THE SOUND ENGINEERING MAGAZINE

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OCTOBER 1981
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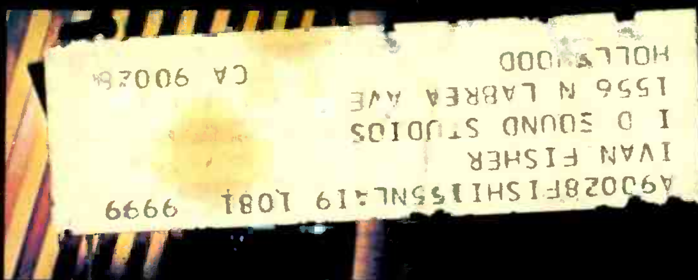

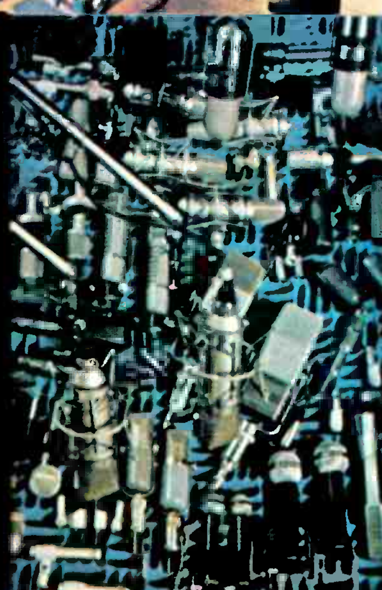

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Graphics
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sales offices

Roy McDonald Associates, Inc.

Dallas, Texas 75237
First Continental Bank Bldg.
5801 Marvin D. Love Freeway
Suite 303
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Denver, Colorado Area
Englewood, Colorado 80112
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ABOUT THE COVER

- Our thanks to C. Nicholas Colleran for this month's cover: a photo montage of some of the architectural acoustics found at Alpha Audio's studios in Richmond, Virginia.

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DEPARTMENTS

FEATURES

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Calendar

OCTOBER

7-9 **Natural Stereo Techniques for Recording Music Workshop.** University of Wisconsin at Eau Claire. For more information contact: Burton Spangler, Audio Coordinator, Media Development Center, UW—Eau Claire, WI 54701. Tel: (715) 836-2651.

13-15 **The 11th Conference of the Western Educational Society for Telecommunications.** Harrah's, Reno, Nevada. For more information contact: Dr. Donald Price, Media Production Services, California State University, Los Angeles, CA 90032. Tel: (213) 224-3396.

25-30 **The 123rd SMPTE Technical Conference Exhibit.** Century Plaza Hotel, Los Angeles. For more info contact: SMPTE, 862 Scarsdale Ave., Scarsdale, NY 10583. Tel: (914) 472-6606

30-Nov. 2 **AES 70th Convention.** Waldorf Astoria, New York City, NY. For more information contact: The Audio Engineering Society, 60 E. 42nd St., Rm 2520, New York, NY. Tel: (212) 661-8528.

NOVEMBER

3-6 **Conference on Corporate Applications of Interactive Videodiscs.** Co-sponsored by Columbia Business School and The American Video Institute. Columbia Business School, Uris Hall (Broadway and 116th St.), New York City. For more information contact: Davis Temin at Columbia—(212) 280-2747 or Miriam Warner at AVI—(212) 864-1415.

12-15 **Billboard Magazine's 3rd Annual International Video Entertainment/Music Conference.** Beverly Hills Hilton, Los Angeles. For more information contact: Billboard Magazine's Conference Bureau, 9000 Sunset Blvd., Los Angeles, CA 90069. Tel: (213) 273-7040.

25-27 **Prosound '81 Professional Sound Equipment Exhibition.** West Centre Hotel, London. For more information contact: Batiste Exhibitions & Promotions, Pembroke House, Campsbourne Road, London N8. Tel: 01-340 3291.

Index of Advertisers

Coming Next Month

• In November, our featured topic is Studio Construction Techniques. George Augspurger gives us his views on "Contemporary Mixdown Room Design" in the first of our two-part feature on Joe Tarsia's Sigma Sound Studios. And from California, we'll present two views (owner's and builder's) of a construction project at Tres Virgos Studios.

Barry Hufker returns to our pages with a computer program for designing Helmholtz resonators, and of course, our regular columnists will be on hand with the latest on digital audio, theory and practice, and sound with images.

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BARRY BLESSER

db Digital Audio

• Sometimes it is entertaining and instructive to step back to look at an issue from a philosophic basis without regard to details. For example, a digital signal is a time-varying voltage. An audio baseband signal is also a time-varying voltage. Therefore, the baseband audio and its digital representation are both the same kind of signal; information comes from a voltage which changes with time. The difference is only one of format. The same sort of comparison could be made within an FM modulation system. Here, the input is the audio baseband and the output is a frequency-modulated sinewave. As above, both are ordinary voltages which change with time. Using this orientation we can say that an A/D converter is a modulator which changes the way in which information (an abstraction) is carried by the physical potential difference between the wires (voltage).

The underlying drift of this series of articles is that the A/D modulation process takes a fragile audio signal and transforms it into an indestructible digital signal. That sounds a little like the perpetual motion machine. The sophomore says, "let's use it everyplace since the digital signal is so much better than the baseband audio." The ol' timer says, "There must be a price for making the signal iron-clad." That price is the required bandwidth. FIGURE 1 shows a piece of baseband audio and the corresponding piece of the digital equivalent. Notice that the digital signal has a large amount of high frequency energy since there are frequent sharp transitions from 0 to 5 volts and vice versa. During the same time interval, the audio baseband signal is very slowly changing.

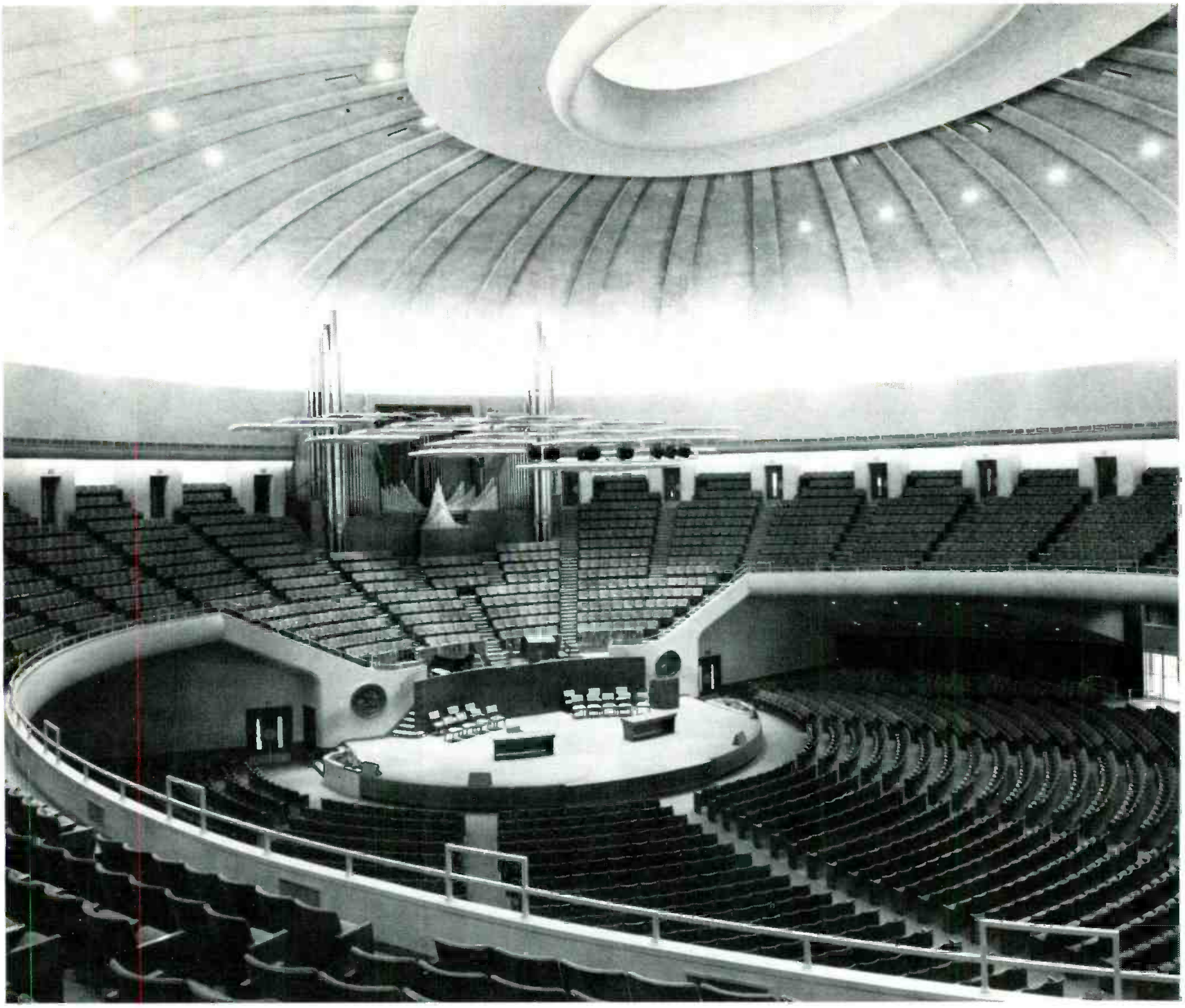
We can state the trade-off in the following way. The immunity of the digital signal to noise comes from the use of a much larger bandwidth than would be required by the baseband audio signal in *unmodulated* form. This is directly analogous to the use of wideband FM modulation instead of AM for communications on radio. The former is much less sensitive to noise degradation than the latter. In standard FM modulation, the bandwidth expansion factor is generally 5:1, since 75 kHz is used for 15 kHz audio. This is explicitly a form of redundancy.

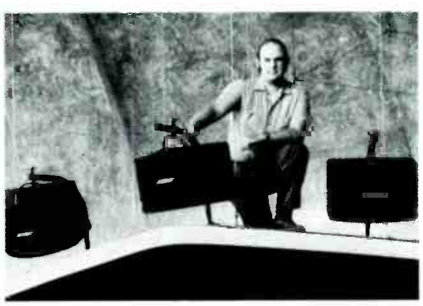
Engineers tend to not appreciate the fact that the digital audio has an expansion factor of something on the order of 100:1. Conceptually, we could transmit the same baseband audio signal in 100 identical versions over the system required for 1 digital audio version. This is another way to add redundancy to the transmission. Digital audio has the image of being robust because there is something magic about digital bits. In fact, the magic is the extra use of bandwidth. For the same redundancy factor, most systems will have essentially the same performance.

ANALOG SIGNALS

I would like to ask you, dear reader, to notice that the above discussion has not used the word analog; rather the input to the A/D converter was referred to as being "baseband audio." We need to do this because the output from a real A/D converter is a signal which is really analog.

Stop. Let's define our terms more carefully. A digital signal is a signal whose voltage values are supposed to be only one of two voltages, e.g. 0 and 5 volts. This is an abstraction. Suppose the actual voltage is 4.6. We say that this is equivalent to 5 volts even though the





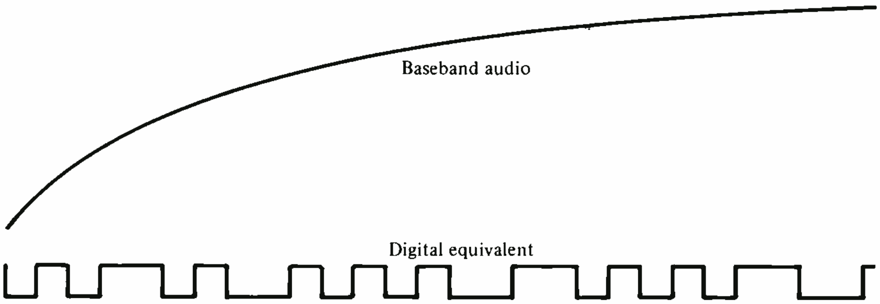


Figure 1. A baseband audio signal with its digital equivalent.

voltage is not 5 volts. An "analog" signal is one which can take on a continuum of voltages. However, the output of a digital device, in making a transition from one voltage to another, is also going through a continuum of voltages. The real way in which the words analog and digital should be used is in the way one talks about the signal. To describe the way a "digital" signal is affected by the low-pass nature of a transmission line we need to think of it as an analog signal. The low-pass filter rounds the corners and smears the bits. This is the language of analog signals.

FIGURE 2 shows both the "digital" signal as it leaves a perfect digital device and the received waveform after transmission over a medium which has some noise and bandwidth limitations. The language of degradation is that of additive noise, phase distortion, amplitude distortion, frequency response, etc. Nevertheless, the digital nature of the *originating* signal means that we can remove the degradation by a special kind of digital-corrector. For example, amplitude errors could be corrected by the following algorithm: if the signal is below 1.5 volts, generate a 0 volt output; if the signal is above 1.5 volts, generate a 5 volt output. Information is only lost if a signal which originated at 5 volts is received at a value less than 1.5 volts. A digital signal is robust because the information tends not to be lost even though the signal is degraded. With a baseband audio signal this degradation also removes information which cannot be recovered if there is no redundancy. We can create an example of pure analog redundancy. Consider sending a precise DC value having 6-digit accuracy (e.g. 1.67639 volts) over a very noisy transmission line with an additive noise that is 100 volts RMS. The receiver could be a low-pass filter with a 1-hour time constant. Such a device filters out the noise (assuming it to be AC) and produces an output of 1.67639 volts. No information was lost because of the redundancy factor. Each piece of the analog signal contained the same information. This was equivalent to sending the same signal an infinity of time. Also notice that a digital representation of the DC signal to 20-bit accuracy would not be received correctly since the 100 volts of noise destroys the digital information.

The robustness of the digital signal is only true if the analog degradations are small enough to avoid destroying the digital information. A signal-to-noise ratio of 20 dB is more than enough to allow a digital signal to remain intact since the voltage values can only be moved 0.5 volts from their transmitted values. However, an S/N of 5 dB would destroy the information. This then points out that the destruction of digital data tends to happen at a threshold. Lower degradations produce no information loss, higher degradation produces complete loss.

DESTRUCTION OF DIGITAL

Now that we are comfortable at looking at a digital signal as if it were analog, we can consider the various forms of degradation. The first is bandwidth limitation. Low-passing a digital signal smooths the corners and reduces the amplitude. In fact, a series of 10101010 (alternating 1 and 0) is actually a square wave. When the bandwidths become too small, the signal is reduced in amplitude and turned into a triangle wave. This form of degradation could easily be corrected since a compensation filter could always be added to match the bandwidth limits. However, if we also assume added noise, then the compensation filter would boost the noise until the digital levels were no longer recoverable. Information loss is thus determined by the combination of noise and bandwidth limits.

Phase distortion is perhaps more serious with a digital signal because phase can be understood as delay. Suppose the delay were not constant with frequency. Then some of the frequency energy from a bit would be delayed more than other energy. This tends to spread one bit into another and makes the result pattern sensitive. There is a simple example of this shown in FIGURE 3. We have the following bit sequence 000000000101010101 which can be thought of as DC (the sequence of zeroes) followed by a squarewave (the alternating 1 and 0). If the degradation produced by a lowpass filter were constant sequence, than the first 1 would look like the last 1. But by intuition we see that eventually the signal will look like a small triangle superimposed on the average value. After awhile, the peaks are shown as 1.8 volts. However, the first 1 only rises to 1.2 volts, since the DC average has not yet established itself. In terms of phase distortion, we say that the initial zeros contained energy which was delayed such that it appeared when the first 1 appeared. After steady state, there were less 0s and hence less 0-like energy to be delayed. Determining the effect of delay distortion on the signal is complex because the experiment is pattern sensitive. Some patterns of 1s and 0s will work fine, others will result in errors.

THE EYE PATTERNS

One analytic tool is called an "eye" pattern because it looks like an eye, as shown in FIGURE 4. This is a difficult concept which can be understood from the following experiment. Send a pattern of random 1s and 0s with the expectation that all possible sequences are present. Take the received series of bits and record them; cut the recording into individual bits and lay them on top. The building of the eye is shown in the

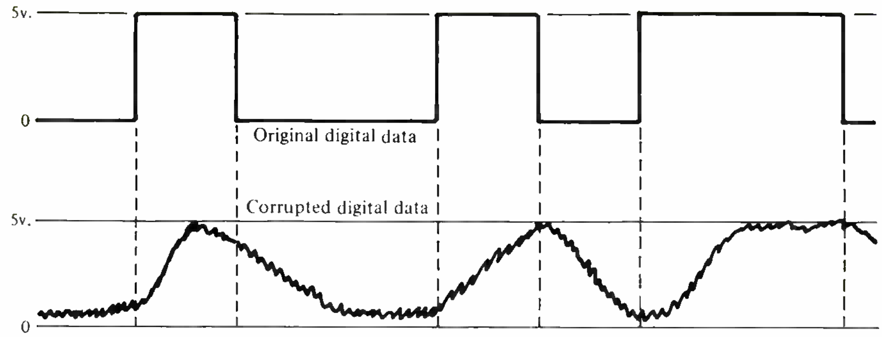


Figure 2. A digital waveform, before and after transmission over a noisy medium.

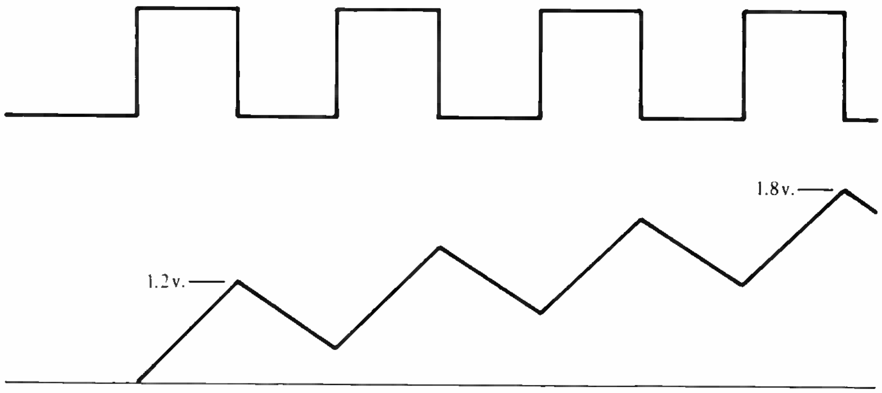
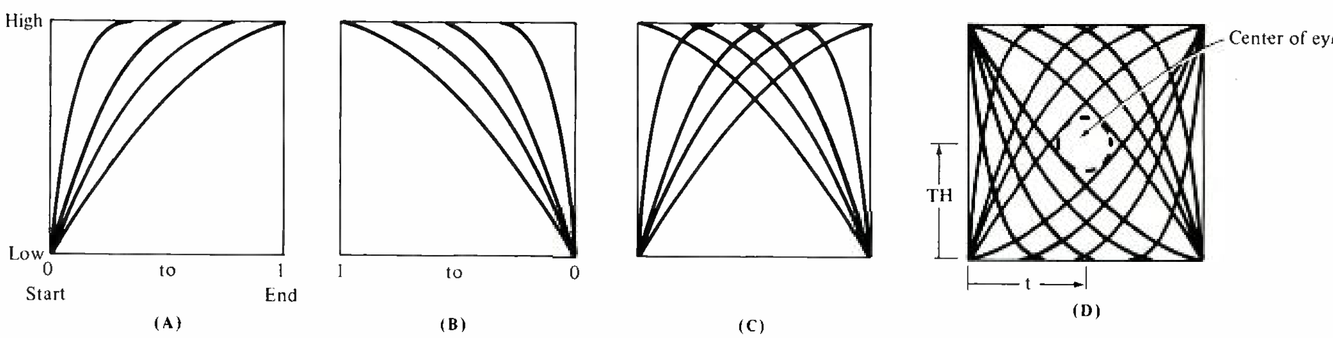


Figure 3. The effect of delay distortion on a digital signal.

sequence of the figure. The top example shows a 0-to-1 transition for several sequences such as 00001, 01001, 11001, 01101, etc. where the actual waveshape is for the last 0-1 transition. The process can continue with various 0-1 transitions shown at the end of the sample cell. The result can be combined to give a composite shown in FIGURE 4C. Finally, the total eye is shown in FIGURE 4D for all possible transitions. If there is a center region (eye) in which there are no transitions, then all 1s and 0s can be regenerated by placing a comparitor at a voltage corresponding to the center of the eye. And the comparitor value must be sampled at a time corresponding to the eye center.

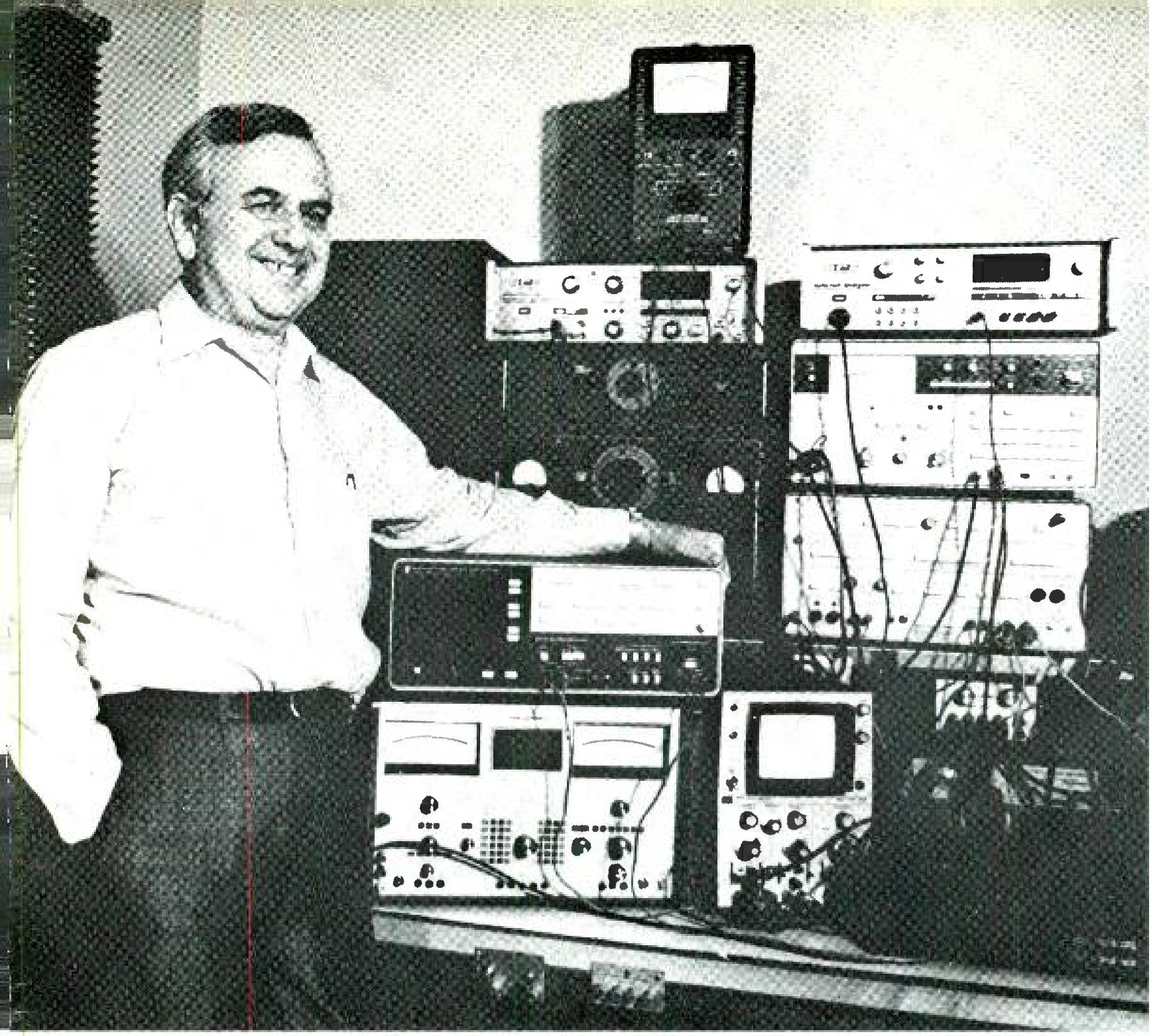


LEGEND:
TH = ideal comparator threshold
t = Ideal sample time

Figure 4. The "Eye Pattern" concept. (A, B) The waveshapes for various sequences of 1 and 0 are observed, and (C) superimposed. After all possible transitions are recorded (D), the center eye pattern provides threshold and sample time information.

The existence of the eye says that there is a unique criterion to determine if the original data can be separated into a 1 or 0, regardless of the sequence. A closing of the eye means bit errors. The size of the eye also gives us information about the sensitivity to noise. If the eye is only 400 millivolts wide, then the maximum noise which can be tolerated is only 200 millivolts. Although we initially said that the noise could be as much as 1.5 volts before a 0 would be turned into a 1, this will only be true with a perfect eye resulting from no frequency and phase effects. As the frequency-phase effect closes the eye, the sensitivity to noise increases.

Digital degradation tends to add in a non-linear interactive way which requires extensive mathematics to understand. Nevertheless, we should note that the transmission and storage of digital data involves the determination of the error rate based on the probability of the eye closing. ■



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NORMAN H. CROWHURST

db Theory & Practice

• Between writing last month's column and this one, the July issue came to hand, with its letters about digital and some interesting suggestions. One writer raised the question concerning a comparison between the effect of continuous versus discrete stimuli on senses other than hearing. I would like to add something to that, before returning to where we left off last month.

Some 40-odd years ago, I became an unwilling participant in a "stimulus experiment." I lost the sight of my right eye due to a severe form of conjunctivitis. Now, why would inflammation of the conjunctiva (the skin of the eyeball) result in loss of vision? The sight went suddenly, during a period of unusually intense pain. Of interest here is the fact that fluorescent lights, and to a lesser extent, looking at a TV screen, aggravated the pain during that period, while sunlight did not.

Fortunately, a visit to a chiropractor terminated the "experiment," my pain, and restored my eyesight. (His adjustment of my spine resulted in a seemingly miraculous cure of my conjunctivitis.) The sight was restored within minutes of the adjustment, which could raise some questions among medical students. One thing that interested (concerned?) me while the experiment lasted, was whether the aggravation caused by fluorescent lights and the TV screen (which in those days was black and white only) was due to its intermittent nature, or its spectral distribution.

While the problem persisted, it interested me both academically and from the practical viewpoint: knowing which it was might help solve the problem. But I never found the answer to that. However, I would suspect it was due to the intermittence. Although the "switching rate" is too fast for me to see, unless the tube is defective or becoming so, I have other evidence which suggests that my retentivity of vision is shorter than average.

When I drive into a tunnel from bright sunlight, I am often aggravated by drivers in front me who obviously take much longer to accommodate to the reduced intensity of illumination, making them slow down much more than I need to do. They tell me that they are virtually blind until their eyesight becomes accommodated to the reduced illumination. Now it would seem logical that, if my eyes can change their sensitivity over a wide range much faster than average, then when subjected to a rapidly fluctuating source, the accommodation mechanism might well be trying to follow it, even though I am not conscious of the "flicker."

Even today, being under fluorescent light gives me a sense of "strain" that is difficult to describe and either will make me feel sleepy, or give me a headache. And I have met a few other individuals with similar observations.

I quoted this experience because it demonstrates, if the explanation is correct, that stimuli can produce effects on our senses, of which we are not directly conscious, although we may be conscious of something we cannot quite identify. Now, back to a comparison of analog and digital in an audio context.

The suggestion that the therapeutic comparison may be explained by the therapeutic effect of noise is interesting, but fails to explain the established fact that noise is therapeutic. Perhaps we should pursue that. Does the presence of noise cause the hearing faculty to relax, and thus have a therapeutic effect on the whole body? Does anyone with experience on this have an answer?

We have covered many distinctions between digital and analog in audio, including the fact that the outer mechanism of the ear is analog, while the

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nerves that convey what is received to the hearing faculty of the brain operate digitally. We have pointed out that our hearing does not identify waveforms by their shape, but by their frequency content. And last month we were getting into the nature of acoustic waves and propagation, which is definitely analog.

While digital systems can handle waveforms as individual entities, a lot more work will be needed before digital can describe the detailed particle movement within sound waves. In the hypothetical plane wave, particle velocity has a waveform identical with sound pressure, so transfer to digital is then just a matter of translation. And the transfer back would recreate the analog from which it was derived.

But the sound wave we hear is never a plane wave, if for no other reason than that our head has to be there, to support the ears with which we pick it up. The presence of our head distorts the wave out of its plane form, assuming it may have been in that form when it arrived. It is that very distortion that is at least partially responsible for our being able to pinpoint sources, or source direction, with such incredible accuracy.

