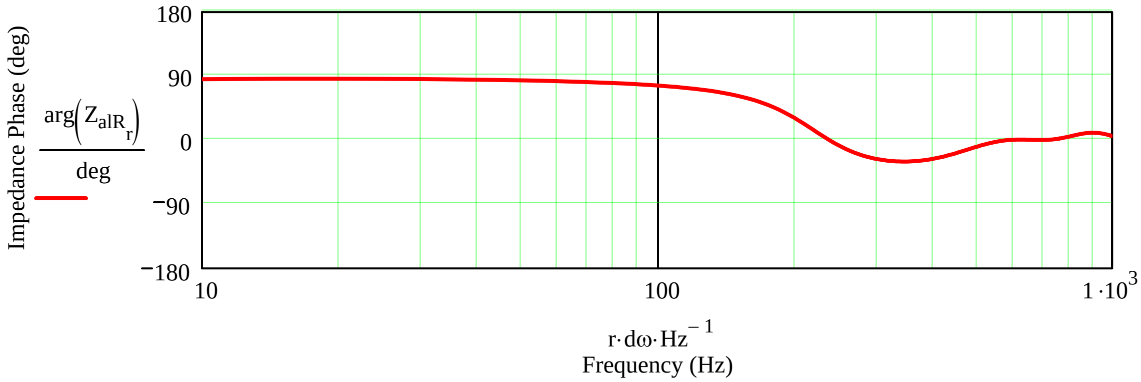
Velocity at the Terminus of the H Frame for a 1 m/sec Excitation at the Driver - Front Cavity



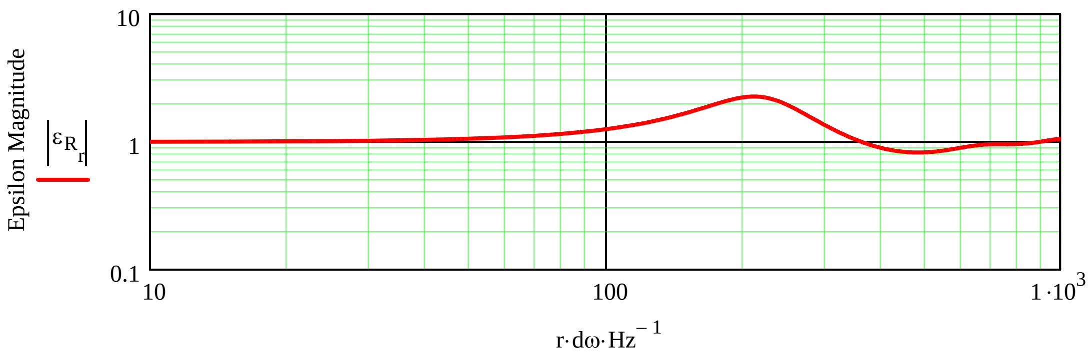


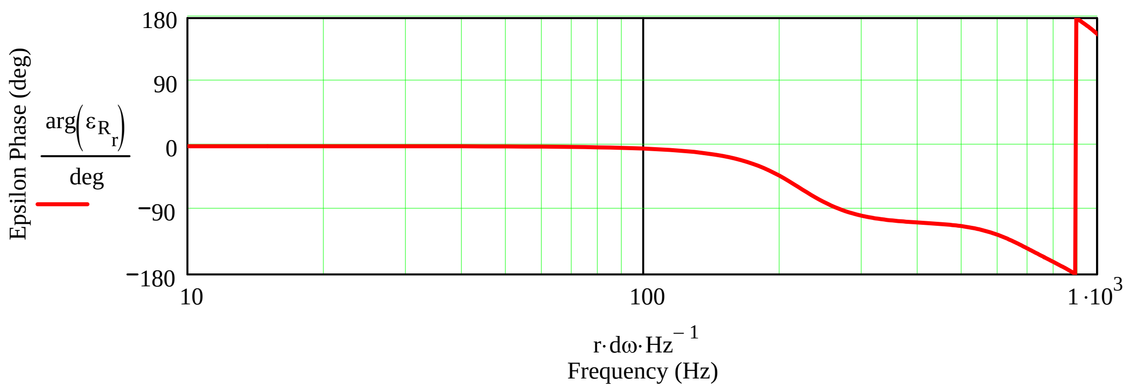
Resulting Acoustic Impedance for the H Frame - Rear Cavity





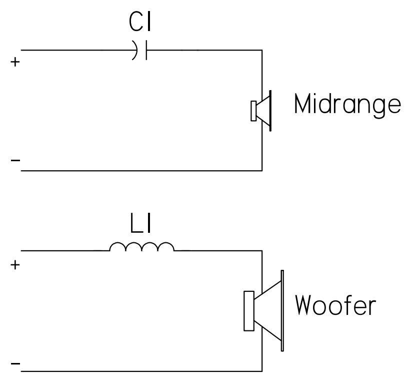
Velocity at the Terminus of the H Frame for a 1 m/sec Excitation at the Driver - Rear Cavity





