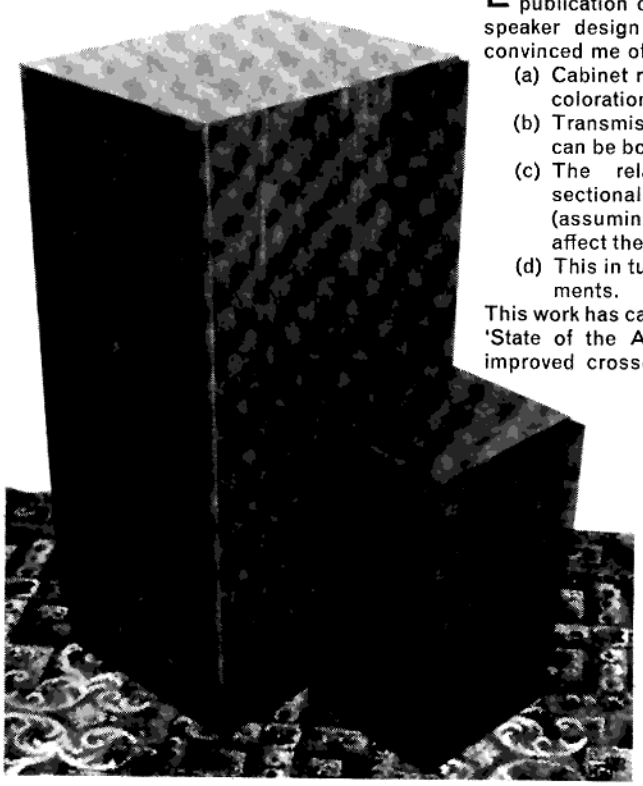
A 'MINI-LINE' TRANSMISSION-LINE compact design by P. Atkinson



The mini-line and maxi-line side by side. The latter has almost identical dimensions to the State of the Art but totally different internals.

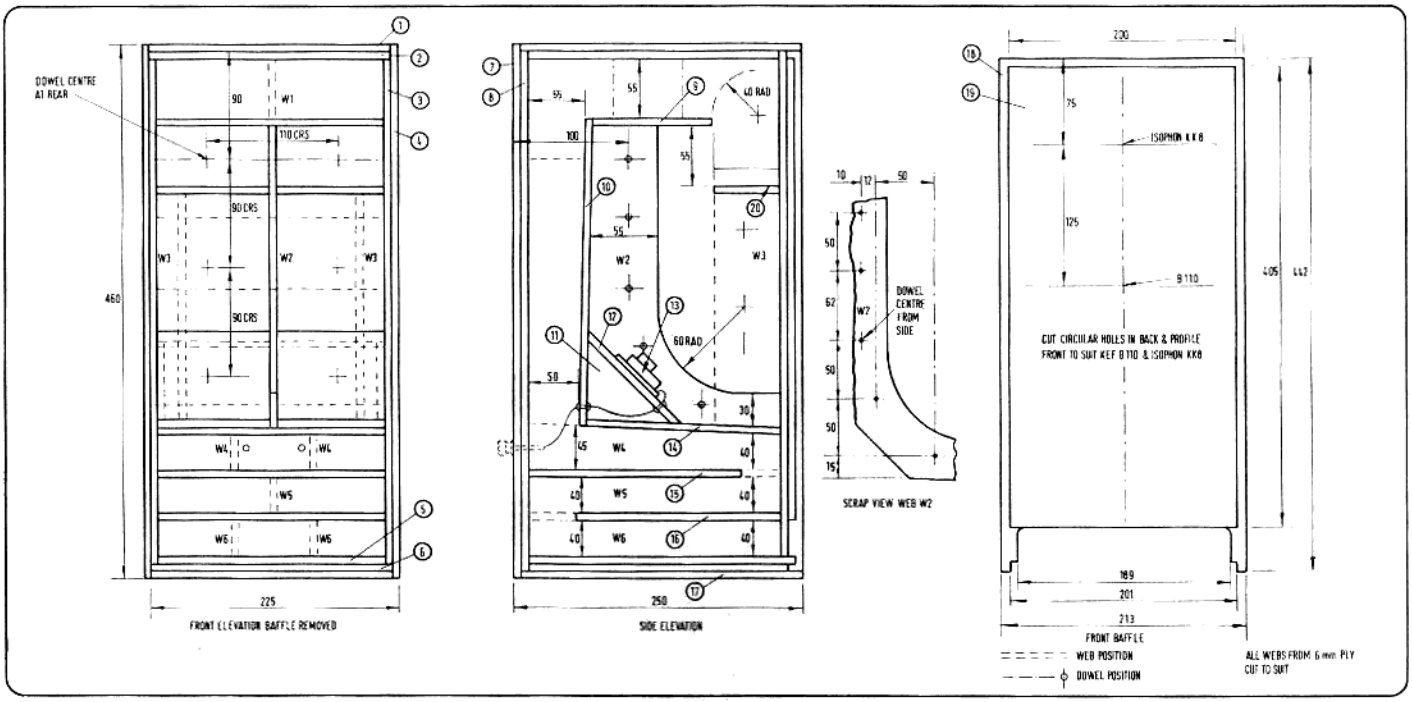
EXPERIMENTS both before and after the publication of my 'State of the Art' loudspeaker design (*HFN/RR* April 1976) have convinced me of the following points.

