THE SOUND ENGINEERING MAGAZINE

AUGUST 1980
$1.95

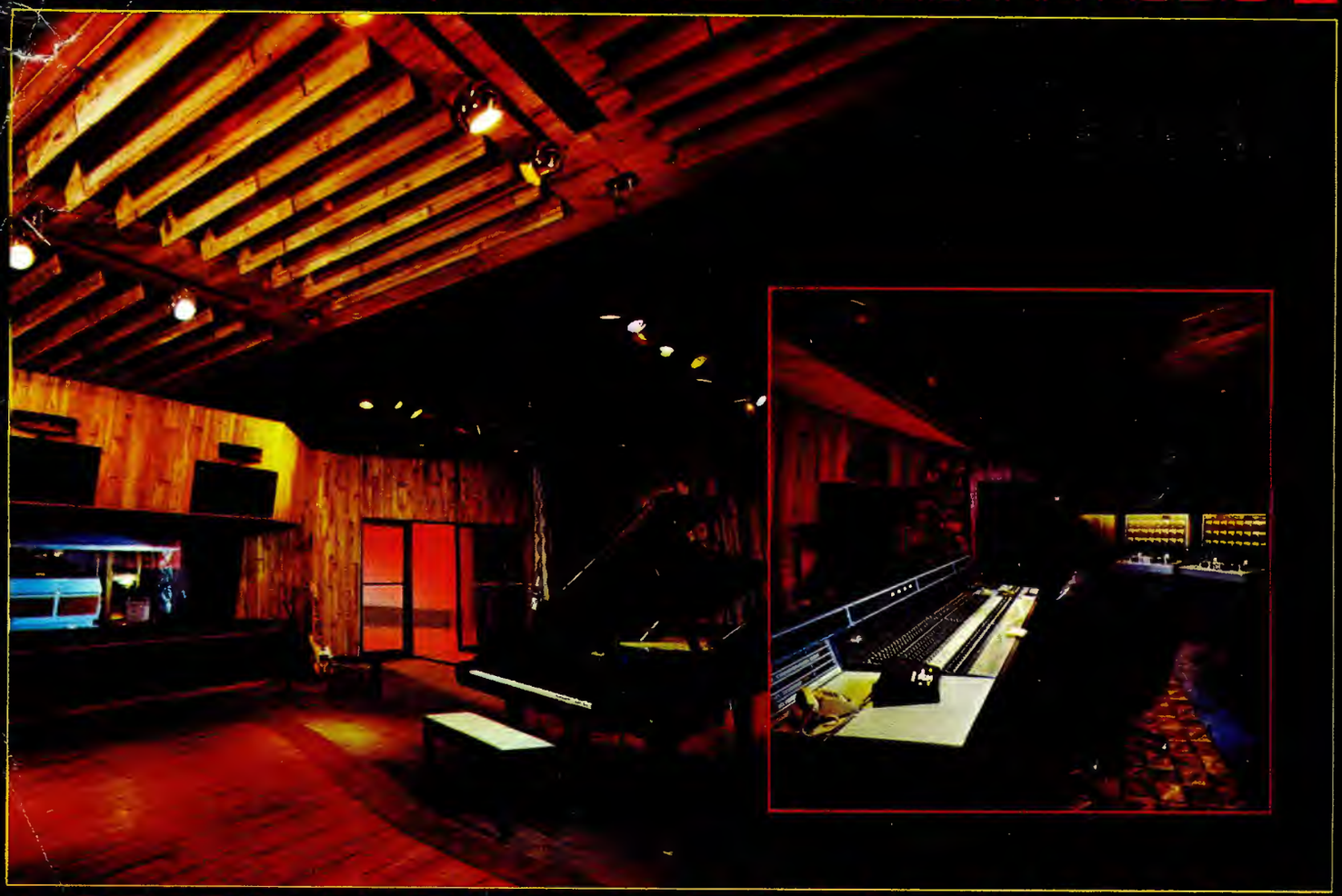
db

Fantasy

studio d

DESIGNED BY

KENT DUNCAN, TOM HIDLEY & SIERRA AUDIO



A STUDIO MAGNIFICENT IN EVERY RESPECT

Fantasy's Studio D represents the zenith of today's recording technology. "D" offers an unprecedented combination of electronic, acoustic, and aesthetic features designed to meet virtually every conceivable recording need.

A fully computerized and automated 48-track studio, "D" is equipped with Studer mix machines and two A800 24-track machines which are interlocked by the Studer TLS 2000 (SMPTE Time Code Synchronizer), giving you 46 usable tracks. Sierra-Hidley Acoustics and Sierra SM1 III studio monitors, Crown Monitor Amplifiers, and a 56 x 48 console by Neve with NECAM computer-assisted mixing.

This mixing system offers amazing flexibility in arriving at the final mix. It gives the ability not only to store as many mixes as desired, but to combine (merge) sections of any number of mixes into the "final mix." Incredible!

The unusually spacious control room affords an unobstructed view of both the 30 x 50 main room and the adjoining 18 x 30 string room. In addition, the main studio area contains three isolation booths and a drum booth large enough for two drum sets. Dramatic modification of color and mood can be achieved by an extraordinary lighting system, while the design of the room permits total acoustic control. Sliding mirror wall panels, ceiling louvers remote-controlled from the console, Sierra Audio's use of marble to hardwood to carpeting all add to the variety of acoustics available. Hearing is believing!

Overall, Studio D provides the ultimate in a comfortable, visually pleasing, and technically complete recording environment. "D" is one part of the Fantasy Studios complex. This unique Northern California facility offers a full line of engineering services, including a superb new Sierra disc mastering room, a 16-track studio, and two 24-track studios.

Studio Dimensions
Studio A (24-track) — 30 x 50
Studio B (16-track) — 21 x 26
Studio C (24-track) — 24 x 37
Studio D (46-track) — 30 x 50 main room
18 x 30 string room

Equipped as follows

Consoles
1 Neve 56 in 48 out
2 Custom DeMidio — 24 in 24 out
1 Quad 8 — 20 in 16 out

Monitor Amps
Crown 300's, 150's, and 75's
McIntosh 2100s

Monitor Speakers
Sierra SM III — Cetec Gauss and TAD
UREI 813
Altec 604E w/ Masterlab crossover
JBL 4311 MDM, Auratone

Echo
EMT 250
EMT 140S
Ecoplate
and live chambers

Outboard Equipment
Eventide Harmonizer
Eventide DDL
Lexicon Prime Time
ADR Complex limiter
ADR Vocal Stresser
MXR Phaser
ADA Flanger
EMT PDM Compressor
Scamp Multi-Rack
Echoplex
and more!

Dolby Noise Reduction — included
DBX Noise Reduction — extra

fantasy studios

TENTH AND PARKER, BERKELEY, CA 94710 • 415-549-2500 • ROY SEGAL - STUDIO MANAGER

Coming Next Month

• September is Broadcast Audio Month at **db**. We'll be measuring the "sound" of radio, examining the usage of wireless microphones, and in general, surveying the impact of recording on broadcast, and of course vice versa. Stay tuned!

About The Cover

• Our artist-in-residence Kathy Lee has created this pastel work based on material sent by Bob Todrank, executive v.p. of Valley People, Inc. The studio pictured is Bee Jay Recording of Orlando, Florida; the complete two-studio facility is by Valley Audio.

THE SOUND ENGINEERING MAGAZINE

AUGUST 1980 VOLUME 14, NUMBER 8

EDITORIAL	30
THE NEW VCA TECHNOLOGY Paul C. Buff	32
FANTASY RECORDING/ZAENTZ FILM CENTER: CANDY STORE FOR THE 80s Larry Zide	38
CREATING THE ULTIMATE ENVIRONMENT Kent Duncan	42
THE MOTOWN SYSTEM Guy Costa	43
STUDIO SYSTEM PLANNING: DON'T FORGET THE BOTTOM LINE Hamilton H. Brosious	47
FUTURE SHOCK TODAY: ROCKING INTO VIDEO Mark "Moogy" Klingman	50
LETTERS	6
CALENDAR	12
NEW LITERATURE	14
DIGITAL AUDIO Barry Blesser	16
THEORY AND PRACTICE Norman H. Crowhurst	24
SOUND WITH IMAGES Martin Dickstein	28
NEW PRODUCTS AND SERVICES	29
CLASSIFIED	53
PEOPLE, PLACES, HAPPENINGS	56

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

Larry Zide PUBLISHER

John M. Woram EDITOR

David T. Gilot ASSOCIATE EDITOR

Kathy Lee ADVERTISING PRODUCTION

Eloise Beach CIRCULATION MANAGER

Lydia Anderson BOOK SALES

Bob Laurie ART DIRECTOR

Crescent Art Service GRAPHICS AND LAYOUT

db Letters

Due to a slight error on our part, in the June issue of db, the names of two of our authors (writing in reply) were mistakenly omitted. The reply to the first letter by Gary Gand was from our columnist, Norman Crowhurst. The second, a letter from Mr. Stephen Temmer was answered by Phillip White.

The reply to Mr. David Klepper's letter in our July issue was written by Michael Rettinger.

All other replies were made by the editorial staff. *Sorry about that!*

Now for the good news. Mr. Ernie Garrison in that same issue asked us to track down the new address of what was *Gray Research.* They are now known as *Micro-trak Corporation* and are located at 620 Race Street in Holyoke, Massachusetts (01040). Glad we could be of help, Ernie!

TO THE EDITOR:

We would appreciate if you could refer us to any organization or person who could assist us with an audio problem. Perhaps you may even know of some literature on the subject.

We have a quantity of 16″ audio acetate discs on which there are original recordings. We wish to transfer these recordings to tape as the first step in a process leading to commercial release on phonograph records and tape.

However, due to the age of these 16″ audio discs (some 30 years old), we are concerned as to how to go about it. (Cleaning the discs, type of playback stylus to employ, etc.) Therefore, we require contact with literature or a consultant who can guide us.

We would be grateful for a response to this letter.

ARTHUR N. RUPE
President
Standard Records, Inc.

db replies:

We spoke to Tom Owen, at Lincoln Center's Rodgers and Hammerstein Archives of Recorded Sound on this subject. Like many others, he recommends the Keith Monks Record Cleaning Machine (For a brief test report, see the October, 1978 issue of db). However,

Index of Advertisers

ADC 13
American Radio Exposition . . . 23
Ampex . . . . . Cover 4
Andrews Audio 34
Auditronics 26, 27
Bose 11
BTX 14
Electro-Voice 21
Fantasy Studios . . . . . Cover 2
Garner Industries 40
JBL 17
Lexicon . . . . . Cover 3
Microtran 24
R. K. Morrison Illust. Mats . . . 18
Neal Ferrograph USA 9
Orban Associates 16
Otari 31
Polyline 24
Pro Audio Seattle 6
Pro Sound International 19
Sescom 18
Shure Brothers 7
Standard Tape Lab 10
Studer Revox 15
Telex Turner 8
The Astatic Corp. 22
The Mike Shop 12
Waters Manufacturing 10

db sales offices

THE SOUND ENGINEERING MAGAZINE

New York
1120 Old Country Rd.
Plainview, N.Y. 11803 516-433-6530

Roy McDonald Associates, Inc.

Dallas
1949 Stemmons Freeway—Suite 670
Dallas, Texas 75207 214-742-2066

Denver
14 Inverness Drive E., Bldg. 1—Penthouse
Englewood, Colo. 80112 303-771-8181

Houston
6901 Corporate Drive, Suite 210
Houston, Texas 77036 713-988-5005

Los Angeles
424 West Colorado St., Suite 201
Glendale, Cal. 91204 213-244-8176

Portland
P.O. Box 696
510 South First
Portland, Oregon 97123 503-640-2011

San Francisco
265 Baybridge Office Plaza,
5801 Christie Avenue
Emeryville, Cal. 94608 415-653-2122

Karaban/Labiner Inc.

New York
25 West 43rd Street
New York, N.Y. 10036 (212) 840-0660

Chicago
333 N. Michigan Ave.
Chicago, Ill. 60601 (312) 236-6345

fact: you can cut conference clutter—and improve the sound in the bargain!

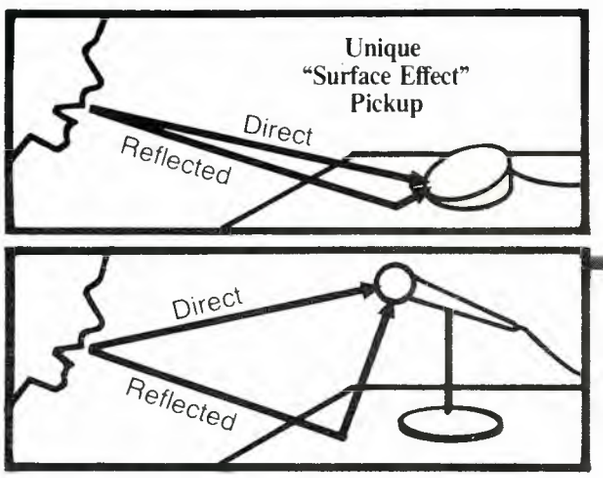
What you can't see . . . lets you hear better!

Eliminate your conference room's "electronic jungle" with the new, inconspicuous Shure Lo-Profile™ SM18 unidirectional microphone designed to lie flat on the table. Distracting (and intimidating) chrome-plated hardware gives way to unobtrusive brown foam-encased units . . . even the brown cables blend into wood-finished table tops.

The Model SM18 is ideal for seminars, press conferences, speakers' platforms, and sales meetings.

But appearance isn't the only advantage. A special "Surface Reflection Effect" configuration eliminates the unnatural hollow sound caused by reflected sounds bouncing off table surfaces. The Model SM18 picks up sound from the front while suppressing audience noise. It is especially engineered for voice range pickup. What you say is what the audience hears . . . period.

For full details, check with your firm's audio visual expert, your sound installer, or send for our new brochure (AL630).



Actual Size

Also available in white.

The New SM18 LO-PROFILE™ microphone by ® SHURE ®

Shure Brothers Inc., 222 Hartrey Ave., Evanston, IL 60204

In Canada: A. C. Simmonds & Sons Limited

Outside the U.S. or Canada, write to Shure Brothers Inc., Attn: Dept. J6 for information on your local Shure distributor.

Manufacturers of high fidelity components, microphones, sound systems and related circuitry.

Circle 30 on Reader Service Card

stay away from alcohol-based cleaning solutions, which could play havoc with acetate disc surfaces.

For playback, Owen recommends a special diamond truncated-elliptical stylus, which is available from Expert Pickups, P.O. Box 3, Ashtead, Surrey, KT21 2QD, ENGLAND. When ordering such a stylus, specify the cartridge you will be using, and the company will prepare a custom-made stylus for you. The typical cost seems to be about $20.00. By the way, Owen uses Shure 35C and 35EJ cartridges for this type of work.

You may also need special playback equalizers, since many of your discs may be pre-RIAA, -NAB, -AES vintage. You may also need a Packburn Transient Noise Suppressor, or similar device, for minimizing the inevitable scratch-noises. Outside of that, there's nothing to it!

And now for the good news: Michael Lane, at Lane Audio has everything you need, right around the corner. You can reach him at Lane Audio, P.O. Box 29171, Los Angeles, California 90029 (213) 469-8007.

TO THE EDITOR:

The enclosed article from our Texas Baptist Standard seems to me a real shocker to normally level-headed ministers. Our pastor talked to his staff and to some laymen about the incident. This is of particular interest to churches that have a baptistry, as most of the large churches have miked the area for good sound.

I question the article. Having seen some European equipment, I wonder if this incident has application here in the United States?

I would like to see your publication comment on this as I am sure every sound installer for decades to come will hear about this incident.

JOE D. DOLLAR

db replies:

The article reported that a minister in Sweden was electrocuted during a baptism service, when an assistant handed him a microphone as he was standing in a heated pool. A church official reported there was a noise like an explosion, and the pastor collapsed.

Unfortunately, the minister was not the first (nor will he be the last) person to be electrocuted by a sound system. In most cases, the tragic event occurs on-stage, typically when an electric-guitar player touches both his amplifier and microphone simultaneously. A hastily-assembled sound system, or a faulty instrument amplifier is usually the culprit.

In most well-run recording studios, such disasters are avoided by careful (careful!!) systems design. However, in

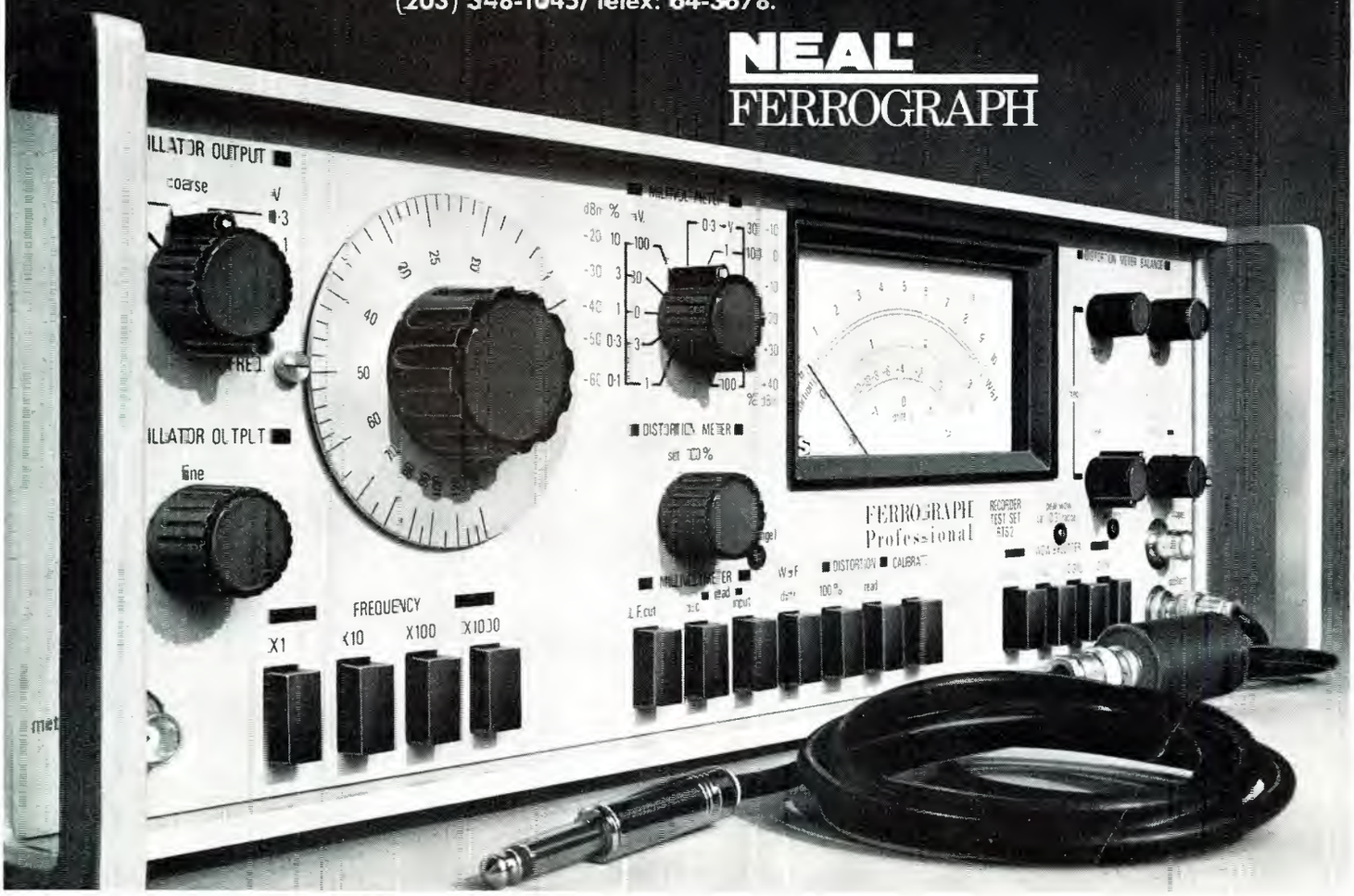
better believe it!

The Ferrograph RTS2 test set can reduce audio test time up to 30%.

Here's how. You connect only a single input and output lead to the component under test. You perform all routine checks for frequency response, distortion, wow and flutter, signal-to-noise ratio, drift, gain, input sensitivity, output power and more just by pushing buttons with this single instrument. You read the results directly in percent or dB so there's no arithmetic or guesswork.

Ferrograph RTS2 speeds your testing of tape recorders in all formats, turntables, preamps, line and power amps, equalizers and other signal processing components. It's easier and faster to use than separate test instruments; yet, it costs far less than other all-function test sets. For complete specifications, and details about how you can acquire the RTS2 at no risk, circle reader service number or contact: **Neal Ferrograph USA, Inc. 652 Glenbrook Road, Stamford, Connecticut 06906, (203) 348-1045/Telex: 64-3678.**

NEAL
FERROGRAPH



Circle 22 on Reader Service Card

most churches, we'd guess that the sound system doesn't receive sufficient attention. And, even if the system is meticulously installed, things can go wrong later on. For instance, was this the first time the minister ever touched a microphone under these conditions? Was the pool's heating system recently turned on? Are there underwater lights in the pool? And so on.

Perhaps the best advice for ministers, musicians, and others who are not quite ready to meet their maker is: water and microphones don't mix. Even using an out-of-the-pool assistant with a microphone on a fish pole is asking for trouble. Depending on the circumstances, you may be able to use a shot-gun microphone, mounted safely out-of-reach, although that is unlikely. What about a battery-operated megaphone? Or, best of all, use a wireless microphone. By the way, we'll have more to say about wireless systems on-stage and in the studio in our broadcast audio issue this September.

TO THE EDITOR:

Michael Rettinger's thoughtful discussion of reflections in monitoring rooms, in **db,** June 1980, brings up a growing problem in our profession. He shows that unquestioning adherence to approaches such as "live end-dead end" ("LEDE") can lead to undesirable frequency-dependent transmission gain and directional errors.

Perhaps the problem is the acoustical sloganeering—or perhaps we just need more precision in our slogans. How about "Gain optimized near end, moderately absorptive dead-end" (GONE-MAD").

DANIEL QUEEN
Chicago, Illinois

MOVING?

Keep **db** coming without interruption!

Send in your new address *promptly*.

Enclose your old **db** mailing label, too.

Write to:

Eloise Beach, *Circ. Mgr.*
db Magazine
1120 Old Country Rd.
Plainview, N.Y. 11803

Unadvertised Special

Sometimes our mailbox brings us a better ad than we could write ourselves. Here's the complete text of a letter we received from Rick Stalnecker, a musician and experienced traveller. Rick's letter says more about the Bose® Model 1800 Amplifier than we could say in a book.

"Enclosed is a picture of our present amp case. These are the original Bose amps which we put on the road in the summer of 1973. In the past six years, these same amps have played in over 500 cities and done at least 3,500 concerts from Anchorage, Alaska to Key West, Florida. This is the fourth road case the amps have outlived, and we use the finest cases available! One week they'll be in a football stadium, through several rain storms, and the next week in a studio or auditorium somewhere. We figure that they have traveled around 500,000 miles and although we have worn out 3 equipment trucks, we have yet to have the first problem with one Bose amp ever! I can't believe it! We have never even replaced a 15-cent fuse! As if that wasn't enough for these work horses, when I get home to our studio I use them for playback, mixdown, and even headphones. The last time they were out of a case, I thoroughly checked them and there wasn't even a casing screw that needed tightening.

