

## Quad Electrostatic Loudspeaker

### MANUFACTURERS' SPECIFICATION

Full range electrostatic loudspeaker with five units.

**Frequency range:** 45 Hz to 18 kHz.

**Attenuation outside band:** Asymptotic to 18 dB per octave.

**Total integrated radiation at maximum output:** Equivalent to 95 phons in rooms of up to 170m with average reverberation.

**Dispersion:** 70° horizontal, 15° vertical.

**Impedance:** 30 to 15 ohms, 40 Hz to 8 kHz, falling above 8 kHz.

**Recommended amplifier:** Quad 303.

**Power supply:** 200 to 250 to 100 to 120V, 50 to 60 Hz.

**Weight:** 16 kg.

**Dimensions:** 880 x 788 x 280 mm.

**Price:** £54 (trade), £72 (retail).

**Manufacturer:** Acoustical Manufacturing Company Ltd, Huntingdon.

IT was suggested in the survey of 'monitor' loudspeakers (May 1971) that the term was virtually meaningless and covered speakers ranging from the good but quiet to the bad but loud. Obviously the choice of a speaker for monitoring purposes will depend on many factors. For anyone wishing to hear what is actually being recorded, the choice is limited to what could be called the good but quiet few. As the Quad *ELS* has been used for many years in monitoring and quality-control rooms, it might be in this class.

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 manufac-

ture 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.

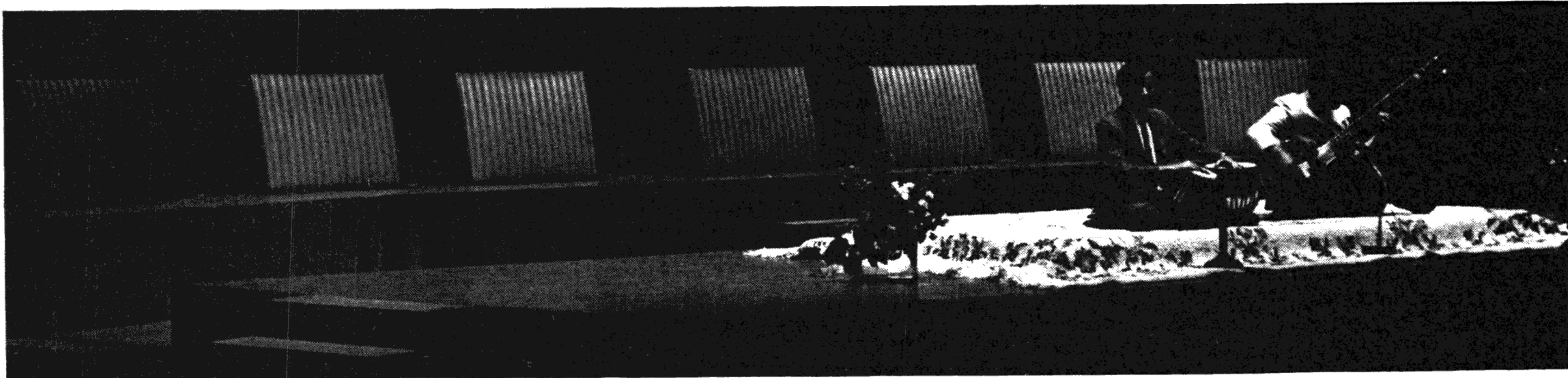
Comparison with other monitor speakers generally showed up the coloration in the other speakers. It was only when compared with the Spondor *BCI* that the 'nasal' quality on speech became apparent.

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.

