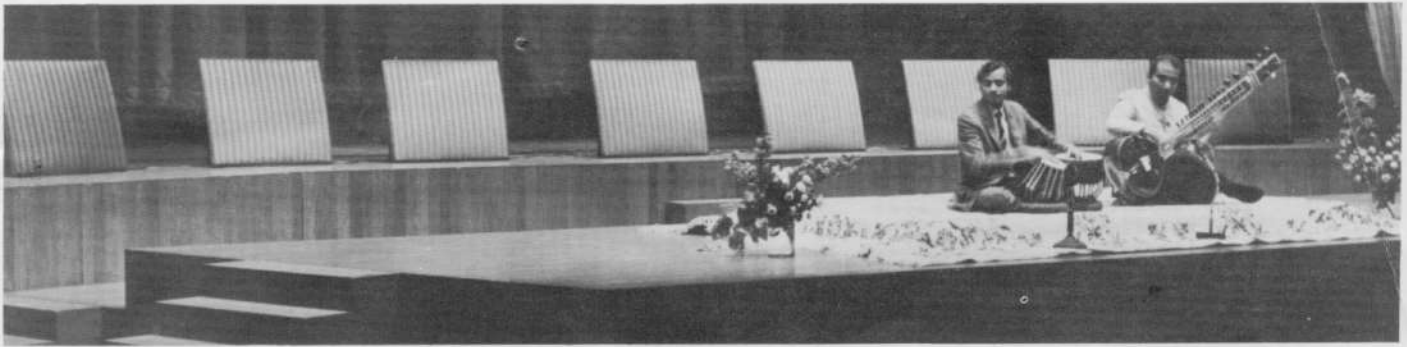


QUAD ELECTROSTATIC LOUDSPEAKER



Eight Quad *ELS* being used for sound reinforcement at the Queen Elizabeth Hall, South Bank.

The purpose of this review is to compare the Quad *ELS* with other high quality speakers now available, and with original sound sources. The *ELS* is basically a large capacitor with outer perforated plates and a central charged diaphragm. The signal is applied in push-pull to the outer plates which deflect the diaphragm.

The electrostatic system has several advantages over moving coil in that the diaphragm is driven over its complete surface, making its movement predictable. An electrostatic diaphragm can also be made light enough to follow the signal even at very high frequencies.

The designer of such a speaker has three main problems to overcome. First, a basic capacitor transducer is non linear as the force on the diaphragm is not proportional to the applied signal voltage. Second, the load presented to an amplifier is essentially capacitive and therefore difficult to match. Thirdly, the manufacture of a practical full range unit at a realistic price is not easy. In the Quad *ELS* the first problem is overcome by a simple but effective device. Instead of applying a constant voltage to the diaphragm, once it is charged the polarising potential is disconnected. The diaphragm now carries a constant charge and experiences a force proportional to the applied signal voltage. In this way it in turn applies a force which acts directly on the air and is a linear function of the applied signal voltage. The second and third problems are solved together by constructing the speaker of strip units progressively increasing in plate spacing and area from the centre line, together with suitable crossover networks. In conventional jargon, the centre strip is the super tweeter, the two on either side of this the tweeters, and the two outside strips the woofers. Since the centre strip is vertical and narrow, its horizontal dispersion is excellent. Unless some measure were taken to improve it, however, the vertical dispersion would be poor. In the Quad *ELS*, the plates are curved to assist the vertical dispersion.

As constructed, the *ELS* is a doublet source - i.e. the diaphragm radiates on both faces (at least at low frequencies). Having no upward or sideways radiation, it cannot directly excite room modes in two out of three room dimensions. In addition, its polar diagram is such that the mean spherical radiation is reduced by a factor of three at all frequencies, further reducing colour due to the listening room by the same factor.

For optimum results this construction requires that the speaker be free standing and placed well into the room. Two *ELS* were used in this way for the listening tests. They were also tried close to a wall and found to give excellent results provided they were not placed parallel to it. My usual test

tape was played and the opinions of the listening panel are given below.

Choir: Clear natural sound, very pleasing.

Bell and percussion: Excellent transients, very clean and bright.

Organ: Full pleasant and natural tone. Having heard the popular fiction that the *ELS* is lacking in bass, we were surprised by the amount of bass produced.

Folk singer: Voice and guitar both very natural.

Dance band: Natural pleasant sound. The leader claimed that the sound was exactly what he heard when conducting.

Piano concerto: The strings had the right sort of 'sheen' and the piano a pleasant singing tone.

Wind quartet: Excellent balance with natural sound from all instruments.

Speech: Opinion was divided here. Some listeners thought male speech a little nasal, others that it was the most natural they had heard. Faults in the recordings were clearly heard.

Full orchestra: Climaxes handled well. A good sound generally with firm bass.

Military band: Listeners claimed that the sound was exactly what they heard when listening to bands in the park. The sound certainly had an 'open air' quality though the recordings were made in a concert hall.

