Offset Driver in an Open Ended Transmission Line - Acoustic and Electrical Response 12/20/03

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Line Configuration : Near End Closed.
Offset Driver.
Far End Open.

Unit and Constant Definition

$cycle := 2 \cdot \pi \cdot rad$

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

Air Density : $\rho := 1.21 \cdot kg \cdot m^{-3}$

Speed of Sound : $c := 342 \cdot m \cdot sec^{-1}$

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

Driver Thiele / Small Parameters : Seas H1208(nytt datablad)

$f_d := 21 \cdot Hz$ $\qquad V_{ad} := 93 \cdot liter$

$R_e := 6.1 \cdot \Omega$ $\qquad Q_{ed} := 0.29$

$L_{vc} := 3.76 \cdot mH$ $\qquad Q_{md} := 3.13$

$Bl := 10.7 \cdot \frac{newton}{amp}$ $\qquad Q_{td} := \left(\frac{1}{Q_{ed}} + \frac{1}{Q_{md}} \right)^{-1}$

$S_d := 220 \cdot cm^2$ $\qquad Q_{td} = 0.265$

Reference : Derivation and Correlation of a Viscous Damping Model Used in the Design of a Transmission Line Loudspeaker System
by Martin J. King, 3/04/01

The following dimension were derived from "Figure 18 : Cabinet Construction Details and Dimensions (inches)" of the referenced article. This is the most accurate model for the Focal 8V 4412 two-way transmission line enclosure. All of the required input data has been entered below directly into the Geometry Definition section of the worksheet. No variable definitions have been used to describe the enclosure geometry.

Transmission Line Definition (0 lb/ft^3 < D < 1 lb/ft^3)

$n\_closed := 0$ (n_closed > 1)

$n\_open := 1$ (n_open > 1)

Geometry Definition

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

Section Length	Initial Area	Final Area	Stuffing Density
$L_{c_0} := 25.4 \cdot cm$	$S_{c_{0,0}} := 3 \cdot S_d$	$S_{c_{0,1}} := 3 \cdot S_d$	$D_{c_0} := 0.6 \cdot lb \cdot ft^{-3}$
$L_{c_1} := 1 \cdot in$	$S_{c_{1,0}} := 3 \cdot S_d$	$S_{c_{1,1}} := 3 \cdot S_d$	$D_{c_1} := 0.4875 \cdot lb \cdot ft^{-3}$
$L_{c_2} := 2 \cdot in$	$S_{c_{2,0}} := 3 \cdot S_d$	$S_{c_{2,1}} := 3 \cdot S_d$	$D_{c_2} := 0.4875 \cdot lb \cdot ft^{-3}$
$L_{c_3} := 1 \cdot in$	$S_{c_{3,0}} := 3 \cdot S_d$	$S_{c_{3,1}} := 3 \cdot S_d$	$D_{c_3} := 0.4875 \cdot lb \cdot ft^{-3}$
$L_{c_4} := 1 \cdot in$	$S_{c_{4,0}} := 3 \cdot S_d$	$S_{c_{4,1}} := 3 \cdot S_d$	$D_{c_4} := 0.4875 \cdot lb \cdot ft^{-3}$

