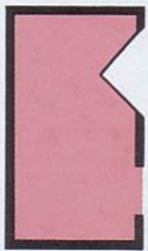


... to design a high accuracy speaker system of true bookshelf size, with greater low-bass output, higher efficiency, and more uniform response and dispersion than any previously available . . .



SEALED



VENTED

### Sealed or Vented?

**Vented Systems are more difficult to design properly, but they obey the same laws of nature.**

Especially in the case of home high fidelity systems, designers have often selected the sealed acoustic suspension system as the basis for their efforts. Sealed system design is relatively simple and straight-forward. The direct relationship of enclosure volume, low frequency response, and efficiency has been described in great detail in consumer publications.<sup>1</sup>

By contrast, design of vented systems has been an enigma. The basic idea is very appealing; instead of containing half the woofer's output inside a sealed box, the vented enclosure makes that energy available for use in the listening room. With far more variables to juggle, a simple relationship (like that of the sealed system) did not fall into designers' laps, resulting in the notion that vented systems required an empirical cut-and-try design technique.

As it turns out, vented systems have a similar interdependence of enclosure volume, low-frequency response, and efficiency — a conclusion drawn from an elegant technical study by Australian researcher, A. N. Thiele.<sup>2</sup> By describing system low-frequency response in the same terms as electrical filter response, Thiele indicated many choices of system response, and more importantly, exactly what changes to make in the loudspeaker and the enclosure to produce the desired performance.

If this same analysis is applied to sealed systems, the inherent advantage of vented systems becomes obvious.

### The Vented Advantage

**Vented systems can offer improved performance compared to sealed systems . . . Equalized vented systems have an even greater advantage.**

Compared to a sealed system, a vented system can have:

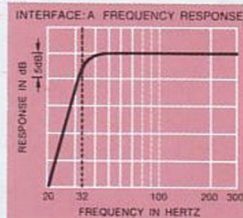
- 1/2 octave more bass, or;
- 4 1/2 dB more efficiency, or;
- an enclosure 1/3 the size.<sup>3</sup>

So much for the theory. Now we must set specific design goals. We wished to design a system with response lower in frequency, greater mid-band efficiency, and smaller physical size than the best acoustic suspension systems. To further increase the vented system advantage shown above, we selected a system response (sixth order Butterworth Class I) which employs an auxiliary circuit or equalizer.<sup>4</sup>

### 32 Hertz. Really.

Most speaker frequency response specifications in print today are meaningless. They have little relationship to the measured or perceived performance of the product. However, low-frequency response can, in fact, be precisely defined and measured.

The low-frequency limit (3 dB down) of the Interface:A is 32 Hz, a nice round number, musically speaking. Low C of a 16-foot organ stop is 32.7 Hz, three octaves below middle-C. By comparison, the lowest note of a standard-tuned bass viol or bass guitar is 43 Hz.



### How do we do it?

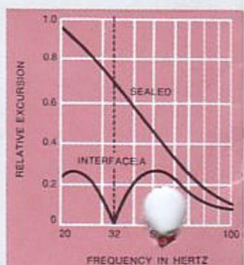
**The only "trick" employed is a novel method of tuning a very small cabinet to a very low frequency.**

Tuning the 3/4 cubic foot enclosure of the Interface:A to 32 Hz required something more than just a hole in the box. The smallest usable hole would require a duct several feet long. The Interface:A uses a vent substitute (a), sometimes called a passive radiator, to properly tune the enclosure. It looks like a 12-inch woofer, but it has no voice coil or magnet. In fact it is a 10-inch diameter piston with a mass of 400 grams, equivalent to the air in a "real" vent of this diameter, 20 feet long.



### Less Distortion

The woofer cone in a sealed system must move much farther at very low frequencies, inevitably increasing distortion. By comparison, the Interface:A woofer's excursion decreases as the lowest frequencies are approached and the vent substitute becomes effective (below 45-50 Hz). Total harmonic distortion at 32 Hz, with full power in-



put, is in the order of 1%, remarkably low by sealed system standards.

### Equalization

**An active equalizer extends low-frequency response and acts as a subsonic filter.**

With Interface:A, flat acoustic output requires only modest equalization: 3 dB at 50 Hz, rising to a maximum of 6 dB at 35 Hz. Below 30 Hz, the equalizer rolls off sharply to eliminate undesirable low-frequency components (record warp or rumble, for instance) before they reach the power amplifiers and speakers.

As a bonus, we have placed the high-frequency control, a three-position switch, on the equalizer rather than on the back of the speakers. This is, of course, much more convenient for adjustment and also allows more precise control of equalization.

The equalizer contains two identical channels and is designed to be connected at the tape monitor jacks of integrated electronic components. It may also be connected between pre-amplifier and power amplifiers. An extra set of jacks and switching are provided on the equalizer to permit connecting a tape recorder into the system.

### Uniform Acoustic Power Output

**Accurate reproduction requires smooth response and uniform dispersion.**

Thus far we have been concentrating on low-frequency design and the advan-

tages of vented systems over sealed systems. Even if we were designing a sealed system, however, we would pay close attention to uniform high-frequency performance. The character of the sound you hear in a typical listening room depends largely on the *total power* being radiated by the speaker: the sum of its output in all directions. What is desired is uniform *response* on axis and uniform *dispersion* to provide uniform *total acoustic power output*.

Since the vent substitute produces most of the acoustic output below 50 Hz, the active woofer can be a smaller-than-typical 8-inch unit with better mid-range dispersion (b). This speaker provides direct output up to 1500 Hz as well as acoustically driving the vent substitute.

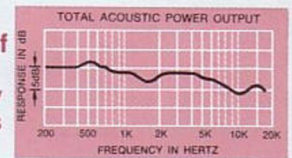
Those all-important high frequencies come from a brace of tweeters, one in front and one on the rear.

A unique, yet simple device consisting of foam and felt squares improves the dispersion of the front tweeter (c). At the low end of the tweeter's range, say 1500 or 2000 Hz, the felt is acoustically transparent, and the entire cone area of the tweeter is contributing output. Toward the high end of the tweeter's range, say 10,000 Hz, the felt square becomes opaque to sound, and only the small hole in the center is contributing output. Thus, as frequency goes higher, the effective diameter of the tweeter becomes smaller, substantially improving high-frequency dispersion.

Above 8,000 Hz, the tweeter mounted on the rear of the cabinet (d) contributes output. The power output of the

rear tweeter increases the total high-frequency energy into the room without making the "on axis" sound directly in front of the speaker overly bright. The amount of space behind the speaker is not a critical consideration. Interface:A may be placed as close as an inch or two from the wall.

**Total Acoustic Power Output of the Interface:A is exceptionally uniform over its entire range.**

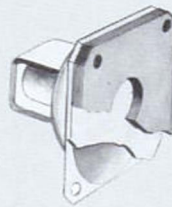
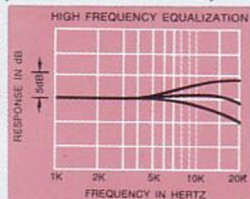
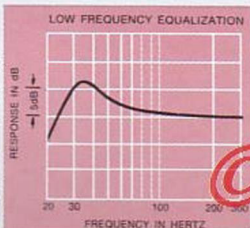


### Power Ratings are a puzzlement.

If the normal input to a speaker were continuous, such as a sine wave, it would be relatively easy to establish meaningful power ratings. However, musical program material has considerable dynamic range with peaks 10 to 100 times the average level. Add to this the varying frequency content of music, and you have a nearly undefinable situation.

