



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

Copyright 2009 by Martin J. King. All Rights Reserved.

Unit and Constant Definition

$$\text{cycle} := 2 \cdot \pi \cdot \text{rad}$$

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

$$\text{Hz} := \text{cycle} \cdot \text{sec}^{-1}$$

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



Part 1 : Thiele-Small Consistent Calculation

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

Series Resistance

$$R_{\text{add}} := 0.0 \cdot \Omega$$

Driver Thiele / Small Parameters : Seas FA22RCZ H1507 Average Driver Properties

$$f_d := 30 \cdot \text{Hz}$$

$$V_{\text{ad}} := 134 \cdot \text{liter}$$

Adjustments

$$R_e := 5.7 \cdot \Omega$$

$$Q_{\text{ed}} := 0.38$$

$$R_{\text{av}} := R_e + R_{\text{add}}$$

$$L_{\text{vc}} := 0.09 \cdot \text{mH}$$

$$Q_{\text{md}} := 4.36$$

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

$$Bl := 6.46 \cdot \frac{\text{newton}}{\text{amp}}$$

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

$$S_d := 222 \cdot \text{cm}^2$$

$$Q_{\text{td}} = 0.35$$

Enclosure Geometry Definition : Model of Internal Air Volume

$$L := 1145 \cdot \text{mm}$$

(Internal Height)

$$z_{\text{driver}} := 286 \text{mm}$$

(Driver Internal Distance From Top < Height)

$$z_{\text{port}} := L - 220 \text{mm}$$

(Port Internal Distance From Top < Height)

$$S_0 := 202 \cdot \text{mm} \cdot 282 \cdot \text{mm}$$

(Internal Area of the Top End, $z = 0$)

$$S_L := S_0$$

(Internal Area of the Bottom End, $z = L$)

$$\text{Density} := 0.3 \cdot \text{lb} \cdot \text{ft}^{-3}$$

(Stuffing density : $0 \text{ lb/ft}^3 < D < 1 \text{ lb/ft}^3$)

$$r_{\text{port}} := 35 \text{mm}$$

(Inside Radius of the Port)

$$L_{\text{port}} := 50 \cdot \text{mm}$$

(Length of the Port)

$$\text{Power} := 1 \cdot \text{watt}$$

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

End of Abbreviated User Input

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

ML TL Definition

(0 lb/ft³ < D < 1 lb/ft³)

$n_{top} := 4$	($n_{top} > 1$)	$x_{top} := z_{driver}$
$n_{open} := 4$	($n_{open} > 1$)	$x_{open} := z_{port} - z_{driver}$
$n_{bottom} := 4$	($n_{bottom} > 1$)	$x_{bottom} := L - z_{port}$
$n_{port} := 4$	($n_{port} > 1$)	$x_{port} := L_{port} + 0.6 \cdot r_{port}$

Geometry Definition

$TR := (S_L - S_0) \cdot L^{-1}$	$TR = 0 \text{ m}$
$S_D := S_0 + TR \cdot z_{driver}$	$S_D = 0.057 \text{ m}^2$
$S_P := S_0 + TR \cdot z_{port}$	$S_P = 0.057 \text{ m}^2$

Top Section of Enclosure

(Driver ---> Top of Enclosure)

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

Open Section of Enclosure

(Driver ---> Port Position)

Section Length	Initial Area	Final Area	Stuffing Density
$L_{o_0} := x_{open} \cdot (n_{open} + 1)^{-1}$	$S_{o_{0,0}} := S_D$	$S_{o_{0,1}} := S_{o_{0,0}} + TR \cdot L_{o_0}$	$D_{o_0} := \text{Density}$
$L_{o_1} := x_{open} \cdot (n_{open} + 1)^{-1}$	$S_{o_{1,0}} := S_{o_{0,1}}$	$S_{o_{1,1}} := S_{o_{1,0}} + TR \cdot L_{o_1}$	$D_{o_1} := \text{Density}$
$L_{o_2} := x_{open} \cdot (n_{open} + 1)^{-1}$	$S_{o_{2,0}} := S_{o_{1,1}}$	$S_{o_{2,1}} := S_{o_{2,0}} + TR \cdot L_{o_2}$	$D_{o_2} := \text{Density}$
$L_{o_3} := x_{open} \cdot (n_{open} + 1)^{-1}$	$S_{o_{3,0}} := S_{o_{2,1}}$	$S_{o_{3,1}} := S_{o_{3,0}} + TR \cdot L_{o_3}$	$D_{o_3} := 0.0 \cdot \text{lb} \cdot \text{ft}^{-3}$
$L_{o_4} := x_{open} \cdot (n_{open} + 1)^{-1}$	$S_{o_{4,0}} := S_{o_{3,1}}$	$S_{o_{4,1}} := S_P$	$D_{o_4} := 0.0 \cdot \text{lb} \cdot \text{ft}^{-3}$

