SYNERGETIC AUDIO CONCEPTS

newsletter

Volume 12, No. 3

Spring 1985

P.O. Box 669, San Juan Capistrano, CA 92693
Ph: 714-728-0245

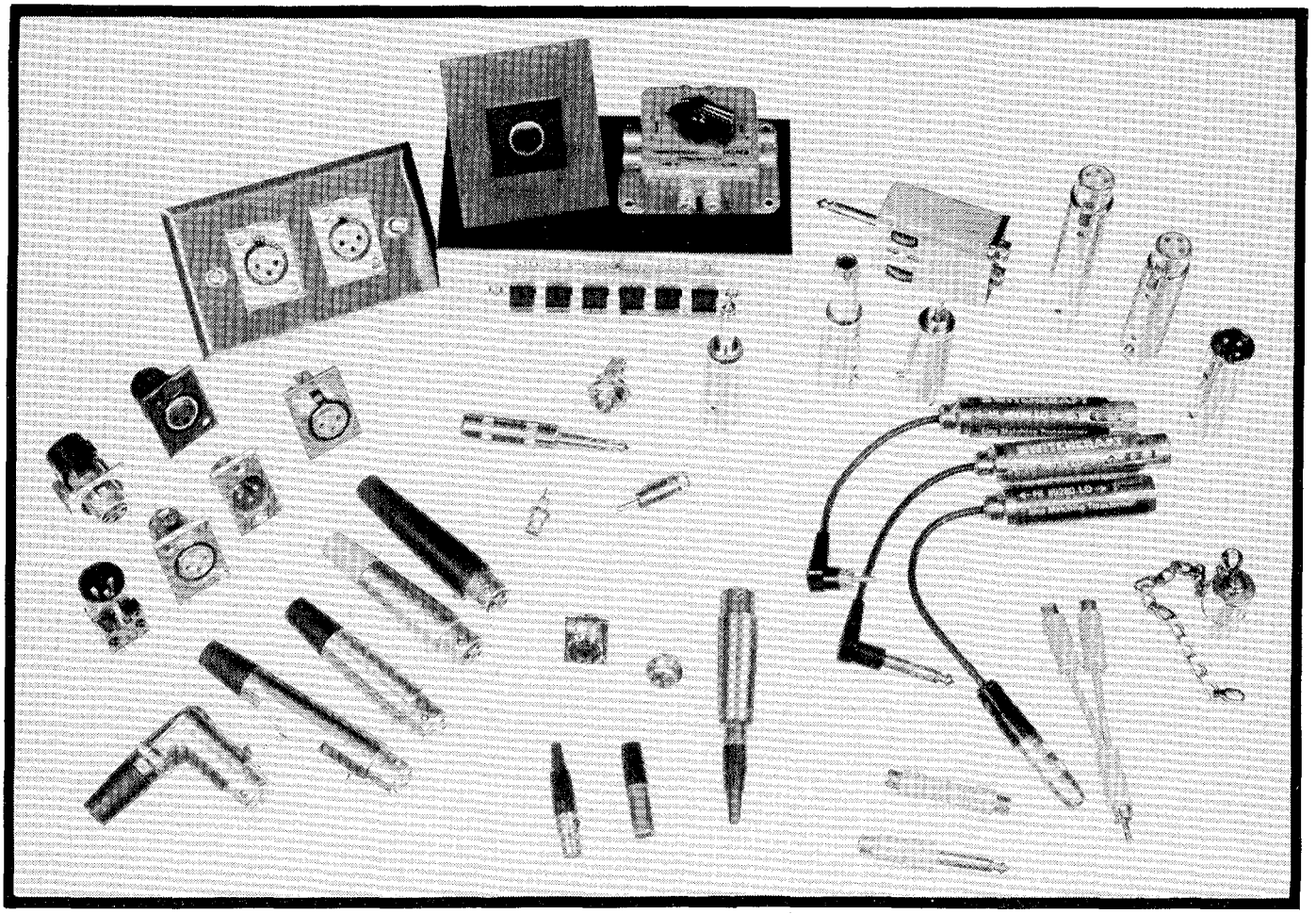
SYNERGETIC
Working together; co-operating, co-operative

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
We exchanged dollars
I still had a dollar

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



SWITCHCRAFT CONNECTS TO SYN-AUD-CON

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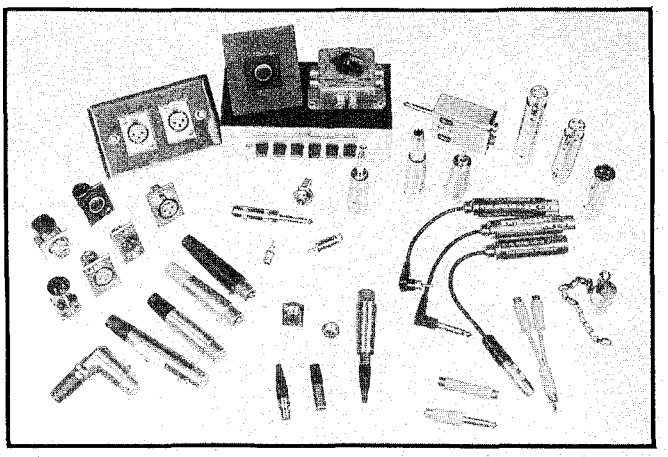
A NEW SYN-AUD-CON SPONSOR

Switchcraft, Inc., a Raytheon company, is a major manufacturer of a broad line of electronic and electro mechanical components (6000) for telecommunications, sound, computer, medical, military, and instrumentation markets. That touches just about every facet of a professional audio man's or woman's life from the cradle to the grave.



Switchcraft has been an established name in audio for over forty years, supplying quality connectors, jacks, plugs, switches, adapters, and audio accessories. Over 60 million Switchcraft components are shipped each year. Many audio companies abandon audio when married to one of the larger electronic firms, but in Switchcraft's case, we have a new crop of men and women focused on audio as important to them and their company.

Syn-Aud-Con is very pleased to have Switchcraft as one of our sponsors and we sincerely believe the new leadership there intends to participate vigorously in the Syn-Aud-Con sharing of better audio ideas.

When a manufacturer asks us what is involved in becoming a Svn-Aud-Con sponsor, the first item we discuss is listening--opening up a channel for input from Syn-Aud-Con and the 6000 plus "grads." We like to think that you will feel free to call the contacts listed in the sponsor brochure for each of our sponsors. Call and say, "I'm Joe Audio. Why do you do it this way?" or, "Why don't you do it this way?" Syn-Aud-Con is very proud of the audio progress that has come from Syn-Aud--Con "grad"/sponsor interaction.

Get acquainted with Randy Opela at Switchcraft. Tell him Don Davis sent you, or write for Switchcraft's Catalog A404K.

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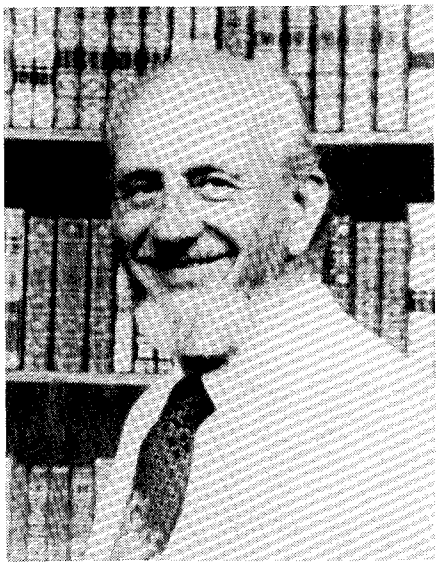
Syn-Aud-Con NEWSLETTERS and TECH TOPICS are published quarterly by Synergetic Audio Concepts, P. O. Box 669 (Rancho Carrillo), San Juan Capistrano, CA 92693.

This is Volume Twelve, Number Three, Spring 1985.

Subscriptions are available for $32.00 per year. Single or back issues are available. Write for price list. Air Mail subscriptions outside the United States are $38.00.

VIC HALL REACHES "RETIREMENT?"



Carolyn and I have known Vic Hall of Communications Company in San Diego for over 20 years. The reason for the question mark after the word "retirement" is our belief that "re-deployment" would be more applicable. Some other very fortunate activity is about to receive a wonderful infusion of high integrity input. Vic is a genuine living historical figure. He represents what we feel is America's promise to its sons.

Raised in the great depression in Kansas, serving his country in World War II, developing a very successful business, happily married to the same woman since 1942, blessed with a fine family, grandchildren, and hundreds of children he worked with in the Boy Scouts, Vic Hall has transmitted much of great worth to the future generations.

Vic Hall started to work early.

Vic Hall, standing in the rain last Christmas, ringing the bell for the Salvation Army (taken with a telephoto lense, unknown to Vic, by his brother, Max).

To properly tell Vic's story would take a fascinating book but one picture, taken of him with a telephoto lense without his knowledge, reveals the real "tip of the iceberg" of a remarkable man. It's of Vic standing in the rain last Christmas, ringing a bell for the Salvation Army collection. My father who had been a Marine in World War I, left me three important prejudices:

1. My country, may she always be right but my country right or wrong.
2. Never give up a free man's right to bear arms.
3. Support the Salvation Army. (They had been the only ones to help him in the hospital.)

To see a totally successful businessman, rich with this world's rewards, standing in rain to help the Salvation Army touches deeply the real strength behind such men. Such a man never retires, he just changes the emphasis on his activities. #

AN ENTREPRENEUR'S ADVICE

"Physics Today" asked.....Edwin Land what advice he would give a physicist just starting a company today. He replied:

"Work only on problems that are manifestly important and seem to be nearly impossible to solve. That way, you will have a natural market for your product and no competition." ♦

TEF® WORKSHOP - HAMBURG

Super Workshop Staff

We use the word "Super" very rarely but when a single workshop is staffed by:

Chips Davis • Don Eger • Dick Heyser • Doug Jones • Hellmuth Kolbe • Ron McKay • Gene Patronis • V.M.A.Peutz

it's a bit unusual.

Each of these men has a special niche in the history of audio, with Dick Heyser and V. M. A. Peutz already acknowledged by various peer group societies as giants in our field of endeavor. To Syn-Aud-Con graduates, with their advance knowledge of what's really going on, the rest of the list is recognized by us as giants in fact, if not in public fancy.

There is not a single question in our mind that these men are the Wente and Thuras, Steinberg and Snow of our day and that the work they are doing will provide solid foundations for the next generation of workers smart enough to study the best of the past first.

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Continued next page.....

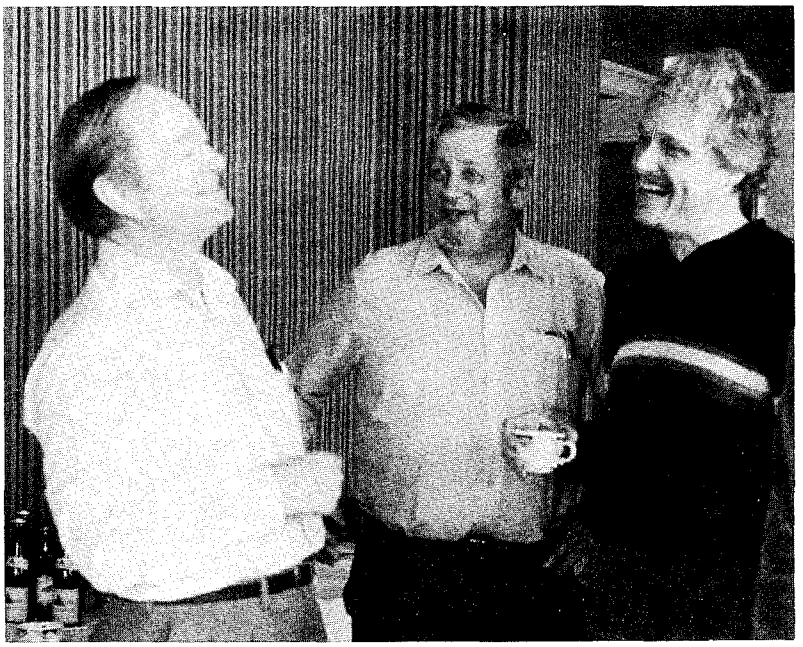
Four outstanding audio manufacturers: BOSE • CROWN • JBL • SHURE

Four of our sponsors helped underwrite our Syn-Aud-Con Super Workshop in Europe in March. They shared with us the belief that European audio and acoustic people are ready to appreciate the advances being made in this country via TEF analysis and in LEDE control rooms and are ready to meaningfully input these new approaches with the best of the classic European analytical thinking that has provided important theoretical foundations in the past and we're sure will again.

These four sponsors represent America's advanced aggressive approach to superior audio products. They also represent the best of our ability to listen, share, and combine with the best all over the globe. We were pleased to have had them as our special associates during this special workshop.