Then there is the fact that a low-frequency tone, such as a fog-horn at sea, can give us a clear indication of direction, while the same sound enclosed in even a reasonably large room, loses all sense of source direction, apparently because of the standing waves it generates. But that can be discussed only on the assumption that waves arriving at the head on which our ears are mounted are plane waves, at least until our head "gets in the way."

Now comes the part of the stereo illusion that was first exploited by the CBS "Isophonic" system, coupled with the simpler phenomenon that can be used to help explain it. Go back to the primitive way in which we used to "phase" speakers. We would select one speaker as our "standard" and phase all the others to it by connecting them, one at a time, in parallel with our standard, while we listened at a distance, to determine which polarity connection was correct.

The speakers were placed side by side, fairly close together, while we listened from a point in front of both of them, on their combined axis, so as to be equidistant from each, or equally off-axis from each. In this position, when the two units are in phase, the sound appears to come from a point mid-way between them. If they are close they seem, jointly, to be the source of the sound. But incorrectly phased, the sound loses its sense of source completely: it could be coming, according to our sense of hearing, from anywhere *but* those two loudspeakers sitting there. Why?

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of phase. So directly in front, where the sound from both is at equal intensity, air particle movement is transverse to the direction in which the sound wave moves forward from the units. This transverse wave also moves forward, reducing in intensity more rapidly than the inverse square law, as we showed earlier. It is nothing like a plane wave.

But now it comes to your head, stuck there in the way. Up to that point, there had been much more particle movement than sound pressure, which was close to zero. The particle velocity was due to the difference in sound pressure (being of opposite phase) on either side of this line of radiation. But now your head creates an obstruction, and particle velocity creates sound pressure in opposite phase at each ear, which is not a normal experience. Hence your confusion.

The same thing happens, perhaps somewhat modified, when your listening position is edge-on to an open-backed loudspeaker. In front, you probably hear the sound fidelity its designer intended. In back, the speaker frame interferes somewhat, but the quality is essentially similar. But as you travel round the unit, or rotate it while you listen, when you are precisely edge-on, it takes on a completely different character. All the bass disappears, and you lose the sense of direction as to where the sound is coming from.

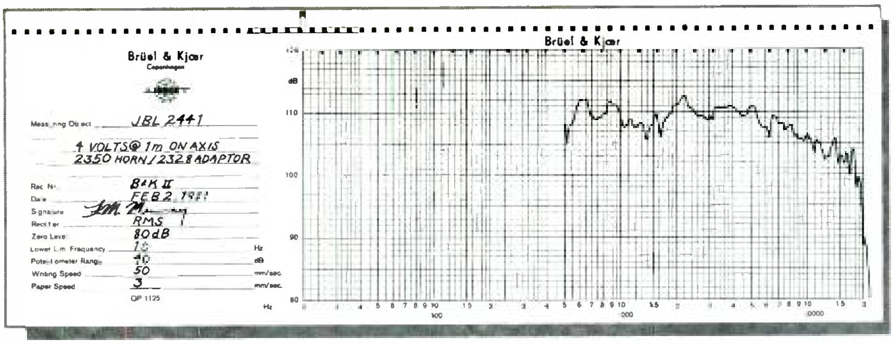
The CBS isophonic system utilized the same principle: the complexity of air particle movement in the vicinity of open-backed speakers. Two of them were used to create an illusion of stereo in which the listener's head plays a part. By obstructing the air particle movement due to the combined acoustic field from both of them, it creates sound pressures at your ears that very closely simulate the true stereo illusion, even when you are not in that favored position between units.

In those days, "getting stereo" was very much dependent on being equidistant from the two units. Cartoonists had a heyday, suggesting that stereo was anti-social, because to hear it properly the listeners had to sit in a single-file line, along the axis between the two loudspeakers, thus one in front of another, so that all anyone but the front listener could see was the back of the head of the person in front of him.

Admittedly, stereo has "come of age" since then. Producers realized that accurate placement of every source element of the program was not stereo's primary purpose (as was then supposed), and they found better ways to get "separation" between channels, which would give the illusion the same quality that enthusiasts had come to expect from mono by that time. But we can learn something from those "along the way" experiences.

The principles of which those observations were evidence have not changed

This is not the only reason to buy JBL's new 2441 compression driver.



Unequalized frequency response of a typical 2441 on a JBL 2350 horn.

As you can see from this frequency response curve, the new JBL 2441 delivers impressive levels of performance. From extended bandwidth to high sensitivity and smooth, peak-free response.

But as important as these performance parameters are, they're only part of the story. Using the latest laser holography and computer analysis techniques, JBL engineers have developed a unique diaphragm design that allows the 2441 to match its outstanding response with unprecedented reliability and power capacity. That means you get exceptionally high performance without the trade-offs found in previous driver designs.

The secret behind this increased performance lies in the diaphragm's three-dimensional, diamond-pattern surround.[1] As outlined in a paper published in the Journal of the Audio Engineering Society,[2] this surround is both stronger and more flexible than conventional designs. This permits the diaphragm to combine all the traditional reliability and power capacity benefits of its aluminum construction with the extended frequency response of more exotic metals. It also maintains consistent diaphragm control throughout the driver's usable frequency range to eliminate uncontrolled response peaks.

Additionally, each 2441 is built to JBL's exacting standards. The magnetic assembly is machined from rugged cast iron and steel. Extremely tight machining tolerances and hand tolerance matching maintain unit to unit consistency. And finally, each 2441 is individually tested to ensure that it meets published specifications.

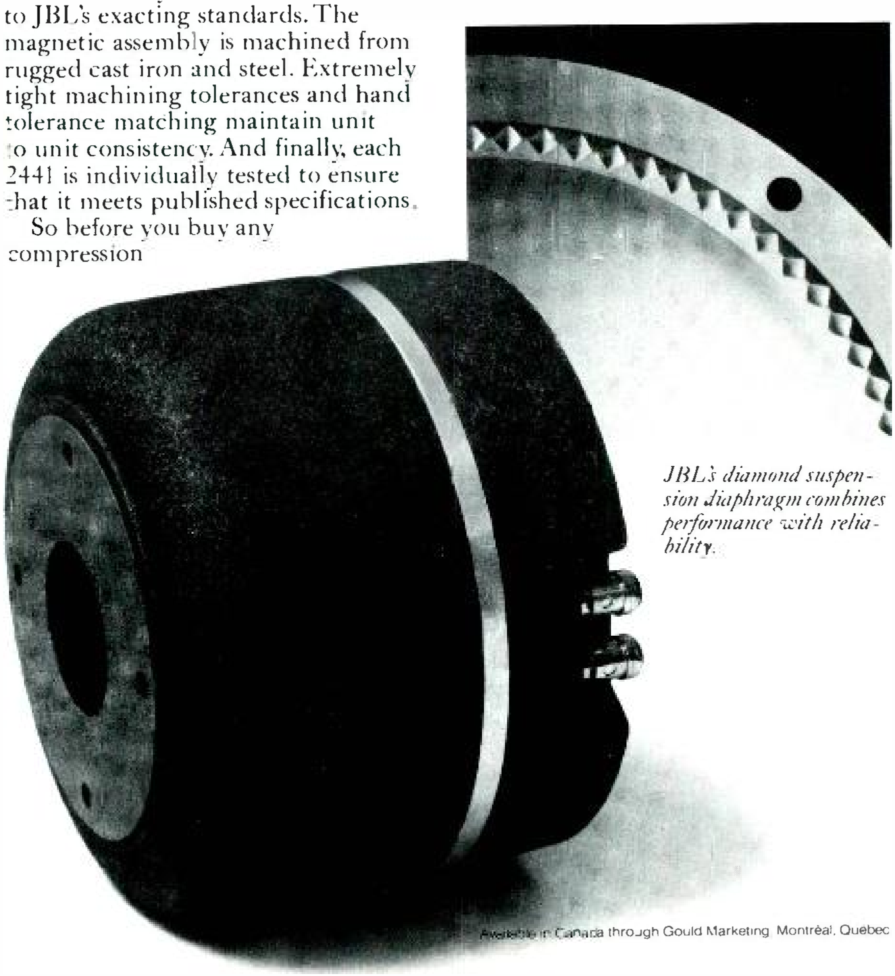
So before you buy any compression driver, ask your JBL professional products dealer about the 2441. It'll deliver a lot more than just an impressive frequency response.

1. Patent Applied For

2. Journal of the Audio Engineering Society, 1980 October, Volume 28 Number 10. Reprints available upon request.

James B. Lansing Sound, Inc.
8500 Balboa Boulevard,
Northridge, California 91329 U.S.A.

Specifications		
Horn Throat Diameter	50 mm	2 in
Nominal Impedance	16 Ω	
Power Capacity	70 W continuous program	
Sensitivity (1 watt, 1 meter)	111 dB SPL (on axis of a JBL 2350 90° radial horn)	
Frequency Range	500 Hz to 18 kHz	
Voice Coil Diameter	100 mm	4 in
Voice Coil Material	Edgewound aluminum ribbon	
Flux Density	1.8 T (18,000 gauss)	



JBL's diamond suspension diaphragm combines performance with reliability.

JBL Professional Products Division

Available in Canada through Gould Marketing, Montréal, Quebec

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just because our technology has advanced. We may have liberated ourselves from in-line listening, but the principles that made in-line listening desirable under those conditions has not changed. It is still with us, even though we have contrived to get around it, or not to be conscious of it any longer.

This means that listening is always an experience in which the complex acoustic wave movement in the vicinity of each listener's head reacts to produce the illusion he "hears." That never changes; what we do with it changes. And the air particle movement is essentially an analog thing: it can never be digital, because each air particle, and the associated sound pressures around it, must satisfy various equations of continuity, which is not incumbent on digital waveforms.

Comparisons between analog and digital are either subjective or objective. Subjectively, the listener compares them from the viewpoint of the illusion they create. Objectively, waveforms are compared for the accuracy with which they reproduce, each one an original waveform. There is no way to compare the radiated acoustic waves in all their complexity on a digital base or, if there is, maybe someone will enlighten me as to how it can be done.

If you compare waveforms from each channel of two-channel stereo, or of quadraphonic in its four channels, you may have difficulty in finding that digital degrades the waveform in any visible way. But you can only compare them one at a time. You cannot make a composite comparison of the kind on which your subjective comparison is eventually based.

Maybe you cannot hear the coding frequency, just as my eyesight could not see the flicker rate of fluorescent lamps. But this does not mean that I am not affected by that flicker rate, and we have reasonable evidence to conclude that some indeterminate proportion of the population is affected by it. In fact, it is not impossible that everyone is affected by it in different degrees.

If this is the case with the faculty of vision, why should it not be possible with something we cannot consciously hear, but which affects the auditory nerve or some other element of our hearing faculty? To rule out the difference between analog and digital as inaudible, and therefore having no effect, reminds me of the tests back in the '30s, when audio experiments determined that nobody could hear distortion if it was below 5 percent. Don't laugh: it's true! How did we learn better than that?

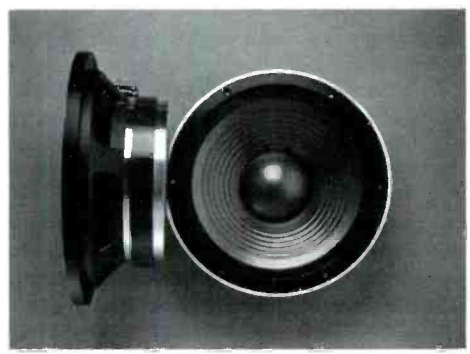
Obviously the cause of such false conclusions is that they are based on insufficient facts, or data. No engineer should ever consider himself so smart that he knows it all! ■

Experience previously unattainable performance in the mid-frequency range, an evolution of pure audio. Discover the best sounding 12" mid-frequency loudspeaker available. Listen... and experience the TM-1201 from TAD.

Assembled in the hands of veteran audio craftsmen, the TM-1201 is especially designed for mid-frequency applications, with a usable range of 200 to 3000 Hz. Ultra-low distortion, smooth extended frequency response and high power handling establish the TM-1201 as a hallmark in the evolution of sound.

Evolutionary in itself, with a lighter, more rigid material than currently used in the field, the polymer graphite cone has true pistonic motion throughout its specified range, with none of the peaks and valleys associated with cone break-up or doubling. In addition, a high power 4" voice coil with edgewound copper conductors better utilizes the flux within the magnetic gap to increase acoustic conversion efficiency. A corrugated cloth surround, for extreme linearity in high power applications, and a rugged 6-spoke die-cast aluminum frame assures both durable and reliable performance.

Conquer the peaks and valleys of sound with the unprecedented mid-frequency performance found in the TM-1201.



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Detailed specifications and performance data available upon request.

LEN FELDMAN

db Sound With Images

Handling Beta and VHS Audio

• Let's face it! As a person involved in the professional end of audio you will, sooner or later, have to deal with the audio tracks of so-called "home video recorders," whether they are Betamax VCRs or VCRs which subscribe to the VHS format developed by JVC and used by a dozen or more other companies who distribute their products in the U.S. More and more, pro audio people (whether in broadcasting or recording studio work) are finding it necessary to deal with the less-than-high-quality (to put it mildly) audio tracks which are treated almost as an afterthought in both the Beta and VHS home video recording formats. Of course, the poor quality of the audio signal recorded on video tape should come as no surprise to those of us who have been involved in both audio and video for some time. The attitude of video people has always been: "The picture comes first, and let the audio fall where it may." It wasn't until just a couple of years ago, when satellite transmission of sound and picture (for public TV, at least), and multiplexing of audio on the video coaxial cable became a reality that anyone worried about audio frequency response extending beyond 5 kHz or so. That, after all, was the high frequency capability of "typical" long-line telephone lines that were used to carry the audio portions of network programs around the country. No wonder then that the originators of home VCRs didn't place too much emphasis on audio quality when they standardized their formats.

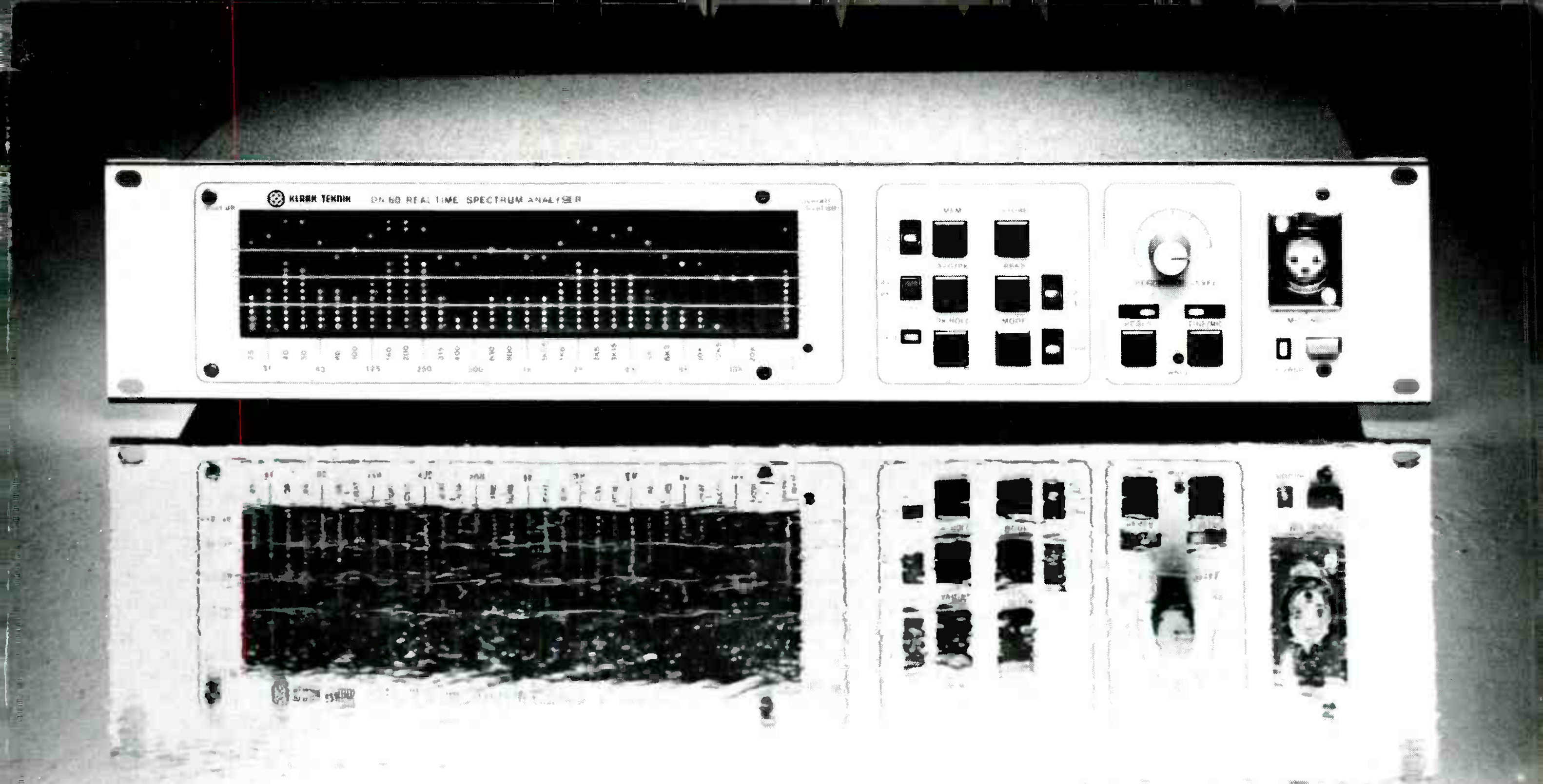
Before we can deal with Beta or VHS audio in the recording or broadcast studio, let's take a look at just what we can expect by way of audio fidelity in each of those VCR formats.

Have you ever wondered why the home VCR systems which, after all, are capable of storing video signal frequencies of well above 2 MHz, have so much trouble maintaining flat *audio* frequency response out to 10,000 Hz (or, in some cases, to a lot less than that)? To understand this seeming contradiction, you have to know a little about how both video and audio signals are recorded in a VCR. In the accompanying diagram we see the tape path employed in both the Beta and VHS video recording systems. Video record/play heads are mounted so that their gaps are on the perimeter of a rotating drum. That drum rotates at 1800 rpm, which adds up to 30 revolutions per second. This speed was selected because in the U.S., the NTSC TV standards call for 30 pictures or "frames" per second to be projected on our video screens. So, although the tape itself is moving at a relatively slow speed, as far as the video head-to-tape speed is concerned, it is extremely rapid. In just one revolution of the video head drum, the system has scanned two video fields, or one complete video frame.

That's all well and good as far as the video luminance (brightness) and chrominance (color) signals are concerned. But when it comes to the audio signal, notice that the *audio* recording/playback head in *both* the Beta and VHS systems is *stationary*. The tape speed relative to the audio head is extremely slow.

ACTUAL AUDIO TAPE SPEEDS IN BETA AND VHS VCRs

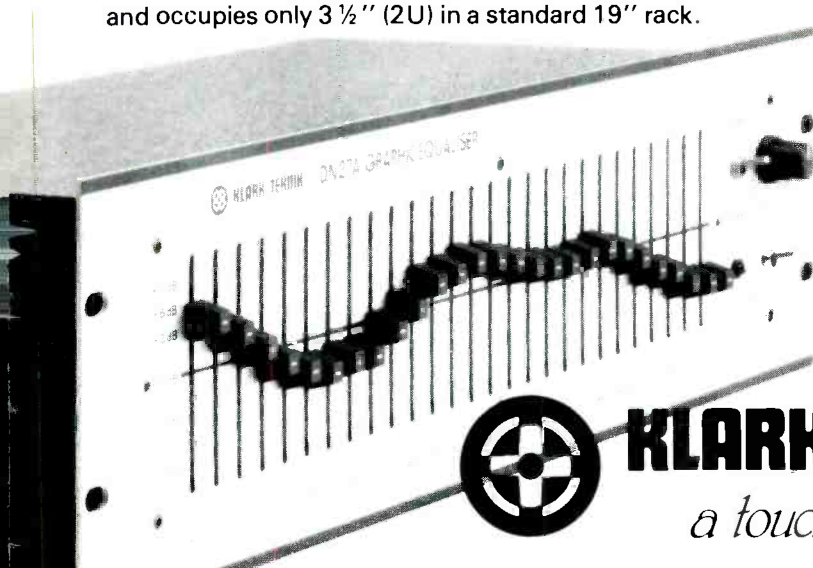
The original Betamax units were capable of recording and playing back pictures and sound for a maximum of 1 hour (1.7 hours when tape lengths were increased). Beta machines having this capability were said to employ a Beta I format, which involved an actual tape speed of 1.57 ips. That, if you stop to think of it, is actually slower than the 1⅞ ips speed used on home stereo cassette machines. Yet, at that speed it was possible to achieve passably good frequency response for the audio track, and reasonably good signal-to-noise ratios. Today, however, the Beta I speed has become all but obsolete (a few machines available can *play back* old tapes made



"REFLECTIONS OF YOUR SOUND JUDGEMENT"

The "DN60 REAL TIME ANALYSER" is the heart of a new audio measurement system from the engineers at KLARK-TEKNIK and is the perfect compliment to the new DN27A Equaliser shown below. Using Micro-Processor based circuitry, the DN60 is capable of performance checks on virtually any audio equipment, and is especially well suited for aligning audio tape recorders. On-site performance verification, whether of a 10,000 seat arena, or a studio control room, is easily facilitated with the DN60; and is an excellent method of building your customer's confidence.

If you're a recording or broadcast studio, include the RT60 Option and provide quick and accurate alignment for your reverberation systems (plates, springs, digital). The DN60 incorporates a pink noise source internally, and occupies only 3 ½" (2U) in a standard 19" rack.



If you take your sound on the road, the DN60 can help make that 5 p.m. sound check go easy, leaving enough time for a quick dinner before showtime. With the inclusion of Three Memories, and a Peak-Hold function, you can expand the scope of your sound check, and provide that extra edge of excellence.

The DN60 is Micro-Processor technology at a price you will like.

Other useful features include:- "A" Weighting , Average or Peak Reading and Selectable Response Time.

DN60 Options:- • Calibrated microphone
• RT60 (Reverberation time) package • X/Y Plotter and oscilloscope interface • Dot matrix printer interface.

Now complete your system with the new DN27A ⅓rd OCTAVE EQUALISER and quickly adjust your sound to perfection.

The new DN27A is the successor to the DN27, acclaimed world-wide as the industry standard in graphic equalisation. New features include improved headroom, earth lift facility and fail-safe system bypass plus the legendary reliability and performance of it's predecessor.

Please contact us and get our DN60 and DN27A data sheets and related literature.

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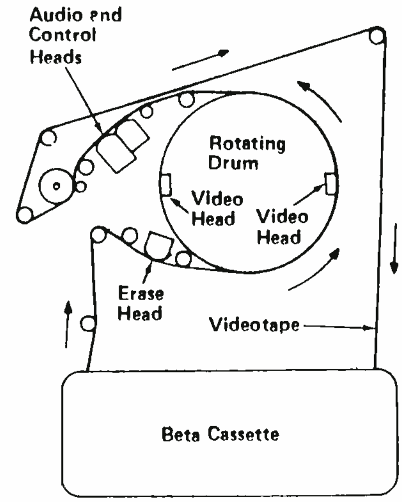

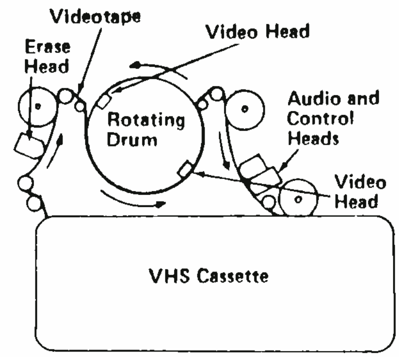

Although Beta and VHS Systems employ different tape loading systems, both use stationary audio recording and playback heads.

at that speed, but none that I know of can record at that speed any longer).

The two popular Beta-format speeds used these days are known as Beta II and Beta III, and they correspond to actual linear tape speeds of 0.79 and 0.53 inches per second respectively. Is it any wonder that audio frequency response is limited and that signal-to-noise ratios are less than ideal? Speaking of signal-to-noise ratios, one would expect them to be well above 50 dB even at these slow speeds, given today's high grade tape formulations, but such is not the case. The makers of VCRs all seem to sacrifice S/N in favor of extended frequency response. As anyone involved in pro audio knows, you can always apply so much preemphasis during recording so as to extend frequency response somewhat, but in doing so, you sacrifice signal-to-noise ratio during playback. It's like turning up the treble boost on a playback amp to lift high end response. Tape hiss and noise come right up with the extra treble response.

My own experience with the Beta VCRs that I have tested is that their -3dB high end roll-off points generally fall somewhere between 8 and 12 kHz for the Beta II speed and between 4 kHz and 6 kHz for the slower Beta III speed. As for measured signal-to-noise ratios, I generally find them to be between 40 and

44 dB (referenced to maximum audio level for 3% distortion) for the Beta II speed and a dB or so poorer for the Beta III speed. Given the actual Beta II and Beta III speeds, you would think that the signal-to-noise ratio for the slower speed would be a good deal worse than it is for the Beta II speed. The reason that this turns out not to be true is simply because the restricted bandwidth associated with the Beta III speed tends to offset the increase in noise inherent in that slower tape speed.

As for VHS machines, there are now three speeds commonly used. These are usually identified as SP (Standard Play), LP (Long Play) and ELP, or EP (Extra Long Play, or, simply, Extended Play). Record/play times for these speeds are 2, 4 and 6 hours respectively, while actual *linear* tape speeds are 1.31 ips for the SP speed, 0.66 ips for the LP speed and 0.44 ips for the EP speed. Simply comparing these speeds with those for Beta II and Beta III, and assuming that all other things are equal (which is not always the case), we might arrive at some conclusions regarding audio fidelity of the two systems. We would expect that fidelity of the SP VHS speed would be a bit better than the fidelity obtained at the Beta II speed. Indeed, that does turn out to be the case—at least with the *average* of the Beta and VHS machines that I have tested thus far. Typically, a well designed VHS machine will deliver response out to 12 or in rare cases 13 kHz (for the −3 dB roll-off point). However, when we switch to the EP speed, and compare it with results obtained at the Beta III speed, the Beta III format usually wins out by a small margin. This, too, is not unexpected inasmuch as the Beta III speed (0.53 ips) is marginally faster than the EP speed of 0.44 ips. Typically, signal-to-noise ratios run about the same as for the Beta format machines, with variations in S/N more a function of the grade of tape used than of the machine itself or its format.

WHAT YOU CAN DO TO IMPROVE VCR AUDIO

It almost goes without saying that if you have control of the situation and know in advance that you are going to have to do some dubbing from a VHS or Beta format video tape, make certain that whoever operates the VCR does so at its fastest linear tape speed. Since most video cameras come equipped with "external mic" jacks as well as their own built-in microphones, if videotaping live action, it is better to use an external mic whose characteristics you know (and which can be placed close enough to the audio source to avoid room effects) than to depend upon the omnidirectional electret mics that usually come with video cameras.

If you have to deal with audio material on video tape that is "after the fact," there are still some obvious steps you can take to clean up the audio during its transcription. If you are dealing strictly with the spoken word, inserting a graphic equalizer in the line can do wonders for reducing tape hiss without impairing intelligibility of the audio material itself. If you need to transcribe a music track from a video tape, rather than trying to cut out hiss by means of a fixed graphic equalizer you may be a lot better off using a dynamic filtering system, such as those now being promoted and licensed by National Semiconductor (who make a chip that forms the central component of such dynamic noise filtering systems). Such dynamic filters, unlike other encode/decode noise reduction systems, are intended as "open loop" devices, in which *no* previous encoding is required. Their operation is based upon their ability to "sense" high frequency program content and amplitude—opening up system bandwidth when "highs" are present in the program material which will mask residual tape hiss, and closing down to limited bandwidth when no musical highs are present, reducing audible tape hiss significantly.

Admittedly, audio fidelity from home VCRs is not what is could or should be, but with a little experimentation and care you should be able to "cover up" the audio sins and omissions of the originators of both the VHS and Beta machines. ■

db New Products & Services

ELECTRONIC PACKAGING COMPONENTS

• Unibox is a versatile line of packaging components designed for industrial, O.E.M. and experimenter use. Comprised of a series of enclosures and a wide selection of accessories, the components may be custom assembled to meet the user's specific requirements. Enclosure sizes range from 1¼-in. high x 2-in. wide x 2¾-in. long to 2-in. high x 4-in. wide x 5¼-in. long. For circuitry construction, custom epoxy-glass gridboards are available for horizontal and vertical mounting in the enclosures. The gridboard hole pattern accepts I.C. sockets and other standard lead configuration components. Two sizes of transparent windows are available for use with LED or incandescent read-outs, indicators, etc. Also available are two sizes of opaque gray panels for mounting switches, potentiometers, connectors, etc.