In practice things are not really so difficult. Speaker components are capable of handling short duration peaks of about ten times their continuous power rating. In addition, the average power delivered by an amplifier will be a fraction of its maximum output if peaks are to be passed cleanly.

Interface:A is designed for use with the wide spectrum of available amplifiers and receivers. The higher efficiency of Interface:A means that more sound output will result from the same power input than with many acoustic suspension systems. (If high listening levels and amplifiers larger than about 60 watts per channel are to be used, we have special operating suggestions for you. Our Interface:A Owner's Manual describes methods for protecting



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Archiv Michael Otto

## EQUALIZED SPEAKER SYSTEM BY ELECTRO-VOICE



ur unit from excessive input levels including fusing and the use of our TS1 accessory "Tweeter Saver".)

### Goal of balance

ur goal was to create in Interface:A a well-balanced system of reasonable price, extended frequency response, excellent dispersion, useful efficiency, and wide dynamic range. We believe these goals have been achieved and that the Interface:A is eminently suited for the vital task of reproducing music every stamp . . . in your home, accurately, and with musical validity.

### Interface:A is for the music.

We've been involved with sound since 1927 when our founder learned that he could make better microphones than he could buy. From the first, we've had the attitude that if we can make our products a little better than the other guy, we'd succeed. And so far it seems to have worked out that way. In large measure, our products reflect the creativity and resourcefulness of our engineers—products that do the job better than it has been done before.

An excellent example: H. Kloss, "Loudspeaker Design," *AUDIO*, March 1971.

N. Thiele, "Loudspeakers in Vented Enclosures," *J. AUDIO ENG. SOC.*, May & June, 1971.

H. Small, "Efficiency of Direct-Radiator Loudspeaker Systems," *J. AUDIO ENG. SOC.*, November, 1971.

J. Newman, "A Loudspeaker System Design Utilizing a Sixth Order Butterworth Response Characteristic," *J. AUDIO ENG. SOC.*, July/Aug., 1973.

The Interface:A equalizer is listed by Underwriters' Laboratories, Inc.

### Specifications

#### EACH SPEAKER SYSTEM

(Equalizer high-frequency contour control in Position 1)

Frequency Response, 1 m on Axis, Anechoic Environment

$\pm 3$  dB 32-18,000 Hz

Total Acoustic Power Output vs Frequency

$\pm 4\frac{1}{2}$  dB 32-18,000 Hz

Dispersion, 6 dB Down, 600-9600 Hz Octave Bands, Horizontal & Vertical

$125^\circ \pm 30^\circ$

Sound Pressure Level, 1 m, 1 W into 8 Ohms, Anechoic Environment

89 dB

Suggested Amplifier Power Ratings, Continuous Avg. Power per Channel, at 8 ohms

Minimum: 10 watts

Typical (Long-Term Avg. Power Capacity not to be Exceeded): 30-50 watts

Maximum (Long-Term Avg. Power Capacity not to be Exceeded): 250 watts

Avg. Sound Pressure Levels, Midband, in Reverberant Field of Typical Living Room (R=100), with Peaks 10 dB Above Average

10 W per Channel Available: 93 dB

30-50 W per Channel Avail. 98-100 dB

250 W per Channel Available: 107 dB

Long-Term Avg. Power-Handling Capacity

32-1500 Hz: 25 watts

1500-20,000 Hz: 25 watts, dropping to

10 watts at 10 kHz

Short-Term Power-Handling Capacity (10 ms)

32-1500 Hz: 250 watts

1500-20,000 Hz: 250 watts, dropping to 100 watts at 10 kHz

Crossover Frequencies

Acoustic: 50 Hz

Electrical: 1500 & 8000 Hz

Nominal Impedance

8 ohms

Minimum Impedance

5 ohms

Dimensions

14" x 22" x 7 $\frac{3}{4}$ " deep

Net Weight

27 lb

### EQUALIZER

(Each Channel)

Midband Gain

Unity

Maximum Equalization

6 dB at 35 Hz, fixed

Maximum Input Signal, RMS Sine Wave

Midband: 5 V

35 Hz: 2.5 V

Noise Output, 20-20,000 Hz Bandwidth

80 dB below 200 mV

Total Harmonic Distortion, 1.5 V RMS In, 20-20,000 Hz

.05% or less

Intermodulation Distortion, 60 Hz & 7000 Hz 4:1 Ratio 1.5 V RMS Equivalent Sine Wave Input, Control in Position 2

.005%

Suggested Minimum Load Impedance

10,000 ohms

Input Impedance

100,000 ohms

High-Frequency Contour Selector

3 positions & power off

Input Selector

Tape-Source

Power Requirements

110/120 V, 50/60 Hz, 3 W

Dimensions

2 $\frac{3}{4}$ " H x 8" W x 7" D

Net Weight

2 lb, 10 oz

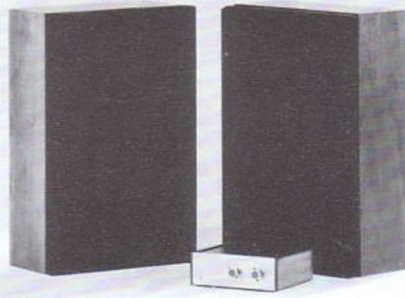
### Warranty

Interface:A is guaranteed against malfunction due to defects in workmanship and materials. If such malfunction occurs, Interface:A will be repaired or replaced (at our option) as follows:

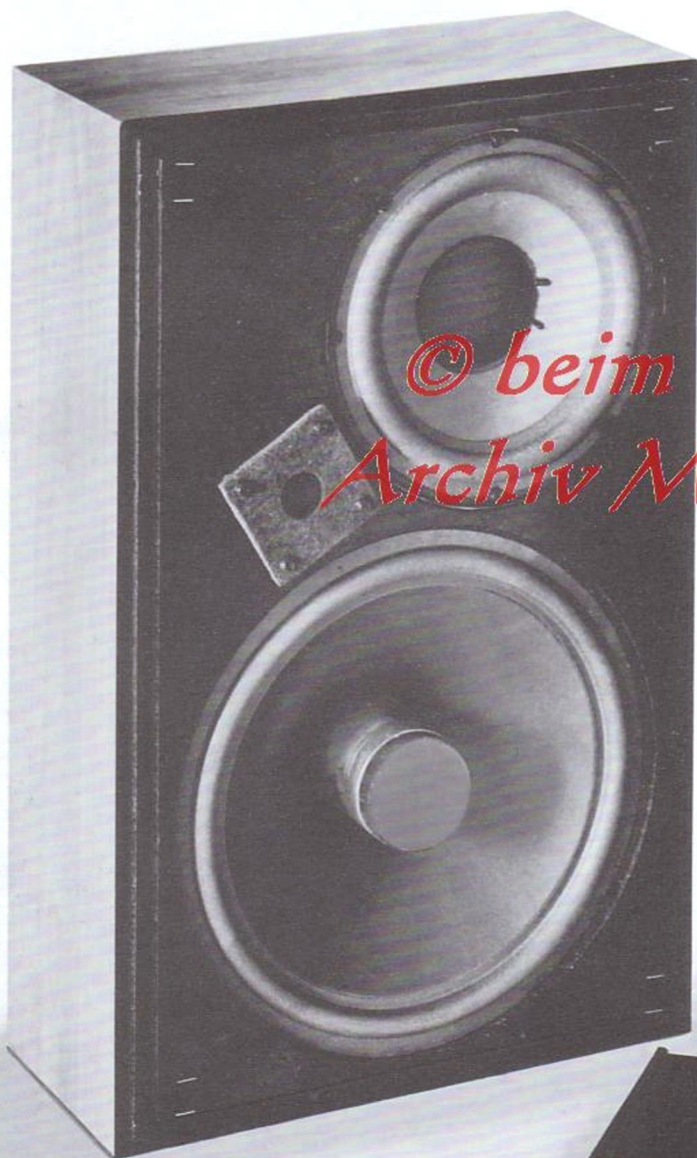
Speaker systems will be repaired or replaced without charge for parts or labor for a period of five years from date of original purchase.

