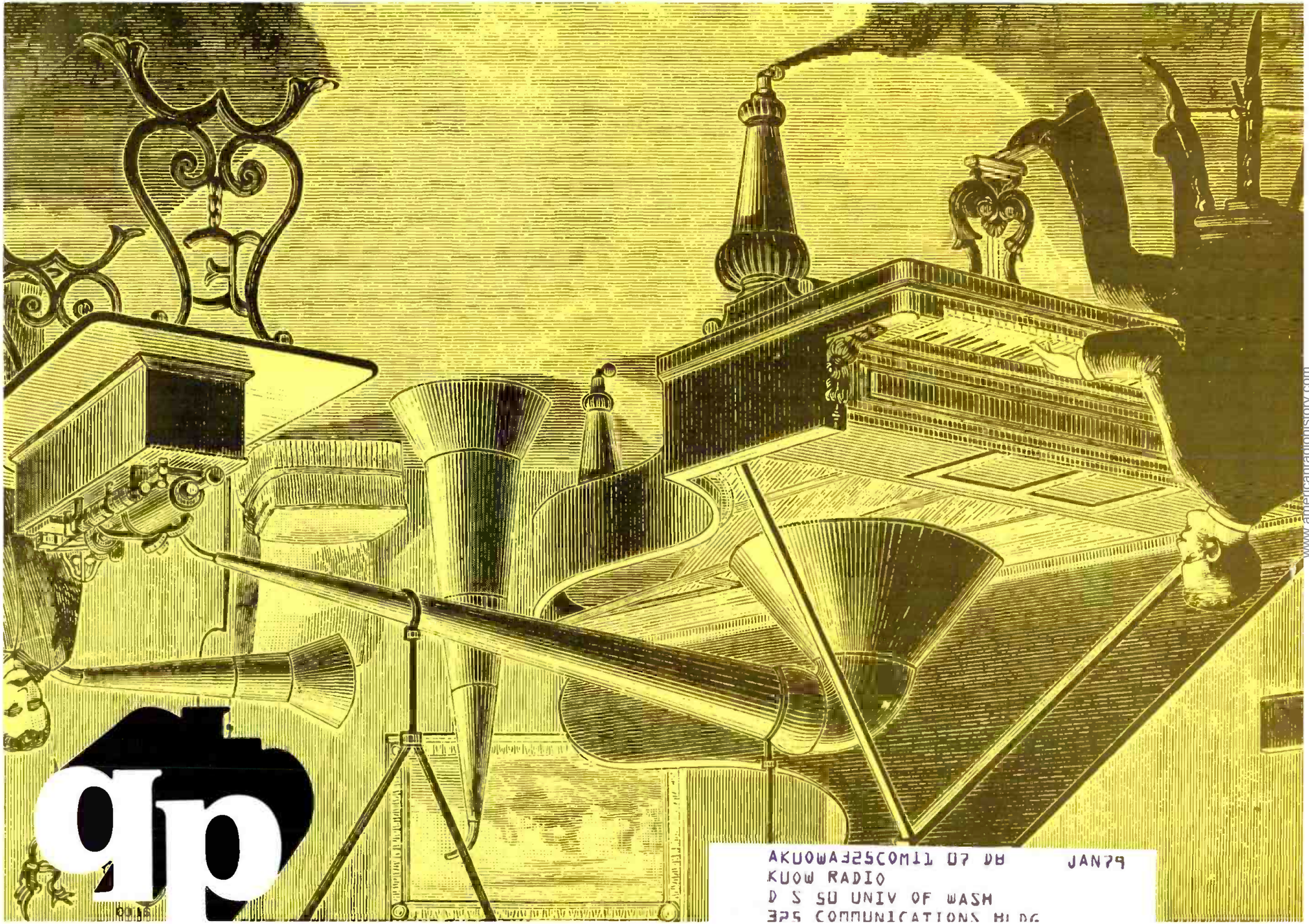

AKUOWA325COM11 07 DB JAN79
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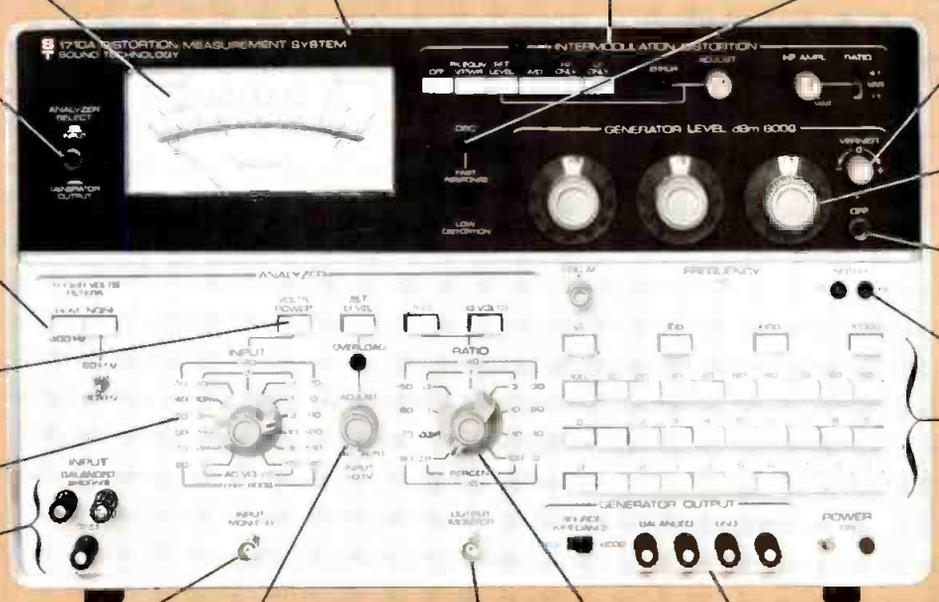
Here's how useful a distortion analyzer can be



Two of the above features are so outstandingly valuable that we especially invite your attention to them.

One is the fast, easy measuring you get with pushbutton-selected distortion-measuring circuits (signal source and measuring circuits are simultaneously selected with the same pushbuttons). Pushbuttons make it so simple to measure quickly and to repeat measurements.

Secondly, you can drive virtually any type of circuit from the signal source output — whether balanced, unbalanced, off-ground or whatever. That's because the signal source output circuit is fully **isolated and balanced.**

There is no output transformer to introduce noise or distortion.

Besides these outstanding conveniences, you can have the Sound Tech 1710A with an option that enables you to measure **intermodulation distortion.**

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coming next month

- ALAN FIERSTEIN appears again in our pages with *The Equalization Myth* in which he discusses how balanced room ambience — being a time decay situation — cannot be achieved by patchwork equalization.
- MARTIN DICKSTEIN will have a new article on a sound system of considerable interest for this summer.
- Another *db Test* will examine a new moderate power amplifier from BGW.
- And there will be more pictures from the L.A. AES Picture Gallery that could not fit this issue.

about the cover

- Who says close miking is new? This illustration first appeared in *Scientific American Magazine* in their October 12, 1899 issue and is entitled "Apparatus for Registering Piano Music by the Phonograph."

db

THE SOUND ENGINEERING MAGAZINE

JULY 1977 VOLUME 11, NUMBER 7

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

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CALENDAR

AUGUST

15-19 **Mid-East Business Conference.** St. Francis Hotel, San Francisco, Ca. Contact: John J. Fogarty, 420 Lexington Ave., Suite 646. New York, N.Y. 10017 (212) 490-0125.

22-23 **N.Y.U. Seminar on R&D Management.** Contact: Ms. Heidi Kaplan. N.Y. Management Center, 360 Lexington Ave., New York. N.Y. 10017. (212) 953-7262.

27-29 **National Music & Sound Show.** Hilton Hotel. New York City. Contact: Music Retailer, 50 Hunt St., Watertown. Ma. 02172. (617) 926-3770.

SEPTEMBER

12-18 **International Audio Festival and Fair.** Olympia, London. U.K. Contact: British Information Services, 845 Third Ave., New York. N.Y. 10022. (212) 752-8400.

13-15 **Synergetic Seminar,** Kansas City, Mo. Contact: Don Davis. Synergetic Audio Concepts. P.O. Box 1134, Tustin, Ca. 92680. (714) 838-2288.

20-22 **Synergetic Seminar,** Syracuse. N.Y.

27-29 **Synergetic Seminar,** New York. N.Y.

16-18 **Consumer Hi-Fi Show.** Sheraton Motor Inn, New York, N.Y. Contact: Charles Ray, Communications Show Corp. 30 E. 42nd St., Suite 1620, New York, N.Y. 10017. (212) 986-7592.

26,27 **Electronic Representatives Assoc. Show.** Statler Hilton Hotel. New York City. Contact: Gil Miller c/o Gilbert E. Miller Assoc. 375 N. Broadway. Jericho. N.Y. 11753.

OCTOBER

5-7 **Synergetic Seminar,** Boston. Mass. Contact: Don Davis. Synergetic Audio Concepts. P.O. Box 1134. Tustin. Ca. 92680. (914) 838-2288.

18-20 **Synergetic Audio Seminar.** Philadelphia, Pa.

5-9 **Hobby Electronic Fair,** O'Hare Exposition Center. Chicago. Ill. Contact: Industrial & Scientific Conference Management, Inc., 222 W. Adams St., Chicago. Ill. 60606.

(continued)

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OTARI MX-5050 the original (and still the best) compact professional recorder

Just over two years ago, Otari introduced a unique new product —the first truly professional recorder in a compact package— the MX-5050. Since then, the performance and reliability of this innovative new machine have been tested and proven in over a thousand critical professional applications—by broadcasters, recording studios, A/V departments, musicians, and semipro recordists worldwide. Universal acceptance and repeat orders by these satisfied customers tell this remarkable recorder's success story better than we can.

Bias can be re-optimized in seconds.

As you compare the MX-5050 with other recorders, keep this in mind. The MX-5050 is not a hi-fi machine with a few professional features added later as an afterthought. It was designed from the ground up based on Otari's 10 year experience as Japan's leading manufacturer of professional recorders and high speed duplicators. It is a full professional machine with the performance, features, and field proven reliability that you expect to find only in the larger professional recorders.

Here are some of the key reasons why the MX-5050 is the best compact recorder available today.

Production Features: Creative production is simplified with: Front panel edit to spill tape. Lift-up head cover to mark splices and clean heads. Built-in splicing block on head cover. Adjustable cue to defeat head lifters. Selective reproduce to add new tracks in perfect time synchronization. Two speed operation, 15 and 7½ or 7½ and 3¾ ips (field changeable in dc servo versions).

Performance Features: Headroom is 19 dBm, a full 15 dBm over the switch selectable fixed output of +4 dBm. This standard reference level output can be rear panel switched to −10 dBm to drive a PA system or power amplifier. S/N ratio is NAB weighted 69 dB full track, 68 dB half track, and 65 dB quarter track. Crosstalk is greater than 60 dB half track. Outputs are 600 ohm balanced (standard on half track) or unbalanced. Line input and output connectors are XLR.

Operating Features: Bias is front-panel continuously adjustable (not limited to fixed positions). With built-in test oscillator (not available on other compact professional recorders) bias can be optimized in seconds when changing tape. Record EQ and standard reference level are also front adjustable. Straight-line tape path simplifies threading. Capstan is located on back side of tape for improved tape life. An extra reproduce head is standard on all versions to allow playback of tapes in different formats. For pitch control and freedom from power line variations, an optional dc capstan servo is available with ±10% correction range.

Easy threading; capstan on back side.

Versatility: Available in full-track (with half-track reproduce capability standard), two-track, and quarter-track versions. Walnut case (standard), rugged portable road case, rack mounting adaptor, or floor console. Universal power supply standard. Low impedance input and output transformers and remote control also optional accessories.

See your nearest Otari dealer for the full story or contact Otari. And, if it's multichannel you need, ask about the standard-setting four and eight channel versions of the MX-5050.

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Suginami-ku, Tokyo 167, Japan
(03) 333-9631 Telex: J26604

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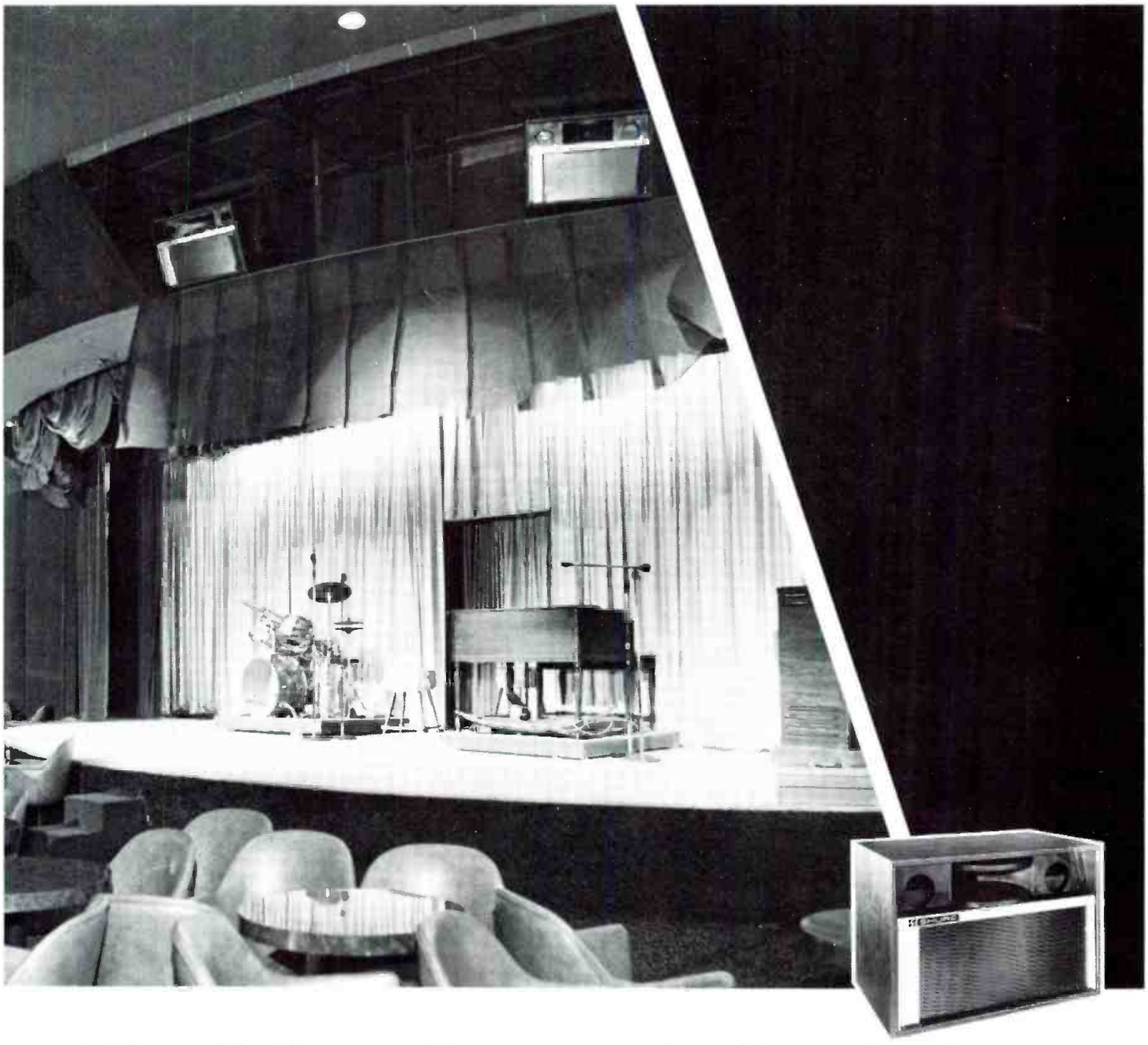
CALENDAR (cont.)

15-19 **Instrumentation - Automation Conference.** Philadelphia Civic Center, Philadelphia, Pa. Contact: Instrument Society of America, 400 Stanwix St., Pittsburgh, Pa. 15222. (412) 281-3171.

16-21 **SMPTE Technical Conference & Equipment Exhibit.** Century Plaza Hotel, Los Angeles, Ca. Contact: SMPTE, 862 Scarsdale Ave., Scarsdale, N.Y. 10583.

18-20 **Western Educational Society for Telecommunications Conference.** Harrah's Hotel. Reno. Nevada. Contact: Wendell H. Dodds. Radio-Television Ctr., University of Nevada 89557.

25-26 **New York University R&D Management Seminar.** Chicago. Ill. Contact: Heidi Kaplan. New York Management Center, 360 Lexington Ave., New York, N.Y. 10017. (212) 953-7262.



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Everybody prays for a little miracle in Las Vegas. The folks at the Sahara Hotel got theirs in a little speaker from Shure.

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The answer was the versatile, new, super-powerful, super-compact Shure SR112 speaker system . . . a unit so small that four of them fit comfortably into the soffit. And so efficient that they are 6 dB more sensitive than comparable-size units noted for their efficiency.

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db Letters

THE EDITOR:

Part of Patrick Finnegan's *Audio and the F.M. Process* article in the January, 1977 issue has triggered a core-dump of some long stored-up ideas I've had about f.m. broadcasting practices.

On page 17 Mr. Finnegan says that the FCC-required pre-emphasis boost of 17 dB at 15 kHz is "entirely too much" with today's audio equipment. I think the background should be clarified a little more. The original intent for pre-emphasis/de-emphasis was to reduce noise originating between transmitter and receiver by the amount of rolloff in the receiver. This worked just fine and would work even finer with today's equipment if it weren't for the ideas of many (most?) f.m. station managers.

The harsh fact of economic life is that station managers figure the more they can modulate, the more listeners they reach. And more listeners means more advertisers and thus more money to help break even this month.

By defeating pre-emphasis they know they can modulate without getting the FCC on their backs, so they use numerous kludges (my opinion) which do this automatically in response to audio level and frequency. As Mr. Finnegan hints, they also use compressors, limiters, filters, clippers and any other atrocity they can find to keep that modulation *up*, baby, *UP*. (I know—I used to have to fix them in the middle of the night.)

The fact that the listener winds up with swishy, rumbly, volume-pumping, distorted *and* noisy sound (thus nullifying the original advantage f.m. had over a.m.) is met with at most a shrug of the shoulders and a little hand-wringing, even by the FCC.

Often you will find that these f.m. station managers used to, or still do, manage a.m. stations. As engineers, we know that an a.m. carrier *does* appear to be usable farther away when modulated more. You just can't convince them, though, that f.m. reception tends to be either "go" or "no-go" with relatively sharp boundaries, regardless of modulation level.

With hands grimy from practical work around stations, I've found that the best sounding f.m. stations are *always* those with the least possible amount of equipment between turntable and transmitter—and all being

THE MULTICELL:

We're not doing anything new, we're just doing it right.

Often heard, but little understood

Nothing beats a multicell for pattern control. It has greater projection and throw capabilities than any other HF horn. But given the multicell as it has been produced over the last thirty years, it has brought an equal number of headaches. Besides being too heavy and structurally too weak for most applications, the advantage of coverage was often outweighed by excessive resonance and distortion, so that the use of a multicell often meant a choice of coverage over clarity.

