SPECIAL ISSUE! DIGITAL RECORDING

EQ

THE CREATIVE RECORDING MAGAZINE

JULY/AUG 1990•DISPLAY UNTIL AUG 31

- **DAT SHOPPING GUIDE**
- **LIVE-TO-DAT RECORDING**
- **DIGITAL WORKSTATIONS**
- **REVIEWS:** SOUNDTOOLS, DYAXIS, TASCAM MSR-24
- **SHEP PETTIBONE:** DANCE REMIX MASTER

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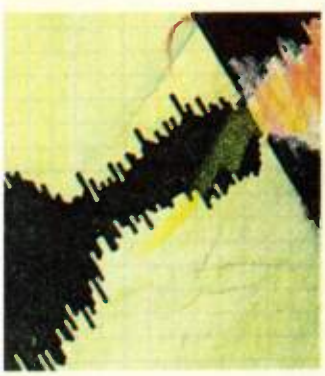
EQ

VOLUME I, ISSUE #3 JULY/AUG 1990

THE CREATIVE RECORDING MAGAZINE

FEATURES



DEPARTMENTS

SPECIAL ISSUE

It seems many studios are buzzing, or perhaps buzzing *less*, now that they're using the latest digital technology. *EQ* explores the machinery, the techniques, and the media itself in this, our first special issue.

Each of our three feature sections includes a general theoretical overview, gritty details, and real-life applications in the digital domain. Start with page 26: Twelve Things To Know.

IN REVIEW

COLUMNS

Walls Are Falling

IN NO TIME AT ALL, IT WILL BE 1992, AND PEOPLE INVOLVED in Europe's recording scene know what that means: 12 European countries will form an economic union of 380 million people—the largest consumer group in the Western world. The continent is pulling together at an incredible rate; and, as recent events illustrate, even East Germany, Hungary, and other Eastern Bloc countries may join the European Economic Community.

Perhaps that's why one could walk away from two recent overseas conventions (see Update, page 14) with the feeling that the European Community is focusing more energy on developing music and recording gear for customers in its own backyard. Many people no longer feel that conquering the North American market is the sole definition of success.

I think, for instance, of manufacturers like Raindirk (consoles), ADT (more consoles), Publison (digital effects), and others who seem to be doing quite well, with little or no presence on this side of the pond. I met a Yugoslavian speaker-maker who was bursting with pride just at the opportunity to show his designs to colleagues from neighboring countries. I talked to a producer who had a string of hits in the Euro-charts, but who had no desire to work in the U.S. And I can still hear the thuds of acid-house music targeted expressly for European dance clubs.

Some people in the recording industry see the European Community as a threat to technology and music. They fear that the "United States of Europe" will fortress itself economically and culturally against outsiders, their wares, and their talents. I prefer to hope that Europe will open itself even further. There is a wealth of musical and technical talent beyond the North American shores. The walls falling in Europe today may broaden everyone's artistic horizons tomorrow.

Think of the creative opportunities that will result from a less-partitioned world. As a producer or engineer, if Barcelona becomes an international recording hotbed, wouldn't you want the chance to work there? As a musician, think of your first MIDI data swap with a "modem pal" on a Moscow-based computer bulletin board. As a manufacturer, look forward to emerging markets. As a human being, celebrate the chance for people from historically estranged cultures to get to know one another better. Music as the universal language? *C'est possible.* This may be your chance to speak it.

• • •

EQ is off to an amazing start. After just two issues, our subscriptions are four times what we expected, newsstand sales are going strong, and we're enjoying distribution in an incredible 44 countries! If you're a new subscriber, one of GPI's former *HR* newsletter subscribers, or have bought *EQ* on the newsstand—thank you for your support. I hope you like our hands-on approach to serious creative recording, and our no-nonsense product reviews.

For many of us, digital recording has been a long train coming, but it's finally pulling into the station. We climb aboard it in this first Special Issue of *EQ*.

To fans of our Down To Business and Studio Clinic columns, How It Works, and Studio Solutions—these regular features will return in the coming issues of *EQ*.

And to Palladium, New York City, thanks for letting us have a photographic heydey with Shep Pettibone.

Brent Hurtig

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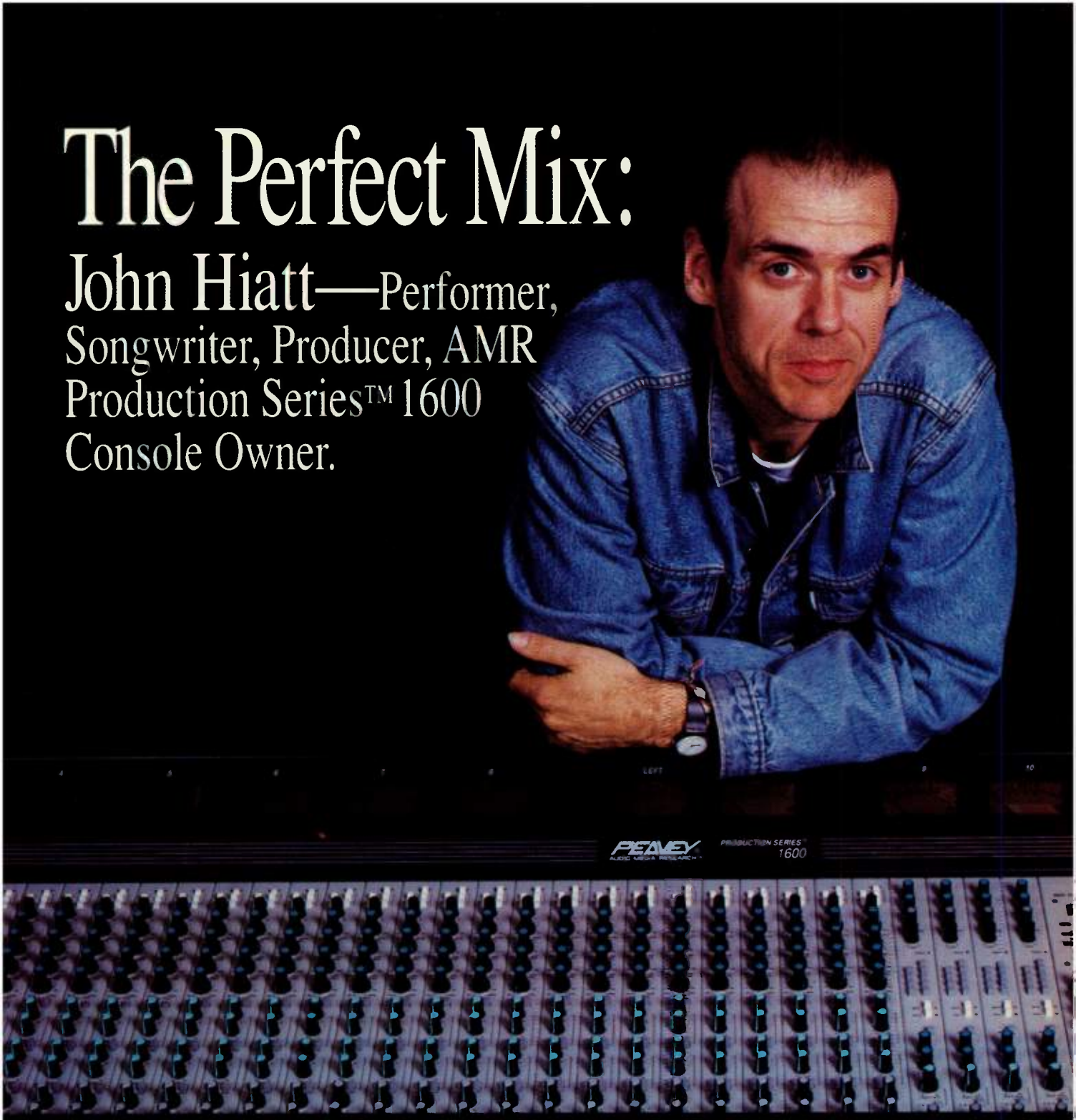

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future watch

A Long, Strange Trip To Good-Sounding TV

BY LINDA JACOBSON

A PSYCHEDELIC MELANGE OF tie-dyed Deadheads was the sight that greeted the swarms of red power-tied dark suits who scurried, ambled, or trudged to and from Atlanta's Georgia World Congress Center. The Center held 1990's National Association of Broadcasters convention, and it stood right next door to the last stop on the Grateful Dead's spring tour.

Inside the convention center buzzed a city of shining technology. This city springs up every April when broadcast, production, and video professionals gather to explore the present and future of TV and radio technology, engineering, and management. This year's techno-metropolis was populated by product exhibits, seminar rooms, and over 55,000 people.

Just ten years ago, the conservative broadcasting industry generally regarded audio pros the way they regarded the Deadheads in Atlanta: as starry-eyed, idealistic, non-mainstream. Back then, conventions were segregated, with radio and audio exhibits relegated to a separate area. Back then, the TV types snorted, "Who cares about quality sound? TV sets have 3" speakers!"

They're singing a new tune →

Jack Nilles' Guest Editorial on working at home [EQ *May/June '90*] is a flagrant example of ethnocentric elitism and economic naivete. Who does he think is going to manufacture those miracle modules with which he produces his HDTV multimedia masterpieces? If he tries to wire them up from scratch in his idyllic little cottage, I can promise you he won't be up and running by 1995.

Except in specialized areas, the so-called information revolution doesn't replace industrial technology. Instead, it builds on the base provided by industrial technology. And who is building the modules? The Japanese, Koreans, Taiwanese, that's who. They're thronging into overcrowded, alienating cities, just the way our great-grandparents did in the first industrial revolution. They're also reaping the economic rewards, while self-absorbed Americans flounder ever deeper into the swamp of the trade deficit in order to diddle with our high-tech toys.

Except when it relates to basics like how to grow crops and build bridges, information is a luxury. And we know what happens to cultures that overvalue their luxuries while undervaluing hard-headed business acumen. I hope Jack Nilles has his SMPTE-synced fractal animation software backed up on hard disk when the barbarians come knocking at the door.

JIM AIKIN
Cupertino, California

Jim Aikin is the managing editor of Keyboard *magazine.*

I was moved. Your first issue's cover story [*Mar/Apr '90; "Studio Wars: Everybody Must Get Zoned"*] was very pertinent. Being a musician transformed by the techno-revolution, and a family man, I can only emphasize the conclusion of Cary Tennis' feature story and salute him for writing a fine piece of journalism. One emotionally difficult aspect of a musician's life is to have to leave the family to go on tour. Especially when your mate is also an associate, as my wife and I have been. Then, children suffer. The new tools available have changed the equation, and given musicians the opportunity to get back to a more decent lifestyle, to come back home.

Living in a remote region of North America, publications like yours maintain an open channel decisive to the evolution of us back-woods lumberjacks. How sweet it is to get back to the ol' log cabin after a day of wrestling bears, hunting beavers, and discussing Gabriel Garcia Marquez with an open-minded moose, and sip on fermented maple water and indulge in your magazine!

RICHARD POULIN
Atholville, N.B., Canada

Regarding L.A.'s studio controversy, I would like to thank Mr. Tennis for his article, particularly for his closing statements. Due to continuing technological innovations and the financial barriers "major" studios often present for many artists and musicians who seriously want to compile a body of their work, I feel small studios are indeed a sign of our evolving industry, and society as a whole. Because "integration of life, work, and art" is a goal sought by more and more individuals within our society, regardless of their profession, and because "the powers that be" wish to remain so, the "studio wars" present a microcosm of larger events that warrant close scrutiny. Please continue to investigate and report these important developments.

PAUL NIGHBERT
Artist Sound
Danville, California

I enjoyed your premier issue and Cary Tennis' "Studio Wars" immensely. As a sole proprietor, I can sympathize with the "pro" studios. However, please consider: Why should Jones not be permitted to make money in his own house when others can make money there? The doctor who makes a house call, the band hired to work there on New Year's Eve, the landscaper that does his lawn, the company that rents him his cable TV, all make money from some activity on his property. Are they breaking zoning laws? Tennis' astute perception is accurate in that the L.A. zoning approach is a desperate and pathetic tack on the part of the "pro" studios.

Next, why does the IRS encourage precisely this activity by allowing people living in L.A. (or anywhere) deductions for home office space used for business purposes?

According to L.A. law, I as a composer/music teacher am denied the right to make money in my home when this right is granted to an MD, DDS, shrink, palm reader, and that special breed, the lawyer. To deny any artist the right to make money from his pursuit in his own home tells you something about our pathetic society...

...I can sympathize with both sides. Some *are* taking advantage of the situation, but the recording industry has had artists over a bar-

CONTINUED ON PAGE 62

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LINE IN/LINE OUT

WE FIND WRITERS AND ARTISTS IN all the usual ways, and some unusual ones as well. Take the case of Scot Halpin, the artist whose icons adorn our workshop columns, and whose illustrations appear with our Future Watch and Across The Board columns. It turns out that Scot earned his 15 minutes of fame playing with The Who in 1973. During a concert in San Francisco, Keith Moon passed out on stage. Scot, who was standing at the edge of the stage, told promoter Bill Graham that he could play drums, and in no time at all he found himself under the lights with Pete Townshend and company, banging out "My Generation." During a visit to our office he mentioned that he still played music in his home studio and worked as a graphic artist. Before you could say "Call Me Lightning," we asked him to submit designs for *EQ*. We think the kid is all right.

Our report on the status of the digital audio workstation was co-authored by our own Jeff Burger along with Scott Martin Gershin, whose byline often appears in our product review section. Gershin is a Los Angeles-based sound designer who has employed digital audio workstations on projects including Disney's *Honey I Shrunk The Kids* and CBS-TV's *Beauty And The Beast*. Gershin and his coworkers at Sound Deluxe worked on the soundtracks of *Glory* and *Born On The Fourth Of July*. Both were nominated for Grammy Awards for best sound; the former won. •

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New Products & Reviews

Send new product information to be included in a particular issue to "Update," c/o Jeff Burger at our Cupertino office, at least three months prior to the cover date. We also review recording and production equipment, both hardware and software. In addition, we review new records and CD releases, as well as instructional videos, software, and books, so send record/video/book release information to "Reviews" c/o Linda Jacobson, *EQ*, 20085 Stevens Creek, Cupertino, CA 95014.

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today. The people want good sound. That means advertisers care about sound. And that means broadcasters must care. Now audio is respected, as evidenced by the omnipresence of audio exhibitors at the NAB show. Over 100 exhibits (of 750) showed audio and sound products. There were NAB "old-timers" like Ampex, Dolby, Otari, and Sony, who've long inhabited both audio and video houses. Names familiar to studio folks were relatively new kids on the block at NAB, including Sonic Solutions, Digidesign, GML, ART, and more.

No matter whom you visited—audio or video—the buzzwords were digital, digital, and digital. Engineering seminars covered digital audio topics. TV/video engineers shopped for DAT hardware, MIDI gear, digital stereo production mixers for post work,and digital audio workstations. They checked out Sony's serial digital video system, which provides four channels of digital audio. Interactive laser-videodisc displays attracted educational a/v types.

All these pros are relying more and more on RAM- and disk-based digital recording and editing—soon they'll be hooked.

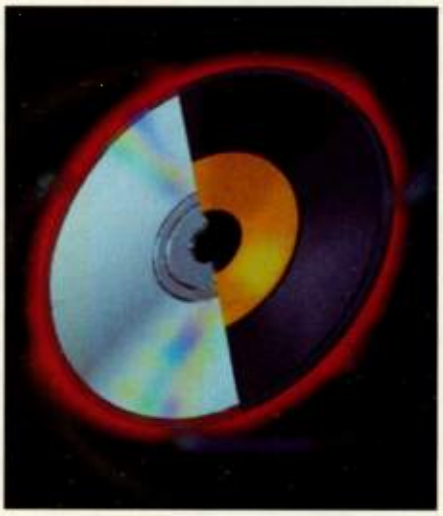
Besides DAT, the most-seen initials at the show were "HDTV." High-Definition TV delivers twice as much vertical and horizontal picture resolution as our present NTSC TV. The result is a *stunning* image and CD-quality audio that will be delivered to our homes on wide, flat screens with 2-way speakers. The HDTV exhibit, set up as an actual production environment, integrated all the elements of this new type of TV. Companies supporting this exhibit with audio gear were NVision, Dolby Labs, and New England Digital. NED supplied the new PostPro SD workstation, providing digital audio for the exhibit; Dolby contributed a digital audio modulation system; and NVision supplied a digital audio multiplexer, which interconnects with digital video recorders →

Analog Can Do

THE MOST CONTROVERSIAL subject discussed by recording engineers nowadays is whether to record analog or digital. I've used both analog and digital for a few years, and, like my colleagues, sometimes prefer one over the other. I know producers and engineers who still prefer analog; I also know a prominent engineer who requests more money (royalties) for the artist and label when a project is recorded, mixed, and mastered in the digital domain, because record labels and digital multitrack manufacturers make more money from CDs with the DDD notation (digitally recorded, digitally mixed, and digitally mastered). Admittedly, analog recording soon may be history, but it's still a great working medium for many purposes. Digital, on the other hand, is undoubtedly the way of the future, but not yet perfected.

The advantages of digital audio are impressive, yet many theoretical claims have been disproved. The notion of "infinite" copies with inaudible loss of fidelity is just not true. Storage capabilities are questionable and idiosyncratic (*supposedly* the data on these tapes will last forever). Editing and assembling digital is awkward compared to analog, especially in the open-reel format. Hard-disk editing lets you be very precise, but it takes so much longer to do. Other problems, such as mysteriously uncontrollable transports, arise at the most inopportune times.

I will use digital, but it's not my first choice for most projects, especially projects with budgetary constraints. When I use 3/4" U-matic videotape to store digital audio, I have to do expensive electronic editing and assembling in a mastering suite (costing about $250 an hour). But with analog, I can assemble and edit an album using a razor blade, with clean ins and outs for the beginnings and ends of songs, all in the recording studio, for about $75 an hour.



Analog has been around awhile and is about as good as it ever may get. A well-recorded tape using Dolby SR noise reduction and mixed with an automated system such as GML or Neve's Flying Faders is just as clean as digital. In any case, most people can't tell if it's digital or not. (Speaking of "clean," if your tape has distortion or is shedding, you can hear it on analog. But you can't hear digital dropouts much of the time until you get to the mastering lab, which can be many playbacks later.)

I just finished a project that illustrates my feelings. My client, a jazz musician, was given a typical recording budget by his label. We recorded and overdubbed at Mad Hatter, a major L.A. studio. I advised mixing to 1/2" tape using Dolby SR, since the studio had great (analog) 2-track machines and we were over budget. But the record company wanted to go digital and since the 3/4" storage format was out of the question (budget-wise), we mixed down to an "easy-to-edit"

CONTINUED ON PAGE 62

"Analog recording soon may be history, but it's still a great working medium for many purposes."

BY IRA CORD RUBNITZ

Ira Cord Rubnitz is an independent recording engineer based in L.A. He is a graduate of University of Miami's music engineering technology program, and has engineered recordings by James Brown, Aretha Franklin, Smokey Robinson, Chick Corea, The Bangles, Robben Ford, Mark Isham, and many others.

VIDEO ILLUSTRATION: REYNOLDS T. SHOMAKER

Herbie Hancock

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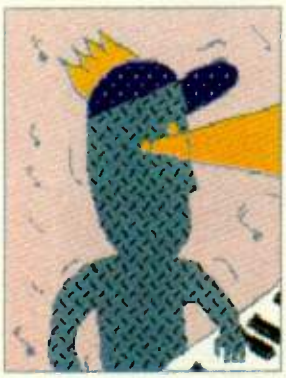
Thomas Dolby



"As for which sequencer you choose, I think that depends on what style of musician you are. The one that I've finally settled on, and which I'll use for the next album, is Opcode's Vision."

Jan Hammer

"If you compare all the really good sequencers on the market, Vision is more than the sum of all of those sequencers."

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WRH

future watch continued

Also participating was the European Broadcasters Union, who ushered in digital audio broadcasting, combining digital stereo sound and echo-resistant digital transmission. The resulting CD-quality digital audio would be delivered with as much coverage as FM.

Hi-def equipment today is like TV was in the '50s: bulky, heavy, not quite perfected (except for audio—always ahead of our time!). Unlike the '50s, however, the Europeans and Japanese are leaders in HDTV development; the Japanese have worked for 20 years on it. We Yanks, in the meantime, haven't seen much public demand for hi-def because we've had little exposure to it. And Uncle Sam isn't helping. The FCC has told broadcasters that they can't stop NTSC broadcasting, and wants U.S. manufacturers to develop their own HDTV hardware and set their own standard, compatible with NTSC—independent of significant European and Japanese developments—so the U.S. can maintain a global technolead.

Some industry observers suggest we *could* concentrate on providing hi-def *programming*, adapt HDTV from overseas, and let it co-exist with the NTSC TV sets out there, like CDs do with LPs. But America's broadcasters have a big investment to protect.

Their future looked brighter after a major NAB announcement by Zenith, America's lone surviving major TV-maker. Zenith, with AT&T's help, unveiled Spectrum Compatible HDTV, a proposed production standard that lets broadcasters transmit HDTV signal in the same bandwidth as today's broadcast standard, compatibly and simultaneously. It's scheduled to be tested by the FCC in 1991—with a new broadcast standard to be selected in 1992.

Meanwhile, prototype HDTV receivers and studio production systems are in development. So sometime this decade we'll reap the benefits of a fantastically improved a/v medium for entertaining, educating, and communicating. Stay tuned. •

Timing The Conversion To Digital

THE DIGITAL AUDIO TRAIN may be pulling out of the station, but choosing the right moment to jump on board is tricky. With the selection of appropriate hardware, purchased at the right moment, you'll board unscathed, and emerge with a higher-quality product than ever before.

Whenever an industry undergoes significant technological change, there's a transitional period in which formats (and manufacturers) do battle. Sometimes one format comes to dominate; sometimes the market is broad enough to allow competitors to coexist peacefully. Personal computers can be divided into "before the IBM PC" and after. This machine redefined the standards for desktop units, but meanwhile, companies such as Eagle and Osborne, which once made millions each year selling personal computers, are history. It would take quite a nervy gambler to lay down a bet on which digital audio formats will persist for the next ten years. Or five years, for that matter.

So some clever cost/benefit analysis must take place when it comes to purchasing digital audio equipment. It isn't tough to justify buying a DAT machine, because it costs about the same as a decent half-track recorder, and unless you need to cut and splice tape, it outperforms its analog counterpart. But digital multitracks are a much tougher nut.

Multitrack digital tape recorders and disk-based systems are expensive, and that's not going to change for a while. If you can afford to book hundreds of hours of time at world-class rates, the return on investment in a high-end digital multitrack will be rapid enough to justify a purchase or lease. But if payments must extend for years, and you can't be sure of a steady income for the loan/lease life, it might be time to drop back and punt—don't make that big-time purchase yet.

A different problem is posed by digital recorders that use unique, proprietary formats, such as Yamaha's DMR8 (8 to 24 tracks) and Akai's A-DAM (12 to 36 tracks).

J. D. Sharp is the owner and proprietor of Bananas At Large, a Northern California pro audio and music dealership.

While the A-DAM delivers professional performance [*see* EQ *Mar/Apr '90*], and the DMR8 promises the same, their formats probably will remain proprietary, which would restrict their ultimate acceptance.

But that doesn't mean they aren't viable machines for the right user. Again, the key is *return on investment*. Say you're recording an acoustic music album and are about to drop 20 grand in studio time. It might make perfect sense to buy an A-DAM instead and "roll your own." That way you can enjoy the benefits of digital recording, and your investment can be recovered in one or two projects, so the purchase would make sense—even if the A-DAM becomes obsolete.

Tape-based systems aren't alone in the format battles. The area of disk-based, multitrack and 2-track systems is one where proliferation of non-standard machinery will accelerate into mass confusion over the next few years. But that doesn't mean you shouldn't buy one. The question to ask is, "Does this system meet my re-

CONTINUED ON PAGE 23

Return On Investment Justifies The Jump To Digital

BY J.D. SHARP

ILLUSTRATION: SCOT HALPIN

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UPDATE

News & Notes From The World Of Modern Recording And Knob Twisting

Compiled by *EQ* editors


Otari MTR-15

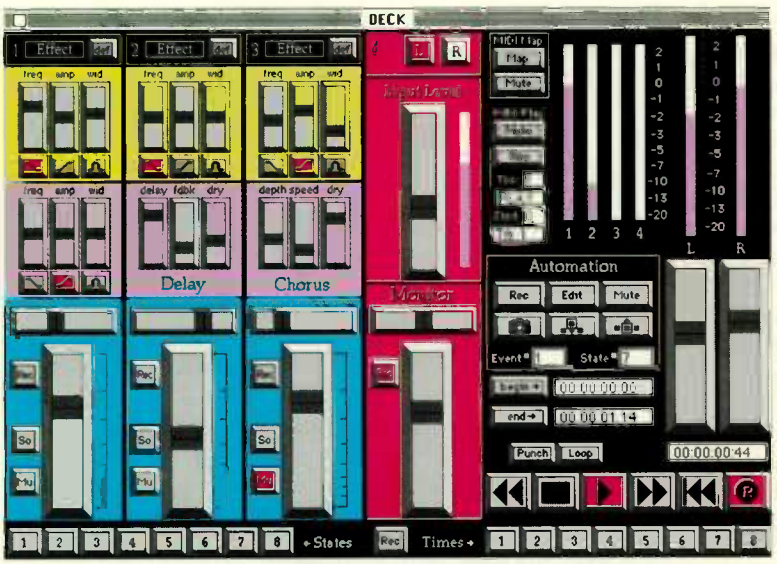
New Open-Reel Machines

SEVERAL NEW open-reel recorders have been announced recently. The 2-track MTR-15 from **Otari** supports 4 speeds (3.75, 7.5, 15, and 30 ips); four headstacks are available—1/4" half-track, 1/4" half-track plus center time-code track, 1/2" half-track, and 1/4" full-track. Each headstack bears an electronic I.D.: The machine can be programmed to auto-align EQ and bias fully in playback and record modes for four tape types—at each speed, independently, on each headstack. The transport offers closed-loop tension control of reel servos, a time-code-based four-position autolocator, and user-definable functions. Interfaces include Otari parallel I/O and RS-422 machine control. Options include a rolling stand with flying meter bridge, and a plug-in board that pitch-shifts fast tape playback down an octave for better high-speed editing. The price will be around $10,000.

The **Tascam** BR-20 is a 1/4" 2-track available in two versions for mastering and broadcast production: BR-20 and BR-20T with center time-code track. Features include rackmount flanges, tension servo-controlled motors, gapless and seamless punch in/out (20T), spot erasure, and independent reel size selection, along with independent record and monitor select for each channel. The transport supports three autolocate points (plus return-to-zero) and a block repeat function. Options include transport remote, built-in monitor speaker, and built-in microphone inputs. Tentative prices are $2,295 and $2,995.

In multitracks, **Fostex** just announced the G-16, a 1/2" 16-track designed to succeed the popular E-16. We saw the machine at the Frankfurt Musik Messe and thought the transport felt substantial and autolocate functions were impressive. Features include Dolby C, a removable front panel/remote control (*à la* the Fostex R-8), jog wheel, spot erasure, and rackmount kit. Programmable functions include meter ballistics for average, peak, peak-hold (with user-definable duration), and spooling speed. While the E-16 includes a standard Fostex sync port, front-panel controls are included for an optional internal 8330 synchronizer card that reads both SMPTE and MIDI time codes. Price is $8,000.

These exciting new products indicate that in a world that's going digital, there's still plenty of room for advancement in the area of analog open-reel machines. •



The Latest In Computer-Based Digital Audio Products

AS WE GO TO PRESS with our special Digital Audio Workstation feature (page 27), our phones are ringing off their hooks with manufacturers' late-breaking product announcements.

One of the most exciting is **Digidesign**'s Deck ($349)—a 4-track digital recording software program for the Macintosh II family. The system also handles MIDI file playback and simple 16-track MIDI recording using the same onscreen "transport" control screens: This combination lets live tracks such as guitars and vocals parallel MIDI tracks in a single environment. Now you can bounce tracks an unlimited number of times without degradation, and a special 4-track-to-2-track bounce mode allows internal mixdown with the full complement of tracks. Internal digital effects such as EQ, chorus, stereo synthesis, and delay can be added to individual tracks. Deck can control track volume using the mouse with on-screen faders, or MIDI-controlled fader systems, and mixdown can be automated. Other features include sound-on-sound, looping, autolocate, and punch-in/out (with pre- and post-roll).

Deck requires one of Digidesign's 16-bit 44.1kHz NuBus cards: Sound Tools [see page 66] or the new Audiomedia board ($995). When used with Deck, Sound Tools has a signal-to-noise spec of greater than 90dB, supports only non-real-time DSP, records one track at a time, monitors two tracks while recording, and offers external sync capabilities. Working with Deck, Audiomedia has a signal-to-noise spec of greater than 85dB, supports real-time effects, simultaneously records two tracks, monitors up to three tracks during record, and does not support external sync—yet.

Steinberg soon will release the much-touted Topaz, a disk-based recorder for the Mac II family. The unit comes in a stand-alone chassis and offers real-time editing and DSP processing during playback. Up to eight units can be controlled from a single Mac for a total of 16 channels, which is impressive, although it may not be a cost-effective proposition at current prices (each chassis sells for around $25,000). The hardware can be driven by various task-specific software packages, all of which are designed to provide true multitasking when used with Steinberg's CuBase sequencer software.

The DR-2 from **Alpha Audio** is a disk-based recorder employing the Exabyte 8200 console. Single-drive systems can be setup in increments of 15 track-minutes ($10,000), 30 track-minutes ($12,000), or 60 track-minutes ($15,000). Up to seven additional drives can be added. Each drive holds up to 256 discrete audio elements, such as takes or cues. DR-2 systems can be controlled from a video editor, audio editor, or a console with integral machine control. An optional dedicated controller with cut/paste functions ($1,995)—with a small footprint and unique design—is needed if no other external control is used. Backup to 8mm is available via SCSI with a speed of 40% of real time. •

CyberArts Update

CYBERARTS INTERNATIONAL IS THE conference on interactive and multimedia technologies in the arts, to be co-hosted by *EQ* and *Keyboard* magazines. Since we announced it last issue, many leading cyber-thinkers have agreed to make presentations. For instance: Bob Moog, Joel Chadebe, Don Buchla, and Dave Smith will discuss instrument design; Peter Gotcher (head of Digidesign) will talk about what it takes to assemble a desktop multimedia production system; Adrian Freed (UC Berkeley) and Andy Moorer (Sonic Solutions) will cover audio and video DSP technology; Durand Begault (NASA) will focus on the facts and fiction of 3D sound; Jaron Lanier (VPL Research) will demonstrate virtual reality; Frank Radice (ABC-TV News Interactive) will run an interactive videodisc authoring workshop; and Gary Rydstrom (LucasFilm) and Jay Riddle (Industrial Light & Magic) will deal with sound effects and computer animation.

Also in the works are three evenings of concerts, a CyberArts gallery, hands-on workshops, and manufacturer-sponsored exhibits.

Four-day admission is $450 ($395 if received before June 30). The conference will take place on September 6-9, 1990, at the Los Angeles Biltmore Hotel. For information on attending or exhibiting, contact: CyberArts International, 500 Howard St., San Francisco, CA 94105; telephone (415) 267-7646 or fax (415) 995-2494. •

Reporting From Europe. . .

LAST SPRING, many audio industry people spent almost a solid month ogling new equipment, getting bumped from airplanes, negotiating deals, and powershmoozing. The cause of all this activity was three major trade shows, held back-to-back: the Audio Engineering Society convention (Montreux, Switzerland), Musik Messe (Frankfurt, West Germany), and the National Association of Broadcasters convention (Atlanta, Georgia).

As we reported in our premier issue (Mar/Apr '90), several manufacturers are getting tired of the expense and hassle of so many trade shows. In fact, the talk of the AES show was less about gear and more about the "British boycott." For reasons too complicated to discuss in less than a Dostoevsky-length tome, many U.K. manufacturers were dissatisfied with the choice of Montreux as venue, and at the show, one couldn't help but notice the conspicuous absence of large consoles. (Most British companies ended up showing their wares at the Association of Professional Recording Studios [APRS] show held in June in London.) Still, there were some highlights:

Studer showed the D820-48 digital 48-track tape recorder (around $225,000), which first was unveiled at the AES show in New York last October. Studer is known in North America mostly for tape recorders and broadcast-oriented mixers. The new 990-series (price TBA; "not cheap") may be the board that brings Studer into the limelight as a recording console maker. An analog board with extensive digital control, the 990 comes standard with VCA automation and fully resettable switching. While we expect that all boards ultimately will process audio digitally, analog/digital hybrids such as the 990 are powerful stepping stones. In time, look for more affordable versions of this hybrid approach from other manufacturers.

The 990, by the way, also offers the option of full, moving-fader automation. Other companies touted moving faders, as well, including **Otari** with Diskmix 3 and **Audiomation** with the aptly named Moving Fader system.

Digidesign showed, for the first time in public, a version of Sound Tools ($2,995) for the Atari (see page 66 for information). **E-mu** announced the Proteus/2 ($1,495), a new version of the popular Proteus/1 that has 8MB of orchestral and classical samples rather than 4MB of pop/rock sounds. For just $495, half of these new sounds also can be added to a Proteus/1.

Active speakers were out in full force from **Vandenberghe BV**, **Genelec**, **Meyer Sound Labs**, and others. This class of monitor—which is widely accepted in Europe—has built-in active crossovers for better transient response and greater efficiency, and integral power amps that are optimized for the individual components.

