SYNERGETIC
SYN AUD CON
AUDIO CONCEPTS
P.O. BOX 1115, SAN JUAN CAPISTRANO, CA

# newsletter

VOLUME 7, NUMBER 3
SPRING, 1980


SYNERGETIC
Working together; co-operating, co-operative

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

EXCHANGE OF IDEAS

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

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

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# "TRY BACH NOT ROCK"

Readers of Glamour magazine were advised last year by Dr. John Diamond to "Try Bach, not Rock". This may be the Rock generation's answer to the Sphincter muscle ray gun.

IF YOU WANT TO EXERCISE, MAKE LOVE OR REARRANGE THE FURNITURE TO MUSIC, **TRY BACH, NOT ROCK**

Though rock music may turn you on, it may literally be turning you off too—at least so far as strength is concerned. Dr John Diamond, psychiatrist and president-elect of the International Academy of Preventive Medicine, has found that a musical beat present in about half the rock singles that make the charts can cause a temporary loss of up to two-thirds of the body's muscle strength.

The beat that can leave you feeling beat is "anapestic"—two short beats followed by one long, loud one ("di di DAH") and is found in the chorus of this year s hit, "We Are The Champions' by Queen, as well as in some songs by Stevie Wonder, The Band, Captain and Tennille, the Rolling Stones and other rock groups.

This anapestic beat, according to Dr Diamond, appears to interfere with co ordinated brain activity It is also the exact opposite of some of the body s rhythms The heart and blocd have "first beat" rhythm patterns—blood, moving through blood vessels, goes "dah di di"; the heart goes "dah di, rest " When confronted with the unnatural anapestic beat, the body goes into a state of temporary stress which can cause a loss of muscle strength and also disorientation, perceptual problems, a feeling of irritation and even minor sexual problems.

Dr Diamond has tested his theory on thousands of people using an electronic strain gauge that subjects push down on while listening to different kinds of music. Ninety-nine percent of those tested so far experienced a loss of approximately two-thirds of their muscle strength as they listened to certain rock songs. Other kinds of music had no negative effect on strength A waltz, for example, with a beat similar to the heart's, actually increased strength in some cases.

Rock seems to be the only kind of music that contains an anapestic beat. In his analysis of over twenty thousand albums, Dr Diamond found the beat nowhere else—with the exception of the finales of Stravinsky's "The Rite of Spring" and Ravel's "La Valse." He does point out that not all rock has it. No Beatles songs have an anapestic beat.

The next time you exercise, make love or rearrange your furniture, try Bach or the Beatles instead of The Band.

## HUMAN STRESS PROVOKED BY DIGITAL RECORDINGS

Philosophers have for centuries sensed the concept of "being in harmony" and "being out of harmony" with the universe surrounding us. Religionists have wrestled with the problem, bouncing from predestination to no destination. Physical scientists have oscillated between causality and non-causality.

It doesn't take much use of the "gears between the ears" to discover that there are indeed "laws" to respect -- major ones like gravity -- minor ones like - well like - maybe none of them are minor. Even brutes tend not to step off tall buildings. Following another car too closely is also a violation of the law of gravity and leaves the offender at the mercy of the good or bad judgment of the driver ahead of him. The laws are seemingly immutable; the rules flex in individual cases because of the interaction of vectoring influences. When the shattering crash comes after 10,000 incidents of following too closely, it's often referred to as an accident. It was just one vector waiting for another vector to be present.

True civilization is not the material Gee-Gaws of the industrialized nations--though they are manifestation of civilized *thought*--but rather the accumulated *understanding* of the immutable laws and an intelligent construction of *individual rules* for least violation of them.

There are in the world today many clever humans but few civilized ones. To be civilized is to have an inkling of the forces that motivate action. Further, it is to have constructed one's own rules for being in harmony with these forces. The uncivilized often perform immense services if only as examples of the penalities, but more often as gad flies whose misadventures instruct the wise to look for the underlying factors and better understand them.

The work of Dr. John Diamond is an interesting example of an observer finding an underlying vector in the seemingly childish behavior of a cult group such as a "rock fan". (See "Try Bach not Rock".)

Dr. Diamond to Give Paper at AES

This May's AES Convention in Los Angeles will witness what we are coming to feel could be a significant event. Dr. Diamond is bringing his electronic strain gauge to the session, Magnetic and Disk Recording, chaired by JOE MARTINSON. The title of his paper is "Human Stress Provoked by Digitalized Recordings". The abstract reads,

> A simple test has been devised in the discipline of Behavorial Kinesiology that can give an immediate indication of the level of stress affecting an individual. Results show that all digitalized recordings cause a profound loss of muscle tone throughout the body by a factor of up to 300%. This test, easily performed, will be demonstrated using music recordings, digitalized and analog. The implications of these findings are quite alarming as they indicate that, should the present enthusiasm for digitalized recordings continue, all of our present-day musical heritage will be recorded in a form that will be stressful to all listeners, both today and in the future.

There is abundant physical evidence that the digital sampling rate is too low; therefore, it becomes fascinating to contemplate just which detector in the human array of transducers and analyzers might be being triggered.

Is it the sampling rate itself? Is it the phase shifts attendant upon the steep anti aliasing filters? Which hemisphere in the brain is the controller of muscular strength? Does it affect Japanese listeners the same way as Occidental listeners?

We hope Syn-Aud-Con graduates come to Dr. Diamond's session prepared to evaluate the demonstrations.

# TOM OSBORNE

Tom Osborne was one of the key men in the development of the original HP 35 scientific calculator. He has been a literal wellspring of the important ideas behind HP's rocket-like rise in the field of computers and calculators.

Carolyn asked Tom Osborne if he would lead off the AES session, Computer/Calculator Applications in Audio, chaired by Gerald Stanley and Dave McLaughlin of Crown International. Mr. Osborne will open the session with a tutorial paper and has chosen to discuss some really important questions.

To quote from his abstract for the paper, "On a more technical aspect, the potential benefits of highly non-linear digital signal processing algorithms which rely on digital buffering will be investigated. Finally , some methods for eliminating redundancy from digital signals will be *shown*." (italics mine)

Already a living legend in his field, we consider it a unique privilege to have him apply some of his innovative thinking to our audio problems. This session presents you with a rare opportunity to hear and meet a truly remarkable man.

# KLEPPER QUIPS

DAVE KLEPPER lists among his many accomplishments a Syn-Aud-Con graduate's certificate (which we trust he keeps on the wall in a gold frame). Readers of past Newsletters know that, on occasion, he honors us with various discussions from his wealth of experience.

Dave currently is working on one of the toughest assignments we are aware of -- the all glass church in Garden Grove, CA.

We are very pleased to share these latest observations from Dave.

Two observations I'd like to share with you, and which you may share with your readers.

1. NEWSLETTER, WINTER 1980, pg. 17, GLEN BALLOU ANSWERS TERRY HOFFMAN

A study of the E-V and Altec data presented on that page reveals that neither the E-V nor Altec horns are "perfect" directional horns. Of course, the Altec horns have more constant directional characteristics . But they are bigger, and there will be applications where the E-V horns will "fit", and the Altec horns will not. Now J. B. Lansing has brought its Don Keele-designed horns to the market, and preliminary data indicate they are closer to perfection in directional characteristics than the Altec horns. But they are still bigger and may not fit in every situation that the Altec horns will fit. Lucky the sound system contractor who has access to all three lines of horns; he can truly optimize the loudspeaker system for each application. Also lucky is the independent acoustical consultant who can select the best product for the application without worrying about inventory or stocking agreements with manufacturers.

2. TECH TOPICS VOL. 7, NO. 5, PAPER BY L. K. IRVINE AND R. K. FULLMER, "SPEECH REINFORCEMENT IN A LARGE CATHEDRAL"

I was chairman of the session where this paper was presented in Salt Lake City, last November. It represents an excellent application of the Electro-Voice HR-series horns discussed above, in a location where the Altec (or the JBL) horns would not fit. Without in anyway detracting from the excellence of the system design or the presentation of the paper, I have two points I would like to make:

a) The three E-V horns used in the installation are not in spatial phase alignment, as illustrated in the "Side View" of Figure 2, and the direct field response in the overlap zone bordering the coverage pattern of any two horns should logically be expected to look like that of a comb filter. This could explain the fall-off from 90% word intelligibility at the front and the rear of the cathedral to "only" 85% (still good) in the middle. In practice, the comb filter response is probably not objectionable, as it is masked to some extent by reverberant energy.

(Editor's note: I'd like to insert here Jim Fullmer's comment re "spatial phase alignment": "I am not sure how you go about designing a cluster that will have total phase or time alignment, especially if it is not hanging out in the open. In this case, I felt lucky to be able to get a grill opening large enough to allow me a reasonable chance at good coverage. Perhaps when UREI makes their 'time align-adjustable delayed crossover' available we will have some more knobs to work with." I added Jim's comment in order to get in the plug for the UREI micro-second time delay which is discussed elsewhere in the Newsletter and which is supposed to be shown at the May AES and in our mid-May class.)

b) The fact that "speech delivered in too rapid order can create difficulty" is probably not due to the Cathedral's reverberation time. Three seconds is really not too long for a large cathedral nor too long for good intelligibility with a well-designed system. Scaling from Figure 1, we find that the loudspeaker cluster is approximately 60 feet high, meaning that for many listeners, the amplified sound arrives rather late to be combined with the live sound. Under such circumstances, the priest must either speak softly, allowing the sound system to do all the work and reducing the live "pre-echo", or else speak slowly, giving the ear additional integration time. Most priests would rather speak slowly than softly!

None of the above is meant as a criticism of the system design. We encounter the same sort of design compromises on a daily basis, much as we try to minimize them.

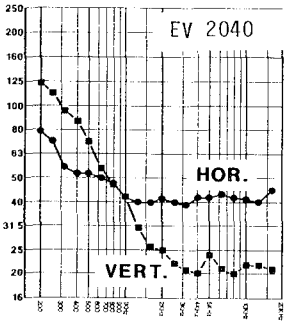
# MORE ON CONSTANT DIRECTIVITY HORNS

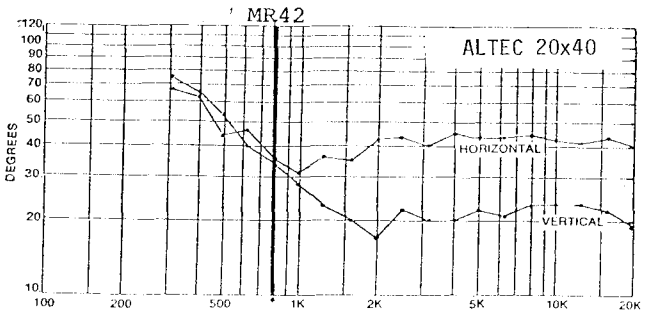
Syn-Aud-Con would like to throw its "consultant" hat into the ring with regard to the Ballou-Hoffman et al exchange of letters. We are delighted to consider Altec's Manta Rays, EV's big white horns, and JBL's new series designed by Don Keele as constant directivity devices. We recommend all of them without reservation for their ability to minimize reverberant field sound levels while maximizing direct sound field levels.

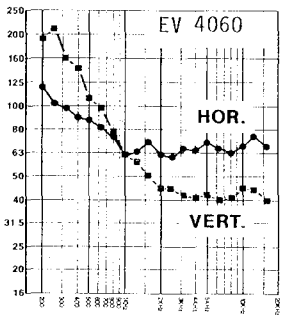
As DAVE KLEPPER has properly pointed out, it's a fortunate sound contractor who has access to all three. It goes without question that EV's data sheets on their horns are still the most complete and useful available today from a manufacturer.

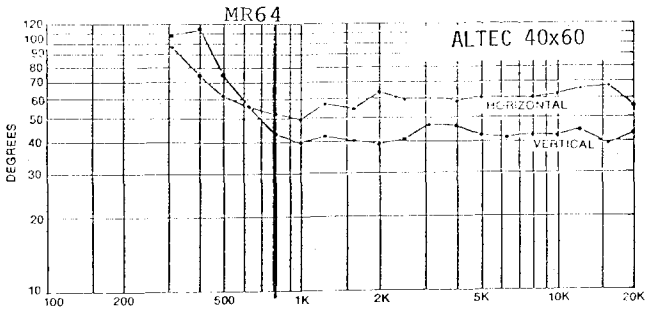
Now, we have to put the editorial hat back on, with apologies for not properly doing our editorial job. We published GLEN BALLOU's Tech Topic, "Constant Directivity Horns" in which he made a statement that TERRY HOFFMAN objected to (See Newsletter Vol 7 # 1, page 7). Glen answered Terry's letter in Vol 7 # 2, page 17, and we failed to catch that Glen was comparing "apples with oranges". Glen compared the Altec MR42 with the EV HR 40, etc. We called EV to apologize and to get the correct data. We'll let Jim Long's letter clarify the issue:

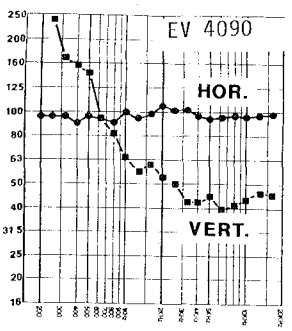
> As we discussed, I've enclosed a complete set of engineering data sheets on our HR horns. The three "large" horns (HR9040A, HR6040A, HR6020A) are high enough in their vertical dimension to provide beamwidth control to a lower frequency than that provided by our "small" horns which were compared recently to the Altec Mantaray series, which I would classify as "large." I think the engineering data sheets will clarify the "apples-and-oranges" comparison problem.
>
> I thought of one comment of detail I might throw in myself: even the "large" HR horns are smaller in the vertical dimension than the "large" Altec Mantaray horns. This gives the Mantaray design control in the vertical plane to a somewhat lower frequency than our HR design. This is a conscious trade-off we made in order to make our original "large" HR horns more palatable from a physical installation viewpoint. As it turned out, some people found even the somewhat compromised (reduced) vertical dimension of the original HR horns "too large". For this reason, we developed the four "small" HR horns which maintain constant directivity to the extent possible with the physical size constraints we selected.

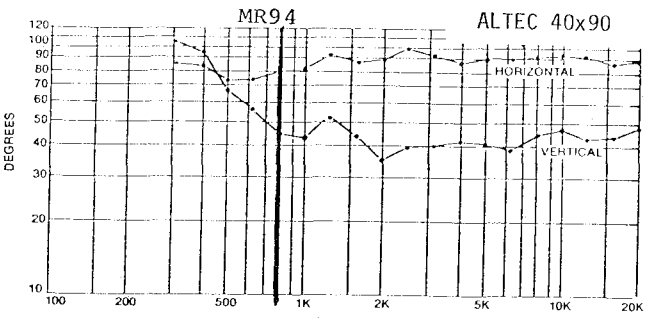


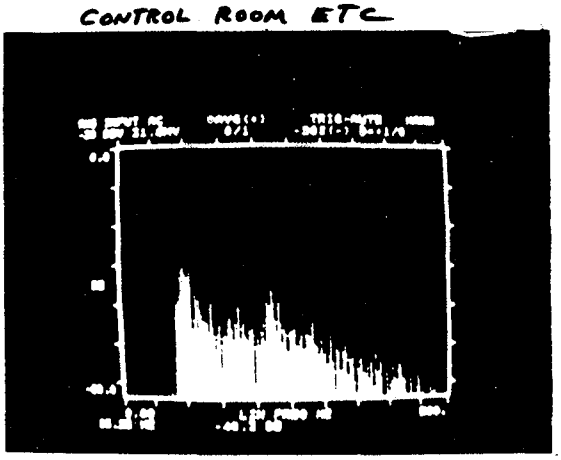



# WHY ALIGN SPEAKER ARRAYS

Persistent reports reach us of the audible benefits resulting from "on axis" Time Align™ of large arrays. DENNIS FINK of UREI was one of the first to suggest the logical reason for these audible differences: *Each reflection of a direct sound signal contaminated with 'time smear' will also have time smear.*




We know this to be true and have observed it many times in control rooms which are improperly designed. (See ETC measurement.)