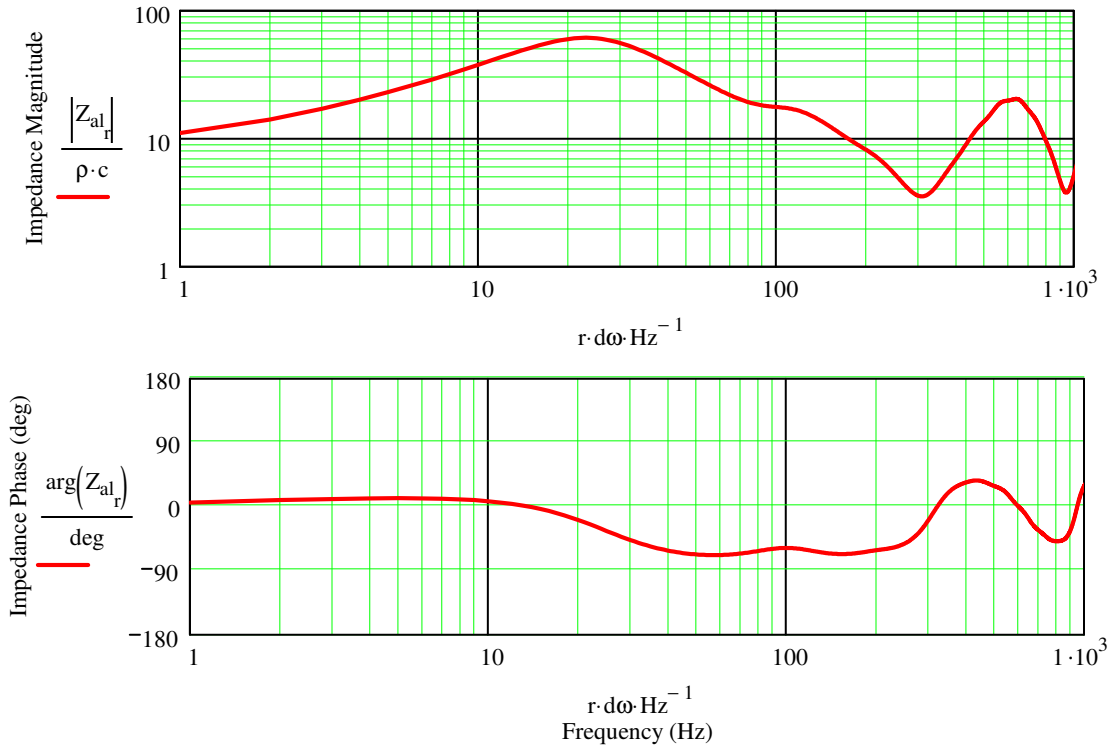
Open End of Transmission Line (Driver ---> Open End)

Section Length	Initial Area	Final Area	Stuffing Density
$L_{o_0} := 0.254 \cdot cm$	$S_{o_{0,0}} := 3 \cdot S_d$	$S_{o_{0,1}} := 3 \cdot S_d$	$D_{o_0} := 0.6 \cdot lb \cdot ft^{-3}$
$L_{o_1} := 152 \cdot cm$	$S_{o_{1,0}} := 1.2 \cdot S_d$	$S_{o_{1,1}} := 0.9 \cdot S_d$	$D_{o_1} := 0.6 \cdot lb \cdot ft^{-3}$
$L_{o_2} := 3.9375 \cdot in$	$S_{o_{2,0}} := 3.7715 \cdot S_d$	$S_{o_{2,1}} := 2.2857 \cdot S_d$	$D_{o_2} := 0.4875 \cdot lb \cdot ft^{-3}$
$L_{o_3} := 0.75 \cdot in$	$S_{o_{3,0}} := 2.2857 \cdot S_d$	$S_{o_{3,1}} := 2.2857 \cdot S_d$	$D_{o_3} := 0.4875 \cdot lb \cdot ft^{-3}$
$L_{o_4} := 3.9375 \cdot in$	$S_{o_{4,0}} := 2.2857 \cdot S_d$	$S_{o_{4,1}} := 3.7715 \cdot S_d$	$D_{o_4} := 0.4875 \cdot lb \cdot ft^{-3}$
$L_{o_5} := 3 \cdot in$	$S_{o_{5,0}} := 3.7715 \cdot S_d$	$S_{o_{5,1}} := 3 \cdot S_d$	$D_{o_5} := 0.4875 \cdot lb \cdot ft^{-3}$
$L_{o_6} := 24 \cdot in$	$S_{o_{6,0}} := 3 \cdot S_d$	$S_{o_{6,1}} := 3 \cdot S_d$	$D_{o_6} := 0.4875 \cdot lb \cdot ft^{-3}$
$L_{o_7} := 3 \cdot in$	$S_{o_{7,0}} := 3 \cdot S_d$	$S_{o_{7,1}} := 3.7715 \cdot S_d$	$D_{o_7} := 0.4875 \cdot lb \cdot ft^{-3}$
$L_{o_8} := 3.9375 \cdot in$	$S_{o_{8,0}} := 3.7715 \cdot S_d$	$S_{o_{8,1}} := 2.2857 \cdot S_d$	$D_{o_8} := 0.4875 \cdot lb \cdot ft^{-3}$
$L_{o_9} := 0.75 \cdot in$	$S_{o_{9,0}} := 2.2857 \cdot S_d$	$S_{o_{9,1}} := 2.2857 \cdot S_d$	$D_{o_9} := 0.0000 \cdot lb \cdot ft^{-3}$