Equalizer will be repaired or replaced without charge for parts for a period of three years from date of original purchase and without charge for labor for a period of one year from date of original purchase.

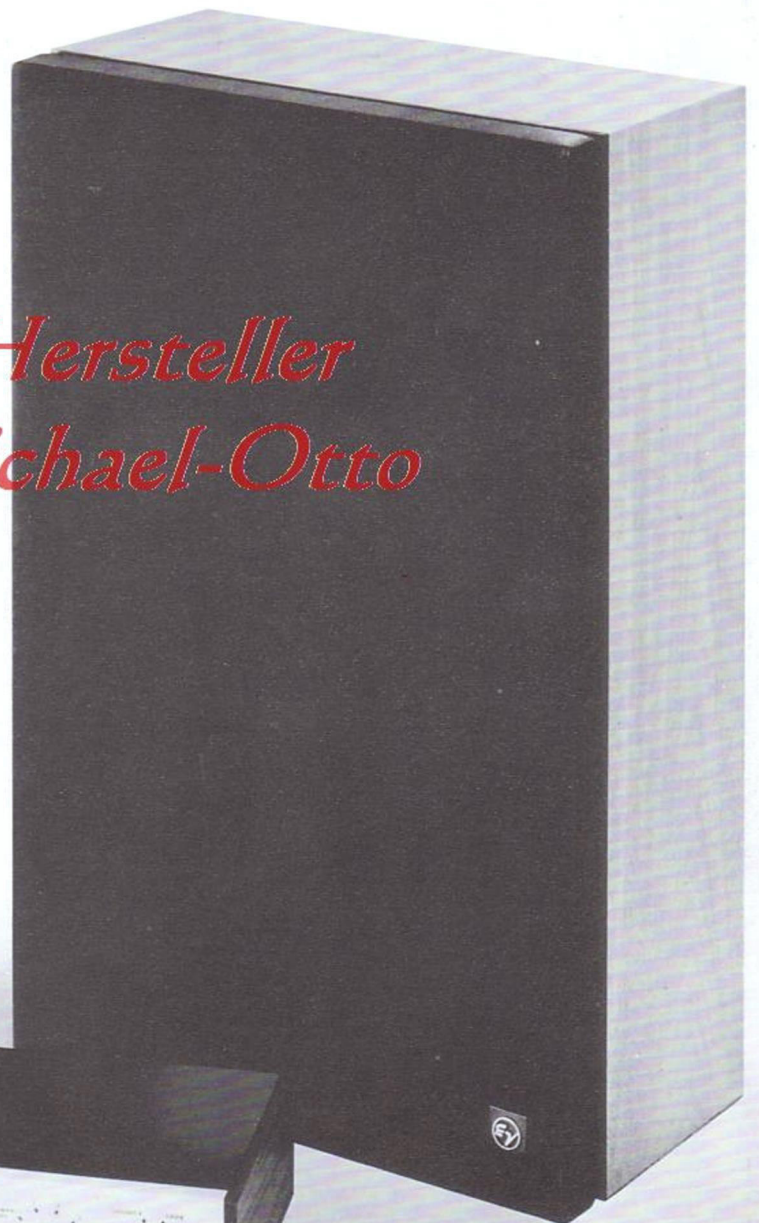
All units must be delivered prepaid to the proper Electro-Voice service facility and will be returned prepaid. Warranty does not cover finish or appearance items or malfunction due to abuse or operation at other than specified conditions. Repair by other than Electro-Voice or its authorized service agencies will void this guarantee.



**Interface: A**



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**Electro-Voice**<sup>NC</sup>  
a **gulton** company

600 Cecil Street, Buchanan, Michigan 49107

Form 1525A

*Hifi-Studio am Tarm  
Brockton (Mass.) Am. Radio-Company, Inc.  
Tel. 617-339-2221*

Printed in U.S.A.

# Electro-Voice

Interface: A

Das (hör-)bare Klangwunder

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Archiv Michael-Otto*



# Interface: A

Tatsächlich gibt es Hunderte von Arten, einen Lautsprecher in ein Gehäuse zu montieren. Die meisten von ihnen sind falsch. Falsch deswegen, weil sie ein zu großes Gehäuse erfordern, oder zu viel Verstärkerleistung absorbieren, oder

Der Bau eines Lautsprechers (für welchen Zweck auch immer) ist ebenso sehr eine Sache der Zielauswahl als ein technisches Problem. Ist ein hoher Wirkungsgrad erwünscht, oder ein großer Frequenzbereich, ein kleines Gehäuse, oder etwas anderes? Und wieviel will man bei einer Eigenschaft opfern, um das Maximum bei einer anderen zu erzielen?

Da seriöse Grunduntersuchungen in der Physik des Lautsprecherbetriebes in der Praxis sehr selten durchgeführt werden, basieren die meisten Lautsprecher-Systeme auf dem Kopieren bestehender Technologien. Und die hörbaren Unterschiede beruhen hauptsächlich darauf, wie Ingenieure (oder Verkaufsabteilungen) eines oder mehrere der angestrebten Ziele auf Kosten der anderen in den Vordergrund schieben können. Für die Wahl sind dann kaum einander konkurrierende Technologien maßgeblich, sondern der Umstand, welches Merkmal die eigenen Wünsche am ehesten befriedigt.

Gegensätzlich dazu ist die Konstruktion ventilierter Systeme ein Rätsel gewesen. Die Grundidee ist sehr ansprechend: anstatt die Hälfte der Ausgangsleistung des Tieftonlautsprechers im Gehäuse zurückzubehalten, gelangt durch die ventilierte Konstruktion diese Leistung in den Zuhörerraum. Da weit mehr Variablen zu erfassen sind, fiel den Konstrukteuren nicht (so wie beim luftdichten System) eine einfache Gleichung in den Schoß, was zur Erkenntnis führte, daß ventilierte Systeme eine Konstruktionstechnik unter Verwendung empirischer Untersuchungsmethoden erfordern.