Bottom Section of Enclosure

(Port Position ---> Bottom of Enclosure)

Section Length	Initial Area	Final Area	Stuffing Density
$L_{b_0} := x_{\text{bottom}} \cdot (n_{\text{bottom}} + 1)^{-1}$	$S_{b_{0,0}} := S_P$	$S_{b_{0,1}} := S_{b_{0,0}} + TR \cdot L_{b_0}$	$D_{b_0} := 0.0 \cdot \text{lb} \cdot \text{ft}^{-3}$
$L_{b_1} := x_{\text{bottom}} \cdot (n_{\text{bottom}} + 1)^{-1}$	$S_{b_{1,0}} := S_{b_{0,1}}$	$S_{b_{1,1}} := S_{b_{1,0}} + TR \cdot L_{b_1}$	$D_{b_1} := 0.0 \cdot \text{lb} \cdot \text{ft}^{-3}$
$L_{b_2} := x_{\text{bottom}} \cdot (n_{\text{bottom}} + 1)^{-1}$	$S_{b_{2,0}} := S_{b_{1,1}}$	$S_{b_{2,1}} := S_{b_{2,0}} + TR \cdot L_{b_2}$	$D_{b_2} := 0.0 \cdot \text{lb} \cdot \text{ft}^{-3}$
$L_{b_3} := x_{\text{bottom}} \cdot (n_{\text{bottom}} + 1)^{-1}$	$S_{b_{3,0}} := S_{b_{2,1}}$	$S_{b_{3,1}} := S_{b_{3,0}} + TR \cdot L_{b_3}$	$D_{b_3} := 0.0 \cdot \text{lb} \cdot \text{ft}^{-3}$
$L_{b_4} := x_{\text{bottom}} \cdot (n_{\text{bottom}} + 1)^{-1}$	$S_{b_{4,0}} := S_{b_{3,1}}$	$S_{b_{4,1}} := S_L$	$D_{b_4} := 0.0 \cdot \text{lb} \cdot \text{ft}^{-3}$

Port Section of Enclosure

(Port Inside ---> Port Outside)

Section Length	Initial Area	Final Area	Stuffing Density
$L_{p_0} := x_{\text{port}} \cdot (n_{\text{port}} + 1)^{-1}$	$S_{p_{0,0}} := \pi \cdot I_{\text{port}}^2$	$S_{p_{0,1}} := \pi \cdot I_{\text{port}}^2$	$D_{p_0} := 0.0 \cdot \text{lb} \cdot \text{ft}^{-3}$
$L_{p_1} := x_{\text{port}} \cdot (n_{\text{port}} + 1)^{-1}$	$S_{p_{1,0}} := S_{p_{0,1}}$	$S_{p_{1,1}} := \pi \cdot I_{\text{port}}^2$	$D_{p_1} := 0.0 \cdot \text{lb} \cdot \text{ft}^{-3}$
$L_{p_2} := x_{\text{port}} \cdot (n_{\text{port}} + 1)^{-1}$	$S_{p_{2,0}} := S_{p_{1,1}}$	$S_{p_{2,1}} := \pi \cdot I_{\text{port}}^2$	$D_{p_2} := 0.0 \cdot \text{lb} \cdot \text{ft}^{-3}$
$L_{p_3} := x_{\text{port}} \cdot (n_{\text{port}} + 1)^{-1}$	$S_{p_{3,0}} := S_{p_{2,1}}$	$S_{p_{3,1}} := \pi \cdot I_{\text{port}}^2$	$D_{p_3} := 0.0 \cdot \text{lb} \cdot \text{ft}^{-3}$
$L_{p_4} := x_{\text{port}} \cdot (n_{\text{port}} + 1)^{-1}$	$S_{p_{4,0}} := S_{p_{3,1}}$	$S_{p_{4,1}} := \pi \cdot I_{\text{port}}^2$	$D_{p_4} := 0.0 \cdot \text{lb} \cdot \text{ft}^{-3}$