Since the majority of the energy radiated is in the "on axis" area it is also the energy that will predominate in the reverberant sound field. This means that if the axis of maximum energy output is allowed to have "time smear", then every reflection, including first, second, etc., orders will also have time smear, in addition to the other problems they pick up on their travels.

If, for some reason, the reverberant sound field were receiving a majority of its energy from a different angle than "on axis", then the Time Alignment™ should take place at that angle. (Time Alignment™ is a trademark belonging to E. M. Long Assoc.)

Still another aspect of this subject is the possibility for creative misalignment whereby a fixed microphone location is benefited by increasing acoustic gain potential due to placing it in between two energy returns on the ETC analyzer (remember each vertical line on an ETC display is an entire spectrum.)

It is Syn-Aud-Con's current feeling that exploration of array alignments in time offers opportunities for important and useful additions to our present knowledge of total system behavior.

This Spring's AES Convention should see the first products (digital time delays with 100 μsec increments) designed to allow the array's time adjustment electronically rather than physically. DENNIS FINK, working with DON PEARSON up in San Francisco, have been the motivating force behind UREI's new product.

An educated guess would be that these units will head toward 10μsec increments rather quickly once the usefulness of the concept is both proven and accepted

$$\frac{(1130')(12")}{1\ \text{sec}} = \frac{?\ \text{in}}{.000001\ \text{sec}} - .0135 \text{ per } \mu\text{sec, or } .135" \text{ per } 10\ \mu\text{sec}$$

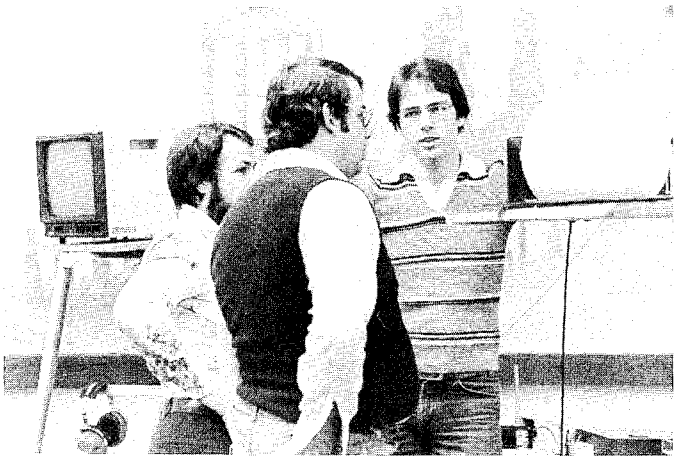
As soon as UREI has the prototype available, he says that he will bring it to a Syn-Aud-Con class to demonstrate it.

# A BAFFLING STUDY

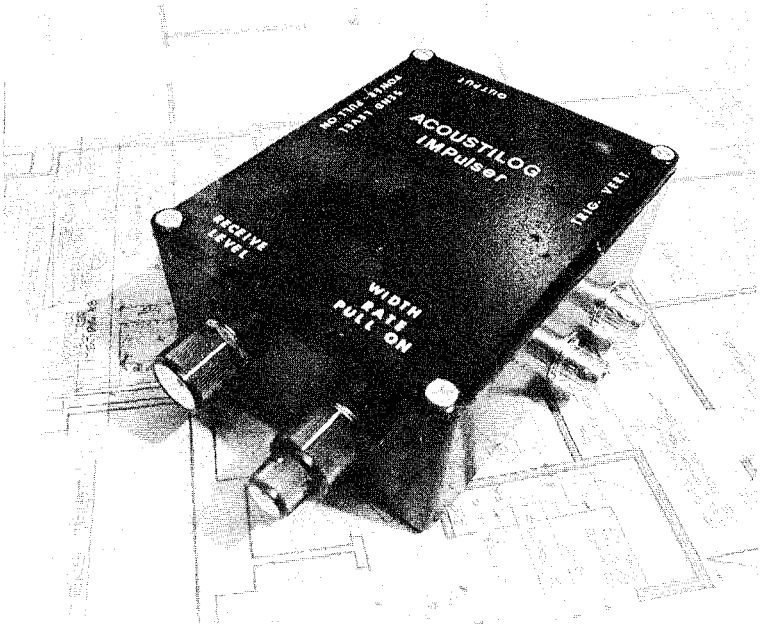
We have been demonstrating in recent classes a loudspeaker baffle with intriguing characteristics. Apparently a pair of "lighting globes" are glued together and then truncated at one end for a given loudspeaker. The results are, to say the least, unusual.

One key feature is that an 8 watt rating 8" loudspeaker will now happily handle several hundred watts without going out of the gap (thermal destruction is still possible, however).

You'll be hearing more about this product later but, in the meantime, take it from us that while Thiele-Small is great stuff some very simple geometry may send them back to their equations before too long.



# ACOUSTILOG IMPULSER




AL FEIERSTEIN has come up with a series of very useful accessories for TEF™ work. One new device is called the IMPulser. The IMPulser is battery operated, greatly extending its usefulness. The photograph and the data sheet reproduced below give details. You do not have to be licensed to buy the IMPulser.

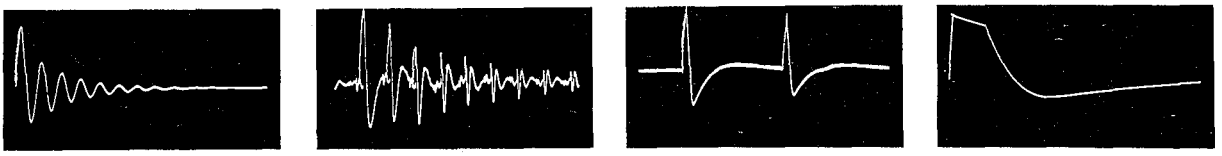
The IMPulser -$225.00

ACOUSTILOG
19 MERCER STREET
NEW YORK, N.Y. 10013
Phone: (212) 925-1365

## THE IMPulser

Our new IMPulser allows you to see as well as measure polarity, phase-alignment and impulse response of speakers, microphones and electrical systems. The IMPulser emits a positive-going pulse (similar to $\cos^2$) with a frequency that is variable from 40 Hz to 10KHz and a repetition rate from 0.3 to 10 pulses/second. This signal is fed to an amplifier and speaker, and the received impulses from the measuring microphone are amplified and displayed on any triggered oscilloscope. Instantly observable on the oscilloscope screen are the following:

Normal-Direct Sound | Reversed Polarity | Time Delayed Pulse | Speaker Alignment



Ringing | Flutter Echo | Rear wall Slap Echo | Speaker Clipping

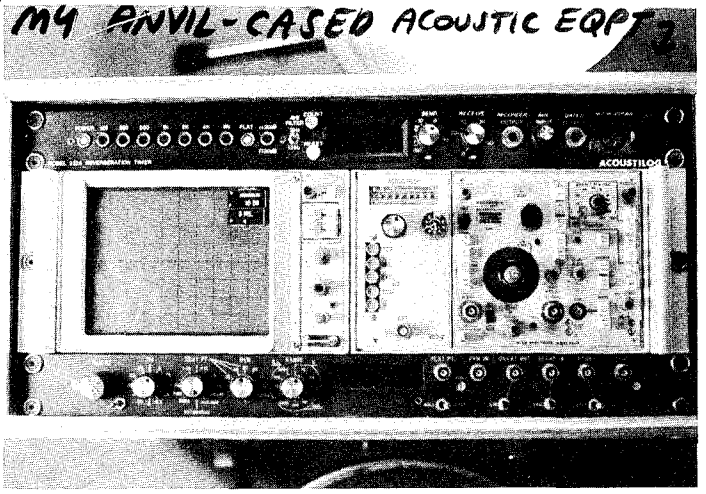
Conventional phase testers using "In-phase" "Out-phase" lights are limited to the first item above-the direct sound polarity. Yet even for this single measurement such systems are often plagued by inconsistent readings that give little in the way of confidence to the acoustician or soundman. The Acoustilog IMPulser completely eliminates these errors, because the waveform is viewed directly and and not "interpreted" by some level-sensitive electronic comparator.

The IMPulser also serves excellently for Transmission Loss measurements. It can generate very high SPLs non-destructively due to the low duty cycle of the pulses. The pulses can also be made to simulate a bass drum for determining the effectiveness of isolated walls or rattling in Studios and Discos.

The IMPulser is available for immediate delivery. Also available is a factory retrofit installation of the IMPulser in any Model 232 or 232A Reverberation Timer presently in the field.

Acoustilog....continued

Al has also developed a VCO-2 for TDS licensees wishing to use the Tektronix 5000 series oscilloscope mainframe and their 5L4N Spectrum Analyzer plug in. We have not, as yet, worked out using the Tektronix units for ETC work (in conjunction with an FFT) but Al's work has overcome the first obstacle, that of obtaining TDS displays.




We recently had an occasion to remind ourselves of how effective Al's VCO-1 is. Our HP Synthesizer had a major power supply failure leaving us with an extremely efficient fuse blower. At this point Al's VCO-1 was turned on and once again reminded us of what a fine job Al did on this unit. The VCO-1 is stable, easy to tune, drives the FFT to more than adequate level, and more than satifies any normal TDS usage. You *must be a TDS or TEF™ licensee* to purchase either the VCO-1 or VCO-2. You *do not need to be licensed* to purchase the IMPulser. Al is a clever innovator of highly useful accessories needed in the acoustical measurement of sound systems and their environments.

# WHO WILL BE THE FIRST TO TRY A RADICAL SUGGESTION FOR IMPROVED MONITORING?

Having now played at length with a high frequency "sled test" on the Emilar system, we have a number of subjective impressions.

1. You sure can hear a few inches of misalignment.
2. Woofers driven with a sine wave signal at crossover don't sound like the high frequency unit driven at crossover with the same signal.

We know that at least part of the difference may lie in the difference in both Q and $C_L$ at crossover between the woofer and tweeter.

In our experience many really good woofers have a Q = 2 or 3 while it is our considered opinion that high frequency units for studio monitoring work should have $Q_S$ from 10 to 15.

There is also the problem of achieving really good bass response using the studio window wall as part of the surface for your low frequency development.

One solution to this dilemma is to mount the high frequency units about operator head level on either side of the window between the control room and studio and the low frequency unit overhead in the ceiling. Why?

1. With a LEDE™ control room it is no longer necessary to raise the high frequency units and then angle them downward to avoid detrimental rear wall reflections because the rear wall is now a controlled diffusion surface. By lowering the high frequency units to ear level you now *avoid* the clearly audible console reflection by not striking it with concentrated energy from the direct sound field.
2. The low frequency unit now can be mounted in the live ceiling surface directly over the operator's head and thereby using the hard ceiling surfaces as an extension of the enclosure.
3. The distance from the low frequency unit to the operator's ears can now be adjusted for equal direct to reflected ratios at the operator's ears as determined by the difference in the Q of the low frequency unit compared to the Q of the high frequency unit.

$$D_{LF} = \frac{D_{HF}}{\sqrt{\frac{Q_{HF}}{Q_{LF}}}}$$

Where $D_{LF}$ is the distance in feet or meters from the low frequency unit to the operator's ears

$D_{HF}$ is the distance in feet or meters from the high frequency unit to the operator's ears

$Q_{HF}$ is the Q of the H.F. unit at the crossover frequency

$Q_{LF}$ is the Q of the L.F. unit at the crossover frequency

continued

A Radical Suggestion --- continued

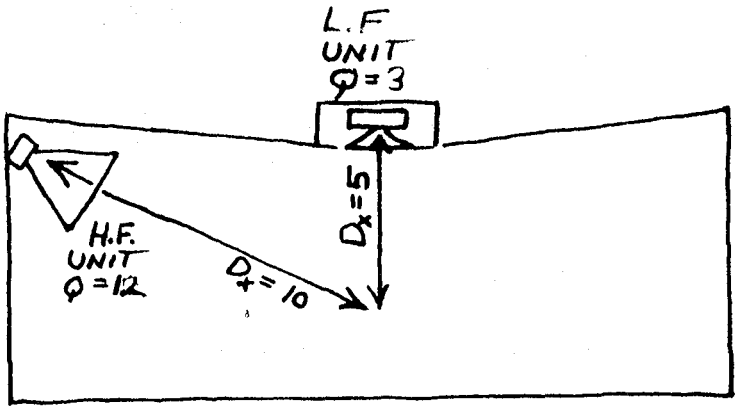
AN EXAMPLE

Suppose that our high frequency unit has a Q = 12 and our low frequency unit has a Q = 3. We find that $D_2$ from the H.F. unit to the operator's ears is 10 feet. What should the L.F. unit's $D_2$ distance be for an equal ratio of direct to reflected sound to be received at the operator's ears?

$$D_{LF} = \frac{10 \text{ feet}}{\sqrt{\frac{12}{3}}} = 5 \text{ feet}$$

A drawing of the installation is illustrated here.

$$D_{x\ L.F.} = \frac{D_{x\ H.F.}}{\sqrt{\frac{Q\ H.F.}{Q\ L.F.}}}$$




The imminent advent of digital time delays with adjustments in usec increments bodes well for the timeliness of this, up to now, radical idea. One usec is the equivalent resolution of .01356 inches.

Is there another "CHIPS DAVIS" awaiting his chance out there?

# THE J. W. DAVIS MARKETING OF DICK HEYSER'S SBA CONCEPT

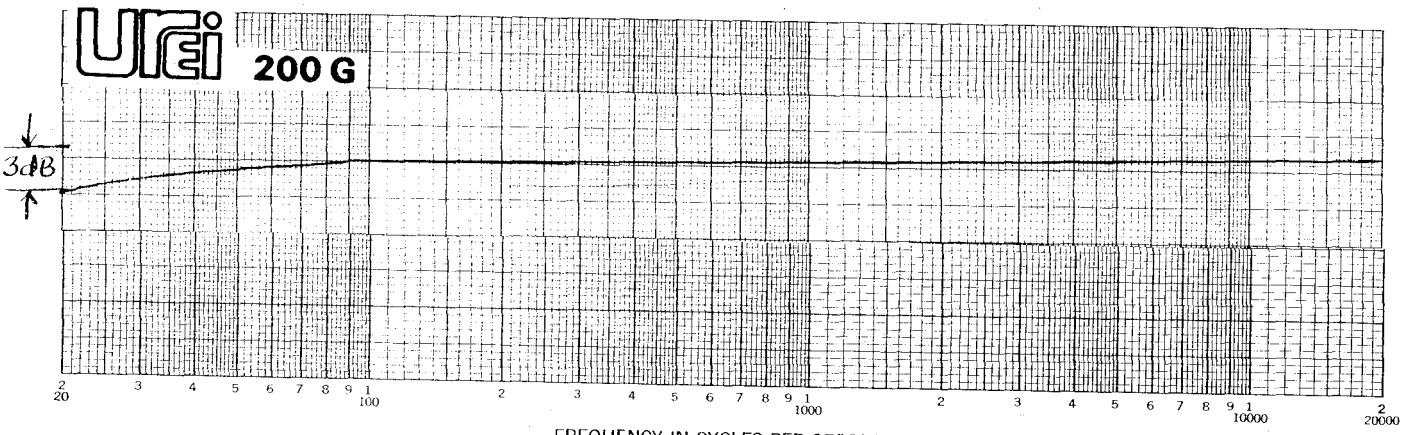
We are now receiving back from the field the first enthusiastic reports on the J. W. Davis SBA Distributed Sound System™. DAVE ANDREWS in New York ordered a sample set, then 5 more remotes, then a few days later 100 units.

