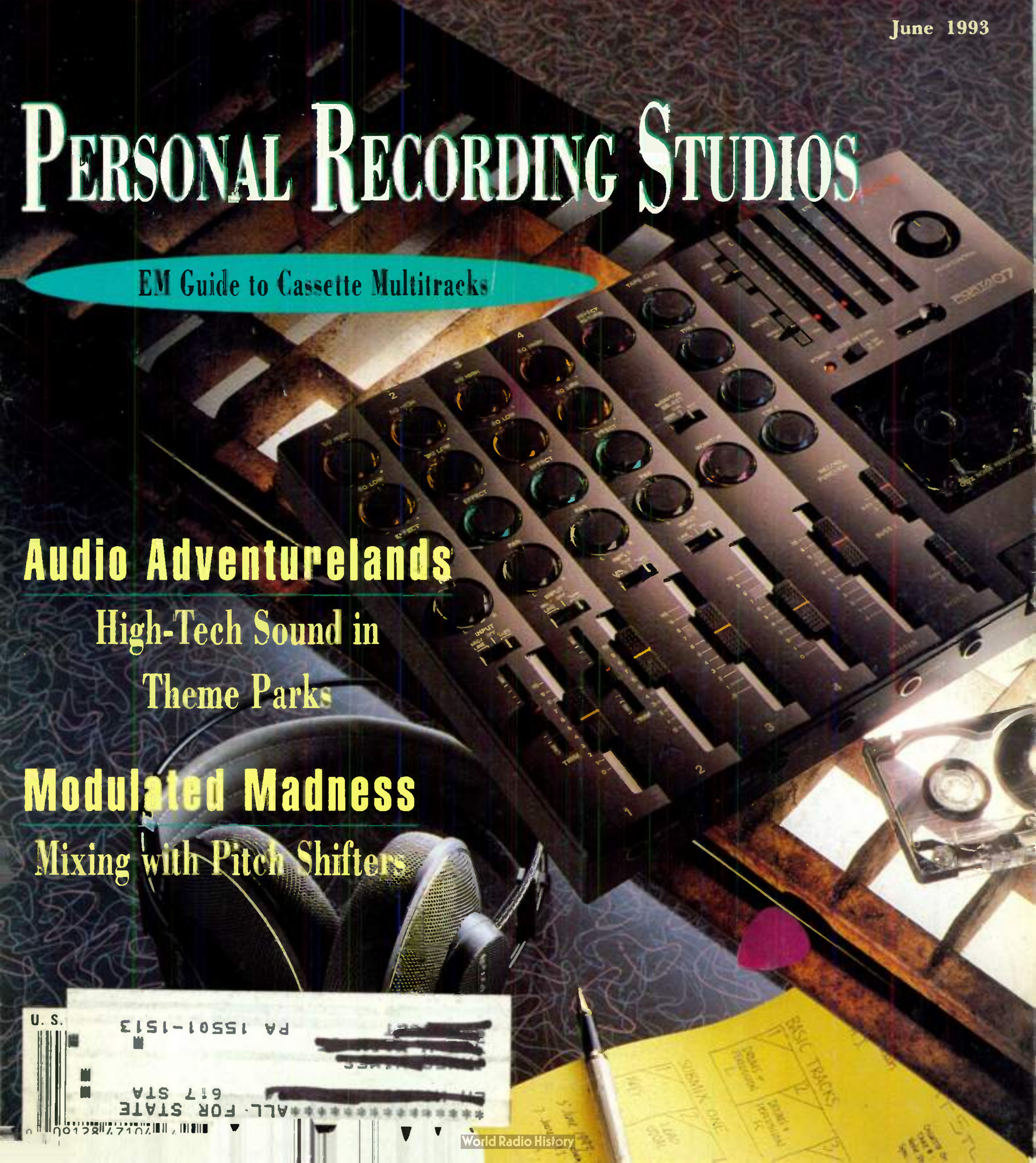
5 Multimedia PC Audio Programs under $150

Electronic Musician

June 1993



Personal Recording Studios

EM Guide to Cassette Multitracks

Audio Adventurelands

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Mixing with Pitch Shifters

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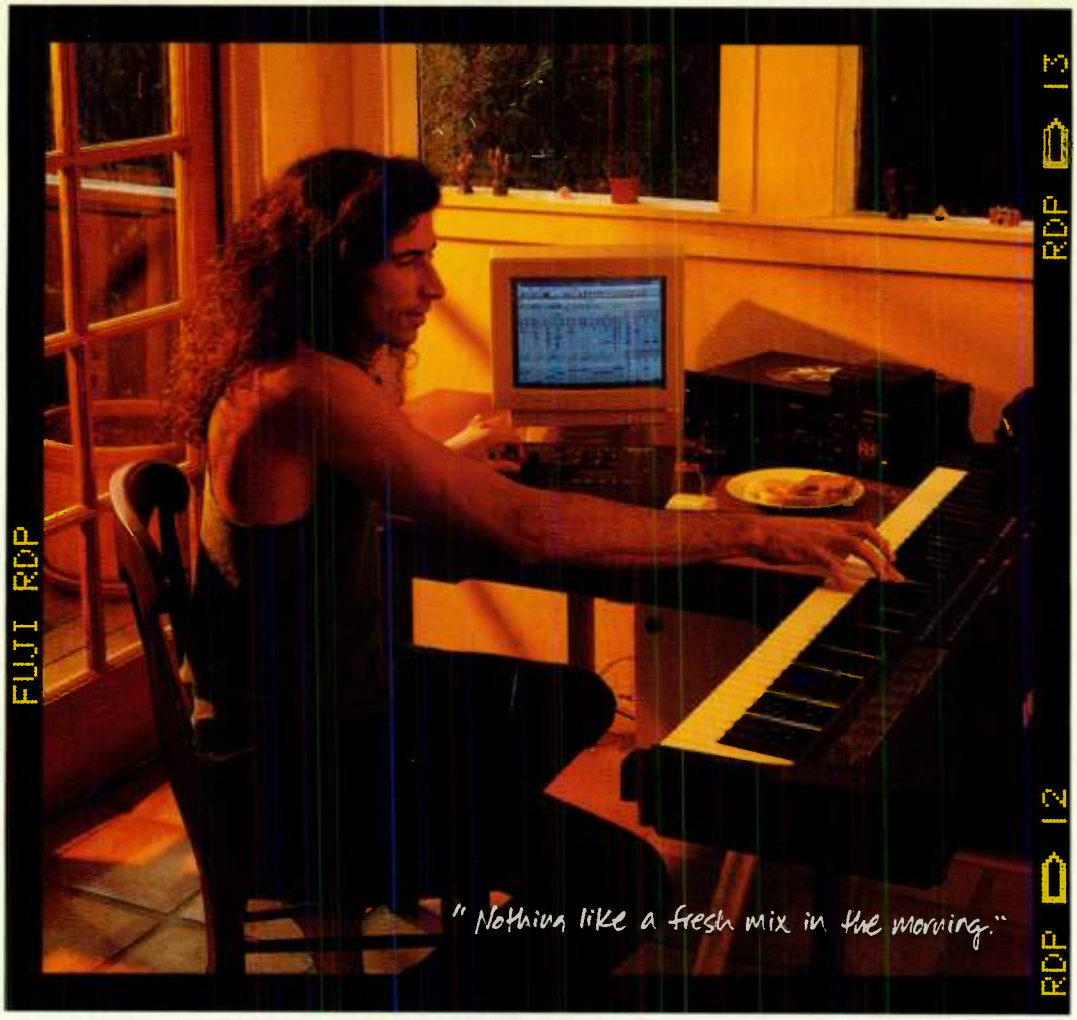

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REVIEWS

DEPARTMENTS

Cover: Photo by Mark Johann.
Special thanks to Tascam.

Get It On Tape

Even in this digital age, low tech is hot.

ANNE HAMERSKY

One of my favorite tasks as editor of **EM** is to think about the future of musical equipment. Now, to some of you, that may sound as exciting as watching paint dry. But I get a real kick out of trying to figure out where technological advances and new product developments are headed.

Like many journalists who cover the high-technology marketplace, if I see a few encouraging signs (ground-breaking demonstrations, impressive spec sheets, etc.), I may start writing off today's models as hopelessly archaic, expecting the future to appear immediately.

As you might imagine, this isn't always the best approach.

For example, in the realm of personal recording devices, I've been convinced for years that random-access hard-disk systems and digital tape recorders would surpass cassette recorders as the popular choice Real Soon Now. Well, despite all my predictions to the contrary, low tech is still hot. In fact, it's way hot. According to the reader survey we conducted last fall, the number of readers who own multitrack cassette recorders is nearly fifteen times the number lucky enough to have a multitrack hard-disk system or digital tape recorder.

Of course, with the continued success of Alesis' ADAT, the recent introduction of Tascam's DA-88, and the downward spiral in the cost of computer-based systems, those numbers have undoubtedly changed somewhat since the survey was conducted. Still, it'll probably be well into the latter half of this decade before we see the number of more technically advanced devices overtaking cassette "ministudios."

It's not hard to see the appeal of little multitrack cassette recorder/mixers. For one thing, they integrate almost everything you need for a simple studio into a single package: mixer, EQ, and recorder. (Alesis announced a new cassette recorder/mixer at the January NAMM show that goes a step further by incorporating a built-in digital effects processor.) Most are portable, which is handy for many applications. On top of that, they're easy to use. Even musicians who have access to full-blown recording studios often prefer to work with a ministudio to sketch their initial songwriting and arrangement ideas—or even release commercial albums, as in the case of Bruce Springsteen's *Nebraska*. Finally, these devices are still a lot less expensive than other options. As great as the new stuff may be, not everyone can afford it.

Amazingly, many of the new ministudios sound pretty darn good. If you're working on demos and personal projects, a good-quality cassette multitrack may be all you need, particularly when Dolby S noise reduction is incorporated into these recorders. To help you become familiar with today's models, we've put together a buyer's guide (see "Musical Notebooks" on p. 32) that explains the relevant features and includes a comparative chart to help you decide which model is best suited for you.

• • •

On an unrelated note, I'm pleased to announce two new additions to the **EM** staff. Joining us as editorial assistant is Diane Lowery, who previously worked in the children's book business. Our new associate art director is Patsy Law, who comes to us from *Mix*, our ACT III sister magazine. Welcome aboard.

Bob O'Donnell

Electronic Musician

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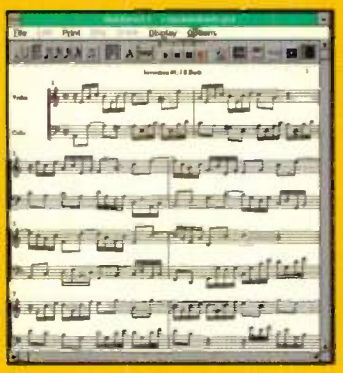

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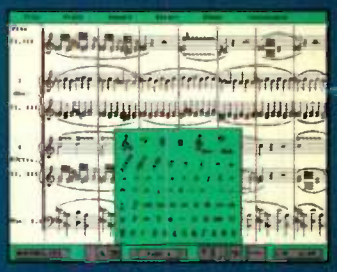

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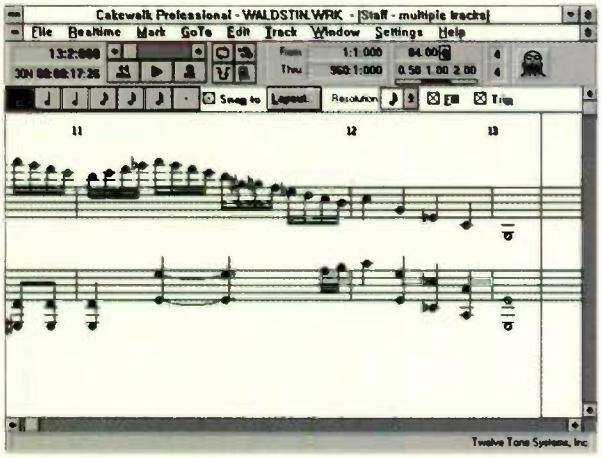
Cakewalk Professional for Windows™ is the 256-track MIDI sequencer that's powerful *and* easy to use.

Express Yourself

The detailed **Event-list** view lets you view and edit all MIDI events on multiple tracks at once. You can even insert non-MIDI "special" events like digital audio waves (voice, special effects) that play back on .WAV-compatible sound cards.



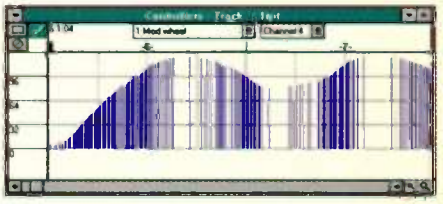
Staff view

Tempo

Take Control

Cakewalk Professional also has a graphic tempo map and **Controllers** view for drawing tempo and Controller changes with your mouse.

Use up to 16 assignable faders to send out MIDI Controller events while recording or during playback. Fader positions update in the **Faders** view during playback to show Controller values.



Controller view

Professional Staff

A multi-track **Staff** view lets you edit up to 10 staves of standard notation. You can insert, delete, and move notes with your mouse. Like all views, the Staff window scrolls during playback.

Use the **Piano-roll** view for inserting, resizing, and moving notes in a piano-roll grid. You hear the notes change pitch as you move them. And you can redraw note velocity levels as well.

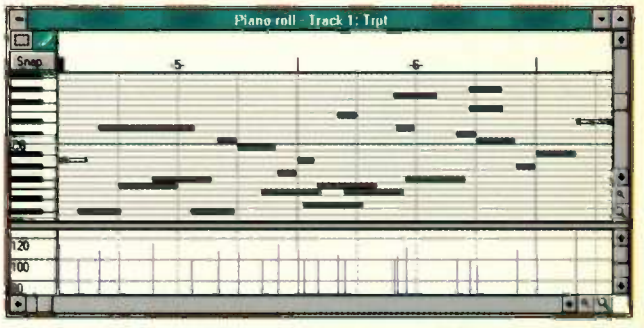
Markers

Get On Track

Use the **Track/Measure** view for assigning track parameters like MIDI channels and patches. And you can adjust parameters in real time, like volume, pan, key offsets, and velocity levels. All Track parameter columns can be moved and sized. Use the Measure pane for fast "drag-and-drop" editing of selected measures.

Professional Experience

Cakewalk Professional works hard to earn its "professional" status: a variable timebase of up to 480 pulses per quarter note; support for all SMPTE/MTC formats; a Meter/Key map; a **Markers** view for creating a text list of "hit points"; and a powerful



Piano-roll view

PROFESSIONAL HELP.

Event Filter for selective edits, like splitting out drum notes onto separate tracks.

Faders view

(edit CAL)

CAL-SWING 16.CAL

Cakewalk Professional has a 256-bank System Exclusive generic librarian, for storing and sending your instrument sound banks and presets.

Event-list view

Sysx

4/4

Meter/Key

And the built-in Cakewalk Application Language (CAL) even lets you create your own editing commands, like chord generators, drum maps, and "swing quantize" routines. (A free library of CAL routines is available to all registered users.)

Get Help Fast

Unlike some sequencers, Cakewalk Professional has context-sensitive, **on-line help** available at any time. Just press the F1 key to get help with what you're working on. Examples, definitions, and even a list of answers to common questions are a mouse-click away, supplementing the comprehensive *User's Guide*.

Comments

See A Professional Today

Cakewalk Professional for Windows ($349) is sold at finer music and computer stores worldwide. For more information, or for the name of a dealer near you, call

800-234-1171 or
617-926-2480.

A demo disk is available for $10.

System Requirements: IBM PC with 10 MHz 80286 or higher; 2 MB of RAM, hard drive, mouse; Microsoft Windows 3.1. Supports any combination of up to 16 MIDI ports on devices with Multimedia Extensions drivers (including Roland MPU-401 compatibles and Music Quest MQX interfaces).

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This last, critically important spec bears some explaining. The absolute, utter, theoretically lowest **possible** limit of E.I.N. is -130.85 dBm @150 ohms. That's the "noise" output of a 150-ohm resistor at 70°. No mixer in existence can achieve it. Many ultra-expensive studio consoles such as Neve and SSL **do** spec out at -129dBm. But the MicroSeries 1202 is the only mixer in its class that has a real and **verifiable** E.I.N. specification this low — within 1.25dB of the theoretical noise floor! The MS1202's preamps also have extremely high headroom and a natural, uncolored, **musical** sound. In fact, the 1202 is becoming the overwhelming choice of audiophiles for live-to-DAT recordings. Our secret? Instead of cheap, off-the-shelf integrated circuits, Mackie preamp stages use discrete circuitry with 4 conjugate-pair, large-emitter geometry transistors — the lowest-noise/highest-quality available. This means virtually undetectable E.I.N. even when you're running a channel at extremely low gain levels.

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LETTERS

APRIL SHOWERS

First, I can't say enough about how much I've learned from reading, and how much I really enjoy, **Electronic Musician**, even though I am not a musician. (I am a MIDI hobbyist.)

I suspect that many of your subscribers may be MIDI hobbyists by now, but your April 1993 article "EM's Guide to Keyboard Synthesizers" seems to imply that your readers are strictly professional and would not be interested in "home" keyboards, since home keyboards were omitted (or were you just waiting for another article?).

I would be interested in a guide to home keyboards, and other semi-professional MIDI stuff, for that matter. Am I the only one out here with semi-professional electronic music interests?

Richard Auclair
San Diego, CA

Richard—I'm sure you're not the only reader interested in home gear, but to maintain a reasonable scope for the keyboard buyer's guide (and to ensure we were comparing apples to apples), we chose to focus solely on pro keyboards for that article. We don't currently have a home-keyboard buyer's guide planned for EM*, but we will be producing the second edition of the* Digital Piano Buyer's Guide *this fall, and it will include extensive coverage of electronic keyboards, digital pianos, and other home gear. In the meantime, if there is a great deal of interest from other readers for an* EM *article, we're open to considering it. Drop us a line to voice your opinion.—Bob O'D*

SERIOUS JOURNALISM

Shame on you! How could you waste valuable journalistic space on something so obviously entertaining as April's "Alphanumeric Soup" ("From the Top")? Don't you know that **EM**'s readers want serious information about electronic music stuff? And speaking of wasted space, I hope that Hinle-Turner person's letter has taught you the importance of being politically correct in the process.

Call me an idiot, but I enjoy reading things like "Alphanumeric Soup." What's more, when I read an item like February's "Dream Home Studios," I have to confess that I'm shallow enough to think only of the studio, and not the owner. (Who were those guys—er, persons—again?)

In a weak moment I'm willing to admit such things, but I warn you: Should I ever come to my senses, I may be forced to cancel my subscription. Perhaps then the Turner person could recommend a suitable replacement.

Danny Baker
Newbury Park, CA

P.S. A community property question: When folks like the Hinle-Turners split up, who gets the hyphen?

MARCH MUSINGS

I read Doug Walker's letter and Michael Molenda's response about music and the music business in the March 1993 issue with interest. Music for art's sake and music as a business are different. It would certainly be a lot easier if the distinctions between selling art and selling out were bright, clear, and unchanging. If the music is available for a price, then it is commercial music, but is it "experimental," "alternative," or something else? Though we'd probably all disagree on which music fits into which category, most of you know the type of music that I'm writing about. I call it "ArtMusiK", because most of the other labels carry so many misconceptions and preconceptions.

Technology changed the accessibility of ArtMusiK. You can now make a fairly good recording in a home studio, duplicate it, and make it available to the public (relatively) easily and inexpensively. A number of alternative channels of distribution are now available, such as electronic bulletin board services. KALX-FM in Berkeley, California, has a program called *The Next Big Thing*, which features cassette-only releases, and WHUS-FM in Storrs, Connecticut, has a similar program called *Pushing the Envelope*.

I learned from **EM** that what I'm doing is referred to as the "cassette underground," which, personally, I consider the perfect compromise. There are no record company executives to tell me whether my music fits into their business plans. I can tailor my business plans to fit my music.

The major labels and distributors do ignore music that doesn't sell well. There's no ArtMusiK exception in the Bankruptcy Code. But there are alternative avenues of distribution for ArtMusiK. I would like to know how those of us who make ArtMusiK can find people who want to listen to it. Where do we go from here?

William Holt Penninger, Jr.
Springfield, MO

William—You already seem to have your head in the right direction, as you've named some good radio and musician's networks for ArtMusiK. **EM** *ran a feature entitled "Marketing Your Demo" in the June 1991 issue that offers other options for the cassette underground. You could also interest a local, independent record store in becoming a merchandiser and "hang out" for your community's underground artists. Step 1 is getting our indigenous ArtMusiK cabals to support each other's work. Good luck getting the word out.—Michael M.*

BIO RHYTHM

My biography in a recent article (February 1993, "Build the EM MIDI Drum Brain") read: "John Simonton is...founder of **Electronic Musician**." This is one of those rare

AD Mc CAULEY

statements that says both too much and too little.

If you think of the founder of something as being the guy in whose garage it starts, then I plead guilty. **Electronic Musician** did start as the "PAiA User Group Newsletter," and I did write the first few issues.

But I've always thought that the appellation "founder(s)" should be reserved for the person(s) who have the vision to see what something can become. When this definition is applied, the founding group gets much larger and includes, at the very least, Marvin Jones, the first editor of *Polyphony*, and Craig Anderton, the original editor of **EM**. The temptation is great to "and" in four or five other men and women, but once that starts there is no clearly defined stopping point. Suffice it to say, a lot of very talented people gave a lot of themselves so that **EM** would have the foundation to become what it is today.

I was there, but a lot of others said "Hey, Spanky, let's put on a show..." and nearly everyone involved had a better idea of what that show should be than I did.

And that's the truth.

