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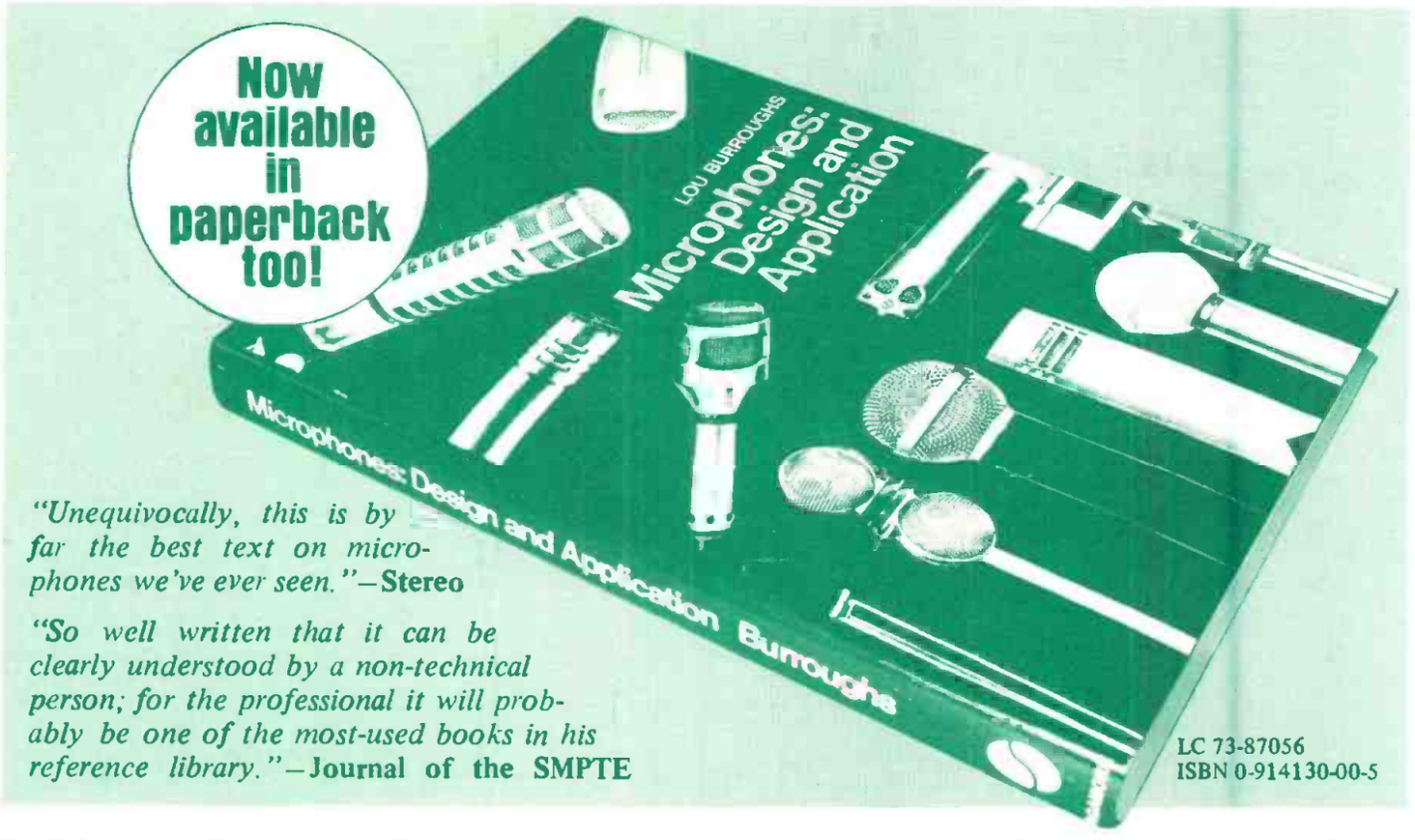

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- How does dirt in the microphone rob you of response?
- How do you space your microphones to bring out the best in each performer?

Microphones: Design and Application. As *Stereo* put it, "It's a hard book NOT to learn from." Order your copies today.

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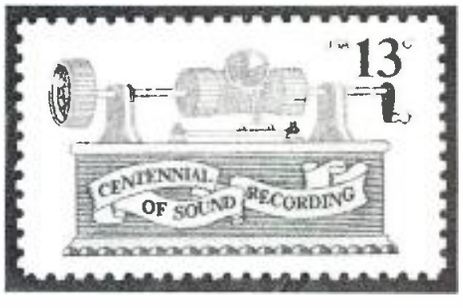
coming next month

● AN FET AUDIO LIMITER by D. M. Gualtieri describes a sophisticated low-distortion, high s/n limiter that uses only three integrated circuits and seven transistors per channel.

The Los Angeles AES Convention is over. We were there, and there will be a picture and text story on the exhibition, papers, and perhaps even the museum.

A db TEST will appear that examines the Technics 1500 open reel tape recorder. This is a unit that overlaps the consumer/pro field and thus may just find its way into some studios.

Coming next month, in **db**, The Sound Engineering Magazine.



about the cover

● The one hundred year anniversary of the beginnings of sound have even been noticed by the U.S. Postal Service. This 13 cent issue should still be available at your local post office.

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THE SOUND ENGINEERING MAGAZINE
JUNE 1977 VOLUME 11, NUMBER 6

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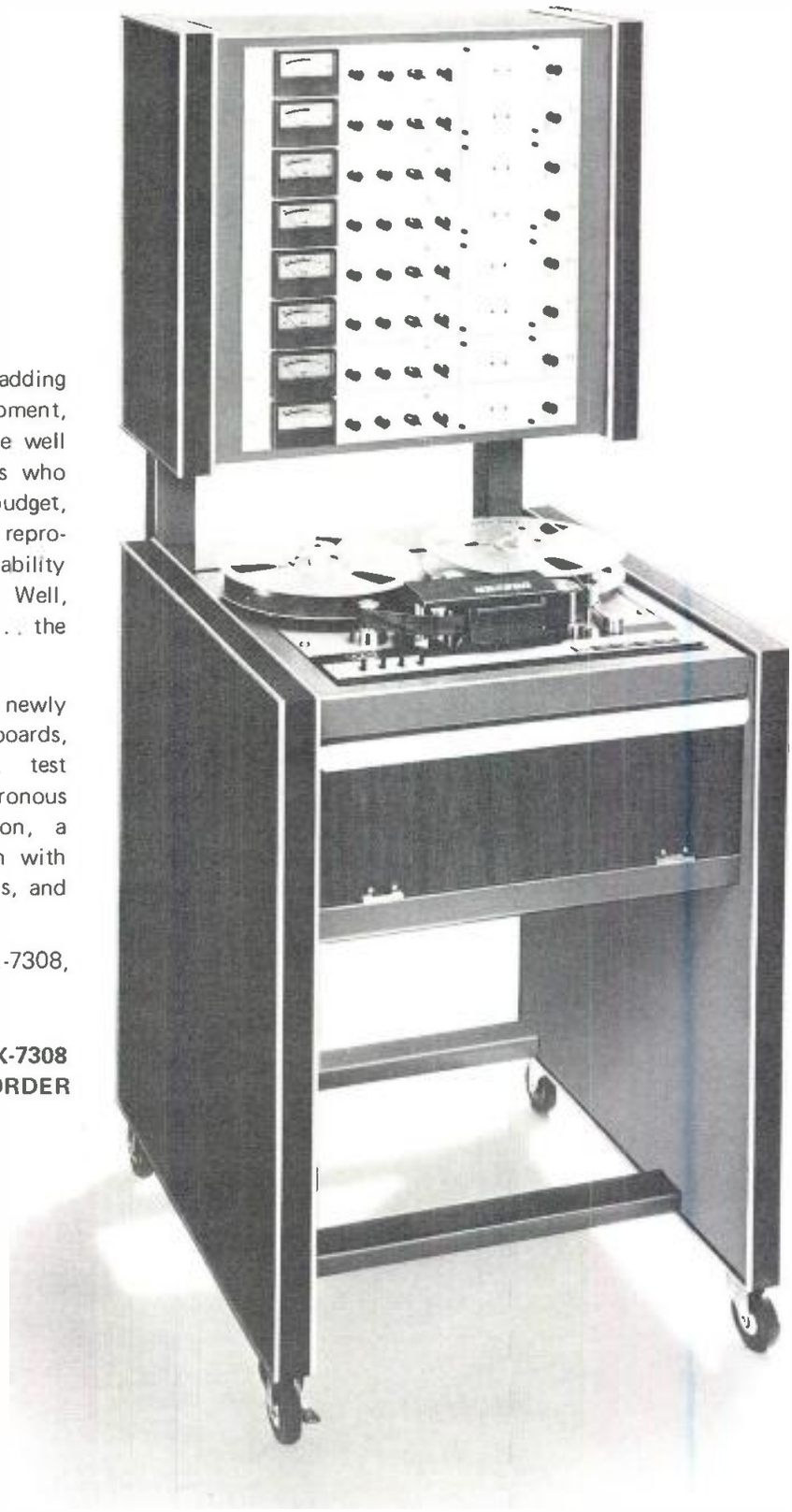

Here is the new recorder you can't miss . . . adding to your studio, replacing your present equipment, or just opening your own studio. You are well aware that even the professional musicians who come to you for recording with limited budget, yet they want professional quality – perfect reproduction, easy to use, extreme accuracy, durability and easy-to-afford cost per performance. Well, OTARI has the answer to the new trend . . . the new MX-7308 multi-channel recorder.

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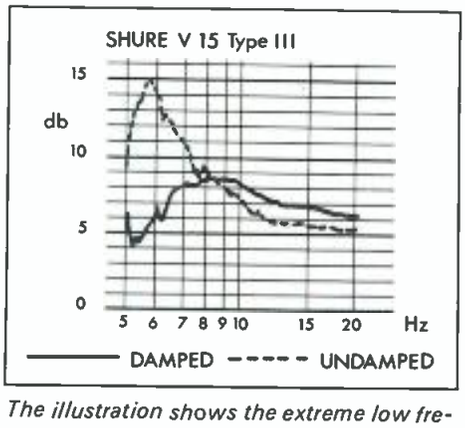
3009+FD200

The FD200 is a new accessory from SME: a fluid damping device which can be fitted, easily and quickly, to any Series II or Series II Improved arm. The benefits of fluid damping have long been known: resistance to external shock, audibly improved bass, and reduction of spurious low frequencies; but these are not fully realised when the damping is applied at the bearings. For this reason the FD200 is designed to be fitted at a point along the length of the arm.

The FD200 design overcomes the usual problems of leakage and low efficiency. It offers a choice of two damping rates, to suit a wide range of cartridge compliances. The attractively presented kit includes viscous fluid and full instructions.



The illustration shows the extreme low frequency response characteristics of a typical high-quality cartridge in the Series II Improved arm.

Note the substantial reduction in the Q of the low frequency resonance. Although these frequencies are themselves outside the range of human hearing they give rise to undesirable side-effects which are audible.

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F.M. Monitoring Problems

• The f.m. modulation monitor should provide us with accurate information about the carrier modulation during programming, and it can supply much more information about the signal when testing out the system. The accuracy of the monitor, however, depends upon its calibration and operation, as well as the proper functioning of individual circuits in the monitor. This month we will discuss some of the problems in monitoring and testing the f.m. transmissions.

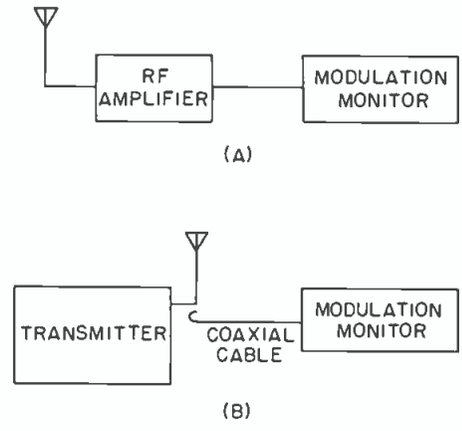


Figure 1. Two ways to drive the monitor. Either method can distort the signal in its own way: (A) at a distance and (B) local.

INPUT

To operate properly, the monitor must have a correct rf input signal. There are two aspects that must be considered: the amplitude of the signal and the method of feed.

The rf input level must be within the specifications for the particular model. Too little signal will cause the monitor to operate erratically, and too much signal will overload and burn out the input circuitry. The sampling loop in the transmitter should be adjusted to provide only a little more power to the input than needed, and then the input control can be adjusted to set the carrier meter or indicator to the correct amount.

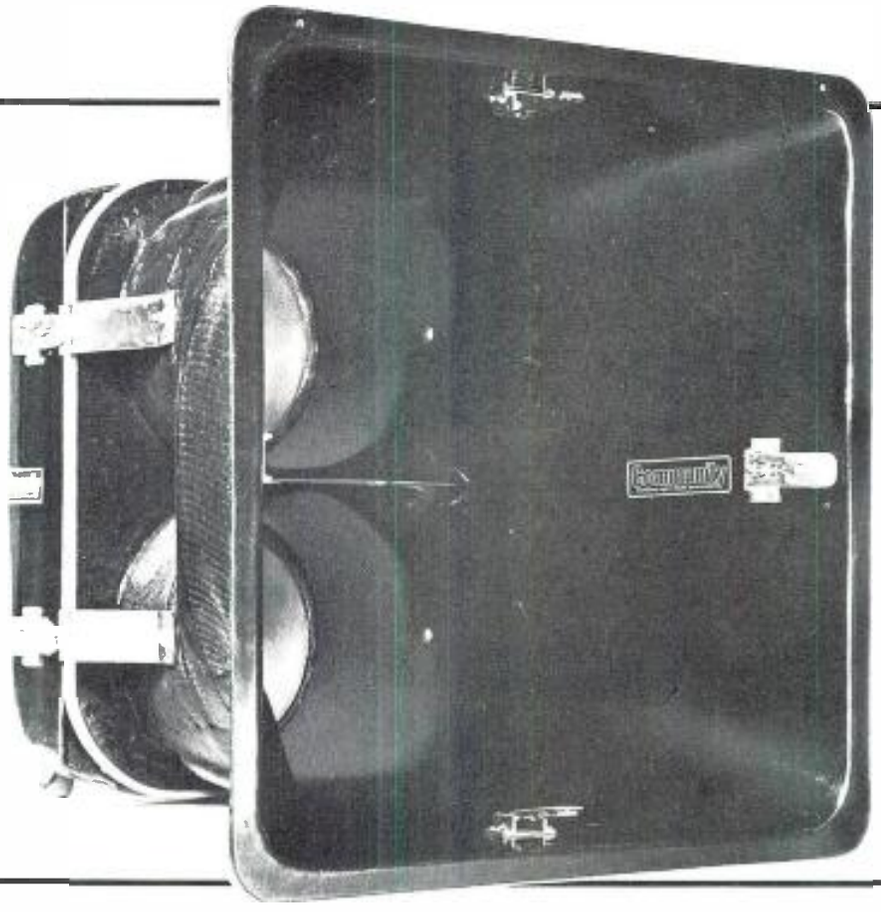
The method of feed is an important factor since this places an additional element in the signal path. Because of transmitter and monitor separation, some installations require an rf amplifier to feed the monitor, while others connect directly to the transmitter by coaxial cable. Overload of the amplifier input must be avoided, but very importantly, the amplifier must be broadbanded. This amplifier must faithfully amplify and pass on the original rf signal without any change.

COAXIAL TABLE

When coaxial cable is the connecting link, a new set of conditions exist. The cable has its own characteristic impedance that must be matched properly by the load. When the match is incorrect, there will be reflections on the cable. These reflections are out of phase with the modulated wave and they cause phase shifts and cancellations to occur in the main wave. The carrier, its sidebands, and the phase relationships must remain intact throughout the circuit paths to the detector output. If something happens to them, the output audio recovered from the system will suffer in some manner.

The impedance which terminates the line must match the line impedance at the frequency of the carrier and all its sideband components, that is, it must be a broadband match. An ordinary carbon resistor that measures 50 ohms on an ohmmeter (d.c. resistance) will have a far different value at 100 mHz (rf resistance). The difference is caused by the fact that the rf signal will travel only on the surface of the resistor (skin effect).

The best arrangement for matching the cable and load is with a directional coupler and wattmeter. The coupler elements should be for the frequency range and also for the small power levels involved. The actual power delivered to the monitor can be first measured by positioning the coupler to measure forward power. This will keep the rf level within the monitor specifications. The important element in the match is the reflected power, so the coupler should be repositioned to measure reflected power. Make adjustments to the load resistance until the reflected power is zero. You may

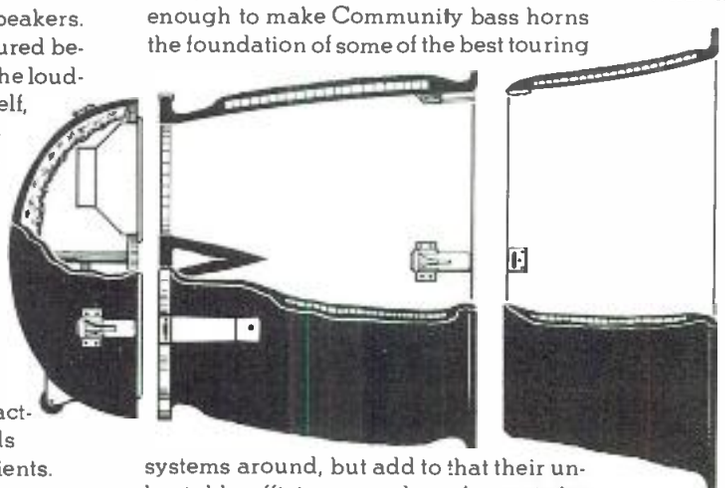


LEVIATHAN BASS HORN

This is the legendary Leviathan, our fiberglass bass horn for two 15" loudspeakers. It comes in three sections as pictured below: the back pod which houses the loudspeakers, the 48 Hz flare horn itself, and the optional extension for increased frequency range, projection and efficiency.

Not shown are our other bass horns: the FRC/B, designed to provide true horn performance in the smallest possible package, and the aptly named BLT, or Bass Long Throw, which does exactly that over several hundred yards with the closest attention to transients.

Like everything else that we make, our Levi, FRC/B and BLT are rock solid, portable, and built to last. That's reason enough to make Community bass horns the foundation of some of the best touring systems around, but add to that their unbeatable efficiency and you've got the bottom line for a full spectrum of professional applications.



What does efficiency mean? Because of our design criteria any Community bass horn's output is typically 4-6 dB above its wooden competitor's. To you, the professional sound person, this means that you need fewer bass horns to fulfill your requirements and, consequently, less drivers and electronics to power them. In addition, our bass horns weigh thirty to forty percent less than the old wooden horns meaning an additional savings in reduced installation and freight charges.

Need a couple of bass horns? See your Community dealer. You might only need one.

