newsletter

SYNERGETIC AUDIO CONCEPTS

P.O. BOX 1134, TUSTIN, CALIFORNIA 92680

VOLUME 5, NUMBER 4
JULY, 1978

EDITORS: Don & Carolyn Davis

SYNERGETIC
Working together; co-operating, co-operative

SYNERGISM
Co-operative action of discrete agencies such that the total effect is greater than the sum or 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
New we each had two ideas

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SYNERGETIC AUDIO CONCEPTS

1978-79 SEMINAR SCHEDULE

Forget everything written in the last Newsletter about a new 4-day seminar schedule. We have decided against it. There are several reasons but the main one is that we felt that the charge we would have to make for the 4-day seminar would be more than we would want to charge. As it is, we must increase our charge to $400 for new attendees and $225 for graduates. Meeting room charges have gone up over 100% in many cases as have hotel rooms and meals for those attending.

Chicago - September 13-15
New York - September 26-28
DC - October 4-6
Atlanta - October 17-19
Orlando - Oct. 31-Nov. 2

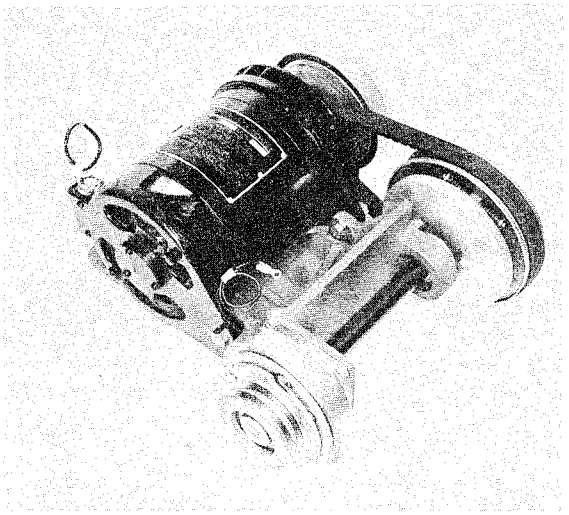
Tentative 1979
Anaheim - February 27-March 1
San Francisco - March 13-15
Salt Lake City - March 27-29
San Diego - April 10-12
Los Angeles - May 22-24

And, as mentioned in the previous Newsletter, Rauland-Borg is sponsoring three Syn-Aud-Con seminars in St. Louis, Orlando and Los Angeles during the Fall of 1978 for their dealers.

MANNY MOHAGERI'S NEW PRODUCT

Manny Mohageri of Emilar Corp is a very unusual man and I would be willing to go out on a limb and say that he is the equivalent of James B. Lansing to this generation. Both men represent the class of genius able to take ideas and turn them into sculptured metal in ways that are beautifully practical but that require breathtaking precision to accomplish.

Manny, not content with scaling audio's most difficult problem -- the high quality, high efficiency, high performance, high frequency compression driver -- is also directly involved in all types of space-age transducers through his Systems Magnetic Co.



Recently Manny and I were having lunch when he told me of another new product he is working on: a generator (30 amp output) designed to go under the hood of a car or truck and provide substantial electrical power, while the vehicle is essentially idling, for all remote or portable usage.

We run our country home's entire electrical needs from a 30 amp Onan generator. This unit, hidden under the hood, hence less likely to be stolen,provides reliable energy in a remarkably compact package. We are having one installed in our truck and hope to have it with us on the Fall tour. It means we can use Carolyn's microwave oven at lunch stops on the road (in our Airstream), our copy machine, etc. I can't imagine a rental outfit without one in every truck.

Price: $693.75. RMK Industries Inc., 2837 Coronado St., P O Box 6128, Anaheim, CA 92806 (714) 632-8900

ACTIVITIES AT CROWN INTERNATIONAL

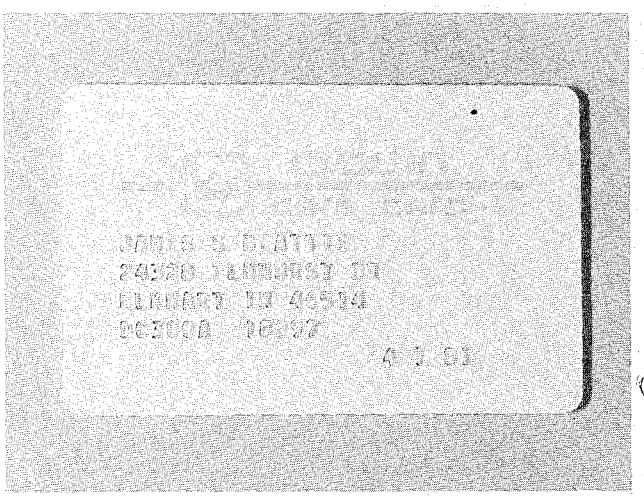
First of all, Crown is offering their new RTA-2 1/3-octave real time analyzer to Syn-Aud-Con graduates at a one-time-only price of $2,000 (whether you are a Crown dealer or not). Syn-Aud-Con considers that a remarkable buy.

Crown has just introduced their "Care" card. Normally, one of these plus 50¢ will buy a cup of coffee. This one is different.

"Each Crown component must meet or exceed all published specifications for a period of three years. If it doesn't, Crown will repair or replace the unit at no cost to the customer. In addition ALL ROUND TRIP shipping charges are covered as well as a complimentary shipping carton, if needed."

It is evident that Crown is serious about providing service, insight, and certifiable performance to the professional sound field.

As mentioned before in our Newsletters and Tech Topics, we consider their I.O.C. technique as an indispensable tool whenever high sound levels are to be generated with a minimum of distortion.



SPECIAL OFFER TO SYN-AUD-CON GRADUATES ON REAL TIME ANALYSER - 2,000

Syn-Aud-Con is pleased that Crown International has chosen to recognize Syn-Aud-Con graduates as deserving of special consideration when it comes to professional acoustical measuring equipment.

Syn-Aud-Con considers $2,000 for the Crown RTA-2 an exceptional buy. When compared to the HP 8050A developed by Hewlett Packard in conjunction with Don Davis in 1972, its remarkably high performance at a very low price is easily seen.

ALTEC-HP 8050A	CROWN RTA-2
20 dB vertical display	30 or 60 dB vertical display, switchable
40 to 16,000 Hz frequency response	16 to 20,000 Hz frequency response
Uncalibrated input attenuator	Calibrated input attenuation
1/3-octave filters	1/1 or 1/3-octave filters
2 integration rates	4 integration rates
No noise source	Pink noise source internally available
Can not be used as an oscilloscope	Can be used as an xy oscilloscope
Price (1972) $2250. (Dealer cost almost $3,000 before withdrawn)	Price (1978) $2000

TO: CROWN INTERNATIONAL
1718 W. Mishawaka Road
Elkhart, IN 46514

SYN-AUD-CON GRADUATE POLICY

CROWN will sell direct to any United States of America Syn Aud Con graduate of or his supporting company, one (1) only RTA at a cost of $2,000 through December 31st, 1978. Orders from Syn And Con graduates must be accompanied with a check in advance. They are suggested to call before placing their orders so that we can assign an approximate delivery time to them. This way their money is not tied up for a large amount of time.

I have read CROWN's Syn-Aud-Con Graduate Policy statement and in order to purchase an RTA-2 must provide the following information:

NAME:_____

ADDRESS:_____

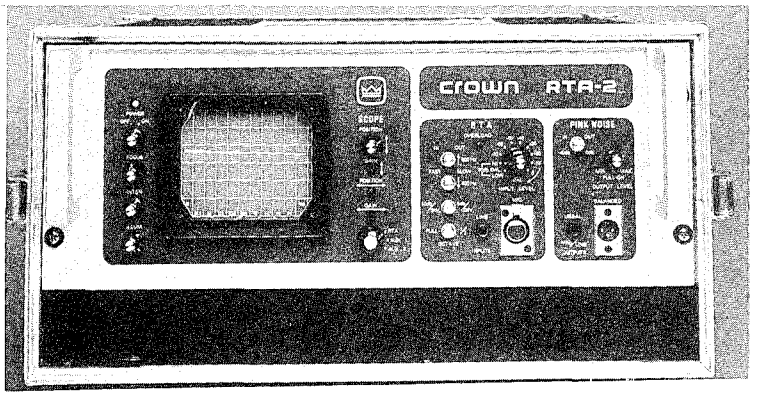
CITY & STATE:_____ ZIP:_____

DATE OF SYN-AUD-CON GRADUATION:_____

_____
SIGNATURE

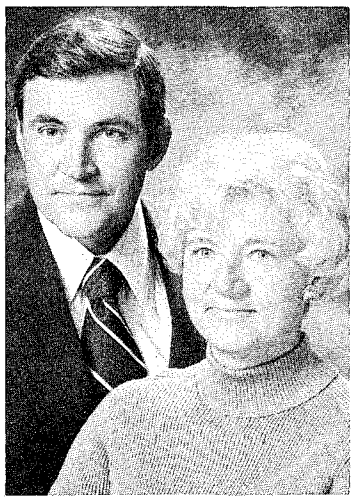
_____
TODAY'S DATE

NOTE: YOUR RTA-2 must be paid for at time of order. Before you send a check, it is suggested that you call (219) 294-5571, Cinda Pittman, for a firm delivery time.



Syn-Aud-Con has used the RTA-2 in several classes and found it to be ideally suited for equalization measurements. The display is easy to view for long periods of time, the unit ships well by air (we used one in the Vancouver class this Spring that came as baggage with DENNIS BADKE).

We feel that it is unlikely that Syn-Aud-Con graduates will be offered anything remotely like this array of features at this price in the near future cd



ACHIEVEMENT AWARD

Don & Carolyn were the recipients of the Upper Midwest Chapter of the Acoustical Society of America Annual Achievement Award at their awards banquet in Minneapolis on May 25, 1978.

The award was "In recognition of notable contributions to audio engineering by developing and promulgating a unified engineering approach to sound system design."

Don and Carolyn were present to receive the award and personally thank the members for the recognition of their work.

SYN-AUD-CON LICENSED TO TEACH TDS

Syn-Aud-Con is pleased to announce that we have received a license from the California Institute Research Foundation to engage in the practice of time delay spectrometry (TDS) under U.S. patent NO. 3,466,652. This is the patent that resulted from the work done by Richard Heyser of Jet Propulsion Laboratories.

Syn-Aud-Con is not only licensed to build a TDS analyzer and use it in the practice of TDS but received a special endorsement for instructing others in its audio applications: "have the right to discuss this system and instruct others in its capabilities and mode of utilization...with the further proviso that ....the recipients of such information are not authorized to use the system unless they acquire a license or utilize instruments acquired from a licensed manufacturer".

Since there are, at this time, no licensed manufacturers, the sole means of legally practicing TDS is through an individual license issued by the California Institute Research Foundation. Cost of license is a nominal $100.

Syn-Aud-con has found a method of TDS for less than $4,500 that is portable (35 lbs-battery operated), requires no modification of the basic instrument and uses off-the-shelf auxiliary equipment. Best of all, this new analyzer does a better job than the highly modified unit demonstrated in class last year and again serves as a full wave analyzer in addition to its TDS usage. Thus, in one year, the price, weight and accessibility of TDS measurements is a problem 1/3 the size it was a year ago. We are pleased that there are attendant gains in accuracy and versatility as well.

We sincerely feel that we are in the middle of another fundamental measuring improvement comparable to the acquisition of 1/3-octave real time analyzers and that TDS analyzers are the logical companions to use with the best of the new accurate and low cost 1/3-octave units.

All the necessary apparatus is available today from electronic instrumentation rental companies for very reasonable fees.

Syn-Aud-Con will be pleased to assist any graduate wishing to license under this patent, and we sincerely hope no one will attempt to practice TDS without doing so, to apply to the California Institute Research Foundation. If you are interested, write telling us so, include your check for $100 made to the California Institute Research Foundation. We have prepared a special set of instructions for doing TDS measurements that will be sent to each Syn-Aud-Con graduate who licenses. Our package of materials has a charge of $5 to cover cost of handling. We will make application for your license.

The present Syn-Aud-Con graduates who are licensed are (in the order issued):

Cecil Cable, Cecil Cable & Assoc., Edmonton, Canada
Don Davis, Syn-Aud-Con
Nelson Meacham, WED Enterprises, Burbank, CA
Richard Jamieson, Jamieson Assoc., Minneapolis
Al Feierstein, Acoustilog, New York

Current uses of TDS include but are not restricted to:

1. Obtaining direct sound spectra
2. Obtaining reflected sound spectra
3. Observing the effects of absorbent materials
4. Measuring transmission loss
5. Measuring direct-to-reverberant ratios
6. Measuring Q (directivity factor)
7. Observing anomolies produced by discrete multiple source combinations. (I can't imagine anyone working in the recording studio-control room environment, especially in a consultant capacity, being without TDS)
8. Determining the acoustic center

TDS is a very useful tool in the tool box. Used in conjunction with conventional 1/3-octave real time analyzers, it allows much greater insight into the acoustical behavior of small dead rooms, in particular.

For those of you who saw our early demonstrations of TDS last year, we have advanced remarkably from those simple applications. We will be writing more on TDS in the coming Newsletters.

LEASING TEST EQUIPMENT

Leasametric is a measuring instrument leasing company that specializes in Hewlett Packard test equipment. They maintain offices all over the U.S. and have toll free numbers for all areas away from the metropolitan areas.

For those of you who only require expensive test equipment less than three months per year, such rental equipment makes real sense. There are many companies in the business now. Check the yellow pages of your phone book, or read a current issue of Electronics Magazine for a listing and advertisements. In addition to renting equipment, most of the companies have good buys on used test equipment, and some will take one piece of equipment on trade for another, if you are wanting to upgrade your present equipment.

SYNERGETIC AUDIO CONCEPTS

THE PRESSURE RECORDING PROCESS (PRP)™

Ed Long and RON WICKERSHAM (we always put Syn-Aud-Con graduates in caps) have, as we have previously reported, been involved with a series of recordings issued under the name "Reference Recordings".