## Der Vorteil der Ventilierung

Es hat sich erwiesen, daß bei ventilierten Systemen ein ähnlicher Zusammenhang zwischen dem umschlossenen Volumen, dem Frequenzgang bei tiefen Frequenzen und dem Wirkungsgrad besteht — eine Folgerung, zu der der australische Forscher A.N. Thiele in einer eleganten technischen Studie gelangte. Dadurch, daß der Frequenzgang des Systems bei tiefen Frequenzen mit dem Frequenzgang elektrischer Filter in Zusammenhang gebracht wurde, machte Thiele viele Angaben über die Wahl des Frequenzganges von Systemen und, was noch wichtiger war, darüber, welche Änderungen am Lautsprecher und seiner Umhüllung durchzuführen sind, um die erwünschte Wiedergabequalität zu erhalten.

Wenn diese gleiche Analyse auf luftdichte Systeme angewendet wird, tritt **der Vorteil ventilierter Systeme klar zutage**. Kurz zusammengefaßt kann ein ventiliertes System haben:

- 1/2 Oktave mehr an Baß, oder
- 4 1/2 dB mehr Wirkungsgrad (Leistungsfähigkeit),
- oder eine Umhüllung mit 1/3 der Größe.

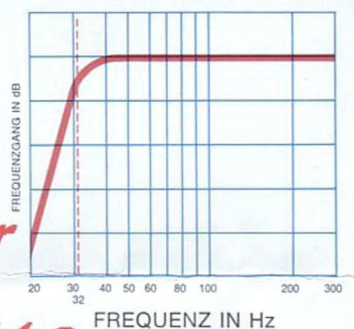
So viel von der Theorie... nun sind die spezifischen Konstruktionsziele festzusetzen. Wir wünschten ein System mit einem guten Frequenzgang bei den tiefen Frequenzen zu erreichen, einem größeren Wirkungsgrad bei den mittleren Frequenzen und einer kleineren physischen Größe als das beste Bücherregalsystem mit «Acoustic Suspension». Zur weiteren Verbesserung der oben angegebenen Vorteile des ventilierten Systems wurde ein Frequenzgang (Potenzfilter Butterworth, 6. Ordnung, Klasse I) des Systems ge-

wählt, bei dem ein Hilfskreis oder Entzerrer verwendet wird.

## Tatsächlich 32 Hz

Die meisten der heute gedruckten Frequenzgangspezifikationen sind nichtssagend. Sie haben keine Beziehung zu den gemessenen oder wahrgenommenen Wiedergabequalitäten des betreffenden Produktes. Jedoch kann der Frequenzgang bei tiefen Frequenzen tatsächlich genau definiert und gemessen werden.

INTERFACE: A FREQUENZGANG



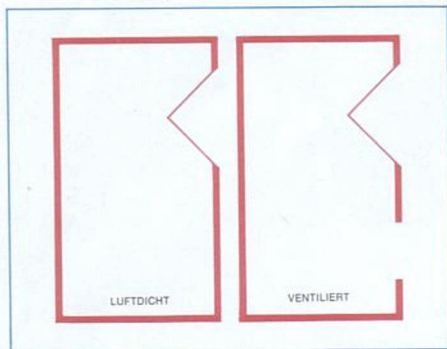
Die untere Grenzfrequenz (Dämpfung 3 dB) des Interface:A ist 32 Hz, musikalisch gesprochen ein netter runder Wert. Das tiefe C einer 16 Fuß Orgelpfeife ist 32,7 Hz, drei Oktaven unter dem mittleren C. Vergleichsweise ist der tiefste Ton einer normal abgestimmten Viola da gamba oder Baßgitarre 43 Hz.

## Wie es gemacht wird:

Die Abstimmung der 28 Kubikdezimeter fassenden Umhüllung des Interface:A auf 32 Hz erfordert mehr als gerade nur ein Loch im Gehäuse. Das kleinste brauchbare Loch würde einen mehrere Meter langen Ventilierkanal erfordern. Das Interface:A verwendet eine praktische Alternative (oder einen Ventilierersatz) um die Umhüllung sauber abzustimmen. Er sieht wie ein Tieftonlautsprecher mit 30 Zentimeter Durchmesser aus, hat aber weder Schwingspule noch einen Magneten eingebaut. Praktisch ist er ein Kolben mit 25,4 Zentimeter Durchmesser mit einer Äquivalentmasse, die gleich der Luftmenge ist, welche zur Abstimmung auf die 32 Hz der Umhüllung erforderlich ist. Eine «echte» Ventilierung mit diesem Durchmesser würde an 0,7 Meter lang sein; jedoch sollte hier keine Verwechslung mit Resonanzröhrenkonstruktionen wie etwa Orgelpfeifen erfolgen.

## Entscheidungen, Entscheidungen

Besonders im Falle von HiFi-Lautsprechersystemen haben die Konstrukteure als Basis für ihre Bemühungen oft das luftdichte «Acoustic-Suspension System» gewählt. Die luftdichte Systemkonstruktion ist verhältnismäßig einfach und unkompliziert, grundsätzlich legt eine einzige Gleichung alles was man zu wissen wünscht fest, um eine gute Wiedergabequalität in den



niedrigen Frequenzbereichen zu erreichen. Der direkte Zusammenhang zwischen dem eingeschlossenen Volumen, dem Übertragungsfrequenzgang bei tiefen Frequenzen und dem Wirkungsgrad ist sehr eingehend in Konsumentenveröffentlichungen behandelt worden.

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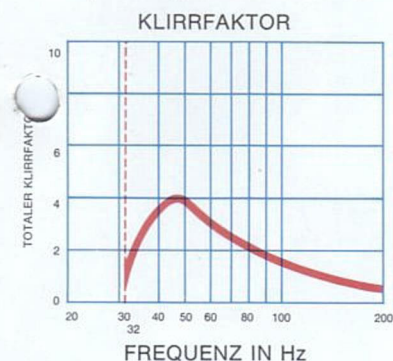
bei hoher Leistung zu große Verzerrungen ergeben, oder die Wiedergabequalität in der niedrigsten Oktave beeinträchtigen. Und oft sind ihre Kosten im Handel zu groß. Electro-Voice setzte sich deshalb zum Ziel, dem anspruchs-

vollen Musik-Freund und -Fan endlich die Erkenntnisse auf dem Gebiet der modernsten HiFi-Technik nutzbar und hörbar zu machen. Zu einem Preis, der sich sehen und hören läßt. Das Resultat: Interface:A. Vergleichen Sie die Wiedergabe-

Qualität mit jedem andern Gerät dieser Preisklasse. Von den höchsten bis zu den tiefsten Tönen. Bis 32 Hertz! Hätten Sie geahnt, daß Ihre Bänder und Platten soviel hergeben können?

## Eine unterschiedliche Form der Verzerrungskurve

Unterschiedlich zu einem luftdichten System liegt die maximale Auslenkung dieses «Tiefertonlautsprechers» beim Interface:A im Bereich von 45 bis 50 Hz. Statt einer konstant ansteigenden Verzerrungskurve wie bei luftdichten Systemen, verringert sich die Verzerrung,



wenn der Niederfrequenz-Abstrahler wirksam wird. Der totale Klirrfaktor bei 32 Hz liegt bei voller Eingangsleistung in der Größenordnung von 1%, eine bemerkenswert niedrige Zahl bei luftdichten Systemnormen.

