SYNERGETIC SYN AUD CON AUDIO CONCEPTS

newsletter

VOLUME 9, NUMBER 1
FALL, 1981

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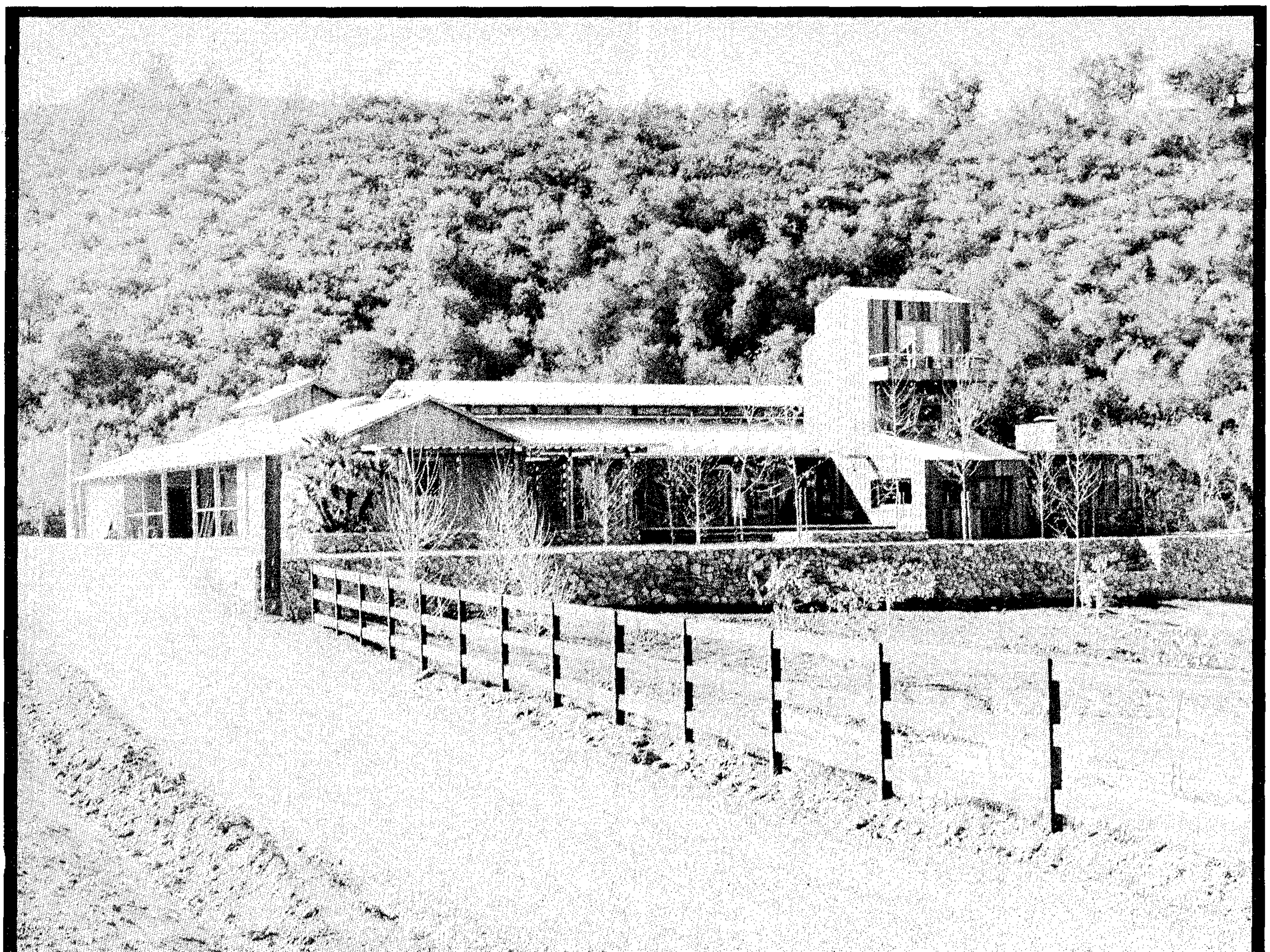
Don & Carolyn Davis

SYNERGETIC
Working together; co-operating, co-operative

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

EXCHANGE OF IDEAS

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



SYN-AUD-CON AUDIO INDUSTRY SEMINAR CENTER

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THE UNITED STATES OF AMERICA

The United States of America is a marvelous, powerful, beautiful country, full of remarkable men and women whose lives are oftentimes sagas of strength, virtue, honesty, self-respect, and success in the real meaning of the word.

The only way to know how really true the statements above are and how deeply woven into our national fabric these concepts have penetrated is to get out and travel the highways and byways of the heartland of this country. Unfortunately, while these same traits predominate in cities also, the mental pollution present there makes them much more difficult to uncover, but we have found the beautiful qualities in New York City, Los Angeles, and Chicago -- whenever we have been fortunate enough to dive beneath the floating debris on top of the stream.

We travel many thousands of miles per year from the west coast to the east coast and from Canada to the Mexican border in presenting our Syn-Aud-Con seminars. We do not travel by air, not only because of the problems of shipping all the equipment we wish to show, but because you cannot see the United States that way.

The land is everlasting and beautiful and not even man at his worst can deface it but temporarily, and everywhere the magnificence of the gift is apparent and still full of promise and fullfillment. It's the people, however, that the traveler needs to meet, get to know, and appreciate. And therein is the joy of being "On the Road" again this Fall.

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

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

NEW SYN-AUD-CON SPONSOR -- COMMUNITY LIGHT & SOUND

Syn-Aud-Con is very pleased to announce that Community Light and Sound of Philadelphia has become a Syn-Aud-Con sponsor.

Community was among the very first to recognize the importance of Q and coverange angle measurements and to provide the industry with extensive measurements of their products and products from compatible companies.

Another Syn-Aud-Con sponsor, Rauland-Borg, has very effectively used Community horns under an OEM agreement to compete successfully with other top-of-the-line commercial sound devices.

Measured by the enthusiasm of their users, they rate at the very top of available products. We have never encountered a dissatisfied Community customer in a Syn-Aud-Con class and the majority of those attending our classes have had experience with one or more of their products.

Recently, two of the more promising young men in the audio industry have joined the already proven successful team at Community and their presence suggests that we will see important new ideas coming from Philadelphia in the near future. Cliff Hendrickson was involved with the Altec MantaRay horn design and CHRIS FOREMAN, also formerly with Altec, where he added further experience to his already extensive marketing skills.

After reading Christine Kofoed's article in dB Magazine about RANDY VAUGHAN's installation at Billy Bob's in Texas (Ms. Kofoed is Executive Vice President of Community), and thinking about the movement of Hendrickson and Foreman from Altec to Community and the dramatic improvement in array design that is on the horizon, we asked Community if we couldn't work together and were delighted that they accepted.

Since a company's future is dependent both upon its past history and the caliber of its personnel, we can easily predict in this case that "the best is yet to come."

1982 SEMINARS AND WORKSHOPS

WORKSHOPS AT THE SEMINAR CENTER	SOUND ENGINEERING SEMINARS: SEMINAR CENTER, CA	SOUND ENGINEERING SEMINARS: TRAVELING SEMINARS
LEDE™ CONTROL ROOM DESIGN........JANUARY 19-21, 1982	FEBRUARY 2-4, 1981	MAY 5-7, SAN FRANCISCO AREA
ENGINEERING LOUDSPEAKER ARRAYS...FEBRUARY 23-25, 1982	MARCH 23-25, 1982	MAY 12-14, SALT LAKE CITY AREA
TO BE ANNOUNCED......................APRIL 6-8, 1982	APRIL 20-22, 1982	MAY 25-27, MINNEAPOLIS AREA

Registration information for the LEDE Control Room Design Workshop and the Loudspeaker Array Workshop is included with the mailing of this Newsletter. The size of the workshop will be limited to 25. Under no circumstance will we consider more than 25 for these very important workshops. Those who have sent us the Interest in Workshop forms will be given first consideration.

If you wish to register for one of the Workshops, don't send money. Just let us know. We will bill you about six (6) weeks prior to the Workshop.

Information on the PZM™ Workshop will be sent to you in the next Newsletter mailing.

AES NEW YORK 1981

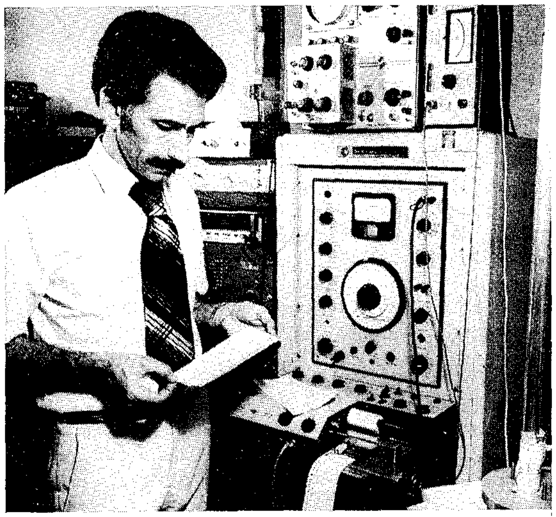
Syn-Aud-Con will not have an exhibit space at the New York AES Convention this Fall but we will be there on Friday and Saturday.

We felt that we would not be able to sustain our energy level to properly conduct our classes in addition to having an exhibit space at the convention. (We are holding more classes than appear on our schedule -- special in-house classes.)

So that we won't miss the main joy of AES -- being able to visit with our graduates and to hear about all your new activities, we have reserved a suite at the Waldorf which will be open from about noon on Friday to the afternoon of Saturday, November 1.

We will plan to leave cards listing our suite number with our sponsors that are exhibiting at AES.

AROUND THE WORLD - SOLO - IN A SINGLE ENGINE AIRCRAFT??



How many of you are ready to fly completely around the world in a single engine aircraft? Me neither!

How many of you are ready to do it solo? Manny Mohageri of Emilar is doing just that in his Mooney single engine aircraft. He will have to make pinpoint landfalls in the middle of the Pacific, avoid disputed airspace in Asia, and count on the steady roar of that single engine as he wings his way eastward around this immense, interesting globe we live on.

That Manny is adventurous, goes without saying. His life history reflects a continuously adventuresome attitude. That he is skillful enough to pull it off also goes without saying, as is reflected by the way he runs his businesses, handles machinery, and weighs risk taking.

As I write this, Manny is about mid-trip and headed into the vast Pacific area he has to cross. It is a major regret that we will not be able to be at the airport to greet him when he lands. Those who will be there have the rare privilege of welcoming home a real modern American adventurer.

MIX MAGAZINE'S STUDIO DESIGN ISSUE

We found the entire issue of interest and believe you will also. Scott Putnum and Tom Lubin's article, "Dealing with the Building Department," leads any thinking person to the quick conclusion that building in New York, Chicago and Los Angeles is difficult.

Two of the articles have special interest to Syn-Aud-Con graduates who are engaged in the recording arts and sciences. The first is by Edward M. Long and is entitled, "The Monitor Field."

Ed's discussion of the fundamental differences between a Monitor loudspeaker and a "consumer" (home hifi) loudspeaker is illuminating and to the point. Ed discusses his philosophy with regard to his trademarked Near Field Monitoring™ and has important judgments on the new UREI products, Tannoy, John Meyers Sound Lab loudspeakers, (Ed feels that while they are expensive they are very "cost effective"), and the new JBL "Dolly Parton" studio monitor.

As is always the case there is no substitute for reading Ed in the original. We are especially pleased with his comments regarding absorption near the loudspeakers:

> *When considering acoustical treatment in a monitoring environment, treating the surfaces closest to the monitors first is the most cost effective. Absorbing the strongest first order reflections does the most to clean up the time smear, since later reflections contribute less to obscuring detail. Simple absorbing panels can be constructed using light frames, R-703 material, and a cloth covering. Placing these panels on reflecting surfaces near the monitors, can clean up a lot of problems in a hurry. They can be put in place and removed easily for clients who are not ready for articulate sound without time smear.*

The second article is by CHIPS DAVIS and ED BANNON on "Designing for a Quiet Control Room". This article shares a great deal of material from Chips and Ed's work on new LEDE™ control rooms around the world and has specific construction techniques carefully detailed in illustrations. They also illustrate and discuss floor isolation and loudspeaker mountings.

A fully annotated energy time curve, ETC, of a control room is shown containing early, early sound, EES, re-radiating from a control room ceiling *after* traveling there through the structure rather than through the air path.

This issue of MIX also has some comments written by Don on what a control room designer should be familiar with.

NEW SCIENTIFIC SOCIETY

We have a proposed name for a new society of those in audio industry who view themselves as "scientists."

It is the Audio Scientist Society and we will be delighted to recognize those who seek such status as self-appointed ASS's.

PLANTRONICS CLASS - JULY 28-30, 1981

LABOR ESTIMATING

The varying disciplines that have grown up in the audio marketplace are today each seeking their own level for the exchange of ideas and the general improvement of their peer group.

The 2nd National Sound & Communications Conference held in Atlanta this spring catered to the commercial sound contractorships throughout the nation.