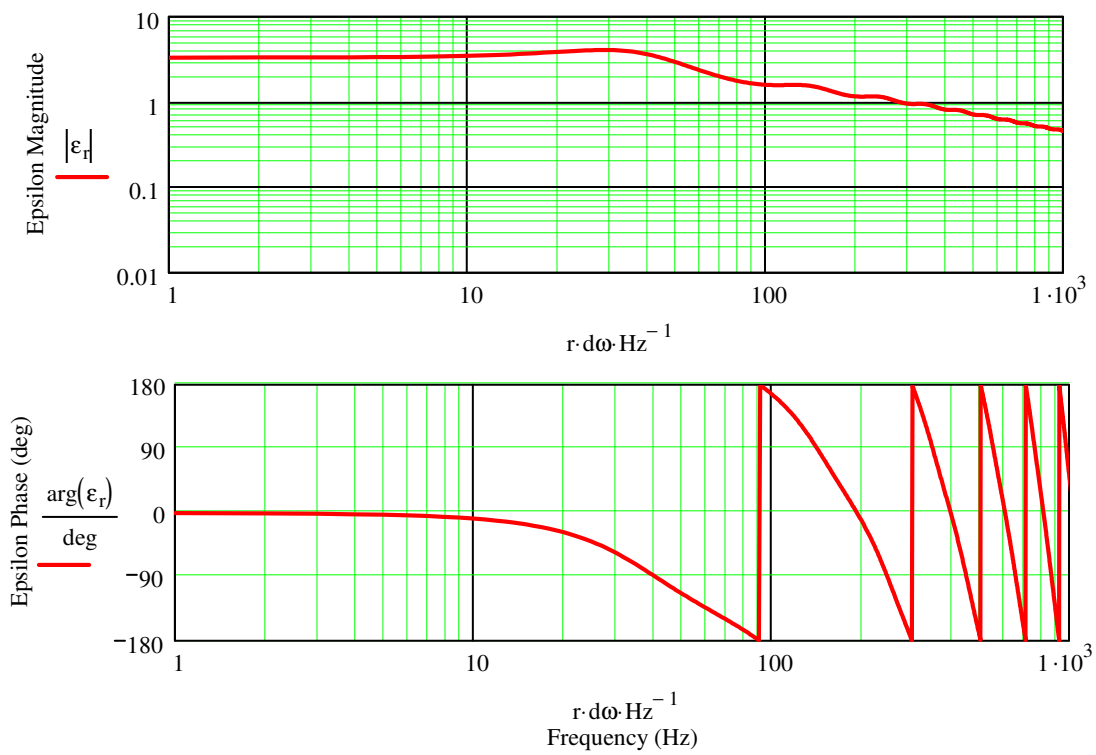
Total Length of the Transmission Line

$$\sum_{i=0}^{n\_closed} L_{c_i} + \sum_{i=0}^{n\_open} L_{o_i} = 