## Entzerrung

Eine flache akustische Ausgangskurve macht nur eine geringe Entzerrung erforderlich: 3 dB bei 50 Hz, bei 35 Hz auf ein Maximum von 6 dB ansteigend. Unterhalb des nutzbaren Frequenzganges des Systems dämpft der Entzerrer scharf, um unerwünschte Niederfrequenzkomponenten (beispielsweise Schallplattenverkrümmungen oder Schwingen des Plattentellers mit

sehr tiefer Frequenz) zu dämpfen, bevor sie zu den Leistungsverstärkern gelangen. Eine Hochfrequenzregelung am Entzerrer erlaubt die Einstellung des Lautsprecher-Frequenzganges an der logischsten Stelle im ganzen System.

Der Entzerrer enthält zwei identische Kanäle und ist so konstruiert, daß er an den tape monitor Buchsen von Tunerverstärkern angeschlossen werden kann. Er kann auch zwischen dem Vorverstärker und den Leistungsverstärkern geschaltet werden.

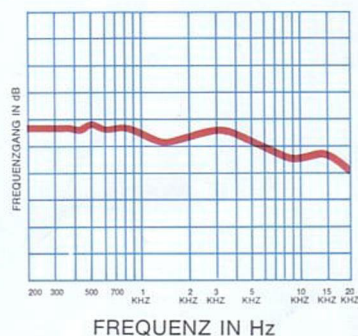
## Gleichmäßige akustische Ausgangsleistung

Bislang haben wir uns auf den niederfrequenzmäßigen Aufbau und die Vorteile ventilierter Systeme, verglichen mit luftdichten Systemen, konzentriert. Jedoch würden wir auch bei der Konstruktion eines luftdichten Systems eine gleichmäßigen Hochfrequenz-Wiedergabequalität eine eingehende Aufmerksamkeit schenken. Viel wurde hinsichtlich eines flachen Frequenzganges, gemessen direkt vor dem Lautsprecher, unternommen, aber die Charakteristik des Klanges, den der Zuhörer in einem typischen Zuhörerraum vernimmt, hängt weitgehend von der totalen vom Lautsprecher abgestrahlten Leistung ab: von der Summe seiner Ausgangsleistungen nach allen Richtungen. Gewünscht wird ein **gleichmäßiger Frequenzgang** auf der Achse und eine gleichmäßige **Ausbreitung** zwecks einer gleichmäßigen **totalen akustischen Ausgangsleistung**.

Idealerweise sollte das Abstrahlungsgebiet eines Lautsprechers mit **zunehmender Frequenz abnehmen**, um die Ausbreitung konstant zu halten. In dieser Beziehung hilft der niederfrequenzmäßige Aufbau des Interface:A. Der äquivalente Ventilierkanal, der einem Tiefertonlautsprecher mit 30 Zentimeter Durchmesser entspricht, erfährt den untersten Teil des Spektrums. Da er diesen Spektrumteil nicht beherrschen muß, kann der «richtige» Tiefertonlautsprecher des Interface:A kleiner als ein typischer Lautsprecher mit 20 Zentimeter Durchmesser mit einer gleichmäßigen Ausbreitung im mittleren Frequenzbereich sein.

Der Hochtonlautsprecher beginnt bei 1500 Hz wirksam zu werden. Seine gesamte Fläche strahlt durch die Schaum- und Filzquadrate vor ihm, da letztere in diesem Frequenzbereich akustisch durchlässig sind. Mit zunehmender Frequenz **absorbiert das Filzmaterial Aus-**

TOTALE AKUSTISCHE AUSGANGSLEISTUNG

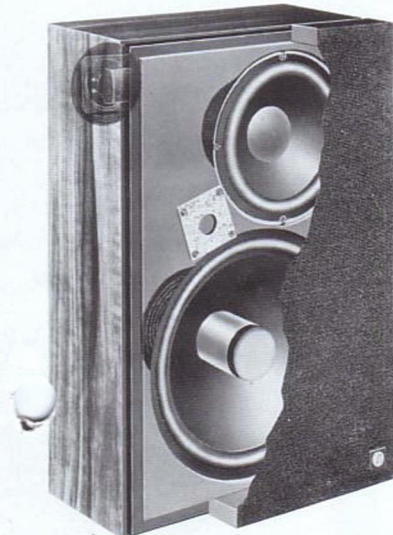


**gangsleistung** vom Hochtonlautsprecher, wobei nur das Loch in der Mitte zur Abstrahlung der höchsten Frequenzen verbleibt.

Über etwa der höchsten Oktave des Systems liefert ein auf der Rückseite des Gehäuses montierter Hochtonlautsprecher Ausgangsleistung, welche mithilft, im Raum eine gleichmäßige akustische Leistung zu erhalten. Der rückseitige Hochtonlautsprecher soll nicht als «Reflexionslautsprecher» aufgefaßt werden; die Aufstellung des Gehäuses in bezug auf die Wände ist nicht kritisch.

## Der Ausgleich als Ziel

Unser Ziel war, mit Interface:A ein gut ausgewogenes System in bezug auf vernünftige Größe, erweiterten Frequenzgang, hervorragende Ausbreitung, einen brauchbaren Wirkungsgrad und weiten dynamischen Bereich bei einem realistischen Preis zu schaffen. Wie gut dieses Ziel erreicht wurde, ist eine Frage, die jeder selbst beantworten sollte. Und eine derartige Beurteilung erfolgt am besten nach aufmerksamem Zuhören und Vergleichen. Wenn Sie die neueste Liste von HiFi-Händlern haben möchten, die Ihnen Interface:A vorführen können, dann schreiben Sie uns noch heute.



# Electro-Voice

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Seit Jahrzehnten ist die Marke Electro-Voice Inbegriff für optimale Tonqualität. Schon während des zweiten Weltkrieges baute Electro-Voice die ersten geräuschdämpfenden Mikrophone, und mit den ersten CDP-Lautsprechern wandten sich die EV-Techniker auch den Problemen der Electro-Akustik zu. Neue Erkenntnisse wurden damals wie heute zur Perfektion entwickelt.

Das Electro-Voice-Programm umfaßt Mikrophone, Hi-Fi-Systeme, Lautsprecher-Chassis und Hochleistungs-Lautsprecher.



*© beim Hersteller  
Archiv Michael-Otto*

# *Electro-Voice*

Ihr Fachhändler berät Sie gerne:



Interface:A  
Vented, Equalized  
Speaker System

*© beim Hersteller  
Archiv Michael-Otto*

# Interface: A™

We've been involved with sound since 1927 when our founder learned that he could make better microphones than he could buy. From the first, we've had the attitude that if we can make our products a little better than the other guy, we'll succeed. And so far it seems to have worked out that way. In large measure, our products reflect the creativity and resourcefulness of our engineers — products that do a job better than it has been done before.

Transducer development is a demanding engineering discipline. Part mechanical, part electrical, part science, part art... speaker designs are as difficult to explain as they are to create. And because performance definitions are obscure, more liberties have been taken with speaker specifications than perhaps any other component.