SPECIFICATIONS	EXTENDED LEVIATHAN	BLT	FRC/B
Flare Rate	48 Hz	52 Hz	66 Hz
Operating Range	from 50 Hz	from 60 Hz	from 75 Hz
Driver	Two 15"	One 15"	One 15"
Size (HEIGHT/WIDTH/DEPTH)	43¼"/69¼"/64"	44"/44"/56"	30½"/40"/44"
Weight (less drivers)	175 LB	90 LB	65 LB

Community

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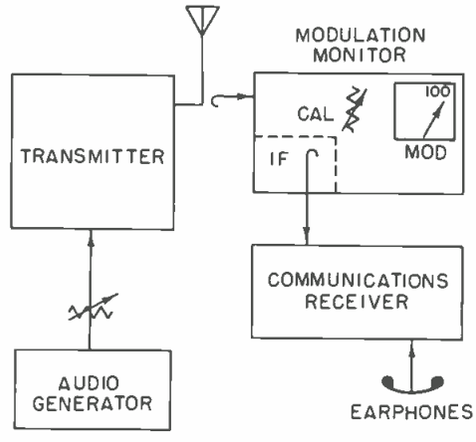


Figure 2. The setup to check calibration with the carrier nulls. Tune the receiver to the i.f. in the monitor or to the carrier itself.

not actually be able to achieve zero, but work for the very minimum. Remember that the higher this reflected power is, the greater effect there will be on the modulated wave.

THE FRONT END

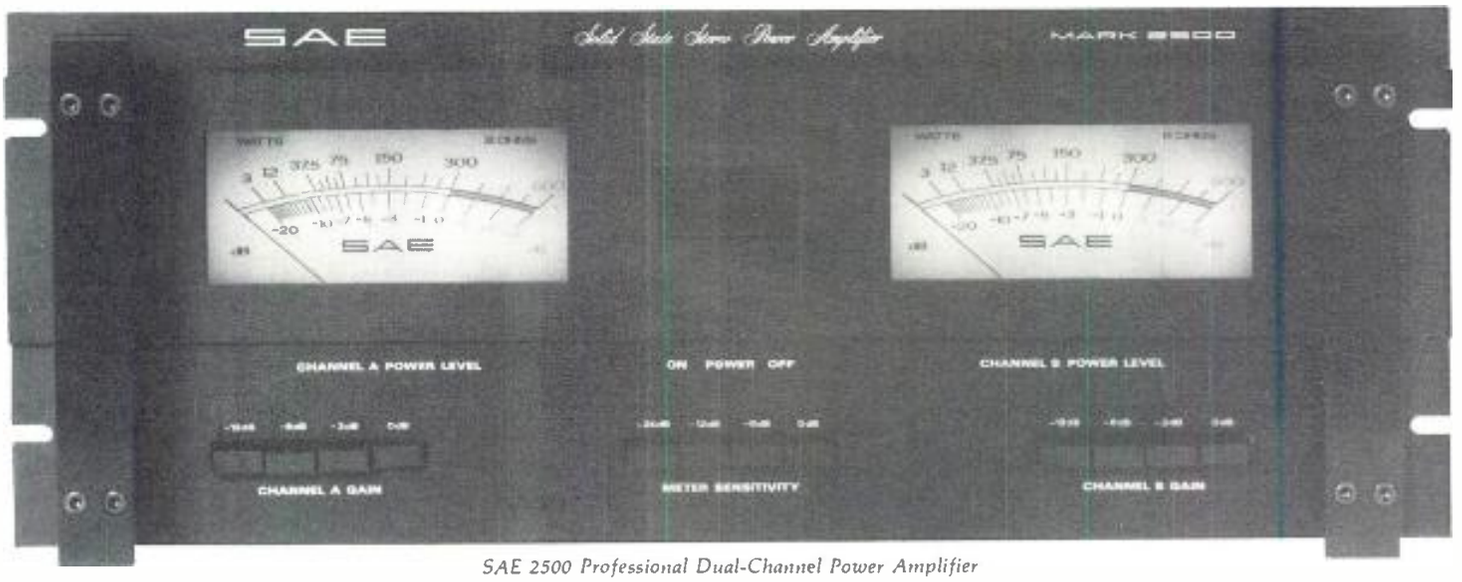
When the rf input level is correct, the next important factor is the level of local oscillator signal into the mixer. High conversion efficiency requires that the local signal level be several times higher than the incoming signal. The oscillator should not be tuned to peak, but rather on its slope at about the 80 per cent point. When tuned to peak, if there is a small drift in the wrong direction, the oscillator will quit—and so will the monitor. When a fixed bandpass filter is used in the i.f. section, the oscillator frequency must be tuned so that the i.f. resting frequency is right down the center of the filter bandpass. Should the carrier be tuned off to the side of center, the modulated wave will be clipped on that side of the filter, affecting the audio.

CALIBRATION

The monitor must be calibrated if it is to indicate modulation percentages correctly. There are two ways to do this: by internal calibrating signals, or by monitoring the carrier nulls on a receiver. Methods are provided in the instruction manual, but I would like to bring out a few points here.

Most monitors provide an internal i.f. or audio signal for calibration, and they may also provide for the injection of an external audio signal for calibration. Whatever the calibrating signal, it must be accurate both in waveform and peak amplitude. Use an oscilloscope to observe and measure these factors, whether it is an internal signal or one that you are injecting. If the waveform is distorted

Powerful alternative.



SAE 2500 Professional Dual-Channel Power Amplifier

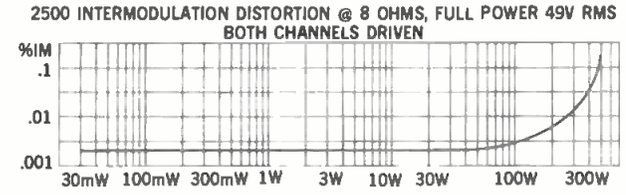
When you compare power amplifiers, you have to look at the hard facts. The SAE 2500 Professional Dual-Channel Power Amplifier has them—top power, specifications, reliability and features that make it the most "powerful alternative."

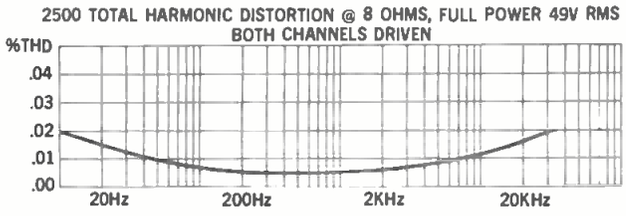
Power. 450 Watts RMS per channel, both channels driven into 4 Ohms from 20Hz to 20kHz at no more than 0.1% total harmonic distortion. Or, 300 Watts RMS per channel, both channels driven into 8 Ohms from 20Hz to 20kHz at no more than 0.05% total harmonic distortion.* Plus, a new, smaller wide-channel 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.
Frequency Response at rated power..... ±0.25dB, 20Hz to 20kHz
Noise.....Greater than −100dB below rated power
Transient Response of any Square Wave ..... 2.5μsec. rise and fall time
Slew Rate .....40V/μsec.
Dimensions ..... Front panel: 19"Wx7"H, Chassis: 15¾"D (excluding handles, controls and connections)

*These specifications comply with FTC requirements for power amplifiers.





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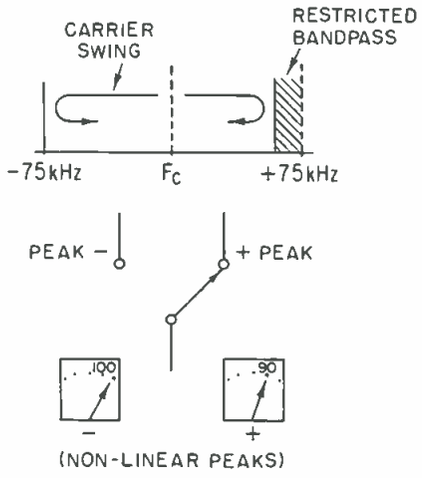

Figure 3. The monitor can check the linearity of the carrier swing and system bandpass.

in some manner. for example. the peaks may be clipped or the fixed level incorrect; then the calibration will be in error.

After the signal is verified to be correct and the modulation meter adjusted to indicate 100 per cent. modulate the transmitter with the same frequency audio signal until the monitor indicates 100 per cent. Now observe the waveform and amplitude of the recovered audio from the detector. Also check the required audio level at the input to the transmitter. If this is different from previous measurements, there is something wrong in the transmitter or front end of the monitor. This method is somewhat indirect and you can't be really sure of the true modulation.

A more accurate method is to measure the carrier deviation with a communications receiver and tone modulation. This is not a difficult method. Just think of it as though you were going to copy a cw signal through much interference. So use the most narrow filter on the receiver and the bfo to provide a suitable beat note. The basic principle of the signal is that for a given audio frequency sine wave modulation, at different input levels, the carrier will null (its amplitude drops to zero). There can be several nulls; these depend upon the selected modulation index, the deviation, and the selected audio modulating frequency. The procedure then is to tune in the unmodulated carrier and set up the receiver. After that, modulate the transmitter with the audio frequency you selected and the null that will be 75 kHz deviation. Slowly increase the modulation level and carefully listen for the nulls. Count the nulls until you reach the

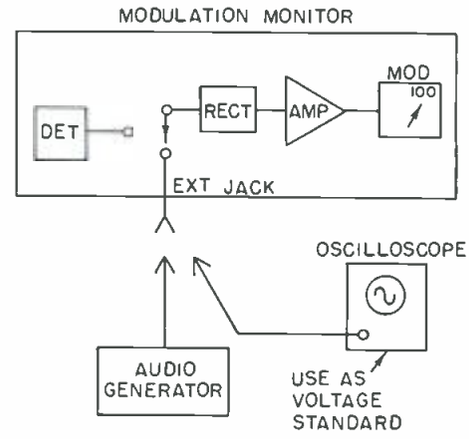

Figure 4. The setup to check the response of the modulation meter circuit.

correct one for 75 kHz deviation. This is 100 per cent modulation and the monitor should indicate 100 per cent. If not. adjust its calibration. Two important facts: the only two signals which have 75 kHz deviation are the carrier itself and the i.f. in the monitor. All others in the transmitter will be affected by multiplication factors and your calculations will not be correct. Also. ignore all the sideband beats; concentrate on the carrier.

LINEARITY

A very important aspect of the f.m. transmission system is its linearity. This isn't so much amplitude linearity. although that can occur ahead of the modulator or in the metering section of the monitor, but the frequency linearity of the system bandpass. Nonlinearity will cause problems with the recovered audio. a stereo signal and SCA.

System linearity can be checked with the monitor and sine wave modulation of the carrier. Modulate the transmitter to 100 per cent as indicated by the monitor. Then. switch the plus and minus selector switch to measure the peak modulation. The modulation should be the same for either peak. The plus peak is a measure of the carrier up frequency swing, while the minus is a measure of the carrier down frequency swing. If the two peak readings do not agree. then check the monitor circuits. Inject the same audio signal at the correct level into the external input of the monitor and again check the plus and minus peaks.

If they now agree. the problem is in the system from the detector back to the modulator. Of course. if they do not agree. then there is a problem in the metering section of the monitor. If the problem is in the system. look for something that is restricting or distorting the bandpass, such as a mistuned rf stage that has the band-

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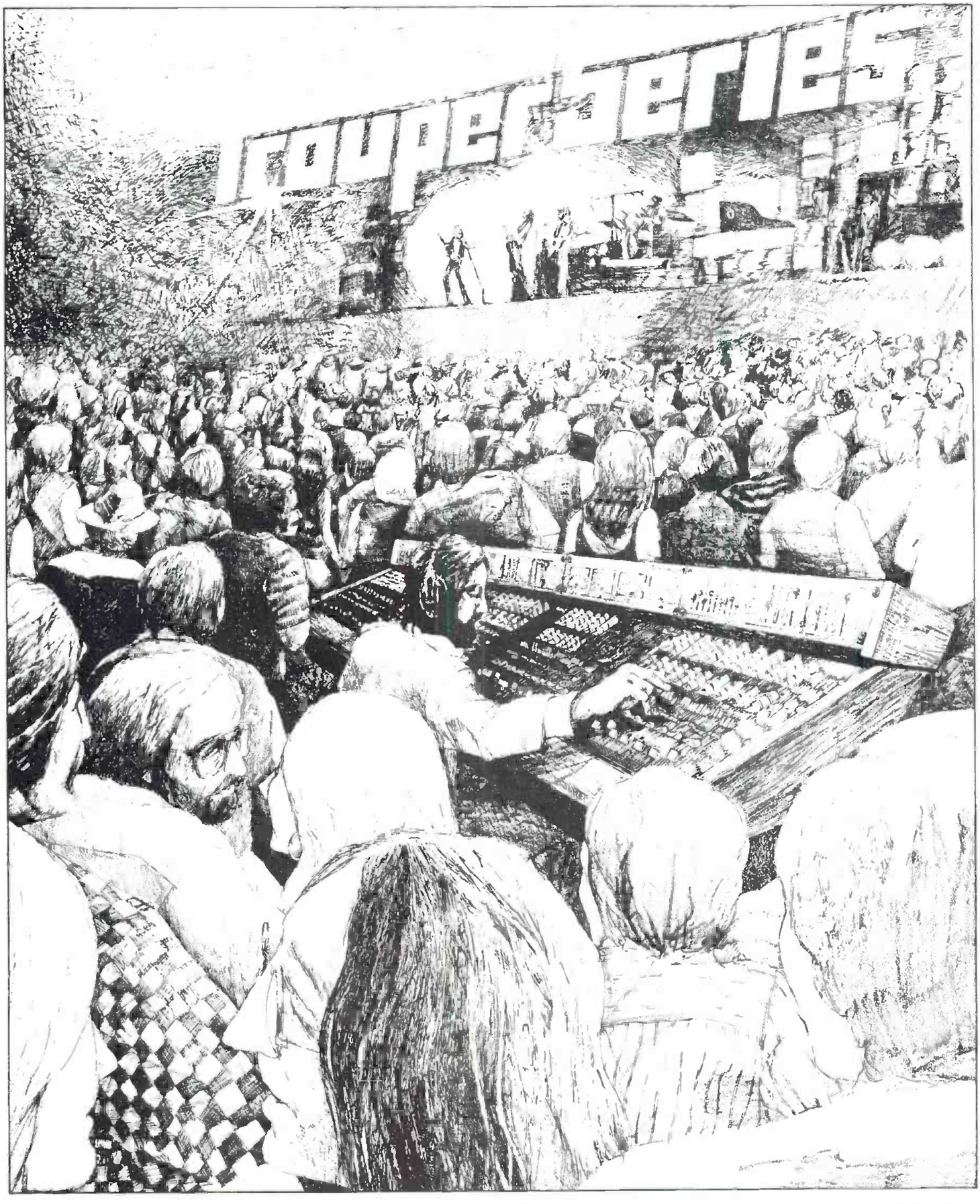

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pass tilted, a too high Q, a defective filter, or the difficulty may be back in the modulated oscillator itself.

METER RESPONSE

The modulation meter circuit must track within ½ dB over the audio range 50 Hz to 15 kHz (for a monaural monitor), or within 1 dB over the range 50 Hz to 75 kHz (for a stereo monitor). The modulation meter must have a flat response. Besides meeting FCC specs, this meter is used for measurement of the system response. If the meter response is out of tolerance, the engineer may be overcompensating the system to make up for a poor meter response!

The metering circuit can be checked with an audio signal generator and oscilloscope. Inject a 1 kHz audio sine wave to the external calibrating input and adjust until the modulation meter indicates 100 per cent (0 dB). Use the 'scope to measure the signal at the monitor input; each tone signal should be set to this amplitude on the 'scope. Now make a regular frequency response run, but use the oscilloscope as the level standard and compare the indications on the modulation meter. If the meter doesn't track within the required specs, then some maintenance is due.

NOISE AND DISTORTION

The pre-emphasis and de-emphasis filters used in the f.m. system to overcome noise also *work against* the measurement of noise and distortion. The boost of up to 16 dB for high program audio content is possible due to the fact that there is not that much actual high frequency component in the audio signal anyway. What is present does not have the same energy content as the sine waves with which we test the system. If we were to feed sine waves into the transmitter at a flat response, this boost would seriously overmodulate the transmitter. So consequently, the input levels of audio tones describe a de-emphasis curve.

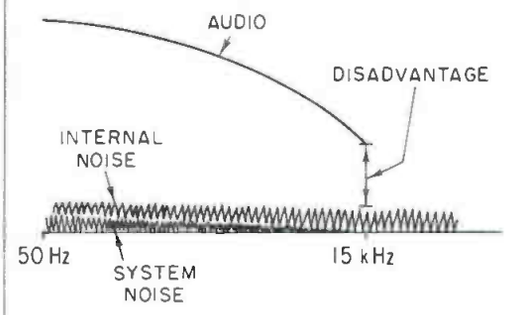

Figure 5. The de-emphasis filter in the monitor places the signal at a 16-dB disadvantage to the internal noise of the distortion drive amplifiers.

In essence then, the carrier is actually modulated with a flat response curve rather than with pre-emphasized audio. The output of the detector in the monitor will pass through a de-emphasis that will roll off the high end 16 dB; this places the tones at a 16 dB disadvantage to the noise in the distortion drive amplifier. The *internal* noise of this drive amplifier is the limiting factor on noise and distortion measurements.

If system noise and distortion read out of specs and everything appears to be normal otherwise, check out the distortion of this amplifier by injecting audio into the monitor external calibrate input. If the noise and distortion of this amplifier itself is out of tolerance, it isn't possible to get an accurate measurement of the system.

SUMMARY

We have only touched on a few of the many facets of measuring and monitoring the f.m. system. Because of the vhf carrier and character of modulation, the station needs a specialized test instrument such as the monitor. But to provide meaningful information about the signal, the monitor must be kept in good repair, calibrated and operated properly. ■

Home Cookin'!

See that guy at the board? Once upon a time he was an engineer at the busiest studio in town. The place had everything big money could buy. And it cranked out super-slick albums at an absolutely psychopathic rate. But because its hourly rate matched its image, it wasn't only the busiest studio in town, it was also the most expensive. Which was alright if you had a fortune to spend– which the band you see here didn't.

After years of being a staff engineer he decided he'd been sitting behind somebody else's board long enough, thanks. So with the money he'd saved, he invested in a complete TASCAM Series recording studio by Teac– 80-8* eight track, 25-2* two track, mixing consoles– the works!

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Well, the band cut a demo at his new studio and with it they got a record deal. And with the front money, they invested in their own Teac mini-studio. So with the band members taking turns at the board, they laid down the tracks for their album. And to make sure they got the most out of the tracks they made, they asked the old pro to do the final mix.

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db the sync track

JOHN M. WORAM

As a recording-studio observer, the condition of audio in broadcasting has always been somewhat of a puzzle to me. It seems at times that a station will spend hours polishing its antenna and perhaps minutes adjusting the azimuth on its tape recorder (if indeed the station even has an azimuth wrench). Such space-age technology as 10½-inch reel or a machine that spins at 15 i.p.s. is often unheard-of. (No kidding: I once showed up at a reasonably well-known station for a talk show, bringing along some musical examples on just such a reel. The station couldn't play it.)