We have a more sensible solution. Why not use a multicell that doesn't have the problems inherent in a metal horn?

We're not doing anything new...

This is the Community 2×5, one of a family of multicells that includes a 2×4, a 1×2, and a Single Cell horn. We believe that it's a great series—not because we make them (although that would sway a lot of people), but because we've produced the old concept (which was essentially a great design) without all the disadvantages created by the old manufacturing methods. How? By carefully constructing our multicells in hand-laminated fiberglass.

We're just doing it right.

Our multicells are strong and weigh in at less than 30 pounds. The strength means solidity, which guarantees that the old kazoo-like tonal quality is no more. We carefully machine the cell ends where they meet under the manifold to minimize distortion. And by keeping our cells round instead of square, we've considerably reduced VHF lobing. While we were at it we added some extras: inherent weather-proofing, for one. You can paint a metal horn and weather-proof it ... for a while. But fiberglass will resist weather indefinitely. Another plus is that we make our horns individually to fit any commercially available loudspeaker—so that throat adapters are never necessary.

And now we've done it, you'll have to re-think the multicell's role in sound reinforcement. There's a myriad of applications that would benefit from the use of a Community multicell. Write to us for more information and detailed specifications.

Community

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of top quality. I'll never forget persuading KRUZ in Santa Barbara one night in 1971 to patch out their Audimax and Volumax *just for once* during the classical music hour. The results were astounding, and I was 90 miles away! NO noise, NO record rumble, NO distortion, NO irritating volume-pumping, NO pillow-sound—just wide-response, breathtaking dynamic range, even from a record! And the station didn't overmodulate even once. To my knowledge, they've never tried the experiment again since.

The first thing the FCC and the trade should do is to distinguish between f.m. stations catering to "serious" listeners (classical, etc.) and those catering to background music and other listeners who don't mind (and sometimes want) restricted dynamic range, filtering, etc. Listener comments entered in the stations' open files should help make the distinction. Then ethical and/or FCC action is needed to prohibit the alteration of frequency response, dynamic range, or waveform in any manner except standard 75 μs pre-emphasis during any station's "serious listener" time.

Tape transcription of any material that could have been done live should be either prohibited or subjected to much more rigorous standards of fidelity; many stations' tape transcription is much too painfully obvious.

It's high time for the rest of the station audio chain to be subjected to more modern minimum standards of response flatness, distortion, gain linearity, noise, and flutter/wow as measured from signal source to broadcast transmitter modulator *simultaneously*. (This will also reveal how much the audio is degraded in some of those minimum-cost microwave and hardwire links from studio to transmitter sites.)

Listeners could help this revival of f.m.'s potential performance by putting pressure on the FCC and the sponsors as well as the station managers. Too many station managers get their only technical advice from broadcast trade magazines that cater as much to the acid-rock background-music and a.m. stations as to anyone else. Let's get in our two cents' worth as listeners!

As for those who want to replace pre-emphasis with Dolby encoding, please consider the following: Dolby processing would render millions of high-quality existing receivers obsolete unless modified, making lots of people mad. Ray Dolby's system itself is very slowly fading from the foreground as other more recent processes take its place. Dolby decoders make receivers cost a lot more, partly because of royalties.

Many of today's generation of engineers have *never* heard f.m. sound unaltered by devices at the station, so who can blame them for thinking this is an inherent limitation? But I venture that ten minutes of hearing an *unprocessed* f.m. broadcast from top quality station equipment will send most of them scurrying to fix the real weak links in the chain, such as their antennas, speakers, and room acoustics. They'll often find that most of the noise they hear is coming from the record played by the station, including the latest Dolbyized recordings!

As for the broadcaster's fear of overmodulation, let me suggest a long-lost solution. It's called "TURNING DOWN THE LEVEL." A serious-listener station can do this with no fear of losing listeners because the broadcast channel usually has more dynamic range available than the source material itself offers. And for this type of station, the reasoning that the listener will pass it by because of having to turn up his volume control a bit is obviously specious.

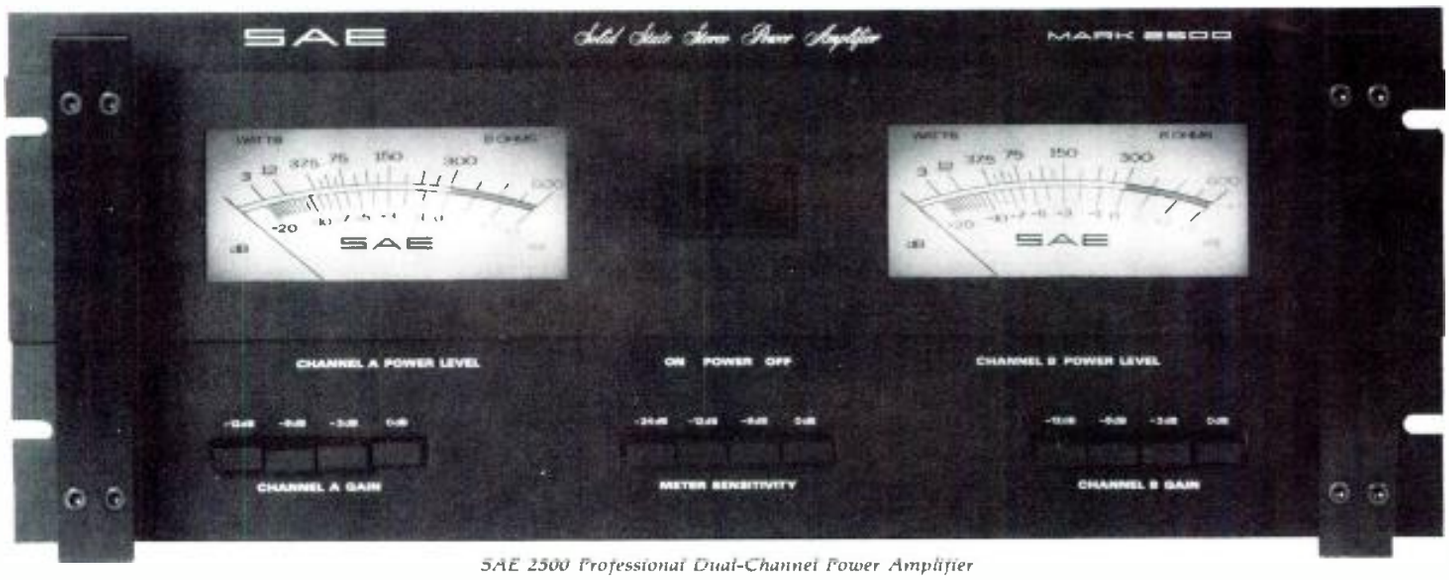
I make no apology for this letter going far beyond the scope of Mr. Finnegan's article. The listeners' viewpoint needs to be heard, and this is as good a time as any to get it all into the open. So let's start convincing some station managers that quality counts as much as quantity, and maybe someday a high-performance f.m. receiver will once again become a worthwhile investment.

RONALD W. PURCELL
Sunnyvale, California

Dolby Laboratories, Inc. comments:

We agree with Mr. Purcell that in f.m. broadcasting there is too much signal processing that cannot be compensated for by the listener. It is unfortunate that in this country all too few listeners have the opportunity to hear the full dynamic range potential of the f.m. system. Of course, there are some programming formats on which a considerable amount of signal processing is acceptable—it may even be desirable. Unfortunately, signal processing has spread to programming formats in which the effects described by Mr. Purcell are clearly audible. For these formats, the removal of all signal processing would seem to be ideal, but in the real world this is not a practical thing to do. Instead, by using a complementary signal processing technique offered by the Dolby f.m. system (which com-

Powerful alternative.



SAE 2500 Professional Dual-Channel Power Amplifier

When you compare power amplifiers, you have to look at the hard facts. The SAE 2500 Professional Dual-Channel Power Amplifier has them—top power, specifications, reliability and features that make it the most "powerful alternative."

Power. 450 Watts RMS per channel, both channels driven into 4 Ohms from 20Hz to 20kHz at no more than 0.1% total harmonic distortion. Or, 300 Watts RMS per channel, both channels driven into 8 Ohms from 20Hz to 20kHz at no more than 0.05% total harmonic distortion.* Plus, a new, smaller wide-channel power transformer coupled to 4 computer-grade capacitors for a power supply that varies no more than 10% from no load to full load. (For extra protection, there are relay and thermal cut-out devices.)

Other Specifications:

IM Distortion from 250mW to rated power at 4 or 8 Ohms with any 2 mixed frequencies between 20Hz and 20kHz at 4/1 voltage ratio.....0.05 Max.
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Transient Response of any Square Wave ..... 2.5 μsec. rise and fall time
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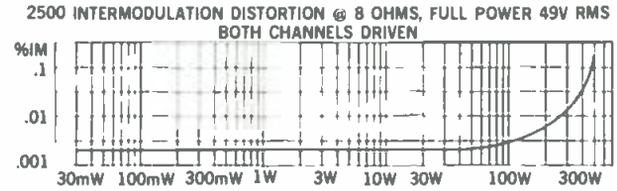
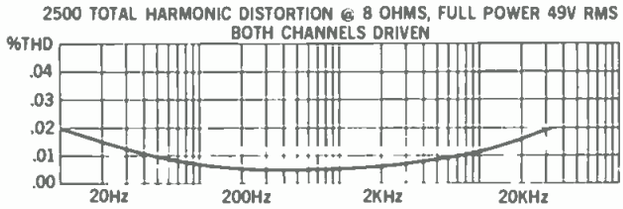
Dimensions..... Front panel: 19"W x 7"H. Chassis: 15¾"D (excluding handles, controls and connections)

*These specifications comply with FTC requirements for power amplifiers.





Reliability. The SAE 2500 gives you high current capability with Parallel-Series-Output Circuitry (PSO)—without loss of wide power bandwidth, low leakage current or super-high slew rate. Sixteen triple-diffused output transistors have an electrical and thermal SOA 50% higher than maximum design requirements for reliable high demand capability. This configuration can handle anything from continuous full signals to highly reactive surge loads—all day long without failure or overheating. Dual relay disconnect circuits and plug-in board design further assure reliable performance.

Features. Feedback level controls assure a constant input impedance of 50k Ohms and reduce the noise figure to more than 100dB below rated output in all positions. Loudspeaker protection relay-activated circuit automatically disconnects speakers in case of ±DC outputs. Plus, direct power reading VU meters and forced air cooling.

The SAE 2500 Professional Power Amplifier weighs only 58 lbs. making it practical for portable sound reinforcement, public address, communications and recording applications.

The professional alternative.

SAE

Scientific Audio Electronics, Inc.
P.O. Box 60271
Terminal Annex
Los Angeles, California 90060

Please send me the reasons (including available literature) why the SAE 2500 Professional Dual-Channel Power Amplifier is the "Powerful Alternative."

Name _____

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City _____ State _____ Zip _____

bines the Dolby B-type noise reduction system with a change in the pre-emphasis time constant to 25 μsec), the broadcaster can fully modulate his transmitter with a signal which is processed, but only mildly so. The Dolby f.m. system gives the listener the opportunity, for the first time, to be able to restore the signal processing and thereby achieve a totally linear channel between transmitter input and receiver output.

Mr. Purcell has raised various specific points about Dolby f.m. We would like to offer the following comments: We disagree that Dolby f.m. processing renders existing receivers obsolete. Experience in the field massively confirms this. The signal is processed to be sure, but it is acceptably compatible. Listening tests show that the undecoded signal is usually much closer to the original signal than signals which have been limited and compressed by conventional means.

The Dolby system may be fading from the foreground, as happens to any new idea when it becomes generally accepted, but in the background it is stronger and more popular than ever. Production of consumer products with built-in Dolby B circuits is increasing all the time. Of these, about fifty models are receivers with full Dolby f.m. decoding capability of which about 300,000 have been made so far.

The extra cost argument was often used against us when we first demonstrated the feasibility of the high fidelity cassette recorder in 1969. Now people are glad to pay the extra cost. In the same way, it's true that receivers with built-in Dolby decoders do cost more. We should add, though, that the average royalty component of the extra cost is only about $0.21 per circuit (two circuits in a stereo receiver).

We agree that compressed sounds are taken too much for granted and that there is insufficient awareness that it really is possible to do something about this situation. If the station removes all its signal processing and turns down the level in order to avoid high frequency overmodulation, then the ± 75 kHz f.m channel capacity is being wasted. Over most of the audio frequency band the deviation will be only about ± 40 kHz or even less, depending on the type of program. This obviously reduces the signal-to-noise ratio and geographic area of coverage. It is also a senseless waste of frequency space in the f.m. band. With Dolby f.m., the station can utilize its full alloted channel capacity of ± 75 kHz and, at the same time, the listener has the opportunity of restoring the signal completely to the state of the source material.

In summary, when used properly, Dolby f.m. makes possible, without a loudness compromise, a wide-dynamic range, wide-frequency response, low-noise signal by which f.m. can fulfill its original promise as a high fidelity medium.

JOHN W. GIBB
F.M. Applications Engineer
Dolby Laboratories, Inc.
San Francisco, Ca.

THE EDITOR;

I was pleased to see in February's issue Norman Crowhurst's article representing the communication industry's other interest: what is being communicated.

Once upon a time, radio was the object of the same loud attacks that are today being directed largely at television by parents, teachers, psychologists and even state officials. Some of the objections were crackpot and some were legitimate, but these days, both programming techniques and critical research are more refined.

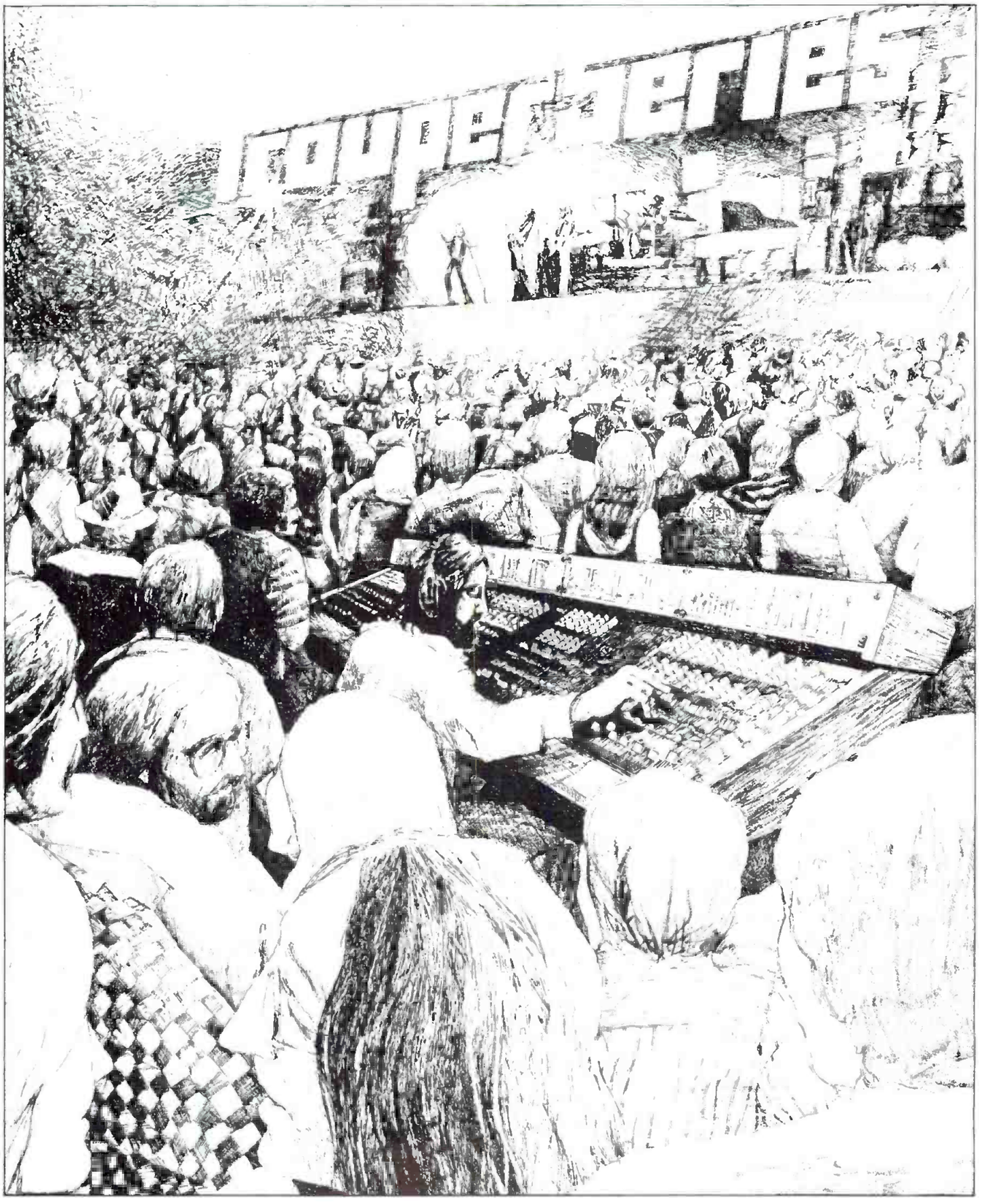
And so we would hope to have achieved some sort of happy symbiosis where both public and the industry participate in a vital association enlightened with mutual regard for the other's welfare. But the enormous pressure for new material to refresh the failing appetites of a satiable audience should be proof enough that mass-media is not the successful give and take that we like to think it is.

Listeners will continue supporting a music industry for years to come and advancing technology will continue to supply the much desired tools. But programmers and producers owe it to themselves to recognize the commercial and social value of broadening their fields of service.

With the same determined cleverness that in the past saved radio from disappearing altogether in the wake of television's success and eventually spurred music on to new inventiveness and prosperity, programmers, by creatively backing off from the narrow focus of music or news, can pave the way for entrepreneurs to seek out new areas (education being one) for the application of our highly successful production techniques. Their success would find a new audience with a new awareness and it would bring to audio the most dynamic material available in any contemporary medium.

BROOKS GARIS
Evanston, Ill. ■

There's a Trouper in every crowd!



Where there's good music, there's a crowd.
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COAXIAL, WAVEGUIDE COMPONENTS

Switches, variable, step and control attenuators, bolometers, dummy loads, crystal detectors, microwave diodes, zeners, and noise sources are listed in this catalog. Mfr: Micronetics, Inc. 36 Oak St., Norwood, N.J. 07648.

POWER SUPPLY

This 12-page catalog encompasses series regulated, switching, ferroresonant, and d.c. to d.c. power. Mfr: Sigma Instruments, Inc. 170 Pearl St., Braintree, Mass. 02184.

AUDIO CARTRIDGE MACHINES

Mono 19½ in. rack or desk mounted units are described in this leaflet. Mfr: UMC Electronics, 460 Sackett Point Rd., North Haven, Conn. 06473.

NOISE CONTROL PRODUCTS

Mastic and felt products for noise control are detailed in this brochure. Mfr: GAF Corporation, 140 W. 51st St., New York, N.Y. 10020.

MECHANICAL COMPONENTS

A chubby little book lists hundreds of gears and other precision items. Mfr: Winfred M. Berg, Inc., 499 Ocean Ave., E. Rockaway, N.Y. 11518.

