EMINENT TECHNOLOGY LFT-3

LINEAR FIELD TRANSDUCER LOUDSPEAKER

ATTENTION:

Extremely strong magnetic fields are present at and around this loudspeaker. Devices that are adversely affected by high levels of magnetic flux, such as television sets, should be kept at least three feet away from each speaker. Also keep this in mind when any ferrous objects are brought close to the speakers. Hold steel tools securely when setting up and adjusting the LFT-3, to prevent a hex key or screwdriver from slipping from your hand and damaging the mylar diaphram.

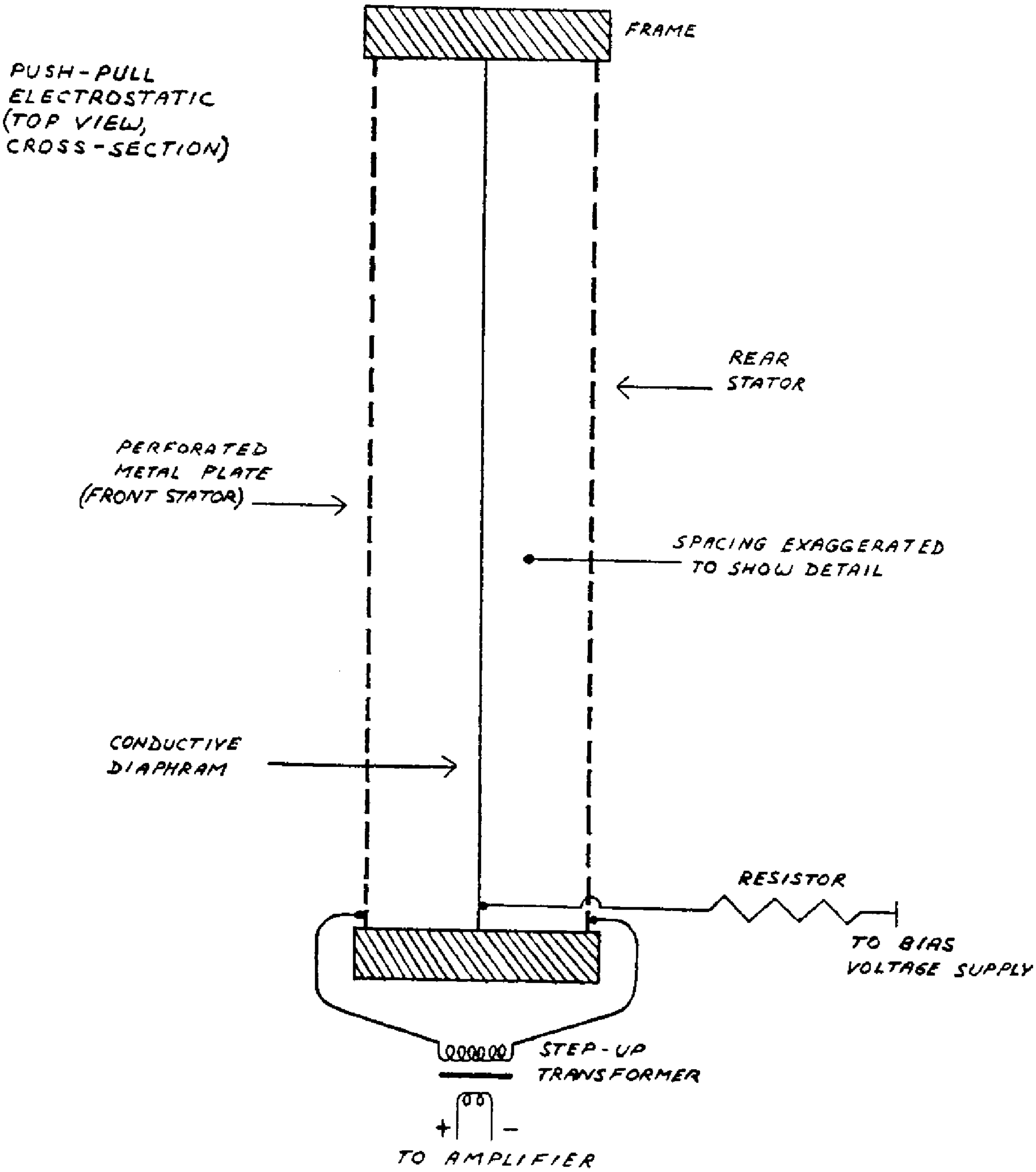
TECHNICAL DESCRIPTION

The Eminent Technology Linear Field Transducer is a full-range, push-pull, dynamic planar loudspeaker. In a sense, it is the magnetic equivalent of a push-pull electrostatic speaker, differing in that it requires no step-up transformer or bias voltage, and that the audio signal is applied directly to its diaphram.

To fully understand the strengths of the LFT design, one must first consider the design and operation of this speaker's three most notable antecedents: the push-pull electrostatic loudspeaker (ESL); the traditional, single-ended planar magnetic loudspeaker; and the ribbon loudspeaker.

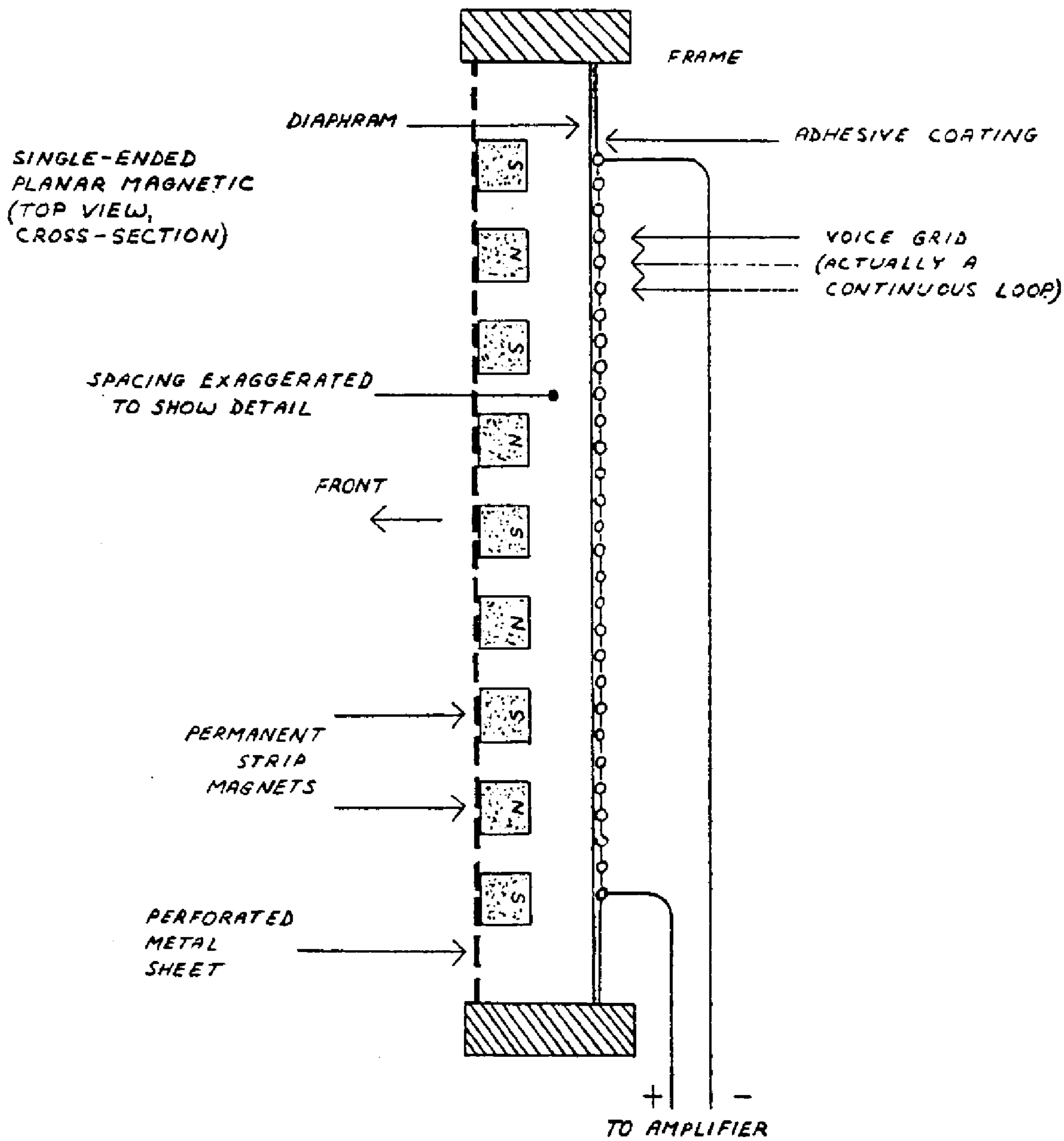
The electrostatic starts with a very thin (half-mil or less) diaphram made of Mylar or a similar material, to which a light coating of a mildly conductive substance such as graphite has been applied. This diaphram is suspended in a rigid frame and sandwiched between two stationary conductive grids (usually perforated metal plates) called <u>stators</u>.

