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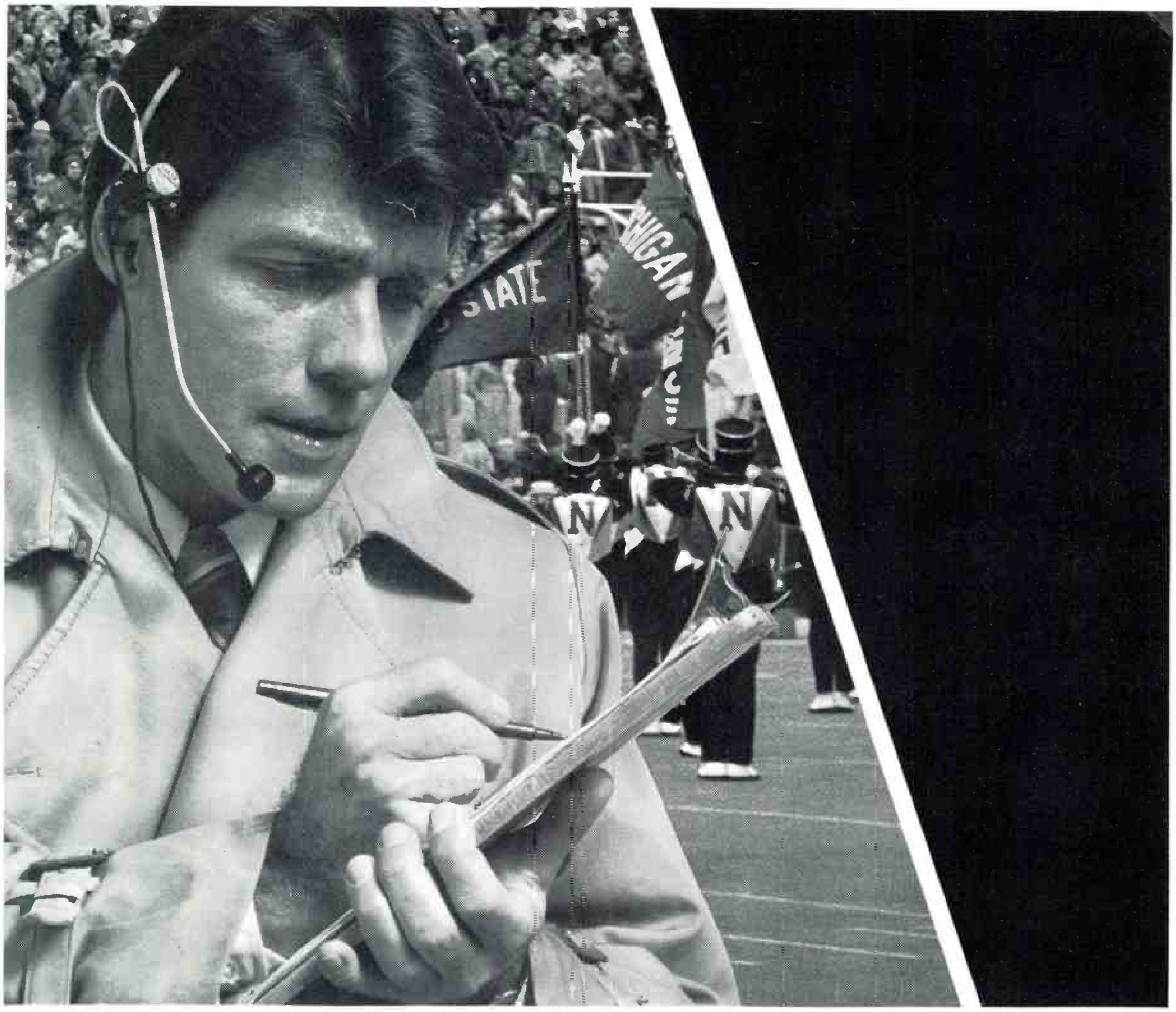
db

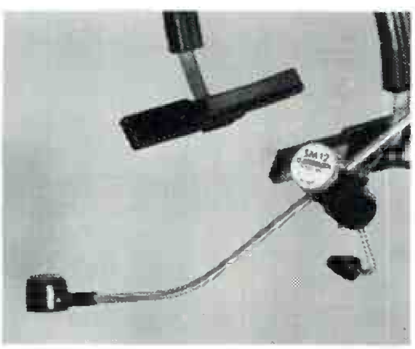
THE SOUND ENGINEERING MAGAZINE

AUGUST 1976 $1.00

IN THIS ISSUE:



Next best thing
to a sound proof booth.



Shure's new headset microphones are coming through loud and clear. With their unique miniature dynamic element placed right at the end of the boom, Shure's broadcast team eliminates the harsh "telephone" sound and standing waves generated by hollow-tube microphones. The SM10 microphone and the SM12 microphone/receiver have a unidirectional pickup pattern that rejects unwanted background noise, too. In fact, this is the first practical headset microphone that offers a high quality frequency response, effective noise rejection, unobstructed vision design, *and* unobtrusive size.

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20. The Audio Cyclopedia (2nd ed.). *Dr. Howard M. Tremaine.* New and updated, here is the complete audio reference library in a single volume. It provides the most comprehensive information on every aspect of the audio art. This new edition includes the latest audio developments including the most recent solid-state systems and integrated circuits. It covers all subjects in the fields of acoustics, recording, and reproduction with more than 3400 related topics. Each topic can be instantly located by a unique index and reference system. More than 1600 illustrations and schematics help make complicated topics masterpieces of clarity. 1760 pages, 6½ x 9⅜ hardbound. **$34.00**

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13. Acoustic Design & Noise Control. *Michael Rettinger. 1973.* NEW, revised and enlarged edition covers physics of sound, room acoustics and design, noise and noise reduction, plus noise and its problems. Many charts and graphs. A practical and useful book. 562 pgs. **$22.50**

16. Magnetic Recording. *Charles E. Lowman.* Reference guide to the technology of magnetic recorders used in audio recording, broadcast and closed-circuit TV, instrument recording, and computer data systems. Includes latest information on cassette and cartridge recorders; TV recorders; direct and FM signal electronics from low to wideband; servo-control and signal record/playback circuitry; capstan, reel, and head-drum servos for longitudinal, rotary, helical-scan, and disc recorders. Glossary, index, bibliographical information. 274 pp. **$19.50**

28. Environmental Acoustics. *Leslie L. Doelle.* Applied acoustics for those in environmental noise control who lack specialized acoustical training. Basic information in comprehensible and practical form for solving straightforward problems. Explains fundamental concepts; pure theory minimized. Practical applications stressed, acoustical properties of materials and construction listed, actual installations with photos and drawings. Appendixes illustrate details of 53 wall types and 32 floor plans and other useful data. 246 pgs. **$22.50**

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24. Basic Electronic Instrument Handbook. *Edited by Clyde F. Coombs, Jr. Hewlett-Packard Co.* A basic reference background for all instruments. Offers saving in time and effort by having complete information in one volume on how to get the most benefit from available devices, how to buy the best instrument for specific needs. Reduces chances of costly errors. Ideal reference book, it is an excellent source for the beginner, technician, the non-electrical engineering man, or general non-engineering scientific and technical personnel. 800 pages. Hardbound. **$29.50**

25. Operational Amplifiers-Design and Applications. *Burr-Brown Research Corp.* A comprehensive new work devoted entirely to every aspect of selection, use, and design of op amps—from basic theory to specific applications. Circuit design techniques including i.c. op amps. Applicatons cover linear and non-linear circuits, A/D conversion techniques, active filters, signal generation, modulation and demodulation. Complete test circuits and methods. 474 pages. **$18.95**

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31. Solid-State Electronics. *Hibbard.* A Basic Course for Engineers and Technicians. An extremely practical reference book for anyone who wants to acquire a good but general understanding of semiconductor principles. Features questions and answers, problems to solve. 1968. 169 pp. **$12.50**

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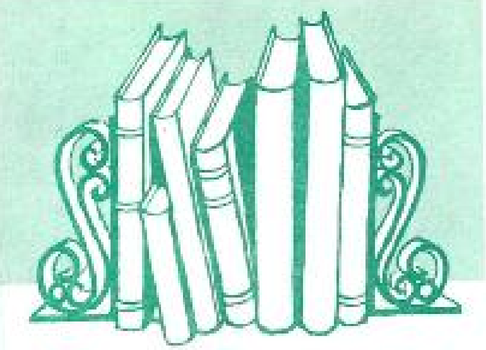

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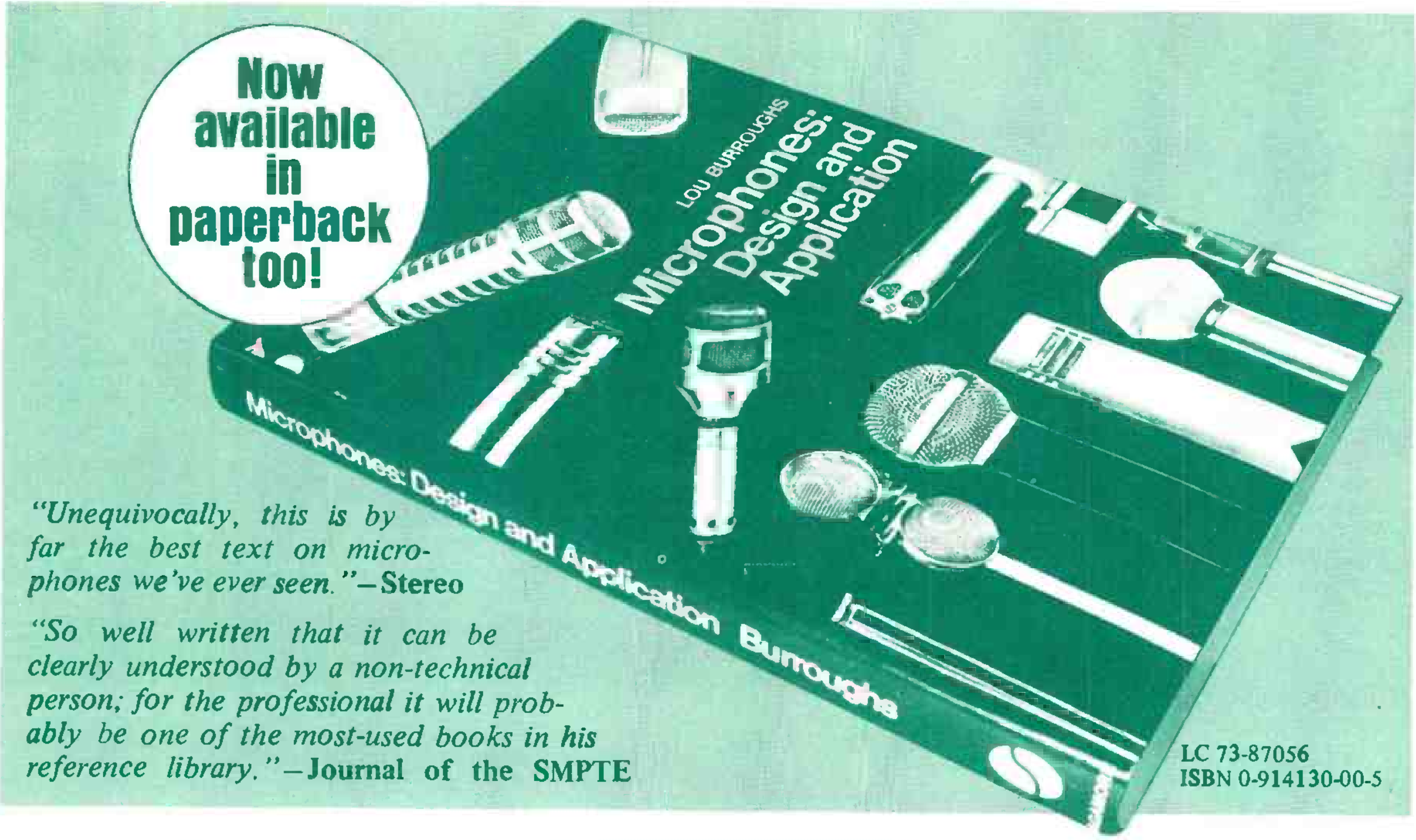

"Unequivocally, this is by far the best text on microphones we've ever seen."—**Stereo**

"So well written that it can be clearly understood by a non-technical person; for the professional it will probably be one of the most-used books in his reference library."—**Journal of the SMPTE**

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ISBN 0-914130-00-5

And the rave reviews go on and on. "At last...a decent book on microphones," said David Lane Josephson in *Audio*. "Excellent chapters on various aspects of microphones, which are discussed in great detail," said Werner Freitag in *The Journal of the AES*.

They're applauding **Microphones: Design and Application**, by Lou Burroughs, who has written this practical, non-theoretical reference manual for everyone involved in the application of microphones for tv, motion pictures, recording and sound reinforcement.

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"The chapter headings give a clear idea of the down-to-earth contents of the book...each chapter contains advice, direction, suggestions and warnings couched in the clearest and most unambiguous language possible." *(Journal of the SMPTE.)* Here are all 26 chapters.

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Microphone Overload
Proximity Effect
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Microphones Electrically Out of Phase
Microphone Interference
Acoustic Phase Cancellation and the Single Microphone
Microphone Maintenance (this chapter alone "is worth the price of the book" said D.F. Mikes in *Audiovisual Instruction*)
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coming next month

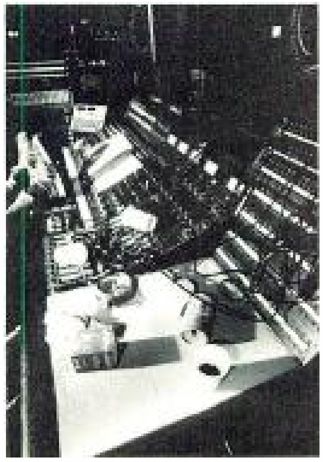
- Imagine an echoing racetrack stadium, resounding with crowd noises—and you want to announce the next race. How to get your p.a. system ABOVE THE ROAR OF THE CROWD is explained by Herbert Jaffe.

- An item for the workshop genius is contributed by Frederick E. Majewski as he describes the construction of an inexpensive tape synchronizer in THE UNIVERSAL TAPE SYNCHRONIZER.

- Walter G. Jung is back with Part III of THE SIGNAL PATH, this time discussing digital/analog leveling control.

- Our faithful columnists will be on hand. Patrick Finnegan tells about audio in the loop and Norman Crowhurst discusses crossovers.

about the cover



- A view at the Big Apple Studio in New York City after a hectic session.

db

THE SOUND ENGINEERING MAGAZINE

AUGUST 1976, VOLUME 10, NUMBER 8

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

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One of the family

The DO54 joins a distinguished family of E-V dynamic microphones. Including the very popular 635A, the extended-range RE55, and the low-noise RE50. The new DO54 shares many characteristics with our other omnidirectional mikes, but its differences can provide a very useful alternative.

The runt

First, the DO54 is slightly shorter and slimmer than a 635A. The first mike designed with the cable connector in mind. It's not tacked on. Looks great for handheld use, and it's easier to tuck away in odd corners.

Truly full-range

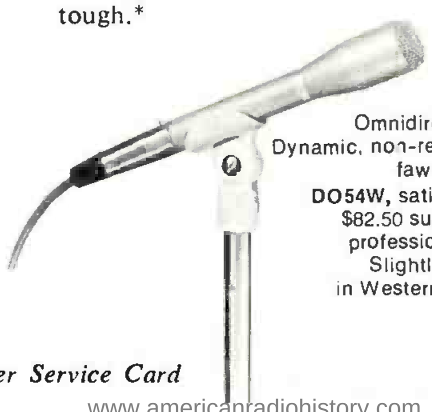
Despite the miniaturization, the DO54 boasts a response of 50 to 18,000 Hz ± 3 dB. Which rivals some very expensive competition and makes it ideal for demanding close-in instrumental pickups.

