Quad ESL-989 electrostatic loudspeaker

By Larry Greenhill • November, 2002

I first heard Eugene Gigout's pipe-organ masterpiece, the *Grand Chorus in Dialogue*, in the Smetana Concert Hall of Prague's Municipal House (Obecnim Dome) on a Saturday evening before the 2002 flood. I recall seeing the delicate, youthful Michele Hradecka sway from side to side to reach the pedals. In response, a massive wall of deep organ chords shook the hall, the magical acoustic blending the delicate, extended highs with the thunderous bass. But this memory mixed the music with the beauty of Prague's soaring church spires, brilliant red terracotta roofs, and lavish palaces.

Similarly, Quad's ESL-989 electrostatic loudspeaker caught my visual attention before I ever heard them. I was already strongly attracted to the speaker for its unique place in the history of high-end audio. Just as Prague's historical richness enhanced the classical-music performances I heard, the Quad ESL's unique reputation was appealing on its own.

History and Rebirth

The ESL-989 is the fourth version of the longest-surviving consumer-grade electrostatic speaker, which is now approaching its 45th year of sales. Back in 1989, when I last did a full review of a Quad ESL for *Stereophile*, it was one of only 11 full-range electrostatic systems listed among 1376 loudspeakers in *Audio* magazine's "Annual Equipment Directory." These 11 models were made by only four of the 257 speaker companies listed. Today, full-range electrostatic speakers are even rarer.

The first Quad loudspeaker was the ESL-57 (the number indicates the year of design), which remained in production for 25 years. It employed a "constant charge" feature to distribute electrons across its entire Mylar diaphragm. The speakers' curved rectangular panels imaged beautifully, yielding an extraordinarily lucid midrange, speed, and transparency.

However, owning a pair of ESL-57s required dedication and a generous masochistic streak. The speaker had low power handling, high-frequency beaming, limited bass response, and widely fluctuating impedances. The driving amplifier had to be able to handle the '57's capacitive load, whose impedance fell to 1 ohm at high frequencies. This required an amplifier designed to swing low amounts of voltage while remaining stable; the Quad 303 and the Levinson ML-2 worked the best.

Nor was that all. Configured as a gnarly, stubby panel, the speaker was often mistaken for an oversized space heater. Left on, it sucked up dust and grime as its panels filtered the air. Worst of all was the danger of arcing—the flickering blue lights in the panel that signaled diaphragm perforation and destruction. Wilson's Peter McGrath, then running Sound Components in Miami, offered to teach me how to do my own Quad repairs using rolls of Mylar and a hairdryer.

Quad designer Peter Walker sought electrical and sonic relief in the next generation, the ESL-63, which premiered at the 1981 CES (footnote 1) and featured two major innovations. The first was the speaker's unique radiating element, which used driver plates that employed a

printed circuit board of concentric rings fed by delay lines comprising some 12 miles (!) of wire, which allowed the flat diaphragm to radiate the sound first at the center and last at the periphery, as if it were a radiating sphere—the ideal shape for approximating sound emanating from a point source 12" behind the panels.

The ESL-63's single electrostatic element also eliminated the Venetian-blind, treble-beaming effect found in speakers with multiple panels. This design had near-perfect phase coherence, as shown by Quad's show-stopping demos, in which two squarewaves out of phase with each other were fed to two Quad speakers. A microphone placed between the speakers showed that the two signals canceled each other out completely.

The ESL-63's second major innovation was its triac clamping circuit, to protect the speaker from arcing. The circuit operated by limiting voltage at the input. If that failed, the input was shorted by an electrical "crowbar," activated by an RF "sniffer" that detected the ionization of air that occurs just before an electrostatic speaker arcs.

Other improvements were on the way. In 1983, Quad changed the ESL's protection circuitry so that the speaker could tolerate higher voltage levels, increased its shutdown time to four seconds, modified the metal grille louvers to reduce resonances, and built a pad into the dustcover to damp a 60Hz resonance (footnote 2). In addition, a brisk aftermarket industry of Quad modifications emerged: stands from Arcici to replace Quad's own Stand and Deliver units, new grillecloths, new AC connections, rewiring internal connections with heavier cables, capacitor bypasses, and replacing the snap-in power-cord terminals.

Footnote 1: See Reg Williamson's detailed description of the Quad ESL-63 in *Speaker Builder*, February 1982, Vol.3 No.1.

Footnote 2: See Anthony Cordesman's review in *Stereophile*, Vol.7 No.7.

The speaker's structural rigidity was increased for the launch of the ESL-63 USA Monitor in 1988. This evolved from a special "pro" version used by Philips' European recording division for location recording. Quad replaced the '63's aluminum frame with steel, and put handles on the sides and rubber kick pleats at the base. Philips was delighted, and soon other studios requested the "pro" version. Quad decided that the improved structural rigidity made it the best version for export, even though it increased the speaker's weight by 30%.