Mfr: Amerex
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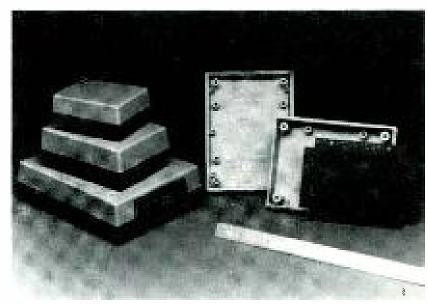

P.A. SYSTEM

• The Executive II is a battery operated personal sound reinforcement system that is self-contained in a briefcase. The Executive II can be used virtually anywhere, indoors or out, for sales meetings, lectures or any other occasion requiring sound reinforcement. With more than one unit, a systems expander accessory can be used to create a master unit and slaves for additional power and coverage. The input jack allows music played through the system (from an outside source) to blend with the speaker's voice. Program material can be recorded through the input or output jack, depending on the recorder. Components include a dual speaker system, solid-state amplifier and unidirectional dynamic microphone, all packed in the briefcase.

Mfr: Argos Sound
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THE NEW TOA RX SERIES SUB-COMPACTS.

THE TRAVELLING CONSOLES THAT WON'T DRIVE YOU TO THE POORHOUSE.

For any demanding high quality professional sound reinforcement requirement, there's now a choice between the real expensive and the embarassingly inadequate: The TOA RX Series.

Starting as low as $1,130.00 for our RX-5A console and all the way up to our 32 by 8 RX-7 Model, you now have the performance, features and flexibility to create a professional sound system that can handle the simple showcase gig or the big concert job. Of course, if you need to record, the necessary features are all there.

Our top-of-the-line Series, the RX-7 is available from 16 in/4 out (pictured below) to 32 in by 8 out. It's modular, and has features too extensive to cover here. When an RX-7 is more than you need, we make three smaller RX Series consoles that will more than get the job done: The RX-5A (8 by 2); The RX-6A (12 by 2); and the RX-5/16A (16 by 2).

Whatever model you choose in the series, you get a −128 dBm E.I.N. hum and noise figure (20 Hz - 20 kHz). Quiet. THD at +10 dBm is typically less than .08%. Clean. And crosstalk is −60 dB (1kHz, input to output), −70 dB on the RX-7 Series. Professional. All the way, including heavy-duty XLR type connectors on many of the I/O's.

Give us a call at (415) 588-2538. We'll rush out all the spec's and the name of your nearest qualified TOA dealer. We're confident you'll want to sit behind the superb handling of an RX. The consoles that have performance and features to spare —and the serious subcompacts that won't drive you to the poorhouse while you're on your way to the top.

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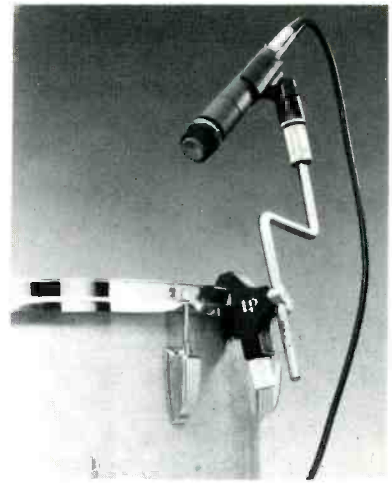
TAPE SYNCHRONIZER

• Adams-Smith, Inc. has announced the availability of a new 24-frame program for its Model TS-605 Tape Synchronizer, a central controller which ties two slave audio recorders to a master video recorder to form a television audio post-production system. The new 24-frame program allows audio recorders to be synchronized to equipment using 24 frames per second time code while keeping track of real time. The TS-605 simplifies the production of a master audio track from the original recording, with the addition of effects, music and new dialogue, and laying this master audio recording back on to the video tape or film. The Tape synchronizer uses the SMPTE/EBU time code to synchronize, and can operate with "real world" tapes containing inconsistent and mixed time codes, splices, noise and drop-outs. Synchronizing resolution and tape offset adjustment capability are 1/100 of a frame. Other features include provision for rapid cueing, chasing, roll-back and record control. The TS-605 interfaces without dedicated circuitry or transport modification.

Mfr: Adams-Smith, Inc.
Price: $15,000.00
Circle 50 on Reader Service Card

DRUM MIKE



• The Claw, featuring a built-in shock mount, is a precision machined product of solid, all-metal construction (except for the internal rubber shock mount) finished in satin chrome and black wrinkle. The jaws grip firmly to all drum rims and cymbal stands and its tilting mechanism puts the mike where it belongs and keeps it there. The Claw can also be used for attaching cowbells and other percussion gear to drum rims and cymbal stands without any tools.

Mfr: Latin Percussion Inc.
Price: $49.95
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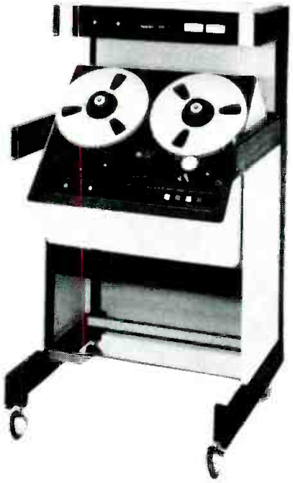
REEL-TO-REEL



• The 770 Series Reproducer and Recorder/Reproducer have been designed for broadcasters. The reproducer is suited for use in program automation systems while the recorder/reproducer is a moderately priced, general purpose reel-to-reel machine. The 770 Series is designed to meet or exceed the National Association of Broadcasters standards for reel-to-reel tape reproducers and is available in a variety of configurations including one or two track, mono or stereo capabilities and tape speeds of 3¾, 7½ and 15 ips. Constructed with a heavy ½-in. thick aluminum tool plate deck for stability, the 770 Series is equipped with a professional head assembly that utilizes two torque motors for supply and take up reel handling, plus a D.C. servo capstan motor for tape drive.
Mfr: International Tapetronics Corporation
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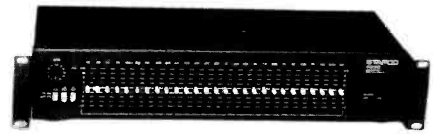
DIGITAL DELAY

• The Model 3050 is a new digital delay introduced by Fostex. Delay or echo time is selectable in ten steps from 0.13 msec. to 270 msec. Modulation width can be adjusted to a maximum ratio of 1:4, making for excellent flanging/chorus effects and double tracking. Modulation can be externally controlled by feeding a control signal into the external jack. The 3050 has separate output level controls for both dry signal (unaffected sound) and the effect so they can be adjusted for the optimum output blend. LED indicators on the 3050 indicate signal present, normal and limit.
Mfr: Fostex
Price: $450.00
Circle 53 on Reader Service Card

EQUALIZER

• The 2230 third-octave equalizer offers 27 bands of equalization from 40-16,000 Hz with 12 dB of boost or cut on standard ISO center frequencies. The 2230 also has true combining filter action which not only increases the accuracy of the equalization, but, because it reduces interaction between individual EQ filters, also increases the effective amount of control available. Switchable high and low-pass filters are also built into the 2230.
Mfr: E-V/TAPCO
Price: $429.00
Circle 54 on Reader Service Card



(Continued on page 70)

db Editorial

Architectural Acoustics in the Studio

TODAY, WHEN THE conversation turns to architectural acoustics, sooner or later someone will mention bass traps, isolation booths, absorption coefficients and PNC curves.

Although these buzz words have been in the recording studio vocabulary for a long time, some of them have not been around forever. In fact, the more ancient of us may recall a day when a bass trap meant nothing more than the low notes in "Ol' Man River."

Historians tell us that back in the acoustical dark ages (that is, more than 25 years ago), musicians would often assemble in a large room, all at the same time! There, they would actually play together, in front of a single microphone (well, maybe a few microphones). The engineer would listen carefully and possibly ask the musicians to move around a bit until the musical/acoustical balance was just right.

Well times have changed, haven't they? If you've ever tried to move a modern studio musician, you know just how difficult that can be. Even if the musician is actually willing to be transplanted, chances are the studio design gets in the way. The drum booth is permanently built into the wall, the vocal booth is too small for the piano, the rhythm area is too dead for the chorus, and the percussionist can't stand the slap echo in the string room.

The current tendency to permanently assign specific areas in the studio to certain "sounds" places a formidable burden on the shoulders of the studio designer. Once the drum booth has been built into the studio structure, it just can't be moved around between sessions. So, the acoustic design had better be right the first time. Ironically, the more successful the designer is in meeting the specified acoustic requirements, the more "locked-in" the studio becomes to today's music (or at least, to the kind of music for which the studio was designed).

At least a few studio owners have come to grief trying to record big band jazz in a rock-and-roll room. And, how many amplified groups have been demolished by the otherwise-superb acoustics of a "classic" concert hall? In other words, there's really no such thing as a truly "*all*-purpose" room—one that works just as well for fusion jazz, symphony orchestra and punk rock.

Perhaps the best advice for today's studio owner is to forget about great acoustics and just try to make the musicians comfortable within the space available. If the string room is twelve-by-twenty, all the pecky cypress in the lumber yard is not going to turn it into a symphony hall.

Spend as much time as possible worrying about air-conditioner rumble and outside noises. These may be tolerable distractions down at symphony hall: in your new control room they're an absolute disaster. In fact, the definition of digital stress may eventually turn out to be your new-found ability to clearly hear 24 tracks-worth of toilet flushes, door slams and police sirens on your favorite client's master tape.

In addition to this month's features on architectural acoustics, we're delighted to present a special supplement on British Audio. This has been prepared exclusively for **db** Magazine by the Central Office of Information, on behalf of the British Overseas Trade Board. ■

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DAVID HASTILOW

One Man's View of the British Audio-Engineering Industry Today

OVER THE PAST 20 years, the sound of British musical creativity has been received enthusiastically the world over. Much of this success is owed to top groups, such as The Beatles, Cream, The Rolling Stones, The Who, The Kinks and others, and their recording engineers and producers.

With such an ancestry, it is hardly surprising that British musicians today are still emerging with evocative sounds and innovative ideas. There is also an ever-increasing number of recording studios which are being pushed to their limits to provide not only time, but facilities to cope with and to aid composers in their search for artistic excellence. As the studios are pushed, so too are the equipment manufacturers and the electronics engineers.

STUDIOS BREED IN THE BRITISH ATMOSPHERE

In 1966, there were only 44 recording studios in the London area and 34 in the whole of the rest of Great Britain. The better-equipped studios had 4-track and stereo recording equipment fed by, perhaps, a 20- or 24-channel mixing desk; and the tape delay, echo room or echo plate comprised the sum total of "effects."

By 1978, the number of studios in London had increased to 83, with 63 in the provinces, and today there are well over 200 recording studios operating throughout Britain, plus an unknown number of smaller "home" studios.

I can pick up any music paper and be confronted with a whole page of small display-type ads describing 8- or 16-track facilities located in anything from a disused warehouse in London to an Elizabethan manor in the middle of the countryside. I've even been to an 8-track recording studio in a disused wartime bunker in the middle of Cornwall!

Many of these up-country recording studios were set up when comparatively inexpensive 4- and 8-track recording equipment became available on quarter-inch and half-inch tape formats. Many musicians became fed up with not being able to record their music anywhere other than in large multitrack studios—which were, more often than not, fully booked and too expensive to consider anyway.

The large studios might also be unwilling to record just a few songs or to take the risk on some demonstration tapes which the record companies might not even bother to audition because they were busy working on artists whom they had already signed (and consequently taking up all the available studio time).

So, the small 8-track studios found instantaneous popularity, and some remarkable success stories resulted. The now-famous and highly rated Manor Studio at Shipston-on-Cherwell in Oxfordshire began with a modest 4-track facility and is now the equal of any top London studio.

It is not uncommon to hear of a studio in some remote village, which began as an 8-track a year ago, updating its facilities to 16- or 24-tracks. Someone else might decide to start a recording studio in a barn in North Yorkshire, 250 miles away from London and an hour's drive form the nearest city, and go straight to 24-track.

SCARCE RECORDING TIME

Even with this explosion in the number of recording studios, musicians are still hard-pressed to obtain recording time. For example, during a visit to a studio in a Cheshire market town, I met musicians from London working there, an on another occasion I met a group from Liverpool working in the 8-track studio just around the corner from my flat in Richmond, Surrey. Both groups had travelled over 200 miles to get their music suitably recorded.

Music publishers, record labels and film-music libraries are currently overwhelmed with demo tapes but, because of the economic recession, many labels have 'tightened their belts,' and the acquisition of a recording contract is still a painstaking process for even the best artists.

Technological advancement has now brought many studios to within a dB of each other, and I don't mean this literally, i.e., in terms of tape alignment. Many studios are offering virtually the same facilities in monitoring, equalization, channel and track capability, effects such as delay devices, harmonizers and signal processors, cassette duplicating etc.; so much so, that recording rates are highly competitive.

This is particularly true in London, where one had merely to walk around the corner to get a better deal; a studio with 24-track recording can be booked for as little as £15 (US $24.00) per hour. Consequently, attention is now concentrated not on the recording environment and control-room equipment, but on what facilities there are for eating and relaxing between takes.

Studio reception areas and lounges containing electronic video games are the norm, and a kitchen providing a custom-pressed steak sandwich on request, or even a complete meal, is common, along with overnight accommodation.

Today, a group wishing to record an album may do it in central London, with all of its nightlife and choice of restaurants, or spend a week in a converted half-timbered Tudor manor house or farmhouse offering, not only up-to-date technology, but a swimming pool, sauna, tennis and squash courts, horse riding, nature walks and five-star accommodation. The result is a healthy creative scene, coupled with rapid technological advancement.

A PACKAGE DEAL

As recording contracts are still so difficult to acquire, many groups just record their material and get it pressed themselves, either through the studio as part of the deal or at a custom-pressing facility.

Figure 1. A recording studio?

Many studios, even smaller 8-track ones, offer custom pressing and will even produce the artwork for the cover, photographs and, in some cases, distribution. I could, literally, walk out of my flat along the road to the local 8-track studio and come back in two or three days' time with 2000 singles.

This is exactly what many home-grown record producers are doing, and the range of their material on disc is almost unbelievable: wildlife sound recordists are pressing up albums of birdsong; church choirs are recording Christmas albums, and handbell ringers are ringing the changes, not only for themselves and their audiences, but to a complete reversal of recording philosophy.

Whereas at one time it was the big star and his music who accounted for the bulk of record sales, now one can just as easily get a disc of the church bells of some Cotswold village (or a fisherman telling tales in Cornish dialect, or English mediaeval music played on authentic instruments) as buy a 12-inch reggae single.

There is, too, a large market for limited-edition records of unknown groups: I've even received an EP of steam trains which were recorded binaurally using the dummy-head system—but I did find that the action takes place *behind* the listener—so watch out!

Cottage industry is taking over: a small record label situated in the Cotswolds recorded and produced an album of music, poetry and 'sounds' of Bristol and sold 29,000 copies—and the quality is superb, thanks to modern technology.

MAKING A VIRTUE OF NECESSITY

The advent of small-budget 4- and 8-track recording studios found the British manufacturers of recording equipment somewhat unprepared. They were more accustomed to producing high-specification devices for the professional sound and film recording studios of London, so they could not immediately produce anything cheap enough to attract the small-studio owner.

The latter, having spent most of his money on the multi-track tape machine and the mixing desk, had very little cash left for exotic peripherals. This had a two-pronged effect.

First, there was a return to the production techniques of the early days of mono, stereo and 4-track recording, in which music was produced while it was being recorded, with no decisions being deferred to the mixdown session as is the case with 16- and 24-track recording.

Second, there was greater use of microphone, tape recorder and ambient room techniques to produce effects. After all, recording should be "fun," and it is the ambience in which we hear musical instruments and people singing that gives them that magic we so often wish to capture on tape.

THE '60s SOUND'

It was precisely these techniques that contributed so much to the British sound of the 'sixties, a sound which is still much sought after. Initially, it was American manufacturers of peripheral equipment who filled the need for budget-priced effects devices.

Early designs, offering delayed echo and reverberation, evolved into providers of flanging, phasing, pitch bending, ADT, ATT, Haas effect, rotating speaker or Lesley effect, room ambiences, cardboard-tube echo—and all in a single 19-inch rack-mountable unit.

However, it is an English company that now makes what are, arguably, some of the best effects devices on the market. Advanced Music Systems, of Burnley, Lancashire, has engineered its way into the effects racks of top recording studios throughout the world with the DMX15—80 and 15-80 S digital delay units.

Studios in Spain, Japan, France, the Netherlands, Singapore, Hong Kong, Canada, Norway, Switzerland, Denmark, West Germany, Belgium and, of course, Britain, have all heard, and been converted to, AMS's philosophy that quality does not come cheaply.

A studio may start small, but, with the number of recording musicians increasing daily, it soon becomes big, and so cheaper effects units, with their inherent technical shortcomings, are no longer acceptable.

Figure 2. Yes! It's the Knight 8-track studio in Ponsongath Cornwall.

INTERFACING STUDIO AND PA EQUIPMENT

Because of their restricted budgets, 4- and 8-track operators often hooked up their newly acquired tape machines to the same desk as they were using to mix the PA at live shows. Many of them chose a mixing desk manufactured by Soundcraft Electronics of London. Realizing this, Soundcraft, like other concert-console manufacturers such as Amek, modified its consoles to interface directly with 4- and 8-track recording equipment.

This meant increasing the number of output groups and hard-wiring the tape monitoring. The latest Soundcraft Series 800 console is not only an advanced-specification concert, theatre, front-of-house or stage-monitor mixing desk, but is also capable of giving the engineer total flexibility in a professional 8- or 16-track recording studio through the provision of a series of module options.

Soundcraft manufactures not only mixing consoles, but now also has 8-, 16- and 24-track tape recorders on the market, all manufactured to the highest technical specifications and giving ease of operation for the engineer. For instance, on the 24-track machine, all the VU meters are mounted directly on the line-up cards for the tracks they represent. Also, the auto locator not only has nine memories, but also offers a subgrouping system for complex record drop-ins. It is hardly surprizing that Soundcraft equipment, like AMS, is now found all over the world, and is a good example of a proper artist/electronics engineer relationship.

MINIMISING THE DOWNTIME

Time is money in a recording studio, be it 4-, 8-, 24- or 32-track, but no price can be put on the loss of creative energy and frustration which occurs if the recording engineer continually has to leave the "head" position to alter the monitor mix. Also, things are made more difficult if the monitors are on a completely different part of the console from the input and master mixing groups. The faster-working inline-type mixing desks are, therefore, becoming the norm, but are often less versatile than the conventional format for the same amount of money.

The situation is further aggravated, and the important continuity of concentration on the recorded sound is lost, every time the engineer has to leave his seat to adjust the parameters of rackmounted effect and signal-processing equipment, or to make insertions into ever-expanding jackfields.

With this in mind, Solid State Logic, of Stonesfield, Oxfordshire, has developed its Series 4000 mixing console, a design in which every channel contains a compressor, limiter and expander gate; every item of studio equipment appears on the console in the form of a routable switch, making the jackfield out-of-date. Every equalizer setting on the console is remembered by the SSL Total Recall computer, which also remembers the engineer's name, the title of each track and gives a printout of the tape contents on a label to be stuck on the tape box at the end of the day.

AN ORDERED SYSTEM

The SSL desk is designed to be an integral part, if not the heart, of the recording studio, and not just another piece of equipment tacked on the end. Whereas some automated systems are designed primarily to assist in the mixing process, the SSL Total Recall Computer is of enormous value right from the start of the session. It is busy locating and cueing up takes automatically to be worked on via its floppy-disc memory. However, no matter how extensive a computer's control of the signal route may be, in the final analysis it is the sound at the output which determines the usefulness of a console and its signal-processing capabilities.

Many gold and platinum discs have been produced using the SSL, which proves that this design is not just gimmicks or flashing lights, but is musically viable too. Musicians such as Ian Hunter have commented that, not only is this computer-controlled system easy to use, but it also sounds great.

When examining the SSL console for the first time, many people's reactions have been of reluctance to accept it—either through fear of computers and the problems that they may cause, or nervousness at the sight of so many knobs and

Figure 3. The Solid-State Logic installation in a Danmarks Radio mobile studio.

buttons. But these days, studios are asking for more and more tracks, and even more input channels, and they must either invest in a system in which everything is routed through the console, or they battle with an enormous jackfield. It is the opinion of SSL that they get a lot more aggravation by doing the latter.

Once an engineer has worked with an SSL for a while, and he appreciates that it is a more-ordered system, his initial reservations are quickly overcome.

Record Plant, in Los Angeles, is in the process of installing a third SSL board, a tribute to the fact that everyone in the SSL team is fully conversant with the current recording-studio problems and techniques.

AN HONOUR FOR A DESIGN

In April of this year, Solid State Logic was awarded the Queen's Award to Industry to honour its design innovation and the fact that 95 percent of its consoles have been exported.

Danmarks Radio Copenhagen has the world's first computer-controlled sound-recording vehicle, which has an SSL 4000E Series console hooked up to the SSL Total Recall Computer and this, being able to store every aspect of all rehearsal settings, is an invaluable asset in recording events or preparing for live broadcasts. The British Broadcasting Corporation (BBC) has also chosen its first SSL system, after nearly a year's evaluation.

SSL has also been awarded the British Design Council award, and Managing Director Colin Saunders and Industrial Design Consultant Anthony van Tullsken recently attended a ceremony at London's Royal Festival Hall where they were presented with their awards by HRH Prince Philip, the Duke of Edinburgh.

IN THE MID-PRICE RANGE

For the smaller studio operator who is unable to make a huge financial investment in a top-line mixing console, but who requires something more versatile and ergonomically viable than a desk containing separate input and monitoring sections, there are several British companies offering middle-price (around £20,000-£30,000) inline automation-ready mixing consoles. On the majority of these systems the Allison 65K programmer is incorporated.

The Amek Auto Pak is a handy device which allows electronic editing and keyboard control of the tape machine from such desks, using SMPTE time code to synchronize the handling of information with the music it represents.

Amek is a Manchester-based company which evolved its M1000, M2000/2500 and M3000 series of master recording consoles after gaining considerable experience with its earlier MS and X series of concert sound-reinforcement and small recording desks.

Because Amek was continually being asked for ever-larger configurations of these earlier models, necessitating extensive and time-consuming modifications, and the desire to cater for the many variations possible, the later series was based on a flexible modular and chassis system. Normally, the automation used on these consoles is a derivation of the Allison system and allows any channel fader to become a subgroup, of which there are ten available.

Trident Audio Developments, of Shepperton, Middlesex, is catering for the studio operator who, though considering expansion to 24-track, is primarily interested in equipping a 16-track facility, by offering its Series 80, a 24 main frame 16-track automation-ready console for around the £22,000 mark.

Soundcraft has also entered the recording-studio-console market with its Series 38 16-, 24- and 32-track fully modular consoles at a price of £13,245 for 16-track (non-automated) and £16,215 for the 32/32. All these consoles are automation-capable and utilize the Allison 65K system.

PACKAGE DEALS

With the range of expandable consoles increasing, a studio wishing to purchase equipment and to update its track facility has a tough decision to make, especially when this may also involve a complete refurbishing of the studio acoustics and monitoring to cater to more-discerning clients.

As a result, British equipment manufacturers and suppliers are now offering package deals which include, for an all-in figure, complete acoustic treatment and installation of every item of studio equipment.

On the one hand, this is a good thing in that studios are more compatible with one another, and clients may be assured that their tapes will sound good in a number of locations. On the other hand, as I mentioned earlier, studio rates are highly competitive, making the "big investment" decision a hefty one.

To attract clients, many studios have now entered the video market, and it is not uncommon to find even rehearsal studios and PA companies offering combined video and 8-track recording packages, either in the studio or at live performances.

With the video disc on the horizon, and the need for a growing number of groups to prove their performing abilities, as well as their musical talents to interested recording companies, the age of the multimedia studio is approaching.

MATCHING VIDEO TO AUDIO QUALITY

These multimedia studios will permit time-coded multitrack recordings of live performances to be worked on in the studio and transferred to time-coded video/audio tracks, so that the sound quality is the same as that available from the best audio cassettes or discs. Then, not only will a group have an excellent demonstration tape of its sound, but also a medium by which it may promote its visual image anywhere in the world and, it is to be hoped, open up new markets.

Creativity is a largely spontaneous and sometimes an irrational process. It will be a sad thing if technology advances to a point at which the producer and the recording engineer are unable to communicate with each other or the recording process impinges upon the spontaneity of the performance.

Music and art are about people and their feelings, and musical instruments are extensions of man's ability to communicate the highest aspects of those feelings. Computers are simply machines and have no feelings, no matter how one may try to personalize them. One has only to recall the film "2001: A Space Odyssey" to see what might happen to people who live and work in an environment governed by electronics.

We can only hope that recording studios will remain the warm and pleasant working environments that they are; places which inspire creativity and make a musician feel like working on his music for as long as it takes.

It is sometimes difficult to concentrate totally on sound when also confronted by a television screen with a computer status readout across it. Perhaps it is a good thing that the small recording studio revolution, with its return to basic recording techniques and the original pioneering spirit, is there to keep the balance and let raw creativity reign along with the spin-off of limited-edition albums and gut-inspired singles. "And did those feet, in ancient time...?" ■

DAVID HASTILOW

Digital Recording in Great Britain

DESPITE THE CURRENT economic climate in Britain, which is affecting not just the recording industry (and also the rate at which the consumer is prepared to spend money on records and tapes), technological advances are being made every day in the digital recording studios of Britain.

All the digital systems available are being worked and pushed to their limits. Although few recording companies are prepared to make a major investment until a particular system takes precedence, those studios which have taken the plunge are finding no shortage of work for their new equipment.

IN THE FOREFRONT

The studios that are leading the digital revolution in Britain are those at EMI, Abbey Road, London, where the Beatles once forged ahead with their highly original and innovative recording techniques, and the Roundhouse Studios in North London, which purchased and installed the first 3M 32-track Digital Mastering system in Europe.

Although several pop groups have been attracted to digital recording, the principal daily application of digital technique is in the classical-music sector, where the recordings represent a long-term as well as a short-term investment.

In the short term, recordings made from digital masters already sell extremely well to an ever-expanding hi-fi market, even though pressed in the conventional analogue-disc format. Such "digital" records exhibit cleaner highs, owing to lower distortion on the high peaks, and instrumentation and stereo positioning are clearer because of the absence of phase shifting between tracks. All this is made clearer when the records are played on good hi-fi equipment.

A LONG 'SHELF LIFE'

As a further inducement, classical recordings made today will still sell years hence, unlike rock and other "younger" forms of music which are more subject to the whims of fashion. Digital master recordings do not deteriorate or suffer from print-through in storage, and so a fair amount of stockpiling of recordings is taking place in readiness for the arrival of a completely digital audio disc system.

Digital recording rates may be low at the moment, compared to what they may be once the digital disc is state-of-the-art, but, by today's standards, they are still fairly expensive when compared with analogue rates. This is more apparent since the economic recession has brought about a great deal of price cutting and competitive dealing among even the best multi-tracking recording studios and budget-conscious labels. It is particularly true in pop music, where an investment in an artist does not necessarily guarantee a wage for anyone at the end of the day.

PROBLEMS OF INCOMPATIBILITY

However, it is not just financial reasons that cause rock artists to opt for analogue recording in preference to digital. Rock music requires more over-dubbing, often in a different studio from the one in which backing tracks were laid, a situation which cannot be easily catered to in digital recording, owing to the current incompatibility between systems used from one studio to another.

Also, many rock artists own, or have access to, their own recording facilities, owing to the availability of lower-priced multitrack recording equipment, and they can manipulate and produce their sounds more efficiently in analogue studios. This speeds up their creative schedules and, at the same time, enables them to try out new ideas with a minimum of fuss.

Many rock musicians have become accustomed to the sound of compressed high frequencies, caused by saturating or overpeaking on analogue tape, and do not, in general, like the "clean" sound of digital recording.

Dropping-in, the technique of interpolating new material into a recording, was a slow process in analogue, but the changeover from play to record on a digital recorder is so fast that it causes a click. However, I understand that this has now been overcome on the 3M digital system with the insertion of "cross-fade" cards in the record electronics of the machine.

Eager to make the most of their recording budgets, most rock musicians still view digital recording with a certain amount of scepticism, and tend to think of it as being hassle-bound.

Figure 1. The SE 7000 instrumentation deck built at EMI's SE Laboratories at Wells. The digital audio tape recorder system was developed by EMI's Central Research Laboratory at Hayes.

Figure 2. EMI Records audio engineers Colin Johnson (left) and Melvin Toms check out the prototype digital recording system prior to a recording session at Abbey Road Studio 3.

