Offset Driver in an Open Ended Transmission Line - Acoustic and Electrical Response

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

Part 1 : Thiele-Small Consistent Calculation

Mach5audio IXL-18.4 Fs = 15.4HzRe = 3.2OhmQms = 4.87Qes = 0.39Qts = 0.36Vas = 556LSd = 1029.2
15.1Mms = 228gCms = 0.37mmSPL = 89.2Xmax = 22mm

Series Resistance

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

Driver Thiele / Small Parameters :Mach5audio IXL-18.4 Average Driver in Final TL Enclosure

$f_d := 15.4 Hz$

$V_{ad} := 556 liter$

Adjustments

$R_e := 3.2 \cdot \Omega$

$Q_{ed} := 0.39$

$R_e := R_e + R_{add}$

$L_{vc} := 3.5 \cdot mH$

$Q_{md} := 4.87$

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

$Bl := 15.1 \cdot \frac{newton}{amp}$

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

$S_d := 1029.2 cm^2$

$Q_{td} = 0.361$

Power := 100 watt (Input Power, Applied Voltage Referenced to 8 ohm Driver)

Enclosure Geometry Definition

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)

$n\_closed := 2$ (n_closed > 1)

$n\_open := 3$ (n_open > 1)

Geometry Definition

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

Section Length	Initial Area	Final Area	Stuffing Density
$L_{c_0} := 0.1 \cdot in$	$S_{c_{0,0}} := 1.1 \cdot S_d$	$S_{c_{0,1}} := 1.1 \cdot S_d$	$D_{c_0} := 0.4875 lb \cdot ft^{-3}$
$L_{c_1} := 0.1 \cdot in$	$S_{c_{1,0}} := 1.1 \cdot S_d$	$S_{c_{1,1}} := 1.1 \cdot S_d$	$D_{c_1} := 0.4875 lb \cdot ft^{-3}$
$L_{c_2} := 0.1 \cdot in$	$S_{c_{2,0}} := 1.1 \cdot S_d$	$S_{c_{2,1}} := 1.1 \cdot S_d$	$D_{c_2} := 0.4875 lb \cdot ft^{-3}$
$L_{c_3} := 1 \cdot in$	$S_{c_{3,0}} := 3 \cdot S_d$	$S_{c_{3,1}} := 3 \cdot S_d$	$D_{c_3} := 0.4875 lb \cdot ft^{-3}$
$L_{c_4} := 1 \cdot in$	$S_{c_{4,0}} := 3 \cdot S_d$	$S_{c_{4,1}} := 3 \cdot S_d$	$D_{c_4} := 0.4875 lb \cdot ft^{-3}$