69.943\,in$$

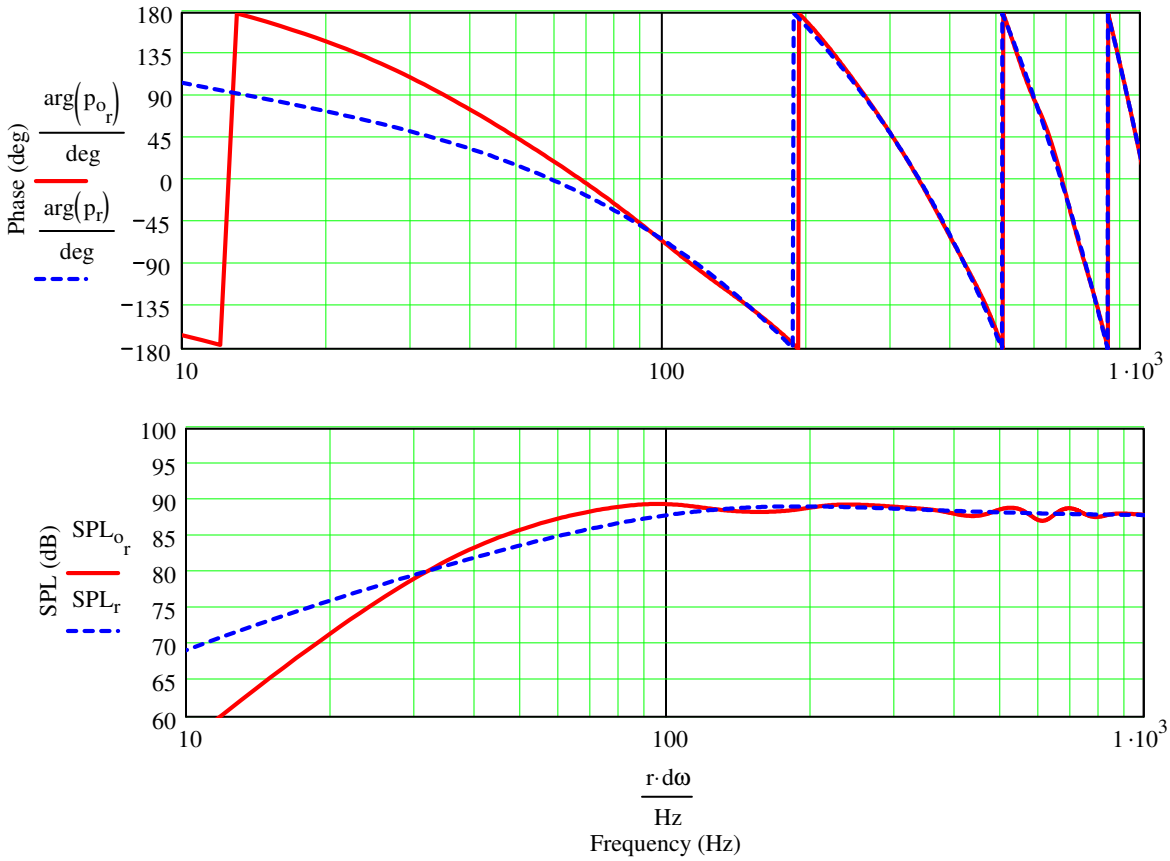
Resulting Acoustic Impedance for the Transmission Line



