newsletter

SYNERGETIC AUDIO CONCEPTS

P.O. BOX 1134, TUSTIN, CALIFORNIA 92680

VOLUME 4, NUMBER 4
July, 1977

SYNERGETIC
Working together; co-operating, co-operative

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

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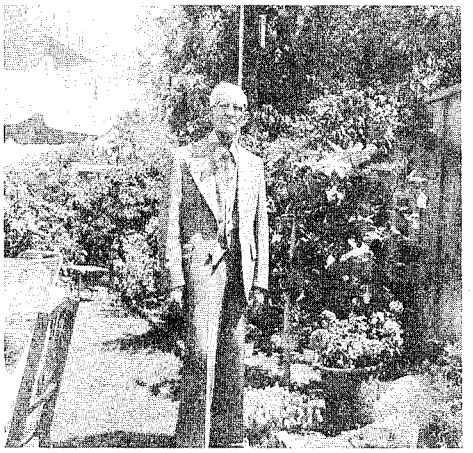
VOLUME 4, Number 4

THE REASON WE'RE LATE THIS ISSUE

It is only once in a hundred years that one has the privilege of celebrating the 100th birthday of a loved relative. Carolyn's great Uncle Roy celebrated his 100th over the 4th of July weekend. We didn't get back from our Mid-West tour until late June so we weren't able to work on the Newsletter until after the party. It takes us about three weeks from the start of writing it until its in the mail.

Uncle Roy the day before the party showing friend Paul Cleveland how well his fig tree is doing that Dr. John Hilliard gave him 2 years ago.



Uncle Roy, the day of his party, standing in the garden that he tends.

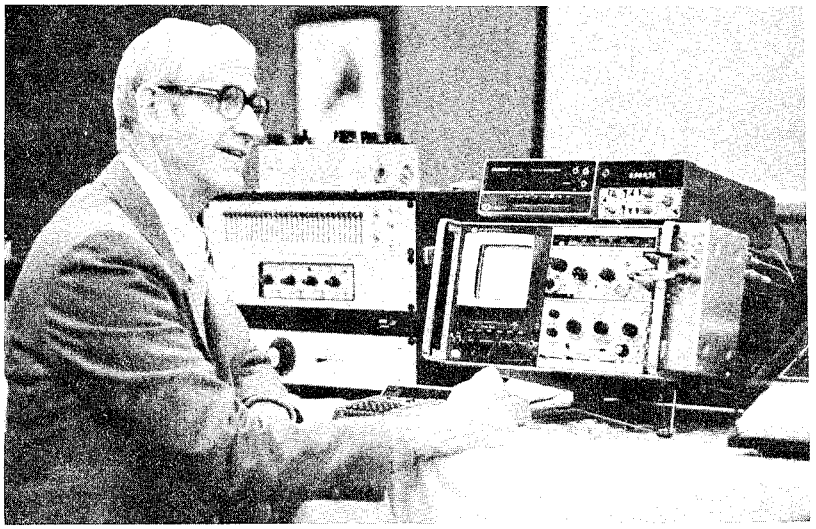
TIME DELAY SPECROMETRY (TDS) AND SYN-AUD-CON

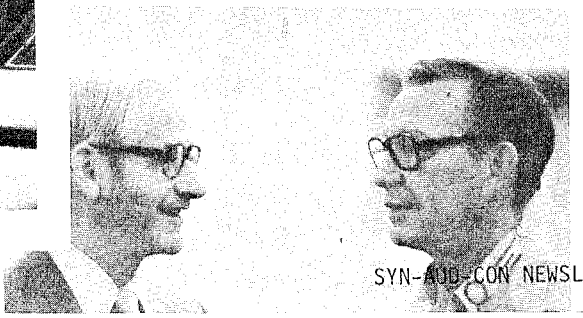
Starting this May Syn-Aud-Con classes have been greatly enhanced by the presence of CECIL and BARBARA CABLE from Edmonton, Canada.

Cecil Cable is now demonstrating his Time Delay Spectrometry equipment in each Syn-Aud-Con class (L.A., Dallas, Indianapolis, Chicago and Minneapolis) and as we expected, we learn something new each class. At the present time, the only practitioners of TDS that we are aware of are Dick Heyser and Cecil Cable. (See write up of papers given in Carolyn's session at AES for a full description of the importance of TDS work.)

The montage on this page shows Cecil in action during the Spring classes mentioned above. We believe the Cecil Cables' presence in this year's Syn-Aud-Con classes constitutes a unique opportunity for the serious audio professional to witness the future we've so often talked about happening in front of your eyes.

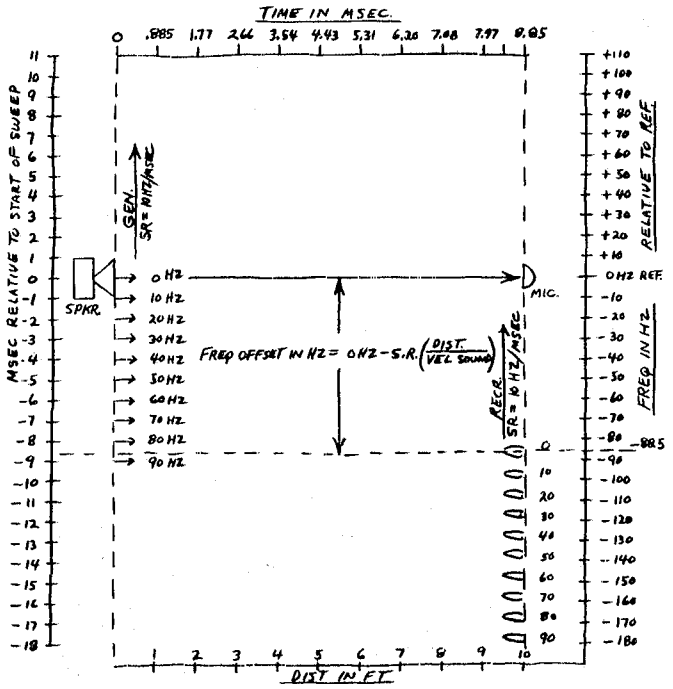
The Cables will travel with us for our Fall Tour.





BASIC TDS THEORY

How does such a fascinating tool operate? The drawing below graphically illustrates the basic idea behind the technique. The TDS analyzer in its simplest form consists of a very narrow band (5 to 10 Hz) rapid sweep (audio signals are hetrodyned up to RF so sweep speeds can be high) bandpass filter with a tracking sine wave generator capable of precisely tracking the filter at the same sweep rates. This basic analyzer is then modified so that the tracking generator can be "tuned" *ahead* of the filter by any desired number of cycles. For example, you can have the generator begin its *linear* sweep from 0 Hz to 10,000 Hz (at a rate of 10,000 Hz per second) 88.5 Hz *ahead* of the bandpass filter. That is, the filter will not begin its sweep at the same rate (10,000 Hz per second) *until* the tracking generator has reached 88.5 Hz. After that, both the bandpass filter and the generator *remain* 88.5 Hz apart for the remainder of the sweep.



Referring to the drawing again we can see that graphically the generator and filter are moving upward with time. Horizontally we can see graphically illustrated that the loudspeaker and the measuring microphone are 10 feet apart (bottom scale) or 8.85 milliseconds apart in time (top scale).

Since sound, at normal room temperature (70°F) travels approximately 1130 feet per second, then we can calculate the equivalent number of Hz the generator should be ahead of the filter so that if the generator feeds the signal to the loudspeaker and the measuring microphone is connected to the filter, then the filter will be "tuned" to exactly 0 Hz as 0 Hz signal arrives at the microphone 8.85 msec *after being sent from the loudspeaker*. The factors we must account for are:

1. The sweep rate (in this example 10,000 Hz per second or 10 Hz per millisecond)
2. The distance the sound will travel between loudspeaker and microphone (In this case 10 ft.)
3. The velocity of sound at the temperature in the space (presumed for this example to be 1130 ft. per second.)
4. The starting frequency of the sweep (we assume 0 Hz in this example)

From these basic parameters we can write the following relationship

$$\text{Freq offset in Hz} = 0\text{ Hz} - \text{S.R.}\ \frac{\text{Dist.}}{\text{Vel of sound}} \quad \text{or} \quad 0\text{ Hz} - \frac{10{,}000\text{ Hz}}{1\text{ sec}}\left(\frac{10\text{ ft.}}{1130\text{ ft/sec}}\right) = \text{a frequency offset}$$

of the generator of 88.5 Hz (the generator is 88.5 Hz ahead of the filter or the filter is 88.5 Hz behind the generator.)

When the offset is dialed in, then the measuring microphone will see only the direct sound (the filter will discriminate against any other than the desired frequency and since the only information at that frequency as the filter passes it is direct sound from the loudspeaker then the screen on the analyzer will display the anechoic response of the loudspeaker.

Next, let's imagine that instead of using the exact offset we "tune out into space" - that is, we don't allow the filter as it sweeps to arrive in time to see the direct sound but make it arrive enough later that it sees only the first reflection energy off of a nearby surface. For example, suppose that the nearest reflective surface is 10 ft. away. Then as the direct sound is emitted from the loudspeaker it takes 10 ft. times .885 msec/ft to travel to the surface and 10 ft x .885 msec to travel back. Since we are sweeping at a rate of 10 Hz/msec it would take the sound 17.7 msec to travel 20 feet and at 10 Hz/msec the equivalent in Hz would be 10x17.7 = 177 Hz. This would be added to the 88.5 Hz already used to see the direct sound spectrum so the total frequency offset to see the spectrum of the nearest reflecting surface would be 265.5 Hz.

AES 1977 -- SOUND REINFORCEMENT

Carolyn was the first woman session chairman in the AES. So many excellent papers were received for the session that it was divided into two parts with Cecil Cable chairing the morning session. The afternoon session was chaired by Carolyn and was 100% preprinted. The session included some outstanding papers.

ELECTRONIC DETECTION OF ACOUSTIC FEEDBACK AND AUTOMATIC SOUND SYSTEM GAIN CONTROL, by Dr. Eugene Patronis. Dr. Patronis' paper on the control of feedback we have nicknamed "the acoustic circuit breaker" because when the system is pushed into feedback by whatever means his device detects the feedback and reduces the gain until the feedback ceases. Then it cautiously tests to see if the gain can safely be brought back up to where it was originally set.

A commercial version of this could be very useful and would be widely used.

continued next page

AES 1977 - SOUND REINFORCEMENT, continued

UTILIZATION OF A NEW TIME-GATED SPECTRUM ANALYZER TO MEASURE SOUND SYSTEM EFFECTIVENESS, by John Prohs.
JOHN PROHS of Ambassador College discussed his new Time-gated spectrum analyzer and found interest among listeners even greater than he had expected with definite interest shown by manufacturers present. See Newsletter Vol 4, # 2, page 5 and 6 for an early discussion of his development but better yet, order the preprint from AES.

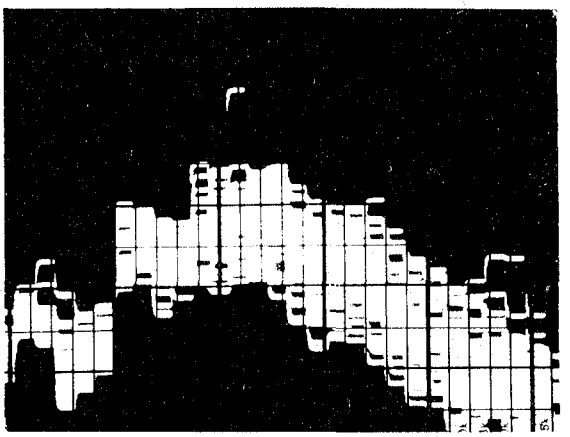
A SIMPLIFIED EQUALIZATION ANALYZER by BILL BEVAN of Shure Brothers. His paper gave a very thorough discussion of their exceptionally successful equalization analyzer.

LOW COST 1/3-OCTAVE REAL TIME ANALYZER by Robert Thurmond. Bob Thurmond *demonstrated* a battery operated 1/3-octave RTA that he hung around his neck and walked around with. This was a one-only prototype and is not scheduled for commercial use as yet. It does, however, illustrate the point that if a private consultant can build one for his own use, it surely shouldn't be difficult to make a commercial version. To my mind, the key words in Bob's demonstration were "Battery Operated."

ENVELOPE METHOD OF EQUALIZATION.

RALPH GIBSON, Gibson Associates in New Hartford, Conn (2-time graduate) gave a paper in 1976 at the West Coast AES on doing the acoustics for the new board room for Pratt Whitney. Sort of in passing he mentioned a new form of equalization that he and GLEN BALLOU had used to equalize the board room and he showed a few slides, which were not part of the reprint. We were sufficiently interested in the process that Carolyn asked Ralph to give a paper for her session at the Spring 1977 AES Convention.

We have demonstrated the process in recent Syn-Aud-Con classes. It is a useful technique for equalizing systems having multiple sources such as overhead distributed speaker systems . The procedure is to equalize the *upper envelope* of a series of house curves taken at every major listening area within the primary coverage pattern. The idea is to equalize for the smoothest upper envelope of the desired shape rather than equalizing any single position.



When we equalized the sound system for the Chicago class we were able to get good sound except for the front right hand table. At that table only there was a honk to the sound. And we tried several different kinds of equalization but not envelope equalization during set up. It wasn't until the last day when we demonstrated envelope equalization that we found the problem.

Note the 630 band sticking up 9 dB. Immediately to the right of the front right hand table was a large pillar against which the dividing wall was pushed back. Cecil quickly calculated the wavelength of the panel: 619 Hz.

Ralph Gibson is preparing his paper for the AES JOURNAL in which he will carefully detail the philosophy and procedure.

TIME DELAY SPECTROMETRY INVESTIGATION OF REGENERATIVE SOUND SYSTEMS by CECIL CABLE.

In this paper he clearly demonstrated that the feedback modes that occur when a sound system is used in an enclosed space is due to the room modes riding on the "comb filter" response of the time align anomolies generated by the early reflections' spectrum. This coincidence of the early reflection spectrum and the room modes at long last demonstrated why it seemed as if the room modes joined into clusters of modes rather than operating as individual very narrow areas.

To quote Cecil's paper, "If a room mode is suppressed without depressing the time align anomaly upon which it sits, the oscillatory feedback mode will simply shift a few hertz to an adjacent room mode *sitting on the same anomaly. (italics mine)*

"If a number of very narrow band filters are installed to suppress each of these oscillatory room modes as they appear, the time align anomaly is suppressed. This might better have been done with a single filter of greater bandwidth *designed to suppress the time align anomaly."(Italics mine)*

During the demonstration of TDS in the class, Cecil actually displays on the screen of the analyzer the room modes with the time align anomalies just below them on the screen so that it is possible to watch which mode feeds back and see that it sits right on top of the anomaly.

AES PRODUCTS OF INTEREST TO US

Three new products particularly attracted our attention at the May 1977 AES Convention in Los Angeles:

CROWN REAL TIME ANALYZER

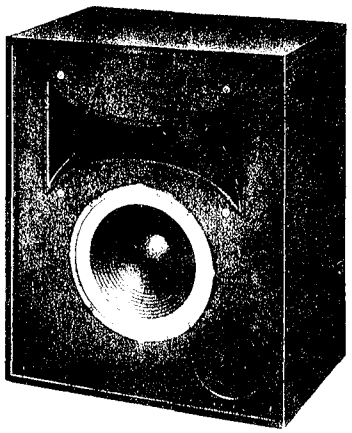
The first of these new units is an audio frequency real time analyzer from CROWN INTERNATIONAL for an *estimated* $2500 to the end user with an *estimated* delivery in January 1978.

The unit we viewed allowed either octave band or 1/3 octave band displays at the push of a button. We were impressed with the excellent display circuit (usable integration times with easy-to-read markers). We think they have a winner in this unit.

AES PRODUCTS OF INTERST TO US, continued

RAULAND'S NEW MONITOR LOUDSPEAKER

We have just received two of the new Rauland monitor loudspeakers utilizing the EMILAR horn and driver along with a 12" woofer (MLS-3 2-way Speaker System).



Our first tests with it were to use it to generate wide band, high level, noise signals for the measurement of RT time in a high ambient noise level public building.

We will be reporting on this unit in much greater detail as we gain experience with it. It's our present belief that this unit should consititute the ideal solution to a vast majority of small to medium sized auditoriums plus critical monitoring situations in *sound reinforcement* control rooms.