I say all of this for one reason. Right now, everybody and their great uncle is claiming their amp to be the best, and I don't think your advertising has been saying enough about your amps. Personally, I can't say enough about their reliability, power, and inaudible distortion.

There is one bad thing though, I probably will never need to buy another amp from you!"

Thanks, Rick! Letters like yours make all of our work seem worthwhile and rewarding.

BOSE®

Bose for Pros

Bose Corporation, Dept. SE
The Mountain Road
Framingham, MA 01701

Please send me a copy of the Bose Professional Products Catalog and a complete dealer list.

Name: _____

Address: _____

City: _____

State: _____ Zip: _____

Telephone: ( ) _____

db Calendar

SEPTEMBER

2-4 **Prosound International Exhibition** will be held at the West Centre Hotel, London. Contact: Batiste Promotions & Exhibitions, Pembroke House, Campsbourne Road, London.

20-24 **International Broadcasting Convention** to be held at the Metropole Exhibition Center, Brighton, England. Contact: British Information Services, 845 Third Ave., New York 10021. (212) 752-8400.

24-25 **REPCON '80 Exhibit** will be held at the LaGuardia Sheraton Inn, Elmhurst, New York. For more information contact: Electronics Representatives Association, 8243 Jericho Tpke., Woodbury, New York 11797. (516) 692-5044.

25-26 **University of Wisconsin** will hold a Recording Classical Music Workshop. Contact: Burton Spangler, University of Wisconsin, Eau Claire, Wisconsin 54701. (715) 836-2651.

26 **Society of Broadcast Engineers 7th Regional Convention,** Syracuse, NY, Hilton Inn. For more information contact: Hugh Cleland, Channel 24, Old Liverpool Road, Liverpool, NY 13088. (315) 457-0440.

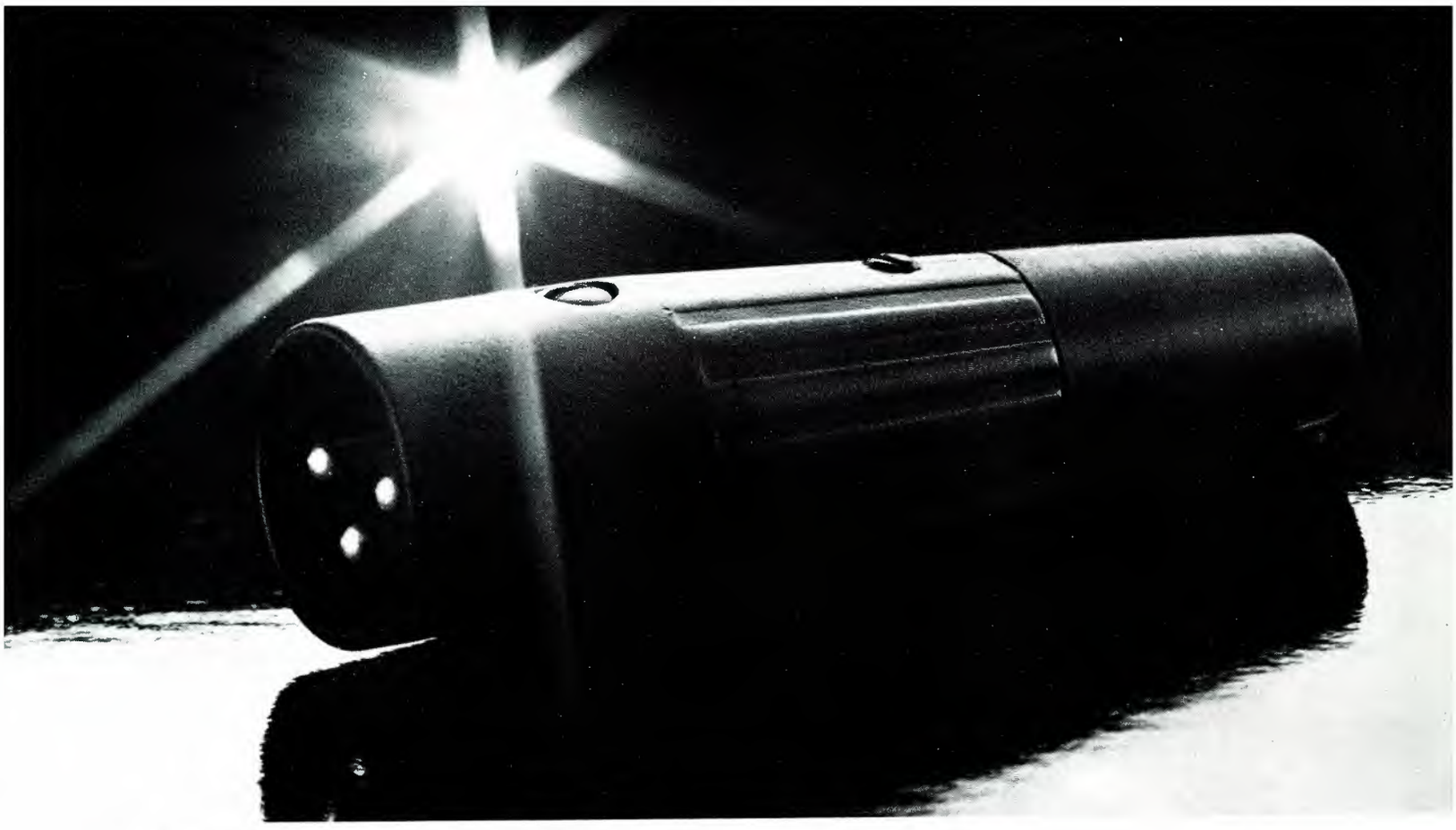
OCTOBER

5-8 **National Radio Broadcasters Association (NRBA) Convention** to be held at the Bonaventure Hotel, Los Angeles. For further information contact: NRBA, 1705 DeSales (NW), Suite 500, Washington, D.C., (202) 466-2030.

9-10 **The Society of Broadcast Engineers (Pittsburgh Chapter) 7th regional Convention and Equipment Exhibition,** Howard Johnson's Motor Lodge, Monroeville, PA. For more information contact: Henry R. Kaiser, Chairman, man, 248 Sleepy Hollow Road, Pittsburgh, PA 15216. Phone: (412) 341-2384.

14-16 **Internepcon UK '80** will be held at the Metropole Exhibition Center, Brighton, England. Contact: British Information Services, 845 Third Ave., New York, New York 10022, (212) 752-8400.

28-30 **TESTMEX Exhibition** to be held Wembley Conference Center, London. Contact: British Information Services, 845 Third Ave., New York 10022, (212) 752-8400.



Black Beauty

ADC's ultra-reliable audio connectors are available in black matte-finish shells. Now ready for immediate delivery.

Here's a case in point why more and more manufacturers are making ADC their sound connection. ADC has taken the regular family of low impedance input and output connectors and receptacles and finished them in a glare-free, conductive finish. Their rich, black matte finish adds a professional touch to your professional equipment. That's one reason ADC calls them the Professional Audio line.

Another good reason is that these units are highly reliable. Tested to 5,000 insertions. And all Professional Audio Connectors and Receptacles are completely interchangeable and compatible with existing audio connectors. Female connectors have positive latch locks to prevent accidental disconnection. There is also a choice of standard or small diameter strain relief grommets.

Most important, Professional Audio Connectors are available immediately. They're great performers. So make ADC your sound connection. Call or write ADC Products, 4900 West 78th Street, Minneapolis, MN 55435. Phone (612) 835-6800; TWX 910-576-2832; Telex 29-0321.

ADC Products

A DIVISION OF MAGNETIC CONTROLS COMPANY

4900 W. 78th Street, Minneapolis, MN 55435 (612) 835-6800
TWX 910-576-2832 TELEX 29-0321 CABLE ADCPRODUCT

Sales offices in: Atlanta, GA (404) 766-9595 • Chicago, IL (312) 655-2441, 2440 • Dallas, TX (214) 241-6787 • Denver, CO (303) 761-4061 • Fairfield, CT (203) 255-0644 • Los Angeles, CA (213) 594-6160 • Melbourne, FL (305) 724-8874 • Minneapolis, MN (612) 835-6800 • Mountain View, CA (415) 964-5400 • Washington, DC (202) 452-1043 • Montreal, Quebec (514) 677-2869

Circle 33 on Reader Service Card

db New Literature

VIDEO/AUDIO CATALOG

• A new catalog containing hundreds of items for audio and video users was recently made available. The 1980 version introduces new products like the pocket cable tester and the littlelite. Name brands like Maxell, Memorex, Switchcraft, Shure, Belden, Amphenol, Vaco, Brady are among the many offered in the catalog. **Mfr: WIDL Video, 5245 West Diversey, Chicago, Illinois 60639.**

ENGINEER'S NOTEBOOK

• "Engineer's Notebook: Integrated Circuit Applications" is a new handbook of 415 electronic circuits for electronic hobbyists, experimenters, technicians and engineers. The handbook contains 128 pages of useful and thought provoking circuitry in a unique hand-executed style that resembles a master circuit designer's notebook. **Mfr: Radio Shack, One Tandy Center, Ft. Worth, Texas 76102.**

DICTIONARY-AUDIO

• "Dictionary of Creative Audio Terms" is a new booklet which updates commonly used terms and references in the audio industry, be it recording or broadcasting. Its references are both useful and up-to-the-minute. **Mfr: Cameo, 10 Delmar Avenue, Framingham, Massachusetts 01701.**

MULTITESTERS/METERS

• A new 8-page catalog covering a complete line of VOM multitesters and panel meters was recently introduced. Detailed information on these VOM multitesters, as well as its techlite battery tester, is provided including complete product descriptions, usage specifics and technical specifications. Also featured are the illuminated front-mount panel meters. Technical data and charts are provided for all models. **Mfr: Mura Corporation, 177 Cantiague Rock Road, Westbury, NY 11590.**

PROFILE

• A company profile newly released by Electro Scientific Industries gives a concise history of the company's growth in serving three electronics markets: laser trimming for microcircuit manufacturers, resistance standards and calibration, and resistance-impedance measurements. **Mfr: ESICOM, Electro Scientific Industries, 13900 NW Science Park Drive, Portland, Oregon 97229.**

FIBER OPTICS

• A brochure describing the products offerings and capabilities in the field of fiber optics is now available. The brochure provides a matrix that compares key performance areas of fiber optic cable versus six conventional cable types. While fiber optics is still expensive, its performance is unmatched, particularly with respect to its low attenuation, extended bandwidth characteristics, and immunity to EMI. **Mfr: Brand-Rex Company, Willimantic, Conn. 06226.**

The A 800.
The recorder only Studer could build.

In all the world, only the Willi Studer factory in Switzerland has the facilities, designers and craftsmen to build the tape machine recognized as the world's finest—the A 800. Manufacturing tolerances surpass spacecraft standards. Precision construction eliminates shims, so all parts are perfectly interchangeable from machine to machine. A sophisticated microprocessor monitors tape direction, speed, tension and switch status of the electronics for safety, accurate timing and perfect punch-in/punch-out recording and erasure, even in varispeed mode. A "rehearse" function lets you preview an edit, and you can energize just the erase head to wipe out clicks. Motors are high-torque ½ HP, and you can stop 14" reels of 2" tape in two seconds with controlled tension. The multichannel electronics are phase compensated for excellent transient and square wave response. You can even interlock an A 800 with a video/film system or another A 800.

STUDER REVOX America, Inc.
1425 Elm Hill Pike, Nashville, TN 37210, (615) 254-5651
Offices: Los Angeles (213) 780-4234, New York (212) 255-4462
In Canada: Studer Revox Canada, Ltd.

Circle 29 on Reader Service Card

BARRY BLESSER

db Digital Audio

Quantizing: The Digital Counting System

THE SAMPLE

In the previous article, we introduced you to the concept of digital audio by showing how a single analog voltage could be represented by a single integer number. We divided the total voltage range of the signal into regions, with each region demarked by a quantization level. For example, the range from +1 to −1 volt could be divided into 1024 equally-spaced regions, with each region assigned its own number, N. The digitization process is nothing more than saying that region N is the best approximation to the voltage value. The number is just a counting system; we call this process *quantizing* or *digitizing.*

But now, if we wish to digitize an audio music signal, rather than a single voltage, we are faced with another issue: while audio is a continuously-changing voltage, quantizing only converts single voltages to single numbers. The only way to solve this issue is to convert our audio music signal into a sequence of voltages. This can be done by considering the audio only at specific times, for example, at every 10μsec interval. For example, we extract the voltage of the audio at t = 00, at 10, at 20, at 30, etc. and we ignore all other values of time. That means the audio values at t = 11, 12, 13, and 14 would all be ignored. This might strike you as throwing away most of the signal. We will return to this later in the discussion: for the moment, simply realize that this is not the case.

The process of considering only specific time points is called *sampling,* since only samples of the signal are used. The sampling process is familiar to us if we consider the movie camera. This camera is actually a still camera which takes a

Cherokee Studios, Hollywood, California.

JBL 4313 Studio Monitor.
It flattens the competition.

JBL

Introducing the 4313.

Flat frequency response. It means accuracy. Naturalness. Reality.

JBL gives it to you without the bigger box that you'd expect along with it, since the 4313 only measures about 23" x 14"x10"!

This new, compact professional monitor produces deep, distortion-free bass. And does it with a newly developed 10" driver. Its massive magnet structure and voice coil are equivalent to most 12" or 15" speakers. Yet it delivers heavy-duty power handling and a smoother transition to the midrange than most larger-cone speakers.

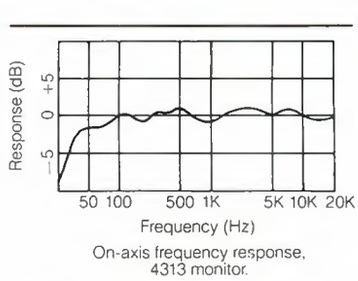
The 4313's edge-wound voice coil midrange accurately reproduces strong, natural vocals and powerful transients.

Up top, a dome radiator provides high acoustic output with extreme clarity and wide dispersion. A large 1" voice coil gives it the ruggedness needed in professional use.

Working together, these precision matched speakers offer superb stereo imaging, powerful sound levels and wide dynamic range.

Audition the 4313 soon.

We think you'll agree that its combination of flat response, power and moderate size flattens the competition.



On-axis frequency response, 4313 monitor.

James B. Lansing Sound, Inc.,
8500 Balboa Blvd.,
Northridge, California 91329.

JBL First with the pros.

Circle 24 on Reader Service Card

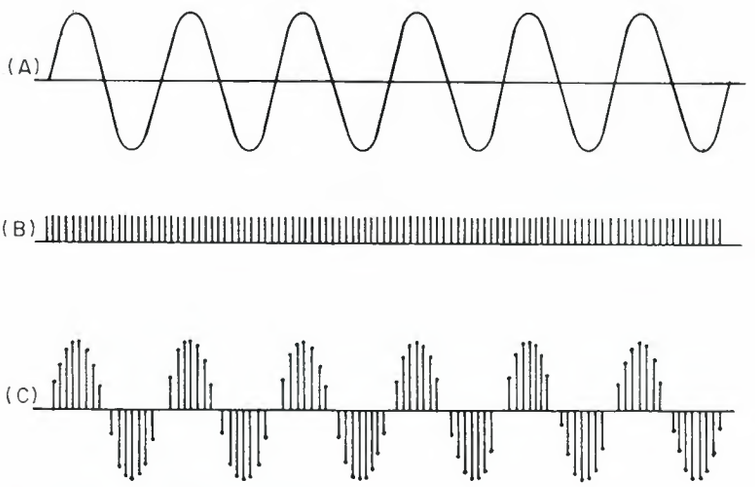
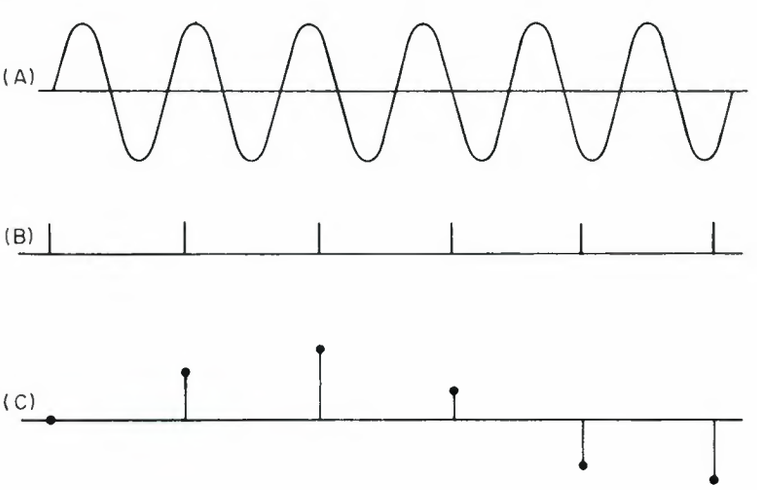


Figure 1. Illustration of the sampling process: (A) the audio sinewave at 580 Hz to be sampled; (B) the sampling signal at a 10 kHz rate; (C) the sampled 580 Hz audio signal.

new still picture every 1/24 second. Each still picture is a sample of the visual world at the time that the shutter opens. In-between shutter openings, the camera does not record any visual events. Yet, when we view the sampled pictures in the cinema, we do not have the sense of having lost information. A walking man appears to us to move continuously, without jerks or jumps. The ability of the sampled picture sequence to represent visual reality is based on the fact that moving objects do not move very far during the time between samples. When our man is walking, he does not move very far in 40 milliseconds. Similarly, the audio signal cannot walk very far in 10μsec.

We are now in a position to complete the digitization of audio. At regular intervals, the continuous audio signal is sampled, and this produces a sequence of individual analog voltages, each of which can be digitized. Notice that the fully-digitized audio signal is a sequence of numbers, where sequence corresponds to sampling, and numbers corresponds to quantization. In a certain sense, this completes our introduction to the subject. However, the sampling process can produce some difficulties and we also need to consider the rate of sampling.

Figure 2. Illustration of the sampling process with too low a sampling rate: (A) the audio sinewave at 580 Hz to be sampled; (B) the sampling signal at a 500 Hz rate; (C) the sampled 580 Hz sinewave.



PROSOUND '80 Exhibition

The Exhibition covering all aspects of Audio Equipment and Services

2—4 September 1980
West Centre Hotel London

Prosound '80 will provide a meeting place for manufacturers and visitors to exchange ideas and information on the many aspects of the audio industry. For further details on the Exhibition and Conference please use the coupon.

PROSOUND '80

Batiste Exhibitions
& Promotions,
Pembroke House,
Campsbourne Road,
Hornsey, London N8
(01-340-3291)

Please send information on the following:
Renvoyez s'il vous plaît les particularités suivantes:
Bitte schicken sie die folgenden Einzelheiten:

☐ Exhibition Stand Space	☐ Conference	☐ Organised Visits	☐ Hotel Accommodation	☐ Admission Tickets
☐ Emplacement pour stand de l'exposition	☐ Conférence	☐ Visites d'études	☐ Logement en hôtel	☐ Billets d'entrée
☐ Ausstellungsstandfläche	☐ Konferenz	☐ Gesellschaftsreisen	☐ Hotelunterkunft	☐ Eintrittskarten

Name, Nom, Name _____

Company, Société, Gesellschaft _____

Address, Adresse, Adresse _____

Country, Pays, Land _____

Telephone _____ Date _____ Signature _____
Téléphone _____ Date _____ Signature _____
Telephon _____ Datum _____ Unterkunft _____

Please print clearly – Écrivez en lettres moulées s'il vous plaît – Bitte schreiben sie im Druckschrift

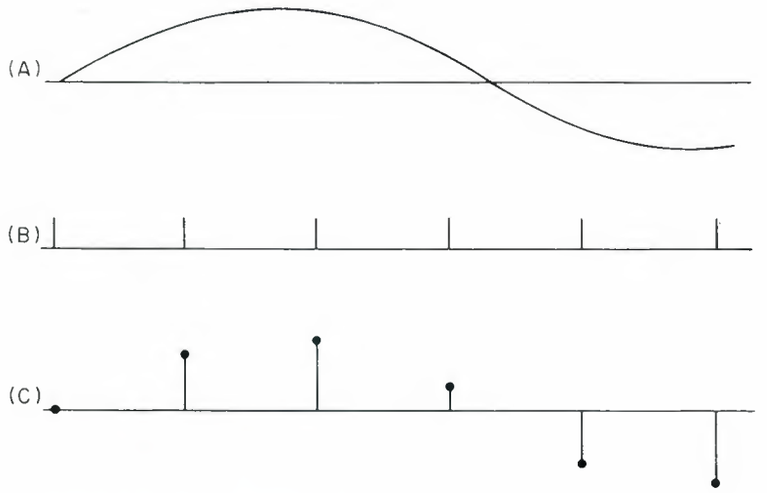


Figure 3. Illustration of an equivalent sine-wave which produces the same result as in Figure 2: (A) the audio sinewave at 80 Hz to be sampled; (B) the sampling t a 500 Hz rate; (C) observe that Figure 2(C) is the same as Figure 3(C).

THE SAMPLING RATE

The rate at which the samples are taken is a very critical issue. Sampling very rapidly will result in a very large amount of digital numbers, which generally places a severe burden on the digital system. A lower sampling rate is much better, since there are fewer numbers: sampling at 1 MHz produces 100 times more data than sampling at 10 kHz. On the other hand, if we sample too slowly, the information which we throw away between samples will be very important. If we ran our movie camera at 1 frame-per-second, the walking man would become very jerky; if we ran it at 1 frame-per-hour, it would be impossible to follow the subject.

UNDER-SAMPLING AND OVER-SAMPLING

The issue of under- and over-sampling is difficult to explain and we will use a series of figures to introduce the topic. In FIGURE 1(A), we have our audio signal represented by a 580 Hz sinewave. This signal is to be sampled by the 10 KHz sampling signal in FIGURE 1(B), to produce the resulting sampled audio signal in FIGURE 1(C). We can think of the operation of sampling as being one of multiplication, since the sampling signal is zero everyplace except at the sampling intervals. [We can also think of the sampling signal as operating a switch which is open except at the sampling intervals.] Please notice that the sampled audio signal looks like the original sinewave of the same frequency.

Let us now do the same analysis of a sampled sinewave using a 500 Hz sampling frequency, as shown in FIGURE 2. Notice that the sampled audio signal does not look like a 580 Hz sinewave anymore. In fact, it looks like it might be an 80 Hz sinewave. FIGURE 3 shows the sampling of an 80 Hz sinewave at this same 500 Hz sampling frequency. It's interesting to discover that the sampled signals are the same: FIGURE 2(C) is identical to FIGURE 3(C). In other words, a 500 Hz sampling of a 580 Hz audio signal produces the same result as a 500 Hz sampling of an 80 Hz signal.

Although this appears to be a strange result, the same phenomena occurs with movie cameras. If one tries to film a rotating wheel, such as that of a stage coach, one often observes that the wheel stops and then turns backwards, even though it is clear that the wheel must be rotating forward. Let us imagine that the wheel turns an amount of corresponding to 1.1 revolutions between the successive frames of the camera. A full revolution has no meaning and the wheel appears, in a given frame, to be only 0.1 revolutions further along than the previous frame. Hence, the wheel slows down to the eye. This is a clear case of under-sampling.

