Elac

FS207.2 'JET' Loudspeakers

Many audio companies like to highlight their long and glorious histories, but few can hold a candle to Germany's Elac, which traces its history all the way back to April 15, 1908, although it didn't start to manufacture under the Elac brand until 1948, in which year it started manufacturing Elac turntables. Until that time, the company had been operating as an OEM 'Other Equipment Manufacturer' plant, building radios for Siemens and phono cartridges for Seignette.

Nine years later, in 1957, Elac was granted the first patent on a stereo phono cartridge, the design of which it later licensed to companies around the world, including Shure.

Loudspeaker manufacturing started in 1984, building on technology developed by Axium Electroakustik, which became part of Elac, and by legendary loudspeaker pioneer Oskar Heil (See Sidebar), whose famous air-motion transformer tweeter revolutionised the hi-fi world in the late 70s and early 80s, following its invention in 1972. The Heil tweeter was basically a corrugated membrane, driven from its edge, rather like a miniature accordion. The idea was that as the folds squeezed together, they compressed the air between the folds and moved it outwards, creating sound.

The beauty of Heil's system is that because the 'pleats' in the membrane are highly efficient (think of how far you can 'squirt' an orange pip by squeezing it between your fingers, compared to throwing it with your hand), the motor system has neither to be large nor high-powered. Also, because the pleated membrane is inherently 'loose', its resonant frequency is well outside its operating range—something that can't be said of any dome tweeter.

Elac

Brand: Elac
Model: FS207.2
Category: Floorstanding Loudspeakers
RRP: $3,200–$3,400
Warranty: Ten Years
Distributor: Synergy Audio Visual Pty Ltd
Address: 55 Down Street
Collingwood
VIC 3066
T: (03) 9416 4161
F: (03) 9416 4163
E: info@synergyaudio.com
W: www.synergyaudio.com

Over the years, Heil's basic tweeter design has been developed and produced by several different manufacturers around the world and marketed under several different names, including AVT (Air Velocity Transformer) and Air Motion Transformer (AMT). Elac calls its version a 'JET' tweeter.

Elac's JET tweeter is similar to the Adam company's A.R.T. (Accelerated Ribbon Technology) tweeter, which is also based on the original work of Oskar Heil. Adam says the advantage of the Heil technology is primarily that 'all other loudspeaker drive units, whether they are voice-coil driven, electrostatics, piezos or magnetostatics, act like a piston, moving air in a 1:1 ratio. This is undesirable, as the specific weight of air is much lower than that of the driving mechanics. Speaking in terms of electrical engineering one could say there is a bad match between source and load. The A.R.T. [JET] principle achieves a 4:1 velocity transformation between (the) driving diaphragm and driven air. In other words, the air moves in and out four times faster than the folds are moving. This superior motor system is responsible for the enormous clarity and transient reproduction that is to be heard from the A.R.T. drive units.'

For all its inherently superior technology, the JET tweeter looks remarkably ordinary—some might say downright plain. Positioned midway between the two bass/midrange drivers on the upper portion of the FS 207.2's front baffle, the pleated diaphragm is almost hidden behind five slots, each of which is approximately 25mm wide and 5mm high, that are cut into the plastic faceplate. As with all the other components used to build the FS 207.2, the tweeter is built in Germany by Elac itself. The crossover frequency (from the bass/midrange drivers) is relatively high, at 2.7kHz, effectively removing any crossover effects above the normal audio range for fundamentals. The JET tweeter has a high-frequency performance that extends all the way up to 50kHz, so it's ideally suited to SACD and DVD-A, as well as extended-range PCM. It's worth noting also, however, that there are myriad acoustic benefits to be had from extending tweeter response to 50kHz even when using source music that's band-limited to 20kHz, such as ordinary CDs, as demonstrated by Tsutomi Oohashi *et al* in their paper '*High-Frequency Sound Above the Audible Range Affects Brain Electric Activity and Sound Perception*'.

Elac's technology isn't limited to just the JET tweeter: the two bass/midrange drivers used in the FS207.2 are also quite unusual, which you might guess even by looking at them, because of the oddly-cast frames and the shallow, dish-like cone structures. Instead of the cones being made from just the one material, Elac's engineers bond a thin layer of aluminium sheet to an underlying layer of wood pulp. The layer of aluminium acts to stiffen the cone, so it operates more like a piston at low frequencies,

Oskar Heil

Interestingly, several audiocentric websites credit Oskar Heil with the invention of the field effect transistor (FET), and it seems appropriate in this review to put that theory out of its misery, because nothing could be further from the truth.