PERSONAL CALCULATOR DIGEST

This "magazine" not only contains a thorough quick-reference description of various calculators, but some food for thought. What is the effect of calculator use on a child's math ability? Mfr: Hewlett-Packard Co., 1000 N.E., Circle Blvd., Corvallis, Oregon 97330.

STEREO HEADPHONES

Technical points regarding their headphones are detailed in this brochure. Mfr: AKG, Philips Audio Video Systems Corp., 91 McKee Dr., Mahwah, N.J. 07430.

MINIATURE SWITCHES

Toggle, rocker, and miniature push button switches are listed. Mfr: IEE/ Schadow, 8081 Wallace Rd., Eden Prairie, Minn. 55343.

RF TRANSISTORS

A 16-page booklet (Catalog #503) offers a revised listing of microwave VHF, UHF, linear and mobile radio product lines. Mfr: TRW RF Semiconductors, 14520 Aviation Blvd., Lawndale, Ca. 90260.

VIDEO SUPPLIES

Over 400 items are listed in this catalog of video accessories. Mfr: WIDL Video, 5325 N. Lincoln, Chicago, Ill. 60625.

ENGINEERING SUPPLIES

Equipment and supplies needed by engineers are listed in this catalog. Mfr: Track Audio, Box 24722, Seattle, Wa. 98124.

ELECTRONIC KITS

400 electronic kit products are described in this new catalog. Mfr: Heath Company, Benton Harbor, Mich. 49022.

LOUDSPEAKERS

The quirks and innards of loudspeakers are included in this brochure describing the manufacturer's line. Mfr: Allison Acoustics, Inc., 7 Tech Circle, Natick, Mass. 01760.

John Woram's The Recording Studio Handbook

FOR RECORDING ENGINEERS, TECHNICIANS AND AUDIOPHILES

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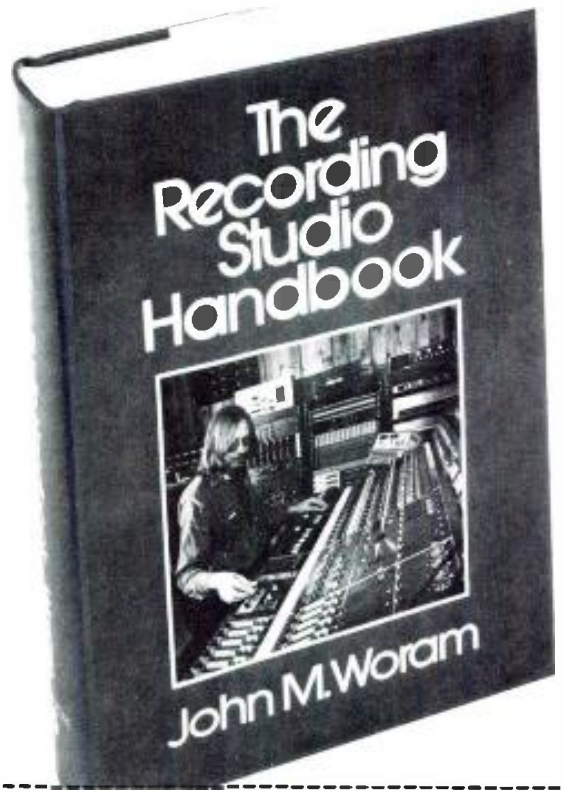
- Tape Recorder Alignment
- Noise and Noise Reduction Principles
- Studio Noise Reduction Systems
- The Modern Recording Studio Console
- The Recording Session
- The Mixdown Session



In addition, there is a 36-page glossary, a bibliography and five other valuable appendices.

John Woram is the former Eastern vice president of the Audio Engineering Society, and was a recording engineer at RCA and Chief Engineer at Vanguard Recording Society. He is now president of Woram Audio Associates.

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db Broadcast Sound

Stereo Modulation Monitor

• The f.m. station which transmits in stereo must monitor the stereo aspects of the transmission as well as the total modulation of the carrier. The total modulation function is essentially the same as the monaural monitor we discussed in an earlier column, except that it must have wider specs. This function may be part of a combined monitor or it may be activated by a separate unit. The trend is toward separate monitors—one for total modulation and one for stereo functions. Whatever arrangement is used. the monitor or monitors must be FCC-type approved for stereo use. The stereo section works with the composite signal, which is recovered by the demodulator in the total monitor. or in some cases it may use a separate demodulator for the same purpose. There are a great many circuits and functions in the stereo section of the monitor, more perhaps than the a.m. and monaural f.m. monitors combined. Space doesn't allow us to discuss all these functions but we will try to touch on a few of the more important ones.

THE SIGNAL

As far as the f.m. carrier modulation and demodulation are concerned, these are essentially the same for monaural or stereo, except that for stereo the modulating signal is a composite signal rather than audio.

The composite signal is created in a stereo generator which is external to the transmitter. This generator will blend the station's left and right audio program channels together by one of the several methods in use today. Regardless of the processing method, the generator output will be only *one* signal—the composite signal, which contains three components: the L+R component. double sidebands of the amplitude modulated, suppressed 38 kHz subcarrier, and a 19 kHz pilot component which is taken from the oscillator circuit of the subcarrier oscillator. All these components have a phase and amplitude relationship to each other that must remain intact throughout the transmission and recovery process.

DISTRIBUTION

The composite modulating signal will be recovered by the demodulator in the total modulation monitor and then distributed to the various monitoring and measurement functions. The total modulation monitor section will measure the modulation of the f.m. carrier by the composite signal with its modulation meter and flasher circuits, just as it would do with an ordinary monaural modulating signal.

The various functions in the stereo section will work with either the full composite signal or with one or the other components of the signal. When only a single component is required, the component will be extracted from the composite signal by an accurate filter. The filters must not distort the extracted components (or the composite signal) in any manner; otherwise the measured results will be in error. The accuracy of these filters

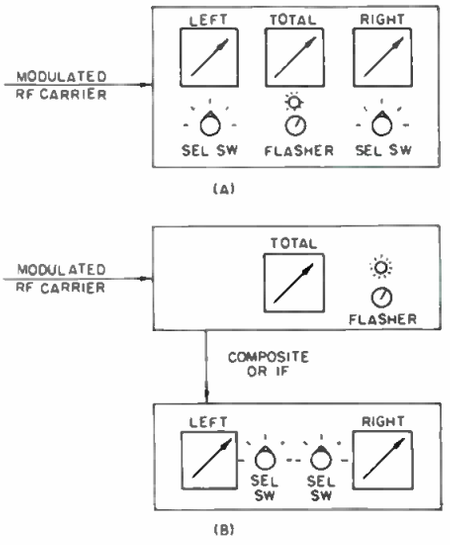

Figure 1. Two different arrangements can be used; a combined unit or separate units. The left and right meters also serve as test meters. At (A) a combined monitor, and at (B) separate units are shown.

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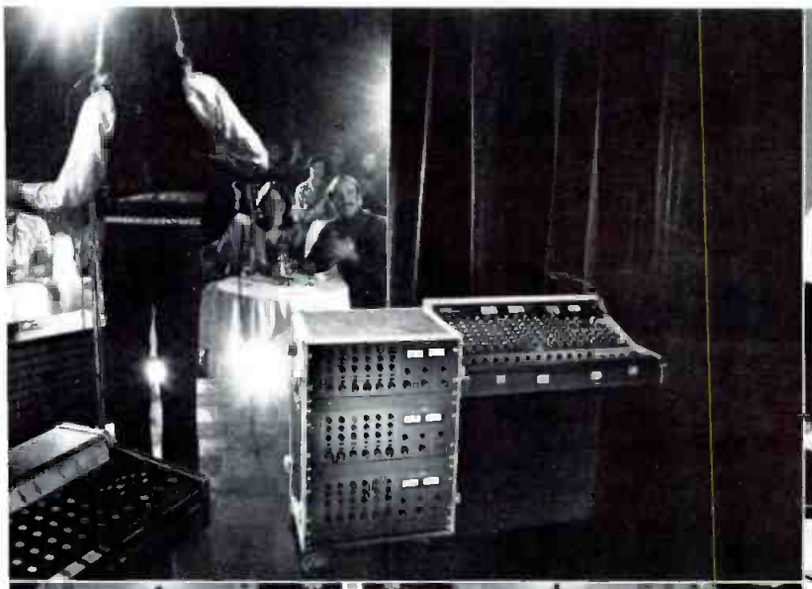

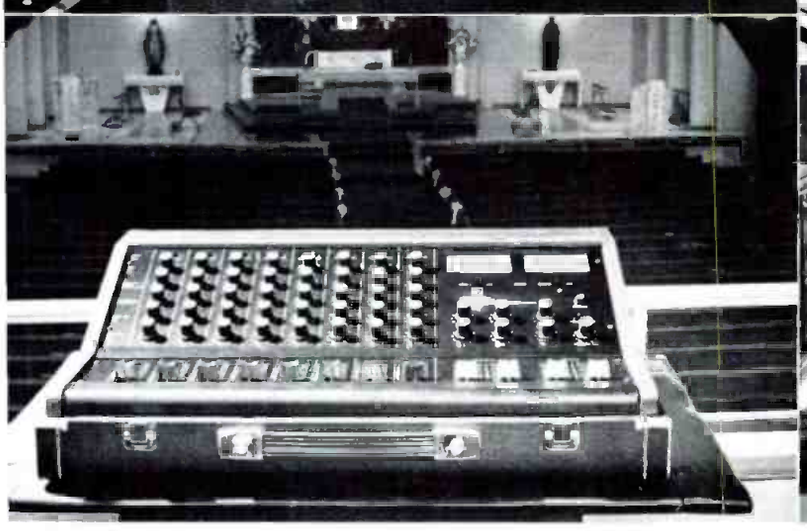

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YAMAHA

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enter into the overall accuracy of the monitor.

THE PILOT

The 19 kHz pilot component is an important element in the subcarrier sideband recovery process because it will be used to reconstruct a 38 kHz subcarrier. The amplitude at which the pilot is transmitted must be measured and held to within 8 to 10 per cent of the total modulation. A narrow pass filter is used to extract this component from the composite signal and then it is routed to a front panel selector switch. This switch is the input selector for a wideband a.c. voltmeter circuit. Besides other scales and markings, the meter face has a special scale for measuring the pilot in percentage.

The extracted 19 kHz is also amplified and doubled in a frequency doubler to 38 kHz This 38 kHz is now a reconstructed subcarrier and will be used in the recovery process, but it must have the same phase relationship to the sidebands as did the original subcarrier. Some monitors will use a phase-lock loop to tightly control the phase of this signal, while others use a manual phasing control.

STEREO DEMODULATION

Restoring the left and right audio channels actually involves two separate processes: recovery of the L-R audio from the subcarrier sidebands, and the matrix of this L-R audio with the L+R component to reproduce the left and right audio output. Although these are separate processes, they are generally done at the same time and often in the same circuitry.

The modulation components in the sidebands of an amplitude-modulated wave cannot be faithfully recovered by simple rectification of the sidebands alone—a carrier must be present. In normal a.m. modulation, for example, our a.m. broadcast signal, the carrier is transmitted right along with the sidebands, so a simple detector can be used. But when the carrier is missing, as is the case with our subcarrier in stereo multiplex, we must either reinsert a carrier or use a carrier to operate the detector. This carrier must have the same phase relationship to the sidebands as did the original carrier and it must be several times the amplitude of the sidebands.

THE DETECTOR

There are several different detector circuits in use today for stereo demodulation. I.c. technology continues to develop more types; some of the older circuits are now on an i.c. chip with a great improvement of the performance. A detector which has been popular in some monitors is similar to the double-balanced modulator, except that it is worked in reverse. I will discuss this type of detector to show the decoding action, but will use a simple circuit of discrete components without the balancing and trimming resistors necessary for discrete components.

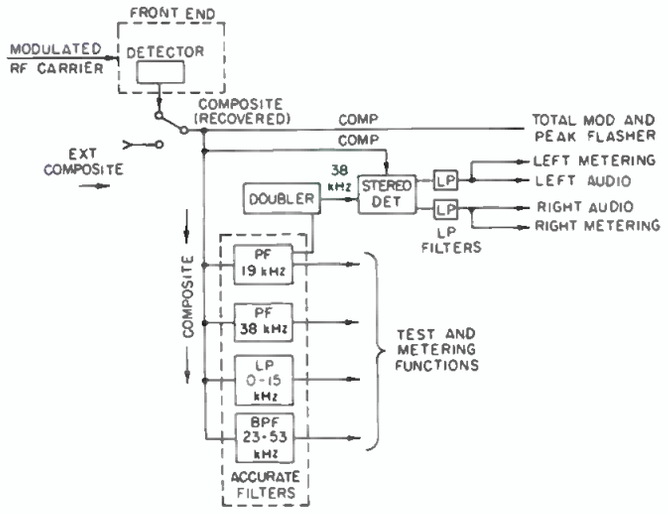


Figure 2. The composite signal is distributed to many circuits. Some use only one component of the signal; this is extracted by an accurate filter.

Four diodes are placed in a quad arrangement for detection. The matrix action takes place in the load resistors at the detector's output ports. (To simplify things, I will discuss the two actions separately.) A reconstructed subcarrier is used to operate and to control the detector's action; this is coupled across the quad by the transformer. The full composite signal is applied to the center connection of the two load resistors—the opposite ends of these resistors connect to the detector's output ports and to the left and right audio outputs.

SIDEBAND RECOVERY

Since the composite signal is fed to the center connection of the two load resistors, it appears at the opposite ends of these resistors at the same instantaneous phase and amplitude. If the pilot is missing or if the signal is monaural, the audio outputs will feed the left and right amplifiers in-phase monaural audio, or they will respond to the L+R component in the composite signal. In either case, the monitor's audio amplifiers reproduce a monaural audio signal.

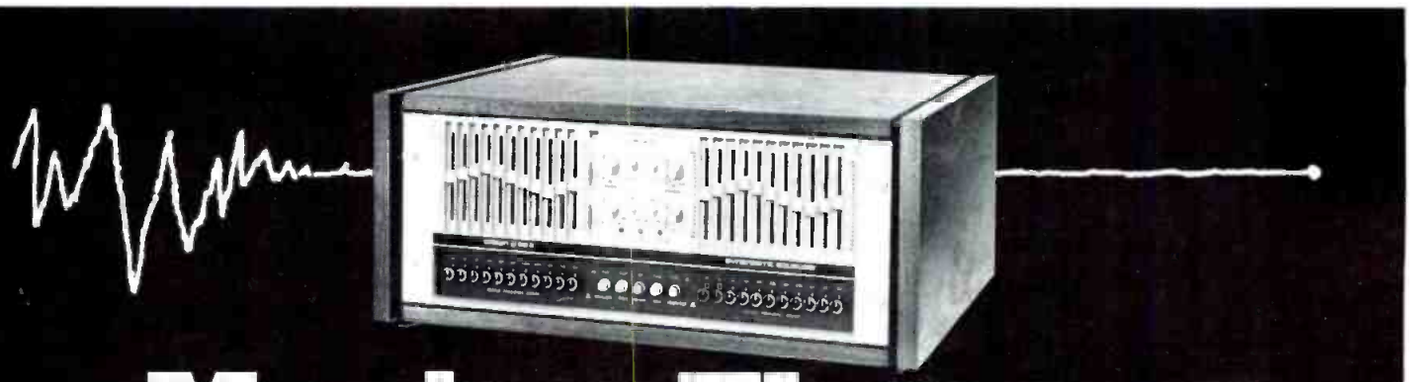
When operating in stereo with the pilot present, there is a reconstructed subcarrier and the detector becomes active. The 38 kHz is coupled to the quad and is effected by normal transformer action. As the first half cycle of the 38 kHz goes in a positive direction, it appears across the secondary, reversed in phase. The secondary is center-tapped so the voltage is 90 degrees out of phase from each end to the center-tap; the top is minus with respect to the center-tap, the bottom plus with respect to the center-tap. These equal-but-opposite polarity pulses cause diodes 1 and 2 to conduct. This grounds the lower end of R1 (and right audio output) through the center-tap of the transformer.

At the same instant this action takes place, the sideband voltage is also in a positive direction at the left and right audio outputs. But the right output is grounded by the diodes, so nothing can pass to the output. The sideband voltages do pass to the left audio output.

As the subcarrier goes negative during its second half cycle, opposite conditions occur on the transformer secondary so that the upper end is now plus and the lower end is minus. This causes diodes 3 and 4 to conduct, thus placing the left output at ground. At this same instant, the sideband voltage is also negative going at both outputs, but now the left output is grounded so nothing can pass. Therefore the right ouput receives a pulse of negative sideband voltage. At each half-cycle of the 38 kHz subcarrier, this action alternates in the detector and results in the recovery of the L-R audio component from the sidebands. The phase (polarity) of the recovered audio at each of the outputs is opposite to that of the other. The recovery into two separate outputs is somewhat similar to the use of two separate detectors in the a.m. modulation monitor for selection of positive and negative modulation peaks.

MATRIX ACTION

The composite signal is made up of different components that have a phase and amplitude relationship to each other. Besides the sidebands, the L+R component is present at the same



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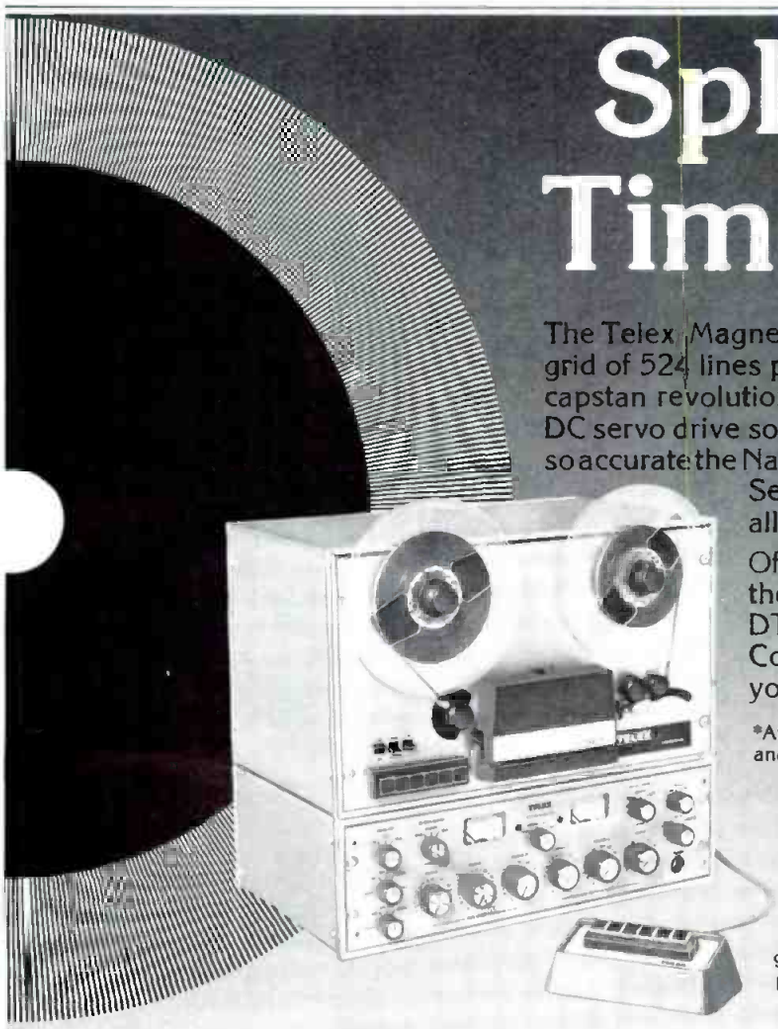

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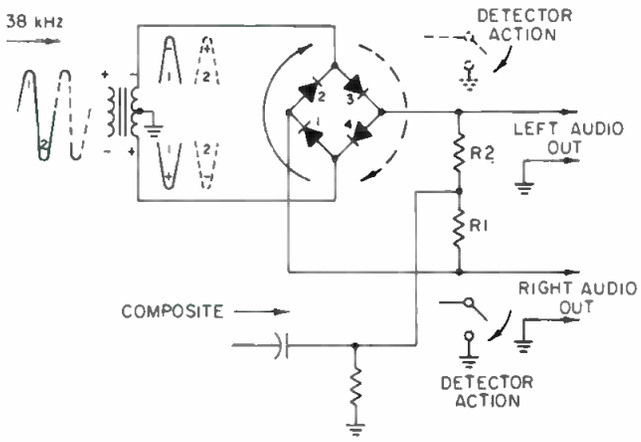

Figure 3. The stereo detector and action by the 38 kHz reconstructed subcarrier.