Full output

And the DO54 puts out. With level that matches the RE55, and a dynamic element that won't be overdriven by enthusiastic horns, drums, or close-up vocals.

Quietly reliable

Our internal shock protection stops handling and cable noise with the best of them. And our Acoustalloy® diaphragm is almost indestructible. The DO54 easily earns the same unconditional protection against malfunction as all our other Professional Microphones.
So its got to be tough.*



DO54
Omnidirectional Dynamic, non-reflecting fawn beige.
DO54W, satin white.
$82.50 suggested professional net.
Slightly higher in Western states.

Add-on Flexibility

Of course the DO54 fits our 3/4″ microphone options, like the security clamp (when you can't control access to the mike), a very neat stud mount adapter with switch, a most effective shock mount, and super Acoustifoam® windscreen.

In short (no pun intended) the DO54 is a versatile new omnidirectional dynamic in the best tradition of E-V. Dependably delivering great sound from a most modest package.

Get your toughest microphone problems in hand... with this new Electro-Voice DO54. Available now from your helpful E-V professional sound specialist.

*If your DO54 fails to function for any reason (cable, connectors, and finish excepted) within 2 years of purchase, send it back. We'll fix it free. And fast. And there's no time limit to replacement or repair of faults in workmanship and materials. That's our limited Professional Warranty in a nutshell.

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Circle 13 on Reader Service Card

db letters

THE EDITOR:

It was with great interest that I read Mr. Runstein's article, A VSO SWITCHING SYSTEM, in the May, 1976, issue.

The system he uses, along with the problems and precautions involved, remind me of a similar situation I found myself in a number of years ago.

When Audio Services at Western Michigan University was first started, in 1971, one of the first pieces of equipment requested by the producer, Eli Segal, was a variable speed unit. This was to be used for corrective dubbing, along with the possibility of using it for effects. Because of the limited usage, and small budgets, the then available commercial units at about $450, were excluded.

It was decided that I should design and build a suitable unit. The unit need only be capable of driving one capstan motor and for maximum flexibility, it was to be used on the three speed Crown-700 series, rather than the Scully 280's. The basic circuitry is shown in the drawing.

The oscillator covered a range of 45-75 Hz. It was felt this would provide a good range of control, while easily managed by a single control having a 270 arc. Limiting the range also provided a stable, constant signal. This variable signal was then fed to a power amp, with a 25 volt filament output transformer, operated backwards This allowed for a modest p.a. while providing a high degree of load regulation. Along with an output voltage control and meter, a frequency reading meter was used to accurately indicate the signal frequency. A "calibrate" momentary switch was also provided to check the frequency calibration, and to allow for a running check or line frequency so the tape deck could be synched to line speed while in the variable mode. The machine could then be returned to the power line, without the slightest notice.

Another note of interest; if all of the capstan wires are brought out to the switching system, it is possible to reverse the direction of the capstan motor, thus reversing the direction of tape movement, providing real time back timing, or creating effects.

JAMES R. BUCHANAN
Regional Educational Media Center
Mason, Michigan

THE EDITOR:

The cover of the June, 1976 issue of **db** was aesthetically satisfying. "About the Cover" said it was a psychedelic interpretation of a tape recorder reel. However, your engineer and scientist readers will recognize it as a photograph of a reel taken with polarized light. The picture is a classic example of *birefringence* ("bi-refrigence" or two indices of refraction). The colors shown are "1st Order." Yellow is observed, and violet (the complementary color) extinguished (absorbed) when the retardation is 4,000 angstroms. Red is observed and green extinguished when the retardation is 5,000 angstroms. Blue is observed, and orange extinguished, when the retardation is 6,500 angstroms. Green is observed, and red extinguished, when the retardation is 700 angstroms.

Concentration of stresses around holes, slots, and corners is clearly indicated. These are locked in during injection molding. This is evident in the cover photograph. Note the more symmetrical, parabolic-like stress pattern at 8 o'clock on the reel's hub, a result of not being opposed by a tape loading slot.

When I was involved in the manufacture of magnetic tape, I built a polariscope to observe just such stress patterns in reels from different suppliers. Those with the highest degree of built-in stress invariably had the greatest eventual warpage and caused scraping and other problems in tape recorders. Which brings me to a conclusion that is apparently not widespread—good mechanical engineering is an important part of tape hardware and, yes, software, design.

Again, your June cover was scientifically and aesthetically pleasing. But, science, engineering, mathematics and art are not really separable.

C. ALAN LINDQUIST, JR.
Product Manager
Recording Media Prods.
Pfizer Minerals, Pigments & Metals Div.
Easton, Pa.

THE EDITOR:

While I realize that you cannot possibly please everyone with your editorial policy, any more than I can program for everybody, I do feel that your otherwise fine magazine suffered a lapse of judgment in publishing the "Digital Clocks and Things" article by Robert Berglas in the May, 1976, issue. The article in question was skeletal at best, and left out much more about the subject than it included, such as chips that can drive directly and many more fine designs in clocks that can be supplied by some of your advertisers, such as ESE. Indeed, the market is much more vast than Mr. Berglas' cursory handling would indicate. This small complaint aside, we enjoy your publication and wish you the best of luck.

BRIAN R. FLORA
CHE Broadcasting Company
Albuquerque, New Mexico

THE EDITOR:

I have received excellent response to my letter about the problem with scraping reels on the Revox A77, recently published in your magazine. In addition to the letters you have printed, I've received some directly from very helpful readers of your magazine. I will continue to read **db** with enthusiasm.

R. DENNIS ALEXANDER
Radex Productions
Greencastle, Pa.

Copies of all issues of **db—The Sound Engineering Magazine** starting with the November 1967 issue are now available on 35 mm. microfilm. For further information or to place your order please write directly to: **University Microfilm, Inc.
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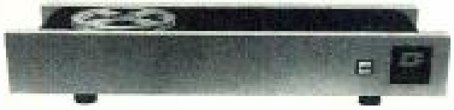

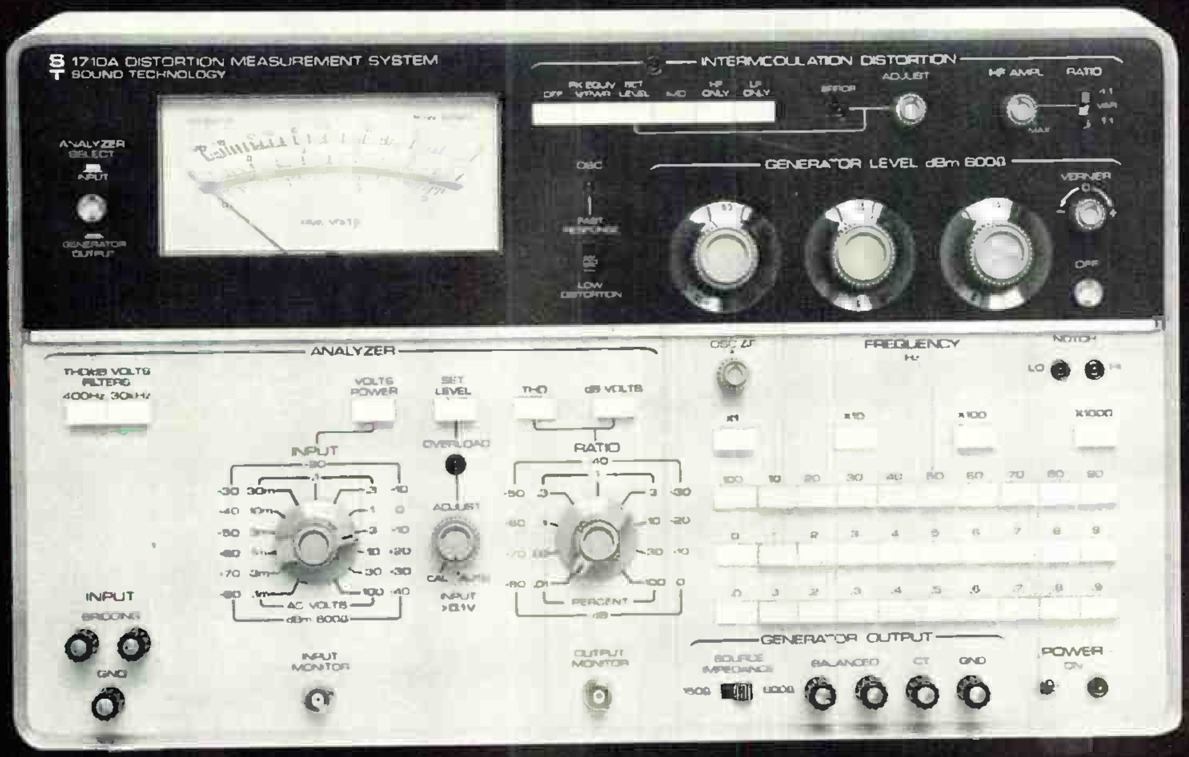

Your new automatic distortion measuring system for balanced measurements

REDUCED OPERATOR ERROR

Here's something you'll like — Sound Tech's new distortion measuring instrument for use in balanced work.

The new 1710A is much more than just a distortion analyzer. It's a system.

It contains its own ultra-low-distortion generator tracked with the analyzer. It's a system that greatly simplifies measuring — gives you fast measuring with simple operation that reduces operator error.

For example, push the frequency buttons and you set both generator and analyzer. Push "Distortion" and you have your reading. Automatically. No slow, tedious manual null-searching.

Features in the new 1710A include:

- **a balanced, floating output (600/150 ohms)**
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- **a high-level +26 dBm signal**
- **+26 to −90 dBm attenuator**
- **distortion measurements to .002%**
- **fast 5-second measuring speed**
- **automatic nulling, optional automatic set level.**
- **both harmonic and optional intermodulation distortion measurements.**

SPECIAL OUTPUT CIRCUIT

In the 1710A you get a transformerless audio generator output that's balanced and floating. No transformer means no transformer distortion. Floating *and* balanced means you can connect to virtually any audio circuit regardless of configuration. And you can set the output from +26 to −90 dBm in 0.1 dB steps.

FAST, SIMPLE MEASURING

Automatic nulling and the automatic set level option (ASL) give you extremely fast measuring and little chance for operator error. You can measure in 5 or 6 seconds. *With ASL you can measure distortion vs. frequency, and distortion vs. voltage or power without resetting level.*

IM OPTION

An additional optional bonus is that the 1710A also measures intermodulation distortion. After you've made a harmonic measurement, just push the "IMD" button. In 3 seconds you'll have the IM reading. With this option you'll be ready for future IM requirements.

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It's worth while getting the information on this major new distortion measuring system. Call Larry Maguire or Bob Andersen now and get our new product brochure. It's ready and waiting.

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FREE LITERATURE

BATTERY SELECTION CHART

This chart gives details about the four series of batteries produced by the manufacturer, including models, number of plates per cell, number of cells, amp-hour capacities, voltages, dimensions, weights, etc. Mfr: Globe-Union, Inc.

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VARIABLE SPEECH

Varispeech II, the cassette tape recorder which compresses and expands speech, aimed particularly at educational and other presentation situations, is described in a four-page brochure. Mfr: Lexicon, Inc.

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TITLING

Hints about creating good film titles, including lighting, typography, placing, and wording are contained in this leaflet entitled "Titling: The Neglected Art" Mfr: Motion Picture Laboratories, Inc.

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ELECTRONIC EQUIPMENT RENTAL

This rental catalog lists items from over 100 manufacturers available for short-term lease, including signal conditioners, analyzers, calculators, computer-related esuipment, oscilloscopes, recorders, and telecommunications test equipment. Mfr: Electro Rent Corp.

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TV-VTR FURNITURE

Storage cabinets and console tables for use with t.v. and v.t.r. equipment are described in a 12-page catalog. Mfr: Bretford Mfr. Co.

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SQ QUADRIPHONIC

"Spatial High Fidelity Through SQ Quadriphonic Recording and Broadcasting" is the title of a compact booklet explaining all about SQ decoders. Mfr: CBS Technology Center.

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ELECTRONIC HARDWARE

All the bits and pieces of hardware used in electronic equipment are listed in a 110-page catalog. The catalog includes a cross-reference to parts numbers from other manufacturers. Mfr: R. A. F. Electronic Hardware, Inc.

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COAXIAL CABLE SYSTEMS

The CATELEGRAM is a bulletin published periodically to inform those who work with CATV and CCTV systems of the news about equipment for coaxial communication systems, particularly the interface with broadband networks. Mfr: Catel.

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TRANSIENT VOLTAGE SUPPRESSION

"A Comparison Report of Trans-Zorb vs. Metal Oxide Varistors" is the title of an 8-page report on voltage suppression. The report contains comparative data and oscillograph-derived demonstrations of the dynamic performance parameters of devices under simulated transient conditions. Mfr: General Semiconductor Industries, Inc.

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NOISE ABSORBERS

Free hanging noise absorbers which combine the blocking characteristic of screens with the absorption of rising sound waves are discussed in this bulletin. Mfr: Industrial Noise Control, Inc.

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DIGITAL REAL TIME ANALYZER

A very detailed description of the applications of model 2131 digital one-third octave real time analyzer is supplied in this 16-page brochure. Mfr.: B. & K. Instruments, Inc.

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PROFESSIONAL MIXERS FROM INTERFACE

NEW SERIES 104 AND 108

Interface Electronics new Series 104 and 108 mixers now feature four or eight outputs respectively, each with corresponding echo output (optionally four or eight stereo submixes), plus four pre/post cue sends, large lighted inclined VU meters, monitor-only solo, preslider break-in jack, panpot, six-position gain trim switch with two input pad positions, phase reverse and phantom power switches (108 only), fully modular construction, black anodized cases, and many options, plus all the features of the proven Series 100 (which they will replace) such as several input module options, mainframes for up to 32 inputs, three frequency equalizers, long-life conductive plastic slider attenuators, low distortion (under 0.1% at 400 Hz, +3 VU) and noise, flat response, 20 db headroom, crosstalk below noise, plug-in integrated circuits, XLR input and output connectors, module outputs, and rugged, reliable construction. Options include output transformers for balanced +8 dbm output, mixdowns, talk slate module, foam-lined trunk or walnut furniture console, and more. The Stage Monitor version uses the Model 104L input module and makes eight completely independent mixes; color coded send pots each have pre/post equalizer switch and low frequency cutoff switch, and module includes six-position gain set trim, three frequency equalizers, and mute button; mainframes as above with up to 32 inputs and large lighted VU meters.

SPECIFICATIONS

Inputs: Microphone: max 5v. RMS, balanced 200 ohms XLR
Line: max 50 v. RMS, unbal. bridging phone plug
Outputs: Tracks: 600 ohm unbalanced +2 dbm XLR
(balanced +8 dbm with transformers)
others: 600 ohm unbal +2 dbm phone plug
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CALENDAR

AUGUST

24-25 **B&K Seminar: Community Noise.** Contact B&K Instruments, Inc. 5111 W. 164th St., Cleveland, Ohio 44142. (216) 267-4800.

SEPTEMBER

9-12 **Stereo '77.** Skyline Hotel, Toronto, Canada. Showing of hi-fi equipment, sponsored by AudioScene Canada Magazine. Contact: AudioScene, 481 University Ave., Toronto, M5W 1A7, Ontario, Canada. (416) 595-1811.

13-19 **International Audio Festival & Fair.** London, England. Contact: British Information Services, 845 Third Ave., New York, N.Y. 10022. (212) 752-8400.

