

Achieving full range sound in typical British living rooms - IPL Speakers S2TLK CD3.0 Ribbon Transmission Line Speaker

March 2018.

Introduction



Firstly I think I should declare the reasons why I decided to build a pair of DIY speakers – please take your time to read this, as it might help you save a lot of time and money in trying out different solutions.

The motivation behind this was not financial (note: IPL speakers are exceptionally good value!), but I was trying to get good audio reproduction across the full frequency range in a typically sized British living room – my living room is 4m wide and 5m long with the speaker firing down the length of the room. I have very little opportunity to place speakers significantly away from the wall and you can forget about acoustically treating the room. The speakers also need to be relatively compact in their dimensions.

These restrictions are probably very common for a lot of people.



One thing you realise quite quickly on your route to becoming an ‘audiophile’ is that almost all of the speakers offered by the major manufacturers need some clearance from the wall behind the speakers, otherwise you get very poor bass and very muddled sound through the rest of the frequency range due to acoustic reflections.

Like me, you have probably also had an amazing demo of some new piece of HiFi equipment, only to purchase it, get it back home and find it doesn’t sound as good. This is all due to the fact that the acoustic properties of your room have a major impact on sound reproduction. HiFi retailers typically demo their kit in acoustically treated / ‘tuned’ rooms – you can’t blame them for this as it gets the best out of a system and allows for a more detailed comparison. Ideally all rooms should be acoustically treated for best performance. But an acoustically treated room is not really compatible with a typical living room. It is also useful to know that there isn’t really a half-way house in acoustically treating a room – to be useful you need to have property sized bass traps etc... you won’t get a decent improvement by installing a bit of fluff on one wall. So unless you have a dedicated room you can pretty much forget about acoustic treatment.

Some other advice if you are wanting to get a full range sound in a small to medium sized living room. You might have thought about getting a 2.1 system... small bookshelf speakers and a sub-woofer. My advice to you – DO NOT BOTHER! I have tried this and failed with numerous sub-woofer configurations in a number of different living rooms. Before you comment, yes I have tried all of the big brands and done loads of research and testing on setting up subs. In my opinion it never produces a satisfactory response if you’re after the reproduction of music. If you can incorporate 2 or more subs into your room then it might work as you’ll get an even frequency response – but with

one sub, I think it's probably best to just forget about it. Also, think about the cost and space considerations... you would be much better with two compact full range floor standing speakers. The subs I tried were ported, sealed boxes (some with passive rads as well) and also isobaric – I would expect a transmission line subwoofer (or two) to perform better though because of the nature of transmission line design.

One solution which previously worked quite well for me was a pair of small bookshelf speakers (Spendor D1's in my case) and a Devialet amplifier with SAM. The active speaker matching gives a good boost to the lower frequency response of small speakers. For a typical British living room this is a pretty good solution and sounded quite good. But there are compromises – small speakers do not have the soundstage of larger floor standing speakers (you need a >40-50 litre speaker cabinets to start getting true soundstage), and to me the lower frequencies produced by the Spendor D1's with SAM enabled at 70%, whilst very good, is not the same as having proper bass produced by a larger cone – only so much can be done to cheat physics. Please note that I thought the Devialet was a wonderful sounding amplifier – but I eventually sold it due to functionality limitations.

So why transmission line? The transmission line speaker design helps by effectively stopping the sound wave from the back of the speaker driver reflecting off the wall behind the speaker (the front wall) and then bouncing back towards the front of the speaker causing an acoustic 'null' – this reflection is a major factor in good sound production. The transmission line also helps by redirecting this rearward wave from the driver to the front of the speaker – this gives a useful boost to lower frequencies emitted from the front of the speaker towards the listener. I won't provide further detail behind transmission line speakers here, but it's safe to say that I would be very hesitant about purchasing a sealed or ported speaker again (Exception to this would probably be Spendor D7/D9 which have a twin-venturi design, and some transmission line traits apparently - they're also very 'British' speakers and I have found them to work well in living rooms and are relatively unfussy about near wall placement – Spendor A series is also good, but the tweeters are not the same grade as those in the D series).

If you want to hear the difference a transmission line speaker can make, and you don't have a friend who has an IPL speaker, then go have a demo of a PMC floor standing transmission line before purchasing an IPL speaker at considerably less!

So, this is how I arrived at building a pair of IPL S2TLK CD3.0 Ribbon Transmission Line Speakers. This is my first ever DIY build, all of my other speakers have been from major manufacturers. My comments pretty much echo feedback you will read from others who have built Ivan's speakers.

There are lots of forum posts on IPL builds that you can look at, what I'd like to give you is my observations following completion of the build. I'd also like to cover points that I don't think other people have necessarily answered.

