June 1991 Recording ■ Engineering ■ Production $4.00

R-E-P™

The Pro Audio Applications Magazine

STUDIO PRODUCTION

■ED LONG: MASTER OF TIME
■DIGITAL ZERO

AN INTERTEC PUBLICATION

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Reference is the ultimately damped, high excursion amplifier. A dual velocity feedback system enables Reference to take its low frequency damping range to in excess of 20,000. This makes low-end response tight, well-defined and incredibly natural. Crown has also enhanced ODEP™ (Output Device Emulator Protection) circuitry for Reference, creating precise transfer function (monitored by IOC™) and thereby accurate control of the music signal within the amplifier.

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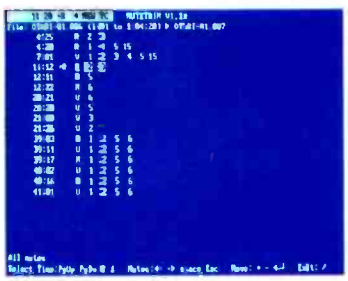
Circle (1) on Rapid Facts Card

crown

A new justification for investing in a moving fader automation system.

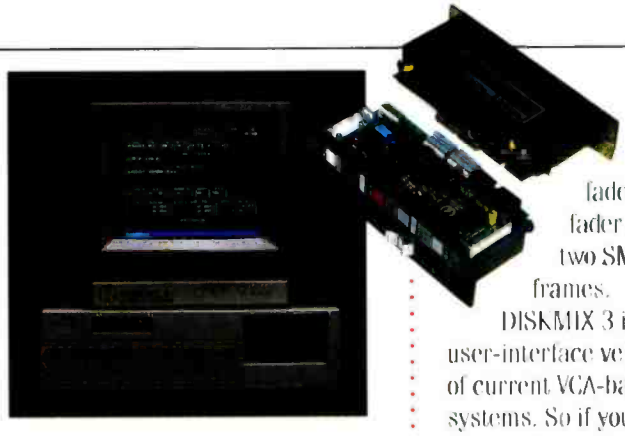
Not everyone's business demands moving fader automation.

But if you've been feeling competitive pressures, as well as pressures related to this technology —like the ability to instantly "re-create" last week's mix with the sonic transparency that only moving faders can provide—we can remove some of the obstacles you've been facing.



Our new mute trim function allows mutes to be inserted and deleted, or trimmed, on a frame-by-frame basis. Fader values and mutes (and unmutes) may be entered off-line via direct keyboard entry.

First, Otari's DISKMIX 3 *Moving Faders* system is one of the finest you can buy, and it doesn't carry a premium price tag. And our leasing program makes DISKMIX 3 even easier to put in your studio.



The highly versatile DISKMIX 3 software is combined with the latest in motorized fader technology from Penny & Giles to create a high quality yet affordable fader/mute automation system.

Interested?

DISKMIX 3 is a time-code driven system that provides unlimited mix data storage direct to hard disk, as well as complete off-line editing, including splice, merge, copy, fader and mute set and trim, plus insert and delete. The system uses multiple micro-processors and 10-bit data conversion, while high speed, dual ported RAM distributed over a proprietary bus system facilitates maximum data transfer with no system delays. This technology is optimized for the latest *Penny & Giles* motorized faders to provide full fader travel in less than two SMPTE time-code frames.

DISKMIX 3 is designed with a user-interface very similar to that of current VCA-based automation systems. So if you are already using automation systems, DISKMIX 3 will be a quick study. In fact, the entire system is easy to understand and to use. It keeps you abreast of what's happening during all phases of mixing and gives you constant feedback in all modes of automation.

For a new brochure that gives you a complete run-down on these and a host of other features that allow you to deliver a better, more creative product to your clients, call your nearest Otari dealer, or call Otari at (415) 341-5900. Perhaps this time, your decision about fader automation can be a positive one.

DISKMIX™

OTARI *DISKMIX 3 automation systems are designed and manufactured in the U.S.A. by Otari Corporation, Console Products Group.*

Circle (4) on Rapid Facts Card

Contents

Volume 22, No. 6

June 1991

8

Audio Production

Sound Reinforcement

14

Departments

On The Cover: Studio A at the Enterprise Recording Studio, Burbank, CA, during a vocal overdub session for Julian Lennon's upcoming album. Photo by Elizabeth J. Annas.

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PRESENTING THE LEXICON 300

A unique digital effects processor with analog and digital inputs and outputs, time code automation, and magnificent sound.

There may be digital effects processors that rival some of the 300's features, but you'll never find one with them all. The 300 delivers precise delay and stereo pitch shifting, as well as stunning reverb and ambience. It automates sound changes with SMPTE/EBU time code. And it inputs and outputs analog, as well as consumer and professional digital formats — in any combination. All with magnificent Lexicon Sound.

The 300 is a powerful tool in audio for video applications where time code synchronization is essential. And in digital video editing, the 300 ensures that scene changes are handled smoothly — in the digital domain. Because the 300 has digital inputs and outputs, it's the perfect choice for RDAT and CD mastering. And for music production there is an incomparable set of sounds, as you would expect from Lexicon.

Connectivity redefined

The 300 redefines connectivity standards for digital signal processors. Unique analog and digital circuits accept analog signals or digital signals in the consumer SPDIF or professional AES/EBU formats. Whether the source is a CD player, RDAT recorder, or open reel digital deck — the 300 identifies and locks onto the incoming format.

You can then select between analog and consumer or professional output formats, regardless of the input format.

Consumer in, professional out, analog in, digital out. The 300 handles them all. You can even mix analog and digital signals.

This kind of connectivity just isn't available anywhere else.

Total MIDI control

With the 300's real time MIDI automation you can record parameter changes on most any sequencer. The 300 also includes Lexicon's Dynamic MIDI® allowing you to control the 300's effects parameters from any MIDI controller.

And of course, the sound is superb. The 300 delivers nearly unmeasurable distortion and exceptional phase linearity through the use of state-of-the-art converters.

They're so advanced you can use their outputs as a system reference.

The 300 joins the Lexicon family of digital effects processors. From the economical LXP-1 to the world renowned 480L, they all share the Lexicon Sound.

For more information about the 300 or any of Lexicon's products, call (617) 736-0300, FAX (617) 891-0340, or write Lexicon, Inc., 100 Beaver St., Waltham, MA 02154.

Lexicon

The Art and Science of Sound

Circle (5) on Rapid Facts Card

We built our woofer and tweeter a better home.

DMT AND TRANSDUCER HOUSINGS —

All Cabinets used in the new Tannoy Monitor Series represent considerably more thought and design than the average 'chipboard cabinet of the correct volume'.

Cabinets are constructed from a high density space-frame with rounded corners and edges, supporting MDF/high pressure twin laminated walls

Rounded corners and edges greatly inhibit sound reflections and diffractions from cabinet boundaries. These can be major sources of irregularities in the reproduced sound, particularly in terms of the perceived placement of instruments within the sound stage. For the high frequency unit to make an effective job of launching all the detail that it can generate into the listening space, it must be held rigidly in the cabinet throughout its operational frequencies.

This is the key to the Tannoy cabinets. If a 'rigid' cabinet is used, the redundant energy from the rear of the bass unit and frame cause endless resonance problems within the cabinet. Differential Material Technology provides the answers by using a variety of different adhesives between the rear of the drive unit and brace, the cabinet walls and the brace and within the layers of the MDF laminate.

TANNOY

HEAR BELIEVE

The lossy couplings effectively transmit and absorb energy in a frequency selective way. Put more simply, at low frequencies the drive unit sees the cabinet as a rigid structure and at higher frequencies as a resonance absorbing/damping structure.

DMT provides an ideal cabinet solution for the complete frequency range, eliminating unwanted loudspeaker biases.

The overall result is a true representation of the mix, unequaled referencing capability, guaranteeing what you hear is what you get — *every time.*

Tannoy / TGI North America Inc. • c/o Bill Calma • 300 Gage Ave., Unit 1, Kitchener, Ontario, Canada N2M 2C8 • (519) 745-1158 • Fax (519) 745-2364

Not your average woofer and tweeter.

Circle (6) on Fast Facts Card

Recording ■ Engineering ■ Production

R•E•P™

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R•E•P is an applications-based publication targeted at professional individuals and companies active in the commercial business of studio and field recording, audio for video, live sound production and related fields. Editorial content includes descriptions and demonstrations of audio production techniques, new products, equipment application, maintenance and audio environment design.

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Sustaining member of Acoustical Society of America
Member, International Communications Industries Association
Associate member of Society of Professional Audio Recording Services

From the Top

What Makes A Magazine Sing?

Every so often, we get a letter from a reader who asks a variation on the following question: "Why do there have to be ads in R•E•P? They only detract from the space for the articles and product reviews we enjoy reading. Why can't you just fill the magazine with the stuff we like to read?"

Our answer? R•E•P, like most of the magazines that deal with specific industry-related subjects, is known as a trade magazine. It exists both as an informational tool for the industry, and, of course, to generate an income for our publishing company, which spends vast amounts of dollars every year sending writers and editors to trade shows, visiting studio facilities around the world, taking and processing photographs, producing and printing the magazine, mailing it (the majority of the cost of doing magazine business), etc.

Subscription revenue is, at best, a break-even proposition in the magazine publishing business. The production dollars come almost exclusively from ads. The majority of readers feel that this serves multiple positive purposes: It lessens the burden of magazine subscription costs to them directly, and, via the ads, it educates them as to new or interesting products available from the manufacturers.

Dennis Milan, the publisher of R•E•P, and I, as the editor, work very hard to ensure that the *ratio* of ads to editorial material is monitored closely. Obviously, we want to maintain a profit for the company, so the magazine can continue to be as successful as it has been for the past 21 years. But just as importantly, we have no interest in having the book look like the front of some lifestyle consumer magazine — 80 pages of ads before you get to the table-of-contents page, followed by four fluffy articles. That does our professional audio reader — you — a disservice. Our goal is to continue to provide the largest amount of useful and practical editorial material we can possibly cram into the mag, the kind of in-depth, technical, nuts-and-bolts features unavailable among the competition.

Which brings up a question from our side: How are we doing? It's been exactly one year since we revamped the look and feel of R•E•P, with a phenomenal amount of positive response. Along the way, we have adjusted the focus of different departments and features, attempting to find that magical balance (if there is one) between all of the special interest readers we address: studio rats, creators, mixers, A for V post, film sound, live SR, you name it.

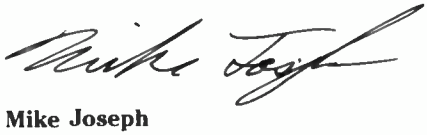
The goal of all of the staff at R•E•P is to create the one magazine that most effectively delivers, without the fluff and hype we all see elsewhere, the material most valuable to you in these rapidly progressing technological times. Information you *need* to survive and prosper. Material that jumps out at you quickly without your having to wade through pages of low-level coverage.

With this in mind, we would like to instigate an informal survey.

It would help us immensely if you would take a brief moment of your time and jot down a short list, or some comments, on what you would want R•E•P to be. Pretend it's yours to install editorial material into as you see fit. What would you include? How can it be even more effective for you?

Mail me off a note. Maybe jot it on the back of your facility brochure. Be creative! Do you want to see more product reviews? More in-depth technical evaluation or education pieces? More or fewer studio descriptions and visits? How about the human interest pieces, like interviews and project coverage? Do the production spotlights work for you, like Fresh Track's Focus column? What do you think of sound system/concert reviews? All Access? Roadwork? How about the new product section? Should it be bigger? Smaller? Different in coverage? Computers? Hard drives? Let us know. Contribute to this endeavor called R•E•P, which benefits all of us in the industry.

Make a small investment in time and a stamp, and let us know what you'd like to see continued, dropped, expanded or added. Do it for yourself *and* for us. We want this to be the best damn trade magazine you need to read. ■



Mike Joseph
Editor

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Overland Park, KS 66212

Letters

DAW Reaction

From: Colin Pringle, head of marketing, Solid State Logic, Begbroke, Oxford, England.

I found the hard disk survey in the March issue ["Reality Check"] very interesting. We feel the poor scoring of ScreenSound in the backup stakes is because the authors were not comparing like with like; many of the comments made were not accurate.

- For the record, ScreenSound does not have a slow tape streamer. It does backups at the same speed as all the other systems — 2.5× real time. However, it backs up the whole system, in much the same way that a mainframe computer backup works (would you want to back up your System 38 every time you finished a spreadsheet?). Other systems back up individual files (which actually involves a greater degree of risk). You can see that this approach makes even more sense when you look at the system in conjunction with SoundNet, where the centralized audio and edit data are managed in a truly professional manner, off-line.
- Our sampling frequency is fixed at 48kHz for A/D conversion. As the system operates at 48kHz internally, we do not see the sense in providing an option. For digital inputs, however, 32kHz, 44.1kHz and 48kHz are all accepted, either user-selectable or auto-selectable.
- Tracks are not bounced through analog circuitry, but digitally.
- The automation integral in ScreenSound is entirely digital. There are no VCAs.
- It is possible to perform a crossfade within a track.
- Other points may have been true when written, but have been added in recent software releases.

Stalking the Magnesaurus

From Jim Boyk, president, Performance Recordings, Los Angeles.

I thought R•E•P's coverage of the Magnesaurus was excellent. I must confess that I've been startled at how many people read R•E•P. Quite a number of people have told me they read the piece, and several people mentioned in the article say they've had the same experience.

One professional at a major label has been trying to put 351-type heads and electronics on an Ampex ATR, and I was able to pass on the word that it won't work. I know, because that was my own first idea of how to do the job.

The first Magnesaurus recording was released on LP and CD in May through Harmonia Mundi USA, the exclusive U.S. distributor. The CD is the only one in the world that has the entire program twice, once from analog (the Magnesaurus tape) and once from digital. The two master tapes were made at the same time off of identical microphone feeds.

A final note: Magnesaurus is a trademark.

R•E•P is influential!

From: Conrad J. White, manager, Modern Language Center, Department of Media Services, Harvard University, Cambridge, MA.

"Stalking the Magnesaurus," in the February issue, was a very interesting article, particularly to us old "tube-a-philes." However, there was a large omission: No mention was made of the manufacturer or the type of tape that was used.

Was it Ampex, 3M, Radio Irish brand or Brand X? Perhaps the new 3M 996? All of us out here would like to know. Keep up the good work.

Editor's Note: Jim Boyk, the man behind the Magnesaurus, uses Ampex Grandmaster recording tape. He is also evaluating 3M 996 on the Ampex 351 tape machine.

Answers to DAT Questions

From: Steven Huston, president, Yattunes, Houston.

Regarding the mystery of why the DAT recording was not even in the running with the one made on the Ampex 300 traveling at 15 ips ["DAT Questions," Letters, April], perhaps it bears out what some of us from the "old school" of recording have been saying all along: *nothing* captures the "warmth" in music better, or even close to, an honest-to-goodness analog recording made on a machine that has stood the test of time.

Dolby SR is something that should be used on occasion *if warranted*, but not as an everyday, automatic practice. Using 15ips requires much less compensation for losses at the end of spectrums compared to 30ips, and DAT machines may be "pure" in theory, but "new idea" engineers are perhaps better at being computer geniuses than they are using their ears.

I hail from the recording "school of hard knocks" and only use machines that too-many-to-count great recordings have been made on. I still cut tape with a razor blade, and I challenge anyone to find my edits. I still believe that making great recordings is an art one learns from another who knows how it's done. Then, you have 10 or 15 years of practice and you can do it too, if you're lucky.

I don't know if this is the definitive answer, but it could be that the Ampex 300 recording sounded best because the machine is superior for sound recording, and the engineer running the machine knew how to make recordings.

The DAT Agreement

From: Ronald Steven Mintz, Los Angeles.

I was shocked and amazed to read that a settlement of a class-action lawsuit was based on the condition that all manufacturers of DAT machines degrade the quality of their products ["DAT in the Real World, Part 1," April]. Such an agreement, on its face, appears to be illegal as a "horizontal" restraint of trade.

As for the copyright aspect of the agreement, it appears that the parties have forgotten that the purpose of the copyright laws is to afford protection for Limited Times (capitalization in the original, i.e., the U.S. Constitution). The scheme now followed defeats the basic purpose of the copyright laws by preserving *in perpetuity* the inability to copy protected works.

Such a subversion of the copyright laws' purposes is worse than the mere possibility that the use of better DAT equipment would serve to contribute to a possible infringement. To carry the parties' logic to its conclusion, all "consumer" cassette decks should be similarly degraded in some way, or else they, too may be used to infringe protected LPs and other music sources.

Editor's Note: Due to inaccurate information furnished to R•E•P, Sear Sound's phone number in April's Letters column was incorrectly listed. The correct phone number is 212-582-5380. ■

Send letters to R•E•P, Box 12901, Overland Park, KS 66212; fax 913-541-6697. All letters must be signed and may be edited for length and clarity.

Rather than show you a picture of George Massenburg posing in front of our digital multitrack, here's why he stands behind it.

Legendary recording engineer and producer, George Massenburg, has so many reasons for buying a Sony PCM-3348 DASH 48-track, you don't need to see his face to get the picture.

The PCM-3348 has developed a reputation for steadfast reliability.

Reasons like the transport. "It's the finest I've ever run. When you press play, it plays without throwing loops. And it stops, starts, and locks-up incredibly fast."

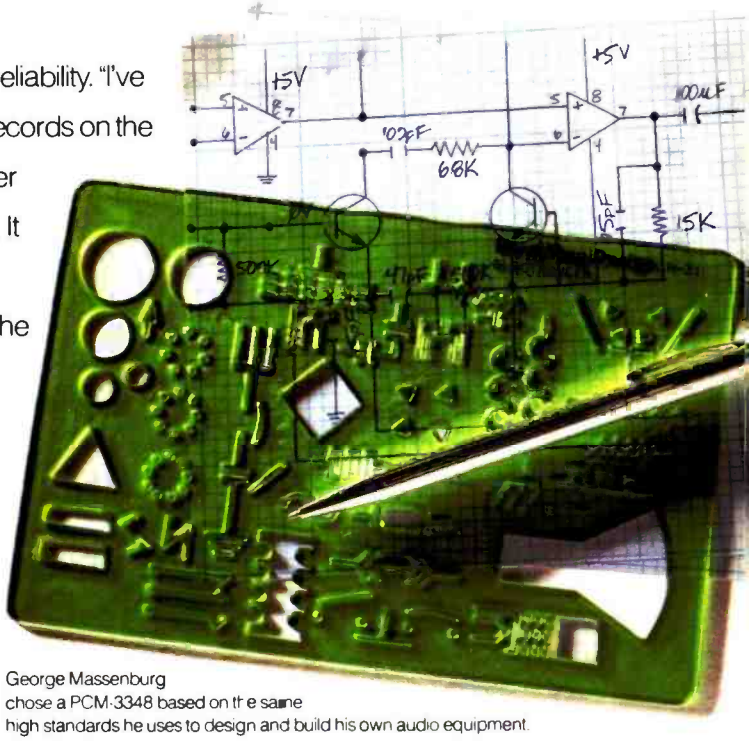
Reasons like its user-friendly, ergonomic design. "The 3348 seems like it was designed with the engineer in mind. It never fights you."

Reasons like reliability. "I've produced a lot of records on the 3348, and I've never had any problems. It always works."

Reasons like the people behind the 3348. "I like Sony's philosophy. They're looking way over the horizon. They've given the 3348 features I've only begun to use now, but I know they'll be essential down the road."

And, of course, the most important reason of all. "The sound is excellent. In fact, I've digitally transferred all of my current projects from 32-track to Sony's 48-track, and now I can't imagine using anything else."

And that, coming from George Massenburg, is music to our ears.



George Massenburg chose a PCM-3348 based on the same high standards he uses to design and build his own audio equipment.

For even more reasons to consider the PCM-3348, call the Sony Professional Audio Group at 1-800-635-SONY.

Sony's unique transport enables the PCM-3348 to move tape faster than any other multitrack recorder.

SONY

BUSINESS AND PROFESSIONAL GROUP

Random Access

STUDIO UPDATE

Name/Location	Details
NORTHEAST	
Interface Video Systems/ Washington, D.C.	Bill Winn has joined the staff as senior audio engineer.
National Sound/New York	Newly formed division of National Video Center; has purchased an NED PostPro and Synclavier.
Right Coast Recording/Lancaster, PA	Completed construction of a modular, remote recording system, offering analog and digital recording.
Sear Sound/New York	Has received a fabricated 1/2-inch 2-track head stack for Studer A-80 recorder from John French of JRF Magnetic Sciences. Also purchased: a pair of closely matched AKG C-12A mics.
Showplace Studios, Dover, NJ	New recording studio with an Amek Mozart console with Rupert Neve modules and Supertrue automation, an Otari MTR 90 III, Digidesign Sound Tools, an Apple Macintosh IIci, Studer A820 and Lexicon 480L; designed by H&M Audio. Located at 347 S. Salem St., Dover, NJ 07801; 201-328-4400; fax 201-328-4833.
University of Lowell/Lowell, MA	Sound Recording Technology Program has opened a new 24-track studio; equipment includes a Soundcraft TS24 console with Audio Kinetics Master Mix automation; Otari MTR 90 and MTR 10 tape machines; and a Studer Editech Dyaxis.
MOUNTAIN	
Colorado Sound/Westminster, CO	Equipment purchases: Apple Macintosh IIci; Digidesign Sound Tools; Sontec mic pre-amps; Meyer HD-1 monitors; Panasonic SV-3500 DAT machine; and eight additional Uptown Automation faders.
SOUTHERN CALIFORNIA	
The Last Stop/Universal City	Post-production facility owned by the Arthur Co. is available for outside clients. Facility includes a video on-line bay, two video off-line bays and six audio sweetening suites. A mixing room with a Neve 8108 console and Westlake monitoring has been added.
Little Wing Recording/ Marina del Rey	Facility has moved from the Bay Area to Los Angeles; business direction is now away from post-production services and toward location sound work. Address: 4163 Via Marina #409, Marina del Rey, CA 90292; 213-305-8280.
Pacific Ocean Post/Los Angeles	First phase of expansion project has been completed; additional audio facilities, including an audio room, pre-lay room and voice-over booth, are new.
Sound Chamber Recorders/North Hollywood	Moved from Pasadena to Hollywood location in May; has three studios designed by Jack Edwards and Beno May. Services include music recording, MIDI work and post-production.
NORTHWEST	
Lawson Productions/Seattle	Ann Wilson, Nancy Wilson and Howard Lees of Heart have built a studio at the Lawson complex. Studio A has been updated, Studio B has been remodeled and a third digital audio workstation has been purchased.

NEWS NOTES

Martin Audio/Video has restructured its equipment sales group; accordingly, all pro audio sales will be consolidated under A.F. Associates, Martin's sister company. The group will be led by Mike Bogen, director of sales. Dave Bellino is sales manager, and Philip Celia is field manager.

Because of the acceptance of its Macintosh-based products, **Digidesign** has announced that it will no longer market and distribute C-Lab Atari products, or its own Atari product line, in the United States and Canada. Atari Sound Tools users may "side-grade" to purchase or swap the appropriate hardware and software to run the Sound Tools on the Mac. For more information, contact the company at 1360 Willow Road, Suite 101, Menlo Park, CA 94025; 415-688-0600; fax 415-327-0777.