A DC charge of high voltage (in the thousands of volts) but very low current, known as the <u>bias voltage</u>, is applied to the conductive diaphram and kept constant. A step-up transformer is introduced to increase the useable voltage of the amplifier's output (while simultaneously decreasing current), and the two ends of the transformer's output coil are connected to the two stators.



As the amplifier produces a continuously varying AC voltage (the amplified music signal), the charge on the two stators will also continuously change in synchronization with the music; and since the two stators are connected to the two different ends of the transformer's output, one stator will take on a predominantly negative charge at the same time and to the same extent that the other stator takes on a predominantly positive charge. The constant-charge diaphram will thus undergo a continuously changing state of attraction to and repulsion from the two stators as their polarization changes, and it is this motion that excites the air to the front and rear of the speaker and produces sound.

The traditional planar magnetic also starts with a thin Mylar diaphram, one side of which is coated with adhesive and fitted with an aluminum wire voice grid (analogous to the voice coil of a conventional cone driver). The diaphram is held taut in a metal frame. On the front of this frame is a large sheet of perforated metal, to which a row of vertically aligned strip magnets has been fastened.

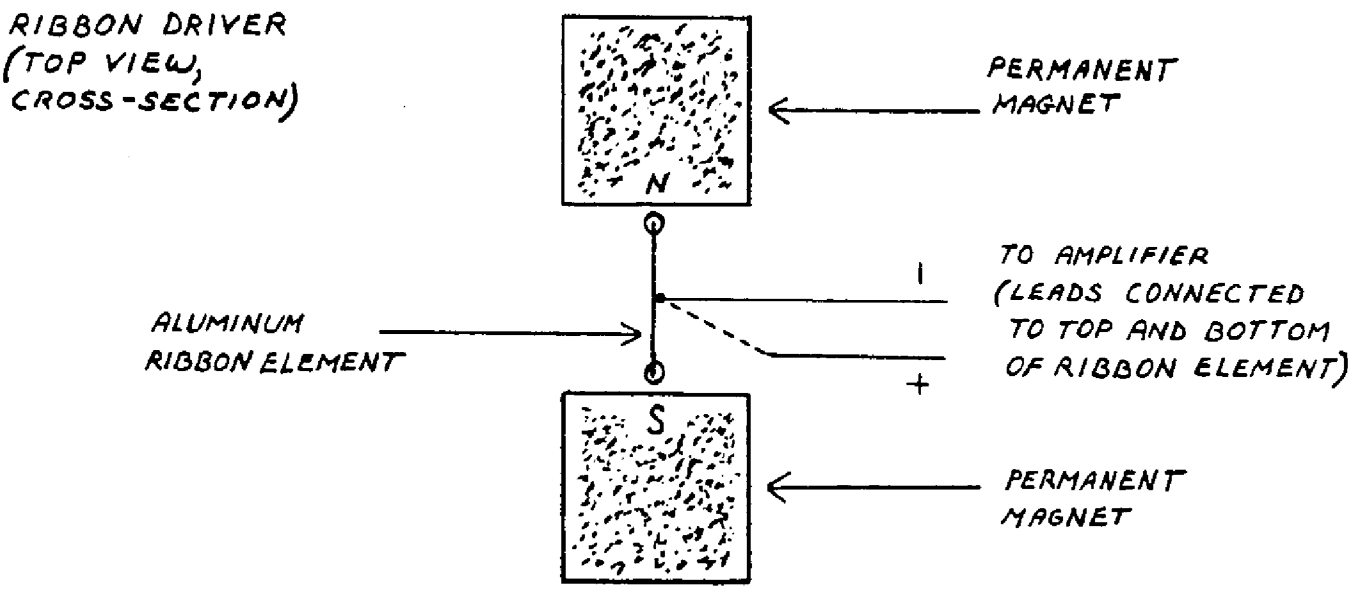


From there, the operation of a single-ended planar magnetic speaker is remarkably similar to that of a conventional cone driver: The amplifier's output is sent directly through the voice grid, and, because it is suspended within a stationary magnetic field, the grid moves back and forth within that field in synchronization with the AC voltage that is the amplified music signal. Since the voice grid is permanently fastened to a taut diaphram, the diaphram also moves in synchronization with the music signal, exciting the air and producing sound.

The third and final antecedent to consider is the ribbon: a distinctly different sort of transducer, but one that is similar (in principle, at least) to the single-ended planar magnetic. The ribbon's primary distinction is that its "diaphram" and "voice element" are one and the same.

A ribbon driver is based on a long, narrow strip of conductive material; in practice, thus far, all true ribbons have used a strip of very thin corrugated aluminum for this purpose. The two ends of this strip are electrically connected to the amplifier's output, and are physically anchored such that the strip is suspended within a stationary magnetic field--with said magnets positioned at the edges of the strip.

The operating principle is straightforward from there: The amplifier's output passes directly through the aluminum strip--which, because it is suspended within a permanent magnetic field, moves back and forth in synchronization with the signal, producing sound.



Not surprisingly, each of the approaches described above has its own unique set of pros and cons. The electrostatic, because its diaphram is so thin and light, offers exceptionally good transient response and reproduction of subtle, low-level musical detail. And because it is a true push-pull device (i.e., its diaphram is, by design, driven from both the front and the rear), the ESL operates in a linear fashion. Typically, gross distortion results only when the driving amplifier clips into the speaker, or when, in an attempt to play the speaker louder than its design allows, its step-up transformer reaches a point of saturation. On the negative side of the ledger, the ESL does require passing the amplified music signal through a transformer, which can introduce its own colorations and non-linearities. Also, some ESLs are prone to a condition known as arcing: Under the condition of stress induced by playing an ESL loudly, it is not uncommon for an electrical spark to jump between one stator and the diaphram (a phenomenon exactly analogous to lightning), burning a minute hole in the diaphram and, over time, ruining it.