If the wheel had turned exactly one revolution between frames the wheel would appear to stand still since it is in the same position each time the shutter opens. This is the principle by which a strobe light can "freeze" motion. In fact, 2, 3, or 4 wheel revolutions-per-frame all produce the identical result. To return to the audio case, we could say that a 10 kHz sinewave, when sampled at 10 kHz, looks like DC. At each sample, the sinewave has the same value.

We can look at the issue from another

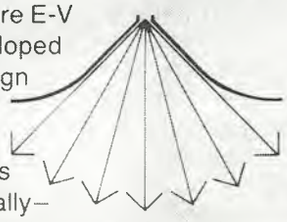
con·stănt di·rec·tiv'i·ty

The characteristic of a horn that directs all of the frequencies where you want them to go.

Most horns offer some control of the sound pattern they produce. The problem is that frequencies at the center of the pattern are different from those at the edges.

Unless you use **HR Constant Directivity** *horns, that's the problem you'll have.* To the audience this means unintelligible, too bright, too dull, and sometimes just plain bad sound at many seats.

These patented[1] **HR Constant Directivity** horns from Electro-Voice provide full-range frequency coverage and effectiveness of pattern control unheard of before E-V engineers developed this unique design concept.



Demand for the "white horns" has grown dramatically—almost completely by word-of-mouth. Once a sound engineer, musician or facility owner hears the difference **HR Constant Directivity** makes, a new demand is created.

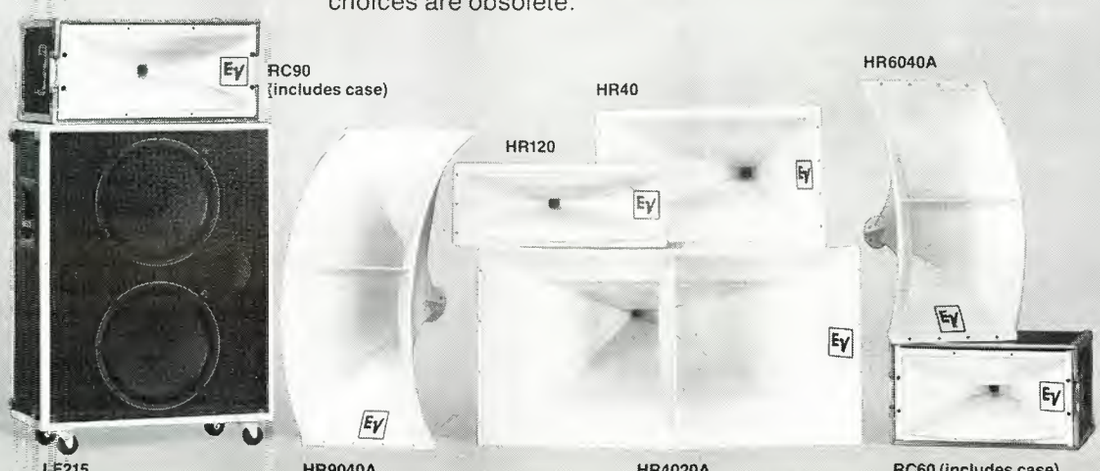
Ask someone who has used or heard them, or buy a pair and try them yourself. You'll probably hear that HR horns are so clearly superior that other choices are obsolete.

Write to Electro-Voice for more information. We'll send you a complete set of Engineering Data Sheets and a paper comparing the today performance of HR constant directivity horns with yesterday's promises. Include $1 with your request, and we will put you on the mailing list for the E-V "PA Bible," a down-to-earth series of papers on the selection and application of professional PA products and concepts!

[1] U.S. Patent Number 4071112

Electro-Voice®
a gulton company

600 Cecil Street, Buchanan, Michigan 49107



Circle 32 on Reader Service Card

point of view. Let us consider frequency of the sampled data in terms of samples-per-cycle. One cycle of the sequence below has a period of 10 samples, since the sequence repeats after every 10th sample.

(1) 0, 1, 6, 3, 2, 5, 9, 6, 0, 9,
0, 1, 6, 3, 2, 5, 9, 6, 0, 9

Let us ask the question: what is the highest possible frequency in any sampled signal? The pattern below repeats at a rate of once every two samples.

(2) 1, −1, 1, −1, 1, −1, 1, −1, 1, −1, 1, −1, 1, −1

Think about this pattern in terms of audio. The sampled audio signal cannot have a repetition frequency of greater than one-half the sampling rate. A 10 kHz sampling rate implies that there cannot be a frequency greater than 5 kHz in the sampled signal.

This brings us to the question: what happens when we do sample a signal with a frequency greater than half the sampling rate? As we saw in FIGURE 3, the result is a new frequency which is less than half the sampling rate.

Rule 1. An audio signal to be sampled must not have any frequency components which are larger than one-half of the sampling frequency.

Any components above this magic limit will be *aliased* to a new frequency within the restricted band. The frequencies in the sampled signal, called f_{AS}, can be related to the unsampled audio, f_O by the following relationship.

(3) $$F_{AS} = |Fo \pm NFs.|$$

where f_S is the sampling frequency and N is any integer number which brings the resulting f_{AS} within the region from 0 to $f_S/2$. The bars in equation (3) mean magnitude.

The process can be illustrated with our 580 Hz sinewave sampled at 500 Hz. Equation (3) becomes as follows:

(4) $$F_{AS} = |580 - 1 \times 500| = 80.$$

We would also find that a 420 Hz sinewave would produce the same resulting 80 Hz.

SAMPLING PROCESS CAN CHANGE FREQUENCY

We should not be surprised that the sampling process can change frequencies since sampling is like multiplication or modulation. Actually, the sampling process is exactly like the operation of heterodyne de-modulator in an AM receiver. A local oscillator is used to multiply the input to move the frequency down to the standard IF. The difference is that this movement is desired in the receiver and unwanted in the sampling process. To avoid the aliasing problem, sampled systems have an *anti-aliasing* low-pass preceding the sampling to remove all energy above half the sampling frequency.

Since this filter allows only frequencies which can be represented in the sampled signal, there is no frequency translation. With our 500 Hz sampling, we must only allow energy from 0 to 250 Hz if frequencies are not to be moved. Clearly for quality audio of 20 kHz, the sampling frequency must be at least 40 kHz.

THE NYQUIST FREQUENCY AND RATE

In the professional literature, the highest audio frequency which can exist in a sampled system is called the *Nyquist Frequency*. A sinewave of 20 kHz is the Nyquist frequency in a 40 kHz sampling system. The converse is that a *Nyquist Rate* of 40 kHz is required to sample a 20 kHz sinewave. Nyquist was the scientist-mathematician who discovered the rule.

CONCLUSION

The sampling process does not produce any degradation if the rate is high enough; but to guarantee this, we need an anti-aliasing lowpass filter. ■

The Greatest Radio Event Of 1980

October 5-8, 1980

Bonaventure Hotel Los Angeles, California

- Specially-Selected Speakers And Sessions To Prepare You For The Unique Communications Challenges Of The 80's
- Giant Exhibit Area—You'll See The Tools Of Tomorrow
- Learn The Latest *American Lifestyle Trends*
- Ratings Clinic: "Last-Minute Fine-Tuning For The Book"
- Superstar Concert
- Multimedia Shows And Movies
- Special "American Radio Expo" Awards Presentations

- **Large And Small Market Sales Clinics Featuring "New Methods For Co-op"**
- **Radio Vs. Records: "The Copyright Debate: Should Radio Pay To Play?"**
- **Formats — The Present And Future:**
  Top 40, AOR, Black, Beautiful Music, Country, Pop Adult, News/Talk
- **Promotion In The 80's: Covering Everything From Letterhead To TV Spots**
- **Participate In A Futuristic "Delphi Study" Of Our Industry**
- **The Latest From The Networks And Syndicators**
- **FCC & Engineering Panels**
- **Hospitality Suites**

And So Much More...

Registration Information

RETURN TO: NRBA • 1705 Desales St. NW • Washington, D.C. 20036 • (202) 466-2030

Please Print Or Type

Name(s) & Title(s): _____

_____

_____

Station(s)/Company: _____

Address: _____

City/State/Zip: _____

Phone: _____

FEES *

NRBA MEMBERS	
1st registrant	$150.00
each addt'l registrant	$130.00
NON MEMBERS	
1st registrant	$190.00
each addt'l registrant	$170.00
SPOUSES	$ 50.00

NOTE: Pre-registration deadline is September 25. After September 25, registration will be handled on site.

* There will be an additional charge of $25 per person for registrations received after September 1st.

Hotel Reservations

Please use separate forms for each room requested. This form may be duplicated.

Name(s) & Title(s): _____

_____

Station/Company: _____

Address: _____

City/State/Zip: _____

Phone: _____

Arrival date: _____

Departure date: _____

Please circle preferred type of accommodation.

	Standard	Medium	Deluxe
Single	$57	$67	$77
Twin (2 beds)	$69	$79	$89
Double (1 bed, 2 people)	$69	$79	$89

NOTE: NRBA is processing hotel reservations as a convenience to registrants. *To change or cancel your hotel reservations* you must do so directly with the Bonaventure Hotel (213) 624-1000.

If rate requested not available, nearest available rate will be assigned.

Reservations will be held until 6:00pm unless guaranteed by a first night deposit (payable to hotel) or a credit card.

Credit card type & #: _____

Expiration date: _____

** For Guaranteed Reservations Only **

I understand that I am liable for one night's room and tax which will be deducted from my deposit or billed through my credit card in the event that I do not arrive or cancel on the arrival date indicated.

Signature: _____

NORMAN H. CROWHURST

A.G.C. and Masking

• The logical development of the subject last month, strongly suggests that the middle-ear mechanism provides a full-frequency-range a.g.c., while the complicated mechanism inside the cochlea is responsible for the frequency selective a.g.c. which accounts for the effect measured by Fletcher and Munson and given the name "masking." Actually, masking is in effect an inverse of this effect.

THRESHOLD OF HEARING

As measured by Fletcher and Munson, masking is the amount by which the threshold of hearing is raised by the presence of another sound. If a sound of specified frequency and say 50 phon level is present, the threshold of hearing is no longer at zero phons. If the middle-ear mechanism were responsible for this rise in threshold level, then the rise would be uniform at all frequencies. In fact the presence of a 50 phon level would set the threshold for *other* sounds at about 50 phons.

Actually, if you think about it a little more that is not quite true. For if the middle-ear mechanism were responsible for all of the a.g.c. action, there would not be a differential in the spacing of the Fletcher-Munson curves at different frequencies. The fact that there is, is further indication that some of the a.g.c. action occurs in frequency selective manner, and thus takes place inside the inner ear.

What this means is that, if the a.g.c. were full-range, achieved by adjustment in the middle ear, then the loudness contours would be equally spaced throughout their length, so that 10 phons would equal 10 db, at the low frequencies as well as the mid-range and high. But they squeeze together at the low end.

MASKING CONTOURS

A further indication that the ear's a.g.c. action is frequency-selective is in the shape of the masking contours. The presence of any frequency of specified intensity produces a new threshold level that is higher for frequencies close to the masking frequency, than for frequencies further removed from it. This clearly means that the ear's a.g.c. system turns down the gain, so to speak, on frequencies where sound is already present, more than at other frequencies. And this must happen, somehow, in the inner ear, where frequency discrimination and recognition takes place.

COMPRESSION AND EXPANSION—EARLY "DOLBY"?

Now we referred last month to the effectiveness of compression and expansion systems in improving dynamic range. We said that, except for certain things that Dolby was invented later to overcome, compression and expansion had an effect very similar to what Dolby provides today. So now we want to take a look at what that difference is, and how Dolby takes advantage of, or perhaps it would be better to say, works with, characteristics of the human hearing faculty to achieve its improved effect.

What we mentioned last month was the distortion problem, but there is more. Any device that provides variable gain, must do so by using a device with a curved transfer characteristic. So it must introduce some distortion that a linear device would not. In some correspondence about distortion, a reader claimed the fact that some distortion-reducing measures work by introducing precisely opposite curvature to that known to exist in the system already, which is true. Distortion can be reduced only by one of two means: (a) using the input as a reference and using feedback to make the output more like the input; or (b) knowing precisely what curvature the system introduces and using an equal and opposite curvature to offset it.

The first attempt we made to do this was in a system that used compression and expansion, because there was no other way to eliminate the curvature. And feedback couldn't do it, because that would also eliminate the gain changes we wanted, which was the purpose of the compression and expansion units in the system.

But there was another fact connected with the use of compression and expansion. The large input signals, that had to be turned down on compression, used

more of the variable gain device's curvature than the small ones, so that loud passages resulted in more distortion, even if it could be reduced by some other means. At low levels, the much smaller signals resulted in much smaller distortion, even though the curvature was the same at both operating points.

ENTER DOLBY NOISE REDUCTION

This was one thing that Dolby was invented to offset. But there was another. This was particularly noticeable when compression/expansion was used on musical programs with little sound in the higher frequencies, such as a recording or transmission of a string bass, playing at variable loudness. With compression and expansion, the low frequencies do not mask the high frequency hiss, which is how most noise is perceived. Consequently, when the bass played softly, the hiss would come up, due to greater amplification, and when it played loudly, the hiss would go down.

The result was that musical program with sounds prevailing in the low frequencies, would sound as if it was accompanied by something like the ocean waves, surging on the shore. And sometimes that effect might not be wanted!

Dolby overcomes both these problems, by using a linear amplifier to handle the maximum sound levels, both on the compression part and the expansion part of the operation. For the older type compression and expansion, control of the a.g.c. action was taken from the output of the compressor and the input of the expander. If the original program had 70 db dynamic range, and the compressed signal had 40 db dynamic range, then the control for both units was taken from 40 db dynamic range signal. This was the only arrangement that would be stable, using that system.

With Dolby, the basic system uses constant-gain, linear amplifiers to handle what, in effect, is the maximum signal level, at all frequencies. Then, if the input level is low, an auxiliary amplifier comes into action, to boost the output level, so it is only 40 db (for example) below maximum, instead of 70 db. As the input level comes up, this boosting diminishes.

BOOSTING IN SEPARATE FREQUENCY BANDS

In addition to this, by doing it this way, such boosting can take place in separate frequency bands, to approximate the masking differences of human hearing. And at the other end, low level in a particular frequency range, uses the auxiliary amplification, this time to reduce the level of that part of the frequency spectrum, as compared with the maximum level gain.

This means that absence of high frequency program content, for example, turns down the playback gain in that frequency range, by some 30 db. If there is a high level program content in that range, gain comes up, by reducing this offset, so the full effect is heard. The better, higher priced Dolby systems use more frequency bands than the lower cost versions, but the principle is the same.

ELIMINATING DISTORTION

Distortion has always been a problem, by its very nature, with louder signals. Small signals use only a small part of the curvature, and a small piece of any curvature is closer to linear than a big piece of the same curvature. So by decommissioning the compensating amplifiers at high level, leaving only the linear, high level amplifiers operative, distortion is very low, where it was highest in the older compression/expansion system.

Where control for the older compression/expansion system was taken from the intermediate level, the dynamic range-reduced level, Dolby does the opposite. The control for the equivalent of the compressor is taken from its input, not its output. And the control for the playback or receiver unit is taken from its output, not its input.

The use of a lower level to provide booster amplification of the lower signal levels at the recording or transmitting end, acts like any a.g.c. and thus is inherently stable. The part of the older system that would have been unstable would have been the output end, where a higher level would have increased gain, and could thus have gone into self-oscillation. But with Dolby, the direction of change is reversed. At maximum level, the auxiliary amplifier is inoperative, while it comes into action only at low levels of output, at a given frequency, and that to reduce output level at that frequency. Thus it cannot become unstable.

Thus Dolby overcomes both the distortion problem, and the masking problem that could result in a spurious "breathing," or waves of the sea effect. Also, where use of the old expansion system, where no compression had been used, would produce an unnatural effect, Dolby tends to enhance any reproduction, with the possible exception of speech.

SOME QUALIFYING REMARKS...

Now, just a word of warning. Some readers have written in to question the validity of what we have been saying, on the apparent assumption that the auditory nerve (and thus presumably also the optic nerve) uses a biological equivalent of pulse code modulation. This could be a dangerous analogy.

It is true that any single nerve fiber can carry only some organized set of pulses. But pulse code modulation is something else altogether. Intensity of a signal may be coded, for example, into a binary set that gives the numerical amplitude of a signal at a point on its waveform. And this is conveyed over a single channel, the equivalent of a single nerve fiber, for each channel of sound to be conveyed.

It may be possible to pulse code a whole stereo or quadraphonic program onto a single channel. At the most it would take either two or four channels. But the human hearing faculty carries many times this many channels, or nerve fibers. So we are talking about a very different system.

Sounds are identified by the coincidence of pulses received over different sets of fibers, not by recognition of a specific pulse code over a single fiber. Eyesight functions in much the same way. Now, if you look at a field of grain, what do you see? A mass of color, perhaps with some impression of texture to it. But if you wonder what kind of grain, what then? Of course, if you get out of your car and go over the field, examine an ear of grain, you know in detail what it looks like.

But if you are a farmer, you probably can tell what the grain is, without even stopping the car. You observe an ear of wheat, or a spray of oats, and see sufficient of them to determine whether the field is all of one grain, or mixed. Are you now looking at the field in the same way you did when you observed it as a mass of color, with a texture to it?

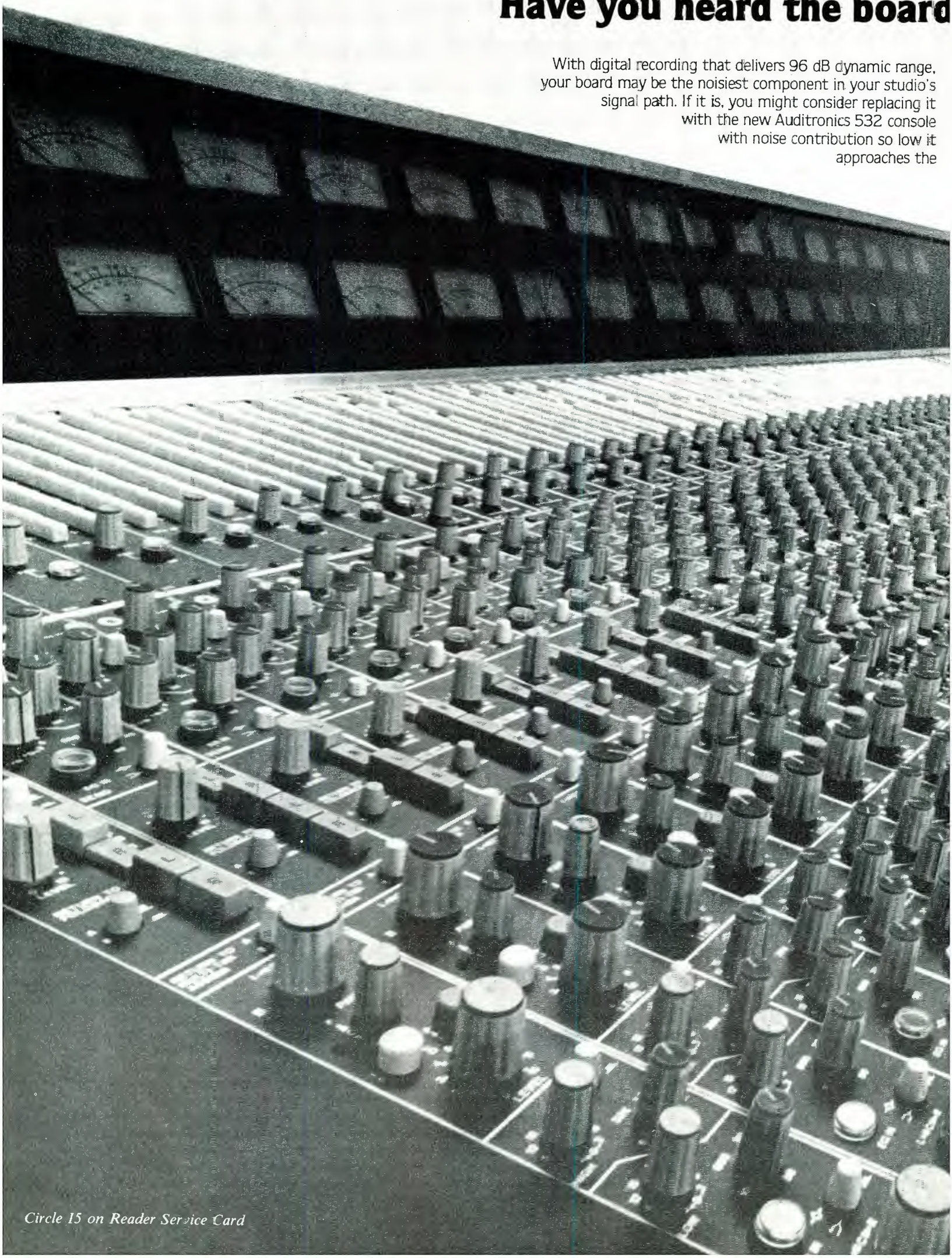
It is true your eye does not work like a zoom lens, to change from wide angle to telephoto. But your eyesight has a similar capability. You can examine what you see, or be conscious of it, at both levels, or perhaps somewhere in between. If you photograph a mountain that is on the skyline, it may have looked to your eye, like a big mass of land thrusting upward against the sky. But you photograph it and when you look at the picture, you have trouble finding the mountain at all. It's just a little bump on the skyline. You'd need a telephoto lens to get the impression you saw with your eye. Yet your eye also takes in the whole skyline, like the photo does.

Your hearing does substantially the same. You can listen to a whole orchestra or, if you want to, you can examine just the performance of the violin section. In a crowded room, you can listen to just one conversation, while a tape recording of the same thing would be a mere confusion of a great many voices. If you think about it, you realize this is something a microphone could not do. Or even a selective amplifier.

