ISSN0011-7145

THE SOUND ENGINEERING MAGAZINE

MARCH 1978
$1.00

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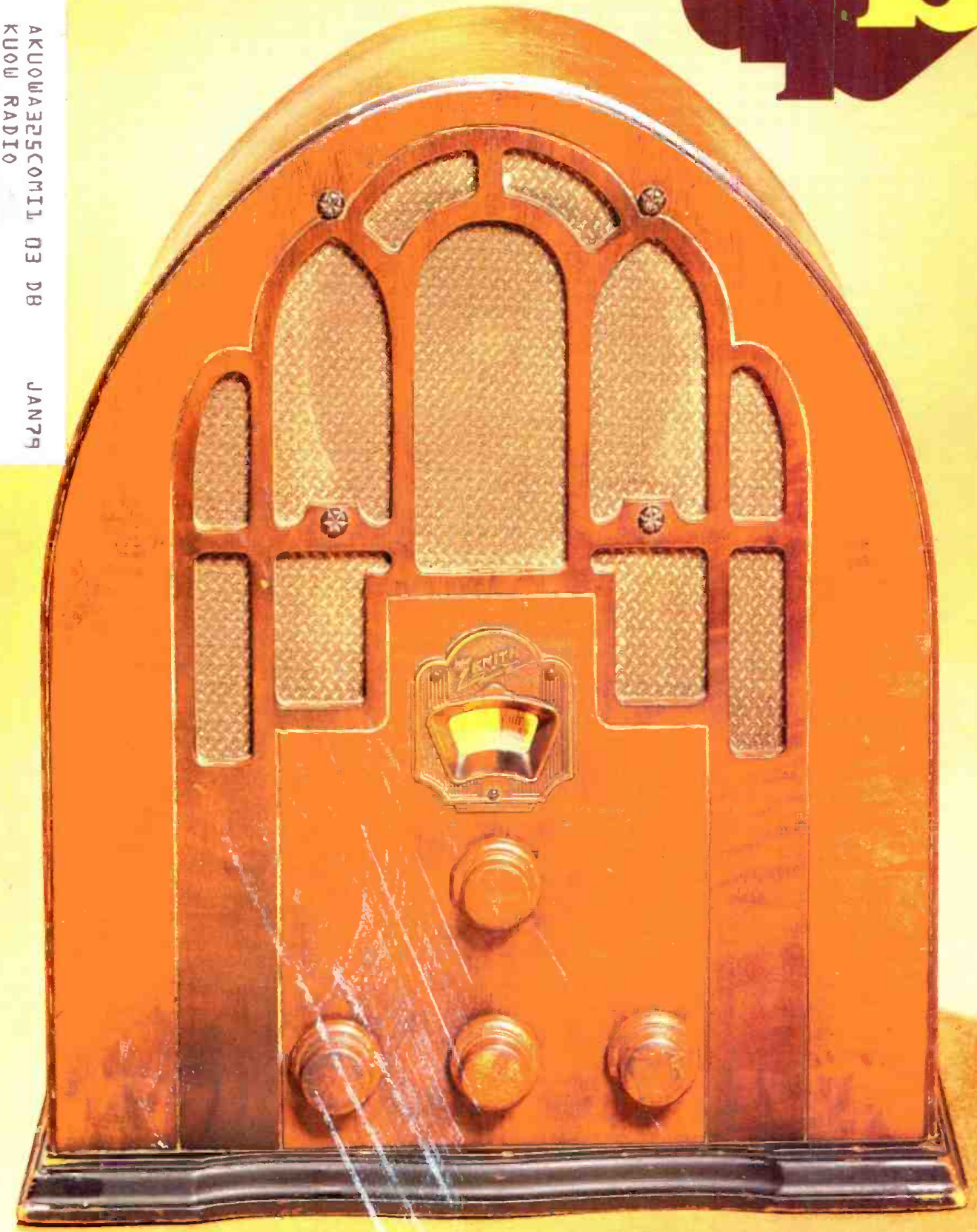

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Coming Next Month

- Next month, we take another look at digital audio and its possible effect on studio design and construction.
- We begin with a digital logic review by Ronald Ajemian, who will help us sort out the ANDs from the ORs and the NANDs from the NORs.
- Next, Michael Rettinger examines various methods of measuring studio noise levels, and finds that digital audio may eventually oblige us to come up with a more appropriate measurement system.
- The problems of speech privacy in open offices are reviewed by R. Max Mayer, who finds that a variety of factors must be successfully integrated to achieve the optimum results. Some techniques apply to studios as well, and some don't. We leave it to our readers to sort them out.
- And, Sidney L. Silver returns to our pages to sort out the complex variables involved in sound measurement techniques.
- It's all in next month's issue of **db**, The Sound Engineering Magazine.

About The Cover

- Win a free trip to beautiful downtown Plainview if you can guess the vintage of this Zenith table radio. Photo by H. Armstrong Roberts.

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THE SOUND ENGINEERING MAGAZINE

MARCH 1978 VOLUME 12, NUMBER 3

db is listed in **Current Contents: Engineering and Technology**

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db Calendar

MARCH

20-23 **Noisexpo '78,** National Noise and Vibration Control Conference and Exhibition. Holiday Inn, O'Hare/Kennedy. Chicago. Contact: NOISEXPO, 27101 E. Oviatt Rd., Bay Village, Ohio 44140. (216) 835-0101.

30-31 **U. of Chicago Seminar,** "The Federal Procurement Process." Chicago. Contact: Heidi E. Kaplan. Dept. 14NR. New York Management Center, 360 Lexington Ave., New York, N.Y. 10017. (212) 953-7262.

APRIL

3-5 **NYU Seminar, "Project Management for Engineers,"** New York, N.Y. Contact: Heidi E. Kaplan, Dept. 14NR. New York Management Center. 360 Lexington Ave., New York, N.Y. 10017. (212) 953-7262.

6-7 **NYU Seminar,** Los Angeles. "Unlocking Creativity," stimulating idea sessions. Contact: See above.

7 **National Radio Broadcasters Assoc. sales management seminar,** for sales managers of member stations, at the Welsh Co., Tulsa, Okla. Contact: NRBA, Suite 500, 1705 De Sales St., N.W., Washington, D.C. 20036. (202) 466-2030.

8 **Midwest Acoustics Conference, "Audio Transducers."** Norris Center, Northwestern U., Evanston, Ill. Contact: David S. Goldsmith, 8359 S. Crandon Ave., Chicago, Ill. 60617. (312) 731-1388.

10-11 **Wharton School Seminar, "Effective Production Planning & Inventory Mgmt."** Toronto, Ontario. Contact: Heidi E. Kaplan. Dept. 14NR. N.Y. Management Center, 360 Lexington Ave., N.Y.C. 10017. (212) 953-7262.

12-14 **NYU Seminar, "Effective Communications for Engineers,"** Los Angeles, Ca. Contact: See above.

13-14 **Electronic Music Festival & Workshop,** Jersey City State College. Contact: Abigail K. Hoffman, Music Dept., Rossey 206, Jersey City State College, 2039 Kennedy Blvd., Jersey City, N.J. 07305.

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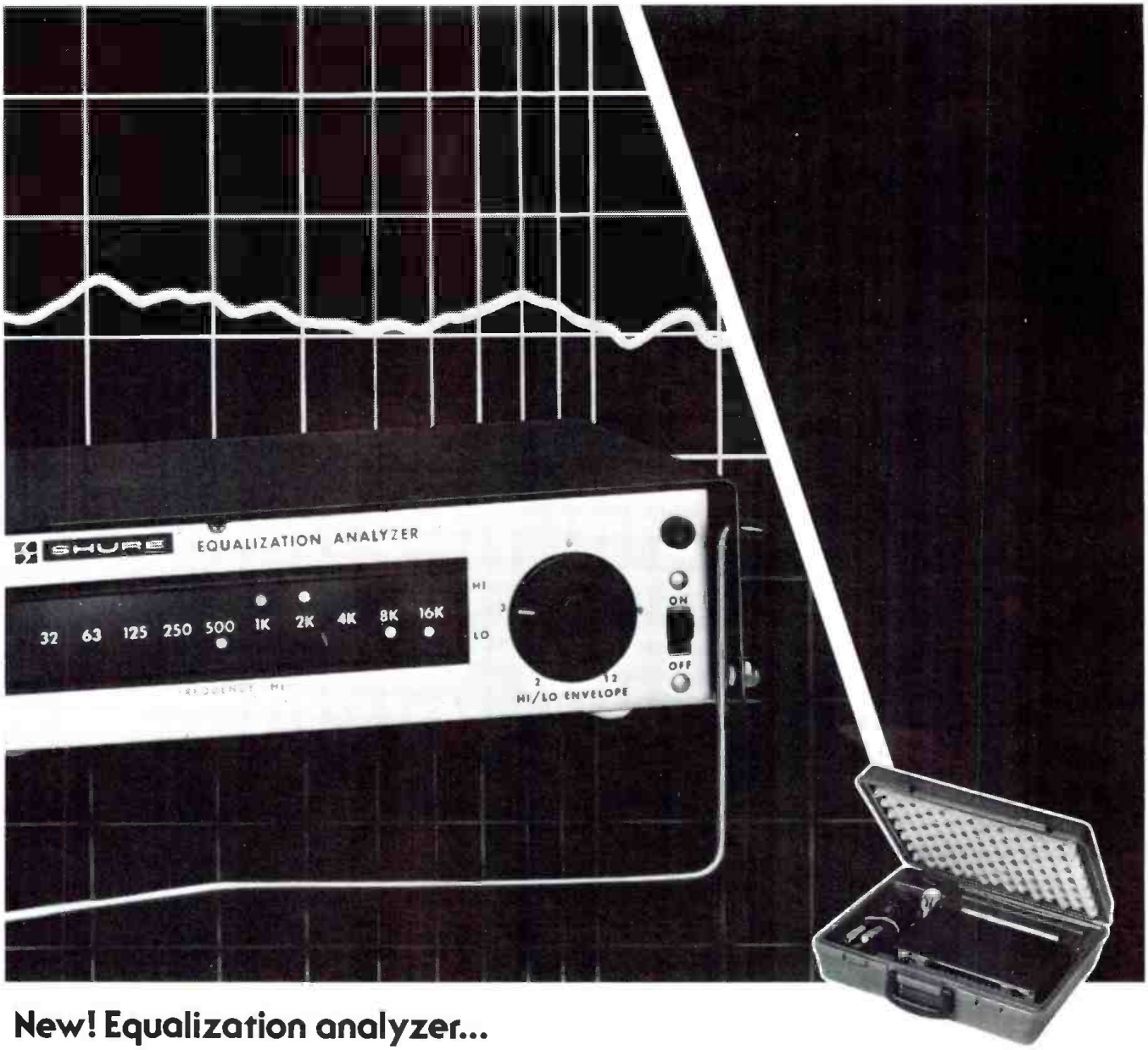

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calendar (cont.)

19-21 **NYU Seminar, "Management of New Technology Projects,"** Houston, Texas. Contact: See above.

24-26 **NYU Seminar,** "Fundamentals of Industrial Engineering." Chicago. Contact: See above.

24-26 **NYU Seminar,** "Automation of Manufacturing Operations," New York. Contact: See above.

27-28 **NYU Seminar,** "Industrial Noise Control," New York. Contact: See above.

MAY

2-6 **Audio Engineering Convention,** Los Angeles, Hilton Hotel. Contact: Dale Manquen, 1623 W. Victory, #16, Glendale, Ca. 91201. (213) 248-6988 or A.E.S., 60 E. 42nd St., New York, N.Y. 10017. (212) 661-2355.

10-12 **Synergetic Audio Concepts Seminar,** Los Angeles. Contact: Bidwell Sales Associates (213) 770-0300.

