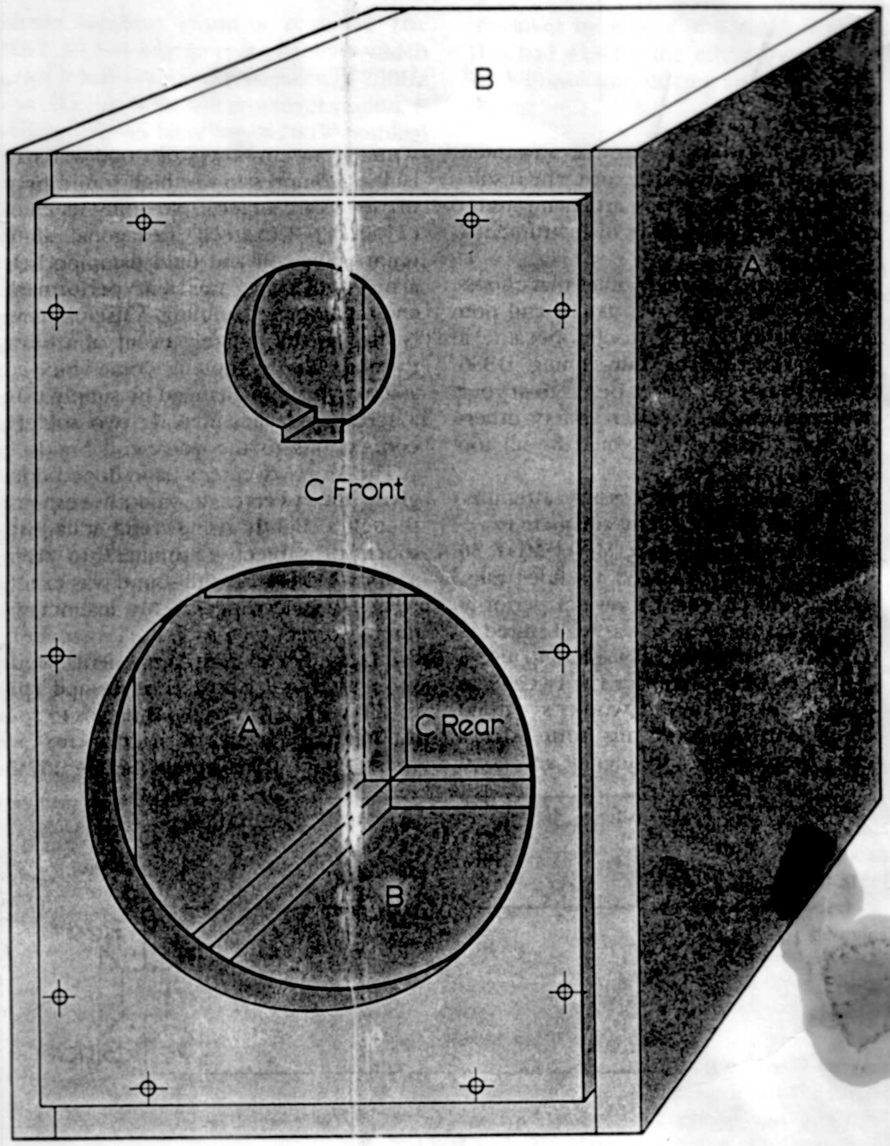


MADE TO MEASURE

THE DBS6 SPEAKER

With leather look baffle, a compact DIY speaker design – bi-wirable and with hard-wired crossover

by Dave Berriman

Two or three years ago, the Editor asked me to design a compact kit loudspeaker for publication in *HFN/RR*, following in the tradition of my earlier DBS4 and DBS5 designs. These featured about 10 or 12 years ago in the now sadly defunct *Practical Hi Fi/Hi Fi Today* magazine and proved very popular – with kits being sent as far as Malaysia and Australia. (There must be a DBS loudspeakers' owners club out there somewhere judging by the numbers sold). More recent years have seen my laboratory designing more commercial loudspeakers than I care to remember, so to return to writing for a DIY audience proved to be a refreshing change.

The concept

The idea behind the new design was to make a neutral and accurate loudspeaker, not favouring or discriminating against any particular types of music – a loudspeaker which would work just as well with the Stranglers as Stravinsky. The brief seemed simple, but in reality the task proved much more difficult.

The design

From the start, I intended the DBS6 to employ the simplest crossover possible. From experience, I would say that simple crossovers (or none at all) work best, provided the drivers are good enough and the design is competently carried out. Unfortunately simple crossovers make life difficult because they give designers less leeway to filter out or correct for undesirable traits in drive units. Sometimes one or two extra crossover parts are needed to get the desired result, so one can't be too pedantic when applying philosophy.

The design process started with the woofer. Commercially-available 200mm woofers virtually always feature an extended frequency response which ranges up to 5kHz or so – often with a rather ragged top-end performance – designed on the assumption that the crossover will cut this down to two or three kHz and 'remove' the unwanted resonances. Unfortunately, even if this is done, the mechanical problems which cause the resonances will not have gone away and tend to still be audible.

Surprisingly, with all the effort which is put into extending frequency response of drivers these days, it is actually quite difficult to make a 200mm woofer which rolls off by itself smoothly at, say, 2 or 3kHz. None were available, so I had a woofer built specifically to achieve the required roll-off and the other characteristics I required. (Please note, this is available only from kit suppliers DBS Audio).

On the whole this fulfilled my specifications, though in the end it did require a small series inductor coil to reduce the midrange level just a touch and bring it more in line with the bass output. The coil also has a mild high-frequency filtering action, but the main filtering for the crossover takes place mechanically, within the drive unit, and in a very smooth fashion as intended.

One major problem with bass/midrange drivers is cone flexure at low frequencies, which produces distortion and 'woolly' bass. This can be a problem with polypropylene, which is a relatively soft material. In the DBS200 woofer this is taken care of by a fairly steep cone profile and a thick, rigid cone. Next, come resonances introduced by conventional dust caps. These can be a major problem. In many cases, the dust cap is attached to the cone at some distance from the voice coil former. As a result, the mass of the cap 'bounces' on the cone's compliance to create resonances – not to mention ringing in the cap itself. In the DBS200 woofer this has been avoided by glueing a stiff egg-shaped dust cap directly to the high-power voice-coil's 32mm (1¼inch) diameter former, making a structure much less prone to unwanted flexure and helping the woofer's smooth roll-off. A piece of acoustic foam under the cap absorbs reflections from the pole piece and damps structural resonances, while a rearventilated pole piece eliminates the violent changes in the pressure of air trapped under the cap which can cause it to buckle, thus creating distortion and more resonances. The whole lot is mounted on a solid cast chassis to reduce unwanted chassis resonances and flexure. The resulting woofer creates a very articulate sound with very little clouding of instrumental detail.

So articulate was the woofer that choosing a tweeter which was as fast and non time-smearing as the woofer became a major problem. The burgeoning DBS6 required a tweeter rather better than your average common-or-garden variety, otherwise the discontinuity would be all too apparent to the ear.