Listening observations

- I must firstly state that this speaker lives up to all of the stated capabilities that Ivan has put on his website. “A natural open sound quality, a natural light and detailed midrange, and a very extended but controlled bass”. At medium volumes upwards these speakers are also incredibly dynamic - the Fountek Ribbon Tweeter and HK mid-bass driver speaking in perfect unison and sounding wonderful.
- IPL transmission line speakers do not need a sub! The bass is superb and very musical. In my room the frequency response measured from 20kHz down to 30Hz. This is a true full (or near/restricted full) range speaker in a compact form. I very much doubt any typical living room without acoustic treatment would correctly deliver a frequency response under 30Hz anyhow. The other thing you notice about these transmission line speakers is that bass boom is not apparent – bass response is very even throughout the room, you also don’t get build-up of bass in the corners of rooms like I have witnessed with other speakers and subwoofers.
- Large dynamic shifts are rendered with impressive force and the scale of sound is just huge (probably not 10-12 inch driver huge, but extremely impressive given the size of the speakers). It’s all done with an astonishing sense of ease. At no point do these speakers sound strained or close to their limits, even at high volumes.
- Now it's not perfect, no speakers are:
 - Occasionally a bass note will blur into a room mode and hang for a little longer than it should at higher volumes (just exciting the room mode somewhat). Better placement will resolve this, but the speaker perform extremely well considering the fact that I have them spaced only a couple of inches off the front wall.
 - Initially I had a problem with lower volumes as the speakers sounded lean and recessive in the midrange – whereas from moderate volumes upwards they are superb. This was resolved as follows:
 - Running in for a couple of weeks seemed to help – so be patient and wait a little before doing any further adjustments.
 - The narrow vertical dispersion from a ribbon tweeter means you really need to be on axis (seated, rather than standing) to hear the magic – to my ears there was a noticeable loss of life in the midrange if you’re off axis. Correctly toe in the speakers.
 - Flat frequency response – a flat frequency response is very unfatiguing, but I question if it’s actually the best solution. There is a lot of good guidance out there on how to construct a good frequency response curve using room-correction software. I found that following the existing voicing of the speaker gave a very good result. The IPL speakers seem to include a ‘BBC Dip’ at 3kHz – I am not exactly sure of the science behind this but maintaining the BBC dip helped the sound of the mid-range and voices a great deal. See section on ‘Dirac Live’ at the end for further information.
- All things considered, especially the room, I consider this system is as good as it's going to get. Especially given the amazing price of the IPL's. How would I further improve this system? Well not much to be honest, law of diminishing returns.
 - If you don’t already have a good amplifier, then get one – you will notice the difference. I have never tried tube amplifiers, but I think they might work well given the sensitivity of the speaker – I would like to try one.
 - I feel that a three way transmission line would be very good, for improved mid-range, but they tend not to exist in these dimensions. One speaker which is potentially a post-card for how the design could be furthered is the USA made Acoustic Zen Adagio. It is also a transmission line speaker, but three-way with a

AMT tweeter (improved dispersion over a planar ribbon) in an D'Appolito style arrangement. Rave reviews about this in the USA, and technically at least it appears to offer some advantages. It also has very compact dimensions – I'd like to hear one.

- Perhaps Ivan would consider selling the kit with a dome tweeter, and maybe even a high-end version with more exotic parts. A wide dispersion tweeter would be great (Ivans smaller kits do include these). Also, how about bamboo panels to get an even stronger cabinet – you can never have too stronger cabinet and the less resonance the better (usually anyway).
- Troels gravesen does a number of transmission line kits – they are significantly more demanding to construct. To be honest I don't know if I'd like to attempt it, they are also considerably more expensive and I'd be gutted if I couldn't achieve the fit and finish that Troels does. They do incorporate more design features to help with dispersion (bevelled and countersunk design ideas here), and you can also get models with larger drivers. 10 inch Audio Technology sounds like it is an amazing driver – but the cost of this driver alone is the cost of the whole IPL kit! Completely different idea, but thinking back to my original issues, the Troels 8008 corner is an interesting design specifically for near wall / corner placement (bass reflex – but may well work well).
- Finally your other option is don't bother with DIY, dig deep in your pockets, and go for some PMC or Spendor speakers. I still think the cross over design in Spendor speakers is the very best. I don't think you could hope to replicate Spendor D7 or D9 as a DIY project when you look at the design features of them. I like the fact that the mid-range driver on the D9 is in a separate sealed enclosure.