The ESL-63 maintained a firm hold on its Grade B ranking in "Recommended Components" from 1987 through 1996. Why? The '63 produced a sense that one could "reach out and touch the musicians," as John Atkinson noted in the December 1992 article naming the ESL-63 his "Editor's Choice" component in *Stereophile*'s Product of the Year listings for 1992. JA also enthused over the speaker's precise imaging and lack of coloration. I also felt the ESL-63s had formidable imaging, specifically its front-to-back depth and horizontal dispersion—it was possible to move around and keep the stereo image (no pinpoint "sweet spot"!). On the other hand, the '63's midrange lacked the ESL-57's transparency, its image height was restricted, and its bass response remained limited, requiring a subwoofer. The Finnish Gradient subwoofer, designed for the ESL-63, made an extremely smooth acoustic and visual match, but the Velodyne HGS-18 sub went far deeper.

John Atkinson's choice of the Quad ESL-63 USA Monitor as his "Editor's Choice" for *Stereophile*'s 1992 Product of the Year listings summed up the yin-yang experience of many

audiophiles: "...as good as the '63 is, it could be better. It doesn't go loud. It doesn't go deep. It needs to be used on stands to get the cleanest upper bass. (The recommended Arcicis clamp the speaker in a loving embrace, stiffening the rather torsion-prone frame.) The limited lateral dispersion in the top two octaves renders the sound rather dull for those who sit more than 10' away in well-damped rooms. There is a slight fizzle in the mid-treble that annoys some listeners more than others. But in the areas where it excels, it still outperforms almost every other speaker."

Enter the ESL-989

In 1995, Quad Acoustics was sold to the Verity Group, which at that time owned Mission Loudspeakers. In 1998, International Audio Group (IAG) purchased Quad, and set out to remanufacture the classic ESL-63 using modern methods. They first produced the ESL-988, a direct replacement for the ESL-63 that retains all of its original features. The rigidity of the speaker's frame was improved, and 95% of the components were upgraded. IAG improved the quality of wiring in the delay lines, and increased the concentration of copper in the electrodes. All new Quad ESL models were given a 5 degrees backtilt.

They also produced a new model, the ESL-989, which had 50% more radiating area than the '63, weighed about 11 lbs more, was nearly 16" taller, and had two additional bass panels for improved low-frequency performance (-6dB at 30Hz *vs* the '988's 35Hz rating). The '989's power handling was also increased, particularly in the deepest bass range. Quad's Julian Maddock stated, "The '989's protection circuitry is all but identical to that found in the ESL-63, albeit with higher-quality components. However, the upper voltage limit for the ESL-989's protection circuit has been increased, due to the greater power handling and low-frequency performance of the larger diaphragm. We can let more through. Similarly, the power supply is a bit beefier too."

IAG expanded Quad's manufacturing facilities and production staff, and facilities were built in China that adhered to the strictest quality control Quad engineers could devise. Each plant features a large, air-conditioned anti-static room (with double doors, etc.). Quality control was also improved by testing each speaker for 72 hours before release.

The protective metal screens just under the grillecloth were heavily modified. No longer is the screen made up of downward-firing slots. Rather, it uses "straight-through" circular perforations. More important, Quad increased the rigidity of the chassis to which the screen attaches. The effect of this change was similar to taking a moving-coil speaker off a shelf and putting it on a good rigid stand.

But in order to preserve Peter Walker's vision, IAG changed little else. Like their predecessors, the '988 and '989 operate as electrostatic doublets or dipoles, radiating as much sound behind as in front. As IAG's website and instruction manual state, the Quad uses "a very light, electrically polarized diaphragm suspended between two sets of concentric annular electrodes. By using a series of concentric anodes, rather than just two plates, the Quads are able to produce a spherical sound-pressure pattern. A series of electrode rings are fed with delay lines, so each ring responds to the change in current a split second after the previous ring, creating movement in the diaphragm identical to a 'ripple in the pond.' The motion of the diaphragm produces a sound-pressure pattern which is an exact replica of that from an ideal source placed some 30cm behind the plane of the loudspeaker diaphragm."

Like other electrostatic loudspeakers, the ESL-989 must be plugged into AC mains to charge the diaphragms. Operating them without plugging them in can damage them. A 6VA, 100mA fuse sits in the AC socket on the speaker's rear panel next to its On/Off switch and power-on LED. The step-up transformers also have fuses, to protect the speaker's internal power supply

from extreme voltage surges. Replacing these fuses involves removing the cover of the power supply.

Each of my vintage ESL-63s has a sliding wood top and a base plinth of black plastic embossed with the company's name. The ESL-989 substitutes for this a plastic top cap engraved with "ESL." The frames and cloth grilles are available in black, blue, or silver.

Setup

Listening was carried out in my lightly damped, rectangular, 5400-cubic-feet living room, which has a 12' semi-cathedral ceiling. The listening room is only 30' above sea level, which is important—the ESL-989's peak SPL output becomes compromised at higher elevations. I placed the Quads 5' from the back wall and 5' from the side walls.

My room has a pair of Quad AC power cables permanently installed, which meant I could quickly switch between the '989s and my reference '63s for comparisons. Unlike my '63s, which need to be plugged into AC for 15 minutes before they have enough charge on their panels, the '989s could play music immediately.