SPECIFICATIONS

Type of System: 2-Way
High-Frequency Horn: Rauland SRE90F radial horn (90° horizontal dispersion 40° vertical dispersion)
High-Frequency Driver: Rauland SDF30 compression driver
Low-Frequency Speaker: Rauland WF-12 12" speaker
Crossover Network: Rauland CN800-8 crossover network
Shelving: Continuously variable, 0 to over −20 dB
Frequency Response: 50-15 000 Hz
Axial Sensitivity: 97 dB at 4 feet with 1 watt input
Power Handling Capacity: 50 watts RMS
Impedance: 8 ohms
Size: 23" wide 15⅞" deep 28⅜" high
Finish: Charcoal black with matching black cloth grille
Weight: 84 lbs.
Associated Item: MK-6 Mounting Kit for suspension mount

FEATURES

- **Unprecedented Speaker Efficiency**
- **Smooth, Balanced Response**
- **Fully Controlled Dispersion**
- **Integrated System Design**
- **50-Watts RMS Power Rating**
- **12" Low-Frequency Speaker**
- **90° x 40° Radial Horn**
- **High-Frequency Compression Driver**
- **Adjustable Crossover Network**
- **Compact, Rugged Design**
- **Tuned-Port Enclosure**
- **Readily Installable – Only 84 Pounds**

U.R.E.I. TIME ALIGN$^{T.M.}$ MONITORS

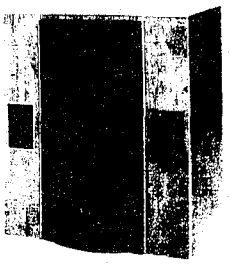
Recording studio control rooms offer enormous opportunities to the knowledgeable audio acoustic engineer today to achieve major improvements in the art.

TIME ALIGNED™
STUDIO MONITOR SYSTEM
™ Licensed by E. M. Long Associates

MODEL
813

FEATURES:

- First TIME ALIGNED™ monitor system designed for the professional studio.
- Features UREI 800 series TA™ network (patent pending)
- 604BG duplex with UREI custom H.F. horn for extended and more uniform H.F. response.
- Second L.F. 15" direct radiating driver fed from 3-way TA network for extended L.F. response and higher power handling capability at low frequencies.
- >12 cu. ft. quasi closed box for excellent damping at low frequencies with good efficiency and low distortion.
- Unique enclosure damping method provides high efficiency conversion of low frequency sound pressure to adiabatic energy.



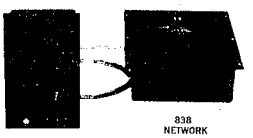
800 SERIES TIME-ALIGNED™
CROSSOVER NETWORKS*
AND CUSTOM HIGH FREQUENCY HORN
™ Licensed by E. M. Long Associates

MODELS
824 834
828 838
800H
*Patent pending

FEATURES:

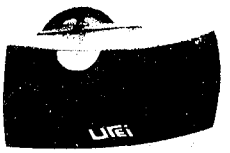
- Four models of TIME ALIGNED™ networks for all 604 duplex speakers.
- Available in two way models for single 604's or three way models for adding second TIME ALIGNED™ low frequency woofer.
- Separate high frequency, mid range and low frequency controls.
- Aircore optimum form factor inductors.
- Peak current lamp indicators, as well as fuses, provide overload protection.
- Packaged for convenient installation in existing systems.
- UREI custom 800H high frequency horn provides extended and more uniform high frequency response.

800 SERIES TIME-ALIGNED CROSSOVER NETWORKS



838 NETWORK

838 CONTROL PANEL



UREI 800H HORN

The U.R.E.I. Time-Aligned$^{T.M.}$ Studio Monitor System and the Time-Aligned crossover networks and custom high frequency horn constitute an essential for any serious recording studio today.

For those of you who haven't heard one of these systems directly compared to the very best of the other available units, you are in for quite a surprise. Time-Align is without question of any sort the next fundamental factor all loudspeaker manufacturers must come to grips with.

"DEAD" REAR WALL IN CONTROL ROOM WRONG?

Cecil Cable and I have discussed in recent classes our thoughts that a "dead" rear wall with a hard front wall in a Control room is fundamentally questionable.

Presuming that the loudspeakers are *properly* flush mounted, then the early reflection spectrum will look like a comb filter with very broad (one octave or wider) humps which are very audible. If again, the loudspeakers are *properly* flush mounted (an art in itself) and the adjacent surrounding area is made very absorptive and the rear wall is made *hard and diffuse*, then the early reflection spectrum will look like a comb filter with a large number of very narrow humps which individually are not significant but as a group enhance the sound level. Obviously the larger you make the control room the better (they all are too small for good acoustics) with up to 40 feet in depth offering fascinating acoustic possibilities.

Two recent advances have made the above more noticeable: TDS allows us to look at the spectrum of the early reflections and objectively analyze them and the advent of the Time-Align™ monitors which have eliminated so many of the subtle masking effects that we can increasingly subjectively hear these effects.

SYNERGETIC AUDIO CONCEPTS

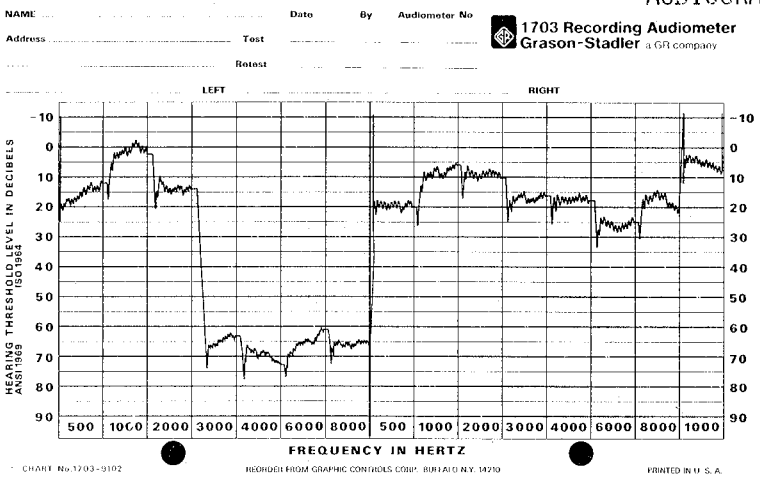
1977 SYN-AUD-CON FALL SCHEDULE

September 13-15	Kansas City
September 20-22	Syracuse
September 27-29	New York area
October 5-7	Boston area
October 18-20	Philadelphia area
November 2-4	D.C. area
November 15-17	Nashville, Tn.
November 28-30	Orlando

REGISTRATION FEE:	1 participant	$375.00
	2 participants	350.00 each
	3 or more	325.00 each
SYN-AUD-CON	GRADUATES	200.00 each

If you think you want to attend a Fall class it would be well to register early. We returned 10 late registrations for the Los Angeles class. This is hard for us to do, especially when it is a Graduate and we won't be in the area again for a year.

AUDIOGRAM



The hearing loss in the left ear was caused by the ear being approximately 2" directly off of end of 3/4" diameter steel shaft when a pulley slipped and squeaked Hearing loss was instant and required about 2 years to adapt and reprogram for loss of ability to place source. Cannot square dance to a caller because when left ear faces caller the words are missed.

Left ear is very comfortable with telephone. Levels of SPL above about 92 dB cause break-up and discomfort.

COMMUNICATIONS COMPANY CONTRIBUTION

LARRY HALL, 2-time graduate from Communications Company in San Diego, sent in two items to share in the Newsletter:

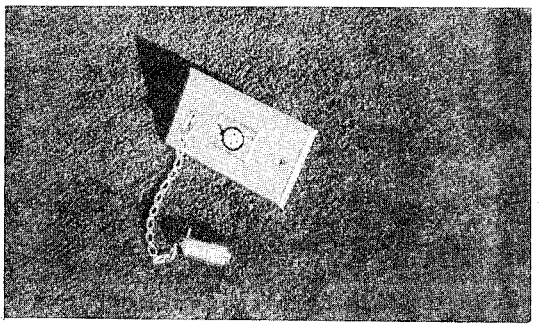
1. Communications Company staff has been responsible for another very useful "goodie" becoming commercially available. ComCo wrote Switchcraft July 23, 1976 outlining a problem: "As a sound contractor, we often have occasion to install equipment in locked equipment racks or closets where the only control accessible to the user is the system power switch. This insures that controls do not get misadjusted and that system balance is maintained. It also presents a problem of input noise resulting from unterminated microphone inputs.

"On many of these occasions, a shorting plug would be a problem solving device of great value. What we have in mind is a connector of low profile similar to your model R3M with a short chain that could be attached to the stainless steel receptacle plate. On this plug pins 2 and 3 would be shorted.

We would like to suggest that you consider a device of this type as an addition to your product line. We believe that a survey of sound contractors and other users would reveal a rather substantial marketing potential." Signed BOB CHASE.

Several months and several letters later, Switchcraft wrote Bob Chase on April 1, 1977 "The shorting connector, Bob, that you originally brought to our attention in July of last year has just been released for its initial manufacturing run. We call it the QG shorting plug part #N3MS. The list price on this new product is $5.40.

"Enclosed in the attached mailing bag, Bob, is the very first sample which we wanted you to have. Hope this is exactly what you need and can use."



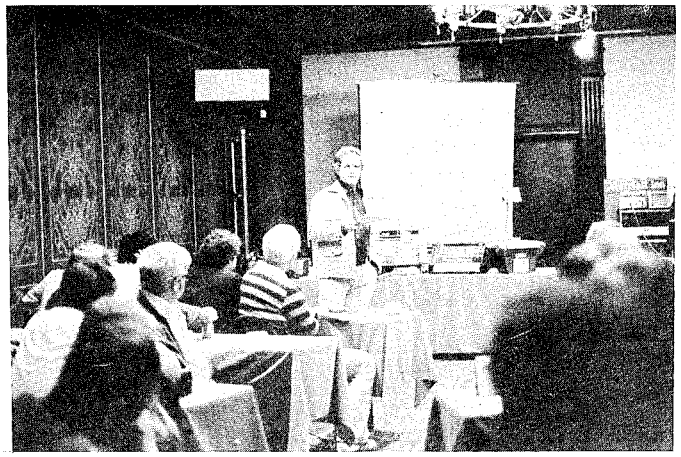
Larry, writing about the new shorting plug says, "We anticipate very good customer acceptance and use for technical as well as aesthetic reasons. (The shorting plug will also keep the receptacle clean and the chain will keep the item captive.) Dave Johnson, Bob Chase and I worked on the original concept. We should include Vic also; he must have had some input."

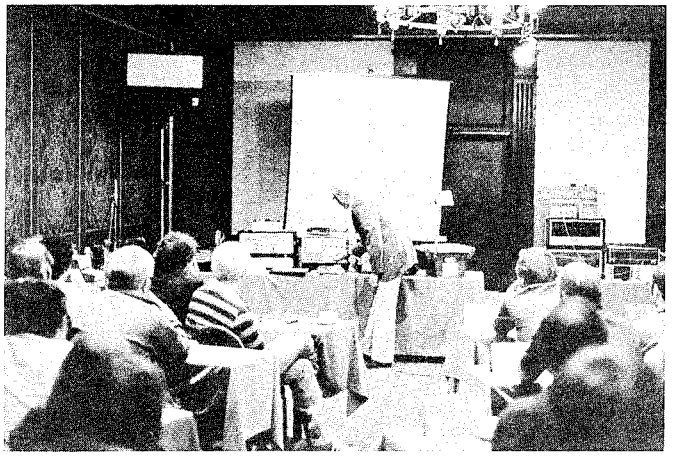
SECOND:

"Anyone of your grads who flies speaker arrays in existing construction, large rooms or churches may have been faced with the problem of attaching 500 to 1,000 pounds to a smooth plaster or acoustic ceiling. Save your old 8" speaker grills. Make the access hole necessary to bolt a suitable anchor strap to the side of the ceiling joist above. Neatly cut an appropriate hole in the grill to pass over the portion of the strap that extends below the ceiling level. Generally three and nearly always four such penetrations will support anything you want to fly in an existing building. On particularly high jobs, these anchors will double for your safety tines tiepoints. In this case, the life you save is most definitely your own."

SYN-AUD-CON & AES SECTION MEETINGS

Syn-Aud-Con presented AES Section Meetings at Seattle, Indianapolis and Minneapolis with the opportunity to see the latest in electro-acoustic measurement equipment and techniques.





The pictures show the chairman of the Indianapolis section addressing the group prior to the meeting and Cecil Cable in the process of demonstrating Time Delay Spectrometry (TDS).

Ralph Townsley of Purdue University was in attendance at the Indianapolis meeting. Ralph is the author of *Passive Equalizer Design Data* and easily the most experienced audio engineer in Indiana.

These meetings were specially scheduled to be held the evening before the regular class and have only been done where our schedule allows us an extra day at the hotel for setup, etc.

FURTHER REPORT ON ACOUSTILOG

Al Feierstein (2-time graduate of the New York classes) sold us one of his Reverberation Timers at the May AES Show. We now have had an excellent chance to evaluate it on two consulting jobs and during five classes. Even better, we have had a device to compare it against that is even more precise, namely Cecil Cable's very fast wave analyzer used with his TDS system.

We are pleased to report that the Acoustilog Reverberation Timer is truly a precision instrument. We are confident about measurements well below 0.1 second and have found it interesting in class to see the slope shapes that RT_{60}s take on Cecil's TDS system. Since Cecil's approach costs over $10,000, Al's unit at under $1,000 is a good buy when precision measurement of short time intervals is needed.

Should you want to be in touch with Al Feierstein his address is 19 Mercer St., New York 10013. (212) 925-1365

DAVID CLARK HEADSETS & ED LETHERT

That's Ed Lethert wearing the David Clark Headsets. Ed is a 3-time graduate from Northwest Sound in Minneapolis. He contributed a lot of material for this Newsletter - and is capable of great accomplishments.

Ed's response to the David Clark demo of their headset is typical. When Don or Cecil's heads are in 110 to 120 dB-SPL noise fields, they can communicate easily with whoever has the other headsets on in the classroom.

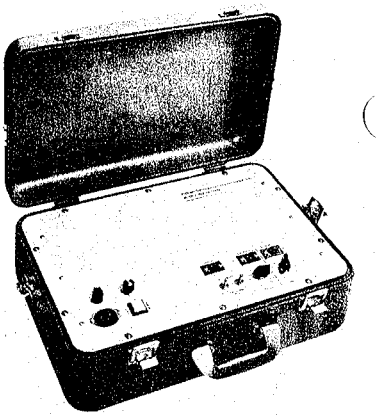
Graduates tell us they have never heard better headsets for noise isolation as well as maintaining high quality reproduction.

Photos by Richard Jamieson, Minneapolis

INDUSTRIAL RESEARCH PRODUCTS, INC.
A Knowles COMPANY

SYNERGETIC AUDIO CONCEPTS

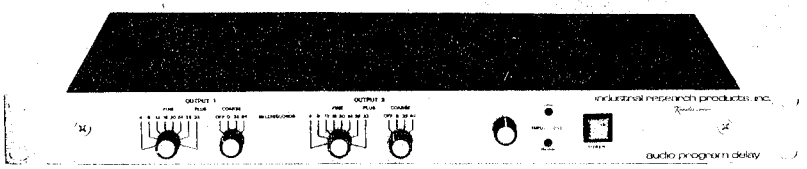
A NEW SYN-AUD-CON SPONSOR



We take particular delight in announcing Industrial Research Products, Inc. (IRPI) as the 10th Syn-Aud-Con sponsor because we have had a long association with the engineering philosophy of their owner and founder, Hugh J. Knowles, and with their Director of Research, Mahlon Burkhard.

Hugh Knowles founded Knowles Electronics as well as IRPI and is one of the real pioneers in electro-acoustic engineering. He recently was honored by the Acoustical Society of America as the recipient of their Silver Medal. Hugh Knowles writings on electro-coustics have formed a part of my technical library since its inception.

Mahlon Burkhard is one of those thoroughly grounded in fundamentals, well read in the available literature, and perpetually inquisitive about new ideas, scientist-engineers that can usually provide helpful insights into any technical question that I take to him. Mahlon truly qualifies as a digital audio pioneer and has been directly and creatively involved in solving the difficult problems that originally faced this type of product.



Further Syn-Aud-Con has had direct and continuing experience with IRPI's digital time delay instruments having used nothing else since the first Syn-Aud-Con classes.

Our current IRPI product, the DA 4002 has two outputs from one input allowing 240 milliseconds of delay in 5 millisecond increments. The S/N (in excess of 90 dB) is so good that noise no longer can be cited as a problem in these units and the excellent dual level lights allow easy precise settings of this unit's gain within a complex system to insure maximum S/N without clipping.