Portions of the extensive program are reprinted in the June 1981 issue of Sound & Communications. Starting on page 22 of that issue is a section called "Labor Estimating" by Rod Uffner of Industrial Communications Company. Mr. Uffner does an excellent job of enumerating the multitude of expenses that go into a realistic appraisal of costs and overhead in today's sound contracting business.

Financial acuity is an essential component in a successful contracting business, and while a Harvard MBA is probably not the desired model, we know that a LOHK (life of hard knocks) usually can cope with the realities of competitive bidding at a profitable level. We believe you will find Uffner's remarks entertaining and educational.

Reprinted with permission from Sound & Communications and Industrial Electronic Distributors Show.

LABOR ESTIMATING ·

Rod Uffner
Industrial Communications Company, Oak Park, Michigan

Fundamentally, estimating is the determination of a cost and proper price for a given amount of work in advance of actually doing that work. Expanding the definition slightly, estimating is the mental and physical process a person goes through to determine, through accurate quantity survey and intelligent analysis of all variable conditions, a reasonably accurate dollar figure that will defray all costs of labor, direct job expenses, a proper share of the overhead or operating expenses, and a normal margin of profit for the sound contract.

No matter how accurate, no estimate can be absolutely correct except by accident, because it is concerned with too many variable factors. An example of this: two years ago our firm installed the sound systems in two identical schools in Troy, Michigan. Our salesman-estimator estimated that each job would require 240 man-hours to complete. Both projects were with the same electrical contractor and both were completed at approximately the same time.

Our final job tabulations indicated that school number one required 266 man-hours to complete, which was 10 percent over the estimate. But school number two took only 201 man-hours to accomplish exactly the same work, which is 20 percent under the estimate.

So, in the final analysis we perhaps could best define estimating as guessing. I'd like to review with you some of the things that we all might consider in the fine art of guessing.

Historically speaking, fifteen or twenty years ago guessing labor was not as important as it is today. Primarily because the labor portion of any job was much smaller than the material portion. And, the wages we paid to technicians back then were much lower. My recollections are that we used an 80/20 ratio—80 percent being material, 20 percent being labor.

In 1965, for example, a $10,000 project would break down into $8,000 material, $2,000 labor and the profit would be divided accordingly. Today, with the high wages and benefits paid to sound technicians, it is not at all unusual for the selling price of labor to exceed the selling price for the material. An excellent example of this came through our office last month.

We were asked to design and install a noise-masking system for one of our regular customers, for an open-office landscape-type building. Total selling price of materials involved in the job came to $45,734. Total labor for the project at $33 per man-hour amounted to $47,000 or more than 50 percent of the total job. Therefore, the profit on this particular job was heavily labor dependent.

I would like to talk about costs and I suppose if we as guessers were going to make a profit for respective companies, we should know what to sell our labor to our customers for. Before we know what we can sell anything for, we (a) have to know what it costs, including overhead; (b) determine the amount of profit we would like to make, and (c) add the two figures together to come up with what we're going to sell it for.

When we deal with labor costs, I would like to break the cost into two categories—direct costs, and indirect or hidden costs. Depending on how you wish to set up your own bookkeeping, some of the latter or hidden costs might surprise you, as they did me.

I'm going to profile an $11-per-hour sound technician who costs us $29.27 an hour.

Under direct costs, the first thing to consider is the technician's hourly rate. Presently in Detroit the rate is over $11 per hour. And in addition to the base hourly rate, there are other direct costs, such as FICA,, which is 6.65 percent of his pay up to $29,700; disability and life insurance, $13 a month; medical and hospital insurance, which currently is a whopping $183 bucks a month; unemployment compensation, 3.8 percent for the first $6,000 of income; FUTA, which is federal unemployment, 7/10ths of 1 percent for the first $6,000; pension plan, $10 a week; sick leave up to three days per year; and paid holidays, nine in all, or seventy-two hours.

Using the above direct costs, the $11-per-hour technician now costs our company $14.35 an hour or 130 percent of his base hourly rate.

Admittedly some of the following costs do not universally apply to every sound contractor here. Nor, do they apply to every project we're involved in. They do, however, present an interesting insight into what our $11-per-hour man might cost us.

How about efficiency, or proficiency if you prefer? Are all of our installers 100 percent efficient all the time? I doubt it.

What about supervision? If we hire one man to supervise our crew, what's it cost per man-hour? Auto expense—do you pay your people mileage for getting to and from a job or, worse yet, furnish them with a company vehicle?

Union dues—we don't have to pay them in Detroit, but it's a possibility. Here's one—commission. If our sales persons are paid commission on the overall selling price of a project, then we have to include their commission. It's part of the cost of labor. Any override agreements with your managers could also qualify under this category.

Schooling—let's say your major supplier has a service or installation school. You send part or all of your crew. If so, their regular pay, plus their expenses, are all part of their indirect labor cost.

Nonproductive labor—I'm sure we all know that at one time or another, through no fault of their own, our technical people will incur some nonproductive time—warranty labor, for instance. It's a cost.

Now those are just a few of the many indirect labor expenses that effect our cost per man-hour.

For base salary, I use $11 per hour times 40 hours per week, times 52 weeks a year: 2,080 hours, $22,880. FICA, fairly simple, $22,880 times 6.5 percent divided by the 2,080, 73¢ an hour. Disability and life insurance, same thing applies, 7¢ an hour. Medical, Blue Cross and Blue Shield, up to $18 per month times 12 months, divided by the 2,080, $1.05 an hour. Unemployment compensation, 3.8 percent of the $6,000, 10¢ an hour. FUTA—I was glad to find this one, because it will only cost me 2¢ an hour. Sick days, 12¢ an hour. In Detroit we pay up to three days. From then on they have insurance. Vacation days—some of our technicians get up to three weeks, fifteen days, 63¢ an hour. Pension plan, 25¢ an hour, $10 a week times 52 weeks a year, is $520 divided by 2,080. Paid holidays—currently our people get nine paid holidays, seventy-two hours off with pay, 38¢ an hour.

Acoustical consultants are the world's greatest estimators, just above architects and engineers. If you want an acoustical consultant's formula for estimating a job, which of course is the figure that the owner gets, I'll be glad to share it with you at this point.

Take your cost of material and multiply it by 50 percent, period. You architects and engineers and consultants know I'm only kidding, and you sound contractors know I'm not.

So, if our man is 90 percent efficient, he's 10 percent inefficient, and that costs $1.10 an hour.

Union dues, $10 a week, $520 a year, 25¢ an hour. Supervision—let's say you hire one supervisor; you may call him your chief engineer, or vice president, or shop foreman or whatever, to oversee and schedule your six-man crew, and he makes 1.5 times as much money as your technician. That's $34,370 a year; with all benefits it will round out to $36,000 a year or $6,000 a man for an incredible $2.88 an hour.

Continued next page

LABOR ESTIMATING, continued (by Rod Uffner)

Auto expense—let's hope we can recoup this from our customers, but any way you look at it, auto expense has to be considered a cost. Let's make it low, 12,000 miles a year at 30¢ a mile. That's $3600 divided by 2,080, $1.73 an hour. Incredible!

Commission—okay, your sales people are paid a commission on the selling price of a job, which includes labor. Let's also make this low, say 6 percent. If your selling price of labor is $33 an hour, that's another nearly two bucks, $1.98 an hour cost.

Schooling—we want to keep our technician up to snuff on what's going on in the wonderful world of sound. So, we send him to Chicago for a week-long training session. He eats, he drinks, he sleeps. Hopefully he learns something. Hopefully he doesn't pick up anything. We pick up the tab—$75 a day is very conservative, plus plane fare, plus his wages for a week. All this is going to cost us is another lousy 58¢ an hour.

Warranty labor—I'm not going to elaborate on this, but I think 5 percent is a reasonable figure. Now, our $11-per-hour technician is up to $23.42 an hour, or 412 percent of his base pay, and we haven't even started talking about overhead, just basic costs.

What about overhead? Today, because of manufacturing delays, service requirements, customer demands and so on, a sound contractor must stock equipment if he is to keep his customer base. I am sure you will all agree that stocking equipment, both for installation and for service, is expensive. It's overhead.

Some of the indirect and direct cost for labor may be considered as overhead. However, here is a list of other items which must be taken into consideration that are essential to perform the work we secure through sales, all of which relate to the cost of labor under the heading of overhead:

Advertising, automobiles, trucks, bad debts, charitable contributions, collection expenses, depreciation and amortization, dues and subscriptions, employee benefits, freight expense and postage, heat, light, power, water, interest expense, insurance, general insurance, public liability insurance, legal and accounting, office supplies, pension plans, rent, repairs and maintenance, salaries including general administrative, engineering, warehousing, selling, clerical, etc., telephone and telegraph, taxes, tools, travel and entertainment, and so on and so on. I would estimate conservatively that a medium-sized sound contractor in a medium-sized marketing area would have overhead expenses in the amount of 20 to 30 percent.

So, adding 25 percent to our $11-per-hour technician, who costs us $23.42 an hour, brings our labor rate to $29.27 an hour. And you can determine for yourself what profit margin you would like to make on your investment. If it's less than the current rate for money market certificates, we might well be advised to place our priorities somewhere other than the sound contracting business.

But, let's say we want to make 15 percent on our investment of $29.27. That's a profit of $4.39 an hour. We must sell our labor to our customers at 302 percent of our technician's base rate of pay to make 15 percent.

So how do we, at $34 an hour, compare with other service-oriented businesses? Your doctor, when he's not on the golf course, will charge $100 an hour. Your lawyer will whack you $35 for a phone call. It will cost you $50 or $60 an hour to get your xerox repaired, and your friendly local Cadillac dealer will charge you $35 to $40 an hour.

To tell you the truth, I didn't have the guts to check with a plumber or a CPA. Can we justify charging $34 an hour? I would say we most definitely can.

Now that my $11-per-hour man, who costs me $30 an hour, is ready to hit the road, what other labor related expenses might I run into? Here's a list that I've come up with, and I'm sure you have many, many more.

How about job clean up? Customers demand it. Overtime—some jobs require it. License fees, permits, inspection fees, customer contacts. At $30 an hour, a cup of coffee with the local receptionist can cost us a mint.

Special tools or equipment, for instance, scaffolding or cherry pickers. They don't come cheap. Outsider or subcontract fees. Travel time, out of town or per diem expenses, special insurance, bid and performance bonds, rental charges, field engineering. I like this one. I want to see if I can get it right.

Field engineering—that's when our technician tries to make the system work the way the salesman said it would, but it won't. How about a few more goodies like trucking or special transportation, job site storage, change orders—you know, the customer wants six or seven more of those and so on and so forth.

All of these items should be taken into consideration when estimating any significant project. So, how do we in the business of selling sound systems assure ourselves that we are taking all the variables into consideration? That's easy. We simply profile our needs for a professional estimator and pick one up off the streets or at the local pub.

Here's my profile of a professional estimator. He is durable, flexible, confident. Although acoustical consultants seem to try, they can never stump him. Give him a mismatched set of plans and specs and he'll still give you back a competitive price with a built-in profit. His mind is like a steel trap

Double Your Money

Want to find out how long it will take to double your money? Use RULE OF 72. Take the interest rate you are presently earning and divide it into 72. For example, let's say your interest rate is 7.5 percent. Using 72 as the numerator and 7.5 as the denominator, it will take 9.6 years to double your money. On the other hand, if you've made an investment that yields 18 percent a year, then your money will double in 4 years.

From "The Idea Bank Letter" published by FMI Publications, a Division of The Fails Management Institute 5151 Glenwood Ave Raleigh, NC 27612

KEN GRUBER GIVES DON A BELT

At the May 1981 Los Angeles AES Convention, KEN GRUBER, a many-time Syn-Aud-Con graduate from Disneyland, presented Don with a beautiful handmade, engraved belt.

Don now wears this belt along with one of Crown's limited edition belt buckles as his "traveling" belt.

The photograph shows Ken and Don holding the belt while standing in Syn-Aud-Con's new display at the AES convention.

MASON INDUSTRIES

Mason Industries, Inc., has long been a preferred source of vibration control devices in Syn-Aud-Con's list of vendors.

Norman Mason has, over the years, put out more informative material than his competitors and has always tackled new problems with the zest of a real enthusiast.

One of Mason's more interesting bulletins is SCS-100 on "Seismic Control Specifications for Floor Mounted Equipment."

An excellent United States seismic zone map appears on page 6 and reveals one major advantage for south Texas, parts of Louisiana, and the southern half of Florida--no earthquakes. It's fascinating to see that the only places in the United States free of earthquakes happen to be the most hazardous hurricane areas in the country.

Another bit of side data that drops out of the "snubber" discussion is the fact "that normal shipment by truck or train subjects mechanical equipment to 5 g and that, on occasion, levels even approach 10 g." It is interesting then to find out that 4 g suffices for earthquake snubbers.

The complexity of the overall problem is well illustrated in this excellent bulletin. We certainly advocate that snubbers be installed on all large woofer bins in any Zone 3 area of the U. S. seismic map. To the uninformed the generic terms in the Mason Industries snubber specification would serve as a real deterrent to bidding until they discovered for themselves just what is being requested.

i.e.: *The computer report shall include the following information along the X, Y and Z axis.*

a. *The six natural frequencies of the system both with and without snubbing.*

b. *The most probable movements (RMS values) at all mounting or combination mounting and snubber locations as well as remote source points such as duct, pipe and electrical connections and the machine extremities.*

c. *Maximum accelerations at the center of each significant system element such as the motor, fan, compressor, heat exchanger, or pumps as well as the mounting or combination mountings and snubber locations, all expressed in g units.*

d. *The most probable force (RMS value) at each mounting or mounting and snubber location expressed in pounds.*

The six computer readouts would be impossible to duplicate unless they recognized that it was a Mason Industries' specification. (How many of *your* competitors would detect that?)