In the "cool-things-that-weigh-less-than-ten-pounds" department, **AKG** unveiled the new K1000 headphones ($895)—a system that rests on the head but sits away from the ears (like *very* near-field monitors). **Beyer Dynamic** introduced the MC 742 stereo condenser microphone (under $3,000), featuring two double-diaphragm capsules (stacked vertically) and a remote power supply with adjustable polar patterns. The upper condenser can be rotated 360 degrees in relation to the lower capsule, accommodating various stereo recording configurations.

All in all it was a busy season. Jet lag has worn off just in time for the summer's round of industry conventions.•

Hans Zimmer: On Track With *Days Of Thunder*

STOCK CARS WERE not the only things moving fast on the set of the new Tom Cruise film, *Days Of Thunder*. Soundtrack stylist Hans Zimmer had to work at breakneck speed under most unusual circumstances to create the film's music. "There was no real post-production schedule," says Zimmer, "so we had to work fast. The first half of the film was being dubbed before the second half was done shooting." In fact, shooting wasn't completed until April 21, a scant six weeks before the film's release date.

To meet the deadline, Zimmer—whose previous work includes Oscar-winners *The Last Emperor*, *Driving Miss Daisy*, and *Rainman*—worked on location in Florida, creating music every day as footage was shot. He would score the parts, then send disks overnight from his Atari-based Notator sequencer to engineer Jay Rifkin in Los Angeles. Rifkin would set up the sequences using the same sounds as Zimmer, and record them on a Mitsubishi X-850 digital 32-track. Live musicians then would be brought in for overdubs and a DAT mix would be rushed to Zimmer for approval.

An alternate method involved Zimmer mixing backing tracks on an Akai A-DAM DR1200 (12-track digital recorder). When recording with the A-DAM, he would send tapes to Los Angeles instead of disks.

Zimmer's makeshift Florida studio was outfitted with plenty of gear for on-the-spot composition, including a Fairlight, three Roland Super Jupiters, Roland MKS-20 digital piano, two Yamaha TX-816s, Oberheim Xpander, and eight Akai S1000 samplers (each with 8MB RAM), along with a custom optical disk drive.

All that gear not only allowed Zimmer to compose nearly complete tracks—it also helped him communicate his musical ideas-in-progress to the producers—a task he considers the biggest hurdle

on any project. "Convincing other people that you know what you're doing will be the right thing for their film is always tough," he says. "By the time someone has spent 50 million dollars, they're usually pretty worried." So, if you go to the theater to see Tom Cruise on the track, don't forget to pay attention as well to the tracks that broke the land-speed record for composition and recording. •

A Rose By Any Other Name

TWO PRODUCTS mentioned in last issue's Update (May/June '90) have taken on new names since their original release. The new Soundtracs console, originally called Prism (a name already being used by Neve for its series of rackmount signal processors), now is in production as the Soundtracs Quartz.

We also reported on Digital Audio Vision, which allows Opcode's Vision sequencer and Digidesign's Sound Tools to work in tandem. The software now is known as Studio Vision and will sell for $995.

From our premier issue (Mar/Apr .) cover story on the pro vs. home studio controversy: The anonymous, Chilean-born composer/producer who lives in Sherman Oaks uses Steinberg Mimix automation software, not Megamix.

Upbeat 2.0, the rhythm scoring software for the Mac (reviewed last issue), along with other Intelligent Music software packages for the Mac and Atari, now are being distributed instead by Dr. T's Music Software. Intelligent Music plans to invest its resources in exploring alternate MIDI controllers.

A final addition: The Drawmer M500 dynamic processor reviewed in the last issue lists at $2,500. •

MANUFACTURER LISTING

Audiomation, Rockwood House, Barn Hill, Stanley, Co. Durham DH9 8AN, England, (02) 0 728-2880 [U.S. Distributor: Audiomation, 96 Dudley Rd., Sudbury, MA 01776, (508) 443-8053]; **AKG**, 1525 Alvarado St., San Leandro, CA 94577, (415) 351-3500; **Alpha Audio**, 2049 W. Broad St., Richmond, VA 23220, (804) 358-3852, **Beyer**, Theresienstrasse 8, Postfach 1320, D-7100 Heilbronn, (07) 1 316-0459 [U.S. Distributor: Beyerdynamic, 5-05 Burns Ave., Hicksville, NY 11801, (516) 935-8000]; **Digidesign**, 1360 Willow Rd, Menlo Park, CA 94025, (415) 688-0600; **Fostex**, 15431 Blackburn Ave., Norwalk, CA 90650; **Genelec**, Tehtaantie 17, SF-74100 Iisalmi, Finland, (358) 771-3311 [U.S. Distributor: Quest Marketing, P.O. Box 20, Auburndale, MA 02166, (617) 964-9466]; **Meyer Sound Labs**, 2832 San Pablo Ave., Berkeley, CA 94702, (415) 486-1166]; **Otari**, 378 Vintage Park Rd., Foster City, CA 94404, (415) 341-5900; **Steinberg**, Billwerder Neuer Deich 228, D-2000 Hamburg 28, West Germany, 040-789-8516 [U.S. Distributor: Steinberg/Jones,17700 Raymer St. #1001, Northridge, CA 91325 (818) 993-4091]; **Studer**, Althardstrasse 10, CH-8105, Regensdorf, Switzerland, (41) 1 840 2960 [U.S. Distributor: Studer Revox, 1425 Elm Hill Pike, Nashville, TN 37210, (615) 254-5651]; **Tascam**, 7733 Telegraph Rd., Montebello, CA 90604, (213) 726-0303; **Vandenberghe BV**, De Hoogt 8, 5175 AX Loon op And, The Netherlands, (0) 4166-2434.

StudioTech '90

STUDIOTECH '90 IS A one-day treat for recording enthusiasts happening in San Francisco on July 21. This "recording technology fair" (resembling a mini-trade show) consists of exhibits, demos, and workshops on recording and production technology, along with seminars on the topics of career and job opportunities, and hearing and ear protection (with 12 experienced ears participating, including those of an audiologist and musician Jeff "Skunk" Baxter, formerly with Steely Dan). A seminar on record production in the '90s features six veterans, including producers Arne Frager (Prince, Paul McCartney) and Walter Afanasieff (Michael Bolton) and legendary drummer Hal Blaine. A seminar on studio design (including among its panelists major facility designers John Storyk and Chips Davis) will be moderated by *EQ*'s own Linda Jacobson. Notable pros will focus on interfacing, maintenance, film scoring, and sound design. Reps from WaveFrame, Digidesign, Otari/Sound Workshop, Roland, Lexicon, Agfa Tape, Dolby Labs, Meyer Sound Labs, Eventide, and other firms will be on hand to discuss their stuff.

Co-sponsored by Agfa Tape, *Mix* magazine, and Audio Images Corp., StudioTech '90 is presented by the SF chapter of the National Academy of Recording Arts & Sciences. NARAS members get in free; others pay $8 in advance, $10 at the door. It's at Golden Gateway Holiday Inn on Van Ness in SF. For info or to reserve your ticket, call SF/NARAS at (415) 441-0662.

EQ will be attending StudioTech '90 . . . if you'll be in the Bay Area on Saturday, July 21, come by and say hi. •

PHOTO: CINDY KARAM/GPC

Shep Pettibone

Master Remixer M-M-Makes Hot Dance Tracks.

BY AMY ZIFFER

"I JUST DO WHATEVER I feel like I'm led to do on each individual song. Each mix is representative of the artist. I guess that's why I get hired and rehired—because of the way I go about doing things," laughs remixer *extraordinaire* Shep Pettibone. Hired and rehired indeed. Pettibone has worked on several hundred records with dozens of high-caliber artists: Janet Jackson, Paul McCartney, Madonna, and Paula Abdul, to name a few. His high-energy 7" and 12" dance tracks have kept him in constant demand since the early '80s, when he parlayed his record store and DJ experience into an opportunity to create custom, five-minute re-edits of songs for New York radio stations. Soon Pettibone's work was all over the airwaves and his phone was ringing off the hook. By initiating the ever-popular "stutter-edit" and the practice of re-recording instruments for remixes rather than simply using original album tracks, Pettibone profoundly influenced the techniques of other remixers.

At first glance, the remix market is confusing. A typical 12" single contains three to six versions of a song, produced by processes ranging from simple re-structuring to complete re-recording. "The purpose of all those mixes is to give the customer something extra to listen to," explains Pettibone. "But it's also to satisfy the club market. There are all different kinds of clubs that play different versions of songs. There's a demand for an underground-sounding mix—called the dub or the house mix—where things get really outrageous. Then there are the clubs that play the more mainline, commercial-sounding version, an extended version of what you hear on radio. With Janet Jackson's 'Rhythm Nation,' for instance, the 'House Nation' side caters more to the clubs that play house music. The 'United' side caters to clubs that play rap music."

Often included with this is an instrumental version with just background vocals or no vocals at all. Another increasingly popular permutation is the *a cappella* version.

To get the variety of material he needs to make each mix distinct and interesting, Pettibone almost always re-records many parts, sometimes to the extent that the lead vocal is the only part shared in common by his mix and the album version. One example is Madonna's song, "Like A Prayer." Pettibone says, "You have your A-side, which is like the radio version, and when you turn it over, it's totally different. It has a new sound and groove to it." Often Pettibone uses the original performances to trigger new sounds, so a sound is replaced but the performance remains.

Although many people think of remixers as engineers, when Pettibone infuses a recording with a new sound and groove, he feels he's acting as the producer of the remix. In fact, he works regularly with engineers so he doesn't have to split his attention between the demands of production and engineering.

It might seem more logical to record additional parts (ad libs and solos, for example) during the initial production stage, so when it's time

CONTINUED ON PAGE 18

PHOTO: REX MILLER

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SHEP PETTIBONE

CONTINUED FROM PAGE 16

to remix, there's existing material that the remixer can use. Yet that rarely (if ever) happens. "That's not what album producers are hired for," says Pettibone. "They're hired to produce a single that will get played on the radio. When I'm hired to produce something, they expect me to create both: something that can go on the radio *and* a 12" dance version."

Pettibone creates all his remixes for a song in about three days. "The first day I do all the production. The next two days are mixes. On the first day of the mix, I try to get a better version of their 7", mainly with the production that was given to me, because they always request that. The day after that, I go for the dance version, with more of the production I've done." Pettibone has no blueprint for reconstructing songs; he simply experiments.

He *does* have a standard setup to get the ball rolling. "I start off by getting some kind of a click track and load that into the Roland SBX80 SMPTE-to-MIDI converter. From there I use the IBM Sequencer Plus to run all the different samplers I might be using: Akai S900 or S1000, Emulator III, and all kinds of synthesizers."

Producer's Tip:

"ON THE 12 dance mix of Madonna's 'Like A Prayer,' there's a brief special effect on the vocals that sounds as if the tape accidentally got mangled. It has the same rhythmic effect as a stutter edit, but it's not as artificial-sounding. I accomplished this by gating the lead vocal and triggering the gate to open and close with a sixteenth-note input signal."

—Shep Pettibone

Pettibone's favorite outboard device is the Eventide Ultra-Harmonizer H3000B, and he expects to get the new SE version soon. He also prefers tube equalizers (Pultecs and Langs), primarily to use on bass and kick drum, and recently started using the Neve Prism rack.

Pettibone, rather than the record company, generally decides whether to record analog or digital. "When I'm producing something from scratch, I like to record analog first, and then while that sound is fresh on tape and has the nice compression and full sound that analog can give you—including hiss—I transfer to Mitsubishi digital. When you record directly to digital, it tends to give an icy sound. For mastering, I usually go to half-inch analog first, then to DAT."

Considering the sophisticated technology Pettibone uses in his productions, it's interesting that remixes probably offer the only music market in which vinyl will have a long life. "There are some clubs playing CDs," Pettibone notes, "but not a lot can really afford to have them as part of their sound systems. Turntables and vinyl are a lot less expensive."

Also, vinyl is more readily available when it comes to extended mixes, and the situation probably will remain that way for some time. "The CDs are 95 percent promotional only," says Pettibone. "There are only maybe five percent that you can buy."

Still, Warner Bros. is launching a 5" CD single, starting with Madonna's "Keep It Together," and undoubtedly the company will monitor market response. The 5" CDs probably will offer customers as many versions as 12" vinyl now does.

Whatever the format, Pettibone feels that remixes will continue to be in demand by dance fans, DJs, and others. "There's always going to be a market for somebody to mix your record and make it sound better, and that's what I try to do." •

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HANDS-ON PRODUCTION

Replacing Drum Tracks

BY MICHAEL MARANS

DIGITAL SAMPLERS COMMONLY ARE used to record and play back drum and percussion sounds. They're of tremendous benefit to both professional engineers who wish to create intricate electronic percussion tracks, and to personal recording enthusiasts who typically have neither the space nor the microphone collection necessary for recording a live drummer.

Samplers offer more than power and convenience. In today's world of escalating studio costs, a sampler can keep a project within budget. Before they were available, often days—and sometimes weeks—were spent getting just the "right" drum sound. To top it off, that sound usually was used for an entire project. *Boring.*

These days, some producer/engineers are just as likely to spend only a few minutes miking a drum kit and bringing it up on the board. During mixdown, all their drum sounds will be replaced by samples. This allows the drum sounds to be custom-tailored for each song, and manipulated right up to the final mix. The live drums are recorded strictly for feel and to provide an analog voltage source which can be used to trigger the sampler.

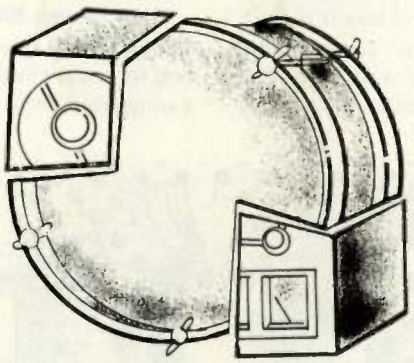
There are two methods of replacing tracks and, of course, a number of variations on the themes. The techniques are straightforward, but not completely without pitfalls.

Method #1: Direct-To-Sequencer. The first (and most flexible) method requires that the drummer's kit be outfitted with triggers—usually small piezoelectric transducers connected to either the heads or the shells of the drums. The outputs from these triggers then are fed into a trigger-to-MIDI converter, such as the Roland Pad-8. (Some samplers, such as the Emulator III, include inputs that accept the analog trigger signal without any conversion.)

If you don't have access to triggers, you could mike each drum, then feed the trigger-to-MIDI converter (or sampler) with direct line outputs from the appropriate mixing console inputs. Microphones typically will induce more false triggers, however, as we'll see below.

The next step is to record the output of the MIDI converter or sampler into a MIDI sequencer that is slaved to time code printed on tape. This allows you to make a real-time, backup MIDI recording of the drummer's performance. Once a successful take has been recorded, the MIDI sequence can be edited easily to fix mistakes, clean up timing errors, embellish fills, and so on. (It's a lot easier to edit MIDI data than it is to splice tape and/or do numerous punch-ins.)

There is, however, a major drawback of recording this way: The performance recorded on the sequencer will lag anywhere from five to 50 milliseconds behind the tape track. This is due to the time it takes a converter to process a trigger impulse and convert it into MIDI data, and the inherent delay between the time a sampler receives a MIDI NOTE ON command and the actual sounding of the sample. But don't despair—this delay is easy to fix. Most sequencers have a TRACK SHIFT function that allows an entire track to be moved forward or backward in time in incredibly small increments (called *clock pulses* or *ticks*). These increments are frequently 1/384 to 1/480 of a quarter-note. Since the sequencer is synced to the time code on tape, the drum track may be shifted forward in time until the feel is right.



Triggering Samples From Acoustic Drums Can Save Valuable Studio Time While Expanding Your Sonic Options.

Method #2: Post-Session Replacement. Our second replacement tip is similar to the first. The difference is that no triggers are used on the actual drums, and a MIDI sequencer isn't part of the picture until *after* the basic tracks have been recorded. This method also requires that each drum or percussion part be recorded to an individual tape track. Consequently, unless you're replacing just a small number of percussion parts, you'll need at least a 16- or 24-track tape recorder.

In this method, the line output from each drum tape track is taken directly from the console (or tape machine) and fed into the converter or sampler. When the tape is played back, the sampled sounds are triggered by the tracks themselves.

While it *is* possible to mix the sampler's audio output directly to 2-track as the original tracks are playing, it makes a lot more sense to record the MIDI output of the converter or sampler into the sequencer, so that the editing options from Method #1 remain available.

Beware Of False Triggering. These procedures may sound relatively simple to you, but there are a few problems that you may encounter. The most common is false triggering. This usually is caused by one drum sound leaking into another's track—often the result of improperly gated microphones. Sometimes striking one drum will cause a trigger mounted on an adjacent drum

Michael Marans is a recording engineer, and assistant editor at Keyboard *magazine.*

ILLUSTRATIONS: SCOT HALPIN

IT'S ABOUT TIME

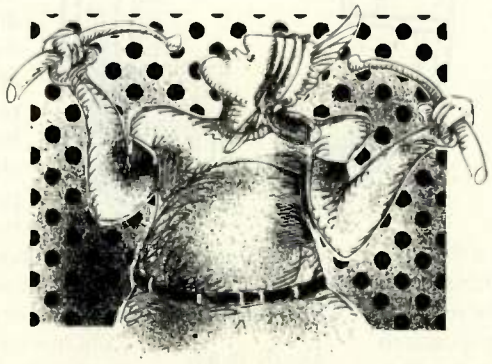
Creative Programming Ideas

BY NORM WEINBERG

ON SOME PROJECTS, THE DRUM AND percussion lines can help turn an average composition into a creative masterpiece. Coming up with an interesting groove can influence a tune's compositional direction, and a unique rhythm often serves as the hook that captures the listener's attention.

But it's not always easy to be original. As producers, engineers, and musicians, we have stockpiled preconceived notions about what music is and how it should sound. One way to induce originality is to turn off the musical experiences and influences of your past. This way you leave yourself open to new ideas.

Blind Programming. Here's a simple yet effective technique for building drum machine patterns that are unique. First, turn off all the audio outputs coming from your drum machine. Next, put the machine into RECORD mode and start hitting buttons. Naturally, quantizing is fairly essential to the success of this technique.



Be Original. Break Some Of Your Own Rules.

Since you won't be able to hear the machine's metronome, you won't be influenced to support the meter in the traditional manner (like putting a snare on counts two and four). In addition, you won't be able to hear any sounds as the pattern loops, so you won't be listening to how one instrument interacts with another (such as bass drum relating to snare or hi-hats).

Once you've banged on the buttons for a while, turn up the audio outputs and see what you've got. If it sounds too busy, press fewer buttons next time. If it sounds too spare, press more buttons. Try playing at different dynamics, assigning different sounds to the buttons, or try recording with different levels of quantization.

The nicest aspect of this technique is that you can create 40 to 50 patterns in a short amount of time. From that large number, you should find at least three or four that sound hip. Another five or six might work out fine with a few minor changes; perhaps adding or deleting a single bass drum or a snare drum in the proper place would do the trick.

Alternate Sound Generators. A drum machine is nothing more than a box of sounds with an internal sequencer. Have you ever thought of sending the sequenced MIDI information from your drum machine to a different sound generator?

One technique that works extremely well is to MIDI your drum machine directly into a multi-timbral sound generator that contains percussion sounds (such as the Roland D-110, E-mu Proteus, or Korg M1). Sometimes the timbres will correspond (the drum machine's bass drum also will fire the sound generator's bass drum), but the most original patterns occur when something completely unexpected happens. Maybe the drum machine's bass drum will fire a cowbell or a timbale on the sound generator.

Even if the drum machine's rhythm track is fairly standard, the relationship of the different percussion colors coming from the sound generator will make the pattern distinctive. If you have a computer-based sequencer, consider recording the drum machine pattern into the software, then transposing the track. Since these instruments typically contain 60 or more drum sounds, you're likely to find a transposition that contains many colorful relationships.

Oops, Wrong MIDI Channel. If you work with a fairly complex MIDI system, you've probably run across this next technique by accident. Simply send the melody of a song from your sequencer to your drum machine (bass lines and *ostinatos* also work well). Since melodic passages usually are longer than rhythmic grooves, the trick is to listen to the passage and try to find an interesting phrase.

Once you run across something you like, loop the passage and see how it feels as a drum pattern. If single melodic lines are used, then the rhythm track will sound "linear" in nature. A polyphonic section like a fugal passage, background chords, or a melody/counter-melody structure will produce a "vertical" drum track.

This technique can take you in one of several directions. You can use the melodic material from one piece as the rhythm track of another composition. Or you can achieve a degree of unity by using materials that originate from the same composition.

When you strive to be creative, keep an open mind and two open ears. The real beauty of MIDI and electronic instruments is that hundreds of ideas can be tried quickly and inexpensively. If you come up with something that doesn't work, throw it away and try again. Your next effort may be the one that wins critical acclaim for its originality. •

Norm Weinberg is an associate professor at Del Mar College in Corpus Christi, Texas. He has written extensively about the topics of electronic percussion and music education.

ILLUSTRATION: SCOT HALPIN

KEVIN KILLEN

CONTINUED FROM PAGE 19

records are like soundscapes."

Killen engineered and mixed on Gabriel's *So* LP, as well as the single "Biko" from the film *Cry Freedom*. He describes the halo effect on many of Gabriel's sounds as a result of serially chaining effects together. "It's a technique I learned from Brian Eno," he explains. "You send the source signal into each successive effect, then start sending the effects back into each other, and the result is a constantly changing sound. You can hear this effect quite well on U2's *Joshua Tree* record; the guitar is sent through a couple of long delays, then through a pitch shifter and a sparkly reverb, then back to the pitch shifter and finally to an amp."

Killen's present mission is engineering and co-producing a Boston-based act called The Walkers, a so-called "alternative roster" band on Atlantic Records. His current collection of favorite audio toys includes the TC Electronics TC2290 multi-effects processor, which he employs in a unique fashion. The unit's 32-second sampling capability lets him use it as a virtual digital recorder to fly in parts in other locations of a song, a technique he says has helped him resuscitate the flawed bits of otherwise great performances.

Another Killen trick involves using the soundboard of a piano as a resonator: he takes a signal, pumps it through a speaker near the piano with a weight resting on the pedal, then mikes the soundboard and sends that back to tape. He enthuses, "It can add a wonderful resonance to certain types of instruments."

Killen continues, "Another great piece of equipment is the Korg SDE 3000 digital delay. They stopped making them several years ago, and I wish they hadn't. It has a great front end and works great as a preamp for guitars."

One Killen trick involves using the soundboard of a piano as a resonator...

Tricks and treats aside, Killen's greatest respect is reserved for the artists. His fondest memory is of a session with the late great Roy Orbison. Killen was doing overdubs in a Los Angeles studio for producer T-Bone Burnett on Orbison's *Mystery Girl* LP, and remembers, "T-Bone told me that when Roy came in to sing, he would want to have the track played once while he sang softly. That's exactly what happened, and I was tempted to increase the mike gain, but T-Bone said no. Then, on the next pass, T-Bone said, 'Make sure you have it in record this time.' I did so and all of a sudden, that amazing voice came through. Every hair on my body was standing on end. He did the vocal in one pass." •

Engineer's Tip:

"PUTTING some distance between the microphone and an acoustic instrument really helps in improving the sound. Too often people will put the mike in close to get the presence, but if you let the sound breathe a bit before trying to capture it, you'll be pleasantly surprised at the results. With acoustic guitars, for instance, try putting the mike back about four feet from the box."

—*Kevin Killen*

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Kevin Killen

At The Controls With Peter Gabriel, U2, Elvis Costello, And Roy Orbison.

BY DAN DALEY

IF JAMES JOYCE HAD made a provision for a recording engineer in the book *Ulysses* (he certainly provided for almost everything else), the character's prototype could have been Kevin Killen. The Dubliner once studied at Joyce's *alma mater*, Trinity College, but was sidetracked from a career as a construction engineer by another pursuit: music.

He's pursued it on both sides of the Atlantic and, in doing so, has racked up a credible discography. Among the more luminous artists for whom Killen has engineered, mixed, and/or co-produced are U2, Elvis Costello, Peter Gabriel, Kate Bush, Bryan Ferry, Roy Orbison, and Hall & Oates. The sum of this peripatetic career thus far is a study in Zen and the art of audio engineering. "I'm a sort of jack of all trades," the 30-year-old Killen says, "and the reason I've done as well as I have is because I can promote an environment in which artists feel creative. It's a grey area of why someone's personality can be conducive to creativity for others, but whatever it is I bring to a situation, it's also helping me make the transition from engineer to producer."

That ability manifested itself early in the '80s when, as an assistant engineer at Windmill Lane studios in Dublin, Killen started working with U2 on the band's third LP, *War*. The chemistry worked, and he moved to engineer status on subsequent releases *The Unforgettable Fire* and *Rattle & Hum*.

Recalling the formation of the band's studio sound, Killen describes The Edge's spare, fluid guitar tone as being the result of using an ancient Vox AC30 amp with a nearly contemporary Electro Harmonix delay unit, miked through a single Shure SM57, with an occasional Neumann U87 thrown in for ambience. Larry Mullen's drums weren't as straightforward. Killen and Mullen opted to record them in the studio's tile-and-concrete reception area, which meant waiting until after 6 PM each day for the receptionist to go home.

In 1984, Killen decided to leave Ireland to seek wider horizons. He moved to New York six years ago because he felt it presented a better challenge than London. He did have to re-invent his career, and began as an engineer's assistant at Electric Lady Studios in Manhattan. A recommendation from his past client Peter Gabriel landed Killen a shot at co-producing and engineering Mr. Mister's *Go On* LP. Despite that record's lack of success, Killen's name was getting around. A phone call from out of the blue brought him together with Elvis Costello on the critically acclaimed *Spike* LP.

"The difference between Elvis and Peter Gabriel was quite dramatic," recalls Killen. "Elvis likes to work fast in the studio. He always tries to capture a moment and spends very little time getting sounds. He quite literally plugs in to his Fender Twin or Vibrolux and says, 'I'm ready.' Peter, on the other hand, is a consummate sound manipulator who views sounds the same way a cinematographer looks at pictures. His

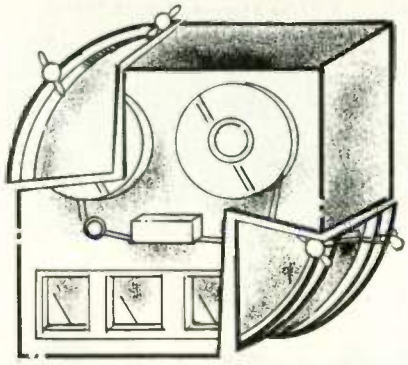
CONTINUED NEXT PAGE

to send out a signal. Double-triggering also may occur when a drum vibrates sympathetically to another being hit, or even to its own head ringing. These trigger signals can wreak havoc when you attempt to convert them to MIDI.

Often the easiest solution is to edit out the notes in the MIDI sequence that were caused by false triggers. This can become a bit of an effort, however, if, for example, every snare hit produces multiple false triggers. In that case, your best bet is to spend a bit of time adjusting the SENSITIVITY and other trigger parameters found on your converter or sampler.

Avoiding Trouble. When planning a session where percussion tracks are going to be replaced, you can save time and mental anguish by following a few simple rules:

1) If using a sequencer, always stripe your tape with the sync code *before* you record any basic tracks. 2) Lay down more code than you think you'll need—you'll be grateful when you decide later to let the fade-out run for an extra minute. 3) Use gates on the kick, snare, and tom mikes to help minimize bleedthrough. 4) Record each drum that you plan to replace on its own track. 5) Sample your drum sounds with the ambience or processing you normally would use on acoustic drums, saving



your outboard devices for other instruments. 6) Make sure each sample is properly *truncated* (no "dead space" between its start time and the moment at which you hear the sound). 7) Assemble your sampled drum banks so the same drums are located on the same note—for example, snare drums assigned to *D1*, kick drums to *C1*, floor toms to *F1*. This lets you audition different drums while the sequencer plays, simply by changing sampler presets.

Finally, don't forget that samplers allow you to combine a number of sounds digitally into one mondo sample. Your next great kick sound might be a car door slam combined with a two-by-four whacked against a wall! •

SHARP ANGLE

CONTINUED FROM PAGE 10

quirements for the next two or three years, and can I afford to pay for it in that time period?" Hard-disk editing can save time, and when time equals lots of money, these systems can be justified today.

Analog is still a viable format, especially since Dolby's SR noise reduction has brought digital-like performance to the 24-track studio. At the other end, machines like Tascam's MSR-24 1" 24-track and Fostex's upcoming G-16 1/2" 16-track bring further power to personal studios. How much work can you do on an analog multitrack in the next few years? If the answer is two or three albums, or a couple dozen commercials, or a soundtrack—or even lots of personal enjoyment—analog is still more than worth the investment.

Many people believe that manufacturers are holding back cheap digital multitracks until they unload all their analog stuff. I haven't investigated any warehouses, but all the evidence points to a different truth: There's just no way to produce an inexpensive digital recorder today. This will change, but not overnight; three to four years is a realistic time frame before we see any "musician-priced" digital multitrack. •

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Digital recording has become accessible to us all. DAT is taking its place as a preferred mixdown medium; indeed, numerous commercial releases are being mastered directly from DAT recordings. Digital audio workstations are being used for everything from music recording, mixing, and editing to CD mastering, commercial production, and film soundtracks. And digital multitrack machines are becoming status quo in commercial facilities. Now that the technology is there, what do you do with it? How are your colleagues using it? What should you know before using, purchasing, or renting digital audio equipment—or even before you reserve studio time to use the stuff? EQ continues its mission of bringing you a "how-to," "hands-on" approach to technology, delving into the realm of digital recording and editing. In the following pages, we give you "12 Things You Need To Know Before Going Digital":

SECTION 1

Digital audio workstations are the latest high-tech addiction in the studio. If you're seeking a straight line through the techno-babble, **Valley Of The DAWs** gives you a taste of the new technology. **Page 27.**

With so many products touted as "digital audio workstations," it helps to know which does what. **The Players** specs start on **Page 29.**

Find out how a DAW can change the way you work in the studio, with **Dave Marcus: Living In The Digital Domain. Page 34.**

SECTION 2

As DAT machines enter the mass marketplace, our **Shoppers' Guide To DAT** sheds light on how much DAT machine you need. **Page 37.**

Changing your DAT deck's filters can enhance your DATabilities. **Hot-Rodding Your DAT Machine** reveals some options. **Page 43.**

Thinking of recording a live, acoustic or electric performance directly to DAT? **DAT Naturally: Prepping For Your Live-To-DAT Session** sets the stage for you. **Page 44.**

Once you've bid adieu to tape hiss, you'll want to trust your work to a tape you can bank on. **An Inside View Of DAT Tape** provides a checklist of all available brands. **Page 47.**

Timbuk3 wanted to record an album at home—digitally—but they didn't have big bucks to toss around. So they innovated "multitrack" DAT. **Timbuk3: On The Edge Of Multitrack DAT** reveals how the duo developed an intriguing new recording technique. **Page 46.**

SECTION 3

If you're getting ready to take off into the wild blue yonder of digital taping, Roger Nichols' **Digital Recording Pre-Flight Checklist** will help get you off the runway. **Page 50.**

All digital recording gear uses the same basic technological process. **Digital Audio Basics** demystifies the ones and zeroes. **Page 56.**

Most major digital multitrack tape recorders employ one of two formats. **Format Choices: ProDigi And DASH** provides you with a crash course, without the rocket science. **Page 54.**

The first major recording center to embrace digital multitrack was (surprise!) Nashville. **Steve Fishell In Digital Country** looks at one artist's view of the benefits. **Page 53.**

DIGITAL AUDIO WORKSTATIONS

Into The Valley Of The DAWs

Hacking A Path Through The Technical Thicket Of Digital Audio Workstations

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With so many manufacturers touting these dynamos, it's easy to get lost in all the marketing hoopla, whiz-bang demos, and techno-jargon being bandied about. How do we define "digital audio workstation"? How do we establish the differences among dozens of offerings ranging in price from under $10,000 to over $100,000? With how many acronyms must we acquaint ourselves? *EQ* sets off through the Valley Of The DAWs to answer these questions and more.

• • •

Digital audio workstations—DAWs—fall into three basic categories: RAM-based sampling technology, disk-based recording technology, and a hybrid of the two. Let's dig in.

RAM-Based Systems

Recording. Digital samplers such as E-mu's Emulator III and Akai's S1000 have proliferated over the past decade; digital audio workstations in this category represent a further step by adding significant amounts of

BY JEFF BURGER & SCOTT MARTIN GERSHIN

RAM and a user-interface optimized for sound effects work. The concept of sampling is fairly straightforward: A/D converters transform standard audio signals into digital data at a fixed rate, which then can be manipulated by a microprocessor. [Ed. Note: *See* "EQ *Background Notes: Digital Audio Basics" on page 56.*] As sounds are sampled, they are parcelled off to their own segment of RAM (random access memory). These segments also can be archived on floppy disks, hard drive, or other storage media.

The sampler plays back a sound by routing the data from the corresponding segment of memory through a D/A converter. If the playback rate is the same as the sampling rate, the sound will be the same pitch as the original source; faster or slower playback rates yield higher or lower pitches, unless a fixed-pitch "time compression/expansion" mode is employed.

The number and length of sounds that can be stored *in memory* is determined by how much RAM is available. One megabyte of RAM yields about ten seconds of mono audio at a 44.1kHz sampling rate. With many systems, you can allocate this sound memory any way you want: our 1MB example might contain a single ten-second sample, or 20 half-second samples, or one 5-second and two 2-1/2-second samples. As we'll soon see, 1MB does not a DAW make.

