

Appendix A

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Loudspeaker Dimensions

Woofer		
Outside diameter	W_{diam}mm.
Woofer radius	R_wmm.
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.....
Midrange		
Outside diameter	M_{diam}}	.....mm.
Tube radius	R_m	.....mm.
Tube height	H_m	.....mm.
Cone depth	M_{cone}}	.....mm.
Flange thickness	M_{flange}}	.....mm.
Flange width	M_{rebate}}	.....mm.
Cut-out diameter	M_{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.....

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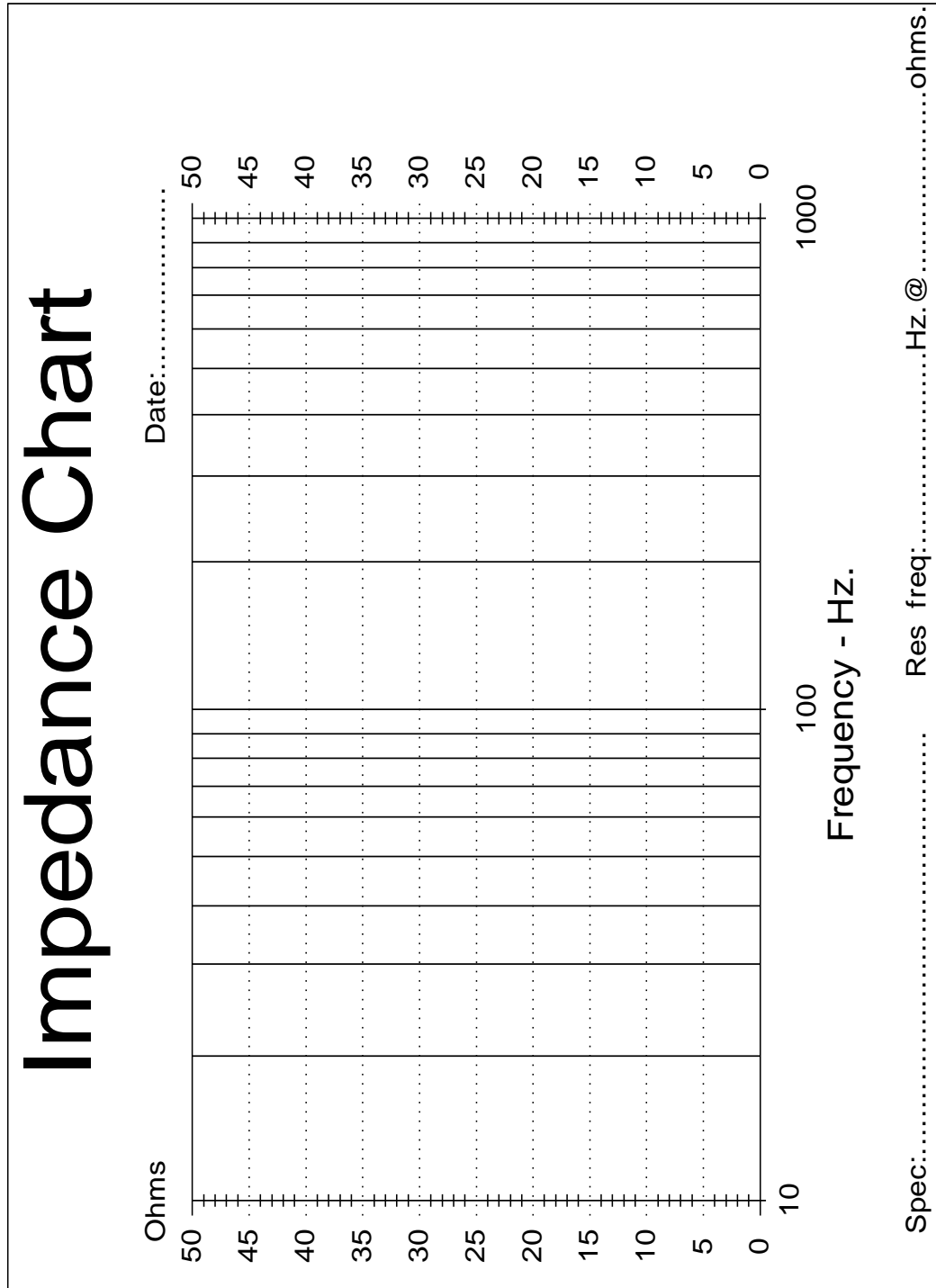
FREQUENCY Hz.	V _S mvolts.	V _R volts.	IMPEDANCE Ohms.
10			
15			
20			
25			
30			
35			
40			
50			
60			
70			
80			
90			
100			
200			
300			
400			
500			
600			
700			
800			
900			
1000			
Resonant Frequency - F _s			