Also unlike the old Quads, the ESL-989's speaker terminals have no provisions for banana plugs or biwiring. When the speaker lugs are unscrewed, they open up a tiny slot in the plastic, into which one can slide a wire. I slipped the point of a Pure Silver Cable's spade lug into this slot, but tightening the terminal's lug didn't secure the spade. However, a few minutes' work with a blade pops out plastic inserts in the center of the binding post, allowing a 4mm plug to be inserted. Quad might replace these posts in future production with heavier-duty connectors of their own design. According to Julian Maddock, "If we do go ahead, then the new terminal should be an easy retrofit for the customer or, more likely, the dealer. This cannot be confirmed at this time, but I'm 99% certain this will take place and be retrofittable."

Final adjustments before audition included comparative nearfield (9') and farfield (16') listening, phase checks, pink-noise listening, and finding the listening position that gave the best soundstaging and imaging. Setting the volume so that the 100Hz output registered 0dB on my RadioShack sound-level mete (C weighting, fast response), the '989's bass response was within ±2dB from 200Hz down to 50Hz. At 41.5Hz, the output rose to +4dB; at 31Hz, it was down by -4dB. By 25Hz, the signal had dropped to -10dB, with no doubling (second-harmonic distortion) apparent.

Playing *Stereophile*'s *Test CD 3* to check channels and phasing, I moved my listening chair into the speakers' nearfield until I could hear the in-phase pink-noise signal as a centrally focused patch. Soundstaging was optimized when speakers and listening chair described an isosceles triangle 9' on its longer sides, measured from the centers of the panels.

The '989's panel extends from 5" to 52" above the floor. This covered an area from below my seated ear height of 38" almost up to my standing ear height, which explains why the '989's tonal balance didn't change when I stood up while playing pink noise. In fact, I heard no major changes in pink-noise tonal balance until I stood *beside* a '989, in the null point of its figure-8 dispersion pattern.

During most of my listening I drove the '989s directly with a Bryston 14B-SST power amplifier. Later I used either Mark Levinson No.334 or Krell FPB 600C two-channel amplifiers. Alternatively, I routed the line-level signal directly to the internal electronic crossover of my Velodyne HGS-18 subwoofer, in which case all signals of 80Hz and higher were redirected to the Levinson No.334.

Paradoxically, the higher-powered amplifiers were less apt to trigger the ESL-989's protection circuit than the Mark Levinson No.334 (125Wpc into 8 ohms). Although the Levinson's power rating is within the 150W maximum specified in the '989's instruction manual, the speakers frequently shut down with some static when I played highly dynamic percussion music that exceeded peaks of 94dB, as measured at my listening chair, 9' away, with the RadioShack meter. (The RS meter under-reads peaks by 10-15dB; so more power is involved.) When overdriven, the '989's triac clamping circuit cuts in, short-circuiting the speaker terminals. This in turn would activate the Krell's protection system, indicated on its front panel by a single blue LED and, of course, no sound. After I switched the '989s off, the Krell's usual three LEDs came back on and music could be played.

Quad sent another set of '989s for me to check that the protection circuit of first pair hadn't been set to be too sensitive. However, the protection system in the second pair was activated at the same volume level with the same recordings. I concluded that moderate sound-level settings were necessary with highly dynamic music.

Was the ESL-989's protection circuit more sensitive than the ESL-63's? It's hard to say, because I always use my *ca* 1989 ESL-63s with the Velodyne HGS-18 subwoofer, which shunts all deep-bass signals away from the Quads, which in turn means that the Levinson No.334 rarely triggers the '63's triac. I did most of my listening with the '989s run full-range, where they proved to be more sensitive to voltage peaks. I had to do some gain-riding to determine the maximum preamplifier setting and volume level.

Sound

Set up near the corners of my large listening room, the Quad ESL-989s generated lots of satisfying bass from Stravinsky's *Firebird Suite* (tracks 3, 5, 7) and *The Rite of Spring* (tracks 21-24), both from Eiji Oue's recording with the Minnesota Orchestra (CD, Reference RR-70CD). The bass whack at the end of track 7 shook the room before it shut off one of the '989s. The speaker's pitch definition and solidity of bass response was surprisingly good, though it was optimal above 30Hz in my room, where it was so solid that I had to check twice to make sure my subwoofer wasn't turned on. "Gnomus," from Jean Guillou's organ transcription of Mussorgsky's *Pictures at an Exhibition* (CD, Dorian DOR-90117), was reproduced with a mix of solid deep-bass notes balanced with delicate highs from the organ's flute and trumpet pipes.

I tried extending the '989's bass response deeper and increasing its output level by routing the line-level signal from the Krell preamp through the Velodyne HGS-18 subwoofer's electronic crossover. This filters all signals below 80Hz to the subwoofer and passes the remaining midrange and treble information to the Quads. After several hours of fussing with cables and matching the 30Hz output of the '989-Velodyne combination to the '989's 200Hz output, I found that the reproduction of organ-pedal chords and bass-drum whacks was tighter, better-defined, and somewhat airier than when the '989s were played full-range. While I was able to play the entire system about 5dB louder, the Quads still shut down on peaks exceeding 98dB. I further tamed the protection system by increasing the Velodyne's crossover frequency from 80Hz to 125Hz, but this fattened up the midbass response. Because of these complications, I much preferred listening to the '989s full-range—which was, after all, the point of creating a larger ESL in the first place.