Crossover Definition - 1st Order High and Low Pass

Schematic



Theoretical Values

$C_1 = 120.117\,\mu F$

$L_1 = 8.754\,mH$

Enter Actual Component Values Below

High Pass

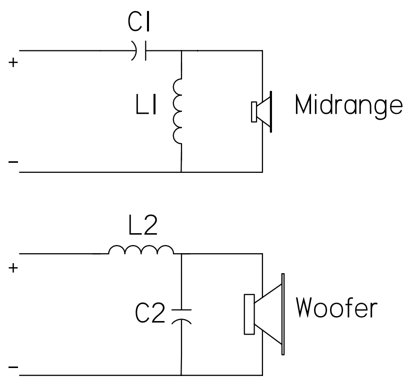
$C_1 := 120 \cdot \mu F$

Low Pass

$L_1 := 9 \cdot mH \qquad R_1 := 0.3 \cdot \Omega$

Crossover Definition - 2nd Order High and Low Pass

Schematic



Theoretical Values

$C_1 = 69.307\,\mu F$

$L_1 = 5.848\,mH$

$L_2 = 17.507\,mH$

$C_2 = 144.686\,\mu F$

Enter Actual Component Values Below

High Pass

$C_1 := 51 \cdot \mu F$

$L_1 := 5.6 \cdot mH$ $\quad R_1 := 0.3 \cdot \Omega$

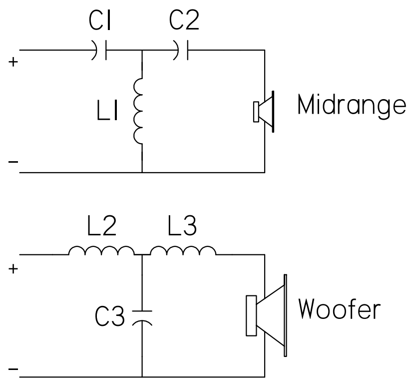
Low Pass

$L_2 := 13 \cdot mH$ $\quad R_2 := 0.5 \cdot \Omega$

$C_2 := 150 \cdot \mu F$

Crossover Definition - 3rd Order High and Low Pass

Schematic



Theoretical Values

$C_1 = 80.078\,\mu F$

$L_1 = 2.531\,mH$

$C_2 = 240.234\,\mu F$

$L_2 = 13.130\,mH$

$C_3 = 385.830\,\mu F$

$L_3 = 4.377\,mH$

Enter Actual Component Values Below

High Pass

$C_1 := 80 \cdot \mu F$

$L_1 := 2.5 \cdot mH \quad R_1 := 0.2 \cdot \Omega$

$C_2 := 240 \cdot \mu F$

Low Pass

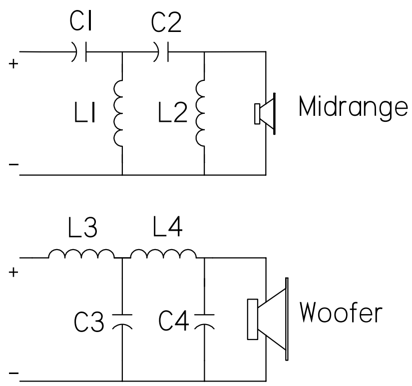
$L_2 := 13 \cdot mH \quad R_2 := 0.5 \cdot \Omega$