Total Amount of Stuffing

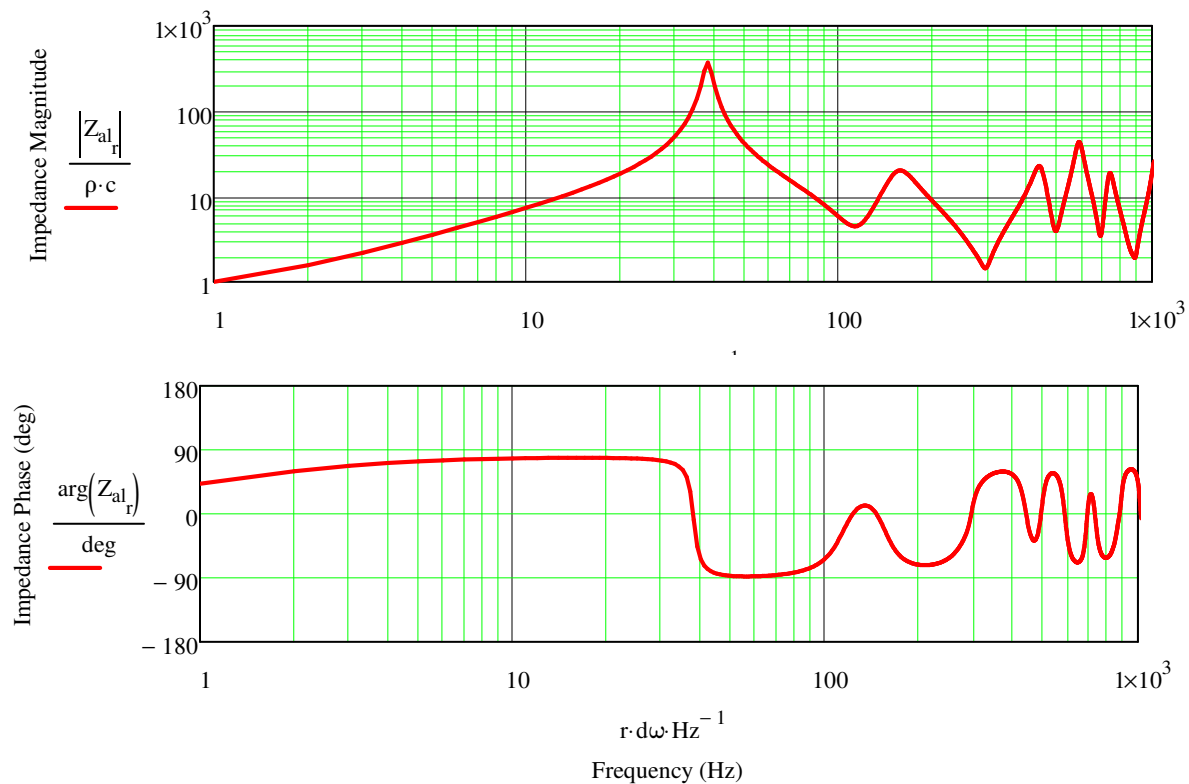
$$\begin{aligned}
 & \sum_{r=0}^{n_{\text{top}}} \left[\frac{(S_{c_{r,0}} + S_{c_{r,1}})}{2} \cdot L_{c_r} \cdot D_{c_r} \right] + \sum_{r=0}^{n_{\text{open}}} \left[\frac{(S_{o_{r,0}} + S_{o_{r,1}})}{2} \cdot L_{o_r} \cdot D_{o_r} \right] \dots = 0.404 \cdot \text{lb} \\
 & + \sum_{r=0}^{n_{\text{bottom}}} \left[\frac{(S_{b_{r,0}} + S_{b_{r,1}})}{2} \cdot L_{b_r} \cdot D_{b_r} \right] + \sum_{r=0}^{n_{\text{port}}} \left[\frac{(S_{p_{r,0}} + S_{p_{r,1}})}{2} \cdot L_{p_r} \cdot D_{p_r} \right]
 \end{aligned}$$