In any case, we highly recommend that you write for a copy of this most intriguing bulletin.

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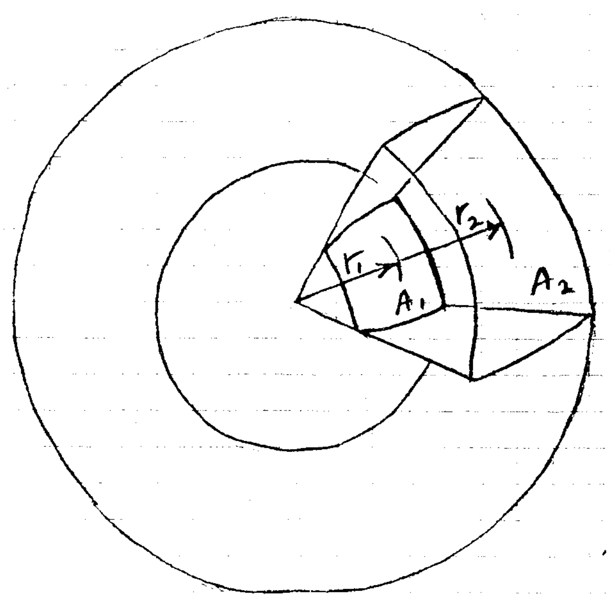
92-10 182nd Place
Hollis, New York 11423
212/523-3355

Mason Industries, Inc.
3335 E. Pico Boulevard
Los Angeles, California 90023
213/263-9557

ILLUSTRATING INVERSE SQUARE LAW



Area varies as r^2
(If $r_1 = 1$ and $r_2 = 1$, then $A_1 = 1/4\ A_2$)

Power per unit area varies as $1/r^2$
(The inverse square of the radius)

$$A_1 \text{ and } A_2 = \frac{4\Pi r_1^2 \text{ or } r_2^2}{Q}$$

$$\text{Relative power per unit area} = \frac{Q}{4\Pi r_1^2 \text{ or } r_2^2}$$

<u>Area of Total Sphere (A_T)</u>

$A_T = 4\Pi r^2$

$A_T = 4\Pi(r_1+r_2)^2$

THE SYN-AUD-CON HP 41C CALCULATOR GROUP FOR EXCHANGING PROGRAMS

To those of you interfacing with the home computer revolution (Pet, Commodore, Radio Shack, Apple, Osborne, etc.) it is very evident that one of the dynamic industries of the present decade will be "software". Of interest to us is the increasing realization on the part of programmers that pricing of software can be made high enough to become a genuinely profitable endeavor.

In light of the above, the efforts of the group of Syn-Aud-Con graduates led by JOHN LANPHERE to carefully document the myriad of audio and acoustic programs available for the HP 41C and make them available to all Syn-Aud-Con graduates for the bare costs involved represents an exceptional bargain. The documentation developed by John Lanphere is easily read and understood. It is accurate because the men working with John (RUSS BERGER, KEN WAHRENBROCK and FARREL BECKER) are all familiar with audio as well as programming and they have taken the time to "proof" each program, The ideas they are sharing benefit from the enthusiasm that only professionals who are also dedicated to the idea that sharing is the seed bed of progress can generate.

John Lanphere (center)

You can write John at A/V Design Service
1408 Elwood Ave, Ste 213
South Bend, IN 46628

Be sure to include a self-addressed, stamped envelope.

The greatest math course available is programming. Studying a well written, properly documented program, followed step-by-step to see why the programmer did what he did is a totally engrossing form of self-instruction that rapidly expands one's mathematical capabilities.

We sincerely hope that all Syn-Aud-Con graduates now into programming or getting ready to do so will take advantage of this service and join with John and his committee in helping this activity grow rapidly and successfully.

HP 41C CALCULATOR USED IN SYN-AUD-CON CLASSES

Syn-Aud-Con has purchased 33 of the HP 41C calculators for use in our classes this Fall. It is our firm belief that this model will dominate the handheld scientific calculator market for at least the next three years. We can now acquaint each class member with the keyboard he is most likely to acquire for his own use outside of a Syn-Aud-Con class.

The HP41C offers the user the opportunity to become familiar with alpha-numeric operations and basic programming techniques. We believe that you will find these marvelous tools as exciting as we have.

NIKOLA TESLA

KEN WAHRENBROCK recently shared with me an article by Fred Shunaman on Nikola Tesla,"Pioneer of Radio" in the October, 1980, Radio Electronics.

Nikola Tesla died in semi-poverty in 1943. Listed here are just a few of his accomplishments which stand as proof that being first and knowing what you are doing does not mean that others will be able to recognize its worth.

1. Developed the first practical AC system that led to the freedom of the world from dependence on DC power systems
2. In 1899 generated more than 12 million volts (not again duplicated until 70 years later)
3. Transmitted via wireless 10kw to light lamps 26 miles from his transmitter (has never been duplicated)
4. Patented electrical resonance, patent #568,178 in 1896. Later sued Marconi whose successful radio systems infringed, lost in court due to the court being unable to understand the logic of the argument. In 1943 the Marconi patent was declared invalid on the basis of prior work by Tesla.

Mystery still surrounds the life of Tesla, leaving many serious technical questions unanswered. His brilliance in his youth is unchallenged. The neglect of the man and his ideas for the last 30 years of his life is not pleasant to contemplate and one can't help wondering if we are doing the same today to others of his capability.

DR. DIAMOND COMMENTS ON DOUBLE BLIND TESTS AND TESTERS

Dr. John Diamond has made a very penetrating observation regarding the use of "double blind" testing. He has observed in his book, *The Life Energy in Music*, that one of his audiophile friends easily "hears" differences between components during relaxed sessions at home but was unable to do so when the same components were used in a "double blind test". (By "double blind" we mean that neither the tester nor the subject knows at anytime which component is undergoing test.)

Dr. Diamond points out that when relaxed and listening to music, the right cerebral hemisphere dominates but that when we are listening to the same music under "test conditions" we switch to our left cerebral hemisphere.

Anyone who engages in a sport, for example target shooting, has experienced this effect many times. When you are practicing alone, totally relaxed and squeezing the trigger subconsciously, every time the sights align correctly there is a rhythm established that results in bull's-eye after bull's-eye.

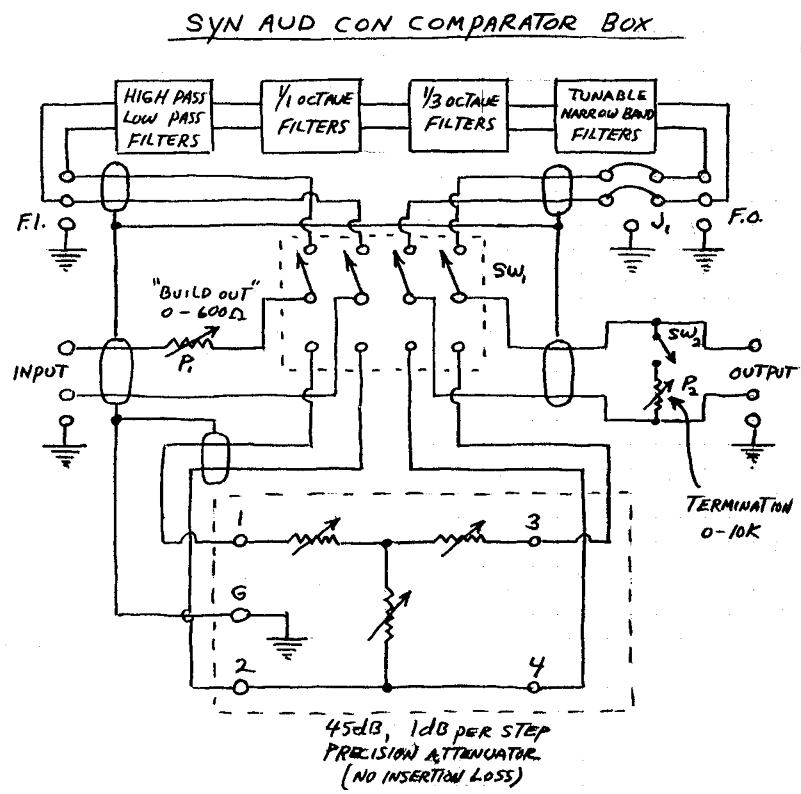
On the other hand, when shooting with an observer present and consciously desiring to score well, inexplicable "flyers" occur that can only be attributed to the intellectual left hemisphere getting in the way of the instinctual right hemisphere's functioning. Skiing, horseback riding, and race cars, once they become experience patterns, are instinctual and the maneuvers required to survive often unfold without conscious thought, but reflexively.

In my *opinion*, and its only that, double blind testing is fatally flawed and what is required for meaningful evaluation of sensitive people's response to subtle influences is a testing procedure wherein the "sensitive" is observed but not tested to see what their reaction is to alternate choices. Again, in our opinion, that's not every easy to construct.

BUILDING AND USING A COMPARATOR BOX

The simple easy-to-build Syn-Aud-Con comparator box provides its user with a myriad of functions difficult to duplicate any other way. Just a few of its uses are:

1. An A-B comparator between an equalized and unequalized sound system.
2. A variable attenuator for determining the value of pad desired.
3. A quick test box for finding "build out" and termination values for "link" circuits.
4. The calibrated control for feedback threshold response measurements.
5. A "patch panel" for instrumentation access into a sound system.
6. A quiet "on-off" switch for any kind of acoustic test wherein both on and off are correctly matched conditions.
7. A way to calibrate other gain controls by the comparison method.



It's surprising that there are not more of these devices available but the fact is that they are rarely seen on the job. Syn-Aud-Con feels that a real understanding of equalization requires the use of such a device and encourages graduates to construct one.

WED CLASS - AUGUST 4 & 5, 1981

THE EFFECT OF ALTITUDE ON THE VELOCITY OF SOUND IN AIR

DR. PHIL COX in the Denver 1981 class suggested that we discuss the effect of altitude on the velocity of sound as he had recently read an article which contained misleading statements about a recording studio built in a higher altitude.

The theoretical expression for the speed of sound, c, in an ideal gas (air, for example) is:

$$c = \sqrt{\frac{\gamma P}{\rho}}$$

Where c is the velocity in M/sec
P is the ambient pressure
ρ is the gas density
γ is the ratio of the specific heat of the gas at a constant pressure to its heat at constant volume

The equation

$$PV = RT$$

Where P is the ambient pressure
V is the volume
R is the gas constant
T is the absolute temperature

Considering the definition of density (ρ), our first equation can be re-written as

$$c = \sqrt{\frac{\gamma RT}{M}}$$

Where M is the molecular weight of the gas

It can be seen that the velocity is dependent only on the type of gas and the temperature and is independent of changes in pressure.

This is true because both P and ρ decrease with increasing altitude and the net effect is that atmospheric pressure has only a very slight effect upon sound velocity. Therefore, the speed of sound at the top of a mountain would be the same as at the bottom of the mountain if the temperature is the same at both locations.

CALCULATING THE RATE OF DECAY OF REVERBERANT SOUND ENERGY

The classic Sabine equation is:

$$RT_{60} = \frac{0.049V}{S\bar{a}}$$

Because the reverberation time in seconds is calculated to be the time required for the sound energy to decay to $\frac{1}{1,000,000}$ th (-60 dB) of its original value prior to switching off the sound source, we can further write:

$$\text{Decay rate in dB/sec} = \frac{60\text{ dB}}{RT_{60}}$$

And, because

$$\frac{S\bar{a}}{0.049V} = \frac{1}{RT_{60}}$$

We can derive the following direct equation for decay rate in dB/sec:

$$\frac{60\ S\bar{a}}{0.049V} = \frac{60}{RT_{60}} = \frac{1225.5\ S\bar{a}}{V}$$

Example

The church we use as an example in our Syn-Aud-Con classes has an RT_{60} of:

$$RT_{60} = \frac{0.049(500,000)}{9800} = 2.5\text{ secs}$$

and a decay rate of:

$$\frac{dB}{sec} = \frac{1225.5(9800)}{500,000} = 24\text{ dB/sec}$$

To check, we can take:

$$\frac{60}{2.5} = 24\text{ dB/sec}$$

NEW TEF™ LICENSEES

Reprint from Vol 8, # 4

TEF™ licensing continues. Once the dedicated TEF analyzer is released to the market, there will be no further TEF licenses issued as the license fee then becomes a royalty built into the analyzer's base price. The advantage of a separate TEF license is that it allows the holder to build and use one TEF analyzer (including legal add-ons and modifications to a dedicated one if he wishes).

The user of the dedicated unit is legally restricted to that unit alone, though at the present time that doesn't seem that it will be much of a limitation.

We now estimate that our issuance of the TEF licenses under this program will cease about January, 1982. (We stop whenever Crown sells their first analyzer to the public.)