Hellmuth's Dream

Hellmuth Kolbe is one of the few people in the world with both the full B&K TDS equipment and the Tecron TEF 10. He knows both systems intimately. "Hellmuth's Dream," given spontaneously during the Hamburg TEF Workshop, is a "from the heart" assessment of the thrill and frustrations of interfacing with this century's "Fourier-Hilbert" named Dick Heyser. As those of us using the Heyser disks can testify, his mountain is indeed still growing, but at least we're not among the lost. One of life's most exciting and rewarding experiences is hearing Heyser's clear demonstration of his transform as a "hyper surface" (curvature) and the extremely clear proof that the Fourier transform is merely a special degenerate case of a "hyper plane" (no curvature) with very limited properties compared to the general case Heyser transform. Dick made it abundantly clear that even as sophisticated as the TEF analyzer is, it's still only using the most limited access to the new domains available. Dick's discussion in this workshop provided an unusually clear view of his mountain as we all rowed toward it.



Hellmuth Kolbe (C) with Richard Heyser (L) and Jim Brown (R).

HELLMUTH'S DREAM

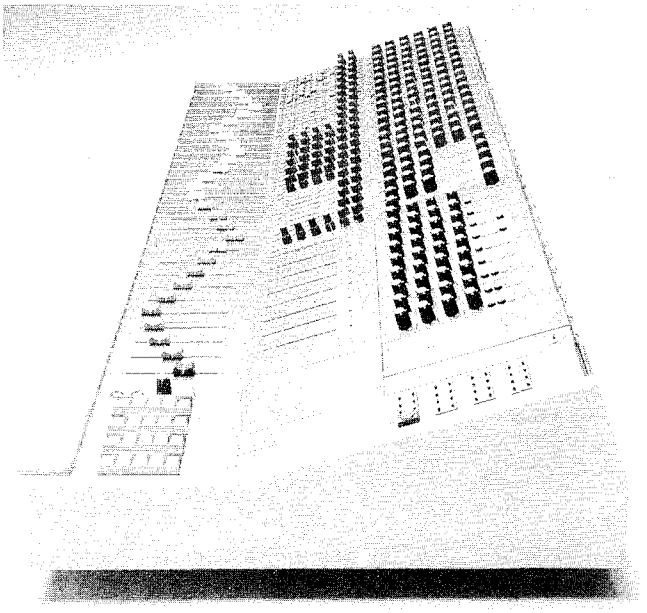
I saw the gang of us, all the people of the big Syn-Aud-Con family,
Rowing in a boat in one direction;
We saw a little rock which was a Fourier rock--Fourier was sitting on it;
And another rock; Hilbert was sitting on it;
And then far, far back a huge rock like the Matterhorn --
And Dick Heyser was sitting over there,
Having the global transform in his hands.
What we're doing still, we're trying to row in his direction,
And to approach him and to come closer and closer.
We pass Fourier and Hilbert, that's not the problem,
But to land on Heyser's rock--that's the problem.
I hope we're able to come closer and closer and closer
Unless he builds up his rock higher and higher.
On the other hand, we had a lot of boats rowing across us,
And that's the people that are lost.

Matti Sarapaltio

Matti Sarapaltio of Helsinki, Finland, has attended several European Syn-Aud-Con gatherings. Matti is truly the strong silent type until he gets to know you. A gifted engineer, he's involved with MS-Audiotron consoles, and the ones we looked at during the Hamburg AES were exceptionally well made with tremendous versatility.

Each input stage of their Simultimix live/multitrack console has an RMS/ppm bargraph meter, stereo mixing as an independent function, and extremely versatile monitoring facilities.

Continued next page.....

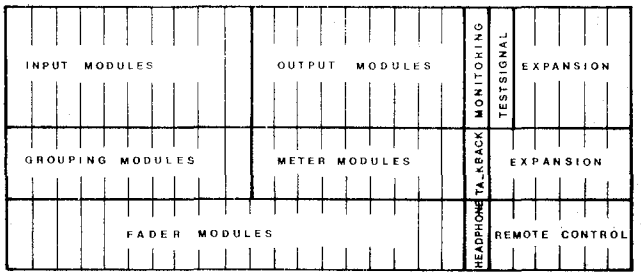


Matti Sarapaltio (R) with Richard Heyser and members of the workshop.

MULTIMIX is the sound mixing console designed for professional applications like theaters, auditoriums, concert - and multipurpose halls - for all purposes where versatility and reliability are required. The MULTIMIX console meets the international studio standards from electronic and the mechanical point of view.

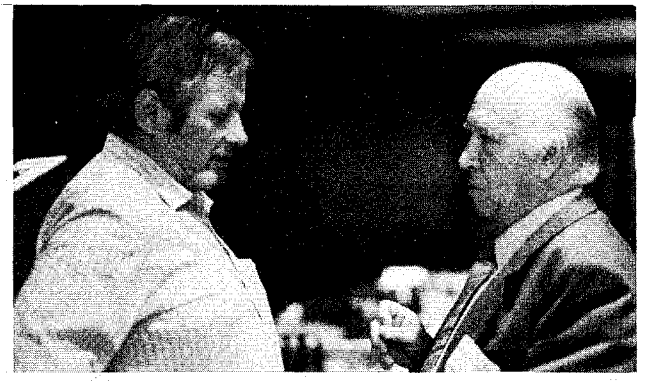
The special point of the modular system: the grouping modules do not depend on input modules and grouping of input signals to outputs is practically up to the user. Grouping modules shall be chosen according to the amount of outputs and the application of the console itself. Selection of faders is also up to purpose. Modular construction allows almost unlimited amount of choices to combine input, grouping, and output modules.

Expansion of console is simple, as well as later modifications.



Mr. Hummel of K & H

One of the distinguished members of the Hamburg TEF Workshop was Mr. Walter Hummel of Klein and Hummel. Mr. Hummel has built an important audio company out of the post war years in Germany and now markets a full line of loudspeakers and electronics. We found Mr. Hummel to be a true gentleman of the old European school and a gifted administrator of a complex technical enterprise. Running successful businesses makes men in all countries very much alike, and the talents we witnessed in talking with Mr. Hummel would have made him successful anywhere in the world. His alertness in checking out TEF measurements speaks for itself. He's shown here with Hellmuth Kolbe of Zurich (on the left). Both men personify what we enjoy about Europe. #




PRAN, INC. - NOV. 20-21, 1984
MARYLAND SOUND - OCT. 24-25, 1984

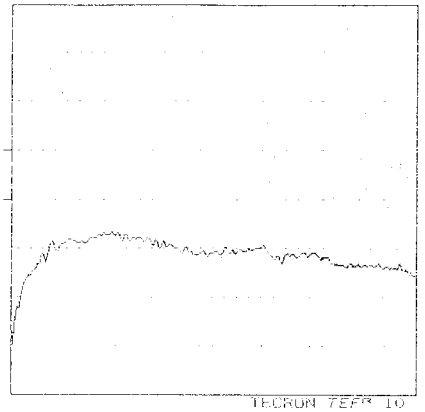
JBL 240 TI

Hans Drobilitsch loaned us a JBL 240TI for the measurements in the Grosser Musikvereinssaal in Vienna.

We were extremely impressed with this loudspeaker's very smooth EFC and its ability to handle the slow sweeps at healthy power levels that we used in obtaining our ETC measurements. Our recommendation would be to remove the grille cloth for critical listening. Anyone with a pair of these is, in our opinion, in for a good stereo listening experience. Hans said he was happy to see the measurements confirm what his ears told him subjectively.

Its EIA sensitivity is 39.8 dB and its suggested maximum recommended amplifier power is 300w. Since EIA rating plus amplifier power in dBm equals the maximum L_p at 30 ft.,

$$39.8 \text{ dB} + 10 \text{ Log}\left(\frac{300}{0.001}\right) = 94.5 \text{ dB}$$



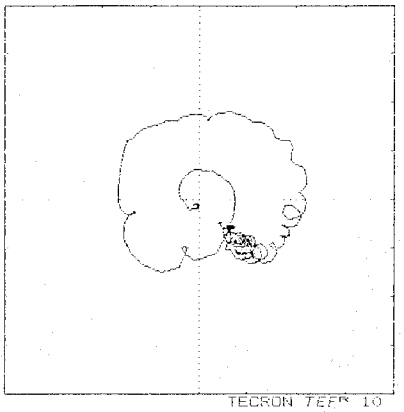
Vertical: 10dB/div with base of display at -133.8dB
odB is located at .775 Volts

Horizontal: Auto 0.00Hz to 19998.10Hz
scale: 234x.58Hz/inch or 2152.63Hz/cm.

Resolution: 6.8669E-02 meters & 5.0096E+03Hz

Time of test: 10203 microseconds, 3.5098E+00 meters

Sweep Rate & Bandwidth: 5009.55Hz/Sec & 1.0000E+00Hz



Resolution: 6.8669E-02 meters & 5.0096E+03Hz

24dB of automatic screen gain.

Frequency range: Auto 0.00Hz to 19998.10Hz

Time of test: 10203 microseconds, 3.5098E+00 meters

Sweep Rate & Bandwidth: 5009.55Hz/Sec & 1.0000E+00Hz

Compare these measurements with a "Phase Coherent? Loudspeaker," Newsletter Vol. 12, No. 2, Page 11. #

NOTE FROM THE EDITORS

We're changing over to a new word processor. We have on hand material already typed for this Newsletter; therefore, we will mix type styles and perhaps even layout (one or two column) in this Newsletter and the summer issue. Bear with us. #

ABCs OF ARRAY DESIGN

You have the contract to build a large array. Hopefully:

1. You have used the Prohs "Sphere" program and have an accurate idea of the number of devices needed for coverage and what their individual C_Ls should be. Also, hopefully,

2. You have not neglected making sure of the Qs each device has and the N that has resulted from their combination allows an acceptable $\%AL_{cons}$. Finally,

3. We also hope that the position the array will be placed in allows your PAG to equal NAG. These three, often conflicting, requirements *must be engineered* first.

First Steps in Array Construction

When the above three requirements have been properly met, you know the angles from reference axes that each device needs to be adjusted to. Some of the real life problems that now arise are:

1. Signal alignment of the array.

   (A) Acoustic centers
   (B) Apparent apexes
   (C) Wavefront formation

2. Physical space available to each device without interference with another device.

3. Acoustic overlap areas between devices.

Signal Alignment of the Array

Do you align acoustic centers, apparent apexes or wave front formations, i.e., the mouths of horns? Don Keele of Tecron has suggested that physical alignment of horn mouths coupled to electronic alignment of acoustic centers results in acceptable signal alignment over a wider coverage angle. Let's suppose we do carefully orient all of the devices in the array at their correct angles for coverage and with their mouth areas carefully arranged on a single curved plane, i.e., spherical surface.

This now leaves us the problem of locating the distance of each acoustic center from this plane and delaying the signals from those devices reaching the surface first until their arrival is equal to those that without correction had arrived last. This can be best done using very high T_R ETC measurements and the Sunn ADS Alignment Delay System. (This can also be accomplished with the Sunn ADS *and a pair of well calibrated ears.*)

Physical Space Conflicts

Problems that can occur are the inability to keep horn mouths aligned to the spherical surface without having their length result in some parts of two devices trying to occupy the same space at the same time. Surface radius may have to be increased or other compromises examined. It is here that TEF® measurements are invaluable as they allow you to see at once what the acoustic end result of each rearrangement will be.

Acoustic Overlap

Before an array is hoisted to its final position, it is wisdom to first hoist it about ten feet off of the ground. (This can also be done in a work area in the back of a large shop.) Using the ability of TEF analysis to see only L_D, carefully inspect the entire pattern for previously unsuspected anomalies.

Summary

It is hoped that any grads having information about or experience with other manipulations of these parameters will take the time and effort to share them with us in future newsletters. Syn-Aud-Con has many investigative projects going on with various users of large arrays which we hope to report on in the future. It is our belief that with the advent of TEF analysis readily available in the field that improved array design is a particularly fruitful area for all of us to work in. #

LANDMARK RULING

According to "Business Week," March 18, 1985, the Delaware Supreme Court (where so many U.S. corporations are based--like Altec) has ruled that corporate directors can be held accountable, even financially, for bad corporate decisions. "It's a signal that the pendulum has swung as far as it's going to in letting managements and boards do whatever they want without regard to fundamental shareholder rights," says Pennsylvania lawyer Richard D. Greenfield.

It's a controversial decision but it no longer leaves the stockholder in total frustration when a company is being badly managed. Often corporate directors have little or no knowledge of the company. Harold Geneen, former chairman and CEO of ITT Corporation, says in his recent book, *Managing*, that "Outside board members sit there and listen. Then they go to lunch, and then they go home and open the envelope which contains their fee." #

TEF® OWNERS

TEF owners not listed previously:

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We have included in this mailing a list of TEF Owners. If our list is not complete or not accurate, please let us know so we have an accurate list. #

WHAT'S GOING ON IN AUDIO?

There's a fundamental change going on *right now!* It's called TEF® analysis. The TEF analyzer is old news. What Heyser, Peutz, Stanley, Jebelian, Keele and others are doing to the programs is absolutely mind boggling. Some examples:

1. Do you want your EFC in log or lin, with or without scales, log scales or 1/3 and 1/1 octave scales or decades?

2. Would you like the cursor to jump where you indicate, either in percent or frequency or time?

3. How about dual cursors that let you integrate between them, find the RT_{60} between them, or find the % power between them?