White Instruments has moved to 1514 Bluestein Blvd., Austin, TX 78721; 512-389-3800; fax 512-389-1515.

Attendance at the 90th **Audio Engineering Society** convention in Paris totaled 6,256 people from 57 countries. A total of 270 companies exhibited. Despite initial fears of an attendance decrease because of the Gulf War, the association said the convention was one of its largest European events to date.

3M has donated audio- and videotape to New York's Museum of Broadcasting for archiving purposes.

Monitor manufacturer **DynaudioAcoustics** has appointed 21st Century Ltd. as its dealer in the Los Angeles area, located at 2002 N. Beachwood Drive in Hollywood.

SALES NOTES

Neotek announced that 1990 was its most successful year ever, with 1991 expected to set records. Most of the company's growth is expected to come from sales of the Encore film and TV post-production console.

Valley International is now selling its product line direct to the industry, allowing a 30% reduction in distribution costs to be passed on to customers. A toll-free number has been set up for orders: 800-800-4345.

Music To Your Eyes

JVC's DS-DT900N R-DAT recorder is designed to integrate perfectly into any video post production environment. All of the features needed by audio and video professionals are standard on the DS-DT900N, but optional on other machines. Features like video sync and SMPTE time code for pinpoint synchronization with video, parallel and serial remote control, and AES/EBU digital inputs and outputs.

With a manufacturer's suggested list price of less than $4,500, no other professional R-DAT recorder gives you the features and performance of the DS-DT900N.

For more information about the DS-DT900N, call 1-800-JVC-5825 or write JVC PROFESSIONAL PRODUCTS COMPANY, 41 Slater Drive, Elmwood Park, New Jersey 07407.

Circle (8) on Rapid Facts Card

JVC®

PROFESSIONAL

Random Access

STUDIO UPDATE

Name/Location	Details
MANUFACTURERS	
AMS Industries	Point 12 (Paris) has purchased one of the first 16-output AudioFile Plus systems.
API Audio Products	Third Discrete Series console has been sold to Pinebrook Studios (Alexandria, IN); API 2016 owned by Steve Hennig has been refurbished and will be used in a new Nashville studio he is constructing.
Philip Drake Electronics	TV-am (London) has purchased the first 2000 Series stereo audio production console.
Harrison by GLW	TV-4 stereo teleproduction console sales: WMAQ (Chicago); and KIRO (Seattle).
Neve	VR console sales: Ardent Recording (Memphis, TN); Pyramid Sound (Ithaca, NY); and Village Recorders (Hollywood).
New England Digital	International sales: NTV Video Corp. (Japan), PostPro SD; German public broadcasting, three PostPost SDs and a Synclavier; Studio Time (Paris), PostPro SD; Teletota (Paris), Tapeless Studio system; Pro Video (Helsinki), Synclavier 3200; and Finnish Film Commission, PostPro and Synclavier 6400.
NVision	First 20-channel NV2000 High Definition Audio System has been installed at KLS-TV, Salt Lake City.
Otari	Zoetrope Studios has taken delivery of an Otari/Sound Workshop Series 54/Film console.
Solid State Logic	SL 4000 G Series sales: The Plant (Sausalito, CA) and Bosstown Recording (Atlanta). The Enterprise Recording Studios (Burbank, CA) has become the first studio to use SSL's new automation system, Ultimation, in a new SL 4000 G Series, the facility's sixth. Audio Post House (New York) has added a second ScreenSound.
Sony	Wim Vonk Sound Produktions BV (Netherlands) has purchased a 36-channel MXP-3036 console.
Soundcraft	Console installations: Hunt-Vincent Advertising (Lakewood, CO), 32-channel 200 Delta; Oberlin College Audio Services (Oberlin, OH), 32-channel 200 Delta; and Wood Entertainment Services (Little Rock, AK), Venue.
Soundmaster International	Integrated Audio Editing System sales: Magno Sound and Video (New York); Weddington Productions (North Hollywood); Warner Bros. Studios (Burbank, CA); and Film House (Toronto).
Studer Editech	Dyaxis sales: Chapman Recording Studios (Kansas City, MO); and Elit Post (Nashville).
DESIGNERS	
Acoustics Design Group/Guildford, U.K.	Appointed to design a new control room for Studio 2 at Abbey Road (London).
Russ Berger Design Group/Dallas	Designed facility expansion at General Television Network (Oak Park, MI), scheduled to be completed this summer.

JBL Professional has issued its own credit card, which allows pre-approved customers to upgrade or outfit an entire setup within a flexible payment schedule. Applications are available at JBL dealers; for more information, contact JBL Financial Services, 8500 Balboa Blvd., Northridge, CA 91329; 818-893-8411; fax 818-893-3639.

Because of sales demand for its 500 and 200 series signal processors, **Symetrix** has expanded its manufacturing, warehousing and shipping facilities by more than 60%.

Fostex has shipped 1,000 D20 DAT recorders worldwide since its introduction.

Sales figures for **Digidesign's** Sound Tools reached 4,000 on the second anniversary of its release. Sales in March 1991 were the largest in the product's history.

Telex Communications has landed contracts for the Winter and Summer Olympics. CBS has puchased a CS9700 communications system for the main broadcast center at the Winter Games in Alberville, France. NBC has purchased a CS9700 for use in its broadcast center at the Barcelona, Spain, Summer Games.

PATENTS

Rane has been issued a patent for its Accelerated Slope equalization design, first introduced last year in the FMI 14 microphone pre-amp.

Soundmaster has been awarded a patent for Smart Sync, the basic synchronization system for the Integrated Audio Editing System.

REP NEWS

White Instruments has appointed PCM Marketing as its representative in Northern California and northern Nevada.

Bag End Loudspeaker Systems has appointed Techshare Marketing as its representative in Maryland, Delaware, Virginia, southern New Jersey, eastern Pennsylvania and Washington, D.C. William Ray and Associates will represent the company in Georgia, North Carolina, South Carolina, Tennessee, Alabama and Mississippi.

Bay Roads Marketing Group is now representing **Adams-Smith** product line in the metropolitan New York area. ■

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Circle (9) on Rapid Facts Card

Fresh Tracks

Joni Mitchell: "Night Ride Home"

Label: Geffen
Produced by: Joni Mitchell and Larry Klein
Mixed by: Mike Shipley and Dan Marnien
Engineered by: Dan Marnien
Additional engineering: Tony Phillips, Steve Churchyard, Julie Last, Henry Lewy, Richard Cottrell, Julie Last, Paula Garcia, Kristen Connelly, Jim Hill, Bob Voght
Recorded and mixed at: Kiva Studios, A&M Studios, One on One Studios
Mastered by: Bob Ludwig, Masterdisk (New York)
SPARS Code: AAD

Comments: Consistency reigns throughout the latest release from J.M., in musicality, artistic message and production. Mitchell has recorded one of her more mainstream works with catchy hooks and melodies that are embellished by a uniform, engineered mix.

Of special interest: The popularity of Kiva as the studio for creating some of the latest creative works must certainly be a deliberate choice among the artists who voice where they want to track. Many of the albums recorded at Kiva (and those subsequently reviewed in this department) have exhibited the variety of the mixes and significant consistency of the productions merit recognition. ■

Riff

Label: SBK
Produced by: Dennis Lambert, Pam Reswick, Steve Werfel, Monty Seward, Winston Johnson, Dale Van Rensalier, Ron Robinson, Brooks Arthur, Steve Lindsey, David Lawrence, Faye Greenberg
Engineered by: Brian Malouf, Jeremy Smith, Gabe Veltri, Frank Roszak, Charles Alexander, Winston Johnson, John van Nest, Gabe Moffat, Eric Anest, Tom Fritze, Dave Jenkins, Steve van Arden
Recorded at: The Zoo (Encino, CA); Can Am (Tarzana, CA); Marathon (New York); Studio Ultimo; Westlake; Winsonic Digital; the Hit Factory; Steve Lindsey Studio (Los Angeles); Image Recording (Hollywood); Valley Center Studios (North Hollywood); Ground Control
Mastered by: Bob Ludwig (Masterdisk, New York)
SPARS Code: N/A

Comments: Machine tracks with some tasty guitars and saxophones. The vocals by this five-piece are phenomenally impressive. Their blending brings to mind at once Take Six and the Temptations. Riff ought to take the Grammy next year for group vocals. It's amazing to hear what kind of record you can make with vocalists who can really sing.

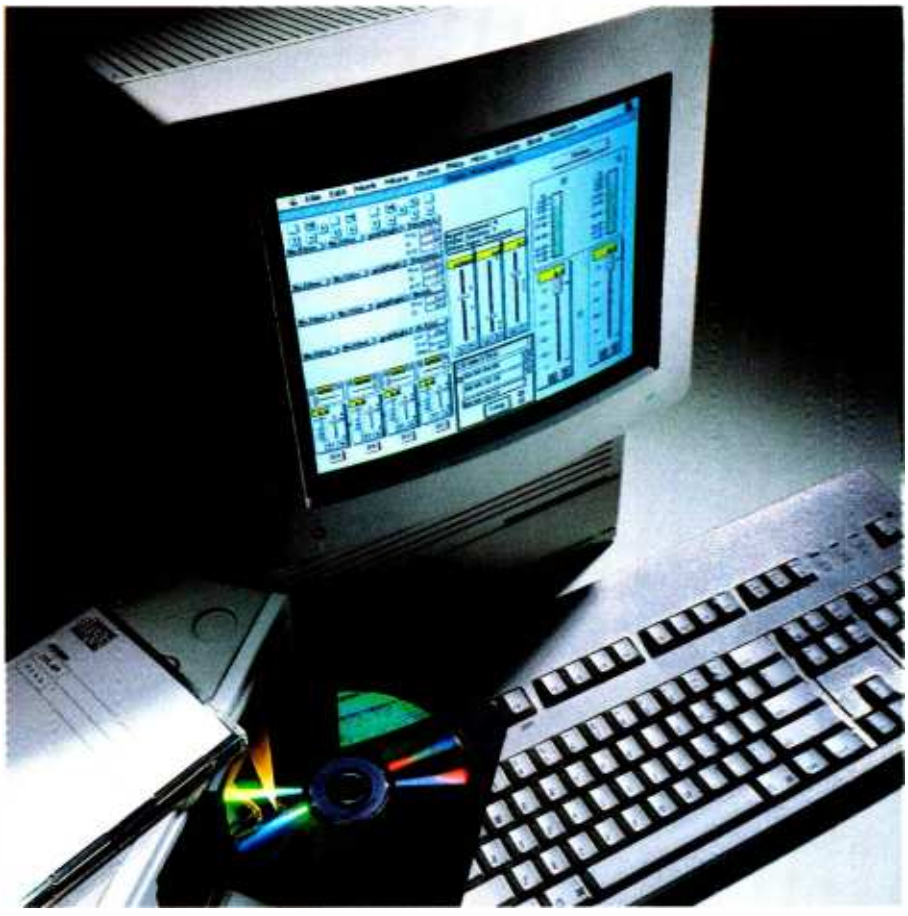
Of special interest: "All Or Nothing" is the funky track with some cool rhythmic and sampling effects. "If You're Serious" is a velvety smooth romantic ballad, reminiscent of Stevie Wonder. ■

Material Issue: "International Pop Overthrow"

Label: Mercury
Produced by: Material Issue and Jeff Murphy
Engineered by: Jeff Murphy
Mixed by: Jeff Murphy
Recorded at: Short Order Recorder (Zion, IL)
Mastered by: Greg Fulginiti, Artisan Sound Recorders (Hollywood)
SPARS Code: AAD

Comments: Good, tight pop songs, solid writing, with a young idealistic edge; a cross between Shoes and REM. The real achievement of the production is in the casual ambience captured while still getting all of the details just right; the vocal performances sound natural and effortless. An alternative band with great promise; it may be a few albums before MI cross over to the mass appeal which REM is now receiving, but it will be fun on the way.

Of special interest: There is a lot of obvious care in the production and engineering, yet the recording smartly avoids sounding "slick" or overproduced. "Valerie Loves Me" is a good radio track. ■



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Fresh Tracks

Traut/Rodby: "The Duo Life"

Label: Columbia
Executive producer: George Butler
Produced by: Steve Rodby and Ross Traut
Recorded and mixed by: Rich Breen
Assistant engineers: John Armstrong, Dennis Tousan and Tom Hanson
Recorded live at: Universal Recording (Chicago)
Mixed at: Chicago Recording Company (Chicago)
Mastered by: Classic Digital (Evanston, IL)
SPARS Code: DDD

Comments: How exciting could an album of jazz guitar and double bass be? Chicago musicians Traut and Rodby provide some articulate comebacks to an often tried-and-tested format that envelopes this listener in an unusually warm and homogenous mix.

Of special interest: Engineer Rich Breen has taken the sparse nature of the performance and extended to the listener an array of environments which, more often than not, add exceptional depth and warmth to the musicality of these recordings. While the album clearly hypes its DDD rating, thankfully absent are the harsh treble anomalies and digital "grit" prominent in most full digital recordings. ■

The Godfathers: "Unreal World"

Label: Epic
Produced by: Steve Brown
Engineered by: Steve Brown, Nick Robbins, Richard Chappell
Mixed by: Steve Brown
Recorded at: Elephant Studios (London); Real World Studios
SPARS Code: AAD

Comments: We liked the Godfathers the first time we heard them, three years (and three albums) ago. Their music is based heavily on guitar sounds with their roots in 1960s psychedelia. But the band uses this influence only as a starting point, building upon it with a freshness and youthful innocence which is at once compelling, brash and ingenious.

Of special interest: Too often, bands that play upon influences from other eras, be they rockabilly, Byrds-clones or psychedelia, do so with an irritating and studied self-concsiousness which creates a barrier to the music. The Godfathers avoid this by approaching their psychedelic roots not from the standpoint of a '90s band doing '60s music, but rather, by picking up the 60s sounds and exploring them as though no time had elapsed. A remarkable compositional and production achievement. What you might expect to hear if the Beatles had made another album between "Revolver" and the "White Album." ■

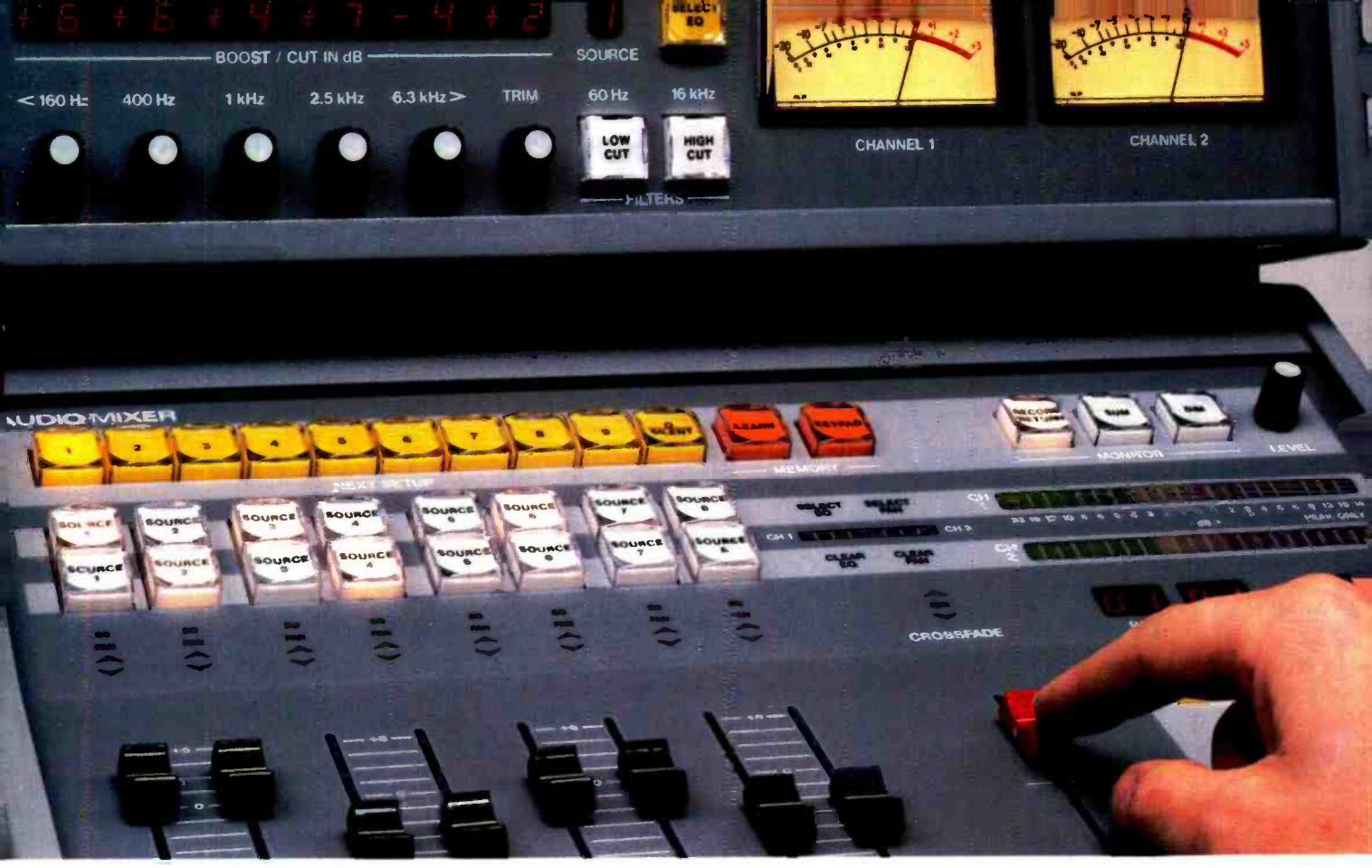
REISSUE ROUNDUP

The following compact discs of classic music have recently been released. As with all Fresh Tracks reviews, R•E•P recommends these selections either for pure enjoyment, or for building up a basic library of recordings.

Queen: "A Day At The Races," "Sheer Heart Attack," "News of The World" and "Hot Space" (Hollywood Records). Freddie Mercury, Brian May and the boys deliver. "We Will Rock You," "Killer Queen" and "Under Pressure" are among the songs included here. The production was years ahead of its time — there is still a lot to be learned from these tracks. May's guitar tones are among the best around.

James Brown: "Star Time" (Polydor). A four-CD set(!) spanning Brown's career. The songs are carefully chosen, the sonic quality is good and, of course, the Godfather of Soul was doing stuff 20 years ago that still can't be touched. The ultimate rock and roll/soul package.

EMI Legends of Rock & Roll Series: EMI has within its catalog Imperial, Liberty, United Artists and other classic labels. The reissues are packaged with replicas of original artwork and include every song you can imagine by the respective artists. Highlights of the series (must haves) include best-of compliations of the Ventures, Ricky Nelson, the Isley Brothers, and Ike & Tina Turner. There is also an amazing collection of Cher singles without Sonny, including "Needles and Pins" and "Alfie." The production on these rivals that of Phil Spector, with whom Sonny and Cher had their humble beginnings as background singers. ■



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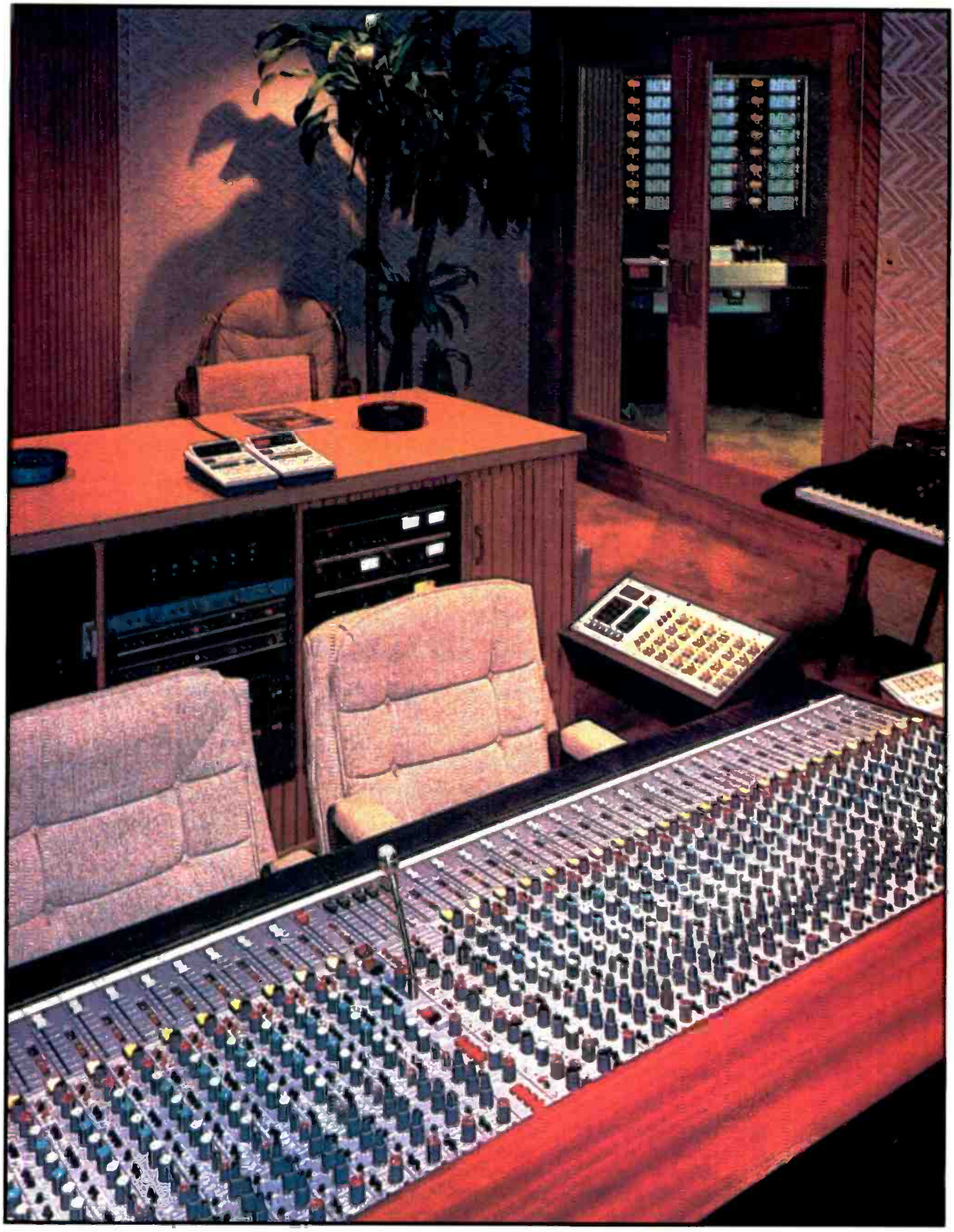

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Image and Reality

By Howard Schwartz

During the past year, there have been a number of demises in our industry that were not a result of the recession or the Gulf War or any other outside reason.

Some of these facilities had been in business for more than 20 years; some never really got started. No one has the ability to guess what went wrong or why these things happened — they just did! The success of many facilities is based on terms like "It's a great room to track in" or "The best place to mix!" or "Mick has been there for a month!" or "Bob Clearmountain says...!"

