SYNERGETIC
SYN AUD CON
AUDIO CONCEPTS

newsletter

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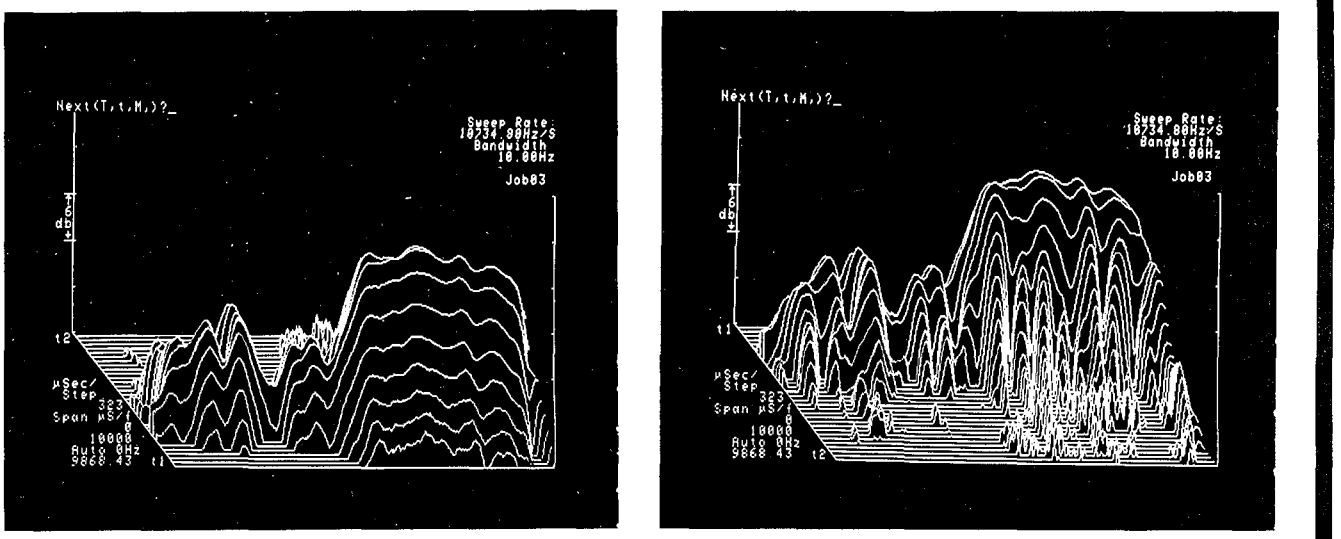
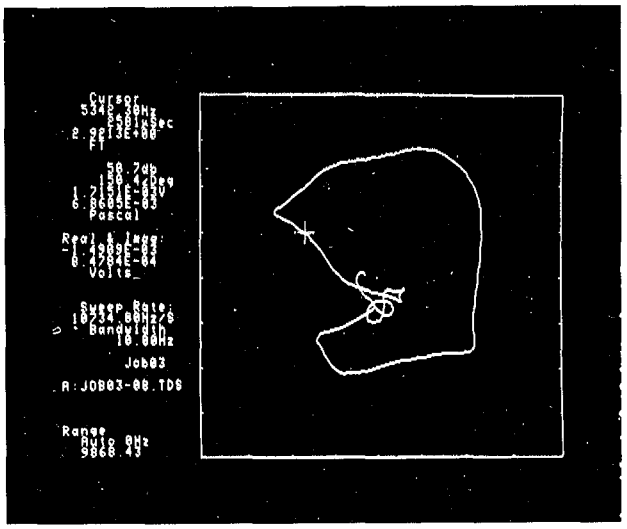
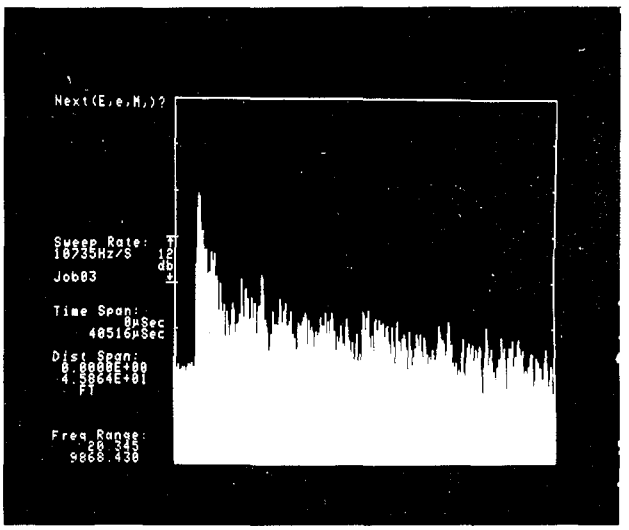
FALL 1982



TEF® FRONT AND BACK "WATERFALL" DISPLAY



TEF® NYQUIST PHASE PLOT



TEF® ETC DISPLAY

TECRON (CROWN) TEF® TECHNOLOGY ARRIVES

TABLE OF CONTENTS

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.

EXCHANGE OF IDEAS

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

CROWN AND SYN-AUD-CON TO SHARE SUITE AT AES

Since we are going to be wherever the new Crown TEF® analyzer is, DON EGER of Crown International very kindly agreed to share our hospitality suite at AES in Anaheim. We don't have the number of the suite now but we do know that it will be in the Bonita Tower. Check our exhibit space (#910) for our suite number.

The Syn-Aud-Con Newsletters and Tech Topics are published quarterly by Synergetic Audio Concepts, P. O. Box 669, San Juan Capistrano, CA 92693. Telephone: (714) 496-9599. The subscription rate for graduates of Syn-Aud-Con seminars is $30 per year in the United States ($35 in other countries). Newsletter subscriptions are available to non-graduates for $50 per year in the United States ($55 in other countries). Non-graduate subscribers may credit the $50 subscription rate to the registration fee for a Syn-Aud-Con Sound Engineering Seminar should they register during the year of the subscription.

**Syn-Aud-Con graduates are capitalized throughout Newsletter.*

FIRST "HANDS ON" OF TEF® ANALYZER

We have now had our first "hands on" experience with the TEF® analyzer and found the interactive nature of the displays extraordinary.

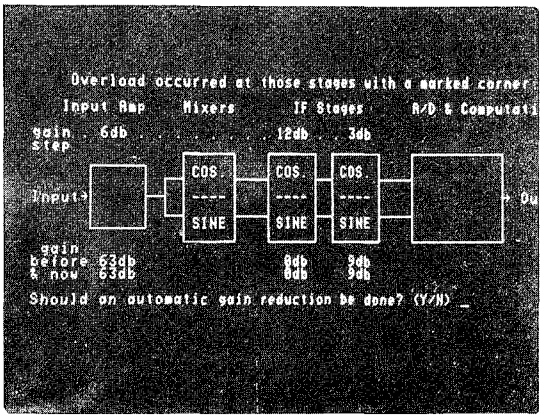
We plotted a three dimensional "waterfall" display at 32 points in time surrounding the main output signal of a loudspeaker (total time window approx. 1.0 msec.). We then called up a reverse display--we looked at the rear side of the frequency vs amplitude display. We then called up the "cursor" and had moved it about, both in time and in frequency, until it sat on top of the mountain peak the contour lines had depicted on the screen.

Later when we called up a phase plot (Nyquist plot form) and asked for the cursor, we found it at exactly the same frequency, and of even greater interest, the phase plot of this same loudspeaker had been automatically made at the exact same "time" offset we had left the cursor at when we excited the "waterfall" display.

Incidentally, watching the "front" of the waterfall display gives an excellent idea of the initial transient response capabilities of a transducer, but looking at the "rear" of the waterfall display is devastating as you view inertia hard at work.

Our first impression? WOW!! ZOWIE!! ENCORE!! and "is that me making and interpreting such formerly complex measurements?

GERALD STANLEY has earned himself a unique and immortal niche, along side Richard Heyser, in Syn-Aud-Con's Hall of Fame with the design of the TEF® analyzer. The ease of measurement, the unbelievable accuracy of measurement, and the depth of measurement now possible have totally surpassed any other system we have ever seen or heard about. You simply wouldn't consider the alternatives (all of which are only dim shadows of a small portion of the total, even if they were half the price instead of the six times the price figure they actually are.



Are we excited about the TEF® anayzer? When I first saw an ETC display (reported in the April 1979 Newsletter), I asked Heyser if it were for real. He said, "You'd better believe it."

One delightful feature of the new Crown TEF® analyzer is a display that can be called upon whenever the "overload" label appears at the top of the screen. A flashing cursor in the affected block on the diagram indicates where the overload occurred:

A. Input amplifier
B. Mixers
C. IF stages
D. A/D and output stages

Gain settings that were chosen before overload was indicated are displayed and you can change them to new values one at a time.

PROPOSED EUROPEAN CONCERT HALL TOUR

We are very pleased to have received so many interested responses to the proposed special concert hall workshop in Europe during March 1983. We are even more pleased to have heard from V.M.A. Peutz in Europe that plans are proceeding favorably at that end in terms of an orchestra's cooperation.

The renowned V.M.A.Peutz is the acoustical consultant arranging for the orchestra and halls, and he is, in addition, adding a full day at his own laboratory facilities (one of Europe's finest) so we may hear special recordings of a myriad of additional halls where the orchestra and repertoire were the same for each concert.

We will have the Crown TEF® instrument with us and we are receiving permission to conduct measurements in the halls we visit.

As you can appreciate, it is no small task to arrange to hear the same orchestra performing the same music in three separate auditoriums within three days. We asked Mr. Peutz if he could arrange such a tour de force the week prior to the AES in Eindhoven (March 15-18, 1983). At this time Mr. Peutz has the dates of March 22-24 arranged. We are not calling this a firm date yet, as Mr. Peutz would like to examine all options.

We presently anticipate a cost of $1,000.00 for each participant. This charge will include transportation from Eindhoven to each of the concerts, to Peutz's laboratories on the fourth day, and return to Amsterdam where we hope to attend the Concertgebouw, but not as part of the planned activity of the Concert Hall Design Seminar.

Meals during the four days, except the evening of the fourth day, are also included as are the ticket charges for each hall we visit. We will make arrangements for your hotel rooms during the tour and AES; however, all hotel bills are your responsibility (estimated at $40 to $50 per night on the tour), as is transportation to and from Europe and attendance at the AES convention. (Currently, KLM is charging less than $600 round trip from New York to Amsterdam.)

Full details will be in the mail to those applying by January 15, 1983. We believe this will truly be the opportunity of a lifetime for serious students of concert hall acoustics.

PHASE MEASUREMENTS USING THE CROWN TEF® ANALYZER

Minimum Phase Response

Minimum phase response is a subject you will be hearing a great deal more about in these pages during the next few years. In fact, "phase" will probably become one of the most studied parameters we deal with in audio and acoustics because of the enhanced resolution such measurements offer when examining various alignments between transducers.

An extremely useful discussion of minimum phase networks is the Syn-Aud-Con Tech Topic Volume 5, No. 10, written by GERALD STANLEY of Crown. In this Tech Topic, we encounter the Laplace transform.

The use of the Laplace transforms in the solution of network problems may be compared with the use of logarithms to simplify the solution of mathematical computations.

In a similar manner, Laplace transforms can be used to reduce the problem of solving integrodifferential equations to a purely algebraic process and, moreover, complex excitations such as square waves, etc., can be analyzed by these same algebraic procedures. This usually is accomplished by a table of transform pairs which performs a function similar to a table of logarithms.

The Laplace transform of a given function of time f(t) into the quantity "s," a complex variable composed of a real part $\propto$ and an imaginary part μ allows these parameters to be plotted onto the complex-variable plane or "s" plane. Once this is accomplished, then the following definitions apply:

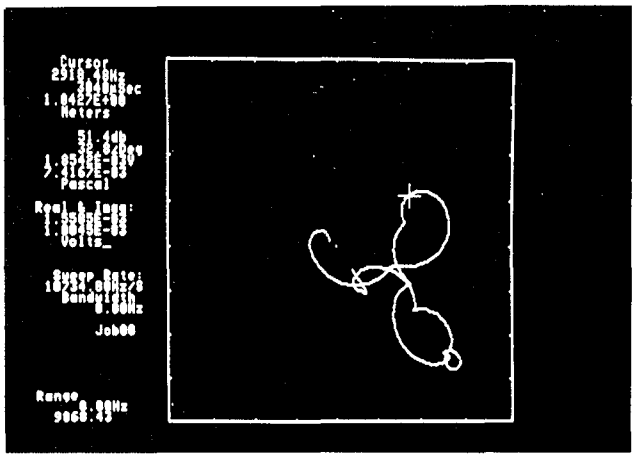
1. A minimum-phase shift network has the minimum possible phase shift for any specified shift in the amplitude characteristics.

2. A minimum-phase passive network will have no poles or zeros in the right half of the "s" plane. An active, unstable network could have poles in the right half plane, but to be classified as minimum-phase it must have no zeros there. (For an excellent description of poles and zeros see Stanley's Tech Topic.)