We have measured the electrical response of one of these production systems and confirmed that it is indeed a high fidelity signal at a price normally associated with only the lowest quality P.A. type apparatus.

Total electrical test instruments required for precision installation work is an ammeter.

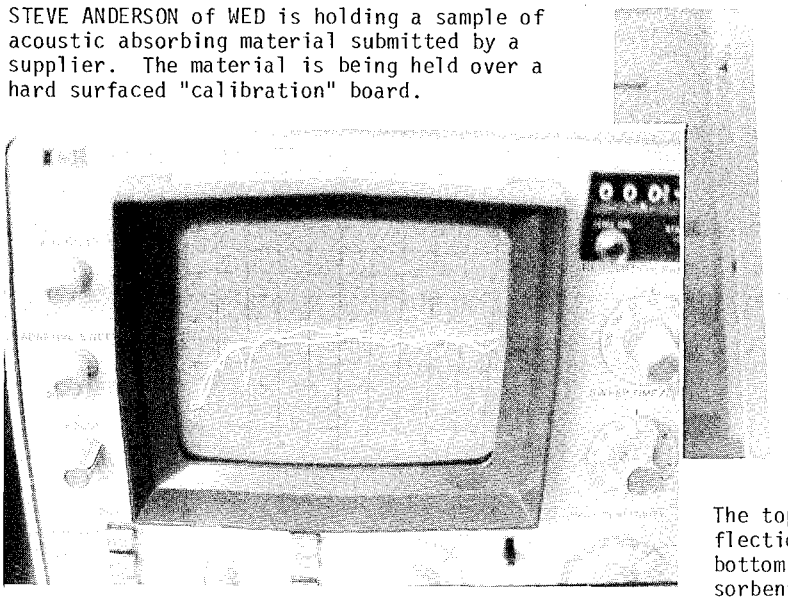
We are reproducing J. W. Davis' new installation and operating instructions for this system, both for your access to current data on this advanced, superior quality equipment and as an example of a well-written, easy-to-understand set of instructions.

Once again Syn-Aud-Con would like to caution prospective buyers to not let the grass grow under your feet. The SBA system is vastly superior to any other approach to large, low sound level, distributed sound systems - so much so that you'll not believe it until you try it. Its acceptance will be immediate in our opinion. I'd be uncomfortable if I had any low sound level distributed systems specified the old way.



# TESTING AN ABSORBENT MATERIAL

STEVE ANDERSON of WED is holding a sample of acoustic absorbing material submitted by a supplier. The material is being held over a hard surfaced "calibration" board.



The top trace on the analyzer screen is the reflection off of the calibration board. The bottom trace is the reflection off of the absorbent material. The linear sweep is from 0 to 10 KHz with each horizontal division 1000 Hz and each vertical division 10 dB. At 4000 Hz, greatest absorption point, this material absorbs 5 dB.

The absorption coefficient 'a' is found by:

$$a = 1 - 10^{\left(\frac{-dB}{10}\right)}$$

or

$$a = 1 - 10^{\left(\frac{-5}{10}\right)} = .684$$

Conversely, if you have an absorption coefficient of .68 and wish to know how many dB down the reflected signal will be then:

$$dB = 10 \text{ LOG } (1-a)$$

or

$$dB = 10 \text{ LOG } (1-.684) = -5.0$$

This material would not be our first choice (or last choice, for that matter) in an LEDE™ control room.

# PPC PERSONAL PROGRAMMER'S CLUB

The HP 41C has a number of idiosyncrasies that clever users are examining and finding solutions for.

The Personal Programmers Club (PPC) has a newsletter called the *PPC CALCULATOR JOURNAL*. The Journal contains much interesting data, not the least of which is the information that plugging a "card reader" into a HP 41C raises the current drain on the HP 41C's batteries to 2.8 ma, whereas simply turning the HP 41C on and then off *after* inserting the card reader drops the current drain to 8.9 ua.

This was but one of a series of fascinating observations being shared in this specialty newsletter. $15/year

PPC Calculator Journal
2541 West Camden Place
Santa Ana, CA 92701
Richard Nelson, Editor

# TRANSISTOR TESTER

FRANK OSTRANDER of Mt. Kisco, NY, has sent us a very simple but useful transistor tester. KEN WAHRENBROCK has run tests on the Transistor Tester and reports that it is a handy tool for the basic tool box. Further information can be had by writing: New Castle Sound, 342 Lexington Ave, Mt. Kisco. NY 10549.

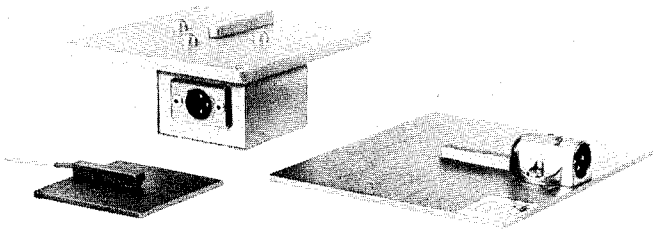
# HOW TO ACQUIRE A 'PZM'ICROPHONE

Crown International has the exclusive manufacturing rights to the Pressure Zone Microphone™. Wahrenbrock Sound Associates will continue to manufacture and sell PZM™ units, under agreement with Crown International, until Crown's production capacity for these units reaches a satisfactory level capable of handling the current demand of their dealers. PZM™ units produced by Crown International can be purchased by Syn-Aud-Con graduates through Wahrenbrock Sound Associates, who will be a franchised Crown dealer; however, it will be much more advantageous to purchase direct from Crown International if you are a Crown dealer.

The superiority of Pressure Zone Microphony for recording musical events where fidelity is a prerequisite is now well established. We expect quite a revolution in both home and professional recording situations once Crown's production reaches their excellent dealer network.

The material reproduced below is an example of some of the new literature that Crown is generating relative to this new product line.

## REVOLUTIONARY MICROPHONE PROMPTS CROWN TO ENTER NEW PRODUCT AREA



The new Crown Pressure Zone Microphone™ opens a whole new area for Crown dealers.

This new microphone technology will give Crown dealers an unparallelled opportunity in the sound reinforcement, recording, and music fields.

Pressure Zone Microphones (PZM™), represent the first fundamental advance in microphone technology in over 45 years. As evidenced by sound engineers and recording engineers nationwide, the PZMicrophone offers startling advantages over conventional microphones:

**Audibly Superior Performance.** Conventional microphones, regardless of construction, craftsmanship or cost, are performance limited by phase cancelling effects occurring whenever direct sound is mixed with reflected sound at a microphone element. Pressure Zone Microphones, which respond to a coherent wave front at the surface of an acoustic boundary, eliminate this response problem, known as comb filtering. The result is a much smoother frequency response in actual use, which gives much more accurate sound reproduction.

**Elimination of Directional Discrimination Characteristics.** Most currently available microphones exhibit audibly noticeable aberrations in their output spectra when receiving sound from moving or shifting sources. In contrast, the PZMicrophone responds in a hemispherical pattern, so response is unaffected by the motion or direction of the sound source. The hemispherical pattern is created by mounting a pressure calibrated element facing an acoustic boundary (i.e., flat plate, wall or floor) so that it responds to the pressure zone developed at the surface of the boundary. Since the construction allows open access to the element from essentially any direction, no single response axis if favored.

**Reduced Microphonics.** Because of the relatively small size of the electret module used in the PZM™, the inertia of the element is low. Therefore, microphonic problems are practically non-existent.

**Simplified Miking Techniques.** Reports from dozens of different performances, concerts and recording sessions held throughout the country reveal that PZM™ recording requires fewer mike channels then would be required with conventional microphones. Set ups and hook ups are thus less complicated with PZM™ methods.

**Increased Subject Visibility.** Because of their unique performance characteristics, PZM's can often be mounted in such a way as to be completely unobtrusive. This makes the Crown PZM™ an ideal mike for television, theater, concert and public address applications.

**Handles 150dB SPL.** Pressure Zone Microphones from Crown are capable of handling sound levels of 150dB. Thus they can be placed inside a drum or directly in front of an electric guitar amplifier or other instrument. Placed inside a kick drum or a piano, the PZM assures accurate, distortionless reproduction.

**High Benefit To Cost Ratio.** The benefits of this new technology are available at a surprisingly affordable price. With a suggested retail price of less than $350, Crown Pressure Zone Microphones offer a performance/cost ratio superior to that of microphones costing three times as much.

**PZM™**

Pressure Zone Microphone operation is based on the principle that within a few millimeters of a rigid surface, the incident and reflected sound waves from a pair of equal level signals **add coherently**. Thus, in close proximity to the surface or "boundary" the signals are still "in phase" as they are reflected after being brought to a stop by the boundary. This creates what is called a "pressure zone" right at the surface of the boundary. In such a pressure field, the instantaneous pressure is every where uniform and response is not a function of the angle of incidence.

By mounting a pressure calibrated electret capsule within a few millimeters and facing a boundary, incoming sound is received indirectly. No signal can arrive on - axis but can only enter at the sides of the opening between the microphone's diaphram and the metal plate.

Thus, not only does the Pressure Zone Microphone maintain a "flat" response but it does so for all angles of incidence in the hemisphere surrounding it.

The result is a cleaner or more "true" sound because the signal is totally free of anomallies caused by the phase cancellation of direct with reflected sound

# SYN-AUD-CON 1980 SUMMER AND FALL SCHEDULE

| | |
|---|---|
| **July 15-17** | **October 14-16** |
| **August 12-14** | **November 11-13** |
| **September 16-18** | **December 9-11** |

As this Newsletter goes to print, Syn-Aud-Con has held one TEF™ class and *six* regular classes at the Marina Inn in Dana Point, California. These meetings have offered:

1. Limited attendance (16 participants maximum per class).
2. Hands on opportunities with TEF™ equipment.
3. The enjoyment of exploring the Marina's six excellent restaurants with a compatible peer group as part of the seminar -- seafood, beef menus, Mexican food - all included in the class fee.
4. A more relaxed schedule that leaves the evenings to experiments, demonstrations, and question and answer sessions.

The photographs of these classes tell their own story. A beautiful physical environment, an invigorating mental environment - all available for less than it would have cost to have brought even a fraction of these benefits to you in your home area *this year*. We are now able to include significantly more equipment and two truck loads instead of one now arrive at each class. Ask any one of these graduates in the pictures and they'll tell you why a West Coast class beats anything we've ever done in the past.

# NEW AUTOMATIC MIXER FROM INDUSTRIAL RESEARCH

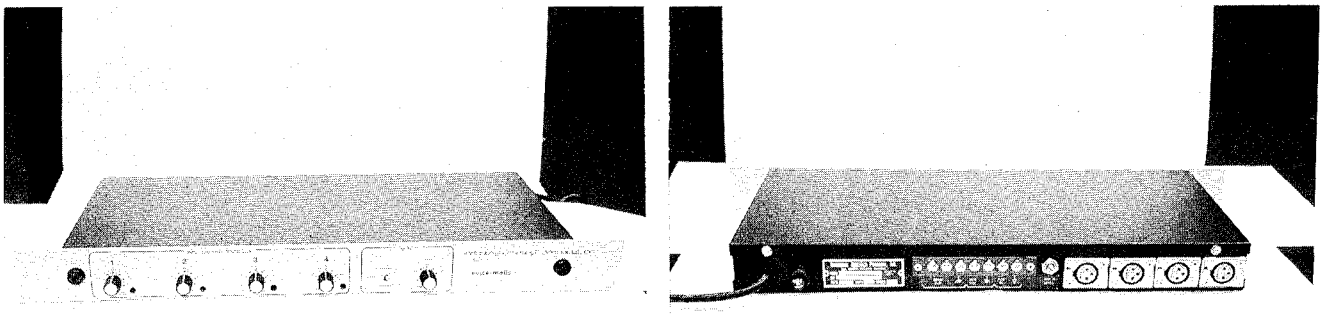
We received the information printed below just before this Newsletter went to the printer. Because of the importance of such a practical step in the evolution of automatic mixers, we have reprinted Industrial Research's press release in detail. We suspect that this new mixer is ideally tailored to the typical church job far better than the larger units now available.

Soon to be Released

The DE-4014 does the same job as the predecessor unit, the DE-4013, namely, providing maximum gain before feedback in a multiple microphone sound system. Equivalent gain to a single microphone system is achieved by automatically attenuating any inactive microphone, thereby reducing background noise and reverberation pick-up.

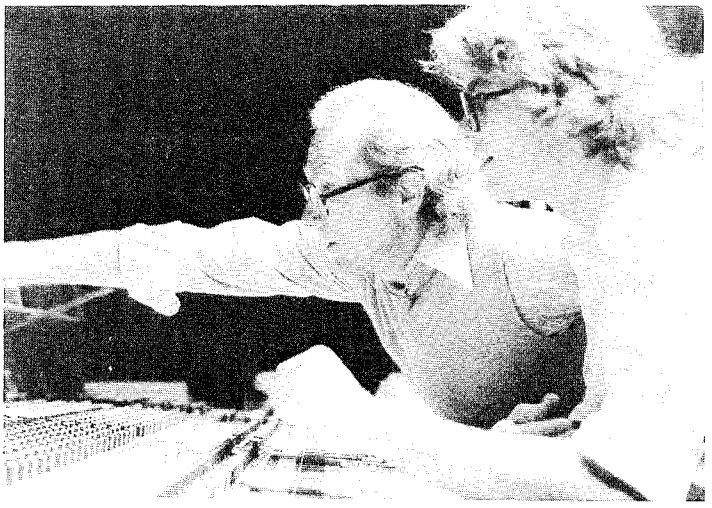
The Model DE-4014 contains 4 microphone input channels plus an auxilliary line level input which is adjustable. An auxilliary output is also a standard feature. Front panel controls include: Input channel sensitivity for each channel; LED status light for each channel; Master level; Voice-matic/standard mode.

In a four microphone installation, the Industrial Research Products, Inc. DE-4014 Voice-Matic Microphone Mixing System provides the maximum possible gain before feedback (equivalent to a single microphone system) for an active microphone while inactive microphones are attenuated to reduce background noise and reverberation pickup. The DE-4014 uses DTS (Dynamic Threshold Sensing) to update the status of each microphone channel. The DTS system avoids the adjustment compromise of the fixed threshold gate (VOX) types of mixers. Each input is compared to a sweeping threshold level that covers 80 dB of level range. The channel with the highest level input sensed at each scan is given "channel on" status. This DTS detects active microphones in preference to inactive microphones over a wide level range. Two or more active microphones can simultaneously have "channel on" status; stable mix gain is maintained by automatic master attenuation. In operation, the automatic mixing decisions of the DE-4014 are inaudible while remarkable system gain improvement and noise reduction result.