$C_3 := 400 \cdot \mu F$

$L_3 := 4.5 \cdot mH \quad R_3 := 0.2 \cdot \Omega$

Crossover Definition - 4th Order High and Low Pass

Schematic



Theoretical Values

$C_1 = 69.358\,\mu F$

$L_1 = 2.139\,mH$

$C_2 = 120.151\,\mu F$

$L_2 = 9.218\,mH$

$L_3 = 16.500\,mH$

$C_3 = 460.545\,\mu F$

$L_4 = 8.250\,mH$

$C_4 = 102.364\,\mu F$

Enter Actual Component Values Below

High Pass

$C_1 := 70 \cdot \mu F$

$L_1 := 2 \cdot mH \qquad R_1 := 0.1 \cdot \Omega$

$C_2 := 120 \cdot \mu F$

$L_2 := 6.5 \cdot mH \qquad R_2 := 0.3 \cdot \Omega$

Low Pass

$L_3 := 17 \cdot mH \qquad R_3 := 0.5 \cdot \Omega$

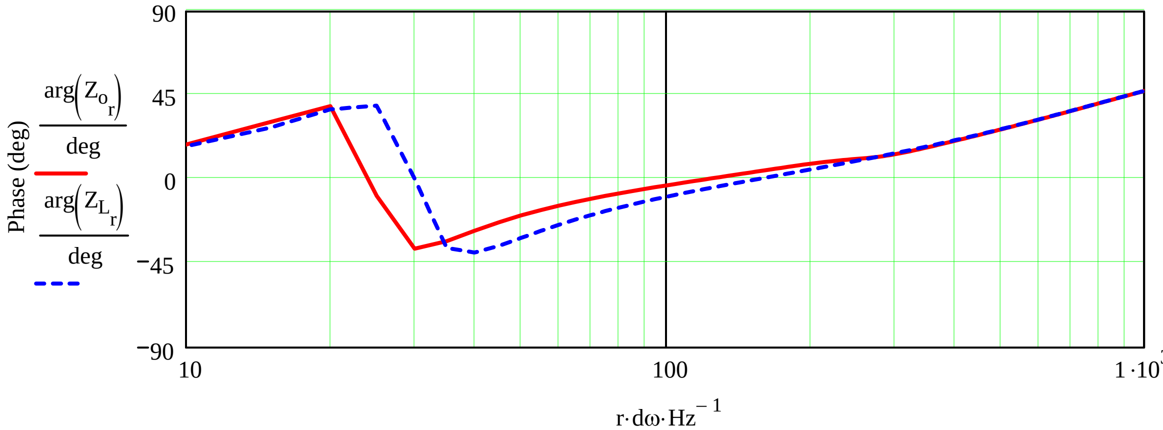
$C_3 := 460 \cdot \mu F$

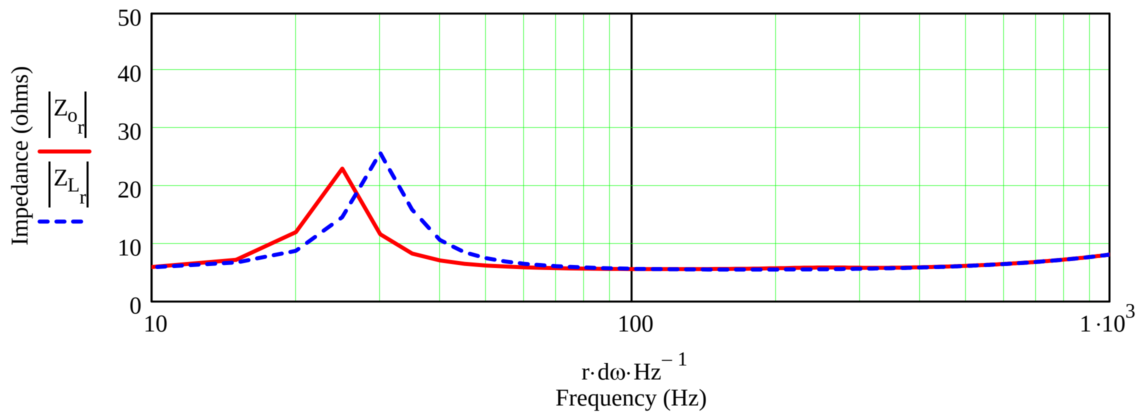
$L_4 := 8 \cdot mH \qquad R_4 := 0.3 \cdot \Omega$

$C_4 := 100 \cdot \mu F$

H Frame and Infinite Baffle Woofer Impedance

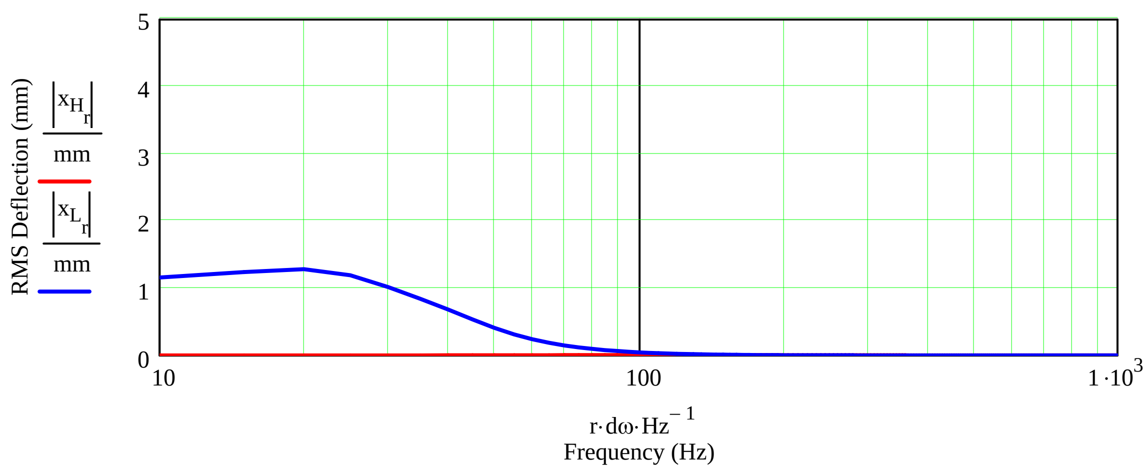
Solid Red is the H Frame Response
Dashed Blue is the Infinite Baffle Response





Driver RMS Displacements

Solid Red is the OB Driver Response
Solid Blue is the H Frame Woofer 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

$X_0 := 3 \cdot ft$ (Front Baffle Distance from Rear Wall > Depth of Enclosure)

$Y_0 := 2 \cdot ft$ (Front Baffle Distance from Side Wall)

$\theta_0 := 30 \cdot deg$ (Rotation Towards Room Center)

$Z_0 := 8 \cdot ft$ (Floor to Ceiling Distance)

$stand := 0 \cdot m$ (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

$H_{width} := 21 \cdot in$ (H Frame External Width)

$H_{height} := 21 \cdot in$ (H Hrame External Height)

$depth := L + 0.75 \cdot in$ (H Frame External Depth)

$y_c := 10.5 \cdot in$ (Terminus Center y Coordinate)

$z_c := 10.5 \cdot in$ (Terminus Center z Coordinate)

$w_{mth} := 20 \cdot in$ (Terminus Width)

$n\_mth := 10$ (Number of Points Across the Width)