We also continue to feel that possessors of original TEF licenses have historical proof that they were there when it happened. Here are two new licensees:

Mr. Robert Young
Plantronics, Inc.
P. O. Box 635
Santa Cruz, CA 95061

Mr. Keith Kavanaugh
Premier Audio, Inc.
2552 Royal Lane, A-293
Dallas, TX 75229

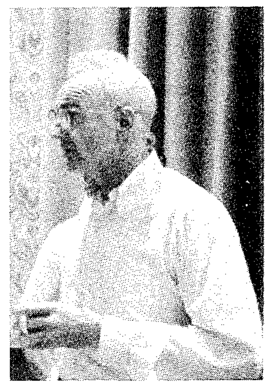
IS THAT WRITTEN UP IN THE ANALS OF THE AES?

When we told the story to the Denver class of the riot control loudspeaker intended to resonate the anal sphincter muscle of the rioters and of its inherent flaw of omnidirectionality, Dr. PHIL COX immediately responded with, "Is that written up in the anals of the AES?"

(Sphincter is defined in the dictionary as "a circular band of voluntary or involuntary muscle which encircles an oriface of the body or one of its hollow organs." *Infrasound and Low Frequency Vibration* edited by W. Tempest, Academic Press, 1976, says that for a standing subject bowel bladder pressure is most disturbed by a frequency of from 10-27 Hz.)

Another member of the class, JOE MITCHELL, contributed, "Do you know what you have when a line of rabbits all take one step back?" to which a blank response elicited, "A receding Hare line."

We can honestly say that Denver is different and that altitude does affect attitude.



Dr. Phil Cox

ENERGY TIME EQUALIZATION

If a TEF™ sweep were to be placed at the beginning of every recording, it would then be possible to build an equalizer to correct energy-time aberrations.

This equalizer would consist of a series of amplitude adjustable delay (digital) devices able to readjust undesired reflected energy to new amplitudes while preserving their time relationship.

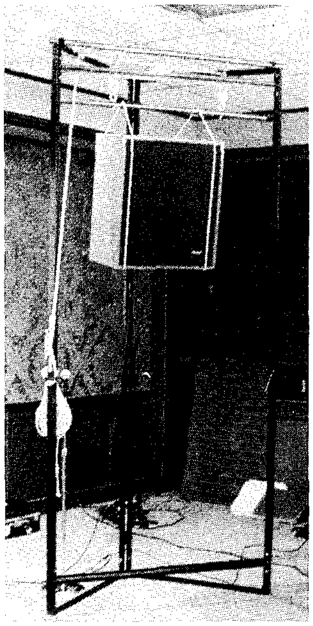
BACKGROUND MUSIC AND USING BOTH SIDES OF THE BRAIN

There seems to be evidence that most of us do not use both sides of the brain at once -- the intellectual, reasoning left hemisphere at the same time that we use the intuitive, creative, subjective right hemisphere.

Is this the reason background music is rarely installed in the Executive Suite? Is this why its main value is in the "assembly-line" areas?

Which side of the brain does White Noise go on (masking or speech privacy systems)? This is an important question since speech privacy systems are installed primarily in the "thinking" areas.

ONE-MAN DEMO HOIST



Loudspeaker Hoist

The extremely effective loudspeaker hoist shown here was designed and built by ELK EBERT of Multicom in Vancouver, British Columbia. The hoist folds up into a usable transportable package and is a *one man* demo hoist for heavy loudspeakers. We were very impressed to say the least and feel that Elk would have a good marke[t] for the drawings for its construction should he care to sell them.

EMILAR AND BGW WEDDING

The high fidelity industry is a fickle siren that can destroy good engineering companies and reward merchandisers of sheer fluff (when the latest fad blows that way). Thus, it is not totally unexpected when a company fortunate enough to have built a base upon engineering rather than on merchandising begins to increasingly turn towards the professional and commercial users of products and away from the consumer-oriented market place. It is not an automatic conversion process. Many ingrained values must be reevaluated (bandwidths narrowed, stability increased, etc.) so their engineering is relevant to the end user who, in this case, probably will actually measure not the printed specifications but rather the actual relevant performance "in situ."

The greatest stumbling block of all for electronic manufacturers to overcome is to become familiar with the electroacoustic devices that will be attached to their electronic marvel.

With all this in mind, we find it extremely exciting when we hear that BGW has partnered with Emilar to market systems containing both their products. Expect no instant miracles but what can happen is a synergy as they share insights, work out *systems* problems together, and begin the logical integration of the basic virtues of each line into a series of possible new products.

It's not the marriage that excites us; it's the possibility the offspring may possess. We're going to watch the next nine months with great interest.

THE DECIBEL AND THE NEPER

The neper is a logarithmic *level* based upon the Napierian logarithm. The Napierian base "e" equals 2.7182818284.... and the neper was defined as:

$$e^{(1 \text{ neper})}$$

and was made a *voltage* ratio.

Thus: $$N \text{ nepers} = 1.0 \ln\left(\frac{V_1}{V_2}\right)$$

Since the decibel is defined as: $$N \text{ decibels} = 10 \log\left(\frac{P_1}{P_2}\right)$$

Because: $$\frac{P_1}{P_2} :: \left(\frac{V_1}{V_2}\right)^2$$

Then: $$N \text{ nepers} = 0.5 \ln\left(\frac{P_1}{P_2}\right) \qquad \left(0.5 \ln \frac{P_1}{P_2} \equiv \ln \sqrt{\frac{P_1}{P_2}}\right)$$

This means that: $$10^{\left(\frac{dB}{10}\right)} = e^{\left(\frac{\text{nepers}}{0.5}\right)}$$

And for 1 dB we can write: $$\ln 10^{\left(\frac{1}{10}\right)} \quad \ln e^{\left(\frac{\text{nepers}}{0.5}\right)}$$

And: $$\frac{0.5 \ln 10}{10} = 0.115129255 \text{ nepers/dB}$$

As always, we can then take the reciprocal and obtain the inverse.

$$\frac{1}{0.115129255} = 8.685889634 \text{ dB/neper}$$

DEFINITION OF ACR

There has, on occasion, been questions raised with regard to my use of the terms AC resistance and DC resistance when discussing impedance during Syn-Aud-Con classes.

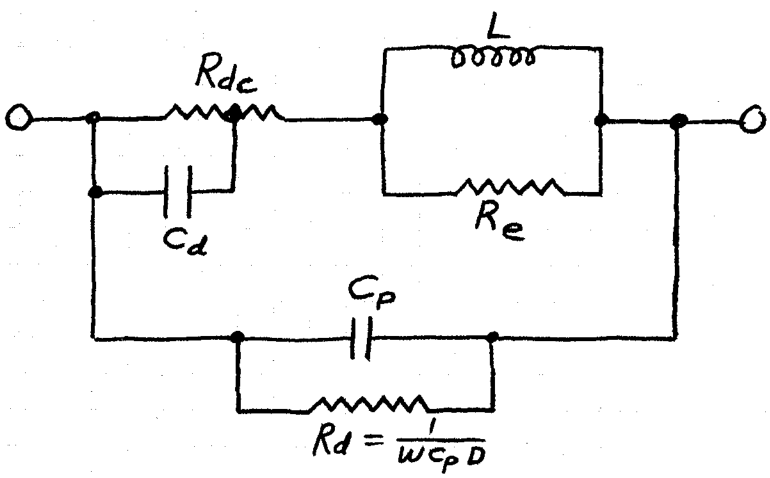
The following definitive and easy to understand definition appears in *Electronic Measurements and Instrumentation* by Bernard M. Oliver and John M. Cage, McGraw-Hill, 1971, in Chapter Nine, "Impedance Measurements," written for the book by Henry P. Hall.

> "At DC, the resistance of a linear two-terminal device is defined as the ratio of the voltage across it to the current through it by Ohms law R = E/I. This quantity is often called the DC resistance (R_{dc})."..."For sinusoidal AC, the ratio of the voltage to current in general is complex. The AC equivalent of Ohms law in Cartesian form is E/I = Z = R+jx, where Z is called the impedance of the device."..."The real, or dissipative, part of impedance is referred to as the effective or AC resistance (sometimes written R_e or R_{ac}). The imaginary part is called reactance and represents the energy-storage part of impedance. These quantities R and X are both functions of frequency. At DC, X is either zero or infinite."

> "Resistors change value with frequency because of inductance, lumped and distributed capacitance, dilectric loss, skin effect, and eddy current losses, plus a few other minor effects as well."

EQUIVALENT CIRCUIT OF A RESISTOR

(First-Order Difference Terms Resulting From Listed Effects)



Where:

- C_d is distributed capacitance
- C_p is lumped parallel capacitance
- L is inductance (which affects the equivalent parallel resistance)
- R_e is resistance caused by "eddy current" losses and first order "skin effects"
- R_d is distributed resistance
- R_{dc} is the DC resistance

STILL MORE ON THE DECIBEL

As we have mentioned in the past, prior to 1923 the unit of gain and loss used by telephone engineers was the mile of standard cable (MSC). This was the change in level occasioned by one mile of 19 gauge open wire telephone line (88Ω/mi and .054 ufd/mi).

What we have not commented on before is their derivation of the multiplier ten in the decibel equation. They did the job in the following manner:

$$\frac{P_1}{P_2} = 10^{\{0.1\}} = \text{power ratio of 1 dB}$$

Therefore: $\left(\frac{P_1}{P_2}\right) = 10^{\{0.1\}\{dB\}}$ and: $\log_{10}\frac{P_1}{P_2} = \log_{10}10(0.1)(dB)$

And since: $\log_{10}10 = 1$

Then: $\log_{10}\left(\frac{P_1}{P_2}\right) = (0.1)(dB)$ or: $\frac{\log_{10}\left(\frac{P_1}{P_2}\right)}{1/10} = dB$

Which simplified becomes: $10 \log\left(\frac{P_1}{P_2}\right) = \text{decibels}$

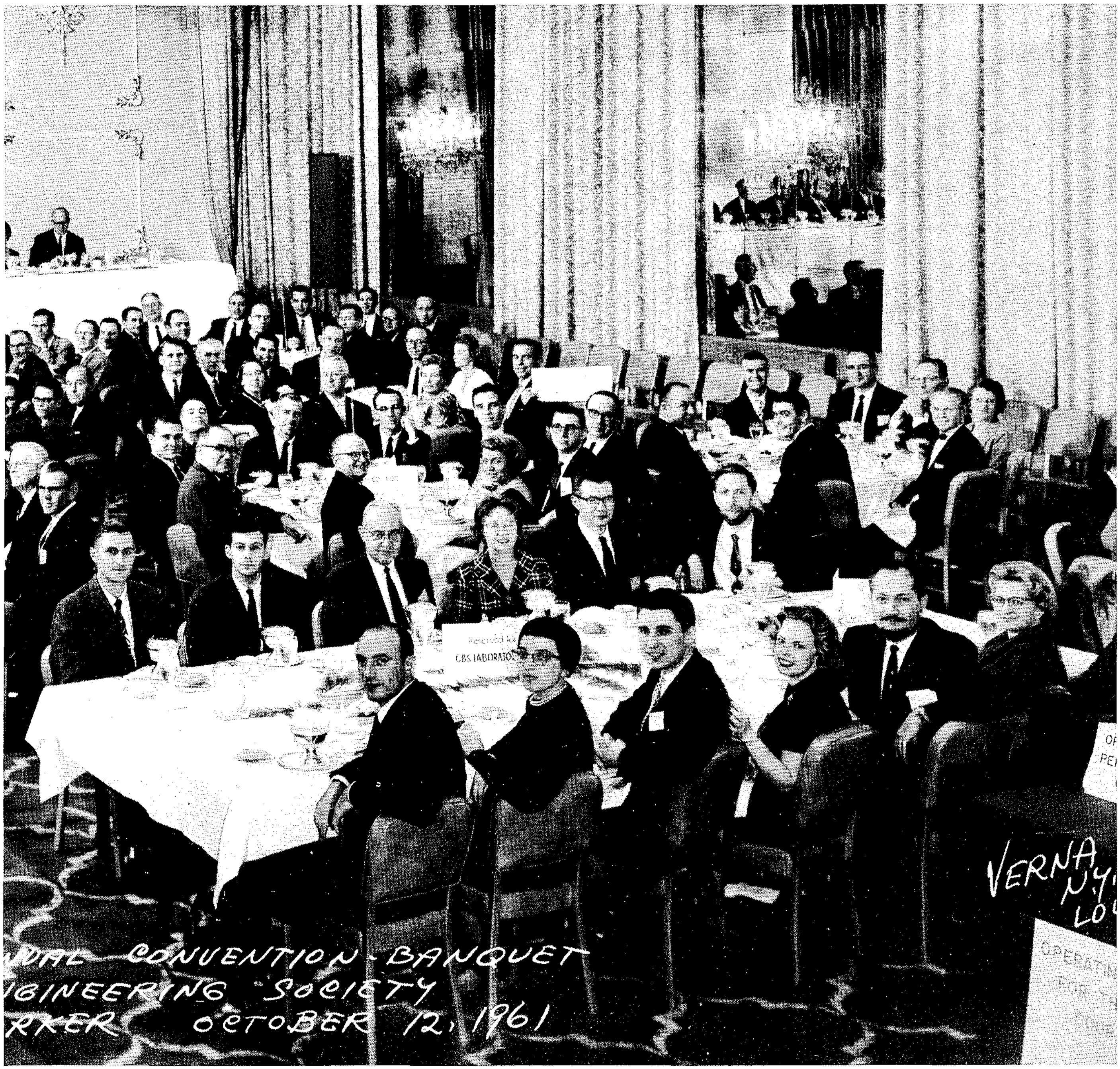
This goes to show that there is more than one way to look at where a constant comes from.

