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OCTOBER 1978
VOLUME 9 — NUMBER 5

Recording engineer producer

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RELATING RECORDING SCIENCE • TO RECORDING ART • TO RECORDING EQUIPMENT

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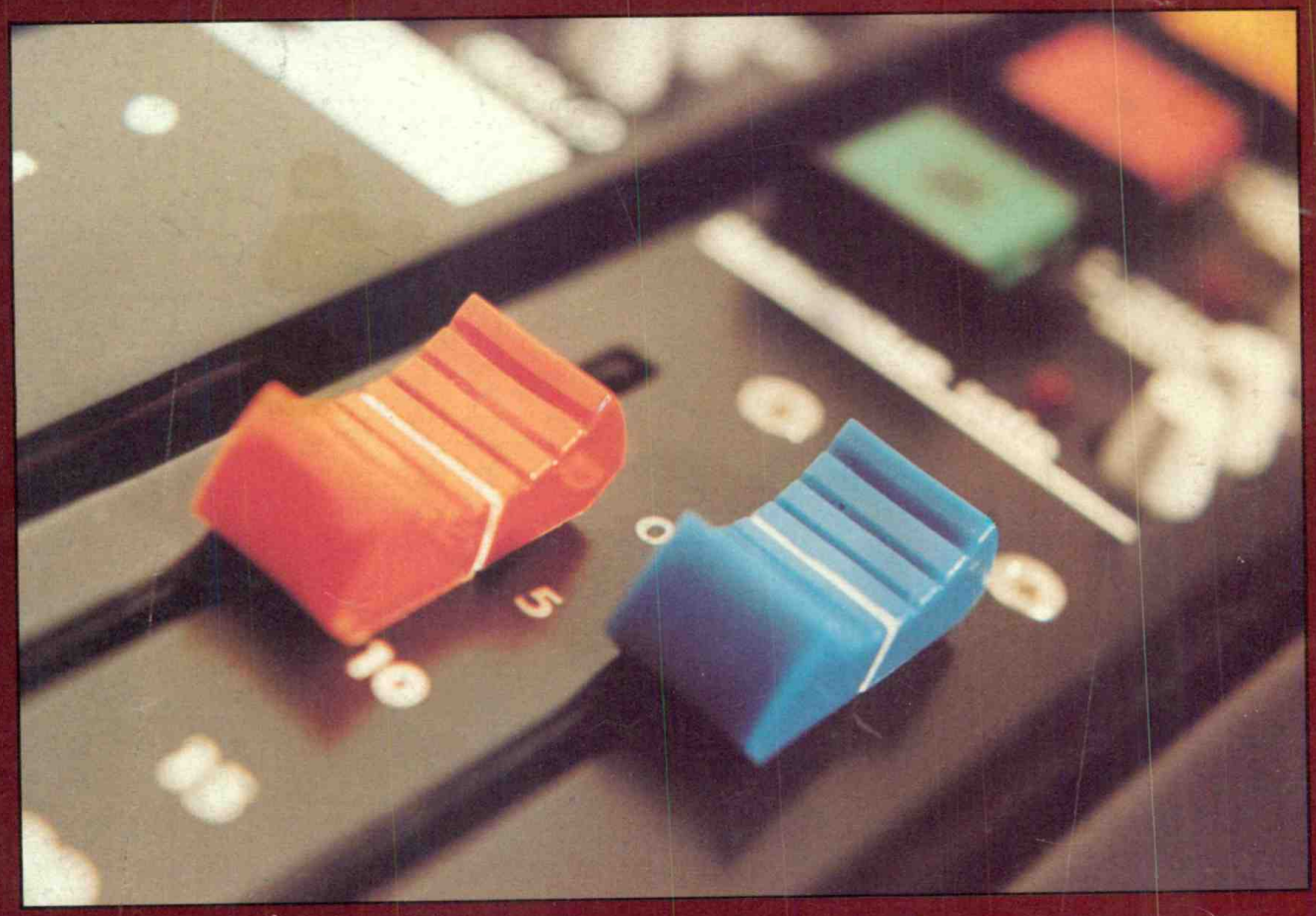

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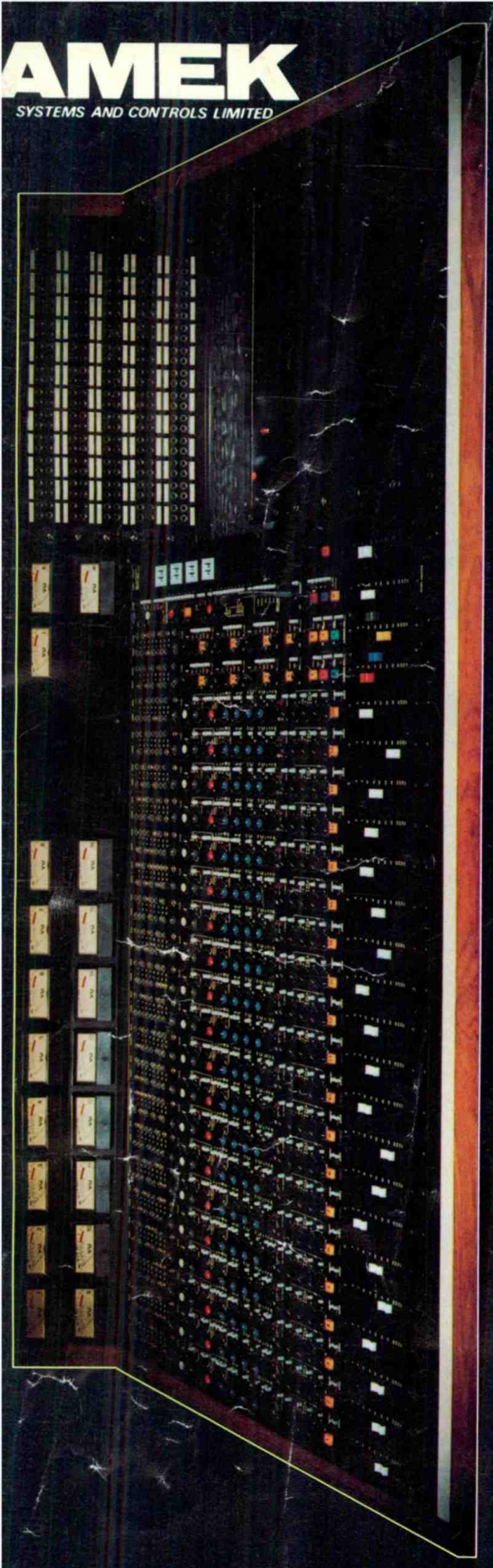

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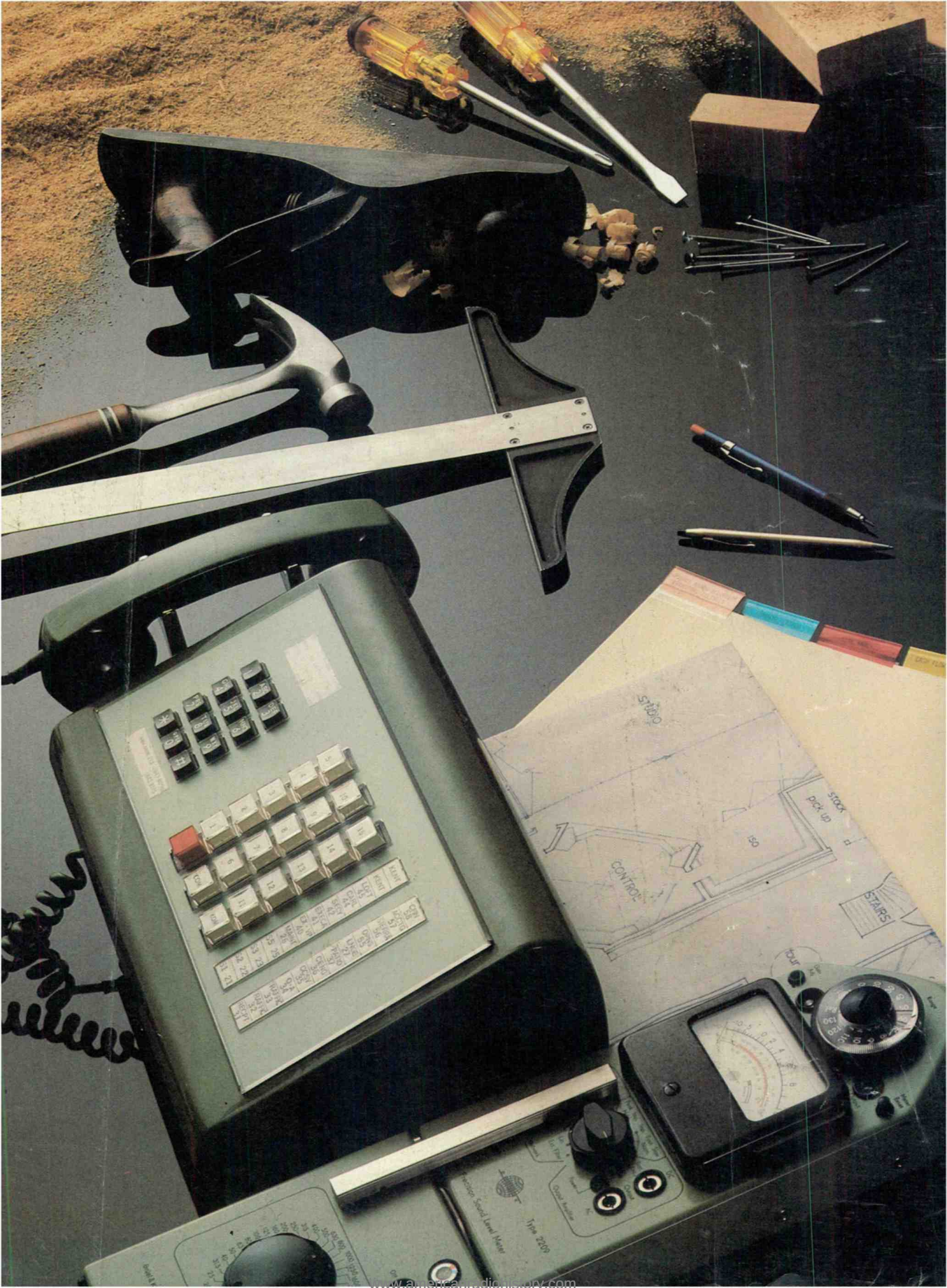
R-e/p 3



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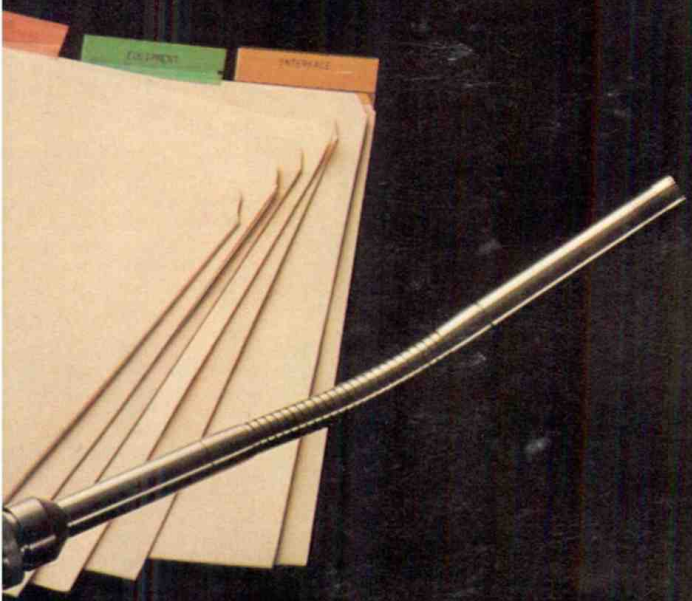

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RECORDING engineer/producer

– the magazine to exclusively serve the **Recording Studio** market . . . all those whose work involves the recording of commercially marketable sound.

– the magazine produced to relate . . . Recording **ART** to Recording **SCIENCE** to Recording **EQUIPMENT.**

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OCTOBER 1978
VOLUME 9 — NUMBER 5

— Contents —

the cover —
Photography by Wayne Yentis at Westlake II, Los Angeles.

If listening is your profession...

we've got some pros you should meet.

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for additional information circle no. 1

R-e/p 7

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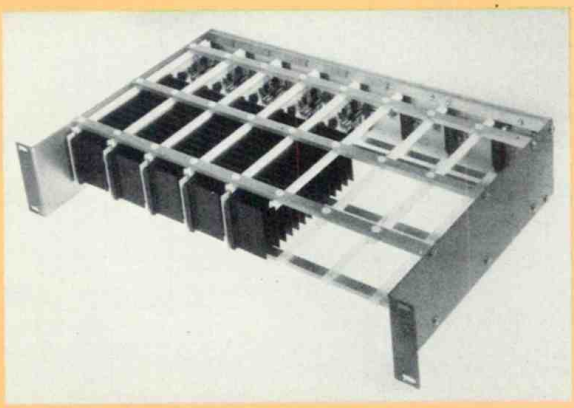

If you have not heard the new **SPECTRA SONICS** Model 701 Power Amplifier, it just might mean that you are missing the privilege of listening to the best. For complete specifications, see your Professional Audio Dealer, or contact:

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for additional information circle no. 2

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The 163 is as easy to install as it is to operate. It's light and compact—two may be rack mounted in a 1¾" space—and it interfaces easily with phono connectors.

But the easiest part of this "Over Easy" limiter is its cost. The nationally advertised value of the 163 is $189.* With the money you save on a pair of 163s, you can get two extra hands in the studio. You can hire yourself an assistant.

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for additional information circle no. 4

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Series 3 is backed by Soundcraft's comprehensive 2-year warranty.

THD	+4dBv line input to any line output at +4dBv, 20Hz < 0.03%, 1kHz < 0.01%, 20kHz < 0.05% Signal at mic input with 50dB gain (200Ω at source), 20Hz < 0.1%, 1kHz < 0.01%, 20kHz < 0.1%
Frequency response	+4dBv line input to any line output at +4dBv, 20Hz to 20kHz: −1dB Signal at mic input with 50dB gain (200Ω at source), 20Hz to 20kHz: −1dB
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Prices (correct at time of going to press) 24/16 £10,712 $27,426 (FOB New York), 32/16 £13,350 $33,986 (FOB New York). All other territories on request.

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for additional information circle no. 5

Letters

from:
John Lord
Paideia
Santa Monica, CA

Ed Lever's article on the mixing of *The Last Waltz* was extremely interesting. The illustration on the bottom of page 44, however, may mislead people who are not into film sound. It shows a "pilotone head" whose azimuth is tilted "x" degrees "so as not to interfere with the audio signal".

The tilted azimuth idea was a feature of some early systems like Rangertone, but it is long, long gone. The Nagra, which is the standard movie machine, uses what Kudelski has trademarked as a "neopilotone" system. This employs a head with two very narrow, separated tracks near the center of the tape, with the coils wired 180° out of phase. When these two tracks are played back by a full-track head, you get nothing — provided the neopilotone head's azimuth and the azimuth of the playback head are *not* "out of azimuth".

Disc-oriented engineers often express puzzlement at why one would go to all this trouble to lay down a simple 60 Hz tone. Couldn't you just assign it to one track of a multi-track machine? The answer, of course, is yes; and that was done on films like Altman's *Nashville*, as well as by lots of semi-pro filmmakers. In fact, it's the very simplicity of the signal (usually 58 - 62 Hz, not interested in the amplitude at all) that led to the fancy heads in the first place: engineers didn't want to concede tape space to it. Subsequent improvements in tape and electronics have lessened that concern, but in the meantime the principle has gotten frozen into the equipment and people's SOP's. For example, returning to the box at the bottom of page 44, Nagra 4's are usually purchased with the self-resolving feature, which means that the box marked "sync lock" is actually part of the mono tape machine. The 60 Hz reference signal is taken from the line, via a step-down transformer, and the sprocketed mag film recorder is driven by a synchronous motor powered by the same line. The distributor is superfluous and would only be used in shops that didn't have enough transfer work to set aside a recorder for the purpose (i.e., a recorder not tied into the interlock system used for mixing). So it is basically the convenience of the neopilotone systems realization by Kudelski that keep the system afloat. Their newer machines, incidentally,

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"STUDIO UPDATE"
To Be New **R-e/p** News Feature

Starting with the next issue (December, 1978) and then on a continuing basis thereafter, **R-e/p** will begin an entirely new, illustrated feature column to announce significant studio and production news.

If you would like the audio world to know that you have:
- *expanded or moved*
- *built another room or redesigned*
- *replaced a console*
- *gone to 8 or 16 or 24 tracks*
- *changed monitoring systems*

. . . or in many other ways improved the means by which you've operated; added people . . . won awards . . . etc., etc., the **STUDIO UPDATE** column will be your opportunity to call the industry's attention to your growth and progress.

How? Just make certain that you contact **R-e/p.** Be sure to write us with the details: who, what, where, when and why . . . and send whatever photos apply for inclusion in the next available issue.

R-e/p: STUDIO UPDATE
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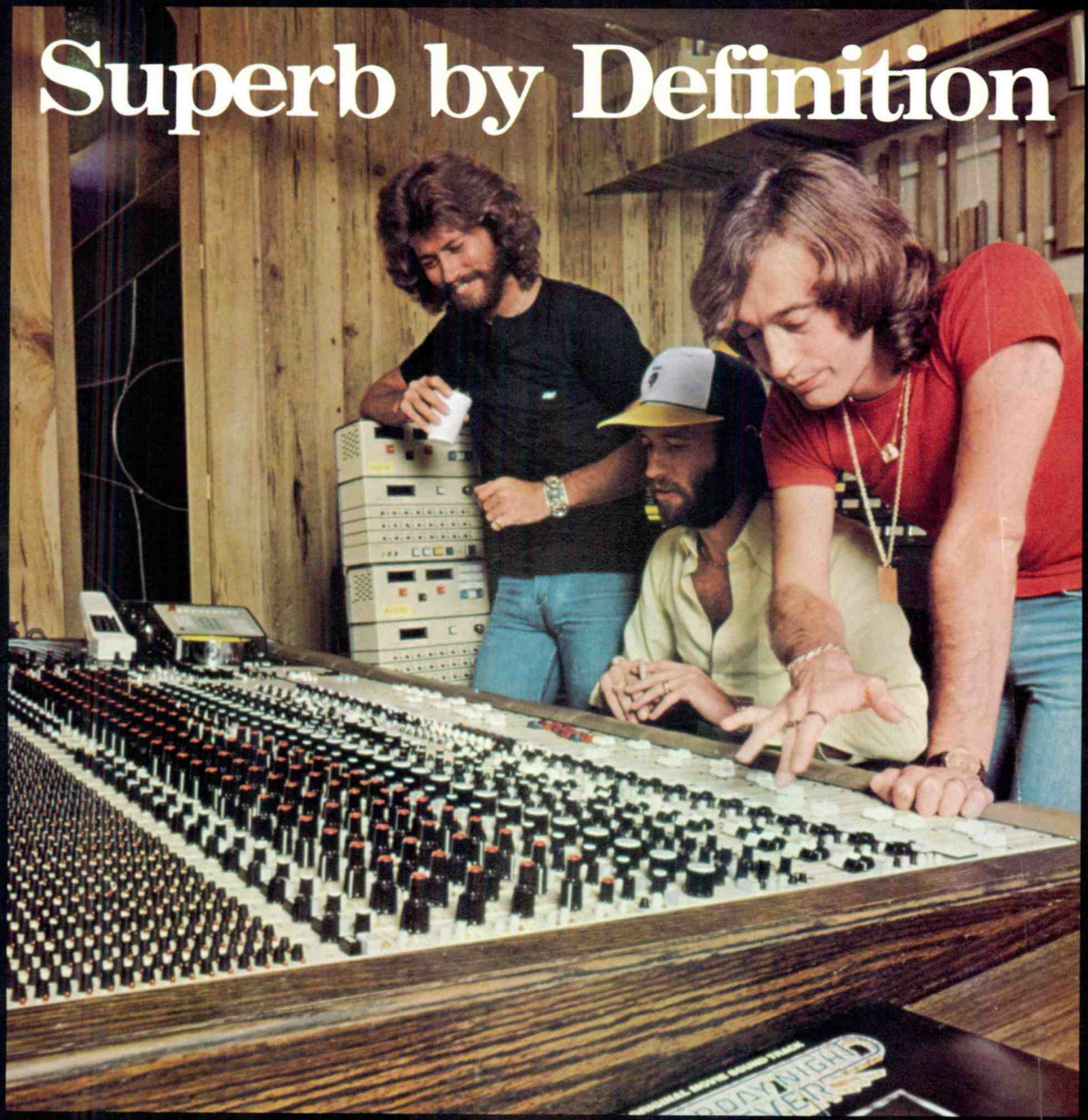
Hollywood, California 90028

Superb by Definition



Bee•Gees (bē-jēz) *N.* 1. Maurice, Robin, and Barry Gibb. 2. Singers, songwriters, and musicians who have made an important impact on the music industry. 3. Professionals who have displayed an almost uncanny awareness of the directions music is travelling. **(see talent, creativity, and perfectionism)**

tal•ent (tal-ənt) *N.* 1. A mental or physical aptitude; specific natural or acquired ability. 2. Natural endowment of ability or superior quality. 3. Gifted people collectively.

cre•a•tiv•i•ty (krē-ā-tĭv-i-tē) *N.* Characterized by originality and imagination.

per•fec•tion•ism (pər-fĕk-shə-niz-əm) *N.* A propensity for setting extremely high standards and being displeased with anything less. **(see perfection)**

per•fec•tion (pər-fĕk-shən) *N.* The highest degree of excellence. **(see MCI Professional Recording Equipment. Designed for professionals like the Bee Gees)**

MCI

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for additional information circle no. 6

R-e p 13

like the stereo Nagra and the Nagra SN, use different systems.

People who dispense with the neopilotone and its readily available machinery often also dispense with the capstan servo: the 60 Hz taken off a track is amplified by, say, a Crown DC300 and used to drive the sync motor on the sprocketed film recorder!

Lastly, your readers might be interested to know that the newer film cameras, like the Arriflex 16SR or the CP16R, are coming already fitted to accept time encoding on the film. Each frame will have, along the edge, a pattern of dots exposed by LED's in the film gate, the pattern encoding the time and date on which the film was shot. This will be translatable to SMPTE time code and will permit fully automatic synchronization between sound and picture.

reply from:

Ed Lever
Canyon Recorders

Jack Lord's comments regarding the "Pilotone" recording method are quite correct. The use of the other system he described in fact occurred during a phase of the motion picture production in which we had not yet become involved and, unfortunately, our naivety about certain aspects of film sound permitted us to pass on incorrect information (that was given to us). Nevertheless, the recordings made on the Nagra while filming the concert were subsequently used only as rough cueing tracks to aid the film editors while cutting picture.

As described in The Last Waltz *article, all of the multi-track masters used for the film soundtrack (and album) did in fact carry the 60 Hz tone on one of the tracks, in addition to the SMPTE time code on an adjacent track. It was only through the use of this method that we could insure that the SMPTE printed on a subsequent mag reel would bear any relevance to that printed on the tapes.*

In any case, it is gratifying to learn that R-e/p *readers are knowledgeable in this particular field. I wish to thank Mr. Lord for his interest and information, and especially for his comments regarding the SMPTE innovations on new motion picture cameras which should make our work in this area a good deal easier.*

□ □ □

from:

Geoff Sykes
Mixing & Mastering Engineer
Kendun Recorders
Burbank, CA

In reference to your August, 1978 article on Disc Mastering; I feel that several points still need further comment.

The importance of tones cannot be over emphasized. Tones are not only an indication of where your record machine was at at the time of the mix; but, rather, a reference by which the mix can be accurately played back on the other systems.

When using any type of noise reduction, care must be taken not to encode the tones. This is especially disastrous if accomplished with dbx.

In regard to A/B testing a disc to the tape, it must be remembered that the disc is a polished performance and should always sound better than the two-track original. Whatever means it takes to accomplish this is permissible, but consider — that the mixing engineer probably had a pretty good idea of what he wanted the music to sound like. Care should be taken not to alter things that may have been done intentionally. The majority of corrections should be directed toward achieving compatibility between different mixers, studios, and machines. They should be dealt with as corrections as mastering is not re-mixing.

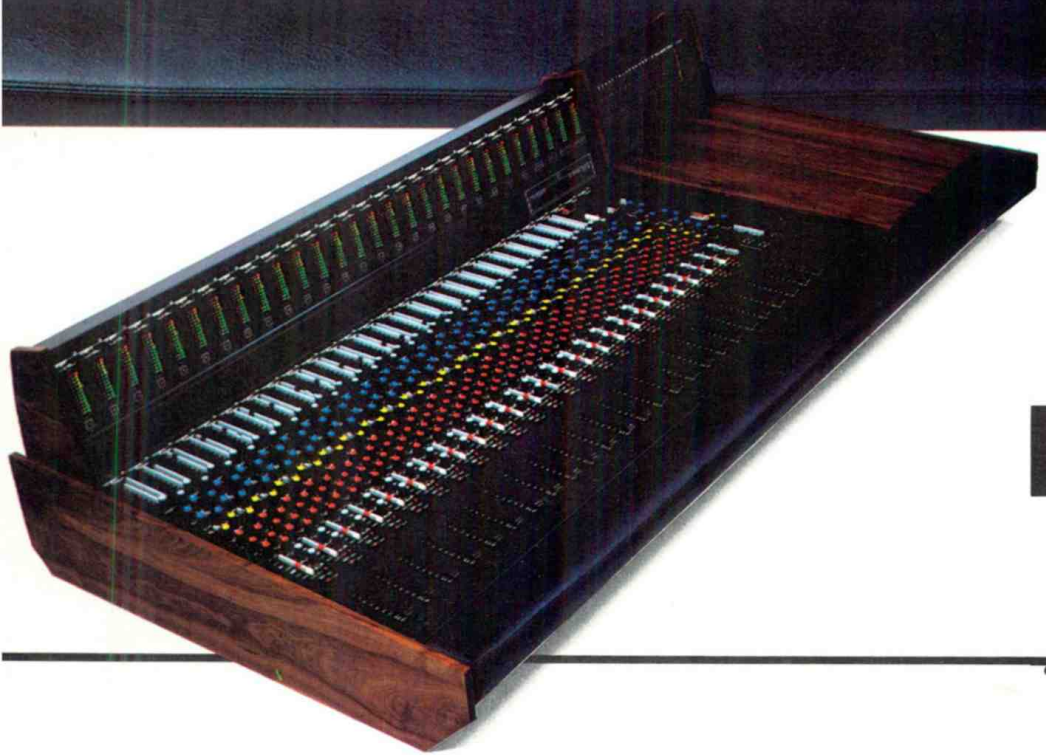
By listening to most direct-to-disc recordings, you realize that only a small percentage of recorded material actually needs limiting. The two reasons for limiting are either to save a poor mix or to allow room on the disc for sides of excessive length where level does not want to be compromised.

It might be of interest to note that it is possible to get almost anything on to a disc. The challenge then is getting it off accurately. Overcuts, unless excessive, are only occasional problems. More important is that the playback stylus has considerable mass and can only move so fast. A drastic peak occurring on a disc would be related to being told by a passenger in your car that the street you're crossing at 60 MPH is the one you should have turned at, only the playback stylus can't go around the block.

High frequency problems are usually the result of too much level, sibilance being the worst offender. Here the playback stylus cannot modulate fast enough to track the signal, and it mistracks the groove, resulting in distortion. This is different

continued on page 22

Tangent conquers the big problem with high-quality consoles.



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R-e/p 15

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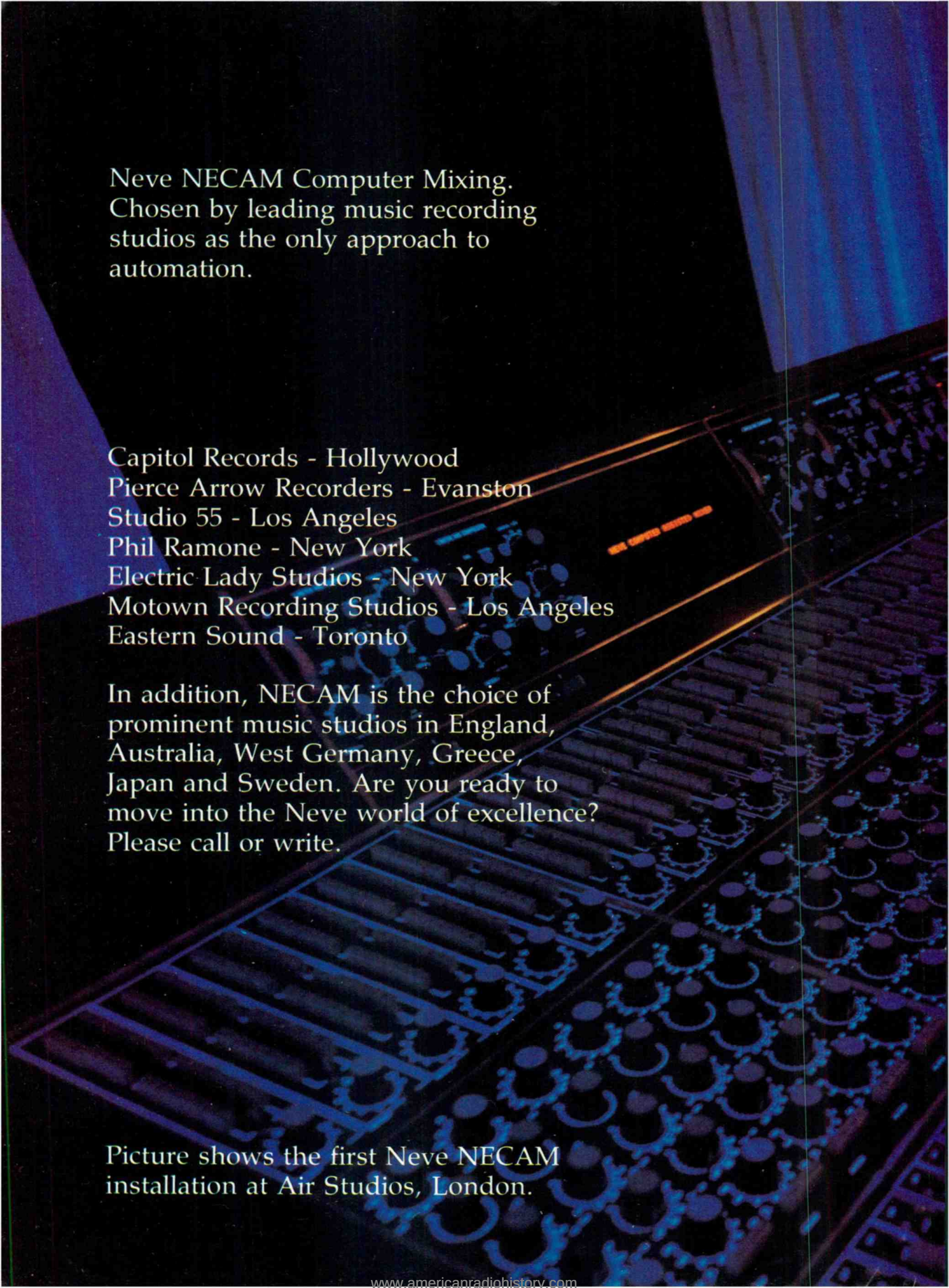

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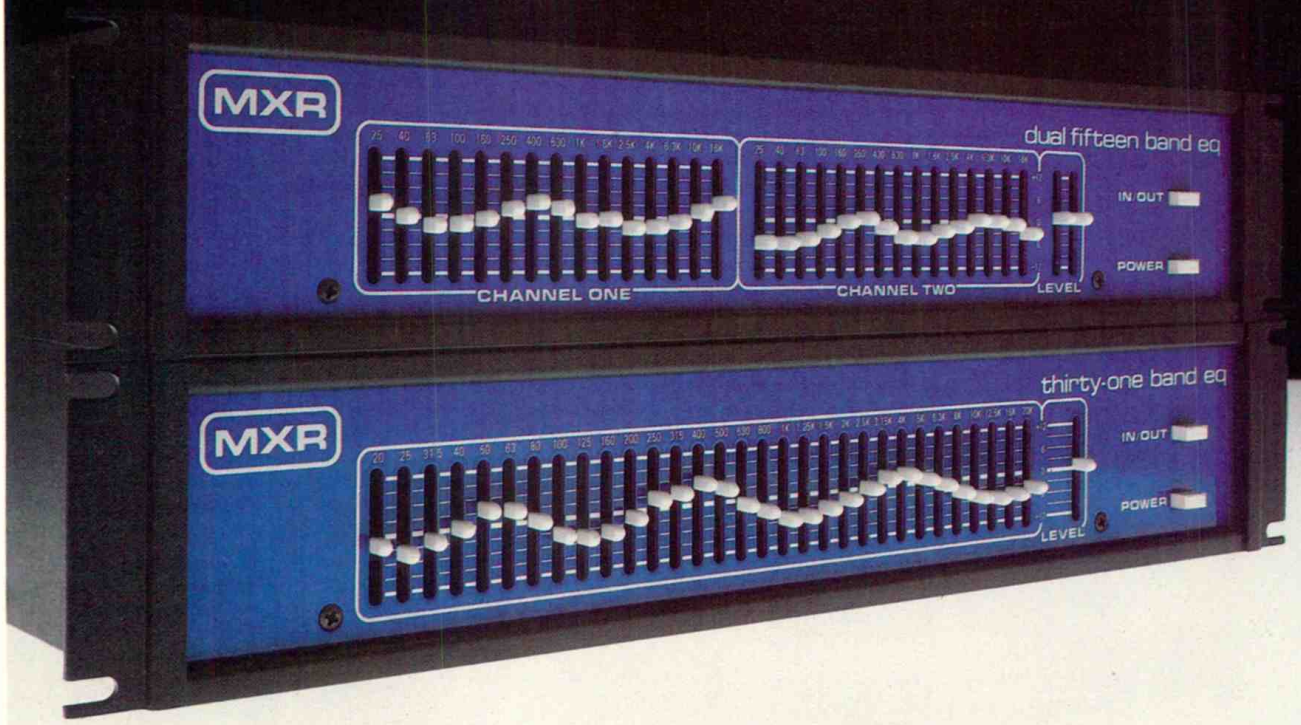
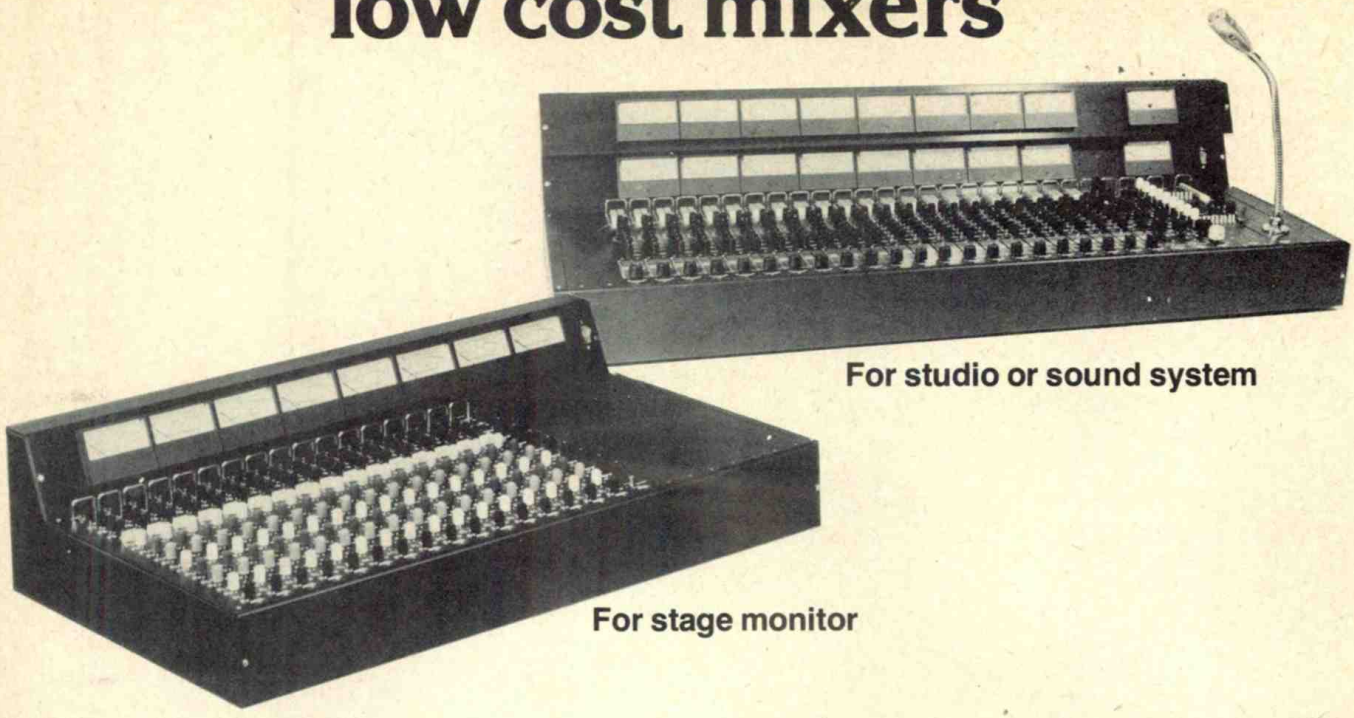
MXR Innovations, 247 N. Goodman Street, Rochester, New York 14607, (716) 442-5320.

MXR Professional Products Group



for additional information circle no. 11

Rugged high performance low cost mixers



For studio or sound system

For stage monitor

Over 500 INTERFACE ELECTRONICS mixers are now in use in recording studios and sound systems and wherever high performance at low cost is needed. These mixers have been used in making gold records and they are also specified by many rock groups for road use because of their ruggedness, reliability, flexibility, immunity to stray fields, and high performance — equal to or better than that of consoles costing many times more. Mainframes are available for 8 to 32 inputs, and modules can be ordered as needed. The many possible options and configurations allow you to have it just as you want it.

TYPICAL RECORDING MIXERS

Model 400 Low Cost Stereo mixer is a full professional modular mixer with eight inputs, two outputs (stereo) plus echo send and cue, LED input overload indicators, 3 equalizers with 4-frequency active mid, 4 position low frequency cutoff, professional VU meters. Suggested retail price $1300.

Model 8X4 Portable Four Track eight input mixer for location recording or remote pickup; includes phantom power, phase reverse, solo to monitor only, echo send plus three cue sends, three equalizers with four frequency mid, four position low cutoff, panpots, LED input overload indicators, dual monitor mixdown, 4 VU meters, output transformers options. Suggested retail price $2900 as above with type J modules, $2628 with type D modules.

Model 16X8A-16J/NTS Eight Track recording mixer with 16 type J input modules (see above), control room mixdowns with solo, talk-slate module.
Complete with 16 inputs 8 outputs $8,586.
Complete with 24 inputs 8 outputs $11,346.
Complete with 32 inputs 8 outputs $14,106.
Complete with 12 inputs 4 outputs $4,866.
Complete with 16 inputs 4 outputs $7,186.
Complete with 24 inputs 4 outputs $9,546.
Complete with 32 inputs 4 outputs $11,906.
All have type J modules, mixdown and talk-slate.

Model 24X16A-24D/NTS Sixteen Track recording console with control room mixdown and talk-slate: suggested retail price $11,190; with 32 inputs, $14,290, with type D modules.

TYPICAL SOUND SYSTEM MIXERS

Model 24X8S-24J/NSTI House Mixer, 24 inputs type J, 8 stereo submasters with large lighted VU meters, house mixdown with pan and house slider master, operator can monitor any submix or any input solo and can talk to any mix or other operators. Transformer outputs. Type J modules include phantom power, phase reverse, 4-position input pad, 4-position gain set, LED input overload indicator, three equalizers with 4-frequency active mid, 4-position 12 db/octave low cutoff, echo send and three cue sends, breakin, module output, line/mike input switch. Suggested retail price $11,570; Anvil case $350. Options include slider submasters, center-mounted masters.

Model 24X4A-24L/3ETI Stage Monitor mixer with 24 inputs and 8 independent output mixes, three equalizers on each input, eq in/out switches, six octave-band graphic output equalizers, talk-intercom module allows operator to listen to any mix, talk to any mix, or intercom with other operators. As above, suggested retail $12,374. Anvil case $350.

Model 16T8 Theatre Mixer has 16 inputs feeding any combination of 8 submix busses with submix masters, pot matrix can feed any combination of the submixes to each of 8 outputs with slider masters going to different places in the theatre. Solo available to each output, large lighted standard VU meters can monitor submixes or outputs; uses 6" Duncan conductive plastic sliders. Suggested retail price $11,740.

Model 12X4S-6J/6S/NSTS8H Production mixer can handle up to 12 microphones or 6 mikes and 6 stereo line level sources such as turntable or tape; stereo inputs have A/B switch and have cue/preview switch at bottom of slider, type J modules have on-air switch at bottom of slider and on-air enable switch. Four stereo mixes, mixdown/monitor module can mix submixes or listen to any mix as monitor or output switcher, and can listen to any type J input solo. Talkback can talk to any mix to slate a take or talk to the studio, or both. Slider masters, transformer outputs. Suggested retail price $6,072, $6,222 with internal reverb.

These are just a few typical examples of a large variety of mixers that can be assembled to customer's needs from Interface Electronics components.

SPECIFICATIONS

Frequency Response ±1 db 20-20000 Hz,
Distortion under .05% @ +18 dbm,
Equivalent input noise −128 db ref .775 v.,
Headroom 20db.

OPTIONS (plug-in)

Graphic equalizers, monitor-intercoms, output limiters, tuneable crossovers, output transformers, joystick quad input modules, parametric filter input modules, talkslate, 110/220 volt export version, more.

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Georgia: Oliver Elect., Atlanta (404) 351-1790
Illinois: Gill Custom, Palos Hills (312) 598-2400
Indiana: Allied, Richmond (317) 962-8596
Mass.: Terry Hanley, Cambridge (617) 661-1520
New Mexico: Pace Audio, Albuquerque (505) 293-4277
New York: Sound Associates, NYC (212) 757-5679
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American Concert, Austin (512) 472-2437
AST Sales, Arlington (817) 461-4576

Dealer inquiries invited from other areas.

INTERFACE ELECTRONICS

3810 Westheimer Houston, Texas 77027
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continued from page 14

than inner groove distortion, where the groove velocity is so slow that high frequencies create a wavelength smaller than the 7/10 mil radius of the playback stylus, causing it to ride over the top of the modulation.

As for the overall high reject rate of lacquers before cutting, I think it unreasonable to reject a lacquer on surface appearance alone. Imperfections such as orange peel and minor non-foreign substance-related dimples are purely cosmetic and rarely indicate damage in the area some two mils below the surface where the groove is actually being tracked.

Indeed, the lacquer process is the most accurate and most nearly perfect recording process.

□□□

from:

Mark Levinson
Mark Levinson Audio Systems, Inc.
Hamden, CT 06514

The August 1978 issue *(Volume 9, No. 4)*, there is an article on disc mastering which mentions a monitor system used by Bob Ludwig at Masterdisk, in New York. I am referring to page 67, paragraph 4, which begins: "The Hartley speakers that Ludwig uses at . . . " For the information of readers who may not readily identify this system, it is a version of the HQD System designed and marketed by Mark Levinson Audio Systems, Ltd., in Hamden, Conecticut.

The difference between this and the normal HQD System is that Masterdisk has not yet purchased four of our ML-2 Class A Power Amplifiers and is currently using other amplifiers in their place.

It should also be noted that Bob Ludwig is no longer using the Pioneer ribbon tweeters which were originally supplied with the system when it was first developed three years ago. He is using modified Decca ribbon tweeters which we have been supplying for over two-and-a-half years.

The HQD System was originally designed for my own use, but because of the interest in the audio community we have made it available to the general public. The price of the complete HQD System is currently about $28,000, which includes an ML-1 Preamplifier, two LNC-2 Crossovers, and minimum of four ML-2 Class A Power Amplifiers, and a full complement of drivers. Professionals interested in this system should contact the factory. A detailed brochure is available from the factory at a cost of $5.50, postage paid.

I would appreciate your mentioning at least some excerpt from this letter in one of your future issues. If your magazine would like more information on the HQD System, our new retrofit electronics for certain Studer tape recorders, and our other products, please contact me at your convenience.

It is rather interesting that many mastering and recording studios use several hundred thousand dollars worth of equipment, but for actual listening they use fairly inexpensive speakers which are primarily designed for the consumer market. When such equipment as Studer recorders, Neumann lathes, and custom-built consoles are in use, then a system such as the HQD is a natural choice. In addition to superbly accurate sound quality, the HQD offers an extremely low fatigue factor which should be of great interest to professionals who must listen to music for many hours a day.

□□□

Late News

SOUTHERN RECORDING ASSOCIATION FORMED

In a bold sweep to establish credibility and confidence in Central Florida as a viable recording environment, seven Orlando studios have formed the Southern Recording Association (SRA) around a common denominator. This purpose is to demonstate that recording in Orlando is both profitable and to the artist's distinct advantage. A second goal is to provide an active "consciousness raising" program for the metropolitan Orlando area concerned with the importance of recording as a community resouce, and the reciprocal advantages that each offers the other. The SRA inaugurated these goals with a special workshop that was held September 16th, at the Hilton West Hotel in Orlando, Florida. Guest speakers included Roger Sovine of BMI, and Gerry Wood, presently of *Billboard Magazine*, formerly of ASCAP. The main subject was a discussion of the 1978 copyright laws.

Response has been very encouraging according to Eric T. Schabacker, SRA Executive Secretary. "The Orlando Sentinel will run a 'Studio Track' column on a regular basis, and Orlando radio station WDIZ will support the SRA through such activities as news spots that report on current studio activity in each of the affiliate studios."