Reference Recordings have been made using special Bruel and Kjaer *pressure calibrated* ½-inch condenser microphones placed in opposition to a hard formica surface to form a pressure cavity. Group delay is stated to be less than 12 microseconds which we would intrepret to mean that the microphone's diaphragm was less than .16" from the formica. (With substantially smaller microphones we have been using spacing of .005" or approximately .37 usec and obtaining remarkable results.)

An excellent use of these recordings is to make subjective evaluations regarding time align™, TA, loudspeakers and live-end-dead-end, LEDE, control rooms. In the process of selecting monitor loudspeakers and in the listening tests of varying degrees of reflective properties and their effects on early reflection delay times, a recorded reference that can be relied upon is invaluable.

One example of the usefulness of having a standard reference: Having heard "Lo! Hear the Gentle Lark" as done by the Kotekan Percussion (RR3) with a near perfect capture of the spatial geometry of the group on the disc, played back over TA loudspeakers, we then took the record home and listened over non-TA loudspeakers. We could actually clearly hear the female soloist *in a different physical location* relative to the bass instruments when played back over the non-TA system. Also the remarkable sense of geometric "focus" was now slightly blurred.

When the same recordings are heard over TA loudspeakers in an LEDE configuration the results are more than impressive. CHIPS DAVIS re-did one of his control rooms in his recording studios in Las Vegas in the prescribed LEDE fashion and found that "there is a sense of being surrounded by live sound but with a sense of directivity detection normally felt only with headphones." Chips made still another comment, "Reaching a good mix was many times faster because you can hear what's happening in the studio."

First reports of this new technique all indicate that we have indeed uncovered a fundamental misconception in the previously accepted approaches to control room design.

The two Reference Recordings that we have found of the most use to us as of this date are: Kotekan Percussion and.. (Classic series RR-3) and Piano - Steven Gordon Plays Chopin (Classic Series RR-2)

With these recordings as your reference, you are freed from having to worry about how microphones were placed or misplaced, how much phase error was introduced in the electronics, etc. Here are two clean channels that have accurately recorded on them the true amplitude, time and phase relationships that really were present at the microphone locations minus any spurious anomolies caused by placing the microphones in that location. A very useful tool to say the least. That the performances are totally enjoyable and worthwhile as musical experiences is "icing on the cake."

Dick Heyser has pointed out that our five senses will accept the grossest degrees of distortion *until* a comparison allows the distortion to become instantly detectable and, thereafter, intolerable.

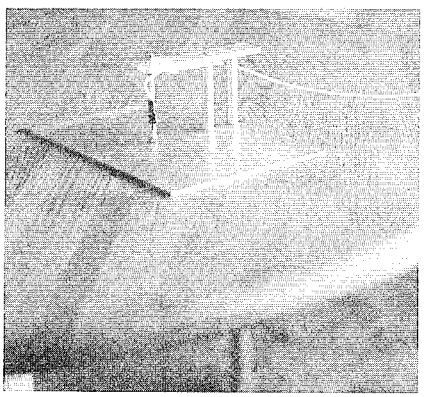
If satisfied at present with your 5-way monitor aimed at a dead rear wall in your too dead control room as you listen to your 32+ channels of signal sources processed through as many or more unknown phase or even polarity manipulators known as limiters, compressors, equalizers, noise reduction devices, etc., these PRP recordings listened to over TA loudspeakers in a LEDE control room will cause you untold grief, if not acute mental disorganization, as distortions you have learned to accept become warts on the end of your "aural" nose.

Reference Recordings can be purchased for $12 each at high fidelity shops specializing in outstanding recordings, or write Reference Records, P O Box 5046, Berkeley, CA 94705.

PRP MICROPHONY

For those of you interested in obtaining what we consider to be an exceptional PRP microphone setup, write: KEN WAHRENBROCK, 9609 Cheddar St., Downey, CA 90242.

Ken has pairs of PRP microphone systems (20 feet of cable on each microphone to a custom power supply - battery - and special transformers by Deane Jensen, along with connectors, power switch, etc. for $200 a pair. This price includes paying Ed Long and Ron Wickersham a licensing fee as the PRP concept belongsto them and is the "subject of a patent application".



We have tested this unique system and feel Ken's design is unusually well done. These pressure calibrated microphones are adjusted to .005 to .006 inches from the polished metal plate.

These are not cosmetically packaged units but rugged, accurate tool room designs that allow an experimenter to start right *now* with a pair of PRP units ready for the next recording session, stage production, conference system, altars in churches, in addition to being an exceptional recording microphone.

Ken's production capabilities are limited so it will be a case of first come-first served.

COMMENTS ON "AMPS, AMPS EVERYWHERE....."

ED LETHERT, Northwest Sound Services in Minneapolis, writes:

BILL PETERSON'S experience (January 1978 Newsletter, pages 20-21) with the portable generator powering several large amplifiers certainly made interesting reading. I was somewhat puzzled, however, by his explanation of the causes.

Two factors are apparent, I believe. 1) The five kilowatt generator has a finite output impedance and was designed to deliver only its rated output power. If it is loaded in excess of this maximum rating, then power transfer from source to load will rapidly deteriorate. 2) The prime mover, a gasoline engine, has a certain horsepower rating which was selected to supply the power needs of the particular generator. As the load demand exceeds the power producing capability of the unit, problems will surely develop.

When the same sound system load is connected to a properly designed electrical service, we now find that source impedance is no longer a problem. Current is now limited only by any overcurrent devices which are part of the circuit. Such a circuit is capable of delivering very high currents before protection devices trip. Also, circuit breakers usually have a built-in time lag and they will allow short duration excesses without tripping. There have been situations where a circuit breaker did not trip after the line had been completely and permanently short-circuited.

It is also worth mentioning that the energy required to handle "peaky transients" is supplied by the power amplifier's filter condenser. The condenser's energy requirements are then met by the power source, but replenishment takes place over a longer time period and at lower current levels.

One final point to remember is that watts RMS is not a valid or measurable quantity. The product of RMS volts and RMS amps gives AVERAGE watts (NOT RMS WATTS!).

NASA "TECH BRIEFS"

KARL KROPP of 3M Company in St. Paul has sent us several samples of NASA "Tech Briefs", (page taken from one of the samples reproduced here).

Karl informs us that it can take up to a year to hear from them after you send in the subscription, but the nature of the material is worth the wait and worth the effort of at least trying.

I sent in our subscription 6 months ago and haven't heard anything and can't be sure that I will.

In any case, if you want to try, write:

Director
Technology Utilization
P O Box 8757
Baltimore/Washington International Airport
MD 21240

We are told there is no charge for the publication.

If anyone has any information to help us obtain the NASA Tech Briefs, please let us hear from you.

Acoustic Testing of Materials

Sound-absorption coefficients can be measured with or without an anechoic chamber.

Langley Research Center, Hampton, Virginia

Most measurements of sound-absorption coefficients for oblique angles of incidence are either interference methods or are methods based on the determination of small differences between large signals. Interference methods are not suitable for testing materials with large absorption coefficients, as they rely on measuring wave-interference maximums and minimums that will be quite small if there is little reflection.

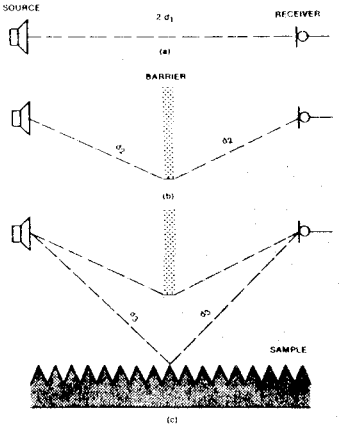
Difference techniques are either complex and expensive or are sensitive to small changes in geometry, tracking-amplification factor, and other variables. These drawbacks are overcome by a new method that is simple and accurate.

In this method, sound pressure-level recordings are made in an anechoic chamber with the configurations shown in the illustrations: (a) directly, (b) with a line-of-sight barrier, and (c) with a line-of-sight barrier and the sample in place. Without the barrier and sample, the output signal of the receiver, $p_1(f)$, is a function of distance d_1, the wave number in air, and F(f), a function describing the frequency dependence of the source/receiver system.

With the barrier in place without the sample, the receiver output, $p_2(f)$, is a function of d_2, F(f), the phase change due to the barrier, and $|B(f)|$, which is the absolute value of the barrier attenuation.

The receiver output with both the barrier and sample in place, $p_3(f)$, is a function of F(f), $p_1(f)$, d_3, the phase angle of the reflection factor, and $|R(f)|$, the absolute value of the reflection factor of the sample for the particular angle of incidence.

By properly combining the expressions for $p_1(f)$, $p_2(f)$, and $p_3(f)$, one can obtain expressions for $|R(f_{max})|$ and $|R(f_{min})|$, where the subscripts max and min represent the frequencies when the reflected and scattered signals are in phase (max) and 180° out of phase (min).



Configurations of the Source, Barrier, Sample, and Receiver are shown for measuring (a) direct response, (b) response with a barrier blocking the line of sight between source and receiver, and (c) response with the barrier and the sample in place. Positioning the lower edge of the barrier at a height equivalent to 1/2 wavelength at the cutoff frequency of the wedges [for the test case about 6 inches (15.2 cm)] prevents interaction effects.

$$|R(f_{max})| = \frac{d_3}{d_1}\frac{|p_3(f_{max})|}{|p_1(f_{max})|}\left[\frac{|p_3(f_{max})|}{|p_2(f_{max})|} - 1\right]$$

$$|R(f_{min})| = \frac{d_3}{d_1}\frac{|p_3(f_{min})|}{|p_1(f_{min})|}\left[1 - \frac{|p_3(f_{min})|}{|p_2(f_{max})|}\right]$$

The sound-absorption coefficient is by definition

$$\alpha(f,\Theta) \equiv 1 - |R(f,\Theta)|^2$$

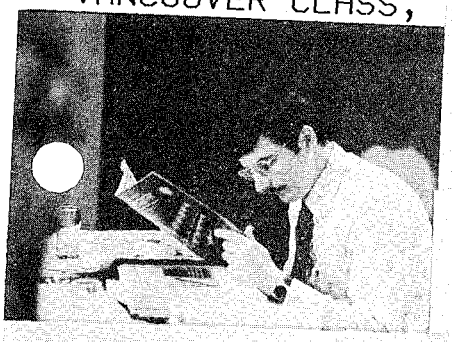
for angle of incidence Θ.

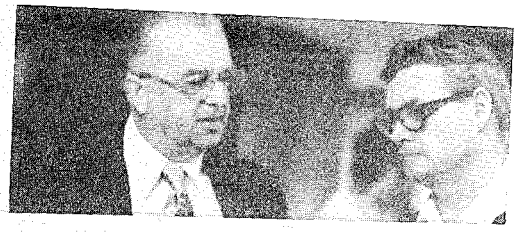
As can be seen from these expressions, the determination of α requires only the amplitudes of the sound pressure levels (easily recorded on a chart recorder) and d_1 and d_3. No phase information is needed, and the absence of d_2 indicates that the details of how the barrier attenuates sound are inconsequential.

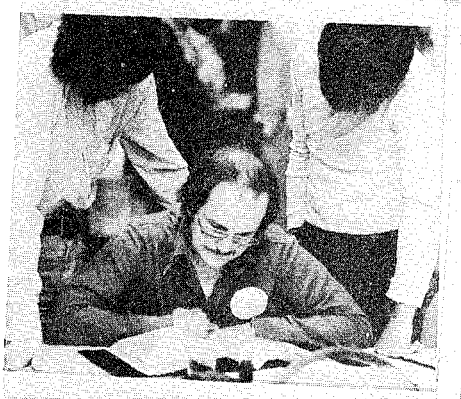
This technique could also be used for in situ measurements of α for concrete, gravel, ground, and other subjects that could not be placed in an anechoic chamber. The direct response of the source/receiver configuration is first recorded in an anechoic chamber at a convenient distance, d_e. From the resulting response curve, the responses for other distances, d_1, can be derived by a distance correction term. For application, one need record only the response curve for configuration (c).

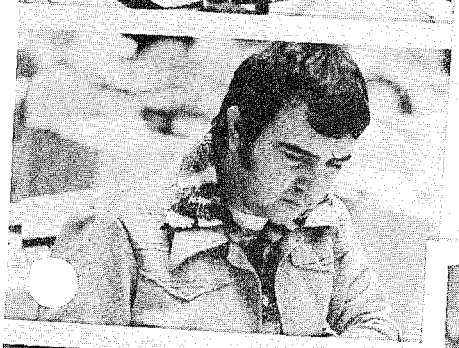
This work was done by Bolt Beranek and Newman Inc. for **Langley Research Center.**

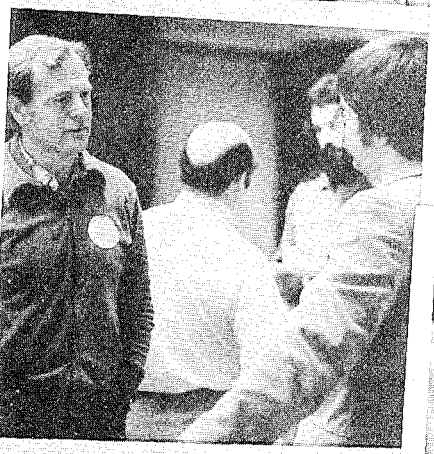
VANCOUVER CLASS,

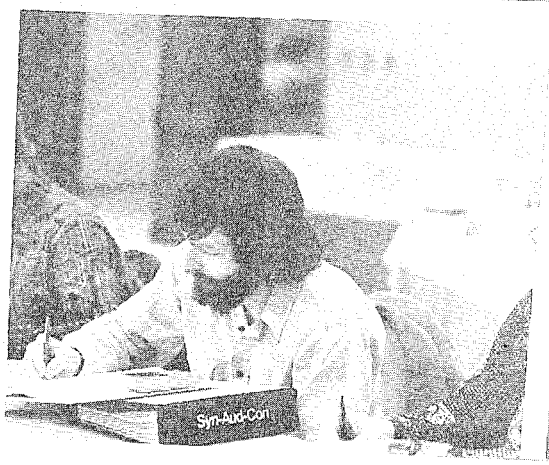












HOW SIZE OF MICROPHONE AFFECTS FREQUENCY RESPONSE

Most wide range (extended frequency response) microphones are of cylindrical shape with the diaphragm at one end. The physical size of the microphone causes diffraction of sound waves when the wavelength of the sound is not appreciably greater than the dimensions of the microphone.