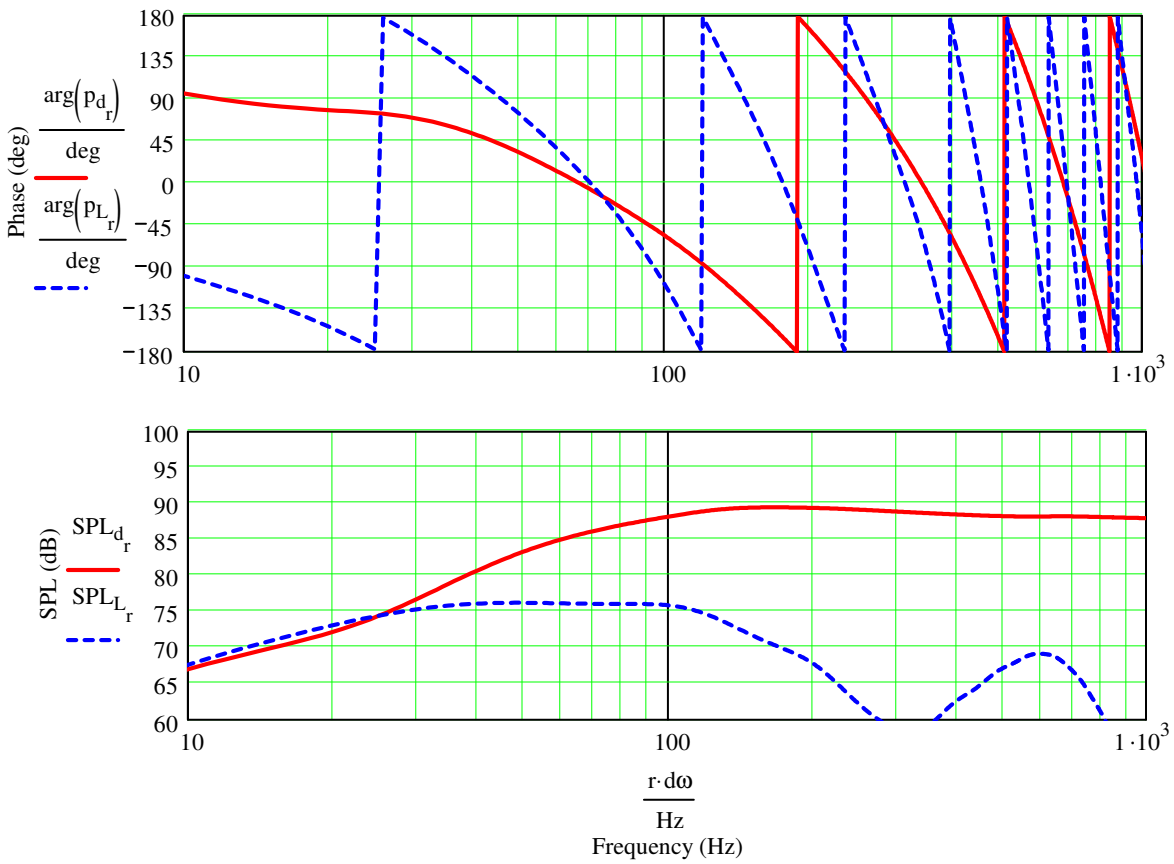
Velocity at the Terminus of the Transmission Line for a 1 m/sec Driver Excitation



