SYNERGETIC
SYN AUD CON
AUDIO CONCEPTS

newsletter

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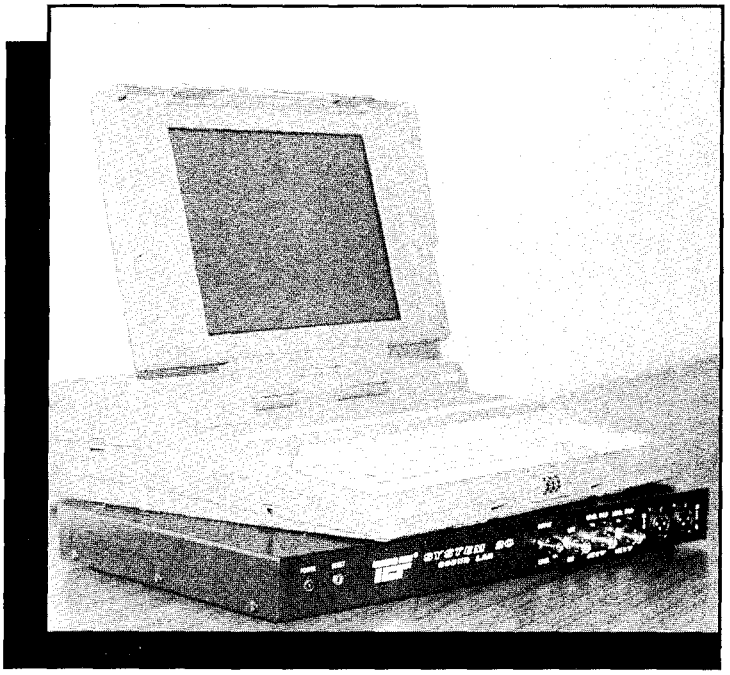
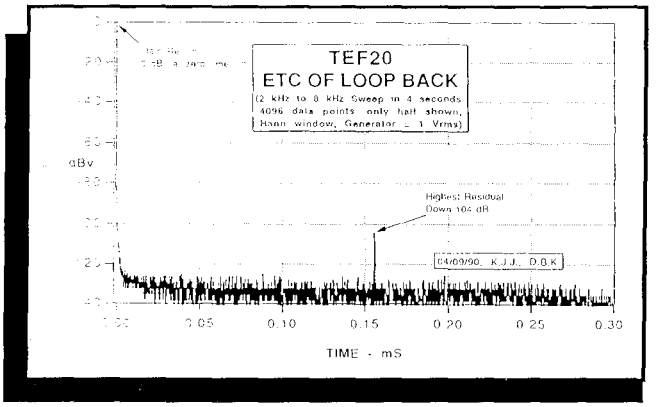
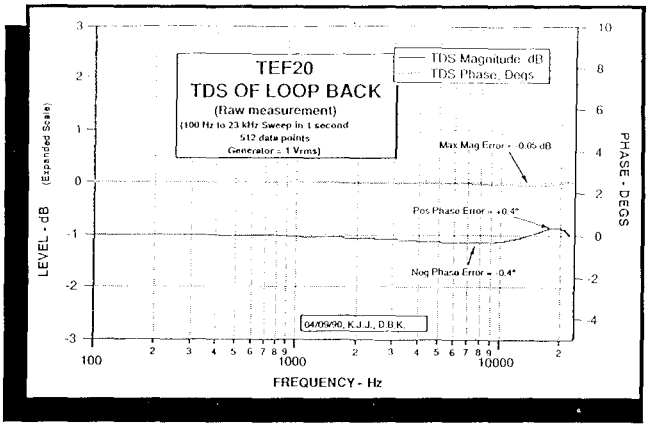


TEF System-20 Sound Lab





Made to work with your Macintosh™ or IBM™ compatible computer

SYNERGETIC SYN AUD CON AUDIO CONCEPTS

EXCHANGE OF IDEAS

I met a man with a dollar
We exchanged dollars
I still had a dollar

I met a man with an idea
We exchanged ideas
Now we each had two ideas

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

Design & Layout: Dashia Alfonso

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.

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When Do I Renew?

You can check to see when your subscription will expire by checking the mailing label on the envelope in which your newsletter was mailed. In the upper righthand corner, beside the name, a date will appear (i.e. 4-90). This means that you will receive this issue and it will be the last issue sent unless you renew. Renewal notices will be sent at this time. You must renew before the next quarter's newsletter is mailed or your subscription will become inactive.

Introducing the Techron TEF System 20 Sound Lab

Don Davis
Synergetic Audio Concepts

Dear Don:

Here it is. The Techron TEF 20 product design and prototype is finished. The box contains two compartments, one digital and one analog/digital. The analog box section contains the analog in and out. This section is physically and electrically isolated from the chassis and digital circuits. The output is line level, 1 volt RMS with a front panel attenuator. The output data conversion rate is 400kHz (8 times over sampled). The input is two channel, line level or Mic preamp. The input data conversion rate is 100kHz mono and 50kHz two channel. The Nyquist is always 25kHz but the input filter allows data to be gathered up to 23kHz before the magnitude starts to roll off.

We used a Motorola DSP 56001 running at 25.8048 MHz on the digital board. The DSP has two memory segments for storing measurement data. Each memory segment is 32k by 24 bits in zero wait state RAM. This provides a maximum of 32k complex data points or 64k Real only points. There is also 8k by 24 bits of alterable Program space. This memory is retained during power off but can be field loaded with new applications. The last memory area is 16k by 24 bits in Eprom. This area contains the software necessary to do TEF and FFT's as well as run the box. The TEF 20 communicates thru a standard serial port and an IEEE 488 instrument buss. The terminal connected to the TEF 20 can be any serial port capable of the 57.6 k baud serial rate (IBM/MAC/...) or a computer with a GPIB port.

The data plots were done with an internal analog loop back. (See Front Cover.) They show the purity of the TEF 20 instrument. Mathematical post processing has not been done to the 'Loop Back' data sets, rather these measurements are an unbiased look at the hardware. The TEF 20 box Transfer function can be removed when desired, but should not normally be required. The TEF20 transfer function was removed in the 'Loopback Residuals' data sets.

Keith Jebelian, Techron TEF division 4/10/90

TEF 20 Time Table

The **TEF** System**20** Sound Lab will ship on August 15, 1990
The **TEF** System**20** Demo Disk will ship on August 15, 1990

Is available in three different configurations:
SL1—Sound Lab, Line Level input, Software for one host (IBM or Mac)
SM1—Sound Lab, Mic. Level input, Software for one host (IBM or Mac)
SM2—Sound Lab, Mic. Level input, Software for two hosts (IBM & Mac)

Model	Pricing Regular	Pre Production
SL1	$3950	$3950
SM1	$4250	$4000
SM2	$4500	$4250

The TEF 20 will ship with the following measurements as standard
—Energy Time Curve (ETC)
—Energy Frequency Curve (EFC)
—Phase Frequency Curve (PFC)
—TEF-Speech Transmission Index (TEF-STI/RASTI)
—Noise Criteria Curves (NC Curves)
—Equivalent Sound Level Measurement (Leq)
—Equivalent Day/Night Sound Level Measurement (Ldn)
—RT_{60}

Evaluation of Speaker/Microphone Relationship in Conference Rooms

Kurt Graffy of Paoletti Associates in San Francisco recently sent us some interesting TEF data he had taken while examining the claims of several proprietary board room systems that, among other things, utilize out-of-polarity microphone and loudspeaker groups. Melvin S. Draper of NASA gave a paper at AES, 1969, titled, "A Sound Reinforcement System for Multiple Conference Rooms." Quoting from the introduction to the paper: (where Mr. Draper uses phase, read polarity)

"Thus far, out-of-phase connection of speakers has been purposefully avoided. Although established audio systems have individual merits, a new approach to audio systems design was indicated to obviate complexities, excessive equipment, high costs and awkward operational procedures. The design of a two-way acoustic transducer using speakers connected in opposite phase to take advantage of the self-cancelling, balanced wave forms from the speakers with the microphone located in the equilibrium area proved the simplest most economic solution. (See Figure 1 below for typical example.)"

Chris Jaffe took a similar approach in his patent, #3,992,586 published in 1976. Quoting from his abstract: (again where he uses phase, read polarity.)

"A sound reinforcement system for a meeting room provides improved effective communication. . . .by positioning a pair of speakers driven out of phase with one another at each individual location and positioning a microphone within the acoustical cancellation zone of the corresponding speaker pair."

See Figure 2. (18 represents the individual speakers and 22 represents the individual microphones.)