As for the planar magnetic, its strengths are similar to those of the ESL--although the addition of several feet of wire and a coat of adhesive make for a somewhat more massive diaphram, limiting this design's transient capabilities by comparison. But the planar magnetic requires no step-up transformer or bias voltage supply, and it has the added benefit of being an extremely manageable load for most amplifiers. However, the most significant drawback of the traditional planar magnetic is that it is a single-ended (as opposed to push-pull) device: As the diaphram's physical excursion increases, the voice grid moves further away from its optimal location within the permanent magnetic field (at least in one direction). Thus, at the very instant when this speaker is called upon to reproduce large-amplitude waveforms, it is least able to do so without distortion.

In many ways, a ribbon driver can be an excellent performer: The moving element (the "ribbon" itself) is extremely light, allowing good "speed" and transient performance as well as freedom from coloration. And there is no significant physical structure on either of the two sides of the ribbon's radiating pattern, thus preventing the dispersion problems that can plague single-ended planar magnetics. The ribbon's main problem is not one of performance but of application: It can not be used as a reproducer of low frequencies. To create a moving element large enough to generate frequencies lower than a few hundred Hz would mean moving the opposing magnet poles so far apart that they would no longer exert a sufficient magnetic field over the entire area of the ribbon; the driver simply would not work. Also, when a ribbon is operated at frequencies approaching the moving element's own resonant frequency (which is naturallt quite low, due to its very high compliance), the ribbon element stretches and "bows" to a point where it is no longer within the magnetic gap; again, the driver will not work. To get around either of these problems means to move the permanent magnet structure from the edges of the element to one entire side of the element, and/or to bond the element to a "host" diaphram, such as a sheet of Mylar, and to clamp that diaphram around its perimeter--in either of which case the driver is no longer a ribbon at all but is, in fact, a planar magnetic. To date, no one has succeeded in creating a full-range ribbon loudspeaker.

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Eminent Technology's Linear Field Transducer, introduced here as the LFT-3, represents a new approach to the design and construction of a high quality planar loudspeaker*, one that builds on the strengths of the above designs while eliminating many of their drawbacks.

The construction of the LFT-3 begins by laminating a very thin sheet of aluminum foil to a half-mil-thick sheet of Mylar. A voice grid pattern, created by means of CAD (Computer-Assisted Design) technology, is silk-screened onto the foil side; the remainder of the aluminum--the part not covered by ink from the silk-screening--is chemically etched away, in a manner similar to

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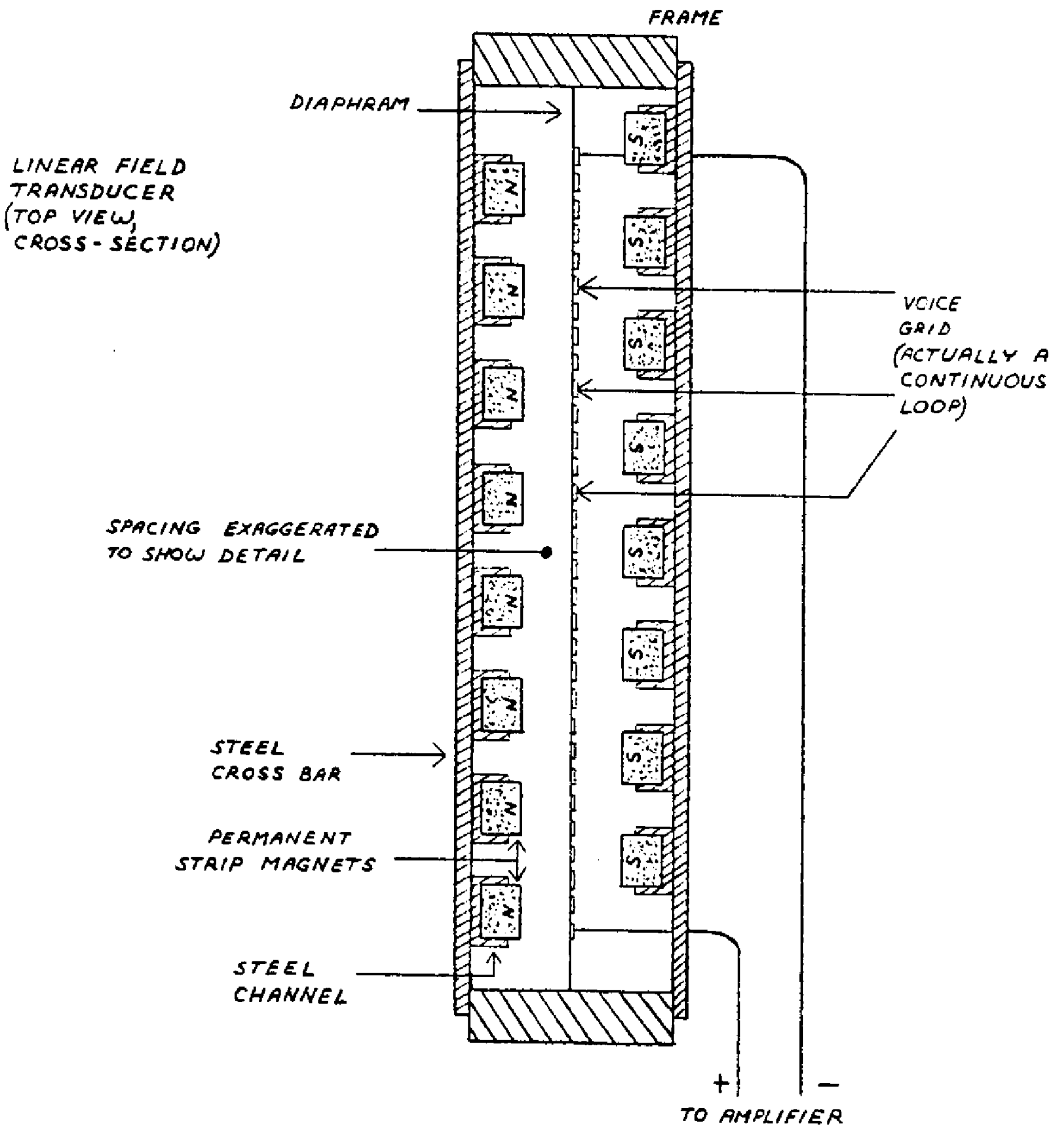
* The design and construction of the LFT-3 are patent pending.

the etching of traces on a printed circuit board. The ink is then washed away, leaving a voice grid of near-perfect uniformity. This technique results in a diaphram/voice grid that is still less than one mil in total thickness, and also permits relatively narrow gaps between the individual traces, so the diaphram can be evenly driven over its entire surface.

The magnet/frame structure developed for the LFT-3 is also unique. Eminent Technology builds its strip magnets into individual steel channels, the size and shape of which have been carefully designed to help "focus" the magnetic flux lines and concentrate the strength of the magnetic field on the appropriate area of the diaphram/voice grid. These channels are then welded to steel cross-bars (four per drive unit, vertically spaced 6-½ inches apart), which in turn are bolted to the aluminum frame that holds the diaphram in place.

Interestingly, one of the biggest challenges faced in creating a true push-pull dynamic speaker was not a design consideration but rather a matter of construction difficulty: to assemble a perfectly rigid structure with very powerful permanent magnets at the front and the rear, both sides opposing each other with tremendous force. It was not until Eminent Technology developed a special machine for this assembly procedure that the Linear Field Transducer became a reality.