The various responses start to diverge at the frequency at which the diaphragm of the microphone (D) is equal to approximately 1/10 of the wavelength (W) of the sound. $D = \frac{W}{10}$

Thus the frequency (f) at which the variation begins is $f = \frac{V}{10\ D^*}$ $\quad *10\ D = W$

Where V is the velocity of sound in ft/sec

For example, a 1/2" measuring microphone will begin to vary from omnidirectional, though only slightly, at

$$f = \frac{1130}{10\left(\frac{.5}{12}\right)} = 2712 \text{ Hz}$$

and will be down approximately 3 dB at 10,000 Hz.

There is no question that for smoothness of response in omnidirectional microphones the smaller they are the better. The problem usually revolves around the smallest diaphragm possible vs the lowest noise level, or put another way, the smaller the diaphragm the lower the microphone sensitivity.

Microphone diffraction effects are of critical importance in measuring microphones and it is because of this that we always recommend that you purchase a sound level meter with a microphone diaphragm *no larger than 1/2 inch*, and capable of being removed easily from the sound level meter for critical measuring work.

TRAVEL TIME OF SOUND

In the course of working with PRP™ (pressure response pickup) techniques we grew interested in how long it takes the sound striking the reflector first to travel to the diaphragm. Our very small Knowles microphone has been used at a distance of .005" from a reflector plate. Since sound travels 1130'/sec it then travels

$$\frac{1130'}{1\text{ sec}} \times \frac{1\text{ sec}}{1{,}000{,}000\ u\text{sec}} \times \frac{12"}{1'} = \frac{.01356"}{u\text{sec}}$$

Thus, a time interval of 12 $u$sec as quoted by Reference Records means that the sound traveled

$$12 \times .01356" = .16"$$

Conversely if I spaced a microphone .005" from a reflector the travel time would be

$$\frac{.01356"}{u\text{sec}} = \frac{.005"}{x\ u\text{sec}}$$

$$X\ u\text{sec} = .005\left(\frac{1}{.01356}\right) = 0.37\ u\text{sec}$$

Since frequency is $\frac{1}{T}$ then the frequency of one wavelength of this distance is

$$\frac{1}{.00000037} = 2{,}702{,}703 \text{ Hz}$$

and for 12 $u$sec

$$\frac{1}{.000012} = 83{,}333 \text{ Hz}$$

AMERICAN NATIONAL STANDARD FOR PREFERRED NUMBERS

Mahlon Burkhard of Industrial Research Products, Inc. recently sent us a copy of the American National Standard for Preferred Numbers in response to our interest in Renard numbers. The introduction to this document is most helpful.

> "Preferred numbers were developed in France by Charles Renard in 1879 because of a need for a rational basis for grading cotton rope. The sizing system that resulted from his work was based upon a geometric series of mass per unit length such that every fifth step of the series increased the size of rope by a factor of ten."

This document then goes on to develop the standard that results in the preferred number list found in SSE on page 174, table 9-4.

We are grateful to Mahlon as this data further elucidates the question asked by TIM GUHL of Syracuse, NY and discussed in the January Newsletter, Vol 5, No. 2, page 27.

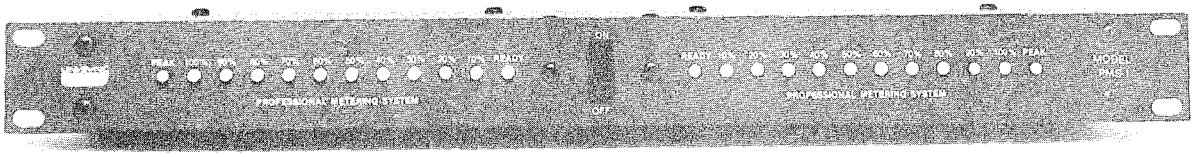
The standard includes how to handle metric absurdities such as a gear with 31.5 teeth (it suggests that the Renard number be rounded to 32 teeth in this case) and other internal inconsistencies inherent in the metric system under a subheading entitled, "Deviations from Preferred Numbers." These deviations often end up in good old fashioned English System intervals.

This standard is interesting reading (few standards are) and we are pleased to have it.

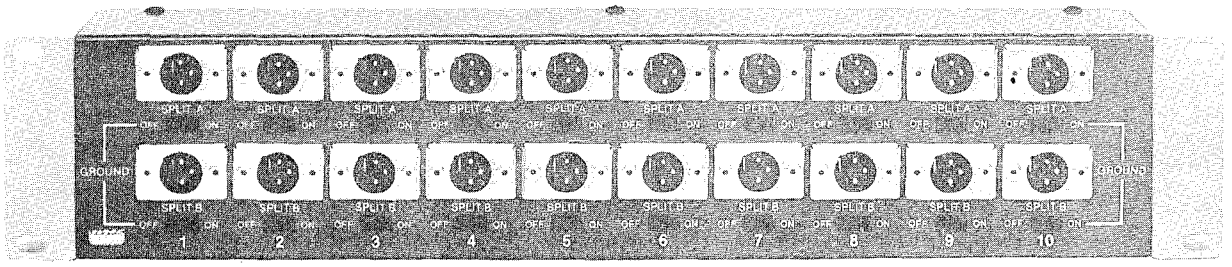
SYNERGETIC AUDIO CONCEPTS

UNI-SYNC

LARRY JAFFE, Vice President of Marketing at Uni-Sync, was in our 1978 LA class and he brought into the class a couple of pieces of Uni-Sync accessory items that should be of interest to Syn-Aud-Con graduates.

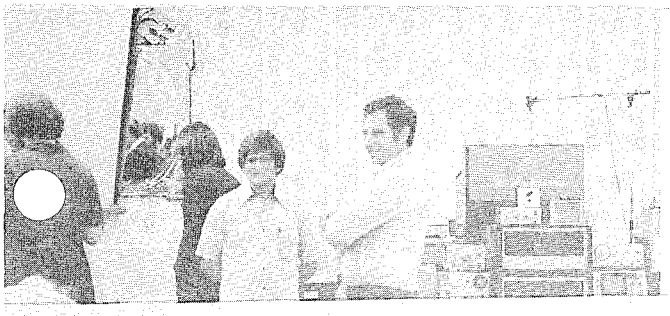


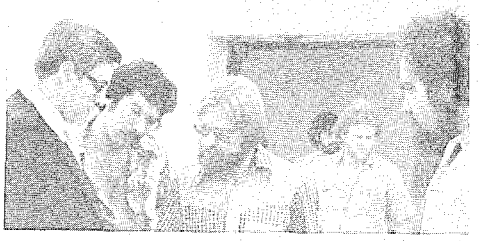
The first is a useful metering system that lets you add peak indication to an existing system, the PMS-1. It is capable of monitoring line levels or power levels either balanced or unbalanced. Price $149.



The second item is one that is usually difficult to find when you need one. The Uni-Sync 10x3 microphone splitter. From each of the ten units you can 1) go direct, 2) bridged output # 1, 3) bridged output # 2. Price $840.

LOS ANGELES CLASS, 1978





It takes real talent to louse up 2 rolls of film in one class, but I did! Sorry!
cd

CECIL CABLE JOINS ACOUSTICAL FIRM

As of March 1978 Cecil Cable joined a firm well known in the noise control field and is heavily involved in community noise surveys, field testing of new dwellings, etc. The work has many interesting challenges for Cec and opportunities for him to further his knowledge.

We'll miss Barb and Cec on the Syn-Aud-Con tour - as will everyone who had the opportunity to get to know them. Cec's enthusiasm in the Q discussions and TDS were infectious. His pioneer work with TDS laid the groundwork for the industry and for that we can all be grateful.

PHILOSOPHY LESSON

In an advertisement in Electronics Magazine recently the following quote from James Allen was employed: "You are today where your thoughts have brought you -- you will be tomorrow where your thoughts take you."

Hewlett Packard's Key Notes publication (for users of their programmable calculators) refers to the users of such calculators as "Homo Programmus."

Man was "Homo Programmus" long before calculators or even mathematics was thought of. From time immemorial there have been those who studied what happens and why by gathering experience, weighing it, recording it, if only in memory and through verbal tradition, and expanding this combination of record and experience until insights, unattainable by only one of these tools, but synergetically accessible when brought into a growing program against which new experiences can be measured and evaluated, and most important of all, be continuously modified. In contrast, there are those who prefer not to measure, collect, or correlate. The following poem by Kipling gives both groups food for thought.

THE GODS OF THE COPYBOOK HEADINGS

As I pass through my incarnations in every age and race,
I make my proper prostrations to the Gods of the Market-Place.
Peering through reverent fingers I watch them flourish and fall,
And the Gods of the Copybook Headings, I notice outlast them all.
We were living in trees when they met us. They showed us each in turn
That Water would certainly wet us, as Fire would certainly burn:
But we found them lacking in Uplift, Vision and Breadth of Mind
So we left them to teach the Gorillas while we followed the March of Mankind.
We moved as the Spirit listed. They never altered their pace,
Being neither cloud nor wind-borne like the Gods of the Market-Place;
But they always caught up with our progress, and presently word would come
That a tribe had been wiped off its icefield, or the lights had gone out in Rome.
With the Hopes that our World is built on they were utterly out of touch.
They denied that the Moon was Stilton; they denied she was even Dutch.
They denied that Wishes were Horses; they denied that a Pig had Wings.
So we worshipped the Gods of the Market Who promised these beautiful things.
When the Cambrian measures were forming, They promised perpetual peace
They swore, if we gave them our weapons, that the wars of the tribes would cease.
But when we disarmed They sold us and delivered us bound to our foe,
And the Gods of the Copybook Headings said "Stick to the Devil you know."

On the first Feminian Sandstones we were promised the Fuller Life
(Which started by loving our neighbor and ended by loving his wife)
Til our women had no more children and the men lost reason and faith,
And the Gods of the Copybook Headings said: "The Wages of Sin is Death."
In the Carboniferous Epoch we were promised abundance for all,
By robbing selected Peter to pay for collective Paul;
But, though we had plenty of money, there was nothing our money could buy,
And the Gods of the Copybook Headings said: "If you don't work you die."
And the Gods of the Market tumbled, and their smooth-tongued wizards withdrew,
And the hearts of the meanest were humbled and began to believe it was true
That All is not Gold that Glitters, and Two and Two make Four--
And the Gods of the Copybook Headings limped up to explain it once more.

****

As it will be in the future, it was at the birth of Man--
There are only four things certain since Social Progress began:-
That the Dog returns to his Vomit and the Sow returns to his Mire,
And the burnt Fool's bandaged finger goes wabbling back to the Fire;
And that after this is accomplished, and the brave new world begins
When all men are paid for existing and no man must pay for his sins,
As surely as Water will wet us, as surely as Fire will burn,
The Gods of the Copybook Headings with terror and slaughter return!

Contributed by my good friend, Ron Hall

And, it was Kipling that said, "They followed all they could follow but they couldn't follow my mind, so I left them sweating and stealing a year and a half behind."

GRIN

GORDON WOLFE, Otto K. Olesen Electronics in LA area, sent in the following quip, "If God wanted us to use the metric system, He would have given us 10 deciples instead of 12 disciples."

THE INTERACTION OF Q, $S\bar{a}$, Wa

THE INTERACTION OF Q, $S\bar{a}$, Wa ON THE RATIO OF DIRECT-TO-REVERBERANT SOUND LEVELS

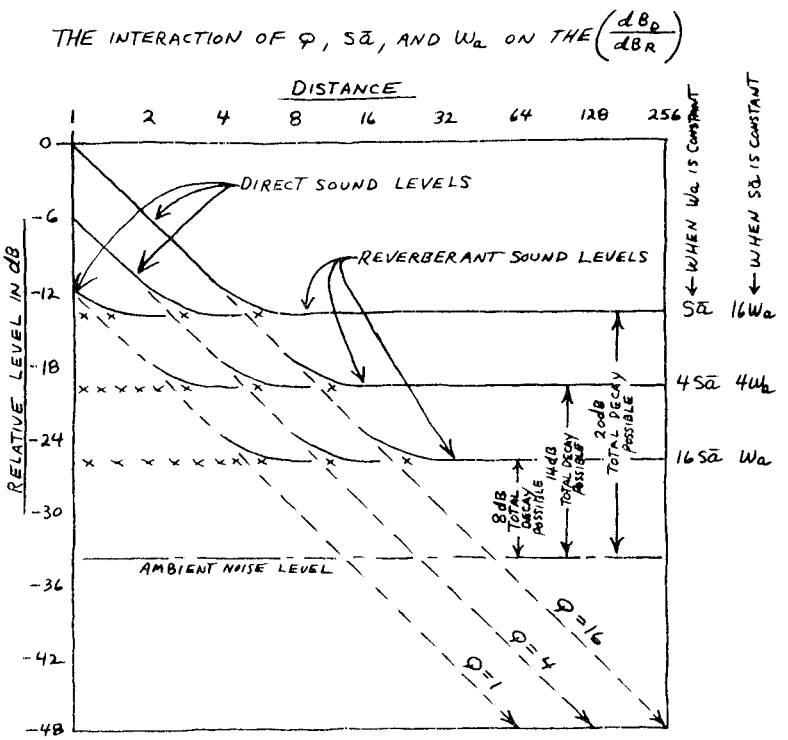
With the advent of high Q horns (Qs up to 100 at 2000 Hz) the relation of Q (directivity factor), W_a (acoustic watts), and $S\bar{a}$ (the total absorption in sabins) to each other and to the ratio of the direct sound level to the reverberant sound level (dB_D/dB_R) becomes of interest.