Woofer Impedance Data Chart. (Left hand)

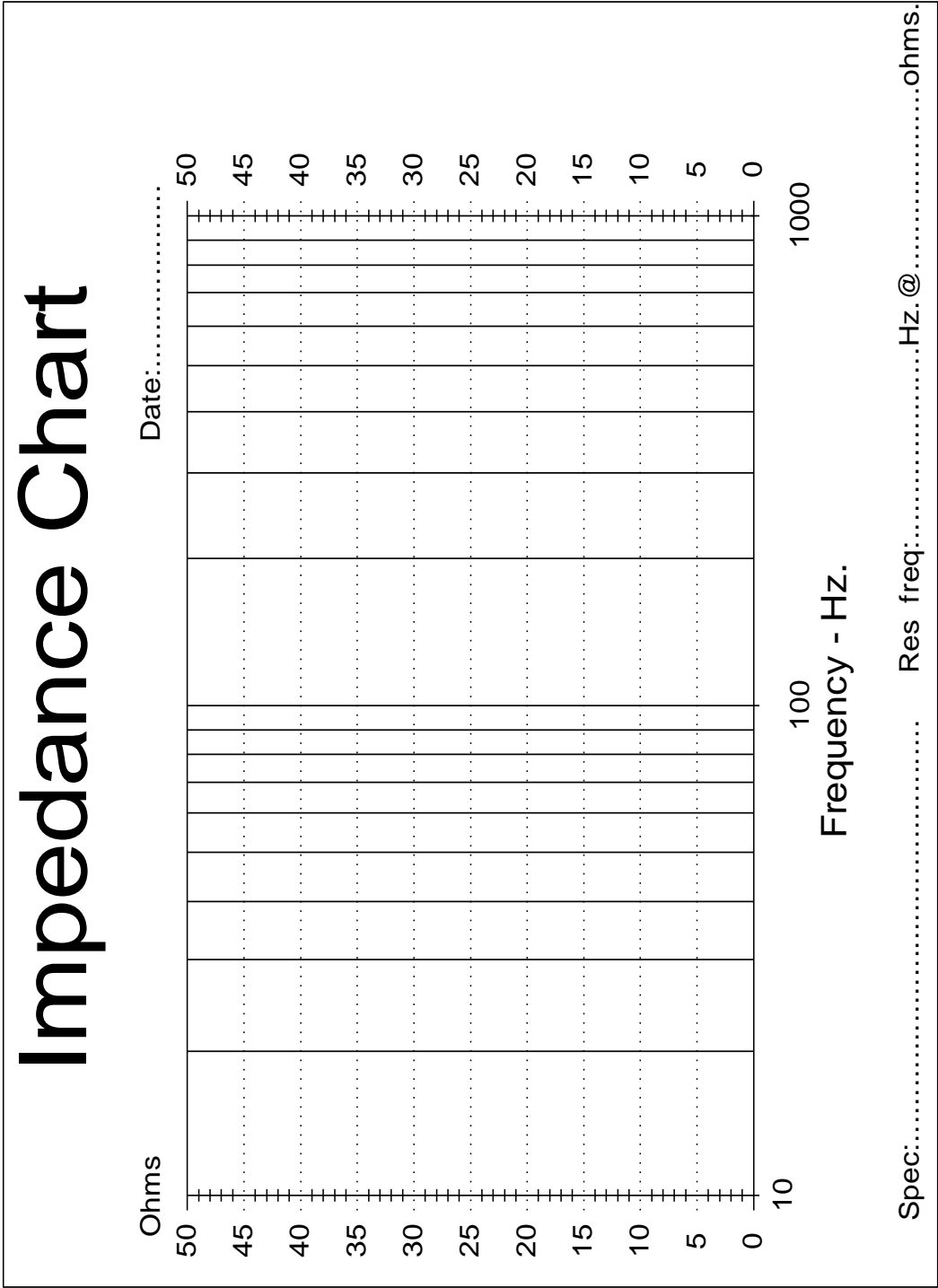
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FREQUENCY Hz.	V _S mvolts.	V _R volts.	IMPEDANCE Ohms.
10			
15			
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25			
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35			
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50			
60			
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)

