About The Author
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Alex first picked up a bass when studying engineering at university, and his quest for sonic perfection led him to found Barefaced Audio, while also leading The Reluctant, an alt-ska/funk outfit.

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But This Goes to 11…

Welcome to the world of bass rigs.

With just a light dusting of snow outside it seems a good time to bring a new phrase into the fun and games of bass amps – polar response. Confusingly this is nothing to do with our festive weather but is about how a loudspeaker's output varies between when you're standing directly in front of it (on-axis) and when you're off to the side (off-axis). Here are some plots of two extremely high-quality 12" loudspeakers on-axis (bold line) and 45 degrees off-axis (thin line):

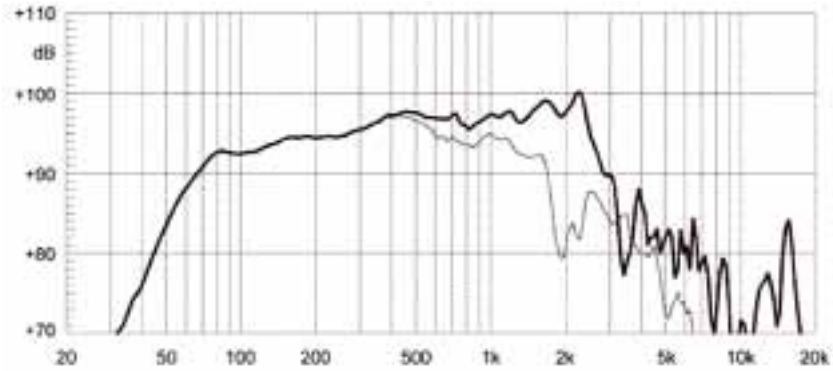

Fig 1 – a 12" subwoofer

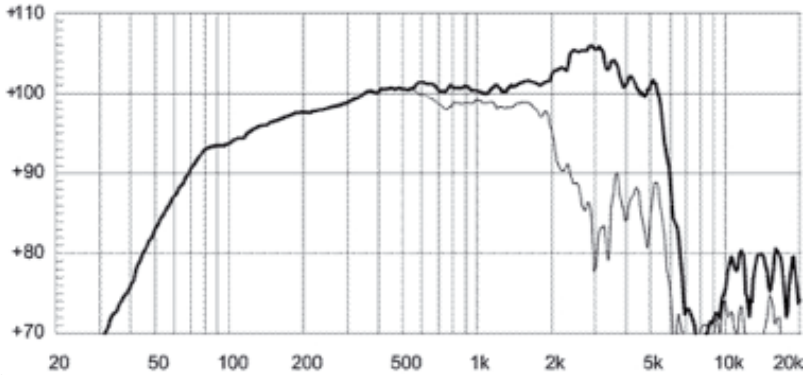

Fig 2 – a 12" mid-bass driver

These are two very dissimilar speakers – the first one is designed for compact PA subwoofers, while the second one is designed for high-output PA tops. Despite the substantial difference in bass and treble extension (below 200 Hz these curves don't show what can be achieved in a correctly tuned ported enclosure – the subwoofer speaker can go a lot lower) they both suffer the same dispersion challenge: that around 2 kHz the speaker starts to beam most of its energy directly forwards, rather than evenly dispersing it around the room.

Here we have a plot for a beast of a 21" subwoofer for PA use:

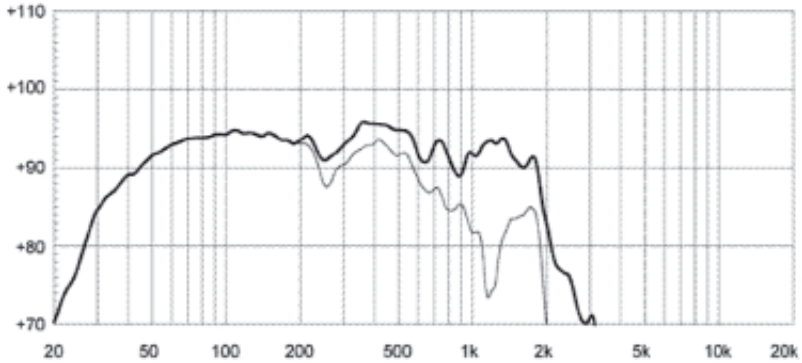

Fig 3 – a 21" subwoofer

Note that it goes almost as high in the treble as the 12" subwoofer but its off-axis performance is substantially worse – in fact, the response diverges almost an octave lower, which is exactly what you'd expect as the width of the radiating area is almost twice as large. The frequency at which a loudspeaker's dispersion becomes poor is inversely proportional to the size of that loudspeaker in that direction – so if we had an elliptical loudspeaker (like some 70s hi-fi woofers) where the ellipse was tall and narrow, the speaker would exhibit better horizontal dispersion and worse vertical dispersion.