So there you go. I know this is not a huge amount of text on what they sound like, but you should take the lack of comment as a good thing. In terms of sound quality I feel that the IPL speakers easily compete with designs I have heard from major manufacturers in the £2-3k range, potentially even higher. This is why I am glad I took my time to get a good finish on the kit supplied by IPL acoustics.

Kit and build observations and tips:

- Just be aware that the cost of the speaker is in the build time - the time commitment is quite high at circa 80hrs to build (most of this time is on the cabinet work – particularly veneering if you choose to do so). Still a considerable bargain. If you don't have the time to build one, then look at the kit building service provided on the IPL website. Please note that Colin from IQSpeakers / Nord Acoustics no longer builds IPL kits – he's moved onto NCore amps now.
- Help is on hand – I had finished constructing the cabinets, and also the crossovers, but I had no sound. I couldn't for the life of me work out what the problem was as I had followed Ivan's instructions to the letter. I thought I'd made an error in the crossover, but Ivan helped and proved that it was actually fine. A great deal of searching later and I found the problem elsewhere with my amplifier. Ivan's support was really good.
- T-nuts for the supplied floor spikes and mounting the bass units need to be hammered into position before you put the cabinet together. If you forget, then then you can fix the T-Nuts into place by putting a washer around the head of the supplied screws (so they don't screw through the MDF) and screwing the T-Nut to pull it into the MDF – not really recommended though and you stand a high chance of stripping off your screw heads. If you've forgotten to do this stage earlier, then this is probably the only solution.
- Internal bracing is strongly recommended for the cabinet – you will need to pick up some extra wood to do this as it's not included in IPL's Total Kit. Whitewood or pine is a good choice. I used one of Wickes Pine Round Edge Stripwood Moulding (PSE) 15 x 36 x 2400mm.
- The MDF kit panels supplied are cut to a very high quality – follow the provided instructions and ensure that the MDF at the top of the speaker is aligned when you start putting them together. This means that any overlap (1-2mm) will be at the bottom of the speaker and can be sanded off.



I didn't have enough space to leave glued MDF panels to set whilst clamped/weighted so I chose not to use the wood block method described by Ivan. I decided to glue and screw using Spax countersunk MDF screws. This worked really well and produced solid cabinets. Please do not let this put you off the methods Ivan suggests as they would work really well if you have the time/space. Also note that any wood glue will definitely be strong enough (the bond strength of all wood glues is better than the MDF itself provided you get the right amount of pressure during gluing). I used picture framing clamps to get good 90 degree angles when I started to put the MDF panels together – it worked well.



You'll need to order min. 5m HU1 cable from Ivan to complete the internal wiring as it is not included in the total kit – this is a really good cable so I suggest not bothering looking elsewhere.

I thought the gold binding posts on the connection panel looked cheap - so I switched them for silver plated CMC-858-M-AG Silver Plated medium speaker terminals. These terminals look to be good quality, but the internal screw connections are not great as they will not screw down low enough to hold the HU1 speaker wire unless the speaker wire is bend back over itself to present double the width - but then the screw won't fully clear the holding nut. Modify Ivans design with caution! If I was to do this again I would choose a terminal which incorporated a lug to solder the internal speaker wire directly onto.

I used a paxolin board to mount the crossover component on – I actually quite liked this and thought it was a bit of a success. But by having the additional paxolin board you create extra joints, as a length of HU1 need to go from the speaker terminals to the crossover components, this is never a good idea as there is (albeit small) resistance in every joint, and this can be amplified by the transformer in a ribbon tweeter. Again – modify Ivan's design with caution!



- For wire stripping get yourself a pair of KKmoon TU-2021 Precise Wire Stripper Cutter, or similar. I tried other tools and they were all rubbish – leading to wasted wire.
- Soldering - All you need is a good quality electronic solder which will have flux built in, as long as every component joint is scraped clean and wires twisted together, this will make a perfect joint with a 40watt plus soldering iron. Remember to clean and scrape all junctions before twisting together and soldering – it states this in the instructions, but is easy to miss. In addition to this I used 0000 liberion fine steel wool (purchased for the veneering work) to get a good shine up and remove oxidation on the wire ends before twisting and soldering the crossover components together.
- Soldering to bass unit terminals – a lap solder is fine and no need for overkill. A lap solder allows for easy removal should you need it. The ribbon tweeters are screw connection, so no need for soldering.