The FET was invented in 1927 by Dr Julius Edgar Lilienfeld and patented by him on March 7, 1930. Born in Germany in 1881, Lilienfeld emigrated to the US in 1927. Lilienfeld was a genius who corresponded with Albert Einstein. Not only did Lilienfeld invent the FET, he also invented the first electrolytic capacitor (Patent #1,906,691, filed on March 28, 1928) and a solid-state rectifier (Patent #1,611,653, filed 1926). It seems the reason his work may have been overlooked or ignored is because in the aftermath of WW1, when Lilienfeld was still working in Germany, the US patent office assigned the rights to all his US patents to the Alien Property Custodian. It is certainly true that Oskar Heil patented a FET in Britain in 1935 (Patent #439,457), but based on prior art rules, this patent should never have been allowed.

To ward off those who wish to disagree with my interpretation, I'd like to point out that Lilienfeld applied for three patents in all. The first two, from 1926 and 1928, describe what's now accepted as the field-effect transistor (FET) structure. The first patent (J. E. Lilienfeld, A Method and Apparatus For Controlling Electric Currents, US Patent #1,745,175, filed on October 8, 1926, and granted January 18, 1930) is for a MESFET or metal/semiconductor FET. The second patent (J. E. Lilienfeld, A Device For Controlling Electric Current, US Patent #1,900,018 filed March 28, 1928, patented March 7, 1933) is derived from the first and gives a description of a depletion mode MOSFET. The third patent (J. E. Lilienfeld, An Amplifier for Electric Currents, US Patent #1,877,140, application filed December 8, 1928, granted September 13, 1932) describes two other transistor structures, the Metal Base Transistor or the Semiconductor/Metal Semiconductor Transistor (SMST) and the Schottky-Barrier-Collector Transistor or MSMT. (The word transistor had its beginning in 1946 in work at Bell Telephone Laboratories that used high-purity germanium to create a solid-state amplifying device.) Re-invention of transistors some twenty years after the Lilienfeld's work, by John Bardeen, Walter Brattain and William Shockley earned these Bell Telephone Laboratories employees three Nobel Prizes, but Bell Labs was forced to abandon all patent claims to the field-effect transistor because of Lilienfeld's prior art. Over his lifetime, Lilienfeld was granted fifteen German patents and sixty US patents, amongst which was one for a particularly innovative loudspeaker (Patent #1,723,244).

so reducing distortion, while the wood pulp backing prevents the aluminium from 'ringing' at high frequencies. In other words, you get all the advantages of a metal-cone driver without any of the disadvantages! The drivers are rated with a diameter of 150mm, but their Theile/Small diameter is much smaller, at 117mm. The chassis is made from pressed steel, at the business end of which is a very large, heavily shielded double-magnet assembly. This drives a voice coil wound on a Kapton former.

Heavy-duty Figure-8 cables run from the JET tweeter and the bass/midrange drivers back to the crossover network, which is PCB-based and mounted to the rear of the rear terminal plate. Because the FS207.2 is set up for bi-wiring, there are actually two completely separate filter networks, each on its own PCB. The HF section has three 100V non-polarised electrolytics, three inductors, four ceramic resistors as well as two polypropylene capacitors and a positive temperature coefficient resistor (Protec). The LF section is comprised of four inductors, five ceramic resistors and three non-polarised electrolytics. What I found most interesting was that the PCB has a movable link marked 'Jet Level 0' and 'Jet Level +1' indicating that it's possible to adjust the high-frequency level of the tweeter by 1dB, though this is not mentioned in any of Elac's literature. The link on my sample was set to '0', where I left it (about which more later).

The tall FS207.2 is a bass reflex enclosure with two ports that exit through the rear of the cabinet. I was intrigued to find that Elac provides two foam plugs that can be used to modify the low-frequency performance of the FS207.2, but provides no information on how the plugs should be used. A flurry of email exchanges with local distributor Synergy Audio Visual revealed that Elac doesn't recommend blocking both ports because the drivers in the FS207.2 were not designed for use in a sealed enclosure, and that the choice is whether to block the top or the bottom port, to modify the bass response according to where in the room the speakers are located.