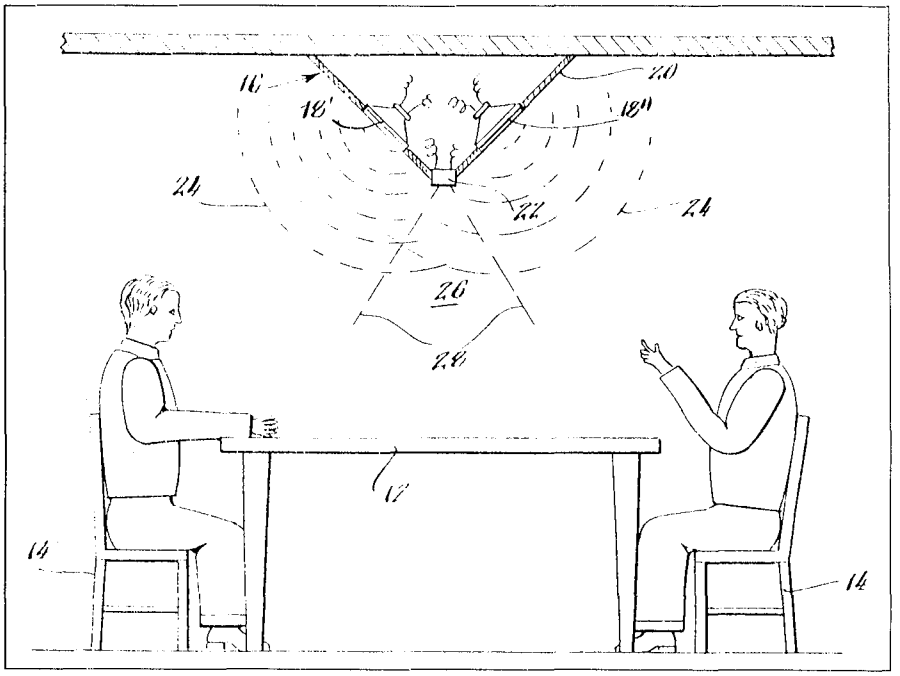


Figure 2 (Chris Jaffe)

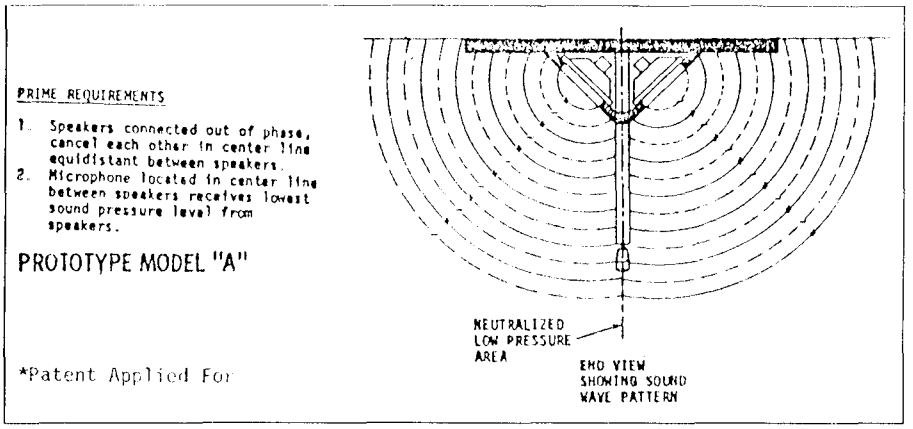


Figure 1—Two-way Acoustic Transducer (Draper)

Editor's Note: Excuse the quality of the reproduction as our copy machine was not the greatest quality in 1969 when we made the original copy.

Bill Webb, who designed the post-war sound systems for the Indianapolis Motor Speedway tried such schemes for announce microphones exposed to high powered loudspeakers in the pit area. When both microphone location and loudspeaker locations can be fixed, the concept can be made to be quite useful over the speech region.

Kurt's remarks plus his carefully made data tells its own story. Be careful to observe the vertical scale markings in each case as some are 6 dB/div and others are 12 dB/div. Our thanks go to Kurt for quantifying the effect with TEF analysis.

From Kurt Graffy:

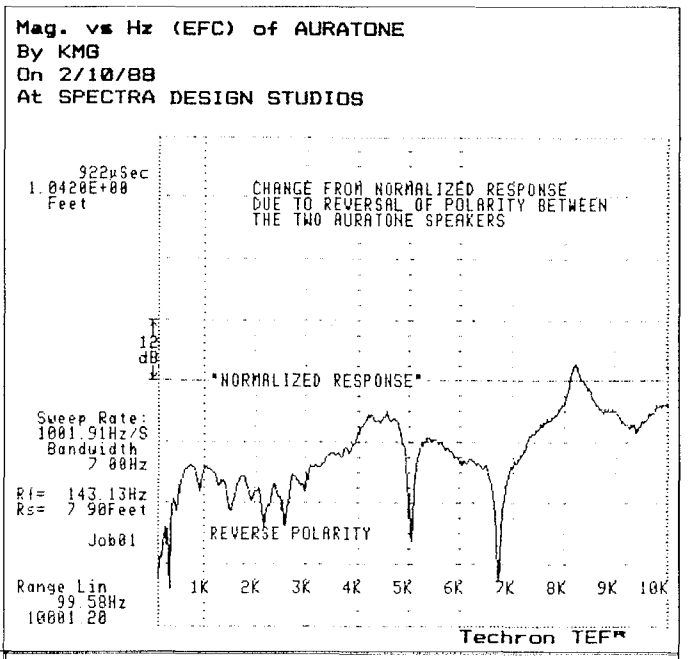
We do a fair number of Conference Room sound and teleconferencing systems at PLA. One firm which sells audio systems for boardrooms, and has encouraged us to specify them is SCT, Sound Control Technology, which is a kind of an offshoot of TAI (which was related to Jaffe Acoustics and Bozak). Both of these systems are proprietary systems which utilize ceiling mounted loudspeakers and microphones.

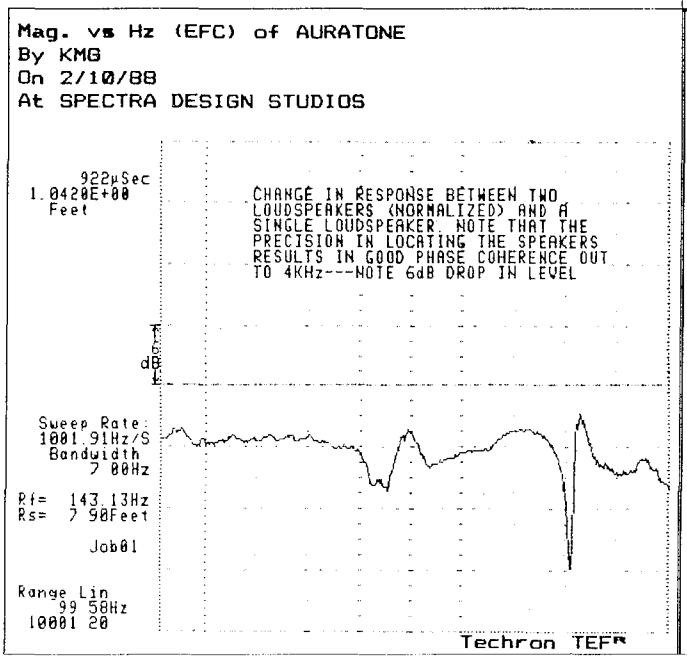
To provide additional gain before feedback, they wire certain microphone groups or certain loudspeaker groups out of polarity with other microphone or loudspeaker groups, and achieve acoustic cancellation. The mics and loudspeakers are located with a specific tolerance from each other.

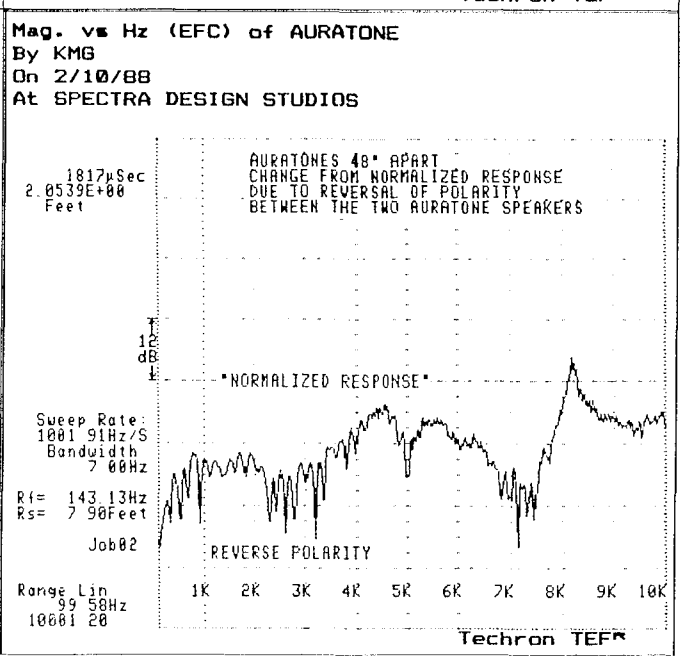
I was curious to the validity of this approach. I mocked up a test using a PZM mic and two Auratone loudspeakers. The loudspeakers were on the floor, facing up at the 9' ceiling, and were separated from each other by either 24" or 48". The PZM was on a piece of plywood between them, spaced off of the floor so that the PZM was on the same plane as the face of the loudspeakers, and equidistant between the two loudspeakers.