4. Imagine the ability to not only difference two signals but have an infinite number of overlays on the screen.

5. Just for starters, the TEF now measures:

   A. Impulse response.

   B. Doublet response.

   C. Coincident response.

   D. Quadrature response.

   E. Magnitude.

   F. Phase.

   G. Group delay.

   H. Nyquist.

   I. Harmonic distortion--the full magnitude and phase responses of the first nine harmonics.

   J. It is a TEF, 12 bit FFT, 12 bit digital oscilloscope, Schroeder RT_{60} meter, and direct $\%AL_{cons}$ meter.

   K. Our ETCs now expand to the equivalent of a 12,800 line FFT storage capacity, i.e., times of 987 nanoseconds/line.

   L. How about both *vector* and scalar averaging with any sweep that has interference of any sort in it being rejected and repeated automatically.

   M. As if that's not enough, now there are FTC plots with cursor controlled side plots of the time behavior over the whole plot for that frequency on one cursor and the frequency response for that time on the other cursor plus a full 3-D view for reference all in addition to the FTC contour plots.

So what's the big news? All of these will sound obsolete by the time you can get to a Syn-Aud-Con two-day class. What's happening in audio and acoustic measurements is fundamental, unbelievably useful, and failure to keep up will leave any sound contractor competent only for packaged rentals. #

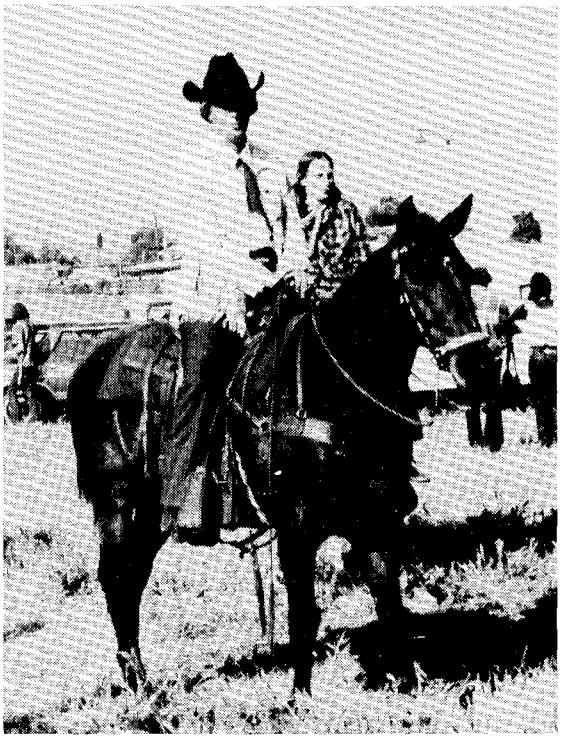
JAN KREITZ

In the last issue of the Newsletter, we gave the "Motto at Syn-Aud-Con":

If I cannot be free,
To do such work as pleases me,
Near woodland pools and under trees,
You'll get no work at all;
For I would rather live this life
and die a begger or a thief,
Than be a working slave
with no days free.

William H. Davies (1871-1940)

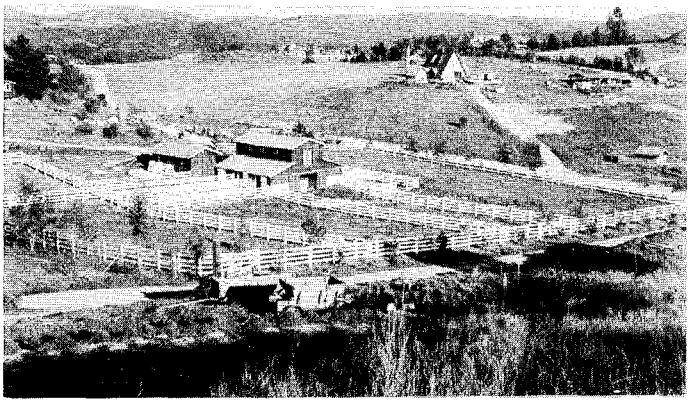
Jan Kreitz, who has worked so closely with us for 5 years and without whom we were sure we could not keep Syn-Aud-Con going, was working "with no days free."



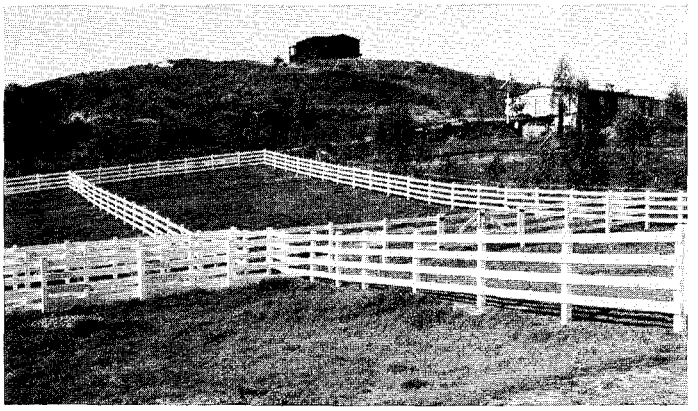
Jan at one of the many horse events held in San Juan Capistrano.

Jan installed her phone in our office and it wasn't many months before her phone was ringing as much as ours, which meant that she had to work nights and weekends to follow up the phone calls. Country Estate Fence Company is thriving and Syn-Aud-Con is surviving.

About a year ago, she and her husband, Jerry, started a business they call Country Estate Fence Company, selling a white rail fencing that is maintenance free, won't chip, crack, rot, rust, or peel.....and it never needs paint! Also, the horses can't eat it. The fencing is made from specially formulated PVC.



So they would "know their product," Jan and Jerry installed some at their home in Rancho Carrillo. This is our "new" view looking east from our hilltop home.



.....and as Jan and Jerry look west toward our home.

Pat Carlson, who has been with us for about 3 years, is the new office manager and she is doing great. Her new helpers are Debbie and Micheline. Many of you have already talked with them and know how helpful they are. Jan is still on our Newsletter staff and is in charge of the layout.

Carolyn asked me to add a few comments, so I thought this would be a good opportunity to say "hi" to everyone that I've met through Syn-Aud-Con and that I consider friends. Pat, Carolyn (when she's in town) and I still converse frequently, which gives me the chance to keep up with what everyone is doing. And by doing the layout work on the Newsletter (which I enjoy), I have firsthand information on all the "new" things you "grads" keep getting involved in as well as what's happening in audio -- a very interesting field that Don and Carolyn introduced to me.

Jerry and I are busy with our new company and its future looks promising. Our fencing material was originally developed for (although not limited to) use with horses, so it provides me with a close business tie to something I've always had as an avocation. Of course, I haven't had as many "days free" as I would like to enjoy my own horses, but hopefully that, too, is in the "promising future." s/Jan #

AMPLIFIER FROM INDUSTRIAL RESEARCH

Introducing
The Model DH-4020 Power Amp

SPECIFICATIONS

OUTPUT POWER	Dual (per channel)	Bridged	
	8 ohms, 20-20kHz 100W	8 ohms, 20-20kHz 300W	
	16 ohms, 20-20kHz 65W	16 ohms, 20-20kHz 220W	
	4 ohms, 20-20kHz 140W		
DISTORTION (THD @ Rated Output)	20-20kHz < 0.10% 8 ohms; < 0.15% 4 ohms Typically < .02% @ 1kHz 8 ohms; < .08% 4 ohms		
FREQUENCY RESPONSE	+0.0,- 1.0 dB, 20-20kHz		
NOISE	105 dB below rated output, 20-20kHz		
INPUT SENSITIVITY	1 V_{rms} for rated power		
INPUT IMPEDANCE	100K ohm active balanced 50K ohm unbalanced 60K ohm transformer - optional		
CROSSTALK	-85 dB, 20-20kHz		
CONTROLS	Recessed On-Off power switch, independent level control knobs or screwdriver slotted with security caps, transparent security panel.		
INDICATORS	Green LED indicates power on Green LED indicates signal present Red LED indicates overheat or DC offset Red LED indicates clipping		
CONNECTORS	Inputs: 1/4" (tip, ring, sleeve) and Terminal Block in parallel Output: Terminal Block Ground Lift: Terminal Block		
COOLING	Passive, high efficiency output stages and all aluminum construction		
AMPLIFIER PROTECTION	AC line breaker; thermal sensors in each output stage and power supply protect against overheating; short circuit and open circuit protected		
LOAD PROTECTION	All solid-state load protection, 1 second delayed turn-on, instant turn-off, power supply shut down in presence of excessive low frequency or DC offset		
POWER REQUIREMENTS	120V/240V, 50-400 Hz 20 Watts @ idle 300 Watts @ 200 watts output		
DIMENSIONS	1 3/4" (4.45cm) L x 19" (48.3cm) W x 14" (35.56cm) D		
WEIGHT	9.5 lbs. (4.25 kg) net		
OPTIONS	70V transformer for outboard mounting Input Transformer Security caps for screwdriver level controls		

Industrial Research Products, Inc., has introduced their first power amplifier. They now produce an integrated line of electronic devices that include automatic mixers, automatic level controllers, transversal equalizers, superb signal delay devices, and now a power amplifier (the DH4020) utilizing a signal dependent 100 kHz switching power supply. We're impressed with the specifications (reproduced here) inasmuch as they indicate to us a conservatively designed amplifier with a new twist in power supply.

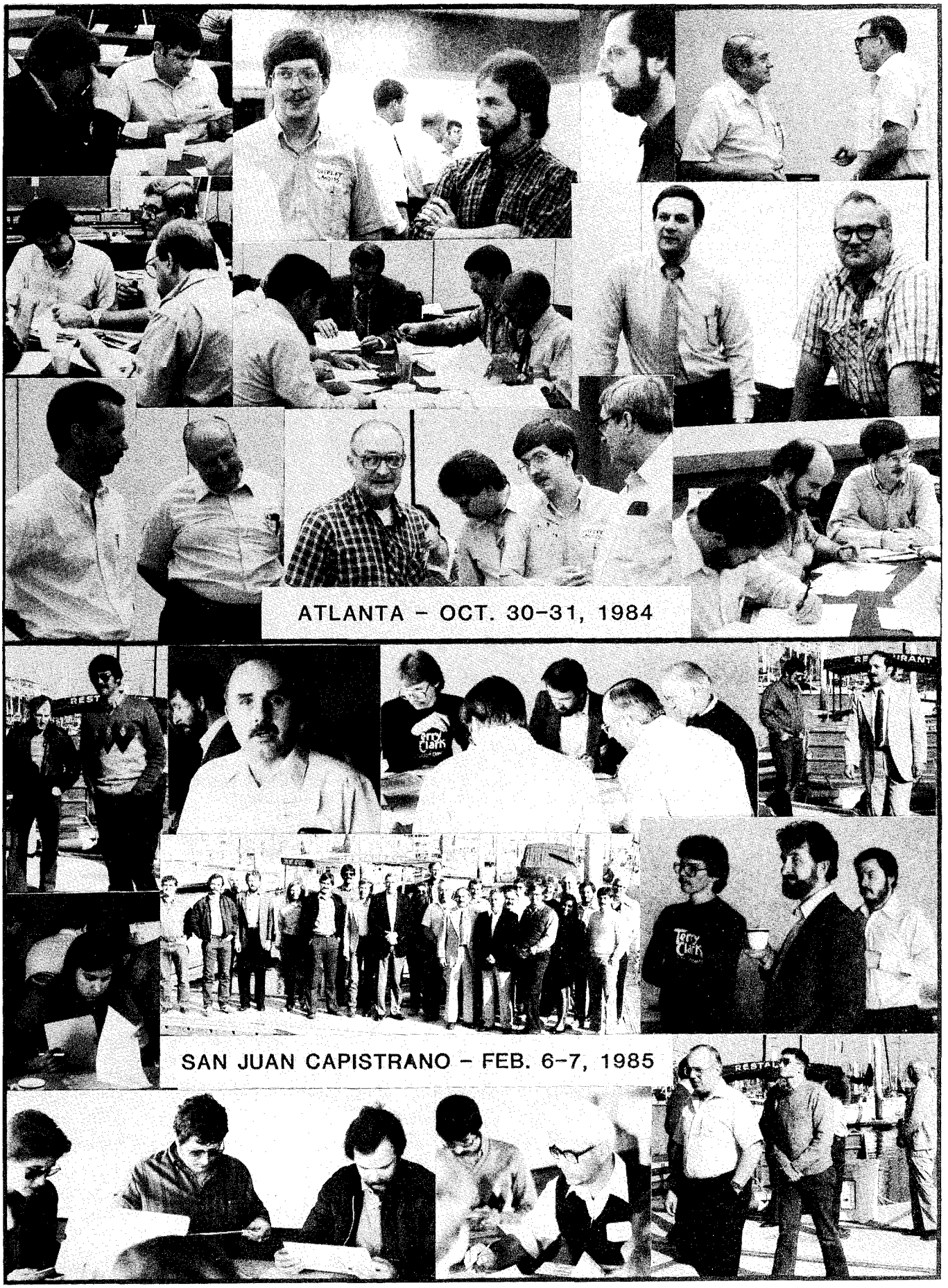
The longer we're in business, the more conservative we get about amplifiers. We are very pleased to see the development of another potentially full-line professional equipment manufacturer. #

COST OF CREDIT

From "Business Week," March 18, 1985:

It's no secret that if you don't pay off your credit card bill each month, interest charges soar. One cardholder figured just how much when he learned that as a "valued customer" he could "skip this month's payment on his $250 bill, although "finance charges will continue to accrue."