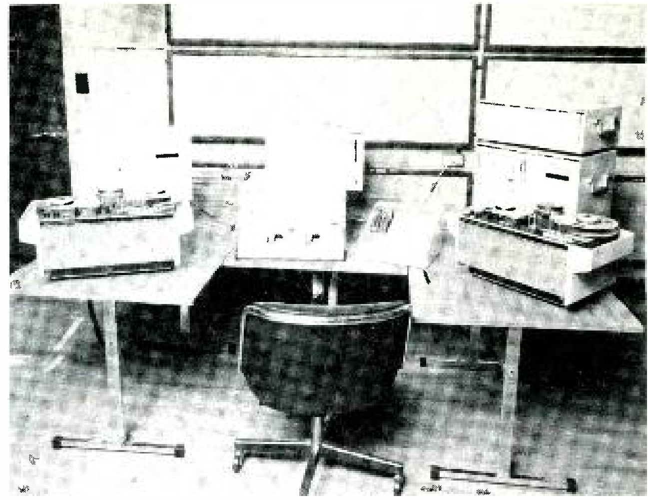


Figure 3. The Decca digital recording ystem.

BALANCE EXPERTISE

Dropping-in and overdubbing are not often encountered in classical music production, and scores are quite often mixed directly onto 2-channel recorders—demanding a great deal of expertise on the part of the balance engineer.

Studio 1 at EMI's Abbey Road complex has been highly rated as a classical-music studio for many years, and virtually 90 percent of its current work programme is for digitally recorded classical music.

EMI has recently developed a digital mixing console, which has been undergoing field trials, along with the firm's own digital recorder. I say "recently developed," but the idea for the console was conceived as long ago as 1975, when many studios were still toying with the idea of buying computer-aided mixdown systems.

The 2-track digital equipment employed at Abbey Road includes the EMI, Sony and JVC systems. The whole set-up has proved to be reliable and with well advanced electronic editing techniques, over 100 LP sides have been recorded over the past year.

EMI also hires the 3M machine at The Roundhouse quite often. One of the main advantages of digital recording to a company like EMI, with more than 30 subsidiary companies overseas, is that master recordings may be duplicated and interchanged, with no deterioration in quality. So, if a master is sent to the USA, Japan or Germany, each subsidiary receives a copy-master that is every bit as good as the original. This is the way that EMI originally planned to use its digital recordings —as an interchange medium rather than for producing LP records immediately—but the recording medium caught up rapidly and proved very popular in the classical record market.

IRONING OUT THE PROBLEMS

Initially there were teething problems with the digital equipment, but these were soon overcome. There are still a few problems in the electroplating stages, or in the actual pressing, to get the sound of digital on to disc. However, the maxim that a better quality signal should transfer better is more often than not a reality, and this is why digitally recorded analogue discs sell.

One would envisage that problems might be encountered when attempting to cut discs from digital masters, but the only differences occur in the types of previewing equipment necessary to operate the variable-groove-spacing apparatus, and little fuss is encountered. If a cutting room does not have the correct interface equipment, then the 2-track digital machine is simply wheeled in and converted to analogue accordingly.

DIGITAL ON THE MOVE

As I mentioned earlier, EMI and its research team have proved that a totally digital recording complex, with a digital console as well as recorders, is a viable proposition, but they are not alone in their researches.

Decca has also been developing its own 2-track digital-recording equipment and mixing desk. If Abbey Road and The Roundhouse are ahead with their studio complexes, then Decca must certainly take the prize for being the most mobile.

In fact, Decca has undertaken work in venues all over the world, and its equipment is very often at London's Heathrow Airport awaiting the next flight to somewhere else! Since Decca merged with Polygram it has wound down most of its rock-recording commitment and is ready to go totally digital with all of its classical-recording schedule.

The company has ten Decca digital 2-track machines in operation all over the world, and more in production. This is a continuation of the policy that it is better to achieve a good balance and mix straight to 2-track stereo at the time of recording.

Decca has been working with these recorders or prototypes over the past three and a half years. It has also developed its own electronic editing system, and has almost 100 digitally recorded albums on the market, plus a library of well over 100 edited LP sides awaiting release, and this is not counting tapes awaiting editing which, I understand, number even more than that.

Like other classical music companies, Decca's strategy is two-pronged, necessitating the recording of its library to the highest possible standards as soon as possible. The firm is using a Neumann VMS 80 lathe to cut all of its digital recordings, backed up by all the knowhow of the international Polygram group and Neumann.

SUCCESSFUL RESULTS—HEARD AND SEEN

To summarize, it is clear that research and development on digital recording in Britain is proving to be highly successful in terms of technological advancement and financial investment, and the results are being handled and heard the world over.

Will the digital disc mean that we shall all need to take a pink-noise generator into our living rooms, or will all hi-fi equipment incorporate a generator and a 25-way graphic equalizer? However, it is not just the audible aspect of digital recording that makes it a better proposition than analogue: audibly similar results are obtainable with an analogue ½-inch recorder running at 30 in/s. But this still does not provide the sophisticated editing and post-production facilities without deterioration of the original signal inherent in digital techniques.

FINANCIAL COMMITMENT

Obviously, few studio operators are prepared to make a huge financial commitment to a particular recording system now, only to find in a few years' time that other studios have opted for a different system.

One disadvantage of a studio being both digital and analogue at the moment is that it gets a reputation for being digital, and non-classical producers tend not to book it for that reason. Things would be better if there were many other digital studios, so that work could be shunted around them in the same way that a fully booked annalogue studio will advise an uncatered-for client of another studio offering similar recording facilities.

Also, studio owners who are re-equipping their studios now tend to consider the video disc as being imminent, as well as the digital audio disc, and are extending their facilities to include video production and post-production areas, with all the sound and video recording equipment running synchronously.

This obviously seems to be better value for the money than the spending of £91,000 on a single digital tape recorder and its associated peripheral equipment. However, it seems safe to conclude that, in the next few years, many, if not most, recording studios will be running digitally.

ARRIVAL OF THE COMPUTER

The outlay involved in the purchase of a computer to run an analogue mixing desk and to lock analogue multitrack machines to video machines to carry out video post-production techniques may seem unnecessary, when the same computer can just as easily govern every aspect of digital sound recording and editing and video editing too.

In fact, it does not need much of a stretch of the imagination to visualize one machine recording video and digital sound, and the same floppy- and hard-disc drives and editing equipment being used to assemble both simultaneously. ■

Acknowledgement: thanks are due to Tony Griffiths, of Decca Research and Development Dept.; Ken Townshend of EMI, Abbey Road; Richard Yeoman-Clark, Chief Technical Engineer at The Roundhouse, and Gordon Vicary at Townhouse Studios Cutting Room, for their invaluable help in the preparation of this article.

TERRI ANDERSON

The 'British Sound'— truth or legend?

THE RECORDING BUSINESS is more obviously, more colourfully, international than any other. Artists, producers and engineers from all over the world travel extensively to record in studios of all countries, and international audio hardware exhibitions proliferate, to show and sell equipment being developed and manufactured by every advanced nation. Logic would seem to dictate that out of this technological stewpot should come recordings which were notable for their quality, but certainly not for their individual or national characteristics.

Logic can take a back seat. There is, according to many authoritative American music makers, music recorders and record buyers, a "British sound." What do those Britishers who are presumably responsible for creating it think it is?

Geoff Emerick started work at EMI's now world-famous Abbey Road studios in 1962. He trained there and learned a great deal as second engineer to Beatles' engineer Norman Smith. The first record he worked on alone was "Pretty Flamingo" by Manfred Mann (which went to number one in the UK in May 1966). When Smith left in 1967, Geoff took over the control room at Beatles sessions and he engineered all their LPs from "Revolver" onwards. He agrees that there is certainly a "British Sound" (although like everyone else he cannot define it) but recalls that it was the "American sound" which everyone was talking about when he was a trainee. "I put that down to the musicians; it had nothing to do with the studios," he asserts.

At Abbey Road they knew they were producing something very special and enormously commercial in the way of sounds, but Emerick did not think of it as a matter of nationality until he first went to work in the US (at the Record Plant) in 1973. He was suddenly bombarded with questions like, "How do you get that British sound?" Emitting comical groans at the effort of trying to pin down and list dispassionately the difference between the two sounds—and the even more arguable reasons for those differences—Emerick recalls: "By 1973/74 we were more technically advanced here in British studios. I don't think that the American major studios could really match us for acoustics or equipment. The US studios were always, and still are, much more dead acoustically. And they went in for uniformity in acoustic design (like Westlake or Eastlake) far more than we ever did here."

MONITORING

"Also, in the UK, monitoring is very important. In the US they seem to go about it a different way, and they sometimes colour the control-room sound rather than aiming for strict accuracy (which you can get because equipment is so good now). Then there's the console. An experienced engineer can always tell which board the sound on a tape has gone through.'

Ultimately, Emerick feels that the British sound is down to the musicians, and to the engineers—and particularly to the breed of independent, highly experienced producer/engineer to which he belongs. "I believe that in Britain the sound is down to the engineer. Our engineers tend to be more technically involved than their American counterparts. Engineering is

Figure 1. The "British Sound" at work in the BBC's new music studio in Manchester.

painting a picture with sound, and we have had to keep up with artistic techniques; I started with mono and now work regularly with 46 tracks (69 at a recent session with the Little River Band at Air Montserrat)." And talking about Montserrat—while Emerick will work in any studio with any equipment ("unless it's really bad") and will get what he wants chiefly by changing the EQ on the desk—his dream studio is Air Montserrat.

He does not care how biased his personal interest in the place might make him sound. "Apart from being absolutely beautiful, it is the finest studio ever built, technically." It is a British studio in every way, and just happens to be in the Caribbean. The desk is a custom-designed and -built Neve, sent there all the way from Cambridge, England. Monitoring comes in a choice of JBL 4350 and 4343, Tannoy Super Reds (JBL and Tannoy have been interchangeable first and second choice for the majority of UK studios for many years, whereas JBL probably yields most often to UREI in the US, and Tannoy makes few appearances), Altec wheel-ins and Auratones. Tape machines, synced to give 69 tracks (or more if wanted), are MCI. There is—as in all but the smallest of UK studios—an elegant sufficiency of electronic "toys" in the racks for the clients' use.

Musing on the differences between US and UK studios, although not in anyway claiming that the following have any effect on the actual "national sound," Emerick notes that most outboard equipment, or even basic studio instruments such as piano and drums, have to be hired in America, while they are permanently available, covered by the basic studio rate, in Britain.

Figure 2. The Solid-State Logic console in the BBC's Manchester control room.

ABBEY ROAD AND THE BBC

Perhaps Abbey Road (and the BBC broadcast studios, which have trained countless engineers now dispersed at all levels of the recording industry) can claim more than a little responsibility for the "British sound." Ex-Abbey Road engineers include Ken Scott, Alan Parsons, Peter Henderson, Phil McDonald—and David Harries, who moved on to manage Air London studios nine years ago. He designed the acoustics at Montserrat, after long discussions to find out what everyone wanted.

"The ingredients in British or American sound must be the people and the music," he states. "If you take a British group to an American studio, or bring an American group here, they still produce their own sound... or do they? Perhaps a lot of people would argue with that!" However, Harries feels the studio themselves have been responsible for some types of music. "Disco evolved from the tight, damped, dead American-studio acoustic (with lots of echo added). I'll risk saying we've never done a really good disco record in the UK, and we've never been able to get the perfect brass sound they get in the US.

"But here we're steadily moving away from the over-damped, over-miked sound. UK studios have a much more natural, more spaced, sound. The equipment these days gives such cleanliness and clarity that all that acoustic treatment, all those mikes, are unnecessary. Here in (Air London's) huge Number One studio we recorded drums last week with the kit just on a riser in the middle of the room—and just stereo mikes. No one could have dreamt of doing that as recently as five years ago."

LANSDOWNE VIEW

Adrian Kerridge has been engineering at North London's Lansdowne Studios for over 20 years, and just over a year ago—in partnership with composer/arranger Johnny Pearson—he bought the place. Like everyone else, he reacts to the phrase "British sound" with a cheerful murmur of recognition, which changed to a squawk of anguish when asked to define it and—even worse—describe how it was produced.

One of two 24 input 16 output sound consoles built to the requirements of the Air Studios London in 1969.

Echoing Emerick, he ponders: "I suppose people talk of the British sound the same way that we talk of the American sound. Perhaps it's just that the grass is always greener on the other side. Yes it exists; no I can't define it. It is easiest to detect in comparisons of UK pure pop with US pure pop." The superiority of the US jazz brass sound he acknowledges, and puts it down to the musicians more than the studios; the specialist brass sections who are always working together on sessions. For the same reason, he believes that the British string section is unbeatable in sessions, and both factors put their stamp on the national sound—the more so because artists with the budget to make the choice tend to record the former in a US studio and the latter in a UK facility. Kerridge theorises that national character is another factor; there is a comparison between the relaxed style of US West Coast living and its music, while "things are definitely less relaxed" in the UK.

LIVE ACOUSTICS

The preference for live acoustics in UK studios is stressed by Kerridge—although he points out that this is no novelty, because Lansdowne (like many older UK studios which have never drastically changed their original acoustic design) has always been a very live room. Where monitoring is concerned, he agrees that preference in the UK is for totally impartial systems. He proudly waves the flag for UK desks, which he feels, allow the engineer so much scope. "All good engineers are artists; if they are not, they should not be in the job. But I think that in Britain they are not given the kind of professional respect they deserve (and which they get in America and most of Europe, particularly Germany). This could be why many experienced British engineers opt out of ordinary studio work and set up on their own, to work as producer/engineers with groups."

Speculating that the idea of British sound comes from the Swinging Sixties, Kerridge recalls that so many hits in a similar vein came out of UK studios that recording work flooded here. Overseas artists and producers all wanted to consult the electronic guru. The "sound" comes, he feels, from simplicity of approach—even now. He recalls engineering the sessions where London groups started to fight the Beatles-led Liverpool phenomenon. "When the Dave Clark Five came into Lansdowne to record, we had a four-track valve (tube) console (no outboard equipment, only an old EMT echo plate) and, because the group wanted to stand near each other, there was no real separation. This is what gave that 'roaring' sound. Having established the hit sound, we went back and remembered what we had done, and did it again!"

GEORGE MARTIN

Beatles producer George Martin mulls the question of whether there was anything about British technology at the time which was responsible for the awe-inspiring success of the group. He feels that technology had little to do with it. After all, the Beatles' earliest recordings were made on 2-track, while US studios had moved on to 3-track half-inch. However, the UK then moved straight to 4-track Studers, while three-track persisted for some time in America. It was a question of attitude; and it possibly still is, he thinks. "There is a new breed of artist/producer/engineer now which is rather alien to someone like me. They want clinical accuracy, measured by instruments. As a result, there is a loss in the human element. This is happening more in the US than in the UK—where there is a very healthy attitude to live performance on record, I feel.

"The breakthrough in 'the British sound' 20 years ago was a result of adventurousness on the part of the artists, and the studios' ability to get a much cleaner sound than before. The Beatles were very inquisitive; they were always asking what I had on my palette, because they wanted to use a new colour. I always used to indulge in gimmicks, and I experimented a lot with electronic music before they came along (with delays, tape reversal, speed variations). These were all tools, and they wanted to use them. Today everyone has reached such a high standard that there is nowhere much for anyone to go. When the Beatles were around there really was very little competition."

AN OBJECTIVE VIEW

If there is such a thing as objectivity on a question like this, Malcolm Davies at London's Pye studios might well have it. He doesn't do the engineering in the studios, and he doesn't do the mixing—except that which is required "at the cutting lathe." He has listened to the work of hundreds of artists and engineers, from scores of studios. It is not quite a case of "you name it, he cut it," but he is one of the UK's most experienced cutting engineers. And he is yet another Abbey Road graduate, having worked there from 1958 to 1968, in the cutting room for all but the first two years. He spent the following seven years cutting at Apple, and then joined Pye.

"I've always found, speaking generally (and going right back to early Cilla Black and the Beatles) that American recordings somehow sounded louder. Then, and now, European—particularly British—music comes in with more bass bias, which affects cutting. There's a new breed of engineers, (or is it producers?) who are too keen on using electronic toys; some really have gone a bit over the top. Recently I've been getting in tapes from small studios—down to 8-track, even—and they are fantastically good. They are closer to the Sixties sound—but it's still difficult to say whether the sound is the result of the choice of studio or of engineer. Music is really about people, not about gear. Give me a good room and an old 8-track and a decent band, and I'll give you a good sound from their tape."

On reflection, Davies is cheerfully ready to blow the idea of British sound altogether. "UK hits created the myth of the UK sound. It's a mental association people make—such as the guy I met who had heard and liked a lot of hits on one label and swore he could recognise 'the Parlophone sound'—as if the label had any bearing on the sound of the records! Except of course in the case of Tamla Motown."

Whatever Davies's views, there are few myths which can claim to have been heard and recognised by so many hundreds of pairs of trained ears—on both sides of the Atlantic. *Vive la difference*... whatever it is! ■

TERRI ANDERSON

Why Dolby Has Put Down Some Roots in Britain

THANKS TO MINIATURISATION, computers and automation—which have all come to Dolby's aid in the last 12 years—the world's foremost producer of noise-reduction equipment has been able to forge ahead commercially while staying put geographically, so to speak. Although Dolby Laboratories has increased its productivity manyfold, it has stayed in the same modest-sized premises in South London. Recently, however, a burst of physical expansion has almost doubled the production area.

Although he opened a sales and marketing operation in his home city of San Francisco in 1975, Ray Dolby steadfastly kept all production in the same area of London where he started the business in 1965. However, he told me that he was considering starting production in the US—at a second Dolby establishment to be opened in San Francisco—when he was in London in late June, for a few "brain-strumming sessions" with his UK executives.

A RESULT, NOT A CAUSE

Noise reduction technology is closely associated with the UK but, when asked if this was why he had set up his company in England, Ray Dolby pointed out that the association was the *result* of his establishment in London, not the cause of it. "It is because the first widely produced noise-reduction system was produced here, and that was the Dolby system," he pointed out. "I believe that most businesses get started in a certain place because that is the place the person who starts it happens to be at the time. I had been living and working in Britain (or her 'Empire') for eight years when I started the company. There is no rational case to be made out for why I started in London instead of going home to America to do so, except that I was in London—and London was and is a major recording center of the world. It was obviously a potentially big market for us.

"If you are going to establish an audio-engineering company anywhere in the UK, London—or nearby—is the place to establish it. You need people who have a cosmopolitan outlook both in respect to their engineering, and culturally, especially in regard to music and the engineering which goes with music. To design that kind of equipment they must have had opportunities to listen to music, work in good recording studios, meet other designers and so on."

At the time that Dolby rented his first small premises in London in early 1965 and started work, there had already been many attempts to produce noise-reduction equipment—mainly in the US, England and Germany. Dolby's own progress towards setting up his company started with his education. He graduated from Stanford University in 1957 with a degree

Dr. Ray Dolby (left), inventor of the Dolby Noise Reduction System, listens with interest to a BASF cassette recorded with the Dolby B system. With him is Henry Pattinson, manager of the Audio/Video division of BASF.

in electrical engineering. He then went to England, to do post-graduate work involving X-rays, at Cambridge. During the six years he was there he developed X-ray-analysis equipment which had various possible applications, including use in medicine. (When it is suggested that this work seems a long way from developing a noise-reduction system, Dolby gently points out that "X-rays are pretty noisy things, you know.")

MEDITATING IN INDIA

Having always wanted to spend some time working in an emergent country, he decided to go to India and work on applications of his equipment in the medical field there. Being a musician who has played both piano and clarinet since his childhood, as well as a long-standing recording and hi-fi enthusiast, he took his instruments and portable recording equipment with him. "It was during my two years in India that I thought of the basic ideas on which my noise-reduction system works," he recalled. He returned overland, arriving in England in May 1965, and immediately started work on developing his ideas.

While at Cambridge he did a lot of recording—all the university music-society recordings, for example, and other orchestral concerts. This activity had brought him regularly to

Dolby Laboratories in South London—part of the British-American way of life!

London to complete projects in professional studios. In this way he had got to know the Decca studios in North London well, and in particular had made the valuable acquaintance of Cyril Windybank there. In 1965 he went back to Decca, told Windybank about his idea, and asked if he would be interested in testing a prototype. The reply shook him: he was told that Decca would gladly give his system a trial—but the studio was already testing three other prototypes: EMI in the UK, EMT in Germany, and Fairchild (with 3M) in the US were all, unbeknown to Dolby until that moment, working towards the same objective as himself. Dolby had no idea what their equipment was—and neither had Windybank because all he had been given were sealed black boxes.

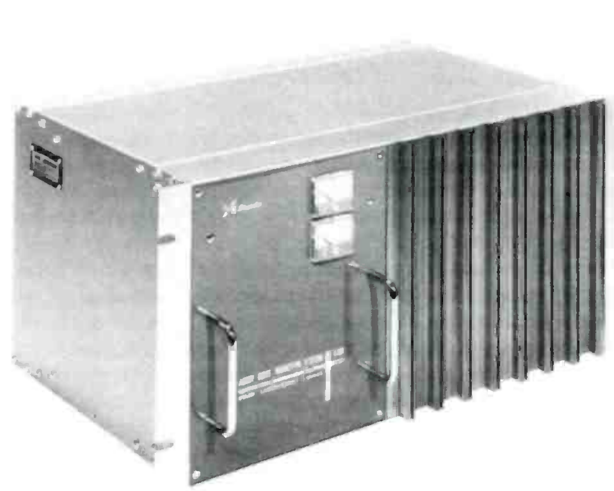
TAKING A CHANCE

Dolby decided to take a chance and go ahead with his prototype. By November of that year his first A Type system was ready. "With my money rapidly running out, I tested my system out with my own mics and equipment. Its first outside use (and I don't think I've ever mentioned this to anyone before) was on a recording of the Wimbledon Symphony Orchestra, conducted by Ken Jones. The second test was at Angus McKenzie's Olympic Studios, where it got a good reaction from the much-respected Dick Swettenham.

"But he gave me the first taste of a problem I was going to meet again. He said, 'Well it seems to work, but of course I can't use it because no-one else has one.' I went back to Windibank, and my system was tested at Decca on solo vocals and orchestral recordings. The test pressings came up, and were submitted to Sir Edward Lewis. He had the final say, although everyone else at the studios agreed on approving my system. He played the records on his Victrola, kindly claimed to be able to hear a difference—and that was it!

The Dolby A-Type Model 361

The Dolby A301 Audio Noise Reduction System



Working on the Racal computer tester at Dolby Laboratories in London.

"It was a big decision for Decca; quite a lot of money was involved. But I did not hear anything from them for a while. I decided to plunge ahead and start on the first production models. In fact, I had to wait until March 1966 for Decca to issue its first purchase order. That was for nine units of A 301, at £700 each. I delivered the five I had already made, but they were not used until all nine were delivered.

"The important thing is always to get the repeat order, of course. I carried on production, thanks to my bank manager, and eventually that second order came. It took a long time to make each unit manually at that time; I worked on all of them, even silk-screening the front panels myself."

FIRST RECORDS ISSUED

In November 1966 the first records made with the system were issued by Decca (Mahler 2nd Symphony, SET 3256), but Dolby had already started looking around for customers outside Decca. The reception he had was an unpleasant surprise after Decca's enthusiasm. The other UK record companies did not reject his solution to the noise problem—they denied that there was a noise problem to solve! Dolby started writing to potential customers in America. Telexes started to return, with RCA in the vanguard of those showing interest. Another interested party was Fairchild—offering to market the Dolby system. Dolby went to the US to introduce his system. He sold his two demo units and came back with orders for 17 or 18 more—from New York record companies such as RCA, CBS, MCA and Vanguard, and from several independent studios. There was also a gratifying resurgence of interest in his work from the audio and music press.

The units were at that time marketed under an "SN Stretch" name and logo. However, when Dolby was visiting Pye studios in London one day to see a couple of his units in action there, he overheard two engineers discussing the new noise reduction system. They were referring to the units simply as "Dolbys." Feeling much as the Duke of Wellington, Lord Sandwich and John Loudon Macadam must have done at certain turning points in the history of waterproof footwear, fast food and road surfacing, Dolby decided to go with the trend and call his invention by his own name.

A WIDER AUDIENCE

It was inevitable that the application of Dolby noise reduction would soon widen from those in the professional audio studio. Dolby had, through the years, made contact with many fields—recording, radio, TV, hi-fi, video, signal processing, motion pictures (he had at one time harboured an ambition to be a Hollywood cameraman). As early as 1966 he did his first demonstrations to the film industry, at EMI's Elstree studios. He also found customers at the General Post Office (for telephones) and at the British Broadcasting Corporation (for radio transmission). But on the film side it became rapidly evident that there were a lot of problems to iron out before they could get round to having a use for such sophisticated improvements as noise reduction.

This had not been the case with sound recording. "The state of the art there when I started was such that practically the whole process was perfect—except for the noise. By comparison, film was in a mess!" He left the film industry to put its mechanics into better working order before he had another crack at designing sound equipment for it.

In 1968, EMI asked him to look at the sound systems in their cinema theatres. "I did not have enough money or people to devote to that project until 1970," he recalled, "but it has been a more or less continuous effort in that direction since then." Gradually acceptance in the cinemas came "because we offer them a way of upgrading their sound without necessarily having to completely re-equip."

Dolby has succeeded for a number of reasons, and one of them is patience. When trying to sell noise-reduction systems to the film industry he knew he would need patience and plenty of it. "You have to work slowly and sympathetically with experienced people's sensibilities—and we are still doing that. We have to be aware that there is still the old guard who does not trust or understand this equipment.

"One of the things we had to provide on our units was a big bypass switch, so that the technician could feel that he could fall back on his own expertise instantly, if necessary!"

A VIEW FROM THE TOP

Looking the general recession squarely in the face, and at the same time casting his eye through his window at the new Dolby Labs' London extension, managing director Gary Holt conceded that 1981 has not been the busiest time in the firm's history, although it has been better than 1980. The expansion of the production area is aimed at giving everyone a bit more elbow room and breathing space, and—as Holt pointed out—"You have to be ready for when the market goes up again."

The Labs are making about 20 discrete product lines, plus the modules which go into some of them and are sold separately. All are, in Holt's opinion, equally important—which is why the inevitable exhibition visitor's question of "So what's new?" is one which will cause a barely perceptible sagging of the shoulders of those on the Dolby stand.

In the Dolby catalogue are such professional workhorses as the M Series units, which in volume terms are the most important; the multitrack units introduced in 1972 are still going strong; on the film side the CP 50s continue to sell throughout the world; and Dolby A has been a standard in the professional recording world since its introduction—and will remain so for a long time. These items of Dolby equipment remain as they are because they work—it is as simple as that.

"You could say our problem is that we make things which last far too well," Holt mused. While dismissing any suggestion that Dolby will be joining the planned-obsolescence stakes, he recalled laughingly that one suggestion made in the past was that the Lab could breed a "solder weevil" and surreptitiously introduce a few of these into the parts trays on the production line.

A CARD FOR DOLBY C

Newish on the catalogue, however, is the 330 series, allowing compact cassette duplicators to encode Dolby C, by means of a new card. Then there is the CP 200, affectionately referred to by Holt as the Big Bertha of the film sound units, intended for those beautiful all-singing all-dancing 70 mm movies.

With units which are still in work after 10 years, with a depressed studio and film market, and with a responsible realisation that it would greatly upset those who have spent large amounts to equip with Dolby if they were expected to keep changing and updating equipment which was perfectly adequate in the first place, Dolby looks outward to export. The company has always sold abroad energetically, and continues to open up new markets. Some 80 percent of what is produced is exported from Britain, with about 40 or 50 percent going to the US. ■

The British are coming... to AES

British author Terri Anderson, Features Editor and Recording Studio Specialist for the magazine "Music Week," takes a look at some of the British firms exhibiting at AES in New York. Each firm was approached individually, and the comments and information supplied by the companies themselves as to their products and what they hope to achieve at AES, form the basis of Mrs. Anderson's article.

Allen & Heath Brenell Ltd.
Pembroke House, Campsbourne Road, London N8 7PE
(telephone: 01-340-3291)

AHB declines an opportunity to demonstrate the quiet modesty which is supposedly part of the British character. The company describes its latest addition to its Syncon Series of studio equipment as "the ultimate in tape recorders." On the stand will be the Syncon M24—a handsome two-inch recorder, with a computer brain to keep note of what it has done and what it is expected to do in any session. The heads can be changed in 15 seconds.

Conrad Wagner, marketing manager, intends to use AES to prove to as many people as possible that the M24 is a "tape recorder from the future."

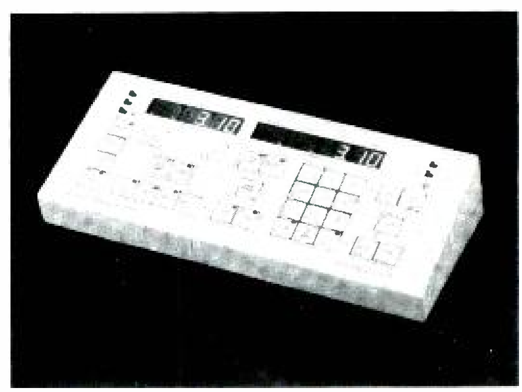
Audio Developments
Hall Lane, Walsall Wood, W. Midlands, England WS9 9AU
(telephone: 05433 5351)

Following a very successful show in November 1980, Audio Developments is exhibiting again, this time with an already established agent who will be able to deal very rapidly with the many enquiries the company expects to receive about its portable mixers.