After a few unsuccessful attempts, trying otherwise perfectly adequate tweeters, I chanced upon the Morel MDT 30 and immediately realised its fine transparency and excellent transient performance would be ideal. It was well suited in more ways than one. I wanted to use a 12dB/octave crossover for the tweeter as an ideal match to the woofer's natural roll-off, but to achieve this from 2kHz, a very low resonance frequency and good power handling would be required. The MDT 30 has a large rear chamber which helps it achieve a low resonance of 700Hz – well away from the crossover region. A claimed power handling of 200W nominal with a transient power of 1,000 watts and lack of compression of high sound pressure levels are all ideal. No doubt its 28mm (1⅛inch) 'Hexatech' hexagonal aluminium voice-coil and fluid damping helps achieve the fine transient performance and high power handling. A useful benefit is that, in the unlikely event of a blown tweeter, the complete dome/voice-coil assembly can be changed by simply using a screwdriver and making two soldered connections to the voice-coil braids.

The Morel tweeter's hand-doped dome gives the tweeter a smooth response, though a slightly rising trend adds just a touch of subjective thinness to treble sounds. Otherwise, the sound was exactly what I was looking for. My instinct was not to correct for this in the crossover on the basis that to add components would spoil the sound. However, it seemed a pity to allow the slight treble thinness to spoil the natural timbre of instruments and vocals, so I tried compensating in the crossover by means of a zobel network. This had exactly the effect I had hoped for, without introducing any harmful side effects.

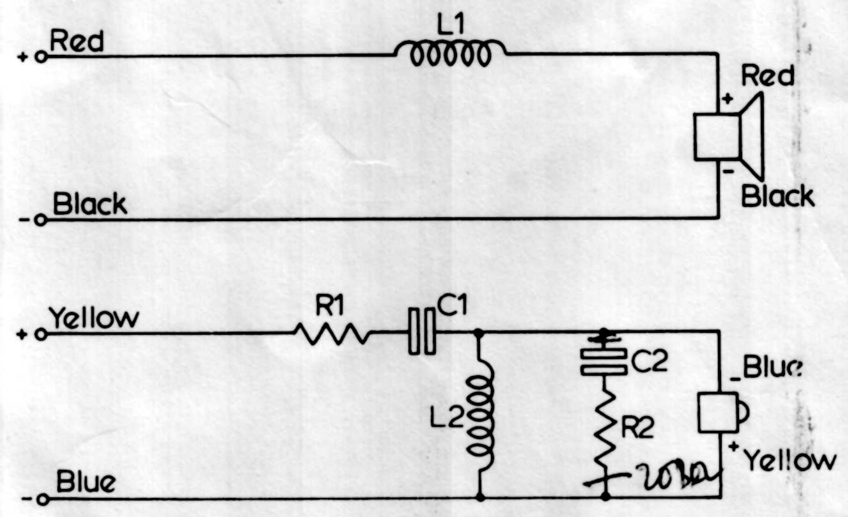


Fig: 1 DBS6 crossover

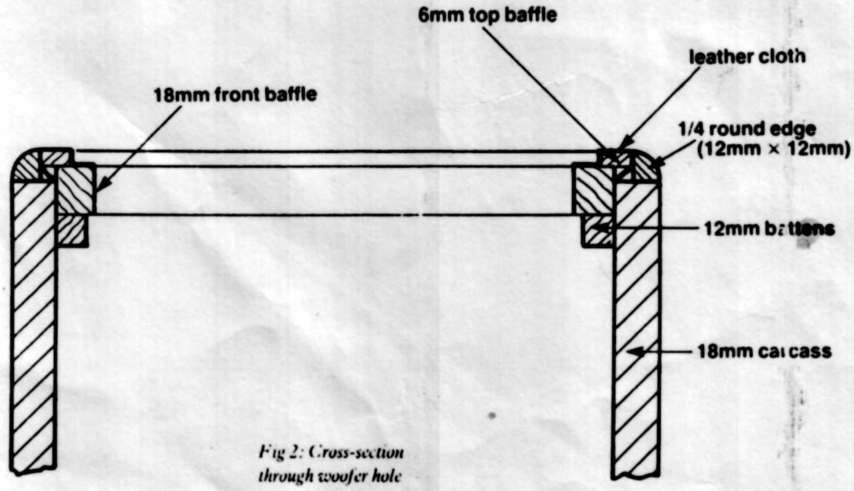


Fig 2: Cross-section through woofer hole diameter (horizontal)

The crossover

The resulting crossover is shown in fig 1. It has a single air-cored-coil feeding the woofer and polypropylene capacitors in the tweeter network. The type of components proved crucial. The capacitor make and construction method were chosen specifically on the basis of sound quality. These capacitors, made by ICW of Wales, are wound on to a solid core using thicker than normal polypropylene film. The thicker film enables more tension to be used, for a tighter construction and less unwanted vibration. Leaving the solid core in place after winding (as opposed to the usual practice of removing it) also helps to reduce unwanted mechanical resonances. A by-product is a higher working voltage of 630V, as opposed to the more usual 100V or 160V and a much larger size. (The cost is significantly higher, but the improvement in sound quality is worth it.)

Also, to further enhance sound quality, the lead out wires are of solid copper, hand-soldered to the metalised film. This avoids the sound degradation which can be caused by lead outs with a high steel content, which are usually welded in place. The end result of all this is a series of capacitors which sound exceptionally transparent, but which avoid the harshness so often introduced by polypropylene metal film types.

To connect between the crossover and drive units, and from the input terminals to the crossover, I chose van den Hul CS12 HF Linear Crystal Oxygen-Free-Copper cable. This multi-strand cable is silver plated in a way which reduces impurities in the silver (which can add treble brightness and harshness) and avoids stressing the copper, (which would spoil the linear crystal structure). I had been put off silver-plating by bright-sounding cables heard in the past, but this criticism does not seem to apply to the van den Hul. Changing from ordinary cable to the CS12 HF brings about a dramatic improvement in overall transparency and a reduction in treble harshness and grain. At the same time, bass becomes firmer and more realistic. It is as though a window has been opened. The cable is expensive, but I felt I had to include it in the kit because to do otherwise would have compromised the performance. It is very thick and requires a little care during soldering, but there is a simple trick which helps achieve this, so soldering should not deter anyone, providing they have a 60 watt iron with a tip in good condition.

The DBS6 crossover is hard-wired. That means the component leads are soldered directly to each other and to the connecting leads. This may not look very 'technological' but past experience has shown this method sounds better than when printed circuit boards are used. I have no 'proof' as to the cause, but feel it's most likely due to the reduction in metal-to-metal junctions (which always contain some impurities no matter how carefully they are soldered) combined with the elimination of the extra DC resistance introduced by thin copper tracks.

Bi-wiring

Each crossover is bi-wirable. The kit comes complete with two ready-wired crossovers and two input 'cups' (one for each speaker) which fit into a rectangular hole in the rear panel. Each terminal cup has four high-quality gold-plated brass binding posts. These can either be connected together by the gold-plated brass shorting straps supplied with the kit, for conventional single-pair amplifier connection. Alternatively, the straps can be removed for true four-wire bi-wiring.

Bi-wiring – connecting woofer and tweeter via separate leads to the amplifier – does bring very tangible improvements to clarity and stereo imagery. Contrary to what has been written in some journals, it is effective even with simple crossovers due to the reduction in current paths common to both woofer and tweeter, both along the inter-connect cables and within the speaker. Bi-amping (the use of separate amplifiers for woofer and tweeter) can bring further benefits to sound quality.