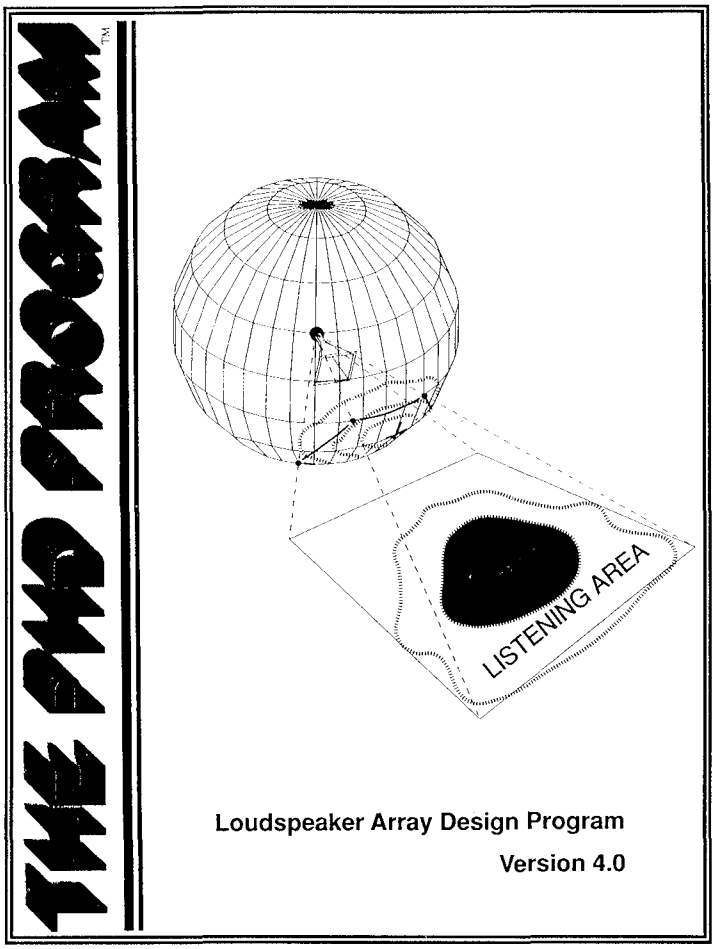
I ran the test at the two different distances of speaker separation, and I quick diff'd the change due to reversing the polarity on one of the speakers. This is what is shown on the measurements which I've enclosed. I didn't expect to see the depth of cancellation, (close to 18dB out to 3500 Hz) or how high up in frequency the cancellation continued. ■

Kurt Graffy of Paoletti Associates









Thanks to the magnificent and unselfish giving of time and effort by John & Melissa Prohs of Ambassador College and of David Andrews of Andrews Audio Consultants the updated PHD Program, version 4.0 along with the beautifully illustrated and detailed manual has been mailed to all who had previously purchased the DOS version of The PHD Program.

What is New in the PHD 4.0

First of all the manual. It is 109 pages with 115 graphics plus index and Table of Contents. Sample jobs that run all the way from architectural acoustics to performance analysis.

Architectural Mapping:

When editing and reviewing the architectural mapping, you are now able to:

(G)o to another seating area

(C)hange cluster being edited/reviewed (In multiple cluster mode).

A new calculation has been added for convenience in installation:

The Slope distance--The distance along the seating area from the row of the right front corner to the row of the point being referenced.

The horn and driver data has been updated with the latest data from manufacturers on isobars and horn specs.

Architectural Acoustics:

Able to edit data.

Able to calculate area and volume much easier.

Power Analysis:

A new calculation has been added for each horn in the power analysis: Relative dB

The power analysis now assumes designs use one single driver.

You no longer have to enter the driver name for every single horn. If you have a design with mixed drivers, you have to edit the driver names in the power analysis in edit mode.

Horn and Driver Data:

New horn data is now entered in terms of Q or DI. You do not have to calculate modifier values with complicated fudge factors any more.

As most of you know, John & Melissa Prohs and Ambassador College have donated The PHD Program to the Richard C. Heyser Scholarship Loan Fund. What most people may not know is that David Andrews of Andrews Audio Consultants in New York has donated his time and money to copy the program and mail to each person ordering The PHD Program. Further, he has printed the new manual at his expense and mailed the updated program and new manual to all owners of the DOS version of The PHD Program.

Why? Because the Prohses and David loved and respected Richard Heyser.

Richard C. Heyser Scholarship Loan Fund For Graduate Studies in Audio and Related Fields

There is over $50,000 in the Heyser Scholarship Loan Fund. Amy Heyser, who administers the Fund, is seeking worthy recipients to the Scholarship Loan Fund. The loans are available to selected graduate students, who are registered and can demonstrate a need for the amount of the loan requested to pursue his or her course of study in Audio Fields.

A graduate student may borrow a sum not exceeding $2,500 each year, nor more than a total of $10,000. A borrower is not required to make payment on the loan while a graduate student. When repayment does start, the repayment is $70/month at a rate of 6% on the unpaid balance.

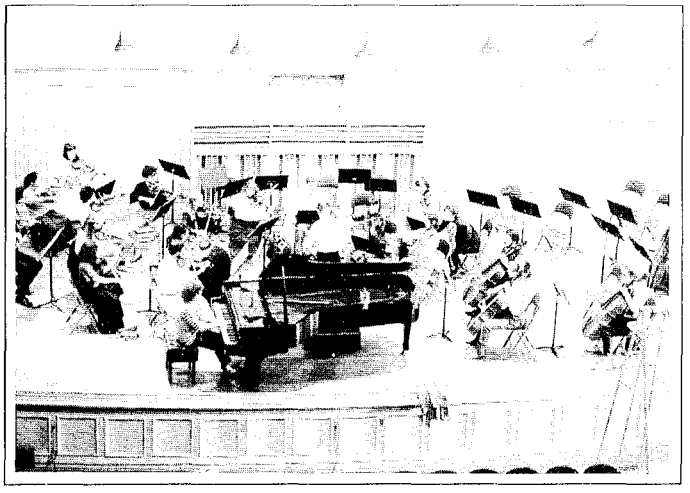
Write to: Amy Heyser, 10415 Fairgrove Avenue, Tujunga, California 91402 for more information.

ITE™ Experiment at Troy Music Hall

Craig Dory and Dorian Recordings presented us with an exceptional opportunity to test our In-the-Ear, ITE, recording technique in the Troy Savings Bank Music Hall in mid-October 1989.

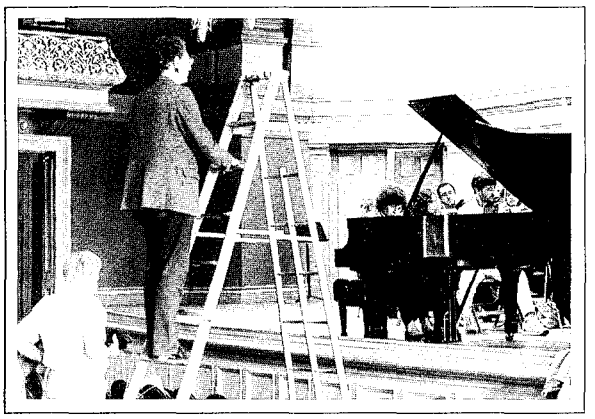
We were tremendously pleased as it meant that we would be able to spend hours listening to a chamber orchestra, while being able to move to every area of the concert hall to listen in this highly acclaimed concert hall. It also meant that we would be able to have three different listeners record with our In-the-Ear microphones in the same selected seats in the auditorium. Unfortunately, not the same music for each recording.

We recorded on the stage, just above the stage, and in each of the balcony areas with three different heads: Ernie Pence, Tom Zorn of DCI, and Carolyn. This was all done during rehearsal by the St. Cecilia Chamber Orchestra, who generously put up with the distractions of ladders and personnel crawling around in the orchestra itself.



While we are not free to discuss Dorian's proprietary techniques we can say that their care in getting in and out of analog-to-digital and back again impressed us beyond what we have knowledge of elsewhere. Dorian Recordings made the first commercially released recording using fiber-optic instead of microphone cable.