John Simonton
PAiA Electronics
Edmond, OK

THE LOW-DOWN ON HI-TECH

Kudos on a spectacular publication!

I am a young amateur keyboard musician and a new subscriber to your fine magazine. I am new to the world of electronic music and am unfamiliar with much of the terminology used in your magazine. In spite of my ignorance, I am fascinated by the electronic music field and am eager to learn as much about it as I possibly can. I've picked up a little from reading **EM**, but I would like to know if you could suggest any books which would explain, in simple English, the highly technical terms used in your articles and advertisements. Your advice is greatly appreciated!

James R. Theisen
Lincoln Park, MI

James—Funny you should ask. Tech Terms: A Practical Dictionary for Audio and Music Production *(Hal Leonard Publishing Corporation) is now available exclusively from Mix Bookshelf (tel. [800] 233-9604 or [510] 653-3307). Written by our very own products editor, Steve Oppenheimer, and* Mix *magazine products editor George Petersen,* Tech Terms *contains not only basic technical definitions, but also gives up-to-date explanations of digital-audio, home-recording, and computer-music terminology.—Mary C.*

PEN PAL

Lately I've been appalled, even flabbergasted, by the number of letters you have printed that are no more than someone's sour grapes. I mean topics such as "too many of your articles are above the average layman," "too many of your articles are banal to advanced users," and most recently "your articles are demeaning to women and relegate your magazine to the status of macho four-wheel-drive magazines." This is getting a little out of hand.

First, **EM** addresses a wide variety of topics related to the electronic music field. Those searching for more detailed knowledge should check out their local libraries, manufacturers' tech manuals/lines, or maybe a college course. As for less technical info, while I feel that the magazine addresses these topics as well, library books and community college courses are to be recommended. As for Dr. Hinle-Turner's letter alleging sexual bias, I challenge her to find one sexually demeaning article or advertisement on the pages of **EM**. Better still, Doctor, why don't you quit looking for faults and begin bettering our field instead. Write us a letter or a column and teach us about what you have been doing that is of merit. I don't mean this snidely; I really *would* like to know. As for the rest of you: If you have any suggestions, please make them. I'm tired of reading mindless criticism.

Now, for *my* suggestions. I am a more advanced user, and my focus is on electronic music synthesis, composition, and recording. The "Virtuoso Synthesist" (February 1993) was a welcome addition. I am pleased to see "The EM Guide to Keyboard Synthesizers" (April 1993). I was also pleased to read that I am not the only composer that has noted stagnation in the development of new forms of synthesis. I am privately researching my own synthesis techniques, but I lack sufficient funding to move at more than a snail's pace.

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• LETTERS

I am transmitting MIDI SysEx data in response to performance gestures from a computer to a bank of synthesizers as a means of development for new forms of electronic music synthesis. Is anyone out there working on something similar? Is there funding available for such research? Does anybody really care? Please give us some information on the "cutting edge" of electronic music-synthesis technology.

By the way, I would take my own advice and find a book or a class on this subject, but I'm already way beyond what's offered at my local college, and I can't find any literature on it. Can you help?

Keep your chin up, **EM** staff; you're doing an excellent job.

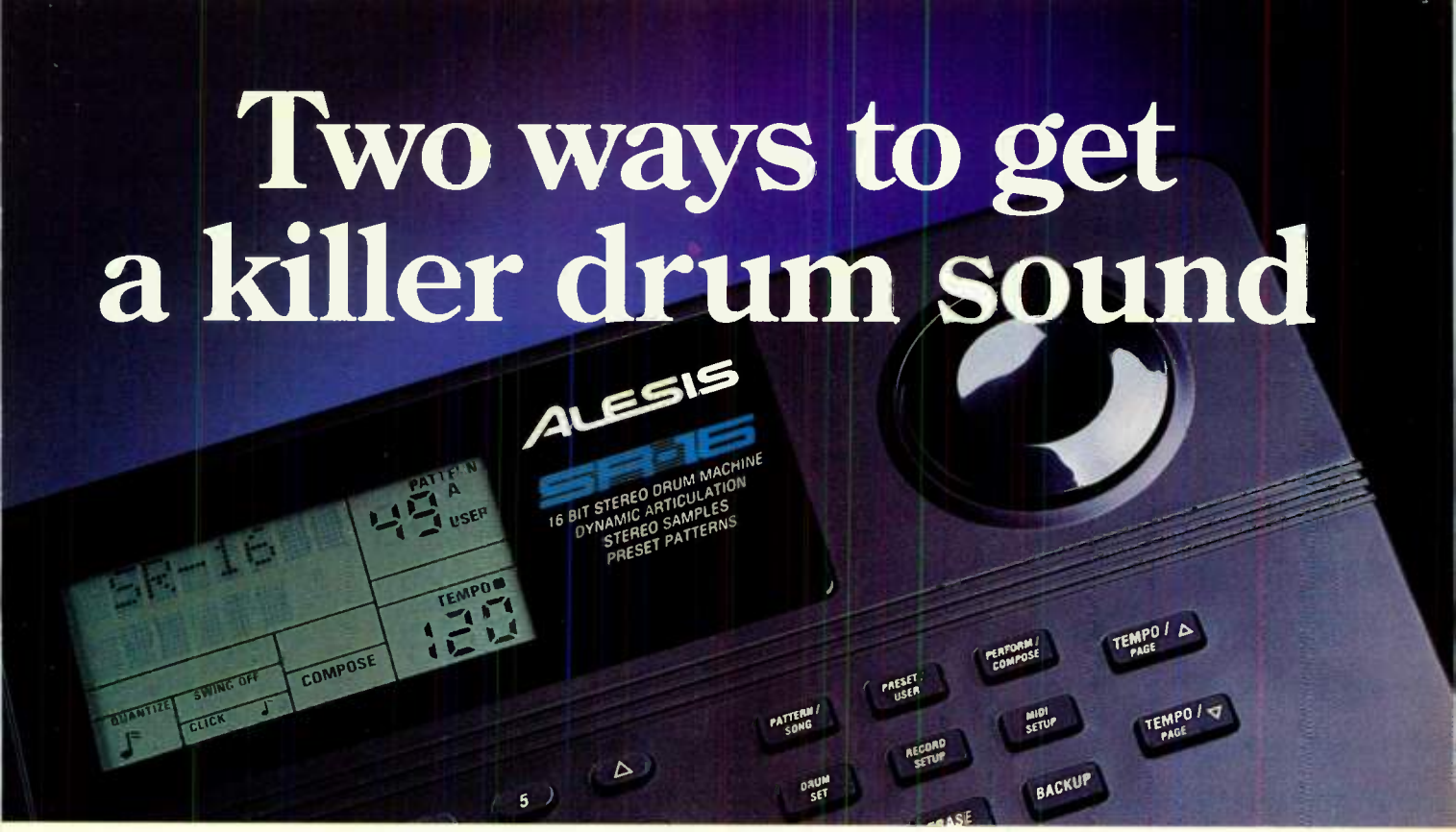
Lawrence Benzmiller
Wake Village, TX

Lawrence—I'm glad to find another creative mind investigating new methods of synthesis and control. You are far from alone. Cutting-edge research on these and related topics is carried on in such institutions as the Center for New Music and Audio Technologies (CNMAT) at the University of California-Berkeley; the Massachusetts Institute of Technology (MIT) Media Lab; the Institut de Recherche et Coordination Acoustique/Musique (IRCAM), in Paris, France; and Stanford University's Center for Computer Research in Music and Acoustics (CCRMA). Most of these facilities can be reached via electronic mail on the Internet telecommunications network.

Academic controller research was discussed in "The Control Freaks," in the June 1992 **EM**, *and electronic-music visionary Craig Harris contributed a highly recommended sidebar that lists sources of additional information. Many of the synthesis methods discussed in "Synthesis Techniques for the 1990s and Beyond," in the February 1990* **EM**, *also are being researched in these facilities, along with even newer ideas. Back-issues are available from Mix Bookshelf. The Bookshelf also is a good source for books on synthesis technology—Steve O.*

We welcome your feedback. *Address correspondence to "Letters,"* Electronic Musician, *6400 Hollis St. #12, Emeryville, CA 94608. Published letters may be edited for space and clarity.*

Two ways to get a killer drum sound



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Studio photo courtesy of: Recording Arts, Nashville, TN.

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WHAT'S NEW

▲ MIDIMAN VIDEO SYNCMAN

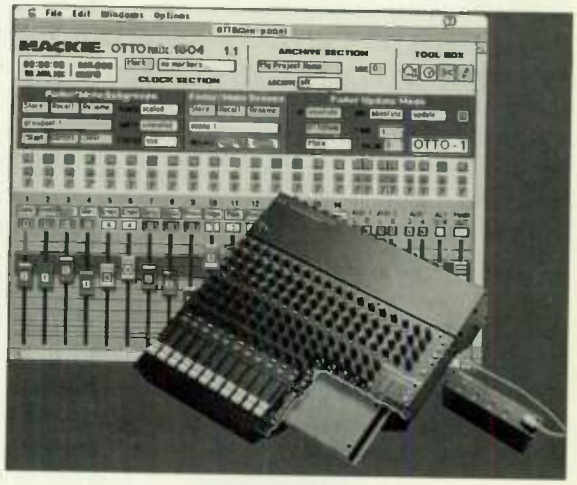
MIDIMAN combined features of its Syncman MIDI synchronizer box with a video screen burner to produce the Video Syncman ($399). The screen burner displays SMPTE time code onscreen as either white-on-black, or black-on-white. Horizontal and vertical character position can be set with a pair of knobs, and character heights can be selected via MIDI SysEx messages. The unit features video I/O jacks, allowing the SMPTE generation and screen-burnt time-code characters to be phase-locked to an incoming video signal. The device converts MTC to SMPTE time code; generates and reads 24, 25, 30, and 30 drop-frame SMPTE time code; and can generate SMPTE synched to house sync, video, MTC, or internal crystal. Offset times can be specified and SMPTE writing can be controlled via MIDI. MIDIMAN; tel. (818) 449-8838; fax (818) 449-9480.

Circle #402 on Reader Service Card

▼ MACKIE DESIGNS OTTO-1604

Mackie Designs is shipping the OTTO-1604 automation system ($799) for the company's popular CR-1604 mixer. The system consists of a board that installs inside the mixer's main chassis and an external box that contains MIDI In, Out, and Thru connectors and Learn, Snapshot, Mute, and Bypass controls. According to the manufacturer, the system does not add zipper noise or degrade the audio signal.

OTTO-1604 provides 28 channels of automation, including gain control for the sixteen channel faders, four stereo Aux returns, Alt 3/4 bus, and main L/R outputs. It offers preprogrammed crossfades as long as sixty seconds (adjustable in 0.1-second increments) and can recall up to 80 "snapshots" of level status in its internal memory. It can be controlled from any MIDI fader box or sequencer with onscreen "virtual" faders that sends MIDI Continuous Controller messages.



The product also comes with *OTTOmix* software for the Macintosh, which runs along with a sequencing program to provide special features, such as unlimited scaled or unscaled subgroups (across up to three CR-1604 mixers), auto-fades, "on the fly" storage and recall of mutes and fader subgroups, snapshot store and recall, time-code cue-point marking, and automatic mix archiving. Mackie Designs; (800) 258-6883 or (206) 487-4333; fax (206) 487-4337.

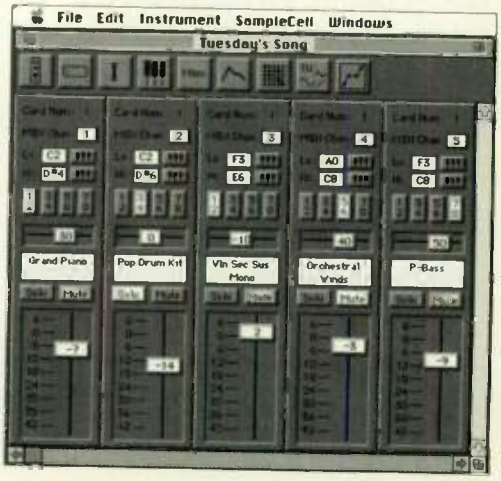
Circle #401 on Reader Service Card

▼ DIGIDESIGN SAMPLECELL II

Digidesign is shipping SampleCell II ($1,995 without RAM), a stereo, 32-voice, 16-part multitimbral, 16-bit sample-playback system for the Apple Macintosh II series, Quadra series, Centris 650, and Performa 600 computers. The system consists of a NuBus card, *SampleCell Editor* control software, and a special version of *Sound Designer II* sample-editing software.

The hardware supplies dynamic digital filters and eight independent, polyphonic, analog outputs and can use up to 32 MB of RAM (eight 4 MB SIMMs). The system is compatible with Digidesign's Sound Tools II, Audiomedia II, and Pro Tools hard-disk recording and editing systems, as well as the new TDM internal audio-networking bus, which is expected to ship later this year. The *SampleCell Editor* software links directly with *Sound Designer II*, *Turbosynth* 2.2, and Jupiter Systems' *Infinity* sample-looping software. SampleCell II comes bundled with two CD-ROM disks containing over 600 MB of instrument samples and sound effects, and you get a third CD-ROM when you send in your warranty card. Digidesign; tel. (415) 688-0600; fax (415) 327-0777.

Circle #403 on Reader Service Card



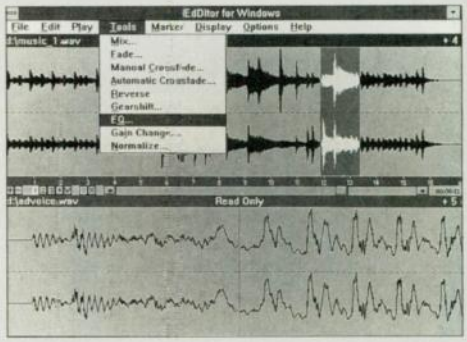
REV UP ▲▲▲▲▲

▼ FOSTEX

Fostex has released the X-28H Multitracker ($599), an upgraded version of the X-28 4-track cassette recorder. The new deck adds 3¾ ips tape speed for superior sound quality. According to the manufacturer, the higher speed decreases wow and flutter by 30% and increases the frequency response by 15%. You can alternate between normal (1⅞) and high speed by pressing the Rehearsal and Stop buttons. The unit is otherwise identical to the original X-28 and is available for the same price. Fostex Corporation; tel. (310) 921-1112; fax (310) 802-1964.

Circle #404 on Reader Service Card

▶ DIGITAL AUDIO LABS



Digital Audio Labs announced *The EdDitor* 3.0 ($250; upgrade from 2.0, $50). The PC-based hard-disk recording program now offers *Windows* 3.1 compatibility, so it is multitasking and works with any PC audio card that supplies *Windows* 3.1 MME drivers. The new version lets you trigger sounds via MIDI or SMPTE time code. New editing tools include Sample Reversal, which plays the selected region backward; The Gearshift, which simulates the speeding up or slowing down of an audio tape, with changes in pitch and playback speed; and gain Normalize. The new Playlist Editor lets you assemble collections of soundfiles and segments in a library; create a playlist; add pauses; designate start time, end time, and duration; and trigger the events from SMPTE time code. Digital Audio Labs; tel. (612) 473-7626; fax (612) 473-7915.

Circle #405 on Reader Service Card

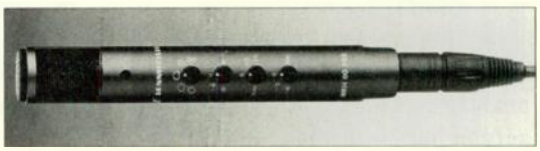
SOUNDTREK

Soundtrek released *The Jammer Pro* 2.0 ($175; upgrades $39) for PC-compatibles. The new version features two new "Musicians": the Melody Composer, a melody-creation module, and the Drum Fill Composer. The company also introduced *The Jammer Standard* ($88; upgradable to *Pro*), which includes all the basic features and styles of *The Jammer Pro,* except that you can't edit the "Musicians'" styles. Soundtrek; tel. (404) 623-0879.

Circle #406 on Reader Service Card

▶ SENNHEISER MKH80

Sennheiser introduced the MKH80 ($2,950), a transformerless, multipattern condenser mic. The mic provides five switchable polar patterns: omnidirectional, wide cardioid, cardioid, supercardioid, and figure-8. Other features include 3-position attenuation, treble-boost, and bass-cut switches, and an integrated LED that shows the best direction of reception.

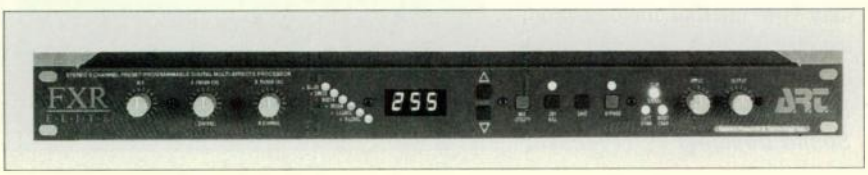


The capsule is part of a tuned circuit in a radio-frequency system, minimizing noise and protecting it from humidity. Its symmetrical, push-pull capsule design uses optimal resistive loading to minimize intermodulation distortion. According to the manufacturer, the small (26 x 176 mm) capsule also offers an excellent bass response. Frequency response is rated at 40 Hz to 20 kHz, maximum SPL at 136 dB (142 dB with pad), and dynamic range at 117 dB. Sennheiser; tel. (203) 434-9190; fax (203) 434-1759.

Circle #407 on Reader Service Card

▼ ART FXR ELITE

ART unveiled the FXR ($199) and FXR Elite ($299) 1U rack-mount signal processors. The FXR is a true stereo device that can operate as two independent processors and has onboard RAM. Its 250 non-editable presets produce up to four simultaneous effects, including reverb, gated reverb, several types of delay, chorusing, flanging, pitch-shifting, and room simulation. Inputs and outputs use electronically coupled, ¼-inch jacks for improved noise isolation.



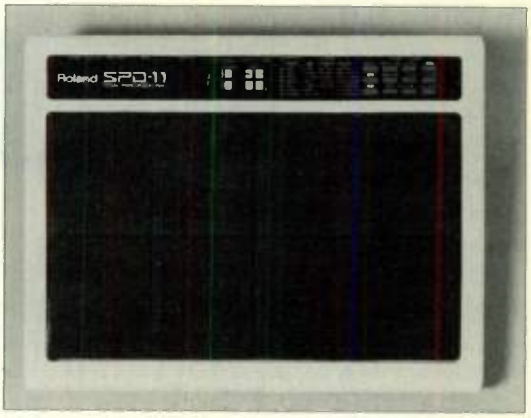
The FXR Elite is a programmable version of the FXR that has over 250 user program locations. Its front panel includes an LED matrix showing which parameter is being controlled. (One parameter can be modulated for each stereo channel.) The Elite responds to Program Change commands and lets you step through chains of Program Changes. ART; tel. (716) 436-2720; fax (716) 436-3942.

Circle #408 on Reader Service Card

▶ ROLAND SPD-11

Roland is shipping the SPD-11 Total Percussion Pad ($795), a self-contained electronic percussion device that includes an 8-pad controller, sound module, and MIDI In/Out. The unit has 64 user Patch locations, and you can create up to four patch chains. There are three stereo, dynamics-sensitive trigger inputs, and a fourth input can admit either another external dual trigger or a Roland FD-7 electronic hi-hat pedal. When one trigger input is used with a KD-7 kick-drum trigger, you have a complete, compact drum kit. A 3-digit x 7-segment LED provides visual feedback.

Each of the velocity-sensitive pads can control two internal sounds and can be assigned to two MIDI transmit channels, with independent velocity curves. According to the manufacturer, the pads offer low striking noise and a natural playing feel.



The 14-voice polyphonic sound source provides 255 preset sounds, including 59 percussion sounds, 28 sound effects, 51 snares, 20 kicks, and pitched percussion, including marimba, timpani, and steel drum. The sounds are of similar quality to those in Roland's R-series drum machines. Editable parameters include pitch, decay, velocity filter, pan, velocity curve, and level. The SPD-11 includes an onboard effects processor that can produce reverb, delay, chorus, and flanging. It has ¼-inch, L/R audio outputs; a headphone output; and a master volume pot. Roland Corporation; tel. (213) 685-5141; fax (213) 722-0911.

Circle #409 on Reader Service Card

▶ BILT 4-SPEED KEYBOARD

Bilt Technology announced the 4-Speed Keyboard ($1,000 to $5,000 including synthesizer), a unique, weighted keyboard action. The manufacturer sells a variety of popular instruments, including synths by Ensoniq and Roland, with the 4-Speed keyboard installed instead of the standard keyboard.

The 4-Speed's keys are laid out in a symmetrical pattern of twelve alternating flat and raised keys per octave, instead of the usual asymmetrical clusters of black and white keys. The keys do not use the familiar black-and-white color pattern and are specially contoured: The 1-inch-wide flat keys have playing surfaces both in front and between the raised keys, while the raised keys have broadened posteriors. According to the manufacturer, this enables you to play in all keys using the same fingering and aids in performing fast passages on the raised keys. Middle C is identified by its dimpled surface and gray color. The manufacturer is offering a demonstration videotape (VHS) for $5. Bilt Technology Ltd.; tel. (706) 295-2530; fax (706) 290-1234.