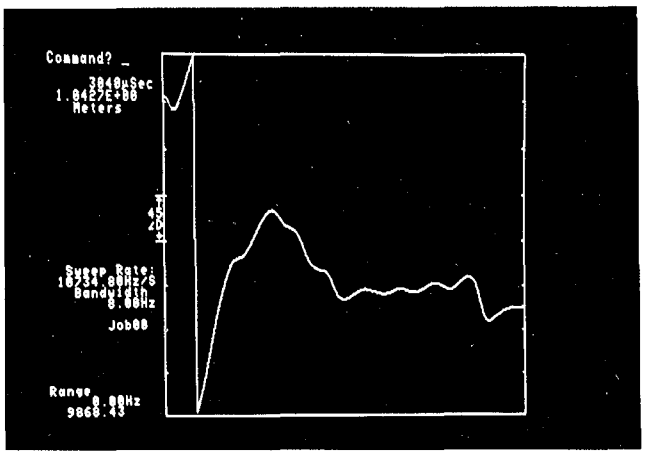
Summary of Above

Passive networks may have *zeros* in either the right half of the "s" plane (the non-minimum phase case) or in the left half of the "s" plane (the minimum phase case) but they will never have poles in the right half of the "s" plane.

It's really small wonder that the knowledge of a loudspeaker's minimum phase or non-minimum phase behavior at differing frequencies has been known to so few. The Crown TEF® analyzer is now a reality. The prototype TEF® analyzer is now in full effective operation. This means that there is no longer any question about "can the analyzer be made to work" but only what's the latest production schedule. We will have access to instant measurement of electrical and acoustical phase adjusted to the actual propagation path and displayed either as a Nyquist plot (the magnitude as a vector length shown as a point rotating through the phase angle as frequency is changed) or as a Bode plot (relative phase angle versus frequency).



Phase on a "Junk Fi" speaker.
Nyquist (real vs imag.)



Phase on a "Junk Fi" speaker.
Phase vs Frequency

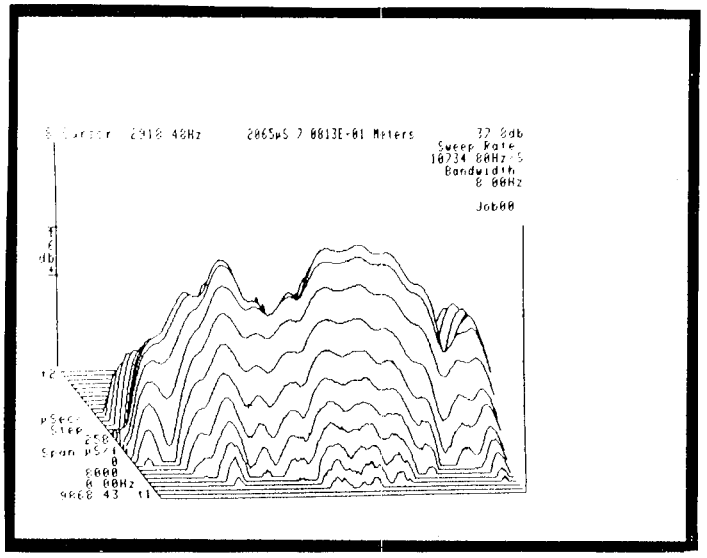
One of each of these plots is shown in the illustrations. The device being measured is a "junk fi" loudspeaker. The epicycles (a loop on the main circle) indicate non-minimum phase frequencies and, through the use of the cursor built into the TEF® analyzer, these frequencies are read directly on the analyzer screen.

The unbelievable power of the TEF® analyzer is yet to be recognized by those who feel they are familiar with it. These same phase plotting modes can be used to plot instant complex impedances. The analyzer doesn't care whether it's a microphone or a direct electrical pickup at its input, it simply processes the signal in the prescribed manner.

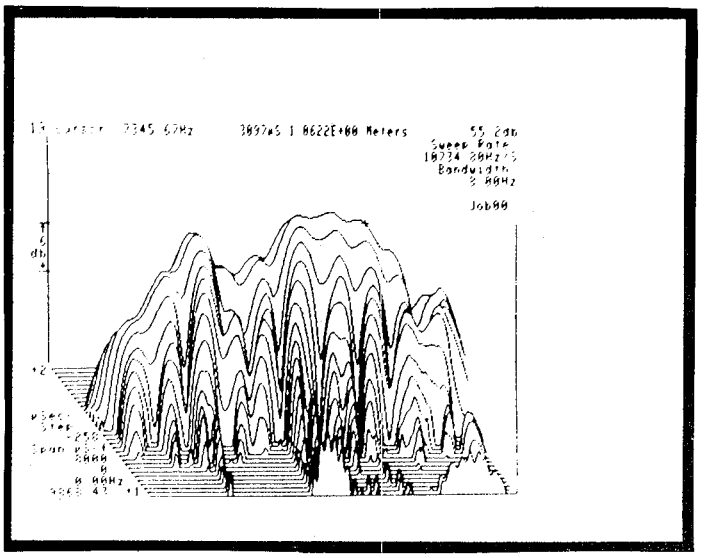
Continued next page....

In the case of the complex electrical impedance, the resolution obtained is extraordinary because the sweeping filter now allows discrimination against the ambient noises the loudspeaker happens to be listening to during the test.

An interesting question to experiment with will be to study the energy time curve (ETC) of the complex impedance of various transducers.



(a) Magnitude response plane of a speaker system in a small room.



(b) Backside of same data as (a).

The new Crown TEF® analyzer does the classic "waterfall" display of 32 "frequency responses" but with an unbelievably exciting variation. You can view the display from either the front or the back. Transient response problems become living, breathing entities in such a display format.

From what Syn-Aud-Con has seen the prototype unit do, we feel it vital to call to the attention of every potential buyer of one of these analyzers that now is the time to place your order and a deposit with Crown. If you want one of these first instruments (it requires little or no imagination to visualize what six months head start in the field with this power can accomplish), we believe immediate action is necessary. Unless we are seriously mistaken, there will not be sufficient instruments to serve the initial users and, as is usually the case, he who hesitates is lost.

I know of nothing comparable to the magnitude of improvement in measuring capabilities offered by the Crown TEF® analyzer during my 40 years of involvement in such work.

ERRATA

AL GRUNDY, one of the founders of the Institute of Audio Research in New York City and a student of the decibel that we have genuine respect for, chided us for letting a carelessly written equation slip through our editing net. In Newsletter Volume 9, No. 4, page 12, we wrote:

$$10 \text{ LOG } (1 + 10^{d/10})$$

Which should have read:

$$10 \text{ LOG } (1 + 10^{\frac{-d}{10}}) = \text{Value to be added to higher value level}$$

Where: -d is the difference in level between two level readings, L_1 and L_2, such that the lower level is subtracted from the higher level $(L_2 - L_1)$

The value 1.0 is present because the $10^0 = 1.0$ and 1 + 1 then yields the proper doubling of the ratio.

EXAMPLE

$L_2 = 95$ dB, $L_1 = 94$ dB $\qquad 95 + 10 \text{ LOG } \left[1 + 10^{\left(\frac{-(95-94)}{10}\right)}\right] = 97.54$ dB

Al is one of the very few instructors we have met that we feel students are privileged to be exposed to. We're always pleased to find our peers reading the Newsletter.

TEF® MEASUREMENTS

We have, in the past, divided our present view of TEF® measurements into:

1. Energy density vs frequency or energy, frequency curves (EFC)
2. Energy density vs time or energy, time curves (ETC)
3. Energy density distribution in time by frequency or Frequency time curves (FTC)
4. The absolute and relative phase (Θ)

Combinations

Just a little experience with these basic forms leads directly to interest in Wigner distributions as an advanced form of FTC measurements, a study of Nyquist and Bode relative phase plots, the meaning of minimum phase and its determination, and some totally new perspectives, such as the ETC of the complex impedance (the analyzer doesn't know what's at the input and the phase plotting capabilities are not restricted to acoustical measurements).

In a recent article by Ando and Alrutz in the Acoustical Society Journal, March 1982, entitled "*Perception of Coloration in Sound Fields In Relation To The Autocorrelation Function*" we come across the following arresting statement: "*The autocorrelation analysis* (in human beings) *is supposed* (believed) *to be performed in the neural part of the auditory system* (i.e. the brain) *within the time domain.*" Coloration, such as described in this article "*is clearly perceived*" when the delay is slight for one of two signals and they proceed to justify this with the autocorrelation function (ACF).

On TEF® we see *and hear* this every day as two energy packets separated in time on the ETC and as a comb filter on the EFC.

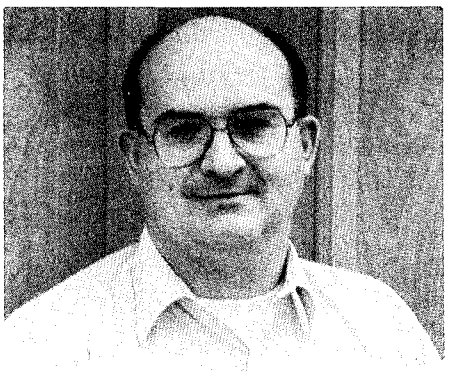
Every time we show a well qualified engineer one of our discoveries with the TEF®, which is audible when pointed out, as well as measurable, they usually say, "Why hasn't the manufacturer been able to see this in his test chamber?" The increased *resolution* that TEF® provides is so startling that a majority of first time users find it difficult to believe. After a few carefully constructed experiments designed to prove that what we are measuring is real, another TEF® addict is born.

To those of us with almost forty years of experience with measuring instruments (I bought my first oscilloscope in 1942 for use in ham radio) these are the most thrilling years of our lives. We are seeing what has been, in our experience, abstract mathematics turned into the most relevant, practical and self-instructive measuring instruments we could have ever imagined. Even more exciting is the forty years of subjective listening experience finally finding rational objective underpinnings.

We have always suspected that what sounded "bad" to our ears and brain, in spite of tremendous hoopla and hype to the contrary by "experts," "designers" and "authorities" would one day be measurable in an objective way. We're pleased that our mental integrity has been supported by TEF® measurements to date.

Crown now tells us that their new TEF® analyzer *will be* on display in the Syn-Aud-Con suite at the October AES Convention in Anaheim and that full deliveries will begin in June, 1983.

We think that's an outstanding way to begin Syn-Aud-Con's eleventh year. We may have a birthday cake there to celebrate the occasion (chocolate, of course).



IS OUR FACE RED?

A treasured Syn-Aud-Con graduate does a unique, newsworthy installation, photographs it, and writes up an excellent description of the whole job.

How do we reward him? We overlook giving him credit for it.

Special Communications Systems, Newsletter Volume 9, No. 4, pp 24-25 was written by RUSSEL L. O'TOOLE, Audio Electronics, 46 Abbeywood Drive, Romeoville, Illinois 60441. Telephone: 815-886-5155.

SYN-AUD-CON 1982 & 1983 SCHEDULE

1982 Schedule

Sound Engineering Seminar	San Juan Capistrano	October 19-21
Sound Engineering Seminar	San Juan Capistrano	October 28-30
TEF™ Instrumentation Workshop	San Juan Capistrano	November 16-18

1983 Schedule

Sound Engineering Seminar	San Juan Capistrano	January 18-20
TEF™ Instrumentation Workshop	San Juan Capistrano	February 1-3
Microphone Application Workshop	San Juan Capistrano	February 15-17
Concert Hall Design Workshop	The Netherlands	March 18-21
Microphone & Teleconferencing	San Juan Capistrano	April 5-7
Financial & Management Workshop	San Juan Capistrano	April 19-21
Loudspeaker Array Workshop	San Juan Capistrano	May 3-5

There may be some shifting of Workshops and Seminars within the dates established. Anyone interested in the Workshops should let us know, as we always notify those who have expressed an interest in a Workshop in advance of the general mailing. No money is required to put your name on the list for a particular Workshop.

MICROPHONE APPLICATIONS WORKSHOP FEB. 15-17, 1983

Shure will sponsor a special series of microphone application workshops for Syn-Aud-Con. The inaugural session will be at Syn-Aud-Con's West Coast Seminar Center, February 15 to 17, 1983.

Every effort will be made to have on hand an example of worthwhile microphone models in use today in the recording, broadcasting, and "live" entertainment fields. Experts on the design, construction, evaluation, and application of all these types will be part of the staff, and the most powerful diagnostic tool in the audio world today - the Crown TEF® Analyzer - will be used to examine what these devices do and how they do it. Recording of "live" groups with the different devices will be an important part of the session. Participation will be limited and all attending will have "hands on" experience with the professional recording equipment that will be available for demonstration purposes.

European, PZM®, Shure, wireless and many other systems will be studied and evaluated. Best Audio will provide the equipment used in the recording portions of the session. Emphasis will be on identifying current "best practices" with the goal of discovering possible "next steps" in the art of applying microphones to recording and broadcast opportunities.