The number of sounds a sampler can *play back simultaneously* (known as "polyphony") directly corresponds to the number of voices—anywhere from four to 64 voices in current technology. These can be different sounds for each voice, or the same sample data can be accessed by multiple voices using a technique called *dynamic voice allocation. Dynamic output* allows each sample to be re-routed to its own output: Outputs can support from one voice up to the full polyphony of the machine, depending upon design.

MicroSound Disk Recording System
Manufacturer: Eltekon Technologies, 37491 Schoolcraft Rd., Livonia, MI 48150; (313) 462-3155.
Price: $3,495-$4,529.
Strengths: Direct-to-digital recording system designed for music production; IBM-PC front end; 2- or 4-track recording at 15 sample rates; optional rackmount color monitor; optional monitoring of digital inputs; SCSI-based archiving; real-time DSP.

Processing. RAM-based machines can manipulate various aspects of a sample in real time. Parameters such as pitch, volume, and timbre can be manipulated in software; some machines, such as the NED and WaveFrame products, can support real-time control of these parameters via MIDI.

PostPro SD
Manufacturer: New England Digital, 49 N. Main St., White River Junction, VT 05001; (802) 295-5800.
Price: $130,000 base.
Strengths: Hybrid workstation designed for post-production work. 8-track, disk-based recorder plus optional 8-track expansion modules (24 tracks total); Macintosh front end; Synclavier 8-output sound module with up to 64MB for 32 voices; sample editor; 200 track EDL/sequencer; SMPTE code generator/reader.

Digital editing involves such functions as cut/copy/paste and looping, complete with on-screen waveform display. DSP (digital signal processing) covers equalization, time compression/expansion, audio compression, resampling, resynthesis, pitch shift, and rate conversion. These functions all work together to tailor specific sounds to the distinct requirements of an audio passage.

Applications. RAM-based systems, such as the base version of the NED Synclavier 3200, primarily are used in post-production work rather than music recording. It is not uncommon for them to support dozens of megabytes of RAM to accommodate long, multiple sound-effects tracks, or entire commercials.

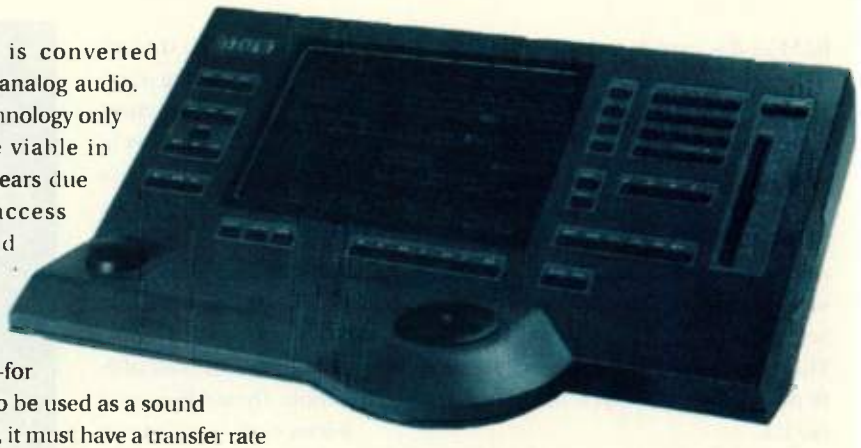
The biggest benefit of RAM technology concerns performance: Voices can be triggered randomly in time via computer keyboard, MIDI, or SMPTE time code. For example, actual performance—playing the same sound with multiple pitches and using pitch bend—is common in sound effects work. Most RAM-based workstations have built-in sequencers or cue lists that let you log in points at which specific sounds are to be

fired. In post-production work, the sound designer/editor typically watches the picture and "plays" the desired effect at the appropriate time to log it into the list. Additional passes can be made to log the same or different sounds at various locations. After all effects have been logged—or at any point along the way—playback against time code can trigger the sounds at their desired points while the output is recorded onto multitrack or master tape.

Disk-Based Systems

Recording. RAM-based DAWs require lots of memory to record long sounds. For instance, 32MB is *a lot* of RAM—yet that provides for only three minutes of stereo recording at 44.1kHz. That's why these machines have limited applications for mastering. What is really required for longer tracks is the digital *emulation* of a tape deck. Enter disk-based recording.

These systems employ the same A/D and D/A conversion technology found in RAM-based systems. The key difference between RAM and disk-based technology is the latter's use of a mass storage device (magnetic or optical disk drive) to hold the sounds. Sound is converted to digital data and immediately stored on the hard drive; during playback, the data comes off the drive and immediately is converted back to analog audio. This technology only became viable in recent years due to the access time and transfer rates it required—for a drive to be used as a sound recorder, it must have a transfer rate greater than 300K per second and an access time of around 30 milliseconds or better.



A 760MB hard drive is not uncommon; applying the same rule of ten seconds mono at 44.1kHz for every 10MB, such a drive would yield 38 minutes of stereo tracks. (Some manufacturers have developed data compression techniques that increase the musical capacity of storage media.) Need more? Try a 1.2 gigabyte drive—that's 60 minutes in stereo. Now we're talking mastering. The recording and playback capabilities of most drives are specified in *track minutes* or *track hours;* the actual time can be derived by dividing that specification by the number of tracks.

Opus, Opus/e
Manufacturer: Lexicon, Inc., 100 Beaver St., Waltham, MA 02154, (617) 891-6790.
Price: Opus, $160,000 base; Opus/e, $110,000 base.
Strengths: Dedicated disk-based recording system designed for a/v post-production. Integrated, full-function, 12-channel digital mixer with faders and scrub wheel; 8-track mixes from 99 virtual tracks; expandable to 4.8GB of disk storage for 790 track minutes. Opus/e is similar, but without integral mixing console (use as stand-alone or connected to consoles).

Soundstation II
Manufacturer: Digital Audio Research, 6363 Sunset Blvd., Ste. 802, Los Angeles, CA 90028; (213) 466-9151.
Price: $57,000-$150,000.
Strengths: Dedicated disk-based recorder/editor for sound effects pre-lay, post-production, video post, and multitrack recording; touch-screen interface; up to eight channels of audio; special ADR software; nondestructive editing; external machine control.

Most disk-based recorders sample at one of three rates, making it easy to transfer between digital media: 44.1kHz (CD-compatible), 48kHz (DAT-compatible), and 44.056kHz (video-compatible). Disk-based workstations employ the metaphor of "tracks" to record and play audio data, just like their tape-based models—anywhere from two to 32 tracks depending on the workstation. In theory, the number of tracks a hard drive can handle is equal to (transfer rate÷sampling rate) x 2. In reality, most disk-based workstations record in stereo and play back two to four tracks per hard drive. Some systems allow you to expand the number of tracks by adding multiple hard drives, each with their own D/A converters and dedicated audio outputs.

Processing. DSP technology brings many of the same editing tools found in RAM-based systems to disk-based systems—EQ, time compression, mixing, and the like. The simple difference is that these operations must be performed on chunks

of data that live on the hard drive rather than in RAM. Therefore, the system must pull chunks of data off the drive, manipulate them in limited memory, and finally write them back out to disk. The average processing time is about twice that of real-time play length.

Storage. The latest storage technology is the optical drive, which employs basically the same technology found in CDs. These typically hold 650MB on two sides. At this point optical drives come in two styles—WORM (Write Once, Read Many), which can "burn" the data into the platter once and play it back until the end of time (at least in theory), the magneto-optical, which can be written to and erased as many times as desired, much like a gigantic floppy disk.

One big benefit of optical drives is that the media itself is removable. This is great, since no existing media has enough storage capacity for you to keep dumping unlimited amounts of material onto it. An optical drive is ideal for archiving ongoing work on different cartridges. Several manufacturers of RAM-based products have incorporated the magneto-optical drives into their workstations; faced with the added requirement of real-time access, the makers of disk-based recorders are busily writing code to enable recording straight onto these drives.

Backup is an important issue. If your archived master becomes prey to unwanted magnetic forces, you'll be glad you have a safety copy. This might be a second optical disk stored safely in another location. A less expensive backup alternative is magnetic tape, typically with 8mm videotape. Backing up to this medium is known as *tape streaming*, because the stream of data must be placed on this linear media in serial fashion.

DAWs built on popular computer platforms (Macintosh, IBM PC, Atari) often offer more choices in external storage devices than do DAWs that use proprietary hardware.

AudioFrame Digital Audio Production System
Manufacturer: WaveFrame, 2511 55th St., Boulder, CO 80301; (303) 447-1572.
Price: $50,000-$250,000.
Strengths: Hybrid system for production and post-production; disk-based, 8-track 16-bit system; IBM-PC front end; up to 60MB of RAM-sampling, up to 48 voices triggered from internal sequencer or cue list; digital mixer with EQ and stereo reverb; optional sound effects libraries; internal 24-bit processing; digital I/O.

Applications. Disk-based systems (such as the AMS AudioFile Plus) are best suited for tracking situations, such as mixes. Since disk-based recorders can access any section of recorded material in a matter of milliseconds, they far surpass the editing capabilities offered by recording to tape. Transport controls are emulated, often with scrubbing functions (the process of rocking tape manually across a head to find a specific edit point). Markers can be positioned for editing and "transport" location.

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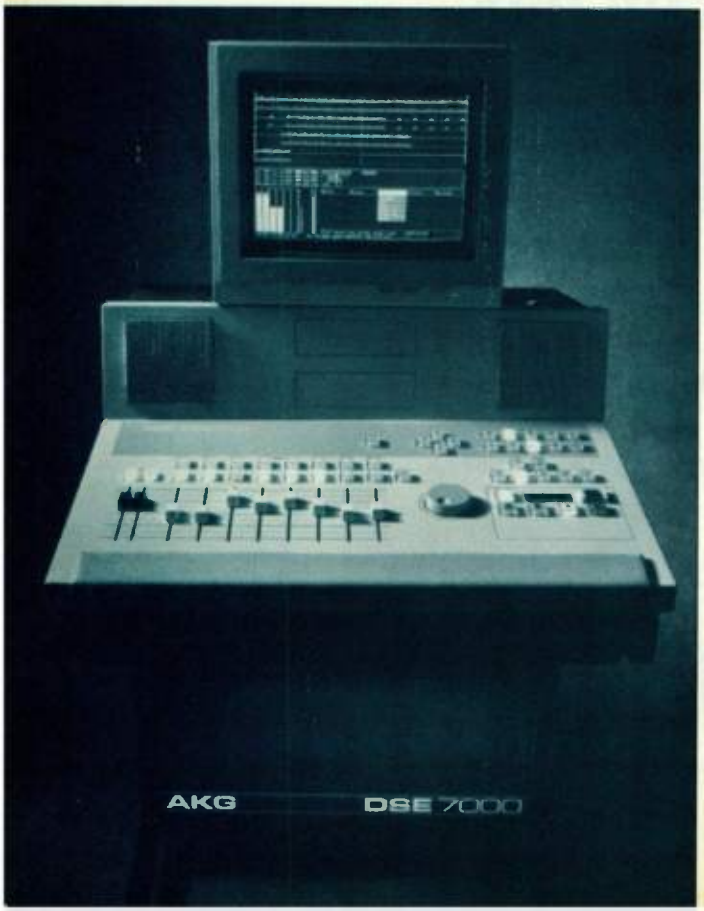
These features let you record a mixed version of a song, then section it into smaller files such as verse, chorus, and bridge. By digitally editing the "playlist," different versions of the song can be constructed—much like the process of stringing patterns or sections together into songs with MIDI sequencers. These files then can be edited together into any combination without actually committing to the combination. This approach—known as *nondestructive editing*—is a powerful tool in projects that require several versions of a song. You could create 15-, 30-, and 45-second versions of a 60-second jingle, without ever having to risk cutting the master version. Twelve-minute dance mixes can be generated from four minutes of material.

DSE 7000 Digital Sound Editor
Manufacturer: AKG Acoustics, 1525 Alvarado St., San Leandro, CA 94577, (415) 351-3500.
Price: $37,500 base.
Strengths: Dedicated hybrid recording/editing system for broadcast production; 8-track digital recorder; 10-channel mixer with faders; color monitor; scrub wheel; up to 48MB of RAM optional.

Hybrid:A Perfect Match

Many high-end DAWs such as WaveFrame's AudioFrame incorporate both RAM- and disk-based recording technologies. This approach represents the ultimate in flexibility and helps fight against generation loss. For example, in assembling sound effects for a film cue, it might be practical to play back one or more long ambient tracks (such as traffic noise) from the hard disk, while simultaneously triggering shorter RAM-based effects (such as car doors and dog barks). Alternately, RAM might be filled with samples that can be triggered against time code while recording to hard disk, freeing up memory for more samples.

ScreenSound
Manufacturer: Solid State Logic, Begbroke, Oxford, OX51RU, (0865) 842118.
U.S. Offices: 320 W. 46th St., New York, NY 10036, (212) 315-1111; 6255 Sunset Blvd., Los Angeles, CA 90028; (213) 463-4444.
Price: $100,000 base.
Strengths: Dedicated post-production system; tablet/stylus user-interface; Quantel HarrySound mode; 50 to 230 track-minutes; emulation of eight tape reels; network capabilities for up to four online machines; external machine control; optional sound effects library.



Choosing The Right System. While both types of systems are extremely powerful, they are best suited for different applications.

RAM-based machines are best at triggering a multitude of sounds against a cue list or via live performance. Disk-based recorders are best at emulating lengthy tape tracks, and provide a variety of mix and structure options via nondestructive editing. Hybrid systems are the way to go when the advantages of both technologies are needed. Depending upon requirements, two digitally interfaced systems might even be more cost-effective than one hybrid system.

This is still relatively new technology. If a new DAW manufacturer continues to grow, it can keep supplying users with updates and other support. Since digital audio workstations seem to be multiplying with each rotation of the earth, it is important to investigate the potential longevity of the manufacturers and their plans for the future. Get the facts, read the articles, attend the trade shows, but the most important thing is to take a test drive and see if the feel, features, and logic of the workstation are right for you and your studio. •

Jeff Burger is associate editor of EQ. *Scott Martin Gershin is an L.A.-based sound designer with credits including* Beauty And The Beast, Honey I Shrunk The Kids, Glory, *and* Born On The Fourth Of July.

More Players

WE COMPILED OUR LISTING OF workstations—in all price ranges and categories—from manufacturers' specifications, keeping in mind that specs, options, storage capacities, and prices change with regularity. Many systems can be purchased with optional components and accessories, so we include base prices when a price range is unavailable. Also, we didn't call out the hard-drive capacities, since many of the systems are expandable and can be upgraded with hard and optical drives, tape backup, and other storage media.

ADAP II Digital Audio Recorder/Editor
Manufacturer: Hybrid Arts, 8522 National Blvd., Culver City, CA 90232; (213) 841-0340.
Price: $9,995-$14,995.
Strengths: Disk-based recorder for Atari Mega ST; used primarily for 2-track mastering, waveform manipulation, and post-production; RAM-based sampling for cue work; built-in EDL; MIDI control; scrubbing; digital I/O.

AudioFile Plus
Manufacturer: Advanced Music Systems, AMS Industries Park, Billingham Rd., Burnley, Lancs. BB11 5ES, England; (0282) 57011.
U.S Distributor: Interface Audio, 3125 Presidential Park Way, Atlanta, GA 30340, (404) 458-1976.
Price: $28,030-$95,000.
Strengths: Self-contained, disk-based, 8-track recording system; designed primarily for post-production work; built-in high-resolution graphics display, scrub wheel, SMPTE code generator/reader, and RS-422 control over all functions.

Dawn (Digital Audio Workstation Nucleus)
Manufacturer: Doremi Labs, 4927 Glen Arden Ave., Covina, CA 91724; (818) 966-2454.
Price: $10,700-$14,000.
Strengths: Hybrid post-production system; designed for sound design, sample recording and editing, ADR and dialog track splitting; Macintosh front end; generates soundfiles editable by Sound Designer, Alchemy, and others; expandable to 16MB of RAM.

DPR 100 Digital Audio Workplace
Manufacturer: Symetrix, 4211 24th Avenue W., Seattle, WA 98199; (206) 282-2555.
Price: $79,500-$159,00; product available fall 1990.
Strengths: Disk-based, 24-bit recording system for broadcast, multimedia, and post-production; Macintosh front end; simultaneous 8-track recording and playback; online mixing of 40-tracks from disk; serial control of external audio/video transports; optional moving faders.

Dyaxis Digital Audio Production System
Manufacturer: Studer Editech, 1370 Willow Rd., Menlo Park, CA 94025; (415) 326-7030.
Price: $6,500 - $15,000.
Strengths: Disk-based recorder for production and mastering; 4-channel playback with 2+2 option; Macintosh front end; can mix many disk tracks down to a stereo soundfile; nondestructive playlist editing; up to 12 track-hours of disk recording.

Fairlight MFX.DR
Manufacturer: Fairlight ESP P/L, 30 Bay St Broadway, NSW, Australia 2007; 61 (2) 212-6111.
Price: N/A; product available fall 1990.
Strengths: Hybrid disk-based and RAM-sample system designed for audio post-production, based on Fairlight CMI Series III; playback of eight disk tracks and eight sample voices simultaneously; trigger up to 32MB RAM manually or via cue list; custom keypad with scrub wheel.

56K Digital Audio System
Manufacturer: Turtle Beach Systems, Box 5074, York, PA 17405; (717) 843-6916.
Price: $1,295-$3,685.
Strengths: Disk-based recording system for

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low-cost 2-track mastering; IBM-PC front end; requires mouse or trackball; standard digital I/O allows DAT machines to fulfill A/D and D/A functions; analog I/O optional; NeXT compatibility; AES/EBU and S/PDIF interfaces.

ProDisk-464

Manufacturer: Digital Dynamics, 270-02 East Pulaski Rd., Greenlawn, NY 11740; (516) 271-5600.

Price: $28,495 base.

Strengths: Disk-based recording system for multitrack recording; Macintosh front end; field-expandable from 4 to 64 tracks in 4-track increments by adding hard drive/processor units; includes MIDI synchronizer.

Sound Tools

Manufacturer: Digidesign, 1360 Willow Rd., Suite 101, Menlo Park, CA 94026; (415) 327-8811.

Price: $3,285 (Mac version); $2,995 (Atari version).

Strengths: Macintosh- or Atari-based, stereo disk recording system for 2-track mastering and sound design; real-time DSP; extensive editing features; optional DAT I/O; optional Pro I/O; SMPTE time code capabilities; Q-Sheet-compatible.

Synclavier 3200 Digital Audio Workstation

Manufacturer: New England Digital, 49 N. Main St., White River Junction, VT 05001; (802) 295-5800.

Price: $60,000 base.

Strengths: Hybrid system for music production and post-production; up to 32MB RAM sampling with 32-voice polyphony and 16 outputs; Macintosh front end; 200-track EDL-style sequencer; optional disk-based multitrack (4, 8, 12, 16 tracks). •

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Living In The Digital Domain

By Dan Daley

"DIGITAL SYSTEMS OPERATOR." Dave Marcus is exactly that, but he calls himself something different—depending on what he's doing that day. "Sometimes I call myself a sound designer, sometimes a systems engineer or creative engineer; some days I'm a wizard or a warrior, " says the San Francisco native who now lives in New York.

Job titles aside, for the last two years Marcus has run the New England Digital PostPro/Synclavier digital recording and editing system at Manhattan's Magno Sound & Video. Working in a room he designed and built, Marcus designs the audio for commercials, films, and television programs—all digitally.

Marcus first faced digital audio in 1981, when, armed with a college degree in electronic music and composition, he encountered an early Synclavier in Los Angeles. The pivotal event came in 1985, when Marcus was using two Synclaviers in his transfer and dub work on films. He was working at L.A.'s Modern Videofilm when Paramount Television, a client, wanted to cut the post-production costs of its new ABC-TV *MacGyver* series. Marcus recalls, "Paramount was skeptical about posting digitally. We asked [executive producers] John Rich and Henry Winkler to come in for one day. After that demo, they were convinced"—so convinced, in fact, that a new room was designed and built around the Synclaviers, an SSL 6000E console, and six 24-track decks—with considerable input from Marcus.

Marcus has spent his entire career in the digital domain, and for him, occasional brushes with analog serve to reinforce digital's capabilities. "You realize that digital frees you from a lot of analog's tedium of audio assembly on a day-to-day basis," he says. "It frees you to be more creative, and it's changing the relationship between peo-

ple and equipment by placing more demands on traditional roles. For example, take the distinction between mixers and sound editors in film: With systems like the tapeless PostPro, sound editors can give mixers a much more prepared piece of audio than traditional editors could with analog. You can assemble sounds to the point where they simply play with virtually no need for manipulation in the mix stage."

Overall, Marcus points out, "the key to using random access is how the information is entered in the first place. With optical disk technology, you can put so much sound onto a disk that grouping sounds in some logical fashion is critical."

Another relationship that's changing because of digital technology is the studio/client one. Marcus notes, "The ability offered by digital to so dramatically change the nature of sound means that client expectations are changing; they hear more, so they want more. It's gotten to the point where some clients let me make creative decisions because I can come up with something completely unexpected, using things like track slipping and time compression."

With a client who's new to digital, adds Marcus, "I work at developing and transforming the syntax of how we communicate. I use analog terms with them, and don't bowl them over with techno-speak. Once they're used to digital, they don't want to go back. Some clients are getting hip to tapeless capabilities, like being able to get more information into the same amount of time; they're bringing in 32-second spots to compress down to 30 seconds."

The engineer of the future, says Marcus, will be someone who can integrate the mechanics of the technology with the creative demands that systems operators will need to be competitive. That engineer must be able to "begin with nothing and deliver the finished product to the client in one session," according to Marcus. "You'll need to perform the functions of engineer, mixer, editor, operator, and musician. A jack of all trades is a good thing to be in digital." •

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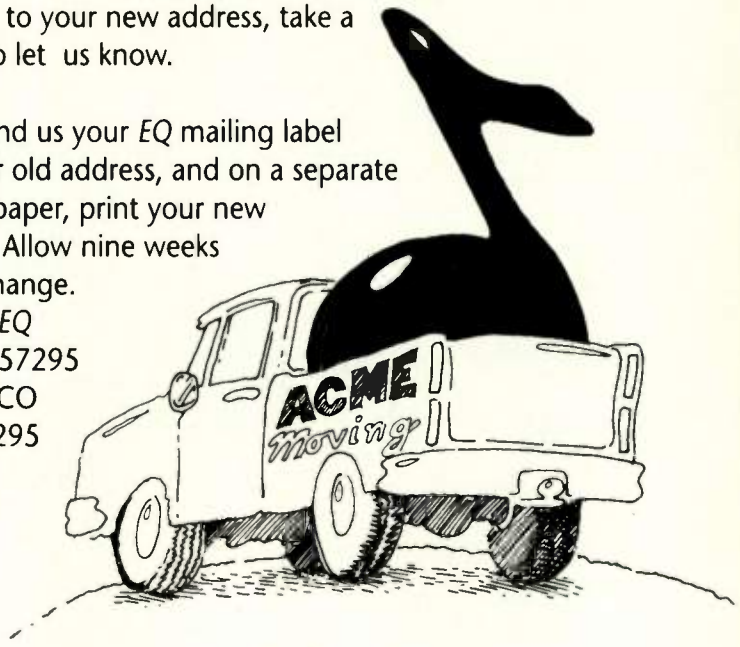

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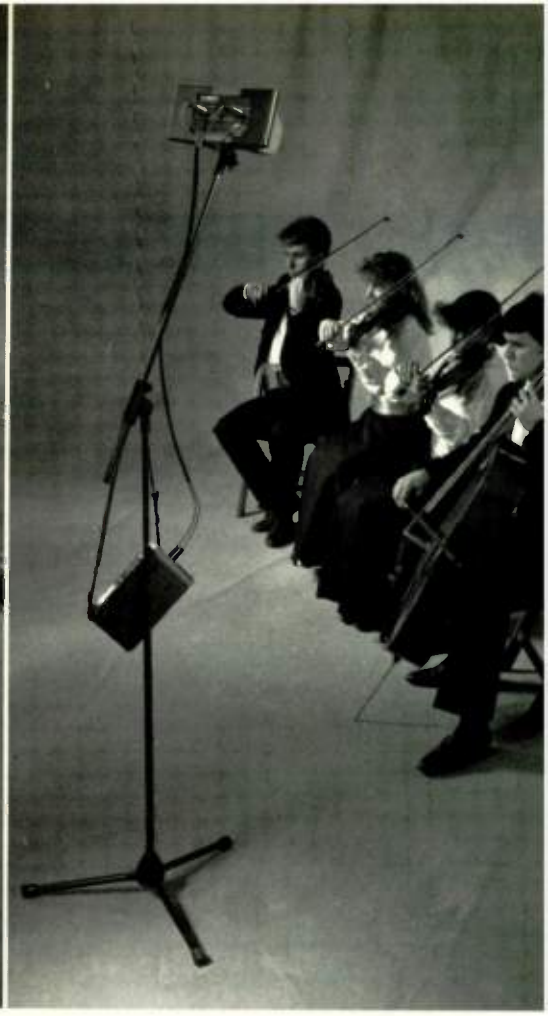

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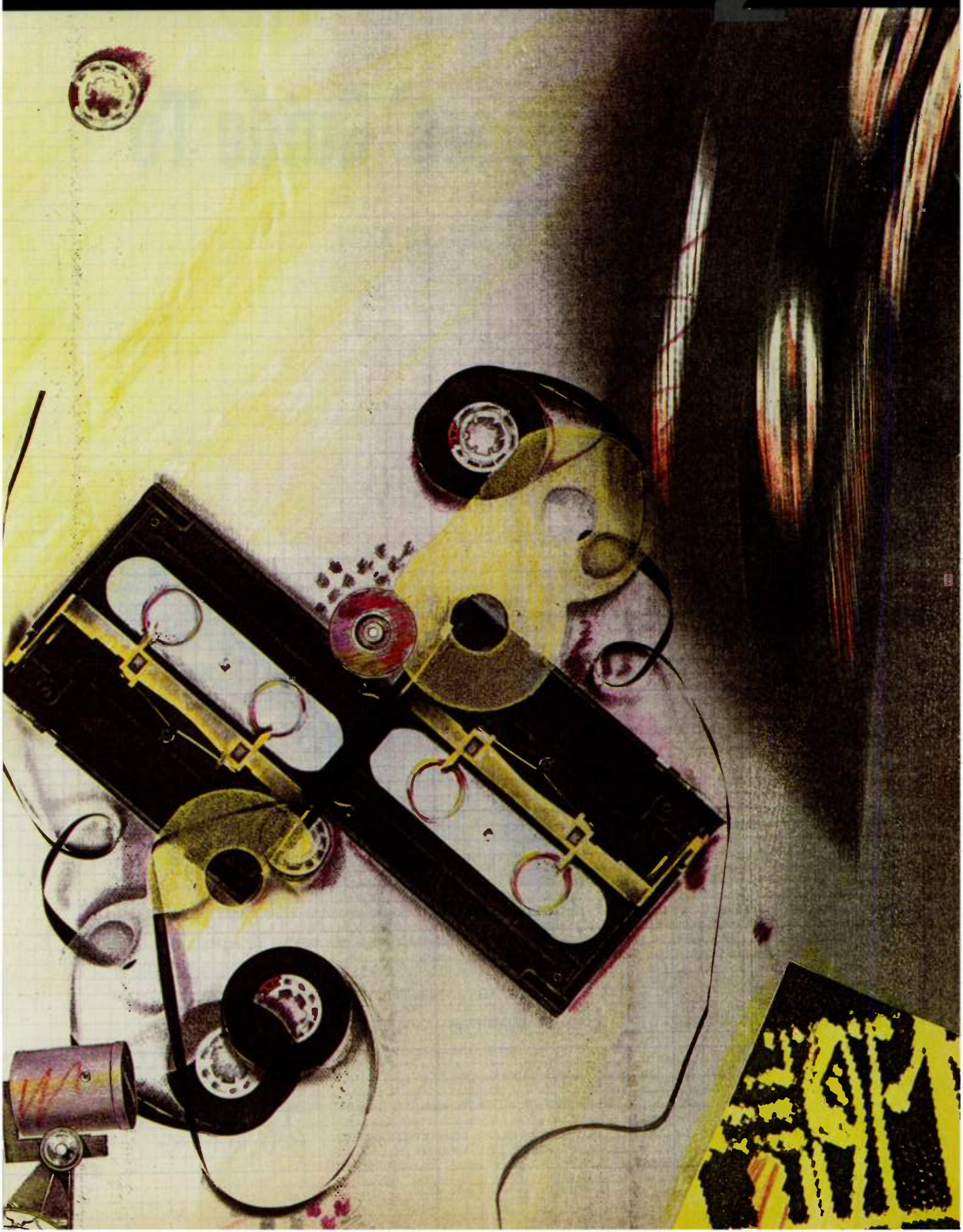

The EQ Shoppers' Guide To DAT

Evaluating The Features Of Today's DAT Machines—How Much Recorder Do You Really Need?

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• • •

DAT cassettes are slightly smaller than standard analog audio cassettes. Similar to an 8mm videocassette, the DAT shell has a protective cover. (See "Moving Parts: An Inside View Of DAT Cassettes" in this section.) The similarities to videotape don't stop there. A DAT machine, like a VCR, employs a rotating head to create a high "apparent" tape speed, as the tape itself moves slowly against the fast-spinning head drum. In fact, DAT originally was called *R-DAT,* for Rotary-head Digital Audio Tape. Also like video, the digital tracks are recorded "helically," or vertically on the tape.

The current DAT format provides two digital audio tracks (left/right), various subcode tracks (including location identifications), two optional longitudinal tracks, and, in certain new decks, a provision for a SMPTE

BY BRENT HURTIG

time-code track. The actual digital audio is stored on tape as 16-bit PCM (pulse code modulation), although the DAT protocol allows for future systems with up to 20-bit storage. Unlike compact discs and other optical media, DAT is not an instant-access system; you have to wind tape from point A to point B. Still, DAT does allow for detailed "location IDs."

The following paragraphs and accompanying chart will help you sort out some basic issues and decide which current DAT machine is the right one for your studio.

Using The EQ Shoppers' Guide To DAT

Our chart shows a listing of most of the DAT recorders on the market as of summer 1990. We've included professional- and consumer-oriented machines, since both are finding their way into the recording studio. The primary differences among most pro and consumer machines are the analog interface connectors and digital interface formats.

If you're new to DAT, just about any DAT recorder may sound impressive. There are sonic differences, however, that are apparent to those among us without golden ears. Before you buy, we recommend you listen to various DAT recorders and compare for yourself.

Keep in mind that the specs listed here are those claimed by the manufacturers, and we have not confirmed these specs on our test bench. (We'll be running DAT Lab Tests in upcoming *EQ*s.) We've done our best to ensure that the listed features, specs, and prices were accurate at press time. Following are explanations of the information provided in the accompanying chart:

	RETAIL PRICE	SIGNAL-TO-NOISE RATIO	FREQUENCY RESPONSE	TOTAL HARMONIC DIST.	LINE-IN LEVEL	LINE-OUT LEVEL	MICROPHONE INPUT	OPTICAL I/O (DIG. S/PDIF)	COAXIAL I/O (DIGITAL)	REMOTE?	SMPTE TIME-CODE TRACK	D/A CONVERSION	SAMPLING FREQ., RECORD	SAMPLING FREQ., PLAY	COMMENTS
AIWA HD-X1	$1,200	>92dB	2Hz-22kHz	.005%	-10	-10	MINI-PHONE	NO	MINI-PHONE S/PDIF	YES, WIRED	NO	16-bit	48	48, 44.1, 32	A, B, H, I, K, R
AIWA XD-001	$1,600	>92dB	2Hz-22kHz	.005%	-10	-10	NO	NO	RCA	YES, WIRE-LESS	NO	16-bit	48; 32 on dig. in	48, 44.1 32	C
AKAI D930	$1,400	>92dB	2Hz-22kHz	.005%	-10	-10	NO	YES	RCA	YES, WIRE-LESS	NO	16-bit	48, 32	48, 44.1, 32	Q
CASIO DA 2	$1,500	>85dB	10Hz-20kHz	.005%	-10	-10	1/4" PHONE	NO	NO	NO	NO	16-bit	48	48,44.1, 32	B, H, I, K, R
FOSTEX D 20	$8,000	>90dB	20Hz-20kHz	.05%	+4	+4	NO	NO	XLR	YES, WIRE-LESS	YES	16-bit	48,44.1	48, 44.1	D, F, G, J, L, Q, P, Q
JVC XD-Z900	$1,700	92dB	2Hz-22kHz	.004%	-10	-10	1/4" PHONE	YES	RCA	YES, WIRE-LESS	NO	18-bit	48, 32	48, 44.1, 32	J, L, Q
JVC XD-Z1100	$1,950	90dB	5Hz-22kHz	.005%	-10	-10	NO	YES	RCA	YES, WIRE-LESS	NO	16-bit	48, 32	48, 44.1, 32	C, Q
NAKAMICHI 1000 PRO	$11,000	106dB	5Hz-20kHz	.005%	+4/-10	+4/-10	NO	NO	XLR/ RCA	YES, WIRED	NO	20-bit	48,44.1, 32/ (dig. in)	48, 44.1 32	G, J, P, Q
NEC KD-1000	$1,850	>90dB	5Hz-22kHz	.005%	-10	-10	NO	YES	RCA	YES, WIRE-LESS	NO	16-bit	48, 32	48, 44.1, 32	A, Q
PANASONIC SV-255	$2,700	>93dB	10Hz-22kHz	.05%	+4	-10	XLR	NO	MINI PHONE OUT	NO	NO	16-bit	48	48, 44.1	A, B, E, H, I, Q
PANASONIC SV-3500	$2,500	93dB	10Hz-22kHz	.05%	+4	+4/-10	NO	NO	RCA	YES, WIRED	NO	18-bit	48, 44.1, 32	48, 44.1 32	Q
PANASONIC SV-3700	T.B.A.	93dB	10Hz-22kHz	.05%	+4/-10	+4/-10	NO	NO	RCA	YES, WIRED	NO	18-bit	48, 44.1	48, 44.1, 32	N, Q
PANASONIC SV-3900	T.B.A.	93dB	10Hz-22kHz	.05%	+4/-10	+4/-10	NO	NO	XLR/ RCA	YES, WIRED	NO	18-bit	48, 44.1	48, 44.1, 32	N, O, Q

CHART CONTINUED ON NEXT PAGE

Retail Price. Manufacturer's suggested selling price in U.S. dollars. Some machines, however—including those from Aiwa, Akai, JVC, Pioneer, Technics, and a few from Sony—are imported to the U.S. via the "grey market." For these machines, the retail price is an approximation that reflects their current market value.