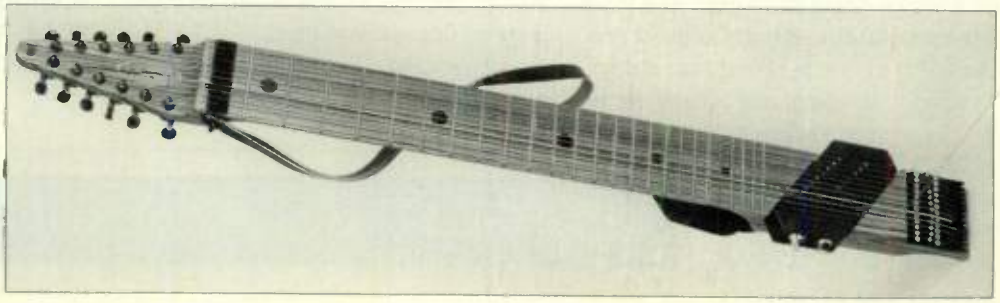
Circle #410 on Reader Service Card

▶ STICK ENTERPRISES GRAND STICK

Stick Enterprises' electric Touchboard stringed instrument, The Stick, is now available in a 12-string model dubbed The Grand Stick ($1,641). Both the 10-string Stick and 12-string Grand Stick feature an adjustable bridge/tailpiece that allows the user to adjust and fix in place the height and vibrating length of each string. Sliding blocks are fastened onto a baseplate to control string intonation without losing sustain. Saddle screws on each block adjust the low string action. Each saddle screw and corresponding tailpiece slot accepts any size string, bass or melody, in any sequence, allowing a wide variety of tunings. The Stick is designed to provide two separate fingerboards on one neck; you can reposition an interior block on the bridge assembly to divide the strings into groups of 6 + 4 or 5 + 5 on the regular Stick, and 6 + 6 or 7 + 5 on the Grand Stick.

An exposed, rear-adjustable truss straightens the fretboard immediately. The nut sets the height of each string at one end of the board, and the bridge adjusts string height at the other end. The pickup assembly is height-adjustable, as are the individual pole screws of the coils (which control individual string volume). Stick Enterprises; tel. (818) 884-2001; fax (818) 883-0668.

Circle #411 on Reader Service Card



▶ YAMAHA SPX990

Yamaha announced the SPX990 multi-effect processor ($1,095), which features 20-bit A/D converters. The unit offers 80 presets and 100 user memory locations. The architecture begins with pre-effects processing, which can be 3-band, parametric EQ; compression; harmonic driver; or a combination of compression, distortion, and EQ. There are 36 main effects, including a variety of reverbs, early reflections, delays, modulation effects, pitch shifting, panning, Freeze (produced with 20-bit sampling), and 2-part multi-effects (flanger and reverb, chorus and reverb, etc.). Finally, a post-effects section adds either parametric EQ, compression, or harmonic driver.

Delay time can be programmed in terms of tempo or note length and entered via a footswitch or MIDI. The SPX990 features intelligent, MIDI-controllable pitch shifting based on a specific key and scale type, and it offers dynamic waveform analysis for more precise shifts. Some effects parameters can be modulated in real time with MIDI Control Change messages. All inputs and outputs are electronically balanced, with both XLR and ¼-inch, TRS connectors. Yamaha Corp.; tel. (714) 522-9011; fax (714) 739-2680.

Circle #412 on Reader Service Card

▲ JLCOOPER DATAMASTER

JLCooper's dataMaster ($749) provides several sync options for the Alesis ADAT. Like the JLCooper dataSync, dataMaster generates MIDI Time Code from ADAT's internal sample clock. This capability lets you sync the ADAT to an external sequencer, controlling the tape transport from the sequencer, or vice-versa, without using a tape track.

In addition, dataMaster has a SMPTE time-code reader/generator with jam sync, selectable offset, and flywheeling. It supports 24, 25, 30, 30-drop, 29.97, and 29.97 drop-frame rates. The device also translates ADAT transport functions to and from MIDI Machine Control. An optional Sony 9-pin/ES-Bus sync adapter is available for control from video-editing systems. JLCooper; tel. (310) 306-4131; fax (310) 822-2252.

Circle #413 on Reader Service Card

▼ ZETA UPRITE

Zeta has added the UpRite solid-body, electric double-bass ($4,995) to its line of electric stringed instruments. The instrument offers a rigid, 3-piece neck (maple/purple heart/maple) and ebony fingerboard. The transducer system uses a pair of pickups for each string and four separate preamps. The bass offers independent level control of each string as well as master volume, bass, and treble. A 3-way toggle switch provides control over tonal response.

The combination bout/heel is detachable, and the instrument can be positioned with either the traditional spike, or an optional ball-joint tripod. Zeta Music Systems; tel. (800) 622-6434 or (510) 261-1702; fax (510) 261-1708.

Circle #414 on Reader Service Card

▼ KAWAI RV-4

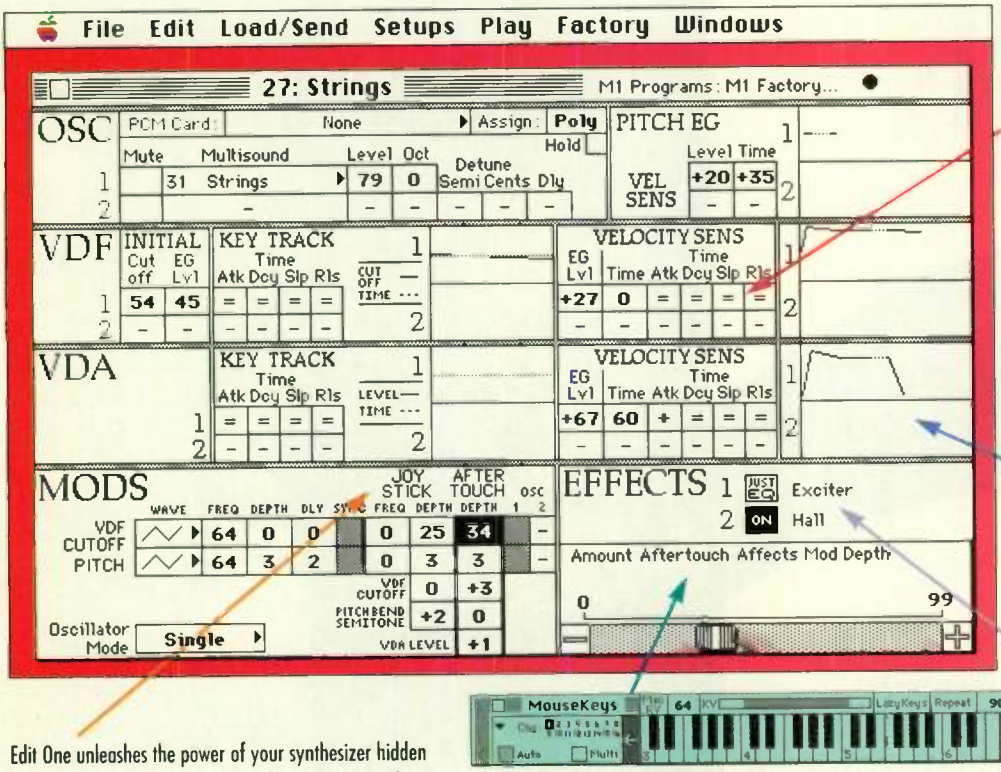
Kawai's RV-4 multi-effects processor ($1,195) integrates four independent, stereo effects processors in a single-rackspace unit. The RV-4 offers nineteen effects algorithms, including seven reverbs, four delays, flanging, chorusing, and 3-band stereo EQ. Each processor can produce one effect, for a total of up to four simultaneous effects, routed in series or parallel. All RV-4 settings and parameters can be controlled in real time via MIDI Control Change messages, and the unit's 50 factory Programs, 50 user programs, 200 factory effects settings, and 200 user effects settings can be called up with program Change commands.

Each processor has its own 18-bit D/A converter and ¼-inch, L/R input and output jacks. Processor 4's analog outputs double as master L/R mix outputs, so you can use the unit as an 8 x 2 mixer with effects. In addition, the unit features optical, stereo digital I/O. Kawai America; tel. (310) 631-1771; fax (310) 604-6913.

Circle #415 on Reader Service Card

50,000 Maniacs Agree

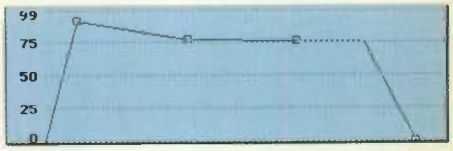
Opcode's Sound Editing Software Has the Look No One Else Can Match



Edit One unleashes the power of your synthesizer hidden behind that tiny LCD. Editors are designed for specific synths and display all parameters at once with unrivaled graphic feedback for easy editing.

Edit One sends every edit you make immediately to your synth so you can hear what your changes sound like — even use the mouse to play notes with our on-screen keyboard.

Edit One gives you the power to create your own sounds — or just tweak one of your favorites, even while your music plays in Vision, Opcode's professional sequencer.



Edit One has simple graphic editing for each envelope, letting you quickly make a sound with a sharper attack, or a longer decay.

Edit One lets you instantly hear a string sound in a large hall, or a picked guitar with digital delay.

Introducing Edit One™...

Opcode has been making editor/librarian software for the Macintosh for 8 years. Tens of thousands of satisfied musicians control their MIDI synths and effects with our products every day — and whether they're maniacs or not, they trust Opcode.

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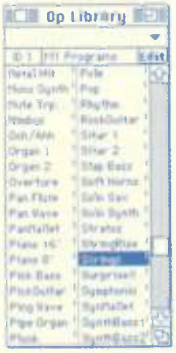

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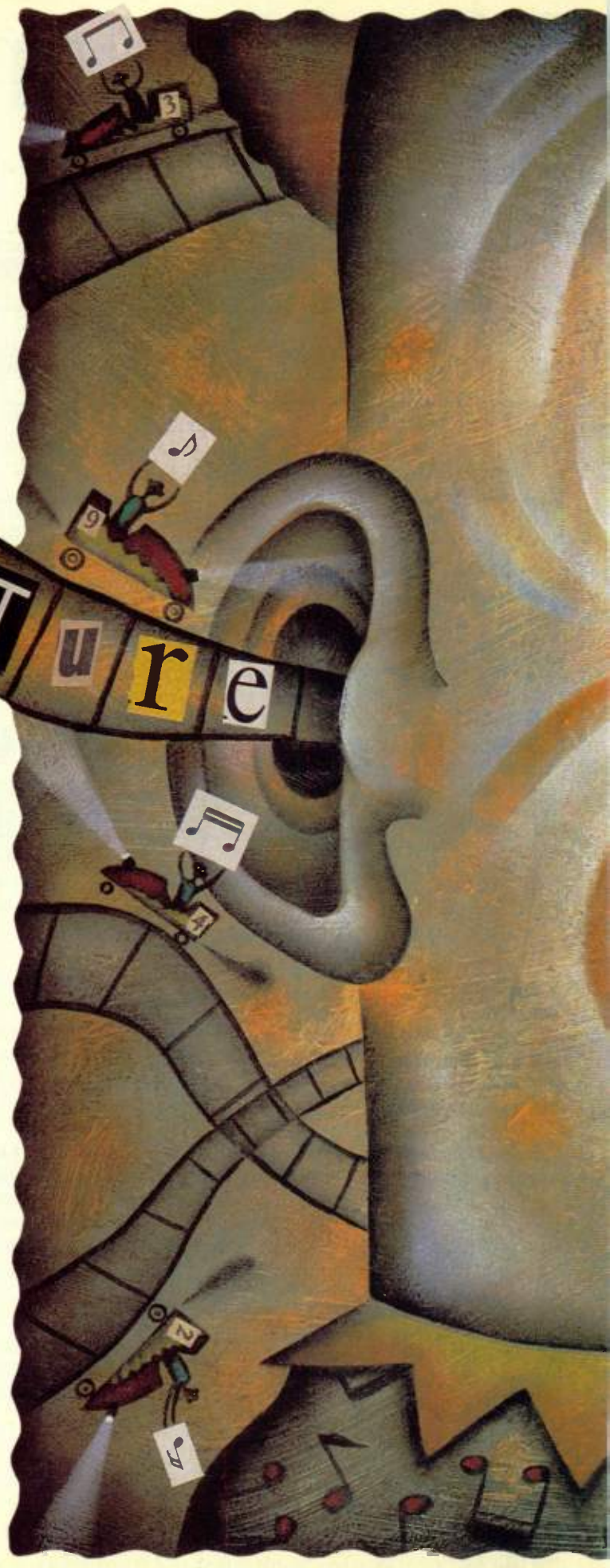

Who can ever forget their first trip to Disneyland (or Great America, or Busch Gardens, or your own favorite amusement park)? The excitement and magic of the rides, the shows, the food, and the people all leave an indelible image on the minds of children and adults the world over.

Part of the excitement stems from the music and sound effects that surround you from the moment you enter these parks. Once you get into the rides, shows, and other attractions, you hear even more audio pouring from a multitude of hidden speakers lurking in nooks and crannies everywhere. And just as watching a movie without a soundtrack lessens the impact of the visuals, catching a ride in one of today's many high-tech theme parks without the appropriate audio environment dimishes the impact of the experience.

Amusement-park and attraction designers are well aware of this fact. With technology on their side, they are crafting innovative new uses for today's high-tech music tools.

By Scott Wilkinson

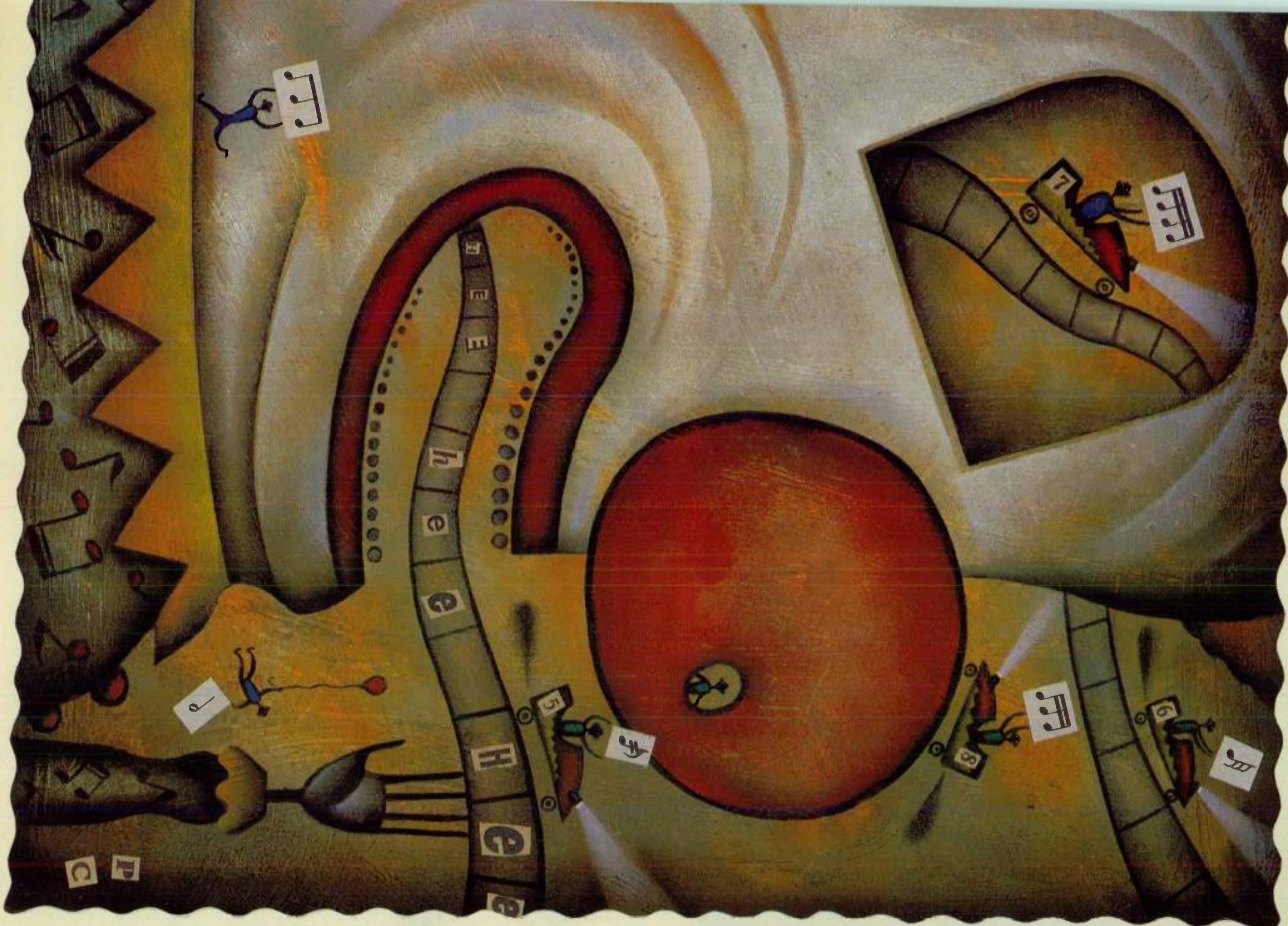

Illustration by Patrick Corrigan

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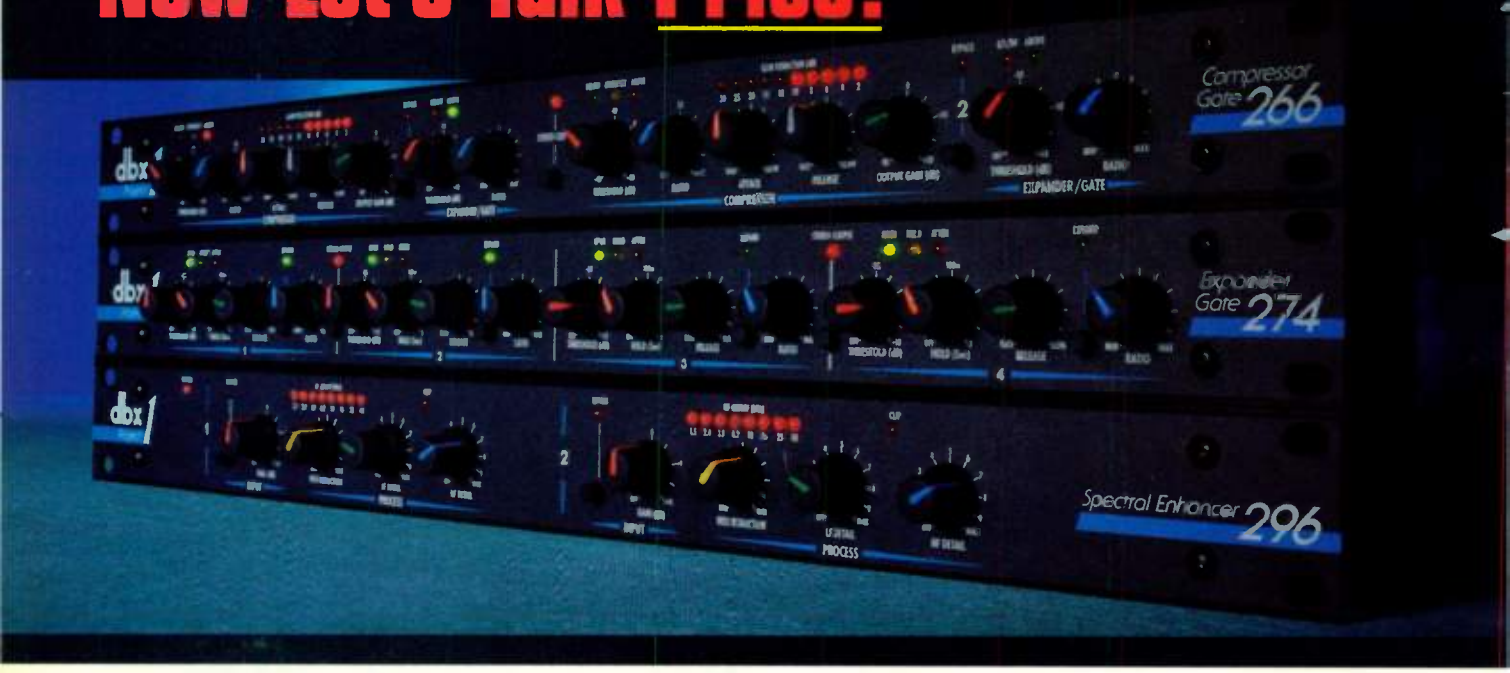

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WAITING IN LINE

The most popular attractions always have one thing in common: waiting in line. This used to be the most frustrating part of the amusement park experience, but park operators are trying to change that. *Queue-line entertainment* offers video and audio distraction and prepares the crowd for the primary ride. This feature is especially important for rides based on movies; the story is told in the line so people understand what's going on during the ride.

These queue lines are surprisingly interactive, thanks to modern technology. According to John Miceli, a producer with Soundelux, an audio post-production company that works on film, television, and record projects, as well as amusement parks, "The sights and sounds are different every time. It always seems fresh, because we randomly cycle through the cues as people trip a certain sensor, or the system might sense how many people are in the queue line and adjust levels and EQ accordingly."

Background audio and special effects are also used in the children's playground areas situated within many theme parks. Miceli recalls a particularly interesting playground at Universal Studios Florida (Orlando). "Fievel's Playground is a big interactive play area in which kids are the size of mice compared to the objects around them. One of the coolest things there is a harmonica slide. As they slide down, they hear the sound of the harmonica glissing downward. We put a speaker at the top, a speaker at the bottom, and a light trigger at the top. When they trip that, different notes play as they slide and a VCA [voltage-controlled amplifier] fades from the top speaker to the bottom speaker, so the sound moves with them."

FIG. 1a: Wylie Stateman and John Miceli record fire effects for the Backdraft attraction at Universal Studios Hollywood.

AMUSEMENT POST

So how is the sound for amusement park attractions produced and presented? Production is usually performed in the standard manner, using synths, samplers, sequencers, and the other tools of electronic music. "My department generally gets involved once the scripts are written and the design development is under way," says Ted King, vice president and senior producer for Landmark Entertainment Group. Landmark specializes in theme-based environments, film and television, toy design and licensing, and live theater. "With the exception of dialog, we do all the production here in our studios. Of course, the dialog is done in the language of the country where the attraction is located, so we take a team over there. Then we add the sound effects and music."