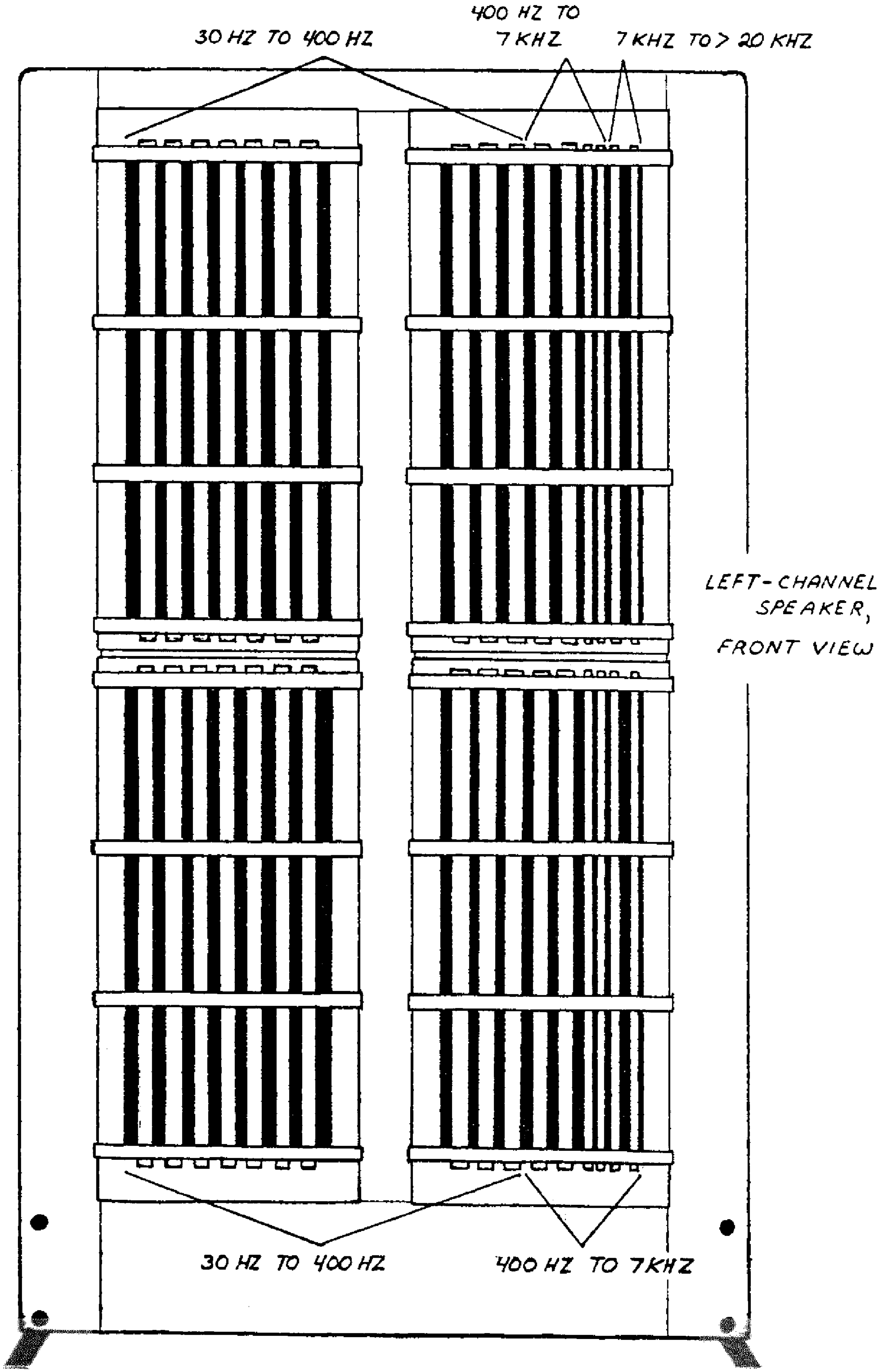
By applying such new techniques to planar loudspeaker construction, Eminent Technology has been able to eliminate many of the flaws inherent in earlier designs. The use of a welded channel-and-crossbar frame dispenses with the need for perforated sheet metal--an "off-the-shelf" material presumably used for reasons of economy and ease of manufacture--thus greatly improving dispersion, especially at high frequencies. And since it is now possible to have a powerful, precisely aligned magnet structure on both sides of the driven diaphram, true push-pull operation has been achieved: Regardless of the degree of excursion the diaphram undergoes, the voice element is always optimally positioned within the magnetic field. The result is extremely linear performance throughout the audible range, with a profound increase in dynamic range and an absolute minimum of distortion.



Each LFT-3 has four individual driver panels. The lower inside panel on each is divided into separately driven bass and (line-source) midrange areas, with the former operating from 400 Hz down, and the latter operating from 400 Hz up to 7 kHz. The upper inside panel on each LFT-3 is similarly configured, except that the innermost 1-inch-wide strip is separately driven as a line-source tweeter, operating from 7 kHz up to and beyond 20 kHz. The midrange and tweeter sections are distinguishable by their thinner magnet structures.

Both upper and lower outside panels operate as woofers, from 400 Hz down. Actually, all of the panels, including the "woofers," are physically capable of operating to beyond 20 kHz, but would exhibit undesirable diffraction effects and poor dispersion if allowed to do so, which is why the panels are segmented into different sections for different portions of the frequency range. The use of a flat panel design maintains excellent phase response throughout the audible range.

By choice of wiring, the LFT-3 can be made to operate at almost any impedance; our present choice of a nominal 4-Ohm impedance has been made in the interest of maximizing efficiency and amplifier compatibility. Because of the large surface area of the panels and the resulting good heat dissipation (a function also of the material choice for the voice grid), the LFT-3 can handle tremendous amounts of power before any risk of damage.