Grille and baffle

Loudspeaker grilles are always a problem. They are almost always detrimental to sound quality, yet in most cases are essential to ward off inquisitive fingers and to render the finished item more acceptable in the home. Like most commercial designs, previous DBS loudspeakers have featured clip-on grilles which should be removed for serious listening. The DBS6 is no exception, except that the thickness of the frame has now been reduced to minimize reflections. This has been made possible with the Morel tweeter, because its dome is recessed very slightly in a short, curved horn.

If the woofer and tweeter are mounted straight on to a flat baffle so that their flanges protrude, this introduces some serious deviations to the frequency response, and in particular a rising response with a plateau at high frequencies (around 12kHz–15kHz). It is essential to avoid this by means of flush mounting the tweeter.

However, a major problem for home builders is rebating holes so that drive units can be flush mounted. Normally, rebating requires a router – expensive unless hired for the occasion.

In the DBS6 this problem has been solved quite simply. An extra 6mm thick plywood front baffle, with holes to clear the outer diameters of woofer and tweeter, is glued to the main baffle. The extra baffle has the further benefit of stiffening and damping the front baffle by adding the extra strength of plywood and a glue damping layer, which have a dramatic effect on front panel vibration.

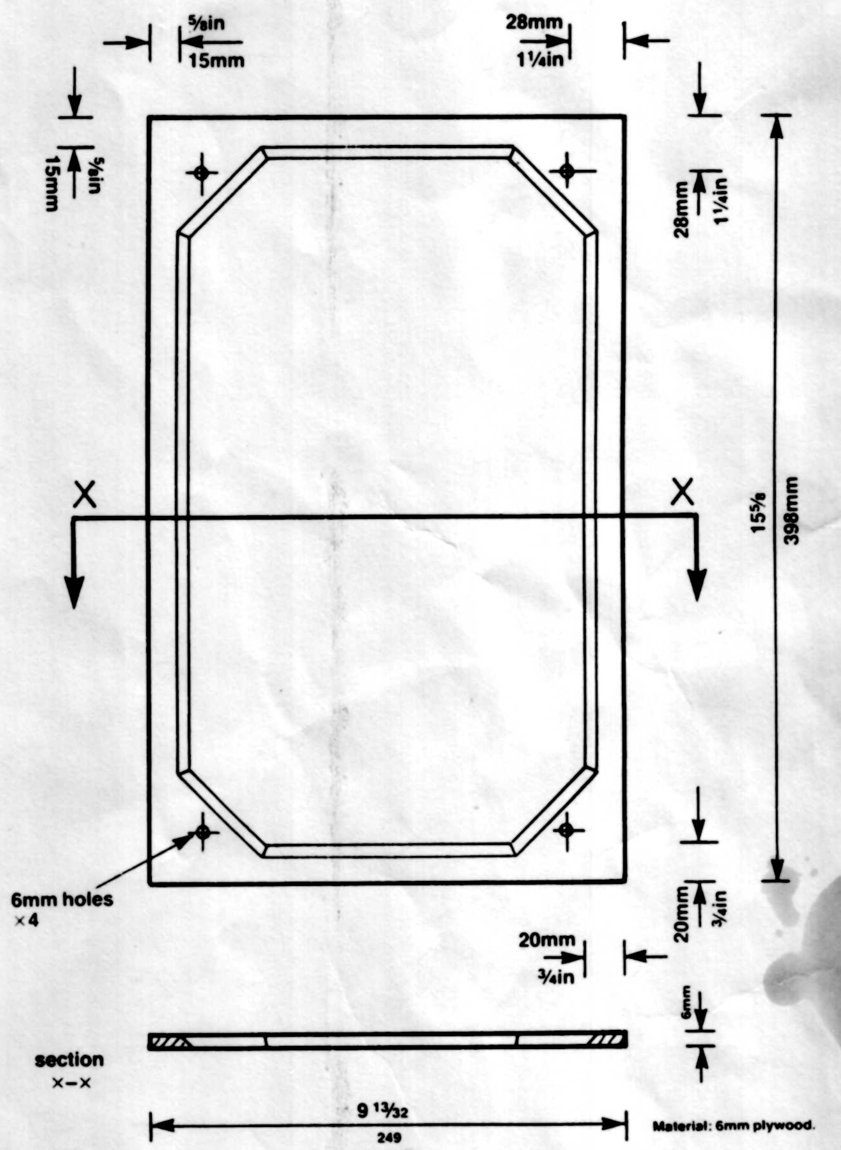


Fig 3: Grille frame

This extra panel is about the right thickness for the woofer flange (allowing the rounded edge of the woofer chassis to protrude harmlessly by about 0.5mm) but is too thick for the tweeter. Cutting (and if necessary gently sanding) a small spacer disc cut from 3.2mm hardboard is the answer. This is glued to the baffle under the tweeter flange to bring its front face flush with the front baffle surface.

Baffle finishing

Unfortunately, even very careful cutting can result in slightly uneven holes and to paint an untidy front panel would not give a very professional-looking finish. If you are a very neat worker, you could veneer the front panel, but not everyone can cut perfectly circular holes.

I puzzled long and hard about how to achieve a craftsman-like finish without the use of professional techniques. When I saw a pair of Sonus Faber Extremas, the answer finally hit me – leathercloth. These loudspeakers looked smart and well finished. Why not cover the DBS6 front baffle similarly and hide a multitude of DIY sins into the bargain? In practice the idea works well: the leathercloth (supplied with the kit) stretches into the driver rebates, giving the DBS6 loudspeaker a luxurious appearance very different to the run-of-the-mill and not looking at all home-built. The soft black grille-fixing sockets supplied with the kit blend anonymously into the leather-cloth for unobtrusive grille fixing.

In order to accommodate the double thickness where the leather-cloth is glued under the frame, the main baffle is raised proud of the cabinet sides by 6mm. The thin fixed front baffle is made smaller than the cabinet width and height. This allows enough space and depth to fit a 12mm round or square cross-section hardwood or ramin frame around the front baffle and takes into account the thickness of leather-cloth (see fig 2). This fixed frame makes a flush surface with the front baffle and neatly hides the edges where the leather-cloth is wrapped round, to provide a very neat and professional appearance. Preferably, the cabinet veneer can be applied before the frame, which can then be glued on to make a neat butt joint. The frame may be in the same wood as the veneer, though for contrast, a different wood can be used. It's really a matter of personal taste.

The square frame offers the prospect of a completely rectilinear profile, whereas the ¼ round frame is perhaps not so crisp visually, but is very slightly superior acoustically.

If you adopt the rounded styling, you will need to make the removable front grille frame, which supports the cloth, smaller than the cabinet dimensions, as shown in fig 3, to fit neatly, fractionally larger than the leather-cloth area, and leaving the ¼ round hardwood/ramin frame visible around it. For a square frame, the removable grille may be as above, or the same size as the cabinet front. The difference in sound between square and rounded fixed frame will be marginal, so the choice can be made on mainly cosmetic grounds.