19-21 **International High Fidelity Show.** Georgia World Congress Center, Atlanta, Ga. Contact: Inter. High Fidelity Show, 331 Madison Ave., New York, N.Y. 10017. (212) 682-4802.

20-22 **International Light & Sound Show.** Sheraton Atlanta Hotel, Atlanta, Ga. Entertainment equipment. Contact: Multimedia International Inc., 155 Michael Dr., Syosset, N.Y. 11791. (516) 364-1912.

26-6/2 **Fundamentals of Recording.** Seminar at Banff Center for Continuing Education. Contact: Banff Centre, Box 1020, Banff, Alberta TOL OCO, Canada or Stephen F. Temmer, Gotham Audio Corp., 741 Washington St., New York City 10014. (212) 741-7411.

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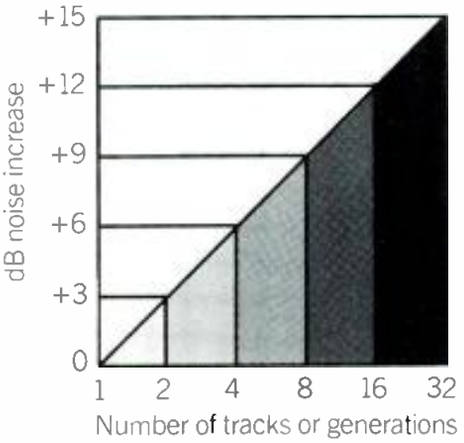
Additive Noise Chart



All you need do is press the playback buttons to hear noise-free, full dynamic range reproduction of your music.

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Tape Recorder Measurements

● The performance of an audio tape recorder depends upon its many elements working together as a system. Head replacement, component failures, and general wear are but a few of the reasons we need to make measurements and adjustments from time to time to maintain or restore the recorder's performance. This month, let's take a look at some of these elements of the recorder's system, their measurement and adjustment.

AZIMUTH

A very important element in recorder performance is the head azimuth alignment. When the machine is recording a tape, the record head prints a magnetic track longitudinally along the tape. The playback head will sense this track and reproduce the audio contained in it. To obtain the most optimum transfer of audio through this magnetic system, the heads and the tape must be in perfect alignment with each other. So that tapes recorded on this machine can also be interchanged with other recorders, the head alignment should be made to an "outside" standard, such as the NAB head alignment tape.

When the heads are replaced on the recorder, the mechanical alignment of these heads should be done as a first procedure. The effort devoted to this physical positioning of the heads will pay many dividends. When precision gauges are used to make this mechanical alignment, the heads will be set very close to correct alignment. Any tape guides on the machine should be included in this physical alignment and care taken that the tape equally spans the pole pieces on the face of the heads. This is more important in a multi-track system than in a full track system.

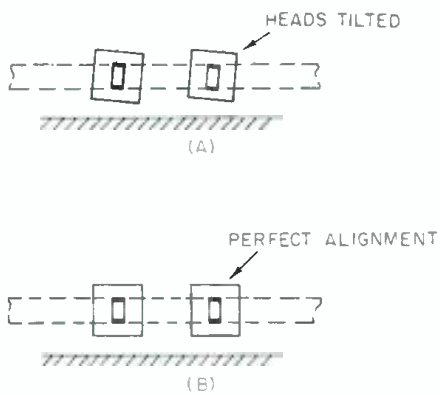
Should the tape position be such that one of the tracks is recorded on the edge of the tape, the audio quality will suffer if the edges of the tape becomes damaged or ruffled. When a tape which has the tracks recorded in the wrong positions is played on a machine where the head positioning is correct, the audio output will be low, and there can be crosstalk caused by the play head picking up signal from an adjacent track.

Although precision gauges and careful positioning may have the alignment close to perfect, always follow the mechanical alignment with an electrical alignment. This will allow the system to be fully optimized. To do this electrical alignment, play the NAB head alignment, tape first. Trim up the playback head adjustments while observing the audio output of the playback unit; adjust for maximum audio output. This will optimize the playback head to the NAB standard. Then set up and record a 15 kHz tone on a blank tape. Trim up the record head adjustments while observing the audio output of the playback unit—trim for maximum output. By using the already optimized playback unit as the indicator for correct record unit alignment, this will optimize the record head to the NAB standard also.

BIAS

Another very important element in recorder performance is the high frequency bias applied to the record head during the recording process. The magnetic properties of the tape and the heads will not permit a linear or efficient transfer of the audio signal through the magnetic system. A high frequency bias is used to overcome

Figure 1. Play and record heads should be in perfect alignment with each other and an outside standard. In (A) the machine will produce good results only on itself. In (B) tapes can be interchanged with other recorders.



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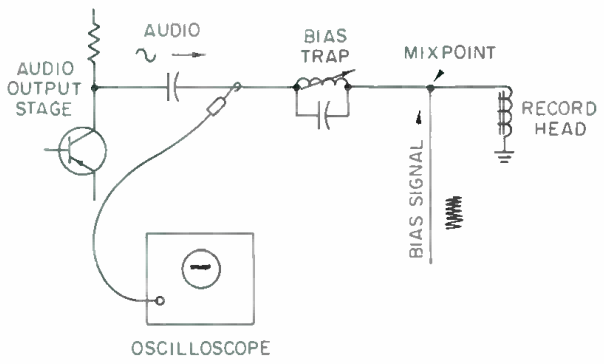


Figure 2. Attach the 'scope probe to the amplifier side of the trap. Then tune the trap for minimum bias indication.

these undesirable traits of the magnetic system. The amplitude of the bias signal is much higher than the amplitude of the audio signal, and it is mixed with the audio signal just before the record head.

In a general way, we can compare the high frequency bias of the magnetic system to that of the d.c. bias in an audio stage. The d.c. bias sets the operating point of the audio stage to the most linear part of its input/output transfer curve. In a similar manner, the high frequency bias sets the "operating point" of the magnetic system to the most linear part of its transfer curve. It is the magnetic properties of the tape and heads on the machine at that time which determines what the optimum bias current should be. So consequently, we should adjust the bias to the most optimum setting for those conditions—not for some arbitrary meter reading point, or a value that may have been optimum for another type of head previously on the machine.

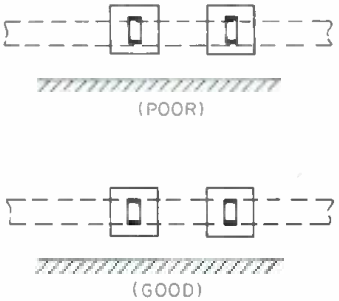
The upper audio frequencies are the first to suffer from poor bias adjustment, so these are a more sensitive indicator of optimum bias than the 1 kHz often recommended in the instruction manual. To adjust the bias for optimum, set up and record a 10 or 15 kHz tone on a blank tape. Observe the audio output of the playback unit while recording, and adjust the bias for peak audio output. Make a note of what the bias meter reading is for this optimum bias setting. You may find that this optimum indication of the bias meter is far different than some 100 per cent point on the meter, or that of the previous heads. But for this combination of heads and tape, this is the correct setting for the bias.

BIAS TRAP

The high amplitude bias signal will be recorded on the tape and recovered by the playback head, but will have little effect on the playback amplifier because of its narrow bandpass and the equalizer. But that bias signal *can* affect the output stage of the record unit. Since the mixpoint of the bias signal and the audio signal is really the output circuitry of the audio output stage in the recorder, the high amplitude bias signal can cause intermodulation in that stage. Should this happen, intermodulation distortion components will be added to the audio and degrade the recorder's performance. To prevent this from occurring, a parallel resonant trap is inserted in series with the circuit on the amplifier side of the mix point.

Once the bias trap has been properly adjusted, it is ordinarily stable, unless components fail, or the bias oscillator changes frequency for some reason. It is advisable to check on the operation of this trap occasionally, and if necessary, readjust to correct the operation. An oscilloscope is the best indicator to use for this measurement. Attach the 'scope probe to the amplifier side of the trap. Place the machine in record mode, and observe any bias signal appearing at this side of the trap. Do not use audio input to the recorder because this will only clutter up the 'scope trace. If any bias is pres-

Figure 3. Tape should be positioned so that it equally spans the pole pieces on the face of the heads.



The recording industry needed it... so Stanton developed a new stylus system for playing back stampers

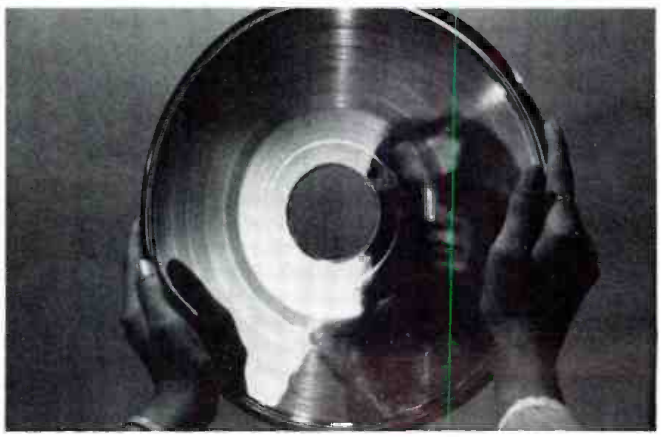
Stanton Magnetics is proud to introduce the world's first and only stylus system Model 681 BPS*; capable of playing and repairing metal stampers and matrices.

Up until now, it was impossible to check the quality of the matrix until the metal mother was made, or the plating quality in the stamper, until actual records were pressed. By introducing this new special stylus system, Stanton is offering to the record industry the tool which will save precious time, improve the quality of the records, and offer a new way to evaluate the quality of the pressing by comparing it to the first generation copy of the master matrix.

Because this new 681 BPS stylus system is designed around the famous Stanton 681 Calibration series, its performance is recognizably superior, and matches that of a 681 Triple-E Calibration Standard cartridge.

Stampers and matrices being negatives of the record require a counter-clockwise rotation of the turntable** and a custom mounted tonearm, or a special arm with head shell offset in the opposite direction.

The new stylus system has two models: the BPSR, which tracks at 3 to 7 grams, for making minor repairs on stampers; and the BPSM, which tracks at 1 to 1½ grams, for stamper and matrix evaluation.



Audiophiles, who think highly of the professional quality of Stanton products and use them for home entertainment purposes, will find it difficult to use this new system . . . unless the distribution of metal stampers heads for the consumer market. At any rate, with this new system Stanton maintains its position as a prime innovator and supplier to the recording industry.

*Patent applied for.

**Stanton is even making special turntables for this purpose.

For further information write to: Stanton Magnetics, Terminal Drive, Plainview, N. Y. 11803

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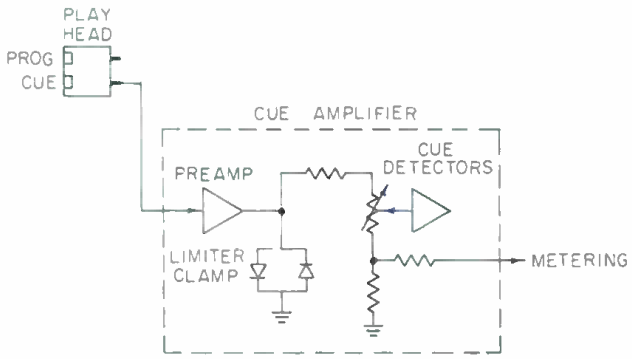


Figure 4. Check the instruction manual and circuit diagram to learn the accuracy of on-board metering. In this instance, the sample point is behind a limiter clamp. The indication can be misleading in some cases.

ent, adjust the trap for minimum indication on the 'scope.