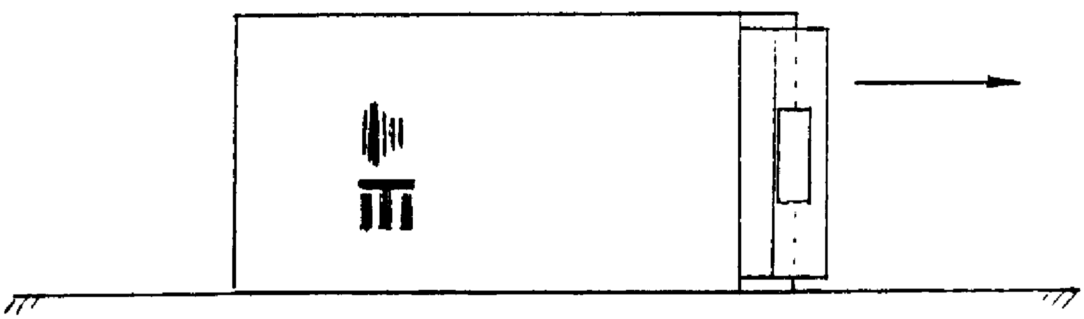


400 HZ TO
7 KHZ
30 HZ TO 400 HZ
7 KHZ TO > 20 KHZ
LEFT-CHANNEL
SPEAKER,
FRONT VIEW
30 HZ TO 400 HZ
400 HZ TO 7KHZ

UNPACKING THE SPEAKERS

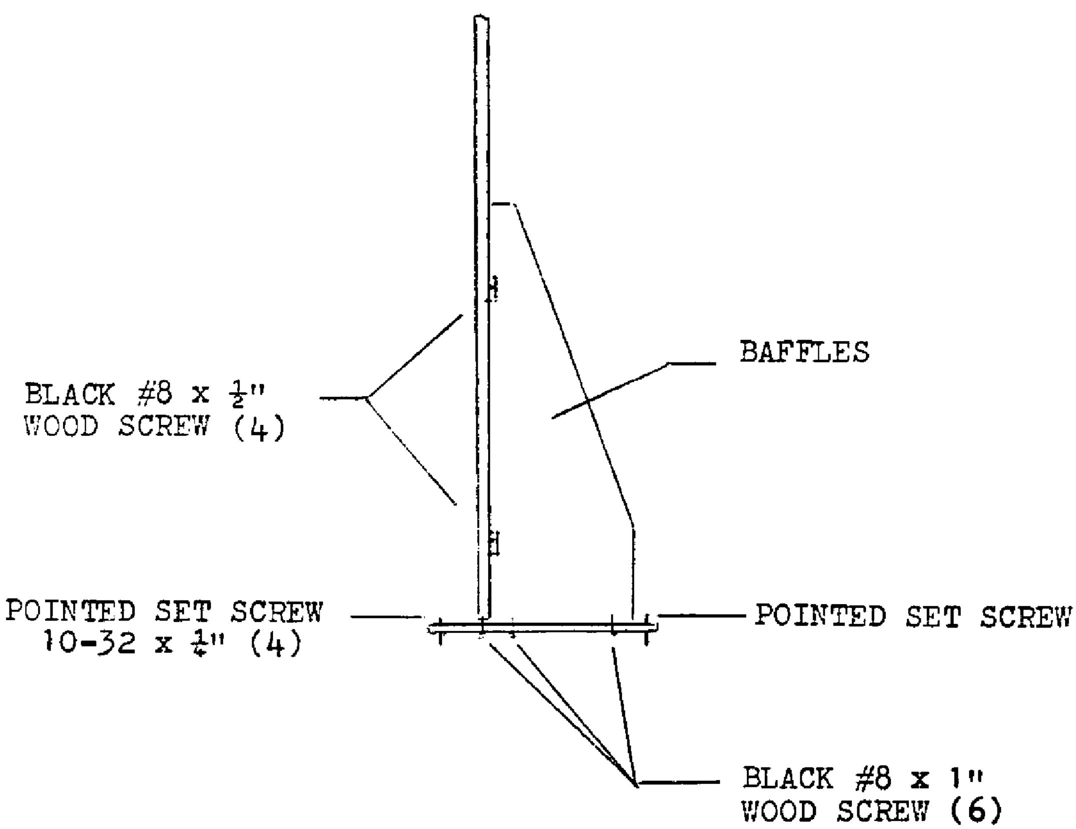
It may help to have two people remove the speakers from the boxes because of there weight.

Position the box on its side andopen the end of the shipping carton. Remove the padding from the bottom and slide the speaker from the box as shown below.



After removing the speaker from its carton it can be leaned against a wall standing up or placed with the front face of the speaker lying flat on carpet. then the black strapping should be removed. These straps tie the feet (wrapped in paper) the baffles (black triangular boards) and the grill cloth (covered by a large cardboard sheet) to the speaker. After the strapping is removed these will seperate from the speaker.

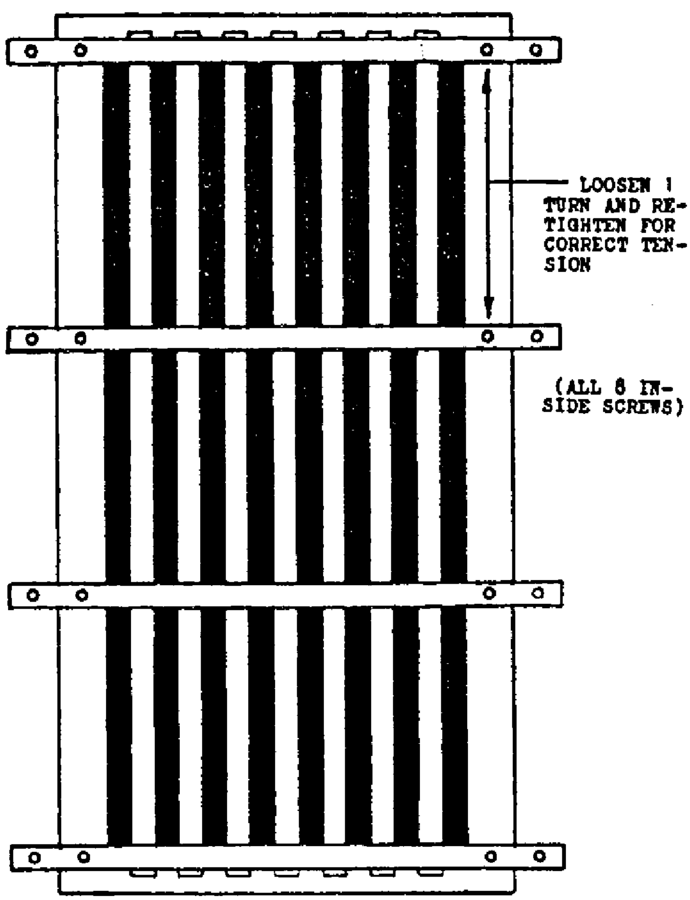
Assemble the feet and baffles with the speaker lying front face down on the carpet. Use the drawing below to identify the correct hardware locations. Grill cloths snap into place with velcro fasteners at each corner on the front and back of the speaker.



RE-TENSIONING THE DIAPHRAMS

For proper low frequency performance and to insure against buzzing noises at higher frequencies, the tension of each diaphram is set at the factory. However, there is some chance of this setting being disturbed during transit, so the tension of each diaphram should be re-set after the speakers are set up.

The tension of each diaphram is controlled by the aluminum frame surrounding it. Each frame is clamped into place with 8 socket-head screws located in the steel crossbars (next to the 8 phillips-head screws that fasten the driver panel to the wood frame). To re-tension a diaphram, simply loosen all 8 socket-head screws <u>one full turn</u>, and then re-tighten them <u>the same amount</u>.



The idea is not to tighten these screws as much as possible, but rather to temporarily "relax" the entire frame so the Mylar diaphram can recover its original tension.

The order in which the screws are loosened and subsequently re-tightened is not important; it is only important that the screws should all be loosened one full turn and then tightened back up one full turn. Do this for each of the four panels in each speaker and they will be ready to play.

POSITIONING THE SPEAKERS IN THE LISTENING ROOM

Speaker placement is critical to correct imaging, frequency balance, low frequency performance, and efficiency.

Low frequency performance in particular can be determined by the shape of the room and the speakers' distance from the wall immediately behind them. Typically, the optimal distance between the LFT-3s and the rear wall is 2 to 5 feet in an average room. Because the diaphram of the LFT-3 is very low in mass relative to the air around it,* the air can act to "mass-load" the diaphram, preventing the large physical excursions required for deep bass reproduction; this effect occurs when the speaker is too close to the rear wall.