Of course, the beauty of DIY is that (within reason) you can adapt the design to incorporate your own ideas: so long as you adhere to the basic concepts outlined above you may do as you like. However, avoid recessing the tweeter, adding a deep grille frames or anything around the front panel (such as a permanently-fixed raised frame) which will cause reflections. At least a removable grille-frame can be taken off for listening.

Damping

The 18mm flooring-grade chipboard cabinet is very stiff, but the panels require mechanical damping to suppress resonances, which are audible as strong ringing when an un-damped cabinet is struck with a piece of wood or knuckle and cause noticeable muddling of musical detail if not dealt with. (Consequently don't be tempted to use the cabinets un-treated – the loudspeakers won't sound the same.)

Though they work well on 12mm standard-grade chipboard, the solid bituminous pads used in previous DBS kits were not as effective as I would have liked on the thicker, stiffer flooring grade. Bitumen pads add damping and mass, but virtually no stiffness. They do damp high-frequency resonances, particularly on thinner 12mm (½inch) thick panels, but also tend to shift some resonances to a lower range of frequencies and do little to suppress low-frequency flexure.

A form of damping involving some extra stiffness and relying less on mass would be ideal. This would suppress a wider range of frequencies and reduce panel flexure at low frequencies, for improved bass performance.

Restrained layer damping, in the form of inexpensive and freely-available 3.2mm hardboard glued to the inside of the chipboard panels in two layers, proved to be the solution to the problem. This works in three ways: firstly, the hardboard is fibrous and inherently lossy, secondly, the glue specified dries to a gooey, rubbery layer which absorbs vibration. Because it is restrained between two panels, its damping effect is greatly enhanced. Any panel flexure puts both glue layer in shear, so that the molecules are forced to move relative to each other. Thirdly, the sandwich of hardboard/glue/hardboard is fairly rigid and stiffens up the panels.

A single hardboard layer is very effective and is probably adequate. However, the second layer of hardboard as recommended is better still.

The specified adhesive – Evo-Stik Impact 2, a non-toxic, water-based contact adhesive, is available in the UK (*eg* B&Q) but is unavailable in many countries, so a quantity is included with each kit sent overseas (one 140ml tin and one 210ml tin complete with applicators). This should easily be sufficient for two layers, provided you are not wasteful.

Internal damping of air resonances is dealt with quite separately by high-quality acetate-fibre wadding. This has the secondary but vital effect of slowing the speed of sound within the cabinet, thus increasing the effective volume, lowering the resonance frequency and reducing the total Q of the system to 0.7. This provides for a well-damped transient behaviour for realistic, tight, well-controlled bass.

The design

Design of the DBS6 was carried out by means of extensive listening and measuring using DRA's MLSSA (Maximum Length Sequence System Analyser), a computerised fast-Fourier analyser system capable of in-room pseudo-anechoic measurements. As shown in fig 4a to 4f, very flat responses are achieved through mid to treble, with good low-frequency extension as shown by close-mic measuring in fig 4f. I feel that loudspeakers which measure flat anechoically, sound bass-heavy in normal rooms due to room gain and resonances (which can be substantial), so the DBS6 was engineered for somewhere between free-space (4pi) and close wall (2pi) operation, which in my experience tends to be about right in most rooms. If you use the DBS6 too close to the wall the bass may be a little on the rich and heavy side, while the optimum position will be found out in the room. The impedance plot in fig 4g shows a nominally 8ohm impedance which should present no problem to normally-capable amplifiers.

The aim was to achieve a musically-satisfying performance, rather than text-book excellence, but the measurements do confirm the loudspeaker's basically neutral sound which enables one to hear deep into musical layers and textures.

Next month: *step-by-step construction.*

DBS 6 LOUDSPEAKER

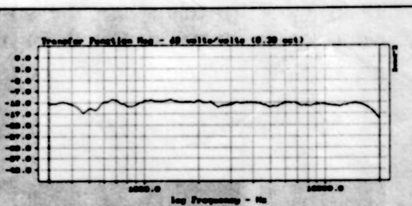


Fig 4a: In-room DBS6 frequency response at 1m, on woofer axis, showing linearity on optimum axis

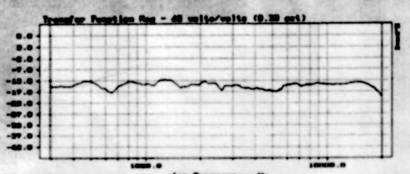


Fig 4b: In room DBS6 frequency response at 1m, mid way between woofer and tweeter

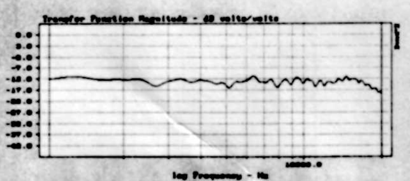


Fig 4c: Pseudo Anechoic frequency response of DBS6 at 1m, on woofer axis, showing match to in-room results

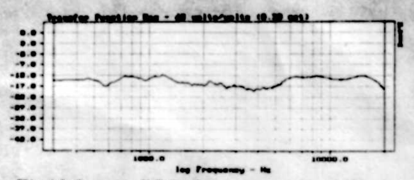


Fig 4d: In-room DBS6 frequency response at 1m on tweeter axis

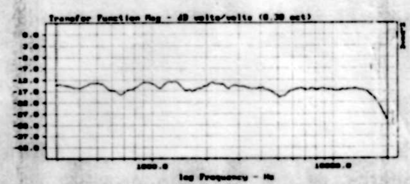


Fig 4e: In-room DB6 frequency response at 1m and 30° off the horizontal axis, showing excellent dispersion

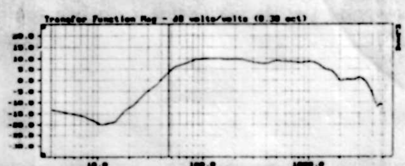


Fig 4f: DBS6 LF response in near field. Bass is −6dB at 48Hz ref 200Hz. Response is set 2dB down at 1kHz