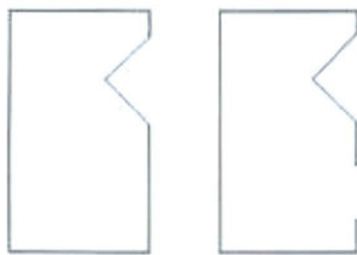
Our engineers have worked hard to produce a speaker system for home use that provides improved performance in every major area. We would like to offer, in lieu of the usual rhetoric, some insight into the design of the Interface:A.

Building a loudspeaker system (for whatever purpose) is as much an exercise in choosing goals as it is an engineering project. Should you opt for high efficiency, or wide range, or small size, or what? And how much are you willing to sacrifice in one department in order to achieve the utmost in another?

Because serious, basic investigation into the physics of loudspeaker operation is really quite rare, most speaker systems are based on existing technology. And the differences one hears are primarily a matter of how engineers (or sales departments) place emphasis on one or more of the desired goals at the expense of the others. Your choice, then, is rarely among competing technologies, but rather which design goal most nearly meets your own needs.

## "YOU CAN'T CHANGE THE LAWS OF PHYSICS."

Of course not. But one can understand and apply the laws more thoroughly, which is what the Interface:A system is about. There are types of enclosures other than sealed, one of which is called vented. By somehow using the energy which is inside the box, it would seem reasonable that low frequency performance could be improved.



SEALED

VENTED

## "WHAT'S SO NEW ABOUT VENTED BOXES?"

Nothing, really. A hole in the box has occurred many times in acoustic history under a variety of names. However, what is new is the ability (1) to understand the vented system so completely and (2) to know how to precisely manipulate it into a multitude of usable forms. In place of mystique, cut-and-try, and old wives' tales, is a coherent scientific presentation of the subject, based on electrical filter response characteristics. Briefly summarized, when compared to a sealed system, a vented system may have:

- 1/2 octave more bass  
or
- 4 dB more efficiency  
or
- an enclosure 1/3 the size

Or some of each, much like ordering at a Chinese restaurant.

## PICK ONE FROM COLUMN A...

Since the aim of high fidelity is to improve all aspects of performance, we elected to spread this technical largesse. In the process, we selected a system response (Sixth Order Butterworth) which employs an auxiliary circuit, or equalizer. This choice further increases the degree of advantage over sealed systems in the areas of bandwidth, efficiency, and enclosure size. We allocated these combined

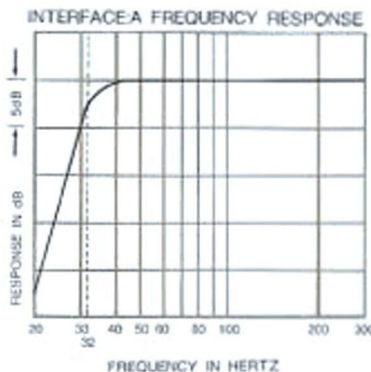
advantages in a manner highly beneficial for home systems:

- 1/3 octave more bass  
and
- 2 dB more efficiency  
and
- 1/2 the enclosure size

## 32 HERTZ. REALLY.

Most speaker system frequency response specifications in print today are meaningless. Prevarication runs rampant for two reasons: everyone *knows* that high fidelity extends down to 20 Hz, and very few people know what the lowest frequencies really sound like.

Response of the Interface:A is down only 0.5 dB at 40 Hz, then quickly turns the corner and drops to -3 dB at 32 Hz. For comparison, 32.7 Hz is the lowest C on the piano, three octaves below middle C. The lowest note of a standard-tuned bass viol or bass guitar is 43 Hz.



## HOW IT IS DONE

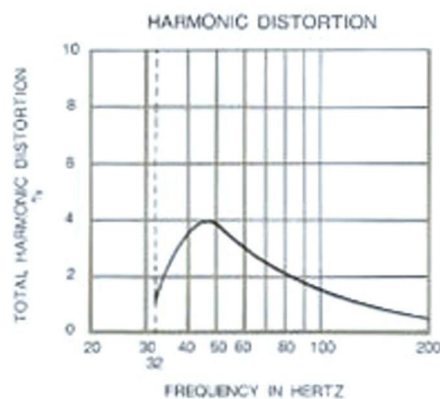
The vent required to tune the 1300 cubic inch volume of the Interface:A to 32 Hz is not just a hole in the box; in fact, the smallest usable hole would require a duct several feet long. The Interface:A uses a practical alternative (or vent equivalent) to properly tune the enclosure. It looks like a 12-inch woofer but it has no voice coil or magnet. In fact it is a 10" diameter piston with a mass equivalent to the amount of air required to reach 32 Hz tuning. A "real" vent of this diameter would be 20' long, but please don't confuse this with resonant tube designs such as organ pipes.

## A DIFFERENT SHAPE DISTORTION CURVE

In a general way, low frequency distortion is related to speaker excursion. Non-linearities in the cone sus-



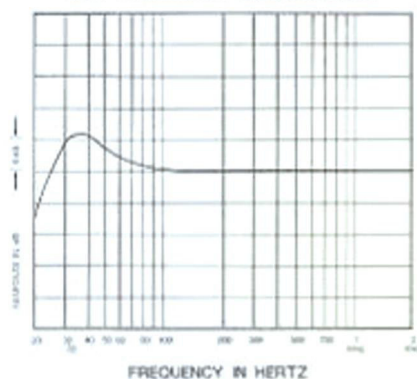
pension, voice coil motion, and even the magnetic flux, combine to give higher distortion levels as excursion increases. Unlike a sealed system, the maximum "woofer" excursion in the Interface:A occurs a half octave or so above 32 Hz. Because the low frequency radiator has no voice coil or magnet, only the suspension nonlinearities are of concern, and are the simplest to avoid. Instead of the constantly rising distortion curve characteristic of sealed systems, distortion actually diminishes as the low frequency radiator comes into play. Total harmonic distortion at 32 Hz with full power input is on the order of 1%, a remarkably small amount by sealed system standards.



### TO EQ OR NOT TO EQ

The use of auxiliary circuits to equalize, contour or boost bass is troubling to some people. And indeed, an excessive amount is troubling to us. There are vented system tunings which require 13 dB of equalization (20 times the power), which we consider excessive for this application. There are sealed speaker systems on the market today that require up to 20 dB, or 100 times the power, at low frequencies. In such cases, there is legitimate concern about the low frequencies "using up all the amplifier power."

LOW FREQUENCY EQUALIZATION



By comparison, the low frequency equalization required by the Interface:A design is modest. Flat acoustic output requires additional input of 3 dB at 50 Hz, rising to a maximum of 6 dB at 35 Hz. This is not an "extra" power requirement for a number of reasons:

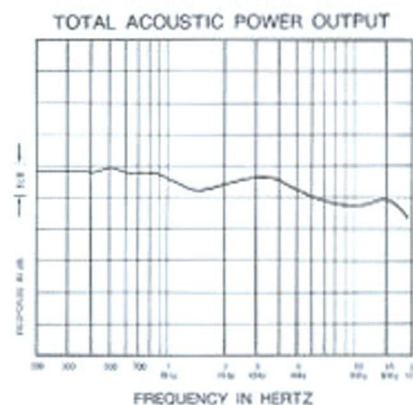
- Use of an equalized, vented system design yielded higher overall efficiency. Average power input with normal program material will be less than for a comparable sealed system.
- Below the usable range of the system, the equalizer rolls off the electrical input to the amplifier, eliminating unwanted low frequency content (turntable rumble, record warp, etc.); thus conserving amplifier power below the speaker system's usable low frequency limit.
- By providing low frequency output *in fact* rather than on a spec sheet, there is less need to use bass controls and loudness switches in an effort to obtain satisfyingly solid low end.