However, it's in the post-production phase that things get interesting. According to King, "The majority of the electronic music industry is devoted to film, television, and record production. But amusement-park applications are completely different, particularly in terms of post-production. With records and films, you mix in one studio and it goes out to hundreds of theaters or thousands of stereo systems. In amusement parks, we customize each soundtrack to one specific room knowing it'll never play anywhere else. The playback system is much more complicated than a traditional theater. Each one presents different challenges."

In order to meet those challenges, it is often necessary to do the final mix in the attraction environment. For example, Soundelux has put together a custom digital audio workstation they call the Integrated Digital Audio Processing (IDAP) system. According to Miceli, "Among other things, the system includes Digidesign Pro Tools and SampleCell, as well as an Akai S3000 sampler, DD1000 magneto-optical recorder, and DR4i hard-disk recorder. We use these tools in the studio to create the material in addition to post-production tasks. We've always believed that you should mix and master in the field. You need to hear it in the actual location. So we put all these pieces together that let us mix and master to several different playback media."

FIG. 1b: The fiery effects come alive in a re-creation of the warehouse scene from the movie *Backdraft*.

The IDAP system came in quite handy recently when Miceli was working on the Backdraft attraction at Universal Studios Hollywood (see **Figs. 1a and 1b**). "We were dealing with fire and other elements that are fundamentally unpredictable. We arrived with four magneto-optical disks full of material and did the final design in the venue before and during the soft opening. [A *soft opening* is a trial run for the public as the final tweaks are made, based in part on audience reaction.] I watched the show and the people. Then, I went back to the workstation, made my changes, and watched the next show. Having our system on-site made it possible for us to make really quick changes."

Most modern park attractions employ multichannel sound systems to create the illusion of a three-dimensional sound space. For example, Landmark

Thrill of Adventure

is building three pavilions for an Asian expo in Korea, which will include a motion-simulator attraction, similar to Universal Studio's Back to the Future ride, using a "wrap-around" domed-theater environment. According to King, "The sound is presented through an 8-channel system that includes speakers in the vehicles."

For the ultimate in multichannel sound, consider a large amusement park's P.A. system. Brian Edwards is the president of Edwards Technologies, Inc., a company that provides technical design for amusement parks and attractions. He describes the P.A. system in one of their projects, Warner Brothers' Movie World, located on the Gold Coast in Australia. "We used a series of computer-controlled, 100-CD jukeboxes for music source material. We modulated their outputs onto various FM frequencies and distributed the signal on the cable system throughout the park. Then we installed an inexpensive FM receiver with a couple of speakers at each location."

PLAYING WITH PLAYBACK

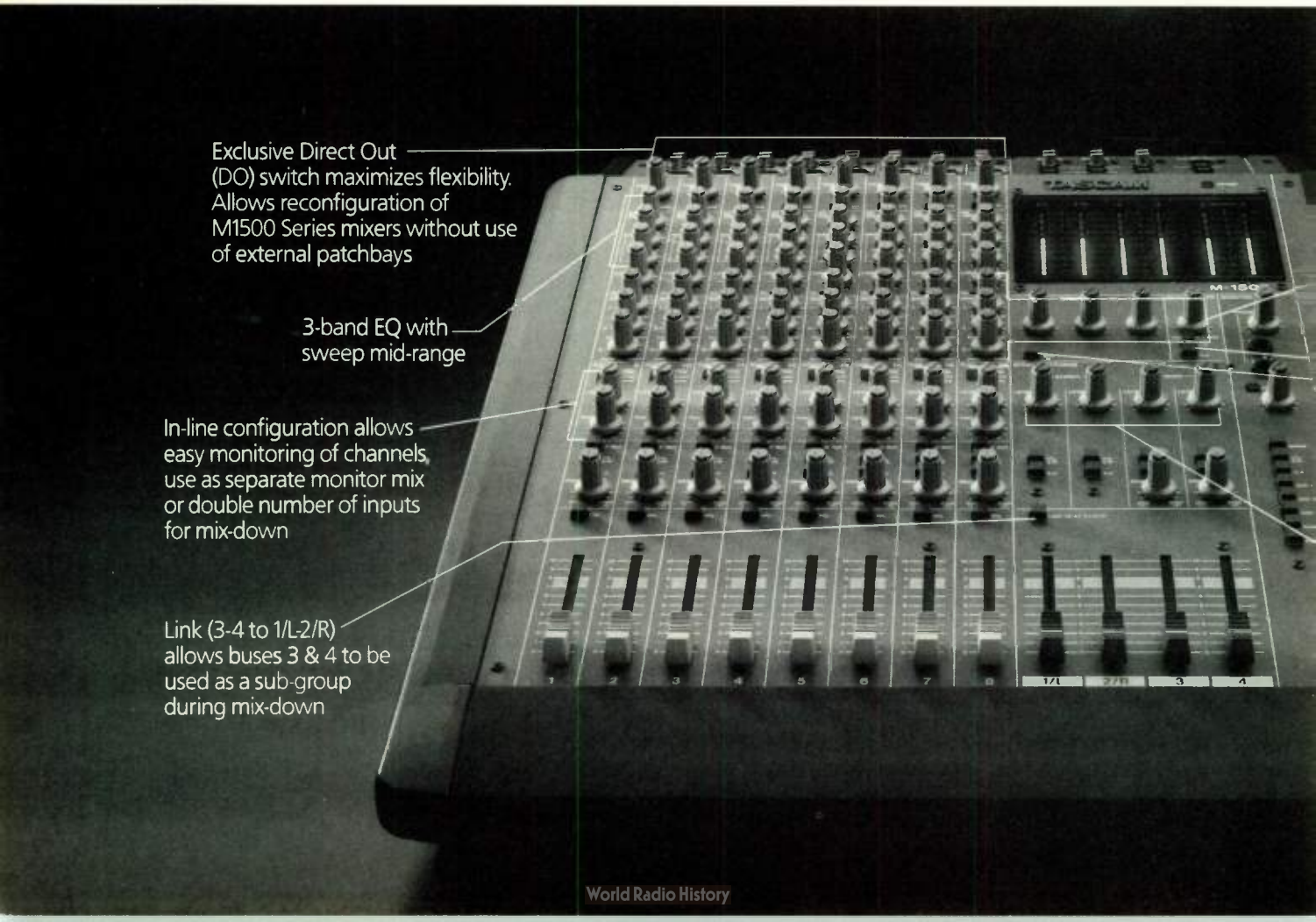
The sound-storage media used in amusement parks has improved tremendously in the last few years. Until recently, multitrack tape decks or *bin loops* (large bins that hold a long, continuous loop of tape) were used. King recalls a project called the "Enchanted Laboratory" that Landmark did for Busch Gardens several years ago. "It's a very complicated show in which live actors interact with robots. That particular show was done on a Tascam MS16 recorder. Even to this day, I believe they're still playing back from 1-inch tape."

These days, most audio is played from optical media. Although the high fidelity doesn't matter in most motion-based rides (where the noise floor is in the 30 to 40 dB range), optical media offer infinite repeatability and excellent potential for automated control. However, most optical-disc players weren't designed for twelve hours of continuous operation every day, which leads to occasional problems.

Interestingly, many attractions use laserdiscs instead of CDs for audio playback. According to Miceli, "In the past, CD players were not as accurate as computer-controlled laserdisc players, but we're working to change that." In fact, Soundelux used CDs in a new ride based on the movie *Top Gun* for Paramount's Great America in Santa Clara, California. "There are eleven channels of audio in the queue line and station areas, which are played from computer-controlled CDs," says Scott Santana, a ride control and park automation technician.

Landmark is working on a different approach to audio playback, as King explains. "Recently we've been exploring the use of hard-disk recorders for playback on-site. This technology lets us make needed changes in the field without re-pressing laserdiscs. In addition, program material can be interchanged with a minimum of cost and hassle."

Like Soundelux, Landmark has assembled a portable workstation to facilitate post-production and hard-disk



mastering on-site. "We just acquired an 8-track Pro Tools system running on a Macintosh Quadra 950, along with an Alesis ADAT and BRC [big remote control]. The system also includes a SampleCell, 1 GB hard drive, magneto-optical drive for backup, Ensoniq DP/4 processor, SMPTE Slave Driver, and Opcode Studio 4 MIDI interface. For on-site applications, the system is controlled with a JLCooper CS-10."

For short audio segments, several companies make EPROM (Erasable Programmable Read Only Memory) cards, which are used in most amusement parks and can be updated with new material at any time. These companies include 360 Systems, Anitech Systems, Alcorn McBride, and Akman. Many of these EPROMs can be mounted in a card cage and controlled by computer.

TAKING CONTROL

Program-delivery systems must include a means of control. Most parks use PLCs (programmable logic controllers), which are industrial computers used for ride control and other applications. Edwards used a PLC to control the audio system in the Walk the Plank Pirate Stunt Show at the MGM theme park in Las Vegas. "The PLC controls a cue-based device from Alcorn McBride called the V16, which controls up to sixteen serial ports connected to laserdisc players and an Intellex programmable audio router/mixer. The Intellex sends audio to four point sources hidden in the scenery and one channel of music and dialog that's located above the audience's head."

One of the most popular amusement-park show-control systems is made by AMX. Soundelux used this system in Fievel's Playground. According to Miceli, "An AMX system controls the laserdisc, as well as the 360 Systems EPROMs and VCAs, which are in a single card cage. As soon as they hit the button in the morning, everything goes into ready mode and then play mode. Certain things, such as the laserdisc, start to play continuously while other things are ready for triggers."

A few attractions use MIDI Show Control. For example, Dan McManus, a writer/producer for Entertainment Design International, describes a special-effects theater show called "The Texas Adventure: Dawn at the Alamo," which they are developing in San Antonio, Texas. "We tell the story of the Alamo using some interesting video and audio techniques in addition to live actors and robots. We're using some special visual effects to create the ghosts of the main characters, such as Davy Crockett, Jim Bowie, and Colonel Travis. The show-control computer keeps track of all the special effects and controls the laserdisc, which provides the audio and video portions of the show. It also controls another computer that controls the robots."

The Miami Vice stunt show at Universal Studios Hollywood uses wireless radio transmitters within the weapons to activate the appropriate sounds, according to John Canton, director of shows and effects. "We have AK47s, 45s, grenade launchers, and shotguns, and each has its own unique sound. The audio routing computer directs the right sound from the digital sound card

Thrill of Adventure

to the correct point-source speaker."

VIRTUAL RIDES

Among the most exciting developments in amusement park attractions is the application of virtual-reality technology. With the use of motion simulation in conjunction with high-resolution images that fill your visual field, these rides offer all the thrills and potential stomach upset of the real thing.

One of the best examples of this trend is the new Back to the Future ride at Universal Studios Florida (and opening soon in Hollywood), which was created in collaboration with Imax (see Fig. 2). Famous for their high-definition, large-screen movie theaters around the country, including several in large amusement parks, Imax technology is well-suited for other types of attractions (see the sidebar "Imax to the Max" for more).

"Back to the Future is a motion-simulator ride," says Canton. "You climb aboard a DeLorean inside an Omnimax theater dome and fly through time with Doc Brown. There are actually two domes, each thirteen stories tall. This lets us accommodate more people; we can be loading one while running the other. The sound system in each dome pumps about 10,000 watts. There are several large speaker clusters behind the Omnimax screen, as well as some speakers in each car.

"Each car is mounted on a hydraulic platform similar to an aircraft flight simulator. In addition, we've developed a technology called 'frequency

IMAX TO THE MAX

Although Imax is well-known for their impressive movie theaters, the technology behind the screen is being applied to several motion-simulator rides in amusement parks around the world. For example, the Back to the Future ride at Universal Studios takes place within an Omnimax dome, which wraps around the riders and completely fills their field of view.

A new Imax simulator ride called Asteroid Adventure is scheduled to debut this year at Phantasialand in Bruhl, Germany. This will be the first Imax simulator ride to use the Imax HD (high-definition) dome-screen format, which uses a frame rate of 48 fps. This is twice the normal film frame rate, resulting in greater clarity and brilliance.

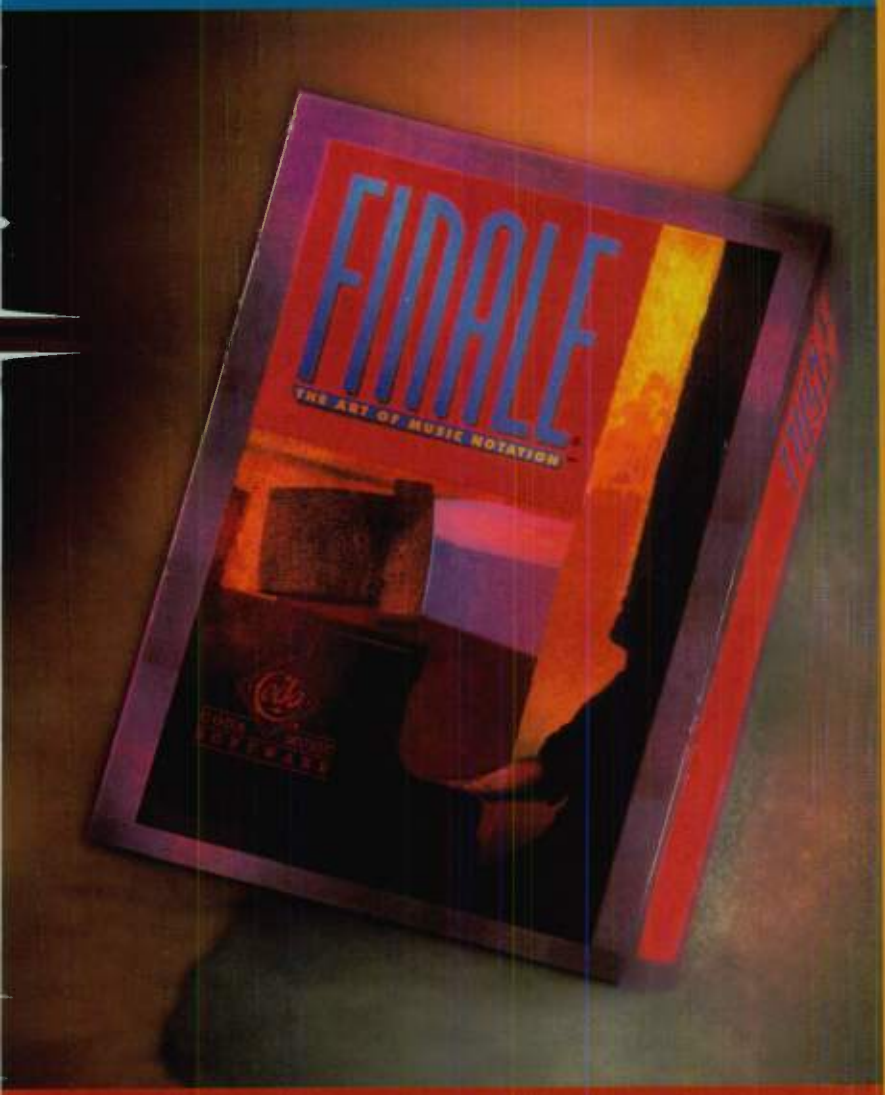
Another innovation of interest is offered by Imax 3D, in which viewers wear polarized glasses while watching a standard Imax screen. This works well, and the glasses are light and disposable, but there are some inherent limitations, such as distortion if the user tilts their head.

As a result, Imax has developed a new 3-D technology called "Solido." In this system, viewers wear a lightweight, wireless headset that includes special LCD "shutter" lenses. These lenses alternate between opaque and clear at a rate that is synchronized with the film projector. Combined with the Omnimax dome screen, this creates a stunning 3-D effect. As objects move about in space, viewers actually see them from different angles.

On the audio side of things, Imax is working on a 3-D audio system with its subsidiary, Sonics Associates. Called the Imax Personal Sound Environment (PSE), the system incorporates small speaker elements in the LCD shutter headset. These are not headphones in the traditional sense. Instead, they are positioned to take advantage of the directional characteristics of the outer ear without interfering with the audio from the theater sound system, or spilling over to the next seat.

The PSE system allows sounds to be associated with visual objects and maintains their association as the objects move around; in essence, the sounds track along with the objects in 3-D space. In addition, the system can deliver spoken material in several languages simultaneously; each viewer selects the language they want to hear. Obviously, this has far-reaching implications for attractions of all sorts.

REACH FOR PERFECTION:



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Thrill of Adventure

injection', which sends very low-frequency sound waves in the 4 Hz range into the motion-simulation mechanism, enhancing the effect. There are twelve cars in each dome, but you can't see any of them once you are inside your own car, which seats eight. The Omnimax screen fills your entire field of view. It's quite a ride."

As exciting as this sounds, true motion simulation is extremely expensive. However, an intriguing and relatively inexpensive alternative is available from several companies, such as Renaissance Entertainment, a full-service production company specializing in entertainment and educational shows and attractions.

Their product is called Audio Reality. It is based on a technique called *binaural recording*, which has been around for years. In this process, two microphone elements are mounted in carefully designed ears on a dummy head, and a stereo recording is made. Listening to the recording through headphones simulates the three-dimensional quality of live sound, which arises in part from the effect of the outer ears and the shape of the head on which the mics were mounted. When combined with appropriate visual images, this is said to provide an excellent simulation of a motion simulator (without the actual motion, of course).

Jon Binkowski and Ken McCabe are the principals in the company. As Binkowski explains, "Our first installation was at the Space Camp in Florida. They had a replica of the space shuttle, and they wanted to do something inside that was more than just a movie, so we outfitted a hundred seats with headphones. The audience experiences what it sounds like inside the shuttle when it's taking off. It was so popular, we did another installation right away at Expo '92 in Seville, Spain." McCabe continues, "Then we did a production called 'Listen to the Earth' for Moody Gardens in Galveston, Texas, which takes the audience to the rain forest, glaciers, and other exotic locations."

FIG. 2: The Back to the Future attraction at Universal Studios lets you hop into Doc Brown's DeLorean for a trip through time.

Full-blown virtual-reality (VR) technology is finally finding its way into commercial applications, as well. One of the leaders in this effort is Horizon Entertainment, a division of the Edison Brothers retail stores, of which there are 2,800 around the country. Andy Halliday is the president of Horizon, which has installed about 90 VR systems in their Exhilarama entertainment centers (see **Fig. 3**).

"We import and distribute the Virtuality system in the U.S., which is the first commercially available virtual-reality entertainment system. It is based on an Amiga 3000 computer, which acts as an audio controller and host for the video and tracking subsystems. The sound system is CD-ROM-based, and audio is delivered to headphones, which are an integral part of the head-mounted display called a 'Visette.' Voice communication between players is also possible via microphones mounted on each Visette," says Halliday.

Horizon is also working on a virtual-audio environment in which people navigate through cyberspace with no visual cues. According to Halliday, "You sit down at a station with headphones on and a joystick with which you maneuver your position in a three-dimensional sound space. You might locate a sound somewhere off in the distance and then maneuver in that direction to approach the sound source. It's quite interesting to experiment with."

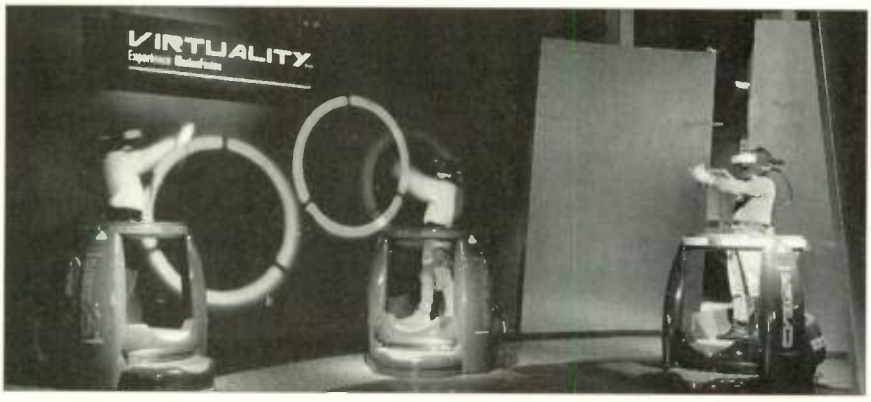

FIG: 3: Three players try their hands at Virtuality, a virtual-reality entertainment system from Horizon Entertainment.

TIME TO GO HOME

Already? Well, it's getting late, and the park technicians have to reset the computers for tomorrow. The next time you visit an amusement park, take a look around. Most of the technology we've examined is well-hidden, but now you know some of the secrets behind the scenes. Meanwhile, please fasten your safety belt, and keep your hands in the vehicle at all times.

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JIM CHECK THIS OUT! DALE

November 17, 1992

Dale Kauffman
Crown Service

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The last time I was on the phone fighting for some semblance of fairness, it occurred to me that I'd never, ever had this sort of conversation with Crown. I mentioned the thought to the person on the other end of the line (customer service manager of one of your competitors), and his reply was "yeah, but that's Crown !" End of discussion. As I hung up, having had my simple request refused, I thought about what that meant. Apparently, your competition considers your level of service an unreasonable, unattainable standard that they can't possibly match, and, so they think, still be competitive. The week before, I had told yet another manufacturer about your policy of letting me charge you list price for warranty parts."That's crazy", he said."Why would they do that?" Both these men are smart guys in upper positions in their companies, but they just don't get it.