EQUALIZERS

The magnetic system, even when properly aligned and recording bias optimum, will not produce a good audio response curve by itself. Equalizers are required in both the recording and playback amplifiers to make up for the magnetic system deficiencies. The record equalizer presents a steeply rising curve with increasing frequency; the playback equalizer is complementary to this. The equalizers must be adjusted very carefully, and then only *after* head alignment and bias adjustments have been done. The equalizers should only be used to compensate for the deficiencies that remain after the magnetic system has been optimized. Over-compensation by the equalizers can mask true system performance, create overload and saturation, distortion, and noise.

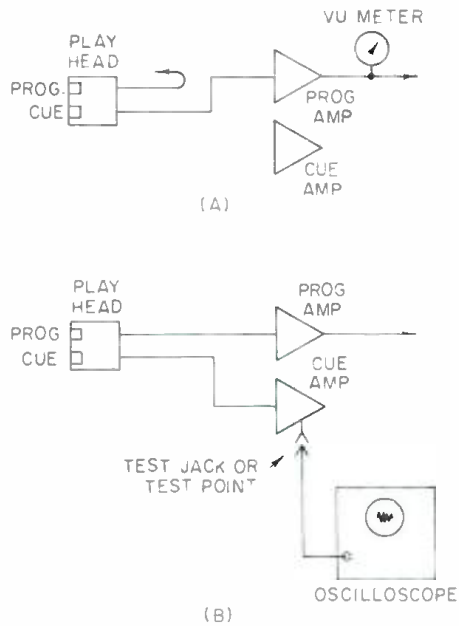
When heads are replaced with the *same type*, the equalizers often need no adjustment at all, or only a touch-up adjustment. But different types of heads, tape, or circuit component replacements can require a greater amount of adjustment of the equalizers. Start with the playback unit first. Play the NAB audio frequency response tape and observe the audio output of the amplifier for a flat response curve. Touch up the playback equalizer as needed to achieve this flat response. This standardizes the playback system to the NAB standard. Then set up and record audio tones on a blank tape, and again observe the audio output of the playback unit while recording. Adjust the record equalizer to achieve a flat response. Be careful to feed the tones into the recorder at least 10 or 15 dB below normal program level. Higher input levels will cause tape and head saturation—and a false response curve.

CUE TRACK

Cartridge tape equipment is used extensively in broadcast stations. Because of the special cue track on the tape, this equipment lends itself well to automation systems, automatic logging, and other auxiliary functions. The cue track is an audio track. Although the performance of the cue channel in terms of bandpass are not as stringent as those of the program channels, it does require performance quality in terms of signal levels, waveform fidelity, low noise factor and absence of transients. Many of the cartridge machines do not provide adequate means of measuring the cue channel, so other methods must often be used.

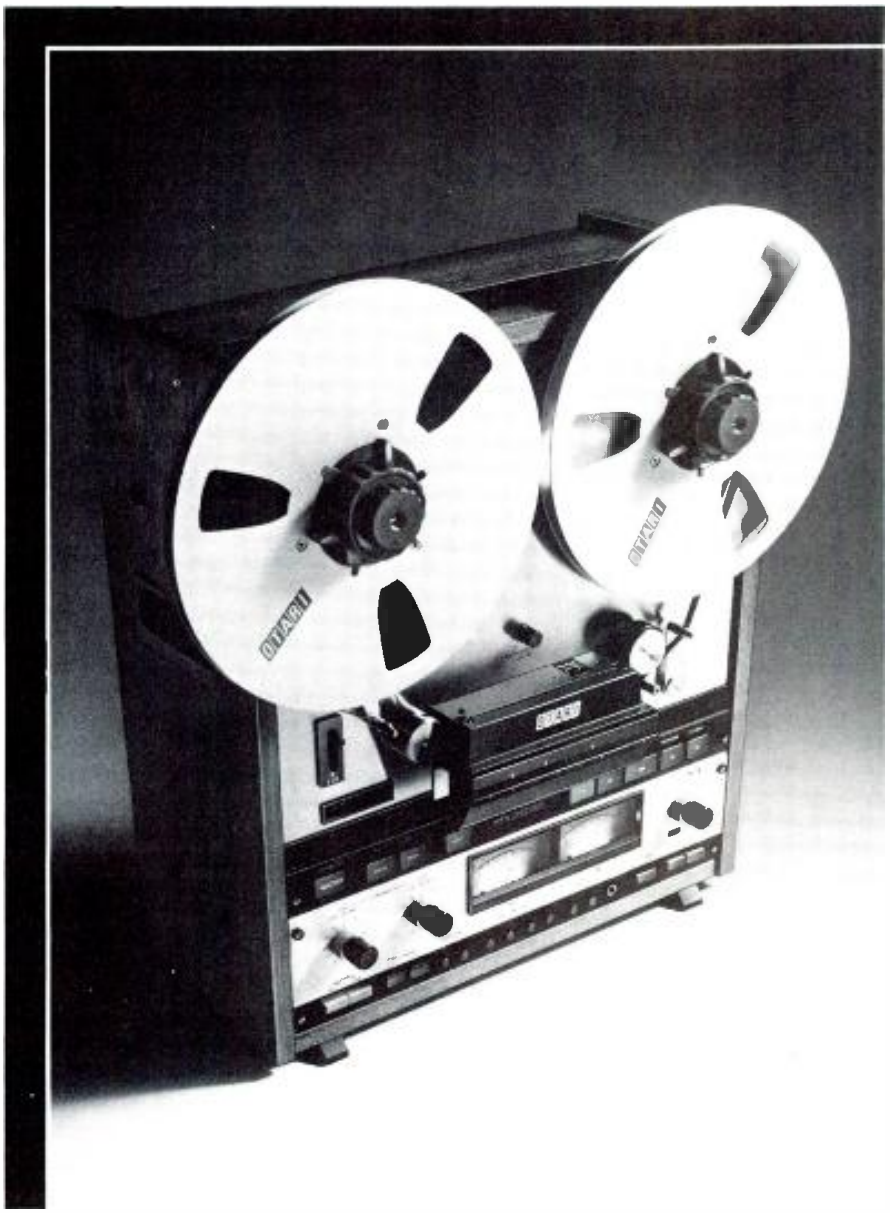
A program channel can be used to measure some of the functions of the cue track—provided the cables can be interchanged between the playback cue head and program amplifier. If so, feed the cue head into a program channel. The audio output meter of

Figure 5. Two methods of measuring the cue channel. In (A) we see the use of a program channel. (B) shows an oscilloscope method.



OTARI

From Otari for uncompromising recordists. MX5050-2SHD designed for peerless two-track quarter-inch masters.



It's an exception of compact recorders. Specially designed for critical professional applications from the ground up. It leaves nothing to be desired. 68dB signal-to-noise and greater-than-60dB crosstalk. Variable speed DC-servo capstan motor for less than 0.05% wow/flutter and ±7% pitch control. +19dBm headroom before clipping. Motion sensing control logic. Front panel edit and cue; stepless bias adjustability; built-in test and cue oscillator; all front accessible. 600 ohm, +4dBm or -10dBm fixed-level output and XLR connectors. Remote controllability for all transport functions. In short, it's a sheer professional masterpiece to produce desired 15 or 7-1/2 ips masters.

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the unit, or the console and its meter can be used to measure levels. This also has the advantage of making it possible to listen to the track on the console monitor speaker. Set the program channel to normal level with a test tape for reference. Change the head cables and play a tape which has cue or data signals recorded on the cue track. Observe the program channel audio output for the level of each of these tones or data. The levels should be within the NAB standard levels for such tones.

On some machines, the head cables cannot be easily interchanged, so an oscilloscope can be used for measurement. If there is a data test point on the cue playback amplifier, use this point. If there are no test points, then find your own. When a suitable test point is selected, you may wish to permanently install a test jack. The 'scope will measure peak-to-peak voltage, so you will have to compute the dB values. Aside from this drawback, the 'scope offers the advantage of viewing the waveforms, as well as noise or switching transients that may be present.

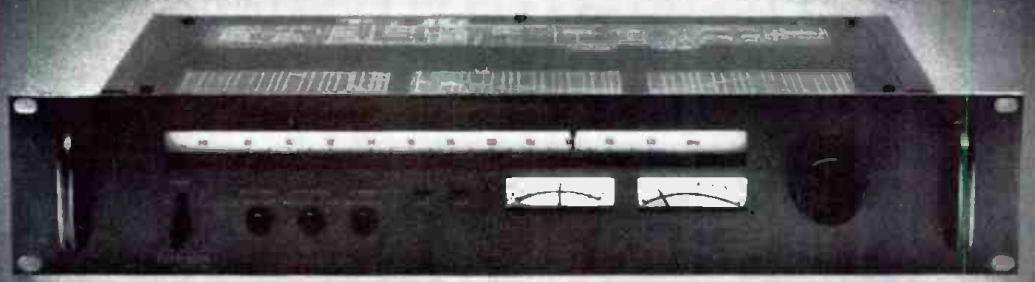
ON BOARD METERING

Most recorders provide some degree of metering the functions of the recorder. But the indications are often only intended as relative indications—not absolute values. This can be important when troubleshooting problems and actual values are needed. It will pay you to sit down with the circuit diagram and instruction manual and determine exactly what the metering does on a particular machine, where and what it samples. In one cartridge machine, for example, metering of the cue channel is done after a clamp circuit in the cue playback amplifier. If you were trying to determine the signal levels of a logger data train using this meter for example, excessive levels would indicate as normal since the clamp would not allow them to reach higher than the clamp level for the cue circuitry. The clamp would affect only the metering, not the true level on the tape.

SUMMARY

Overall performance of the recorder requires many elements functioning together as a system. Measurement of individual functions is important when making adjustments. Some units provide on-board metering which can be used for this measurement, but it is well to know how reliable the indications are in each case. These are often only relative indications and not suitable for accurate measurement. In all cases, human judgment is still needed. ■

The Technics ST-9030 tuner. Purists would feel better if it cost over $1,000.



To some, tuners that offer 0.08% THD, 50 dB stereo separation, a capture ratio of 0.8 dB and waveform fidelity should demand a price tag of over $1,000. But with the ST-9030 this performance can be yours for under $450.

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db New Literature

SHOCK CONTROL PRODUCTS

"Kinetics Vibration Isolation and Shock Control Products" entitles a four-page looseleaf brochure describing spring-designed devices holding heavy equipment away from vibrational surfaces. Mfr: Peabody Noise Control Inc., P.O. Box 655, Dublin, Ohio 43017.

DIODES

A new 238-page product catalog lists Zener diodes, temperature compensated diodes, NPN switching transistors, TransZorb silicon transient voltage suppressors, and high-speed, high-voltage switching transistors. Mfr: General Semiconductor Industries, Inc. P.O. Box 3078, Tempe, Az. 85281.

ATTENUATORS

A line of attenuators, microwave components, and noise products, over 150 items, listed in new literature. Mfr: Micronetics, Inc., 36 Oak St., Norwood, N.J. 07648.

PRECISION MECHANICAL COMPONENTS

576 page Manual A8 describes gears, assemblies, breadboard components, hardware, bearings, linear motion components, couplings, and plastic drive belts, etc. Mfr: Ampersand, P.O. Box 388, Rockville Center, N.Y. 11570.

BREADBOARDING/TEST EQUIPMENT

Electronic prototyping, development, and testing hardware such as logic probes and digital pulsers are covered in a 12-page catalog. Mfr: Continental Specialties Corp., 70 Fulton Terr, New Haven, Ct. 06509.

ELECTROLYTIC CAPACITORS

Both axial and radial aluminum capacitors are covered in a 6-page technical brochure. Mfr: Tradeline, Inc., 1 World Trade Center, Suite 1829, New York, N.Y. 10048.

SEMICONDUCTORS

Cross-referenced, in alphanumeric order, more than 137,000 industry part numbers pertaining to semiconductors are listed in the 1978 ECG Semiconductor Master Replacement Guide. Mfr: General Telephone & Electronics, 1 Stamford Forum, Stamford, Ct. 06904.

