Appendix A

Loudspeaker Dimensions

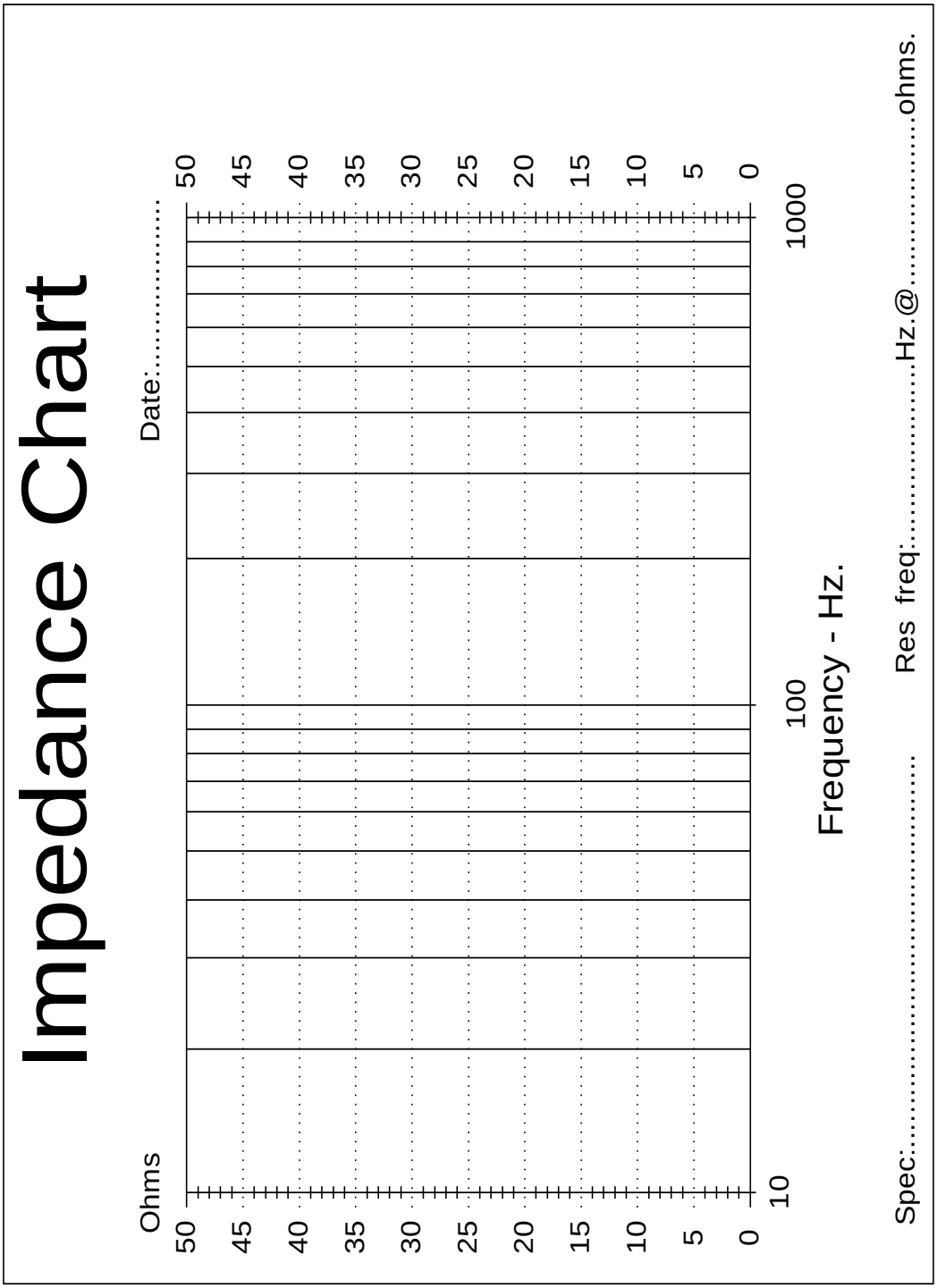
Woofer		
Outside diameter	W_{diam}	……mm.
Woofer radius	R_w	……mm.
Magnet radius	r_w	……mm.
Woofer height	H_w	……mm.
Cone depth	W_{cone}	……mm.
Flange thickness	W_{flange}	……mm.
Flange width	W_{rebate}	……mm.
Cut-out diameter	W_{hole}	……mm.
Mounting screws		M…..
Tweeter		
Outside diameter	T_{diam}	……mm.
Magnet radius	R_t	……mm.
Cone depth	T_{cone}	……mm.
Flange thickness	T_{flange}	……mm.
Flange width	T_{rebate}	……mm.
Cut-out diameter	T_{hole}	……mm.
Mounting screws		M…..