The cardholder calculated that at an annual interest rate of 21%, or 1.75% monthly, delaying the $250 payment for a month should cost only about $4. Knowing that an additional $1,450 worth of charges would show up on his next bill, he accepted the offer. "When I pay off the entire balance next month, they'll get $4 extra," he figured. But the next bill showed he owed $20 in finance charges. Here's why: Unless you have paid off your previous monthly bill in its entirety--in which case there is no interest due--charges are figured on your average daily outstanding balance over the period. So, instead of accruing on just the $250 owed for the first bill, the 21% interest charge went to the average of that amount and the next bill's $1,700 total ($250 plus the additional $1,450 worth of charges). Paying $20 for owing $250 an extra 30 days is like paying an annual interest rate of almost 100%. #


ATLANTA - OCT. 30-31, 1984
SAN JUAN CAPISTRANO - FEB. 6-7, 1985

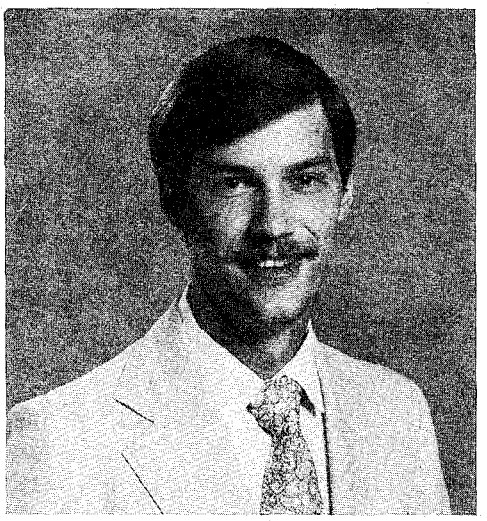
A LOUDSPEAKER SYSTEM ENGINEERING DESIGN COMPUTER PROGRAM

The "ELEPHANT" program to which John Prohs and David Harris have given so much of their time and intelligence is now called **The Prohs Harris Design (PHD).**

It is now ready for shipment to TEF® owners. If you are not a TEF owner, use the enclosed order form to tell them what computer you have. They are working to have the program available for other computers this summer.

We asked John and David to send us all the details on the completed program:

John Prohs conceptualized and performed all the math for the PHD program.



David Harris, programmer for the PHD.

***The PROHS HARRIS DESIGN™ Program** brings together the major engineering elements to do sound system designs with loudspeaker arrays using any loudspeaker manufacturer's products. With it you can do a complete:*

1. *Architectural Analysis including Fitzroy, Sabine and Norris-Eyring math plus room area and internal volume calculations.*
2. *Loudspeaker Array Configuration for the Cluster Computer.*
3. *Power Analysis with horns and drivers of your choice.*
4. *Performance Analysis using the Peutz intelligibility equations.*

A useful Common Absorption Coefficients Chart is also included.

The PHD computer program does not preclude the need to exercise a good understanding of sound system engineering principles and design. Nor does it purport to deal with the effects of room reflections or other problems better suited for a program dealing primarily with the acoustical environment itself. But what this comprehensive sound system engineering program does claim to do, it does well.

The PHD Program takes into account narrow room dimensions and how much energy is absorbed when the sound affecting reverberation time first hits a surface. It allows you to also examine such factors as evenness of direct sound coverage and potential versus needed gain.

Utilizing V. M. A. Peutz's latest available equations on intelligibility, the PHD Program easily handles situations where speech intelligibility is paramount.

The PHD Program is completely menu driven and includes a tutor mode to help familiarize you with its use. Each Analysis Section can be directly accessed so the program's output can be tailored to suit your needs. In addition, the user is given handy editing capability so certain information, like horn choices, can be updated or deleted at will.

As an optional feature, graphics are available which enable the designer, before mapping the final position on the sphere, to visualize the room from the array's perspective with the array in a variety of locations. This is especially valuable in situations involving ceiling structure limitations for positioning and hanging the cluster and cases where balconies, press boxes, or other structures may shadow seating areas and alter the sound wave path.

With the PHD Program, there is no need to re-enter data to reposition the cluster; and the recalculations are done for you in a matter of seconds.

A design analysis of this complexity previously would have taken a sound system design engineer days of laborious mathematical computations. Now you can speed through the calculations, cutting design time down to little more than the speed it takes to enter the data into a computer. Results can be available in just minutes.

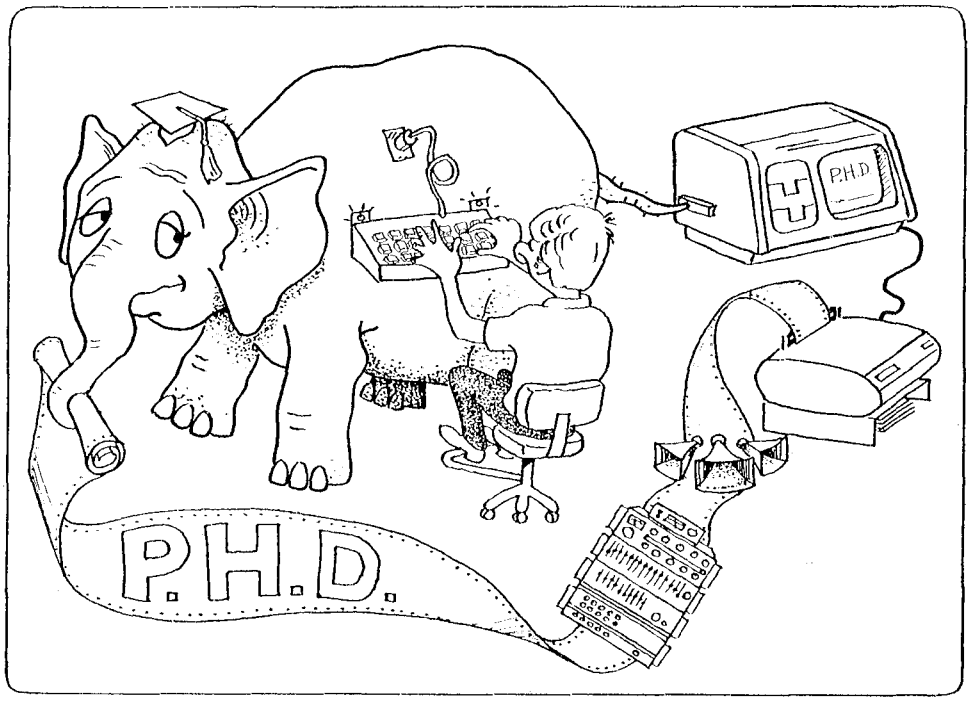
Continued next page.....

The PHD Program loudspeaker configuration section works with the spherical mapping method known as Cluster Computer. The Cluster Computer system equipment and license needed to do the actual mapping is also available.

No other sound system engineering design and mapping program combines such accuracy with speed of execution as The PHD Program, selling with graphics for $280.00.

Updates and other programs along this line are in the works.

The PHD Program is available now for the Crown TEF computer. Depending on demand, other formats will be available in the near future. Target date for the IBM is July. TEF owners may send a check to:



ELEPHANT gives birth to PHD.

The PHD Program™ • 233 S. Orange Grove Boulevard • Pasadena, CA 91105 #

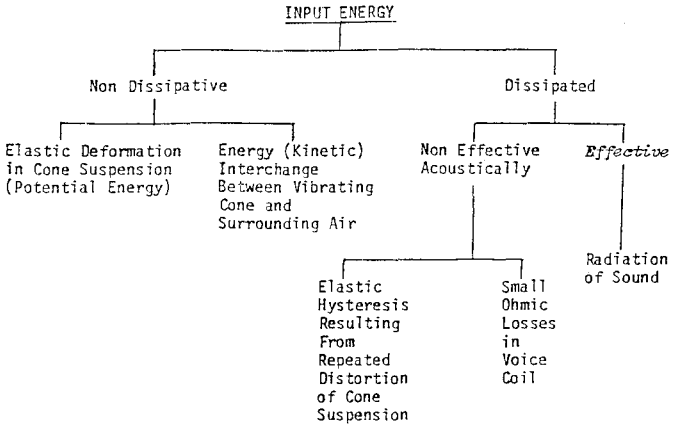
COMMUNITY ANNOUNCEMENT

We just received the following announcement from Community:

> *Effective 3/29/85, all supplies, technical updates and license information regarding the* ***Cluster Computer System*** *will be available from:*
>
> *CLUSTER COMPUTER SYSTEM*
> *233 South Orange Grove Boulevard*
> *Pasadena, CA 91105*

Community filled an important need -- making the Cluster Computer System available to early users. Now it makes good sense to have the Cluster Computer System incorporated with The PHD Program. #

INPUT ENERGY



Four points of significance in a loudspeaker response curve:

- f_r the resonant frequency of the cone
- f_w the frequency at which the corresponding wavelength is comparable with the linear dimensions of the cone or diaphragm
- f_b the frequency at which the wavelength is comparable with the linear dimensions of the baffle
- f_n the approximate frequency above which different parts of the cone are no longer vibrating in phase and indicates the existence of complex modes of vibration #

CHECKOUT OF A SOUND SYSTEM

Electrical Tests

FIRST TEST

Measure the total impedance of each line connected to the output of each power amplifier to ascertain that it is equal to or above the design value. If below the design value, investigate why and correct it.

SECOND TEST

Connect an audio oscillator to the input of each power amplifier and an oscilloscope across the output of the amplifier and ascertain that:

1. full voltage for rated power can be reached without noticeable deformation of the waveform.

2. the waveform is free of spurious oscillation, hum, noise, or other unexpected additional outputs. A "no signal in" should always result in a "no signal out." Record for owners future use Z_{IN}, Z_{LOAD}, E_{IN}, and E_{OUT} for each of the power amplifiers. These figures can be extremely useful to any later user of the system troubleshooting a system malfunction.

THIRD TEST

Measure and record at each input and output of all speech or music input equipment, line amplifiers, and signal processors the Z_{IN}, Z_{OUT} (source), E_O (open circuit voltage) and E_{IN}. Calculate and record all L_{AIP}s and the gains and losses of each "block" shown on the single line block diagram.

The values to be recorded are both the maximum value obtainable and the actual working value for normal system operation.

OVERALL CONSIDERATIONS

Low frequency loudspeakers should be carefully "buzzed out" with an oscillator (the small Loftech TS-1 is ideal for this purpose with its continuous tuning from 20 to 20,000 Hz). The oscilloscope should always be across the power amplifier output except when actually being used at one of the line level outputs with the power amplifiers not being driven. This allows any transient effects to be quickly detected should an inadvertent grounding error or other connection aberration occur.

Acoustic Tests

ROOM TESTS

First, measure the ambient noise level in octave bands and plot on the standard NC curves in order to verify that the specified NC rating has been met.

Next, measure the RT_{60} in the 2000 Hz octave band.

Again, make sure that the specified criteria has been met. (An integrated ETC curve - 20 to 50 msec - is ideal for this purpose if a TEF analyzer is used.)

Additional room tests when TEF analysis is available is to measure the return of reflections to critical areas, such as, the main microphone location.

Sound System Tests

FIRST TEST

ETC measurements are performed first. Each driver individually and then in combinations of two until all drivers affecting a given area are operating simultaneously. Great care in obtaining the widest *area* of coherent signal arrivals without seeing overall energy levels lost can result in quite meaningful aural results. It is the "mouth" of horns that should be brought into alignment (all wavefronts should join in the same plane). The control of acoustic centers, when needed, should be done either electronically with all pass devices as in the case of multiple horns, or with special networks when frequency dependancy enters the picture as in the case of L.F. and H.F. units operating together. Carefully distinguish between acoustic centers, apparent apexes and where the wavefront is formed.

SECOND TEST

Perform a Nyquist plot of the array in key audience areas. The Nyquist is one of the most sensitive indicators of misalignment, unexpected destructive interferences and undetected cabinet resonances in a large array (epicycles). While it is common to use the PFC measurement to insure that the correct zero reference time has been chosen, the Nyquist is then returned to for its detail. The PFC is an instant indication of polarity, as well.

Continued next page....

CHECKOUT OF A SOUND SYSTEM continued

THIRD TEST

Even coverage of the audience area is vital. At this stage of the checkout you should not be too concerned about the shape of the EFC obtained so long as the dips and peaks you are observing are not caused by signal misalignment or early reflections. What you should be concerned with is that the EFC shape be the same (within $\pm$ 2 dB) at all seats in the audience area.

FOURTH TEST

When all coverages, alignment, and all levels are correctly adjusted, the process of equalization may be undertaken. Care must be taken that only that which is proper to equalize is equalized. The L_D is equalizable within power limited bounds. The L_R should not normally be part of the consideration in terms of equalizer use. Loudspeaker and microphone resonances should not normally be equalized (the faulty component should be replaced with one that is free of resonances).

Always "talk test" the system at every stage of testing to insure that some inadvertent change has not crept in as a result of the adjustment at hand at that moment.

