

RS *duet*

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The RS *duet* speaker is a floor-standing, 2-way, 2-driver design using Dayton Audio loudspeakers, an RS225-8 woofer and RS28F tweeter. Based on his RS22528A design from 2005, Mark Krawiec ("markk") graciously agreed to update his crossover to accommodate the non-shielded RS225-8 and fabric-dome RS28F for the RS *duet*. Additionally, I designed a floor-standing, mass-loaded transmission-line (ML-TL), to replace Mark's original small, sealed box, for a significant extension in bass response.

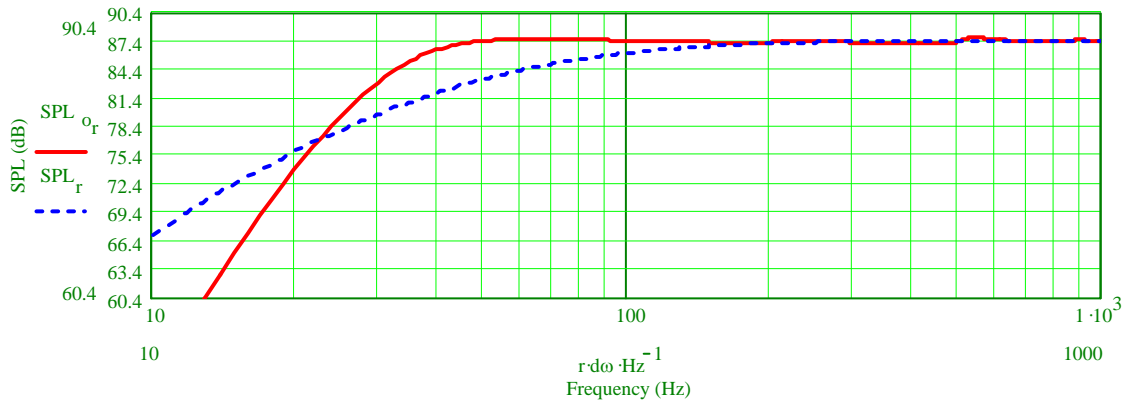
On its base the cabinet stands just over 40" tall and has a footprint that's 10-1/2" wide by 11-1/4" deep. External cabinet dimensions are 10"W x 9-7/8"D x 38-3/4", with internal dimensions of 8.5" x 8.5" x 38", enclosing a volume of 1.6 cubic feet. As with all ML-TLs the overall system tuning is derived from two factors, the 1/4-wavelength resonant frequency of the line's length, which is the internal height of the cabinet in this case, and the mass-loading port's dimensions (the port is on the back panel near the bottom). The top 19-3/4" of the cabinet contains polyester fiber stuffing at a uniform density of 0.75 lb/ft³. The system tuning frequency is 29 Hz, resulting in a modeled anechoic F3 of 32 Hz, F6 of 28 Hz and F10 of 23 Hz. Design and modeling of the ML-TL was accomplished using Martin King's ML-TQWT Worksheet (Version 2/09/08).

Mark's crossover is a notched, Cauer-Elliptic having quasi-8th-order roll-offs at a corner frequency of 1400 Hz. Depending on which version is desired, one with a nominally flat response or one with a mild "BBC dip" and slight top-octave attenuation, the crossover contains 2 (or 3) resistors, 4 inductors and 6 capacitors. This combination of roll-off rate and corner frequency allows the tweeter to play low in frequency without distorting, while adequately suppressing the woofer's higher-frequency breakups. Incorporated into the crossover's design is 3-4 dB of BSC, resulting in a final sensitivity of 84-85 dB (2.83v/1m). An input of 50 watts will cause the woofer to reach X_{max}+15% at 42 Hz with the system generating 105 dB SPL at 45 Hz and above. With an input of ~20 watts, the output is 100 dB SPL and the woofer's excursion is 75% of X_{max}. The *duet's* impedance is very amplifier-friendly, 7 ohms or higher up to ~1300 Hz, decreasing to ~4 ohms at 2 kHz, reaching a low of 2.8 ohms at ~2.9 kHz (phase angle of -16 degrees), then rising to 5 ohms and higher in the last octave of the audio range. Read Mark's crossover description at: http://www.audioheuristics.org/markk_wp/?p=376