Full details will be available shortly. Those who have put their names on a list as interested will be notified first. At that time, you may firm up registration with a deposit. Fee is expected to be $600.00. Call Jan at (800) 854-6201.

THE JOY OF SYN-AUD-CON

That's not a prayer session but two dedicated audio men discussing a point of interest to both. The joy of Syn-Aud-Con is that it exists as a forum for the presentation of new, old, odd and outstanding ideas that need the light of shared and focused mental energy.

Don and WARREN EDIGER of Omaha, Nebraska. (Warren contributed the "Smile" in Newsletter Vol. 9, No. 4, page 28.)

PRECISION AUDIO LINK from HME

In current Syn-Aud-Con classes we are using one of the most useful tools it has been our pleasure to possess. It's HME's PAL System (an audio telemetry link). "PAL" stands for "precision audio link."

To make acoustic measurements, we simply clip the precision transmitter on our belt, plug our precision sound level meter into it, and take a walk out into the measuring area. The receiver is sitting next to the 1/3 octave real time analyzer or the TEF® analyzer and provides them with the *identical level* and *frequency response* they would have received *directly from the sound level meter* alone. How many times have you had to move measuring equipment, cables, etc., in a large space in order to get all the measurements you should?

We have always preferred the format and display of our Crown RTA 1/3 octave analyzer but because it is tied to the ac line, it couldn't conveniently be used to check coverage over a wide audience area. We, like many of you, employed the IVIE IE30 analyzer to do this job. Now it's "child's play" to have someone walk the area with the PAL unit and sit with the instruments and watch the display. Best of all, the price of the Crown RTA *plus* the "PAL" approximates the price of the IE30.

How accurate is "PAL"? The photo shows a 0 to 20,000 Hz sweep on our present TEF® analyzer and the total variation at 20 KHz is -1 dB between the GR 1933 precision sound level meter directly into the analyzer and then through the "PAL" system.

TECHNICAL DATA **PAL SYSTEM**

Audio Telemetry Link

What is PAL?

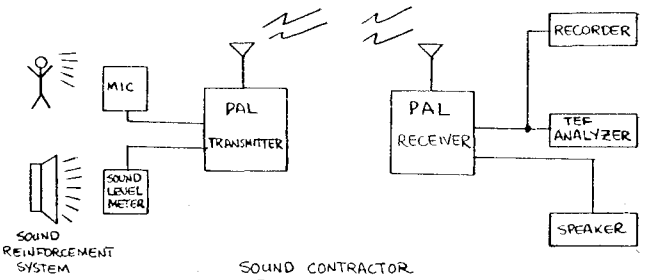
"A wireless Precision Audio Link capable of processing and transmitting a wide range of audio information with a high degree of accuracy and stability."

Applications:

- Remote sound level measurements
- Interface to TEF analyzers, spectral processing equipment
- Sound contractor data analysis
- Sound reinforcement installation setups

Features:

- Wide bandwidth 20-20 kHz
- VHF hi-band operation
- Compatible with B & K and General Radio sound level meters
- Microphone balanced input for audio measurements or communications link
- Provides complete transparency between sound level meter and recording or measuring equipment
- Transmission capability to 1000'
- Battery or external supply operation
- Ruggedized construction



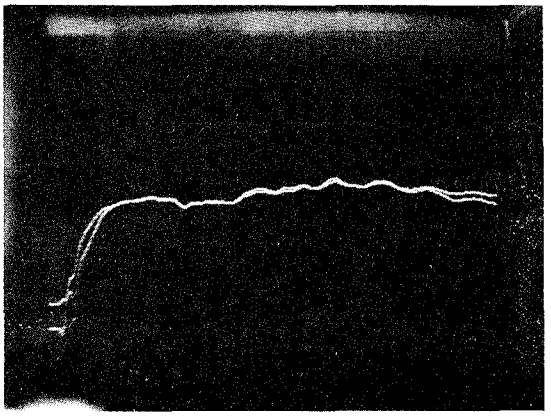
SOUND CONTRACTOR TYPICAL SET-UP FOR SOUND REINFORCEMENT INSTALLATION

PRERELEASE

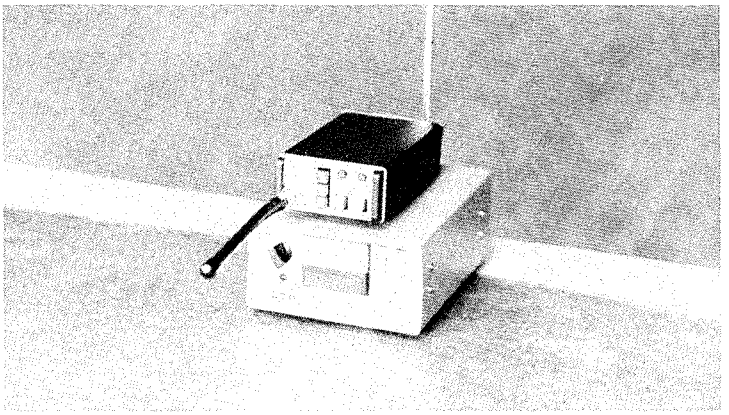
hme™
HM ELECTRONICS INC
6151 Fairmount Ave.
San Diego, CA 92120.
Phone (714) 280-6050
Telex 697-122

9/82

The repeatability is absolutely remarkable and such accuracy of frequency response is unheard of in conventional wireless microphone systems. We are reproducing HME's preliminary data sheet for your information. The most pleasant news of all - a *precision* telemetry system for only $2200.00.



Frequency response of PAL vs the frequency response of the SLM. 0 - 20,000 Hz.



PAL System - A wireless Precision Audio Link.

HP-41C VIDEO INTERFACE

I have just completed my first experience with the HP 82160A IL Module tied to the HP 82163A Video interface and one of our Syn-Aud-Con Panasonic Black and White monitors. WOW!!! For the engineer who wears reading glasses, you now have a large display "that he may run that readeth it." Any choice of printer functions can be chosen for display on the screen.

This Fall's Syn-Aud-Con classes will be able to see the HP-41 stack x, y, z, and T on the monitor as each step is taken during a calculation. Any memory or program can be displayed as well. Every function is displayed, helping a newcomer quickly learn the * is times and / is divide, etc., as well as insuring that they know exactly what happens in the stack at each operation.

BARCODE FROM THE HPIL MODULE

A Remarkable Tour de Force

JOHN LANPHERE has found a PPC program that allows the standard HPIL module to do Barcode. (H.P. insists that those of us who bought their new printer wait until they finally get around to shipping their HP extended IL module, which they now say will be in early 1983.)

This remarkable program requires the PPC module to originally get it into the calculator due to extensive use of synthetic programming, but is easily transportable from such a calculator to another calculator by magnetic cards (only requires two cards).

John Lanphere has received permission to make the cards available through his HP-41 Audio Club to club members for 50¢/card. Membership to this invaluable club is $15.00. See TT V9 N4 for full details. John's new address is: P. O. Box 6201, South Bend, IN 46660. Phone: (219) 234-1991.

For those who would like to meet John Lanphere he will be present in our exhibit area, #910, or our Syn-Aud-Con Hospitality Suite at the October 1982 AES Convention at the Disneyland Hotel, Anaheim, California.

If you are a serious HP-41 programmer, you will want to join the PPC Club as well. $25.00 per year.

Richard Nelson, Editor Publisher
PPC Calculator Journal, 2541 W. Camden Place, Santa Ana, CA 92704

One thing we are definitely sure of: A great deal of computer work is in our future between the HP-41CV system and the Crown TEF® analyzer.

SOME REMARKS ON DIGITAL SAMPLING RATES

Syn-Aud-Con claims no expertise in the problems besetting digital audio but merely observes the scene of battle as an interested, concerned spectator.

Anyone who has been reading Barry Blesser's writings on digital audio in *db* magazine realizes the complexity of choosing a satisfactory sampling rate. Shannon's criteria suggest a sampling frequency f_S *slightly* higher than twice the maximum frequency f_{MAX} (i.e., three samples per Hertz).

$$f_S = 2 \times f_{MAX} + \text{(small amount)}$$

For an audio system with a highest frequency of 20,000 Hz, it would seem advisable to approach 60,000 Hz as a sampling rate. 47,000 Hz and 50,000 Hz may be readily seen as counting heavily on theory and hoping practice confirms expectations.

R. Gene Smiley of Entek Scientific Corporation, Cincinnati, Ohio, in an article entitled "Vibration and Performance Testing With Small Digital Systems" in the April 1982 *Sound and Vibration* provides the illustration shown.

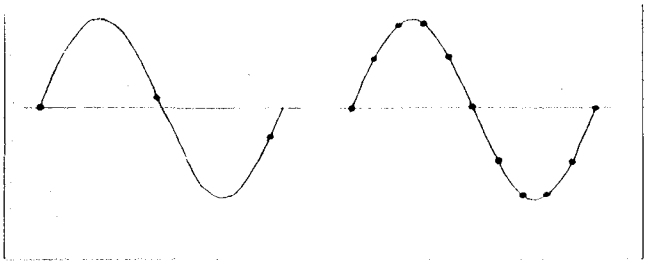


Figure. Example of why Shannon's sampling criteria for sample frequency slightly greater than $2\times f_{max}$ (left trace) for frequency domain does not hold when histogramming time functions. Worst case amplitude error when sampling at $10\times F_{max}$ (right trace) is only 5%

If applied to audio recorders, and we suspect these criteria are nearer that needed than the presently accepted criteria, we then would have:

$$f_S = 10 \times f_{MAX} \quad \text{and} \quad f_S = 10 \times 20{,}000 = 200{,}000 \text{ Hz}$$

As we have said before, time will tell.

DANGERS TO AVOID IN THE USE OF "ARCHITECTURAL MAPPING" IN THE DESIGN OF ELECTROACOUSTIC ARRAYS

Let's begin by making the unequivocal statement that we are totally in favor of "Architectural Mapping" as a useful tool in designing electroacoustic arrays.

What do we mean by "Architectural Mapping"? We use this term to describe any process that converts architectural room dimensions of an audience area in lineal feet or meters into an equivalent set of parameters describing the same area as viewed from a chosen location for an electroacoustic array in angular (in degrees) and range (in dB) notation on a suitable calibrated projection grid (usually one with latitude and longitude notation).

This "mapping" is from architectural dimensions to essentially spherical angular coordinates (vector angle and vector magnitude) or vector dimensions. *See Illustration.*

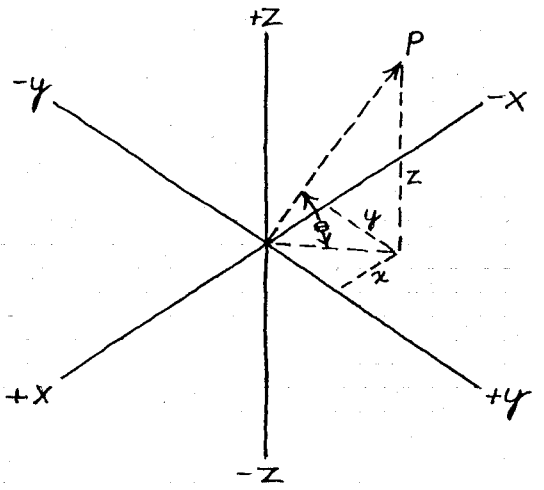
In a historical sense, those responsible for the present use of these techniques specifically for the design of electroacoustic arrays are:

1.	Edward Seeley	1978	May AES Preprint
2.	TOM MC CARTHY	1978	Oct AES Preprint
3.	FARREL BECKER	1981	May AES Preprint
4.	TED UZZLE	1981	May AES Preprint
5.	JOHN PROHS *	1982	Syn-Aud-Con Loudspeaker Array Workshop - Feb.

*Product to be marketed by Community Light & Sound.

Each of the first four chose to map to a flat surface and accept the distortions *inherent* in such mapping.

VECTOR NOTATION



$P = \sqrt{X^2+Y^2+Z^2}$ ((P) IS THE VECTOR LENGTH)

$\Theta = TAN^{-1}\left[\frac{Z}{\sqrt{X^2+Y^2}}\right]$ ((Θ) IS THE VECTOR ANGLE)

Spherical vs "Flat Earth"

John Prohs chose not to compromise and devised a system that "maps" directly onto a spherical surface. Convenient as the "flat earth" mapping schemes are, and they are remarkably better than guessing or building elaborate models, they do possess distinct disadvantages when compared to Prohs - Community sphere technique. In addition to solving the severe distortions at high angles inherent in the "flat earth" techniques, Prohs - Community technique allows not only the vertical, horizontal, or diagonal angles to be accurately obtained, but allows the rotational angles as well (not possible in the other techniques). Community Light & Sound will market the Prohs' spherical system and will show it during the October AES Convention in Anaheim.