The '989's midrange response was outstanding within its 94dB peak-volume limit, and characterized by an open, transparent perspective free of congestion or distortion. Sam Tellig's comment about the ESL-988's "world-class resolution" ("Sam's Space," November 2001) came to mind when listening to vocal, clarinet, and piano selections. I began with one of my favorites, Eva Cassidy's super show-stopping "Bridge Over Troubled Water," from *Live at Blues Alley* (CD, Blix Street G2-10046). The '989s rendered Cassidy as a solid, holographic presence

right there in the room. There was an immediacy I hadn't heard before, that "palpability" that ST has referred to. Her vocal range, power, phrasing, pinpoint intonation, effortless control, and big dynamic range were all there. I also was deeply moved by Emmylou Harris' vocal blend on "Calling My Children Home," from *Spyboy* (CD, Eminent EM-25001-2). Her voice sounded transparent, effortless, and ethereal.

Male vocalists were superb through the '989, benefiting from its midrange transparency and immediacy. José Carreras' clear tenor was beguiling, clear, and lilting as never before during the *Kyria* of Ariel Ramirez's *Misa Criolla* (CD, Philips 420 955-2). Harry Connick, Jr.'s "Don't Get Around Much Anymore," from the soundtrack to *When Harry Met Sally...* (CD, Columbia CK 45319), was natural, with no sign of the muddiness and honk I sometimes hear with dynamic loudspeakers. Willie Nelson's voice on "Getting Over You" and "Don't Give Up," from *Across the Borderline* (CD, Columbia CK 52752), was clear, clean, and free of grain. The combination of ESL-989 and Bryston 14B-SST preserved the sweet, sad, delicate harmony of Richard and Linda Thompson's voices singing "Dimming of the Day," from the *Divine Secrets of the Ya-Ya Sisterhood* soundtrack (CD, DMZ/Columbia CK 86534). The song has a sweet, sad, lovely melody; its emotional impact was the result of the singers' talents and the '989s' imaging.

Instrumental timbres were rich and involving. The palpable tonalities of the saxophone and guitar were seductive on the title cut of the L.A. Four's *Going Home* (Japanese CD, Ai 3 2JD 10043). Buddy Miller's mando-guitar accompaniment to Emmylou Harris' "Prayer in Open D" on *Spyboy* had a rich, warm, natural timbre that was thoroughly enjoyable.

The '989 reproduced the brassiness of trumpets with no irritating edginess. Listening to Eiji Oue conduct *The Rite of Spring* on Prof. Keith Johnson's recording, these horns had the raw, hot, passionate brassiness that this piece demands. During the opening of Alison's Krauss's "Sitting in the Window of My Room," from the *Ya-Ya Sisterhood* soundtrack, I could clearly discern the distinct musical characters of the delicate hammered dulcimer, the lap-steel guitar, and the tack piano.

The ESL-989s' imaging was topnotch, conveying a seamless, wall-to-wall soundstage that did not seem to emanate from the speakers themselves. They captured the soundstage depth and width of "Naris," from Patricia Barber's *Blue Café* (CD, Premonition/Blue Note 5 21810 2). Percussion was open, airy, fast, and transparent. José Carreras in *Misa Criolla* was startling, his soft tenor in the foreground, a large, muted drum playing deep and to the left of center stage, backed up by the large, distant chorus. The perspective was spacious and eerie, suggesting the desolation and emptiness of a high South American plateau. Suzanne Vega seemed to materialize between the two ESLs, close enough to touch, as she sang "Tom's Diner," from *Solitude Standing* (CD, A&M CD 5136).

The '989's treble range was effortless—grain-free, smooth, beguiling, and extended. There was no extra brightness, steeliness, or metallic edge. I heard the great stick definition and good, warm undertones characteristic of the 20" Zildjian Custom Ride cast-bronze cymbals played by Brady Blade on *Spyboy*. Chimes heard through the Quad had a magical sheen, as heard on *Prelude and Aztec Dance* from Owen Reed's *Fiesta Mexicana* (Reference RR-38CD). Paul Simon's vocal sibilants on "Trailways Bus," from *Songs from the Capeman* (CD, Warner Bros. 46814-2), didn't offend, but sounded natural and light. Billy Drummond's brushed ride cymbal in the opening of "The Mooche," from the Jerome Harris Quintet's *Rendezvous* (CD, Stereophile STPH013-2), had the right amount of buzz and shimmer.

Some music was just too dynamic to enjoy at high volume levels. If there are no SPL limits, the drum solo in "The Maker," from *Spyboy*, is a mind-blowing experience as rim shots, tom-tom beats, and kick-drum notes explode high above the muttering and conversations of the

crowd. They also activated the triacs of both '989s when I gave in to temptation and increased the volume, which happened often.

