= Quad Electrostatic Loudspeaker =

The Quad Electrostatic Loudspeaker (ESL) is the world 's first production full @-@ range electrostatic loudspeaker , launched in 1957 by Quad Electroacoustics , then known as the Acoustical Manufacturing Co . Ltd . The speaker is shaped somewhat like a home electric radiator curved slightly on the vertical axis . They are widely admired for their clarity and precision , but known to be difficult speakers to run and maintain .

The original ESL , in production between 1957 and 1985 , has been hailed in Sound & Vision as one of the most important speakers of the 20th century . It was succeeded in 1981 by the ESL @-@ 63 , which remained in production until 1999 . As of 2013 , Quad maintains four electrostatic speakers in its range .

= = History = =

Acoustical Manufacturing Company had launched a ribbon @-@ hybrid , horn @-@ loaded " Corner Ribbon Loudspeaker " in 1949 , but this was not commercially successful . The electrostatics were designed by David Williamson , and the company 's founder , Peter Walker , from a principle elaborated by Edward W. Kellogg for General Electric that was granted a patent in 1934 . However , more immediately , a book published in the US in 1954 extolling the scientific merits of the electrostatic [ESL] transducer inspired Walker to develop an electrostatic loudspeaker of his own ; this was technologically enabled by the Mylar film developed by Dupont that came to market in 1949 . Walker demonstrated a prototype electrostatic panel speaker (with exceptional clarity in the midrange) , and a full @-@ frequency infinite baffle speaker (with ample bass response) at the British Sound Recording Association Annual Exhibition in May 1955 . After more research , the large panel speaker with better response over the whole frequency range was demonstrated to the Physical Society in March 1956 . The ESL entered commercial production in 1957 , and was discontinued only in 1985 .

Development of its successor began in 1963 , giving rise to the product name " ESL @-@ 63 " , launched in 1981 . It attempted to address both the deficiency in bass response of the original ESL and its extreme directionality at high frequencies . The latter goal is achieved by splitting the stators into eight concentric rings , each fed with a slight time delay compared to the ring immediately inwards , thereby attempting to emulate a point source . The last ESL @-@ 63 left the factory in 1999 , when it was superseded by the ESL @-@ 988 and ESL @-@ 989 .

= = Speaker = =

Stereophile described the speaker as having been designed for " serious @-@ music (call that ' classical ') listeners who play records more for musical enjoyment than for the sound " . Quad launched the speaker in 1957 , priced at £ 52 , believing that an audio system should be able to extract everything of value that is on a recording , while de @-@ emphasising the irritations of mediocre sound recordings . It consists of a minimalistic , slightly curved , flat panel . The " Quad Electrostatic Loudspeaker " or " ESL " , as the designers intended to call it , is variously referred to as the Quad 57 and the Quad 55 . Its descendants are still often simply referred to as Quad Electrostatic Loudspeaker as part of the legacy . Walker called the concept behind the ESL @-@ 63 FRED , being the acronym for " Full @-@ Range Electrostatic Dipole " .

= = = Design = = =

An electrostatic speaker has only a frame to support the charged diaphragm . It uses ultra @-@ thin stretched Mylar (Biaxially @-@ oriented polyethylene terephthalate) film as the main component of its drive units . There are two perforated plates with a potential difference of up to 10 @,@ 000 volts , between which a very thin film , coated with a mildly electrically conductive substance , is sandwiched . Sound is produced when the audio signal ? amplified by a step @-@ up

transformer ? sets the film diaphragm into motion . The different charge between the two plates allows the diaphragm to be alternately attracted and repelled by each plate . In the original QUAD , two bass panels flank one treble panel to provide full range sound .

Its treble panel diaphragm is further subdivided into midrange and tweeter sections , achieved by clamping it on each side of its centre . Both midrange and tweeter sections are driven separately , and the entire treble unit operates at substantially lower voltages ? operating voltages are said to be 6000V for the bass and 1500V for the treble . The speaker needs to be plugged into the mains and must be charged prior to use . This is because the diaphragm operates in a " constant charge " mode , and it takes time for the charge to build up . In practice , the speaker is usable after charging for less than half a minute , but the sound gradually improves as the charge builds up . Best performance is achieved when the speaker has charged fully , which can take up to an hour . The electricity is only to charge the diaphragm , so consumption is negligible .