The IRPI Voice-matic Microphone Mixer has been selected for installation in many facilities, such as the General Dynamics Boardroom, St. Louis, MO, Council of Government, Washington, DC, Hartford Coliseum, Hartford, CT, St. Paul's Catholic Church, Daytona Beach, FL, City Council Chambers, Norman, OK, Performing Arts Center, Scottsdale, AZ, to name only a few.

# WALLY HEIDER RECORDING-STUDIO 4 LEDE CONTROL ROOM



*The most notable difference in the room from before is that the monitoring is clearer without being devastating. You can now listen, whether at high or low levels with absolutely no loss of sound....For our clients who really like to blast, you can listen tremendously loud without it going to pieces.*

Bones Howes
April, 1980

*The LEDE™ concept creates a very realistic listening environment. I hear everything characteristic of each instrument rather than the characteristics of the control room. In other words, you don't fight the control room to get the sound you want -- the control room helps you.*

Joeff Howe
April, 1980

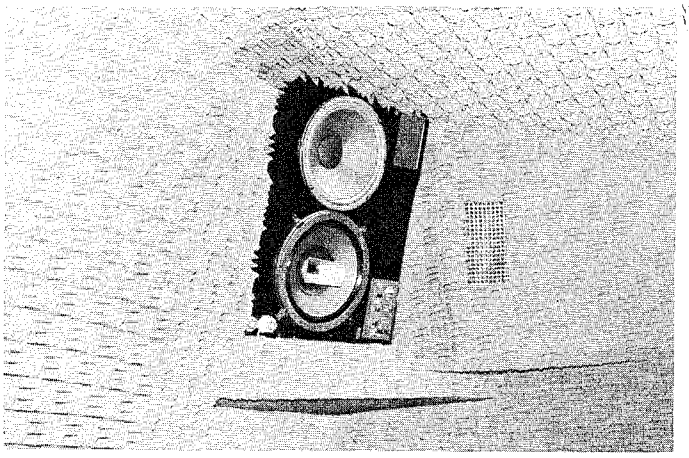
The Evolution of an LEDE™ Control Room

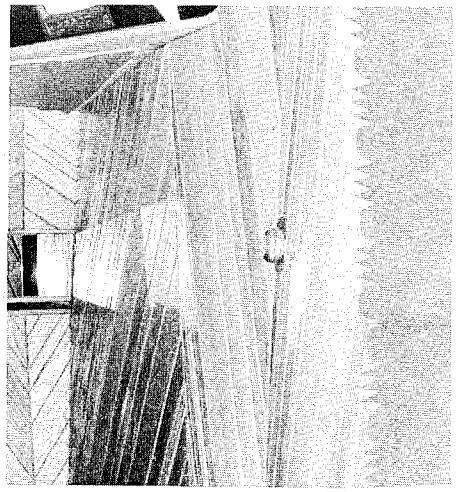
The ultimate success of a new concept has its roots in the interaction of many talented and receptive persons before it is manifested as an entity of its own. This is a record of one such project in terms of the personalities that made material contributions to its success. The next issue of the Newsletter will have a complete Tech Topic with biographical material on the force that made Studio 4 a reality. Here we are showing a few pictures of Bones Howe, legendary producer, and his son, Joeff, working on the soundtrack album from the film, "ROADIE" which will be released by Warner Brothers.

First in this list of credits is the decision maker who has to bet his reputation on the consultant's new ideas if he really wants to be the leader in his own area. That decision maker was Laurence H. Estrin, president of the Heider Group.

The Wally Heider Studio 4 features an LEDE™ control room. Studio 4 easily qualifies as the most advanced development in the acoustic environments on the West Coast.

The Heider LEDE™ control room in Studio 4 is unique in a number of ways. The photograph shows the Time Align™ UREI 813 monitors mounted in the Sonex material on Mason Industry spring shock mounts. The Sonex material proved to be surprisingly pleasant to look at inasmuch as it diffuses light as well as sound. (See Newsletter Vol 7 # 1, pages 22 and 23 for acoustic measurements of the Sonex.)

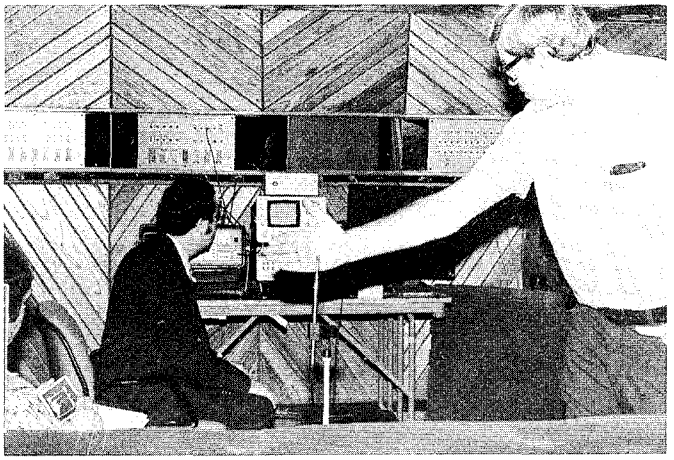




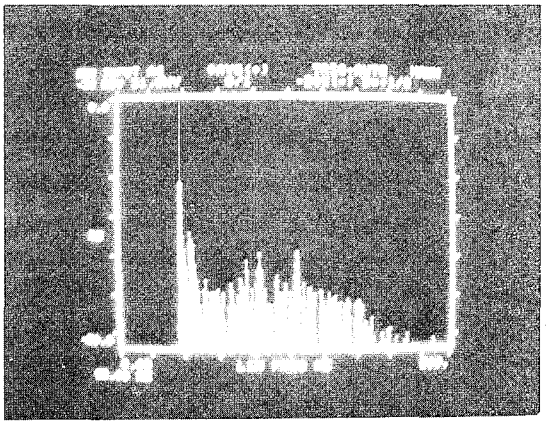
The "live end" is a work of art in textured hardwoods. This photo illustrates a part of the complex ceiling construction near the junction of the live end with the dead end. The entire ceiling as well as surrounding walls of the outer shell are concrete for the bass frequencies. The inner shell is beautifully executed in select hardwood.

continued next page

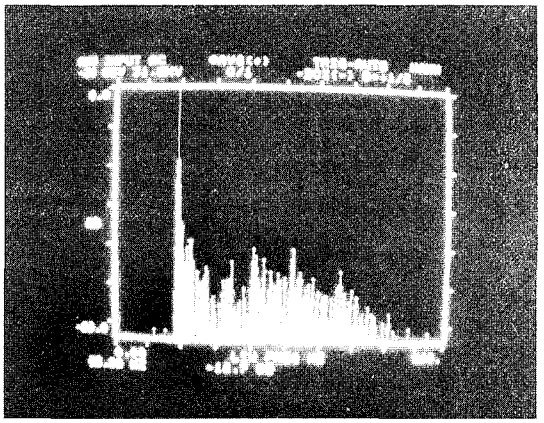
Studio 4 -- continued



This photograph, taken during the confirming TEF™ measurements, gives an excellent idea of the rear wall angles and surface alignments.



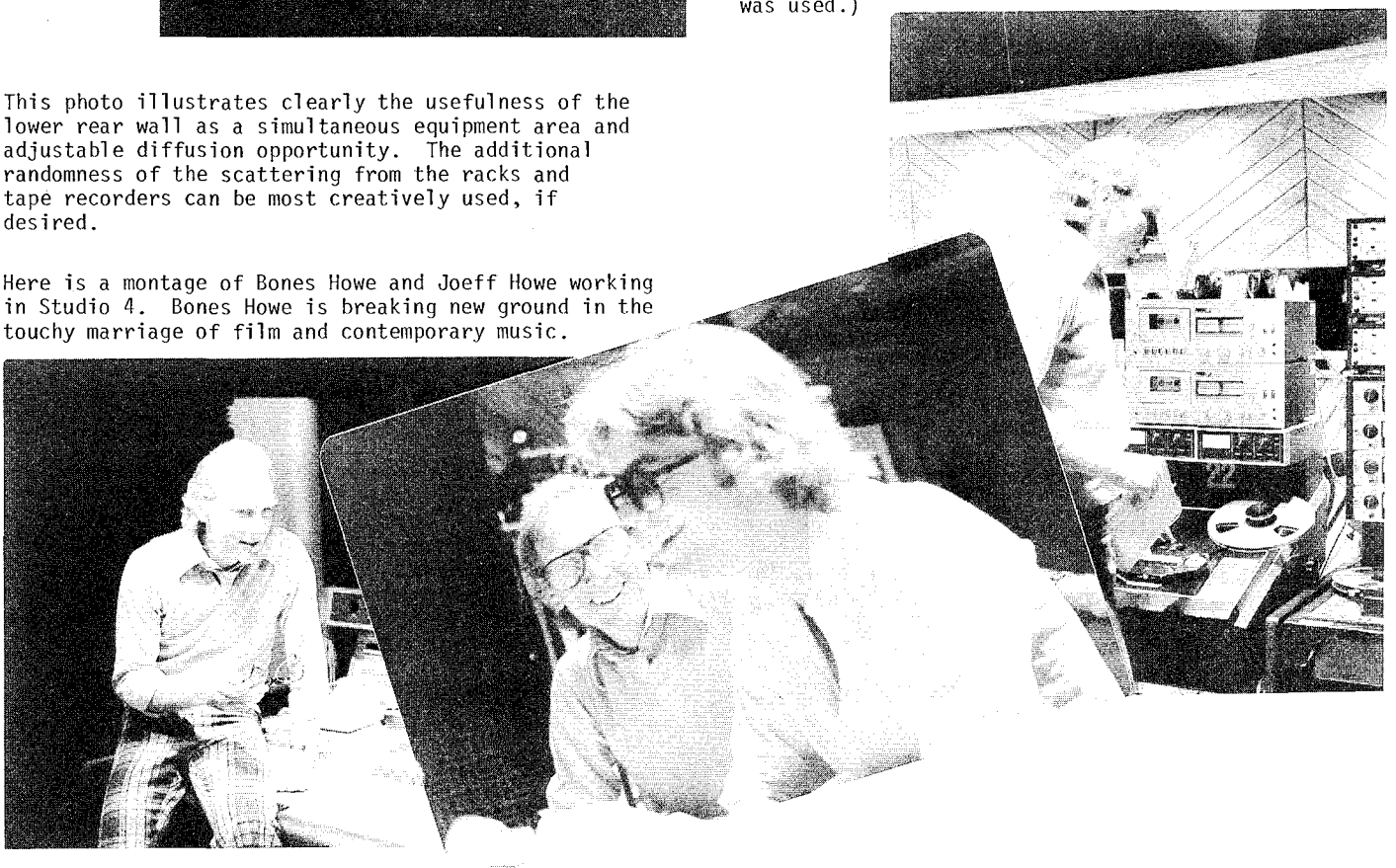
The ETC display of the control room without the front edge of the console covered with absorption is shown here.



This photo shows the ETC when the absorption is applied. One very interesting point is that with the Sonex material the reflection off of the console is not as great as when Fiberglass was used on the front. (See Tech Topic Vol 6, # 13, page 3 for an example of an LEDE™ control room where Fiberglass was used.)

This photo illustrates clearly the usefulness of the lower rear wall as a simultaneous equipment area and adjustable diffusion opportunity. The additional randomness of the scattering from the racks and tape recorders can be most creatively used, if desired.

Here is a montage of Bones Howe and Joeff Howe working in Studio 4. Bones Howe is breaking new ground in the touchy marriage of film and contemporary music.



# THE MUSIC PLACE

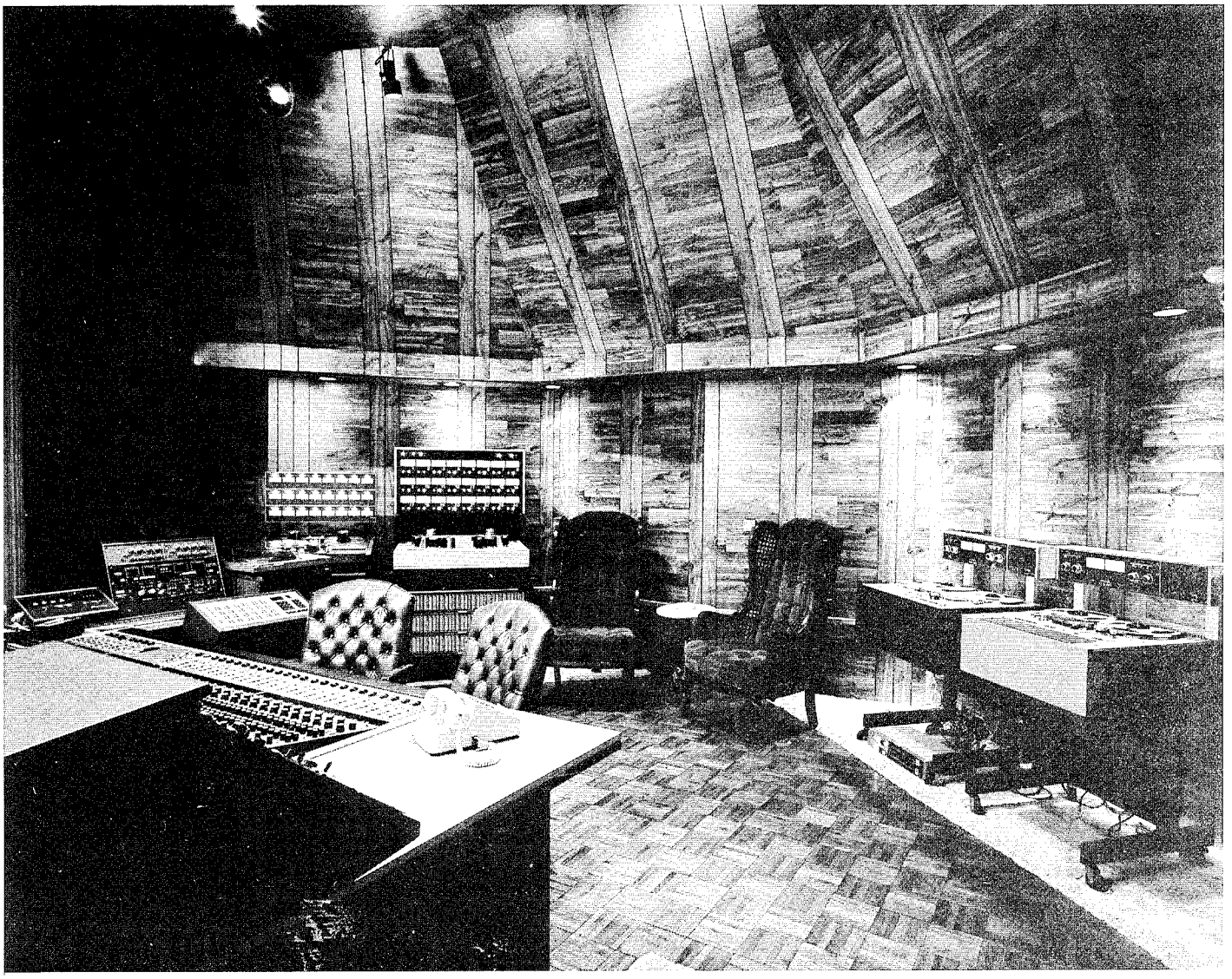
The Music Place in Birmingham, Alabama, is currently receiving much favorable mention in Bill Board magazine as well as among the users of the facility. We recently received these more detailed photographs from Randy Richards. The really beautiful woodwork in the construction of the diffuse hard rear wall is easier to visualize in this photograph. The care with which CHIPS DAVIS plans his rear walls results in well spaced energy packets that completely satisfy Kuttruff's criteria for extending the Haas effect.