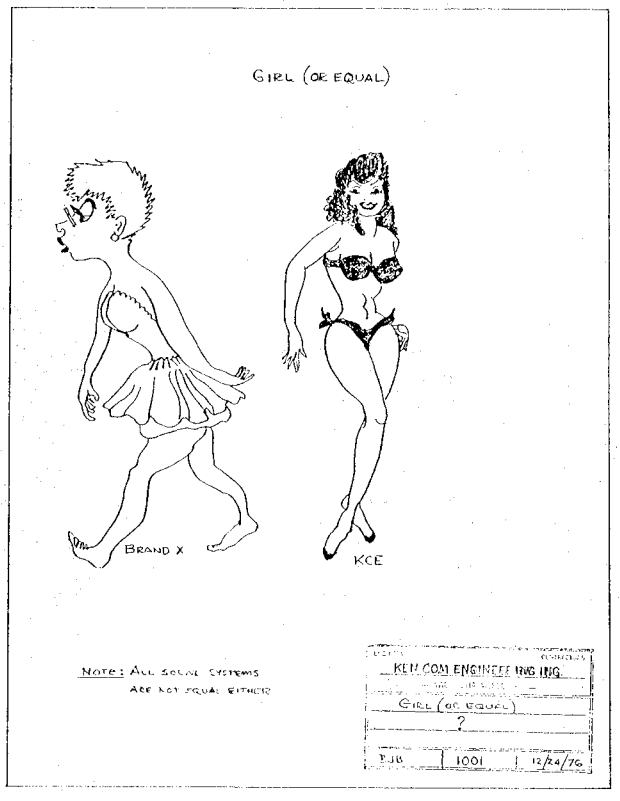
IRPI recently introduced professional quality digital time delay units (up to 90 millisecond of delay) for less than $1,000 per unit.

IRPI is well known to the military and government agencies and to the group of other professional companies that are OEM accounts, but are not so well known to the professional sound contractor, the recording engineer, and end user.

If you are not familiar with the excellent products IRPI offers the professional audio engineer we suggest you contact: Roger Carroll, Sales, or Mahlon Burkhard, Engineering, Industrial Research Products, 321 Bond St., Elk Grove Village, Ill. 60007. (312) 439-3600.

GIRL (OR EQUAL)

BURT BOETTCHER of Ken-Com Engineering in Waukesha, Wisconsin (2-time graduate) and an early friend from Acousta-Voicing days, felt that he needed something to get the idea across to the consulting engineer that "or equal" wasn't enough to assure a good specification and finished job, so he prepared "Girl (or Equal)", which does the job beautifully.

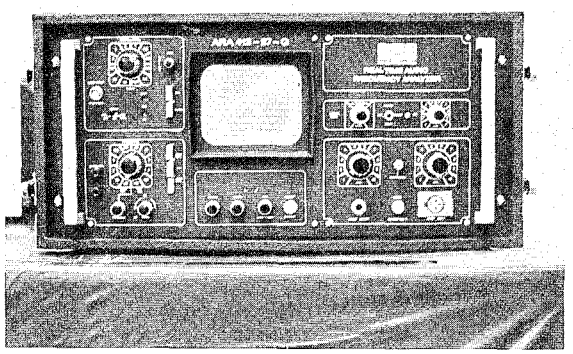


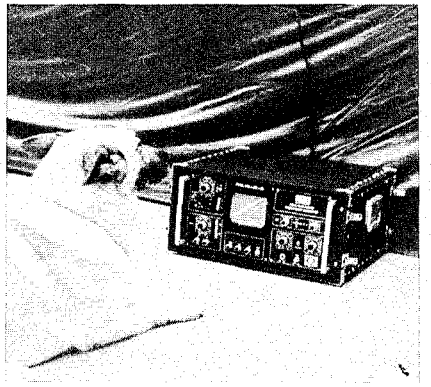
COMMUNICATION'S COMPANY NEW REAL TIME ANALYZER

Here are three views of VIC HALL and DAVE JOHNSON'S newest version of their RTA. It also serves as an audio frequency oscilloscope, and has a pink noise generator.

Judy's ears laid back are a quick indication that the White Noise she is watching has exceeded her upright ear level, L_{ue}. L_{1be} occurs around 85 dBA.

Vic's new package is attractive, compact, rugged, and as usual, reasonable. Contact Communications Company, 3490 Noell St., San Diego, CA 92110 (714) 297-3261





SHOWER MIKE

RICH CHINN (Seattle class) called from Seattle to give us the following information about the Shower Mike that we have been carrying in class since he gave it to us in February, The instruction manual (or sheet) says Rowen Associates, Honolulu, HI, though they are probably sales promotion people. Someone told Rich that they have been dealing with Lou Toscano at Drummer, Inc., 225 5th Ave, New York City 10010. Rich bought his at Bon Marche, Men's Cologne Dept., 3rd and Pine, Seattle, WA 98901. Cost (at Marché) $5.00 each). As some one said when they saw the Shower Mike, "Someone is really cleaning up with it."

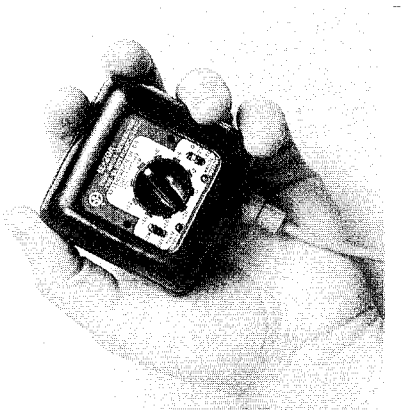
IVIE ELECTRONICS PINK NOISE GENERATOR

Ivie Electronics of Provo, Utah has for sale a very handy pink noise generator. Their model IE 20A. Quick preliminary tests indicate that it is stable in output vs frequency and that its level calibration is accurate. As delivered, the generator will give outputs from 940 mv at the o dB setting (can be reference to lv if desired) down to 1.2 mv (-58 dB) in 2 dB increments. Its noise approximates Guassian distribution.

The illustration indicates the very small size of the unit.

It takes approximately 3 to 4 hours to charge the batteries and will then provide approximately 12 hours of output. An exceptionally well written, comprehensive, and useful owners manual is provided with this instrument.

We intend to examine and report on Ivie's Model IE 10A audio spectrum analyzer as well, but the initial sample sent us developed some difficulties and we are waiting a second sample to complete our tests. In the meantime, we feel the IE 20A represents a worthwhile acquisition on the part of the sound engineer and its instant availability (you'll carry something this size everywhere in your briefcase) means you will have a way to "listen" to systems anywhere.



HEWLETT PACKARD FOURIER ANALYZER

Hewlett Packard has brought out what appears to be an automatically calibrated Fourier Analyzer for $29,900. The Model 5420A. We are getting in line to see if this unit can give us the transfer function of a real-life loudspeaker at a distance beyond the near field. If it can, then it promises to have wide audio application. We'll report further after we have had a chance to try one.

QUOTE

MIKE DUFOUR of Disneyland (Anaheim 1977) said after class, "A Syn-Aud-Con class is like dying of thirst in the desert and falling into a well only to find out that I can't swim. Next year I'm coming back with water wings."

SYNERGETIC AUDIO CONCEPTS

LETTER FROM A GRADUATE

(excerpt)

February 28, 1977

Dear Carolyn and Don:

I want to thank you for the wonderful Syn-Aud-Con experience. I realize that I am not typical of your attendees in that I am not an audio professional but I found the entire course to be perfect for my degree of interest and level of expertise. I was especially pleased by the historical slant, Don -- few of us realize where our roots are and respect them as you do. (end of excerpt)

DON C. CREEVY, M.D., Palo Alto, may not be a typical Syn-Aud-Con graduate but we have few graduates with a greater love of professional audio.

Dr. Creevy had an extra pleasure added to the class. Harold Lindsay was present (2-time graduate). Harold was the powerful force and incentive in encouraging A. M. Poniatoff to produce a tape recorder after World War II. He had much history to share with Dr. Creevy.

Harold Lindsay and Dr. Don Creevy

LOOSE LEAF SOUND SYSTEM ENGINEERING

In the Los Angeles class ROBERT TOURKOW of Filmways Audio said that he would like to be able to buy *SOUND SYSTEM ENGINEERING* in loose leaf. It appealed to us since we get three copies of the unbound 3-hole punched book each time we have a new printing (now in its third printing in less than 2 years -- 5,000 copies per printing).

We wrote Sams and got the following answer: "Yes, it is possible for us to do this for you. I do not have an exact estimate of the cost, but I doubt that there would be much savings. Most of the operations for the hard binding would still have to be done, plus a few additional ones. Of course the cover material would not be needed, but when you add the cost of the 3-ring binder, it would no doubt be as much or more than for the hard bound book."

"THERE ARE NO DUMB QUESTIONS"

Legend?

Reginald Fessenden of Purdue University wrote a chapter on wireless in some encyclopedia that I read in 1919, but the name of which I have long since forgotten. He explained the function of the vacuum tube, including heterodyne reception, and gave an elementary explanation of current flow within the tube where electrons flow from the hot cathode to the cold plate.

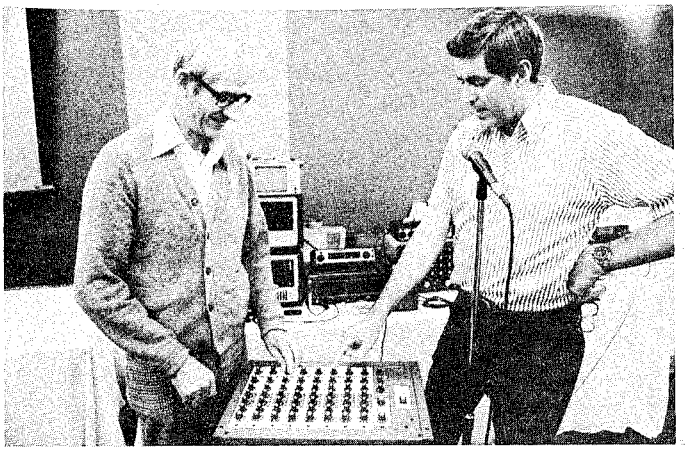
I then asked my physics teacher to reconcile this with the teaching in our physics book (Millikan and Gale) that the "current" went the other way. He admitted he didn't know, but said he'd "think about it." A couple of weeks later, he called me into his office (which gave me a scare), and reminded me of my question. He said he still didn't know the answer, but that what might have happened was that Ben Franklin, when he flew his kite, assumed that the cloud was positive and the earth negative, and that the "current" flowed down the wet string. He had two choices, and guessed wrong.

The "flow of current from positive to negative" persists to this day. The right-hand rule, symbolized by the IEEE logo, is accepted, and the electron flow in a vacuum tube is still in the "wrong" direction, to continue to confound the young physics student. Does anyone have a better explanation? Is the Ben Franklin legend the way the dilemma really got started?

Paul W. Klipsch
Klipsch and Associates Inc.
Hope, Ark.

← In a recent Letter to the Editor of the IEEE, we found this fascinating query which goes to prove again that "there are no dumb questions" and that you are never too much of an expert to seek answers.

SUNN SERIES 2000 MIXERS



Don and Cecil working with the new Sunn Mixer.

EXECUTIVE REPORT

KEN O'TOOLE (2-time graduate of the Boston class) sent in the following, "For years I have been subscribing to a publication which has benefited me very much. Enclosed please find descriptive brochures describing this publication, "Executive Report". The cost is relatively small, less than $150. per year. I would definitely recommend any one in business today, especially small companies, to inquire about this very unique and valuable publication." Information can be obtained by writing Prentice-Hall Inc., Englewood Cliffs, New Jersey 07632

CONSIDERING (N+1) AND M AS D_C MODIFIERS

Following the Banff class in Alberta in January 1977, we received the following letter from LOU J. LOMBARDI, Project Engineer with General Sound & Theatre Equipment Limited in Toronto:

I am experiencing some difficulty in the application of two items in Sound Systems calculations. The first is M. As described in the text book, it is a critical distance modifier, for which 1 is usually chosen except in special instances. The question is, how is a special instance determined, what circumstances should I look for and how do I arrive at the figure (other than 1)?

The second is n+1, the inclusion of this figure in the calculations is obviously very important, equally important is the interpretation as outlined in the textbook.

On page 68 of the textbook (bottom left) a listener is shown covered by two speakers in the direct sound field, two additional speakers are shown contributing to the reverberant sound, as a result n+1 = 2. Two common occurances are: 1) a distributed system in a large room such as a Fieldhouse or Ballroom, more specifically I am working on a Fieldhouse system where we have 30 846U Altec speaker systems in an area 290 feet long, 210 feet wide and 33 feet high where a listener at any given time could be covered by one, two or four speakers for direct sound. Should I consider the minimum and say that 29 speakers are contributing to the reverberant sound making n+1 = 30 or somewhere in between?

The second occurrence is a large cluster where we have a multitude of LF and HF horns arranged to cover a 360° audience seating arrangement. If I understand the explanation correctly in the Newsletter of October 1975, contributing to n+1 are all loudspeaker groups that are not contributing to direct sound. But since the Q of HF and LF horns are different this would require two separate critical distance figures. I am sure I have lost something in the translation, and since n+1 has a heavy influence on articulation loss it is most critical that I understand it for the sake gf good systems design.

I would like to express my gratitude for the amount of knowledge I acquired from you in the course in Banff. It made the difference between the customer having to take my word because of experience, and being able to prove what I am talking about on paper.

ANSWER TO LOU LOMBARDI

Your questions in your letter of March 22 are good ones and while I usually touch briefly on the answers to them verbally in class I have not written them out. The material below is my best thoughts on this subject at the moment:

Considering (n+1 and M as D_C Modifiers

First of all, in sound system work involving speech reinforcement or reproduction, we are primarily concerned with intelligibility or articulation percentages. This means that we restrict our main efforts to predicting the effects of the room's RT_{60}, ambient noise, and critical distance to the 2000 Hz octave band.

Acousticians may be forced to evaluate these same parameters every 1/3 of an octave from below 100 Hz to over 10,000 Hz in concert hall design, for example, but such detail is not justified for speech reinforcement. (We attempt to keep the Q of the woofers and the Q of the HF units the same at crossover whenever possible.) Therefore, we need to know for the 2000 Hz octave band:

1. The RT_{60} in seconds
2. The volume of the room in ft^3 or m^3
3. The Q of the sound source
4. The number of potential sound sources and *their coverage pattern.*

From this basic information, we can calculate:

1. D_C
2. Reverberant field sound level
3. The effects of n+1 on D_C
4. The $\%AL_{cons}$ at differing locations but usually at Max. D^2.

Normally, in the overhead distributed type of system *if* coverage is proper (ie, Figure 6-20 page 101 of SSE), then any listener receives direct sound from at least five sources at the same time. Even those listeners near a wall boundary, as the mirror image reflections from the nearest overhead loudspeakers, can be counted as, in most cases, the same as direct sound. Therefore, the 1 in (n+1) is equal to 5 units. Thus, n is the number of other groups of 5 units. A second way to look at this is to say that

$$(n+1) = \frac{\text{Total loudspeakers}}{\text{\# of loudspeakers supplying direct sound to listener}}$$

In arrays of loudspeakers such as central clusters in arenas, auditoriums, etc., the array has to be scrutinized very carefully to determine which horns are supplying direct sound to the "worst case" listener location. This usually leads to the realization that in such large spaces it is important to keep the $RT_{60} \leq 2.0$ seconds maximum. It also points up the vital necessity to have a way to turn off unused parts of the array for partial audience conditions.

In large central arrays the problem becomes that of obtaining coverage at the expense of increasing (n+1) detrimentally so far as "apparent" Q is concerned. Consider that in an arena you might need a 360° horizontal angle and say a 40° vertical angle in order to provide coverage of the audience area from a centrally located cluster. Referring to Table 3-3 on Page 49 of SSE which shows the proportion of spherical surface area various zones cover (See Figure 3-12 same page) we can sum them as follows:

(continued on next page)

LETTER TO LOU LOMBARDI, CONT.

0.087155744 x 2 = area covering 5^0 either side of center line on surface. Total 10^0
0.171663302 = area on either side of first area. Total 10^0
0.163799217 x 2 = area on either side of areas above. Total 20^0. $10^0 + 10^0 + 20^0 = 40^0$
0.67353224 = total area

$$Q = \frac{1}{\text{Area proportion}} = 1.5$$

For three loudspeakers with Q = 5 (typical for good loudspeakers with smooth coverage angles of $120^0 \times 40^0$)

$$\text{Apparent } Q = \frac{Q \text{ of loudspeaker}}{(n+1)} = \frac{5}{3} = 1.7$$

So, the agreement between the likely geometric Q and the apparent Q found by considering (n+1) are near enough in agreement to provide guidance to the system designer. An effective overall Q = 1 for an arena array is close to the facts as measured.

A Church Example

Suppose that you find that you need a Q = 25 to reach the furthest listener in a church and that a horn with a Q = 25 doesn't have the coverage angle, C_L, necessary to allow proper coverage of the front of the audience area. In such a case you resort to using two horns, one for the front audience area (short-throw) and one for the rear audience area (far-throw). This creates an (n+1) of 2; therefore, to counteract this the Q of each device must be doubled. This means that the far-horn now needs a Q = 50 and the near-throw horn needs a $Q = \frac{50}{4}$.

Q's are power ratios and the near-throw horn will have its on-axis beam aimed at the middle seat in the auditorium -- that is, at the seat needing 6 dB less direct sound level compared to the furthest seat, and -6 dB is 1/4 of the power so the Q for the furthest seat is divided by 4.