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TYPE : P/N : DATE :		
	LEFT HAND	RIGHT HAND
<u>Woofer parameters :</u> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; display: inline-block; margin-bottom: 10px;"> <u>Crossover point:</u> Hz. </div> <div style="display: flex; justify-content: space-between;"> <div style="width: 25%;"> R_e F_s Z_{fs} Z_{f3} F_1 F_2 Q_{ts} </div> <div style="width: 40%;"> Ohms. Hz. Ohms. Ohms. Hz. Hz. </div> <div style="width: 25%;"> Ohms. Hz. Ohms. Ohms. Hz. Hz. </div> </div> $Z_{fs} = \frac{V_s}{V_r} \frac{mV}{V}$ =	Z_{fs} Ω $Z_{f3} = .707 \times \dots = \dots \Omega$	Z_{fs} Ω $Z_{f3} = .707 \times \dots = \dots \Omega$
<u>Impedance Z:</u> L_o $Z_{f3} = .707 \times Z_{fs}$ F_1 & F_2 is the frequency of Z_{f3} above & below F_s .	Z_{fs} Ω $Z_{f3} = .707 \times \dots = \dots \Omega$	Z_{fs} Ω $Z_{f3} = .707 \times \dots = \dots \Omega$
<u>Speaker Q:</u> $r_0 = \frac{Z_{fs}}{R_e}$ $Q_{ts} = \frac{F_s}{F_1 - F_2} \times \frac{R_e}{Z_{fs}} \times \sqrt{r_0}$	$r_0 = \dots = \dots$ $\dots \times \dots \times \sqrt{\dots}$ $Q_{ts} = \dots$	$r_0 = \dots = \dots$ $\dots \times \dots \times \sqrt{\dots}$ $Q_{ts} = \dots$
Check F_s : ($\pm 1\%$) $F_s = \sqrt{F_1 \times F_2}$ Hz	$\sqrt{\dots \times \dots} = \dots$ Hz	$\sqrt{\dots \times \dots} = \dots$ Hz
Calculate $L_{ref} = R_e \times \sqrt{2}$ Find L_{ref} above F_s and record F_5 . (>300Hz.)	$\dots \times \sqrt{2} = \dots \Omega$ $F_5 = \dots$ Hz.	$\dots \times \sqrt{2} = \dots \Omega$ $F_5 = \dots$ Hz.
<u>Max Output.</u> $SPL = 10 \log(P) + S$ P = rms watts. S = sensitivity- dB@1w/1 m	$= 10 \log \dots + \dots$ $= \dots$ dB SPL.	$= 10 \log \dots + \dots$ $= \dots$ dB SPL.

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$$C7 = \dots\dots\dots \mu F.$$

$$R4 = \dots\dots\dots \Omega.$$

$$F_5 = \dots\dots\dots \text{Hz. (see data chart)}$$

$$\text{Where } L_e = \frac{R_e}{2 \times \pi \times F_5} \times 10^3 = \dots\dots\dots \times 10^3 = \dots\dots\dots \text{mH.}$$

$$C7 = \frac{L_e}{R_e^2} \times 10^3 = \frac{\dots\dots\dots}{(\dots\dots\dots)^2} \times 10^3 = \dots\dots\dots \mu F.$$

$$R4 \text{ (Use a standard 5watt value close to } R_e. \dots\dots\dots \Omega. \\ \text{Check the impedance curve as a reference} \\ \text{and aim to get a straight line)}$$

Note: Use R4 as Z_w in the woofer crossover calculation chart if using an impedance equalizer.