20-24 **International Broadcasting Conference.** London, England. • Contact: British Information Services.

14-16 **Synergetic Audio Concepts Professional Audio Seminar.** St. Louis, Mo. Contact: Don Davis, Synergetic Audio Concepts, P.O. Box 1134, Tustin, Ca. 92680. (714) 838-2288.

28-30 **Synergetic training seminar.** New York City. (See above.)

13-16 **B&K Seminar, Human Acoustics.** Contact: B&K Instruments, Inc. 5111 W. 164th St., Cleveland, Ohio, 44142. (216) 267-4800.

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OCTOBER

1 **Society of Broadcast Engineers,** Chapter 22. Regional Convention and equipment show—open to all. Syracuse Hilton Inn, Syracuse, N.Y. Contact: Paul Barron, WCNY-TV/FM.

11-14 **B&K Seminar; Designing Quiet Products.** Contact: B&K Instruments, Inc., 5111 W. 164th St., Cleveland, Ohio, 44142. (215) 267-4800.

26-27 **B&K Seminar: Microphones & Accelerometers: Their Calibration and Use.** (See above.)

29-Nov. 1 **Audio Engineering Society Show.** New York City. Waldorf-Astoria. Contact: AES, Room 929, 60 E. 42nd St., New York, N.Y. 10017. (212) 661-8528.

26-29 **Microforum '76.** London, England. Contact: British Information Services, 845 Third Ave., New York, N.Y. 10022. (212) 752-8400.

NOVEMBER

2-6 **Dixie Electronics Reps. Conference,** Boca Raton, Fla. Contact: Dixie Electronics Reps., 1720 Peachtree Rd., Suite 322, Atlanta, Ga. 30309. (404) 872-5981.

7-8 **Convention, Society of Broadcast Engineers.** Holiday Inn, Hempstead, N.Y. Contact: Mark Schubin, Society of Broadcast Engineers, P.O. Box 607, Radio City Station, New York, N.Y. 10019. (212) 765-5100, ext. 317.

8-11 **B&K Seminar: Acoustical Materials & Structures: Design, Testing, and Applications.** Contact: B&K Instruments, 5111 W. 164th St., Cleveland, Ohio 44142. (216) 267-4800.

8-12 **National Automated Production Exhibition.** Manchester, England. Contact: British Information Services, 845 Third Ave., New York, N.Y. 10022. (212) 752-8400.

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db theory & practice

NORMAN H. CROWHURST

● Last month, we called attention to the fact that loudspeakers do not make very good resistors, as well as *vice versa.* In this connection, one thing that advocates of the horn type loudspeaker, with high-pressure drivers, emphasize, is its impedance characteristic, claiming that it is nearer to sounding like a resistor, at least over the loudspeaker's operative frequency range, than any other type of loudspeaker.

This raises the question of whether to (and how to) combine units of different loudspeaker types in a multiway system. The horn advocates would like to have only horn units, of different sizes. But when you think of getting down to 20 hertz, or even to 40 or 50 hertz, the horn seems rather big. If you've ever heard the enormous horn installed in the British Science Museum, or one like it, you'll know that the sound from such a unit is good. Very, very good, especially considering when that was built—back in what some people think were the dark ages.

But such big units are not practical. For stereo, you'd need three houses, one to live in, and one on either side, to house your loudspeakers. For quadriphonic, you'd need your own housing development! So even the horn advocates do not insist on straight horns, like the one in the Science Museum, but have their low frequency horns folded, which is never quite the same.

Even a folded low-frequency horn is a big brute. In the average listening room, you can get more convincing bass from a smaller box by using an infinite baffle, a vented reflex, or some modification of these, by one of the many names by which they are known.

I do not know what the electrical impedance of the horn at the Science Museum looks like, but I do know that any of the more complicated loudspeaker types in common use have electrical impedance characteristics that look pretty wild. When the unit is unmounted, the primary resonance of the unit reflects as an electrical resonant circuit, with a few minor kinks in it, due to secondary acoustic effects.

But when, to get more uniform response over a satisfactory frequency range, you mount the unit in its complicated enclosure, that impedance characteristic takes on a crazy shape, one for which you could never design a crossover! So what do you do?

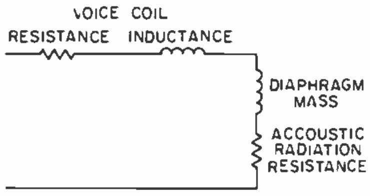

Figure 1. An equivalent circuit for a low frequency unit (woofer), taken at crossover frequency (ignoring elements whose effect is at lower frequencies).

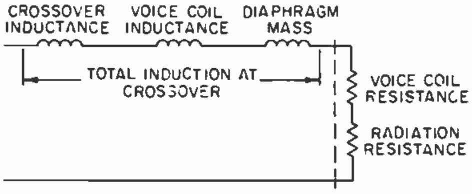

Figure 2. Rearrangement of Figure 1, to show how the inductive parts can be regarded as part of the total crossover inductance.

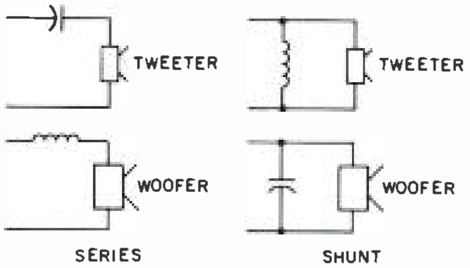

Figure 3. Possible configurations of the simplest crossover filters, using only one reactive element each.

CROSSOVER FILTERS

Any crossover is really a combination of a low-pass filter, to feed the woofer, with a high-pass filter, to feed the tweeter. If you go more than two-way, the intermediate units use band-pass sections. Now, until you get to crossover frequency, over the range of the woofer, all the filter does is to connect the loudspeaker's impedance, whatever it is, directly to the amplifier output.

And in the range of the tweeter, the high-pass filter merely connects the impedance of that unit, directly to the amplifier output. Where something different from that happens, is in the region where the Ls and Cs of the filter sections have some effect, which will be about an octave either side of crossover frequency.

As we have said, if the outputs of

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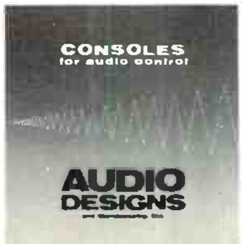

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two such filters, correctly designed for some working impedance, such as 16 ohms, are both loaded with precisely 16 ohms, a resistance of that value, then the impedance presented to the amplifier by their combined inputs, will be 16 ohms, at all frequencies—flat. Many of the difficulties we run into happen because loudspeaker impedances are not that simple.

That is not always easy to remember. We buy a unit specified as having a frequency response from here to there, and an impedance of so many ohms, and we tend to take that specification as gospel, assuming it has that impedance, like a fixed resistance, at all those frequencies. Even though we know it doesn't, it is not always easy to keep that fact in mind.

Those jiggles down at the low-frequency end of the woofer response, caused by struggles to maintain a uniform low-frequency response, are something we can do nothing about, unless it is to buy another loudspeaker. The network will just pass them straight on to the amplifier out-

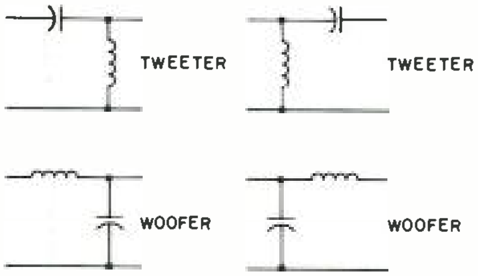

Figure 4. Possible configurations of two-reactance filters, also known as half-sections.

put. Where we are concerned is where we put the crossover frequency. We change over, from the woofer, to either a mid-range or tweeter unit, because the woofer can no longer hack it at those frequencies.

One reason the woofer cannot produce at those frequencies is reflected in its impedance response. The mass of the diaphragm, which gets harder to move as frequency goes up, reflects as an inductance. Additionally, the voice coil itself has an inductance, which limits the drive unit's efforts at trying to move the diaphragm at those frequencies.

So our woofer's impedance, as we approach crossover frequency, looks like a resistance, due partly to voice

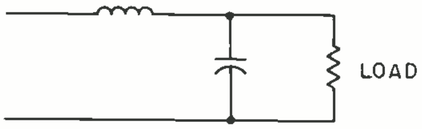

Figure 5. The filter section, for which variation in loading is discussed in detail.

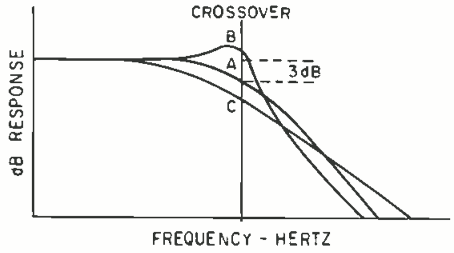

Figure 6. Variation in response described in the text: (A) with design value of load; (B) with value too high in resistance value; (C) with value too low in resistance value.

coil resistance, and partly to acoustic radiation (FIGURE 1) and an inductance, caused by a combination of voice coil inductance and diaphragm mass. The radiated sound is essentially due to part of that resistance value, at least in this range of the unit's response.

(continued)


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PASS RANGE

So one way to approach design of a good crossover is to regard the resistive part of the woofer's impedance as the crossover output, and the inductive part as part of the crossover (FIGURE 2). To do this, the output leg of the low-pass filter must be an inductance. We'll come back to what this means later.

As I have said, in the pass range, which means at low frequencies for the low-pass filter, and at high frequencies for the high pass filter, each just acts as a "straight through" connection, from its output, back onto the amplifier. Where something different happens is in frequencies within, say, an octave and, more especially, half an octave, of crossover frequency. Then what happens?

As I will describe more thoroughly as I get into details about crossovers, one way of delineating them is in terms of how many reactive elements—inductors and capacitors—each filter uses. Thus the simplest uses only one: an inductor in series, or a capacitor in shunt, with the low frequency unit and a capacitor in series, or an inductor in shunt, with the high frequency unit (FIGURE 3).

Assuming that the output loads, rather than having complex impedances, as loudspeakers do, consist of resistors, if the value is wrong, all that happens is changing the turnover point a little. What that does to the overall response, when combined with the other element of the crossover, I will discuss later, when I put it all together.

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The second-order filters are also known as *half-sections* (FIGURE 4).

At crossover frequency, they have a property similar to that of a half wavelength of critically-loaded line.

This means that terminating a half section with a resistance higher than the design value will reflect an impedance lower than design value, at that frequency, and *vice versa*. This is an important principle to keep firmly in mind in applying the behavior to the overall performance.

To illustrate one set of possibilities, consider a low-pass section, intended to feed a woofer, and for connection at its input in parallel with the high-pass section intended for the tweeter (FIGURE 5). Correctly loaded with the design load value, the response will be 3 dB down at crossover, and follow the curve A at FIGURE 6.

If a load of higher value, for example 24 ohms on a circuit designed for 16 ohms, is connected to its output, at crossover, the reflected load will be about 2/3 nominal, or about 10 ohms. This means it will take about 3 dB more from the amplifier at that frequency, resulting in a response with a peak, curve B in FIGURE 6.

Now, if the load is lower than nominal, say 8 ohms on a 16-ohm design, the reflected load will be more like 32 ohms at crossover, resulting in a loss at crossover. In thinking of this, remember that below crossover, in the pass range of the filter, the values are transferred directly.

Thus, making comparisons with the 16-ohm value for which the circuit is designed, when you use 24 ohms, in the pass range, 1½ times the resistance will absorb some 2 dB less of the power than 16 ohms would. But at crossover, 2/3 of the resistance will absorb about 2 dB more than the 16 ohms would.

When you use 8 ohms, in the pass range, half the proper resistance will absorb twice the power (3 dB more) at least until distortion sets in to limit it, as the 16-ohm load would. But at crossover, the reflected 32 ohms will absorb only half the power that the 16-ohm load would, resulting in a droop as the response goes through crossover.

That is just one instance covered with the various possibilities. Next time, I will put together the results of a number of different configurations, and particularly get into how to offset them when possible. ■

db broadcast sound

PATRICK S. FINNEGAN

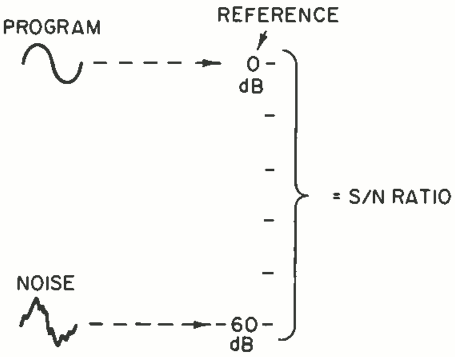

Figure 1. In broadcasting, noise is measured below program level and referenced to program level.

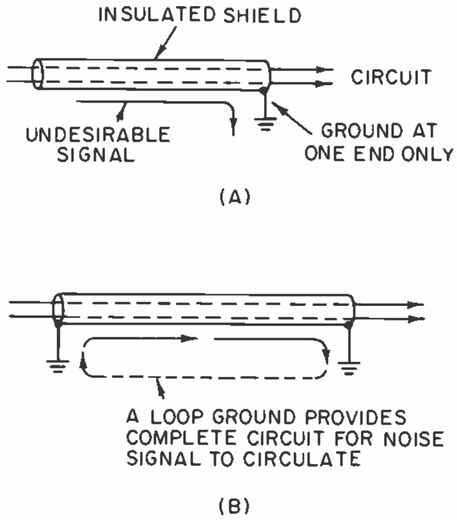

Figure 2. (A) The controlled shield ground has insulated shields that tie to common ground at only one point. (B) If both ends of the shield are grounded, undesirable loop grounds are formed.

• All electronic systems are afflicted with noise in one form or another, which can act as a limiting factor on the system's capabilities. The more noise-free a system can be made, the greater effort can be focused on fine tuning the desired functions of the system.

In this column, we will confine discussion to noise in the broadcast audio system. These factors are applicable to other systems as well, but the environment of the system must be taken into consideration. The environment will contribute to and shape the noise which can afflict a particular system.

NOISE

In a broad sense, noise can be defined as any unwanted signal or audio-producing voltage in the audio system. When there is a specific problem at hand, however, it is helpful to put a name tag on the specific type of noise present. For purposes of the article, the following name tags will be used:

White Noise: A broad spectrum of noise that extends from the audio band on up into the high rf ranges. When listening to this type of noise, it sounds to the hearer as though sand or buckshot were being poured rapidly and steadily on a tin roof.

Hum: This type of noise is self-explanatory. In general, it is related to power line frequencies or its multiples.

Crosstalk: Low amplitude crosstalk is considered a noise problem, while large amplitude amounts are considered interference. The low level type, creating unintelligible background to the program, is noise.

Other noise problems can be caused by feedback, oscillations and rf interference. In the audio system, one or more of the noise types may be present to some degree. Just how much can be tolerated and the predominant type will determine the usability of the system and the maintenance required.

IDENTIFICATION

When there is a noise problem in the system, the first thing to do is to try and identify as many of the elements that go into the problem as possible. This outlines the arena in which the troubleshooting must be done. When many facts are known about the problem, troubleshooting can take place in a logical manner. Identification of the type of noise can often point to the source, although not necessarily the particular cause at the time.

White Noise: This is generally caused by electron movement through the system's wiring and components. If there are impurities or defects in basic components, the noise can be aggravated. Resistors and capacitors are common offenders. Transistors, by their very nature, can be sources of noise.

Hum: One of its basic causes is a difference of potential between two circuits or to earth-ground reference. The a.c. power line is referenced to earth ground, as should the audio system. Radiation is another way in which hum can get into the system. This may be picked up from the field around power cables, power transformers, and other devices, such as the ballasts in fluorescent light fixtures. Of course, there is also the direct connection through power supplies.