We are receiving increasing "intelligence" that LEDE™ is causing a great number of current studio and control room designers "fits" as they are asked to comment on the idea. We sympathize as a majority of them have never experienced a LEDE™ room, have no access to TEF™ technology, and have, in the past, advocated theories and techniques currently being *proven* incorrect. As human beings, their response is not always rational or even gentlemenly. We're sorry for their state of confusion but it's their responsibility to correct it, not ours. What is startling to us and most pleasing is that among those who either can understand the technical proofs we are making or who have good ears and have taken the trouble to experience a true LEDE™ room we are receiving an unbelievable unanimity of opinion in our favor.

Like all new ideas, LEDE™ will pass through three stages in the minds of those opposed initially:

1. I don't believe it.
2. I've always believe it.
3. Actually, it was my idea.

The Music Place -- continued



The magnificent control room at The Music Place. We have frequently commented on the necessity to make the control room larger. By the careful arrangement of energy arrivals within the Kuttruff criteria, it is possible to arrive at control rooms with the visual appear of The Music Place, capable of magnificent bass response, and with the complete freedom LEDE™ offers acoustically.

## "LEGENDARY THREE DAY SEMINARS"

It was bound to happen sometime and we're grateful it was perpetrated by an Englishman conscious that normally the "title" belongs to the "Age of Camelot," not to technological endeavors.

Syn-Aud-Con and Don are referred to as -- "his now *legendary* three day seminars" -- in an article by Haydon Warren in the January 1980 issue of *PUBLIC ADDRESS*. This is the journal for sound reinforcement personnel in England.

We thought Syn-Aud-Con graduates would like to know they are now part of an acknowledged legendary period in audio history.

## SMILE

DAVID GLASSER at NPR in DC sent us an addition for Murphy's Law: The Ralph Woods Line of Sight Probability Theory -- "I'll believe it when I see it."

David is originally from Boston where we heard this quip in class: If a hydrogen bomb went off in NYC, Boston newspaper headlines would say, "Boston man killed in New York blast".

# EXAMPLES OF COMPUTER PROGRAMS

Those of you fortunate enough to have followed Syn-Aud-Con Newsletters and Tech Topics from their beginning have encountered the name of ED LETHERT frequently and always associated with practical, useful new ideas.

In recent years Ed has entered the world of computer addicts and like all of that ilk, emerges periodically to communicate some message from the Master-Machine. We are reproducing examples from a good-sized booklet that Ed sent us. If you are interested in greater detail, contact Ed Lethert, 3656 Ensign Ave N., New Hope, MN 55427 Ph 612-545-7756

1. A printout of the results of the various methods of calculating $AL_{cons}$

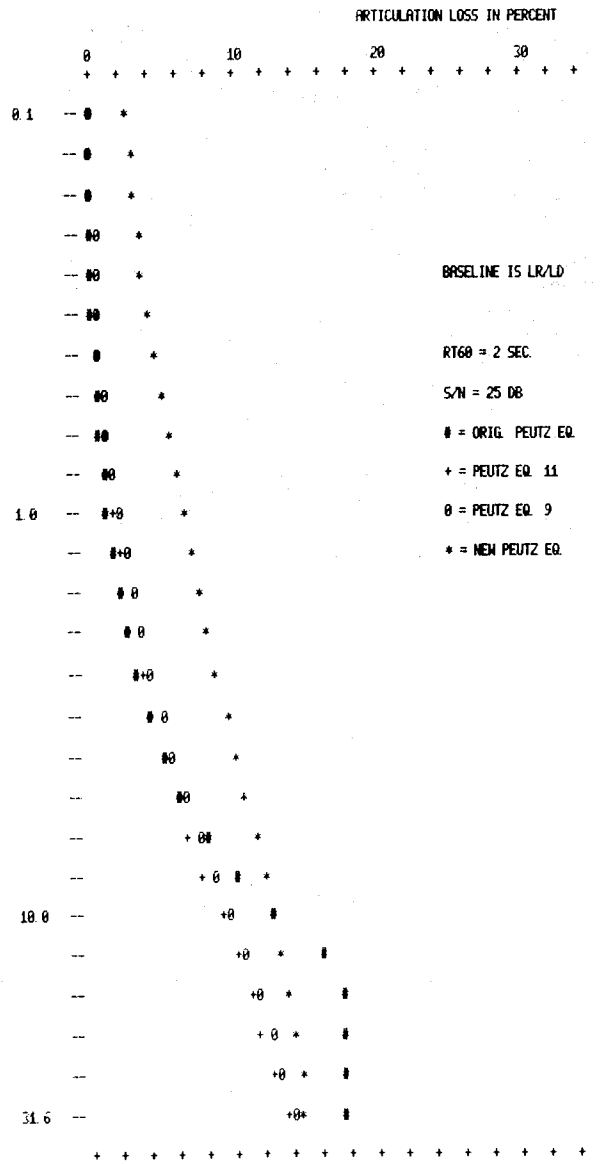
   \# - The original Peutz equation and the one used in *Sound System Engineering*

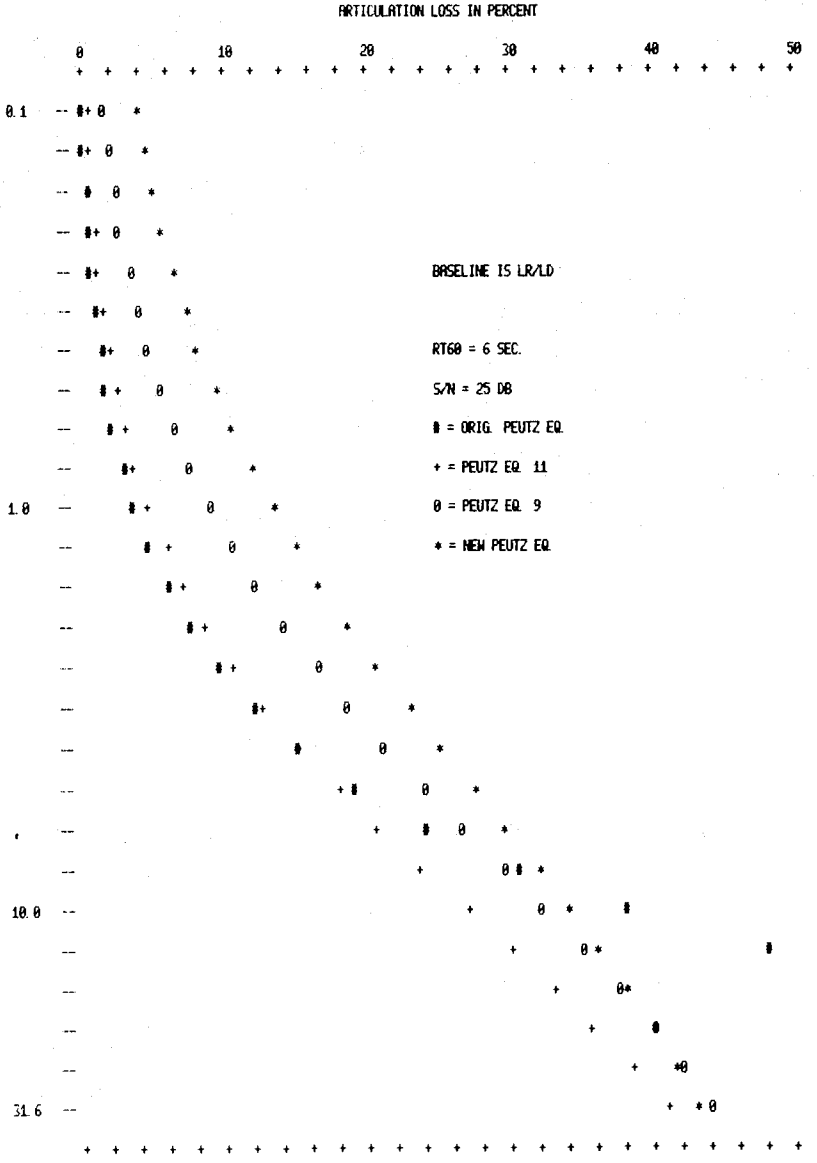
   Φ - From Peutz 1971 AES paper, Eq. 9

   \+ - From Peutz 1971 AES paper, Eq. 11

   * - New Peutz equation, Syn-Aud-Con Tech Topic, Volume 5, #12

   The variations are interesting and provoke some thought as to which is the best one to use.



Example of Pages 1-4 -- Relative SPL ref. Increasing Power (1 watt reference power)

RELATIVE SPL WITH INCREASING POWER (REFERENCE 1 WATT)

| WATTS: | SPL: | WATTS: | SPL: | WATTS: | SPL: | WATTS: | SPL: |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 26 | 14.1 | 51 | 17.1 | 76 | 18.8 |
| 2 | 3 | 27 | 14.3 | 52 | 17.2 | 77 | 18.9 |
| 3 | 4.8 | 28 | 14.5 | 53 | 17.2 | 78 | 18.9 |
| 4 | 6 | 29 | 14.6 | 54 | 17.3 | 79 | 19 |
| 5 | 7 | 30 | 14.8 | 55 | 17.4 | 80 | 19 |

Example from Pages 5-8 -- Relative SPL ref. Increasing Distance (1 foot reference distance)

RELATIVE SPL WITH INCREASING DISTANCE (REFERENCE 1 FOOT)

| DISTANCE: | SPL: | DISTANCE: | SPL: | DISTANCE: | SPL: | DISTANCE: | SPL: |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 26 | -28.3 | 51 | -34.2 | 76 | -37.6 |
| 2 | -6 | 27 | -28.6 | 52 | -34.3 | 77 | -37.7 |
| 3 | -9.5 | 28 | -28.9 | 53 | -34.5 | 78 | -37.8 |
| 4 | -12 | 29 | -29.2 | 54 | -34.6 | 79 | -38 |

Example of Pages 9-12 -- Relative SPL ref. Increasing Distance (4 foot reference distance

RELATIVE SPL WITH INCREASING DISTANCE (REFERENCE 4 FEET)

| DISTANCE: | SPL: | DISTANCE: | SPL: | DISTANCE: | SPL: | DISTANCE: | SPL: |
|---|---|---|---|---|---|---|---|
| | | 26 | -16.3 | 51 | -22.1 | 76 | -25.6 |
| | | 27 | -16.6 | 52 | -22.3 | 77 | -25.7 |
| | | 28 | -16.9 | 53 | -22.4 | 78 | -25.8 |
| 4 | 0 | 29 | -17.2 | 54 | -22.6 | 79 | -25.9 |
| 5 | -1.9 | 30 | -17.5 | 55 | -22.8 | 80 | -26 |
| 6 | -3.5 | 31 | -17.8 | 56 | -22.9 | 81 | -26.1 |
| 7 | -4.9 | 32 | -18.1 | 57 | -23.1 | 82 | -26.2 |

Pages 13-14 -- Relative SPL ref. Increasing Distance (10 foot reference distance)

RELATIVE SPL WITH INCREASING DISTANCE (REFERENCE 10 FEET)

| DISTANCE: | SPL: | DISTANCE: | SPL: | DISTANCE: | SPL: | DISTANCE: | SPL: |
|---|---|---|---|---|---|---|---|
| | | 26 | -8.3 | 51 | -14.2 | 76 | -17.6 |
| | | 27 | -8.6 | 52 | -14.3 | 77 | -17.7 |
| | | 28 | -8.9 | 53 | -14.5 | 78 | -17.8 |
| | | 29 | -9.2 | 54 | -14.6 | 79 | -18 |
| | | 30 | -9.5 | 55 | -14.8 | 80 | -18.1 |
| | | 31 | -9.8 | 56 | -15 | 81 | -18.2 |
| | | 32 | -10.1 | 57 | -15.1 | 82 | -18.3 |
| | | 33 | -10.4 | 58 | -15.3 | 83 | -18.4 |
| | | 34 | -10.6 | 59 | -15.4 | 84 | -18.5 |
| 10 | 0 | 35 | -10.9 | 60 | -15.6 | 85 | -18.6 |
| 11 | -.8 | 36 | -11.1 | 61 | -15.7 | 86 | -18.7 |
| 12 | -1.6 | 37 | -11.4 | 62 | -15.8 | 87 | -18.8 |
| 13 | -2.3 | 38 | -11.6 | 63 | -16 | 88 | -18.9 |
| 14 | -2.9 | 39 | -11.8 | 64 | -16.1 | 89 | -19 |
| 15 | -3.5 | 40 | -12 | 65 | -16.3 | 90 | -19.1 |

Example of Pages 15-22 --These are the equivalent distances for the equation

$$D_{xe} = \left\{ \frac{1}{(1/D_x^2)+(1/D_C^2)} \right\}^{\frac{1}{2}}$$

EQUIVALENT DISTANCE FOR REVERBERANT SPACES

| DC (FT): | 1 FT: | 2 FT: | 3 FT: | 4 FT: | 5 FT: | 6 FT: | 7 FT: | 8 FT: | 9 FT: | 10 FT: |
|---|---|---|---|---|---|---|---|---|---|---|
| DX (FT): | | | | | | | | | | |
| 5 | 1 | 1.9 | 2.6 | 3.1 | 3.5 | 3.8 | 4.1 | 4.2 | 4.4 | 4.5 |
| 10 | 1 | 2 | 2.9 | 3.7 | 4.5 | 5.1 | 5.7 | 6.2 | 6.7 | 7.1 |
| 15 | 1 | 2 | 2.9 | 3.9 | 4.7 | 5.6 | 6.3 | 7.1 | 7.7 | 8.3 |
| 20 | 1 | 2 | 3 | 3.9 | 4.9 | 5.7 | 6.6 | 7.4 | 8.2 | 8.9 |
| 25 | 1 | 2 | 3 | 3.9 | 4.9 | 5.8 | 6.7 | 7.6 | 8.5 | 9.3 |
| 30 | 1 | 2 | 3 | 4 | 4.9 | 5.9 | 6.8 | 7.7 | 8.6 | 9.5 |
| 35 | 1 | 2 | 3 | 4 | 4.9 | 5.9 | 6.9 | 7.8 | 8.7 | 9.6 |
| 40 | 1 | 2 | 3 | 4 | 5 | 5.9 | 6.9 | 7.8 | 8.8 | 9.7 |
| 45 | 1 | 2 | 3 | 4 | 5 | 5.9 | 6.9 | 7.9 | 8.8 | 9.8 |

Example of Pages 23-28 -- These are charts for use with a Tech Topic I shall write soon

