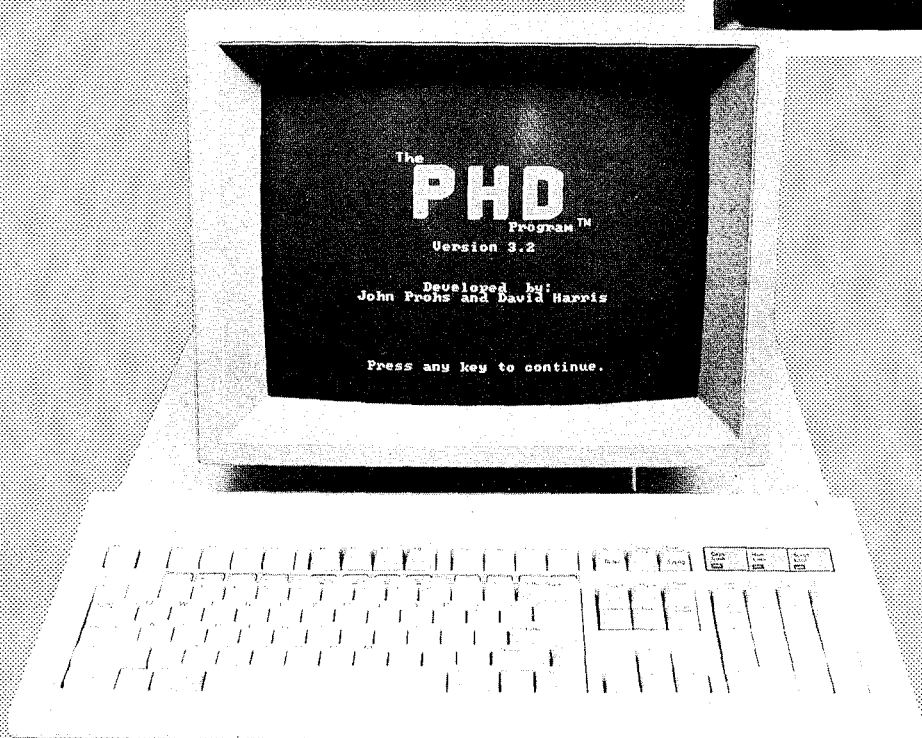
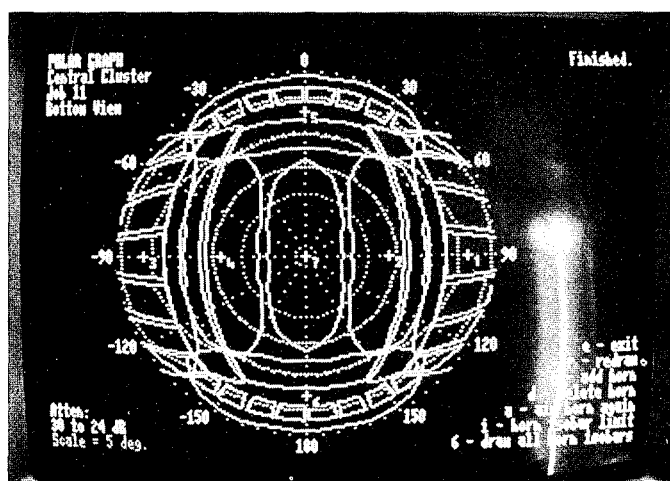


SYNERGETIC
SYN AUD
CON
AUDIO CONCEPTS

newsletter

Volume 15, Number 2
Winter 1988
©Don & Carolyn Davis

New
3.2 Version



of the
PHD
Computer
Program

SYNERGETIC
SYN AUD
CON
 AUDIO CONCEPTS

Synergetic: Working together; co-operating, co-operative.

Synergism: Co-operative action of discrete agencies such that the total effect is greater than the sum of the two effects taken independently.

Editors: Don Davis
 Carolyn Davis

Staff: Dashia Alfonso
 Laura Bailey

Creative Assistance:
 John & Jean Odum

Copyright 1988 by Synergetic Audio Concepts. All rights reserved. Printed in the United States of America. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior written permission of Synergetic Audio Concepts.

The information conveyed in this NEWSLETTER has been carefully reviewed and believed to be accurate and reliable; however, no responsibility is assumed for inaccuracies in calculations or statements.

To receive a subscription to the Syn-Aud-Con quarterly Newsletters and Tech Topics for one year, your cost is \$32.00 in North America. All other countries \$38.00 airmail payable in U.S. Funds, by Mastercard or Visa.

If you attend a Syn-Aud-Con Seminar during the year, your subscription will be extended one year. (You receive a subscription for one year as part of the registration fee.)

For additional information contact:

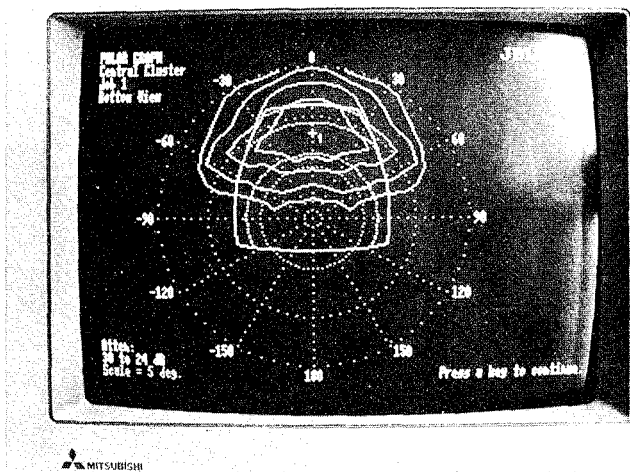
Synergetic Audio Concepts
 P.O. Box 1239
 Bedford, IN 47421
 (812) 275-3853

CONTENTS

- 3** New PHD Program
 Heyser Scholarship Donation
 - 4** LEDE® Listening Rooms
 - 5** Peter, the Great!
 Domain Chart Named
 Don Officially an FOF
 - 6** Signal Synchronization
 Using an RTA
 New Chief Engineer at
 J.W. Davis Co.
 - 7** Rolly Brook on Loudspeaker
 Alignment
 - 8** Hell Must Be a Hotel
 Forty Loudspeakers...
 Shall We Laugh or Cry?
 - 9** Syn-Aud-Con Schedule
 Bill Matthews
 - 10** Compressors & Limiters
 Errata
 Denver Class Montage
 - 11** Workshops at the Farm
 - 12** Russ Berger - Vice Pres.
 New TEF Owners
 - 13** Polar Responses &
 a Polarization
 Chris Maione - A Talent
 - 14** Using The Kolbe Human
 Dummy Head
 Tom Mardikes &
 KC Class
 - 15** A Walk in the Woods
 Chicago Class Montage
 - 16** BIAMP
 Resolution in Measurement
 - 17** John Wiggins Asks Some
 Pointed Questions
 Programs for the HP41C
 - 18** Intelligibility & The AES
 New Products from Bench-
 mark Media Systems
 - 19** AES Crosstalk Video
 - 20** Big John Can Do Anything
 Sarnoff Review
 Washington Class Montage
 - 21** Book Review: *Engineers &
 Electronics*
 New York Class Montage
 - 22** New Shure Microphone,
 Mixer & Amplifier
 Professional Services
 - 23** Bose at the Olympics
 Heyser Video Tapes
 Smile
 How Many Ways Can You
 Use RPG Diffusers?
 Sound Level Meters
 - 24** Smile
 We Found Sounder
 Handbook for Sound Eng.
 Mary Gruszka
 Digital Level Meter
 - 25** Ron McKay of MCB
 Article on Psychoacoustics
 - 26** I Thought We Knew
 What to do With It.
 Smile
 Show Stopping Theater
 Design
 - 27** Doug Jones Writes...
 "...a Cup of Tea"
 - 28** Polarity & Phase Illustrated
 Tektronix Scope
 - 29** Reverse the Polarity . . . ?
 - 30** Damping Factor
 - 31** Environmental Noise Level...
 Authors That Predate Haas
 Classified
- Tech Topics
 Activities in Europe
 Compressor /Limiters:
 Applications and Design
 by Bob Rodgers

Updated PHD Program™

Proceeds Donated to The AES Heyser Scholarship Fund



The 3.2 version of the PHD program will be in color

The Richard C Heyser Scholarship Loan Fund has been set up to honor Dick Heyser with a lasting memorial. The purpose of the scholarship loan is to financially assist promising graduate engineering students in the field who, otherwise, could not continue with their studies. As recipients repay the money after graduation additional students can be helped.

Last March Dick died, just a few months before he would have assumed the office of AES President. He not only was active in AES but he contributed enormously to our field's fund of knowledge. Dick shared, on the intellectual level, his stunning Time Energy Frequency discoveries but he gave of himself on a personal level as well. Dick, himself, gave so much to all those with whom he came in contact, especially those just starting out; we feel Dick would have been pleased to know he is being remembered in this way.

New PHD Program

In conjunction with this memorial, a major update of The PHD Program will be dedicated to Dick Heyser. All the proceeds will go to the Richard C Heyser Scholarship Loan Fund thanks to Ambassador College, the new owner of The PHD Program.

The sound system design engineering program is based on the time proven, highly accurate, spherical mapping method developed by John Prohs. Staff at the college is steadily working to complete the update.

The program is in glorious color. CGA™ mode is supported. A Screen Aspect Ratio adjustment feature has been added so the graphics will display true on portables or other computer monitors requiring a correction factor. The program will take up more than one 360 K disk so a hard drive is strongly recommended for owners with the lower density drives.

What the New Program Can Do

Data from former jobs could be reviewed, reprinted, added

to, or copied onto another disk. Also an entire job could be duplicated on the same disk. Sections could be deleted within the program, or to clear up disk space, all data in the job may be eliminated. Designers can also add to, edit, or delete isobar patterns if desired. No accessory hardware is needed. The mapping is done entirely on computer which cuts design time substantially. After room data is entered, the designer can proceed right to a Polar Graph view where he can have the room swiftly plotted on the screen and try out different loudspeakers.

All contours can be seen at once when adding horns or have the 3dB or 6dB horn contours displayed individually. The patterns are quickly drawn on the polar graph and can be re-aimed, or even changed and very rapidly redrawn right there. The rotation effects on coverage are easy to try and view. The rotation needed is evident for cluster installation. In a very short time several major cluster changes can be tried.

The room map, or the horns, or the entire design can be printed out--in color if you have an IBM compatible color printer with graphics capability and the right printer drivers.

Horn information saved in the Polar Graph Section is automatically transferred forward to the Power Analysis Section. After you enter the drivers desired, the power needs are ready to be calculated for you. New isobar horn patterns from manufacturer's polar plots are easily entered. With practice a designer should be able to enter a new horn into the horn data files in about a minute or two and not much more than that if one is inexperienced.

Heyser Donation

Any individual designers or contractors making a donation to the Richard C Heyser Scholarship Loan Fund of \$300.00 or more, who wish a copy, will be granted a license to use the program when it is ready for release; individual prior owners making a donation of \$50.00 or more will be given an update. Equipment manufacturers desiring to distribute copies of the program to their customer base can contact John Prohs at Ambassador College about donations.

Contributions to the fund gives each of us a chance to honor Dick by nurturing the education of others.

According to Amy Heyser, Dick's widow, tax exempt status is pending. But, if you would like to help and have your donations tax deductible now in the US, just make them payable to: the Richard C. Heyser Scholarship Loan Fund/AES, 60 East 42nd Street, New York, NY 10165-0075.

How to Order

The next issue of the newsletter will include an order form for the new PHD 3.2 update. In the meantime, you can send your donation to the AES, with a copy to Syn-Aud-Con. We will place your order with Ambassador College and notify you of the release date for the PHD program.

LEDE[®] HOME LISTENING ROOMS

The Tech Topic on LEDE rooms accompanying this Newsletter is reprinted from the August *Audio Magazine*. It was written to correct serious misinformation published earlier by the same magazine.

The LEDE concept has become the predominant design for serious professional rooms.

The main new information since the article was written is the recognition of the importance of hiding the specular reflection, which triggers the Haas effect, into the first arrivals from the diffusors and at about the same peak level as those arrivals.

What is New in Home Listening Rooms?

Now we are hearing that the hi-fi industry is becoming very much aware of the fact that the listening environment is just as important as the purity of their equipment. As Doug Jones says, in our professional field, great attention is paid to the acoustics of a recording studio and control room and our control room monitors suffer. In the high fidelity industry, the equipment design is pushed to the nth degree with very little thought given to the acoustics of the listening room.

That is changing! Charles Bilello, Peter D'Antonio, Rich Zwiebel and Doug Jones are giving us glowing reports of the enthusiasm with which the high fidelity manufacturers, owners of sales rooms and their clients are responding to the improvements that can be made with absorption and diffusion. Rich Zweibel will be in one room of the Rowland Research suite at CES with his TEF analyzer showing people that they can hear with their ears what they see with their eyes on the TEF analyzer. And he will be giving away the Tech Topic on LEDE from *Audio Magazine*.

LEDE Certification for Home Listening Rooms

Charles Bilello has encouraged us to certify LEDE listening rooms. Charles is helping us prepare the cer-

tification and it should be available soon. To anyone working in this area, we encourage you to share your work. We are hearing of \$250,000 communication systems. Rich Zwiebel has a client now that says that he doesn't care what it costs, just make it sound good.

Quoting Charles Bilello

I have set up modular type RPG applications including the first Free-Standing Diffusor Clusters, Free-Standing Abffusor Clusters, and the "all new" Floor Foil.

The Free -Standing diffusors (on wheels) can be positioned as desired behind the listening position. It is not always practical to mount the cluster(s) on the rear wall because of an entrance way to the room or because their placement would be too great a distance from the listening position.

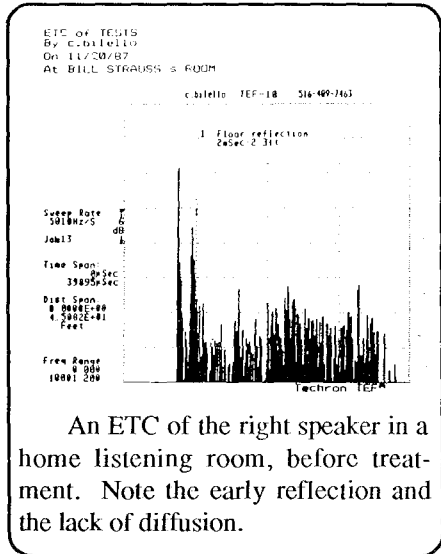
RPG will offer adjustable "flaps" (mirrored) on the sides of a cluster which can focus specular energy back to the listening position. So what's the "flap" all about? I guess it Haas to be heard!

The Free-Standing Diffusors can also be placed between and slightly behind the speakers. This allows the rear diffusors to feed the front diffusors, and elongates the early sound field.

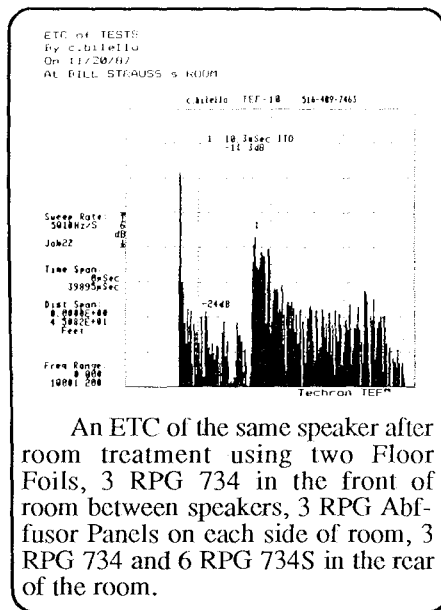
The Free-Standing Abffusors are placed to the sides of the speakers eliminating early reflections with fantastic results in the low frequency region. Abffusors hung off the ceiling slightly (2 to 4 inches), in what is called a "cloud" configuration, eliminates the ceiling reflection at the listening position, and looks real good.

The Floor Foil (soon to be

TMed) is essential in a home listening room. It is simply portable absorption (a pair of foam wedges) that eliminates the "hot" floor reflection (which is eliminated in control rooms by the presence of the console...that's a twist!)



An ETC of the right speaker in a home listening room, before treatment. Note the early reflection and the lack of diffusion.



An ETC of the same speaker after room treatment using two Floor Foils, 3 RPG 734 in the front of room between speakers, 3 RPG Abffusor Panels on each side of room, 3 RPG 734 and 6 RPG 734S in the rear of the room.

Anyone the least interested in home listening rooms reading what Charles Bilello and Peter D'Antonio are doing can't help but be excited. Charles joking says that he is Head of Research at RFG. It's true that he has enormous input with Dr. D'Antonio. And the great thing about Peter is that he is listening. ■

PETER, THE GREAT!

Two very important papers given at the fall AES in New York City were "Complex Time-Response Measurements Using Time-Delay Spectrometry, Part I, AES preprint 2542 (B-1) by Peter D'Antonio and John Konnert, along with "Sound Intensity and Interaural Cross-Correlation Measurements Using Time-Delay Spectrometry, AES preprint 2543 (B-2) by Peter D'Antonio, John Konnert, Farrel Becker and Charles Bilello.

These absolutely superb papers can be faulted for only one thing -- using the term time delay spectrometry instead of TEF when talking essentially about ETC-based measurements.

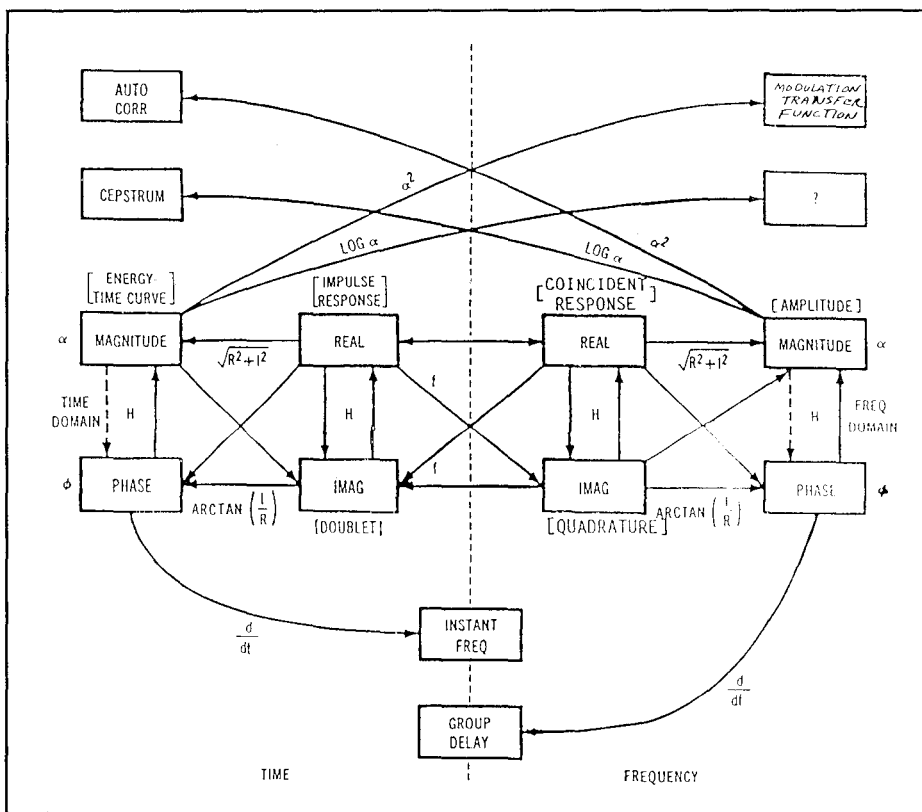
Both papers introduce completely new and important ways to use the TEF analyzer. The first paper mentioned above is particularly exciting to us because it reveals the caliber of work and workers still here to carry on Heyser's vision. No serious TEF student should fail to obtain a copy of these preprints. The phase of the energy time curve is going to be the tool that opens many a closed door in electroacoustic.

? ON DOMAIN CHART IS NAMED

Peter D'Antonio opened one door for me during a recent telephone conversation. He identified one of the "question mark" boxes on the domain chart as the *modulation transfer function* (see illustration). My response was to hit my forehead with the palm of my hand and say of course! Yes! Of course it is but I didn't see it until he had said it. It's that kind of thinking that makes Dr. D'Antonio Peter, the Great.

Schroeder's modulation transfer function in plain English states that the MTF is the magnitude of the Fourier transform of the squared impulse response (impulse in this case meaning the ETC). It's been there in words all along and the Domain chart has shown that box as the squared ETC Fourier transformed from the time to the frequency domain. Schroeder's equation is:

$$MTF = \frac{\int_0^{\infty} p^2(t) e^{-j\omega t} dt}{\int_0^{\infty} p^2(t) dt}$$



It also became apparent to me as I looked at the domain chart why the %ALCONS measurements made from the ETC outperforms the smoothed data of the MTF. We simply see more of the fine structure of the interfering elements.

I would be willing to "guess" that the problem with observing modulation effects is that some are harmful and some are not, just as some comb filters are harmful and others are not.

It's not a guess that we need a great deal more fundamental work on whether or not MTF has any real utility for measuring intelligibility.

It's sometimes hard to believe TEF is still in its infancy and ten years from now we'll look back and say "how come it took us so long to see what Dick was *really* trying to tell us."

DON OFFICIALLY AN FOF

The polite translation of FOF is "Faithful Old Follower". Don's status has been confirmed by no less an authority than the Acoustical Society of America who presented him with their Silver Certificate for a continuous membership record of 25 years. Just think, a whole generation studying acoustics and he doesn't know it all yet. Maybe they have a Gold certificate for 50 years of continuing ignorance.

SIGNAL SYNCHRONIZATION USING A REAL TIME ANALYZER

While there are over 250 TEF analyzers in the field now, there are thousands of real time analyzers. JBL/UREI, Audio Digital, etc wouldn't be manufacturing microsecond signal delays if only contractors with TEF analyzers would be able to use the delays.