It can be seen that we always try to get our coverage with a single device whenever possible. When two horns are used in the manner described above, they are then fed equal electrical power with the result that the far-throw horns' on-axis direct sound level will be 6 dB higher than the near-throw horns' direct sound level (for equal distances) solely due to the fact that the near-throw horns' C_L spreads the available acoustic power over a much wider angle than the far-throw horn.

Considering the 'M' Factor

The 'M' factor is a very real parameter which is theoretically understood but is difficult to accurately predict. The problem lies in the fact that we invariably have a C_L that is only fractionally encountering the special area of absorption. Since our coverage of the absorption is uncertain and the absorptive area itself is often not clearly specified for the angles of incidence between it and the sound source plus we aren't sure about how many early reflections can be included in the calculations, I normally never calculate M but do everything in my power to make it as high as possible by

1. Turning off any loudspeakers to areas where there is no audience and confining partial audiences to the covered areas.
2. Seek out whenever possible the application of carpet on the floors, cushions on the pews, seats where absorption looks like a person when the seat is unoccupied.
3. Adjust coverage angles by loudspeaker selection and placement to maximize 'M' and minimize reflections.

We all have run into auditoriums and arenas where empty they are unusable and full they are quite tolerable. These are very real cases of the 'M' factor doing a good job.

Summary

When you are calculating the acoustic gain parameters you should always be careful to use the de-rated Q that compensates for the (n+1). In two and three horn arrays when the Q's are each 1/4 of each other, use the lowest Q in the array divided by (n+1) to find either D_C or the Hopkins-Stryker equation. The true Q is the actual rating of the loudspeaker by itself.

I hope this lends some insight into the problem.

MORE ON ACOUSTICAL FACILITY IN CANADA

In our last Newsletter we wrote about "A New Acoustical Facility in Western Canada". Since then KEN HEWITT sent us some additional material about the facility:

The Facility and its Justification by E. H. Bolstad, President

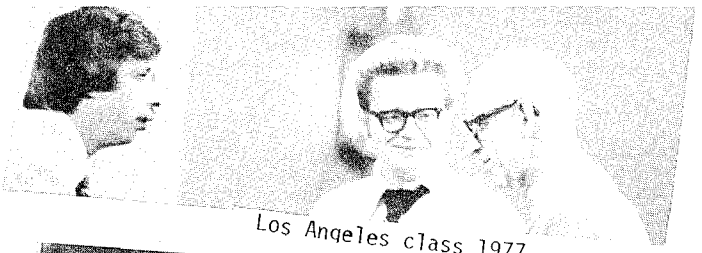
With regard to our measurement of the RT_{60} in the facility, very briefly, we married a B&K 2305 chart level recorder to a Hewlett Packard 5300 measuring system, via a magnetic reed switch system and electrically interlocking and unlatching relays which count either the RT_{20} or RT_{30} dependent on the ambient noise level. Ten counts are entered into a Hewlett Packard 9815 programmable calculator for each frequency band, and in conjunction with the empty room characteristics, previously entered and stored etc., the calculator calculates the absorption coefficient and NRC for any sample tested.

We have also designed a field testing kit which will record on tape the RT_{60} times for each frequency band and we can then play back into the measuring system in the lab if required.

Indianapolis class 1977

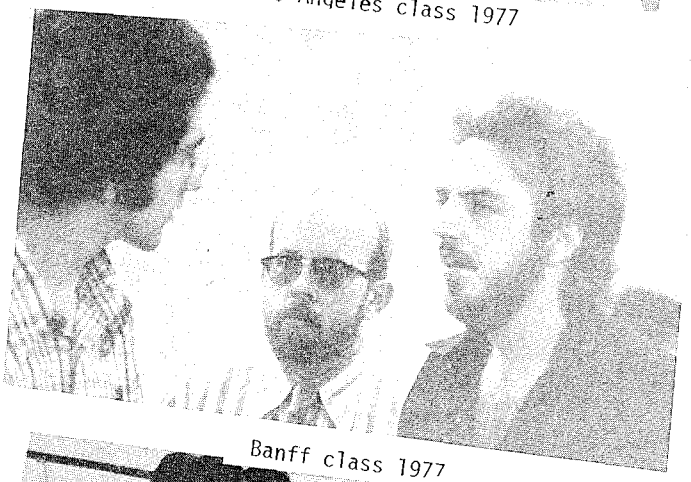
Minneapolis class 1977

Indianapolis class 1977



Los Angeles class 1977

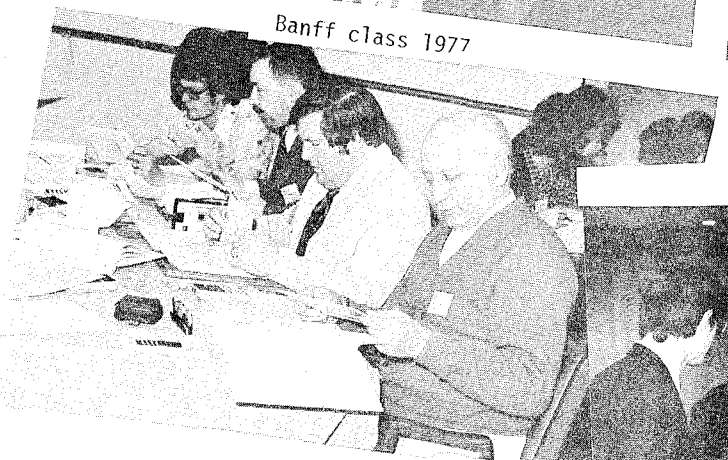
San Francisco class 1977



Communications Co.
San Diego class 1977

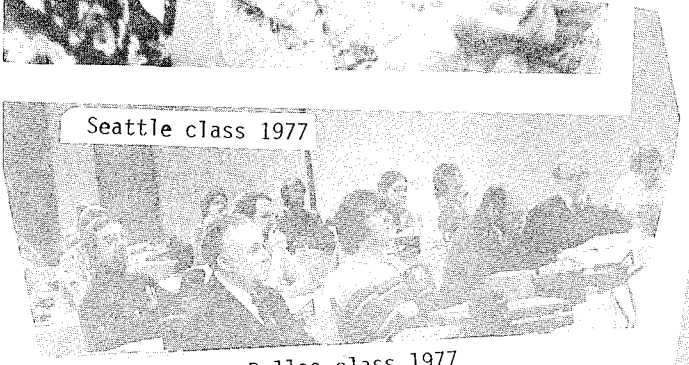
Communications Co., San Diego class

Banff class 1977

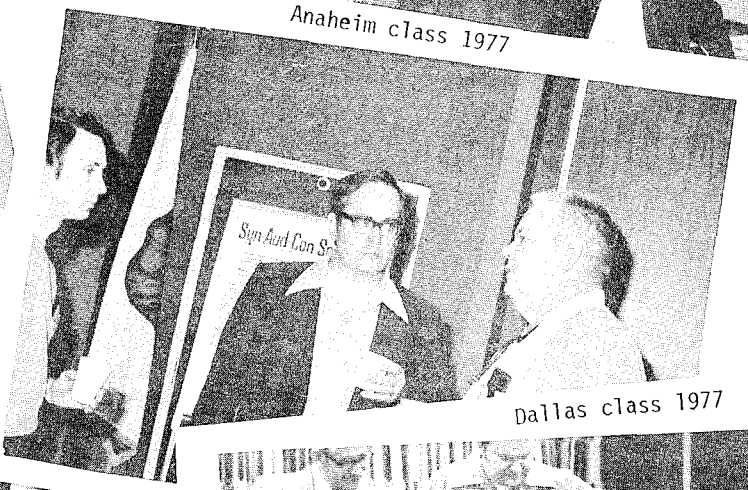


Chicago class 1977

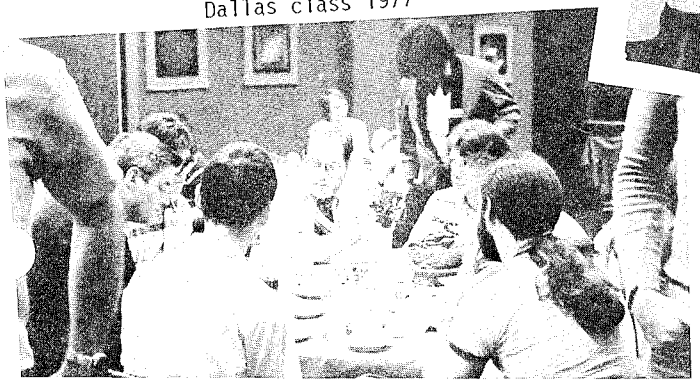
Anaheim class 1977



Seattle class 1977



Dallas class 1977



Dallas class 1977

In the San Francisco class 1976 we paid a photographer to take pictures of the class and we never heard from him again. So we started in 1977 taking pictures of each class. We'll be using more and more pictures in each Newsletter.

DAFFY DEFINITIONS

2-time graduate, ROBERT McKENNY, Manager, Studio Sound at CBS Television in Burbank, gave us a list of Daffy Definitions which we enjoyed.

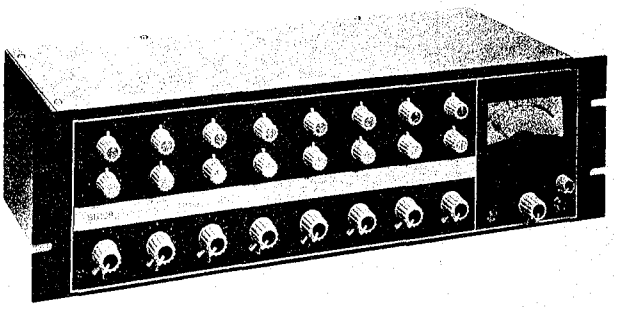
ATTENUATOR	One more than a Nine-U-Ator
AUDIO	First name of a famous Murphy
BALOP	Sound made by dropping a flat rock into water
BROADBAND	An all-girl orchestra
BROADCAST	Used on an elephant with a broken back
CAMERA MATCHING	What happens when two Japanese tourists meet
CHROMA	Trim on an Italian automobile
COLOR BALANCE	Result of school bussing
COLOR BURST	Result of shooting a peacock with a shotgun
COMPRESSED WHITE	Anglo-Saxon midget
CONTROL TRACK	What the rabbit runs on at a dog track
CROSSTALK	Wife's comments at 2 AM homecoming
DEGAUSSER	Indigestion remedy
DIELECTRIC	First degree murder sentence
DIODE	Poem about death
DOLLY IN	A girl at home
DROPOUT	Danger associated with low-cut dresses
FILM LEADER	John Wayne
HEAD CLOG	Stopped-up toilet aboard ship
HEAD WHEEL	The biggest big shot
HIGHLIGHT	Chandelier on a short chain
HORIZONTAL BARS	Level saloons
ION	A device for pressing clothes
LAP DISSOLVE	A loss due to standing up
LIMITER	Man's wedding ring
LIP-SYNC	Extremely small wash basin
MICROWAVE	Greeting between two Micros
MULTIPLEXED	Perplexed by many things
MULTIVIBRATOR	Plump girl without girdle
NUVISTOR	First time visitor
OHM	An Englishman's house
PEDESTAL	Bicycle powered horse stall
PHASE CORRECTOR	Plastic surgery
REEL	Popular dance in Virginia
REGISTRATION	Mr. & Mrs. John Smith, on motel records
STREAKING	Popular Spring college pastime
SYNCING	What Titanic was doing after hitting iceberg
TIP PENETRATION	Discussion point at rape trial
TIP PROJECTION	Ample endowment, no bra, and shear blouse
TRANSIENT RESPONSE	Answer from a hobo
VARIABLE RESISTOR	Girl who sometimes says no
VERTICAL BANDING	Basketball referee's shirt marking
VERTICAL SYNC	Result of jumping from airplane in flight
VIDEO	Surname of a famous captain
WHITE CLIPPER	Barber in a segregated shop
YOKE	Funny story in Sweden

Bob McKenny (right) and Pete Dawson, Hurley Electronics

NEW PRODUCTS FROM SHURE BROTHERS

New products and new techniques have poured from the Shure factory during the past year. This kind of output is not unexpected when the depth of the engineering department is discerned.

New Mixer Amplifiers



The SR109 professional mixer has a noise figure (N.F.) of 5.3 dB (300 to 20,000 Hz).

I personally prefer greater output capability (+30 dBm for broadcasting or recording usage). The broadcaster, according to Hans Schmid in the January 1976 issue of SMPTE Journal, needs 10 dB vu meter lag + 6 dB clip level (margin) + 6 dB impedance stabilizing pad loss for a total of 22 dB above his program level. This would restrict this mixer to a maximum program level of -3 vu (+ 7 dBm) when used by broadcasters following this rule. (Schmid insists on vu being used only for complex waveforms and dBm only for sine waves, hence by his definition they are always 10 dB apart due to vu meter lag.)

Shure gives the EIN in open circuit dBV values and to find the EIN in dBm requires taking their output noise value with the gain controls open and adding it to the stated gain figure to obtain the desired value:

-38.8 - 87 = -125.80 dBm

-174 + 10 log (20,000 - 300) = 131.06

-131.06 - 125.80 = 5.26 dB

REFERENCE RECORDS

RON WICKERSHAM and Ed Long are involved in a new record company using a process they call *The Pressure Recording Process*. And, at this time they aren't talking about how they have made the very exceptional recordings. Cost $12.00 each. If you can't find them in specialty record stores, write Box 77907, San Francisco, CA 94107.

Q DATA FROM COMMUNITY LIGHT & SOUND

Community Light and Sound has been gathering extensive directional data on both their own devices and those of selected competitors. We have reproduced below some data sent to us by RANDY VAUGHAN of Norfolk, VA.

Sensitivity is given at one watt for band limited pink noise at 4' and 1 meter. The relative response in 1/3 octave intervals is provided and the coverage angles are measured for each 10^0 at 1/3 octave intervals both vertically and horizontally.

Finally, the directivity factor, Q, and the directivity index, D_I, is calculated at each of the standard 1/3 octave frequencies.

One factor of interest is that on the device shown in this data, the Emilar EA 175-16 (normally around 20-25% efficiency) shows only 4% efficiency.

$$dB\text{-}PWL_{-12} = dB\text{-}SPL - 10 \log Q - 20 \log \left(\frac{0.925}{DM}\right) - 0.2$$

and acoustic watts =

$$10^{\left(\frac{dB\text{-}PWL}{10}\right)} \times 10^{-12}$$

SENSI 101.52 ###
Dm 4.00 ###
Q 7.10 ###
dB-PWL 105.52 ###
ACOUS WATT 0.04 ###
WATTS/cm² 1.3E-06 ###

The intensity in W/cm² =

$$10^{\left(\frac{dB\text{-}SPL - 0.2}{10}\right)} \times 10^{-16}$$

DEVICE: COMMUNITY RH90-C DRIVER: EMILAR EA175-16

HORIZONTAL

	400	500	630	800	1K	1.25	1.6K	2K	2.5K	3.15	4K	5K	6.3K	8K	10K	12.5	16K
0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
10	98	100	100	100	100	100	100	100	9	100	100	100	100	100	100	100	100
20	98	98	98	98	98	100	100	102	100	100	100	100	98	100	100	98	98
30	96	96	94	96	96	96	98	100	98	100	100	100	100	100	100	96	94
40	92	92	92	94	94	96	96	94	96	96	96	98	98	98	98	94	
50	90	90	90	92	92	90	92	92	90	92	90	90	90	92	90	88	86
60	88	88	88	90	88	88	88	88	88	86	86	86	86	86	84	82	78
70	86	86	86	88	86	86	84	84	84	84	82	82	82	82	80	78	74
80	86	86	84	86	84	84	82	82	82	82	80	78	78	80	78	74	70
90	82	86	84	84	80	80	80	82	78	78	76	74	72	74	72	68	64
100	82	84	82	82	80	80	78	82	78	78	74	74	72	72	70	66	62
110	82	84	84	80	80	80	78	82	76	76	74	72	70	70	68	64	60
120	82	84	84	82	80	80	78	80	74	74	72	70	68	70	68	64	66
130	83	84	83	82	81	80	78	79	75	74	72	69	67	66	66	64	65
140	84	84	82	82	82	80	78	78	76	74	72	68	66	64	64	64	64
150	84	84	84	82	81	81	80	77	76	75	72	68	66	64	64	64	64
160	84	86	86	82	80	82	82	76	72	76	72	68	66	64	64	64	64
170	87	89	87	84	80	81	81	77	76	76	72	68	66	64	64	64	64
180	90	92	88	86	80	80	80	78	76	76	72	68	66	64	64	64	64

VERTICAL

	400	500	630	800	1K	1.25	1.6K	2K	2.5K	3.15	4K	5K	6.3K	8K	10K	12.5	16K
10	100	100	100	100	100	100	98	100	98	100	98	100	98	100	98	98	98
20	98	100	100	100	98	98	96	98	96	98	96	96	94	94	92	90	90
30	98	98	98	98	96	96	94	92	94	94	94	92	90	90	90	86	86
40	96	98	96	96	94	94	92	92	90	92	90	90	86	86	84	80	82
50	96	96	94	96	94	92	92	92	88	88	88	86	84	82	80	76	78
60	96	96	94	94	92	90	90	90	88	86	86	84	82	80	80	78	74	76
70	94	96	92	92	90	88	88	90	86	86	84	82	80	78	76	72	74
80	94	94	90	90	88	88	88	88	86	84	82	80	78	78	76	72	74
90	92	92	90	88	86	86	86	86	84	84	80	78	76	76	74	72	72
100	92	92	88	86	86	84	82	84	82	80	78	74	72	72	68	68	68
110	90	90	88	86	84	84	80	80	80	80	74	72	70	70	66	68	68
120	90	90	86	86	82	82	80	82	78	76	72	68	66	66	64	64	64
130	89	89	85	86	82	81	76	81	77	74	70	67	65	64	63	63	63
140	88	88	84	84	82	80	72	80	76	72	68	66	64	62	62	62	62
150	89	89	85	84	81	80	74	79	74	71	69	67	65	63	63	63	63
160	90	90	86	82	80	80	76	78	72	70	70	68	66	64	64	64	64
170	90	91	86	84	80	80	78	76	74	74	70	68	66	64	64	64	64
Q	5.5	4.8	6.9	6.1	8.1	8.2	9.1	7.1	11.5	8.6	9.9	9.4	11.2	9.9	10.9	14.2	20.6
D(I)	7.4	6.8	8.4	7.8	9.1	9.2	9.6	8.5	10.6	9.3	10.0	9.7	10.5	10.0	10.4	11.5	13.1
RESP	-11	-4	-3	0	0	1	1	0	2	2	1	1	-2	-1	-3	-8	-14

SPL, 1W PINK NOISE 400 HZ TO 16K HZ, 4FT 101.52 DB 1M, 103.24 DB

"K" PADS BY KENTROX

RUSSEL L. O'TOOLE, 2-time graduate from Audio Electronics in Romeoville, IL tells us of the telephone company's use of "K" pads made by Kentrox of Portland, Oregon.