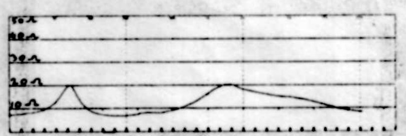


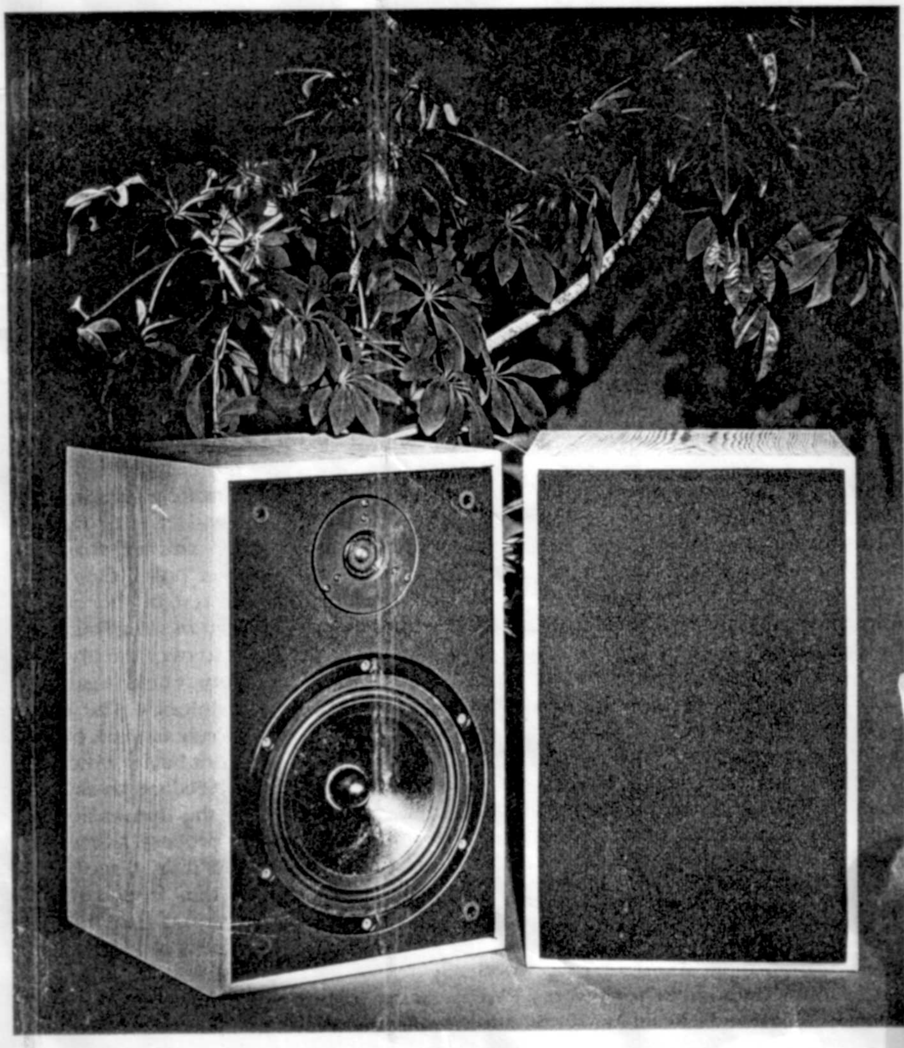
Fig 4g: Modulus of impedance, showing nominal 8 ohms. Minimum value is 6.4 ohms at 150 Hz to 200Hz

Supplier: *DBS Audio, PO Box 91, Bury St Edmunds, Suffolk IP30 0NF. UK price of kit £187 (inc P&P).*

MADE TO MEASURE: PART 2

Everything you need to know to build this speaker, from start to finish

by Dave Berriman



I have already described the grille and baffle in some detail [*HFN/RR* Feb], so I need not go over this too slavishly. The cabinets will be the first parts to construct, so we may as well start here. All cabinet panels can be cut from a single sheet of 8ft×2ft (344cm×61cm) flooring-grade 18mm chipboard. The edges are usually pre vee-tongued and grooved for creak-free floors, so these areas should be treated as waste when marking and cutting out.

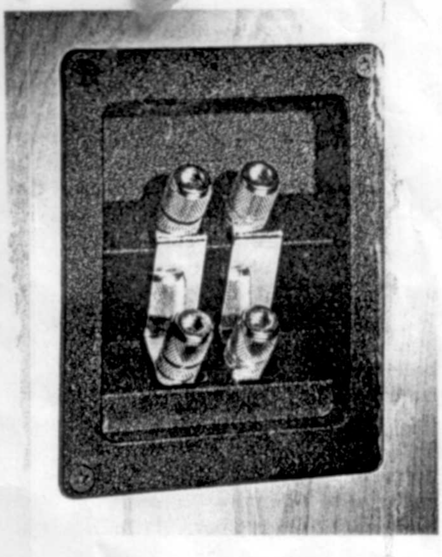
Don't be too wasteful: there is only just enough width to get the two side panels out (see cutting plan, fig.5). Note that, in the text, the dimensions have been given in mm and inches (except for sheet material, which in Europe is generally supplied in mm thicknesses.) Wherever possible, stick to either mm or inches: the measurements have been calculated so that the panels should all fit together (though do check for fit as you proceed). If you make some panels in mm and some in inches, the fit will be less than perfect due to slight rounding up and down errors. (Note, both the inch and metric dimensions assume the panels are purchased in mm thicknesses – *eg* 18mm chipboard, 6mm plywood).

Cutting

Flooring-grade chipboard is particularly tough. You can use a sharp rip or tenon saw to cut the pieces to size, though, for an easy life, a tungsten-carbide-tipped circular saw is ideal.

Set the saw to 235mm (9¼inches) to cut the top, bottom, back and front of both speakers, and ensure a good fit all round. Likewise, re-set the saw for the sides. When marking out, don't forget the saw thickness. Mark and cut panels as you go, checking dimensions and right-angles carefully (particularly the front and rear panels). Don't mark out all the panels at once as shown on the cutting plan (fig.5), or they will come out under-size.

The holes in the main baffle and rear panel, as shown in fig.6a and 6b, can be cut with a power or hand fret or key saw; this should be done before cabinet assembly. After cutting and cleaning up any rough edges with fine garnet (sand) paper, the top, bottom and sides can be offered up to each other to check for fit. At this time, cut the 1½inch square central braces and sand the ends until they fit perfectly between the sides, tensioning them very slightly. Also cut the 12mm ramin battens to length so that they will support the front and rear baffles and secure the cabinet corners. When fixing the [illegible] battens, remember to bring them forward by 6mm so that the front baffle will protrude by 6mm.



Damping pads

Glue the damping pads in before cabinet assembly, remembering to keep the areas which will be occupied by battens clear of glue or pads. Firstly, cut the pads to size as shown in fig.7, either with a tenon saw or sharp knife. If a knife is used, you can cut half-way through from the shiny side and bend the remainder to break through.

Remove any raised edges and loose particles produced by cutting, so the pads will mate together well. Prepare a firm, horizontal surface and place a sheet of paper on it. Have ready a second flat surface *eg* a piece of chipboard) and a few sheets of paper (to prevent the excess glue sticking the pad pairs together).

Taking each pairing of pads in turn, glue the two rough faces fairly liberally with Evo Stick Impact 2, using the foam applicator. Bring the two surfaces together immediately, place the first pair on the sheet of paper on the flat surface and press down. Repeat for all the paired pads, stacking them on each other with a sheet of paper between each glued pair. Then