The electrostatic design does away with two major weaknesses of boxed speakers : enclosure colourations and signal degradation due to the crossover . The crossover in the ESL consists merely of resistors which work with the inherent capacitance of the speaker elements to obtain a first @-@ order response . Because it is bipolar , both sides of the elements are not enclosed , but radiate directly into the air . Thus , colourations due to crossover components and box @-@ induced reflections are minimised .

Fast transient response and low distortion are both characteristic of electrostatics . The driver , being only 0 @.@ 00137 @-@ inch thick and weighing only 3 mg , is thus capable of stopping and starting seemingly instantaneously with no damping necessary to the drive units . However , the design also limits bandwidth to between 40 Hz and 10 kHz . Kohli of TNT noted that upper register starts to taper above 10 kHz and then falls off severely beyond 13 kHz , and is 15 @-@ 20dB down at 20 kHz . The speaker 's design makes them extremely directional , and the general practice is to toe in the speakers to point directly to the listener . Although a slight deviation did not seem to make a difference , it is in practice not possible for more than one person to enjoy a reasonably balanced sound stage with the ESL .

Contrary to the flat appearance of the loudspeaker , all three panels are slightly curved along the vertical axis to improve quality . The panels themselves are flat , but obtain their curvature by being slightly bent to a curved backing . With the bipolar nature of the speaker emitting sound from both front and back surfaces as it does , the application of a felt sheet to the rear of the panels damps and absorbs high frequencies radiating from the back . A crossover network , set at 500 Hz , remains necessary to adjust for back @-@ to @-@ front interference causing loss in output at low frequencies . In addition , the speaker should stand in free space to achieve optimum sound . The instructions book contains advice against placement of the speaker in corners or positions close to or parallel with walls , and further explains that a corner placement will adversely affect bass response and be detrimental to the midrange because of standing waves generated .

Its impedance is 1 @.@ 8 ohms at 20 kHz , to over 60 ohms at 150 Hz , and its load is highly capacitive . It does not consume large amounts of power so much as it feeds it back to the amplifier in opposition at some points during each cycle . This is very demanding on amplifiers ' stability .

Although it is designed to be used with the QUAD II , 303 , or 405 power amplifiers with limiters , a power amplifier capable of delivering 15 watts per channel suffices ? excessive voltage input is known to cause arcing within the speaker panels . In fact , the instructions book states that any properly @-@ regulated amplifier delivering no more than 33V is unlikely to cause damage to the speaker . Electrostatic speakers are more accurately rated by voltage , not power . In the ESL 's case , at the rated nominal impedance of 16 ohms , the limit of 33 volts would be reached when the amplifier 's power output reaches 15 watts (if it were driving a conventional load) .

The most common failure modes were loss of sensitivity caused by dust infiltrating the speaker panels , and internal arcing of the panels caused by excessive power to the step @-@ up transformer ; use at high altitudes may also cause the same effect . Also , because of its novel electrical characteristics , the speaker could cause some amplifiers to become unstable and could result in damage to either or both . Late in the speaker 's life , many owners found that the highly @-@ stable 15 @-@ watt Naim NAIT launched in 1983 worked well with the ESL .

= = = Construction = = =

The ESL measures 31 by 34 @.@ 5 by 10 @.@ 5 inches (79 cm × 88 cm × 27 cm) and weighs 35 pounds (16 kg) . In terms of appearance , the original ESL has an expanded metal grille , and three little wooden feet . The earlier version has golden @-@ bronze grilles and classic teak end caps . Later production versions have black grilles , and end caps have a rosewood finish ; other minor variants exist . The speaker 's electronics components , consisting mainly of an audio transformer , EHT power supply , crossover and mains transformer , are fixed to the base of the cabinet .

The original ESL @-@ 57 suffered from reliability issues , frequently caused by use of inappropriate amplification or being driven too hard . In the main , the diaphragm would arc from being overdriven , or the audio transformer would seize up from being exposed to excessive voltages .

The design 's lack of structural integrity is seen as another significant weakness of the Quad ESL @-@ 63 since its inception , and lived on in its various successors . Other shortcomings include very limited sound pressure levels , meaning that it won 't play loud , and its bass response was lacking . In addition , one reviewer experienced problems with shut @-@ downs playing music with high intensity bass drums .