At Russel's request Kentrox sent us a sample of two mountings, the 30000106 for a single pad and a 30000206 for two pads plus three "K" pads themselves, in this case, 3 dB, 6 dB, and 20 dB units.

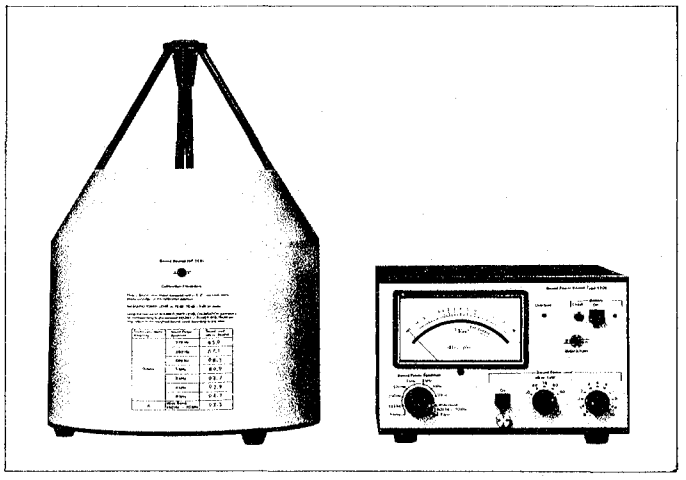
Unfortunately, the accompanying literature gives only model numbers, prices and attenuation. There is no mention of what circuit configuration they are, whether they are balanced or unbalanced, what maximum and minimum levels are advisable, what color code to use, or accuracy tolerances. (We are writing to Kentrox for further information).

On the plus side, the mounting is the best we have encountered and simply sticks to any available smooth surface by means of an effective double-faced tape of the type used to fasten rearview mirrors to windshields in automobiles.

The pads come in the values shown. Individual pads cost in lots of 1-99, $2.70 each. Single mountings are $8.00 and double mountings are $16.00. They provide standard mountings for up to 72 "K" pads in their catalog which can be obtained by writing Kentrox Industries Inc., 14335 N.W. Science Park Drive, Portland, Oregon 97229

dB LOSS	PART NUMBER	dB LOSS	PART NUMBER	dB LOSS	PART NUMBER
0.0	40000	10.0	41000		
0.2	40020	10.2	41020		
0.4	40040	10.4	41040		
0.6	40060	10.6	41060		
0.8	40080	10.8	41080		
1.0	40100	11.0	41100		
1.2	40120	11.2	41120		
1.4	40140	11.4	41140		
1.6	40160	11.6	41160		
1.8	40180	11.8	41180		
2.0	40200	12.0	41200	20.0	42000
2.2	40220	12.2	41220	20.2	42020
2.4	40240	12.4	41240	20.4	42040
2.6	40260	12.6	41260	20.6	42060
2.8	40280	12.8	41280	20.8	42080
3.0	40300	13.0	41300	21.0	42100
3.2	40320	13.2	41320	21.2	42120
3.4	40340	13.4	41340	21.4	42140
3.6	40360	13.6	41360	21.6	42160
3.8	40380	13.8	41380	21.8	42180
4.0	40400	14.0	41400	22.0	42200
4.2	40420	14.2	41420	22.2	42220
4.4	40440	14.4	41440	22.4	42240
4.6	40460	14.6	41460	22.6	42260
4.8	40480	14.8	41480	22.8	42280
5.0	40500	15.0	41500	23.0	42300
5.2	40520	15.2	41520		
5.4	40540	15.4	41540	24.0	42400
5.6	40560	15.6	41560		
5.8	40580	15.8	41580	25.0	42500
6.0	40600	16.0	41600		
6.2	40620	16.2	41620	26.0	42600
6.4	40640	16.4	41640		
6.6	40660	16.6	41660	27.0	42700
6.8	40680	16.8	41680	28.0	42800
7.0	40700	17.0	41700		
7.2	40720	17.2	41720	29.0	42900
7.4	40740	17.4	41740	30.0	43000
7.6	40760	17.6	41760		
7.8	40780	17.8	41780	35.0	43500
8.0	40800	18.0	41800	Infinity	49999
8.2	40820	18.2	41820		
8.4	40840	18.4	41840		
8.6	40860	18.6	41860		
8.8	40880	18.8	41880		
9.0	40900	19.0	41900		
9.2	40920	19.2	41920		
9.4	40940	19.4	41940		
9.6	40960	19.6	41960		
9.8	40980	19.8	41980		

MOIR'S SOUND POWER SOURCE



James Moir, the renowned British acoustical consultant, now has his latest invention being built and sold by Bruel and Kjaer of Denmark. The Model 4205 Sound Power Source appears to be the best candidate for solving the measurement of Q (directivity factor) in the field (originally discussed in Newsletter Vol 3 # 4, page 20.)

While the manufacturer's data gives some polar response information, they fail to give Q data which we feel is a major oversight in that it forces the use of the device in a semi reverberant space rather than in a free field.

Another questionable factor in the data sheet sent out by B&K is that the test cases shown are in test spaces "too dead" to establish any kind of reliable reverberant sound field.

We have been unable to obtain a sample for test as yet but our interest continues at a high level as Mr. Moir's idea is basic, better and beneficial to audio engineers.

MURPHY RIDES AGAIN

GERALD STANLEY, the young man that walked into Crown International carrying the result of a college project under his arm several years ago - the DC300 which literally turned the amplifier industry upside down, sent in the following:

Murphy's Law concerning the intransigence of inanimate objects has been widely acclaimed and observed. This would for all intents and purposes establish it as "scientific fact". However, all things should be proven and to this end I submit the following proof:

Let S be the set of all statements
Let T be the set of all true statements
Every element of S (every statement) is either in the set T or in the set C=S-T, which is the complement of T, and not in both.

Consider: (1) Every statement within this rectangle is an element of C. (2) Murphy's law is true.

Statement (1) is either in T or in C and not in both. If (1) is in T, then it is true. But if (1) is true, it asserts correctly that every statement in the rectangle including (1), is in C. Thus the assumption that (1) is in T implies that (1) is in C.

CONTRADICTION: If (1) is in C, we must consider two cases: The case that every statement (2) is in C and the case that (2) is in T. If (2) is in C, then both (1) and (2), that is, every statement in the rectangle, is an element of C. This is exactly what (1) asserts, and so (1) is true and is in T. Thus the assumption that both (1) and (2) are in C implies that (1) is in T.

CONTRADICTION: If (2) is in T (and (1) is in C), then the assertion of (1) that every statement in the rectangle is in C is denied by the fact that (2) is in T. Therefore (1) is not true and is in C, which is entirely consistent.

The only consistent case is that in which statement (1) is in C and statement (2) is in T. Statement (2) must be true. Therefore, Murphy's law will be obeyed. After much procrastinating, hope the inevitability of Murphy's Law has been proven.

BASIC REFERENCE LIBRARY

1. *NOISE AND VIBRATION CONTROL*, Edited by Leo L. Beranek, McGraw Hill Co., Inc. 1971. 650 pages
2. *MOTION PICTURE SOUND ENGINEERING*,* Research Council of the Academy of Motion Picture Arts and Sciences, D. Van Nostrand Co., Inc., 1938. 547 pages
3. *SPEECH AND HEARING IN COMMUNICATIONS*, Harvey Fletcher, D. Van Nostrand Co., Inc., 1953. 461 pages
4. *ACOUSTIC DESIGN CHARTS*,* Frank Massa, The Blakiston Co., 1942. 228 pages
5. *HANDBOOK OF NOISE MEASUREMENT*, Arnold P. G. Peterson and Ervin E. Gross, Jr., General Radio (GenRad, Inc.) (seventh edition 1972) 322 pages
6. *PASSIVE EQUALIZER DESIGN DATA*, Ralph R. Townsley, Tab Books, 1973. 496 pages (8½x11 format)
7. *ELEMENTS OF SOUND RECORDING*,* John G. Frayne and Halley Wolfe, John Wiley & Sons, Inc. 1958. 686 pages
8. *COMPENDIUM OF MATERIALS FOR NOISE CONTROL*, Illinois Institute of Technology Research Instruction, U.S. Dept. of Health,Education and Welfare, 1975. HEW publication # (NIOSH) 75-165. 341 pages
9. *A GUIDE TO AIRBORNE, IMPACT AND STRUCTUREBORNE NOISE CONTROL IN MULTIFAMILY DWELLINGS*, National Bureau of Standards, U. S. Dept. of HUD, HH 131 24/2. 1973. Approx. 398 pages. #023-000-00250-7
10. *BASIC MATHEMATICS FOR ELECTRONICS*, Nelson M. Cooke, McGraw-Hill Book Co. 1960. 679 pages
11. *THE ACOUSTICAL FOUNDATIONS OF MUSIC*, John Backus, W. W. Norton & Co., 1969. 312 pages
12. *SOUND SYSTEM ENGINEERING*, Don and Carolyn Davis, Howard W. Sams & Co., 1975. 295 pages (8½x11 format)

*these books may be hard to obtain as they are out of print, but they are well worth a search. Newsletter Vol 4, no. 3, page 17 listed 4 book search firms.

FERROFLUIDICS

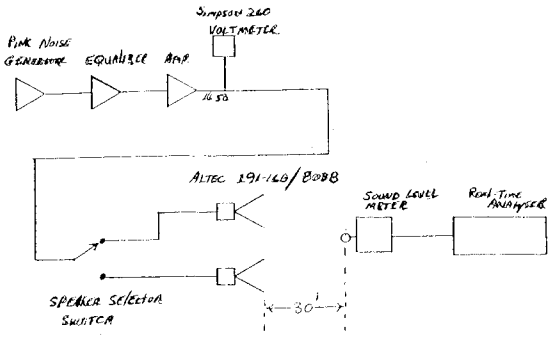
TOM HAYES, Audio Director of the Krannert Center for the Performing Arts at the University of Illinois has conducted a series of tests of Ferrofluids' audible response when applied to a heavy duty high frequency driver unit. We found Tom's data of genuine interest and feel that you will also. We're eager to hear how Tom's units hold up in field use and what next summer's tests on the same units will reveal.

Tom's letter to:

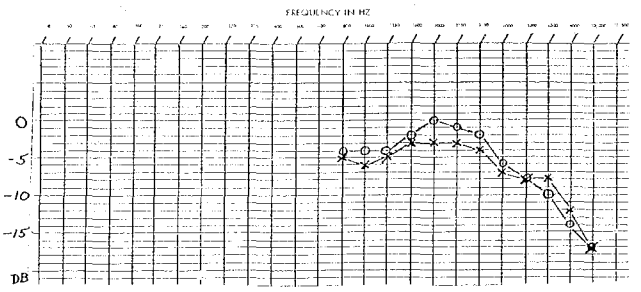
Walter R. Reed, Sales Manager
Ferrofluidics Corp.
144 Middlesex Turnpike
Burlington, Mass 01803

Dear Mr. Reed:

With the warm weather here, I finally conducted some outdoor tests of the ferrofluid sample given me months ago. My test objectives were simple: to determine if ferrofluid can make an audible difference in sound reinforcement system performance.



O= ALTEC 291-16G/803B WITHOUT TREATMENT
X= ALTEC 291-16G/803B WITH FERROFLUID



Of your four performance claims made about the fluid, increased power handling, voice coil centering, increased efficiency and flattened response, I tested for the third and fourth improvements, increased efficiency and flattened response. Not that the other parameters are not important, but I do not have the resources to test voice coil power handling by blowing up $68 voice coils. It does seem completely logical, however, that the increased thermal conductivity afforded the voice coil by the ferrofluid would serve to increase the power handling.

One other thought on driver power handling: as you know, a high frequency driver can fail from either an electrical failure, too much power causing the voice coil to open, or a mechanical failure of the suspension caused by excessive excursion at low frequencies.

In all my present two-way system designs I am using a crossover frequency of 800 hertz with a 12 dB/octave slope. A rule of thumb for H.F. drivers is that you can increase the power applied by 6 dB each time you double the crossover frequency. With this crossover frequency and the addition of ferrofluid, I feel that increasing the power applied to a driver/horn system by about 7 to 8 dB is not taxing the driver excessively. Think of the saving in terms of not having to install additional speakers in order to get the desired sound pressure level out of the system! As for the voice coil centering, your demonstration at the Fall AES show seemed adequate to prove the ability of ferrofluid to center a voice coil.

My test procedure was as follows: I took two Altec 291-16B high frequency drivers, one treated with ferrofluid and one not so treated, and attached these to two Altec 803B H.F. horns. The horns were erected next to each other, outdoors, thirty feet from a General Radio 1565-A sound level meter. The output of the meter was connected to an Altec/H.P. 8050A third octave real-time analyser from which the enclosed graph tracings were copied. The drivers were presented with one watt of band limited (800 hz High Pass) pink noise from an Altec 8080B pink noise generator, Altec Model 1650 third octave equalizer and Altec 1594B power amplifier. A diagram of the test setup is enclosed.

As measured on the sound level meter, both drivers produced a S.P.L. of 91 dBc with the conditions described above. Obviously, no increased output from the ferrofluid-treated driver was noted. The plot of the frequency response did show striking differences between the two drivers. The driver with ferrofluid exhibited a flattening of the frequency response in the order of 3 dB in the 2 KHz region. In addition, there was a 2 dB improvement in the frequency response above 5 KHz. The dramatic improvement is more evident as one begins to equalize the sound system. With the system less peaky to begin with, less equalization is required to bring the system to the preferred house curve. This, of course, means less attenuation is needed from the equalizer, thus maintaining amplifier power output and signal-to-noise ratio.

In all, I am pleased with the improvements obtained with the ferrofluid. I would like to do some additional testing with different Altec drivers to determine how different voice coil/diaphragm materials perform with ferrofluid. The particular drivers used in this testing, the Altec 291-16B,are not Altec's best H.F. drivers. The 288-16G has much better high frequency response at the expense of power handling. I am optimistic that ferrofluid in the 288-16G gaps will decrease the failure rate of the 288 diaphragm making the improved high frequency response capabilities available to the high level concert sound reinforcement market.

Thank you for a good product.

Sincerely,

Thomas B. Hayes
Audio Director

COLOR CODED WINDSCREENS FROM SHURE BROTHERS

Shure Brothers of Evanston Ill. were one of the earliest of Syn-Aud-Con Sponsors. DON PATTEN, Manager Engineering Services writes telling us of the color coded windscreens available from Shure Brothers.

If you have ever had the problem of a crowded stage with many hand-held microphones, and you couldn't find the right input at the mixer, then Shure's color coding is for you. Observe what color windscreen the performer is using and then locate that color dot on the input connector at the mixer.