The equalizer is designed to be connected to the tape monitor jacks found on most components. It may also be used between preamplifier and power amplifiers. The equalizer includes two channels of equalization for use in stereo systems. Once the equalizer is added, additional Interface:A speaker systems (for remote speakers, for instance) may be connected to the same amplifier and receive the proper equalization.

### UNIFORM TOTAL POWER OUTPUT

With so much design concentration on uniform and extended bass output, the tendency is to overshadow performance at higher frequencies. Yet mid- and high-frequency performance is of great significance to the overall sound of, and satisfaction with, a speaker system. A speaker's *total acoustic power output* indicates, as a function of frequency, all of the sound radiated by the speaker — at

all angles. This total acoustic power output correlates well with a speaker's perceived performance in the listening room, and is therefore a measurement of major importance. Total acoustic power output may be related to more familiar measurements: uniform *frequency response* combines with uniform *dispersion* to provide uniform total power output.



The primary tweeter (mounted behind the square-of-felt-with-a-hole-in-it) incorporates a 2-inch diameter piston with 5/8-inch diameter aluminum dome. The tweeter output radiates through foam and felt squares to maximize dispersion as frequency increases. In effect, the tweeter size is "shrunk" above 5000 Hz to maintain high dispersion, while the whole piston area radiates at lower frequencies, enabling the tweeter to be used down to 1500 Hz.

A second tweeter located on the rear of the speaker enclosure operates above 7000 Hz, which helps maintain constant acoustic power in the upper octave of the system. Placement of the system is not at all critical, however.

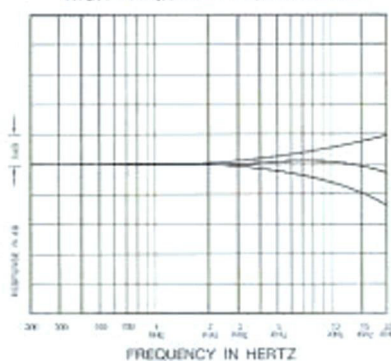
### MORE EQ

Since a piece of electronics is required for low frequency equalization, it has been utilized at high frequencies as well. A choice of three switch-selected equalizations provides both operational and technical benefits:

- Choice of equalization is available at the equipment position, not buried in the speaker cabinet.
- Removing the tweeter control from the crossover eliminates a major long-term reliability problem of speaker systems.

# Interface: A™

## HIGH FREQUENCY EQUALIZATION



### SHOULD A LISTENER EXPECT TO BE OVERWHELMED BY THE SOUND OF THE INTERFACE:A?

No. Any speaker which immediately stuns you should be suspect. Systems which attempt a spectacular first impression often cheat on overall balance of parameters, and may soon produce dissatisfaction growing out of listening fatigue. It is also possible to make any system good or bad simply by judicious selection of program material, of course. There are some general differences you will find with the Interface:A however:

- Our concern with total acoustic power output, coupled with our somewhat higher efficiency, results in the subjective judgement that the Interface:A is "brighter." If the program material has good clean high frequency response, the effect is one of opening a curtain on a live performance. On the other hand, if the program material is distorted, fuzzy, clipped, or whatever, a speaker system with less high frequency output will offend the ear less. If high frequency distortion is a

problem, one must either get clean program material, or roll off high frequency response. Since we have no desire to forever limit you to rolled-off response, that option is available on the equalizer at the turn of a switch.

- Bass response can be misleading. The ear tries to judge low frequencies by comparison to higher frequencies. Thus if a speaker system has a bumped-up bass response, or rolled off high frequency response, one may conclude it has "more bass." Characteristics of the listening room make a tremendous difference in the perceived amount of bass, which also depends upon where one is located in the room. However, if the program material has fairly continuous power below 50 Hz, the Interface:A will reproduce it, providing a solidity and foundation to the music that defies description.

In summary, Interface:A is the result of a painstaking study to identify the optimum design choices available to the serious audio engineer. Using objective measurement as a guide, plus a thorough understanding of basic transducer theory, we have created a system with a clear advantage in every important performance attribute. Interface:A is eminently suited to the vital task of reproducing music of every stamp . . . in your home, accurately, and with musical validity.

Interface:A. It's not as far from perfect.

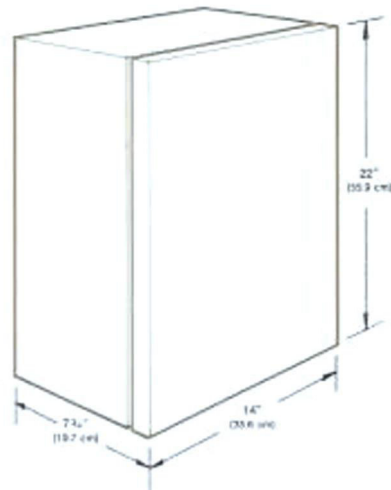
## WARRANTY

Interface:A is guaranteed against malfunction due to defects in workmanship and materials. If such malfunction occurs, Interface:A will be repaired or replaced (at our option) as follows:

Speaker systems will be repaired or replaced without charge for parts or labor for a period of five years from the date of original purchase.

Equalizer will be repaired or replaced without charge for parts for a period of three years from date of original purchase and without charge for labor for a period of one year from date of original purchase.

All units must be delivered prepaid to the proper Electro-Voice service facility and will be returned prepaid. Warranty does not cover finish or appearance items or malfunction due to abuse or operation at other than specified conditions. Repair by other than Electro-Voice or its authorized service agencies will void this guarantee.



# Electro-Voice®

ELECTRO-VOICE, INC., 600 Cecil Street,  
Buchanan, Michigan 49107

a **Gulton**  
COMPANY

Certain design concepts included in the Interface:A have been the subject of technical papers given by Electro-Voice engineers:  
D. E. Keele, "The Vented Loudspeaker Cabinet: A Restatement," Audio Engineering Society Convention, May, 1972.  
J. R. Gilliam, "Distortion in Dynamic Loudspeakers Due to Modulation of the Permanent Field," AES Convention, May, 1972.  
R. J. Newman, "A Loudspeaker Designed Utilizing a Sixth Order Butterworth Response Characteristic," AES Convention, September, 1972.



# Interface: A™

A rational discussion

lower frequencies. This accounts for the somewhat rounded slope of the bass rolloff in our response curve, though the effect is difficult to hear in most program material when A/B-ing the sound with the equalizer in and with it out.