FREQUENCY Hz.	V_S mvolts.	V_R volts.	IMPEDANCE Ohms.
10			
15			
20			
25			
30			
35			
40			
50			
60			
70			
80			
90			
100			
200			
300			
400			
500			
600			
700			
800			
900			
1000			
Resonant Frequency - F_s			

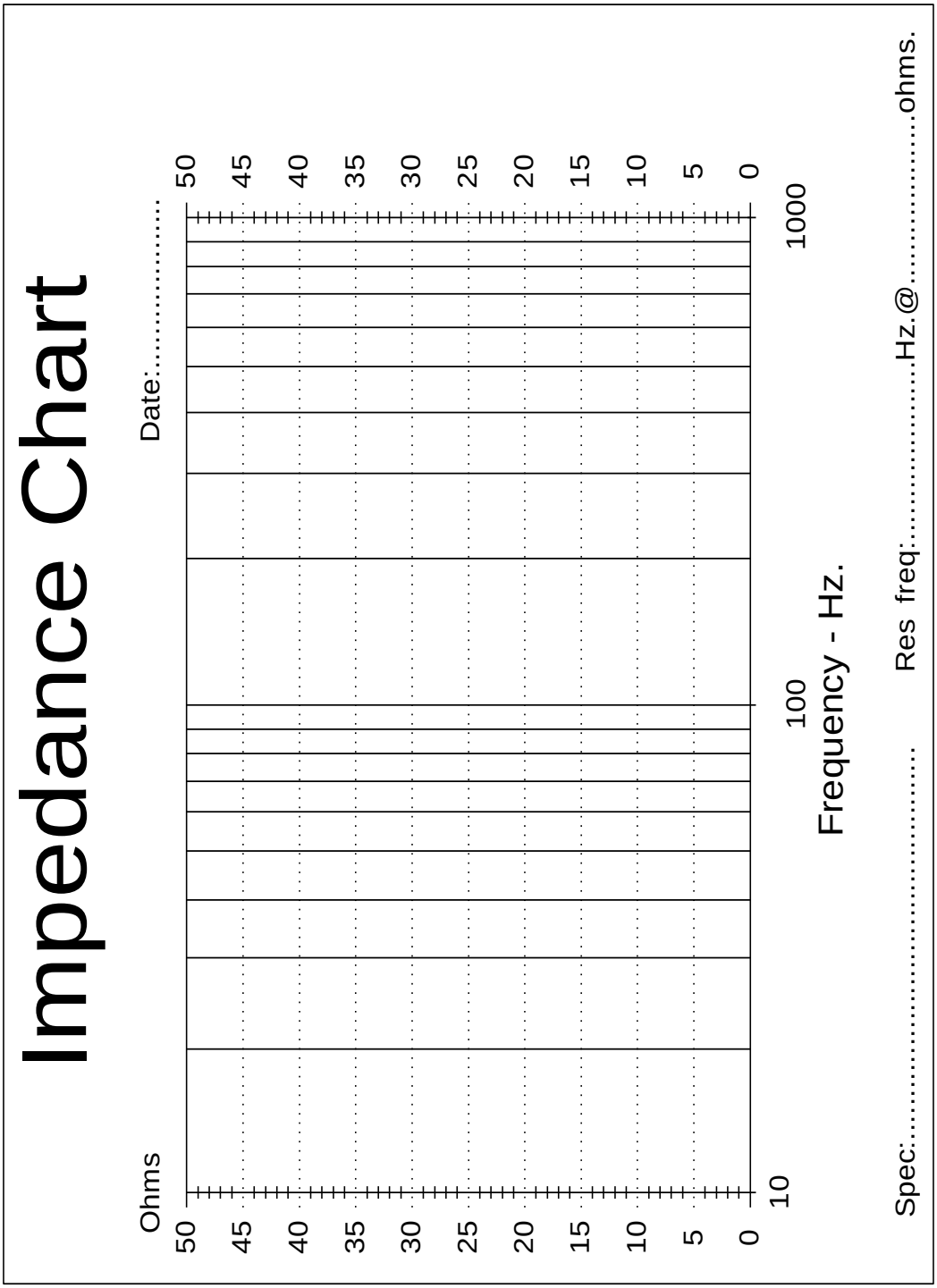
Woofer Impedance Data Chart. (Left hand)

FREQUENCY Hz.	V_S mvolts.	V_R volts.	IMPEDANCE Ohms.
10			
15			
20			
25			
30			
35			
40			
50			
60			
70			
80			
90			
100			
200			
300			
400			
500			
600			
700			
800			
900			
1000			
Resonant Frequency - F_s			

Woofer Impedance Data Chart. (Right hand)



Woofer Impedance Curve Chart. (Left hand)



Woofer Impedance Curve Chart. (Right hand)

TYPE : ..…….....…..... **P/N** : ...…….....……... **DATE** : ……..…..