There are fascinating lessons to learn from experiments at Troy Music Hall. Of the three "ears" that we listened to in the different seats, Tom Zorn had the warmest, sweetest sound. Ernie Pence's ears gave an "edge" to the music as though he may have a greater emphasis in the 3 to 4,000 Hz region in his pinna response than Tom or Carolyn. The Dorian Recording microphones and their choice of where those microphones were placed yielded a superior tonal response to our ITE recordings when played back over loudspeakers, though the conventional microphones did not provide geometry and room envelopment. Our best sounding, in a tonal sense, recordings were made with Carolyn right in the center of the front of the orchestra.



ITE recordings made at the microphone location that is best for conventional playback were not the same sound as what the conventional microphones picked up. Our conclusion is that truly great conventional recordings, and Dorian Recordings have earned that title, are an artistically created illusion of a real event, not a laboratory record of sound pressure level.

Craig Dory, like Jack Renner at Telarc, has gone to a great deal of trouble to insure loudspeaker monitoring at the music hall of their microphone placements that correlates with their monitoring facilities back at their main control room.

Having had this experience we stand even more in awe of those who can create an illusion of being present in another acoustic space using conventional playback techniques.

Following our marvelous experience at Troy we went to AES in New York to participate in Peter D'Antonio's tour d'force, a 4-day workshop. A fascinating hour was spent with Jack Renner, Chief Engineer at Telarc, telling a rapt audience how he has achieved his remarkable recordings. He carries with him all the necessary paraphernalia to "construct" a control room on location. His reference disk, Stravinsky's Firebird Suite, must sound right before he starts placing his microphones, diffusors, absorption in the recording space.

Auditory Image Processing Device

CONFIDENTIAL

Description of the Auditory Image Processing Device

The auditory image processing device concept can be viewed as an advanced pan pot. The concept is that an auditory signal can be processed so that the resultant image can be placed almost anywhere in auditory space, i.e. the image can be moved not only in the horizontal plane, but in vertical planes as well. Additionally more realistic distance placement is attainable.

Recent psychoacoustic articles (Bloom, 1978; Watkins, 1978; and Butler, 1977) have shown that manipulation of the spectrum of a sound source influences the vertical position of the resultant auditory image in space. Specifically, when a sound enters the ear from a certain source position, the spectrum of the sound is filtered by the pinna in such a way that position-dependent peaks and dips are overlaid on the signal spectrum. A system which successfully mimics these peaks and dips creates the appropriate auditory image position. Most of the previous systems employed to generate these peaks and dips in the spectrum have used delay and add systems to approximately mimic the filtering effect of the pinna (Watkins, 1978; Batteau, 1968). However, pinna transformations can be more accurately obtained using impulse response techniques. The method most often utilized to obtain impulse responses of the pinna employs a spark gap. The output of the spark gap is filtered by the pinna and collected by a microphone. It should be noted, however, that the spark gap does not produce an impulse, but rather a doublet, and thus the response collected by the microphone is really the doublet reponse of the pinna. This response must then be integrated to obtain the 'impulse response' of the pinna, and the response of the microphone must be subtracted.

Recently, a more feasible system has been developed by Mehrgardt and Mellert (1977). The method is to produce a digital impulse and send it through a speaker whose output is collected using a small microphone (i.e. B and K or miniature Knowles Electronics) and digitally sampled. The microphone is placed in free space at a position where the subjects lateral end of the external au tory meatus will be. The collected response is the impulse response of 1) the speaker, 2) the microphone, and 3) the elecrtical network of preamps and filters prior to the actual conversion and digitization. In the time domain this response can be expressed as:

Equation 1 $I(control) = S(t) * M(t) * E(t)$ * convolution

JAR 5-8-79 GSK. 5/9/79
TLH
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There were several technical papers and workshops at the Fall AES in New York as well as exhibits on the subject of auditory image processing devices. We had a long letter from Carolyn "Puddie" Rodgers' mother this Fall bringing up some interesting points about Puddie's work, so we went to the file that we had collected while Puddie was alive. I came across a file marked "Confidential". I know that I have read the file before but after hearing and reading all the papers at AES on auditory imaging processing devices I felt that it would be worthwhile to publish Puddie's confidential material since those who signed the disclosure were freed to use the material in May 1989 (Terry Lee Hubler, JoAnne Robbins, and Gary S. Kendall.)

The response can then be transformed to the frequency domain using digital FFT routines. Then Equation 1 becomes:

Equation 2 $I(control) = s(w) \cdot m(w) \cdot e(w)$. multiplication

The impulse response of the system (speaker, mic, and electrical network) is then taken several times (25-1000) and averaged. Next the microphone is placed in the subject's ear canal at a position close to the lateral end of the external auditory meatus. The procedure outlined above is then repeated. Now the sampled response can be expressed:

Equation 3 $I(total) = S(t) * P(t) * M(t) * E(t)$ P is the pinna

When Equation 3 is forward transformed it becomes

Equation 4 $I(total) = s(w) \cdot p(w) \cdot m(w) \cdot e(w)$

Again 25-1000 samples are taken and averaged in the frequency domain. Using computer routines about 100 samples a minute can be processed. By dividing Equation 4 by Equation 2 we get p(w) for the particular source position.

Eq. 4/Eq. 2 = $(s(w).p(w).m(w).e(w))/(s(w).m(w).e(w)) = p(w)$

In this manner, everything is cancelled except the impulse response of the pinna in the frequency domain. Thus the effects of the speaker, microphone, and electrical system are eliminated. Of course, this procedure is done binaurally so that the resultant is two signals which have not only spectral information but also the normal localization cues of interaural time and interaural intensity differences. (See sample FFT dividing routine)

The procedure outlined above will be carried out on many subjects for several source positions and the results either averaged over the subjects or chosen for one subject whose response seems most appropriate (See Butler, 1977). The final p(w) 's (one for each ear) for each source position will be stored digitally.

The next step in the development of the auditory image processing device is to multiply the p(w) for the desired image position by the input signal (i.e. track of music on tape, etc.) This is called convolution when performed in the time domain and is explained in Dr. T. Stockham's chapter in Gold and Rader's digital processing book. (See sample convolution routine)

Now these two signal processing procedures will be contained in a digital device currently called the Auditory Image Processing Device. The device will be much like an advanced pan pot. Its two main features will be an input control to set elevation of the auditory image and an input control for horizontal positioning of the image. At first the controls will have discrete steps. For example, for stereo initially

J.A.R. 5-8-79 G.S.K. 5/9/79

nine horizontal steps might range from 90 degrees left to 90 degrees right and five vertical positions from - 60 degrees elevation to +60 degrees elevation. The horizontal control would be much like the current pan pots - utilizing mainly intensity cues, however phase and spectrum cues will also be included in the horizontal processing to define position and fusion. The vertical positions will also include phase and intensity cues, but will be more heavily dependent upon the spectral processing.

For each of the initial 45 positions (9 horizontal times 5 vertical) there will be a spectrum for each pinna (channel) by which the spectrum of the input signal will be multiplied in the frequency domain. The output of the system will be best perceived via headphones - especially insertion type headphones. However, because the localization cues are mainly spectral, the output will also work over loudspeakers (Bloom 1978). The cues are best (i.e. least changed) when the speakers are placed at +60 degrees elevation.

Several Modifications can be made to the Auditory Image Processing Device.

A. To make the device work in four (or more) channels some modifications must be made. For example, to get a sound on the sides defined, the sound from the front speaker and the back speaker must arrive at the EAM having approximately the same spectrum. Additionally the sounds must have the spectrum which cues side positioning.In the present 4 channel systems, the sound from the back speaker is filtered differently by the pinna than the sound from the front speaker. Thus the sounds arrive at the EAM with different spectra, neither of which is the spectra for side, and the image is diffused. Using the modified auditory image processing device, the sound from the front speaker would be processed to arrive at the EAM with a spectrum close to that of the sound arriving from the back speaker. Additionally both signals would be processed to have the 'side' spectrum. In this manner the image would be more clearly defined.

B. The device eventually will be made with continuous settings rather than discrete settings.

C. Additional circuits can be added to the device to give computer simulated distance information which could specify environment quality and dimensions.

D. Phase effects could also be incorporated to add image fusion and size effects (much like those used in the Aphex Aural Exciter)

The device can be used either as an outboard device i.e. one device servicing all channels or can be incroporated into mix boards i.e. one device for each channel.

Witnessed Perry Lee Hubler 5-7-79
JoAnne Robbins 5-8-79
Gary S Kendall 5/9/79

C.A. Rody 6 MAY 79
C.A. Rody 9 May 79
Donald L. Hoos
Notary Public
Evanston, Illinois
9th May, 1979

AES 8th International Conference

The Sound of Audio

Washington, D.C.—May 1990

The AES 8th International Conference is certainly a session where Carolyn "Puddie" Rodgers would have made a valuable contribution.