— continued on page 128

Prime Time™

Digital Delay Processor

professional quality delay plus special effects

Lexicon's new Model 93 "Prime Time" digital delay processor gives recording studios and entertainers an easy-to-use professional quality time delay with special effects and convenient mixing all at a price you can afford. It combines a degree of flexibility and versatility never before offered in equipment of full professional quality.

- Two delay outputs independently adjustable from 0 to 256 ms
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- Integral VCO for special effects like vibrato, doppler pitch shift, flanging and automatic double and triple tracking
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- 90 dB dynamic range, total distortion below 0.08% at all delay settings

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for additional information circle no. 14

ALBHY GALUTEN and KARL RICHARDSON

With seven number one singles in 1978, the production team of *Albhy Galuten* and *Karl Richardson* has dominated the charts in a way that hasn't been matched since George Martin came up with four Beatle hits during a six-month period in 1964. Records by The Bee Gees, Andy Gibb, Frankie Valli and Samantha Sang gave Galuten and Richardson the string of singles that held the number one position for 30 weeks this year.

Galuten, a native of Westchester County near New York City, was an assistant of producer Tommy Dowd for a time before moving into that role himself. His background includes session work at Stax, in Memphis, and studies at Berkelee College of Music, in Boston. An accomplished songwriter and arranger, Galuten has co-written several songs recorded by Olivia Newton-John and Eric Clapton.

A native of Miami with a degree in electrical engineering, Richardson began work at Criteria Studios as a disc masterer. He moved into the recording studio and engineered hit albums for Dr. John, Firefall, Aretha Franklin and Eric Clapton's *Layla*.

It was while working at Criteria that the two first met. Galuten was playing keyboard at the Miami studio for Brook Benton and Petula Clark sessions.

Later, Richardson was assigned to a Bee Gees recording session for the album *Main Course*. The Bee Gees selected Richardson for their next record and, after the producer left and the group itself had acted as producer, Richardson recommended Galuten for the job. *Children Of The World* was the result, and marked the beginning of co-production work of the two.

by Tom Lubin

Tom Lubin: You seem to use very few special effects in your music.

Albhy Galuten: There are some tricks, but they're very subtle. For instance, on "Stayin' Alive", Barry's [Gibb] acoustic guitar is all phased. If you listen on earphones the level on the left and the level that's sort of on the right are about the same. The one on the left is straight but the one of the right is phased.

Karl Richardson: It's such a subtle thing that when we added it up in mono we made sure that it didn't interfere with what was going on.

Albhy Galuten: If you listen in stereo the echo on the horns is all 7½ ips delay. It created a nice effect in the studio. There are little subtle things going on throughout these records. Another example on "Stayin' Alive" is the guitar line. It was a little laid back so we played it in sync and then delayed it until it was just a bit more pushed.

Karl Richardson: We don't use technology or effect as a hook line; it's always to augment what's going on. We keep the technology where it's not too much of a game. We use the tricks for seasoning; like salt and pepper.

Albhy Galuten: On the new Andy Gibb single, "Everlasting Love", the piano is run through a Marshall Time Line. You might not hear it unless you listen closely through a pair of stereo headphones. But had I not done it, I wouldn't have been as pleased with the record's sound. That's because the piano was just a Rhodes and that's the way it sounded. Now it really doesn't sound quite like a Rhodes. It's a subtle thing, not something gigantic.

Tom Lubin: The piano on "Good Feelings" has some sort of signal processing on it also.

Albhy Galuten: It's a grand piano through a guitar Leslie. And, in fact, there's one bass string that I'm plucking with my thumbnail. I think we drove it with a little Music Man amp. From the piano, to the board, back out to the Music Man and into the Leslie.

Tom Lubin: Did you do that in the mix or cut it that way?

Albhy Galuten: Cut it that way.

Tracks to Glory

The road to success is not the easiest one to follow. At Otari, we help to pave the way by providing the professional tools you will need to follow your chosen star.

If you are thinking of building your own studio, make sure that the equipment you choose is up to the professional standards you will have to meet, now and in the future. The MX-5050-8D half-inch 8 track mastering recorder, and the MX-5050-B 2 track mix down recorder are two of the best ways available to make your own tracks to glory. They outperform everything in their class.

For the full story on these, or any of our other fine full track, 2 track, 4 track or 8 track mastering recorders, contact your nearest Otari professional dealer or call Ruth Pruett at Otari on 415/593-1648.

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three-quarters-of-an-inch of tape on the 24 track. I think "Grease" has about 14-or-so such edits. Takes a while, but when you get done, it feels better.

Tom: Where do you get pieces if you have to put in more time?
KR: Some of the pieces I took out.

Tom: That's difficult with pieces so small.
KR: A steady wrist is necessary.

AG: We did it on another song. The drummer had played sensational fills and we weren't sure if we would get him again. His approach to the song was just right, his dynamics were incredible, so we had this great drum track but it wasn't quite consistent, so we put it in meter . . .
KR: . . . as best we could. I learned a lot about editing on that. Try splicing an eighth-of-an-inch of 24 track tape.

We've also done a couple of interesting things with loops rather than the rhythm machine.

AG: We did a tune awhile back where we needed to use a rhythm machine or something, but the machine sounded terrible. So we cut one bar of drums from a song we'd previously recorded, looped this bar and VSO'd the machine to control the loop tempo. It sounded so much better than a click track that it ended up becoming the drum track.
KR: That's in the mix.

AG: You can use tape loop drums to play almost any pattern you want. After the basics were cut we went back and overdubbed some fills and the hi-hat.

Tom: How do you set up your loops?
KR: With rubber bands. That particular loop was on quarter-inch tape. The loop went through the head stack, came around a mike stand, then around the reeling motors, (which are disconnected), back into the guides, and on into the head block. The mike stand boom extends outward, over the machine top, to keep the loop flat with the back side against the deck. Sometimes you can just use a seven-inch plastic reel hanging over the side of the machine. The inside diameter of the reel becomes an additional guide. If you need more tension you use a mike boom and just keep moving it back until it's right.

Tom: What's right?
KR: On an MCI it's easy because the left hand swing arm, that little teeny arm, determines the tension. If it's in the middle you're right.

In general, the position of all the tension arms should move about halfway. We've used 24 track loops. It's a little tricky. I got one of those small two-inch video reels, the little white plastic ones, and found an Ampex hub and platter assembly that was used for tape on pancakes. I set the platter on top of the mike stand and stuck a pencil through it for a spindle so the platter would turn. Since the platter had an Ampex hub, the two-inch reel fit right on. Then I inverted another assembly on top of the pencil and set it on top of the two-inch reel. I found out that since the pencil was only a pencil, I had to take a rubber band and run it across to whatever was handy to gaff down the assembly. It worked. You could sit there for 20 minutes and listen to the same loop without flinching.

Tom: Along with the rhythm, the vocal textures you do are pretty amazing.
AG: On the new Bee Gees record there's even more. We're using slave machines and an interlock.

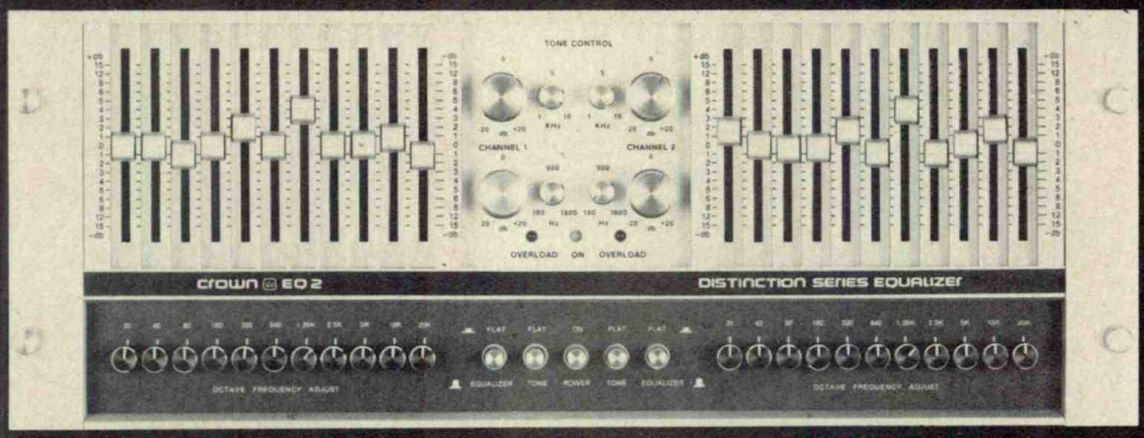
Tom: Twin 24 tracks?
KR: Yeah, I'm using a Mag-Lync and it seems to do the job perfectly well.

Tom: How do you use the sync system?
KR: I make a guide slave and transfer over 6 to 8 tracks of all the essential instruments that I need. One track has a sync code. I end up with 15 open tracks, which is lovely. So we load them up with vocals. Maybe we don't want two of the tracks in the same chorus, but in the fade we want all eight of them up as well as the other seven tracks of low parts, whatever. What we do is I'll use the computer to mix those tracks down to stereo. Then we transfer them over to two tracks on the master. The computer data track for the vocal mix gets stashed right on the slave tape. That way when we start mixing and the trumpet part is brought in and I find out I need more of that high harmony, I'll just go back and interlock the slave reel with the master. I've got all the vocal there. So I just change what I need to. The computer matches it for me. The advantages are numerous.

AG: We've got a lot of slaves.
KR: When I want to do horns, I take the vocal slave off and put on the horn slave. I've got the horns on another reel. Then I bounce the horns using the computer. Strings are on another reel. The advantages are, first, you don't have to erase it after you've bounced it down. Typically when you're doing multiple passes of instruments you have to erase preceding layers as you progress.

AG: If you don't like the bounce later? Too bad. You're just stuck.

The "better than" equalizer



crown EQ-2

The Crown EQ-2 is a ½-octave equalizer on octave centers with two channels, eleven bands per channel. ±15dB of boost/cut is available for each band. That's one reason why the EQ-2 is a better choice. But there's much more.

Adjustable center frequencies – The Crown EQ-2 is better than a parametric because you can control boost and cut for eleven-bands per channel with adjustable center frequency for all 22-bands. It cures many more room problems.

Simple set-up – The Crown EQ-2 is better than a ⅓-octave graphic because it's simpler to set up, yet provides full-range control. The EQ-2 can also be cascaded to create a 22-band, ½-octave mono equalizer.

Unique tone control – The Crown EQ-2 is better than other equalizers because of its unique tone control section. Shelving-type bass and treble controls with selectable hinge points reduce phase shift problems, since low and high frequency problems can be resolved before equalizing begins. This feature also permits quick reshaping of the response curve for different room populations without altering basic equalization.

Superb specifications – The Crown EQ-2 is "better than" because of a signal-to-noise ratio 90dB below rated output, and THD less than .01% at rated output.

Reliability – It's "better than" because it's Crown. That means reliability, ruggedness, and better value.

New RTA – It's also "better than" because Crown now manufactures a real time analyzer which, used in conjunction with EQ-2, makes the job of equalizing even easier.

Write or call today. We'll be glad to arrange a demonstration of both the EQ-2 and the new RTA at your convenience. Your systems deserve to be "better than."

crown

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KR: The other advantage is that I'm bouncing off the play head rather than the sync head when I'm doing the bounce. Everything on the slave machine comes off the play head. The Mag-Lync sync signal is monitored by the play head and just follows itself.

AG: And the computer makes it so that whenever you have to do a bounce you just bounce it. Whatever change is needed we just update onto one of the old guide tracks. There's usually enough of the old sync tracks so you can have a number of updated computer data tracks. Once we start using the sync reels we don't even play the master until we do the bounce. Then we mix. We don't overdub per se on it.
KR: You need to have a nice budget to do that.

Tom: Undoubtedly.
AG: But I think we're making better records and not just making more expensive ones. It gives you a lot more flexibility.

KR: I mean a lot of times you get a lead track that has a great ad lib in the third verse and you're running out of tracks. You don't really want to go over that, but if you're dealing with 24, you're forced to.
AG: Or, you have to go a few generations. So he sings it two times and you make a composite vocal of that to a third track. He sings it some more and you have to make another composite out of that to keep everything you want. Now when we do lead vocals, they'll go out and sing six or seven passes without worrying about combining.

KR: Then we'll come in and sort it out together.
AG: We try to not influence the creativity negatively.

KR: We want to get the emotion out of the song. At the same time, we're trying to go for a great performance.
AG: Feel it now and think about it later.

KR: That's really where it is. It really helps the artist, because now the artist doesn't have to think about how many tracks he has to do the vocal on. If the guy's only got two tracks he's thinking, "I hope I'll get it". If he knows he's got room, he know's he'll get it. It frees him up.
AG: It's really not that much more expensive once you have it down. It costs an extra $50.00 an hour for running two machines, but normally we're only running the one. We only need a second machine when we make the bounces. And the Mag-Lync costs a couple of grand. You end up taking less time in setting up the bounce mix.

It used to be that you'd spend ages getting the balance on the bounce because there was no changing it after it had been done, the original tracks having long since been erased. But this way you bounce the way it feels and you'll probably be right. If you're not you can go back and re-do it because nothing has been erased to open up tracks. We're just beginning to get the system down. This is the first album we've done this way. But I think we'll find it's no more expensive than working on one machine.

Tom: Not having to use both machines during mixdown helps a lot.
AG: We've got to thank Phil Ramone for that.

KR: Yeah.
AG: Phil was next door doing Chicago.

KR: I knew he had been doing it and I was really curious if it would work. We tried it and have had no problems. It does take a while to sync up the two machines, but since the bounce mix is done with the computer, you only have to sync up the machines once.

Tom: You run at 30 ips?
KR: 30 ips Dolby.

AG: Something I've noticed is that most people are still hung up with the old idea of hot recording. They forget that when you use Dolbys the hiss, the reason you record hot, goes away. Most engineers, when they go to peak meters, say, "Jesus, these meters are all wrong". Earl took his tape of *The Children of the World*, which was done on VU, to Montreal, where they have peak meters. The needles on the peak meters just sat there on zero. He smiled very self-satisfied, as if to say to himself, "I know about saturation".
KR: You can hear it.

Tom: What type of tape do you use?
KR: Ampex 456. MCI did some tests two years ago on 250 and 456. I looked at the results. What more can I say?

Tom: Your records have a lot of low end. Most machines have a low frequency bump. Do you do any special set-up?
KR: It probably has a lot to do with the MCI machines.

Tom: What frequency do you use to check out low end?
KR: Depends. Multi-track I use 60 Hz,

...five years ago, I've done all of Shaun Cassidy and Leif Garrett on it, most of Donny and Marie, plus Al Martino, Sammy Davis, Debby Boone, the Supremes and others."

"After 20 singles and 12 albums on this console, 25 of them gold and platinum, I guess you could say my Auditronics 501 (serial number 0002) is a real money-maker. It does what I want as well as when it was new, and I'm still cutting on it today."

Independent producer Michael Lloyd is one of over 300 satisfied Auditronics console users. If you'd like to learn some of what they know about Auditronics console quality and reliability, circle reader service number or write to

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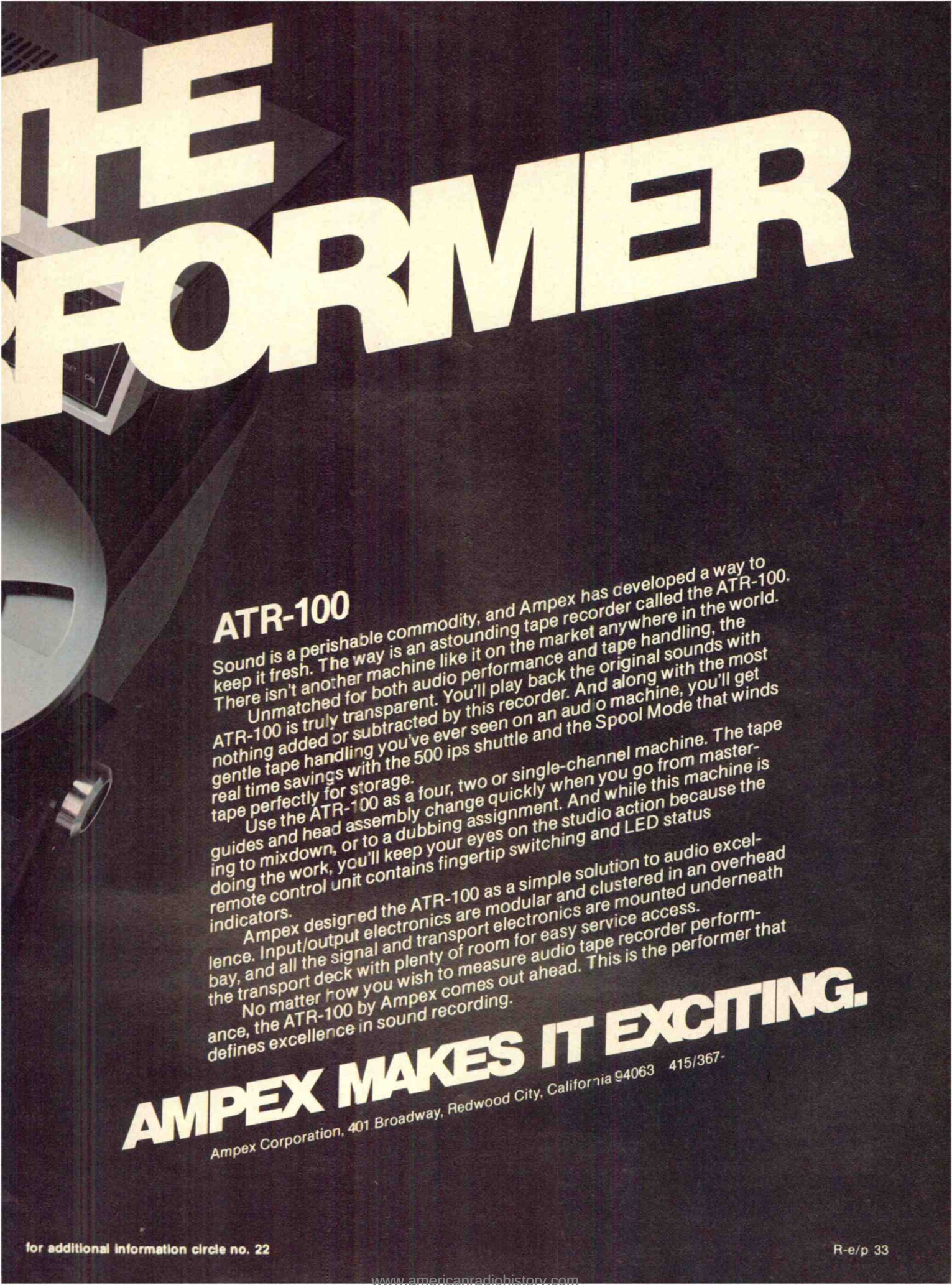
R-e/p 31



ATR-100

Sound is a perishable commodity, and Ampex has developed a way to keep it fresh. The way is an astounding tape recorder called the ATR-100. There isn't another machine like it on the market anywhere in the world.

Unmatched for both audio performance and tape handling, the ATR-100 is truly transparent. You'll play back the original sounds with nothing added or subtracted by this recorder. And along with the most gentle tape handling you've ever seen on an audio machine, you'll get real time savings with the 500 ips shuttle and the Spool Mode that winds tape perfectly for storage.

Use the ATR-100 as a four, two or single-channel machine. The tape guides and head assembly change quickly when you go from mastering to mixdown, or to a dubbing assignment. And while this machine is doing the work, you'll keep your eyes on the studio action because the remote control unit contains fingertip switching and LED status indicators.

Ampex designed the ATR-100 as a simple solution to audio excellence. Input/output electronics are modular and clustered in an overhead bay, and all the signal and transport electronics are mounted underneath the transport deck with plenty of room for easy service access.

No matter how you wish to measure audio tape recorder performance, the ATR-100 by Ampex comes out ahead. This is the performer that defines excellence in sound recording.

AMPEX MAKES IT EXCITING.

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for additional information circle no. 22

and on the 2 track we use 100 Hz. It's the difference in head stacks.

AG: One of the things I would like to see emphasized a little more is Karl's technical design ability. A number of things at the studio started out on Karl's drafting board. His position right now is one of interface between the actual function and the technical design of the equipment we use. He's one of the few engineers I've worked with who has both a feel for the music and a knowledge of which electrons go where. So if I say I want a *gloopdoi* to do a *flip flop*, he knows not only how to get the electrons to go there, but where to put a knob to control it so a human being can actually use it.

KR: A lot of engineering background I have is from Tom Dowd. I sort of went to school with Tom. I'd be doing mastering sessions and Tom would be working in the control room, The Young Rascals or something. I would quietly sneak in and watch. I learned an awful lot from Tom — things like dynamics and basically not using much EQ. I think we had one or two limiters in the whole studio. The philosophy was that the musicians work for you and so do the microphones — they just have to be put in the right place. That seems to be the philosophy that Atlantic still has. Tommy's still vice president of Atlantic Records, in charge of engineering.

Tom: How did you two meet anyway?
KR: I was working at Criteria, as a mastering man, when Albhy came to Miami. First time he came to the studio he was visiting some musician friends he had hung out with in Memphis. They had moved to Miami and were cutting records with Jerry Wexler. Well, my relationship with Albhy began 'cause he needed a place to stay, and I was sharing an apartment with another engineer, Chuck Kirkpatrick. We rented him our living room for $25.00.

AG: That was about seven years ago.
KR: Albhy and I have known one another a long time.

Tom: How did you get out of mastering?
KR: I was doing mastering and a lot of other things including some mixing. I rebuilt the mastering room because I knew electronics. I said to them, "If I do this maybe I can get to do more mixing." They said, "Sure," and I did. I worked with some good producers — Tom Dowd, Arif Mardin. I did some funky albums — "Dr. John". I was still learning. One of the projects I happened to do was *"Main Course"*, so that's how I started working with The Bee Gees.

Tom: At what point did you meet Andy Gibb?
AG: Andy was successful in Australia on his own. A couple of labels were interested in signing him, but he wanted to talk to his older brother Barry as well as to Robert Stigwood before he made a commitment. At that point Barry said, "I'll help produce it." And Robert Stigwood said, "I think I'll sign him."

KR: We met Andy after that happened.

Tom: How much do you guys go to discos?
AG: I've been to a few in Miami. I don't enjoy it that much. It's too loud.

Tom: Do either of you dance?
KR: Not very often.

AG: I go with my girl friend to see what the disco scene is doing.
KR: Man, most of the discos I've been in, down on the floor the level must be 120 dB, and they're out of A-7's.

Tom: Getting back to business, what's your favorite microphone, Karl?
KR: I have no one favorite microphone, although I suppose a Neumann U-87 gets more use. It seems to have been used so often in recording studios that we have become accustomed to the sound. I wouldn't doubt if speaker manufacturers have designed stuff around the sound of the 87 so many recordings have been made with them.

Let's say you've got 10,000 recordings; 8,000 of those probably had the vocals recorded with an 87. And why do they sound good on certain speakers, certain stereo systems? Trends become popular in the recording business; people grab on to them and use them. I think that sonically, people's ears go for the 87 again and again. I've tried different vocal mikes on all kinds of different singers. Sometimes I'll use a C-500, RE-15, or SM-58 — there's a million good vocal mikes. But time and time again I find I come back to the U-87.

Tom: The microphone used on the cello and viola on "Too Many Looks in Your Eyes"?
KR: AKG-414 on the cello. The violas are through a stereo Schoeps.

Tom: "Children of the World" solo vocals. Were they done against the track and the tracks keyed out?
KR: No. Albhy was out there conducting. He had on a set of earphones with a click track turned way down, a snare drum or something.

AG: Something interesting. A lot of people don't notice the modulation. The way we did it was we had a track with a piano chord in the new key. They couldn't hear the old key, they just heard this chord. And I also had the old track in my phones. So they just came in singing in the new key.

Tom: What about drum sounds?
KR: I usually go for something that fits with the song. I don't think there's any such thing as one great dum sound. Like on a snare. A fat R&B sound is necessary on a fat R&B record. But that sound is kind of useless on a jazz record. It doesn't make sense, because a jazz musician is popping. Something that's tight won't sound that way. So consequently no two records are ever going to sound that similar when you're using different musicians, different picks, different techniques, different drums or different microphones. If I'm at Wally Heider's and can't get an AKG-414EB or a 377, which happen to be my two favorite snare drum microphones, then I'll use an AKG-451. It's nice and bright.

Tom: What do you like on a kick drum?
KR: I like the Sony C-55. They only made it for a couple of years. Typically what I'll do with a drummer is when he first comes in he'll say, "Hey, man, I just bought a new 24-inch bass drum." I'll say, great. So I put 15 mikes right in front of him and put them right in the exact same place. I'll sit at the console and listen to the different mikes and invariably I'll go back to the Sony. God only knows what will happen if those microphones ever break.

On hi-hat I've been wandering around from mike-to-mike. It has so much to do with the drummer, where you put the mike; how loud it's going to be; how big his hi-hat is and how tightly he closes it. There's a lot of parameters to consider. You have to have a console that has enough head room to handle the transients of the percussion.

AG: I think some of this comes back to the level he puts on the tape. For years I've watched engineers look at Karl's snare drum level and go, "Man, there's no level on the tape." Because the meters just don't catch those transients. They're too fast for the ballistics of the meters. That's why there's no problem of tape hiss.
KR: Not at all.

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The Record Pressing Problem ?

Tom: Do you have any thoughts on pressings?
KR: That's a good question. On this next album I intend to follow it through to the extent that the Fleetwood Mac album reportedly was. *(R-e/p, April 1978.)* I was really impressed with those guys. They were pissed with the idea that you can't get a decent pressing anymore. You spend hundreds of thousands of dollars making an album and some guy goes out and buys it and can't play it.

Tom: In preparation for this interview I bought several albums and most of them were warped.
KR: And the situation isn't just with our records. It's a very common problem. What's happening today is a very simple thing. Look out this window at L. A. That's what's happening. When you're dealing with that much product your problems are compounded. Five years ago when an album sold a million units — my God! — that was incredible. Now everybody is selling five, six, even seven million. People ship a million units. *"Sergeant Pepper"* shipped 3½ million units as a double album. You're asking pressing plants to grind out this stuff like cheese.

AG: One of our heartbreaks recently was *"461 Ocean Boulevard"*. We both worked on it. In the studio it sounded great.
KR: A beautiful, natural sounding album.

AG: It was all played live. I bought the record two months ago and it sounds like dog meat, because it was re-mastered a few times after everybody lost control of it. The pressing quality is just awful.
KR: I have the intention on this new Bee Gees album of sincerely following it through to the degree that I want a test pressing from every stamper. I don't care if I have to pay four of my friends to sit up all night long and listen to them so that they can tell me if they hear anything — click, squeals . . . anything. I mean I'll sit up and listen to half of them. You just can't control that quality; I mean what are you going to do? You'll call the plant and they'll say they've already been shipped.

AG: The artist must demand in his contract that he be paid on returns resulting from defects in the pressing or shipping of records. Maybe it gets too hot in the truck and all the records are warped . . . but I don't understand what warps records.
KR: The first thing that warps records is that machine that goes boom. (Slapping hands together.) The factory is pumping petroleum into this machine and if they blow it they don't get the petroleum back. What they get back is used vinyl, and there isn't much of a market in used vinyl. The new vinyl market is new petroleum. It's the times. The 70's and 80's have seen the cost of petroleum really hit home. The economic reality is that the people running the pressing plants can't afford to have the same kind of quality control that people who sell 50K albums on Deutschgrammaphone can have.

AG: A lot of record companies just don't have good quality control. Maybe they play ten seconds of one cut and it sounds okay. Then they'll say, "Next!"
KR: We're selling a lot more albums than ever before with a lot less control.

Tom: Doesn't that volume give you more clout?
KR: Yes, but what are we supposed to do? It's hard to control.

AG: In other words, you tell them, hey, it's no good; do it again. And the guy says, "Wait a minute, we've got all this oil goin' in on one side and all the money comin' out the other." He doesn't want to know that what he thought was money is now used vinyl. It all comes down in dollars. They can't afford to have the sort of quality control that artistic and creative people demand.

Tom: But they're charging more for records.
AG: Sure, because of the price of vinyl and a number of other factors. The percentages have gone up. It used to be that producers got a point-and-a-half or two points. Today producers know what they are doing. They expect three or four points.

What I really wish is that the pressing plants could get it together so that they knew positively that a good record comes out of every machine; and that the record will be shipped and not show up warped. The people who plate stampers have to get it down to an exact science where there can be no foul-ups. That's really what the secret is. But I don't think they'll do that. Everybody out there is looking for the dollar sign. The people at the plants are dealing with laborers. It's such a super, mass-produced physical entity.

AG: Hot recording is from the old days when you'd get the snare to sound far out as a result of over-recording.
KR: Every once in awhile I'll sit in the studio and play the drums. I'm no drummer but anybody can stomp on a pedal. I'll just fool around. You have to know what the prospectives are. You have to know how it sounds in the studio.

There's a trick that Tom Dowd used to do always. He'd be in constant motion between the studio and the control room. He'd walk out there and listen to what those guys were doing every once in awhile, then compare it to what was in the control room. Don't confuse this with musicians who like the sound out there because it's loud. I mean you can crank it up in the control room to get it just as loud. But that's not what I'm talking about. When you get out there you understand a lot of the feeling that's on the floor, what's going on.

AG: For instance, you can take the best garbage can you can buy and then use the best, most expensive microphone to mike the garbage can. Play it back through expensive speakers. It's going to sound like a well-miked, good sounding garbage can . . . nothing more. It boils down to this: You've got to have something that is better than a garbage can to put in front of the microphone. That's my philosophy.
KC: If you don't do that and you lock yourself into the control room, you won't get that perspective. I've been guilty of it occasionally, when you do a lot of overdubs in the control room with just a few pieces of equipment. But generally it's very advisable to walk out there and see what the guy sounds like.

AG: Something else relative to this is phase consciousness. Not electrical phase, but acoustical phase problems because of multiple mike techniques. I think it comes from Karl's mastering background. We walked into a prominent studio that turns out major product. Karl listened to the monitors and said that they were out of phase. Do you know that they had been up there for six months? The components in the monitor were out of phase. On drums it's easy for acoustic phase cancellation to happen.
KR: Acoustic phasing can cause you all kinds of problems. Equalization in the monitors can cause phase problems as well. You see some studios that have 8 dB of EQ in one direction. Did you ever see what happens to the phase of a signal with that much EQ?

Tom: What do you think of Acoutavoicing?

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R-e-p 37

KR: We use it. Everybody uses it. The less you use the better off you are. The new studios at Criteria need very little EQ, maybe two knobs moved on the mid-range and a couple on the bass on each side.

Tom: What sort of speakers?
KR: Don Gehman is an engineer at Criteria. He used to be on the road with Clare Brothers, the sound reinforcement company; he's a speaker expert. Don and I designed the speakers. We went back to Harry Olson's books on cabinet shapes and such and compared the frequency response of various cabinets. We came up with a shape that we thought would work.

The bottoms are twin JBL-15's. The mid-range is a Gauss 2000 and the top end is a JBL. The driver is just through a hole. The mid-range goes through a lens for dispersion. Everything in the cabinet is asymetrical.

I found out that as soon as you place drivers symetrically within a cabinet, you're going to produce standing waves on the front of cabinet. For the edges of the cabinets we came up with a six-inch bevel. The back side of the box is done the same way. You see, what happens is that instead of creating standing waves in front of the monitors, they're being folded behind. We've created a monitoring system that I feel for all practical purposes is one of the nicest monitors I've ever heard.

AG: I traditionally don't sit in the middle. That's where Karl sits. Of the 30 or 40 professional studios I've worked in, that room [at Criteria] is far and away the best for walking around in and not having the sound change. In most studios when you sit on the couch behind the console, it sounds like someone rolled off the high end, all woof. Same thing in front of the console; it sounds like thump, thump, thump.
KR: Just doesn't do it in that room.

AG: Same thing is true on the left to right field — very even.
KR: A lot of the responsibility for the rooms belongs to a guy in New York named Bob Hansen. He's been an acoustical designer for about 40 years. The man is a genious. So the concept of the studio goes to Bob as well as to Mac [Emerman], the owner of Criteria. Mac picked the surface treatment of the walls.

Tom: You work mostly at Criteria. They must have fairly quiet air conditioning.
KR: Studio B, the original studio, gets a little nasty depending on what you're trying to accomplish. But we get around it. Because it's a local phenomena.

AG: The rest of the studios are independent and very controlled. B's the only one that if you're doing a flute solo, you might hear it.

Tom: Do you turn it off or just roll it off.
KR: Just roll it off.

AG: It never really gets in the way, since B is set up for doing rock and roll.
KR: The Steve Stills stuff is done in there and it's really loud, so you just don't hear it. It's so far down that it doesn't really matter.

AG: I keep waiting for someone to ask us about the Network record.
KR: I don't think anyone heard it.

AG: It's the one record that sounds different. It was Tony Matola's group. They started off as an R&B group. After they were through rehearsing and ready to start recording, Tony decided it should be heavy metal. The direction is a bit unusual — heavy metal, R&B.
KR: It's allright.

AG: I thought it was a great record. Cal Rudman has an end-of-the-year report. He said he'd made a mistake on that album and realized that it was the most underrated album of the year. He thought it was probably one of the best new albums and he's sorry he panned it. The record was a flop, but it was a lovely record. I really like it. It was nice to do something that wasn't so distinctly Top 40. I wish it had been at least Bottom 40.
KR: Instead of None 40.

AG: We've since stolen the keyboard player; we've used him a lot. He's on the Terri de Sario, Andy Gibb and Samantha Sang records.
KR: We used every trick I could find on the Network record.

Tom: Tell us about The Bee Gees' live album.
KR: The Bee Gees' live album? Well, first of all, the recording was done at the Forum in L. A. with the Wally Heider truck. We were doing it for the King Biscuit Hour. That was the original reason we did the recording. I kind of supervised the recording. I talked with Ray Thompson, the engineer, for awhile: we got along very well, so everything was cool. I gave him the cues in the truck.

We only recorded one show out of that whole tour and we used every song from one night's performance. It was a last night's performance, as well, and they're usually a bit "zooey". There wasn't much to fix, either. We mixed the album in France at the Chateau, the same place we recorded "Stayin' Alive" and "Night Fever".

Tom: How did you like working at the Chateau?
AG: There's nothing like a boring place to stimulate you.

Tom: You didn't like it there?
AG: It was cold; it was drafty. The showers didn't work. The monitors sounded like a Hidley demo system that had fallen onto hard times. A funky API board; ah, God knows.

KR: The only thing that worked really well in France was the echo chambers. They really enhanced the sound of that live album. That plus a little EQ and that was it.

Tom: The Forum is gigantic. How did you approach recording there?
KR: It is. First, we suspended the crowd mikes. Ray had done quite a few shows at the Forum so I asked him where he was going to put them. He said, "I've got a place." It seems he knows the guy that works inside the pendant that hangs down in the center of the Forum. So we hung two U-87's in omni straight down from each side of the pendant at about 40 or 50 feet above the crowd. Some of that was mixed in. And it really helped in the balances. The hi-hat was pretty loud out there and it made it sound real.

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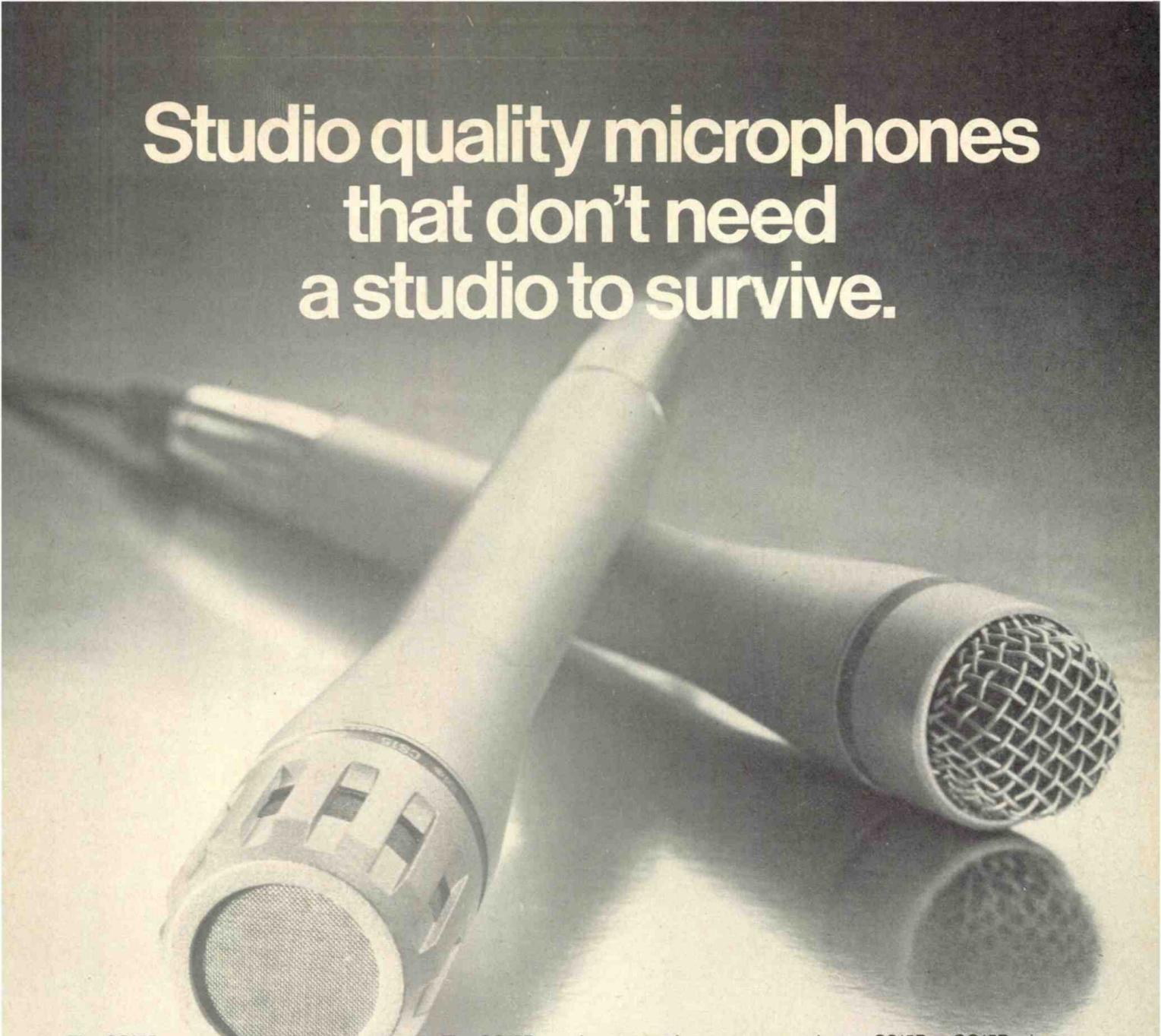

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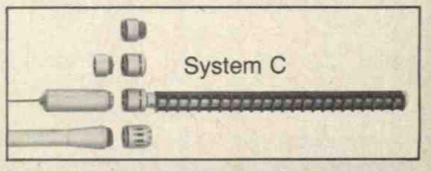

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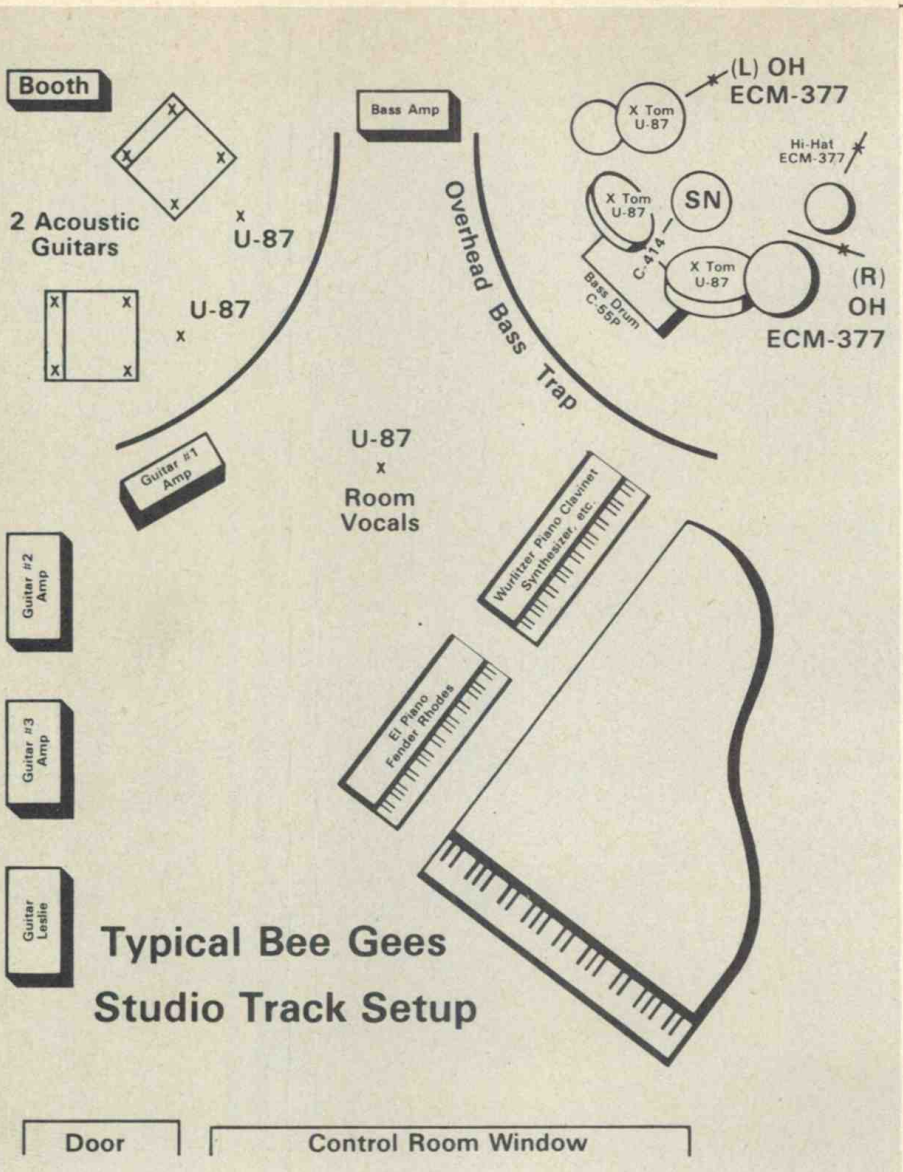

AG: For me the amazing thing was that everything came from one show. Some of the key people played without flaw. There were no repairs in the drums or horns.

KR: Most of the repairs were on the falsetto vocals and doubling the string lines.

AG: The ARP string ensemble sounds good in a big hall, but on records, it doesn't sound impressive. So we just took another string ensemble and doubled the passages and then ran it through an echo chamber. Some of the bass lines were re-done for sonic reasons.
KR: The EQ in mastering was a little strange because I mixed the whole album on Auratones. We added some overall EQ on the whole album and that's where we left it.

Tom: Tell me about the Terri de Sario record.
AG: That was a two-day record, as was the Frankie Valli "Grease" record.

KR: An L. A. experience. We came out here to Wally Heider's to do those.
AG: On the Frankie Valli "Grease" record we did something a little different with the horns. After we'd recorded and doubled them, we recorded one more track at half-speed. When it was all played back, the last track went up an octave.

KR: We mixed in just enough of that track to get an edge.
AG: We've done a couple things with strings that way.

Tom: Terri de Sario's record had a pretty unusual piano sound.
AG: I think a lot of the sound comes from the fact that the piano is a very old Steinway — a baby grand with big, fat legs.

KR: It was a rock and roll date and an interesting thing happened to one of the piano strings. The "E" had a ring. It's a low "E". The song is in the key of E flat, and when it reaches the fade the song goes to the key of "E", so every time he hits the "E" it sounds like a bell.
AG: One string in the whole piano. The hammer just hit it somehow. Everytime he hit that low note this bell sound would happen, too.

Tom: I assume you guys are going to do an album with Terri.
KR: No. Actually the album is being done by someone else.

AG: We just don't have time right now.

Tom: Was that the situation with Samantha Sang? You guys produced two of the tunes on her album, but the rest of the album was done by Nick deCaro and Gary Klein.
KR: Just no time.

AG: How those four sides came about is interesting. We had just finished the "Saturday Night Fever" stuff in Miami. Now Barry Gibb has the desire to produce other people besides Andy, his brother, and The Bee Gees. Well, we knew Terri since she lives in Miami.
KR: So Albhy went to a club to listen to her. Then Barry heard her and liked her. So we spent a week and made a couple of records.

Samantha had toured with The Bee Gees years ago in Australia. They were kids together. At some point Barry had promised to write her a song, so while we were in France doing "Saturday Night Fever", she decided to collect on the promise and showed up there. Barry did write her a song, "(Our Love) Don't Throw It All Away", which went on Andy's album. But the guy who played it just couldn't cop our groove.

AG: She didn't like it that much.
KR: So Barry said, "Okay, I've a couple of other songs." One of them was "Emotion".

AG: And "Here For A Little While".
KR: She said, "Okay, I can sing that, but you've got to produce it." And we did. Both Samantha's and Terri's records were done the same day.

AG: The next day we had a string date and they sang.

— continued on page 134

George Martin's choice...