Crosstalk: This is the coupling of the audio from one circuit to another, and in most cases, comes from intermixing cables of different signal levels. But it can also come from rf interference where the audio is demodulated and added to the program. In mixers or switches, a circuit may not shut off completely when switched or faded out and this can leak through as a background noise.

Oscillations: These can be caused by feedback or by equalizers. If a stage takes off into full oscillation, we don't think of it in terms of noise, but if the stage is sensitive or on the verge of oscillation, then audio peaks may trip it into brief bursts of spurious signals or parasitics. Excessive equalization can be a cause of this occurrence and the circuit may trip off at random according to certain frequencies in the audio. In addition, strong audio signals can "ring" equalizers by shock excitation and produce similar results. In most cases, the spurious signals will not be high enough in level to be identifiable or intelligible, but they will produce a low level background.

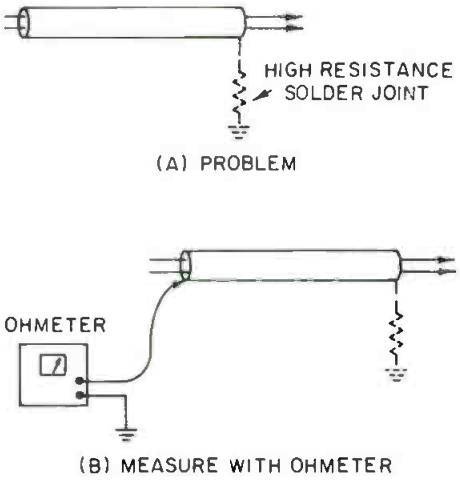

Figure 3. Check that the shield is properly grounded with a zero resistance joint. An ohmmeter will determine if a high resistance connection or open shield is the problem.

MEASURING NOISE

Listening tests can often detect when large amounts of undesirable noise are present in the system.

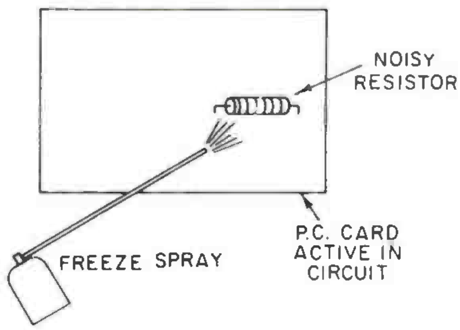

Figure 4. If heating of a component causes noise in the program to increase, use one of the freeze sprays to find the culprit.

Lesser amounts of noise, however, may not be identifiable in this way, and the noise in the program may be "felt" rather than heard. That is, the listener may not detect the noise, but after awhile, it gets on his nerves.

The best way to measure noise in the system is with a noise meter. This is a sensitive, broadband audio voltmeter. Many of these instruments also provide an output for oscilloscope viewing of the noise being measured. This output is driven by an internal amplifier to raise the measured level to a range the 'scope can handle. When there is any question of identification, the 'scope should be used in this manner to determine what the predominant noise factor is in the problem.

Since noise can be a limiting factor to a system's capabilities, noise is always considered in relationship to the audio level being measured at that point in the system. This relationship is termed the *signal-to-noise ratio* (s/n). In broadcast work, noise is referenced to the program audio and is measured *below* the program reference. Some other industries measure noise differently; for example, the Telephone Company measures noise *above* a fixed, very low level reference point.

To make a measurement then, feed sine wave tone from a signal generator to the system or amplifier input. The noise meter is calibrated with this tone at the point in the system to be measured. The signal generator is then removed and the system input terminated with a resistor equal to the input impedance of the system. The noise meter then measures the noise as so many dB's below that reference point. The measured noise level to the calibrating signal level is the signal-to-noise ratio at that point in the system.

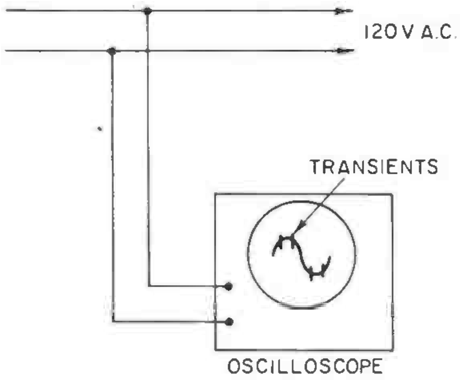

Figure 5. Check the a.c. power circuit leaky lighting arresters on the high line primaries or by heavy motors in the building.

SHIELDING

The best defense against a variety of noise problems is a good tight shield system. If this is a new installation, careful attention should be paid to the shielding system. Even on a temporary basis, care must be exercised or the shielding (or lack of it) can introduce noise problems.

The *Controlled Shield* system is an effective method often used. This works best with a balanced audio system. That is, both audio wires of the circuit are above ground. The shields of various cables are insulated from each other and a connection is made to a common ground at only one end of each cable. Any signal picked up on the shield is carried to ground since there is no complete circuit for it to circulate. If both ends of a cable are connected to ground, then there is a complete path and a *loop ground* is formed. This must be prevented.

It should be pointed out that no shield system is 100 per cent effective because there are many ways for noise or other interfering signals to gain entry to the program circuits. But a good shield system will keep a large number of the unwanted signals out.

SOME TECHNIQUES

Open Shields: When a problem has been determined to be in a particular part of the system or in a particular cable, check out the shields on the cable. First, note if both ends have been tied to ground, allowing a loop ground situation. The reason there may have been no problem before may be due to the fact there was no strong noise signal present, but there is now, and the shield is not effective. If only one end is tied down, note if the connection is actually in place—

it may have come off. Go to the other end of the cable where the shield is ungrounded and measure with an ohmmeter to common ground. There should be a dead short. If it is open or indicates a high resistance, the shield is open or there is a high resistance solder joint.

Balanced to unbalanced: When these two system are connected together, there can be hum problems. The unbalancing need not apply to an entire system, but may be in a single unit, such as a tape recorder. With one side of the unbalanced circuit at chassis ground, there may be a difference of potential between the two circuits and hum will ensue. An audio isolation transformer will almost always solve this problem when inserted between the two circuits. If the arrangement is to be permanent, then wire in the transformer permanently.

Noisy Components: Resistors or capacitors with impurities or faults may become very noisy after the circuit and component heats up. Finding the culprit is not always an easy matter. Try tapping on individual components on the card or chassis on which the suspected component is situated. The jar from the tapping will often agitate the situation and stir up the noise. In other situations, try one of the freeze sprays with a long narrow nozzle that will apply the spray only to the individual component. In some cases, the noise will disappear almost immediately—but only temporarily, and it will return as soon as the defective component heats up again.

Transients These can be carried in on the power lines. One source may be with leaking lightning arresters on the hi-line primaries. If this is suspected, then observe the a.c. power line with an oscilloscope. The transient noise may appear to be 120 Hz, but it is probably coming from the 60 Hz line and not from power supplies. As a temporary measure, use line filters to the sensitive amplifiers, but call in the power company to correct the problem.

Transients: These can be carried on the a.c. power line in a building from heavy motors in an air conditioner, transmitter etc. If the air conditioner is suspected, it can be turned off temporarily. Should that be the source, then try filters at the unit itself.

D.C. Control Circuits: Both transients and hum signals can be carried on d.c. buses. Because they are d.c., we may tend to overlook them. But power supplies for relays may not be well filtered and can carry a high ripple voltage. Transients from the coils or arching contacts on the relays can also be a source. ■

MARTIN DICKSTEIN

• In past months, this corner has touched on the subject of the importance of various phases of audio-visual presentations and the equipment used. The professional in the a/v field, who has set up and torn down many setups of different kinds under some of the worst circumstances imaginable, already has gained the knowledge and experience that shows itself every time he has another job to do. But how did he gain this experience? He made mistakes when he started, just like any novice or relatively inexperienced person in any work. Aldous Huxley put it wisely when he said that experience is not what happens to a man, but what he does with what happens to him. Perhaps some new ideas of what to watch for might strike even a fairly experienced a/v man or woman.

THE ROOM

First, let's take a look at the room itself. You've been asked to set up a room for a sales meeting, and to arrange for the needed equipment for the presentations. You know how many people are expected to attend, that the meetings will take place on three successive days, and you are given a run-down on what will be done at the meetings. (No dancing girls—just straight business.) The best thing you can do, for your own sake as well as your client's, is to take a look at the meeting room. Sometimes —or usually—the same room is not used for all three days, and so there are the problems of security, moving the equipment from one room to another, etc.

Be sure to call ahead and make an appointment for a time when the room is not in use. It is very difficult to look at the room's inside from the outside. Peeking in the door is never enough. Get dimensions from someone (not just a rough "about . . .") or pace off the room, figuring about a yard to a step. This will get you a better estimate than you might get from someone's imagination. If you can get floor plans of the room (or rooms), usually available from conference centers or hotels, you may not even feel that you have to make a sketch. If such plans are not available, you should at least make notes. Are there pillars? How about chandeliers? (Any obstructions at all will make projection a problem.) Can the windows be darkened?

PROJECTION

Does the room have projection facilities at all? If there is no rear screen built in, is there a ceiling-mounted pull-down screen? These usually are located toward one side and in the center of the room, immediately limiting the seating arrangement. Do not be hesitant to ask how the tables will be set up, if there is to be food served at those tables, if there have been any instructions given for a dais or head table or for a podium (with or without a microphone). The people at the hotel responsible for setting up the room may seem to feel that since they have always done it in a certain manner, this must be the best possible way. They probably don't realize that there will be a presentation with projection because they have not been told. Tell them! A small rearrangement might solve your problems very simply.

Perhaps the dais table can't be moved, but the lectern doesn't have to be dead center where it will block the screen. It could be put a short distance off the middle or even toward a corner so the screen is clear. Maybe you don't have to use the built-in screen and can do better with your own portable setup. Be sure, however, that the person speaking from the rostrum, if one is to be used, can see the screen when slides are shown. Most speakers either read from the slides or make reference to them.

TABLE ARRANGING

If you can have any say in the arrangement of the tables for the audience, think in terms of sight lines toward the screen and the speaker, and the location of the screen and projection equipment. If round tables are used, for a luncheon meeting, for example, some of the people will just have to turn around or shift their seats during the presentation. Try to locate the screen (and the lectern somewhere near it) so that as few people as possible will have to move. This might mean putting the screen behind the dais, off to one side, across the corner of the room, or even on a side wall. If the screen and lectern are not near each other, be sure the speaker can read the slides easily without contortions and without turning away from the microphone too much.

Should you find out that there will be no food served and that rectangular tables will be used, there are several arrangements possible. Depending on the number of people attending, the tables might be set up parallel to the front wall (classroom style). You might even have a choice of which wall to face, depending on projection requirements and windows, doors, lights, etc. Using this setup, you should determine whether a center aisle might be needed to clear heads with front projection slides or film. Will there be a table provided to raise the projectors high enough to go over the audience or will you have to bring your own?

Another arrangement possible with rectangular tables is V-shape classroom style, with tables set angled toward the center of the room. This will permit a nice center aisle and will leave plenty room at the front to clear the screen. The lectern can be placed slightly to the side and still get good eye contact with the audience.

Sometimes there is one table arranged down the center of the room, formal board room style. Try to determine just how far the length of the table will extend and how much room is left to set up the equipment. Here, too, the screen is usually in the center of the front wall so everyone can see easily without turning around. Shooting the image down the middle of the table is pretty easy, of course, if there is enough room for the projection table or if you can set up on the conference table itself, and if none of the people at the meeting will be sitting either at the head or foot of the table. With a lectern at the side, just a bit off center, will the presenter be able to see the screen in case he will have to point to it during the presentation? Will a corner screen work better? Some things to think about, anyway.

PROJECTION EQUIPMENT

Once you have sketched out the locations of tables, the dais, the lectern, and the screen, check the resulting position of the projection equipment. Try to put the equipment near a wall, in a corner, or in an open space where people will not knock it over as they mill around with drinks or coffee during a break or on their way to the tables. An open location with enough room to get around easily is not too bad, but don't leave any loose cables or equipment lying or hanging about to catch or trip the less careful millers. (Be sure you tape down all cable runs in the open, or tuck the wires under the carpeting.)

Your projectors should be as directly in front of the screen as possible to avoid keystone images (one side longer or wider than its opposite side). A few degrees off center can be tolerated, and sometimes putting the screen in a corner of the room can help because it can be seen easily by all viewers even if the image is cheated slightly in regard to proportion. With the screen in the center of the wall, it is difficult to locate the projectors anywhere but in the center of the opposite wall or space. No written or unwritten law makes a center screen a must.

In the event the size of the room and the number of attendees requires that the seating be arranged in auditorium style (all seats facing front with no tables) check to see how far forward and how far back the seats will go. Leave enough room for the screen if there is to be a portable setup with the projection equipment at the rear. Here again, shooting across a diagonal might help to provide more room at the front for the lectern or a small table for the speaker or speakers. If the projection is straight down the middle, leave enough room at the front to avoid hitting tall heads in the first two rows. If there is an aisle down the center, maybe leaving out the first one or two of the seats in the front rows might be enough. If there is no center aisle, think in terms of a semi-circular arrangement of the seats. This creates a little space at the front center and could make the difference in projection. It is a bit embarrassing to have to tell the tall man in the center to crouch low or move just because his head is blocking the bottom lines of the slide copy.

LIGHT CONTROLS

Other things to look for are the light controls. If they are located in a place where the projectors might logically be placed, the projectionist might easily be able to reach them a moment before starting the film, for example. If not, indicate in the sketch where the controls are, and what they are. Are there dimmers, or on/off only switches? Try them. Can the lights just above or near the screen be turned off completely and, if so, what other lights go out at the same time?

It is not wise to put the room into total darkness during a presentation, because the speaker should have eye contact with the audience (to see reactions or if anyone is going to sleep) and wants to be seen by them. A light on the lectern is assumed if the room is to be in semi-darkness so the speaker can read his speech or notes during the presentation, but this light is not enough to show up the person at the lectern very much

sound with images (cont.)

or to help him see the people in the room. Some light should also be available for the audience to make notes. This consideration for the speaker and audience is also a bit selfish for the projectionist. A little light helps to see notes, scripts, whether the film is cued properly, and spare parts in emergencies, if nothing else. A semi-dark room is also easier on the eyes of all concerned for projection of slides, and most times, of films, too. The sharp contrast between a bright screen and a dark room is taxing for a long period of time.

DIMMERS

Sometimes, in hotels especially, the dimmers are tucked away very carefully on a wall (in a closet or exposed) in the kitchen or service room across the hall. Check the settings and mark them for the proper dimness so the person adjusting them during the presentation will have no problems locating the correct settings. Actually try them out. Some dimmers don't work the way you might expect them to. They might be crudded up and go off completely at a very unexpected point just half way around. Surprise? Not if you find out way ahead of time. Mark down the location of critical controls and even settings. Make a note to preset any lights you can before the meeting gets under way so you will have less to think about at zero moment.

Also, you might now start to think whether the lights will have to be adjusted or changed during the presentation. Will anyone be using charts? Will there be a period during which the speakers will be talking without using audio-visuals? How much time between light changes? If the lights stay in semi-dark position, can the speaker be seen well enough to make light changes unnecessary? Is the period of full lighting so short that a quick light change might be too disturbing for the people? Will the projectionist have time to go back and forth to the light controls and still be able to start films on time? Is the seating such that it is just about impossible for the projectionist to maneuver at all? Arrangements as simple as these are sometimes overlooked until too late, and the day of the meeting, after the room is all set up and ready to go, is too late.