Farrel Becker's technique, which uses standard polar charts and manufacturer's quoted coverage angles, is by far the most convenient of the "flat earth" techniques and, in our opinion, is more accurate whenever the coverage angles are obtained by the users from real measurement of the devices rather than from the manufacturer's specifications.

Because these techniques are, in their crudest form, a vast improvement over not having them, you will witness a flood of "me too" imitations with minute variations and mammoth rhetoric.

The Dangers

There is, however, a danger lurking in this Garden of Eden. It is the temptation to become so involved in obtaining superior coverage that you overlook the very real problems of:

1. When to vary the Q of a device and when you can vary its L_W instead
2. The cumulative 'N' factor
3. The necessity to use the L_W of only the devices supplying L_D to a point of measurement or observation vs the total L_W supplying L_R
4. When to turn from the Peutz equation using Q, V, RT_{60}, etc. to the Peutz equation using L_D, L_R, L_{AMB}, AND RT_{60} (This is, in our opinion, one of the most serious flaws in several of the most promoted "flat earth" techniques and one, we fear, not even understood by these advocates.)

Continued next page.....

5. Solving $\%AL_{cons}$ and PAG=NAG before N is accurately determined leads to nonsense such as $\%AL_{cons}$ predicted from relative dB values obtained from range and device coverage but divorced from the shifting L_W due to N

"Architectural Mapping's" day is at hand. Integrated into a mature understanding of the other parameters affecting intelligibility, Architectural Mapping becomes the solution to the final *major* problem in array design in terms of currently available devices. Used incorrectly it results in *uniform* unintelligibility.

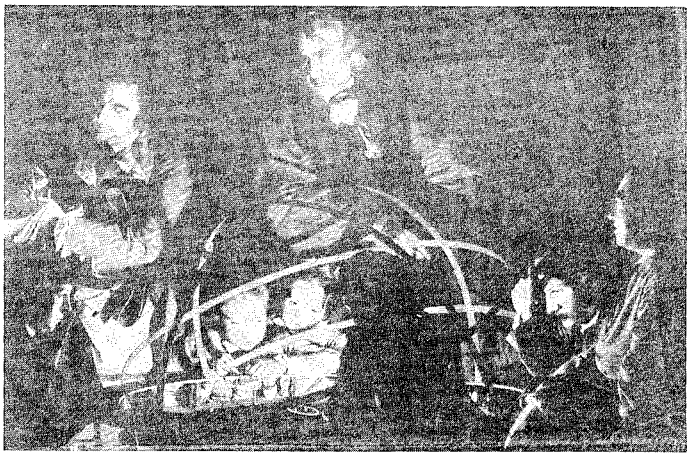
JOSEPH FOURIER (1768-1830)

We have mentioned "The Orrery" in a past Newsletter, Volume 9, No. 2, Pg. 12. Imaging our delight to find a famous painting of an "Orrery" reproduced on The Home Forum page of THE CHRISTIAN SCIENCE MONITOR, Feb. 11, 1982.

"Orrerys are intricate mechanical models of the solar system, operated by turning a crank, that allow the viewer to see the planets revolve around the sun and to observe the satellites of each planet as they revolve around the planets, as well.

This remarkable painting depicts the wonder both of the artist's treatment of depicting light on canvas, and the subjects' wonder at watching the Orrery operate.

A century earlier, this artist probably would have done a religious painting. In this painting, science, in its infancy, is being shown to children (aren't we all children as we first discover any truth?). A century earlier, this "Philosopher" might have been writing up heretics for burning at the stake.



'A Philosopher Lecturing on the Orrery' (c. 1764): Oil on canvas by Joseph Wright of Derby.
Courtesy of Derby Art Gallery

The question still askable today, "is what we consider fact, dogma, doctrine, or demonstrable? Physical scientists are the ones today who need to carefully review the dangers of thinking what they do well in the laboratory has any bearing whatsoever on social, political, or religious issues.

Centuries ago, when the church held temporal power over many, they felt that religious knowledge was transferable to all other phases of understanding. Their error was that they did not possess as much of the truth as they imagined.

So it is today with the physical scientist. As an old professor once said to me, after I telephoned him to tell him of my success using his process by exclaiming, "Doc, I've done it," his reply over the long distance lines came loud and clear. "Stay humble, stay humble."

The philosophical implications of each momentous breakthrough in human thought, be it social, religious, scientific, or a complex amalgamation of all three, generously mixed with a dash of speculative nonsense, affect thought for decades and sometimes centuries, as in the case of Newton.

Let's be sure never to leave "speculative nonsense" out of our mental universe, because it plays an important role in a surprising number of major breakthroughs. It has been written about Joseph Fourier (1768-1830) that his calculations "went through an incredible computation, that could serve as a classic example of physical insight leading to the right answer in spite of flagrantly wrong reasoning" and of interest to us, "It is a tribute to the insight of Legendre (1752-1833), Laplace (1749-1827), and Lagrange (1736-1813), that they awarded Fourier the Grand Prize of the Academy despite the glaring defects in his reasoning."

Rudolf Langer, to whom we are indebted for these quotations, says, "It was, no doubt, partially because of his very disregard for rigor that he was able to take conceptual steps which were inherently impossible to men of more *critical* genius." (Italics ours).

Why have we dwelt on this particular philosophical point? Perhaps because as we witness the emergence of the TEF® analyzer, we sense the mental chasm between those who will attempt to use it to re-do conventional measurements and those who will stumble, back, fall into, or fall over new startling concepts of how we view the generation, distribution, and disposal of that energy we call acoustic.

WHAT IS TV DOING TO AMERICA?

All that human beings can know about reality must present itself in consciousness. To be unconscious is to be without visible sign of life. Mankind is increasingly able to *be conscious* of some of the component parts that go into consciousness, especially some of the complex electro, chemical, mechanical functions of the brain. That brain is not mind is to a large degree accepted by thinkers today, with mind tending to be identified with the universal mental energy sea we all swim in. The brain is like the local device that downloads protocols from the main access center (mind).

Materialists dislike the "unknown" and the metaphysical, religionists often feel they have the only "dedicated line" to the main access center, and the majority just keep pushing the button marked "pleasure."

Environmentalists, who quake at smoke, dirt, radiations, etc., sit calmly night after night in front of an almost total source of mental pollution. As less than desirable habits, tendencies, or other human traits are exposed to discussion, we either respond by sincere efforts to adjust to an enhanced awareness of what might be better for us, or we rebel at this unasked for intrusion into our activities.

"We smokers have determined that your bitching may be hazardous to your health"

was one recent bumper sticker we observed. Or, a Marine bound for Lebanon had the following in his rear window:

"Kill 'em all. Let God sort them out."

Syn-Aud-Con is not in the business of telling anyone how to live. We are, however, interested in the current research into TV viewing, which indicated that those seeking to avoid detrimental mental effects should be aware of the dangers posed and able to react to them in their own individual manner.

The first item reprinted below was our answer a few years ago to a highly creative graduate who wanted to video tape a Syn-Aud-Con class. Our response to him reflected our "gut" feeling at that time:

There is no doubt in our minds that you would do a splendid job on the taping you propose.

We simply are not ready for such a venture. Your most generous quotation amounts to the donation of your time on our behalf and the thought behind the offer is very much appreciated. What we're not ready for is the necessary time to write a proper script, rehearsal, and the time necessary to edit the content to our satisfaction.

On top of our unpreparedness is our belief that visual stimulation by means of video is exactly what we are trying to jar students out of into studying deeper meanings in the printed word.

Some ideas like leaves
on the top do flow
but he who wants
the truth must beneath
the surface go
into the deep where
those who know
have shared their
hard won insights
while still aglow
with the excitement
of the moment rare
that gives its discovery
to all to share.

Cyril Connolly wrote, "Approaching forty, I had a singular dream in which I almost grasped the meaning and understood the nature of what it is that wastes in wasted time."

I guess what I'm trying to convey is that watching a TV screen is the antithesis of what I try to convey to a Syn-Aud-Con student attending a class. Making the video tape is a legitimate creative act--watching it is, for the majority, a mesmeric waste of valuable mental resource.

The signals that emanate from me to the student have a "bandwidth," if you will, far too wide for video. It would be dangerous to put forth a shadow graph of Don Davis on a video tape minus the love he feels and reflects for his students, the spontaneous response to challenge, and the inherent humbleness that requires an appreciation of my depth of research before it can be realized that the more you know, the better equipped you are to understand the vastness of what you don't know. I'd dislike having a prospective graduate think the shadow gram was the substance and "turn off."

The second item is an excerpt from U.S. NEWS & WORLD REPORT (AUG. 2, 1982) *What Is TV Doing To America?* The article confirms our instinctual reaction.

(Continued on next page)

HOW THE BRAIN REACTS TO TV

Until recently, there was little research on how the human brain absorbs information from TV. Many scholars long have been convinced that viewers retain less from television than from reading, but evidence was scarce.

Now a research project by Jacob Jacoby, a Purdue University psychologist, has found that more than 90 percent of 2,700 people tested misunderstood even such simple fare as commercials or the detective series "Barnaby Jones." Only minutes after watching, the typical viewer missed 23 to 36 percent of the questions about what he or she had seen.

One explanation is that TV's compelling pictures stimulate primarily the right half of the brain, which specializes in emotional responses, rather than the left hemisphere, where thinking and analysis are performed. By connecting viewers to instruments that measure brain waves, researcher Herbert Krugman found periods of right-brain activity outnumbering left-brain activity by a ratio of 2 to 1.

Another difficulty is the rapid linear movement of TV images, which gives viewers little chance to pause and reflect on what they have seen. Scientists say this torrent of images also has a numbing effect, as measured electronically by the high proportion of alpha brain waves, normally associated with daydreaming or falling asleep.

The result is shortened attention spans--a phenomenon increasingly lamented by teachers trying to hold the interest of students accustomed to TV. To measure attention spans, psychophysiologist Thomas Mulholland of the Edith Nourse Rogers Memorial Veterans Hospital in Bedford, Mass., attached 40 young viewers to an instrument that shut off the TV set whenever the children's brains produced mainly alpha waves. Although the children were told to concentrate, only a few could keep the set on for more than 30 seconds.

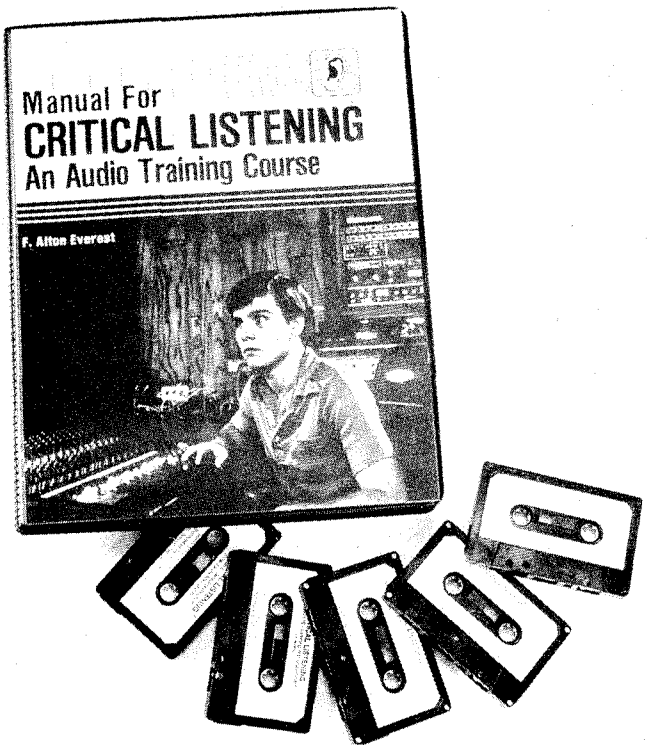
U. S. NEWS & WORLD REPORT, Aug. 2, 1982

CRITICAL LISTENING

As we drove across country in the motorhome on the way to the Chicago class, Carolyn listened to F. Alton Everest's "Critical Listening Course" on a small cassette player with headphones. I would hear her exclaim, "Oh, how clever" or "We must include that demonstration in the class" and similar enthusiastic outbursts.

After extended listening, we both believe that a major use of this remarkable product will be the ability to demonstrate to a church or auditorium committee the exact effect on intelligibility of a poor S/N or exactly what 2% THD really means on their music system. Don't be misled by the thought that this manual and cassette set is "for the beginner." It's our opinion that the more professional you already are, the more uses you'll find for it *every day*.

For more details on "Critical Listening" see Newsletter Volume 9, No. 4, page 30.



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REFLECTIONS ON LIFE IN THE HILLS OF INDIANA

It is early September in the middle of the Norman Uplands in the hill country of Southern Indiana. Here we sit back on the edge of a bluff rising out of a shale bottomed stream running through a hardwood forest that was once the hunting ground of a tribe of Indians. Buried close by in an obscure, private burial ground, is a sergeant from the Revolutionary War, who came west after the battles were won and wrested a farm from the all enveloping woods. Tall, ancient, red, black and white oaks, walnuts, beech, poplar, hickory, sycamore, cherry, and maples tower over us deep in this forest, not too dissimilar from the forests Daniel Boone's mocassined feet silently trod and where he was held captive by the Indians of his time somewhere in what was to become southern Indiana.