Signal-To-Noise Ratio. These specs are "A-weighted" to represent more accurately how much noise we actually hear. All these machines are exceptionally quiet compared with traditional open-reel analog mastering, which typically offers a S/N ratio of 65 to 72dB (with no noise reduction). [*Ed. Note: Panasonic does not offer a comparative S/N spec for the SV-255; our sister publication* Keyboard *recently tested this deck and found a S/N ratio of >93dB.*]

Frequency Response. Several manufacturers don't list the tolerance for their frequency response (i.e.: 20Hz-20kHz, *±1dB*), so we've only listed the claimed bandwidth. Surprisingly, certain open-reel analog 2-tracks have better frequency response than some DAT players. Almost any 30ips 2-

Key To DAT Chart Comments

A. input level limiter
B. portable
C. can be modified to record at 44.1kHz, digital input only
D. connections provided for external transport synchronization
E. location IDs cannot be edited
F. SMPTE time code I/O
G. hardware-upgradable
H. supplied with battery pack
I. has mic/line preamp; input selectable bet. mic or line
J. off-tape monitoring
K. no memory programmability
L. word-sync connection (input only, Sony PCM-2000; output only, Sony PCM-2500)
M. built-in speaker, remote holds mike; comes with carrying case and A/C adapter
N. available this summer
O. RS422 port
P. punch-in/out recording
Q. 1/4" stereo headphone outputs
R. 1/8" (mini) stereo headphone output

CHART COMPILED BY ERIC TURKEL & LINDA JACOBSON

	RETAIL PRICE	SIGNAL-TO-NOISE RATIO	FREQUENCY RESPONSE	TOTAL HARMONIC DIST.	LINE-IN LEVEL	LINE-OUT LEVEL	MICROPHONE INPUT	OPTICAL I/O (DIG. S/PDIF)	COAXIAL I/O (DIGITAL)	REMOTE?	SMPTE TIME-CODE TRACK	D/A CONVERSION	SAMPLING FREQ., RECORD	SAMPLING FREQ., PLAY	COMMENTS
PIONEER D-900	$1,800	92dB	2Hz-22kHz	.005%	-10	-10	NO	YES	RCA	YES, WIRELESS	NO	16-bit	48, 32	48, 44.1, 32	Q
SHARP SX-D100BK	$2,200	90dB	5Hz-20kHz	.005%	-10	-10	NO	YES	RCA	YES, WIRELESS	NO	16-bit	48	48, 44.1, 32	Q
SONY DTC-500ES	$1,750	>92dB	2Hz-20kHz	.007%	-10	-10	NO	YES	RCA	YES, WIRELESS	NO	16-bit	48,32	48, 44.1 32	Q
SONY DTC-300 ES	$1,300	>92dB	2Hz-22kHz	.007%	-10	-10	NO	YES	RCA	YES, WIRELESS	NO	16-bit	48,32	48, 44.1 32	Q
SONY PCM-2500	$3,550	>90dB	2Hz-22kHz	.05%	+4	+4	NO	NO	XLR, RCA, BNC	WIRED & INFRARED	NO	16-bit	44.1, 48	48, 44.1, 32	K, L, Q
SONY TCD-D10	$1,900	>85dB	20Hz-22kHz	.06%	-10	-10	1/4" PHONE	NO	NO	YES, WIRED	NO	16-bit	48	48, 44.1 32	A, B, E, H, I, K, M, Q
SONY TCD-D10 PRO	$2,900	>85dB	20Hz-22kHz	.06%	+4	-10	XLR	NO	XLR	YES, WIRED	NO	16-bit	48	48, 44.1, 32	A, B, E, H, I, K, M, Q
SONY PCM-2000	$5,000	>90dB	20Hz-22kHz	.07%	+4	-10	XLR	NO	XLR	NO	YES	16-bit	48, 44.1, 44.056	48, 44.1, 44.056 32	B, I, E, K, L, Q
SONY DTC-M100	$1,400	90dB	5Hz-22kHz	.008%	-10	-10	NO	YES	RCA, IN ONLY	YES, WIRELESS	NO	16-bit	48, 32	48, 44.1, 32	Q
TECHNICS SV-MD1	$2,050	90dB	10Hz-22kHz	.008%	-10	-10	1/4" PHONE	NO	MINI-PHONE	NO	NO	16-bit	48	48, 44.1	A, B, I, E, H, Q
TECHNICS SV-DT100	$1,900	93dB	1Hz-22kHz	.05%	-10	-10	NO	YES	RCA	YES, WIRELESS	NO	16-bit	48, 32	48, 44.1, 32	Q
TASCAM DA-50	$4,000	90dB	10Hz-22kHz	.005%	+4/-10	+4, -10	NO	YES	RCA	YES, WIRED	NO	16-bit	44.1, 48	44.1, 48	Q
TASCAM DA-30	$1,899	>94dB	1Hz-22kHz	.004%	+4/-10	+4/-10	NO	NO	XLR/RCA	YES, WIRELESS	NO	18-bit	48, 44.1, 32	48, 44.1, 32	N, Q

track analog deck boasts real-world performance over 25kHz in the top end; DAT machines are restricted to a high end of less than 22kHz, thanks to the cut-off point of their anti-aliasing filters.

Total Harmonic Distortion. Low THD is one of the highlights of digital recording. But for some fans of analog (where THD levels are often ten times as much as those found on many DAT decks), harmonically "agreeable" distortion may add "warmth" and "fullness." A fondness for digital recording may be an acquired taste.

Line-In & Line-Out Levels. Analog input/output (I/O) operating levels. Since DAT initially was designed as a "consumer" product, the majority of units operate at -10dBV levels and have unbalanced RCA connectors. Machines running at "+4" levels sport 3-pin balanced XLR connectors, and operate at the "pro" +4dBm level. Some machines offer both switchable levels (+4/-10), as well as XLR and RCA connectors. (One machine, the Fostex D-20, has +4dBm XLR I/Os, and 1/4" monitor outputs.)

If the DAT deck of your dreams doesn't operate at the same level as the rest of your gear, remember that in many cases, -10 and +4 DAT decks can be used with either -10 or +4 consoles, thanks to variable input and output gain options on the deck or console. If you run into problems, or want to maintain a balanced line between a pro console and a -10 DAT deck, use a level-matching converter (from Aphex, Valley Audio, and others).

Microphone Inputs. The Aiwa HD-X1 has a single, stereo mini-phone (1/8") jack. Several other machines (including all the portables) offer a 1/4" or XLR pair of inputs. If you plan to record with mikes directly to DAT (without a mixer), the quality of the preamps is important. Listen carefully for noise, distortion, and general "accuracy" of these inputs. If you own a high-quality board, you'll probably be better off using one of its microphone inputs, and running a line-level signal to the DAT deck. For on-location recording, you may even want to use a high-grade outboard preamp, from John Hardy, Symetrix, or another supplier. Before long we'll see outboard microphone preamps with digital outputs.

Optical & Coaxial Digital I/Os. Most DAT decks offer digital inputs and outputs, in addition to the conventional analog I/Os. Digital I/Os allow the transfer of information among different digital devices (other DAT decks, CD players, even signal processors) with theoretically no signal loss. (Analog I/Os introduce small yet cumulative amounts of distortion and noise.)

The digital I/Os of consumer-type machines abide by the Sony/Philips digital interface format (S/PDIF), and consist of an analog-style RCA coaxial connector. Some decks also offer a fiber-optic port. Fiber-optic cabling can be run over longer distances than a coaxial cable, with less chance of external radio frequency interference (RFI). The Serial Copy Management System (SCMS) agreement will be applied to all S/PDIF format digital jacks in the future.

Pro decks follow the digital format ratified by the Audio Engineering Society and the European Broadcaster's Union. The AES/EBU connector usually is a 3-pin XLR, though we may see AES/EBU optical ports before too long. By agreement, AES/EBU digital jacks are exempt from SCMS. (It is possible, by the way, to connect S/PDIF to AES/EBU ports, although rates and digital levels must be watched, and certain types of subcode and timing information—including SCMS—may not be passed.)

Remote Control. A hand-held remote control, wired or wireless, comes in handy when you're assembling a master or cataloging a tape of samples. While you might like a wireless remote, it could require turning to face the DAT deck every time you want to use it. That's why some people pre-

Just about any DAT recorder may sound impressive. There are sonic differences, however.

fer wired remotes.

Some remotes go the extra step beyond basic transport control. The Fostex D-20's remote lets you address any location directly from a ten-key pad, and switch between input and output monitor modes. The Panasonic SV-3900's remote has a "jog wheel" that lets you "rock" the transport back and forth to locate a section of tape.

SMPTE Time-Code Track. Most professional open-reel analog (and all digital) recorders can be locked to an external synchronizer. They also can record a separate track for SMPTE/EBU time code. This is vital for video, film, and multimedia work. Since DAT originally was designed as a consumer format, the original spec did not provide for a time-code track. Today, there are three "after-thought" approaches to adding time code.

The simplest is found on the Sony PCM-2000. This is an advanced portable DAT recorder, designed primarily for on-location video and film work. As we discussed earlier, the audio tracks for DAT are recorded helically, as "vertical" tracks. The DAT format also allows for auxiliary longitudinal tracks, which get recorded like a traditional analog tape track. The PCM-2000 uses one of these tracks to record and play back time code. But the system is not perfect: Time code cannot be read when the deck is stopped, and the transport isn't synchronizable.

At press time, only the Fostex D-20 offers a viable approach to DAT time code. The D-20 records time code as part of the subcode information, which also includes location IDs, and is recorded along with the digital audio tracks. This information can be read when the transport is stopped, it's reliable, and the transport itself is synchronizable.

It appears that other manufacturers will not adopt the Fostex approach. Sony, Panasonic, and several others plan to release synchronizable DAT decks with a new time-code track standard. Their approach is similar to Fostex's, in that the time code becomes part of the subcode information, but the two systems are not compatible. Look for Sony's upcoming PCM-7050 and PCM-7030 DAT recorders to appear in pro audio stores toward the end of 1990. Meanwhile, Fostex says that existing and future D-20s can be modified to support the new time-code track standard.

D/A Conversion. Current DAT decks record digital audio onto tape with a 16-bit resolution (see "Digital Audio Basics" in the Using Digital section). Several DAT machines offer a higher-resolution digital-to-analog conversion, since some designers consider that a higher D/A resolution yields a smoother playback across the entire dynamic range of the deck. But more bits is by no means a guarantee of better-sounding playback: A high-quality 16-bit D/A will outperform a lesser-grade 18-bit

Hear the Apogee Difference

Over the past few years, Apogee has become famous for enhancing the sound of digital audio recorders and processors. Now Apogee quality is available for virtually any digital audio system, with the introduction of the **AD1000** and **DA1000 Portable Reference Converters**. They're free-standing, can be battery-powered, and use the very latest Apogee digital components. They'll interface with most systems with digital I/O, including DAT machines and EIAJ/F1 format digital audio processors.

An inexpensive digital I/O modification may be required for EIAJ processors. Apogee also produces a range of OEM digital products: data sheets and leaflets are available on request.

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D/A—hands-down.

Sampling Frequency (Record & Play). The "standard" rate offered for recording and playback by all DAT recorders is 48kHz. All machines play back at a 44.1kHz rate (the "CD" rate); some also record at 44.1. A few machines also provide the rarely used "broadcast-quality" 32kHz rate, which can record up to several hours of reduced-performance audio.

By using a 44.1kHz recording option, your master tapes can be transferred digitally for CD mastering without the need for rate conversion. However, thanks to the legal ramifications of being able to record a CD digitally and make perfect DAT replicas, consumer decks lack the capability to record at 44.1kHz. Certain decks can be modified to work around this limitation (see "Hot-Rodding Your DAT Deck" in this section). Most current pro-oriented decks record at 44.1. Now that SCMS is status quo, expect to see most (if not all) lower-priced decks able to record at 44.1kHz—with the SCMS copy-of-copy limitations in place.

• • •

Today, professional and semi-pro users are the ones buying DAT. Their choices have been limited to a handful of professionally oriented decks, and a larger handful of consumer decks imported through the (legal) "grey market." That's primarily because no manufacturer has been willing to face the snarling fangs of record and publishing industry lawyers by importing a DAT deck aimed at consumers to the U.S.

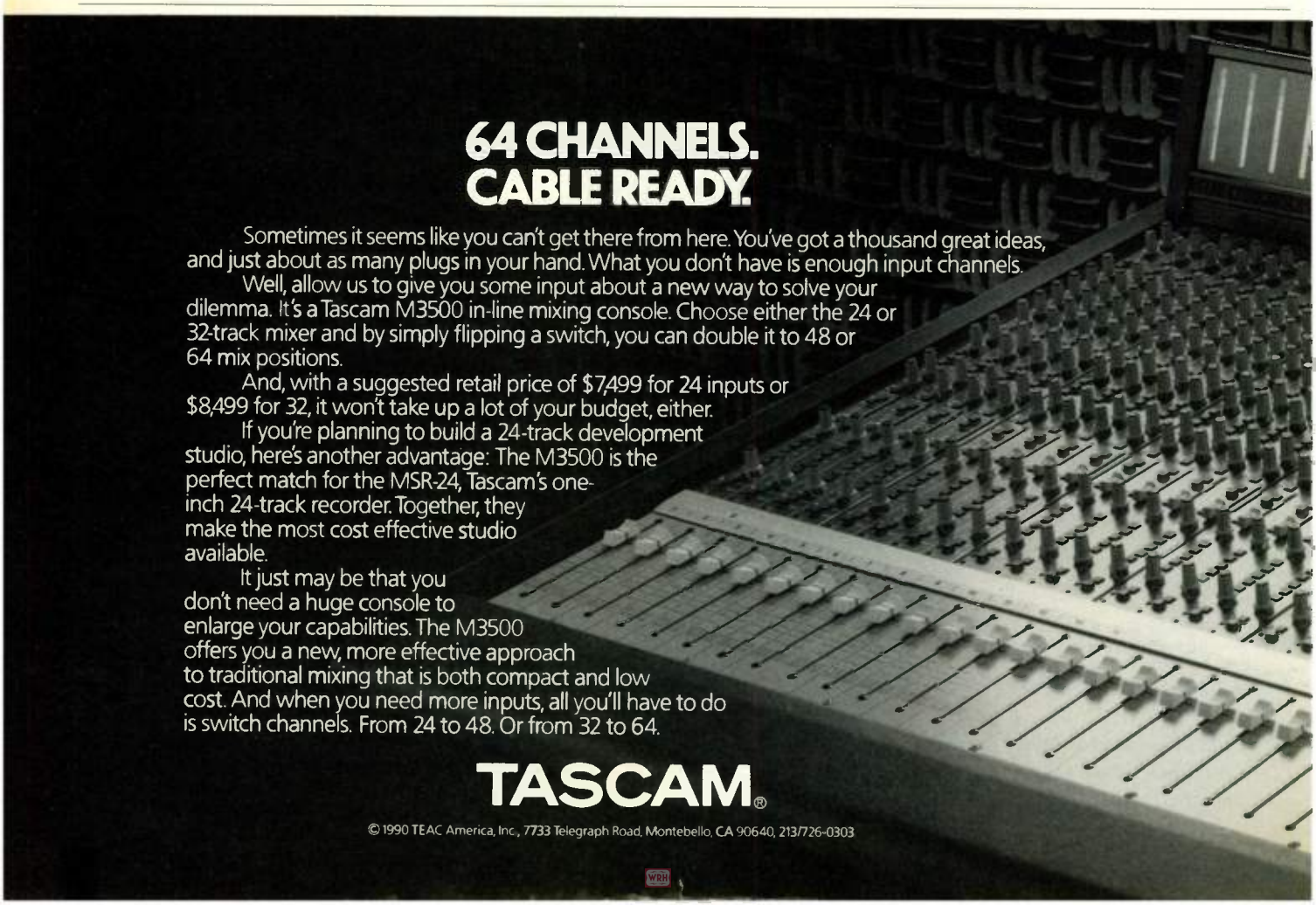
We explored the problem in the last issue of *EQ* (May/June '90, "The Tangled Story Of DAT"). The principal complaint about DAT, voiced by the record and music publishing industries since DAT was introduced over three years ago, is that it can make near-perfect recordings of compact discs—particularly so if the DAT recording is a digital-to-digital one (via a CD player's digital output to a DAT deck's digital input).

Last year, however, the Serial Copy Management System was established. SCMS is a copy-protection protocol agreed to by electronics manufacturers and the record industry. Essentially, using a CD player's digital output and a DAT deck's digital input, SCMS will allow a first-generation DAT copy of a CD. Because of subcode technology, however, it will not allow digital *copies of the copy*. Not every new DAT machine will be equipped with SCMS: Professional machines, with AES/EBU-format XLR digital inputs and outputs, are exempt from SCMS (although their S/PDIF RCA digital I/Os may be equipped with SCMS).

Other technologies such as recordable CD offer promise as future mixdown media. But nothing is as affordable and well-entrenched as DAT. With SCMS now clearing the decks for DAT, expect to be listening to those tiny, great-sounding tapes into the next century. •

Eric Turkel is an arranger/producer based in the metropolitan New York area. He is the author of Arranging Techniques For Synthesists *and numerous articles on music and technology.* ***Brent Hurtig*** *is the editor of* EQ. ***Linda Jacobson*** *is* EQ*'s managing editor.*

EQ *would like to thank Jesse Jacobson and Scott Ikier of The DAT Store in Santa Monica, California—as well as the DAT manufacturers—for supplying technical data and clarifications.*



Hot-Rodding Your DAT Deck

ALL DAT MACHINES ARE NOT created equal, as the EQ Shoppers' Guide To DAT indicates. Fortunately, there are several modifications and accessories available for the almost-happy DAT owner who wishes to improve the performance of his or her recorder.

Most consumer decks lack the ability to record at a 44.1kHz sampling rate. The older Sony DTC-1000 and Aiwa XD-001, however, can be modified by a competent technician to record at 44.1 through the digital or analog inputs. The JVC XD-Z1100, NEC KD-1000, and Sony PCM-2500 also can be modified for 44.1 work, but via their digital inputs only. The mods cost $150 to $300. Most pro audio suppliers can steer you toward someone who can do the mod, or you can turn to a DAT specialist store.

Owners of the Sony DTC-1000 or the Aiwa XD-001 may be interested in the "full-blown" DAT treatment offered by Audio+Design (U.S. contact: Gotham Audio in NYC, tel: (212) 765-3410). For about $2,000, your conventional machine can be turned into an A+D ProDAT, complete with the 44.1 mod, AES/EBU digital I/Os, balanced analog I/Os, improved anti-aliasing filters, and more.

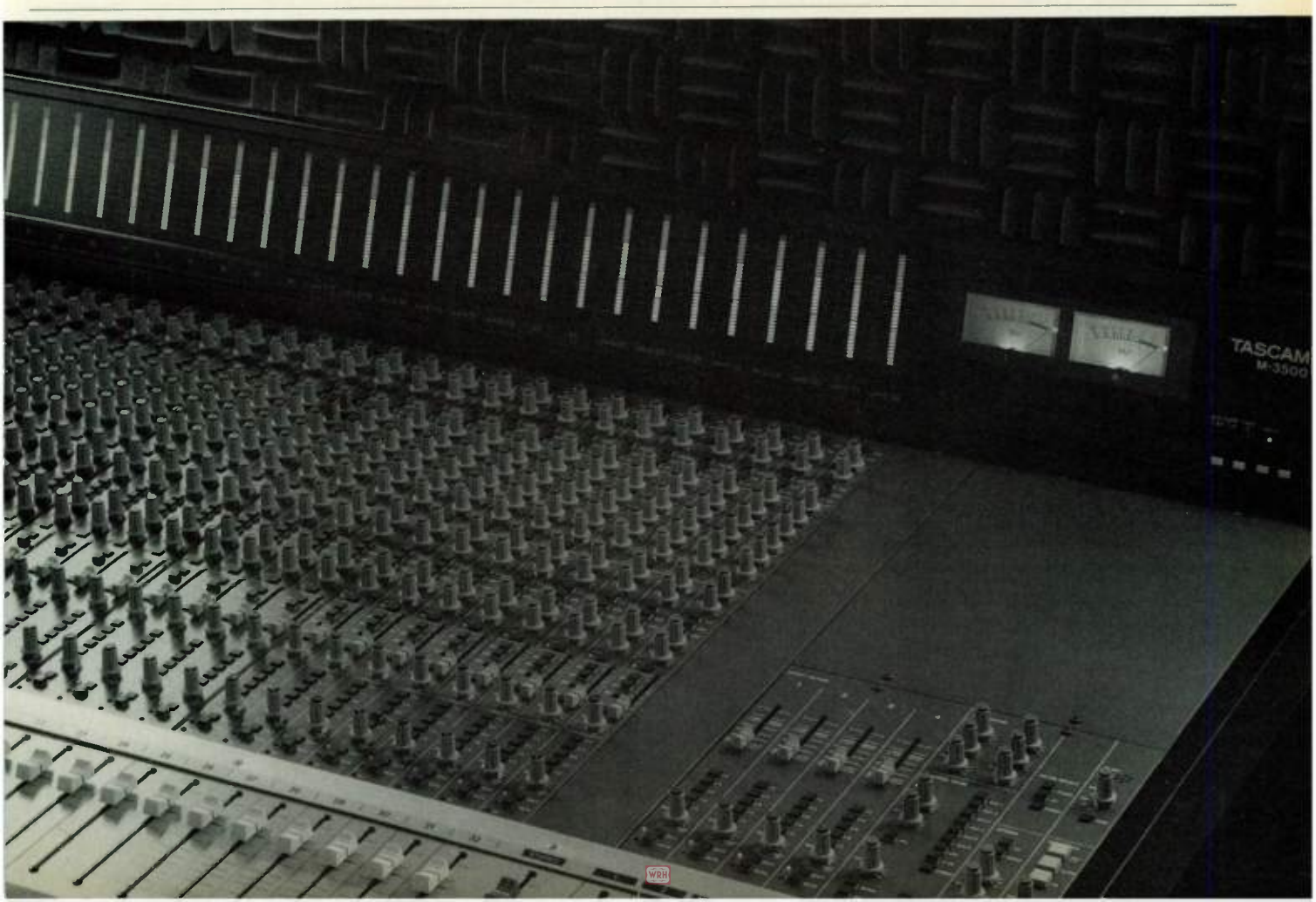
Speaking of filters, a popular current modification for the DTC-1000, PCM-2500, and XD-001 involves replacing their stock anti-aliasing filters with superior ones made by Apogee Electronics (Santa Monica, California, (213) 828-1930). [See "Digital Audio Basics" for the scoop on aliasing.] Many users find these new filters "warm up" the sound of the deck, especially in the upper-mid to high frequencies, reduce harshness, and increase overall clarity. The mod runs from $300 to $500 installed.

At this writing, there are no commercially available A/D converter chips to replace the stock ones, so internal upgrading is not yet an option. However, such companies as Philips, Sony, Burr-Brown, and Analog Devices currently are developing the next generation of A/D convertors.

Apogee has just released the AD1000 and DA1000 external stereo A/D and D/A converters. Armed with one of each—and a DAT deck with a digital I/O (AES/EBU or S/PDIF)—it's possible to bypass all the stock analog audio stages of the deck. The AD1000 ($995) is analog line-in, digital-out, and includes Apogee's fine anti-aliasing and A/D chips; the DA1000 ($795) is digital-in, analog line-out. Costing not much less than some DAT decks, you may find them expensive. But consider this: Unlike an installed mod, these converters are portable, and can be used on a wide variety of machines. Add them to a high-grade DAT deck, and you have a serious mastering medium for a lot less than the $12,000+ price tags of some open-reel analog 2-tracks.

If you're shopping for a DAT deck, don't let these high-end possibilities paralyze your purchase plans. Most DAT machines offer great audio quality, right out of the box, and many are priced below their analog relatives. But if you're looking to push the envelope of DAT performance, the tools are ready and waiting.

—Eric Turkel



Acoustic Live-To-DAT Recording

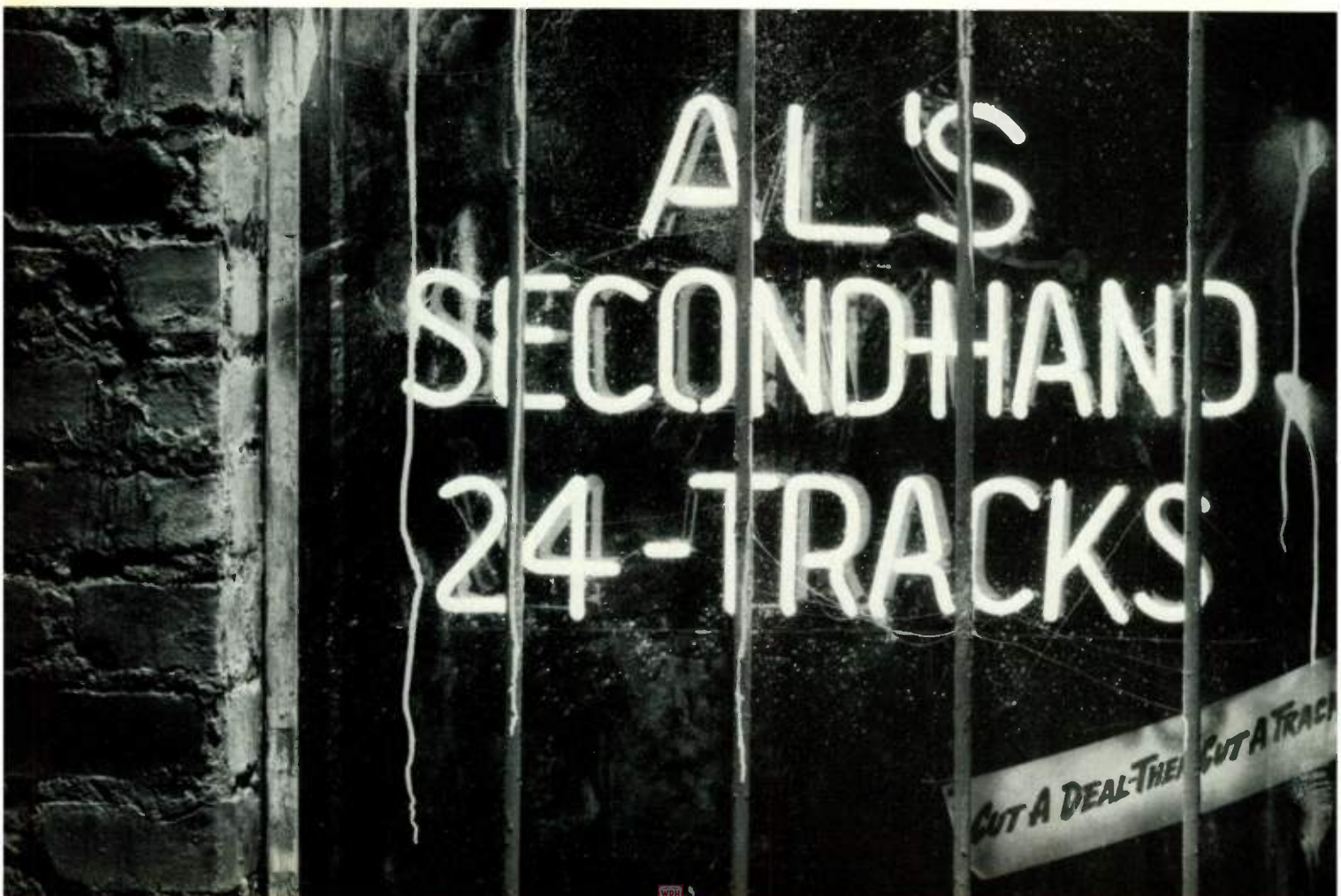
Tips For Getting The Most From Your DAT Session.

BY HARVEY REID

WITH JUST A DIGITAL AUDIO tape recorder, one or two high-grade microphones, and your wits, it's possible to cut a world-class, CD master-quality sound recording for hundreds, rather than thousands, of dollars. And if you're used to hearing analog hiss and distortion, you might not be prepared for just how *good* a recording you can make. Here are some tips and tricks so you can avoid the pitfalls of this great live-to-2-track technique.

Preparing Yourself. Because digital machines are so sensitive, and because there's no tape hiss to cover background noises, you need to do a "sonic scrub" before your live recording session. So spend some time in the quietest place you know, listening carefully to yourself and your instrument. It's amazing what tiny nuances of sound show up on digital audio tape; you can hear things like the sound of your mouth opening before you sing. This usually happens at the beginning of a song, just before you start to play, when it matters the most. Squeaky chairs, piano benches, and shoes pose problems, and so does bumping the top of a guitar with a pick. If your nose is congested, you can make audible noises just by *breathing*. When I record, I always wear a long-sleeved cotton shirt with no buttons. It fits snugly enough around my arms to keep the cloth off my guitar strings, and keeps my arm from sticking to the guitar (just peeling a sweaty arm off the top of a guitar can make a nasty noise). Check your instruments carefully for string rattles, buzzes, and other noises. Likewise, noises in the room or from outside will show up on digital tape. If you play a noisy instrument like an autoharp, you'll hear the thumping of the chord bars and the click of picks hitting the muted strings. Listen, listen, listen, and try to cut the noises.

Preparing The Equipment. With digital recording, the important issues of microphone choice and placement are more crucial than ever. Experiment with different microphones if you have access to them. You can learn a lot with just a DAT deck, a good mike, and some headphones, exploring your instrument with the mike to find the best-sounding distance and the angle and direction for placement. Try pointing the mike up and down and at different angles; moving it a couple of inches can make all the difference. Then when it's session time, you'll have a good idea of where you



want the microphone. Many choices are entirely questions of artistic judgment rather than "right" or "wrong."

Preparing The Setting. When you record directly onto DAT, you can't go back and fix mistakes. So don't bother with all those studio distractions that evolved as a way to "punch in" fixes to a take. I think people use isolation, baffles, and headphones too much in the studio. If you know your music and are comfortable, you can get a better recording without all that stuff.

When recording with another musician, it is essential that you can see and hear each other. In multitrack sessions, engineers like to separate and isolate the musicians so one track can be fixed without "bleed" from another. If you record totally live, you can sit a couple of feet from the other musician(s). Why worry about bleed from one track to another when it's all on two tracks anyway? And you probably can mix better while you play than at the mixing board a month later. The subtle cues, crescendos, and silent communication between musicians occur instantaneously and spontaneously, and you can anticipate those more accurately than would an engineer trying to follow you with a fader. First get the music right, then find the best way to capture it on tape. I like to set the levels extremely carefully and just play a lot of music.

[*Ed. Note: You may have to deal with phase cancellations, though. To ensure your music doesn't suffer from "swishing" phase problems, follow the 3:1 rule for microphone placement: Place mikes apart from each other at least three times the distance they are from the sources. For instance, if you're playing guitar with another guitarist, and place a mike one foot from each guitar, make sure the mikes are at least three feet apart from each other.*]

Preparing The Music. The fastest, cheapest, most natural way to record to DAT is by playing and taping your song over and over, and keeping the best take, rather than piecing things together later. Playing a whole piece of music from beginning to end is what music is all about anyway, and ideally it shouldn't be different in the studio. The patterns of tension, resolution, and suspense that build up in a performance are a crucial part of what makes a recording great. But this requires some planning.

First, forget about getting that "magic first take." With direct-to-digital, you need to throw away the first few takes anyway, as you get the levels, EQ, reverb, and mix right. In the process of recording test takes, you can warm up, stretch your strings, and find the noises in the instruments and room. You don't want to waste a perfect performance when the levels might be wrong.

When you record with other players, you find that no one ever really learns the song from the tape you give them a few weeks before. They end up finding their part in the studio while you're paying for it. I like to learn the song with them, and if I don't know exactly what I'm doing, we all feel better and work together from a similar place. If you're recording live and one person blows it, everybody else has to re-do the take, and tensions can build. So work out the song arrangement details together and (re-)learn the song while you or the engineer sets levels.

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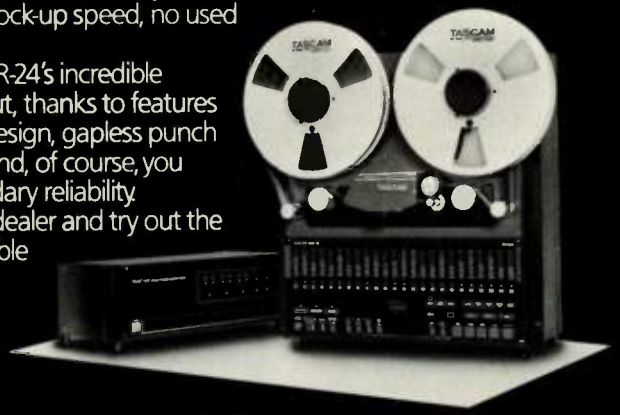
*Manufacturer's suggested retail price.