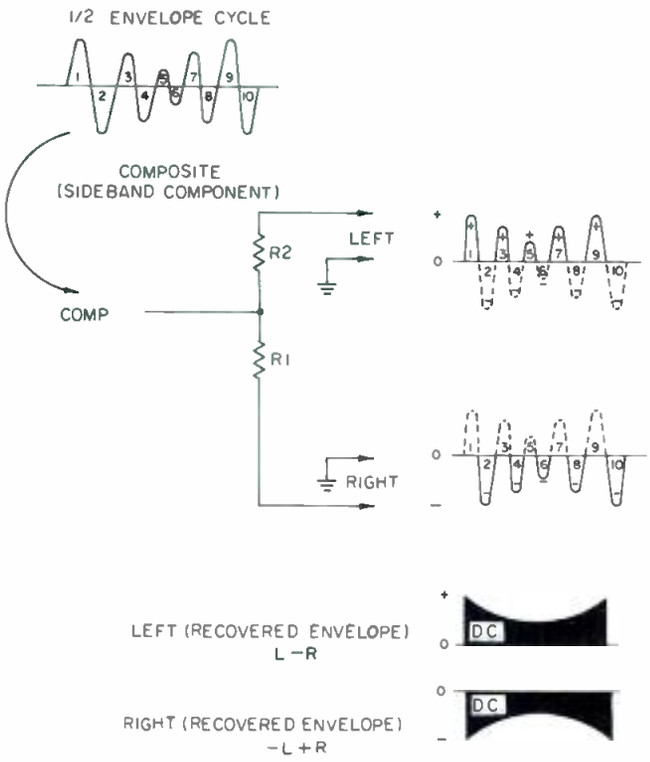

Figure 4. Detector action in recovering the audio from sidebands. (Waveforms are expanded for clarity, and only one-half of the sideband envelope is shown.)

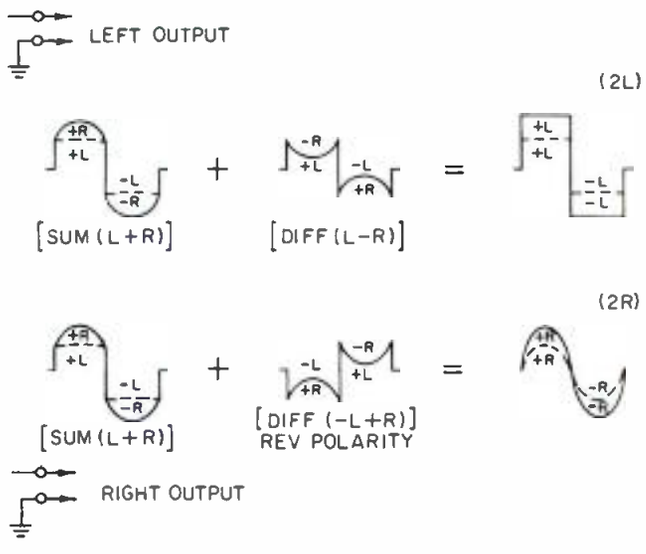

Figure 5. Matrix action at the detector load resistors. (The original audio signals are a square wave and a sine wave.)

time. The detector does not recognize individual components, but simply works on the circuit and all signals that are present at that instant. Besides recovering the L-R audio, the detector is working on the L+R component at the same time.

The L+R component of the composite signal is the same as the audio signal in a monaural transmission and actually serves the same purpose for a monaural receiver that is tuned into a stereo transmission. This component will always appear at both outputs in-phase, as I mentioned earlier when discussing a monaural signal. With the L+R at both outputs in phase, and the L-R also at both outputs (one is reversed in phase), the matrix action is adding these signals together so that a left and right audio results. The left will be twice the amplitude of the L component (2L) and the right twice the amplitude of the R component (2R). This is not a circuit gain. The original audio was divided up in the stereo generator, so this action is now restoring the original amplitudes.

TESTS

Besides the monitoring of the program facilities provided by the monitor, many test facilities are also provided. The desired test functions are selected by front panel selector switches which couple the desired signal components to wideband, a.c. voltmeters. These voltmeters have accurate calibrated pads making it possible for a variety of measurements to be made. A few of the tests provided, are stereo separation between left and right audio channels; crosstalk measurements between main channel and sub-channel (and reverse); 38 kHz sub-carrier suppression, as well as the usual noise and distortion measurements of the left and right audio channels. Individual monitors also provide a variety of other measurements.

SUMMARY

The stereo monitor is a complicated and versatile test and monitoring facility. The detectors and the accuracy of the filters determine the overall accuracy of the monitor. The calibration and operation also affect the results obtained. The variety of test procedures available in the monitor is a boon for f.m. stations, who would otherwise have to purchase a variety of test instruments to measure the stereo system. As with any test instrument, aside from basic accuracy and operation, the results obtained depend upon the procedures used for the particular monitor and understanding of its circuitry. Next month, I will discuss some of the problems in monitoring the stereo transmission. ■

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Amber model 4400 Multipurpose Audio Test Set.
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The Amber model 4400 Multipurpose Audio Test Set—a powerful, comprehensive test instrument combining in a single package almost all the test and measurement facilities needed for professional audio testing.

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It incorporates a function generator with low sine wave distortion, 10 octave log sweeper, tone burst generator, noise generator and high power (over +30 dBm) output amplifier. It has an auto-ranging digital dBm meter with over 150 dB measurement range, a frequency counter, a multifunction filter that can be used as a spectrum analyser and four digital memories that give you X Y frequency and phase response plots on any non-storage oscilloscope.

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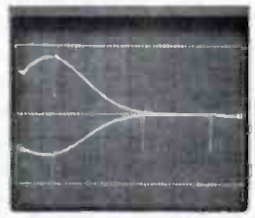
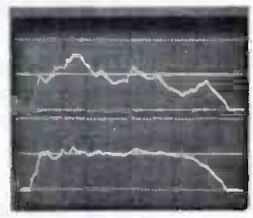
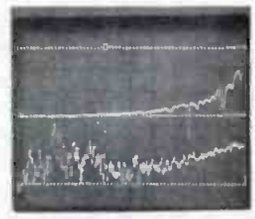
Oscilloscope photographs of some typical examples of plots made using the 4400 and an oscilloscope.



Swept sine wave frequency response plot of the reciprocal action of a low frequency equalizer. The small negative spikes are markers at 62Hz, 1kHz and 8kHz. The amplitude window between the top and bottom reference lines is 30dB; the horizontal axis is log 20Hz to 20kHz.



Frequency response of the speaker and room in a monitor system. The top trace, with 40dB window between reference lines, is before equalization; the bottom trace after equalization. The source was pink noise and the plots were made using the spectrum analysis mode with a ⅓-octave bandwidth.



Spectral analysis of the noise floor of a tape recorder playing back erased tape. A 2% filter bandwidth was used. Bottom reference line is −90dBm, top −30dBm. Second trace is phase shift versus frequency between two reproduced tracks. Top reference line is +180°, middle 0° and bottom −180°. The marker is at 4kHz in the 20Hz to 20kHz sweep.

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NORMAN S. CROWHURST

Use of Analogs: Part I

• Some recent questions I have received have related to comparisons among different kinds of loudspeaker enclosures, such as acoustic suspension, loaded reflexes, and so forth, and some problems in modifying such designs, or in converting from one to the other. In tackling these procedures, it is not long before someone tries to draw an analog diagram to see what he is doing. And that is where the problems in understanding *really* start. If you study one of the classic textbooks, you will find a whole set of analogs rather than just one, which seems to add to our confusion.

An excellent paperback published as a translation in English, by Bent Gehlshøj from the Danish Academy of Technical Sciences, in 1947, has been sitting on my bookshelf (but is well worn) for many years. Here in TABLE I will repeat a table of mechanical analogies from that book:

VELOCITY

The acoustical analogy is similar, but complicated by the fact that *volume* current, rather than just current, substitutes for velocity. The introduction of area through which air flows adds an extra dimension that is not in the mechanical or electrical systems. But that is not the main cause of most peoples' difficulty.

The real problem is more basic than that. In a mechanical system, all units break down to simple integral exponents of basic dimensions. Starting with the fundamental dimensions of d for distance, or length, m for mass, and t for time, velocity is d/t, acceleration is d/t^2 and force is md/t^2.

From that, mechanical impedance is force divided by velocity, which becomes m/t. You can complete the table, if you wish. But now turn to the electrical analogies. Using basic definitions of force and motion, work done, etc., we derive units in terms of mechanical basics, based on electrostatic or electromagnetic phenomena.

Whichever you use, you end up with fractional exponents of m and d, and when you correlate the two systems the ratio of their dimensions is always a velocity (d/t), a reciprocal of a velocity, or the square of a velocity, or its reciprocal.

You know by now, of course, that this velocity is the propagation velocity of electromagnetic waves. But the problem arises because we have difficulty thinking about fractional exponents as dimensions. I have met a lot of people who have trouble with the exponent in acceleration, d/t^2. When that is compounded with m and d to various fractional powers, we tend to give up trying to think in those terms at all!

What was a help to me was the theory of interrelation between electric currents and magnetic fields as they appear in inductances and transformers. First take a simple, solid cored, gapped inductor (FIGURE 1).

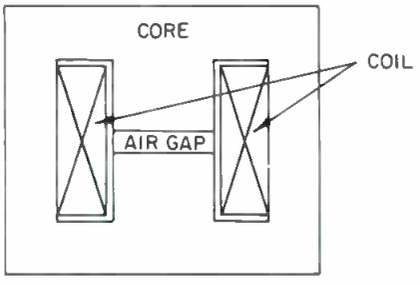


Figure 1. Cross-section of inductance, using a core with an air gap. How does inductance depend on the gap dimensions?

Suppose the air gap is 1 inch square by 0.2 inch between the poles and the inductance of 1000 turns on such a core is 420 millihenries. What will be the inductance if the gap is reduced to 0.1 inch, or if it is increased to 0.4 inch?

You think of the analogy between magnetic field and an electrical circuit. Reducing the length of the magnetic path in air will reduce the magnetic potential needed; increasing the length will increase it. So you might conclude that reducing the gap would reduce inductance—increasing the gap would increase it. But you would be wrong.

Inductance depends on the *permeability* of the magnetic circuit which, in electrical analogy, is equivalent to admittance. So reducing the gap from 0.2 inch to 0.1 inch will increase the overall permeability of the magnetic circuit to about twice because most of it is in the air gap. Reducing the air

TABLE 1

Mechanical system		Analogy I Impedance Diagram		Analogy II Admittance Diagram	
force	f	voltage	v	current	i
velocity	v	current	i	voltage	v
impedance	z	impedance	z	admittance	Y
mass	m	inductance	L	capacitance	C
compliance	c	capacitance	C	inductance	L
elastic energy	$\frac{1}{2}cf^2$		$\frac{1}{2}Cv^2$		$\frac{1}{2}Li^2$
kinetic energy	$\frac{1}{2}mv^2$		$\frac{1}{2}Li^2$		$\frac{1}{2}Cv^2$

Table 1. The table of mechanical analogies.

gap from 0.2 inch to 0.1 inch will increase inductance from 420 millihenries to about 840 millihenries.

Going the other way will reduce inductance. But a gap of 0.4 inch will cause considerable fringing of the field, increasing the effective area considerably above 1 square inch. So the inductance will not fall to half, but to something above that.

LEAKAGE INDUCTANCE

So much for simple inductance using a core, the main reluctance of which—the air gap—can be adjusted or controlled. Now let us turn our attention to something a little more complicated—leakage inductance. First consider it as two windings, as in a transformer, on the same core (FIGURE 2).

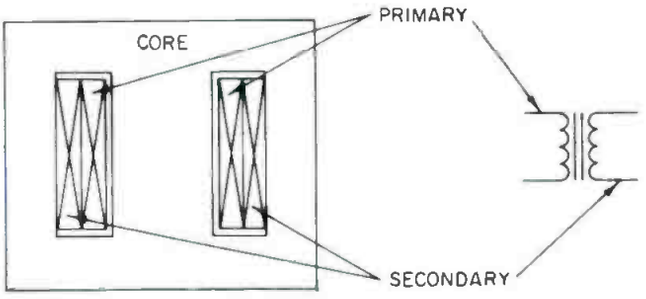


Figure 2. Cross-section of an ordinary transformer, to show relationships relative to transformation.

The main inductance is due to the high-permeability core, which is a complete magnetic circuit. If one winding has 1000 turns and the other has 2000 turns, and the permeability of the core is very high, the inductance of the 1000 turns may be more than 100 henries and that of the 2000 turns will be more than 400 henries.

I say *more than* because the inductance of a high-permeability core carrying a winding is not only high, but variable. Normally other values in the circuit will be such that this inductance is not critical anyway. So, suppose the 2,000 turn winding connects to a load of 10,000 ohms and delivers 4 volts across it. The current into the 10,000 ohms will be 400 microamps.

Now, by transformer action, because the inductances are so high that negligible current flows due to them, the 1000 turns will require 2 volts across it to produce the 4 volts across the 2000 turns. And the 1000 turns will require 800 microamps into that to produce the 400 microamps taken from the 2000 turns. What does this mean?

A resistance that takes 800 microamps at 2 volts is 2,500 ohms, or one fourth the load connected to the 2000-turn winding. Impedance is transformed by the square of the turns ratio.

LEAKAGE BETWEEN THE WINDINGS

But so far we have not considered leakage inductance *between* the windings. If the main inductance is in hundreds of henries, the leakage inductance of a good transformer will be in tens of millihenries. But here is the question: how does leakage inductance depend on the dimensions of the windings and their disposition one to the other?

One simple configuration is shown in FIGURE 3, where dimensions I_t, L_L

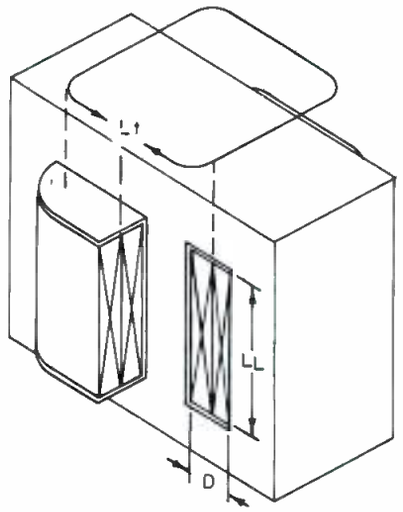


Figure 3. Dimensions of transformer windings, relevant to leakage inductance. How does leakage inductance depend on these dimensions?

and D are identified. How does leakage inductance vary as each of these dimensions is changed, keeping the others constant? The best way to resolve this is to get a clear picture in your mind what leakage inductance really is—an inductance due to imperfection in coupling.

In one sense, it is like the inductance due to the air gap of FIGURE 1. Lengthening the leakage flux path will reduce the inductance while increasing its area so there is a greater amount of leakage flux will increase the leakage inductance. So applying that principle, increasing L_t and D will increase inductance; increasing L_l, will reduce leakage inductance.

In transformer design, especially for audio work, the usual problem is to keep leakage inductance as small as possible and primary inductance, due to the core, as large as possible. Pursuing the techniques by which this can be done is a very interesting study, but there is an even more interesting application. Instead of regarding leakage inductance as an enemy, to be minimized, can we actually use it, as an element in filter design. for example?

USED IN FILTERS

Over the years, I have designed some quite successful filters in which leakage inductance has been used as an element. It has several advantages over ordinary inductances that I will come to later. For now, I want to settle something that comes in the realm of theory and practice and that has caused many arguments over the years, some of which have been settled only by demonstrating that it works!

Many transformer books treat leakage inductance as being the amount by which a coupling factor falls short of 100 per cent. In a good audio transformer, the coupling factor is probably 99.99 per cent, or even better. But there is a danger in viewing it that way. The primary inductance, which is 100 per cent, uses a core of some magnetic material with permeability and thus has an essentially variable inductance.

So many people believe that because leakage inductance is the remaining 0.01 per cent, or whatever it is, that it must be variable too. The fact is, it is not, because the path of the leakage flux to which this inductance is due is totally in air, or at least in nonmagnetic material, such as the turns of the windings. But, while it is thus a sort of *air-cored* inductance, it can have a higher Q than ordinary air-cored inductors of the same size, because the use of a core changes the basic dimensions very radically.

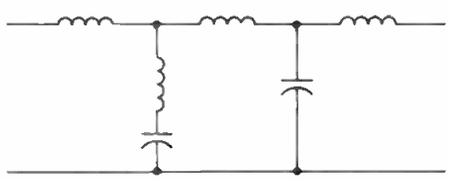


Figure 4. A form of m-derived low-pass filter that can easily be tailored to use leakage inductance for all the inductor elements. How would you go about designing it? Answer next month!

Now, how do you use this inductance to build a filter? FIGURE 4 shows a filter that lends itself very well to the use of leakage inductance. Space has gone for this month, so I suggest that, as an exercise in theory and practice, or if you prefer, an exercise in how new methods of instruction, leaving you with a challenge, can be employed, you spend some odd moments between now and when next month's issue arrives trying to figure out how to build the filter. I'll go into it reasonably thoroughly (after all, this is not an inductance design course) next month. Then, you can check your own findings with mine! ■

MARTIN DICKSTEIN

db Sound With Images

• In the past few months, this corner has tried to indicate to those who are responsible for setting up an audio visual meeting at a hotel conference room or other similar location some of the precautions to take and a few of those checklist items that are essential to a satisfactory presentation. In the past month or so, further evidence has been presented to me that there is still a great need for improvement in the relationships between the renter, the rentee, and the possible middle man—the hotel sales person (catering person, in some cases). So, please let us enter a few more pleas for greater involvement by the rental companies in the total project.