One can use a real time, especially if they have seen a demo of TEF loudspeaker Synchronization and know what to look for.

We plan to do a carefully documented Tech Topic on using both a TEF and a real time analyzer to Synchronize identical horns covering the same frequency range, but for now we would like to show you a few pictures made in class of two identical loudspeakers in and out of Sync. (Be sure to read Newsletter Vol. 14 No. 1, page 10 and Newsletter Vol. 14, No. 3, page 23.

When you are Synchronizing two horns with a real time analyzer, turn on each horn one at a time to be sure that their response curve is the same. Record the response. Take a Polaroid if you can't print out the response. Then turn on both speakers. See Figure 1 for two speakers out of sync. Be sure that the mouths of the horns are together, otherwise you will be Synchronizing your horns for one location in the auditorium. You can Sync the acoustic centers with digital

delay units. If the mouths of the horns are lined up, you now have a coherent wavefront.

Measure the distance between the out of sync horns and calculate your delay: 79 microseconds = 1 inch. For example, if you measured 5 inches out of Sync, dial in 400 microseconds. Does the curve look like one speaker is on except 6 dB higher in level, perhaps not all frequencies but some will be 6 dB higher. If not, adjust the signal delay in both directions by 10 and 20 microseconds. Figure 2 shows the two speakers in perfect sync. Figure 3 is 10 microseconds out and Figure 3 is 20 microseconds. Don't settle for a signal delay that has 20 microseconds adjustments. It is too coarse. Note the roll off on the high end. With speech that may not be important but for music it is.

If you have any doubts about the importance of Signal Synchronization, read Rolly Brook's comments in this Newsletter.

We would be very grateful to all of you using Signal Synchronization to send us your pictures and measurements. We can put together a much more valuable Tech Topic if we have your input. We will give proper credit to all the material used.

New Chief Engineer at J.W. DAVIS CO.

Michael E. "Mike" Lamm has joined J.W. Davis Co. as chief engineer. Mike, well known to Syn-Aud-Con grads for his work with boundary PZM microphones, will be in charge of new product development and quality control. A Syn-Aud-Con grad and TEF owner now with a Syn-Aud-Con sponsor -- always a welcome combination.

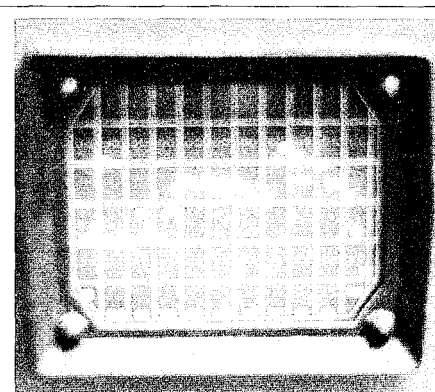
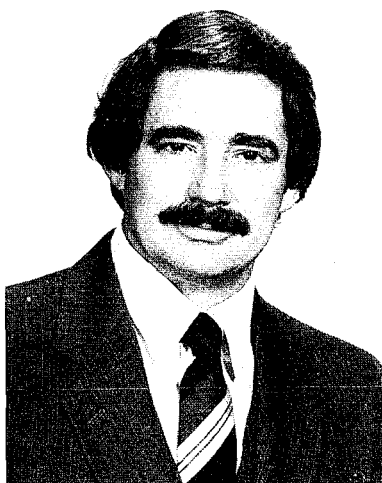


Fig. 1 Two speakers out of Sync

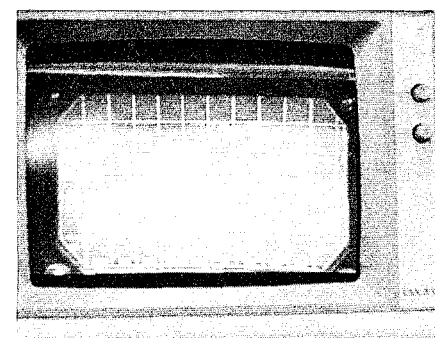


Fig. 2 Two speakers in Sync

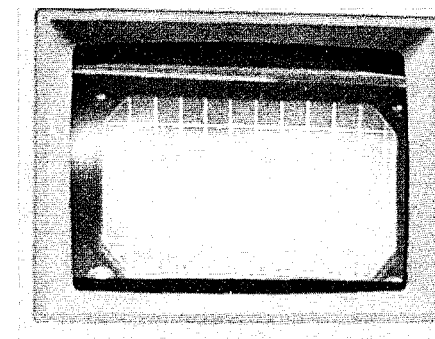


Fig. 3 Two speakers out of Sync by 10 microseconds.

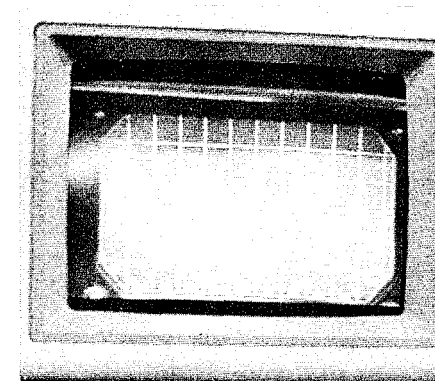


Fig. 4 Two speakers out of Sync by 20 microseconds.

Rolly Brook on Loudspeaker Alignment

Rolly Brook of RB Systems in Tarzana, CA wrote us a lengthy Christmas letter full of acoustical news of real interest to us - much of which we can't quote because it is proprietary.

The parts we can quote are fascinating. Men like Rolly are few and far between. He is a super competent acoustic consultant, an increasingly skillful TEF innovator, and a perpetual learner of all that's new and worthwhile. All of this radiates from the part of his letter we quote here. As is also evident Rolly is a sharer of hard-won approaches. Syn-Aud-Con is blessed with an ever increasing number of first rank acoustic consultants who are using TEF and who are sharing what they find with all of us. We can honestly say that the TEF revolution is moving quicker and surer than equalization did because of the very high caliber of early participants.

It recently occurred to us that many of the ignorant articles we carp about are written by TEFless people -- they can't help it. To be TEFless in today's audio world is to be handicapped to an unbelievable degree. To be a Rolly Brook is to labor in the fields frequented by giants.

The First Baptist Church of Pomona, CA is a 2500 seat room with main floor and balcony. It has a mid-band RT of about 1.5s with no acoustical problems for the sound system. The room is fully carpeted with heavily upholstered benchseating. Ron McKay lost the battle with the church committee to hold down the fuzz in order to get a higher RT and better support for the choir. Now, of course, the music people are less than thrilled with the choir sound. Why, oh why, do folks pay us so much money for advice and then ignore it?

The cluster (drawing enclosed) is made up of three little mini-clusters each consisting of a JBL 4648 dual 15" LF and a JBL 2360/2445 90x40 HF. The cluster is located directly above the pulpit. It is not boxed in, thus it is directly open to the pulpit and stage area below. This is not my favorite way to do it, but far too often one does what will fit the space and/or the budget.

The building was completed just before the long-scheduled grand opening and before we had time to align the cluster (isn't it always the way!). The contractor (Continental Sound - one of the best) balanced the system and did an EQ for the opening. The alignment would follow the next week.

The opening went well and there were no real problems with the system. The gain-before-feedback at the pulpit was adequate, but certainly not generous. My estimate was that

when the pulpit was removed and the area used as a stage, multiple mic'ing would likely be a problem.

Before doing the alignment, I walked the room with pink noise on the system. No doubt about it, the area under the pulpit was hot. The phasing hash in the two overlap zones was obvious on the main floor but much less so in the balcony - a curiosity I'll have to look into someday. The overlap zones are centered in two aisles - more good luck than clever design. The phasing hash was not limited to the aisles, it overlapped about 4 seats on each side.

I aligned the cluster in two steps: first aligning the crossover of each section; then bringing the side

=====
Crossover alignment is worthwhile, overlap alignment is nearly mandatory.
=====

sections into alignment with the center section in the overlap areas. Following the procedure I had worked at Orange County PAC, I located the test mic at the center of the worst of the phasing hash in the overlap zone. ETC was used to get the delay times close, then the final delay setting was determined by looking for the best amplitude and phase response. The correct setting was clear and unambig-

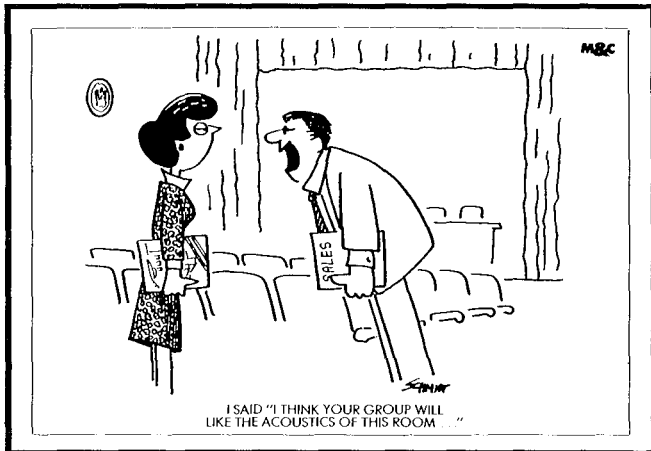
uous.

After alignment I found the following four items of interest:

1. Not surprisingly, the system sounds better. Much better definition in the mid-range.
2. The overlap zone hash, while not completely gone, is greatly reduced in area in harshness. In fact, I can not hear it at all in program material. Even with pink noise, there is no hash in the seating, what remains is entirely in the aisles.
3. The high-frequency band level went up so much that it was necessary to reduce the gain of the HF amplifiers by 6 dB. Wow, 6 dB of 'free' headroom just from aligning! When we did the new EQ, we pulled the mid-highs (2-3K) down a little more.
4. The stage area under the cluster is now almost a sonic hole. Upon walking onto the stage area from the congregation, the falloff is very noticeable. The minister even complained that he could not hear himself coming back from the system. The under-cluster area has benefited not only from the 6 dB HF drive reduction, but also a lobe has been removed. The increase in gain-before-feedback at the pulpit is in the order of 9 dB.

There is no doubt in my mind about the cost/benefit ratio of an alignment system. Crossover alignment is worthwhile, overlap alignment is damn near mandatory. ■

Hell Must Be a Hotel



We have held meetings in all kinds of environments. The sensitivity of the salesman in this cartoon is almost exactly what we're told when the NC = 70. We have had hotels deny us the meeting room we had contracted for, try to set up the next meeting while our class was still in session, serve us rice when chicken and rice was ordered and paid for, and in general test us for any latent homicidal tendencies. One hotel ran the heat up

to 100° in the room. Civilization is best measured in stressful situations as the veneer often cracks at such times. Since they don't get their just deserts in this life, I can only assume hell must be a hotel.

FORTY LOUDSPEAKERS ARRANGED ON STAGE AS AN ORCHESTRA

Barry Fox writes in the December issue of "Studio Sound" of an interesting demonstration that he attended at the Audio Fair in Japan:

It was on an open air concert stage.....The concerts weren't live, they were off tape. What made them special was the system used.

Out of sight a Mitsubishi 32-track played Denon master tapes into a TAC SR9000 desk. An engineer used the 32 channels to create 40 feeds and sent them to 20 Accuphase stereo amps. On stage there were 40 loudspeakers, of all different types. At first sight it looked as if the speakers were arranged in higgledy-piggledy fashion. But then the penny dropped.

The loudspeakers were arranged in exactly the same layout as the Count Basie band. Drums high at the

rear with JBLs stacked even higher to handle the high cymbal tracks. At left of stage, clusters of speakers took the piano track, the bass track and guitar track. Over on the right, a front row of sax speakers sat in front of the trombone row and a trumpet row, each raked higher than the one in front. For the Carmen McRae number only the piano, drums, bass and vocal speakers were used. For Count Basie the mixer opened up to hit all 40 channels. The effect was truly remarkable and the sooner someone tries it in Britain the better.

(Editors Note: Make that the United States also.)

Shall We Laugh or Cry?

A recent issue of an audio magazine printed an article on the opening of a new concert hall. The article was primarily about the sound system. A contract to redo the sound system was being negotiated by the time the article was in print. We would like to reproduce here a brief extract from the article plus a portion of a recent letter from Rolly Brook.

Quoting from the article:

"A combination of mechanical and electronic methods are used to align the mid- and high-frequency components. The mid-frequency cabinets are mounted in a curved line source array physically on a plane with the mouth of the high frequency horns to provide a coherent wavefront free of acoustic shadowing or reflections. The signal to the mid-frequency amplifiers is appropriately delayed to provide a phase coherent wavefront through the crossover point. The fact that the central cluster has a vertical range of trims from 28 feet to 42 feet above the stage required overlapping design calculations to ensure uniform coverage in all trim positions."

Letter from Rolly Brook

"You already know the design of the original loudspeaker cluster, and you know it didn't work well enough. In a way it was a bit of a shame to destroy that thing; it was such an outstanding example of what's wrong with large mid-range line arrays - lots of lobing, dead spots, phasing hash, poor sound quality, many areas of unacceptable intelligibility. Of course the intelligibility problems were partly the fault of the room, but still the cluster did not do its job. It was a "banana type" cluster taken to an extreme."

After reading the above one doesn't know whether to laugh or cry.

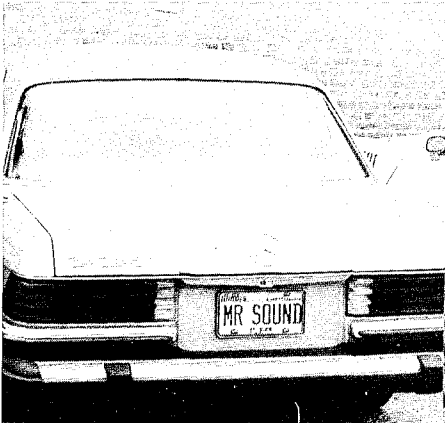
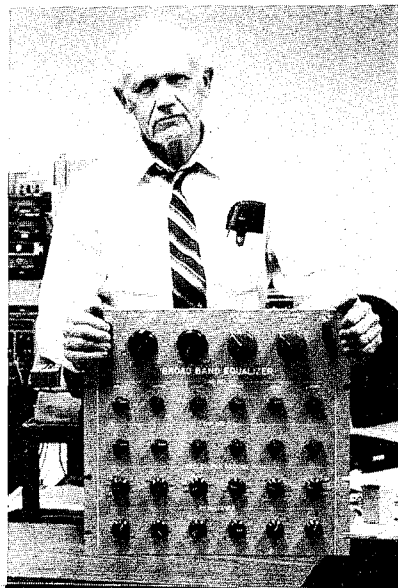
Syn-Aud-Con Seminar & Workshop Schedule

BILL MATTHEWS

Recently we had the pleasure of teaching a special "in house" seminar for Rent Com in the Chicago area. Our friendship with Ron Steinberg goes back to the Boom Electric days when Milton Boom was the main Altec contractor in Chicago (1960's). It was my privilege to have talked the Boom organization into licensing to Dr. Boner for equalization back before Altec had done so (about 1965). The engineer assigned to learn the equalization process and perform the jobs was Bill Matthews.

Ron invited Bill to sit in on the Rent Com seminar. Like all of us in those old days Bill, built a "Broadband" equalizer per the Boner specifications. The one I had at Altec has vanished but Bill made a present of his original one to Syn-Aud-Con. That's Bill holding it in the picture. If you want to know what senior audio engineers do, have a look at Bill's Mercedes and its license plate: MR SOUND. Audio engineers don't just fade away, they zoom away. Bill is one of audio's real gentlemen and has,

if anything, greater enthusiasm and genuine interest in the new developments of audio such as TEF analysis as he possessed back in the Boner EQ days. Meetings between old Dr. Boner trainees is a little like "Battle of the Bulge" survivors. We wouldn't have missed it for the world, and nothing could ever entice us into repeating it.



SEMINARS

Anaheim, CA
January 27-28

Seattle, WA
February 17-18

Orlando, FL
March 9-10

New York Area
April 22-23

Nashville, TN
May 3-4

Toronto, ON
June 23-24

Syracuse, NY
June 28-29

WORKSHOPS

Loudspeaker Design
Atlanta, GA
April 15-17

SOUND REPRODUCTION
Syn-Aud-Con Farm
Indiana

June 16-18

July 21-23

August 18-20

September 15-17

Compressors & Limiters by Bob Rodgers

We first met Bob Rodgers at the EV conferences in Europe, Fall of 1987. Bob, along with Gary Ewald of EV, impressed us with their unassuming manner and solid accomplishments. The Tech Topic that Bob wrote which accompanies this Newsletter grew out of a discussion we had

with Bob while visiting the British Science Museum to see Babbage's original computer components from the early 1880s. We appreciate the skill and knowledge it takes to keep a complex subject simple: Tech Topic Volume 15, Number 3, Compressor/Limiters: Applications and Design.

Errata

The Fall 1987 Newsletter (Vol. 15 No. 1), page 26, Gallons, Liters.....should read:

2. Given:

A five gallon gas can. Find the capacity in liters. (1US gallon has a capacity of 231 in³.)

$$5(231)\text{in}^3 \left[\left(\frac{2.54\text{ cm}}{1\text{ in}} \right) \cdot \left(\frac{1}{100\text{ cm}} \right) \cdot \left(\frac{1\text{L}}{0.1\text{m}} \right) \right]^3 = (5(231)\text{in}^3) \times 0.016387064 \frac{\text{L}}{\text{M}^3} = 18.85\text{L}$$

and

$$1\text{L} \left(\frac{1\text{M}^3}{0.016387064\text{L}^3} \right) = 61 \frac{\text{in}^3}{\text{L}^3} \frac{61.02\text{ in}^3}{231\text{ in}^3} = 0.264\text{ gal/L or } 3.785\text{ L/gal}$$

Denver Class



WORKSHOPS AT THE FARM IN INDIANA

As of this Newsletter Syn-Aud-Con has completed 15 years and happily begins its 16th year of dedication to the audio industry with hard-to-believe new opportunities at its door. We are beginning a special program of training for those TEF owners who are going to specialize in testing home listening rooms and music systems, retrofitting them with a reflection free zone and diffusers so they can be certified as a home LEDE.® listening room, or who intend to provide design-build services for complete new rooms for this purpose.

Workshop on Home Listening Rooms

It appears from the reports we are receiving from Peter D'Antonio, Charles Bilello, Doug Jones, and others that a real market for special consultation on TEF measurements in home listening rooms is developing. In fact, at their requests, we are initiating a special LEDE certification program for home music reproduction environments. People want certified listening rooms.

We are beginning a special program of training for those TEF owners who are going to specialize in testing home listening rooms..

This is going to require a lot of fundamental psychoacoustic investigation supported by advanced TEF measurements. To accomplish this we are going to have a series of three day "hands on" workshops where limited groups (10 max) of Syn-Aud-Con grads work on projects associated with

measuring loudspeakers and listening rooms both objectively and subjectively and performing psychoacoustic tests under careful measurement control. Each participant's hearing will be tested as part of each workshop as well as his or her pinnae transforms. The end result should be not only improved

they can pass the tests they indeed hear accurately and may indeed have a worthwhile opinion to express.

Pinnae Transforms

TEF analysis is a natural for running pinnae transform measurements. All you have to do is measure the probe microphone in the free field with the desired angular orientation followed by "quick difference". Then insert the probe into the entrance of the ear canal and measure once more. Presto - a pinnae transform.

Workshops at the Farm

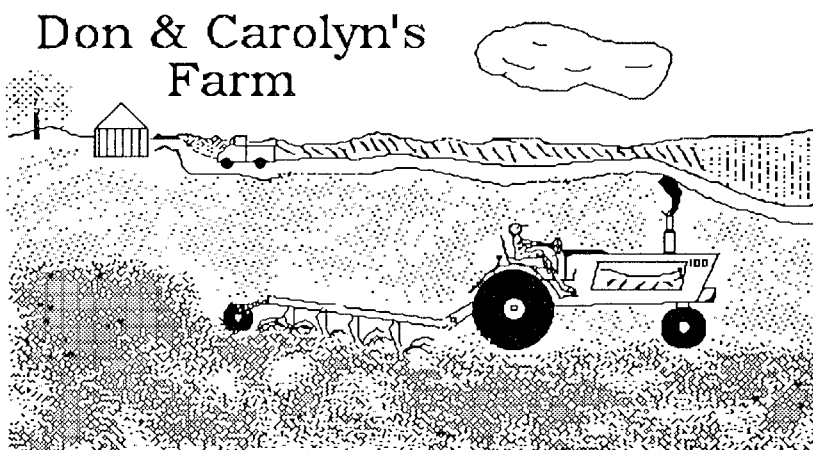
We will use our new lab facilities as the workspace. The

lab is 24x54'. The first workshop will be **Using the TEF Analyzer to Measure loudspeakers.**

We will set up and measure a variety of loudspeakers for ETC, phase, magnitude, polar, 3-D, and FTC responses plus careful listening evaluation in order to determine as closely as possible what resolutions to choose that most closely match what we heard.

We have available at the lab a number of tools we haven't had room to carry for our "on the road" classes.

The two nearest airports to the farm are Indianapolis (90 miles) and Louisville (80 miles). Participants will need to rent a car at the airport for the drive to Bedford, IN and for getting back and forth from the motel to the farm each day (15 miles). The workshop will last for three days. Sandwich lunches will be provided. Participants are responsible for their own motel reservations (under \$50) and for breakfasts and dinners. We suggest you include outdoor clothing so you can enjoy the woods on the 500 acre farm. The first workshop will be held June 1988. We will have one a month during July through September. ■



loudspeakers and listening rooms but a great deal more knowledge about listeners as well.

Noted experts in this new field will be guest lecturers during these Workshops.