Compared to my veteran ESL-63s, the ESL-989s had more bass, more inner detailing, more depth and sense of spatial location, and a much more extended top end. Besides its more prominent bass response, the '989 sounded sweeter and more detailed than the '63, through which applause and vinyl record noise were softer, less apparent. Both Quad designs were less efficient than speakers I've tested recently, and neither could play dynamic music crazy-loud.

Conclusions
Does the Quad ESL-989 correct the criticisms this magazine has made in the past about the ESL-63? In some ways yes, in others no. With its 50% greater driver area, the '989's frequency extremes were significantly better than the ESL-63's. It reached down to 30Hz in my room, and provided satisfying deep-bass pipe-organ notes. However, it still couldn't reach the 20Hz extreme required for a full-range Class A rating in "Recommended Components."

The ESL-989 didn't require Arcici stands to achieve clean upper bass or to avoid the "slight fizzle in the mid-treble" that so annoyed Richard Heyser (footnote 3), as the 5 degrees backtilt and the more rigid frame have reduced the floor bounce that caused these problems. In fact, the ESL-989's treble and upper-midrange responses equaled those of the $46,500/pair Burmester B-99 I reviewed last June, showing that even at $8000/pair the ESL-989 offers strong value for money.

However, the '989 did not play much louder than the '63, and you've got to determine the maximum volume for the electronics and the room if you want to avoid triggering the protection circuit. This might convince some audiophiles to seek an electrostatic speaker with wider power limits, such as MartinLogan's Prodigy ($10,000/pair), whose dynamic woofer permits it to play 10dB louder. As for moving-coil speakers, "companies like B&W, Sonus Faber, Wilson Audio, and Thiel were just getting started when the Quad appeared, and they haven't stood still," noted Sam Tellig in the November 2001 issue.

The Quad ESL-989 is a study in contrasts. It delivers topnotch imaging, smoothness, focus, low distortion, and low listening fatigue. Yet as supplied, its binding posts accept only 22-gauge wire, or cables terminated with pins. Even with better terminals, the '989 won't break any leases, because its protection circuit will shut things down before the party gets going. This may lead some to use the '989 in smaller, less damped rooms, paired with amplifiers in the middle power range, playing classical music and jazz.

Not I. Kicking back and listening to the Quad ESL-989s' warmth, transparency, transient response, and power as they played Keith Johnson's recording of Eugene Gigout's *Grand Chorus in Dialogue*, from *Pomp and Pipes* (CD, Reference RR-58 HDCD), I couldn't think of another loudspeaker I'd rather own.

Footnote 3: The late Richard Heyser was one of the first reviewers to advocate (in the June 1985 *Audio*, Vol.69 No.6, pp.116-120) lifting the Quad ESL-63 off the floor to avoid floor-bounce interference. [*Another was Martin Colloms in the UK.—Ed.]* Heyser was bothered by fuzz on "upper-register transients" that sounded like distortion. Yet the ESL-63 had very low distortion. Using sophisticated FFT and energy-time curve analysis of the 10' listening

condition, Heyser discovered that sound reflected from the floor interfered with the '63's direct sound and exacerbated the audibility of this "fuzz."

Article Continues

Quad ESL-989 electrostatic loudspeaker:
Specifications

Sidebar 1: Specifications

Description: Full-range electrostatic loudspeaker. Power capacity: 100W, 10V RMS, 40V peak maximum signal input. Program peak for undistorted output: 40V. Permitted peak input: 55V. Impedance: 8 ohms nominal, 6.2 ohms minimum. Sensitivity: 86dB/2.83V/m. Frequency response: 30Hz-20kHz, ±6dB.
Dimensions: 52" (1335mm) H by 26" (670mm) W by 12.25" (315mm) D. Weight: 55.7 lbs (25.3kg) net.
Finishes: black, blue, or silver.
Serial numbers of units reviewed: 901969, 901970, 9890003, 9890004.
Price: $7999/pair. Approximate number of dealers: 20.
Manufacturer: Quad, IAG House, Sovereign Court, Ermine Business Park, Huntingdon, Cambridgeshire PE18 6WA, England. Tel: (44) (0)1480-447700. Fax: (44) (0)1480-431767. Web: www.quad-hifi.co.uk. US distributor: IAG America, 15 Walpole Park S., Walpole, MA 02081. Tel: (508) 650-3950. Fax: (508) 650-3905. Web: www.iagamerica.com.