Elac says that in its experience, blocking the upper port is usually sufficient to tame any excess bass, but if not, the lower port should be blocked

instead. Remember, too, that if you're not locating the speakers in 'mirror image' locations, so that the ports in each speaker are equally loaded by nearby walls, it's not necessary to have identical plug configurations. For example, if one speaker has a wall alongside and the other doesn't, you could insert a plug only in the speaker close to the wall, to better-match the bass output to that of the other channel.

Size-wise, I thought Elac had struck a perfect balance with the FS207.2s. At just 935mm high, 170mm wide and 285mm deep, they're visually appealing from virtually any angle, with or without the grilles fitted. This size enables a good internal volume, as well, in the order of 43 litres, to help out the bass. Some assembly is required, as they say, because the speaker base comes packed separately from the speakers, but it's only four screws per base, which is an easy ask. The cabinet comes in three finishes. A pair of FS207.2s with a cherry veneer finish costs $3,200. Silver and titanium finishes are a little extra: $3,400 per pair. The warranty is 10 years on the drivers and 3 years on the cabinets.

Listening Sessions

My listening room is set up so that the left speaker sees exactly the same 'room load' as the right speaker, so I had only to work out whether I preferred the sound of the speakers with the top holes plugged, the bottom holes plugged or with both ports left completely open. To my mind, there was no doubt that the bass seemed punchier and more dynamic with the ports left open, and this is, for the most part, the alignment I used throughout my time with the FS207.2s. That said, I have to say that with some rock albums, particularly those mastered in the 80s, I found the level of the bass could be just a little too elevated, at which point I found that blocking off the top ports worked a treat. Yes, I lost a little of the punch and dynamism in doing so, but the balance came right back into line. I didn't run into any situation where I found the need to block the bottom ports with anything other than orchestral music, where I found blocking the lower port seemed to give a smoother, more melodious feel to the orchestra's lower-pitched instruments.

As for working out which way I should set that internal jumper, I didn't. I decided that room acoustics and speaker positioning would affect the high-frequency response by more than 1dB and so that it would be fairer to all concerned to listen using the 'factory-set' position. All I can say is that you should also do this and if, after several months, once you've become thoroughly accustomed to the sound, you think you could do with a little lift in the highs, switch the jumpers over then and only then. Having decided this, I can honestly say there wasn't a moment during my time with the FS207.2s—with any type of music—that I thought I'd made a bad call in leaving the jumpers in their original position.

Which is by way of saying that I found the balance of the sound was superb. The weight of the bass meshed perfectly with the delivery of the midrange, which then segued so effortlessly into the treble that there was not even the slightest sense of there being a transition from one driver to another. The sense of naturalness to the sound that this imbues cannot be overstated, particularly with instruments that have a wide frequency range, such as keyboards of all kinds. I was particularly reminded of this when playing a new CD ('Transcriptions of Concertos after Vivaldi and others' on Void 9813 A/B—it may be difficult to obtain!) by Dutch pianist Ivo Janssen, who's undertaken the somewhat daunting task of recording all Bach's keyboard works. The recording captures the sound of Janssen's Yamaha C7 to perfection. It could be the best-recorded piano I've ever heard.

The Elacs handled keyboard sound wonderfully well, capturing the attack and sustain and excelling at the extremes, delivering depth to the bass and pearly trills in the upper reaches. The JET tweeter proved absolutely brilliant not only at the reproduction of pianoforte, but also reproducing harpsichord and harp, where the clarity and purity of the sound in the higher octaves were second to none.

That said, it's actually more important to get the midrange right, and here Elac has scored big-time, because the sound is exactly neutral, yet doesn't have the 'soft' sound that most speakers acquire in the process of attaining this neutrality. Indeed the Elac midrange is light, airy and immediate, sounding forward without being forward, and 'full of life' without being bright. The performance is so good there's not even the slightest suggestion when listening that one musical style might be handled by the speakers better than any other; the Elac FS207.2 takes everything in its stride, from rock, to jazz, to popular, through the various 'world music' sub-genres. The clarity and crispness on vocals is revelatory—you won't be straining to decipher a lyric if you own a pair of FS207.2s!