"Experience told us that our producers fit very nicely into a niche in the American market so far untouched by their domestic manufacturers," says sales director Anthony Levesley. "We now anticipate a steadily growing business in conjunction with our New York agents, Scharff Communications, 1600 Broadway, New York, NY 10019 (telephone: 212-582-7360).

"Our range of mixers includes the following models: AD007 Mini Mixer, AD031 Micro Mixer, AD045 Pico Plus Mixer, AD049 Mixette, AD060 ENG Mixer, AD055 Stereo Compressor/Limiter, and AD070 Prographic Equalizer.

"We will be looking forward to meeting active dealers from other states who are interested in becoming partners with Audio Developments in the expanding professional portable mixer market in the U.S."



The Audio Kinetics Q-Lock 3.10 Synchronizer

Audio Kinetics (UK) Ltd.
Kinetic House, Verulam Road, St. Albans, Herts., England AL3 4DH
(telephone: 0727 32191)

AK director Ian Southern notes that: "The necessity is growing for the recording studio to install facilities for recording and mixing to a video picture.

"The Q-Lock synchronizer, which we are showing here, has been designed to make this extension of facilities as simple and economical as possible."

The Q-Lock SMPTE/EBU time-code-synchronizer system has a central control unit offering total transport control of a multimachine system. The demonstration will illustrate the use of the Q-Lock in a video post-production sound sweetening application. The master is a video U-matic cassette machine, Slave 1 a multitrack audio and Slave 2 a 2-track. The dedicated software interfaces to each machine are optimized to give an uncompromised performance, and Q-Soft interfaces are available for most major audio, video and film machines.

Unique sync routines transfer a minimum amount of flutter from the master to the slave machines, adding typically no more than 0.01 percent to the slave machines' manufacturers' specifications, while keeping a tight ±50μs lock between the transports. Tach pulses are read at wind speed, eliminating the need for wideband amplifiers and spooling across the heads. The ten-memory cycling autolocator will operate with or without time-code present. Q-Lock also has an integral multi-standard time-code generator capable of 24, 25, 30 and drop frame code generation.

Canary Mixing Desk Ltd
17 West Hill, London SW18 1RB
(telephone: 01-870 7722)

Those who already know Canary will recognize several items from its normal range on the stand. But there is also Canflex—a new modular mixing system which, its developer and manufacturer states: "leads the world with a remarkable new approach to modular mixing boards. This revolutionary patented idea enables you to buy the modules you need and plug them together, to make your own design. There is no expensive, limiting main frame, so the variations are endless."

Asserting that "standard one-piece chassis designs are virtually obsolete now," Canary offers a system in which channel modules come in two formats—standard and pro—which can be mixed together with master modules.

The Canflex mixing board can be broken anywhere and stretched at a later date to add more channels, master equalization, electronic crossovers etc. The electronic design offers low noise, ample headroom and incorporates the latest audio technological development. The modules are of a rugged construction to withstand the rigours of the road as well as studio use.

"You can start small and expand, with your needs, up to 35 channels. To add more channels takes five minutes; all you need is a screwdriver. You could even break the board in two for transport, it's so easy."

Hill Audio Ltd
Hollingbourne House, Hollingbourne, Maidstone, Kent, England ME17 1QJ
(telephone: 062 780 555)

This year's New York AES marks this company's American sales debut, although Hill systems have enjoyed considerable success in the US (notably through its use by AC/DC and Gary Numan). The bow at AES coincides with the opening of two factory-run customer centres in California and New York.

Featured on the stand will be the new J Series 2 modular mixing console offering eight buses, 12-way bar LEDs, four-band switchable parametric equalization and four auxiliary sends; the M Series monitor console with parallel XLR inputs, 12-way LEDs, and all designation by fader controls; the DX 701 3½-inch rack mounting stereo power amplifier delivering in excess of 600 W per channel, and the TX 800 tri-amplifier specially designed for full range cabinets and monitoring.

Typical retail prices would be: 32/8/2 J Series 2—$12000.00; 24/8 M Series—$5000.00; DX 701—$1150.00; TX 800—$1350.00.

International Musician & Recording World—USA
Cover Publications Ltd, Grosvenor House, 141-143 Drury Lane, London WC2B 5TE
(telephone: 01-379 6342)

The magazine has a stand at AES: "to promote the image of *International Musician & Recording World—USA* which is now an established publication in the music and recording business, and to meet new and established companies in the business." It plans "to distribute the magazine to exhibitors and visitors and to obtain more subscriptions and sales of copies eventually from newsstands around the USA."

A further aim of the magazine is to obtain information from the recording engineers and manufacturers "to improve our editorial coverage of the recording scene."

Klark-Teknik Research Ltd
Walter Nash Road West, Kidderminster, Worcestershire, England
(telephone: 0562 741515)

This time, the company is exhibiting itself only and will not, as in the past, be showing Statik Acoustics' product lines.

At this show, Klark-Teknik is unveiling its latest graphic equalizer. The new DN30/30 equalizer has two complete channels of 30 x 1/3rd octave equalization in a compact 3-unit-high 19 inch package. It features subsonic filters; fail-safe system bypass; range switching (±6 dB or ±12 dB) and new computer-designed high-performance N.I.C. filters.

Also new is the DN27A graphic equalizer. This is the latest version of Klark-Teknik's 1/3rd octave 27-band equalizer which has become an industry standard in many countries throughout the world (often copied, never equalled), and the RT 60 reverberation analyser.

Also on display are: DN60 1/3rd octave real-time spectrum analyser (microprocessor controlled). Features include: peak hold, three memories, internal noise source, selectable display time constants, selectable display resolution and much more.

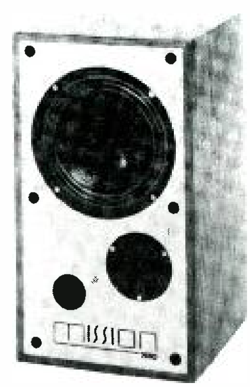
DN 70 digital time processor—a digital delay line with three ouputs, each with variable delays up to 653μs. A high clocking speed of 50 kHz permits frequency response to 18 kHz on all delays. There are many other outstanding features.

DN71 controller—a "low-cost" add-on sound-effects generator to complement the DN70.

DN34 analogue time processor—"probably the most versatile sound-effects generator on the market today."

DN22 graphic equalizer—a dual 11-way unit with both high- and low-pass filters on each channel.

DN72 memory bank for DN70. This allows 18 preselected memories with nonvolatile memory. It has read store and fail-safe facilities.



The Mission 700 15-80 W Speaker System

Mission Electronics
Unit 9a, George Street, Huntingdon, Cambridgeshire, England PE18 6BD
(telephone: 0480 57151)

Mission, a relatively new company in the audio field, claims "unprecedented success in establishing many of its advanced products as the standard reference now used by many recording studios, broadcast companies and hi-fi reviewers. The last have continually nominated the Mission 770 as the finest loudspeaker system available, regardless of cost."

The Mission research team has used extensive R & D experience to produce a new range of speakers that, the company promises, "will be outstanding in quality and finish"—listed below:

700 15-80 W speaker system; 717 15-125 W speaker system; 727 20-150 W speaker system; 770 broadcast monitor; 773 HC high-output moving coil cartridge; 774 reference tone arm; 775 transcription turntable; 776 straight line pre-amp; 777 125 + 125 W power amplifier.

Neve Electronics International Ltd
Cambridge House, Melbourn, Royston, Herts., England SG8 6AU
(telephone: 0763 60776)

A veteran AES New York exhibitor from the UK is Neve, making its tenth showing here.

A 48-track music recording console, of the latest type 8108 and fitted with NECAM (Neve's computer-assisted mixing system), is on the large stand. There is also a working demonstration of Necam II (Neve's computer-assisted dubbing system for TV and film post-production work.)

There are also 8-, 12- and 16-input small mixers, including a suitcase version for mobile use.

Exhibiting in the name of Rupert Neve Incorporated (the marketing and service company in Connecticut), Neve is also showing NECOMM units, a new intelligent intercom system designed for TV and other professional audio centres.

Neve is already well established in North America, managing director Derek Tilsley points out, having a "sales value to match any North American competitor," and the company has always made its presence at international exhibitions such as AES (and APRS in London) a focal point of its worldwide marketing strategy.

Songwriter/producer Phil Wainan (right) bought the first 8108, to be installed in his Utopia studios in London, where it is pictured with his new state-of-the-art desk and his chief engineer.

Penny & Giles Conductive Plastics
Newbridge Road, Pontllanfraith, Blackwood, Gwent, Wales NP2 2YD
(telephone: 0495 228000)

David McLain, marketing director, is particularly keen to see the company represented at the USA-based AES shows. "Our USA sales are an important and growing part of the business," he states, "and we use the shows to support the market and our office in Santa Monica."

The Penny & Giles range of conductive-plastics linear-motion studio faders are already recognized as a standard in the recording and broadcasting industries of the world. The development of the plastics itself won Penny & Giles a British Queen's Award for Technological Innovation—and the faders the company has made out of that plastics have been selected by the British Design Council for a Design Award.

This year at New York AES, the company is introducing a new, extended range of 3000 Series faders. These are robust, high-performance faders with full environmental shielding; stroke lengths of up to 124 mm. They have largely been developed to suit the American market.

P&G is also exhibiting a rotary fader, which is finding increasing sales in the local-radio-station market, for which its high performance, fully sealed construction, and zero maintenance make it ideal.

The full range of faders and quadraphonic pan pots will be demonstrated, and engineers will be on the stand to discuss customers' technical requirements.

Penny & Giles Conductive Plastics

Raindirk Ltd 400 Series Broadcast Mixing Console

Raindirk Ltd
33A Bridge Street, Downham Market, Norfolk, England PE38 9DW
(telephone: 03663 2165)

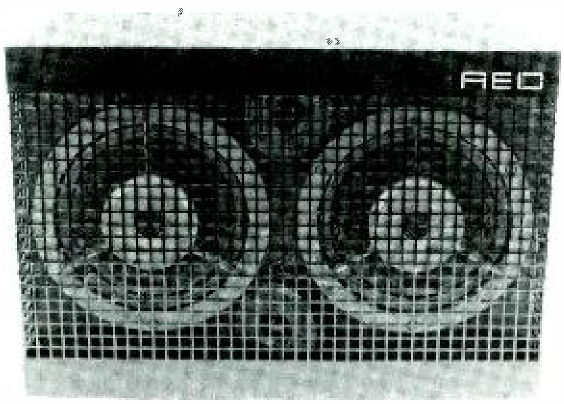
On the stand of this relatively small, but well-known and respected company, are the 400 Series broadcast mixing consoles (which were designed to meet the requirements of the South African B.C., but which are flexible enough to be configured to suit all types of broadcast organization). Raindirk is showing the 400 Series because the company believes, "they offer cost-effective alternatives to the established US-manufactured products." This AES is, in fact, the first opportunity for many East Coast members of the audio industry to see these consoles.

Also being shown for the first time is the Status range of equipment—the Status 500 power amp (giving 250 W per channel into 8 Ω), which is now being used for monitoring in a number of British studios; and the Status 20 stereo control unit (a professional quality pre-amp intended for cutting suites and demo rooms).

The output stages of the Status 500 employ power MOSFET devices. Its growing popularity in studios is felt to be due to its ability to drive difficult loads with low harmonic and intermodulation distortion.

The Series 20, described as "virtually unique," offers separate modules for both moving-magnet and moving-coil cartridges, and input resistance, capacitance and sensitivity are fully adjustable by changing internal plug-in components. A three-section semi-parametric tone control stage is fitted, and electronically balanced outputs permit interface with other balanced equipment.

Raindirk is also offering its custom-built service.



Red Acoustics two-way Speaker System

Red Acoustics Ltd
Chelsea Wharf, 15 Lots Road, London SW10 ORN
(telephone: 01-351 1394)

The distinctive styling of Red Acoustics' speaker systems ensures that people remember what they look like—and the fact that numerous British studios and live rigs include this system is proof that many are impressed by the way they sound.

At this AES, the company is exhibiting its A4 and A3 active speaker systems, and its P4 and P2 passive systems. Both these two-way units boast clean, high sound level, compact size, and dynamics compatible with digital sources.

They incorporate a double-suspension high-power LF driver—and a Tristar sound disperser of original design and manufacture. They also have one-inch HF dome direct radiators.

The A4 active speaker module (19-in. x 13.6-in. x 12.8-in. WHD) is suited for a wide range of monitoring and PA applications. These active Red systems can be used with any driving signal of more than 500 mV, and they are overload-proof.

Solid State Logic
Churchfields Road, Stonesfield, Oxford, England OX7 2PQ
(telephone: 099 389 8282)

SSL is a British export success story of no mean proportions. Its first eight desks were sold outside the UK, and British studio owners are still resigned to joining a waiting-line for delivery.

At this AES, SSL is showing the SL 4000 E Series master studio system, which won this year's British Design Council Award for engineering products. It was the first equipment of its kind to get such an award, and its attributes are listed as providing recording engineers with a greater degree of flexibility, efficiency, ease of operation and ease of maintenance than any other similar system.

The SSL Total Recall Studio Computer (TM) will be demonstrated, and there are a number of hardware and software updates.

SSL says: "Participation in AES conventions in Europe and America has helped to establish our reputation as one of Britain's leading exporters. And it is with special pleasure that we go to AES New York with this year's Queen's Award for Export Achievement."

For the first time in New York, the SL 4000 E Series console will include the stereo plasma display meter option. This flexible bar graph monitoring system features 200-segment resolution displays on multitrack, main bus and auxiliary outputs with a choice of VU or PPM characteristics and a unique simultaneous peak store and display mode. Alternatively, the multitrack meters may be switched to show a 27-band, 1/3rd octave spectrum analysis in stereo, or they may be used to display inline computer mix information.

Each bar graph unit also has a set of illuminated scales and legends which details the source being monitored, how it is being monitored, and whether that particular track is armed ready for record.

Software updates include an extended 48-track listing, and 48 bargraph displays on the primary studio computer monochrome TV display.

For further information in US: Doug Dickey, Musicworks International, 2352 Wisconsin Avenue NW, Washington D.C. 20007 (telephone: 202 333 1500).

Studio Sound
Link House, Dingwall Avenue, Croydon, Surrey, England CR9 2TA
(telephone: 01-686 2599)

Studio Sound, now in its 22nd year, is the monthly international professional audio magazine written by and for sound engineers and producers. It provides news, features and technical reviews which will be both interesting and useful to these people in the recording, broadcasting and live-sound environment.

In addition to regular news of equipment, studios and exhibitions, each issue carries extensive surveys and reviews of a particular range of equipment.

Circulation of *Studio Sound* is worldwide, going to over 95 countries. The magazine is available free of charge to those professionally involved in the industry. Coverage is similarly wide-ranging, with regular contributions from many parts of the world. Advertisement and editorial staff will be present throughout the show.

Soundcraft Electronics Ltd
5-8 Great Sutton Street, London EC1V OBX
(telephone: 01-251 3651)

Soundcraft is at AES New York because "it is a vital opportunity for all manufacturers of professional audio equipment to exhibit their products—particularly new products." A regular exhibitor at North American AES shows, Soundcraft has steadily increased its sales in that market for several years.

In conjunction with its USA subsidiary (Soundcraft Inc., of Torrance, California), Soundcraft will be exhibiting its full range of sound mixing consoles and multitrack tape recorders, which are designed to meet the requirements of a very broad market from 24- to 8-track studios, video sweetening, sound reinforcement and broadcast.

Of particular interest is the Series 2400 automated master recording console, which features a new generation of automation system developed by Soundcraft; and the Soundcraft Magnetics 16- and 24-track recorders which open new horizons to more budget-conscious studios wishing to upgrade and to engineers requiring transportability of the multitrack machine, with synchronization feasibility (employing BTX or Audio Kinetics systems).

The company promises: "the pursurance of a policy with a high. feature-to-value ratio, without any compromise on technical excellence."

Soundcraft won a Queen's Award for Export in 1979, and exports 70 percent of its output. ■

C. NICHOLAS COLLERAN

The Saga of Sonex

The following is the story of an acoustic product discovered while searching for a cost-effective sound absorber to refurbish Alpha Audio's studios.

WHILE MOST OF US like to think that the studio business is on the cutting edge of modern technology, this is not always the case. In many instances, products and materials may exist for years in industry before finding their way into the recording studio. Sometimes this is due to the high cost of development which can only be supported by a large industrial market. Computers are a good example of this. It is doubtful that the need for automation of the recording console could possibly have supported the research and development cost necessary to create the technology. Similarly, the noise restrictions on industry provide a greater market incentive to develop absorptive acoustic material. There are a lot more factories than recording studios, folks! Besides, when was the last time you saw the OSHA man at your session measuring noise levels and threatening to shut you down?

One day while casually flipping through a periodical featuring new products for industry, what should our chief engineer, Joe Sheets, see but a new sound-absorbing material. Alpha Studio had a very bad "slap echo" problem from our rear wall; and, as every good studio engineer knows, an anechoic wedge is the best thing to get rid of this. We knew that foam rubber absorbed high frequencies rather well without any special shaping, so it seemed reasonable that the anechoic wedge pattern just might work. We ordered enough to do our rear wall, more than 650 square feet, twice! Having worked around flutters and reflections for many years, we were determined to get rid of them once and for all.

Mr. Colleran is President of Alpha Recording Corporation, which operates four recording studios in Richmond, VA. Additionally, they operate Alpha Audio Acoustics, which distributes Sonex Anechoic Wedge Foam.

THE GREAT SONEX EXPERIMENT

The wall, as it existed, was primarily left-over 1960s "acoustics." The bottom half was 3½-in. fiberglass covered with burlap, while the upper portion was Armstrong IB acoustic tile. It was a mixture of traditional, dead studio wall and broadcast booth. As we previously stated, we were determined to get rid of the flutter echo altogether, so we saw no reason not to leave this material on the wall—the more absorbing materials, the better. On top of this layer came the great Sonex experiment. Looking at the graphs, we noticed the absorption curve rolled off below approximately 400 Hz. It seemed reasonable to expect that by creating a cavity, we could extend this low frequency absorption further. To do this, we covered the rear wall with what has become known as the indented pattern Sonex. (This is also referred to as the negative pattern or the female version.) We then proceeded to build an absorptive wall with a depth varying to 1½ feet distant from the rear wall. The bottom half was curved, 10 feet in height and in excess of 32 feet wide. This was supported by thin plywood strips, which were easily bent to form a curve, and covered with Armstrong Soundsoak (primarily to give the appearance of a solid wall and also because the material conformed to the curve rather easily). At this particular time, we did not know how well the Sonex was going to work so we hedged our bets with the Soundsoak. The upper part of the ceiling was constructed in 4-foot squares with the wedge-shaped Sonex mounted on pegboard. This frame sloped forward from approximately 4 inches at the bottom to 1½ feet, creating a cavity, which varied in depth, and a membrane absorber. This was covered with the wedge-shaped Sonex, the traditional anechoic design. (This pattern is also referred to as the positive or male version.)

The results we achieved were spectacular. Nothing came back from the wall. We had fooled those pesky sound waves into believing they were in the great outdoors. Alpha Audio had found a new acoustic material, which some people have come to refer to as the "Black Hole of Sound."

The new Lexicon PCM41 Digital Delay . . . with "the sound that makes the difference"

You're a performer ready to move up. Or you have a small studio — and big ideas. Performer or studio owner, you're ready for sound that's better. And that means Lexicon.. the digital delay top performers insist on . . . the same delay you'll find in world-class studios.

Only now you can get it for a lot less dollars with our new PCM41.

This new Lexicon system is based on the same PCM technology that goes into the big Lexicon systems. You get a broad repertoire of creative effects — double tracking, flanging, vibrato/tremolo, arpeggio, doppler pitch shift, slap echo. All the big-system stuff plus some dramatic new goodies. Like articulated sweep in The VCO Envelope Follower that automatically tracks the attack of **your** sound for dramatic new effects. Only Lexicon has it! Plus infinite repeat for background rhythm and counterpoint effects.

All major functions can be foot-switch controlled for easy on-stage or studio use. But the big plus is the sound! Listen to Lexicon's PCM41 for yourself at your pro-audio or instrument dealer. It's different. And it can make a big difference for you!

Lexicon

60 Turner Street, Waltham, Massachusetts 02154 • (617) 891-6790/TELEX 923468
Export: Gotham Export Corporation, New York, NY 10014

Circle 41 on Reader Service Card

Figure 2. Phil Coxon conducts the "Industrial Strength" Orchestra in a Studio I jingle session.

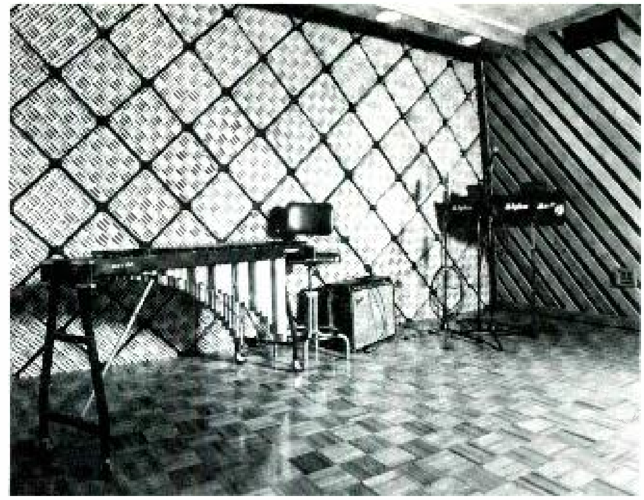


Figure 3. Audiotiles on the rear wall of Alpha's Studio IV.

THE BIG COVER-UP

Having realized the effectiveness of the Sonex acoustic material, and marvelling at our success, we began to wonder why we had not heard of this material before. One reason became quite clear to us when we were in Nashville for a SPARS Board of Directors' meeting. We had heard from the manufacturer that "a lot of the stuff has gone into that town, but nobody's ever seen it."

We were quite curious to see what evidence of Sonex we could find.

After the Directors' meeting, we were treated to a tour of working studios, as well as being invited to see a new studio under construction. What should we find there but a crew of studio builders surrounded by a wall of wedges. It became clear that those who knew the merits of Sonex were keeping it covered up—inside the walls. We listened to the reasons for its use from the builders.

According to one designer, Sonex allows the building of a bass trap in approximately half the space previously required with flat surface materials. Four-inch Sonex provides a surface area 4½ times as great as that of the surface which it is covering. Every square foot of plywood covered with Sonex has a 4½ square foot surface area of absorption. It is the increased surface area that allows the size of the trap to be reduced and still provide the same effective absorption. Considering the premium price for floor space in New York City, this fact alone could prove of enormous value in urban areas.

Besides the acoustic values, it was also noted that Sonex helps avoid the Studio Builders Disease: Fiberglass Itch! By the time of our Nashville revelation, we had already begun distribution of Sonex to the audio industry. In doing so, we could not help but wonder what leading acousticians would have to say about the product. No sooner had the thought crossed our minds, than we read of its testing by Don Davis of Synergetic Audio Concepts and his subsequent recommendation of the product as a suitable material for live-end, dead-end control rooms (LEDE™). As we have just seen, the material was already being used in rear bass traps and traditional hard-front compression ceiling studios. While we will probably never see universal agreement on which studio design is best, and really do not wish to argue the point here, we were beginning to see that leading acousticians were agreeing that whenever they wanted the absorption, Sonex was the material to do it.

The acceptance for use in live-end, dead-end control rooms is the result of several characteristics unique to Sonex. First, it has a uniform absorption curve, extending below 500 Hz with significant absorption down to 250 Hz. This is the range in which wave acoustics cross over to geometric acoustics in most control rooms. Absorption below 500 Hz will depend upon the structure of the room shell. Above 500 Hz, Sonex provides almost 100 percent absorption. Secondly, the anechoic wedge pattern provides a surface to break up standing waves. Any sound that does manage to bounce back is diffused. According to the theories, the absorption *and* diffusion characteristics prevent close-order, early reflections from coming back and combining out-of-phase with direct speaker signals, which would otherwise provide comb filter effects and significant anomalies in frequency response. By eliminating the close-order, early reflections, the mixer hears just the direct sound of the loudspeaker and makes judgements on the sound quality uninfluenced by room acoustics. One of the first major uses of Sonex for a live-end, dead-end control room was in Wally Heider's Studio 4. Here, Don Davis himself provided the consulting services and subsequent documentation of its performance.

Figure 4. Wally Heider's Studio IV control room.

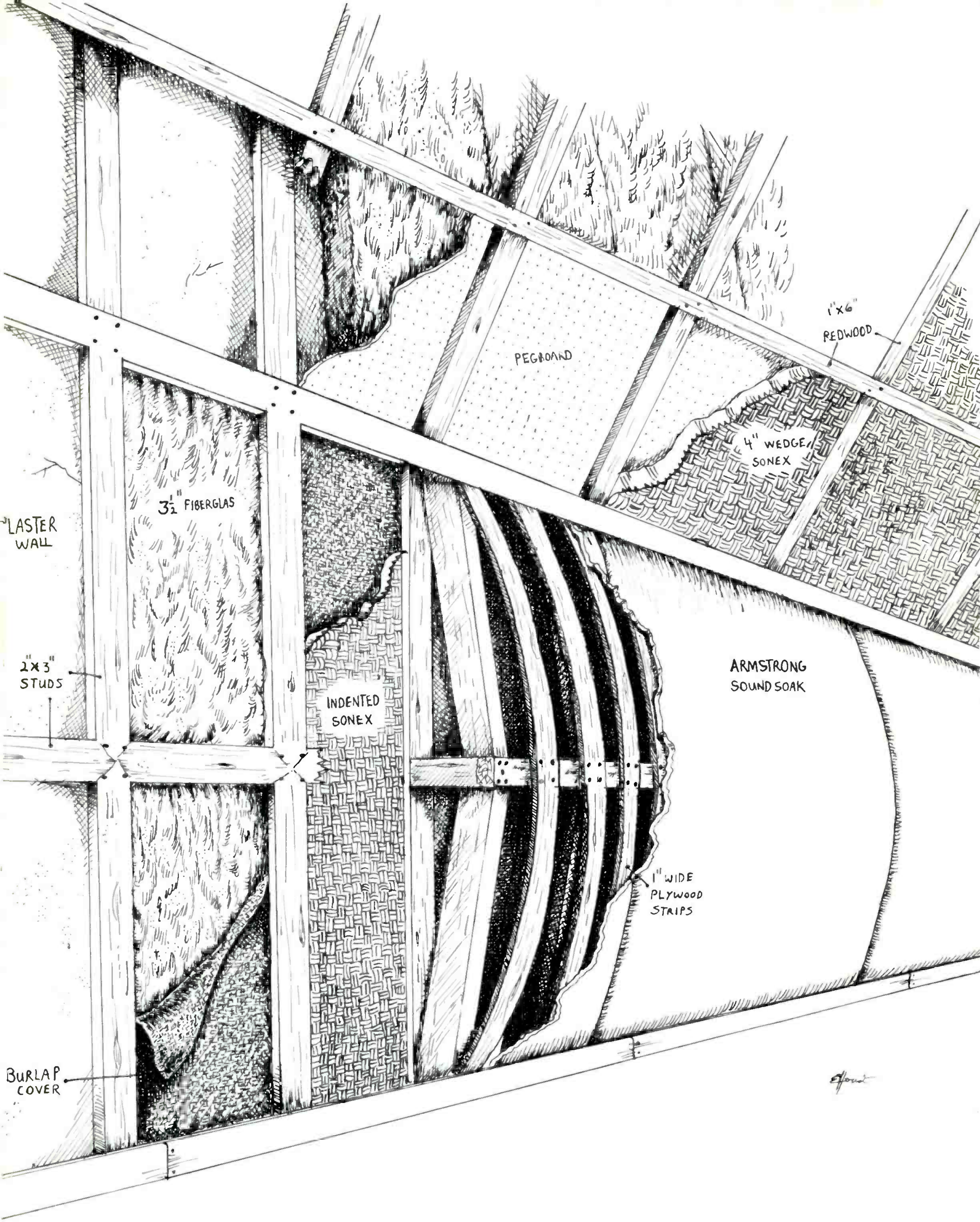


Figure 1. Artist's conception of the rear wall of Alpha Audio's Studio I.