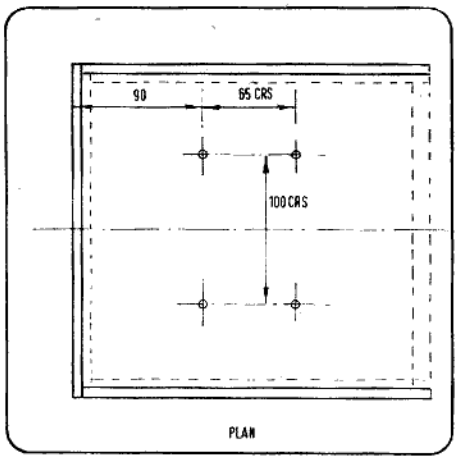
(a) Cabinet rigidity is fundamental to low coloration.
(b) Transmission lines give bass which can be both clean and deep.
(c) The relationship between cross-sectional area and length of the line (assuming rigidity of cabinet) can affect the need for damping in the line.
(d) This in turn affects crossover requirements.

This work has caused me to think again on the 'State of the Art' speaker, resulting in an improved crossover (a simplification of the existing network). This in turn led to a totally new Maxi-Line and, as with the Mini-Line and a Midi-Line which I have also constructed, no damping is used in the line, only in the de-coupling chamber.

Space will not permit discussion of the work done to find suitable drive units for the Mini-Line, but my final choice was one with which I could obtain the required results. Although several alternative tweeters were tried, the Isophon KK8 linked best with the KEF B110 in this particular speaker. My faith in the B110 has not been shaken by listening to its competitors and, since the object was to produce a design having the smallest possible physical dimensions and low weight (essential for shelf mounting or mobile audio-visual presentation) but retaining a full range performance, the B110 was the obvious choice.

To achieve the above requirements I have used a rather novel method of construction using 6 mm ($\frac{1}{4}$ in.) ply. The following building instructions are aimed at those with only a minimum of woodworking equipment and experience. The more fortunate could machine the outer panels from 12 mm ($\frac{1}{2}$ in.) ply or veneered chip-board (with a consequential increase in weight.) Resin bonded ply is almost essential for the outer skin in order to ensure sound edges, but standard grade ply can be used for all inner members in the interest of cost and lightness. It can also be argued that the use of laminations of different densities will improve damping





properties, but if the more wealthy wish to use resin-bonded ply throughout they may do so. In either case, only PVA adhesive should be used.

The constructional technique is based on the building of an inner core first, but it is necessary to start with both inner and outer front baffles. This to ensure accurate alignment of the driver cutouts on final assembly. Therefore proceed as follows:

(a) Mark out the pair of outer front baffles (19) for the circular holes, cut out and file if necessary, then position (19) on (18) and mark through. Cut the holes in (18) and again file to suit. Re-position (19) on (18) and install the B110 and KK8 then mark round the profiles. Cut out and file the profiles, as necessary, fit (19) and (18) together and make sure that the drivers can be installed with (19) in the correct position on (18).

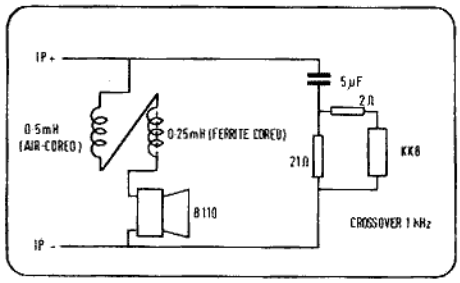
(b) When all is well, spot through the fixing holes in the drivers then open these holes up with a $\frac{1}{4}$ in. drill to receive the 2 BA tee-nuts. These will be too long for the 6 mm ply so scrap pieces of ply should be drilled $\frac{1}{4}$ in. dia. and pressed onto the tee-nuts. A dab of two-part epoxy resin (Araldite or similar) should be added round the protruding stem which can now be fed through one of the holes from the inside of (18). When all eight are in position on each front panel, lightly smear round the holes with Vaseline to prevent accidental adhesion, then clamp the drivers in place so that the tee-pieces will be in exact alignment whilst the resin sets.