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





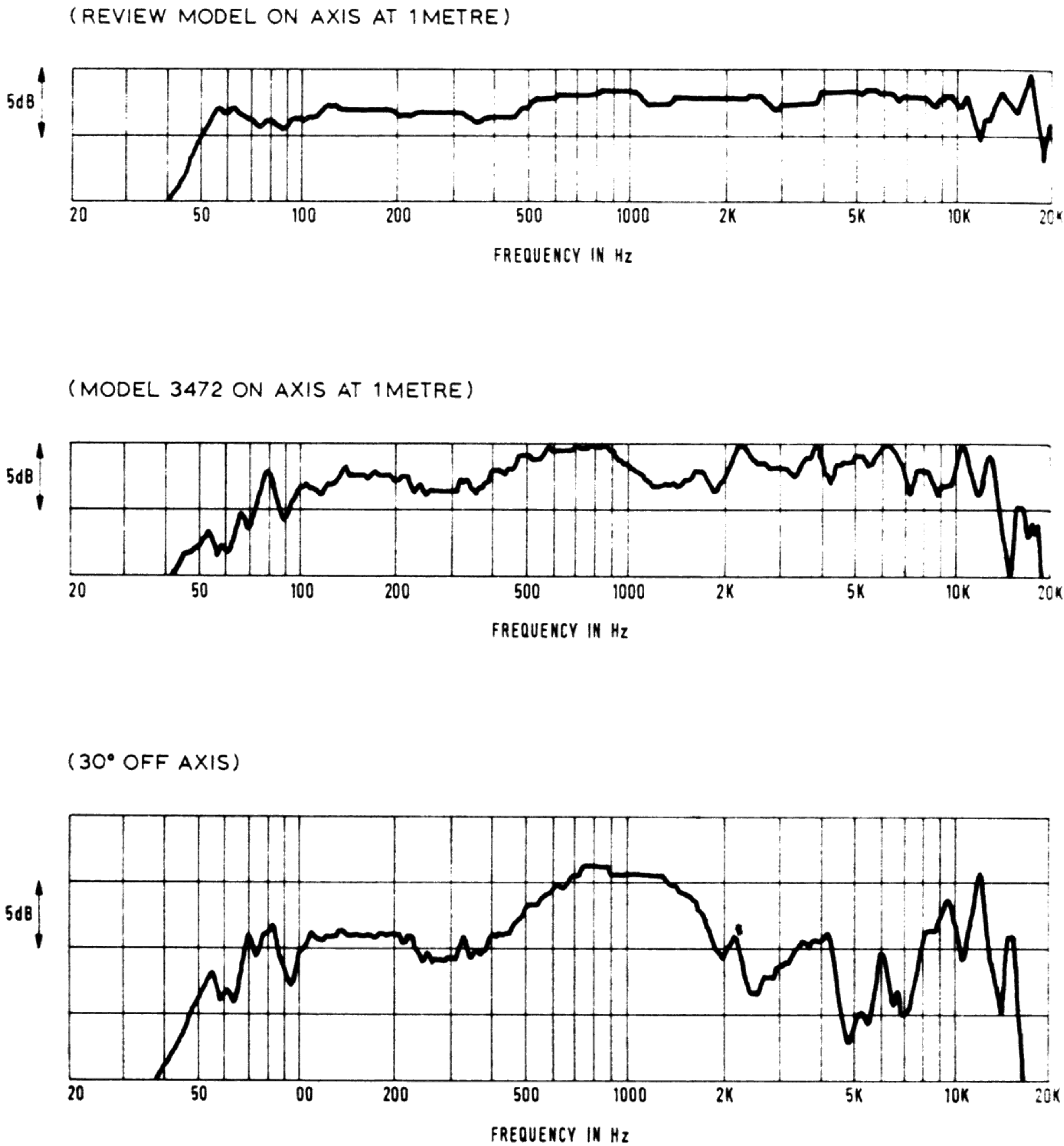
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The transient response of the *ELS* is quite exceptional and, as all material tried on the speaker gave such excellent results, we decided to try to stretch it to the limit. A recording was made consisting largely of deep pedal notes on a large organ 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 pinpointed.

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 but does not handle enough power for use at the high levels required in some studios. The size of the *ELS*, together with the fact it should stand reasonably clear of walls, make it unsuitable for use in very small control rooms where its power handling might otherwise be adequate. Studios interested in what is actually being recorded might consider having a quality control room fitted with *ELS* where their more discerning customers and engineers could listen. The *ELS* handles sufficient power for monitoring classical music at moderate levels and is well suited to this purpose. Some studios have been using them in this way for quite a time now, often in conjunction with a woofer to satisfy people wanting to hear thumping bass. When doing serious balancing, the response curves show it is clearly advisable to switch the woofers off and balance on the *ELS* alone.