'AUDIOTILE'

Having witnessed the acceptance of Sonex for various control-room situations, we felt it could only be a matter of time before the audiophile (better known as the diehard hi-fi nut) tried it on his walls. Since Sonex as a building material is rather bulky, we decided that the product for home use should be in a smaller package and of a size more easily installed by a single person. Hence, the 15-inch square "audiotile" came to be. We had been wanting to recommend padded rooms for some of our hi-fi friends for many years. Now we had a good acoustic reason for doing so.

Within a few months, we were being sought out by those sound addicts who realized their listening environment was the "final component" in achieving good sound. One such true believer was Dennis Lockhart of Charlotte, North Carolina, who made several calls around the United States and out of the country to track down this author at home on the week-end. By Tuesday, Dennis had a listening environment whose sound quickly overcame his neighbors' jokes about rubber walls.

Since that time, several hi-fi enthusiasts have installed live-end, dead-end listening rooms in their homes. Most notable among them is the associate editor of Audio Magazine, Bert Whyte. Both he and Mr. Lockhart have said that when they play records now for their friends and associates, no one can believe their ears. It seems reasonable that symphonic music, in particular, should sound better in this environment as it allows you to hear the acoustics of the hall in which the music was recorded, rather than the acoustics of your own listening room.

LIVE SONEX

Almost as if it were planned, we were next given the chance to experiment with Sonex in live broadcast. The chief engineer of WLEE Radio, Dave Bennett, called and requested our advice in rebuilding the station's main on-the-air control room. After a few hours of discussion, they had our sketches of an untried design with our firm assurance that it "might work." What followed was a designer's dream! They followed the design concept through in every detail.

The design uses the live-end, dead-end control room layout, but in reverse. The announcer/disc jockey is in the live end of the room facing the control room glass. By being in the live end, he hears a more natural live sound. The announcers agree this is psychologically better as it is impossible to sound excited or enthusiastic in a dead room. The microphone, of course, is facing the dead end of the room, and little room reflection is picked up. The speakers are behind the announcer in the dead end and operate in accordance with standard LEDE™ Theory. This arrangement allows the announcer on-the-air the same feeling he would achieve were he doing a live show. In live performances, the music is behind the announcer and the reverberance comes from the hall out front.

The results of the new room were dramatic. Listeners called to inquire what had been done to improve the sound. In the past, there had been no such response when any new piece of processing gear had been added to the audio chain. The response proved that the GIGO Theory (Garbage In—Garbage Out) applies to broadcast as well as computers. Improved sound at the source will produce dramatic results and allow the signal processing equipment to do its intended job of polishing the performance, not saving it. We feel certain that there will be a greater emphasis on broadcast acoustics in the future, and this design, in particular, which provides a good working environment; a clean, live signal, and accurate uncolored monitoring of the material being broadcast.

Until now we have covered only a few of the major uses of Sonex for sound control and accurate monitoring. What follows are some small scale, but no less significant applications of the product.

OTHER USES FOR SONEX

One of the more obvious applications, requiring only a few sheets of the material, is studio gobos. Anyone who has read Lou Burrough's book on microphones has shuddered seeing the graph of microphone frequency response when placed in close proximity to a normal flat surface sound barrier, such as a typical studio gobo or sound stage flat. Since the sound absorbing properties of Sonex are essentially the same as an open window at the most critical frequencies, the degenerative effect of reflections from a surface in close proximity to the microphone are eliminated.

Sonex has also found application as a testing tool. It is regularly used in Syn-Aud-Con classes when performing TDS™ (time delay spectometry) measurements. Placing Sonex in the path of a reflection effectively eliminates it. Individual reflective surfaces may be located and their effects cancelled by changing the placement of one 4-ft. x 4-ft. sheet of 4-in. Sonex.

We are supplying more and more of the material for use in trade shows for a variety of reasons. A number of booth designers find it to be decorative and that it blends in well with

Figure 5. The rear wall of WLEE's main control room, showing Sonex and speaker placement.

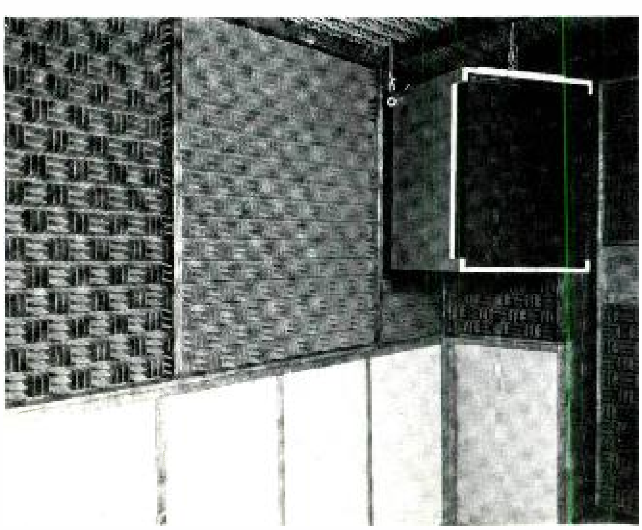
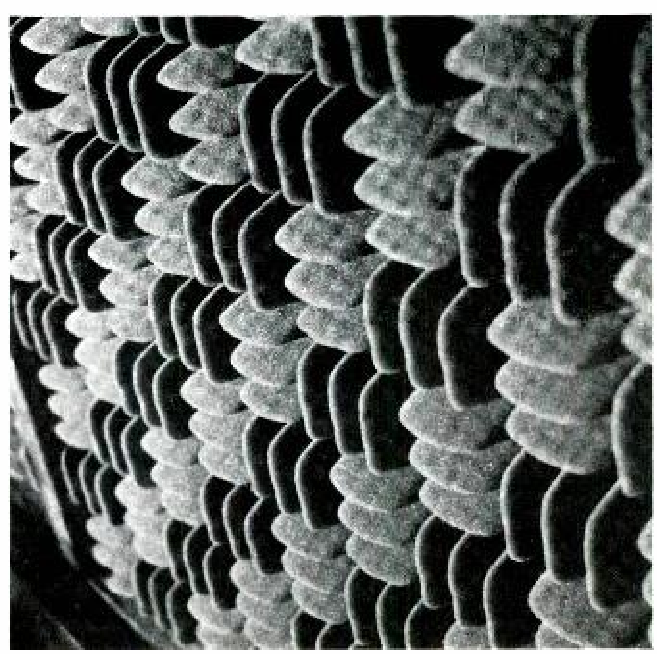


Figure 6. Close-up of natural Sonex used at WLEE.



FREQUENCY (Hz) MATERIAL	128	256	512	1024	2048	4096
A	.07	.47	.55	.70	.77	.74
B	.55	.68	.95	.90	.79	.80
C	.28	.73	1.00	1.00	1.00	1.00

(A) Armstrong 2B Cushiontone ½" x 12" x 12" perforated ¾" center.
(B) 3-inch fiberglass insulation.
(C) "Super Sonex" R-100 acoustical foam (wedge shape, 6" high approx.)

Figure 7. Absorption coefficients of wall coverings for Recording and Broadcast Studios.

an audio show, due to its "acoustic" look. Speaker manufacturers, such as UREI, line their listening rooms with it so that the full effect of the Time-Aligned™ speaker may be heard in the less-than acoutical paradise of the hotel room. A major speaker manufacturer, JBL, finds use in the purpose for which Sonex was originally developed, noise control. They have built sales booths for those conventions where on-the-floor sales are allowed. Sonex on the wall provides a quiet environment in which to discuss product and write orders.

Much of the Sonex being supplied to TV stations is also finding application in noise control. We first thought we were seeing a new emphasis on acoustics in TV. In some cases, we were. However, one of the major uses of the material has been to quiet down the racket from all the VTRs.

The most common small-scale application of Sonex in the audio field is the small production studio, or broadcast announce booth. As one studio designer told us, "It is great when you need to perform miracles in a closet!" You can take a 10-ft. x 10-ft. room and at least eliminate the bad acoustics. It is of great use when you don't have the necessary volume or space in the room to angle the sidewalls properly to prevent direct reflection. In cases like that, no acoustics are preferable to bad acoustics.

Elsewhere on these pages we have attempted to summarize typical questions and answers derived from our discussions with users over the past two years and distilled from the hundreds of discussions we have had on the product at more than half a dozen trade shows. Hopefully, the ideas we have presented up to now will prove interesting and useful to you in your pursuit of better acoustics.

We have attempted neither to argue acoustic philosophy nor claim that we have discovered the only true great American control room design for the hits of the 80s. We *will* state that we feel that Sonex is the most cost-effective material for the uniform absorption and diffusion of sound. We will leave it up to you to determine if and where its properties will best serve your needs. ■

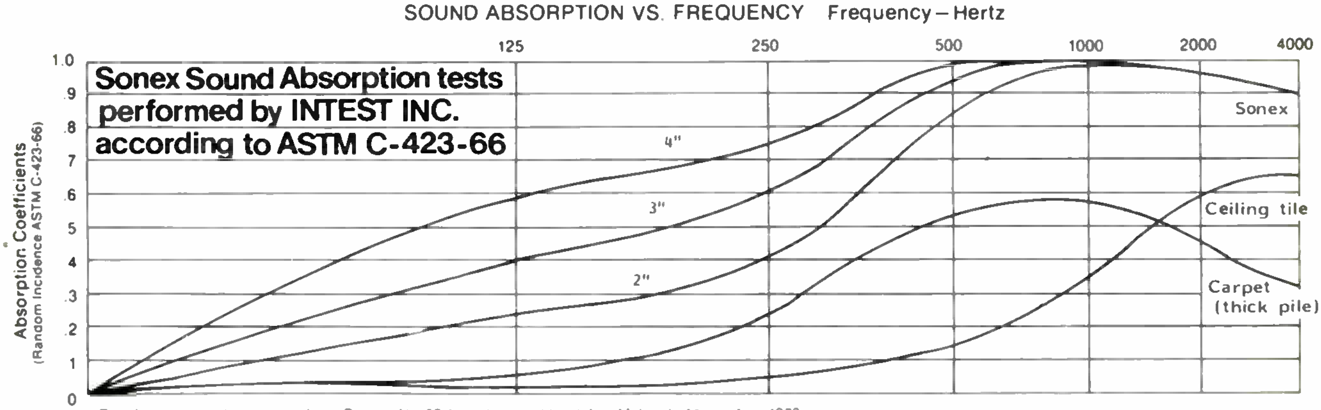
SONEX Sound Absorption tests performed by International Acoustical Testing Laboratories, Inc., INTEST January 1980 according to ASTM C-423-77

SOUND ABSORPTION COEFFICIENTS
1/3 Octave Band Center Frequency (Hz)

Depth	125 Hz	250 Hz	500 Hz	1K Hz	2K Hz	4K Hz	NRC*	NRC Actual
2"N	0.08	0.25	0.61	0.92	0.95	0.92	0.70	0.68
3"N	0.14	0.43	0.98	1.03	1.00	1.00	0.85	0.86
4"N	0.20	0.70	1.06	1.01	1.01	1.00	0.95	0.95
2"S	0.08	0.27	0.55	0.82	0.90	0.91	0.65	0.64
3"S	0.14	0.45	0.98	0.99	1.00	1.00	0.85	0.86
4"S	0.23	0.75	1.05	1.03	1.00	1.00	0.95	0.96

N = Natural Foam S = Fire Retardant Overspray

SOUND ABSORPTION VS. FREQUENCY Frequency — Hertz



Data for carpet and ceiling tile from Bulletin No 32 Acoustical and Insulating Materials Association 1973

MICHAEL RETTINGER

Control Room Acoustics

The following is an edited excerpt from the author's new book, "Studio Acoustics," published by Chemical Publishing Company.

THERE ARE NO hard-and-fast rules regarding the volume which a control room should have in relation to its associated studio. For studios up to 50,000 ft^3, a control room with a volume equal to 10 percent of that of the studio is sometimes suggested; for larger studios a figure of 5 percent, and for studios of less than 5000 ft^3, a figure of 20 percent is generally found acceptable.

Nor are there rigidly binding rules in respect to the floor covering of a control room. Some prefer wall-to-wall carpeting of the non-electrostatic type to prevent shocks, while others employ Nylon flooring for the easier wheeling about of cart-mounted recorders, synthesizers, and other equipment. This element is a functional requirement, and should be decided by the studio personnel. Satisfactory rooms with either carpet or plastic flooring can be designed.

The interior decor of the enclosure should always be provided by an expert in this field, particularly in respect to the color scheme of the room.

Control room acoustics have come to be considered equal to, and by many recording engineers more important than, the acoustics of the studio itself. This is due to the prevalent practice of combining numerous tracks in such a room towards a final mix of great sales appeal. When 16, 32, and even 64 tracks are electronically joined, the significance of any one track diminishes, and it is the union of the many signals which comes to determine the commercial success of the ultimate product. This is especially true for electronic music, where no studio is involved, and true also when tracks of any description from various studios are to be blended.

The following represents a summary of the acoustic requirements of such an enclosure.

SHAPE OF ROOM

The plan or horizontal cross section of the enclosure should not be rectangular but trapezoidal or quasi so; that is, the frontal sidewalls should not be parallel but should be slanting linearly or curvilinearly like a horn. This tends to avoid coincidental reinforcement of the normal modes in the room and will certainly prevent flutter echoes when these sidewall sections are made reflective. There is no way to eliminate normal modes of vibration in a closed space, because they are a natural phenomenon with their number dependent only on the volume of the room for any one frequency interval.

FIGURE 1 shows the average frequency space between modes for a 5000 ft^3 control room. As an example, at 21 Hz, the modes are spaced 100 Hz apart; at 120 Hz, only 1 Hz apart.

The frontal part of the horizontal cross section of the room should display some reflective panels, not unlike the area of an exponential horn near the "throat" of the unit. This tends to direct sound towards the mixer which might otherwise not be heard by him, because of the directionality of emission associated with every loudspeaker. It also constitutes more acoustic load for the low-frequency drivers of the reproducing system.

The vertical cross section of the room should similarly show a reflective area near the frontal part, between the console and the loudspeakers. Such splays, sometimes called a tier drop ceiling, assist sound direction in a manner similar to that discussed above for the slanting and reflective sidewall panels. When the ceiling splay or splays are flat, care should be taken that their angle of orientation is not the same as that of the sloping console panel, since this would introduce an undesirable parallelism between these hard surfaces. It may also be noted that when such a parallelism exists between the flat front wall and the console, these areas should be treated sound-absorbently.

The rear sidewall portions and the rear part of the ceiling should be designated moderately absorptive, which implies a degree of absorption which provides the optimal reverberation time for the enclosure after taking into account the highly absorptive rear wall (see below).

REAR WALL

This area should receive an abundance of sound absorption so that only the four first-order reflections (the two sidewall, the floor, and the ceiling reflection) are returned to the recording or balance engineer. See FIGURE 2.

LOW NOISE LEVEL

For a control room, an A-weighted sound level of 30 dB-A is suggested, although it is not always possible to obtain it on account of the various pieces of recording equipment which are located in this room. This does not mean that the noise from the outside of the building or the rumble of the air-conditioning system inside should not be kept to a very low order. There are many rehearsal periods in the control room when the recording equipment is not in operation, and during these quiet periods the recording engineer sets the general balance of the mix. Hence, even though the dynamic range of the signal in the control room during the actual takes may be in the order of 50 or even only 40 dB, the signal-to-noise ratio on the tape may be as much as 60 dB.

Nothing is gained by specifying the noise level limit in a room using a Preferred Noise Criterion *(PNC)* curve. According to this method, a noise is not acceptable when *any* part of its spectrum exceeds this limiting curve, no matter how narrow the frequency band which surpasses it. But another noise, which closely approaches the pertinent *PNC* curve without ever surpassing it, may be judged acceptable. Yet the "Acceptable" curve may have a higher A-weighted sound level than the "unacceptable" curve, as seen in FIGURE 3.

Michael Rettinger is an acoustic consultant and author of "Acoustic Design and Noise Control" and "Studio Acoustics."

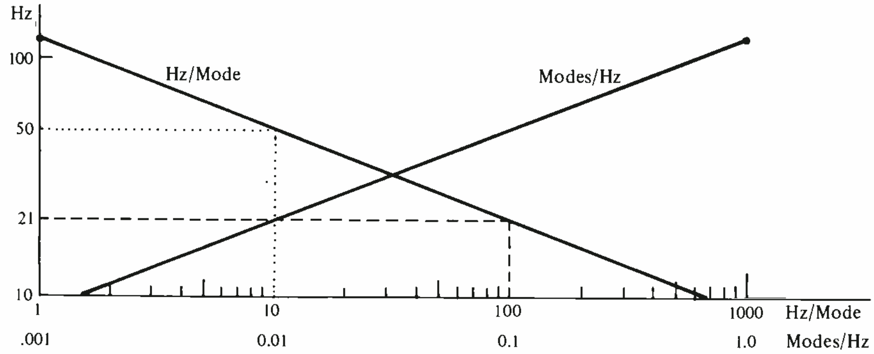


Figure 1. The average frequency space between modes (Hz/mode) for a control room of 5000 ft³ volume, as a function of frequency. For example, at 50 Hz, a frequency space of 10 Hz exists between modes (dotted line). At 21 Hz, the modes are 100 Hz apart (dashed line).

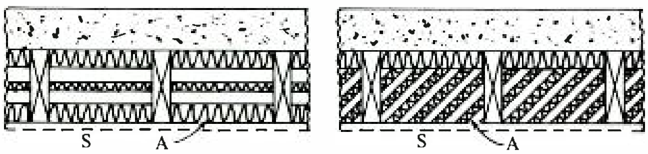


Figure 2. Anechoic treatments for the rear wall of the control room. A decorative screen (e.g., loudspeaker grill cloth) protects the 2 inch (5 cm) thick sound-absorbent fiberglas boards.

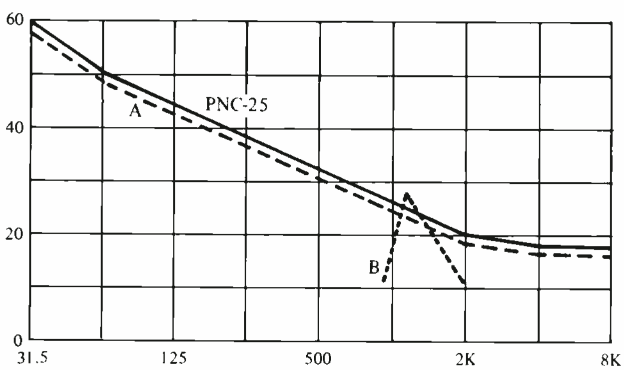
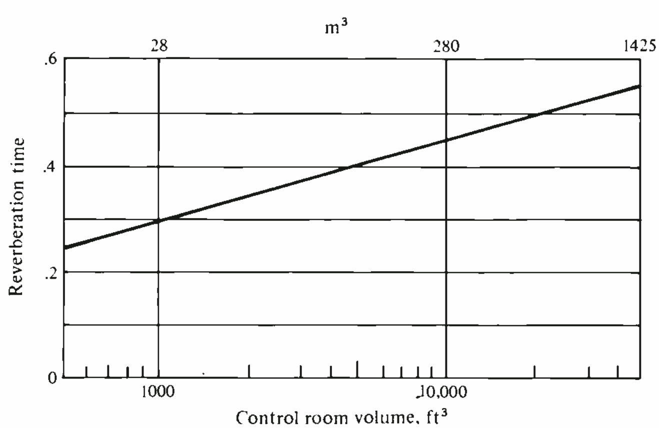


Figure 3. Noise A is rated less than PNC-25, *and should be considered acceptable; yet it has an A-weighted sound level of 35 dB-A. "Non-acceptable" noise B exceeds* PNC-25, *but has an A-weighted sound level of only 26 dB-A.*

Figure 4. The variation of 500 Hz reverberation time T, *with control room volume,* V.



FREQUENCY RESPONSE

The variation of the reverberation time with frequency should be flat between the lowest frequency which is desired for recording and say, 4000 Hz. Beyond the latter frequency, it is very difficult to maintain the reverberation at a constant value, because of the inevitable air absorption in the enclosure. A relative humidity of 50 percent is recommended for the room, because a lesser humidity increases this molecular conversion of sound energy into heat.

REVERBERATION TIME AT 500 Hz

The optimal reverberation period in the mid-frequency of the audio spectrum should be in the order given by the equation (see FIGURE 4).

$$T = 0.15 \log V - 0.15 \text{ or,}$$
$$= 0.15 \log V' + 0.07,$$

where V = volume of the control room (ft^3) or,
V' = volume of the control room (m^3).

Thus, when the enclosure has a volume of 5000 ft^3 (141.5 m^3), the reverberation time should be

$$T = 0.15 \log 5000 - 0.15 = 0.40 \text{ s.}$$

There is a point to be made about reverberation which is not generally known. When a listener is close to a source of sound, and the signal is suddenly terminated, the subjective impression of the reverberation is much less than when one is at a greater distance in the room. It has similarly been learned that when one measures the reverberation time in a live room, with the microphone close to the source of sound, there occurs initially in the graphically recorded sound decay a sudden steep drop in the sound level, after which the curve assumes the slope obtained at most other places in the room. The point of the discussion is that when a mixer is too close to the monitor system, he or she may be tempted to introduce more reverberation to the recording than if he or she sat a little farther from the monitors.

LOUDSPEAKERS

The purpose of the following is not to recommend certain loudspeakers for the control room, only to indicate that when the frequency response of the recording is to extend to 30 Hz, few single woofers are capable of providing adequate low-frequency sound pressure levels. This may be demonstrated as follows:

Assume that the sound power level requirement of a loudspeaker at 10 ft from the unit is of interest, where the direct sound energy density predominates over the generally reflected energy. The pertinent equation is

$$WL = SPL + 20 \log R - 10 \log Q + 0.7 \text{ or,}$$
$$= SPL + \log R' - 10 \log Q + 11,$$

where WL = sound power level relative to 10^{-12} W,
Q = directivity factor,
SPL = sound pressure level relative to 0.0002 μ bar,
R = distance between loudspeaker and observer (ft),
R' = distance between loudspeaker and observer (m).

When $Q = 2$ and $R = 10$ ft, then

$$WL = SPL + 20 \log 10 - 10 \log 2 + 0.3,$$
$$= SPL + 17.3.$$

In terms of the sound power,

$$W = 10^{(SPL - 102.7)/10}$$

If SPL = 112.7 dB at 10 ft, the acoustic power at any frequency is 10 W.

The peak displacement of the loudspeaker cone from its mid or rest position, when the unit is mounted in a large baffle and assumed to move as a piston, is given by

$$d = \frac{115{,}200\,[10^{(SPL - 102.7)/10}]^{1/2}}{f^2 D^2} \text{ (in.)}$$

$$d' = \frac{1{,}888{,}128\,[10^{(SPL - 102.7)/10}]^{1/2}}{f^2 D2^2} \text{ (cm)}$$

where d = peak displacement,
f = frequency,
D = cone diameter (in.),
D' = cone diameter (cm).

If f = 30 Hz, D = 16 in., SPL = 112.7 dB, then

$$d = \frac{115{,}200\,[10^{(112.7 - 102.7)/10}]^{1/2}}{30^2 16^2}$$

$$= 1.6 \text{ in.}$$

This is far too great an excursion for a single loudspeaker cone. If it is assumed that the maximum travel of a diaphragm is in the order of 0.4 in., then four units are required. As one may readily learn by examining the so-called equal loudness contours for the human ear, for a 30-Hz note to seem as loud as a 1000-Hz tone with a sound pressure level of 90 dB, the sound pressure level for the low frequency has to be at least 20 dB higher, so the figure of 112.7 dB employed above is quite realistic.

Note also that it is not the required acoustic power of 10 W which is the critical quantity, since even for a 10 percent loudspeaker efficiency, the electric power is still only 100 W (not a difficult quantity to achieve in modern power amplifiers), but rather the required cone travel of the woofer.

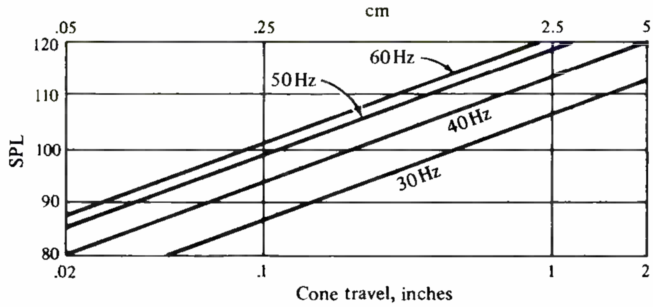


Figure 5. The required cone travel, D, *of a 16-inch diameter loud-speaker cone from its mid or rest position at the indicated frequencies to generate various sound pressure levels,* SPL, *at a distance of 10 feet (3.05 m).*

It is also recommended that the loudspeakers be placed in a large cabinet extending the width of the control room, so as to avoid undesirable diffraction effects produced by the projected panels of the individual loudspeaker housings.

FIGURE 5 shows the required cone travel for a 16 in. diameter loudspeaker at 30 Hz and at 10 ft, for various sound pressure levels.

The cyclic air volume displacement required by a vibration baffled piston in free air to achieve a given SPL at a distance R (ft) or R' (m) at a frequency f comes to

$$V = \frac{0.00004R \times 10^{SPL/20}}{f^2} \text{ ft}^3 \qquad V' = \frac{.0000034R' \times 10^{SPL/20}}{f^2} \text{ m}^3$$

$$= \frac{0.069R \times 10^{SPL/20}}{f^2} \text{ in.}^3 \qquad = \frac{3.4R' \times 10^{SPL/20}}{f^2} \text{ cm}^3$$

FIGURE 6 shows this relationship graphically for an observer distance of 10 ft. Thus, for an *SPL* of 120 dB at 10 Hz, the cyclic volume displacement comes to 4 ft^3 or 0.1 m^3.

For frequencies in the infrasonic range, the required cyclic air volume displacements become exorbitantly large, and it becomes difficult to construct generators capable of radiating high loudness levels below 15 Hz.

FIGURE 7 shows the variation of the sound pressure level with the frequency below 100 Hz for various loudness levels in phons. The equation describing the *SPL* as a function of phons and frequency is

$$SPL = 160 - (67.5 - 0.42N)\log f,$$

where N is loudness level in phons.

For example, at 10 Hz, the *SPL* corresponding to a loudness level of 120 phons comes to

$$SPL = 160 - (67.5 - 0.42 \times 120)\log 10$$
$$= 142.5\text{ dB} \quad \cdot \quad \text{(see dot in FIGURE).}$$

The corresponding cyclic air volume displacement for an *SPL* of 142.5 dB at 10 ft (3m) is, therefore, 53 ft^3 ($1.5 m^3 = 1.5 \times 10^6 cm^3$).

Assume a circular piston of 1382 cm (45 ft) diameter; its area is $1.5 \times 10^6 cm^2$. For a volume displacement of $1.5 \times 10^6 cm^3$, the travel of such a large piston is 1 cm. The air load contributed to the mass of the piston due to the inertia in the air which must be set into motion comes to

$$M = \frac{8r^3\rho}{3}$$

when r = piston radius = 691 cm, and
ρ = density of air = 0.0012 g/cm^3
$M = 2.67 \times 691^3 \times 0.0012$
$= 10^6$ g $\cong$ 1000 kg or 1 metric ton!

This is the load when one side of the piston is terminated in an infinite pipe. When both sides of the piston radiate the energy into free space, the load is twice as much, or 2 metric tons! This shows the practical impossibility of reproducing such a subsonic note on an impressive scale in a theater, as in the case of "Sensurround," a low-frequency sound reproduce system employed in theaters for effect. One may obtain a patent for the reproduction of infrasonic notes in show places, so that the tactile or contactual perception of such signals will cause a heightened response to a play or motion picture, but its realization is not possible, economically, in accord with the inventor's idea (see English Patent No. 432,221, granted to George Victor Dowding, July 23, 1935, for the use of infrasonics in theaters).

The reproduction of infrasonic sound would not be fraught with many difficulties if the listener were in a small air-tight enclosure. The "load" on the loudspeaker would be an acoustic capacitance below 10 Hz—the way the air volume between a headphone and the ear comes close to an acoustic capacitance. Thus, below 10 Hz, only the required volume amplitude is needed and not the radiated power to obtain the required sound pressure level.

MIXING CONSOLE

Since this unit is generally placed on a raised platform, a railing or balustrade should be installed around its perimeter so that the occasional visitor to this area does not fall off when accidentally stepping sideways.

Also, the metal panels on the sides of the console should be treated on the inside with a viscoelastic damping compound to avoid rattles.

When a parallelism exists between the reflective front wall below the window and any of the panels of the console, sound-absorbent treatment should be applied to one or both of these surfaces to prevent a pronounced resonance condition in front of the unit.

FIGURE 8 shows a recommended plan and elevation of a control room which incorporates the acoustic features discussed above. Note the three-position raised console and behind it the still higher position for the producer or sponsor.