We believe now is the time to do it because

1. Owners of expensive systems are having, for the first time, good LEDE type rooms built that when heard by other system owners results in instant recognition of its superior quality.
2. We have unique tools for the job for the first time:
 - A. TEF analysis
 - B. Advanced LEDE techniques
 - C. Quadratic residue diffusers
 - D. Ability to measure the listener's pinnae transforms
 - E. Ability to let listener's hear systems through another's pinnae (i.e., a golden ear if the listener doesn't happen to possess one)
 - F. The ability to measure and certify truly meaningful criteria under controlled conditions with psychoacoustic tests that detect and reject posturing phonics and their bleatings. If

Russ Berger – Vice President of Joiner Rose Group

Russ Berger of Joiner Rose in Dallas has been made a Vice President of the firm. We have watched with joy and pleasure his steady rise in his 7 years at Joiner Rose.

When we met Russ he worked at a music store, Arnold and Morgan. Russ had a recording studio in his home. When he heard of the TDS license he not only licensed but purchased the full kluge of equipment necessary to make TDS and ETC measurements. I don't think there were more than 3 people who make this investment. Russ used his equipment

to design recording studios on the side.

One day Russ walked into the Joiner Rose organization (then Joiner Pelton Rose) and asked if they wouldn't like to come to his house to see what could be done with his instrumentation. Russ was hired to develop a studio design department.

Anyone with even a smattering of knowledge about studio designers knows how successful Russ has been. Russ is a super sharing, totally involved and intelligent human being. We rejoice at the news of his success.

New TEF Owners

Steve Ponsetto
SPL Sound, Inc.
177 Woodcrest Dr.
Vineland, NJ 08360

Tom Walker
Comtech
247 Charlott Street
Ashville, NC 28801

Duke Mewborn
Baker Audio
2195 Norcross Tucker
Norcross, GA 30071

Charles Baxley
Capitol Systems
8081 Phillips Hwy. #15
Jacksonville, FL 32216

Steve Durr
6216 Bresslyn
Nashville, TN 37205

Jerry Partridge
Peavy Electronics #4
711 A Street
Meridian, MS 39301

Pat Brown
Pro Sound Audio Services
614 N. Clark Blvd.
Clarksville, IN 47130

Tom Breithaupt
Robert Bosch Corp.
38000 Hills Tech Rd.
Farmington Hills, MI
48018

Paul Kitchka
Rowe International
1500 Union Ave., S.E.
Grand Rapids, MI 49507

Al Osborn
Electronic Sound
691 39th St.
DesMoines, IA 50312

Bob Woodburn
Woodburn Sound Services
400 Highland Court
Iowa City, IA 52440

Henry Lewis
Lewis Sound
210 S. 2nd Street
Milwaukee, WI 53204

Marc Thrippler
American Sound & Lighting
1755 Jen Kee Drive
Florissant, MO 63031

Rich Zwiebel
Audible Visions
P.O.Box 18492
Boulder, CO 80308-8492

Pat Thompson
Thompson Engineering
3651 Oakley Avenue
Riverside, CA 92501

Hughes Aircraft
2601 Campus Drive
Irvine, CA 92715

Mr. Daniel Commins
COMMINs BBM
33 Rue Des Petits
Ruisseaux BP81
91371 Verriere Le Buisson
France

Mr. Pannel
SONO/AUDIOTECH
2 A 12 Rue de Bellevue
75940 Cedex 19 Paris
France

Mr. Ranchin
SOCIETE BAYOUX
93 Quai de Valmy
75010 Paris
France

Mr. Venet
3 A
Les Granges
St. Jean d'Ardieres
69220 Belleville
France

Peter Mapp
5, Worthington Way
Lexdon, Colchester
Essex C034JZ
England

Shuttlesound
Unit 15, Osiers Est.
Osiers Rd., London
England SW18-1EJ

Bell Northern Research
3500 Carling Avenue
Nipean, Ontario
Canada K1Y 4M7

Orchestral Arts
227 Cosburn Ave. #706
Toronto, Ontario
Canada M4J 2L6

Marcello Croce
Audio Reinforcement
20124 Milano
Via Volturmo 37
Italy

Road Runner Unlimited
Via Del Nuoto
26 00194 Roma
Italy

Horst Janssen
Janssen Electric GmbH
Stresemannstrasse 25
1000 Berlin 61
West Germany

Masurenaller 8-14
1000 Berling 19
West Germany

POLAR RESPONSES & A POLARIZATION

Figure 1 is the vertical polar from 500 Hz to 3000 Hz taken every 250 Hz for the Bose 802 used in the September 1986 Intelligibility Workshop. Figure 2 is the vertical polar response for the EV 40 x 20 constant directivity horn used in the same Workshop and measured in identical manner.

It is well to remember that all these polars we have published from that Workshop were done in the identical manner and supervised by the factory personnel for that product and witnessed by competent technical observers.

The EV vertical, Fig. 2, is interesting because it shows the skewing of the vertical polar compared to the horizontal polar when the same "on axis" reference point is chosen.

The reason for presenting these measurements is simply to show that when we published the horizontal plots we were not trying to pick out worst case examples, merely the most likely ones. Once again, we'd like to emphasize that the use of the Bose computer modeler program predicts both these type devices to have the same intelligibility in a reverberant room.

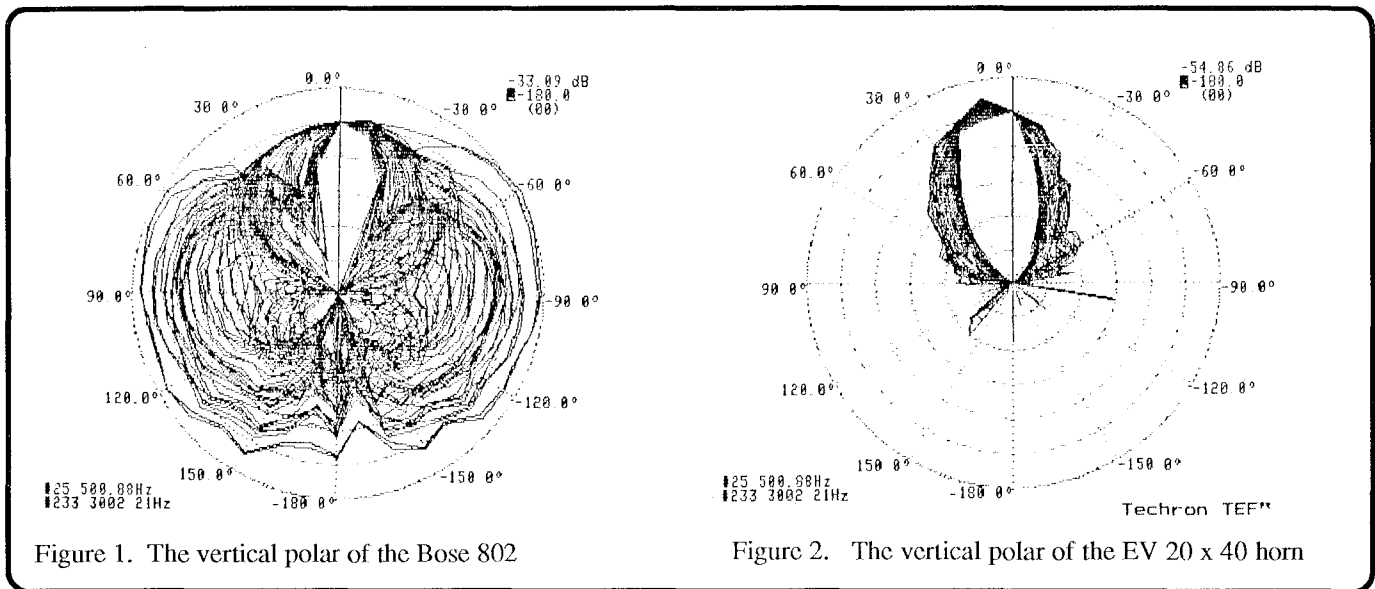


Figure 1. The vertical polar of the Bose 802

Figure 2. The vertical polar of the EV 20 x 40 horn

Chris Maione — A Talent

I am automatically attracted to enthusiastic people. When that enthusiasm is backed up by obvious hard work and a sharing attitude, my interest becomes even greater. When I see such a person interface like a brother with someone else I know of similar talents, then I'm sure I'm in the presence of a gifted person and I rejoice in the privilege of knowing them.

Chris Maione of TSI in Mineola, NY attended a Syn-Aud Con class for the 5th time in New York this year. Chris is a natural born communicator. You have only to look at these pictures of him in action to sense the energy, integrity, and intelligence, to say nothing of the friendliness and helpfulness inherent in his whole approach to life, other people and the sharing of ideas.

Chris demonstrated on a Compaq their complete electrical-acoustical level program using Lotus 123 spreadsheet. Another disc includes component scheduling, pricing, and alternate component choices to meet the technical as well as financial requirements of the job being bid. Chris showed how easy it is to quote a job while on the phone to the customer and not overlook anything essential to its performance or profit. TSI is making both programs for IBM and compatibles available to the industry for \$10 each! Just send \$20 to Mario Maltese, TSI, 393 Jericho Turnpike, Mineola, NY 11501 (516) 294-5390 and TSI will send you both programs. Mario believes that sharing is the key to growth.



USING THE KOLBE HUMAN DUMMY HEAD



Hellmuth Kolbe wearing the dummy head microphone

We reported on Hellmuth Kolbe's human dummy head, HDH, including a complete schematic and parts lists (Tech Topic Vol. 14, No. 6, Spring 1987). When headphones are used to listen to recordings made with these microphones carefully placed in your ears at the entrance to the ear canal the sound is out in space,

completely away from the headphone physical location. You can tell if the sounds came from the front, side or back, how far away in that direction. Many listeners have a very difficult time believing that the signal is actually coming out of the headphones. One of the more interesting experiences is to listen to something using someone else's pinnae and head size and

shape. Usually you hear most accurately with your own head but not always

To quote from **Spatial Hearing** by Blauert page 312, *Finally, we note an observation made by Bulter and Benduck (1977) that the pinnae of certain individuals are particularly good at*

generating the patterns of monaural attributes necessary for directional hearing in the median plane. Subjects can sometimes hear directions in the median plane better using these pinnae than using their own . . .

This observation points to the conclusion that the evaluation of monaural attributes of the ear input signals cannot be explained simply as a learning process in which the central nervous system adapts to the pinnae.

As an example of this, I actually heard spatial clues more accurately through Hellmuth's head than I did through my own whereas when Carolyn wore the microphones, I could not detect frontal directions as easily probably due to the difference in the size of our heads. Working with the HDH has led us to a series of new insights as well as a technique that we feel will be a superior way to check out the validity of subjective listener's opinion.

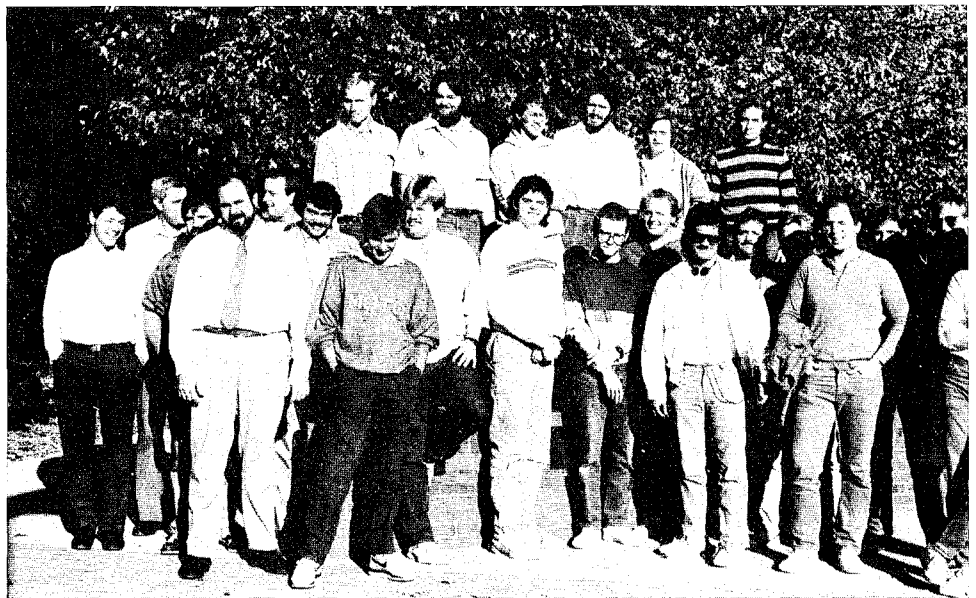
TOM MARDIKES & THE KANSAS CITY CLASS

Tom Mardikes is head of the recording department at the University of Missouri at Kansas City. It is over subscribed and the students in the department are delighted with the curriculum and their leader. Tom has his own studio nearby in a huge facility.

Tom invited us to hold our Kansas City class at the University as he had 12 students that would like to attend. They joined sound contractors from the area.

The class was held in the Performing Arts Center. The evening of the 1st day we attended rehearsal of the local orchestra. The orchestra conductor allowed the class to attend, moving about, making TEF measurements, and at one point stopped the rehearsal to

have an open discussion with members of the orchestra. We concentrated on how to listen to the orchestra and the acoustics of the concert hall. One member of the class said it was worth the class attendance to learn how to use his ears to study the acoustics of a space.



A WALK IN THE WOODS

On the day after Christmas, I took a walk in the woods on our farm in S. Indiana. This is hill country covered with woods and shale bottomed branches. This December has been almost like midwinter in the coastal mountains of S. California -- wet, mild temperatured, and windy.

Our new German Shepard went with me as well as a dog named "Mine" belonging to a little neighbor girl. The two dogs chased each other with total abandon, up hill, down hill, across streams, first crashing into each other, and then circling around me like wild Indians.

A deep Indiana woods in the winter is a remarkably different place than during the summer. This summer it was a jungle and a 100 foot clear view was an exception. Now I can see the lay of the land, what condition the timber is in, and where the edges of the smaller woods are at. Each side branch is flowing free with water from the fields, and the main branch is now a stream with deep pools of water and rapids spaced along its length as it curves and carves its way through the center of the farm.

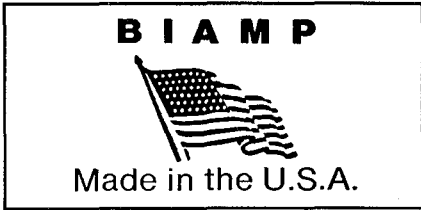
A flight of wild geese honk their way towards the southwest, flying in a huge V formation. I count at least 100 of the magnificent birds as they fly right over my head.

A woods is an ever changing tablet being written upon by all of nature. A huge dead tree lay across my path that wasn't there the last time. The animal tracks each tell their own story of the movement of the real owners of the woods. Some people feel threatened by being out in the woods; others like myself, feel sheltered.

City dwellers would be hard put to look at the farm today and see much that attracted them. Because of the rain mud is everywhere, ankle deep around the barns. The predominant color is grey. Yet, down in the woods, some primitive gene passed on to me in some mysterious way springs to life in my mind. I feel something flow into my sense of life that must have flowed in the veins of my ancestors. My gratitude is deep. I have been given another beautiful day in God's great outdoors.

Chicago Class





We are seeing a steady informative flow of letters and specification sheets from Biamp. That impresses us because we are seeing them seek out feedback from their end users, and we're feeling a dynamic product response to such feedback.

While there are certain greedily priced equalizers marketed with hype and innuendo by more prominent manufacturers in terms of advertising revenue, Biamp ignores them and goes on building an excellent parametric equalizer, the EQ 140. Utilizing a single rack space, Biamp provides four parametric filters that can be individually switched in and out, and allow their frequency, level, and Q (bandwidth) to be adjusted with ease and accuracy. Each filter as well as the overall equalizer has an overload indication that flashes 10dB below clipping.

The Biamp ADVANTAGE ONE

and AG automatic microphone mixer is packed with the most sought after features and is priced below the competition.

If you haven't discovered the Biamp's RACK MAX, drop Ron Camden, their sales manager, a line asking for their data sheet on this 16 input, high performance, stereo, full feature mixer in a rackmount unit only

10 spaces high and 3 inches deep complete with power supply.

Biamp has been selected by Rodgers Organ Company to supply the power amplifiers for their line of organs.

This is a small company making American products that are competitive anywhere and they deserve your closest attention.



Ralph Lockhart, President of Biamp, working on a sound system problem during the Portland class. Art Noxon standing to his right.

RESOLUTION IN MEASUREMENT

Fundamental to the understanding of the "time smear" observed in energy time curve displays is the knowledge that

$$F_R \times T_R = 1.0$$

and that

$$1/F_R = T_R \text{ and } 1/T_R = F_R$$

where:

F_R is the frequency resolution

T_R is the time resolution

The T_R of an ETC display is dependent upon two factors.

1. The bandwidth of the filter and, of course, of the device under test.
2. The number of lines in the display (400) in the case

of the TEF.

For example, if we sweep from a -31669 to a +31669 for a total of 63,338 Hz, we get a $T_R = 1/63,338 = 15.8$ μ secs per line and with 400 lines we get a full screen time of 6.32 msec.

In doing intelligibility measurements, it is often very limited bandwidths that we employ such as 500 --3000 Hz or even narrower.

$$(1/2500)10^6 = 400 \mu\text{secs/line}$$

$$\text{and } 400 (1/1414.2)10^3 = 283 \text{ msec.}$$

This would mean that a first arrival that encompassed 20 lines on the display had a $1/f = 14$ msec.

JOHN WIGGINS ASKS SOME POINTED QUESTIONS

At the NSCA convention in New Orleans last April Jesse Klapholz conducted a session sponsored by *Sound & Communications Magazine*, called "From the Drawing Board to the Catwalk...and Back Again".

Sound & Communications reprinted a summary of the talks. The reprint contains useful material. We were especially interested in John Wiggins' (Community) comments under the title, "Suspicion", which we would like to reproduce here:

Suspicion

In this business it is healthy to have a degree of suspicion when viewing a specification for a loud-speaker system.

Recently, we have observed many inconsistencies in some specification sheets.

We are not talking about those organizations that can produce polar plots, contour plots, swept distortion, sensitivity measurements, and so on that are based on good scientific documentation. For example, some suspect statements we have recently seen on spec sheets:

"phase and time coherent"

Great! Where is the documentation, phase curve, or energy versus time graph?

"no mechanically induced distortion"

This speaker must literally be a rock.

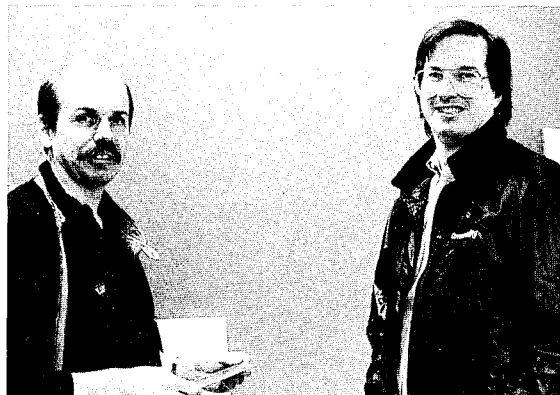
"less than 1% distortion"

At what frequency level, and bandwidth? Do the curves actually exist?

"phase response - coherent"

What does this mean? What happened to good old plus or minus degrees?

How about speakers designed with "the art of sound?" Perhaps, the art applies to polar response curves too.



Ed Wijnker of Stage Accompany from the Netherlands talking with John Wiggins at the New York seminar.

Ask questions, lots of them, listen very carefully to the answers and the kind of answers you get back. Is this person throwing up a smoke screen, or are they trying to provide useful down-to-earth factual information. Can they back up their view with the appropriate documentation? If their response

seems to consist of "no reply" or some form of audio mysticism, then do yourself, your client, and the world a favor -- don't use the product in question. More than likely you will be risking your reputation and your professionalism..... Perhaps if you do not cast a wary eye upon certain claims now, YOU may end up suspect later.

I would like to tell you about John Wiggins and why I feel that he can ask these questions without egg on his face. About three years or so ago John Wiggins called me to say that their new CD horns were in the prototype stage and ready to go into production, EXCEPT that he had observed something that troubled him in the TEF measurements. He described a problem that I have heard Dr. Patronis expound on at great length. He asked me if other manufacturers had the same problem. I told him that it was a problem shared by all the current models from other manufacturers.

John Wiggins said that once they knew the problem existed it must be solved before they went into production. Community held up the introduction of the product for nine months. This came at a time when Community was suffering a severe financial crunch.

In case you wonder why I have a special place in my heart for Community.

PROGRAMS FOR THE HP41C

We get several calls a year asking where they can get good sound system design programs for the HP41. We contacted Ted Uzzle of Altec to see if they will make their large library available to anyone in need. Ted answered:

All our calculator programs are available in individual quantities (that is, sets of one each) to anyone who wants

them. Barcodes are printed on each. The quickest, easiest, and cheapest way to receive them is a note addressed to their literature department in Oklahoma City.

The most expensive program is \$0.95 and most are \$0.25 or less. Write Altec, P O Box 26105, Oklahoma City, OK 73126-0105. PH 405-324-5311

INTELLIGIBILITY & THE AES

Ben Kok was with Peutz and Associates for many years and wrote the %ALcons program for the TEF analyzer. He was present at the Bose paper given by Ken Jacob,



Ben Kok has the look of being very capable of taking care of himself on an intellectual level. Indeed he does.

"Development of a New Algorithm for Predicting the Speech Intelligibility of Sound Systems in Rooms," at the Fall 1987 AES convention. During the Question period following Jacob's paper, Ben challenged the accuracy of the paper and the paper

published in the *J. Audio Eng. Soc.* in December 1985, "Subjective and Predictive Measurements of Speech Intelligibility - the Role of Loudspeaker Directivity". When Ben finished, there was nothing left for me to say, which tells you how thoroughly Ben handled the subject. Ben made the comment in the session that Mr. Peutz regarded the paper published in the *AES Journal* as so inaccurate as to not be worthy of an answer.