Colors available include: True blue, Well red, Mean green, Screaming yellow, Florida orange, Sound brown, All colors white, and No colors black

ECHO

JOHN KRAUTBAUER, 2-time graduate from Duluth, gave us the origin of Echo: In Greek mythology, Echo was a nymph who kept up an incessant talk with Hera in order to distract her attention from her faithless husband. Discovering the trick, Hera punished Echo by taking away her power of speech until she was first spoken to, at which time she was compelled to answer. She fell in love with Narcissus, who didn't love her, and so she pined away until there wasn't anything left except her voice.

A REAL ENGINEERING MANAGER

In an absolutely fascinating article on the winner of the 1976 Award for Achievement given by the Editors of ELECTRONICS magazine, there occurs a description of how Robert C. Dobkin was hired by National Semiconductor.

Robert Widlar, who hired Dobkin remarks that "it was the culmination of two years of irritating phone calls. Every now and then I would get these calls from a wild sounding freak. He was always asking questions. Finally, I hired him and told him to go answer his own damned questions."

"The freak" turned out to be one of the most prolific circuit designers ever, with over 20 patents at age 33 and remarkably high ratings from his peers.

"Bob has an almost uncanny capacity to absorb information he needs from tests on the work table, he'll read everything he can get his hands on. If that's not enough, he'll corner anyone he thinks has information he needs. Then he'll go back to pushing and poking at the problem until he has an answer - the answer."

Dobkin left MIT in his sophomore year. "I left because I was bored," he says, "I was climbing the walls. They just expected me to sit there, take notes, and take tests. I need a productive situation to do my best. So I got out."

The article appeared in the October 28, 1976 issue of ELECTRONICS and is well worth reading.

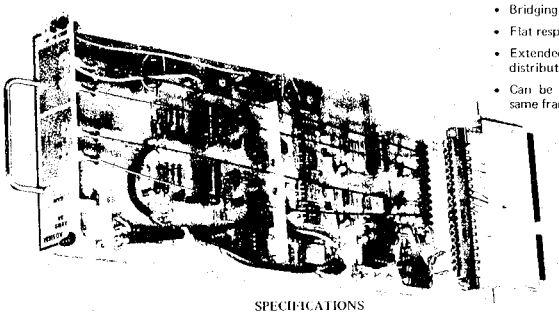
DYNAIR DISTRIBUTION AMPLIFIER

In sound systems for large public buildings, the need quite often arises for a high quality distribution amplifier that will allow the program to be fed to many remote points. Because the user of these remote feeds may accidentally or otherwise put almost anything back onto the line, real isolation is also required.

Over the years, we witness some clever on-the-spot custom solutions. There is, however, a really cleancut commercial solution to this problem. Dynair Electronics Inc. already well known for their video distribution equipment have added the logical extension to their product line in the Model AD-5980A audio distribution amplifier.

We are reproducing Dynair's data sheet as the best solution to this problem that we have seen to date.

The man to contact is an old Syn-Aud-Con graduate and supporter, Doug Brown, Dynair, 5275 Market St., San Diego, CA 92114. (714) 263-7711



FEATURES

- Six +24 dBm outputs – +22 dB gain
- Bridging input – 60 dB common mode rejection
- Flat response to 20 kHz
- Extended bandwidth to 50 kHz for data distribution
- Can be used with the Series 5900 modules in same frame

SPECIFICATIONS

INPUTS:	
Balanced/Differential	100K-ohm bridging, balanced (transformerless)
Common Mode Rejection	Better than 60 dB to 20 Khz
Level	+24 dBm (with 12 dB input pad in)
OUTPUTS:	
Number	6 (transformerless)
Impedance	600-ohm balanced
Level	With ±24 VDC (nominal) power supply – +18 dBm With ±28 VDC (nominal) power supply – +24 dBm
Isolation	Better than 60 dB 20 Hz to 20 kHz
PERFORMANCE:	
Gain	27 dB overall, front panel adjustable (-5 dB to +22 dB) or (-17 dB to +10 dB with input pad in)
Frequency Response	±0.2 dB 20 Hz to 20 kHz ±1.0 dB, 5 Hz to 50 kHz
Total Harmonic Distortion	0.15%, 20 Hz to 20 kHz @ 0-dBm out 0.25% 20 Hz to 20 kHz @ +18 dBm and +24 dBm out
Hum and Noise	Better than -80 dB below maximum output level
Temperature Range	0° to +50°C
Power Required	±24 VDC or ±28 VDC nominal @ 225 mA
FRONT PANEL:	
Test Points	1 input and 1 output pair + volts - volts ground
Controls	Gain
CONNECTORS	Screw type terminals
MODULE SIZE	4 3/8" H x 11⅝" D x 1¼" W (11.11 x 29.21 x 3.18 cm) One space in Series 5900 Frame
NET WEIGHT	1 pound (0.45 kg)
SHIPPING WEIGHT	2 pounds (0.91 kg)

MATHEMATICAL EXPRESSIONS

MEL SPRINKLE of the Dynacom Division of Dynalectron Corp in Arlington, VA. sent along some basic improvements in "The Proper Use of Mathematical Expressions in Scientific Publications".

Proper Use of Mathematical Expressions in Scientific Publications

A continually recurring problem in organizations such as ours, which are engaged in scientific research, is the introduction of new members of the staff to the proper technique of writing technical papers. Such papers must be complete and clear to the reader as well as conform to the basic precepts of scientific report writing. Although the scope of the subject is broad, this article shall be restricted to the consideration of a few points relative to the use of the notations of mathematics, based upon the author's long experience in researching the literature of chemistry and physics and, especially, engineering.

Perhaps the first principle that the new chemist or engineer must bear in mind is that it is never considered in good taste to designate the sum of two quantities in the form:

$$1 + 1 = 2 \qquad (1)$$

Anyone who has made a study of advanced mathematics is aware that

$$1 = \ln e$$

and that

$$1 = \sin^2 x + \cos^2 x$$

Further,

$$2 = \sum_{n=0}^{\infty} \frac{1}{2n}$$

Therefore, Equation 1 can be expressed more scientifically in the form:

$$\ln e + (\sin^2 x + \cos^2 x) = \sum_{n=0}^{\infty} \frac{1}{2n} \qquad (2)$$

This may be further simplified by use of the relationships,

$$1 = \cosh y \cdot \sqrt{1 - \tanh^2 y}$$

$$e = \lim_{z \to \infty} \left(1 + \frac{1}{z}\right)^z$$

Equation 2 may therefore be rewritten:

$$\ln \left\{ \lim_{z \to \infty} \left(1 + \frac{1}{z}\right)^z \right\} + (\sin^2 x + \cos^2 x) = \sum_{n=0}^{\infty} \frac{\cosh y \cdot \sqrt{1 - \tanh^2 y}}{2n} \qquad (3)$$

Courtesy NASA

or

$$\ln \left\{ \lim_{z \to \infty} \left(1 + \frac{1}{z}\right)^z \right\} + (\sin^2 x + \cos^2 x) - \sum_{n=0}^{\infty} \frac{\cosh y \cdot \sqrt{1 - \tanh^2 y}}{2n} = 0 \qquad (4)$$

At this point, it should be obvious to even the casual glance, that Equation 4 is much clearer and more easily understood than Equation 1. Of course, there are various other methods which could have been employed to clarify Equation 1, but these should become obvious once the reader has grasped the underlying principle.

—Philip A. Crispino, Foster D. Snell, Inc., by permission of the Chemists' Club

(I hope you can read the type as reproduced here. The typist rebelled (me) at re-typing it. cd)

GROUND LOOP IMPEDANCE TESTER (GLIT)

In the recent Minneapolis class in June 1977, ED LETHERT (3 time graduate) introduced us to a Ground Loop Impedance Tester (GLIT) distributed by the Daniel Woodhead Company, 3411 Woodhead Drive, Northbrook, ILL 60062.

The GLIT, unlike other testing devices, tests a *live* circuit while its hot. It actually sends through the ground, from the power source itself, a momentary (1/25 of a second) surge (actually a short circuit) of about 20 amperes. This is short enough interval to avoid actuating the overcurrent protection devices.

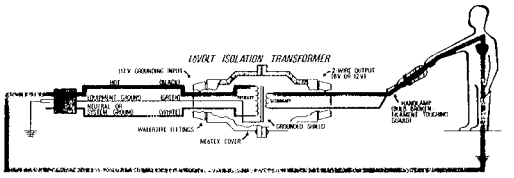
The resulting impedance is then calculated electronically and shown on the GLIT's meter scale in ohms.

For example, on a 20 ampere circuit, the ideal ground should have an impedance of no more than 1.2 ohms. That is, the ground path should permit five times the rated current to flow:

$$\text{Desired } Z \quad \frac{\text{AC volts}}{5 \times \text{rated current}} = \frac{120}{5 \times 20} = 1.2 \text{ ohms}$$

The GLIT, in conjunction with this simple equation tells you immediately if you have a low impedance ground.

A ground fault in a 115 Volt circuit may cause serious injury or electrocution, if the proper conditions exist. Voltages far less than 115 Volts have produced fatalities when workmen are using ordinary portable lighting under grounded or wet conditions!



A LOW VOLTAGE
Wired into the supply cord is a stepdown transformer, which converts the 115 Volts into a safe 6 or 12 Volts. This low voltage minimizes the amount of current which the "electrical pressure" can force through a worker's body.

B ISOLATION TRANSFORMER
The primary and secondary windings of the transformer are isolated from each other so that there is no complete electrical path between the convenience receptacle and the portable lamp. Even if the user comes into contact with one of the secondary conductors, no current flows because there is no complete conductive path. A grounded metal shield between the two windings ensures that this isolation is maintained.

NOTE: At 6 Volts or 12 Volts, the light output of a 75 Watt lamp is approximately equal to that of a 115 Volt 100 Watt rough service lamp.

PRIMARY AND SECONDARY CORD LENGTHS

PRIMARY: Since there is no significant voltage drop any practical length of cord can be supplied on the primary side without affecting performance.

SECONDARY: The length of the secondary cord is limited by the permissible voltage drop. The maximum lengths are as follows:

110/ or 220/ 6 Volt transformer – 60 ft. maximum
110/ or 220/ 12 Volt transformer – 120 ft. maximum

Longer lengths can be supplied on special order.

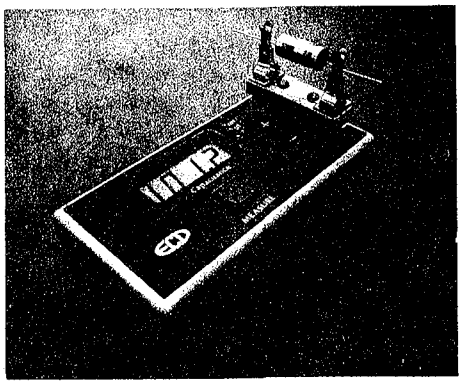
An additional safety factor can be achieved by using left hand threaded lamps and sockets; thus making it impossible to accidentally insert the lamps into a standard voltage socket.

The GLIT comes with a plug in test probe, in addition to the regular line connection, for checking grounding of conduit, outlet boxes, portable tools, machine tools, piping systems or other grounded equipment. Price is $180.

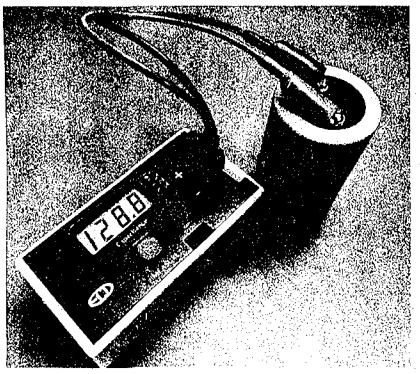
The Woodhead Company also manufacturers heavy duty industrial cord sets, receptable adapters (often hard to find) and other electrical supplies. They also supply a transformer isolated low voltage trouble light system for working in wet areas.

ECD CORP.--THE C-METER

We have been loaned a "C" Meter by the ECD Corporation, 196 Broadway, Cambridge, MA 02139 for evaluation. At $298 this direct reading, autoranging digital meter provides speed and accuracy for DC capacitance measurements.



Larger axial lead capacitors are connected with the component clip, which plugs into the banana jacks. This can also be used to test capacitors on rolls, without removing them.



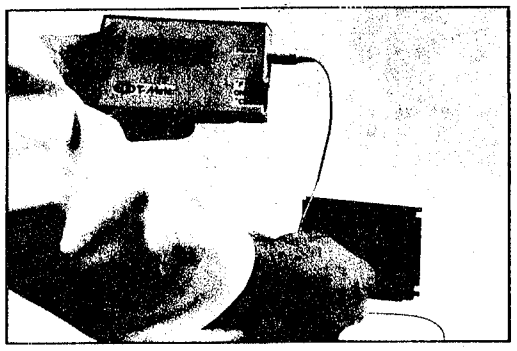
Clip leads connect large axial lead and screw terminal capacitors.

GREGG HANKS, Chief Engineer at Wally Heider Studios, introduced us to the unit when we were working there last winter.

One of the handiest uses for this unit is the location of breaks in cable not accessible to other inspection, such as buried cable.

ECD CORP.--THE T-METER

Another interesting and useful item from ECD Corp. is the "T" Meter. This digital readout temperature meter reads from -150°F to 400°F or -100°C to 200°C. At $189 it is an ideal instrument to measure heat rise in rack cabinets on the surface of heat sinks or the water in the swimming pool.



NEW YELLOW PAGES LISTING: SOUND SYSTEM CONSULTANTS

All California Yellow Pageslistings now include SOUND SYSTEM CONSULTANTS (those who specialize in the design of sound systems. Such systems are designed for theatres, auditoriums, schools, hotels, etc.)

If California will do it, most likely every state will do so if approached. We can thank DON NULL (Anaheim 1977), NULL ENGINEERING CO., Topanga, CA for this accomplishment. Don wrote recently: Enclosed is a copy of a confirmation letter from Pacific Telephone regarding my request for the Yellow Pages heading: SOUND SYSTEM CONSULTANTS. It is my understanding that this heading is good for all California directories.

Mr. Robert Finer, Pacific Tel., helped to get this heading. I would appreciate itif others would write thanking him for his efforts. It you have any questions, you can phone him collect at (415) 542-5682.

SHE WATERS LAWN TO REPAIR PHONE

We have been telling PAT ROUTLEDGE'S "unusual telephone service call" around the country. Someone sent us a news clipping from the Indianapolis Star, June 19, 1977 with the comment, "When you don't have an automatic dog you just have to do the best you can."

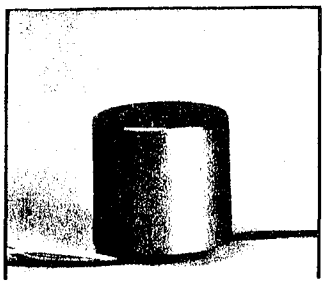
She Waters Lawn To Repair Phone

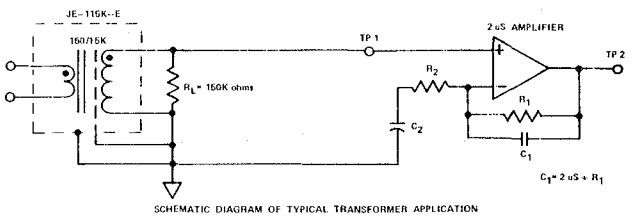
Stuttgart, West Germany (WNS) — When Erika Bauer's telephone fails to work, she goes outside and waters the front lawn. "In a few minutes, the phone is in perfect order again," she says.

Frau Bauer discovered the trick quite by accident "after trying to cool down after several frustrations with the phone. Repairmen tell me that it has something to do with the earth wire, whatever that may be."

JENSEN TRANSFORMERS

Transformers are a perennial audio problem. Traditionally the West Coast has had a history of innovative transformer designers going back to Ercel Harrison, the designer of the original Peerless 20-20 units that made the words "High Fidelity" possible. Ercel Harrison's engineering work spanned the era of the advent of talking motion pictures on into the development of professional commercial sound engineering in the late 1960s.





SCHEMATIC DIAGRAM OF TYPICAL TRANSFORMER APPLICATION

GENERAL CHARACTERISTICS

Turns Ratio	1:10
Impedance Ratio	150/15K
Primary Source Impedance	150 ohms
Secondary Load Resistor	150K ohms
Secondary RC Network	None required
Faraday Shield	Separate lead
Magnetic Shield	30dB, separate lead
Max. Input Level at 20Hz	+1dBV (Re: 0.775V)

PHYSICAL CHARACTERISTICS

Package	Mu-metal can
Termination	Wire leads
Dimensions	1-1/8" diameter, 1-1/16" high
Mounting	2 holes, 0.7" center-to-center, self-tapping screws supplied.