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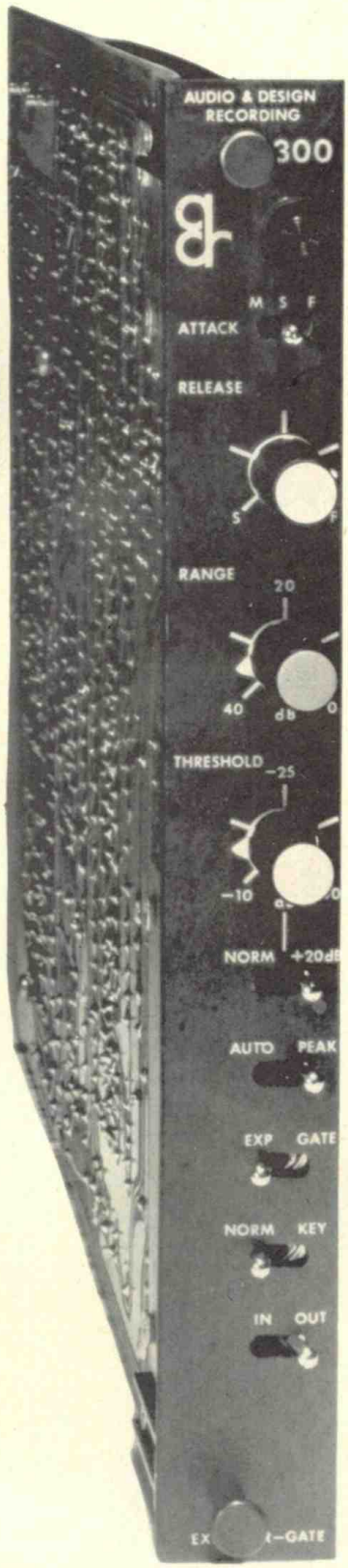

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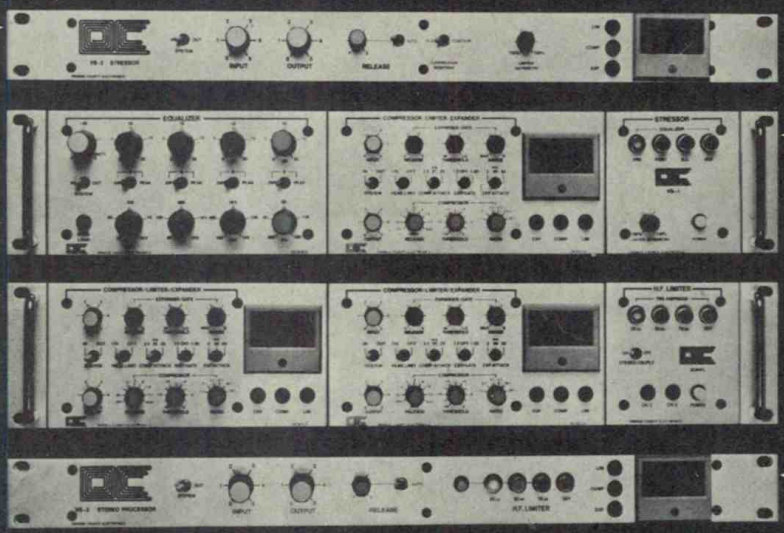

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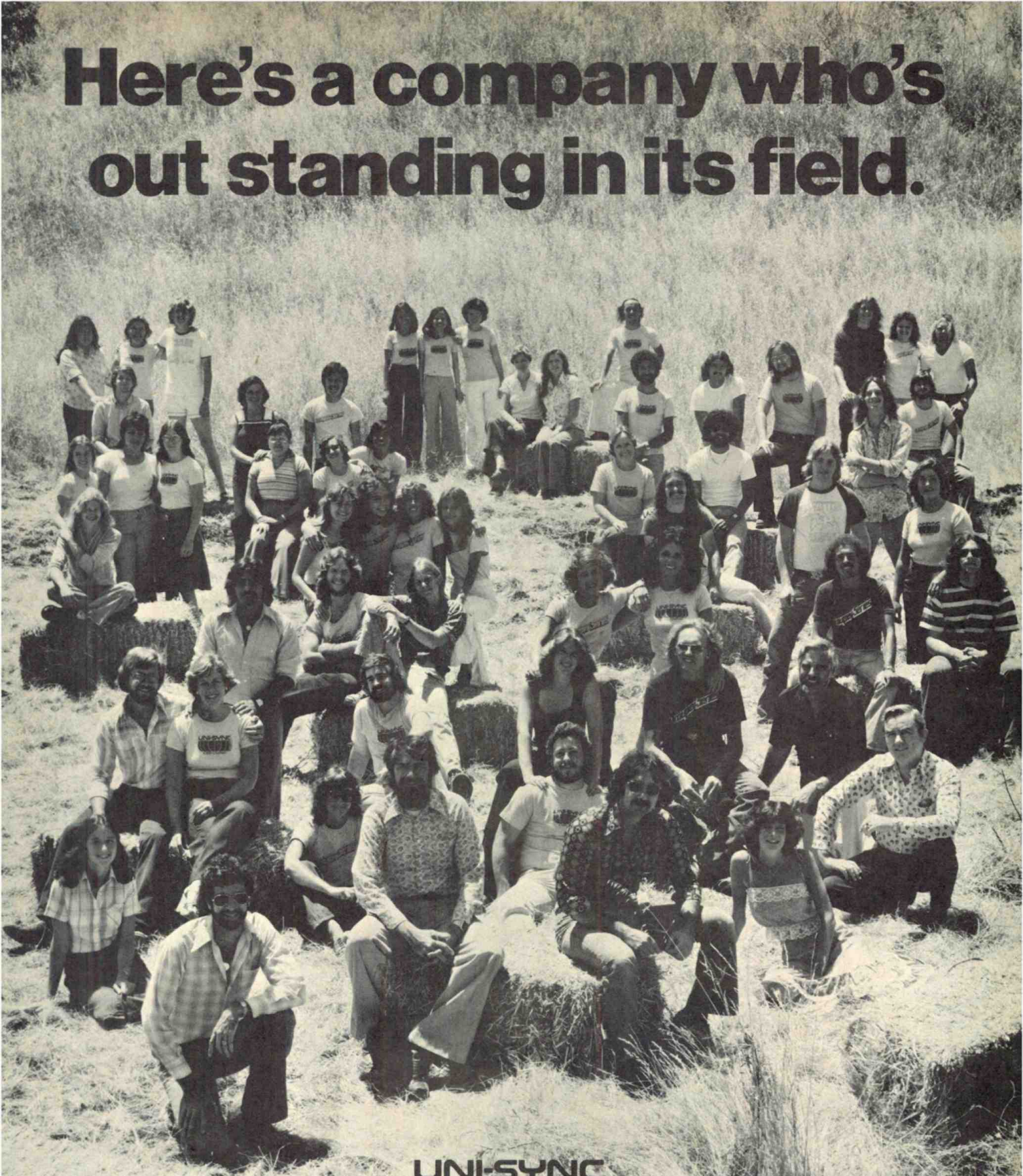

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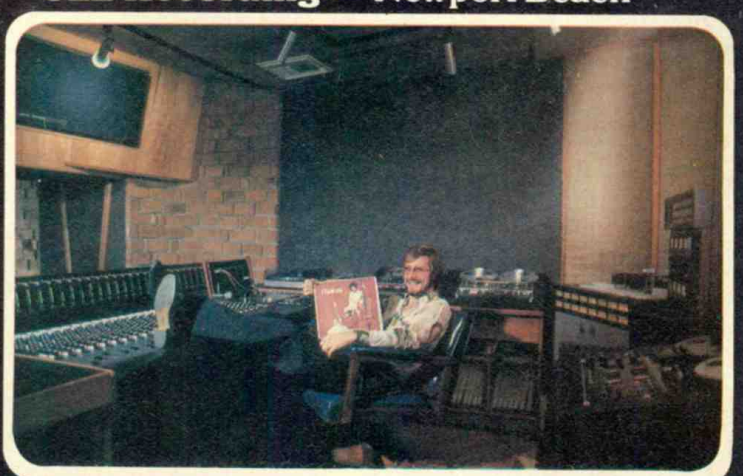

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for additional information circle no. 29

SPEAKER WIRE

by

Ray Kimber

State-of-the-art amplifiers are literally wire with gain. But all the gains of having near "perfect" amps can be lost if the speaker cables do not transfer the information to the speakers. This, of course, brings one to search for cable that optimizes delivery of signal. Investigation reveals that "perfect" speaker cable should have the following characteristics:

1 - Zero DC resistance.
2 - Zero electromagnetic and/or electrostatic pick-up.
3 - Zero electromagnetic and/or electrostatic radiation.
4 - Pulls itself through conduit.
5 - Possesses no faults which would alter the complex musical signal.
6 - Zero cost.

Examination of the above list reveals some obvious impossibilities (at least until I find my magic wand). But how close are we and how much closer can we get to "perfect" right now? Let's look at the list one item at a time.

Cable Resistance

Resistance is easier to lower if information is available on how much exists in cable currently used. Here are some charts that I'll bet not many audio engineers have ever seen. The author realizes that all the combinations and variations are not shown, but then I'm writing an article — not a book. All resistance is shown in 100-foot round-trip (200 feet) format.

Bare Solid Copper Conductor

Gauge	68°F	75°F	85°F
22	3.240	3.290	3.363
20	2.040	2.071	2.117
18	1.278	1.298	1.326
16	.804	.816	.834
14	.504	.512	.523
12	.318	.323	.330
10	.199	.202	.206

Now no one I know uses solid wire for speaker cable, but this is the chart most widely used. I have added the approximate resistance values for 75°F and 85°F since most environments that speaker wire lives in is hotter than 68°F. The heat resistance relationship is linear from -50°F to 500°F and changes approximately .22% per degree Fahrenheit.

This next chart shows bare copper stranded conductors.

Gauge	Stranding Makeup	68°F	75°F	85°F
22	(19 x 34)	2.880	2.924	2.989
22	(7 x 30)	3.040	3.087	3.155
20	(19 x 32)	1.770	1.797	1.837
20	(7 x 28)	1.912	1.941	1.984
18	(19 x 30)	1.130	1.147	1.173
18	(7 x 26)	1.202	1.221	1.247
16	(19 x 29)	.886	.889	.919
14	(19 x 27)	.560	.568	.581
12	(19 x 25)	.352	.357	.365
10	(27 x 26)	.238	.241	.247

Notice that values between solid and stranded vary both higher and lower, and with different percentages of change.

This next chart shows tinned copper stranded conductors (which, unless I miss my guess, most of you use for speaker wire).

Gauge	Stranding Makeup	68°F	75°F	85°F
22	(19 x 34)	3.080	3.128	3.197
22	(7 x 30)	3.260	3.310	3.384
20	(19 x 32)	1.904	1.933	1.976
20	(7 x 28)	2.030	2.061	2.107
18	(19 x 30)	1.212	1.231	1.258
18	(7 x 26)	1.276	1.296	1.324
16	(19 x 29)	.940	.954	.976
16	(7 x 24)	.896	.910	.930
14	(19 x 27)	.594	.603	.616
14	(7 x 23)	.542	.550	.562
12	(19 x 25)	.374	.380	.388
12	(7 x 22)	.338	.343	.351
10	(19 x 23)	.212	.215	.220
10	(7 x 20)	.210	.213	.218

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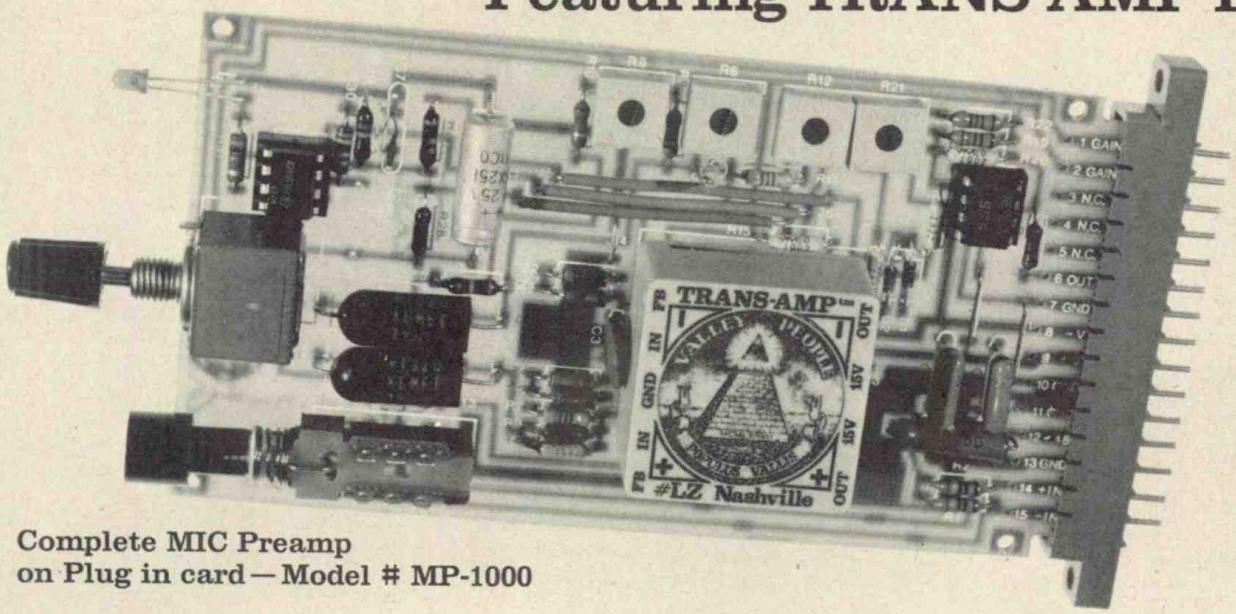

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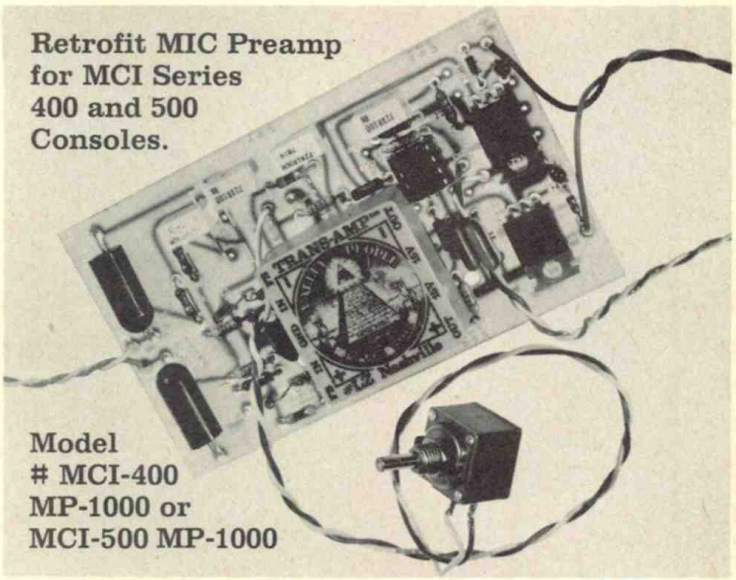

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SPEAKER WIRE

Okay, now we have all this information, how can we use it? Low resistance is important for good power transfer between the amplifier and the speaker, and a round-trip resistance of one ohm or less is sufficient to accomplish this. But all the power in the world will not sound good unless the speaker is properly damped by the amplifier. Amplifiers all by themselves do not really have a "damping factor", because damping factor is reached by adding the output impedance of the amplifier to the resistance of the round-trip speaker cable and dividing this into the impedance of the speaker.

Speaker Impedance/Amplifier Output Impedance + Speaker Resistance = Damping Factor

The damping factor of the system should be 40 or greater. Damping factors less than 40 do not present enough braking/damping to the woofer for clean sound. Damping factors greater than 40 are nice, but the returns rapidly diminish (diminishing returns).

Let's look at some examples. Take an 8 ohm speaker, with an amplifier output impedance of .05 ohms with 100 feet of tinned conductor cable that runs in a ceiling space (85°F). What size do we need to reach our damping factor of 40?

$$8 / .05 + X = 40 \text{ (or greater)}$$

Let's try #10 (7 x 20) tinned stranded:

$$8 / .05 + .218 = 29.85$$

Oh, no! We can't reach it with that. Let's try it again but with the amplifier with the lowest output impedance that I know of, which is as follows:

$$8 / .008 + .218 = 35.4$$

We're getting closer. Of course, we could move the amplifier closer to the speaker. Let's try 50 feet.

$$8 / .008 + .109 = 68.38$$

That's good. In fact, we can drop to a #12 (19 x 25) tinned stranded and still make it very close.

$$8 / .008 + .188 = 39.6$$

We made it! By using the best amplifier with the best speaker cable, distances of 100 feet are usable while still maintaining the same perceived audible quality.

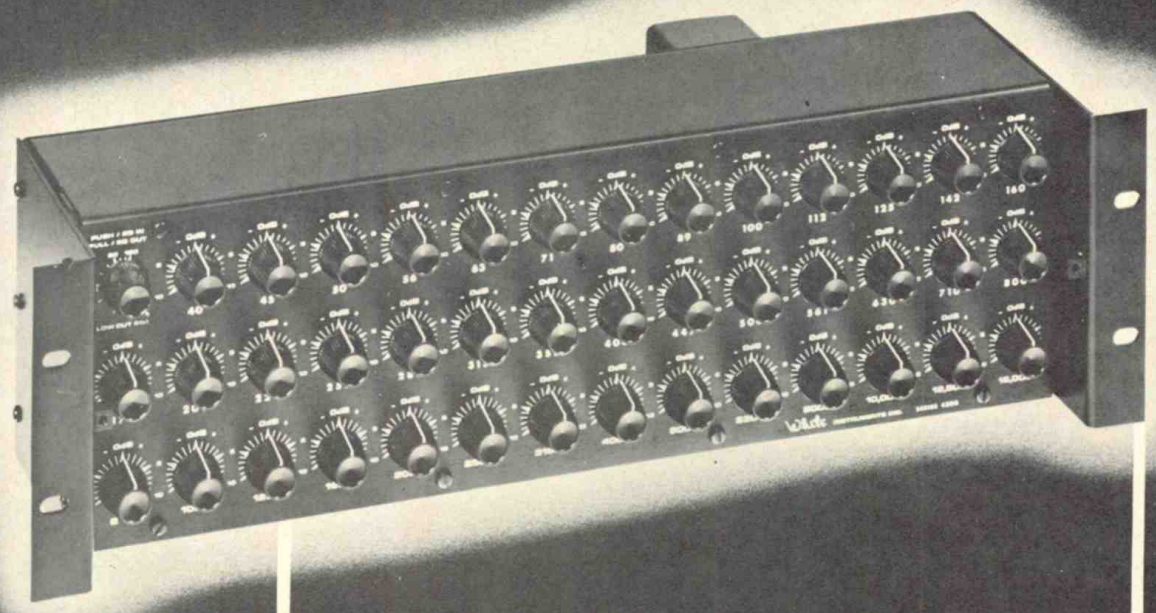
Electromagnetic and electrostatic characteristics of speaker cables are difficult because of the dynamic range of music. And also, speaker lines carry **power**, not just voltage, making normal shielding procedures such as shielded cable not very practical or available (where did I put my roll of 10-2 with shield?). The next best thing is to make the cable so the conductors are so random that there can exist no coherent pattern to act as a transmitting or receiving antenna.

There is such a cable and it looks something like your Grandmother's pigtails in that it is a braided cable made up of several red conductors and several black conductors.

Wire Picks Up Noise

Now, everyone knows that if you modulate the ground plane of an amplifier, it's, in effect, the same as modulating the hot or signal side. That is to say if you move the ground plane up and down in reference to the hot, it acts as though

1/6 OCTAVE: A NEW STANDARD IN MONITOR EQUALIZERS



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you put signal in on the hot and held the ground constant.

Speaker wire, unfortunately, acts as a huge antenna gathering all the electromagnetic and electrostatic garbage in the near vicinity, and injects it onto the ground plane of an audio system. Since the ground plane typically runs clear through into very high sensitivity stages, you can see why it's very easy to end up listening to a local radio station, lighting dimmer, transformer, motor, or power cable.

Client: "Why are the speakers humming?"

Sound Technician: "They must have forgotten the words."

I promise I'll work on a self-pulling speaker cable; the plan calls for it to snake through the conduit as if by magic. And speaking of pulling, check your leg (disregard last paragraph).

'Skinning Effect'

Everyone who's familiar with any radio frequency theory and operation knows that there is a phenomena known as "skinning effect". What this means simply is that at DC levels, current flows evenly through the entire cross section of a conductor. This means that in each one of the conductors that make up a stranded cable, every strand is considered a conductor. So that within a stranded cable, in each one of the little strands, DC flows evenly through the entire cross section. On a solid wire it flows evenly through the entire cross section. As frequency increases, the current flows more-and-more only on the outside of the conductor, or only on the skin.

In the case of tinned conductor, the tin has more than five times the resistance of copper (the exact ratio is .159:1). Therefore, as frequency increases the signal will encounter more-and-more resistance.

This does not affect sine wave response very much up through the normal audible frequencies, say 20,000 cycles. But as anyone knows, music has rise times that correspond to higher frequencies than audible sine waves and definitely correspond to frequencies in the RF region. Therefore, time rises affect the tiny intricacies and subtlety of coloration that are exhibited when we change the current capability of the frequency response of the cable.

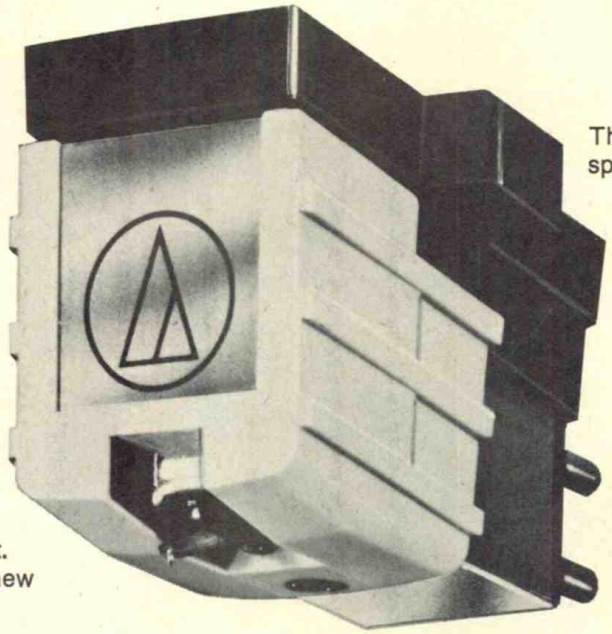
So the ideal speaker wire should be very fine strands of copper and a lot of them. This is so that we have as much surface area as possible in relationship to the actual cross section core of the conductor. It should be solid copper, not tinned.

New Interest In Speaker Cable

Speaker cable in an audio system has typically taken a last-Indian-on-the-totem-pole position. This is all being changed, however, when we find that speaker cable characteristics offer not only an important audible contribution to the sound, but may offer other benefits as well. Unless you have had your head in the sand and/or don't read audiophile magazines, you will have noticed a revolution going on in home speaker wire for the audiophile.

Advertisements for these new cables typify the cable as having gain — that is to say less loss, less coloration; they say it lifts a veil from the music and makes it more sharply defined and clear, along with other marvelous and sundry claims that sound almost like patent medicine. However,

Audio-Technica rewrites the book on professional phono cartridges.



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Don't confuse the ATP Series with other "professional" cartridges that are merely modified home units. ATP units don't have to be treated with kid gloves. And yet we haven't sacrificed tracking ability to make them rugged.

The all-new ATP cartridges were specially developed for the working environment. Three models provide a choice of either spherical or elliptical styli. Each cartridge is hand-tuned for optimum performance, with stereo channels matched within 1.5 dB to eliminate balance problems.

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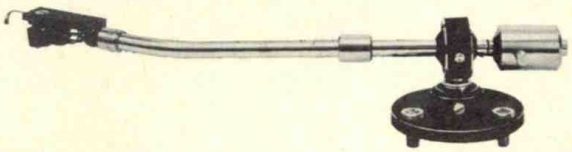

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SPEAKER WIRE

some, if not all, of these claims are true to some extent.

I don't intend to re-document all the various claims, but just say that it does sound better. All the people I know who have heard a high-performance speaker cable have all said they could hear an improvement in the sound. And, after all, that is what we professionals should be putting forward is quality of sound. Certainly something as easy as changing the speaker cable we use to give us an audible improvement in sound should be worthy of interest to us.

After more than a year of working, measuring, listening and, of course, making it economical to manufacture — there is finally a high-performance speaker cable for the professional. It's a braided cable with fine pure copper conductors. The resistance per 100 feet round-trip (200 feet total) is as follows for the two sizes:

	68°F	75°F	85°F
ACI 8PR 20V	.181	.183	.188
ACI 4PR 20V	.362	.368	.376

It does have low DC resistance and the use of pure fine copper stranding minimizes coloration of the sound. As for interference pick-up; the following test was conducted using 30-foot lengths of zip cord, twisted pair, and ACI braided cable.

All the cables were bundled together along with an AC cord with a 10 ampere current flowing through it. One end of all the cables were terminated with an eight ohm resistor.

The other end was connected to a scope with the following amounts of interference measured:

	Impulse Noise	Random Noise
Zip Cord #12	500 mv	20 mv
Twisted Pair #12	500 mv	15 mv
ACI Braided Cable	55 mv	7 mv

The author has recently used over 6,000 feet of this high-performance cable in a large four-channel, 28-driver system in a roller skating rink for high-powered disco music. The system was a quad-amped situation with woofers operating from 20 to 250 cycles, upper bass cabinets operating from 250 to 800 cycles, mid-range operating from 800 to 5,000 cycles, and tweeters operating from 5,000 cycles and up. Woofers and upper bass drivers used the heavy cable, while mid-range and tweeters used the lighter cable.

Even with a massive disco lighting system and many long cable runs, there was no audible noise in the sound system. As for the sound itself; it is glorious. And that is what really counts.

My Rule #1:

If two items have identical specifications but sound different, the wrong things were measured.

My Rule #2:

If two items sound the same but have different specifications . . . well? We all need to remember that the fancy numbers are meaningless if the ultimate test device (the ear) isn't happy. □ □ □

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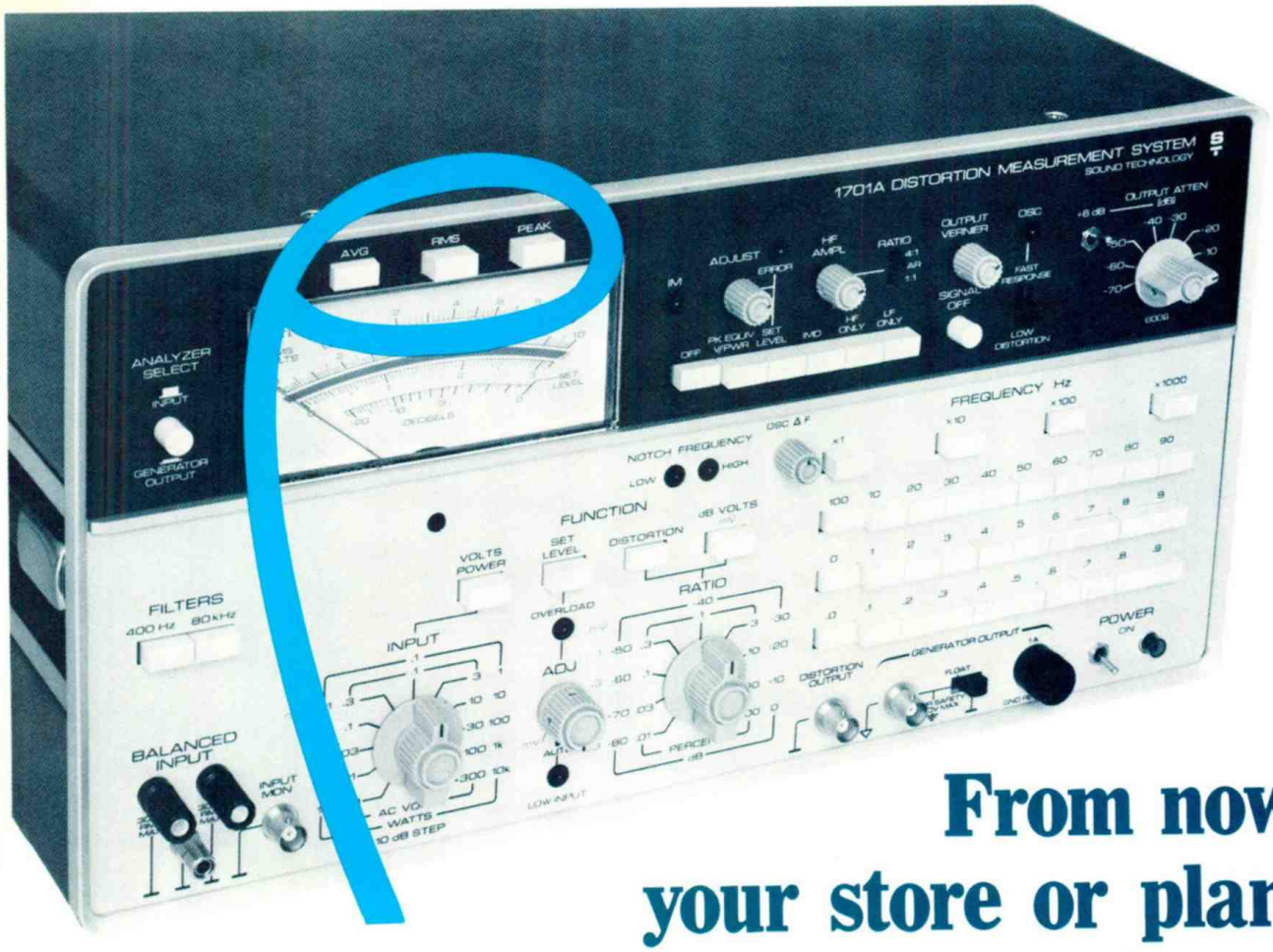

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Changes in distortion standards

Expect some new types of questions from your customers soon about distortion measurements.

Because you will find that the Institute of High Fidelity recently introduced a change in the type of measuring circuit to be used in distortion measurements on amplifiers.

For example, current IHF standards require an **rms-responding** meter circuit for measuring amplifier distortion, but an **average responding** meter for measuring receiver distortion.

What's more, when making total harmonic distortion measurements with either type of circuit, it can be important to know what the distortion **peaks** measure. Because peaks can be large even though rms or average values are small.

Your choice of three responses

So in the new Sound Tech 1701A Distortion Measurement System, we now give you **three metering circuit responses.**

You can measure with an **average, rms** or **peak** circuit. Just push the desired button.

Measure lower distortion, too

Sound Tech distortion analyzers have become the industry standards. When they were introduced four years ago, they gave nearly a 10-times improvement in distortion range and a 100-times increase in ease of use.

Now our new 1701A improves the distortion range even more — to .001% from 10 Hz to 10 kHz. Overall distortion measuring capability continues superior over the full 10 Hz to 110 kHz range.

There's lots more features, too, including our automatic set level and intermodulation distortion options, balanced input circuit for measuring bridged amplifiers, and lower distortion tracked signal source.

Demos and clinics

The 1701A is just what's needed to demo receivers, amplifiers, and other audio equipment to your customers.

For clinics, too.

It will give your store the prestige of technical leadership in your area.

And in receiver/tuner production, it's the only such instrument that will give the various types of distortion information you need.

Call for data

Be prepared for customer questions. Get the details now on the 1701A by calling Mike Hogue or Larry Maguire. Or send in the coupon. Now.

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R-e/p 55

for additional information circle no. 37

THE Doobie Brothers CONCERT SOUND

—AN IN-DEPTH LOOK AT THEIR TOURING SYSTEM

by Stan King and
P. Robert Marich

The frequent set up and tear down of touring sound reinforcement systems is recognized as a major constraint on equipment design. Providing mobility to accommodate frequent movement presents many problems. In addition, the demands concert halls put on such equipment are substantial. Since concert halls are constructed for any number of purposes, vary greatly in size and were often built decades apart, the acoustic characteristics of each is unique and so sound reinforcement must be able to meet a variety of requirements. Furthermore, concerts may be staged outdoors as well as indoors.

To provide mobility and flexibility in sound reinforcement, The Doobie Brothers have put together a system that meets the demands of touring and offers recording studio quality in many aspects.

Two API mixing consoles were custom built for the band with a 700-point patch bay that permits interface with a variety of audio processing devices. Among those are an AKG-BX-20 reverb, Orban/Parasound spring reverb, MXR digital delay, Eventide Phasor, Eventide Harmonizer and Eventide Digital Delay which are patched into the bay to achieve studio-type effects in the concert hall environ-

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Ingenuity is truly rare. Repeated ingenuity is true genius. Like the Technics 4-track RS-1506. It offers twice the program time of our 2-track RS-1500.

It also offers the award-winning RS-1500's "Isolated Loop" tape transport with a quartz-locked, phase-controlled, direct-drive capstan.

By isolating the tape from external influences we minimized tape tension to a constant 80 mgs. Providing extremely stable tape transport and low head wear. While reducing modulation noise and wow and flutter to a point where they are barely measurable on conventional laboratory equipment.

Electronically, too, Technics RS-1506 provides the same level of professional control as its predecessor. A separate microphone amplifier. Mixing amplifier. And separate three-position bias/equalization switches. While IC full-logic function permits absolute freedom in switching modes. Also available is an optional full-feature infrared wireless remote control (RP-070). It lets you operate all transport functions and record from up to 20 feet.

For the same performance as the RS-1506 with the convenience of auto reverse, there's the RS-1700.

Compare specifications. Even with the best 2-track decks. TRACK SYSTEM: 4-track, 2-channel recording, playback and erase. 2-track, 2-channel playback 4-head system. FREQ. RESP.: 30-30,000Hz, ±3dB (—10dB rec. level) at 15ips. WOW & FLUTTER: 0.018% WRMS at 15ips. S/N RATIO: 57dB (NAB weighted) at 15ips. SEPARATION: Greater than 50dB. RISE TIME: 0.7 secs. SPEED DEVIATION: ± 0.1% with 1.0 or 1.5mil tape at 15ips. SPEED FLUCT.: 0.05% with 1.0 or 1.5mil tape at 15ips. PITCH CONTROL: ±6%.

Technics 4-track RS-1506 and auto-reverse RS-1700. A rare combination of audio technology. A new standard of audio excellence.

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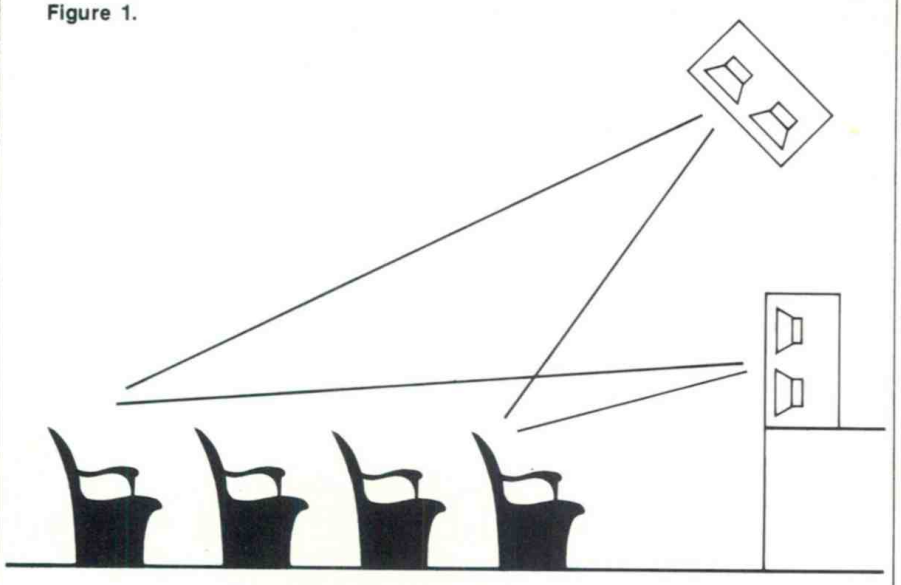
R-e p 57

Figure 1.



Stage Mounted Speakers vs. Flying Systems
Produce more equal path lengths and SPL to listeners.

ment.

The component of each sound reinforcement system that most obviously sets it apart from others is the loudspeaker system. The Doobie Brothers use loudspeakers that, like the consoles, have been custom built for touring. Al Siniscal, of A-1 Audio in Hollywood, California, developed the design which combines high, mid and low range speakers along with two power amps into a single two-part integrated enclosure.

"You can imagine the efficiency of an integrated design," explained Siniscal. "With a typical system, the speaker cabinets are a bunch of odd shapes. There's a woofer here, a tweeter there and a mid-range over here. To top it off, they are patched together by 10 different types of connectors."

Speakers Designed For 'Flying' Applications

The Doobie Brothers' speaker system, in addition to having been designed for extreme portability performance site to performance site, were also specifically designed to 'fly' (be suspended) within the acoustic environment. Rather than use the more simple stage-mounted system of speaker stacks where sound *throws* to various parts of the listening area are at great variance, the objective of the Doobie Brothers' system is to raise the speaker clusters as high as possible. This will equalize the distance the sound must travel to the various parts of the listening environment. (Figure 1)

The loudspeakers are actually based on a design developed by RCA engineers beginning in the late 1940's. At that time, technology had evolved to the point where a single power amp channel and a single loudspeaker combination operated at only 30 watts as compared today to about 250 watts RMS per channel into eight ohms. The RCA engineers, then, had to stress efficiency in their cabinets to achieve maximum sound reinforcement potential. "They took the design so far and we took it the rest of the way," said Siniscal.

A-1 Audio modified the internal phasing, internal damping, internal bracing and external construction of the RCA design. A HP-3580-A spectrum analyzer, White 140 real time analyzer, and Amber 4400-A multi-purpose test set and spectrum analyzer with four memories were utilized to test the design and aid in making refinements. The result is what Siniscal calls the "Vertically Integrated Power"™ (VIP) speaker that measures 10 by 4 by 3 feet and costs $12,000 per unit to construct, including components. The Doobie Brothers road system uses 16 VIP units at a cost of about $200,000. Though the detailed blueprint specifications are proprietory, the basic electronic, acoustic, and physical design features are not.

Each VIP unit in the system is tri-amplified, utilizing BGW 750B power amps for the bass end, with each channel of the power amp connected to only one of the bass speakers. (Figure 2) This provides for a reservoir of power plus much cooler operation. The bass speakers are currently Gauss 5831's, with the extra long voice coil and special gluing by A-1 Audio. A-1 Audio tested more than 10 different bass loudspeakers before selecting the Gauss components that, measurements indicated, offer maximum output and minimum distortion in the enclosure.

The mid-range is powered by a second BGW 750B power amp, with one side powering two JBL 2482 compression drivers on two matched JBL 2350 90-degree radial horns. The other side of the BGW 750B power amp powers the eight tweeters. The sheer number of high-frequency transducers on a 90-degree convex curvature that matches mid-range coverage tends to

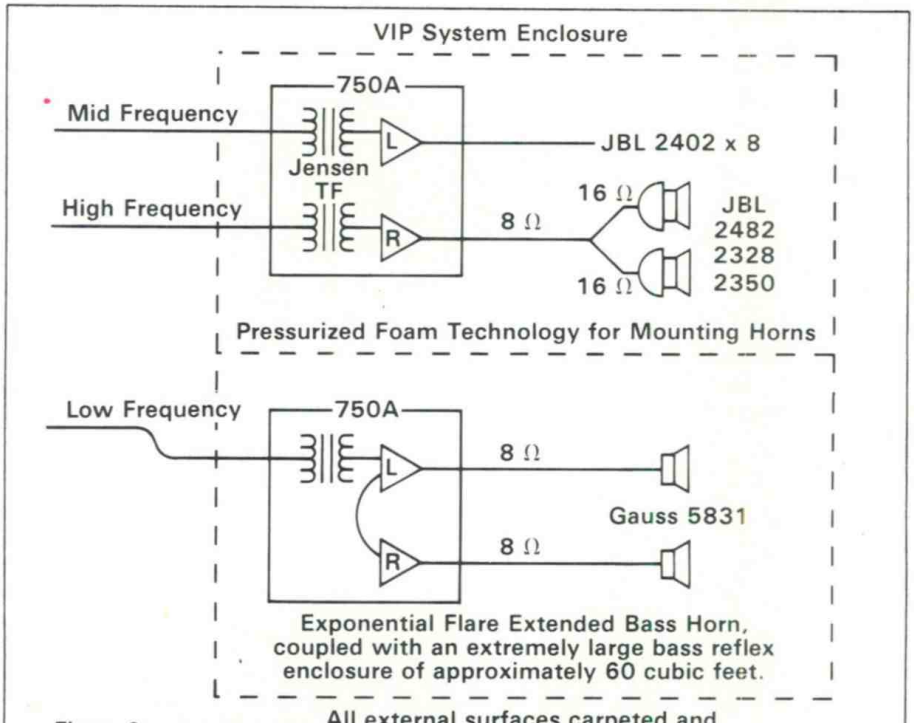


Figure 2.

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Spectra Sound Products Inc.

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for additional information circle no. 39

reduce unwanted interaction.

"We don't even address the problem of clipping," said Siniscal. "Sure, you can blow out a few tweeters and we do that occasionally. But you get a beautiful, clear, loud high-frequency sound."

Throughout the system, there are fuse/lamp/test circuits which continuously monitor and report on status during the actual performance. In addition, each power amplifier channel has an LED meter readout which indicates the power delivered to each loudspeaker and compression driver.

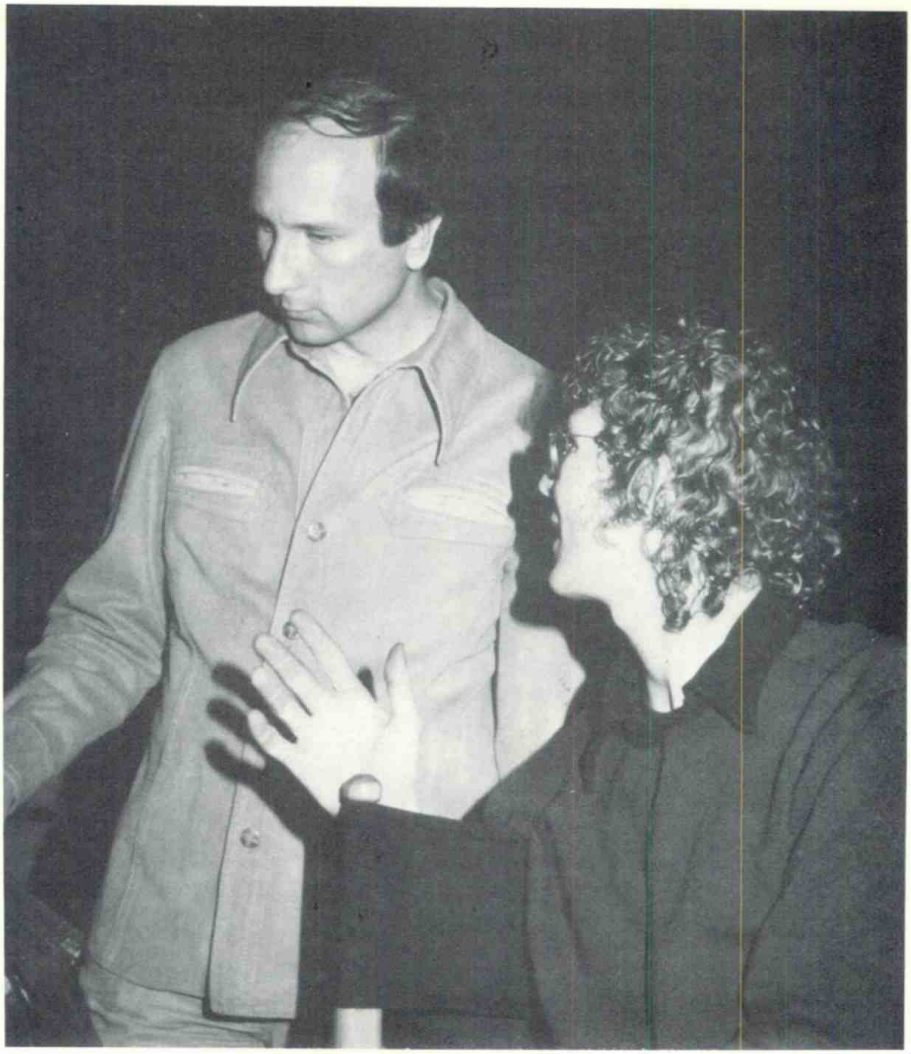
The power amplifiers are isolated by the newest Jensen plug-in transformers and are separately shielded and external to each power amplifier. "When the system is fully assembled, there are no hums, buzzes, oscillations and group loops to limit the dynamic range, overheat the equipment or distract the audience," said Siniscal.

Integral Format Offering Benefits

The advantages of integrating speakers, drivers, and power amps in one unit are many, according to Siniscal. The wire lead from the amp to speaker is 10 gauge and measures no more than four feet in the VIP unit. This results in a system damping factor in excess of 200. The length of wire leads between speakers and amps of other non-integrated units is usually 16 gauge or more and often measures more than 50 feet. The resistance of such longer cable typically results in a much lower damping factor of only about five or ten. The higher damping factor means close to full potential of power amp current is delivered to speakers and not lost to resistance.

Also, the wiring clutter typical of road sound reinforcement systems is eliminated by the VIP units. One connector is all that is needed for each speaker cabinet. The connector is a military type with jam-nut clasp and gold flash pins. Other leads between amps and speakers are integral. The signal lead to VIP units is an 11 pair snake type that contains inputs for low, mid and high range speakers plus the following: left, center, and right signals. In addition, there are two mono channel inputs.