Maybe some day a computer will be able to take such a signal, and process it so that you can isolate sounds in the same way human hearing can. But that day is not here yet. To what extent can we definitely listen for something, as distinct from merely analyzing what we hear? And precisely how does that work? These are questions to which biologists have not yet given us answers. ■

Have you heard the board

With digital recording that delivers 96 dB dynamic range, your board may be the noisiest component in your studio's signal path. If it is, you might consider replacing it with the new Auditronics 532 console with noise contribution so low it approaches the



Circle 15 on Reader Service Card

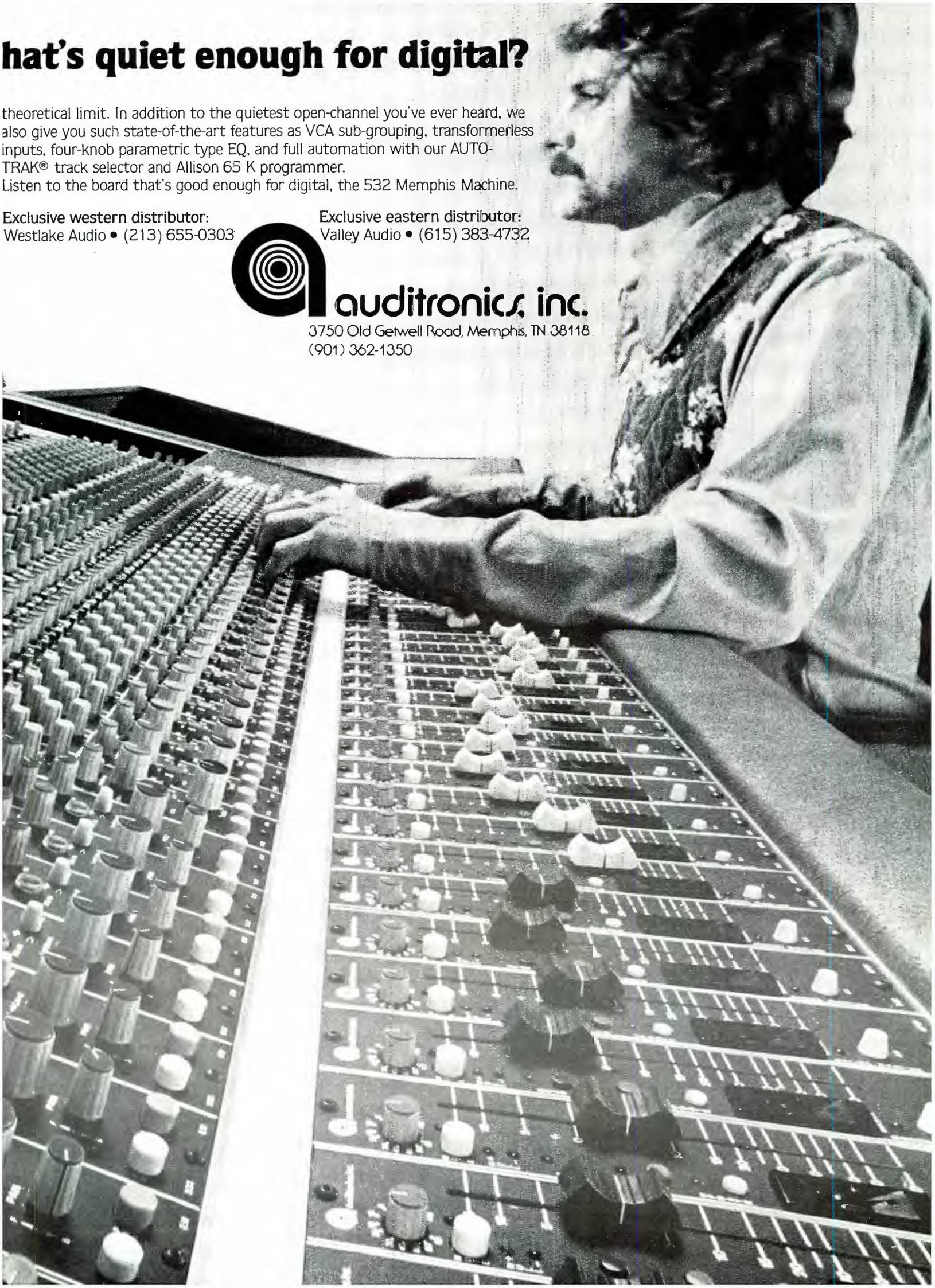
hat's quiet enough for digital?

theoretical limit. In addition to the quietest open-channel you've ever heard, we also give you such state-of-the-art features as VCA sub-grouping, transformerless inputs, four-knob parametric type EQ, and full automation with our AUTO-TRAK® track selector and Allison 65 K programmer.
Listen to the board that's good enough for digital, the 532 Memphis Machine.

Exclusive western distributor:
Westlake Audio • (213) 655-0303

Exclusive eastern distributor:
Valley Audio • (615) 383-4732

auditronics, inc.
3750 Old Getwell Road, Memphis, TN 38118
(901) 362-1350



MARTIN DICKSTEIN

db Sound With Images

• In the beginning (of audio visual presentations that is), there was a single screen. Soon after, someone came up with the idea of using two screens, side-by-side, with either the simultaneous movement of both projectors, or independently. Then came three screens—same situation though: either move all of the slides at the same time, or in combinations.

MULTIPLE PROJECTORS, SAME SCREEN

Then, along came the idea of making the slides move faster, and more than one projector *had* to be used on each screen. This was soon followed by programming devices which controlled the projector moves, lights, and all plug-in equipment. Now, there are punched paper tape units; others put audio signals on a magnetic tape. And finally there are the digital information systems, with astonishing memories to really make the projectors go through their paces. Some manufacturers of these programmers tell of how up to 100 projectors can all be controlled at the same time.

IS THERE A LIMIT?

The question now is how far can you go before you go *too far?* Just suppose you decide that nine projectors is enough for your needs. Now, the next question arises: should all images appear on one screen, two screens, three screens, or two screens with an overlap at the center? What it all boils down to is; how many screens will meet your needs?

FOVEAL AND PERIPHERAL VISION

To answer the question of how many screens will depend on how we are to view what is on the screen(s). Note that normal human eyesight covers about 180 degrees horizontally, and approximately 150 degrees vertically, when the eyes and head are not moving. This means that a screen 1000 feet wide can be seen from 100 feet away. (You can check your own peripheral vision horizontally by holding both hands out in front of you with arms straight, then spreading the straight arms right and left. Where you lose sight of your hands, the angle of the arms is the peripheral angle of your own sight.) However, in order to see something in detail, the eyes must look directly at the object. This is called foveal vision. To see something off to one side in detail, the eyes must look directly at the object. This is the foveal vision. To see in detail something off to one side or the other, we either shift the eyes or turn the head.

The foveal vision area is quite small, while the peripheral area is quite large. Tests and measurements have shown that, at about two feet on either side of an object, our ability to see detail drops off dramatically.

THE EYE'S "CINEMASCOPE"

How, then, do we visually absorb the whole picture? Tests taken of the eye while looking at a photograph show that we see most detail when the eye is fixed at certain points, and very little during the times the eye moves from one point of interest to another. The eye scans the image, resting at the places where some detail is desired, and moving very quickly in between. Some points of the picture are not fixed-upon at all. It has been found that fixation usually lasts eight-tenths of a second to two seconds. Movement can take from one- to eight-hundredths of a second. It all comes out to about 95 percent of the time in fixation, and about 5 percent in movement.

Staring at a fixed point for any period of time can create a lack of interest because the eye naturally wants to scan the whole image. For example, when talking to someone, the eye moves across the face, and sometimes off the face to either side. Generally, the listener's face is scanned periodically, unless there is a desire for *specific detail.* However, staring at the other person can cause restlessness and embarrassment.

INHERENT ATTRACTION TO MOVEMENT

In experiments, where a central image is kept constant, and peripheral images changed, it is noted that the eye was always attracted away from the center position, to the place of movement. Thus, movement of images is a great attention getter. Depending on the context of that image, the eye was able to scan quickly enough to get sufficient information to relate it to the rest of the picture in view. The whole scene could provide enough information for the viewer to retain even when the eye only fixed on one, or at best, a *few* points. It has been determined that, in order for the viewer to recall specific details, it is necessary to provide a complete or coherent image of the scene.

PERCEPTION

Perception involves a continuously-active process of scanning, fixating, constructing whole scenes from parts, interpreting and remembering. The viewer must be taken into the whole picture, but viewing is limited by the constraints of the eye and its ability to move and focus. An observer who takes part in the active process of scanning can take away a large amount of information, and the eye performs more effectively when it is challenged by the whole field of vision. The brain can "see" more than the eye can. Two eyes and a brain can see three dimensions, while the screen shows only two. If the same manual operation, for instance, were seen from different angles or sides simultaneously, the brain would assimilate quickly and easily, and would retain it much longer. Thus, the simultaneous-image format creates greater interest, higher level of recall, more involvement, and superior effectiveness than faster movement of a single image on a single screen.

This is not to say that single-screen presentations cannot be effective. It depends on the purpose of the presentation. If specific information is to be imparted, and greater concentration is required by the viewer to "get" that information, perhaps a single screen is the best choice. If however, an environment or atmosphere is the intent, or a mood is to be set, the multi-image, multi-screen presentation will be more effective. An audience will believe it saw more than it really did if the eyes and the brain of the observers were kept in constant scanning motion, than if they were limited to single-image fixation.

Just remember that relevance of the individual images to the total picture is extremely important for greatest effect. Overall meaning is remembered long after the specific stimuli are forgotten. Also remember that showing an image too long can create boredom, and showing it for too short a time may create uneasiness and frustration.

CONCLUSION

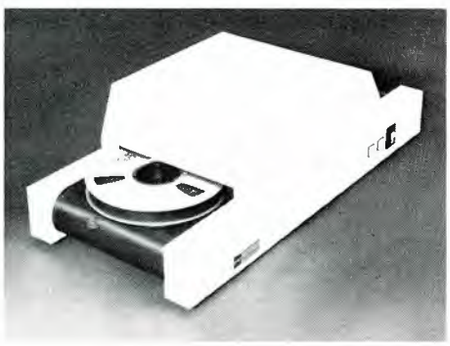
Above all, take the audience into consideration before you start production. Who are they? How many will there be? Where will it be shown? What do you want to communicate? Single-screen, multi-screen, single-image, multi-image, single-medium or multi-media (slides mixed with film and sound)—they're not all the same, and they may not always fill the purpose of the showing. Just don't be afraid to use more than one screen, or more than one image, as long as you know *why* you're doing it, and to what end. ■

db New Products & Services

AMPLIFIER

• The new PRO-300 monophonic power amplifier is intended for high power sound reinforcement applications as well as high accuracy demands in the laboratory, studio, and audiophile installations. The PRO-300 is rated at 300 watts into either an 8 or 4 ohm load, and is capable of delivering well in excess of 350 watts before clipping. The PRO-300 utilizes the same components as the DH-200 in a virtually identical circuit, but its bridged monophonic output delivers 50 percent more power than a simple addition of the two stereo channels, while retaining the same durability.
Mfr: David Hafler Company
Price: $450.
Circle 51 on Reader Service Card

DEGAUSSER

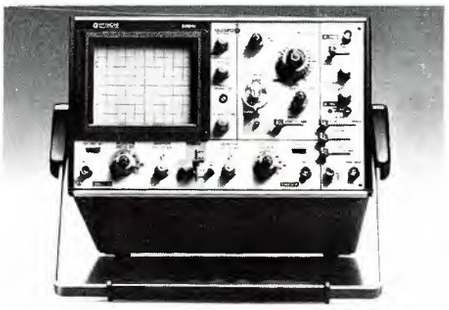


• The Model 1100 bulk tape degausser is of a high-speed design especially geared for 1-inch high-coercivity video tapes, and can also be used on high-density video cassettes and audio tapes. It will erase up to thirteen reels per minute and can handle reels up to 10½-inch in diameter.
Mfr: Garner Industries
Circle 52 on Reader Service Card

LINEAR PREAMP

• The linear preamp has been designed as a reference system for the critical audiophile. It serves as the basic control unit of any stereo set-up, processing audio signal without adding distortion or coloration of its own. In addition, the linear preamp features a subsonic filter, two tape or processor loops, and left-right mono/reverse capabilities. A unique gain switch offers 20 dB of additional gain only when needed for optimum s/n ratio.
Mfr: MXR Innovations, Inc.
Circle 53 on Reader Service Card

OSCILLOSCOPE



• The V-550B oscilloscope offers a 6-inch square CRT with an internal graticule. The use of an improved metal backed phosphor makes the 10 kV tube as bright as the older 15 kV CRT. Among the features are: trigger view, variable trigger hold-off, full TV triggering and single sweep capability. An additional feature is automatic focus correction which restores proper focus whenever intensity or sweep range control settings are altered.
Mfr: Hitachi Denshi America Ltd.
Circle 54 on Reader Service Card

CARTRIDGE

• A new line of phono cartridges were recently introduced designed for multiple applications. Deemed, the SC39 Series, all models in the new line are designed to meet professional standards for ruggedness and reliability. A major new feature of the SC39 Series is resistance to stylus damage, even when subjected to the rigors of slip-cuing, backcuing, and other fast-paced studio abuses. Each SC39 cartridge has an internal support wire and special elastomer bearing that insures stable and accurate backcuing without groove jumping.
Mfr: Shure Brothers Inc.
Circle 55 on Reader Service Card

AMPLIFIER

• The Model 6500 amplifier offers modular construction which allows the user to remove either channel for inspection or exchange while the amplifier is mounted in the rack. Each channel is totally independent with its own power supply and even its own continuously variable cooling fan. The Model 6500 provides 275 watts RMS at 8 ohms with .1 percent THD and up to 1,200 watts RMS in mono mode at 4 ohms.
Mfr: UREI
Circle 56 on Reader Service Card

Radio & Recording III—The Studio as a System

ONCE UPON A TIME—that is, in the days when direct-to-disc was the *only* way to record—the studio was probably not considered as a "system." One merely went from microphone-to-console-to-lathe. This was before the days of mixdowns, time codes, and video tape. In fact, there wasn't even any *audio* tape yet.

Each control room was its own little universe, and it didn't much matter what was going on elsewhere, since it couldn't affect the session anyway. At the time, "communication" meant nothing more than a talkback system.

As you've probably noticed, all that has changed a bit over the years. Nowadays, mixing instructions may be stored on a floppy disc, the master tape may actually be *two* tapes, and there may even be an accompanying video tape as well. Needless to day, communication now means more than a talkback button. All of this paraphernalia isn't going to work very well, unless you have taken a systems-approach to your studio design.

The console is perhaps at the heart of the system. On second thought, maybe the computer is the heart of the system, and the console is the soul. Well, whichever (or, whatever) it is, the console is certainly also a system in itself. And within that system, the voltage-controlled amplifier (VCA) is playing an increasingly-significant role.

VCA technology has been around for some years now. Like most other technologies, its earliest days were marked by "growing pains." In fact, the moving faders in Neve's celebrated Necam system were, in part, a highly-innovative way of avoiding the early-VCA problems entirely.

Of course, today's VCA technology is a far cry from those first-generation devices. And one of the leaders in today's state-of-the-art VCA design is Paul Buff. His company—formerly, Allison Research—recently merged with Valley Audio, to become Valley People, Inc., where Paul is now v.p. Recently, we asked him to bring us up-to-speed on the capabilities of the latest VCAs. For more on the subject, see his feature story, "The New VCA Technology."

Last month, Jeff Cooper offered us a look at the Saul Zaentz Film Center in Berkeley, California. The Center is part of the larger Fantasy/Zaentz system, which **db** publisher Larry Zide recently visited. This gives us the opportunity to view the film center in context, as one part of an impressive total audio/visual system. Fantasy's Studio D is a recent Sierra Audio project, so we asked Sierra's Kent Duncan to add his own comments on creating an "ultimate environment." You'll find Duncan's observations following Zide's description of the Fantasy/Zaentz "candy store."

At Motown/Hitsville, USA, even the construction crew had to adopt a systems approach to their work, since the project included not only a new studio, but renovation of some older ones. Before the old ones could be re-done, the new one had to be completed. However, the new studio was to be located directly over one of the old ones. Naturally, the old one had to remain functional until the new one was ready. Motown's Guy Costa took care of the necessary juggling, which was required to successfully put together the Motown system.

Before rushing off to fulfill your own fantasy of a hitsville studio system, pay some heed to Ham Brosious at Audiotechniques, who reminds us not to forget that old "bottom line." In order words, don't assemble a studio system that your clients can't afford to book time in. Although Brosious probably wouldn't mind selling you a mega-buck system, you should make sure—up front!—that your rate card will be able to support your dream studio on the first of each month.

Should you consider video in your systems planning? Perhaps not, according to Arista Records' president Clive Davis. In a Billboard Commentary (June 7, 1980) entitled, "Videodisk: Hope or Hype?", Davis writes, *"All hard evidence, and past history, points to the new visual medium making strong inroads in general interest films, educational films, pornographic films... but minimal waves in music... I'm not sure what the future holds, but my gut feeling is that the videodisk involving music won't have the immediacy of a concert, the imaginative dimension of the aural record, or the sustaining grip of the story film."*

For a quite-different point-of-view, Mark "Moogy" Klingman urges us to join him in the audio/video studio of tomorrow. He predicts that, "*...all record companies* (except Arista?—**Ed.**) *will want video for all the rock they record."* If so, you had better leave some room in your systems budget for the necessary hardware.

At the recent seminar on Audio Recording for Video (New York City, June 17-19), Klingman delighted the audience with his opinions on the subject. As he left the podium, we snatched his notes away, in order to share them with you.

Read them and form your own opinion. Do you agree with Clive or Moogy? Or is reality somewhere in between? We shall see. ■

the New Workhorse

Quietly, you have made the OTARI tape machine a standard for reliability and performance in literally hundreds of stations and thousands of production studios—worldwide! The legendary 5050 series were the first compact professional recorders accepted by the industry and remain, dollars for dB's, the best tape recorders made. Whether moving ¼" or ½" tape, these SMPTE adaptable machines are complete with every necessary production feature.

Our ARS Series Reproducers have been accepted by the most prestigious automation manufacturers in the business. These people must have a reliable product before they put their name on it. Our MX-7800 1" transport production machine remains the most functional eight track on the market.

The OTARI pre-eminence in engineering is more than fifteen years old and encompasses tape formats from full track to twenty-four track and tape speeds from 3¾ to 240 ips. To the broadcaster OTARI has earned its envied reputation for reliability with technological leadership and 100% pre-shipment check-out.

Behind our product is a further commitment: factory support with a large domestic parts inventory, thorough documentation and communicative personnel. A qualified and dedicated dealer network is the final link in OTARI's comprehensive approach to the broadcaster.

You have made OTARI—*The New Workhorse*. We have made them the most comprehensive line of tape machines in the world.

Call or write today for your nearest dealership. They will be happy to put you on top with an OTARI.

OTARI®

Otari Corporation
1559 Industrial Road
San Carlos, CA 94070
(415) 592-8311

In Canada:
BSR (Canada, Ltd.)
P.O. 7003 Sta. B
Rexdale, Ontario M9V 4B3

Models 5050B & Mark II-4 shown in optional cabinets available from the Rus Lang Corporation, Bridgeport, Conn. (203) 384-1266

Circle 28 on Reader Service Card

PAUL C. BUFF

The New VCA Technology

In the past, many audio professionals avoided VCA technology like it was the plague—regardless of its admittedly high potential. Well, that potential has now come of age with proven performance that is capable of changing even the most skeptical.

VCAs, OR VOLTAGE CONTROLLED AMPLIFIERS, are necessary elements in the realization of many functions of present-day professional audio systems. With the rapidly increasing usage of computer control and automation techniques, together with higher levels of sophistication in signal processing peripherals such as limiter/expander/compressor/noise gate type of devices, the VCA has indeed become a standard piece of audio hardware.

EARLY VCA TECHNOLOGY

In the past, VCAs were sometimes considered as compromise devices to be avoided wherever possible. The reasons were simple...VCA performance had not been equal to the performance offered by conventional fixed-gain amplifiers. In fact, during the 70s, VCAs were equated with marginal noise levels, high distortion, modulation noise, crossover distortion and temperature sensitivities affecting distortion parameters.

It was not uncommon to find VCA signal chains which exhibited SMPTE IMD, on signal peaks, in the range of 0.3 percent to 1 percent. Even at low signal levels temperature-induced errors in the distortion nulling circuitry could produce an unpredictable amount of distortion, extending into the same general range. Now this is not to say that all VCA circuits of the 70s produced exaggerated levels of distortion. With proper manipulation of the operating parameters, distortion levels in the general range of less than 0.1 percent THD and 0.25 percent SMPTE IMD could be achieved. However, the cost was a corresponding increase in noise levels. In many VCA console designs, this noise increase has been the limiting factor in overall noise performance.

VCAs IN TODAY'S PRODUCTS

For console usage, the audio requirements of a VCA are considerably more stringent than for a piece of peripheral equipment. Firstly, the VCA forms a more-or-less permanent part of the console. All audio signals pass through it at least twice: once during the recording session and again, during mixdown. Thus, any distortion in VCA is multiplied. Secondly, since most professional consoles process at least 24 tracks of audio, 24 tracks-worth of VCA noise are summed in the mix. As the mathematics of combining the noise from 24 sources would have it, this represents a noise increase of about 14 dB over the noise of an individual signal source (N = 10 log 24 = 13.8 dB). Thus, if we are to achieve a 70 dB signal-to-noise ratio in the mix, we must have at least an 85 dB ratio at the VCA outputs, at the normal mixing gain. Since the console itself is not supposed to be the limiting source of noise—this being reserved for the tape media and mic pre-amp thermal noise—a VCA signal-to-noise ratio more like 90 dB is realistic.

As for distortion, the same thinking should apply. Even though an analog tape path may produce distortions in the 0.25 to 0.5 percent range, a console producing similar distortion figures should not be tolerated. With the digital recorder making its appearance, the rest of the signal path should be extremely clean and transparent, in order to allow the fullest usage of the new medium. Certainly, a $100,000+ pro audio console should be as transparent as the equipment on which the consumer plays the final product. I would think, and most of my customers would agree, that a distortion figure of around 0.025 THD or IMD is about tops, if the equipment is to perform without question as to its coloration (or lack thereof).

DEVELOPMENT AND ADVANCEMENT

Of course, there is also the question of Transient Intermodulation Distortion (TIM) and slew rate (full power bandwidth), as well as any other form of distortion or noise which could affect the signal quality.

Previous VCAs simply could not meet these criteria, and listening tests of a critical nature often exposed the culprit. Yet, ever-growing technology was making it very clear that the VCA was a device which must be...the audio world could not live without it any any more.

ENTER ALLISON RESEARCH

These were the underlying realities which caused Allison Research to develop an electronic gain control device (VCA) which is fully capable of meeting the requirements. It might be argued that this sort of performance is very easy to achieve with modern op-amps, and that it should have been applied to VCAs a long time ago. This sounds good on paper, but there is one area unique to VCA design: a negative-feedback loop cannot be placed around a VCA, as it can be with a fixed-gain amplifier. A VCA with feedback ceases to be a VCA, since the nature of feedback is to maintain a fixed-loop gain, regardless of changes

Paul C. Buff is president of Allison Research Inc. of Nashville, Tennessee.

in the open-loop gain. Yet, large amounts of feedback are the primary means by which op-amp circuits yield to low distortion.

Thus, in a VCA circuit, low distortion must be achieved by other means, such as complementary anti-distortion structures, to compensate for the inescapable non-linearities in the transistor elements. Fortunately, such anti-distortion circuits can be configured, using the same elements as produced the distortion in the first place, given clear circuitry and careful component selection.

Such has been the case, in the configuration of the Allison EGC 101 series VCAs, which are described next.

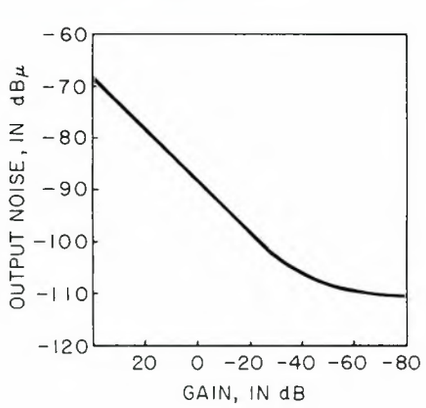
THE ALLISON EGC 101 VCA

The Allison EGC 101 is a precision electronic gain control circuit, fully capable of meeting all of the above outlined performance requirements. When supplied in its elementary form, the EGC 101 may be user-configured to perform the VCA function, using a minimum of external parts, and may be tailored for optimum performance in a wide variety of applications. In this basic form, the EGC 101 is fairly inexpensive (around $7 to $10 in OEM quantities), and is extremely reliable. The device is also offered in several "complete VCA" packages, such as the EGC 205M (universal package), EGC 202 (dbx retrofit) and EGC 2500 (MCI 500 series console retrofit).