A.C. OUTLETS

You should also check for a.c. outlets. How far are they from the equipment? How can you run cables to the wall receptacles without too much trouble; how will you make sure the receptacles are not on a switch in an electrical closet; how to insert a three-prong plug into a two-prong receptacle—and so on. All these are considerations that make it essential to check the room out before the day of the meeting. This does not even include the equipment to be used. Will there be a screen available, a tape recorder, a slide projector, a film projector, an overhead projector, etc?

All I've mentioned so far has been checking out the room, well in advance, and making notes and sketches to take back to the client. He will appreciate knowing how the room will be set up and what to expect for the presentation. Then, you must find out what equipment for which can you expect to be responsible. What will be the order of the presentation? Light cues, scripts, etc? What time is the meeting? If it is early morning, you might check to see if the room is available the preceding afternoon for setup. Check overnight security. Maybe you can get the equipment into the site the previous afternoon where it can be stored safely until morning if the room is not available for setup. If the meeting is in the afternoon—after lunch, for instance—how much time will you have and how long do you anticipate taking? Will you need help setting up in the allotted time? How about break-down and carry-out time?

All of these questions and answers come almost instinctively to the experienced a/v person, but they are learned by the inexperienced in part beforehand by helping others or being around when shows or presentations are put up and torn down, and by making mistakes. Learning from mistakes is invaluable experience. But Cicero said that stumbling twice against the same stone is a proverbial disgrace.

In future columns, the subject of presentation equipment will be discussed. Do-and-don't type of information will be introduced. You can be of help. If you have any advice to offer our readers, or experiences you learned the hard (or easy) way, we'd appreciate hearing from you. ■

Long echo delays, short variable delays, double voicing, short slap-back echoes, hard reverberation, flanging, true vibrato, FM modulation. All this in the MXR digital delay system. Who else could do it?

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db new products&services

INNOVATIVE RECORDER

● Several features make news in the ATR-100 tape recorder, designed especially for the production of disc masters and for the use of automated radio stations. The recorder uses a closed loop servo system which maintains constant tape tension at each reel in all operating modes, eliminating the need for pinch rollers; the reels control the motion of the tape. Built-in computer logic controls the movement of the tape by adjusting the tape tension so that it is equal on each side of the capstan. It senses the motion of the capstan, in what direction it is moving, and recognizes the size of the heads and width of the tape, then automatically adjusts the tension accordingly. A matrix-type control panel about the size of a pocket calculator, installed either on the left or right, contains all operating buttons. 14-inch reels provide continuous play time of six hours at 3¾ in/sec. Other features are PURC (pick up recording capability), electronic tape timer, editing knob which permits the operator to manually move the tape to a desired edit point, and ferrite heads. The ATR-100 operates at speeds of 3¾, 7½, 15, and 30 in./sec. of which a combination of any two speeds, not necessarily adjacent, can be selected at one time.
Mfr: Ampex Corp.
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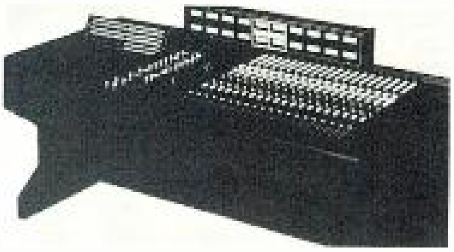
INTERCOM STATION

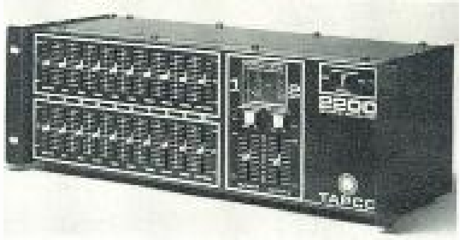
● Permanently mounted intercom station, designated King Biscuit KB-110, is designed for paging situations when a headset is not necessary. The speaker/mute switch will disconnect the speaker in the device to allow for private conversation with the handset only. Signalling is initiated by the illuminated speaker/mute switch. The weatherproof 4-in. speaker and handset are driven by a 2-watt amplifier. Maximum output in the handset is greater than 113 dB.
Mfr: Clear-Com (Lumiere)
Price: $154.00
Circle 51 on Reader Service Card

PROFESSIONAL RECORDING CONSOLE



● Modular, solid-state QA-3000 console may be outfitted with as few as 8 input and 8 output busses, or up to 40-in by 16-out, all with quad mixdown. The console is equipped with four echo busses, quad mix with panning, monitor mixing, cue and solo, talkback, phantom power, 8-frequency/4-knob equalization, high and low cutoff filters, mic pad and level trim, true vu meters, and conductive plastic faders. Options include joystick quad panners, combination patch bay / producer's desk, double-sized housing and mounting pedestals.
Mfr: Quantum Audio Labs, Inc.
Circle 52 on Reader Service Card

GRAPHIC EQUALIZER

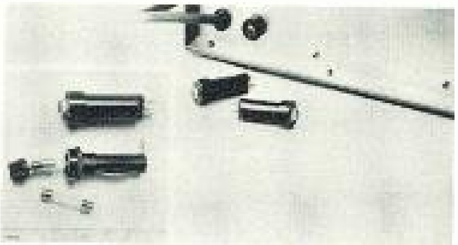


● Built-in line drivers allow model 2200 graphic equalizer to be interfaced directly with hi-fi equipment and low level mixing systems. The unit's balanced and single-ended inputs and outputs can be used in any combination, in place of transformers. Separate e.q. in/out switches allow each channel of the equalizer to be programmed independently: the vu meters can be set for any reference level with the calibration controls. Two independent channels have ten equalization bands, each controlling one octave of the audio spectrum with 15 dB of boost and cut.
Mfr: TAPCO
Price: $289.
Circle 53 on Reader Service Card

THREE-WAY SPEAKER

● A 10-inch acoustic suspension woofer is incorporated in the AR-12 speaker system. The unit has a 2¼-inch cone midrange and ¾-inch hemispherical dome high range which make use of magnetic fluid to center and suspend their voice coils in the magnetic gap, a process that is claimed to improve the efficiency of heat dissipation. In mid-range, a 1-inch voice coil is combined with a 2¼-inch cone. A pair of 3-position switches adjusts the level of drivers to suit various rooms.
Mfr: Teledyne Acoustic Research
Price: $225.
Circle 54 on Reader Service Card

PUSHBUTTON CIRCUIT PROTECTOR



● Resettable circuit breaker Re-Cirk-It® is the same size and costs about the same as a fuse. The protector trips after a suitable delay on sustained overloads and instantaneously on short circuits, is reset with a push-button action. The protector trips only on electrical overcurrent conditions, and has a time delay to prevent nuisance tripping. It cannot be turned off manually by accident. Re-Cirk-It is available in current ratings from 3 through 20A at 120V a.c. or 32V d.c.
Mfr: Heinemann Electric Co.
Circle 55 on Reader Service Card

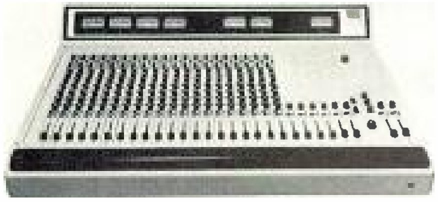
DUAL MIC MIXERS

● Portable dual mic mixer DML-2 has individual limiting/compression, with an internal tone generator for line level set, internal battery and/or optional a.c. supply, phone monitor/talkback function and XLR mic and output connectors. Response is from 20 Hz to 20 kHz ± 1 dB; claimed distortion 0.1 per cent; 90 dB gain max; balanced inputs and 600 ohm balanced outputs; 10 dBm output level; 1.5 microsec. attack time and s/n ratio of −26 dB.
Mfr: Ramko Research
Price: $225-$249
Circle 56 on Reader Service Card

T.V. AUDIO CONSOLE KIT

● A variety of portable consoles may be assembled through the use of model 210 microphone input panels. The configuration shown, using two panels, includes a 16-input/4-output t.v. production console, incorporating a test oscillator, slate mic and boom, p.a., and auxiliary feeds. Pushbuttons and meter are lighted.
Mfr: Opamp Labs, Inc.
Price: 1604 TVK kit: $4,700.
1604 TVW (wired): $7,500.
Circle 57 on Reader Service Card

MODULAR AUDIO CONSOLES

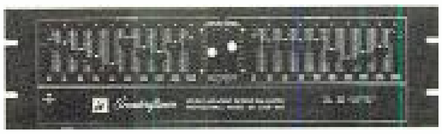


● Four chassis/enclosure modular sizes are available in series 20A consoles, including 2½ ft. with 21 positions, 4 ft. with 31, 5 ft. with 39, and 6 ft. with 47 positions. The operator may plug modules into any position. With emphasis on real-time operation, the following features are offered. Interstage patch points are mounted at the top of input and submaster modules for easy identification. Preset "on" selection on input modules allows sources to be activated in predetermined groups. A variable microphone preamplifier provides control of signal overdrive conditions with live mics. Peak indicators flash to adjust mic sensitivity. Modules included are input, submaster, pan submaster, and master. In addition, a pre-set distribution system module controls the outputs of the console where required. This makes it possible to rehearse, preset, and perfect the mood, movement and space relationships of signals.
Mfr: Cetec
Circle 58 on Reader Service Card

BROADCAST CARTRIDGE TAPE MACHINES

● Audio cartridge tape reproducers and recorders in this new series feature a patented pancake hysteresis synchronous direct drive motor. Two basic models are available, each in mono or stereo, record or playback. for either desk or rack mounting. Type 10 is used for A-size cartridges; type 20 can be used for processing A, B, and C-size cartridges. Units may be stacked one above the other in different configurations.
Mfr: Beaucart, UMC Electronics
Circle 59 on Reader Service Card

RECORDING/PLAYBACK EQUALIZER



● Zero-gain equalization monitoring is featured on model SG2205-600 equalizer. The unit contains led input/output level monitoring; 10 octave ranges with ± 12 dB control per octave; toroidal and ferrite-core inductors; solderless wire wrap connections. Frequency-spectrum-level zero gain controls forleft and right channels provide a continuously variable 18 dB range for unity gain compensation from −12 dB to +6 dB.
Mfr: Soundcraftsmen
Price: $399.
Circle 60 on Reader Service Card

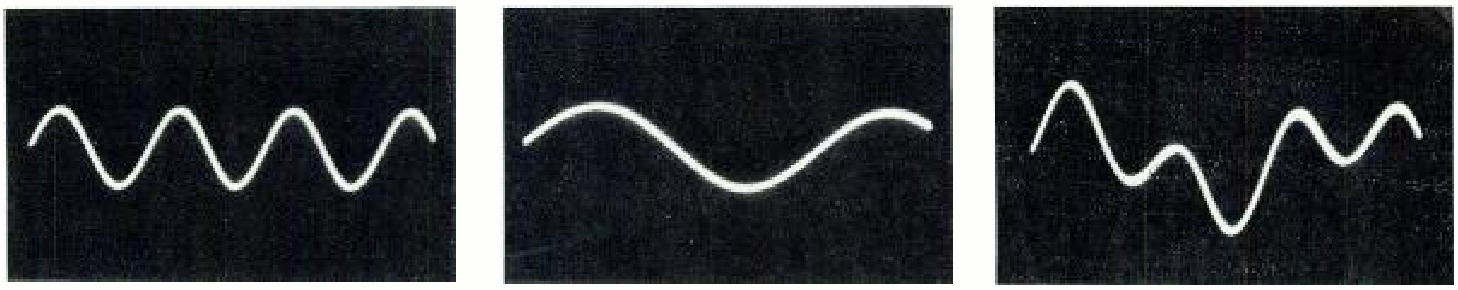


Figure 1a. Actual oscillograms of synchronized sine wave addition.

DON DAVIS

Biamplification Why and How

Agreed: biamplification decreases distortion. Here are the formulae for achieving correct balance in your system.

Among well-trained and experienced professionals in the audio industry there is no disagreement about biamplification versus a single amplifier when the question is phrased, "Which sounds better?" They all agree that the biamplified system sounds much better. It has *much* lower audible distortion.

When you ask the question in a slightly different way, such as, "Why is biamplification better?" good friends will sometimes fight over often obscure theoretical virtues of these basic audio systems.

IS THERE SOMETHING FOR NOTHING?

It's surprising that this question should even get a split second of attention from an engineer, yet many articles in the audio publications have presented biamplification as magically providing more power from the same watts. If this were indeed true, it would be audio's greatest contribution to the energy shortage. The law of the consumption of energy is, however, still in force.

Let's have a look at how this particular myth got started. An overeager biamp proponent posed the following problem in a publication: Take two sine wave signals. One is an octave above the crossover frequency and one is an octave below the crossover frequency. He gives each signal a value of 10V rms into 10Ω and proceeds to calculate

$$10 \times \sqrt{2} = \text{peak voltage}$$

Total peak voltage = peak voltage No. 1 + peak voltage No. 2. (See Figure 1.) And then find the peak power as

$$\text{Peak power} = \frac{(\text{total peak voltage})^2}{100\Omega}$$

Which in this case equals

$$\text{Total peak power} = \frac{(10\sqrt{2} + 10\sqrt{2})^2}{10\Omega} = 80 \text{ peak watts.}$$

(See Figure 2.)

In order to support 80 peak watts, it would require an amplifier capable of 40 *average watts* (often misnamed rms watts).

Our biamp proponent now takes two amplifiers, putting one of the sine wave signals in one and the other in the second amplifier. The first amplifier has a peak power requirement of

$$\text{Peak power} = \frac{(10\sqrt{2})^2}{10} = 20 \text{ peak watts}$$

Since two amplifiers are needed, the total peak power is 40 watts.

Isn't that wonderful—just by biamping we get the same performance out of half the power. Wonderful, if true, but it isn't true for at least two reasons. Since we are, in this special case proposed, using sine waves, he could have the embarrassment of having a *single* high level sine

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Don Davis, president of Synergetic Audio Concepts of Tustin, California, conducts audio seminars.

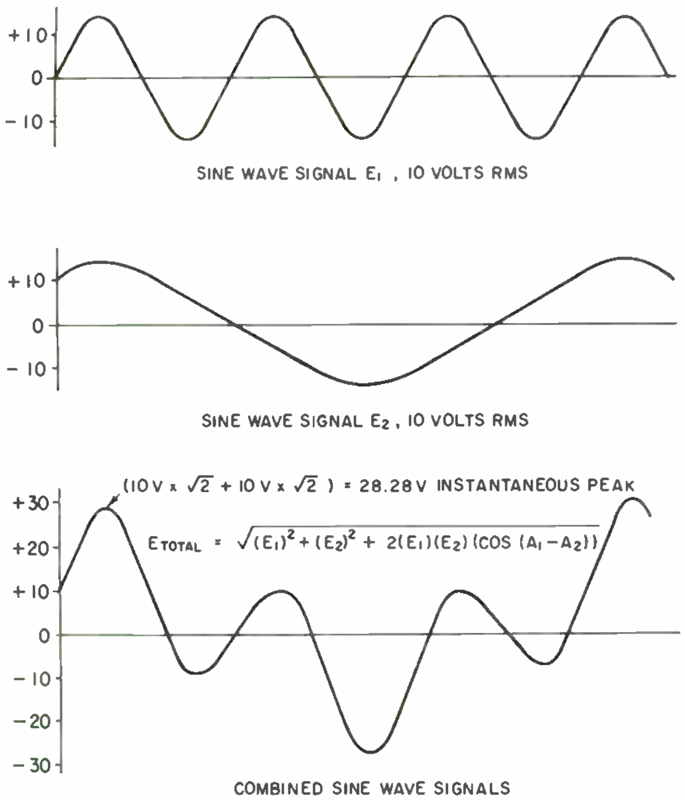

Figure 1b. Combining voltages.