TYPICAL PERFORMANCE

Voltage Gain	19.7dB
Input Impedance	1350 ohms @ 1kHz 1150 ohms @ 10kHz
Secondary Source Impedance	19.5K ohms @ 1kHz 19.9K ohms @ 10kHz
Total Harmonic Distortion (Below Saturation)	0.31% max. @ 20Hz 0.17% max. @ 30Hz 0.082% max. @ 50 Hz 0.01% @ 1kHz
Input Level @1% Saturation (dBV Re: 0.775 volts)	−7dBV @ 20Hz −1.5dBV @ 30Hz +5dBV @ 50Hz
Equivalent Input Noise* (dBV Re: 0.775 volts)	−128.6dBV BW = 20kHz
Noise Figure*	2.75dB Re: 133 ohms†
Common-Mode Rejection Ratio	>86dB @ 1kHz >65dB @ 10kHz

(TRANSFORMER WITH SECONDARY TERMINATION ONLY)

Frequency Response (Re: 1kHz)	−0.5dB @ 20Hz +0.1dB @ 20kHz +0.2dB @ 55kHz (peak) −3dB @ 140kHz
Phase Response	−5° @ 20kHz
Rise Time	2.5uS (10%-90%)
Overshoot	6.6%

(INCLUDING 2uS AMPLIFIER)

Frequency Response (Re: 1kHz)	−0.5dB @ 20Hz −0.2dB @ 20kHz (No resonance peak) −3dB @ 76kHz
Phase Response	−19° @ 20kHz
Rise Time	4.5uS (10%-90%)
Overshoot	<1%

JE-115K-E
MICROPHONE INPUT TRANSFORMER

*With a typical discrete amplifier, (e_n = 3nV/rt Hz, i_n = 0.5pA/rt Hz)
†Parallel value of source impedance and input impedance.

Ercel Harrison's engineering work spanned the era of the advent of talking motion pictures on into the development of professional commercial sound engineering in the late 1960s.

The presence of the motion picture industry, the very large and active Hollywood Studio Community, plus the many West Coast manufacturers of high quality audio equipment has created an active market place for quality transformers of all types.

Deane Jensen of Jensen Transformers by Reichenback Engineering is the logical successor in this distinguished line of audio engineers if he is judged by his efforts relative to the JE-115K-E microphone input transformer.

The data sheets available on these transformers are extremely detailed with exceptionally clear labeled oscillograms of the transformers' square wave response.

Jensen Transformer's price list includes: Mic input, bridging, line input, direct box, mic splitters, mag head input transformers.

We are told by Syn-Aud-Con grads who have used these units that our judgment of Jensen's engineering capabilities are apparent in the components delivered.

If interested, contact Jensen Transformers, 1617 North Fuller Ave, Hollywood, CA 90046 213-876-0059.

TIME KUBE

JOHN PHELEN of Shure Brothers (2-time graduate) brought his new Time Kube to class with him. He's now prepared to out-Klipsch Klipsch when asked for the time.

The Time Kube, sold by Radio Shack is a battery operated WWV receiver for 5, 10 and 15MHz.

After asking "Where am I?", John simply adjusts the front panel slide rule to that time zone (either daylight saving or Standard time zone) pushes the desired frequency and lets the questioner listen to the correct time to a trillionth of a second.

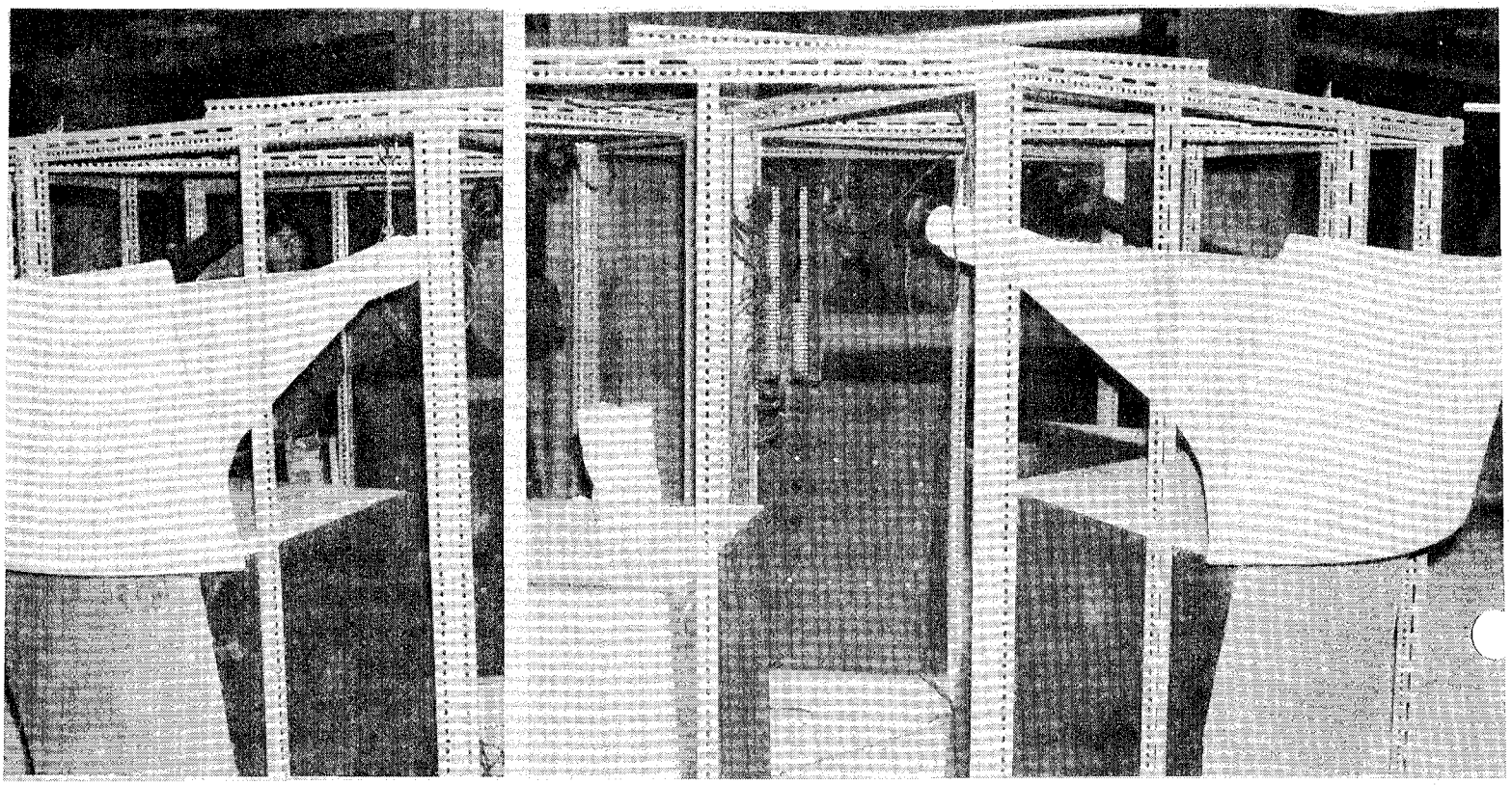
It's an irresistible bargain at $29.95.

Be the first on your block to be capable of measuring the rotational variations of the earth.

SYNERGETIC AUDIO CONCEPTS

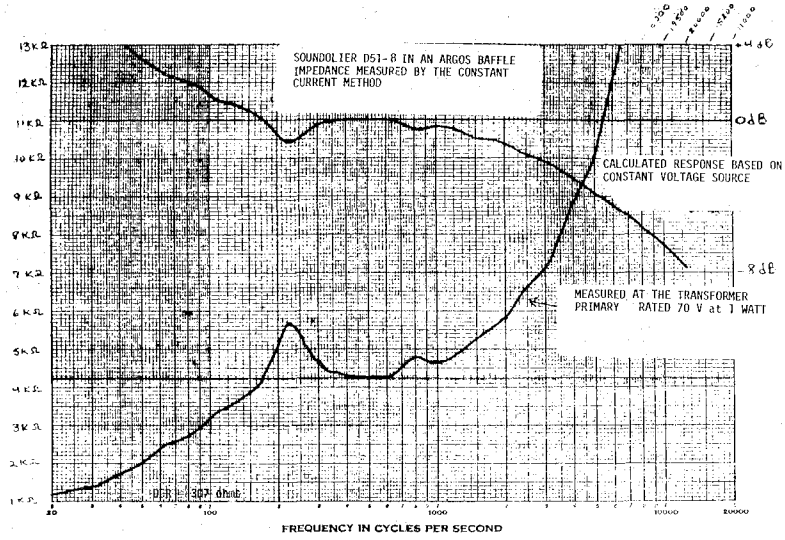
DEXION SLOTTED ANGLES

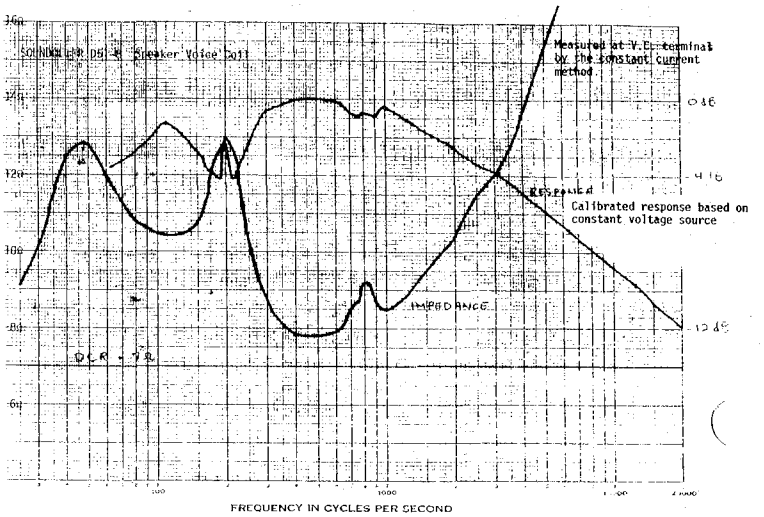
GARY LINES, owner of Cable Brothers in Edmonton, gave us some pictures and literature at AES this year showing how he used Dexion Slotted Angles to construct a hanging array. Gary said that it was very fast, very safe and very flexible. "The Dexion System consists of four Dexion Slotted Angles having a similar pattern, for use either alone or in combination. The slot pattern gives quick rigidity with minimum effort; round holes provide positive location with bolts fully in bearing; transverse slots provide for local strengthening and for joining short lengths. All angles are obtainable in steel, rust-protected and stove-enamelled battleship grey, or in aluminium alloy, natural finish. Their address is: 114 Clayson Rd., Weston, Ontario M9M 2H3. (416) 741-6622.



INTERESTING CURVES

The curves shown below were measured by ED LETHERT of Northwest Sound in Minneapolis. We're publishing them with no comment as they speak for themselves.





dB RELATIONSHIPS

The March 31, 1977 issue of ELECTRONICS included an interesting chart showing the relationship between dBW, dBm, dBrn, dB re .006 watt (called phone) and watts.

The basic equation form for *any* of these reference systems is:

$$dB? = 10 \log \frac{\text{power}}{\text{reference}}$$

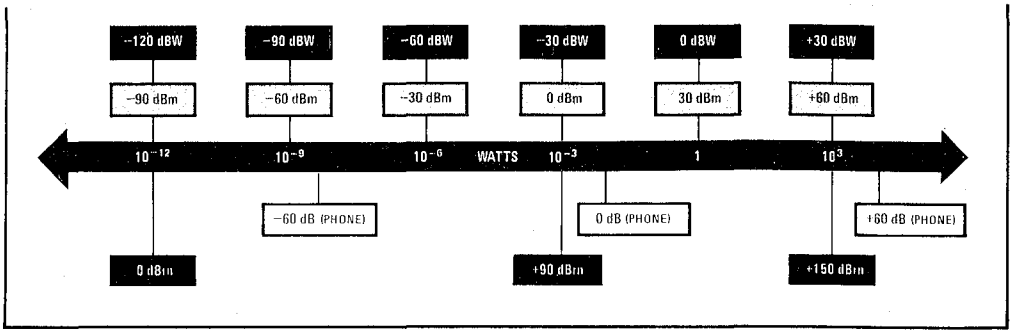
and

$$\text{Power} = \text{reference} \times 10^{\left(\frac{dB?}{10}\right)}$$

Example:

$$dBm = 10 \log \frac{1 \text{ watt}}{0.001 \text{ watt}} = +30 \text{ dBm}$$

$$1 \text{ watt} = 0.001 \times 10^{\left(\frac{30}{10}\right)}$$



Decibel relationships. Values of power are shown relative to decibel levels of different references. Note that linear decibel scales (four are shown out of at least 75 with different references throughout the world) correspond to logarithmic power scale

PYTHAGORAS RESTATED

DON PETROS, Estron Industries in Calgary, along with BOB GIBSON of the Calgary Exposition had enough witticisms to keep the Banff class entertained for three days. An example:

1st squaw bears a son on a buffalo hide
2nd squaw bears a son on a deer hide
3rd squaw bears twins on a hypopotomus hide

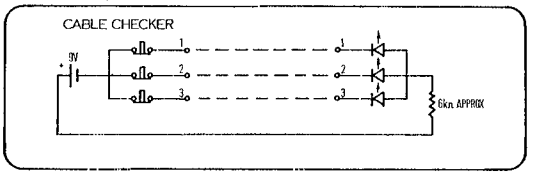
Which goes to prove that:

The sons of the squaw on the hypopotomus hide is equal to the sons of the squaw on the other two hides.

WHY DIDN'T I THINK OF THAT?

INTERCONNECTION

When a cable is plugged in, all leds will light, assuming the cable has electrical continuity. By depressing each push button in turn, the corresponding led should go out verifying the phasing, unless the connectors have been cross-wired, when it will indicate which connections are reversed. If a button is depressed which does not extinguish any led, a short circuit exists between connections.



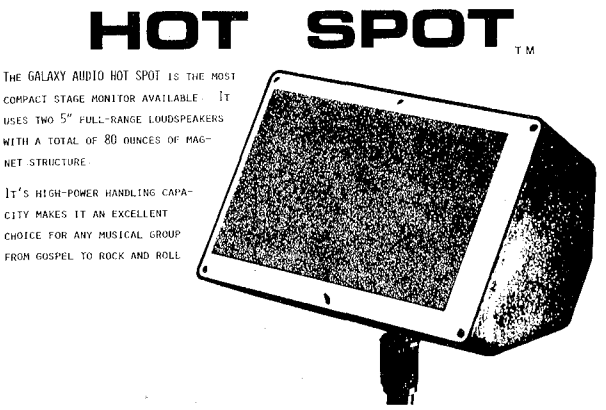
THE HOT SPOT T.M.

BROCK JABARA of Galaxy Audio in Wichita, Kansas recently sent us a pair of their new monitor loudspeakers that allow a substantial decrease in the D_2 distance by being mounted on a standard microphone stand.

The units we received are very ruggedly constructed of high impact ABS plastic and present a professional and pleasing appearance. We have not, as yet, had the opportunity to try them out and we will present the acoustical test data on them in a later Newsletter.

In the meantime the concept is a good one and those of you needing something new in monitors might want to investigate these units.

Galaxy Audio, 1417 E. Central, Wichita, KS 67214
(316) 263-2852



HARDWARE "COOKBOOK"

ED LETHERT of Northwest Sound in Minneapolis (three time graduate) listed the following electrical instruments of use to a sound system engineer. We have written up a number of these instruments in other Newsletters. Of particular usefulness are the receptacle testers, the ground loop impedance testers, the snap around ammeters, and the meggers. Ed's list includes typical prices for these items as well as typical manufacturer's names.

Woodhead receptable tester
#1750 - $9.00

Woodhead ground loop Z tester
#7040 - $180.00

Woodhead insulation & continuity tester
#7020 - $124.00

Square "D" (solenoid) tester
#5008 - $17.50

Square "D" (neon) tester
#5009 - $17.50

Ideal voltage tester
#61-065 - $9.85

Ideal test-glo
#61-040 - $3.95

Ideal continuity tester
#61-030 - $3.95

Amprobe snap-around ammeter
RS3 - $63.25
A45L - $8.00

Biddle battery megger tester
#21822 - $115.00

You can write the Daniel Woodhead Company, 3411 Woodhead Drive, Northbrook, Illinois 60062 for the Woodhead representative nearest you.

NICKEL-CADMIUM BATTERIES

We recently received the following from KEN STOLTENBERG of Electronic Engineering Services in Rochester, Minn. Ken is a 3-time graduate and a frequent and valued contributor to Syn-Aud-Con publications. Ken wrote:

My grateful thanks to you again for permitting my 4.5 Sabins of absorption in your Minneapolis session. These seminars are always time well invested. You verbally wondered about your "repeat customers". You should be aware that in addition to providing the latest data in the field, your enthusiasm provides inspiration in addition to knowledge.