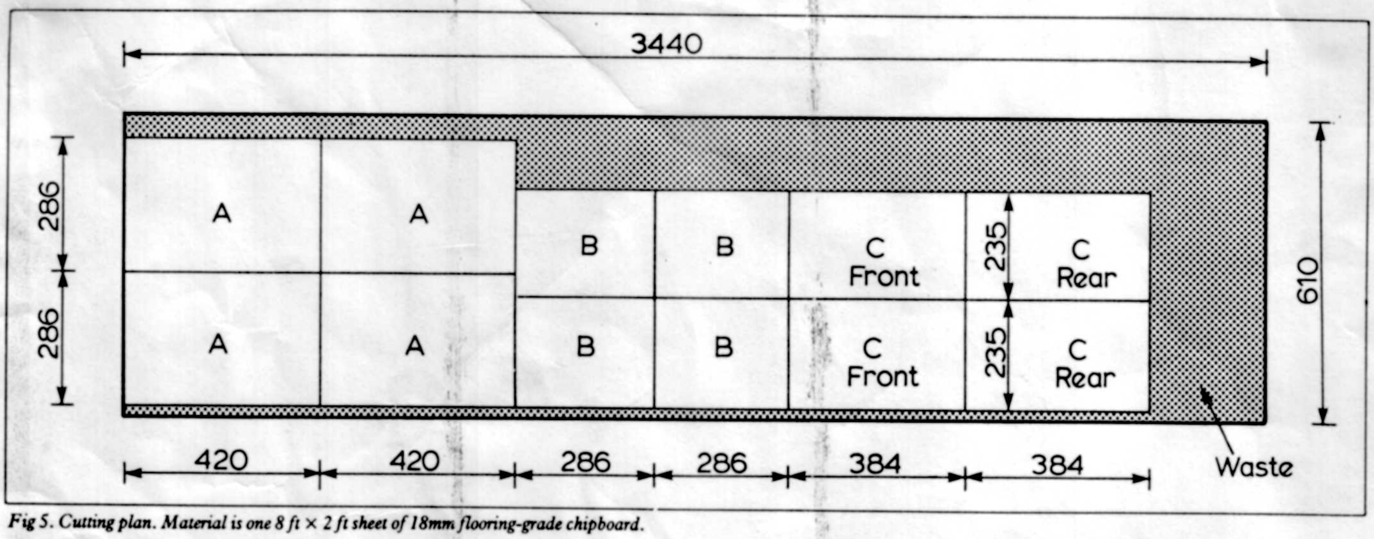


Fig 5. Cutting plan. Material is one 8 ft × 2 ft sheet of 18mm flooring-grade chipboard.

place the other flat surface on top with some weights to press the pads down and leave for a few hours to set.

When the glue has set, un-stack and remove any unwanted glued paper. Then stick each pad in its correct position, on the inside of the cabinet panels. Pads U go on the top, bottom and lower rear panels (below the input 'cup'); pads V fix to the sides above and below the central brace. Pads W should be glued horizontally to the front baffle, between the tweeter and woofer holes, and to the rear, above the input 'cup'. Apply glue to both surfaces and bring together immediately, placing a weight on each pad to hold the surfaces in contact. It's a good idea to stick all the damping pads in one session, otherwise you'll waste a lot of adhesive rinsing out the applicator pad.

Cabinet assembly

Using liberal applications of PVA wood glue, such as Unibond (The Universal PVA Adhesive) or Evode Resin W, screw and glue the battens which will support the front and back to the sides, top and bottom (see fig.8). The battens which will fix the top and bottom to the sides can simply be glued in place later.

Offer the top, bottom and sides up to each other to form a carcass frame as shown in fig.8. First, make sure the front and back panels are square, drill counter-sunk clearance holes in the chipboard, so that the fixing screw heads will be slightly sub-flush when finally driven home. Glue and screw the 1½inch square central brace in position between the side panels to clamp them gently to the top and bottom. Then insert the rear panel into the frame, again using plenty of PVA glue. Screw through the back into the battens on the top panel, the sides and the bottom panel. Then screw and glue the front panel into place onto the front battens, when it should look like fig 3 [see last month]. When set and before veneering, the sub-flush counter-sunk screw heads and any gaps must be filled with a wood filler such as Brummer stopping. This must be sanded down before veneering.

The thin front baffle holes and the inner side of the removable grille frames (both in 6mm plywood) should be hand cut with a fine fret or coping saw for a neat edge. If you want a really circular and regular hole for the tweeter, you can use an adjustable hole cutter fixed in a brace and bit. One way of making sure the thin front baffle (fig. 9) will fit is to make it initially just a little smaller than the cabinet. Cut the driver holes, then lay it on the front baffle fixed in the cabinet with the drivers placed *in situ*. The ramin edging can then be laid over the plywood around the periphery (held against a smooth square woodblock). The ramin can then be used as a rule to mark out the outer edges of the front baffle, which can then be cut to size. Needless to say, you must be careful that the thin baffle does not move during this process. A few blobs of Blu-Tack will hold it in place.

Before fixing the thin front baffle or leather-cloth in place, make sure the front baffle, with the thickness of leather-cloth glued over its edges, will fit within the ramin frame. Also check that there is sufficient gap for the leather cloth to fit between the holes and the drive-unit flanges. Mark the driver-hole positions with pencil for aligning the front baffle when glueing.

To fix the thin front baffle, apply PVA glue liberally to the surfaces of both baffles and lay the thin front baffle on. Position the ramin around the edges to align it and place something flat of similar surface area (such as the other loudspeaker cabinet and, for example, a few heavy books) on top, checking that it hasn't moved with the ramin edging once again. When the front panel glue has set, the drivers can be temporarily dropped into their recesses to check for fit. The edges can also be sanded to size at this stage, if necessary using sandpaper on a flat rectangular wood block.

After cutting out, the removable grille frame may be laid on the front baffle. Mark out the grille fixing peg positions. Firmly hold down the grille frame and drill pilot holes through the grille frame into the baffle (not right through). Drill one hole, then push a spare drill bit into the hole to locate the baffle, then drill the others. The holes in the grille frame can then be enlarged to 6mm and those in the front baffle to 12mm diameter (12mm deep). Make sure the rubber cups fit the baffle holes before applying the leather-cloth.

The grille-fixing pegs should be driven in from the rear of the frame using a wooden mallet, with the frame on a flat solid surface so that the end of the peg is flush with the grille's front surface (not right up to the shoulder). The frame may then be stained black. When dry, the cloth can be fitted. Glue the back of the frame, lay the front on to the grille cloth, stretch the cloth around the edges, sticking it onto the rear of the frame. Make sure the cloth does not sag and hold it firm with Buldog clips or clothes pegs until set.

Leather-cloth

The leather-cloth can be fixed to the front baffle using Unibond Universal PVA adhesive. Cut the material to the same size as the cabinet front. Carefully place the leathercloth flat and centralised on the front baffle, so that the excess overhangs the edges equally all around.

When the glue has set, make a second application around the periphery, fold the cloth around the edges and tuck it underneath into the recess, holding it in place with scraps of hardboard. Use some extra glue at the corners and tuck the leather-cloth under tightly here, wedging more pieces of hardboard to hold the corners in while the glue sets. (Keep glue clear of the front surface, which will be exposed to view.) After fixing, some leather-cloth can be left under the driver flanges to form extra gaskets, but the rest, from the hole centres, should be trimmed away with scissors.

The next stage is to apply glue under the cloth and to the wood around the rebates. The woofer and tweeter can then be pushed home to stretch the cloth into the rebates. Leave these here for the glue to set. Pilot holes for the drive-unit fixing screws can then be drilled through the mounting holes, ready for assembly later.

Cut the ramin frame using a tenon saw and a mitre block of the sort used to make picture frames. Be careful to achieve 45 degree angles all round and check for fit.

Veneering

Some veneers are more expensive than others, and of course walnut is very popular. Ash, a very light coloured wood in its unstained state, is less expensive and in my view looks very modern with the contrasting black front or black grille cloth. The ramin edging is very close to ash in colour and makes a good match. If you go for walnut, a darker, or red hardwood would go well.