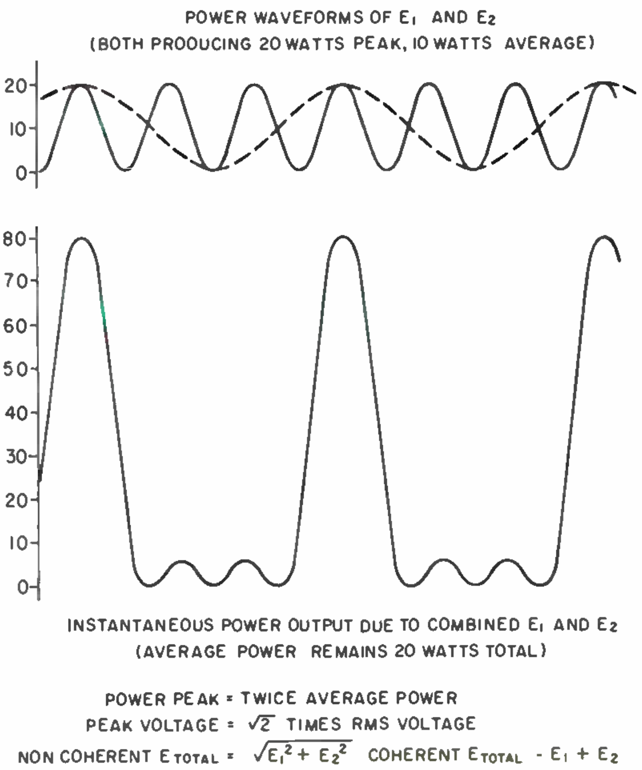

Figure 2. Calculating instantaneous peak power.

wave signal. This would place the biamplfied system at a 6.02 dB *disadvantage.*

$$10 \log \frac{80 \text{ watts}}{20 \text{ watts}} = 6.02 \text{ dB}$$

The second reason however, is the more important. Speech, music and other natural sounds *are not sine waves.* They are complex waveforms. This means they do not add together coherently, as our biamp salesman assumed from watching his sine waves on the oscilloscope. Instead, these real signals have added together in the following manner:

$$\text{Total V} = \sqrt{(10\text{V})^2 + 10\text{V}^2} = 14.14 \text{ volts rms}$$

$$\text{Average power} = \frac{(14.14\text{V rms})^2}{10} = 20 \text{ watts}$$

Therefore, the peak wattage is 40 watts.

Going to the biamplified system, we find that

$$\frac{(10)^2}{10} = 10 \text{ watts}$$

Since there are two amplifiers needed, 20 watts average power or 40 watts peak is required. In this real case, the disadvantage suffered by the biamplifier system should a single sine wave appear is only 3.01 dB

$$10 \log \frac{20 \text{ watts}}{10 \text{ watts}} = 3.01 \text{ dB}$$

Ideally, each amplifier in a biamped system should have the same power as that assigned to a single amplifier system.

Okay, so more power for single amplifier systems is true only for the "Unity Amplitude and Phase Sine Wave Sonata" lovers. Others mutter mysteriously about "network losses," matching (what is usually not specified), iron cores, etc. Let our answer be simple. Passive loudspeaker networks of advanced design contain no more problems than will be introduced in biamped networks.

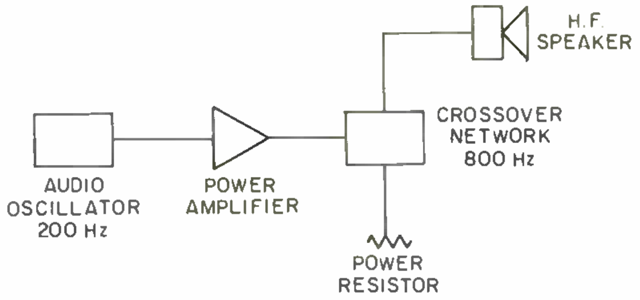

Figure 3. This is a demonstration of the high frequency transient distortion that is developed when the amplifier overloads at a frequency well below the crossover frequency.

WHY THE "SMART MONEY" BIAMPS

Looking at FIGURE 3, we see an oscillator overdriving into square waves a single amplifier at a frequency well below the crossover frequency. Instead of the woofer, a large power resistor of the same value is attached to the crossover network. A graph of the sound coming out of the high frequency unit looks like the oscillogram depicted in FIGURE 4 and is the result of the harmonics generated when the amplifier squared off. It is this gross transient distortion that so annoys any critical listener when a sound system is operating near its full power capabilities.

It should be remembered that the normal energy content of program material (speech, music and sound effects) calls for more power at low frequencies than it does at high frequencies. This distortion is much more common than realized. It is also sobering to remember that it's never measured or specified. So, while manufacturers scrape for 0.001 per cent of something you can't hear, you are left to listen to 25-40 per cent transient distortion.

Once you have made this test on your own music sys-

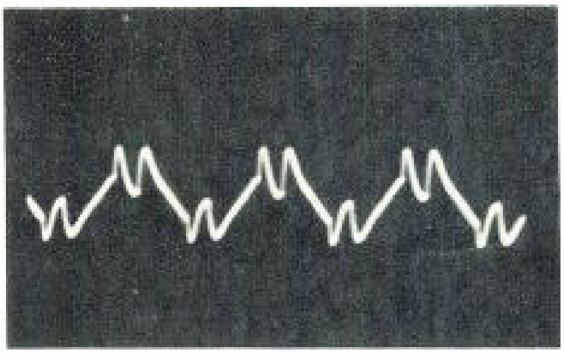

Figure 4. An oscillogram taken across the high frequency driver input terminals during low frequency overload.

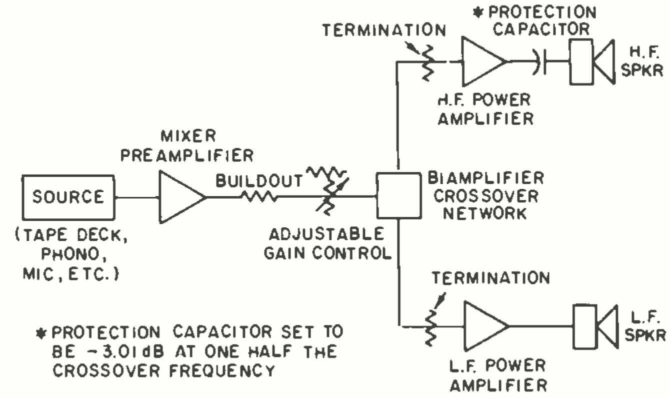

Figure 5. Basic components of a biamplifier channel.

tem and heard the tearing buzzsaw sounds it produces, you will become seriously interested in biamplification (or perhaps in one kW audio amplifiers so you no longer worry about squaring off at low frequencies).

HOW TO BIAMPLIFY YOUR SOUND SYSTEM

Having found out why we want to biamplify, the next logical question is how. FIGURE 5 illustrates the basic components needed. If the biamp crossover network chosen is a passive one (and some excellent ones are) you should look into providing a build-out resistor on the output of the preamp and a pair of termination resistors going into each power amplifier. Build-out resistors are calculated by:

$$R_b = R_d - R_m$$

Where R_b is the build-out resistor value
R_d is the desired impedance
R_m is the measured impedance

Termination resistors are calculated by

$$\frac{1}{R_T} = \frac{1}{R_D} - \frac{1}{R_M}$$

Where R_T is the termination resistor value
R_D is the desired impedance.
R_M is the measured impedance.

Some sort of overall gain control is required, going into the biamplifier crossover network, because the gain controls on the power amplifiers have become balance controls. The overall *gain control* is used to adjust the overall headroom for the final stages. Even when the biamplifier crossover network is active, this overall gain control is a passive unit added ahead of the network and again it would require a build-out and termination inspection.

Another very frequently overlooked component is the *high frequency protection capacitor*. This is placed in series with the high frequency unit or units one octave *below* the biamplifier crossover network's crossover frequency. The proper calculation of this capacitor is dependent upon the loudspeaker driver's impedance and the amplifier's *true* output impedance (not its nominal rating such as 8Ω.)

Today's amplifiers with their vast amounts of feedback usually have very low internal impedances. In calculating the correct capacitive reactance (x_c) we use these two rules:

1. If the amplifier output Z = load Z, then x_c should equal 2Z
2. If the amplifier output Z < load Z, then x_c should equal Z.

For cases that fall in between, the exact value can be found by

$$x_c \text{ for -3 dB down} = (R_L + R_S)$$

Where R_L is the load impedance.
R_S is the internal source impedance.

Once the correct x_c value in ohms is obtained, then the equation becomes

$$C \text{ in } \mu\text{Fd} = \frac{500{,}000}{\pi f Z}$$

If, for example, we have a very low internal impedance amplifier, an 8 ohm driver and a biamplifier crossover network frequency of 800 Hz, then $x_c = 8\Omega$. $x_c = R_L$ when $R_S < R_L$. F = one octave below crossover frequency, or 400 Hz.

Thus, the proper capacitance for our protection capacitor is

$$C \text{ in } \mu\text{Fd} = \frac{500{,}000}{\pi \times 400 \times 8\Omega}$$

In the past, oil filled, non-polarized motor-starting capacitors, usually purchased on the surplus market, have been used. There are today, however, reliable Mylar dieelectric capacitors available. This protection capacitor normally should not be seen by the amplifier because no appreciable signal in its frequency range should pass through the biamplifier network. In the event of a catastrophic failure in the high frequency power amplifier, the capacitor is there to stop low frequencies from damaging the high frequency drivers.

ADJUSTING BIAMPLIFIER SYSTEMS

To do a proper job, an acoustic-type real-time spectrum analyzer is required. By acoustic-type, I mean a unit comprised of contiguous bandpass 1/3-octave filters. The narrow band sweep type are excellent for electrical measurements but nearly useless for acoustic measurements (other than vibration-work) in real rooms because of their excitation of normal room modes.

The loudspeakers' high and low frequency levels should be adjusted at the listener's position. Often loudspeaker driver sensitivity is mistakenly adjusted rather than the driver's acoustic power output. Care should be taken that in the process of matching levels at the crossover frequency, the extreme high end is not excessively lowered in level, making any room-sound system equalization unduly complicated.

Yes, there is an excellent reason why you should consider biamplifiication. It's not easy, it's not inexpensive, it's just vastly better performance. That's reason enough. ■

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ROBERT FAULKNER

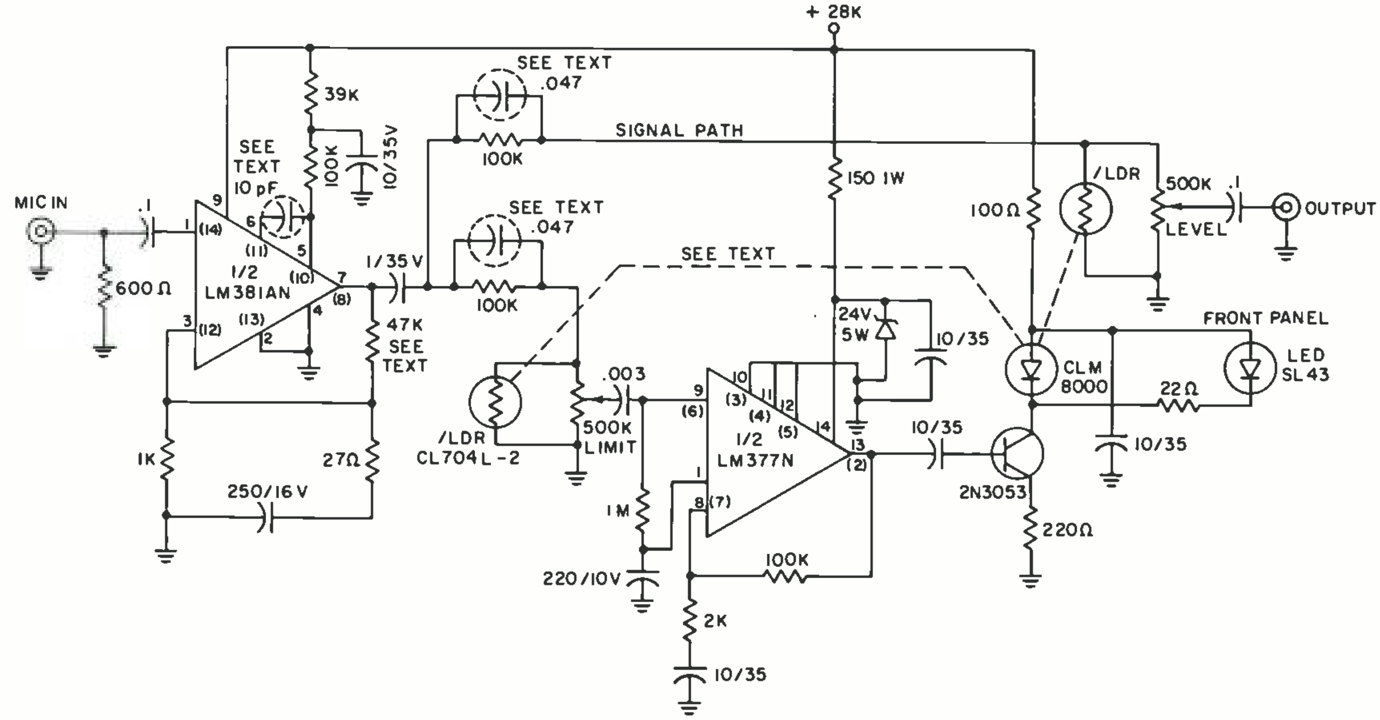

Figure 1. The limiter described in the text.

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Robert R. Faulkner is with Audio Research & Mfg. in Redondo Beach, California.

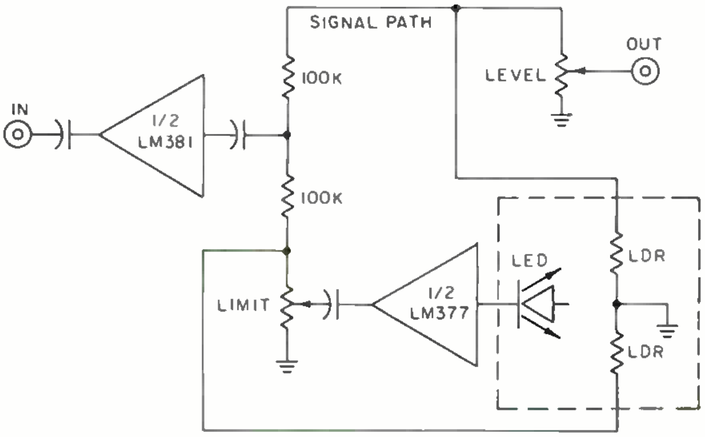

Figure 2. A simplified diagram of the signal path.

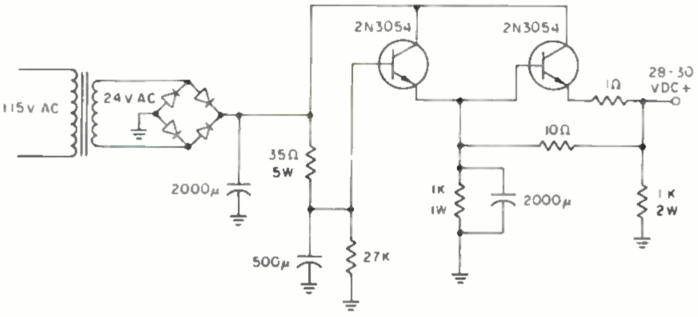

Figure 3. The power supply used.

amp. With the limit pot closed, the signal passes, unprocessed, through to the output. The front panel has four controls and 2 leds. A limit pot and a level out pot for each channel and a led indicator for threshold of limiting for each channel is included.