Woofer Impedance Equalizer Calculation Chart.

$$\eta_{\text{eff}} = \frac{0.0953 \times (F_s^3 \times V_{as}) \times 10^{-6}}{Q_{es}} = \frac{0.0953 \times ((\dots\dots\dots)^3 \times \dots\dots\dots) \times 10^{-6}}{\dots\dots\dots} = \dots\dots\dots\%$$

$$Q_{es} = \frac{Q_{ms}}{(r_o - 1)} = \frac{\dots\dots\dots}{(\dots\dots\dots - 1)} = \dots\dots\dots$$

$$r_o = \frac{Z_{fs}}{R_e} = \dots\dots\dots = \dots\dots\dots \quad (\text{see data chart for } R_e, Z_{fs}, F_h, F_l)$$

$$Q_{ms} = \frac{F_s \times \sqrt{r_o}}{(F_1 - F_2)} = \frac{\dots\dots\dots \times \sqrt{\dots\dots\dots}}{\dots\dots\dots} = \dots\dots\dots$$

$$V_{as} = 1.15 \times \left(\left(\frac{F_{box}}{F_s} \right)^2 - 1 \right) \times V_{box} = 1.15 \times (\dots\dots\dots - 1) \times \dots\dots\dots \\ = \dots\dots\dots \text{liters}$$

Woofer Relative Efficiency calculation chart.

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TYPE : P/N : DATE :		
	LEFT HAND	RIGHT HAND
Midrange parameters : <div style="border: 1px solid black; border-radius: 10px; padding: 5px; width: fit-content; margin: 10px auto;"> Crossover point: L_oHz & H_iHz </div> $Z_{fs} = \frac{V_{s_r}}{V_r} \frac{mV}{V}$ Impedance Z:	R_e Ohms. F_s Hz. Z_{fs} Ohms. Z_{ml} Ohms. Z_{mh} Ohms. _____ = $Z_{fs} =$Ohms. = _____ = $Z_{ml} =$Ohms. M_{Lo} _____ = $Z_{mh} =$Ohms.	R_e Ohms. F_s Hz. Z_{fs} Ohms. Z_{ml} Ohms. Z_{mh} Ohms. _____ = $Z_{fs} =$Ohms. = _____ = $Z_{ml} =$Ohms. M_{Hi} _____ = $Z_{ml} =$Ohms.

Midrange Impedance Calculation Chart.

Parameters: $F_n =$ Hz

$R3 =$ Ω

$L6 =$ mH

$C6 =$ μF

 $C_{ideal} = \frac{1}{2 \times \pi \times R_e \times F_n} \times 10^6 = \frac{10^6}{\quad} =$ uF

 $L_6 = \frac{1}{C_n \times (2 \times \pi \times F_n)^2} \times 10^3 = \frac{10^3}{\quad} =$ mH

 $R_3 = R_e =$ ohms.

F_n is the frequency of the notch you want to control and is usually equal to F_s .
 Calculate C_{ideal} , then choose the nearest standard value capacitor for C_n to enable a small enough coil to be wound (<6mH).

Midrange Notch Filter Calculation Chart.

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TYPE : P/N : DATE :		
	LEFT HAND	RIGHT HAND
<u>Tweeter parameters :</u> <div style="border: 1px solid black; padding: 5px; margin: 10px 0; display: inline-block;"> <u>Crossover point:</u> Hz </div> $Z_{fs} = \frac{V_s}{V_r} \frac{mV}{V}$ <u>Impedance Z:</u>	R_e Ohms. F_s Hz. Z_{fs} Ohms. Z_t Ohms. _____ = $Z_{fs} =$Ohms. $H_i =$ _____ = $Z_t =$Ohms.	$.....$ Ohms. $.....$ Hz. $.....$ Ohms. $.....$ Ohms. _____ = $Z_{fs} =$Ohms. $=$ _____ = $Z_t =$Ohms.

Tweeter Impedance Calculation Chart.