The EGC 101 cell is configured as a Class A log/antilog multiplier, using both complimentary and symmetrical balancing and cross balancing, in a patented circuit. The unique circuit structure, in which each transistor component has a complimentary "anti-component," together with close computer matching of the components themselves, results in essentially a complete cancellation of all nonlinear effects of the circuit elements. The resulting distortion products are held to the range of 0.0005 percent at nominal signals, rising to around 0.0003 percent THD and 0.0009 percent SMPTE IMD, at elevated levels. Throughout most of the range, the distortion products are unmeasurable on conventional equipment, and may be detected only through specialized lab equipment, such as high-resolution spectrum analyzers.

The device offers a gain control range which extends beyond a 150 dB range, from over 50 dB gain, to over 100 dB attenuation. Throughout this range, the EGC follows an exacting log relationship of control voltage-versus-gain/attenuation. This parameter is user-definable, with common scalings being 20 dB/volt or 10 dB/volt. If the loose industry standard of 20 dB/volt is chosen, the EGC will normally be

Figure 1. Graph depicting output noise vs. gain in the Allison EGC 101 (typical configuration.)



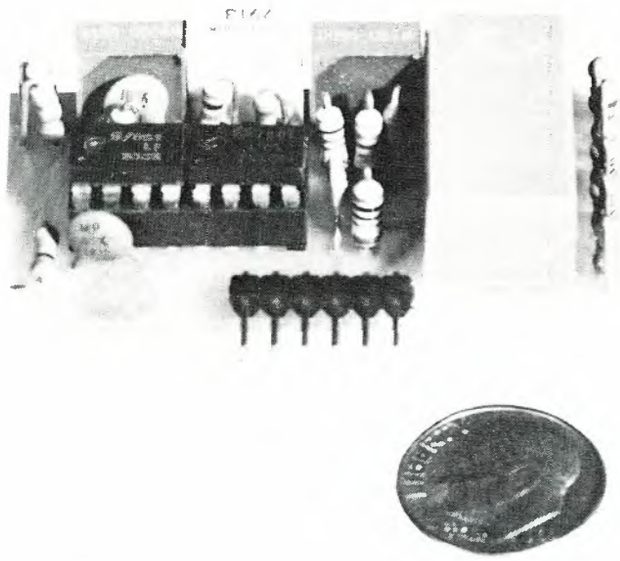


Figure 2. The EGC 101 voltage control amplifier from Allison Research.

configured to have unity audio gain with zero control volts, and will attenuate 20 dB for each positive volt applied to the control terminal, and will exhibit forward gain at the rate of 20 dB for each negative volt of control. The control voltage terminal is normally configured as an active current-summing point, so that multiple sources of control may be applied. This will be discussed in detail in later paragraphs.

As for noise levels, in most configurations the output noise will range from below -110 dBu at maximum attenuation, to around -87 dBu at unity gain, and on up to around -70 dBu at +40 dB gain, in accordance with the graph of FIGURE 1. It should be noted that throughout most of the active gain range, a 20 dB increase in VCA gain will be accompanied by only around a 10 dB increase in output noise. This characteristic should be considered when configuring a VCA circuit for optimum gain structure in a given application. (For those unfamiliar with the term "dBu," this is a measure of signal level, relative to 0.0775 volts RMS, and is synonymous with the term "dBv re 0.775 V").

Unlike earlier Class AB VCAs, the EGC 101 exhibits essentially no modulation noise (about 100 dB below signal level).

When configured with inexpensive bi-fet op-amps, slew rates of 13V/ μsec are obtained, along with full power bandwidths of around 150 kHz. Twin-tone IMD tests reveal very low intermodulation products at frequencies up to 100 kHz. These factors assure the absence of audible TIM (transient intermodulation distortion).

As might be expected from the above descriptions, the VCA behaves, and sounds like, a vey high quality conventional amplifier, and is totally undetectable in the most critical of listening tests. Although in most critical applications, the device is adjusted for minimum distortion with two trimpots, these adjustments are fully stable, and not sensitive to temperature effects, as were present with earlier devices.

CONTROL CIRCUIT

As mentioned before, the control circuit of the EGC 101 is log-responding, with the scale factor being user-definable. The device is capable of a rate of gain change on the order of 100 dB/ μ sec. while the control circuit feedthrough into the audio output is trimmable to under 10 mV for gain changes between -100 dB and +30 dB. There is some amount of thermal sensitivity in the control feedthrough term, wherein temperature *differences* across the natural EGC 101 gain cell can cause increases in control feedthrough. With reasonable isolation from heat-producing elements, good rejection figures can be maintained in most applications. Along these lines,

additional design work is in progress, and is expected to essentially eliminate this thermal sensitivity.

LOG CONTROL IMPLICATIONS

Now that the performance of the device has been discussed, I should like to discuss some of the applications for VCAs in general, using the EGC 101 as a model. Before proceeding very far in this direction, an understanding of the implications of the log format of the control circuit should be acquired, as this relationship forms the backbone of modern VCA flexibility.

In discussing this relationship, I shall assume that a good many readers do not relate as confidently to dc control circuits, as they do to audio circuits. This particularly applies when these control circuits are log-responsive. However, once the principles are shown, most readers will quickly understand just why log-form control processing is such a powerful tool in VCA applications.

Let us first look, not at a *log* control circuit, but at a *linear* control circuit, to seek a clearer understanding of the advantages of the log format. A typical linear control multiplier response is graphically depicted in FIGURE 3. Here, it is seen that a 20 dB change in control voltage produces a 20 dB change in audio gain. For example, a control voltage change from +10 volts to +1 volt is a 20 dB gain change, as is a change from, say 10 mV to 1 mV. An immediate obstacle is apparent to anyone who has configured dc amplifiers, in that the stated control voltage for the −100 dB gain point is 1 μV, while a mere increase of 9 μV would establish a −80 dB gain point. Since typical op-amp offset voltage errors run around 3 mV, there is no way that these microvolt control voltages could be resolved. Even if they could be resolved, it is apparent that the slightest bit of noise or rf on the control lines would cause wide gain modulation, at the low end of the spectrum. Real-world considerations limit the accurate useful range of linear responding VCAs, or multipliers, to a total gain control range of 60-to-70 dB.

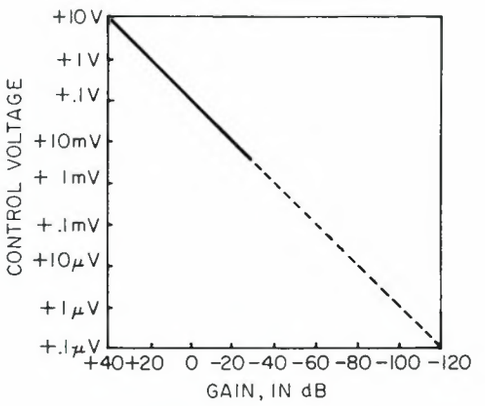


Figure 3. A graph comparing control voltage and audio gain (linear control) with solid line equal to usable gain control range.

Now, let us delve further into the implications, and assume we have fitted the control input of our hypothetical linear-control VCA with a summing amplifier, in the hopes of controlling it from multiple sources. If we assume that +1 volt is applied to one of the summing inputs, the VCA exhibits a gain of +20 dB, according to FIGURE 3. If we now apply +9 volts to a second control input, the gain would go up, by 20 dB, to +40 dB. This implies, initially, that when +9 volts is applied to a control input, the audio gain will go up by 20 dB. However, if we repeat the experiment with only, say, 10 mV applied to the first control input, the addition of +9 volts to the second input no longer causes a 20 dB gain increase. Rather, a gain increase of nearly 60 dB results. Conclusion? A linear-control VCA or multiplier cannot easily be employed in multiple-control applications such as VCA group masters, due to the inherent non-constant scale factor.

Now let us look at the control-versus-gain graph for a log-control VCA (EGC-101), as depicted in FIGURE 4. Here a 1 volt change in control voltage produces a 20 dB gain change, regardless of the absolute gain or attenuation of the VCA. This comes down to a scaling of 50 mV-per-dB. Normal values of op-amp offset voltage (generally in the 3 mV region) have little effect on the VCA gain accuracy, since a 3 mV error in the control voltage results in a gain error of only 0.06 dB. This holds true, regardless of the actual VCA gain or loss. Thus, non-critical op-amps may be used in the control circuit, generally without offset error correction, and a 150 + dB range of control is a practical reality.

The same set of characteristics work to make a log-control VCA much less susceptible to gain modulation due to noise or rf signals on the control lines.

Now, if we again fit the control input with a control voltage summing network, let's see how the log control VCA responds to multiple gain-control inputs. Assume that +1 volt is applied to one of the control inputs. The VCA gain is now −20 dB, to −40 dB. If we put, say, −2 volts on a third control input, the gain rises by 40 dB, to unity. It is thus easy to see that the log-control VCA responds at a fixed rate of −20 dB-per-volt, to the algebraic sum of all applied control voltages, regardless of the absolute gain of the VCA. In effect, the VCA control circuit computes the antilog of the sum of the applied control voltages, thus performing a multiplication based on the identity: A × B ×

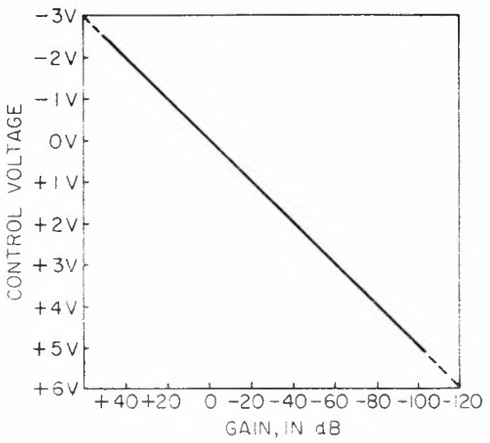


Figure 4. Graph contrasting control voltage vs. audio gain (log control) of the EGC 101. Solid line is equal to 20-20 kHz gain control range.

N = antilog (log A + log B + log N), wherein A, B and N are the applied control voltages. Rather than actually taking the log of the control voltages, as the identity indicates, these logs are implied.

Since the purpose of this paper is not to get into a heavy study of the mathematics of the logarithmic arithmetic, suffice it to say that the log-control VCA (actually antilog responsive) is capable of an extremely-wide range (over 150 dB) of very-accurate gain control, without requiring precision control circuits or adjustments. The structure is invaluably benefitted by its ability to sum gain controls from any number of controlling sources, at a constant scale factor.

VCA APPLICATIONS

Let us now apply this technology to some examples, to see what the VCA can do for us. Let's assume that we are given a more-or-less conventional mixing console, in which VCAs are to be installed in the electrical position normally occupied by the faders, as seen in FIGURE 5. The conventional passive fader might have an overall range of about 90 dB, and in this example, it is nominally placed in the -20 dB position, followed by 20 dB of post-fader gain. Thus, the overall control range is from +20 dB to -70 dB, with unity gain occurring at the nominal fader position of 20 dB.

In the VCA version, the audio passes through a VCA scaled for -20 dB-per-volt, with the control voltage coming from a potentiometer fed from a source of +7 volts dc. According to the graph of FIGURE 4, movement of the pot through its range would cause the VCA gain to vary from unity (0 volts control) to -140 dB (+7 volts control). Notice, however, that a source of -1 volt causes the VCA gain to be offset upward by 20 dB, thereby making the overall gain-control range from +20 dB to -120 dB. Another way of looking at this, would be to think in terms of the -1 volt serving to offset the 0 to +7 = volt range produced by the pot, to a -1 to +6-volt range.

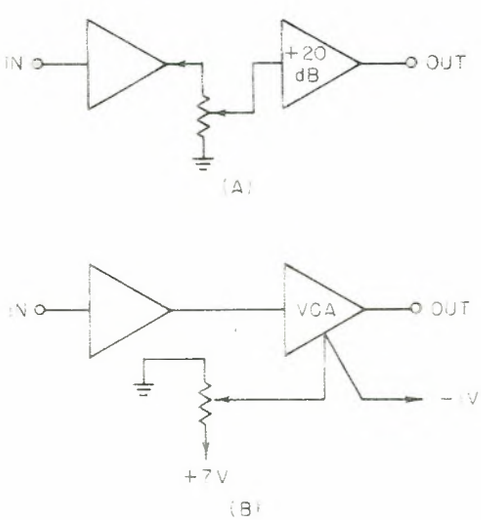
The first benefit of the VCA circuit, over the passive fader circuit, is an increase in the maximum attenuation, from a previous 70 dB, to the new 120 dB figure. (While the EGC-101 VCA will, in fact attenuate by over 120 dB at low frequencies, the maximum shutoff is generally limited, by circuit capacities, to around 100 dB at 20 kHz). Still, a 30 dB or so increase in shutoff is evident, with respect to those figures obtained by high-quality passive faders.

So far, we have not had any great benefit by retrofitting the VCAs, with the exception of an increased shutoff figure. In going a bit farther, we can next place an integrating capacitor in the control summing circuit of the VCA, thus making it responsive only to relatively slow gain changes. In this manner, "pot scratch" can be totally eliminated, even with cheap or dirty controls, and noise immunity on the control lines can be greatly reduced. Typical integration times of around 25 msec, in the control circuit, will serve these purposes well, but will not be so slow as to cause a detectable lagging, or sluggishness in the operation of the circuits.

In going a bit further with the design (FIGURE 6), we add a couple of switches and obtain both a "soft mute" function, and a "solo in place" system, without using relays or additional hardware. When the mute switch is depressed, a source of +7 volts is summed in to the VCA control circuit. Since, at a -20 dB-per-volt, +7 volts represents a 140 dB gain instruction, the VCA gain is reduced by 140 dB, or effectively shut off, whenever the mute switch is pressed. If the VCA has been fitted with control time integration, as discussed above, the mute action will not be a sharp on/off action, but rather, the gain will quickly slide down to -140 dB. This soft action, while still being fast enough to allow tight mute cues, will prevent the sharp crack which occurs when mutes are accomplished, during program material, with conventional switch or relay contacts. (This "crack" is not actually switch noise, but is the result of rapid interruptions of the audio waveform.)

In looking at the "solo in place" system, it is seen that yet another control input to the VCA is connected to the "solo bus" when the solo button is *not* depressed. The same configuration exists on all VCAs in the system which are to respond to the solo system, with the "solo bus" extending across all VCA circuits. When a solo switch is depressed, the corresponding VCA control circuit is disconnected from the solo bus, while a voltage source of +7 volts is connected to the solo bus. Accordingly, all VCAs in the system, except that one whose solo button was pressed, are fed +7 volts, (a 140 dB gain instruction) and are thus turned off, leaving only the solo'd VCA on. This action may be termed a selective mute, since the net result is a muting of all channels except the one desired. Again, the action is soft, rather than being accomplished by hard switching. It is easily seen, by looking at the structure of FIGURE 6, that the solo system is one which allows the "accumulation of solos" in that the pressing of a second solo switch will simply cause that channel's VCA to be lifted from the solo bus, and thus be turned back on.

Figure 5. VCA substitution for conventional passive fader featuring the conventional connection and the VCA connection.



So far, we have only looked at gain control from a single fader, and have added in a mute and solo system. Now, let's look at a more-involved system, using interactive control by a number of faders.

VCA GROUPING/VCA GRAND MASTER

One experience which has probably frustrated all mixing engineers, at one time or another, results when the point is reached in the mix when all of the console faders are near the top of their range, and the bus meters are all solidly in the red. This occurs out of the natural tendency of most producers to always make things louder... never softer. In this situation, the inexperienced engineer, simply reaches for the stereo output master, and lowers it, until the meters are back on scale.

Then, he wonders why the mix doesn't sound as clean as it should. The seasoned mixer realizes that by just lowering the output masters, he has not taken care of the internal console overload, which is caused by the elevated levels between the faders and the output buses. So, he calls a temporary halt to the mixing activities, while he proceeds to lower each individual channel fader by some fixed amount, say 5 or 10 dB. In doing this, he must rely on the fader scale marks, and hope that they are accurate. Usually, a little bit of the mix is lost due to inaccuracies, in addition to a whole lot of time. Then too, he must endure the producer's suspicions that he did not perform the level translation carefully enough, and has messed up the mix.

With a VCA system, a VCA grand master should always be incorporated in the console, precisely for purposes of side-stepping this whole involved process. The VCA grand master simply sums in a gain-modifying control voltage to all VCAs in the system, to effectively raise or lower the overall console gain, with one fader. Since this gain modifying voltage is applied to the same point as is the channel fader control voltage, the effect is exactly the same as would be obtained by lowering or raising each channel fader individually. Thus, any potential overload of later console stages is virtually eliminated. The scaling accuracy of the EGC 101 VCAs is such that a tracking accuracy of typically under .1 dB results from operating the VCA grand master over a 20 dB range or so. If greater accuracy than this is required, the VCAs may be fitted with individual gain trims, and adjusted or even greater accuracies... as close as one cares to trim for. This is not generally done, however, since tracking on the order of .1 dB/20 dB is sufficient for even the hypercritical user.

In the recording session, where perhaps 20 or so microphone channels are fed to any number of tape tracks, the VCA grand master again allows the operator to raise or lower the gain of the entire console with one fader. This can be of the entire console with one fader. This can be of great benefit in situations where the dynamic range of the performed music is very wide, and requires "across the board" gain riding in order to assure optimum signal being placed on the multi-track tape. Such one-fader level adjustments, using non-VCA techniques, would be impractical, since something like a 24-gang fader would be required to cover all contingencies of track assignments.

VCA GROUP MASTERS

Finally, we come down to the subject of VCA group masters. These VCA groups operate in the same fashion as does the VCA grand master, except that instead of modifying the gain of *all* VCAs in a system, a VCA group master modifies the gain of a certain *pre-selected group* of VCAs. In a mixing session, these groups might be categorized as "rhythm group," "string group," "vocal background group," etc. When assigned in this manner, each such group of music sources may be gain-manipulated with a single fader, without disturbing the relative balance between the several tracks which might comprise the group. Thus, when the producer asks for "more strings," the mixing engineer needs only to raise the "string group master" to accommodate. Of course, group mutes—and even solos—are possible with such a structure.

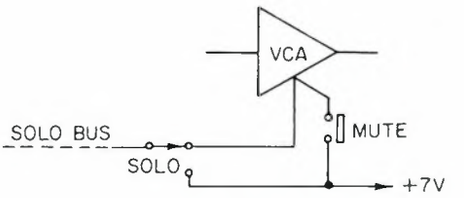


Figure 6. A drawing depicting VCA mute and solo system.

A representation of a typical console structure, wherein VCAs are configured to produce the standard functions of channel gain, channel mute, channel solo, VCA grand master, VCA group masters and group muting, is shown in FIGURE 7. Here it is seen that any number of additional faders may be fitted into the console, and designated as group masters. Like the channel faders, they are fed from a dc voltage source, and are offset in such a manner as to produce a range of both positive and negative output voltages, in order to allow either gain or loss instructions on group master output buses. In the example shown, the output voltage range is from −1 volt (+20 dB gain instruction) to +6 volts (−120 dB gain instruction).

At the nominal mixing positions, the group masters will be scaled at "0 dB," and 0 volts will appear on the buses (0 dB gain instruction). Each group master is also fitted with a mute switch, which, when pressed, will add +7 volts dc (−140 dB gain instruction) to the bus, thereby effectively muting any VCA assigned to that bus. At the channel VCAs, in addition to the previously discussed channel fader and channel mute/solo connections, another VCA control input is taken to a multi-position switch, where it can be connected to one of the group master buses. Normally, a "group 0" position is included so that a channel may be dis-associated from all the group master buses. (Group 0 is usually a no-connection point, or a grounded point.) With such a configuration, any number of VCA group masters may be wired into a system, with any number of channels being connectable, or assignable, to any group. Of course, the circuit impedances must be worked out to assure that the group buses will have sufficient drive capability to supply the required current to all the VCAs which might be assigned to it.

AUDIO PERFORMANCE

The first implication of using the VCA as an element which centrally controls all of the functions listed above, is the obvious benefit enjoyed by limiting the audio path to one element... the VCA. This one element, of course, must be a good one, since its performance sets the stage for overall console audio quality. With this in mind, let's examine the audio performance of the EGC 101 VCA, when it is optimally configured for this console position.

First, we must consider input-handling capabilities, to assure that the VCA input stage will be able to accept the range of signal levels presented to it by the preceeding console stages. The EGC 101 is widely user-definable, in this and other respects, to enable optimization to any level and gain structure. Of particular interest, in the area of input headroom, is the ability inherent in the EGC 101 to operate in the Class AB domain, as well as in the normal Class A fashion. This may be explained as follows: As the input signal to the EGC increases above the point of Class A biasing, (as accompanied by exceedingly low distortion production), Class AB operation will commmence, rather than input clipping. The manifestations of Class AB operation are an increase in distortion products to the 0.2 percent region, followed by still another 20 dB or so headroom (with gradually increasing distortion), before absolute clipping sets in.

Additionally, the point at which Class A operation ceases, and Class AB begins, is a function of the gain to which the VCA is taken, with higher signal levels being permitted as the VCA is taken into attenuation. A typical configuration of the EGC 101, where bipolar 15 volt powering is used, would place the Class A/AB transition point at around +21 dBu at unity gain, rising to +27 dBu at high attenuations. The point of absolute input clipping would fall at around +40 dBu. This situation is an ideal one, for the preservation of excellent input headroom, along with excellent signal-to-noise ratios, in that the input signal-handling capabilities are highest when they are most needed.

This statement may be qualified by setting of examples: Let's assume that an abnormally-high signal level of, say, +25 dBu is presented to the input of a channel VCA, in the console. Under this condition, the operator would obviously not operate the VCA at a normal unity gain setting, as the result would be a +25 dBu level at the console output buses, with the VU meters sitting pegged in the red. The very purpose of the faders is to establish a proper console output level (usually +4 dBu) from a wide range of potential input signals. So, necessarily in this example, the operator would place the fader (VCA) having the elevated input signal, to an attenuating position suitable for producing the proper line level at the console output. Thus, because of the VCA attenuation, the VCA input headroom increases, sufficient to accept the +25 dBu signal, while remaining Class A.

Even if the signal is excessive, to the degree of driving the VCA into Class AB, no serious audible effects would be heard, only a substantial increase in distortion. (In this context, "substantial increase" is still no more than would be produced by the analog tape machine at nominal levels, and much less than tape distortion at elevated levels.)

Thus, if the EGC 101 is configured typically for +/– 15 volt powering, a safe nominal input level would be around +4 dBu. This structure would allow something over 20 dB of headroom with assured Class A operation, while allowing around 36 dB of headroom before the onset of input clipping.

Under these same conditions, the anticipated VCA output noise, at the nominal unity gain fader (VCA) setting, would be –87 dBV, thus giving a 91 dB signal-to-noise ratio.

In a real-world mixing situation, due to the level build up from combining a number of tracks, the faders would be placed somewhat below the nominal unity gain-point. Experience shows that in 24-track mixing, the average fader position (VCA gain) is around 6 to 8 dB below the nominal point. Thus, the output noise form the VCAs, rather than being the stated –87 dBu, would be closer to –90 dBu (see FIGURE 1, again). When 24 such noise sources are summed, the final bus output noise is around –76 dBu, against a +4 dBu signal level, for an output signal-to-noise ratio of 80 dB. As anyone familiar with the typical console output bus noise levels exhibited by even the best of non-VCA consoles would agree, an 80 dB final s/n ratio, on a 24-track system, represents technical excellence. In fact, a number of consoles on the market today, which are accepted as state of the art, would be pressed to achieve a 70 dB s/n ratio, under the same conditions.