Well, if the last convention of the National Association of Broadcasters (NAB) is any indication, *maybe* all that is changing. Held in Washington, D.C. (March 27-30), the convention exhibits were sprawled through three large hotels. The magnitude of some of the exhibit booths staggered the mind of one who is accustomed to the more intimate surroundings of the Audio Engineering Society shows. Ampex's booth alone was about as large as one of the main rooms at most audio-only expos.

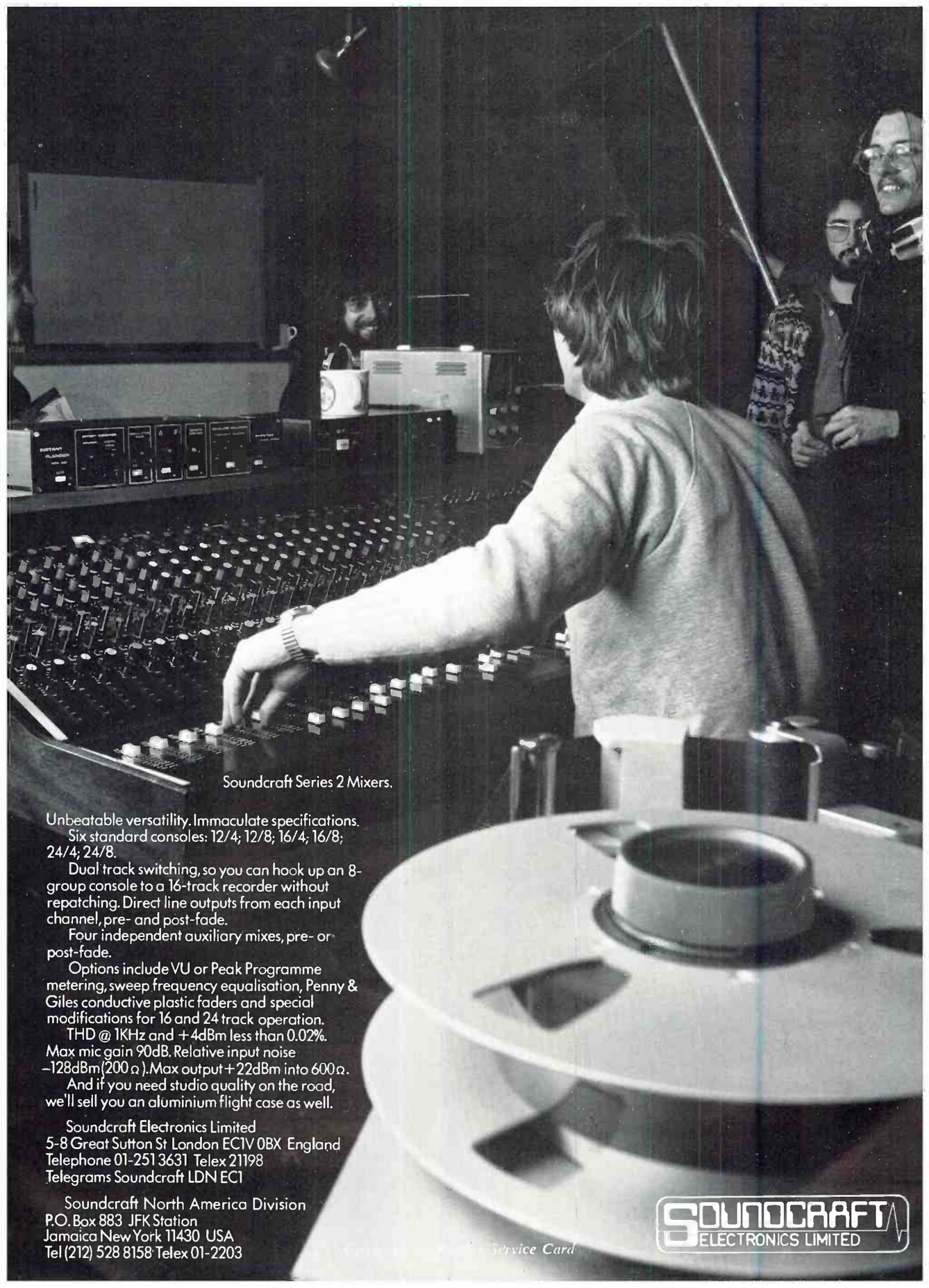
Obviously, broadcasting is *very* big business. (Remember you read it here first.) Just as obviously, television broadcasting is where the big bucks are. And of course, the television lads still think of anything below 20 kHz as just so much d.c. ripple. Consequently, the audio wares at recent NAB shows have been about as disappointing (to an audio freak) as the sound that comes out of most t.v. speakers. But, from the looks of this most recent show, apparently radio broadcasters are beginning to catch on to the fact that perhaps they may be transmitting something that actually deserves to be heard.

In fact, a two-page NAB engineering bulletin devoted itself to an announcement of some new gadgets from Harris Corp. that promise the broadcaster ". . . . loud, *clean* sound." (Italics, mine) In describing a new stereo generator and a dynamic transient response (dtr) low-pass filter, the bulletin noted that, ". . . Advertisers and record buffs should appreciate the dtr filter since it cures an annoying problem—the 'rapsy noise' evident in both stereo channels when a 'hyped' commercial or recording is run on conventional systems." *Rapsy?* I suppose they mean raspy.

CLEAN SOUND

So, clean sound (with *no* rapsies) may be coming your way. Could this mean that record manufacturers will finally have to start making clean pressings? Let's hope so, but don't hold your breath. One prominent record manufacturer said that record pressings are like t.v. audio (lousy, that is) because the public just doesn't give a damn. Yes, some people return particularly gross records to the store where they bought them, but few bother to return the records directly to the manufacturer, demanding satisfaction. Therefore, the manufacturer claims to be "unaware of any consumer complaints." So, until the manufacturer "becomes aware," things aren't going to get any better.

With this sort of inspired thinking going on at the record labels, I suppose it's reasonable that broadcasters are going to spend little time and less money cleaning up the audio. Or is it? As I mentioned earlier, things seem to be looking up at last; here and there on the exhibit floor, one could actually discover quality-type audio gear. In fact, if all the audio exhibitors were placed in one area (they weren't) it would have made a



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fairly respectable-sized audio display.

With the NAB show coming between two AES conventions. much of the audio gear has been—or will be—reported on in our more extensive coverage of these shows. So for now. we'll just take a quick look around at a few items. some of which have not yet made it to Audio Engineering Society shows.

CONSOLES

Although many of the audio consoles seen in Washington are still using rotary faders, there were at least a few on hand that had made the transition to slide faders. And of course, those consoles that come from recording-oriented manufacturers bear a close resemblance to what you might expect to find in any well-equipped small recording studio.

For example, Rupert Neve, Inc.—who shouldn't need any introduction here—has several 12-in/4-out broadcast boards in the $15-20,000 range. These days, that's not much $$ for a recording console, but it is a lot for the broadcaster to shell out, particularly if he's not quite convinced that audio is worth the bother. Nevertheless, the consoles seem to be moving well, and that's good news.

TURNTABLES

If you've been having trouble buying one of the sensational SP 10 Mk II turntables from Technics by Panasonic, it's probably because the broadcasters are getting to them first. In fact, McCurdy Radio is probably the world's largest single customer for the SP 10. These go into McCurdy's complete turnkey installations. and the only problem is that they can't get them fast enough to keep up with the demand. And that's more good news, for it means that the broadcaster can actually do a decent job with phonograph records, when and if decent ones show up.

McCurdy is also marketing an impressive array of outboard equipment (digital counters, Orban reverbs, etc.) and has introduced a modular stereo production console, the SS8500. With ten stereo inputs (each with a conductive-plastic slide fader), it lists for $11,000.

Edco Products, Inc. showed its STE-100 stereo phase enhancer, which they say can be used for stereo head alignment. As most recording studio folks know only too well, phase cancellations in mono are a definite no-no. The STE-111 analyzes high frequency signals (above 1 kHz). and when it finds a phase shift between common-mode signals—that is, the same signal component on both tracks—the leading signal is brought into phase with the lagging signal. I suspect an azimuth wrench would be cheaper, but if the program itself is screwed up, the wrench isn't going to be of much use.

TESTING DEVICES

International Audio. Inc. showed a series of cassette testing devices, including a tension monitor, head and guide gauge, and a cassette tester. The device allows the user to check both the operating conditions of his cassette transport and of the cassette itself.

Some pretty fancy signal processing devices were also seen here and there. Orange County showed up with all sorts of goodies, including equalizers, limiters, compressors and expanders. and the OCAVS-1, which combines all of these in one package.

Scully Recording Instruments seems to be focusing on the broadcast field these days. They introduced their new 250 series machines—a ¼-inch transport available in mono and stereo configurations, with or without recording facilities. The 250-2 is a 7½-15 i.p.s. half-track stereo record/playback machine, and sells for $1,995.

There was much more, but I'm on my way to catch a plane to Los Angeles for the next Audio Engineering Society convention. where there will be *still* more to report about. And with a.m. stereo just around the corner, maybe by next year's NAB time, there will be even more audio in broadcasting. Let's hope so. ■

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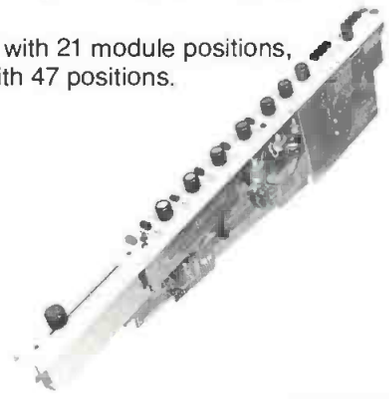

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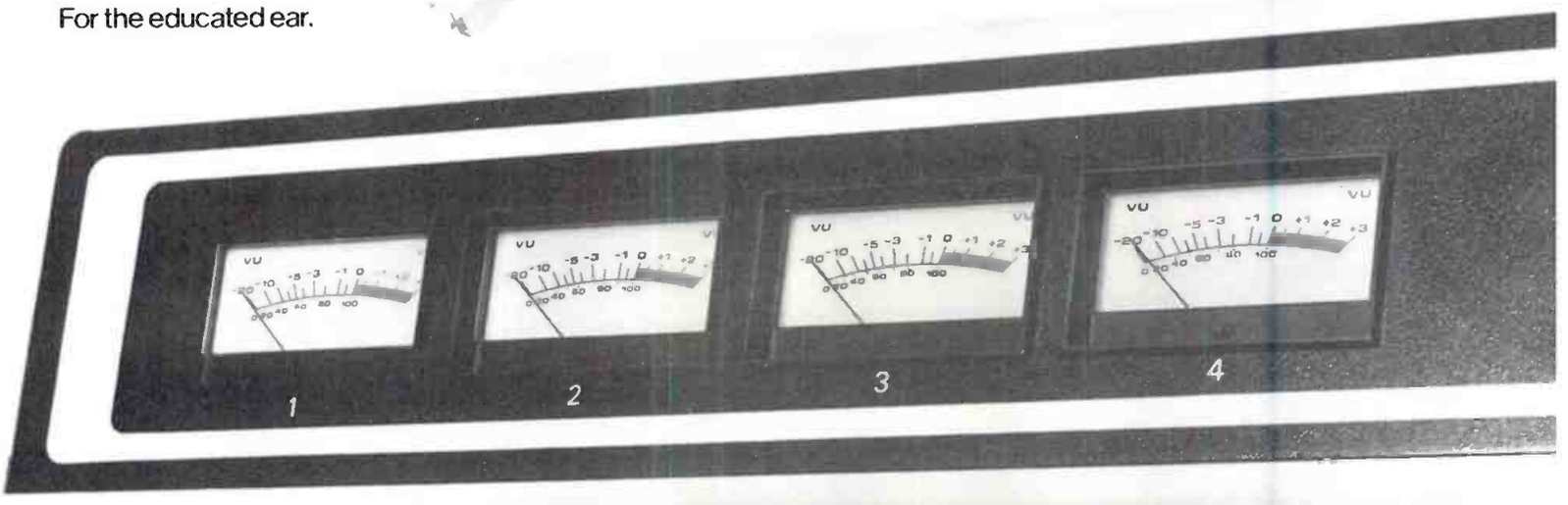
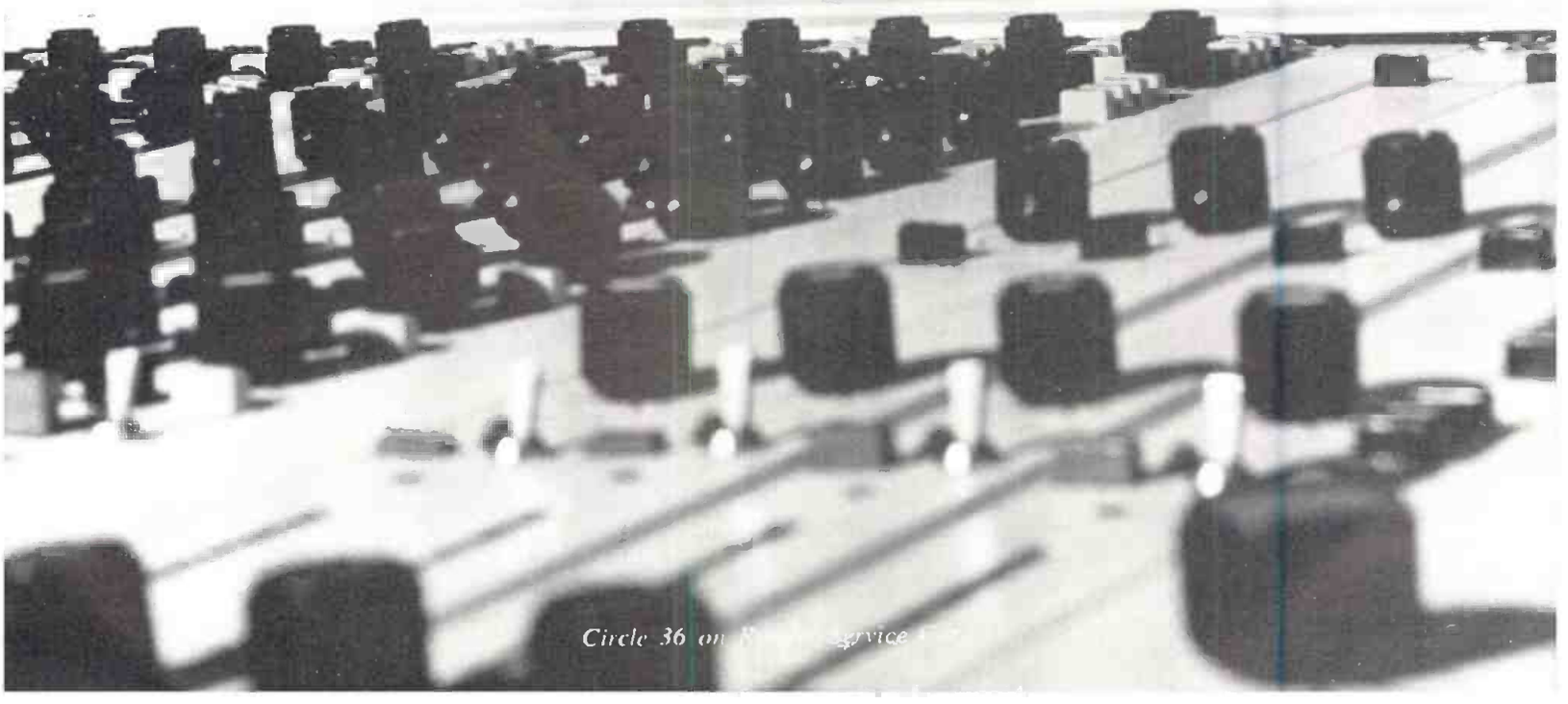




Mediation for Dynamic Education

• Things keep coming together. My last column took a specific look at the spectrum analyzer, along with its partner the oscilloscope, as a measurement tool. Before that, I was into media for educational purposes. Now, as someone pointed out, we can put those pieces together, constructively.

If you learned higher math the way I did, you may feel it is too advanced for ordinary school use, but is it? Why did it seem difficult to us, and need it be so far beyond today's youngsters? After thinking it through, you will agree that there is really no need for this attitude.

OSCILLOSCOPES AND GRAPHING

As I mentioned last month, the oscilloscope, using an ordinary time base, enables us to look at almost any kind of event, against time as the independent variable. Just saying that, may bring to mind graphing, which sounds like a chore because, when we learned it, it was! But everyone has seen oscilloscopes on t.v., particularly in medical pictures, where they regularly show a "vital signs" scan.

School children interested in music become enraptured if you can show the waveforms of various musical instruments on an oscilloscope, and perhaps show the effect of the mute on the tone of the trumpet. Taking a slightly different direction, you can use an X-Y display, rather than a time base, to show frequency ratio and tone intervals. Of course, the octave is the easy one, but the major intervals are close enough to see as a fairly rapidly shifting pattern (using tempered scale) of the Lissajou variety. It is a living image, much more dynamic than ratios, percentages, and graphing! More important than being exciting to look at, the oscilloscope conveys a great deal more with far less effort, and allows the student to get "hands-on" experience, so he is involved.

What else? Well, since the students have already been exposed to medical shows on t.v., the biology department is an obvious field for the oscilloscope, that hardly needs me to spell out a few possibilities. But staying within the physical sciences and math, some of my readers who have been with us longer may remember my saying that calculus ought to be taught much earlier in the curriculum, so it doesn't seem so difficult.

CALCULUS

Those who have, either immediately or eventually, found out how easy calculus really is, readily agree with me: the only reason it *seems* difficult is that students arrive there after a long conditioning that leads them to expect something almost impossibly dfficiult. Those of us who have been successful at teaching it easily, and at a much earlier age, have come into it "backwards," as the traditionalists would see it.

We use everyday happenings, like the acceleration and velocity of vehicles, as successive rates of change, derived from position in space. After working with them for a while, we put in the notation of calculus, and learning it is quite painless, even easy.

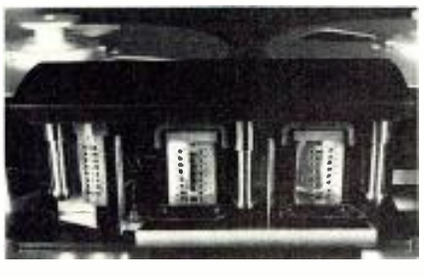
But the obstacle to getting that done on a large scale is the average teacher's conviction, not to mention that of some math professors—that calculus really *is* difficult. I suspect they never really understood it themselves, so they try to teach it the way they absorbed it, which is without understanding a word of it. Getting past that obstacle, admittedly, is tough.