CONCLUSION

Sound system tests are relatively straightforward and not too difficult. Careful execution of them and careful study of what they reveal tend to accumulate into an invaluable storehouse of experiences that in the long run make the instruments secondary to what your *trained* ear instantly detects at the first voice test. #

SYN-AUD-CON SEMINAR SCHEDULE FOR 1985

CHICAGO, IL
Ramada-The O'Hare Inn
September 26-27, 1985

CLEVELAND, OH
Cleveland Airport Marriott
October 1-2, 1985

NEW YORK AREA
The Hilton at Harmon Meadow
October 10-11, 1985

WASHINGTON, D.C. AREA
Ramada at Tyson's Corner
October 22-23, 1985

CLEARWATER, FL
Ramada Inn Central
October 30-31, 1985
"On Location" - November 1

ATLANTA, GA
Perimeter North Inn
November 13-14, 1985

REGISTRATION FEE:

1 Participant ..... $425.
2 Participants ..... $400. Each
3 or More Participants..... $385. Each

REGISTER EARLY: You may deduct an additional 5% if payment is made one (1) month prior to the beginning of the seminar.

WORKSHOP SCHEDULE

LOUDSPEAKER ARRAY AND SOUND SYSTEM DESIGN

JULY 23-25, 1985 LOS ANGELES AREA FEE: $600.

TEF® BASICS

JULY 30-31, 1985 LOS ANGELES AREA
FEE: $400.

TEF® ADVANCED

AUGUST 1-2, 1985
FEE: $400.

TEF BASICS & ADVANCED: $700.

Informal working together - Members of both classes invited: August 3, 1985.

TO OUR READERS.....

Mistakes are intentionally put into every issue of this Newsletter for those who look for mistakes. If you can't find any, keep looking. We aim to please.

THE EDITORS & STAFF

WHAT IS A SOUND PRESSURE LEVEL?

Recently, a friend was confused by my statement that sound pressures are never "levels" but rather "amplitudes" followed by "the sound pressure level" is L_p = 90 dB.

The confusion arises from the fact that sound pressure (S.P.) is in pascals (formerly in Newtons/m^2, dynes/cm^2, and microbars) and any measurement in "pascals" is referred to as an "amplitude" not a "level."

When we go to convert a sound pressure S.P. into a sound pressure level L_p , we, of course, must first turn it into a power expression (just as we do with voltages across a common fixed impedance value). The L_p is the *sound pressure squared* referenced to 20 upa squared. As an example:

$$L_p = 10 \text{ Log}\left(\frac{(20 \text{ pA})^2}{(0.00002 \text{ pA})^2}\right) = 120 \text{ dB}$$

Or, as is more commonly encountered, we double the multiplier instead of squaring the ratio and we obtain:

$$L_p = 20 \text{ Log}\left(\frac{20 \text{ pA}}{0.00002 \text{ pA}}\right) = 120 \text{ dB}$$

Which is, of course, a power ratio expressed as a *level* in decibels.

Sound pressures as indicated above are published in many dimensional formats, the most common encountered being:

1.0 pascal	(pA)	⎫
1.0 Newton/m^2	$(N/m)^2$	⎬ All convert into an L_p = 94 dB
10 dynes/cm^2		⎭
10 microbar	(ubar)	

And:

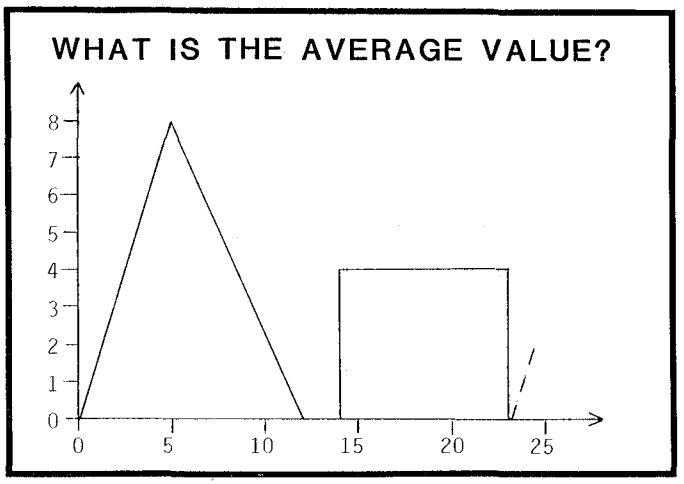
0.1 pA	⎫
0.1 Newton/m^2	⎬ All convert into an L_p = 74 dB
1 dyne/cm^2	⎭
1 ubar	

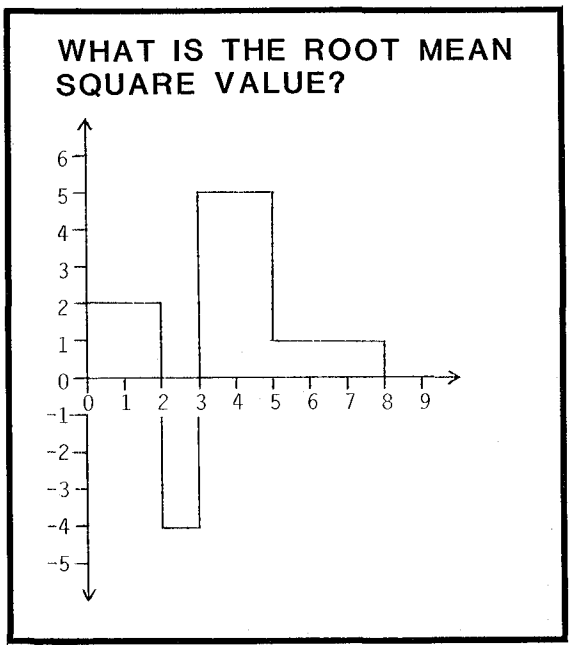
We certainly agree that to anyone interfacing with audio nomenclature for the first time metric messes of this type are frustrating.

Consider the two miracles at hand in this world. Everyone uses the same number system and everyone uses the same musical notation system. However, wouldn't it be dull if everyone were the same in dress, food tastes, artistic appreciation, etc. Our simple plea is to help keep our audio vocabulary as concise and accurate as possible. #

BASIC AMPLITUDE CALCULATION

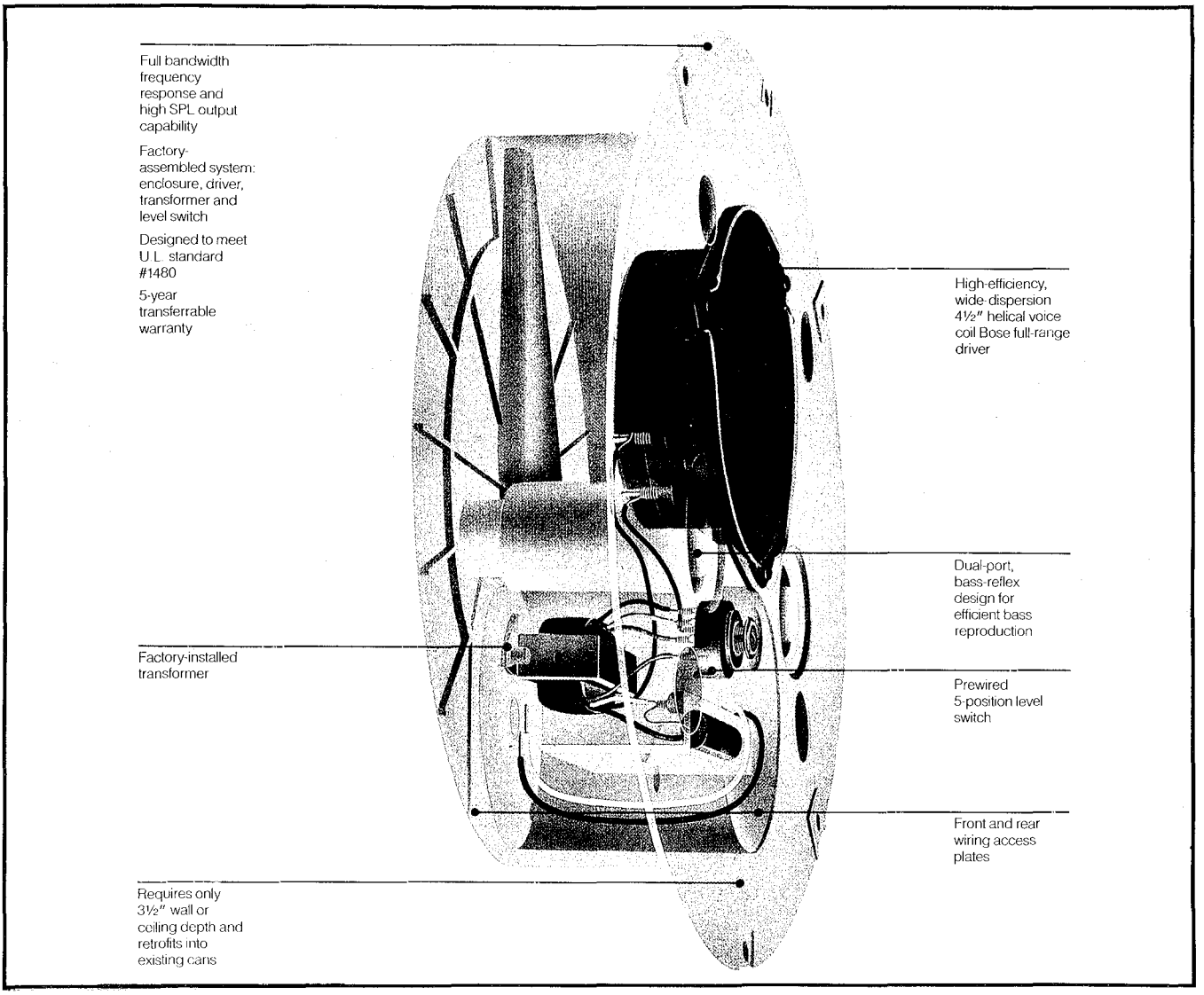
We recently encountered a pair of exercises in calculating average and root mean square values. Do you know how to do so? (The answers are on page 27.) If you have not done this before, examine the answers carefully and ask yourself what am I actually summing. (This answer appears on page 27.) #





NEW BOSE CEILING SPEAKER

The illustration shows a "ghost" view of the new Bose 102 in the ceiling system. It meets U.L. and has a five year *transferable* warranty. We have heard these in operation (Hamburg, Germany) and they have exceptional coverage, quality and power handling. Why be the last guy on the block to latch onto an obvious first place winner? #



COMMUNITY — A Whelen Company

Syn-Aud-Con sponsor, Community Light & Sound, Inc., of Chester, Pennsylvania, has been acquired by Whelen Engineering, Inc., of Connecticut.

Community and Whelen have had a long previous association in the development of high power, all-electronic voice and siren systems used in outdoor, indoor, and mobile applications. The hallmark of Community's products has been the willingness to abandon the orthodox while maintaining engineering integrity. The M-4 driver is an outstanding example of a better solution to a longstanding problem, accompanied by the integrity to keep it a one decade unit. We have only to note the results of those trying to stretch that limit to appreciate Community's original choice.

We look forward with a great deal of interest as to what will emerge from this new alliance. Whelen acquires experienced TEF® technology as a result since Community has been one of the real pioneers in the application of this advanced measurement system. #

WORDS OF WISDOM

Illegitimate non carborundum - (Don't let the bastards grind you down). Gen. Joseph W. Stilwell (1883-1946) ♦

AUTOMATIC CAMERA SWITCHING

One of the more interesting developments in our industry is the remarkable progress being made by Shure in the teleconferencing business. We have recently heard one of their installations and we were truly impressed with the improvement in quality it offered over the AT&T Quorum system it was compared against.

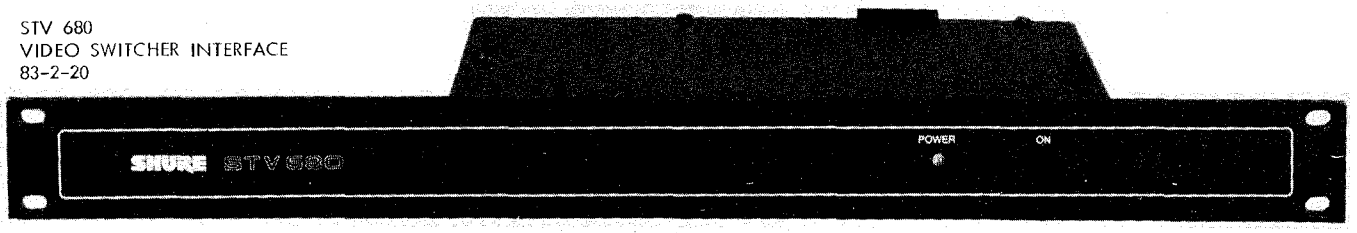
Here is one of the typical problem solvers they are offering to their selected distribution for these products.

SHURE STV680 PROVIDES AUTOMATIC CAMERA SWITCHING FOR VIDEO TELECONFERENCES

Shure has announced the availability of the Model STV680 Video Switcher Interface. When used in conjunction with the Shure Teleconference System and a commercially available video switcher, the STV680 will provide smooth, automatic, voice-activated camera switching for video teleconferences.