Comparison with other monitor speakers generally showed up the coloration in the other speakers. It was only when compared with the Spondor *BCI* that the 'nasal' quality on speech became apparent.

In all these speakers reviews, any apparent fault in reproduction is checked by a live versus recorded comparison so a male voice was recorded first balancing on the Spondor, listening to the playback on the Spondor and then on the Quad. Then balancing on the Quad and again listening to playback on the two systems. In the first case, the Spondor sounded right and the Quad slightly nasal. In the second case, the Quad sounded right and the Spondor slightly bass heavy. Both these effects were marginal and needed careful listening to detect. On these tests alone it would be impossible to state that one of the speakers was right and the other wrong.

Frequency response curves were taken in free air conditions and show the speaker to have a figure-of-eight polar characteristic at low frequencies and a cardioid at high frequencies. The stereo image was good over quite a wide listening area but within a smaller area the image was even better. This effect has probably given rise to the other popular fallacy that the *ELS* permits only one stereo seat. Over the wider listening area, the image was as good as many other speakers tested

and considerably better than most. As can be expected from the excellent response curves, the speaker is one of the least coloured ever tested.

This, coupled with its property of exciting room resonances less than more conventional speakers, makes it very suitable for use where acoustic treatment of the listening room is not possible. The *ELS* gives a particularly clear and clean sound and even listeners who preferred the 'warmer' sound of the Spondor or Rogers speakers were impressed by this.

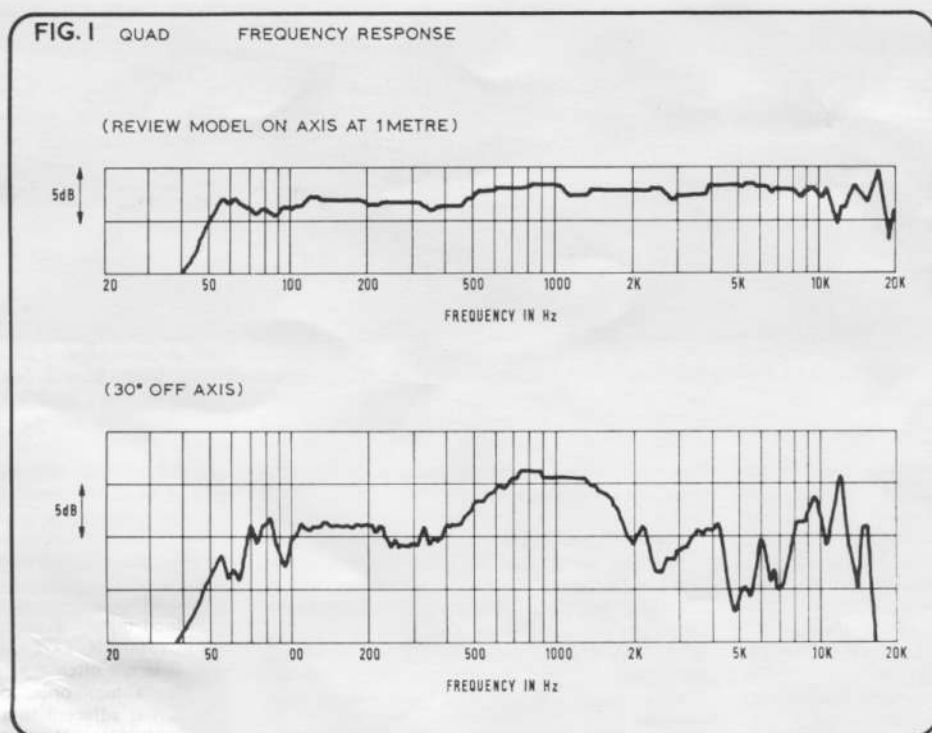
The transient response of the *ELS* is quite exceptional and, as all material tried on the speaker gave such excellent results, we decided to try to stretch it to the limit. A recording was made consisting largely of deep pedal notes on a large organ together with triangle, gong, cymbals, side drum, bass drum, tympani and tubular bells. It thus consisted of frequencies largely below 50 Hz and above 8 kHz with sustained deep bass together with fierce transients, providing a searching test for any set of replay equipment. It was difficult to find a combination of amplifier and speaker that would cope adequately with this tape as it stretched most systems to their limit, and cracked some, but the *ELS* fed by the Quad 303 and 33 functioned well. Listeners to this last recording were struck by the amount of bass the *ELS* would handle and also by the surprisingly high volume of sound they produced. The stereo image was rock steady, all the percussion instruments being accurately pin-pointed.