(continued)

OTARI MX-7308: Unquestionably your best buy in one-inch eight-track machines.

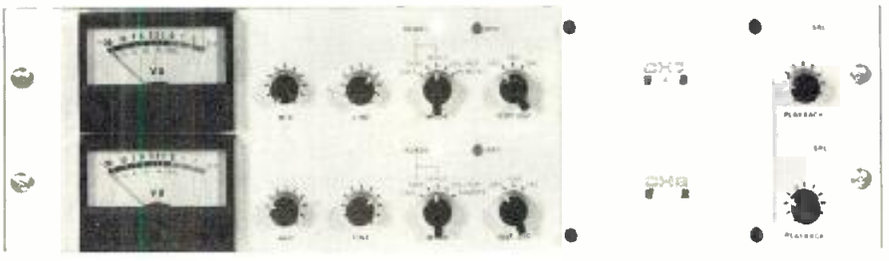
If you're tuned into the multichannel scene these days, you may have heard this news: Your best value by far in one-inch eight-track machines is the Otari MX-7308. Why? We believe it's because it has the same performance and features as the other eight-tracks, but costs 20% to 25% less: $8150 including console. That's enough savings to let you buy a two channel mix-down machine as well.

And when you stack it up against used machines (most of which sell for about the same price as a new factory-fresh Otari), you find the MX-7308 gives you several new features that just weren't around in the old days. Things like motion sensing, reliable FET equalization switching, reel tension servo, long life deep gap heads, and LED peak reading indicators, among others. Consider these features:



Long-life deep-gap Otari heads; plug-in convenience.

Heads: Superior quality extra long-life deep-gap heads; brass block mounted Permalloy construction for even wear and quiet performance; plug-in for ease of removal and realignment. These heads really deliver the goods and they keep on delivering session after session.



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Now, Mr. Fourier's analysis is getting into the really tough part, isn't it? By the time I learned that, I had spent more than a year studying under a professor who put notes on the board so fast, it was all we could do to get them in our notebooks, before he erased the whole thing. After which, since our brains had not been "in gear" during that process, we just tried to reconstruct from our notes, when it came to homework time.

So like so many others, we just absorbed the routines, without having opportunity to find out why they worked. Sometimes I would wonder about the validity of Fourier, but I did not have time to explore it for myself, until I came to write Volume 4 of my *Basic Math Series*, when my own discipline required me to explain it in terms the reader could understand. And that means that, first, I must now understand it myself.

Had I not made that effort, I probably never would have been quite sure about Fourier, although I might have gone on using his excellent series all my life.

FOURIER VIA A SPECTRUM ANALYZER

But now you can perform Fourier visually if you have the tool known as a spectrum analyzer. All you need is to generate a square wave or any other wave shape you fancy analyzing, feed it into a spectrum analyzer, and there it is, looking at you from the screen. One equals the other. If a student is not quite sure, he can fiddle for himself, playing with the mark-space ratio, and see how the spectrum changes. Fascinating! Seeing is believing.

Do you remember laboriously plotting out a fundamental and odd harmonics adding them together to see how they progressively came closer to a square wave? But now, you can do the same thing electronically. With phase-locked, synchronizable function generators, you can generate the actual waveforms, display them individually, and summated. You can shift individual phases, and see the classic effects of filters with too sharp a cut-off, by simulating amplitude and phase response.

The possibilities are endless. If you try to stay in the old framework, you will be in trouble. Neither the teacher nor the professor will know what you are doing. But the kids, the students, are not inhibited by the conditioning that "it's impossible." Something you can see happening cannot be impossible. So they ask why—what does it mean? You're into Fourier analysis by what the old timers would doubtless call "the back door."

The beauty of it is that the students can make endless variations by themselves and observe what happens all the time. They'll learn more advanced math in a few minutes, or in a class period, than you ever learned in a whole year's course! So what is wrong with that?

ACTIVE MEDIATION

There is another plus: how did you learn math? First addition, then subtraction as the "reverse" of addition; then multiplication, and division as the reverse of multiplication; and so on till you came to differentiation, and integration as the reverse of differentiation. Was that it?

Which bothered you most? Finding the explanation or being sure the concept really worked? Those are two of many different learning styles. Some students want to reason their way to a solution, are never sure the solution is right, until they have the structure behind it. Some merely want to satisfy themselves that a method always gets the right answer and do not even care why.

This *active mediation* method, as I would call interaction with such equipment as a spectrum analyzer, an oscilloscope, and sundry phase-locked function generators, etc., allows each student to pursue his own native learning style with the greatest ease.

We have spoken previously of the teaching or communication dimensions of media, how the printed or written word, with line drawings, photos, whatever, are "persistent," while motion pictures, video tape, and such items are "transitory." And there are combinations that split the difference in various ways.

Programming such media attempts to *involve* the student in various ways. You involve him, for example, by testing his existing knowledge. A typical question asks him to complete the statement, "The father of modern recording was, check which: A) Albert Einstein, B) Albert Schwietzer, C) Walt Disney, D) Thomas Edison." The student has to hit an appropriate button. If he hits a wrong one, the programming takes

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- Less than 0.2% IMD
- LED overload indicator
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- Forced air cooling

CS-400 $424.50 *
Stereo power amplifier
- 200 Watts rms per channel
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CS-800 $649.50 *
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- 400 Watts rms per channel
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- Loudspeaker protection system
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him to some corrective material that helps him to assimilate the correct answer!

To me, that is no more than a mediated version of a lot of programmed instruction I have seen in book form. The only creativity it expects or motivates in the student is the putting of an X in the appropriate space in the book or the hitting of the appropriate button on his computerized learning machine.

Everything the program can respond must have been previously programmed into it. It is a closed system, in that sense. If the student has a sneaky suspicion the answer is "None of the above," he cannot make that response, unless the book provides such a space, or the computer such a button to press. And even if it makes that provision, the program has no way to explore, or help the student explore, whatever alternative he may think of for himself.

With an interactive system, such as can be built round an oscilloscope, a spectrum analyzer, a variety of generators, programmable or manually operated, the student can choose his own learning style. He may like to try something simple first, that he can easily understand, then build from there, until he finds what he wants by a process of reasoning it through. Or he may prefer taking stabs at the problem more intuitively. Each is equally possible with such a sytem, or any combination or variation that suits the individual best.

USING COMPUTERS

The only thing that even comes close in effectiveness to this form of teaching is hands-on, unstructured work with a computer. Some years ago, Don Davis, who also writes in this magazine from time to time, told me that a Hewlett-Packard desk-top computer virtually taught him all the math he knows. In school and college, by his own statement, he was useless at math. I do not know whether I quite believe that, but I am sure he did not thoroughly understand it, like so many others.

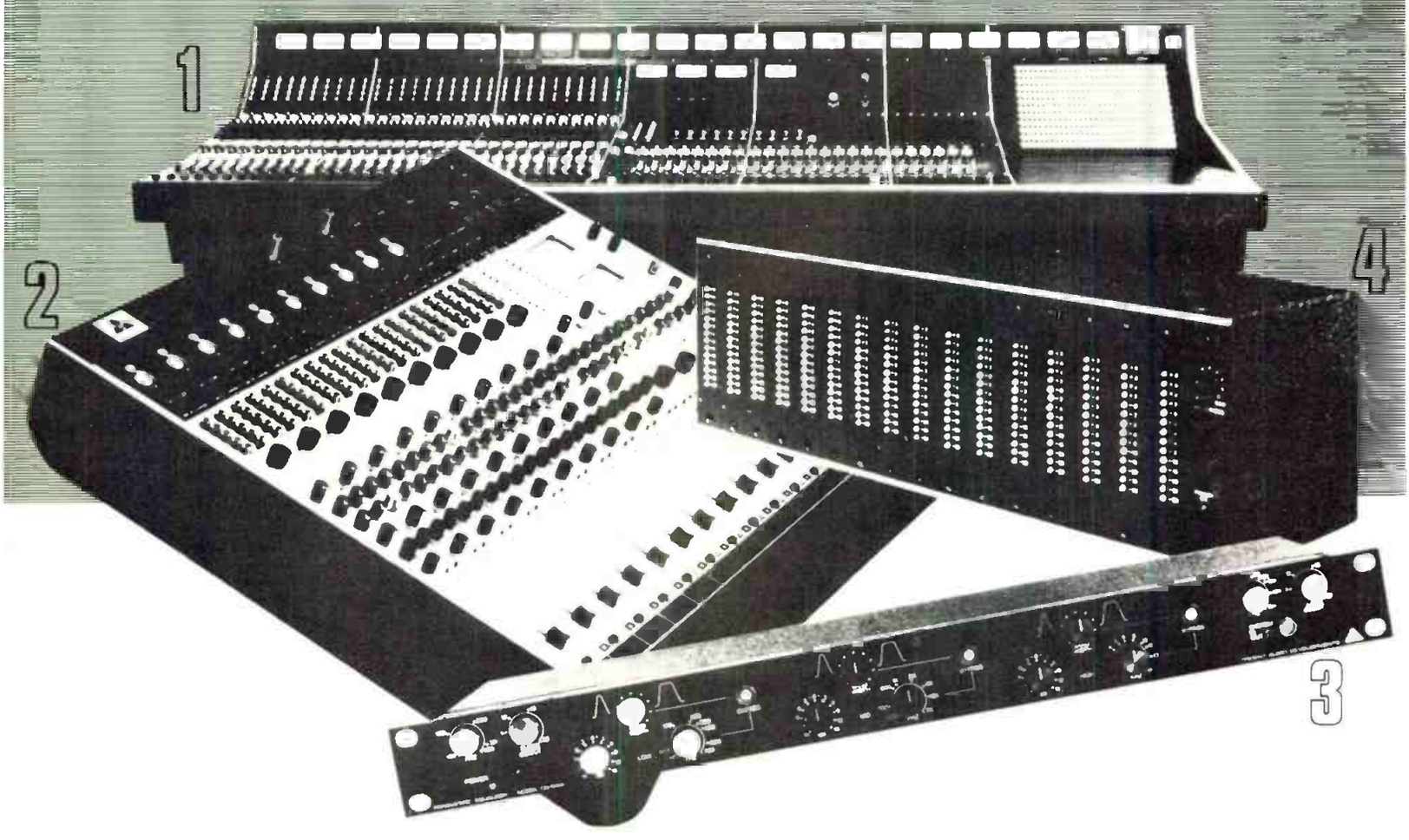
Then he got this desk top computer and just played with it, and found out what you can do and what you cannot do. He found his own way down to the basics, the why of what you can and cannot do. At the time, he commented on what a wonderful tool it could be in the classroom, if students were given freedom to do their own thing, to find out in their own way.

He had tried it, but found that teachers always wanted to get in the way, to prepare their "lesson notes." So it degenerated to "enter the number . . . , hit the times button. . . ." Just as always, they were unwilling to let students loose to find out for themselves, in whatever way they individually could best learn. The process had to be programmed so teacher could keep tabs on everything.

At best, the computer, which gives only digital readouts, is a poor second best to something whose displays can be as visual as an oscilloscope, particularly when the more sophisticated accessories, such as a spectrum analyzer, are available.

Of course, the last question, when I've said all that, is cost. When Don told me about his experience, the desk top computer he used cost about $4,500, maybe more. Today, for $19.95, or at most $29.95, you can get a pocket version that would serve the purpose equally well. With modern miniaturized data processing systems, quantity is the answer. And what better way to get quantity, than to set about having several in every classroom? What we need is a trait that is getting more rare in recent years: vision! ■

Trident perfects the Recording art



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1. 'A' Series Studio Consoles for users requiring a highly sophisticated system. 16-frequency graphic equalisation on every channel, 4 independently controllable foldback circuits, 6 pushbutton selected echo groups, quad systems, dual scaled VU/PPM metering and separate LF/HF equalisation on each echo and foldback circuit. VCA fader grouping as standard option. Phantom mic powering, electronic stop-clock and phase meter as standard.
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db sound with images

MARTIN DICKSTEIN

● Before going into this month's subject, let's go back a bit and catch up on what has happened since a couple of previous columns were written.

In February, this corner recalled some memories of audio tape editing days and mentioned Joel Tall, the inventor of the block used in almost all of the editing facilities anywhere. He read the column and sent in the following letter:

Dear Marty,

Thanks for mentioning my work in your last article in **db**. *It will be nice for people around the world to know that I am still alive and working to improve tape editing!*

You know, I began editing WIRE in 1946—a show cut on wire and recorded around the world by Lee Bland and Norman Corwin. Then when the first Brush recorders came out in 1947 I began editing the then paper tape with black oxide coating. The troubles were legion. The coating flaked off, the tape broke, re-recording distortion was about 5 per cent or more, noise level—mostly hum—was about 35 to 40! I finally took the power pack out of one machine, hooked it up through a ten foot cable, which reduced the hum to about 55, then introduced a little negative feedback (adjustable) to reduce distortion a bit, and that was the machine on which I began to edit I Can Hear It Now *discs. I edited and broadcast, to three networks at once, the first tape documentary,* The British Crisis *in 1947.*

Inventing the Editall Block was the result of a dream, believe it or not. Cutting with scissors was a nuisance and I made up a few blocks with different kinds of channels to hold the tape but none really worked right. One night I kept thinking that any kind of coated material tended to shrink on the coated side; if I could utilize that tendency, maybe I could make a block that would hold the tape snugly so it could be cut cleanly. I dreamed of a curved-bottom block with a small retaining shoulder—and that was the invention! Vic Piliero of CBS Master Control made the first block for me by hand!! Love that guy!

I was the ONLY tape editor at CBS for some years. One of my first students was Max Weiman. Then Ed Gille appeared and the others, including Mort, who is very good indeed. You know, to be a really good tape editor requires so much of a man that very few become excellent editors. I think that if there are fifty, world-wide, it's a lot.

There is so much room for improvement in tape editing that I have decided to write, along with an excellent tape editor named John Burr, a new book containing everything I have learned over many years plus all the latest techniques in multi-track tape editing. This should be ready for publication in a year or so and should help to improve tape editing world-wide; at present it is in very poor shape!

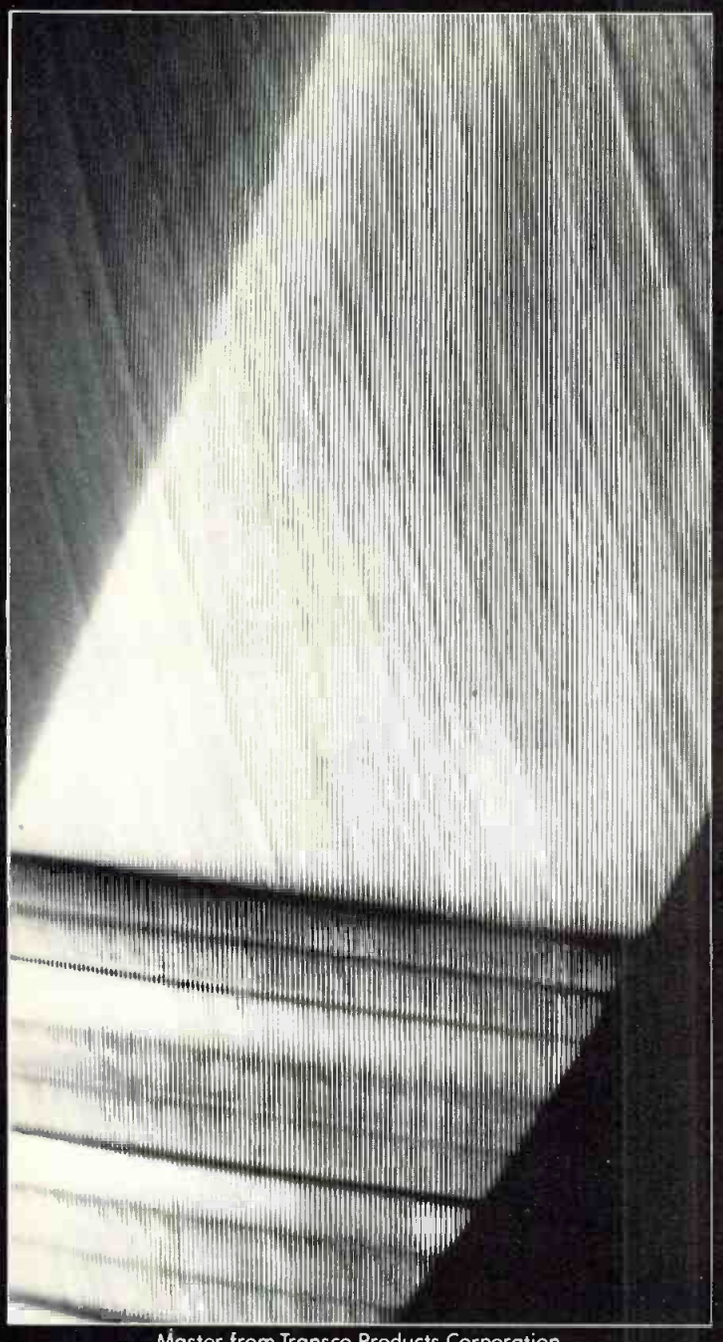
If you think any of the above would interest your readers you have my permission to print it.

Well, as you can see, we thought all of it was interesting enough to print, Joel. Thank you for writing, and our best wishes to you for a quick recovery from your recent operation.

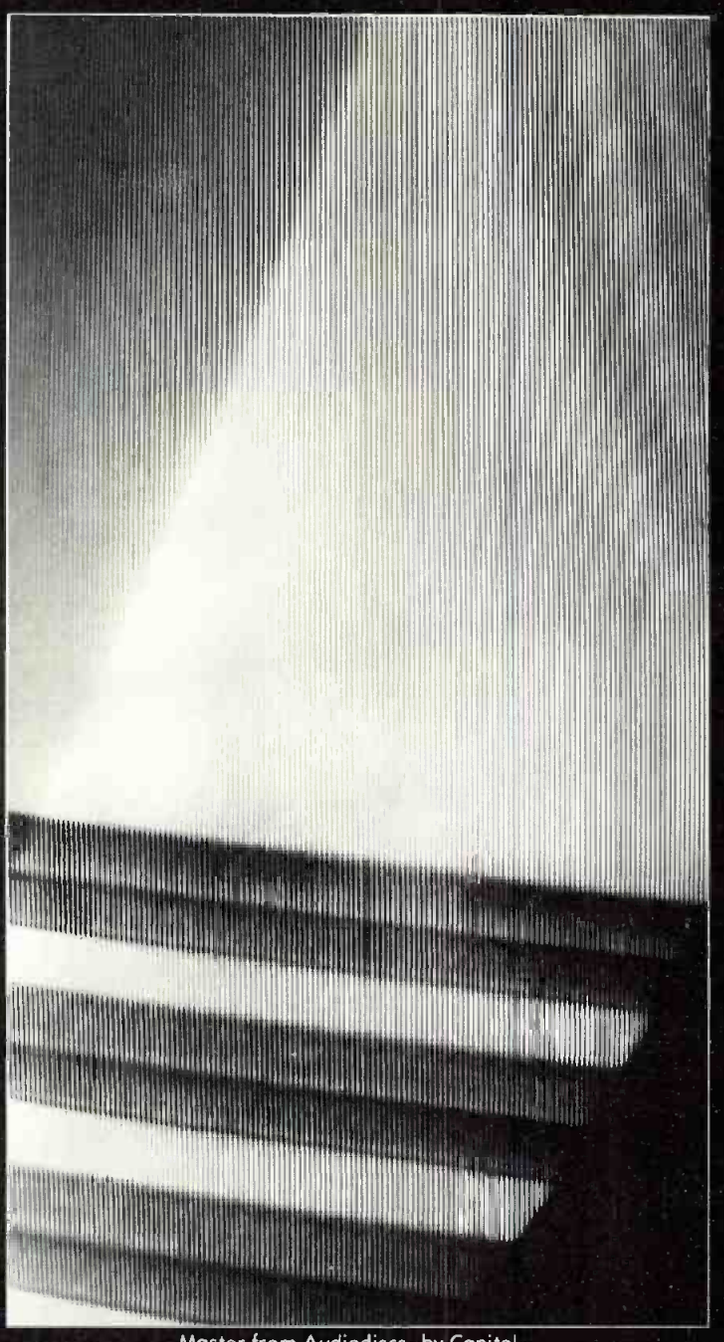
UNIVERSAL SLIDE DRUM

In the May column, the subject was projection setups in the field and some of the problems, including one related to the new translucent universal slide drum. Evidently others had similar troubles, perhaps under similar or other circumstances. Anyway, Kodak got wind of the problem and did something about it. If you are not aware of Kodak's solution yet, let us entertain you with the news.