Let's go back a few years and remember A&R Recording, started by Phil Ramone and Don Frye. Or how about Regent Sound and the late Bob Liftin? Or Wally Heider on Selma and Cahuenga, or Bob Fine in the Great Northern Hotel on 57th Street, or Kendun, or Artisan, or Columbia 30th Street, or even the home of more singles than any other studio in the history of the business, Bell Sound. And let's not forget the Record Plant, and Chris Stone and Gary Kellgren.

Each one of these facilities had one thing in common, even though they were vastly different in size, structure, ownership personality, location and style. *They had an image.* Whether the image was created by the owners or by the loyalty of the customers or the stories about them, good or bad, this was an image.

Image is one of the most powerful tools for anyone or any business. When operating on a day-to-day basis, we are many times unconscious of the image that we promote for ourselves. This image, 90% of the time, is more important than any equipment list available for your facility or business.

One step further is our sense of self-esteem. Unfortunately, this is the hardest of all professional emotions to master. How do you feel among your peers? What is your market position? What are your rates compared with the top guy in town? Is your facility as good looking or as sexy as Studio X?

Howard Schwartz is a member of the SPARS board of directors and president of Howard Schwartz Recording, New York.

Most of us can only conjecture about what our relative position is in the marketplace, because we are so busy doing what we are doing that there is no time for us to go out and look at what the other guys are doing. Some of us are the only game in town, so that is a problem. And then there are some who think so low of themselves that they are afraid to ask for a tour or meet with their competitors.

Image is one of the most powerful tools for anyone or any business.

There is only one facility that can be the top in the market, and that does not mean that the owner is making the most money — or making any money at all. In fact, what are the criteria for creating and maintaining a successful facility? It seems to be very different for each facility and is directly related to how people see themselves as business operators, or how they perceive themselves to be thought of by their peers, clients or prospective clients.

I, for example, have always operated under the assumption that I have to try harder and that there will always be one or two facilities in New York that are a bit hipper, more technically advanced, better looking, more profitable than me, cleaner, better-run or busier. I wanted to be the top studio in my market. Privately, I think that I am. Publicly, I try to exude that feeling so that my facility is attractive to my current and prospective customers. I pray every day that I make the right decisions and that nine studio rooms worth of clients believe me.

The previous paragraph has to do with "Facility Esteem." My esteem is verified each time I go to a SPARS event. In New York, we have "Studio Only" meetings. These meetings have no structure, no agenda — we just let 'er rip. This is the regular three-hour verification that my life is going to be OK. We all work in a vacuum and this is where we all hear that we are not alone in our little spaces, and that others have the same problems.

We all have the ability to buy the same stuff, and we all have the ability to hire the same people, and we all have the ability to contract the right architect, and we all have the ability to borrow the needed cash — some months of the year — and what all of this ability boils down to is *sales.*

Sales is your PR pieces in the trades. Sales is your picture in an ad for some piece of gear that none of us need. Sales is the committee that you're on for the charity you can't afford to give to. Sales is making a speech at a school in the neighborhood. Sales is the lunch tab that you pick up even when you don't eat anything. Sales is the returned phone call to someone you can't stand. Sales is all the pro bono work you say yes to even though you don't know what pro bono means.

Memory, Image, Studio Esteem, Sales — these are the ingredients that make a ballgame. You have to use each one carefully and in the right order so as not to spook any current or prospective clients. High Studio Esteem does not mean being boastful. And it is definitely very unattractive to badmouth your closest competitor. At SPARS, we promote doing business according to all the rules of the state and local municipalities so that there is never a question of unfair advantage because of zoning regulations or sales tax. Your best promotion could come from your relationship with your fiercest competitor.

I have a day-to-day relationship with many of my competitors. Because most of them are SPARS members, they know I will always take their calls, discuss their various situations and try my best to answer their questions.

Sometimes the questions are not what you'd expect to hear. For example, a facility owner from outside New York once asked me if I thought $800,000 a year compensation for himself was excessive. Another told me that he only pays cash for his equipment and he has no notes on the business at all, because that's the only way he can make a profit. And yet another told me that he kept his rates so low because his clients wouldn't pay a penny more, and I should lower my rates so that I would be in line with him.

My responses to them were, "You're kidding," "You've got to be kidding" and "You must be kidding." Each of them had different self-images and I certainly perceived different images of them.

Ob-La-Di, Ob-La-Da. ■

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Circle (14) on Rapid Facts Card

The Mod Squad

By Rick Schwartz

It's ironic that at the same time manufacturers are packing more and more circuitry onto a single chip, there is an equally strong movement toward discrete technologies.

Instead of simply buying the newest gadget, did you ever think about upgrading a piece of gear you already own? It's amazing the difference a low-cost upgrade can make. To find out more about the subject, I spoke with Jim Williams, a frequent contributor to R•E•P's Hands-On reviews, and the owner of Audio Upgrades, a company that specializes in component-level upgrades and performance analysis.

GOING DISCRETE

According to Williams, components have changed enormously in the last several years. In particular, analog integrated circuits have improved greatly. Three years ago, the best op-amps you could buy were discrete packages that were large, expensive and consumed lots of power. Designs like the Jensen/Hardy 990 discrete op-amp are nothing more than good integrated chip designs made with separate components.

The main advantage of going discrete is the designer can select each transistor for its part in the circuit to optimize performance. Although discrete devices generally have more head room, it doesn't necessarily translate to lower noise performance. The processing has become so refined at chip manufacturing plants that integrated circuits are now able to go beyond discrete capabilities. By optimizing input transistors on the die, integrated circuits are capable of lower noise than discrete devices. Good parts aren't cheap, however — you can easily pay several times more for a replacement part.

Most U.S. electronics manufacturers stopped designing discrete devices in the late 1970s, but the Japanese never did. As a result, Japan makes some of the best transistors in the world for audio applications.

GOLDEN CIRCUITS

Williams feels the reason there is such a big market for audio upgrades is because most designers are of the "group-think" school. "Audio design engineers are like recording artists; one guy gets a hit and they all jump on the bandwagon with similar sounding stuff." Most designers use the same chips: the 5534 is the chip you will find in consoles from Neve, SSL and many others. The reason chips like the TL-072 are so popular is that they're cheap and easy to work with — the downside is that they're fairly noisy.

"There are great parts out there the manufacturers don't seem to know about," Williams says. "For example, NEC makes a chip that replaces a TL-072 (called the 4570) which is just as quiet as the 5532, but is more stable, easier to install and doesn't need as much power. It costs about 22 cents from Japan. With inexpensive substitutions like this, it makes me wonder why people even use bi-fet op-amps anymore."

A THREE-POINT PLAN

Williams has a few suggestions for console engineers: "I would first ask them to get rid of their noisy FET amps. Next, I would have them eliminate all of the electrolytic coupling caps they could. Finally, I would insist that the high-frequency bandwidth of the console was at least equivalent to the slew rate of their op-amps."

Not every chip needs to be replaced. Normally Williams only replaces chips in critical areas like the mic pre-amp and high-frequency EQ circuits with lower noise versions. Next, he replaces electrolytic capacitors with high-grade types designed for use in switching power supplies. High-grade caps work well at high frequencies and pass audio better than standard electrolytic types.

Williams says, "A capacitor is like a window. A very clean window allows you to see clearly, but if you put up a couple of panes of dirty glass, all of the sudden it's hard to make out the details any more. A high quality capacitor is like having a single pane of very clear glass."

The problem with removing capacitors entirely is that the low-end frequency response can go below one cycle. If you didn't put in a servo amp, it could pass dc to your speakers. A servo amp rolls off everything below one cycle, so it won't damage your studio monitors.

THE INVISIBLE FILTER CIRCUIT

The reason Williams replaces capacitors with much larger values is because each cap acts as one pole of a multiple-pole high-pass filter (with a 6dB per octave roll-off). Although one or two filter stages is not so bad, a normal console has the equivalent of 40 or 50 of these roll-offs. If you roll-off at 20 cycles and run a phase sweep, you'll see phase problems start at about 200Hz and get worse at lower frequencies. The low and mid frequencies don't arrive at the same time, which causes a mushy bottom-end. Devices from companies like BBE were created to solve this problem, by slowing down the phase of the high frequencies, so the lows can catch up.

RISK MANAGEMENT

Designers need to seriously consider what effect their mods will have on the power supply. If they replace a lot of bi-fet op-amps with 5534s, they need to be especially careful, because the latter draw about twice as much current. If a power supply doesn't have enough juice, it could shut down. Fortunately, manufacturers generally design console power supplies for the maximum frame size, plus some, so there's an ample amount of headroom. Supplies for inexpensive consoles often have less headroom and tend to run hotter, so they need special attention. Designers need to make sure the power supply can handle the extra drain that additional circuitry can add.

WARRANTY WORRIES

I asked Williams what manufacturers think about his work; he says, "Most manufacturers look at upgrades with a morbid curiosity. They're curious to see if someone can make their product better, but they also tend to be extremely possessive of their designs. If you call the manufacturer first and tell them what you plan to do, they will be more inclined to let you do it without voiding the warranty."

A certain amount of modifications need to be done to mixing consoles anyway, like switching pre/post jumpers. Obviously, if a problem is the result of a modification, they are going to charge you for the repair, whether the equipment is under warranty or not. Many upgrades occur out of warranty anyway, so it's not an issue for most users.

SIGNAL PROCESSING GEAR

Williams believes there are two main problems with most signal processing gear: bandwidth limitations and phase shift.

"My biggest complaint is not the use of crummy chips and capacitors," he says. "My gripe is that people think there's nothing beyond 20kHz. Most people roll things

Rick Schwartz is a contributing editor to R•E•P and director of post-production at Music Animals, Los Angeles.

off before they have to. If you roll off at 20kHz, your phase shift starts at 2,000 cycles and gets worse until you have more than 90° phase shift at 20kHz. We try to maintain a 2Hz-200kHz bandwidth in everything we build. There are exceptions, however, like digital reverbs because of their clocking noise. If you roll off too low, you start hearing phase shift, because the highs don't hit your ears at the same time the midrange does."

Some of the new chips from companies like Analog Devices can pass signals up to 100MHz. With such extreme bandwidths, I couldn't help but wonder about RF interference.

Williams says, "Everyone asks me about RF problems. Most consoles are well screened and shielded with good RF protection on both the inputs and outputs, in the form of ferrite beads or filters. RF is normally more of a shielding problem. High bandwidths will allow it to happen, but aren't the cause of it."

THE MONITOR SECTION

Williams finds the monitoring section to be the weakest part of the entire console.

"It's ironic that you have the worst op-amps at the most important part of the console," he says. "Mixers end up making bad judgments because they can't hear what's really there. Because the stereo mix outputs are often cleaner than the control room feeds, the engineer ends up putting more highs on tape than they're hearing in the control room. Sometimes they won't even realize it until they play back the tape somewhere else. The entire mastering path needs to be extremely clean and transparent."

MICROPHONE UPGRADES

I was surprised to hear about some of the modifications that can be done to solid-state microphones. For example, you can replace the FETs in AKG mics with lower-noise Hitachi or Toshiba types. Manufacturers normally use tantalum capacitors, because they're very small and don't dry out. Unfortunately, they tend to absorb a lot of signal. High-speed, low-impedance electrolytics would be a better choice for some applications.

DIGITAL REVERBS

One of Audio Upgrades' most popular mods involves the Alesis Midiverb III. They start by changing most of the op-amps to a lower-noise type. Next, input filters, output filters and the sample and hold amp are changed. Finally, the output multiplexer chip is replaced with a high-speed CMOS-type. They will even put in a Burr-Brown converter for those willing to spend an extra $25. The result: noise performance improves more than 10dB, distortion goes way down and you end up with a unit so smooth and quiet it competes with devices costing many times its price. ■

THE PETER AND MARY STORY

By Ora Nichols-Noll

Why a West Coast new age composer left the big city to develop a successful commercial soundtrack business in a mansion by the lake, in the name of family life.

If Milwaukeeans touted a "gold coast," they'd point to Lake Drive, which begins on the East Side and winds its way along Lake Michigan to the city's northern-most suburbs. Hardly glitzy, Lake Drive is characterized by the studied elegance of massive old mansions — built by Milwaukee brewing, manufacturing and banking money — set beside newer, but nonetheless pricey, homes.

Staid, tranquil and conservative, this is hardly the expected neighborhood — or city, for that matter — for the business headquarters of a leading-edge commercial sound studio and new age composer. Yet Peter Buffett and his wife Mary chose this environment when they decided to move their facility, Independent Sound, from San Francisco.

The genesis of Independent Sound is fairly well-known in the commercial industry. Peter, somewhat tongue in cheek, describes it as a "mom-and-pop operation." With just two principals and operations located above the family living quarters, it may qualify, but certainly isn't typical, of that business genre.

The mom and pop are composer/recording artist and business/marketing manager, respectively. The business is sound: scoring music for TV commercials and film, new age composition, albums and live performance. The family living quarters occupy a 70-year-old, 3-story greystone mansion built for the family of brewery magnate Herman Uihlein.

Independent Sound dates back to Buffett's decision — influenced by a meeting with Windham Hill founder Will Ackerman — to drop out of Stanford University, where he was working toward an unknown major and make music his living. He moved to San Francisco, rented a studio and equipment and began composing. Mary, who had worked for Columbia and Playboy records and was a performer in her own right, was representing several artists when the two met in 1981. They began working on a recording and were married within four months.

Life in the Midwest: the Buffetts relocated from San Francisco to this three-story mansion overlooking Lake Michigan, built 70 years ago by a brewery magnate.

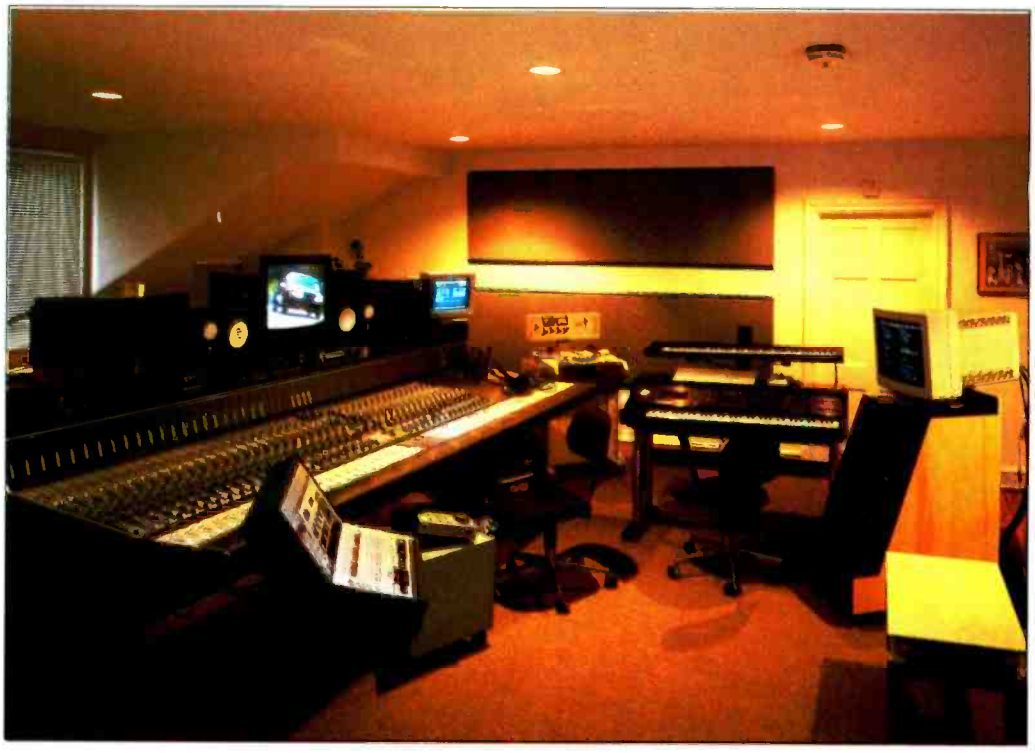
Studio rental and recordings sustained the partnership until word of their unusual sound circulated and advertisers began to take notice. Their first commercial for the Milk Board launched that end of the business. By the time Independent Sound relocated to Milwaukee, annual billings had risen to about $600,000. They were scoring and producing TV commercial music for household names like Apple Computer and working with major ad agencies. Peter had two successful recordings out under the Narada/MCA Mystique label.

The Buffetts had successfully divided their lifestyle and days

into two compartments: business and family. Living in an old San Francisco Victorian mansion, they left the upstairs residence each morning to "go to work" in a basement studio. Business wasn't allowed to infringe on family life; the studio phone had no extension in the living quarters.

However, all that wasn't enough. Discontent hinged on quality of life, summed up by Buffett as wanting "an environment that offered the same freedom we both knew as children, being able to walk outside and look at green grass and trees."

In the course of business travel over about four years, the pair explored locations that would provide the right environment and the accessibility that would enable them to continue to grow their business.



Independent Sound occupies the third floor of Peter and Mary Buffett's Milwaukee residence.

Milwaukee, which they knew well through the Narada affiliation — seemed to provide answers to environmental and business concerns. The Uihlein house tipped the scales. It was a high-risk decision.

"We lost a lot of sleep over it," Buffett says. "My dream was to move here and not have a mortgage payment but instead we set up a challenge that has made us work a lot harder than we might necessarily have had to."

The investment was considerable: a $1,125,000 price tag and about $50,000 for conversion of space into the studio, computer room and offices, along with air conditioning and rewiring. One offset was the fact that the residence floors were completely habitable without remodeling or redecorating.

The family lives on the first and second floors; Independent Sound occupies the third. An area at the top of the stairs is devoted to the studio. Although the room overlooks Lake Michigan, the exterior environment doesn't intrude. Clearly, this is a working studio, with plenty of room for both people and electronic gear (see sidebar).

Philosophical differences and the desire for a lifestyle that conveniently integrated work and residence under one roof were factors in changing the Buffett's relationship with Narada. Shortly after the move to Milwaukee, they resigned as officers of the recording company. Peter, however, continues as an artist on the Narada label; his third album was released this past spring.

Living on Lake Michigan has had a dramatic impact on marketing strategies.

"In San Francisco," Buffett says, "we'd tend to let the jobs come in. Mary would make some phone calls and about every three or four months we would call on agencies. It takes much more work from here and Mary is on the road a lot more. Now we look at our business nationally and internationally and are stretching our boundaries to the coasts and beyond. It's given us wider exposure because we personally call on agencies in markets like New York, Los Angeles or Atlanta. So it's a much more direct approach.

"You learn to get the agency involved early on, and you can't be attached to anything you do."

"The first months here were slow but after we were really able to start working on marketing, January and February 1990 were better than we averaged previously We had a couple of down months last summer, but at year-end were doing double what we did in San Francisco."

Servicing a more geographically diverse

Ora Nichols-Noll is a free-lance writer based in Milwaukee.

EQUIPMENT: INDEPENDENT SOUND

- Console: Otari/Sound Workshop 54, 46-input frame with 40 modules; Disk Mix automation.
- Audio/video recorders: Otari MTR-100 24-track with Dolby SR; Otari MTR-12C 2-track with Dolby SR; JVC CR-6650U 3/4-inch VCR; Panasonic SV-255 DAT; Tascam 122-B cassette deck; Sony TCD-5M cassette deck.
- Digital audio workstation: NED 9600 Synclavier, with 40Mbytes RAM, 80 voices.
- Monitors: Meyer HD-1s; Auratone 5Cs; Yamaha NS-10Ms.
- Amplifiers: AB Systems 205; BGW 750C.
- Processors: Lexicon PCM 70; Roland R-880; Peavey Adverb; Eventide H3000; Eventide 949; Drawmer DS-201 dual gate; Drawmer DL-221 dual comp/limiter.
- Synthesizers/keyboards: Kurzweil 1000PX; Kurzweil 1000GX; Roland D50; Roland D110; Roland MKS-80; Roland MKS-20; Yamaha TX-7.
- Miscellaneous: Technics SLP-500 CD Player; Sony PVM-1910 video monitor.

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market and higher volume is largely technology dependent. In creating a soundtrack, Buffett gets two copies of the 3/4-inch videotape and location audio, working to one and sending the other back to the client for comments. Generally, after a phone conference, he does a fix and ships the revision out.

Clients may fly to Milwaukee for a final in-studio edit, though that happens less than a third of the time. Rarely are clients in the studio at the inception of the creative process; rather, he works up a "draft" for the first conference. That was the case with the recent Infiniti spots.

"I did a demo and they loved it and cut the picture to it but they said, 'Let's make something up,'" Buffett says. "They wanted something beyond what I'd done. When that happens, you come up with it."

By and large, Milwaukee has access to the same delivery technology and capabilities found in any other market, such as overnight couriers, fax machines, computers and modems.

"You can draw a half-circle around Milwaukee and see that we can reach the same people we were working with before and are actually a lot closer to the East Coast," Buffett says. "Also we're an easy 20 minutes from the airport and direct flights to major U.S. cities, which makes it easier for us and for our clients," Buffett says. If a particular sound or style of music is needed, he will have the artist fly in.

Like any other business, Independent Sound focuses on customer satisfaction. According to Buffett, there's no room for temperament, and flexibility is important.

"You learn to get the agency involved early on, and you can't be attached to anything you do," he says. "The first rule in writing music — except for your own albums — is that you absolutely have to give it up if someone else doesn't like it. You try to put everything into it every time but it doesn't always work. The key is finding out what the client doesn't like. You may cut or change only one element or you may start over. But above all, you need to keep a broad perspective.

"Commercials are intellectually demanding, because you have to condense all the information into its simplest form like a haiku. But you have exactly so many seconds to portray exactly what the client wants. And it's great making it work.