First, let's ask a question I have repeated on several different occasions. Is there a reason for rental companies to insist on anonymity in dealing with the people renting the equipment? Does a rental organization like to keep its name in the background to avoid coming in contact with the nuisance of having to deal with the "idiots" who are renting the "stuff"? Maybe it's easier that way. The rental is still made, the bill is submitted, and the charges are usually paid without too much fuss. If the hotel has acted as middle man to the rental, the rental dealer thus avoids getting involved, leaving the hotel sales person to placate the meeting people.

One recourse is that there might be another meeting some time in the future in the same area arranged by a different company or by another division of the same organization; word of mouth can sometimes be a strong weapon. On the other hand, a little extra service, even if the additional cost is added to the bill, will help to spread a good name by the same means.

Perhaps the plea should be for the rental sales person to let the hotels know that even if there are additional requests they will still be able to charge for the rental equipment in the normal manner; whatever extra charges are incurred or added by the rental dealer can even be marked up by the hotel, if only the hotel catering (or sales) personnel responsible for arranging for the rental for the meeting would let the conferees know from whom the equipment is coming so they can deal directly. Not only is the rental company sales person more knowledgeable about the equipment, but he can check immediately with his experts if needed on some of the operating intricacies, preventing problems before they happen.

I recently came across this during an adventure into the hinterlands of the Southwest for a client. The a/v display was for a national sales meeting in which the show designer had decided that there should be a multitude of screens for greater effect. The clients approved, but felt that they would like to have their own technical consultant (me) on the project to coordinate among the program producer, the area audio visual dealer, the conference center personnel, and the people paying for the project—the client.

I went on a survey trip to find out what was in stock at the conference center. Not only did I have to check on the quantity of various devices to be used, but even on specific models because some units could not be used for the intended functions.

The audio room was amazing. A whole wall of a fairly large room was completely covered by amplifiers, mixers, switch panels, patch panels, logic circuit readouts, meters, equalizers, and indicator lights—enough to make the crew on the Enterprise blink. At least a dozen mono reel to-reel tape recorders were on hand, and about the same number (or more) of the latest models of Kodak slide projectors. Film projectors were missing, as were such items as dissolves, etc.

THE MEETING ROOM

Part of the purpose of the trip was to check out the meeting room to be used at the conference. The ceiling was 14 feet high (with no suspended lighting or chandeliers) in the center, and 12 feet around the sides. The length was 89 feet, and the width 34 feet. The ceiling distribution system for the sound was pretty clean with the music coming through. Since microphones and small portable mixers were available, it was possible to set up a mini-mixing location for the microphones. In general, all appeared to be quite satisfactory and the fellow in charge of the operation of the system seemed knowledgeable.

When we started to discuss the details of the show, it turned out that the very large rear screen needed would have to come from an audio visual house in the nearest large city. Okay. This supplier could also provide us with the film projector we needed, and they would bring in the rear projection lenses for both the slide and film units (eleven slide projectors, two film projectors). So far so good. Some doubt started to creep in when we began discussing the dissolves. The only kind the dealer might have would be the Kodak unit, and maybe only one or two, not four.

DISSOLVE CRISIS

Was there any possibility that the

db New Products & Services

PARAMETRIC EQUALIZER

● —40 dB notches can be consistently obtained by Model 622 parametric equalizer, second-generation to Model 621 series. The new model has in/out switches on each of its four bands, standard balanced input with output transformer option, extensive rf shielding and 115/230 volt, 50-60 Hz a.c. power supply. Other features include four cascaded sections, each with noninteracting, continuously variable center frequency, bandwidth, and amount of boost or cut. Each section tunes over a 25:1 frequency range with broadly overlapping coverage. All potential overload points in the circuit are monitored by an overload light; overloads can be corrected with the integral gain control. Claimed thd is less than 0.025 per cent. 20-20,000 Hz at + 18 dBm. The unit is available in single and dual-channel configuration on a rack mount.

Mfr: Parasound, Inc.

Circle 50 on Reader Service Card

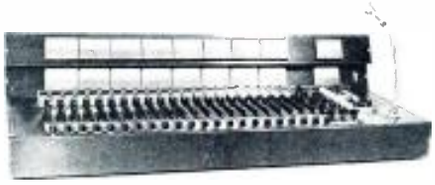
16-TRACK CONSOLE

● Sixteen track outputs plus four independent cue/echo sends are provided on Series 316 sixteen track recording console. Input module targets flexibility, including a parametric mid-frequency equalizer tuneable from 150 to 7,500 Hz. The unit has phantom power, phase reverse, panpot, six-step preamplifier gain set switch with two input pad positions, and a conductive plastic slider attenuator. Console mix-down handles control room monitor and solo-to-monitor-only. Included is a track master and talkback/slate module with gooseneck microphone. The mainframe available with 32 or 24 inputs, has 18 four-inch lighted vu meters, regulated power supply, and masters. The console is modular and uses high-slew rate internally compensated plug-in integrated circuits. Options include output transformers and a dual octave graphic equalizer.

Mfr: Interface Electronics

Price: $8,870.00.

Circle 51 on Reader Service Card



ALIGNMENT OSCILLATOR

● Lining up tape recorders, noise reduction systems, etc. is facilitated by Type 464 alignment oscillator. The device incorporates a 10-frequency oscillator with +20 dBm output capability and frequencies selected by push buttons, matching common test tapes. A calibrated vu meter measures the machine output or oscillator level; the two inputs to the meter may be summed for accurate azimuth adjustment. Frequency range of the oscillator section is 30 Hz to 18 kHz. Maximum output level is +20 dBm. Frequency response is flat to within 0.2 dB throughout the range. Claimed distortion with a 600 ohm load is less than 0.1 per cent thd at any frequency.

Mfr: Midnight Audio (Gregg Audio Distributors)

Circle 52 on Reader Service Card

MIXER/PREAMPLIFIER

● Sleek-appearing S-2500 mixer/preamplifier blends into a disco setting. The stereo mixer features six inputs with individual level controls, master level control, four bands of equalization, two band microphone equalizer, and large illuminated vu meters. A special balance control minimizes the possibility of overdriving speakers and power amplifiers.

Mfr: Showco Mfg. Co.

Circle 53 on Reader Service Card

sound with images (cont.)

hotel a/v man could get four of the kind we needed, somewhere else? Calls would have to be made; since it was a bit late in the day the calls would have to be made the following day. I then asked if I could have the name of the dealer so I might call him myself, not to rent the equipment but to discuss the requirements and to save time and long distance phone calls in case of questions. This meant that if the dealer had a model different from the one I requested, that it might be okay to use it, but I did want to be sure the functions would work in the system as it was to be set up. The rental would still be made by the center.

There was a pause. It was obvious that the conference center fellow was trying to think of a nice way to tell me he wasn't going to tell me. He finally told me he felt he shouldn't tell me. Why? He felt that he could relay any information I gave him to the dealer and that it would be okay. No amount of persuasion would work on this chap. He steadfastly refused.

I asked him to make the calls early in the day so that I could get my information before too late on the following day (with the three hour delay in time between the east and west, N.Y. gets ready to go home when the west goes to lunch). He promised.

The following day, I could not get him on the phone. I left numbers and asked him to call back—even collect. No dice. Then came the weekend, and the next Monday was his day off. No one else knew what I was talking about. I finally got to him and he told me he thought the dealer could get the dissolves.'I would have to call back the next day. With great difficulty. I finally reached him and was told that the equipment would have to come in from the coast—the west coast, that is, not the east. (That might have been funny to him, at the time, and was intended to: a) make me feel better and relieve his embarrassment, b) make me say "Whew! What a relief!" and c) pacify me into agreeing to have the equipment come in by air shipment.) I told him I would bring my own to be sure I had what was needed. He said he would keep trying, to save me the difficulty of having to bring it.

I then made one more check with him to see if he might have had any luck. He told me that the equipment had been ordered from the west coast —that was the best he could do for me. I reviewed our previous conversation with him, but could not make him agree that I had rejected his proposal of getting the equipment from the coast ("the west, not the east"). Well, he could cancel the order, of course, but the client would have to be charged a cancellation fee. Well, (again), we had it out and the matter was settled that the fee would not have to be paid and he would indeed cancel the order.

All of that to-do occurred because the conference center rep felt he had to avoid mentioning the name of the supplier. (I had also tried, by other means, to have the client contact his superior, but that idea was turned down and the fuss all finally settled down quietly.) The decision to bring our own equipment was approved and that was that.

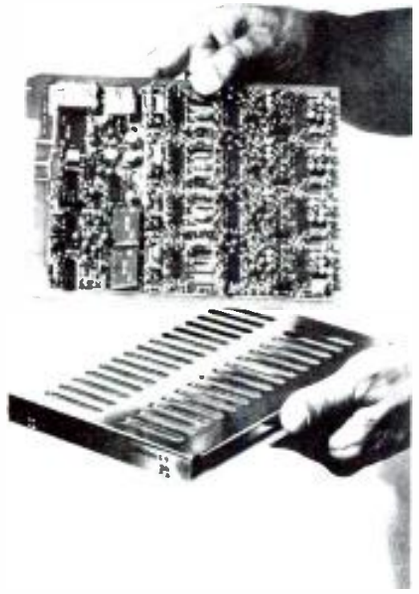
In all fairness, I must say that the fellow did come through with the physical set-up of the screen, the behind-the-screen arrangement, the lighting, the equipment, and so on. I now know the name of the supplier, of course, since they were not reluctant to have their labels on all the boxes, cases, and pieces of equipment. I intend to find out from the dealer myself how he feels about this situation, but I should appreciate hearing from others how they feel. ■

new products (cont.)

COMPANDER NOISE REDUCTION

● The production of a stabilized gain controlled amplifier system is achieved by Telcom C4 compressor/expander (compander) by dividing the audio signal into four separate pass bands and applying the proper attack/release behavior to each of these bands. This is followed by a constant compression over the entire dynamic range. The expander always tracks the compressor properly even if the two are not closely aligned, a valuable asset in situations such as long lines transmission or satellite communication. Telcom C4 is available as a retro-fitting card for units manufactured by Dolby Laboratories. Re-alignment of the system is not necessary when switching over from the cat. 22 card to the Telcom.

Mfr: Gotham Audio Corp. (Telefunken)
Price: $700.00.
Circle 54 on Reader Service Card



DYNAMIC MICROPHONE

● A patented mechano-pneumatic shock mount system on dynamic cardioid SM59 microphone reduces mechanical noise and pickup of floor and desk stand vibrations. Frequency response is 50 to 15,000 Hz. The mic is equipped with a pop filter. It's lightweight (7.6 oz.), suited for both indoor and outdoor use.
Mfr: Shure Bros. Inc.
Price: $132.00.
Circle 55 on Reader Service Card

AUDIO LOAD KIT

• Included in kit ID-5252 are components for an amplifier tester providing loads of 2, 4, 8, 16, or 32 ohms. A series of five-way binding posts allow it to handle up to 240 watts mono or four 60 watt inputs, both into 8 ohms. Also included are jacks for connecting a voltmeter, oscilloscope or other instrument at the load in use. The kit includes four 3-foot #12 gauge leads with spade lugs.

Mfr: Heath Company
Price: $44.95.
Circle 56 on Reader Service Card

PEAK LIMITER/COMPRESSOR

• Stereo or quad applications fit the parameters of flexible Model SC-50 peak limiter/compressor. A wide range of attack, release, and ratio adjustment allows tailoring of the limiting action to suit any program source. A program-dependent dual release time action provides quick recovery from isolated transients while allowing slower release from sustained overdrive. All of this happens through a closed loop detector circuit which keeps the output ceiling accurate at high compression ratios and maintains smoothness down to a 2:1 ratio. Claimed noise is −90 dBV and distortion of less than 0.05 per cent. Gain reduction and threshold are indicated by an l.e.d. display. Two or more limiters may be connected to provide tracking in stereo or quad.

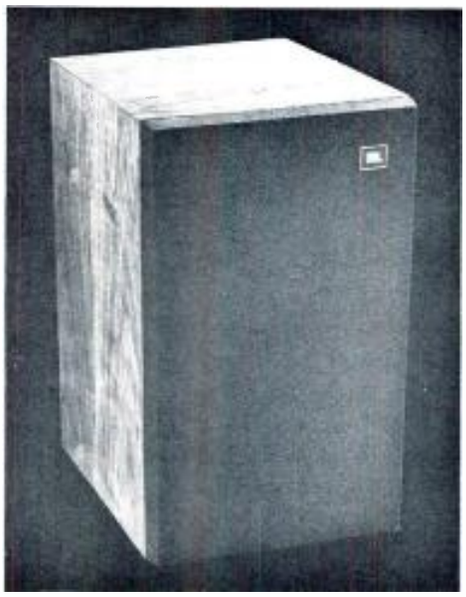
Mfr: Ashly Audio
Price: $299.00.
Circle 57 on Reader Service Card

HEADPHONE MULT BOX

• Source selection (off-stereo, cue 1, cue 2) and level control for four separate head phones are provided by HPM 1200 headphone mult box. The 2-pound box has both phone and XLR connectors. utilizes total printed circuit construction and is complete with an output multing connector. Two watt current limiting resistors protect voltage sources. The box has rubber feet; it can snap on to mic or music stands with optional clamps or be wall mounted.

Mfr: Westlake Audio
Price: $189.00.
Circle 58 on Reader Service Card

MONITOR LOUDSPEAKER



• Compact two-way Model 4301 wideband monitor loudspeaker, with a low-frequency 8-inch loudspeaker, is designed for space-shy quarters. Its 2-inch low frequency coil is suspended in a magnetic field having a flux density of 0.85 tesla; similar ⅝ in. high frequency voice coil has a flux density of 1.5 tesla. High frequencies above 2,500 Hz are reproduced by a 1.4 in. direct radiator. The system has a nominal impedance of 8 ohms and a rated power handling capacity of 15 watts continuous sine wave.
Mfr: James B. Lansing Sound, Inc.
Circle 59 on Reader Service Card

FIBERGLASS BASS HORN

• The unique feature in this (Model 4896) flare horn is that the port is built right into it. If you want to create a single 15 in. ported bass box design, you merely add a single 4 x 8 sheet of board and one 15 in. loudspeaker. The fiberglass composition has the added plus of less weight than a wooden unit.
Mfr: Community Light & Sound Inc.
Circle 60 on Reader Service Card

JOHN M. WORAM

The Los Angeles AES Convention

Herewith, our pictures and text on the recently completed Audio Engineering Society Convention and Exhibition held in beautiful downtown L.A.

WHAT, ANOTHER convention!? I wonder if the Surgeon-General knows that these things can get to be habit-forming? The latest in the series was the 57th convention of the Audio Engineering Society (10-13 May), with about 125 exhibitors on hand with the latest new audio products. Such as:

MICROPHONES

Electro-Voice's CS15 electret condenser microphone has been expanded into the seven-piece System C, consisting of four different heads, two preamplifier systems, and a 10 dB attenuator. The heads are: CO 15E omni, CH 15E hyper-cardioid, CS 15E cardioid, and CL 42E cardiline (shot-gun). The PE 15 preamplifier system is designed for operation with a standard 48 volt phantom power supply, or with any d.c. source between 8 and 50 volts. The SE 15 preamplifier is switchable between phantom and A-B powering—the latter system is found in many Sennheiser microphones. Or, either preamplifier may be battery-powered by two 9-volt alkaline cells. Unlike many other electret systems, the batteries do not fit within the preamplifier casing, but must be mounted in an external housing. Several accessory shock mounts are also available.

Shure Brothers showed their new SM 59, a dynamic moving coil cardioid microphone. The microphone features a built-in pop filter and a mechano-pneumatic shock mount system.

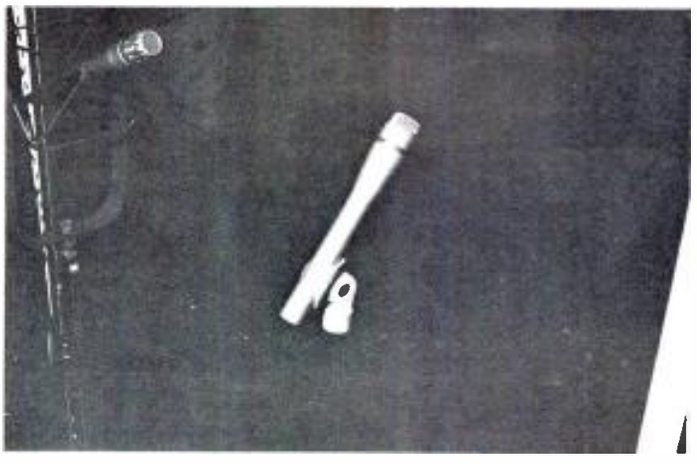
AKG introduced the C-414EB, an updated version of their famous C-414 condenser microphone. The new model features built-in attenuation of 0, 10 or 20 dB, and a bass roll-off switch, providing a 14 dB/octave slope from 75 or 150 Hz. A four-position switch offers omni-, bi-, and uni-directional (cardioid and hyper-cardioid) polar patterns. The microphone may be operated from 12 volt or 48 volt phantom supplies.

For those who are addicted to ultra-close miking, Studer's Colette series should be investigated. In addition to offering five interchangeable head capsules, there is a long flexible cable available; this may be inserted between

THE AES PICTURE GALLERY

Shure's latest entry into the microphone field is this SM59 cardioid, shown against their electronic units.

Electro-Voice unveiled a line of electret condensers in their new System C series. This is a new omni.



the diaphragm capsule and the preamplifier casing. If that doesn't get you into some tight spots, nothing will.

From Sweden, the PML series of condenser microphones was seen at Audio and Design's booth. Those who can't decide between one polar pattern and another will have a rough time with the PML DC-63 condenser microphone, which offers 44 distinct polar patterns, via a set of ring switches and a potentiometer built into the microphone casing. While the patterns are all variations on the usual cardioid-to-omni sequence, the microphone should keep any producer amused for hours.