End of Pre Formatted Default Input

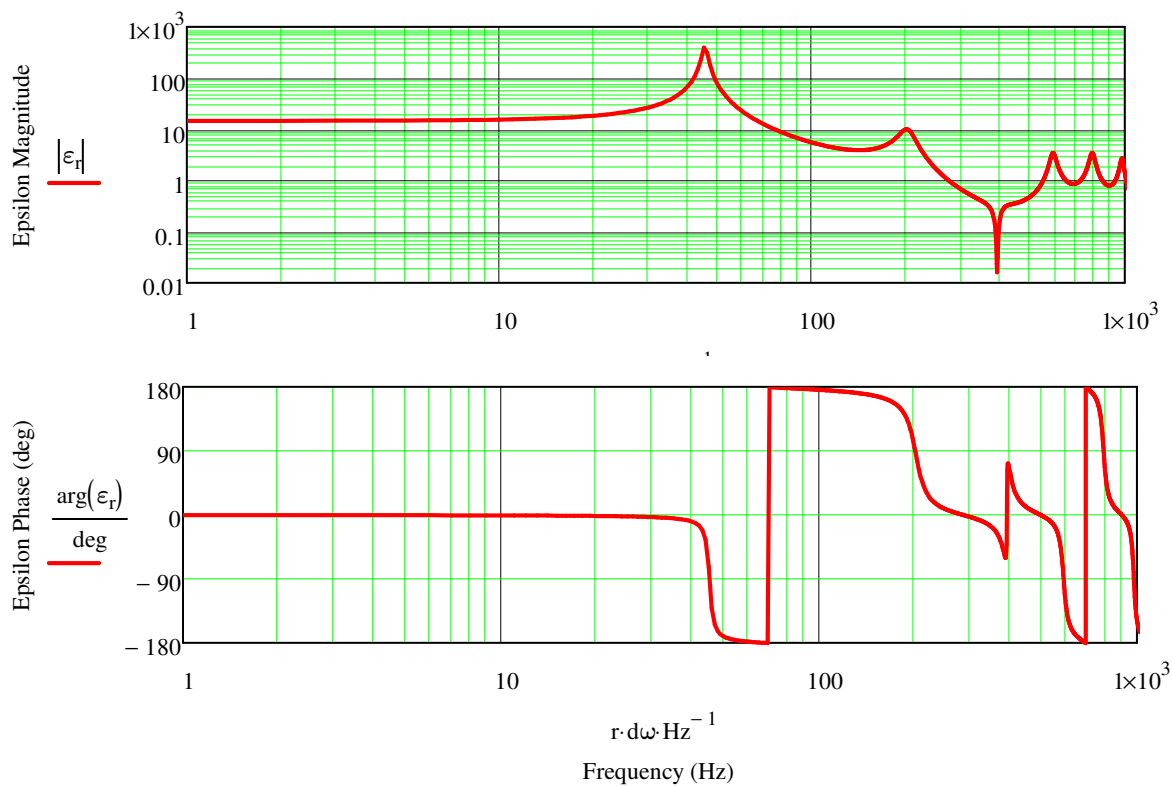
End of Part 1 Input



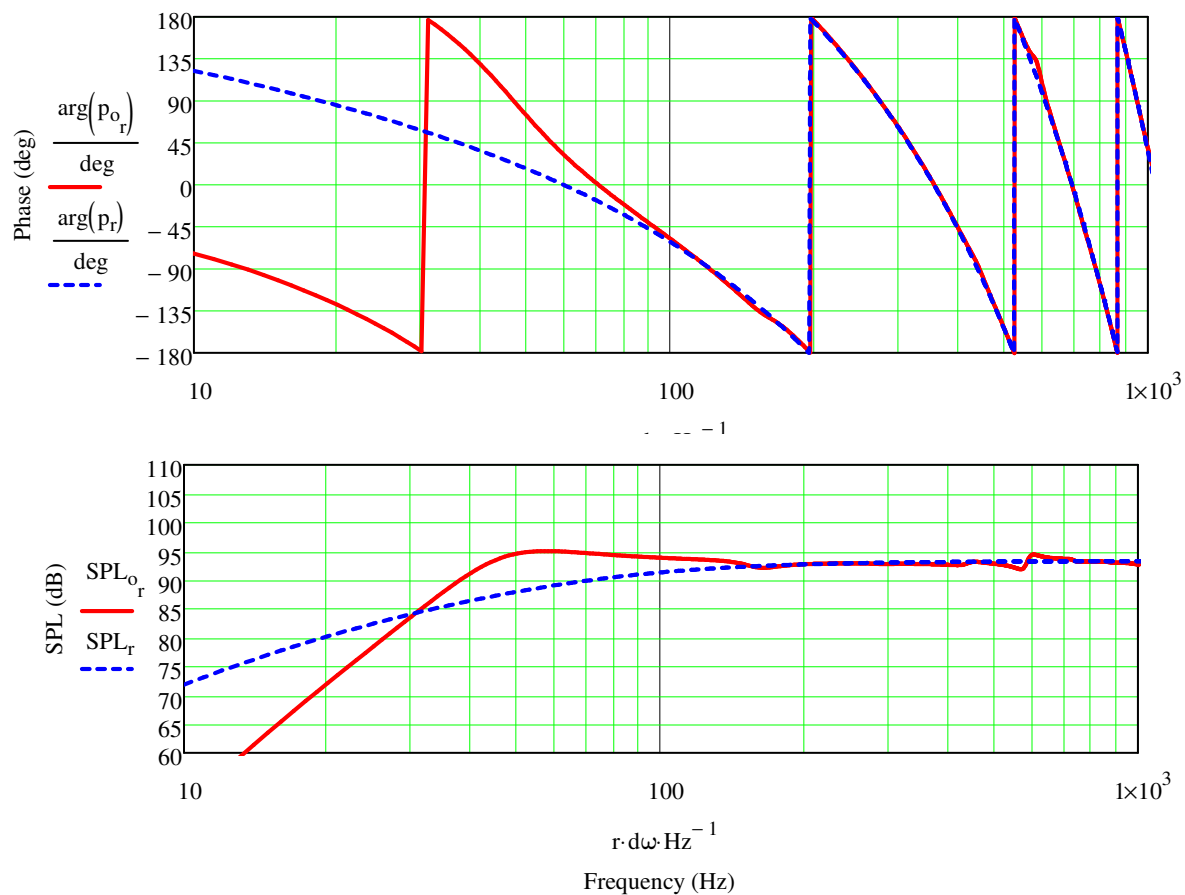