The flat axial frequency response shows one reason for the pleasant uncoloured sound and the excellent polar diagrams account for the very good stereo image. In sound quality, the *ELS* stands up to the very best monitor speakers available today. The *ELS* handles sufficient power for monitoring classical music at moderate levels and is well suited to this purpose. Comparing the performance and measured curves of older *ELS* units with those submitted for review showed a consistency over five to ten years. Only a careful check of serial numbers enabled the units to be accurately distinguished. It seems that every *ELS* is like every other, almost regardless of age. Barring excessive overloading, it seems that the units are outstandingly reliable. Many of them have given trouble free performance over a large number of years.

A device like this which is reliable and consistent from sample to sample is too rarely met. It is still the standard by which others can be judged and is highly recommended to all who want to hear clean, uncoloured and undistorted sound.

JOHN SHUTTLEWORTH

QUAD ELECTROSTATIC LOUDSPEAKER



AT A GLANCE: The Quad is a full-range electrostatic loudspeaker, covering from slightly below 50 cps to well above the limits of audibility. Having no heavy cone or voice coil, it possesses very low mass and correspondingly fine transient response.

The Quad has several limitations of a technical, aesthetic, and economic nature that may limit its general acceptance. In our opinion, however, it represents, by a wide margin, the closest approach to truly natural reproduction of sound in the home that we have yet heard.

Unlike other types of speakers, the Quad should not be installed closer than two feet to a wall, or three feet to a corner. The bass performance is degraded by such improper positioning. As may be imagined, this large and uniquely designed speaker assumes considerable prominence when it is standing in the clear, undisguised as a piece of furniture or anything else but what it is - a radiator of sound. For this reason, those interested in décor more than fine sound may regard it as not readily adaptable to the usual living room. In stereo pairs this visual problem may be further accentuated.

The instruction booklet accompanying the Quad is quite specific in limiting its application to rooms of less than 5,000 cubic feet. Our experience suggests that it will perform to best advantage in rooms considerably smaller than that, and in fact will do a fine job in a room too small to accommodate any conventional speaker. Unlike cone radiators, the electrostatic speaker is literally a window opening on the concert hall, and one can listen to it in comfort at a two-foot distance as well as at twenty feet or more.

In using a Quad some modification of listening habits will probably be necessary for people accustomed to conventional speakers. This speaker should not, and cannot, be subjected to the room shattering levels beloved by some audiophiles.

To do so is to invite breakup and distortion well below the level where the windows rattle. The Quad should be listened to at *natural* levels. When it is heard somewhat above normal level, the effect is that of being transported towards the orchestra; softer levels move the listener to the rear of the auditorium. This effect is very real, and we have not experienced it to anything like this degree in conventional speaker systems.

The Quad sounds quite different from any other speaker we have heard. It is crisp and taut at all frequencies, including the middles and bass. There is not a trace of the boom or boxiness present to some degree in most conventional speakers. The separation of instruments in the orchestra, even in monophonic reproduction, is strikingly superior to anything we have previously heard. Any doubts as to its bass performance were dispelled when records having large bass drum sounds were played. A comparison against the best cone speakers we could muster showed that the cone speakers had much more apparent bass below 50 cps. A thump from the bass drum shook the room in a most satisfying manner. Switching to the Quad eliminated the strong, room-filled bass which we had come to equate with the best in high-fidelity sound. The drum sounded just like a large bass drum - no more, and no less. The absence of bass hangover and excitation of room resonances probably had a lot to do with this naturalness. Others who heard our Quad were equally impressed in its favor.

Having established by listening that this was a superior speaker we were curious to see what our measurements would show. Frequency response, taken out-of-doors, follows the contour of our microphone calibration rather closely. A line drawn through the centers of the many small peaks and dips in the response lies within 5 db of the microphone response from 60 to 15,000 cps. More important is the absence of any of the huge holes or peaks often found on lesser speakers.

The low frequency radiation shows a slow, smooth decline starting at a few hundred cycles, but without the sudden change of slope characteristic of box speakers having a system resonance.

Bass frequency distortion is not outstandingly low between 50 and 80 cps, and rises sharply below 50 cps, which we consider to be the effective lower limit of the speaker's response. At moderate levels and with some increase in distortion, a useful out-put can be obtained at 45 cps. Obviously, this speaker will not reproduce the lower pedal notes of the pipe organ as well as some conventional systems may, but this is probably the only type of music with which it shows any limitation. On bass transients, such as those produced by drums or keyboard instruments, the loss of extremely low frequencies is more than compensated for by the lack of resonance and hangover.

The polar response (not plotted) is a smooth cardioid pattern, down about 10 db at 45 degrees off center axis. The Quad booklet shows a 70-degree effective angle in the horizontal plane, and our measurements confirm this. We measured it at 7 kc, but polar response of the Quad changes relatively little with frequency. This no doubt also contributes to its listening quality.

Tone burst patterns revealed one frequency at which ringing occurred (2.85 kc). At all other frequencies, however, the tone burst pictures were virtually ideal.

The Quad should be listened to carefully, and preferably in one's own home, before buying. Don't be surprised if the result is a feeling of dissatisfaction with your present speaker system.