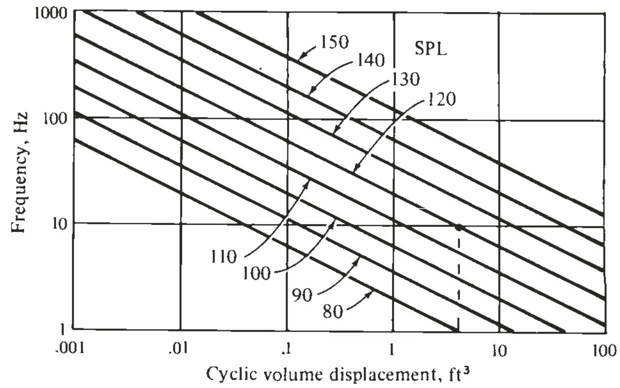


Figure 6. The cyclic volume displacement required for a baffled piston to generate the indicated sound pressure levels at a distance of 10 feet. For example, for a 10 Hz signal, a cyclic volume displacement of 4 ft³ is required to produce a SPL of 120 dB at a distance of 10 feet from the speaker.

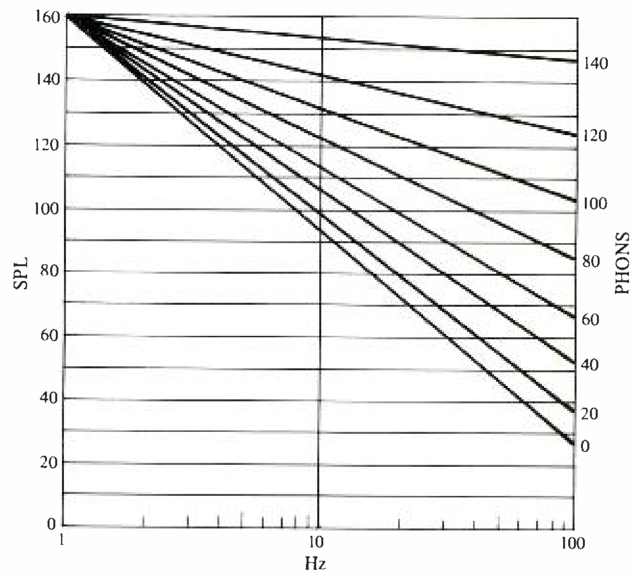


Figure 7. Idealized equal loudness contours below 100 Hz.

The horizontal symmetry features two doors, one of which may be false, the convex Lucite or Lexan tier drop ceiling splays through spotlights which can be transmitted onto the console, and the anechoic rear wall treatment.

These design details are somewhat contrary to the present fashion of an acoustically large but visually small control room in which a furled curtain is placed about three feet away from the walls. But the present control rooms are already too small, and if they are made still smaller, they will depart too far from the final reproducing enclosure, the living room or den in the home. Such a little enclosure provides neither aural nor psychological correlation between mix and ultimate reproduction.

Sound retardant control room windows larger than 1 m x 3 m (3.28 ft. x 9.85 ft.) may produce undesirable sound reflections in the control room. The effect is most pronounced for wavelengths equal to or smaller than the size of the window, and therefore generally concerns frequencies which are above 500 Hz. The same situation prevails in re-recording studios where the mixing console may be a short distance from the rear wall which may contain large windows for either a client's room, a voice booth (where an actor may watch the action on the screen for which he is to add a voice track in the case where "looping" in another enclosure may not be practical), or where an actual control room is located because the dubbing stage is a multiple-purpose facility.

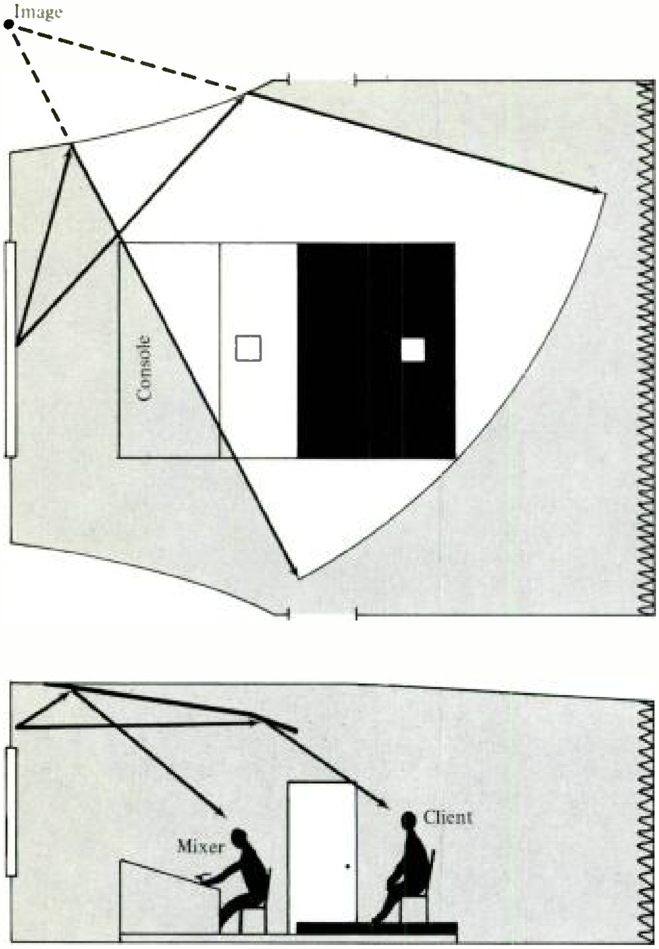


Figure 8. Recommended plan view and elevation for a control room of 5000 ft³.

To employ ordinary glass for a convex window pane is not only undesirable from a cost point of view in that it would have to be specially formed in the factory, but is undesirable also from a breakage point of view if the pane is thick. For this reason curved acrylic sheets should be installed in the window opening, because they are nearly shatterproof. Plexiglas, Lucite, and other such transparent sheets may be used if they are 6 mm (¼ in.) thick so that they may be "cold-bent." Polycarbonate material weighs 7.1 kg/m² when 6 mm thick (1.42 lb./ft.² when ¼ in.-thick), or about half as much as glass, and has a tensile strength of 6.3 x 10⁶ kg/m² (9000 lb./in.²), and when cold-bent introduces no visible distortion in the sheet.

Acrylic resins are thermoplastic materials of high light-transparency which are frequently sold under such tradenames as Plexiglas and Tuffak (Rohm and Haas Company) and Lucite and Lexon (E. I. Du Pont de Nemours & Co.). Plexiglas and Lucite have a light transmittance of 0.92, compared to 0.89 for ½ in. plate glass, while Tuffak and Lexon have a light transmittance of only 0.82 to 0.89. The latter two plastic materials are not quite as good optically as the former, because they are extruded while Plexiglas G and Lucite AR are cell-cast. Although Tuffak and Lexon exhibit greater impact strength than Plexiglas and Lucite the latter two have from 6 to 17 times more impact resistance than double-strength glass. ■

FOOTNOTE

1. We assume here that some sort of noise reduction is employed in the multi-track recording. The reason for this is that when, e.g., 20 tracks are combined, each with a signal-to-noise ratio of 60 dB, the presence of the 20 noise 'floors' lowers this ratio by 10 log 20 = 13 dB.

Calculating Room Modes

ROOM MODES are resonances which occur at frequencies whose wavelengths are twice one of the room's dimensions, as well as at multiples of those frequencies. Ideally, the room's various dimensions will not create two or more identical modes, which would reinforce each other and cause excessive peaks—especially in the low frequency range.

On the other hand, the modes shouldn't be spaced too far apart. A mode spacing of less than 20 Hz should be sufficient to prevent objectionable response variations.

A properly-chosen ratio of room height-to-width-to-length will help satisfy the above criteria for room modes. Michael Rettinger's earlier book, "Acoustic Design and Noise Control" (Volume I—see **db** Bookcase) contains a list of ratios that have been used over the years to define the dimensions of the ideal listening room.

The BASIC computer program given here allows the user to enter his own room dimensions, which are then graphically compared with the various "ideal" ratios listed by Rettinger. Next, the program calculates the resonance frequencies created by each room dimension.

Finally, these frequencies are sorted and re-printed in numerical order. When the same frequency appears more than once, it is inverse-printed (black-on-white) to draw attention to a potentially troublesome mode. The difference between adjacent frequencies is also printed, and when this difference is greater than 20 Hz, it is also inverse-printed.

```
100  DIM F(52), K(52)
110  HOME: VTAB 10
120  W(1) = 1.5: W(2) = 1.6: W(3) = 1.62: W(4) = 1.67: W(5) = 2
130  L(1) = 2.5: L(2) = 2.5: L(3) = 2.62: L(4) = 2.67: L(5) = 3
140  W(6) = 100: L(6) = 100
150  N$(1) = " SABINE"
160  N$(2) = " VOLKMANN"
170  N$(3) = "'GOLDEN SECTION'"
180  N$(4) = " EUROPEAN"
190  N$(5) = " HARMONIC"
200  INPUT "ROOM HEIGHT?";H
210  INPUT "      WIDTH?";W
220  INPUT "     LENGTH?";L
230  WH = W/H
240  LH = L/H
250  WW = WH
260  LL = LH
270  HOME: VTAB 10
280  PRINT "H :  W  :   L      DESCRIPTION"
290  FOR N = 1 TO 6
300  IF WW < W(N) THEN GOSUB 990
310  IF LL < L(N) THEN GOSUB 1040
320  PRINT
330  PRINT 1;
340  PRINT TAB ( 5) W(N);
350  PRINT TAB (11) L(N);
360  PRINT TAB (20) N$(N)
370  NEXT N
380  FF(1) = 1130/(2*H)
390  FF(2) = 1130/(2*W)
400  FF(3) = 1130/(2*L)
410  VTAB 22
420  INPUT "PRESS /RETURN/ TO CONTINUE.";A$
430  HOME
440  PRINT "THE FUNDAMENTAL FREQUENCIES ARE;"
450  PRINT
460  PRINT "       HEIGHT  WIDTH   LENGTH"
470  PRINT TAB ( 8) INT(FF(1)*100 + .5)/100;
480  PRINT TAB (16) INT(FF(2)*100 + .5)/100;
490  PRINT TAB (24) INT(FF(3)*100 + .5)/100
500  PRINT
510  N = 1
520  FOR X = 1 TO 3
530  FOR Y = 1 TO 17
540  F(N) = Y*FF(X)
550  HTAB (8*X)
560  PRINT INT(F(N))
570  N = N + 1
580  NEXT Y
590  VTAB 6
600  NEXT
```

```
61Ø  FLASH
62Ø  VTAB 22
63Ø  HTAB 28
64Ø  PRINT "STAND BY"
65Ø  FOR N = 1 TO 51
66Ø  K = Ø
67Ø  FOR S = 1 TO 51 - N
68Ø  IF F(S) > F(S + 1) THEN GOSUB 11ØØ
69Ø  K = 1
7ØØ  NEXT S
71Ø  IF K = Ø THEN 73Ø
72Ø  NEXT N
73Ø  PRINT
74Ø  NORMAL
75Ø  HOME
76Ø  T = 8
77Ø  PRINT "FREQ.   DIFF.   FREQ.  DIFF.  FREQ. DIFF."
78Ø  FOR N = 1 TO 51
79Ø  IF N = 18 THEN VTAB 3
8ØØ  IF N = 35 THEN VTAB 3
81Ø  PRINT INT(F(N));
82Ø  NORMAL
83Ø  K(N) = F(N + 1) - F(N)
84Ø  IF K(N) < Ø THEN PRINT: GOTO 88Ø
85Ø  IF K(N) > 2Ø THEN INVERSE
86Ø  HTAB (T)
87Ø  PRINT INT(K(N))
88Ø  NORMAL
89Ø  IF N > 16 THEN HTAB 16: T = 23
9ØØ  IF N > 33 THEN HTAB 3Ø: T = 36
91Ø  IF INT(K(N)) = Ø THEN INVERSE
92Ø  NEXT N
93Ø  VTAB 21
94Ø  HTAB 1
95Ø  PRINT "HEIGHT = ";H;
96Ø  PRINT TAB (14)" WIDTH = ";W;
97Ø  PRINT TAB (27)"LENGTH = ";L
98Ø  END

99Ø  INVERSE
1ØØØ  PRINT 1;"     ";INT(WH*1ØØ + .5)/1ØØ;
1Ø1Ø  WW = 1Ø1
1Ø2Ø  NORMAL
1Ø3Ø  RETURN

1Ø4Ø  INVERSE
1Ø5Ø  HTAB 1Ø
1Ø6Ø  PRINT " ";INT(LH*1ØØ + .5)/1ØØ;
1Ø7Ø  LL = 1Ø1
1Ø8Ø  NORMAL
1Ø9Ø  RETURN

11ØØ M = F(S)
111Ø  F(S) = F(S + 1)
112Ø  F(S + 1) = M
113Ø  RETURN
```

PROGRAM DESCRIPTION

120-190 contains the various width, W(N), and length, L(N), ratios, as well as the name, N$(N), associated with the ratios given by Rettinger.

200-260. The user's dimensions are entered, and converted into a 1:W:L ratio, for comparison with Rettinger's list.

280-370 prints a tabulation of the ratios. In 300 and 310, the program branches to sub-routines 990 and 1040, to print the user's own ratios at the appropriate position within the tabulation.

380-400 calculates the fundamental resonance frequencies.

440-600 calculates and prints the fundamental frequencies and their multiples. These are arranged in three columns under headings of height, width and length.

610-640 flashes a "STAND BY" warning while the program rearranges the frequencies in numerical order.

650-720 is a "bubble-sort" routine which accomplishes the numerical sorting of the frequencies, in conjunction with sub-routine 1100-1130. The procedure takes about 30 seconds.

760-920 re-prints the frequencies, F(N), in numerical order, as well as the difference, K(N), between adjacent frequencies. If the same frequency appears more than once, it is inverse-printed [since K(N) = Ø in line 910]. If the difference between frequencies is greater than 20 Hz [line 850], this difference is also inverse-printed. (Generally, frequencies above about 300 Hz—and their differences—may be ignored.)

950-980 prints out the original dimensions that the user entered earlier in the program, and then ENDS the program.

990, 1040 and 1100 are the first lines of the three sub-routines that are called out on lines 300, 310 and 680.

ADDITIONAL NOTES

The various HOME, VTAB, HTAB and PRINT TAB instructions are given for the Apple II computer, and may have to be modified to suit other computers. INVERSE, FLASH and NORMAL instructions are also Apple II commands and may be eliminated if necessary. ■

PAUL N. SERGI

Hazardous Aspects of Commonly Used Acoustical Construction Materials

Before deciding how to sound-proof your studio, be sure you know all *the facts about the materials you are choosing.*

MANY MATERIALS commonly used for sound control and architectural acoustics have little-known dangerous properties which should be carefully considered by anyone planning a studio construction project. For example lead, which is often used as a sound barrier material, is very toxic.[1] Steps must be taken to contain it if lead poisoning is to be avoided. Fiberglass wool, the most common sound absorbing material, may cause lung cancer if inhaled;[2] the dangerous finely divided particles, which can shed from unenclosed fiberglass wool, are difficult if not impossible to control without reducing its effectiveness as a sound absorbing material. Contrary to popular belief the commonly used types of fiberglass wool burn.[3] The most commonly used types of flame-retarded plastic foam sound absorbing material produce highly toxic gases when they burn.[4]

SHEET LEAD

Sheet lead is commonly used as a sound barrier material in sound control construction, because in some applications it is cost effective, despite the high cost per pound. Lead's high density can reduce the thickness of sound barriers, and therefore reduce the amount of floor space occupied by walls used in sound control construction;[5] it's softness, ductility, and ability to conform to complex shapes can reduce installation costs in applications where it would be difficult or awkward to use other materials.[6] But lead is not without its disadvantages, for it has a very low threshold of toxicity; a sustained one milligram per day intake can have a toxic effect on adults. The average adult daily dietary intake of lead is about 0.3 milligram.[1] This means a 0.7 milligram per day intake of lead from exposure to sheet lead can be expected to cause a toxic reaction in adults. Sheet lead can be changed into powdery lead salts by the action of the atmosphere; these salts are poisonous[7] and tend to migrate which makes poisoning more likely. Sheet lead can be a useful and cost effective sound barrier material. However, steps should be taken to insure that the construction crew and building occupants will not be poisoned. In some cases the high cost of sheet lead combined with the high cost of controlling leads toxicity will make it impractical.

FIBERGLASS

Fiberglass is the most cost effective sound absorbing material available for many applications, but it can be a health hazard. In 1968, author N. Irving Sax pointed out that "The possibility of lung injury due to inhalation of fine particles of this material (fiberglass) has been raised repeatedly...." And, in 1975 Sax stated..."it now appears that durable particles of fibrous glass, especially of a particular size range can produce an effect upon lungs like that of asbestos."[9] Despite the fact that these potentially dangerous properties of fiberglass have been suspected for at least ten years, it is hard to convince people that fiberglass is a dangerous material simply because there are many people who have been exposed to it for years without ill effects. Fiberglass was first produced in the late 1930's[2] and is still a comparatively new material; all of its toxic properties may not yet be known. There is mounting evidence that fiberglass may be a dangerous material. "In the case of asbestos, there is a delay of twenty to fifty-five years between the first exposure and the appearance of cancer. Such long delays are not unusual with cancer-causing agents. If fiberglass causes cancer after similar delays, we may only now be entering the period in which illnesses begin to appear."[2] Fiberglass is already a known skin irritant.[2,9] The skin irritation and itching caused by exposure to small amounts of airborne glass fibers may reduce worker productivity and increase employee turnover. As with lead, it does not always stay where it is installed. The question of whether fiberglass duct work continually erodes during normal use, releasing small particles of glass into the air, is still unanswered.[2]

Many people do not realize that the commonly used types of fiberglass wool can burn. The organic binder used in fiberglass insulation causes it to have a heat of combustion of from one thousand to three thousand Btu/lb.[3] Its cost effectiveness should be weighed against evidence which has been accumulating for at least ten years indicating that it may be so dangerous that it should not be used unless steps are taken to insure that it will not migrate into the environment. Fiberglass is often applied to the inside surface of walls where it is a fire hazard and can easily migrate into the environment. There is also the question of what will happen to the glass fibers, which are extremely durable, after their useful life is over. Another problem of an economic nature associated with fiberglass wool is its ability to increase maintenance costs and down time of moving machinery by shedding glass fibers which are by nature extremely abrasive. In most applications there is no known safe way to prevent fiberglass wool from shedding while maintaining its sound absorbing properties.

PLASTIC FOAM

Plastic foam is often used as a sound absorbing material in sound control construction. It is moderately cost effective and has the advantage of not shedding annoying abrasive particles the way fiberglass wool does. Some plastic foams have the advantage of not absorbing liquids, and some are very resistant to chemical attack. The main safety problem of

Paul Sergi is an electronic technician.

plastics in general and plastic foams in particular is that they burn, and some produce highly toxic gases when this happens. "Fire safety experts have long been warning that the large and growing volume of plastics and synthetic fabrics going into building products and furnishings can add enormously to what they call a building's fuel load."[10] Even urea-formaldehyde foam, which is often claimed to be fire proof, burns with a heat of combustion of six thousand Btu/lb.[3] In fact, a plastics industry spokesman has admitted no plastic is really noncombustible.[11] The smoke from burning plastics is denser than the smoke from burning wood.[10] This causes a fire feeding on plastics to be more difficult to escape from than a fire feeding on wood. "Depending on temperature, pressure, humidity and other factors, a single material can give off dozens of different compounds when it burns."[10] "...plastics containing chlorine, such as polyvinyl chloride, release irritating hydrochloric acid when they burn."[10] Flame-retardant treatments are often thought of as the solution to plastics fire hazard problems, but flame-retardants have their own problems. For example, flame-retardant treatments can make smoke from burning plastics blacker.[10] Rats exposed to burning fire-retarded polyurethane foam developed repeated major motor seizures approximately one hour after exposure; rats exposed to burning untreated polyurethane foam did not develop seizures.[4] In another test, "...when, for example, rats had been exposed to fumes from polyurethane foam that had not received flame-retarding treatment, they were able to 'escape' from a plate-sized circle in less than six seconds. But rats exposed to the smoke from flame-retarded foam were so disoriented or convulsive that they could not move out of the circle in less than a minute—if at all."[12] The use of flame-retardants in plastics is fairly new. Therefore, all toxic properties of these materials may not be known. An example of this is tris (2,3-diromopropyl phosphate) the commonly used fire retardant, in use for some time before it was found to cause cancer in laboratory animals.[13] In some cases, manufacturers product information cannot be trusted to give a true picture of a plastics safety problem.[10] According to the F.T.C., test results used by manufacturers in their product literature to create the impression that their products are not a fire hazard, do not indicate how plastics, especially foams, will perform in a real fire.[10] "For example, many materials will 'self-extinguish' if held horizontally during testing yet will burn if held vertically—and will not self-extinguish at all in a real fire because the heat source is not removed."[11] For all practical purposes large concentrations of plastics can not be used safely unless they are contained in fire proof materials, which eliminates plastics as a sound absorbing material in most applications where safety is a consideration.

To the best of my knowledge there does not seem to be an economical sound absorbing material that is totally safe. There are problems in sound control construction for which lead is the only practical solution, and steps can be taken to keep the lead away from people.

The courts and society in general are becoming progressively less tolerant of those who place people or the environment at risk. Those who specify how dangerous materials will be used will probably be judged in the light of the information that is available at the time they are being judged. We now have some indication of how the sound control construction techniques in common use today may be viewed in the future. The time to find and use safer techniques is now. ■

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"Toxic Fumes From Fire Retarded Foam," *Science News*, 1 March 1975, pp. 134, 135.

FOOTNOTES

1. Julian J. Chisol, Jr., "Lead Poisoning," *Scientific American*, (February 1977), pp. 15-23.
2. Peter and Katherine Montague, "Fiber Glass," *Environment*, (September 1977), pp. 6-9.
3. Walter J. Rossiter and others, *Urea-Formaldehyde Foam Insulation: An Assessment of Their Properties and Performance*, (Washington D.C : Department of Housing and Urban Development, 1977), p. 34.
4. "Extreme Toxicity From Combustion Products of A Fire-Retarded Polyurethane Foam," *Science*, (28 February 1975), pp. 742-744.
5. Michael Rettinger, "Sheet Lead Insulation in Recording Studios," *db The Sound Engineering Magazine*, (February 1977), pp. 42, 43.
6. Michael Rettinger, *Acoustic Design and Noise Control*, (New York: Chemical Publishing Co., Inc., 1973), p. 133.
7. Robert B. Leighou, *Chemistry of Engineering Materials*, 3rd ed., (New York: Reinhold Book Corporation, 1968), p. 776.
8. N. Irving Sax, *Dangerous Properties of Industrial Materials*, 3rd. ed., (New York: Reinhold Book Corporation, 1968) p. 776.
9. N. Irving Sax, *Dangerous Properties of Industrial Materials*, 4th ed., (New York: Van Norstrand Reinhold Company, 1975), pp. 769-770.
10. The Fire Alarm Sounds for Plastics," *Business Week*, 16 June 1973, pp. 361, 36K.
11. "The FTC Goal: Realistic Tests," *Business Week*, 20 January 1974, p. 54E.
12. "Toxic Fumes From Fire Retarded Foam," *Science News*, (1 March 1975), pp. 134, 135.
13. Arthur H. Roberts "Developing Flame Retardants in a Political Atmosphere," *Plastics Engineering*, February 1978, pp. 26-30.

Dangerous Properties of Industrial Materials by N. Irving Sax is a guide to more than 16,000 names of common industrial and laboratory materials. Along with a section detailing such general information as formula and physical constants for each material, toxicity information and an analysis of flammability and explosiveness for each chemical, are chapters pertaining to air contaminant control, industrial noise, radiation hazards and industrial and environmental cancer risks. Another important feature is the extensive bibliography following each chapter, making investigation of a particular subject of interest simple to do. Although sections of *Dangerous Properties of Industrial Materials* may be a bit too technical, and contain more information than you could possibly wade through, it is an extremely comprehensive work containing a wide array of useful facts needed by people in a myriad of professions.

Dangerous Properties of Industrial Materials is published by Van Nostrand Reinhold Company, New York City, and is available at a cost of $57.50.

MARK B. WALDSTEIN

Fiberglass Is—Is Not— Hazardous To Your Health...

EVER SINCE the tremendous dangers of asbestos were exposed, scientists and industrial managers alike have been taking a very close look at everyday industrial materials. One of the materials that has gotten a great deal of scrutiny in the past 25 or so years is fibrous glass, better known as fiberglass.

Fiberglass is used in the manufacture of more than 33,000 products ranging from bedspreads and drapes to thermal insulation products. The dangers of fiberglass is not without special interest to those in the audio industry inasmuch as fiberglass is a widely used sound absorbing material. Literally hundreds of studies and reports on the effects of fiberglass on humans and animals have been done, all trying to resolve the question of the potential hazards of contact with this material. Not surprisingly, the findings of these reports often differ. What might be written off as insignificant in one report may be seen as showing a definite trend in another.

According to TIMA (Thermal Insulation Manufacturers Association), there *are* no dangers, and they have the studies to prove it.[1] One of the studies they cite was conducted by Dr. Mearl F. Stanton of the National Cancer Institute. According to TIMA, what Dr. Stanton found was that fine fibrous glass, ranging in diameters from 0.6 to 3.0 microns in length, resulted in mesotheliomas (a tumor developed from mesothelial tissue) in the range of 12 to 18 percent when applied by implantation to the pleura of rats. But TIMA goes on to say that Dr. Stanton specifically warns against directly extrapolating his results to man.[2] However, Dr. Stanton, writing in the Journal of the National Cancer Institute, says, "Certainly [cancer being caused] seems true for the pleura of the rat, and it is unlikely that different mechanisms are operative in man."[3]

Obviously, there is some discrepancy here. Also, while TIMA states categorically that, "[there has been]...no significant chronic health effects in man as the result of exposure to fibrous glass,"[4] Dr. Irving Selikoff, a leader among the investigators on the hazards of asbestos to humans, and the man who first made the correlation between asbestos and cancer, has voiced the opinion that in public buildings in which children spend a lot of time, the ventilation systems should steer clear of the possibility of contamination of circulating air by micro-particles such as fiberglass.

In addition to these differing views on the potential dangers of fiberglass, The Industrial Health Foundation, reporting on the Stanton-Wrench study mentioned above, stated the fact that fine diameter glass fibers, inplanted in high doses, produced carcinogenic effects in the pleura of rats. And yet, on the next page of the brochure, they mention that fibrous glass inhalation studies, using fine diameter fibers in high dosages over the life span of the animals, demonstrated no carcinogenic effects.[5] Sound confusing? It does to us.

So what can we gather from this? First, we see just how many ways a scientific study and its results can be manipulated so as to bring the desired results. Secondly, we see the difficulty in coming to a consensus on the dangers of a material whose effects on humans might not be seen for 25 or more years.

As to the specific question of the dangers of fiberglass to the public, it appears to us that the fibrous glass particles found in most consumer products probably do not pose a health hazard. But, two to five percent of the products *do* contain fiberglass particles small enough to possibly pose a health threat. As far as working with fine particles of fiberglass occasionally, such as in thermal or acoustical insulating, common sense precautions such as the avoidance of dust clouds and the wearing of surgical masks is recommended. And despite what the Industrial Health Foundation and TIMA says, school is still out on the dangers to those who work with this material every day. ■

Mark Waldstein is associate editor of **db** *magazine.*

NOTES

1. "Health Aspects of Fibrous Glass," prepared by Safety and Health Committee, Thermal Insulation Manufacturers Association (Mt. Kisco), p. 8.

2. Ibid. p. 15.

3. Mearl F. Stanton, "Fiber Carcinogenesis: Is Asbestos the Only Hazard?", J. Nat. Cancer Inst., 52:633, Mar. 1974.

4. "Health Aspects of Fibrous Glass," p. 15.

5. "Current Status of Health Aspects of Fibrous Glass and other Man-Nade Mineral Fiber," prepared by Industrial Health Foundation, Bulletin No. 20-79 (Pittsburgh), p. 18, 19.

PETER CHATTERTON

Creating a Sound Studio in Residential London

THE ARCHITECTURAL DESIGN of a recording studio is governed to a large extent by technical requirements; two major factors are the acoustics and sound insulation.

Quiet residential localities seem to attract recording studios, giving major headaches to the acoustical consultant. The enjoyment of such a tranquil environment by (usually wealthy) residents, and the desire of musicians/engineers to increase the decibel levels to more than is good for them, are not always compatible, either economically or practically. Those who believe that "good acoustics" in a studio are to be attained by using acoustic tiles attached to the walls and ceiling, in shades to match to deep pile carpet, underestimate the acoustic design which lies behind such features as panel resonators, modular absorbers, Helmholtz resonators etc.

WHAT ARE GOOD ACOUSTICS?

Agreement in the recording world on the definition of "good acoustics" is as near to being reached as agreement on the definition of a good group. Every recording engineer will make an instantaneous categorization of a good or bad studio with a single clap of his hands; and it is the job of the acoustic consultant to translate this specification into a detailed acoustic design.