While I have only scratched the surface of the tremendous advantages offered by the new VCA technology, I think it is evident that there is no longer any valid argument against their employment in the highest-quality equipment, for the most critical of uses. These statements have been born out recently, by any number of extremely-critical AB listening tests.

To touch upon some of the other advantageous uses for VCAs, consider the situation where the usually-outboard functions, such as limiting, compression, expansion and noise gating are derived by the simple expedient of directing new control voltages to the VCAs are in the console. In addition to a potential increase in cost effectiveness, this sort of structure vastly cleans up the audio path by eliminating the necessity for the signal to pass through additional audio elements, in performing these functions.

Then, of course, there is the whole world of automation, as well as the pre-setting of console parameters via computer memory.

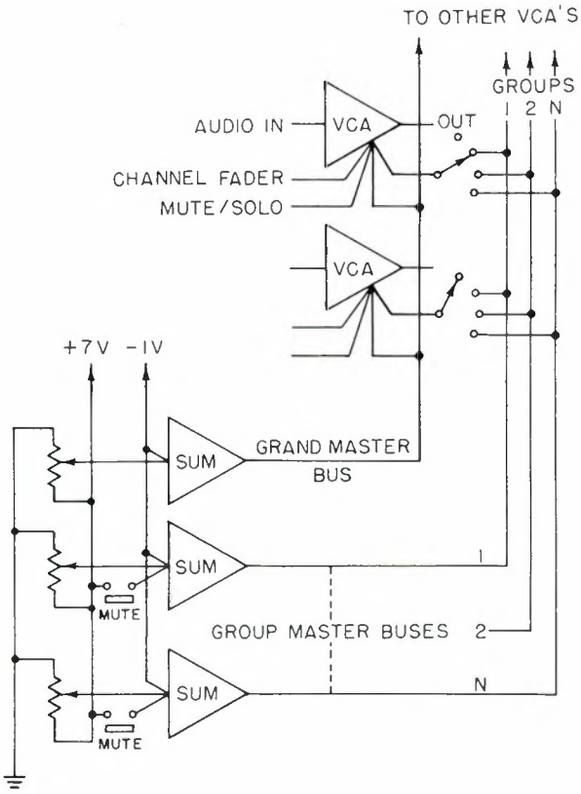


Figure 7. Simplified schematic of console VCA system with grand and group masters.

IN CONCLUSION...

It is my opinion that increasing technology need not add cost and circuit complexity to the pro audio system, as a necessary requisite to achieving increased system capability. Certainly, it is not difficult to argue that technology should never cause a degenerative effect on the signal quality of such systems, for this is anti-progress.

Given the performance capabilities of the new VCA technology, together with a bit of common-sense engineering, there is every reason to expect that better audio quality, at lower cost, with less complexity can be achieved. With the economic situation predicted for the 80s, it would seem these things are not only desirable... they are mandatory. ■

For those who might be interested in obtaining more information on the Allison Research EGC 101 series VCAs, complete engineering data is available by mail from the manufacturer:

Allison Research, Inc.
P.O. Box 40288
Nashville, TN 37204

Or from:

Valley People, Inc.
P.O. Box 40306
Nashville, TN 37204
(615) 383-4737

LARRY ZIDE

Fantasy Recording/ Zaentz Film Center: A Candy Store for the 80s...

Fantasy Recording has everything that a truly state-of-the-art studio can offer.

YES, IT IS PRETTY BIG, and it seems even larger against the background of nondescript bungalows that thickly populate this portion of the Berkeley flatlands. The press release that commemorates its integration with the previously existing Fantasy headquarters next door speaks of it as a seven-story structure, but that is perhaps because of the generous ceiling height (20 feet or so) provided for each floor. Roy Segal, general manager of the Fantasy studios, counts only five floors, the upper two of which await development as the facility expands to accommodate what is hoped will be an ever-increasing flow of traffic. According to Segal, Fantasy's decision to throw open its doors to anyone who can raise the money for studio time is not a make-or-break proposition. "With the size of staff I've got (eight permanent employees), we can make money even if it means shutting down three rooms and going with just one. Everyone will still have plenty to do." But with four fully-equipped music studios, two of which (A and D) are large enough for symphony orchestras, Fantasy obviously intends to get, and to stay, very busy.

THE FILM THEATRE AND STUDIO D

Fantasy's big drawing cards are its well-publicized Studio D on the ground floor, and the 50-seat film-dubbing theatre directly above, on the third floor (see the cover of our June issue, and Jeff Cooper's feature story in July—**Ed.**) The theatre is an exceptionally attractive space, with excellent sight lines provided by the steep decline to the screen, and an interior volume that approaches commercial theatre size. Projection facilities handle both 16 and 35 millimeter, while the audio installation is basically 24 track, with a 42-input automated Harrison console at the general center of things. Radiating out from the theatre itself are a master control room, a machine room presently containing six dummies (I counted only five, but math was never my strong subject), the projection room, and a space devoted to dialogue replacement. For the time being, miking of new dialogue takes place on the actual stage of the theatre—an arrangement that is bound to change once the theatre gets rolling into its anticipated routine of near-constant bookings. Here as elsewhere, the general Fantasy/Zaentz rule applies: Just ask (and pay) for it and we'll build it. Space has

Larry Zide is the publisher of **db** *Magazine.*

Studio D's control room, with the Neve console in the foreground and the two Studer 24-track machines at right rear.

The main room of Studio D, with the door to the string room in the background. Note the adjustable louvres facing the overhead tape.

The drum enclosure in Studio D occupies a corner space adjacent to the wall opposite the control room.

already been allocated for a fully-equipped soundstage, and those two upper floors of the building remain open to any and all suggestions.

A TRULY SHARED FACILITY

A possibly-unique feature of the Zaentz film operation is the neighborly sharing that can take place with Fantasy Records immediately below. Once the final wiring of the complex is complete, there will be direct feeds, including video links, from Studio D to the theatre console, so that scoring sessions can be handled with almost any desired degree of flexibility. As things stand now, the complex is ready to undertake final mixes for all film formats, including Dolby Stereo optical and magnetic, and to do virtually anything that could be desired in the preparation of dialogue and music. Full capability for effects awaits the installation of Foley and some necessary additions to the machine room—all of which are confidently expected to come to pass. In fact, plans are in the making for a comprehensive effects library stored entirely in digital form, so that any item can be retrieved electronically and routed instantly to the console. Prospects like these are unfailingly tempting, and Zaentz already has three film production companies in residence as full-time tenants.

"WORLD-CLASS" STUDIO D

Studio D is regarded by Segal as one of a very small handful of "world class" recording studios in existence, and the only thing of its kind to be found in northern California. A detailing of its architectural niceties would take many more pages than are available, so it must suffice to say that it consists of seven structurally-isolated blocks enclosed in inner and outer shells with plenty of dead space in between. The high ceilings have been appropriated by tuned acoustical traps, many of which are faced with louvres so that the degree of absorption can be finely adjusted. Diverse wall and floor coverings are used throughout. They include wood paneling, mirror glass, cork, curtains, marble, stone and mortar, and carpeting. Carpeting that matches the floor coverings is available on request for lining the walls. Lighting is elaborate, and extremely flexible.

Angled mirrors forming walls of Studio D string room enhance acoustics and provide important sight lines to other areas of the studio.

The heart of the studio is a generous (30-by-50-feet) space that spreads around the control room. On the right-hand side, it is comparatively (but adjustably) live, becoming gradually deader as one moves to the left. At left rear is the semi-isolated drum room, said to be the largest ever built, with a deeply descending trap overhead that renders all acoustical events taking place within relatively dry and neutral. To the extreme left of the control room, and somewhat behind it, is an 18-by-30 foot string room, isolated from the main floor by glass paneling, and usually viewed from the control room through an arrangement of mirrors. Glass and marble coverings on the non-parallel boundaries make the acoustics of the string room exceeedingly "wet" in the mid-range. Ironically, the string room has not yet played host to strings, although results with hand claps, foot stomps, guitars, and vocals augur well for its potential.

THE PRODUCER'S ROOM

Balancing the string room, on the right-hand side of the control room is a glass-enclosed rectangle that Fantasy refers to as the producer's room. This is a domestically-furnished retreat into which artists or production staff can escape, when the SPL get overhelming elsewhere, or when someone wishes to evaluate a mix in something like a home setting. The two glass surfaces that separate it from the control room create a tiny trapezoidal space that can be used as a vocal booth or an isolation chamber for instruments that would have difficulty competing out on the main floor. At the rear of the producer's room, a door opens into the amplifier/computer room. At present, Fantasy's newer monitoring facilities consist of Hidley three-way arrays with crown 300s and 150s in tri-amp configurations, the drivers themselves built into soffits beneath the ceilings. The computer is the Neve-Necam device that serves the 56-in, 48-out automated board in the control room, which in turn serves a pair of Studer A-800 24-track recorders locked in SMPTE time

Entering the main lobby of the Fantasy complex, with reception to the left.

The Bob Allen Band warms up for a take in the generous space of Studio A, part of the pre-existing Fantasy facility.

code. Dolby noise reduction is routine on all tracks, with dbx and other processors available for the asking. A mercifully-brief visit to the control room (it was in use for a *very* loud disco mix) confirms the presence of all these goodies, and also reveals that it is just as spacious as advertised, with ample room for, say, a post-production film team plus invited guests.

DISC CUTTING AVAILABLE

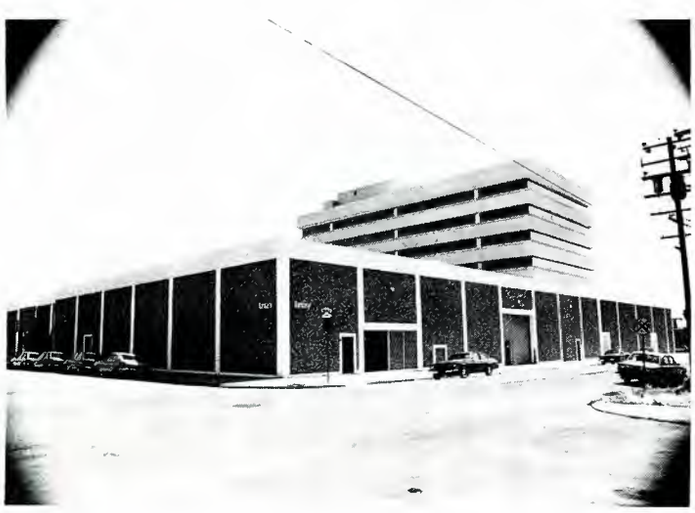
Fantasy no longer just tapes; it also cuts—the man who does the cutting being the celebrated George Horn, who has the latest Neumann equipment installed, along with a Zuma computer system for pitch and depth control. For the moment Fantasy has rejected digital time delay as lacking basic appeal, and so the Studer transport is equipped with the quite-conventional analog preview head. A novel feature of the room, besides its removal from the hurly-burly going on everywhere else, is a TV monitor staring down from the wall directly in front of the control board. This has a greater significance than the general Fantasy policy of video communications at all control points; specifically, it signifies the availability of direct-to-disc recording when requested, with no need to trundle a lathe to the actual recording site and painstakingly set it up again.

FANTASY'S SMALLER STUDIOS

Fantasy's amalgamation with the Zaentz group has in no way diminished its original resources, which consist of three independent studio/control room spaces, plus such amenities as eight echo chambers, numerous editing rooms, a tape copy room (another is planned), and the rest of the paraphernalia appropriate for operating a largish record company. Studio A is a big rectangular area, comparable in size to the main space of Studio D. Without the ceiling traps, it seems even bigger. Wood paneling on the side walls develops in gentle ripples, something like the construction in one of the previous incarnations of Avery Fisher Hall, and all the uncarpeted surfaces are dotted with thick squares of acoustical tile for diffusion and selective absorption. The control room, based on an antique but well-maintained de Mideo console, is Ampex throughout (ATR-100s for mix-down). As in Studio D, Dolby noise reduction on all tracks is standard, with other processors stacked up for grabs. Originally built around 16 tracks, Studio A has now been expanded to 24, and its popularity with rock and R&B productions—never a problem in the past—has been commensurately increased. Monitoring is through Crown amps and Altec 604s, modified with the Mastering Labs crossover.

Studios B and C are somewhat cut-down versions of A. C is the place where Creedence Clearwater staged its revival, and the original "relaxation" room installed especially for them remains intact, complete with water fountain and candy machine. Studio B (16-by-20 feet) is the smallest space available at Fantasy, and one that is steadily in demand for the production of demo tapes. Its intimacy is also appealing to jazz groups, which work the room regularly.

An outside view of the sizeable Fantasy/Zaentz complex.



THE RATE CARD

And now a word about rental costs, which are by no means painful when you consider all that you're buying, and are perhaps even a sufficient inducement to go recording in the Berkeley flatlands. Basic rates subject to all the influences of galloping inflation, are presently:

Studio A: $125 per hour, with extra payments for extras.
Studio B: about $80 per hour, but with plenty of possibilties for elaboration.
Studio C: same as A.
Studio D: $250 per hour, or $12,000 per week if you want to lock the doors.

What it all comes down to is that Fantasy wants to be your one-stop recording center of the future. According to Roy Segal, momentum has started to build, and the day can be foreseen when even such an extensive complex as this will have to start turning away customers for lack of facilities. He is confident that what Fantasy now has to offer is "it" until the maturing of digital technology takes place. What will happen then was not discussed, but all the evidence suggests that Fantasy will still be around, conducting itself as much like an audio candy store as ever. ■

Kent Duncan talks about

CREATING THE ULTIMATE ENVIRONMENT

The Fantasy Record Company and its principles, Saul Zaentz and Ralph Kaffel, envisioned a state-of-the-art studio that must go beyond the normal environment created for recording artists. These very special men dedicated to myself and Tom Hidley—and our company, Sierra Audio—a very large space and a substantial budget, in which we were to create "the ultimate" environment for the artist.

Our challenge was three-fold: first, produce an immensely-creative atmosphere which lacks nothing; second, acoustically develop a unique area with complete flexibility; third, assure state-of-the-art for as long a time as possible.

Zaentz and Kaffel left us to our own design, trusting that our experience and intuition would fulfill their needs, and give them what they required for artists signed to Fantasy Records. Recently, under the direction of Jim Stern and Roy Segal, the company has decided to offer the facility not only to Fantasy artists but to outside clients as well. This gives the bay area a totally-unique facility, five-studios strong, with multiple technologies available for all types of music.

In the space surrounding the control room, we created four primary areas. The first is a string room, capable of accommodating 40 musicians. It doubles as an isolation room for very-low-level instruments that need natural enhancement of midband-to-high frequencies.

STRING ROOM ACOUSTICS

A long midband decay time, plus extreme low-frequency attenuation, is accomplished by a dual-purpose wall. Reflectivity in the midband is achieved by reflective smoked mirrors. Ports into a low-frequency attenuating trap system behind the wall give us the desired low-end absorption. The design is carried out on all sides of the semi-parallel room. A hardwood ceiling, non-parallel to a marble floor, helps us achieve a warm, rich and reflective midband enhancement.

THE RHYTHM SECTION

Next, we move through sliding glass doors to the rhythm area, which rests on its own separated slabs. Here, there is a standard-approach bass cage, and a totally-new drum booth, big enough to handle two drum kits. A separately-isolated piano area and acoustic guitar space faces the rhythm area, so all musicians play undivided by goboes, and face each other as they might set up on stage. Adjacent is a large medium-midband-decay-time area, primarily for percussion and high-SPL bass instruments or road stacks. In this area, there is considerable extreme-low-end attenuation in the ceiling and the surrounding walls.

VARIABLE ACOUSTICS

The most exciting acoustical area in Studio D is a new idea premiered at Fantasy by the Sierra Audio team. This provides an area which is variable from virtually-complete isolation to total broadband reflectivity. This is created by an immobile hardwood floor, surrounded by full-height traps and a wood ceiling. The traps, which provide attenuation at 40 Hz of almost 10 dB, can be covered by movable drapes. This further reduces midband and top-end decay time, to make the area more absorbent. The effect can be completely changed by pulling the drapes back into the soffits, and covering the low-end trapping with a sliding glass door system filled with mirrors. This reflects all the mid-band and top end, while allowing a reduced amount of low end to enter the trap through ports below the sliding mirrors. The scheme is complete with motorized louvers, controlled from the console, which opens the ceiling to a 50-percent trapped condition, giving the engineer and producer complete control, from broadband reflectivity, to low-, mid- and high-end attenuation. This area can accommodate up to 20 musicians.

GUY COSTA

The Motown System

Reconstructing a recording studio does have its headaches, but the problems that Motown/Hitsville faced would send you running for the aspirin.

THE RECONSTRUCTION of a recording studio is always a great inconvenience in terms of money, time and continuance-of-operation. At Motown, this was complicated by the complete renovation of *two* studios; the relocation of the shop, library and Telecine; construction of a new building for the lounge, restroom and production room; expansion of the existing staff and office areas, and the construction of an additional studio and disc mastering operation.

The entire package cost approximately $2,000,000, took fourteen months to complete, tested the patience, understanding, dedication and creativity of the Motown artists, producers and studio staff, and *almost* persuaded a fairly-sane recording studio executive to consider running a dry-cleaning operation.

Planning for the construction took approximately three months, and included the usual problems with the Building and Safety Department and the Planning Commission, who required that we provide additional parking spaces and bring the building up to present California earthquake standards. (The building is only 10 years old, but the code has been upgraded twice.)

Once plans were approved, a construction timetable was prepared and the first of some twenty odd moves began....

DAWN STUDIO

The first really big decision to be made was the selection of a name for the new studio. The original Poppi facility, purchased by Motown in 1971, had named the studios "Sunset" and "Sunrise" instead of the usual A-B or one-two. In 1972 Motown added the "Twilight" remixing room, and now we wanted to continue with related names. After many philosophical "BS" sessions, we finally decided on "Dawn," which many felt signified the birth of a totally-unique facility.

With this big decision safely out of the way, the next phase included the dismantling of the Telecine, Techinical Engineering and Screening rooms, and relocating the majority of their contents to a steel storage shed in the parking lot. The Technical Engineering Department was immediately put on a diet and relocated to a very small office, where they resided for the next ten months.

New construction awaited the demolition of some walls. But first, tie lines were run from the studios, and bright red lights wired into the record commands so that during a take, the construction crew would know to cease its operations. (Naturally, Dawn's control room is located directly over the operating Sunset studio and control room.)

A floating slab was poured and the construction began. All went well. Of course, we did have to relocate the main studio ducts (18 x 64, 32 x 48, 16 x 60) through the cement roof over 60 feet and back down to the main room. And there was a small flood caused by a poorly-capped water line. We also had to wait to construct the final walls until after the console was placed in the room. With the heavy construction out of the way, we analyzed the total project and the projected final costs, and decided that the balance of construction would be handled in-house, by a hired temporary staff of carpenters, electricians and others.

Guy Costa is the vice-president and managing director of Motown/Hitsville, USA in Los Angeles.

"Dawn" featuring a Neve/Necam console and custom monitors.

Construction was completed in October 1978 and modifications to the console monitor, patching and signal routing took another six weeks.

Fortunately (or unfortunately, depending on your perspective) Dawn got very busy, very quickly, and it wasn't until eighteen months later that we were finally able to get back into the console to clean up some of our hastily-wired modifications and begin our in-house program of continuing upgrading.

INSTANT SUCCESS

Dawn proved to be an immediate success, and feedback from producers and engineers confirmed that we had made the right choice of the Neve/Necam 8078 console. Our order for two more Neve consoles was placed.

It was our intention to construct three facilities with similar acoustical properties and identical electronic facilities. This would make it easier to change rooms for mixing and to allow direct-to-disc mixing simultaneously from different rooms.

Note: One project, a recent experiment for the "Motown Sound" Division, required the use of all three studios (all equipped with Necam), seven engineers and the Disc Mastering room for a direct-to-disc mix. While one console was busy cutting the first band on the disc, the others were preset to handle succeeding bands. This eliminated a furious scramble to reset the console during the brief pause between bands.

SUNRISE...

Sunrise is a small studio (6-8 people) primarily used for overdubbing and rhythm. This was the control room's second renovation. It was completely rebuilt in 1972 but there were still some problems with isolation and low-frequency standing waves. This time, we were determined to get it right. We thought we had plenty of time to experiment, but Neve had a client cancel an 8078 purchase and now our console was to be delivered three months earlier than planned.

We were aware of the new "LEDE" theories and other designs, but felt that the construction of a studio should—with the exception of size and other functional requirements—have a natural, typically-home like, acoustical environment. The decision to place the speakers in a semi-near field (8'4") and the fact that most producers and engineers tended to mix from small console-mounted speakers (we have over ten types and can select any of three at a time from the console) made the design, a modified octagon, less critical than the classic "studio" design.

It was during the reconstruction of Sunrise that we began to finalize our own in-house monitor system (this was our design number 911, or "help"!!!) After much pain, blood, multi-ply birch, vodka and some very happy electronic component salesmen, we felt we had the most unique monitor system in the world! Needless to say, they're flat (who's isn't?, loud (126 dB SPL), expensive and big! Recently, however, after a fairly-comprehensive survey, and a tour of competitive facilities (yes Virginia, there is a real world), we decided to replace the 911's. We have narrowed our choice of speakers to three manufacturers of "Industry-Standard Monitors" and expect to make a final decision within the next few weeks. (The "big three" are; UREI 813, Audio-techniques "Big Reds," and Tannoy "Super Reds.")

Boasting 3M recorders (and Necam console) "Sunrise" offers the latest in recording technology.

Given the pressure of the console breathing down our necks and TIM (time is money), we completed Sunrise in seven weeks and at half the cost of Dawn. Client acceptance has been excellent and we've been booked solid for the last seven months.

...SUNSET

Sunset, a large studio (35+ men) designed by Bolt, Beranek and Newman as part of the original Poppi facility, is one of the finest modern "live" rooms in existence. The control room, however, did not meet our criteria for a competitive studio, and in 1972 we completely rebuilt it with a Jack Edwards design. The experience we gained in constructing our other facilities, as well as the general change in studio acoustics and studio hardware systems dictated the latest reconstruction. This was completed in five weeks, at a cost of under $26.50 a square foot.

Because Sunset is our primary recording facility for rhythm, strings and brass we had to rent another large steel storage shed. Here, in six weeks, all the console interconnection wiring and modifications prior to the final installation, which took three days. The only problem we encountered was that the hot California sun raised the steel shed's temperature to 128 degrees. This, however, was solved by covering the shed with a tent and working through those bewitching midnight hours.

FROM TWILIGHT TO DAWN

Dawn was added to replace Twilight, which was then redesigned for disc mastering operation, which had previously been located in our main office building six miles away. Up until the time we converted it to disc mastering, Twilight was responsible for the mixing of over 50 percent of the Motown releases.

Twilight is now equipped with a Neumann SAL 74 cutting amplifier and the Neumann SB 77 console with Telefunken M15A machines. The cutting lathe is scheduled to be converted to the Panasonic SP-02 direct drive system and Sontec Disc Mastering Computer within the next two months.

Other facilities include direct-line access to all reverberation chambers and studios for direct-to-disc mastering.

PRODUCTION

A small casual office environment was added with direct patching access to all studios and the disc mastering room. This enables producers to review their product in a non-studio environment. This gives the producer a totally different point of view and a fresh creative approach to review their mixes. Additionally, it is fully equipped to accept one of our small production consoles for video sweetening, reference mixes or Telecine and mag interlock. The room also serves as a tape copy and screening room.