Some of the acoustic features of the integrated design are noteworthy. The bass speakers are mounted in a wood housing with no metal or resonate plastic parts, and there are bass reflex ports on the top and bottom. Siniscal explained that the system is "acoustically optimized by integrating the undisputed efficiency qualities of exponential-flare extended bass, damped, wooden horns with the recording studio qualities of an extremely large bass reflex enclosure."



Al Siniscal (left), Grey Ingram (right). Photo by Stan King.

Other bass loudspeakers are available in smaller sizes often with fewer or no reflex ports. Both size and reflex ports are crucial to getting a rich sound "because you're dealing with physical realities," Siniscal said, and smaller units are not acoustically suitable.

The VIP mid-range delivers two times the SPL power/punch/quality of identical components in comparable units, Siniscal said, because the mid-range speakers and drivers are rigidly mounted using pressurized foam technology and are set in exact parallel alignment. Improved low cut off, fewer unwanted resonances and longer throw result, partially due to damping and alignment.

Cabinets Suited For Handling

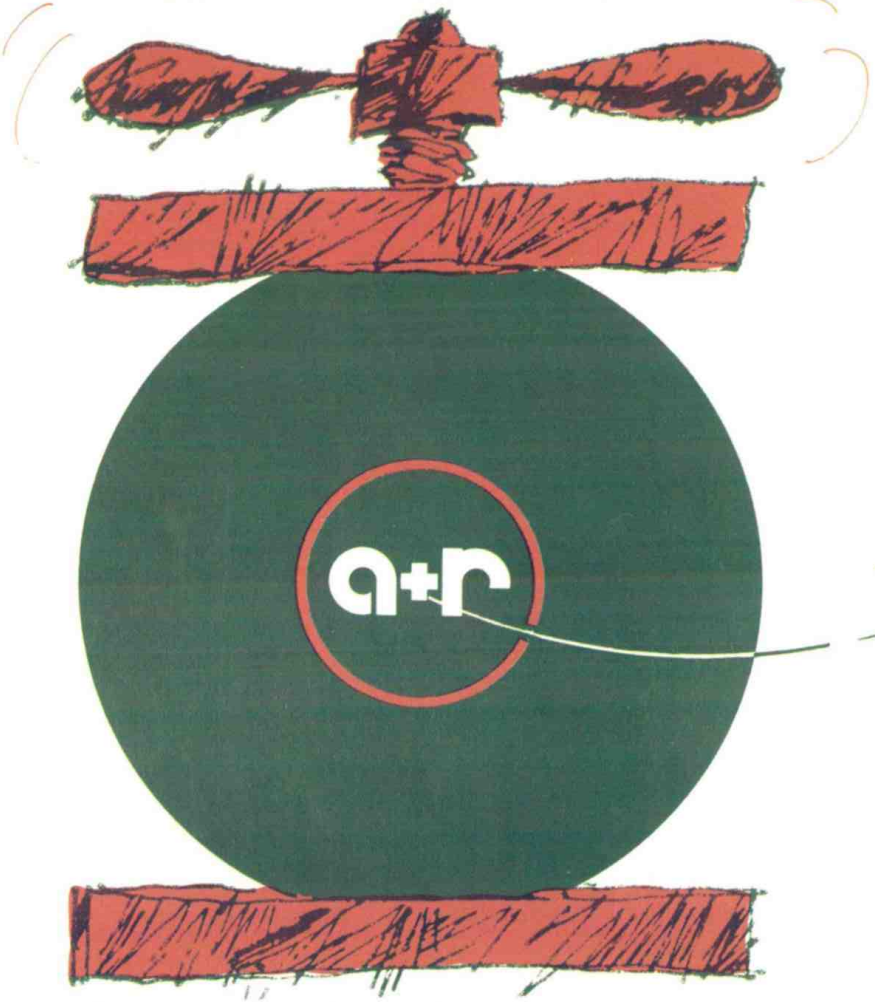
The dimensions of the VIP cabinets allow them to be efficiently fitted in a standard truck trailer, which means maximum cargo utilization is achieved. A fork lift travels with the Doobie Brothers tour for quick loading and unloading. No manual lifting of loudspeakers is necessary because of the fork lift.

"It turns out that you can get this system out of the truck, on stage, up into the air and checked out in less than four hours," said Siniscal.

VIP speakers are flown in six clusters. A group of three speakers secured by a truss forms a cluster. Half-inch cable is used as rigging to support each group, not three-eighths as is typically used, according to Siniscal. Only a total of six hanging points are necessary, and Loadstar CM chain climbing hoists are used. The trusses are made of an alloy steel and their design was stress tested. Each individual truss was proof tested after welding.

"There are people out there going to muffler shops to make trusses," said Siniscal. A registered professional mechanical engineer specializing in structural designs and certified by the State of California approved the truss design, which meets OSHA and ASTM

continued on page 65



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safety standards. Siniscal has state certification as a registered professional electrical engineer.

Special nylon straps attaching the speakers to the truss are rated at 10,000 pounds each (a two-part VIP speaker unit weighs 800 pounds). One nylon strap is needed to secure a speaker to the truss and another strap is attached to act as a safety.

Three carpenters assisted A-1 Audio in constructing the speakers. Thirty-two VIP speakers have been manufactured to date.

Impressive Visual Appearance

The VIP system has what Siniscal found to be an unexpected dividend. The Doobie Brothers feel the uniform appearance of the large speakers is imposing and provides a strong visual charisma. Visual appearance and fidelity of sound reinforcement have also received notice in concert reviews. Visual appearance "was one of the last things I had in mind when I designed them," said Siniscal. "This is just a case of form following function."

The signal the VIP speaker system receives is not limited at the console outputs. This prevents all the program material of a channel from being affected when a single source suddenly gets too loud. Instead, overload protection is achieved by limiting individual channels between the mike and preamp or preamp and equalizer. Each of the API consoles' 48 inputs have a +28 dBm clipping point. Besides API limiters, other types of limiters and compressors are used. They include UREI 1176's, LA-3's, dbx 160's, and **dbx** 162's. Each vocal track has its own compressor set for a slow attack and slow release.

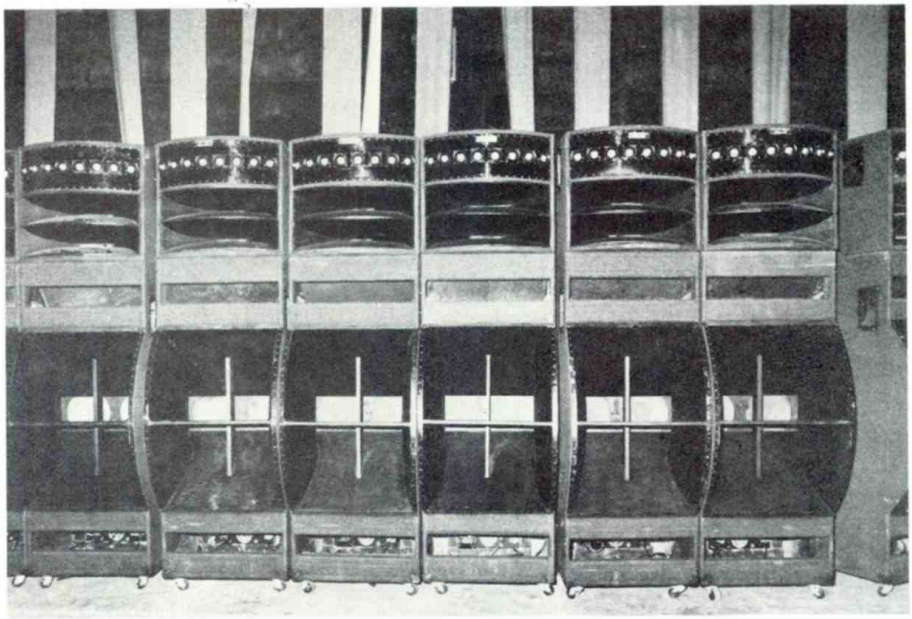
"It tends to level out the bounces when the artist looks away from the microphone and it helps to prevent overloading when someone decides to yell into a microphone," said Grey Ingram, chief engineer/mixer for the Doobie Brothers. "That channel will come down, but won't affect anything else. It takes a lot of practice to get the limiters set just right, but all the effort is really worth it."

The Doobie Brothers hired its own road sound staff, which is headed by Ingram, to handle the band-owned consoles, monitor system, microphones, and AC power system. Then the left, center, and right audio feeds are given to A-1 Audio, which is responsible for the final stages of sound reinforcement.

"We have expensive equipment but the maintenance is so low it's paid for itself," said Ingram. "When we got into it three years ago, no other bands owned their own equipment, except for Pink Floyd. Since then, several other bands have bought their own equipment. It makes a difference and people notice it — especially at festivals when I give the festival sound man the feeds. It's not that other sound engineers are not as good; it's just that they're fighting the equipment. It can take a whole concert for someone to figure out a strange console."

Consoles Operational While In Case

Measuring 36 by 28 by 19, the API mixing boards were designed as portable, durable units with a variety of features. Its sides fold down and the console slides up on roller-type bearings. The console locks into place and is ready to use while still attached to the case. This integral design insures "no one has to pick up the console and put it out on the table," said Ingram. "That's when they usually get broken, because somebody drops them."



Channels are plugged into mother boards that are four modules wide. Wires link each mother board. The modular construction permits the mother board to flex if the console is twisted during handling.

Another design feature is transformer isolating the sends that go back to the stage. Ingram said that this is valuable when the Doobie Brothers' mixing boards are used for mixing other acts that have 220 or 440 volt equipment of European manufacture. Headphone jacks have a pre-fade listen button and deliver 10 watts per channel. The level is often necessary to make program material audible over ambient noise generated by crowds. Each channel or sub-master and each stereo buss also have a headphone jack.

Probably the most unique feature of the mixing boards is the 'centering' button located below each pan pot. Pressing the button will boost a track's level on both stereo outputs, highlighting that track and placing it out in front. The feature is a bypass of the pan pot that pads level slightly when actuated.

The consoles were designed as identical "mirror" images of each other. Hence, sub-master modules are arranged in reverse order when the consoles are put side-by-side. The "mirror" identical design permits substitution of modules and comparison testing to isolate problems. For additional protection, LED overload indicators were used extensively.

"When we built them three years ago, there were not as many high quality portable consoles available as there are today," said Ingram. "Also, we were very concerned with reliability and, even today, many of the 'portable' consoles for sale seem too 'lightweight' to me. After all, you simply cannot tell 20,000 people at a sold-out concert that the show is cancelled because the console died."

He added, "Our units also have full studio-type tip, ring, sleeve patch bay systems, which helps in routing around a faulty component or in setting up a special patch for unusual circumstances such as live recording or combining several different sound systems for large outdoor events."

Top Hat Mikes Point Up

Ingram will mix vocal and instrumental tracks from one console while Bob Hodas, who recently replaced Shep Lonsdale, handles the percussion mix. The Doobie Brothers use two full drum sets and a set of congas at concerts.

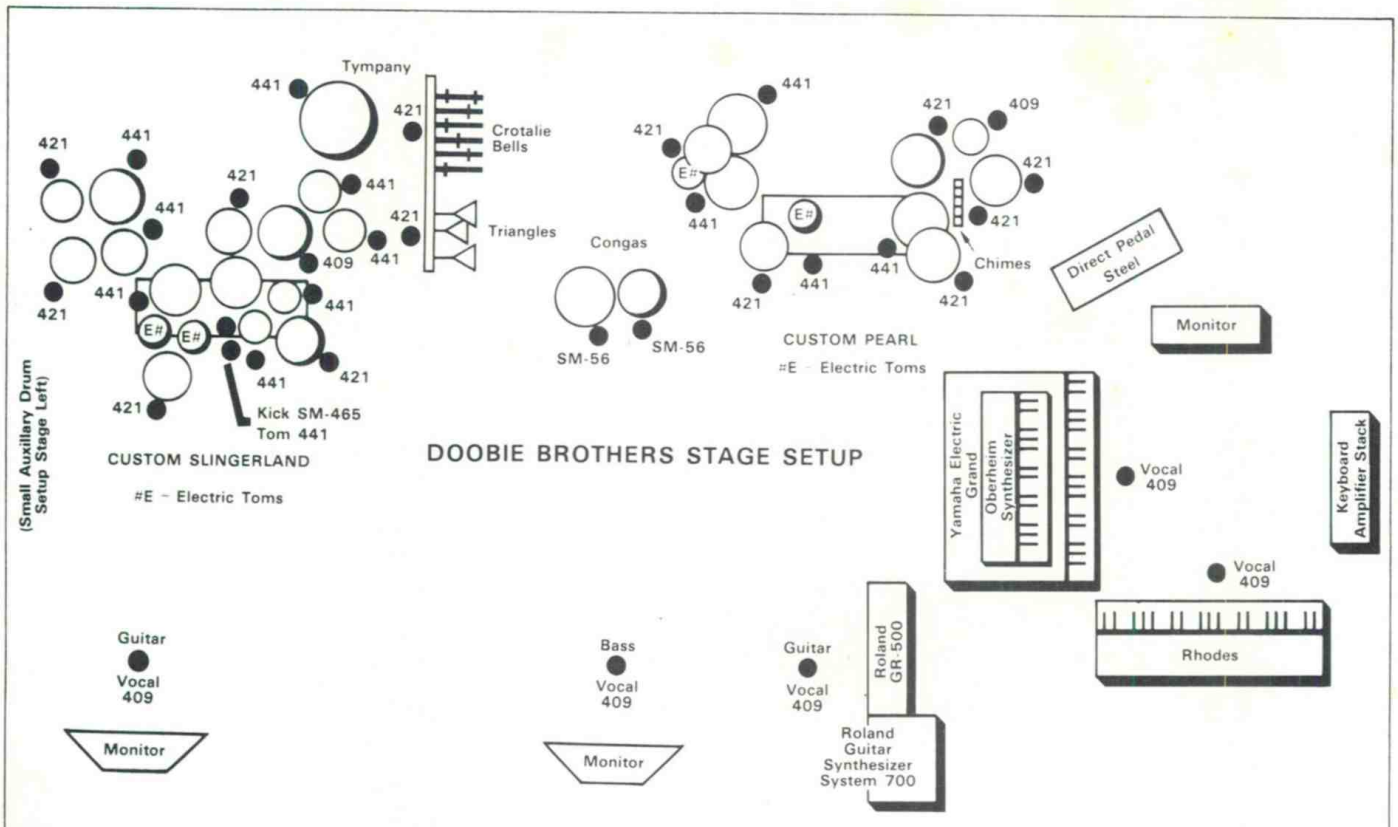


Figure 3.

(Figure 3) Cymbal and drum stands have mounts for microphones, which are isolated from vibration. The integral mike mounts reduce clutter that is created by microphone stands, improving visual appearance of the band. Sennheiser 441's attached to the cymbal stands point upward to cover high hats.

"The sound is a little strange," noted Ingram. "As the cymbal reverberates up and down there's an unusual phasing effect, probably some kind of Doppler effect. But the isolation is incredible."

Drums are damped because the PA excites the head creating sympathetic vibration. On the inside, drums are lined with foam rubber for additional damping. Wads of three-quarter-inch masking tape are usually used to tune the drums flat. If a ball of masking tape proves unsuitable, something like a Kotex may be substituted. More recently, an old wallet was taped to a drum head.

"A drum that sounds good in a room without a PA goes crazy when the PA is going full volume," said Ingram. "The Doobies are helpful in this respect in that they work closely with us on tuning and damping the drums."

Delay Used For Stereo Effect

During concerts, the drum kits can be spread with stereo mixing to achieve a full sound. In most cases, this means Ingram will put equal level into both channels but delay one channel seven to ten milliseconds to get the stereo effect.

"Seven to ten milliseconds seems to be about right," he noted. "You have to be careful about comb filter effects on some instruments and with much more delay than this, you get a double attack on percussive instruments."

The stereo effect is most pronounced in the middle of a hall. For the audience toward the delay side, the left and right signals will tend to cancel so it will hear a mono mix.

Flying the VIP speakers in vee formations of left, center, and right stacks (the center is a combined left and right) is the ideal arrangement for stereo. The flying system aims the sound to the center of the audience and, as already mentioned, distributes the signal more uniformly. When at stage level, sound from speakers tends to overwhelm the audience in the front. Also, the audience nearest speakers at stage level will tend to absorb high frequency waves distorting the radiating signal as it travels to listeners at the rear of the hall.

"First, we always try to fly the system as this produces the best sounding results," said Ingram. "However, sometimes because of structural restrictions in the hall and/or economic reasons, we are not able to fly the system. When the system is at stage level, the main VIP speakers are located on either side of the stage. The stage itself is 48 feet wide with two additional 24-foot sound wings. The total width is about 100 feet."

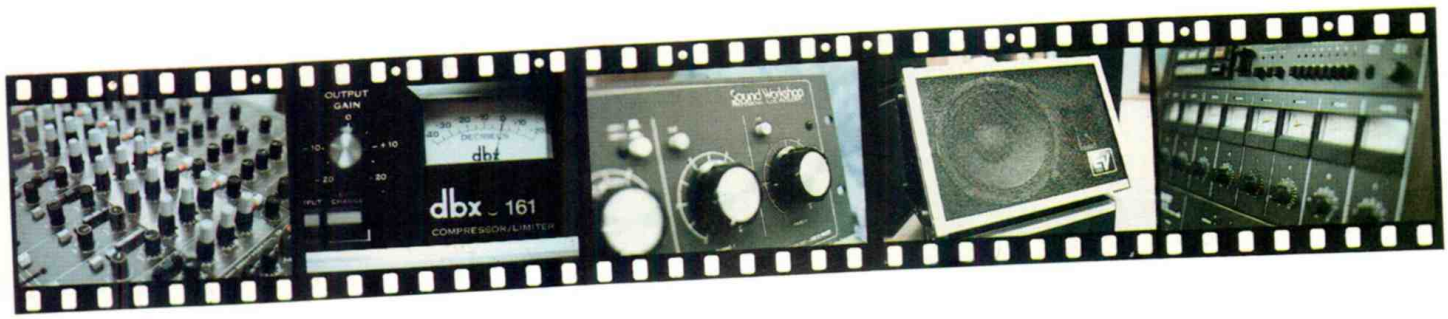
He continued, "The loudspeakers on the sound wings are placed to provide coverage primarily in a forward thrust with additional coverage for the sides. These consist of custom-designed, low-silhouette enclosures with Gauss 2841/JBL 2470 combinations. We have also been using the new, self-powered Yamaha A4115H speaker systems, which we place in the rear light truss. This makes for a very convenient rear fill system."

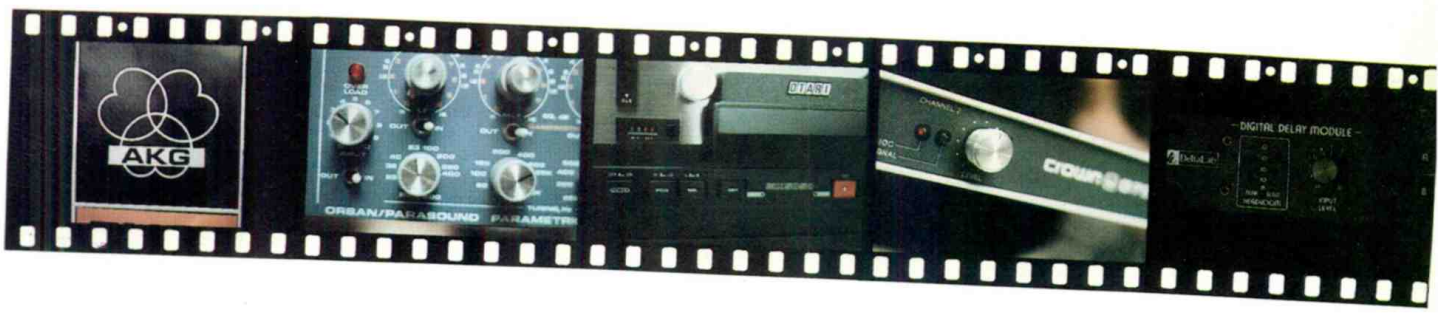
Effects used at concerts are not limited to stereo mixing. Ingram said automatic double tracking of background vocals is frequently employed. Also, a delay is used on the send of a reverb to achieve a unique sound. "It's kind of neat in that it's a real inexpensive unit," explained Ingram. "At the moment, I'm using a Music Man reverb that was built for a guitar."

Harmonizer 'Fattens' Rhodes Sound

Another audio processing device used is an Eventide Harmonizer which is teamed with a Rhodes piano that is tuned flat. Ingram takes a direct signal from the piano and mixes it with a signal

Let us demonstrate:





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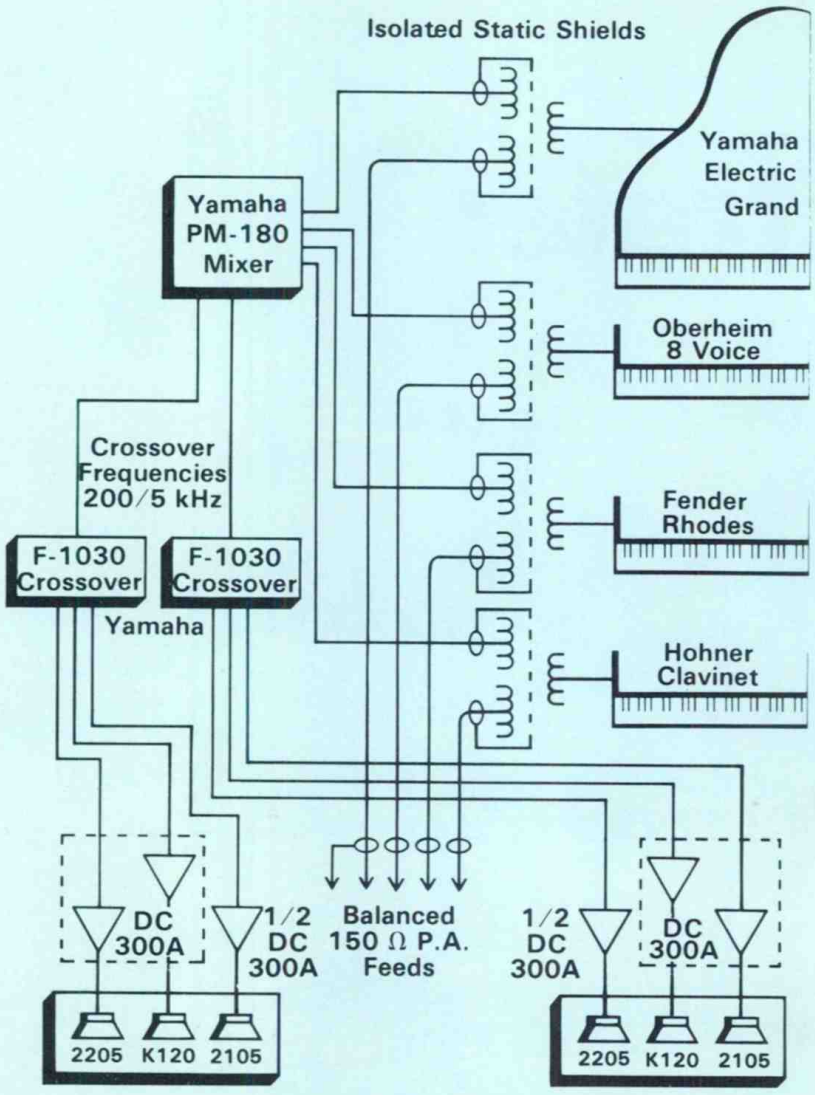

Figure 4. **Keyboard Monitor System**

from the Harmonizer. "It really fattens up the Rhodes sound," he noted. Besides the Rhodes, the Doobie Brothers have a Yamaha electric grand piano.

"Thanks to it being electric, everyone on the crew doesn't have to stop work while the piano tuner works in absolute silence," said Ingram. "It doesn't sound exactly like a grand piano but it sounds a lot better than most attempts to put a pickup on a standard piano, which is what we used to do."

He continued, "Each electric keyboard feeds a special custom Sescom transformer that has a single input winding and dual output windings. One of the outputs from each transformer feeds a channel on a Yamaha PM-180 mixer that is on the keyboardists' amp rack so that he can control his own monitor mix. The second winding from each transformer is sent directly to one of the balanced inputs at the main console." (Figure 4)

All electronic keyboards, bass guitar, guitar, guitar synthesizer and electric drums are taken direct. The bass guitar has 8 dB of limiting which Ingram said makes it sustain better. Acoustic guitars have built-in pickups. "I limit them," said Ingram of the acoustic guitars. "It's not necessary, but it makes the guitar sound more realistic, less tinny."

Microphones of Sennheiser manufacture are widely used. Vocals are picked up by 409's while 441's and 421's are used for drums. "I'm very happy with the Sennheiser microphone," said Ingram. "They are very rugged and just plain sound good. There are also a few Shures and one or two Sony electret condensers."

A 12 buss, 30 input custom console is used for monitor mixing. "It allows us to give each musician exactly what he wants to hear in his monitor," said Ingram. Instead of monitor speakers, guitarist Jeff Baxter wears a Pioneer HP10 headset that gives him a left plus right house mix in one ear.

In preparation for each concert, Ingram said he begins evaluating acoustic characteristics the moment he enters a hall. He listens to the resonance patterns of noise created by workers setting up equipment. Once the loudspeakers are in place, a White Instruments Real Time Analyzer Model 140 reads tones from a pink noise generator to analyze acoustic patterns.

"You don't really have time to use multiple microphones all over the room, which is the way you really should do it," said Ingram. "So we look around the place and figure out several locations where it looks like it will be allright and sample it there. And then we apply an 'experience' factor to tweak it in. Also, after the audience comes in, the room response changes a bit, so we might end up adjusting it a bit during a concert."

Audience's Clothing Affects Absorption

Besides absorbing high frequency signals, audiences tend to break up low frequency standing waves. The type of clothing persons wear can influence this phenomenon. For instance, an audience wearing jackets or other heavy clothes is less absorbent than the same group would be in lighter summer clothing. Temperature and humidity are other factors that affect signal propagation.

Most halls, because of their size, have outstanding resonance between 60 and 125 Hz, Ingram said. There can be numerous resonance points in this range, which complicates sound reinforcement. A graphic equalizer or notch filters are used to overcome resonance problems and smooth out frequency response. When working in circular arenas, Ingram avoids putting consoles at the focus point of the parabola. The sound at the focus point can be confusing to console operators listening to the house mix.

Audio processors that are frequency dependent have to be used with discretion, Ingram added. Devices that fall into this category are phasers or flangers, which react similarly to narrow band filters. "If you use one loud and it sweeps through one of the room's resonance modes, it will cause squeaks," Ingram explained.

Sound checks just prior to the concert aid in analyzing acoustics. The Doobie Brothers will make a few sound checks at concerts early in a tour but once a routine for equipment settings is established, this practice stops. If different supporting acts are used on a tour, sound checks will be made before each performance to enable the sound crew to become familiar with such a band's equipment.

continued on page 133

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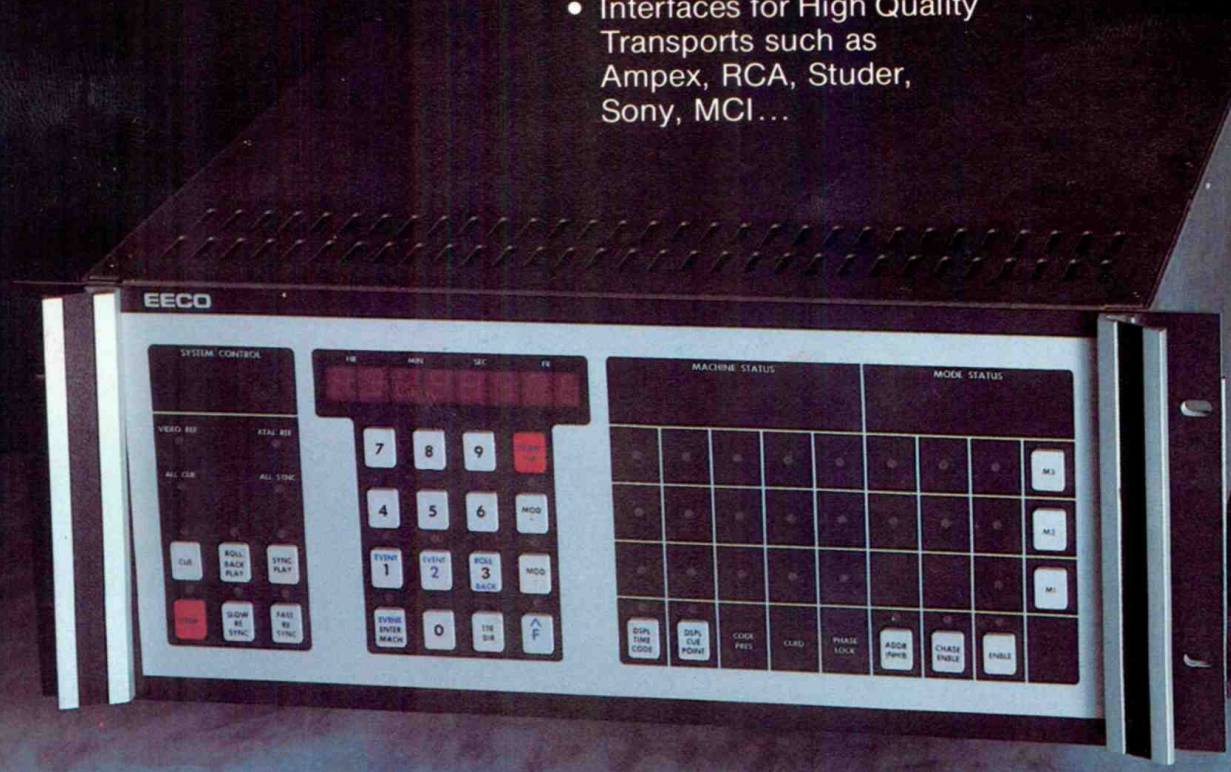

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How To Select and Treat a Mate — YOUR STUDIO MASTERING TAPE

by J. Talmage Ball and W. Jeffry Dahl

"What's that noise?!!! Run it back and let's listen to it again . . . hear it?" With the plaintive cry of the recording engineer fresh on his mind the studio manager renews his search for the "ultimate" mastering tape and the technical engineering crew is checking the bias on the 24 track.

Shortly thereafter the studio manager and chief engineer are in a huddle to optimize the tape, the machine, and the tape/machine interface. They read the trades, listen to the trade show demos, and do a lot of asking around. By the time they realize the answers don't all lie in the same direction, it becomes rather obvious that **the** tape to use is **the one which works best for you.**

In order to make that determination here at Bonneville Productions, we employed a nut-and-bolt approach to provide as much of a factual data base as possible to try and represent what the ear could hear. The facilities of the quality control lab were pressed into service to administer our own tests and determine how to treat a mastering tape and how it behaves in return.

A random selection (as random as can be with blindfold in place, one arm tied in back, one leg in a cast and three brush fires burning in the studios) was made from our own tape stocks of each of the following in a 1/4-inch format:

Ampex	456
3M (Scotch)	250
Ampex	406
3M (Scotch)	206

The samples of these four tapes were checked for behavior in the following areas:

1 - Biasing Methods
2 - Sensitivity, Response
3 - Headroom, THD
4 - 3rd Harmonic Distortion
5 - Modulation Noise
6 - Intermodulation Distortion
7 - Print-Through
8 - Signal-To-Noise

The following test equipment was employed in making the measurements:

Oscillator: Sound Technology 1700B
ACVM: Hewlett-Packard 400FL
Oscilloscope: Tektronix 466

continued on page 74

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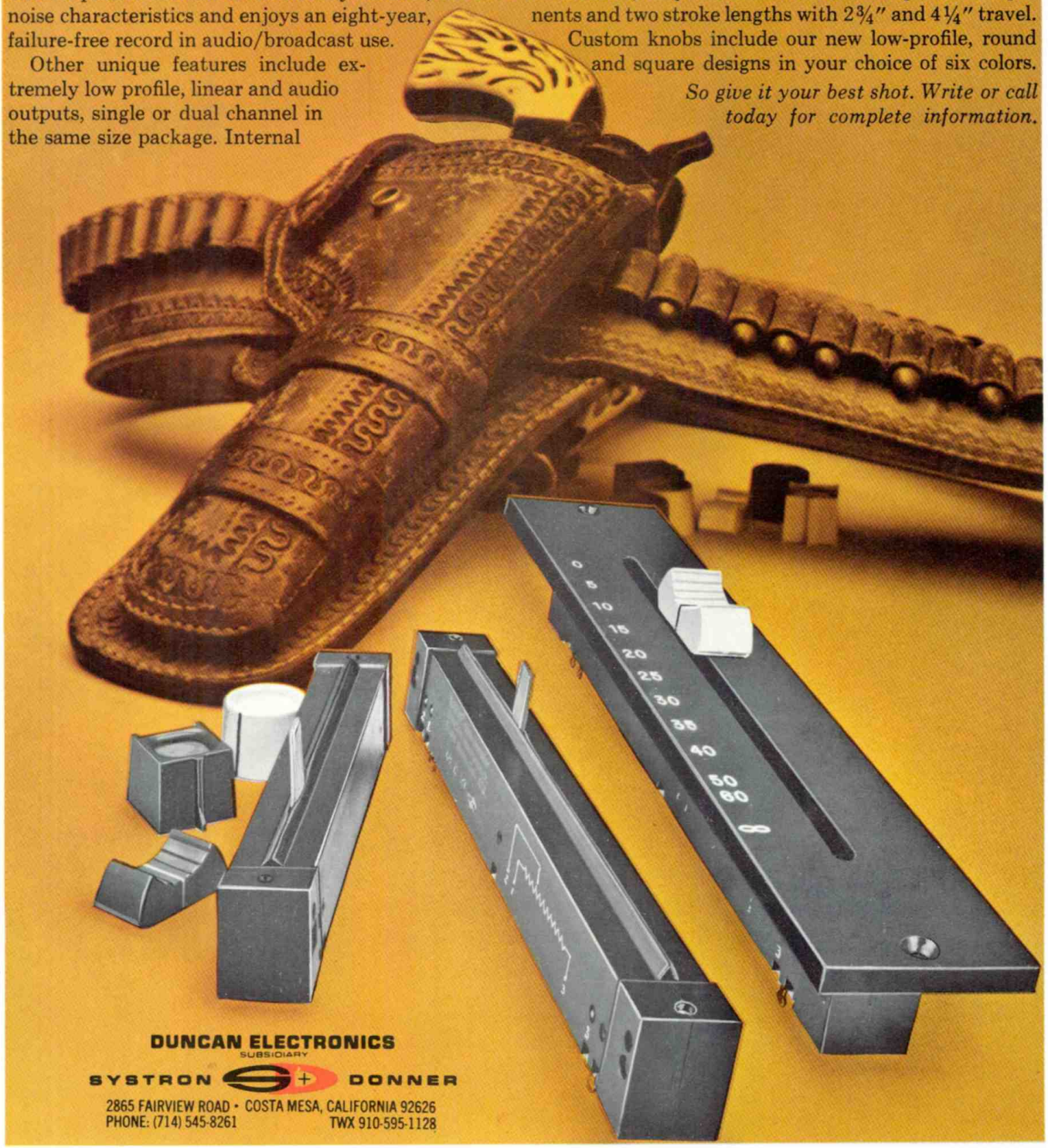

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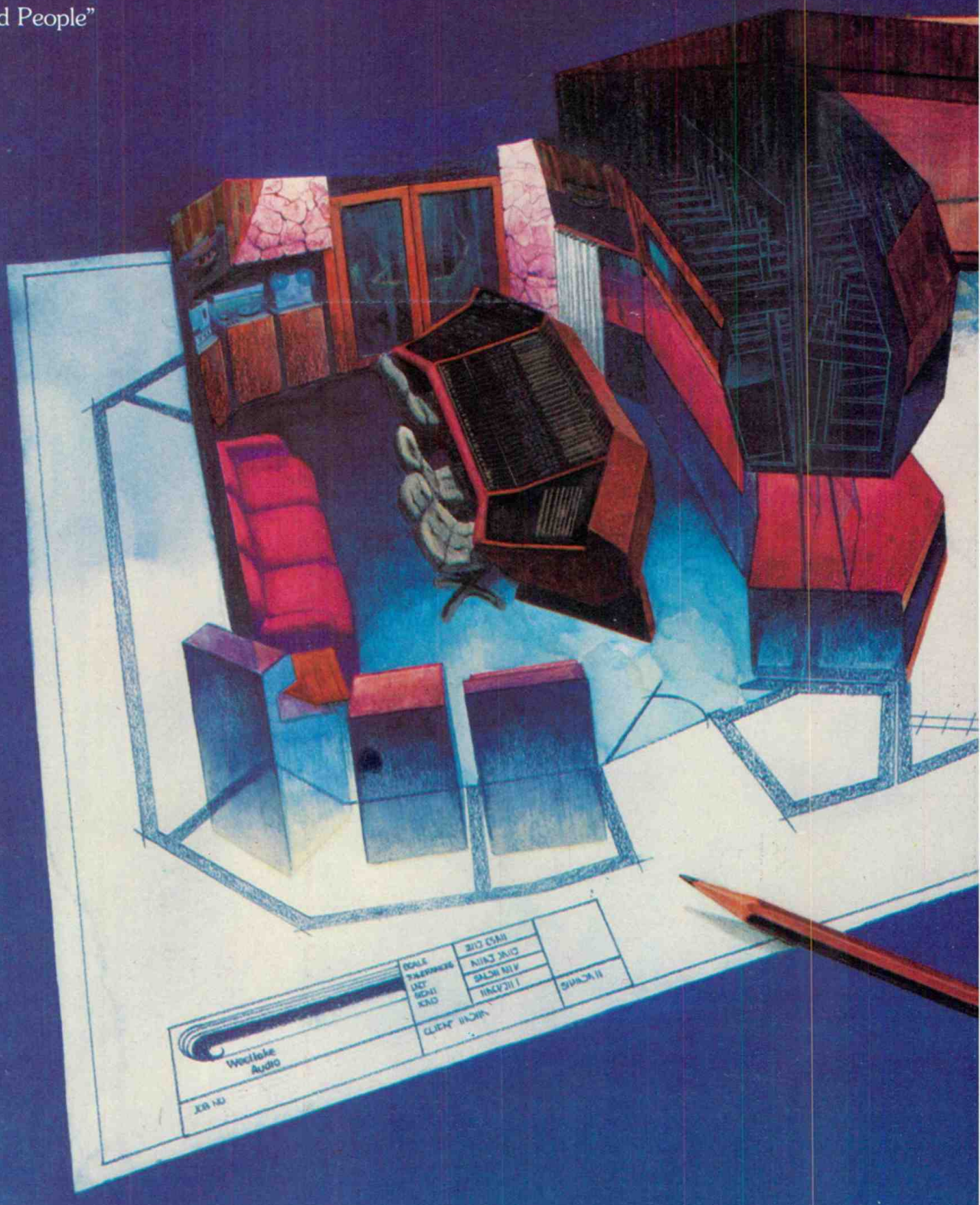

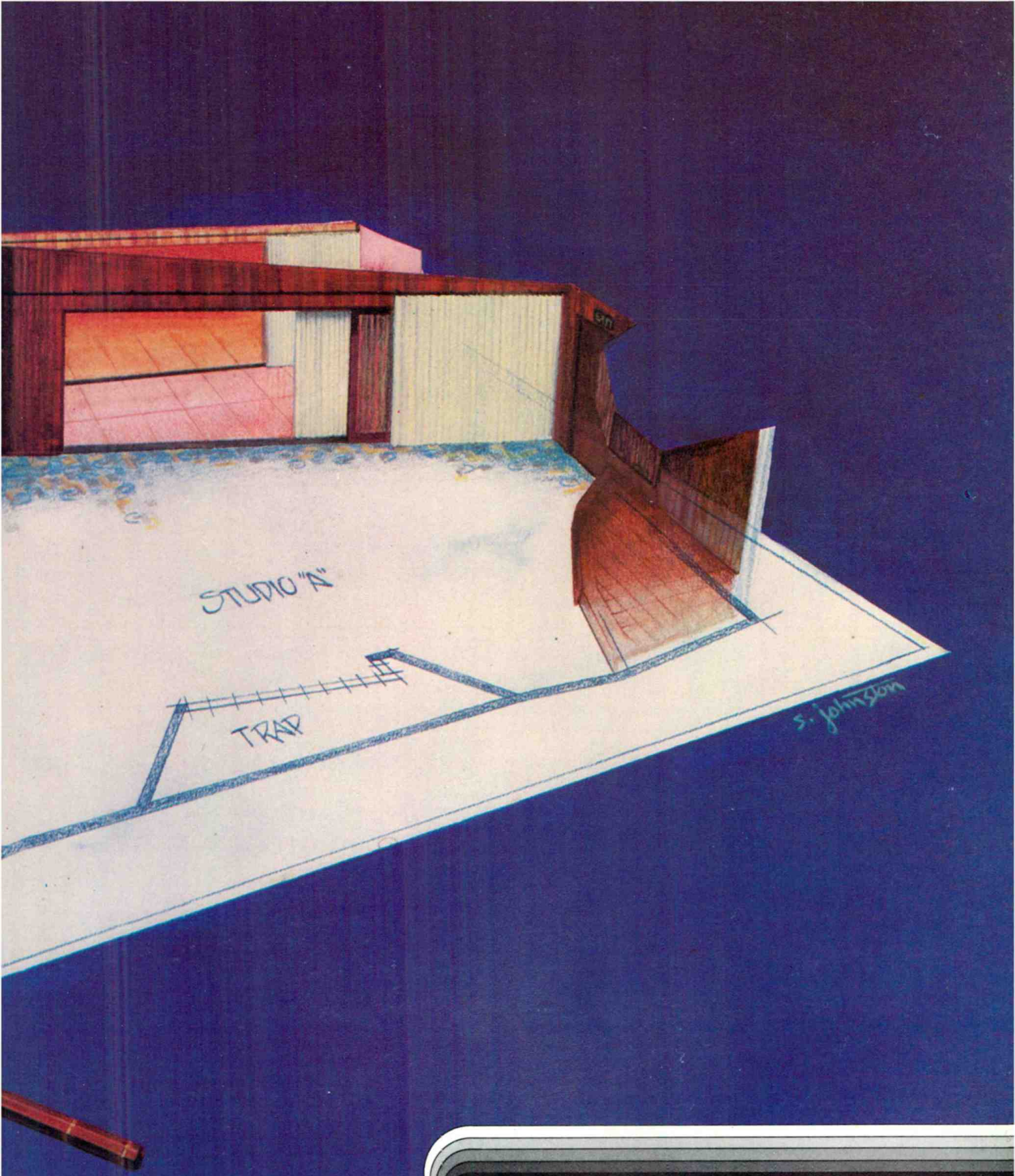

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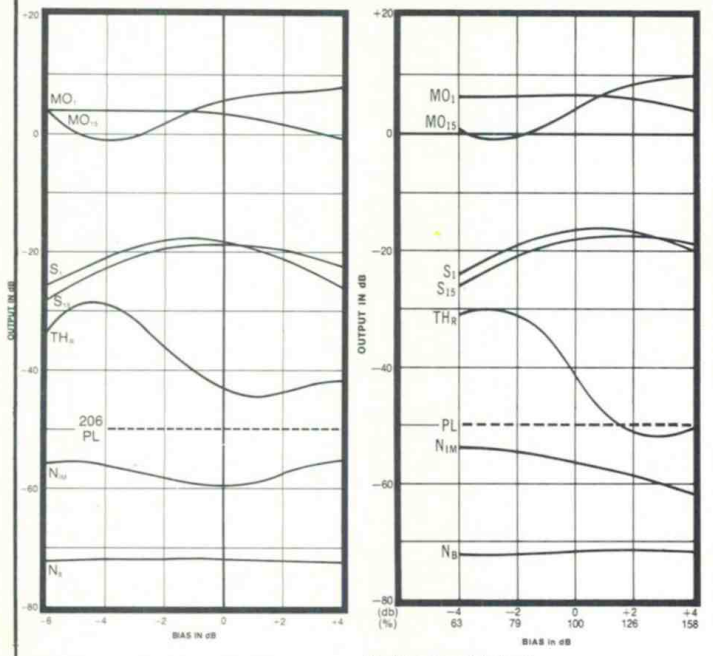
3-M 206/207 | 3-M 250 | Ampex 406/407 | Ampex Grand Master

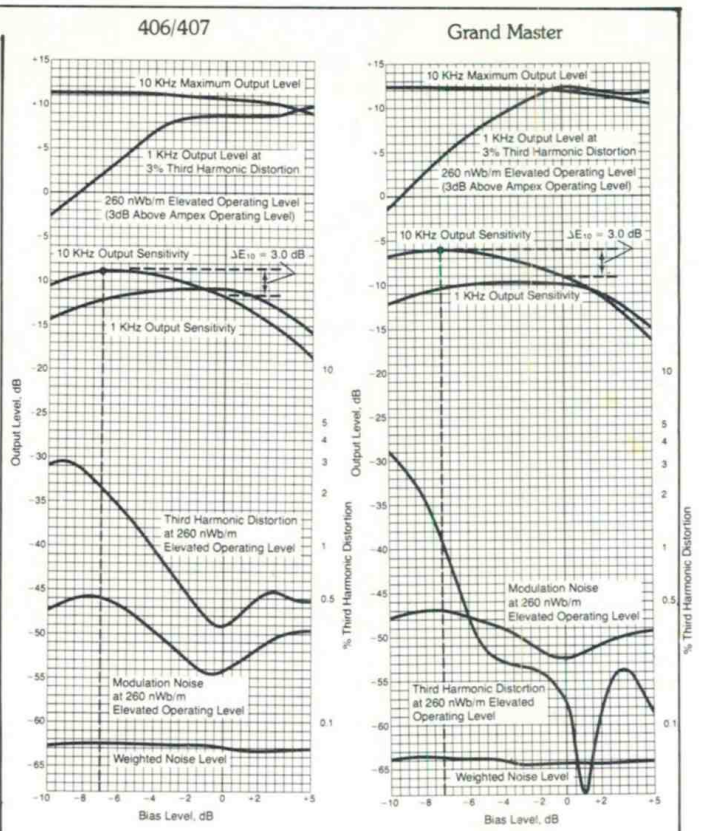
FIGURE 2



MO_{15}—Maximum Output, 15 mil Wavelength
MO_1—Maximum Output, 1 mil Wavelength
S_{15}—Sensitivity, 15 Mil Wavelength
S_1—Sensitivity, 1 mil Wavelength
TH_R—Third Order Harmonic Level at Reference Output
PL—Print Through Level

N_B—Biased Tape Noise Level
N_{IM}—Intermodulation Noise Level

Zero level output equals 32 mM/mm (DIN Reference level)
Zero dB bias is peak 15 mil bias on DIN Reference Tape
Track Width—0.240 in. (6.1mm)
Record Head Gap—0.001 in. (0.025mm)



Wave Analyzer: Hewlett-Packard 3581A
X-Y Plotter: Hewlett-Packard 7035B
1/4" Tape Recorder: Ampex ATR-102; 1/4" tape, half-track format
Notch Filter: UREI 565T

All measurements were made at a tape speed of 15 ips.