AES CONVENTION, 1961

October 12, 1961, the old Hotel New Yorker - the event: the 13th annual convention banquet of the Audio Engineering Society. Don had just delivered his first AES paper the day before, which was on the use of acoustical measurements by commercial sound contractors. Twenty years ago there were no real time analyzers, 1/3-octave equalizers, handheld calculators, TEF™ measurements, and the first transistor devices were just

appearing in practical audio products. Large sound systems were principally installed by factory service companies rather than sound contractors, and $10,000,000 a year was considered record sales by the larger companies in audio.

This photograph includes many distinguished AES members including Ben Bauer, Dr. Hunt of Harvard, H. H. Scott, Sherman Fairchild, Norman Crowhurst, Dr. Harry Olsen of RCA, C. J. LeBel, Col. Ranger, C. G. McProud of Audio Magazine, and many, many others. How many can you identify? We would be very pleased to hear from you if you can identify other people.



COMB FILTER AND ANOMALY DEFINED

In discussing the effect observed when signals from two acoustic sources combine at near equal amplitudes but at slightly different time intervals, we use the terms "comb filter" and "frequency response anomalies."

The IEEE Dictionary defines comb filter as:

> "Filter, comb (circuits and systems). A filter whose insertion loss forms a *sequence* of narrow pass bands or narrow stop bands centered at *multiples of some specified frequency.*" (italics mine)

It is the "sequence" of "peaks and notches" in the amplitude vs frequency plot that look like a "comb" and gives the effect its name.

It is the "multiple of some specified frequency" that makes it plot at even intervals on a linear frequency scale.

The term "anomaly" is defined in the American College Dictionary as:

> "Deviation from the common rule or analogy"

In astromony the definition is:

> "An angular quantity used in defining the position of a point in an orbit." (i.e., the rotation of the phase of a signal with frequency.)

And finally, the Merriam-Webster Dictionary says an anomaly is an "irregularity."

In the specific case of the frequency response of a sound system (amplitude vs frequency or rate of phase change) phase anomalies cause frequency response irregularities that when viewed as a spectrum are called "comb filters". It is our common practice to call the single peak or dip resulting from such phase relationships an anomaly and to refer to a series of them as a comb filter.

The peaks in a comb filter are the result of a 0° relative phase between two signals at a specific point and frequency, and the deep notch is the result of a 180° relative phase between the two signals at the same point but different frequency.

SOUND ENERGY IN ENCLOSED SPACES

In the direct sound field the sound level, L_D, measured is dependent upon the directivity factor, Q, which is dimensionless, of the source; the distance in meters from the source, D_x; and the acoustic power in watts emitted by the source, L_W.

$$L_D = L_W + 10 \text{ Log } \left(\frac{Q}{4\pi (D_x)^2}\right)$$

At three to four times the critical distance, D_c, the reverberant sound level L_R is dependent upon the acoustic power, in watts, W, emitted by the source, L_W, and the acoustic absorption, $S\bar{a}$, present in the enclosed space. (At four times D_c *in a truly reverberant space* the relationship of the direct sound level, L_D, to the reverberant sound level, L_R, is ($L_R - L_D = 12$ dB)). L_R is not affected by further increases in D_x once D_c is exceeded, and Q can affect L_W only as the special limiting case of *all* directional energy being directed exclusively into a totally absorptive area is approached. Therefore, for the reverberant sound field:

$$L_R = L_W + 10 \text{ Log } \frac{4}{S\bar{a}}$$

The Decay Rate, D

The decay rate must necessarily be of the *reverberant sound field, L_R,* just as the reverberation time of 60 dB of decay, RT_{60}, must by *definition* be of the reverberant sound field also.

$$D = \frac{60}{RT_{60}}$$

The most common error in measuring D is to measure the travel time of several discrete reflections rather than the decay of the sound energy in the reverberant sound field.

Ascertaining the Presence of L_R

Since D and RT_{60} are dependent upon a true L_R, a procedure for determining its presence is a necessary preliminary step. We suggest the following technique as simple, reliable, and economical:

1. Measure the ambient noise level, L_{amb}, minus your test source signal
2. Measure the total sound level, L_T, with your test source turned on at the position you suspect to be in the reverberant sound field.

(continued on the next page)

3. Measure the direct sound level, L_D, well within the D_C -- at least 10 dB closer to the source than the D_C. This is accomplished by walking toward the source until your sound level meter rises at least 10 dB. Carefully note the distance at which this occurs. Extrapolate via inverse square law to obtain the L_D at your chosen measurement point in the hoped-for reverberant sound field.

4. Calculate L_R

$$L_R = 10 \log \left[10^{\left(\frac{L_T}{10}\right)} - 10^{\left(\frac{L_{amb}}{10}\right)} - 10^{\left(\frac{L_D}{10}\right)} \right]$$

Attempts at practical use of this equation reveal that whenever L_T is not significantly greater than L_D at the selected measurement point (significantly defined as at least 6 dB), then you are essentially wasting your time. It is perfectly possible to see a rise of 3 dB in L_T as you approach a wall, for example, that has nothing to do with L_R but is merely the influence of that wall's reflected energy. Thus the difference between L_T and L_D of at least 6 dB is a minimum and 10 dB preferable.

If L_R is not at least 20 dB above L_{amb} you again have a most questionable basis for making an RT_{60} measurement.

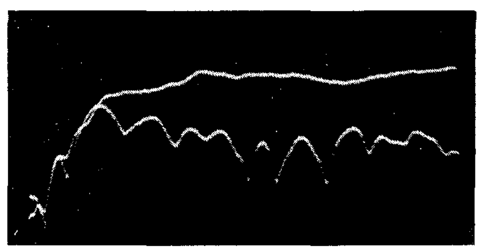
Implications Inherent in the Above Formula

In truly "homogeneous mixing" (Ergodic) enclosures, the classic equations are valid, reliable and accurate *Detection of the lack of a reverberant sound field* is of the utmost importance to the sound system designer because the interaction of L_D with early reflections, L_{refl}, will have significant *audible* consequences since there will be no masking from any other sound field. While "comb filtering" is important to consider whenever acoustic feedback is possible, as they are usually the selection mechanism that triggers feedback, they are usually less audible in reverberant sound fields than they are in direct sound fields, plus finite early reflections.

Those Syn-Aud-Con graduates who have not discovered Tech Topic Vol 6 # 5, "The Sabine Reverberation Equation and its Offspring" should carefully study it in the light of the remarks made here. The Summer Newsletter, Volume 8, # 4, pages 29-30, contains equations for calculating the level of early reflections and for the calculation of comb filters from signals of differing levels, separated by small differences in time - travel path length. These are the equations to be used when a reverberant sound field is not present.

Remembering that the level and time delay of the first significant reflection determines to a surprisingly large degree the subjective judgment of an acoustic enclosure, it is rewarding to ponder the basic parameters put forth here.

ABSORPTION COEFFICIENT OF PEOPLE



The photograph represents a "wide" sample (Ken Wahrenbrock) of the absorption of human beings.

To convert % absorption into dB absorption:

dB absorption - 10 Log (1 - % absorp)

In Egan's *CONCEPTS IN ARCHITECTURAL ACOUSTICS*, page 34, we find

		500Hz	1,000Hz	2,000 Hz	4,000Hz
Audience seated in upholstered seats	Coeff	.80	.94	.92	.87
	dB	-7.0	-12.2	-10.9	-8.8
Students, informally dressed, seated in tablet-arm chairs	Coeff	.49	.84	.87	.84
	dB atten.	-2.9	-8.0	-8.8	-8.0

The sweep time is from 0-10,000Hz and the data for 2000, 4000, and 8000Hz correlate well with Egan's data.

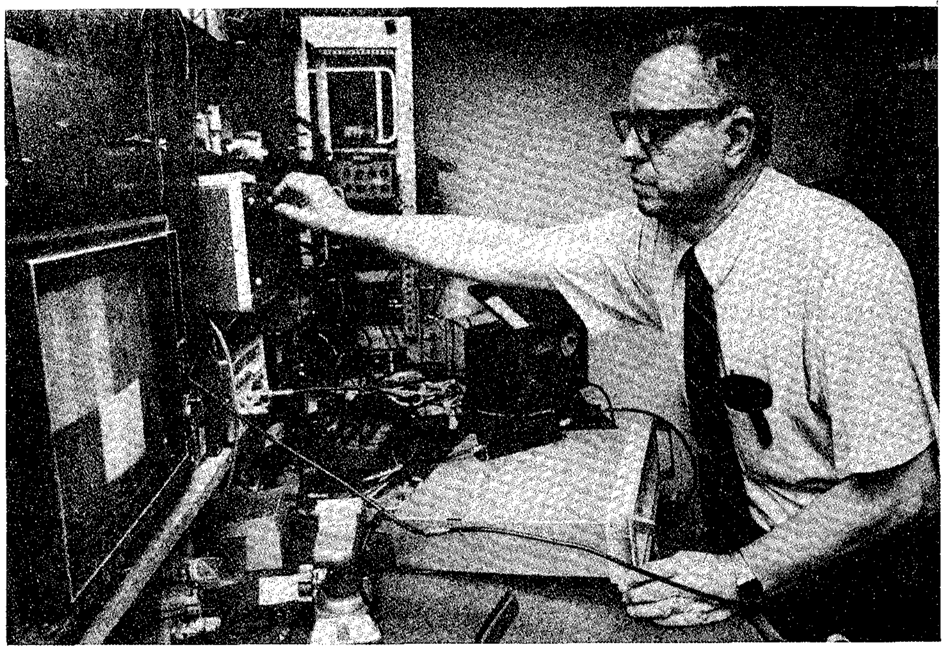
Of interest to us is the absorption at higher frequencies. We feel that TEF™ measurements will allow a far better appraisal of the long term controversy over the absorption coefficients for live audiences. If we assume 5-6 ft^2 for the total area of a human, then Ken is providing a total of 0.92x6 = 5.52 sabins at 2000Hz.

We hope those graduates with TEF™ capability will find the opportunity to observe the energy returns from large audiences with the 1/r mode on the ETC analyzer. We hope to report further on this in future issues of the Newsletter.

CAPP LOUGHBORO - PART OF SPACE SHUTTLE

CAPP LOUGHBORO, a long time loyal friend and graduate of Syn-Aud-Con, was part of the recent successful space shuttle support team. Capp supplied the "closed circuit" TV via a local RF transmission system that allowed dignitaries to see the shuttle's approach in great detail.

That Capp was awarded this contract by finding a better way to accomplish the end result is typical of this versatile, competent and extremely likeable engineer.



To Capp Loughboro

You have good reason to be proud of your contract with NASA for Space Shuttle transmitters and receivers. It's nice to note that it wasn't any of your equipment that caused the launch to be delayed. 4-11-81

Capp Loughboro of Oak View has a NASA contract to provide UHF equipment that will televise the space shuttle landing at Edwards Air Force Base

County man to put shuttle on TV

NASA contract for spacecraft landing goes to Capp Loughboro

By Jim Bates

If everything goes according to schedule, the space shuttle "Columbia" will blast off Friday from Cape Canaveral, Fla., for its maiden voyage into outer space.

The shuttle is scheduled to land two days later at Edwards Air Force Base in Kern County. Because of Capp Loughboro of Oak View, thousands of people will be getting a close-up view of the historic landing.

Loughboro has been working the past few months to provide UHF transmitters and receivers at Edwards.

The equipment will beam UHF television signals of the historic landing to people gathered near the landing site. The television signals will originate from NASA cameras that are on the ground or attached to airplanes that will chase the shuttle once the spaceship returns to the atmosphere.

Loughboro, president and owner of Capp's TV Electronics in Ventura, was awarded a $22,700 contract in January by the National Aeronautics and Space Administration (NASA) to do the work. He received permission late last month from the Federal Communications Commission to start the project.

The UHF signals will be picked up by television sets watched by reporters, guests of NASA, space shuttle contractors and network news technicians monitoring the landing.

Loughboro's contract also requires him to provide 65 television sets that will be placed throughout the area around the landing site.

Because the signal is being carried over the air instead of through a cable system, some of the thousands of people expected to travel to Edwards to watch the landing also will be able to watch it on television, Loughboro said. They can see the landing if they bring a battery-operated television set with them and tune in UHF Channel 68, Loughboro said.

The equipment at the base normally would have been installed using cable. That would have required wiring cable through six miles of the base, Loughboro said, so he suggested to NASA that the signals be transmitted over the air.

"Can you imagine running six miles of cable across that desert? It's just not practical to do it by cable," he said.

Loughboro credits his inexpensive proposal and his experience working with the major television networks for helping him to get the NASA contract.