TELECINE

A small audio-visual post-production room was added on the second floor, adjacent to the mag and video machine room, for the purpose of supplying product for Motown artists and other clients who require direct film mixing or video transfers and interlock.

"Sunset" highlighted by its "live" design.

Telecine is fully equipped with four-track high-speed Magna-Tech 16mm and 35mm recorders, 16mm slide and 35mm Telecine transfer, complete Dolby, total remote control including channel A/B switching and all forms of audio tape transfer.

OVERALL SYSTEM DESIGN

All three control rooms have identical electronic components and physical layouts which allow the engineers to change studios for acoustical purposes while maintaining identical electronic and reproduction characteristics.

These features also allow more-efficient scheduling of studios for mixing and overdubs and all personnel have a more-thorough understanding of the equipment.

The three 40-by-24 Neve/Necam consoles have a separate monitor section for 32 inputs which, when used for the return of special effects and echo, increases the effective inputs to 72. The consoles have been modified to include the following:

1. complete multi-track remote machine control and indication.
2. fourteen sources of monitor selection.
3. fully buffered meters with peak reading functions.
4. multiple speaker selection (5).
5. extensive patching functions.
6. minimum transformers.
7. separate stereo signal routing.

Because the stock design of the 8078, with its modular construction and point-to-point wiring, could easily be modified, we felt it offered us the flexibility to upgrade and add as technology and operating conditions changed. The Necam system itself is very easily assimilated and does not require an interruption of the normal creative recording process to operate. Eventually, other computer systems will offer data logging features, but this will be accomplished with a separate off-line system which can be operated simultaneously by the assistant engineer. Additionally, each control room is equipped with the following:

1. two 3M Model 79 24-track recorders.
2. Audio Kinetics Q-lock synchronizers.
3. Ampex ATR 100 and 3M 2-track recorders.
4. complete Dolby systems.
5. simultaneous access to six live chambers with two separate speaker systems and stereo returns.
6. access to four stereo EMTs.
7. Lexicon 224
8. complete Allison package of toys.
9. six limiters.
10. eight assorted equalizers.
11. five different monitor systems.

Additionally, all rooms have tie lines to the disc-mastering room for direct-to-disc recording mixing. There are thirty-seven tie lines for multiple recording studio usage, complete remote control of the four channel Magna-Tech Telecine room, as well as complete distribution of video interlock, sync, intercom and four video tie lines.

In March of 1980, the studio name was officially changed to Motown/Hitsville, USA in honor of the original Motown studios in Detroit—"As it was, so it is." ■

HAMILTON H. BROSIOUS

Studio System Planning: Don't Forget the Bottom Line

Don't let your ego run away with your wallet when planning your studio, because the bottom line is profit—just like any other business.

AT THE NOVEMBER 1979 AES CONVENTION in New York, I was on a panel convened to discuss the dramatic rise in importance of the home recording studio system and it's place in the commercial recording world. One of the panelists, well-known folk musician Tom Rush, listened intently as panelist after panelist extolled the technical excellence possible in these studios and related their successes to their sound quality. Rush's comment..."I'm amazed not to hear one mention the artist, song, players or producer as having any bearing on the success of home-produced records. Show me one album that ever became a million seller because of good signal-to-noise!" I realize that such statements are considered heresy in these days of super consoles, space-age recorders and digital techniques, but the point is well made, and deserving of attention.

Studio owners, present and future, are caught up in a technological race which frequently identifies the most-costly equipment as the principal key to the studio's success. But these technological advances are great only as long as they don't cost the owner so much that he has to double his rates, and in the process, drive away clients to other studios, that can afford to book their rooms at substantially-lower prices.

This article is written for present and prospective studio owners and managers, as an attempt to direct attention to the relationship between system purchases and studio profit/loss. The primary topics of concern are major equipment, such as consoles and tape recorders. Although it may not be apparent here, I am really not opposed to purchases of extremely-high-cost equipment by well-established studios with sound financial management. I am, however, attempting to discourage studio owners from these high-cost expenditures, they are made with the expectation that clients will flock to their door regardless of hourly cost.

Its even worse, when studio owners actually seem to be unaware of the effect these purchases will have on their hourly operating costs.

Hamilton H. Brosious is president of Audiotechniques of Stamford, Conn.

SET YOUR EQUIPMENT BUDGET WITH RESEARCH... NOT EGO

The financing has been secured, architects and designers retained, plans approved and now you're ready to place orders for the equipment. And, naturally, that means you're going for the top gear, because money is no object! Hold it! Before you place that phone call to your studio systems dealer, stop and do some research about the market. Where do you expect to position your new studio in the competitive milieu? First off, will it be R&B, industrial, pop album, disco, etc.? Take your pick of several (but don't take 'em all 'cause that means that you don't know your market), and your research is under way.

Now, look at your prospective clients and guestimate how much they spend for recording time. Follow that up with a study of the competition. What's the going rate for 8-, 16-, and 24-track recording in your area? What's the high, average and low rates? If you're going to be the only act in town, better check comparable cities and localities and develop the same information. Can a super studio with $200.00-per-hour rates make it? Or do these guys argue about a $75.00-per-hour rate card?

It's all well and good to decide that your studio's equipment and construction costs entitle you to charge New York rates, but if you're in Tulsa or Rochester, watch out! We all fondly desire to have the finest studio money can buy, but a more logical and sounder goal is to *have the finest studio the market can support!*

Being the newest kid on the street does give you a license to boost the going rates a little, but be careful that your initial costs are not so great that your rates must be substantially higher than the rest of the competition.

The vision of attracting superstar groups and artists to your new super studio is a tantalizing fantasy, but in an era of dwindling budgets and intense competition among hundreds of world-class studios for the big acts, your chance of realizing this dream is pretty slim. And, the payments still come due the first of each month, and overhead costs go right on. Right about now, the local groups would sound pretty good in your studio, if they could only afford your rates.

THE BOTTOM LINE COMES FIRST

As a former resident of the White House was fond of saying, "let me make one thing perfectly clear"... recording equipment is capital equipment and the same basic commercial realities of profit and loss which dictate the purchase of new drill press or a delivery truck also pertain to recording gear. One would think that this statement is so obvious that it need not be made, but it ain't so! Many owners and managers get confused by the blinding avalanche of technological advances and claims, and others are driven by "keeping up with the Jones'." Add a bit of ego, and a host of new owners (former set-up men who confuse the superstar's success with their own, and rich kids who've learned to play the guitar), and the importance of the "bottom line" is frequently the last thing to be considered... it should be the first!

A popular philosophy, especially among neophyte studio owners and operators, equates high cost and complex technology with excellence and desireability. According to this rationale, the acquisition of a super whiz-bang console which automates everything but the deli service at a cost of $400,000 plus, automatically boosts the studio into the super class. It also automatically boosts operating costs by $40 per hour, which if one plans to work for a profit, requires an hourly rate-card boost of at least $55.00! All of this is OK if the clients will pay. But, more likely, they will balk at paying 40 to 50 percent more than before, especially when the competition points out that one result of the new super whiz-bang is an increased amount of studio time!

In some cases, the $400,000 console may be a wise expenditure. Consider, for example, a well known mid-Manhattan operation, booked months ahead with gold and platinum acts, and turning clients away every day. Their recent delivery of a $400,000 console, coupled with the booking situation and their cash flow, is a wise move. When you've got it going that way, hell yes... open the new room, equip it to the nines and pour it on!

On the other hand, a new studio recently opened in a major eastern city with a dream list of equipment headed by a $300,000-plus console and all the rest, for an equipment total of well over $500,000. Add to that a costly design-and-construction figure, plus overhead, and you have a classic studio owner's "Catch 22." He bought the expensive package to attract top-flight clients whose producers faced with declining budgets—can't or won't, pay the high studio charges necessitated by the expensive gear. Instead, they turn to other (well-equipped but less-sophisticated) studios with more-attractive rates.

Moral: Before you succumb to the temptation of high-cost glamour-equipment technology, spend time studying the manufacturer's beautiful brochure. (It's not as much fun, but it's going to make you sleep a lot better in the years to come!)

TABLE A
EFFECT OF EQUIPMENT COST ON HOURLY STUDIO RATES

Cost of Purchase	Typical Monthly Payments*	Cost Per Hour**	Hourly Rate Increase***
$ 50,000	$1190	$ 4.84	$ 7.26
125,000	2975	12.09	18.13
250,000	5950	24.20	36.36
400,000	9520	38.70	58.05

KEY ASSUMPTIONS
*Includes 15 percent interest on five-year lease or bank financing.
**Based on an estimated 246 hours of billed studio time per month. Re-adjust to suit your actual (or estimated) monthly billing.
***Cost-per-hour, multiplied by profit factor of 1.5.

A major equipment purchase, or lease, requires a rate-card increase, if the studio wishes to stay profitable. Can your studio (i.e., your clients) afford it?

TABLE B
STUDIO COSTS AND OVERHEAD AS FUNCTION OF HOURLY RATE CHARGES

Equipment	Construction	Total	Monthly	Cost Per Hr.	Overhead	Overhead Cost Per Hr.	Total CPH	Hourly Rate
$100,000	30,000	130,000	3,094	12.58	4,000	16.26	28.84	43.26
200,000	75,000	275,000	6,645	27.00	8,000	32.52	59.53	89.30
300,000	150,000	450,000	10,710	43.54	12,000	48.78	92.32	138.48
500,000	300,000	800,000	19,040	77.40	15,000	60.97	138.37	207.55

KEY ASSUMPTIONS

1. Interest, hourly assumptions and profit factor as in table A. While obviously rough estimates,the figures nonetheless show conclusively the relationship of the cost factors to the hourly rates necessary to make a reasonable profit. Initially, a new studio will be lucky to realize bookings of even 50 percent of that 246 hour monthly average during the first year. Therefore, the need for adequate capital financing to carry the operation over the initial slim income period is self evident.

FOR EXAMPLE...

A Brooklyn studio owner goes 24-track by adding modules to his existing console, selling his 16-track recorder and getting a good used 24-track machine. Net result is an added capability for the studio, slightly-increased payments and a *small* increase in hourly rates. Present customers stay with him, and he gets some new 24-track clients because his rates did not have to zoom upwards to help amortize super-cost new equipment. A major equipment expenditure would have killed off his client base and forced him to compete in an unfamiliar market with little chance for success. Of course, he would love to have an all-new automated console and recorder, but his bottom line research told him to forget it!

ECONOMIC RETURN IS THE KEY

One of my friends in the professional audio capital equipment business, Dave Harrison, recently published a perceptive advertisement concerning the present negative economic period in the music recording industry, suggesting that the time could be a positive learning experience for all.

Harrison said, *"The most important lesson learned by all of us is that there is a limit to the economic return that can be achieved from our daily business activities."*

(I'm certain that he did not mean to imply that the American dreams of growth and increased rewards were no longer possible, but that in a given economic situation and time frame in a fixed physical environment, there was a limitation on the amount of revenue that could be produced.)

Further quoting... *"Budget limitations on new products have made the artist and the producer more discriminating. They are selecting studios that can deliver a final product of finest quality at reasonable hourly rates. They have come to realize that the 'whizbang bells and whistles' that double studio rates have nothing to do with the quality or economic success of the product produced."* Bravo, David!

HOURLY RATES AS A FUNCTION OF COSTS

Most major equipment purchases by recording studios are financed. Whether it be a chattel mortgage from the regular bank, a lease-purchase arrangement from one of the hundreds of lease companies and lease brokers, a guaranteed note from a money source, or what have you... it all comes down to the same thing. You borrow some money and expect to pay it back, together with interest, out of the increased business generated by the purchased equipment.

Question is... will the new purchase help us or strangle us? In order to consider this problem I have made a few assumptions which are, admittedly, subject to question. However, for the purpose of this article they will suffice (and might even prove accurate!)

Some recording studios operate seven days a week, 24 hours a day, while others only open their doors two or three times a week and for a few hours at a time. In order to establish a monthly estimate of studio hours, I have assumed four 5½ day weeks of fourteen hours per day with an 80 percent occupancy: about 246 hours of operation per month ($4 \times 5.5 \times 14 \times 0.8 = 246$). If the number isn't right for your occupation, substitute any figures you desire... the point is to arrive at *some* figure which is your approximate number of hours of monthly operation.

By taking all of your fixed costs, such as payments, and adding on overhead costs, the total monthly costs can be calculated. Divide by 246 and, *Voila,* the cost per hour. If it costs you $246.00 per month to operate, the cost per hour would be $1.00. You could charge $2.00 per hour, make a 100 percent profit and be booked through the year 2000! Silly, of course, but you get the point.

Let's look at some more-realistic situations. With an $8,500 monthly overhead and equipment payments of $2,500 monthly, we have a total cost of $11,000 which, divided by our 246 hours, gives an hourly cost of $44.72. Multiply this by a profit factor of 1.5 and we come up with 67.07, which is probably a pretty-reasonable rate for your market and your equipment.

Without belaboring it any further, I believe it's pretty easy to apply this quite simplistic formula to your operation and see where you fit.

Now let's look at the effect of additional equipment purchases on the hourly rate. Figure out your current hourly cost and then let's see what you can, and cannot, afford to do.

CONCLUSION

Whether it's the high-priced ultimates, or some of the fine home-type recording equipment available today (or any of the equipment that you can get between those two extremes), there's a right price level and range for your studio. If your clients demand all the bells and whistles and are willing to pay for them, full-speed ahead! Just make certain that it's their pocketbooks, and not your own desire and ego, that's giving you the message.

Keep your eye on the anticipated bottom line and you won't have a problem making the decision. ■

MARK "MOOGY" KLINGMAN

Futureshock Today: Rocking into Video

Today's recording artists are looking to the future now to reap the multiple benefits of video rock—that is, video disc and tape. The video field is growing in leaps and bounds and its scope seems limitless.

I STARTED IN THE MUSIC BUSINESS as a musician and songwriter during the mid-60s. Things were simpler then, and so were recording studios. Because there was little room for overdubbing, rock records were made simply, effortlessly and above all, cheaply.

70s BRING CHANGE

As the 70s came in, record sales increased. With more money came expansion, technological advances and the corporate ethic entered the music business.

During the early 70s I became a recording studio owner. Things began to change, as the multitrack style of rock recording took hold; instead of going for something spontaneous, we went for product—we replaced inspiration with perspiration. We assembled our audio performance with computers taking one line of a vocal from this fader, another line from that fader. We replaced excitement with perfection, and what was fashionable became the law of the land.

KEEPING UP WITH THE TIMES

We had to keep up with the Jones', for the Jones' got all the big work from the record labels. If the Jones' went 24-track, then *we must* go 24-track. If the Jones' added computer mix-down and a digital machine then we must go computer and digital. If it's going to cost us a little more, well, that's okay, because we're going to charge the next guy a little more for our services, and then everybody's happy. *Or are they?*

The artists and producers became confused, paranoid, even afraid to let their recordings be heard until they represented absolute perfection.

But we the studio owners were a happy lot because the equipment we had bought to save time and effort in the studio had the reverse effect. Budgets shot up, hours in the studio became endless. Studio costs to the artist went through the sky but we the studios made more money, the record company made more money, so everyone was happy.

Twenty-five years of nothing but expansion!

But things have changed. Changes have happened so fast we've hardly had time to catch our breath, let alone contemplate what these changes mean.

SOME OF THE CHANGES

The most obvious change: after twenty-five years of steady growth, the record industry is now in a state of decline. Sales are down, as well as profits. Things are tight. The plague of inflation has made costs exhorbitant across the board—dare I

Mark "Moogy" Klingman is the president of West End Studios and the host/producer of the cable TV show, "Manhattan Alley."

say, prohibitive. The fun-loving, devil-may-care unit known as the rock band can no longer afford to tour. Gas, hotels, food prices have soared. The audio studio, after years of expansion, can no longer afford to keep up with the Jones'—credit is tight. And, if you do manage to borrow the money for that piece of gear, are you *so sure* it will be profitable? Or worse yet, will it be the purchase that breaks the back of your business? These are questions that all of us are thinking about. And why are we all so worried? Because the audio business is shrinking.

After all these years of business habits based on steady growth, why should one now continue to expand when our industry is contracting? We can see the signs everywhere.

RECORDING BUDGETS RUN LOW

The record company budget for recording costs—once an almost-bottomless income pool for studio owners—has been cut drastically. Signings are down, so less records are being made. Even the biggest superstars now have to watch the bottom line like a hawk to insure profits.

In recent weeks, manufacturer and record company prices have been increased to record retailers; a move which can only do great damage to an already-dwindling marketplace. And, in a week or two, Governor Carey plans to sign a bill into law in New York State dealing with so-called "Drug Paraphernalia;" papers, pipes, screens. This law would make it illegal for record stores to sell these items. Record stores now more than ever need these additional revenues to ensure they stay in business. If this bill becomes law, it will be another crippling action sure to hurt the small businessman who owns these record stores.

My mind tells me to pursue venues that hold more visible growth potential than we're now seeing in the record industry, but my heart and my soul are still into the music—quite a dilemma.

THE RISE OF VIDEO

But what do we now notice about video? Video magazines on the newsstands; *Videography, Home Video,* and even *Video X.* It seems everytime I hit a magazine stand, a new video magazine has been born. Video software stores are opening and expanding all over town. *Video Shack, Fotomat,* and *Video-to-Go*—all selling and renting video software.

Video hardware sales are booming: up in May as much as 70 percent over one year ago. Pornography—once the bread and butter of video software—now takes a back seat to more-traditional family fare, as home video moves from novelty to mass acceptance.

Cable TV is expanding at unbelievable clips, with bidding wars still in progress in Queens, Brooklyn and Staten Island. We will see amazing growth as these boroughs acquire cable—and amazing growth potential for the many makers of video software who will market their product to these numerous cable companies.

And what of Newsweek's cover story of June 16th? Ted Turner and his amazing 24-hour-a-day live news for cable. Something that was once reserved only for radio is now on cable. President Carter even made a TV appearance on this news station, to wish Ted well and announce that he is having the White House wired for cable so he can tune in Ted's news network. (He'd better be careful that little Amy doesn't stay up late and watch "Midnight Blue.")

But seriously folks, in January of 1981, when the video disc wars will start up, we will see the changes occur with far-greater intensity than we have reason to believe, or even imagine, right now.

VIDEO ROCK

All around us, these changes are an obvious indication of our future. Video rock clubs are proliferating. At Danciteria, fifteen video screens play all night long with the latest new-wave rock bands. Down at the Ritz, they have a 30-foot video screen helping rock stars enter the new age of Wide-Screen Glamour. What could be more advantageous for a new band than to have

Mark "Moogy" Klingman

rock video played 30 feet high at the Ritz on a Friday or Saturday night to the many thousands of people going there? With other clubs—Hurrah, Trax, The Mudd Club and Max's Kansas City—now having video screens playing rock, we are entering a new age—*the age of Video DJ.* And the Video DJ isn't just at the clubs. He's on cable TV. Paul Chinkel's "Innertube" and Pat Ives & Emily Armstrong's "Night Clubbing" are two video rock shows showing the new wave of rock bands in Manhattan.

WHAT LIES AHEAD?

Let us contemplate the future together. Let's look into Moogy Klingman's crystal ball and see rock in the video future. It's 1983 or 84, and radio—once the mainstream of record promotion—has been replaced. Replaced by a series of cable channels playing rock video: many of these channels are 24 hours a day. Like radio stations, many will be playing only the hits. They have a top-ten list, and if you like the single enough, you just might want to run out to your record store and pick up the video disc album—to *see* the rest of the record. Radios, even portables, will have a small TV screen so you can see as well as hear your favorite songs. Just last month "Video Concert Halls"—a new music TV series—began being beamed to many cable networks across the country. In Manhattan, it's two hours a night of rock video. And what do they play? The hits, folks, only the hits.

By the early to mid-80s, cable will have made very serious inroads to promote rock records and its effects on radio will be devastating. Even the clubs will ultimately be playing video discs exclusively instead of audio records, video jukebox exclusively, instead of audio jukeboxes. The record promo man will hustle form the Video DJs at the club to the Video DJs at the cable station. And, as producer and host of "Manhattan Alley," a popular New York rock cable show, I can say this has already begun. Every week more and more video tapes are sent my way, from record execs, bands and production companies. These videotapes are not only from New York, but from all over the country. With the incredible savings of the video disc player and the video disc over that of video cassettes and video cassette recorders, I predict the video disc will sell quickly and become the industry's standard for what a record is. When you walk into your record store to buy the latest Blondie album, are you going to buy the poor sightless record or, for a few dollars more, the video record? I believe the transitions from sightless records to video disc will be comparable with a similar trend in movies 50 years ago: from silent films—almost overnight—to talkies.

Revolutionary rock artists like David Bowie and Todd Rundgren are now creating ground-breaking rock videos that will be a "must-have" for most rock fans. Rock video-disc fever will spread like wild fire through the early 80s, and emerge as the major form of rock entertainment, reducing the sightless, almost pathetic, analog audio record to the status of dinosaur.

PREDICTIONS

I predict, after the first few major-selling rock video discs, all record companies will want video for all the rock they record. And, I believe this trend will happen quickly. The record companies will radically change their approach to the recording artist. Dance teachers, acting teachers, costume and hair designers will all be on the payroll. Every new artist signed will have to be put through the treadmill of glamour in order to be an effective and versatile performer. Companies will put out musical videos to rival anything form MGM's glorious days of the movie musical.

And what of our record stars of the 60s and 70s? Their story will not be an easy one for, like the silent film star of yesteryear, many sightless record stars will not make the transition to "vidies" (that's short for video discs)—silent films to "talkies," sightless records to "vidies." Some of these recording artists—the ones with an open mind and the ability to change and grow—will make the transitions. Mostly, though, I think we'll see a greater proliferation of new stars than one could possibly imagine. And I also believe that many of them will come right out of the incredibly booming club scene—today's low-budget new-wave cable TV performers are tomorrow's platinum video disc superstars.

BIG DECISION FOR STUDIO OWNERS

We audio studio owners have no choice. We must make the change or we're doomed to extinction just like the dinosaur, the buffalo and the silent movie. We must shift our business from the shrinking marketplace to the expanding one.

I predict there will be a mad rush for rock video software, because right now it just doesn't exist. With only a handful of rock video available, there is now a crying need for this software. And it won't be just for new music either. Catalog sales will be very important. By 1983 or 84—with audio disc catalog sales greatly diminished by video disc fever,—the big companies will want to make videos of all their old Beatles albums, let's say, or their old Bob Dylan, Donna Summer and Fleetwood Mac albums.

There will be a flood of video software productions like we've never imagined and this flood will be the biggest since the one that Noah built his ark for. It's about time we started building our own arks.

SET-UP VIDEO NOW

I propose that we audio studio owners not only readjust our facilities with post-production equipment like video players and sync units—but that we try to make our facility capable of actual video production; that is, audio and video recorded, edited and mixed under one roof. The studios that make this bold leap will be the ones with the greatest profit potential for the 80s and the strongest chances for survival.

I'm not talking just about the big guys—even small-studio owners can get into video now. You don't need 24 tracks to make an audio-only album. But you do need video cameras, editing systems and video recorders to make an audio-video album.

So if you're a studio owner and you don't have a 24-track machine—*don't buy one*—save your money and buy video equipment—learn to make records with less tracks. The rock artist of today doesn't want big bills—he wants audio and video of his product, so he can promote himself and build his video disc catalog *now*!