The Desired Ratio of Direct-to-Reverberant Sound

Thanks to the research of VMA Peutz on the articulation loss of consonants ($\%AL_{cons}$) we now know that a knowledge of the ratio of the direct sound level to the reverberant sound level (dB_D/dB_R) describes the $\%AL_{cons}$ in rooms with a reverberation time in excess of 1.6 secs ($RT_{60} \geq 1.6$ secs) and a signal to noise ratio of 25 dB (S/N $\geq$ 25 dB). In typical public buildings with RT times from 1.6 to 10 seconds, a dB_D/dB_R of 0 to -10 dB is required. Thus the desired ratio is easily calculated today by means of the Peutz equations. Built right into the Peutz equations is Q, $S\bar{a}$, and indirectly, W_a (through the need to achieve a minimum S/N).

What Happens When You Raise Q?

Figure # 1 can be used to illustrate these interactions we are discussing. We can observe that a loudspeaker with a Q = 1 at a distance equal to 1, the direct sound level is at a relative -12 dB and the reverberant sound level is at a relative -14 dB. For a Q = 4, the relative level of the direct sound at 1 is -6 dB and for a Q = 16, the relative level at 1 is 0 dB. Raising the Q raises the level of direct sound at a given observation point. Note that as long as $S\bar{a}$ ($S\bar{a} = S\bar{a}$) and W_a ($W_a = 16W_a$) remain the same, only the direct sound level rises, leaving the reverberant sound level as it was.



Note, too, that the level difference between the reverberant sound field and the ambient noise level allows a total of 20 dB of decay (if this were a 9 sec room at this frequency, then we would have 3 secs of decay before it merged into the ambient noise level.

$$\frac{9 \text{ sec}}{x \text{ sec}} = \frac{60 \text{ dB}}{20 \text{ dB}} = 3 \text{ sec}$$

Using a High Q Effectively
Or, What Happens When You Lower W_a?

Let's suppose for a moment that a Q = 1 gives a sufficient ratio of dB_D/dB_R but the area being covered would allow us to use a higher Q (for example a Q = 16). Since a Q = 16 delivers 12 dB more direct level than we require at a power of 16 W_a, we could reduce the power 12 dB and still have the dB_D/dB_R that the Q = 1 provided. The benefit? The reverberation sound field is lowered 12 dB as well. This leaves only 8 dB of total decay possible, or

$$\frac{9 \text{ sec}}{x \text{ sec}} = \frac{60 \text{ dB}}{8 \text{ dB}} = 1.2 \text{ secs}$$

Subjectively this 9 sec RT_{60} room *would sound less reverberant* with the higher Q device even though the RT_{60} technically has not changed. What has changed is the length of time the decay is audible.

What Happens When You Raise $S\bar{a}$?

Again, studying the illustration it can be seen that either lowering W_a or raising $S\bar{a}$ results in a lower level reverberant sound field. It is necessary to remember that raising $S\bar{a}$ will usually lower the ambient noise level, thereby reducing the subjective sense of a shorter reverberation period that is audible.

Optimization of These Parameters

The choice of Q and $S\bar{a}$ in order to achieve intelligibility while maintaining an acceptable ambient noise level provides natural constraints on the choice of Q. Normally $S\bar{a}$ should be no greater than that required to control the ambient noise level. Additional dB_D/dB_R should be obtained by raising Q whenever possible. In large public buildings where the area to be covered by sound is so large as to preclude the use of high Q devices then $S\bar{a}$ must be increased at the expense of needing greater W_a.

Because W_a determines the reverberant sound level when $S\bar{a}$ is a fixed parameter, it is important that multiple speaker systems supply equal powers to the reverberant sound field and adjust their direct sound levels by means of Q.

When each of these parameters is optimized, system performance benefits.

IVIE ELECTRONICS IE-17A

Ivie first showed their new IE-17A microprocessor at the West Coast AES convention in May. This unit, according to preliminary data, will help you measure:

1/3 octave RT_{60}
1/1 octave RT_{60}
Room/time delays
Articulation losses
Room reflections
Time delay spectrums

among many possible uses in conjunction with the Ivie IE-30 spectrum analyzer.

We often talk in Syn-Aud-Con classes about the fact that audio has had very little new input since Western Electric and Bell Labs early work.

Now we are seeing almost "future-shock" change, due in part to the fall-out from our space race.

We also talk in class about the fact that Hewlett Packard and their likes are not interested in our little underdeveloped, under-exploited market, but *their engineers are*.

Such companies as Ivie Electronics have several on their staff from Hewlett Packard. Engineers from such companies are going to up-end our sleeping industry.

The new IE-30A spectrum analyzer and the IE-17A (a microprocessor controlled audio analyzer) are contributing to our audio revolution.

We haven't had an opportunity to test either of the new units and will enjoy doing so as soon as Ivie gets out of their back order position.

Acceptance of the Ivie units at AES was quite high and I'm sure all of you will be seeing them in the field in the very near future. We intend to have the IE-30A in our Fall classes.

cd

ALTEC-HP 8050A REAL TIME ANALYSER FOR SALE

$1900 (Nineteen hundred) for our Altec-HP 8050A real time analyzer. It has had excellent maintenance and service and it has no known problems. It obviously isn't the best buy on the market (see write up of special offer from Crown) but if an 8050A is what you have always wanted this is a good buy. Contact Syn-Aud-Con.

COMMUNICATIONS CO. ARA 412A REAL TIME ANALYSER

VIC HALL called to say that he has upped the production considerably on their ARA 412A and are able to reduce the selling price to $1,100. This is the model that works into a separate scope. $1,100 makes the ARA 412A the most reasonably priced 1/3-octave real time analyzer available. Their service record and customer satisfaction has been good.

A STUDY GUIDE TO SOUND SYSTEM ENGINEERING

SAM ADAMS, recently retired from the Sound Branch of the US Army Infantry School in Fort Benning, GA, has performed a very valuable service for Syn-Aud-Con graduates who want to get practice working the formulas on the slide rule and the HP and TI calculators. He has put together a "Study Guide" for the test questions and answers that are on pages 281-288 of Sound System Engineering.

The first Tech Topic, Vol 4 # 12, was published July 1977, and each quarter we publish a new one. If you are interested in working these problems, don't fail to use Sam Adam's Study Guide.

KLIPSCH PAPERS

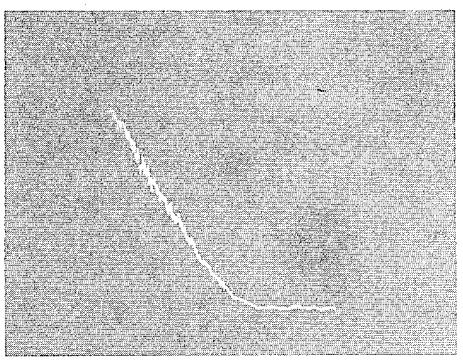
Paul Klipsch of Klipsch and Associates sells a three-ring binder containing 22 papers (maybe more now) by Mr. Klipsch (many of timeless interest) plus the reprint of Bell Telephone Laboratories' *Symposium on Auditory Perspective* and W. B. Snow's *Basic Principles of Stereophonic Sound*. We believe that the entire package at $10. represents a fantastic bargain in today's overpriced world of mediocre work. As Paul Klipsch is fond of pointing out, fundamentals don't change.

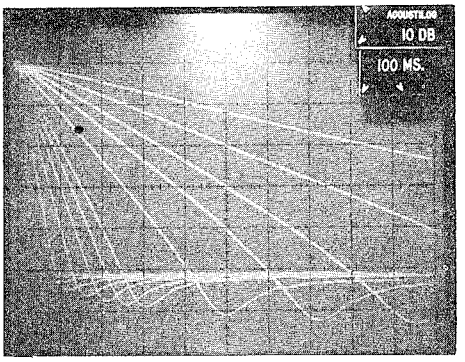
Paul Klipsch received the Silver Medal from the Audio Engineering Society this Spring. We all asked the same question in unison, "How come not the gold?"

ACOUSTILOG REVERBERATION TIME MODIFICATION

AL FEIERSTEIN of Acoustilog, New York, has developed a modification of his 232 Reverberation Timer that we consider extremely useful. The option, listed as "09", provides a true RMS logarithmic signal for displaying the *decay curve* on an oscilloscope. A log output for the signal and a pulse output for triggering the scope is provided.

Our unit was modified by Al during the Los Angeles AES convention and we gave it a tryout during the Los Angeles Syn-Aud-Con class the week after AES. It performed accurately and usefully. We not only obtained RT_{60} measurements that agreed directly with other measuring methods, but we were able to view the echo patterns in the decay slope because of flutter echos present in the classroom that were clearly audible. (See first photo).





The spacing on the time scale of the oscilloscope makes identification of the distance between the walls causing the echos to be easily determined.

The second photograph shown is taken from Al's calibration instrument that gives the instrument a calibrated decay to read plus a display of the decay from the log amp of the instrument.

Our feeling is that this improvement in this particular unit is of significant importance when exploring rooms too dead, of questionable geometry, or where dual decay rates are involved.

SOME BASIC ACOUSTIC PARAMETERS

Sound is the disturbance of air molecules in a certain fashion. Because the air has elasticity and density, the propagation of the disturbance travels at a finite rate. The molecules being disturbed (displaced) will exhibit a maximum amplitude (max A) of displacement, a velocity of the displacement, and a frequency of displacement.

In the propagation of sound (viewed as a wave) the molecules do not travel but simply oscillate back and forth about a mean position and transmit their energy to distant molecules by successive collisions.

We are able to measure this molecular activity as a pressure generated by the ensemble of molecules that are set in motion by a sound source. The molecular motion will have the same frequency and the particle displacement will have the same amplitude as the sound source.

Shown below are some of the basic relationships between the displacement amplitude of the molecules, their frequency, the density of air, and the velocity of sound in air.

These equations are rarely employed as shown but they do allow you to relate the mechanical energy action of the molecules to the concept of acoustic power in watts and to see that the acoustic watt requires the same basic energy per unit of time as does the electric watt.

$$\text{intensity} = \frac{\text{energy}}{\text{area x time}} = \frac{\text{power}}{\text{area}}$$

$$\text{power} = \frac{\text{energy}}{\text{time}} = \text{intensity x area}$$

These are basic physical relationships and are used in mechanics, electricity, acoustics, chemistry,etc.

$$P_{RMS} = 2\pi f A \rho c$$

Where: P_{RMS} is the root mean square sound pressure in pa (N/M^2)
f is the frequency in Hz
A is the root mean square amplitude of the air molecule in M
ρ is the density of air in Kg/M^3
c is the velocity of sound in M/sec
ρc is the acoustic characteristic resistance in Rayls (406 Rays for air at sea level)
I_a is the acoustic intensity in W/M^2

Thus

$$I_a = 4\pi^2 f^2 A^2 \rho c = \frac{P_{RMS}^2}{\rho c} \text{ (at r**)} = \frac{W}{4\pi r^2}$$

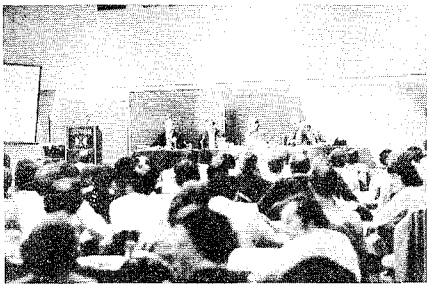
$$A^* = \sqrt{\frac{I_a}{4\pi^2 f^2 \rho c}}$$

$$\text{dB-SPL} = \left(\frac{P_{RMS}}{20\mu PA}\right)$$

*Max A = $A\sqrt{2}$

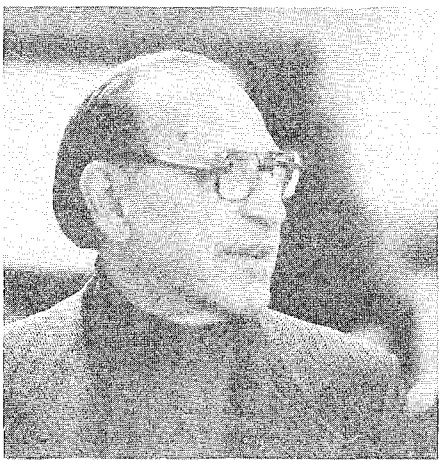
**r is the distance from the sound source in M

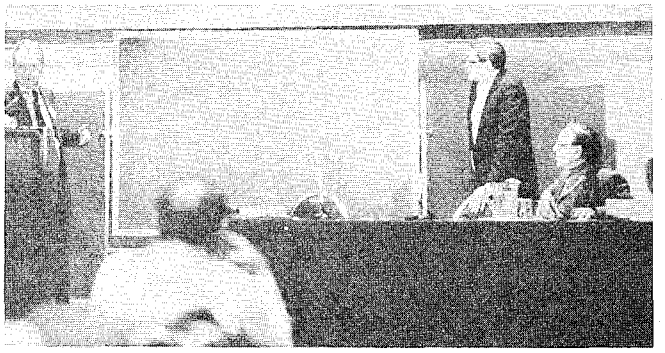
1978 SPECIAL GRADUATE SEMINAR



ATTENDANCE? Over 100 Syn-Aud-Con graduates

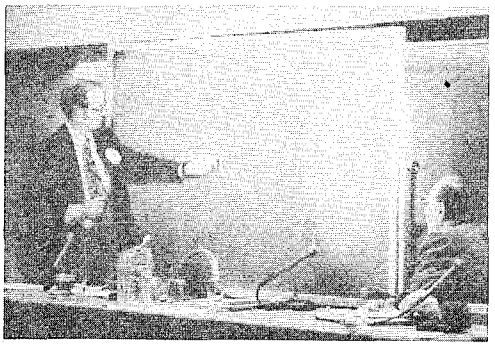
WORTHWHILE? Ask a graduate.