Stanley Lipshitz on Integrity

Stanley Lipshitz, the new president of the AES, was present. He got up after Ben's statement and said that "anyone with integrity would write to the *Journal* and correct erroneous papers." It was one of the times that I was stunned speechless. When I got to a dictionary I looked up Integrity," 1a: an unimpaired or unmarred condition...b: an uncompromising adherence to a code of moral, artistic, or other values: utter sincerity, honesty, and candor: avoidance of deception, expediency, artificiality, or shallowness of any kind...".

I don't believe that Mr. Lipshitz knows Mr. Peutz or the meaning of integrity, otherwise he could never have made that statement.

No one with any intelligence intends to enter an argument where the judges, referees and *Journal* editor are either incompetent or disinterested in the truth, which is regularly trampled in the *Journal*.

Not being a man of any great intelligence I submitted two letters to the *Journal* regarding an article on LEDE in which I felt that two articles published in the *Journal* over a year ago seriously misrepresented my work.

I promptly challenged the articles and to this date, so far as I know, the letters have not been reviewed for publication. In any case, the *Journal* has not notified me of any action taken.

Somewhere lies the broken spirit of the AES cast down by gross interests and a self-perpetuating clique interested in revenue from shows, high salaries, and hidden revenues from non-reported sources.

New Products from Benchmark Media Systems

Benchmark Media Systems of North Syracuse, NY has inaugurated their own Newsletter called The Benchmark Update. It is an excellent source of new information on both products and techniques.

Benchmark has introduced two new products:

1. The HPA-1. A stereo headphone amplifier mounted conveniently on a 1/4" TRS jack. It has a panel mount stereo gain control with a range from full off to +18 dB. It's ideal for high quality "Studio Series" headphones in the 200 to 600Ω range, but will work with 8Ω headphones.

2. The DOM-1, a jack mounted

differential output/mixer. As with the DOA-1, the DOM has 60 ohm outputs and can drive bridging inputs with lines as long as 300 feet. Used as a two input mixer, it provides an easy way to derive a mono signal. Or it may be used as a virtual ground mixer with multiple inputs. The gain range is from Off to +6dB.

If you don't have Benchmark's "A Clean Audio Installation Guide", please write Benchmark Media Systems, 3817 Brewerton Rd., North Syracuse, NY 13212. PH 1-800-BNCHMRK Few engineers know more about the subject than Benchmark president, Allen Burdick.

Here is honor, the dying knight
and here is truth, the snuffed out
light
and here is faith, the broken staff
and here is knowledge, the
throttled laugh
and here is fame, the lost
surprise
virtue, the uncontested prize
and sacrifice, the suicide
and there the wilted flower, pride
under the crust of things that die
living, unfathomed, here am I
George Patton

Indeed one day the "silent majority" of the AES members will retake their society and restore a democratic management. Until such time, the Stanley Lipshitz of the world will continue to bray -- but without us, pray.

AES CROSSTALK VIDEO TAPE

Sound & Communications Magazine sponsored a CrossTalk video panel discussion on speech intelligibility and speech intelligibility measurements. The moderator was Jesse Klapholz. The panel consisted of Daniel Queen, David Klepper, Don Davis and Cliff Henricksen. Present in the audience was Ben Kok, who implemented the %ALcons program on the TEF while he was at Peutz and Associates, Steve Romeo, formerly at Bose and now JBL, Don Keele of Techron, and the writer of the Techron TEF RASTI and full STI programs. Ken Jacob was in the audience, as well as many knowledgeable people.

Since you can have your own copy of this 45 minute video tape in living color for only \$29.95 for *Sound & Communications Magazine*, Syn-Aud-Con recommends it as a good view of how different people approach this common problem.

This video tape has some interesting moments such as when Jesse Klapholz asked David Klepper if the series of tests made at the Syn-Aud-Con Intelligibility Workshop in 1986 were conclusive.

David Klepper

I think some things can be concluded from it. For example, I strongly believe that the tests were conclusive that directivity of the loudspeaker has a positive influence in most situations on intelligibility. I know that there are some people that would disagree with me about that but I feel that it was strongly proven, but I don't think that the tests were fine enough to really say that we hold on one packet of sound energy and that the ear does not integrate over a short interval as regards to speech intelligibility, because to say that would throw out completely all the work of Lochner and Burger.

Don Davis

Yes.

David Klepper

I think that Lochner and Burger did a fine piece of work and that I'm

not really interested in throwing it all out at this point. For years I have designed concert halls, speech auditoriums, lecture halls, worked for architects churches considering Lochner and Burger as valid and by and large I haven't been caught with my pants down doing that.

Don Davis

But, by and large, you have always had high level direct sound too.

Jesse Klapholz

So you are saying that directivity may not necessarily be everything that is important to say, not totally locked in.



If something is really obvious and somebody comes up with a whole slew of measurements that disproves the obvious, I tend to suspect the measurements.



David Klepper

No, I don't think that directivity is and I don't think that just the initial sound is. I think that it is a more complex situation than that. Let me tell you why I think that directivity is important. Lets say that we have a hard room, a hard reverberant room, and we have an open window and we have a directional loudspeaker system and we aim that directional loudspeaker system out the window. It is set back from the window but it aimed so that all the sound energy practically goes out the window. You aren't going to develop much of a reverberant field in that reverberant room and the articulation between the window and the loudspeaker it is going to be very high. Now I replace that directional loud-

speaker with an omnidirectional loudspeaker or a partially directional loudspeaker that puts some of the energy sideways, the intelligibility is obviously going to go down.

OK, if something is really obvious and somebody comes up with a whole slew of measurements that disproves the obvious I tend to suspect the measurements. I don't tend to suspect obvious. I think there is something peculiar about the way these measurements were made that doesn't relate to the real situation. The answer can well be if you do put directional loudspeakers in a hard reverberant rooms without aiming them at an audience. Ken Jacob, for example, suggested a railway station. True, but the majority of applications -- theaters churches, concert halls, music pavilions -- you do have a sound absorbing audience that you are aiming your loudspeaker at. And I would think that techniques for the design of sound systems should take that into consideration.

Jesse Klapholz

Sounds like you are in agreement

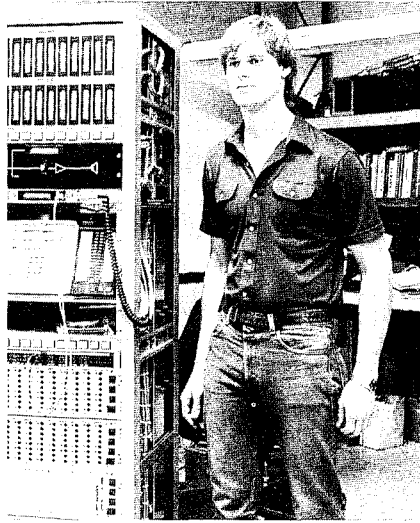
Don Davis

Absolutely, no question about that. If you want to make a test in which you would like to deprecate the role of directivity, aim them all at a hard wall and not take natural advantage of how they are used and then, of course, they will start to equalize out a little more. The real way you would have to do these tests over a long period of time is an in situ test of actual installations with a known measuring system and that is what we have now. With TEF %ALcons it is possible to go in and get reasonable measurements in situ in all kinds of situations and correlate it back against what we have actually installed there, rather than these tests where we go in with hoists and things. We need to make realistic real life tests.■

Big John Can Do Anything

Big John can do anything! So we were told by everyone at Rent Com. After meeting John we believed it. First of all, he is big: 6'7". Second, he *can* do anything. He owns his own machine shop which he keeps at Rent Com. He owns his own bulldozer, dump truck, etc. The special microphone housing for conferencing systems in board rooms that he builds for Rent Com have to be seen to be believed. So far as that goes, Rent Com has to be seen to be believed.

The rack big John is standing next to is especially designed for a major investment group who can use it to directly and immediately reach and interlink all their offices in Dallas, London, New York, etc. We are told that with telecommunications of this complexity that there are no delays in making bids or in selloffs, even on Black Monday - though we are as-



sured that this customer was out on the Saturday before.

John is a unique young man (24) of formidable talent, extremely pleasant man, and we are convinced "he can do anything."

SARNOFF REVIEW

Two recent books reveal some of the truth about David Sarnoff of RCA - an utterly ruthless man who literally pushed the inventor of FM to suicide: *The General: David Sarnoff and the Rise of the Communications Industry* by Kenneth Bilby, Harper & Row. \$20.95 and *RCA* by Robert Sobel, Stein & Day. \$19.95.

Edwin Howard Armstrong brought into being a radio system with a 1000/1 s/n advantage over its predecessor. Much like Heyser, Armstrong's contemporaries did not comprehend the uniqueness of what had been set before them. The vast propaganda system Sarnoff had put together was threatened by Armstrong's invention and the attorneys and courts, fueled with RCA money, destroyed the inventor.

Some of us stand on the shoulders of giants, others on their bodies.

Washington, D.C. Class



Book Review: *Engineers & Electronics*

Engineers and Electrons by John D. Ryder and Donald G. Fink, published by the IEEE press 251 pages. This interesting popular history of electrical engineering touches many familiar areas such as Armstrong's misuse by RCA, British radar disclosures to the U.S. *before* we were in the war, and gives us the first name of the illusive H. Nyquist (Harry).

We are told that in 1893 the telephone could talk from Boston to Chicago (the limit due to resistive loss). By 1911 the telephone was reaching from New York to Denver, thanks to loading coils (inductors) properly placed to overcome the capacitance of long lines. Finally in 1914 (a test) and 1915 (actual use), Washington,

D.C. talked to San Francisco, thanks to three carefully located vacuum tube repeater amplifiers.

Much of real importance is missed such as MIT's decision back in the 1930's to use LaPlace transforms in place of Heaviside operational calculus which led in turn to their remarkable advance over universities who didn't do so until much later.

Engineers & Electrons is a worthwhile book with a good general overview of how to go about some in depth readings on the subjects and people mentioned. We are reminded that Charles Proteus Steinmetz was almost refused entrance to the U.S. because he was crippled. Introducing complex

notation in impedance problems as early as 1893, Steinmetz said in an AIEE paper, "analysis of the complex plane is very well worked out, hence by reducing the electrical problems to the analysis of complex quantities they are brought within the scope of a known and well understood science."

Since complex plane analysis did not seep into electrical engineering education for many years, his audience had to take that statement on faith. Steinmetz and Heyser had much in common especially an overestimation of the capability of their audiences.

We heartily recommend this book to our readers as an easy introduction to a lot of the giants shoulders we all stand on.

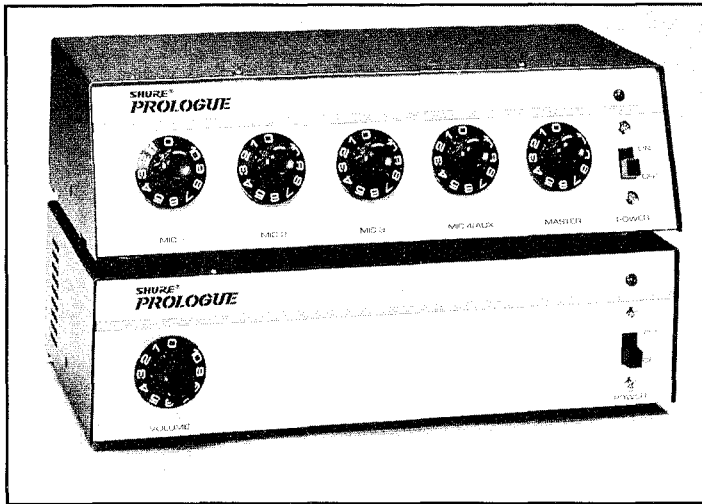
New York Class



NEW SHURE MICROPHONE MIXER & AMPLIFIER

Shure Brothers Inc., Evanston, IL has introduced Model 200 Microphone Mixer and the Model 210 Amplifier. Both products have been designed to provide a high level of reliability and audio quality at an economical price.

built-in resettable circuit breaker to protect the power amplifier and power supply, two phone jacks for loud-speaker connection, a low-impedance microphone -- level input, and two parallel auxiliary-level input jacks which can be used simultaneously



The 200 Mixer incorporates four low-impedance balanced microphone inputs, one of which is switchable to an auxiliary level input suitable for tape, tuner, or CD player. In addition, the "200" has individual channel volume controls and a master volume control.

The key features of the 210 Amplifier are the 10-watt power output, a

with the microphone input.

The 200 and 210 are designed to complement each other, but they provide the flexibility to be utilized with other system components. They can also be operated from 12V mobile sources

with the appropriate power cord. User net prices are \$125 each for the 200 Mixer and the 210 amplifier.

I wish something like this had been available in the early 1950s when I had just begun doing small PA jobs. I was wrapped up in high fidelity and recording until then. Simplicity, performance and reliability in an affordable package -- a rarity then and today.

"If your amplifier is really sending 10 megahertz signals through the cable to the speaker, you should have it repaired."

There is an article in the September/October issue of *db* Magazine that is a real sleeper, "Motion Picture Sound 1987: Dawn of a New ERA--The Mann Village Theater" by Drew Daniels from JBL, a man for whose intelligence and integrity we have the upmost respect.

Now, would you think that what you were really going to read about was wire and cable.

Drew ends his highly readable and entertaining article with the following:

"The truth is that outside of wire and connection resistance, all the fancy construction and packaging of speaker cable is nothing more than cosmetic. If your amplifier is really sending 10 megahertz signals through the cable to the speaker, you should have it repaired.

PROFESSIONAL SERVICES

We would like to start a page in our Newsletter for Acoustical Consultants. There is no charge. The only requirement is that you have attended a Syn-Aud-Con seminar and have an active subscription to the Syn-Aud-Con Newsletter. If you would like to be on our Consultants page, send in 4 business cards for our file.

RB SYSTEMS

ELECTRONIC SYSTEMS
FOR THE PERFORMING ARTS

ROLLINS "ROLLY" BROOK
DESIGN CONSULTANT

5715 CALVIN • TARIANA • CA 91356 818•345•5419

KMK

7 Holland Avenue
White Plains, New York 10603
Telephone (914) 761-8595

David L. Klepper
Consultant in Acoustics

KLEPPER MARSHALL KING ASSOCIATES, LTD

Russell E. Berger, II
Principal



The Joiner-Rose
Group, Inc.

Consultants in Acoustic Technologies

4125 Centurion Way
Dallas, Texas 75244

(214) 392-7800
Fax: (214) 991-3781

BOSE AT THE WINTER OLYMPICS

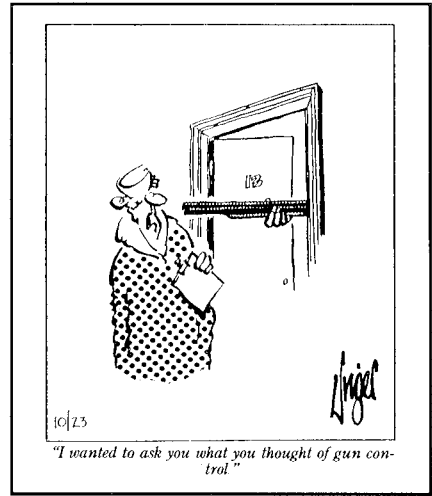
Bose Corporation has been named the official supplier of professional sound equipment for the winter Olympics at Calgary. This means our little audio industry is really growing up. This is the first time that an audio company has considered itself of sufficient size to take on the expense of such a project.

Heyser Video Tapes

When we announced the availability of the Heyser video tapes, I overlooked the fact that we need 25 orders for Richard Jamieson to get the special duplicating fee. As we go to press we have almost 25. We may hold for a few days past receiving 25 orders but we will not hold long so as to not keep the original 25 waiting unduly for their video tapes.

If your order does not arrive in time for the 1st duplication we will hold the order until 25 more are received. Your check will not be cashed until the duplication order is sent to Richard Jamieson.

SMILE

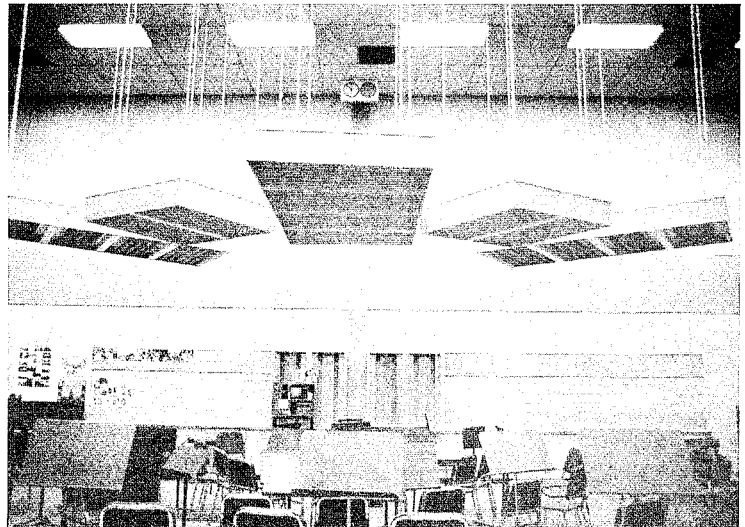


The test of a great cartoon is its ability to make both sides of a controversial question laugh. We felt the one shown here easily qualifies.

How Many Ways Can You Use RPG Diffusors ?

David Marsh is a principal in the acoustical firm of Pelton Marsh Kinsella in Dallas. He sent us a picture of the RPG diffusors hanging from the ceiling in a band rehearsal room. David said that those plus side and end wall diffusors solved their problem. As Dr. Diffusor says, don't absorb it, diffuse it. (Recently we are torn between calling Peter D'Antonio, Dr. Diffusor or Peter, the Great.)

David Marsh is a name you want to jot down. His programs for sound system design are very worthwhile. (Syn-Aud-Con Tech Topics Vol. 14 No. 3 and Vol. 14 No. 5.) Pelton Marsh Kinsella has changed their name from PMI and they have expanded to new facilities: 15303 Dallas Parkway, Suite 10-75, LB6, Dallas, TX 75248.



ARTICLE ON SOUND LEVEL METERS

A particularly useful two part article on sound level meters written by John R. Barcham of Bruel and Kjaer appeared in the July and Sept. *Sound and Video Contractor* magazine. John knows what he is talking about and has Syn-Aud-Con's respect as he is an expert in instrumentation. A really useful

discussion of practical filters, constant percentage bandwidth vs constant bandwidth, and linear vs logarithmic scales is included. These articles are at the most basic level, but if you're not familiar with the complexities of modern sound level meters, that's the place to start.

Mary Gruszka



Mary Gruszka, formerly an engineer with CBS, now an independent consultant in the New York city area, has been polishing her writing skills with a series of first rate articles on TEF analysis as applied to TV audio and acoustic needs. The series of articles appearing in *TV Technology* started March, 1987. Mary uses a simple RC network to introduce the reader to the basic TEF displays and measures a loudspeaker to illustrate acoustical applications of the TEF.

Her writing is easy to read and her path through the TEF labyrinth is a direct and helpful one. Mary is a highly skilled TEF operator with a lot of hard-won experience in both the broadcast and the recording business.

For reprints, write Mary Gruszka, MCG Audio Consulting, 88 Myrtle Ave., Edgewater, NJ 07020, (201) 224-4937. You will find the

DIGITAL Level Meter

The Soar Corporation has a "digital level meter" model 1700. It measures both angle and grade. It is battery operated and uses photoelectric angle sensors. The level meter is controlled by a microprocessor; it is an ultimate gadget. Priced at \$100, it makes the Swedish INOGON, which is distributed by Sylva Corporation, 342 Madison Avenue, New York, New York 10017, a bargain at about half the price. See Newsletter V.12 No. 1, Fall 1984.

We Found Sounder

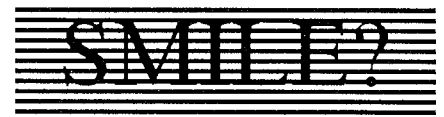
Mark Gander from JBL called us to say that Jeff Peters was our unknown at Sounder. Then Jeff Peters called us to say that he wasn't getting enough orders to stay in the business. He is now working at UltraSound full time. He did say that a manufacturer has approached him to build 1,000 of his units, which means that they would cost less than he had been charging. We will stay in touch with Mr. Peters and keep you informed.

That is rather indefinite and doesn't help those of you that need a polarity checker now. Several grads reported in with checkers that they know about. The new Turbosound "Phase Polarity Reference" was mentioned the most. We personally can't recommend it as we haven't tried it.

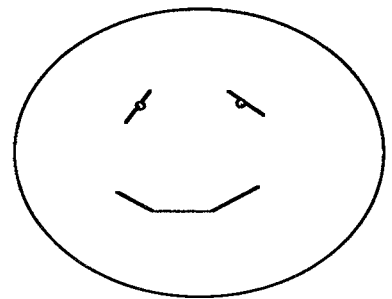
Handbook for Sound Engineers

Have you purchased your copy of the **Handbook for Sound Engineers - The New Audio Encyclopedia**? We would like to help you by including an order form with this Newsletter to purchase it at a very special price of \$65 including shipping.

The article in this Newsletter, *Shall We Laugh or Cry?* points out the real problem of using current audio magazines as our source of reliable technical information. **The Handbook for Sound Engineers** is written by professionals in our audio world that you can trust.



J
Charged
my
mind
at
the
last
minute!



Ron McKay of MCB

We have enormous respect for acoustical consultant Ron McKay shown here during our Peutz Workshop in Pasadena.

Ron recently left BB&N after nearly 29 years with them and has started McKay, Conant, Brook, Inc. (MCB).

Ron tells us that they are consulting in architectural acoustics and audio visual systems. They have been awarded 60 projects and plan further expansion in the upcoming year.