= = = Product revisions = = =

Quad have now brought out five generations of the classic electrostatic design . Originally designed for monaural sound in a domestic context , the popularisation of stereophonic sound prompted the manufacturer to modify the electrostatic panels to improve their stereo dispersion . These speakers featured larger panels and a revolutionary stator design , made up of eight concentric rings fed from the centre outwards through analogue delay lines , so that the audio signal gives the illusion of radiating from a point source one foot behind the panel .

Quad addressed the limitations of the original design to some degree with the ESL @-@ 63 . Development of the newer design was initiated in 1963 and the product was released at the CES of 1981 . Because of a changed orientation , the ESL @-@ 63 measures 36 by 26 by 6 inches (91 cm × 66 cm × 15 cm) , the speaker seemed smaller than before . New " triac clamping " protection circuit was incorporated to prevent arcing . Another " crowbar action " protection circuit could detect the high @-@ frequency noise that accompanies the ionisation of air when the speaker arcs , and shuts down the power when that occurs . Power rating is increased to 100W . Furthermore , because the panels in the original ESL were prone to attracting dust , ESL @-@ 63 was made dust @-@ proof .

In 1989 , a new marketing position was needed for the US market . As the rising Pound Sterling made the product much more expensive for US customers , it was decided to improve the specification of the ESL @-@ 63 and target the $ 4 @,@ 000 price point with a " US Monitor " version . It was modelled on the more rugged " professional " model that possessed metal grilles and a steel frame (instead of aluminium) which had been created for the recording division of Philips .

= = = Reception = = =

Its launch was eagerly awaited : even before it was launched , several articles were written about it in Wireless World in 1955 ; it appeared on the cover of the 1956 Hi @-@ Fi Yearbook . Generally well @-@ received from its launch , the speaker was dubbed " Walker 's Wonder " very early on . The loudspeaker was used as studio monitors for controlling the sound quality of broadcasts . Such professional users included Philips and the BBC .

The original ESL , in production between 1957 and 1985 , sold 54 @,@ 000 pairs during its life . Despite some major weaknesses , it is universally hailed as one of the most important speakers of the 20th century . Home Theater Review said it was " the most cherished hi @-@ fi product ever " , and that Walker had been elevated to god @-@ like status in the audio world . What Hi @-@ Fi

notes the fanatical loyalty from owners of the speaker or fascination from people who yearn to own them . Demand for second @-@ hand versions of the original 1957 ESLs or the later ESL63s remains buoyant many years after their being discontinued .

Demand from customers resulted in manufacture of the " ESL @-@ 57 " continuing in the UK until 1995 . Quad 's machine tooling for their manufacture was then bought by QUAD 's representative in Germany , QUAD Musikwiedergabe who continue to manufacture complete speakers and spare parts , and overhaul customers ' speakers . There are small companies all around the world dedicated to servicing this speaker .

Commenting on the ESL @-@ 63 , J. Gordon Holt of Stereophile considered it was a major failure of the speaker for it to shut down during orchestral climaxes . He said that " regardless of the sonic merits it possesses [the speaker] simply did not have the power @-@ handling capability " for more recent program material on CD .

= = = = Signature sound = = = =

The ESL is renowned for sonic transparency and very low distortion . Its midrange performance is usually described in superlative terms , common to other electrostatic designs . Its sound is tonally neutral , exceptionally spacious , and transient response very fast . A properly configured stereo pair would generate a very small ' sweet spot ' where the sound stage snaps into focus . This led to criticisms of the speaker 's directionality which in practice was rarely a problem and had the benefit of reducing the effects of room resonances .

The experience of listening to the ELS is often described as non @-@ fatiguing or listenable . Sam Tellig wrote in Stereophile in June 1989 of the neutral sound emanating from the ESL @-@ 63 : " There is no discontinuity from bass to midrange to treble ? it 's all so natural . Transient response is excellent . There are no boxy colorations because there are no boxes " . Its superior sonic characteristics were offset by its moderate power handling , and the need for a relatively large space in which to " breathe " . Its usable frequency response is from 40 Hz to well past 20 kHz , and is occasionally criticised for being bass light . Its moderate bass extension is considered adequate for classical music fans , although later incarnations are said to deliver better bass performance .