Comparing the performance and measured

FIG. 1 QUAD FREQUENCY RESPONSE



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**

FIG. 2 QUAD IMPEDANCE

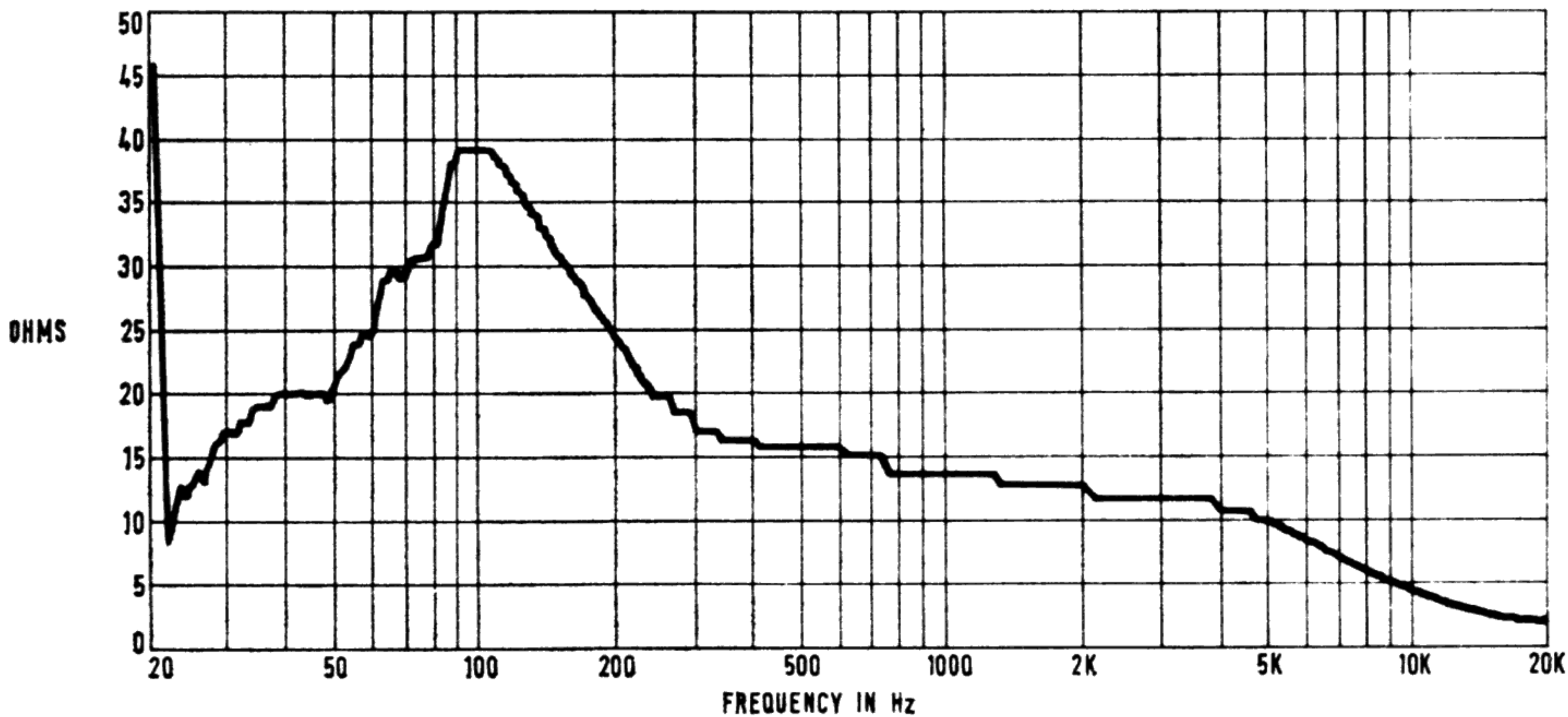


FIG. 3 EQUIVALENT CIRCUIT OF QUAD