Extended Range Driver OB Geometry Input

$OB_{width} := 20 \cdot in$ (OB panel width)

$OB_{height} := 20 \cdot in$ (OB panel height)

$y_{dc} := 13 \cdot in$ (Driver Center y Coordinate w.r.t. lower left corner of OB)

$z_{dc} := 12 \cdot in$ (Driver Center z Coordinate w.r.t. lower left corner of OB)

$\xi_{ob} := 0.5$ (Fraction of the Total Depth of the H Frame : $0.001 < \xi < 0.999$)

$n\_high := 4$ (Number of Points Across Diameter)

Listening Position

n_listen = 0	(Listening Position Relative to Speaker)
radius := 1·m	(Calculation Radius Along Axis of the Extended Range Driver)
θ := 0·deg	(0 deg is along the Driver's Axis, -80 deg < θ < 80 deg)
z_p := 33·in	(Default Height is Equal to Seated Height)
n_listen = 1	(Listening Position Relative to the Room Corner)
X_p := 10ft	
Y_p := 7·ft	
Z_p := 33·in	(Default Height is Equal to Seated Height)
n_listen := 0	(Method Selection)

Floor Condition

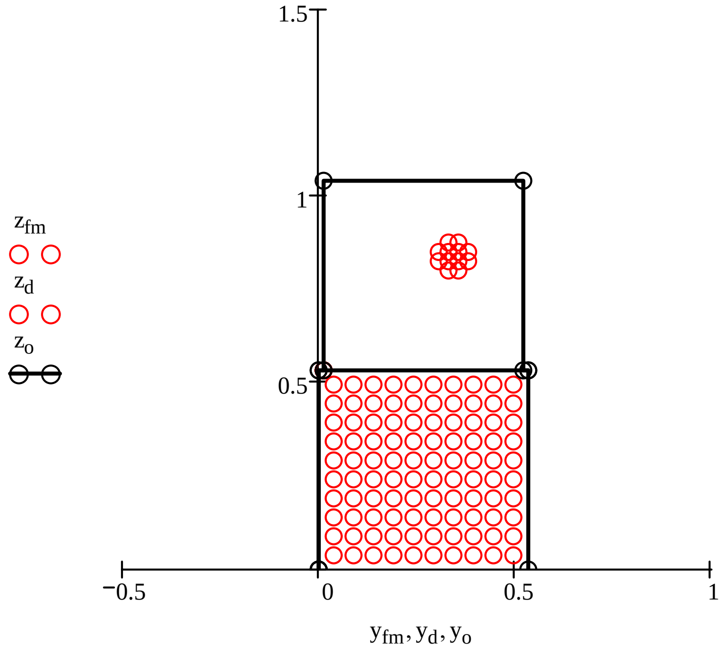
Reflect := 1	(0 = hardwood or concrete, 1 = carpeted)

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

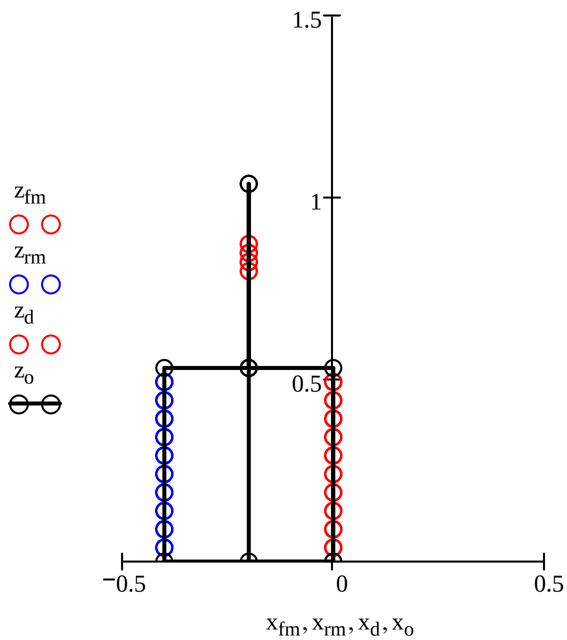
Inc_floor := 1	(Floor, Z = 0)
Inc_rear := 0	(Rear Wall, X = 0)
Inc_side := 0	(Left Side Wall, Y = 0)
Inc_ceiling := 0	(Ceiling)

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

Front View



Side View

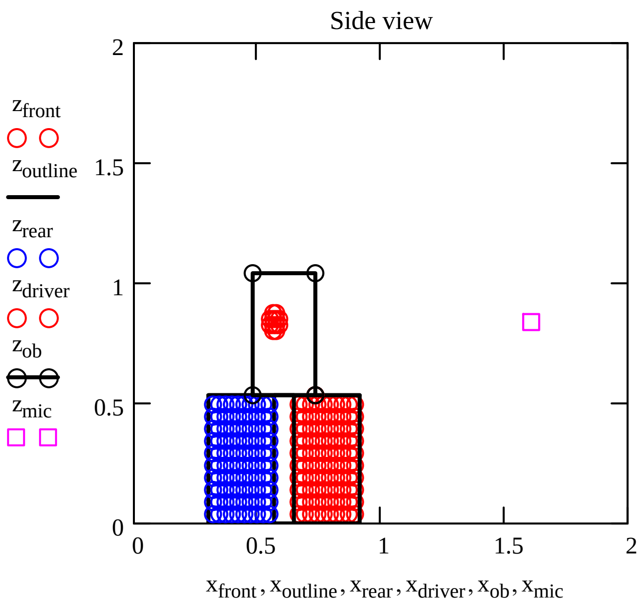


Red sources represent extended range driver.
Red sources represent front terminus.
Blue sources represent the rear terminus.
Black outline represents the baffle edge.
Origin is at the bottom front left corner of the enclosure.