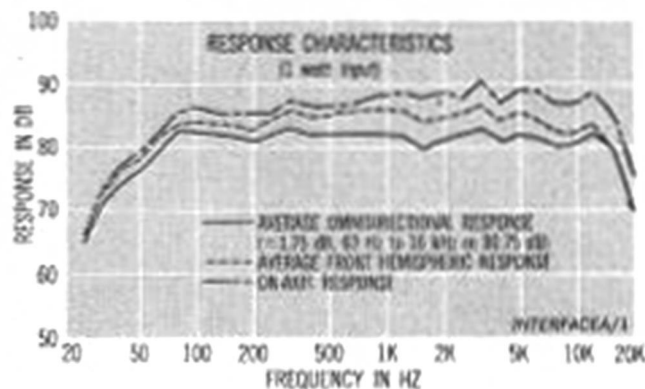
In a normal room the bass response seems better than the curve would suggest of course—a normal condition due to room reinforcement of the low frequencies. Down to about 35 Hz test tones remain strong and unusually clean; below that frequency response falls off. At the top end, thanks to the dual tweeters, there is very little sense of beaming. With test tones the response is reasonably smooth and, though cancellation can be spotted at 90 degrees off axis above 10 kHz, very well dispersed. From that frequency upward, the sound becomes progressively beamy. At 18 kHz it is considerably down in level and is audible (to those of our listeners whose hearing extends that far) only on axis.

On musical material we judged the Interface A to be unusually clean and smooth, though—perhaps because of its utter lack of boominess in the bass—it conveys somewhat less sense of "body" in orchestral music than you might expect in typical bookshelf systems. "Crisp" was one word used to characterize its reproduction of music—particularly instrumental music. And though the sound is not colored in the usual sense, its flat upper range led some listeners to call it "rather bright."

Efficiency of the system is higher than that of typical acoustic-suspension systems. It requires 4.4 watts to produce the standard midband output of 94 dB at 1 meter on axis. It handles up to 100 watts of steady power for an acoustic output of 108 dB, and it handles pulses to 160 watts average for 113 dB output—an ample dynamic range.

Nominal impedance measured 5 ohms in the lab—as opposed to E-V's 8-ohm rating. From the rating point at about 200 Hz the impedance rises to beyond 16 ohms in the region around 1 to 2 kHz, then descends to about 8 ohms from 5 kHz upwards. But though most of the curve lies relatively high, it might be better to treat the Interface A as you would a 4-ohm model in multiple-speaker hookups.

The Interface A is handsome both in sound and in ap-



#### Electro-Voice Interface A Harmonic Distortion\*

Output Level (dB)	Frequency			
	80 Hz		300 Hz	
	% 2nd	% 3rd	% 2nd	% 3rd
70	0.50	1.0	0.55	0.60
75	0.45	0.70	0.55	0.60
80	0.60	0.70	0.55	0.60
85	0.95	1.1	0.55	0.60
90	1.5	1.8	0.55	0.60
95	3.1	3.4	0.55	0.60
100			0.58	0.60
105			0.58	0.82
108			0.65	0.65

\*Distortion data are taken on all tested speakers until distortion exceeds the 10 per cent level or the speaker produces the spurious output known as buzz (G) whichever occurs first.

pearance. The unusual shallowness of its enclosure makes it really fit on a bookshelf, though if you want to retain the full high-frequency dispersion provided by its rear-firing tweeter you should plan on a space of at least two inches between the enclosure and the wall behind it. The enclosures can be positioned either vertically or horizontally (E-V gives you their medallions in a separate envelope so you can orient them accordingly after you have decided on placement) and their thin profile makes them seem less bulky than most enclosures when they are free-standing.

CIRCLE 143 ON READER-SERVICE CARD



## E-V's Speakers-Plus-Equalizer Combination

**The Equipment:** Electro-Voice Interface A, a stereo speaker system in walnut enclosure, sold in pairs together with equalizer unit. Dimensions: 22 by 14 by 7 3/4 inches (each speaker); 8 by 2 1/2 by 6 1/4 inches (control/equalizer unit). Price: \$400 for two speakers plus control/equalizer unit. Warranty: 5 years parts and labor on speakers; 3 years parts, 1 year labor on control unit. Manufacturer: Electro-Voice, Inc., Buchanan, Mich. 49107.

**Comment:** Interface A transcends the commonplace in a number of respects. Most obvious is the inclusion of an active equalizer unit. Less obvious—until you remove the black knit grille cloth—is the design of the bass reproducer: a 10-inch driver coupled with a port-loading device that resembles a 12-inch woofer. And only when you look at the back of the enclosure will you discover that in addition to the front-firing tweeter there's one facing the back.

An avowed design aim of the system is to deliver "uniform total acoustic power output" into the listening room. The back-firing tweeter contributes to this aim, and its effectiveness is demonstrated by the response graph, which is unusually flat (plus or minus only 1 1/2 dB from 63 Hz to 16 kHz!) in the omnidirectional measurement. A second design aim—and one that would seem a contradiction in terms at first glance—is to keep the enclosure size relatively small while increasing efficiency by contrast to typical acoustic-suspension systems, and to do so without sacrificing bass performance. This is what the port-loading "passive radiator" (a term E-V dislikes in this application) is all about. Its size and mass are chosen so that its loading of the air within the 1,350-cubic-inch enclosure is equivalent to that of a 20-foot air column 10 inches in diameter—the size of an air column needed to tune the enclosure to 32 Hz. E-V calls this loading device a "vent equivalent"; it is intended as an equivalent of a larger ducted design and to this extent does reduce enclosure size without paying the rule-of-thumb price in bass response and/or efficiency.

To set up the Interface A you begin by connecting the

control unit to the tape recording/monitor jacks of your stereo system. The control unit itself has outputs for two tape recorders, plus monitor input for one. You can therefore run one tape deck (normally connected to the jacks pre-empted by the control unit) to the control unit and add a second deck, feeding its playback output to the aux jacks on your stereo system—thereby increasing the tape flexibility of the system as a whole. A tape/source switch on the control unit will then allow you to monitor from the first of these decks. A second switch is marked "off/1/2/3" and controls tweeter response in the speakers. At the "off" (which cuts AC power to the active equalizer's circuitry) position, signals will get through, but they will sound fuzzy. To prevent this from happening accidentally, you can plug the control unit into a switched convenience outlet on your receiver or amp and drive another unit you want similarly switched (perhaps a separate tuner) from the convenience outlet supplied on the back of the E-V.

The speakers are connected in the normal way, using binding posts that will accept spade lugs or bared wires. In addition to the two for the audio signals, each speaker has two "extra" binding posts, one of which is delivered strapped to the common terminal. This second pair is for E-V's TS-1 tweeter protector (\$15), an optional accessory that uses a reed relay to cut power to the tweeters for as long as it is dangerously high—though not on transients too brief to damage tweeter windings. E-V cautions against connecting power leads to these terminals by mistake.

The lab measured the control range of the three treble positions on the equalizer as about plus 6 (the "1" position) or minus 6 dB ("3") above 10 kHz with respect to the normal setting at "2"—the setting used in all subsequent lab tests. Some of our listeners preferred the sound with the setting at "3"; those who have expressed a preference for "flat" response in the past preferred the normal setting. The equalizer also adds some boost in the bass. According to the lab tests it increases gradually below about 100 Hz, reaching some 6 dB of boost around 35 to 40 Hz, and falls off again at

### REPORT POLICY

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