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

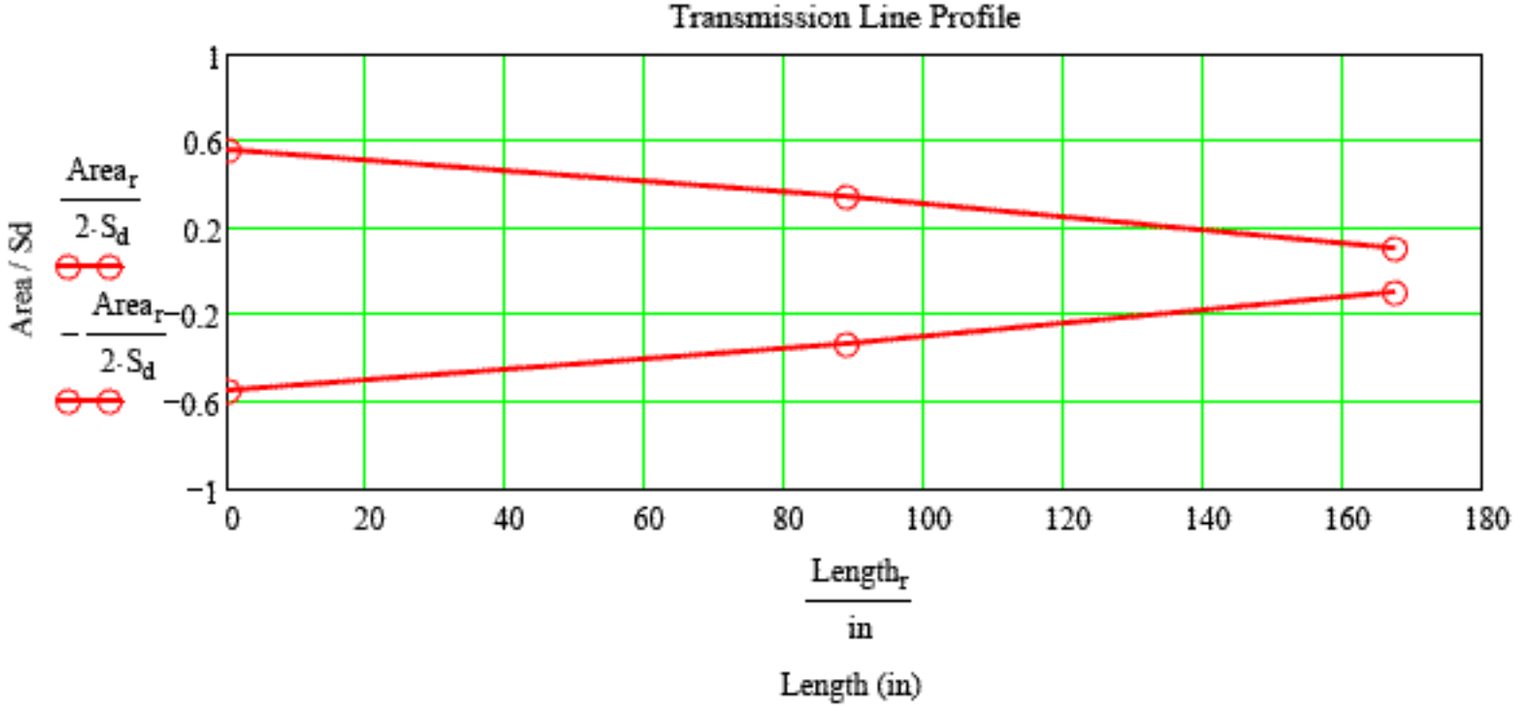
Section Length	Initial Area	Final Area	Stuffing Density
$L_{o_0} := 88.5827 in$	$S_{o_{0,0}} := 1.1 \cdot S_d$	$S_{o_{0,1}} := 0.67808 S_d$	$D_{o_0} := 0.4875 lb \cdot ft^{-3}$
$L_{o_1} := 78.74 in$	$S_{o_{1,0}} := 0.67808 S_d$	$S_{o_{1,1}} := 0.2 \cdot S_d$	$D_{o_1} := 0.24375 lb \cdot ft^{-3}$
$L_{o_2} := 0.001 \cdot in$	$S_{o_{2,0}} := 0.2 \cdot S_d$	$S_{o_{2,1}} := 0.2 \cdot S_d$	$D_{o_2} := 0.24375 lb \cdot ft^{-3}$
$L_{o_3} := 0.001 \cdot in$	$S_{o_{3,0}} := 0.2 \cdot S_d$	$S_{o_{3,1}} := 0.2 \cdot S_d$	$D_{o_3} := 0.24375 lb \cdot ft^{-3}$
$L_{o_4} := 3.9375 in$	$S_{o_{4,0}} := 2.2857 S_d$	$S_{o_{4,1}} := 3.7715 S_d$	$D_{o_4} := 0.4875 lb \cdot ft^{-3}$
$L_{o_5} := 3 \cdot in$	$S_{o_{5,0}} := 3.7715 S_d$	$S_{o_{5,1}} := 3 \cdot S_d$	$D_{o_5} := 0.4875 lb \cdot ft^{-3}$
$L_{o_6} := 24 \cdot in$	$S_{o_{6,0}} := 3 \cdot S_d$	$S_{o_{6,1}} := 3 \cdot S_d$	$D_{o_6} := 0.4875 lb \cdot ft^{-3}$
$L_{o_7} := 3 \cdot in$	$S_{o_{7,0}} := 3 \cdot S_d$	$S_{o_{7,1}} := 3.7715 S_d$	$D_{o_7} := 0.4875 lb \cdot ft^{-3}$
$L_{o_8} := 3.9375 in$	$S_{o_{8,0}} := 3.7715 S_d$	$S_{o_{8,1}} := 2.2857 S_d$	$D_{o_8} := 0.4875 lb \cdot ft^{-3}$
$L_{o_9} := 0.75 \cdot in$	$S_{o_{9,0}} := 2.2857 S_d$	$S_{o_{9,1}} := 2.2857 S_d$	$D_{o_9} := 0.0000 lb \cdot ft^{-3}$

Total Length of the Transmission Line

$$\sum_{i=0}^{n\_closed} L_{c_i} + \sum_{i=0}^{n\_open} L_{o_i} = 167.625\text{in}$$

Total Amount of Stuffing

$$\sum_{r=0}^{n\_closed} \left(\frac{S_{c_{r,0}} + S_{c_{r,1}}}{2} \cdot L_{c_r} \cdot D_{c_r} \right) + \sum_{r=0}^{n\_open} \left(\frac{S_{o_{r,0}} + S_{o_{r,1}}}{2} \cdot L_{o_r} \cdot D_{o_r} \right) = 4.337\text{lb}$$



End of Detailed Input

End of Part 1 Input