Parameters: $F_n =$ Hz

$R_2 =$ Ω

$L_5 =$ mH

$C_5 =$ μF

$$C_{ideal} = \frac{1}{2 \times \pi \times R_e \times F_n} \times 10^6 = \frac{10^6}{.....} =uF$$

$$L_5 = \frac{1}{C_n \times (2 \times \pi \times F_n)^2} \times 10^3 = \frac{10^3}{.....} =mH$$

$$R_2 = R_e =ohms.$$

F_n is the frequency of the notch you want to control and is usually equal to F_s .
 Calculate C_{ideal} , then choose the nearest standard value capacitor for C_n to enable a small enough coil to be wound (<6mH).

Tweeter Notch Filter Calculation Chart.

Crossover points :&.....

Date :

$Z_w^* = \dots\dots\dots$ $Z_{mh} = \dots\dots\dots$ $Z_{ml} = \dots\dots\dots$ $Z_t = \dots\dots\dots$

*Alignment: **n** = C x & L x.....

Woofer :

$$L4 = \frac{Z_w}{2\pi \times F_L \times 10^{-3}} * \mathbf{n} = \dots\dots\dots = \dots\dots\dots \text{mH}$$

$$C4 = \frac{1}{2\pi \times Z_w \times F_L \times 10^{-6}} * \mathbf{n} = \dots\dots\dots 1 \dots\dots\dots = \dots\dots\dots \text{uF}$$

Midrange :

$$L2 = \frac{Z_{mh} \times \sqrt{2}}{4 \times \pi \times (F_h - F_L) \times 10^{-3}} * \mathbf{n} = \dots\dots\dots = \dots\dots\dots \text{mH}$$

$$L3 = \frac{Z_{ml} \times (F_h - F_L)}{2 \times \sqrt{2} \times \pi \times F_m \times 10^{-3}} * \mathbf{n} = \dots\dots\dots \times \dots\dots\dots = \dots\dots\dots$$

$$\text{(Where } F_m = F_h \times F_L \text{)} = \dots\dots\dots \times \dots\dots\dots = \dots\dots\dots \text{mH}$$

=.....x.....

=.....)

$$C2 = \frac{F_h - F_L}{\sqrt{2} \times \pi \times Z_{mL} \times f_m \times 10^{-6}} * \mathbf{n} = \dots\dots\dots = \dots\dots\dots$$

$$= \dots\dots\dots = \dots\dots\dots \text{uF}$$

$$C3 = \frac{1}{\sqrt{2} \times \pi \times Z_{mh} \times (f_h - F_L) \times 10^{-6}} * \mathbf{n} = \dots\dots\dots 1 \dots\dots\dots = \dots\dots\dots$$

$$= \dots\dots\dots 1 \dots\dots\dots = \dots\dots\dots \text{uF}$$

Tweeter :

$$L1 = \frac{Z_t}{2\pi \times F_h \times 10^{-3}} * \mathbf{n} = \dots\dots\dots = \dots\dots\dots \text{mH}$$

$$C1 = \frac{1}{2 \times \pi \times Z_t \times F_h \times 10^{-6}} * \mathbf{n} = \dots\dots\dots 1 \dots\dots\dots = \dots\dots\dots \text{uF}$$

* Notes: 1. Use R1 from impedance equalizer chart as Z_w if using an impedance equalizer on woofer.

2. '**n**' is the multiplier for the different alignments – see Table 1 page 16.

Crossover Network Calculation Chart.

Filter	1 st order	2 nd order		
	As calculated with the text book formulas. For higher orders multiply the standard values with the appropriate multiplier.	Butterworth	L/R	Bessel
C1		0.707	0.50	0.57
C4		0.707	0.50	0.57
L1		1.414	2.00	1.74
L4		1.414	2.00	1.74
		n th multipliers		

Table 1

Crossover Parts List.

+ = series connection. * = parallel connection.

Tweeter: crossover point =Hz.

C1 = μ F =@.....V@.....V

C5 = μ F =@.....V@.....V

C6 = μ F =@.....V@.....V

R1 = Ω = or

R2 = Ω =

L1 =mH

L5 =mH

Midrange: crossover point =&.....Hz.

C2 = μ F =@.....V@.....V

C3 = μ F =@.....V@.....V

C6 = μ F =@.....V@.....V

R3 = Ω =

L2 =mH

L3 =mH

L6 =mH

Woofers: crossover point =Hz.