Bass performance is commensurate with the FS207.2's physical size and the size of its bass/midrange drivers in terms of extension, comfortably reaching down into the lowest octaves at normal listening levels, but not exhibiting what I'd term 'big' bass when driven at very high volume levels. Anything it lacks in raw power at the very deepest frequencies it more than makes up for with a taut, dry low-frequency presentation that permits you to follow bass lines without thinking about it and to easily discriminate the pitch of even the shortest of bass notes. There's also none of the overhang or bass 'bloom' that affects large paper-coned bass drivers.

In the course of connecting several different amplifiers to the Elac to establish their amplifier-friendliness, I discovered they were not particularly tolerant of poorly designed amplifiers: you really need a good-quality audiophile amplifier to give it the freedom to perform at its best: an AM/FM or AV receiver really won't cut it at all unless it has a properly-designed output stage using discrete output devices.

Conclusion

German engineering has been one of the world's marvels for many decades (think BMW, Mercedes, Porsche…) so it's really no surprise that the Elac FS207.2 loudspeakers follow in the same fine tradition. Superb engineering, superb sound quality, and a design that really is different from the 'me too' approach that currently plagues the hi-fi loudspeaker manufacturing industry. And as for that JET tweeter: count me as a convert!

greg borrowman

LAB REPORT

Readers interested in a full technical appraisal of the performance of the Elac FS207.2 'JET' Loudspeakers should continue on and read the LABORATORY REPORT published on the following pages. All readers should note that the results mentioned in the report, tabulated in performance charts and/or displayed using graphs and/or photographs should be construed as applying only to the specific sample tested.

Test Results

Figure 1 shows the performance of the Elac FS207.2 with a wideband pink noise stimulus. Note that there's no smoothing applied to the trace, which means that the frequency response between 200Hz and 10kHz in particular is exceptional, not only for its general smoothness and linearity, but also because of the overall flatness. As you can see from the scale to the left of the graph, the graphed frequency response extends from 80Hz to 30kHz ±2.5dB, and both the upper and lower limits are forced on the speaker by limitations of the measurement process itself: the low frequency response by the size of the room in which the speakers were measured, and the high-frequency response by the 30kHz upper limit of the graph itself.

Figure 2 shows a high-resolution version of the high-frequency performance of the Elac FS207.2, measured using a sine stimulus that was gated to remove room effects to return a true anechoic response. Again on this graph you can admire the superb linearity of the Elac's frequency response, as well as its high-frequency extension, particularly above 20kHz. The crossover between the bass/midrange drivers is just visible on this graph, at 3.1kHz, just a fraction over the claimed nominal 2.7kHz. Such a high crossover frequency allows the midrange sound to be more uniform. The 'dip' in the response at the crossover point, visible between 2.7 and 3.5kHz is only around 1dB, which is a fantastic result. Note also the response above 10kHz is fractionally higher than it is when pink noise is used. This is because the high-level pink noise stimulus thermally stresses tweeters beyond what they'd normally experience. The response using the sine stimulus in this graph is what you'd expect with a music signal. Despite this, the difference between the two traces is very small, so in this regard, the JET tweeter performs better than any other tweeter *Australian HI-FI Test Laboratories* has ever tested. Note also if the level of the tweeter were lifted by 1dB using the internal jumpers, the measured performance would be even flatter than it already is.

The third graph in the series (*Figure 3*) shows the low-frequency performance of the Elac FS207.2 acquired using a near-field measurement technique to eliminate room effects. The black trace shows the frequency response of the higher of the two bass/midrange drivers. You can see that at 250Hz, where the lower bass/midrange driver starts rolling off, its response continues out flat to beyond 800Hz. (The reason the response appears to roll off at 800Hz on the graph is due to a limitation of the near-field measuring technique that means that because of driver size/mic spacing, there's no longer a pressure field). The red trace shows the response of the lower of the two bass/midrange drivers, and you can see that it has slightly more output in the region between 65Hz and 175Hz than the upper bass driver. The blue trace shows the output from the higher of the two bass reflex ports when the vent is open, while the green trace underneath shows the response when the port is plugged. Without the plug, the response is quite peaky, with the *maxima* at 43Hz. With the plug, the output is flattened, and the output reduced considerably (obviously!).