DISTRIBUTED LOUDSPEAKER SYSTEMS - UNIT & ROW SPACING

CENTER TO CENTER COVERAGE - ORTHOGONAL ALIGNMENT

| COVERAGE ANGLE -> | 60 DEGREES: | | 75 DEGREES: | | 90 DEGREES: | |
|---|---|---|---|---|---|---|
| SPACING -> | UNIT: | ROW: | UNIT: | ROW: | UNIT: | ROW: |
| H - L: | | | | | | |
| 4 | 2.3 | 2.3 | 3 | 3 | 4 | 4 |
| 5 | 2.8 | 2.8 | 3.8 | 3.8 | 5 | 5 |
| 6 | | | | | 6 | 6 |

Another example from Pages 23-28

DISTRIBUTED LOUDSPEAKER SYSTEMS - UNIT & ROW SPACING

CENTER TO CENTER COVERAGE - DIAGONAL ALIGNMENT

| COVERAGE ANGLE -> | 60 DEGREES: | | 75 DEGREES: | | 90 DEGREES: | |
|---|---|---|---|---|---|---|
| SPACING -> | UNIT: | ROW: | UNIT: | ROW: | UNIT: | ROW: |
| H - L: | | | | | | |
| 4 | 2.3 | 1.6 | 3 | 2.1 | 4 | 2.8 |
| 5 | 2.8 | 2 | 3.8 | 2.7 | 5 | 3.5 |
| 6 | 3.4 | 2.4 | 4.6 | 3.2 | 6 | 4.2 |
| 7 | 4 | 2.8 | 5.3 | 3.7 | 7 | 4.9 |

Example from Pages 29-30

+ - + - + GEOMETRIC Q + - + - +

| DEG: | 5 DEG: | 10 DEG: | 15 DEG: | 20 DEG: | 25 DEG: | 30 DEG: | 35 DEG: | 40 DEG: | 45 DEG: | 50 DEG: | 55 DEG: | 60 DEG: |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 1651.2 | 826.4 | 551.8 | 414.8 | 332.8 | 278.3 | 239.5 | 210.6 | 188.2 | 170.4 | 156 | 144 |
| 10 | 826.4 | 413.6 | 276.2 | 207.6 | 166.5 | 139.3 | 119.9 | 105.4 | 94.2 | 85.3 | 78 | 72.1 |
| 15 | 551.8 | 276.2 | 184.4 | 138.6 | 111.2 | 93 | 80 | 70.3 | 62.9 | 56.9 | 52.1 | 48.1 |
| 20 | 414.8 | 207.6 | 138.6 | 104.2 | 83.6 | 69.9 | 60.1 | 52.9 | 47.2 | 42.8 | 39.1 | 36.1 |
| 25 | 332.8 | 166.5 | 111.2 | 83.6 | 67 | 56.1 | 48.2 | 42.4 | 37.9 | 34.3 | 31.4 | 29 |
| | | | | | | | | | | | | 24.2 |
| | | | | | | | | | | | | 20.8 |
| | | | | | | | | | | | | 18.3 |
| | | | | | | | | | | | | 16.3 |
| | | | | | | | | | | | | 14.8 |
| | | | | | | | | | | | | 13.5 |
| | | | | | | | | | | | | 12.4 |
| | | | | | | | | | | | | 11.6 |
| | | | | | | | | | | | | 10.8 |
| | | | | | | | | | | | | 10.2 |
| | | | | | | | | | | | | 9.6 |

Example from Pages 31-33 -- Speech power produced by a talker

SPEECH POWER PRODUCED BY A TALKER

| | < - - - Q = 2 - - - > | | < - - - Q = 2.5 - - - > | |
|---|---|---|---|---|
| SPL (2 FT): | MICROWATTS: | PWL (DB): | MICROWATTS: | PWL (DB): |
| 30 | 2.239E-03 | 33.5 | 1.778E-03 | 32.5 |
| 31 | 2.818E-03 | 34.5 | 2.239E-03 | 33.5 |
| 32 | 3.548E-03 | 35.5 | 2.818E-03 | 34.5 |
| 33 | 4.467E-03 | 36.5 | 3.548E-03 | 35.5 |
| 34 | 5.623E-03 | 37.5 | 4.467E-03 | 36.5 |
| 35 | 7.079E-03 | 38.5 | 5.623E-03 | 37.5 |
| 36 | 8.913E-03 | 39.5 | 7.079E-03 | 38.5 |
| 37 | 01122 | 40.5 | 8.91E-03 | 39.5 |
| 38 | 01413 | 41.5 | 01122 | 40.5 |
| 39 | 01778 | 42.5 | 01413 | 41.5 |
| 40 | 02239 | 43.5 | 01778 | 42.5 |

Example from Pages 34-42

ARTICULATION LOSS AS A FUNCTION OF SPLR / SPLD

( SPLR IS RELATIVE TO SPLD )

| RT60 -> | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 1.9 | 2 |
|---|---|---|---|---|---|---|---|---|---|---|
| SPLR | | | | | | | | | | |
| -10 | .1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | .1 |
| -9 | .1 | 1 | 1 | 1 | .1 | .1 | 1 | 1 | .2 | .2 |
| -8 | .1 | 1 | 1 | 1 | .2 | .2 | .2 | .2 | .2 | .2 |

Example from Pages 43-51 -- Signal-to-Noise correction factors as taken from the Peutz graph on page 71 of SSE(Figure 4-22) Multiply %AL by the appropriate factor

SIGNAL-TO-NOISE CORRECTION FOR ARTICULATION LOSSES

| RT60 -> | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 1.9 | 2 |
|---|---|---|---|---|---|---|---|---|---|---|
| S/N (DB) | | | | | | | | | | |
| 25 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 24 | 1.07 | 1.07 | 1.06 | 1.06 | 1.06 | 1.06 | 1.06 | 1.05 | 1.05 | 1.05 |
| 23 | 1.14 | 1.14 | 1.13 | 1.13 | 1.12 | 1.12 | 1.11 | 1.11 | 1.11 | 1.1 |
| 22 | 1.22 | 1.21 | 1.2 | 1.19 | 1.19 | 1.18 | 1.17 | 1.17 | 1.16 | 1.16 |
| 21 | 1.3 | 1.29 | 1.28 | 1.27 | 1.26 | 1.25 | 1.24 | 1.23 | 1.22 | 1.22 |
| 20 | 1.39 | 1.37 | 1.36 | 1.34 | 1.33 | 1.32 | 1.31 | 1.3 | 1.29 | 1.28 |

# DANA POINT CLASS-JANUARY 1980

# DANA POINT CLASS-FEBRUARY 1980

# SHURE BROTHERS SUPPLIES EQUIPMENT FOR MOSCOW WORLD TRADE CENTER

We recently received word that another Syn-Aud-Con Sponsor, "Shure," has supplied audio equipment to the Moscow World Trade Center (being built as part of the Summer 1980 Olympic Games).

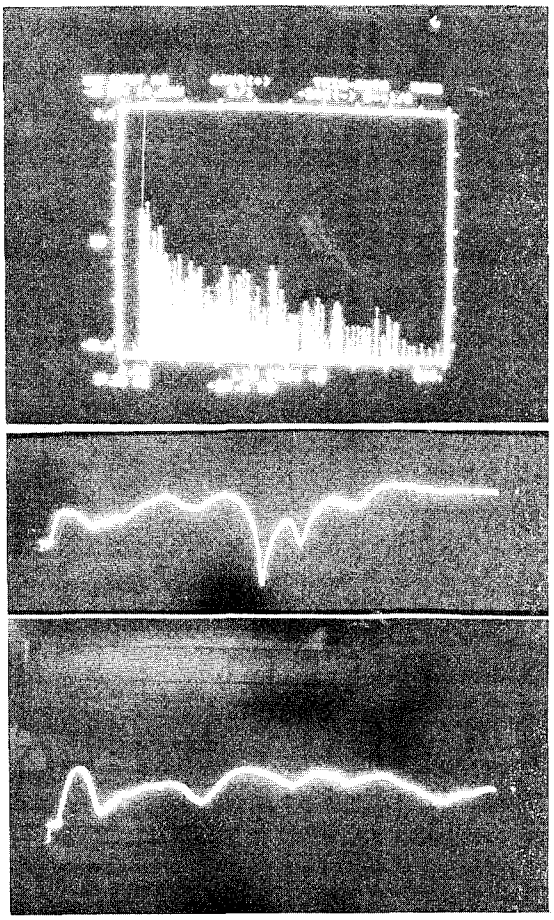
The Soviets have discovered what Syn-Aud-Con has been preaching for eight years now, namely, that our Sponsor's products allow *superior systems* to be designed from diverse suppliers.

Eight of Shure's SE30-2E gated compressor/mixers were purchased in addition to (60) SM53, (29) SM51, (12) SM61, and (120) 545D microphones.

It's reassuring to know that American technology can and does produce products so superior in performance, so rugged and reliable, that even one of the most controlled economies in the world must recognize the claims if they wish to operate up-to-date audio systems.

Our congratulations to Shure for having helped the balance of payment situation. We, however, will be on the lookout in the future for a SM80 (stands for Soviet-Minsk model 1980) microphone developed during the 1980 Olympics.

# AN INTERESTING LOUDSPEAKER TEST



We recently tested a new loudspeaker design that shall remain nameless, with the following interesting results.

We should first preface this account by mentioning that claims had been put forward that it raised the ratio of direct-to-reflected sound substantially.

The first photograph is the ETC display of this unit. The direct sound shows clearly that a series of unaligned drivers are in operation and each reflection faithfully mirrors the time smear of the direct sound.

The second photograph is an EFC (Energy Frequency Curve) display made with the TDS analyzer. Note that this loudspeaker does eliminate a portion of the output but it is its own direct sound output.

Photograph #3 shows what happens when you block off the rear radiator.

It is of interest to us that there are listeners whose subjective preference tends towards loudspeakers possessing considerable "time smear". (Typists Note: I tend to think that the listener has conditioned the ear to accept "time smear" and once the time smear is demonstrated to him, or her, "catastrophe" a la Heyser strikes. Then time smear becomes a totally unacceptable sound.)

It should be further noted that this preference is only dominant on music and they often do not like the sound of speech on the same system. This raises the interesting question of building an electronic 'time smearing device rather than making it an integral part of an expensive loudspeaker system. It also identifies a fascinating psychological research area for some enterprising degree candidate.

There is, of course, always the possibility that these same listeners simply represent the same genre that think harmonic distortion sounds good because it increases signal level.

# NEEDED: SHURE 520 "GREEN BULLET" MICROPHONE

We recently received an interesting telephone call from a professional harmonica player asking us to help him locate up to 20 of the obsolete Shure model 520 microphones, known as the "Green Bullet" or "biscuit" microphone.

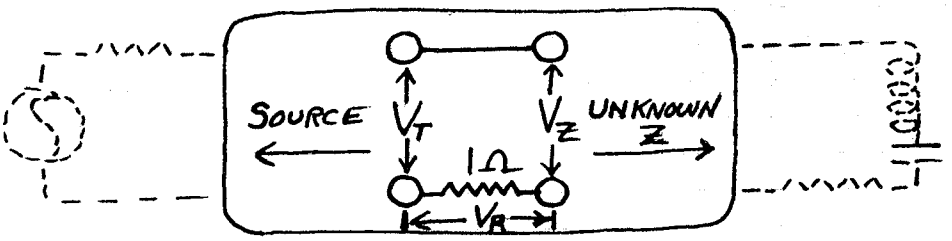
According to Buck Holiday, 5N957 Route 31, St. Charles, IL 60174, Ph 312-377-0189, these microphones provide an exceptionally pleasing "tonal coloration" to the basic sound of a harmonica. Apparently the harmonics are resonated in a desirable fashion. Mr. Holiday states he will purchase up to twenty of these units should any of you have them on hand.

It might be an interesting side project to see what these microphones do that newer ones don't and then find out if a "black box" circuit could duplicate the effect with current models.

# USING A VOLTMETER TO MEASURE IMPEDANCE, REACTANCE, PHASE ANGLE, AND RESISTANCE

Any high quality voltmeter such as the H.P. 3466A can perform impedance measurements with the assistance of a precision non-reactive 1 Ω resistor. I'd suggest a small box with four terminals such as shown in Figure No. 1. Pick any suitable audio level and proceed as indicated. See Figure No. 2.

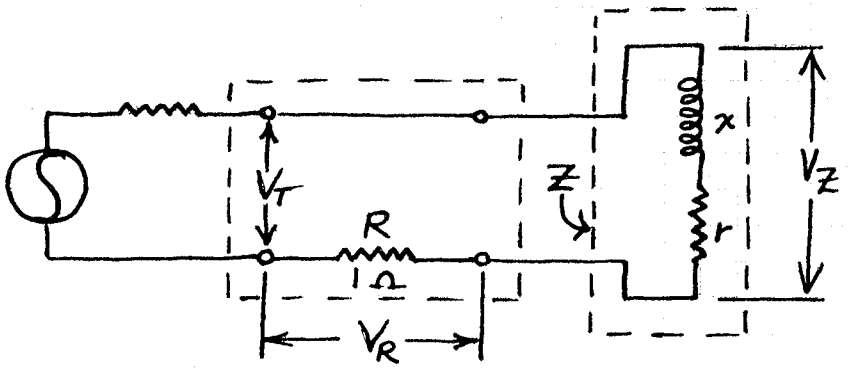
Figure No. 1: TEST BOX FOR VOLTMETER MEASUREMENTS



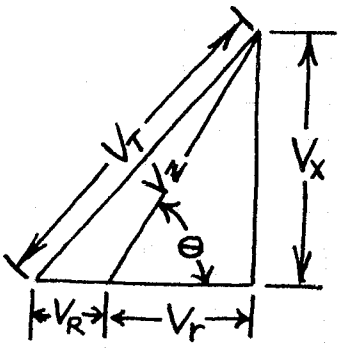

1. Connect source and unknown Z to indicated terminals
2. Measure $V_T$, $V_R$, and $V_Z$
3. Calculate parameters: (A) Phase Angle θ
   (B) Reactance X
   (C) Resistance r
   (D) Impedance Z

As shown in Figure # 2.

Figure No. 2: VOLTMETER MEASUREMENT OF IMPEDANCE PARAMETERS




1. Measure $V_T$, $V_R$, and $V_Z$ (R= 1Ω)
2. Calculate $V_r$: $V_r = \dfrac{(V_T)^2 - (V_Z)^2 - (V_R)^2}{2V_R}$
3. Calculate $V_X$: $V_X = \sqrt{(V_Z)^2 - (V_r)^2}$
4. Calculate Phase Angle θ: $\theta = \text{ARCTAN} \dfrac{V_X}{V_r}$
5. Calculate I: $I = \dfrac{V_R}{R}$
6. Calculate X: $X = \dfrac{V_X}{I}$
7. Calculate r: $r = \dfrac{V_r}{I}$
8. Calculate Z: $Z = \dfrac{V}{I}$




VECTOR DIAGRAM

This calculation is a worthy candidate for a simple efficient HP 41C program.

This simple, but extremely effective technique was discussed in great detail in Syn-Aud-Con Tech Topic Volume 2, No. 4, in 1975 written by William J. Kessler P.E.