Ron was the acoustician for Ambassador Auditorium which we continue to consider one of the United States' truly outstanding concert halls.

Ron also was one of the key contributors to early LEDE technology and shared his insights with us to help speed its acceptance among early practitioners.

Syn-Aud-Con sincerely wishes



our three good friends at MCB every possible success that rightly belongs to the competent. We have known Ron almost his entire BB&N career (we first met in late 1959 or early

1960) and he has remained throughout the intervening years a valued mentor, a warm friend, and an example of unswerving integrity.

ARTICLES ON PSYCHOACOUSTICS

A good basic set of articles on psychoacoustics was in *BM/E (Broadcast Management and Engineering Magazine)* starting in the February 1987 issue. This four part series concluded in the September 1987 issue. The illustrations are exceptionally well done and all the key parameters are introduced, correctly explained and illustrated. The author, Paul B. Christensen, is chief engineer of WIVY-FM, part of the Gilmore Broadcasting Corp, Jacksonville, FL.

The table in Part I showing the dependence of subjective quality vs physical parameters is an example of how he approaches interfacing what we measure with what we hear.

As Mr. Christensen states and we concur, "A considerable amount of the hearing function is conducted by the ear, but research over the preceding century has shown how influential the information processing that occurs in the central nervous system is on the perception of sound....One of the most interesting qualities of the auditory system is

its ability to selectively localize a sound source: from the mixture of musical instruments in a symphony orchestra, a listener can identify the sound of a single instrument. During a noisy party, crowded with people, it is possible to identify a specific person. Even during periods of deep sleep we can train ourselves to ignore the sounds of city traffic, but to awaken at the sound of an unusual noise."

Here is an easy to read writer on the basics of an interesting subject, outlining in an easy to understand way the complexities to be covered. Recommended reading for those of you

serious about understanding how to go about seeking measurements that relate to what we hear.

Write BM/E for copies of the articles:

Table 1

Physical Parameter	Subjective Quality			
	Loudness	Pitch	Timbre	Duration
Pressure	***	*	*	*
Frequency	*	***	**	*
Spectrum	*	*	***	*
Duration	*	*	*	***
Envelope	*	*	**	*

* - Weakly Dependent
 ** - Moderately Dependent
 *** - Strongly Dependent

BM/E
 296 Madison Avenue
 New York, NY 10017

I Thought We All Knew What to do With It.

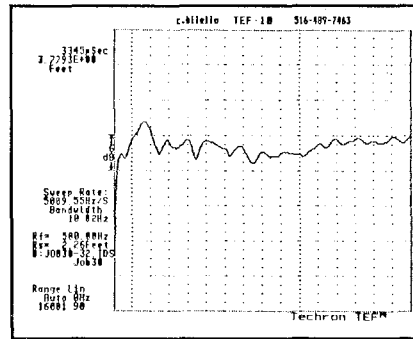
Charles Bilello writes:

One day while performing TEF measurements at a recording studio, I took advantage of some free time, and just had to look into this matter!

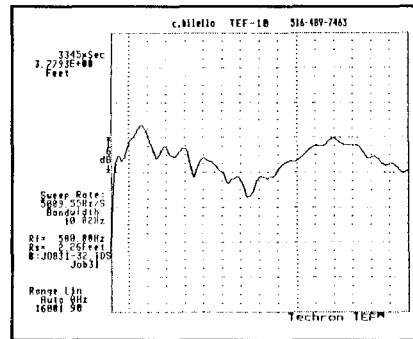
Here is the data I collected on the Yamaha NS10m monitors. They cost about \$315 a pair. They are one of the most widely used small speaker "studio reference monitors". Everyone uses them!

What's interesting is they are always used with toilet paper covering the tweeter (some use "single ply"). These measurements show "double ply".

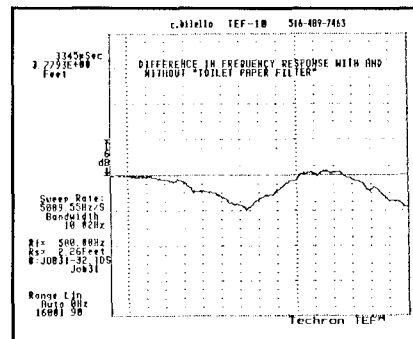
My question is, "Why would anyone want to do that to a good monitor response?". But, look carefully at the response. Notice the periodicity in the ripple. Perhaps the toilet paper reduces the ripple. Our ears are very intolerant to periodicity in response. We can tolerate aberrations if they are random. We have measured the NS10m without double ply in class and we got a similar measurement. We measured also what came off the back of the box and it was nil. A good frequency response in a tightly controlled box is only part of what makes a good monitor, but it's a good start.



Frequency Response is 0 - 16,000 Without Paper - Right Speaker



With Paper - Right Speaker



Difference in frequency response With and without paper

SMILE

Acoustical consultant, Jim Yerges of Downers Grove, IL, has a marvelous wit. After the Sound Designer's Workshop he sent us a "press release" on a new product he dreamed up: PRD's -- Really Pricy Diffusers. Here are a couple that I enjoyed:

Designer Nuance Series

This trendy series of units epitomizes diffusion in the '80s. In fact, we prefer to call them "perfusers." What was originally emitted as harsh, specular, white sound returns to envelope the listener in warm, diffuse, beige sound. Sensitive, artistic spectral coloration is introduced where appropriate. The garish, blatant pink sound from open office masking systems becomes a mellow suffusion of tasteful taupe sound or soothing mauve sound.

Prerequisite Series

This series is slanted toward the upscale corporate market, where each hurdle leapt and each rung climbed brings compensatory rewards. The periodic sequence is a direct function of years of service and performance. As the executive ascends the corporate structure, the wells in his diffusor become deeper and narrower, and the materials of construction become more luxuriant. Fine leathers and imported woods are used throughout. The top-of-the-line units (CEO Series) are trimmed with precious metals (subject to market price.)

"SHOW STOPPING THEATER DESIGN"

We recently read a well written article entitled "Show Stopping Theater Design" by Burt J. Boettcher. The article appeared in the *Construction Specifier* of Alexandria, VA.

Burt is senior stage systems designer at the Peter Albrecht Corporation in Milwaukee, Wisconsin. He has

47 years of experience in various phases of technical theater design throughout the world. We have known Burt for nearly 30 of those 47 years and have enjoyed his skills and unique humor over the years. For reprints write:

Peter Albrecht Corp.
325 E Chicago St.
Milwaukee, WI 53202

The Peter Albrecht Corp. is the company cited in the new *Stage Rigging Handbook* as a major contribution to the art of rigging.

Doug Jones Writes for Church Publication

Techron reprinted three of Doug Jones' articles that appeared in *Resources*, a publication for churches: "How Does Good Sound Work?", "How you can Evaluate Your Church's Sound System" and "What a Consultant Can Add to the Evaluation of your Church's Sound System."

The articles are excellent. Any sound contractor who works in the church market should give a copy of the reprints to the local minister of a church he is working with. (Techron has the reprints available at a small price for quantity orders.) The articles are written in a language a minister can understand. Doug uses several interesting analogies in order to help the minister understand the sound system. I'd like to excerpt a few key points to show you Doug's style of writing:

The rule of thumb is to put as few speakers into a system as possible. The reason for this is not all economic. The ideal sound system would be an infinitely small point source that projected sound to only those part of the audience where it is needed. Sound that is produced by a loudspeaker that is not directed to specific listeners, is not just wasted, it is actually harmful as it increased the apparent reverberation of the room. Another way to think of this is to consider a large group of people reading in unison. It is always more difficult to understand a large group of people reading at once, no matter how well trained they may be, than it is to understand one reader. Every time a speaker is added to a system, it is like adding one more reader to a room. Even though these "readers" are all saying the same thing, the sound is coming to any given listener from many sources at once, increasing the confusion and decreasing the intelligibility significantly.

The best system for most churches is the single cluster system where one or more speakers are located at one point in the room, usually above the pulpit. Single cluster systems have

Doug discusses how the ear hears. I'd like to reproduce here a small section of the article:

The eardrum and the ossicles form a very sophisticated transformer whose job is to transfer the energy of the moving air molecules to movement within a fluid. To get some appreciation for this task, imagine being in a swimming pool under water with someone standing on the side trying to talk to you. If you have ever tried this you will know that it is virtually impossible. The sound hits the water and 99.9% is reflected back into the air. Only one tenth of one percent of the sound actually makes it into the water. This is because there is an enormous difference in impedance between air and water. Vibrations simply don't transfer

very well between the two. The amazing thing is that the eardrum and three special bones accomplish the transfer of energy from air to liquid with almost no loss at all.



Doug Jones (L) talking with Hellmuth Kolbe at the Studio Designer's Workshop at MasterSound Astoria.

the advantage of usually being the cheapest and most intelligible systems for most churches.

In the first of the series of articles, "How does Good Sound Work?",

"I Think I'll Have a Cup of Tea"

A number of years ago there was an English troupe who played out a series of wartime disasters related to a typical London family during the Blitz. Each scene saw them with less

of a house from each bombing. Each time they would end the scene by turning from the disaster with the sentence, "I think I'll have a cup of tea".

Here are a few recent events from the NY AES that sent me for "a cup of tea":

A Bose salesman at the AES delivering an eulogy at the conclusion of his paper about Ken Jacob's original intelligibility paper.

Stanley Lipshitz getting up and saying that Peter D'Antonio had made

an error in his paper on the Phase of the ETC. The fact that after the meeting Peter proved that he had not made the error didn't lead Lipschitz to correct the statement in the next session.

Bart Lochanthi saying that the yet unpublished Heyser paper would be reviewed for the AES by Lipshitz and Vanderkooy. After being challenged about this, he then stated, "I guess it should be reviewed by someone that knows something about *architectural acoustics*."

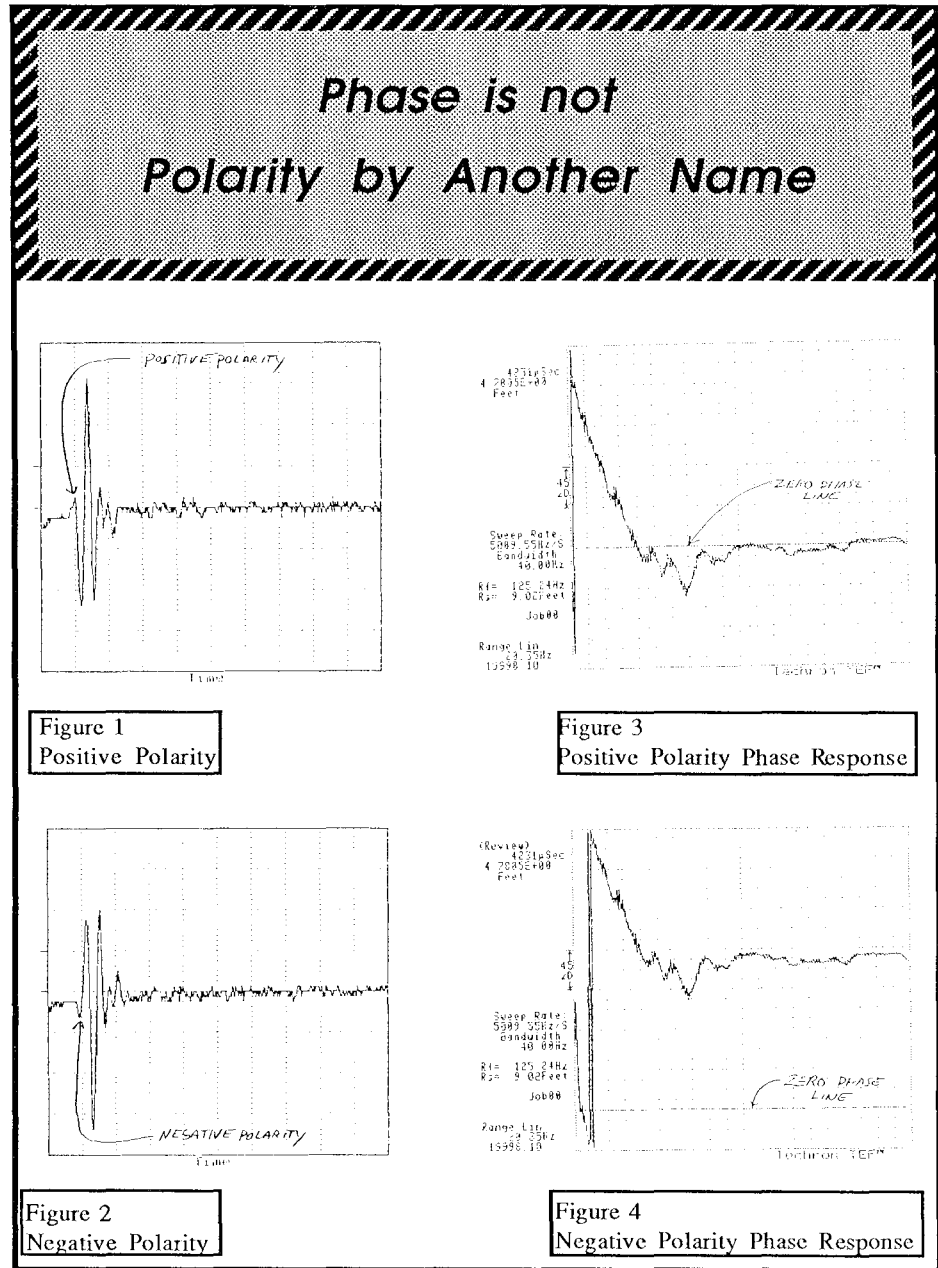
POLARITY AND PHASE ILLUSTRATED

A positive electrical impulse polarity should result in a loudspeaker diaphragm producing a positive pressure acoustic response (i.e. an increase in pressure above that of ambient atmosphere pressure.) In real life loudspeaker, this will occur when tried, but the acoustics signal output - an overpressure - will often be severely limited in amplitude. (see Fig.1).

If we then deliberately reverse polarity, we can observe the initial underpressure that occurs has the same limitations. (See Fig. 2) This can lead, in some impulse type polarity testers, to their reading the first large pressure variation rather than the first pressure change. To verify that the impulse measurements were indeed telling us the truth we measured the total phase response in both polarity connections. The data is reproduced here. (See Figs. 3 & 4) Remember our basic definition

"Phase is frequency dependent"
 "Polarity is not frequency dependent"

The impulse response displays allow you to easily visualize the 180° step in time taken by a polarity reversal. The peak amplitude is 180° in the opposite direction.



NEW TEKTRONIX OSCILLOSCOPE

The July 15 issue of "Sound & Video Contractor" also contained an article written by Larry Johnson of Tektronix which describes the many applications for their new 2225 50 mHz oscilloscope. Syn-Aud-Con has just purchased one of these and has found it to be an excellent buy for the money (just under \$1,000). This scope allows low sensitivity microphone outputs to be viewed directly, and sensitivity meas-

urements proceed with minimal fuss. Trying to measure outputs in the millivolt area without a scope is to often measure everything but the desired signal.

Our scope travels well and has measured everything we have asked it to without extraneous pickup of any undesired noises or interferences. We know of few instruments more basic to a newcomer's growth in audio.

Reverse the Polarity of a Driver?

Dr. Patronis and Don are writing a new book called Loudspeaker Systems: Theory, Design and Construction. The first chapter that Dr. Patronis' tackled is one that he is uniquely equipped to write, Crossover Networks.

I'd like to drop into the middle of the rough draft of the chapter to reproduce a few paragraphs, since we read so much in the press about reversing the polarity of the driver in the low frequency section of a two way loudspeaker. Dr. Patronis is talking here about the active and passive realizations of the second order Butterworth filters.

From Dr. Patronis:

The measured amplitude characteristics are displayed in Figures 13A and 13B, while the phase behavior can be observed in the Nyquist diagrams of Figures 13C and D.

The increased attenuation slopes are evident in Figures 13A and 13B as compared with the first order curves in Figures 1 and 4. Upon examining the summed response one finds

$$(19) \quad H_L + H_H = \frac{S^2 + \omega_0^2}{S^2 + \sqrt{2}S\omega_0 + \omega_0^2}$$

The summed response displayed in equation (19) is not independent of frequency. It has a value of unity at the frequency extremes where S is either very large or very small while at the crossover frequency, where $S = j\omega_0$, the value is given by

$$(20) \quad \frac{-\omega_0^2 + \omega_0^2}{-\omega_0^2 + \sqrt{2}j\omega_0^2 + \omega_0^2} = 0$$

Equation (20) states that the combined output of the network at the crossover frequency is zero!

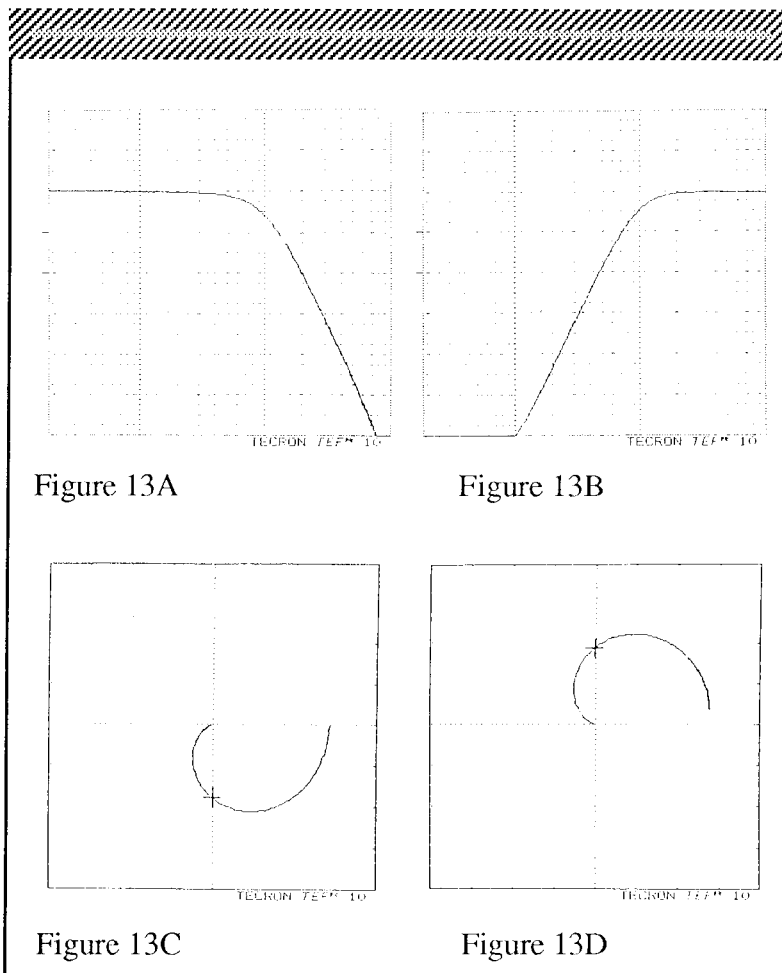
This is graphically portrayed in Figure 13C and D.

The Nyquist diagram of 13C depicts the output of the low pass section to be on the negative imaginary axis at the crossover frequency, that is at an angle of -90° , while Figure 13D shows the output of the high pass section on the positive imaginary axis at the crossover frequency indicating the angle of $+90^\circ$. Since the magnitudes of the two signals are equal at crossover, this phase difference of 180° leads to a net sum of zero. This behavior led one high end audio manufacturer to include a third driver in his basically two way loudspeaker system to fill the "hole in the middle". Much advertising copy was generated by this approach.

Another approach taken by others is to reverse the polarity of the driver in the low frequency section of a two way loudspeaker. This has the effect of taking the difference between H_H and H_L for the summed response as given by

$$(21) \quad H_H - H_L = \frac{S^2 - \omega_0^2}{S^2 + \sqrt{2}S\omega_0 + \omega_0^2}$$

Equation (21) has a value of -1 at very low frequencies, a value of $\sqrt{2}j$ at the crossover frequency, and a value of $+1$ at very high frequencies. The corresponding values in the language of the Bode plots would be 0 dB with an angle of $+180^\circ$ at low frequencies, $+3$ dB with an angle of $+90^\circ$ at the crossover frequency, and 0 dB at an angle of 0° for very high frequencies. *It is true that this technique produces an improvement in the combined amplitude response but it does so by changing the phase response. Neither of the behaviors given by equations (19) or (21) is ideal. They each suffer from both frequency as well as phase distortion. (Editor's note: italics mine)*



DAMPING FACTOR

The subject of damping factor subject comes up so often we are re-printing this answer given to the question many years ago. Mr. Tiers is succinct, accurate, and complete. This nonsense surfaces regularly with uninformed power amplifier designers and wire hype artists.

Lest I become embroiled in an audiophiles' subjective controversy, I hasten to point out that I am not attacking Mr. Kimber's favorite wire, just his technical explanation and formula. If you like the new wire, use and recommend it; just don't claim that halving the wire resistance doubles the damping. Now for the proof.

Let's start at the beginning. A loudspeaker is intended to transfer energy by air, by setting the air in motion, alternately creating high and low pressure zones near the cone. In order to move air, the speaker cone must move. The cone has some non-zero mass, so it has kinetic energy which is non-zero. The energy is stored when the cone is accelerated, and given up when it slows down. Because of this storage, the cone does not instantly reach full speed when a "step" of voltage is applied to the voice coil, nor does it instantly stop and reverse direction when the polarity of the voltage is reversed. When the cone is moving, its kinetic energy must be removed in order to stop it. That is, since work equals force x distance, and also work done on a moving body equals the change in kinetic energy of the body, a force must be applied while the cone moves some distance, in order to stop it. The force applied may be due to suspension friction, it may be due to the air resisting cone motion, or it may be due to electrical damping. If the rate of energy removal is low, (low damping, low friction, and poor coupling to the air), oscillations may occur at the resonant frequency of the speaker — the characteristic "hangover" or "tubbiness" in the bass (ringing also occurs in tweeters, and is often controlled by adjusting the suspension friction).