DIGITAL ELECTRONICS

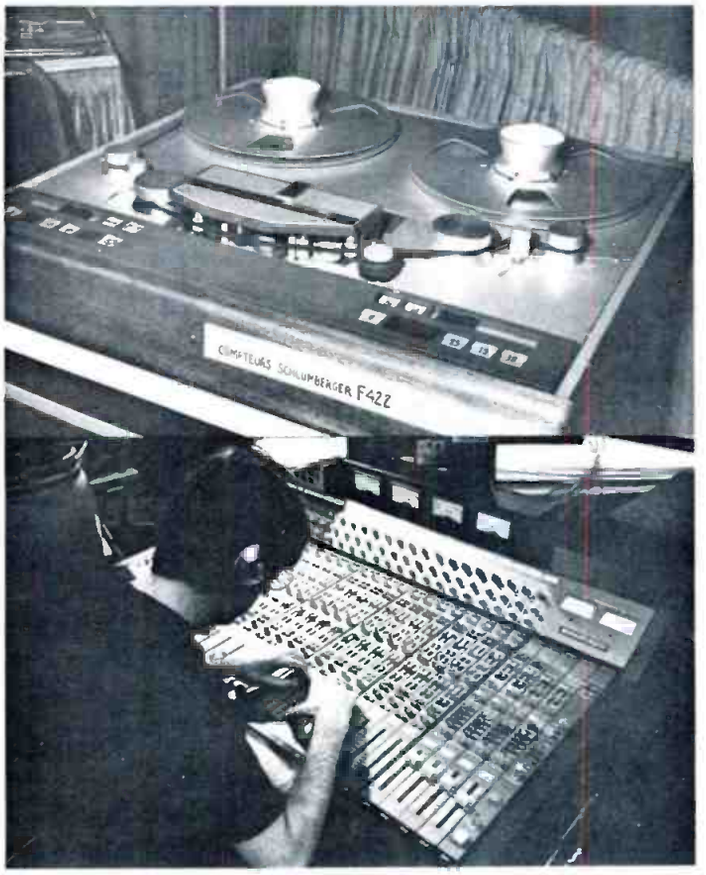
The Mitsubishi Electric Corp. introduced a prototype PCM (pulse-code modulation) tape recorder in their fourth floor demo room, while Soundstream made their second AES appearance with their digital tape recorder. Although neither machine is quite ready for off-the-shelf delivery, it's a fair bet that both represent the wave of the future. The Soundstream recorder was described in an AES technical paper given at the last New York show. (*Longitudinal Digital Recording of Audio. AES Preprint No. 1169*). A paper describing the Mitsubishi recorder was presented at this convention. (A *Stereo PCM Deck Employing Stationary Head. AES Preprint No. 1227*). Both papers are available from the Audio Engineering Society, 60 E. 42nd St., Room 449, New York, N.Y. 10017

Lexicon introduced the Model 92, a digital delay system which they have designed for "smaller installations." At $1,560, the system is a 1-in/2-out device. Each output is independently adjustable—in 7.5 millisecond increments—to a maximum delay of 120 milliseconds.

Quad/Eight Electronics is completing the development work on a computer-programmed reverberation system,

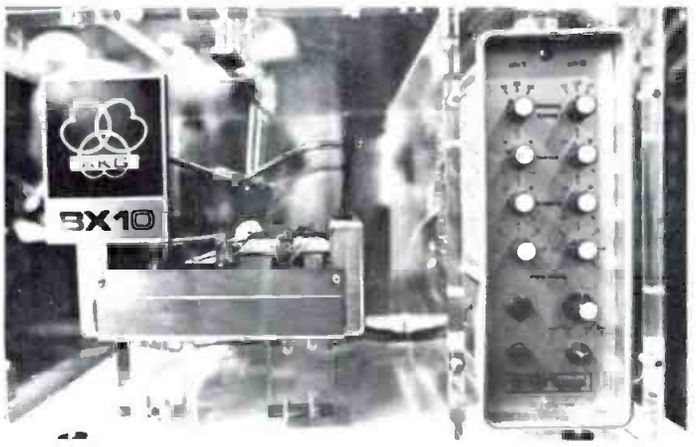
This sixteen track isolated loop by Bourse was seen at the Audio Concepts booth.

France is sending us this sophisticated quarter-inch machine made by Compteurs Schlumberger.



The big Westlake Audio booth had many things, including this Shimic console newly arrived from Japan.

Sescom now has one of the most versatile lines of accessory boxes and prepared cables.



AKG's BX-10 reverb was displayed with transparent sides to show its innards to good view.

Super-sophisticated SQ decoding by the Scheiber unit at the bottom and a prototype Tate I.C. unit is now available.

Orban-Parasound showed this new Optimod-FM but they really scored with giveaway yo-yos everybody was using.

Lexicon now has a model 92 lower cost unit digital delay to add to its well-known Delta-T line.

and an engineering prototype was shown in their demonstration suite. Reverberation time is variable between 0.25 and 20 seconds, and an eight-position "room size" switch selects the appropriate delay before the onset of reverberation. A four-position program switch allows the user to select reverberation characteristics of: room, plate, echo, or aux. (special effects, for example). In addition, there are variable controls for low frequency filtering and high frequency damping. The device should sell for just under $6,000. For more information, contact Quad/Eight, 11929 Vose St., N. Hollywood, Ca. 91605. (Not us—we'd like to know more too!)

In Ampex's demo room, the EECO MQS-100 Synchronizer played to SRO crowds. This little black box will keep any combination of three machines synchronized, including mixtures of multi-track audio, magnetic (sprocketed) audio film, and video. While the machine probably makes a lousy cup of coffee, it will do just about anything else you require, including roll-backs, cues, working from mixed time codes, slaving any machines to any master, and whatever else may occur to you. If you *really* want to impress your friends, you can order a crt readout that will keep you informed about what's going on. There's also a keyboard option for typing in instructions.

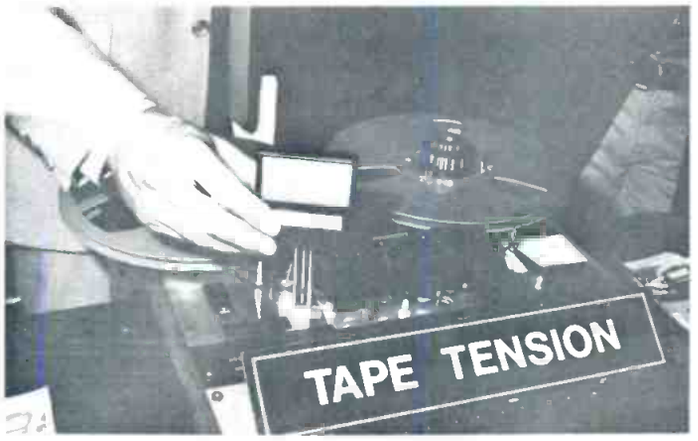
PARAMETRIC EQUALIZERS AND OTHER SIGNAL PROCESSORS

UREI introduced its Model 545 four-band parametric equalizer. The first three bands are: 24—310 Hz, 190—2.24 kHz, and 960—12.5 kHz. The final band is 15—200 Hz, with a three-position multiplier switch (x1, x10, x100). A concentric knob on each band offers ± 15 dB equalization, and bandwidths are variable between 0.25 and 2

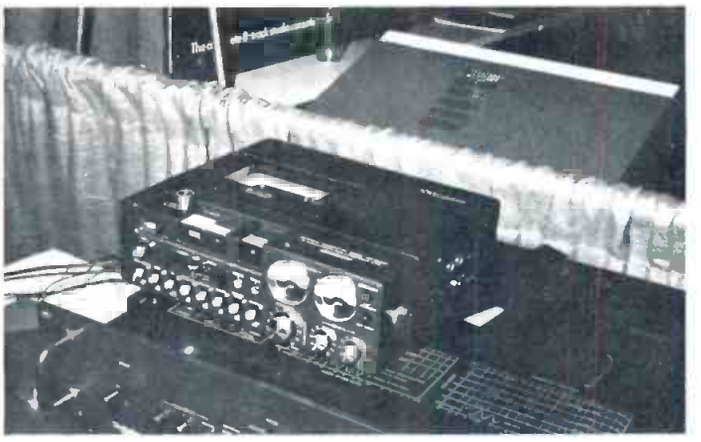
Scully unveiled a new low-cost two track machine, primarily geared toward the broadcast market.

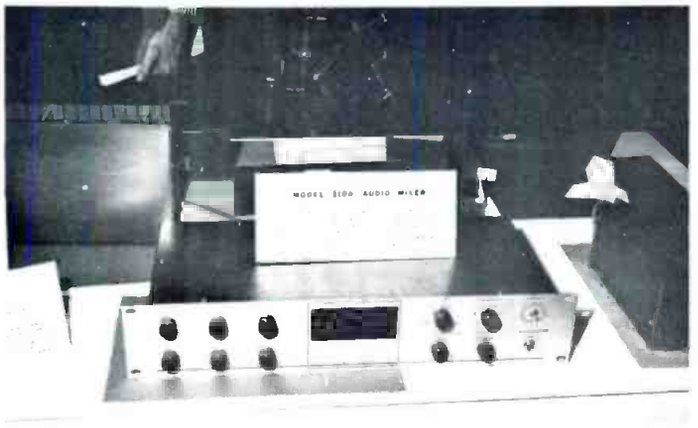
Stephens also produces an isolated multitrack machine, this one featuring eight tracks on one-inch tape.

The Tentel series of tape tension measuring devices belong in every modern studio setup.



At the other end of the size spectrum, here is a Technics battery-portable stereo cassette recorder.



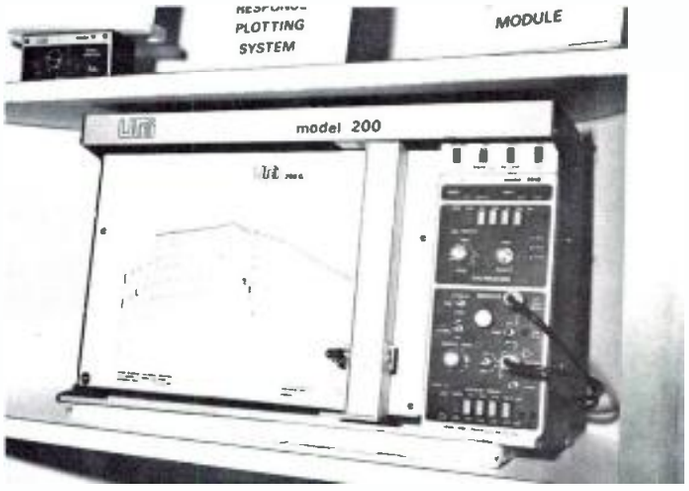


Spectra Sonics has much more than the big consoles it displays. This is a small and complete mixer.

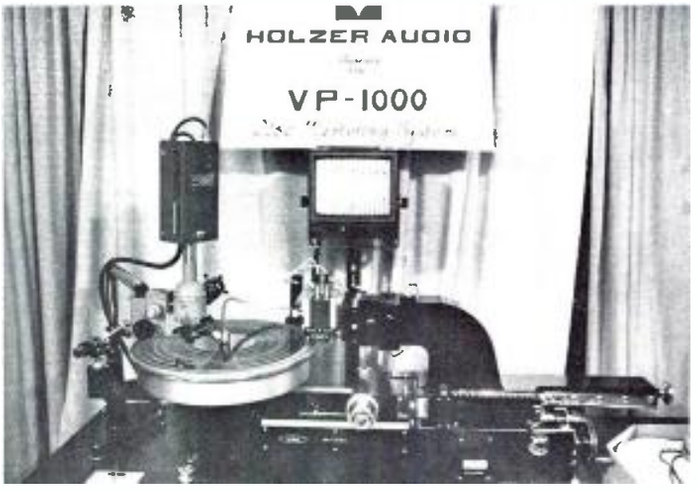
Among a growing number of consoles coming from Great Britain, we saw this versatile Soundcraft.

SAE has come from the high fidelity home equipment field into the pro market with this new parametric equalizer.

John Woram has already written about the new EMS Vocorder. It's much more than a reverb.



UREI's latest addition to their model 200 x-y plotter is the model 2010 level and auto frequency detector.



One of the more interesting uses of t.v. is Haeco's hookup to a lathe microscope so everyone can see the cut.

octaves. If that's not enough to keep you busy, there are also continuously variable low and high cut filters. It's all yours for $396(!).

Audio and Design Recording's E950 Paragraphic is a combination parametric and graphic equalizer, consisting of two sections of six slide faders offering ±14 dB of equalization. The center frequency of each fader may be varied over a four octave range, and each bandwidth may be varied between ⅛ and 6 octaves. The system may be used as a 12-section mono equalizer, or as two separate 6-section devices. It's about $1,100.

Interface Electronics is now offering a parametric equalizer modules to fit its 104/108 series mixers. The module offers ±15 dB parametric equalization in the 150 to 6 kHz range. Bandwidth is variable between 0.1 and 1 octave.

Allen and Heath's Feed Forward Limiter produces—in effect—a negative attack time. The system delays the direct signal by about 1 millisecond, giving the gain reduction system the chance to function *before* the signal gets to it. A front panel stereo switch allows two units to be interconnected for stereo program limiting. The specs claim that the compression ratio is infinity (now *that's* limiting!), with maximum gain reduction available 20 dB from threshold (whatever that means).

Allen and Heath also have an Automatic Double Tracker—a 2-in/2-out device with switchable delay times of 6, 12, 18 and 24 milliseconds, or a total of 48 milliseconds delay with the two channels in series. Front panel controls allow the user to mix the direct and the delayed signals together, so the device may be placed directly in the signal path, with no auxiliary returns required.

CONSOLES

Consoles continue to proliferate, and there was no shortage of new models from which to choose.

Uni-Sync introduced its Trouper series of "live music mixing systems" and accessories. The company feels that studio recording consoles are not suitable for sound reinforcement applications and so has designed a series of consoles specifically for sound reinforcement. Basic output control modules are available with various combinations of house and monitor output level controls, group level controls, and from four to eight input controls. Several add-on input expander modules are available, each with ten additional inputs.

Accessories include a vu meter/line amp system, and limiters, graphic equalizers and electronic crossovers. Also available are a series of microphone snake cables and stage boxes with provisions for eight or ten microphone lines.

Allen and Heath have expanded their product line to include the Syncon System—a console with up to 28 in/out modules, 28 vu meters and 16 mixing busses. The console should sell for less than $20,000.

From Montreal, LaSalle Audio Products Ltd. showed the British Chilton QM series console, available with 12 to 24 inputs, and 4 to 8 outputs. Standard features include a vu meter with PPM ballistics (?) on each input channel, four aux. sends, built-in oscillator, etc. A 12-in/4-out board sells for about $9,000.

And from Japan, the Shimic 2424 portable console was seen at Westlake's booth. Measuring about 3 x 4 ft., the console has 24 inputs, 24 direct outputs and 4 mixing busses.

TAPE RECORDERS

From Britain, Brennell Engineering Co. introduced their 8 track, 1 in. tape recorder, which will sell for about $7,900. All alignment controls (bias, eq., etc.) are screwdriver-adjustable from the front panel.

International Electro-Magnetics (IEM) has entered the pro machine arena with the IEM/Optro Model 1000 series multi-track tape recorder. Formerly manufactured in Australia, the machine will now be built at IEM's factory in Palatine, Illinois. The Model 1000 will be available in configurations from 4 tracks on half-inch to 24 tracks on two-inch tape. Speeds are 7.5, 15, and 30 i.p.s.

Needless to say, this report has only scratched the surface; there were many more new goodies than I've mentioned here, and I'm sure I've forgotten at least a few of the more important ones, and certainly the ones that you were hoping to read about here. However, I've got to catch another *&!!=% plane—this time for the Consumer Electronics Show in Chicago. But there's good news for **db** readers; that show will not be reported on in this column. ■

DEVLIN M. GUALTIERI

An FET Audio Limiter

An fet core makes possible high s/n, symmetrical/asymmetrical function, frequency selection, control metering, and stereo coupling.

AUDIO LIMITING has always been important in broadcasting and recording to maintain a high signal-to-noise ratio by allowing a higher average signal level without fear of overmodulation or distortion. The heart of any audio limiter is its gain control element, which responds to a d.c. control signal derived from the audio peak amplitude above a reference level to reduce the channel gain and "limit" the audio signal. Various solid state devices can operate as gain control elements.

The operational transconductance amplifier (ota), such as the CA3080, has a linear control voltage/gain response, but suffers from a low s/n ratio. This is because the ota input signal must be attenuated to less than 100 mV to prevent excessive distortion and a typical ota limiter would have barely 50 dB s/n.

The diode as a variable resistance element suffers from the same input limitation. A light-emitting diode/light-dependent resistor (led/ldr) combination is a better quality gain control element.[1] The led eliminates the thermal response lag of older ldr units in which a filament bulb was used as a light source, but ldrs have a "memory" and are not wholly suitable for professional applications.

The field effect transistor (fet) has many advantages in comparison to other variable resistance elements. The d.c. control signal applied to the fet gate to vary the drain-source resistance (R_{DS}) is well isolated from an audio signal applied between the drain and source, eliminating d.c. "thumps." Fets also have a very high ratio of off-to-on resistance, but R_{DS} is linear only over a small range of drain-source voltages (V_{DS}). We might, therefore, expect the same trouble as for a diode limiter, but the fet is a three-terminal device with a separate control input. Consequently, we can supply a negative audio feedback signal that can be mixed with the d.c. control signal at the gate to reduce distortion by an order of magnitude.[2,3,4]

THE CIRCUIT

A realization of an fet limiter is shown in FIGURE 1. The fet, Q5, is in the negative feedback loop of low noise amplifier IC1A so that high values of R_{DS} lead to reduced amplifier gain. Transistor Q6 buffers the fet V_{DS} in an emitter follower configuration and applies this audio signal to the fet gate through a 1M resistor. This negative feedback connection reduces the signal distortion. The d.c. control signal is derived from the output of IC1A by the threshold rectifiers Q1 and Q2.[5] These Darlington transistors conduct heavily when their base-emitter voltage exceeds 1.2 volts. Q1 produces a d.c. control signal proportional to the level of positive peaks above the threshold, and Q2, which is driven by an inverted audio signal produced by IC1B, responds to the negative audio peaks. When Q1 and Q2 conduct, their collector voltage becomes more negative and the 0.47 capacitor, C, charges through the 4.7k resistor, R2, to this voltage. The d.c. voltage across C is buffered by the Q3/Q4 source follower and is applied to the IC2 meter driver and the IC3 level shifter. IC2 drives a 1 mA meter to give the conventional "backwards" metering of the limiting action, with Q7 altering the amplifier response in a piecewise linear approximation to match the Q5 fet limiting characteristics. IC3 allows the fet to be biased at its proper operating point and reduces the 20 volt range of the control signal across C to the one volt range needed to control the fet.

ADJUSTMENT AND OPERATION

Circuit power can be supplied by any well regulated ± 12 volt supply. Since d.c. levels are important, a dual tracking supply is preferred. Initially, the three 20k trim pots (meter, zero, bias) should be adjusted to mid-range. The zero pot should then be adjusted to give zero volts

Table I. Resistance and capacitance value for various limiter release times. The attack time is held constant at about 2 ms.

Release Time seconds	R2 ohms	C mFd
0.1	4.7 k	0.47
0.3	1.3 k	1.47*
1.0	390	4.7
3.0	120	14.7*

*Parallel capacitors.

Table II. Meter calibration for the author's limiter. The meter has the conventional "backwards" response.

Meter mA	Limiting dB
1.0	0
0.8	1.5
0.6	2.0
0.5	4.0
0.4	6.0
0.2	11.0
0	16.0

Dr. Gualtieri is with the University of Pittsburgh, Pittsburgh, Pa.