Loughboro's experience with the networks includes working on Academy Awards broadcasts and building the cable system at the ABC Entertainment Center in Century City.

"I think it's kind of a prestigious thing that we've been selected to do this," Loughboro said. "They (NASA) talked to several other people, and decided that my approach was the right way to go."

A MILLI-BEL

We are told that a reviewer in one of the "underground" audio publications uses the term milli-bel ("mB"??). If he is using the conventional meaning of the words this would be 1/1,000ths of a bel, or a power ratio of

$$10^{\left(\frac{\text{Log}_{10}10}{1000}\right)} = 10^{\frac{1}{1000}} = \sqrt[1000]{10} \quad \text{and} \quad X\ \text{Log}_{10}\ 10^{\frac{1}{1000}} = 1\text{mB}$$

So that:

$$X = \frac{1\ \text{mB}}{\text{Log}_{10}\ \frac{1}{1000}} = 1000$$

Therefore, a 2/1 power ratio in mB would be:

$$1000\ \text{Log}_{10}2 = 301.03\ \text{mB}$$

Which means that for each dB there are 100 mB. We'll leave you to contemplate this without further comment.

PARAMETERS AFFECTING THE OUTPUT OF A LOUDSPEAKER

HARVEY EARP of J. W. Davis & Company called our attention to an AES Journal reprint of a pioneer paper by Beers and Belar which appeared in a recent edition of the AES Journal.

To us, the main item of interest is an equation for the parameters affecting the amplitude,"A" of a loudspeaker.

$$A = K\frac{\sqrt{P}}{F^2D^2}$$

Where A is the amplitude in inches of the cone's displacement
P is the acoustic power in watts
F is the frequency in Hz
D is the cone diameter in inches
K is the constant (not given in the article)

By transposing terms we can write

$$K = \frac{AF^2D^2}{\sqrt{P}}$$

By referring to our increasingly precious copy of Massa's *Acoustic Design Charts* we find on pages 132-133 that at a frequency F = 200Hz from a cone with a diameter D = 10", that the amplitude "A" necessary to radiate an acoustic power P = 1 watt becomes A = .029". Placing these values in the Beers-Belar equation yields

$$K = \frac{.029''(200)^2(10)^2}{\sqrt{1}} = 116{,}000$$

The complete set of equations can then be written as

$$A = 116{,}000\frac{\sqrt{P}}{F^2D^2} \qquad P = \left(\frac{AF^2D^2}{116{,}000}\right)^2 \qquad F = \sqrt{116{,}000\left(\frac{\sqrt{P}}{AD^2}\right)}$$

$$D = \sqrt{116{,}000\frac{\sqrt{P}}{AF^2}} \qquad K = \frac{AF^2D^2}{\sqrt{P}}$$

From these simple equations it can be determined how a change in one parameter affects another. For example, to double the acoustic power requires 4 times the amplitude if all other parameters remain fixed. Holding the same amplitude and cone diameter, but lowering the frequency to one-half its former value results in one-quarter the acoustic power. Put another way, you would have to increase the amplitude by 4 times if you halved the frequency in order to maintain constant acoustic power.

It's interesting to see what amplitude a 15" woofer in an infinite baffle would be required to produce in order to have an acoustic watt at 30 Hz.

$$A = \frac{\sqrt{1}}{(30)^2(15)^2}(116{,}000) = 0.57'' \text{ or over } 1/2''$$

A worthwhile project for some computer enthusiast would be to convert the Massa charts back into equations. Massa's book was originally published in 1942 by The Blakiston Company in Philadelphia.

THE DEFINITION OF A LOGARITHM

The definition of a logarithm is given in *Mathematics for Electricians and Radiomen* by Cooke as: *The logarithm of a quantity is the exponent of the power to which a given number, called the base, must be raised in order to equal the quantity.*

$$(\text{base})^{\text{logarithm}} = \text{number}$$

or

$$b^n = a/c$$

Where b is the base
n is the logarithm
a/c is the number expressed as a ratio

Then using our familiar expression

$$\text{Log}_b b(n) = \log_b a/c$$

Since

$$\text{Log}_b b = 1$$

We then have the basic *logarithmic* equation

$$\text{Log}_b\ a/c = n$$

Its original form $b^n = a/c$ is called the exponential form.

METRIC MYTHS

When I read that the metric system is

1. Based in its entirety on one unit of measure, the metre
2. It is thoroughly consistent
3. It is strictly decimal
4. It is the essence of simplicity

as claimed by a recent writer who assumes that all opposed to this marvelous system are ignorant inhabitants of the hinterlands, I am reminded of the line of soldiers all doing a right face except one. That one, seeing the man next to him pointing in a different direction, whispers, "Other way, fool."

Let's take these points one at a time.

1. The metric system, or more correctly, "Le Systeme International d'Unites (SI), is based, not upon a single unit of measure, the metre, but upon seven base units and two supplementary units. These are:

SI Base Unit	Unit Name	Unit Symbol
A. Length	Meter	M
B. Mass	Kilogram	Kg
C. Time	Second	S
D. Electric current	Ampere	A
E. Thermodynamic temperature	Kelvin	K
F. Amount of substance	Mole	MOL
G. Luminous intensity	Candela	cd
SI Supplementary Units		
Plane angle	radian	RAD
Solid Angle	Steradian	Sr

2. As to the consistency of the system, all base units are to be minus prefixes but mass is in KG rather than g. The meter is not 1/10,000,000th of the earth's guadrant. The liter is not identical to an equal number mass unit. The Knot still must be used in navigation due to the inconsistency between the SI system and latitude-longitude measures.

3. Since when is time in hours, seconds, etc., decimal? In fact, a great deal of Mother Nature's actual functioning, which we feebly attempt to "model" with mathematics, is in no way decimal. In ballistics, electronics, and many other sciences, Mother Nature seems to come closest to exponential increments, not decimal increments.

4. The SI is so complicated that only France has legislated its total adaptation. One has only to look at the immense conversion tables used in the exchange of familiar, centuries useful, terms for SI derived units with special names (usually totally nondescriptive of the unit's functional purpose) to discover the needless complexity of the system.

Kilopascals for tire pressures is a beautiful example, though even SI countries continue to use the inch measurement for wheel sizes. Pounds per square inch is absolutely simpler to understand, even for one raised in the SI system, as a pressure over an area, than is KPA, for which not even the Frenchmen have an intuitive feel because of its recent derivation.

The most telling argument regarding the SI is the admittedly inferior international standards that would replace our American national standards should we adopt such a system.

There are advantages, at times, in each system and when such advantages occur, it is appropriate to use that system. The advent of the modern calculator and the most basic knowledge of the factor-label system negates any advantage placing the world on a single system ever implied.

$$\frac{.30\ \not{in}}{1} \times \frac{2.54\ \not{cm}}{1\ \not{in}} \times \frac{10\ mm}{1\ \not{cm}} = 7.62\ mm$$

Cancel labels and multiply and divide factors using unit conversion values:

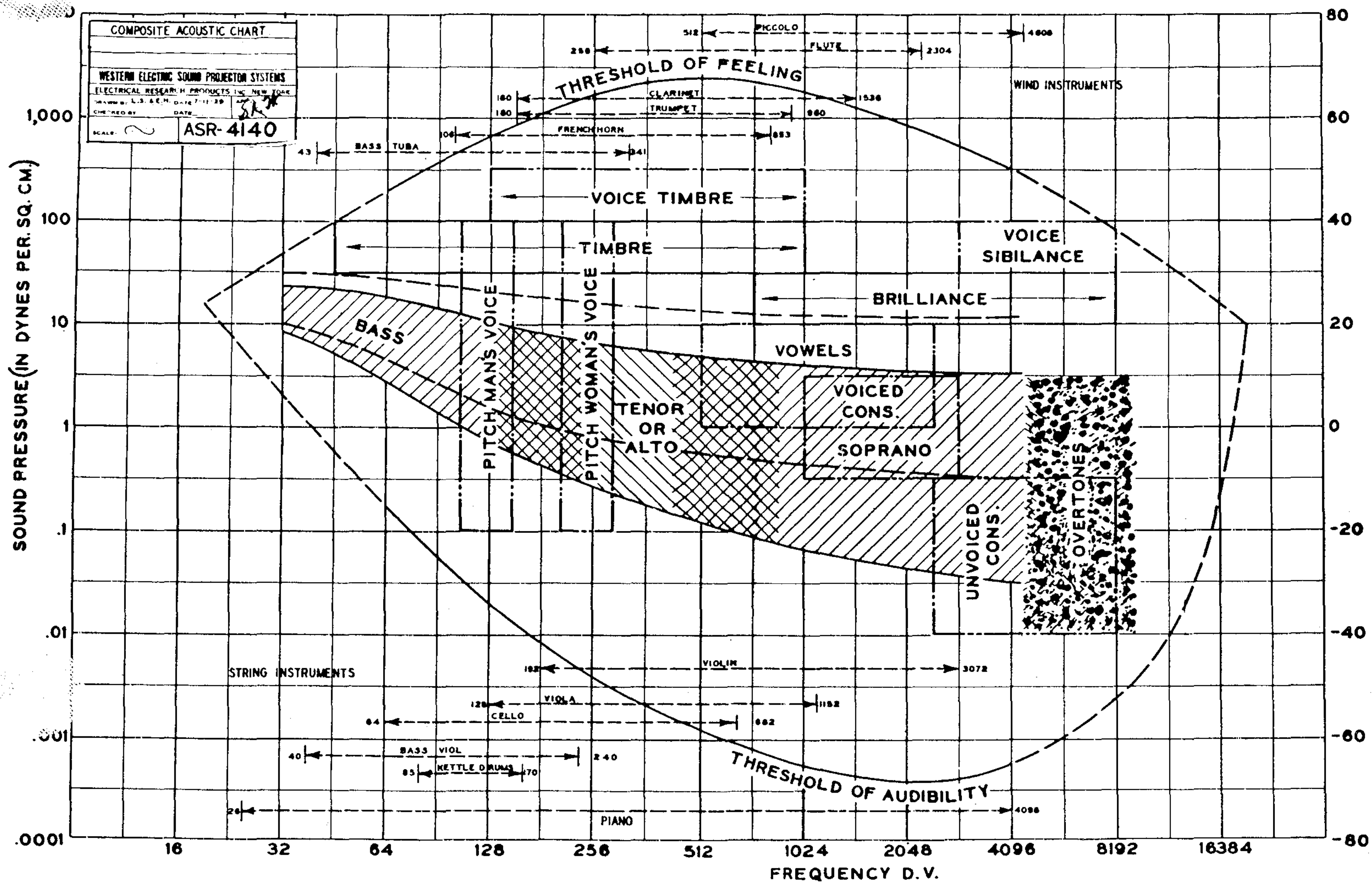
$$\left(\frac{2.54\ cm}{1\ in}\right) = 1 \qquad \left(\frac{10\ mm}{1\ cm}\right) = 1$$

Let's hope the half-informed, led by the impractical academician, doesn't lead us into a new way of measuring national bankruptcy.

COMPOSITE ACOUSTIC CHART

ED BANNON of Las Vegas Recording (and the first TEF™ licensee) arrived at our office with the following drawing. It's the July 1929 drawing from the Bell Labs Record of their "to become famous" Composite Acoustic Chart.

Note that 0 sensation units is 1 dyne per square centimeter which is 74 dB-SPL (today's nomenclature would term it 0.1 pascal and a Lρ of 74 dB). This venerable chart is in its 51st year of hardy usage and will probably appear (without credit) in thousands of books on sound.



COURT DECISION OF IMPORTANCE

Reprinted from Newsletter, Volume 3, Number 3

On December 14, 1974, the Federal 1st Circuit Court affirmed a very important decision handed down by the United States District Court, Mass., in the case of Whitten Corp. vs. Paddock, Inc. The U.S. Supreme Court has rejected further appeal and further review.

Four major judgments regarding specifications develop from this landmark decision:

1. An engineer may limit his specification to one brand only without being in violation of anti-trust law
2. The specifier is the sole judge of what equipment may be accepted as "or equal"
3. Only the specifier may change what equipment is allowed
4. It is up to the supplier to convince the specifier that his equipment is suitable. (He must sell the specifier if he wishes to be included in the specification.)

You can write tight specifications without fear of legal actions forcing acceptance of other products. Remember, however, that while the specifier has greater power now, he also can be held legally responsible for any specification that turns out badly, or, for example, causes injury, etc.

DENVER CLASS - SEPTEMBER 1-3, 1981

SIMPLE ?? NUMBERS

When you use the digits 1, 2, 3, etc., you unconsciously are assuming quite a number (no pun intended) of things.

1. Numbers have *magnitude*. Two is larger than one; three is larger than two, etc.

2. Numbers have *signs*. If we wrote down what we assumed, we'd have written +1, +2, +3, etc.

3. Numbers are ratios. We recognize this *every* time we do a decibel problem. 1/1, 2/1, 3/1, etc.

4. Numbers have exponents. We don't always indicate them, but we assume them. For example, we could write 1', 2', 3', etc.

5. Then, there is that marvelous digit zero. It has no magnitude, ratio, exponent or sign. It is the symbol for the idea of nothingness. Zero is the "placeholder" in large numbers.