The latest of the universal drums is again being made in black and opaque. Just in case you might think that this will cause confusion with the previous black trays, there are a couple of obvious differences. The new drum is made with slots wide enough to take slides up to ⅛-inch thick, as the original grey and translucent ones did, while the previous black drums took the thinner mounts only. It is also provided with white slide numbers, and comes with a bright orange non-metallic latch in the center, really different from previous metal or even the black plastic latches. The new black models are called *Ektagraphic Universal Slide Trays* while the previous black ones



Master from Transco Products Corporation



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At this point, look at the pictures again... they speak louder than words.

For a free sample and brochure, write on your company letterhead, or call Harry Preston at (213) 462-6252.

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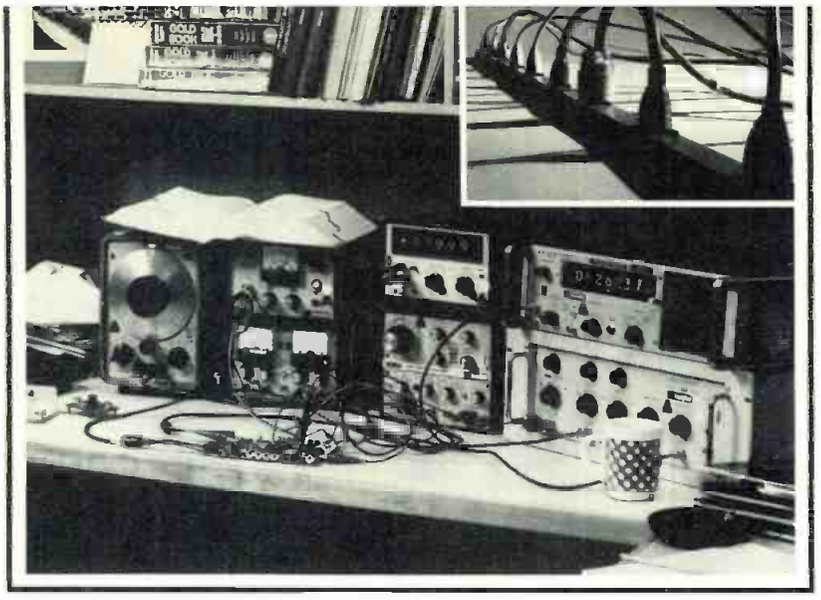
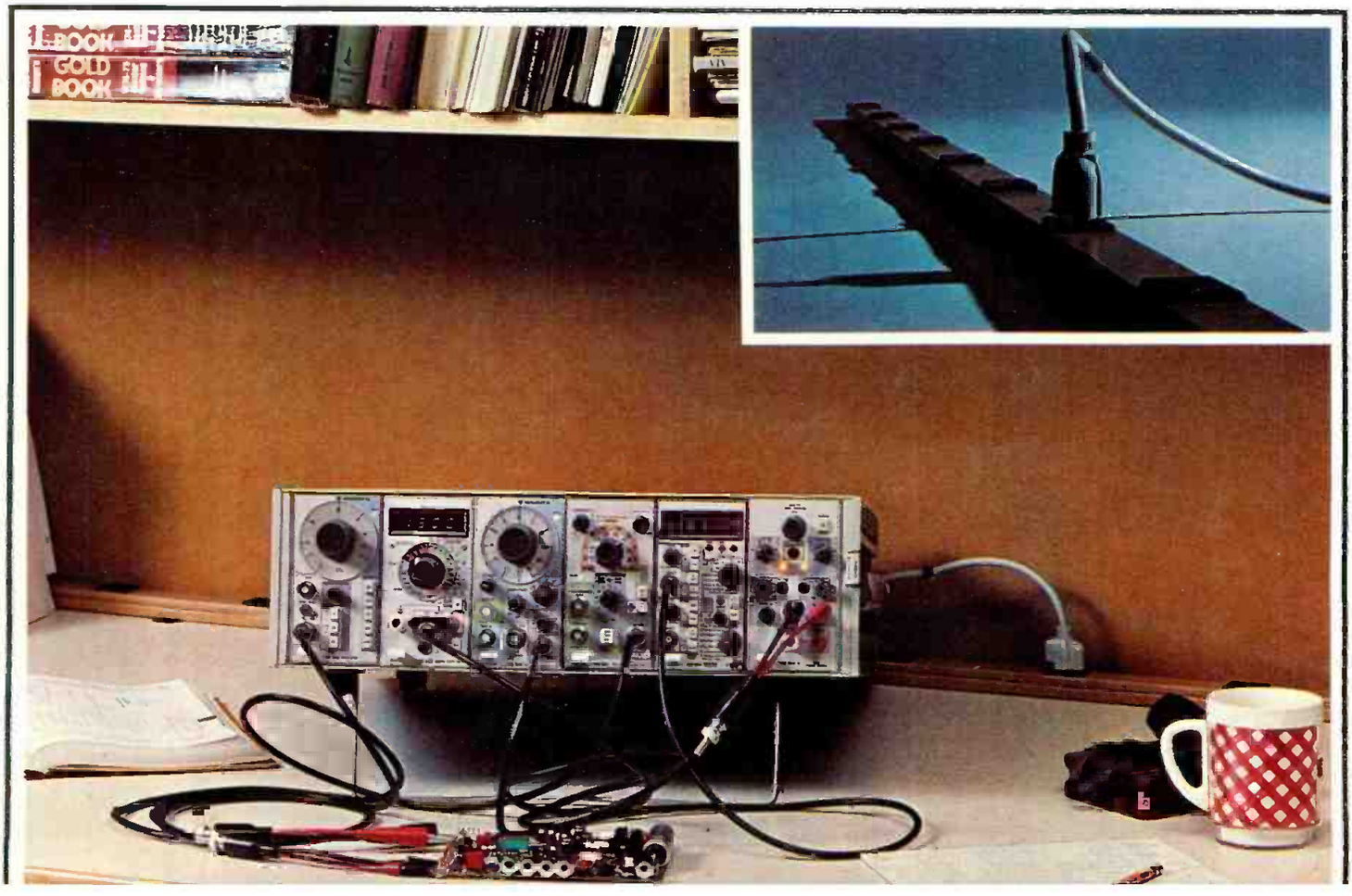
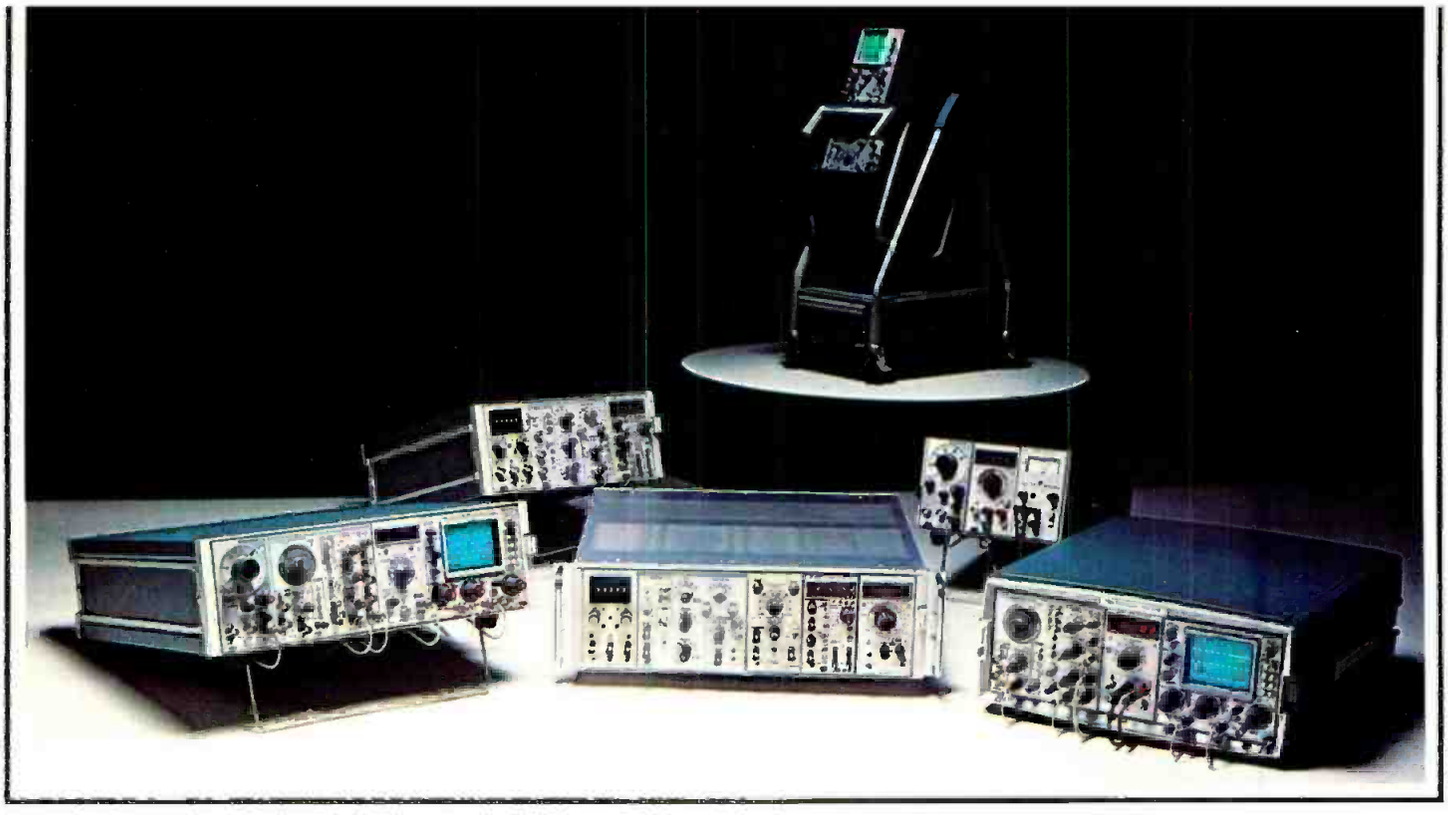


Here's an idea that could change your thinking about test equipment.

A complete test station doesn't have to be an assortment of special-function instruments. A working workbench doesn't have to be crowded and unhandy. And a truly portable test lab doesn't have to be out of reach.

TM 500 offers you an alternative: a modular line of compact, interchangeable plug-ins and mainframes. Multiconfigurable both in packaging and in performance, TEKTRONIX TM 500 is designed around the idea that test equipment which is compatible in every respect can, in fact, cover a broader range of functions and meet a wider variety of measurement situations. To say nothing of its ability to adapt more readily to new challenges.





Modular DMMs, counters, generators, amplifiers, power supplies, oscilloscopes, logic analyzers, and word recognizers can be interfaced electrically. Signals

can be routed from one plug-in board to another via the mainframe mother board, thus enabling you to build a test instrument that's more powerful than the sum of its parts.

The plug-ins can be configured together in six widths of mainframe and four types of packages, depending on where and how you'll use them. Select the plug-in modules you need just as you would monolithic instruments, and then combine them in the appropriate mainframe for a convenient, uncluttered bench setup; mount up to 6 functions

side-by-side in a 5¼-inch rack; build a rollabout station that "follows" you around the lab. Or

pack a portable test station in the small-as-a-suitcase TM 515 Traveler Mainframe, which carries up to 5 modules and typically weighs less than 35 pounds, including the modules.

The result is a total test system that looks like a unit . . . works as a unit . . . yet is still configurable to new or changing measurement requirements. So the next time you're looking into test instrumentation, specify the one product line that's designed for configurability.

For further information or a demonstration of TM 500 Instrumentation, write or phone: Tektronix, Inc., P.O. Box 500, Beaverton, Oregon 97077, (503) 644-0161 ext. 5283. In Europe: Tektronix Limited, P.O. Box 36, St. Peter Port, Guernsey, Channel Islands.

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TM 500...designed for configurability.

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were only called Carousel Slide Trays. (The translucent drums, in case you didn't know it, were called *Carousel Transvue Slide Trays.*)

Incidently, there is a remedy for preventing stray light from causing trouble with these trays. Either you can make a small shield to hook on part of the drum to block some of the light and not hurt the cooling process, or you can wrap black tape around the drum, or you can do the job properly by using a full-size template for making a light shield. This information is available in Kodak Publication S-70-6-4, called *Light Control with Kodak Ektagraphic and Carousel Transvue Slide Trays.* Write to Kodak in Rochester, N.Y. 14650.

LAMPS

Incidentally, as long as we're on the subject of slide projectors, let's continue on for a few steps further and talk about the lamps. In the May column, there was also mention of the fact that the lamps were too bright for the small images and close projection distances. The handiest means immediately at our disposal to cut down the light was to use neutral density filters which are carried in my "survival kit."

There are other ways, too, and these can also be applied to film/slide chains to prevent burn-in and image wash-out. One method is to use a resistor or rheostat in the power line. This will reduce the voltage to the bulb, but it may also change the color values after a certain point, so be careful. Another way is to cut a small aperture-plate hole in a piece of cardboard, for example, and place it in front of the lens. This will stop down the lens and give a full image with reduced light output. The hole can be made smaller than needed, then enlarged. It should be smooth, round, and centered as much as possible.

BULB TYPES

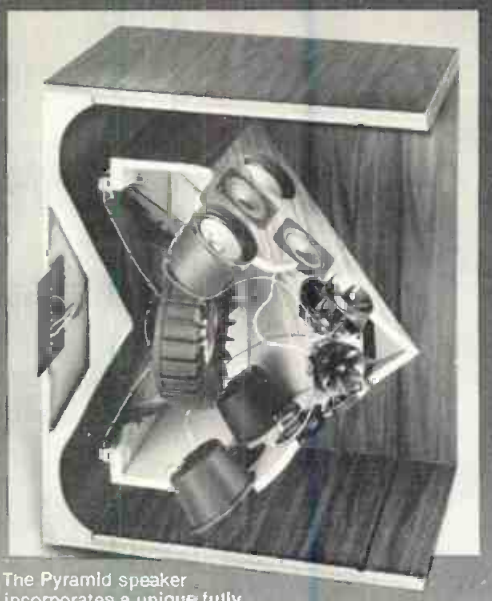
Of course, the best way is to use a different lamp, if possible. There are three different bulbs available for the Kodak slide projector. In the tungsten-halogen projectors there is the standard *ELH* which provides good brightness and has a life of 35 hours on the average. The *ENG* offers 30 per cent more brightness but a life of only 15 hours. Where light is not required to be at these intensities, there is the *ENH* with a rating of over a hundred hours but which gives off only 65 per cent of the light available from the ELH. These levels are given for the projector switch in the high position. By using the low light switch position, the brightness is reduced on each of the lamps, but the life is extended somewhere between two and four times—quite a saving.

By the way, there is one thing I neglected to mention in all this discussion of new things and improvements. The new carousel—er, sorry—ektagraphic trays—are also packaged in a different box. The previous boxes were square to hold the circular drum. The newer ones—the boxes, that is—are rectangular in shape. The drum has not changed its shape—it is still circular—but the new space has been added with small cardboard partitions cutting across two corners of the box. This provides two places in which the user can store audio cassettes to make carrying a whole synchronized slide/sound show a lot easier. The box is also made to permit a script (of normal thickness) to be placed flat on top of the drum to complete the presentation aids.

Well, I was going to discuss slide presentations, and some of the overkill that has become inherent in much of the up-to-date multi-multi-image shows, but I'll save that for another time. ■

Nearly every concert tour by a "super group" in recent years has had its origin at Showco. We design and build the huge, high-level sound systems, intricate lighting and special effects systems, and provide the stage designs for over 1000 concerts a year. At the conclusion of the tour, the tapes that we produce have resulted in best-selling "live" albums.

Now, through Showco Manufacturing Corp., we are bringing this same highly acclaimed expertise into discotheque sound systems. We are in full production of the S-2500 Disco Mixer, S-2501 Electronic Crossover Network, and our concert proven Pyramid* 1000 and 900 speaker systems designed to be suspended from the ceiling or to be floor mounted with the optional base. Developments are underway for still other new and innovative products. Call or write for the name of your nearest dealer.



The Pyramid speaker incorporates a unique fully symmetrical folded bass horn which in turn allows the mid and hi frequency drivers to be optimally mounted for wide dispersion. The overall result is a single full range, high level, extremely efficient cabinet ideally suited to discotheques.