And I'm giving up trying to tell them. I'll tell you instead what your fairness and support buys you; when a potential customer walks in my shop to ask my opinion on what type of amp he should buy, I answer without hesitation "Crown". If someone asks me how Crown amps are from a service standpoint, I tell them quite honestly they rarely break, and if they do, the customer will be taken care of. Quickly. At no charge. To their satisfaction. I'm confident about that, just as I'm confident a new Crown product will work well, that I'll be able to get parts and service manuals for it and that if it can't be repaired, you'll replace it.

What I'm trying to say is that my shop has your unqualified support, and customers know it, which is only one reason we sell so much Crown. If every company I dealt with understood this, my life would be so much simpler, but no one else shows signs of getting it so totally, completely right. My loss, your gain, I guess.

Thanks, guys.

Steve Stoeckel
Service Manager
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Photograph by Mark Johann

EM Guide to Cassette Ministudios

MUSICAL NOTEBOOKS

THE RUMORS REGARDING THE DEATH OF CASSETTE MINISTUDIOS ARE GREATly exaggerated. Heck, these analog throwbacks taunt progress with a "Digital Smigital" attitude. Hard-disk recorders and affordable tape-based digital systems don't seem to faze them at all.

Maybe that's because cassette ministudios continue to offer several valuable services. First and foremost, a ministudio is just that: a portable, self-contained recording studio. But portability is just the beginning. Ministudios are the preeminent musical notebooks for songwriters, composers, record producers, and band members. Complicated arrangements can be worked out simply by turning on the deck, inserting a cassette, and recording your ideas. You don't have to step into a commercial studio or power up a home recording system to construct musical sketches. In addition, ministudios are easy to use. Anyone can learn the basics of audio engineering by simply getting intimate with their cassette multitrack.

Last, and possibly most important, all these sonic services add up to make the cassette ministudio the ultimate demo machine. If you're careful, anything produced on a ministudio can exhibit enough audio quality to merit submission to music publishers, club booking agents, and even record-label A&R executives. As many models hover around the $500 to $900 range, the ministudio is one of the best deals you can cut in this brutal music industry.

Our comparison chart on pp.42-43, introduces you to these musical mighty mites. The following paragraphs mirror our chart categories

By Michael Molenda

CASSETTE MINISTUDIOS

CHANNEL INPUTS

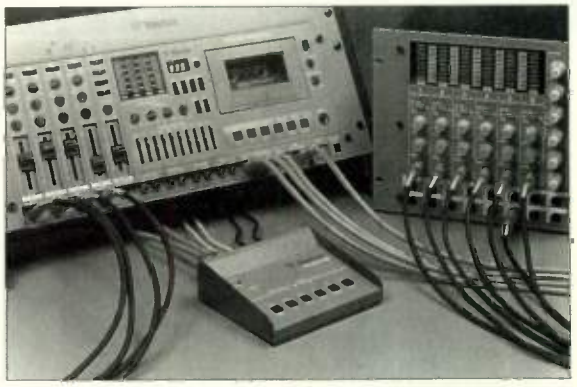
The majority of cassette ministudios employ ¼-inch input jacks. This nod to keeping things simple and inexpensive serves most purposes quite well. MIDI-oriented recordists need only plug a few cables from their keyboards into the ministudio's line inputs. Want to add a vocal? Purchase a ¼-inch conversion cable for your pro microphone, or stick to semi-pro models with attached ¼-inch cables. The ¼-inch world only becomes an issue if you plan to upgrade your demos by using better microphones, because most professional mics and direct boxes require XLR connections.

No ministudio currently offers phantom power, so if you want to use condenser mics, you'll need to purchase an outboard phantom power supply or find mics that can be battery powered. However, if you plan to record acoustic music or live performances, access to XLR connections is invaluable. (If you want to brush up on your understanding of microphones, check out "From The Top: Microphones Made Easy" in the November 1991 **EM**.)

MIC TRIMS

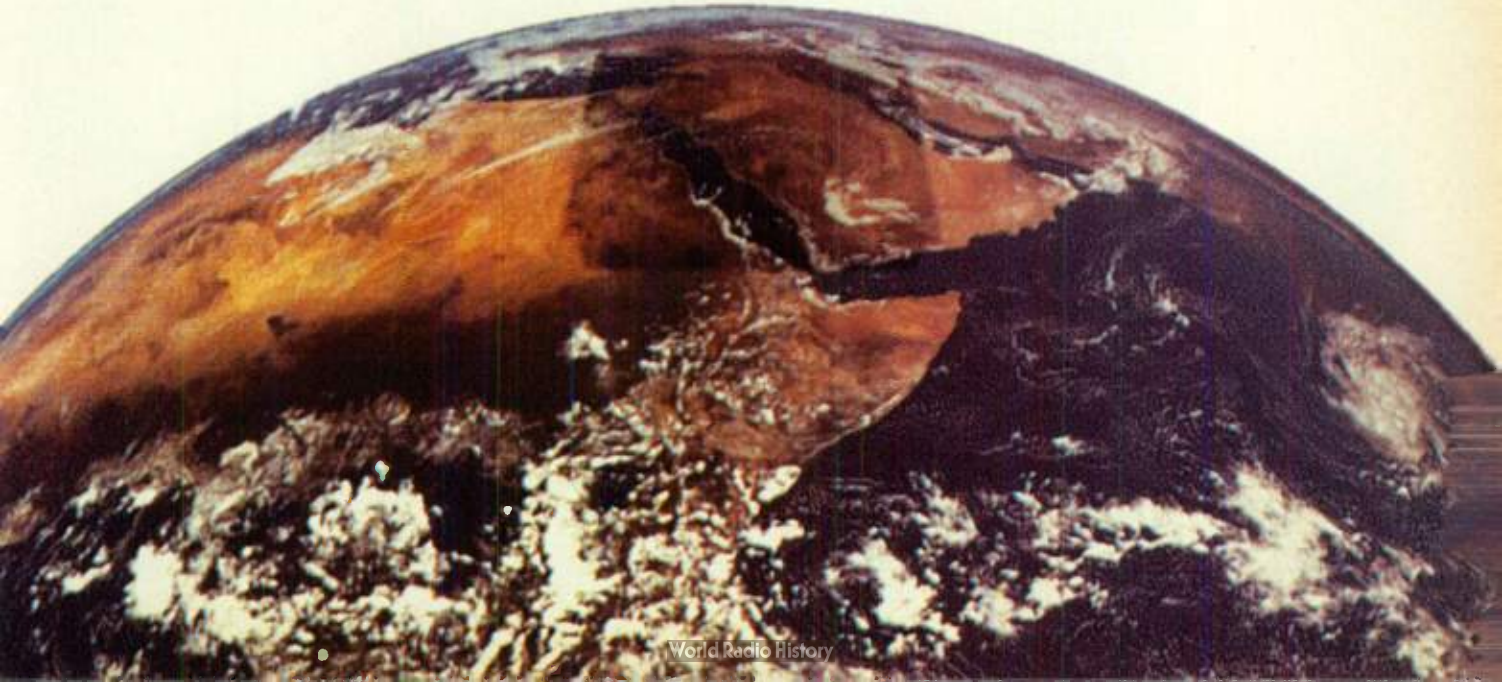
Occasionally, your recording career bisects with the input signal from hell. It's a tricky devil. Sometimes the signal hits so hot that the faders are powerless to prevent the level meters from slamming into the red. At other times, the signal is so weak that your record levels limp below the "hiss abyss" (not enough signal to minimize analog tape noise). A mic-level input trim helps solve these two problems by allowing additional level control before the fader. You can cut hyperactive signals before they overload your input and boost wimpy signals to more ideal recording levels.

Most ministudios do not offer mic trims on each input channel, so audition your input signals before recording to ensure that the signals requiring additional gain adjustments are routed to channels with trims. Also, mic trims can be double-edged swords. The "gain staging" allowed via the signal input, mic trim, and input fader (and/or subgroup fader) can produce audible distortion if levels are not optimized. (For more on gain structuring,



The Vestax MR44S and MR66S, synched together via the MSX-2 MicroSync with MIDI and MIDI Machine Control (MMC).

IMAGINE A RACKMOUNT MIXER...



CASSETTE MINISTUDIOS

see "Recording Musician: Maximizing Your Mixer" in the April 1992 EM.)

EQ

Let's face it, the EQ on most ministudios isn't designed for stunning timbral modifications. Usually, what you get are serviceable tone controls capable of adding a little sparkle or boom-boom to your tracks. If you use mic positioning and/or synth programming to reproduce pleasing tonal spectrums, the spartan EQ won't slow you down at all. However, I'll be the first to concede that comprehensive tonal control is often critical in pro recording and mixing sessions. If you plan to use your ministudio to make club or deal-shopping demos, look for a model with 3-band equalization and sweepable mids. Some models offer 5-band graphic EQ on the stereo bus (which routes the stereo mix sent to the mastering deck), and this arrangement allows reasonably comprehensive "master" tone enhancement.

For the most part, models with 2-band fixed EQ (or those with no EQ) are suitable only for simple sonic documentation. But don't forget that careful mic placement and sound programming can wring marvelous timbres from a ministudio with limited EQ control. I've heard some amazing demos produced on systems with 2-band EQ.

Marantz PMD740

AUX SENDS/RETURNS

How nice is it to turn a knob and get a reverb, or a pitch shifter, or any number of signal-processing options. An aux send connects your ministudio to the signal processor or multi-effects device of your choice. The output of the processor is returned to the ministudio via an (you guessed it) aux return. Ministudios are not designed for ultimate processing options, so most models offer a single aux send with a stereo return. Keep in mind that a single aux send does not limit you to one effect. Channel inserts and tape (direct) outs can be employed to drive additional signal processors.

TRACK ASSIGNMENT

Direct track assignment means channel 1 sends signals exclusively to track 1, channel 2 to track 2, and so on. Because you can't assign channel 1 *and* 2 to track 1, direct assignment doesn't allow free and easy submixing. This can be a bummer if your music requires more parts than you have tracks to record them on. Group assignment is more versatile, as it allows you to

WITH ALL THESE FEATURES AND THE SOUND OF A PROFESSIONAL STUDIO CONSOLE.

- 22 inputs. 10 XLR balanced inputs featuring a low noise, padless preamp design. Six true-stereo inputs.
- 4-Band EQ. High and low shelving filters: low band 80 Hz/high band 12 kHz. Two resonant mid-band filters: low mid 800 Hz/high mid 2.5 kHz.
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- Rotating jackfield for conventional mixing or rackmounting.
- 5 dB more overall gain than any mixer in its class.

- High quality, center-detent Panasonic® faders.
- 128 dB overall signal-to-noise ratio, A weighted.
- Panasonic sealed potentiometers.
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- 4 true-stereo returns.
- Ceramic hybrid channel design that further reduces noise and optimizes stability.
- The only 4 buss design in its class (using 4 dedicated sub group faders) with discrete Group and Main summing outputs.

THE NEW MPL 2242

Our new rackmount mixer has more features than anything in its class. But the real key to mixing technology is *sound*.

In fact, it has already come through with flying colors working alongside studio consoles costing over 10 times as much!

We love defying people's expectations. That's why we can hardly wait for you to get your hands on the new MPL 2242.

Because it's easy to see all the features that set us apart, but a lot harder to show you how great it sounds.

SAMSON AUDIO

For more information about the MPL 2242, please contact Samson Audio, a division of Samson Technologies Corp., P.O. Box 9068, Hicksville, NY 11802-9068 (516) 932-3810 FAX (516) 932-3815

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CASSETTE MINISTUDIOS

submix several input channels to a common tape track, or tracks. Full-featured ministudios typically offer four subgroups.

A simplification of the subgroup theme is L/R bus assignment. Basically, the L/R bus method can be conceptualized as two subgroups. A signal can be routed to tape via the left bus (which services tracks 1, 3, 5, 7) or the right (which handles tracks 2, 4, 6, 8).

METERS

The history of recording has yielded its share of technical outlaws who shun meters. "Use your ears," they command. Well, most of us need a little more help to avoid frying input and output signals. Meters offer instant

CASSETTE MINISTUDIO MANUFACTURERS

Fostex
15431 Blackburn Ave.
Norwalk, CA 90650
tel. (310) 921-1112
fax (310) 802-1964

Marantz Professional Products
700 North Commerce St.
Aurora, IL 60504
tel. (708) 820-4800
fax (708) 820-8103

Tascam
7733 Telegraph Rd.
Montebello, CA 90640
tel. (213) 726-0303
fax (213) 727-7635

Vestax Musical Electronics Corp.
2860 Cordelia Rd., Suite 120
Fairfield, CA 94585
tel. (707) 427-1920
fax (707) 427-2023

Yamaha Corp. of America
6600 Orangethorpe Ave.
Buena Park, CA 90620
tel. (714) 522-9011
fax (714) 739-2680

EM GUIDE TO CASSETTE MINISTUDIOS

Manufacturer/ Model	Tape Tracks/ Simultaneously Recordable	Mixer Configuration	Channel Inputs	Mic Trims	EQ	Aux Sends per channel/ Aux Returns	Track Assignment
Fostex 280	4/4	8 x 4 x 2	1/4" (8)	4	3-band, sweepable mid	2/1 stereo	direct, L/R bus
Fostex MC-102	2/2	10 x 2 x 2	1/4" (12)	2	2-band fixed	1/2	direct
Fostex Model 10	4/2	4 x 2 x 2	1/4" (4)	2	none	1/2	direct, L/R bus
Fostex X-28H	4/4	8 x 4 x 2	1/4" (8)	4	2-band fixed	1/2	direct, L/R bus
Marantz PMD720	4/4	8 x 4 x 2	1/4" (8) XLR (2)	4	2-band shelving	1/1 stereo	direct, L/R bus
Marantz PMD740	4/4	8 x 4 x 2	1/4" (6), XLR (4)	6	3-band, sweepable mid	1/1 stereo	direct, L/R bus
Tascam 424	4/4	8 x 2 x 2	1/4" (4)	4	2-band fixed	1/2 stereo	direct
Tascam 464	4/4	12 x 2 x 2	1/4" (4) XLR (4)	8	3-band, sweepable mid	2/2 stereo	direct
Tascam 488	8/4	12 x 4 x 2	1/4" (10)	2	2-band shelving	2/2 stereo	group
Tascam 644	4/4	16 x 4 x 2	1/4" (6) XLR (2)	8	3-band, sweepable mid	2/2 stereo	group
Tascam 688	8/8	20 x 8 x 2	1/4" (10) XLR (10)	10	3 band, sweepable mid	2/2 stereo	group
Tascam Porta 03	4/2	4 x 2 x 2	1/4" (2)	2	none	0/0	direct
Tascam Porta 07	4/2	4 x 2 x 2	1/4" (4)	0	2-band shelving	1/1 stereo	L/R bus
Vestax MR300	4/2	5 x 2 x 2	1/4" (3)	1	5-band graphic	0/0	group
Vestax MR44S	4/4	4 x 2 x 2	1/4" (4)	4	5-band graphic (stereo)	1/1 stereo	direct, L/R bus
Vestax MR66S	6/6	6 x 2 x 2	1/4" (12)	6	none	0/0 (channel insert system)	direct
Yamaha MT120	4/4	6 x 2 x 2	1/4" (4)	4	5-band graphic	1/1 stereo	direct, L/R bus
Yamaha MT8X	8/4	9 x 4 x 2	1/4" (8)	4	3-band (inputs 1-4), 2-band (inputs 5-8)	2/2 stereo	group

KEY: AL auto loop, AP auto punch-in, AR auto rehearse, CI channel inserts, CM channel mutes, MMA MIDI mute automation, RP remote punch-in, RTZ return-to-zero, SMM separate monitor mix, ST sync tone in/out, TB tape outs

signal-level status reports and help ensure you're recording optimum signals to tape. Some ministudios offer switchable meters that also allow monitoring of effect and mix (stereo bus) levels. The facility to check various levels in the signal chain is invaluable for tracing butchered gain stages. For example, if your carefully recorded vocal sounds distorted during a mixdown session, the ability to check if you're overdriving a reverb (effects) send can prevent an ulcer post haste. Metering visuals still run the full gamut from classic VU types to LED "ladders" to LCD displays.

TAPE SPEED

Just like on professional analog recorders, the faster the tape speed, the cleaner the signal. One reason some audiophiles vilify commercial stereo cassettes is that the medium's slow tape speed (1⅞ ips) invites audible hiss and distortion. Most ministudios run at 3¾ ips and employ noise reduction (more on this later) to deliver reasonable sonic quality. Some models offer a choice of speeds to allow more recording time when needed. (Recordists who produce theatrical soundtracks or document live performances often need every last second on a 90-minute cassette.)

PITCH CONTROL

Variable pitch control is essential for "tuning" taped performances to fixed-pitch instruments such as pianos. But even if your recordings never venture beyond electronic keyboards and vocals, pitch control is a valuable tool. For example, if you've recorded an entire track that is slightly outside of your vocalist's range, you can slow down the tape until he or she can comfortably reach the high notes.

This facility also opens up the floor for weird effects. You can record "chipmunk" vocals by slowing down the tape, singing as high as you can, then returning the deck to normal speed. Want to track some sensual "Barry White" baritone raps? Speed up the deck and speak in a low voice. When the track is slowed down to normal speed, your sonorous lows will quake the house. I also increase tape speed to record subwoofer-level psychoacoustic bass, or just to add more oomph to kick drums and electric basses.

Yamaha MT8X

Meters	Tape Speed (ips)	Pitch Control Range	Noise Reduction	Recorder Frequency Response (± 3 dB)	Additional Features	Price
LED (stereo bus, tape)	3¾	10%	Dolby C	40 Hz-14 kHz	AL, AR, CM, MMA, RP, RTZ, SMM, ST, TO	$849
LED (stereo bus)	1⅞	10%	Dolby B	40 Hz-14 kHz	CM, SMM, channel solo	$499
LED (mix, tape)	1⅞	10%	Dolby B	40 Hz-12.5 kHz	SMM, TO,	$399
LCD (stereo bus, tape)	1⅞, 3¾	10%	Dolby B	40 Hz-14 kHz	AL, AP, SMM, TO, stereo bus inserts	$599
VU (cue, effect, L/R bus, tape)	1⅞, 3¾	10%	dbx	40 Hz-16 kHz	CI, CM, SMM, ST, TO	$679
VU (cue, effect, L/R bus, tape)	1⅞, 3¾	10%	dbx	40 Hz-16 kHz	AL, AR, CI, CM, RTZ, SMM, ST, TO, bandwidth control	$949
LED (L/R bus, track)	15/16, 1⅞, 3¾	12%	dbx	40 Hz-16 kHz	RTZ, SMM, ST, TO	$599
LCD (L/R bus, track)	1⅞, 3¾	12%	dbx	40 Hz-16 kHz	AL, AP, AR, RTZ, SMM, ST, TO, 3 auto-locate points	$899
LCD (L/R bus, track)	3¾	12%	dbx	40 Hz-14 kHz	AL, RP, RTZ, SMM, 3 auto-locate points	$1,649
LCD (L/R bus, track)	1⅞, 3¾	12%	dbx	40 Hz-16 kHz	AL, AP, AR, MMA, RP, RTZ, SMM, TO, MIDI/tape sync	$1,499
LCD (cue, group, L/R bus, track)	3¾	12%	dbx	40 Hz-16 kHz	AL, AP, AR, CI, CM, MMA, RP, RTZ, SMM, ST, TO, MIDI/tape sync	$3,499
LED (input, tape)	1⅞	none	Dolby B	40 Hz-12.5 kHz	SMM	$249
LED (L/R bus, track)	3¾	12%	dbx	40 Hz-16 kHz	RTZ, SMM, ST	$449
LED (input, output)	1⅞	10%	Dolby B	40 Hz-12.5 kHz	ST	$399
LED (L/R bus, tape)	1⅞, 3¾	10%	dbx	20 Hz-18 kHz	RP, RTZ, SMM,ST, TO	$695
LED (input, tape)	1⅞, 3¾	10%	dbx	20 Hz-18 kHz	AL, CI, RP, RTZ, SMM, ST, TO	$1,299
LED (stereo bus, tape)	1⅞, 3¾	10%	dbx	40 Hz-18 kHz	RP, RTZ, SMM, ST, TO	$520
LED (stereo bus, tape)	3¾	12%	dbx	40 Hz-15 kHz	AP, AR, CI, RP, RTZ, SMM, ST, TO, separate stereo mix/monitor outputs	$1,599

NOISE REDUCTION

Want to start an argument? Just ask a room full of musicians which is better: Dolby, dbx, or no noise reduction at all. Tastes still vary widely on the tonal qualities of noise-reduction systems and how they affect the (ahem) sound of music. Luckily, the cassette multitrack market offers just about every choice. The only choice I wouldn't recommend is none. The cassette medium is too "hiss happy" to risk recording entire productions without noise reduction. Most ministudios allow global disabling of noise reduction, or "channel off" to allow proper recording of a sync tone.

I've used dbx for years on a Tascam MS16 (1-inch, 16-track) deck, and just like those bug spray ads say, dbx "kills hiss dead!" However, dbx *does* add some compression and audible coloration. I sometimes defeat the noise reduction (on the appropriate channels only) when recording lead vocals, distorted electric guitars, and snare and kick drums to avoid dbx's slight "breathing" sound. Obviously, when noise reduction is defeated, recording levels must be increased to push the hiss factor beyond readily audible parameters.

Although there's no perceptible breathing inherent in Dolby noise reduction, some people complain about the system's treatment of high-end information. (Highs can seem slightly dull.) I've heard Dolby S on pro decks and it's truly amazing. When the consumer variety becomes available on cassette multitracks, it should be a further boon to sonic quality. However, please don't use this background information as fuel for future qualitative arguments regarding noise reduction. To my ear, all systems sound very good and are essential to producing pristine sonics on ministudios.