	LEFT HAND	**RIGHT HAND**
Woofer parameters : Crossover point: ….....Hz. R_e F_s Z_{fs} Z_{f3} F_1 F_2 **Z_{fs}** = $\frac{V_s}{V_r}$ mV V **Q_{ts}** = $\frac{F_s}{F_1 - F_2}$ x $\frac{R_e}{Z_{fs}}$ Z_{f3} = .707 x Zf_s F_1 & F_2 is the frequency of Z_{f3} above & below F_s.	...……..... Ohms. .....…..... Hz. ...…….... Ohms. ...…….... Ohms. ....…..... Hz. ....…..... Hz. _____ = ...……..... Ω ...…….... x ...…….... Q_{ts} = ...……..... Z_{f3}=.707 x …… =…..…...Ω	..... Ohms. ..... Hz. ..... Ohms. ..... Ohms. ..... Hz. ..... Hz. _____ = ...…..... Ω ...…….... x ...…….... Q_{ts} = ...……..... Z_{f3}=.707 x …… = …...…Ω
Check **F_s** : (±1 %) **F_s** = $\sqrt{F_1 \times F_2}$ Hz	√……x……. = ……. Hz	√.....x..... = ...…...Hz
Calculate **L_{ref}** = Re x √2 Find L_{ref} above F_s and record F_5.(>300Hz.)	= ……. x √2. = …… Ω F_5 = …….. Hz.	= ……. x √2. = …… Ω F_5 = …….. Hz.
Max Output. SPL =10LOG(P) + S P= rms watts. S=sensitivity- dB@1w/1 m	=10LOG.....+..... =.....dB SPL.	=10LOG.....+..... =.....dB SPL.

Woofer Crossover Calculation Chart - Zobel/Butterworth.

Zobel Network: Date: …….

R_5 = ……..….Ω **C_9** = ……..….µF

R_e = ..……...…Ω **F_5** = ……Hz. **L_e** = ……...mH.

$$L_e = \frac{R_e}{2 \times \pi \times F_5} = \frac{\quad}{2 \times \pi \times \ldots\ldots} \times 10^3 = \ldots\ldots\ldots\ldots\text{mH}$$

$$C_9 = \frac{L_e}{R_e^{\,2}} = \frac{\quad}{(\ldots\ldots\ldots)^2} \times 10^3 = \ldots\ldots\ldots\ldots\ldots\ldots\mu F$$

R_5 = R_e @5watt = ……Ω

Crossover Network:

Crossover point: F_{lo} =..…….……Hz.

L_4 =…..……mH **C_4** = ……..……µF

$$\chi = \frac{\sqrt{2}}{2} = 0.707$$

Frequency factor ωcap = $2 \times \pi \times \sqrt[4]{3} \times F_{lo}$ = 4.78 x ……..…. = ……..……

$$C_4 = \frac{\chi}{R_e \times \omega\text{cap}} = \frac{0.707}{\ldots\ldots \times \ldots\ldots\ldots} \times 10^6 = \ldots\ldots\ldots\ldots\mu F$$

$$\lambda = \sqrt{2} = 1.414$$

Frequency factor ωind = $\frac{2 \times \pi \times F_{lo}}{\sqrt[4]{3}}$ = 4.78 x ……..…. = ……..……

$$L_4 = \frac{\lambda \times R_e}{\omega\text{ind}} = \frac{1.414 \times \quad}{\quad} \times 10^3 = \ldots\ldots\ldots\ldots\text{mH}$$

TYPE : ..…….....….....	**P/N** : ...…….....……..	**DATE** : …….....
	LEFT HAND	**RIGHT HAND**
Tweeter parameters : Crossover point: ….....Hz. R_e F_s Z_{fs} $\mathbf{Z_{fs}} = \frac{V_s}{V_r}$ mV / V	...……..... Ohms. .....…..... Hz. ...……..... Ohms. _____ = ...…….....Ohms.	..... Ohms. ..... Hz. ..... Ohms. _____ = ...…….....Ohms.
Zobel Parameters : Calculate: $\mathbf{r_o} = \frac{Z_{fs}}{R_e}$ Reference impedance : $\mathbf{R_{ref}} = R_e \times \sqrt{r_o}$ Record F_3 and F_4 where R_{ref} is above & below Z_{fs}.	r_o = _____ = …… R_{ref} = ……. x √…… = R_{ref} = …….. Ω F_3 = …….. Hz. F_4 = …….. Hz.	r_o = _____ = ……... R_{ref} = ……. x √…… = R_{ref} = …….. Ω F_3 = …….. Hz. F_4 = …….. Hz.
Check $\mathbf{F_s}$: (±1 %) $\mathbf{F_s}$ = $\sqrt{F_3 \times F_4}$ Hz	√……..x……. = …… Hz	√.....x..... = ..….....Hz
Calculate $\mathbf{L_{ref}}$ = Re x √2 Find L_{ref} above F_s and record F_5.(300-1000 Hz.)	= ……. x √2. = …… Ω F_5 = …….. Hz.	= ……. x √2. = …… Ω F_5 = …….. Hz.