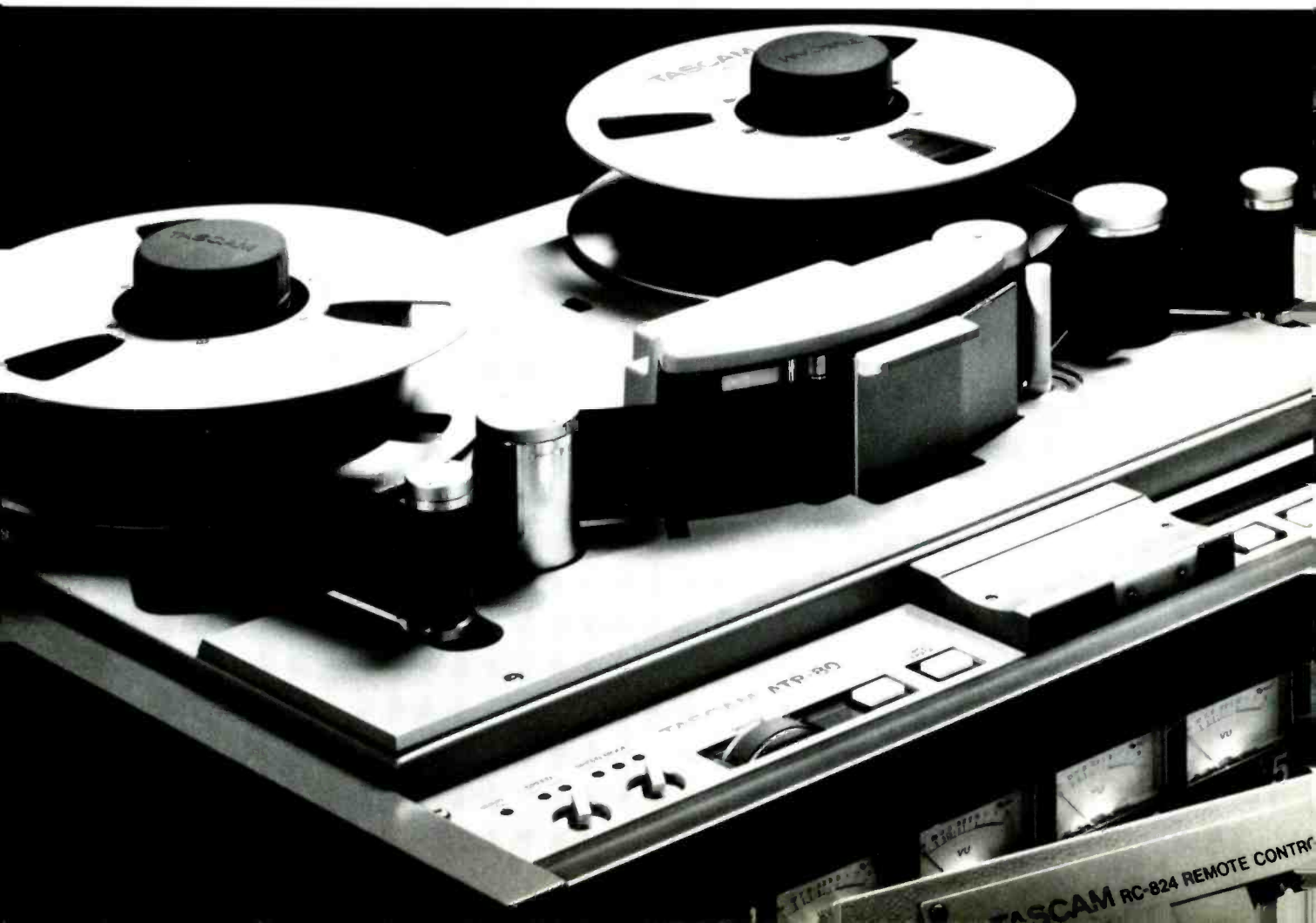
"In a market that's very technology-conscious, you have to be willing to give clients the sound they want. Ever since I started, everything I've done was created electronically, beginning with synthesizers because that's all there was then. I've done more and more with acoustic instruments because I think we're experiencing a backlash against synthetic sound and people want acoustic elements brought back in. Now I use sampled sound, which gives me the ability to play real instruments off the keyboard and work with a palette of sound that goes anywhere from jackhammers to violins."

In addition to Mary's past recordings and the Narada albums, Peter's recent credits include the score for a scene in "Dances With Wolves," a live performance at its premiere and an appearance in the Milwaukee Symphony's summer pops series.

Buffett has a unique marketing approach to film work.

"When movie or TV films are being cut, they need some kind of early music interaction. There are always stacks of tapes or CDs around in any music house or post-production studio. My CD becomes a business card. It was made with the intent to end up in somebody's film. When they're watching the film and hearing this temp music, that becomes what they want."

Scoring a complete film is one of Buffett's objectives and he sees his work on the Kevin Costner film as an entry to that market. Another performance with



members of the Milwaukee Symphony Orchestra is also a goal.

When asked if moving Independent Sound signals an industry direction toward a cottage industry, Buffett is ambivalent. Twenty years ago, he admits, he couldn't have done what he's doing now. The technology simply wasn't there. Advanced hardware is expensive but it invariably moderates in price. The result is that more people are writing music.

"My banker's a musician," Buffett says. "So is my attorney. Regardless of how good they are, there's a whole new wave of amateurs and professionals who can fulfill their musical dreams at home. It means that you end up with a huge strata; a new level of people who can get things done for a lot less. Ten years ago there were perhaps 10 music houses in Chicago compared with about 90 today. The question of the future of our industry is a pretty big one. Part of me wants to say that once it all shakes out, it probably won't change that much. In fact, the good music will still be heard and good people will still be doing it — you'll have more varieties of style and ways to get the job done.

"I have some ideas about how things may happen technologically. With satellite uplinks and the capability to send video and audio by phone lines, more people will be working at home or in their offices instead of at a post-production facility. We're trying here to set up a network of studios, probably locally first, where one Synclavier can talk to another and you can actually work together from different locations. Or I can be playing and watching a picture here and someone in New York can be on-line with audio and visuals and making comments."

The bottom line will rest on the ability of the artist to identify the really productive technology and then to have the financial stability to make these investments. Buffett speculates that technologically and artistically advanced home facilities will force their larger competitors to second-guess spending and direction.

"The biggest studios will always have a unique place because you can only get certain projects done there," he says. "I believe that we could see the emergence of an electronic cottage industry and that it will basically change the scope of the business. It will help a lot of people but put others out of work — the stuff doesn't break down very often and you don't need the same level of support staff. But marketing will become much tougher. How do you differentiate yourself from the increasing number of competitors?

"If music is cheaper, it's not necessarily better. There will be some good people doing it for less. The trend toward narrowcasting, directing programs and commercials to specific genres, which is what cable is doing, will provide a demand push. With more product choices, audience segmentation will grow and affect our business. There could be four different commercials made for the same product or four different sets of background music for the same commercial, narrow-casting to different tastes and needs."

If the industry has been affected by a reportedly tight advertising market, Independent Sound seemingly hasn't lost any options to choose work. Besides the Infiniti campaign, the firm has recently finished spots for GTE, du Pont and Miller Brewing. The Buffetts have turned down work where the product and marketing direction went against the grain, but Buffett is pragmatic.

"It's not a perfect world. I have a mortgage payment and have to decide what aspects of a spot I can live with and what I can't. Luckily agencies know our mindset and, because the people we work with the most often end up being friends, they bring us work that we collectively enjoy." ■

r industry's best-known trademarks are the result of this audio giant.

ED LONG: BREAKTHROUGHS & DEVELOPMENTS

By Mary C. Gruszka

Edward M. Long is probably best known to the audio and recording industry as the inventor of Time Align monitors, Nearfield Monitoring, Pressure Recording Process microphones and ELF extended low frequency bass systems.

What may not be known is that these developments came from his enormous research and development work on loudspeaker drivers and microphones, and his insatiable curiosity to find out how things work and to have fun doing it at the same time. When he can't find the answers from books or other "experts," he figures things out for himself, often in collaboration with friends. A holder of numerous patents and trademarks, he takes a fresh look at problems and comes up with unique solutions.

"Ed Long is a true pioneer in the industry with developments in many different fields. He has pushed the industry forward and is always striving for excellence and quality," says studio designer Chips Davis.

Photo by Alison Long

Working in his basement lab in his Oakland, CA, home overlooking a canyon (where he occasionally holds intensive loudspeaker design workshops), Long writes; reviews turntables, cartridges and styli, and headphones for *Audio* magazine; consults; teaches and is a great story teller.

Mary C. Gruszka is the owner of MCG Audio Consulting, a New York-area company specializing in TEF analysis, systems design and acoustical consulting.

WHERE IT ALL STARTED

Hailing from Rochester, NY, Long had been interested in math and science back in high school.

"I bought the freshman chemistry book that was used at the University of Rochester," he says. "It went into more detailed explanations. I need to know more about stuff."

He attended St. John Fisher College and worked as a lab assistant in the research lab at the Eastman Kodak Company, in Rochester. His work at the lab turned out to have a round-about influence in getting him involved in audio.

First, although the lab was doing some interesting research, after about six or eight months on the job, Long decided that he didn't want to be a chemist. "That was more like being a glorified cook," he says.

But what to do? Fortunately (for the audio industry), he was introduced to "high fidelity sound" by one of the researchers

who was working with him.

"I remember hearing a recording of Les Paul through an Altec 604 system, driven by a home-built amplifier and fed by a Pickering magnetic cartridge mounted in a Garrard record changer," he recalls. "I wanted to obtain a record player that was, what I considered, to be 'above average.'" he continued. "In an Allied Radio catalog, I found a General Industries turntable that had not only a tonearm and cartridge, but a separate arm with a cutting head to make records."

He ordered the turntable with a crystal cutting head, because his brother knew where he could find a used amplifier with a high impedance output. "We bought some Wilcox-Gay recording blanks and made many records." Ed's brother, who made a beautiful case for the system, still has it today. That turned out to be the beginning of a life-long interest in audio.

"I continued to develop a love for audio and soon had my first home-built tape recorder, which used a Tapemaster transport," he says. "Later, I bought a 16-inch Presto cutting turntable to which I fitted a Rek-O-Kut overhead lathe. I rebuilt a Presto 1C cutter head and drove it with an all triode, Class A power amplifier, which I designed and built. This led me into the commercial record business and I made many records for clients such as Rochester area schools and organizations, and even for the museum exhibits."

Long says that he taught himself what he needed to know about amplifier, tape recorder and cutter head design. "I learned by reading and experimenting. I would look at a schematic and draw in the waveform that I expected would be at a certain point, and then verify it. It was like a game. This wasn't just work; I realized I could be having fun with this stuff."

His education was enhanced while he was in the Army during the Korean War. He attended Microwave School at Ft. Monmouth, NJ, where he eventually was assigned as an instructor, teaching microwave and FM theory, and pulse coded modulation systems.

After the Army, he began his career in engineering at the Eastman Kodak Naval Ordinance Division, working on projects such as the test systems for the sidewinder missile components. He later helped develop for other companies such diverse products as an ultrasonic beverage foamer, a dimmer control system for fluorescent lights, an SCR tester and a high intensity sound system for aircraft component testing.

PROFESSIONAL AUDIO

Long's professional audio career began when he joined the Stromberg Carlson Co., which was forming an amplifier design group and were hiring engineers to join it. When he applied for the job, one of the questions on the application form was, "Why do you want to work for Stromberg Carlson?" Long's reply: "It is obvious from your products that you need help."

"I thought I'd never get the job," he says. "But the person who hired me said that I was exactly the kind of guy that they wanted."

The CRM-100 monitoring system at Paradise Sound, Index, WA.

"I was fascinated by the idea that we could expect to reproduce the sound of a symphony orchestra by a device that used a piece of paper, a coil of wire, some steel and a magnet."

When Long joined the company, the amplifier group wasn't quite ready to begin work, so he spent his first few months working with a special group that was devoted to research in acoustics and psychoacoustics.

"We had an anechoic test chamber and a large assortment of Bruel & Kjaer and other measuring equipment, including a phase meter." (Yes, he was measuring phase as early as the 1960s!)

"I consider this experience to be invaluable in my work in loudspeaker design," Long says. "As an example, we measured loudspeakers the usual way, like everyone else, using decibel and frequency scales. When we tried to correlate the objective measurements with information we collected from subjective listening tests, we had difficulty seeing why people selected certain loudspeakers over others. When we converted the amplitude vs. frequency response data to loudness and pitch scales, these choices became very clear. The lights went on, so to speak."

He became hooked on loudspeaker design. "In many of the projects," Long says, "I noticed that most of the other engineers had little interest in the loudspeaker part. I was fascinated by the idea that we could expect to reproduce the sound of a symphony orchestra by a device that used a piece of paper, a coil of wire, some steel and a magnet. It is rather incredible when you think of it like that. As I learned more and more about loudspeakers, slowly but

surely, I became known as 'the loudspeaker expert,' and my colleagues would turn to me for information."

Long always insisted on listening to anything he (or his colleagues) designed. He related the story of a colleague who had just finished an exhaustive series of polar measurements on a driver, and once finished, realized that the curves looked terrible.

"I asked him, 'Did you listen to it? What does it sound like?'. He could have saved himself the time of making all those measurements had he listened to the tweeter. It was obvious that there was something wrong."

ON TO CTS

Later in his career, Long went to CTS of Paducah, KY, which was the country's largest OEM loudspeaker driver manufacturer during the 1960s.

At CTS, Long learned to tailor designs for diverse applications such as commercial aircraft, communications, radio and television receivers, portable phonographs and tape recorders, and high fidelity systems. He designed drivers for such companies as Zenith, Motorola, Sylvania, Scott, Fisher, Harmon-Kardon and Ampex.

While at CTS, he worked with Bob Gault, who later founded Eminence Speaker Corporation, and Jim Novak, who developed the worksheet form for doing loudspeaker design that Long used.

"I used his format to write some computer programs to calculate volumes and resonant frequencies," he says.

Long now had the opportunity to actually develop and build some of the drivers that he had been thinking about even before he joined CTS.

"I made them, tested them, adjusted the formula, and tried again," he said. "I made some of the actual cones myself. I took the material and put it in the beaters to make the slurry, adjusted the pH, etc. to make special stuff. I had fun with it."

In the process, he kept volumes of notebooks on his experiments and developed charts that are available nowhere else. After his stint at CTS, Long joined Ampex, a company that he long admired, in the the consumer audio division in Chicago. Other jobs brought him to California, where he eventually established his own businesses, E.M. Long Associates and Calibration Standard Instruments, which he still operates.

MIXDOWN MONITORS

One of the first products to come out under his own company's banner was the Nearfield Monitor.

"Because I was interested in knowing more about the program material that my loudspeaker designs were intended to reproduce, I made many recordings so I could better understand the relationship between recording and reproduction," Long says. "This led me to design a monitor which I could use when I made recordings.

"Because the acoustics of the spaces where I set up my recorder were usually so bad, I designed my monitors so that I could sit close to them. I discussed recording techniques with professional recording engineers and, in trading information, they became aware of my monitors. I began making the MDM-4 monitors for them.

"The designation MDM-4 stands for Mix Down Monitor 4-channel because the early users were engaged in 4-channel recording, as was I. I came up with the trademarks Nearfield Monitor and Nearfield Monitoring; a written description for the requirements had to be met. Just placing a loudspeaker close-in isn't enough to meet the requirements." (Interestingly, Long is once again involved with 4-channel reproduction, but this time it's for surround-sound.)

TIME ALIGN MONITORS

Following the development of the Nearfield Monitor came another significant design, the Time Align loudspeaker system. Papers by Dick Heyser in the AES Journal caused him to think about the time offsets in multi-way loudspeaker systems. He became interested in Time Delay Spectometry (TDS), which provided a way to delay the spectrum analyzer to compensate for the microphone-to-loudspeaker distance. In his design work, Long noted that crossovers didn't work the way he would have predicted.

"I knew something wasn't quite right," he says. It turned out that "you need to know what the filter does in the time domain. Although TDS operates in the frequency domain, I wanted to see things in the time domain; this resulted in the Time Align generator and display, which I used to design loudspeaker systems.

"I came up with the concept of the Time Align generator and Ron Wickersham breadboarded it. It uses bucket brigade delays and an outside clock oscillator, and

ED SPEAKS UP

Using your ears: "It is important to listen to what you are testing. While at CTS, I once showed a client a driver with a flat frequency response that sounded terrible. It turned out that the voice-coil was rubbing. So a flat frequency response isn't everything. A measuring mic has no taste whatsoever, it just measures the sound pressure.

"But at the same time, you can get fooled on listening tests too. Change the placement of drivers in the room, or change your position in the room. You can hear that."

Loudspeaker measurements: "A problem with measurements is that you can measure a circular loudspeaker four times, rotating it 90°, and get different curves each time. A "round" speaker is not necessarily symmetrical."

Creating a matched set of loudspeakers: "Each loudspeaker is different. To get two loudspeakers close together, run curves on the drivers and then hand-select them. Then you can guarantee that they will be the same for awhile."

The importance of phase overlap (at the crossover region): "The overlap can't be trivial. It is not just a matter of making the crossover frequency flat. You need to do it over a range, especially if you are using mass-produced drivers with a tolerance for the phase shift. With mass-produced products, you should get phase overlays reasonably good for over an octave. For most loudspeaker designs, the two phase curves from the woofer and tweeter don't come together."

Differences between monitors and consumer loudspeakers: "There has to be a difference between loudspeakers intended to be used as monitors and consumer loudspeakers that are used for listening. The monitor must allow excellent program material to sound excellent and bad program material to sound bad. A consumer loudspeaker, to be successful, must make excellent program material sound good and bad program material sound acceptable. A recording engineer needs to hear the bad sound so he can fix it; a listener can't do anything about the program material, so the loudspeaker should ameliorate the bad sound and make it acceptable.

"The majority of consumers just want 'nice sound' and the successful companies are the ones who realize the deficiencies of many recordings and take this into account in their loudspeaker designs. This is not just idle speculation on my part. It has been demonstrated by monitors and consumer loudspeakers designed by me and others as well." ■

I still use it to this day. I've used this system to design a number of consumer and professional loudspeaker systems, including the Sonex Two, the UREI 813, and the CSI MDM-TA2 and MDM-TA3."

At the time Long was doing his first Time Align designs (in the early 1970s), a self-contained, single unit TDS or TEF analyzer was not yet available. Now he also uses the Techron TEF analyzer to verify his designs. "I use it especially to show the phase overlap of two drivers," he says.

His first Time Align product was a consumer loudspeaker system, developed about 1975. This resulted in interest from UREI, and a reacquaintance with the Altec 604 coaxial driver.

Bill Putnam, of UREI, Coast Recorders, United Recorders and Quad Eight Studios fame, sent Long an old gray cabinet outfitted with an Altec 604E.

"I built a Time Align network for it, and we listened to it and it did sound more realistic," Long says. After the successful demo, he and UREI started on the project.

"We started with 604Es and ended up with 604Gs. But I have a crossover design for the 604Es, if anyone is interested." Long also designed the 15-inch bass driver for the original 813s, but after JBL bought UREI, the most recent version makes use of a JBL woofer. The first UREI 813 came out about 1976.

After the UREI project, Long developed a time-aligned monitor system under his own company.

"The audio world is a better place, thanks to Ed's creative achievements."

"The MDM-TA3 came about because people were asking me why I didn't have a time-aligned monitor of my own," he says. "The MDM-4 was in fact less than 100 microseconds off, which is good, but I didn't feel that I could call it a Time Align Monitor. So I developed the MDM-TA3, a smaller and less expensive loudspeaker that could be soffit-mounted. This came out in 1979."

Long had also built a smaller Time Align monitor system for himself that was housed, along with a power amplifier, in a portable case that folded up. His inspiration hearkened back to a set of Ampex portable speakers that went with the 600 recorder. He used his prototype during his experiments "to check out mics and other things."

"The MDM-TA2 evolved from the portable speaker project and was finally brought out in 1982, when I had it right."

The MDM-TA2 has some features that are quite unique. First, it has a metal cover that adheres to the front face of the enclosure.

"Because the loudspeaker produces vibration energy other than acoustical, this helps to subdue transmission of that energy out of the box," Long says. The MDM-TA2 also has a 3/4-inch dome tweeter that provides smooth frequency response off-axis.

Two of the other interesting features are the absolute acoustical polarity switch, and the "program/position" switch, which adjusts the high-end equalization to compensate for both listening position (Nearfield Monitoring or distant) and program source (original or final).

The latter switch was incorporated in the design of the MDM-TA2s after Long observed how mixers used the MDM-4s.

"They sat in one position when recording and another when listening to the final product," he says. The switch simulates the response at these two different listening positions.

THE PRESSURE RECORDING PROCESS

Long, along with Ron Wickersham, developed the Pressure Recording Process and the PRP microphone out of a need to make recordings that sounded like the original performance.

"Normal recording techniques just didn't capture what I could hear when I made the recordings," he says. "I realized that when the ratio of direct and reverberant sound seemed right, the sound was always duller than what I heard live. When Ron Wickersham and I were asked by Tam Henderson to make the first album for Reference Recordings, we began to discuss how microphones respond to direct and random incidence sound."

Long then proceeded to investigate microphones. What he found was that "the random incidence response of most microphones is rolled off compared to the response for direct sound. We realized that if we could cause a microphone to have the same spectral response for the direct and random incidence sound, we could adjust its position to achieve a desirable ratio of direct and reverberant sound without paying the penalty of dull sound."

He collaborated with Wickersham, his long-time friend, on this project. They figured they needed a pressure capsule and realized that just placing a mic down on the floor wasn't good enough. The result was the Pressure Recording Process (PRP), for which they were granted a patent.

Long auditioned some of his recordings that he made with his experimental mics at a Syn-Aud-Con class, hosted by Don and Carolyn Davis. After that, Ken Wahrenbrock made up PZM mics using electret capsules; eventually, Crown was licensed to produce them.

"Ron and I made four albums for Reference Recordings and another album for the Ambience label," Long says. "We did the recordings to see what could be accomplished, and to see why things didn't work the way we thought they should."

ELF

"Ron and I also collaborated on another interesting problem which resulted in a patent," Long says. "I had designed many subwoofer loudspeaker systems but I was never satisfied with the results. Together we came up with the Extended Low Frequency technology, which produces the most realistic bass I have ever heard.

"Because the ELF technology doesn't rely on wavelength-dependent, assisted-resonance ideas, it can be scaled for use in automobiles, personal stereos, TVs, keyboard instruments and even games. It's the most versatile way to produce bass that I know."

ELF allows the installation of a large diameter bass driver in a smaller cabinet than would normally be possible with conventional design. Paraphrasing Long's description of the ELF circuitry, it allows a bass driver to be driven with a signal which is exactly complementary to its response above and below resonance. It produces a rolled-off response above resonance, and a response which is flat down to the lowest frequency limit that is chosen in the design.

CRM-100 MONITORS

Once Long had the ELF technology to give him the realistic bass that he was looking for, he had all of the pieces that he needed to make his premier monitor loudspeaker system, the CRM-100.

The 8-inch driver that is used had already been designed when he was work-

Photo by Alison Long

CRM-100 CUSTOM MONITOR SYSTEM

The CRM-100 custom monitoring system was designed by Ed Long for high level control room monitoring applications. It incorporates Long's Time Align and ELF technologies.

The basic system consists of two CRM-1TA Time Align mid/high range modules, two CRM-B18 ELF bass modules, the HLE2 ELF Electronics, three power amplifiers and interconnect cables. Another version designated as the CRM-100/SS is available for surround sound monitoring. Each system is calibrated to produce a flat acoustical output from 30Hz to 20kHz.

The CRM-1TA consists of a TD3/5 high frequency driver, two MD20/182 midrange drivers, and a passive time delay crossover network with protection circuitry that monitors the RMS heating current. It has a separate fuse for each driver and these are mounted on a front plate with an overload protector. The black laminate-finished, internally braced MDF enclosure measures $19'' \times 20'' \times 9\frac{3}{4}''$.

The CRM-B18 bass system uses an 18-inch driver in a $20'' \times 20'' \times 11\frac{3}{4}''$ black laminate MDF enclosure, with an internal volume of only two cubic feet. It is designed to work with the HLE2 ELF Electronics, which incorporate the patented Extended Low Frequency technology. Additional CRM-B18 modules can be added to the system.

These monitors have been installed at Paradise Sound Recording, Index, WA (Chips Davis, designer); Limelite Video, Miami; ABC Post-Production Audio Sweetening 1, New York, and a personal studio for musician Steve Miller (all three designed by Russ Berger, Russ Berger Design Group). ■

ing at CTS.

"For more than 1½ years, I worked on the 8-inch driver and tried to get perfection. I wasn't satisified at first with what I could do, so I worked to make it come off better. With the 8-inch driver, the sound is real and you can listen to it for long periods."

The high end section of the monitor system was yet another design that Long had already worked out years ago. His goal was to produce high frequencies at a high SPL, and with good off-axis response. The solution: a large diaphragm and a small orifice.