If you are one of those bigtime studio owners with several 24-track recording facilities within your empire, figure out a way to cut costs now, so your clients can use your audio and video facilities without going bankrupt. If you have to sell one of your studio's 24-track machines and boards to raise the money to convert to video, for God's sake, do it, before it's too late.

If you have made rock video, or are about to make some and don't know what to do with it, bring it to me. I'll put it on my show. And if it's not right for my show, I'll make sure it gets on Cable TV anyway by bringing it to the executives in charge of Public Access. They'll put it on the air, *they have to!* (For more information see box at the end of story—**Ed.**)

My cards are on the table, literally and figuratively.

And you don't need to *out* state-of-the-art NBC, ABC or CBS. Good functional video equipment is inexpensive and getting cheaper all the time.

THE COST FACTOR?

Audio and video can be done cheaply and effectively. My show, "Manhattan Alley" is done for no money (several hundred dollars a show at best). But it has good production values. Though we record our audio only on 8-track and our video through single-tube cameras, production values are everything.

YET, SOME PEOPLE ARE STILL SKEPTICAL

Clive Davis, recently wrote a scathing editorial attacking the future of rock video in Billboard magazine (June 7th issue—**Ed.**). He ended his article by saying that there are two things one should be able to enjoy with your eyes closed, and one of them is music. Well Clive, with your limited vision of the future, the other thing you must enjoy doing with your eyes closed is obviously *sleep*!

Ann Rand states in her book, "The Fountainhead," that change doesn't come easy—and the world has a history of opposition to new ideas:

> *"Thousands of years ago, the first man discovered how to make fire. He was probably burned at the stake he had taught his brothers to light. He was considered an evil-doer who had dealt with a demon mankind dreaded. But thereafter men had fire to keep them warm, to cook their food, to light their caves. He had left them a gift they had not conceived and he had lifted darkness off the earth."*

> *"Throughout the centuries there were men who took first steps down new roads armed with nothing but their own vision. Their goals differed, but they all had this in common: that the step was first, the road new, the vision unborrowed. Every great new thought was opposed. Every new invention denounced. The airplane was considered impossible. The power loom was considered vicious. But the men of unborrowed vision went ahead. They fought, they suffered and they paid. But they won!"*

I can no more turn my back on the audio-video decade now upon us than I can insist the world is flat. I'm not looking to the future, I'm living in it. And there's room there for all of us. So please join me. ■

WHY THEY HAVE TO PLAY YOUR VIDEO PRODUCTION

In keeping with an agreement made with the City and State of New York, Teleprompter and Manhattan Cable have assigned two channels strictly for public video productions (Channels C and D). In order to bring cable TV into the area, both had agreed to provide these channels as a public forum/public service. This would be the perfect outlet for your video production.

db Classified

Closing date is the fifteenth of the second month preceding the date of issue.
Send copies to: Classified Ad Dept.
db THE SOUND ENGINEERING MAGAZINE
1120 Old Country Road. Plainview, New York 11803

Minimum order accepted $10.00.
Rates: 50¢ a word.
Boxed Ads: $25.00 per column inch.
db Box Number: $1.00 per issue.

Frequency Discounts: 3 times,10%; 6 times,20%; 12 times,33%.

ALL CLASSIFIED ADS MUST BE PREPAID.

FOR SALE

Lexicon Prime Time: FOR IMMEDIATE DELIVERY. **UAR Professional Systems, 8535 Fairhaven, San Antonio, TX 78229. 512-690-8888.**

FOR SALE: USED CROWN SA-2 amp, M-600 mono amps, Dayton Wright Electrostatic speakers XG8-Mark III. Call **Jim (215) 322-6358.**

SPECIAL SALE of AKG BX-20E, C-414EB. **(212) 354-1470.**

AMPEX AG-350-2: consoled, $1300.00; unmounted, $1100.00. Crown 800 transports-quad heads, $500.00; with electronics, $650.00. Magnecord 1028-2 $225.00; no electronics $75.00. **(215) 338-1682.**

CANADIANS!
Interested in semi-pro multitrack recording?
Headquarters for
OTARI MCI SOUNDCRAFT dbx TEAC TASCAM DeltaLab JBL
and many more!
Write or call
RICHARD AUDIO INC.
5078 Sherbrooke St. W. Montreal, Quebec H4A 1Y1
(514) 487-4085

FREE CATALOG & AUDIO APPLICATIONS

CONSOLES
KITS & WIRED
AMPLIFIERS
MIC., EQ, ACN, LINE, TAPE, DISC, POWER
OSCILLATORS
AUDIO, TAPE BIAS
POWER SUPPLIES
OPAMP LABS INC.
1033 N. SYCAMORE AVE.
LOS ANGELES, CA. 90038
(213) 934-3566

SCULLY 280-FOUR channel ½ inch recorder, 7½-15 ips, sync, motion sensing and console. Excellent condition $3975.00. Contact **Joe. (219) 374-7645.**

AMPEX AG-440C 8 track recorder. Mint condition $6500. **(516) 585-9600.**

AMPEX, OTARI, SCULLY—In stock, all major professional lines, top dollar trade-ins; 15 minutes George Washington Bridge. **Professional Audio Video Corporation, 384 Grand Street, Paterson, New Jersey 07505. (201) 523-3333.**

TEST EQUIPMENT: (2) AMBER 4400A with plotter option. (1) IVIE IE30A, (1) IE17A, (1) IE 15A, (1) IE20B, (1) IE10A. (1) Leader Scope LB0508m, (1) UREI plotter, (1) Sound Techology 1000A. All demonstrators with full factory warranty and sizeable discounts. Write or call, **AVC Systems, Inc., 1517 East Lake Street, Minneapolis, Minnesota 55407. (612) 729-8305.**

ORBAN. All products in stock. FOR IMMEDIATE DELIVERY. **UAR Professional Systems, 8535 Fairhaven, San Antonio, TX 78229. 512-690-8888.**

REELS AND BOXES 5" and 7" large and small hubs, heavy duty white boxes. **W-M Sales, 1118 Dula Circle, Duncanville, Texas 75116 (214) 296-2773.**

BEST PRICE—IMMEDIATE DELIVERY & FREE consultation on TEAC Tascam, Ampex, Sennheiser, Eventide, Studio Master, UREI, BGW, EV, Lexicon, ADR, Orban, JBL, Beyer, AKG, Technics, MXR & more. **Paul Kadair's Inc., Baton Rouge, Louisiana, (504) 924-1001.**

WANTED
RECORDING EQUIPMENT OF ALL AGES AND VARIETIES
microphones, outboard gear, consoles, tape decks, etc.
Dan Alexander
6026 Bernhard
Richmond, Ca. 94805 USA
(415) 232-7933 or (415) 232-7818

TEST INSTRUMENTS: B & K Sine-Random Generator 1024 $1500.00, Level Recorder 2305 $2800.00. Both $3900.00. Leader LBO-505 $540.00, LAG-125 $325.00, LDM-170 $405.00. All three $1100.00. Ferrograph RTS-2 $810.00, Telequipment D61 $445.00. Both $1120.00. All equipment in mint condition. **(212) 354-1470.**

SCULLY, NEW and used: FOR IMMEDIATE DELIVERY. **UAR Professional Systems, 8535 Fairhaven, San Antonio, TX 78229. 512-690-8888.**

AMBER 4400A MULTIPURPOSE audio test set W/X-Y interface. Used as demo... $3,999.00—Save $951! **(206) 854-1004.**

PRO-SOUND equipment. Mail order discount catalog free. Write or call **Sonix Co., Dept. D, P.O. Box 58, Indian Head, MD 20640 (301) 753-6432.**

¼-INCH TAPE duplicating system. Six Crown 800 transports. New 4-channel heads. Solid state. Mint. $4,200.00. **(215) 338-1682.**

YAMAHA PM-1000-24 CONSOLE with Anvil roadcase. Mint condition. Please call **(212) 228-9315 or (914) 583-5356.**

BGW: FOR IMMEDIATE DELIVERY. **UAR Professional Systems, 8535 Fairhaven, San Antonio, TX 78229. 512-690-8888.**

ELECTRO-VOICE SENTRY IV-B, V, III professional monitors. Electro-Voice Interface A, B, C, D, speakers, 25% plus discount—immediate shipment. **(305) 462-1976.**

AMPEX, OTARI & SCULLY recorders in stock for immediate delivery; new and rebuilt, **RCI, 8550 2nd Ave., Silver Spring, MD 20910.** Write for complete product list.

BX20 AND BX10 AKG reverberation systems. FOR IMMEDIATE DELIVERY. **UAR Professional Systems, 8535 Fairhaven, San Antonio, TX 78229. 512-690-8888.**

PROFESSIONAL AUDIO EQUIPMENT

Shop for pro audio from N.Y.'s leader, no matter where you live! Use the Harvey Pro Hot-Line, (800) 223-2642 (except NY, AK, & HI) Expert advice, broadest selection such as: Otari, EXR, Ampex, Tascam and more. Write or call for price or product info:

Harvey Professional Products Division
2 W. 45th Street
New York, NY 10036
(212) 921-5920

FOR SALE: NEVE CONSOLE 24 tr., 3M M79 24 tr. tape recorder, including brand new 16 trk head assm., 24 tr. Dolbys, 3M M79 2 tr. w/Dolby, Crown & CM Lab pwr amps., UREI Speakers, UREI 1/3 octave eqs., Kepex Rack, AKG BX-20 reverb, everything needed for 24 trk studio $117,000 takes all. Call **Tim Hunnicutt (602) 258-1610 or 258-9282.**

SELLING SCULLY 284B 8 TRACK, Quantam QM128 12 x 8 board in-producer's console, and miscellaneous. Make offer(s). **(612) 253-6510.**

OTARI MX7300—8 TRACK recorder/reproducer. 1 inch format, with remote unit. Excellent cond. $6000.00. AKG BX10 reverb unit, excellent cond. $1250.00. **Spectrum Productions (402) 474-3111.**

USED RECORDING equipment for sale. Soon to be in Hollywood. **Dan (415) 232-7933.**

LEXICON 224 Digital Reverberation. FOR IMMEDIATE DELIVERY. **UAR Professional Systems, 8535 Fairhaven, San Antonio, TX 78229. 512-690-8888.**

THE LIBRARY...Sound effects recorded in STEREO using Dolby throughout. Over 350 effects on ten discs. $100.00. Write **The Library, P.O. Box 18145, Denver, Colo. 80218.**

BTX, TELCOM—USED/NEW SMPTE time code equipment. Contact: **DYMA Engineering, P.O. 1697, Taos, NM 87571. (505) 758-8686.**

AKG, E/V, Sennheiser Shure, Neuman: FOR IMMEDIATE DELIVERY most models. **UAR Professional Systems, 8535 Fairhaven, San Antonio, TX 78229. 512-690-8888.**

TEST RECORD for equalizing stereo systems; Helps you sell equalizers and installation services; Pink noise in 1/3-octave bands, type QR-2011-1 @ $38.00. Used with various B & K Sound Level Meters. **Bruel & Kjaer Instruments, Inc., 185 Forest Street, Marlborough, Mass., 01752.**

IVIE ELECTRONICS REAL-TIME ANALYZERS, etc. Very slightly used demonstrators at discount. Full factory warranty. Money-back guarantee. **JML Company, 39,000 Highway 128, Cloverdale, CA 94525.**

UREI: FOR IMMEDIATE DELIVERY most items. **UAR Professional Systems, 8535 Fairhaven, San Antonio, TX 78229. 512-690-8888.**

NAB ALUMINUM FLANGES. We manufacture 8", 10½", 12½", and 14". Also large flanges and special reels to order. Stock delivery of assembly screws & nuts & most aluminum audio, video, & computer reels. For pricing, call or write **Records Reserve Corp., 56 Harvester Ave., Batavia, N.Y. 14020. (716) 343-2600.

dbx 155: FOR IMMEDIATE DELIVERY. **UAR Professional Systems, 8535 Fairhaven, San Antonio, TX 78229. 512-690-8888.**

STUDER B67 2/2 VU mint, little used DBX 158 with 2 #410 modules—mint. **Royal (404) 253-6419.**

WANTED

WANTED: RECORDING EQUIPMENT—mikes, recorders, consoles, outboard gear. **Greg Field, Box 243, San Mateo, CA 94401. (415) 343-1353.**

WANTED USED 2" AUDIO TAPE, 206-250-406-456 caliber. **Texas Demos, Box 401166, Garland, TX 75040.**

WANTED: AMPEX MM1100 16-TRACK head stack, remote control and spares. Also 16-track console MCI, Audiotronics, etc. in the $15,000 range. **Dennis Reed, Box 50022, Palo Alto, Ca. 94303. (415) 494-9344.**

SERVICES

ACOUSTIC CONSULTATION—Specializing in studios, control rooms, discos. Qualified personnel, reasonable rates. Acoustilog, Bruel & Kjaer, HP, Tektronix, Ivie, equipment calibrated on premises. Reverberation timer and RTA rentals. **Acoustilog, 19 Mercer Street, New York, NY 10013 (212) 925-1365.**

ASTRO STUDIO: Limited to gospel music. Free recording and mix to serious gospel singers. Correspondence: **P.O. Box 262, Harrisburg, PA 17108.**

STUDIO AIR CONDITIONING & ELECTRICAL DESIGN SERVICES

International specialist in studio air conditioning & electrical design; detail drawings and specifications, & site management for new facilities or to solve existing problems. Contact:

Neville Holden & Associates
Suite L
947 N. La Cienega Blvd.
Santa Monica, California
phone **(213) 664-5743**

db People/Places/Happenings

• **General Electric, Matsushita Electric, Victor Company of Japan (JVC), and Thorn EMI Ltd. of England** confirmed recently that discussions are being held on the feasibility of forming three jointly-owned companies to support the introduction of the video high density (VHD) video disc system in the United States market. The proposed joint venture would consist of a hardware manufacturing company, a software title and artistic production company, and a software manufacturing company.

• With as many as four digital recording systems currently under evaluation—and several more still under wraps—multitrack studios are soon going to be faced with the problem of which one to install. With a view to exploring the possibility of studios adopting an international digital standard, **The Association of Professional Recording Studios** has agreed to act as secretariat to coordinate the activities of such a panel. Anyone interested in joining the panel on digital harmonization should contact: **Edward Masek, 23 Chestnut Avenue, Chorleywood, Herts WD 3 4HA,** as soon as possible.

• **Shure Brothers, Inc.** of Evanston, Ill. recently announced several additions to their staff. Appointees include: **Robert Layton,** international sales manager; **James Jay Paton,** merchandising administrative manager; and **Lottie Morgan,** national sales manager. Shure is a major manufacturer of high fidelity components, microphones, sound systems, and related circuitry.

• **Howard Lilley** has been appointed national sales manager of **Ampex Corporation's** Audio-Video Systems Division. Lilley will direct US sales activities for the division's full line of professional audio and videotape recorders, broadcast cameras, switching systems, and computerized editing and video storage systems. He has been with Ampex since 1965.

• **Judith Hodges** is up to her neck in audio oscillators, wow and flutter meters, and phono preamplifiers. That's because she is the new assistant engineer at **WNCN, 104.3 FM-New York City,** and responsible for audio production and equipment maintainance. While Ms. Hodges is new to the 24-hour-a-day classical station, she is hardly new to the broadcasting field. She is a graduate of the **New York School for Broadcasting, the Announcer's Training Studio,** and **the Institute for New Cinema Artists.** She holds a BA in romance language from Hunter College, and an MA in adult education from Tuskagee Institute, where she worked mainly in audio-visuals and closed-circuit television.

• Pick up your phone and diai a **famous Hollywood voice** to narrate your next sound track. It is that easy and it is less costly than you might think. For as little as $260 for talent, sound studio and engineer for a 12-minute sound track, you can have narrators and voice actors who have played such famous roles as **Goofy, Owl, Tigger, Minnie Mouse, Jack Armstrong, the Lone Ranger, Peter Pan, Jiminy Cricket,** and hundreds of others. These same narrators have recorded thousands of commercial and industrial sound tracks for virtually every major corporation in America.

• **Vanguard Recording Society** announces the opening of its remodeled recording studio at 208 W. 23rd St. in New York City. The studio, which has recorded for most of the major labels, in addition to handling all of Vanguard's in-house work since its inception in 1967, has been redesigned by engineer **Jonathan Thayer.** In addition to state-of-the-art equipment, Vanguard has completely renovated the acoustics of the control room, constructing special monitor baffles to accommodate the highest volumes; as well as provide excellent focus. The room's new decor provides a pleasing environment for producer and artist.

• **Clifford A. Henricksen** has joined the staff of **Community Light & Sound, Inc.** He comes to Community from the **Altec Corporation** where he was supervisor of acoustic research. Mr. Henricksen is a member of Sigma XI, ASME, AES and ASCAP.

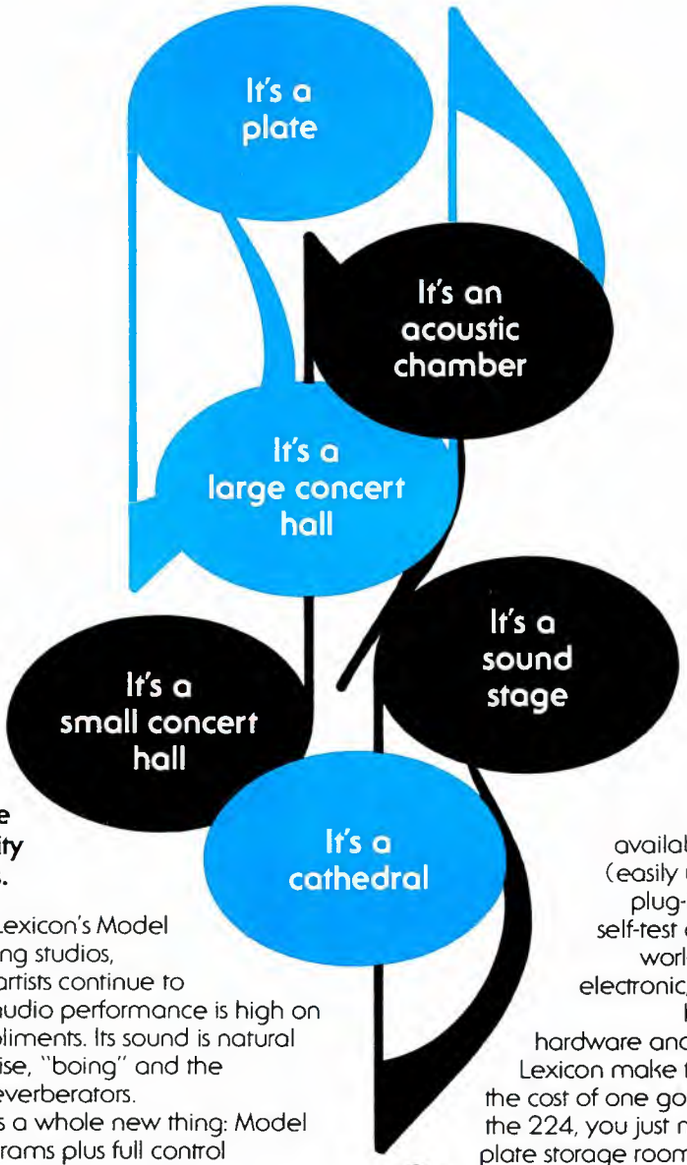
• **Ronald Larson** has been appointed plant manager of the **Switchcraft's** manufacturing facility in Paxton, Illinois. In more than 16 years with the company, Larson has gained broad experience in engineering, manufacturing, sales and customer service. Most recently he had served as marketing manager for the assemblies section.

• **Jacob C. Turner** has been appointed vice president of **RG Dynamics Inc.** Most recently he had served in a similar capacity for **Koss Corporation.** Turner brings years of experience in business planning and distribution management.

• **Paul Ackel** has been appointed sales engineering coordinator for **Panasonic's** Professional Audio Division. In his new position Mr. Ackel will be responsible for field sales management, product planning and technical training. He will also supervise the planning and organization of seminars, shows and exhibits.

• **Herbert P. Rickman,** special assistant to **Mayor Koch,** has been deemed special liason to the music industry. The music industry includes recording, publishing, talent representation, manufacture and sales of musical instruments, records, stereo and other industry-related special equipment.

• **Ewald J. Consen** has been chosen to head **ESS, Inc's** Pro Division. Consen brings to ESS more than 20 years of experience in marketing professional audio equipment. He most recently served as vice president of sales and marketing for **UREI.**



... A complete repertoire of the very highest quality reverb at your fingertips.

Rave Notices for Lexicon's Model 224 from the world's leading studios, broadcasters and musical artists continue to pour in. The 224's superb audio performance is high on the list of everyone's compliments. Its sound is natural and completely free of noise, "boing" and the problems of mechanical reverberators.

And its versatility is a whole new thing: Model 224's multiple reverb programs plus full control of all reverberation parameters allow audio engineers to create the sound that "is exactly right for the material." It's a whole stable of quality reverb capabilities in one compact package.

The model 224 Digital Reverb is available with 2, 4 or 6 basic reverb programs (easily updated in the field by simple program plug-in) and comes complete with extensive self-test diagnostic programs that take the guess work out of maintenance. Its mainframe, all electronic, requires only 7 inches of rack space.

If all this sounds expensive, it isn't. Digital hardware and software technology breakthroughs by Lexicon make the 224 surprisingly affordable ... about the cost of one good plate. And after you've experienced the 224, you just might find more productive uses for your plate storage rooms and acoustic chamber!

For full details write or call — better yet contact your leading Pro Audio dealer for a demonstration. Once you've heard it you'll never want to do another session without it.

WORLD CLASS REVERB

Lexicon, Incorporated 60 Turner Street Waltham, Massachusetts 02154/(617) 891-6790/TELEX 923468
Export: Gotham Export Corporation, New York, New York

Lexicon

Circle 11 on Reader Service Card

AMPEX MM-1200. WHERE GREAT STUDIOS START.

Select your multitrack recorder as carefully as the other facets of your studio. Select the Ampex MM-1200. Because it's the one multitrack recorder that can go through every change your studio goes through on its way to greatness. And still be as economical and easy to operate as the first great day you got it.

Growth without growing pains. With the MM-1200, you'll seldom be faced with a situation you can't solve. Because the MM-1200 comes prewired to make upgrading from 8 to 16, or 16 to 24-track operation simple and swift. And if adding channels won't solve your problem, the MM-1200's versatility will. Mastering, live sound reinforcement, double system sound, video sweetening or film and TV production/post production are all jobs that the MM-1200 can handle. Built-in single point search-to-cue, elevated record level capability, 16" reel capacity and fast start times also help you grow.

Performance you can depend on. The MM-1200 has proven itself under some of the most adverse conditions. The massive, stable top plate comes aligned and stays aligned . . . through repeated sessions in the comforts of the studio, or on remote locations.

Ampex keeps your options open. The list of optional accessories for the MM-1200 is the longest in the business. You can add multi-point search-to-cue and store 20 cue locations. This time-saving tape handling accessory provides tape time readout, cue point readout, "on-the-fly" cueing and more. Other accessories include the PURC™ Record Insert Controller, Search-To-Cue Remote Control, and MSQ-100 Synchronizer for job that require more than 24 tracks. Contact your Ampex sales representative for complete details.

AMPEX MAKES IT EXCITING

Ampex Corporation, Audio-Video Systems Division
401 Broadway, Redwood City, CA 94063 415/367-2011

Circle 12 on Reader Service Card