The above is not, however, the only consideration in determining the best distance between the LFT-3s and the wall behind them. At certain exact distances from the wall behind them, dipole speakers can exhibit multiple low-frequency cancellation effects, causing bumpy, "comb-filter"-like bass response. At the same time, low frequency information can be <u>reinforced</u> by experimenting with the distance between the listening area and the wall behind it. Generally, if the listener is seated close to the wall behind him, there will be more apparent low frequency information; as the listener moves away from the wall behind him, toward the center of the room, low frequency reinforcement will decrease. Trial and error remains the best way to sort things out and achieve

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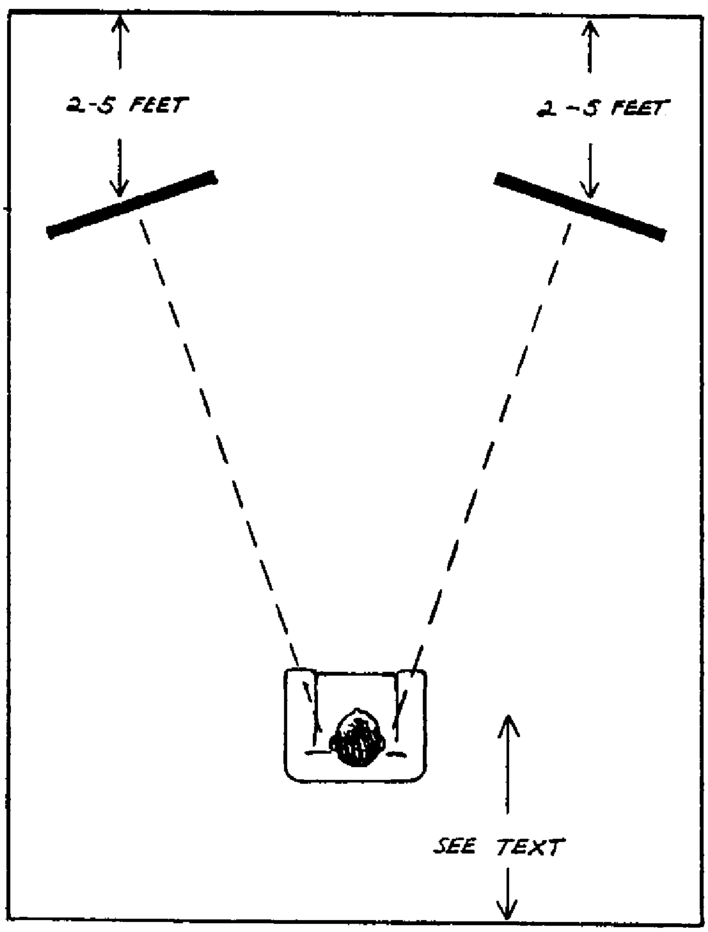
*The diaphram mass is about equal to a 1-inch layer of air of equal area.

the best bass response; there are no hard and fast rules.

The overall frequency balance of the LFT-3s is somewhat affected by the degree to which the speakers are toed in toward the central listening position. The on-axis frequency response of the LFT-3s is essentially flat, and it is often best to position the speakers so that the main listening position is about on axis with each speaker.



Slight midrange frequency balance changes can be obtained by pointing the speakers slightly away from the listening position. This balance can also be altered by adjusting the speakers' degree of vertical tilt with the pointed feet.

The high frequency performance of the LFT-3s can be tailored with the tweeter level control. A jumper is mounted under the crossover cover. There are three tweeter level positions. If the jumper is disconnected, the treble energy is rolled off slightly and this is the lowest setting. When the jumper is connected to the third terminal up from the bottom of the right hand row of six terminal points, this sets the tweeter output in its middle position. The highest tweeter level setting is achieved when the jumper is moved up one terminal to the fourth one. It is best to start with the tweeter level jumper disconnected, position the speakers for the best overall frequency balance, and then decide if more high frequency energy is needed.

Overall imaging performance depends primarily on the distance separating the two speakers relative to their distance from the preferred listening position; it is also affected by the degree of toe-in. We cannot accurately predict what will work best in your listening room, and can suggest only that you begin with the drawing on the previous page as a starting point or general guideline. Keep in mind that the parameters that affect frequency ba-ance also tend to affect imaging properties, and vice versa, so it is best to adjust speaker placement in small increments and to note carefully all of the changes effected by each shift in position before proceeding further.

AMPLIFIER REQUIREMENTS

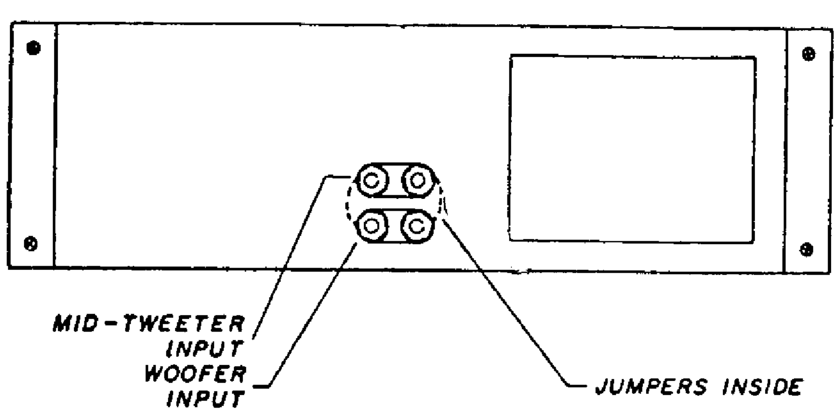
The standard version of the speaker is wired for 4-ohm operation, and is appropriate for use with most higher powered tube and solid state amplifiers. It has an efficiency of 80dB (1watt into 4 Ohms, or 2.0 volts RMS), or 83dB with a 2.83 volt drive(1-8 Ohm watt). This efficiency rating is lower than average. However, the LFT III radiates a planar wave-front, and as such its apparent efficiency at the listening position is slightly higher than the rating implies. The speaker has a minimum power requirement of about 150 watts per channel for tube amplifiers (4 Ohm tap), and about 100 watts per channel for solid state amplifiers. The solid state amplifier should have the ability to almost double its power rating into 4-Ohms. The LFT III can handle "music power" levels (short term berst) of 500 watts or more without difficulty. In general, the limit of the speaker is only reached when the diaphragm actually "bottoms out" against the magnets.

The above minimum requirements are really only estimates and depend on listening taste and the listening environment. More power will be required if the listening room is large, or if average sound pressure levels higher than 90dB are desired.

BI-WIRING AND BI-AMPING

The LFT-3 is configured to allow bi-wiring or bi-amping with a minimum of trouble. The two pairs of inputs on the crossover cover are connected together internally, hot to hot and ground to ground. During normal use, speaker cables can be connected to either the top or bottom pair of inputs.