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the **human** touch

Timbuk3: On The Edge Of Multitrack DAT

By Linda Jacobson

LIKE ALL OF TIMBUK3'S PREVIOUS recordings, *Edge Of Allegiance*—released last fall on IRS—is as much poetry set to music as it is melody, harmony, rhythm, and lyric. Unlike Timbuk3's previous recordings, this one was co-produced by the band and Denardo Coleman (son of Ornette), and recorded in the Doghouse, Timbuk3's new home studio. The Doghouse is behind their home in Austin, Texas. It's small; to get to the studio room from the control room, you have to walk outside. But it suits their needs well.

The Doghouse studio is "like an overdubbing room," says Barbara K Macdonald (she and husband Pat Macdonald are Timbuk3). "We wanted to record there without sacrificing quality, so we came up with a way to record digitally by using DAT, time code, and synchronization."

After building the Doghouse and installing their MIDI and outboard gear, Timbuk3 bought a 16-channel Studiomaster board and Fostex equipment: D-20 DAT machine, E-8 1/4" 8-track recorder, 1040 SMPTE time-code generator/reader, and 2050 synchronizer. Barbara explains, "The idea was to close-mike and go direct to DAT. We went with Fostex because they had the only DAT machine that let you pre-stripe a separate SMPTE time-code track.

"First we'd stripe DAT and 8-track tape with time code. We used Maxell 120-minute DAT cassettes, with continual striping. The DAT was the master and the 8-track was the slave, but we used the 8-track and our mixing board exclusively for monitoring. To monitor vocals we used our trusty old JVC boombox, the same one that's been on New York streets and in Austin bars and on *Saturday Night Live*!

"When we recorded each take onto DAT, we'd start at an even number like 10 minutes, 20 minutes, and so on, so we could have 12 takes, or 'tracks,' per DAT tape: 120 minutes of tape spaced out at ten-minute intervals, enough for each song. That way it's real easy to log and locate, and with two DAT tapes you have 24 'tracks'!

"Each song was arranged before we recorded it. We'd already sketched out the drum tracks—just your basic kick/snare/hi-hat thing—using my Atari ST computer and the program Real-Time. We began by laying down the drums from computer onto 8-track, starting at exactly, say, 2 hours, 0 minutes.

"Then, with the 8-track synced to DAT, we recorded bass [direct to DAT] while listening to drums off 8-track. If we did three tracks of bass, we logged them at 0, 10, and 20 minutes, then took the best track or dumped all three onto 8-track and compiled it.

"After you have bass tracks, you do rhythm guitar takes, as many as you want—it's like unlimited digital tracking! While we listened to bass and drums off the 8-track, we recorded guitar, using a rented AKG C414 microphone. We recorded a dry signal, straight from the mike into a Symetrix preamp into the DAT recorder. We bypassed the mixer, patch bay, and all that wiring.

"Then we cut vocals on a rented AKG C24 tube mike. We laid down our vocals at the same time—Pat's vocal on the right side of the DAT, mine on the left.

"After we finished recording, we transferred from the DAT machine's digital output into the digital inputs of a Sony 3324 at Digital Services, a studio in Houston. We dumped each DAT take onto the 3324 one at a time, locked to code, and compiled everything on the 3324. The transfer took eight days—it was the first time anyone did anything like this, so there was lots of trial and error!"

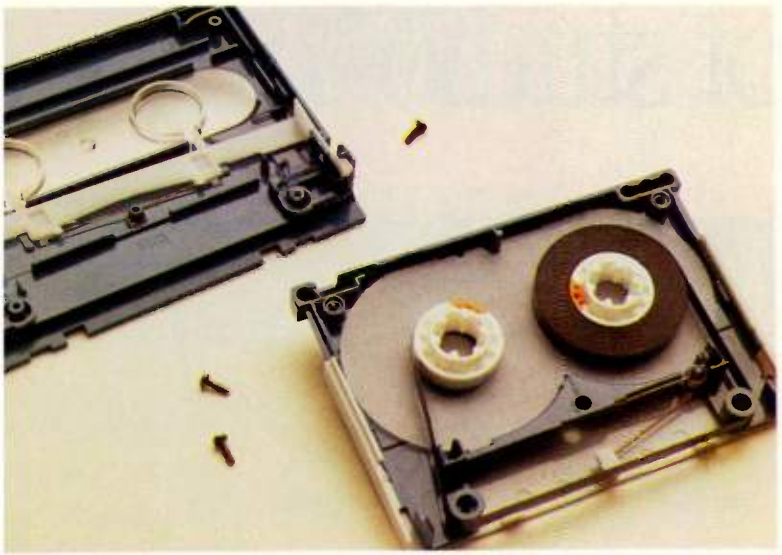
At this moment, Timbuk3 (which now includes drummer Wally Ingram) is in the Doghouse, taping the next release—recording champagne tracks on a beer budget. •

Keep Good Notes. If I'm paying for studio time, I always bring blank cassettes into the studio for doing my critical listening later on my own time. When you do multitrack recording and pay $20 a song just for *blank* tape, you really have to decide immediately which take to use, and you rarely keep more than a couple around unless you're rich. With two hours of digital audio tape costing $10-15, you can afford ten takes of every song. (And you are spared that sick feeling when you think you can do a better job, erase a good take, then botch it.) It's just as expensive to listen to your takes in a studio as it is to record them. I often ask the engineer to run a simultaneous cassette when I'm in the mood to play, then I can do the song four times, and only listen to the one I thought was best. Once the levels are set, you just roll tape and play music.

Always slate your takes: Say the name of the song and the take number before you start to play. If you're working with an engineer, make sure you agree on take numbers. It can be a mess when you have five takes each of ten different songs, with false starts on half of them! And if your project is like most, it can be weeks (or months) between start and finish, and you'll need to refer to your notes later.

As a "New Digital Purist," I am excited about the possibilities offered by inexpensive direct-to-digital recording. I hope it ushers in a new era in which people are concerned about capturing real things played by real people. Remember, all music was taped live for the first 40 years of recording. Imagine if Don Law had brought a portable DAT machine when he recorded Robert Johnson in that hotel room, or if Hendrix or Lennon had made hotel-room digital tapes . . . .•

Guitarist ***Harvey Reid*** *lives in Portsmouth, New Hampshire, and has worked full-time as an acoustic musician since 1974. He has recorded seven albums (including three direct-to-digital double CD albums) for Woodpecker Records.*



Moving Parts:
An Inside View Of DAT Cassettes

By Jesse Jacobson

ONE PROBLEM CONFRONTING pilgrims entering the brave new world of digital audio tape technology is an age-old dilemma: Which brand of machine do you buy, and which brand of tape?

At this juncture in DAT's evolution, the only machines readily available in this country (through grey market or direct U.S. sources) can be distinguished by their features or subtle differences in specs. Generally, you don't have to worry about steering clear of inferior machines, because the official U.S. releases are quality decks designed for the pro market, while the Japanese units imported by independent wholesalers/retailers generally are limited to mid- and high-end machines. Dealers are required to warranty these machines themselves—a policy of self-imposed standards that tends to weed out the bubble-gum and paper-clip DAT recorder.

This does not apply to DAT cassettes.

Unlike standard analog cassettes, DAT length does not seem to affect the durability or consistency of the tape's performance. Although DAT is a one-sided format, travelling at roughly one-sixth the speed of an analog cassette (8.15mm per second), very little actual tape-length is used—even for two hours of recording time.

Today's best-selling DAT length is the 120-cassette (two hours at 48 or 44.1kHz, four hours at 32kHz on JVC or NEC machines). However, in some instances—if you're just recording two songs, for example—shorter-length DATs are desirable, despite the increased cost-per-minute.

All "major label" DAT cassettes are made in Japan, in 120-, 90-, and 60-minute lengths. Some manufacturers also offer shorter-length and cleaning cassettes (see chart). The only brand of digital audio tape manufactured from start to finish (including the actual cartridge) in the U.S is sold by DIC Digital.

Difficulties with cassettes seem to crop up most frequently in situations involving portable DAT machines, such as the Casio DA-2, Sony TCD-D10, and Panasonic SV-255. These portable machines have smaller diameter heads and delicate loading mechanisms, which are contributing factors to cassette failure in *some* instances. One possible technical explanation for failure concerns the construction of the cartridges or shells. This in mind, one notices the particularly dense, sturdy cassette shells made by Denon, Panasonic, and TDK. [*Ed. Note: We've seen samples of Ampex DAT cassettes that seem prone to trouble—moving the integral "record safe" tab causes the top parts of the shell to separate slightly. We suggest that Ampex rectify this as soon as possible.*]

DIC Digital is in a unique position to exercise total quality control over its cassettes. When users complained that DIC DAT cassettes would not go into the RECORD mode on JVC DAT recorders, DIC promptly re-engineered the tape cartridge (results are pending). Hopefully, other manufacturers will be as responsive to constructive feedback.

In terms of retaining information over the long haul, the tape composition comes into play, and ultimately, time will tell. The mechanical failure rate of digital audio tape is relatively low, but the likelihood of its losing digital information (via mutes and dropouts) poses a continuing threat. While all manufacturers say their DAT cassettes use "finest possible," "new and improved" formulations, remember that you might be using the DATs as master tapes—even when you use proven brands, make at least a couple of backup digital dubs. •

Tape Type:	15	30	46	60	90	120	Cleaning
Agfa				√	√	√	
Ampex				√	√	√	
Denon			√	√	√	√	
DIC	√	√	√	√	√	√	√
Fuji				√	√	√	
Maxell			√	√	√	√	√
Panasonic				√	√	√	
Scotch 3M		√	√	√	√		
Sony			√	√	√	√	√
TDK				√	√	√	

Prices for 120-minute cassettes range from about $12 to $18; 90-minute tapes go for $10 to $13; 60-minute tapes cost $8 to $11, and 46-minute tapes cost about $7.50 to $9. Tape prices vary from company to company, although Ampex and Agfa are the highest. The other brands all list within pennies of each other, and the least expensive is DIC tape.

PHOTO: PAUL HAGGARD

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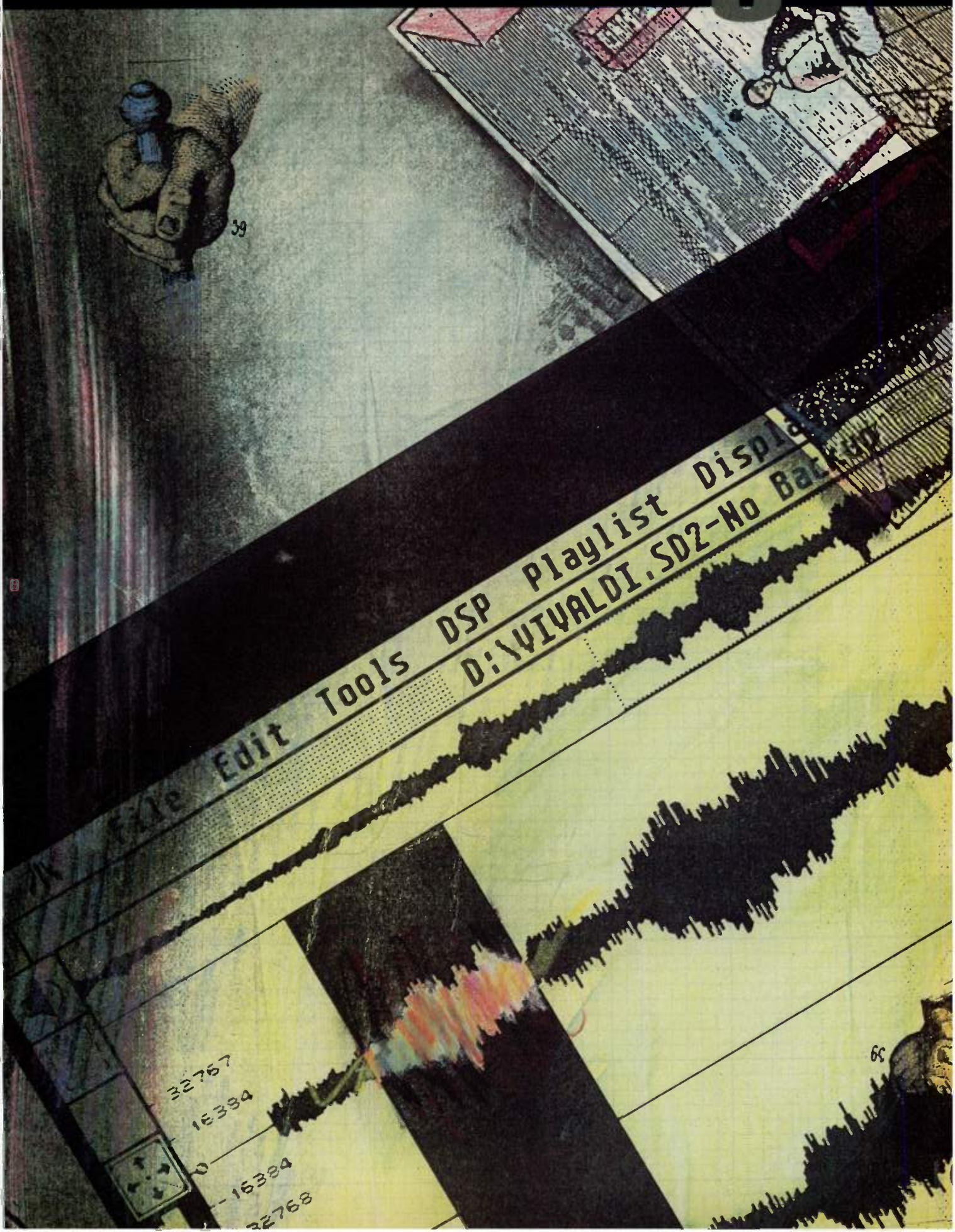
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The Digital Pre-Flight Checklist

A Grammy-Winning Engineer Tells You How To Avoid The Pitfalls Of Digital Recording

ONE MORNING I WAS DRIVING DOWN HOLLYWOOD BOULEVARD BY Mann's Chinese Theater thinking about my approach to this article, when I looked up ahead and saw a bush on the side of the road burst into flames. People were running over to it to see what had happened. As I pulled over and got out of my car, I heard a voice say, "I have some information for you. Please call me." I knew then that it was time for me to receive the Ten Commandments of Digital Recording. As it turned out, the bush burst into flames because of a natural gas leak under the sidewalk, and the voice was from my pager. I knew *then* that I was going to have to brave it on my own.

In my opinion digital recording is a great medium for storage of audio information. You can move recorded instruments from one track to another without any loss, punch in and out of record mode in the middle of a vocal line without holes the size of the Grand Canyon, make exact safety copies of your tape, duplicate sections to edit into other places, perform nondestructive edits by assembling the pieces to a second machine as you would in video editing, and make a record at home that sounds as good as what can be done in lots of major recording studios.

All this is well and good, but with every plus, there are equal but op-

BY ROGER NICHOLS

posite minuses. Knowing what to expect can keep you from any major pitfalls, so your album can sound as good as the studio invoices *look* like it should sound.

Quiet, Please! Record in as quiet a place as possible: Professional studios all over the world are being re-designed to provide quieter environments for digital recording. When you record analog, the quietest thing on the record will be tape hiss. On your new digital recording there will be no tape hiss to cover up the sound of the air conditioner, the toilet flushing in the next room, or the dog barking next door.

On The Levels. With digital machines you should record as hot as possible without any "over" lights coming on. The "over" light means that you have clipped your signal. This is an absolute clip, not a gradual limiting. It usually will sound like a large click or a tearing sound. Some engineers have said they were told that a few red lights once in a while were all right, as long as they didn't stay red for long. That's like saying that it was okay to drive through the red light because it had only been red for a little while. It is not a good thing to do, so DON'T DO IT!

Know When To Say When. Equalize the instruments the way you want them to sound, then stop. A keyboard player's genetic make-up will not allow her or him to stop changing things after the sound is perfect, but a recording engineer should be able to stop. Digital recording will reproduce faithfully what you put on the tape. When recording analog, you must make up for the deficiencies of the analog medium by over-compensating for the losses. Percussive sounds have a tendency to deteriorate with time on analog tape. This is not so with digital tape. What you start with will be what you end up with.

Cleanliness. . . Clean the heads and maintain a clean machine. In 1959 I heard a saying, "Cleanliness is next to high fidelity." Well, nothing is closer to the truth when dealing with digital recordings. The best thing about digital recording is that it plays back exactly what you record. The worst thing about digital recording is that with enough tape errors, it will play back nothing.

Tape errors usually come from dust scratching the oxide off the tape. The oxide piles up on the heads and causes errors. Digital recording is a very robust medium. Extra data is stored along with your audio to make sure that any errors on the tape can be corrected, and the signal that comes back out of the machine is exactly what you put into it. If the error rate gets too high and the error correction circuitry can't fix the data, it turns everything off until it gets good data to put out. Analog tape is more forgiving in this department. If what is left on the analog tape sounds like crap, the machine just puts out the crap. Personally, I would rather nothing come out than something sub-standard.

Format First. Pre-formatted tapes are common to video editors. "Black" video information is put on the tape from one end to the other before any meaningful work is done on the tape. This formatting operation puts a *control track* on the tape. The control track provides information to the playback electronics so the machine can synchronize the electronics in the machine with the information coming off the tape.

Much the same thing takes place in digital audio multitrack machines. You always will be safe if you pre-format tapes before you use them. It is possible to record on a tape that is not formatted, but you open a can of worms—only do this if you really know what you're doing. On Mitsubishi and Otari 32-track digital machines, you can format the tape as you record, but if you stop the tape at the end of one take and start up again for the next, there will be a seam in the control track that never can be recorded over. While recording the Rickie Lee Jones album *Flying Cowboys* on a Mitsubishi X-850, we did not pre-format the tape because "I knew what I was doing." Everything was fine until Rickie decided she wanted to play a part that needed to extend past the end of the track. The part crossed the seam in the control track and the X-850 turned it into lunch meat. We had to rent another 32-track, format the tape, transfer the take we were using, then re-do the ending that she wanted to add to the song. It took about four hours to undo

what 30 minutes of formatting would have prevented.

The DASH-format machines have an additional record mode called ASSEMBLE. This mode lets you extend the control track seamlessly during intermittent recording, so you don't get stuck. For this to work, however, you must back up a ways into the previously recorded material and go into record mode before the seam. So, know your machine and plan ahead. If you are taping live performances and recording non-stop through the entire reel, then everything will be fine. If you will be starting and stopping the tape during the recording, use pre-formatted tapes.

Silence Is Golden. When dealing with DAT and other digital 2-track machines, you don't have to worry about formatting tapes, but be sure to leave plenty of run-up and run-out on either end of your mixes. Remember, a digital machine needs the

ILLUSTRATIONS: COURTNEY GRANNER

control track signals to synchronize all the various electronics and transport mechanisms, and it takes a second or so after the tape starts before audio starts coming out. If you start the tape machine recording too close to the beginning of the music, chances are the front of the tune will be clipped off during playback. It is better to have ten seconds too much before the start of the music than a 1/4-second cut off the beginning of a killer mix.

On an open-reel machine, if you need to add some blank tape between tunes to improve the spacing, you can't use virgin tape to do it. The tape must contain the control track information, or else there will be another mute at the beginning of the next tune. Use a piece of tape with control track recorded on it.

Some DAT machines can start recording closer to the beginning of the tape than others. It is possible to record something at the top of the tape on a Panasonic 3500 DAT machine, and not be able to playback the first few seconds on a Fostex D-20 DAT machine. Leave extra room!

Safety In Numbers. Make backups of your masters. If you use a digital multitrack, make safety copies of the master tapes after the original tracking sessions, and again every couple of weeks after that. It sounds like a lot of extra expense and work, but believe me, it's cheaper than re-recording the stuff that got lost or damaged. During all the Steely Dan records, we never made safety copies of any of the multitrack tapes. We knew it was risky, but we would never want to use an analog copy of anything because of the generation loss, so we elected not to back up our tapes. When we were recording the *Gaucho* album a tune got erased, and we didn't have any copies of it. It cost over $60,000 to try to re-record it. The re-tries didn't come out as good as the original, so it never made it onto the album. With digital recording there is no excuse for not making copies.

If you print mixes to a DAT machine, put in a second tape and print the mix a second time. If you use a professional digital 2-track, put on another reel and print a second copy of the mix. Last March I recorded and mixed three tunes for Michael Franks. When it came time to assemble the mixes for mastering, the Mitsubishi X-86HS ate one of them. I had printed safeties of everything, so all I had to do was replace the mix with the safety and I was back in business.

Hear, Hear! Listen back to your tapes. It's always a good idea to play back your mixes after you've printed them to make sure they made it to the 2-track. Everybody usually does this, but I know few people who listen back to digital copies of their tapes after they are made. It has been assumed that digital clones are exact copies of the original. This is true in most cases, but I have run into problems when making copies of tapes. It may be a temporary or design problem with one machine, but the only way you'll find out is to *listen*. Compare the original to the copy. Make sure they're the same. In certain cases, I have achieved better results making the copy in the analog domain than in the digital domain.

Tape Types. When it comes to deciding the format to use, you have to weigh many variables: number of tracks, reliability of the machine, cost of the rental or purchase, ease of use, availability of another machine of the same format for copies, which machines are compatible if you have to go somewhere else to work on part of the project, and—one of the most overlooked considerations—the cost of the tape for the particular machine. Try to figure out how many tracks you need and how many reels of tape you're going to use. Factor this in along with the cost of the digital multitrack. The machine you thought would be the most cost-effective for your project may end up being the most expensive. By the way, an hour's worth of 24-track analog tape costs four times as much as an hour's worth of 24-track digital tape. During the Steely Dan *Gaucho* album we used 360 rolls of 2" analog tape.

Digital tape comes in two basic groups: reels of tape for reel-to-reel machines, and tape loaded into some sort of cassette for hands-off, easy handling. The tape available on reels comes in widths of 1", 1/2", and 1/4", stored on your choice of 10-1/2", 12", or 14" reels. The length of time that can be recorded on a reel of digital tape depends on the machine's transport speed, and the size of reel you're using. Cassette-based tapes include 3/4" videotape, 1/2" videotape, DAT, 8mm videotape, and proprietary 8mm digital tape.

The Going Rates. Sample-rate choices will turn any sane engineer into a blithering idiot. The four basic sample rates are 48kHz, 44.1kHz, 44.056kHz, and 32kHz. The easiest to deal with is 32kHz. That's because you won't be able to find a machine that records at that rate. It's only used, maybe, for broadcast of digital audio information, and it is the worst-sounding of sample rates because it won't allow any frequencies over 15kHz.

If you can't decide which sample rate to use, go with 48kHz. Everybody else does their multitrack digital recording at 48kHz, so you might as well do it, too. If you are recording a digital multitrack while it is locked to video, you may be better off using

44.056kHz because of the ease of synchronization between the video and digital machines at this sample rate. There actually are devices that let you sync anything to anything, no matter what the sample rate, but that's a whole 'nother article.

If you're mixing to a DAT machine in the studio and want to be able to make copies of the tapes at home between two home-type DAT units, then by all means, set the studio machine to 48kHz. Consumer DAT machines will not make copies of tapes recorded at 44.1kHz. Also, many can not record analog at 44.1kHz, so if you recorded stuff in the studio at 44.1kHz and want to record something else on the tape in your home studio, the sample rates will change between cuts and mute the output of the DAT machine during the transition.

Sony PCM-format 1610 and 1630, and JVC DAS-90 and DAS-900 machines can record at 44.1kHz or 44.056kHz. The 44.1kHz is the standard for CD masters. Use 44.056kHz for locking to a video reference. Sony F1 and compatible video-based machines record at 44.056kHz if they are NTSC-standard units, or 44.1kHz if they are PAL format units.

Your album can sound as good as the studio invoices look like it should sound.

There are plenty of sample-rate convertors around, and they are pretty good at maintaining the audio quality during the conversion. I do all my recording and mixing at 48kHz, then go through one sample-rate conversion to the CD master, which must be at 44.1kHz whether you like it or not.

Under The Knife. When making razor-blade edits on an open-reel digital machine, you must leave a hairline space between the two pieces of tape being edited together. This tells the machine that there is, indeed, an edit coming up and causes the electronics to perform a crossfade across the edit point. Use a residue-free marker to mark your tapes. Do not use a grease pencil, under *any* circumstances, to mark digital tape. Make sure you use "digital" splicing tape. This tape is specially formulated not to leave any residue behind. I guarantee that if you use regular analog splicing tape, your edits will not play back two weeks after you did them.

All's Well That Ends Well. Finally, we get to the end product of all this high-tech foolishness. All CDs are digital, whether they are recorded analog or digital in the beginning. Your master mixes will be transferred somewhere to a Sony PCM 1630 master tape, then sent to the CD plant where they make those little silvery discs.

If you're assembling your final mixes onto a digital 2-track machine, obey the following rules before mastering:

Place plastic leader before the first tune and at the end of the last tune of your album. There must be at least 1-1/2 seconds of blank, formatted digital tape between the leader and the start of the first tune. The spaces between the tunes must be made up of blank formatted digital tape, not leader. Be careful when editing in these little spaces—digital tape plays only in one direction. If the piece is spliced-in backwards, the digital machine will mute. After the last tune, use blank formatted tape for a few seconds before the end leader comes up. After the end leader, place about one minute of reference tone. You don't need multi-frequency tones, but you can put them there if you want. The one that is required is 1kHz at 14dB below clipping. If the level is different from -14dB, note it on the box label.

Well, that about covers it. If this helps get you through any rough spots, then it was all worth the effort. Have a good time with your digital recording, and I'll be down at Tower Records waiting for your CD. •

In digital's early days (1983) our Across The Board columnist **Roger Nichols** *assembled* The Big Chill *soundtrack, which featured vintage Motown tunes. After raiding the Motown Hitsville vaults, he transferred the original masters onto a digital recorder, watching as the original tape oxide crumbled to the floor. But not before he had recaptured history.*

the human touch

Steve Fishell In Digital Country

By Phil Hood

THIRTY-SIX YEAR-OLD STEVE Fishell has spent his career on both sides of the glass. As an instrumentalist he's done loads of digital multitrack sessions, starting with the 1986 *Trio* album by Emmylou Harris, Dolly Parton, and Linda Ronstadt. As a producer his recent credits include Jann Browne's highly acclaimed *Tell Me Why* (Curb Records), an analog-to-digital affair recorded in California. Shortly before we spoke with him, Fishell finished the debut album of McBride And The Ride (RCA), which he and Tony Brown produced at Soundstage in Nashville, using a 32-track Mitsubishi X-850 (retrofit with Apogee filters) and an SSL 4000E console.

Although Fishell has mixed feelings about digital recording, he loves the medium for mixing and editing. "In the old days," he says, "if you were unsure about a bass punch, you'd cut tape and have the tape leader start where you wanted the punch to go in, then add the leader where you wanted it to end. There's less guesswork now.

"As far as

the human touch

continued

copies are concerned, a safety copy is an exact replica when you are dealing with digital, which is great. And, of course, anything you bounce, such as taking vocal comps from four tracks and dumping them onto a fifth track, saves you a generation loss in sound quality."

Despite the advantages, he has both aesthetic and financial concerns about digital multitrack recording. "In country music," he says, "200,000 units is considered a threshold of success. It doesn't always make sense to spend $100,000 on a project in a genre where the record sales don't justify it. With digital you'll spend that and more. My view is that it's not necessary to spend more than $80,000 to make a quality country record that is CD-ready. I'll use digital when the situation calls for it, but it's nice if the artist can recoup some money, too.

"Also, on many digital rock and country projects, the low end lacks a certain fatness and excitement. I was at a session where they ran from a digital multitrack recorder, through the repro head of an analog 2-track, then back into a digital 2-track machine. A project like that is actually a D/A/D (digital-to-analog-to-digital) experience, because you've gone through analog, but you haven't used analog tape. In that instance, when I heard the difference, it was amazing." •

DASH & ProDigi

An Explanation Of Digital Multitrack Open-Reel Formats.

BY BILL TESAR

EVER NOTICE HOW MANY things are grouped into opposing pairs? Hot/cold, day/night, right/wrong, and IBM/Mac? The world of open-reel digital tape recording is no different, with the battlefield clearly divided into two incompatible camps: DASH and ProDigi, or PD.

Two main manufacturers build multitrack open-reel digital audio recorders. Machines from Sony adhere to the Digital Audio Stationary Head (DASH) format, which also is supported by Studer, Tascam, and Matsushita (Panasonic). Machines from Mitsubishi also have stationary heads, but their technology follows the PD (for Professional Digital) format, which also is supported by Otari and the European-based AEG.

A few years ago, many studios held off from "going digital," hoping a winner would emerge from the DASH vs. PD contest to form an open-reel standard as universal as analog 2" 24-track. Today it's clear that both formats are here to stay, at least as long as digital audio is recorded on tape. Hundreds of machines in each format are in use worldwide. Some studios buy the machine they believe sounds best; others are influenced by the appropriate combination of tracks, auto-location power, and other factors, including client demand.

DASH. The Sony DASH multitrack family consists of three machines: the original 24-track PCM-3324; its replacement, the PCM-3324A; and the 48-track PCM 3348. All three are compatible with each other in the 24-track mode. Tascam makes a 24-track DASH machine, the DA-800, which is compatible with the Sonys. Studer has designed a 24-track DASH recorder, and is expected to release a multitrack DASH 48-track recorder in the near future. DASH prices range from under $100,000 for the DA-800, to under $125,000 for the 3324A, to over $225,000 for the Sony PCM-3348.

Studer D820-48 DASH Recorder

The DASH multitrack format uses 1/2" tape to record its 24 (or 48) audio tracks, along with two cue tracks, a time-code track, and a control track from which all the digital data is clocked. Current 3348 users enjoy being able to place a fully recorded 24-track DASH tape on the machine and add up to 24 additional tracks. The 3348 also offers an internal digital sound memory that allows approximately 20 seconds of *mono* audio to be stored in RAM.

Just over one hour can be recorded on a 14" reel of tape. Error correction is encoded into the data stream, with the 3324 using three levels of error coding, and the 3324A and 3348 using five levels. The new DASH machines have two-times oversampling and extensive large-scale integrated circuitry to reduce power consumption, heat, and weight.

ProDigi. Several machines live in the PD camp: the original Mitsubishi X-800, X-850, and new X-880, and the Otari DTR-900 and DTR-900B. All offer 32 digital audio tracks across a 1" width of tape, plus two analog cue channels, a time-code track, and two auxiliary digital data tracks. Unlike DASH, which has a dedicated control track, clocking

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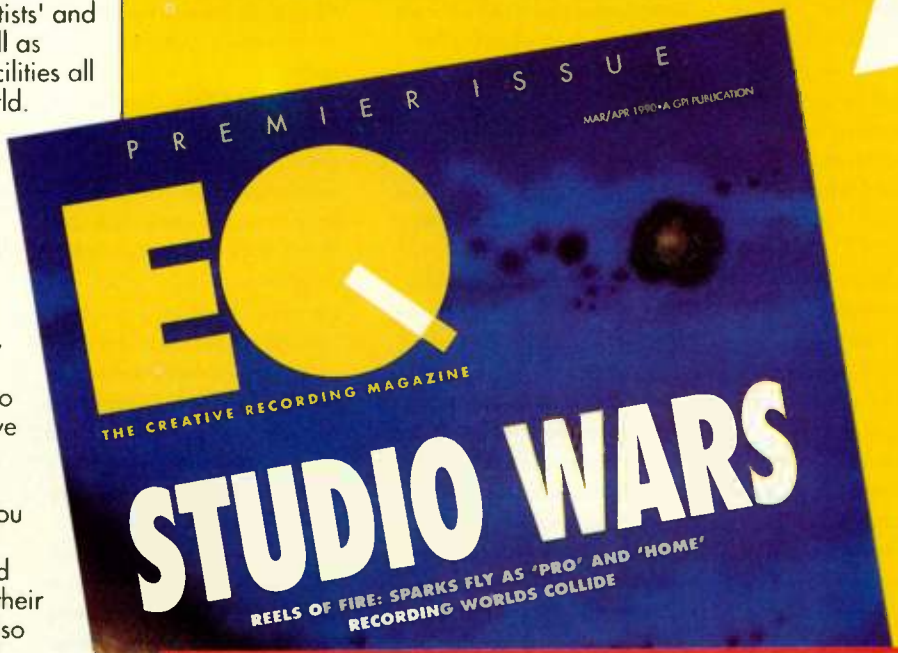

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control data for PD can be derived from any of the 32 digital audio tracks. One hour can be recorded on a 14" reel of tape. The 32-track PD machines from both Otari and Mitsubishi sell for under $150,000.

While the original protocol for 32-track PD allows for future 64-track machines, no manufacturer has shown a 64-track PD recorder.

ProDigi's strengths include error correction that many consider to be unmatched. The format uses two separate error-detection/correction techniques that allow up to eight tracks of data to be lost due to dropouts, tape damage, and head clogs, without affecting recording or playback of the audio.

• • •

Open-reel digital tape still offers many advantages over disk-based recorders, especially for music, since tape is a cheap, easy, archival medium, and one that is familiar to all engineers.

While the two formats remain incompatible, working on one machine doesn't preclude working on another: Otari offers the CB-503 bidirectional DASH-to-PD converter, which allows digital transfers and bridges the gap between the two realms.

So which format is better? Well, they both deliver high-quality audio and meet their intended purposes. The large number of contented customers of both formats suggests that there are true believers on each side of the fence. •

Bill Tesar is president of the Toy Specialists, a pro audio rental house based in New York City.