I. Biasing Methods

Bias setting is an area of much debate and discussion. We therefore set out to find an optimum bias for each tape that would allow it to perform best in the most important tests. In doing this we found that the graphs supplied by the tape manufacturers (see Figure 1) were accurate and helpful.

First, the tape machine is cleaned, degaussed, proofed and praised. (This opens up another huge area of opinion and procedure which will not be pursued here.) Then, with the manufacturer's chart in hand we attempt to make the tape and the machine the best of friends. May we indulge first, however, in some nut and bolteeze, since an understanding of gap lengths and recording wavelengths is helpful in properly setting bias for a partcular tape.

When a single tone is recorded on the tape as the tape passes the record head, the modulated bias waveform (or, the waveform of the tone "riding" on the high-frequency bias wave) aligns the oxide particles on the tape in a magnetic (not physical) pattern. This pattern depends upon the frequency (pitch) of the tone and the speed of the tape.

When recording a 1 kHz tone, for example, one complete 360-degree cycle of the waveform will leave a magnetic impression in the tape oxide in a given length. If the tape is moving across the head at a speed of 15 ips, one thousand complete 360-degree waveforms will be recorded in the space of fifteen inches. A single 360-degree waveform will be recorded in one thousandth of that space or 15 milli-inches (15 mils). The metric measurement for this distance is .381 millimeter or 381 μm.

A 15 kHz tone will be much smaller in its magnetic length on the tape since more 360-degree cycles are recorded in the same amount of time — one second. The 15 kHz **wavelength** will be one milli-inch long, or, in trade talk, one mil.

Now, how does this wavelength on the tape appear to the record and reproduce heads? Moreover, who cares?

Without becoming too stuck in detail, it may be summarized that **the performance of the tape cares**. And, because of this, the distance across the gaps in the heads of particular machine determines how the machine should be **biased** for a particular tape. (For completeness, the head gaps of the ATR-102 recorder used in these tests were: Record 12.5 μm; Reproduce 2.5 μm.)

Many tape machine manufacturers suggest setting the bias using a 1.5 mil wavelength (10 kHz at 15 ips, 5 kHz at 7.5 ips), adjusting the bias for maximum output and then increasing the bias until the output falls 2 - 3 dB (2 - 3 dB over bias), the exact value depending upon the particular tape in use. Biasing by this method may allow a user to obtain the tape manufacturer's rated performance for a particular tape, but **better** performance can be obtained by another route.

It was found that setting the bias (while recording a 1 kHz tone at 185 nWb/m) for lowest third-order harmonic distortion component by using a wave analyzer proved to be a more accurate method for optimizing tape qualities.

Two interesting and informative lessons were learned while performing these bias tests:

(1) While Scotch 250 has a very broad area to set optimum bias, the Ampex 456, in contrast, has a very narrow area (see Figure 1). To adjust bias on the 456 for lowest third-order harmonic distortion requires the use of a wave analyzer since a slight

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Michael

Notes-New Product Release

Audio Machinery Shared Access Memory System

The Audio Machinery Shared Access Memory System approaches digital signal processing hardware from a totally new prospective. The system is built around an active mainframe which contains up to six seconds of Random Access Memory (RAM). The mainframe accepts up to eight plug-in modules that can access all or part of the memory. The memory "distribution" is under microprocessor control. This computer is part of the mainframe, and also keeps track of how much time (at full bandwidth, 16kHz) is available in the memory.

If the amount of time called for by the various modules exceeds the RAM space available, several modes of operation allow for lowering of the sampling rate to accomodate the "time request" (at reduced bandwidth). The sampling rate may be adjusted manually, or the microprocessor can handle it. In either case the processor adjusts the filters to match the sampling rate selected.

Design Parameters:
availability of long delays (up to 6 seconds)
exceed present performance standards
quick setting of delay times
1 ms steps plus sweepability
internal oscillator control of VCO
external voltage control of VCO
straight A/D and D/A without companding, compression,
or pre/de-emphasis
cost effectiveness
eliminate splice clicks inherent in pitch shifting
true room simulation reverberation with complete control
of variable parameters (including width and length
of room)

The mainframe contains two readouts which display how much time is available in the memory and at what bandwidth. Three momentary pushbuttons control the operating modes which include computer setting of the sampling rate, manual setting of the sampling rate, and the initial set-up mode. The mainframe also provides 2 audio input busses and 2 voltage control auxilary busses which are all accessable from each module. The memory "tap" switch bypasses the analog signal input and "taps" the memory being used by the adjacent adjacent module allowing the 2 to be in series without additional D/A and A/D conversion.

Modules available include Pitch/Delay, Delay, Output, Reverberation, and
more

continued from page 70

adjustment of the bias pot can raise the third harmonic level more than 12 dB with only a slightly noticeable change of output on the AC voltmeter.

(2) The gap length of the record head plays an important role in the amount of over-bias at 10 kHz when biasing by this method. Since a wave analyzer is not necessarily a standard piece of test equipment in a studio, an alternate procedure for the "low-third" biasing technique is suggested: Since all record heads are different enough in gap length that a "universal" bias point of 1.75, 2 or 3 dB over-bias of a 1.5 mil wavelength signal is not optimum (for certain tapes in particular) a one-time determination of the optimum over-bias point will be logged. Future biasing will then be checked against this logged value.

In other words, beg, borrow or steal a wave analyzer or build a 3 kHz bandpass filter and determine the optimum bias point for each tape machine/head stack. Record this value. Consult this value for future bias setting. And, of course, re-determine the over-bias point as the heads wear.

The following figures of over-bias were determined on the ATR-102 at 15 ips with the bias adjusted for minimum third-harmonic content of a 1 kHz signal recorded at 185 nWb/m:

Ampex 456:	1.7 dB
3M (Scotch) 250:	2.5 dB
Ampex 406:	2.5 dB
3M (Scotch) 206:	2.3 dB

This may seem a bit of an overkill to some readers. Again, whatever works best for you is the procedure you should use. 12 dB of third harmonic may be worth the additional pain, however. A "look" at **audible** distortion is forthcoming, so read on.

II. Sensitivity Comparisons

Sensitivity measurements were made by comparing the four tape samples using Ampex 456 as the measurement reference. The ATR-102 was biased and equalized for the 456 tape. A 1 kHz tone was recorded at 261 nWn/m and the record calibrate control adjusted for 0 VU. This record level was used for all four tapes. The biasing procedure was that of adjusting for lowest third harmonic content of 1 kHz with the equalization adjusted for the 456 tape, record/play response as follows:

	1 kHz	10 kHz	15 kHz
Ampex 456	0	0	−1.3 dB

Substituting the other three tapes and re-biasing for each, the record/play response became (no change in equalization settings):

3M (Scotch) 250	−1.2	−3.5	−6.4
Ampex 406	−1.2	−4.2	−6.7
3M (Scotch) 206	−2.2	−5.7	−8.0

The test was performed again for all four tapes with biasing per manufacturers specifications (over-biasing at a 1.5 mil wavelength) with no appreciable difference in the results noted.

III. Headroom

Maximum output level at 3% total harmonic distortion was measured. A 1 kHz tone was recorded at 185 nWb/m. The tape machine output was adjusted to +4 dBm (1.228 volts). The recording level was then increased to give 3% THD on playback. (Biasing was optimized for each tape for lowest third harmonic.) The resultant increase in output is noted:

Ampex 456	15.6 dB
3M (Scotch) 250	14.6 dB
Ampex 406	11.5 dB
3M (Scotch) 206	10.4 dB

It might be interesting to note that if Ampex 456 is over-biased by 3 dB on the ATR-100, the maximum output rises 18.6 dB over the 185 nWb/m reference. The 3M 250 didn't change with more bias.

IV. Distortion

Third-order harmonic distortion products of a 1 kHz signal recorded at 360 nWb/m (+5.8 dB over an operating level of 185 nWb/m) speak for themselves. (See Figure 2.) Each tape was biased for **lowest** third harmonic distortion at 1 kHz:

Ampex 456	.14%
3M (Scotch) 250	.45%
Ampex 406	.95%
3M (Scotch) 206	1.20%

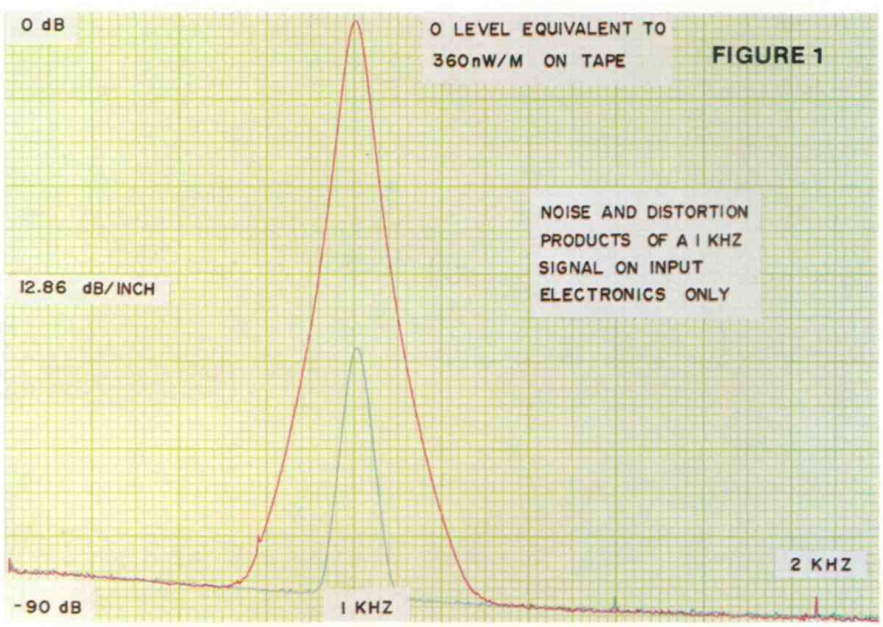
It is informative to note that Ampex 456 third-order harmonic distortion was 0.5% when biased 3 dB over at 10 kHz. 3M 250 displayed little difference.

V. Modulation Noise

After reading many definitions and philosophies of this entity, a treatise will not be started here. Perhaps a summary of ideas on the phenomenon may be offered: The increase in noise over the audio bandwidth when an audio-frequency fundamental (something in addition to the bias frequency — which may cause broadband noise and "bumps" of its own accord in conjunction with the record head) is introduced into the recording process.

No attempt will be made to draw the line which differentiates between modulation noise and distortion products. A plot of the wave analyzer on the X-Y plotter (hard-copy spectrum analyzer) will be offered instead. These tests turned out to be the most interesting of all:

Figures 2, 3, and 4 are representatives of the more common method of plotting modulation noise. John Woram, in his book **Recording Studio Handbook,** differentiates between wideband "modulation" noise and a narrow band segment on either side of a recorded signal called "asperity" noise. The latter may be clearly noted on the exhibits. For purposes of this article, the term "modulation noise"



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R-e/p 77

shall remain. The choice of semantics is left to the individual reader until such time as terms are standardized. Figures 2, 3, and 4 were obtained with the following test setup:

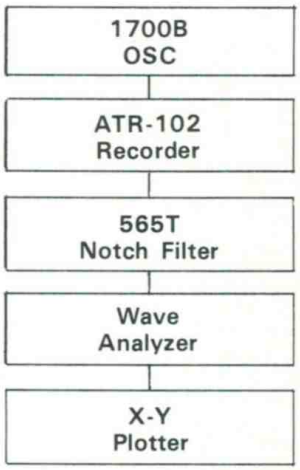


Figure 2 is a representation of the audio signal of 1 kHz going through the input electronics of the ATR-102. The red trace represents the 1 kHz tone with no filtering. The blue trace represents the single 1 kHz tone with a 45 dB notch (centered on 1 kHz) provided by the UREI 565T dip filter (Q = 10) in the circuit.

Figure 3 represents the same test conditions only plotting the output of the ATR-102 while recording and playing back on Ampex 456 tape. The 1 kHz tone was recorded at 360 nWb/m and the tape was biased for minimum third harmonic content.

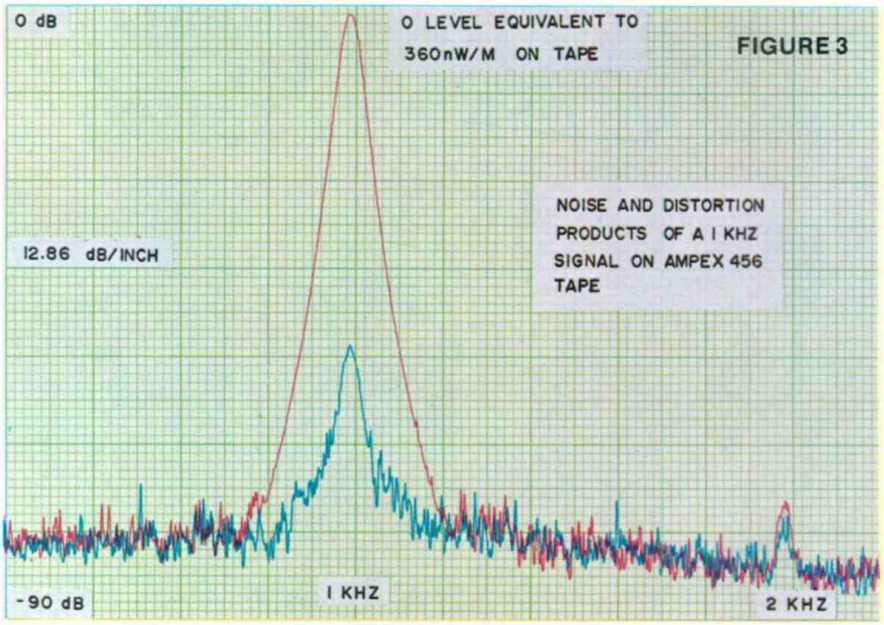
Figure 4 represents the same test conditions with Scotch 250 tape. The tape was biased for minimum third harmonic content.

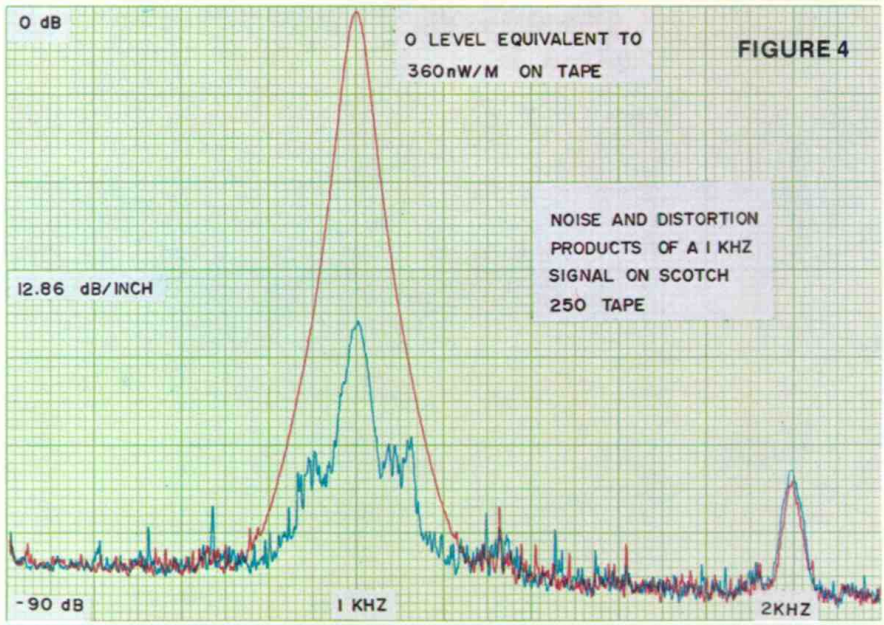
Figures 5 and 6 represent identical test conditions with Ampex 406 and Scotch 206 tapes, respectively.

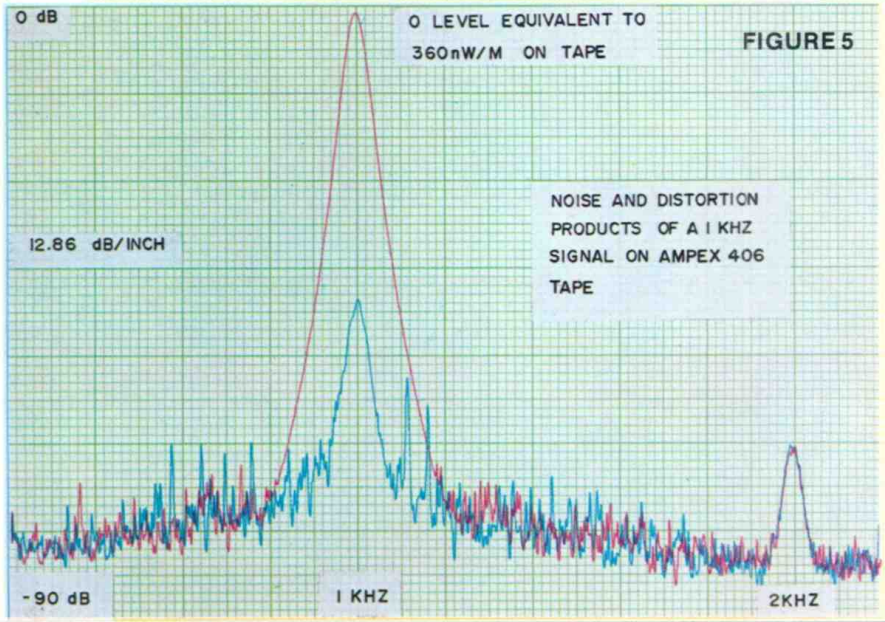
On Figures 7 - 10 the linear frequency scale (x-axis) may appear strange to readers used to logrithmic plots. This is a function of the sweep rate of the wave analyzer. That's the only reason for the graph to be formatted in this manner.

A similar situation exists with the amplitude (y-axis) plot. The full 90 dB spectrum of measurement capability was plotted without the benefit of a 9-division y-axis graph. To use the next convenient scale proportion would have meant that the information close to the baseline would be obscurred from interpretation.

Figure 7 utilizes the same test conditions as Figure 3 for the 456 and 250 tape, only the plot was extended to 20 kHz. Figure 8 expands the plot in a like manner for Ampex 406 and Scotch 206 tape.







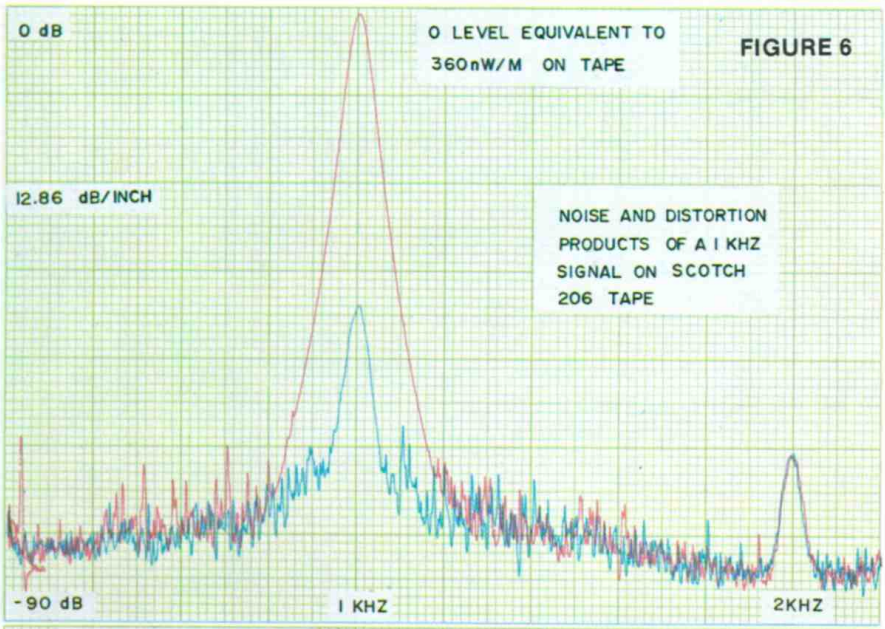


FIGURE 6

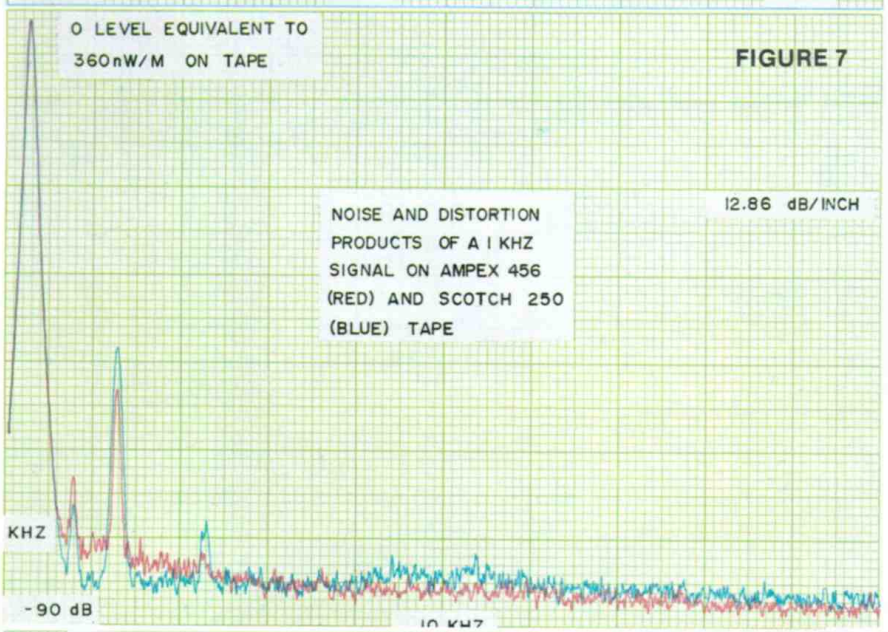


FIGURE 7

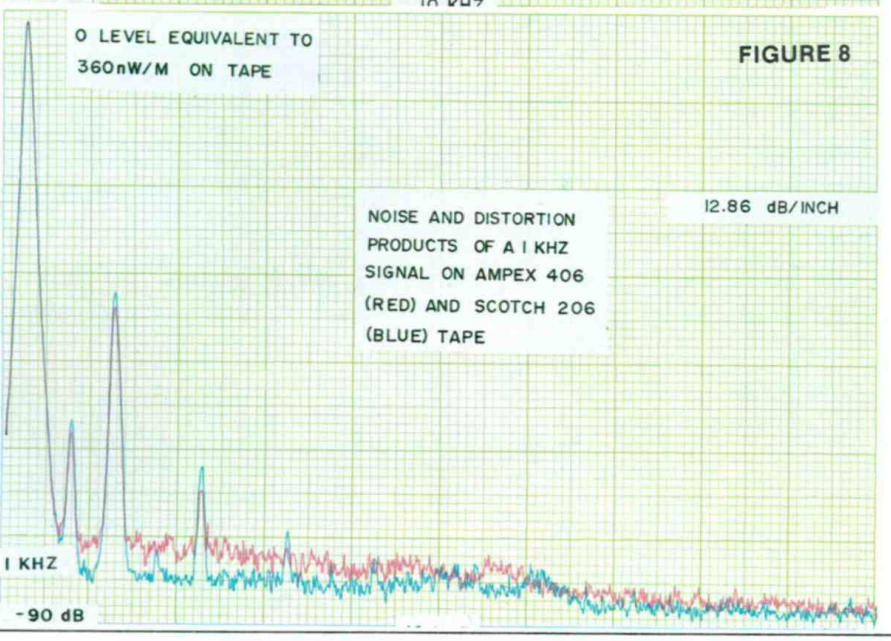


FIGURE 8

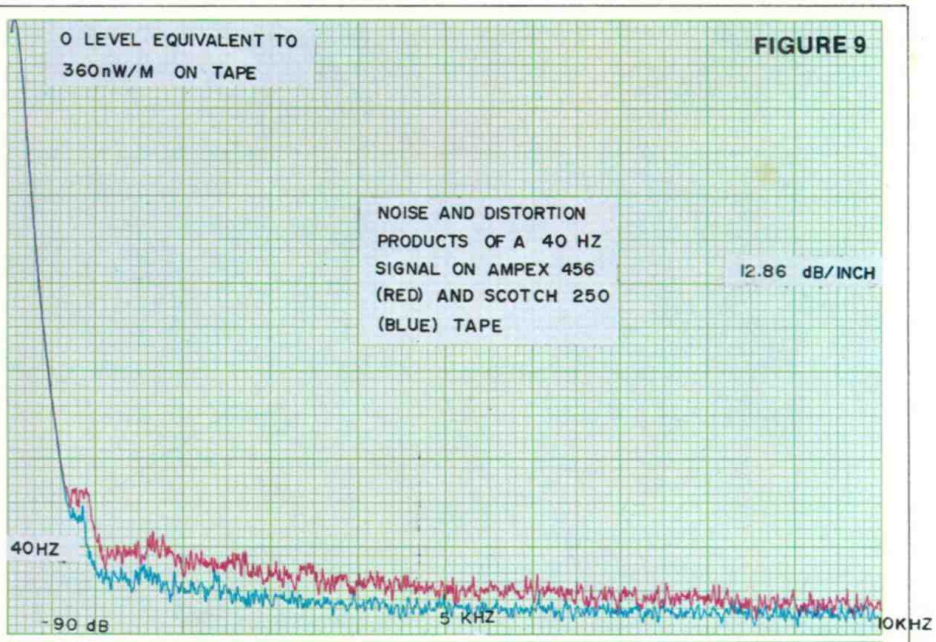


FIGURE 9

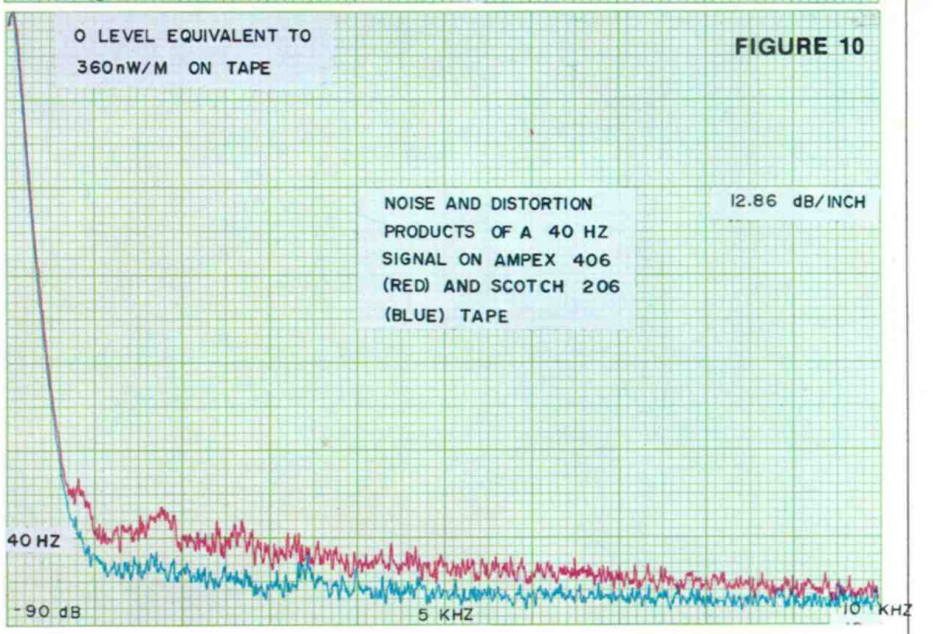


FIGURE 10

Figure 9 plots the noise present across the audio bandwidth while recording a 40 Hz tone at 360 nWb/m on Ampex 456 tape (red trace) and Scotch 250 (blue trace). The ATR-102 was biased for minimum third harmonic distortion for each tape respectively.

Figure 10 plots the audio-bandwidth noise for Ampex 406 tape (red trace) and SCotch 206 (blue trace) with the 40 Hz tone recorded at 360 nWb/m. Again, the ATR-102 was biased for lowest third-order harmonic content for each tape.

VI. Intermodulation Distortion

The IM test revealed some interesting tape characteristics. Frequencies used were 60 Hz and 7 kHz mixed at a 4:1 ratio respectively. The readings indicate a maximum level output at 1% and 10% distortion referenced to 260 nWb/m.

	1%	10%
Ampex 456	+9.0 dB	+14.4 dB
Scotch 250	+0.5 dB	+11.5 dB
Ampex 406	−2.8 dB	+ 8.5 dB
Scotch 206	−2.5 dB	+10.2 dB

VII. Print-Through

Test results for print-through were obtained from the first echo heard prior to hearing the 1 kHz signal recorded at 360 nWb/m:

Ampex 456	−48 dB
3M (Scotch) 250	−49 dB
Ampex 406	−55 dB
3M (Scotch) 206	−51 dB

Scotch 206 print-through leaves us surprised. Remember, it had the lowest sensitivity at 1 kHz.

VIII. Signal-To-Noise

The unweighted 20 kHz bandwdith (UREI 555 bandpass filter, 18 dB/octave slopes, −3 dB points at 20 kHz and 20 Hz; H-P 400FL average-responding AC voltmeter) signal-to-noise **comparisons** are shown as follows referenced to a fluxivity of 360 nWb/m for all tapes:

Ampex 456	56 dB
3M (Scotch) 250	58 dB
Ampex 406	57 dB
3M (Scotch) 206	57 dB

Conclusions

Although the tests have been based upon samples, several batches of tape over a period of five months have been measured to demonstrate the repeatability of the results which have been presented. Suggestions for different or modified test procedures will surely be submitted, as they should be, if we are all to become more informed about the realm of the behavior of magnetic tape. The subject of "modulation noise" is still not completely understood. Noise introduced by the bias waveform in the record head and the resulting pops, bumps, "gratchels" and other associated creatures of magnetic domains are not discussed to the extent that the technical staff can free the recording engineer from the plagues of these problems. Hopefully, in time, they will be the subject of more discussion.

It is hoped that this article has emphasized the fact that each tape has its strengths and weaknesses, and it is up to each user to learn how to maximize the strengths and minimize the weaknesses to suit his own applications.

□ □ □

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Enhancement as opposed to equalization

In the field of audio reproduction, obvious deficiencies in analog recording, such as noise, distortion and limited frequency range lead to the development and use of selective frequency manipulation devices. Equalizers and signal processors of similar type were used primarily to offset those deficiencies in the recording process and help recreate the natural sounds.

With the arrival of dramatically improved analog, direct-to-disk and digital recording, natural frequency relationships can be more accurately reproduced then ever before. Also with these improvements comes more concern in the audio field for the preservation of these natural frequency relationships. Most signal processors today are being judged in the market place both for their ability to perform their specific function and also by their avoidance of distorting the natural frequency relationship of the signals they process.

In the field of color video reproduction, the boosting or attenuating of selective colors within the color spectrum has never been widely used for obvious reasons. Even a small change in a primary color of the color spectrum changes the color relationships of the whole spectrum. For example, a small boost in the yellow part of the color spectrum makes the video image of a person's face very noticeably unnatural looking. Therefore video enhancers were introduced for the purpose of adding clarity, image separation and contrast to video reproduction without changing the delicate balance of color relationships.

In the audio field, selective frequency boosting devices are still widely used but because of their own design, what they were created for is now the primary complaint against them. They change a selective part of the frequency range therefore interfering with the natural frequency balance of the entire audio spectrum.

Equalization as an artistic audio instrument will never be replaced, but its use as an audio reproduction tool is at best limited. Using it to give clarity or separation has the high cost of lost naturalness. EQing a vocalist to cut through a full mix is a trade between projection and realism. Every successful engineer and producer has had to make this conscious decision numerable times, but they've had no other choice.

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MAGNETIC REPRODUCER EQUALIZATION ACCURACY or FLATTER is FATTER

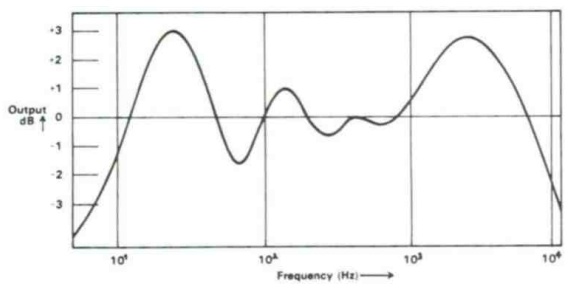
by Peter Butt

One of those minor annoyances contingent upon the business of audio equipment technology, other than the lack of adequate studio lighting for the normally sighted, is the delinquent detail that will not conform to the ideal of realizable perfection that most of us carry around in the back of our heads. We are generally aware of the not-quite-flat VU meter whose needle flutters at low frequencies, the bridging device that isn't, the noise gate that's noisy, or the logarithmic gain device that tends towards the linear.

For each intellectual thorn, we each have the choice of finding the cause of the irritation and laying it to rest or merely shrugging it off as "the way things are."

I confess that the temptation of the latter option has, on more than one occasion, been the most prudent as well as the easiest course. However, like the tiny pebble in one's boot, some mental barbs refuse to accept disregard and grow more acute with time. There are, of course, chemical and/or medicinal remedies for persistent or temporary mental discomforts of a symptomatic nature. Social commentary could be aired at considerable length on the subject of diversions from reality. Since such discourse does not fall under the editorial policy of this publication and is quite tangential to the subject at hand, I shall opt to leave that facet of the problem to other periodicals such as High Times.

Figure 1. Frequency response of a generalized 15 ips tape machine as observed playing back its own recording.



More to the point of this article is the phenomenon of non-flat record-reproduce frequency response as observed in the majority, nay, the preponderance of tape machines of my experience. This problem has been part of my subconsciousness for the last ten years now. Specifically, the problem manifests itself as a "hump" observed in the record/reproduce frequency response in the region between 1 kHz and 10 kHz, leveling out above 10 kHz and falling off above 15 kHz. Figure 1 shows a curve that is typical of such a response characteristic. In days gone by this sort of thing was attributed to "worn heads", or to various other euphemisms alluding to the age of the machine of interest. This seemed to satisfy my need for a rationalization for the inability to make things look better than they did for a number of years. These must have been pretty good rationalizations because, as I prefer to recall, they found good use among my contemporaries as well.

Vain Philosophy

Alas, dear readers, there comes a time for the reckoning of many things. I owe the solution of the non-ideal frequency response characteristic to the synergistic combination of seemingly unrelated events in my post-formative years. One of these was the use of the flux loop as a stimulous for driving the reproducer electronics without the need for a recorded tape. My early adventures

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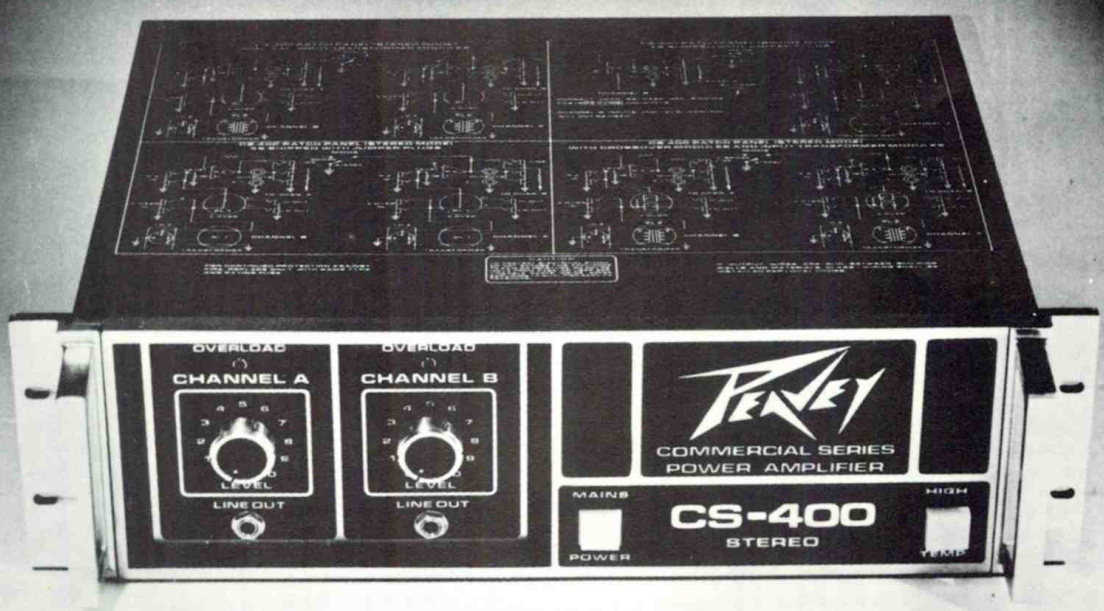

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in this area are documented in a generally-accurate article published some years ago in this very magazine.[1] Another event contributing to the perception of light at the end of the proverbial tunnel was the availability of inexpensive portable numerical computational capability in the form of the ubiquitous hand-held electronic and programmable calculator. One of the others, and probably the most profound contributor to my enlightenment, was my involvement in the high-speed tape duplication industry and my persistent ignorance of the depths of mediocrity that pervades it almost universally. As far as I am aware, only London-Decca in Britain and Philips in The Netherlands turn out duplicated tape product that I would consider acceptable. There evidently are no such producers in the Western Hemisphere.

Perhaps the point of this preambling is that enlightenmentt and benefit can derive from unexpected sources. It appears to be true that we are at any time the sum total of our experience, and that the importance of any given influence may be far greater than it is perceived to be at the time of the event. It may be that even the facetious assertion that "ignorance is the foundation of wisdom" may have greater validity than its apparent contradiction would seem to imply.

Non Sequitur

Regardless of the roots of the knowledge to be imparted below, it has been demonstrated repeatedly that there is significant benefit to be had in the achievement of a very flat record-reproduce frequency response. Before we set upon the cure, let us examine the sordid disease.

Fundamentals

First, it is important to realize that the most frequently encountered reproducing head is of the ring type consisting of a more-or-less torroidal core section composed of a magnetically highly permeable material having some turns of insulated wire wound about it. The winding section is the means by which an output voltage proportional to the time rate-of-change of magnetic flux within the core is derived. The toroidal core is generally constructed as two halves of the torous, each wound with part of the total number of wire turns, the two pieces fitted together to form the torous. At the interface of the two core pieces is a narrow slit filled with some kind of non-permeable material such as mica. This narrow slit is commonly referred to as a "gap", and is positioned so that the magnetic flux remaining in the oxide of the magnetic tape can make a fairly intimate contact with the toroidal core about the gap region. A portion of the flux originating in the tape oxide can then be diverted into the core material itself and thus cause a small voltage across the core winding terminals.

Inherent in the construction of any realizable reproducing head are the properties of inductance, resistance, and distributed capacitance within the core windings. It is to be emphasized that the frequency response of the head is not flat of itself, but rises at a 6 dB per octave rate, neglecting other effects, for a constant rms value of flux within the core. This is decribed by Faradays Law which is generally stated:

$$E = -N\,(d\phi/dt)$$

where E is the induced voltage, N is the number of turns of conductive wire, ϕ is magnetic flux, and t is time.

This 6 dB per octave rise in response is corrected for by

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following the reproducer head with a device that has a 6 dB per octave fall in response. Such a device is frequently called an "integrator". We can then expect that the resultant signal amplitude observed from a reproducer head driven by a constant amplitude of magnetic flux will exhibit a flat response with frequency if its output is passed through some kind of integrating device prior to measurement. Sounds slick so far.

Equalization

There is the matter of some modifications to the 6 dB octave response of the integrator response. Most reproducer systems are designed in such a way as to deviate from the typical integrator response such that the integrator output stops falling at the 6 dB per octave rate and levels off to a flat response at some frequency. The frequency at which this occurs is a matter of some standardization. It is specified in the various standards issued by the various standardizing organizations around the world. Primarily the American National Standards Committee, National Association of Broadcasters and the Electronic Industries Association here in the United States and by the International Electrotechnical Commission and CCIR in Europe.

The frequencies at which the integrating device is determined to deviate from a classical integrating-type response is determined by a resistor-capacitor network generally placed in the feedback circuit of the integrator. The characteristics of this resistor-capacitor combination are customarily specified, not in terms of the resistance and capacitance values nor in terms of the frequency at which the integrator stops integrating. The nature of the R-C network is specified by the **product** of the resistance in ohms and the capacitance in farads of the components comprising the network. For example, a 10,000 ohm resistor in combination with a 0.005 microfarad (0.005 x 10^{-6} = 5.00 x 10^{-9} farads) would have an R-C product of 50 x 10^{-6}. Either expectedly or unexpectedly, this product of ohms times farads has the dimension of time in seconds. This product, having the dimensions of time, is a rather useful tool in the analysis of electrical networks. It is so useful, in fact, that it has been given a name: the Time Constant. The network described above would be said to have a Time Constant of 50 microseconds.

This seemingly tangential discussion has some bearing upon our standard magnetic reproducer response. The time-constant specification enables us to determine, with the help of our handy little programmable calculator, the precise ideal response of our reproducer-modified integrator system for the special case of a constant flux drive to the head.

Reviewing briefly, we have under consideration, a system made up of a constant flux driving system (the flux loop coil), the reproducer head, the aforementioned integrating device and an AC voltmeter. Figure 2 conveniently sums things up showing the system signal flow from top to bottom with the response of each component of the system shown to the right of the block diagram. The point of our discussion now is that, for the case of the ideal reproducer, we can characterize the reproducer response given only the specifications governing the response of the modifying network because the head response and the integrator response complement one another to yield a net flat frequency response for a constant flux drive as seen by the head.

If any given magnetic reproducer conforms to the ideal specified flux-frequency response, it must conform to the response of the modifying filter only. Any other component of the system that causes the net response to deviate from the ideal will result in a record-reproduce response that will be observed to be non-flat within the bandpass of the system. These components, and their effects, are the flies that we seek to extract from the ointment.