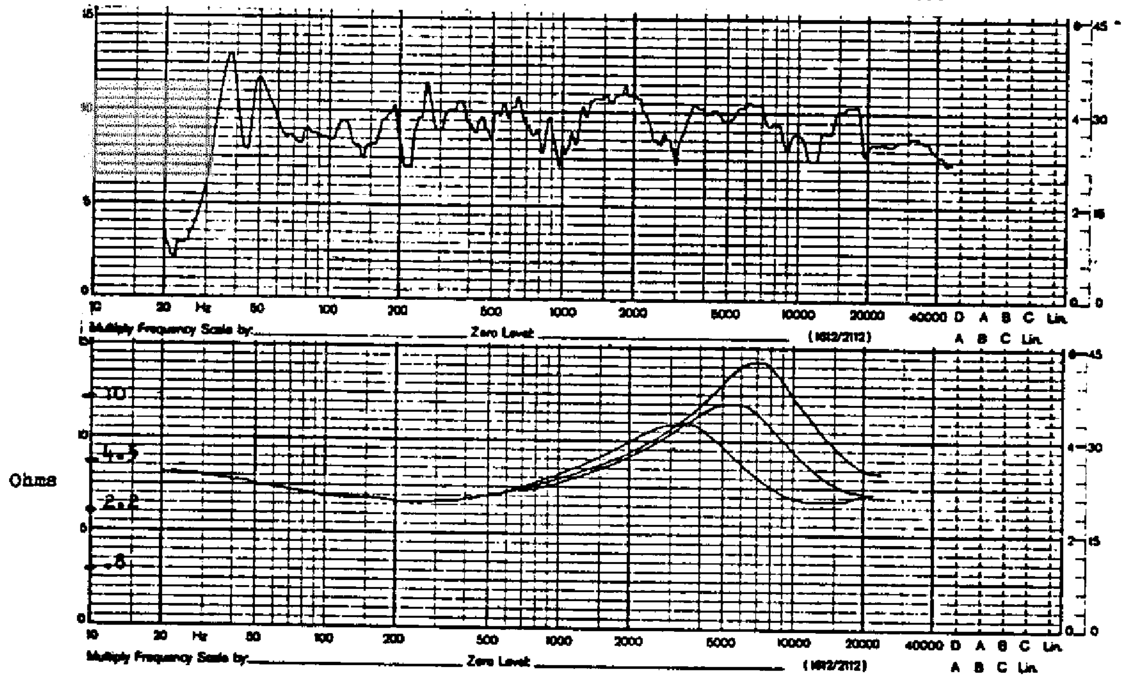
For bi-wiring or bi-amping, the internal jumpers connecting the upper and lower input terminals must be severed. Remove the four phillips-head screws that hold the crossover cover in place and carefully remove the cover; there is just enough slack in the wiring between the speaker and the cover to allow this. Sever the two jumper wires with cutting pliers and bend them slightly so they cannot contact one another or touch the metal cover. Severing the jumpers divides the inputs so that now the lower terminals power the low frequency drivers, and the upper terminals power the midrange and high frequency drivers. Both pairs of inputs continue to power their drivers through the internal cross-overs, which cannot be bypassed.

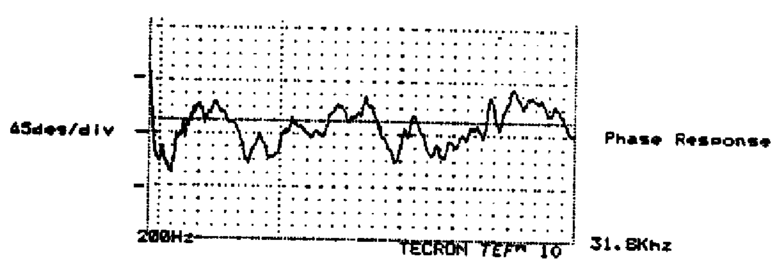


Bi-wiring simply means connecting a single stereo amplifier (or two mono amps) to a pair of speakers by using two pairs of speaker cables. Connect the hot and ground conductors of a pair of cables to the same output terminals on one channel of the amplifier; the other ends are connected to the now-separate woofer and mid/tweeter inputs of the LFT-3. (All speaker cables should be the same length.) The effects of bi-wiring tend to be subtle, but the slight improvement may be worth the relatively modest cost of an extra pair of speaker cables. Bi-wiring also permits experimenting with different types of cables for the two inputs; you may find that one type is well-suited for bass performance, while another works best on the mid/treble side.

Bi-amping requires an additional stereo amplifier or pair of mono amps. You will also need some means of insuring that only the desired portion of the frequency range reaches each amplifier. The simplest way to accomplish this is with an external electronic crossover; however, this can also be done by hard-wiring low-pass and high-pass filters into the inputs of the bass and mid/treble amplifiers, respectively. For the low frequency amp, a 400 Hz low-pass filter (6 dB/octave) is required; for the mid/treble amp, a 400 Hz high-pass filter (also 6 dB/octave) is required. If you wish to pursue this method, your dealer or the manufacturer of your amplifiers should be able to help you determine the specific parts necessary. Note that you will also need a level control on either one of the stereo amps or on the crossover, regardless of which approach you take to bi-amping.

Frequency Response and Impedance Measurements





Horizontal: 200.24Hz to 31798.30Hz
scale: 8639.21Hz/inch or 3401.26Hz/cm. (linear)

Resolution: 4.9122E+00 Feet & 2.3004E+02Hz

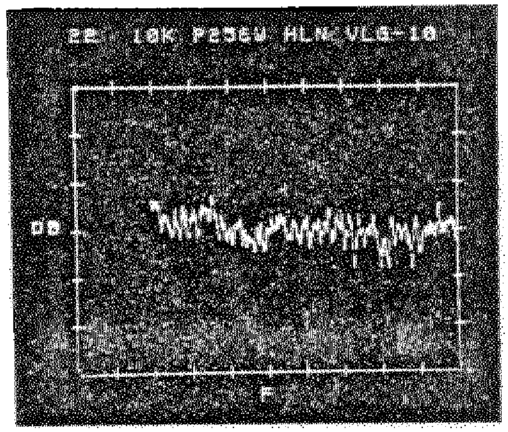
Time of test: 3157 microseconds, 3.5672E+00 Feet

Sweep Rate & Bandwidth: 10734.80Hz/Sec & 4.6665E+01Hz

Input configuration: Non-inverting
with 48dB of input gain & 21dB of IF gain.

FFT measurements-listening room

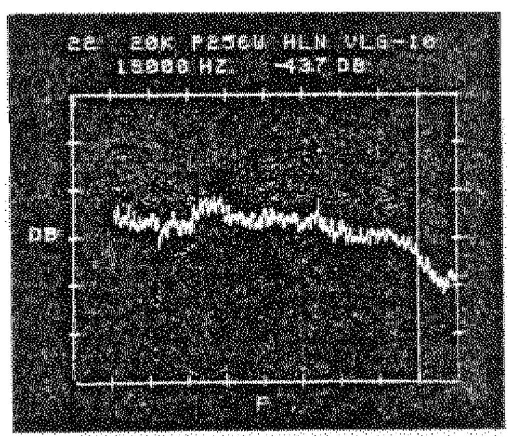
10dB/ div



2Khz 10Khz

Pink noise- Mic 1 foot from center of speaker, Linear scale

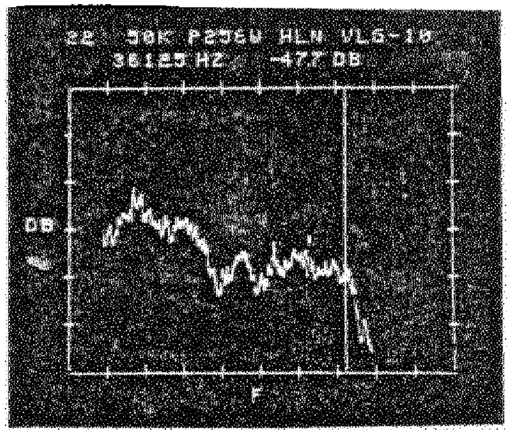
10dB/ div



2Khz 20Khz

Pink noise- Mic 1 meter centered at tweeter, Linear scale, Tweeter level middle

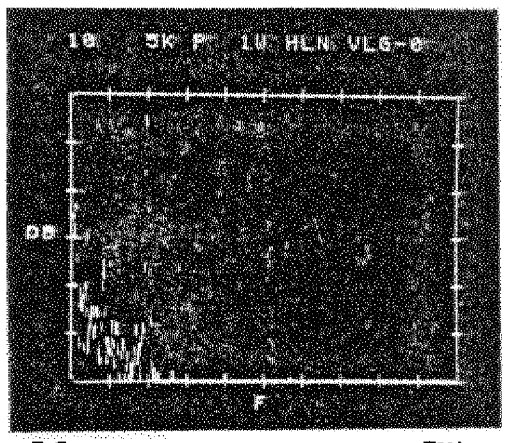
10dB/
div



10Khz 50Khz

Pink noise-Mic @1 meter centered at
tweeter, Speaker begins rolloff
above 36Khz.