EQ BACKGROUND NOTES

Digital Audio Basics

WHETHER IT ENDS UP AS A groove cut in a wax cylinder, or magnetic particles arranged on tape, analog recording works by creating a reproducible model—an analogy—of the sound being recorded. Digital audio is a different story.

A digital audio device (recorder, sampler, processor, or whatever) first analyzes sound. By means of an *analog-to-digital (A/D) converter*, it converts the sound into numeric codes—a combination of simple "1s" and "0s." These numbers then can be stored, and altered in level, EQ, and other characteristics (if applicable). Finally, they are read and converted back to audio by a *digital-to-analog (D/A) converter*, for ultimate playback.

Since only codes are stored, altered, or played back, anything not recognizable as code is irrelevant. Analog tape heads (which look for magnetic variations) read random magnetic particles as broadband noise, which, to our ears, is tape hiss. Random particles may also exist on digital tape, but a digital audio device doesn't recognize them as digital audio code, so—no hiss. (If you make a digital recording of something that exhibits hiss, however, the digital process simply ascribes codes to the hiss, and you'll still hear it.)

Digital Storage. Just like you and me, digital audio codes need a home. Current digital audio storage formats include tape (such as that used in DAT cassettes and on PD- and DASH-format multitracks), disk—optical, hard, or floppy (used in digital audio workstations and sampling keyboards)—and random access memory (RAM). Employed in such devices as digital delays and sampling keyboards, RAM is a temporary medium; the digital information stored in it can be retrieved instantly, but generally is lost when power to the device is switched off. Since it takes several milliseconds or longer to access information from an optical or hard disk, workstations and other devices often use RAM "buffers" to store information that must be accessed ASAP.

Sampling. A device converts sound to digital code by taking brief samples of the sound, at a rate of many thousands of times per second. A numeric code is assigned to each sample. As the sound changes, so do the numbers. You can think of each sample as a "pulse" that registers a value for the audio being sampled. (The most common approach to digital audio recording is called PCM recording, for Pulse Code Modulation.)

Two factors work together to determine the quality of a digital recording. The first is *sampling rate*—how many times per second a sample is taken. In most digital systems, the higher the sampling rate, the better the high-frequency response. The second factor is *bit resolution*, which concerns how detailed each sample may be. All things being equal, a higher bit resolution yields a greater dynamic range.

Sampling Rate. Digital samples are the audio equivalent of snapshots: They are instant, coded representations of audio at a given fraction of a second. Like a single snapshot, a single sample does not tell the whole audio story. So how many are needed? That depends upon how well you want to tell the story.

In theory, a digital device must sample at least twice as many times per second as the desired high-end frequency response, in cycles per second. For instance, if you want a top-end response of 20kHz, you need a device that samples at least 40,000 times per second. (That's in theory; in the real world, frequency response is usually limited to about 40% that of the sampling rate.) The reason for this "doubling" is that each audio cycle has both a peak and a trough (resembling an ocean wave), and both must be registered to describe the cycle. Typical digital audio sampling rates include 48kHz, 44.1kHz, and 32kHz.

Bit Resolution. We've mentioned that each digital sample is stored as a number. That number's complexity depends upon how many bits ("1s" and "0s") are used in the code to form a *bit word*. For instance, a 2-bit word sample can be expressed as four different codes: 00, 01, 10, 11. That's 2^2 different codes, which could describe four different dynamic levels: off, quiet, louder, loudest.

An 8-bit system—generally the minimum requirement of the professional user—offers 2^8, or 256 different levels. Most pros, however, look for 16-bit performance, which can offer 65,536 different levels. Multiply the bit rate by six to calculate the approximate dynamic range; a 16-bit system offers a rough dynamic range of 96dB—which is CD quality. (A new type of recording process that uses 1-bit resolution is gaining popularity. Look for a detailed introduction to this new approach to digital recording in an upcoming *EQ*.)

Aliasing. If a digital device records a signal that exceeds half its sampling rate, the recording will be inaccurate. The samples can no longer represent peaks and troughs of the audio cycles, and the resulting "digital picture" is all wrong. This unhappy event is known as *aliasing*, and it sounds like something you wouldn't want to bring home. Low- and high-pitched gurgles, chirps, and swooping sounds are typical of aliasing. To keep them at bay, digital devices employ *anti-aliasing filters* at their inputs. These are extremely steep low-pass filters that cut off any high frequencies that exceed half the sampling rate.

Looking for more information? Turn to Ken Pohlmann's *Principals Of Digital Audio*, Second Edition (published by Howard Sams, 1989) for an excellent (and highly technical) reference.

—Brent Hurtig

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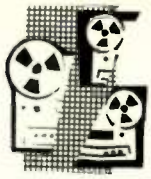


BASIC TRACKS

Mike Those Drums

BY TOM LUBIN

LAST ISSUE WE LOOKED AT SETTING up and tuning drum kits for a session. This time we explore other aspects of getting good acoustic drum sounds: choosing microphones, placing them, and assigning them to tracks.

Choosing & Placing Microphones. Each part of a drum kit needs a different mike type and placement. Generally, drum mikes should be *directional* in pattern, for the least feedback and leakage from other sound sources. So, mikes with cardioid and supercardioid patterns generally are preferable to omnidirectional.

When miking drums, think this way: The bigger the instrument, the bigger the mike. For instance, those relatively small condenser mikes (such as AKG C-451 and Shure SM81) use thin, lightweight diaphragms that are most responsive to high-frequency instruments such as cymbals. Place these cardioid condensers one to two feet above the cymbals, with a distance of several feet between them. Point them straight down at the cymbal edges, angling them out if greater separation is desired. (Or you may prefer a more phase-coherent XY stereo mike approach with the mikes angled together as shown in the diagram.) These mikes may need only a minimal presence in the mix, since cymbals usually are picked up by other mikes on the kit; their level will determine how "open" the drums sound. A boost at 10kHz or higher produces more brilliance, while a roll-off below 500Hz helps eliminate low-frequency leakage.

Basic mike placement for a drum kit. Two overhead options are shown: placed wide, or pointed together in an XY stereo configuration.

On hi-hats, place condenser microphones opposite the drummer about six inches above the cymbals' edges. You can produce more sizzle by boosting frequencies in the 10-12kHz range.

You can use condensers on snare and toms, but dynamics (such as Sennheiser MD-421, Electro-Voice N/D408, Shure SM57) are better, since they can handle high volume levels without distortion.

On snares, place the microphone about an inch in and up from the rim, pointed directly at the head's most frequently played area. If you position a second mike similarly on the underside to capture more snare rattle, *reverse the phase* on one of the mikes.

On toms, place the microphone about one inch above and two inches in from the rim, angled about 45° down toward the head. To minimize cymbal leakage, orient the tom mikes so the sonic dead spots are pointed toward the cymbals. If you place the mikes inside the toms, you'll keep them away from drum sticks, reduce cymbal leakage, increase volume, and produce less attack and more ring. Single heads, however, produce a more fundamental pitch and less resonance than double heads. Ideal inner placement would be off-center, a few inches from the head. You can add fullness to high toms with an EQ boost around 200Hz, and to low toms with a boost around 100Hz.

On the kick drum, go with a large-diaphragm dynamic microphone, because of the low-frequency response. Good ones for this are the E-V RE-20, Beyer M-380, AKG D-12, and AKG D-112. Take off the kick's front head and dampen the other head by placing a blanket against it. Then use a boom to position the mike inside, a few inches from the head. Place the mike close to the beater for more attack, farther away for more boomy shell sound, or farther off-center for more skin resonance. Rolling off frequencies above 5kHz reduces cymbal bleed; cutting 300-600Hz frequencies removes boxiness; and a boost between 2.5-5kHz increases punchiness.

Microphone/Tape Track Relationships. When you have a limited number of microphones and recording tracks, mono miking may be your best bet. This entails hanging a single overhead mike, augmented with a mike on the kick drum and another mike on the snare, all three mixed to a single track. A microphone on the hi-hat would be the next priority.

The next step up involves adding a second overhead microphone and using a stereo pair of tracks: Pan the snare and kick equally between two tracks; pan the overheads to the desired amount of stereo image; and pan the hi-hat to the side shared by the overhead that's above the hi-hat.

In an "ideal" situation, traditionally the kick, snare, and hi-hat each get their own

Great Drum Tracks Start With The Right Mikes And The Right Placement.

CONTINUED ON PAGE 62

Tom Lubin is an American expatriate who teaches recording at Australia's film, television, and radio school.

MIDI & COMPUTERS

Computers For The Studio

BY JEFF BURGER

THANKS TO TECHNOLOGY'S ONGOING march, the computer in today's recording studio requires constant upgrading and expanding. Some musicians, producers, and engineers have even postponed buying their first computer until just the right time.

Numerous valid choices exist (Mac, IBM PC, Atari, Amiga, and more), but there probably is no "bad" choice—many tasks can be accomplished on any of these major platforms. The true quest is in finding the one best suited to your tasks, environment, and budget.

Analyze Your Needs. The universal answer is (drum roll please): "Find the software/hardware combination that does the job you need, then buy the computer on which it runs." It's also important to plan ahead for future tasks—consider MIDI sequencing, editor/librarian programs, disk-based recording, computer-aided composition, and music notation. You also might want your computer to handle word processing, database management, accounting, designing flyers, and printing tape labels.

How To Make The Right Choice—When There Is No "Wrong" Choice.

Also consider whether a single machine will do the job. If a computer is going to be used for disk-based recording, you may want a second machine for MIDI work. If you're operating a studio business, it's best to dedicate separate machines to music and office functions.

If multiple machines are in order, decide whether compatibility is required. For example, if a machine that's used part-time for disk-based recording also will double as a second sequencer, you'll want to run the same sequencing software on both machines.

Interfaces. Sequencing is the primary task for studio computers. With the trend toward more and more virtual tracks, the limitation of 16 MIDI channels becomes a concern. Some interface builders provide for multiple MIDI buses, each with 16 channels. The software you use will need to know how to deal with this superset of MIDI, however. Unfortunately, it's primarily a proprietary situation at this point. For example, Opcode, Mark Of The Unicorn, and Steinberg all make multi-bus interfaces, but typically only their own respective sequencer programs can take full advantage of all the goodies.

Whether or not you do soundtrack work, consider an interface that has SMPTE time-code capabilities built in. The integration of a time-code reader lets compatible software refer to musical events in bars and beats or time code. Perhaps more importantly, tempo maps can be created, edited, and saved within the computer. This is infinitely preferable to using an external box that can store only one map, or has no battery-backed memory.

Operating Systems. Every MIDI power-user should know about *multitasking* (operating multiple programs simultaneously) and *task switching* (switching among several programs in memory, with only one active at a time).

The advantage of either one is that you don't have to quit one program to run another—for example, switching out of a sequencer into an editor to load a sound, then switching back to the sequencer to use that sound. With multitasking, control changes made from within the editor can be recorded and played back by the sequencer! But remember, the more your computer does at once, the more memory is required.

Then there is the issue of compatibility. Amiga users have it fairly easy, in that Amiga's operating system uses multitasking. IBM PC developers rely on the add-on standard of Microsoft Windows. Apple's MIDI Manager provides standards for MIDI port usage when task-switching between programs. Atari users have the widest software sea to navigate—Dr. T, Steinberg, Hybrid Arts, and C-Lab each have created task-switching and multitasking environments in lieu of Atari's single-task operating system. And software must be designed specifically to run under each operating system. Hence it's not always possible to use one company's sequencer with another's editor/librarian.

Processor Speed And Bus Architecture. Some computers just can't keep up with the throughput requirements of digital music. If you intend to use your computer as a multimedia workstation, buy all the speed you can afford. On machines with graphic-intensive displays, a page of notation might not be able to refresh fast enough to keep up with complex musical output. (Big screens are nice but they take longer to refresh.) Multitasking slows machines down, as well. And for digital audio, bus architecture is equally as important as processor speed. If, for example, you're working with 16-bit stereo samples, a 32-bit bus will pass both left and right samples in parallel, where a 16-bit bus would have to pass them serially.

Some general guidelines: In Macintosh land, the 68020 or 68030 series coprocessors will provide more speed than the 68000; in IBM PC systems, look for the 286 or 386 machines. Many packages will run at 8MHz, but a 16MHz or 25MHz system will speed up things considerably.

• • •

Choosing the right computer is not a simple decision. The best rule of thumb is to evaluate the big picture before starting to buy pieces of the puzzle. And it's okay for your answer to be different from someone else's! •

Jeff Burger is a songwriter/producer who has an extensive MIDI studio. He's also the associate editor of EQ.

FILM & VIDEO SOUND

If The Future Is Here, Where's My Digital Editor?

BY LARRY BLAKE

IN THE MID-'80s, THERE WAS TALK about bringing rickety, old, sprocketed magnetic film into the realm of digital recording. Compatibility with modern working methods, mag film's re-editing flexibility, and the quality of digital were just some of the many real-world advantages that would justify the creation of digital mag. Right?

Wrong. The first death knell to digital mag came with the 1986 introduction of Dolby Spectral Recording (SR) noise reduction technology. In one fell swoop, any benefits of "digital" (as in "clean" and "noise-free") became a non-issue, what with an SR-encoded signal every bit the match for a digital recording.

Driving the second stake in the heart of digital mag was the generally unspoken fact that creating it would have been like putting white sidewalls on a jalopy. Despite all the pluses of working with mag, the single gain offered by the creation of digital mag—the sound quality of digital recording—would not outweigh the costs that the film and video industries would incur in converting to digital equipment for post-production.

Mag-gie May Leave, But Not Until There's Something Better.

Furthermore, digital mag offered no real potential for cost *savings*. One real advantage of sprocketed mag film compared to multitrack is its flexibility in conforming to changes in the picture edit, as discussed in the last issue. But this "flexibility" comes at a price: Mag is extremely manual- and labor-intensive. While it is possible to re-arrange mag film in every which way, these changes must be made manually, with virtually no chance of automating the process.

To paraphrase Ed Norton's plea in *The Honeymooners'* classic "Chef Of The Future" episode: We want a kitchen appliance, I mean a sound editing system, that can do *all* of the best things offered by digital, mag, and multitrack!

The answer is disk-based digital editors. They offer the potential for the sound quality of digital multitrack or Dolby SR analog, combined with even greater precision and flexibility than afforded by mag film. While it may be hard to argue these points, why hasn't all of film and video post-production converted to disk editing?

The key word is "potential." While the capabilities of disk-based systems should far exceed those of mag, most systems now in use ignore the whole picture. Specifically, I mean the failure of disk-based editing systems to do what computers do best: manage data.

Few systems offer powerful, built-in capability to conform (match) edited sound effects and dialog to a new picture edit. This should be simple, since most systems don't actually change the original source audio on the disk, but simply edit it according to an edit decision list (EDL). Granted, a total auto-conform is not possible; you would have to override even the best software manually when conforming complex soundtracks to convoluted picture changes. Nevertheless, a computer-conform should take a fraction of the time it would take to conform the same units on mag film.

This re-conforming feature would save much time and grief in the latter stages of post-production, and also allow sound editors to start work earlier—even during picture editing, something that is just not done on mag-edited shows today.

Along these lines, I wonder why the printing of standard cue sheets (and not simply lists of numbers) from EDLs is not designed into every editing system. Again, the data is there, and the system designers could save us much time if they printed it in a usable form.

I'm also baffled by the absence of a comprehensive sound effects database for disk-based effects editing. It seems the manufacturers of these editing systems don't realize how many sound effects are contained in a large library. With 30,000 effects from which to choose, a single 15-character display just doesn't let you distinguish accurately between similar effects.

An important adjunct to a sound effects database is a program to "spot" and "pull" effects. "Spotting" entails going through a film scene by scene, figuring out what sounds are needed. A car chase might have spots for tire squeals, suspension creaks, and so on. "Pulling" effects is the next step: listening to all the various tire squeals and car suspension sounds in a library and deciding which ones best fit the image.

In this case we need a large, centralized effects library with *all* sounds on-line (that is, accessible by many users at the press of a button, with no manual loading and unloading of tapes or discs). Sure, there are commercial CD effects libraries, but top sound effects companies rely on in-house recorded effects for most of their work. A central effects library will reduce substantially the time it takes to pull a complex film.

These ideas seem pretty straightforward, right? All the different parts of the process can be handled today by various systems. Even standard mag post-production companies have been using computer effects databases and cue sheet programs for years. But I don't know of a single system, software or hardware, that enables a clear flow of materials from original effects recording to final mix.

Until the arrival of an all-inclusive, digital editing system that lives up to Ed Norton's mandate, mag will forever resemble the guest who wouldn't leave. •

Larry Blake is a sound editor and re-recording mixer with Weddington Productions in North Hollywood.

THE BIG PICTURE

The Six Phases Of Video & Film Production

BY ROBERT WAIT

AS WITH NEARLY EVERYTHING IN LIFE, video and film production entail six main processes: thinking about it, getting ready to do it, doing it, finishing it, showing it off, and reaping the rewards. In film and video production language, this translates to: development, pre-production, production, post-production, release, and lie by the pool (sipping exquisite tropical drinks). Here's an outline of the steps.

(I) Development. This term applies to everything that happens from the time you first decide to make a film or video until the time you actually begin planning the technical aspects of making the project:

A. The Premise—what's at the heart of the story; why this film or video is being made.

B. The Concept—the idea that carries the premise.

C. The Shooting Script—the concept written in story form as it will be shot.

Since writing is taking place and production funding is being negotiated during development, this phase of a project may be very lengthy.

(II) Pre-Production. Once funding is in place and a script is finished (or close enough to be finished by the time production starts), pre-production officially begins. All details necessary to plan a shoot are addressed. These include:

A. Finalizing A Budget—breaking the script down into shooting days and individual cost factors, and prioritizing places to spend the most money to receive the most production value.

B. Scheduling—arranging the schedule around actors' availability, access to locations, renting of special equipment, and so on. Staying within budget means planning a tight schedule while keeping several alternate schedules in the back of your mind to switch to in the event of potential emergencies. (For example, the trained giraffe gets a sore throat and must be used next week, so the helicopter reserved for next week needs to be shifted to this week.)

C. Assembling Cast—auditions, pay negotiations, attitude adjustments, rehearsals.

D. Assembling Crew—see above.

E. Finding Locations—and paying for permission to use them.

F. Obtaining Equipment—camera, sound, lighting, grip, wardrobe, props, make-up, special mechanical effects, animal actors, picture cars, and so forth.

Generally, the person who oversees the technical production details has the title of "production manager," while the producer and director oversee casting and creative details.

(III) Production. With any luck, once shooting starts, it runs without a hitch.

A. Set Up—arrive at location, light the shot, dress and make up the actors.

B. Shoot.

C. Wrap—pack up and get ready for the next location. (Filmmaking often feels like a traveling circus.)

(IV) Post-Production. "Fix it in post" is every producer's favorite term, and every post-production person's potential nightmare. Post-production *seems* like the most relaxed aspect of filmmaking, but it's where all the triumphs and all the mistakes of production must be shaped into the best possible final product. This is the time when you run out of people who can "fix it" later:

A. Develop Film/Transfer Sound And/Or Video—whether working with film or video, one always makes backup copies of the original footage to use in the editing room. Original film negative or master video is stored until all editorial changes have been made. Then it's time to conform this original footage to the edited "work picture," or "workprint."

B. Edit Picture.

C. Edit Sound—make dialog recording sound cleaner, layering sound effects for greater impact.

D. Replace Dialog—fix imperfect audio recording or add lines to the dialog.

Organization Is The Mother Of Creativity.

E. Create "Foley" Sound Effects—on a Foley stage, a Foley artist is recorded under studio-quality recording conditions as he or she mimics sound effects (footsteps, door slams, and so on) in sync with the actions on screen. (In productions with tight budgets, samplers loaded with sound-effects libraries are becoming the preferred method of Foleying, since they save the costs of stage time and hiring Foley artists.)

F. Audio Sweetening (video only)—enhancing video sound quality by layering and pre-mixing effects in sync with picture.

G. Add Special Visual Effects—may take months for a feature film; many effects for video can be created in a day or two in an on-line editing session.

H. Mix Audio—a feature-length film mix takes, on the average, four weeks; a short video mix typically is handled in a day-long sweetening session.

I. Preview—before a real live audience.

J. Shoot Additional Scenes—responding to how the audience responded to the preview.

K. On-Line Edit (video); Cut Negative And Make Final "Answerprint" (film)—both processes involve conforming the original footage to the edited work picture. In video, the process is handled electronically; in film, the original negative is physically cut and spliced together.

(V) Release—and distribute.

(VI) Sip Tropical Drinks—at poolside. •

Robert Wait is a post-production supervisor, film director, editor, and composer working in Hollywood.

CONTINUED FROM PAGE 58

track, and there is a microphone for every tom. To save tracks, most engineers combine and pan the toms with the overhead mikes into a stereo left/right combination. The two overhead mikes are assigned separately to this stereo pair of tracks, with the overhead over the floor tom panned the same as the dedicated floor-tom mike.

When dealing with several toms, I usually have higher-pitched drums share identical, bidirectional mikes positioned between each pair of toms. (If the drum kit is huge, find out up front which drums *really* will be played—that way you won't spend hours getting a sound you don't need.)

Regardless of how few tracks you have, avoid recording all the drums on separate tracks and combining them after the drummer has left. The generation loss of clarity, attack, and definition is significant.

Getting Drum Sounds. While "getting" your drum sound, make sure the drummer strikes the drums as hard as they'll be struck during recording. The hits should be consistent while you're getting things set. (Some drummers quickly tire of hitting the same drum during the soundcheck, and start hitting them progressively lighter; others get mad and start hitting them harder!) To get accurate levels, make sure the drummer plays drums that share tracks.

During digital recording, watch your levels like a hawk—and during analog recording, you may want to "push" the levels to get a squashed, tape-compressed sound.

Finally, you also can use contact and boundary microphones to great advantage, and outboard processors such as gates and reverbs can make a big difference in the sound of drum tracks. We'll come back to that in another installment of Basic Tracks. Next issue, we'll talk about how to record guitar. •

REFLECTIONS

CONTINUED FROM PAGE 6

rel for a long time—witness the recent DAT disgrace. Denying *citizens* copy-uninhibited DAT technology because they will, in some hypothetical future, break a related law, tries and convicts the consumer of a crime *before* he has even thought of committing it, even if he never does. This argument is legally sophomoric and smacks of Orwellian thought-crime found in totalitarian states. Why not then deny private airplane or boat ownership because everyone will—as the paranoid commercialists would argue—use the technology to run drugs across borders?

Bravo Cary Tennis! You are to be commended and are right on the money. No longer indispensable are the bigger studios and other sectors of the American anti-culture industries. They may not yet be history, but their informal monopolies and omnipotence over artists are. The foolish and unenforceable L.A. laws will undoubtedly be rewritten.

RICHARD P. RABATIN
Setauket, New York

I bought your premier issue with some sense of wonderment. "Hum, another fun little magazine to read in the studio!" I wish you best of luck and would like to encourage you to do as you said in the Editor's Notes—commit to serious evaluations concerning product reviews. With many magazines, we readers are left with a generic and safe conclusion. This is especially tough for us small-town folks who don't have hands-on access to equipment.

PAUL ADAMS
Peoria, Illinois

I just bought my first copy of *EQ* and found it to be a very good magazine, particularly the studio monitor article. I read most of the industry mags, and rarely do I get a subjective, *Consumer Reports*-style comparison of pro audio products. We have been shopping for near-fields, and your article proved really helpful as a starting point. Hope we get more articles like this on power amps, drum machines, portable effects processors, and the like. Keep up the great work.

DENNIS SY CHAM
Studio One
Manila, Philippines

GUEST EDITORIAL

CONTINUED FROM PAGE 8

open-reel digital 2-track deck.

Now, I had used an earlier version of this digital 2-track in a session where, after a rather tricky bit of splicing (using my binary latex gloves, surgical steel, and glow-in-the-dark marker), the machine played majestically through the splice—then decided to go on a high-speed chase, ignoring my efforts to "logically" halt it. After the tape decided to stop (as did my heart), I tried to explain to the client what happened. I don't think he believed me.

So when I was offered use of a newer deck—the same model equipped with "mellowed" filters—for the jazz project, I reluctantly agreed to mix and edit with it. On the first try we had so many error-correction problems, the audio resembled Morse code more than jazz. After re-seating cards, cleaning guides every time we exhaled, and incessantly trimming levels to keep from going "over," we finally achieved playback. I insisted on repeated listening of the mixes to assure no dropouts or other problems. We needed copies in all formats, and we listened on every speaker system known to humanity. So far, so good.

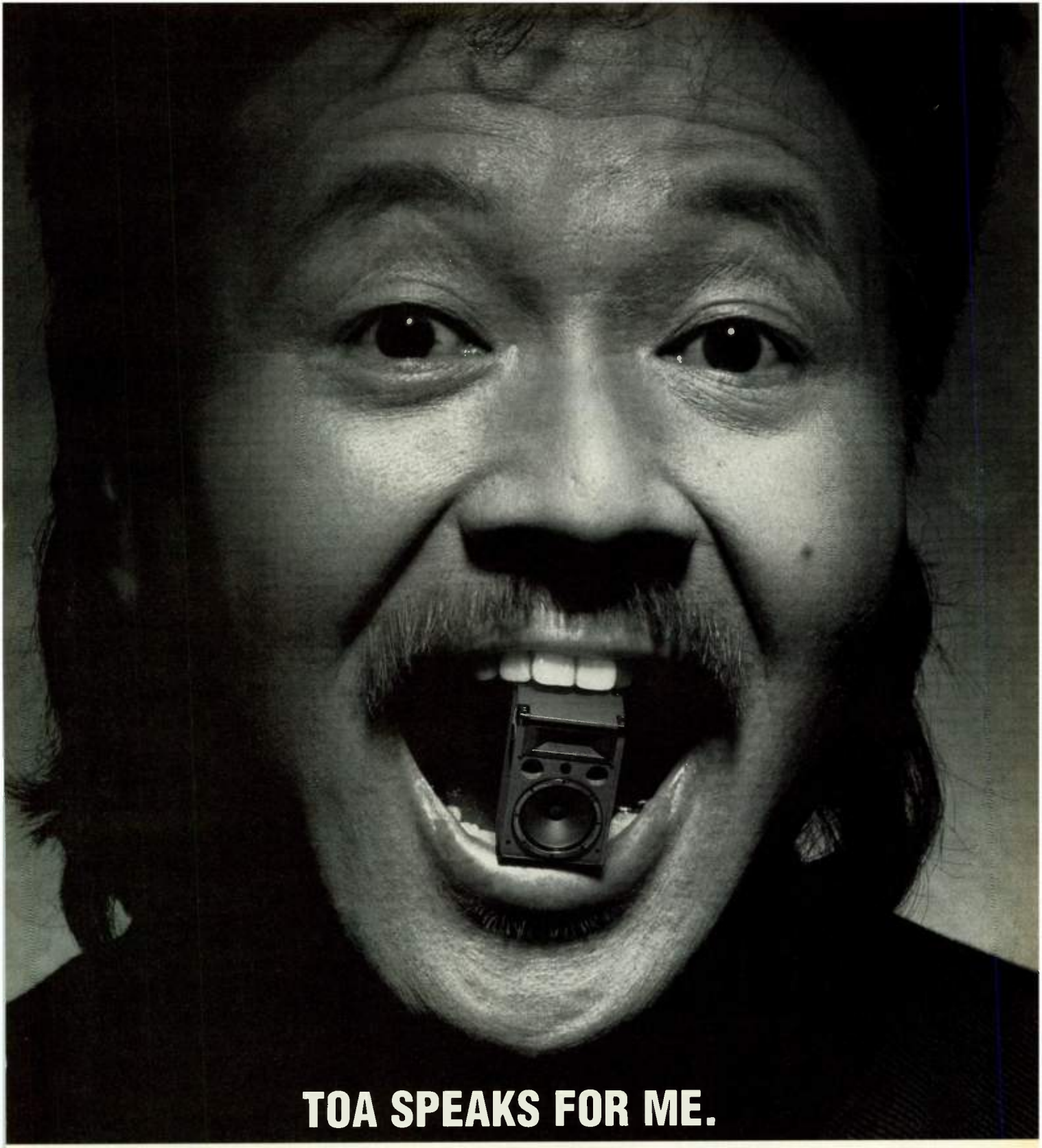
While mastering at Hollywood's Mastering Lab, I was all smiles, until suddenly: "Hang on—what was that glitch?" The engineer, Doug Sax, rewound the tape and claimed that we might have overlooked the glitch (which occurred at the long tag of a 16-minute opus) because of the all-nighter we pulled doing the mix. I said we had listened *very* carefully *many* times to the tape, because of the previous error-correction problems. Then I played our DAT safety tape, which had not a single glitch. In response, we were told something mysterious happened to the tape between mixing and mastering, even though it was only played four times.

Never fear—technology will find a way out! We digitally transferred the DAT recording into a Macintosh computer with a disk-based, digital audio editing system. Then we matched the DAT with the rest of the mixes. The system did remove the glitch—but also introduced a new one! The ultimate solution was a rather masterful (analog) fade-in during the mastering.

While these problems could occur in the analog domain, I'm reasonably certain I would have *heard* a glitch, dropout, or distortion while we were listening back to the mixes in the studio, *not* after the fact.

While we were dealing with the glitches, Doug Sax told me, "Specs are meaningless, but with signal-to-noise ratio, you're arguably higher on Dolby SR than digital. And storage is one of the weakest points of digital. Old U-matic tapes don't like to play, and after they play about 25 times, they have four or five times the errors they originally had!"

This hot techno-issue should be left to the subjective taste of whoever is in charge of the project. But we know all the idiosyncrasies of analog and can compensate for or be respectful of its unique sound; we still have corners as yet unturned in digital. Thanks to the cost difference, ease of editing and assembling, 25dB gain in S/N ratio with Dolby SR, and that ol' sound we're used to hearing, I'm sure analog has quite a few good years left. •



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WRH

Digital Tape Recorder Formats

By Roger Nichols

NOT TOO LONG AGO, PEOPLE wondered which digital tape formats would survive into the '90s. While some digital tape recorders no longer are in production (such as the 3M machines), all the formats listed here are in use to this day.

This chart indicates the various machines, their tape formats, and their digital interface formats. Machines with the same "Compatible Tape Group" letter can—in most cases—interchange tapes hassle-free. (With stereo processors, this assumes you've used the same format.) In addition, the recording format (such as DASH) is indicated in parentheses.

Machines with the same "Digital Interface Format" generally can be interconnected for a digital-to-digital transfer. In a few cases an adaptor cable is necessary; in other cases, the transfer may need to be "kluged" with an accessory digital format converter. The Akai multitrack, for instance, has an optional digital format converter that outputs AES/EBU format. Also, S/PDIF to SDIF-2 transfers can take place with reasonable success, assuming digital levels and rates are matched, and certain subcode information need not be passed. [*Ed. Note: Next issue,* EQ *will look at digital format converters.*]

All 24- and 48-track DASH recorders from Sony, Studer, and Tascam use balanced SDIF-2 connectors. And all the stereo processors can work with 1/2" Beta or VHS, or 3/4" videotape; the tape group indicates the tape most commonly used with a particular processor. One exception is the Toshiba DX900, a 1/2" VHS VCR with a built-in 14-bit PCM processor. •

RECORDER	TAPE	SPEED	COMPATIBLE TAPE GROUP	DIGITAL INTERFACE FORMATS
Sony 3324 24-track	1/2"	30 ips	A *(DASH)*	SDIF-2
Sony 3324A 24-track	1/2"	30 ips	A *(DASH)*	SDIF-2; AES/EBU
Sony 3348 48-track	1/2"	30 ips	A *(DASH)*	SDIF-2; AES/EBU
Studer D820-48 48-track	1/2"	30 ips	A *(DASH)*	SDIF-2; AES/EBU; MADI
Tascam DA-800-24 24-track	1/2"	30 ips	A *(DASH)*	SDIF-2; AES/EBU
Mitsubishi X-800/X-850/X-880 32-track	1"	30 ips	B *(PD)*	ProDigi
Otari DTR-900/DTR-900B 32-track	1"	30 ips	B *(PD)*	ProDigi
Mitsubishi X-400 16-track	1/2"	30 ips	C *(PD)*	ProDigi
3M 81 32-track	1"	45 ips	D	3M
3M 81 4-track	1/2"	45 ips	E	3M
Mitsubishi X-80 2-track	1/4"	15 ips	F	ProDigi
Mitsubishi X-86 2-track	1/4"	15 ips	G *(PD)*	ProDigi
Mitsubishi X-86-C 2-track	1/4"	15 ips	G, F play *(PD)*	ProDigi
Mitsubishi X-86-HS 2-track	1/4"	15 ips	H,G *(PD)*	ProDigi
Sony 3202 2-track	1/4"	15 ips	I *(DASH)*	SDIF-2; AES/EBU
Sony 3402 2-track	1/4"	15 ips	I *(DASH)*	SDIF-2; AES/EBU
Soundstream 8-track	1"	28 ips	J	Soundstream
Sony 1610 stereo processor	3/4" video		K	SDIF-2
Sony 1630 stereo processor	3/4" video		K	SDIF-2; AES/EBU option
JVC DAS-90 stereo processor	3/4" video		L	JVC
JVC DAS-900 stereo processor	3/4" video		L	JVC
Sony F-1 stereo processor	1/2" Beta		M *(EIAJ)*	n/a
Sony PCM-701/501 stereo processor	1/2" Beta		M *(EIAJ)*	n/a
Sony PCM-601 stereo processor	1/2" Beta		M *(EIAJ)*	S/PDIF
Nakamichi PCM-100 stereo processor	1/2" Beta		M *(EIAJ)*	n/a
Aiwa PCM-800 stereo processor	1/2" VHS		M *(EIAJ 14-bit)*	n/a
Sansui PC-X1/PC-X11 stereo processor	1/2" VHS		M *(EIAJ 14-bit)*	n/a
Technics SRV-100 stereo processor	1/2" VHS		M *(EIAJ 14-bit)*	n/a
Toshiba DX900 stereo processor	1/2" VHS		M *(EIAJ 14-bit)*	n/a
Sony PCM-10 stereo processor	3/4" video		M *(EIAJ 14-bit)*	n/a
Sony PCM-100 stereo processor	3/4" video		M *(EIAJ 14-bit)*	SDIF-2
dbx 700 stereo processor	3/4" video		N *(Delta Mod)*	dbx
Akai DR1200 12- to 36-track	8mm video		O *(A-DAM)*	Akai
Yamaha DMR8/DRU8 8- to 24-track	8mm (Yamaha)		P	Yamo.; AES/EBU; S/PDIF
Digital audio tape, 2 tracks	DAT		Q	S/PDIF; AES/EBU; SDIF-2

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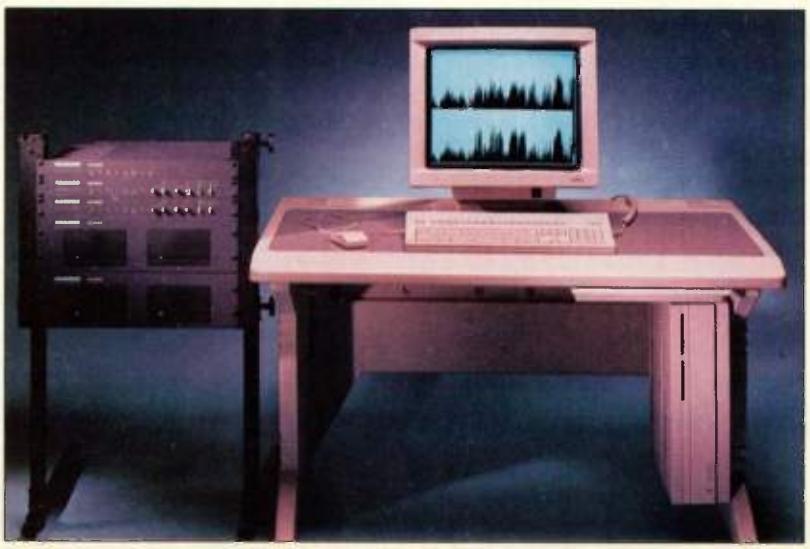
EQ Tests Two Disk-Based Recording Systems: Dyaxis And Sound Tools.