The heart of the STV680 is an 8748 microcomputer which actuates the remote-control input of a video switcher in response to the action of a Shure Teleconference Mixer. Video cameras covering individual microphones are automatically switched on when their respective microphones are activated, causing the video presentation to follow the flow of the audio discourse smoothly and naturally.

STV 680
VIDEO SWITCHER INTERFACE
83-2-20



"Essentially, the STV680 is an electronic version of a human director," said Dick Williams, Shure Teleconferencing Systems' Director of Marketing and Sales. "It doesn't actually switch the video cameras itself, but it provides signals in a logical sequence for a video switcher to follow. For example, the STV680 will only signal to switch a camera after a new microphone has activated for at least two seconds. If someone coughs, interjects a word or quick phrase, or activates a microphone for some unintentional reason, his camera won't suddenly be selected.

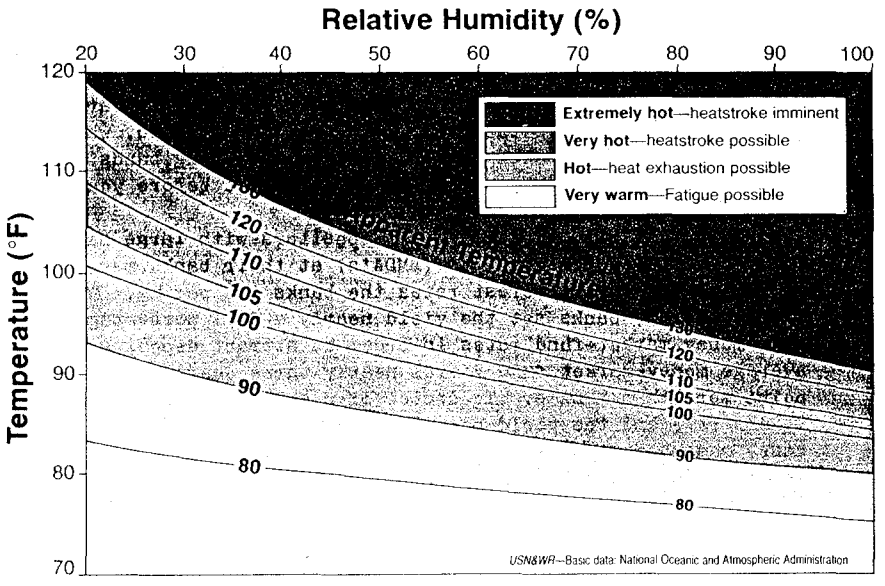
If two or more microphones are activated at the same time, the STV680 will make one of two decisions, selectable by the installer. It can either rotate among the cameras in the installation (2.7 seconds on each camera) or switch to a wide-angle overview camera or another predetermined camera. If no microphones are activated for an extended period (over six seconds), the STV680 will automatically switch to the overview camera.

Other options available to STV680 users include an "override" option, which suspends automatic action and permits external manual switching of a particular video channel, such as a graphics camera. A "disable" option, which suspends all automatic action and allows manual camera selection via switches externally connected in parallel to the STV680 outputs, is also available.

The Shure STV680 Video Switcher Interface can be mounted in a standard 19-inch equipment rack or, using supplied feet, on any horizontal surface. Its user net price is $1,650.00. #

JANUARY SPECIAL

HEAT INDEX. Because humidity deters the evaporation of perspiration, which ordinarily cools the body, high temperatures become even more uncomfortable -- and sometimes hazardous -- when combined with high humidity. The National Weather Service has prepared a heat index, right, to show how heat and humidity combine to make the apparent temperature seem hotter than the thermometer shows. #



AUDIO TRIANGLES

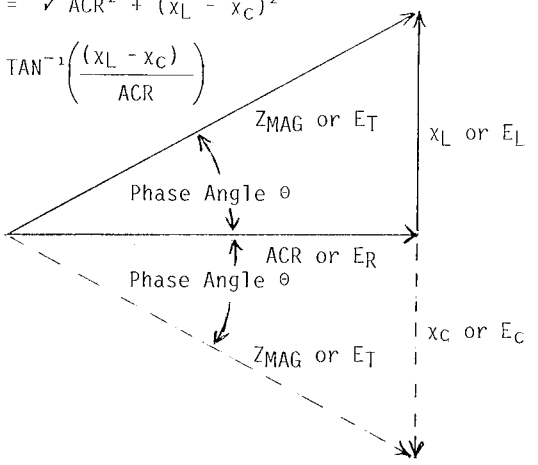
Most of us, if we had known we were going into audio, would have paid a great deal more attention to the mathematical concepts attributed to Pythagoras of Samos 580 - 496 B.C. It is interesting to note that one of the taboos of the Pythagorean school was that of eating beans (more properly, lentils), which would suggest that a non-Pythagorean could be referred to as "full of beans." *(A History of Mathematics* by Carl B. Boyer -- the beans taboo only, not the conjecture about non-Pythagoreans.)

There are many triangles in technology and we present here three of the most useful ones.

THE IMPEDANCE TRIANGLE

$$Z_{MAG} = \sqrt{ACR^2 + (X_L - X_C)^2}$$

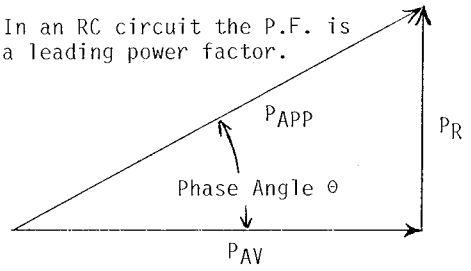
$$\Theta = TAN^{-1}\left(\frac{(X_L - X_C)}{ACR}\right)$$



THE POWER TRIANGLE (ELECTRICAL)

In an RL circuit the P.F. is a lagging power factor.

In an RC circuit the P.F. is a leading power factor.



P_{APP} is the *apparent* power in volt-amperes *VA.*

P_R is the *reactive* power in volt-amperes-reactive *VAR.*

P_{AV} is the *average* power in *watts.*

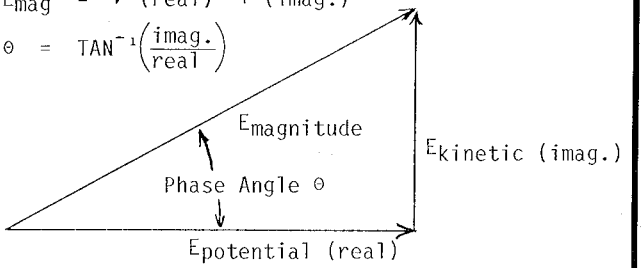
Power Factor (P.F.) = $COS\Theta = \frac{P_R}{P_{AV}}$

Reactive Factor (R.F.) = $SIN\Theta = \frac{P_R}{P_{APP}}$

THE ACOUSTIC TRIANGLE

$$E^*_{mag} = \sqrt{(real)^2 + (imag.)^2}$$

$$\Theta = TAN^{-1}\left(\frac{imag.}{real}\right)$$



$E_{mag}\ COS\Theta$ = real $\qquad$ $E_{mag}\ SIN\Theta$ = imag.

*energy density

If you'd really like to know why some amplifiers made quite a different sound from identically specified amplifiers on the same test loudspeaker, measure what each of the amplifiers do on a capacitive load instead of a resistor. You then have the choice of searching the sacrificial bird's entrails, i.e., speaker wire, or studying the engineering reasons why. #

JULY SPECIAL

As we write this (April 15), we are having 90-95° days and it's bearable to look at the effect of wind and cold. Anyone who lives in Chicago near the lake knows that at 20 degrees above with a 20-mile-an-hour wind, it can seem like Minneapolis at -10° with a 4-mile-an-hour wind. #

Wind Speed MPH	When the thermometer reads (degrees Fahrenheit): The temperature equals this in its effect on exposed flesh:													
	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30
4	35	30	25	20	15	10	5	0	−5	−10	−15	−20	−25	−30
5	32	27	22	16	11	6	0	−5	−10	−15	−21	−26	−31	−36
10	22	16	10	3	−3	−9	−15	−22	−27	−34	−40	−46	−52	−58
15	16	9	2	−5	−11	−18	−25	−31	−38	−45	−51	−58	−65	−72
20	12	4	−3	−10	−17	−24	−31	−34	−46	−53	−60	−67	−74	−81
25	8	1	−7	−15	−22	−29	−36	−44	−51	−59	−66	−74	−81	−88
30	6	−2	−10	−18	−25	−33	−41	−49	−56	−64	−71	−79	−86	−93
35	4	−4	−12	−20	−27	−35	−43	−52	−58	−67	−74	−82	−89	−97
40	3	−5	−13	−21	−29	−37	−45	−53	−60	−69	−76	−84	−92	−100

Cold Very cold Bitter cold Extreme cold

NUMBER THEORY IN SCIENCE & COMMUNICATION

A Totally Fascinating Book

Die ganzen zahlen hat der liebe Gott gemacht, alles andere ist Menschenwerk -- Leopold Kronecker

The above appears as the first sentence in the introduction without translation. For those without German, the terms "Gott gemacht" and "Menschenwerk" serve as sufficient clues to remember "God made the integers, all else is man's works."

Number Theory in Science and Communication

Published by Springer-Verlag, 1984
Berlin, Heidelberg, New York, Tokyo

This book, written by Dr. Manfred R. Schroeder, Direktor, Drittes Physikalisches Institut, Universitat Göttingen, and Past Director, Acoustics Speech and Mechanics Research, Bell Laboratories, Murray Hill, New Jersey, is a remarkable summary of the efforts of Menschenwerk since "Gott gemacht" began. It is in English!

I currently have on my bookshelves well over 100 books on mathematics and this one is easily the most instructive of them all. Let me give just a few of thousands of highly readable, useful, and insightful items Herr Professor-Doctor Schroeder discusses.

64 5. Fractions: Continued, Egyptian and Farey

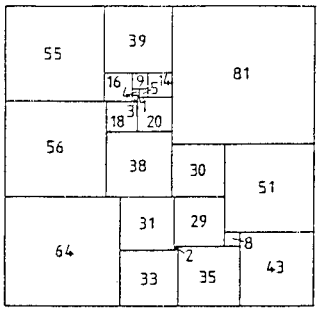


Fig. 5.6. The first squared square, a solution based on the theory of electrical networks and continued fractions (courtesy E. R. Wendorff)

The application of CFs to electrical networks has, in turn, led to the solution of a centuries-old teaser, the so-called Puzzle of the Squared Square, i.e., the problem of how to divide a square into unequal squares with integral sides. This problem had withstood so many attacks that a solution was widely believed impossible [5.5]. Thus, the first solution, based on network theory, created quite a stir when it appeared (Fig. 5.6).

22.5 How to Divide a Circle with Compass and Straightedge 231

22.5 How to Divide a Circle with Compass and Straightedge

How to divide a circle into N equal parts by compass and straightedge, i.e., by purely geometric means, was one of the classical problems of geometry first brought into prominence by the ancient Greeks. They discovered that a circle could be so divided if $N = 3$ or 5. Since angles can also be halved geometrically, additional possibilities are $N = 6,12,24,\ldots$ and $N = 5,10,15,\ldots$. Finally, it is not difficult to see that by dividing a circle both into 3 *and* 5 equal parts, the angle $2\pi/3 \cdot 5$ can also be obtained, thereby permitting division of the circle into 15 equal parts.

In general, according to Euclid, a circle can be divided into N equal parts by compass and straightedge if

$$N = 2^k \cdot 3^m \cdot 5^n , \tag{22.47}$$

where k is any nonnegative integer and n and m are either 0 or 1.

Since dividing a circle into N equal parts is equivalent to constructing a regular N-gon, i.e., a polygon with N vertices (or edges), the lowest-order regular N-gon that could not be constructed was the 7-gon or *heptagon*.

Since the time of Euclid, for almost 2000 years, mathematicians and amateurs alike had been trying to smash the boundary at $N = 7$, but in vain. Then, on March 30, 1796, an 18-year-old Brunswick (Germany) youth scribbled in his brand-new notebook, at the top of page 1, (see Fig. 5.1) freely translated from the Latin that he was using: "How to divide the circle by geometric means into 17 equal parts." In other words Gauss (the name of the young man) had just discovered that the numbers 3 and 5 of the ancient Greeks had to be supplemented by 17 and, in general, by primes of the form

$$2^{2^n} + 1 , \tag{22.48}$$

i.e., the Fermat primes F_n of which then, and to this day, only 5 are known: $F_0 = 3$, $F_1 = 5$, $F_2 = 17$, $F_3 = 257$ and $F_4 = 65537$.

Of equal significance, Gauss proved that the *only* regular N-gons that can be constructed by geometric means are of the form

$$N = 2^k \prod_n F_n , \tag{22.49}$$

where the product is over *distinct* Fermat primes. Thus, apart from the factor 2^k, there are at present $2^5 - 1 = 31$ different regular odd N-gons that can be constructed geometrically: from the triangle and the pentagon to the 17-gon and the $3 \cdot 5 \cdot 17 \cdot 257 \cdot 65537 = 4\,294\,967\,295$-gon. (The author strongly advises against attempting the latter case. Gauss said it is possible and that should suffice. On the other hand, there is a *suitcase* at the Mathematics Institute of the University of Göttingen which is jam-packed with the details of constructing the regular 65537-gon.)