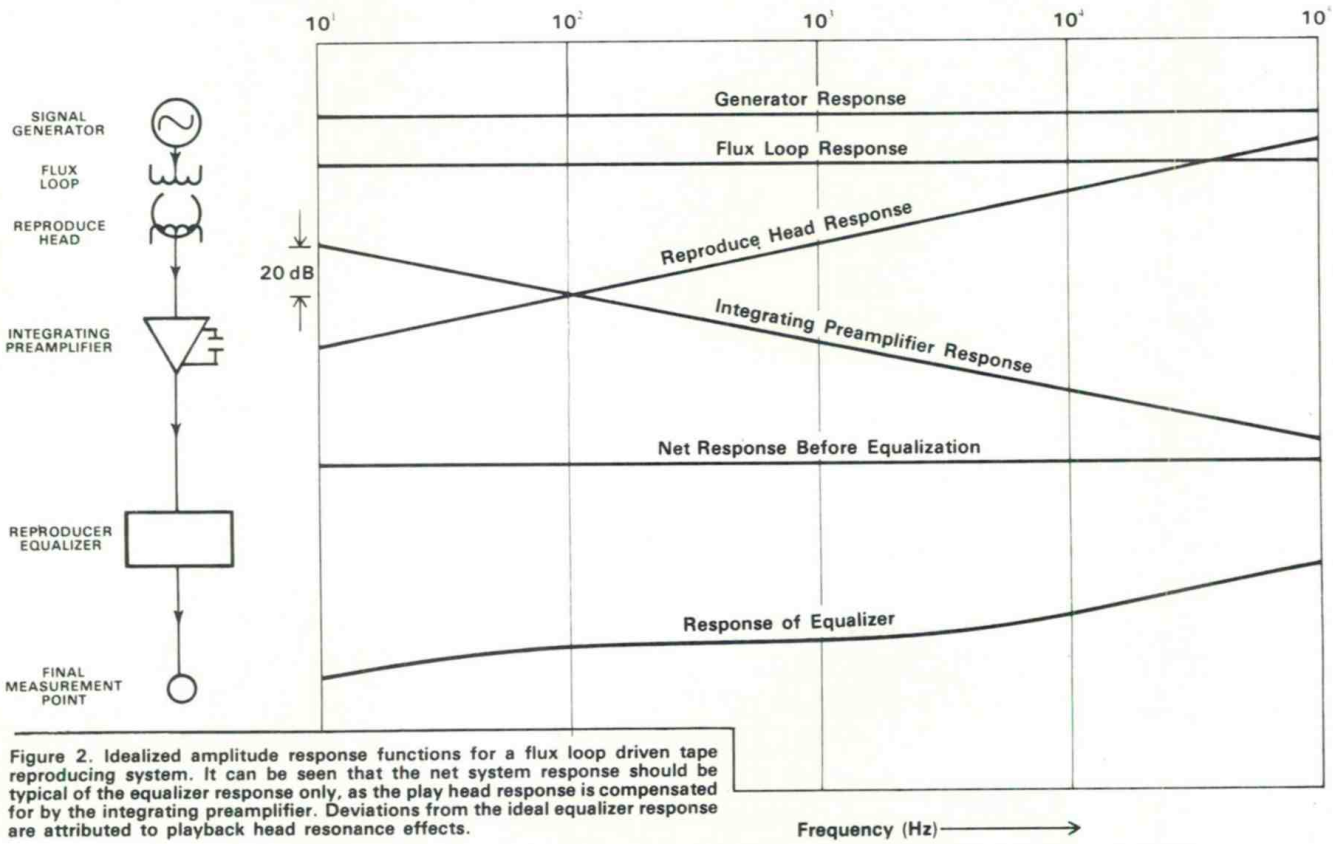
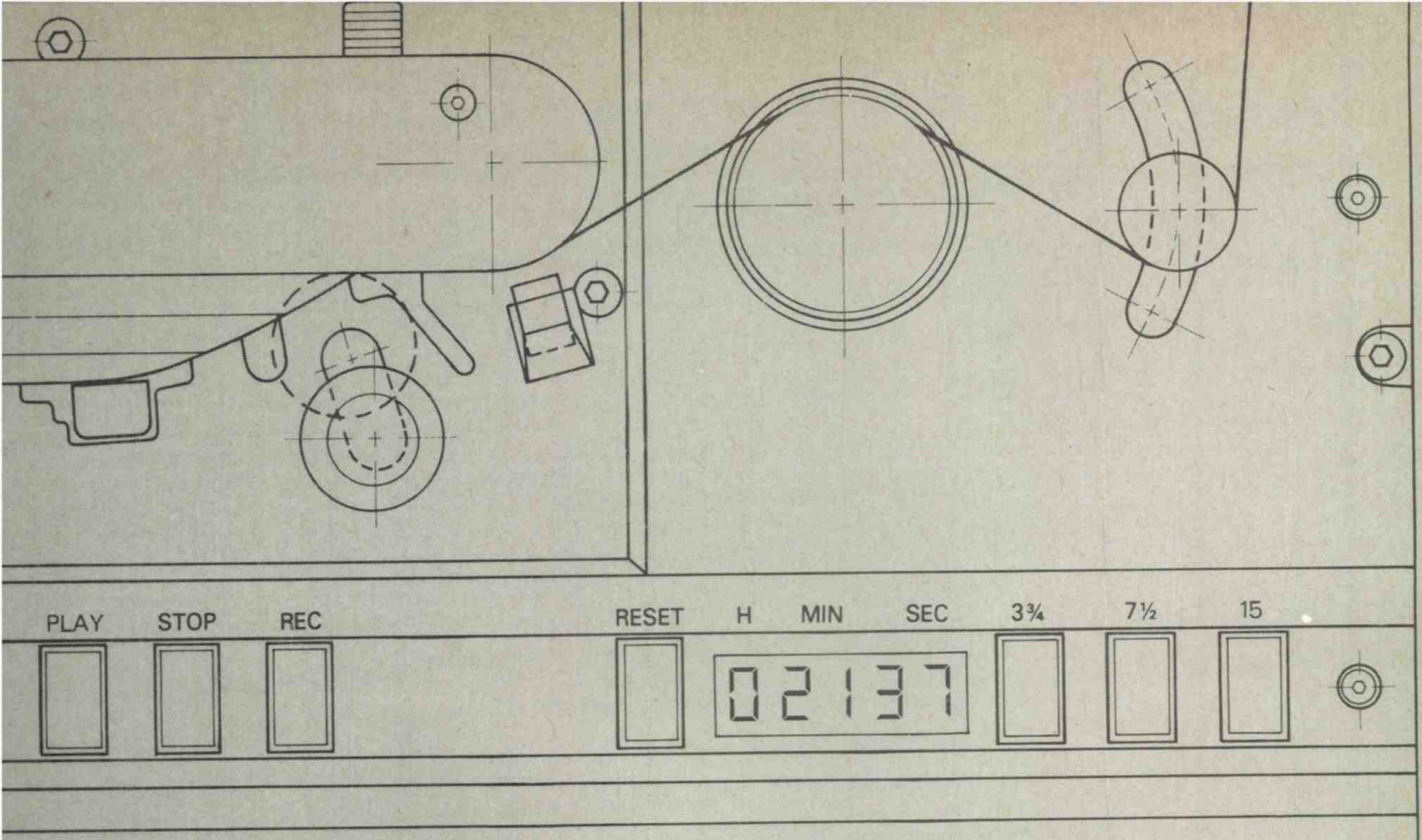


Figure 2. Idealized amplitude response functions for a flux loop driven tape reproducing system. It can be seen that the net system response should be typical of the equalizer response only, as the play head response is compensated for by the integrating preamplifier. Deviations from the ideal equalizer response are attributed to playback head resonance effects.



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The Problem(s)

We are now presented with a couple of problems here: A) How do we go about predicting the exact theoretical frequency response of the modifying filter? B) How do we go about constructing a coil suitable for the induction of a magnetic flux field within a reproducing head? C) What range of frequencies is to be taken as the system bandpass? D) How are we to go about recognizing the culprit(s) responsible for any non-flat, i.e. non-standard, response within the system bandpass? E) What are we going to do about arresting the culprits once recognized?

Purloined Technology

In response to problem A, we can resort to the various standard publications published by the various standardizing organizations mentioned earlier. One such publication is the Electronic Industries Association Standards Proposal No. 1066-A (also known as ANSI S4,13,1976, EIA RS 432): a description of a standard for 8-track endless loop cartridge recordings at 3.75 ips (9.53 cm/sec.). The interesting part of this standard is not the applicability to 8-track cartridges but the specification of the reproducer flux-frequency characteristic that is to be considered the standard for the reproducer of interest. The nugget we wish to extract from this publication is the algebraic expression for the required recorded tape flux charactertistic response for a constant amplitude sinusoidal input signal. It is stated thusly:

$$N(dB) = 20 \log \sqrt{1 + (1/(2\pi f t_2))^2}$$

$$- 20 \log \sqrt{1 + (2\pi f t_1)^2} + K$$

The quantities t_1 and t_2 are time constants describing the nature of the integrator modifying filter response. Time constant t_1 describes the high frequency response and t_2 describes the low frequency response. The constant K is just a fudge factor to make the results of the subtraction of the two logarithms equal to zero at some reference frequency, taken to be 400 Hz in the standard.

A little good old fashioned algebraic manipulation can be introduced to make the given expression a little easier to compute. The whole ball of wax can be boiled down to the following:

$$N\ (dB) = 10 \log (1+(f_2/f)^2)/(1+(f/f_1)^2) + K$$

This, please recall, is the expression for the flux level to be seen by the reproducing head that is to result in a flat frequency response when all is said and done and equalized. To obtain the response of the reproducer, we simply invert the righthand side of the equation:

$$N\ (dB) = 10 \log (1 + (f/f_1)^2)/(1 + (f_2/f)^2) + K$$

where,

$$K = 10 \log (1 + (400/f_1)^2)/(1 + (f_2/400)^2)$$

because I have slavishly chosen to retain the 400 Hz reference frequency used by the standard. This neat little formula will enable determination of the standard reproducer response to a sinusoidal signal of a constant flux within the core of a lossless head. Well, that's sort of true. A careful reading of the standard itself reveals that the recorded tape flux characteristic rather than the ideal reproducer charactertistic is given. The two are not quite the same.

Ointment Maggots

The difference between the recorded flux response and the response of the reproducer to that recorded flux is a bit different from what some might suppose in that there are losses within the head itself due to the circulation of eddy currents within the conductive core of the head itself and also due to the inability of the finite gap of any real reproducing head to respond to recorded wavelengths that approach the gap dimension itself. This is the fabled and heralded "gap loss" that cogniscenti are expected to introduce into any discussion of the tape recording and reproduction processes. Also fighting the cause of unlimited fidelity is the much-revered spacing loss that also contributes to attenuation of short wavelength recorded signals.

If we are, indeed, to yield a flat response to the **recorded** flux as it passes by the reproducer gap as the magnetic field passes by it within the tape oxide, we must then build into our reproduction electronics some sort of compensation for the various losses described above. That, dear reader, turns out to be a very tall order. In fact, the only loss that has been seriously proposed for correction in the reproduction process is the gap loss.[2]

Sins Of Others

Gap loss compensation has evidently been attempted in the case of Ampex AG-440A/B and MM-1100 machines by the addition of a resonating capacitor in parallel with the reproducing preamplifier input transformer secondary. The resonance peak caused by the interaction of the transformer-head-head cable properties and the added capacitor was intended to correct for the loss of signal due to the onset of gap loss. The 3M model 79 reproducer electronics also incorporates a resonance peak system for gap loss compensation, but does so by inserting a resonant L-C circuit in the preamplifier feedback loop along with the reproduce equalization components. Both of these approaches have very nearly the same result. The Studer A-80 reproducer follows the Ampex method with a resonating capacitor across the input transformer secondary.

Laurels

The MCI JH-114 multitrack tape machine, on the other hand, takes the attitude that the reproducer high-end response should approximate the ideal single-pole modified integrator response. MCI has installed a trim pot across the secondary of the reproducer preamp input transformer where others have either installed a resonating capacitor or left the issue alone by neglecting to install that capacitor. The Ampex ATR-100 dispenses with the input transformer completely, providing for resonance damping with a variable resistance across the preamplifier input port. Parenthetically, it is interesting to recall that the high frequency reproducer equalization method used in the case of the old Scully 280A reproducer consisted of a 1 megohm pot connected across the reproducer head allowing adjustment of the resonance peak, due to the interaction of head inductance and cable capacitance, for flattest high frequency response.

Flight From Reality

At this point let me candidly state that I have opted for the choice of standard electrical frequency response on the part of the reproducer rather than the incorporation of either fancy or simple corrective gee-gaws to make things spec out a bit better. I have come to believe that there are worse audio faults than non-flat record/reproduce frequency response. I have the following reasons or rationales to offer, depending on which side of the corrective fence one resides: First, gap loss is not too bad in most heads now in current use in professionally-used tape machines. Gaps are 250 micro-inches (6.35 μm) or less, generally less. For a 250 micro-inch gap, the gap loss

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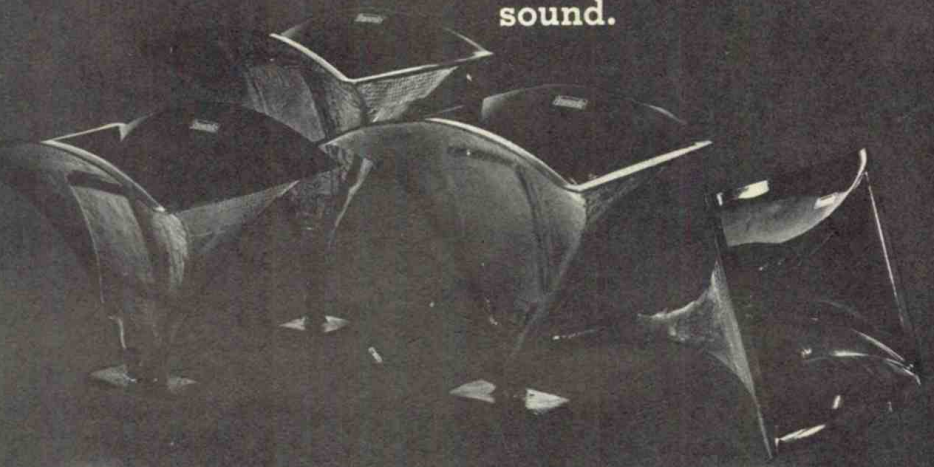

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R-e p 91

amounts to 3.0 dB at a wavelength of 625 micro-inches, (15.9 μm) or a frequency of 24 kHz at 15 ips.[3] This does not seem to be an intuitively outrageous situation. Complaints of 15 ips tape machines being down 3 dB at 24 kHz are not often heard in the day-to-day sequence of professional audio life.

Secondly, the response curve for a single-pole filter is convenient to calculate. For the lazy, this is a **distinct** advantage. Thirdly, the phase response of a resonant bandpass transfer function added to the phase shifts that are already inherent in both the recording and reproducing halves of the signal path will cause the phase response, and therefore, the transient response of the audio channel to be degraded in proportion to the Q and number of the resonances included. Lastly, subjectively, and perhaps most importantly: reproducing systems that have had their head reasonances damped to the extent that the deviations from the ideal response curve amount to less than $\pm$0.5 dB of the ideal do seem to sound better, more accurate, more distinct, more intelligible, having superior mid-range and low-end transient response characteristics, retaining more distinct stereo imaging than have identical reproducer systems having undamped resonances. SMPTE code plays back better, too. This is the value judgement that I wish to offer here as a rationale or justification for embarking upon a program of achievement of super-flat reproducer response for whatever reproduction standard one may choose. Yes, cassettes, too, can benefit from head damping balm.

Having made this candid declaration in favor of mindless subjectivity and sensuality, let us consider that the problem of predicting the theoretical response necessary to the solution of problem A, above, has been dealt with. For those of us having Hewlett-Packard model 97 or 67 programmable calculators, a program for the solution of that equation is included in these pages. T/I users will have to fend for themselves.

The Flux Loop

As we move on through our stack of Problems to be Solved, we now settle upon Problem B: construction of the flux loop. We shall, having survived the prior discussion of some of the shortcomings of the tape reproduction process, find it only marginally necessary to describe the advantages of direct induction of the test signal into the reproducer head core. All of the frailties of the magnetic recording process as well as the mechancial problems of orderly passage of the tape across the head, geometrical errors such as azimuth, dynamic skewing, gap loss, gap non-linearity, spacing loss, fringing effects, noise, dynamic range limitations, the contour effect (head bumps), as well as nasty old distortion, are avoided. If that is not enough to induce the reader to embrace the gospel of the flux loop, he need only consider the intricacies of insertion of a test signal into the low side of the reproduce head circuit by driving a 10 ohm resistor installed between ground and the head low signal lead. A nuisance at best, a sticky wicket in many cases. And, it turns out, somewhat misleading as it seems that the head responds differently when driven this way.

The flux loop is a gratifyingly simple device to construct. Materials needed are a rectangular piece of low-permeability material in sheet form, such as fiberglass Vector board, some #30 or similar enameled wire, a length of signal cable, preferably shielded conductor, a resistor of fairly high quality (for stability's sake), some quick-hardening epoxy, and an appropriate connector for the other end of the signal cable. The #30 wire can be obtained from a discarded relay coil and is wound in the rectangular pattern shown in the photograph of Figure 3. If the wire loop is made too small, the field caused by the current flowing opposite to the direction of the current flow in the conductors at the front edge of the assembly will tend to cancel, reducing the efficiency of the coil. The resistor is chosen to have a value nearly equal to the source resistance of the signal generator to be used to drive the loop so as to prevent any excessive loading of the generator output.

If there is any doubt as to the flatness of the loop, once constructed, connection of an AC voltmeter across the resistor and observation of the IR drop with frequency will confirm or dispell doubts. Very flat response to about 60 kHz can be obtained for coils having about 30 turns of wire in them. After the solder connections have been made and the electrical performance of the loop has been verified, the coil itself can be epoxied to protect it against damage due to abrasion and to insulate it from contact with the head face.

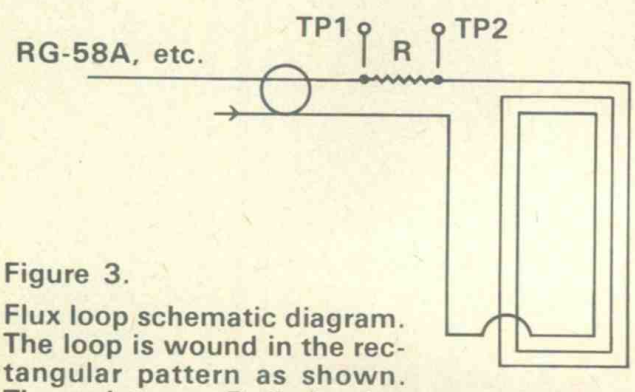


Figure 3.

Flux loop schematic diagram. The loop is wound in the rectangular pattern as shown. The resistance, R, limits the current through the loop and tends to minimize changes in loop current due to coil inductance.

Another Laurel

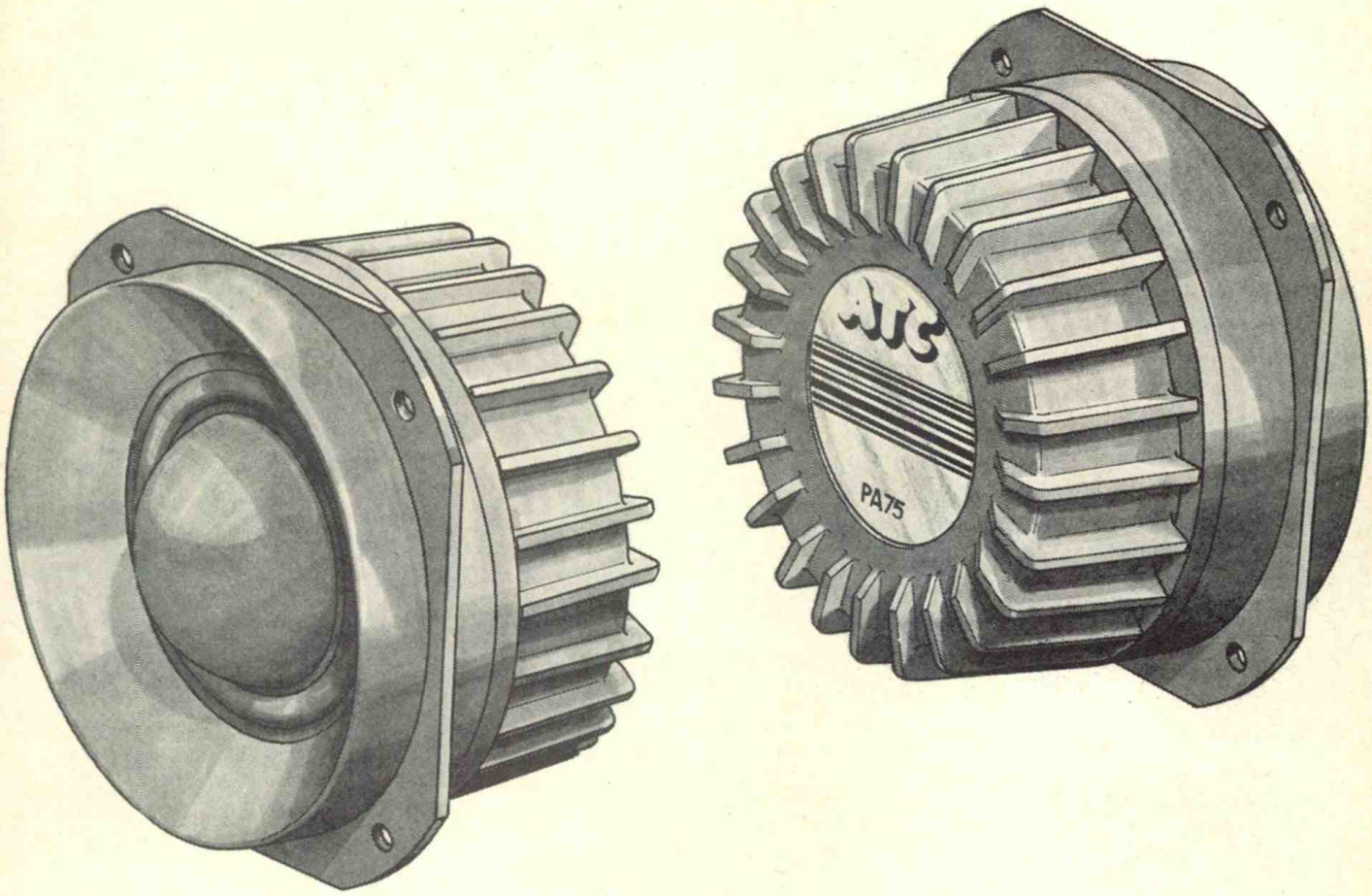
Those familiar with the Ampex ATR-100 service manual will recall a ready-made flux loop (Cat. No. 4020423) and a driving amplifier (Cat. No. 4040424), that has been pre-equalized to render exact computation of the reproducer response unneccesary, is offered on page 5-17 of that machine=s manual.[4] That's a fine way to go as one need only optimize his reproducing system for flat response using that device. Anyone having one of those probably need go no further in reading this article. Those of us who don't have one by now probably never will as my friendly neighborhood Ampex sales office informs me that the loop driving amplifier has been discontinued.

Those still bearing with us will just have to build their own loop drive (pre-equalized and calibrated, of course) or substitute the HP67/97 software for the hardware. I've been doing it the numerical way for at least three years and haven't suffered badly for it.

The Recipe

The application of the flux loop to practice is no more complicated than simply placing the coil of the loop assembly in as close proximity to the reproducing head gap as can be managed within the physical limitations of the playback head and shield geometry. To this date, the best means of attaching the home-brew loops I have grown to love seems to be with the use of whatever amount of plain old masking tape that seems to be equal to the task of sticking the loop onto the head. Just position the loop for maximum reproduce output at 400 Hz.

CAN YOU AFFORD NOT TO HAVE THE BEST??



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R-e/p 93

Program Description

Program Title: TAPE EQUALIZATION
Name: Peter Butt
Address: Box 91857
City: Los Angeles
State: California
Zip Code: 90009
Date: 10JUL77

Program Description, Equations, Variables, etc. This program solves for the theoretical response of a lossless magnetic tape reproducer system to a constant-flux sinusoidal signal of varying frequency. One or two pairs of defining time-constants may be used. In the case where a time-constant of infinity is desired, as in IEC response characteristics, the quantity 1 EEX 99 should be entered. If only a single pair of time-constants is entered, the ultimate data output will be the frequency of interest in Hz followed by the relative boost or cut of the signal at that frequency in deciBels. If two characteristics are to be solved for simultaneously, the data outputs will consist of the frequency of interest, in Hz, the relative response of curve A, E_A, in dB, the relative response of curve B, E_B, in dB, and the difference between the two responses, $\{E_B-E_A\}$, in dB, displayed in that time sequence. The value of this last output is that it permits the response of a reproducer adjusted to one characteristic, curve B, to an alignment tape for a different characteristic, curve A, to be determined. The equations solved in the program are as follows:

$$f_{hx}=1/(2*PI*T_{hx}) \quad , \quad f_{lx}=1/(2*PI*T_{lx})$$

$$E_X = 10*LOG((1+(f/f_{hx})^2)/(1+(f_{lx}/f)^2)) - 10*LOG((1+(400/f_{hx})^2)/(1+(f_{lx}/400)^2))$$

where X=A,B

Operating Limits and Warnings

DO NOT USE THIS SPACE

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	LBL A	31 25 11	INITIALIZE, COMPUTE f_1, f_h and 400 Hz ref. level for curve A
	CL REG	31 43	
	P≤S	31 42	
	CL REG	31 43	
	1	01	
	4	04	
	STI	35 33	
	R▼	35 53	
	GSUB 1	31 22 01	
010	CF 0	35 61 00	
	RTN	35 22	
	LBL B	31 25 12	compute f_1, f_r and 400 Hz ref. level for curve B
	1	01	
	7	07	
	STI	35 33	
	R	35 53	
	GSUB 1	31 22 01	
	SF 0	31 51 00	
	RTN	35 22	
020	LBL 1	31 25 01	
	4	04	
	0	00	
	0	00	
	STO E	33 15	
	R▼	35 53	
	GSB 2	31 22 02	compute 400 Hz ref.
	ISZ	31 34	
	R	35 53	
	GSB 2	31 22 02	
030	RCL E	34 15	
	RCL(I)	34 24	
	DSZ	31 33	
	CLx	81	
	x^2	32 54	
	1	01	
	+	61	
	RCL(I)	34 24	
	ISZ	31 34	
	ISZ	31 34	
040	RCL E	34 15	
	+		
	x^2	32 54	
	1	01	
	+	61	
	+	81	
	LOG	31 53	
	1	01	
	0	00	
	X	71	
050	STO(I)	33 24	compute and store data for for curve A
	RTN	35 22	
	LBL C	31 25 13	
	STO A	33 11	
	1	01	
	5	05	
	STI	35 33	
	R▼	35 53	
	GSB 3	31 22 03	Test for curve B T-C
	RCL (I)	34 24	
060	-	51	
	STO B	33 12	
	F?0	35 71 00	
	GSB 5	31 22 05	
	GSB 6	31 22 04	
	LBL 5	31 25 05	
	1	01	
	8	08	compute and store data for curve B
	STI	35 33	
	RCL A	34 11	
070	GSB 9	31 22 03	
	RCL(I)	34 24	
	ISZ	31 34	
	-	51	
	STO C	33 13	
	RCL B	34 12	
	-	51	
	STO D	33 14	
	LBL 4	31 25 04	
	2	02	
080	0	00	
	STI	35 33	
	RCL(I)	34 24	Transfere data to stack for displayfor two curves
	ISZ	31 34	
	RCL(I)	34 24	
	ISZ	31 34	
	RCL(I)	34 24	
	ISZ	31 34	
	RCL(I)	34 24	
	DSP 2	23 02	
090	STK	32 84	
	R/S	84	
	LBL 2	31 25 02	
	EEX	43	
	6	06	
	CHS	42	
	X	71	Compute f_h, f_l, from T-Cs, stor data
	2	02	
	X	71	
	PI	35 73	
100	X	71	
	1/X	35 62	
	STO(I)	33 24	
	RTN	35 22	
	LBL 3	35 25 03	
	RCLI	34 24	
	DSZ	31 33	
	+	81	
	x^2	32 54	
	1	01	
110	+	61	
	RCL(I)	34 24	
	ISZ	31 34	

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4 f_{lA}	S5 f_{hA}	S6 E_{400A}	S7 f_{lB}	S8 f_{hB}	S9 E_{400B}

A: f | B: E_A | C: E_B | D: $E_B - E_A$ | E: 400 | I:

Simplicity hath charm.

Now, Problem B is solved. On to Problem C. The bandpass of the system of interest shall be taken as the bandpass of the equalized preamplifier stages at the last signal terminal after the equalization process has been completed. Please note! The system bandpass shall not be taken as that exhibited at the playback signal output connector of the tape machine itself! This is important as most tape machines have low-pass filters at the input of their line driver amplifiers or take steps to roll off the line driver response by use of feedback capacitors. The effects of resonances that are very apparent to the preamplifier circuit may not be apparent at the output of the line driver. A serious peak may exist at 30 or more kilohertz but may

Program Listing

KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
ISZ	31 34					
RCL A	34 11		170			
+	81					
X^2	32 54					
1	01					
+	61					
+	81					
LOG	31 53					
1	01					
0	00					
X	71					
RTN	35 22		180			
LBL 6	31 25 06					
2	02	Display Curve A				
0	00	data only				
STI	35 33					
RCL(I)	34 24					
PAUSE	35 72					
R/S	84					
			190			
			200			
			210			
			220			

LABELS

X	A X	B X	C X	D	E	
	a	b	c	d	e	
	1 X	2 X	3 X	4 X		
X	6 X	7	8	9		

FLAGS: 0 X; 1; 2; 3

SET STATUS

FLAGS	ON	OFF
0	☐	☐
1	☐	☐
2	☐	☐
3	☐	☐

TRIG: DEG ☒, GRAD ☐, RAD ☐

DISP: FIX ☒, SCI ☐, ENG ☐, n = 2

User Instructions

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load side 1 and side 2	------	----	0.00/----
2	Input high frequency response time-constant in microseconds.	T_h	ENT	T_h/usec
3	input low frequency response time-constant in microseconds.	T_l	-----	T_l/usec
4	Initialize program; compute f_l, f_h, and value of response function at 400 Hz, E_{A400}, for reproduce equalization curve A.	-----	A	E_{A400}
5.	(If required) Input second curve high-frequency response time-constant in usec.	T_h	ENT	T_h/usec
6.	(if required) Input second curve low-frequency response time-constant in usec.	T_l	-----	T_l/usec
7	Press B to compute f_h, f_l, and value of function at 400 Hz, E_{B400}, for second equalization curve B.	-------	B	E_{B400} f/Hz
8	Input frequency of interest in Hz.	f		
9	Press C to compute relative boost or cut at frequency f. Display is in the sequence given:	------	C	f/Hz
	(Press gSTK for review of outputs)			E_A/dB
				E_B/dB
				$E_B - E_A$/dB
10	Repeat 9 and 10 as required.			

be obscured by a line driver response roll-off.

In all cases where a flux loop is to be used to establish or to verify reproducer equalization accuracy, it is necessary that the preamplifier response as it interacts with the head be considered separately from the line driver response. I have been taking the frequency at which the preamplifiers' rising response to the constant flux drive of the flux loop peaks and drops off about 3 dB below the maximum level as the reproducers bandpass. The reason for doing this is to be very sure that I have swept to a sufficiently high frequency to have observed the worst-case deviations from the standard reproducer response as modeled by the calculator response program. Even though the maximum peak usually occurs fairly far above what is

considered to be the maximum audible bandwidth, a high frequency peak response can extend its effects far down into the audible range.

Having persisted this far, we now move on to dealing with Problem D. Namely, how do we recognize villainy in any given reproducer chain? I could be very wrong, however my techniques for isolating problem(s) is to set the machine of interest for the highest speed equalization convenient without modification. Then, install and optimize the flux loop. Connect an AC voltmeter to the repro preamplifier output port, setting the loop driver oscillator for 400 Hz at a level that will yield a reproducer output level approximately 20 dB below the usual zero setting for that machine. The purpose of this is to insure that clipping will not occur at any time during the measurement process. Those having fundamentally insecure natures will likely monitor the AC voltmeter indication with an oscilloscope to further assure themselves that clipping or slew-rate limiting is not taking place during the measurement. By the way, the reason for selecting the highest speed equalization is to also protect against clipping of the preamp as the higher speed reproducer curves are generally the less severe, and therefore require less boost than do lower speed EQ's for the same frequency.

Fancy Footwork

Now for the tricky part. Using the calculator, or a tabulation, determine the values of expected boost relative to the 400 Hz reference level that should occur at 10 kHz, if the reproducer HF control is properly adjusted. Then, change the loop generator frequency to 10 kHz and adjust the reproduce HF EQ control to yield that amount of boost. For example, if we are setting a preamp for a 30 ips AES curve, 10 kHz is 3.43 dB higher than the 400 Hz reference. Reset both frequencies again until they are both as accurate as possible In doing this, use a counter if necessary to insure that your frequency settings are within ±3% or less of the nominal values needed. Having done this, now set the low end equalizer for the ideal calculated response at 50 Hz. Now go back and check the 400 Hz and 10 kHz readings and re-adjust where necessary to make the 50 Hz, 400 Hz and 10 kHz points exactly correct. Accuracy is important here because we will be trying to achieve a cumulative accuracy of about ±1/4 dB if we can. Of course, your test equipment should have been certified some time recently. All of it.

Calculating the theoretical response figures for frequencies above 10 kHz by 1 kHz intervals, check for a rising AC voltmeter indication above what the expected calculated reading should be. When the difference between the observed indication and the calculated readings rise to a maximum and then drops back to theoretical and then below it, we will have observed a peak, most likely due to the repro head inductance interacting with its cable capacitance. Note the frequency and the magnitude of the peak for reference as we seek to damp it out so that it rises less than a 1/4 dB above the calculated value. This is the point where an accurate meter and a level generator is the determining factor in how well we succeed in our efforts.

The Home Stretch

As things stand now, we've isolated the source of the problem. We have determined the frequency and magnitude if the reasonance peak in our reproducer response. In all the cases of which I am aware, the culprit has been the resonating playback head. The cure for this, Problem E, is to add resistance in parallel with the resonance until it no longer presents us with a significant rise in response.

The point at which the damping resistor can be most advantageously added to the circuit is at the input to the preamp in the case of Mincom M-79, M-56, M-23, or M-64 reproducer preamps. Ampex AG-440A/B/C preamps, MM-1100/1200, Studer A-80 preamps, and MCI JH-114 preamps do best with the damping resistor across the secondary of the reproducer preamp input transformer. That's where it should be for the case of the Mincom sync input transformer also. After a value of damping resistor is installed in the appropriate place, the response calibration and measurement sequence should be repeated, going through the 50 Hz, 400 Hz, 10 kHz routine and then checking for progress against the peak. For the MCI JH-114, just adjust the damping pot to a larger value if the peak cannot be observed, or to a lower value if it can, and do it again.

If the worker is overtaken by boredom, stubbornly crossed eyes, or numbness in the extremities, it's time to consider either settling for what has been accomplished or diversion to other activities until his acuities return. This is, basically, the method that seems to draw ohs and ahs from mixers and other clientele.

Lingering Doubts

Do I detect skepticism among the populace? Are there murmurings of doubt? Sniggers? I daresay, outright guffaws? Step a little closer my friends. It's time to circulate among you the assorted tangible proofs of the proverbial pudding.

Among these very pages are to be seen illustrations of the efficacy of the remedy I have endorsed at such length.

Obtained with great difficulty in the trackless wilderness of Darkest Hollywood, Figure 4 shows a flux loop frequency sweep of a virginal Ampex 440C obtained using a Hewlett-Packard 3580A spectrum analyzer. The two traces displayed show the response of two 17.5 microsecond reproducing preamps, each loop-equalized per spec at 50 Hz, 400 Hz, and 10 kHz. The trace scale factors are 5 kHz/div. horizontal and 10 dB/div. vertical. The output levels were fairly closely matched at the 400 Hz area of the curves, although the trace having the lesser level variation was about a dB or so higher below 1 kHz. Close scrutiny may reveal that the traces cross one another around the 17 kHz region. The trace having the greater high frequency level through the 25 kHz + region is a stock 440C preamp. The other trace is a stock 440C

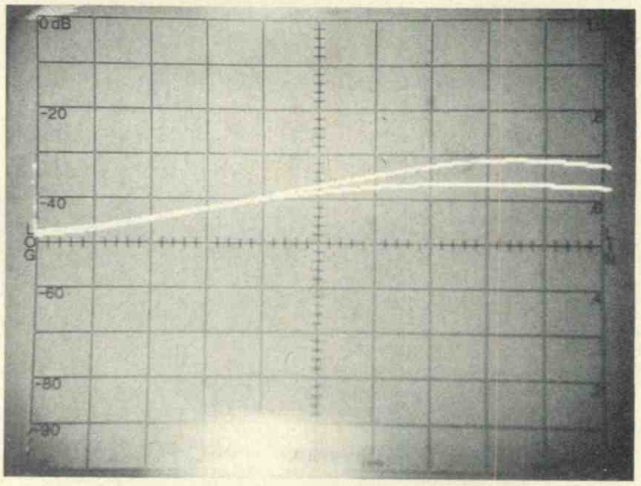

Figure 4: Flux loop sweep of two 440C preamplifiers. The scale factors are 5 kHz and 10 dB per division. The upper trace shows undamped response while the lower shows damped response. The preamps are othewise identical.

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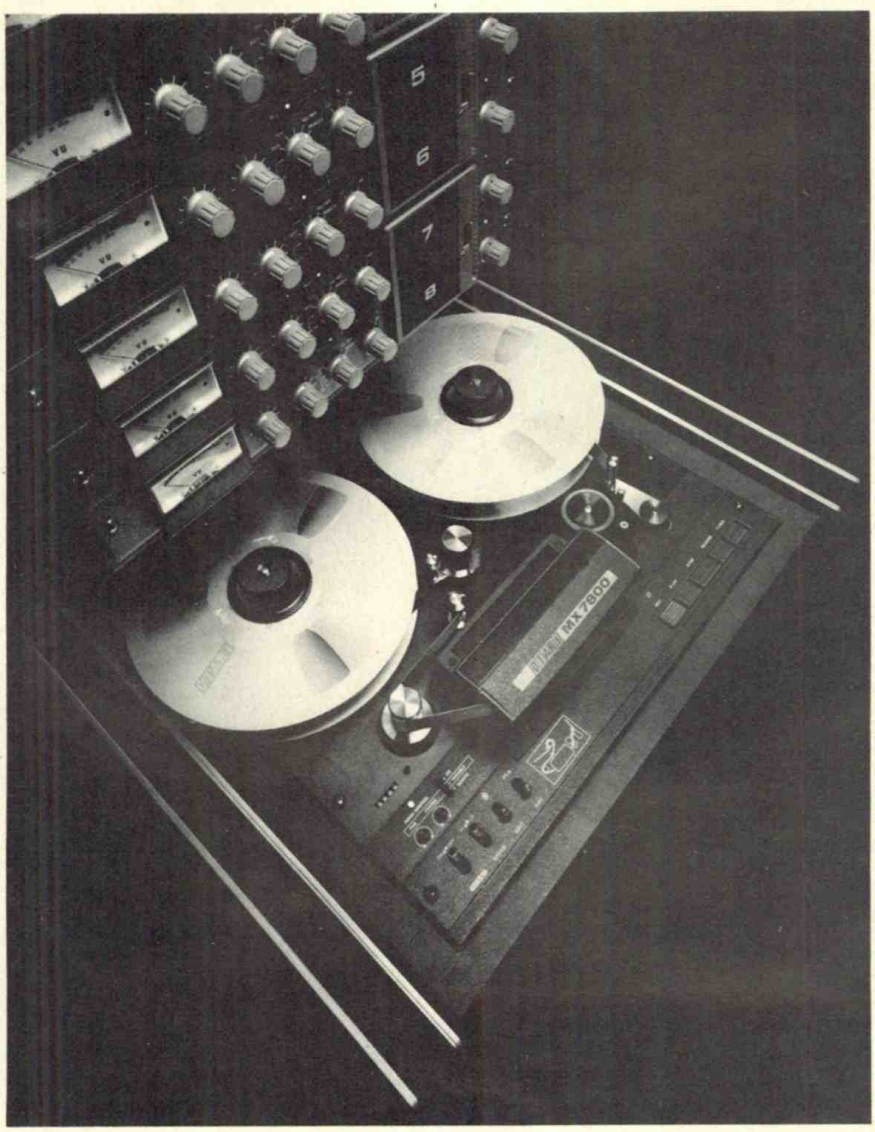

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preamp that has had an emperically determined damping resistor placed across its input transformer secondary. The optimum value of the resistor was determined to be around 430 kilohms. A metal film 432 kilohm resistor was used.

The reader will note that in the case of the undamped preamp, the audio band response dips below the ideal theoretical between about 1 kHz and 10 kHz, remains about the same as the damped unit to about 17 kHz, and then rises well above the damped response beyond 25 kHz. That dip between 1 kHz and 10+ kHz is what is perceived as a response hump in the record/playback response in that part of the spectrum. It's only about a dB and a half at its worst, however I maintain that the correction has been worth the effort. It is the high frequency response peak that is the real culprit. These traces only serve to illustrate the kind of resonance deviations that have proven troublesome.

A Brighter Day

Now for the spectacular part. Keeping our flux loop in place, we transfer the signal cable to the output of a square wave generator. We again observe the same two 440C preamps square wave response in the time domain. To make the test conditions a little more like the true-to-life situation, an 8 microsecond single pole R-C filter was used to slow down the square wave rise time to something more closely resembling a recorded acoustic transient. Figure 5 shows the preamplifier response to this filtered 2 kHz square wave with the EQ controls set to the 3180/50 microsecond theoretical loop response values as 50 Hz, 400 Hz and 10 kHz. The upper trace is the output of the damped 440C preamp while the lower trace is the output of the undamped preamp. Although neither waveform would win any prizes in a transformer beauty contest, the output of the damped preamp clearly exhibits less overshoot with practically no ringing compared with the undamped unit.

Figure 6 shows the same sort of situation as does Figure 5 with the exception that the preamps' equalizers are set to conform to the infinity/17.5 microsecond loop response values at 50 Hz, 400 Hz, and 10 kHz. The previous commentary still applies.

The Tape

The square wave test was also applied to the tape and the preamp response to the recorded signal was observed. The 440C was equipped with shorting plugs in place of the bridging line input transformers. The tape used was Ampex 406 biased 3 dB over the maximum sensitivity peak at a 1.5 mil wavelength in each case. The square wave was recorded at a machine VU meter indication of -4 referred to a 260 nWm reference at a medium wavelength. Further reductions in recording level did not noticeably change the traces observed at the preamplifier output terminal. An unfiltered 2 kHz square wave was used for comparison with the results obtained with the flux loop. Figure 7 shows the 15 ips record and playback responses. Figure 8 shows the 30 ips playback. I submit that these tests infer that subjective comparison of music reproduction of damped and undamped reproducers will result in the preference for the damped reproducer in the great majority of cases. That has been my experience over the past three years, and I expect that it will continue to be.

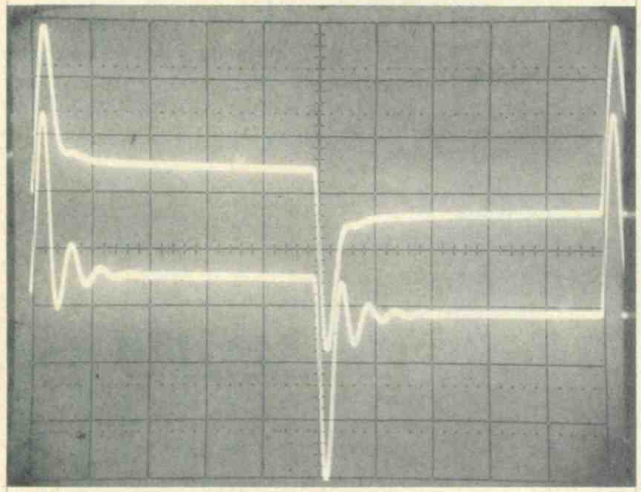


Figure 5: Loop-induced bipolar 2 kHz square wave response of the two preamps of Figure 4. The output of the damped preamp is shown by the upper trace while the lower trace shows the undamped unit. Both preamps are equalized to the 3180/50 microsecond characteristic.

Panacea Endorsement

I submit that, once again, the introduction of additional poles and/or zeroes into the audio reproduction equalization network is beneficial for purposes of specsmanship only. Even though the effects of such compensation can somewhat justifiedly be said to be

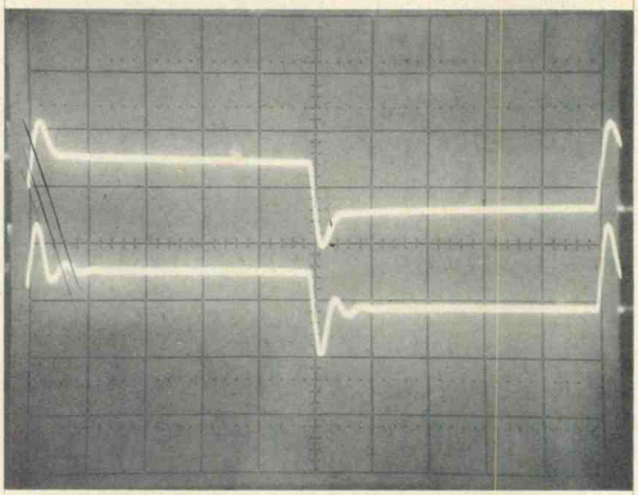


Figure 6: Loop induced bipolar 2 kHz square wave response of the preamps of Figure 5 with equalization set for the infinity / 17.5 microsecond characteristic. Trace assignment as in Figure 5.