Resulting Acoustic Impedance for the Enclosure



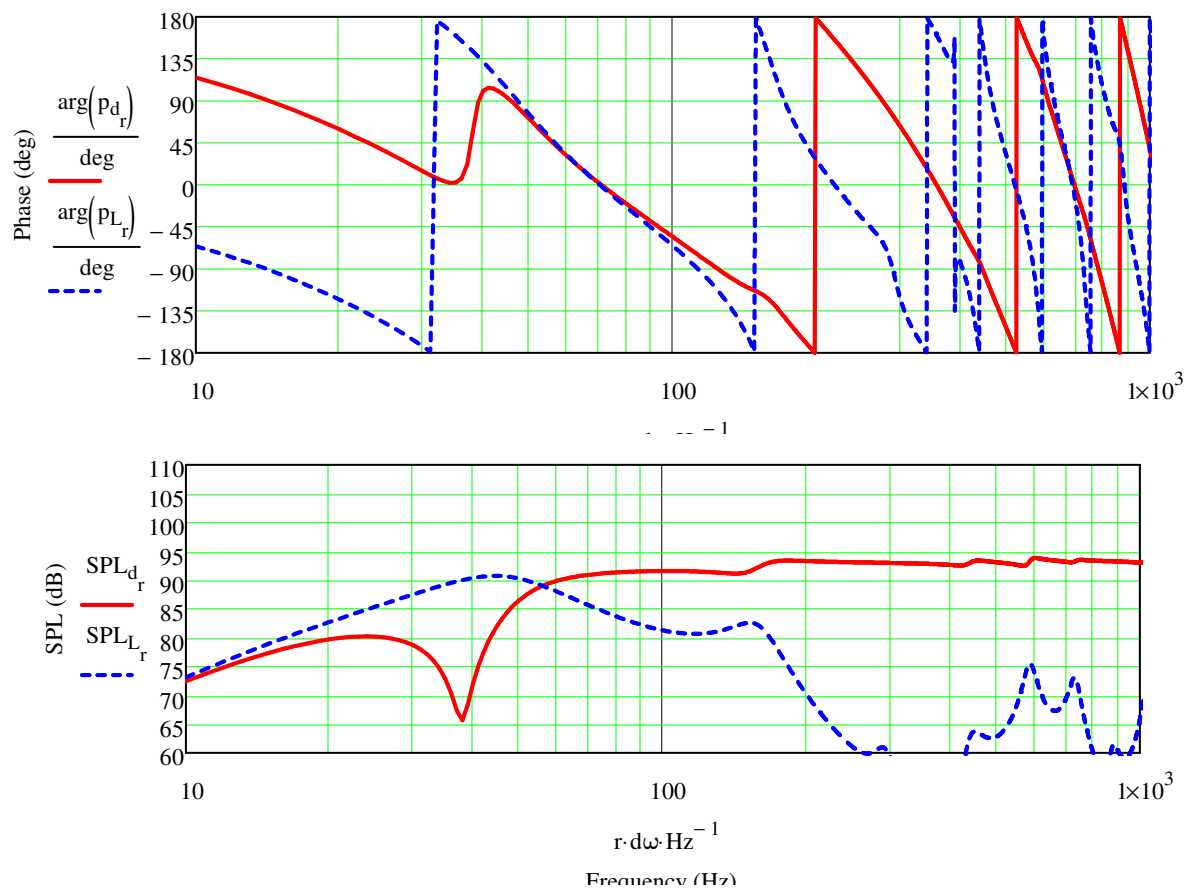
Velocity at the Terminus of the ML TL for a 1 m/sec Excitation at the Driver Position