- Veneering – lots of hints and tips here. This was my first time veneering so I learnt a lot:
 - To complete a pair of speakers you will need 2 sheets of 2500mm by 640mm – I purchased my veneer from Reliance Veneer and was very happy with it. I used engineered veneer, rather than natural veneer because natural veneer doesn't come in such large sheets – it's also cheaper and more environmentally friendly because it's made from wood from a sustainable source. The engineered veneers are constructed using natural wood veneer. The veneer is pre-dyed, ripped into very small pieces and layered by hand, using computer software to create a new tree trunk (similar to Paper Mache). The dye is all the way through the engineered veneer, so treat as regular veneer i.e. you can (and should) sand it prior to varnishing. You can often purchase veneer on eBay, or if you want a really easy solution just choose one of Ivan's affordable iron on options. You can cut the veneer to basic shape using good quality scissors – no need for fancy tools here.



- I purchased a veneer saw for finishing the veneer – I had limited success with it though and I would highly recommend that you get a router for a professional finish. A Stanley or craft knife works well around the openings, but you will want either a veneer saw or a router for the longer junctions to get a good quality joint.
- Buy yourself an electric hand sander – you need a perfect flush finish before veneering – don't bother attempting to remove any surplus mdf by hand.



- Ivan's veneers are already iron on – so are really good options. If you decide like me that you want to use your own veneer to make your speakers a bit special then you should buy some hot glue sheets. I purchased mine from Glues Direct 'Heat Reactive Iron On' Glue Film – you will need three sheets.
- I used hot glue sheets because it is transparent – if there is bleed through of the glue through the veneers (which is highly likely) then you will not see the glue. There are

other methods of veneering, but I think this is probably the best for this application and requires minimal equipment.

- Veneering process

- Cut the glue sheets to basic size
- Put your iron up to max temp with no steam (for all of this work) and iron the glue sheet to the MDF and remove the backing.
- Important – then trim any surplus glue sheet off using a Stanley knife. If you leave the glue sheet on then when you come to trim the veneer later on you will have excess glue at the junction that you'll need to remove – it's much neater if you remove the surplus at this time.



- Then apply your veneer and with a thin tea towel between the iron and veneer and move the iron very slowly one row at a time. You need to leave the iron in place for a good few seconds to melt the hot glue. Don't worry about scorching the veneer – the tea towel will protect it. Immediately after melting the glue, place a heavy book on the melted area to ensure that the veneer and MDF are bonded together for a few seconds afterward. After you have completed veneering one side, tap your fingers over every area – you will definitely find areas (bubbles) where the glue hasn't held the veneer to the MDF. Repeat the process as many times as needed.





- Very important lesson: even if you tap all over the MDF checking for parts that haven't glued you will have missed some and they will only become apparent once you start varnishing as any loose veneer will bubble up once it becomes wet with the varnish. The way you avoid this is by spraying the unvarnished veneer with water – this will cause the unglued veneer to bubble up. Retreat this – you can keep reheating the glue until everything is stuck down.
 - If you miss a few areas and they bubble up during varnishing then there is hope! Get yourself a clean microfiber cloth and once the varnish has gone off and is no longer soft (minimum of 1 week) re-do the areas affected. The microfiber cloth provides a bit more protection from the iron and you will not damage your varnished finish provided you are careful.
 - Sand all veneered surfaces down to a fine finish before varnishing – if you don't get a good starting surface for varnishing now then the finish won't be good. Hoover and make sure all surfaces are dust free prior to varnishing.
- Varnish – minimum of 4 coats of Osmo Clear Polyx hardwax. Leave a minimum of one day between coats. Between each coat you need to rub down by gently running 0000 grade steel wool over all areas – this is because dust will get caught in the varnish and you'll end up with a nasty rough finish if you just keep adding more varnish on top of this. Finish off with the steel wool as well on your final coat.
 - Speaker grills – I think these are a really nice design that Ivan has come up with and a doddle to fit. I used a staple gun to secure the grill cloth, rather than hot glue.



- Speaker feet – I decided to fit out outriggers from KJF Audio instead of the supplied feet. I think these look good, but probably don't offer the same amount of adjustment as the IPL supplied ones.

Further enhancements:

I find the ridged foam used for the ports is fine, but the project would probably look a lot better with a mitred aluminium frame inside the aperture and a grille cloth cover to match the grille covering the speakers. This is something one of the kit building service providers does at www.alchemyloudspeakers.uk. I think it would be great if this could be purchased as a part of the total kit from IPL acoustics in the future.

Dirac room correction – as alluded to earlier, this did improve things for me, but the default curves are not great in my opinion. You should read [A Brief Guide To Creating custom target curves in Dirac Live Rev 2.1](#) to creating custom target curves. I found that no hump in the bass region is required, instead follow the existing voicing of the IPL speaker. The BBC dip at 3kHz is very important and should be retained in my opinion.



I would like to say a big thank you to Ivan for producing such wonderful kits and making DIY speaker building accessible for people like me.