STATION TO STATION

BY MICHAEL MARANS

DISK-BASED recording is many things to many people, and well it should be; this technology offers no generation loss, no tape hiss, and the capability to audition various song sections or complete mixes without destroying the integrity of the original data. In other words, it allows risk-free editing, from mastering and re-mixing to assembling complex film cues with hundreds of sound effects synchronized to time code.

Disk-based recording is not only a reality, it's accessible. One of the most popular computer platforms, the Apple Macintosh, is graced with two popular disk-based recording systems. One comes to us via Studer, the venerable manufacturer of professional recording gear. (Last year Studer acquired Integrated Media Systems, which developed the Dyaxis, one of the first computer-based, direct-to-hard-disk recording/editing systems.) The other system, Sound Tools, was developed by Digidesign, who pioneered graphic waveform editing software for digital samplers. As



The Digidesign Sound Tools (top), and the Studer Editech Dyaxis. How do these two Mac-based workstations compare? We put them to the test.

you might expect, each system has advantages and disadvantages, but both provide CD-quality stereo recording, and both prove to be extremely capable. A deeper look reveals that each system is ideally suited to different tasks.

DYAXIS BY STUDER EDITECH

THIS SYSTEM'S FUNCTIONALITY IS powerful, yet basic: Data can be recorded, edited, mixed, and output as a stereo file. Unlike most digital recorders, however, that dedicate an output channel to a specific waveform or soundfile, the Dyaxis lets you create a mix consisting of multiple tracks, and the system automatically mixes down these tracks to stereo. (Studer also recently released the Dyaxis 2+2, with 4-channel playback.) The concept is analogous to working at a studio console: Multiple tracks from tape (the hard disk) are fed into the channel inputs (the mix window), the individual tracks are manipulated (pan, level, and so on), and the resulting mix appears at the stereo master outputs of the console (the Dyaxis soundfile).

The System. A full-blown Dyaxis consists of the digital audio processor, one to six SCSI hard disks, the time-code interface for synchronizing the system to an external source, and MacMix software, which provides the environment for recording, processing, editing, and mixing of soundfiles. While the system runs on virtually any Mac, the processing and display requirements dictate at least a Mac II, if not a Mac IIcx. (We used a Mac IIcx with the Studer-supplied 320MB hard disk, which provided about a half-hour of stereo recording at 44.1kHz; a fully configured system can record up to six hours of stereo or 12 hours of mono data at 44.1kHz.)

The Dyaxis' main unit is the multi-format digital audio processor. Its rear panel contains analog audio inputs and outputs (balanced XLR connectors), and digital I/Os in AES, SDIF, S/PDIF, PD, and Yamaha formats. The processor can convert one format into another, so the S/PDIF digital output of a DAT recorder, for example, could be fed directly into the SDIF input of a CD pre-mastering machine. Left/right record levels and analog output levels are adjusted via front-panel knobs, and switches let you select analog or digital input, as well as toggle between monitoring the input source or repro. All the processor's functions (except the analog I/O levels) are automatic or can be addressed via the Mac.

Digital recording can be performed at the standard 48kHz, 44.1kHz, and 32kHz rates. Rates are adjustable when recording and outputting analog audio signals. Emphasis detection is automatic during both digital recording and hard-disk playback; it's user-selectable when recording analog sources.

Studer also makes an optional DSP board that plugs into an internal Mac card slot. At present, the board provides real-time metering and real-time waveform display. By the time you read this, real-time EQ and gain change, along with sample rate conversion, also should be available.

EQ LAB TEST

Product: Dyaxis.
Manufacturer: Studer Editech, 1370 Willow Rd., Menlo Park, CA 94025; (415) 326-7030.
Price: $14,999.
Frequency Response:
Claimed: 20Hz - 20kHz
Tested: 12Hz - 20,750Hz (+0/-0.45dB)
Dynamic Range (noise floor to max. output level):
Claimed: >90dB
Tested: 88.94dBm (unweighted); 91.2dB (weighted)
Crosstalk:
Claimed: n/a
Tested: -79.15 @ 1kHz
Total Harmonic Distortion:
Claimed: <0.02% @ 1kHz
Tested: 0.036% (unweighted); 0.032% (weighted)
Claimed: <0.02% @ 10kHz
Tested: 0.029% (unweighted); 0.018% (weighted)
Maximum Input Level:
Claimed: +24dBm
Tested: +23.65dBm
Maximum Output Level:
Claimed: +24dBm
Tested: +23.65dBm

MacMix Editing. The Dyaxis file hierarchy is complex, but much of it is transparent to the user. For the most part, users need only concern themselves with two file types: views and mixes. View files contain pointers to specific soundfiles (recorded data), and hold playback and edit information. Mix files don't contain sound, but instructions for playing the view files (or portions of view files) that they contain.

As mentioned, before you enter data in a mix file, you prepare the data in view windows. A view file contains a graphic representation of your data; file length and cursor location information is displayed in SMPTE time-code values, real time, film feet and frames, or graphically. You can place edit markers simply by clicking on the mouse during playback.

Segments within the soundfile are defined with cursors for editing and manipulation. Zoom in/out functions help you select exact edit points, with single-sample accuracy. The distance between the cursors can be stored in memory, so once a length is defined, you can use it to select other data sections of the same length.

There is virtually no limit to the number of segments that can be defined per window, and segments can overlap. You can access and open multiple views of the same data simultaneously. You can process a defined segment, copy it into a new view window, or copy it into a mix window. The Dyaxis always treats view-window data linearly, so when you delete a segment, you don't actually remove it from the file, but it is skipped when the file is played back. This lets you delete data nondestructively.

Various playback modes are available, including PLAY SELECTED SEGMENT, PLAY UP TO SELECTED SEGMENT, and PLAY AFTER SEGMENT. You can play back at half-speed, and a LOOP-IN-PLAYBACK mode lets you check the rhythmic integrity of the selected segment. A scrub function lets you play data forward or backward, using the mouse as the controller. We found the playback options invaluable, both when defining segment boundaries and when auditioning the continuity between two segments separated by deleted data. When we were editing a commercial voiceover, the PLAY BEFORE and PLAY AFTER modes made the process of removing unwanted breaths and mistakes a simple yet accurate procedure, since we could audition the data we were editing as well as the continuity of our cuts.

With the Dyaxis you can reverse waveform data, and convert stereo files into mono files. (There is no provision for converting mono files into stereo.) Time compression/expansion also is available, which is useful for fitting an existing segment into a predetermined time for TV, radio, or film work. You can create dynamic amplitude envelopes with multiple break points, and compress or expand an envelope to cover any range of data. Most of the time we found that the envelope utilities worked well, although a few times, clicks were in-

troduced into the sound at the end of the file.

MacMix Mixing. The true power of the Dyaxis lies in its digital mixing capabilities. Constructing a mix, which essentially is an edit decision list, is simply a matter of entering view files or sections of view files, one at a time, into the list. A file doesn't need to be open on the screen before it can be entered into a mix, so if you're constructing a sound effects cue, you easily can bring sounds in your disk library directly into the mix.

Each time a file is entered, you're given the choice of pasting it to the mix window's current cursor position or pasting it to the time-code position it held in the view file. Files can abut each other or crossfade by any amount, up to the length of the file. You can enter crossfade times as numerical values, or create them visually.

Individual files can be moved back and forth freely in time, and locked to time-code start times. Also, you can program the mix as a whole to initiate playback at a specific time-code location, and a slew function lets you offset the synchronization one frame at a time while the mix (or a view window) is playing.

Levels of mix elements can be adjusted from -100 to +10dB, and you can use the programmable ducking envelope to bring down segments automatically to a specified level during a voiceover. Also provided are pan position and mute and solo utilities.

We found that the Dyaxis sometimes has difficulty playing a long series of extremely short repeating segments or a series of short segments stored at widely varying locations on the hard disk. You can avoid problems by mixing the segments into one contiguous file. Studer reports that these types of mixes can be played successfully if the segments are stored on two or more hard disks.

You can convert a final mix into a new, contiguous soundfile, and delete the mix's original components, to free up space on the hard disk. All mixing is done entirely in the digital domain, so individual mix elements do not lose their sonic integrity.

Unfortunately, each time you add an element to a mix, or change an existing element, the mix must be rewritten. Even muting a track, then unmuting it—in other words, not doing anything at all—requires that the mix be rewritten before playback can be initiated. The time it takes to rewrite is approximately twice real time. Sometimes that's just too long to wait.

Fortunately, you can speed up things considerably by using a mode called FAST MIX. In this mode, only data that has been processed in some way—crossfaded with an adjoining piece of data, for example—is rewritten to disk. When a mix consists of completely unprocessed data (no crossfades, overlaps, gain changes, and so on), playback may be initiated instantaneously. You can minimize the mix time by working on relatively small sections of material at a time, then combining these sections into one larger mix. Shortly after we completed our tests, the people at Studer announced that they are shipping systems with a hardware upgrade which reportedly speeds up mixing time by 60 percent.

The Listening Test. We recorded both analog and digital information into the Dyaxis. Regardless of our source, we could hear no difference between our source material and the Dyaxis reproduction. We also detected no difference between the sound of an individual element and the same sound after it was mixed. We also tried recording analog signals with the EMPHASIS mode on. While the resulting sound quality was noiseless and distortion-free, we felt the boosted high end detracted from the normal warmth of the low end.

Which System Should You Buy?

ALTHOUGH DYAXIS AND SOUND Tools overlap somewhat in functionality, each is designed to perform a specific duty. The Dyaxis is best suited to constructing complex mixes with multiple overlapping sounds, as is the case in a sound effects cue. Sound Tools is designed primarily for mastering and remixing. Still, comparisons are inevitable. So we've looked into the following major areas of interest to see how the two systems stack up:

Sonic Quality. Excellent on both. Each features CD-quality, 16-bit linear quantization. The Dyaxis may have a slight edge due to its maximum 48kHz sample rate versus Sound Tools' 44.1kHz rate using AD IN—although Sound Tools can "sample rate-convert" to the 48kHz output for DAT. The advent of Pro I/O reportedly will take Sound Tools to 48kHz (analog and digital).

Interfacing. Here the Dyaxis is the clear winner. It features balanced XLR connectors; Sound Tools' AD IN uses unbalanced 1/4" jacks. The Dyaxis supports five digital formats, Sound Tools supports two. In Sound Tools' favor, it integrates fully with Opcode's Vision sequencer, but Dyaxis does not support MIDI at all without the optional System Synchronizer. Both systems can read SMPTE time code (both LTC and VITC). Pro I/O offers balanced XLRs, along with additional formats.

Record Time. Equal. Both systems use SCSI hard disks as the recording medium, working with up to six drives. Drives may be any size, with approximately one minute of stereo recording per ten megabytes of disk space. Only Sound Tools lets you record on noncontiguous disk space, although playback timing accuracy may be compromised.

Ease Of Use. Both systems are easy to learn and use. Sound Tools has a slight edge in this category, as it follows many of the same conventions established for graphic waveform editing software.

Waveform Processing. Sound Tools has all you'll need and more. Dyaxis files can be exported to Passport's Alchemy for processing.

Mix Processing Time. Linear, non-crossfade files are mixed instantly. Mixing tracks out of real time takes longer depending on the number of tracks. (Dyaxis' capacity for a large number of source tracks can translate to long mix times.) Studer Editech's new hardware reportedly speeds up the Dyaxis by at least 60 percent, and software is being developed to speed up the processing of minor changes made to a mix.

Cost/Performance Value. Excellent for both. Sound Tools is the least expensive professional digital mastering/editing system you can buy. If you're creating sound effects cues, Dyaxis may offer the best power/cost ratio of virtually any digital recording system. It may cost more than Sound Tools, but each time you create a multi-file cue list, you'll be glad you shelled out the dough.

—Michael Marans

Conclusions. The strongest asset of the Dyaxis is its ability to address multiple sound files in a single mix. That may not sound like a big deal unless you're working with sound effects cues. But even if you only use the system to mix music tracks, you can combine individual tracks from multiple takes, as opposed to simply rearranging the order of an existing 2-track mix (although the system allows you to do that easily). At its most basic level, the Dyaxis could be used to arrange the playback sequence for a CD master. At the other end of the scale, you can use the Dyaxis to record, edit, and master a complete TV or radio commercial—or, for that matter, an hour-long TV show, complete with dialog, music, and effects—without using any external gear.

The Dyaxis isn't perfect. The processing time required to execute mixes is liable to make clock-watching clients a bit nervous. This shouldn't be a problem for too much longer, as Studer is working on new software that only mixes those areas in which changes have been made. That software, combined with the new hardware upgrade, should help speed things considerably. We're also a bit disappointed by the lack of sound-processing utilities, such as pitch-shifting and paste/merge.

Despite these few shortcomings, we were really impressed with the Dyaxis. The operational syntax is clear, the playback utilities make light work of file editing, and the multitrack mixing capabilities are extremely powerful.

If you edit TV/film sound, operate a post-production facility, or run a commercial recording studio, give this piece serious consideration—especially if you want to stay on top of the latest digital technology. Who knows, you just might get good money for your splicing block at the local antique shop.

SOUND TOOLS BY DIGIDESIGN

SOUND TOOLS IS AN EXTREMELY SOphisticated system, although conceptually, it is quite different from the Dyaxis. It also costs significantly less. The primary difference between the systems stems from the fact that the Dyaxis lets you stack multiple elements from assorted files in a single mix, while Sound Tools always deals with a single, stereo sound file. You can address multiple files linearly in a single "playlist" (edit decision list, or EDL), and EDLs can exist inside other EDLs, but you only can stack multiple elements using paste/merge techniques, much like those used in graphic waveform editors. While this could be a significant limitation for people who design film sound effects cues, Sound Tools offers an excellent environment for stereo mastering and the creation of complex remixes.

The System. Analog signals are recorded into Sound Tools via Digidesign's AD IN analog-to-digital converter. The AD IN accepts signal levels from -10dBV to +4dBm, but sports only 1/4" input jacks. If you use a +4dBm console and XLR jacks, you'll have to get adapters. We did that, and noticed no degradation of the recorded signal. (As we went to press, Digidesign announced an alternative A/D converter—the Pro I/O—which features balanced XLR I/Os, house sync, digital meters, and new Apogee filters.)

The system's second component is the Sound Accelerator digital signal processing card, which performs the D/A conversion, as well as numerous real-time processing functions such as graphic equalization. The last element is Sound Designer II audio editing software, which provides waveform processing utilities and functions as the system's master control panel. Also available is an optional bidirectional digital interface, the DAT I/O, which supports AES/EBU and S/PDIF formats. Digidesign recently introduced the Master List software package, which lets Sound Tools digital data be recorded via the DAT I/O onto digital audio tape, in a format that can be read by the CD mastering equipment at Optical Media International (OMI) of Los Gatos, California. The end result: You can master to Sound Tools and OMI will press a CD for you—for a very reasonable fee.

The whole system is tied together with a Macintosh II or SE/30 computer (a slightly different version for the Atari Mega series is available). There's also a Mac SE version, but its bus architecture limits the sampling rate to 32kHz for stereo recording (44.1kHz for mono). Various hard disks (including optical and removable media) may be used; Digidesign provides a list of compatible drives.

All functions, with the exception of the analog signal input level, are addressed via the icon-based Macintosh software with its assorted pop-up and pull-down menus. For example, the recording window features tape transport-style controls, and you access it by clicking on a tape recorder icon. Simple, no? We found the system incredibly easy to learn and use.

Both recording and playback may be synced to SMPTE time code (all formats, including VITC), and chase-lock is supported. Digidesign recently announced that its Q-Sheet A/V 2.0 software upgrade supports integration with Sound Tools, providing a common user interface for simultaneously syncing digital audio and MIDI to time code.

Soundfiles, Regions, & Playlists. Once you record data, it becomes a soundfile. The file can be displayed graphically, with duration/location information shown as minutes and seconds, SMPTE time, film feet and frames, or sample numbers in hex or decimal. You can initiate waveform playback from the mouse or the computer keyboard, and scrub utilities are provided.

You can divide a soundfile into an unlimited number of sections, called regions. Regions can hold data included in other regions, and there is no limit to a region's

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EQ LAB TEST

Product: Sound Tools.
Manufacturer: Digidesign, 1360 Willow Rd. #101, Menlo Park, CA 94025, (415) 327-8811.
Prices: Sound Tools (w/ AD IN) $3,285; DAT I/O $995; Q-Sheet A/V 2.0 $995; Sound Tools Utility Disk (Master List, Live List, DATa) $95; Pro I/O $2,995.

Frequency Response:
Claimed: 20Hz - 20kHz ±1dB
Tested: 12Hz - 20.187kHz +0.3dBm/-1.0dBm
Signal-To-Noise Ratio:
Claimed: >88dB (weighted)
Tested: 90.08dB (@ -10dBu, weighted); 76.87dB (@ max. output level, weighted)
Crosstalk:
Claimed: n/a
Tested: -74.96 @ 1kHz

Total Harmonic Distortion:
Claimed: <0.02% @ 1kHz
Tested: 0.039% (unweighted); 0.038% (weighted)
Claimed: <0.02% @ 10kHz
Tested: 0.065% (unweighted); 0.032% (weighted)
Maximum Input Level:
Claimed: +8dBu
Tested: +8.08dBm
Maximum Output Level:
Claimed: n/a
Tested: +8.47dBm

Tascam MSR-24 24-Track Tape Recorder

ON THE LAST ISSUE of *EQ*, we reviewed two relatively new 2" 24-track recorders, the Otari MX-80 and the Tascam ATR-80. Our perspective was that while digital recording was clearly in everyone's future, the 2" 24-track format still had a lot of life left, given its acceptance as a format, the cost of digital, and the fact that analog recording can sound very good.

But if $30,000 or more seems like a lot of money for a technology in its sunset years (or if there's simply no way you can justify that sort of investment), less than half that amount can get you a brand new analog 24-track—in a 1" format.

Enter the Tascam MSR-24, perhaps the last analog 24-track we'll see from a major manufacturer. It would be wrong to consider the MSR-24 to be anything less than a serious tape recorder. From our hands-on tests and evaluations, we feel this machine could find a happy home in a personal studio, the MIDI room of a large commercial facility, or even certain post-production settings. And for those who still doubt the abilities of certain narrow formats (such as 1/2" 16-track, which enjoys rather broad acceptance in a/v scoring and music recording settings), yes, 1" works well.

Overview. The MSR-24 is a 2-head, 1" 24-track tape recorder. It actually consists of two units: The main section houses the transport and the electronics (including the integral dbx noise reduction); the separate power supply reduces the chance of AC-induced noise.

The two-speed transport (15/7.5 ips) incorporate one phase-locked DC direct-drive motor for the capstan and two DC motors for the reel drive. The transport is similar to the "constant tension" designs found in more expensive decks, and allows a single reel to be rocked (in the EDIT mode) while the other reel takes up slack. The deck has ports for a remote control, a punch in/out pedal, and two accessory inputs which Tascam reports to be compatible with most synchronizers.

The MSR-24 is designed for -10dBV unbalanced operation, and its back panel sports 24 RCA input and output connectors. (-10 to +4 balancing converters are available from Tascam and other suppliers, should you wish to interface the deck with a +4dBm mixing console.)

Those using an 8-bus mixing console with the MSR-24 will find the "channel link" feature to save a lot of patching hassles. It allows inputs 1-8 to be normalled, via a selector, to inputs 9-16 and/or 17-23. In this way, bus 1 would be linked to tape input 1, which would automatically feed tracks 1, 9, and 17; bus 2 would feed tracks 2, 10, and 18; and so on. (You select which tracks are to be recorded on the front or the remote.)

Track 24 has been specifically designed for time code or other sync codes, and is not included in the channel link system. Like the Tascam TSR-8 and MSR-16 decks, the MSR-24's "sync-lock" feature defeats dbx on track 24 (to prevent any interference between the code and the noise reduction system), and also prevents accidental erasure of the time code once its recorded! It's a brilliant safety feature for those of us who have had to reconstruct time code after a late-night punch-in blunder.

A full set of spare parts including power supply fuses, LEDs, a PCB extender card (for testing and servicing), and special tools are provided in the shipping carton. In typical Tascam fashion, the owner's manual is superb, and is a great resource for everyone from technicians to first-time multitrack owners. We wish every manufacturer would provide these useful touches.

Using The MSR-24. Aside from the more pedestrian transport controls of PLAY, REWIND, and so forth, a host of editing features are also provided: SPOT ERASE; TAPE LIFTER DEFEAT (for cueing during high-speed winds and when rocking the reels); TAPE DUMP (used when razor blade editing to spill tape between cuts); and a SPOOL mode for tight tape packs. There's also a pitch control (±15%), and a combination tape counter/pitch % display.

The controls are all clearly laid out, but we wish the RECORD button was located a bit further away from the adjacent play button (or that its raised guards were higher), to lessen the chance of accidental erasure when any of the tracks are in a record ready mode.

The fascia of the MSR-24 is dominated by 24 easy-to-read, 12-segment LED indicators—large enough for peak lev-

EQ Lab Test

Product: MSR-24 24-track recorder.
Manufacturer: Tascam, 7733 Telegraph Road, Montebello, CA 90640; (213) 726-0303.
Price: $13,999 (inc. RC-424 remote).
Tape Format: 1", 1.5 mil (Ampex 456, 3M 226, Agfa 469).
Reel Size: 10.5", NAB hub.
Track Format: 24-track, 24-channel, Tascam proprietary format.
Frequency Response:
Claimed:
15ips: 40Hz to 20kHz ±3dB (@ 0VU);
7.5ips: 40Hz to 16kHz ±3dB (@ -10VU).
Tested:
15ips: 30Hz to 20kHz ±3dB (@ 0VU);
7.5ips: 40Hz to 18kHz ±4dB (@ -10VU).
Total Harmonic Distortion:
Claimed: <0.8% (@ 1kHz, 0VU) (250nWb/m @ 15 and 7.5ips).
Tested: <0.6% (@ 1kHz, 0VU) (250nWb/m @ 15 and 7.5).
Signal-To-Noise (@ 3% THD):
Claimed ("A" weighted):
15ips: 108dB (dbx);
15ips: 65dB (no dbx);
7.5ips: 105dB (dbx);
7.5ips: 60dB (no dbx).
Tested ("A" weighted):
15ips: 106dB (dbx);
15ips: 66dB (no dbx);
7.5ips: 102dB (dbx);
7.5ips: 58dB (no dbx).
Fast Wind Time (2400' reel):
Claimed: 120 seconds.
Tested: 114 seconds.
Adjacent Channel Crosstalk (@ 1kHz, 0VU, with dbx):
Claimed: >80dB.
Tested: >90.7dB.
Erasure Depth (@ 1kHz, +10VU):
Claimed: 70dB or better.
Tested: 73dB or better.
Wow and Flutter (DIN weighted):
Claimed: 15ips: ±0.06% peak;
7.5ips: ±0.08% peak.
Tested: 15ips: ±0.06% peak;
7.5ips: ±0.09% peak.
Tape Speed Deviation:
Claimed: ±0.2% (15 and 7.5ips).
Tested: ±0.02% (15 and 7.5ips).

els (which are "held" momentarily by the meters) to be read from across a control room. Tape/source monitor and track record status buttons for each track are also over-sized and easy to use.

The MSR-24 has a "mini-autolocator" of sorts built in. It includes two autolocation points and a RETURN TO ZERO function. The memory points and zero are coupled with selectable AUTO-PLAY, which puts the deck into PLAY once the deck reaches its destination after a high speed wind.

An AUTO PUNCH IN/OUT system cues itself from the tape tach counter, and works well: The punch points are programmed "on the fly" (during PLAY). (It's possible to rehearse the punches without actually recording. With the RHSL and INSERT buttons engaged, the input monitor will switch from tape to source.)

Another trick feature: The deck will remember the amount of tape that "pre-rolled" before RECORD was entered, and at the conclusion of auto-recording, it will return to the pre-roll start point and go into PLAY—just like you would do manually after a take, to hear the results. Nice. For repeating passages, the REPEAT 1-2 mode will cycle between the two memory points indefinitely.

A remote, the RC-424, is included, and it duplicates most of the controls found on the front of the deck, including the tape counter. If you're looking for more sophisticated autolocation facilities, the Tascam MIDIizer ($1,995.00) is what you'll need. While it will bring you all sorts of SMPTE-to-MIDI and transport synchronization options, a disappointing shortcoming for MSR-24 owners is that the MIDIizer only controls the status of the first 16 tape tracks.

The 2-head MSR-24 lacks a dedicated "repro" head. When aligning the unit it is necessary to record test tones and then rewind and play back for alignment and calibration. (A third head would allow off-the-tape monitoring while recording.) For most users this won't be a problem, and indeed, the lack of the third head undoubtedly helps the MSR-24 hit its price point. But with 24 tracks worth of adjustment, a technician will be occupied for several hours "setting up" the machine.

Consequently, we would recommend that you choose a tape type and stick with it, to avoid having to recalibrate the machine very often. Since moving a tape recorder around can also affect its alignment, a slow-to-calibrate 2-head machine may be problematic for mobile recording.

All in all, the MSR-24 is a joy to use. It handles a full reel of tape smoothly and precisely, and all of its functions respond well and are easily learned. It's a solid-feeling transport, and we expect that it would withstand the harsh life of a commercially operated studio.

Listening To The MSR-24. No doubt the integral dbx Type I noise reduction is responsible for how quiet the machine is—our bench test signal-to-noise and crosstalk specs are good enough to rival many digital recorders!

In most cases, we found this to be a good-sounding machine. Frequency response is full and even, tracks sounded clear and "open," and crosstalk was in most cases virtually inaudible.

We did find, however, that the overall tone of bass and some other lower-pitched instruments sounded less like the original source than did voice and other higher-pitched tracks. Specifically, certain sustained bass tones sounded slightly "mushy," and less than perfectly clear.

We also heard, in some instances, a minor sort of "overdubbing crosstalk" that our 1kHz crosstalk test didn't uncover. This was heard as a very faint low-frequency warble on tracks that contained high frequency sounds (like bells or high synth sounds) when these high tones were recorded adjacent to tracks that contained low-frequency tones (such as a synth bass).

Tascam claims the punch-in and -out is gapless, and our experience confirmed this: Clean punches are a matter of course for the MSR-24. The circuitry does, however, require you to "anticipate" the punch by a fraction of a second, presumably while the bias oscillator ramps up. A little practice makes this a perfect operation every time.

Conclusions. As mentioned, we did hear less-than-perfect low-end clarity and faint "low-end rumble" (as it's described in the MSR-24's operation manual). These are complaints that have been associated historically with the processing action of dbx noise reduction.

Still, it's important to consider them in context: Most signals are passed through the MSR-24 with virtually no signal compromise at all. Depending upon the nature of the music, some users might never notice the problems we heard.

Futhermore, this is an *affordable* 24-track—while the most demanding of users might find these sonic shortcomings to be unacceptable, they had best be prepared to shell out the big bucks for a 2" machine. (And even then, they had better budget for Dolby SR, if they hope to get the sort of S/N specs the

PHOTO: RAY OLSON

MSR-24 delivers.)

We suspect that the sacrifice of 2" format compatibility won't matter much to the buyers of the MSR-24. They'll be too busy enjoying the cost savings of 1" tape over 2" (about $70 vs. $175)—and the cost savings of the actual machine. The well-built MSR-24 provides 24 tracks on an affordable medium, and does so for just $14,000. This is a true breakthough. If you've been waiting for 24-tracks, and can't afford a $30,000 ticket, then the MSR-24 is a godsend.

—Rolf Hartley & Brent Hurtig

ART SGE Mach II Multi-Effects Processor

ONE OF THE MOST explosive areas in music technology is multi-effects processing. Manufacturers are scrambling to pack more simultaneous effects into smaller boxes with smaller price tags. Following in the footsteps of the original SGE (Studio Guitar Effector), ART has released their latest entry into the multi-effects frenzy—the SGE Mach II.

The unit boasts twelve simultaneous effects—three more than the original SGE. And it has over 70 different effects to choose from. The new version also has two seconds of sample memory that can be used by the DELAY algorithm or the new SAMPLER algorithm (which supports both manual and triggered modes).

Hardware. The SGE Mach II is a single-rackspace unit with an internal power supply. The unit supports true stereo processing with 1/4" unbalanced ins and outs (-10dB) for each channel. (In a 1-in/2-out hookup, you can use either input and both outputs—the effects image comes out in stereo and the original signal is output in the center. With a 2-in/1-out setup, the input and processed signals are summed to the output being used.)

Operation. 200 preset locations are selectable via the front panel or MIDI, 110 permanent and 90 user-definable. Function parameters and preset names are presented on a 2x16-character LCD backlit display. Preset numbers are displayed in a 3-character LED which includes status lights when editing existing presets or creating new ones. The PRESET SELECT keys will advance or reverse through the list one at a time. Numeric/function keys provide direct access to a preset by typing in its 3-digit number. But you'd better be quick—after only one second between digit entries, the display will revert back to the current preset.

Presets are created by selecting a blank memory, entering EDIT mode, and adding the desired effects with the ADD EFFECT and ENTER keys. The 70-plus individual effects are grouped into 28 categories, most with several options to choose from. Six of the processors—called "dynamic effects"—are always available. This group consists of HARMONIC EXCITER, EQUALIZER, COMPRESSOR/LIMITER, DISTORTION, EXPANDER/GATE, and LINE EQUALIZER. The availability of the remaining digital effects is limited only by the unit's processing capability and memory, as selecting certain effects will preclude using others. For example, you can't use the STEREO PAN with the CHORUS or FLANGER.

When adding effects to the chain, the display keeps a running count of the number of effects in use. Dual effects—such as COMPRESSOR/LIMITER or EXPANDER/GATE—usurp the space of two effects (however both effects can be used simultaneously). A minor point: When scrolling through the available processors, the display permits only forward movement through the list: If you skip an effect, you are forced to jump to the beginning and start stepping through them again. When editing an effect, however, the display does permit stepping through the parameter list in reverse.

The order in which effects can exist in the chain also is predetermined in the Mach II's design. Certain effects, however, make use of a PRE/POST function that permits the user to reposition them in the chain relative to other effects.

What's interesting about the SGE is that the dynamic effects are always first in the processing order. In addition, you can use the POST DYNAMIC EFFECTS input function to tell the unit to keep the dynamic effects in the audio path, even if the MIX slider is set fully to DRY. By keeping the dynamic effects first—and always in the audio path—you can retain the full effects of the compression, distortion, and so on, while using the MIX control to vary the amount of digital processing in the final output. This, in essence, retains separate control between critical guitar sound functions and digital embellishments—useful stuff.

Once the desired effects are placed in a chain, each of the individual effects can be adjusted as needed. Pressing the SELECT key puts the unit into EDIT PARAMETER mode, at which point the user can scroll through the parameters starting with the first effect in the chain. Certain effects have fixed or somewhat limited ranges. For example, the EQUALIZER has fixed frequency bands, and only three of them (100Hz, 1kHz, and 10kHz), and boost/cut level adjustments are available only in coarse increments: ±3dB, ±6dB, and ±12dB. The COMPRESSOR/LIMITER has only two slope ratios—2:1 and 4:1, and the LIMITER has a fixed-peak. With this many effects at this price point, however, these sort of compromises are to be expected.