Winding back over a 1/4 mile lane, past a 100 year old house rich with family memories of triumphs and tragedies, comings and goings, friends and foes, around the ancient barns with their hand hewn beams and weathered boards, out over a new pasture so green it hurts the eyes, and cut back into the woods itself, lies our haven on the bluff top.

Virgin timber no longer exists here, but trees over 100 years old do - magnificent trees tall and strong, tight barked and destined to one day come under the craftsman's hands as fine furniture. From these woods and fields sprang armies to preserve the Union, pioneers to settle the remainder of the country - people who can understand the pitiful humor of a federal grant to investigate "self-reliance."

One is conscious that this is the very heartland of America. Neighbors here fought with Patton's army, manned the Pacific Fleet, flew the bombers, fought at the Bulge. The even greater story is their love of the land; their joy in the hunting, fishing, and outdoor life; their solid, unshakeable convictions that fad and fashion bounce off of like the raindrops they ignore when afield on a rainy day.

Ten year olds drive tractors, trucks and motorcycles, hunt deer, and yet tenderly teach a 3 day old fawn to nurse from a nanny goat when it's found abandoned by its mother and under attack by dogs. The goats, lambs, cows, horses, rabbits, chickens, puppies, cats, and always the children; Berry picking, lush gardens, sharing of the bounty from neighbor-to-neighbor are all part of the rich farm heritage, as is the glance that knows a buck deer track from a doe track, an eye that sees a ground hog raise its head 3" out of his hole 300 yards away, ears that know each bird's call. It is a land of gravy and biscuits for breakfast, noodles and beef, chicken dishes of every sort and a loving care in the cooking that recognizes no temporal limitations.

Bambi at 2 weeks old with the farm children. Bambi is now 3 months old, on grass & grain, hides out in the deep grass everyday and returns occasionally to be with the goats and greet the family.

The roar of the diesel tractor, unbelievably complicated equipment, incredibly competent men who can repair anything with baling wire and scavenged parts. Skilled mechanics with massive tool sets and regular update classes would be hard pressed to handle the kind of creative, innovative "poor people have poor ways" solutions to seemingly overwhelming problems.

Tornados can come with devastating suddenness; lightning is an art form here, with intricate patterns that lace the sky with its mysterious patterns.

Now, you may not be from such a background. You may be devoid of such memories or haunting ancestral traditions. But, let me assure you that deep in the forest you'll sense the mental environment of all of our ancestors who laboriously constructed what we call civilization out of the wildness of a native environment, that rose from the hunt and berry picking to the cultivated patch to the village industry and, finally, to the great cities we work in today. It's just that we find it useful to recognize that here in this heartland individual survival is a reality, even if the outside world literally vanished, and that individually it possesses the power to refresh our minds and souls in a fundamental way. The large family farm is said to be passing from the scene and, indeed, the evidence is strong that only corporate farms make a profit. It occurs to us that such farms do not renew us and that true environmentalists perhaps should begin to recognize that while they "bleed" over their wildernesses and parks with their endangered species, they could well improve their efforts in insisting on the preservation of a multitude of small family farms capable of generating once again the talented people who first made the cities work.

dc PHASE?

Leave it to ED LONG to coin a new term. In this case he identifies polarity as "dc phase." Dc obviously has no frequency dependence, but is 180° of phase change at dc. Ac phase is frequency dependent. Congratulations, Ed, we like your definition, even though it's not in the IEEE Dictionary.

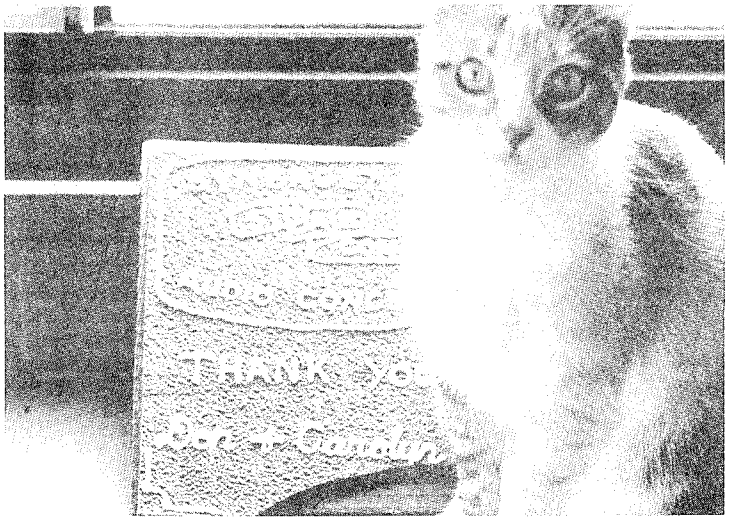
THE FAMILY

Many graduates, when they call in to talk to us, ask about "the family." In addition to Don and Carolyn, "the family" consists of:

1. *JUDY*, our 12 year old German shepherd

2. *RED REED TRUCKLE* (the red horse on the left)

3. *MY LADDIE CROOK* (the palomino on the right)



4. *PUNCH*, the calico cat (shown here saying, "I didn't do it," when a large piece of of the special chocolate *Thank You* card from JOHN PROHS was found missing)

On occasion, we feel like W. C. Fields when he was asked how he liked children and he answered, *"Parboiled."*

These "children" are cherished members of our family and a continuous delight to experience. Syn-Aud-Con graduates comprise a "mental" family and their accomplishments are equally delightful to us.

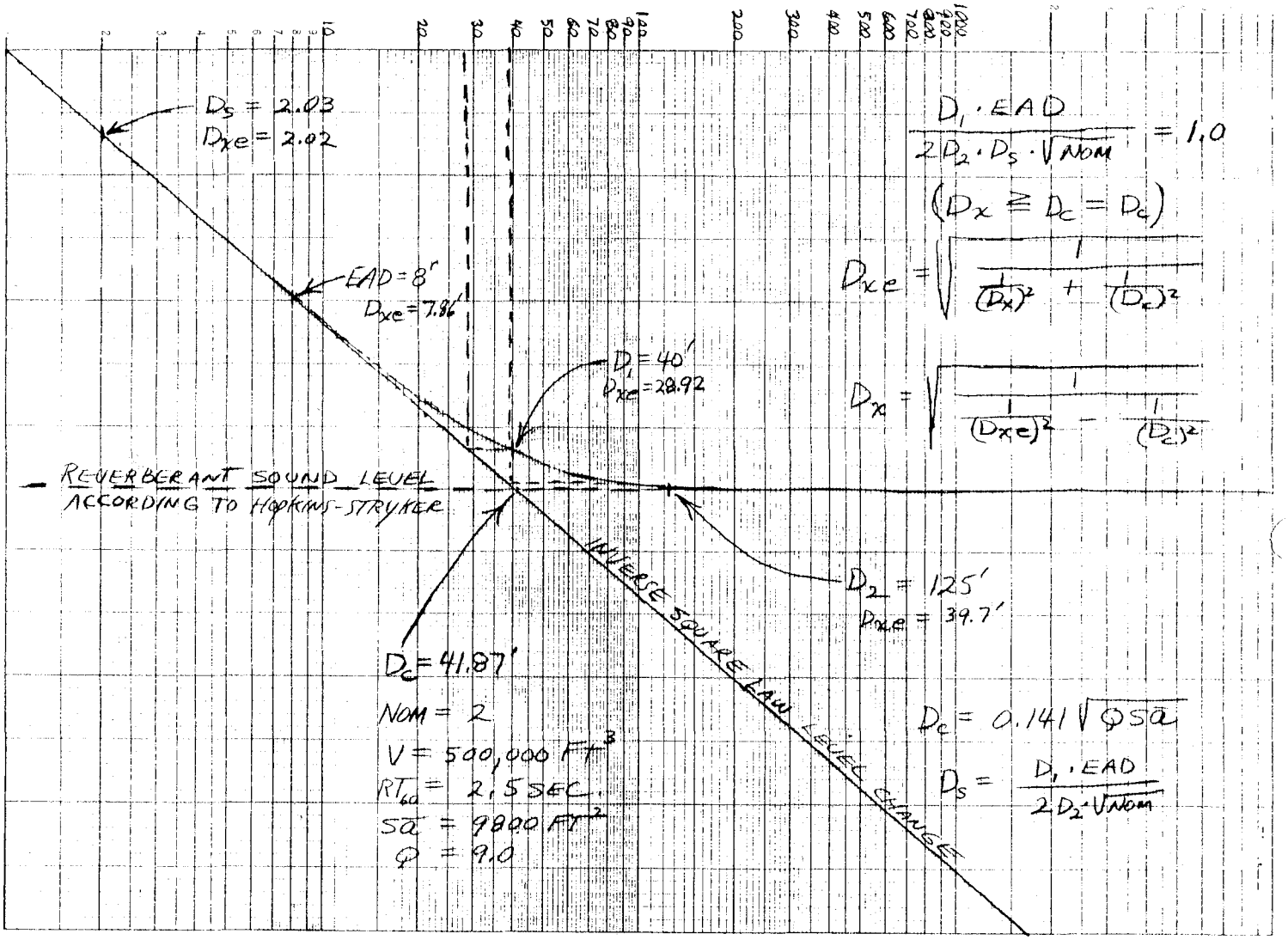
ACOUSTIC GAIN EQUATION - SHORT FORM

The general case expression of the acoustic gain equation in its "short form" is:

$$\frac{D_1 \cdot EAD}{2D_2 \cdot D_S \cdot \sqrt{NOM}} = 1.0$$

Where: D_1, EAD, D_2 and D_S are in feet or meters NOM is the "number of open microphones"

When this equation is used and any distance, D_X, happens to fall in the region surrounding critical distance D_C, then error ratios as high as 1.41 may arise. ED LETHERT of Michaud, Cooley, Hallberg, Erickson & Assoc., INC. of Minneapolis, MN., has provided an exact, and may we add elegant, solution to this problem. He converts the given D_X into a D_{Xe} which is the equivalent distance on the inverse square law scale that matches *the level* at the actual D_X (see illustration below.)



EXAMPLE CASE

In our classic example of a church with:

V	= 500,000 ft^3	Q	= 9.0	D_1	= 40 ft, D_{Xe} = 28.92 ft
RT_{60}	= 2.5 sees	D_C	= 41.87 ft	D_2	= 125 ft, D_{Xe} = 39.7 ft
$S\bar{a}$	= 9800 ft^2	NOM	= 2	EAD	= 8 ft, D_{Xe} = 7.86 ft

Where we would like to know the maximum allowable D_S we use: $D_S = \frac{D_1 \cdot EAD}{2D_2 \cdot \sqrt{NOM}}$ $D_X > D_C = D_C$

which if solved as given yields $D_S = \frac{40\ (8)}{2(41.87)\sqrt{2}} = 2.7$ ft

Continued next page.....

Resolving The Difference

But, if you run the same dimensions through the Hopkins-Stryker equation, thereby converting them into ΔD_Xs, do the gain equation - long form, and re-convert into feet, you obtain a maximum D_S of 2.03 feet.

A study of the illustration shows what the difficulty is. Because the short form is based upon outdoor conditions (i.e. inverse square law level changes) and indoor conditions vary not only beyond D_C but also around D_C, it is necessary to translate levels influenced by the summation of two sound fields, the direct and the reverberant, into inverse square law levels for the rationing of values and then back into distances not directly related to inverse square law level changes.

The equation: $$D_{Xe} = \sqrt{\frac{1}{\frac{1}{(D_X)^2} + \frac{1}{(D_C)^2}}}$$ and $$D_{se} = \frac{(28.92)(7.86)}{2(39.7)\sqrt{2}} = 2.02$$

converts any D_X equal to or less than D_C into its inverse square law equivalent level distance. Conversely,

$$D_X = \sqrt{\frac{1}{\frac{1}{(D_{Xe})^2} - \frac{1}{(D_C)^2}}}$$

reconverts the D_{Xe} for the gain formula final answer back into a D_X distance to be expected in the presence of a D_C.

$$D_S = \sqrt{\frac{1}{\frac{1}{(2.02)^2} - \frac{1}{(41.87)^2}}} = 2.03'$$

Ed Lethert comments: *You may wonder, why go to all this trouble? Well, if you look at the programs that use Hopkins-Stryker to obtain ΔD_X and the inverse Hopkins-Stryker to get back to a D_X you'll find it uses 47 steps of program memory (H.P. 65 days). The following 14 steps do the same job to the same accuracy:*

LBL6	*f?2*
SF 2	*CHS*
LBL1	+
x^2	
1/X	*1/X*
RCLD$_e$	$\sqrt{x}$
x^2	*RTN*
1X	

This subroutine converts D_x to D_{xe} via label 1 and D_{xe} via label 6.