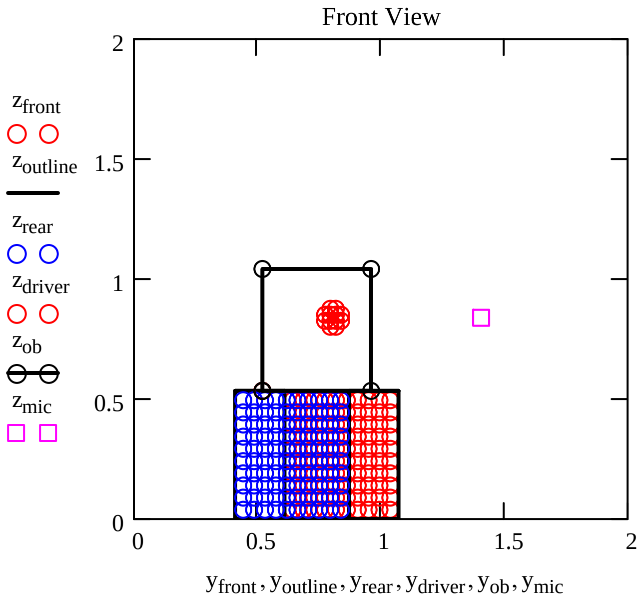
Three Dimensional View

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

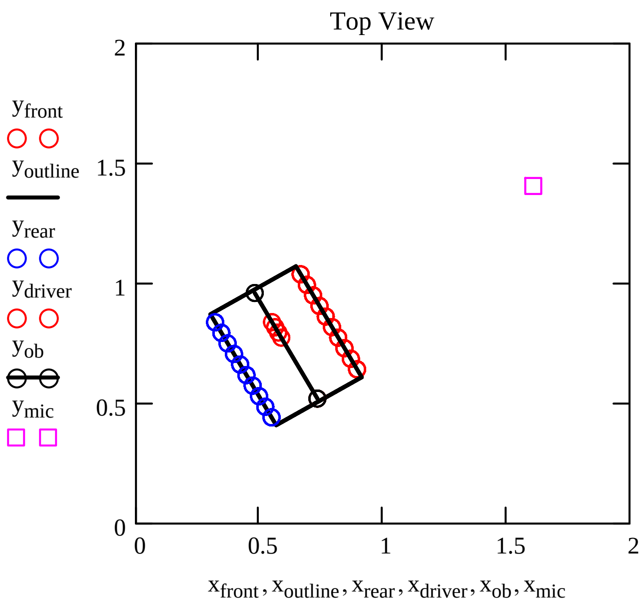
Room Corner is the Origin



Side View - looking out from side wall

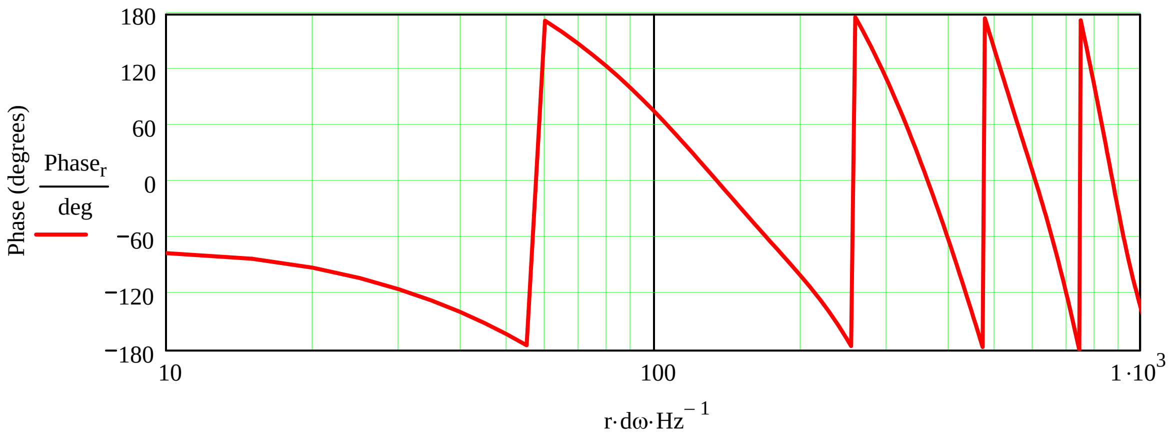