Neglecting everything but electrical effects, let's see what causes the damping force. The force exerted by the voice coil is given by: $F = Bli$, where "B" is the magnetic flux density in the voice coil gap, "l" is the length of wire in the gap, and "i" is the current flowing in the voice coil. "B" and "l" are fixed by the coil and magnetic circuit assembly, and are constant. The variable is "i." Note that this force is either the force exerted by the coil, or the force exerted on the coil. (Microphones also "speak" if power is supplied to them.) In the case we are discussing, the energy is being supplied by

the stored kinetic energy of the cone, and the current "i" is due to cone motion.

Now, taking the low frequency case, current = volts/resistance by Ohms law.

If we are considering the speaker/wire/amplifier system, the equivalent circuit in Figure 1 is useful.

The speaker-generated voltage, V_{spkr} , equals Bli , where "u" is the velocity of the voice coil, while "B" and "l" are as before. Therefore, the current "i" from the first equation is given by:

$$i = Bli / (R_{vc} + R_w + R_o)$$

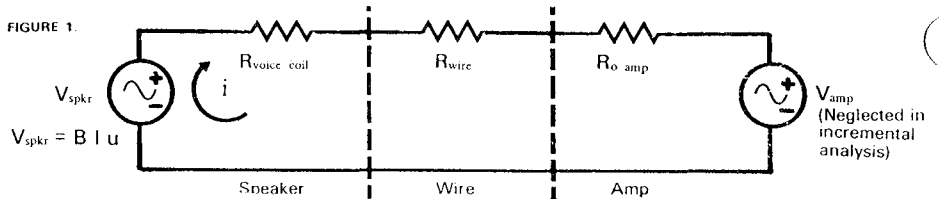
and combining,

$$F = B^2 l^2 u / (R_{vc} + R_w + R_o) = Bli$$

We are neglecting the amplifier output voltage by invoking the principle of superposition, allowing separate solutions for the currents due to the two sources.

Plainly, the damping force "F" is dependent on the current, "i" which is inversely proportional to the sum of the resistances, including the voice coil resistance is the largest resistance in the circuit, typically 5 - 7 ohms for a nominal 8 ohm speaker, it is the determining element. The formula used by Mr. Kimber, since it

FIGURE 1.



neglects this resistance, is invalid.

With respect to Mr. Kimber's "justification" of the omission, in which he claims that it's okay, since "the only difference would be the amount of power available . . .", his reasoning is faulty, precisely because the amount of power available will vary with voice coil resistance. Power, P, equals i^2R . Reducing the resistance will increase the current. Because the current is squared, while R is not, the increase of i^2 more than offsets the decrease due to diminuation of R. The net power supplied by the speaker will increase. Power is the rate of transfer of energy, so a given amount of kinetic energy can be removed in a shorter time if the rate of removal, power, is greater. So, again, the damping effect is greater if the voice coil resistance is decreased, if other resistances are held constant. It's not that the wire has nothing to do with damping, rather, voice coil resistance has the greatest effect because it is the largest resistance in the circuit.

It is erroneous to assume that any version of the "damping equation" used by Messrs. Kimber, Dickensheets, and Brooks

provides any definitive information on speaker damping, since their formula, as well as my own observations above, has neglected an additional resistor which is the acoustic radiation resistance. This provides additional damping, varying from little, in an inefficient acoustic suspension speaker, to a possibly dominant effect in a high efficiency horn system. The horn system is likely to be very tolerant of low damping ratios, as the cone is coupled to a greater mass of air, so that its own mass becomes less important by comparison. The effect is similar to suppressing the "ringing" of an L-C filter by properly terminating the output. Speakers generally have an optimum amount of damping, with which they perform best, and the designer picks a tradeoff involving efficiency, size, range, then adjust the damping to conform to the desired filter function response. See the various articles in the *Journal of the Audio Engineering Society, Audio, etc.*, for more information, especially concerning the large family of bass reflex alignments worked out by A. N. Thiele.

With that caveat regarding the usefulness of any fancy "damping" equations, let me summarize:

1) Electromagnetic forces in the

loudspeaker are a function of the current in the voice coil.

2) For a given voltage, the current in the coil is determined by the total circuit resistance, including that of the coil.

3) Therefore, whatever the actual utility of the equations, it is incorrect to leave voice coil resistance out.

4) Since the voice coil resistance is large with respect to other resistances in the circuit, Mr. Kimber's linear relationship between wire resistance and damping has no basis in reality, the actual relationship looks more like a log curve, and diminishing returns catches up in a hurry.

5) Those wonderful damping ratios in the 30s and 40s are wholly imaginary, and those amplifier DRs of 1,000 will not be attainable in practice.

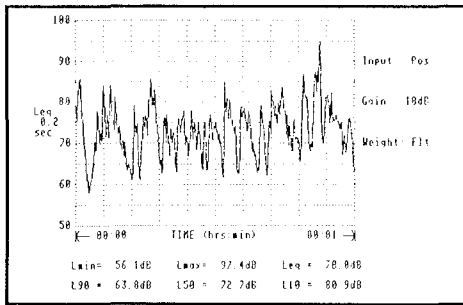
In conclusion, Mr. Kimber's numbers seem a poor basis to choose wire on. It certainly seems adequate to keep wire resistance to around 5% of the voice coil resistance, in order to minimize power losses. Certainly #000 buss bar seems excessive, no matter what glorious numbers result from Mr. Kimber's formula.

ENVIRONMENTAL NOISE LEVEL ANALYSIS VOL. 2 (NLA)

Farrel Becker is not only the father of a marvelous baby girl, but with more time at home in order to help care for Elizabeth he also has more programming time.

This program Noise Level Analysis is an extremely useful adjunct for the TEF analyzer. Simply choose a time interval (our example is for 1.0 minute) and punch Go. The TEF now records the Lp millisecond by millisecond and then provides.

1. A display of the levels.
2. LMIN The lowest level encountered.
3. LMAX The highest level encountered.
4. LEQ The equivalent level as a single event.
5. L90 The level exceeded 90% of the time.
6. L50 The level exceeded 50% of the time.
7. L10 The level exceeded 10% of the time.
8. LMEAN The average level.



Soon to be added L99 and L1 since European users require such measurements. A truly beautiful user-friendly menu-driven program with superb printouts to aid the first time user. Write Farrel to find out when it will be released. Farrel Becker, Audio Artistry, P. O. Box 56, Kensington, MD 20895. Ph 301-493-8323

Authors That Predate Haas

AUTHOR (S)	CONTRIBUTION	DATE
Henry	"Limit of Perceptibility"	1849
Pierce	"Phantom at Nearer Sound"	1890's
Petzold	"Threshold of Extinction"	1927
Fay & Hall	ASA Demonstrations	1935
Snow	Patent No. 2,137,032	1938
de Boer	"Rotation of Sound Image"	1940
Langmuir et al	"First Arrival Effect"	1944
Cremer	"Law of First Wavefront"	1948
Wallach et al	"Precedence Effect"	1949 (July)
Haas	"Influence of a Single Echo"	1949 (Oct.)

CLASSIFIED

WANTED: IVIE 1/3-octave analyzer and IVIE noise generator. Contact: Frank Huang, 3141 E 62nd Ave, Vancouver, BC V5S 2G6. Ph 604-438-1355

WANTED: Used TEF Analyzer 10 or 12. Contact: Brent Gabrielsen, Gabriel Engineering, 833 W. Main, Mesa, AZ 85201 (602) 969-8663

FOR SALE: HP-28C Scientific Calculator, HP-82240A Infrared Printer and six rolls thermal printer paper. New in the Box. My order was duplicated and distributor would not accept returns. Asking \$260 for all. Contact: Ed Burquez (205) 669-5200

FOR SALE: Panasonic WV5400 B&W CCTV Camera with KOWA zoom lens 1:18/12.5 - 75 \$100.
Taxan KX 1202 12" grn display
Computer/TV monitors \$50.
HP 82153 82153A wand for HP41
HP 82162A Thermal printer
HP 82163A Video interface
HP ac adaptors (3)
HP 82160A IL module
HP 82037A Reserve power pack \$150.

Contact: Don Davis, P O Box 1239, Bedford, IN 47421. (812) 275-3853. Carolyn says that if I can sell the above for \$300 I can buy a Daven gain set from Ralph Townsley which I really don't need, but must have.

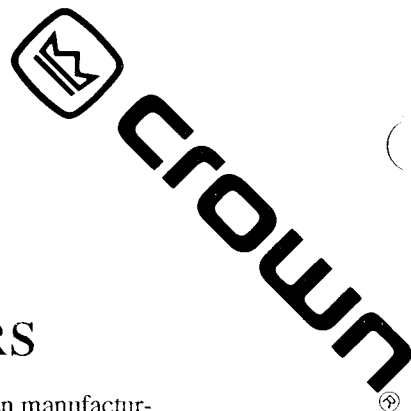
POSITION AVAILABLE: Audio Systems Engineer -- New England's largest multi-discipline communications contractor seeks experienced professional to head established audio systems efforts starting April 1, 1988, preferably sooner. Limited travel. Contact: Tom Bouliane, SESCO, INC., Boston, MA (617) 825-6401 to receive details. All inquires totally confidential.

**Subscribe Now
to the
Syn-Aud-Con
Newsletter**

Only \$32.00 per Year!!



Benchmark



SYN-AUD-CON SPONSORS

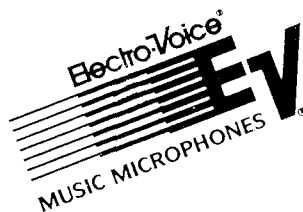
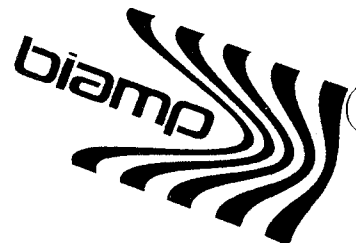
Syn-Aud-Con receives tangible support from the audio industry. Sixteen manufacturing firms presently help underwrite the expense of providing sound engineering seminars. Such support makes it possible to provide the very latest in audio technology while maintaining reasonable prices relative to today's economy and to provide all the materials and continuing support to all graduates of Syn-Aud-Con.

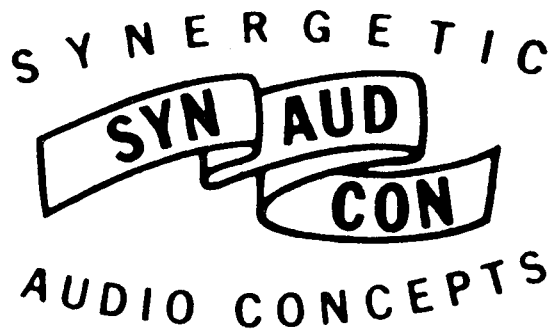
Personnel from these manufacturers receive Syn-Aud-Con training which provides still another link in the communications circuit between the ultimate user and the designer-manufacturer of audio equipment. They are "in tune" with what a Syn-Aud-Con grad needs.

Their presence on this list as a Syn-Aud-Con sponsor indicates their desire to work cooperatively with you in professional sound.



- Altec Lansing Corporation
- Benchmark Media Systems, Inc.
- BIAMP Systems, Inc.
- Community Light & Sound, Inc.
- Crown International
- Eastern Acoustic Works
- Electro-Voice, Inc.
- FSR, Inc.
- HM Electronics, Inc.
- Industrial Research Products, Inc.
- JBL Professional/UREI Electronics
- J. W. Davis Company
- Shure Brothers, Inc.
- Switchcraft, Inc.
- TOA Electronics
- West Penn Wire Corp.





P.O. BOX 1239, BEDFORD, INDIANA 47421

TECH TOPICS

Volume 15, Number 3

Winter, 1988

©1988 Don & Carolyn Davis

Compressor/Limiters: Applications and Design

by

Bob Rodgers, Senior Project Engineer, Altec Lansing Corp

As the quality of paging systems improves in airports, shopping malls, office buildings, and factories, two problems typically result which need to be addressed: the minimization of paging level differences between the various system operators, and the minimization of potentially harmful signal peaks which can cause system overloads. One product which is well suited to both tasks is a compressor/limiter. Before looking at some examples, let's review some basic terminology.

Basic Terminology

Dynamic range is simply the difference between the upper and lower bounds of aural perception and is usually expressed in dB. With regard to electronic products, dynamic range is the difference between the threshold of clipping and the noise floor. Most electronic products designed for professional applications have little difficulty in achieving dynamic ranges in excess of 100 dB.

Compression

Compression is the process whereby the dynamic range of a signal is reduced by an amount determined by the compression ratio. The compression ratio is the ratio of input level change to output level change. For example, if the input dynamic range is 100 dB and the compressed output is 50 dB, the compression ratio is 2:1.

Limiting

Limiting is the process which places a ceiling on the maximum output level of a signal without changing the dynamic range below the ceiling. Compressor/limiters have a threshold control which determines the level at which compression or limiting begins and is usually adjustable over at least a 40 dB range. In many compressor/limiters, the compression ratio is variable from 1:1 (no compression or limiting) to ∞ : 1. At ∞ : 1 no finite increase in input level will cause the output to exceed the threshold level.

Note: Compressor/limiters are typically above-threshold devices meaning that no processing occurs for input signals below the predetermined threshold. This is unlike the compressors used in companding noise reduction systems.

Practical Use of Compressor

Let's assume that several people make announcements over the paging system at an airport, and that their vocal differences and varying degrees of closeness to the microphone produce an 8 dB differential in level over the sound system as shown in Figure 1a. This may result in a scenario where some announcements are comfortably heard while others are lost in the ambient noise.

Suppose a compressor/limiter were installed in the system. If the compression ratio were adjusted to 4:1 and the threshold to the system reference lev-

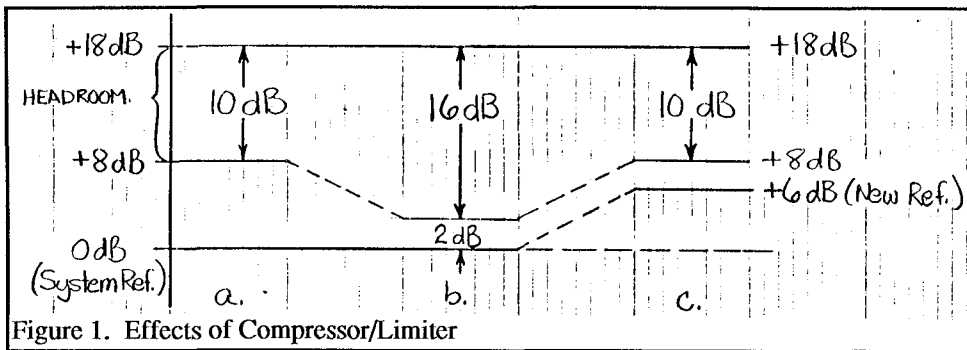


Figure 1. Effects of Compressor/Limiter

whose gain is variable by a dc control voltage applied to a control port input. The level detector senses its input signal and produces a corresponding dc voltage which is used to control the gain in the VCA. With these two function blocks, let's look at some circuit design approaches.

el, the 8 dB differential is reduced to 2 dB as shown in Figure 1b. This process results in a 6 dB increase in system headroom because the system no longer has to amplify the 8 dB differential. If there were 10 dB of headroom before, now there is 16 dB and the level differences have been reduced to provide a more nearly constant paging level. Now that the individual level differences have been minimized, the overall system level can be raised by 6 dB as shown in Figure 1c. This still provides the same amount of headroom as before with the following advantage: *all* of the announcements are more equally heard.

Practical Use of Limiter

Another use of compressor/limiters is in limiting. Suppose there exists the threat of a dropped microphone. The sound energy produced as a result could cause clipping in one of the subsequent stages of amplification and harm the loudspeakers. If a compressor/limiter were used, the signal could be limited to a predetermined safe ceiling to reduce the risk of any damage caused by sudden unexpected bursts of energy. In this application, the compression ratio control would be set to $\infty : 1$ and the threshold to a known safe ceiling level.

If the previous examples suggest to you that the only real differences between a compressor and a limiter are in the adjustment of the compression ratio and threshold control, you're right. Operation as a compressor simply means that the compression ratio is typically set to less than 4:1, and threshold level to the nominal or reference signal level. As a limiter, the compression ratio is usually greater than 10:1 with the threshold adjusted to the desired maximum output level.

Voltage Controlled Amplifier

All compressor/limiters must have at least a variable gain device, usually a voltage-controlled amplifier, and a level detector. The voltage-controlled amplifier, or VCA, is an amplifier

Feedback Approach

One approach to compressor/limiter design is the feedback approach shown in Figure 2. In a feedback design, a signal is applied to the input of a VCA whose output signal is sensed and converted to

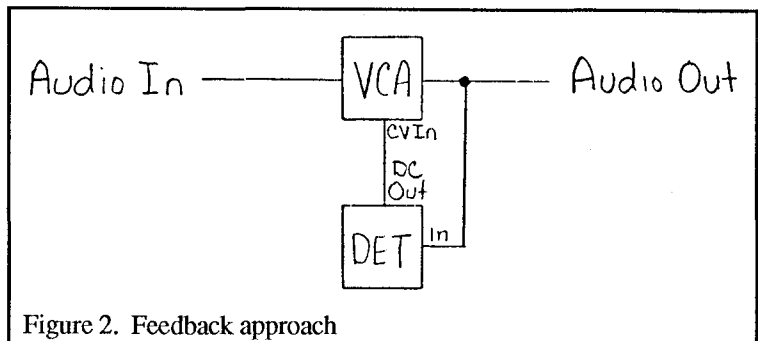


Figure 2. Feedback approach

a dc control voltage by the level detector. The resulting dc control voltage is then fed back to the control port of the VCA. Although the feedback approach works conceptually well, it may become unstable at high compression ratios. This is because the increase in feedback loop gain at higher compression ratios increases the likelihood of oscillation or other instabilities. As a result, the maximum compression ratios are typically limited to less than 10:1 or 20:1.

A second disadvantage is that the attack and release times are program-independent because the detector does not sense the actual input signal; it senses the processed signal (output of the VCA). Even when manual response time adjustments are provided, their dependency on the loop gain negates their effect for all compression ratios except the ratio selected during their initial adjustment.

Feedforward Design

Another approach to compressor/limiter design is the feedforward approach shown in Figure 3. In a feedforward design, the input signal is simultaneously applied to the VCA and the level detector. Since there is no feedback loop, the design is stable at *any* compression ratio.

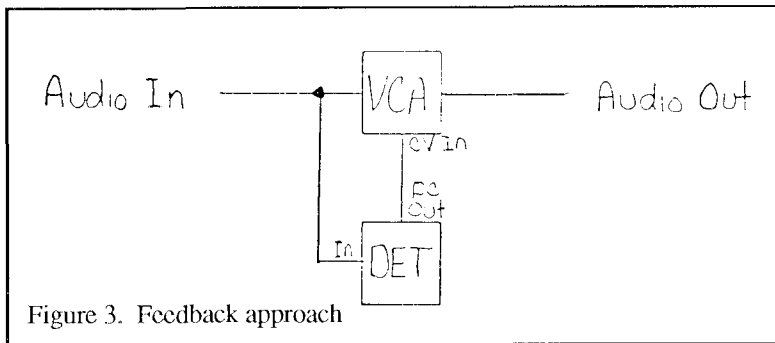


Figure 3. Feedback approach

A second advantage is that the response times can be program dependent. By tracking the input signal's envelope, for example, the response times will vary automatically with the rate of level change. This means that the response times are not actually times at all; they are time derivatives. This eliminates the need for manual adjustments and preserves the naturalness of any given sound. Since no manual response time adjustments are needed, setup and operation are greatly simplified.

The level detector is probably the most important circuit in a compressor/limiter design. It integrates the input signal to produce the related dc voltage. The integration capacitor, C_{int} , determines the range of frequencies in the input signal

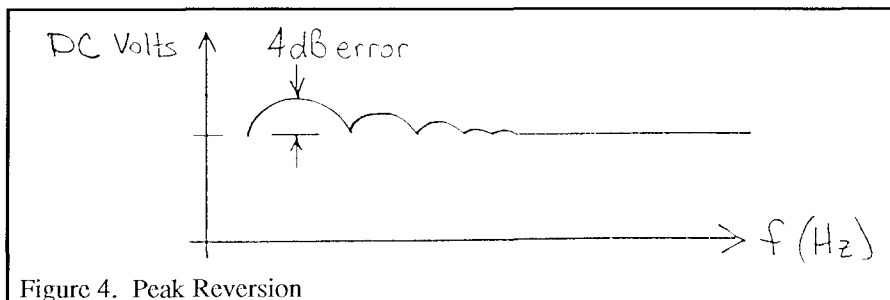


Figure 4. Peak Reversion

that will be integrated. In a broadband design, the dc output will be practically ripple free throughout most of the audio frequency range. However, at low frequencies, a condition known as peak reversion may occur as shown in Figure 4. When input frequencies approach the lower bound of the period chosen by the integration time, ripple increases. At still lower frequencies, the detector actually begins detecting the peaks of the input signal. As a result, the detector is fooled into thinking that there is more low frequency energy present in the input signal. For sinewaves, this results in a 4 dB error (sinewaves have a peak-to-average ratio of 4 dB).

Music may have much higher peak-to-average ratios. In rock music, for example, the peak-to-average ratio may approach 9 dB. If so, then a 9 dB overstatement of low frequency may occur. In a compressor/limiter design, this would cause ex-

treme over-compression and noise modulation resulting in a very unnatural sound. Peak reversion correction maintains the naturalness of the original music which results in better transparency during processing, but is peak reversion correction necessary in speech-only applications?