Try to get veneers 12 inches wide as they will be larger than the panel sides. If you have to settle for narrower veneers, you may need to lay them down in two or more strips.

Whichever way you do it make sure there is always some surplus to trim off with a very sharp knife. Lightly sand the chipboard surfaces with fine sandpaper on a woodblock. Clear away all dust. Work on one panel at a time, glueing both surfaces and veneering alternate cabinets as you go. If you need to use more than one strip you should overlap them carefully, prior to glueing, then cut through both layers with a very sharp knife against a metal straight edge. Remove the two surplus strips to leave two perfectly-mating pieces, which will butt-join neatly.

To attach the veneer, use traditional contact adhesive such as the original Evo-Stick Impact and prime the panels 36 hours prior to glueing. At the veneering stage, apply the adhesive to both surfaces and lay the veneer immediately in a rolling action, starting at one edge and working across to the other, smoothing as you go to avoid air bubbles. The moist glue allows some movement, allowing you to position the veneer to perfectly mate butt joints for example. Leave for the glue to set, trim off much of the surplus with a sharp knife but leave a little protruding for sanding down with some fine glasspaper on a flat wood block for neat right-angled edges at the corners. Remember to veneer in the following order: bottom, back, sides and top.

I am no expert on veneering – for more detailed hints and tips consult one of the many books on woodwork and veneering which can be borrowed from the public libraries. If you've never done it before, practice veneering with some scraps first.

Assembly

This is the easiest bit! First, place the crossover inside the cabinet through the woofer hole. Pass the input terminal 'cup' through the hole in the rear panel and turn so that the tweeter inputs are at the top and the woofer inputs are at the bottom. Place the crossover below the cup on the rear panel and screw in place using ½inch wood or chipboard screws through the corners of the crossover board into the damping pads and rear panel. The driver wires should be brought out through their respective holes (red and black for the woofer, blue and yellow for the tweeter).

Half the white acoustic wadding should be placed in each enclosure (250 grammes in each). Make sure this is not tightly compressed, but expands to fill the whole internal volume. It may touch the driver chassis and magnets, but should not contact the rear of the woofer diaphragm. You can use the leather-cloth as a tweeter gasket if you wish (it works quite effectively), or place tweeter gaskets within the tweeter recess (the woofer has a self-contained gasket).

Soldering

The woofer should be placed magnet-side up, partly over the woofer hole, and the wires brought out to the tags. Place some paper or card over the leather-cloth and woofer cone to protect them. If you drip solder on to the leather cloth, the PVC surface may melt, undoing all your hard work in achieving a smart finish. Molten solder, or the tip of the hot iron will not do the cone any favours, either.

Before soldering, the silver-plated wire ends should be twisted together to make neat 'tails'. These should be 'tinned' by applying the tip of a soldering iron and multicore solder (supplied) to the wire simultaneously. The solder will flow into the strands, drawn by capillary action. The solder tags of the driver should be similarly 'wetted' with solder. This prepares the two conductors for soldering proper and will help make sound joints.

The red wire should be laid on to the terminal marked with a red dot. To hold this in place for soldering, a small piece of tinned copper wire (supplied) can be wrapped around the bared wire and the tag, then twisted to hold them together. The joint can then be soldered by placing a soldering iron on the tag and bared cable end at the same time as applying multicore solder to the joint close to the tip. When hot enough, the solder will flow freely between the two. When it has completely 'wetted' the joint, the solder and iron can be removed. Do not move the wire or woofer until the solder has set completely, or you may get a 'dry' joint (which could be unreliable or spoil the sound quality). It really is that easy. Just repeat the process for the other three joints taking care to make the correct connections according to the circuit diagram and the cable colour code. This is the most technical task you'll have to undertake and it's dead simple.

Before soldering, double-check the connections: yellow to the tweeter '+' tag (red 'plus' sign), blue to the other, '−' tag. While soldering the tweeter, prop it upside down in its own hole, protecting the leather cloth as for the woofer, being careful to avoid squashing the dome. Don't labour long and hard over these joints, or you could damage the internal

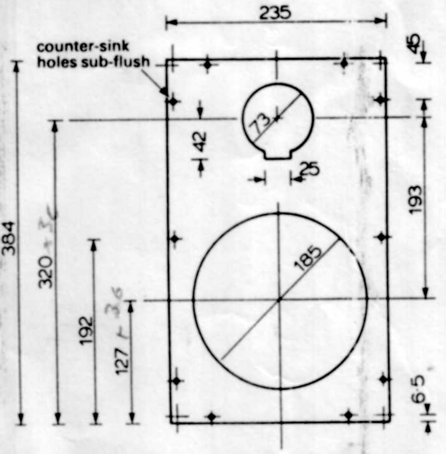


Fig 6a. Main baffle (panel C, front, on cutting plan) must be mounted 6mm proud of cabinet front edges.

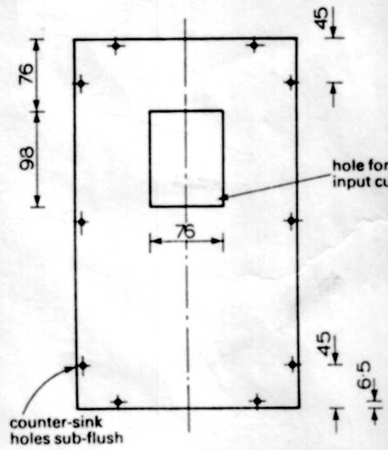


Fig 6b. Back Panel (panel C, rear, on cutting plan).

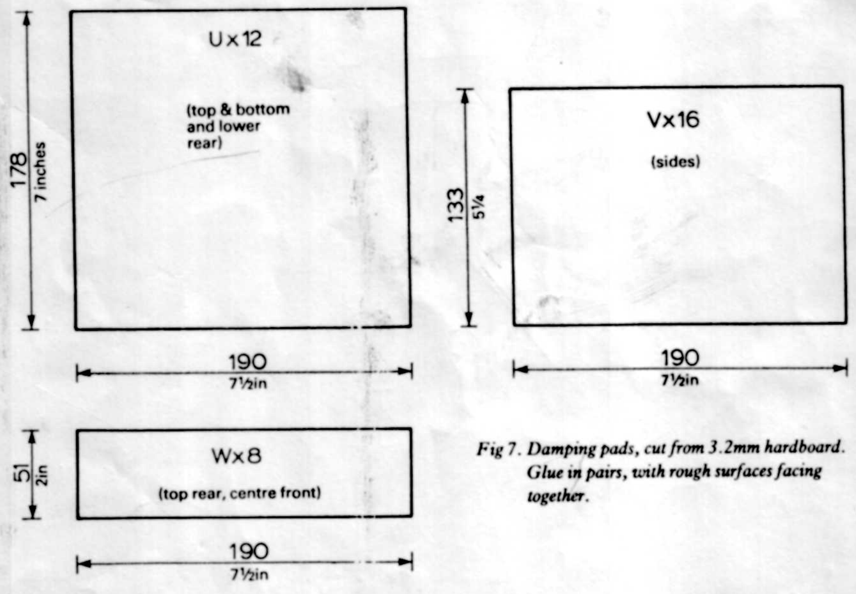


Fig 7. Damping pads, cut from 3.2mm hardboard. Glue in pairs, with rough surfaces facing together.