During a conversation with Carolyn, the subject of NiCad batteries was discussed. As you use these batteries in the HP 21 and other test equipment, possibly some information I wrote for the SPT Journal would be of value (Society of Photo-Technologists):

Nickel-Cadmium batteries are a vital part of much of today's electronic equipment. N/C batteries power flash units, operate motors in cameras and energize electronic circuitry in many photographic products (ED: the same would be true for calculator and audio measurement devices). It is therefore fitting and proper that we understand the care, the feeding and the testing of this component.

To over simplify, N/C batteries are like people: they that are exercised well and not fed too much are healthy. Those that are overfed and under-exercised are fat and lazy. In order to obtain maximum useability from a battery - USE IT. Put it to work, operate it for its rated period and then recharge it properly. Using a battery for a short period and then recharging and continuously repeating this procedure will cause the battery to lose capacity. It will "memorize" this limited ability and then fail when put to full use. This memory can be "erased" by working the battery to its normal limits over a period of time. So--if a user complains about short battery life, obtain a detailed description of how he used the device. For example, some people only use their electronic flash units at Christmas and then wonder why it does not perform or only take several pictures before it fails.

Battery capacity is rated in ampere-hours (AH). To test: a fully charged battery is discharged into a load which will dissipate the rated capacity in one hour. A 500 MAH battery is drained at 500 mills. A 4 AH battery is discharged at 4 amperes. The discharge is for one hour in all cases. If, after an hour, the output voltage is about one-volt-per-cell, the unit unquestionably meets its capacity rating. (Thus a 3 cell battery should measure 3 volts or more after the one hour period.) If voltage reaches one-volt-per-cell in LESS than one hour, it's unquestionably below rated capacity.

This is not too difficult to do in the shop, nor does it take that much time. 1) Charge the battery as per manufacturers instructions. 2) Place a heavy duty resistor across the battery. (Ohms law will tell you the size resistor to draw the proper current for the battery under test. R=E/I. Wattage of the resistor can also be determined - Watts = I^2R and then double this figure for a safety factor.) Place a voltmeter across the resistor and glance at it every 10-15 minutes. Check the time your battery reached one volt per cell. If it lasts for an hour, it's good. If it lasts for 48 minutes you have 80% capacity. DO NOT OVER DISCHARGE the battery. The industry seems to indicate one volt as the sacred level. Discharging a battery below the one volt level seems to give rise to the possible reverse charging of a cell.

To sum up - 1) Avoid sustained overcharge. (Do not leave on the charger for long periods when not in use.)
2) Avoid frequent *complete* discharge. Use for normal cycle and use *most* of the capacity.
3) Avoid working off the top of the battery's capacity (memory), short charge/discharge cycles.

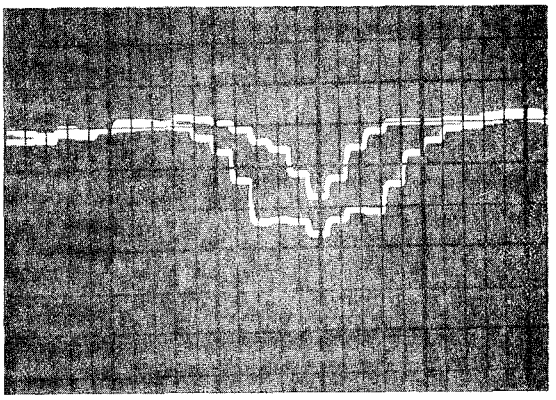
Note: Information similar to that contained here has been published by General Electric Company and other makers of Nickel-Cadmium batteries.

"PUT DOWN" OF THE YEAR

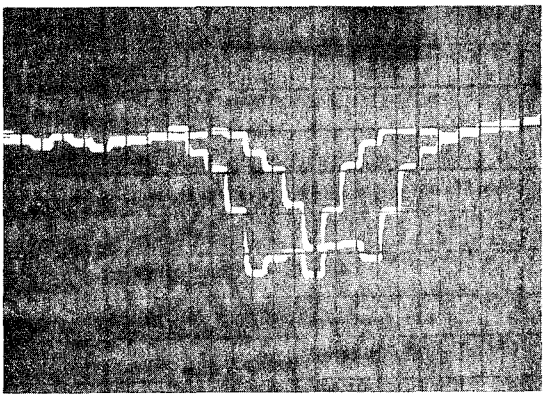
A leading candidate for the "put down" of the year occurred in the Letter to the Editor column of PHYSICS TODAY magazine. Discussing a critic who believes that computers can imitate Mind as well as brain, a writer states, "The book makes an excellent case that his (the critic) whole life's work, for all of its impressive technical expertise, is essentially devoted to trival aspects of an important problem."

HOW TO TELL IF FILTERS COMBINE PROPERLY

One of the most frequently asked questions in classes is how to tell if a filter set has "combining" filters. The illustrations below show a combining set and a non-combining set as seen on the screen of a real time analyzer.



Combining filters



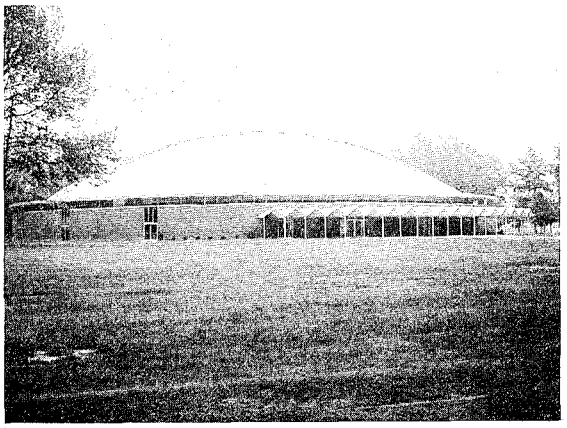
Non-combining filters

The left-hand photograph shows (inside curve) a single filter at maximum depth. The outside curve is three filters set for maximum depth clearly showing the summing or combining effect in the center. The right hand photograph illustrates the same test on a non-combining filter set. In this case, three filters together have the same depth as each one separately.

Subjective judgement says that the combining filters work the best and objective measurements reveal that changes in response needed *between* filter center frequencies can not be properly handled by non-combining filters.

18 SECOND REVERB TIME

The picture to the right is of the reverb measurement made with a GR grapic level recorder (*Acoustical Tests and Measurements*, page 119) and below, a picture of the auditorium - 1,400,000 cu. ft.



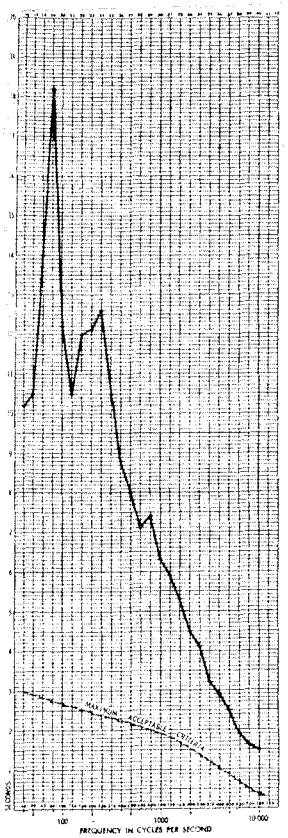


Fig. 6-9. Reverberation curve obtained in 1,400,000 cu ft problem auditorium.

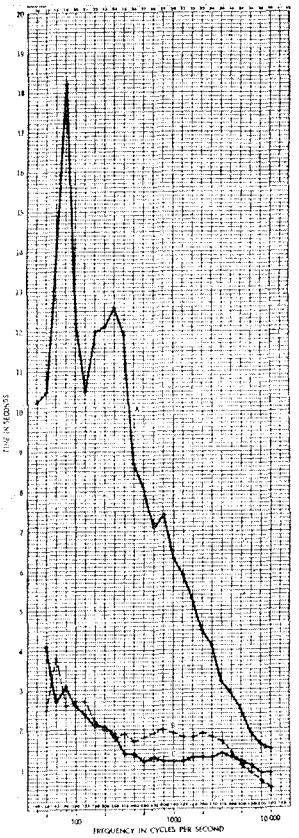


Fig. 6-10. Three reverberation curves compared

ARTICLES OF INTEREST

THE NOTEBOOKS OF WALLACE C. SABINE by Leo Beranek in the JOURNAL OF THE ACOUSTICAL SOCIETY OF AMERICA, March 1977, Volume 61, No. 3.

A remarkable discovery has been made some 58 years after the untimely passing of Wallace C. Sabine in the finding of twelve of his handwritten notebooks kept by him during his work in founding architectural acoustics. Ralph Huntley of Riverbank Acoustical Laboratories in Geneva, Illinois discovered these notebooks and through the assistance of Leo L. Beranek they have been carefully indexed and placed in the Harvard University Archives.

In the article, *The Notebooks of Wallace C. Sabine*, Mr. Beranek has reported on this find and explored the material contained in these notebooks. Reproductions of Sabine's handwriting are included plus a listing of the principal contents of each book.

Leo Beranek provides three fascinating hypotheses as possible explanations for the mystery of no notebook entries during the period 1900-1904 (the period when it is assumed he made his confirming measurements of his masterpiece -- Boston Symphony Hall). Beranek's scholarly reporting of this important event gives the reader insight into the technical and human achievements of this remarkable acoustic pioneer.

In the bibliography of this article (#4), Mr. Beranek mentions that he still has available for sale a limited number of William Dana Orcutt's biography of Sabine for which he charges only the cost of binding. This book is, in my opinion, an invaluable collectors item for anyone with a serious interest in Architectural Acoustics. (I found my copy years ago through Mr. Beranek's assistance.) If you are interested in a copy, address your request to: Leo Beranek, Bolt Beranek and Newman, 50 Moulton St., Cambridge, Mass. 02138.

***

PUBLIC ADDRESS SYSTEMS by I. W. Green and J. P. Maxfield in the JOURNAL OF THE AUDIO ENGINEERING SOCIETY, April 1977, Volume 25, No. 4, pages 184-195. Reprint that originally appeared in the Transactions of the AIEE, Volume 42, pages 64-75 in 1923.

1977 is turning into the year of historical review of the audio industry. AUDIO MAGAZINE, THE JOURNAL OF THE ACOUSTICAL SOCIETY, and now the JOURNAL OF THE AUDIO ENGINEERING SOCIETY have all published or republished valuable articles worthy of inclusion in any serious professional's notebooks. Dr. John Hilliard has undertaken for the AES to act as a Guest Editor in the selection of early papers of lasting and permanent value for reprinting in the current Journals.

If you want to appreciate our modern decibel notation, just read how these men worked in units of *standard cable miles (SCM)*. A standard cable mile was one mile of standard 19 guage telephone cable with a resistance of 88Ω per mile and a capacitance of .054 ufd per mile. Near 1,000 Hz a standard cable mile approximately equaled a 1 dB loss. (.947 times a standard cable mile equals one decibel.) The reference level chosen was that of the output of a standard telephone transmitter of that period (the 1920s) and was 6 milliwatts. Thus we can write:

$$1.056 \times 10 \log \left(\frac{\text{watts}}{0.006 \text{ watts}} \right) = \text{SCM} \quad \text{and} \quad 0.947 \times \text{SCM} = \text{decibels} \quad \text{or,} \quad 10.56 \log_{10} \frac{\text{watts}}{0.006 \text{ watt}} = \text{SCM}$$

Here in 1923 are these Western Electric engineers taking a *systems* approach to the problem and accurately defining the problems as well as the best paths for potential solutions that seem like prescience to a 1977 reader.

Our congratulations to the AES JOURNAL for their wisdom in selecting John Hilliard as their guest editor.

***

HISTORY OF RECORDING by Robert Angus is a reprint of a series that originally appeared in MODERN RECORDING. The reprint is published by Cowan Publishing Corp., 14 Vanderventer Ave., Port Washington, New York 11050. We found the series of 6 articles to be more orderly, better written, and with better accuracy than we normally encounter on this subject. Cost is $3.50.

I found myself drawn into reading the entire reprint again in the process of scanning it for this review. Mr. Angus is an engaging writer and the stories he has to tell are interesting and unusual.

***

INTERFACING THE PORTABLE SOUND SYSTEM WITH THE PERMANENT SOUND SYSTEM by CHRIS FOREMAN in RE/P
An easy to read description of when not to or when to use a house system when on tour with a musical group. How to combine the "traveling" system with the parts of the house system are well covered. Mutual protection of the systems during interface and typical types of equipment likely to be encountered are discussed in detail. Chris cites Texas A&M Theatre Complex and Theatre Manager, STEVE HODGE (2-time graduate) as a beautiful example of "real world" interface of an excellent house system with the touring system.

***

Syn-Aud-Con graduate CHRIS FOREMAN is rapidly becoming well known for his well written, informative, and pertinent articles relative to entertainment type systems. Along with Gary Davis, Chris has been providing the technical writing for many of Yamaha's operating manuals. A recent manual received was the P-2200 operating manual (Cost $6) which is extremely well done. It is virtually a small textbook of fundamentals for the young sound man. Sections 6 & 8 are beautifully illustrated and cover basics that a beginner must find out about somewhere (usually by lengthy experience). Gary and Chris are to be congratulated. It's a rare operating manual whose value lasts past the installation of the device.

BOOKS OF INTEREST

ACOUSTICAL AND THERMAL PERFORMANCE OF EXTERIOR RESIDENTIAL WALLS, DOORS AND WINDOWS by Hale J. Sabine and Myron B. Lacher, Owens-Corning Fiberglass Corp along with Daniel R. Flynn and Thomas L. Quindry of the National Bureau of Standards.

This is one of the latest in a series of books available from the U. S. Department of Commerce relative to the NBS Building and Science series.

The practical bent of this book is immediately indicated in its introduction, by the statement, "In order to make the test results more immediately useful to American architects and designers, *customary (Italics mine)* engineering units are used rather than the (metric) International System of Units (SI) normally used in NBS publications. A Table of Conversion factors is given in Appendix A".

The book has much useful data on performing tests and a representative sampling of commercially available devices.

NBS Building Science Series 77, Supt of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Catl. # C13.29/2.77. Price $2.35

Other important books in this series are: *COMPENDIUM OF MATERIALS FOR NOISE CONTROL* reviewed in Newsletter Vol. 4, No. 2; *A GUIDE TO AIRBORNE, IMPACT & STRUCTUREBORNE NOISE CONTROL IN MULTI-FAMILY DWELLINGS*, Newsletter Vol. 3, # 3; *ELECTRONIC FACILITY BONDING, GROUNDING & SHIELDING REVIEW*, Newsletter Vol. 3, # 3.

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SIMPLIFIED ENGINEERING FOR ARCHITECTS AND BUILDERS. Fifth edition by Harry Parker, published by John Wiley & Sons 1975. During the Minneapolis class in June, ED LETHERT, a goldmine of skills and techniques, introduced me to this book.

Simplified Engineering for Architects and Builders is a basic book on structural mechanics that is easy to read, full of examples and intended to allow those without formal training in the subject to arrive at successful safe answers. The section on steel construction certainly equips the reader to make quick useful estimates of beam strengths, etc. when planning large arrays.

CLASSIFIED

STOLEN: B&K Impulse Precision Sound Level Meter and accessories. Meter Description: Pale green with black trim. Meter, Model # 2209, Serial #, 594717; Mic, Model # 4133, Serial # 591373; Pistonphone, Model # 4220, Serial # 577844; Octave Band Filter Set, Model # 1613; Serial # 576400. Carrying case is pale green and about medium suitcase size. REWARD FOR RECOVERY OR INFORMATION LEADING TO RECOVERY. Contact Jerry Marshall, Howell Electronics, 2873 Pershing Drive, El Paso, TX 79903. (915) 566-3968.

FOR SALE: Shure M615 AS, Equalization Analyzer System. $350. Contact Jack Patterson, 2420 Bermuda, Kissimmee, FL 32741. (305) 846-4641 (after 8 p.m. EDT)

FOR SALE: (2) sets of Altec Model 9014A filter sets. (Collector's item) Contact Ed Wille or Burt Boettcher of Ken-Com Engineering, 2323 (D) Bluemond Rd., Waukesha, WI 53186. (414) 784-1610.

FOR SALE: All Bruel & Kjaer equipment: (1) Audio Frequency Spectrum Recorder model 3313. (This is a combination of the wave analyzer 2112, 1/3-octave bands from 12.5 Hz - 40 KHz and the level recorder 2305.) (2) Random Noise Generator, model # 1402, (3) Sound Level Calibrator 4230, (4) Microphone preamp and cables and adaptors 2619. PRICE $7,500. (NEW PRICE $22,000). Equipment is four years old. Tom Pos, Audiotronics, 507-509 19 Ave SW, Calgary, Alta T28 0E3, Canada. (403) 263-4230.

FOR SALE: GenRad Chart Recorder with P4 Wave Analyzer with plug in Module. John Odum, Music Mart, Pennyrile Mall, Hopkinsville, KY 42240. (502) 885-5386

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