Long was so pleased with this system that he installed handpainted, hand-brushed aluminum nameplates with his initials, EML, on all of the system components.

Because Long looked up to the Ampex logo, as it symbolized to him a high level of quality, he honored that concept and paid tribute to Ampex's contributions to the audio industry with his own logo. The ELM logo uses the same lettering as Ampex's. These monitors have found homes in recording studios, broadcast facilities, and post-production rooms. (See the sidebar, "CRM-100 Custom Monitoring System.")

Russ Berger, of the Russ Berger Design Group, and a noted studio designer, says, "There is no 'perfect' monitor system, only appropriate ones. Long's MDM, TA and CRM series monitors not only cover a wide range of accurate audio monitoring needs, but are also some of the most pleasant-sounding monitor loudspeakers I have experienced."

Chips Davis, now with Frank Hubach Associates, concurs: "The CRM monitors have a clear low end, a smooth mid range, and no high end sizzle that a lot of monitors have."

Summing up his feelings about Ed Long's work, Berger says, "The audio world is a better place, and we've all benefitted both directly and indirectly, thanks to Ed's creative achievements."■

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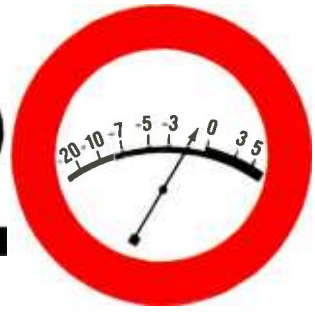
Where's the ZERO?

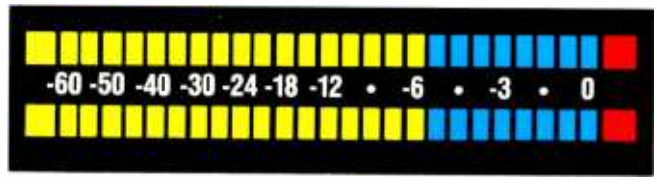


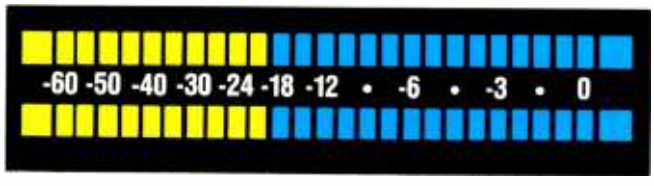
Coming to terms with digital calibration levels, wherever they are hiding...

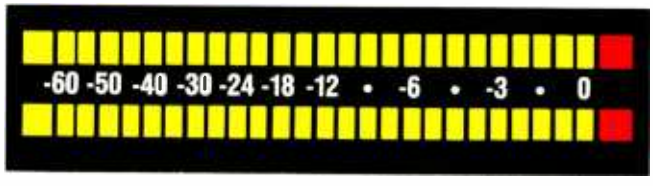
By Bob Bushnell and Rick Schwartz

With recording, as with life, there are certain absolutes. In the analog world, only so much magnetic fluxivity can be forced onto a tape before the signal becomes extremely non-linear. If you cut high levels on a stereo LP disk master so that you have overcuts (when you used to do such a thing), you'll have problems. If an AM radio station overmodulates (the FCC regards that as a major sin), you'll hear massive distortion.

Even transferring audio from magnetic film to an optical soundtrack has its own special problems. Light valve ribbon clash is possible, wherein the peak levels on the audio track cause the light-modulating ribbons to come together, or "clash." This condition creates a form of distortion unlike anything most of us have heard. If you want to squeeze one more decibel of level past clash when doing an optical transfer, it's not possible. These are some of the physical absolutes in magnetic, disk and optical recording.







Where should you set digital calibration levels? This isn't an idle question; a single slipped bit can render your digital recording useless.

Peak audio levels are critical in digital recording because of the brick-wall nature of digital overloads. Although the digital zero on a DAT machine's meter (zero-headroom-left) is a hard ceiling, over-recorded (clipped) tapes are not a rarity in the industry. Where are the nominal audio level standards for digital processing equipment? Should they be 18dB below "digital zero?" Or 20dB?

Why do the digital equipment manufacturers disregard the inherent relationship that exists between nominal recording levels and absolute peak recording levels? Why are these same manufacturers reinventing the recording standards wheel? With present digital equipment, the actual level-indicating device is antiquated and often useless, relative to nothing except internal dynamic range (bit count).

THE STANDARDS

Three feet is equal to one yard. One foot as a linear measurement is a standard. And if we put 5,280 feet together, it's called a mile. These words and distances are universally adopted. Why? Simply because various groups and people have agreed to those names and the distance they reference for commonality, convenience and universal understanding. Not because they have any magical significance in the grand scheme, but using them works.

If you define a foot as being equal to 13 inches, you'll be all right talking to yourself, but you'll have problems when trying to communicate with other people, or having a cabinet built to a certain size.

To avoid confusion, let's provide some definitions. These analog operating levels apply to professional audio, and may not hold true for the broadcast industry. An-

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Where's the ZERO?

alog and digital recording have maximum signal levels. These levels are different in amplitude, and in the nature of their maximum levels.

Using an analog tape machine or processing device, a level of +4dBm in and out of a machine represents the nominal operating or 0VU level. It meters as such. Conversely, in digital processing, "digital zero" is the highest signal amplitude, determined by bit count, that may be processed without distortion. For analog audio signals, VU meters are calibrated so that +4dBm, or 0VU for a sine wave, is equivalent to a power level of 4dB above 1mW in a 600Ω line.

No standard exists for the maximum level (clipping of the audio signal at any point in the chain), but for most professional electronic devices, the level is +24dBm to +28dBm. Therefore, 20dB or 24dB of headroom is typically available between the operating level and the maximum level.

In using digital machines or processing devices, no industry-wide standards exist for the nominal audio operating level. As stated, zero-headroom-left on a digital device corresponds to a digital word of all 1s. For a digital device, this word represents the highest or loudest signal level possible. Because there is no industry-wide standard for the nominal operating level, the desired headroom must be chosen for each separate digital recording.

ANALOG RECORDING IN PERSPECTIVE

To align your favorite 24-track analog recorder, you use your reference tape that has a recorded signal referenced to 185nW per meter. This reference is your nominal audio level standard — an agreed-to setting. The meter settings and operating signal level calibrations have specific meanings in terms of headroom-to-tape saturation, fidelity and distortion.

The hazards of analog tape recording are well-known and understood, and analog metering techniques are accepted by manufacturers, studios and engineers. Equally understood are the hazards of amplifier clipping. In short, analog tape recording isn't perfect, but well under control.

DIGITAL RECORDING

Let's move into the fascinating field of digital signal processing and recording. DASH and PD machines, PCM units and DATs operate under assorted protocols. When looking at any digital processing device that accepts an analog input (as opposed to taking in or converting a digital signal directly), there are three major active elements: the A/D converter, the digital processor itself and the D/A converter.

The A/D converter must manage the expected dynamic range and create the digital word, with the D/A reassembling this back to analog. The digital portion of the system has its own designed-in limits: word length, error correction scheme, bit count and sample rate.

The "all-ones-on" condition, whether it lasts for one clock pulse or half a minute, represents the loudest signal that can be processed. Just like valve clash, just like overcuts on the disc, just like overmodulation on AM, that's the absolute maximum signal level. If you — the engineer using this equipment — stay below that absolute maximum signal level, you're in fine shape. If you remain under the maximum level on the DAT recorder and set levels according to the manual, you'll be OK.

But how *do* you go about setting levels on your DAT machine? Dig out your Panasonic SV-3500 manual and see what is mentioned about digital levels. Surprisingly, instructions differ little from those for a $40 toy tape recorder.

"To set recording levels, adjust the record level control while watching the peak level meter." You try to set the controls so that average audio levels will give the meter a reading around mid scale, and the loudest portions of the recording will not cause a reading higher than 0.

It's difficult to understand why a company that prints detailed specifications, including fast forward and rewind times, would not bother to state its nominal audio level standards. For example, the audio level on tape required to produce an output level of +4dBm on the 3500 is not stated. It's not just Panasonic: if you check with the other manufacturers, they all seem to ignore the subject. So much for the manufacturers' standards.

MEASURING CONSENSUS

Ask pro users concerning what they have to say about digital standard levels. Person No. 1: "I'm not sure, but Nashville uses −15 from clipping." Person No. 2: "The digital standard level is always equal to −18." Person No. 3: "The digital standard level is always equal to −20." Person No. 4: "I always used −10 on the F-1, so that's what I use with DAT." Person No. 5: "I always use −12, or −6."

There *isn't* a strong consensus here. Prosonus, makers of the Studio Reference Disc, say that all its internal levels are referenced to a "zero" calibration level, which is 6dB below the clip level on the front panel meters fitted to the Sony PCM-1630 Digital Audio Processor. That level was chosen to allow for deviations in the headroom between commercially available CD players.

But what do *you* do? Say you've experimented with your various pieces of digital equipment, and the indicating devices on them don't all have the same reference level. You set up normal levels for your system, probably +4dBm from your analog board, and you feed it to a digital device that has a gain control. You're not sure what's happening inside that digital device, level-, dynamic- and headroom-wise. You can see that these devices don't have uniform nominal audio level indication, so you feed the signal to the digital device. At manufacturer's indicated level setting, somewhere between minimum and max gain (supposedly unity gain), they all differ radically in their on-board metering.

For setting a recording level, isn't it simply a matter of pulling out your digital reference level standard tape, the one that's equivalent to an MRL or STL calibration tape, and merely adjusting your recording levels? Or using your digital generator and feeding the digital device a standardized signal? You say there isn't such an alignment tape?

The problem is that the various industry organizations and manufacturers of these digital devices haven't agreed on level standards for digital processing. They haven't provided a uniform calibration or nominal audio level point, "X" dB below the zero-headroom-left ceiling, for most of the systems.

Do they realize that "all-ones-on" is the maximum level? Good, that's a first step. Do they further realize that "all zeros" is the minimum level? That's another step. Do they also realize that this equipment must be used in the real world? That's yet another step. Do they acknowledge that level standards for digital processing would allow various devices to be used together, with a minimum of interface confusion? That you're not sure about.

LEVEL TONES

When was the last time you received an analog master without any tones or reference to operating levels? It's almost unheard of. Why then is there no direction from manufacturers for DAT tape nominal operating levels and calibration points? Why no suggestions for alignment tones and documentation? You've seen people

RECORDING TO DAT FROM AN ANALOG SOURCE

By Rick Schwartz

The following guidelines assume that the output meters for the source's master bus have been properly calibrated to 0VU at +4 = (1.23Vrms).

HEAD TONES

1. All new blank DAT masters should start with at least 20 seconds of 1kHz, 10kHz and 100Hz reference tones. (To avoid indexing the tones, start the tape with the Auto Index feature on, then turn it off before the tones start).
2. Tones should be printed at nominal operating level for the DAT machine that they were recorded on (we suggest −20VU referenced to digital zero, with input from 0VU at +4dBm).
3. After tones have been printed, press the Record Mute button to place five seconds in between tones and the start of program material.

METHOD ONE: SETTING RECORD LEVELS

1. Patch a 1kHz tone into an open input channel on the mixer. Adjust the level of the oscillator so that the analog mix bus meters read 0VU.
2. Put the DAT machine into record standby, by pressing record and pause.
3. Adjust the input of the DAT recorder so that the tone appears at −20 (below "zero-headroom-left" on the DAT machine's meters), or, if you so choose, at the machine's suggested nominal operating level.

METHOD TWO: ELEVATED RECORD LEVELS

1. Put the DAT machine into record standby, by pressing record and pause.
2. Adjust the input of the DAT recorder for maximum modulation without overload.
3. Patch a 1kHz tone into an open input channel on the mixer. Adjust the level of the oscillator so that the mix bus reads 0VU on the board. (Do not touch the master fader after this point).
4. Make a note of the resulting reference level on the DAT's meters on all ensuing recording logs (i.e.: 0VU on the board reads −6 on the recorder).

RECORDING

1. Leave at least a second of silence on the DAT after you start recording and before the engineer rolls the 24-track. This ensures that the program will not be cut off.
2. Turn off Auto Index after you hear the start of the program, in order to eliminate extra index points.
3. Watch the DAT meters very closely during recording. If at any time they reach 0VU or the peak indicator flashes, stop recording and roll-back to the previous start ID. Re-record at a lower level.
4. All stand-alone mixes should have a verbal tail marker or two short low-frequency pulses at the end of program material, for ease of identification. Exceptions to this might be sequenced, edited material. ■

print tones at an arbitrary level, such as −10 below digital zero on a DAT, and then set input levels for maximum modulation. Those max mod levels are set without any reference at all to the tones, which is worse than not having any tones at all.

This begs the major question: How do you go about setting levels on your DAT player? (See the sidebar, "Recording to DAT from an Analog Source.")

Many professional users set up their DAT levels for maximum modulation on the meter. You should be aware that there are several potential problems with this method of alignment. First, it is very hard to guess accurately what your true peak readings will be. A single clipped sample can render an entire take useless. How much dynamic range do you really need?

The crest factor will vary greatly depending on whether you are recording rock 'n' roll, a radio commercial or a classical symphony. Even if you can accurately gauge your headroom needs by setting up your input levels to record at maximum modulation, you're not out of the woods. There's a good chance that you're recording up to 20dB hotter than the zero VU reference on a professional analog tape recorder, all things being equal.

Before you can accurately set levels on a digital recorder, you need to ask yourself a few questions: Do you plan to use the digital inputs or outputs? Do you plan to sum, mix or crossfade elements together in the digital domain? What is the crest factor or dynamic range of the program material? This will tell you the headroom you'll need. Will the tape ever leave your facility?

Where's the ZERO?

Good metering is essential in setting levels on a digital recorder. Most DAT recorders include fairly good peak metering, but very few digital machines mark nominal recording levels. Many good meter circuits also have an infinite peak hold feature, so there is no question whether clipping occurred during a recording.

One commercially available meter bridges the gap between analog and digital by providing peak readings on the same unit. Digital "zero-headroom-left" is at the top of the scale, and the corresponding analog reading is +20dB. We asked Mike Dorrough, the manufacturer of this meter, why he selected that reference level. "It agrees with the Sony 1630, which talks +20 as where they crash. There's no +21." He also consulted with a major record company, which does a considerable amount of digital mastering.

TARGET NUMBERS

To sum up the problem, our industry is increasing the use of digital audio technology at a geometrically progressive rate. We are in danger of succumbing to a multitude of independently manufacturer-determined nonstandardized "standards" that will complicate our working life, making copying, digital transfers and mastering to CD quite difficult.

At the risk of incurring the slings and arrows of outrageous fortune, we suggest the following value as a possible solution: With a 16-bit digital word, and a sampling rate of 48kHz, the digital standard level should be −20dB below the maximum ceiling.

There's not magic here. It mirrors what we are used to in the analog world, and may at the very least be a solid place to begin the discussion. ■

AUDIO NOISE AND AC SYSTEMS

The 2-phase solution to a difficult problem.

By Martin Glasband

During the past 30 years, the state of the art of audio electronics has advanced perhaps as much as any of the modern technologies. However, these advances have outdistanced the standards we have become accustomed to in the electrical power industry.

Although the consoles, transports and digital electronics are more refined, we are still relying largely on the same technology used in the vacuum tube years. It seems that no one has given enough thought to tailoring ac supplies to meet the needs of sophisticated audio equipment. Some would argue that isolation transformers with Faraday shields address this need.

In fact, the core of the problem goes much deeper. The very systems and power distribution methods used today are not fully compatible with audio electronics. There still exist serious deficiencies in electrical engineering methods that pertain to audio installations. The use of any 120V single-phase ac system means potential problems for audio equipment.

Since the development of the JBL "T" circuit in the mid-1950s, balanced audio signal circuits have become the industry standard. Audio power supplies, as well, are not truly designed to operate in an unbalanced manner, but commonly, they are "force-fed" single-phase (unbalanced) ac anyway. Why? Because that's the electrical industry standard.

Amazingly, most audio engineers and manufacturers, studio designers and electricians, share the same blind spot. The standards have remained unchanged for a very long time.

Martin Glasband is an electrical system design specialist and contractor based in Selma, OR. He has designed and built power systems for the Zoo Studios, ABC Radio Network, New World Pictures, KCET Television and Baby 'O Recorders.

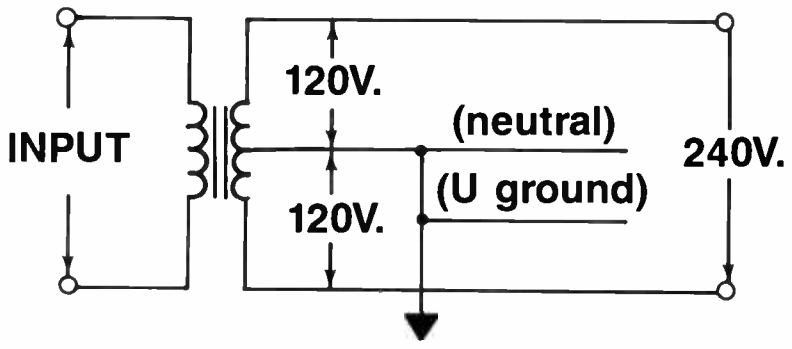

Figure 1. The most common type of 120V ac system.

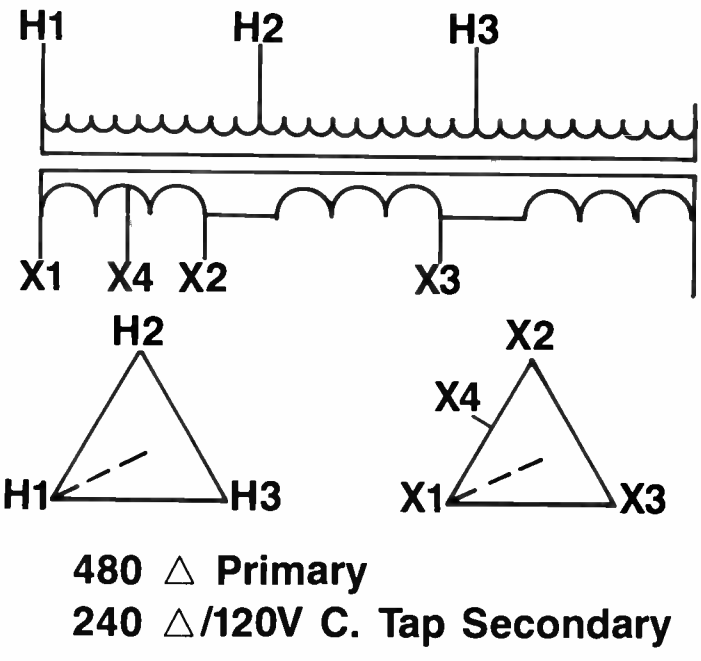

Figure 2. A 120/240 delta 3-phase system.

Ideally, the correct type of ac power for audio gear in the United States is 120V, 2-phase (balanced) power. Commercial use of 2-phase (equi-potential) ac isn't new. In fact, it is probably the first type of ac power ever put into widespread use in this country (Chicago in the early 1900s). Nevertheless, its commercial use is all but dead these days. Properly grounded 120V 2-phase wiring systems aren't mentioned at all in the National Electrical Code (NEC).

This unfortunate fact didn't deter a few innovative engineers and studio execs from employing a 120V equi-potential ac system in the Zoo Studios, Studio City, CA.

Short of changing an entire electrical system, there are some interim steps that can be taken to improve noise problems in many studios.

Soon after its opening, a studio musician plugged in his Fender Stratocaster and declared it was broken because there was no hum. Much to his surprise, his amp worked just fine. He mentioned to the studio engineer that this was the first studio he'd ever worked in where his amp simply made no noise at all. It should also be noted that it was not necessary to drive a single ground rod. That's pretty clean ac.

EXPLAINING THE BASICS

The root cause of most studio noise problems has little to do with grounding techniques. Accordingly, the balance of this text addresses the source of studio noise, unbalanced ac, and of course, the remedy.

First, let's examine some typical ac systems:

Figure 1 is the most common type of 120V ac system. The transformer outputs furnish both 120V and 240V to the rest of the electrical system. Figures 2 and 3 are 120/240 delta and 120/208 wye 3-phase systems. In both of these 3-phase systems, single-phase 120V is available for branch circuit wiring. Figure 4 is an example of a system more commonly found in recording studios. It exclusively furnishes 120V to all branch circuits.

The common thread in all of these systems is a grounded neutral conductor. Here lies the sole cause of almost all ac-induced noise in audio installations.

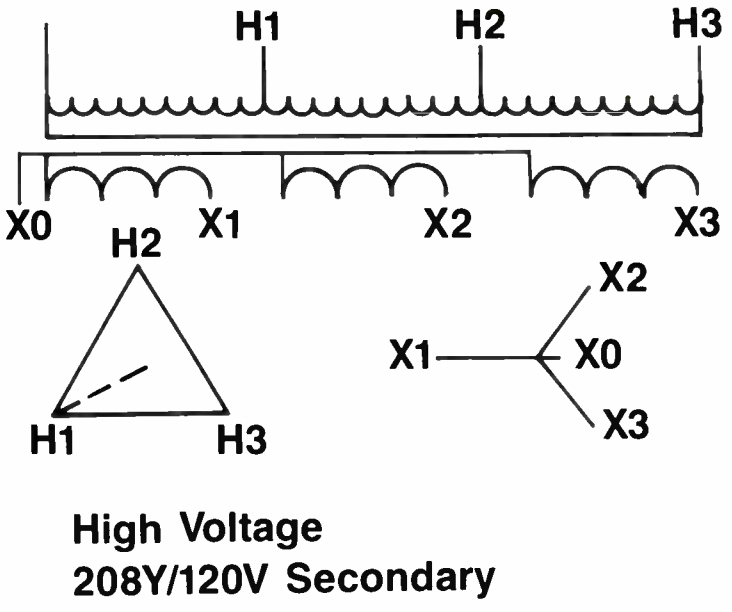

Figure 3. A 120/208 wye 3-phase system.

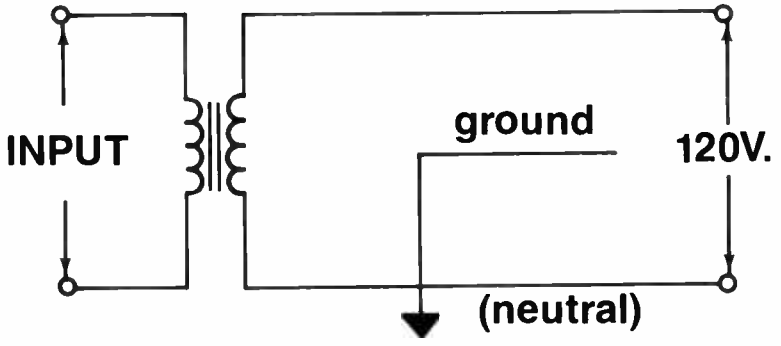

Figure 4. The ac system more commonly found in recording studios.