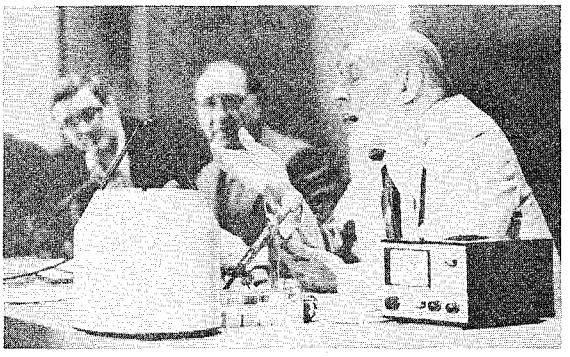


VICTOR PEUTZ described a variable acoustic that could alter volume, surface area, absorption, diffusion and reflection dynamically during a piece of music being played by an orchestra over a range of reverberation times from .5 sec to 5 secs. (Only one of a vast number of concepts that Victor Peutz shared.)

HISTORY by John Hilliard



DICK HEYSER'S contribution can best be visualized when you read his definition of mathematics on page 17, which issued spontaneously during his morning talk.



JAMES MOIR demonstrated his power level measurement device made by B&K and gave valuable hints on the use of double decay slopes as a means of achieving better compromises in rooms where both speech and music must be handled.

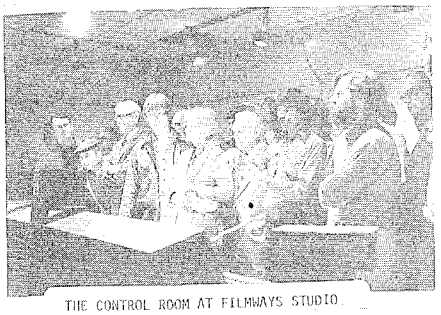
APRIL 30 GRADUATE MEETING, continued

Carolyn and I have just finished listening to the four 90 minute tape cassettes that were recorded during this meeting. The price of the tapes is $15 per set for those who attended; $25 for those who didn't. There will be only one production run and the quantity will be determined by the orders received on the attached order form. Payment must accompany your order as we will not bill you.

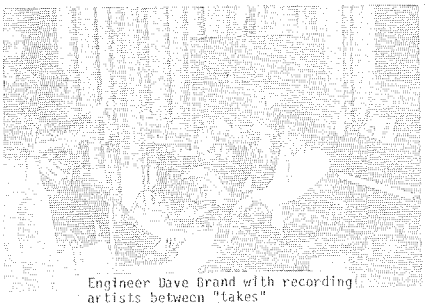
Data from this meeting will be appearing in Newsletters for quite some time as we assimilate more of it ourselves.

Each graduate attending the meeting received one of our new Syn-Aud-Con belt buckles.

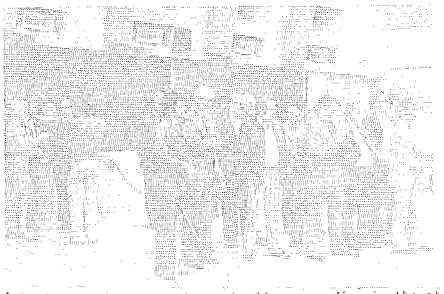
In the evening after dinner we bussed over to the Heider-Filmways sound stage and heard a live vs recorded PRP-TDS demonstration. LARRY ESTRIN, president of Filmways Audio Group, produced a highly skilled crew who took a *verbal* description of PRP and "live end-dead end" (LEDE) and worked out a first approximation of how to do this kind of recording. Filmways' assistant chief engineer, DAVE BRAND and recording engineer Grover Helsley proceeded from "you've got to be kidding" when first presented the idea of PRP to a live vs recorded demonstration in the studio -- all in less than 24 hours.



THE CONTROL ROOM AT FILMWAYS STUDIO.



Engineer Dave Brand with recording artists between "takes"



Listening to the playback of the live recording in the studio.

(A side note on all this it that CHIPS DAVIS, Las Vegas sound man and recording engineer, has built the first LEDE control room. We'll report more on this remarkable event in the next Newsletter. Chips' results are better than hoped for and we are indeed in a new era.)

Don Davis and Grover Helsley

At the end of our recording session at Filmways, the engineer who did the mix introduced himself to me with "you don't remember me but I was the engineer who worked with you at the RCA studios 10 years ago when you made the original Acousta-Voicing equalization record." (When we started Acousta-Voicing there were no real time analyzers)

The ultimate measure of this meeting is in what happens within the thought of those who attended. Early feedback indicates that this gathering will result in remarkable effects during the coming year. We'll be pleased if that happens.

CASSETTE RECORDINGS OF THE SPECIAL GRADUATE SEMINAR NOW AVAILABLE

Those of you who were able to attend the special graduate meeting on April 30, 1978 already know what remarkable "mental chemistry" these tapes contain. You all know the difference between reading *Sound System Engineering* by yourself as compared to using it in class where questions can be asked and the tone of voice, inflections, and other verbal clues that are present can be listened to.

Our lecturers at this seminar were like men scattering precious gems, like seeds to the wind. The printed word hardly does justice to the way Dick Heyser delivers it on the tape but here's a sample of what happened as a side comment at one point in the day:

Most of us think of mathematics as those chicken tracks - little wiggle signs. That isn't math! - that's the fossil remnants of a thought.

The thought is the math. It is the structured reasoning that is the math. And when you start taking things we refer to as common sense and observation and you begin to structure that in a reasoning mode - that's math.

The axioms and postulates of that which most of us would call common sense - that's math! When it's dried up and withered and appears as little chicken tracks on a piece of pater - that ain't math! - that's just the residue of it - just a shorthand that lets people know that a mind went past here on this page.

Math is structured reasoning.

Many of the ideas presented were to the casual listener simple basic ideas, but upon listening to them quietly on the tape it is realized that the basics discussed in that lecturer's context have profound ramifications.

Victor Peutz has the ability to deliver vital new concepts in such an understated way that one finds himself many times saying, "Wait, back up and say that again". That is what makes the tapes so valuable. You can do that.

A full set of the tapes - four (4) 90-minute tapes - is $15 for those who attended the April 30 meeting and $25 for those who did not.

This offer is based upon our receiving sufficient orders to cover the basic duplicating costs. If insufficient orders are received, your money will be refunded to you. Therefore, it is important that *if* you wish a set of these tapes that you place your order *now*.

DETACH AND MAIL THIS PORTION

SPECIAL GRADUATE SEMINAR TAPE ORDER FORM

SET OF FOUR (4) TAPES - $15/SET FOR ATTENDEES*
$25/SET FOR NON-ATTENDEES*

*ORDER MUST BE ACCOMPANIED BY PAYMENT

TO: SYNERGETIC AUDIO CONCEPTS
P. O. BOX 1134
TUSTIN, CA 92680

Don - I wish to order_____sets of cassette tape recordings of the April 30, 1978 Special Graduate Seminar.

I did__/did not__ *(check one)* attend the Seminar.

☐ Check enclosed in amount of _____
(Check may be made to SYN-AUD-CON)

☐ Charge my Master Charge, Visa, BankAmericard
Account No._____ Exp._____

Name_____

Address *(if different than shipping address)*

_____ _____

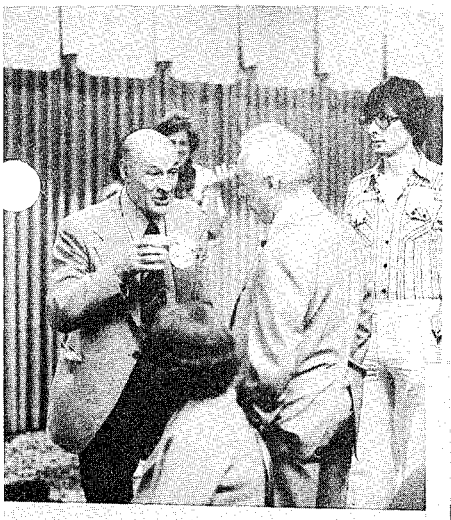
PLEASE SEND TAPES TO:

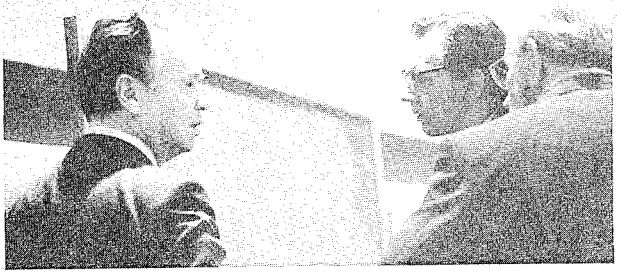
NAME:_____

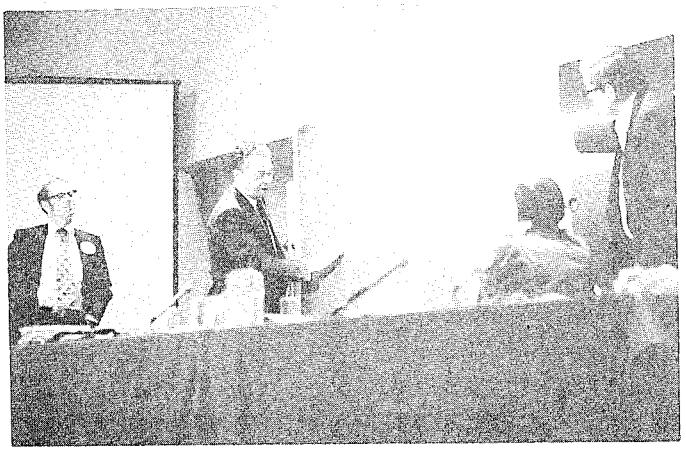
COMPANY:_____

ADDRESS:_____

CITY, STATE & ZIP_____







GENRAD CATALOG, 1978

The latest GenRad catalog, 1978 has its usual interest to all users of acoustic and electronic instrumentation. This year there is an excellent tutorial section on Impedance measurements (pages 11-16) in addition to their complete line of bridges and meters.

For further information, write: GenRad, 300 Baker Ave, Concord, MA 10742, and ask to be placed on their mailing list.

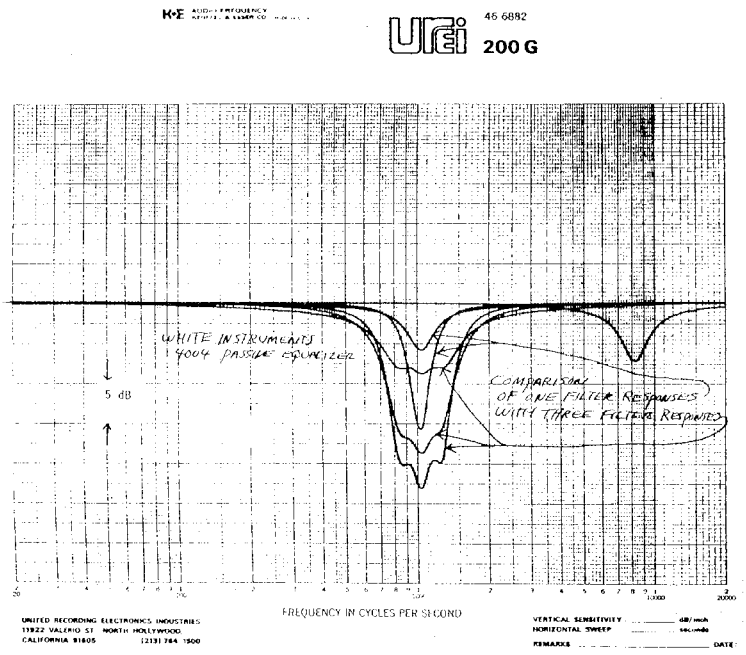
Featured in the vast array of acoustical instruments is their new 1995 integrating real time analyzer.

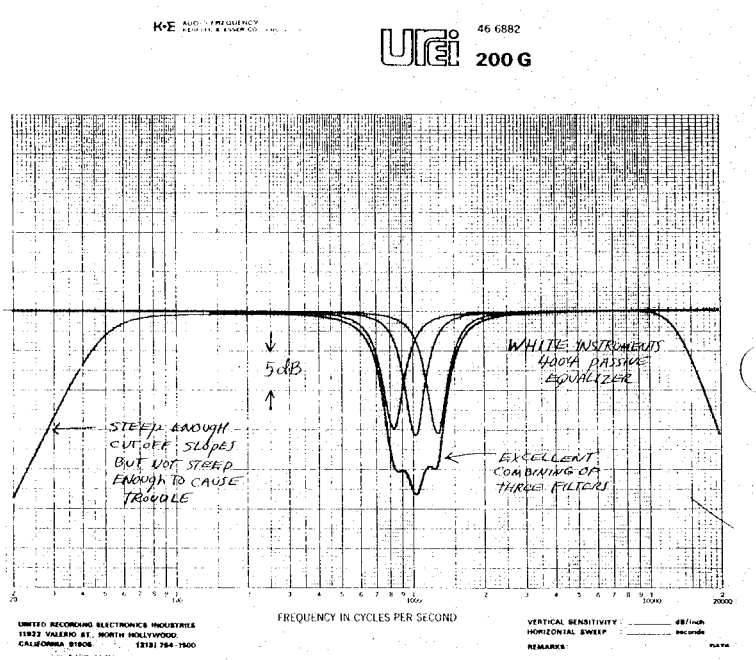
WHITE PASSIVE EQUALIZER

Tom White of White Instruments in Austin, Texas recently sent us one of their model 4004 passive equalizers to examine. We have had a number of these units brought in for test in various classes and were found to be "combining", but having the 4004 in the lab gave us the opportunity to test it further.

White Instruments has filled an important gap in the equalizer marketplace by providing the *only professional passive* equalizer, that we know of.

The degree of accuracy provided in their calibration of the continuous rotary controls is good. They were never more than 1/2 dB different in actual measurement as compared to the control settings (for controls used one at a time.) When three adjacent filters were set at 2 dB each, the total curve was 6 dB deep, as we feel it should be. See charts from the UREI 200 Level Recorder.





Use of this unit, or *any passive unit*, requires that you know how to provide "build out" and "termination" resistors as it is a true 600 ohm device. For instance, our Shure M-67 mixer is marked 600 ohm output but actually measures 120 ohms (this is a typical situation because the "600 ohm output" means it would like to work into a load of 600 ohms or greater). Therefore, I use a "build out" resistor *in series* with the output of the mixer that is the difference between 600 ohms and 120 ohms: 600 - 120 = 480 ohms. Since the input to my Shure 105 amplifier is approximately 15,000 ohms, I can put 600 ohms in parallel (shunt the input) with its input, and I then get excellent results with the White equalizer.