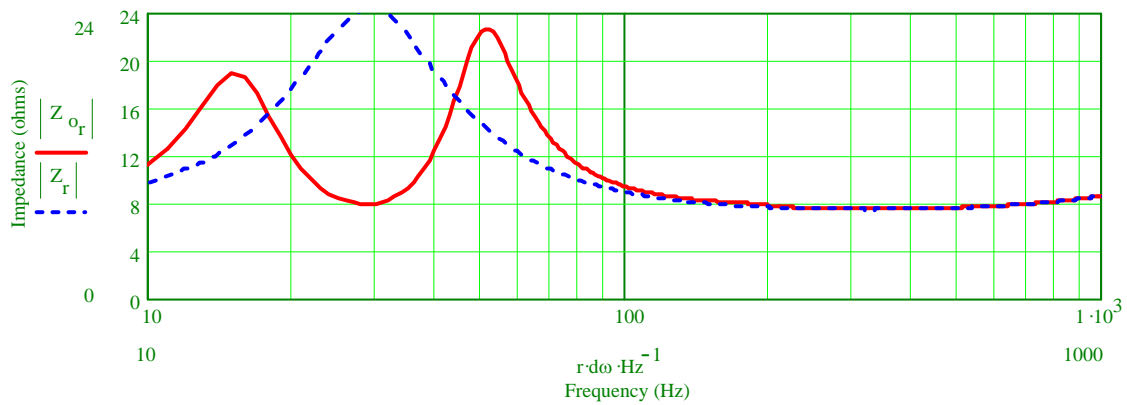
The cabinet was constructed from 18-mm Russian Birch throughout, including braces. Solid Brazilian Cherry in 3/4" thickness was used for the driver bezel on the top half of the cabinet as well as for the perimeter of the base assembly. This combination of a 1-1/2"-thick driver mounting area and ample internal bracing results in a "sound" cabinet structure. Grilles are held on with four magnets recessed into the back of the each grille board that align with the heads of mounting bolts on each woofer.

The crossover components were attached directly to the top of the base, and the crossover/base assembly is attached to the cabinet bottom via four 1/4"-20 bolts into T-nuts anchored in hardwood corner gussets (foam sealing "tape" was applied to the bottoms of the cabinet's four panels to form an air-tight gasket when compressed).

Modeled anechoic system bass response (red line):



Modeled woofer impedance curve (red line):



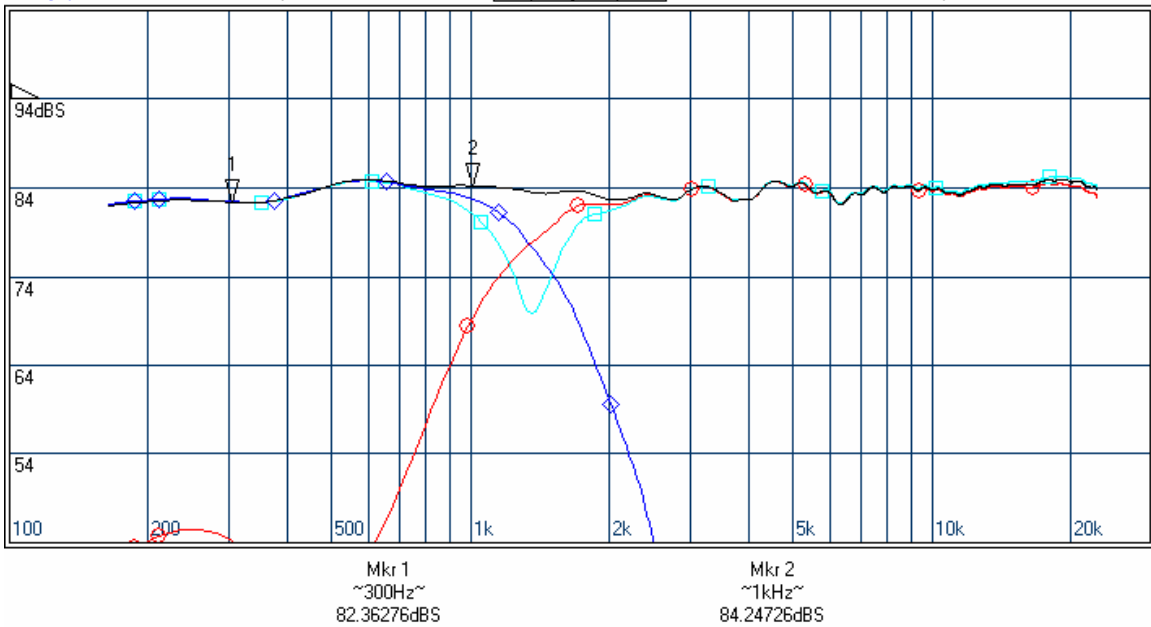
System's measured frequency responses:

RS Duet on axis frequency response measured outdoors at 1.5 meters. Normalized to 1m/2.83v and smoothed 1/12 octave.