A National LM381AN integrated circuit is used as a dual pre-amp. A National LM377 integrated circuit is employed as a power amp to drive the limiting portion of the circuit. The LM381AN offers two completely independent amplifiers, each with an internal power supply decoupler-regulator, providing 120 dB supply rejection and 60 dB channel separation. The pre-amp is a wide band high gain unit, which is unsurpassed where low noise performance is critical. Short circuit protection is also provided.

The LM377 is a wide band, low distortion 2-watt audio power amplifier with 75 dB channel separation. This device is used to drive the 2N3053 transistor and is not in the signal path.

HOW IT WORKS

The signal enters the 600 ohm input of the LM381 and is amplified. The output of the LM381 is picked off by the two 100k isolation resistors. One resistor feeds directly to the output pot. The other one feeds the input of the LM377 power amp. The power amp drives a 2N3053 transistor, which acts as a variable resistor and controls the brightness of the Clairex CLM8000 led (modified). The led is coupled to a *dual element* light-dependent resistor. As the signal level increases, the led gets brighter.

The brighter the led, the lower is the resistance of the ldr. One half of the ldr is swamped across the output control. The other half is swamped across the input of the LM377 power amp. As the signal increases, the led gets brighter and the ldr resistance decreases and acts as an attenuator to the input of the LM377 power amp, causing it to stabilize. Because the ldr is a dual resistive unit fed by a single light source, the same resistive information is passed on to the output pot of the pre-amp and the input of the power amp simultaneously.

When the power amp stabilizes, so does the output of the pre-amp. Any further increase of up to 40 dB at the input will show no increase in level at the output, and with no distortion. The front panel led fires with the CLM8000 led to indicate the threshold of limiting. Both leds are isolated from the signal path and therefore cause no distortion. Limiting is accomplished by pure resistive pads—nothing more.

ADJUSTMENTS

The following steps detail the adjustments necessary.

1. Turn the limit pot off.
2. Adjust your input control to normal.
3. Bring up the level pot of the pre-amp until your record meters are peaking at Ø vu.
4. Gradually bring up the limit pot until the front panel led is firing intermittently.
5. Watch your record vu meter and continue to bring up the limit pot until you have taken about 5 vu off the top.
6. The vu meter will now be peaking at —5 vu.
7. Turn up level pot until the vu meter again peaks at Ø vu.

Using this procedure, limiting does not occur until the

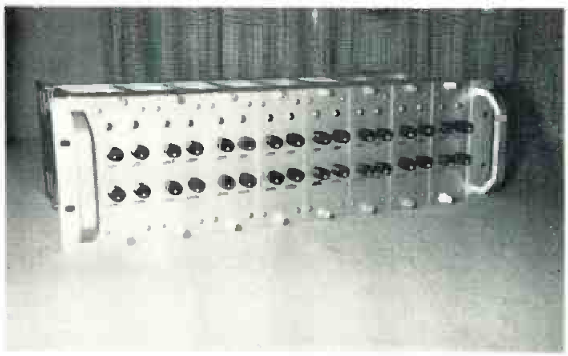

Figure 4. The completed 16 channels of limiting.

signal reaches —15 vu. From there on, the level is held at Ø vu, even though the input could increase 40 dB.

CONSTRUCTION

Parts should be mounted on a p.c. board (4½ x 6) keeping input and outputs physically separated as far as possible; of course, the standard p.c. board techniques apply. Resistors are the low noise metal film type (Dale). Capacitors are made of tantalum, for input and output. Standard p.c. board electrolytics are used for the other items.

Low Z-balanced inputs require a transformer. For low Z output use, use a suitable f.e.t. in a source follower configuration or transformer. Limiting is not affected by the impedance the pre-amp looks into. The CLM8000 Clairex led/ldr device comes from the factory with a single unit ldr. The single unit is removed and replaced with a Clairex CL704-2 ldr, a *dual* unit. The 500k pots are Centralab JMP-503 miniature linear taper. The units are mounted in a Vector CMK-3/CMG-7 cage. The front panel leds are Arcolectric SL-43.

SCHEMATIC TEXT REFERENCES

The 10 pF capacitors connected between pins 5 & 6 of the LM381 determine the high frequency roll-off of the pre-amp. I use a 10 pF, which starts the high frequency roll-off at about 12 kHz. If you want to go all out, place a 0.047 capacitor across the 100k isolation resistors and a 4.7 pF in place of the 10 pF. The amp will then be flat from 30-30 kHz with some increase in noise. The gain may also be altered to suit your requirements.

Raising the 47k resistor in the feedback loop increases the gain. Lower the 47k resistor for lower gain. I have selected a trade-off value of 47k in the feedback loop so as not to overdrive most hi-Z mic inputs and still have enough gain for most line inputs.

For a power supply, I use a capacitor multiplier circuit. (See FIGURE 3). This power supply is as quiet as a battery, with no hum whatsoever.

Is seems that no matter how good anything is, there has to be one little annoyance. The one difficulty with this unit is that *all* resistive light cells have a memory, for storage in darkness for an extended period of time. They will not stabilize instantly after being in the dark overnight. What you must do is to give them a few minutes of light before recording begins. This can be done by turning up the limit pots while the talent is tuning up or rehearsing. A half-minute or so is usually sufficient.

Those of you who don't care to chase parts, modify the led unit, make p.c. boards, etc. are welcome to contact me. I can supply the p.c. board and hard-to-come-by components on a professional basis. Write to: Robert R. Faulkner, P.O. Box 26, Redondo Beach, Ca. 90277. ■

M. C. VOLKER

A Modular Bus-Structured Broadcast Console

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SUITED BOTH for the novice and the professional, this modular, n-channel, bus structured broadcast console serves any desired number of channels (practical limit, approximately 15), which may be configured together on a common bus system. The entire console consists of a power supply, the desired number of input molules, cue, monitor, and output amplifiers.

INPUT MODULE OPERATION

The console consists essentially of multiples of the basic input module. A user can define his own output requirements, but input module and its internal control circuitry is the key item of presentation.

In the first mode of operation, assume that we have a novice user who wishes to mix three input signals, say a tape drive, a turntable, and his announce microphone. He must first activate the three modules to which he has connected those sources. He does so simply by depressing the upper pushbutton on each of the respective modules, illuminating them, (color-coding may be convenient). Any unused modules which remain illuminated from a previous session may be deactivated by depressing the same pushbutton switch. Thus, the operator's attention is directed to the three illuminated modules, each of which is labelled by both print and color to associate it with the correct source. All other modules are completely "dead."

If he now chooses to start his program with a disc selection, he depresses the lower pushbutton (thereby illuminating it) which activates a preview amplifier system to enable him to cue the desired selection. This clearly identifies the source being previewed. Once the selection is cued, he may again depress the same button to disable the preview system—if he forgets to do so, depressing the preview button on any other module will automatically cancel those previously set. Only one source can be previewed at a given time. The activation of any selected module level slider will also cancel any preview button which is set if so desired (*e.g.* a module fed by a microphone can thus avoid accidental pick-up from the cue speaker).

To blend his three inputs, he uses the level slider. When the microphone module is off, the control console output signal may be monitored by either the monitor speakers or headphones. When using the microphone, he can only monitor via the headphones since activation of a microphone module slider kills the monitor speakers. For this reason, the module must "know" whether it is to be used as a microphone module or other signal module. (This is set by means of a small switch).

When a level slider is activated, the device which that module controls is started. For example, if the slider for the turntable module is moved upward, (to increase level), the turntable motor is started at the lower end of the slider's travel by a switch built into the slider. In many current designs, this switch is used to perform the cue function and hence two separate operations are re-

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quired—one to start the device and one to control the signal level. When a module is used for a microphone, the switch at the slider's lower end of travel is used to kill both the monitor and preview speakers. In essence, the microphone may be considered as "started" or readied for voice input.

Except when a microphone module slider is activated, any input device which is idle may be previewed in preparation for the next selection. This mode of operation thus enables one to perform simply all essential mixing functions. The upper switch is used as a master switch and is set once only. Only two controls remain, the level slider with its built-in start switch and the preview pushbutton.

UPPER PUSHBUTTON

The second mode of operation is very similar to the first, except for one important variation. In this mode, the upper pushbutton switch is used somewhat differently. This switch may be viewed as a master switch. It is best explained by an example. Often it is necessary to *hot pot*, starting a device with the signal at some predetermined, usually full, level. This is particularly essential in sound effect applications where no noticeable time delay can be tolerated between the starting time of a device and the time at which the full level is reached. To use the module this way, cueing of the appropriate selection is accomplished as before. Once this is done, the upper pushbutton is depressed in order to deactivate the module.

Now it is possible to position the slider control at a given level. When that particular input is required, the operator need only depress the upper pushbutton, which then starts the device at the preset level. In the case of a microphone or several microphones, this pushbutton simply acts as an on-off switch and eliminates the need for constantly repositioning the slider.

The entire module then assumes a switching role. A time lag of a few milliseconds has been incorporated into the upper pushbutton circuitry, which causes switching of the input signal just after the pushbutton has been depressed. This allows the monitor kill function to take place just prior to the microphone or device activation, eliminating transient acoustic feedback burst and motor switching noises. Hence, the second mode of operation, although requiring no additional setup or alterations, extends the module's flexibility by the manner in which it is operated.

It should be noted that the first-mentioned mode of operation is that which the user would accept as obvious. The second will only be employed at such a time when the need to do so arises. Initially, a user need not be burdened with knowledge of the second mode of operation.

CIRCUIT OPERATION

The input module and common output section functional schematics are shown in FIGURE 1. There are five common buses for the audio and control signals. The use of such common buses greatly simplifies wiring complexity and eliminates the need for individual cabling for each module and corresponding summing points. The salient benefit of a common bus system is that the number of modules comprising a system may range anywhere from one to approximately fifteen. The three logic control buses—the monitor kill, monitor mute, and cue clear buses, employ open collector NAND gates in a wired-AND configuration. There are two basic signal circuits, the audio (analog) and the control (digital) circuits. All control is digital and all audio switching is solid state.

Looking at the audio section, the input signal is first amplified by amplifier A1, the input of which is approximately 60 dB. Any inputs which deviate significantly from either the high or low level input ranges may be compensated for by trimmer adjustments. Thus, modules for primary sources can be trimmed for optimal levels. The audio signal now takes two paths.

One path is for the mixing function, through amplifier A2, which controls the program level by a d.c. control signal supplied by the level slider. The output of this amplifier is switched by an analog gate, AS1, which receives a signal from the control logic.

ASI has an internal delay of a few milliseconds to avoid sound bursts during switching, as discussed in the previous section. The output of this gate is fed through a summing resistor to the common program bus feeding summing amplifier A3, which in turn drives a balanced 600-ohm program line (amplifiers A4 and A5), the vu meter (amplifier A7) and the monitor speakers via an analog switch, AS4, and electronic attenuator, EA1, and finally, the monitor amplifier, A9. The analog switch and the electronic attenuator perform the monitor kill and monitor mute functions respectively, each receiving a control signal from the control circuitry.

The other audio path is via an analog switch, AS2, to the cue bus. The analog switch is controlled by the cue logic. In the common section, the signal from the cue bus drives cue amplifier A6 via another analog switch, AS3, which blocks the signal if an attempt is made to "activate" a microphone while another module is in the preview mode. This depends on the microphone location and if acoustical feedback is not a problem, AS3 would not be switched by the microphone. More will be said about this when discussing the control logic.

The listening volumes of both the monitor and cue amplifiers may be manually controlled by the operator. These controls are the only ones associated with the common output section. The cue speaker intentionally produces an aural signal which is deliberately of an inferior quality to that of the monitor speakers. The sound is more tinny and emanates from a smaller, more aurally located, speaker than that in the monitor. The cue signal is distinguishable from that of the monitor to avoid potential sources of error which could occur by mistaking the cue signal for the monitor's.

Whenever a preview button has been selected, the monitor speakers are partially muted, so that the level drops somewhat but is not cancelled entirely. This permits the operator to eavesdrop on his program material; the impending end of a program selection may be detected even though another source is being previewed. Although the audio portion of the input module is rather straightforward, the input section and the analog switching technique are improvements over many contemporary systems.

CONTROL CIRCUITRY

The control circuitry is unique because it is largely this portion of the module which has facilitated overall simplification. All circuitry is ttl (transistor-transistor logic), the logic levels being zero (0.0V) and 1 (5.0V). All integrated circuit chips are standard low cost types (less than a dollar each). The NAND gates are of the open collector variety (ttl type 7401). Some of them are connected in a wired-AND configuration, thereby eliminating several gates and facilitating common buses as opposed to individual module connecting arrangements.

Starting with the upper switch on the module, the master switch, as it has been referred to, enables the program feed and remote starting functions. Depressing the master switch causes the associated flip-flop, FF1

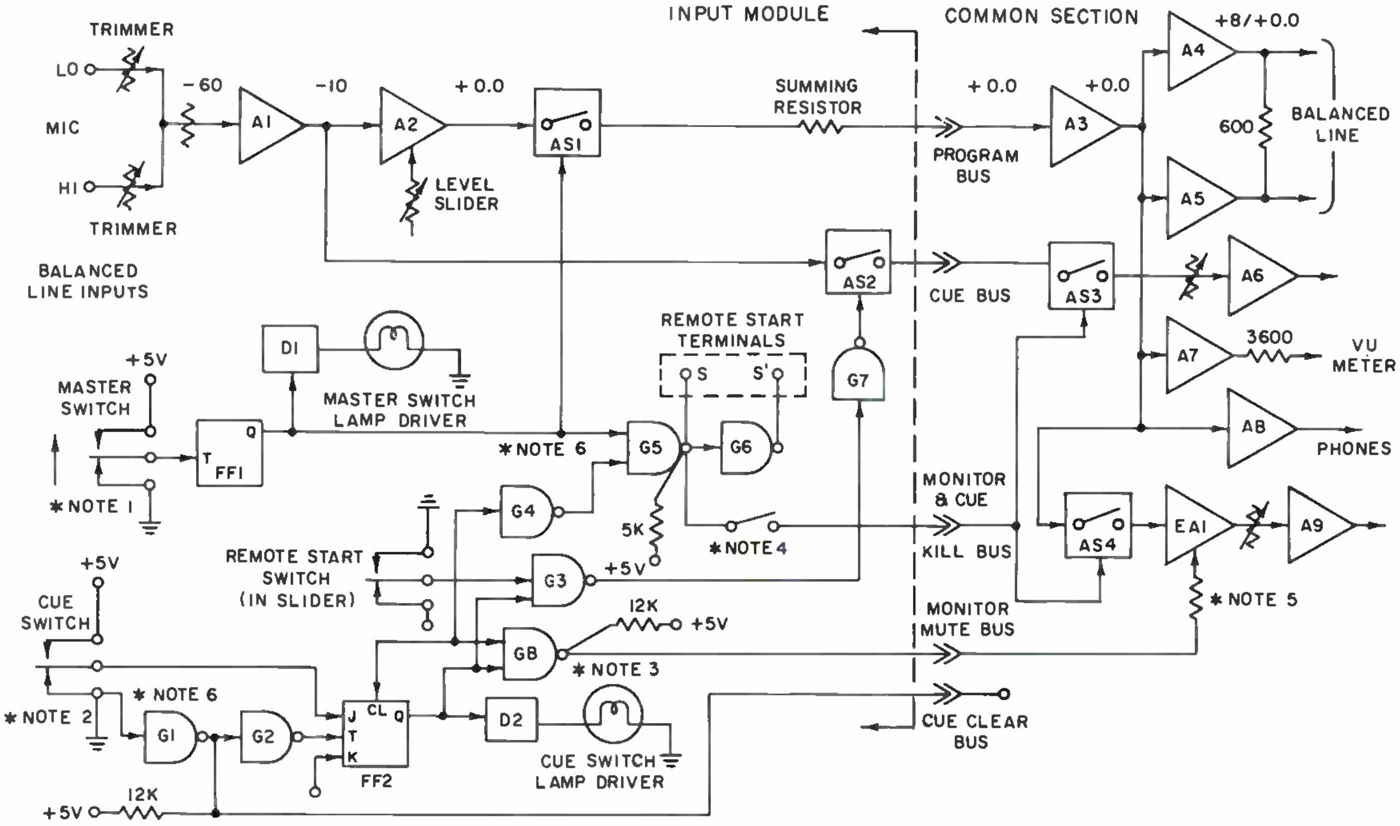

Figure 1. Input module and common section functional schematic.