At the Spring AES convention in Los Angeles, White Instruments also exhibited an equalizer (series 4300 active equalizer) utilizing 1/6-octave filters from 40 Hz to 804 Hz and then 1/3-octave filters from there up in frequency.

Syn-Aud-Con would like to see an equalizer that is 1/6-octave from 500 Hz up. The reason for this is that response anomolies we are seeing by means of time delay spectrometry today are spaced, on a linear frequency scale, equal distances apart. For instance, a reflection with a path difference of 10 feet generates anomolies with bandwidths of 113 Hz. This is approximately a 1/3-octave bandwidth at 500 Hz, a 1/6-octave bandwidth at 1000 Hz, and becomes a smaller and smaller fraction of an octave as the frequency increases. Therefore, both experience and theory suggest that we'd like the 1/3-octave filters at the lower frequencies and the 1/6-octave at the higher frequencies, and, of course, we'd like them to be attenuate-only. In the meantime, White Instruments has made a valuable start by providing the first commercially available 1/6-octave unit of any kind.

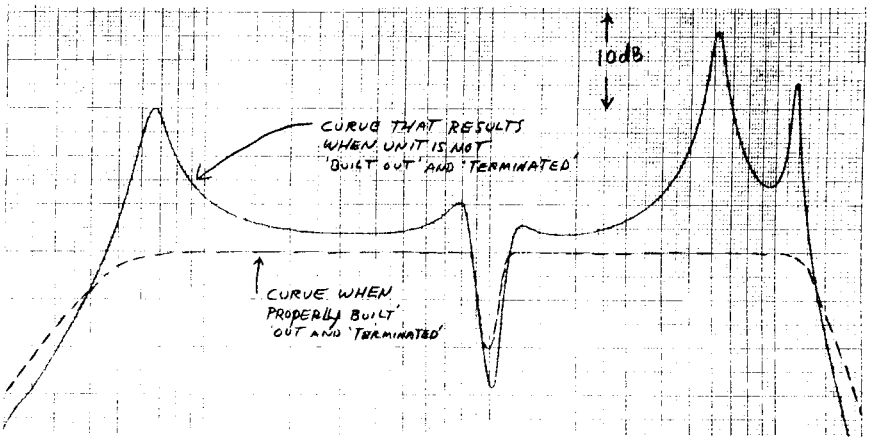
Those of you wishing further information on these units can write: Tom White, White Instruments, P O Box 698, Austin, TX 78767.

BUILD OUT & TERMINATE PASSIVE EQUALIZERS

Here is what happens when you fail to provide the White Instrument 4004 passive equalizer with build out and termination resistances of the correct value.

In the case shown, the incorrect source Z = 10 ohms and the incorrect termination Z = 100,000 ohms.

Inspecting the data obtained with correct impedances reveals why it's well worth while to learn to properly install passive units. Once a high quality passive unit such as the 4004 is *correctly installed* you can rely on it forever.

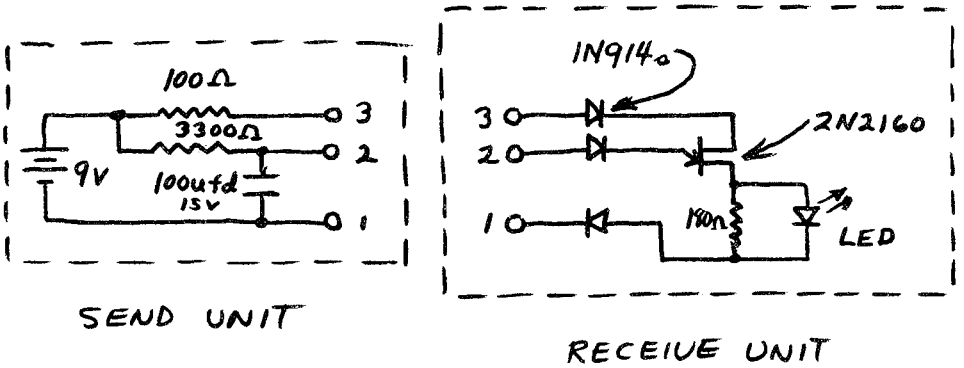


CABLE TESTER DELUXE

From ED LETHERT, Northwest Sound Service, Minneapolis :

It seems to me that the ideal cable tester should give an indication of correct or incorrect wiring, faults, etc. without flipping any switches or pushing any buttons.

I know it can be done digitally but the cost is up there, I'm sure. Here is an interesting little circuit for such a device and the cost is very low for the components.



There is only one correct indication with this circuit. The LED will flash at a slow rate. For this to happen, all wires must be continuous, connected to the correct sequence, and not shorted to each other. This tester requires only one visible component, the LED . Current drain is very low, even when it is operating, and nil when the units are unplugged. No ON-OFF switch is required. (There is one other indication given by this unit. When pins 2 and 3 are reversed, the LED glows steadily, but remember, it must be flashing if everything is ok.)

The only test not made is faults to ground, but most other testers don't check for that anyway.

I find no need for the unit to give an indication of what is actually wrong as when I get a fault indication, the procedure is always to open and check both ends of the cable.

In a future issue I will describe the audible indicating version of the tester.

SLIDE RULE AVAILABLE FROM MODERNFOLD

Modernfold Company of New Castle, Indiana recently sent us a new slide rule they offer for use in solving sound isolation problems. The rule is designed for them by William J. Cavanaugh, noted acoustical consultant of Natick, MA.

The sound isolation performance calculator was designed as a guide for architects, designers, interior space planners and others who are concerned with determining the proper STC (sound transmission class) rating for a partition used to divide an interior space into two adjacent rooms. This calculator reduces the process into three easy-to-handle steps.

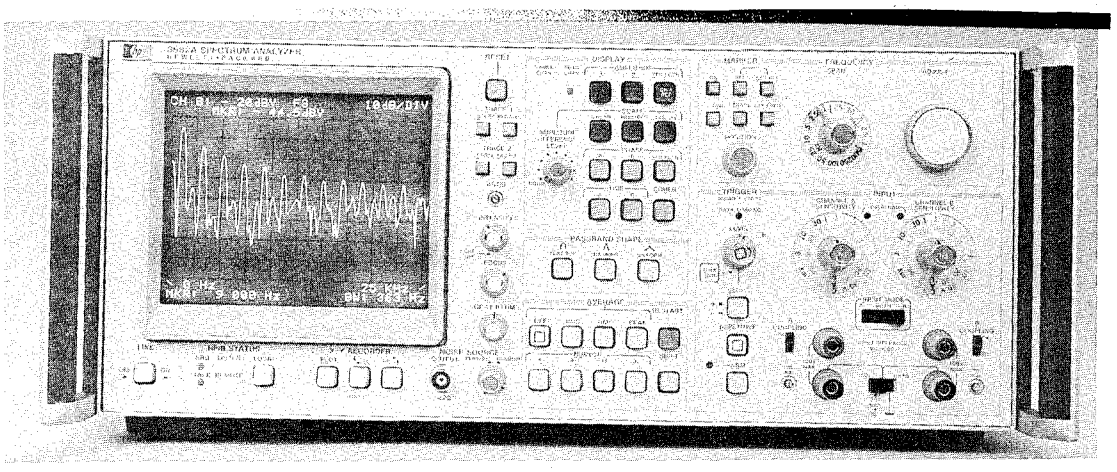
Comparing the rule to conventional equations is not easily accomplished because 10 log A, where A is the total absorption in sabins in the receiving room, is not included in this rule. The ratio between the floor areas of the two rooms is calculated instead.

The rule would be of greater value to me if the basic equation had been published with it.

If you wish to obtain a sample slide rule, write: Dave Maloney, Marketing Communications Manager, Modernfold, Box 310, New Castle, IN 47362

A NEW H.P.FFT ANALYSER

The new H.P. 3582 Spectrum Analyzer opens up new vistas in spectrum analyzers. A two channel FFT with a 10 msec acquisition time for the spectrum from 0 to 25,000 Hz. The simple delay of the SLM signal back to the input makes



it a highly effective FFT-TDS analyzer. Using two channel delay, TDS phase measurements should be accessible. The unit includes its own periodic noise source which is ideal for such measurements. At $10,000 (just a very few years ago these features cost $100,000), this analyzer demands serious consideration by anyone involved in measuring audio frequency transfer functions.

HP 3466A DIGITAL MULTIMETER

We have now had occasion to use our new HP 3466 digital multimeter in several classes. It would be difficult to find a more useful unit for general use. (The Fluke meter described elsewhere in the Newsletter is easier to use for specific audio gain measurements provided you really have an accurate impedance, but it is not a general use unit in the sense that the HP 3466A is).

The 1 uv sensitivity on DC and the 10 uv sensitivity on AC allows direct measurement of all transducers we currently are using. One milliohm with just two test leads is most useful as is the autoranging feature.

When you have the HP3466A plus an accurate way to measure impedance, accurate dBm measurements become a snap.

For example: say you measure .375 volts across a line you find is 8.7 ohms (the loudspeaker's Ƶ at that frequency, for example).

$$dBm = 20 \log \frac{V\ meas}{V\ ref^*} + 10 \log \frac{600}{Ƶ\ meas.}$$

which in this case becomes:

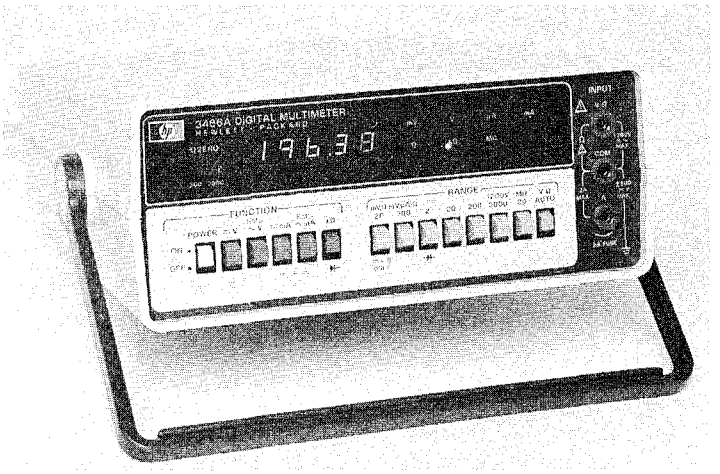
$$dBm = 20 \log \left(\frac{.375}{.775}\right) + 10 \log \left(\frac{600}{8.7}\right) = 12.08\ dBm$$

and the electrical power this represents is, of course:

$$10^{\left(\frac{dBm}{10}\right)} \times \text{ref. power}^{**}$$

or

$$10^{\left(\frac{12.08}{10}\right)} \times .001 = 16.1 \text{ milliwatts}$$



*V ref. is .775 volt (.775V across 600Ω = 0 dBm)

** 0 dBm = .001 watt

We have recently been informed by HAROLD LINDSAY of Emilar that a limited production of Sennheiser's ZP-2 impedance tester is available on a first come - first served basis. The ZP-2, when modified per Syn-Aud-Con Tech Topic Vol 4, no. 7 by FLOYD R. GRAHAM, becomes a truly versatile and useful companion instrument to the HP 3466A multimeter. The combination eliminates choosing the wrong Ƶ or obtaining an incorrect level on a complex waveform and thereby frees you to state with accuracy and assurance the power levels involved in various circuit configurations.

WHY USE TWO MICROPHONES ON A LECTERN

WARDE TULLOCH, General Sound & Theatre Equipment in Winnipeg (Banff class 1977) wrote:

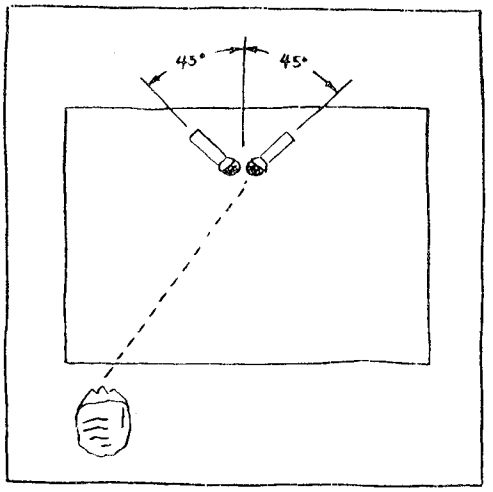
> Can you send me any info on the advantages of using two microphones on a lectern or podium, rather than one? Also on preferred types (omni/cardiod), spacing, phasing, etc.

I answered Warde,The main reasons a second microphone is put on a podium are:

1. Redundancy - in case one fails the other is there.
2. To widen the acceptance angle when some discrimination is desired but a single microphone is too narrow.
3. To deliberately create a differential microphone (close talking noise cancelling)

The microphones should be placed as shown on the illustration. Lou Burroughs' book, *MICROPHONES: DESIGN AND APPLICATION* is useful for this type of information (Chapter 10)

Normally, cardioid microphones are used because some discrimination at the back of the microphones is desired. A small, truly flush-mounted, omni-directional microphone usually works better.



Proper set up for two microphones on a lectern

"MURPHY'S LAW AND OTHER REASONS WHY THINGS GO ƃNOЯM"

There is a new book entitled Murphy's Law and Other Reasons Why Things Go ƃNOЯM! by Arthur Bloch. Perhaps when the remains of our society are dug up and some of these sayings are recovered they will become "proverbs" in a new Canon:

Heller's Law

The first myth of management is that it exists.

Murphy's Law of Thermodynamics

Things get worse under pressure

Rule of Accuracy

When working toward the solution of a problem it always helps if you know the answer.

Etorres Observation

The other line moves faster

Cole's Law

Thinly sliced cabbage

H. L. Mencken's Law

Those who can - do; those who can't - teach

Martin's Extension

Those who cannot teach - administrate

Inhoff's Law

The organization of any bureaucracy is very much like a septic tank - the really big chunks always rise to the top.