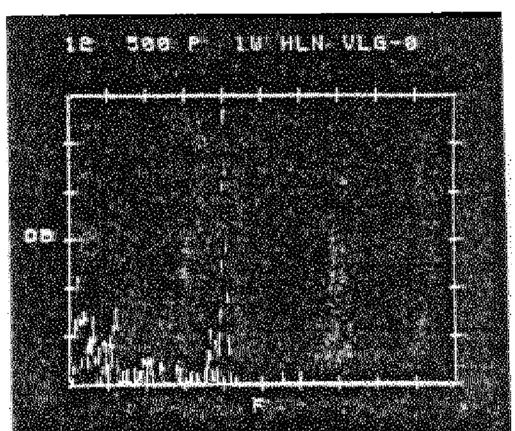
10dB/
div



DC 5Khz

Distortion test-1Khz @ 90dB sine wave
Absence of harmonics above 1Khz indicates
distortion below .1%. (noise floor of room)
Typically measures .03%.

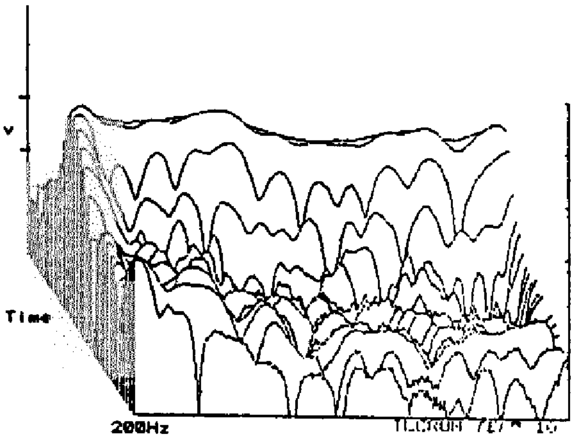
10dB/
div



DC 500Hz

Distortion test-200Hz @ 90dB sine wave
Absence of harmonics above 200Hz indicates
distortion below .1%. (noise floor of room)
Typically measures.04%

3-D of LFT



Vertical: 12dB/div with base of display at 13.6dB
0dB is located at .00002 pascals

Horizontal: 200.24Hz to 17778.10Hz
scale: 5412.94Hz/inch or 2131.08Hz/cm.

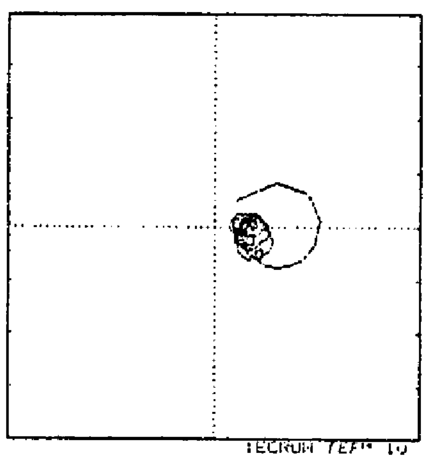
Resolution: 5.6500E-01 Feet & 2.0000E+03Hz

Time of test: 13000 microseconds 1.4690E+01 Feet (front)
to 3000 microseconds 3.3700E+00 Feet (back)
-323 microseconds/step or-.3645161290322 Feet

Sweep Rate & Bandwidth: 10734.80Hz/Sec & 5.3674E+00Hz

Input configuration: Non-inverting
with 48dB of input gain & 33dB of IF gain.

Nyquist (NFP) of LFT



Resolution: 4.9122E+00 Feet & 2.3004E+02Hz

12dB of automatic screen gain.

Frequency range: 200.24Hz to 31798.30Hz

Time of test: 3157 microseconds, 3.5672E+00 Feet

Sweep Rate & Bandwidth: 10734.00Hz/Sec & 4.6665E+01Hz

Input configuration: Non-inverting
with 48dB of input gain & 21dB of IF gain.

SPECIFICATIONS

Power Requirements: 100 watts minimum

Sensitivity: 82 dB (pink noise, 20-20Khz) at 1 watt/1 meter (2.83v)
84 dB sine wave at 1Khz at 1 watt/1 meter

Frequency Response: 35Hz-20Khz ±4 dB (typical room, close-mic measurement)
-12 dB at 35Khz

Phase Accuracy: ±20 100Hz-31Khz

High Frequency Level: Flat, -6 dB, -12 dB at 20Khz smooth rolloff

Impedance: 4 ohm rating (3.7-15) see curve

Maximum SPL: 105 dB at 1 meter

Diaphram Resonance: 38Hz

Diaphram Area: 580 sq. in. (front)

Harmonic Distortion: Less than .04%, 100Hz-20Khz, 90 dB, 1 meter

Dimensions: 27" wide X 54" high X 1" thick (3" at base)

Shipping Weight: 95 lbs. each

Foil Thickness: .00033"

Mylar Thickness: .0005"

Laminate Adhesive Thickness: .00015"

Gap Between Conductors: .03"

Peak-toPeak Diaphram Displacement: .4"

Warranty: 3 year parts, 1 year labor

Price: $3250 (retail)

Music: all of the above is done for the enjoyment of music.

Designers: David Collie & Bruce Thigpen

WARRANTY

Eminent Technology Inc. warrants the LFT-3 loudspeaker to be free from defects in materials and workmanship for a period of 30 days from the date of purchase. Within that period, any failure of the LFT-3 will be corrected without charge for parts, labor, or transportation from the factory. After this period, pending receipt of the warranty form (filled out and mailed to Eminent Technology, and postmarked no later than one month after the date of purchase), the above warranty will be extended to three years for parts and one year for labor. This warranty is transferable to subsequent owners, pending notification from the original owner, in writing, within 10 days of the personal sale. The obligation of Eminent Technology under the terms of this warranty does not extend to:

1) Any LFT-3 installed or operated without regard for the instructions contained in this manual.

2) Any LFT-3 while under performance testing, or after being used in such a test, by any personnel or facility not authorized by Eminent Technology.

3) Any other component or part connected to or operated in conjunction with the LFT-3.

4) Any traumatic damage, accidental damage, or damage incurred in shipping, or defects which upon examination by Eminent

Technology and in its sole opinion have been caused by abuse, neglect, improper or abnormal installation, or operation for extended periods in industrial applications.

This warranty is not applicable if any part of the LFT-3 has been removed or taken apart, repaired, altered, or modified by anyone without prior authorization in writing from Eminent Technology, nor if the serial numbers have been defaced or rendered illegible.

If an Eminent Technology product is removed from the country in which the original consumer purchase was made, Eminent Technology dealers and distributors in other countries are not obligated by the terms of this warranty. Eminent Technology reserves the right to incorporate design refinements and changes to its products without notice or obligation. If practical, such design modifications will be made available to owners of existing units for a reasonable charge.

Under the terms of this warranty, Eminent Technology expressly does not insure for loss of use of the LFT-3 due to failure or periods of repair. Warranty repairs will be carried out by the factory. The LFT-3 must be returned prepaid in its original factory carton to:

Eminent Technology Inc.
225 E. Palmer St.
Tallahassee, FL 32301
(904)224-5999

WARRANTY FORM

Name ____

Address ____

City ____ State ______ Zip _____________

Home Phone Number ___________________________________

Dealer Purchased From ______________________________________

Dealer Address ____

____

Date Purchased _____________________________

Serial Numbers _________________________(L) _____________________________(R)

Please complete this form and return to:

Eminent Technology Inc.

P.O. Box 6894

Tallahassee, FL 32314

USA