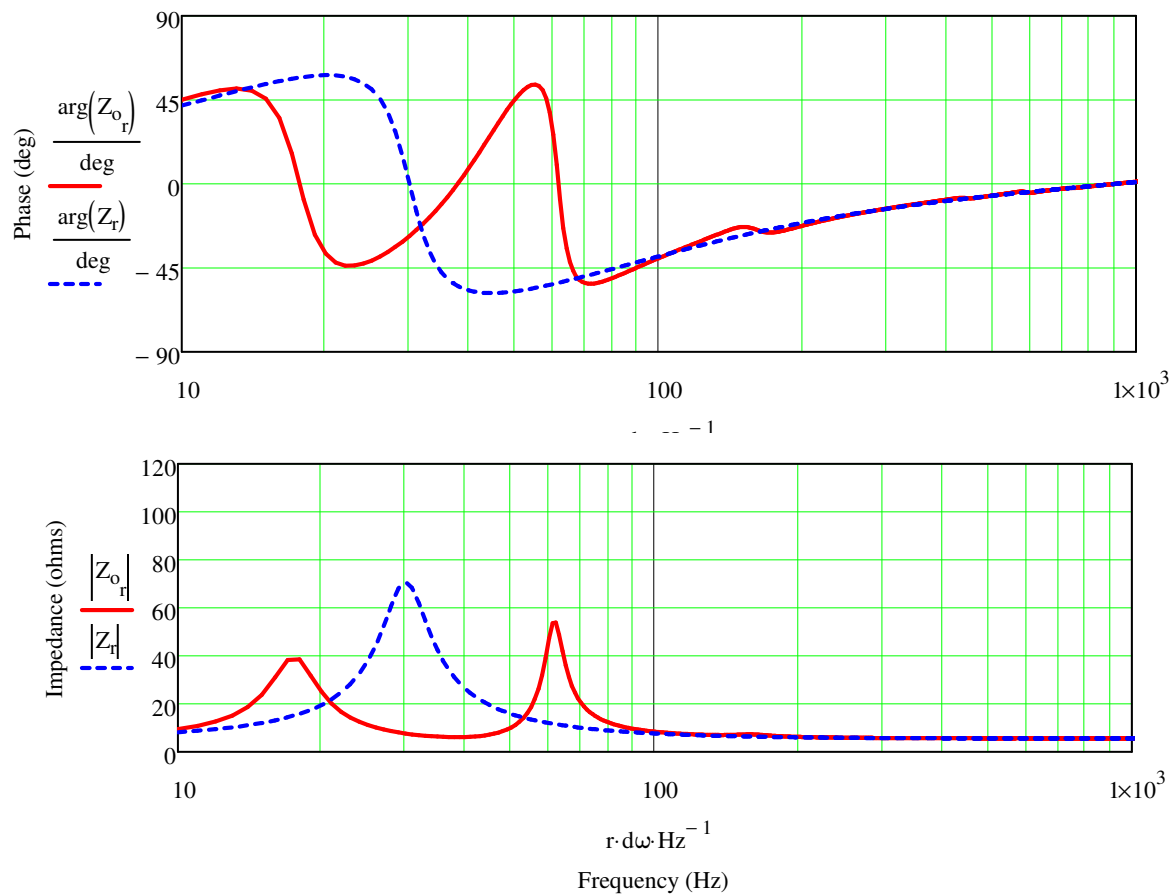
Far Field ML TL System and Infinite Baffle Sound Pressure Level Responses