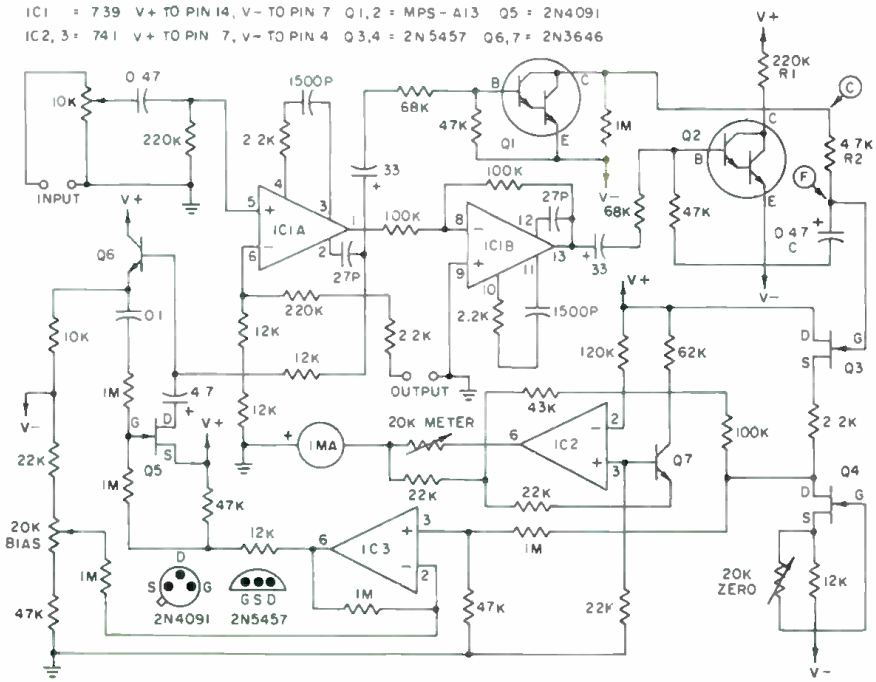


Figure 1. Schematic of the fet audio limiter. Attack and release times are set by R1, R2 and C. Points "C" and "F" allow stereo coupling of two limiters, as explained in the text.

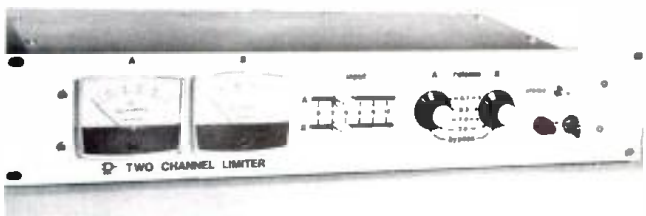
at the drain of Q4 when point F is shorted to ground. Use a vtvm or other high impedance voltmeter for this adjustment. The meter pot is adjusted for full-scale deflection of the meter. The bias pot is then adjusted to give maximum negative voltage at its wiper, biasing Q5 fully *on* and giving maximum gain for IC1A. A low level audio signal, small enough to prevent the output voltage from reaching the limit threshold (about —30 dB) is then applied to the limiter input, and an oscilloscope or sensitive a.c. meter is connected to the limiter output. The bias pot is then adjusted to give a small, but reproducible, gain reduction, about one or two dB. The limiter is now adjusted for proper operation.

The limiter attack time is set by R2C, and the release time is basically R1C. For the values given, the attack time is 2 ms and the release time is 0.1 seconds. Changes in these times can be accomplished by changes in R2 and C (see TABLE I), leaving R1 as 220k for proper circuit operation. Two milliseconds is judged by most limiter manufacturers as an optimum attack time. TABLE II shows the meter calibration for my unit. The 3 dB points of the limiter are below 20 Hz and above 40 kHz, and the input equivalent noise is —75 dB for no limiting, to —90 dB at full limiting.

MODIFICATIONS

Several modifications of the basic fet limiter can be made. The input impedance can be reduced by lowering the resistance of the input pot to give a better noise figure for low impedance sources. For operation as a mic channel limiter, a microphone preamp can be added before the input pot to bring the signal up to line level. The 220k resistor in the feedback loop of IC1A, which controls the gain of the controlled stage, and thus the limiting threshold, can be increased to give a larger control range at the expense of s/n in the quiescent state. The gain of IC1B can be decreased by changing the feedback resistor to allow the asymmetrical limiting desirable for a.m. broadcasting. Decreasing the gain of IC1B to 0.80 would give 125 per cent limiting on positive peaks and 100 per cent limiting on negative peaks, referred to the input phase.

Frequency selective limiting, which is desirable for f.m. broadcasting, can be easily accomplished by reducing the 33 mFd capacitors in the base circuits of Q1 and Q2 to give the 75 or 25 μ time constant of pre-emphasis. NAB equalization circuitry can also be inserted at this point to give a "recording limiter" response. For a constant R1, various values of R2 and C can be switched by a selector switch to give variable release time, as in TABLE I. Stereo coupling of two limiters to preserve L + R balance is easily accomplished by tying the points C and F of one unit to the corresponding points on the other. In this way, the channel specifying the greatest gain reduction will dominate.



The two channel limiter with variable release time. Stereo coupling is accomplished by a dpst switch which connects the C and F tie points of the two limiters.

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2. Sherwin, J., *Program Multichannel Audio Gain*, Electronic Design *23(3)*, 68-72, 1 February 1975.
3. Sherwin, J., *A Linear Multiple Gain-Controlled Amplifier*. AN-129, National Semiconductor Corporation, 2900 Semiconductor Drive, Santa Clara, CA 95051, August 1975.
4. Self, D. R. G., *High Quality Compressor/Limiter*, Wireless World *81*, 587-590, December, 1975.
5. Ristad, C. H., *Volume Compressor With 50 dB Range Built Around Single Op Amp*, Electronic Design *21(10)*, 110, 10 May 1973. ■

db Test Report

The Technics RS-1500US Tape Deck

The Technics RS-1500US tape deck.

WHEN is a tape deck professional? That question assaulted us, since it is our aim to always keep **db Magazine** purely professional in content. This machine uses phono jack inputs and outputs at the rear, and medium impedance unbalanced mic inputs on the front panel via phone jacks. Doesn't that define a consumer machine? Surely it does, yet here is a report on this unit—justified on the grounds of its definitely professional performance, and the fact that an identical pro-configured version is to be released in the near future.

The RS-1500US is a three speed (3¾, 7½, and 15 in/sec), three motor direct drive deck. With that standardized description, we move away from normalcy in decks. and immediately see a feature that never has appeared in this category of machine before. The tape drive system is a closed loop. The capstan has a diameter of 3.4 cm and has pinch rollers on both sides. When the system is activated, an isolated loop of tape is created around the head nest.

The capstan is directly driven by a slow speed motor similar in type to those used to drive Technics' direct

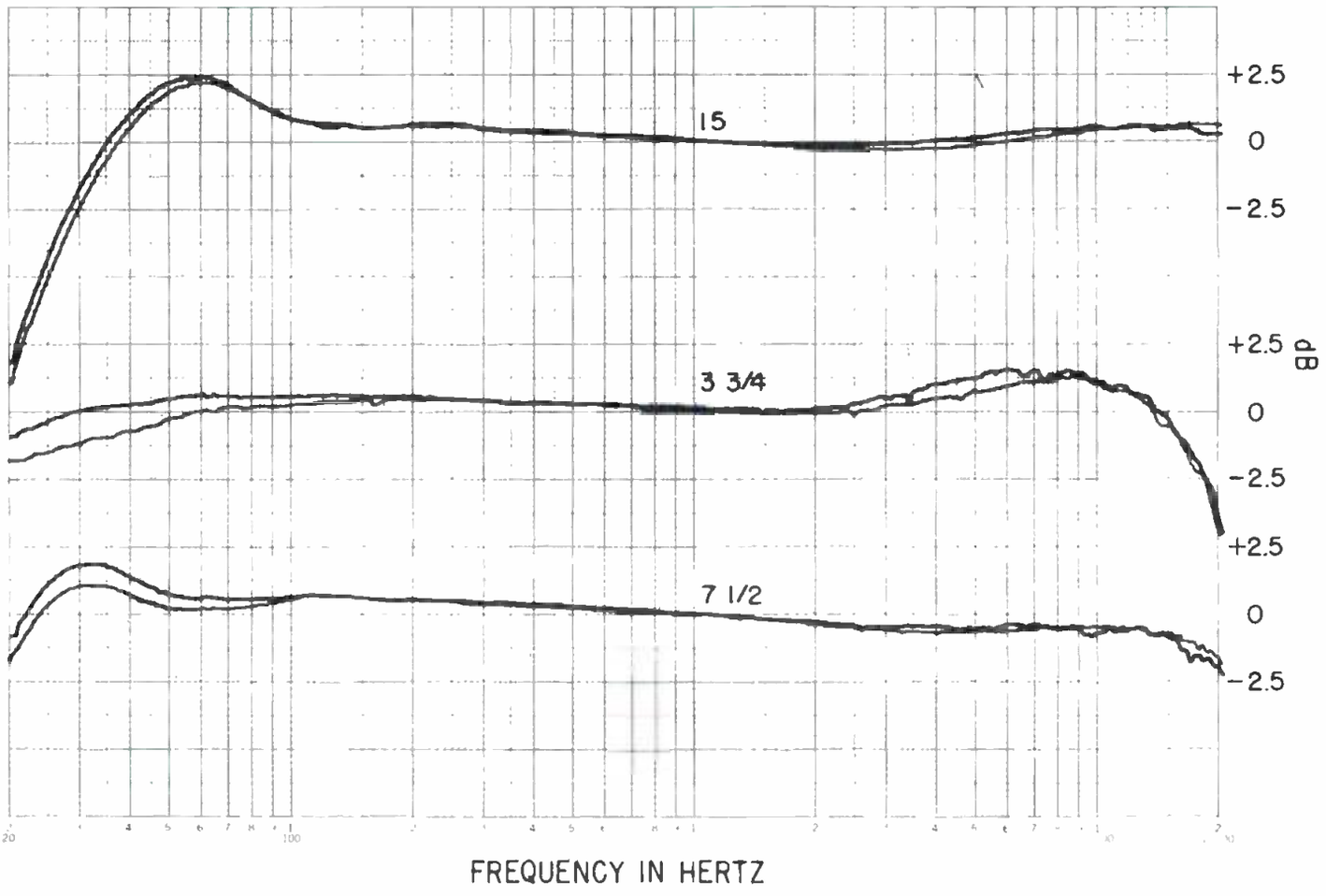

Figure 1. The record/play response of the Technics RS-1500US. Maxell UD-50 tape was used. Vertical sensitivity of the UREI automatically printed graph is 5 dB per inch and horizontal sweep was 60 seconds.

drive SP-10 turntable. This d.c. motor runs at 3.6 r.p.m. (at 15 in/sec.) and is locked to a quartz-referenced servo circuit with a quartz oscillation frequency at 4,194,304 Hz. The speed accuracy is such that the manufacturer has felt secure in making the lower turn-around shaft an illuminated strobe.

The quartz locked servo circuit can be disengaged by a front panel switch, resulting in a ±6 per cent adjustment around the nominal speeds. If the push-pull knob is returned to the fixed position, the exact speed will be instantly re-achieved.

TENSION CONTROL

The reel motors are driven by separate direct drive d.c. motors. Each has a speed-dependent tension control that provides constant tape tension, independent of reel size or hub diameter. The tension is sensed by the air-damped idlers located above the capstan system; when the machine is first started, you will see them move into an appropriate position of tension control, depending on the tape's tension.

The tension within the closed loop is fixed and steady, of course. This results in excellent tape contact at the respective heads—contact that is independent of the tension control operation outside the loop.

That head nest supplied as standard (other configurations will be available) has four heads. Facing the machine, the left side has (counter clockwise) four-track play and two-track erase. As the tape motion goes around the strobe idler, the right side heads are (again counter clockwise as per the tape motion) two-track recording and two-track play. A switch on top of the head nest selects either the quarter-track or half-track play heads.

The heads themselves are super permalloy and are nested in a readily interchangeable nest.

The controls are pretty much straightforward. Tape motion is controlled by light-touch buttons. *Record* is activated by a separate button electrically tied to two (one for each channel) safety switches. When they are in the *record* position, flying starts can be made using the *record* and *play* buttons. A separate *pause* button will stop the moving tape in any mode without disturbing that mode. In addition, a mechanical *cue* lever can be used during fast wind to bring the tape closer to the heads.

Other front panel features include a real timer that is calibrated against the 15 in/sec. speed directly and runs off the strobe idler. The system is quite precise and the slip is sufficiently low so that a full reel of tape set at zero and wound from one end to another will return to the same tape mark within ¼ inch of tape.

Two push button switches are used to set up the meters for +3 or +6 maximum. The second switch is a 20 dB attenuation on the mic inputs.

Finally, two switches of note are at the right hand lower side under a title *tape select*. Both are three-position switches. One selects one of three specific bias settings

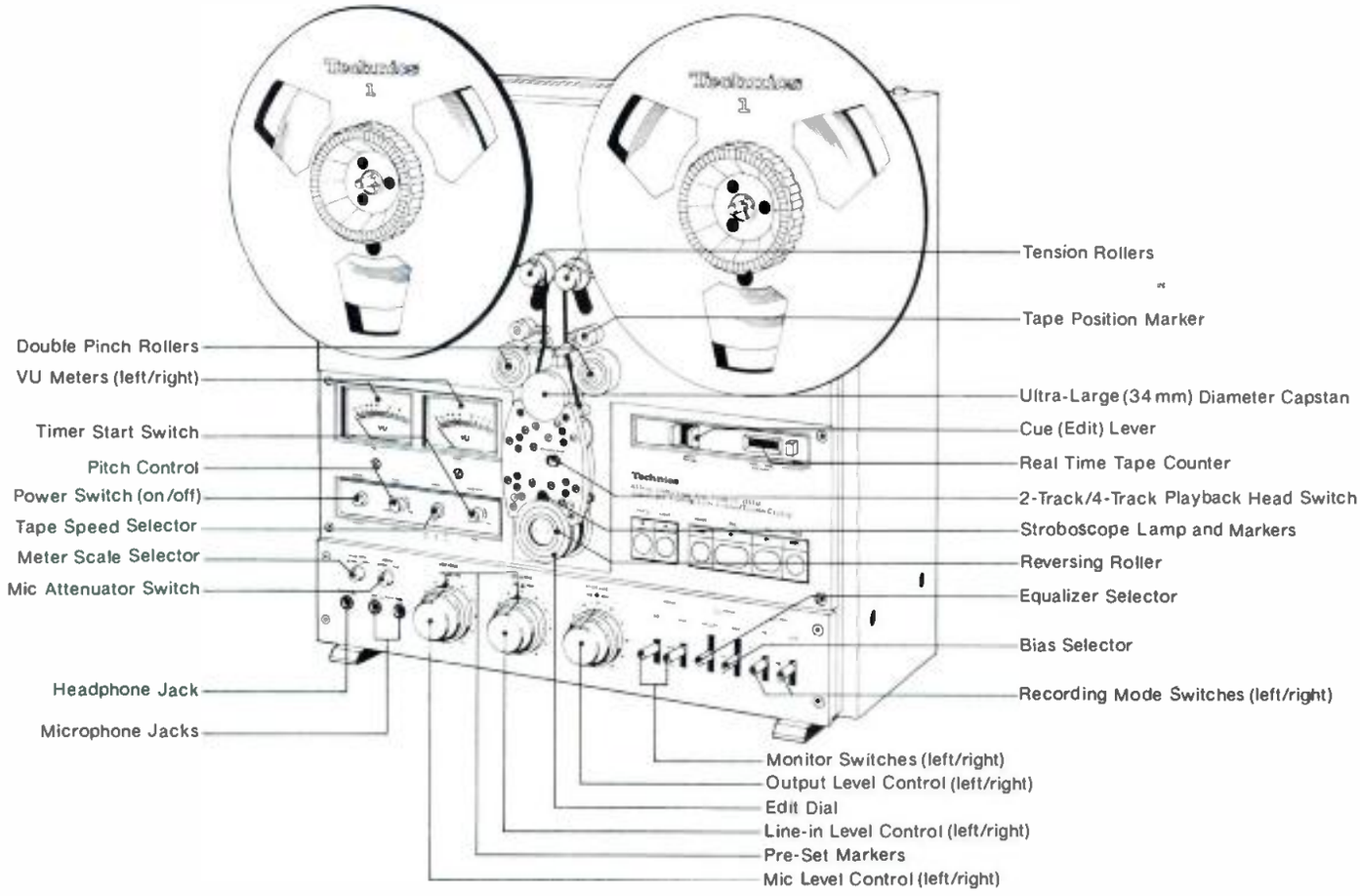

Figure 2. The features of the Technics deck.

and the other selects one of three record high-frequency equalization positions. These are the only bias and equalization settings available.

Removing the bottom plate of the machine reveals the circuit board with the bias and equalization circuits. But much as we attempted to understand the Japanese nomenclatures and logics, we could not find any other bias adjustment for the tape other than the front panel switch. Playback equalization is on the circuit board, but again, the record eq. is apparently limited to the three-position front panel switch. As will be seen, this is less harmful to the ultimate performance than you would believe.

LAB TESTS

The playback curves shown on the graph were created by a UREI automatic plotter. They were achieved by manipulating the bias and eq. switches for optimum performance at the three speeds with the tape at hand. The curves shown were derived from Maxell UD-50 tape, but essentially similar performance was achieved with Scotch 250 and Ampex 456. What is impressive on this machine is the close tracking of the two channels. Note that the 15 in/sec. curve was derived at 0 vu (185 nanoWebers), while the 7½ in/sec. was run at —10 dB and the 3¾ in/sec. was run at —20 dB. As is characteristic of all good machines, high frequency response improves at higher speed, but at the sacrifice of some low frequency response.

A check of the NAB playback response using the standard Ampex test tape resulted in a +1.5,-0 dB curve over the tape's range of 50-15,000 Hz. If anything, this increases the validity of the record/play curve derived above.

Distortion and noise are both outstanding. At 0 vu total harmonic distortion at 1 kHz, 15 in/sec. speed was 0.46 per cent. With the input raised to +3 dB, distortion went up to 0.6 per cent. At +6 dB, distortion was 1 per cent. Using that 1 per cent point, signal-to-noise was measured to be —62 dB weighted CCIR standard.

Finally, flutter was measured as a record/play function. That is, a 3.15 kHz signal was recorded at 0 vu and then played back for a combined flutter indication. At 15 in/sec. it was 0.022 per cent, at 7½ in/sec. it was 0.045 per cent, and at the slowest speed it measured 0.10 per cent. Clearly, the isolated loop system and tape handling has resulted in new levels of low flutter.

SUMMARY

Where then is the proper position of this machine? Is it a pro unit? Surely, on the basis of its performance it more than meets pro standards. And if the isolated loop system does much for performance, it does nothing but make it harder to edit on the machine. You can't spill tape. Technics has provided an editing system using dots on the strobe idler. They are supposed to line up with the play head and a cutting point, but they don't. So forget this machine for editing.

But if yours is a small two-track studio, or even larger, and you want a machine to make the finest master tapes possible, you won't buy a better machine at any price. This version sells at $1,500. The new version yet to come which will have the variable bias and eq. as well as xlr-type connectors will be higher in price, but no price or date of distribution was available at press time. We will keep you informed in these pages. L.Z.