Liberty-praxis: RS duet on axis FR.px2

[Frequency Response]

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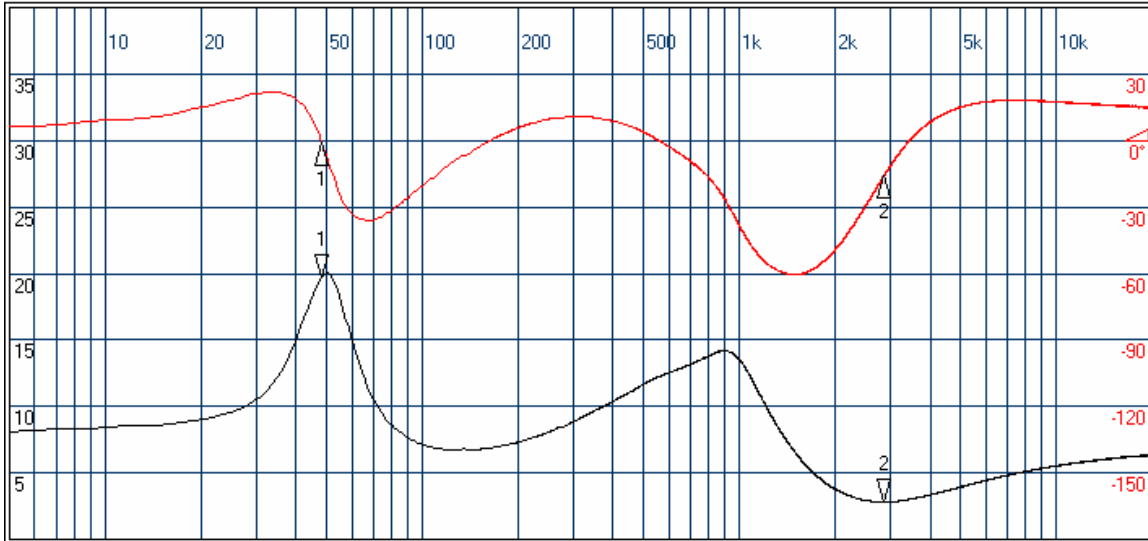
System's measured impedance magnitude and phase:

RS duet 4/15 ohm lpad. Does not include the added 0.5 ohm t leg amp side R. This graph measures a sealed test box, not the actual TL alignment.

Liberty -praxis- RS duet impedance.px2

Impedance

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Mkr 1
~48Hz~
19.750hm
-811.5m°

Mkr 2
2.864kHz
2.8090hm
-15.86°

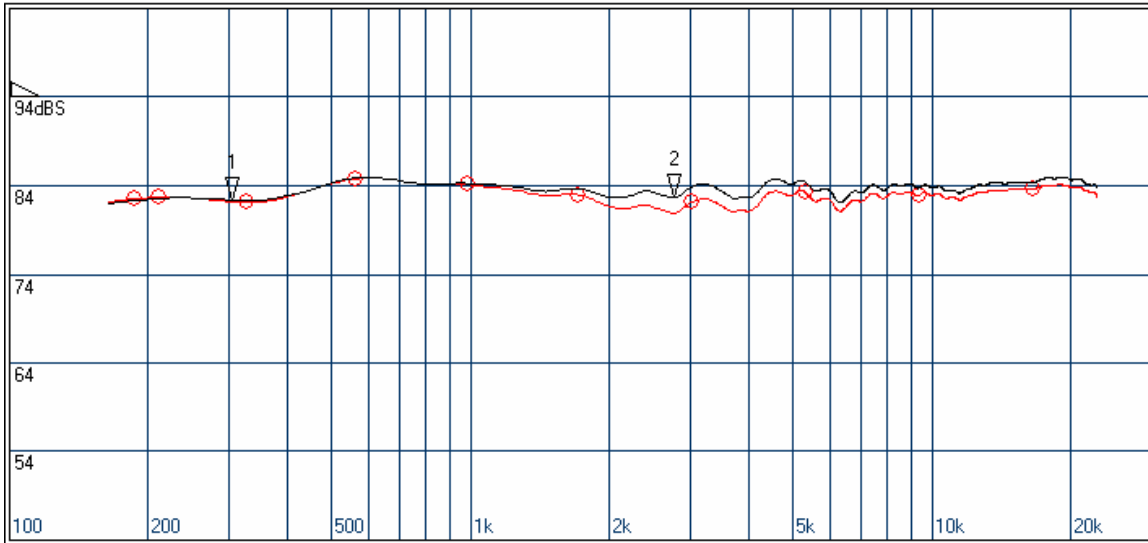
Responses with and without “BBC dip”:

RS Duet on axis frequency response measured outdoors at 1.5 meters.. Normalized to 1m/2.83v and smoothed 1/12 octave.

Liberty -praxis- RS duet on axis FR.px2

Frequency Response

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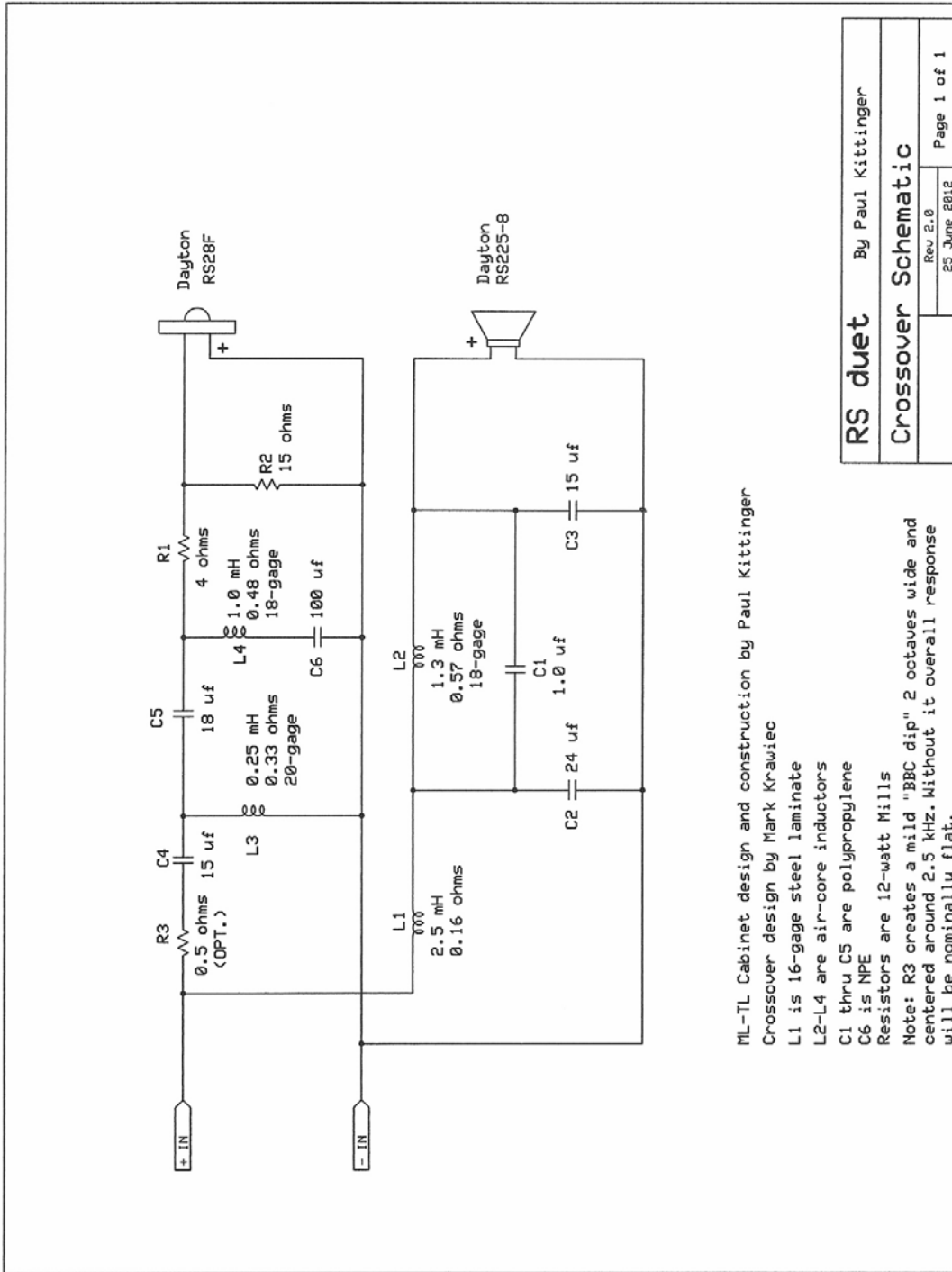