FLEXIBLE DISCS

The Verbatim flexible disc line is listed in a four-page data sheet. Mfr: Information Terminals Co., 323 Soquel Way, Sunnyvale, Ca. 94086.

RECORDER BUYER GUIDE

The most important features required in a full-capability X-Y recorder are discussed in this 4-page data sheet and information bulletin. Mfr: Inquiries Mgr., Hewlett-Packard Co., 1507 Page Mill Rd., Palo Alto, Ca. 94304.

WIRE/CABLE CROSS REFERENCE

Part numbers for the manufacturer's line, plus corresponding numbers from 10 other manufacturers, covering wire, cable, and cord sets are included in this guide. Mfr: Columbia Electronic Cables, 11 Cover St., New Bedford, Ma. 02744.

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JOHN M. WORAM

db The Sync Track

More on Cleanness vs. Loudness

• I'm always amazed by reader reaction to this column. Every so often, I'll sound off on the state of the recording scene (November, for instance), and then watch for the angry Letters to the Editor to start arriving. I'm still watching, but there's not even a postcard in sight.

But, way back in June, I took a gentle poke at broadcast management, and the letters are still arriving. One was printed in the October issue, and a few others were excerpted in December. The October contributor has written again, more-or-less supporting some of my responses, but raising a point or two that I'd like to belabor.

First is a clarification (sort-of) of what I originally wrote back in June. This may seem like a bit of nit-picking, and perhaps it is, but I see a more important issue here than the one we appear to be discussing. That issue is the simple (or impossible, perhaps) art of communicating.

I reported that a console manufacturer, well-known in the recording industry, appeared to be selling a lot of $15-20,000 consoles to broadcasters. I thought that was a lot of money for a broadacster to shell out.

In his most recent letter, the broadcaster says, *"You say we should spend 15 to 20 grand for a (brand X), mainly for its better quality, rather than 5 to 8 grand for a (brand Y, Z) etc. . . . I still say that from a business point of view, all that extra money would attract very few new listeners and make(s) it a foolish expenditure."*

Now wait a minute! Did I say the broadcaster should spend 15 to 20 grand, etc.? No way! I reported that these consoles "seem to be moving well, and that's good news." What bothers me is that such an observation about a manufacturer's sales can get twisted around into a directive to go out and make "foolish expenditures."

By now, some may be saying, so what? (The thought had occurred to me.—Ed.) Well, this magazine is involved in the art of communication, and from reader reactions, it seems that a lot of you are active in the communications field. So, it's to the point that there seems to be at least a partial breakdown in communications here that I'd like to repair, especially since similar statements are sure to appear on these pages again.

OBJECTIVE REPORTING

When **db** reports on the goings-on at one or another audio-related convention, press conference or whatever, that report should not be interpreted as anything more than what it is. It's a simple fact of life that many of our readers are unable to attend all the meetings that take place around the country. In fact, to get to all of them would be more than a full-time job. We get to a few, and like to pass on a little bit of what we see. Well, last June, it appeared that at least one manufacturer (actually, many) had discovered a market for high-quality broadcast consoles. If you want to uncover some hidden meaning in all this, how about "reading into" the report that some stations do not seem to think that 15 to 20k is a foolish expenditure? As for your own station (or recording studio, sound reinforcement company or whatever), its up to you—not us—to decide what's foolish and what's not. If you are lucky enough to see all the new equipment at first hand, and already know what your colleagues are doing, you're very fortunate. But many readers are not so lucky, and look to **db** (we hope) as a window on what's happening in the world of audio. But that does not make the magazine, or any of its writers, a dictator of what shall be done. When we pass along some little piece of news —often with an editorial comment thrown in for good measure—this should help some readers in deciding what's best—for them. But, please don't construe any remarks here as a directive to do something foolish.

I bring all this to the surface here because it's not the first time a reader has attached more significance to something written than it deserves. Unfortunately, there's a tendency to believe

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anything—as long as it's in print—and that's bad enough. But to read even more into the printed page than is actually written there is often dangerous —both to the reader and the writer.

Moving right along, the letter writer says, *As for reverbs* (on newscasts. etc.), *I personally don't like them, but who are you or I to tell a station it is bad to use one, if they have made a professional judgment that it will increase listenership?* etc. Well, I would never say such a thing. unless the station had called on me for advice—which seems unlikely, to say the least. However, I do reserve the right to chide such foolishness, and suggest that the broadcast management may grossly underestimate the mentality of its audience.

Which brings us to yet another letter, from the director of engineering at a southern a.m./f.m. station, who notes that I offer my . . . *opinion of the idiots in the listening audience and sum up listeners' pyschology in a few words. He may have made a whole new territory to attack.* (?—JMW)

Woram may not be aware that millions have been spent in audience research to determine just what attracts or discourages listeners. and that the experts have been unable to sum it up so concisely.

It is quite obvious that Mr. Woram is out of his field of expertise (and) not intimately aware of the basic problems facing broadcast engineering today.

Well, yes and no. First of all, I haven't summed anything up concisely in years. And my opinion on "idiots" was that there are no more of them in the listening audience than in the control room (October *Sync Track*, if you're keeping score). Does the writer disagree? I can't tell.

COMPROMISES

As for the millions that have been spent, with all due respect. I submit that a lot of people probably choose a station because of its format (hard rock, MOR, all-news, "beautiful music" etc.). Unless the station is grossly distorted, the typical listener (not an idiot, but not an audio engineer either) may not be aware that *some* of the distortion he hears is unnecessary. On the other hand, some of it may be unavoidable, due to the trade-offs that are necessary to stay on the air and competitive.

As in the recording studio, compromises must be made. And, just as some recording studios go too far in doctoring the sound, so do some radio stations. To paraphrase a recent obscenity ruling, "I may not know how to define filth, but I know it when I hear it." And that's my "expert opinion," as a casual listener who does not have an intimate acquaintance with the "basic problems facing broadcast engineering today."

But what about those problems? Perhaps some of our broadcast industry readers could define them for our other readers, and for me, since here I am certainly out of my field of expertise—which seems to be getting into trouble with readers.

By the way, I have purposely not identified the writers mentioned here, since I would prefer that my counter-attacks are taken generally, rather than personally. However, I really do appreciate hearing from them, since it gives me the opportunity to present conflicting viewpoints (and saves me the work of having to write the whole column myself). And so, here's a note to future letter writers; if it's okay to mention your name, please give permission to do so. Otherwise, I'll continue to use my own judgment, and you know what *that* could mean! ■

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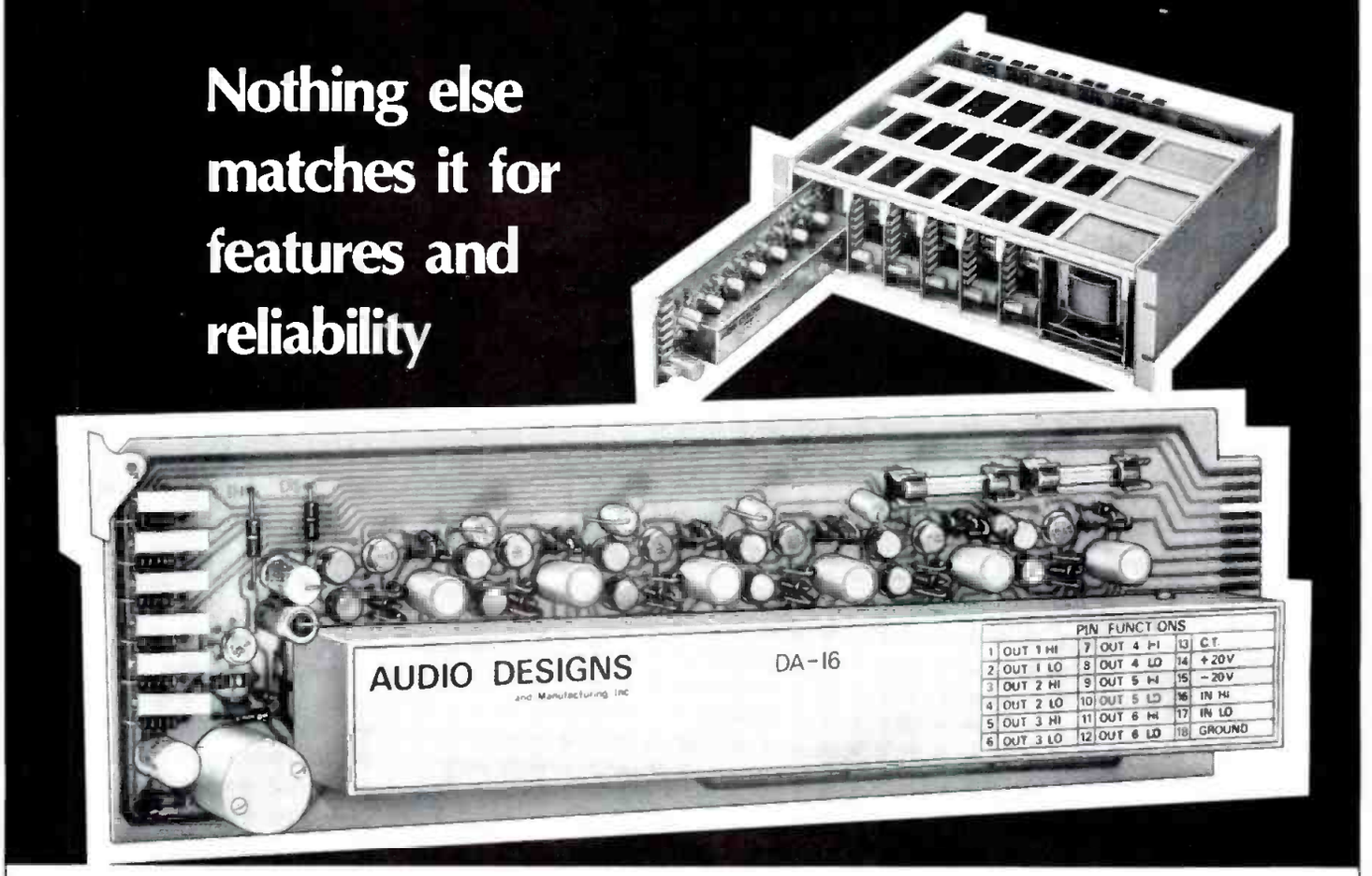

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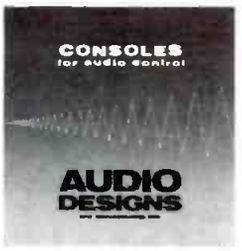

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NORMAN S. CROWHURST

db Theory & Practice

Control Room Feedback

• Recently I have been receiving questions about setting up various kinds of systems where loudspeaker-to-microphone feedback can be a problem. Of course, this is well enough known in the ordinary public address or sound reinforcement system, but the kind of situation that my correspondents have been inquiring about have been where the microphone and loudspeaker are both one step removed, so to speak, from the main audience area.

This could be in a radio station, where the audience is actually invisible to the operator, or it could be in a public address or sound reinforcement situation, where the operator is provided with a sound-proof booth so he can see the audience area and the performing area, but is acoustically insulated from them.

In either of these situations, the operator is provided with a monitor loudspeaker system, so he can hear, hopefully, what the audience hears. In the case of a radio station, this is not difficult. When dealing with a sound reinforcement system, there may be level problems; how does the operator know the relationship between the level at which he hears the sound in his monitor system and that at which the audience hears it?

In passing, I should mention that the recording studio control room is something like the radio station control room, although each presents its own variations of the problem.