6. Finally, there is the fact that simple numbers have direction (vectors). The most famous of these directional indicators is the Argand or Gauss plane. (See illustration)

7. Any digit raised to the exponent of zero equals unity. 10^0, 100^0, 1000^0, all = 1.

8. Digits raised to positive number exponents are larger numbers. $2^2 = 4$

9. Digits raised to fractional number exponents are *roots* of numbers. $2^{1/2} = \sqrt{2}$

10. Digits raised to negative number exponents are fractional numbers. $2^{-\{2\}} = 1/4$

    $$+ (2/1)^{-2} = +\left(\frac{.25}{1}\right)^1$$

11. Numbers are reciprocals $1 = \frac{1}{1}$

    $2 = \frac{1}{.5}$

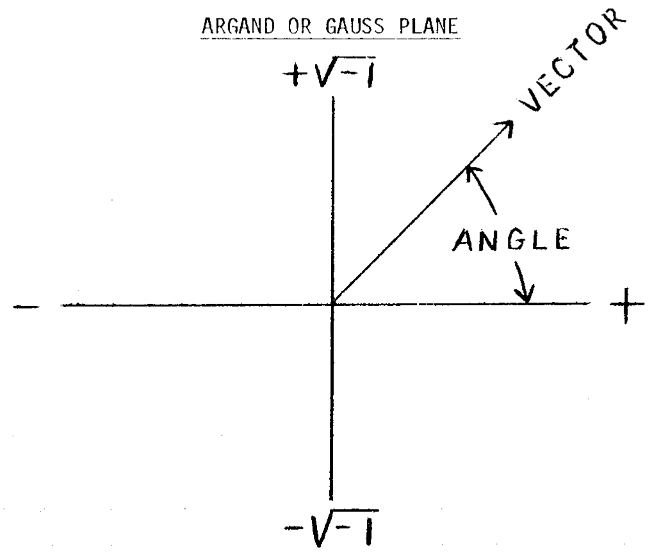
    $3 = \frac{1}{.33}$

12. Numbers are roots $1 = \sqrt{1}$

    $2 = \sqrt{4}$

    $3 = \sqrt{9}$

ARGAND OR GAUSS PLANE



$$\sqrt{-1} \equiv j \equiv i$$

When *labels* are added to numbers then they can no longer be thought of as simple, but even in their simple forms the meanings they have can easily be overlooked by the casual observer.

A SLIGHTLY DIFFERENT VIEW OF ACOUSTIC REFERENCES

$$L_W = 10 \log \frac{X \text{ watts}}{10^{-12} \text{watts}}$$

Substituting a value of 1 for X:

$$L_W = 10 \log\left(\frac{1\text{w}}{10^{-12}\text{w}}\right) = 120 \text{ dB}$$

Therefore:

$$L_W = (10 \log X \text{ watts} + 120) \text{ dB}$$

$$L_p = 20 \log \left(\frac{X\text{PA}}{20\mu\text{PA}}\right)$$

Substitution of 1 for X gives:

$$L_p = 20 \log \left(\frac{1\text{PA}}{20\mu\text{PA}}\right) = 94 \text{ dB}$$

Therefore:

$$L_p = (20 \log X \text{ PA} + 94) \text{ dB}$$

CONVERTING LINEAR SCALES TO LOGARITHMIC SCALES

A linear frequency scale is one on which each equal length division represents an equal number of Hz. Thus, addition of this equal number of Hz to the last frequency gives the next frequency in the series.

A logarithmic scale is one on which equal length divisions represent an exponential constant. Thus, multiplying the last frequency by the exponential constant gives the next frequency in the series.

LINEAR AND LOGARITHMIC SCALING OF EQUALLY SPACED INTERVALS FROM 0 TO 300

LINEAR SCALE (6 INTERVALS – 7 POINTS)

0 50 100 150 200 250 300

$$\text{EACH INTERVAL} = \left(\frac{\text{HIGHEST VALUE LABEL}}{\text{NUMBER OF INTERVALS}}\right) = \left(\frac{300}{6}\right) = 50/\text{INTERVAL}$$

LOGARITHMIC SCALE (6 INTERVALS – 7 POINTS)

1 2.59 6.69 17.32 44.81 115.95 300

$$\text{EACH INTERVAL} = \left(\frac{\text{HIGHEST VALUE LABEL}}{\text{LOWEST VALUE LABEL}}\right)^{\frac{1}{\text{NUMBER OF INTERVALS}}} =$$

$$\left(\frac{300}{1}\right)^{\frac{1}{6}} = 2.59^{(\#\text{ OF POINT})}$$

ie: $2.59^0 = 1$
$2.59^1 = 2.59$
$2.59^2 = 6.69$
$2.59^3 = 17.32$
⋮
$2.59^6 = 300$

ALTERNATIVE PLOTTING

$x \text{ LOG}(\text{HIGHEST VALUE LABEL}) = \#\text{ OF INTERVALS}$

$x \text{ LOG } 300 = 6 \text{ INTERVALS}$

$x = \frac{6}{\text{LOG } 300} = 2.42$

$2.42 \text{ LOG } 300 = 6 \text{ INTERVALS}$
$2.42 \text{ LOG } 44.82 = 3$ "
⋮

EXAMPLES

If I wish to divide a linear scale into six equal parts (seven points including the first and the last with six equal length intervals enclosed between the points) with the maximum value equal to 300 and the beginning at zero, I merely divide the maximum value by the number of equal intervals desired.

$$\frac{300}{6} = 50/\text{interval}$$

The first point is 0; the second point is 50 (enclosing one interval); the third point is 100 (enclosing the second interval); the fourth point is 150 (enclosing the third interval);... the seventh point is 300 (enclosing the sixth interval).

If, instead, I wish to divide the same length scale into six equal logarithmic intervals from 1 to 300, I need to obtain the multiplier constant.

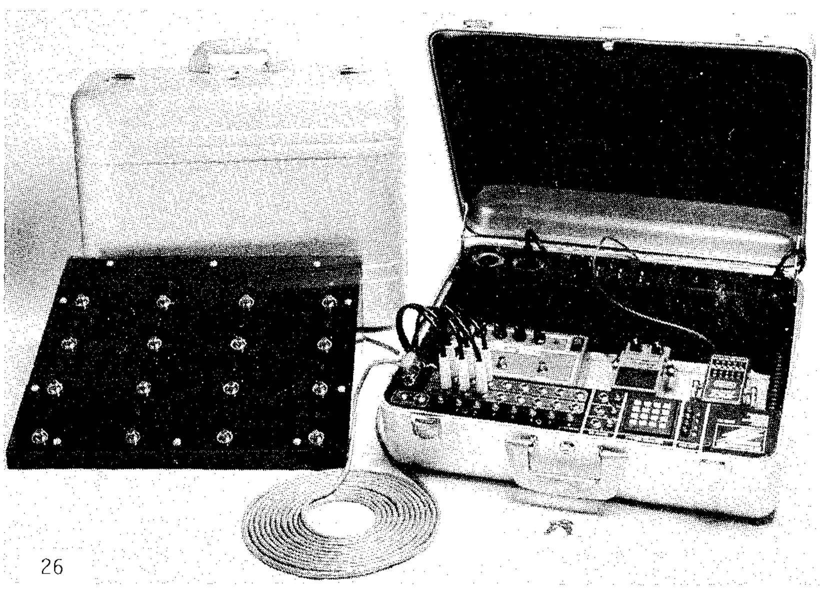
$$\left(\frac{300}{1}\right)^{1/6} = 2.59$$

The first point is then 1.0; the second point is 2.59 (enclosing the first interval); the third point is 6.69 (2.59 X 2.59) (enclosing the second interval); the fourth point is 17.32 (2.59 X 2.59 X 2.59) (enclosing the third interval);....the seventh point is 300 $(2.59)^6$ (enclosing the sixth interval).

These two scales are illustrated above along with the mathematics for their division into 6 intervals with 7 points.

1/3 octave scales are logarithmically spaced intervals. Time delay anomalies are equally spaced on linear scales. The decibel scale is a logarithmic scale. The voltmeter scale is a linear scale. We need to cultivate familiarity with both types of scales and often real insights are gained by transferring data from one of these scales to the other.

THE CONTROLLER FROM SOUNDER ELECTRONICS



Sounder Electronics of Mill Valley, CA produces a product called the Controller. It features 16 easy-to-program "presets" that are combinations of:

8 signal path bypass switches
8 control switches
4 outputs

Intended for use by musicians, we felt the basic device offered real potential as a controller of security systems where the 16 microswitches could be the basis of a detection system at a reasonable price in a compact form.

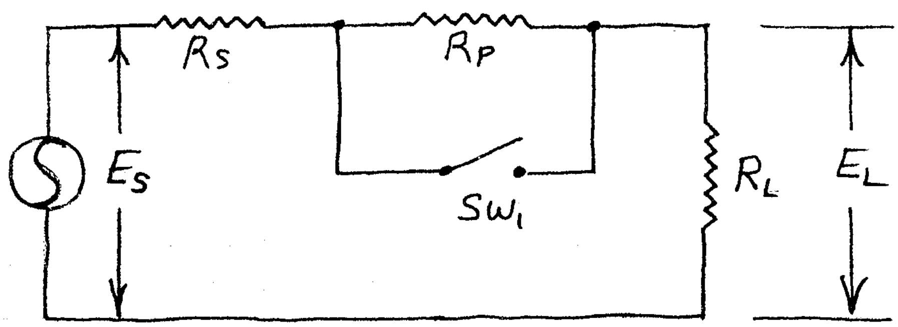
For further information write:

Sounder Electronics Inc
21 Madrona St.
Mill Valley, CA 94941
(415) 383-5811

WHAT ARE "K" NUMBERS AND WHERE DO THEY COME FROM?

Back in the early 1930's, P. K. McElroy developed lengthy tables of "K" numbers for the design of attenuators. Prior to the advent of scientific calculators with their marvelous 10^x keys, finding antilogs could be a tedious excursion into Bruhn's seven place logarithmic tables or Vega's ancient ten place tables.

The example given here should aid you in understanding how "K" numbers came into being and what you really are doing when you employ them.



WHAT R_P WILL DROP E_L BY 3.01 dB WHEN SW_1 IS OPENED.

$$R_P = R_S + R_L(K-1)$$

To the question, "What Rp will drop E_L by 3 dB when SW_1 is opened?", we can calculate:

$$E_{L_1} = E_S\left(\frac{R_L}{R_S+R_L}\right) \quad (Sw_1 \text{ closed})$$

$$E_{L_2} = E_S\left(\frac{R_L}{R_S+R_L+R_P}\right) \quad (Sw_1 \text{ opened})$$

And since we wish to know:

$$\frac{E_{L_2}}{E_{L_1}} = 3.01 \text{ dB}$$

We write:

$$10^{\left(\frac{3.01 \text{ dB}}{20}\right)} = \frac{R_S+R_L}{R_S+R_L+R_P}$$

$$\text{And:} \quad R_P = R_S+R_L\left(10^{\frac{3.01}{20}}-1\right)$$

Or substituting K for $10^{\frac{3.01}{20}}$: $\quad R_P = R_S+R_L(K-1)$

EXAMPLE

If we have an $R_S = 0$ and an $R_L = 8\Omega$, then: $\quad R_P = (0+8)(1.41-1) = 3.31\Omega$

Proof: $\quad 20\log\left(\frac{8}{8+3.31}\right) = -3.01 \text{ dB}$

Thus, by this procedure we have defined "K" as: $\quad K^2 = \frac{\text{power in}}{\text{power out}}$ (for pads)

From which it follows that: $\quad$ Pad loss in dB $= 20 \log K$

And by transposition: $\quad K = 10^{\left(\frac{\text{pad loss in dB*}}{20}\right)}$

When utilized in this form, "K" is always greater than unity (1.0) - values less than 1.0 indicate gain - and 1.0 represents a short circuit between input and output.

*Where pad losses are expressed as positive numbers of so many dB.

GENERATION OF "CONVERSION FACTORS" BY THE USE OF THE "FACTOR LABEL" METHOD

Suppose we wanted to generate a conversion factor for the changing of miles per hour (mph) into kilometers per hour (kmph).

$$1 \text{ mi}\left(\frac{5280 \text{ ft}}{1 \text{ mi}}\right)\left(\frac{12 \text{ in}}{1 \text{ ft}}\right)\left(\frac{2.54 \text{ cm}}{1 \text{ in}}\right)\left(\frac{\text{M}}{100 \text{ cm}}\right)\left(\frac{\text{km}}{1000 \text{ M}}\right)$$

then: $\quad \frac{5280 \times 12 \times 2.54}{100 \times 1000} = \text{km} \qquad 1 \text{ mi} = 1.609344 \text{ km}$

and: $\quad 1/x$ yields $1 \text{ km} = 0.621371 \text{ mi}$

COMPLEX NUMBER OPERATIONS

1. TO ADD COMPLEX NUMBERS

   Use rectangular form. $(A + iB)$. Add real parts and then add i parts ($j \equiv i \equiv \sqrt{-1}$).

2. TO SUBTRACT COMPLEX NUMBERS

   Use rectangular form. Subtract real parts and then subtract i parts.

3. TO MULTIPLY COMPLEX NUMBERS

   Use the polar form ($A\angle\theta$ or $Ae^{i\theta}$). Multiply magnitudes and add angles.