(c) Next, carefully mark out the four inner sides (3) and cut the slots for baffles (9) (10) (14) (15) (16) and (20) BUT NOT (12). Make any adjustments necessary to ensure easy assembly.

(d) The back (8), front (18), top (2), and bottom (5) inner panels should be used as a glueing fixture; these panels should be secured by a few panel pins only—NOT GLUED. When all is ready, assemble the baffles in side panels and pin (not glue) the sides to the top, bottom, front and back inner panels. Make sure that all is square before applying glue to baffles in the slots in the side panels. Concentrate on good assembly at this stage, using only a minimum of adhesive. Sealing can be accomplished later and is not too important in this design anyway. Set aside to dry.

(f) When the inner core assembly has set, remove the front, back, top and bottom panels. Glue the angle pieces (11) in place and make sealing runs of adhesive on both sides of joints between the side panels and internal baffles. Set aside to dry.

(g) Holes should be drilled in baffles (10) and (12) and two-colour lighting flex cables passed through and sealed with silicone rubber (bath surround sealant). Glue baffle (12) in position.



(h) Check webs W1, W2, W3 (2 off), W4 (2 off), W5 and W6 (2 off), in turn for size and shape by trying in position and when satisfactory glue the webs to the inner core sub-assembly.

(i) Drill the inner (8) and outer (7) back panels for the two colour-coded terminals. Do not use recessed terminal panels. Set aside the outer panel and pass input cables through the holes in inner back (8), glue and pin to the inner core using the inner top panel (2) as a setting guide.

(j) Glue and pin the inner top panel (2) to the inner core.

(k) Glue and pin the inner bottom panel (5) to the inner core and set sub-assembly aside to dry.

(l) Cut inner front panel (18) to form outlet orifice, glue and pin to sub-assembly. Glue and pin middle base (6) in place.

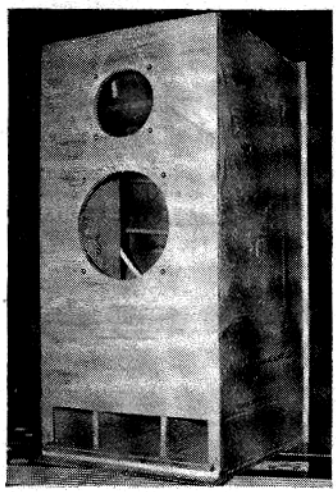
(m) Drill all the 6 mm dowel holes and lightly countersink to provide recess for a ring of glue around each dowel. Take a length of dowel, put a dab of PVA adhesive on one end and pass it squarely through a dowel hole until it buttons on a web or baffle as the case may be. Cut the dowel off flush with the inner core panel and add a ring of glue in the recess provided. Repeat for each dowel and set aside to dry.

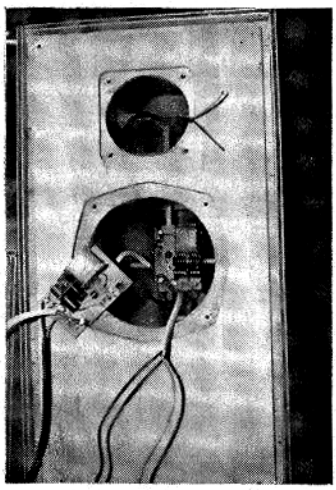
(n) When completely set, the sub-assembly should be cleaned up as necessary with a Surform (or similar) block plane. Try all the outer panels in position and adjust for size and shape as necessary. They can now be glued in place starting with outer back (7) through which the input wires must be threaded. As this panel will not be veneered, only a minimum of pins (if any) should be used. Glue the outer front (19) making sure that the recess round the edges is equal round the top and sides.

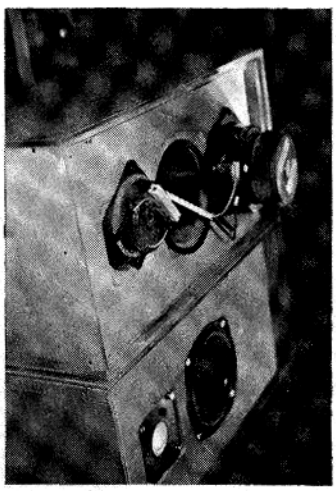
(o) When the outer back and front have completely set remove the drive units and glue and pin top (1), side (4) and lower base (17) panels in place.