Among the papers being given are "Spatial Sound Processor for Headphone and Loudspeaker Reproduction" by Gary Kendall (you will recognize his name as having signed Ms. Rodgers' confidential disclosure in 1979) and, "Hearing in Three Dimensions: Sound Localization" by Dr. Fred Wightman, the professor who "supervised" Ms. Rodgers' Ph.D. dissertation. The same Dr. Wightman is currently being sued by Nancy Walczak, a Ph.D. candidate, for essentially the same complaint that Ms. Rodgers had against Dr. Wightman.

Principal Parameters Producing Acoustic Power

Equations are useful because they allow an easy inspection of the cause and effect relationship between multiple parameters. In the frequency regions where loudspeakers can be modeled as pistons the classic Beers and Belar equations allow us to see the principal parameters that go into producing acoustic power Wa

$$W_a = \left(\frac{AF^2D^2}{K}\right)^2$$

where: A is the RMS amplitude in inches or in cm
F is the frequency in Hz
D is the effective cone diameter in inches or cm
K is the constant
U.S. 1.16×10^5
S.I. 1.9×10^6

This equation shows us that acoustic power is directly proportional to:

1. The RMS amplitude of cone displacement
2. The square of the frequency
3. The square of the diameter

For example, it is not necessarily intuitive that holding the amplitude and diameter constant while raising the frequency will dramatically increase power. If we have an A = 0.5", D =15" and we go from 30Hz to 1000Hz, what will the increase in W_a be?

$$W_a = \left(\frac{0.5(30)^2(15)^2}{1.16 \times 10^5}\right)^2 = 0.76W$$

$$W_a = \left(\frac{0.5(1000)^2(15)^2}{1.16 \times 10^5}\right)^2 = 940{,}565.5W$$

Suppose we want to know what 'A' is required if the power stayed at 0.76W and F = 1000Hz.

$$A = K\left(\frac{\sqrt{P}}{F^2D^2}\right)$$

then:

$$A = 1.16 \times 10^5\left(\frac{\sqrt{0.76}}{1000^2 15^2}\right) = 0.00045"$$

At this point we might begin to sense that a 15" woofer capable of 0.5" displacement at 30Hz might not be the ideal choice for a frequency as high as 1000Hz and indeed they are not.

The Importance of Driver Choice

The only acoustic role a low frequency enclosure plays is at the lowest frequencies (i.e., below 300 Hz).Therefore, over the majority of the audible frequency range the sound is radiated directly by the driver or the driver horn combination. These equations allow a rational estimate of what's truly likely to happen in real life cases. Such tools are powerful antidotes to the mesmeric autosuggestion often presented to the unwary in acoustic devices.

Look Up "Innovative" in the Dictionary and You Will Find FSR

A sound contractor, when confronted with today's special customer requirements, has two choices—design and build, or try to buy what he needs.

FSR, Inc. has established themselves as a particularly significant resource for many Syn-Aud-Con grads. That is why they are growing (they have just moved to a new 30,000 ft^2 facility—244 Bergen Blvd., West Paterson, NJ 07424). FSR is extremely responsive to customer needs. Within the space of a few months, FSR has announced a new Sequential AC Power Switcher SP-ES that can be expanded to handle many loads using the SP-2E unit and has supervisory feedback signals;a new RGB plus sync DA providing three sets of outputs; a new version of the very popular ML-112 Hotel Audio Combining System which combines the independent audio systems of up to ten rooms in any combination with the touch of a button; the MPA-2, a two-channel microphone mixer designed to be used with either dynamic or phantom powered microphones; and the VDA-3 and VDA-6 Video Distribution Amplifiers, two units which accept a 75-ohm video line input (1VPP, BNC) with three or six independent outputs.

Using the Words "Audio" and "Acoustic"

Here at Syn-Aud-Con we use the word "audio" when we are speaking of electronic circuits at audio frequencies. We use the word "acoustic" when we are discussing auditory signals in the AIR. Why the distinction? Because audio frequencies in the electromagnetic domain can vary in velocity from 982,080,000 ft/sec (free space) down to 73,920,000 ft/sec in 19 gauge cable in telephone circuits.

When we use the word "acoustic" the velocities may vary from 1130 ft/sec in air up to 17,063 ft/sec in steel. The following table listing some common media for signals and the velocities and wavelengths that result.

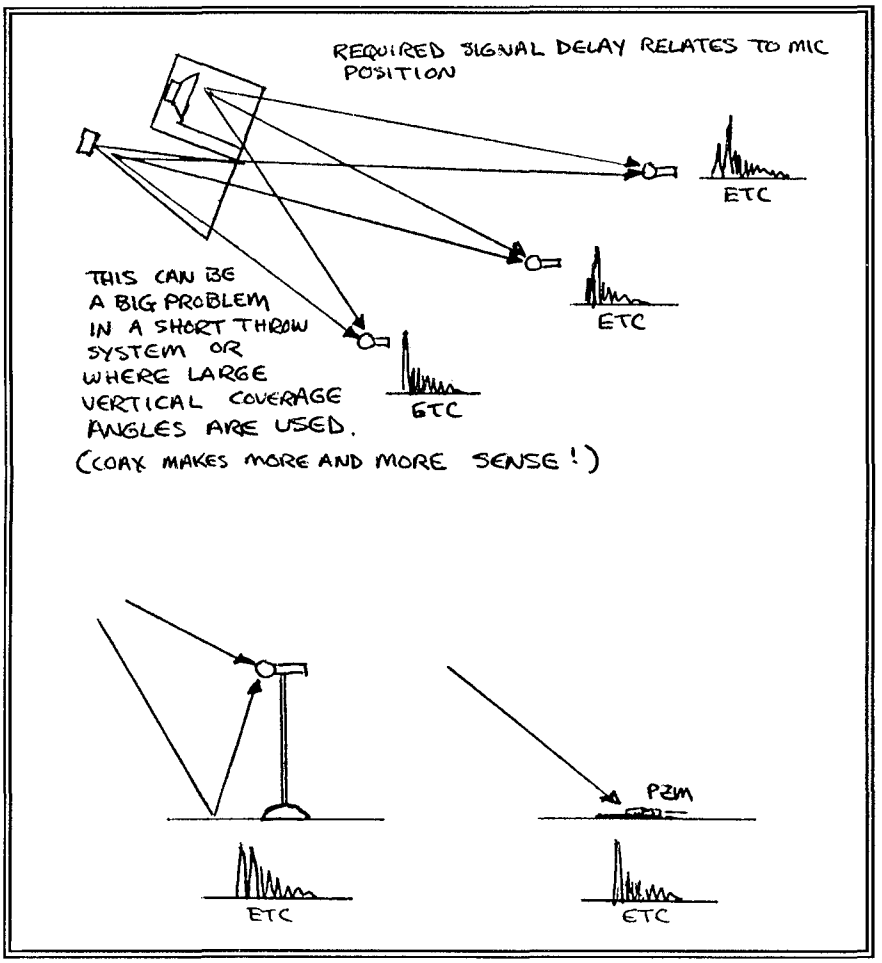
Audio and Acoustic Velocities

Audio Velocities (c)	Audio Wavelengths (λ)
982,080,000 Ft/Sec. (Free space) 299, 414,634 M/S (1000 Hz)	982,080 Ft 299,414 M
792,000,000 Ft/Sec. (High quality carrier) 241,463,415 M/S	792,000 Ft. (1000 Hz) 241,463 M
73,920,000 Ft/Sec. (19 Gauge cable) 22,536,585 M/S	73,920 Ft. (1000 Hz) 22,536 M

Acoustic Velocities (c)		Acoustic Wavelengths (λ)	
U.S.	S.I.	U.S.	S.I.
1130 Ft./sec. (AIR)	344.42 M/sec.	1.13 Ft. (1000 Hz)	0.344 M
4983.3 Ft./sec. (Water)	1520 M/sec.	4.98 Ft. (1000 Hz)	1.52 M
5107.6 Ft./sec. (Human body)	1558 M/sec.	5.11 Ft. (1000 Hz)	1.6 M
17,063 Ft./sec. (Steel)	5200 M/sec.	17.06 Ft. (1000 Hz)	5.20 M

$$\lambda = \frac{c}{f};\quad f = \frac{c}{\lambda};\quad c = \lambda f$$

Microphone Height and Signal Alignment



From Barry McKinnon of Calgary (you can't help having read Barry McKinnon's excellent writing. He writes for most of the audio publications and he is absolutely tops.)

"I was just reading through Jim Yerges article on System Adjustment (Fall 89 Newsletter) and I thought I would offer an observation and a tip. Jim mentions getting the measurement microphone above the seating far enough to reduce the level of the reflection from the seating to do signal alignment. A problem I have run across doing this is outlined in the enclosed sketch. This can be a large problem in a very short throw type of system, or where the actual difference in signal path is small.

What I have been doing is carrying a chunk of Sonex to suck up the reflection which allows me to keep the test microphone at ear height. In gymnasiums and spaces with open floors and no seats, I prefer to use a PZM for signal alignment; it eliminates one entire family of reflections to sort through."