4. TO DIVIDE COMPLEX NUMBERS

   Use the polar form. Divide magnitudes and subtract angles.

5. TO OBTAIN POWERS OF COMPLEX NUMBERS

   Take the power of the magnitude, *i.e.*, A^X, and multiply the angle by the exponent of the power, *i.e.*, $e^{iX\theta}$.

6. TO OBTAIN ROOTS OF COMPLEX NUMBERS

   Use the polar form. Extract the root of the magnitude, *i.e.*, $\sqrt[X]{A}$, and divide the angle by the index of the root, *i.e.*, $\angle\theta/X$ or $e^{\frac{i\theta}{x}}$.

   A^X where the base, A, is raised to the power of the exponent, X.

   $\sqrt[X]{A}$ where the X root of the number A is obtained. X is the index of the root.

CONVERSION FACTORS FROM BASE UNITS

Suppose we wanted to generate a "conversion factor" for converting $\frac{\text{lbs (f)}}{\text{ft}^2}$ into pascals (pa). (The pascal is the same as newtons per square meter $\left(\frac{N}{M^2}\right)$.)

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

Then: $pa = M \cdot KG \cdot S^{-2} \cdot M^{-2}$ Or: $pa = \frac{KG}{M \cdot S^2}$

There are: 2.204622 lbs.in 1 KG And: 3.28084 ft. in 1 meter

However, newtons are a "force" measurement so we don't want the weight but the lbs. force (slugs) per ft. sec^2 which is the same as a pressure in $\frac{\text{lbs f}}{\text{ft}^2}$.

Therefore, we divide the weight by the gravitational value 32.174040 to obtain slugs.

$$\frac{\left(\frac{2.204622}{32.174040}\right)}{3.28084} = \frac{0.020885 \text{ lbs f}}{\text{ft sec}^2} \qquad \text{Or:} \qquad 1 \text{ pa} = \frac{0.020855 \text{ lbs f}}{\text{ft}^2}$$

and $1/X$ yields $\frac{1 \text{ lb f}}{\text{ft}^2} = 47.880260$ pa

Atmospheric pressure is said to be 2116.2 lbs/ft^2 at the earth's surface (sea level). Then 47.880260 X 2116.2 gives the number of pascals: 101,324.2055 pa.

Our zero reference sound pressure is .00002 pa (20 upa).

Then full modulation of atmospheric pressure would be a sound pressure *level* of:

$$20 \log\left(\frac{101{,}324.2055 \text{ pa}}{.00002 \text{ pa}}\right) = 194.0937 \text{ dB}$$

DECIBEL -- THE NAME FOR THE TRANSMISSION UNIT

In the Bell System Technical Journal of January 1929 there is an article entitled, "Decibel -- The Name for the Transmission Unit" by W. H. Martin.

In this article the predecessors to the decibel, dB, namely, the "mile of standard cable and the transmission unit, T.U., which superseded the "M.S.C." in 1923 are identified.

The new unit, the dB, is defined as:

"Any two amounts of *power* differ by "N" transmission units when they are in the ratio of $10^{N(.1)}$"

$$\frac{P_1}{P_2} = 10^{N(.1)}$$

Thus, we can perform the following manipulation mathematically

$$\mathrm{Log}_{10}\frac{P_1}{P_2} = \mathrm{Log}_{10}\ 10(N)(.1)$$

Since

$\mathrm{Log}_{10}\ 10 = 1$, we can write $\dfrac{\mathrm{Log}_{10}\frac{P_1}{P_2}}{1/10} = N$

Or, simplified

$10\ \mathrm{Log}_{10}\left(\frac{P_1}{P_2}\right) = N$ Where N is the number of decibels

$.947(SCM) = dB$

$1.056(dB) = SCM$

WRITING EQUATIONS FOR COMPUTERS AND TYPEWRITERS

The Hopkins-Stryker equation

$$\Delta D_x = 10 \log \left(\frac{Q}{4\pi(D_x)^2} + \frac{4}{S\bar{a}}\right)$$

can be written as:

$$\Delta D_x = 10 \log ((Q/4\pi(D_x)^2) + (4/S\bar{a}))$$

and be kept all on one line.

The Norris-Eyring equation

$$\bar{a} = 1 - e^{-\left(\frac{.049V}{S\cdot RT_{60}}\right)}$$

becomes

$$\bar{a} = 1 - e(\exp)\ (.049V/S\cdot RT_{60})$$

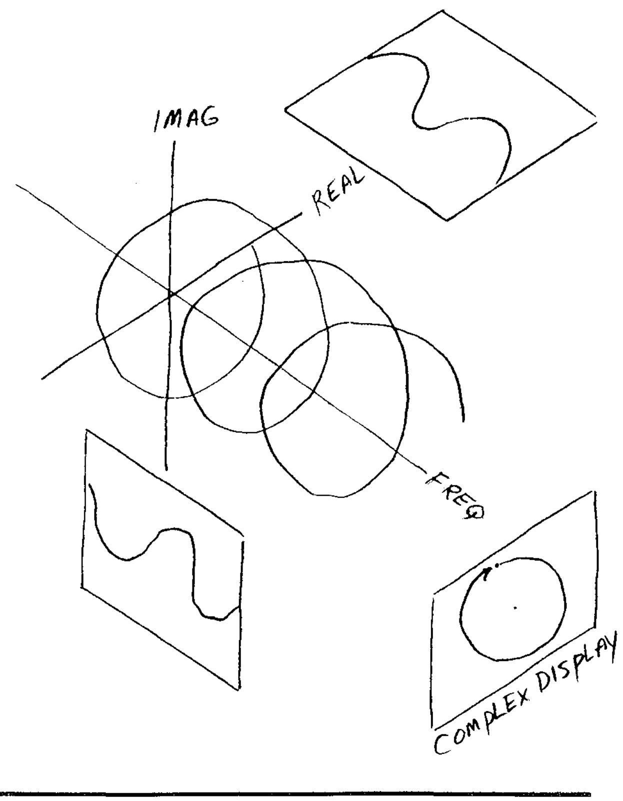
And, finally, carried to its logical conclusion

$$Ae^{i\theta}$$

would become

$$Ae(\exp)(i\theta)$$

THE SINE WAVE IS A CIRCLE



SMILE

From U.S. News & World Report, June 15, 1981, in an article discussing Santa Fe, New Mexico: (excerpt)

> The premier character is the artist known as "El Diferente" -- real name Tommy Macaione -- who lives with 21 dogs and 75 cats and who has run unsuccessfully for mayor six times. He can get up to $2,000 for his impressionistic landscapes but may part with one for much less if he needs pet food. It's a matter of some speculation locally just why Macaione has so many animals. When asked, he pauses, and says at last: "The dogs eat my paint. Then, of course, they pass it. Reds, blues, greens. What Picassos!"

BOOKS OF INTEREST

IGOR SIKORSKY - HIS THREE CAREERS IN AVIATION

GLEN BALLOU of Sikorsky in Connecticut recently sent us a book on Igor Sikorsky, written by Frank J. Delear and published by Dodd, Mead and Company, 1976, revised edition.

Until this little volume came into my hands I suffered the illusion that I had at least a slight grasp of the history of aviation. *Igor Sikorsky - His Three Careers in Aviation* accomplishes a series of significant results:

1. It reminds us still again of the vitality, resourcefulness and creativity of immigrants to the United States and their role in our security and well being
2. It introduces us to the absolutely unbelievable 4-engine air *ships* that Sikorsky built and flew *prior* to World War I. Airship is the proper word as these flyers built balconies in front of and promenades on top of huge aircraft that actually used such facilities in flight.
3. It introduces us to Igor Sikorsky's part in the world's first 4-engine aircraft, the world's first successful flying boats, and the world's first successful helicopters anyone of which was individually a worthy lifetime accomplishment,

The photographs are startling and include pictures of the "Grand", the first 4-engine aircraft, and the "Ilia Mourometz", the first 4-engine bomber being landed in St. Petersburg with two crewmen standing on the catwalk on top of the fuselage with only a hand rail for support.

Especially intriguing are the wings designed by Michael Gluhareff, a Sikorsky associate, that raised the old Jenny's speed from 70 to 90 mph and eliminated the treacherous stall tendencies previously associated with that aircraft.

The history of the great Pan American Flying Clippers prior to WWII and their remarkable superiority over foreign competitors is beautifully told including the use of increased wing loading and the introduction of "flaps" to overcome the real objection to increased wing loading, namely a higher landing speed. The advantages of increased wing loading included higher speed, larger range, and better performance on less than 4 engines.

Too much is written today about depressing personalities. This is an uplifting book about a dreamer who lived his dreams through courage, perseverance, and inspiration. Those are qualities worth sharing vicariously.

THE HUMAN SIDE OF ENGINEERING

THE HUMAN SIDE OF ENGINEERING--Tales of General Electric Engineering over 80 years, by Philip L. Alger. Published by the Mohawk Development Service, Inc., 1972 (soft back).

Mr. Alger is a long-time General Electric engineer fortunate enough to have experienced the era of engineering giants at General Electric and perceptive enough to have recorded much of interest about their personalities and beliefs.

I originally purchased the book seeking to find out who the management genius was who managed Charles "Proteus" Steinmetz (1865-1923). The man was Edwin W. Rice, Jr. (1862-1935), Technical director of the Thomson-Houston Company, Lynn, Massachusetts. Rice became Elihu Thomson's right-hand man, chief engineer of the General Electric Company, formed in 1892 and, later, president of the company.

Mr. Alger writes that Rice was "in 1917, president of the AIEE" and he was awarded the Edison Medal in 1931. "His *judgment* of men and his engineering knowledge were invaluable in building up the technical staff and the achievements of General Electric."

Rice had the intelligence of mind and the wisdom capable of appreciating Steinmetz's unique gifts and he gave Steinmetz complete freedom within the company.

W.L.R. Emmet (1859-1941) said about Steinmetz, "Steinmetz was a wonderful teacher. His understanding was lucid to an extraordinary degree.....He could draw diagrams and make calculations which made everything clear in the simplest way, and he took a great interest in giving his help to anyone who wanted it....His greatest work was to start the General Electric engineers upon the use of proper methods of calculation."

Steinmetz had a quotation hung on his wall that he greatly admired:

The man who once most wisely said
Be sure you're right, then go ahead,
Might well have added this, to wit:
Be sure you're wrong before you quit.

There are probably more clues to what really constitutes a real manager of major enterprises in this book than I have been able to find in the most obese management texts. Alger's contempt for "job descriptions" and their insidious "fencing off" of talent is generously illustrated with real-life examples.

This book is a difficult one to lay down. It is divided into short sections devoted to the many famous engineers who have worked for General Electric. Mr. Alger is obviously a very talented man in his own right and has produced a beautiful example with his title, *The Human Side of Engineering*.

ELECTRONIC CALCULATOR USERS HANDBOOK

I've always admired the intestinal fortitude of authors willing to write something like the *ELECTRONIC CALCULATOR USERS HANDBOOK.*

Most are obsolete before the ink dries on the original manuscript, to say nothing of the printed version. This book, however, by M. H. Babani is a powerfully useful collection of conversion data, formulas, and equations for accomplishing almost any mathematical engineering task.

If you don't find out how to do it in this book, you are into higher mathematics.

NEW CALENDAR

In our spare time we have been working on the idea of revising our present calendar which has been so traditional for many years. Much study has produced a new version especially designed for sales and production. Perhaps you will find this as useful as we did.

NEG.	FRI.	FRI.	THUR.	WED.	TUE.	MON.
8	7	6	5	4	3	2
16	15	14	13	12	11	9
23	22	21	20	19	18	17
31	30	29	28	27	26	25
38	37	36	35	34	33	32

THIS NEW CALENDAR TAKES CARE OF RUSHWORK . . . SINCE EVERYONE WANTS HIS JOB YESTERDAY, . . . AN EXECUTIVE CAN NOW ORDER HIS JOB ON THE 7th AND HAVE DELIVERY ON THE 3rd . . . MOST WORK IS REQUESTED FOR FRIDAY, HENCE TWO FRIDAY'S IN EVERY WEEK. . . . THERE ARE 7 EXTRA DAYS AT THE END OF EACH MONTH TO ALLOW FOR RUNS WHICH MUST BE MADE TO MEET MONTH-END DEADLINES. . . . ELIMINATING SATURDAYS AND SUNDAYS HELPS AVOID WEEKEND WORK SCHEDULES . . . A NEW DAY CALLED "NEGOTIATION DAY" HAS BEEN ADDED SO THAT NEW SCHEDULE DATES CAN BE NEGOTIATED AND MODIFICATIONS REVIEWED ONCE A WEEK.

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CLASSIFIED

FOR SALE: HP-3580A Spectrum Analyzer
HP-3385 Synthesizer Function Generator
GenRad 2512 Spectrum Analyzer

The above equipment is used with the Heyser (TEF™) interface module. It is identical to the equipment that Syn-Aud-Con uses for their TEF™ setup.

Price: $12,000 (one half original cost). For further information contact Ed Bannon of Las Vegas Recording, currently working on a job at Tres Virgos where he can be reached by telephone - (415) 456-7666.

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SYN-AUD-CON SPONSORS

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

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

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

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