Notes: 1, 2. Switches are momentary contact push-button type.
3. Switch activated by slider at lower end of travel (shown with slider in off position).
4. Switch closed for microphone operation.
5. Trimmer adjustable to control muting.
6. NAND must be of the open-collector type (e.g. ttl 7401).

(All flip-flops are ttl type 7473), to change state. When the flip-flop output is high (5V), a lamp illuminates the master switch, indicating to the operator that the module has been selected. The same high signal causes analog switch AS1 to close, allowing the signal from amplifier A2 of the audio portion, subject to slider level position, to pass to the common program bus. The flip flop FF1 output also drives NAND gate G5 so that when the slider switch (the switch which is activated at the lower end of the slider's travel) is moved upward, a *1* level appears at the other G5 input, causing the G5 output to go to zero. Hence the remote start output is able to start an input device motor via the appropriate starting logic (which will vary from source to source). Such a remote start output avoids the necessity of providing more than one basic type of module design.

ACOUSTIC FEEDBACK

If a module is controlling the level of a microphone which may cause acoustic feedback, then the output of NAND gate G5, a zero level, is sent via an operator-activated switch located adjacent to the microphone input connector, to the monitor and cue kill bus (one bus for both monitor and cue kill), which causes that bus to go to zero, since that bus is acting as a wired-AND gate. This zero level kills both the cue and monitor system by opening analog switches AS3 and AS4 respectively. If microphone feedback is not a potential problem or if the module is controlling another type of input device, then those analog switches cannot be activated by that module.

The cue control logic comprises NAND gates G1, G2, G3, G7, and flip-flop FF2. Gates G1, G2 and flip-flop FF2 are connected in a manner so that if the cue push-button is depressed once, the cue system is on, and when depressed again, the cue system is off (see **db**-Sept. '75). The G1 output is taken to cue clear bus, another wired-AND circuit which allows only one module to be in the cue state at any given time. Depressing the cue push-button on any module will cause any previously set cue on any other module to be cleared. The flip-flop FF2 output activates the lamp of the cue switch and also provides a 1 at one of the two NAND G3 inputs. When the level slider is in its lower position, i.e. the level slider switch is off, then a 1 level also appears at the NAND G7 output, causing analog switch AS2 to assume the *on* position. Gate G8, which operates identically to gate G3, drives the monitor mute bus. Hence any module in the cue mode will cause electronic attenuator EA1, of the common output section, to mute but not kill, the monitor speakers.

The control circuitry has been designed to perform the control function, as defined, simply, and with a minimum number of operator controls. ■

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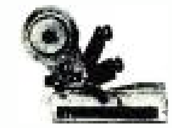

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DUPLICATORS, blank cassettes, recorders, boxes, labels, cassette albums and supplies; lowest prices, top quality. Write for free brochure, "50 Tips for Better Duplication." **Stanford International, Box 546, San Carlos, Ca. 94070.**

AMPEX TAPE. Ampex Audio studio mastering tapes; 631-641, 406-407, and "Grand Master" in stock for immediate shipment; ¼", 1" and 2"; factory fresh. Best prices. **Techniarts, 8555 Fenton St., Silver Spring, Md. 20910. (301) 585-1118.**

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3M 4-TRACK-IN CONSOLE, 15-30 in/sec; excellent, $3,900; Ampex 351 2-track in console, $1,000; Ampex 350 stereo ¼-track in console, $800; Scully 280 2-track in console, 15-30 in/sec., $2,400; Sony C-57 condenser microphones (2) @ $125; MC 60, $100; MC 75, $125; UREI filter 550A (2) excellent, $100. Pultec filter HLF-3c, excellent. $125; Countryman 967 phase shifter, $190; Spectra Sonics console 24 x 16, $17,000; V.S.O.: McIntosh 200 watt, drives anything, $400. **(213) 461-3717, ask for Brian.**

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(continued)

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ARP SYNTHESIZERS: Strings, $1,385; 2600, $2,190; Axxe, $700; Prosoloist, $875, Odyssey, $1,165. **Dickstein Distributing, 1120 Quincy, Scranton, Pa. 18510.**

FOR RENT, full floor/penthouse with terrace, midtown NYC. Recording studio and office complex. Control room remodeled 1975, plus conference room, four offices, kitchen and reception area. Present rent: $850 mo.; sublease to 12/31/76, then new lease. **MZH, Inc., 56 W. 45th St., New York, N.Y. (212) 986-1084.**

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AUDIOARTS ENGINEERING Model 3100A parametric equalizer/preamplifier. **Audioarts Engineering, 286 Downs Rd., Bethany, Conn. 06525.**

TASCAM WARRANTY SERVICE STATION. Mixing consoles, $1,350; ½" recorders. $1,950; 8-track machines, $2,950. All shipped prepaid & insured, including free alignment + equalization + bias + calibration + life test. **Sonic Engineering Labs, 11½ Old York Rd., Willow Grove, Pa. 19090. (215) 659-9251.**
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MCI 16-TRACK recorder with Auto-Locator. New machine specifications $13,500. **Guggenheim Productions, Inc., 3121 South St., Washington, D.C. 20007. (202) 337-6900.**

3 AMPEX Sel-Sync units—3-channel; 90-day warranty, $150 ea. **Danny Antell Productions, 521 W. Bradley Ave., El Cajon, CA 92020 (714) 447-7180.**

FOR SALE: AMPEX AG440B4 recorder with ½" 4-track, ¼" 2-track, ¼" mono heads; remote control; machine is 7½-15 but 15-30 kit is included. In walnut formica roll-around cabinet. $3,000. **(701) 223-7316.**

LANGEVIN AM4A SOLID STATE CONSOLE: 12 inputs, 8 outputs. Modified for stereo panning, stereo cue, stereo echo sends. Includes patch bay and bud rack. $7,500 or best offer. Contact **Pat Higdon, Cedarwood Pub. Co., Nashville, Tenn. 37203. (615) 255-6535.**

FOR SALE. Scully 284-8 tape recorder, very good condition, $6,200. Audio Designs console, 10-in/4-out, wired for 8-track recording, $9,500; excellent condition. **(419) 241-5961.**

HARMONIC PERCUSSION for older Hammond organs. Easy installation, $75. Free details. **Linear Devices, P.O. Box 5750, San Francisco, CA 94101.**

2 SONY C-37P condenser mics; new in factory-sealed boxes with AC-148 power supply, $650. Wanted: 8-track head block for Ampex 300 deck (with or without heads). **Jim (603) 878-1078.**

TRACKS!! The complete semi-pro recording center. Get our low prices on Tascam, TEAC, Neotek, Multi-Track, dbx, MXR Pro, Shure, BGW, Tapco and many others. Complete studio packages available. Tracks!! from **DJ's Music Ltd., 1401 Blanchan, La Grange Park, IL 60525. (312) 354-5666.**

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WANTED: MB-8 RACK MOUNT for Sony 850; Marantz RA-1 rack assembly. **M. Horonzak, 332 Newport, Webster Groves, Mo. 63119.**

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SOUND ENGINEER needed to travel with country-rock act on national college circuit. Send resume, references, and salary requirements to **Promising Artists Management, 456 East Beaver Ave., State College, PA 16801.**

PROFESSIONAL COMMUNICATION contractor in Philadelphia, Pa. area requires a competent, technically qualified salesperson. Please send resume and requirements to: **General Sound, Inc., 3500 N. 9th St., Philadelphia, Pa. 19140.**

CHIEF ENGINEER for NYC recording studios. Must have heavy experience in all facets of electronics and automation for audio, film, video; leadership qualities. **Dept. 73, db Magazine, 1120 Old Country Rd., Plainview, NY 11803.**

EXPERIENCED MUSIC MIXER
For major N.Y.C. studio, expanding staff. Send resume to **Dept. 72, db Magazine, 1120 Old Country Rd., Plainview, NY 11803.**

ENGINEER/MIXER available. Over 4 years experience. Did 10 James Brown l.p.s plus many others. Young, very ambitious. **Bob Both, 18 Hiawatha Pass, W. Milford, N.J. 07480 (201) 697-7540.**

IMMEDIATE OPENING for experienced maintenance person for major Los Angeles Studio. Salary open. Replies strictly confidential. **Write P.O. Box 25369, Los Angeles, CA 90025.**

SERIOUS RECORDING ENGINEER with 2½ years experience and some equipment looking to advance career in a progressive, creative studio. Hard worker. Capable of routine maintenance. Strong musical and technical background. **Dept. 71, db Magazine, 1120 Old Country Rd., Plainview, NY 11803.**

WANTED: DISCMASTERING ENGINEER, full/part time. Experienced use of latest computerized mastering equipment. **Trutone Records, 428 Briarwood La., Northvale, N.J. (201) 768-9212.**

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• A new roster of officers has been elected by the **Institute of High Fidelity.** Bernie Mitchell, president of **U. S. Pioneer Electronics,** was elected president and **George DeRado,** president of the **TEAC Corporation,** vice-president. **Walter Stanton,** president of **Stanton Magnetics** and **Pickering & Co.** was elected treasurer. The new secretary is publisher **Richard Ekstract.** The new board includes **Victor Amador, Arthur Gasman, Ed Hopper, Jerry Kalov, Jay Schwab,** and **Gertrude Nelson Murphy** as executive secretary.

• **Peter Untersander** has been promoted to the post of corporate vice president of the **Pickering Company,** Plainview, N.Y. Mr. Untersander's bailiwick will be Europe, Middle East, Africa, Australia, and New Zealand, with headquarters at Cully, Switzerland. Mr. Untersander, a Swiss citizen, has been with Pickering since 1970.

• The sprawling **JBL Sound Co.,** which now occupies six buildings in the Los Angeles area, will be moving to a single location at 8500 Balboa Blvd., Northridge, Ca. gradually during the next eighteen months. The new facility will consist of nine buildings on a 40 acre site. The administrative offices are currently being installed in the new location; the manufacturing divisions will follow.

• Two management changes have been made at **Ampex Corporation,** of Redwood City, Ca. **Richard Sirinsky** has been named national marketing manager for the audio-video systems division. Mr. Sirinsky was formerly national sales manager for the division. In the same division. **Donald V. Kleffman** has been named general manager. Mr. Kleffman had been national manager of the division's marketing program since 1972.

• Responsibility for international sales at **CCA Electronics Corporation,** of Gloucester City, N.J. will center on newly appointed vice president **Bruce D. Buck.** Mr. Buck comes to the U.S. company from their Canadian subsidiary, **Caldwell A/V Equipment Co.**

• Stereo veteran **James Cunningham** has been appointed director of technical facilities of **United/Western/Coast Recorders,** of Hollywood. Ca. Mr. Cunningham was a pioneer in the field of stereo broadcasting and recording while he was at **NBC.** Most recently. he has been accociated with **Sound Market Recording.**

• Audio-visual instruction kits. designed to augment their regular seminars, are being developed by **RCA.** Initially, the material will be based on the operation of the TK-76 electronic journalism camera and other advanced equipment. Later offerings will cover general subjects, such as digital technology, microprocessor applications, image processing, and other subjects relating to electronic technology. For information contact: Paul F. Amedick, RCA Broadcast Systems. Camden. N.J.

• **Topper Schroeder** has been named general manager of the Los Angeles branch of the **ABC Record** and **Tape Sales Corp.** of Fairfield, N.J. Before joining ABC in 1975, Mr. Schroeder was with **RCA.**

• **Everything Audio** and its sister company, **Video Products Sales,** have moved to a new facility at 7037 Laurel Canyon Blvd., N. Hollywood, Ca. Their telephone numbers are (213) 982-6200, 982-5600. The new location has a control room as well as expanded stocking and demonstration areas. and the equipment for interfacing audio and video on the professional studio level.

• **Charles A. Steinberg** has been named vice president of audio-video systems and data products by the **Ampex Corp.** of Redwood City, Ca. Mr. Steinberg has been with Ampex since 1963. Prior to that, he was with **Airborne Instruments Laboratory.**

• There has been a Call for Papers by the **International Conference on Acoustics, Speech, and Signal Processing, in** preparation for their annual conference. to be held in Hartford. Conn. on May 9-11. 1977. The schedule calls for submission of Title and 100-Word Abstract. October 15 and submission of a 4-page Photo-Ready Paper by January 14. Submit papers to: Dr. N. Rex Dixon. Technical Program Chairman. IBM-T.J. Watson Research Center. P.O. Box 218, Yorktown Heights. N.Y. 10598. Educational exhibits from non-profit institutions will be accepted at no charge. There is also provision for commercial exhibits.

• **Glenn R. Phoenix,** formerly with **3M,** has been elected president of **Westlake Audio,** Inc. of Los Angeles. Former president **Paul Ford** is now Chairman of the Board. Westlake has recently been appointed as the exclusive U.S. distributor for the Harrison models 4032 and 3232 master recording consoles. Sales and service will be provided by Westlake's Los Angeles and Nashville offices.

• **Capps & Co.,** Valley Stream, N.Y., has been appointed as distributor of **Westrex** recording equipment products in New York, Massachusetts, Rhode Island, Connecticut. New Jersey, Delaware, Pennsylvania, Maryland, and Washington, D.C. **Dick Marcucci** and **Sal Gualtieri** will handle the account.

• **Adelphi University,** of Garden City, N.Y. has honored **Dr. Peter C. Goldmark** with an honorary Doctor of Science degree. Dr. Goldmark, known for his invention of the long-playing phonograph record, was honored for "his distinguished achievements which have immeasureably improved the quality of life for people the world over." Dr. Goldmark, president of **Goldmark Communications,** is currently engaged in a project called the "New Rural Society," aimed at improving the quality of life in existing rural communities.

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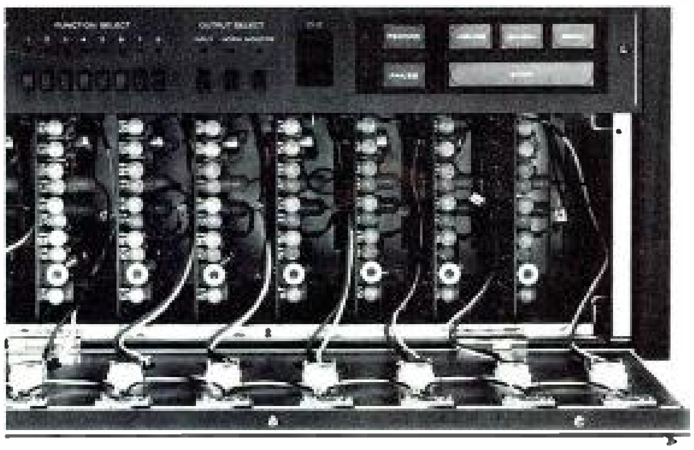

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If you've never thought of your mixing console as a musical instrument, we'd like to invite you to stop by your Yamaha dealer. Once you've checked out the operation manual and tested for yourself what the PM Series can do, we think you'll come away a believer.

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