So when it comes to dispersion, what really matters? To answer that, consider where our band mates' and audience members' ears are – even if our band is made up of basketball players and we're playing a gig in Hobbiton there is much less vertical variation in ear position than there is horizontal variation – especially when we consider that drummer stuck at the back of the stage vs that person right down the opposite end of the venue. What about the reverse – is there a benefit to restricting the dispersion in a certain plane? Well, one thing that tends to mess up bass sounds is excess reverb – and that's caused by reflections off walls, floors and ceilings. We can't restrict wall reflections without restricting how well everyone hears us, but we can restrict floor and ceiling reflections without any downsides. How do we do this? By stacking our speakers on top of each other we get the same horizontal dispersion as we would with one speaker but we control the vertical dispersion. And if we make the stack tall enough, that more controlled vertical dispersion isn't a problem because our ears are close enough to being on-axis, unless we're very tall or standing very close to our stack. If you've been thinking hard you might have twigged that this is why at big gigs you now see tall thin 'line arrays' of speakers.

This vertical stacking thing holds true not only with cabs but also with the speakers in them, so there's a lot to be said for the wide dispersion of a cab with multiple speakers where they're in a vertical line or close to it, rather than side by side. However, do not panic if you own a 4x10"! A 2x2 array of 10" speakers (as in a typical 4x10") is about as tall and wide as the 21" speaker whose plot we have above. The 10" speakers probably have a relatively similar treble response to the second 12" speaker's plot on-axis, but the large array width means the off-axis response will differ from the on-axis response about as much as on the 21" plot. Fortunately this just means that the sound tends to dip in the mids, which is a nice way of mellowing out and fattening up many bass sounds. It does mean that anyone on-axis will be hearing quite a different sound to those off-axis, but such is life. But this also means that if you're having one of those nightmare gigs where you can't hear yourself, then pointing your 4x10" at you might give you enough extra mid range for it to work. This also means that if your guitarist tends to whine that you're too loud, make sure they're not saying that because they're right in the line of fire of your cab. If you're someone that's tended to use 4x10" cabs because they've hit the right balance of loudness, bottom and portability, but have always been a bit frustrated by the tone varying from venue to venue, get your ear down to your cab and have a listen and see if the lack of mid-range dispersion might be the cause of this.

Finally (and this is worth printing out and sticking to your guitarist's forehead), 4x12" guitar cabs have really really bad dispersion – they are so wide that they send a narrow beam of sound straight out and put hardly any mid range out to the sides – so all you hear off-axis is the lows and reflected mids from the walls (which obviously aren't as clear as direct mids). This is one of the most common reasons for guitarists being way too loud – all that mid range fires straight past their knees (basic anatomy lesson number 1 – ears are not in your knees) and kills the front row of the audience (ever wonder why the audience is hiding at the back of the pub? If they stand in the middle at the front, all they'll hear is his guitar …).

What about 2x12" and 2x10" guitar combos? They have equally poor horizontal dispersion but good vertical dispersion. And now for a magic trick …! Find a chair and get your beautiful assistant to place said combo on its side on said chair so the speakers are now above each other. Voilà! Good horizontal dispersion, minimised floor and ceiling reflections and speakers close enough to ear level for your guitarist to hear themself properly. There is nothing else so easy that will have such a vast positive effect on the sound of any band, and the more rock the band, the bigger the effect. And no, the valves don't care which way up they are, and no, it won't overheat on its side. Bear in mind that your guitarist will now suffer the shock of hearing themself properly and will thus complain that they sound too thin and harsh and they can hear all their mistakes – point out that beforehand everyone in the line of fire was hearing that tone, they were just hearing the more flattering dishonest version of their playing. Persevere, provide a kind ear, even buy them a pint if need be – it's worth it!

Figure 4 – a Sound City Concord finally being used the right way up almost 40 years after it was built, beautiful magic assistant out of shot.