C4 = μ F =@.....V@.....V

C7 = μ F =@.....V@.....V

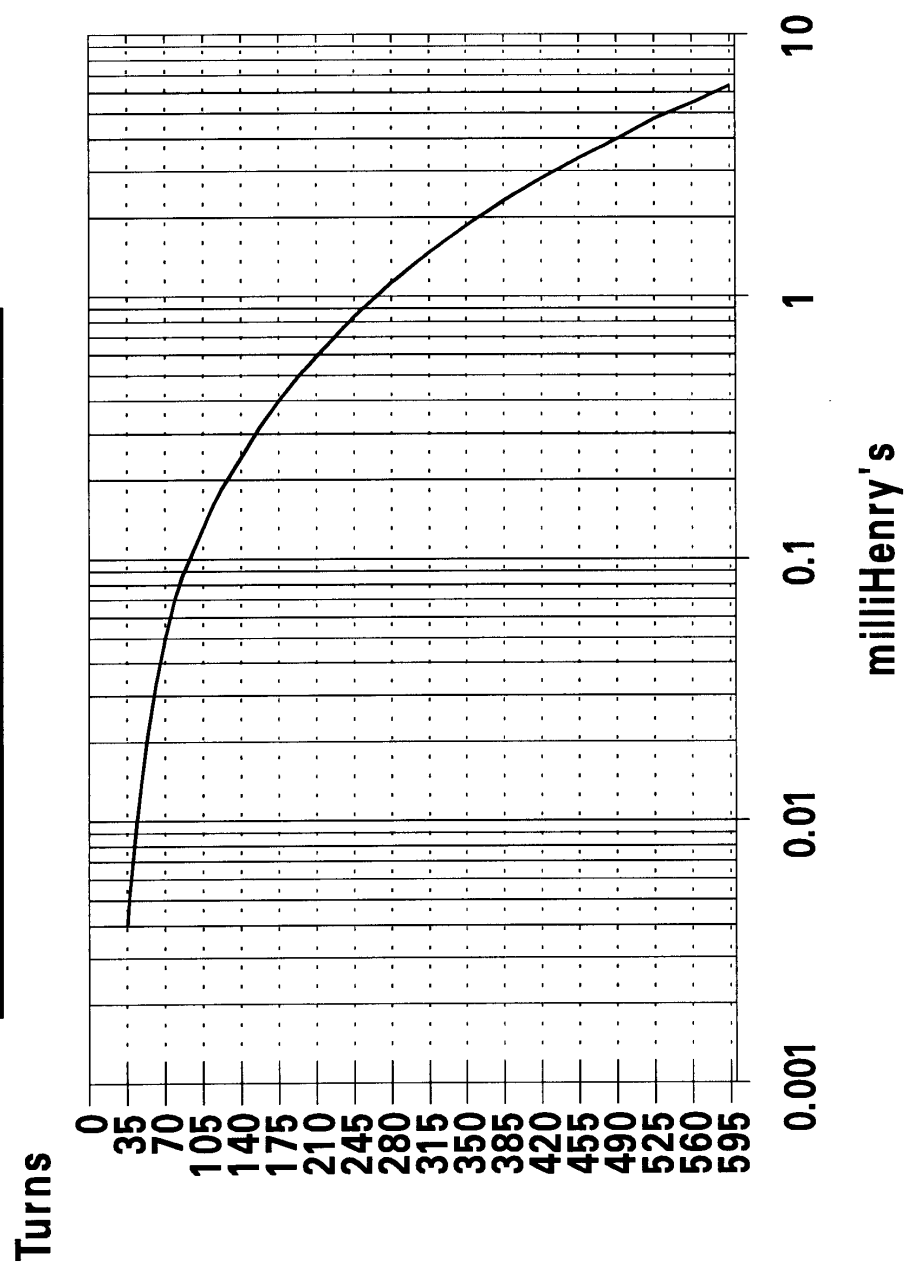
L4 =mH

R4 = Ω =

Note: Use higher voltage rated caps on parallel connection.

Crossover Parts List.

Inductance Chart.



1mm enamelled copper wire.
38mm wide bobbin.(see fig 21)