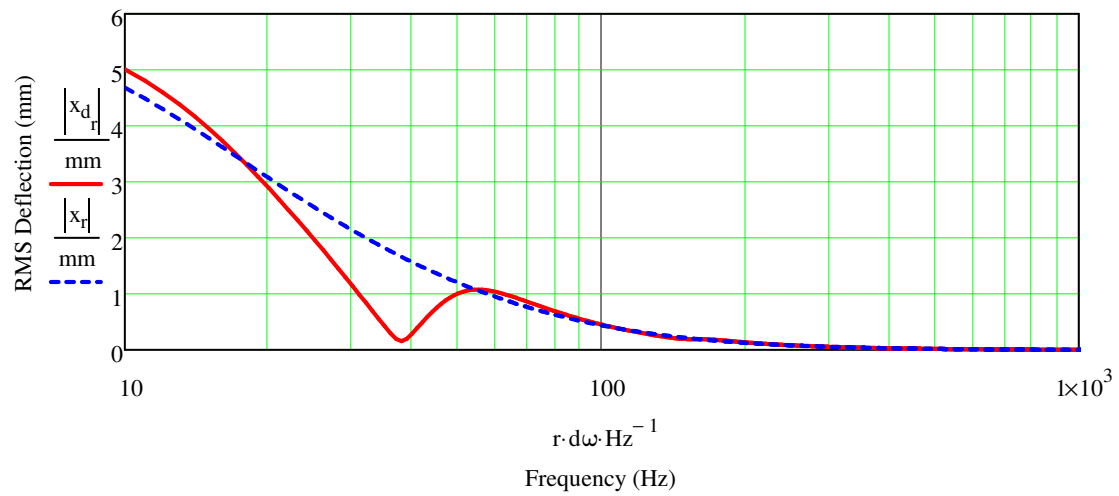
Woofer and Terminus Far Field Sound Pressure Level Responses



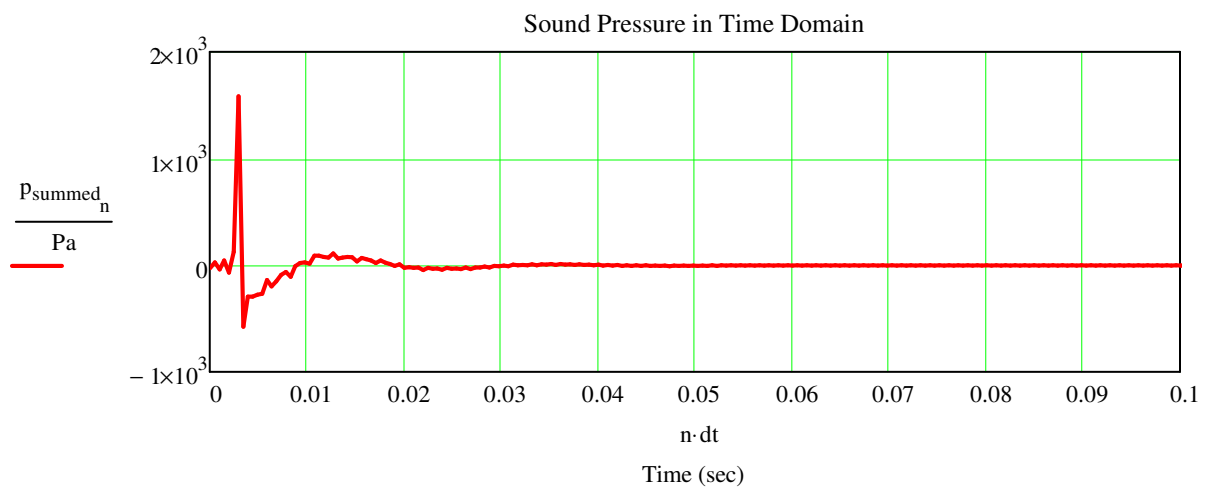
ML TL System and Infinite Baffle Impedance