Tweeter Zobel Calculation Chart - Zobel/Butterworth.

Zobel Network:

R_e = …….Ω **Fs** = ……..…..Hz. **Zfs** = ……..……Ω

L_e = ……....mH. **Q_{ms}** = …..……. **Q_{es}** = ……..……..

r_o = …….. **C_5** = …..……..…µF **C_6** = ….……µF

R_1 = …….Ω **R_2** = ……..Ω **L_5** = ……mH

Calculate:

F_3: …….. **F_4**: …….. (From Speaker Data chart.)

$Q_{ms} = \frac{F_s \times \sqrt{r_o}}{(F_3 - F_4)} = \frac{\quad \times \sqrt{\quad}}{\quad} =$ ……..

$Q_{es} = \frac{Q_{ms}}{(r_o - 1)} = \frac{\quad}{(\ldots\ldots - 1)} =$ ……..……..

$R_{es} = \frac{Q_{ms} \times R_e}{Q_{es}} = \frac{\quad \times \quad}{\quad} =$ ……..…….

Check: $R_{es} = Z_{fs} - R_e$ = ……..… - ….....…=……..…

$L_{ces} = \frac{R_{es}}{2 \times \pi \times F_s \times Q_{ms}} = \frac{\quad}{\quad} =$ ……..……..

$C_{mes} = \frac{Q_{ms}}{2 \times \pi \times F_s \times R_{es}} = \frac{\quad}{\quad} =$ ……..……..…

F_5 = …….Hz (From Speaker Data chart.)

L_e = $\frac{R_e}{2 \times \pi \times F_5} = \frac{\quad}{2 \times \pi \times \ldots\ldots} \times 10^3 =$ ...…….....mH

C_5 = $\frac{L_e}{R_e^{\,2}} = \frac{\quad}{(\ldots\ldots)^2} \times 10^3 =$ …..……...µF

Tweeter cont.

$\mathbf{L_5} = C_{mes} \times R_e^2 = \ldots\ldots\ldots\ldots \times (\ldots\ldots\ldots)^2 \times 10^3 = \ldots\ldots\ldots\ldots\ldots\ldots mH$

$\mathbf{R_2} = \frac{R_e^2}{R_{es}} = \frac{(\quad\quad)^2}{\quad\quad} = \ldots\ldots\ldots\ldots\ldots\ldots\Omega$

$\mathbf{C_6} = \frac{L_{ces}}{R_e^2} = \frac{\quad\quad}{(\ldots\ldots\ldots\ldots)^2} \times 10^6 = \ldots\ldots\ldots\ldots\ldots\ldots\mu F$

$\mathbf{R_1} = R_e = \ldots\ldots\ldots\ldots\ldots\ldots\Omega$

Crossover Network:

Crossover point : F_{hi} …..…….....Hz

$\mathbf{C_1}$ = ……μF

$\mathbf{L_1}$ = …….mH.

$\chi = \frac{\sqrt{2}}{2} = 0.707$

Frequency factor $\omega cap = 2 \times \pi \times \sqrt[4]{3} \times F_{hi}$ = ..8.27.. x ..……..... = ……..…..…

$\mathbf{C_1} = \frac{\chi}{R_e \times \omega cap} = \frac{0.707}{x} \times 10^6 = \ldots\ldots\ldots\ldots\ldots\ldots\mu F$

$\lambda = \sqrt{2} = 1.414$

Frequency factor $\omega ind = \frac{2 \times \pi \times F_{hi}}{\sqrt[4]{3}}$ = ..8.27.. x ..……..... = ……..…..…

$\mathbf{L_1} = \frac{\lambda \times R_e}{\omega ind} = \frac{1.414 \times \quad\quad}{x} \times 10^3 = \ldots\ldots\ldots\ldots\ldots\ldots mH$

Crossover Parts List.

\+ = series connection. * = parallel connection.

Tweeter: crossover point = ……..……..…Hz.

C1 = …..…..…µF = ……..…@…….…v ……..……@…..……v

C5 = ……..…..µF = ……..…@……..…v ……..……@…..…...v

C6 = ……µF = ……..….@……..v ……..@…..……v

R1 = ……..…..Ω = ….…… ……..……

R2 = ……..Ω = ….…… ……

L1 = ……mH

L5 = ……..…mH

Woofer: crossover point = ……..……Hz.

C4 = ……..…µF = ……..…@…….....v ……..@……..…v

C9 = ……..…µF = ……..…@……..…v ……...…@…….....v

L4 = ……..…mH

R5 = ……...Ω = ……..… ……..…

Note: Use higher voltage caps on parallel connection.

Crossover Parts List.