Mach II Performance MIDI. The Mach II's PERFORMANCE MIDI allows control of up to eight effect parameters remotely via MIDI in real-time. MIDI controllers—pitch/vibrato controls, volume/sustain pedals, velocity, after-touch, and the like—can be programmed to control some (but not all) parameters in each preset, complete with scaling. For example, a MIDI footswitch could change the EQ boost or cut; parameters such as a re-

EQ Lab Test

Product: ART SGE Mach II Multi-Effects Processor
Manufacturer: Applied Research & Technology, 215 Tremont St., Rochester, NY 14608; (716) 436-2720.
Price: $749.00.
Frequency Response:
Claimed (wet): 35Hz - 20kHz (±1dB).
Tested (wet): 35Hz - 12kHz (-2, +2.2dB).
At 14.5kHz the frequency response dropped to -4.0dB; at 15.5kHz it dropped further to -8.8dB; at 16.5kHz the response was down to -56.3dB. Our test unit could not achieve claimed wet frequency response.
Tested (dry): 35Hz - 20kHz (±1dB).
Tested (bypass): 35Hz - 20kHz (-2.1, +3.7dB).
Signal-To-Noise:
Claimed: 90dB typical (unweighted).
Tested: -75.9dB unweighted; -79.5dB weighted.
Total Harmonic Distortion:
Claimed: 0.04% @ +4dBm.
Tested (wet): 0.039%.
Tested (dry): 0.017%.
Tested (50% wet/dry): 0.025% with 0dB indicator lit.
Maximum Levels:
Claimed: +16dBV maximum.
Tested (input level with input slider to center): +12dBm (3% THD).
Tested (output level with output slider to center, 100% wet): +8dBm (3% THD).

verb's decay time or output level could be controlled by the mod wheel. The possibilities are vast. MIDI input data also can be scaled so that a precise control feel can be obtained from the MIDI instrument. And a function called MIDI DATA EVENT MONITOR displays incoming MIDI data in real time, which saves time in troubleshooting.

Factory Presets. The Mach II's 110 factory stock programs give the user a very good overall view of what the unit can do. We were particularly pleased with its ability to add flanging to reverb, for example, in TURBO FLANGE. Several chorused presets were rich and full, taking advantage of the Mach II's stereo effect imaging. Presets using REVERB and DELAY algorithms gave the guitar an enormous sound, as expected. WAREHOUSE STACK sounded like exactly that—a stack of amps in a bare, open room. The unit delivered a fair amount of crunch, but to our ears the DISTORTION/OVERDRIVE effects fell just short of real tubes. Presets employing pitch transposition were especially clean and glitch-free. Adding a fifth or sub-octave to the original guitar sound gave it an outstanding fatness.

Conclusion. As a processor that wears many hats, the SGE Mach II does an impressive job. It won't replace every effects device in the studio: Much-used outboard effects like compressors, harmonic exciters, and even graphic EQs just aren't as versatile in the Mach II as in dedicated units. Don't count on 70 effects at this price point and still expect full functionality.

The unit we tested revealed some specs which are not up to fully professional standards (just like several other inexpensive multi-effects units we've seen). Still, most of the effects are perfectly usable in a pro setting. "SGE" stands for Studio Guitar Effector—and the box *is* optimized for guitar processing. As such, it does a fine job of supplying an incredible number of features for the money. With a price of $749, the SGE Mach II may be a welcome addition to your studio's arsenal.

—David Bertovic

Eventide H3000SE Ultra-Harmonizer

MANY OF THE NEW signal processing devices on the market have one fault in common: They try to do too much! As a result, many are used only for specific sounds, even though they are capable of doing quite a bit more. I was prepared to have the same reaction to the H3000SE. With its one all-purpose knob, seven buttons, and a keypad, I was totally prepared *not* to like it. But I was in for a surprise.

Overview. Eventide is no stranger to the studio. For most engineers the term "Harmonizer" (an Eventide trademark) is synonymous with high-quality pitch transposition. The H3000SE is the company's latest offering; like its cousin the H3000S, it does much more than just "harmonize." Reverb, chorus, pan, delay, and other presets are provided. And to say the H3000SE is just an update of the H3000S is an oversimplification. "SE" stands for "studio enhanced," and it definitely is. Although they share many of the same presets, and look alike (the SE being gun-metal grey instead of metallic blue, for those who want to color-coordinate your outboard racks), the SE has many more programs, including a true *stereo* sampling option. Current S models can be updated to SE performance with a $600 factory upgrade.

The H3000SE provides 3-pin XLR stereo inputs and outputs (pin 3/hot; transformerless, differentially balanced). Custom XLR-to-1/4" phone adaptors are available that include pads which reduce the +4dBm output level to -10dBu; internal jumpers can be used to set the input level for -10dBu operation. Both input and output levels can be adjusted easily and level adjustments can be stored and recalled with different effects programs.

The total delay time available is 1.5 seconds, and pitch variation in the MULTISHIFT mode is ±3 octaves (other pitch shift modes offer a +1, -2 octave range). Our test unit included the $995 field-installable sampling option. The sampling rate is 44.1kHz with 16-bit resolution. Sample time is 23.7 seconds of mono audio, or 11.8 seconds of stereo. The sampler can be pitched up and down ±3 octaves.

The H3000SE is MIDI-compatible, with full control over any parameter in real time. MIDI IN, OUT, and THRU connectors are on the back panel.

Sounds Like . . . With 200 presets, 19 algorithms, and the stereo sampler option, there's a lot to play with. We'll touch on some of the newer presets unique to the H3000SE.

The VOCODER preset is a good effect and relatively easy to use. A pitched instru-

EQ Lab Test

Product: H3000SE Ultra-Harmonizer.
Manufacturer: Eventide, One Alsan Way, Little Ferry, NJ 07643; (201) 641-1200.
Price: $2,995.00 plus $995 for stereo sampling option. (H3000S models upgradable for $600.)
Frequency Response:
Claimed: 5Hz - 20kHz, ±1dB, ±0.5dB typical.
Tested: 20Hz - 20kHz, ±0.5dB.
Signal-To-Noise:
Claimed: 92dB.
Tested: 92dB.
Total Harmonic Distortion (@ 1kHz, +4dBm operating level):
Claimed: 0.01% (0.007% typical).
Tested: 0.01% (up to +13dBm); 1.0% @ +21.4dBm.
Maximum Output Level:
Claimed: +18dBm.
Tested: +21.5dBm.

ment (guitar or piano, for example) is sent to the left channel. This provides the "synthesis" input. A voice is sent to the right channel. This provides the "analysis" input. By adjusting the balance of each, you can obtain a true, Laurie Anderson-like vocoder sound. The resultant output is pseudo-stereo. (Use a little of the source vocal in the mix of source and VOCODER, as it helps the articulation.)

I wish the STEREO SAMPLER mode offered longer sampling time, though this shortcoming is more than made up for by the incredibly quick trigger. (No more triggering off the tape recorder's sync head and setting a time delay in order to send a trigger slightly ahead of the tape deck's playback head, as is necessary with some older samplers and trigger-to-MIDI converters.) Samples may be triggered by the standard audio inputs or via MIDI, with NOTE ON/OFF commands or just a NOTE ON command (good for drum triggers).

In one test, I sampled a kick into one side of the Eventide and a snare into the other. Both tracked the originals flawlessly, with no perceptible delay. You can edit samples either by entering start and stop numbers, or by using my favorite, the "all-purpose knob," to "rock" the ins and outs—just as you would do if you were scrubbing tape on an analog machine. The pitch of the samples can be adjusted over a six-octave range without changing the length of the samples. A greater TIME setting (e.g., 200%) results in higher-speed playback without altering pitch.

Something I didn't like about the sampling mode: You cannot enter a stop number before sampling. I use this feature on the TC Electronics TC2290 and find it helpful when I know in advance that I only want, for instance, 1.5 seconds of sample. It saves time later in editing the stop point. With the H3000SE, you must press STOP or it will continue to sample.

The H3000SE also includes programs such as DENSE REVERB, MULTI-SHIFT (a six-octave pitch shifter), STRING MODELLER (ever stick your head inside a piano and hit the strings with your hand?), and PHASER (reminiscent of the original Eventide Instant Phaser). The H3000SE is a true dual-channel processor, allowing, for instance, a reverb algorithm in the left channel and a delay patch in the right.

Currently, many "multi-effects" devices flooding the $300-to-$1,000 market can run programs in series with combinations of other programs. (Typically, combining multiple effects reduces the performance of these units.) By this definition, the Eventide is not "multi-effects." Still, it has settings that offer multiple effects—all with top-notch performance.

The REVERB FACTORY algorithm, for instance, has a particularly nice feature. Ever run into the problem of recording a cross-stick snare track in the verses that switches to a Phil Collins-like "thunder gate" snare in the choruses? Oh gosh, different EQ and different echo on the mix! Well, this program not only includes parameters for adjusting different decay times for the reverb of each sound, it also can change the EQ (2-band parametric) of the reverb for each sound. The program also has a gate that can be set so the threshold is matched to the level of the snare. Anything below the threshold (in this example, the cross-stick) can have its own reverb time and EQ, and anything above the threshold (the full snare) can be set completely differently, using the same basic sound as the foundation.

Another useful preset is DIATONIC PITCH SHIFTING, similar in concept to the "intelligent pitch shifting" offered by the DigiTech IPS33. This lets you—by programming key signatures, scales, or musical modes—have "perfect" third and fifth harmonies that follow the incoming fundamental note. (Random and not-so-perfect harmonies can be created if desired.) This preset could be useful for singers and arrangers who want to audition possible harmonies.

Operations. After a little practice, you'll find the H3000SE's controls really easy to use. The LCD display is backlit (brightness can be adjusted) and contains the program number, program name, and parameter names available in the first menu. Programs can be accessed and parameters changed via the keypad, knob, up/down buttons, or MIDI. You can even call up the name of the original algorithm used.

When a program is loaded, the display changes to show the first set of parameters controlled by the four "soft" keys. Pressing the PARAMETER button puts you in the edit mode, and off you go. Pressing each soft key lets you change the parameter listed above the key, the value of which is shown on the upper-right side of the display. Pressing the PARAMETER button again gets you to the next menu, and so on. This first menu group lets you adjust sounds quickly. However, there also is an EXPERT soft key that gives you access to even more parameters. ("Aren't you done with that snare sound *yet*?!") Some programs also offer SOFT FUNCTIONS, where the soft keys control more than one effect-parameter simultaneously.

MIDI. The H3000SE's MIDI implementation may be the most comprehensive found on any standalone effects unit. Essentially anything that can be controlled from the front panel (except the power) can be automated via MIDI. For instance, flanging rate and/or depth can be varied with a modulation wheel; reverb decay times can change as you play different notes; automated pitch shifting can take place by recording pitch-wheel movements into a sequencer, then running them through MIDI to the Ultra-Harmonizer. The MIDI SysEx dump feature stores H3000SE programs through a sequencer to floppy or hard disk.

Conclusions. I like this box a lot. If you haven't already purchased the original H3000S, spend the extra money: Buy the SE version. It's worth the difference in price. The H3000SE sounds fine and has many effects—too numerous to cover in this review. But suffice to say there are enough silly, straight, and completely useful effects to please everyone on your block—or in your studio.

—Leslie Ann Jones

Yamaha SY77 MIDI Workstation

IT'S UNIVERSALLY acknowledged that the Yamaha DX7 keyboard helped revolutionize the electronic music industry. But much water has gone under the bridge since 1983, and to some people, FM synthesis is old news. Enter the SY77—Yamaha's latest foray into the volatile arena of MIDI workstations. Yes, it's *another* FM machine—but one that blows the lid off everything you know about frequency modulation synthesis. To complete the workstation concept, the SY77 also incorporates sample playback, 16-track sequencer, 3.5" floppy drive, four DSP devices, and two pairs of stereo outputs with dynamic panning.

Sound Generation. The SY77 offers a maximum of 16 AFM and 16 AWM voice elements that can sound concurrently. (AFM is the Advanced Frequency Modulation section; AWM, or Advanced Waveform Memory, is the sample playback section.) Each program can consist of one, two, or four "elements," with each element being an AWM or AFM voice. Stacking one AFM and one AWM sound yields 16 voices: any other combination reduces polyphony to eight or even four voices. Using several 4-element programs could restrict the workstation aspect of the instrument severely. Fortunately, the concept of dynamic allocation applies to the element level rather than the voice level.

The AFM section is where this instrument really shines, so we'll focus on how this section diverges from the standard FM model. The SY77 features 45 significantly enhanced 6-operator algorithms. First, each algorithm has a unique architecture with programmable routings for up to three operators, with multiple routing from a single modulation source available. Second, each operator can be one of 16 different waveforms (rather than being restricted to simple sine waves), which yields countless sonic possibilities not found in the instrument's ancestors. Third, you can use AWM sounds as modulators, and that pretty much dots the i's and crosses the t's of the word "infinite." Fourth, you can specify the starting phase of the waveform for each operator, for subtle yet useful changes in timbre. Finally, we get a real noise generator instead of saturated feedback loops.

The addition of two 12dB/octave resonant filters for each of the elements brings great flexibility to the sound-contouring process. One filter can be configured as low-pass or high-pass; when combined, you get a 12dB/octave high-pass, low-pass, or bandpass filter, or 24dB/octave low-pass filter. The filter resonance will go all the way into oscillation, but independent resonance controls would have been much more useful than the existing common control.

Output envelopes for each operator have eight stages, allowing extremely complex transients. Filter and pitch envelopes have seven and five stages, respectively, and you can enable the pitch envelope selectively for each operator. Both filter cutoff and output scaling are controlled across four user-definable zones.

The AWM section is a straightforward sample/filter/output signal path. User sampling would have been ideal, but given new samples via the Waveform Expansion Card, this 16-voice section could be useful by itself, without the layering that currently is used to fill out the sounds. The filters are the same as the FM section, but the output envelope is six stages—still good. Yamaha calls the combination of the aforementioned technologies Realtime Convolution and Modulation, or RCM.

A third type of voice, a "drum voice," lets you map 61 samples to specific notes for use as (but not limited to) a drum or percussion kit.

The "common" section houses the more generalized functions; panning, micro-tuning, and the effects section are particularly intriguing. The range of options is wide and flexible, letting you really manipulate a program's overall impact. The four DSP devices can be configured in just about any architecture desirable in relation to the two stereo output buses. We can't help but hope, however, that more manufacturers soon get the message that people want individual outputs for each timbre.

User Interface. The SY77 is blessed with a large 240- x 64-character LCD display, which Yamaha has used to its best advantage. The large screen displays are well-organized and informative, often using graphics to indicate a function's activity. However, the non-uniform combo of function keys, ENTER, and YES/NO keys often makes maneuvering through functions a bit confusing. You can disable secondary YES/NO screens, but we don't suggest doing so until you're familiar with the instrument, because the SY77 operating system has no "undo" function. That means the results of any mistakes must be manually corrected.

Product: Yamaha SY77 MIDI Workstation.
Manufacturer: Yamaha, Box 6600, Buena Park, CA 90622; (714) 522-9011.
Price: $2,995.00.
Selected Features: 61 keys (unweighted), maximum 16-voice polyphony, enhanced FM synthesis (45 algorithms), 16-bit sampled sound playback, 16-track sequencer, four DSP effects, 3.5" disk drive, ROM card slot for waveforms, RAM card slot for user programs.

h-dden assets

ZubeTube & Spacephone

Sproing! New Gizmos Produce Zany Effects And That "Ol' Time" Reverb

ONCE, WHEN WE were younger, we had tin cans connected with string (and didn't learn until we were older that if you didn't wet the string, it wouldn't work). Later we had Minimoogs and tape recorders, and we suspended compressor mikes from Slinkies, and made starship weapons sounds. Two currently marketed "science toys" rediscover the oversize spring reverb, and in the hands of clever samplists, recording artists, and people-who-like-to-play with sound, they could prove most useful.

The Spacephone by Toy Science Inc. consists of a pair of red plastic cones connected by a long metal coil. Speak or yell into one end, or tap it with your finger, and the other end produces a chaotic blend of reverb, echo, *sproing*, and original signal (reminiscent of putting a seashell to your ear at the climax of a Zeppelin concert).

We experimented with this effect on piano, violin, guitar, flute, and synthesizer. We found that when the Spacephone was extended about six feet (the minimum distance to keep its coil off the floor), it acted in a manner similar to a spring reverb set to a delay of 250 ms or so (ignoring the *sproing-zap* effects). Positive feedback quickly overwhelmed the high harmonics in every instrument, rendering the original signal inseparable from a high-pitched whining roar after four or five seconds (depending on coil tension). Sound source placement must be very close—within a couple of inches—to one of the cones, which in turn makes it difficult to isolate the dry signal; if you crave the sound of acoustic spring reverb, and a digital fake just doesn't satisfy you, this probably isn't the answer. However, the Spacephone is a neato toy in its own right, and could provide great live/sampled effects for rap or psychedelia.

One caution: The Spacephone is noisy—by design—and cannot be moved without incurring half the phaser-fire in Klingon history; just the thing to have lying around for someone to bump into at the end of a perfect take (*boing! sprang sprang sprang!*).

The ZubeTube takes a slightly more manageable approach to the same idea. Calling to mind an Andean rainstick from *Aliens*, or perhaps a discarded roll of gift wrap, the ZubeTube consists of two (genuine) plastic drinking cups, one set in each end of the colorful cardboard tube. Cemented between the ends is a narrow steel spring. When the ZubeTube is struck against, say, a younger sibling's head, the effect is as above. (*Zarpwangill!*) The major difference here is that the tube is rigid, which means a lot if you've ever tried to tell time from a Dali watch.

Furthermore, the ZubeTube has a port of sorts that can be used as a finger hole to mute/pluck the internal spring, or as a transverse blowhole, which redefines the entire thing into a sort of closed-end flute for fingerless futurists. In this mode we were able to produce several distinct overtones, the most energetic of which (and this is really neat) drove the spring. Never mind your set of *thirtysomething* Zamfir pipes, stick *this* on your Synclavier.

Like the Spacephone, the ZubeTube also functions as a somewhat interesting reverb producer. The rigid construction and transverse soundhole, however, tickled our imagination. Effects combinations like foghorn-flute and reverbed voices, or start-and-stop reverb with photon torpedoes, are the sorts of things most folks pay through the noise for.

—*Paul Mulvaney*

Spacephone can be purchased for around $20 at Nature Company and Natural Wonders stores, and through Edmund-Scientific (609-573-6250) and the Nature Store mail-order catalog (800-227-1114). ZubeTube can be purchased for around $11-12 from major toy stores, although we bought ours for five bucks from a street vendor. Hope it wasn't bootleg.

Multis. "Multis" are groups of up to 16 programs, with levels, pan assignments, and an effects setup for use with the internal or an external sequencer. To enjoy multi-timbral sequence playback, you must set up multis before you use the sequencer. If you don't, only Track 1 plays, and only with the selected voice. Multis take getting used to, but after that, they seem workable enough.

Sequencer. This is the SY77's weakest section. Only one song can reside in memory, so using the keyboard in live performance is difficult, if not impossible. And all sequencer data is lost when you power-down: a dangerous situation that requires frequent backups onto disk.

Editing facilities are good; once familiar with the multiple cursor movements, you can really manipulate data. Editing of MIDI controller data is not as extensive as we'd like.

The main problem lies in the area of time. We found the metronome click to be between one and two clock ticks ahead of the absolute beat, thus causing problems with quantization: It shortens or lengthens the quantization window on either side of the beat.

Even more problematic is the sequencer's inability to play more than five notes without delaying additional notes by two or more clock ticks. This is more obvious when multiple, quantized tracks hit together, sounding like the song is slowing and speeding up. This delay problem is not related to the SY77's polyphonic limit, because it also occurs with one AFM/AWM sound hitting a 7-note chord. We were able to substantiate this problem further: When the same sequence is ported to an external sequencer, re-quantized and played back using the SY77 as a sound module, everything sounds fine. When the polyphonic note limit *is* exceeded, the sequencer *further* delays notes. This is not as desirable as maintaining strict time and just plain cutting out notes.

Overall, this software "rev" of the sequencer is good for "scratchpad" renditions of compositions, but not for a complex final product. Dumping the song via MIDI to a computer-based sequencer does provide you with the flexibility to polish your composition, but those annoying timing anomalies still exist at the MIDI output.

One really cool aspect of the sequencer is that it can be used to record every edit you make while programming. If you make an error and want to return to something you had earlier, you can play back the sequence to retrace your electronic footsteps!

128 Factory Presets. This is

where the SY77 falls short of its potential—Yamaha would do well to encourage third-party software. Although we liked several percussion sounds and all the organ patches, we've heard better standard FM-based instrument sounds (strings, electric pianos, synth basses) on a stock DX7. And many sounds closely resemble the character of those on the Roland D50 and Korg M1.

The sample-based sounds are quite representative of their real-world counterparts. However, most had pitch problems at their loop points—the loops would be sharp or flat relative to the attack portion. Patches using these samples exhibited intonation problems when the sound crossed from the sampled attack to the FM or secondary sample sustain portion.

Strings and pads sounded veiled in the 3-5kHz area and lacked top end. Several bass programs seemed heavy in the 50Hz area and lacked meat in the 500-800Hz range. Many internal presets suffered from envelopes with less-than-musical characteristics, such as decay or release times too short, or attacks too long. The drum kits are all right, but most of the kicks, snares, and toms sounded a bit "papery" and over-compressed to fake fatness. The ride cymbals and percussion sounds were good but the crash and open hi-hat cymbals were a bit short.

Yamaha has added "break points" to the keyboard design to mimic the way a slowly depressed piano key tends to stop before hitting bottom. Consequently, the feel of the 61-note, non-weighted keyboard is outstanding. Unfortunately, the preset sounds exhibited little regard for the feel of the keyboard. Some patches responded too softly at medium velocity levels, yet jumped up to a loud level with minimal increase of velocity—with few in-between dynamic levels. The demo disk's sounds were better, and should have been the stock programs.

Conclusions. The SY77 offers the most advanced audio synthesis computer that any programmer could want. We've only scratched the surface of this instrument's true potential.

Once programmers and third-party developers get a handle on the SY77's power (by reading the entire, comprehensive 255-page manual), we expect to hear some really dazzling sounds. Producers and keyboardists will find that sound libraries are a must because it takes so long to program "real" sounds. Also, we're disappointed that only Yamaha can supply additional AWM waves—at this point, anyway.

The SY77 is an invaluable addition to a computer-based MIDI setup. Before the instrument fully qualifies as a professional MIDI "workstation," Yamaha must address the sequencer problems we encountered. The people at Yamaha now are aware of these problems and indicate that they are working to resolve them.

In the meantime, there are some great sequencers out there, and we can think of plenty of other reasons to invest in the SY77. For its sound generation capabilities alone, the SY77 has a promising future.

—Lance Ong

Do You Hear As Well As You Think You Do?

COMING IN THE NEXT ISSUE OF EQ

ADVERTISERS INDEX

STATION TO STATION

CONTINUED FROM PAGE 69

size. A region can be as large as the entire soundfile or as small as a single sample. Once a region is "captured," it can be named and entered into a playlist. The playlist determines the order and times at which its regions play back. (With Digidesign's new Live List software, playlist events also can be programmed to initiate playback from the computer keyboard or from any MIDI event.)

You can lock each region's start time to a SMPTE time-code number. You can insert regions at any point in a playlist, and use block cut/copy/paste utilities. Several crossfade functions help smooth out the transitions between regions.

Multiple versions of a soundfile's playlist can be created and stored, so you can audition various arrangements. The nice thing is that playlist editing is nondestructive. As a result, your original soundfile remains intact, *and* your playlists require no additional memory.

As mentioned, only one stereo waveform can reside in memory at a time. However, you can access data from multiple soundfiles in a single playlist in one of two ways. You can paste the new data into the data in memory, although this method is a bit of a hassle, because region definitions are not transferred; you have to redefine the areas of new data before they can be entered into the playlist. The other method is to use Master List, the new Digidesign software that lets you import playlists or portions of playlists into the current playlist.

Waveform Editing/Processing. If you're familiar with the Sound Designer graphic waveform editing software, you'll be delighted with the utilities offered in Sound Designer II. In addition to the standard cut/copy/paste, waveform data can be reversed, gain-increased/normalized, and looped (using the included crossfade-loop utilities). But the real magic can be found in the digital signal processing functions.

Two functions, MIX and MERGE, let you combine multiple files into a single stereo waveform. These can be useful when you create an effects cue that requires several elements. MIX lets you blend up to four soundfiles at a time, with programmability over each file's level (independent control over left and right channels), stereo placement, and delay time. MERGE is used to fade one soundfile into another.

Now for the really fun stuff. Got a cue that's a bit too long or short? Just use the stereo time compression/expansion utility.

What other manufacturers accomplish in hardware, Sound Tools does in software, and that keeps the price way down.

What about some music that's slightly bottom-heavy? Try the parametric equalizer, which, by the way, sports five different types of filters and operates in *real time.* Want some more control? Check out the 14-band graphic EQ. You can use all EQ functions to alter data permanently or on playback only, apply EQ to the left, right, or both channels, and save EQ data with the soundfile. Settings can be recalled for use with other files. Other DSP functions include sample-rate conversion and three-dimensional FFT analysis.

Conclusions. In general we're thoroughly enamored with Sound Tools; we're impressed that Digidesign has managed to include so much sophisticated functionality and ease of use in a low-priced package. What other manufacturers accomplish in hardware, Sound Tools does in software, and that keeps the price way down. We have one complaint, however, concerning its inability to access multiple simultaneous soundfiles. This makes the job of assembling sound effects cues somewhat difficult. Although Digidesign's Q-Sheet 2.0 can talk directly to Sound Tools, you're still limited to a single stereo event playing back at any given moment. As we went to press, Digidesign had just unveiled Deck, a software package that expands the system to four independent audio tracks [*Ed. Note: see Update, page 12*].

On the other hand, if you're mastering or doing dance remixes, Sound Tools performs flawlessly and requires a minimum amount of user effort. In fact, all you have to do is supply the creativity. And if you're looking to integrate a digital recording system with your MIDI sequencer, Sound Tools can now operate inside of Opcode's Vision sequencer. The two aren't merely synced together, but actually work as one complete system, known as Studio Vision.

Sound Tools isn't for everybody. Some people think a high-end piece of gear just isn't worth buying unless its price tag keeps you lingering dangerously close by the poorhouse door. Well, while those folks figure out how to keep the creditors at bay, we'll just saunter back into the studio, power up the Mac, and finish up a couple of tracks. •

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I Like My Overs Easy, Thank You!

The Trials & Tribulations Of Getting Proper Levels On Digital Tape.

BY ROGER NICHOLS

I REMEMBER WHEN IT WAS A CINCH TO set the record and playback levels on analog recorders. All the older analog machines, whether they were mono, 2-track, 16-track, or 40-track, were equipped with these little pieces of cardboard that had lines painted on them. In front of the cardboard was a tiny, rubber, needle-like pointer that aimed in the general direction of the painted lines. I know these pointers were rubber because they bounced around while I tried to adjust them.

To set the proper level with analog meters, you only had to turn a knob until the rubber pointer hovered in the vicinity of the required reference mark on the cardboard. The reference point was at 3% total harmonic distortion of the audio signal stored on the tape. This point was called "zero." Any levels deviating from it were calibrated in dB: +1, +2, and so on for levels above the reference, and minus values in dB for deviations below the reference.

I never really knew whether minus levels meant that your recording didn't have enough distortion. If the reading on the meter wasn't exactly what you thought it should be, you just tapped the meter with your finger until the needle moved to the correct position. Trying to be precise during these adjustments was akin to deciding where to stick the garden hose in your swimming pool so the deep end won't get more water than the shallow end.

Then came digital recording. The references we had to go by were thrown out the window. The "zero" reference on digital meters means just that: You have zero room left in the digital data stream. If you make the signal any louder going in, it won't be any louder coming out—it will be clipped, cut off, ugly, unusable. It's like trying to pump two gallons of gas into a one-gallon can. It just don't fit!

Manufacturers of digital recorders have included a little red light at the top of each channel meter, and labeled it OVER. This light doesn't really tell you when you are over the limit; that is not possible on a meter designed to indicate "overs" on playback. That's like being able to tell whether the one-gallon gas can actually had two gallons poured into it. The OVER light is triggered by what I call "The Great Carnak" circuit. It guesses whether or not your signal is over the limit, based on the history of previous samples. So if you have three or four consecutive samples recorded at full level, chances are that some part of the signal had a higher value than could be stored in a 16-bit word. Most professional digital machines calibrate this OVER light to go on between one and four samples.

This OVER scheme really gets sticky when you consider all the secondary digital formats, such as DAT and PCM F1 machines. Most of these machines perform their metering in the analog domain. Some rely on digital information to supply the trigger for the OVER light; others use analog peak indication as the source. The problem lies in where each manufacturer decides to turn on these indicators. Have you ever digitally copied a DAT tape from one machine to another, or played back a recording on a different brand of tape deck from the one on which it was recorded? Then you know what I mean. The meters not only don't read the same from machine to machine—a tape that you busted your rear end to record perfectly on one machine might make the front-panel OVER indicators on another machine light up like a highway patrol car in your rear-view mirror.

The OVER indicator on the Fostex D-20 DAT recorder lights up whenever you have less than 2dB left. That's like saying the 2-yard line is close enough to the goal to count as a touchdown. The Panasonic SV-3500 DAT machine indicates OVER when your levels are less than 0.5dB from death. Terrific. The Luxman KD-117 DAT displays its OVER at 0.1dB before the digital sky falls. You can see that something recorded legally on the Luxman would light a plethora of OVERS on the Fostex. Help!

Sony makes a stand-alone digital meter, the DMU-30, which can accept an AES/EBU (or S/PDIF) digital signal and display levels in the digital domain. I plug this meter into whatever digital machine I'm using. I've checked it with a computer-generated audio signal, and it is *perfect*. Switches inside the device set the number of full-level samples that will trigger an OVER indication.

It's time to tell every manufacturer of digital audio accessories to build one of these gems. We need them! This little goody makes life very simple.

You know the old saying, "If God had meant people to fly, God would have bought us all Learjets," don't you? Well, if God had meant us to get the proper levels on digital tape, God would have bought all of us Sony DMU-30s. •

Grammy award-winner ***Roger Nichols*** *is chief engineer of West Hollywood's Soundworks West (formerly Motown Hitsville).*

ILLUSTRATION: SCOT HALPIN

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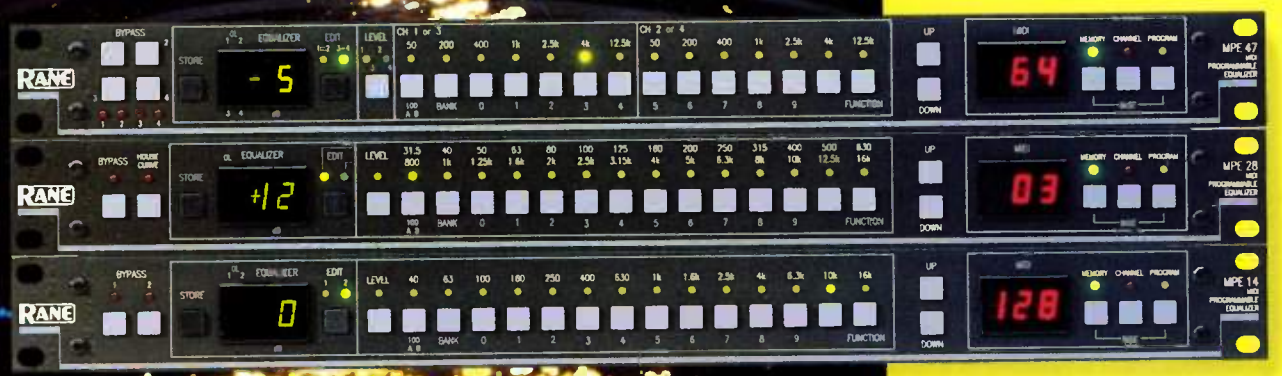
Discover for yourself the new creative dimension that an MPE Series tonal controller can give you. Then let your musical imagination soar.



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Small Monitor. Big Difference.

In the recording business, little things can often make big differences. Studio monitors, highly sophisticated critical listening devices, are certainly no exception. Our Control Series™ compact personal monitoring systems each provide the performance characteristics demanded in today's recording environments.

Take our Control 5™ for example. You get power handling capacity of 175 watts, outstanding dynamic range, smooth frequency response and excellent clarity and imaging. This high power, low distortion system is housed in a non-resonant polypropylene structural foam enclosure.

Today you can find Control 1's in home studios and midi workstations; Control 5's in major recording and teleproduction facilities; Control 10's in foreground and background systems, corporate boardrooms and teleconferencing facilities. And the two-way horn loaded Control 12SR, a logical extension of the technology, in sound reinforcement applications from supper clubs and discotheques to small tour sound systems. Control Series meets such diverse applications because they are, above all else, powerfully honest.

Control Series. Compact high performance monitors designed to meet a broad range of fixed and mobile applications.

Versatility, the Other Advantage.

Designed to accommodate a wide variety of specialized mounting brackets, Control Series monitors can go virtually anywhere. On the console, on the wall, on the ceiling, in a rack, on a tripod, keyboard or mic stand. Control 10's and 12SR's even come with a built-in handle so they travel like a seasoned professional.

Next time you're looking for a super compact high performance loudspeaker system, remember Control Series then go see your JBL dealer. Look at the specs, then listen to the big difference.

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