Loudspeakers and Rooms

by Peter Mapp

From The Hi-Fi News & Record Review 1981

This exceptional series of articles starts with the following paragraph:

"What has a dynamic range of about 55 dB (or less), a frequency response from about 30 Hz upwards within ± 15 dB or so, adds coloration throughout the audible range, significantly alters the harmonic structure and timbre of reproduced sound, reduces clarity and precision, distorts stereo imagery and perspective, alters perceived frequency balance and loudness, and has a transient response about as fast as a tortoise with a wooden leg? Answer—the typical domestic listening room"

Anytime you get a chance to read a Peter Mapp article or the opportunity to hear him speak in person, don't miss it! You can't help but learn.

What is Next in the Recording Process?

We recently received a letter from a recording engineer experienced in conventional recording who was writing in response to several articles that we have published in our Newsletter on the In-The-Ear™ recording and playback process. It wasn't very friendly. It caused us to do a bit of thinking about our role in a few of the new developments that we have been involved in.

When we brought the LEDE™ concept to the attention of the industry, we didn't bring along experience in control room design—but concepts to be explored. The really bright people in our industry took those ideas far beyond what we could do—the early pioneers in LEDE control room design, Chips Davis, Russ Berger, Neil Muncy, Charles Bilello, and most of all, Peter D'Antonio.

Now we have put forth another new concept that we feel needs to be explored: the recording and playback process. Our friend from the recording industry was asking me to explain why, why, why. That is what I want the thinkers in the recording industry that are not bound by conventionality to ask themselves—why? Then try. Try ideas based on their vast experience but with a glimmer of a new idea plugged into their thinking.

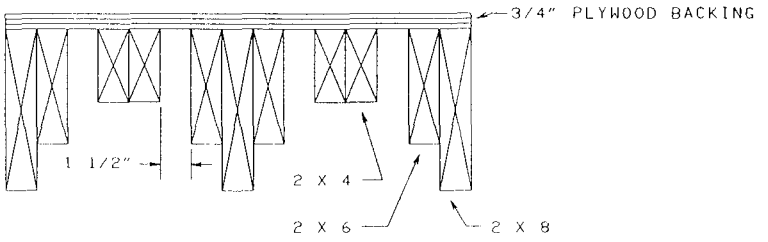
Note that the names I mentioned above, the people who advanced the concept of LEDE control room design beyond what we conceived, were not in the control room design when LEDE was first conceived. Who are they now? The major force in control room design today! Maybe the same will be true in the recording industry.

Anaheim Class—January 22-23, 1990

"Brute Force" Quadratic Residue Diffusor

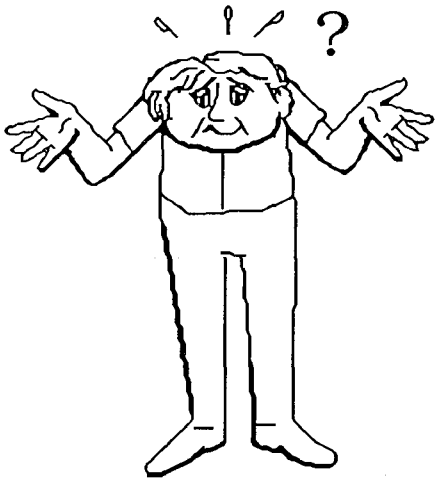
Farrel Becker sent us a very practical approach to obtaining a QRD from readily available material.

"The enclosed drawing shows how to build what I call a "Brute Force" quadratic residue diffusor. I call it brute force because it is constructed from standard 2 by lumber (2x4s and 2x6s and 2x8s) and plywood. It can be built in place quickly and easily. It will be pretty heavy (brute force again) but could be built in sections. The plywood can be left out if the diffusor is being built against an existing sturdy wall. The dimensions are not exact but are quite close to ideal for this configuration. No dividers between wells are provided as I could not come up with a simple way to properly support them. Eighth inch masonite might work. The diffusor should operate from approximately 300Hz to 5kHz. I haven't built one yet but it ought to work. One drawback that should be noted for commercial installations: this method of construction will add significantly to the fire load in a room!"



A BRUTE FORCE OR DIFFUSOR
CONSTRUCTED FROM 2 BY LUMBER & PLYWOOD

(FARREL M. BECKER 8/17/88)



Non-Thinking

Non-thinking, knee jerk-reaction is in vogue today in greater force than ever. Citizens feel more secure as authorities disarm them while simultaneously making sure criminals aren't and opening prisons so "rehabilitation" can take place in the community. If you have a deadly, transferable disease, your right to privacy supersedes any other consideration.

I read that automobile safety experts are increasingly concerned about the 1.8 million injuries and 48,700 deaths that cost the U.S. 64.7 billion dollars yearly. That's the equivalent, we are told, of three fully loaded 747s crashing and killing everyone each week of the year.

What could possibly be the cause?

1. Speeding
2. Failing to yield right of way
3. Driving on the wrong side of the road

Wonderful! Let's ban all of that. Nowhere is the drunken or drugged driver mentioned. Nowhere is the non-English reading driver mentioned. Nowhere is it mentioned that the reason Americans are such lousy drivers is because high school driver education teaches you how to steer but not how to drive.

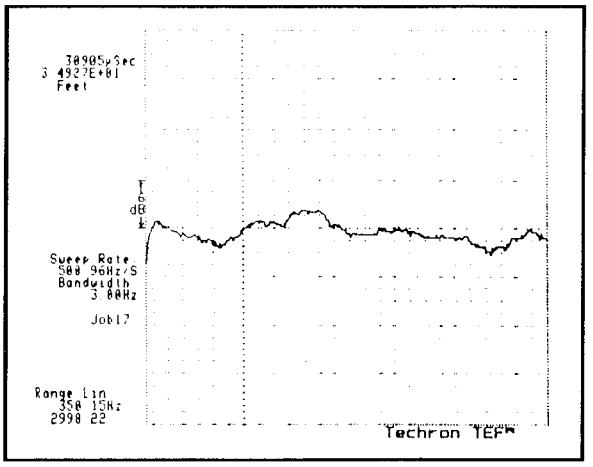
The article ends with the epitome of non-thinking by stating the lucky and unlucky days to drive. Why not a national lottery winner for the one to guess the number of fatalities each holiday?

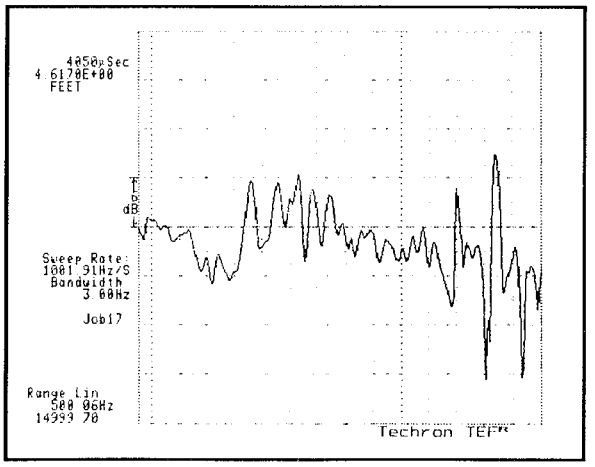
Loudspeakers Behind the Movie Theater Screen or Above the Screen?

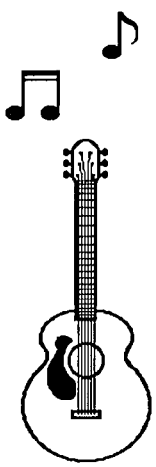
About the time that Don Berg of System One, Puyallup, WA sent us measurements of a coincident loudspeaker that he has designed for theater use, we read an article in *Audio Magazine* by Tomlinson Holman on the THX sound system. Don Berg's measurements show the marvelous response of his loudspeaker through the crossover region. The second measurement shows the differenced data of the same loudspeaker behind the screen.

Tomlinson Holman states in his article in *Audio*, "Attempts to move the screen loudspeakers out from behind the screen, to reduce the screen losses, have been made over the years. The problem is that the sound directed to the left, center, and right loudspeakers is intended by the sound designer to occur on the screen. Sound systems above the screen inevitably draw one's attention upward, those outside the screen draw it outward . . . .Humans localize extremely well in the plane that includes the three screen speakers, so errors in direction are quite important. Mixers spend a great deal of time placing sound correctly, and it is the job of the sound system to reproduce them in the same position they were placed. Since screen losses amount to a simple 6-dB/octave filter, they are easy to overcome with electrical equalization and so cinema screen loudspeakers properly belong behind the screen."

This is an obvious reference to Patronis designed loudspeakers for AMC theaters where the loudspeakers are placed above the screen. If you cup your ears to listen to music before the movie starts, it may be possible for one to localize the speakers above the screen but once the dialogue starts the brain fastens on the action. Anyone who has heard the startling clear, beautiful articulation of the Patronis/EV/AMC theater systems will question the validity of Mr. Holman's statement.