Sidebar 2: Associated Equipment

Analog source: Linn Sondek LP12/Lingo turntable, Ittok tonearm, Spectral moving-coil cartridge.
Digital sources: Krell KRC-28 CD transport, Sony SCD-C555ES multichannel SACD player.
FM tuners: Day-Sequerra FM Reference Classic, Rotel RH-10, Magnum Dynalab MD-102 with Model 205 Sleuth RF amplifier, Fanfare FT-1A.
Preamplification: Krell KCT, Sony TA-P9000ES, Mark Levinson ML-7A with L-2 phono section, Conrad-Johnson Premier 18LS preamplifiers; Duntech MX-10 moving-coil, Margulis phono preamplifiers.
Power amplifiers: Mark Levinson No.334, Krell FPB 600C, Bryston 14B-SST.
Loudspeakers: Quad ESL-63 with Arcici stands, MartinLogan Prodigy, Velodyne HGS-18 subwoofer.
Cables: 75 ohm digital coax: Silver Starlight, Ultralink. Interconnect, balanced: Krell CAST, Bryston, Krell Cogelco Yellow, PSC Pristine R-30 silver-alloy. Single-ended: Randall Research, Mark Levinson HFC (with Camac connectors), Totem Acoustic Sinew, Coincident CST Interface, Ultralink, Performance Audio. Speaker: Mark Levinson HFC 10, PSC Pristine R50 biwire double ribbons, Ultralink Excelsior 6N OFHC, Coincident Speaker Technology CST 1.—**Larry Greenhill**

Sidebar 3: Measurements

Although the different kind of interaction between a panel speaker and the room can make it sound louder than its measured sensitivity would suggest, the Quad ESL-989 is still on the low side, at an estimated 83dB(B)/2.83V/m. Given its strict 100W power handling, this puts quite a low ceiling on its maximum loudness capability, as LG found. Over most of the audioband the Quad is not a difficult load for an amplifier to drive, the impedance (fig.1) remaining above 6 ohms from 32Hz to 3.7kHz and from 18kHz to 32kHz. And though the magnitude drops to

below 4 ohms at 10kHz, the electrical phase angle is close to 0 degrees at the same frequency, which mitigates the drive difficulty. The impedance does drop to a very low value above 50kHz. Fortunately, there will not be any significant musical energy in this region, even with SACD and DVD-A.

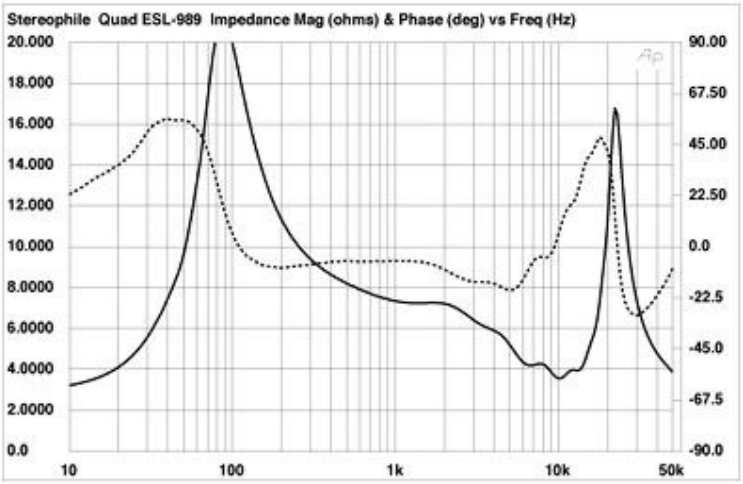

Fig.1 Quad ESL-989, electrical impedance (solid) and phase (dashed). (2 ohms/vertical div.)

Interpreting the measured frequency response of a fairly large panel speaker like the ESL-989 is not straightforward. First, the assumption that the microphone is in the speaker's farfield at my routine 50" distance is no longer true, which means that there will be a slight downward trend with frequency, due to the proximity effect. Second, my usual nearfield measurement of the low frequencies will not show the effect of the dipole cancellation, as the antiphase backwave increasingly wraps around to cancel the speaker's direct output with decreasing frequency. The peaked-up bass shown in fig.2 will therefore tend to be more flat in the farfield than it appears in this graph, with useful extension reaching below 40Hz, as LG found in his auditioning.

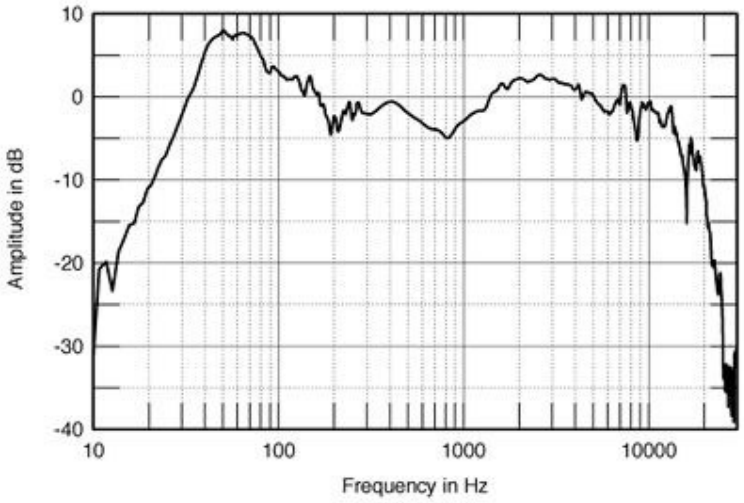

Fig.2 Quad ESL-989, anechoic response on mid-panel axis at 50", averaged across 30 degrees horizontal window and corrected for microphone response, with the nearfield response plotted below 300Hz.