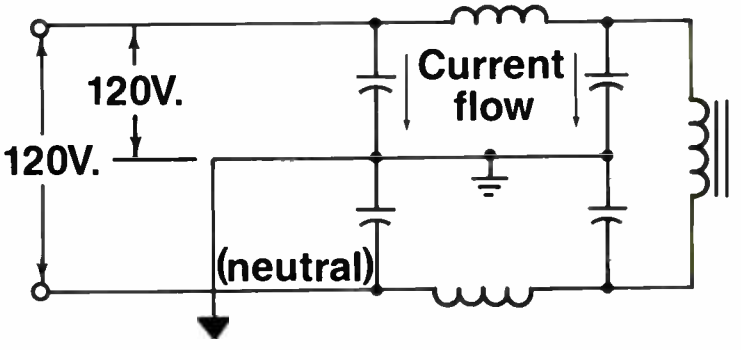

Figure 5. A low-pass (R.F.) filter, found in most power supplies in audio equipment.

Figure 5 is a low-pass filter (R.F. filter) that can be found in nearly every power supply in audio equipment. Note that current flow exists between the 120V side of the ac line and the chassis ground. Simply put, here is the source of most ac-induced audio noise. As more pieces of audio equipment are turned on, the noise floor of the grounding system is raised. This, of course, appears as EMI in most high-gain and high-impedance equipment.

There have been numerous remedies used to eliminate this noise. The common belief is that an improved earth ground will reduce EMI. This is true to an extent, but simple logistics make desired results all but impossible. The theory assumes that a good earth ground will somehow "vacuum" the system clean. However, EMI transmission within a studio grounding system, being a measurable and even predictable phenomenon is, of course, subject to Ohm's Law.

We are still relying largely on the same ac technology used in the vacuum tube years.

Commonly, the chassis-to-chassis resistance in an electrical grounding system is fractional. (For a more accurate estimation of ground circuit conductivity and resistance, refer to Table 8 in Chapter 9 of the NEC, "Conductor Properties.") Even under the most optimum conditions, substantially greater conductivity to true earth ground is virtually impossible to achieve.

Even if it were possible, the resulting conductivity ratio between the system circuit grounding and the system to earth ground would, at best, result only in a marginal improvement in system noise levels. A good example of this is a real case where a studio owner decided to have a well drilling company sink a 60'×3" copper shaft into the earth for his studio's grounding electrode. Unfortunately, the Fenders and Marshalls still hummed.

A somewhat more effective approach is to break the equipment ground connections. Lifting the capacitors from the chassis or using ac ground lifters are ways this is accomplished, but in most cases, electrical safety is compromised. Star grounding is at best a crude approach to the problem. System resistance to true earth ground is still far greater than chassis-to-chassis resistance. EMI continues to be a problem to a greater than desirable extent.

The only cure to this dilemma is to adapt the power system to the gear being utilized, and eliminate the noise at its source. It seems like a simple enough task. Unfortunately though, the electrical code lacks direction in this area. Before we tackle that one, let's look at why a balanced (2-phase) 120V system works. If you're going to attempt to modify the NEC, it's a good idea to have a clear reason for doing so.

HOW IT'S DONE

Figure 6 is a 120V, 2-phase grounded system plugged into a typical R.F. filter. The phase to ground voltage on each side of the ac line is about 60V. Each line of the iso-transformer output is 180° out of phase to its opposite; thus 120V is achieved. When this voltage is applied to an R.F. filter, the current passed through the capacitors is negated at the common chassis ground by its 180° out-of-phase voltage counterpart. This cancellation effect is optimum for audio equipment.

Single-phase systems cause noise flare-ups in other related applications. P.A. systems are particularly vulnerable because of the high impedance and high gain equipment used. Mobile recording units can also be adversely affected. Radio production and broadcasting facilities, and even video editing and telecine installations, are subject to unbalanced ac-induced EMI. Here, too, an equi-potential ac system would greatly help matters.

At the Zoo Studios, there was some initial apprehension when the 120V, 2-phase system was first fired up. Just how would the audio gear respond to this type of ac? Optimistic predictions proved to be correct. There were no examples of any equipment running afoul on 2-phase power. Equipment power supplies operate normally with equi-potential line voltage. Phase to phase (line to line) voltage is critical, but phase-to-ground voltage is irrelevant as far as power supply operation is concerned.

The only real problem occurred when a new electrical inspector showed up and began quizzing everyone about this unorthodox wiring system. Fortunately, his concerns about electrical safety had been anticipated and appropriate safety measures had been taken. After some discussion with the inspector (and his boss), it was agreed that the system was safe. Though not covered in any section of the NEC, the "spirit" of the code had been maintained. In other words, it passed inspection.

Short of changing an entire electrical system, there are some interim steps that can be taken to improve noise problems in many studios. Referring once again to Figure 4 (the more common studio system), if the grounded side of the output on the transformer is lifted, a more balanced ac system will result. This is called an ungrounded 120V split-phase system. It has some drawbacks, but its use is recognized in the NEC for application in hospital anesthetizing rooms. System monitoring equipment is required as well as other conditional installation methods.

One drawback is the lack of system grounding protection. Should there be a short-to-ground, the entire system would "tip over" and revert to a single phase system. Worse would be an ungrounded chassis that became shorted, which would create a shock hazard.

The simple solution to potential safety questions is the use of 2-pole GFCI circuit breakers, or at least a 2-pole GFCI main on the whole system. Additionally, when there isn't a grounded center tap on the transformer, a typically uneven magnetic flux dispersion across the output windings will result in differing phase-to-ground voltages at the outputs. This difference may vary as gear is turned on. A variance of 10V or 15V line-to-ground between the outputs is not uncommon. Nevertheless, EMI noise levels will be reduced by 10dB to 12dB.

When a grounded center tap system is

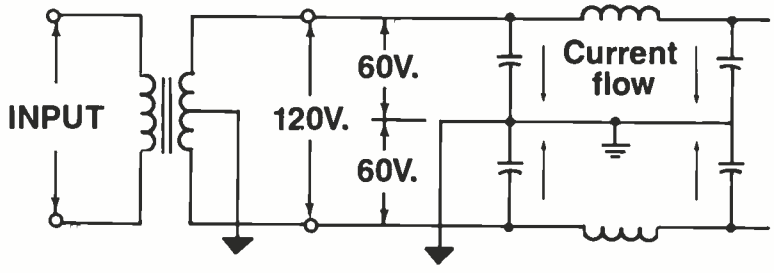

Figure 6. A 120V, 2-phase grounded system plugged into a typical R.F. filter.

used, equal output windings on both sides of the center tap ground reference balances the output voltage. The need for costly GFCI circuit breakers is also eliminated. This is because of a much higher ground fault current potential at the transformer line outputs. Additionally, ac-induced EMI is rendered inaudible.

Inspectors may have other considerations, but it is doubtful that anyone will want to stand in the way of progress.

At the time of this writing, a course of action is being undertaken to include in the NEC provisions for 120V 2-phase electrical systems for special use applications (audio/video installations). In the meantime, local authorities will need special attention until new standards are adopted. Each project needs to be handled case by case. More than likely, local electrical inspectors will want to know why a 2-phase system is needed. They will also require a number of safety measures to be employed in the design and wiring methods used. Some of the basic safety requirements are as follows:

1. The isolation transformer used must have a center tap on the output windings (refer to Figure 6) that is appropriately grounded. This will ensure sufficient fault current to trip a circuit breaker in the event of a short circuit somewhere in the system.

2. Double-pole circuit breakers are to be used for all ac branch circuit wiring. Both line conductors (unlike a single phase circuit) are ungrounded. Therefore, both require overcurrent protection. The breakers selected should include a thermal overload mechanism.

3. Always use orange iso-ground receptacles to identify iso-system outlets. Though they are designated as single phase devices, at this time, there is no practical NEMA configuration alternative. This is part of the code change process currently being undertaken. It is important, though, to identify (with orange) these special system outlets. Additional labeling may be required. Other use outside of studio equipment should be discouraged.

Inspectors may have other considerations, but it is doubtful that anyone will want to stand in the way of progress. The concepts discussed here are new to many, and as stated, there is little if any knowledge of these engineering methods throughout the electrical industry. Local code variances and national code changes will take time. Electrical equipment needs to be standardized and textbooks need to be rewritten. To quote one NEMA code representative, "This is a multi-headed beast." Perhaps a few letters to the National Fire Protection Association in Quincy, MA, will expedite these changes.

Though it may be more than a simple job getting a 120V, 2-phase system legally installed, the rewards are well worth the effort. The savings in downtime and freedom from noise problems will most assuredly justify the installation and the investment. ■

Sound Reinforcement

SLOWHAND IN SINGAPORE

By Winston Goh

The largest indoor venue in the country, the 12,000-seat Singapore Indoor Stadium has been host to the Moscow Circus, David Copperfield, Placido Domingo and numerous other entertainment and sporting events since its opening in January 1990. It is currently the only venue with sufficient audience capacity viable for promoters to bring in major international artists. However, there have been problems with the sound. Performances by such artists as Bobby Brown and Placido Domingo were followed by reviews that carried headlines heralding that the sound was poor. When Music Plaza Ltd. was awarded the contract to provide the sound for rock legend Eric Clapton, we approached the task with a sense of challenge.

Winston Goh is the manager/engineer of Music Plaza, a subsidiary of Yamaha Music (Asia).

AKG Acoustics, Inc.
Allen & Heath
Altec Lansing
Ampex
Analog Devices
Aphex Systems
Apogee Sound, Inc.
ART
Ashly Audio, Inc.
Atlas/Soundolier
Audio Control Industrial
Audio Precision
Audio Research & Technology, Pty.
Barron, Kennedy, Lyzun, & Assoc.
Bertagni Electronic Sound
Transducers
Beyerdynamic
Bose Corporation
Bruel & Kjær Instruments
BSS
Carver Corp.
Clear-Com Intercom Systems
Community Professional Sound
J.L. Cooper Electronics
Crest Audi
Crown International
dbx
DRV Public Address Consultants
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Telex Communications, Inc.
THAT Corporation
G.R. Thurmond & Associates
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Live & Direct

Shopping the Job Market

By David Scheirman

Having received many phone calls and letters during and after the recent winter season from audio technicians and soundmixers who are seeking employment (both "new guys" and industry veterans alike), I decided that something must be afoot. Why would so many capable and skilled, employable sound system practicioners be out of work?

After reading Mike Joseph's perceptive editorial ("What It Is...") in the April issue, I thought that perhaps I had my answer. It wasn't just Saddam Hussein's antics in the Persian Gulf. It wasn't just an extra-cold winter. It wasn't just the recession, the failing thrift institutions, and the shrinking rain forests. It was this: Our industry is changing!

Change can be good or bad, depending on your perspective. If you have found a comfortable niche, don't like to stretch yourself or learn new skills, and don't like competition, then a changing sound industry can be bad for you. On the other hand, if you enjoy new challenges, constantly seek better ways of doing things and have a few good ideas that you might want to test in the real world, then a changing sound industry will be a good climate for you.

IMAGE VS. SUBSTANCE

No matter what sort of clients you or your company serve, it is obvious by now that the general public knows more about sound than ever before. What were once our magic, sophisticated tools for live concert sound (like crossovers and equalizers, compressors and subwoofers) are now found under the dash and on the parcel shelf of nearly every Camaro and Mustang on the road, and in the living rooms and offices of a vast percentage of the American culture. More people know what to listen for, how to shape the sound they are listening to so as to suit themselves, and how to talk about it if they don't like what they hear.

David Scheirman is R•E•P's live performance consulting editor and president of Concert Sound Consultants, Julian, CA.

Those of you who have done any live sound system operation in the past year, even on a small-scale basis, would agree with me that the audiences are more knowledgeable than ever, and more prone to comment on the job that you are doing.

So, to deliver a product or service (sound system operations) that is perceived as being good by those persons listening to your efforts requires that there be truly "good sound" ... that what you are doing is actually providing the substance required by the event you are handling, and not just giving the "image" of good sound with a new mixing console or an impressive speaker system.

Road veterans interested in continuing to work with audio find their way into challenging career areas.

All of the above leads us to the thought that there is a job market for qualified, reliable and consistent sound technicians and mixers, and those who try to slide by with a "good old boy" network or are not willing to raise their own skill levels to match the changing industry and public perceptions, may find it hard to locate work.

CAREER OPTIONS

Many people struggle with the issue of getting off the road. If you are someone who has spent years learning how to tame the savage beast of a large sound system for live music, but is no longer interested in the on-the-road bus lifestyle that is required to travel with a touring system, you may look at different ways to make use of your skills.

Some road veterans who are interested in continuing to work with audio find their way into several challenging career areas. Let's examine a few:

• System installation: Every major city has several sound system installation contracting companies. Although these organizations often work with voice-only communications systems, it's interesting to note that even basic public address systems in schools and restaurants are being overhauled to incorporate music-playback facilities. Who is designing and installing these systems? What companies in your area specialize in such contracts? Can they benefit from the things you have learned about pro audio?

• Design and consulting: When a music store in Texas decides to open a pro audio sales and design office, or an old-line acoustical consulting firm wants to take a piece of the action in the booming outdoor amphitheater design industry, who do they call? What's required in both instances is an industry veteran who knows the equipment, the music, the people and the practical aspects of concert sound. Landing a valid career position with long-term prospects may require that you invest in a year or two of business and engineering courses, but if changing boats in midstream is part of your new direction, it can be well worth it.

• Manufacturers: All pro audio gear that we know and use is designed, built, marketed, demonstrated and sold by someone. Who are those people? Where do they learn their skills to perform their jobs? Do you know something they don't? Is there an audio manufacturer of amplifiers, speakers, or signal processing gear in your area that needs help in one of these critical areas?

Once again, investing in sales, marketing or engineering courses at a local college can enable you to combine new knowledge with proven skills, and to be competitive in job interviews with audio manufacturers.

• Public institutions: Nearly every large auditorium, church and sports arena needs someone on staff to take care of their installed system. Check it out. Has someone just retired from a position of handling sound equipment for the city government? Is there an opening in the local IATSE crew for someone with practical live sound skills? Long-term job opportunities can be found, particularly in smaller to medium-sized towns and cities where a retired "road rat" can offer significant resources to the local production community. Sometimes, educational programs related to the recording industry are ready to expand into the area of event sound production, and your skills can be valuable.

• Sound company management: Many industry veterans find their niche by learning the business and personnel management skills necessary to help steer the ship of an active sound or related production company. In some cases, older company owners may be interested in retiring, and

Touring overseas with Eric Clapton: Music Plaza's touring sound.

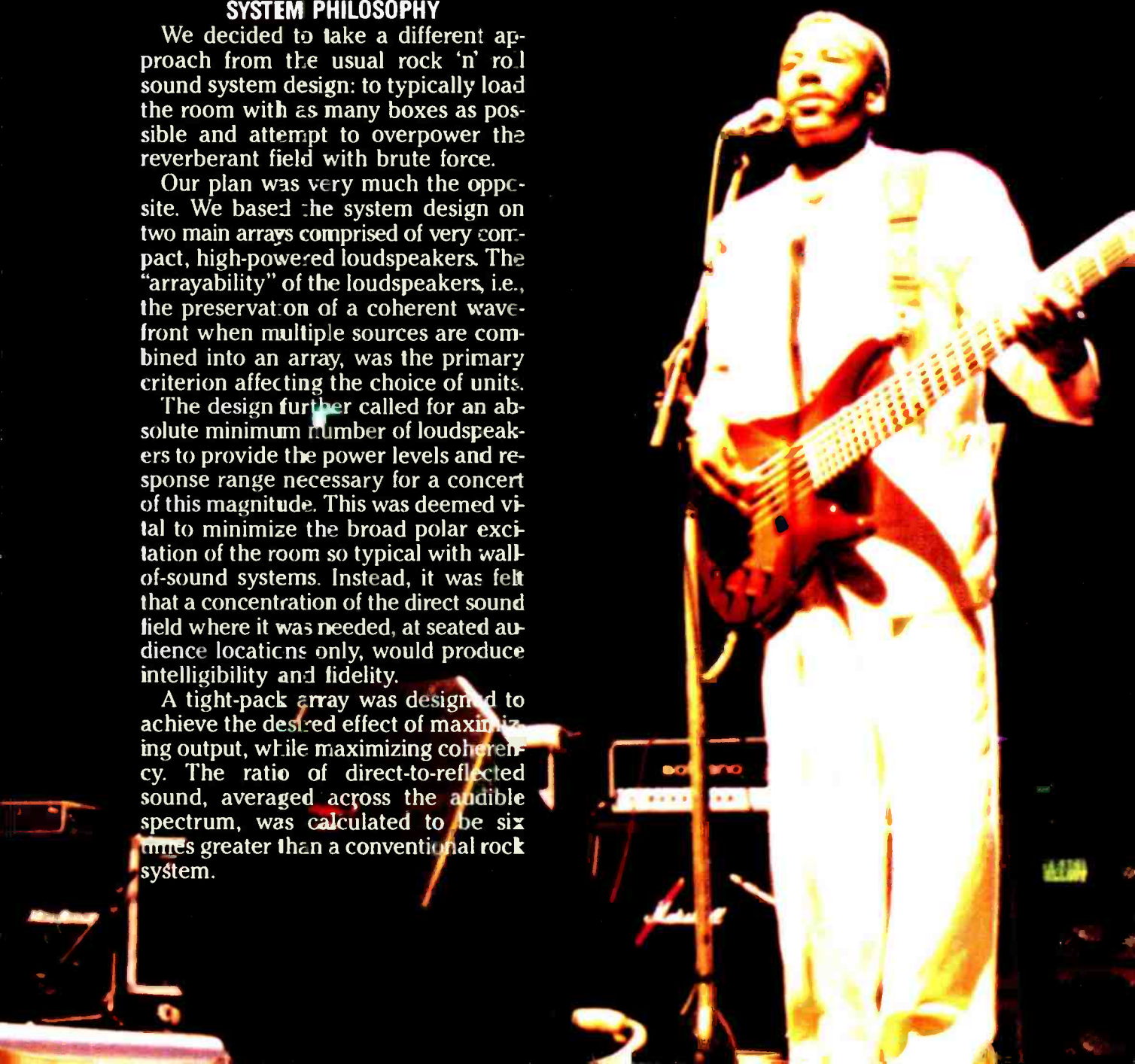
SYSTEM PHILOSOPHY

We decided to take a different approach from the usual rock 'n' roll sound system design: to typically load the room with as many boxes as possible and attempt to overpower the reverberant field with brute force.

Our plan was very much the opposite. We based the system design on two main arrays comprised of very compact, high-powered loudspeakers. The "arrayability" of the loudspeakers, i.e., the preservation of a coherent wavefront when multiple sources are combined into an array, was the primary criterion affecting the choice of units.

The design further called for an absolute minimum number of loudspeakers to provide the power levels and response range necessary for a concert of this magnitude. This was deemed vital to minimize the broad polar excitation of the room so typical with wall-of-sound systems. Instead, it was felt that a concentration of the direct sound field where it was needed, at seated audience locations only, would produce intelligibility and fidelity.

A tight-pack array was designed to achieve the desired effect of maximizing output, while maximizing coherency. The ratio of direct-to-reflected sound, averaged across the audible spectrum, was calculated to be six times greater than a conventional rock system.



RIGGING

We knew a tight-pack array would not achieve the desired results unless that array was located and focused properly. Proper physical location would require flying the system, not easily accommodated in this particular room. In order to obtain permission to hang anything in the arena, a complete plan had to be submitted to the building structural engineer for approval, well in advance of the event. Last-minute changes or modifications to the plan in the field were simply not possible because they would take too much time to obtain approvals. This meant that the plan had to be right the first time.

The ceiling of the Singapore Indoor Stadium is finished with perforated aluminum panels, each 1.5′ ×12′ long, which have to be carefully removed to access the structural steel framework of the building. Once removed, the wire ropes can be attached and dropped in the designated areas. The roof structure is made of ball joints, each with a load limit of 600kg (1,320 pounds). Multiple points may be bridled together to handle large loads.

We chose to fly a complement of 10 Apogee 3×3II cabinets per side in a five-over-five configuration, using the company's factory-built D ring rigging system (Apogee Radial Strapless Rigging). Beneath each cluster, four Apogee bi-amped AE-5 speakers were flown for downward-aimed front fill.

The inner three sets of speakers were inverted to couple the midrange horns for projection to the rear of the auditorium, while the outside pair of speakers had the horns separated, to address the seating along the side of the arena. The arrays were flown above the front edge of the stage at a height of 9.15m (30 feet). Additionally, three 3×3II speakers flanked the stage for lower volume front fill application, providing sound to the areas not included in the coverage pattern of the flown arrays. Six AE-12 dual 18-inch subs were placed at each front corner of the stage for very low frequency reproduction.

LOGISTICS

We were able to gain access to the room the day before the concert, allowing us to set up and test overall coverage in the room, as well as conduct system power tests. Using an Ivie IE30 portable spectrum analyzer enabled us to measure frequency response and SPL levels.

Using an Eric Clapton compact disc as a sound source, we were pleasantly surprised to get tight bass response at 32Hz at the rear of the hall, some 200 feet from the array, without using the subwoofers. Later during the show, we achieved an average continuous sound pressure of 104dBA at the front-of-house mix position.

For Eric Clapton's concert at the Singapore Indoor Stadium, a tight-pack array was designed to maximize output and intelligibility. Average direct-to-reflected sound was six times greater than a typical rock system.

The Apogee loudspeakers were powered by Crest model 8001, 7001 and 6001 amplifiers. During the show an acceptable SPL level was easily achieved in the house, with only occasional signs of soft amplifier clipping.

The Clapton tour carried its own FOH gear, including a Midas Pro 40, with an extender for a total of 50 channels, and an effects rack containing a Lexicon 224XL, Yamaha REV-7 and SPX-90 processors, and a Klark-Teknik DN360 EQ and DN780 reverb, among others. Onstage, there were 14 AE-6Bs, a low-profile Apogee bi-amped floor wedge. These were also powered by Crest amps. A 32-channel Yamaha PM2800 board along with K-T DN360s and DN410s completed the monitor rig.

When Clapton's crew arrived, their first reaction after viewing the relatively small-appearing system was a grave concern that there would not be enough power for the group and/or the room. Because they had no previous experience with the loudspeakers and were comparing them to conventional designs on a size basis only, we suggested that they spend some time listening, to familiarize themselves with the tremendous power potential available.

After 30 minutes of testing the system to its limits, the tour engineers and management did an about-face and were well satisfied that the compact rig would fulfill their requirements. Clapton's manager reported that "He hates sound checks," so with no opportunity for live rehearsal, the sound check became the opening song of the show. The equalizers were adjusted for low end rolloff to compensate for the "boominess" of the room, but before long, the mixing engineer had a tight, punchy sound with lots of level and excitement filling the hall. Though the room was still abundantly reverberant in nature, none of the annoying acoustical effects, poor musicality and low intelligibility plagued the sound as it had so often in the past. The coherent arrays did their job with headroom to spare!

CONCLUSION

As the local sound supplier, the real test for us would be how the critics, both professional and otherwise, would react to the show. Given the problems of the past, we hoped that the critics would listen with open ears. The results were more than gratifying. Newspaper critics acclaimed that the Clapton show had inaugurated the Singapore Indoor Stadium as *the* venue for future rock concerts.

Importantly, for the long run, we were satisfied that the judicious application of modern systems technology was able to achieve the desired end result, that of conveying the performer's message at high levels in a challenging environment, without the loss of intelligibility or musicality from which other physically larger systems have suffered in the past. ■

opportunities can exist for you and a partner or two to buy out the boss. If this is your situation, get ready for a "real" desk job.