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*U.S. Patent No. 3,912,866

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db new products&services

POWER AMPLIFIER

● 180W rms/ch continuous power into 8 ohms is produced by Model 512 power amplifier, with both channels driven. Range is 20-20,000 Hz ± 0.1 dB; claimed i.m. and thd is 0.08 per cent at rated output; hum and noise, —110 dB. Input sensitivity is 1.7V for rated output, input imp. 50,000 ohms. There is a damping factor greater than 1,000, 20-20,000 Hz. Other features include 5 in. 43 dB range power level meters, led peak responding indicators, no current limiters, d.c. offset relay speaker protection, open loop gain of 60 dB—closed 27 dB, propagation delay less than 0.2 ms.
Mfr: Ram Audio Systems, Inc. . .
Price: $1,150.00. . .
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FULL-TRACK RECORDER

● Professional recorder MX-5050 provides full-track single-channel record and reproduce capability, as well as half-track two-channel reproduce function. Included in the unit are front panel edit and cue controls, motion sensing, precision mounted splicing block on a flip-up head cover, XLR connectors for line-in and 600 ohm balanced line output, variable or fixed outputs at +4 dBm or —10 dBm, front adjustable bias and equalization, and a built-in test and cue oscillator.
Mfr: Otari Corporation
Price: $1,450.00. . .
Circle 52 on Reader Service Card

COMPUTERIZED REVERBERATION SIMULATOR

● Fully digital electronic CPR-16 produces numerous reverberation effects, including acoustic chamber, mechanical plates, spring systems, and tape loops. A programmable microprocessor, which has full 16-bit digital arithmetic, allows future expansion for special signal-processing effects. The dynamic range is greater than 80 dB, noise less than —80 dBm, and claimed distortion less than 0.1 per cent thd. Control functions include reverb time: 250 ms to 20 sec., room size decay time setting, high-frequency damping, and low-frequency filtering. The unit fits a standard 19 in. rack.
Mfr: Quad/Eight Electronics
Price: $5,995.00.
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LAPPING KIT

● Relapping and recontouring of worn magnetic heads are done conveniently with the Handylap™ lapping kit. The device is made with a heavy-duty molded frame, chrome hold-down levers, and rustproof construction. The lapping block has a slightly resilient backing for the abrasive film, which attaches to the block with two cam-actuated rubber rollers. The block functions under a stream of water. Other accessories include three different grades of abrasive sheets, a magnifying lens, a head support angle to keep the head vertical during lapping, and a head holder for grasping the head.
Mfr: Nortronics Co., Inc.
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NOISE REDUCTION

● Analog computer technology and integrated circuits control Model DNF 1201A dynamic noise reduction system. The noise filter features an advanced bandwidth controller and complex multistage nonlinear filter. The bandwidth controller measures the high frequency content of the sum of the left and right inputs from the source material and adjusts the bandwidth in accordance with both level and frequency. Dynamic filtering is achieved as the bandwidth controller generates d.c. control voltages to constantly regulate the cutoff frequency of the filter. Cutoff frequency varies between 500 Hz and 30 kHz in accordance with source requirements. Attenuation rate is 9 dB/octave.
Mfr: Burwen Research
Price: $379.00.
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(continued)

John Woram's The Recording Studio Handbook

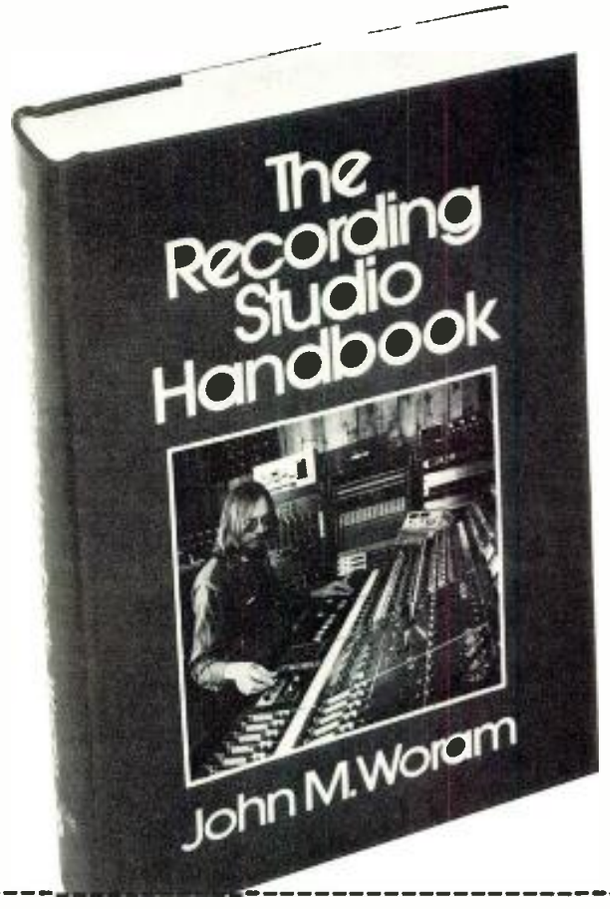
FOR RECORDING ENGINEERS, TECHNICIANS AND AUDIOPHILES

The technique of creative sound recording has never been more complex than it is today. The proliferation of new devices and techniques require the recording engineer to operate on a level of creativity somewhere between a technical superman and a virtuoso knob-twirler. This is a difficult and challenging road. But John Woram's new book will chart the way.

The Recording Studio Handbook is an indispensable guide. It is the audio industry's first complete handbook that deals with every important aspect of recording technology.

Here are the eighteen chapters:

- The Decibel
- Sound
- Microphone Design
- Microphone Technique
- Loudspeakers
- Echo and Reverberation
- Equalizers
- Compressors, Limiters and Expanders
- Flanging and Phasing
- Tape and Tape Recorder Fundamentals
- Magnetic Recording Tape
- The Tape Recorder
- 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.

This hard cover text has been selected by several universities for their audio training programs. With 496 pages and hundreds of illustrations, photographs and drawings, it is an absolutely indispensable tool for anyone interested in the current state of the recording art.

Use the coupon at the right to order your copy of *The Recording Studio Handbook*. The price is only $35.00, sent to you with a 15-day money-back guarantee.

SAGAMORE PUBLISHING COMPANY, INC.
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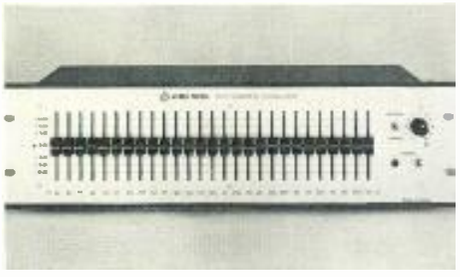
GRAPHIC EQUALIZER



● Thd distortion of less than 0.02 per cent at all settings is claimed for the DN 27 (1/3 octave) and the DN 22 (stereo octave) equalizers. These are reputed to be particularly clean units, with high quality inductors guarding against phase distortion and "ringing" faults. Noiseless bi-pass switches permit the switching of the equalization in and out of circuit while the program is running. The output circuit keeps the output constant over a wide range of loads. Both units are equipped with XLR connectors. Optional balanced inputs and outputs are available.

Mfr: Klark-Teknik
(Hammond Industries)
Price: DN 27: $695.00
DN 22: $749.00.
Circle 56 on Reader Service Card

AUTOMATIC INTERMIX

● Completely automatic intermix between three sequential and one real time program source is possible with Intermix Models 3000-STB (stereo) and 2000-B (monaural). When used in background applications, in radio station automation or while presenting musical programs, transferring between the sequential program sources is keyed through silence sensing, with switching taking place approximately seven seconds after the end of each program selection. If tight cueing is essential, the program transfer can be keyed by a 25 Hz tone and the actual switching can take place at either the beginning or ending of the tone. A built-in variable delay operates in either mode. The units contain all solid-state circuitry utilizing computer-type integrated circuit logic, plug-in cards for switching capability, photo cells for noise-free switching, built-in speakers for cueing or off-the-air monitoring, led program stage indicators, push button rapid advance, vu meters preset so that zero equals + 4 dBm.

Mfr: VIF International
Price: 3000-STB: $1,195.
2000-B: $1,045.
Circle 57 on Reader Service Card

ELECTRET CONDENSER MICROPHONE

• Designed for both hand-held and stand use, Model 1776 cardioid single-D condenser microphone is ruggedly built for road use. The electret mic has a permanently charged element. Frequency response is 60 to 18,000 Hz, with sensitive transient response and high output, as well as claimed good off-axis reduction of sound pickup. The mic is designed to emphasize bass tones when used close up and its gain-before-feedback characteristics are aimed at sound reinforcement situations. The unit is furnished with a 15-foot cable and stand clamp. A 25-foot professional cable with 3-pin connectors at both ends is available.
Mfr: Electro-Voice
Price: $99.00.
Circle 58 on Reader Service Card

OCTAVE BAND ANALYZER

• Battery-operated hand-held Model 150 octave band analyzer is intended for precision. Its triple-tuned filters meet ANSI 1.11 Class II specifications; level in each of ten ISO octave bands centered from 31.5 Hz to 16 kHz is displayed on an led matrix. Display ranges are 14 dB and 28 dB for a resolution of 1 dB or 2 dB. Acoustic sensitivity ranges are calibrated from 34 dB spl to 110 dB spl, creating either flat or A-weighted measurements. The device contains a pink noise source, a battery charger, and carrying case. It's equipped with an Electro-Voice RE-55 microphone.
Mfr: White Instruments, Inc.
Price: $1,400.00.
Circle 59 on Reader Service Card

PHONO CARTRIDGE

● Direct-coupled electret Model 282-e cartridge has a low 5.2 gram mass and dual-bearing suspension system claimed to practically eliminate warp flutter. A built-in microcircuit eliminates mismatch between the cartridge and the preamp by automatically controlling output impedance. This microcircuit also makes the cartridge immune to the effects of cable capacitance, so the unit may be used with turntables lacking low-capacitance cables. Electret transducers are directly coupled to the low-mass miniature elliptical diamond stylus by means of a resolver mechanism. The manufacturer claims accuracy of reproduction coupled with low wear-saving pressure.
Mfr: Micro-Acoustics Corp.
Price: $89.00.
Circle 60 on Reader Service Card

DYNAMIC PROCESSOR

● The ability to invert the compression of dynamics found in most recording is claimed for the Pro 16 dynamic processor design expander. Continuously variable expansion restores up to 16 dB of dynamics to any program source. Overall s/n improvement is claimed at up to 16 dB. The device combines upward and downward expansion with peak unlimiting to restore transients and fine detail. A continuous led display monitors the action.
Mfr: RG Dynamics Inc.
Circle 61 on Reader Service Card

BI-POLAR SCREEN/SUB-WOOFER

● Two bi-polar screens and one center channel sub-woofer comprise Model E-10 system. Each bi-polar screen has eight dynamic midrange and two tweeter elements in a 50-inch open back colinear array. The sub-woofer system operates below 100 Hz and employs a dual concentric voice coil 15-inch woofer, as well as two independent passive crossovers. System response is 38 to 20,000 Hz ± 2 dB.
Mfr: Equasound
Price: $1,000.00.
Sub-woofer only: $350.00..
Circle 62 on Reader Service Card

FREE LITERATURE

SOUND ENGINEERING SEMINARS

A six-page brochure describes three-day nationwide seminars, scheduled for 17 different cities. Mfr: Synergetic Audio Concepts.

Circle No. 91 on R. S. Card.

MULTI-CART MACHINE

A multi-cart machine, designed to eliminate problems common to standard three-slot units, is detailed in a catalog sheet. Mfr: Beaucart Div., UMC Electronics Co.

Circle No. 92 on R. S. Card.

FUSIBLE ALLOYS

Over 150 alloys and low melting solders are described in Technical Bulletin No. FA-20. Mfr: Semi-Alloys, Inc.

Circle No. 93 on R. S. Card.

CASSETTE SYSTEMS

A line of cassette systems and one headset, intended for educational or industrial use, is described in an eight-page booklet. Mfr: Sharp Electronics Corp.

Circle No. 94 on R. S. Card.

HIGH VOLTAGE CAPACITORS

Ceramic capacitors for d.c. applications up to 40 kV and for high voltage power systems are described in an eight-page catalog. Mfr: MuRata Corp.

Circle No. 95 on R. S. Card.

ACTIVE NETWORK DESIGN

This brochure describes a reference book, priced at $21.95, "Active Network Design with Signal Filtering Applications," by Claude S. Lindquist. Mfr: Steward & Sons.

Circle No. 96 on R. S Card.

MINICOMPUTER ACCESSORIES

A 40-page catalog enumerates various accessories and supplies used with minicomputers. Mfr: Minicomputer Accessories.

Circle No. 97 on R. S. Card.

RECORD CLEANER

A device which turns a record around and blows away the dust like a vacuum cleaner, the Vac-o-Rec, is described in this bulletin. Mfr: Vor Industries.

Circle No. 98 on R. S. Card.

PUBLICATIONS CATALOG

More than 220 proceedings, handbooks, textbooks, study guides, cassettes, films, videotapes, standards, and journals on various technical and scientific subjects are listed in this catalog. Mfr: Instrument Society of America.

Circle No. 99 on R. S. Card.

SEMICONDUCTORS

Not free, but 128 pages for $1.95, the Archer Semiconductor Reference Handbook lists a total number exceeding 36,000 of cross-referenced semiconductors, including diagrams and listings. Mfr: Radio Shack.

Circle No. 80 on R. S. Card.

A/V PACKAGING

Stock and custom-made packaging materials, such as storage albums, mailers, and storage equipment for cassettes, cartridges, film strips, and recordings are described in this catalog. Mfr: Reliance.

Circle No. 81 on R. S. Card.

GLENN SNODDY

Custom Disc Mastering

Tape-to-disc mastering, once hidden away in the engineering department, has become a specialty in its own right. The author presents an overview of this phenomenon.

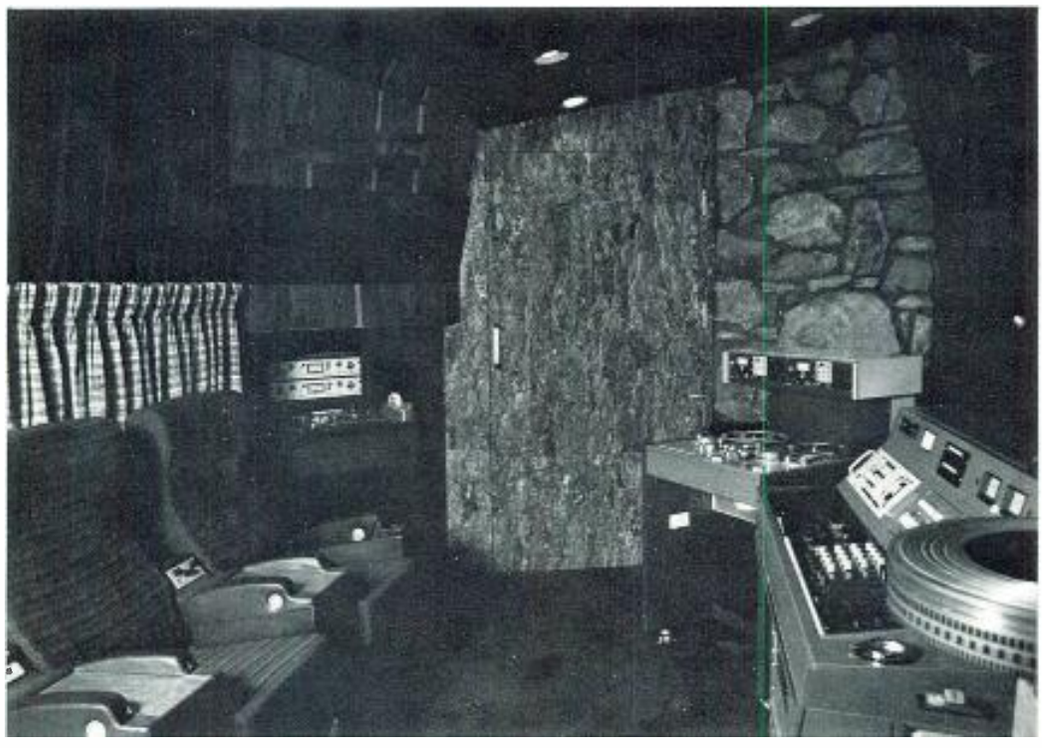
MASTERING has progressed considerably during the past decade, so much so that it may very well be the single most important step in the production of a phonograph record. This electro-mechanical process is also probably the least understood by a great number of music industry people.

In past years, the process of transferring the sound impulses from tape to disc has been hidden in the recesses of the record companies' engineering departments with the final product controlled by engineering personnel with, of course, an okay by the producer. Not that this is bad in itself. If the sound is on the tape, then the one-to-one transfer is a viable method of accomplishing the result that the producer had in mind.

Also, a large record company is faced with producing many parts, one identical to the other. Re-cuts ordered from pressing plants at a later date must be cut to the exact specifications of the original, probably on different lathes. These requirements place a great responsibility on the engineering department and create a demand for some type of consistent quality control. Thus the large companies have engineering specialists who cut lacquers by certain techniques that allow them to repeat the process at will with consistency.

In recent years, the competitive nature of the record business has caused products to question the final result of the tape-to-disc operation. Can we make it better? Do I really have on disc what I thought was on the

Glenn Snoddy is president and technical director of Woodland Sound Studios, Nashville, Tennessee.



This view of the Woodland Sound Studios mastering room shows the tape feed, control, and air line seat components of the chain.

tape? Was my monitor system accurate? Will it sound that good on the radio? If it sounds good on this speaker will it sound good on that speaker and on and on. Not bad questions when you consider that your entire career might depend on the answers.

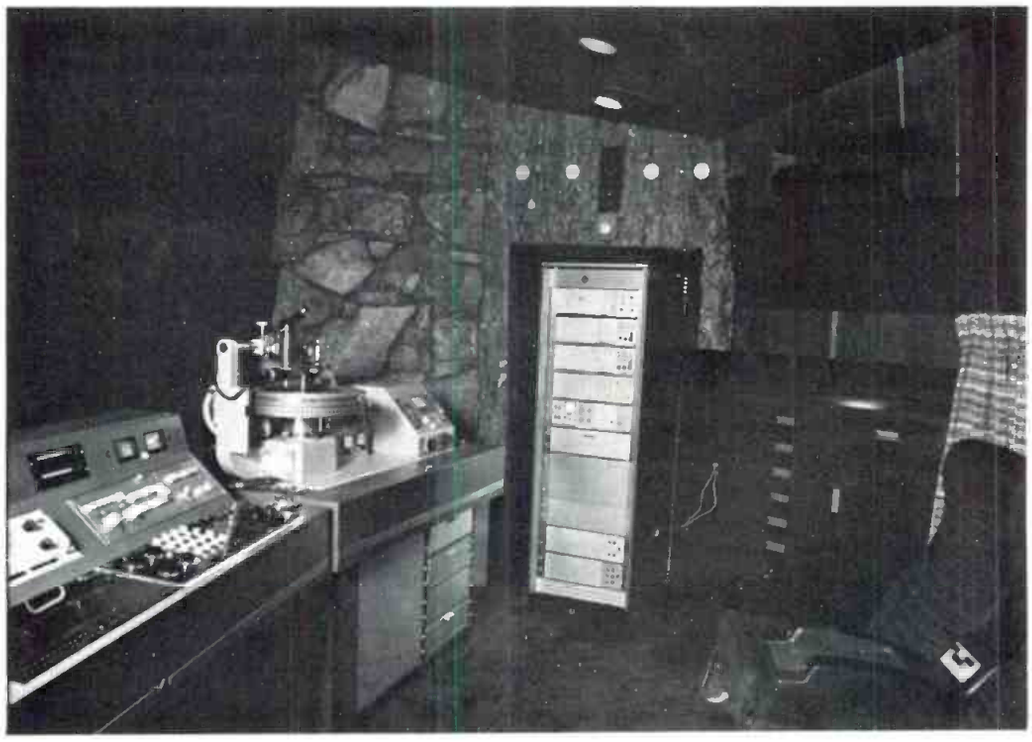
This has caused certain changes in the thinking not only of producers but of designers of mastering cubicles and of progressive mastering engineers. The results have been custom mastering facilities with extensive signal processing equipment unheard of just a few short years ago.