This solidly founded variation of our "short form" originally appeared in Newsletter, Volume 6, Number 2, p. 22. Recent review of this data caused us to again appreciate the fundamental usefulness of Ed's approach.

SYN-AUD-CON MANAGEMENT MEMO

"Sandbaggers": A term used by Syn-Aud-Con personnel to describe a specific type of corporate behavior detrimental to the corporation's long term welfare.

A "sandbagger" is one who manifests these detrimental symptoms. "Sandbagging" is the smashing of a new idea or concept, as a sandbag buries a small animal when dropped on it from a significant height or a felon strikes a victim from behind with a heavy bag of sand to cause a concussion with no outward mark of violence on the victim's body.

Sandbaggers often hide in psuedo-intellectual disguise and witnesses often identify them as gentle, urbane, semi-scholarly, politically successful and with claims to leadership in their field. The first clue to being in the presence of a "sandbagger" is his or her total lack of personal creative output, especially successful new products. A second clue, which requires careful investigation to obtain, is a list of potentially successful products they have effectively stopped, often without exerting direct opposition, but, rather, through the use of skillful innuendo, carefully dropped negative remarks, and keeping key personnel's attention away from the new and untried by focusing on necessary trivia that someone else should have been assigned to.

We have all encountered the sandbagger. They never intrude with "smart ass" new ideas, never are persistent or annoying. Unfortunately, victims are blinded by the "mating dance" of the sandbagger and, only afterward, awake to the fatal sting.

EMILAR TECHNICAL NOTES

You can enjoy playing with Thiele-Small parameters much like you can enjoy "moon lander" on your HP-41C but, if you need a practical enclosure now, the table Emilar prepared supplies the necessary data. Remember, T-S also requires that you test and adjust the actual device. Emilar is providing useful Tech Notes. If you are not receiving them, write George Meals at Emilar.

EMILAR
Sound Energy!

TECHNICAL NOTES #1

RECOMMENDED DIRECT RADIATOR ENCLOSURES FOR EL10, EL12 & EL15 LOUDSPEAKERS

Add volume for additional components such as high frequency drivers, horn, etc.

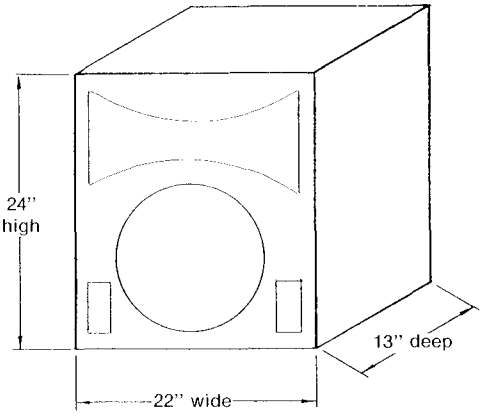
SINGLE DRIVER

	Enclosure Volume	Port/Duct Dimensions
EL10	1.5 Ft^3	Duct 3 in. ID x 2.5 in. long
	2.0 Ft^3	Duct 4.75 ID x 5.5 in. long
	2.5 Ft^3	Duct 4.75 ID x 3.5 in. long
	3.0 Ft^3	Port 13 $in.^2$
	4.0 Ft^3	Port 18 $in.^2$
	Enclosure tuned to 50 Hz.	
EL12	2.0 Ft^3	Duct 4.75 ID x 4.75 in. long
	2.5 Ft^3	Port 11 $in.^2$
	3.0 Ft^3	Port 15 $in.^2$
	4.0 Ft^3	Port 25 $in.^2$
	5.0 Ft^3	Port 37 $in.^2$
	Enclosure tuned to 55 Hz.	
EL15	3.0 Ft^3	Duct 3 in. ID x 3.5 in. long
	4.0 Ft^3	Duct 4.75 in. ID x 9.25 in. long
	5.0 Ft^3	Duct 4.75 in. ID x 6.5 in. long
	6.0 Ft^3	Duct 4.75 in. ID x 4.75 in. long
	8.0 Ft^3	Port 11 $in.^2$
	Enclosure tuned to 30 Hz.	

MULTIPLE DRIVER

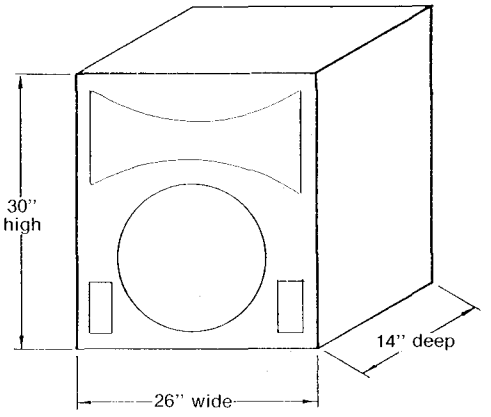
	Enclosure Volume	Port/Duct Dimensions
E L 1 0	**Two 16 ohm drivers in parallel; 8 ohm system**	
	2.0 Ft^3	Duct 4.75 ID x 4.5 in. long
	2.5 Ft^3	Duct 4.75 ID x 2.5 in. long
	3.0 Ft^3	Duct 4.75 ID x 1.5 in. long
	4.0 Ft^3	Port 20 $in.^2$
	Four 16 ohm drivers in parallel; 4 ohm system Four 8 ohm series 8 ohm system	
	4.0 Ft^3	Port 24 $in.^2$
	5.0 Ft^3	Port 35 $in.^2$
	6.0 Ft^3	Port 50 $in.^2$
	8.0 Ft^3	Port 75 $in.^2$
	Enclosure tuned for 50 Hz.	
EL12	**Two 16 ohm drivers in parallel; 8 ohm system**	
	2.0 Ft^3	Closed box
	2.5 Ft^3	Duct 4.75 ID x 1.5 in. long
	3.0 Ft^3	Port 20 $in.^2$
	4.0 Ft^3	Port 35 $in.^2$
	5.0 Ft^3	Port 50 $in.^2$
	Four 16 ohm drivers in parallel; 4 ohm system Four 8 ohm series-parallel connection; 8 ohm system	
	4.0 Ft^3	Port 32 $in.^2$
	5.0 Ft^3	Port 45 $in.^2$
	6.0 Ft^3	Port 72 $in.^2$
	8.0 Ft^3	Closed box
	Enclosure tuned for 55 Hz.	
EL15	**Two 16 ohm drivers in parallel; 8 ohm system**	
	4.0 Ft^3	Duct 3 in. ID x 1.5 in. long
	5.0 Ft^3	Duct 4.75 in.ID x 3.5 in. long
	6.0 Ft^3	Duct 4.75 in.ID x 2.5 in. long
	8.0 Ft^3	Port 20 $in.^2$

ENCLOSURE DESIGN DATA FOR EL 10 OR EL 12, EH 800, & EC 175



MATERIAL: ¾ PLYWOOD OR PARTICAL BOARD
VOLUME: 3.07 FT^3 (INSIDE)
PORT: 2 — 2" x 5" (20 in^2 TOTAL)
BOX TUNED TO: 55 Hz
SINGLE PORT AREA: 15 in^2

ENCLOSURE DESIGN DATA FOR EL 15, EH 800, & EC 175



MATERIAL: ¾ PLYWOOD OR PARTICAL BOARD
VOLUME: 5.05 FT^3 (INSIDE)
PORT: 2 — 2" x 5" (20 in^2 TOTAL)
BOX TUNED TO: 40 Hz

EMILAR CORPORATION
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(714) 632-8500; (800) 854-7181; TWX 910-591-1191

Dc, THE HAAS EFFECT AND S/N RATIOS

Critical distance (D_C), the Haas effect (H.E.) and the signal-to-noise ratio (S/N) are interrelated in a fascinating way when studied in a monumental building such as Notre Dame Cathedral in Paris or one of our contemporary "super dome" style structures.

D_C equations quickly reveal that the internal volume of a space has a dramatic effect on the length of D_C. Using the European equation that makes V apparent as a separate parameter, we find:

$$D_C \doteq 0.3121^* \sqrt{\frac{QV}{RT_{60}}} \qquad *\text{Metric (S.I.) is } 0.057$$

In this form of the equation, it can be seen that D_C is directly proportional to the $\sqrt{V}$.

A very interesting aspect of the classic monumental cathedrals is the immense volume attained by soaring ceiling heights (hence greatly increased D_C) while not increasing the audience area by nearly the same proportions.

In terms of speech intelligibility, reverberation (which by definition is beyond D_C) must, in these cathedrals, arrive at a time interval, relative to the direct sound driving it, well after the Haas fusion zone. Thus, the primary effect it can have on speech intelligibility would be in terms of its S/N and not its "smearing" of the articulation rate.

In a smaller more conventional space, where D_C is on the order of 20 to 30 feet, the reverberant sound energy is detected by the brain along with the direct sound, because it falls within the Haas fusion zone. In such smaller spaces, the apparent S/N of the direct to the reverberant may be very favorable, but the interference with speech may be appreciable.

We are tending toward the hypothesis that the TEF® analyzer will reveal that the following sound fields must be carefully examined:

1. The direct sound field. We have already proven the relevance of looking separately at this signal through the use of our current energy frequency curve, EFC, measurements.

2. The initial time delay gap. Beranek will be long remembered for his emphasis of this key parameter. The relationship between ITD converted to distance and the D_C will be, we believe, found to be a key parameter in concert halls $\left(\frac{ITD}{D_C}\right)$.

3. The early reflected sound field. The amplitude and spacing in time of the first half dozen reflections decide, again in our opinion, the tonal quality of a hall (particularly "string" sound). The temporal spacing and relative amplitudes, especially between the first to third reflections, determine the "smoothness" or "roughness" to string instruments whenever their spacings approach 1 foot (i.e. 1 msec) time differences at near equal amplitudes.

   Early work in this temporal area is R. Kurer's "Schwerpunkzeit"
   (f) - center of gravity of energy on the time axis

   R. Thiele's concept of "Deutlichkeit" -
   (D) - The ratio between early incoming energy 0-50 msec and the total energy; and

   M.R. Schroeder and A.M. Marshall's "Directional Factor" or "Spatial impression."

   It remains to be shown fully the role of direction of arrival on the perception of the ITD.

4. The reverberant sound field. The energy that falls outside of the Haas fusion zone. This may occur as early as 30 msec after the first reflection or can in some cases not occur until nearly 100 msec after the first reflection. The reverberant sound field is often divided into temporal intervals of: 50 - 100 msec 100 - 200 msec 200 - 500 msec

A Worthy TEF® Reseach Project

It is our belief that the future holds a variable acoustic concert hall capable of duplicating the "acoustic period" that matches the "historic period" of the music to be performed in it. To do this with intelligence and integrity requires that we obtain detailed temporal measurements of the great halls from each period so that we can study the actual patterns we wish to recreate in our variable acoustic environment. The initial effort should only attempt to obtain the broad overview that will allow relevant future planning for a more detailed attack on the problem.

SMILE

HARVEY EARP, President of J. W. Davis and Company and from the investment world, gave us the definition of a stockbroker: Often wrong, but never in doubt.

And: A man convinced against his will is of the same opinion still.

FURTHER COMMENTS ON SHURE M267

From STEVE PAOLUCCI of RAM Electra-Acoustics in Clifton Park, New York:

I'd like to make some additional suggestions regarding the content of the article by Mike Pettersen of SHURE Brothers in Volume 9, No. 2, Newsletter, page 25.

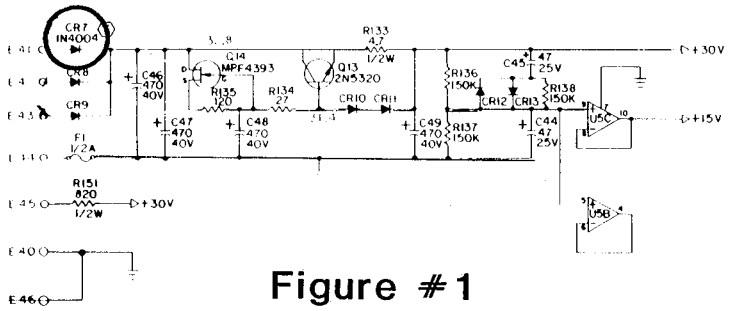


Figure #1

equalizers by connecting it to the battery input terminals marked (+) and (-) on the back of the units. A minor modification to the DC battery input circuit is required to supply voltage for the CRYDOM. See Figure #1. By jumping out or reversing diode CR7, the ALTEC 1650 equalizer will supply a 20-30 VDC output which is adequate to power the CRYDOM. The fact that ALTEC provides terminal for their battery input makes for a clean installation. This modification can be performed on almost every unit that ALTEC manufactures.

If the mixer and/or other equipment is used remote from the amplification rack, a circuit similar to Figure #2 can be used to turn on the system for either the amplification rack or the remote mixer.

Another nice feature of the CRYDOM is that it can be easily mounted in a standard electrical box (Steel City 4" X 4" type). It can be installed permanently by using the 10/24" tapped screw hole provided for the electrical grounding strap. This cuts down installation time as no special box need be fabricated as would be needed with the mechanical type relay. In this manner, any electrician can install the CRYDOM while wiring power for the equipment rack.