Canada Bill Jones' Motto

A Smith and Wesson beats four aces

Mr. Cole's Axiom

The sum of the intelligence of the planet is a constant; the population is growing

First law of socio-genetics

Celibacy is not hereditary

Weinberg's Second Law

If builders built buildings the way programmers wrote programs, then the first woodpecker that came along would destroy civilization.

Only a few of the goodies from a book published by Price/Stern/Sloan, Los Angeles by Arthur Bloch. $2.50

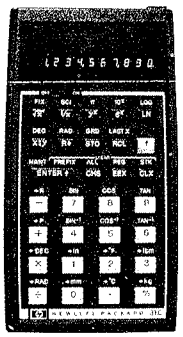
HP SERIES 30 CALCULATORS

Hewlett Packard has announced their new generation of series 30 calculators. The HP 31E illustrated varies from the HP 21 in that it has four addressable memories in addition to the four register stack, a last x, basic metric conversions, a percent key, and indirect arithmetic to the storage register.

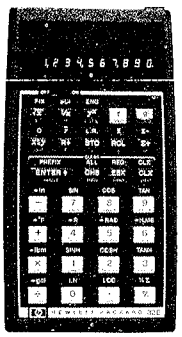
Rumor has it that the first production of these suffered a manufacturing flaw that has caused a production hold. The problem, we are told, is essentially a mechanical one caused by a heat treating process and should soon be resolved. The quoted price is $60, which means that the larger discount houses will be selling it for under $50.

My personal calculator philosophy is increasingly toward convenience and accessibility in the low price range, and then a full alpha-numeric large capacity battery operated, attache case-size calculator in the higher price range.

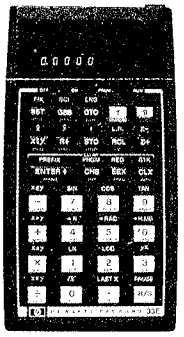
The HP 31 is a good buy for the first-time purchaser, but at this time I can't see that the HP 21 owner has a reason to shift to the 31. Better that he upgrade to the HP 67-97 category.



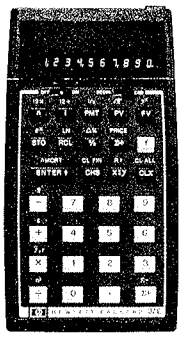
HP-31E. Scientific. Trigonometric, exponential, and math functions. Metric conversions. Fixed and scientific display modes. 10-digit display, and 4 separate user memories. $60



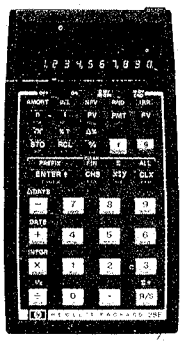
HP-32E. Advanced Scientific with Statistics. More math and metric capabilities than HP-31E, plus 15 user memories, hyperbolics, comprehensive statistics. Engineering, scientific, and fixed display modes. Decimal degree conversions. $80



HP-33E. Programmable Scientific. 49 program lines of fully merged key codes. Editing, control, and full range conditional keys, plus 8 user memories. $100



HP-37E. Business Management. Features for intuitive problem solving. Simultaneous PV, PMT, and FV. Amortization schedules, statistics with trend-line forecasting, plus 5 financial and 7 user memories. $75



HP-38E. Advanced Financial Programmability. No previous programming experience necessary. IRR and NPV for up to 1980 cash flows in 20 groups. 2,000-year calendar, 5 financial and 20 user memories, plus up to 99 program lines. $120

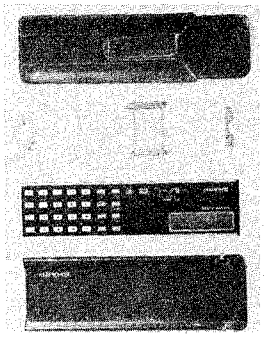
Currently I have two calculators that I tend to use for most of my personal calculations. One is the Sharp EL-5804, which is identical in size, shape, and price to the old shirt pocket Hemmi slide rule I used to carry (see illustration), and an HP 97 for work in the office.

What I am still waiting for from HP is a version of the HP 97 that is alpha-numeric with at least 3000 steps of memory. I'd like the alpha-keyboard to be a separate one about the size of the HP 31 which plugs into the larger unit when alpha is required, which is normally at the programming stage.

In the meantime I still have to pinch myself when I look back 10 years ago at how we solved problems - or failed to solve them - with the tools we had then.

This new HP series contains five new units ranging in price up to $120 for a programmable financial calculator.

If you are in the market for a calculator, the HP 31 series is worth a trip to the store to have a look (August is current appearance date).



ANSWER FROM JIM FORD

Someone questioned JIM FORD (Ford Audio & Acoustics in Oklahoma City) in Modern Recording, "Are they really saying that a 3 dB treble or bass boost doubles amplifier requirements...?"

Jim wrote a good answer: Yes, we really are saying that using an equalizer to boost and cut different frequency bands actually changes the requirements for power. If you are boosting, it also means that the speaker must be capable of handling the increased power from the amplifier. It might help to consider the equalizer as a volume control that works only in certain frequency bands. When you turn up the volume (or tone control) on your mixer, the power amplifier and speakers must be capable of handling the resultant required voltage output. If the amplifier is not capable of the voltage swing, the top of the musical waveform will be cut off (clipping). This results in a squared off wave form and this type of signal is more likely to destroy woofers and high frequency horn drivers.

The loudness control on most hi-fi amplifiers is a type of equalizer. It is designed to boost the low frequencies and the high frequencies when the amplifier is being used at low sound volumes. Our hearing is less sensitive at low sound volumes in the low and high frequencies region. The loudness control when activated is supposed to compensate for our hearing deficiency. At high volumes our hearing is more equal at low, mid, and high frequencies and the equalization of a "loudness control" is not needed. A good way to blow up your speaker system is to be playing your system at a high volume and switch in the loudness control. This would be the same thing as turning up a bass and treble equalizer by about 6 dB (4 times power).

Finally, the laws of physics do not change depending on the type of sound system. Hi-fi systems, studio monitoring systems, and large concert sound systems all follow the same rules.

ACOUSTICAL EQUIVALENT OF OHM'S LAW DEFINITIONS

Electrical

W is the electrical power in watts (W)
I is the electrical current in amperes (Amps)
R is the electrical resistance in ohms (Ω)
E is the electromotive force in volts (V)

Acoustical

I_a is the acoustic intensity in watts per square meter and is the equivalent of electrical power W/M^2
$\sqrt{D}$ is the energy density in watt seconds per cubic meter $W\text{-}Secs/M^3$
The $\sqrt{D}$ is the equivalent of electrical current.

$$\sqrt{D} = \sqrt{\frac{Wa}{\text{Surface area} \times Ra}}$$

Where: Wa is the total acoustic power in watts and the surface area is the total area the power is passing through

R_a is the acoustic characteristic resistance given in $N\text{-}Secs/M^3$
R_a is the acoustical equivalent of electrical resistance
R_a is the density of air in a given temperature and barametric pressure times the velocity of sound and is also labeled RAYLS
R_a in RAYLS = Density in Kg/M^3 times the velocity of sound in meters per sec
P is the sound pressure in N/M^2 or pascals *pa*
P is the equivalent of electrical E

With these definitions we are able to write:

Electrical Form	Acoustical Form	Electrical Form	Acoustical Form
$E = IR$	$P = \sqrt{D}\,R_a$	$R = \frac{E^2}{W}$	$R_a = \frac{P^2}{I_a}$
$E = \frac{W}{I}$	$P = \frac{I_a}{\sqrt{D}}$	$R = \frac{W}{I^2}$	$R_a = \frac{I_a}{D}$
$E = \sqrt{WR}$	$P = \sqrt{I_a R_a}$	$I = \frac{E}{R}$	$\sqrt{D} = \frac{P}{R_a}$
$W = EI$	$I_a = P\sqrt{D}$	$I = \sqrt{\frac{W}{R}}$	$\sqrt{D} = \sqrt{\frac{I_a}{R_a}}$
$W = \frac{E^2}{R}$	$I_a = \frac{P^2}{R_a}$	$I = \frac{W}{E}$	$\sqrt{D} = \frac{I_a}{P}$
$W = I^2R$	$I_a = D R_a$		
$W = \frac{E}{I}$	$R_a = \frac{P}{\sqrt{D}}$		

An Example Set of Parameters

If we had a total power Wa of 1 watt radiating from an omnidirectional point source into a spherical surface .283 meter from the source (surface area = $1M^2$) then we could calculate

$$\sqrt{D} = \sqrt{\frac{1W}{1M^2 \times 406\ Rayls}} = .049629\ldots\ Watts\text{-}sec/M^3$$

$$P = .049629 \times 406 = 20.15\ N/M^2$$

$$20 \log \frac{20.15\ N/M^2}{.00002\ N/M^2} = 120.06\ dB\text{-}SPL$$

Suppose that we measured an average dB-SPL at 123, and our surface area had remained the same. How many $watts/M^2$ are now being radiated?

$$P = 10^{\left(\frac{123}{20}\right)} \times .00002 = I_a = \frac{P^2}{R_a} = \frac{(28.25)^2}{406} = 1.97 W/M^2$$

Some Convenient Equations

$$P = \sqrt{\frac{Wa\ Ra}{\text{Surface area}}} \qquad Wa = \frac{P^2\ \text{Surface area}}{Ra}$$

MAGNETIC SHIELDING MATERIALS

Have you ever wondered why so many small transformers are housed in cylindrical cans? It's because that's the only shape for which there is a highly accurate formula for calculating the attenuation it provides in dB. For more complex shapes, this formula serves as a first guess and the final solution is arrived at by trial.

$$dB\ atten. = 20 \log \frac{ut}{d}$$

Where: u is the material permability
d is the diameter in inches
t is the wall thickness in inches

Example

D = 3"; u = 110,000; t = .040

$$20 \log \left(\frac{110{,}000 \times .04}{3}\right) = 63\ dB$$

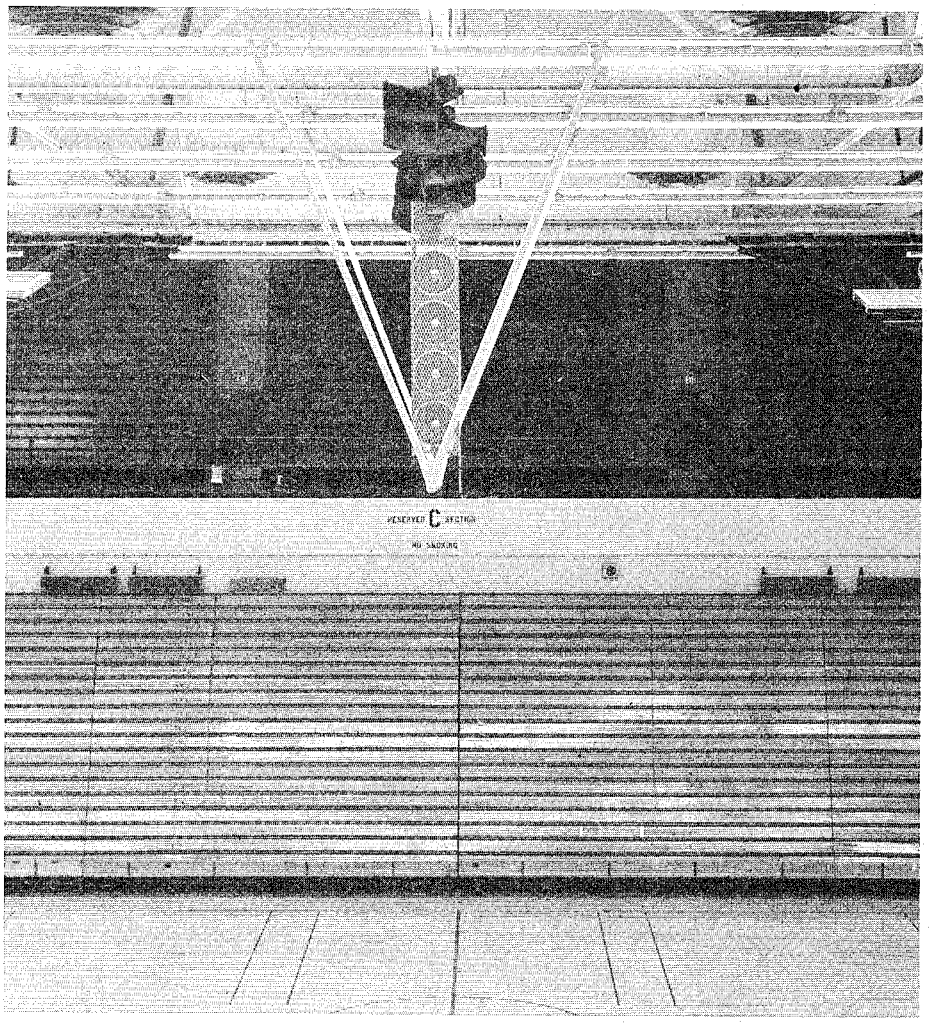
GYMNASIUM SOUND SYSTEM USING FOUR UNENCLOSED WOOFERS

STEVE BARNES of Communications Company of San Diego was good enough to dig out of their files an ideal use of four *unenclosed* 15" woofers in a gymnasium. Bleachers were installed down the side walls (no end wall seats). The bipolar (figure 8) pattern obtained from these low frequency loudspeakers developed a coverage pattern that would have been impossible to duplicate with a conventionally enclosed system.

Note the really precise manner in which standard sectoral horns are raised in Q to compensate for the n+1 factor necessary to handle such wide horizontal coverage angles with uniformity. To our best knowledge, this is the first such array installed in a gymnasium and was installed back in 1971.

Listeners say that there is a distinct coverage area of excellent evenly distributed sound throughout the seats which can then be walked out of into the uncovered areas, such as the floor or end zones which have remarkable sonic isolation by comparison.

Reprinted from Volume 3, Number 4.



INTERESTING RELATIONSHIP

$$b^n = e^{(n \ln b)}$$

Example

$$10^3 = e^{(3 \ln 10)} = 1{,}000$$

$$10^{-3} = e^{(-3 \ln 10)} = .001$$

$$10^{2.5} = e^{(2.5 \ln 10)} = 316.23$$

Employes Say Anti-Noise Device Is Much Too Noisy

By Jeff Raimundo
Bee Staff Writer

For 105 state workers in a new office building at 21st and T Streets, that expensive anti-noise machine designed to make noise to cover up office sounds is making too much noise.