FREQUENCY RESPONSE

There's no real battle here. All of the ministudios on the chart deliver suitable frequency response to produce slammin' demo tapes. If a model offers switchable tape speeds, the figure listed is for the higher tape speed. Slower tape speeds diminish frequency response somewhat, usually topping out at approximately 12 kHz. On the low end, a 40 Hz figure is certainly enough to reproduce the ultimate bass required for most rap productions. If you need consistent sub-lows, the cassette medium probably isn't the best format for you to work in.

The bottom line, however, shouldn't present itself as a tech spec. In other words, listen to these units before you buy one. Make sure the store gives you a demo that's appropriate to your style of music. Listen for clean, sharp highs and tight lows (muddy bass is a no-no). If this is the device you'll use to share your music with others, make sure it's overall audio quality is to your liking.

ADDITIONAL FEATURES

Auto punch-in, auto loop (continuous replay of a user-selected section), and auto rehearse (lets you work out a part

without recording it) are handy features when overdubbing parts all by yourself. A channel insert allows you to patch into the input channel, redirect a signal to an outboard compressor, noise gate, effects device, or other signal processor, and then return it to the channel before it reaches the fader. Channel mutes let you shut off (or silence) the sounds playing back on individual channels, a valuable mixing tool. MIDI mute automation emulates automated pro consoles by using MIDI messages to address the channel mutes.

Remote punch-ins are typically accessed via a footswitch for "hands-off" punching. A return-to-zero (RTZ) function rewinds the tape to the tape counter's zero position. Some models allow additional cue points in addition to RTZ. A separate monitor mix is essential for comfortable overdubbing. Without this function, you'd be at the mercy of the signal levels set during recording. And I've never worked a session where the bass player didn't ask for more kick drum in his or her monitor mix, the guitarist begged for headbanging lead volumes, and so on.

A sync tone in/out bypasses the channel mic preamps and EQ, allowing pristine recording and replaying of sync. Usually, an RCA connection is used for this dedicated input/output. Tape outs (also called *direct outs*) let you send an audio signal from the channel directly to an outboard device. Usually, a direct out is used to provide the input for a dedicated signal processor (guitar on track one goes directly to flanger), thus saving the aux sends for more global effects (room reverbs, etc.) However, I've used direct outs to trigger sampler inputs and run signals to outboard (powered) speakers to record natural room reverb.

▼

Ministudios are tickets into the mysterious world of the recording studio.

FADE OUT

I didn't really get into recording and record production until I bought my own ministudio. For me, the cassette multitrack was more than a musical notebook; it was my ticket into the mysterious world of the recording studio. The ability to stumble and fall over audio engineering and production techniques in the privacy of my bedroom was an awesome experience. And even though I currently own a well-equipped commercial recording studio, the joys of experimentation and aural fearlessness I developed on that simple ministudio remain the foundations of my so-called "professional" career.

EM *managing editor* **Michael Molenda** *sometimes wishes he still owned his Studiomaster 4-track ministudio.*

The world's most popular music workstation at the lowest price ever.

Your Korg dealer is selling the M1 at the lowest price ever. There's never been a better time to get your hands on one.

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KORG M1

Hear Today, Gone Tomorrow

"My name is Peter, and I play in a local band. I'm going deaf, I think. My ears ring all the time, even if I don't play for a couple of days. I'm going on the road soon, and I was hoping to get some ear plugs made for the tour and to protect my hearing in general. Someone told me about customized ear plugs that not only fit a person's ear physically, but can also be tailored to certain frequencies. I'd like to know more about it."

This message was recently left on the answering machine of Hearing Awareness and Education for Rockers (HEAR), a non-profit organization in San Francisco. HEAR distributes information on hearing loss and hearing protection, provides free local hearing screenings, and offers information on hearing testing around the country. According to executive director Kathy Peck, "This is typical of the calls we get all the time."

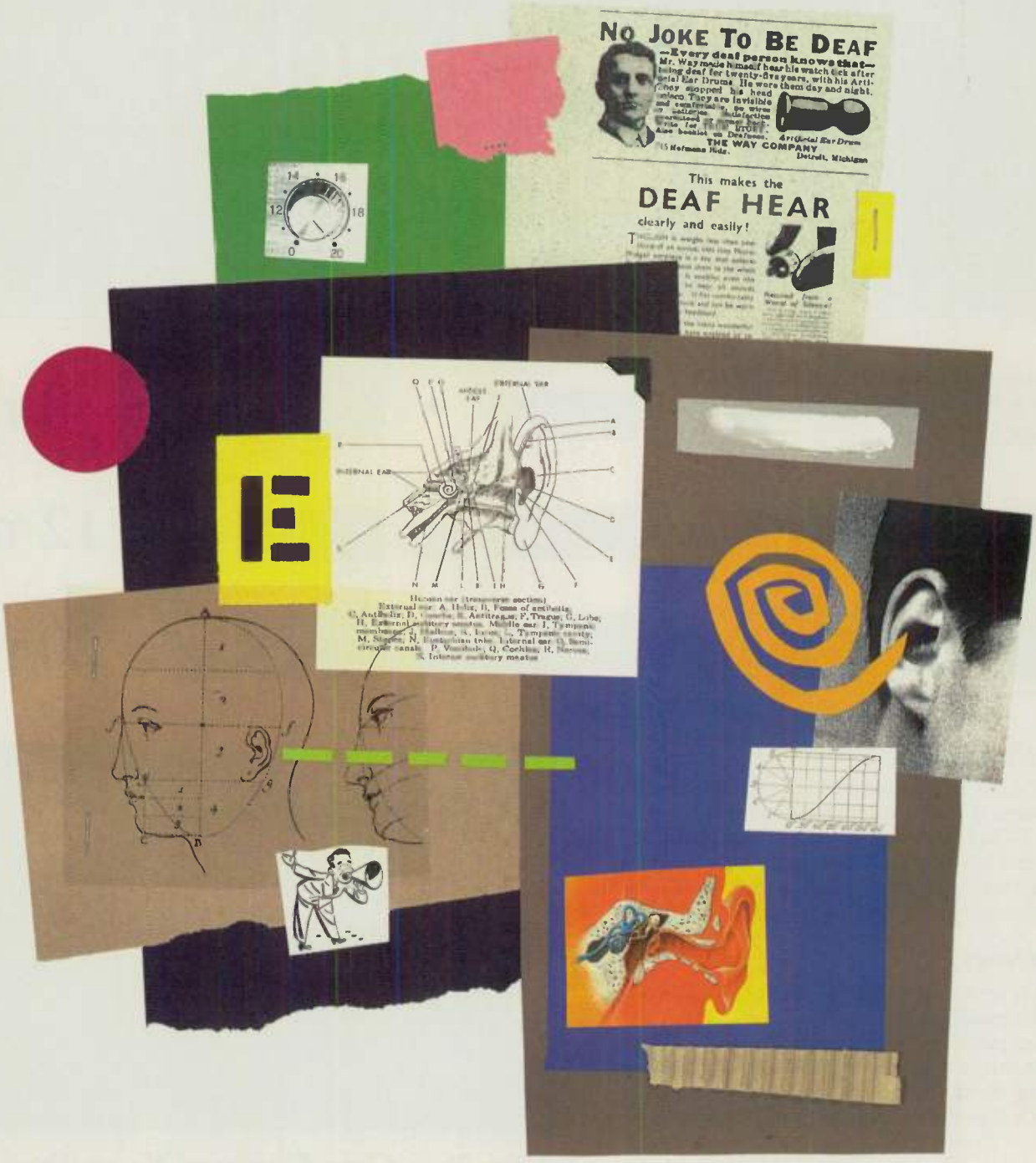
Unfortunately, current trends in music and technology include an increasing risk of permanent hearing loss due to prolonged exposure to extremely loud sounds. In the movie *This is Spinal Tap*, Nigel Tufnel proudly displays an amp that "goes to 11, which is 1 louder than 10, isn't it?" This satire reflects a trend in our society: Music is getting louder all the time.

By Joanna Cazden and Scott Wilkinson

Of vital importance to all musicians, hearing is something we must understand and protect. Once the ability to hear is gone, it's gone for good. The only way to prevent hearing loss is to educate yourself about the dangers of continued exposure to loud sound and make some

What to do when the ringing in your

Illustration by Bob Hambly

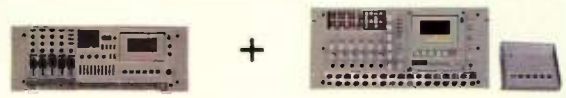


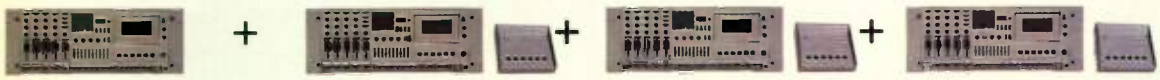
ears isn't your agent calling.

Read My Lips, No New Tracks! Until Now.

Vestax Presents the New, MSX-2 Synchronizer.

Any number of Tracks can be achieved by any combination of MR44S and MR66S.





MR66S *(New)*

The MR66S is one of the most exciting Multitracks on the market. Features 6 tracks, incredible specs that rivals 1/4 reel-to-reel, 34 jack patch bay, on-board mixer, DBX, rack mount, and now our new DCS sync technology. For those of you that are serious about your music, grab a hold of one of our new expandable MR66S.

MR44S *(New)*

The MR44S is the 4 track version of the MR66S. The standard that other companies will have to live up to. Incredible sound quality, patch bay, rack mountable, DBX, 2 speed, full function mixer with dual 5 band EQ, and now our new DCS sync technology. Stack them or Rack them, with the MSX-2 you can expand to as many tracks as you need.

MSX-2 *(New)*

The heart of the system, exclusively designed for the MR66S and MR44S multitrack recorders. Featuring DCS sync technology developed by VESTAX, MIDI in and out for synchronizing with MIDI equipment, signal generator, sync lock LED, remote function control buttons, smart sync position song pointer, accuracy within 50 microseconds.

Upgrade Kit *(New)*

Previous versions of MR66 and MR44 can be upgraded. Kit must be installed by VESTAX USA.

Now You Can Expand Your Tracks As You Expand Your Music.

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Tel: 03-3412-7011 Fax: 03-3412-7013

Vestax Musical Electronics Corporation,
2860 Cordelia Road, Suite 120
Fairfield, CA 94585
Tel: (707) 427-1920 Fax: (707) 427-2023

Hearing Preservation

common-sense changes. In order to prevent hearing loss, we first need to understand how the hearing system works.

THREE EARS

The human auditory system consists of three areas: the outer, middle, and inner ears (see Fig. 1). As a sound wave passes through each area, the signal is processed, altered in intensity and/or spectrum, and analyzed.

The outer ear consists of the visible flap on the side of your head (called the *pinna*), an irregular bowl-shaped depression called the *concha* (where those funky airline headphones fit), and the ear canal, which ends at the *tympanic membrane*, or eardrum. These structures help us localize sound and act as resonators, boosting the incoming signal by as much as 25 dB.

The translucent, semi-elastic eardrum forms a complete seal at the end of the ear canal. Beyond it is the middle ear (see Fig. 1), which contains three tiny bones known as the *ossicle chain*. The first bone is called the *malleus*, or *hammer*, which is attached to the eardrum. As the eardrum vibrates, so does the malleus, which moves the next bone in the chain called the *incus*, or *anvil*. The incus then moves the final bone, which is called the *stapes*, or *stirrup* because of its shape. The stapes is attached to another flexible membrane called the *oval window* at the entrance to the inner ear.

In essence, the middle ear matches the impedance between the eardrum, which vibrates in air, and the oval window, which moves fluid. Infections, arthritis, or other conditions impairing the middle ear can lead to hearing losses of up to 50 dB. These are called *conductive losses* and are often correctable with medical treatment.

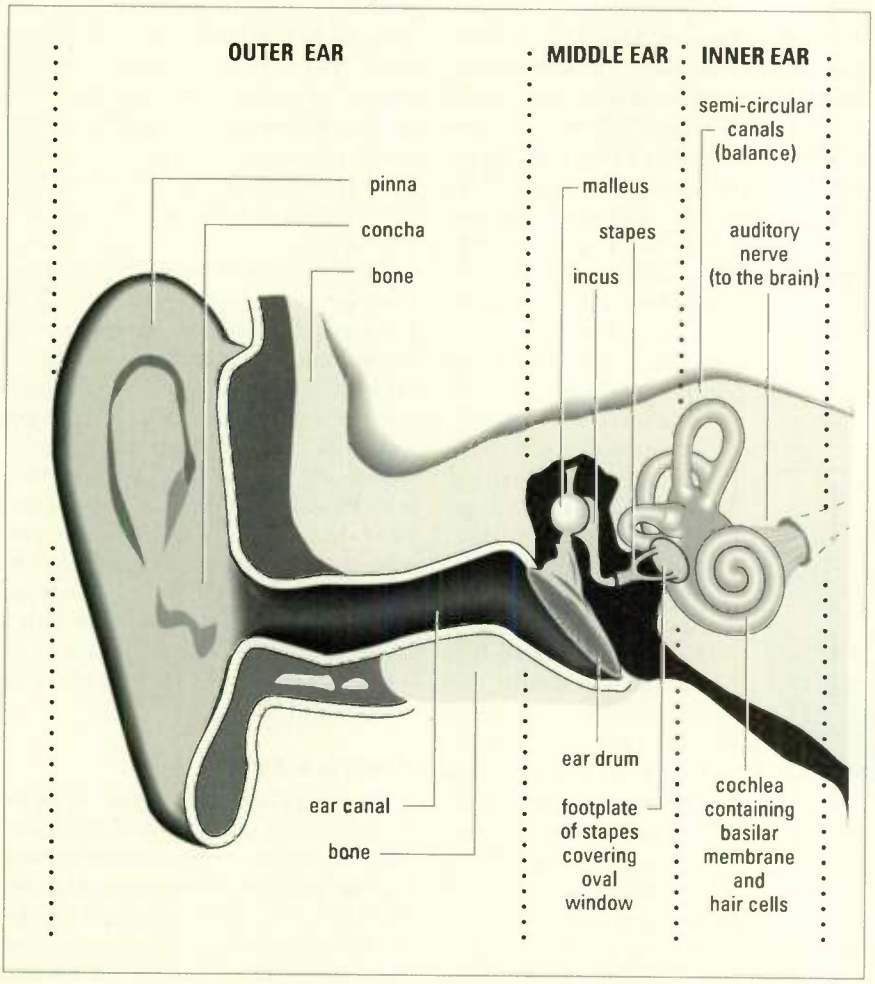

FIG. 1: The human auditory system is divided into three main areas: the outer, middle, and inner ears.

The inner ear is filled with electrically charged fluid. Its structures include the spiral-shaped *cochlea* (pronounced "COKE-lee-a") and the semicircular canals that help us maintain postural balance (see Fig. 1). As the stapes bone rocks across the oval window at one end of the cochlea, its vibration is transmitted to the cochlear fluid.

Within the entire length of the cochlea is coiled a semi-stiff structure called the *basilar membrane*, which picks up the vibratory waveform from the surrounding fluid. Different frequencies cause different regions of the membrane to vibrate; if several frequencies are present at once, several different regions of the basilar membrane vibrate simultaneously.

Sitting along its length is the delicate *organ of Corti*, which contains millions of microscopic hair-like cells connected to receptive ends of the auditory nerve. As different sections of the basilar membrane vibrate, the hair cells in those areas are stimulated, which causes electrochemical changes in the corresponding nerve endings. These auditory nerve signals then travel to the brain.

The end of the basilar membrane nearest to the middle ear, at the base of the cochlea, responds to the highest frequencies, while the far end (known as the *apex*) is sensitive to the lowest frequencies. Thus, the hair cells at the base, middle, and apex of the cochlea transmit high-, medium-, and low-frequency components of the signal to the brain, respectively. In fact, the auditory nerve that leaves the cochlea is actually a bundle of individual fibers in which information about different frequencies is already sorted and organized. The cochlea acts like a finely tuned spectrum analyzer, responding to the harmonic components in the incoming signal.

HEALTHY HEARING

It is relatively common knowledge that the maximum perceived frequency range in humans is 20 Hz to 20 kHz. Of course, this entire range is accurate only for small babies; as we grow older, we become less sensitive to high frequencies. For most people, low frequencies remain perceptible until advanced old age.

The normal intensity thresholds of perception and pain are depicted in a series of graphs called the *Fletcher-Munson*

Hearing Preservation

curves, in honor of the scientists who discovered them (see **Fig. 2**). They are also known as *equal-loudness curves* because they chart the levels at which different frequencies are perceived as equally loud. These curves reflect normal hearing and are calibrated in units of *sound-pressure level decibels*, or dB SPL, which are objective measurements of sound intensity. According to these curves, the ear does not exhibit a flat frequency response when measured in dB SPL.

Sounds below the level of the lowest curve are not perceptible. As the Fletcher-Munson curves show, a normal, healthy ear is most sensitive in the range of 1 to 4 kHz and requires higher amplitudes to reach the threshold of perception at the high and low ends of the frequency spectrum. The curve flattens out at higher intensities; the perceived loudness levels of high, mid, and low frequencies are more similar at 90 dB SPL than at 10 dB.

If recording equipment were calibrated in dB SPL, a mathematically flat response wouldn't sound flat. Instead, most equipment is calibrated in dBA, which relates dB levels to one of the intermediate equal-loudness curves. (In the audio industry, this is known as the "A-weighted scale.") At moderate intensity, dBA levels that exhibit equal loudness on the meters will sound balanced across the spectrum.

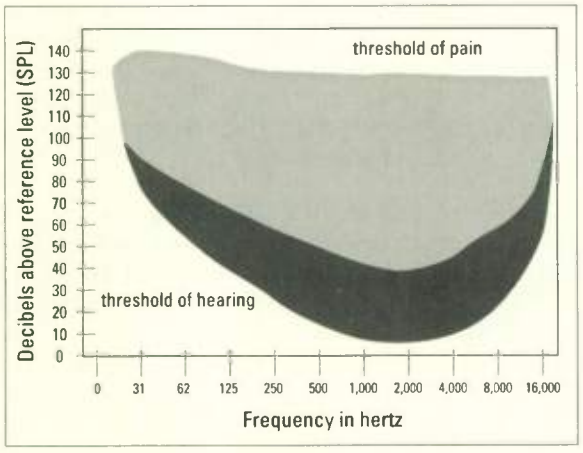

FIG. 2: The Fletcher-Munson curves indicate the levels at which different frequencies are perceived as being equally loud. Levels below the bottom curve are not perceptible. The middle curve provides the reference for dBA measurements.

BIG BANG

After long and repeated exposure to extremely loud sounds, the hair cells in the cochlea lose their ability to respond to vibratory stimulation. Electron-microscope photographs reveal damaged hair cells that are collapsed and in disarray; the respective nerve endings receive no stimulation. The subsequent hearing loss is called *sensory-neural loss*. It is cumulative, permanent, and irreversible.

This damage occurs with long-term exposure to levels of 90 dBA and above. The Occupational Safety and Health Administration (OSHA) defines "long-term" as eight hours per day for ten years. However, the higher the sound level, the sooner the effect accumulates. The OSHA standard cuts the safe exposure time in half for every 5 dB above 90. In other words, 95 dB is considered safe for four hours, 100 dB is safe for two hours, 105 dB is safe for one hour, 110 dB is safe for half an hour, and 115 dB is safe for only fifteen minutes. Rock concerts at sustained levels well above 100 dB can easily last three hours or more.

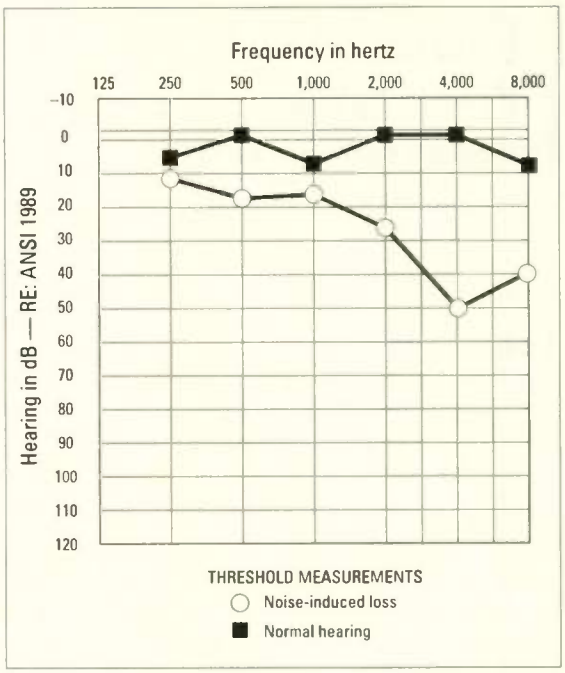

FIG. 3: A hearing test produces an audiogram such as this one. Unlike most audiograms, this one includes two measurements: typical readings for normal and noise-damaged hearing.

Typically, noise-induced hearing loss is not flat. It often shows up as a characteristic "notch" around 3 to 4 kHz, later spreading to include the 6 to 8 kHz range (see **Fig. 3**). Eventually, the perception of all frequencies is reduced. According to Barbara Bell, director of audiology at the House Ear Clinic in Los Angeles, "The higher pitches are affected first because the corresponding hair cells are located at the base of the cochlea, so they get banged first by incoming sounds."

Noise-induced hearing loss usually appears gradually, making it especially insidious. As Bell points out, "Your ears don't bleed. It's very hard to notice until it's too late." In addition, many of the symptoms are temporary at first, which makes them easy to disregard until repeated exposure makes then permanent (see the sidebar, "Warning Signs").