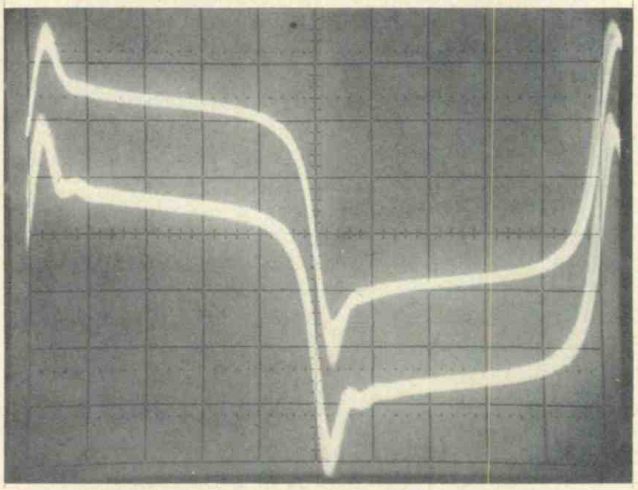
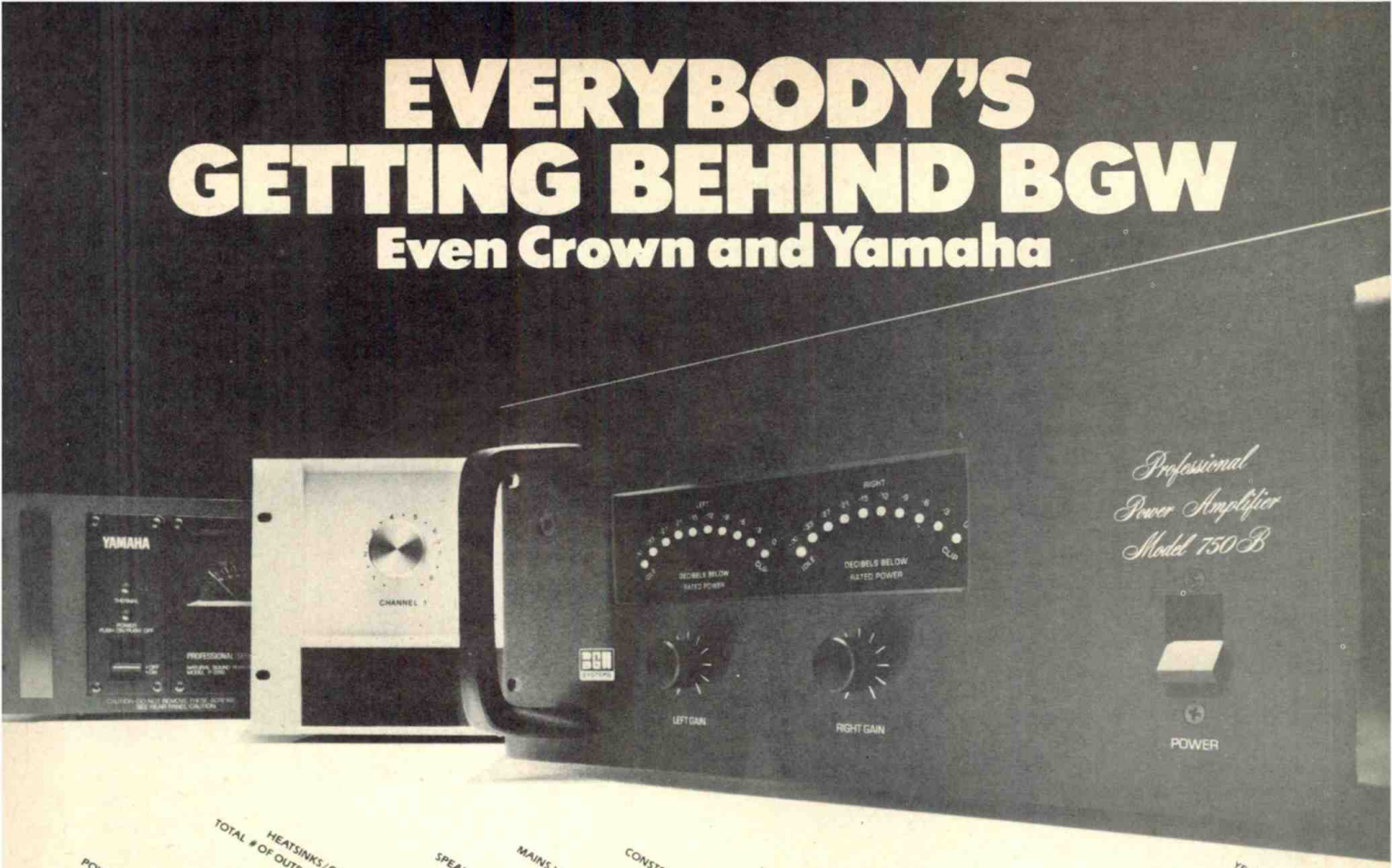


Figure 7: AG-440C 2 kHz square wave record / reproduce response at 15 ips. Trace assignment as in Figure 5.

EVERYBODY'S GETTING BEHIND BGW

Even Crown and Yamaha



	POWER* @8 OHMS	@4 OHMS	TOTAL # OF OUTPUT TRANSISTORS	HEATSINKS/COOLING SYSTEM:	SPEAKER PROTECTION:	MAINS (AC) PROTECTION:	CONSTRUCTION DESIGN:	TURN-ON DELAY:	CIRCUITRY:	T.I.M.	PRICE: *	YEAR INTRODUCED:
BGW 750 B/C	225 Watts/ch.	360 Watts/ch	20	Forced air cooling for 2 massive removable modules	Active arc-interrupting circuitry	Front panel magnetic circuit breaker	Modular all Teflon wiring	Relay operated transient delay circuitry	Full complimentary	0.02%	$ 999 — Model 750C $1099 — Model 750B	1978
CROWN DC300A	155 Watts/ch.	NO FTC RATING	16	Passive airflow only	None provided	Rear panel fuse only	Hard-wired, non-modular	None	Quasi-complimentary	Not specified*	$ 919 ***	1974
YAMAHA P2200	200 Watts/ch.	NO FTC RATING	12	Passive airflow only	None provided	Rear panel fuse only	Hard-wired, non-modular	None	Full complimentary	Not specified*	$1095	1976

Here they are — The big guns of professional amplification: The respected Crown DC300A, The cosmetically impressive Yamaha P2200, And BGW's new, no-nonsense 750B/C.

Top-of-the-line professional power amplifiers from the industry's most respected manufacturers. All boasting impressive reputations. All costing about $1,000.

The table reveals the specifications.* You decide which one is best.

THE RELIABILITY FACTOR

Above all else, professional musicians and audio engineers want to know two things about their power amplifiers: How dependably they function under extreme conditions, and how well they interface with other components.

BGW's new 750 Series amplifiers have taken the lead in both areas. Twenty (20) output transistors as opposed to Crown's 16 and Yamaha's 12 provide a Safe Operating Area unmatched by either the DC300A or the P2200. While both Crown and Yamaha rely on passive "convection" cooling, the extensive heat sinks on BGW's pro amps are cooled by forced air for reliable, continuous performance even on the hottest outdoor concert stages. Unique new arc-interrupting circuitry protects speakers — not just the amplifiers themselves — from catastrophic DC offset.

Like all BGW amplifiers, the 750B and C feature modular construction and front-panel circuit-breakers rather than hard wiring and cumbersome rear-panel fuses. The result: Maintenance is easier both onstage and in the studio — when time and tempers can be very short.

CLARITY AND PRESENCE

Now that audible Harmonic and Intermodulation Distortion have been all but eliminated from professional power amplifiers, Transient Intermodulation Distortion (TIM) has become important. Neither Crown nor Yamaha specifies TIM levels whereas TIM specs for BGW's 750's Series are published with the greatest of pride. The 750B and C consequently produce clearer, warmer, and more open sound.

Pros will also appreciate another BGW exclusive: A delay circuit that eliminates all transient "thumps" when the 750B and C are activated. Neither Crown nor Yamaha has anything like it.

POWER

This is where BGW really leaves the competition behind. While the Crown DC300A and the Yamaha P2200 are rated at 155 and 200 watts, respectively, BGW's 750B/C delivers a full 225 watts per channel into 8 ohms,** leaving the competition behind entirely at 4 ohms, with a whopping 360 watts. Only BGW has FTC rated 4 ohm power specifications.

Both the DC300A and the P2200 are good power amplifiers by conventional standards. But real recording pros don't deal with convention.

They get behind BGW.

Because the competition already is.

*Based on manufacturers' published specifications and prices available 7/1/78.

**BGW 750B/C FTC Specification: 225 watts minimum sine wave continuous average power output per channel with both channels driving 8 ohm loads over a power band from 20Hz to 20kHz. The maximum Total Harmonic Distortion at any power level from 250 milliwatts to 225 watts shall be no more than 0.1%.

*** Includes optional HMB-7 Handles ($20.00, not shown)

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significantly active over the extreme upper region of the audible spectrum, their effects reach throughout the audible frequency range, degrading transient response, intelligibility and stereo imaging. As support for this opinion, I refer the reader to the high frequency peaking controls included in the Mincom M-79 reproducer and sync equalization circuits. Everyone of my acquaintance keeps these peakers, active around 18 kHz, turned **completely off.** Those having access to an M-79 are invited to try raising the HF peaking hump even slightly and observe the effects on program material. Even though the effects on the sine wave reproducer response will still lie within the traditional ±2 dB limit, the audible

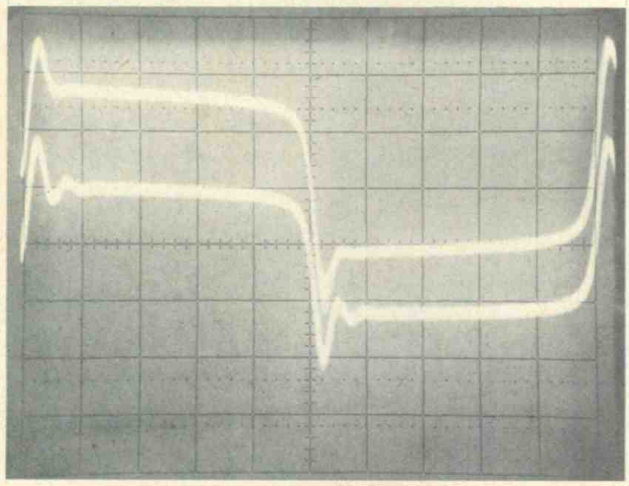


Figure 8: AG-440C 2 kHz square wave record / reproduce response at 30 ips. Trace assignment same as in Figure 5.

experience of even low frequency instruments such as bass and kick drum will suffer out of proportion to the amount of peaking introduced.

Serendipity Clause

Whether a desirable improvement in the playback characteristics of any tape machine is actually realized remains pretty much a matter of subjective judgement. These adjustments to the reproducer response curve were originally undertaken purely for the aesthetic satisfaction of having a record/reproduce frequency response that is maximally flat within the plateau of the machines response range. In most cases the deviation from flat response in the 2 to 8 kHz region amounted to 2 dB or less. This variance can generally be reduced to about 0.5 dB or even less if sufficient care is taken. The difference in the transient response and intelligibility improvement has only recently become apparent to me as it is not often that I have the opportunity to experience the results of my work directly.

Endearments and Advice

With that heavily biased endorsement, we shall now proceed to some tips that may be helpful to the neophyte embarking upon the gilding of whatever lilly he may have available. First, let us recognize that magnetic heads are often inconsistant things. Head assemblies of identical manufacture and part number have proven to require different values of damping resistance. There are MM-1100's that require values ranging from about 160 kilohms in some cases to 270 kilohms in others. MM-1200's require from 150 kilohms to 430 kilohms. Occasionally one is found that requires no damping whatever and is best left alone. M-79's have required

damping values ranging from about 100 kilohms to infinity. The more recent vintage M-79's seem to be less likely to require damping than do the earlier production units. Studer A-80's generally damp out at about 160 to 220 kilohms. In the case of the M-79 and A-80, it is worthwhile to consider that the repro and sync functions are served by separate preamps. Each set of preamps should be treated individually. In the case of multi-track machines it is good to verify that the damping resistor value appropriate for one channel will serve well for its neighbors. A spot check is sufficient in my experience. I know of no multi-track heads that have widely differing impedance characteristics within themselves. If spare head stacks are used with the machine, check compatibility with **all** assemblies. Better safe than sorry.

Finally, dear friends, do not leave the low-frequency reproduce equalization control set at the position determined by the flux loop response for actual recording use. The low-frequency response of any tape recorder cannot be predicted due to the effects of fringing and contour effect. By all means set the reproducer low-frequency response to a satisfactory position against the recorded signal. The low-end response was set during the loop response determination only to make the observed curve match the model more precisely.

Shameless Endorsement

As a closing note for this piece of bigotry, I wish to emphasize the importance of accuracy in choice of instrumentation for the damping process. The deviations from the ideal are rather small and require the utmost care in setting of reference levels and accuracy of generator frequency settings within 1% or better. A 1% frequency error can account for a 0.1 dB observed error in response level.

I have found that a Krohn-Hite 4000A or 4100A R-C generator is convenient as the output frequency is determined by discrete switch settings rather than by a continuous dial. These generators are also leveled very well, making continuous monitoring of their output levels unnecessary. The Hewlett-Packard 400 FL and 400 GL AC voltmeters have served very well as indicators. Mirrored scales are a marvelous invention. Use of a 1X, wideband scope probe for the AC voltmeter signal pick-off is handy although not absolutely necessary. Lastly, have your instruments certified if they haven't already been within the last 12 months. This is very important. I've noticed a lot of meters used by fellow fixers that are in error by more than ±1 dB.

Good luck, fellow fixers. Remember: Everything really does matter.

Gratitude

Many thanks to John McKnight, of Magnetic Reference Laboratory, for his thoughtful comments on the manuscript for this article. □ □ □

[1] P. Butt, -Mundane Applications of the Flux Loop-, **R-e/p**, Vol. 5, No. 4, August 1975.

[2] J. G. McKnight, -Gap-Length Response In Magnetic Reproducers: Calculation, Measurement, and Compensations-, **AES**, Pre-print No. 1297 (C-5), presented at the 58th AES Convention, November 4-7, 1977, New York City.

[3] Ibid.

[4] Ampex ATR-100 Service Manual, Ampex P/N 4890407-01

SAN FRANCISCO AREA SMALL STUDIOS

Are They and Their Operations Unique?

by Tom Lubin

Though the music industry has grown by leaps and bounds in recent years, there has been a decentralization of traditional recording centers as well as a reduction in the number of label-owned studios. The reason, or possibly result, has been the ever increasing number of independent small-town and suburban studios. Many are in pastoral surroundings far from the big city hassel, hustle, and bustle.

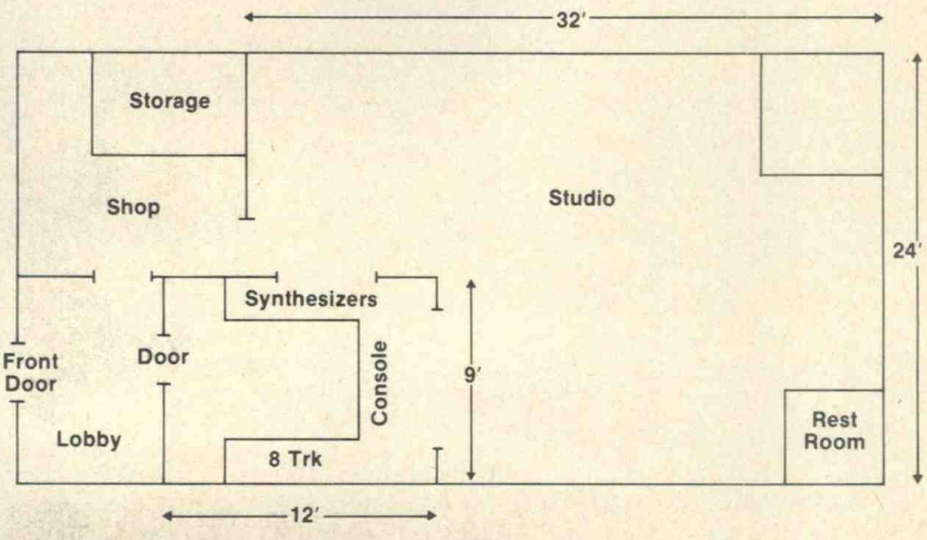
It seems most everyone in the music business wants to participate in the creative process that occurs in a recording studio. A good many want to spend days or weeks on end sitting in a room that's only window looks into another room. Each year, hundreds of studios appear and disappear. In almost all cases, the owners of these studios had hopes of operating commercially and on off-hours producing their own product. Many will fail, losing their hearts and wallets in the studio romance, discovering too late the realities of the affair.

Tom Lubin visited five small studios in the San Francisco Bay Area and discussed the problems each owner/engineer faces to gain an understanding of how their businesses operate and survive. Although each owner/engineer was unique in his approach and background, they all experience obstacles common to small studios everywhere.

Corasound

Corasound, which has been in business for three years, is located in an industrial park in San Rafael at the end of a long concrete warehouse which is shared with a number of other businesses. **Stephen Hart** is the chief engineer and principal owner. The studio has an Otari MX-5050 half-inch 8 track, 1280 Sound Workshop mixing board, JBL-4311 monitors, dbx noise reduction and a number of synthesizers. Jobs engin-

CORASOUND



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If you're an engineer, the 90-16 Function Select panel will make a lot of sense to you. One button operation simultaneously switches three interrelated functions: tape/source, playback/record, and DBX decode/encode thus eliminating the need for three arms. If you're a musician, this human engineering factor means you won't have to wait for the engineer and lose the spontaneity of your music in the process.

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eering demos, budget LP's and many radio and television commercials support their own in-house production activity. Posted rates are $20.00 an hour. Hart was looking for an engineering job and couldn't find one, so he started his own studio.

Chameleon

Located at the end of a dark road in the city of Bolinis, **Chameleon** is appropriately named since it's rather difficult to find. Chameleon has a Tascam 80-8, a Sound Workshop 1280 board, Electro-Voice Sentry V monitors, and dbx noise reduction. The posted rate is $25.00 an hour. The studio has been operating its Tascam for two years. It's a garage studio of the first order featuring a greenhouse, an ocean view and a reputation for recording jazz. **Russ Frehling,** who has a degree in music from Mills College, wanted a studio for his own work and figured he could pay for it by doing sessions for others.

Tewksbury

Tewksbury Sound is in the hills above Richmond. The outside of the building looks like it once was a neighborhood grocery store. The studio has a Scully 16 track, Spectra Sonics board, JBL-4350 monitors, and an extensive selection of microphones. The posted rate is $40.00 an hour. Tewks' owner, **Dan Alexander,** got introduced to recording a few years ago while playing guitar for the Rockets, a Berkeley band that featured Eddie Money.

Ayre

Ayre Studios is located in San Jose in an industrial park similar to Corasound. It is equipped with a Tangent 3216 board, an updated MM-1000 and 604-E's with Mastering Lab Crossovers. Posted rates are $30.00 to $40.00 an hour. **Richard Nebel** opened the studio about six months ago after spending a number of years on the road doing sound reinforcement.

Altmann

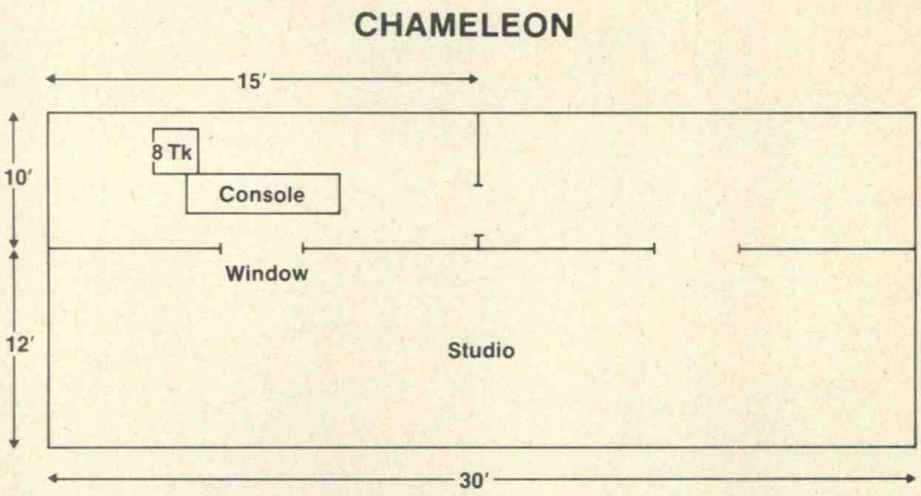
The studio of **John Altmann,** a former sound technician at Mills College, was once his home. Altmann had taken a TEAC stereo 1/4 track and made it into a four track long before the manufacturer offered such a modification. Along with the TEAC, **John Altmann Recording** has an MM—1000, a home-grown console with Ampex MX-10's for mike mixers and L-100 and MDM-4's for monitors. The posted rates are $30.00 an hour. The location is a quiet neighborhood in San Francisco.

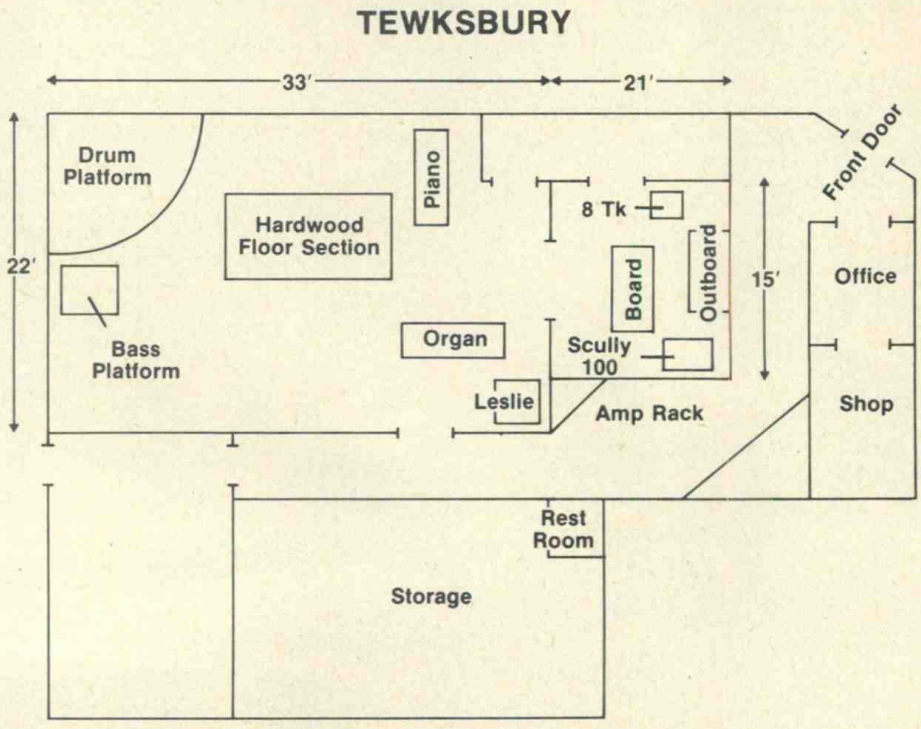
Professionalism

Typically, someone starting a small studio would buy used machines and a board from a larger studio undergoing expansion. A good many pieces of audio equipment have pretty amazing histories — two years at one studio and then three years at another. Many small studios continue with this approach. However, in the last couple of years, there has emerged many professional operations doing commercial recording using what the industry has dubbed "semi-professional" tape recorders and boards. Russ Frehling, for one, objects to TEAC and Otari being called semi-pro.

"A lot of people use them in ways they couldn't use the big systems," he said. "They have made the technology accessible to a lot of people who never would have been able to get into a 'professional' studio. Five or six years ago an artist couldn't go into a studio unless he had a whole lot of money, now he can.

"And just who is the *semi-professional?* The engineer or the artist? There are semi-professional applications such as a band that gets a half-inch 8 track and sets it up in a rehearsal hall so they can work out parts. They are professional musicians but semi-professional engineers. In a studio like mine, or Stephen Hart's, we're engineering all the time. Once you take a lot of money off someone's hands, or you lose a few nights sleep with a session, or an artist





capricorn buys automated console for less than $20,000

It's an undeniable fact that Capricorn's API console* has had more than just a small part in creating one gold record after another. Based on past performance, there was an obvious reluctance to part with the console, yet they wanted to automate.

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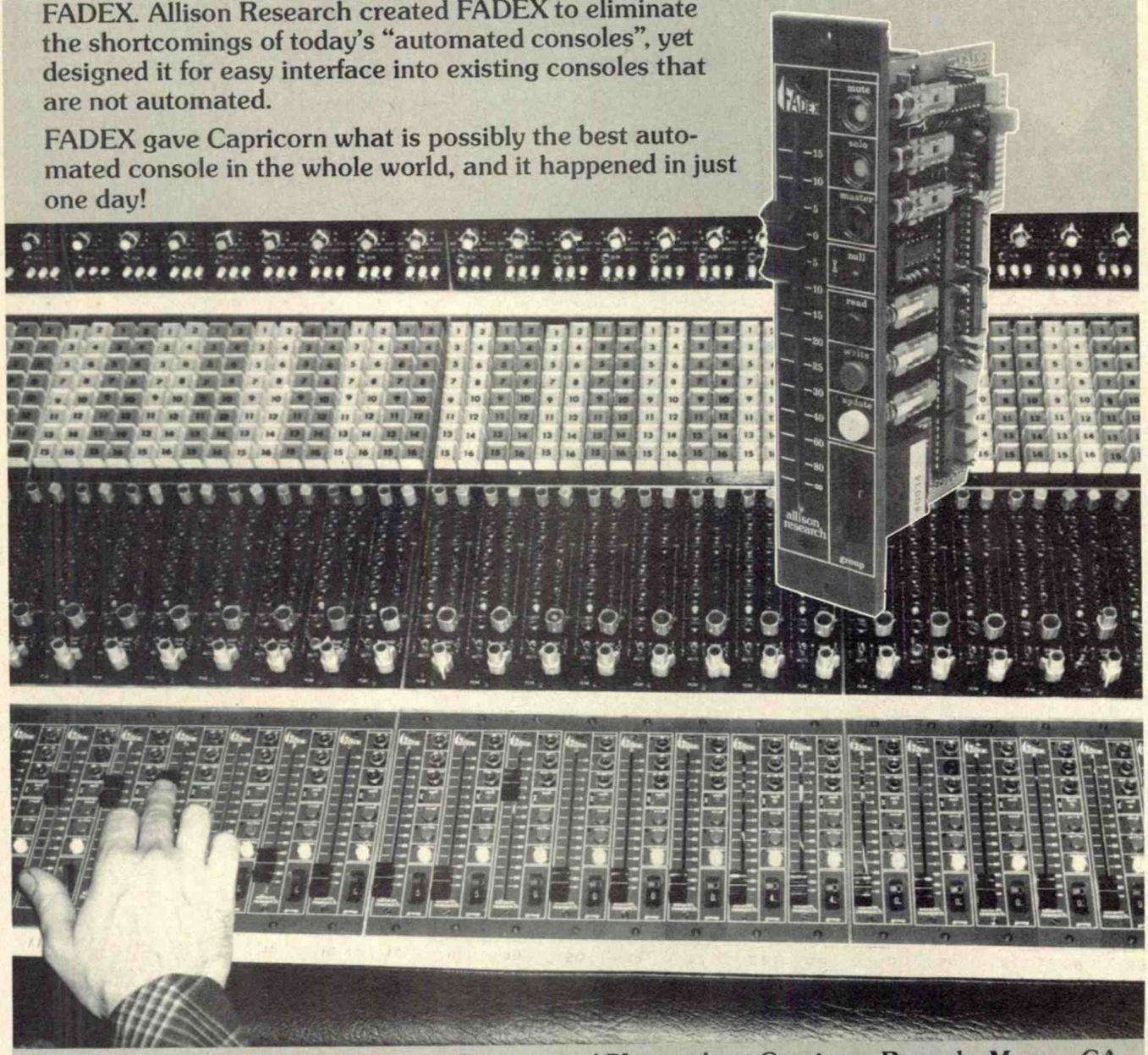

FADEX installed by Electro-Acoustic Systems in API console at Capricorn Records, Macon, GA.

*FADEX will replace the standard 1½"x7" Fader module in most consoles. FADEX is a trademark of Allison Research, Inc.

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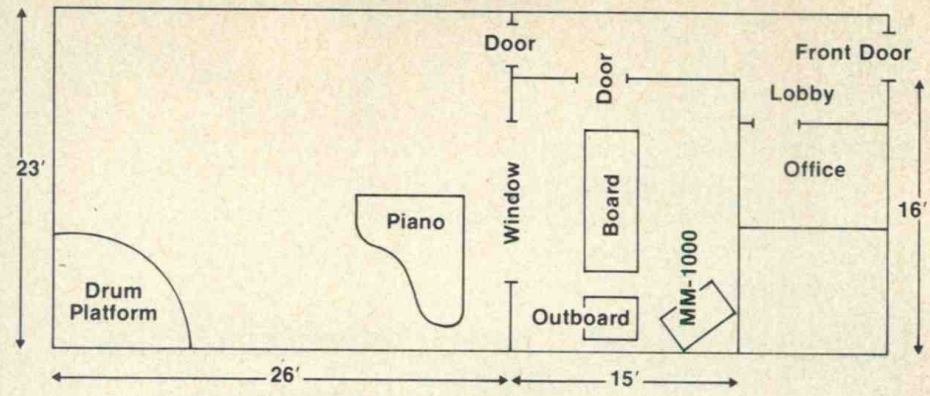
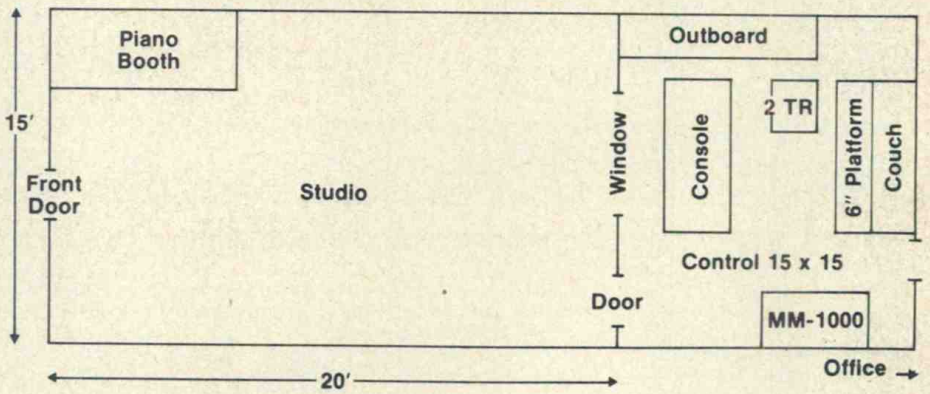


JOHN ALTMANN RECORDING



comes to you especially, then you're sure ***not*** operating semi-professionally."

He continued, "It's a difficult business, a small studio like this, because your client expects the same kind of professionalism that they get at a much more sophisticated studio. It's rough. That and the realization that probably 90 per cent of the people who come here will go no further. Unfortunately, there are too many groups with bigger ambitions than abilities. To keep on top of it is really hard."

Location

All the owners interviewed agreed that location was a major concern.

"You have to find a place that has a market, but the market isn't so big that it's already become saturated," explained Frehling. "That's quite a fine line. You have to find that slot. You can create a market by location."

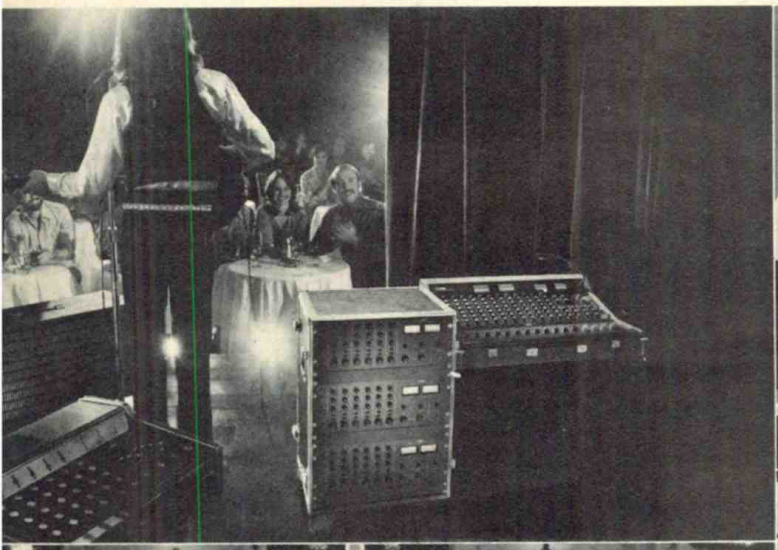
Building a studio in your own home has the advantage in that there is no additional building rent. On the other hand, Frehling and John Altmann agreed that trying to put a commercial operation in your home forces you to constantly do battle with the structure, which is usually less than ideal. Cheap space was also mentioned as a major concern in the selection of the studio site, as was adequate parking. Buying the building or at least having a long-term lease is essential.

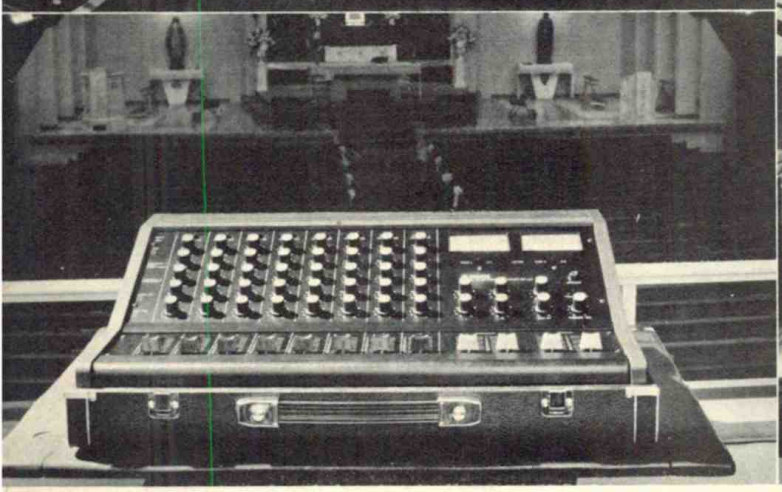
"I've got the money now to do a lot of improvements; put in acoustic treatments and install air conditioning, but unless I'm going to be here for some years the improvements end up belonging to the landlord," said Stephen Hart. "Then there's the point that you can only deduct a *portion* of the money that's spent on improvements. If it's a permanent fixture, it's out the window. It's hard to build a good room that looks right. All the equipment can be moved but you just don't want to improve a room if you know you are going to be moving in the near future."

In many cases the construction might be needed to not only make the room acoustically right but to compensate for some inadequacy in the building. Tewksbury, which has an all-wood floor that's supported on wood beams, has come up with a couple of ways to cut down on the acoustic flanking transmission caused by low frequency vibration in the floor. Dan Alexander built a four-inch drum platform, lined it with plastic and filled it with sand. Made entirely of one-by-six-inch tongue and groove pine board, the drum platform eliminates the resonance that the drums would generate in the wood floor.

'Tewks' also has an interesting way of

Yamaha's PM Series. A mixer to match every job.





No matter what the application, or how tough the job, there's a Yamaha PM Series professional sound mixer that can handle it.

Think of the Yamaha PM mixers as business machines that insure your sound. The PM-170 and PM-180 are ideal as prime mixers for small clubs, discos, schools and the like. Or they're excellent submixers to extend the capability of larger consoles.

The Yamaha PM-430 and PM-700 are the portable heavyweights. They have the specs, power and flexibility to mix well in moderate to major events and concerts, broadcast production and recording studio applications.

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And all your mixes are well under control with balanced, transformer-isolated inputs* and +24dBm (12.3 volts RMS) **stereo** outputs for no-hum sound over long distances. Precision Yamaha engineered and manufactured long-throw, smooth-flow, dB-calibrated faders respond to your most subtle adjustments. And foldback and monitor functions that help you precisely feed the right mix to the right performer or technician.

Send six dollars, and we'll rush you an operating manual complete with schematics on our PM Series. (Please, certified check or money order only. No cash or personal checks.) Or better yet, see your Yamaha dealer and match a Yamaha PM mixer to your job.

*PM-170 uses unbalanced inputs, ideal as a keyboard mixer.

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dealing with the bass amp. The studio has a platform that hangs from the ceiling on wires and springs. A bass player can use the Ampeg bass amp the studio has or put his amp on the platform, which when fully loaded sits about three to four inches above the floor. Altmann has built a booth for his piano in order to get sufficient separation in his small studio.

Reducing Building Costs

Initial interior construction and acoustical treatment is without a doubt a major expense in the starting of a studio. Frehling commented that "a sheet of four-by-eight plywood was going for $20.00." To cut down on the cost of construction, Alexander used surplus building materials.

"Find out where construction sites are dumping their debris and then work out something with the dump guy," he suggested. "The local advertiser is a good source as well for lumber, insulation, lighting fixtures, air conditioning, and so forth."

When it comes to acoustical treatment, they all agreed it is advisable to read extensively on the subject. Books by Runstein, Woram, Borwick, and F. Alton Everest were mentioned as good sources. Everest's *Handbook of Multi-Channel Recording* seems to be particularly useful. Alexander claims to have worn out three copies of it. All of the recording industry periodicals were mentioned as good sources; almost every studio has a stack of dog-eared back issues.

"There's a thousand construction things that cost no more to do right, but if you do it wrong you'll have to tear the room apart to correct it," said Alexander. "Little things like AC outlets, or earphone lines in the right places, or keeping the microphone lines away from the power lines."

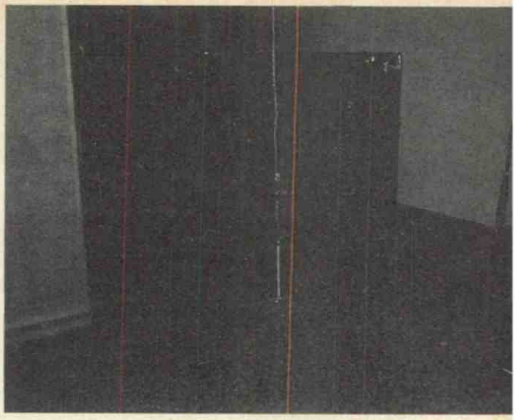
While planning construction, air conditioning or ventilation should be considered. Most felt air conditioning was a significant cost and out of the reach of someone starting on a shoestring. The only alternative becomes some sort of quiet ventilators.

"If the ducts for the vents are built right the air conditioning can be added later using the same ducting," noted Alexander. Switches were always provided so that during a quiet recording the fans could be turned off. To keep warm, Frehling recommends Intertherm Heaters. "They don't make noise and they don't dry your nose," he said.

Financing

Financing is another area in which the owner/engineers face common problems. A figure of $20 - $25,000 seemed to be a realistic amount necessary to start a studio — plus any equipment that can be borrowed and the help of every friend that can wire or swing a hammer. TEAC has begun to arrange financing for its equipment, but generally conventional financing is not available.

"You scrape together the maximum amount of money you can lay your hands on," said Richard Nebel. Leasing and venture capital may be available providing the studio or one of it's principlals have adequate assets.



Tewksbury's hanging bass amp isolation platform.

Trading For Studio Gear

Alexander, out of necessity, acquired his equipment a bit differently than most studios. He started by trading a guitar amp for a TEAC tape machine. He had no cash and no credit. He traded, bought, and sold used equipment and guitars to finance his gradually-expanding facility. Many of the studios have equipment on loan from their vendors. Frehling and Hart agreed that the owner/engineer must have a strong relationship with the guy he buys from.

"If you just walk in off the street they are not going to let you borrow an 80-8," explained Frehling. "But once you've established yourself, you can demo things. I go over to Banana's At Large and J. D. [Sharp, the owner] knows if I try it and like it, I'll buy it."

The logical next question is what can the owner/engineer afford to buy? The consensus was that 8 track was the minimum number of tracks a studio must have to operate successfully.

"Never buy anything that's cheaply made, but one of the advantages of this half-inch format is it's cheap to *operate*," Hart said. "I'm really happy with the Otari, but I've found noise reduction is essential. You should also get the automatic switching that comes with the machine, otherwise trying to do a rolling punch-in is a real hassel."

"I think the half-inch 8 track is great but the one-inch 16 track is a bad idea,"

Frehling added. "I'm a consumer that buys their stuff, but I wouldn't buy one of those. I mean you can buy a used two-inch 16 track for the price of this new machine."

"I took a good look at the Tascam 8 track," said Altmann. "I almost went for one and the board to go with it, but then I happened to get a great deal on my machine."

Altmann Recording, Ayre, and Tewksbury have vintage machines that have undergone extensive up-dating to improve their response and tape handling ability. Altmann's machine had been rebuilt by its previous owner, Alembic, to handle being on the road with The Grateful Dead. The meter is now driven by a pair of push-pull amplifiers being driven by an external oscillator. To vary the speed, the frequency is altered. Tewks' Scully has had the bias rise time lengthened so that the machine does not pop going in and out of record. The Ayre machine now has constant tension rather than constant torque. This improves the tape speed accuracy and eliminates the rise in high frequency output toward the end of the roll — a common problem with constant torque holdback.

Modifications:
Approach With Caution

These modifications were successful. However, many a piece of used equipment has been so heavily "modified" or "customized" that when something goes wrong, neither the factory or the present owner have any idea how to fix it. All available diagrams are of the unit before the changes. Altered equipment should be approached with caution. Not only should the new owner know who made the changes, but the service manual should be updated.

Off-brand equipment often presents similar problems when it comes to getting replacement parts, particularly on mechanical assemblies. Equipment made by prominent manufacturers has another benefit besides parts availability. It will tend to increase clients' confidence in the entire studio operation by association with a trademark with which clients have confidence.

Hart and Frehling have chosen Sound Workshop mixing boards over other similarly-priced consoles because they felt it is the most physically durable board available. "You can push the front of the board and it doesn't move," explained Hart.

"Banana has improved the response quite a bit," said Frehling of his unit. "The board came with Harris 4741 Quad Op-Amps in the input stage. The slew rate on those op-amps is 1.6 volts per

microsecond. Banana replace them with Texas Instrument TLO-74 Bi-FET Op-Amps which are about a half a dB noisier but the slew rate is 13 volts per microsecond. That really improves the high frequency transient response."

Nebel has a Tangent console, with which he is pleased. "I talked to a lot of people when it came out and I almost bought it sight unseen," he explained. "There isn't another board that can touch it for under $20,000. Everything on it is optional and you can continue to add to it. You get what you can afford initially and then build on it as you expand. There's been no problem with it; it's clean, quiet, and has all kinds of head room."

The Tangent console came with a seven segment LED VU display for metering, though displays with more increments as well as conventional meters are available. Nebel felt the seven-segment display was inadequate, "but I calibrated them so they do what I think they should do in relation to what's going on the tape," he explained. "I'm happy with them now."

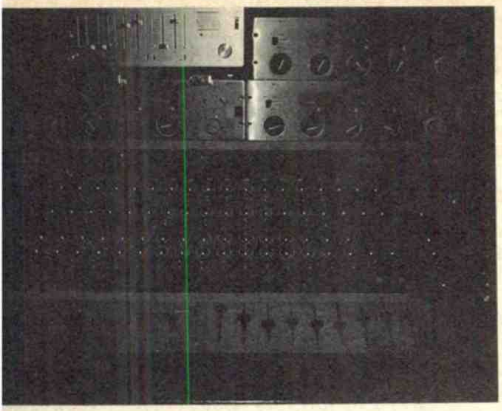
Tewksbury has a small Spectra Sonics 16-input mixing board that has been modified to handle more outputs than it was originally designed for. Altmann uses Ampex MX-10's for microphone inputs and a "home-grown" board for remix and monitoring.

"When we had just the TEAC recorder I needed a mixer so I found this stereo combining network that used a Harris 911 op-amp," said Altmann. "It worked so well that when I got the 16 track, I built more of them for the echo sends and all the other networks that the board needed. The Ampex MX-10's work well as long as you're careful with the gain structure between the input control and the mixer's master. Their one disadvantage is you can't pan between outputs. On the other hand they have that tube warmth. Eventually, I'm planning to put Valley People (Trans-Amp) mike preamps into my board." Altmann also has a number of SAE graphic equalizers that he uses since there is no board EQ.

Monitor Equipment

The type of monitoring system each studio uses varies. The major criteria for selecting monitors seemed to be size. The bigger the control room, the bigger the speaker that is employed. There was a second set in all the control rooms, a pair of Auratones.

Altmann had a particularly interesting set up. The MDM-4's were designed by Ed Long using two six-inch woofers and a tweeter. "They're a little bass light but I think they're truer than the L-100 or Auratones," said Altmann.



John Altmann's hown-grown board.

Microphones

When it came to microphones the owner/engineers were in agreement that it is wise to buy the best microphone you can afford. Almost every one of the studios had an AKG-414, which appears to have become the poor man's U-87. Tewksbury's mike selection is broader than most major studios since Alexander deals in used equipment. Most of them are vintage U-47's, U-67, KM-64, etc.

"Professional microphones aren't usually abused," noted Alexander. "Most of the time they work."

Another expensive necessity is some sort of echo device. The cost of materials and space plus its lack of mobility make a live chamber out of the reach of most small studios. More likely, they will have some sort of spring echo. A few have early EMT plates. All the owners had tried a number of units. When it came to reverb there was agreement that you pretty much got what you pay for. Nebel felt the AKG BX-10 was a good buy. "Next best was the BX-20," he added. "I don't think the BX-20 is worth that much more than the BX-10, but then I don't like spring reverbs."

Hart uses a TAPCO 4400 with MXR mini-limiters on the inputs and noted, "You really have to squash it going in."

"Save your money, I haven't found any of these units all that good," said Frehling.

Altmann has an Orban/Parasound 111B that was often used with a Marshall 5002 delay. Tewksbury has an EMT-140 mono plate.

"It's not too difficult to add an additional contact microphone and make a mono plate into a stereo one," said Alexander. "The price of a used plate, if you can find one, is around $4,000.00."

Tewksbury's EMT has a bit of added mystique having been used on a number of Elvis Presley recordings. "When it arrived it was all rusted," recalled Alexander. "We sanded it down and tightened her up with new springs. It really sings now."

Recommendations For 'Best Buy'

The owner/engineers each had what they considered a "best buy". For example, Hart owns the Ashley SE-66 Parametric EQ.

"I've also been real happy with the Ibanez AD-230," he added. "It's an analog delay. It sounds a little funny when you put it at its maximum 600 millisecond delay, but for short delays it's allright."

"When you have only eight tracks to work with, the Orban Stereo Synthesizer can take a mono drum track and make it a pretty believable stereo," said Frehling. Both Frehling and Hart have dbx 161 limiters.

"Allison Gain Brains are fairly inexpensive and versatile since they are both a peak and RMS limiter," noted Alexander. "And you just have to have a strobatuner and a metronome of some sort."

The availability of musical instru-

ments was mentioned as a strong selling point, though a significant expense for a small studio. Ayre and Chameleon have small grandpianos; others have large uprights. Cora also features a large assortment of drums and synthesizers. A selection of guitars is available from Tewks. Every studio had a synthesizer on hand. A Leslie was also mentioned as a desirable addition since it can be used with a guitar or keyboard instrument.

Ads Draw Responses

Getting business into a small studio is a never-ending challenge. The best form of advertising is word-of-mouth, each of the owner/engineers feel. The telephone directory yellow pages were also recommended. Ayre and Chameleon had good results advertising in *"The Mix"*, which lists Bay Area studios. Ayre got a strong response from a large ad it ran in *"BAM"*, a bi-weekly music business newspaper.