• Other options: There is a fellow who went to work for the rock star who he used to mix for, carrying luggage and making phone calls; he's now a personal talent manager in Hollywood. There is a guy who married a girl on a South Sea island, shipped over some old audio gear from the States, and has the only game in town for P.A. systems. There is the person who bought into a remote recording truck operation, and quickly learned how to align tape machine heads instead of speaker stacks. The list could go on and on.

For 1991, the entertainment industry still needs both experienced road veterans and eager, entry-level talent to make the concert sound industry work. And public and private facilities of all types, from baseball stadiums to dance music clubs, need sound systems and someone to operate them.

If sound is your profession, there are plenty of places to make use of your skills.

For the touring concert industry, the winter season was slower than many in years past, and the spring has warmed up faster than anyone expected. As one sound system rental company owner stated recently, "It's almost as if somebody threw a switch about March 19; bid proposals and tour specs started coming over the fax machine like a white tornado."

Regardless of the economic state of this country, the public continues to seek live entertainment. And entertainment requires sound systems, whether in the movie theater, the concert hall, the rock club or the sports arena. If sound is your profession, there are plenty of places to make use of your skills. ■

All Access

By Mark Herman

MARYLAND SOUND INDUSTRIES, BALTIMORE

Headline Act:
Gloria Estefan & Miami Sound Machine

Dates: March 1-Dec. 31
Region: World Tour

PERSONNEL
House Mixer: Mark Dowdle
Monitor Mixer: Craig Melvin
System Engineer: Mark Bradley
Technicians: Russ Emery and Robert Nelson

CONSOLES
House: (2) Gamble Series EX 56-channel
Monitor: (2) Ramsa WR-S840 40×18

AMPLIFIERS
Main FOH: Crest 7001, Ramsa WP-9220
Lows/Subs: Crest 8001
Monitors: SAE P50, Crest 7001
Sidefills: Crest 7001, 8001, Ramsa WP-9220

FOH MAIN CABINETS
Model: (92) MSI MS12
Crossover: MSI HS 301

FOH LOW END CABINETS
Model: (12) MSI MS18
Crossover: MSI HS 301

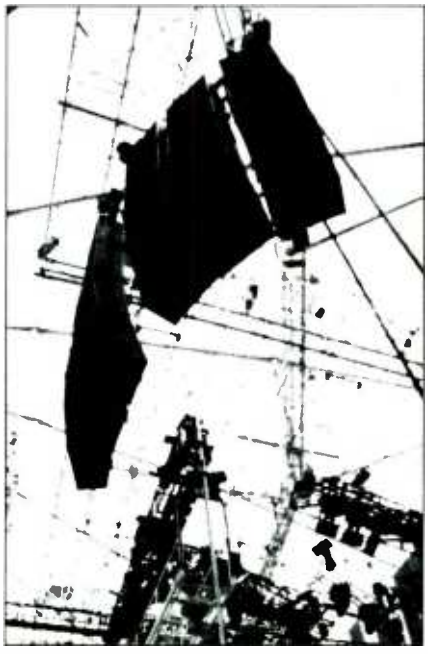
ONSTAGE MONITOR WEDGES
Model: (16) MSI MS 212
Crossover: MSI Digital Select

ONSTAGE SIDEFILLS
Model: (4) MSI MS 3W
Crossover: MSI HS 301

Mark Herman is a contributing editor to R•E•P and the president of Hi-Tech Audio Systems, a sound reinforcement equipment rental company based in South San Francisco.

HOUSE SIGNAL PROCESSING
Equalizers: White 4400, UREI 5547A
Gates: dbx 904, Aphex CXI, BSS 502
Compressor/Limiters: dbx 903, dbx 160X, BSS 402, Drawmer Tube
Reverb: Lexicon 224XL, Lexicon PCM70, Yamaha SPX-90II, Yamaha SPX-900, Yamaha SPX-1000
Delay: AMS 1580, Roland SDE3000
Other Effects: Eventide H3000, Korg 3000
Intercom System: Chaos
DAT Machine: Panasonic SV-3500
Cassette Machine: Tascam 122 Mk II
Real Time Analyzer: dbx RTA

ONSTAGE SIGNAL PROCESSING
Equalizers: Klark-Teknik DN300
Crossovers: MSI Digital Power
Effects: (2) Yamaha SPX-90II
Gates: dbx 904
Compressor/Limiters: BSS 502



MICROPHONES:
Vocals: ATM wireless, Shure Beta 58
Kick: AKG D112
Rack Toms: Sennheiser 421
Floor Toms: Sennheiser 421
Overheads: AKG 414
Snare Top: Beyer 201
High Hat: AKG 460
Guitar No. 1: Shure SM57
Guitar No. 2: Shure SM57
Bass: DI
Keyboards: DI
Other Mics: Ramsa S5, Beyer 88, Sennheiser 409, Sennheiser 431, Shure Beta 58, Shure SM91
Direct Boxes: Countryman

CABLING
House snake: 104 lines
Multi-pair connectors: AMP, MSI
Stageboxes: MSI 8-paks ■

ALLSTAR AUDIO, NASHVILLE

Show:
Country Radio Seminar '91

Dates: March 6-9
Venue: Opryland Hotel, Nashville

PERSONNEL
Artists: Randy Travis, Tammy Wynette, Vern Gosden, Mark Collie, Carlene Carter, Pirate of the Mississippi, Mark Reid, Billy Dean, Chris Ledoux, Kevin Welch, Ray Kennedy, Shelby Lynne, Aaron Tippin, Joe Diffie
House Mixers: Mike Borne, Stan Dacus
Monitor Mixers: Neil Cunningham, Mike Sanderson, John Jackson
System Engineer: Mike Borne
Technicians: Dave Campbell, John Dauphinee, Jack Dedert, John Johnson, Greg Fowler
Riggers: Mike Borne, Neil Cunningham

CONSOLES
House: Yamaha PM3000 40-channel
Monitor: Soundcraft 500 40×12

AMPLIFIERS
Main FOH: Carver 2.0, Crest 8001
Lows/Subs: Crest 8001
Monitors: Carver 2.0, 350
Sidefills: Carver 2.0

FOH MAIN CABINETS
Model: (16) EAW KF-850
Crossover: EAW MX-800

FOH LOW END CABINETS
Model: (8) EAW SB-850
Crossover: EAW MX-800

ONSTAGE MONITOR WEDGES
Model: (17) Allstar 1501
Crossover: Carver PMX

ONSTAGE SIDEFILLS
Model: (2) EAW JF-500
Crossover: Carver PMX

HOUSE SIGNAL PROCESSING
Equalizers: White 4660
Gates: Drawmer 201
Compressor/Limiters: dbx 160X, dbx 166
Reverb: (2) Yamaha REV-7, Yamaha SPX-90II
Delay: Yamaha SPX-90II
Intercom System: ClearCom
Cassette Machine: TEAC
Compact Disc Player: Sony
Headphones: AKG, Fostex

ONSTAGE SIGNAL PROCESSING
Equalizers: White 4650
Effects: (2) Yamaha SPX-90 II
Gates: dbx 904
Compressor/Limiters: dbx 903

MICROPHONES:
Vocals: Electro-Voice 857
Kick: Electro-Voice RE-20
Rack Toms: Sennheiser 421
Floor Toms: Sennheiser 421
Snare Top: Shure SM57
High Hat: AKG 451
Guitar No. 1: Shure SM57
Guitar No. 2: Shure SM57
Bass: DI
Keyboards: DI
Direct Boxes: Countryman, ProCo

CABLING
House snake: Mogami 48-pair
Multi-pair connectors: AMP QL
Stageboxes: (4) Allstar Audio
Splitter: 3-way with transformers ■

Roadwork

By Mark Herman

Europe is a hotbed of touring activity for sound reinforcement company **Clair Bros.** (Lititz, PA). **Sting** is touring outdoor stadiums in Europe with a 96-box S-4 Series II system ... Veteran touring artists **Yes** are covering the European continent with a 54-box rig after finishing their North American spring leg ... **Bob Dylan** finished the U.S., went to Europe and plans to return for another U.S. leg soon ... Up-and-coming pop star **Alexander O'Neil** carried a 32-box system ... **Paul Simon's** great-sounding "Rhythm of the Saints" tour also traveled across the Atlantic with independent engineer David Morgan mixing house and "Dr." Dave Staub mixing monitors ... Clair's **Greg Hall** says, "We have a lot of equipment in Europe. It sure shows you where the dynamic markets are." ... On the home front, **Don Henley** began rehearsals in May for his North American tour scheduled to hit the road early this month with a 48-box S-4 rig ... Steady-working **Kenny Rogers** continues his usual summer-style touring schedule ... Guitarist **Steve Miller** is scheduled to go out in early July.

Clair Brothers Audio Systems' pro audio equipment manufacturing division recently introduced the R-4T Variable Array Trapezoid Loudspeaker System, available for sale to all pro audio companies and installations. This flying loudspeaker system is primarily designed for the permanent installation market, although it is applicable for concert sound. The R-4T is the non-trapezoidal version of Clair's model R-4 regional touring cabinet; the R-4 is half of the famous S-4 box and has been in use by Clair for more than five years. The 45″×22″×30″ full range (37Hz-20kHz) R-4T enclosure is loaded with single 18-inch and 12-inch cones, a single 2-inch compression driver and an optional tweeter (assorted components can be specified).

Probably the most striking aspect of the R-4T is Clair's unique "Infrastructure" rigging design, which features two front weight-bearing 516-inch wire ropes and a single rear wire rope for trimming the splay of the trapezoidal enclosures. Here's the best part: the wire ropes are fed directly through each of the enclosures (up to four boxes), displaying a minimal visual presence. All in all, the result is a remarkably clean appearance, uncluttered and easy to implement. The flying system maintains an 8:1 safety ratio and can be hung horizontally as well as vertically.

Tasco (Camarillo, CA) is well known for working with popular heavy rock and metal bands. This season it's business as usual with Tasco doing **Cinderella's** tour with 36 stacks of Harwell main P.A.s. House consoles were three Yamaha PM-3000 40Cs, and a Midas 36-channel Pro 40 desk for the support act. On stage is a Ramsa WR-S840 plus a Midas 30×10. It must be very loud on stage — a considerable quantity of 2×15, 1×15 and 2×12 wedges are supplemented by 14 EAW KF-850s and 10 EAW SB-850s for side and drum fills ... **Poison's** tour is carrying a new EAW system that includes 36 KF-850s, 12 KF-1000 and 24 SB-850 subwoofers. On-stage 12 KF-850s and six SB-850s were used for side and drum fills. Consoles are two Yamaha PM-3000 40Cs for FOH and a Soundcraft Series 40×16 for monitors ... Also touring with Tasco are David Lee Roth, Nelson and the Black Crowes.

United Sound Associates (Yakima, WA) is a dominant regional sound company in the Northwest, and is also known for steady work in the western U.S. fair circuit. United has 48 proprietary, full range JBL-loaded boxes that contain 2×15″ (2226), 2×12″ (2202), 2445 2-inch compression drivers on 2380 or 2385 horns, and two tweeters each. For extra low-end there are 12 sub boxes loaded with Gauss 4883 18-inch drivers. Power is supplied by Crest 8001, 3000 and 4001 amplifiers. Consoles include a Gamble HC-40 for FOH and a Wheatstone M-16 32×16 for United's numerous proprietary monitor wedges. Both of the house and monitor systems use Klark-Teknik DN360 equalizers. Recent purchases include several T.C. Electronic 2290 digital delay units.

Like many others in the industry, United Sound has felt the pinch from the recent live sound slowdown. Owner **Mark Strosahl** says, "It's ridiculous this year. We are being undercut by 40%. We had the worst spring in the history of our company in regard to live show income. Luckily, we picked up a considerable amount of installation and corporate/industrial work to make up the difference." One of United's major installation contracts is with the Washington State University athletic facilities. A new P.A. is planned for the 50,000-seat stadium in Pullman, WA. Strosahl says, "I don't see how companies can keep their doors open by always bidding shows so low. There have been almost no tours to speak of for us in two years because we just won't go out there for peanuts. And to make this year even worse, the winter and spring fair circuit has been poor also. The state and county fair market is flooded with the influx of companies reeling from the slow concert touring industry. Our company is OK; because we had a great May, and the rest of our schedule already looks busy through October. I really wonder what will happen to the lowballers and some of the weaker companies in the long run." Strosahl's situation and comments are identical to what a large number of other regional sound reinforcement companies are complaining about in North America. Time for the industry to wake up?

Hot Women: Maryland Sound Industries/West landed the Paula Abdul tour, which will begin playing arenas in August. Band and production rehearsals start in June and continue throughout July. By adding the Abdul account, MSI seems to have a firm grip on the hot, touring women of 1991, with headliners Gloria Estefan, Whitney Houston and Sheena Easton locked in.

Located only four doors from Tasco and reporting a fairly busy year filled with touring and continued industrial/corporate work is **Delicate Productions** (Camarillo, CA). Delicate, the largest user of Martin F2 main loudspeakers in North America, recently provided 88 F2 cabinets for a Jane's Addiction date at Madison Square Garden in late April. In case you've never heard the F2, believe me, 88 of them would be quite impressive ... Jane's Addiction's latest tour leg began in late April ... The Happy Mondays continue to tour with a theater-size system ... Delicate will be doing 20 dates in 20,000 to 40,000-seat venues for this summer's Lollapalooza Festival, which will include headliner Jane's Addiction with support from Siouxsie & the Banshees, Nine Inch Nails, Living Colour, Ice-T and others ... Recent equipment purchases include 12 additional Martin F2 cabinets.

Most of the sound reinforcement companies, and much of the media and manufacturer hype, are geared toward live concert sound. All too often audio companies that service the corporate/industrial field are overlooked and remain relatively unknown to many live audio personnel.

Mark Herman is a contributing editor to R•E•P and the president of Hi-Tech Audio Systems, a sound reinforcement equipment rental company based in South San Francisco.

Aquarius Sound (Pacifica, CA) is a nationally oriented corporate/industrial company that works sites across the nation and provides services for its accounts in many foreign countries.

Aquarius Sound was formed in 1968 by current president Bob Ring and Dick Maitland in order to provide professional audio services for Broadway-style shows in the New York area. The company soon landed a job providing sound effects for "Sesame Street" (and has kept the contract for an amazing 21 years). Maitland has won an impressive five Emmy Awards for his efforts there. Bob Ring opened a West Coast office in 1974 and concentrated on sound design for the corporate and industrial market. This early entry into the corporate/industrial has paid off well. Aquarius has since developed into a major player in the market and sports an impressive number of major corporate clients. Owner Bob Ring says, "We travel 200 days a year and we're busy all the time."

Aquarius' loudspeaker inventory includes 16 Meyer MSL-3s, 20 Meyer UPA-1s, numerous Meyer UM-1 wedges, a dozen Ramsa A-200s and loads of old 844 and 1233 Altecs for delays and lobbies. Ring commented on the Ramsa A-200s, "They work out very well for delays because we only put voice through the delay. For our type of show we can't blast the front of the audience, but we must still give the farthest seats good coverage."

Amplifier power is supplied by a mixture of Crest 4001s for the MSL-3s, AB Systems 1200s for UPAs, and Carver 2.0s and 1.5s for monitors. A Rane MA6 6-channel power amp is used for delays. Aquarius still fields Yamaha model PM2000s for house consoles. "We stick with the 2000s because they are so bullet-proof, with all the transformers and such. When we have to hook up to two different video companies and a laser company, and then deal with unstable power at some remote location, they are invaluable. Other consoles couldn't cut it with us in the past."

Unlike most concert companies, Aquarius prefers to keep signal processing gear out of big racks. "Most of our outboard gear is kept in individual, modular, custom cases and hooked together as needed. It is much more flexible for us this way; our needs change so quickly that it would be impractical for us to keep entire racks pre-wired," says Ring. Key staff members Stan Hunter (technical directing and design) and Rich Halvorson (mixer and design), along with a veteran pool of engineers, assist Ring in productions.

Showco (Dallas) is currently out with the monstrous "Clash of the Titans" tour featuring the likes of Megadeth, Slayer, Anthrax and Alice In Chains. Slayer's FOH engineer Greg Bess is mixing on the versatile ATI Paragon super-console. Other touring Showco accounts include ELO, with R•E•P live performance editor David Scheirman mixing house, Steve Winwood, ZZ Top and Joe Cocker. ■

HANDS ON:

AUDIO PRECISION PORTABLE ONE

By Mack Clark

That's right — test gear. You have no doubt perused reviews and evaluations of various pieces of audio equipment within these pages that are accompanied by test results delivered by a piece of audio test gear. This is a review and evaluation of such a piece. This begs the question: What will provide the hard copy measurement results: test gear for test gear?

The Audio Precision Portable One is a 1990s version of the distortion analyzers popular in the late 1970s and 1980s. Those who are familiar with the Sound Technology 1700 series and the Hewlett-Packard 333 and 339 units will recognize the array of functions and configuration of outputs. Although this unit offers significantly more, it appears that the target market is the same. The Portable One is a self-contained 2-channel test unit that requires no additional hardware or software to operate.

At 20 pounds, it is easily transportable for field engineers, even easier with the optional nylon bag with accessories pouch. A protective front cover built into the unit flips down to reveal the controls, display window and I/O connectors. The controls are sensibly laid out. If you are familiar with such devices you could intuitively operate most functions without consulting the documentation. The documentation is clear and thorough, and helpful in explaining features that are not available on earlier units.

DESCRIPTION

There are two generator outputs that are fed from the same actual generator source. Each can be muted individually or they can be muted together. The muting

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is handled automatically during such tests as crosstalk or noise. Available signals are the usual sine and square waves, as well as an IMD test signal when the optional Intermodulation Distortion function is present. The inputs are balanced and selectable for the test at hand. In fact, the generator is also selectable at the input by itself or for comparison with one of the input test signals. This comes in handy when observing gain or phase.

There are three auxiliary outputs at the rear of the unit: a buffered analyzer output signal that displays distortion products when in the THD+N or SINAD mode, a buffered version of the input signal labeled input monitor, and a generator sync output that sends a sine wave at the same frequency as the generator for scope triggering. Signals may be monitored via headphones or an onboard loudspeaker, via an output control.

The display is a backlit LCD with contrast and invert controls providing dark or light background and whatever degree of intensity of characters desired. This window can be selected to display generator parameters, analyzer parameters or both. There is also a bargraph display available that provides "analog" metering. Further across the control panel are the function select buttons, input and output switching, and frequency and amplitude adjustments.

ANALYSIS

At first sight, it looks as if this unit doesn't do much more than a Sound Technology 1710. This notion is quickly erased with the discovery of soft buttons around the display and the flexibility of the frequency and amplitude adjustments (see Figure 1). The soft keys around the window change in function with selection of display. In the generator display, for example (see Figure 2), these soft keys will select the waveform (sine, square, IMD), amplitude units in V (volts RMS), dBV, dBu, dBm (600Ω ref), and Vp (volts peak), and output impedance (40Ω balanced, 40Ω unbalanced, 150Ω balanced, 600Ω balanced).

The frequency can be raised or lowered by a factor of 10 with the ×10 and /10 buttons. The INC and DEC buttons increase and decrease the frequency according to the ISO 1/3-octave values (1.00, 1.25, 1.60, 2.00, 2.50, 3.15, etc.). Fine adjustment is accomplished with a rotary control, which provides a fine resolution of 0.02%. The amplitude is similarly adjusted by the +10dB, –10dB, INC, DEC buttons or the rotary control. The ±10dB buttons are self-explanatory. The INC, DEC buttons raise

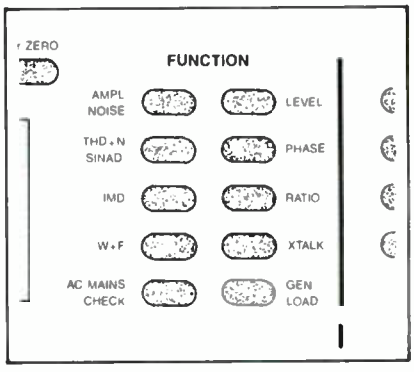


Figure 1. Measurement function keys.

or lower the amplitude by 1dB when in any of the decibel modes. When linear units (volts) are displayed, the INC/DEC buttons will change using the same set of figures as the ISO values mentioned above. The fine control knob resolution is less than 0.01dB.

The soft keys provide other functions when in the analyzer mode. Again, you can select the units of measurement to read volts, watts, percentage, and various decible scales including dBr, where a user reference is chosen. Weighted, unweight

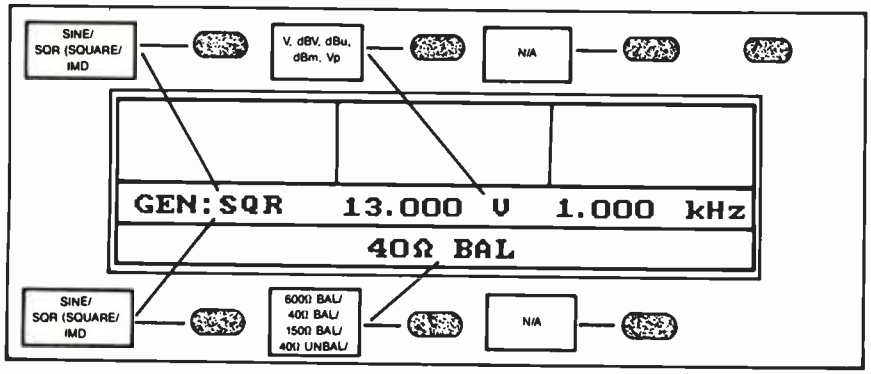


Figure 2. Setting generator parameters.

ed and selective filtering modes are selected with another key. Other buttons select upper and lower band limits, as well as weighting filters and detector responses.

Among the filters selectable are two auxiliary filter positions that correspond to two sockets within the unit. This enables insertion of an optional filter, or to build whatever is needed for a particular application. In selective mode, the frequency controls determine the center frequency of a tunable 1/3-octave bandpass filter. In other measurement modes these soft keys switch between different parameters appropriate to the measurement.

The bargraph display provides a visual representation of the input signal. The value range of the bargraph can be manipulated by selecting one or both ends and changing the range with the amplitude controls. This analog meter function is best applied when monitoring fluctuating signals. It has a selectable hold function as well.

WHAT IT DOES

The Audio Precision Portable One tests include level (two channels), noise, THD+N (total harmonic distortion + noise), SINAD (signal + noise + distortion/noise + distortion), phase, SMPTE/DIN IMD (intermodulation distortion), real-time 2-channel amplitude ratio (interchannel balance or device gain), wow and flutter, real-time frequency selective crosstalk, ac mains check and the measuring of input impedance of the device under test. Each of these tests can be selected at the touch of a button. Two of the 10 function keys toggle between two functions.

Selecting between interchannel comparisons or input to output comparisons is also accomplished with the touch of a button. Either or both of the generator outputs can be muted with the touch of a button. Input for primary display (there are three measurements displayed in most cases) is selected with the touch of a button. Changing frequency or amplitude is quick and effective, whether the desired change is large or small. In a nutshell, with this unit you can quickly assess the technical performance of a piece of audio gear in a flash. While dwelling on certain measurement aspects of a device under test, it is easy to manipulate test parameters to execute your investigation.