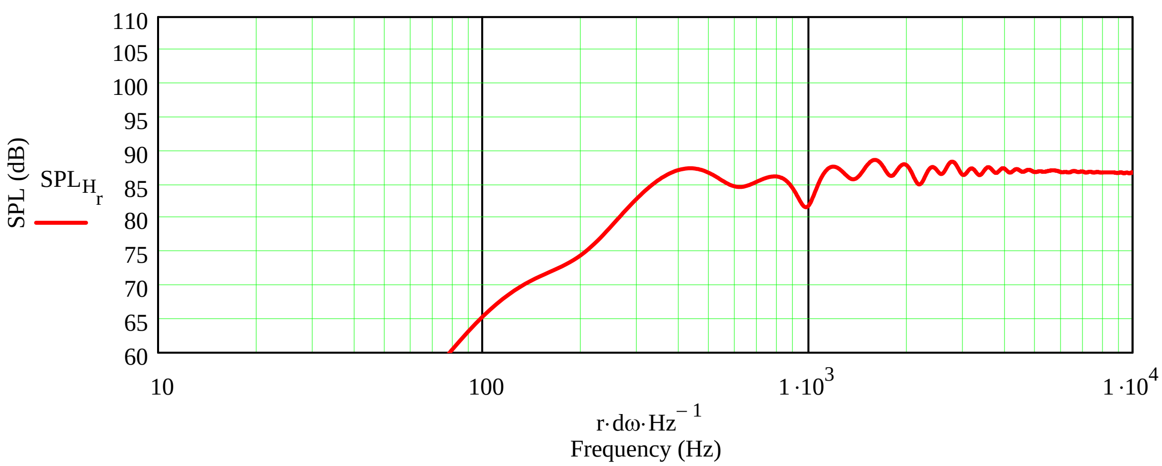
Front View - looking towards rear wall



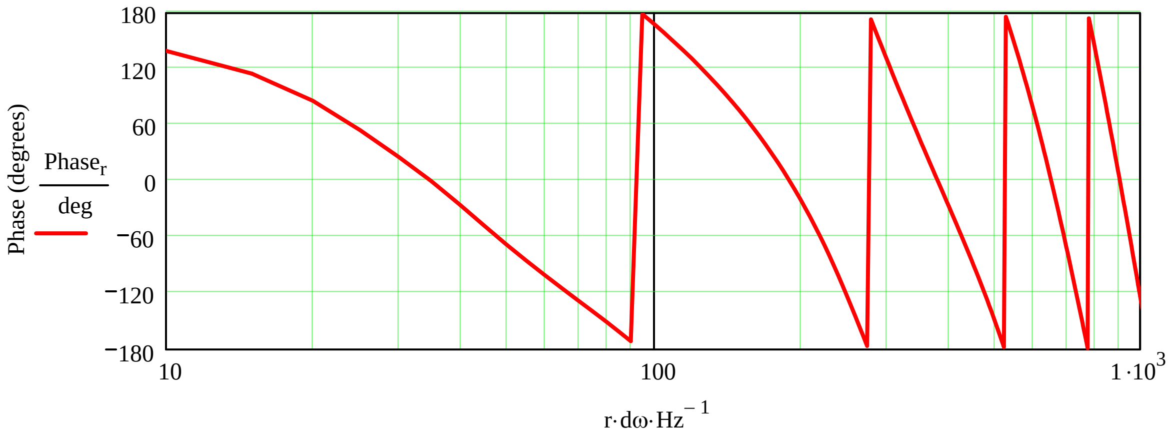
Top View - looking down from ceiling

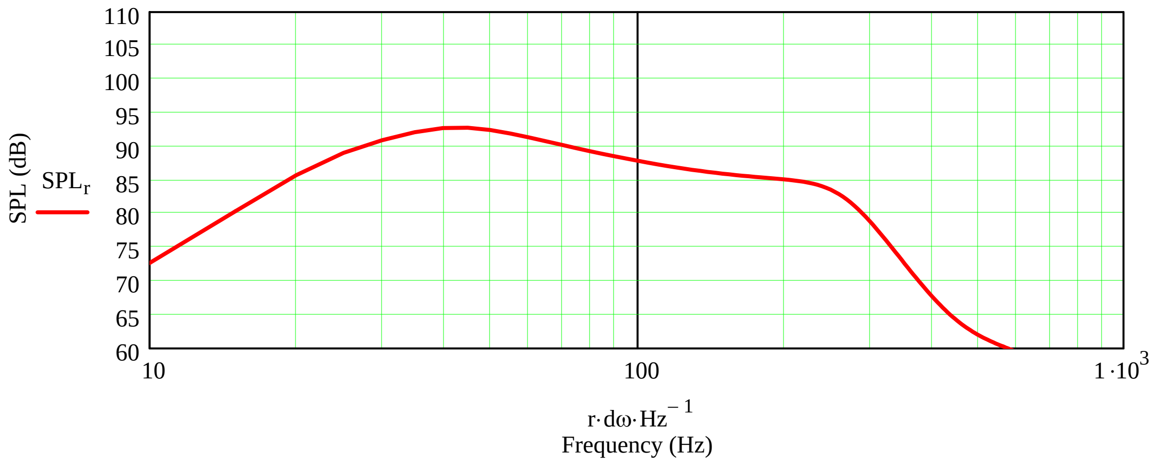
Plotted Response for the Extended Range Driver