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MCI JH-416 recording console, 16-in/16-out, wired for 24-in/out, excellent condition, $15,000 or best offer. **(614) 663-2544.**

MCI 24-TRACK recording console with producer's desk; matching equipment rack; plus extras. $19,500. **(312) 225-2110, Paul.**

A FEW competitively priced used Revox A77 and A700 decks available. Completely reconditioned by Revox, virtually indistinguishable from new and have the standard Revox 90-day warranty for rebuilt machines. Satisfaction guaranteed. Write requirements to **ESSI, Box 854, Hicksville, N.Y. 11802. (516) 921-2620.**

MXR'S DIGITAL DELAY system. Maxell tape, all widths, discounted. **N.A.B. Audio, Box 7B, Ottawa, Ill. 61350.**

COMPUMIX-I 24-channel mixing system, self contained, perfect condition, interfaces to any board, $10,000. Ampex MM-1100 16-track, $15,000. Both $23,000. AG-440-4C plus 2-track block, console $4,600. TM-499 digital delay, $1,800. All items 10 months old. **(303) 499-0545 evenings.**

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STUDIO SOUND—Europe's leading professional magazine. Back issues available from July '73 through June '75. $1 each, postpaid. **3P Recording, P.O. Box 99569, San Francisco, Ca. 94109.**

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.**

MAXELL, AMPEX, Capitol and Columbia reel tape; bulk and custom loaded. Custom length duplicator cassettes. Reels, boxes, leader tape, splicers. For complete catalog, write **Omega Audio Products, Box 39253, Redford, Michigan 48239.**

AMPEX 300, 352, 400, 450 USERS—for greater S/N ratio, replace first playback stage 12SJ7 with our plug-in transistor preamp. For specifications, write **VIF International, Box 1555, Mountain View, Ca. 94042. (408) 739-9740.**

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INFONICS D-8 eight-track duplicator with spare head assembly. Excellent condition. **Tower of Truth Audio, Inc. P.O. Box 245, Hurst, Texas 76053. (817) 284-5196.**

MORE LOW $$'s. Scully 280-2, Ampex 440B, Scully 280-4, Stellavox SP-7, Uher 4000L, AR LST (2), JBL 4341 (2), Gates "Yard," Marantz 15, Lev. LOC M-62 (2). DFN-1100, Marti-Cla 40-H (3), Burwen, and MORE!! Contact: **"MEDIA," G.S.C., Box 2776, New York, N.Y. 10017 or (212) 661-4664.**

AMPEX, SCULLY, TASCAM, all major professional audio lines. Top dollar trade-ins, 15 minutes George Washington Bridge. **Professional Audio Video Corporation, 342 Main St., Paterson, N.J. 07505. (201) 523-3333.**

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TRACKS!! The complete semi-pro recording center. Check our low prices on Tascam, TEAC, Neotek, Micmix, dbx, Multi-Track, MXR, Sennheiser. BGW, Shure, TAPCO, and many others. Complete studio packages available. TRACKS!! from **DJ's Music, Ltd. 9520 47th St., Brookfield, Ill. 60513. (312) 485-0020.**

CROWN CX-744 recorder, 4-track, ¼ in.; 3¾, 7½, 15 i.p.s.; with case; good condition. **Viktor Schuppe, 23236 Robert John Rd., St. Clair Shores, Mich. 48080. (313) 886-8966.**

CUTTERHEAD REPAIR SERVICE for all models Westrex, HAECO, Grampian. Modifications done on Westrex. Avoid costly down time; 3-day turnaround upon receipt. Send for free brochure: **International Cutterhead Repair, 194 Kings Ct., Teaneck, N.J. 07666. (201) 837-1289.**

SPECTRA SONICS custom console 16 x 16, 32 pan pots. Currently in use; good quiet board. $11,000 or best offer. **Fifth Floor Recording. (513) 651-1871.**

SOUND WORKSHOP mixing consoles, reverbs and support equipment setting new standards in the semi-pro industry available in New England at: **K&L Pro Audio, 75 N. Beacon St., Watertown, Mass. 02172. (617) 926-6100.**

DELAYLINE, U.R.E.I., Cooper Time Cube. $450.00; Burwen dynamic noise filter DNF 1000, $2,500.00; Ferrograph RTS1 testing instrument (make offer); Eventide omnipressor. $350.00; TEAC AN300 4-channel Dolby, $100.00; Orban 105C reverb, $300.00; Tentel tension gauge $200.00; Quad Eight RV-10 reverb. $350.00. All are backed by 6 months' guarantee; equipment in excellent condition. Contact. **John Crow, 2000 Beck Bldg., Shreveport, La. 71101. (318) 226-8910.**

FOR SALE: 3M Series M-23 four-track recorder with two-track heads; excellent condition; $3,600.00. Ampex 440-B four-track recorder with two-track heads in portable cases; $2,800.00. Stevenson 100B 12 by 4 console with Neumann fet phantom power; expandable to 16 by 4; $2,700.00. Call **Brandon Wade (312) 922-0983.**

LIGHTING DIMMER SYSTEM for sale. 32 — 3k dimmers, 32 faders with 16 preset memory console. Packed for touring. Must sell! **BC&G Enterprises, P.O. Box 1036, Littleton, Colorado 80160. (303) 751-5991.**

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SCULLY 280-B—4-track, ½ in. tape. 7½-15 i.p.s., with portable case; 3 years old, 20 hours' use. **Viktor Schuppe, 23236 Robert John Rd., St. Clair Shores, Mich. 48080. (313) 886-8966.**

4560 KIT! Using new Community fiberglass flare and one sheet of plywood. Use 15" speaker of your choice. Only $115! Order now from **Gary Gand Music, 172 Skokie Valley Rd., Highland Park, Ill. 60035. (312) 831-3080.**

MODEL AG300 Ampex 8-track one-inch mastering machine; good condition; $5,000.00. Contact **M. R. Rose, Founders Bank, (405) 843-9551. Oklahoma City, Oklahoma.**

PROFESSIONAL SOUND COMPONENTS from Crown, TAPCO, Soundcraft, Eventide, Community, Malatchi, Tascam, Biamp, dbx, Gauss, Spider/Peavey, Sound Workshop, and many more. Hear it all at **Gary Gand Music, 172 Skokie Valley Rd., Highland Park, Ill. 60035. (312) 831-3080.**

DOLBY A301, excellent condition. Used in my home. $650 or best offer. **Morty Tarr, 23 Webster St., Newton, Mass. 02165. (617) 965-4799.**

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BUSINESS OPPORTUNITIES

RECORDING STUDIO. Professional 8-track sound studio currently operating in the Washington, D.C. area. Good location with room for expansion and good potential. $30,000 takes all or will sell equipment individually. For more information and equipment list write **Dept. 71, db Magazine, 1120 Old Country Rd., Plainview, N.Y. 11803.**

WANTED

WANTED: TRANSCRIPTION discs, any size, speed. Radio shows. music. **Box 724-db, Redmond, Wa. 98052.**

EQUIPMENT WANTED: NEUMANN; AKG,Sennheiser microphones; miscellaneous outboard gear, etc. Call or write: **Dan Alexander, 1345 Grove St., Berkeley, Ca. 94709. (415) 232-7933.**

EMPLOYMENT

SOUND SALESMAN

You must be experienced in selling commercial sound systems to new and existing construction prospects. We are the largest commercial sound contractor in the country. Earning potential of $30,000 yearly. Call **(201) 245-8000, Tom Berry. New Jersey Communications Corp., 144 Market St., Kenilworth, N.J. 07033. Equal Opportunity Employer M/F.**

SALES MANAGER, Professional Audio. Responsible for U.S. sales of expanding line of Heil Air-Motion transformer p.a. and musical instrument drivers. Must be able to sell customers face to face as well as motivate reps and dealers. Position requires up to 50% travel. Send resumes, including salary expectations in confidence to: **Phil Coelho, President, ESS, Inc., 9613 Oates Dr., Sacramento, Ca. 95827.**

POSITIONS AVAILABLE. Concert sound/ lighting/scenic technicians and engineers needed. MUST have road experience and references. Full-time, salaried employment. Send resume or call the **Alpha Organization, 6910 Raleigh La Grange Rd., Memphis, Tenn. (901) 388-1032.**

db People/Places/Happenings

• Spurred by the increase in new product development, the **Altec Corporation's** Sound Products Division has promoted two managers who will concentrate in that area. **Mark E. Engebretson** has been promoted to the position of vice president, product development and **Irwin Zucker** to the position of director, product development.

• **Joe Loprire** has been promoted to vice president of sales at **Analog & Digital Systems,** Wilmington. Mass. Mr. Loprire came to ADS from the **Advent Corp.** in 1976.

• Several organizational changes have taken place at **Ampro Broadcasting Inc.** of Feasterville, Pa. **Edward M. Mullin** has been promoted from the post of vice president engineering to the presidency. **Joseph Novik,** coming from the **Belar Electronics Laboratory,** has been named sales manager.

• **Bob Katz,** formerly of **Connecticut Public Television,** and **John Sanford,** formerly of **Bolt, Beranek & Newman** are now doing their engineering in a rural setting at **Suntreader Recording Studios** on Quimby Mountain in Sharon, Vt. The woodland studio boasts 24-track Studer equipment and plenty of fresh air.

• **Raymond J. Noorda** has been elected to the position of president and chief operating officer at **System Industries,** of Sunnyvale, Ca. Mr. Noorda succeeds **Edwin V. W. Zschau,** who has become chairman of the board and chief executive officer.

• The second annual Lieven Gevaert/ S.P.S.E. silver medal award for outstanding achievement in the field of silver halide photography was presented to **Dr. T. Howard James,** head of the **Eastman Kodak Phototheory Laboratory,** at the annual conference of the **Society of Photographic Scientists and Engineers.** The medal is sponsored by the **Agfa-Gevaert** company.

• New facilities planned to accommodate both **Burwen Research** and **KLH,** its parent company, are under construction in Cambridge, Mass. The enlarged quarters will house manufacturing, administrative and warehouse functions.

• **Dar Hyatt** has been elected as executive vice president of the **GBC Closed Circuit T.V. Corporation,** of New York City. Mr. Hyatt, who has been with the company since 1975. was formerly with **SC Electronics Inc.**

• Plans have been finalized for the **New York Chapter of Electronic Represenative's** REPCON '77 show, to be held September 26th and 27th at the Statler Hilton Hotel, 7th Ave. and 33rd St., New York City. For further information, contact **Marty Bettan,** at (212) 591-7600.

• The post of audio product specialist at the **F. Edwin Schmitt Co.** of Elmont, N.Y. has been filled by **Michael Solomon.** Mr. Solomon comes to the Schmitt Company from **New York University,** where he was chief engineer of the campus radio station.

• **Robert L. Gur-Arie** has been appointed executive director of the **Institute of High Fidelity.** Mr. Gur-Arie's trade association expertise derives from marketing efforts for the **International Council of Shopping Centers** and other retailing associations.

Recording pioneer **Percy Wilson** died at his home in Oxford, England on April 30 at the age of 84. During the 1930's, Mr. Wilson made notable contributions to the improvement of electrically reproduced sound, particularly in solving problems of needle-track alignment. From 1923 to 1966, he was connected with **The Gramaphone** magazine, as technical advisor and later, technical editor. Upon his resignation from the magazine in 1966, he formed an audio consulting firm with partner **Geoffrey Horn.** He was awarded the annual citation of the **U.S. Audio Engineering Society** in 1966 and served as president of the British branch of the Society. Mr. Wilson leaves a widow and three sons.

• One of audio's noteworthy leaders, **Harold W. Lindsay,** has retired from the **Ampex Corporation,** of Redwood City, Ca. Joining Ampex in 1946, he was project engineer and chief designer of the Model 200, the first professionally acceptable magnetic tape recorder produced in the United States. Another significant product in which Mr. Lindsay had a hand was the Ampex VR-1000 videotape recorder. Mr. Lindsay plans to continue serving in a consultive capacity.

• An additional contribution of $140.-000 to the **Charles P. Steinmetz Awards Program** has been announced by the **General Electric Company.** Awards are presented biennially to leading GE engineers and scientists, consisting of a $5,000 contribution to the college of his/her choice.

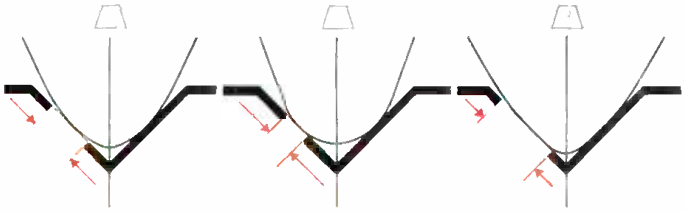
• An opportunity for film instructors and independent film-makers to supplement their incomes while sharing experiences has been initiated by **Super 8 Sound, Inc.** of Cambridge, Mass. A limited corps of sound consultants will be appointed nation-wide who will aid Super8's customers in planning for their needs. Lists of the consultants will be published in national film magazines. For information contact **Edmond G. Dyett, Jr.,** Executive Vice President, Super8 Sound. Inc., 95 Harvey St., Cambridge. Mass. 02140.

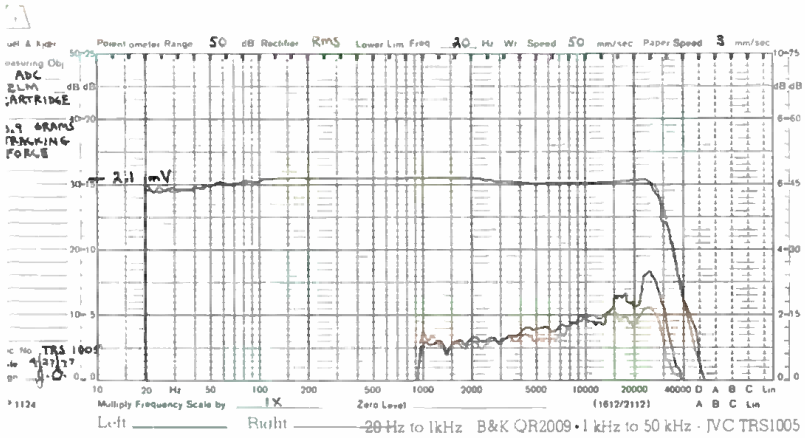
• **Gary C. Schmidt,** working from Southfield, Michigan, has been appointed as a sales rep for **RCA Broadcast Systems. Miles G. Moon** has been promoted as manager, creative services, at RCA's Camden, N.J. headquarters. **Jerry E. Smith,** also operating out of Camden, is now responsible for southern sales.

• A streamlining at the **Altec Corporation** of Anaheim, Ca. has resulted in placing all of the firm's commercial sound marketing efforts in a single department, headed by newly appointed **James E. Morrison** with the title of vice president, commercial sales. Mr. Morrison has been with Altec for five years.

1976: ADC CLAIMS THE XLM MK II SHOWS "NO PERCEIVABLE WEAR OVER THE LIFE OF A RECORD." AND PROVES IT.

1977: ADC CLAIMS THE NEW ZLM WITH THE ALIPTIC™ STYLUS HAS EVEN LOWER WEAR AND BETTER PERFORMANCE. AND PROVES IT AGAIN.





Introducing the ADC ZLM cartridge with the ALIPTIC [1] stylus. It's a revolutionary new cartridge design that has taken the state of the art a giant step closer to the state of perfection.

Because of last year's XLM MK II record wear test results, we confirmed our thinking on how to design the perfect stylus tip shape. It combines the better stereo reproduction of the elliptical [2] stylus shape with the longer, lower wearing, vertical bearing radius of the Shibata [3] shape. The result is our revolutionary new ALIPTIC stylus.

And that's only the beginning. The ALIPTIC shape is polished onto a tiny .004" x .008" rectangular nude diamond shank, which has reduced the tip mass of the XLM MK II by an incredible 50%. This tiny stone is mounted on our new, tapered cantilever, which reduces effective tip mass even further.

The XLM MK II tests also proved the importance of tip polish in reducing record wear. So the ZLM is polished with a new, more expensive, more effective patented polishing method.

The ADC XLM MK II has long been known for its uncolored, true sound reproduction. The ZLM goes even further. Sound reproduction is completely open and spatial. And individual instrument placement can now be identified with even greater ease.

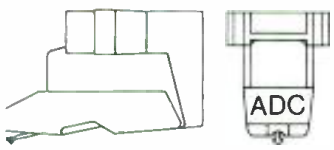
The ZLM tracks between ½ and 1¼ grams. Frequency response is ± 1dB to 20kHz and is flat to even higher frequencies; out to 26kHz ± 1½dB.

As you can see, by reducing the tip mass even further, we've come closer to the ultimate in pure sound reproduction. To prove it, every ZLM comes with its own individual frequency response curve [4], signed by the ADC technician who tested it.

This means that the ZLM cartridge will reach every sound lying dormant in your records, transmitting them faithfully through your hi-fi system without altering the sound or the health of your records.

Not only do we think the ZLM is one of the most exciting cartridge designs to come along in years, but we can prove it.

Superior performance we can prove.



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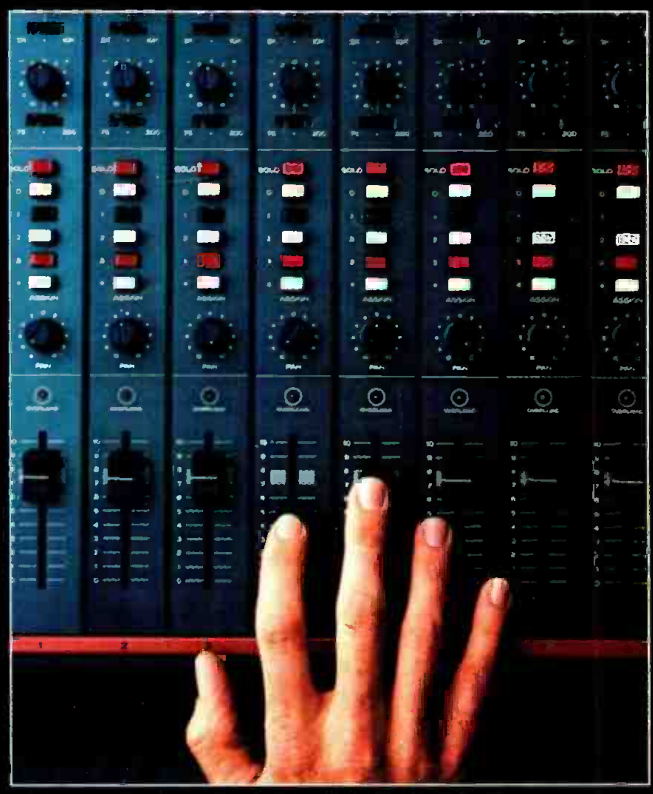

THIS IS WHERE TOMORROW'S GREAT MUSIC IS COMING FROM.

We think musical styles change because musical talents change.

There is hardly a musician making money today who doesn't know as much about recording music as he does about playing it. And recordists know as much about playing music as they do about recording it.

Because both know the equipment that captures music can also be used to improve it.

So while musical styles may change, the interdependence of musician, recordist, and the instruments they use will not. And that is the reason for the TASCAM Series by TEAC.

For not very much money TASCAM lets both musician and recordist get their hands on mixers and recorder/reproducers that let both tailor their music their way.

The Model 5-EX shown with four Model 201 input modules. Model 5 shown with Model 204 talk back/slate modules.

For every kind of music, for every kind of need, at home and on the road, by price and application, everything we make has the same goal as everything you make—be the best.

Because it still takes great talent to make great music.

TASCAM SERIES BY TEAC®

A new generation of recording instruments for a new generation of recording artists.

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