Liberty Devitto discovered this the hard way after playing drums with Billy Joel for eighteen years. "I used to come home from a show and turn on the TV. My wife would say, 'That TV is so loud!' but I could barely hear it. Then it got worse. If I was in a bar talking with somebody face to face, I could hear mumbling from people all around me, but I couldn't make out what the person in front of me was saying. For example, 'ship' might sound like 'slip.' I think drum sets should come with a warning sticker, like a pack of cigarettes. 'This could be hazardous to your health.'"

GOTTA HAVE IT

If you've spent any time at all in a professional recording studio, you know that engineers often monitor recording and playback at extremely high levels. The most common reason for this dangerous behavior is the desire to hear more detail in the music, which may have some basis in fact, considering

that the Fletcher-Munson curve is flatter at high levels.

Another important consideration is the emotional, and even physical, impact of the music, which is especially true of heavy metal and grunge bands. Brendan O'Brien has engineered and produced artists such as Pearl Jam, Red Hot Chili Peppers, and Black Crowes, so he knows about loud studio levels. "This is rock 'n' roll music. It's meant to be loud; it's meant to bowl you over. However, you've got to keep it down to a reasonable volume sometimes to tell if it really sounds good, or if you're just bowled over by the sound."

The problem of monitoring at high levels applies even more strongly to live performance. Jeff Baxter is a well-known guitarist who has played with the Doobie Brothers, Steely Dan, Linda Ronstadt, and many others. For the last three years, he has also served as honorary chairman of House Ear Institute's "Get HIP: Hearing Is Priceless" campaign. "For some people, the idea of rock 'n' roll is to reach out from the stage to the audience, envelop them, overpower them, get them involved in a physical manner. To do that, they think they have to crank."

Unfortunately, the gradual nature of noise-induced hearing loss can cause engineers to push the volume levels to compensate for their own unrecognized injury. "A lot of people start inching up the levels more and more without realizing that they're trying to make up for a deficiency," says Baxter.

Some engineers boost the high-end EQ for the same reason. According to O'Brien, "I'm probably guilty of that. Sometimes my records tend to be a bit 'high-endy' because it just sounds good to me, so maybe I have a high-end loss. I'm certain I'm not the only one."

Live-sound engineers with hearing loss can make the same mistake. This fact has not escaped the notice of M.L. Procise, who has mixed live acts such as Guns 'n' Roses, ZZ Top, Michael Jackson, and Boston with ShowCo for the last eighteen years. "They compensate by putting more of the mid to high frequencies in, which is the absolute worst thing to do," says Procise, referring to the fact that boosting high frequencies in a live mix not only changes the sound for the audience, but could also

WARNING SIGNS

There are several distinctive warning signs that accompany noise-induced hearing loss. Some of these symptoms may be temporary at first, lasting a few hours to a few days. However, these conditions can become permanent if left unattended.

1. Ringing in the ears, which is technically called tinnitus (pronounced "TIN-ni-tus")
2. Sounds are muffled, which is known as a temporary threshold shift.
3. Speech is difficult to understand, especially in a noisy environment.
4. Some sounds at moderate levels seem very loud. This is called hyperacusis, or hypersensitivity. For example, writing on a pad of paper might sound like Niagara Falls. This condition can be mistaken for exceptional hearing, but it is a sign of damage.

Hearing Preservation

result in further hearing damage for the engineers.

JUST DO IT

In cases of permanent hearing loss, the only way to restore some of the lost sound is to get a hearing aid. According to audiologist Barbara Bell, "There are lots of different kinds of hearing aids. Conventional ones are nothing more than a basic amplifier, while the more sophisticated ones are programmable to apply different amplification in different frequency ranges." As it happens, well-known synth and sampler company Ensoniq also makes a sophisticated, programmable hearing aid, the Sound Selector.

Even though hearing aids help to some degree, they can never fully replace the user's former aural acuity. This is painfully obvious to Kathy Peck, who was a bass player in loud bands before becoming executive director of HEAR. "I played for many years in little rehearsal halls. I played all the time and just trashed my hearing. Now I've got 40 percent loss and constant tinnitus [ringing in the ears]. If there was an emergency outside and I had to make a phone call for help, I couldn't hear the phone conversation, even with my hearing aids. I couldn't call for help. That's pretty scary."

Clearly, the best medicine for hearing loss is to prevent it in the first place. Wearing ear plugs is an excellent starting point. Generic plugs of rubber, foam, or wax can be found in most drug stores, and closed headphone-type protectors intended for recreational gun use are often available in sporting goods stores. These products are rated by their attenuation abilities, which typically range from 6 to 40 dB.

For musicians, most of these products suffer the drawback of distorting the perceived frequency spectrum, usually cutting the high end dramatically. Fortunately, several custom-made ear plugs attenuate the entire spectrum equally. For example, the Etymotic Research ER-15 and ER-25 cut by 15 or 25 dB, respectively. These plugs must be custom-molded to each person's ears by an audiologist or hearing-aid dispenser. They're also more expensive than the generic models, but the benefits may well outweigh the cost.

The importance of ear plugs is echoed by many audio professionals, including Procise. "In 1980, I had my hearing tested and found that I was 3 dB down in my left ear at 4 kHz; so I started implementing several measures to protect my hearing. First, I got a good set of ear plugs. I wear the plugs in the venue any time I'm not mixing a show. After the show, I go to a quiet place and try to avoid loud music on the tour bus. I've stopped using headsets whenever possible because they give me hearing fatigue with the drivers so close to the ears. Also, you can get blasted by accident. I carry a small set of monitors to do line checks and so on. I've had my hearing tested twice in the last two years, and I haven't had any more hearing loss at all." (For more information on the specifics of hearing testing, see sidebar "Testing, Testing, 1, 2, 3.")

Jeff Baxter takes a different view of headphones. "I've always worn closed headphones on stage for ear protection and monitoring." Both Liberty Devitto and Brendan O'Brien combine these ideas by using ear plugs when they monitor with headphones. When using headphones or in-ear monitors, it is also a good idea to put

RESOURCES

Hearing Education and Awareness for Rockers (HEAR)

This San Francisco-based, non-profit organization is dedicated to educating the public about the dangers of hearing loss that result from repeated exposure to excessive noise levels. They have produced a video for classroom use featuring music celebrities, engineers, and hearing professionals. They provide a free hearing screening program at the Haight-Ashbury Free Medical Clinic and offer musician's ear plugs at cost. All staff members are volunteers; the organization survives on donations, grants, and benefits. They also educate health-care professionals about the special needs of musicians and encourage more research in the area of noise-induced hearing loss.

HEAR
P.O. Box 460847
San Francisco, CA 94146
tel. (415) 441-9081
24-hour hotline: (415) 773-9590

House Ear Institute

This non-profit organization specializes in researching hearing and balance disorders. They also conduct a hearing-awareness campaign called "Get HIP: Hearing Is Priceless," which is aimed at secondary students and the music industry. To get the message across, the Institute has produced a video and curriculum materials and offers special presentations for school assemblies. In the music industry,they have received support from *Mix* and *Modern Drummer* magazines, as well as manufacturers and other organizations, including Solid State Logic, NARAS, NAMM, and the Cinema Audio Society. They invite you to send for a free pair of ear plugs.

House Ear Institute
2100 W. Third St., Fifth Floor
Los Angeles, CA 90057
tel. (213) 483-4431
fax (213) 484-5900

American Speech-Language Hearing Association (ASHA)

ASHA is the national professional, scientific, and accrediting organization for 67,000 audiologists and speech-language pathologists. Audiologists are the health-care professionals who specialize in preventing, identifying, and assessing hearing disorders, as well as providing treatment such as hearing aids. Their telephone Helpline provides referrals to audiologists throughout the country.

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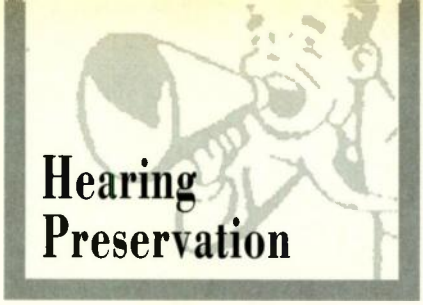

Hearing Preservation

a limiter set to a safe threshold in line with the monitor signal to prevent accidental spikes from reaching your ears; this helps eliminate feedback in open monitors, as well.

Other common-sense precautions include taking quiet breaks during loud sessions and avoiding exposure to non-musical sources of noise such as motorcycles and firearms. If possible, monitor performance, recording, and playback at comfortable, rather than damaging, levels. Remember, you are protecting others in the studio, as well as yourself.

No one is more aware of the trend toward hearing protection than Charlie Lahaie, executive director of the HIP campaign. "We were invited to the NAMM show three years ago, and we received a very chilly reception. People were saying, 'Give me a break, it's not that loud.' But there was a real change in attitude this year. This is becoming an acceptable thing. And NARAS let us hand out ear plugs and brochures at the last two Grammy awards."

Unfortunately, this change in attitude is not universal. For some, denial is a powerful force. According to Baxter, "It's like AIDS. A lot of people think it can't happen to them because they can't see it. For others, there's an element of danger in it, the sense that they're taking a chance. If you're in a heavy metal band, there seems to be some sort of silly, unwritten rule that you've got to be louder and heavier than everybody else. If you're not, this strange piece of pretzel logic implies there's something less heavy about your band."

▼

"A lot of people think it can't happen to them because they can't see hearing loss."—*Jeff Baxter*

Even so, Baxter admits that attitudes are slowly changing. "The bands of the '70s have grown up. Those of us who were twenty then are 40 now. We have children, we have responsibilities that we didn't have back then. I think a lot of us realize our mistakes and would like to pass on whatever knowledge we've gained to the next generation, our own children and members of the musical community."

This concern is shared by many musicians. Liberty Devitto recalls a show with Billy Joel in which something unusual happened. "A couple had brought their young child with them. Billy saw the kid and stopped the show. He grabbed some of those firing-range headphones and put them on the kid. He said, 'That kid's going to go deaf; you'd better put these on.'" Sound advice, Billy.

Speech pathologist **Joanna Cazden** *and* **EM** *technical editor* **Scott Wilkinson** *collaborate on many projects involving music, health, and communication.*

TESTING, TESTING, 1, 2, 3

If you work with loud music on a regular basis, consider it part of your professional routine to get your hearing tested annually. Ask your regular physician for a referral, or contact any hospital or hearing clinic. Tests at university audiology training clinics may be lower in cost.

Tell the examiner you are a musician, and ask to be tested with high-frequency equipment (many audiometers only test up to 8 kHz; those at House Ear Clinic go up to 12 kHz). If your hearing is normal, you'll have a valid baseline for future comparisons. This could be important legally if your hearing worsens and you are no longer able to work.

If you suspect you have a hearing loss, don't panic. Ignoring or denying the problem won't make it go away. Hearing aids can help, and it's never too late to protect the hearing you have left.

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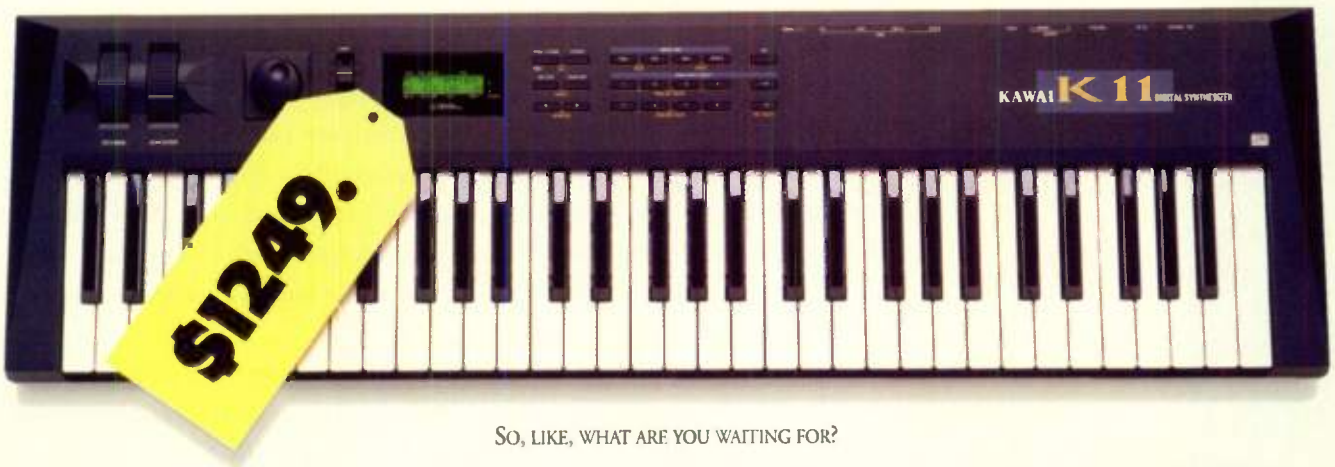

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When I made my first attempts at sampling, back in 1985, the results were extremely gratifying, due in part to my limited expectations. Even the poorest-quality sampled grand piano was a quantum leap over synthesized approximations. At the time, I envisioned three or four boxes of diskettes giving me all the sounds I would ever need for my compositions.

Because today's instruments offer megabytes upon megabytes of quality sampled sounds, it's a little harder to justify the effort involved in creating your own samples, but it still boils down to *your* sounds. Unless you're able to retain the services of a personal sound-designer, no one but you can create the sounds you have in your head.

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Of course, getting those sounds isn't going to be easy. I'd love to tell you the super-secret tricks of the trade, but the truth is there are no shortcuts to producing great samples. You just have to get in there and crank out sample after sample. The more you work at it, the higher your standards will become and the better your samples will sound. Believe me, when you start creating good sounds, the effort is worth it.

RECORDING THE INSTRUMENTS

Unless your closest friends happen to play strings, brass, or woodwinds, my advice is to hire the best musician you can possibly afford for your sampling session and record their efforts on tape. It's not necessary to find someone who is guest soloing with the London Symphony, but they *do* need to be able to produce a clear, consistent tone across the full range of the instrument. Be careful because that's a bit harder than it might appear. If you are fortunate enough to have a quality home studio, some musicians are willing to do your session in exchange for cutting a demo tape for themselves or their group.

At the other extreme, some musicians may become quite upset—even irate—when you approach them about sampling their instruments. Many feel that you are, in some way, taking work away from them. I don't share that sentiment, but it's best to be prepared for any reaction.

Before starting to record, spend some time explaining to the performers exactly what is expected. Do not, under any circumstances, simply shove a mic in their faces and ask them to play notes. Tell them you need a two- to three-second recording of each chromatic note the instrument can produce, with consistent attack and articulation. Keep in mind that what is consistent enough for the player may not be consistent enough for sampling purposes. I recommend getting two or three takes of each note; there will always be one that is better than the others and matches the samples above and below it more closely.

Multiple takes are particularly important when sampling ensembles. The small delays that occur naturally when more than one musician is playing a note can sound great when you only hear that delay *once*. It really gives you the impression of a group of musicians playing together. But when you're playing back a sample that has those small delays every time you hit that particular note, it can sound unnatural and even irritating. The bigger the section, the less you should notice this because the attacks are somewhat spread out and tend to overlap each other.

In addition, one or more of the musicians in an ensemble may slide into the note as they get in tune with the section. Again, this can sound realistic if you hear it once in a while, but it's totally unacceptable when you hear it every time you trigger a note.

At this point, you need to decide if you want the instrumentalist(s) to play with or without natural vibrato. Previous sampling articles in **EM** detailed the pros and cons of each approach (see "Sound Bytes" in the June and July 1992 issues). The bottom line is that for some instruments (bowed strings and flutes, for example), there is just no way an LFO can reproduce the richness of real vibrato.

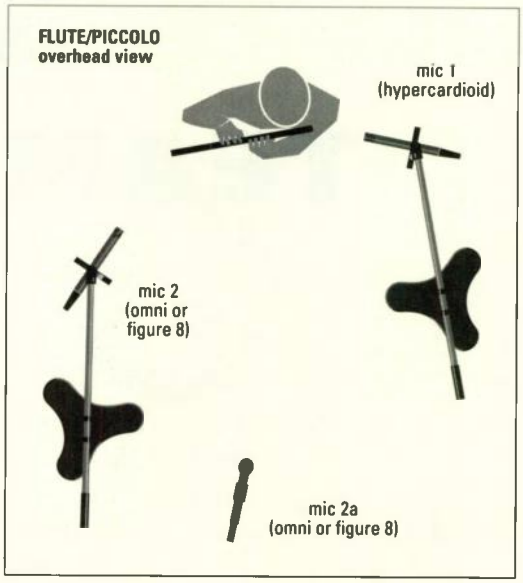

FIG. 2: To capture the breathiness and attack of a flute, place one mic about six inches from the mouthpiece, but away from the direct path of the player's breath. Use a second mic up close for stereo, or further away for more room sound.

On the other hand, samples of reed instruments—oboes, English horns, saxophones, etc.—and many brass instruments, including trumpets and trombones, can deliver a pretty convincing vibrato if you add in just a little filter and amplitude modulation, along with pitch modulation. Sections should always be recorded with at least a small amount of vibrato. This technique usually makes it easier to loop your final sample because you can loop on a natural, cyclical event.

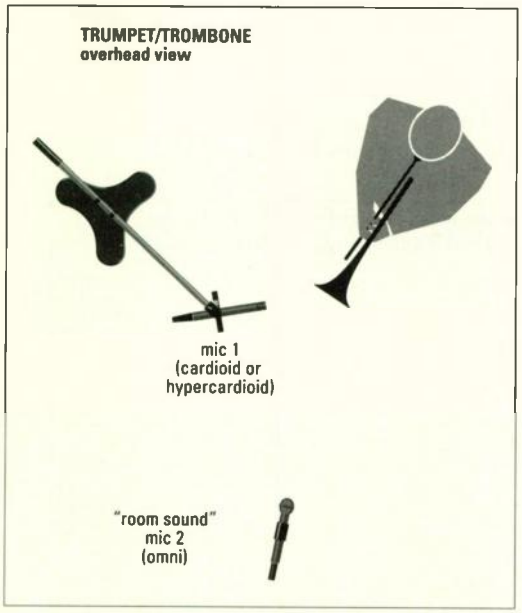

FIG. 1: To sample a trumpet or trombone, place one mic slightly off-axis from the bell and another a few feet away to pick up room ambience.

MICS AND PLACEMENT

While I always advise using the best mic you can lay your hands on, you don't need to own the world's most expensive mics to create great samples. Even when I've had the opportunity to use top-of-the-line B&Ks and Neumanns, I always come back to my AKG 414s (which aren't exactly dogmeat, of course). I know what I can expect of them; I've worked with them for years and know where to place them to get the best sound. I've heard excellent results from surprisingly inexpensive mics and really awful samples made

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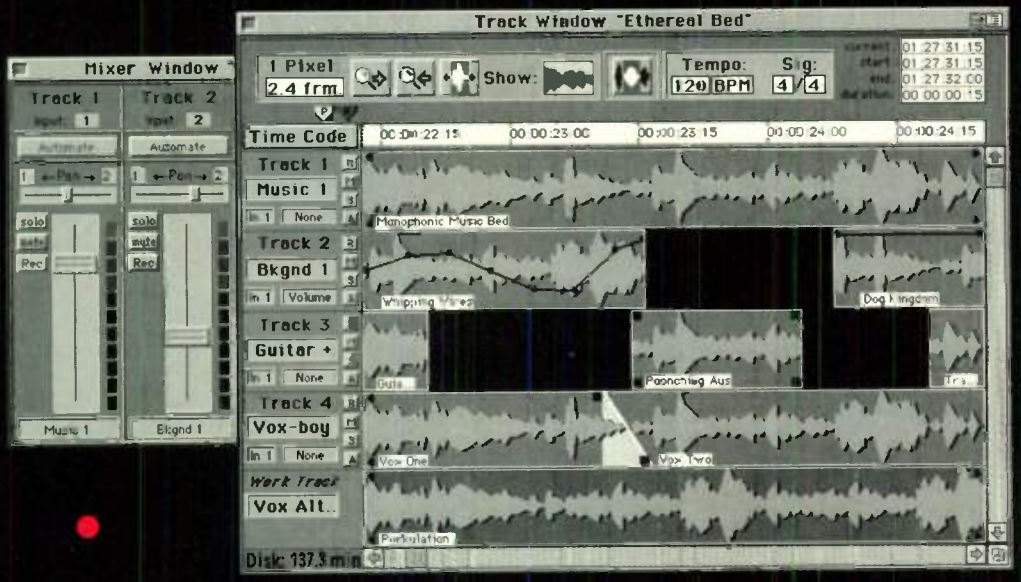

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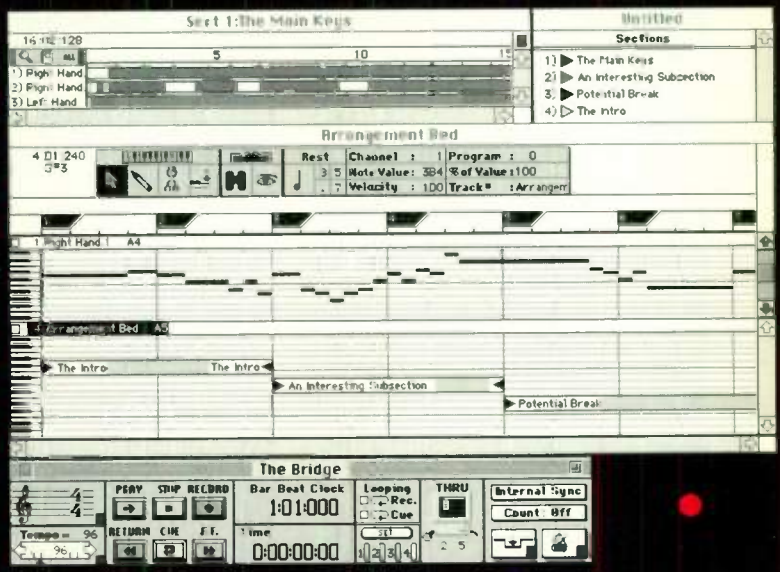

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using some astronomically priced mics. Sometimes, where you mic an instrument is more important than which mic you use.