For additional information, CRYDOM has application notes and spec. sheets available. Write to International Rectifier, 1521 Grand Avenue, El Segundo, California.

For about a year or so, I have been using the CRYDOM solid state relays to do much the same work as the mechanical type recommended in the article. Because of the broad input voltage parameter, 3 - 32 VDC, of the CRYDOM, you only need stock one model. Generally, I use the DC 40 amp unit, Model D1240, and have had no failures in over a dozen applications.

The CRYDOM performs well with the SHURE units M267, M67, M68, M63, M610 and M64 directly connected to the 30 VDC output. I've also used it with ALTEC mixers and

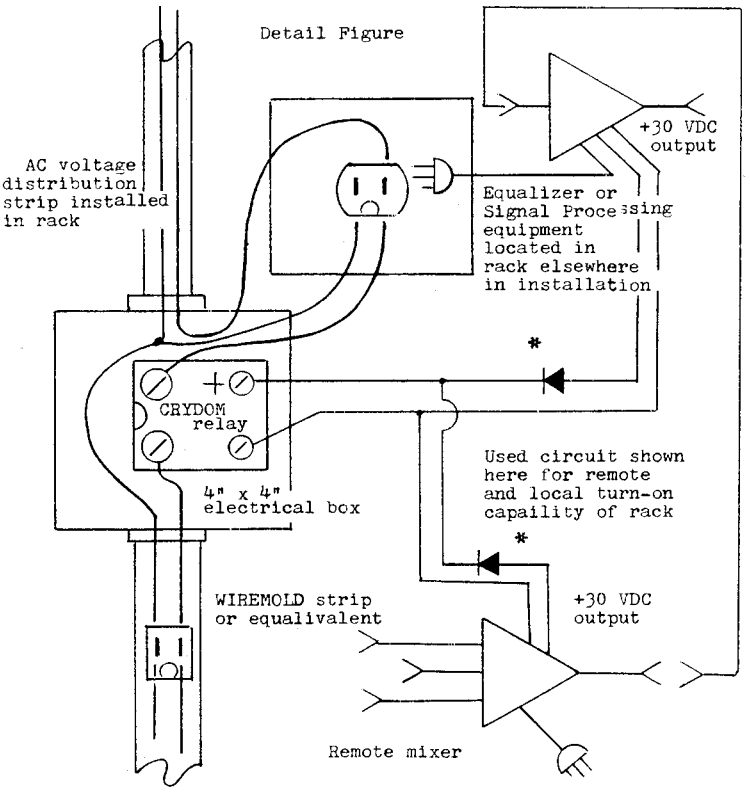
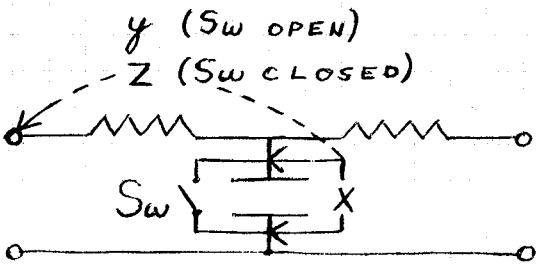


Figure #2 * Diodes are 1N4004 or equal.

FINDING THE VALUE OF A COMPONENT WIRED INTO CIRCUIT

$$\text{True } Z_O F_\chi = \frac{\chi Z}{Y - \sqrt{\chi y - \chi Z}}$$

1. Measure apparent Z across component in circuit (χ)
2. Measure apparent Z with one probe at any other circuit node (Y)
3. Finally, measure (y) again with χ shorted



A NEW S. I. PARAMETER?? - The Clo.

Brüel & Kjaer have introduced the "clo" and the "met." The accompanying pictures tell but part of the story. Your editor is busily engaged in studying the area below 0.2 clo. Every measurement system needs a zero reference. For instance .001 clo may provide a cooler viewee, but an increase in temperature of the viewer (Davis Law).

The Brüel and Kjaer thermal comfort meter shown in the illustration allows some fascinating real experiments as well. Is comfort perceived in the left or right cerebral hemisphere? Is a person who tests outside of the norm indicative of a psychological problem? The B & K literature states "Thermal comfort *is the state of mind (italics mine)* in which satisfaction is expressed with the thermal environment. - - Six parameters are involved - - air temperature, mean radiant temperature, air velocity, water vapour pressure, the person's metabolic rate, and the thermal insulation of his clothing."

If I were a HVAC firm, I believe I'd be out surveying both my own and my competition's systems. How much does a noisy ventilation system reduce "air velocity" requirements? For example, experimental theatres could also benefit from this instrument in the deliberate creation of coolness (along with blue lighting) for those "chilling scenes." What kind of sound would you choose to go along with the above?

It's always fun to encounter a new and better way to reach an understanding of human responses to his or her environment.

For more information, write B & K, Inc., 185 Forest St., Marlborough, MA 01752 (617) 481-7000.

BACKGROUND MUSIC DEFINED

Relentlessly running music faucets and *A non-stop flow of faceless sound.* (Paul Hindemith)

INTERACTION OF ACOUSTIC PARAMETERS

In the equation:

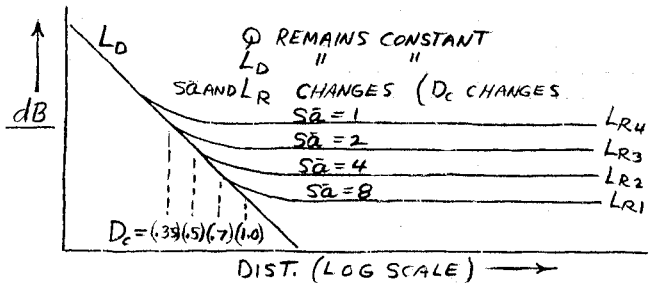
$$L_p = L_W + 10 \text{ Log}\left(\frac{Q}{4\pi(D_X)^2} + \frac{4}{S\bar{a}}\right) + 10.5^* \text{ dB}$$

*Where: D_X and Sa are in English dimensions of ft and ft^2

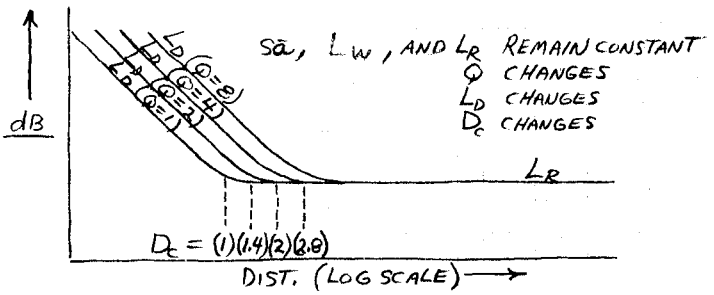
L_W = sound power level

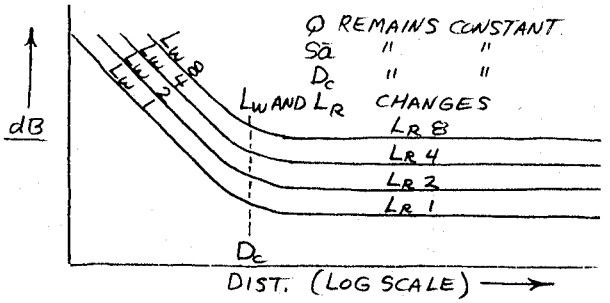
L_p = total level at any given point

The following plots illustrate the effect on the direct sound field (L_D) as L_W and Q are varied and the effect on the reverberant sound field, L_R, as L_W and $S\bar{a}$ are varied.



EFFECTS OF L_W AND $S\bar{a}$ ON THE LEVEL OF THE REVERBERANT SOUND FIELD AND OF L_W AND Q ON THE LEVEL OF THE DIRECT SOUND FIELD





Critical distance varies as either Q or $S\bar{a}$ varies and the N factor is simply another way of accounting for an increase in L_W such as N (L_W). The M_a factor accounts for the effectiveness of absorption prior to any reflections such as M_a ($S\bar{a}$).

The M_e factor is a divisor of D_X such that $\left(\frac{Me}{(D_X)^2}\right)$

L_D is changed whenever L_W, Q or D_X is changed

L_R is changed whenever L_W, $S\bar{a}$ or M_a is changed

A careful study of these basic relationships allows you to select logically among the available choices for a given acoustical result.

METRIC (SI) TEMPERATURE CALCULATIONS

One of the interesting inconsistencies of the S.I. system is its use of degrees Celsius (t_C) or °C instead of the S.I. base unit Kelvin, t_K or K. Note that the term degrees is *not* used with Kelvin. The American system uses degrees Fahrenheit t_f or °F. One degree on the Celsius scale is exactly the same as one unit on the Kelvin scale. The difference is in where they place zero. Helpful conversion factors are shown below:

5/9 (°F - 32) = °C (9/5 °C) + 32 = °F °C + 273.15 = K K - 273.15 = °C

NORMAL ROOM TEMPERATURE

°F	°C	K
72°	22.22°	295.37

FREEZING OF WATER

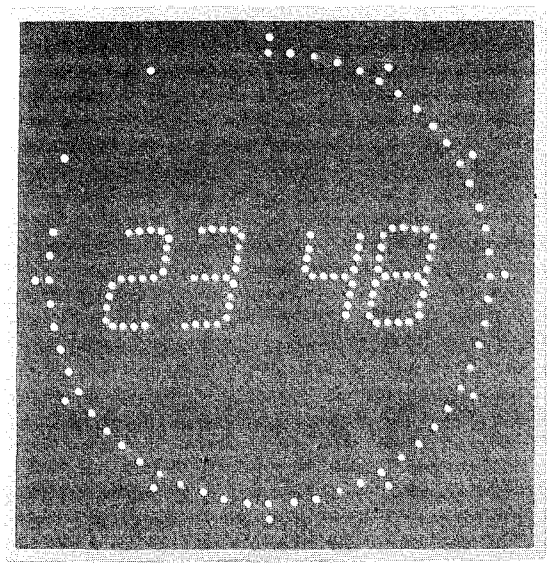
°F	°C	K
32°	0°	273.15

t_f = °F t_C = °C t_k = K

BROADCAST TIME DISTRIBUTION SYSTEM

While we were at the European AES Convention last March, we saw what we felt might be an ideal broadcast time distribution system made by the famous firm of Patek Philippe. We have reproduced an illustration of one of the "slave" displays plus their letter regarding the virtues of their system.

The outer circle of lights indicates the seconds and goes blank and relights sequentially every minute. We found it an easy indicator to synchronize actions to and far easier to work with than a "traveling hand" indicator. We believe such a clock system would be a deluxe touch in any broadcast, sports or scientific system requiring both audio and visual timing signals.



Time distribution in TV or Broadcasting studios is very important, since many people consider the time given by these studios as the official time. Today most of the TV or broadcasting systems throughout the world are equipped with our time centrals. Moreover the clocks located in the studios must be absolutely silent and easily readable, that is why we designed the ZL60 electronic slave clock. The ZL60 combines digital and analog information. Hours and Minutes are displayed by 60 mm high figures and the cumulation of the seconds through 60 diodes around a 286 mm diameter circle. The ZL60 slave clocks are fully electronic, absolutely silent and driven by a serial Irig-B code coming from a time code generator (master clock). The ZL60 show immediately the code sent and do not need any individual setting up.

We will draw your attention to the fact that Radio France in Paris, the Radio Suisse Romande in Geneva and the University of Riyadh are equipped, as are several other users, with our electronic slave clock type ZL60.

Our product range also comprises professional equipment embodying the most sophisticated technologies, viz.:

- Qm compact master clocks, with or without programmer, installed in offices or small industrial plants.

- MIC master clocks and modular time centres, which are to be gound in offices, banks, hospitals, schools, railways, subways and airports, as well as in technical and scientific establishments.

- MIC-P microprocessor time and frequency systems, intended mainly for technical and scientific applications where time is correlated with other information handled by EDP.

- Z4, TDA or CDA systems, conceived for security services which have to record and file information transmitted or received by telecommunications. These systems add the time and date inseparably to the messages recorded. Principal users are police, nuclear power stations, hospitals, banks, etc.

The activities of PATEK PHILIPPE are not confined to sales, but also include the study and execution of projects in collaboration with customers.

PATEK PHILIPPE, Electronics Division, 39 Rue Marziano, 1211 Geneva 24, Switzerland.

LARGE ROOM FREQUENCY

Manfred Schroeder has defined a large room frequency (f_ℓ) as the frequency above which a large number of room modes will be excited to vibrate at the source frequency (i.e. below (f_ℓ) standing waves are the problem to handle).

$$f_\ell = 2000^* \left(\frac{RT_{60}}{V}\right)^{1/2}$$

* 2000 SI (metric constant); 11,885 (U.S. constant)

where f_ℓ is the large room frequency in Hz

RT_{60} is the apparent reverberation time for 60dB of decay in secs

V is the volume of the room in M^3 or ft^3

INVESTMENT TAX CREDITS FOR SOFTWARE DEVELOPMENT

We receive the "Fails Management Newsletter." If the 25% investment tax credit should actually be available for software development, this would be an important tax credit. We know that many Syn-Aud-Con graduates are developing original programs, and it is costly, time-consuming work.