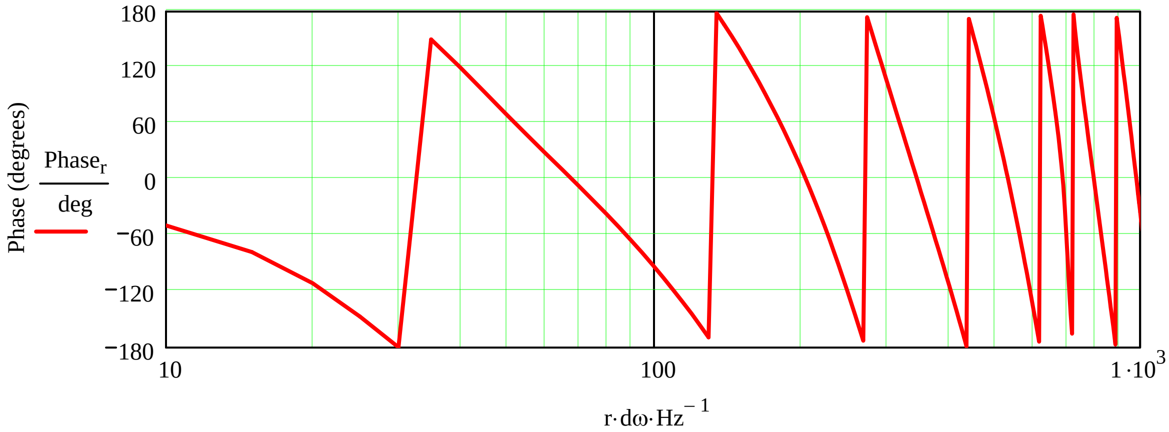


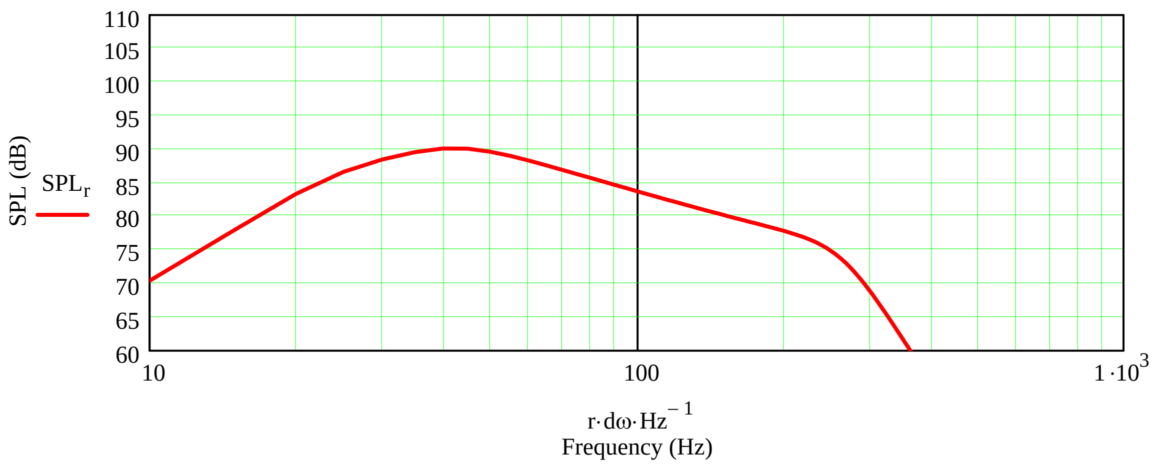
Plotted Baffle Step and Reflection SPL Response for the Front Terminus



