Paul Barton
PSB Loudspeakers

It's hard not to like Paul Barton. Ostensibly the genial Canadian was visiting Australia to promote his company's newest range of loudspeakers, the PSB 'Platinum' series, but as on his previous visit, his presentations make it clear he uses his world tours to act as an evangelist for accountability in speaker design. He's obviously more interested in arguing for putting the science back into loudspeaker design than he is in spruicking his own creations.

In Sydney, he railed against the mediocrity in loudspeaker design that has seen 'home theatre in a box' speaker systems surge in popularity. During a press conference, when one journalist took exception to his comments and pointed out that since most consumers thought that HTIB systems were 'good enough' perhaps PSB should consider introducing such a system, he looked incredulously at his questioner. 'I'm just not interested in sound that's "good enough",' he said. 'I'd like to think I'm aiming at delivering sound that's as good as I can get, and a home theatre in a box sub/sat approach doesn't even come close. I'm really disappointed that stores are not demonstrating to their customers the very evident audible differences that exist between mass-market sub/sat systems and good quality hi-fi loudspeakers.'

Barton has been pursuing the idea of quality for 47 years, when at the age of seven, he discovered music and started the violin lessons that were eventually to see him performing professionally. Since that time, he says, 'to this day there isn't a minute of the day there isn't a tune going around in my head.' So, after his wife Sue and he founded PSB in 1972 (you guessed it: PSB stands for Paul and Sue Barton) he was mightly disappointed when, despite his best efforts, his speakers weren't coming up to the high standards he'd set for himself, even though they were earning a reputation in Canada for their musicality and affordability.

As fortune would have it, a meeting with well-known Canadian audio journalist Ian Masters set up a later meeting with Canadian engineer and acoustician Floyd E. Toole that turned into a life-long friendship. Toole was at the time completing his Ph.D. research into what makes a 'good-sounding' loudspeaker, using the facilities at Canada's National Research Council in Ottawa, a sprawling campus that employs more than 1,000 Ph.Ds across all sciences. Little did Barton know that room 'M37' at the NRC was to become his second home; one where, more than three decades later, he still uses the facilities, including a laser interferometry laboratory (for evaluating cone break-up modes and loudspeaker cabinet vibrations), two anechoic chambers (one of which is reputed to be the world's largest), a reverberation chamber, and the listening room specially built by Toole to conduct thousands of subjective double-blind listening tests to gain data for three papers subsequently presented to the Audio Engineering Society. (This room was to become the model for one of the International Electrotechnical Commission's listening room standards.)

Somewhat surprisingly, Barton still uses the facilities to this day. 'Since becoming a part of the Lenbrook Group I could now build my own anechoic chamber,' he told me 'but I believe in supporting the NRC (it's not cheap to buy lab time there!) and I like being involved with the academic community, partly because there's always someone who'll offer a differing opinion, and partly for the intellectual stimulation that comes from rubbing shoulders with fellow acousticians.'

In typically generous fashion, Barton wasn't protective of what he'd learned at the NRC. On the contrary, he was more than happy to share his knowledge with other Canadian loudspeaker manufacturers. 'PSB was actually the "seed" company for what's now a vibrant Canadian loudspeaker manufacturing industry,' he says. 'Paradigm was started by two former PSB employees, and in fact the first Paradigm speaker was built on my production line. I also designed Mirage's first-ever loudspeaker for them.'

In 1979 Barton was responsible for establishing the Canadian Audio Research Council (CARC), a consortium of four of Canada's loudspeaker manufacturers, to work on DSP applications for loudspeakers. 'We built six DSP engines to research the effects of correcting frequency response via electronic means. The DSP circuit we used later ended up being used by Snell. The system used by TACT was designed by the same person who designed the original DSP for CARC.'

Even today, Barton takes the view that there's strength in numbers. 'I think Canadian speaker manufacturers have been able to succeed individually because of the international recognition that Canada has a very strong, effective and co-operative loudspeaker industry that's bigger than any individual speaker manufacturers who are parts of it.' Then, of course, there's the undeniable advantage of having easy access to Canada's NRC. Says Barton: 'I was having a problem with a particular driver I wanted to use. I could see some peaks and dips on the frequency response, and I could hear their effect on the sound, but I couldn't track the root cause of the problem. After a session on the NRC laser interferometer, I determined the reason was mechanical: the cone was supposed to be acting like a piston at this frequency, but the laser analysis showed it was in fact flopping about like a wet dishrag.'