In either a radio station or a recording studio, level is usually taken care of by modulation level, so that the monitor is more of a quality indicator than a quantity indicator. You are concerned with what is heard, rather than with how loudly it's heard. How loudly they hear it is the listeners' concern determined by their volume controls. You will be using as close to maximum modulation as possible, to secure a good signal-to-noise ratio.

PUBLIC ADDRESS

But in a public address or sound reinforcement situation, the signal-to-noise problem is totally acoustic. The sound you hear on the monitor is usually a replica of that picked by the microphone out there on stage from the person speaking, singing or whatever, or from some musical performance, as the case may be.

What you hear on the monitor will not change according to audience occupancy or activity, because the microphone will pick up the performance just the same. However, what the audience hears is very much affected by audience occupancy and activity. What is more than adequate sound level in a nearly empty auditorium becomes nearly inaudible when that same auditorium is full of people.

And if those people are applauding, whistling, screaming, or otherwise participating in the event, there is even greater demand on the system for a higher level of sound reproduction. How well are you aware of these factors in the sound-proof control room? What may seem to you to be a perfectly adequate level, based on the sound presented to you by your monitor, may be virtually inaudible "out there."

One of the earlier solutions to this was to put the control point in a typical listening position within the audience area so the operator was actually in a typical audience listening position. If he then needed to have contact with the stage or back-stage area, that would be provided by telephone, or other private audio link; communication can get difficult, if the audience sound level happens to be rather high.

A more recent alternative gives the operator better privacy by putting him in a sound proof booth and then provides him with the various audio links he needs, one of which would be with the stage and back-stage areas and another with the audience area so he can sample what the audience is hearing directly. But he cannot do all these things at once; he must have command of the situation so he can monitor each circumstance as he needs to do so.

DOUBLE DUTY

So far so good, but now, with rising costs and all that stuff, we are finding more instances where the people in the control room—or perhaps the person in the control room, because he must handle the entire job alone—have to do double duty. As well as monitoring what the audience is listening to, he must also make announcements or in some other way communicate directly with the audience, speaking into a microphone.

This is the problem about which I have been asked lately. We are back in the old acoustic feedback arena again. If you have ever done public speaking engagements, you can hardly have missed the situation where the audio operator had the gain too high and the system was on the verge of ringing all the time. You wished that, as well as being up there speaking, you could have your hand in reach of the gain control so you could stop that ringing.

From the speaker's point of view, this is a frustrating situation. Is the audio man trying to tell you to speak louder so he can turn the gain back? The trouble is, if you speak louder, you also stimulate that ringing more, and probably set up a full-fledged howl. In more than one instance, where the auditorium has not been too big for me to fill with energy from my own vocal cords, I have switched the microphone off and then used my own unaided voice.

That stimulates a variety of reactions. Most uninitiated people in the audience will conclude that the sound system failed, so I had to raise my voice. You may hear comments about the "good old human larynx is not so bad, after all." The audio man does not know what happened, as a rule. He will probably run round the place like a chicken with his head chopped off, looking for a break in the mic connection, not realizing you switched it off on purpose.

But you may be in the other position, the audio control person. You have to cope with the soft-voiced lecturer who just will not get close enough to the microphone, or the loud-voiced lecturer who just will not get far enough back from it, while you struggle to adjust gain to "compensate"—whatever that may mean. For the soft-voiced speaker who is convinced that you can "take care of it," you operate on the verge of ringing, because other-

wise the audience won't hear anything. For the loudmouth, you have difficulty delivering intelligible sound to the audience because he is blasting the microphone input.

Compared with this kind of problem, a situation where the same individual is running the whole show would seem to have advantages. He can set gain, adjust his voice, and monitor what the audience hears, all by himself, without having some other fool louse it up for him. The trouble is, that is not too easy either.

People have written to ask me the best way to do this. Really, as with so many other problems, there is no one universal, best way. It depends on the precise nature of the situation. It also depends on the faculties of the individual who will be trying to do all those things at once.

The usual problem arises when such a system provides a key, to bring in the operator's mic, and putting the mic on allows acoustic feedback between the monitor loudspeaker and the operator's mic.

USING GAIN

To stop acoustic feedback, you turn back on gain somewhere. Where, in this case? If you turn down the gain from the operator's mic, that will reduce the level at which his voice goes into the system, probably making it too quiet. What you need to do is to reduce the level fed to the monitor loudspeaker.

That is usually a preset control, or at least a less prominent, or easily available control, than that for the microphone. But even when you know what to do, it takes remembering to do it or that acoustic feedback is going to keep happening. One remedy is to use some ganged switching, or keying, that inserts some attenuation in the monitor circuit whenever the operator's mic is turned on.

This may be quite satisfactory for some operators; others may find it difficult to work with. That will be particularly true for those operators who normally operate their monitors at quite a high level. Inserting enough attenuation to prevent acoustic feedback will reduce the monitor level to the point where, when what they are monitoring is their own voice, they will think the monitor "isn't on."

For this kind of individual, the better plan may be to provide headphones for monitoring when they use the operator's mic. Possibly you could provide an electrical interlock so that, unless the headset is plugged in, in turn disabling the monitor loudspeaker's output, the operator's mic will not come on.

Then, when he is about to use his mic, the operator dons the headset and plugs it in, automatically turning the loudspeaker off, and he is monitoring the program on his headset. When he is ready, he keys the mic on, and does his thing. He will hear his own voice in the headset, rather like sidetone in a telephone conversation. The level should be the same as that for the program he was monitoring a moment before.

TWO CHOICES

So we have two basic choices: attenuate the loudspeaker, or substitute a headset. From what I have just said, you may conclude that the latter has the advantage. But really it depends on the individual, as well as the situation. Listening to oneself on a headset while one is speaking can make some people tend to get tongue-tied, because it is an unnatural "sidetone."

The important thing is to arrange the system in a way the operator can live with. Few operators want to monitor everything on headphones; they would rather monitor most of the program on a speaker. So whichever is used involves making changes. Which kind of change can the individual operator, working in the situation presented, handle most easily? That question will probably help you answer the choice correctly.

If you are using a variety of operators and perhaps using the facility in a variety of situations, the best thing may be to make both alternatives available so each operator has his choice. If plugging in the headphones disconnects the input to the monitor loudspeaker amplifier and the keying reduces loudspeaker level by means of attenuation at its output, then each method can work independently.

When the headphones are not plugged in, the loudspeaker volume will be reduced when the operator's mic is keyed on. When the headphones are plugged in, keying the operator's mic will not change the level in them, but the monitor loudspeaker will be off, anyway.

With a flexible system like that, the operator has his option and can pick whichever method of operating suits him best. That is the least you can do for a guy who, for those few moments, will have his faculties rather heavily taxed! ■

MARTIN DICKSTEIN

db Sound With Images

A State-of-the-Art A/V Programer

• In the past, this corner has indicated that there would be columns on hardware in the a/v field, and on occasion there have been. In the November, 1977 column, I talked about the complex presentations that could be produced with the latest programmers. Although none was mentioned, I had received some time ago some literature from a manufacturer of just such equipment, along with a very nice letter. This equipment may be familiar to some of you by this time, but perhaps others would like to learn of some features that are available. This is in no way an endorsement of the devices, but perhaps the beginning of a series on some of the programmers on the market. (Another manufacturer was mentioned not too many months back, come to think of it.)

The covering letter was written by Norman A. Sauppé, President of Spindler & Sauppé of North Hollywood, California. Here are a few excerpts.

I have enjoyed your column Sound With Images *for some time now, and thought you would be interested in three new products our company is introducing that incorporate microprocessor technology. All three products also synchronize with audio tape recorders . . .*

The Producer 32 . . . is the first microprocessor slide projector and is designed for film chain use. A 5,500 Hz synchronizer built into the unit synchronizes its electronic memory programmer with a stereo audio tape recorder. The tape recorder is also used to store the digital data for reloading the memory.

The OmniSystems remote control was shipped starting in March 1977. The memory programmer/audio tape synchronizer was available in the fall of 1977.

The Director 24 is the most feature-laden multi-image programming system ever introduced. A built-in data tape recorder handles storage of the memory, and a 1000 Hz synchronizer is built-in for an audio tape recorder.

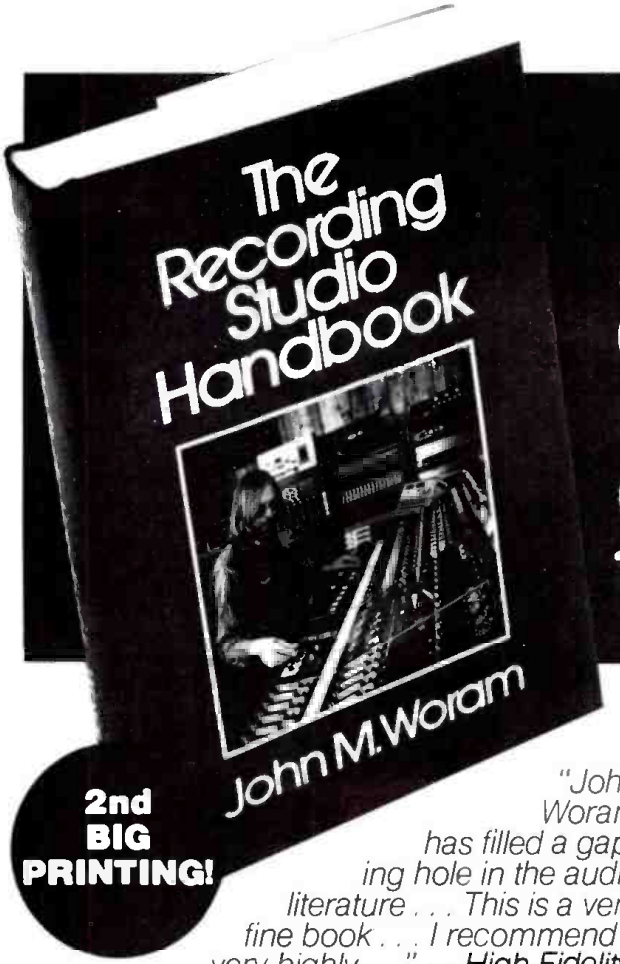
With that for an introduction, I went through the literature to get further details. The following comes from that written material. The excerpts will not be direct quotes, necessarily, but should be precise enough to pique your interest.

SELECTROSLIDE PRODUCER 32

The Selectroslide Producer 32 is the first film chain slide projector to incorporate into one unit a dissolve and special effects system, memory and audio tape programmer and full random access. The system also includes quickly interchangeable precision magazines, preview of all slides without rotation of the magazines, 1000-hr. tungsten-halogen projection lamps with push button lamp ejection, and an air filter for both optics and mechanisms.

The random access is operated automatically in the "shortest way" route with digital readout for each magazine, and sequential automatic reverse. There are 16 precision dissolve rates from "cut" (12 frames) to 15 seconds (450 frames). All rates are available for fade-ins, fade-outs, alternation between magazines, and superimposition effects. Both magazines can be individually sequenced forward or reverse, or crawled either right-to-left or left-to-right. With cuts, slides can be advanced every 1.5 seconds.

All of the above effects, including fast advancing either slide magazine forward or reverse up to 15 slide positions, can be stored in the 451-cue memory. The memory can be loaded with each cue being performed as it is stored, or the memory can be loaded with the magazines in "standby" position. Once in the memory, cues can be advanced or reversed one at a time or at high speed rate of 10 cues-per-second. This automatically will move the slide magazines and switch projection lamps so that proper positions are achieved at the stopping point. The l.e.d. readouts will also follow and indicate position and upcoming cue. A restart button automatically returns the



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Then there's the Director 24. This system makes available a total of 31 dissolve rates, in one-second increments, from a one-second dissolve to a 31-second lap dissolve. These are in addition to a "cut" and a new ultra-fast "chop." Fade-in and fade-out effects can also be programmed at 33 different speeds, and dissolves and fades can be stopped, continued, or changed in rate at any point. The system also allows each projector to perform in a dual role, either as part of a dissolve loop or as an independent projector under the control of a lamp and slide change "fader."