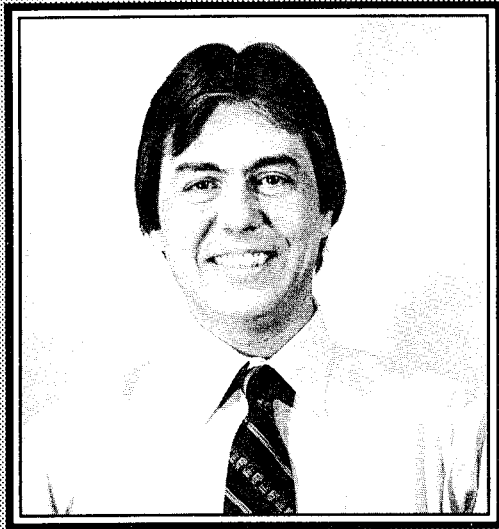
Altec's Feedforward Design with Peak Reversion Correction

At Altec Lansing, we developed the 1712A Compressor/Limiter. It's feedforward design with peak reversion correction and wide adjustment range make it suitable for any application. The compression ratio is continuously adjustable from 1 : 1 to ∞ : 1, and the threshold from -45 dB to +20 dB. An output level control is also provided and varies the output over a ± 20 dB range. Two LED arrays simultaneously indicate the amount of gain reduction and output level. The unit may be referenced to -10 dBm, 0 dBm, +4dBm, or +8 dBm line levels, and features a hardwired automatic circuit bypass, flush mounted screwdriver-slotted controls, and barrier strip connectors for signal connections.

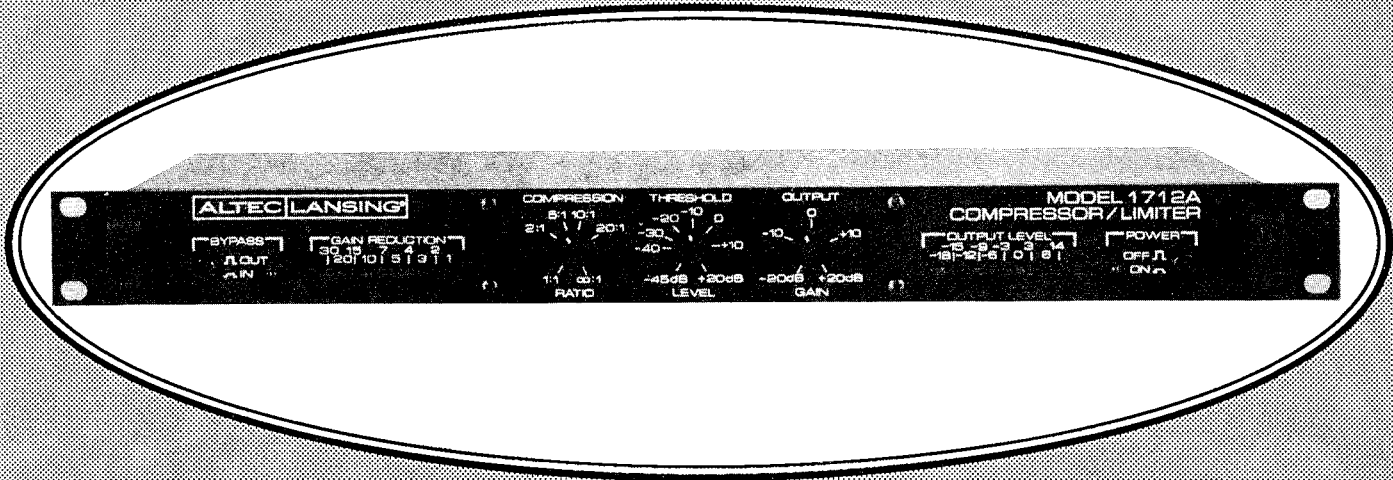
Before deciding on any compressor/limiter, know your application. Then learn as much as possible about the particular compressor/limiter design. This will help you understand its advantages and limitations. If you can't find out what you need to know from the product literature sheet, ask the manufacturer directly or your colleagues.

Compressor/limiters are very useful tools with many applications. As with any signal processing product, however, they can be mis-used. Take the time to learn about them and you will be surprised at the results. ■

COPYRIGHT 1988 by Synergetic Audio Concepts. All rights reserved. Printed in the United States of America. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior written permission of Synergetic Audio Concepts. The information conveyed in this TECH TOPIC has been carefully reviewed and believed to be accurate and reliable; however, no responsibility is assumed for inaccuracies in calculations or statements



**Bob Rodgers, Senior Project
Engineer, Altec Lansing**



Altec 1712A Compressor/Limiter

AUDIO ACTIVITIES IN EUROPE

We were invited by Larry Frandsen of Electro-Voice/Europe to participate in two European conferences, the first in the Frankfurt, Germany area (Bad Nauheim) and the second in London. We flew to Frankfurt and arrived November 3. This allowed us the 3rd and 4th to adjust to the time change.

Head Acoustics

We rented a Ford Escort on the 4th to drive to Aachen to visit Dr. Klaus Genuit of Head Acoustics, manufacturers of a very expensive (\$20,000 and up) artificial head. Wade Bray of Jaffe Acoustics had encouraged us to get acquainted with Dr. Genuit at Head Acoustics

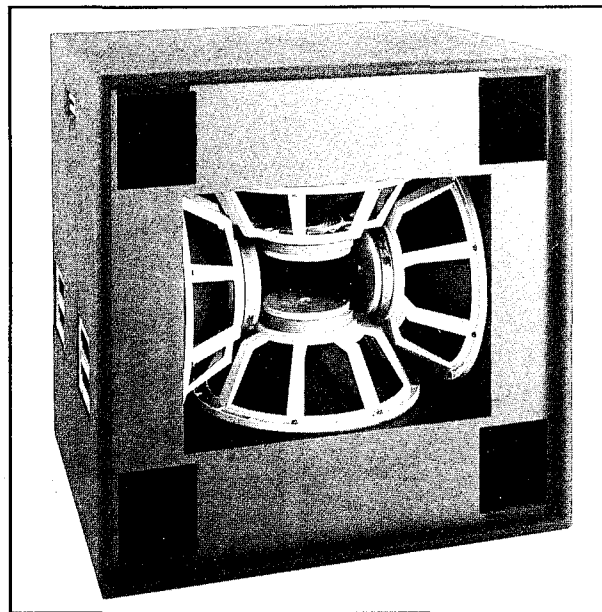
The artificial head is being used by Mercedes Benz, among others, as part of their acoustic measurements in and around automobiles, trucks and other vehicles.

Dr. Genuit is an articulate, intelligent young man who studied under Jens Blauert. Dr. Genuit's 216 page doctoral thesis, "Ein Modell zur Beschreibung von Aussenohrubertragungseigenschaften" contains valuable information on pinnae transforms, clearly identifying the notches caused by the reflections from the listener's shoulders and concha. The

digital electronics used with the artificial head is a good part of why it is so expensive. Variations in the pinnae transform can be programmed.

On Driving in Europe

In driving to Aachen in the usual rain, I discovered several interesting things about a European Ford Escort



The EV MT4 was star of the EV conferences

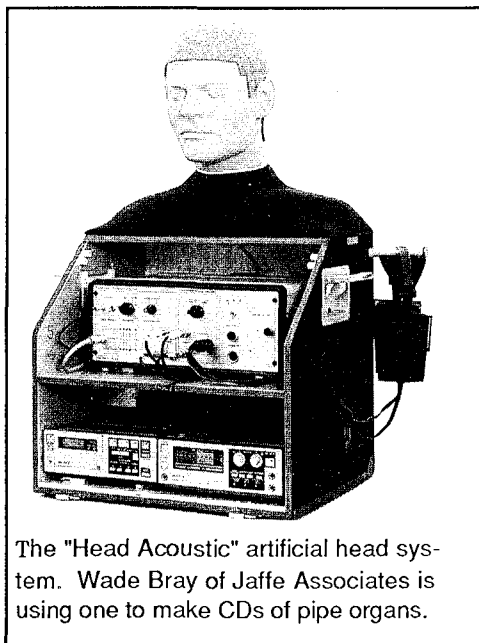
1. It will allow right hand and left hand slides at 160 kph (96 mph). (That's how I avoided contact with a Mercedes going by at over 200 kph.)

2. You can move from one lane to another at that speed in a car length. Steering, brakes and suspension are all tighter and more precise than the U.S. counterpart. (We managed to cover 200 miles in just over 2 hours.)

The EV Meeting in Bad Nauheim

Attendance at the EV meeting was 230 professional audio people. Personnel was there from Siemens, Telefunken (now called ANT), very fine sound contractors from all over Europe, great Tonmeisters, consultants and many OEM accounts. Gary Ewald of EV and Bob Rodgers of Altec were key contributors to the program along with Carolyn and me. EV really put on a first class meeting with excellent accommodations, superb food, and a well planned program.

We met many old friends and made new friends. One of our friends, Wolfram Altenhovel, from the Hamburg/Heyser workshop gave me an exceptional gift: A handmade mahogany case with a cable tester, polarity checker and headphone distribution system/line monitor. We will be writing more



The "Head Acoustic" artificial head system. Wade Bray of Jaffe Associates is using one to make CDs of pipe organs.

about the AMB products as soon as we have had a chance to test them.

I have long contended that the manufacturer who puts together a program to train their sound contractors in Europe would be the manufacturer who would become a leader in the sound reinforcement field. Clearly EV wants to be that manufacturer and they are taking the right steps.

"Operation Purple Warrior"

On November 7 we flew with the EV people to London from Frankfurt. As we checked into the London Tara hotel I was approached by a British colonel who asked me "Pardon me sir, are you here for Operation Purple Warrior?" I replied, "As interesting as it sounds, I'm sorry to say I am not." It turned out he had mistaken me for the Marine Corp colonel they were expecting (we met the marine colonel later in the elevator) and that "Purple Warrior" was some war games to be conducted in Scotland with 20,000 troops. We later saw the British colonel and the party of foreign visitors on TV as they enplaned for Scotland.

Swan Lake at the Royal Ballet

EV had told their English representative, Tony Oates at Shuttle Sound, about our desire to see the Royal Ballet. He contacted Eric Pressler, the Tonmeister for the Royal Covent Garden. Mr. Pressler had tickets for us in the manager's box for a Royal Ballet performance of Swan Lake in its original St. Petersburg format so that we saw not only a new staging of the ballet but also heard music from it we had not heard before.

London EV Conference

The EV London meeting attracted about 130 people at the Queen Elizabeth Conference Center and again we had the privilege of meeting many of the movers and shakers from the British Isles, France, the Netherlands and Scandinavia. The people at Shuttle Sound showed their very innovative installation hardware that they have developed. I understand that EV in the United States are looking into making the hardware available in the U.S. If EV advertises or announces installation hardware, don't fail to check it out carefully. You will be very glad you did.

Just in case you think that we in the United States have a corner on the big sound systems, Peter Mapp, a consultant in England, told the group of audio professionals about his firm's involvement in the design and installation of a sound system for the Jockey Club in Hong Kong: 3,500 loudspeakers in a distributed system as well as "several interesting central clusters." An absolutely huge project using EV and Crown.

Sightseeing

One afternoon I went to see Eric Kennington's bust of T E Lawrence in St. Paul Cathedral (down in the Crypt). Memories anchor on such moments.

King Lear at the National Theater

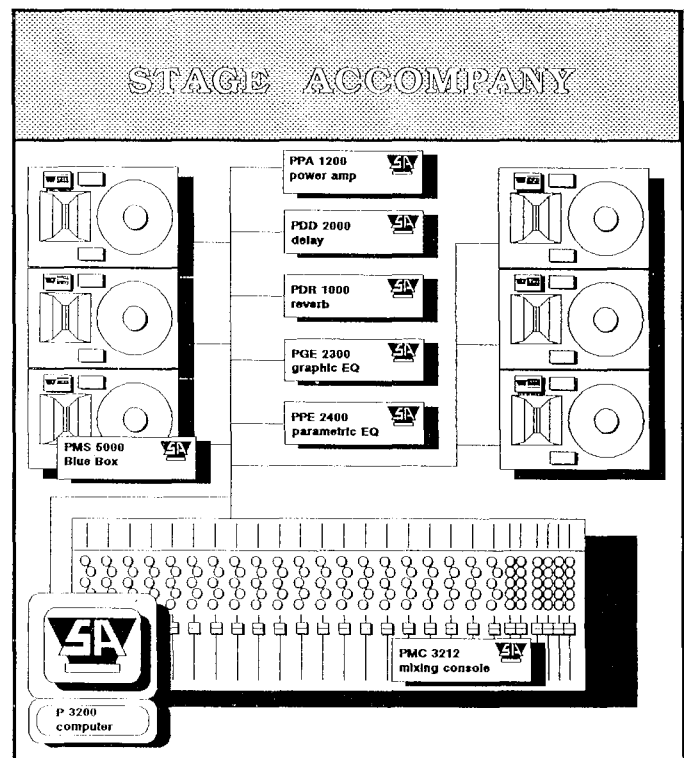
The night of the 10th (the end of the EV meeting) Tony Waldron, who attended and was in charge of sound at the National Theater, arranged for us to see Anthony Newell in Shakespeare's King Lear from one of the management's prize seats. After what seemed like 15 minute we were astounded to find the first act had been an hour and a half. It is often a decade between a production of King Lear because of the difficulty of putting together a good cast. We were privileged to attend a packed house for the 99th of 100 performances.

Neil Grant and the Old Gentlemen's Club

Neil Grant, who is doing TEF measurements for Jaguar these days in addition to all his highly creative loudspeaker and control room design, had reserved the 11th of us. Neil Grant's assistant, Debbie, took us to visit Peter Clarke's Red Bus studio and to hear, at long last, his Boxer monitor loudspeaker system. We liked what we heard! That evening Neil and Debbie entertained us at a private men's club on Curzon St. Neil had been enrolled as a child by his father. To understand England it would be best to have the privilege of having dinner at "the club". Or perhaps a cartoon in Punch magazine would explain England: Punch ran a newspaper headline, "Fog in channel, continent isolated."

The Blue Box

We flew to Amsterdam on the 12th where we picked up a new (rental) Audi Quattro (a four wheel drive sports sedan with ABS-automatic brake system). Top speed on the flat was about 210 kph (126 mph) and on down hill runs with a tail wind of 220kph /132mph.



We drove in a cloudburst to Horn, the home of Stage Accompany SA sound systems to meet with Ben Kok and Mr. & Mrs. Ed Wijnker. They gave us a full demonstration of the unique "blue box" system they have developed. The Blue Box is built around a woofer, and a horn loaded ribbon tweeter capable of 130 dB at 1 meter and flat out to 30,000 Hz, complete with built in power amplifier and *micro-processor*.

The microprocessor allows control of power to the loudspeaker, recording of temperatures, length of time on, and a host of other functions. The Blue Boxes can be used alone, in sets of five or in sets of 25 as a Bessel array -- all controlled by a computer front end. The operator has control over various polar responses, choices of vertical, horizontal, or full Bessel array, and multiple equalizations at the touch of a computer keyboard. We tested a single channel 25 speaker Bessel array and were tremendously impressed with its ability to be either a voice or a music system at a keystroke. One of these 25 speaker arrays in a large church could not only provide the choir with a different equalization than the minister, but even a different polar response (i.e., keep sound off the walls for voice but let it hit walls for music.) Anyone who has attended a Syn-Aud-Con class during the past 3 years knows of our enthusiasm for the Bessel array. The Bessel array allows a combination of drivers to have the same dispersion as a single unit.

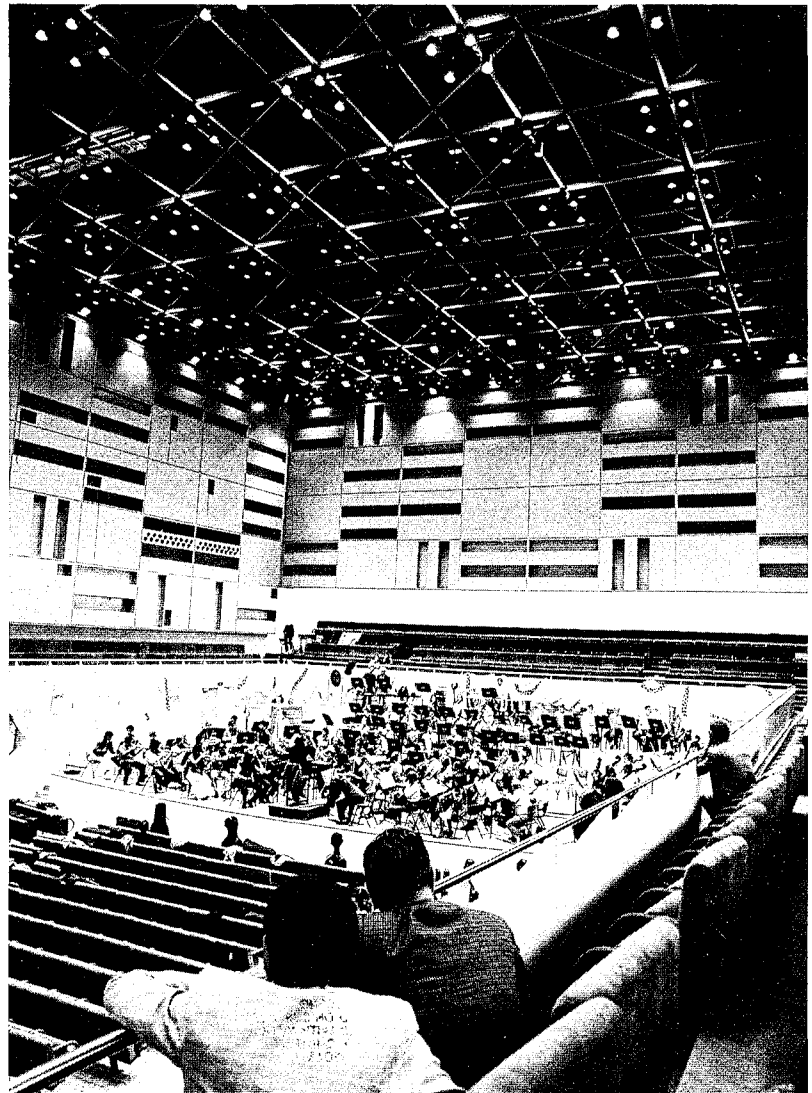
New Concert Hall at the Hague

The next day, the 13th, Ben Kok rode with us to the Hague to meet with Mr. Peutz and his associates. We all sat in on a complete critique of his new concert hall in that city. That night we all attended a concert at the new Dr Anton Philipszaal.

It was a breathtaking experience for the ears of a music lover. I've often heard Mr. Peutz say that a hall's geometry need not be unduly complex and this hall is living proof of the virtue of classic simplicity in the hands of a master of acoustics. We had the privilege of moving to different seating areas after each piece of music and literally encountered no poor areas -- the whole hall is exceptional. Bass in this hall is voluptuous and the loudness set a standard to be followed.

God only allows a few such thrills in a lifetime: to attend a great concert in a great hall accompanied by the hall's designer.

Philipszaal is 2200 seats, cost \$7,000,000 in the current dollar exchange. That means that the hall cost less than an



The Philipszaal at the Hague. Every acoustical consultant dreams of designing and seeing properly constructed a great concert hall. V.M.A. Peutz has realized his dream at Philipszaal.

unbelievable \$5,000,000 in dollars of a couple of years ago. Compare that to some of the \$30,000,000 disasters constructed in recent years in the United States.

Mr. Peutz was hired as the acoustician before the architect was hired. Maybe that accounts for the tremendous success of the hall. The director of the orchestra, Mr. H. B. van der Meer, told us that the acoustics of the hall was their number one consideration. Mr. Peutz has designed a great hall.

Later that evening we went with Mr. Peutz to his home in Nijmegen where we spent the next two days as guests of he and Mrs. Peutz. These days were spent in discussions of speech intelligibility, the Heyser transform, concert hall design, and TEF applications to architectural acoustics. The Peutzes represent the very best that Europe has to offer. There are few places in the world where they have not



V.M.A. Peutz

yet been, and their grasp of the realities are grounded in personal knowledge coupled to innate intelligence. Precious days indeed.

On Cars

On the 15th we drove from Nijmegen in the Eastern Netherlands to Wiesbaden, Germany. I hate to bore those of you who feel speed limits are alright but I live fully

wheel-to-wheel at 120 mph on a German autobahn up against a skilled fellow motorist. There's a slow motion poetry to a bunch of cars, all running at their absolute top speed and matched to within a mile an hour of each other sweeping around sharp turns, up and down steep hills, and only losing position if one prematurely brakes or fails to select the right gear of five for a given situation.

If you have been gifted with the eyesight, balance, reaction time, and previous high speed experience, these speeds are exhilarating, and surprisingly safe. Naturally they are not for cars with poor steering (too many turns lock-to-lock), poor brakes (can't be used hard from 120 mph by the hour) and poor suspension (American cars literally "float" off the road at high speeds.) Detroit is capable of building better cars than anyone else in the world -- that is not disputed by people overseas -- it's just that they don't. Why they don't is not understood. That they could, if they wished to, is. I do know that if the speed limit were lifted a whole generation would cease buying what Detroit produces and Detroit might finally listen. While we have inane speed limits, no one can tell junk from jewels In Europe you don't have to read the car magazines to know a car's relative performance, you find it out wheel-to-wheel in the pouring down rain. In case you think I'm trying to impress you with the idea that I'm a fast driver, forget it. We were being passed at 130 mph by the fast drivers as if we were parked. There are a number of German cars that can and do exceed 150 mph on the autobahn: Mercedes 500 and 600, BMW's new 12 cylinder sedan, a variety of Porsches and a host of hopped up regular cars.