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PSB doesn't make its own drivers, but Barton says the drivers it does use are all 'ground-up' designs built exclusively

for PSB. The tweeters are built for him by SEAS in Norway, for example, and he specifies an aluminium dome because it enables him to get the frequency response out beyond 40kHz yet have a fundamental resonance as low as 990Hz, which means he can cross to the tweeter at 2.2kHz. For his bass drivers, he prefers to use fibreglass cones. 'The beauty of glass is that you can control the stiffness of the cone during manufacture, so that the same basic speaker design can be varied for different models simply by changing the stiffness of the cone.' On his new Image line, Barton uses cones formed from polypropylene, which he's now much happier with. 'My previous polypropylene cones were vacuum-formed, which means the material didn't have a constant thickness. The cones I use now are injection moulded. I am also using a new rubber to form the roll surrounds—or "edge hole" as I call it. The new rubber is almost completely inert so no energy is reflected back into the cone.' Barton showed me two squash balls made from the two different types of rubber. Although both were the same size and weight, and as 'squishy' as each other; they acted completely differently when dropped to the floor from waist level. One (the ball made from the old compound) bounced up from the floor like... well, a rubber ball—whereas the other ball hit the floor like it was a rock, and stayed there, effectively containing all the energy. I don't think I've seen a more impressive demonstration.

Barton's latest research has been into something quite simple: the ubiquitous bass reflex port. 'Every time you use a piece of tubing for a bass reflex port, you're going to run into a problem I call "fluting", where the column of air inside the port will resonate and create its own sound, independent of whatever's happening inside the box, and this can be at any frequency up to 1kHz or so.' He discovered there are three solutions to the fluting problem: curving the port so it's no longer straight; coating the inside of the port with open-cell polyethylene foam so the air velocity is lower there than in the centre of the port; and forming the port into a non-circular shape. He now uses all three solutions individually and in combination, depending on the port's size and physical location in the cabinet.

PSB has always been regarded as a 'value-for-money' brand, even though its speakers are not inexpensive, but Barton has been struggling to bring this same value-for-money equation into its line of powered subwoofers. At least he has until now. The combination of very high BL magnets, 'BASH' (Class-H) subwoofer amplifiers, and a newly designed limiting circuit that prevents clipping without quashing dynamics means that PSB's subwoofers are now ready to take on the world. 'In a Class-H design, the power

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supply tracks the audio signal, so all the power is dissipated in the load, which means we're up to 90 per cent efficient. This means a smaller power supply, less heat and a smaller heatsink, therefore we end up with much better value.' Contributing to the performance of the subwoofers is PSB's latest voltage limiter circuit. 'It's crucial that a subwoofer amplifier should never clip, because then you'll get high-frequency information from the cone which can be localised, so almost all manufacturers include limiting circuits. Most of these work by just clamping the signal when they see clipping, but this approach has the disadvantage of quashing the dynamic range. Our limiter lets the first few cycles of the overloaded waveform through before starting its limiting action. This exposes the ear to the initial loud sound, which establishes the correct volume to ensure the dynamic range is properly perceived, but then cuts it back before the ear can start the localising process. It required some tricky work with time constants.'

Not that Barton is a stranger to tricky work; it's just that he's been doing it for so long now that it's second nature, so he rarely thinks about it. What he is certain about is what it's important to get right when designing a loudspeaker: and that's frequency response.

'There's more to it than just a flat frequency response, of course,' he says, 'but if you don't have a flat response in the listening environment, you may as well not have started in the first place.' This requirement for flat frequency response is not grounded in any technical or electronics theory: it's a direct result of the thousands of subjective trials with listeners conducted by Floyd Toole, using real music played through real loudspeakers. Despite the myriad variables (and Toole's many other findings) Toole's research showed speakers with flat frequency responses are reported as sounding 'the best' in double-blind listener trials. 'It isn't only the on-axis response that has to be flat,' says Barton. 'Response also has to be flat off-axis, because this response dictates the quality of the second-arrival sound. Whereas most designers concentrate on getting it right at 20–45° off-axis, I don't bother much with this angle because any sound heading in this direction will rattle round the room for a while before it reaches you and is thus unable to affect the perceived timbre. It's more important to get the 60–70° off-axis response flat, because it's this sound that will reflect from the nearest wall to become the second-arrival sound.'

Many of the people Barton's talked to over the years at exhibitions, demonstrations and hi-fi shows have told him that a flat frequency response isn't important 'because we all hear differently.' It's an argument he hears often and say's it's wrong. He cites the other significant findings from Toole's ground-breaking research. 'Most people, most of the time, will agree on the relative qualities of a group of loudspeakers, and this is true for both experienced and novice listeners: it just takes the inexperienced listeners longer to decide!'

greg borrowman