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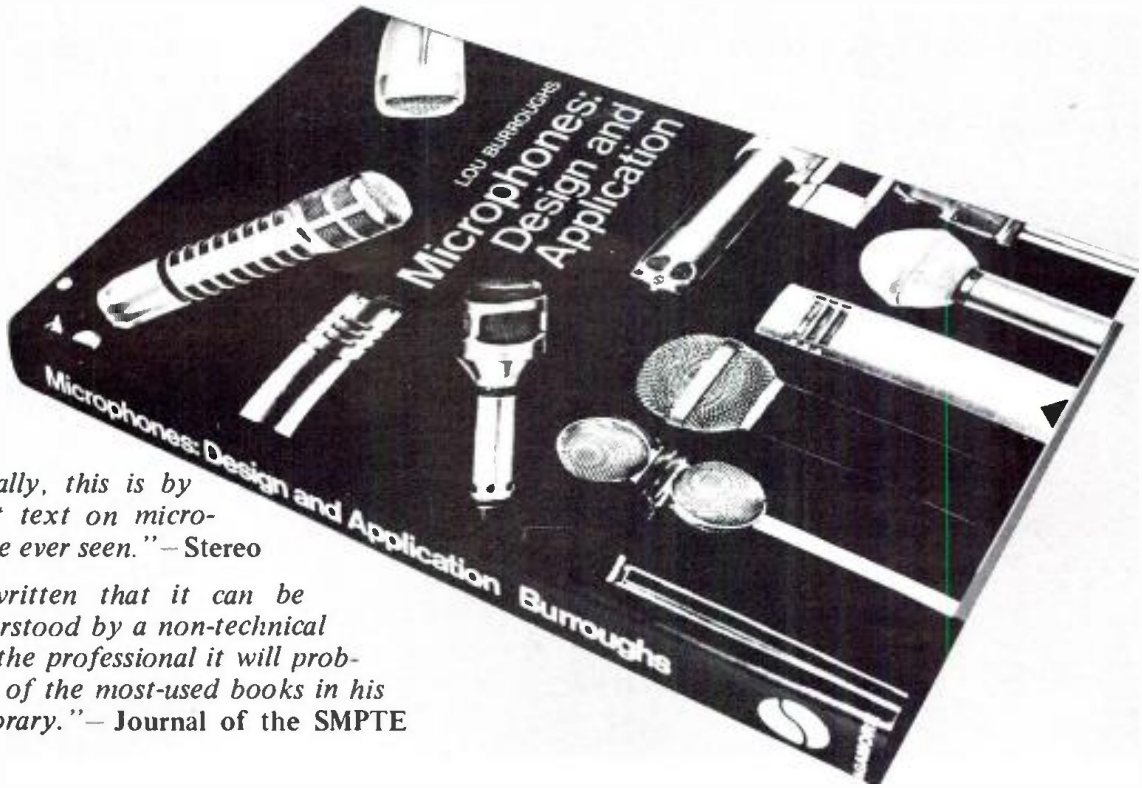

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cues from the memory of early programming systems . . . while using the Director 24 system requires only two cues. This means that a presentation that previously might have required 1000 cues can now comfortably be programmed on the Director 24 in less than 300 cues.

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This leaves to the conventional audio tape, which is used for the soundtrack, only the responsibility for handling a simple, reliable 1000 Hz synchronization pulse to call cues from memory, a task that even an economy model cassette recorder can handle with confidence.

Well, there it is—a brief rundown on a few of the capabilities of some new equipment. We'll be doing this again soon, and if there is any special equipment you'd like to know about or some information you'd like to pass on to others, please let me know. Perhaps I'll get to do a review of programmers so that you can get to know something about almost all of them. You tell me. ■

DAN KEEN

Understanding Maximum Power Transfer

Why must amplifier impedance match the ohms of the speaker system?

ANYONE WHO has ever bought a home stereo system or set up a p.a. for a band or auditorium is aware of the fact that the amplifier output impedance must match the ohms of the speaker system. While most high quality amplifiers today are designed to operate safely into many output loads, there is only one value of load impedance where maximum power will be realized. An amplifier rated at 8 ohms has to be connected to an 8 ohm speaker (or a combination of speakers whose total impedance is 8 ohms) to achieve maximum power from the amplifier. But why is this so? What if they don't match?

Generally, if an exact match isn't possible it is safer for an amp to mismatch "up." That is, an 8 ohm amp can be connected to a 16 ohm speaker without any damage resulting, although there will be a severe loss of volume. Part of the amp's power is being wasted trying to drive the speaker.

Mismatching "down" can be dangerous if the amplifier has not been built to handle a lower impedance load. Should the amp be solid state, this can cause the output transistors to overheat and be destroyed.

However in both cases of mismatching, the system is not operating efficiently. Let's see why the source impedance must equal the load impedance to obtain maximum power transfer from amp to speakers (or source to load).

REASON FOR MATCHING

The amplifier can be considered as a generator with an internal resistance. In FIGURE 1, let Z_s stand for the internal resistance of the amp, and Z_L represent the speaker impedance.

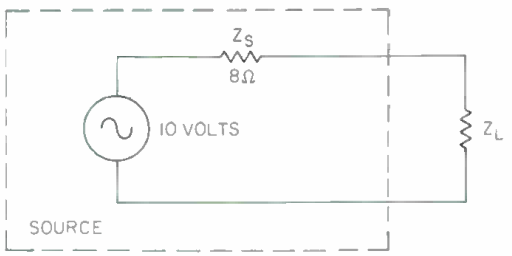

Figure 1. Amp resistance relative to speaker impedance.

Assume the source is 10 volts and the internal resistance is 8 ohms.

When $Z_L = 8$ ohms:

$$\text{(Current) } I = \frac{\text{(volts) } E}{\text{(Total Resistance) } R} = \frac{10}{8+8} = \frac{10}{16}$$

$= 0.63$ amps (Ohm's law)

$\text{Power}_{\text{Load}}$ = (current²) I^2 times (Load Resistance)

$R_L = 0.63^2 \times 8 = 3.18$ watts

Increasing Z_L puts more voltage across the load. But the added resistance decreases the current.

When $Z_L = 16$ ohms:

$$I = \frac{10}{8+16} = \frac{10}{24} = 0.42 \text{ amps}$$

$P_{\text{Load}} = 0.42^2 \times 16 = 2.82$ watts

Decreasing Z_L makes more current available, but this decreases the voltage across the load.

When $Z_L = 4$ ohms:

$$I = \frac{10}{8+4} = \frac{10}{12} = 0.83 \text{ amps}$$

$P_{\text{Load}} = 0.83^2 \times 4 = 2.76$ watts

Thus, to get a load resistance that will give maximum current and voltage simultaneously, the load impedance will be of the same value as the internal impedance of the source. This holds true for d.c. circuits, a.c. circuits, audio, and even transmission lines to transmitters. ■

Dan Keen operates Electronic Music Systems of Cape May Court House, N.J.

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GLENN CALDERONE

British Institute of Recorded Sound

At the national sound archives, the collection is open for practical use.

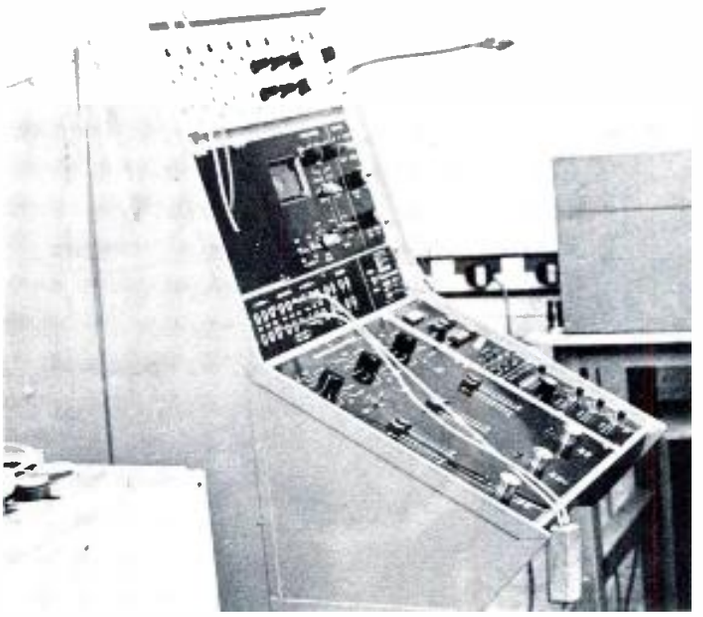
IT'S A SOUND MUSEUM! Where you can look and touch and hear—the British Institute of Recorded Sound—the National sound archives.

A few blocks from the Royal Albert Hall, at 29 Exhibition Road in "downtown" London, the Institute houses an amazing collection of records, tapes, and literature of the record industry. And listening rooms where you can sit and listen.

Their library subscribes to at least 115 current periodicals, indexed and cross-referenced by artist, composer, and title. Publications go back to at least the 1920's, with complete volumes of *The Gramaphone*, *HiFi News*, and copies of *Schwanns*, *EMI*, and the *Columbia* record catalogues.

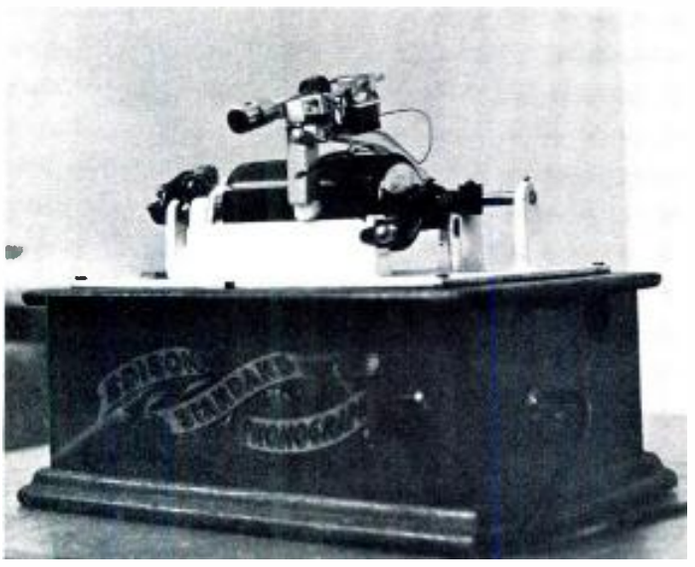
Listening rooms, where you may audition records or reel-to-reel tapes from the Institute's collection, may be used by appointment. There are about half a million discs and thousands of hours of tape stored here—from classical to pop, drama to foreign language, and of course, the world's largest collection of British music.

Two or more times monthly, the Institute hosts special Tuesday evening programs. There may be a lecture or a demonstration of music or recording technology. For ex-



A custom-built dubbing console.

Edison phonograph for wax cylinder with a modified tone arm and Shure magnetic cartridge.



Studer 2-track recorders.

ample, the May 24, 1977 gathering, *An Evening of Wax Cylinders*, celebrated the centenary of the phonograph. In the typical British tradition, meetings usually include a glass of sherry or even a wine and cheese party by candlelight.

ENGINEERING FACILITIES

Upstairs are the engineering facilities, custom-built dubbing consoles, transcription turntables, tape recorders, reference loudspeakers. Currently they are preserving on tape many of the BBC broadcasts, speech, live theatre, or concerts. Automatic time-clocks control the recorders after hours and on weekends. In progress is the transfer of wax cylinder recordings to tape, using their own design servo-controlled motorized Edison phonograph with a magnetic cartridge.