One of the newest of the many recording studios in London is RAK Studios, belonging to Mickey Most, the famous record producer, whose RAK mobile vehicle has been used for everything from Paul McCartney's "Mull of Kintyre," to Kate Bush, The Three Degrees, Yes, Rick Wakeman, Donovan and the BBC's regular pop programmes "Rock Goes to College" and "The Old Grey Whistle Test." The new studio's complex lies in St John's Wood, a wealthy residential area with an ambient nighttime noise level low enough to allow detection of a pin dropping. The building had been previously used as a television rehearsal room, and, as a result, had put the local residents in a fighting mood when a planning application for two recording studios was lodged. The planning permission was obtained, but not without the agreement by the consultant that "insulation would be such that sound from within the studio and control room will be inaudible inside the nearest dwelling at the quietest nighttime period." Such a high specification works in both directions, and will ensure that the arrival of the musicians who turn up late for recording, on motor bikes with sawn-off exhausts, will not be noticed until they are actually inside the building.

SOUND INSULATION

For the technically minded, the sound insulation in this design allows a level of 105 dBA inside the control room, dropping to 25 dBA outside the adjacent residential property. This is particularly striking when visiting the studio as, at first sight, the building does not give the impression of housing a recording studio complex; the existence of six large windows can lead to this misconception, as high sound insulation is not usually associated with such large windows. It was the insistence of the client, who wished to retain the existing outward facade of the building, that led to the window specification giving sound insulation better than cavity brickwork.

This feature is one of the remarkable design aspects of the studio complex, and was achieved by removing the existing windows and constructing new frames using 1-in. thick glass. A separate pane of ¼-in. laminated glass was then placed in a new false-wall construction at a distance of 8-in. inside the control room. This design may appeal to those bothered by sound from road, rail, aircraft and other sources; such enthusiasm will be dampened by the likely cost: $2,000 per window for glass alone!

Use of such materials highlights the requirements for high sound insulation which is primarily dependent upon achieving high mass and stiffness of the structure. As a nice touch, electronically controlled curtains have been placed between the two panes of glass so that the engineers can work in daylight or not, as the mood takes them.

Designing to such a rigid acoustic specification follows the law of diminishing returns. Raising of the sound insulation of the front facade is limited by flanking transmission via the floor and ceiling, necessitating a floating floor and resiliently suspended ceiling system. This effectively isolates a new false floor and ceiling on springs. Attention to detail is critical. The

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Dr. Peter Chatterton is the managing director of Environmental Planning and Design Ltd.

Figure 1. Exterior of building showing replacement windows.

acoustic specification may well include such statements as "at no point should the floating floor system come into contact with the side walls or other structure." Ensuring that this actually takes place at the construction stage usually means that the acoustic consultant must stand and watch the operation. However, it is such attention to detail which will determine whether or not the consultant's original specification and prediction earns him his fees on final sound testing.

PROBLEM OF AIR CONDITIONING

Such total enclosure of any room, combined with the existence of amplification and lighting systems which supply enough heat to simulate a Caribbean beach, will necessitate a high degree of air conditioning, if the musicians and engineers are not to collapse from heat exposure. A ducted-air system was installed to condition the air supply in the studios and control rooms. This leads to considerable problems in the control of noise transmission between studios and control room, and to the exterior.

Ductwork serves as an ideal medium for transmission of noise between rooms. Levels of the order of 105 dBA must be reduced to approximately 15 dBA between studios if the more enthusiastic moments of The Who are not to be superimposed on melancholy moments of Gallagher & Lyle. This can present severe problems if the two studios are linked by one ductwork system.

It is also important to attenuate the noise generated by the fan and moving air. The silencing of noise transmission via ductwork can be achieved using what is known as a splitter silencer. This type of silencer acts on the principle of absorbing sound energy by heat dissipation in the absorbent material. The exact design of the silencer is a compromise between the cross-sectional area for air to flow through and reducing the duct width to a minimum to ensure high sound attenuation. This type of silencer will usually be located in many places in the ductwork system, and will include positions adjacent to the fan, to reduce fan noise, between rooms (to reduce the crosstalk) and to the exterior (in order to reduce noise to the nearby residents). In addition, the fan unit and ductwork will be isolated from the building structure to serve the same purpose, as vibration can easily be transmitted via ductwork and re-radiated as sound in other areas of the building.

Figure 2. View of the control room for the large studio in the RAK complex.

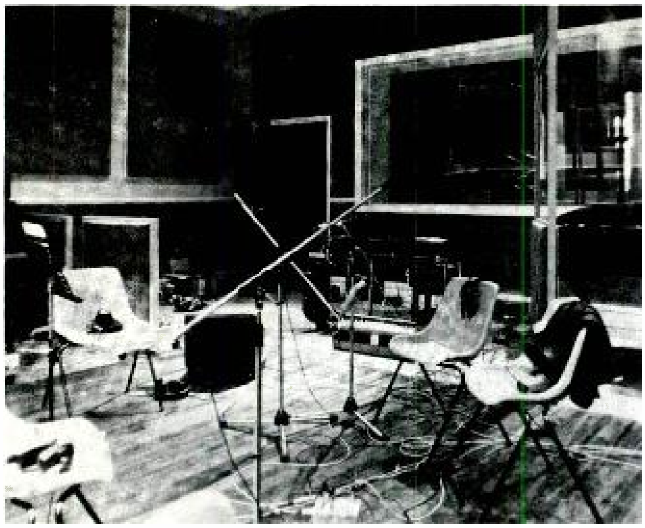


Figure 3. View of the main studio at the St. John's Wood complex of RAK.

STUDIO ACOUSTICS

The internal acoustics of the studio and control rooms are a separate subject to sound insulation. In the latter case, we are concerned with sound breaking out or into a room, heavy stiff materials usually being utilized. In the former case, the concern is to control the degree of sound reflected back from walls, floor, ceiling and other surfaces. This reflected sound is called the reverberant sound energy and is usually required to be minimal in relation to sound radiated directly from the sources, giving a "dead" sound to the room. The degree of reverberant sound is characterised by the reverberation time of the room (the time taken for the sound to decay by 60 dB after the source has ceased to radiate) and is usually quoted at different frequency bands throughout the audio frequency range.

In order to provide an internal acoustic specification at the RAK Studios, surveys were carried out at other studios to correlate a subjective "good acoustics" criterion with the objective measurements. An average reverberation time between 0.5 and 0.6 seconds was aimed at in the large studio, 0.3 seconds in the smaller studio and again 0.3 seconds in the control rooms.

Achievement of such low reverberation times (particularly in the low-frequency region) requires large areas of absorption. The high-frequency absorption may be obtained relatively easily by use of soft absorbent materials, e.g. carpets, acoustic tiles etc.; it is the low-frequency absorption which needs greater attention. The low-frequency absorption was obtained using carpet stretched over battens with an in-fill of rock wool. This system acts like a panel resonator (a flexible membrane enclosing an air space with a rigid backing) and provides broadband absorption in the low frequency region. The cavity depth is changed over different areas in order to change the frequency range of absorption. The combined effect of numbers of panel resonators tuned to different frequencies provides a very broad frequency region of operation. The effect of adding false walls, floors and ceilings in order to provide higher sound insulation also contributes to the low-frequency sound absorption as these also act as a panel resonator system.

WALL CONFIGURATION

The ideal studio will also be constructed with walls out-of-parallel with each other, and with a sloping ceiling. Construction of false walls for sound insulation purposes also presents an ideal opportunity to place them out-of-parallel. If the building contractor has not worked on a studio previously, however, he may well complain that his working drawings have been produced by a draughtsman with a hangover. The larger of the two studios measures 40 x 27 ft. and was constructed using out-of-parallel walls, sloping ceiling and utilizing a polished wooden floor, which is much to the delight of string players.

The reverberation time may be predicted from a knowledge of the room dimensions and absorptive properties of the materials in the room. This type of information is usually available in the form of absorption coefficients of materials, given at different frequencies. If these details are not known, it may be necessary to send a sample of the material, e.g. the carpet, for laboratory measurement. The process of calculation and recalculation of the room acoustic properties is laborious, but the advent of computers has enabled at least this consultant to get home in time for "Star Trek" after a day's work.

Room-acoustic computing software was used on the St John's Wood Studio to calculate the relevant acoustic values. The software includes a data bank of the absorption coefficients and sound-insulation values of most common building materials in octave frequency bands, allowing the effect of changes in materials at design stage or later to be easily assessed. The computer graphics system was used to plot reverberation times at various frequencies, and to predict resultant noise levels outside the studio. The air-conditioning ducting layout was digitized into the computer, allowing a prediction of noise levels to be carried out with a final silencer specification for purposes of fan-noise reduction, crosstalk attenuation, and reduction of noise to the environment.

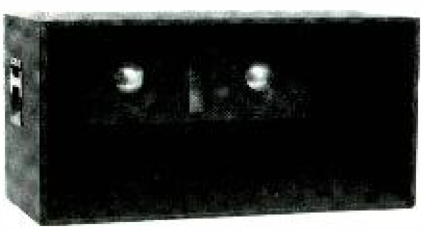
Happily, the studios, when constructed, lived up to everyone's expectations and there were no complaints from local residents. In fact, some of them have praised the impressive look of the building and the high degree of sound insulation attained. Artists who have recorded in the RAK Studios so far include Hot Chocolate, The Who, Wings, Gallagher & Lyle and The Jam. Favorable comments on the internal acoustics were also heard on carrying out the standard scientific test of a good studio—the engineer's hand clap. ■

(Continued from page 29)

MICROPHONE

• The C-535EB is a condenser vocalist microphone designed for field work. The sound of the C-535EB is clear and open with a slightly rising high-frequency response to bring out the character of voices and instruments. Its cardioid polar pattern is uniform at all frequencies to avoid feedback and coloration of off-axis sound. The transducer system is a permanently charged condenser and is field replaceable. The housing is made of die-cast zinc. The complete transducer is shock-suspended and is enclosed in a chrome-plated stainless steel windscreen. Maximum sound pressure level capability of the C-535EB is 130 dB SPL in full output mode and 144 dB SPL in reduced output mode. The C-535EB requires phantom in the 9-52 volt range.
Mfr: AKG Acoustics, Inc.
Circle 61 on Reader Service Card

HORN ENCLOSURE



• The MRH-212 midrange horn enclosure is designed to improve a good, high-level sound reinforcement system. By making it possible to achieve higher sound levels with lower distortion and more uniform coverage, the MRH-212 improves performance of the typical speaker/amplifier system. The horn has a birch plywood cabinet finished in black lacquer. The drivers are rear loaded by a 6-1/3 cubic foot ported compartment. A chrome-plated steel grille is standard as are recessed handles and a foam rubber pad to prevent scratching when building stacks. When added to an existing two or three way speaker system, the MRH-212, according to its manufacturers, will give guitars more presence, tighten up drums, and make vocals sound more natural.
Mfr: Diamond Sound Production
Price: $475.00
Circle 62 on Reader Service Card

POWER AMPLIFIER

• Modular Audio Products has introduced two 5 watt Mic/Line Amplifiers to its IMPAC series of card amplifiers. The MAP Model 4405 Amplifier is a line input 5 watt Power Amplifier capable of driving 16, 8, and 4 ohm loads. The card has an external gain trim adjustment, for a 50 dB gain range. The input impedance is greater than 22K, resistive. The Model 4405 has a flat (±1 dB) frequency response from 20 to 20,000 Hz, equivalent input noise of –107 dB (ref. .775V) and a maximum input level of +20 dBm. The Model 4405-1 is a floating, center tapped mic level input model with external gain adjustable from 18 to 68 dB. It uses the standard MAP Mic Input Transformer. A jumper can be installed to connect the primary center-tap lead to an external point, for either phantom power or balanced applications. Both models are output short circuit and thermal limiting protected, and run on a ±14 to ±16VDC bipolar supply.
Mfr: Modular Audio Products
Circle 63 on Reader Service Card

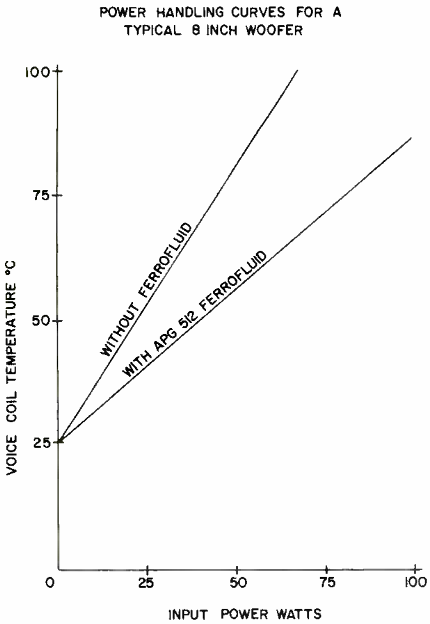
AUDIO LEVEL DISPLAY

• The ALD-12, a 3-color LED-column level indictor, features electrically selectable VU or PPM characteristics, 12 microsecond peak capture and permanently calibrated accuracy of ±0.3 dB at 1 kHz. Other features of the ALD-12 include: wide-angle visibility moving-point format with increased drive to attract operator attention; operation from 10-35 VDC single or bipolar supplies without affecting brightness or calibration, and balanced or unbalanced 47 K ohm input DC-isolated to 50 VDC. An amber Clip indicator (supplied option) flashes whenever level exceeds a value preset by the user.
Mfr: Project Synthesis International
Price: $97.00
Circle 64 on Reader Service Card

SIGNAL PROCESSOR

• The Echo Digital Recorder (EDR), a new signal processor, is computer-controlled and key-operated. With the EDR you can Echo or Reverse Echo (in times from .0011-16.777 seconds), Echo Hold, Record (up to 16.777 seconds), Playback continuous forward or reverse (without tape), record live Sound on Sound or Multi-track; all from the EDR Keypad or from a Remote Control at a distance of up to 100 feet. Two remote control options are available, the REM/1 and the REM/2. The REM/1 is a remote controlled keyboard control for the EDR, and the REM/2 is a foot-controlled remote for the EDR.
Mfr: Imaginearing Audio
Circle 65 on Reader Service Card

FERROFLUIDS



• Ferrofluidics Corporation has introduced a new generation of ferrofluids specifically designed for use in woofers. The APG 500 series of ferrofluids possess a combination of high saturation magnetization and low viscosity. The high magnetization ensures that the fluid will be strongly held in the low magnetic flux densities present in woofer air gaps and prevents fluid migration under normal dynamic conditions. The woofer efficiency will remain virtually unchanged due to the fluid's low viscosity. Three standard ferrofluids are available in the APG series including APG 511 (200 gauss, 40 cp), APG 512 (300 gauss, 75 cp) and APG 513 (400 gauss, 150 cp).

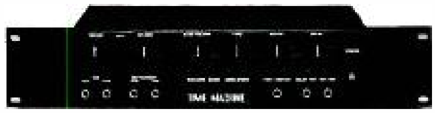
Mfr: Ferrofluidics Corporation
Circle 55 on Reader Service Card

MIXER/AMPLIFIERS

• The new Edcor MA 35, MA 65, and MA 125 (35, 65 and 125 watts), replace the present MA 125, MA 150, MA 175, and MA 200 series (25, 50, 75 and 100 watts). All models are available in transformer output or direct output versions, with 220V operation available as a no cost option. The new series has been designed for portable or rack mounting, with no rack mounting kit required. A twin accessory In/Out jack is standard. Each unit has six input gain controls and all necessary input modules are available.

Mfr: Edcor
Circle 56 on Reader Service Card

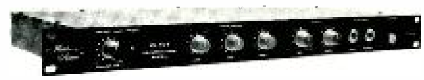
ANALOG ECHO MACHINE



• Utilizing Bucket Brigade Device (BBD) technology, the Time Machine EEM-2000 Analog Echo Machine's adjustable time control (20M Sec-200M Sec) offers a wide variety of delays including reverb, slap back, doubling and discrete echo. Two channel system provides independent control and mixing capabilities for Mic and instrument (line) inputs. Selectable input and output levels allow signal matching to microphones, instruments, amps and mixing consoles. The Time Machine has dual outputs: mix out combining direct sound and echo; delay out for echo only. It also features an optional remote on/off footswitch to control echo.

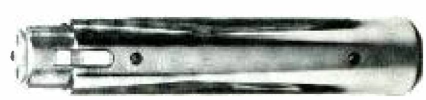
Mfr: Audio Sales Associates
Circle 57 on Reader Service Card

REVERBERATION SYSTEM



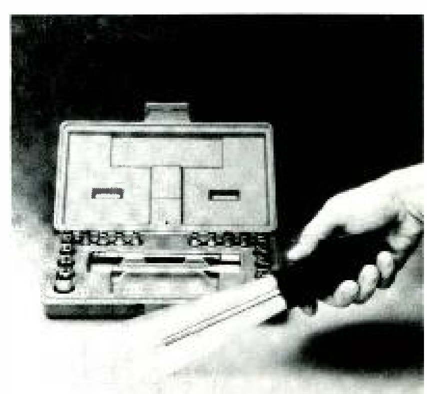
• The XL-121 reverberation system is designed to interface with virtually any audio equipment. The Preamp Gain control allows the unit to accept a low-level musical instrument output such as a guitar, or higher level signals associated with recording and sound reinforcement consoles. The Output Level control permits flexibility in interfacing with other signal processing equipment. The front panel Output Mix control allows blending of the direct and reverberated signals. The Equalization section of the XL-121 is provided to allow the user to tailor the sound of the reverb to exact requirements. Included in this section is a Low, Mid, and High control, all with 12 dB of boost and cut. A dual-colored indicator is provided that illuminates green when power is applied to the unit. This LED serves as an overload indicator by illuminating red when near overload conditions. The XL-121 incorporates ¼-in. signal connections located on both the front and the rear panels.
Mfr: MICMIX Audio Products, Inc.
Price: $450.00
Circle 58 on Reader Service Card

PZM MIKE POWER SUPPLY



• The PXT in-line microphone power supply unit is a small, nickel-plated, metal tube (.75-in. dia. x 4-in. long) with male and female mike connections. It contains electronic circuitry to provide power needed by the PZMicrophone to raise the level of the capsule output. The PXT requires a phantom supply from the mixer.
Mfr: Crown International, Inc.
Circle 59 on Reader Service Card

TOOL KIT



• The Day-Nite Tool Kit is a portable 23-piece screwdriver and socket set featuring the patented twin-lighted power torque handle. According to its manufacturer, it is the only lighted tool set of its kind. The Day-Nite power torque handle is made of ABS plastic and has twin lights built in the handle to shine bright light directly on your work. The Screw-lock on-off switch in the handle is recessed. The Day-Night Tool Kit includes 18 sockets to fit almost any nut or bolt—9 standard and 9 metric sizes—plus a socket adapter with ¼-in. drive, and 3/16-in. standard screwdriver blade and a No. 2 Phillips blade.
Mfr: Katzden Gallery
Price: $29.95
Circle 60 on Reader Service Card

EFFECTS PACKAGE

• Utilizing either a stereo (two channel) or mono input and a stereo (two channel) output, the Panscan will pan the audio image at varying speeds from a very slow soft shift effect to an ultra fast "stereo vibrato" effect. In the Auto mode, the Panscan pans continuously. In the Trigger mode, panning can be triggered either manually by the front panel push button, or by the unique ADR "beat count" circuitry which senses and counts the beat transients direct from either the input signal or from an external source. The count is displayed on a 10 element bar graph. At anytime during a pan, the audio image may be held by the "image freeze" switch. When released, the pan will continue in its original pattern. Additional controls include a variable "image width" pot and an "image center offset" pot.
Mfr: Audio & Design Recording
Circle 66 on Reader Service Card

db New Literature

BROADCAST PRODUCTS BROCHURE

• A new 28-page full color brochure describing EECO's broadcast product line, utilized in audio and video post production, is now available. Included in the free brochure is EECO's MTG-550 Series Edit Code Generator for generating standard SMPTE/EBU Edit Codes used in electronic indexing of video and audio tapes. Designed to aid equipment specifiers, the new brochure contains product photos, specifications, interconnections, interfaces/accessories, features, options and drawings of typical applications. Mfr: **EECO Incorporated, 1601 E. Chestnut Ave., Santa Ana, CA 92701.**

DATA SHEET

• A new two-page, two-color data sheet is available from SMK Electronics Corporation that describes their new line of high-quality low profile IC sockets. The data sheet is complete with dimensional drawings, recommended layout, as well as socket characteristics and detailed ordering information. Mfr: **SMK Electronics Corporation, 113 E. Savarona Way, Carson, CA 90746.**

REFERENCE MANUAL

• Topaz Inc. has announced the availability of its new AC Line Noise Suppression Reference Manual, a basic text on the protection of sensitive electronic equipment from the problems created by AC line noise, transients and spikes. The free manual covers the basics of AC line noise suppression, provides technical data and includes many typical applications. Mfr: **Topaz Electronics Division, 9192 Topaz Way, San Diego, CA 92123.**

TEST AND MEASUREMENT CATALOG

• Leader Instruments has recently announced the availability of their new 1981-82 catalog. The free 48-page catalog includes detailed descriptions, specifications, photographs and pertinent charts and illustrations of over 70 products including oscilloscopes, frequency counters, digital multimeters, etc. Announced in the new catalog are ten new products including the only vectorscope in the industry with CRT-generated vector targets. Mfr: **Leader Instruments Corporation, 380 Oser Avenue, Hauppauge, NY 11788.**

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BROADCAST CONSOLE, 6 x 2, all Altec components, $400; Pultec EQH-2 Program Equalizer, $75; UHER CR-210 cassette recorder with xtal sync generator, $450; UHER CR-134 recorder with xtal sync generator, $375; **Centron Films, P.O. Box 687, Lawrence, KS 66044, (913) 843-0400.**

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TASCAM, BGW, JBL, EV, Nikko, Technics, Onkyo, Hafler, Audio Research, Conrad Johnson, dbx, etc. **P. K. Audio, 4773 Convention, Baton Rouge, LA 70806. (504) 924-1001.**

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EMT 156 PDM COMPRESSOR for sale. Used only a few hours. Absolutely mint, was $6,800.00 new. Will sell for $4,500.00, barely used. Satisfaction guaranteed. **Call (813) 447-1487 at 12 PM or 6 PM or after 11 PM at nite.**

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University Microfilm, Inc.
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People/Places/Happenings

• **Bose Corporation** has announced the appointment of **Jim Greer** to the position of field sales representative, Professional Products, for the South Central territory. For the last two years Greer was employed by **Campion Sales**, an independent rep firm. Greer will sell the Bose Pro line to dealers in the eight-state area bounded by Texas, Nebraska, Southern Illinois, and Mississippi.

• **Empirical Audio**, of Ossining, N.Y. has moved its offices and technical facilities to San Diego, CA.

• **Omega Recording Studios** of Washington, D.C., in conjunction with **JVC Cutting Center** of Los Angeles, has recently completed the first in-studio Digital recording in the Washington, D.C. area. Using the JVC DAS Series 90 System, the sessions were engineered and mixed by Bob Yesbek, Omega's owner. The Washington-based Fusion group **"Tim Eyermann and the East Coast Offering"** plans to promote this Digital Album during their upcoming South American Tour. **Larry Boden** of JVC edited the digital tapes and will do the mastering. Omega plans to add Digital Recording equipment to their new three-studio complex slated for completion by Spring 1982.

• Nashville's **Music City Music Hall** recently became the first studio in the United States to take delivery on the two newest recorders from **Studer:** the A80VU MKIII 24-track with transformerless amplifiers; and the A80VU ½-inch 2-track mastering recorder, also with the new transformerless amps. Removing the output transformers from the line amps enables these new Studers to produce an extended low frequency response, giving the stronger and tighter bass sound preferred by many producers. The ½-inch Studer A80 mastering deck, with twice the tape width of the other 2-track recorders now commonly in use, offers a significant improvement in the signal-to-noise ratio (–75dB). When used in conjunction with noise reduction systems, the Studer A80 ½-inch master recorder effectively eliminates noise to the point where it rivals the new digital mastering systems.

• **Shure Brothers Inc.**, Evanston, Illinois, has announced the promotion of **Robert B. Schulein** to chief development engineer and head of the company's Electromechanical Development Department. Schulein joined Shure in 1966. His previous position was chief development engineer—acoustics.

• **Tom Irby**, president of **Studio Supply Company**, has announced that **John Alderson** has been named vice president general manager of Studio Supply Co. Alderson has been with the company since 1975. Simultaneously, Irby announced the merger of **Studio Supply Miami** with **J. W. Nygaard and Associates**, an acoustical consultation firm. The operation will continue to be known as Studio Supply Miami and will be managed by **Jim Nygaard**, previously founder and president of J. W. Nygaard and Associates. Recent projects completed by Studio Supply Co. include a 48-track recording complex for **Willie Nelson** in Spicewood, Texas, **Spectrum Recording Studio** in Deerfield Beach, Florida, and **Red Enterprises** in the Chicago area.

• In order to meet expanded production needs, **Furman Sound, Inc.** has moved into larger quarters at 30 Rich Street in Greenbrae, California. President **Jim Furman** has also announced the appointment of **Diane Poole** to the post of national sales manager. Her responsibilities are to include: advertising design and co-ordination, new product releases, sales management, and technical liaison.

• **Ray Combs**, vice president of **United Recording Electronics Industries**, has announced the appointment of **Garry Margolis** as director of sales. Margolis will be responsible for all domestic and international sales for the professional audio equipment manufacturer. Margolis comes to UREI from **James B. Lansing Sound.** Margolis joined JBL in 1974 as an applications engineer for professional products and became sales manager of the International Division in 1979.

• **Dr. John D. Holm** has been appointed technical director of **3M**'s Magnetic Audio/Video Products Division. The move was announced by **John E. Povolny**, division vice president. Dr. Holm joined 3M in 1967 as a senior research engineer in what is now the Magnetic Audio/Video Products laboratory. His most recent assignments have been research manager and technical service and product maintenance manager for the division. He will be headquartered in St. Paul.

• In a joint announcement, **Sleepy Hollow Manufacturing** of Ossining, N.Y., and **Valley People Inc.** of Nashville, Tenn., have completed a licensing agreement between the two companies. Under the terms of the agreement, Valley People Inc. will now have exclusive manufacturing and distribution rights to all Sleepy Hollow Products. According to **Winn Schwartau** of Sleepy Hollow, and **Norman Baker** of Valley People, the manufacturing and marketing agreements will permit expanded U.S. sales in pro Audio/Video, semi-pro, and broadcast.

• **AVC Systems, Inc.** a Minneapolis based professional audio dealer recently held a grand opening at their new Chicago location. AVC Systems handles over 80 lines of professional audio equipment and provides studio design, custom fabrication of cabinets, electronics, and metalwork. The Chicago location includes installation and complete service facilities. Manufacturer's representatives were on hand from **Otari, Soundcraft, BTX, Lexicon, Tascam, Ampex, BGW, JBL, UREI, Eventide, Orban** and many more to demonstrate the latest technology to the Chicago user. A complete 24 track studio as well as a 16 track audio tape machine synchronized with a ¾-in. Umatic were in operation along with many ancillary items. Recent installations by the Chicago office include a 24-track, 2-in. Otari MTR 90 and a 2400 Series Soundcraft recording console at **Michigan State University** in East Lansing and a 16-track 1-in. Tascam 85-16 at **Universal Recording Corporation** in Chicago.

Circle 10 on Reader Service Card

FOR THE BRIGHTEST STARS.

Journey___Chaka Kahn___Kansas___Eigo Kawashima___Evelyn "Champagne" King___Kinks___Kiss___Sachiko Kobayashi___
Kool & The Gang___Led Zepplin___Ramsey Lewis___Johnny Logan___Lynyrd Skynyrd___Mary Macgregor___Maze___Lynyrd
Peter Maffay___Chuck Mangione___The Manhattans___Barry Manilow___C. W. McCall___Leslie R. McKeown___Meat Loaf___
Meco___Steve Miller Band___Molly Hatchet___Walter Murphy Band___Willie Nelson___Ted Nugent___Parliament___Chuck Mangione
Dolly Parton___Tom Petty & The Heartbreakers___Pink Lady___The Pretenders___Ronnie Prophet___Raydio___Rush___Molly Ha
Bob Seger & The Silver Bullet Band___Shalamar___Carly Simon___Slave___Bruce Springsteen___Spyro Gyra___Steely Dan___Barry
Barbra Streisand___Styx___Donna Summer___Sun___Supertramp___George Thorogood & The Destroyers___
Pete Townshend___Trooper___Gino Vannelli___Jerry Jeff Walker___Joe Walsh___Bob S
Dionne Warwick___Grover Washington, Jr.___The Whispers___Pink La
Johnny Guitar Watson___Barry White___Ted Nu
Robin Williams___Betty

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 Golden Reel Winners as of 1/81

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