Mkr 1
~300Hz~
82.36276dB

Mkr 2
2.766kHz
82.66579dB

○ RS duet on axis FR amp side pt5ohm t att.px2: RS Duet on axis frequency response with 0.5 ohm amp side added resistance on the tw

Crossover Schematic:



ML-TL Cabinet design and construction by Paul Kittinger

Crossover design by Mark Krawiec

L1 is 16-gage steel laminate

L2-L4 are air-core inductors

C1 thru C5 are polypropylene

C6 is NPE

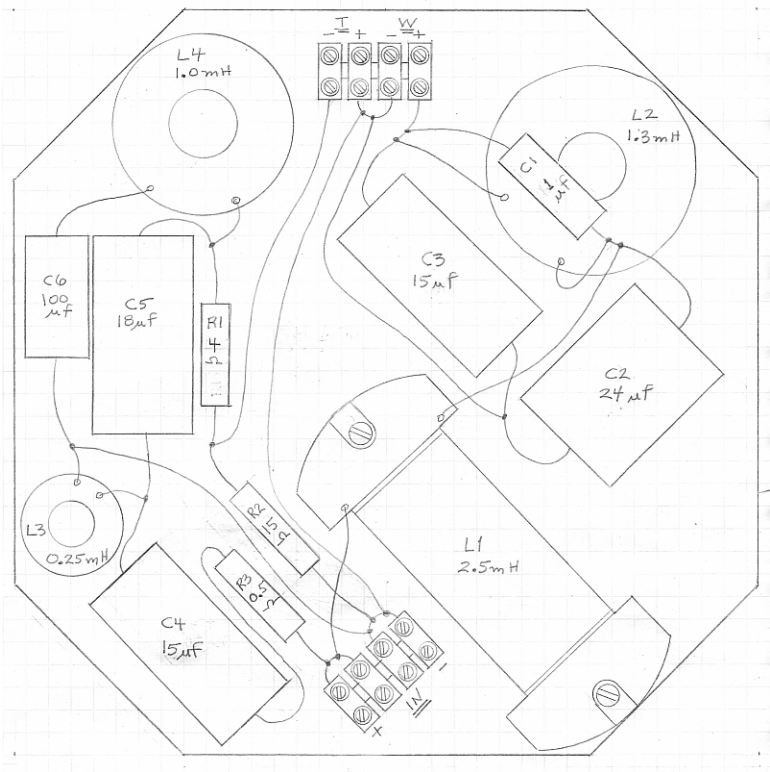
Resistors are 12-watt Mills

Note: R3 creates a mild "BBC dip" 2 octaves wide and centered around 2.5 kHz. Without it overall response will be nominally flat.