TESTING THE TESTER

I had this unit for several weeks of evaluation in the field, as well as on my test bench. The majority of the field environments were professional 24-track studios. The interfacing of the Portable One to all of these rooms was easily accomplished with a set of long TT (or TRS long frame) to XLR cables. Testing systems with 1/4-inch phone patchbays or testing individual pieces of equipment on site would naturally require a comprehensive arsenal of adaptors at the ready. The unit consumes roughly the same volume of space in a studio as its predecessors, and it attracts the customary volume of gawking from operations personnel as a properly designed piece of professional technical equipment should. [This is always very important!—Ed.]

Within minutes, you can accomplish a complete technical performance verification of anything. Begin with Amplitude measurement, for example. The display tells you what the exact level is, in whatever measuring units you like, out to two decimal places. The frequency is displayed to the right of the screen in five digits. The same parameters of the generator output are also displayed, as well as the filters that are imposed on the input signal.

If you want to take a look at a Noise figure — *now!* — press the Amplitude button again and presto chango: there it is. Want to take a glance at the spectral characteristics of the noise? Press a soft key at the bottom of the screen and find the Selective Filter mode, where you may tune the band-pass filter that is now at the input. Seen enough of that? How about THD+N? Press a button; you're there. You can see the distortion figure in the form you desire, the signal level or the frequency. You can feed your scope via the analyzer output to view the distortion products. IMD? Press the button, it's done.

Wow and flutter measurements can be chosen from one of three standards: IEC, NAB, JIS. Again, the display shows the measurement, level and frequency. Level is a 2-channel measurement, which is handy for stereo setups. Ratio, Phase and Crosstalk are just as immediately available.

Other features include the Gen Load function and the Ac Mains Check. The Gen Load function measures the input resistance of the device under test. It is not a precise measurement, nor is it very accurate with reactive loads, yet I thought it was trick to be able to push a button and get some clue about the device input. The Ac Mains Check serves two purposes. The self-diagnostics are accessible here — standard equipment on today's microprocessor-based devices. The measurement mode is of line voltage, frequency and THD+N.

For some reason, I found this to be one of the most interesting things to observe from one studio to another (No doubt this has significant ramifications regarding some personal dysfunction of mine that I will one day trace to my childhood and clear with an unrestrained emotional outburst). Not having ac specs so readily at hand in the past made it a fascinating observation.

Once the novelty of instant measurement began to wear off, I had a tendency to explore, try things that were not so easy with my 1710. It is easy to quantify the phase characteristics of different EQs, investigate the properties of the new tape formulation that just hit the streets, that sort of thing. Punch a few buttons for a macro view, and with a little more time (which wasn't always easy: recording sessions kept bumping me out of the studio), I could develop a technical assessment of any conventional piece of gear.

The bargraph provides the "needle" counterpart to the 1710. As a person who prefers a clock with hands as opposed to a digital chronograph, I still miss a good old analog meter. Aesthetic consideration maybe? OK, call me old-fashioned, but I think there is a feel about a needle that provides a clearer overall sense of what is happening with the signal. (No doubt a sign of yet another unresolved childhood trauma, yes?)

PERSONAL CALLS

There are a couple of minor complaints. Changing level significantly triggers a bunch of relay switching inside the unit, apparently so that it can attenuate the sig-

nal for proper processing. I could not help but think of those placebo relays that are found in consumer electronics devices. You know, the ones that don't do anything but satisfy some neural appetite for sound when you push a button. Call me crazy, I don't like hearing those things clicking. (You make the call: aesthetics or dysfunction?).

Within minutes you can accomplish a complete technical performance verification of anything.

With two inputs, it seems an oversight that there are not two buffered input monitor outputs instead of just one. I think this unit would be a swell piece to stuff onto a test bench all strapped into a patch/switch panel, where your 2-channel devices could be monitored by pairs of ACVMs and both inputs of your oscilloscope. Maybe I'm silly, but here I am with two eyes and I can only see one thing at a time.

I am not sure if it's fair to complain about the lack of a sweep function. Given the apparent design criteria, it was obviously not part of the plan. Possibly, to implement it with the level of quality with which Audio Precision has built its reputation, would have placed it out of the targeted price range. That would be the one addition that I would want to a stand-alone unit like this.

CONCLUSION

Having investigated the depth of features and performance of the Portable One, the more than $4,000 price does not seem unreasonable. The generator output is extremely clean. Moving through the tests quickly is a function of the operator's digital dexterity. Adding the price of the W+F as well as other additional tests makes $4,500 sound like a fair deal compared to a 1710 or equivalent.

What mystifies me is why Audio Precision did not instead develop a laptop companion analogous in spirit to its System One. A high quality interface that improves in performance with each new wave of faster interface hardware and each new revision of software. That would be more in the spirit of these digital times. A small interface box, say 1U high, that is attachable to a laptop and able to move around a little is also a concept that has more appeal to me as a field engineer. I would prefer to spend closer to $1,500 on a dumber piece of dedicated measurement or interface hardware and buy the CPU brains of my choice.

For what it is, the Portable One is an excellent piece of test gear. I think its best application is similar to that of its mentor units — on the bench. If I did not have the budget for a System One, or if I was outfitting a quantity of QC or audio service stations, there might be little need to look any further than this. It does every test required for audio QC, and as a troubleshooting tool it is very fast. The finish is the sort of gray that is kinda hip, kinda now, too. Any qualified tech-type will know all that this thing does inside of half an hour. With all that it does as a single stand-alone unit, it's fun, too. ■

Circle (100) on Rapid Facts Card

Three From A&H

By Laurel Cash-Jones and Fred Jones

BORN IN THE USA

New from Allen & Heath's U.S.-designed and -manufactured family of consoles is the 19-inch rack-mountable Scepter Monitor Mixer. This unit is designed for applications requiring individual control of multiple outputs. Its standard configuration is a 12 input by 10 mixed output. For added flexibility, the Scepter may be operated in pairs, allowing 24-input channel capability. Each input channel has 3-band EQ with a high-pass filter and EQ bypass switch.

The standard microphone input is XLR electronically balanced, pin 2 hot, with optional transformer inputs available. The Scepter has the capability to generate 10 discrete mixes, making it ideal for any situation where a large number of individual mixes is desirable. On-stage monitor mixing, for example, is simplified by the inclusion of an on-board one-to-one microphone splitter system. Operation of the Scepter Monitor Mixer is further enhanced by the 2-band sweep EQ on all of the six balanced line outputs.

Circle (105) on Rapid Facts Card

IMPROVE YOUR VISION

It's easy; all you have to do is get the new Vision mixing console, again from the U.S. brains of Allen & Heath. The highly successful Scepter rack mixer is now available in this 8-, 12- and 16-input desktop version. The Vision has fewer outputs than its sister desk, the Scepter (Surprise! Surprise!).

In addition to the standard left and right stereo electronically balanced outputs, a mono output is also provided. There are also four auxiliary sends, two are pre-fader and two are post-fader. This console is expected to find applications ranging from use by local musicians to sound contracting. The Vision Series is designed to offer installation flexibility from a cosmetic point of view. All connectors have been placed on the rear panel; thus, all wiring will remain out of view in most installations.

Circle (106) on Rapid Facts Card

Laurel Cash-Jones is R•E•P's editorial consultant and a Los Angeles-based free-lance writer. Fred Jones is an audio industry observer and a Los Angeles-based free-lance writer.

SPEAK NOW OR ...

Yamaha's newest monitor speaker, the S8M 3-way, is similar in appearance to the famous NS10M, with its black grill cloth and black wood grain finish. The cabinet is a bass-reflex type that houses an 8-inch woofer, a 5-inch midrange driver and a 3-inch tweeter. The S8M is designed to be a highly sensitive and efficient speaker (90dB at 1W/1m) with a frequency response said to be a very smooth 50Hz to 20kHz.

To protect the speaker from excessive power bursts, an internal auto resetting breaker is provided. Because the speaker components are positioned symmetrically on the baffle, there is no need to worry about a left/right imbalance of the speakers. This monitor is scheduled to be available soon at a retail price of $180 per pair, which should make it a valuable addition to your monitor arsenal.

Circle (107) on Rapid Facts Card

ACROSS THE SPECTRUM

Yet another new console from the prolific Allen & Heath is the Spectrum (this one is from the United Kingdom), the lowest-cost member of the Saber line of recording and sound reinforcement consoles. The Spectrum is centered on a unique bus assignment and tape monitoring system that allows tape channel assignment and monitoring equal to the number of input channel positions.

This enables a Spectrum 32 to be used with any multi-track machine up to 32 tracks or two 16-track machines operating in sync. Each input channel has a switchable tape, mic and line input. Frame sizes available are 16, 24 or 32, with smaller formats expandable at a later date. An additional 16-line input section, plus four mono and two stereo dedicated effects returns, are provided in all frame sizes. All Spectrum consoles may be fitted with optional JL Cooper automation. External switching capability on each channel's tape in/out allows the use of either +4 or –10 operating levels. This can be used simultaneously so that some channels may be operating at +4, while others are operating at –10. A really hip feature is the built-in microprocessor-controlled MIDI mute functions. This means that a Mute Automation sequencer memory is contained within the console, which leaves more outboard sequencer memory free for musical instrument use.

All you need to add for "V4" automated control is an external MIDI clock. As with the Saber Series, all input channels and dual group modules have microprocessor mute functions. The Spectrum, however, also has microprocessor mute functions on all aux send circuits. PFL and solo in place are provided with a selectable mode switch in the master section. A PFL monitor function is used to sample a signal that is unmodified by fader and pan positions. In its smallest format, the Spectrum 16 provides 40 simultaneous inputs, 32 of which have EQ. Eight group faders are always available during tracking and mixdown, and all Spectrum consoles have eight auxiliary buses intended for effects and headphone cue mixing. Multiple switched monitor outputs are provided to enable the use of alternate control room speaker systems.

The best thing about this console is that almost all of the features we've mentioned (and many that we have not) are available as standard and *are not* extra added options, which translates to fewer dollars. This is also known as more bang for your buck!

Circle (108) on Rapid Facts Card

SEND IT WITH SENDIT

From those nice folks at Sendit in Burbank, CA, comes the Summit type A and B series of add-on mixer expanders, which fit practically any console and are perfect for those times when you need more but don't want to pay more.

The Summit A is a single rack space, 8-input stereo effects return mixer. Yes, that means a total of 16 inputs.

It's designed to return lots of stereo effects to a mixer without tying up valuable mixer inputs as returns. The Summit B is designed to ease the addition of a second mixer to your system by allowing you to sum all of the outputs of two different mixers (yes, this does include aux/effects sends) to individual master outputs.

The result: you can completely integrate the two mixers' output functions, even if they are from different manufacturers. If the two mixers are at different operating levels, such as +4 and –10, it can be remedied by minor internal jumpers and so end metering or level hassles.

All in all, these products can relieve many of your console headaches without costing you a fortune. ■

Circle (109) on Rapid Facts Card

Cutting Edge

JVC DAT MACHINE

The DS-DT900N DAT machine provides the capability to read and write SMPTE time code as specified in the IEC guidelines for DAT synchronization. Additional features include XLR and digital I/Os, parallel and serial ports, and a built-in sync generator. Conversion circuits are said to ensure greater low-level linearity and virtually no zero-cross distortion, using 64× oversampling delta sigma modulation, 3-stage FIR filter and fourth-order noise shaper.

Circle (111) on Rapid Facts Card

NEXO SR PRODUCTS

The company has introduced two sound reinforcement products. The TS2400 touring system is a compact enclosure using 3-inch neodymimum diaphragms, and is designed for large touring applications, particularly long-throw situations. The dimensions are the exact sub-multiples of standard internal truck measurements for packing ease, and the enclosure has six separate flying points with Aeroquip tracks for easier flying and hanging. The LSub is designed to augment systems that need extended bass response. The subwoofer is used in conjunction with the TDC controller, which provides variable delay and phase, adjustable 12dB/24dB/48dB per octave slopes and a built-in test signal generator.

Circle (112) on Rapid Facts Card

CELESTION MONITORS

The Studio 5 is slightly larger than Celestion's Studio 3, and houses a 6-inch bass/midrange driver utilizing the same advanced metal dome tweeter technology. The result is higher sensitivity and increased power handling. The 1-piece driver basket and fascia plate provide a low mass-to-high stiffness ratio; a felted fiber cone is used to reduce mass, providing improved low-end articulation.

Circle (116) on Rapid Facts Card

SPIKE and MIC

THOUGHTS WHILE WORKING OVERTIME

Cutting Edge

ENDECO DESOLDERING STATION

ENDECO's 7400 features the same performance as the company's 7200 series but does not require shop air. The patented self-cleaning action expels spent solder into a spittoon and prevents the unit from clogging. Temperature control and spike-free operation are standard; the console and iron handle are static-dissipating. Users can specify between a thumb switch or a foot pedal.

Circle (115) on Rapid Facts Card

SUMMERTONE TIMECODE MONITOR

Summertone's Timecode Monitor is designed to identify and log code errors in all applications where time code is being used. The system is designed to monitor the material unattended, sound an alarm when it detects an error, identify eight

kinds of value, level and time errors, report what it finds on the front panel, store up to 800 errors for review and send the error list to a printer for a permanent record. It is available in portable and rack-mount versions. Manufactured in the United Kingdom, the monitor is available domestically through A/Z Associates, the North American distributor.

Circle (119) on Rapid Facts Card

FOSTEX G-24S 24-TRACK

The G-24S is a 1-inch, 24-track recorder that contains a built-in SMPTE generator/reader with a full chase synchronizer and MIDI controller, Sony VTR emulation for direct connection to a video editor and Dolby S noise reduction circuitry. Included is a standard Fostex 20-pin synchronizer port, which interfaces to Fostex 4030/4035 synchronizers, as well as models from other manufacturers. Suggested retail price is $14,500.

Circle (117) on Rapid Facts Card

LONE WOLF NETWORK SYSTEM

The company's Virtual Studio combines the Virtual Studio software and the fiber optic-based Media Link Network Hardware. The system allows all music, audio and lighting setups to be managed through a graphic window on a Macintosh, Atari or PC compatible computer. Devices may be connected by drawing a line between them on the screen. All connections and configurations are automatically

saved. Because the system is fiber-based, many problems with wired systems, such as interference, ground loops and hum, are eliminated.

Circle (121) on Rapid Facts Card

SAKI REPLACEMENT HEADS

Saki Magnetics has developed a line of factory-equivalent replacement magnetic heads for use in Ampex ATR-100 recorders, including models ATR-100, -102 and -104. Designated the A-100 series, the heads are available in metal or ferrite construction, in both NAB and DIN formats. Most formats can be furnished with Sel-Sync. According to the company, the heads meet or exceed factory specs in all essential characteristics. They can be ordered with the standard Ampex mount and are interchangeable with factory heads without modification.

Circle (120) on Rapid Facts Card

SHURE FP410 MIXER

Billed as the first portable automatic mix mixer, the FP410 is designed for a variety of multi-microphone uses. The unit keeps the unused mics turned down, which automatically improves audio quality and provides a seamless mix. Three features are behind the design concept. Noise-Adaptive Threshold activates mics for speech but not for constant room noise, such as air conditioning; Max Bus Circuitry limits the number of activated mics to one per talker; and Last Microphone Lock-On keeps the more recently activated mic open until a newly activated unit takes its place. User net price is $1,595.

Circle (114) on Rapid Facts Card

PIONEER VIDEODISC RECORDER

Pioneer's Rewritable Videodisc Recorder provides a fast random access time and frame-by-frame editing, providing users with more flexibility and accuracy in editing. In audio applications, the system erases and records simultaneously, allowing it to be used to dub audio onto video. Additional applications include still-frame editing, film and video editing, compiling broadcast libraries and animation.

Circle (122) on Rapid Facts Card

DIGITAL PROCESS HEADPHONE AMP

The Digital Process DPH-4 is a 4-channel powered stereo headphone amplifier, featuring a direct-drive 5532 op-amp that provides low noise and eliminates phase distortion. The unit is equipped with four independent volume control stereo outputs, allowing musicians to set personal levels. A 10dB pad selector switch assures proper performance. The unit can also be used as a pre-amp.

Circle (125) on Rapid Facts Card

NEVE HRC-1

The HRC-1 is a 20-bit A/D and D/A converter based on the company's high-resolution circuit layouts. Additional circuitry provides synchronization, digital interfacing, dc processing and digital redithering. Balanced line-level analog I/O

and AES/EBU digital I/O with limited channel status support are included. The AES/EBU output is available on two separate, independently driven connectors.

Circle (113) on Rapid Facts Card

SHURE VIDEO MIC

The latest addition to Shure Bros.' video production line, the VP64 is an omnidirectional hand-held mic designed for field interviewing in ENG applications. Features include an attractive on-air appearance, neodymium magnet for higher output, internal shock-mounting and rugged construction. User net price is $135, which includes a windscreen and stand adapter.

Circle (123) on Rapid Facts Card

E-V DELTAMAX MONITOR

The DML-1152MC is Electro-Voice's latest addition to the DeltaMax line, offering the same performance as the DML-1152A while incorporating some new features.

Cutting Edge

The system features a 15-inch DL15X LF woofer and a DH1A HF driver on a special verison of the HP64 horn. The monitor comes in a carpet-covered 14-ply Finnish birch cabinet and is equipped with Neutrik Speakon connectors. Using the system controller, the DML-1152MC has a frequency response of 50Hz to 18kHz and can deliver the range at extreme SPLs.

Circle (127) on Rapid Facts Card

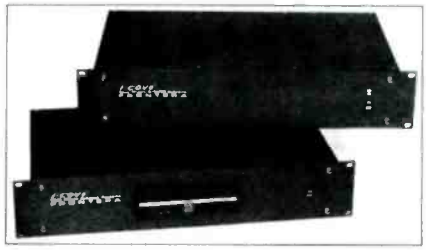
FURMAN VOLTAGE REGULATOR

The AR-PRO ac line voltage regulator handles 30A through a twist-lock connector and supplies clean, regulated ac power at each of 12 rear panel and two front panel outlets. It can supply a nominal 120Vac output from any input from 88V to 264V, allowing it to be used as a power distribution system almost anywhere in the world. Additional features include 21-LED bar graph meters for input voltage and input current, and three status lights indicating output regulation. Suggested list price is $1,749.

Circle (126) on Rapid Facts Card

FRONTERA STORAGE SYSTEMS

Frontera Electronics' i•cove series of rackmount storage systems is designed for SCSI-equipped keyboard samplers and IBM PC, Apple Macintosh, Commodore Amiga and Atari ST computers. Capacity ranges from 40Mbytes to 1200Mbytes, and includes fixed hard drives, 44Mbyte removable, CD-ROM players, and streaming tape and DAT backup systems. All are housed in 2U rack enclosures and have double-shock mounting, auto-switching power supplies and cooling fans.



Circle (118) on Rapid Facts Card

E-V S-40 MONITOR

The Electro-Voice S-40 is a 2-way close field monitor designed for a variety of applications. It features a 5 1/4-inch direct-radiating polypropylene woofer coupled with a 1-inch ferro-cooled soft-dome tweeter; according to the company, the combination produces extended bass response and a smooth top end. PRO circuit protection provides independent protection in case of an accidental overdrive, and automatically resets when the system returns to a safe level. Long-term power handling is rated at 160W per EIA RS-426A.

Circle (124) on Rapid Facts Card

Classified

EUPHONIX AUTOMATION

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TASCAM M-3700 CONSOLE

Available in 24- or 32-channel configurations, the M-3700 is said to be the first console in its class to be available with a complete automation system built-in. The console includes dynamic automation of level control adjustments and signal routing, and includes a built-in disk drive, a SMPTE generator and a write/update mode. The monitor, aux send, main channel and EQ can be muted on each channel. Also included are eight group buses, four fully assignable effects return switches and six aux sends.

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OAP T-212 SPEAKER SYSTEM

The T-212 can be used as a 2-way system when used alone, or as the mid-high section of a 3-way system when used with OAP's TR218 or LF118. The 212 uses two 12-inch transducers and a 2-inch throat large-format compression driver, coupled to either a 90°×40° or 60°×40° constant dispersion horn. The system is trapezoidal with a 15° taper and contains three steel-reinforced points on the top and bottom. An adjustable baffle for the horn and driver allows them to be rotated 90°.

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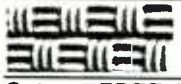

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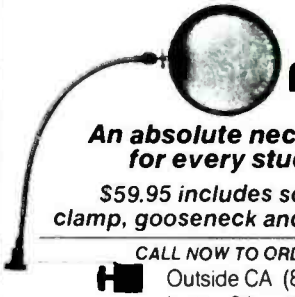

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	Page Number	Rapid Facts Number	Advertiser Hotline
Akai/IMC Pro EMI	19	12	817-336-5114
Aligned Audio	70	59	718/788-6969
Anything Audio	67	55	617/426-2875
Aphex Systems Ltd.	29	16	818/767-2929
Sam Ash Professional	57	38	212/719-2640
Audio Visual Assistance	65	50	612/481-9715
Bryco Products	59	28	818/783-9133
Countryman Associates, Inc.	53	25	800/669-1422
Crown International	IFC	1	219/294-8000
DAT Store	62	32	213/828-6487
DB Engineering	66	53	617/782-4838
Denecke	62	33	818/766-3525
Disc Makers	57	37	216/232-4140
Dolby Labs Inc.	37	19	415/558-0200
Drawmer	25	15	508/650-9444
Eltekon Technologies Inc.	23	14	313/462-3155
Fast Forward Video	59	30	714/852-8404
For-A Corp. of America	17	11	508/650-3902
Full Compass Systems	61	31	800/356-5844
Furman Sound	41	21	415/927-1225
Gand Music & Sound	64	40	708/446-GAND
Hill Audio/IMC	35	18	817/336-5114
HRC Magnetics	51	35	800/443-8457
Image Watches Inc.	59	29	213/726-8050
Jensen Transformers Inc.	45	22	213/876-0059
JVC Professional Products Co.	11	8	800/JVC-5825
KABA Research & Development	39	20	415/883-5041
Lexicon Inc.	3	5	617/736-0300
Magnetic Reference Lab Inc.	63	39	415/965-8187
Markertek Video Supply	67	54	914/246-3036
Mercenary Audio	65	69	617/784-7610
National Foam Inc.	66	52	213/650-8906
Ocean Audio	69	57	213/459-2743
Otari Corp.	1	4	415/341-5900
Oxmoor	55	26	205/985-7040
Peavey Electronics Corp.	IBC	2	601/483-5365
Polyquick	53	24	708/390-7744
Rane Corporation	13	9	206/355-6000
Recording Industry Source	64	41	213/841-2700
Seam Tech	66	51	415/861-6011
Sonic Solutions	15	10	415/394-8100
Sony Professional Audio	7		800/635-SONY
Soundcraft U.S.A.	BAC		818/893-8411
Soundtrax Recording	20-21	13	615/929-0402
Spatial Sound, Inc.	51	36	415/457-8114
Tannoy North America Inc.	4	6	519/745-1158
Tascam	30-31	17	213/726-0303
A Total Effect	71	60	818/345-4404
True Image	68	56	619/480-8961
World Class Tapes	69	58	313/662-0667

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