Schroeder's subtitle is "With Applications in Cryptography, Physics, Biology, Digital Information, and Computing." He might well have added "The History of Rational Thought from Non-Rational Intuitions (Metaphysics?)."

17.2 The Basic Principle of the Fast Fourier Transforms

As we saw in Chap. 16, the Discrete Fourier Transform (DFT) is defined by [17.3]:

$$A_k := \sum_{n=1}^{M} a_n e^{-2\pi i n k/M} , \tag{17.13}$$

which can also be written as a matrix-vector product

$$A = F_M a , \tag{17.14}$$

where F_M is the $M \times M$ DFT matrix, the simplest nontrivial one being

$$F_2 = \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix} , \tag{17.15}$$

which is exactly like the Hadamard matrix H_2. Is F_4 perhaps the direct product of F_2 with itself? Not quite:

$$F_4 = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -i & -1 & i \\ 1 & -1 & 1 & -1 \\ 1 & i & -1 & -i \end{bmatrix} \tag{17.16}$$

However, if we permute rows 2 and 3 and multiply all imaginary terms by a "twiddle factor" i (not to be confused with the "fudge factor," so beloved among order-loving scientists), we obtain

$$\tilde{F}_4 = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 \end{bmatrix} = F_2 \otimes F_2 \quad (!) \tag{17.17}$$

Thus, with a little twiddling and some permuting, we have succeeded in decomposing the 4×4 DFT matrix into the direct product of two (identical) 2×2 matrices, which — as an extra reward — are made up exclusively of ± 1's, requiring only additions or subtractions.

More generally, a properly twiddled and permuted $2^m \times 2^m$ DFT matrix can be written as a Kronecker power of F_2:

$$\tilde{F}_{2^m} = F_2^{[m]} , \tag{17.18}$$

which results in a fast algorithm as demonstrated for the Hadamard transform. This is the basic principle of all Fast Fourier Transforms (FFT). The savings in the number of operations is again governed by the ratio $\log_2 n/n$, where n is the number of data samples.

The rest is exhausting technical detail that is covered by a vast body of literature commensurate with the importance of the FFT (see [17.3] and the references therein).

Continued next page.....

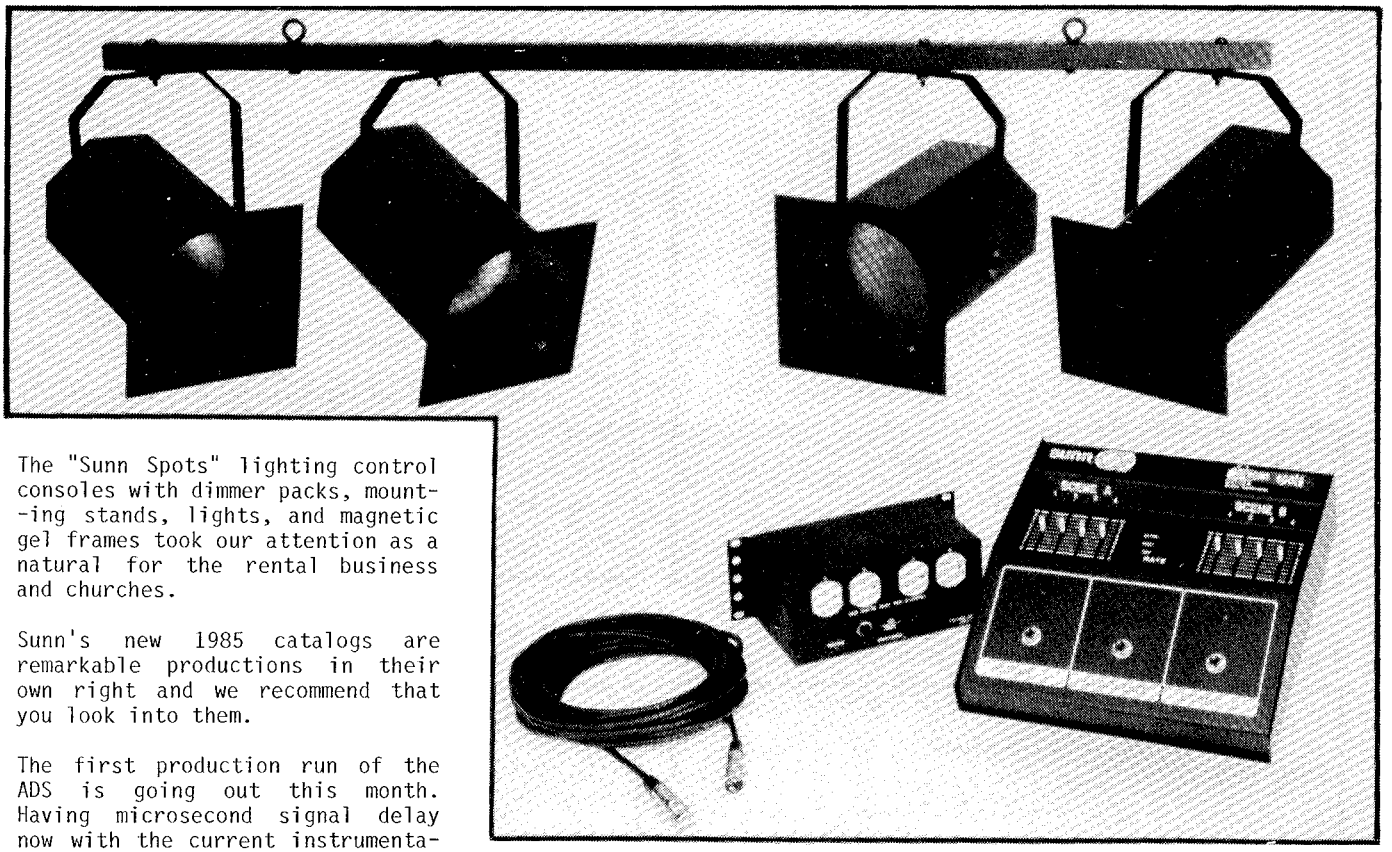
When Chips Davis hired a transit to use in a control room job in Hamburg, Germany, he found it calibrated in "Gons." Schroeder's explanation of the generation of "Gons" is elegance itself. The definition of an angle deals with arcs of a circumference and not with angles between half-lines. From: ***Fundamentals of Mathematics, Volume II, Geometry*** -- H. Behnke, F. Bachmann, K. Fladt, and H. Kunle, page 14.

Schroeder is further distinguished by being a friend of V. M. A. Peutz (they attended school together in Paris after World War II).

Finally, it is Schroeder's work that brought about Quadratic Residue Diffusors as built by Peter D'Antonio and this book has a section specifically devoted to the mathematics of such devices. #

SUNN SPOTS

Sunn Electronics, Tualatin, Oregon, manufacturers of the Sunn ADS (audio delay system) with its 10 usec per step signal delays, has announced a series of new professional audio products. These include new powered mixers, a power amp and a lighting system.

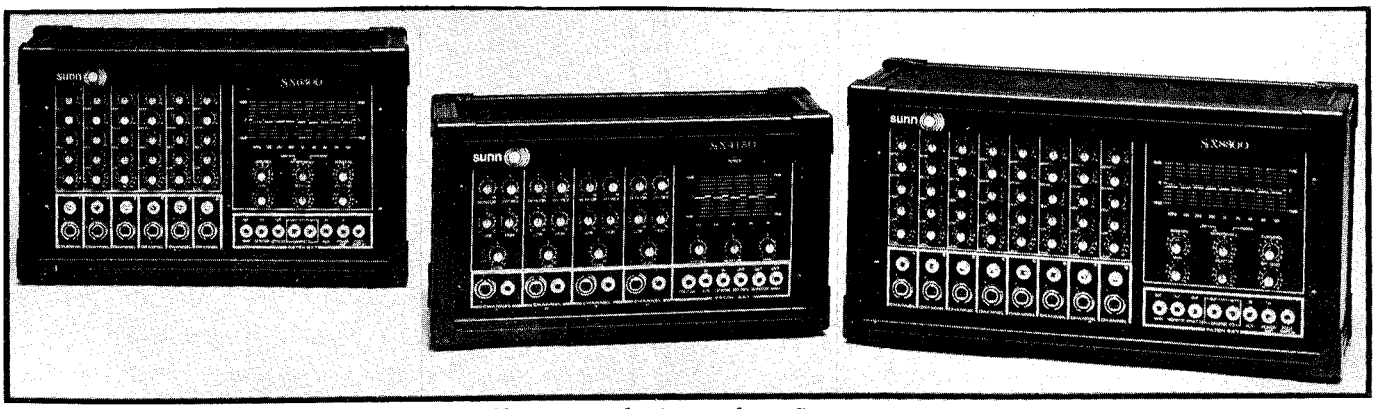


The "Sunn Spots" lighting control consoles with dimmer packs, mount--ing stands, lights, and magnetic gel frames took our attention as a natural for the rental business and churches.

Sunn's new 1985 catalogs are remarkable productions in their own right and we recommend that you look into them.

The first production run of the ADS is going out this month. Having microsecond signal delay now with the current instrumentation is analogous to 1967-68 when

"Sunn Spots"



New powered mixers from Sunn.

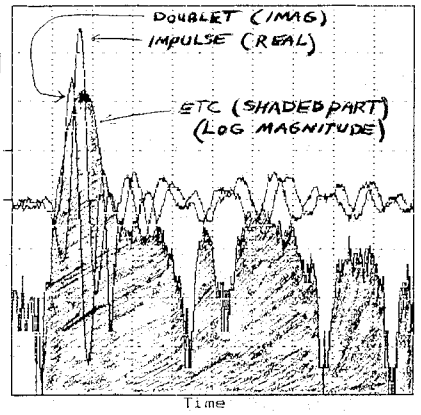
real time analyzers were introduced within a year of the development of 1/3 octave equalizers. The ADS can be used without the TEF® analyzer but a good set of well-trained ears is needed -- with and without the TEF. Contact Bob Hick at Sunn for information.....(503) 692-4650. #

NEW DISPLAY CAPABILITIES FOR TEF®

Elsewhere in this Newsletter is a partial listing of the latest programming efforts of Dick Heyser. Here are a few of the new display possibilities with his latest 'D' disk.

The first display is of the overlay capability with the impulse, doublet, and ETC all compared for a single device. Note also the expanded ETC scaling which is a tremendously useful tool. (Full scale here is 1.25 msec or 3.13 usecs per line -- and this *is not* full expansion.)

Fig. #1



Vertical: 6dB/div with base of display at -1.0dB
0dB is located at .001 volt

Horizontal: 3000 microseconds or 1.03236 Meter to
4253 microseconds or 1.46362 Meter
scale: 1.1791E-01 Meter/inch or 4.6422E-02 Meter/cm.
342 microseconds/inch or 134 microseconds/cm.

Line Spacing: 3.14094 microseconds or 1.08086E-3 Meter
Line Width: 4.27168 microseconds or 1.46997E-3 Meter

Sweep rate: 18785.80Hz/Sec

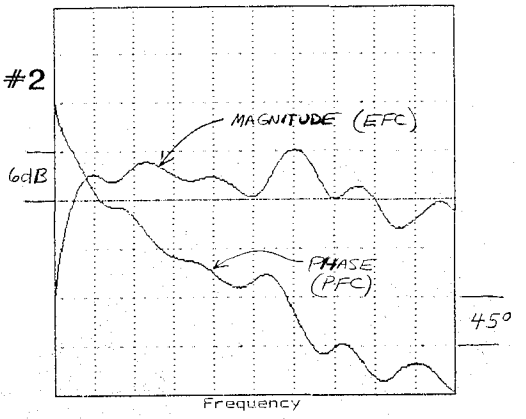
Sweep range: 99.58Hz to 19998.10Hz

Window file name: A:HAMMING.W8T

Input configuration: Channel 1 Non-inverting
with 12dB of input gain & 12dB of IF gain.

The second display is a long sought one by us wherein magnitude and phase responses are overlayed.

Fig. #2



Vertical: 6dB/div with base of display at -1.0dB
0dB is located at .001 volt

Horizontal: 0.00Hz to 10001.20Hz
scale: 2734.43Hz/inch or 1076.55Hz/cm.

Resolution: 3.6636E-01 Meter & 9.3929E+02Hz

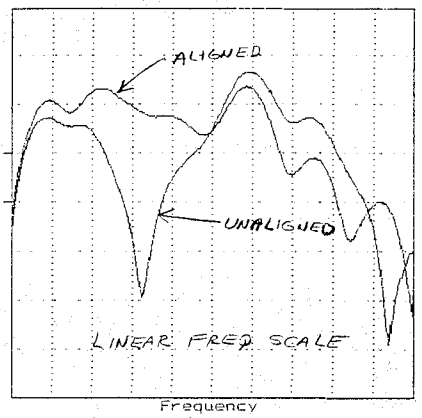
Time of test: 3150 microseconds, 1.0841E+00 Meter

Sweep Rate & Bandwidth: 18785.80Hz/Sec & 2.0000E+01Hz

Input configuration: Channel 1 Non-inverting
with 24dB of input gain & 12dB of IF gain.