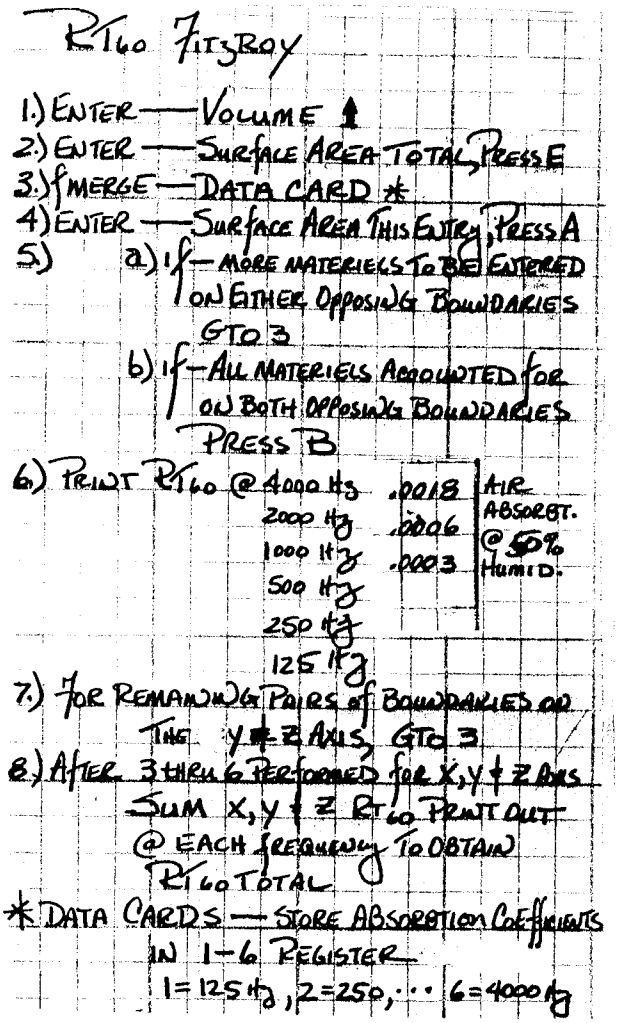
Our version of the concept includes equations from both MEL SPRINKLE and ED LETHERT based upon the graphic technique originally purposed by Mr. Kessler.

# COMPUTER PROGRAM FROM RUSSELL BERGER

RUSSELL BERGER of Highgrove House, Inc. (A recording establishment). Russell is also head of the Pro-Audio Dept at Arnold &Morgan Music in the Dallas area, as well as a new TEF™ licensee. He sent us a number of HP 97-67 programs. We are reproducing one here now and will reproduce more next Newsletter.

Programming remains an unsurpassed way to learn mathematics without boredom. Notice I didn't say, without effort, however.

Russell comments: The "$RT_{60}$ Fitzroy" program is a program from a prior Newsletter article by JIM HAWKINS for $RT_{60}$ Sabine adapted for Fitzroy using the methods of ED LETHERT in a Tech Topic. The factors used for air absorption I believe are correct. To change the air coefficient @ 4000 Hz, take (new value) x (4) and replace in steps 54 through 57; @ 2000 Hz, take (new value) x (4) and replace in steps 61 through 65; for 1000 Hz, take (new value) x (4) and replace in steps 69 through 72. A subroutine could be written to give the option of automatically storing these values or entering new ones. With the new HP 41C it would be easy to have the three sets of six Fitzroy results summed and printed. So far, I haven't figured out a way of doing this given the limited storage available in the HP 97. (Editor's Note: We'd like to hear from HP41C owners as these programs are adapted to the HP41C.)




```
001  *LBLE      21 15
002   CLRG      16-53
003   P≠S       16-51
004   CLPS      16-53
005   STOE      35 15
006    R↓         -31
007   STOD      35 14
008   CLX         -51
009  *LBLA      21 11
010   ST+9   35-55 09
011   STOA      35 11
012     6          06
013   STO7      35 07
014     1          01
015   ST+8   35-55 08
016  *LBL1      21 01
017   RCL7      36 07
018   STOI      35 46
019   RCL7      36 45
020   RCLA      36 11
021     ×         -35
022     1          01
023     0          00
024   RCLI      36 46
025     ÷         -55
026   STOI      35 46
027    CHY        -41
028   ST÷I   35-55 45
029     7          07
030   STOI      35 46
031   DSZI   16 25 45
032   GTO1      22 01
033     6          06
034   STOI      35 46
035   RCL9      36 09
036    PTN        24
037  *LBLB      21 12
038    SPC      16-11
039     6          06
040   STOI      35 46
041   P≠S       16-51
042  *LBL3      21 03
043   RCLI      36 45
044   P≠S       16-51
045   RCL9      36 09
046   P≠S       16-51
047     ÷         -24
048   RCLE      36 15
049     ×         -35
050   STOI      35 45
051   DSZI   16 25 46
052   GTO3      22 03
053   RCLD      36 14
054     .         -62
055     0          00
056     0          00
057     7          07
058     ×         -35
059   ST+6   35-55 06
060   RCLD      36 14
061     .         -62
062     0          00
063     0          00
064     2          02
065     4          04
066     ×         -35
067   ST+5   35-55 05
068   RCLD      36 14
069     .         -62
070     0          00
071     0          00
072     1          01
073     ×         -35
074   ST+4   35-55 04
075     6          06
076   STOI      35 46
077  *LBL2      21 02
078     .         -62
079     0          00
080     4          04
081     9          09
082   RCLD      36 14
083     ×         -35
084   RCLI      36 45
085     ÷         -24
086   P≠S       16-51
087   RCL9      36 09
088   P≠S       16-51
089     ×         -35
090   RCLE      36 15
091     ÷         -24
092   PRTX        -14
093   DSZI   16 25 46
094   GTO2      22 02
095     5          05
096   STOI      35 46
097  *LBL4      21 04
098     0          00
099   STOI      35 45
100   P≠S       16-51
101     0          00
102   STOI      35 45
103   DSZI   16 25 46
104   GTO4      22 04
105   P≠S       16-51
106   CLX         -51
107     0          00
108   STO8      35 08
109   SPC       16-11
110   P≠S       16-51
111   GTOA      22 11
112   P≠S         51
```

# DANA POINT CLASS-MARCH 1980

# AUDIO CONNECTOR

We're asking you. Does this connector have a future in audio?? If you think so, write the manufacturer and tell him about it. Otherwise, another possibly good idea will be abandoned.

# TEF LICENSEE LIST

We are very pleased to report a steady growth of TEF™ licensees including a number of manufacturers. We are beginning to hear from the field exciting reports of licensees getting rental equipment working and solving real room problems

GLENN MEEKS of Indianapolis has begun to demonstrate mastery of the process in both *large* and small rooms. ED BANNON is a fully equipped TEF™ practitioner. FARREL BECKER and DAVE ANDREWS are prepared to assist East Coast studio designers, builders or owners make TEF™ measurements.

These licensees are true pioneers who are rapidly pushing back the acoustic measurement frontier and, like all pioneers, learning that only those who have been there really know what it's all about. As is always the case with major new concepts, it's hard to realize that this is but the baby steps and that this is a unique opportunity to be in at the beginning and grow step-by-step rather than later trying to play "catch up" when it's even more involved.

To us one of the most appealing features of TEF™ is that it is the brain child of a single gifted mind and the inventor is personally accessible through Syn-Aud-Con's special TEF™ classes. A special TEF™ class with DICK HEYSER has to be one of the most important audio events available today and fortunate indeed are those qualified to participate.

Mr. Robert Todrank
Valley Audio
P. O. Box 40743
Nashville, TN 37214

Mr. Ed Bannon
23715 Haynes Street
Canoga Park, CA 91307

Dr. Eugene Patronis
1774 Northridge Road
Dunwoody, GA 30338

Mr. Kenneth Wahrenbrock
Wahrenbrock Sound
9609 Cheddar Street
Downey, CA 90242

Mr. J. G. Mitchell
1120 Stonehedge Drive
Schaumburg, IL 60194

Mr. Dan J. Zellman
Howard M. Schwartz Recording
420 Lexington Avenue, Ste. 1934
New York, New York 10017

Mr. Richard Lee
Compass Point Studios Ltd.
P. O. Box N 4599
Nassau, Bahamas

Mr. Bernie Cahill
Rauland Borg Corporation
3535 West Addison Street
Chicago, IL 60608

Mr. Gerald Stanley
Crown International
1718 West Mishawaka Street
Elkhart, IN 46514

Mr. Farrel Becker
10120 Ashwood Drive
Kensington, MD 20795

Mr. Steve Langstaff
The Audio Workshop
84 Long Avenue
Belmont, MA 02178

Mr. Michael A. Chafee
Michael Chafee Enterprises
1527 Main Street
Sarasota, FL 33580

Mr. Richard N. Jamieson
Jamieson & Associates
P. O. Box 2126
Minneapolis, MN 55402

Mr. John Storyk
Sugarloaf View
31 Union Square West
New York, New York 10003

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I T S
30-18 35th Avenue
Long Island City, NY 11106

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Mr. Don Zenz
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Box 499 Sells Star Route
Tucson, AZ 85716

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1755 N. E. 149th Street
Miami, FL 33181

Mr. Robert Grunberg
Audio Supply
P. O. Box 296
Double Bay, N.S.W. 2028
AUSTRALIA

Mr. Ed Long
E. M. Long Associates
4107 Oakmore Road
Oakland, CA 94602

Mr. Ted Kowdrysh
336 East Fifth Street, 5-RE
New York, New York 10003

Mr. Carlos Piriz
Larrea 1440 7-A
1117 Buenos Aires
ARGENTINA

Mr. David Brand
Filmways Heider Recording
1604 Cahuenga Boulevard
Los Angeles, CA 90028

Mr. Horace Wee
Managing Director
Audiotek, c/o 8 Jalan Antoi
Seletar Hills Estate
Singapore 2880, Rep. of Singapore

Mr. Nelson Meacham
WED Enterprises
1401 Flower Street
Glendale, CA 91201

Mr. Seth Snyder
Recording Studio Equipment Co.
18917 N.E. Fifth Avenue
North Miami Beach, FL 33179

Mr. David Andrews
Andrews Audio Consultants
62 East Fourth Street
New York, New York 10003

Mr. John Laberdie
Andrews Audio Consultants
62 East Fourth Street
New York, New York 10003

RCA SPA
Casella Postale 7158
Roma Nomentano 00100
ITALY

Mr. Glenn Meeks
Sound Investments
2051 East 46th Street
Indianapolis, IN 46205

Mr. Robert Herrick
Production Consultants
8327 Laurelhurst Drive
San Antonio, TX 78209

Mr. Joe Martinson
Martinsound
1151 West Valley Boulevard
Alhambra, CA 91830

Mr. Dow Bowden, Jr.
Sound Contractors Unlimited
41 Hollyoke Lane
Memphis, TN 38117

Mr. Robert Davis
Altec Lansing
1515 S. Manchester Avenue
Anaheim, CA 92803

Mr. W. John Bau
Spica Speaker Company
1570 Pacheco Street
Suite E-16
Santa Fe, NM 87501

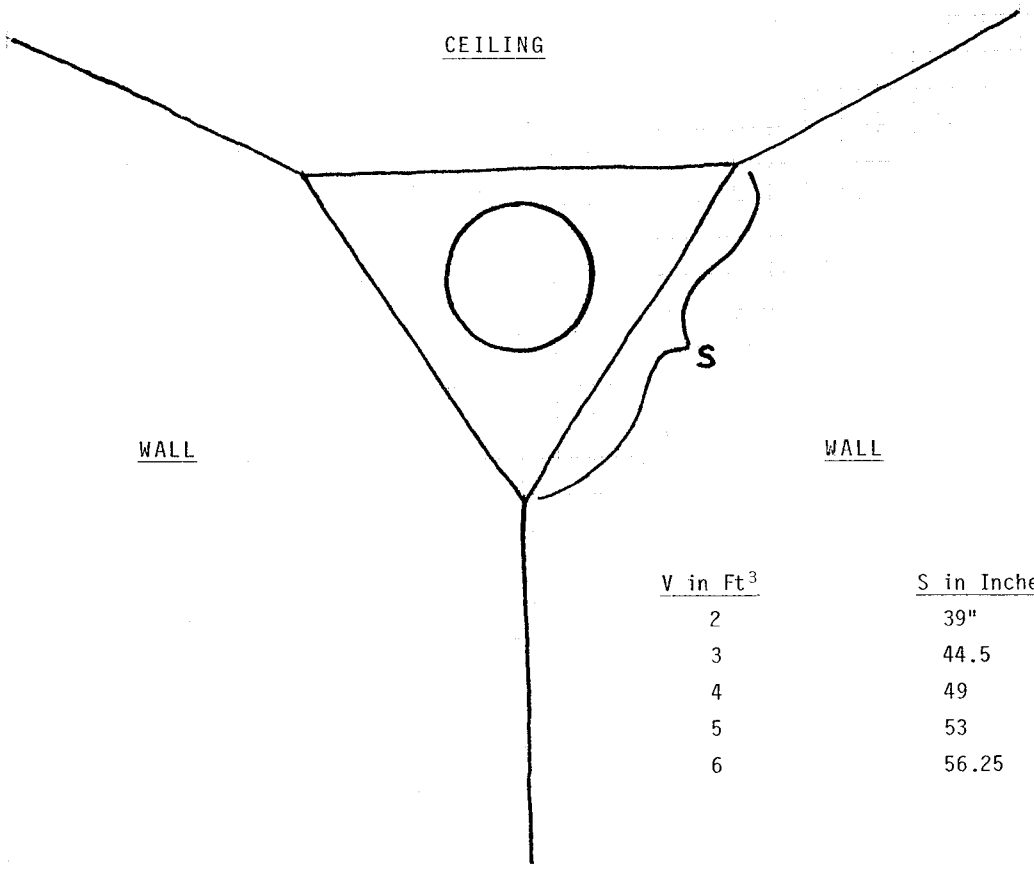
Mr. William Pohts
Pohts Engineering
301 S. Allen, Suite 301
State College, PA 16801

Mr. Russell Berger
Highgrove House, Inc.
3905 Highgrove
Dallas, TX 75220

Mr. Charles Bilello
258 Fairlawn Avenue
West Hempstead, NY 11552

# TRIHEDRAL LOUDSPEAKER ENCLOSURE

Back about two decades ago a Mr. Vern Yeich wrote an article on mounting a small high quality 8" wide range loudspeaker in a trihedral corner.




| V in $Ft^3$ | S in Inches |
|---|---|
| 2 | 39" |
| 3 | 44.5 |
| 4 | 49 |
| 5 | 53 |
| 6 | 56.25 |

Such an enclosure possesses a number of genuine virtues.

1. Simplicity
2. Extremely rigid
3. Resonance free with no parallel walls
4. By flush mounting the loudspeaker, it eliminates diffraction edges
5. The lowest 'Q', directivity factor, is 8.
6. $C_L$ is $90^o$ for the entire room
7. It utilizes an area in the room normally not otherwise used that typically allows the maximum possible $D_I$

CONSTRUCTION

The construction of this type of enclosure, as stated, is simplicity itself. It is only necessary to cut a triangular piece of plywood, saw out a hole in the center, and mount the loudspeaker. When a really high quality single cone loudspeaker is used, time alignment is an automatic plus.

It is probably wise to fabricate strips on the walls and ceiling to mount the plywood panel. 3/4" plywood should be adequate for this shape. Since the resultant interior shape is a pyramid, you may have mystical benefits as well.

It is our opinion that this type of arrangement is superior to, for example, sound columns hung out in space.