"It's an expensive ad, so I dropped it the following month figuring the momentum of the first ad would carry over," said Nebel. "It didn't. So I continued the ad for a while." Ayre's ad showed the control room and offered a reduced rate as an inducement.

Chameleon ran an ad that gave all the details of the studio, but got no response from it. In the next issue, a picture of the studio was included and the response was very strong. "I guess they liked the idea of working in that house," speculated Frehling.

Small studios face many problems in the areas of insurance and security, say the owner/engineers. For coverage over $10,000.00, rates are typically one dollar annual premium for each $100.00 of insured equipment.

"The insurance guy comes in here and sees all this very expensive, very portable equipment and it scares him," said Hart. "So you end up putting in a pretty good burglar alarm."

"When this was just something I did in my living room everything was real simple," said Altmann. "Now that we don't live in the back and the studio is strictly a business, meeting codes becomes a real problem." When the home studio becomes a commercial operation, upgrading the home to meet building, fire, and insurance requirements can become a significant expense.

Ayre Studios control room.

Maintenance

None of the studios had full-time maintenance persons. Most of the owner/engineers do this work themselves. What they can't do is done by technicians working on an hourly rate, or in trade for studio time, or equipments, or a combination thereof.

"I pray a lot," said Frehling. "I mean, if one of the big studios loses a machine they just roll in another. If I lose a machine I'm out of business. I had an input module down. It took a couple of weeks before I could take the board to the shop. You learn to work with the problems."

Again, each stressed the importance of a close relationship with suppliers and maintenance people.

"The guy I use trusts me, so if I can't

pay him right away he'll wait until I can," said Alexander. The small studio, in order to survive, must maintain credibility with those it works with.

It's also a common practice to trade time for other services beside maintenance. Musicians help with in-house productions, paint walls, carpentry, and almost anything else in return for time. Hart stressed that "you have to put some time limit on how long the offer is good for or for sure you'll have one month when everybody wants to collect their free time. You can't create that kind of a cash flow problem."

The clients of these studios are usually very price conscious. Competitive rates become a strong factor in the selection of a studio by a client. A small studio that raises its rates in order to upgrade its facility must take into consideration the possibility of losing a certain amount of it's already-established following due to the increase in rates.

Altmann noted that one of his current competitors is "talking about 24 track. If they do that, it's going to mean more business for me." A portion of the existing business may have no need for upgraded services and would be unwilling to pay for it; or, more times than not, would like the use of the new equipment but simply can't afford the additional cost. How professional the engineering is can have as much to do with the rates as the facility itself.

Rates:
'Don't Undercharge Either'

"Some studios are geared for groups that use loads of time and they base their rates accordingly," said Frehling. "My clients watch every hour so they expect speed as well as quality. That's why they come back."

Frehling added, "You should decide what your time and expenses are realistically worth and charge that. I used to charge $15.00 an hour and that was ridiculous. I raised the price and the business increased. People feel they get what they pay for so you don't want to undercharge either."

One of the most emotionally draining aspects of owning a studio is getting paid. Many times the owner knows that the client is spending every cent he has. When the money runs out and the project is not completed, it becomes a hard thing for the owner to decide what he's going to do. Does he tell the client no more recording until it can be paid for? Does he extend credit? Just what does he do? He knows he might be holding a creative life in the balance.

The situation a small studio faces is quite a contrast to a large studio working with signed acts. Large operations seldom see real money change hands. The artist has a budget and the studio just bills the label. The promise of a check in the mail actually results in a check arriving; and so the purchase order has become the medium of exchange. Smaller operations, on the other hand, are almost exclusively cash-on-the-line. Many times not only is a deposit needed, but full payment based on the anticipated studio time is required.

"Occasionally I bill," said Altmann. "I don't like to, but agencies have a hard time dealing with cash."

Deals With Promising Acts

Many studios find themselves getting involved with speculation deals, or "spec" for short. Studio time is offered for free or next to free to a promising act. In some cases, the owner/engineer will do this even if he doesn't personally like a group's music. The hope is that an act will 'connect' and then continue to work at a studio, as well as pay for time used producing earlier projects like demos. Many times, neither expectations will materialize. Disappointments not withstanding, rates remain flexible depending on the situation.

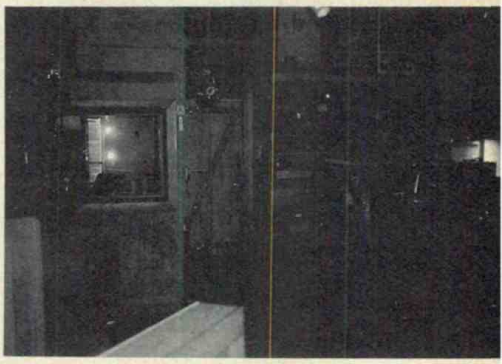
"If I think someone is an up-and-comer I'll work something out," said Alexander. "A studio builds its reputation on the success of those it records," and the capabilities of its owner/engineer.

"It's my hope," said Altmann, "that the people who we're working with now will progress with us so that as we advance in the business they will also."

To deal with economics in the meantime, Altmann has come up with a unique approach to handle the high cost of tape. "For $25.00 we rent the use of the tape for the course of a project," he explained. "Once it's mixed, we bulk it and re-use it a couple more times then sell it for $50.00. That's not a bad deal. It makes getting into 16 track recording a lot less painful for the economy-minded artist."

In passing, one of the owners commented, "You've got to be strong to handle this. It's not easy to say to a client he can't have his tapes because he owes $200.00 on his bill. I mean you know he doesn't have it to pay and you know he's probably banking on the tapes to get gigs or a deal; but then you have to realize you don't have it either."

He continued, "You listen to big records and you say, 'ya, I'm going to do some of that'. But most of the time that's not what's happening. The people you're working with usually aren't that good. So you sit there and listen to them play the same guitar solo 30, 40 times. No matter how they play it it's awful. You want to ask them to go home and practice, but you don't. You just keep going back to the top of the solo and record it again, because that pays the bills."



Views of Corasound's studio and control room.

"I'm a musician," added Frehling. "What I thought I could do was keep composing and make a living recording, since I wasn't making one as a musician. I thought I could use the equipment to compose. What a dream that was. I never in my life busted my ass as much as I have with this. People who build their own studios have got to be crazy or crazy in love with it." □□□

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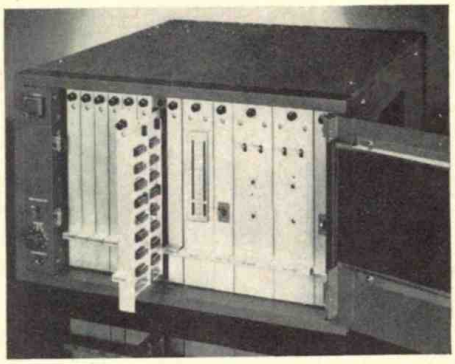

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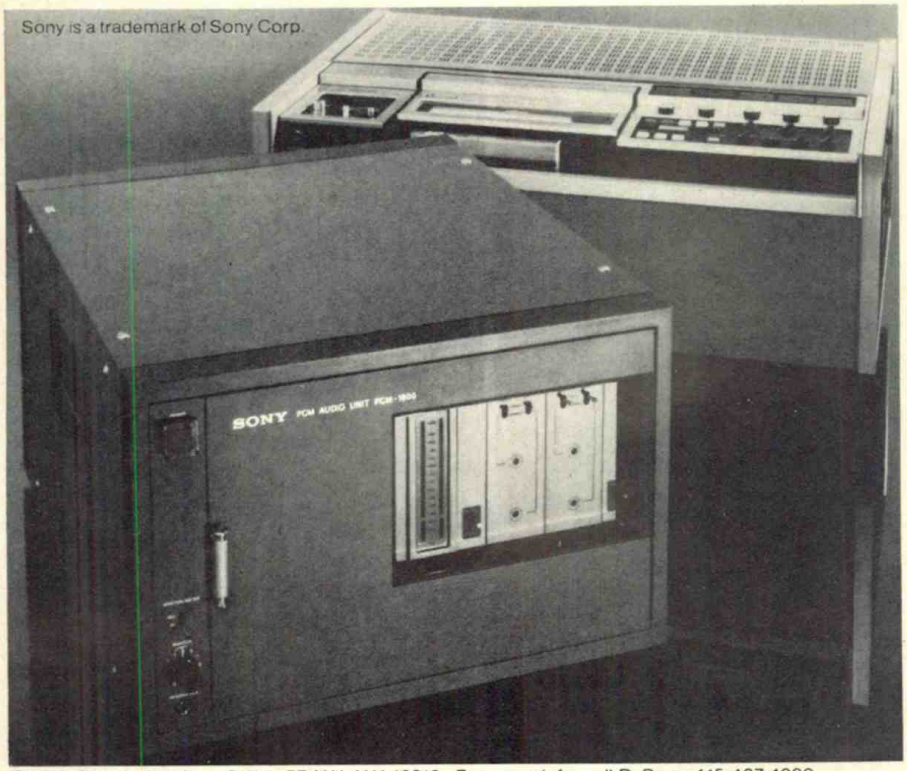

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New Products

SPECTRA SONICS MODEL 701

The Model 701 Power Amplifier, just placed into full production by Spectra Sonics, is a second generation DC power amplifier that will provide even better reliability, a considerable increase in the power output, above what has been available. The Model 701 is more heavily constructed to better withstand hard usage.

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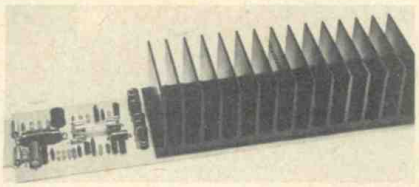
The unit measures 2½" x 10" x 2",



with a net weight of 14 oz., and a shipping weight of 1 lb. 4 oz.

The Spectra Sonics Model 701 Power Amplifier has a suggested list price of only $89.00.

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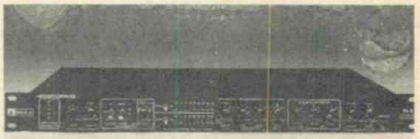
The DL-2 features the same no-compromise sound quality as the DL-1 Digital Delay — 20 to 15 kHz bandwidth at all delay settings, with 90 dB dynamic range. The unit also features two independent channels; delays up to 240 ms in serial (mono) mode; built in VCO;



and optional memory expansion capability. (Extender memory available in spring of 1979.)

The suggested retail price is $1,500.

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Peavey announces its new SP-2 which follows the Peavey tradition of being designed and built in their plants from the ground up. All components of the system represent many months of effort which have resulted in the new 800-cycle horn, the 22A driver, a newly

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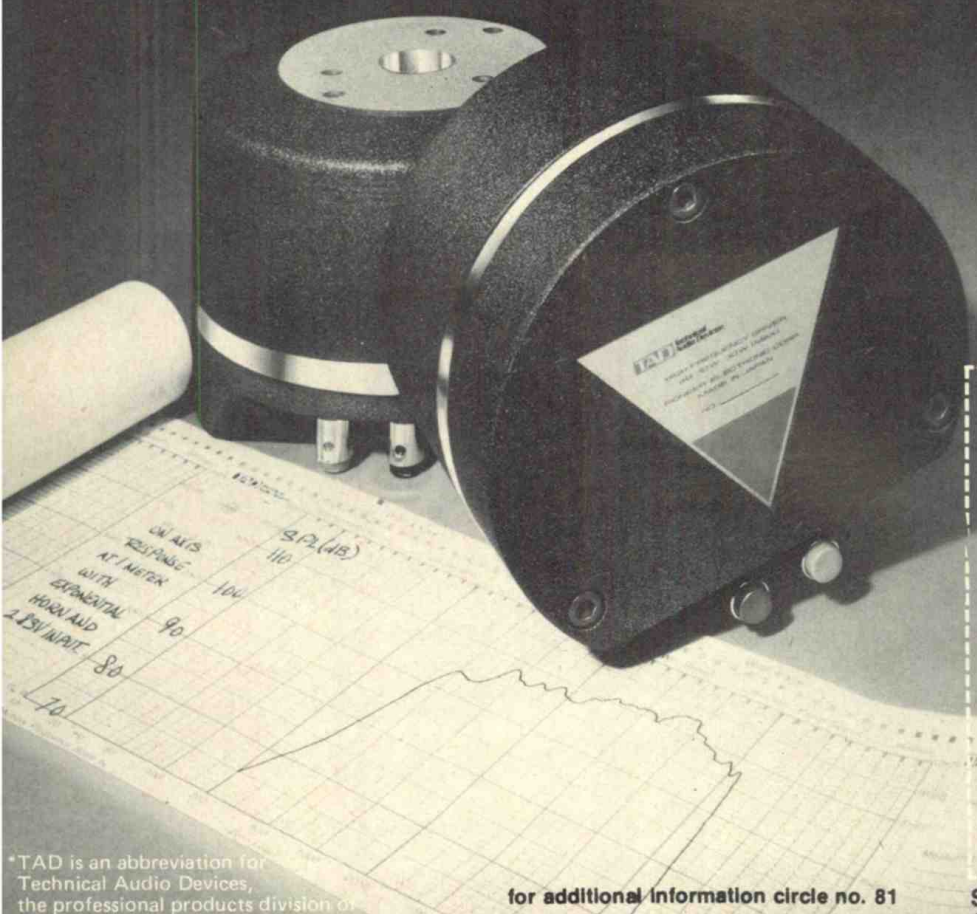

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142 Redneck Avenue, Moonachie, New Jersey 07074
Telephone: (201) 440-8234

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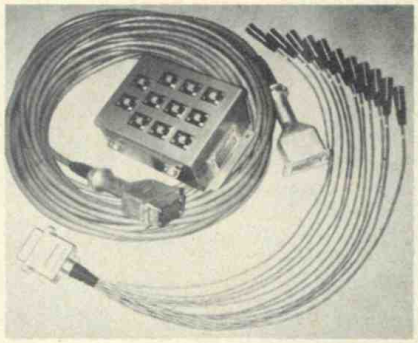

unit terminated at one end with 3-pin or contact professional audio conectors (Switchcraft QG-Series) and at the other end a rugged milspec aerospace multi-pin connector facilitating easy interface with a mating milspec connector at one end of the cable. The opposite end of the cable mates in a similar fashion with the removable stage-plugging box.

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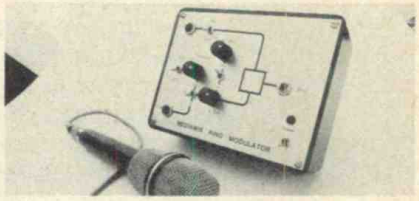
MEDIAMIX VOICE MANIPULATION SYNTHESIZER

Mediamix has introduced the poor man's voice manipulation synthesizer, their model RM-2. At $165.00, the unit



features a built in microphone preamp, an internal dual range oscillator plus the necessary circuitry to allow the user to create a variety of strange but highly intelligent robot voices.

The RM-2 will accept the output of a synthesizer or other instrument enabling the user to sing along with the instrument to create a *singing robot*. With this new device studios and broadcasters can quickly and easily create many of the now popular speech effects that have spun off from the current science fiction craze.

A catalog and 30 minute stereo demo cassette of this and other Mediamix Music Products is available for $5.00.

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DIMENSION FIVE MIKE SNAKES

"Hydra" was the many headed serpent of Greek mythology — and is the name chosen by Dimension Five for their line of standard and custom mike snakes.

A line of standard snakes is available with fixed or detachable cable/fan. All use Switchcraft connectors for the individual mike lines and sends. AMP CPC, M, or G series connector shells with gold plated pins/sockets are used with the multipair cable interconnections depending on requirements.

The chassis/wrap-around tray is of black anodized aluminum; chassis of 16 ga. stock, and wrap-around tray of 1/8" thick stock. The tray extends beyond connectors to prevent damage due to accidental drop or scrapes. Numbers or

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R-e/p 123

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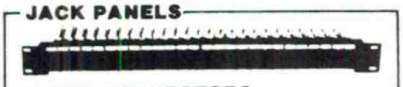

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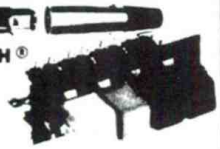

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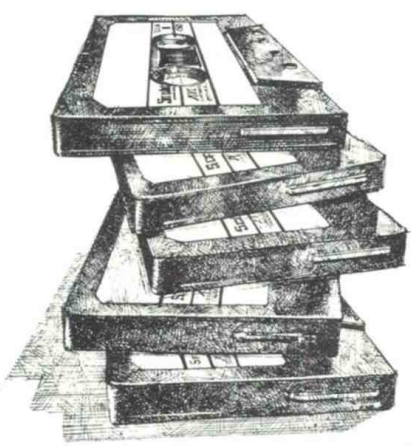

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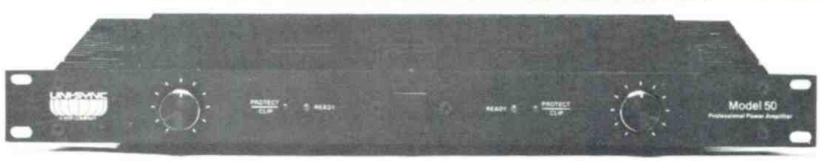

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MICMIX ANNOUNCES IMPROVEMENTS IN DYNAFLANGER™

One of the new improvements now permits the control voltage (CV) tracking-reversal feature to be utilized in all modes. CV Tracking Reversal in this unit allows an increase in control voltage to cause either a higher or a lower fundamental flanging frequency in the output. Originally, tracking reversal applied only to the Dynaflanger's dynamic modes, where the program material being processed automatically determines the instantaneous applied control voltage. The all-mode feature is said to significantly extend the unit's capabilities when it is being controlled by a synthesizer or operated in the modular mode, and particularly when it is slaved to the control voltage output of a second Dynaflanger.

Another product improvement is the addition of a front panel switch that allows the unit to operate in either the normal flange mode, the direct (bypass) mode, or the delay-only mode. The delay-only feature enables dynamic time base modification and thus allows other effects to be realized such as dynamic frequency or amplitude controlled pitch bending and doubling. A pair of Dynaflangers can be set up to provide what the manufacturer has termed "Dynamic Cross Flanging", where there is a zero delay at the fundamental flanging frequency which permits highly dramatic effects to be realized.

Incorporation of these improvements has not changed the pricing of the Dynaflanger, which lists for $895.00

MICMIX AUDIO PRODUCTS, INC.
2995 LADYBIRD LANE
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NEWS—

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Participating studios include: Bee Jay Recording Studio, Southeastern Recording, Glenn Gettings Productions, Creative Recording Workshop, Star Trip Studios, Ambidextrous Studios, and the Orlando Recording Center.

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GULTON TO ACQUIRE TAPCO

An agreement in principle has been reached for Gulton Industries, Inc., to acquire Technical Audio Products Company (TAPCO).

Gulton Industries, a multi-divisional company based in Metuchen, New

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The RS-686DS also gives you controls you won't find on many non-portables. Like a tape/source monitor switch. Low cut filter. Mike attenuator. And a three-minute tape and alert eye.

A less expensive alternative is the RS-646DS. The portable deck with performance specifications usually found only in higher priced cassette decks.

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TRACK SYSTEM: (686, 646) 4-track, 2-channel record/playback. MOTOR: FG servo-controlled DC motor (RS-686DS). DC electronic speed control motor (RS-646DS). FREQ. RESP. ($\pm$3 dB): RS-686DS: CrO_2 tape, 50-16,000 Hz; Normal Tape, 50-14,000 Hz. RS-646DS: CrO_2 and Normal Tape, 50-14,000 Hz. WOW AND FLUTTER (WRMS): 0.07% (686). 0.10% (646). S/N RATIO (Dolby): 66 dB (686). 65 dB (646). DIMENSIONS: 3"Hx9½" Wx7⅞"D (686). 4¼"Hx14¼"Wx11"D (646).

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Technics
Professional Series

R-e/p 129

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continued from previous page —

Jersey, is also the parent company of Electro-Voice, Inc., the 52-year-old Buchanan, Michigan, based manufacturer of high fidelity speaker systems, music speaker systems and microphones, components for professional, commercial and public address sound installations, and microphones for professional, broadcast, film and sound reinforcement industries. TAPCO will become an operating unit of Electro-Voice.

TAPCO, a Seattle, Washington, company began manufacturing mixers and amplifiers for the Pacific Northwest market in 1971. They have grown from a two employee company to a national marketer of products employing 110 people with a 34,000 square foot manufacturing facility. Mixers still constitute most of TAPCO's production, however, the product mix has expanded to include commercial power amplifiers, equalizers and other sound processing equipment. TAPCO's products are well known for their extraordinary quality at prices that are extremely competitive in the music and commercial sound markets.

Under the new organization, Del McNutt, TAPCO president, will be reporting to Bob Pabst, president of Electro-Voice. "No sales organization or management changes are planned for the immediate future," according to Pabst.

This combination of products and skills strengthens both TAPCO's and Electro-Voice's commitment to becoming the dominant force in their respective areas of the music and commercial sound fields.

AMPEX GOLDEN REEL WINNERS

The latest winners of the Ampex Golden Reel award have been announced by George J. Ziadeh, vice president - general manager of the Ampex magnetic tape division.

The 11 top recording acts, their hit albums and the charities they chose to receive Ampex cash donations are (charities in parentheses):

Billy Joel (American Cancer Society) for "The Stranger"; Meat Loaf (N. Y. Shakespearean Festival) for "Bat Out of Hell"; Kansas (Jacques Cousteau Society) for "Point of Know Return"; Tom Petty and the Heartbreakers (Free Arts Clinic for battered children) for "You're Gonna Get It"; Jefferson Starship (Haight-Ashbury Free Medical Clinic) for "Earth"; Andy Gibb (Muscular Dystrophy Association) for "Flowing Rivers"; Atlanta Rhythm Section (American Cancer Society) for "Champagne Jam"; Graham Central Station (Jehovah's Witnesses) for "Ain't No Bout A Doubt It"; Blondie (Juvenile Diabetes Association) for "Denis"; Heart (Greenpeace) for "Magazine"; Eigo Kawashima (Elizabeth Saunders Home) for "Sake to Namida to Otoko to Onna".

Since January, 1977, Ampex has been honoring the performing artists and technical personnel behind top recordings that achieve RIAA "Gold" status or better, and which have been completely mastered and mixed on Ampex professional tape. The company awards Golden Reel plaques to the artists and donates $1,000 to the artists' preferred non-profit charitable organizations.

Plaques are also presented to the recording studios, producers and engineers responsible for the hit records.

"The industry's acceptance and response to the program has exceeded our expectations," said Ziadeh. "The program seems to have grown on its own merits.

"It's the only industry award that recognizes the entire recording team, not just the performing artists. The charity donation is the other unique feature, making it an award that does more than feed the artist's ego — it feeds hungry children, supports wildlife organizations and other worthy causes," Ziadeh added.

The Ampex magnetic tape division manufactures and markets a complete line of professional audio, video and instrumentation tapes for business, education and government applications, a variety of high performance tape for consumer use in the home, and magnetic media for word and information processing.

DEVICE PROTECTS STUDIOS AND CONCERT PERSONNEL AGAINST HEARING LOSS

A tiny ear filter that protects against harmful, high-level sound frequencies without blocking out normal sounds and voices is growing popular among rock musicians and concertgoers who are exposed to damaging noise.

"Sonic II Noise Filters reduce the discomfort and danger of hearing loss from loud music," said Wes Draper, general manager for West Coast Operations of the Norton Company, manufacturer of the unique sound filter.

According to recent press reports, many rock stars have already suffered acute hearing loss as a result of their constant exposure to loud music — Peter Townshend and Roger Daltrey of The Who; Santana Keyboardist Tom Coster; Lee Michaels; and heavy rocker

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MASTERS OF AURAL GRATIFICATION

for additional information circle no. 103

Ted Nugent who, despite his proclamation, "If it's too loud, you're too old," admits to having lost over 50% of his hearing in his left ear.

But it has also been reported that other musicians, including Maureen McGovern, the Ohio Players and the Osmonds and the Osmonds studio band, have opted to use Sonic IIs. Last year, Emerson Lake and Palmer called Norton Products to request 115 pair of the filters — enough to equip their entire touring entourage.

The Sonic II Noise Filters, which have been used effectively by gun enthusiasts for years, weaken high-level impulsive or repetitive noise through a complex acoustical passageway.

A sound level of 90 decibels is the highest level considered safe for long-term exposure. Some rock music reaches 120 decibels, the level at which the ear begins to register pain. Sonic II lets normal sounds, rhythms and tones pass through, keeping the wearer "in tune" with the music.

"The filtering capability actually improves the wearer's ability to hear music at safe levels," said Draper. "Lead guitar, bass, horns, drums can all be heard right down to their most subtle variations, but without the blaring acoustical sting and 'noise hangover' that often follows exposure to high-volume music. Even normal voice communications come through clearly."

The comfortable Sonic II Noise Filters are made of soft, non-toxic, non-allergenic silicone rubber. The unique patented design leaves the ear canals open to air circulation and pressure equalization, eliminating the "plugged up" sensation.

Sonic II Noise Filters retail for $5.95.

MULTI-TRACK DIGITAL RECORDING FACILITY ANNOUNCED BY STANFORD UNIVERSITY

The Center for Computer Research in Music and Acoustics (CCRMA) at Stanford University has announced plans to build a prototype all-digital multi-track recording system that will incorporate, in addition to the acknowleged clarity and accuracy of digital recording, all features available to the most advanced of current recording studios including studio and location recording, overdubbing, editing, mixing, equalization, limiting-compressing-expanding, ADT and AMT, reverberation, delay, localization, pitch change, etc., all in real-time with all functions fully automated. The multi-track capability will range from 30 to 150 tracks of which any or all will be available for immediate editing or processing at any location within a take.

Members of the CCRMA staff include John Chowning, John Grey, Elliot Mazer, James A. Moorer and Loren Rush.

For further information contact Patte Wood at (415) 497-4971.

EWALD CONSEN JOINS UREI AS V.P. MARKETING

As announced by DeWitt F. (Bud) Morris, Executive Vice President of United Recording Electronics Industries (UREI), Consen will be responsible for all phases of marketing the company's professional audio products, both domestic and export.

According to Morris, "Ewald Consen brings to the UREI management team and excellent reputation and expertise in responding to the needs of our markets. He adds balance to our company which, since our beginning as Universal Audio in 1958, has been an engineering oriented company producing innovative, high quality products."

Mr. Consen was formerly with JBL as their National Field Sales Manager, Professional Products Division.

□□□

. . . continued from page 68 -

Five Yamaha F1030 electronic crossovers provide a range of detented adjustments for each performance. Typically, the 500 to 5,000 Hz range is selected for an 18 dB per octave slope. A UREI 539 and two Altec Pro third octave graphic equalizers are used for overall equalization.

"For vocals, I usually use only a little dip here and there — somewhere in the mid-range — to keep the sound tight and some shelving boost at 7 or 10 kHz, in conjunction with a high pass filter at 100 Hz," said Ingram. "I would rather select a mike that sounds close to what I want. One of the biggest problems with rock and roll is that they position the foldback monitors right in front of each musician and they really get loud. So at some point, you start hearing them. The foldback bleed is very important to take into consideration when choosing a microphone and its placement. In addition, we use very tight miking techniques, just because there is no other way to go and still get much separation on stage without baffles or acoustical treatment in the live room."

Level Needed To 'Punch Through'

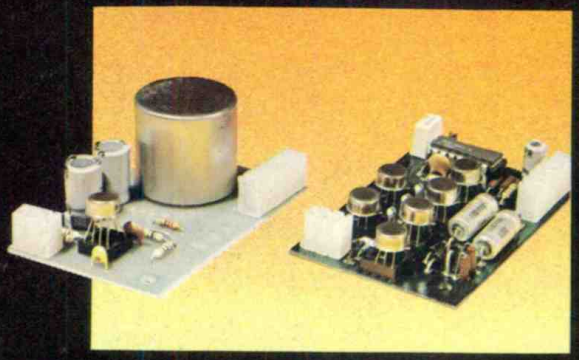
Typically, the sound reinforcement system is set up to deliver an SPL of 100 to 110 dB measured at 100 feet. A Simpson Model 885 level meter on the 'A' weighted scale is used for testing. Ingram, who works as a studio mixer when not touring, says a console operator in a live concert should not be reluctant to turn up the level.

"We don't want to deafen the audience or ourselves, but we have to use enough level to punch through the audience noise," explained Ingram. "Let me tell you, they can make a lot of noise. I have read 124 dB (A) SPL at the console between songs and that's just the audience cheering."

He continued, "Dynamics will greatly improve the quality of the show and it's one of the advantages we have over an engineer in the studio. We do not have to put the max level on a tape or disc. We have the audience right there and we are going after the total effect."

When moving from the studio to live concerts, Ingram said the hardest thing to get used to is that the loudspeakers become a mixer's monitors. Loudspeakers, which are more than 100 feet away, respond very differently than close-up studio monitors. A live concert demands that a mixer work faster and be flexible enough to deal with spontaneous happenings on stage or in the crowd.

"But probably the hardest thing to get used to," he said, "is that there is no rewind button!" □□□



NEW Proprietary Transformerless Microphone Preamplifier is available at no extra cost in all 32C series consoles. Opening up a new world of sonic experience, it's a difference you can hear. Contact your Harrison distributor for a demonstration. For those who would prefer, the traditional transformer mike preamp continues to be available.

NEW 4832C Master Recording Console. 48 I/O module positions with VCA grouping and AUTOSET are ideal for mixing from two locked 24 track recorders. 48 I/O modules also allow effective split operation. Record on one group of modules and monitor on another group. Master modules may be placed in the center for easy access.

NEW 4432C Master Recording Console. A compact, light weight Harrison made especially for remote recording and any other weight or space sensitive application. Utilizing the standard 32C series modules, the Harrison 4432C does not include wood trim or patch bays. It does come with all normal patch points terminated in quick connect splice blocks for easy connection of full external patching. All "normalled" patch points are looped with jumpers on splice blocks so that full patching need not be installed for operation. A new compact aluminum frame and efficient wire routing keep weight extremely low for a full 44 X 32 console. The 4432C is ideal for studio applications where it is desired to customize patching and cabinetry.

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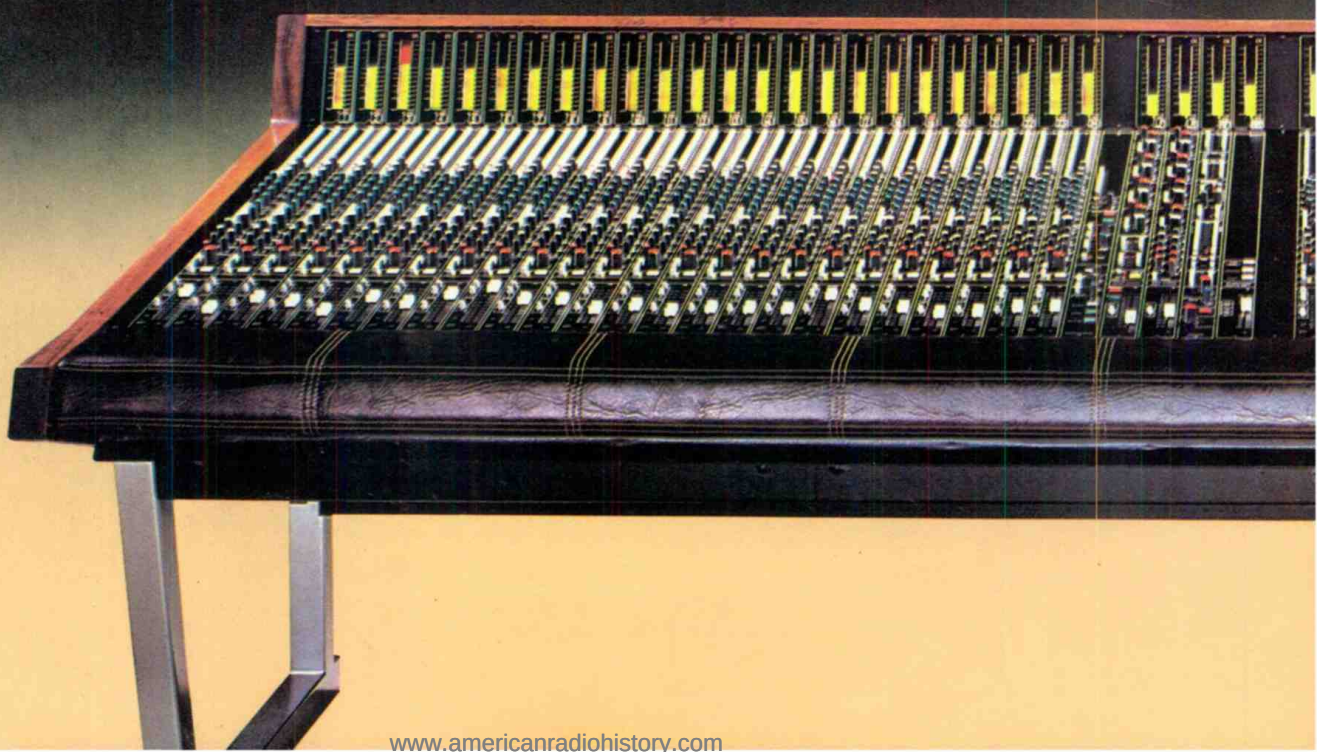

NEW High Resolution LED meters are now standard at no extra cost in the Harrison 32C series console. The Harrison high resolution meters have both true ASA VU Ballistics and true DIN PPM Ballistics available at the push of a button. In addition, each meter includes instantaneous peak detector to indicate overload of the recording medium. The Harrison high resolution meters have no digital clocks or high voltages to interfere with sensitive audio circuits. The 36-segment bar display gives a highly accurate and visible flicker-free display.

NEW AUTOSET Automation Programmer. A true multiprocessor system under software control, AUTOSET can store up to four separate and independent dynamic mixes on each channel of an audio recorder. An integral data cartridge can store up to 630 snapshot or preset mixes. Most important it's simple to operate. Even a guest mixer can use AUTOSET with only a couple of minutes instruction and an experienced operator can virtually perform miracles. Demonstrations can be arranged. Call today.

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GALUTEN & RICHARDSON

Tom: Terri's record came out some time after Samantha's record.
AG: Terri's record was negotiated, Samantha was already with a company and the whole deal. Terri had to get an attorney and work things out.

Tom: The clavinet of "Boogie Child". Does it have a comb filter on it?
AG: No, it's a Mu-Tron "Bi-Phaser".

Tom: The guitar on "Night Fever". Is that a stereo WaWa?
AG: That's Barry Gibb sitting in the control room with Dennis Bryon, the drummer, operating a WaWa pedal. It's two guitars recorded direct, one guitar on each side. Sometimes they don't Wa together. It's nice to have the drummer do the Wa instead of the player.

Tom: Did you mix the "Saturday Night Fever" album before the film was made?
AG: We sent them a good rough mix of the basics at the right tempo. Well, almost the right tempo. "Stayin' Alive" is slightly faster on the record than in the film.

KR: When I mix, I usually use a couple of systems. We try to make it sound as nice as possible on as many systems as we can.
AG: Barry's system is a Sony TC-224 cassette machine; that's what Barry listens to, that's his check. By the time everybody listens to it on his own system it's probably right. I listen on phones a lot. I'm more involved with the music than with the EQ; I trust Karl will make it sound nice. He's listening on the speakers. With phones I can hear, even when it's down in the mix, every instrument and hear just what's goin' on.

For my purposes I want to know what relationship an E flat in the new part has to the "D" in the guitar part recorded two weeks ago. So I listen on phones to hear all the details all the time. Karl listens on the speakers since it's more of an objective sonic point of view.

Tom: When you're doing overdubs, do you work in the control room?
AG: It depends. If we're doing strings, I conduct.

Tom: After mixing on the Auratones, what EQ did you find was necessary while mastering the live album?
KR: A little extreme top, +2 at 12K, somewhere in there. And the mids were pretty hot about 3.5 so I ended up adding a little at around 900 Hz. I left the bottom end alone. Oh, and I think that on one or two tunes we had to put in a 40 Hz chop, because we had to cram 86 minutes of music on four sides.

AG: Those 22 minute sides.
KR: The bottom gets a little funny with sides that long.

Tom: You try to keep the length of a side reasonable?
KR: Yes. Two years in the mastering room teaches you that real soon.

AG: Some of the best advice in the world to someone who wants to be a producer or an engineer is to spend some time in the mastering room.
KR: The mastering room also taught me equalization to a degree that is hard to learn when you're dealing with individual

instruments.

AG: One guitar can take almost any frequency and be interesting, whereas you can't do that on a whole album.

Tom: What do you think is a good length for a side?
KR: I think over 20 minutes is putting pressure on people who probably don't need the pressure. Anything less than 17½ minutes and you're not fulfilling your obligation to people who are buying the record. I think 20 minutes is a realistic number right now. Tomorrow, who knows.

AG: With computer operated lathes and such.
KR: Twenty-one minutes is a little outside, depending on the material.

Tom: What sort of lathe do you use?
KR: At Criteria we just went to the new Scully/Ortofon system. And to me the Ortofon cutting system sounds better. For years our mastering was done on a Neumann, and hopefully I'll be using the Ortofon in the future. The Neumann is running 600 watts a channel and the high end is a little squeezed for my taste. The Ortofon has more power and it doesn't have the resonance problem of the Neumann. The Ortofon sings real pretty up there, a more natural top, while the Neumann has a little grit.

I used to use the Scully Westrex 3D2 type amp, but at that time it had no computer or variable pitch. It was strictly manual. It was an old system but it had a sound. The Neumann is nice, but it has its limitations. The Ortofon is gorgeous when it's operating properly. The bottom end is low and tight at the same time. It doesn't wash out. And the top end just goes out forever. It doesn't have the chatter that a Neumann has.

Tom: Even on the inside grooves?
KR: I don't think there's any way to get the inside grooves to track as nicely as the outside ones. I think all the new developments in that area are great, but the reality is that a guy with a nice $75.00 turntable just isn't going to hear what's going on.

Tom: Getting back to your recording techniques; I'd like to know if you limit bass.
KR: Sometimes, but not often — though most people do. The reason that I don't limit bass is that when you're dealing with a sensitive piece of material, the bass player will play something that has dynamics that are as much a part of the performance as the notes he hits. Some of the notes should burst out and feel that strong. When you limit it you're making all of them the same level for the sake of AM radio. They're going to limit it anyway.

AG: There's something else a bass player will do. A bass player will bring out an important note by playing it thinner. He'll pick right next to the bridge so it comes right out. That note actually has less level with a lot more apparent loudness. As soon as you limit it, the note will stick out in the track. If you bring it out as though it were a soft note, in fact, it will sound loud. Before Karl, on some of the records I made, the bottom got a bit strange — depending on the bass player and how many other instruments occupy the low end.
KR: I don't use too many low end equalizers. I don't touch it except sometimes I roll things off.

Tom: Do you do much limiting on vocals?
KR: Sure, I do some overall peak limiting.

Tom: What type of limiter do you use?
KR: I've been using the dbx 160 and the UREI 1176.

continued

GALUTEN & RICHARDSON

Tom: What sort of ratio?
KR: Four-to-one, say.

Tom: What sort of direct box do you use?
KR: It's just a straight transformer. We've been getting some pretty nice ones. The higher the impedance of the primary side the better off you are. We can get them up to about 80 kilohms on the high side and 250 ohms on the low side.

Tom: How large a transformer?
KR: They'll start clipping around -10 dBm, but high impedance instruments very rarely give off that kind of level.

Tom: Some of the things that come out of a synthesizer are close to a square wave.

KR: Transformers aren't as sharp as that. Sure a square wave is going to get a little feathered off, but speakers don't produce square waves either. I know what the console is going to do, what kind of energy I'm getting. Because I set the preamp for so much amplification, the final gain stage of the console has got a PPM across it. If necessary I tell the synthesizer player to turn it down. There's no way the transformer is going to clip.

Tom: Do you use a lot of limiting on the synthesizer?
KR: I try not to, but sometimes it's necessary. Most synthesizers have pretty uniform outputs for a given frequency.

AG: As you go down the scale it gets much louder level-wise, but not sonically. When you record a synthesizer and you limit it, all of a sudden you're putting as much level on the tape at the top end as you are at the bottom end. This is wrong, because the top end is going to come flying out at you. Because of the equal loudness contours you're going to hear a lot more top than you are the bottom.

Tom: How do you achieve a given texture with a synthesizer? Do you double lines and use different envelopes?
AG: Yes, but there's a few that are single lines. On "You Stepped Into My Life", there's a single synthesizer line. It's just not that loud. "You Should Be Dancin'" is a single line. "Jive Talkin'" has synthesizer and bass. Sometimes you double or triple the same sound to make it warm.

Tom: What sort of synthesizer do you use?
AG: It varies; but most often the 2600.

Tom: How do you use synthesizers in general?
AG: A lot of times my work is to pick out what the song needs and put it in. I start off not with the keyboard but with my mind thinking, "Okay, this is what I need. How do I go about getting it? This is what's called for in the song."

With a synthesizer you can play almost any kind of lick if you know how to change the sound. If you want to do something that's impossible to do in real speed then slow the machine down. Tune the synthesizer to the track and slow the vibrato down so that it doesn't sound funny when it plays at normal

speed. A synthesizer holds up very well sonically. Take a straight note out of a synthesizer. If there are no beats or any kind of animation you can record at 15 ips and play it back at 30 ips, and it will just be an octave up.

Tom: For someone just starting to use synthesizers in the studio, what would you recommend?
AG: Get a teacher. Have someone who knows how to do it show you. There are a few basic sounds you have to learn how to get and the rest is pretty obvious. I learned from Chuck Kirkpatrick, who's in a band in L. A. He had learned how to program a 2600 from a guy named Clark Spangler, who works in a music store out there. He plays synthesizer for movie themes. All the old "Night Galleries" are Clark Spangler on whatever he had then. He would have a score like everybody else. He could do things on cue like, for instance, the sound-of-gargoyle-eggs-hatching. He could figure a way to do it. He'd have maybe eight sounds to get from a tuba to a flute.

There are a few basic sounds. You learn to get a brass sound and a string sound. You have to learn to differentiate basic colorations of natural instruments — the difference between vibrato, which is the variation in pitch; and tremolo, which is the variation in level. Vibrato breaks down a couple of ways: pitch vibrato and filter vibrato. For instance, take a flute. The pitch doesn't go up and down, it gets brighter and duller. It's like opening and closing a filter. With a trumpet the pitch goes up and down.

You learn to differentiate the sonic elements of an instrument. Many of them suddenly get bright and then get duller at a certain rate, like a filter opening. Listen to a trumpet: how fast does it get bright; how soon does it get dull. You learn to master a few instruments.

Tom: What do you think of synthesizer strings?
AG: I've never heard good strings on synthesizer. I'm pretty happy with what I got on "I Just Want To Be Your Everything", but it really doesn't sound like strings.

KR: It just sounds close to strings.
AG: I think I heard a talk by Moog at the AES. He'd done a study of string sounds. He'd come up with five resonance frequencies, a way to get a string sound, but I still never heard it. It doesn't seem to capture it.

Tom: You don't think the ARP does it?
AG: It works fine on stage.

KR: Strings are just too random. You'd have to sit down with a mini computer to make it that random.
AG: The harmonic structure is too complex. With strings you've got the resonance of maybe 20 different instruments and 20 different people vibratoing, their pitch varying. Also, you never get the attack of the note on a synthesizer. An ARP string ensemble, on a high sustained note with some echo and EQ, sounds awfully close. But you never get the attack of the ensemble to sound right. You can't get them to pizzicato or do a legato passage. On a string ensemble they always glitch. The notes will sustain and ring into the next note so you hear two notes at once.

On "I Just Want To Be Your Everything" there's an ARP string ensemble and a 2600, all mixed together in about three different octaves, including a celeste sound. It's a total sound. But you never get that sound of bowing. You treat a synthesizer as another instrument. It's not strings or horns; it's just another sound. □ □ □

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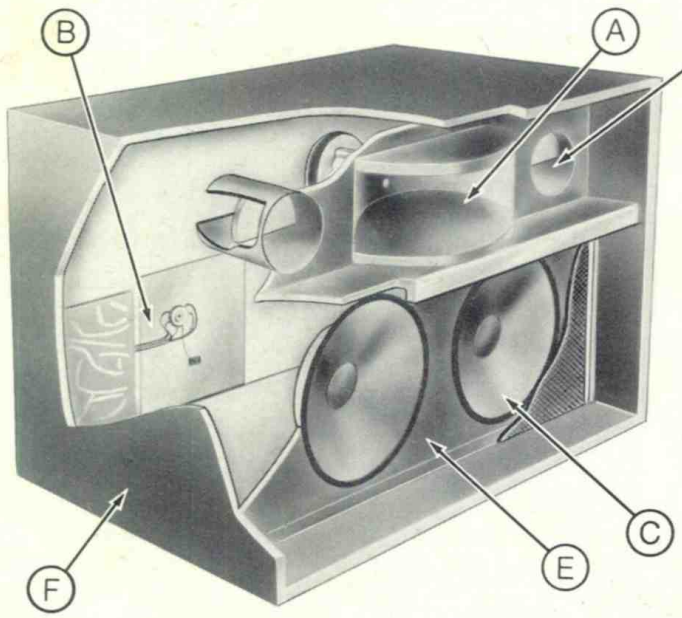

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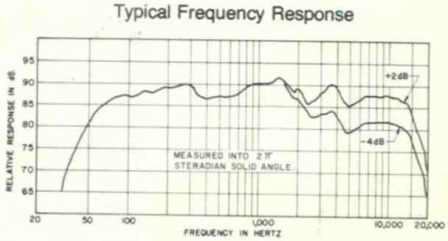

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