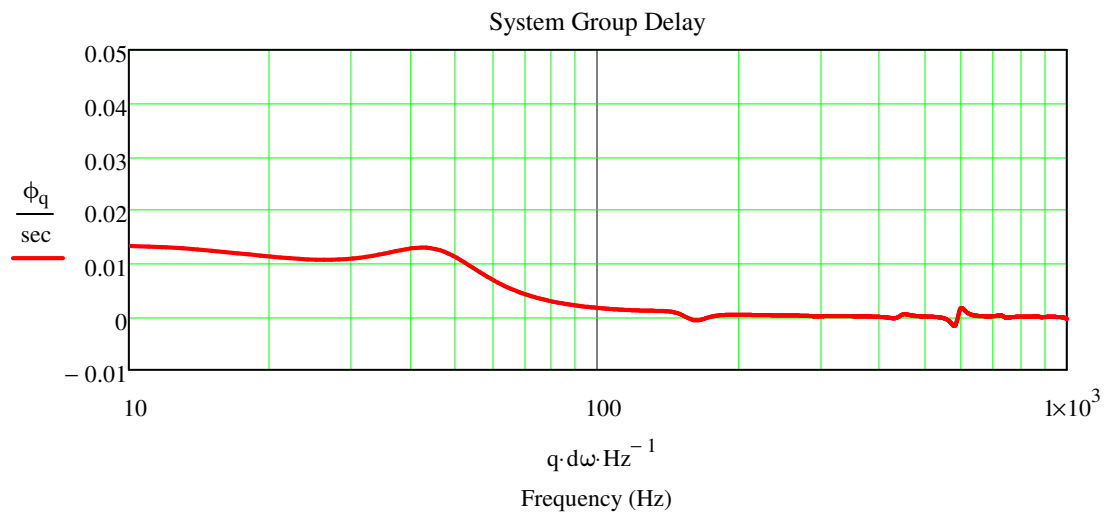
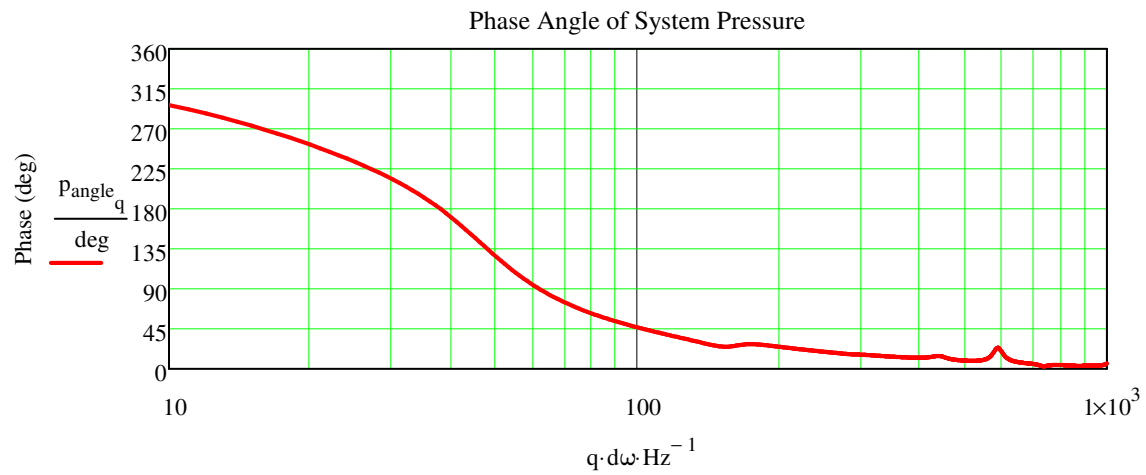
Woofer RMS Displacement



System Time Response for an Impulse Input



System Group Delay



Port Air Velocity (should be $< 10 \text{ m/sec} / 344 \text{ m/sec} = 0.03$)