The next three displays are to show you (1) linear frequency scaling divided into ten parts; (2) Log frequency scaling with calculated grid; and (3) Log frequency scaling in 1/3 and 1/1 octave grids.

Fig. #3



Vertical: 6dB/div with base of display at 5.0dB
0dB is located at .001 volt

Horizontal: 0.00Hz to 10001.20Hz
scale: 2734.43Hz/inch or 1076.55Hz/cm.

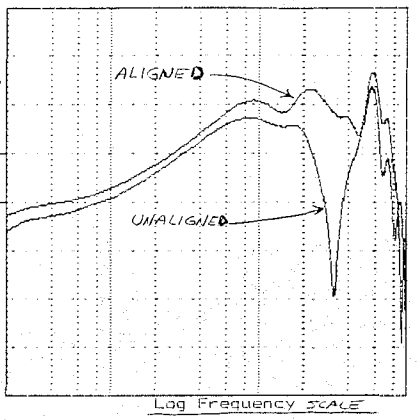
Resolution: 3.6636E-01 Meter & 9.3929E+02Hz

Time of test: 3200 microseconds, 1.1012E+00 Meter

Sweep Rate & Bandwidth: 18785.80Hz/Sec & 2.0000E+01Hz

Input configuration: Channel 1 Non-inverting
with 12dB of input gain & 12dB of IF gain.

Fig. #4



Vertical: 6dB/div with base of display at 5.0dB
0dB is located at .001 volt

Horizontal: 0.00Hz to 10001.20Hz
Log freq axis (2.7decades)

Resolution: 3.6636E-01 Meter & 9.3929E+02Hz

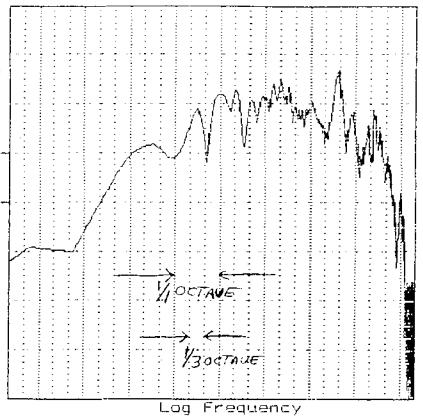
Time of test: 3200 microseconds, 1.1012E+00 Meter

Sweep Rate & Bandwidth: 18785.80Hz/Sec & 2.0000E+01Hz

Input configuration: Channel 1 Non-inverting
with 12dB of input gain & 12dB of IF gain.

Continued next page....

Fig. #5



Vertical: 6dB/div with base of display at 5.0dB
0dB is located at .001 volt

Horizontal: 0.00Hz to 19998.10Hz
Grid lines: Third-Octave and Octave band centers
Range: (9 octaves) Band No. 16 to Band No. 43

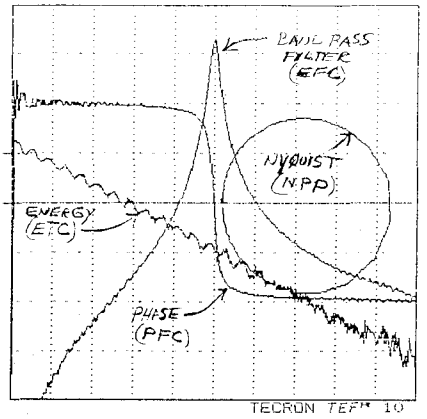
Resolution: 2.5136E+00 Meter & 1.3722E+02Hz

Time of test: 3200 microseconds, 1.1012E+00 Meter

Sweep Rate & Bandwidth: 18785.80Hz/Sec & 1.3722E+02Hz

Input configuration: Channel 1 Non-inverting
with 12dB of input gain & 12dB of IF gain.

Fig. #6



Resolution: 2.5136E+00 Meter & 1.3722E+02Hz

0dB of automatic screen gain.

Frequency range: 0.00Hz to 19998.10Hz

Time of test: 0 microseconds, 0.0000E+00 Meter

Sweep Rate & Bandwidth: 18785.80Hz/Sec & 1.3722E+02Hz

Input configuration: Channel 1 Non-inverting
with 24dB of input gain & 12dB of IF gain.

Finally, an example of the use of all the new storage registers overlayed on the screen for a band pass filter. The wedding of mathematics and geometry is nowhere more evident than in these displays and the programming behind them. Indeed, if we were to design a TEF owner's lapel pin, the last illustration would be our chosen symbol. #

AUDIO AND ACOUSTICS CLUB REVIVED

Ken Wahrenbrock is reviving the Audio and Acoustics Basic Club (AABC) with some of the following programs:

A. PADS which allows the operator to calculate all types of pads.

B. TGAINP which calculates to total gain structure from microphone sensitivity to acoustic level at a listener's ears, either outside or inside, with the modified Hopkins-Stryker equation.

C. SSDAP, SSDBP and SSDCP -- three versions of Sound System design which facilitate the calculations of absorption, Q, coverage angles, mike-to-talker distance, power requirements and PAG.

These programs are supplied on the User Supported System which encourages duplication and sharing. Each program suggests that if it is useful, a payment may be made to AABC. The forwarding of payment to AABC places the registrant on the data base to receive future information of further programs and revisions and updates.

Copies of the programs may be obtained in several ways. Sending a formatted disk in a return postage paid mailer will obtain the diskette. A complete diskette of the programs may be obtained for $10.00.

At present, the programs are available on IBM-PC and Commodore 64. If there are others who wish to translate them to other formats, please contact Ken. He will list you in future info mailings and response to telephone inquiries. If you wish printed listings to enter the programs, you may also obtain these.

Any persons interested in being on the mailing list for the next year is welcome to indicate so to him. He will be establishing a subscription fee for mailings in the near future.

If anyone has programs that they would like to have included in his listing, please let him know.

Some of the programs will also be translated to COMAL, a new faster language developed in Europe.

Ken Wahrenbrock, Wahrenbrock Sound Associates, 9609 Cheddar Street, Downey, CA 90242 - (213) 803-6335. #

B & W LOUDSPEAKERS

We recently encountered an expensive multi-page, multicolor advertisement for B&W loudspeakers. We have never heard one but the ad revealed some fascinating data that suggests they just might know what they are trying to do.

1. They emphasize their enclosure geometry and its ability to reduce "those direct reflections off the back of the cabinet *which can be heard* through the cone of the bass/midrange unit of many loudspeakers."

2. They have recognized that the *fronts* of the radiating devices should be physically in line and that the signal alignment should be done electronically (they call it ETD -- electronic *time* delay but we'll not hold that against them since *what they are doing* is on the right track).

3. The use of Kapton voice coils (Altec used Kapton back in the 1960s and it worked well) suggests an understanding of key materials' importance.

We are genuinely impressed when we see engineering featured in a consumer advertisement and even more so when it represents valid advanced thinking. #

BASIC PHYSICS

We have run this data before but it is worthy of repeating. The expression of basic physical concepts in terms of base units can provide insights to the changes in matter that occur under the influence of external forces. #

DEFINITION OF BASIC PHYSICAL TERMS

FORCE

One KG moved one meter per sec per sec equals one ***Newton.***

KF = MA in S.I. K = 1.0 in U.S. K ≈ 32

$$N = \frac{KG \cdot M}{S^2} \qquad (M \cdot KG \cdot S^{-2})$$

WORK AND ENERGY

When we do work, we are said to expend energy. The energy a mass has due to position is called ***potential*** energy. The energy a mass has due to its motion is called ***kinetic*** energy.

Work (in ***Joules***) equals force (in Newtons) times distance (in meters).

$$W = F \times D = \frac{KG\ M^2}{S^2} \qquad (M^2 \cdot KG \cdot S^{-2})$$

PRESSURE

The amount of force that is acting on each unit area.

A pressure of one Newton per square meter equals one ***pascal.***

$$N/M^2 = pA = \frac{KG}{M \cdot S^2} \qquad (M^{-1} \cdot KG \cdot S^{-2})$$

POWER

The rate at which work is done is called the power (in ***watts***).

The power (in ***watts***) is equal to the work (in Joules) divided by the time in secs.

$$P = W/S = \frac{KG \cdot M^2}{S^3} \qquad (M^2 \cdot KG \cdot S^{-3})$$

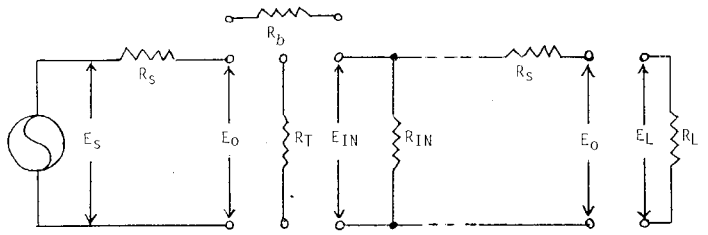
(746 watts = 1 H.P. = 58.73 dBm)

SOUND SYSTEM LEVEL MEASUREMENTS

When a mixer amplifier is connected to a power amplifier, the interface between them is called a "link circuit" as it "links" them together in the system chain. There exists a fundamental relationship between the voltages and resistances (or impedances) in such circuits. It is expressed mathematically as:

$$\frac{E_S}{E_{IN}} - \frac{R_S}{R_{IN}} = 1.0$$

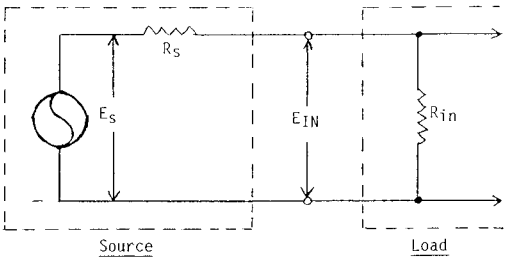
SOUND SYSTEM CIRCUIT DEFINITIONS FOR VOLTAGES AND RESISTANCES



E_S	Source Voltage	R_S	Source Resistance
E_O	Open Circuit Voltage	R	Build Out Resistance
E_{IN}	Input Voltage	R_T	Termination Resistor
E_L	Load Voltage	R_{IN}	Input Resistance
		R_L	Load Resistance

$$\frac{E_S}{E_{IN}} - \frac{R_S}{R_{IN}} = 1.0$$

WORKING WITH THE PARAMETERS OF E_S, E_{IN}, R_S AND R_{IN}



$$\frac{E_S}{E_{IN}} - \frac{R_S}{R_{IN}} = 1.0$$

$$E_S = E_{IN}\left(\frac{R_S}{R_{IN}} + 1\right)$$

$$E_{IN} = \frac{E_S}{\left(\frac{R_S}{R_{IN}} + 1\right)}$$

$$R_S = \left(\frac{E_S R_{IN}}{E_{IN}}\right) - R_{IN}$$

$$R_{IN} = \frac{R_S}{\left(\frac{E_S}{E_{IN}}\right) - 1}$$

SPECIAL NOTES

$E_S = E_O$

$$\frac{R_S + R_{IN}}{R_{IN}} = \frac{1}{R_{IN}}(R_S + R_{IN}) =$$

$$\frac{R_S}{R_{IN}} + \frac{R_{IN}}{R_{IN}} = \frac{R_S}{R_{IN}} + 1$$

If $R_S = R_{IN}$ $E_S = 2E_{IN}$

If $R_S << R_{IN}$ $E_S = E_{IN}$

Special Cases

When $R_S = R_{IN}$, then $2E_S = E_{IN}$. When $R_S << R_{IN}$, then $E_S \simeq E_{IN}$.

It is common practice in modern equipment to make R_S small and R_{IN} large, typical values being 130Ω for a Shure 267 and 50,000Ω for the input of a power amplifier such as Crown manufactures.

What Value Should A Mixer Amplifier's VI Instrument Read?

The VI instrument calibrated in VU should be reading the L_{AIP} which is correctly derived from the E_S and R_S of the mixer's output circuit.

$$L_{AIP} = 10 \text{ Log}\left(\frac{(E_S)^2}{0.001\ R_S}\right) - 6.02 \text{ dB}$$

When this is correctly done, variations in R_{IN} over very wide ranges of values should have no effect on the L_{AIP} reading on the mixer's instrument.

Calculating Gains and Losses

The gain or loss of any system component is found by subtracting from the L_{AIP} at its output the L_{AIP} of the preceding device. *Only in the case of the final power amplifier is the power dissipated calculated at the output of a device as a level.* All other devices have their available power calculated as the level.

$$L_{out} = 10 \text{ Log}\left(\frac{(E_L)^2}{0.001\ R_L}\right) \quad \#$$

ANSWERS TO QUESTIONS ON PAGE 18

CALCULATING AVERAGE AND ROOT MEAN SQUARE

$$E_{avg} = \frac{0.5x5x8+0.5x7x8+0+9x4}{23} = 3.65 \text{ V} \qquad E_{RMS} = \sqrt{\frac{2^2x2+(-4)^2x1+5^2x2+1^2x3}{8}} = 3.1 \text{ V}$$

Answer is the area under the curve. #

SYN-AUD-CON SPONSORS

Syn-Aud-Con receives tangible support from the audio industry, and eleven 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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Community Light & Sound, Inc.
Crown International, Inc.
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Neutrik Products
Shure Brothers Inc.
Sunn Electronics
Switchcraft, Inc.
TOA Electronics, Inc.