Looking higher in frequency, there is a broad depression in the midrange compared with the low treble, while the high treble is first a little peaky, then rolls off sharply above 15kHz or so. Figs.3 and 4 show the '989's lateral dispersion, fig.4 having the off-axis responses normalized to the response on the mid-panel axis. Below 10kHz or so, the speaker shows classic dipolar dispersion, with a deep null to its sides. The contour lines are evenly spaced with an even characteristic off-axis, which correlates with stable, precise stereo imaging. The picture looks less good above 10kHz, with a dramatic rolloff evident even 5 degrees away from the central axis, and a series of peaks rather than smooth off-axis behavior. In terms of the listener getting a full measure of top-octave energy, the ESL-989 is definitely a one-person design.

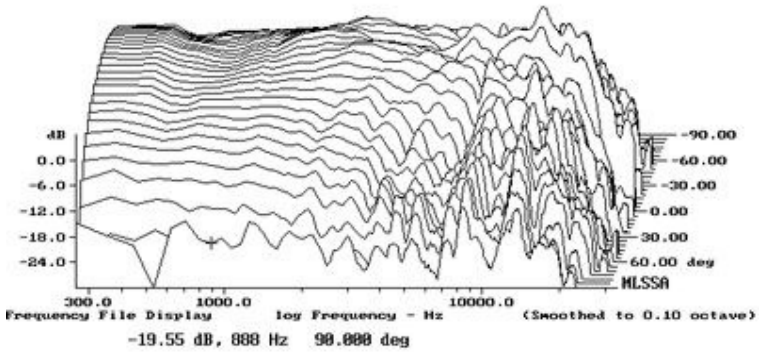

Fig.3 Quad ESL-989, lateral response family at 50", from back to front: responses 90 degrees-5 degrees off-axis, reference response on mid-panel axis, responses 5 degrees-90 degrees off-axis.

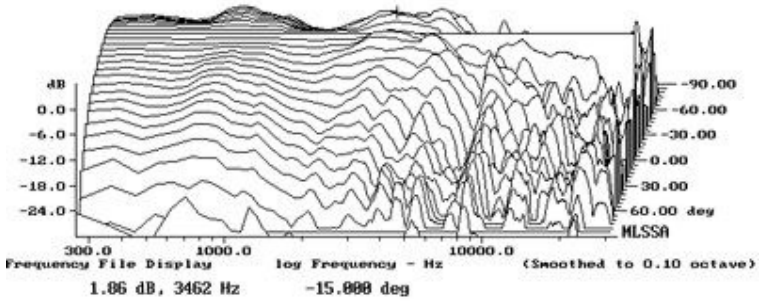

Fig.4 Quad ESL-989, lateral response family at 50", from back to front: differences in response 90 degrees-5 degrees off-axis, reference response on mid-panel axis, differences in response 5 degrees-90 degrees off-axis.

The picture is similar in the vertical plane (fig.5). In order to get full top-octave energy, the listener's ears need to be level with the center of the panels and the speakers toed-in to the listening chair. Even then, the '989 may well sound too mellow in a large room.

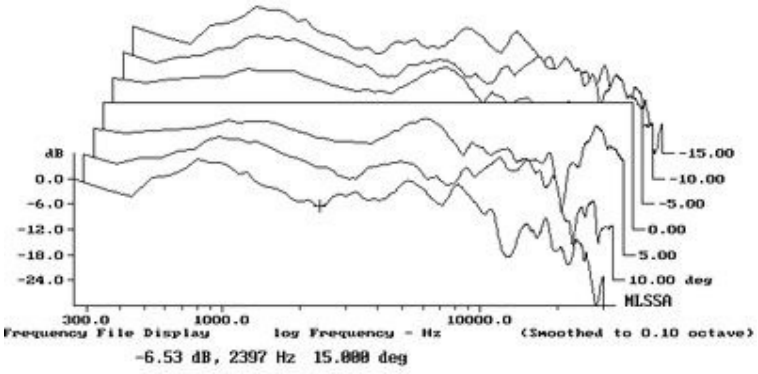

Fig.5 Quad ESL-989, vertical response family at 50", from back to front: differences in response 15 degrees-5 degrees above mid-panel axis, reference response, differences in response 5 degrees-15 degrees below mid-panel axis.

The Quad's impulse response on the mid-panel axis (fig.6) suggests a time-coherent presentation, with some high-frequency ringing evident. The step response (fig.7) has an almost perfect right-triangle shape, disturbed by what must be a reflection of some kind about 300;us after the initial arrival of the step, and again some high-frequency perturbations. These show up as ridges of delayed energy at 8kHz and above in the cumulative spectral-decay plot (fig.8). The initial dieaway of the sound in this graph is fairly clean at lower frequencies but rather hashy at higher ones, perhaps due to the presence of that early reflection. This reflection might well emanate from the dustcover or the grillecloth—many of my most enjoyable musical experiences with Quad's earlier ESL-63 were with these removed, though the speaker then becomes very vulnerable to environmental damage.