Not only the equipment but some rooms have undergone revolutionary design changes, the idea being that the mastering engineer should have at his disposal the very finest in a listening environment. This means a room that will not alter the sound as it emanates from the speakers and it means speakers that will faithfully reproduce the sound as it goes onto the acetate. Actually, in properly designed mastering rooms, the room itself becomes a significant factor in determining what the engineer and producer will do as they begin the mastering process. If they are assured that what they are hearing is a true representation of the product, then any changes can be made will be with confidence.

A common error in the evaluation of tapes and acetates is to equate the two. Only in a properly calibrated playback system can a tape be compared to a disc. Professional mastering systems should have the capability of comparing the master tape to the lacquer which, in turn, will become the basis from which the record is derived. It is beyond the scope of this brief discussion to fully explain the process; suffice it to say that the master lacquer is never played.

CUSTOM FACILITY

With these things in mind, Woodland Sound Studios began a program in 1969 to introduce to the Nashville area a custom disc mastering facility. Our efforts for five years concentrated on introducing to the producers of our area the possibilities inherent in the process of custom disc mastering. We established rates compatible with the efforts involved, not unlike booking studio time. The results were that producers liked the idea of being able to hear their own product as it was being transferred and to know that they had an opportunity to effect certain changes at that time. Also, believe it or not, they



The fully computerized Neumann lathe is at the other end of the line seen in the other view. The room design was by Westlake.

fiked being charged for this service. They were buying a legitimate service without feeling that they were imposing themselves on the facility.

During 1974 we planned for a second room with the idea of the ultimate state of the art. At this point, my old friend Tom Hidley was contacted and together we formed the ideas that would become the basis for building a new concept in rooms especially designed for cutting records. Tom's company, Westlake Audio, together with Woodland's engineering staff, accomplished this with only one thought in mind—the best possible mastering facility.

A completely new Neumann SAL 74 cutting system was flown in from the plant in Germany, complete with Studer playback machines to complement the elaborate room design. The mastering room was designed and fabricated with all the pains of the design and building of a fine violin. Even the seating came in for special consideration. We arranged to have first class seats from a 707 airliner installed for the comfort of the producers. Needless to say, the sound reproduction in this oval shaped room is as close to perfect as we know how to make it. Since the initiation of full service of the new room we have mastered numerous hit singles and albums for top artists and record companies.

ENGINEERING QUALIFICATIONS

The future of custom disc mastering seems assured as long as knowledgeable engineers can be found to work with the producers. Certain qualifications such as good personality, some musical knowledge, some technical knowledge, adaptability and perserverance are prerequisites for these positions. Someone has said a good knowledge of plumbing wouldn't hurt either. It therefore can be said that every engineer would not be suited to fill this role nor, might I add, would want to. It is a specialized field for which there is little training ground but the future is, no doubt, in the hands of such engineers working with producers.

The future efforts of Woodland Sound Studios are being directed toward the automation of disc mastering. Of all the areas in recording, disc mastering lends itself to automation in a very special sense. The repeatability inherent in a well designed automation system would be invaluable to both the engineer and producer in producing identical parts, as well as reducing the time required per master. ■

ALAN FEIERSTEIN

A Portable Oscillator

Headphones, phasing, and mic lines can be tested with this little under-$10 gadget.

MANY RECORDING STUDIOS have their own pet super-device, almost invariably an under-$10 electronic circuit constructed in a grey hammertone minibox. It may be a cable checker, direct box or a 10 dB pad (20 dB for rock studios), but whatever it is, their owners swear by it. If you don't already have a small tone generator, or even if you do, this version may be useful. It can test just about any part of the audio chain. At the studio we test all our headphones every day before sessions, thus reducing costly downtime. I have tried to make the device as simple and versatile as possible, with the following features:

1. Cheap ($10).
2. All parts commonly available.
3. Automatic shut-off and low current drain provides long battery life: (Uses a standard 9-volt battery).
4. Feeds inputs with a wide variety of sensitivities and impedances.
5. It is housed in a grey hammertone minibox.

The completed box can be decorated in any way you choose. Photo by Dave Whittman

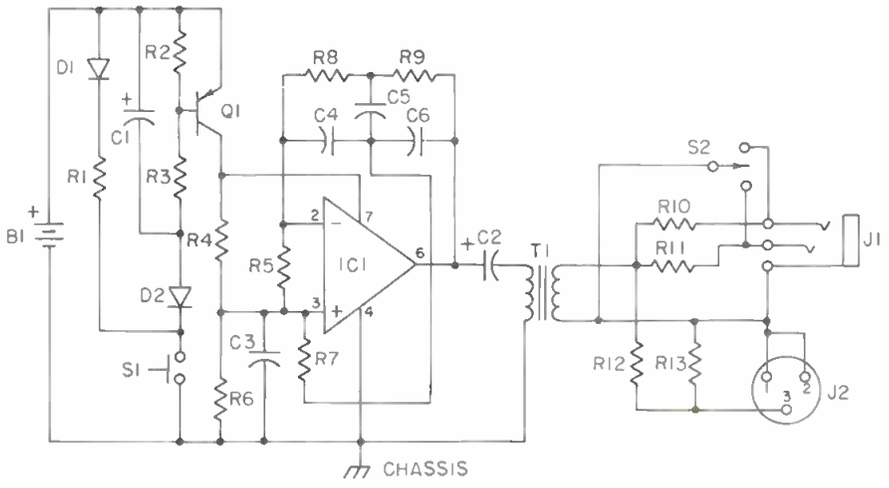
CIRCUIT OPERATION

Pushing S1 momentarily lights the led with 6 milliamperes and charges the negative end of C1 downward. When S1 is released, C1 discharges slowly through R3 and Q1, allowing Q1 to remain on. This applies V+ to the op amp i.c.1. R4 and R6 bias the non-inverting input at one-half the supply voltage for maximum output signal swing. Negative feedback through a notch filter causes sine-wave oscillation at the frequency determined by C4, C5, C6 and R7, R8, R9. This circuit uses the non-inverting input as a virtual ground to permit operation with a single battery. T1 doesn't load the op amp too heavily (which would affect oscillation) and lowers the impedance to permit the feeding of low or high impedance loads. R10 and R11 prevent a shorted headphone cup from shorting out the signal to the other headphone cup. R12 and R13 form a 40 dB voltage divider for feeding low level preamp inputs. After 60 seconds, C1 is discharged. Q1 turns off and all current flow ceases. D2 prevents the led from quickly discharging C1. The circuit draws under a milliampere during oscillation.

CONSTRUCTION

The layout of this circuit will not affect operation. Be careful to install capacitors, diodes and the i.c. with the proper orientation. Install i.c.1 in a socket to increase its reliability.[1] For lowest distortion, you can select R5. If you

Alan Feierstein is an electronics designer and president of Acoustilog, Inc. in New York City.



The circuit as described.

try to lower distortion too much with higher values of R5 the circuit will stop oscillation.

If your facility uses Pin 2 of XLR connectors as the high side, connect the junction of R12 and R13 to pin 2, and tie pins 1 and 3 together. The schematic is shown wired for pin 3 = high side.

For built-in applications, where battery operation and automatic shutoff are not needed, eliminate the left half of the circuit and connect V+ (up to 30 volts) directly to pin 7 of i.c.1; not needed are C1, D1, D2, Q1, R1, R2, R3 and S1. Be sure to use a 30 volt (or higher) capacitor for C2.

OPERATION

Pushing S1 will light the led if the battery is good and start the tone. J1 provides a high-level output sine wave to test headphones. In this mode, switch S2 to its center position. The output of the oscillator feeds through R10 and R11 into the tip and ring of J1, which corresponds to the left and right headphone drivers. The common ground of the drivers returns to the sleeve of J1. If the left headphone cup or its wire is open-circuited (the most common occurrence), tone will only be heard in the right cup, and if the left cup or its wire is shorted, R11 will isolate the short and signal will still only be heard in the right cup. After about 60 seconds, the tone will start to become fuzzy and die away. Pressing S1 will restore the tone.

The oscillator is also useful for testing phase problems in a system. For this test you will need a Y adapter, or if you're testing a system with a jack bay, you can use a set of multiple or *mult* jacks. The Y adapter of mults must be carefully checked to make sure they are wired correctly. Send the tone into the first two inputs on your mixer or console using the mult to split the oscillator signal. Feed mic inputs with J2, and line level inputs with J1. Many installations have both balanced and unbalanced inputs, some using the tip as high and some using the ring as high. Either switch position is all right for balanced inputs, but you'll have to use the correct position for unbalanced inputs.

Now, bring up fader 1, send it to one of the output or mixing busses, and watch the vu meter. As you bring up fader 2 and mix it into the same mixing bus, the level should increase 6 dB. If the signal weakens and cancels out when fader 2 is brought up, something is out of phase and you'd better fix it before your next session. Usually, the problem is caused by the high and low wires in the balanced mic line being reversed.

One major manufacturer of microphone input transformers decided arbitrarily to change the phase inside the case of one model, so you might find several transformers that do not match, as to phase. Check the other channels by comparing them one at a time with channel 1, which is now your reference channel. You can insert equalizers and limiters in the path and see if they reverse the phase. Take note, however, that this test will go bananas with phasing and flanging devices, and tape recorders.

Some other obvious uses for the oscillators are testing mic lines or snakes by sending tone down the line from J2 and listening for it at the other end in your mixer, finding out which audio line is which when you have twenty pairs of wire connecting two rooms 500 feet apart and you forgot to number them before running them, and doing a quick bias on a recorder by feeding J1 in, recording, and adjusting the bias control to obtain the highest reading on the vu meter (the vu meter should be indicating playback level). The oscillator is certainly not unique in its ability to perform any of these tests, but you'll find its small size and versatility set it apart from the others. ■

REFERENCES

1. "The Contributions of Edsel Murphy to the Understanding of the Behavior of Inanimate Objects," Klipstein, D. L., **db**, April, 1968.

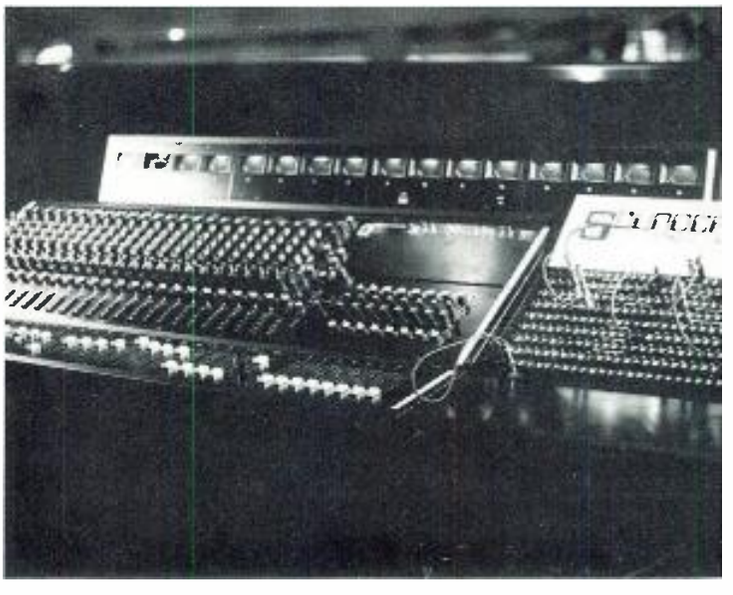
PARTS LIST

B1	9 volt battery	
C1	100 mFd 15 volt capacitor	
C2	10 mFd 15 volt capacitor	
C3	0.1 mFd disc capacitor	
C4, C5, C6	.01 mFd Mylar or polystyrene capacitor	
D1	Led, Type 209	
D2	1N914 or 1N4001 silicon diode, or equivalent	
IC1	LM741 operational amplifier, in 8-pin case	
J1	Stereo phone jack, chassis mount	
J2	Male 3 pin XLR connector, chassis mount	
Q1	2N2907 or equivalent PNP silicon transistor	
R1, R12	1000 ohm	
R2	1 megohm	
R3	180k ohm	
R4, R6	100k ohm	
R5	4.7k ohm	All resistors are ¼ watt, 5%
R7	2.7k ohm	
R8, R9	36k ohm	
R10, R11, R13	10 ohms	
S1	Miniature normally-open pushbutton, spst	
S2	Miniature spdt center-off toggle switch	
T1	Miniature 1k:8 ohm transformer	

LARRY ZIDE

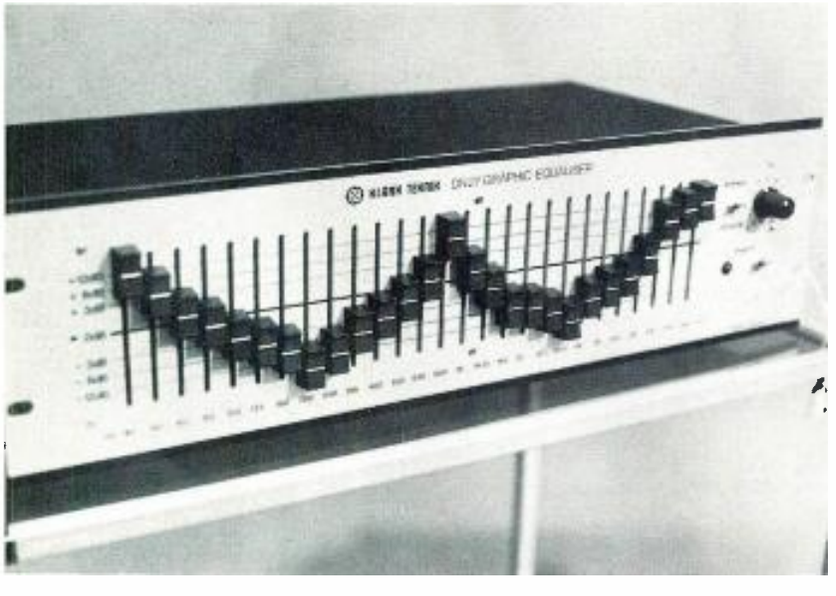
The Paris AES Convention, part 2

THE PICTURE GALLERY that follows shows some equipment demonstrated in Paris that American readers may not be familiar with—as yet. There are movements afoot to bring in a number of the units for distribution here, and as that happens, we will keep you informed.

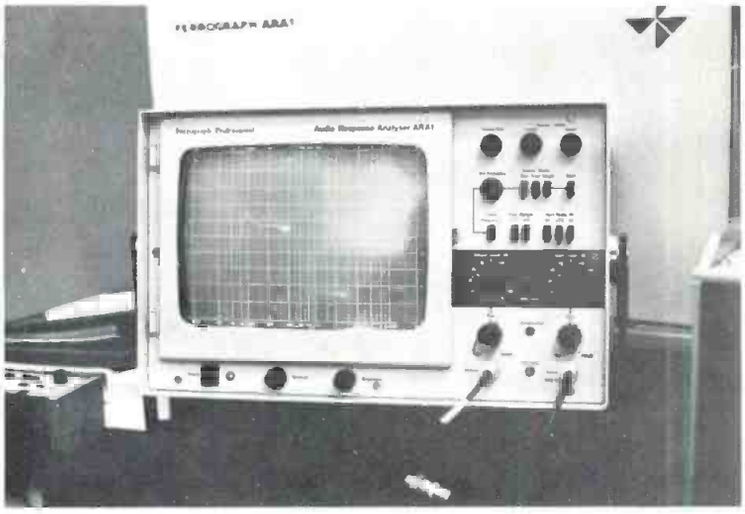


Soundcraft occupied a balcony at the convention, moved from a demo room. It was dimly lit, but the play this U.S.-available console got gave us little time to get our camera in.

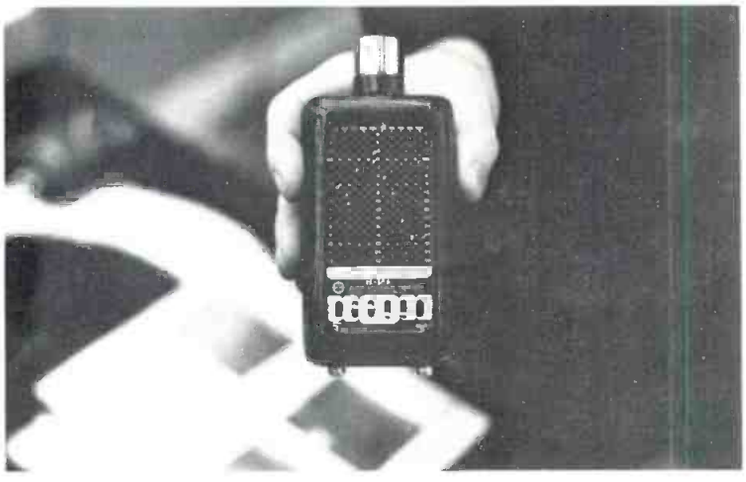
Klark-Technik's DN27 carves up the audio spectrum into ⅓ octave segments. It, too, is already available in the U.S.



Trident Audio Developments are coming into the U.S. and gaining the same kind of good acceptance that they already enjoy in their native Great Britain.

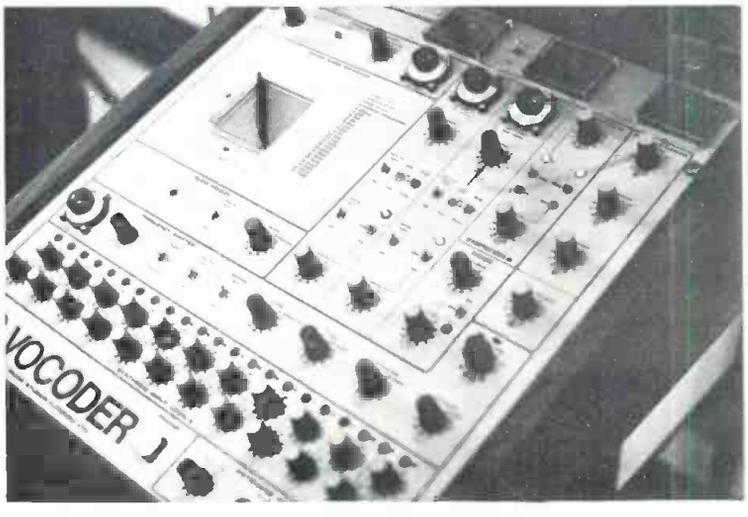


The U.S. will soon get its first look at this interesting audio response analyzer from Ferrograph. It has its own generator and so functions as a complete unit.