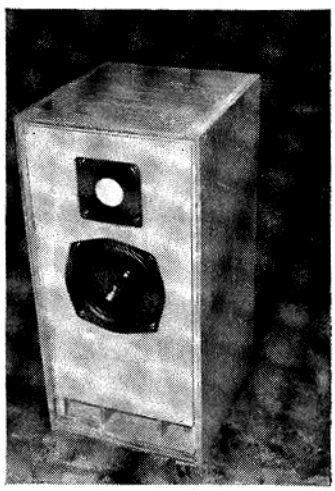
(p) Construct a grill frame from 4 mm (3/16 in.) ramin wood to fit in the recess at front. The width of this ramin strip will depend on individual preference as to whether the cloth is to be flush with cabinet or is to protrude slightly. Paint the frame matt black and fix the cloth with paper staples to the back edge of the frame. No fixing devices should be required but, if necessary, strips of Velcro can be used in the groove.

(q) Either build the network from the components itemised or use an Isophon FW1


Inner case complete


Two views of the crossover


Resistors behind KK8


Outer surfaces applied

crossover with the two fixed resistors soldered to the KK8 connections. The 2 ohm resistor is connected in series and the 21 ohm in parallel. Values are not critical and certainly variations within 1 ohm in either direction should make no audible difference.

(r) Solder the input connections to the crossover and to the terminals. Solder colour-coded leads to the crossover for the drive-units, fix the crossover to the sloping baffle (12). (Alternatively, glue two blocks to web to support network as in the photo.) Fix the terminals to the cabinet back using epoxy resin. Make sure of all polarities and that both cabinets are identical.

(s) Veneer the front edges, sides, top and bottom surfaces according to the veneer manufacturers' instructions. Finish as recommended.

(t) Slip the sealing gasket over the appropriate drive unit cables and solder to the connections, making sure of polarity. Lightly fill the de-coupling chamber behind the B110 with long haired wool (about 2 oz per cabinet) and screw the units in place.

(u) Fix the front grill in place, connect to a suitable system and sit back and enjoy the music.

The fixed resistors give about 3 dB attenuation to the KK8, and whilst more complex network designs give a flatter response curve and a better impedance characteristic, they are more costly, consume more power and, in this case, do not produce a better sound. The output is about 5 dB down at 50 Hz compared with the 200 Hz figures, and while this can be considered to be very good for the size of cabinet (many larger speakers are much worse), another very important fact is that the output levels out again at this figure. The 42 Hz track on the JBL 'Sessions' record, for instance, comes through loud and clear. Because of the cabinet design, the bass control of an amplifier can be used to lift the output at these frequencies to produce a very clean, deep bass with excellent transient response.

The speakers are reasonably efficient but can withstand considerable inputs to give clean outputs well above 90 dB in an average listening room. ●

Part List (per speaker)

1 Outer top	213×244 mm	1 off
2 Inner top	213×220	1 off
3 Inner side	436×220 mm	2 off
4 Outer side	460×244 mm	2 off
5 Inner base	232×201 mm	1 off
6 Middle base	226×213 mm	1 off
7 Outer back	460×225 mm	1 off
8 Inner back	448×213 mm	1 off
9 Top baffle	213×87 mm	1 off
10 Rear baffle	213×213 mm	1 off
11 Angle support	160 mm×45°	2 off
		to suit
12 Angle baffle	201×115 mm	1 off
13 Crossover		
14 Baffle	213×170 mm	1 off
15 Baffle	213×180 mm	1 off
16 Baffle	213×180 mm	1 off
17 Lower base	246×213 mm	1 off
18 Inner front baffle	442×213 mm	1 off
19 Outer front baffle	390×200 mm	1 off
20 Horizontal baffle	201×70 mm	1 off
21 KEF B110		
22 Isophon kk8		
Outer members are resin-bonded 6 mm ply. All inners are standard 6 mm ply.		
W1	130×55 mm	1 off
W2 from	240×200	1 off
W3 from	200×70 mm	2 off
W4 from	220×50 mm	2 off
W5	220×40 mm	1 off
W6	220×40 mm	2 off
Dowel	6 mm×2 m (per pair)	
PVA adhesive	1 pint (per pair)	
Veneer (top and sides only) 8 ft×1 ft (2 standard 4 ft×1 ft sheets)		

Note: We believe that Badger Sound Services of 43 Wood Street, Lytham St. Annes, Lancashire are looking into the possibility of supplying some of the parts for this project.