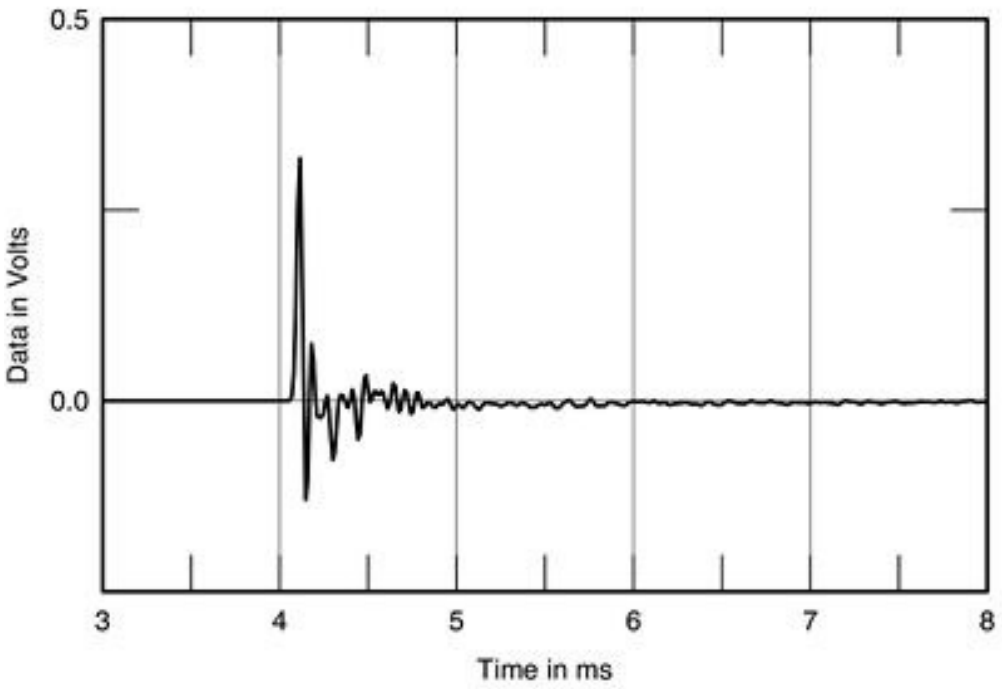

Fig.6 Quad ESL-989, impulse response on mid-panel axis at 50" (5ms time window, 30kHz bandwidth).

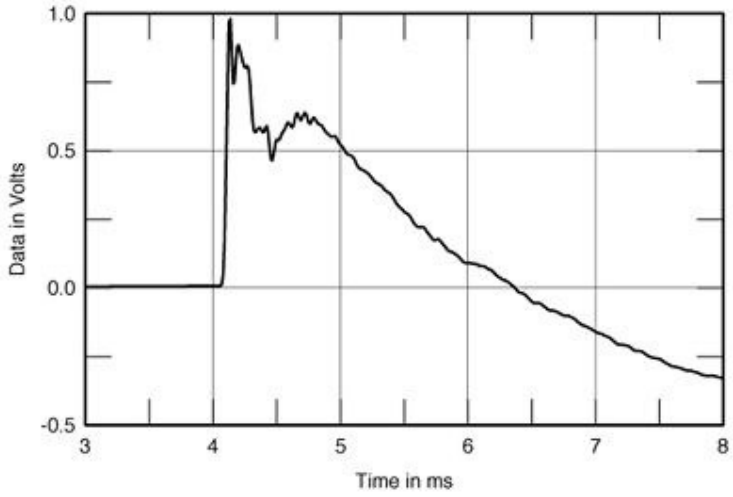

Fig.7 Quad ESL-989, step response on mid-panel axis at 50" (5ms time window, 30kHz bandwidth).

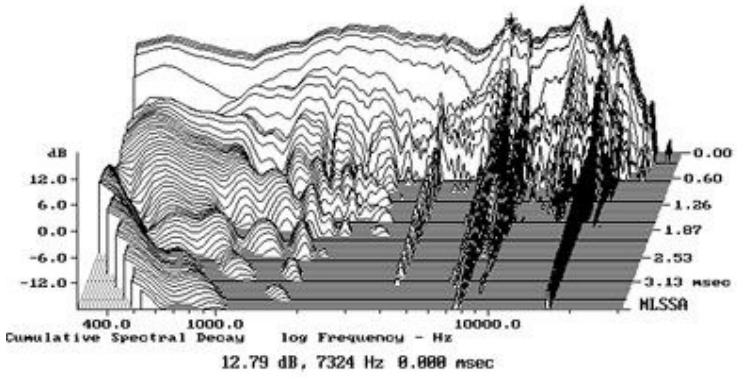

Fig.8 Quad ESL-989, cumulative spectral-decay plot at 50" (0.15ms risetime).

You can find my 13-year-old measurements of the ESL-63 online. Though the measurements were performed with completely different hardware to those for the '989, those graphs are almost identical to and as enigmatic as are these measurements of the ESL-989. All I can say is that the reasons for this speaker's undoubtedly superb sound quality are not readily apparent from its measurements. I hope to explore this subject in more depth in a follow-up.—**John Atkinson**