Listening test

I have known Dave Berriman, the designer of the DBS6, for a long time and count him as a friend, but if his speakers stank you wouldn't have to read about it between the lines. In my judgement, the DBS6 kit is nothing less than the best loudspeaker you can get for the money, and a strong candidate for the best up to, say, £600.

We're talking here about a loudspeaker with strong power handling and a wide dynamic range, both of which go down a long way into the bass (the enclosures are deceptively large), and whose tonal colouring is as close to neutral as you'll find. The tweeter makes treble that is both relaxing and exquisitely detailed – there's none of the metal dome sheen and pushy detail here – and the layered and chameleon-like midband is fully in character. The enclosure talks less than in any otherwise comparable speaker. The emphasis is on subtlety, refinement and discrimination and a fine graduation of tonal and dynamic shadings rather than socking it to you. But they can also boogie . . .

Alvin Gold

tweeter wires. Just wait until the solder has melted and flowed: that's long enough.

When the connections have been made, simply turn the units over, dress the wires away from the drivers (in particular keep them clear of the woofer diaphragm to avoid rattles) and mount the drive units in place with the special screws.

Testing

With assembly completed, now's the time to test the speakers on some low-level music. The sound of both speakers should be neutral and well balanced between woofer and tweeter. If out of phase, reversing the connections at the loudspeaker end of the cable to one loudspeaker should increase bass and correct a vague stereo image. Phase check tracks on a Test CD are useful here.If you have any doubts, re-check the internal connections to the drive units, which must be as shown and colour coded in the diagrams.

The DBS6 loudspeakers are best mounted on tall rigid stands, about 60cm (2ft) high. The optimum listening axis is not critical, but ideally your ears should be somewhere between the woofer and tweeter axes. Directly on the woofer axis is fine. Keep the loudspeakers away from the rear wall and any side walls. They have been designed to work without close-wall assistance for optimum stereo imagery and low coloration levels. Somewhere within the range of 40 to 100cm from the rear wall should prove ideal: some experimentation will be required.

Kit contents

All the major parts to build one pair are supplied by DBS Audio: Two each of DBS200 and Morel MDT30 drive units, two ready-assembled crossovers with internal cabling and bi-wireable input terminal 'cups' (including gold-plated brass terminals and gold-plated copper shorting straps). Also included is the internal acoustic wadding, driver mounting screws for woofers and tweeters. Even the black leather-cloth and black polyester grille cloth have been included. Sundries with the kit include multicore solder and tinned copper wire to secure the cables for soldering. A copy of this feature will be included as a construction guide. For overseas purchasers, two tins of Evo Stick Impact 2 are also included (140ml and 210ml) so the overseas price of the kit is slightly higher.

All you need to purchase, in addition to the kit, are the chipboard, plywood, hardboard, 12mm ramin battens and hardwood mouldings (*eg* from The Wood Trimstore by Mason's Timber Products – available from B&Q), plus PVA adhesive, Impact 2 (required in UK only) Philips screws and veneer. In fact, all the additional parts listed above, except the veneer, are available from B&Q.

The wood, adhesives (including Impact 2) and screws listed above (but excluding veneer) should cost no more than around £30. Cost of the veneer will depend on the wood chosen. The prototypes were finished in a high-grade natural ash which cost £16 (you may find veneers either cheaper or more expensive, so treat this as a rough guide only).

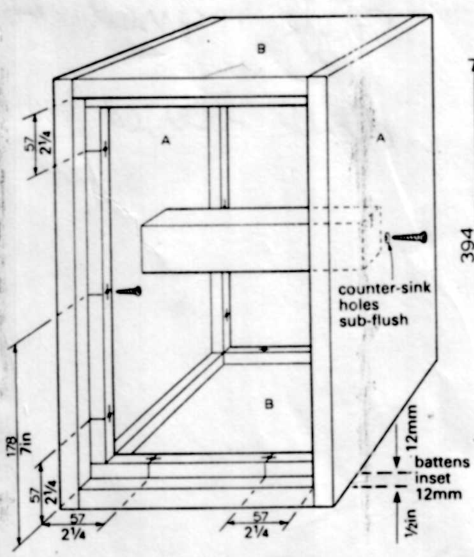


Fig 8. Carcass prior to fitting baffle and rear panel.

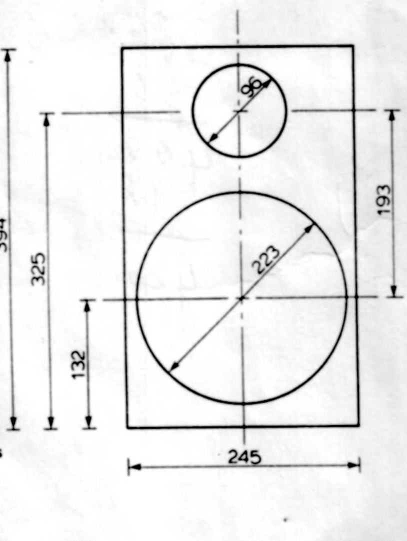


Fig 9. The thin front baffle. Material is 6mm (1/4 inch) plywood.

I tried costing the DBS6 kits for manufacture. In my view, an 'equivalent' loudspeaker, (if there were one) built to a similar quality level and achieving a comparable sound would cost at least £500 a pair at retail prices, so there is no doubt the kit offers good value (and superb sound) for the money. It's also fun to build and quite easy to achieve professional results. If you decide to take the plunge into the rewarding world of speaker building with the DBS6, I hope you enjoy building and listening as much as I have had designing them. Good luck.

Where to get your DBS6 kit

For your DBS6 kit, write to DBS Audio, PO Box No 91 Bury St Edmunds, Suffolk IP30 0NF enclosing a cheque or banker's draft to the value of £187 (£179.50 plus £7.50 for postage, packing and insurance within the UK). Please allow 28 days for delivery. For buyers outside the UK, the price is £186 plus postage and packing. (Note, the genuine kit is available only from DBS Audio – beware of inferior copies.)

Please refer to the table below for the price of packing and postage by air and surface mail. Simply add to the cost of the kit and send a bankers draft or postal orders for the total amount (in £ Sterling only) to DBS Audio. Air mail is covered by insurance and takes from 5 working days to Europe and from 7 working days to the rest of the world. Surface mail (economy service) takes longer at from 10 working days to Europe and from 20 working days to the rest of the world and is not insured.

These prices are based on Parcel Force postal delivery: they do not guarantee the above timings. Federal Express is much quicker but more expensive in all areas except Australia and New Zealand. (Antipodean customers are advised to write for a quote for Federal Express delivery which could save them around £14 on the air-mail price and be more rapid.)

DBS6 design © Dave Berriman 1991.

Overseas postage and packing

Country	Surface	Air
Netherlands, Denmark, Belgium, Switzerland, Jersey, New York USA zip codes Nos 100-4 and 112-4	–	£19.00
Norway, Sweden, Finland, Italy	£23.00	£27.00
Gibraltar, Greece, Malta, USA (other than NY as above), Mexico	£30.00	£35.00
Hong Kong, Malaysia, Japan, Taiwan	£28.00	£39.00
Australia and New Zealand	£39.00	£70.00