All tapes are made for long term storage, so no special noise filtering or equalization is used. This way they can take advantage of future developments in signal processing (e.g. digital computer equalization and scratch removal) as they come about.

The most time-consuming job at the Institute is classifying and cross-referencing the data on each record or tape. At least three staff members spend some of their time at the IBM typewriter preparing index cards for the millions of entries. As expected, they are investigating the use of a computer in the near future to solve their filing problems.

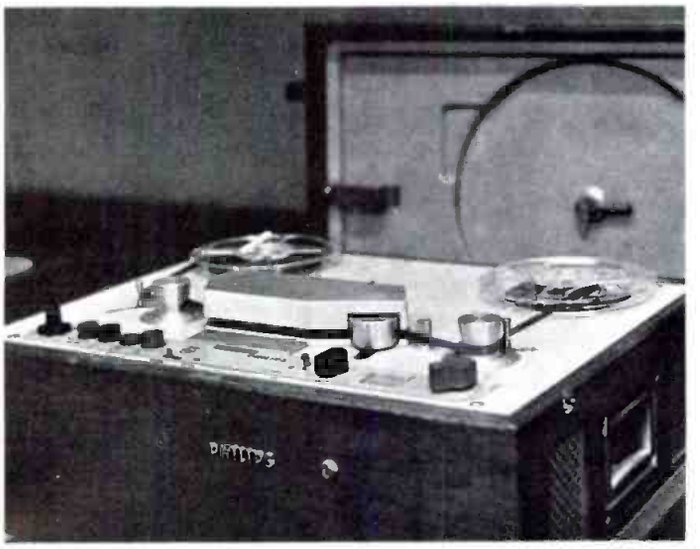
The British Institute of Recorded Sound is a non-profit, Government-aided society. They welcome the loan or donation of private record collections to enlarge their library of sounds. And they publish a quarterly journal, *Recorded Sound*, sent to subscribers who are known as "Friends of the Institute."

Information may be obtained by writing to them at 29 Exhibition Road, London SW7 or by telephone, (01) 589-6603. ■

Reproductions of old sales brochures for Columbia and Pathe phonographs.

A rack full of quad f.m. tuners for BBC air checks, tied into the automatic time clocks for unattended off-air recording

An old Philips tape recorder in a listening room.



ROBERT C. EHLE

Aesthetic and Randomness

Piling random sounds onto a recording tape achieves an aesthetic musical experience.

THE EXPERIMENT described in this article was devised to determine an aesthetic basis for the music being composed today by *avant-garde* and experimental composers. The method for the experiment was evolved through the experience of the music itself. The hypothesis which I attempted to prove is that music by these composers is preponderantly of a random character. To be sure, some of the composers working in the field admit to randomness as a procedure. Others do not. However, even when randomness is deliberately employed, the composer often claims some higher unifying force for which he is at a loss to account in technical terms.

PROCEDURE

The specific procedure employed in this experiment is one that could be duplicated by many amateur composers. It is a procedure of basic interest to the do-it-yourself electronic music composer as well as the serious student of recent compositional techniques. Specifically, this is the technique of random sound superimposition employing a monophonic, quarter-track tape recorder with moveable head position and with the erase head disabled.

The erase head could be disabled by a variety of techniques, including removing it physically from the head assembly or disconnecting it electrically (this latter technique requires that a resistor be placed in the circuit in its place). I chose the simpler and cruder technique simply because I did not wish to disturb the alignment of the recorder. I simply placed a layer of celluloid photographic film over the gap in the erase head so that it would not erase the tape passing over it. In this way I could superimpose any number of recordings.

My specific technique, then, was to create a very dense montage of a very wide range of sonic material superimposed on each of the four tracks of a quarter-track tape recorder, all of which would then be played back on a half-track stereo tape player. The experiment consisted in comparing the aesthetic effect of my random montage with that of many of the current compositions for which great organizational subtlety is claimed.

BACKGROUND

It has been said that there are two types of composers. The first composes something and if on hearing it, he doesn't like it, he changes it. The second, if he doesn't like what he has composed, listens to it until he learns to like it. In line with this, it has also been remarked that the listener has only to listen to the music of the recent experimental composers sufficiently to learn to like it.

In line with comments such as the above, and, not being one to shy away from a challenge, I chose to listen to as much of the recent experimental music as I could, and as often as I could. I took library copies of the recordings and tape recorded them on large reels of long-playing tape. Then, whenever I had time, I played the tapes repeatedly. Of course, I also bought records, scores and read innumerable articles and books on the music I was listening to.

As a result, I discovered that, indeed, I did learn to enjoy this music. I learned that the more I listened to a work the more I could anticipate what was coming—this anticipation contributed to my enjoyment. I also found that I formed preferences. Some of the music made more sense to me sooner than others. I finally discovered that some of the seemingly most intransigent types of music could be enjoyed by taking a different attitude toward the listening process. Rather than listening actively, as is usually the case for Western concert music, I could listen passively, or rather in a trance, as is suggested may be a common practice in listening to Eastern music, perhaps as a companion to meditation. This acceptance of flow made even the most random-seeming music enjoyable, at least to a degree.

At this point, the hypothesis of this experiment first suggested itself to me: *Is it not possible that through the proper mental set or through repetition or conditioning one can actually learn to enjoy random phenomena? And* in line with this: *Is it not possible that the advanced composers of today are not really creating anything of an order of organization which I can actually perceive but that I am listening to and primarily enjoying my own response to what is essentially a set of musically random*

Robert C. Ehle is the assistant director of the School of Music at the University of Northern Colorado at Greeley.

phenomena? At this point, I set out to devise an experiment to test this pair of hypotheses.

SETTING UP THE TEST

Since I had already listened to a very large amount of the type of music under study, I decided that I would use my own response as a test measurement to answer my questions. I would compose an original piece which would be as random as I could make it and then I would compare my response to that test piece with my response to the various other compositions I had been listening to.

The basic piece of equipment employed was a Wollensak quarter-track, monophonic tape recorder with a head assembly that is accessible and a record-playback head that can be moved from Track 1 of a quarter-track tape to Track 2. When running the same tape back through the machine, one can record on what will be Tracks 3 and 4 of the same tape. These two tracks will be in the reverse direction on the tape to those on Tracks 1 and 2. After completing the recording, I would be able to listen to the entire tape, in a sort of pseudo-stereo, by playing it on a Viking 88 tape deck equipped with a half-track stereo head. In this case Tracks 1 and 2 would play on the left channel together while Tracks 3 and 4 would play on the right channel, simultaneously.

It should be noticed that this technique of multiple recording, unlike Sel-Sync (Ampex trade name), sound-on sound, sound-with sound and other more sophisticated techniques does not allow any synchronization of the material on each track being recorded with that which was recorded previously. In fact, the operator cannot even hear what is on the adjacent tracks while he is recording on any one track. This would assure a certain randomness between the channels.

For sources of material, I also tried to find ways to assure randomness. The most reliable technique here was to set the tape recorder in motion at recording and then to record whatever came over the radio at the time, never stopping the tape. For radio sources I used several different radio bands, including the standard a.m. and f.m. bands and the various shortwave bands, including the 49, 31-25, 19-16 and 10-meter bands.

In running the recording of the tape, a single reel of 1½ mil acetate recording tape with a playing time at 7½ in./sec. of a half hour in one direction was chosen. This tape was then recorded a minimum of ten times from different program sources on each of the four tracks. Thus, the finished recording contained no less than forty different recordings being played simultaneously but in no planned synchronous arrangement! The result, I thought, would be random enough to constitute a fair test of my hypotheses.

RESULTS

On completion of the tape recording, which I entitled *Montage Etrange,* I then listened to the tape recording repeatedly in the same way that I had the various compositions by many current experimental composers. My conclusions were largely as anticipated: 1. I did enjoy listening to this randomly composed composition as much as I did those by many other composers. 2. I found that my enjoyment increased with repeated listenings as I learned more of what was on the tape and could begin to anticipate certain sound events. 3. I could even derive enjoyment from long stretches of seemingly monotonously repetitious sounds by employing the meditative listening technique mentioned earlier in connection with certain experimental Western music and much Eastern music. The quality of the trance-like experience seemed to be equal to that produced by many other compositions by well-known composers.

Certain other results were noted that deserve mention here. First, it seems that on successive re-recordings over the same track of tape, the record head erased some of the high-frequency content of each earlier recording on each subsequent pass. This produces an effect in which the most recently recorded track has the best frequency response and each earlier track has a degraded frequency response, corresponding to its order of being recorded with the first track recorded being the worst. The aural effect produced is that of an apparent spatial distribution of the tracks in the sonic space.

The track with the best frequency response appears to be the closest, with the other tracks stretching out in a spatial continuum away from the listener. The explanation for this phenomenon is to be found in the familiar psychoacoustical observation that low frequencies travel around corners and objects and through moist air with less degradation than do high frequencies. Thus the ear has learned to locate sounds in relation to the distance from the listener by means of the relative strengths of higher and lower frequency components in the spectrum.

In the experiment described, a continuum of frequency-weighted spectra was set up which the ear had no trouble in interpreting, as it has learned to do, as a spatial continuum stretching away from the listener. The effect is somewhat comparable to that produced visually by two parallel mirrors.

A second observation worth noting was that in certain sections, the chance or randomly-composed tape was much more interesting than in others; in fact, some of these sections were much more interesting than many deliberately designed compositions. It seems that the very variety and unpredictability of the sound sources chosen often led to specific, very interesting results that do not occur when a composer deliberately limits himself to only a few types of musical instruments or sound sources. Perhaps a composer could capitalize on this phenomenon and create a rather intriguing composition by selecting the most interesting segments from a randomly composed tape and sequencing them. I have since used this technique, as well, but it does not constitute a basic part of this experiment, although it does have curious and interesting aesthetic implications.

CONCLUSIONS

The conclusions I reached as a result of this experiment include the following: 1. Most of the experimental, avant-garde music being composed is highly random in effect, no matter what highly calculated or planned techniques are employed in its composition. (In comparison, my random composition never produced an effect resembling the music of Bach or Mozart, indicating to me that these composers produce a much less random aural effect than composers working today.) The ear can accommodate itself to random sounds and the listener's mentality can learn to appreciate them, either as a stimulus for a sort of reverie or meditation or in a more active way, through repetition, by learning certain sequences of sounds. 3. Through active listening, the listener can, with a considerable effort, find order where apparently none exists or, was created intentionally. This experience as a type of aesthetic experience can provide an interesting tool for the evaluation of aesthetic experiences in general and for psychological inquiry into the processes of perception. 4. The composer of today's experimental music has a great ally in this perceptual process which discovers order in all things.

IMPLICATIONS

The implications of this (as well as other similar experiments in aesthetics which I have conducted) have led

me to form certain conclusions including the following: 1. Contemporary Western music has reached a state of relatively high randomness. 2. Western music was in a state of much lower aural randomness in the 18th century. 3. I have deduced from the above two statements as well as certain other observations that aural randomness has been a gradually increasing quantity in Western music since the time of Beethoven and that this increase parallels and is a direct result of the romantic attitude in the Western world for the past two centuries. 4. I conclude that the romantic attitude is a sort of "suspension of disbelief," enabling the listener to hear order or meaning in chaos in its most extreme manifestations. 5. The ability of a listener or observer to preceive order even in random phenomena has given rise to all sorts of "accidental" current art. It is responsible for the success of the *objet trouvé*, the found sound, drip art, and so forth. 6. There seems to be a successful category of artist who works on the verge of randomness but who steps in to assert himself at certain key points in a work.

EXTENSIONS OF THE EXPERIMENT

After running the experiment as described, I added more parts to the *Montage Etrange*, using home made synthesizer components, amplified musical instruments, and phonograph records. The composition gets more interesting with each added part and I have come to accept the *Montage* as one of my compositions rather than just an experiment. Still, I do not plan to compose any other compositions with just this procedure because I would feel that they would probably be too similar.