> *Thanks to the ERTA 1981, a new 25 percent investment tax credit for research and development is now available to business. While this incentive applies primarily to non-construction organizations, there is one element from which contractors might benefit: Research and development costs also include the cost of computer software that you develop. (Underscoring mine)*
>
> *Costs incurred in developing new or significantly improved programs or routines that cause computers to perform desired tasks are to be eligible for the credit. But costs for modifying standard software or routines where the operational feasibility of the program or routine is not seriously in doubt will not be eligible for the credit.*
>
> *The tax credit is allowed in an amount equal to 25 percent of any excess of research and development expenses over the base period (prior three years) expenses.*
>
> *The 25 percent ITC is available to you when you perform this in-house development. Costs includible are wages and salaries of the programmers, supervisory, and support personnel, supplies used, and amounts paid or incurred for the right to use personal property to conduct the research.*
>
> *If you engage subcontractors to perform the research, then only 65 percent of these payments will be eligible.*
>
> *The IRS will issue interpretive regulations on eligibility for the ITC credit of costs shortly, and we will keep you informed. (Lanny Harer (919)787-8400)*

HISTORY OF ARCHITECTURAL MAPPING

TOM McCARTHY of Northstar Sound in Minneapolis was the first Syn-Aud-Con graduate to expand on Ed Seeley's AES presentation of architectural to acoustical mapping (i.e., going from architectural lineal dimensions to angle and range - in dB - from a chosen source location.

Tom McCarthy (L) talking with Per Forsberg (C) and David Wright (R) during a break in the Minneapolis class.

Tom wrote up an extensive program for the HP 9820 series table-top computer/calculator, estimated from his own "on the lake ice measurements" the coverage plots for the loudspeakers he regularly used, and proceeded to apply his program, plots and coverage overlays to real-life jobs.

Tom dropped into our Minneapolis class this past May to renew acquaintances and bring us up to date on his useage of these valuable techniques.

We have listed the contributors to this technique in past Newsletters and discussed something of the nature of their contributions, which can be summarized as follows:

ORDER OF DEVELOPMENT

Ed Seeley - Gave birth to the concept in terms of audio use. Mr. Seeley gave his paper in the Spring of 1978, which briefly discussed the idea.

TOM MC CARTHY - Gave the first practical field use report on its value. The paper was delivered in the Fall of 1978 at the AES convention.

FARREL BECKER - Designed a variation of immense practical value during the interim period between the idea and accurate specifications for use with it. Gave AES paper in the Spring of 1980.

TED UZZLE - Led the first manufacturer into actually providing specifications and coverage plots specifically for such a process. Gave AES paper in Spring of 1980.

JOHN PROHS - Refused to compromise and designed a complete global system which was then adopted by a leading loudspeaker manufacturer, Community Light and Sound. (1982)

It is our feeling that these five men have, together, provided their industry with an extremely valuable tool, one that had been noticeably lacking and seemingly unsolvable by practical, available-to-everyone techniques. No writing about these new techniques should fail to acknowledge *all* of their contributions.

SMILE

PAT THOMPSON, Thompson Engineering in Riverside, California, has probably attended more Syn-Aud-Con seminars and workshops than anyone, starting with class No. 1 in 1973.

Pat sent us a proposed city noise ordinance with the remark, *It looks like your comments about outlawing kids with noise control laws has started.*

We have excerpted a part of the noise code below:

11.74.035 Maximum Permissible Dwelling Interior Sound Levels.

1. The interior noise standards for multifamily residential dwellings as presented in the following table shall apply, unless otherwise specifically indicated, within all such dwellings with windows in their normal seasonal configuration.

Land Use	Time Interval	Allowable Interior Noise Level (dBA)
Multifamily	10 p.m. to 7 a.m.	35
Residential	7 a.m. to 10 p.m.	45

2. No person shall operate or cause to be operated within a dwelling unit, any source of sound or allow the creation of any noise which causes the noise level when measured inside a neighboring receiving dwelling unit to exceed:

   a. The noise standard as specified in Section 11.74.035-1 for a cumulative period of more than five (5) minutes in any hour; or

   b. The noise standard plus five (5) dB for a cumulative period of more than one (1) minute in any hour; or

   c. The noise standard plus the ten (10) dB or the maximum measured ambient for any period of time.

THE CASE OF THE FLOATING BOOK

by DON GILBEAU, Delta Sound & Radio, Stockton, CA.

I recently had an interesting experience with your book, Sound System Engineering, while on our boat during the fourth of July weekend:

THE CASE OF THE FLOATING BOOK (or Don & Carolyn go up the river). While vacationing on the San Joaquin River near Stockton on our boat, we made an interesting discovery about Don and Carolyn's book, Sound System Engineering. It floats!

I had some catch-up work to do on a specification for a customer, so had made myself comfortable on the stern deck with book in hand. Another boat came by, whose wake upset a bucket on the swim platform. I scurried to save the bucket. Simultaneously, the book caught on the corner of my bathing suit and overboard it went. My wife yelled "there goes your book". In the seconds that seemed like minutes while I pulled off my sunglasses, watch and shirt, I noticed it was floating away in a flat position down the channel in the rapidly moving current. I dived in, fully expecting the plunge to send the book to the deep, dark unknown. The book remained in its flat, floating position until I swam to it, by this time some 25 feet away. The book was rescued and returned to the boat. Strangely enough, after drying off, the cover and pages were dry as a bone. I thought that was quite a credit to the quality of the paper and other binding materials.

You never know, Don & Carolyn, what environments your books will be exposed to, but please continue making "floating books".

A PROPOSED TERMINOLOGY FOR "SMALL" DEAD ROOMS

To repeat ourselves, "small 'dead' rooms do not have a reverberant sound field." This causes confusion among some when they observe a limited series of discrete reflections on the Energy Time Curves (ETC) analyzer. These discrete reflections do not achieve a sufficient "density" due to their small number and wide temporal spacing compared to a true mixing homogeneous reverberant sound field.

I have the following suggestion for terminology to help all of us differentiate between these acoustic effects:

1. Direct sound
2. Discrete early reflected
3. Reverberant early reflected
4. Reverberant

"OFF AXIS" Q AND CRITICAL DISTANCE

Concern is expressed by careful calculators using basic equations such as the Hopkins-Stryker that the use of "on axis" Q is in error when looking at D (the distance from the loudspeaker to the microphone), because the microphone is usually placed well "off axis" from the loudspeaker. For instance, the *relative* Q of the loudspeaker *in the direction toward the microphone* may be ¼ or less that of the "on axis" value.

These people point out that the critical distance, D_C, in that direction is then substantially *shorter*, hence acoustic gain will be affected. This is *not true*. Why? Because *the acoustic level is also ¼ or less* that of the "on axis" area. This means:

1. The direct sound level, L_D, in the "off axis" direction is reduced in level proportionately to the power ratio of the Q difference between the on and off axis values.

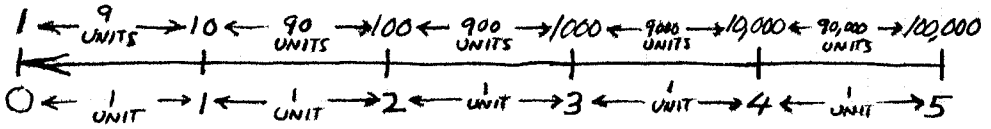
2. That the reverberant sound field, L_R, generated by the total system power is not affected in any way by Q except in a special limiting case.

Thus, while the theoretical D_C is shortened, the acoustic level is lowered in that direction by exactly the same value level as if the "on axis" Q value had prevailed and a longer D_C had in fact been established.

NAPIER'S WAY OF LOOKING AT LOGARITHMS

Napier had expressed his notion of logarithms by comparing the motion of a point whose velocity is constantly decreasing (numbers) with that of another point having a uniform velocity (logarithm).

ARITHMETIC SCALE



LOGARITHMIC SCALE

Notes

1. Zero logarithmically is unity arithmetically.

2. Arithmetic scale value has differing values over equal distances. Logarithmic scale has equal values for equal distances.

ARTICLES OF INTEREST

There is an old saying, "It's better to be stolen from than to have to steal."

Harvey Fletcher (1884-1981) lived to be nearly 100 years of age and when he was ninety we heard him give a vigorous, interesting paper to an AES session in Los Angeles. It was Fletcher's guidance at the Bell Telephone Laboratories that formed and inspired the teams who developed today's high quality sound equipment, especially transducers. Steinberg, Snow, Siven, Dunn, White, Wente, Thuras, Black, Bode, Nyquist - the giants - worked at the labs under Fletcher.

Physics Today (June 1982) has published his description of his "key role" in the famous Millikan "oil-drop experiment" that demonstrated the existence of the electron and the measurement of its principal parameter.

Millikan was to receive the Nobel prize for this work. Fletcher's description of how Millikan arranged to be the sole author of the paper on the experiment (done with apparatus literally invented by Fletcher) is a classic in symbiotic relationships that, like the movie "The Sting," leaves the victim uncertain as to just what really did happen. Fletcher went on to have one of the most fruitful careers in science which leaves one to ponder would his life have been the same had Millikan allowed him to be the co-author of the paper as was his due. I like to think that the humbleness it took to step aside at Millikan's request was the genesis of his later exceptional genius with the young men he in turn inspired and did not rob.

Harvey Fletcher soon after his wedding in September 1908. (Photograph provided by Stephen Fletcher.)

ASA PAPER OF INTEREST

The following paper was contributed at the 103rd Meeting : Acoustical Society of America, Spring, 1982:

ZZ1. Aspirin can potentiate noise-induced temporary threshold shift. Dennis McFadden and H.S. Plattsmier (Departments of Psychology and Speech Communications, University of Texas, Austin, TX 78712)

Temporary threshold shift (TTS) was measured in the same subjects under various schedules and durations of aspirin usage. The exposure stimulus was a 2500-Hz tone of 10-min duration; its intensity was determined for each subject individually in an initial series of sessions conducted without aspirin. TTS was monitored only at 3550 Hz. The highest aspirin dose was 4 grams per day for 2.75 days - a schedule not uncommon among sufferers from arthritis; the lowest dose was 0.49 grams taken 2 h before the exposure. In some condition(s) for all subjects the aspirin itself decreased hearing sensitivity; the typical pattern was of greater loss for the higher frequencies, and no loss below 1000 Hz. *Whenever there was aspirin-induced hearing loss, the loss induced by the exposure added to it, producing a total loss greater than that in the no-drug condition; occasionally the total loss was greater even in the absence of a measureable aspirin-induced loss. The potentiation was often in excess of 10 dB.* (Italics mine). Most recovery curves appeared to be similar in slope for drug and no-drug conditions. *Chronic users of aspirin should be cautioned against excessive exposure to intense sounds.* (Italics mine). (Work supported by NINCDS and Merck, Sharp and Dohme.)

CLASSIFIED

FOR SALE: BOOKS - *HOW TO BUILD A SMALL BUDGET RECORDING STUDIO FROM SCRATCH* by F. Alton Everest. TAB 1166. Price . . . . . $ 10.00

THE MASTER HANDBOOK OF ACOUSTICS by F. Alton Everest. TAB 1296. Price . . . . . $ 15.00

CONCEPTS OF ARCHITECTURAL ACOUSTICS by David Egan. Price . . . . . $ 46.00

The above prices include postage paid if shipped within the continental United States. If you are interested in obtaining any of the above, please contact JOHN LANPHERE, Audio/Video Design Services, P. O. Box 6201, South Bend, IN 46660.

* * * * * * * * * * * * * * *

FOR SALE: Crown CX-822 Tape Recorder . . . . . Make offer

RTA2 Crown Real Time Analyzer with Anvil Flight Case . . . . . Make offer

(Editor's Note: The Crown RTA2 is an excellent companion to HME's new PAL - see page 8)

Contact RICK GARNER, Audio Services, 620 15th St., Moline, IL 61265, Telephones: (309) 797-9891 or 797-6897

* * * * * * * * * * * * * * *

FOR SALE: IVIE 1E30A Analyzer with 1E20B Noise Generator. Original Owner.

Contact PATRICK BALTZELL. Telephone (609) 344-2522.

INDUSTRIAL RESEARCH PRODUCTS, INC.
A Knowles COMPANY

EMILAR CORPORATION

UE QUALITY OF COURSE

SYN-AUD-CON SPONSORS

Syn-Aud-Con receives tangible support from the audio industry, and ten 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 graduate 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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SHURE BROTHERS INCORPORATED

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UREI

Rauland

RAULAND-BORG CORPORATION