The employes of the State Department of Health's Disability Evaluation Program have told their supervisors the machine, which cost $25,000, tends to produce "headaches, tension, distraction, stimulation of allergies, irritation of sinus problems, ringing sounds in the ears, pressure on the eardrums, nausea and irritability" among some of them.

In their petition, they ask that the machine be turned off for one week to "compare the differences between working with 'natural' sounds (and) 'programmed' noise . . ."

Harold Giles, principal administrator of the DEP office, said today the complaints subsided after the electronic device was turned down. The workers moved in April 14 and the petition was presented to him April 21.

One employe said she still is bothered by the sound, similar to that heard "in a jet plane at 35,000 feet."

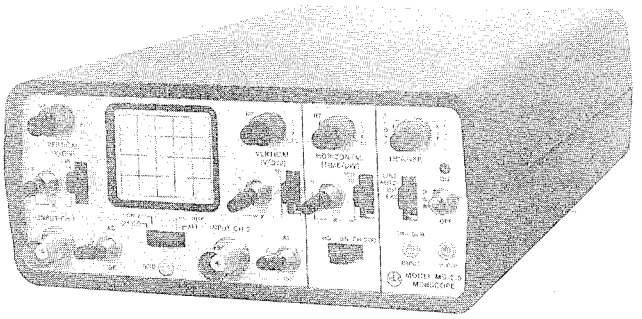
Charles Olver of the State Department of General Services says the machine was designed and researched by sound engineers and has worked successfully at three other state buildings in other parts of California.

BATTERY OPERATED MINISCOPE

A new test instrument that intrigued us is the NLS MS-215 miniscope. It's a dual trace oscilloscope for $395.

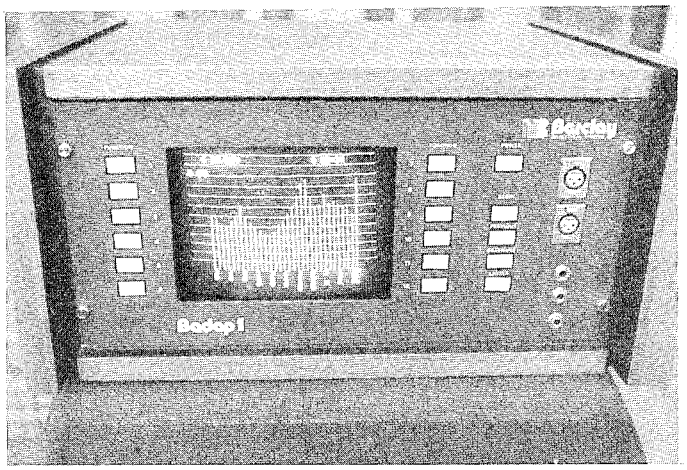
The picture is worth a thousand words. Battery operated, it's good for three hours at a time. Sixteen hours recharge time when instrument is not in use.

The miniscope is made by Non-Linear Systems, Box N, Del Mar, CA 92014 or call (714) 755-1134.



BARCLAY AUDIO MICRO COMPUTER

Occasionally someone does something in advance of what anyone else has done. CLAY BARCLAY, MD. of our Philadelphia class has developed a multi-color real time analyzer-computer that can display, for example, the peak 1/3-octave levels in red, the average levels in blue, etc. It has additional colors of green and yellow.



The display can be held or left dynamic. The BADAP I, as Dr. Barclay calls it, may be set to go up on peaks and hold. The display can be in bars, dots, or symbols of the user's choice (upon application to Barclay's special software division).

We have seen only the prototype unit on display at the West Coast AES and as yet have not had a chance to evaluate it in field use.

Price quoted at AES was $3800. Production is scheduled for this Fall.

If you would like additional information, write: Barclay Analytical, Ltd., 233 East Lancaster Ave, Wynnewood, PA 19096. Or call 215-649-4915

"ANYTHING THAT IS OBVIOUS IN ACOUSTICS IS NEARLY ALWAYS WRONG"

James Moir during the special graduate seminar dropped this gem amongst us.

TELEVISION ADDICTIVE

We are interested to read that television viewing is now considered addictive for a majority of adults in the U.S. In one case 93 out of 120 families turned down $500 offered by a newspaper to shut off their television set for 30 days.

If you have read these comments you are partaking of a unique experience few of your competitors are sharing. Frankly, I'm not panic stricken that so much potential competition is awash in deafening music, drugs, non-judgmental acceptance of their own clique and almost total hypnotism via the boob tube. Those of us who read, study, and use our spare time somewhat constructivelyat least have the competitive advantage over those asleep on the deep.

KNOWLES MICROPHONE ORDERS

We received a rather short tempered phone call last week from Harry Waller of Knowles Electronics advising us that they were receiving many orders from Syn-Aud-Con graduates for the Knowles microphone. He stressed that unless orders are for 100 or more, send the order to Syn-Aud-Con. We have made arrangements with Knowles to purchase them in 100 quantities so that you can try them on a trial basis. Use the enclosed order form. $15 each. If you want more than 100, order from Knowles Electronics.

We have currently shipped well over 100 of the microphones. We are eager to hear from you and would like to share in the Newsletter your experiences with the 1759.

GETTING TO THE SEAT ON PHONE CALL PROBLEM

BOB YARUSS, Sales Manager at Sunn Musical Equipment Co., has heard us tell our classic grounding story and shared this news item from the LA Times: "St. George, Utah. For several weeks the phones in the office of a group of St. George attorneys would ring but nobody would be on the other end. Finally one of the office staff noticed that every time somebody went to the restroom, the "phantom" would call. Closer inspection revealed that when someone sat on the toilet, the phone would ring.

Mountain Bell technicians found that the telephone system in the office had been grounded to the water pipe on the floor below. When someone sat on the commode, the circuit would be broken and the phone would ring."

SYNERGETIC AUDIO CONCEPTS

BOOKS OF INTEREST

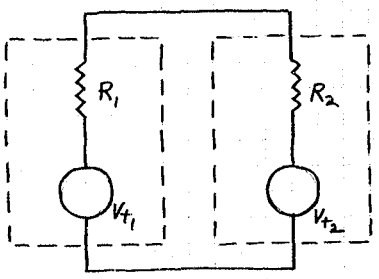
ED LETHERT AND RANDY GAWTRY both recommended a really splendid reference book when we were in Minneapolis recently: *NOISE REDUCTION TECHNIQUES IN ELECTRONIC SYSTEMS* by Henry W. Ott, member of the technical staff Bell Laboratories, published by John Wiley and Sons, 1976. Price $22.75

NOISE REDUCTION TECHNIQUES IN ELECTRONIC SYSTEMS is accurate, rigorous, and readable. It is a fundamental reference text for any audio engineer's library.

The chapter on "Intrinsic Noise Sources" pages 198-213 is superb. The book is worth many times it selling price for its Table 8-3 "Characteristics of Meters Used to Measure White Noise" on page 212; its summaries at the end of each chapter that succinctly sum up what you should retain from the chapter; and its carefully selected bibliography at the end of each chapter that includes the basic papers that first got it right.

One example of the clarity of this text is excerpted below and illustrates clearly the error in Paul Buff's rebuke of Mel Sprinkle in RE/P magazine. (Mel, as usual, is always right if not always brief.)

TWO RESISTORS CONNECTED IN PARALLEL ARE IN THERMODYNAMIC EQUILIBRIUM



POWER DELIVERED TO R_2 BY V_{t_1} (P_{12}):

$$P_{12} = \frac{R_2}{(R_1+R_2)^2}(V_{T_1})^2$$

WHICH CAN BE WRITTEN:

$$P_{12} = \frac{4KTBR_1R_2}{(R_1+R_2)^2}$$

POWER DELIVERED TO R_1 BY V_{t_2} (P_{21}):

$$P_{21} = \frac{R_1}{(R_1+R_2)^2}(V_{t_2})^2$$

WHICH CAN BE WRITTEN:

$$P_{21} = \frac{4KTBR_1R_2}{(R_1+R_2)^2}$$

Thus, the two resistors can be said to be in thermodynamic equalibrium.

Further, the power that generator V_{T_1} delivers to resistor R_1, does not have to be considered in the above equation. This power comes from and is dissipated in resistor R_1. Thus it produces no net effect on the temperature of resistor R_2. Similarly, the power that generator V_{T_2} delivers to resistor R_2 need not be considered.

When the two resistors are equal in value and maximum power transfer occurs:

$$P_{12} = P_{21} = P_N = \frac{(V_T)^2}{4R}$$

Since $V_T = \sqrt{4KTBR}$ Then: $P_N = KTB$ watts

Where: K is Boltzmann's constant (1.38×10^{-23} Joules/$^\circ$K)
T is absolute temperature ($^\circ$K)
B is noise bandwidth (Hz)
R is resistance (Ω)

Thus: if T = 290°, B = 19980 Hz, then:

Noise Power in dBm = $10 \log \left(\frac{P_N}{.001W}\right)$ = -130.97 dBm

THE COMPLETE HANDBOOK OF PUBLIC ADDRESS SOUND SYSTEMS by Alton Everest, published by Tab Books in hardback $10.95; soft back, $7.95.

The title is misleading but the book is useful (the publisher chose the title, not Alton Everest). The author's preface best describes what the book both is intended to do, and in our opinon, goes a long way toward doing it.

> "This book has to do with sound reinforcing systems for churches, clubs, schools and other spaces for public assembly.... This book is written not for those knowledgeable in electronics and acoustics, but for non-technical persons, especially those responsible for managing sound reinforcement systems."

Mr. Everest, a consultant for many years in the field of sound reinforcement, recording and broadcasting, has observed many times the results of laymen interfacing with consultants, sound contractors, etc., and failing to communicate. His book is intended to be placed in the hands of the church committee member, school board member, etc., who needs to know why he needs professional help that is properly trained.

The chapter entitled, "Dealing with the Sound Contractor" (Chapter 14) must be of interest to all sound contractors because it is a fair assumption that *your customer* will have read it.

Just as some manufacturers rarely produce an "A" model that works properly, publishers and authors often have trouble with the first printing of a book. *THE COMPLETE HANDBOOK*....is no exception. The publisher printed the book from the corrected galleys without either correcting them or removing the author's handwritten corrections, but this does not detract from the usefulness of the book. In fact it is amusing -- not to Mr. Everest, I am sure.

The book contains a few illustrations of really low quality portable equipment that I would have preferred that Mr. Everest had not included.

Don wrote the introduction for the book because he felt it was a book needed, as Mr. Everest says in his preface, by the "non-technical persons, especially those responsible for managing sound reinforcement systems."

ARTICLES OF INTEREST

Mahlon Burkhard, Director of Engineering and Development at Industrial Research Products, Inc,, has written an excellent article on the role of time delay in the creation of useful artificial reflected energy in a concert environment. The article entitled *CONCERT HALLS: ROOFLESS AND FLAWLESS* appears in the May issue of Sound & Communication, pages 12-21.

Mahlon uses the Barron experiments plus his own wide experience in the design and application of digital time delay devices to authoritatively bracket the "working area"within which time delay can be creatively employed in outdoor systems. Much garbage has been written on this subject and Mahlon is a breath of fresh air by comparison. Sound & Communication rarely rises to such heights as Mahlon's article in their publication and they are to be congratulated for doing so in this case.

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The July 1978 AUDIO magazine contains two "Equipment Profiles", pages 88-96, written by Howard A. Roberson. These two reports are models of how an engineer, who knows what he is doing, can approach the evaluation of an equalizer and a test set. The discussion on "Filter Boost, Q, and Ringing" is especially well done (pages 90-91 - pages that I tore out to put in my notebook of reference material).

Audio Magazine attempts to maintain high standards in their choice of equipment reviewers. They deserve a wide readership when they produce articles this informative and useful. Sometimes it seems that the most widely read so-called "popular" magazines contain a steady diet of misinformation which can be deadly to personal professional progress.

Real facts often have few followers, unfortunately, but they remain the truth about the subject nevertheless. Writers like Roberson and Heyser in Audio deserve to be read.

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The IEEE Spectrum, December 1977 had an article by a William L. Everitt of the University of Illinois entitled, *THE ENGINEER: A PERENNIAL STUDENT*. Dr. Everitt, it turns out, is the author of Communication Engineering (1932) and has some interesting as well as experienced remarks to make about an engineer's education.

In addition to his emphasis on basic physics as a necessary tool in the engineer's kit he comes up with fascinating discussions such as "Scientists explore what is; Engineers create what never has been." And, "An engineer knows whether a device will work before it is built; any fool knows afterwards." Crucial to the whole concept of education: *"Properly educated engineers have always been able to carry on a continuing education by themselves through self study." (italics mine)*

The entire article is well worth taking time to dig it out at the public library.

CLASSIFIED

FOR SALE:
Hewlett Packard-Altec 8050A real time analyzer. Excellent condition. $1900. Don Davis, P O Box 1134, Tustin, CA 92680. (714) 838-2288.

FOR SALE:
GR 1523 Graphic Level Recorder with a 1523-P4 Wave Analyzer plug-in unit. This combination allows 10 Hz bandwidth, 80 dB dynamic range, linear or log display, 10 Hz or 80 KHz frequency range analysis with a tracking output. This is a deluxe way to measure and record detailed distortion spectrums, filter responses. The equipment is in mint condition. Contact: John Odum, Plaza Music Mart, Penneyrile Mall, Hopkinsville, KY 42240. (502) 885-5386

WANTED:
Sennheiser ZP-2 impedance meter. Please call collect (319) 395-6151. Bruce Thayer, WMT Stations, Cedar Rapids, IA.

EMPLOYMENT WANTED:
Position of responsibility where talents as a sound system designer and manager can be brought to their full potential. Vice President and founder of All American Sound involved in the design, construction and operation of touring sound systems. Contact Will Parry, 111 Galavotti Place, Canastota, NY 13032.

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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.

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