A second composition composed employing portions of *Montage Entrange* is *Ritual Conflicts* for tape and orchestra. In this composition the orchestra is asked to partition itself into groups and to repeat small fragments of music in various ranges of each of the instruments. The result, as in the compositions of Penderecki, is a sound mass effect bordering on randomness. This proved to be an idea context into which I could introduce my random tape sounds and they added the perfect climax to a crescendo of orchestral turmoil.

In many compositions for tape and orchestra, the tape part is approximately random sounds which the orchestral part is of a more traditional 1920's style more like that of Stravinsky; in some cases the reverse is true. It was my feeling that the level of randomness in the two parts should match. Thus a semi-improvised orchestra piece proved to be the ideal foil for a random tape part. This was the concept and the motivation for *Ritual Conflicts* which grew out of this experiment with randomness.

SUMMARY

The purpose of this experiment was to determine if aural randomness was a major factor in much recent twentieth-century music. I feel that the experiment proved conclusively that it is and that it is a major factor even in the music of composers who deny its existence. It seems that randomness is a device used today by nearly all composers at one time or another and achieved by many unintentionally. It also seems that randomness is a compositional tool as well as a philosophical statement and position for many others. Some composers seem to try to come as close to randomness as they can without quite giving up entirely on determination.

As a result of the above, it is interesting to note that the student of composition today may want to learn to deal with randomness in various ways. It should also be obvious that electronic music and, particularly, tape composition techniques, are particularly suitable for random or semi-random compositions. ■

db Test Report

Audio System Analyzer

Leader LAS-5500 Audio System Analyzer

WITH test bench space always seeming to be at a premium, the growing trend to incorporate several functions in a single package is one to be applauded.

This latest Leader unit combines on a chassis that takes little space, an audio oscillator, an a.c. millivoltmeter, flutter bridge, and oscilloscope. The combination goes a long way to filling the needs of an audio measurement test bench.

Connection to existing studio equipment is facilitated by unbalanced 600Ω connections; the resistive loading can be switched out. Let's look at each individual function and what it can and does do.

OSCILLATOR

Five bands and a vernier dial cover 10 Hz to 1 MHz. The dial is calibrated from 1 to 10 and the calibration is accurate. The output of the oscillator feeds an attenuator that permits a range (within the audio band accurate to

0.1 dB) of 0 to 101 dB in 0.1 dB steps. The output voltage at 1 kHz across the 600Ω load is 3V.

The output is a sine wave only, and of low distortion, but not low enough to be of value with high grade audio distortion measurements (with a separate distortion analyzer, of course). We verified the specified t.h.d. to be under 0.25 per cent from 20-20,000 Hz.

MILLIVOLTMETER

The millivoltmeter can perform decibel or voltage measurements over a wide range. At its most sensitive 30 μV is full scale, while at the other end, 100 volts is the full scale. We would have thought that a 300V full scale is more desirable in such a meter, but it is not here.

One thing that is desirable and is here is JIS A-weighted noise measurement. Such a filter can be switched in, thus permitting weighted noise figures that should correlate with tape deck manufacturers.

FLUTTER METER

The three systems of flutter measurement, JIS and CCIR (3 kHz carrier) and DIN (3.15 kHz) are accommodated. Measurement is made easy by automatic leveling, provided the input carrier is within the range of 15 mV to about 10V. For flutter measurement of a tape deck's record/play characteristics, the unit will provide the carrier output at a separate front panel jack. Flutter is switch selectable for weighing characteristics and is indicated on the millivoltmeter dial. The unit will measure flutter as low as 0.03 per cent full scale or as high as 3 per cent full scale.

Drift measurements can also be made. For these a separate edge panel meter is used.

It should be mentioned that this is a quality flutter meter that properly measures this characteristic according to established standards. Those standards are the JIS, CCIR, and DIN with the last two being indicated in peak values according to each standard.

'SCOPE

It's a tremendous value to be able to observe the waveforms being measured. Meters do not always tell all, but a good 'scope display will impart much. This analyzer contains such a 'scope. Bandwidth is up to 5 MHz, certainly adequate for audio measurements. Accurate phase measurements can be made since the 'scope is direct coupled for d.c. response. There isn't too much to say about a 'scope so long as it can display clearly with no jitter and a sharp trace that shows subtle variations. This 'scope certainly fulfills these needs. The usual front panel adjustments you would expect on a good 'scope are to be found here. No, this is not a triggered 'scope, but for this application this sort of sophistication is not needed.

Finally, for those that measure power amplifiers, Leader provides a stereo dummy load that will give you 50 watts of loading at 8 ohms. The load can also be used as a mono 100 watt load by parallel connection (4 ohms) and series connection (16 ohms).

SUMMARY

The Leader LAS-5500 takes but 17¾ inches of shelf space. Weight is a highly portable 26 lbs. We judge the quality of this unit to be in complete keeping with the needs to maintain professional audio equipment. At a list price of $1,995.00 it may seem expensive, but a quick analysis of what this unit replaces will reveal that there is economy in the price. ■

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(continued)

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E-V SENTRY III monitors, $900; Mastering Lab "Big Red" monitors, $1,300; Scully 280-B tape deck with console and remote, $2,800; Pandora Time Line, $2,600; Sony MX-16 mixer, 8-in/4-out, $300. **Audio-Trak Recording. (815) 968-2902.**

AMPEX SERVICE COMPANY: Complete factory service for Ampex equipment; professional audio; one-inch helical scan video; video closed circuit cameras; video systems; instrumentation and consumer audio. Service available at **2201 Lunt Avenue, Elk Grove Village, IL 60007; 500 Rodier Drive, Glendale, CA 91201; 75 Commerce Way, Hackensack, NJ 07601.**

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FOR SALE: MM-1000 16-track, 30-15 i.p.s.; real workhorse, going 24. $12,000. **Shoe Productions, Inc. (901) 458-4496.**

EIGHT-TRACK TASCAM (recorder/reproducer), Series 70 transport, 701 electronics, $2,800. TASCAM Model 10 mixing console 12-in/4-out, many extras. $1,500. **(401) 766-7245.**

GAUSS HF-4000 drivers, $240.00; Dynaco 400A w/meters, fan, $450.00; SAE 2700 equalizer, $450.00. Wanted: 32 or 36 pr. shielded audio cable or anyone interested in ordering same. **(305) 776-4915.**

8-TRACK RECORDING equipment, including console with 16-input, dbx, Dolby, and all usual accessories. Less than 2 years old. For full details: **Laine Real Estate, 125 Durham St., Sudbury, Ontario P3E 3M9, Canada. Phone: (705) 675-6427.**

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ESTABLISHED PROFESSIONAL sound equipment company in Dallas, Texas seeks sales applicant capable of system design and sales. Minimum three years' experience required. Excellent opportunity. All replies held strictly confidential. Send resume and reerences to: **Manager, P.O. Box 8205, Dallas, Texas 75205.**

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db People/Places/Happenings

• The **F. Edwin Schmitt Company** of Elmont, N.Y. has formed a new Consumer Products Division under the leadership of **Chet M. Seponosky.** The firm services radio, commercial sound, communications and retail electronics firms in the New York City area.

• Direction of marketing activities at the Meteor Light & Sound Division of **Hammond Industries,** of Syosset, N.Y. is now in the hands of newly promoted product manager **Joel Schwartz. Vinny Finnegan** will continue to serve as national sales manager for Hammond.

• The 1978 International Summer Consumer Electronics Show will be held on Sunday, June 11 through June 14 in Chicago utilizing the facilities of McCormick Place, McCormick Inn, and the Conrad Hilton Hotel. For information contact: **Electronic Industries Assn. Consumer Electronics Group,** 2001 Eye St. N.W., Washington, D.C. 20006. (202) 457-4919.

• Taking a stand on the **FCC's** proposed reorganization of radiotelephone operator licensing procedures, the **National Radio Broadcasters Association** supports the FCC proposal to eliminate the third class operator's license on the grounds that it is burdensome to broadcasters without easy access to an FCC examining point. The new rules would require technicians responsible for the installation, servicing, and maintenance of broadcast equipment to be certified by the FCC, although no test will be needed.

• **Radio Shack,** the retail chain owned by the **Tundy Company,** has entered the consumer computer market. The first of a chain of **Tandy Computer** stores opened in the new Tandy Center shopping mall complex in Fort Worth, Texas. The stores will concentrate on microcomputers, both in kit and finished forms.

• **Morris F. Taylor Co. Inc.** of Silver Spring, Md. has added two new salesmen to its staff. Headquartered at Miami, **Perry Sobol** will represent the firm in southern Florida. **Fred Barnes,** working from Mobile, Alabama, will cover Alabama, Mississippi, and western Tennessee.

• New director of operations at **Audio-Technica U.S., Inc.** of Fairlawn, Ohio is **Dean F. Slagle.** Mr. Slagle's experience has been as a hi-fi retailing executive, with **Olson Electronics.**

• Promotion of **Frank L. Chabre** to the desk of personnel director for the Electronic Systems Group of **Rockwell International** of Dallas, Texas, has been announced. Mr. Chabre has been with Rockwell for 18 years, primarily in a personnel capacity.

• **Howard Brown** has been appointed national sales manager for the new Signet Division of **Audio-Technica U.S., Inc.** of Fairlawn, Ohio. Mr. Brown was associated with **Bang & Olufsen** before coming to Audio-Technica.

• Accolade as "Electronics Man of the Year" has been accorded to **Wilfred L. Larson,** of **Switchcraft, Inc.** of Chicago. Mr. Larson was presented the award by the **Electronic Distributors Research Institute** at a conference in Port St. Lucie, Florida, the second honor he has received from the organization, also having garnered the EDRI "Hall of Fame" recognition in 1974. Mr. Larson, cofounder and president of Switchcraft for the past 32 years, has been active in industry trade associations. He was recently elected chairman of the board at Switchcraft, with **Raymond Dowling** taking over as president and chief executive of the company. Other recent personnel developments include the appointment of **Charles Giesow** as vice president of industrial relations, **Ernest Kochis** as director of manufacturing, and **William Gautreau,** director of materials control.

• Customer service responsibilities have been assumed by newly appointed **Stephen J. McNamara** at the Broadcast Division of **UMC Electronics Co.** of North Haven, Conn. Mr. McNamara has had wide engineering experience, most recently with **Monitor Controls, Inc.**

• A versatile employment of f.m. sub-channels for the benefit of homebound or institutionalized disabled persons is under way in a pilot program called Project HEAR, designed by the **San Diego, Ca. State U.** Rehabilitation Center in conjunction with **Station KPBS-FM.** A Marcomm SCA-100 table model receiver is placed, for a modest fee, in the listener's home, enabling him to hear not only the regular programs of the station but special educational offerings broadcast through the sub-channel. College credits may be earned without cost, or courses particularly suitable to often-repressed disabled persons such as assertiveness training and life adjustment, may be taken without credit. The student participates in a classroom situation by phone, and there is further personal followup by graduate students who keep in touch with the student by telephone or in person, or conduct hospital discussion groups. **Linda Collins** is coordinating the project, which is manned by students in San Diego State's Rehabilitation Counseling master's program.

• **Phillips Audio Video Systems Corp.** has opened a new West Coast regional office, service, and distribution center at 3940 Higuera St., Culver City, Ca. 90230. The new facility will facilitate warehousing and distribution of AKG Acoustics, Philips Video Products, Audicon Products, and Neutrik Products.

• **Ned "Bill" Heath** has joined **Sunn Musical Equipment Co.** of Orange, Ca. as a sales representative for southern California, Arizona, Las Vegas, and Hawaii. Mr. Heath has been well known in the music industry for 14 years.

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