Don't Play Music If You Want Me to Evaluate Your New Sound System

We are often invited to hear a new sound system installed in a new facility. Even though the sound system will be used primarily for speech, music is often played to demonstrate the system's capabilities.

The average human ear will tolerate all kinds of distortion and imbalance in music. Most of us listen to live speech all day long, but have much less opportunity to hear live music, hence the average person is a poor judge of reproduced music.

Be warned. When you invite me to hear your sound system, have a live microphone ready.

Heathkit Education Catalog

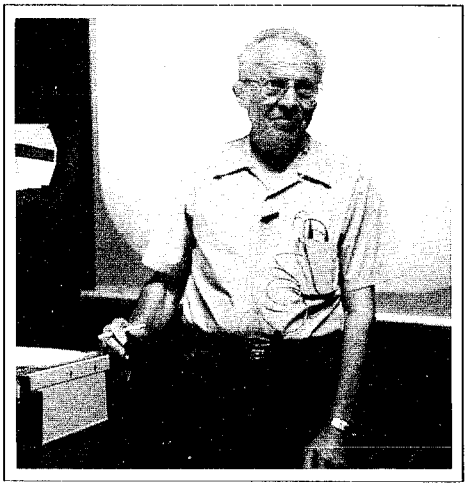
We are sometimes asked how to get basic training in the very basic concepts of audio fundamentals that one should know before taking their first job in audio: Ohms law, dc and ac current, constant voltage etc.

Get Heathkit's Education Catalog. They have many basic courses available. Write Heath Company, P.O. Box 1288, Benton Harbor, MI 49022.

Dr. Sidney Bertram—A Man of Ideas

It has always fascinated me that a man of ideas can hold your total attention with just a pen and an overhead projector while a con artist with the most stunning audio visual show imaginable still leaves you with the taste of "hype" in your mouth when he is done.

In the photograph shown here stands a fully armed man in the battle of wits. Too many people come to such a battle unarmed. Dr. Sidney Bertram continues to send us provocative new viewpoints on what Dick Heyser might have been trying to say.



Dick Heyser Had A Vision

For the past two years a remarkable team of men have met together when they could to probe further into Dick Heyser's work. Dick has been gone three years now. Dr. Patronis, Dr. Bertram, V M A Peutz, Manny Tward, Jerry Stanley, John Prohs, Dennis LeCroissett have worked on the problem with care.

Our goal is not to defend Dick's work from the Ellsworth Tooheys of this world, though that has been an incidental benefit, but rather to know the truth about Dick's vision that we listened to when he was with us, but we were unable to understand. Dick had a vision about energy accounting. Its solution could either be an important next step in physics or the first error any of us ever knew Dick to make. Finding the truth could never diminish Dick no matter what the answer—his fully acknowledged accomplishments are unique, but Dick, too, wanted to know the truth no matter what and it is in that spirit that his friends pursue the Quest. The quality of the men involved insure integrity. Their continuing interest is Dick's greatest memorial.

Dick had a vision about energy accounting. Its solution could either be an important next step in physics or the first error any of us ever knew Dick to make.

The May Intelligibility Workshop II Re-Scheduled to October 1990

October						
Sun	Mon	Tues	Wed	Thur	Fri	Sat
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

When we originally planned for Intelligibility II, we expected to take delivery of the new TEF 20 in early May. (Yes! we did know about it that far in advance.) Since it was to be introduced in April at the NSCA show, we had erroneously felt that May would be a safe date. However, we are told that the first delivery will be in August; therefore, we are re-scheduling, with a two-month safety factor, in October.

The Intelligibility II workshop is state-of-the-art in recording and in-the-ear microphony. For that reason we want the data gathered to have equal integrity. Workshops such as Intelligibility II require an enormous amount of work and dedication. Workshops of this caliber can take place only every two or three years. We don't want to waste the opportunity by not working with state-of-the-art instrumentation.

We sincerely regret any inconvenience this causes those of you already registered and you will receive priority for the October workshop.

Automatic TEF Turntable

Marshall Buck has an ad on our classified page for an automatic TEF turntable. We would like to tell you a little more about the turntable than we could in the ad. The turntable turns at one degree per second, and provides an interrupt to the TEF every five degrees of rotation. By using the delay on the TEF setup, data can be collected every 10 or 15 degrees, if desired. Thus a full set of 32 sweeps, every five degrees, from say -90 degrees to +65 degrees can be collected automatically in 160 seconds of hands-off operation. The photoelectric interrupt activates the serial port on the TEF, and is handled by the standard TEF software, either the original CP/M or TEFDOS versions. The turntable is built very low to the ground, five inches high, to facilitate the ground plane measurement technique. Of course, it is easy to add a tall stool, if one wants to raise the loudspeaker or microphone under test. The turntable is 17 inches in diameter, on a 20 inch square base, and requires 117 volts AC.

Turntable without platform

Measurement is a Process . . . that Doesn't Lend Itself to a Standardized Test."

I was interested to read recently the following remark by Dr. Gerald Calm "it isn't that school children don't understand how to measure something using the metric system, but that they don't understand fundamental concepts about measurement itself." And, Thomas Romberg's comments, "Measurement is a process of doing something that doesn't lend itself to a standardized test."

SYN-AUD-CON
1990 SUMMER SEMINAR SCHEDULE

3-Day SEMINARS

The Farm in Indiana, 1990

May 10-12	August 23-25
June 19-21	September 13-15
July 26-28	October 11-13

This schedule has changed from the previously published schedule. We have had several people tell us that, for various reasons it is not convenient to attend a Saturday class. For that reason we have scheduled June as a mid-week class. The reason that we have scheduled most of our classes Thursday through Saturday is to enable attendees to get an inexpensive stay-over-Saturday-night airfare.

Adding a 4th Day to the August Class?

We are considering adding an extra day to the August class at the farm that will be a tutorial on using computers for sound system design. The extra day will cost an additional $200 above the normal class charge. Let us hear from you if you are interested in adding the 4th day to any of the scheduled classes.

A 3-day Computer Oriented Class?

And let us know if you would like to have a special 3-day class at the farm devoted exclusively to working with sound system design on the computer and CADD related programs.

Registration Fee

At the Farm—$525 for three days
At the Farm—$200 for additional fourth day added to the three-day seminars

Computers & Summer Classes at the Farm

The announcement of the first TEF analyzer designed to drive your own personal computer for the display and manipulation of data gathered with an external "front end" removed the last vestige of resistance on my part of obtaining my own PC. It is a Datel utilizing the INTEL 80386-33 with an INTEl 80387-33 co-processor and a cache memory of 32KB with an access time of 25ns. A 100MB hard disk, a 5-1/4" floppy along with a 3-1/2" disk drive and 4MB of extended memory allows me some freedom of access and speed of utilization.

Programs presently being learned are Quattro Pro 5.0, Word Perfect 5.1, DesignCAD 3D, IED, AcoustaCadd, PHD, Farrel Becker's "Sound System Design," Mario Maltese's Lotus 123 Gain and Loss Program, Joe Mitchell's Amodel, Joel Lewitz's AI, Typing Tutor and all the useful utility programs that hold it all together.

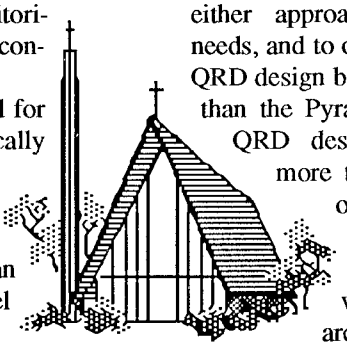
For someone that has not touched a computer for twenty years other than the TEF analyzer, this kind of plunge into MS-DOS is both exhilarating and exhausting. My unit is a medium sized "tower" and the monitor is the new 14" Sony multi-scan H6 driven by a Paradise enhanced VGA card.

This computer will be heavily engaged in the summer classes at the farm along with the new TEF analyzer.

If you are going to be able to benefit from the very genuine revolution in computer aided instrumentation, now is the time to get started with computers.

Study of the Reflected Energy in a Worship Space

Michael Garrison of His Sound in Fresno, CA was hired by Calvary Church of Santa Ana, CA to do a study for their 3,000 seat auditorium, which was under construction.



The ceiling designed for the church was acoustically acceptable but proved too costly for the congregation. Mike was employed to develop an alternative acoustic panel design.

Mike did a very exhaustive study (AES preprint 2879). At the conclusion of the preprint, Mike writes,

"We recommended that the church research the cost difference between the Flat Ceiling design with a total of 424 QRD's inlaid (four per full panel, two per half panel) and the Pyramid Ceiling design. We felt that either approach would meet their needs, and to our pleasant surprise, the QRD design bids came in $50,000 less than the Pyramids. Furthermore, the QRD design saved the church more than $150,000 from the original curved plaster panel design."