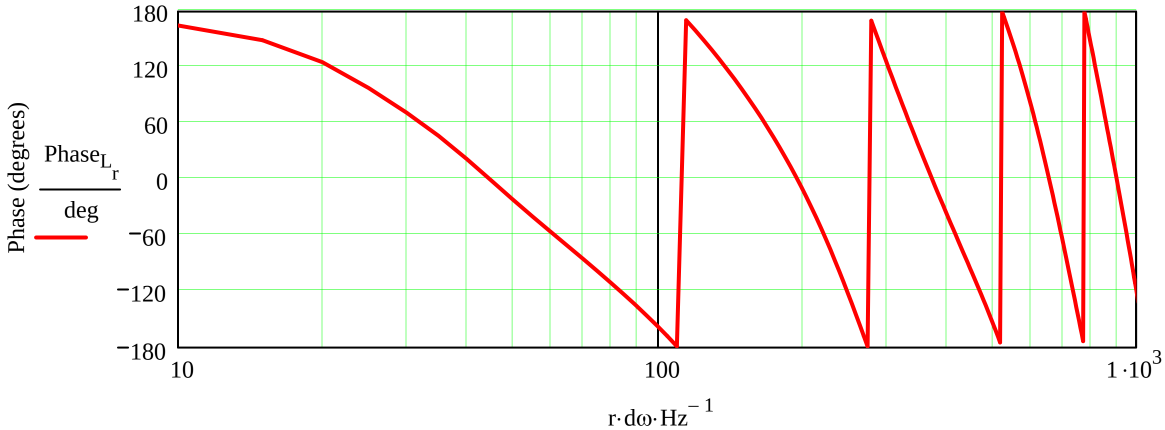


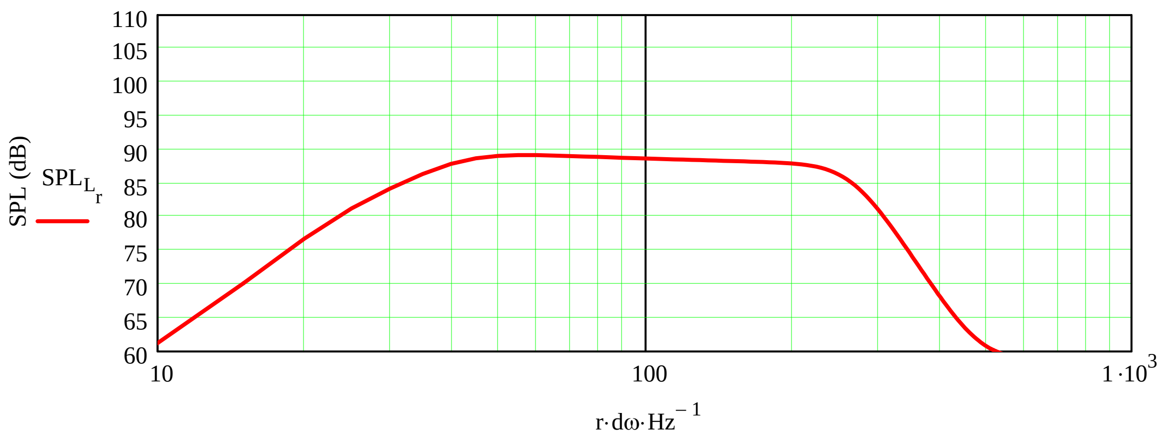
Plotted Baffle Step and Reflection SPL Response for the Rear Terminus



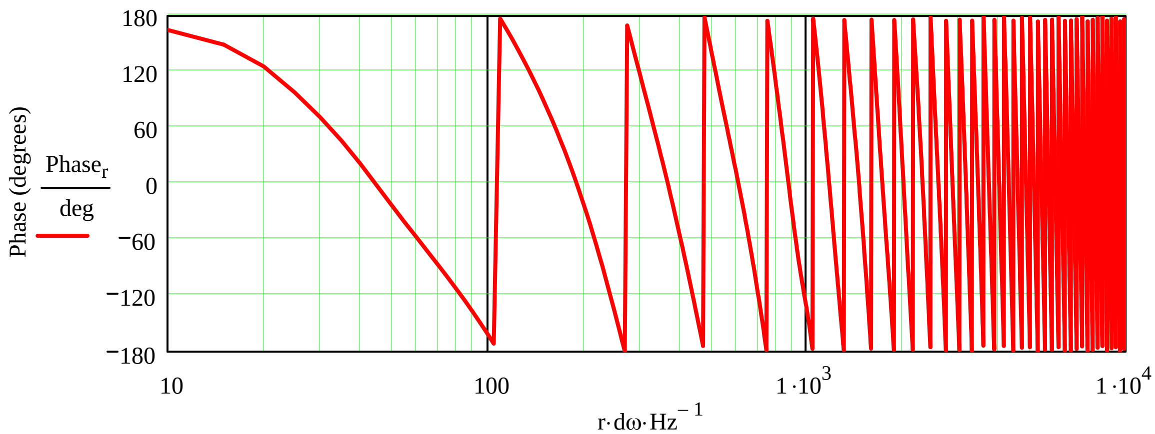


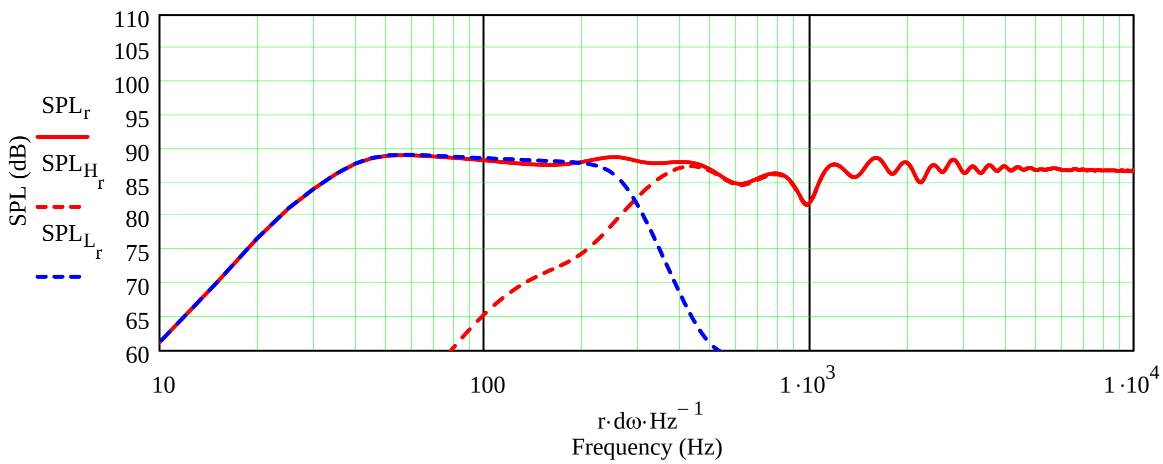
Plotted SPL Response for the H Frame





Plotted SPL Response for the System





System Time Response for an Impulse Input