We'd be interested in publishing in future Newsletters, with appropriate credits, any installations using this concept. For the mathematically minded, we'd like to challenge you to the development of the simplest form of an equation for finding the volume shown from only the equal sides of the triangular baffle (see Figure #1). We'll print the solutions in the appropriate Newsletter.

# BOOKS OF INTEREST

TED UZZLE recently did the unthinkable and traveled westward over the edge of the horizon (located somewhere near Wellesley, MA) and arrived in the Wild West of the Davis'. Upon his return to known civilization he sent, in gratitude for his deliverance without measurable harm from the seismic West, a book entitled, *CONNECTIONS*, by James Burke. (We are told that it appeared on television first.)

In *CONNECTIONS* we again meet our friend Casper Schott, Professor of Mathematics at Wurzburg University. Schott published two books mentioning the famous vacuum experiment of Guericke, the first of which was printed in 1657. We are the proud possessor of a first edition of this historic book, *MAGIAE UNIVERSALIS*.

*CONNECTIONS* is a fascinating book but I feel its author couldn't more totally have missed the point his own book makes. Burke states on the jacket cover, *The driving force (behind inventive progress) is not individual genuis but social inventiveness.* Pardon me, but fooey! The book goes on to prove, at least to me, that good ideas can lie fallow for centuries until genius grabs it as his own. Mr. Burke may be an Ellsworth M. Toohey--more the pity because the facts he has put down deny "social inventiveness" in every fiber.

The book covers the precursors of the computer age with surprising skill. One factor the book does not touch on is the transfer of the center of astronomical instrument making from the Arabs to the West as a result of the Crusades. The Teutonic knights brought back to Nuremberg, beginning about 1200 marvelous new ideas about instruments and calculations. By the middle of the 16th Century precise engraving on brass (due in large part to the interest in printing) was well advanced. Brass gears opened the door to wonderful automata: Gadgets such as the Strasbourg clock of 1354. This device included a mechanical rooster which flapped its wings, stretched its metal feathers, opened its beak and crowed every day at noon.

Automated looms took their ideas from the automated water-powered organs, and Falcon, Bouchon and Jacquard's loom (1728) continued to develop "programming".

From Pascal's calculator in 1642 through Babbage to Von Neumann to Tom Osborne and the HP41C, individualism is the dominant common factor, not social inventiveness.

We never fail to be impressed with the "trigger" material TED UZZLE manages to tempt us with. There is some possibility that Uzzle may descend into "Lotus Land" in the not too distant future in spite of the threat of "brain fade", caused by our famous Los Angeles mental smog.

# CLASSIFIED

FOR SALE:
IVIE IE 30 Demonstrator, factory warranty. Used 6 months, like new. $2,300.
Coastal Electronics Co., 3635 Calden Ave., Beaumont, TX 713-558-2401

WANTED:
Shure Model 520 microphone, known as the "Green Bullet" or "biscuit" microphone. Need 20.
Buck Holiday, 5N957, Route 31, St. Charles, IL 60174. Ph 312-377-0189

WANTED:
HP-45 calculator package
Chris Hood, 5 Harrison Street, Crafton (Pittsburgh), PA 15205. Ph 412-921-2911

EMPLOYMENT OPPORTUNITIES:
If you wish to join an exciting, innovative and creative engineering team, complete with excellent benefits and compensation package, generous relocation allowance and a challenging work atmosphere, contact J. Puckett, Professional Staffing Manager, Ampex Corp., 401 Broadway, Redwood City, CA 94062. Ph 415-367-2846

SOUND SYSTEM ENGINEERS:
We have immediate openings for experienced Systems Engineers to develop and design complex audio reproduction systems.

Successful candidates must be practiced in systems design and documentation with a working knowledge of electroacoustic devices. At least three (3) years experience in systems design is required.

Knowledge of architectural acoustical parameters and digital techniques is desirable. Individuals interested in this opportunity should submit resume and salary requirements to: Professional Staffing, WED Enterprises, 800 Sonora Avenue, Glendale, CA 91201.



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SYNERGETIC AUDIO CONCEPTS

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UEI QUALITY OF COURSE

SHURE

# SYN-AUD-CON SPONSORS

Syn-Aud-Con receives tangible support from the audio industry, and ten manufacturing firms presently help underwrite the expense of providing sound engineering seminars. Such support makes it possible to provide the very latest in audio technology while maintaining reasonable prices relative to today's economy, and to provide all the materials and continuing support to all graduates of Syn-Aud-Con.

Personnel from these manufacturers receive Syn-Aud-Con training which provides still another link in the communications circuit between the ultimate user and the designer-manufacturer of audio equipment. They are "in-tune" with what a Syn-Aud-Con graduate needs.

Rauland

Their presence on this list as a Syn-Aud-Con sponsor indicates their desire to work cooperatively with you in professional sound.

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crown

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sunn

David Clark COMPANY INCORPORATED

GenRad

SHURE BROTHERS INCORPORATED

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SYNERGETIC
SYN AUD CON
AUDIO CONCEPTS
BOX 1115, SAN JUAN CAPISTRANO, CA 92693

# TECH TOPICS

VOLUME 7, NUMBER 9
SPRING, 1980


EDITOR'S NOTE

Syn-Aud-Con Tech Topics will begin, with this issue, to include material being generated by Don and Carolyn for the new edition of the *AUDIO CYCLOPEDIA* under the editorship of Syn-Aud-Con graduate, GLEN BALLOU.

The first of these special *Cyclopedia* previews is on the subject of Q, directivity factor, and includes, we believe, important distinctions necessary to a correct concept of Q.

We particularly solicit suggestions for additions, deletions, or corrections to this material prior to its publication in the *AUDIO CYCLOPEDIA*. Any suggestion you have that would make the material more easily understood would be appreciated. We will provide a portion of each subsequent Newsletter for your responses.

So, to start off, here's the question and answer format so familiar to readers of the *AUDIO CYCLOPEDIA*.

## CYCLOPEDIA PREVIEW

1. What is Q (Directivity Factor)?

"The directivity factor, Q, of a transducer used for sound emission is the ratio of sound pressure squared, at some fixed distance and specified direction, to the mean squared sound pressure at the same distance averaged over all directions from the transducer. The distance must be great enough so that the sound appears to diverge spherically from the effective acoustic center of the source. Unless otherwise specified, the reference direction is understood to be that of maximum response."

2. What other symbols are used in place of Q?

$R_Q$ (for directivity ratio), $\lambda$, $D_F$ (for directivity factor). $\lambda$ is on occasion used in England.

3. Why so many symbols?

Because the letter 'Q' has so many other uses in mathematics and physics and even other uses in connection with loudspeakers, other symbols have been sought. $R_\theta$ has the least other meanings but has received such minute usage in the literature as to be nearly nonexistent.

4. Can Arrays of loudspeakers have a Q?

NO! They can have a modifying influence on the loudspeaker's coverage angle but each loudspeaker has its own unique Q.

5. What is "N"?

N is the number describing the ratio of acoustic power going to the reverberant sound field without supplying direct sound versus the acoustic power going to the loudspeakers providing direct sound to a given listener position.

For example, in an overhead distributed loudspeaker system with four loudspeakers all receiving equal power, the "N" factor for a listener receiving direct sound from only two of them is

$$\frac{\text{Total No. of Loudspeakers}}{\text{No. Providing Direct Sound}} = \frac{4}{2} = 2$$

6. What is $Q_\theta$?

A Q value with a sub symbol is used to indicate a direction other than the one of maximum response. For instance: $Q_{C_L}$ would be the apparent Q at the coverage angle: i.e., a loudspeaker with a Q = 16 would have a $Q_{C_L}$ of 4 (the $C_L$ is by definition 6 dB below the direction of maximum response).

7. Does Q cover an area?

NO! It describes a point.

8. Can the concept of Q be applied to distributed systems?

NO! Each loudspeaker in a distributed system has its own unique Q. The array as a whole can modify the ratio of direct to reverberant sound by virtue of its "N" factor.

9. How can I modify the apparent Q value?

If what is meant by the term "apparent Q value" is the listener's perception of the ratio of direct-to-reverberant sound levels, then moving the loudspeaker closer to the listener raises the level of direct to reverberant sound in accordance with inverse square law changes in level; i.e., a Q = 16 is needed to reach 100 feet in a reverberant auditorium but the only loudspeaker available has a Q = 4. By moving the loudspeaker with a Q = 4 to a distance of 50 feet from the listener and using digital time delay to move the apparent acoustic origin back to the 100 feet position, the listener hears an increase in direct to reverberant sound identical to that he would have experienced had the loudspeaker remained 100 feet distant and had its Q raised to 16.

10. Does Q describe coverage angles?

NO! It essentially describes the ratio of power per unit area going to a selected point compared to the same point had the loudspeaker been omnidirectional. A loudspeaker with a Q = 50 provides 10 LOG Q = 10 LOG 50 = 17 dB higher level at that selected point than would have been the case if the loudspeaker's Q had been 1.

11. What does the coverage angle describe?

The coverage angle $C_L$ is the included angle between the points in the vertical and horizontal planes where the output level is 6 dB below the point of maximum response.

12. What is theoretical Q?

Theoretical Q is applied when the $C_L$s also define the Q; i.e., a perfect loudspeaker. When all the acoustic power passes only through the $C_L$s and none of the power is radiated anywhere else, then:

$$Q = \frac{180}{\text{arc sin}\left[\sin\left(\frac{\text{Horiz. } C_L}{2}\right)\right]\left[\sin\left(\frac{\text{Vert. } C_L}{2}\right)\right]}$$

Theoretical Q also results in the unique situation wherein every point along a spherical area has the same Q.

13. What is the "Q" value used for?

In sound reinforcement work, Q is used to determine efficiency from a sensitivity rating, relative level changes with changes in distance in enclosed reverberant spaces Adx, the percentage of articulation loss for consonants in speech ($\%AL_{cons}$), the ratio of direct to reverberant sound levels, and many other critical parameters.

In sound reproduction work it is used to match low frequency units with high frequency units on an efficiency basis rather than a sensitivity basis and as a judgement of the directional control of the radiated power.

14. How is Q measured by manufacturers?

Manufacturers usually use loudspeaker polar plots and integrate the SPL every 10° in both the horizontal and vertical planes. Since 10° increments do not cover equal areas, a table of "weighting" factors are used.

15. How can Q be measured in the field?

By the critical distance technique or by means of ETC measurements (see section on TEF™ measurements). The critical distance technique is dependent upon the quality of the reverberant sound field whereas the ETC technique is independent of outside influences, either reflections or noise.

16. What is the directivity index?

This is still another way to express the effect of a loudspeaker's directional control and is the Q expressed as the dB of gain over an omnidirectional source radiating equal acoustic power.

$$10 \text{ LOG } Q = D_I \qquad \text{obviously then} \qquad Q = 10^{\left(\frac{D_I}{10}\right)}$$

17. Why is the $C_L$ specified at the 6dB down points?

In the art of obtaining even coverage or, put another way, in the attempt to counteract inverse square law effects, it is desirable to intersect the listener position at $\frac{D_2}{2}$ with one half the direct sound level at $D_2$ on axis. One half the sound level is 6 dB down. Therefore, whatever $C_L$s are quoted are of maximum use when related to 6 dB increments.

18. Can I double Q by stacking loudspeakers?

The strictly correct answer is probably no. The equivocation is due to the fact that you do narrow the vertical $C_L$ by stacking the units, but this does not necessarily increase the power per unit area within the $C_L$ though it does remove (via phase cancellation) some of the energy that would have gone to a wider area. This is an area in acoustics still being actively explored.

19. What is "auto Q"?

This is a technique developed by Altec that utilizes the fact that the sound power level can be accurately measured in the throat of a horn and then compared to the sound pressure level at the mouth of the horn. Since in an omnidirectional loudspeaker the sound power level $L_W$ is essentially equal to the sound pressure level $L_P$ at a radius of 0.283 meter, then the Q has to be:

$$Q = 10^{\left(\frac{L_P - L_W}{10}\right)} \text{ at .283 meters}$$

20. What is an ideal $C_L$?

An ideal $C_L$ would provide every listener with the same direct sound level and vary the $D_I$ in direct proportion as distances from the sound source varied. For example, in many applications, the Q on axis should be lower than the Q off axis points because the $D_2$ on axis is less than the $D_2$ at the off axis points.

21. What is the easiest way to raise Q at low frequencies?

Place the loudspeaker in either a dihedral or trihedral corner. Placing a loudspeaker in a large wall insures a minimum Q of 2 at low frequencies. In the corner formed by the floor and wall or the ceiling and wall, a minimum Q of 4 is assured. In a corner formed by two walls and a floor or ceiling, a minimum Q = 8 is obtained at low frequencies. Bear in mind that as the frequency rises, the Q can easily become greater than these minimum values as the loudspeaker itself becomes the determining factor.

22. Is Q frequency dependent?

Indeed it is. Much of the promise inherent in acoustic research today is the hope that we will gain increasing control over the directional properties of modern loudspeakers.

23. If Q is frequency dependent, at what frequency or frequencies do I need it?

For speech systems, a Q value for the 2000 Hz 1/3 octave band would suffice as over 11% of intelligibility is centered there. For music systems a knowledge of all 1/3 octave bands from 30 Hz to 15,000 Hz would be valuable, especially as a direct comparison to the musical instrument being reproduced.

24. Does Q apply only to loudspeakers?

Certainly not. Microphones have Q's, people have Q's, all musical instruments have Q's, air ducts, motors, in fact, anything capable of generating acoustic energy also has a Q value that can vary with frequency.

25. What is geometric Q?

What is meant by the term geometric Q is that some area described by a geometric equation has the same Q at all points within the area. Obviously, the area has to be some segment of a spherical surface in order to meet the basic definition of Q with regard to a spherical wavefront.

26. What is an $M_e$ factor?

$M_e$ stands for electroacoustic modifier of critical distance $D_c$. It is the modifier that operates as the distance from the sound source is decreased. For example, if you need a Q = 16 but only had available a Q = 4 (see Question 6 as well), then

$$M_e = \frac{\text{Q needed}}{\text{Q available}} = \frac{16}{4} = 4$$

and the new $D_2$ would be

$$\frac{\text{original } D_2}{\sqrt{M_e}} \qquad \text{or, for example,} \qquad \frac{100'}{\sqrt{4}} = 50'$$

The new $D_2$ can also be arrived at by:

$$\text{new } D_2 = \left( \frac{\text{original } D_2}{\sqrt{\frac{\text{Q needed}}{\text{Q available}}}} \right)$$

27. Are there any perfect Q loudspeakers?

NO!

28. What is $C_L$ inversion?

All loudspeakers vary in $C_L$ with frequency. Almost all directional loudspeakers go through an inversion of their stated $C_L$s at some frequency about an octave above their acoustic cut off frequency. For example, a 300 Hz horn with $C_L$s of 40° horizontal to 60° vertical would typically have a "square" rating of 50° X 50° at 600 Hz and then have a horizontal $C_L$ of 60° and a vertical $C_L$ of 40° at 300 Hz.

29. How may Q be varied?

Change the loudspeaker for another.

30. How may $C_L$ be varied?

Stacking loudspeakers in a vertical plane narrows the vertical angle. Stacking and splaying loudspeakers one above the other widens the horizontal angle. Naturally, either of these arrangements can be rotated 90°. Stuffing cells on a multicellular horn will change the $C_L$ but not the Q (the energy is being absorbed not confined to a narrower angle).



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