The final plan that was worked out with the architect includes 1080 2 x 2 QRDs in the main ceiling, arrayed in clusters of 3x4 units; 119 2 x 2 QRDs over the choir, for a total of 1,199 units.

If you ever wondered what Peter D'Antonio does in his spare time!

Courtesy of David Engstrom

$$E = MC^2 \pm 3\ dB$$

A Proposal for Teaching Sound to the Citizens of America

Doug Jones told me that he was invited to be the chairman of a session at AES (New York, November 1989) on Education in Audio. I thought, how boring! What could possibly be said that is new?

I (Carolyn) dropped in to listen to a bit of the session. I was surprised to find myself totally involved and excited by Cliff Henricksen's talk. I am delighted that ***Sound & Communications*** magazine reprinted Cliff's talk. I hope you will get a reprint from S&C. Cliff lays out a public education program to teach acoustics starting in kindergarten.

I would like to reproduce a few excerpts from Cliff's introduction to his proposal.

"Why is acoustics considered an esoteric and almost alchemylike disciple? Why do buyers and users of sound equipment, such as high school directors, arena managers and presidents, home users and musicians possess an almost universal ignorance of the way sound equipment works and behaves? Why do professionals and students in our own field (sound reinforcement) have such a difficult time learning and understanding acoustics? I believe it is because of our complete lack of primary and secondary education in this subject. . . .

"So then, why is the teaching of sound and its characteristics not addressed by our primary and secondary public education system? Why is chemistry, for instances, taught both in lecture and lab and not acoustics? . . . . It almost seems to me to be a gigantic blunder to ignore the early study of acoustics in an age when communication is such an important part of our daily lives and sound accounts for at least half of the communication presented today. There should be at least some exposure to it, but to practically omit sound from the education of the next generation seems unfathomable. True, most, if not all, educators do not understand acoustics (not to mention many people in our own field). This may entirely account for this unbelievable omission but is this a valid reason to put it off any further? I believe not."

Professional Services

Acoustical Consultants may list their cards on this page. There is no charge. The only requirements are that you are a full-time consultant, 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 four (4) business cards for our file.

Bose Looking for an Acoustics Engineer

We smiled with pleasure when we read this Bose ad in recent audio publications. We were surprised, but we can honestly say we are delighted. Bose usually has around 100 degreed engineers on their staff. Think what the potential is at Bose if they begin to think in terms of "compression drivers for pro markets." Perhaps they will find an engineer that understands Q.

BOSE Corporation, has achieved an international reputation in the audio industry through its research, marketing innovation and engineering excellence. Our commitment to quality and creativity shows in our diverse product offerings. BOSE has made significant penetration into the professional sound marketplace, and offers outstanding opportunities for you to help us design the systems of the future.

Acoustics Engineer

Become involved in the development of high power transducers and loudspeaker systems for the professional sound market and for continued engineering of existing products. We require an Acoustics Engineer with a BS and 8 years' experience in transducer and system design. Experience designing high power woofers and compression drivers for pro markets a strong plus.

BOSE®
Better sound through research.

J. W. Davis & Company Appoints Chief Engineer

J. W. Davis & Company has appointed Eric Simonson to the position of Chief Engineer responsible for quality control and product development. Eric received his B.S. and M.S. degrees from Oklahoma State University where he was a teaching assistant in the Electrical Engineering Department. His post graduate work was concentrated in analog circuit design and digital signal processing.

I had an interesting and impressive introduction to Eric. We had a problem during a TEF measurement and I suggested that we call Dr. Patronis the next morning to discuss it with him. When we placed the call the next morning, Eric had worked out the compete LaPlace Transform and was able to very intelligently discuss the *solution* with Dr. Patronis.

Eric Simonson, Chief Engineer at J.W. Davis & Company

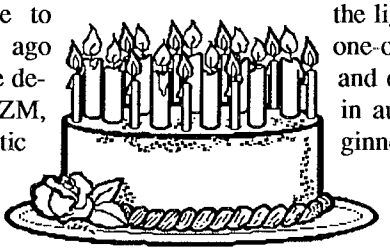
Syn-Aud-Con

is

"18"

This Year

What is Syn-Aud-Con? A dozen and a half years ago we would have felt we could answer that question with authority. Today, matured by our contact with our seven thousand grads, we have come to realize that Syn-Aud-Con has a life of its own independent of our yearly plans and expectations. How were we to know eighteen years ago that the future held the development of PZM, LEDE, TEF, quadratic residue diffusors, array design mapping, signal alignment, In-The-Ear recordings, and a host of other exciting innovations in our industry. How were we to know that Heyser, Stanley, Patronis, Peutz, D'Antonio and a vast host of others would respond to Syn-Aud-Con as they have. Just what have they responded to?



The magic time and the magic place called a Syn-Aud-Con seminar or a Syn-Aud-Con workshop is made magic by the work of the giants that preceded us, remembered and interpreted by the newcomer. Added to this the sometimes wild enthusiasm of an innovator sharing an idea just seeing the light of day, to the often one-on-one tutoring that can and does occur as a master in audio shares with a beginner in audio.

We're pleased. We didn't plan it that way. We began by wanting to share what each giant of the past had accomplished. As we shared with the new generations, we found new contemporary giants joining us. What we've learned is the most exciting news yet. The next eighteen years will make the last eighteen years seem like slow motion.

Florida Class—November 15-16, 1989

"I Don't Think Even Dick Heyser Could Explain It Any More Clearly"

We received a letter from Ed Long of Time Align™ fame with a copy of his letter to Gene Patronis. We appreciated the contents of the letter so much that we asked Ed Long if we could reproduce his letter in our Newsletter. Permission was granted with the comment, "I don't think even Dick Heyser could explain it any more clearly."

Time Align is a registered trademark of E.M. Long Associates

Dear Gene:

I read your letters in the J.A.E.S. (December 1989), and although I am not usually a prolific letter writer, I had to let you know that I think that you did a fantastic job of clarifying the way the TEF Analyzer handles both the TDS and TEF analysis. I have heard rumors that various persons have been saying derogatory things about TEF analysis. I am not sure what these things are, but apparently the original paper by Andrew Duncan must have helped to fuel the attack. It is a shame that the J.A.E.S. took so long to publish your letters and Mr. Duncan's replies. There are some people who seem to be confused by some of the comments that they have heard about the apparent "failings" of the TEF Analyzer. When they ask me questions, I can tell that they are not even certain what the so-called "problems" are. I have defended the TEF system by explaining not only how it works but what the "objections" seem to be. Now I can refer them to your letters. If anyone doesn't understand what it's all about after they read them, then they just don't understand how real world measurements are made. I don't think even Dick Heyser could explain it any more clearly.

FOR SALE: Techron TEF 12 Analyzer, new condition. CONTACT: Randy/Sound-Tech Communications at 414-730-8866

FOR SALE:
TEF System 12, upgraded with battery backup, extensive software including many custom programs. Mic, stand, printer, cables. CONTACT: Laird Pospisil at 708-416-6600

FOR SALE:
Automatic TEF Turntable, motorized, with photoelectric interrupt to TEF. Handles 200 lbs. $599
CONTACT: Marshall Buck Psychotechnology, Inc., 3221 Provon Lane, Los Angeles, CA 90034 — Ph. 213-559-3947 or fax 213-836-3763

POSITION WANTED
I would like a business association on a contractual or subcontractual basis. I have taken courses at Syn-Aud-Con and have a B.Sc. in Audio Technology, Diploma in CAD Design. My work experience is in many phases of audio, broadcasting, computers, CAD system installations and design. I own a TEF analyzer and two CAD stations and am capable of doing design and teaching in architectural, mechanical and technical drafting.
CONTACT: Theodore Kowdrysh, Son-Tech Enterprises Ltd., Box 127 Champlain Station, LaSalle, Quebec H8P 3J1. Ph. (514) 366-8953. Fax 514-366-4094.

EMPLOYMENT OPPORTUNITY
Senior Design Engineer requires physics or engineering degree and/or experience in latest technology. Complete familiarity with acoustic principles, transducer selection, enclosure design, crossover design, time and techniques—especially time delay spectrometry using Techron TEF 12 analysis. Opportunity to follow products from design through manufacturing to application. Established recognized name, small manufacturer of highly regarded commercial loudspeakers in growth period with new products and designs. Excellent benefits and beautiful surrounding area.
SEND RESUME TO: Frazier, Division of Sound-Craft Systems, Inc., Route 3, Box 319, Morrilton, Arkansas 72110-9532 or call 501-727-5543.

SYN-AUD-CON SPONSORS

Syn-Aud-Con receives tangible support from the audio industry. Seventeen 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.

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