Figure 4 shows impedance traces of the left and right speakers (without any plugs fitted) overlaid over each other, plus a third impedance trace run with one of the plugs inserted, as well as a fourth trace measuring the resistance of a precision 3Ω resistor for calibration/comparison purposes. You can see that the impedances of the left and right speakers are virtually identical, which means the manufacturing processes and quality control procedures in place at Elac's German factory are first-rate. With no plugs, the resonant peaks are at 34Hz and 70Hz respectively. The *minima* between them, at 45Hz, coincides almost perfectly with the port's maximum output. As you can see, the impedance of the FS207.2 design is quite low, staying below 4Ω from 130Hz right up to 1.2kHz, so the speakers definitely deserve their 4Ω nominal rating. Elac specifies the minimum impedance as 3.4Ω at 220Hz. *Australian HI-FI Test Laboratories'* measurements put the impedance of the speaker tested just a little lower at the 220Hz point (approximately 3.2Ω) and a bit lower again (3.1Ω) up at 900Hz. The differences are insignificant in an engineering (or practical) sense, the issue is really that Elac specifying the minimum at 3.4Ω just scrapes the speaker into qualifying for a nominal 4Ω impedance rating under the IEC 268-5 ruling, whereas 3.1Ω would have meant a 'nominal' rating of 3.8Ω.

Australian HI-FI Test Laboratories measured the Elac FS207.2's sensitivity at 87.5dBSPL at 1 metre, using an equivalent 2.83V input, which is a little below Elac's specification of 89dBSPL, but *Australian HI-FI Test Laboratories's* measurement technique is unusual, and results in lower figures than the technique used by most speaker manufacturers. Taken together, the impedance and sensitivity results mean the Elac will efficiently convert amplifier voltage into sound pressure levels, but will require the amplifier to deliver moderately high levels of current in the process. Any amplifier that will happily drive a 4Ω load continuously will shoo it in, but if you use an amplifier that will happily drive a 2Ω load continuously, so much the better.

The last graph in the series (*Figure 5*) is a composite graph in which the various differently-acquired traces have been joined using software to form a single trace. This puts the measured response at 55Hz to 30kHz ±3dB. This is self-evidently excellent, and remember that the upper limit is the graph: the JET tweeter's response extends to 50kHz.

Steve Holding

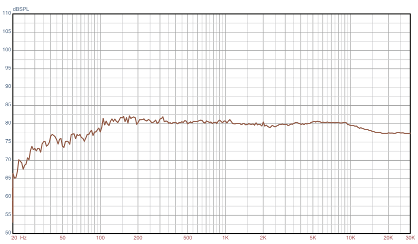

Figure 1: Pink noise frequency response (unsmoothed) at one watt at 1.0 metres.

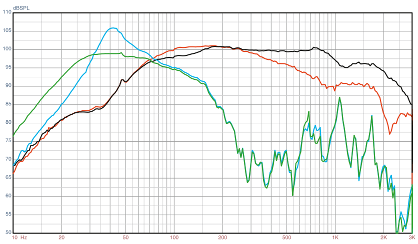

Figure 3: Nearfield frequency response of both bass drivers and reflex port. (Note data for ports has not been re-scaled to compensate for differences in radiating area.)

Figure 2: Gated sine frequency response (unsmoothed) at one watt, at 1.0 metres.

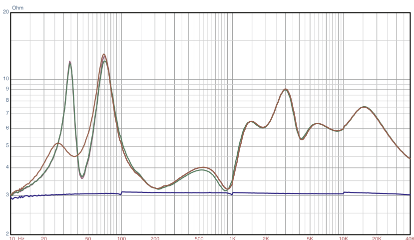

Figure 4: Impedance vs frequency, with both left and right speakers graphed (see copy). Trace under is that of a reference 3Ω precision resistor, measured at the same time for calibration purposes.

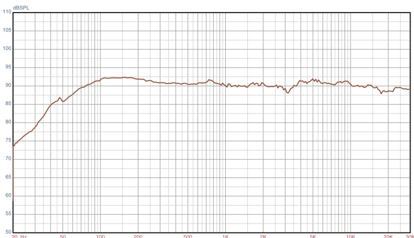

Figure 5: Summed response (see copy).