Staatstheater, Wiesbaden, Germany

The occasion for returning to the Frankfurt area (Wiesbaden) was to attend the opera Hansel and Gretel at the Grosses Haus des Hessischen Staatstheater. We had been taken to this opera house the previous week by Hans-Josef Hammes of EV. Tonmeisters Heinz Weihe and Ute Schatz had attended the EV meeting and invited us to see their facilities at the Staatstheater. The opera house is eclectic, absolutely irreplaceable, and had been the one Kaiser Wilhelm had attended during his rule. Mr. Weihe and Ms Schatz had invited us to come back and hear the house in performance.

A Unique Background Music System

We stayed at a delightful hotel on the hill just above the opera house (the Klcc) and there encountered a unique and very high quality background music system. Full range music of low distortion played softly in the background but we couldn't find the source. Finally, near the end of the meal I realized that we were being covered by loudspeakers under a wall seating area on the other side of the room. The area under the seats was used as baffles, hence the good bass.

Sound Reinforced Opera

Heinz and Ute had arranged for us to occupy the front row in the royal box in the center of the circle. I'll settle for the "class system" if I can be king.

After the opera, Heinz asked us if we detected that reinforcement had been used at one point in the opera. We were frankly stunned. At the point where they had used the reinforcement we had actually remarked to each other how beautifully the children's voices had filled the opera house. Microphone pickup was with a mic mouse and the loudspeakers were 3" loudspeakers in a continuous array all the way from the stage around the proscenium arch back to the stage on the other side.

It is impossible to describe this opera house but any visitor to the Wiesbaden area who misses seeing it has been cheated. The main foyer used during the intermission is an absolute work of art.

After the opera we were treated to a real German dinner, introduced to the hot mineral fountains that abound there and escorted back to our hotel with our memory bank full to overload.

Kloster Eberbach

The morning of the 16th, Gunter Skupin of EV escorted us to the Kloster Eberbach in a small town nearby (this is where the interior shots for "The Name of the Rose" were shot.) You really haven't experienced reverberation until you have been in such a place.

Mercedes Acoustics Laboratory

That afternoon we drove to Stuttgart (home of Mercedes and Porsche) to keep an appointment with Christopher Landmann, senior staff engineer at Daimler-Benz Aktiengesellschaft. (Wade Bray of Jaffe had suggested our visit.) His job

Syn-Aud-Con Tech Topic

is to introduce new technologies to Daimler Benz (i.e., Mercedes). Driving from our hotel to the Mercedes plant in Unterturkheim, Mr. Landmann gave us a dramatic exhibition of the ABS on a wet downhill stretch when a car ahead of us stopped unexpectedly.

Mr. Landmann had worked with Porsche in the U.S. for many years and had a successful record as a rally driver. He exhibited a genuine enthusiasm for both automotive and audio engineering.

Mr. Landmann had arranged for Dr. Gruzel of their Acoustics Laboratory to demonstrate their use of the Head Acoustic's dummy head. Using all digital recording, the latest in electrostatic headphones and a flawless switching system, we were able to listen to a dozen diesel cars of various brands making cold starts, hear cars at speed passing alternately in front and in back of us, and other spatial effects possible only when pinnae clues are included. Getting into the Acoustics Lab is a multi-step exercise in security measures as it is part of the advanced research group at Daimler-Benz.

Stuttgart is like returning home for Carolyn and me as we used to make it our headquarters back in the 1950s when we came over to push Porsches and follow the Mercedes racing team.

West Germany's standard of living is, if not equal to ours, perhaps a little higher at the present time and we had the painful perspective of having once traded four Marks to the dollar instead of 1.6 Marks to the dollar at this time. (That means that a 6 oz bottle of ginger ale costs \$2.30 and one can drink a lot of 6 oz glasses of ginger ale when there is no water on the table).

More on Driving

On the 17th another glorious high speed drive through southern Germany to Zurich. Hellmuth Kolbe was waiting with his Lancia and we won't say what speeds he drove because Switzerland theoretically has a speed limit, but then maybe he thought the limit was in mph.

Hellmuth drove us to Thun just beyond Bern. Located on Lake Thun, this beautiful city is at the foot of the Alps with the infamous perpetually snow covered Eiger mountain as a backdrop. Just as the Alps came into view the overcast lifted and the sun came in at right angles to illuminate with the purest gold the snow covered peaks. It was if a celestial stage manager had chosen that moment to illuminate all creation for the viewer.

Hellmuth Kolbe's New Multi-Purpose Hall

The more we get to know Hellmuth Kolbe the more we respect him. Hellmuth truly has a gift from God in his ear/brain system. He is risk taker in the grand sense of the word -- and make no mistake, that Swiss precision and remarkable engineering skill can't hide the artist at the core of the man.

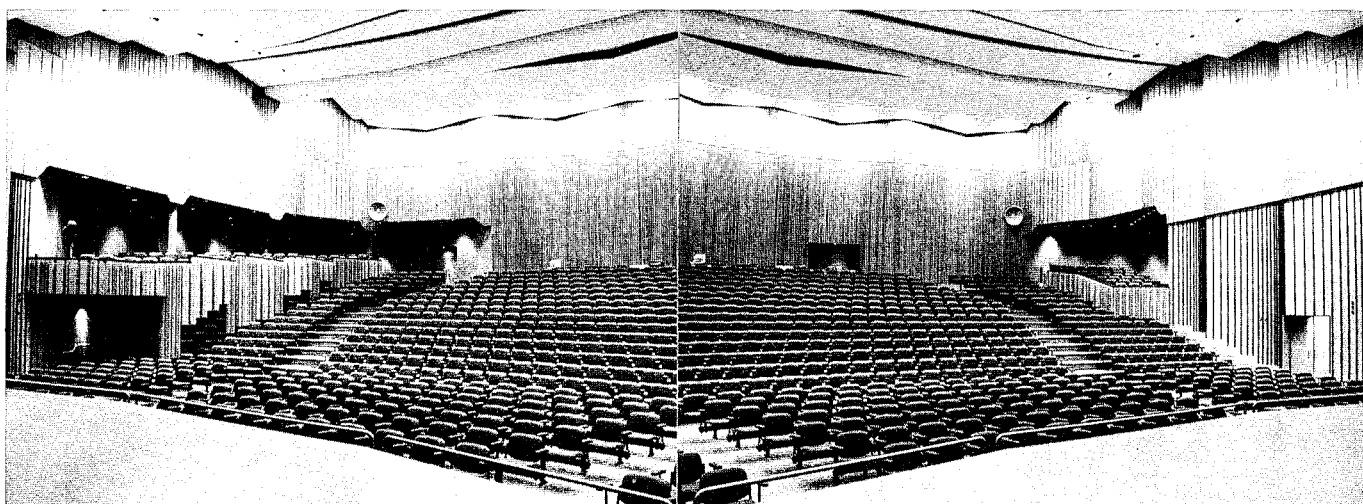
A truly beautiful expression of this man's talent is the new concert hall in Thun, Switzerland. Decreed to be a multipurpose hall, Hellmuth made it such but in the process used correctly new techniques to allow it to be a good concert hall as well. The ceiling, for example, physically raises and lowers. The side wall diffusors are solid wood, and totally effective with no specularly.

The hall has an IACC (interaural cross correlation) of 74. Hellmuth says a true concert hall should have about an IACC of 50 and a theater for speech use should be around 90.

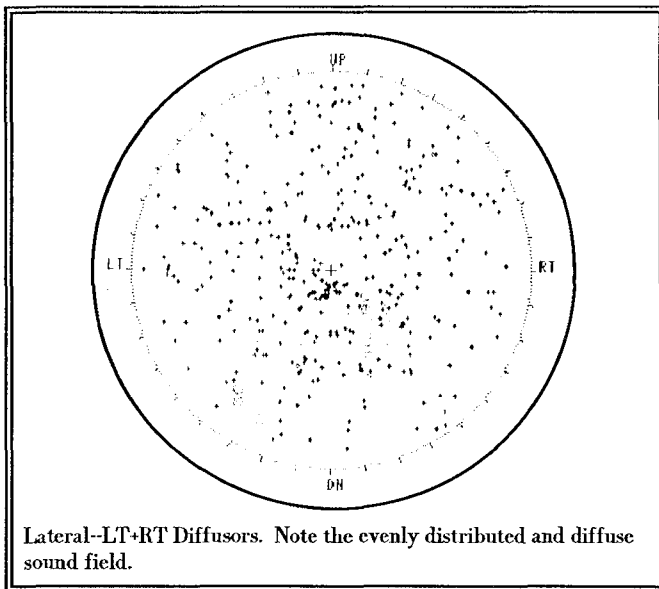
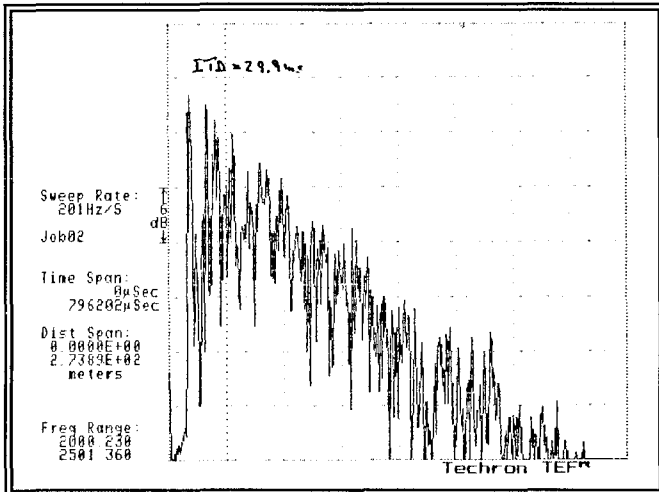
Hellmuth believes that his success in designing such halls has its roots in his musical training and that he has used it over the years to successfully translate what the musicians say they want as a feeling in a hall. Hellmuth the artist translates to Hellmuth the engineer/scientist.

What's really extra exciting to us is the extensive measurements Hellmuth made and the way they correlate with what we heard.

Another rapid ride back across half of Switzerland and we were back in Wallisellen (a Zurich suburb) for a venison



A composite view taken from two angles on the stage of Hellmuth Kolbe's new concert hall at Thun, Switzerland. Note the lavish use of side wall diffusors.



Two measurements made by Hellmuth in the Saal Schadan at Thun. When Hellmuth drops one of his "small city telephone book reports" on our desk we know that he has provided us with accurate precise data that will relate to our ear brain experience in that hall. Other Polar Time Plots reveal that the lateral predominates over the vertical.

dinner at Hellmuth's house. Hellmuth's son had just arrived back from his army service and his service rifle, ammo, bayonet, etc with him. The rifle was the SIG PE57 fully automatic assault rifle. Just think, one of the most peaceful crime free nations in the world has a fully loaded, fully automatic assault rifle in every home.

Hellmuth's Human Dummy Head

The next morning we experimented with Hellmuth's human dummy head, HDH, and found that recordings made with the microphones in Hellmuth's ears made directional hearing even clearer for me than when I had worn them in my ears. This would tend to reinforce the theory that there is no such thing as a compromise dummy head, but there might be

such a thing as a superior dummy head whenever recordings using your own head and pinnae are not possible. As several researchers into the hearing process have subsequently assured us, there is such a thing as a Golden Ear. We now feel that we have a way to measure an individual's closeness or remoteness to such a hearing condition. (See elsewhere in this Newsletter for a purposed special Workshop.

More on Driving

Late in the morning we left for Munich Germany and chose to drive the back roads over to Konstanz and take the ferry across the Boden See to Meersburg - a beautiful trip across a beautiful historic lake. On the German side the rain began and now we were on the narrow back roads of Southern Germany, tree lined, and full of humped back bridges.

The Cathedral in Ottobeuren

Driving fast on these roads was a challenge joyfully accepted and we slid every turn up to Ottobeuren where Hellmuth had told us about an absolutely spectacular church with five organs where he had made one of the E. Power Biggs recordings. The size, decoration, and preservation of this church defies adequate description. Early members are entombed behind glass and are skeletons dressed in the style of their day peering out at you from beds on which they recline with their heads propped up on one arm. Their day was centuries ago. Somehow miraculously the wars have passed it by again and again, and the cathedral sits on a manicured hill at the edge of a beautiful village.

The Gasteig in Munich

We arrived in Munich in the late evening. The next morning, the 19th, we took the subway to the Philharmonic Gasteig Munich - the new concert hall where one of Dr. Ahnert's Delta Stereophony systems is to be installed. We attended a rehearsal which allowed us to move about the auditorium during the concert. The Gasteig is beautifully situated on the Isar river, but it has a series of interesting problems yet to be solved.

In returning to our hotel on the subway we encountered the Barvarian mental set at its worst. We had bought and paid for roundtrip subway tickets. No one told us we had to punch them at each end in a turnstile we passed through. In returning to our origination point a spot check was being conducted and the checker saw we had failed to stamp them. He called out for the guard and we were taken through a labyrinth of rooms to a desk where our passports were taken and a citation issued. It transpired that they wanted \$25 each for the oversight, and we were told to report to an office in another building. I assume we are now on the wanted list in Munich.

At this point we were late in getting away and we really tried out top speed the rest of the day going north past Nurnburg, Wurzburg, Kassel, Gottingen to Branschweg.

East Germany

November 20 -- into East Germany at Helmstedt for the 100+ mile drive to West Berlin. The frontier is unforgettable. First a wall followed by a mine field, men with machine guns in towers following our every move with binoculars, rigorously enforced 12mph speed limit. (Maybe they shoot violators because even Mercedes 600s were going 12 mph.). After about a half mile they take your passport - I mean *take it* and send it up the road on some kind of a conveyor belt. You are now a person without a passport, a man without a country. You have visions of your passport being chewed up in a malfunctioning conveyor belt. At the other end, a glassy-eyed East German looks at you, looks at the passport, looks at you, looks at the passport, and continues to do so until you begin to wonder just whose passport arrived via the belt. Finally, you are passed and now drive slowly for another mile or so through mine fields on each side, then plowed fields where a single footprint can easily be seen.

Once in the open you are allowed 100kph (60mph). Skillfully camouflaged radar cars are regularly spaced, followed by a van of heavily armed police that pull the violators over. Sudden changes in speed limits have to be instantly responded to. If someone enters from an access lane on your right, you must stay in the right lane and not move over. We were carefully briefed by our German friends on the various entrapments employed and were fortunate to avoid them all but we saw plenty being stopped. I have a very vivid imagination and it was with unbelievable relief that we arrived at Check Point Bravo in West Berlin, a delight tempered only by the realization that to get back out meant making the same drive again. (With my paranoia it seems impossible that we spent the summer of 1959 in Moscow.)

Udo Primbs of Janssen Electric was waiting for us at Check Point Bravo to lead us in.

West Berlin

West Berlin -- where to start. Nothing we have heard, read, or seen on film prepared us for West Berlin. It is not a city; it's a state, actually a miniature country: a large city, small villages, open country, lakes, rivers, forests and all unbelievably surrounded by *The Wall*, a place where East Germans kill other Germans because they try to reach freedom.

Janssen Electric

Horst Janssen started as an electrical contracting firm, added a loudspeaker manufacturing facility and more recently, installing sound systems. Udo Primbs is a partner in the loudspeaker and sound contracting firm. They recently purchased a TEF analyzer. They invited Hellmuth Kolbe to conduct a weekend workshop for them and for SFB Radio Berlin who also purchased a TEF. When they heard we were going to be in Europe we were invited to participate in the workshop. Janssen Electric is doing a lot of work in East Berlin and with Dr. Ahnert. It was an exceptional pleasure to find

Dr. Ahnert waiting for us when we arrived at Janssen Electric. Dr. Ahnert is a man of exceptional talent and charm.

Touring West Berlin

Mr. Janssen and Mr. Primbs gave us an 80 km tour of West Berlin that took all afternoon and evening. Starting at Checkpoint Charlie and ending at an excellent Chinese restaurant. We had the most unbelievable tour ever given an ordinary American. Dr. Ahnert was with us during the tour. You can imagine how we felt as we stood on the platforms on the West side to look over into the East side and had a guide from each side explaining exactly what was where. One positive impression we came away with was the fact that more and more East Germans can now pass through it slightly easier than before and West Germans are increasingly allowed to visit their families still behind the Wall.

Is a Berliner different? You bet! Here they have built one of the most modern cities in Europe, invested capital in businesses, schools, research centers, public buildings -- all with the knowledge that, at their whim, the Russians might decide to simply take them over. That creates a mental atmosphere that largely eliminates the weak, vassilating or fearful thought and leaves the Berliner: dynamic, fearless, hard-working, able and willing to try to understand and live with the other side. We left West Berlin with the distinct feeling that there are West Germans, East Germans, and Berliners.

Car-wise Berlin was the only Germany city we visited that seemed to have as many Porsches as the Los Angeles area. Of interest to this old racing fan was to actually drive on part of the old AVUS track from the 1930s. We were also taken to the Olympic stadium where, in 1936, Jesse Owens triumphed over Adolf Hitler's ayran propaganda.

TEF Workshop at Janssen Electric

We spent the day at Janssen Electric going over the fundamentals underlying TEF analysis. Dr. Ahnert attended as well. Janssen is designing the new loudspeakers that will go into the Kremlin early in 1988. Their design includes a crossover with adjustable delays. We feel unique in having worked with the designers of the White House East Room speakers (Dr. Patronis) and the Kremlin speakers (Janssen). It was an enormously stimulating day. The intelligence level of the participants was high. Dr. Ahnert and Hellmuth Kolbe translated my part of the workshop, adding and clarifying my talk.

A Visit to East Berlin

In the evening, Hellmuth Kolbe escorted us via subway into East Berlin where we were to meet Dr. Ahnert and the Janssen people. To go to East Berlin (Dr. Ahnert is always careful to explain that East Berlin is the original Berlin, which incidentally was celebrating its 750 anniversary.)

You get on the subway that goes to the West Berlin airport, Tegel, but you get off at a midway stop *under* East Berlin. Once again the inevitable passport-visa routine plus you

are required to buy about \$25 of East German money that you are not allowed to take back out. When we emerged from the subway we were in another world. All of the East exists on lower light levels at night so one's first impression is of everything grey. I couldn't understand why that was such a surprise to me after having spent the summer of 1959 in Moscow but I realized that in Moscow it is daylight until about 11:00 p.m. in the summer and daylight again about 3:00 a.m.

We met the Janssens, Primbs and Dr. Ahnert and proceeded to the new concert hall directly modelled on the Vienna Musikverinsaal. Dr. Ahnert and the vice director of his institute arranged for a personally guided tour of the hall by its manager. In this hall they don't have to take a back seat to anyone. The handwork evident is no longer available in the West. The hall is a work of art worthy of total praise. We visited several new smaller concert halls and theaters where Janssen speakers were installed.

We then walked through a restored part of the original Berlin that had been rebuilt for the 750 year celebration.

Yes! We had an automotive experience as well. We got to ride in Ahnert's two cycle car which he drove expertly as he drove us to his home on the outskirts of East Berlin. There we had the privilege of meeting his beautiful wife and seeing his children - a daughter who can only be described as angelic in appearance (she was sleeping) and a young son in a crib. The hospitality extended us reached past all exterior considerations and we found the Ahnerts and their home that of friends in the universal family of man. The vice director of Dr. Ahnert's institute was a warm friendly gentleman.

Dr. Ahnert and his family live comfortable by western standards: A house with patio and garden, two cars, two computers, compact disk player -- many of the trappings of success in the west. We asked about a beautiful cabinet in the living room and if it was an antique. "Oh no", Dr. Ahnert replied, "it's only 200 years old."

Because our temporary visa expired at midnight and failure to make it back across the border on time means mandatory arrest, we were grateful to have no car trouble on the 40 km drive back to the subway. While the Janssen organization can bring cars into East Berlin, we were not allowed to accompany them because we lacked the necessary papers, so we again rendezvous on the other side of the wall.

I would not suggest that everyone do as we did and go through the wall on your own. You need:

1. A German speaking guide
2. Friends in the East to tell you that the entrance is not the exit, for example
3. Someone who knows you are there and when to expect you back.

Just as you would be careful to help a foreign visitor

avoid the wrong section of NYC or Chicago, so our friends on both sides of the wall carefully guided us and have our deep appreciation for doing so.

Davis' law states that you judge men and women for what they are, not where they are.

More on TEF

Nov. 22. More TEF workshop until early afternoon. One of the reasons that Janssen held the workshop is because they in turn will hold workshops for tonmeisters from the East. Mr. Primbs said that they have held one workshop on sound and lighting in which 250 tonmeisters attended. Dr. Ahnert will use their TEF analyzer for his work in the East as well.

We left the workshop in the early afternoon. Dr. Ahnert brought us a "care" package for our drive because he knew we had skipped lunch in order to spend as much time at the workshop as possible. He brought us a package of the special potato chips we had enjoyed the evening before in his home.

Once again we had the stress of the drive through the corridor back to Helmstadt. Safely back in West Germany we turned in our Audi with great reluctance but with full appreciation for its good care of us.

In retrospect: The greatest trip to Europe we have ever experienced: the most interesting and hospitable people, fantastic food, faster and better handling cars, new adrenal-pumping experiences, and more new technical ideas than we dreamed possible. The months ahead will see many of them come to fruition and we will be sharing them with you. Which reminds me, I forgot to mention that Dr. Ahnert and Hellmuth made TEF measurements in the Vienna Musikverinsaal in October. As soon as they process the data they will be able to give us very definitive and accurate intelligibility information on C50 and C80.

Syn-Aud-Con's motto has been "I met a man who had a dollar....." for many years. It thrills us to add all the people we met in England and Europe to our family of sharing professionals. We all will be richer as the Europeans begin to share more and more with us.

COPYRIGHT 1988 by Synergetic Audio Concepts. All rights reserved. Printed in the United States of America. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior written permission of Synergetic Audio Concepts. The information conveyed in this TECH TOPIC has been carefully reviewed and believed to be accurate and reliable; however, no responsibility is assumed for inaccuracies in calculations or statements.