This tiny audio analyzer packs a lot of l.e.ds and a microphone into a hand-held case. It's made by Ivie Electronics Ltd. in the wilds of Utah.

The EMS Vocoder created a big splash at the show, as John Woram reported last month. Here it is, and we can report that it will have U.S. distribution.



The Shure M615/SR107 Equalization System

Figure 1. The Shure M615 analyzer and ES615 microphone.

THESE NEW COMPONENTS have been designed for the sound engineer who lacks a big budget for sophisticated analysis gear. This new low cost system will permit a fine degree of speaker/room tuning over the full 20-20,000 Hz spectrum.

The M615 analyzer is used in tandem with an ES615 Shure omni microphone. The unit has been designed specifically for this application, and the analyzer itself has circuitry to compensate for the rolloffs of the microphone. This results in an ability to measure an envelope of narrow range for the full frequency spectrum.

The analyzer itself contains twenty light emitting diodes that represent the high and low ends of the envelope at each octave point from 20-20,000 Hz. In addition, the unit incorporates the pink noise generator that creates the ten-octave spread in an effective and usable way. The pink noise generator can be set to be flat or with a deliberate 3 dB/octave rolloff above 1 kHz, such as is used for some sound reinforcement applications.

The gain of the pink noise signal is controlled by the outer ring of the left hand control on the unit. The inner ring is the input level of the incoming signal—presumably from the microphone, but it could also be via line input as well. If the input signal is too great, a separate front panel l.e.d. will illuminate to indicate the overload condition.

The knob on the right is the envelope control for the display. It adjusts from a maximum envelope size of 12 dB (that is ±6 dB, of course) to an envelope of 2 dB width.

The method of operation is simple. There are two l.e.ds at each octave. The upper one is maximum, the lower minimum. If the signal coming in is too high in relative level, that frequency's l.e.d. will light up on top; too low, and the lower one will show. The object, of course, is to get each frequency band level so that no l.e.d lights, even on the narrowest envelope. This is done with the aid of the SR 107 equalizer—more on that presently.

For most operations, the pink noise signal will be fed to an appropriate input level on your electronics. There are three output jacks on the rear of the unit. There is a mic level output via an xlr-type male jack. There are also

high level outputs via phone and/or phono jacks. The mic input jack has a switch just above it. This permits switching between high or low impedance input termination.

On the input side, the analyzer has phone and phono jacks for standard unbalanced high level inputs. A female xlr-type accepts the microphone input and it, too, has an impedance switch. There are two other switches associated with input. One is a 15 dB attenuator and the other is for a flat mic input, or compensation for the characteristics of the ES615 microphone (supplied). As can be seen, the system is usable for a wide range of inputs and outputs. Operation of the analyzer is by a.c. with a consumption of 5 watts.

Figure 2. The SR107 Audio Equalizer.

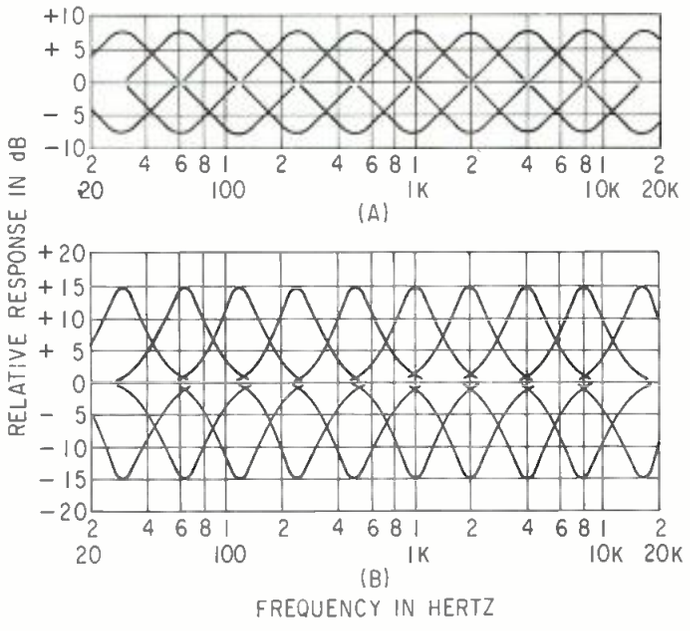


Figure 3. The filter characteristics of the equalizer at both (A) 7.5 dB boost and cut, and (B) maximum boost and cut.

AUDIO EQUALIZER

The SR107 is an all-transistor inductorless active equalizer that provides a matching ten-octave individual control to match the analyzer. It has an essential voltage gain of unity. However, it can be set to give a ±15 dB gain adjustment by using a master gain control. At unity 0 dB, it provides 0 dB out. There is also, then, a −27 dB line input to the aux. output and a −50 dB line input to the mic output.

The rear panel contains the necessary phone and xlr-type connectors to interface between most audio console and power amplifiers. A fully balanced system is maintained with this unit installed.

The front face of this rack-mountable unit contains ten controls at each octave point covering the nominal 20-20,000 Hz ten-octaves; actual calibration points are spaced from 32 Hz to 16,000 Hz, as are the l.e.d. indicators on the analyzer.

BENCH AND PRACTICAL TESTS

The primary evaluation technique used with the analyzer was to employ it for speaker/room equalization under a number of circumstances. This is facilitated nicely by the fact that Shure has supplied a solid plastic case that snuggles in the analyzer and microphone—leaving only a mic stand to be separately carried.

The critical element is how accurate is the envelope control, and is it the same at all frequencies? In a word, it is. One can argue that at the frequency extremes, an envelope setting of 2 dB was more like an actual 2.5 dB, but if you can get your speaker system accurate in its room within a ±1.25 dB range, who cares in practice?

The l.e.d. indicators begin to glow softly so that some warning exists as you exceed the envelope you set. The microphone supplied is an omni and thus is usable under most normal measurement techniques without worry about the problems of close work that cardioids present. The mic has a bass rolloff; there is compensation in the analyzer to offset this, resulting in a flat display. As mentioned earlier, there is a defeat switch for the equalization so that other mics can be used with the system, but if they need correction, you will have to do it mentally.

Used as a team, this mic and the analyzer do the job extremely well and at their relatively low cost certainly seem justified for even limited application. There's even the side benefit of having the pink noise generator output available as a tool for other measurement systems.

THE EQUALIZER

The Model SR107 complements the analyzer function well. Installed in a rack, two or more of them can work as a portable equalization system for a travelling sound reinforcement system.

The important things about an equalizer are low distortion, accuracy of the equalization, and low noise for critical applications. The SR107 satisfies much of this need.

With the equalizer in a bypass position, the internal electronics offer a flat frequency response that is 3 dB down at 20 Hz and at 24 kHz. The Shure spec of 30-20,000 Hz, ±2 dB is thus satisfied.

There seems to be no difference in this spec when the equalizer is in; essentially the same results are achieved as above with all the controls in the flat position.

Total harmonic distortion throughout the system measured well under 0.5 per cent over most of the spectrum. rising to 0.9 per cent at the frequency extremes.

The more critical test for intermodulation distortion, using the standard SMPTE method, resulted in a measurement of 0.18 per cent at a unity gain position, and 0.22 per cent at a +18 dBm output. That output figure, +18 dBm, is the onset of clipping, but the front panel overload indicator will ignite at 3 dB before that.

Under most applications, noise will never be a problem from this unit. A worst-case measurement, maximum level. minimum setting of all controls was −65 dB. More typical operation conditions provide noise levels in the −80 plus dB range.

Taken both as a whole, and as the sum of its individual parts, the Shure equalization/analyzer system offers convenience and quality. L.Z. ■

If you're into exporting, or about to take the plunge, this could be your market research department.

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

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db people/places/happenings

• **Constantine A. "Gus" Spyrou** has been appointed manager, engineering development, at **CCA Electronics Corporation** of Gloucester City, N.J. Mr. Spyrou comes to CCA from **Gates Radio Company.**

• A consulting agreement between Altec Sound Products Division, of Anaheim, Ca. and the Electori Co., Ltd. of Tokyo, Japan has been signed. I. Hattori, president of the Electori Co. will act as executive consultant to W. F. Garmon, president of Altec, in order to coordinate the needs of the Japanese market with Altec's marketing efforts. **W. L. Fowler,** vice president of Altec, will assist Mr. Garmon in presenting to the Japanese firm plans for marketing development and distribution. Other new activity at Altec includes the appointments of **James C. Johnston** as vice president, consumer sales, and **Edward H. Kane** as vice president of sales for the international division.

• **Norman R. Schneider,** of **Technical Reps** of Chamblee, Georgia, has been named by **UREI** as "Rep of the Year." Technical Systems Reps represent UREI in the Southeast.

• Moving up from the position of executive vice president for North America, **Thomas G. Needles** has been elected president and chief operating officer of **Koss-North America,** of Milwaukee, Wisconsin. Prior to joining the firm in 1973, Mr. Needles was president of Catherine Clark's Brownberry Ovens.

• **Starr Recording,** at 201 St. James Place in the Plaza at Society Hill Towers is Philadelphia's newest recording facility. In charge are **Dan and Dave Starobin.**

• **Audio and Design Recording,** of Reading, Berkshire, United Kingdom has been assigned to market worldwide the products of **Midnight Audio,** of Fleet, Hants, U.K. The British firm manufactures an alignment oscillator, and is planning to produce a power amplifier and a turntable unit for broadcasting.

• **Image Devices, Inc.** of Miami, Fla. and Atlanta, Ga. has been appointed U.S. importer, distributor, and servicer of the entire line of Perfectone electronic products. The Swiss-made products include crystal motors for Eclair NPR and 35 Arriflex cameras. audio mixers. and sound-dubbing equipment.

• **TAPCO** has moved to larger quarters in Redmond, Washington. Plans are underway to increase production and expand the territories reached by the firm. The address of the new facility is 3810 148th Ave. N.E.

• Responsibility for the sale of RCA's line of radio and television studio and transmitting systems in Missouri, Iowa, and southern Illinois is now in the hands of sales representative **William B. Martin,** of St. Louis. Mo. Mr. Martin has rejoined RCA after two years with **WINL** of Johnstown, Pa. and a period with **International Video Corp.**

• New marketing manager at **Uni-Sync, Inc.** of Westlake Village. Ca. is **Lawrence Jaffe.** Mr. Jaffe's experience includes writing for **Billboard, Los Angeles Free Press, Creem,** and **Musical Merchandise Review.** In addition to overseeing the marketing of Uni-Sync's products, Mr. Jaffe will focalize their in-house agency, **The Blue Sky Agency.** Assisting him as sales administrator will be **Madlyn Jamison.**

• "Instrumentation, Measurements Engineering and Application" and "Noise Control" are two seminars being offered at **Union College,** Schenectady, N.Y. from July 11-15. Tuition per course is $495. For information, contact Graduate Studies and Continuing Education, Wells House. 1 Union Ave., Schenectady, N.Y. 12308.

• Cited for his activities in the creation of space vehicle development, as well as his role in the designing and manufacturing of sound reinforcement and recording studio equipment, **William G. Dilley**, founder of **Spectra Sonics,** has been awarded the Distinguished Engineering Alumnus award of the **University of Colorado** College of Engineering and Applied Science. The award is the highest honor that the college can bestow upon an alumnus.

• Emphasis on quality control at the **London Company,** of Cleveland, Ohio has been increased with the appointment of **Paul M. Black** to the newly created position of quality assurance manager. Mr. Black has been with the company since 1967, mainly concerned with the service aspects of the operation. **John E. Taylor** has assumed the position of national service manager.

• **Mel Kaiser** has become the sole owner of **Cue Recording, Inc.** and **MusiCues,** of New York City, with **Bruce Kaiser** serving as vice president, studio operations. Plans are under way to expand the firm's operations to include video tape sound enhancement and voice-over recording for vtr commercials and industrial presentations.

• **Filmways, Inc.** of North Hollywood, Ca. has entered into an agreement with **RCA Records** to acquire and operate the former RCA Recording Studio facilities in Hollywood, which will be working in conjunction with Filmway's **Wally Heider Recording Studios,** under the umbrella name of **Filmways/Heider Recording.** The firm has reorganized all of its audio-related businesses into **Filmways Audio Services Group** with **Laurence Estrin** as president. **Ron Trowbridge** heads **Filmways/Heider Recording.** Another affiliate, **Filmways Radio,** has **Gary Standard** as president.

• **Allen Novick,** vice president of **TEAC Corporation of America,** of Montebello, Ca. has been named to the firm's board of directors. Mr. Novick is responsible for the sales and marketing of TEAC's product lines, as well as management and operations functions.

• A boon to blind students taping notes who are often plagued by losing recorded material because of blank leaders on audio cassettes has been developed by **3M,** with their "instant recording" cassettes. Leaders are low noise recording tape, which commence recording as soon as tape motion begins. The new type of cassette, which obviously is useful in applications other than for blind users, is known as **IRC.**

• An agreement has been reached between **Audio & Design Recording** of Berkshire, U.K. for the distribution of their SCAMP system by **ITA** of Berkshire (Reading) under the direction of **Barry Lambden** and **Martin Parmeter.**

• Commencing June 27, a five-week intensive 16 mm film workshop will be offered by **NYU,** including training in film production, sound, lighting, editing, and scriptwriting. Tuition is $725; veterans' benefits and reduced-rate housing are available. Contact **Raymond P. Zelazny,** Film Production Workshop, School of Continuing Education, 2 University Pl., Room 21. New York, N.Y. 10003.

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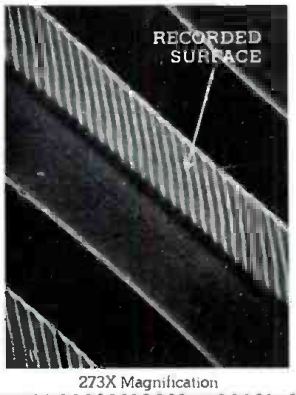
THE PROOF:

267X Magnification

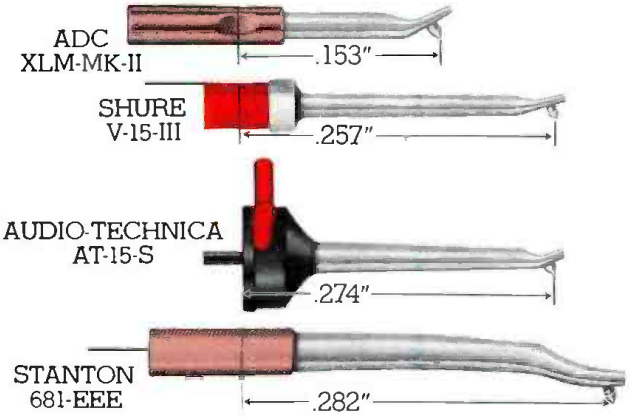
This is a photomicrograph of a 20kHz record groove that has never been played before.



273X Magnification

This is a photomicrograph of a similar 20kHz record groove played 75 times with an ADC XLM-MKII cartridge. As you can see there is no difference.

THE DIFFERENCE:



The way to get the most accurate reproduction of sound is to lower the total effective mass of the moving parts of the stylus. And that's exactly what our engineers did. In fact, of all the leading brands, ADC cartridges have the lowest mass moving system you can buy.

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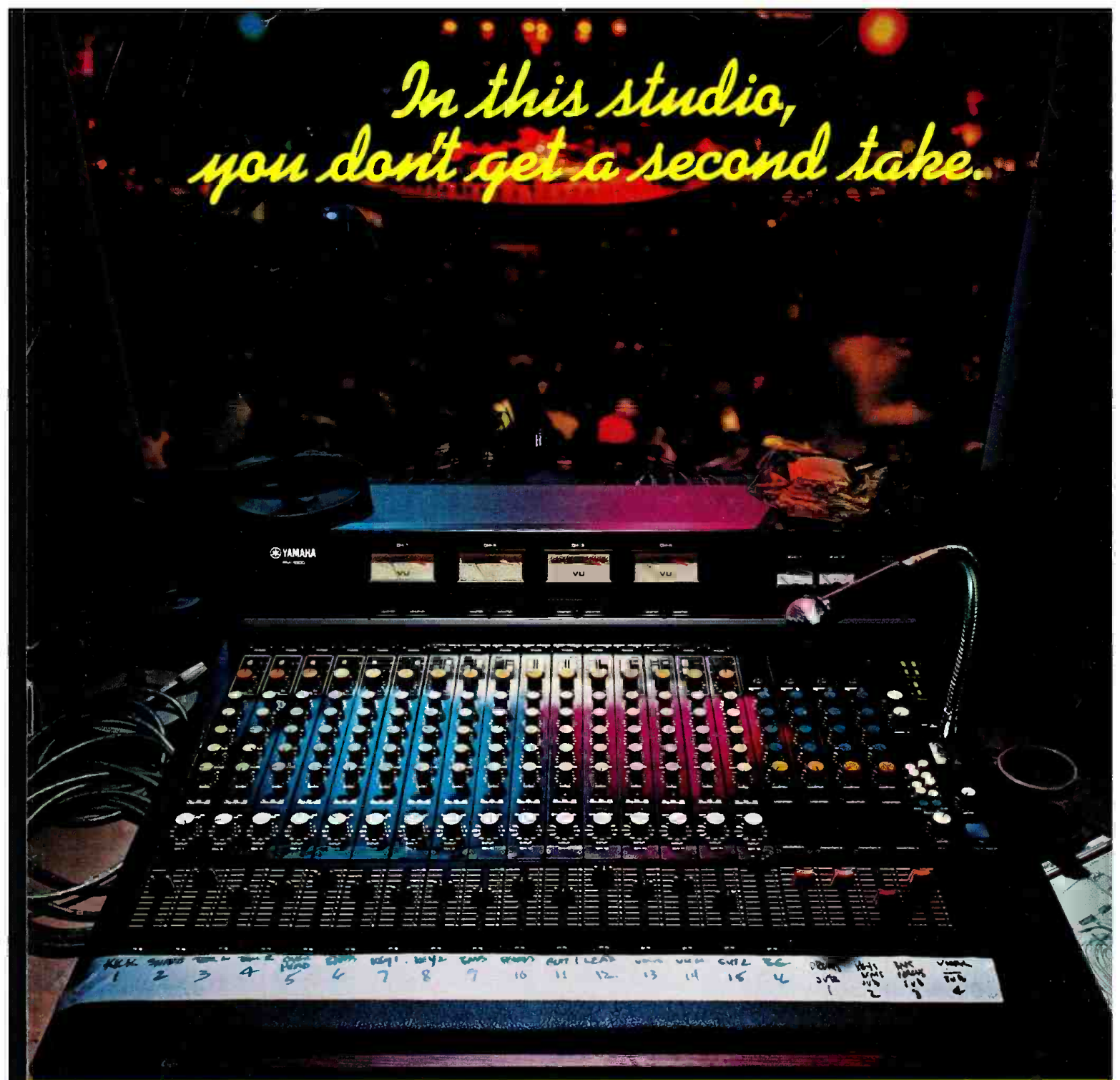

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YAMAHA

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