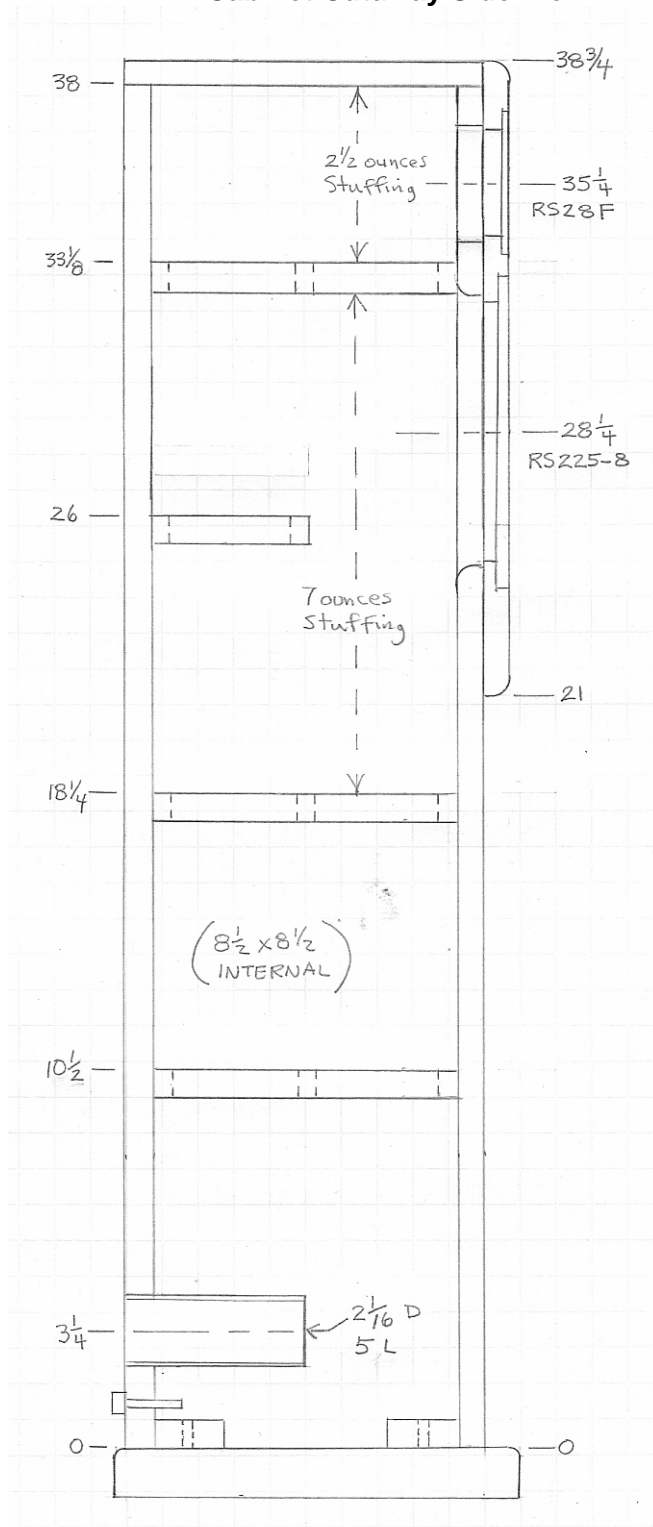
RS duet		By Paul Kittinger	
Crossover Schematic			
Rev 2.0		Page 1 of 1	
25 June 2012			

Photo Collection:





Cabinet Cutaway Side View



List of primary parts for building a pair:

<u>P.E. Catalog No.</u>	<u>Description (and Crossover Identifier)</u>	<u>Qty.</u>
295-356	Dayton RS225-8 Woofer	2
275-140	Dayton RS28F Tweeter	2
091-1245	Dayton Binding Post Pair	2
260-322	Port Tube, 2-1/16" D x 5" Long	2
266-908	Erse Super Q Lam. Inductor, 2.5 mH (L1)	2
266-830	Erse 18-g Air-core inductor, 1.3 mH (L2)	2
255-026	Jantzen 20-g Air-core inductor, 0.25 mH (L3)	2
255-250	Jantzen 18-g Air-core inductor, 1.0 mH (L4)	2
027-410	Dayton MPP Capacitor, 1.0 uF (C1)	2
027-586	Solen MPP Capacitor, 24 uF (C2)	2
027-432	Dayton MPP Capacitor, 15 uF (C3/C4)	4
027-434	Dayton MPP Capacitor, 18 uF (C5)	2
027-360	NP Capacitor, 100 uF (C6)	2
005-4	Mills Resistor, 4.0 ohms (R1)	2
005-15	Mills Resistor, 15 ohms (R2)	2
005-0.5	Mills Resistor, 0.5 ohms (R3), optional	2

Notes

1. R3 creates a mild "BBC dip" that's ~two octaves wide and centered at ~2.5 kHz. Without it, the overall response is nominally flat.
2. Each cabinet requires 9-10 ounces of polyester fiber-type stuffing.