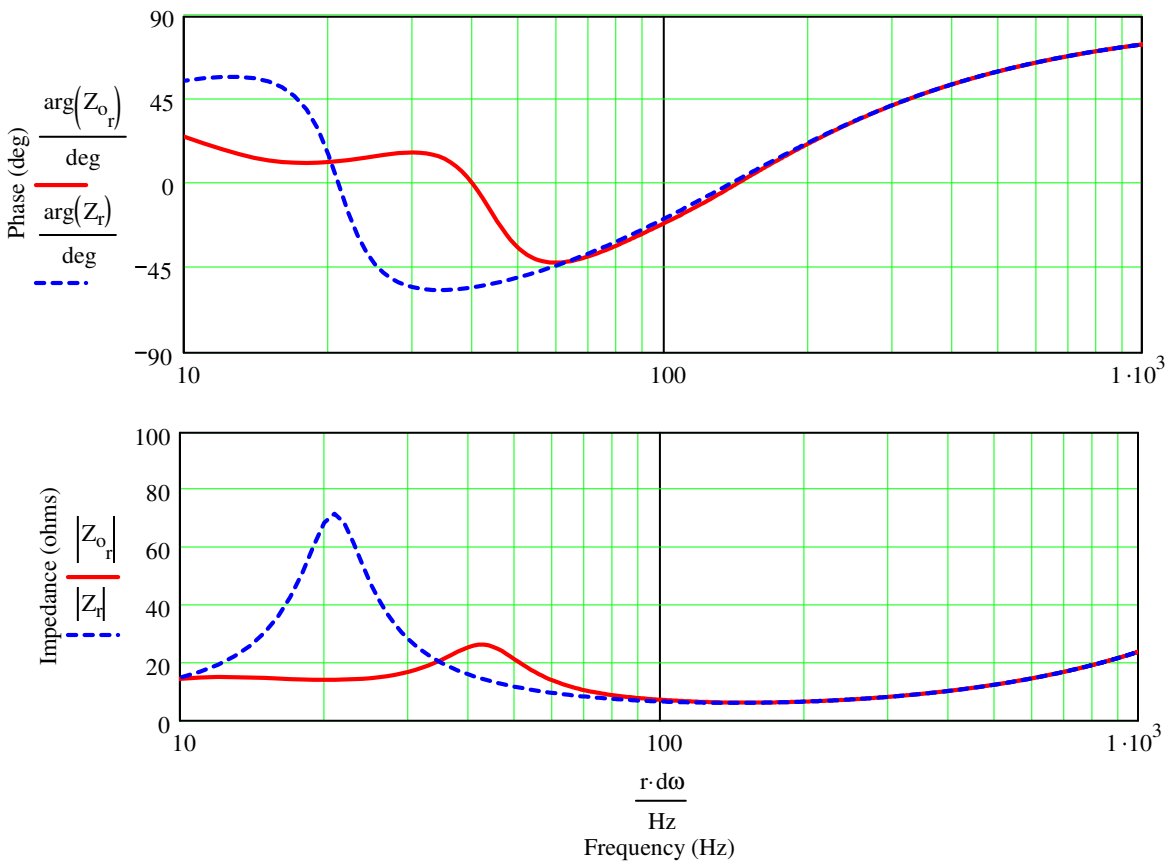
Far Field Transmission Line System and Infinite Baffle Sound Pressure Level Responses



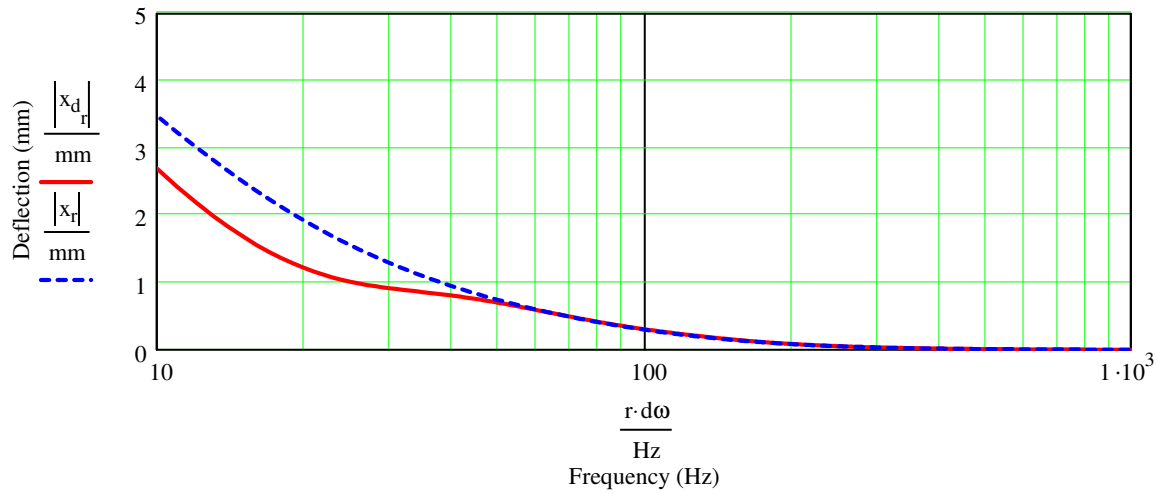
Woofer and Terminus Far Field Sound Pressure Level Responses



Transmission Line System and Infinite Baffle Impedance



Woofer Displacement



System Time Response for an Impulse Input