Mic placement is a complex subject, but I have a few suggestions for particular instruments. If you're sampling a trumpet or a trombone, place one mic slightly off-axis from the front bell of the horn, about two feet away (see Fig. 1). Avoid setting the mic directly in front of the horn; this can cause distortion, some popping (due to wind exiting from the horn), or a thin and brittle sound. Trumpets and trombones sound best with a little indirect room sound added via a second microphone that is set to an omni or a figure-eight pattern and placed about three feet away.

To sample a flute, place one mic about six inches from the mouthpiece (see Fig. 2). Avoid setting the mic directly in the path of the player's breath; this can cause horrible rumbling sounds. Use a hypercardioid or cardioid pickup pattern, if possible. A second mic can be used on the opposite side of the player, about one foot away (for stereo), or about three to four feet away for more warmth and room sound. Set the second mic to omni or figure eight.

Cellos record best if you place the first mic about two feet away, slightly below where the player is bowing, but pointed into that general area (see Fig. 3). A second mic should be set on the opposite side, slightly above the instrument, but pointed toward the strings. Both mics should be set to a cardioid pattern, not hypercardioid. As an experiment, try placing the second mic behind the instrument and setting it to an omni pattern.

For saxophones, one mic should be set about eighteen inches to two feet in front of the instrument, off-axis from the bell (see Fig. 4). Use a cardioid pickup pattern. For more room sound, put another mic two to four feet away and slightly higher or lower than mic 1. Set it to an omni or figure-eight pattern.

FIG. 3: Cellos are best recorded with one mic about two feet away and slightly in front of the f-holes and bridge, and a second mic slightly above the instrument. As an alternative, you can try placing the second mic behind the instrument.

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TO TAPE, TO TAPE

If you've done much sampling, you know it's important to record onto DAT, half-track reel-to-reel, or any other high-quality, 2-track format. Use a high-quality mic preamp, and always record in stereo, or with two mics in different positions (i.e., one close to the instrument and another farther away to capture room sound). Even if you're eventually going to create a mono sample, you'll find one mic usually ends up sounding better than the other, and a mix of both mics almost always sounds much better than either mic alone. In addition, sooner or later you will own a sampler with 64-voice polyphony and lots of RAM, and you won't want to re-record the instruments.

In general, I recommend you create mono samples, rather than stereo, for several important reasons. First, while stereo samples might seem ideal, panning allows you to place individual instruments anywhere you want them within the stereo field. Second, stereo samples require two voices for each note. If you own a 16-voice Akai S1000, for instance, you will only have eight voices to work with if you use stereo samples. That's far too limiting, especially for instruments that can play more than one note at a time, such as pianos, harpsichords, organs, or guitars. Stereo samples also use twice the memory. If you have a 2 or 4 MB instrument, you know how fast you tend to run out of memory. I would rather use that RAM space to include more samples than eat it up with stereo files.

One exception to the rule is drum kits. Panning toms across the stereo field just doesn't sound realistic. Also, the acoustic space in which a drum kit is recorded may add a lot of "air," or room feel, to your samples and reduce the need to radically process the final sounds. Eight voices usually are plenty when working with percussion instruments, as they tend to decay rapidly (except for cymbals).

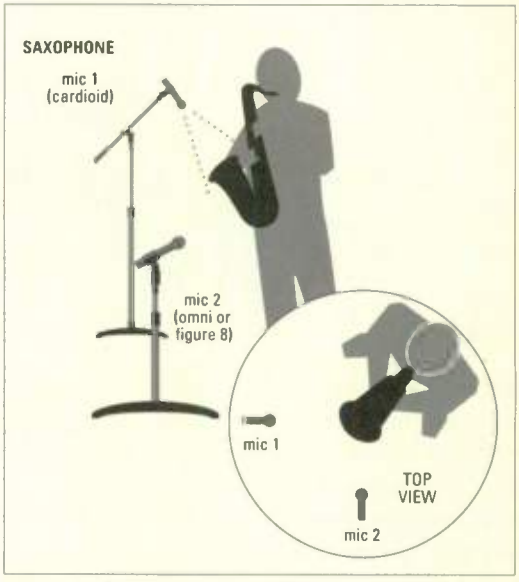

FIG. 4: Saxophones record well with one mic about a foot and a half away, slightly off-axis from the bell, and a second mic positioned a few feet off to the side, above or below the first mic.

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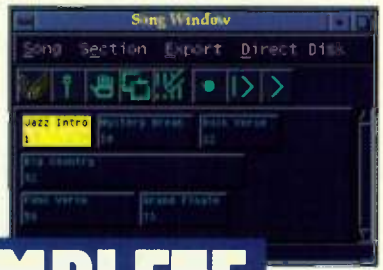

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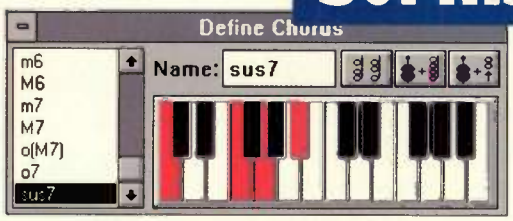

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A second exception is sections. With a large string section, for example, the violins are on the left, violas in the middle, and cellos and basses on the right. Depending on your needs, it may make sense to sample them in stereo to preserve that spread, even though this requires sacrificing RAM and polyphony.

One final note: Keep good records of your sessions. I've just started to realize I'm drowning in a sea of poorly labeled or unlabeled DATs. I remember what most of them are, but it would have been much better to label them during the initial sampling session.

DIGITIZING/LOOPING YOUR SOUNDS

Now that you've recorded a beautiful set of sounds, all that's left is the most painful, grueling, labor-intensive part of the process: digitizing and looping them. I personally hate it and would prefer to do just about anything else, short of having a root canal.

If you have a great set of instrument recordings, don't worry about which sampler you're working with. Many judge the sound of a particular unit by the sample library that comes with it (or that the dealer has on hand from third-party developers), which can be deceptive. True, there are minor sonic differences between models from different manufacturers. But I'm willing to bet that in a blindfold test, no one could consistently identify a particular sampler if the same high-quality recordings are fed into all of them. The quality available today is so high you can get great results from just about any current model.

The way I normally put together a sample set is to start with the lowest note each instrument can sound. From there, I work up the keyboard, sampling as many notes as will fit into RAM. For some difficult instruments (solo violin, for example), I may digitize every note of the first octave or two and then come back and listen critically to determine which samples can be deleted. This process is easy once you have the samples mapped in place because the "clunkers" stand out quite clearly.

After deleting the samples I don't want, I proceed with the remainder of the notes until I have a complete set of digitized samples. This process may take a full day or more for some instruments and only a few hours for others. (Saxes and trumpets are particularly easy.) It's always best to have more RAM than you need for the final sample set. By giving yourself a little breathing space, decisions on which samples to delete need not be made too soon. Throughout this entire process *save to disk often.* Power failures and hardware problems almost invariably occur late in the game, and you'll be a much happier person if you only have to digitize one or two samples instead of fifteen or twenty.

Don't be surprised if after all this effort, you still have one sample that just doesn't sound quite as good as you'd like, or doesn't match the samples above and below it. Many samplers and computer-based sample editors allow you to pitch-shift a better-sounding sample up or down to replace the unacceptable one. I can't tell you how many times this has saved me from a major breakdown. This feature is also

continued on p. 123

Lyric Writing

By Michael Molenda

Meaningful lyrics are seldom born from rhyming dictionaries or catalogs of clichés.

U2's Bono (far right) has been chided by critics for overextending his metaphors, but his mythic lyricism is vital to the band's larger-than-life status.

This column is a tough one. I've often felt that artists and music critics trod over a song's mystique when they publish its lyrics. Without music, most lyrics read *way* dumb. I always pity the unfortunate artist lauded by some record reviewer as the "next poet of pop." It's not that I object to critical darlings, it's just that I fear the printed lyrics that "collaborate" such exuberant praise. The promise of genius is often dashed by couplets such as "Upon your lips was the bliss I dared to taste/But in your eyes I could see my fragile heart laid to waste." Now, that line *might* sound pretty cool spat out over some nasty rock 'n' roll guitars, but as poetry, please!

Legitimate poetry comes alive when read aloud. It should be no surprise that song lyrics are enriched by the phrasing and melodicism of the human voice. There's nothing I can write about rhyme schemes or song structures that would be more important than stressing the oral tradition of lyric writing. If you can adorn a great story or sentiment with vibrant words that sound beautiful when sung, you'll be many hits ahead of less-inspired writers who bury their heads in rhyming dictionaries.

HEADLINE HITS

Stylistically, a popular composition is usually a story ("Cat's in the Cradle" by Harry Chapin; the current chart version is by Ugly Kid Joe), a declaration ("Anarchy in the U.K." by the Sex Pistols), or a dedication ("I Will Always Love You" by Whitney Houston). But whatever the style, the writer's goal is simple: Communicate!

Great storytellers bewitch listeners with seductive plots and colorful language. Although a lyricist must be just as enchanting, he or she doesn't have all day to spin a good yarn. (Epic verse barely survived Milton's *Paradise Lost;* then Don McLean killed the style for good with his sappy ode to innocence, "American Pie.")

The average pop song is four minutes long, so you have to get into the action fast. I like to compare pop lyrics with the punch and immediacy that's essential to newspaper writing. The chorus, or "hook," is your headline; the verses unfold the story in tight, concise prose; and the bridge is like a news sidebar that ties up loose ends or offers a different perspective.

A little "trick" to ensure your writing maintains a focused narrative is to develop an interesting title. A good title provides a mental outline or guide that keeps verses, pre-choruses, choruses, and bridges aligned with the main topic. Once again, you've got three or four minutes to tell a story, so tripping over tangents can be deadly.

But besides keeping a writer honest, developing a great title is smart business. Music publishers and A&R executives react favorably to catchy titles. (Remember the news headline analogy?) If the promise of the title implies a great song, an A&R person may be enticed to listen to an unsolicited demo that normally would not be considered. Some of the titles I've had success with include "Shadows in Paradise," "La Balance," "The Strength of String," and "Love is Justice." All of these songs were unsolicited submissions.

If you get stuck for ideas, the *Billboard* Hot 100 Singles chart is a good resource. I regularly read through the song titles to develop a sense of popular perspective. While I wouldn't compose a song based solely on current trends, it helps to know what types of

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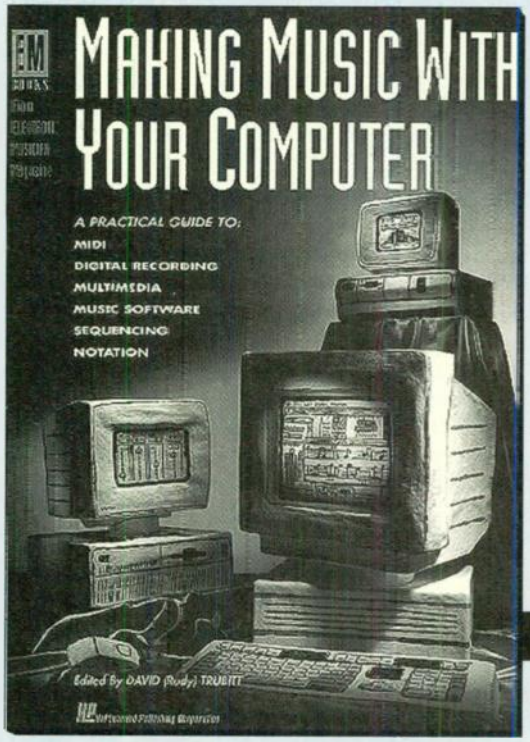

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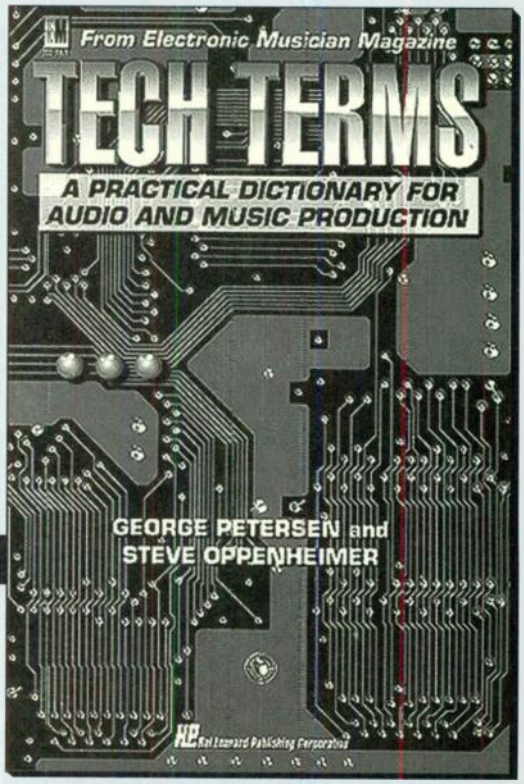

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subjects generate public response. I also get inspiration for titles and songs from the news, theatrical plays, novels, poems, movies, and art galleries. A well-rounded artistic sensibility can be a writer's most valuable commodity.

DIVINE INSPIRATION

During an interview, Keith Richards once copped to some less-than-brilliant lyrics by explaining that he often sings nonsensical phrases as "place-holders" while developing melodic ideas. The hitch, admitted the eternal Rolling Stone, was that when he starts writing the real lyrics, he sometimes can't find words that *sound* better than the gibberish.

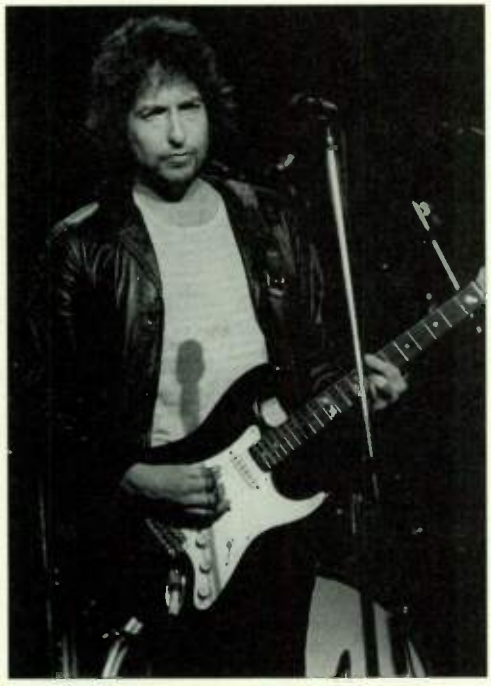
I also compose songs by singing whatever words pop into my head as I seek out vocal melodies, so I can relate to Richards' frustration. In my case, the "first thought/best thought" concept of automatic writing doesn't always apply. My free-form lyrics are usually downright awful, and there's little solace in the fact that pop songwriting has a long heritage of silly verbiage. The basis of this tradition, however, is vital to lyric writing: The words should sound good when sung. "Tutti-Frutti" may be nonsense, but who cares when the words explode from the mouth of Little Richard? And in a more current example, the beautiful, tone-poem vocalizing of the Cocteau Twins' Elizabeth Fraser is non-verbal, but the lack of lyrical content certainly doesn't subvert the emotional power of her music.

David Bowie's lyrical style has undergone as many transformations as his public persona. During an experimental period in the early 1980s, Bowie (shown with Tin Machine) allegedly cut up his lyrics, tossed the scraps on the floor, and considered the haphazard order of words to be a finished work.

Many beginning songwriters kill themselves coming up with multisyllabic words that their college creative-writing professor would drool over. Some of them naively believe that the more "important" the word, the better the song. Unfortunately, it's difficult to sing a word such as "nihilistic" with melodic grace. Keep in mind that poetic writers such as Bob Dylan and Leonard Cohen don't always compose the best melodies; the weight of their vocabularies often limits melodic options.

The battle of phonics and the printed word—or the decision to use words that sound good, rather than words that read well—is nullified when a writer invokes "lyrical vocalizing." As an experiment, try composing a vocal melody without thinking about lyrics. Your voice should automatically form words, syllables, vowel sounds, and consonants that enhance the melody you're singing. Obviously, I recommend this approach, if only to establish a foundation of possible word sounds within a melodic structure. When you sit down to compose "real" lyrics to match these sounds, try to stay true to your original phonic narrative.

You'll find that constructing a lyrical dialog from nonsensical word sounds is quite an exercise, but I've written some of my best songs using this approach. The secret to turning lyrical vocalizing into coherent lyric writing is in the editing process.



Warning: Never allow yourself to be compared to this man! Although Bob Dylan redefined and (arguably) validated rock lyricism, countless writers lauded by ham-headed critics as "the next Dylan" have suffered irreversible commercial damage.

HEMINGWAY'S GHOST

One of my favorite Hemingway anecdotes—it may even be true—is his habit of writing in longhand with a pencil while standing up. (A special podium allowed him to indulge his vertically oriented muse.) Every morning, "Papa" would review and edit the previous day's work and then continue writing.

Because I began my career in the rush-rush arena of print journalism, I envied and appreciated Hemingway's systematic rewrites. But correcting one's textual sins is more than just a creative luxury; comprehensive editing is the foundation of concise prose. The value of such precision to the songwriter, who often summarizes an entire love affair in two minutes and 45 seconds, should be obvious.

Whether you've invoked lyrical vocalizing or conventional prose writing, the editing process is the key to producing masterful work. Never, never, never be satisfied with the first or second thought that leaps from your brain onto paper (or into the word proces-

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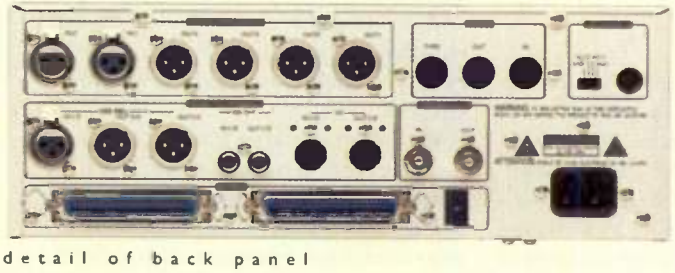

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The CBX-D5 system was designed to let your computer compute and your storage devices store while the CBX-D5 handles the processor-intensive work. The CBX-D5 controls digital multi-track recording, analog-to-digital and digital-to-analog conversions, digital audio routing, digital signal processing and digital equalization, digital inputs and outputs in all standard formats, word clock synchronization, MIDI, and much more.

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YAMAHA

Rickie Lee Jones' slurred, child-like voice and beat-influenced lyrics helped make her first album an instant pop classic. Unlike other singer-songwriters, who often wrote lyrics as if they were getting paid for foisting their self-analysis on the public, Jones' Bohemian cool evoked sincerity by keeping the listener at a distance.

sor). Constantly hold your lyrics up to brutal scrutiny. Make sure that your narrative is solid and direct, your words are descriptive and animated, and that the bond between lyrics and melody is harmonious.

It's a good idea to put your lyrics away for a few days, then read them with a fresh perspective. Judge yourself as candidly as you would another writer. As a matter of fact, try to take your ego out of the process and pretend you *are* critiquing another lyricist's work. Don't forget to sing the lyrics to ensure each word enhances the melody. If you're still happy after these tests, take a big risk and let someone else review your work. Just be sure your critic *hears* the words before he or she reads them. Usually, if your lyrics can weather all this critical pummeling, they're ready for public consumption.

LAST VERSE

While I was gathering background material for this column, a songwriter I admire unwittingly reinforced my trepidations about the whole "learn to write" business and sent me spiraling into a near-fatal case of writer's block. "Good luck," he said. "I've taught hundreds of songwriting seminars, and not only have I failed to help one poor writer improve, I haven't even figured out how or why *I* can write something good."

After that conversation, every time I tried to commit a thought to the word processor, I was reminded of my college writing classes. Of course, each student considered their creative vision and prose to hover around the "genius" strata, and of course, reality proved most of us to be toiling in the muck reserved for conceited children. At the semester's end, the ratio of students who entered the class blessed with talent and the students who could barely pen a shopping list never changed. The instructor was almost superfluous.

The moral here is that no one can magically transform a bad writer into a good writer. Although hearing successful songwriters speak about their art can be inspirational, do not attend expensive songwriting seminars intending to walk out a better writer. Likewise, no book holds the key to success, and no songwriter's association breeds surefire talent. These tools can only offer you road maps of other people's success.

What kept me from trashing this article altogether is the belief that if you're talented, those maps may be all you need to forge your own artistic and/or commercial success. For whatever it's worth, I've added a few routes of my own to the map. I hope they help direct you towards the top of the charts. Good luck! ❁

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Overdubbing

By Neal Brighton and Scott Wilkinson

Create a tasty multitrack sandwich by adding instruments to your recording layer by layer.

DAVE EMBER

Just about every musician dreams of being immortalized on tape. Luckily, you don't need a genie to make this wish come true. Live performers can simply plop two microphones in front of the stage and record a gig onto a cassette or DAT recorder. But while live recordings can capture the excitement of a performance, they also document audience noise, technical glitches, and musical mistakes.

More pristine recordings are usually produced in a studio environment. In the recording studio, audience noise is obviously not a problem (unless you troop around with an entourage of rowdies), and any technical or performance foul-ups can be corrected by re-recording the offending musical part. In addition, recording technology can turn a three-piece band into an entire orchestra. Each musician can double (or triple or quadruple) his or her performance, play different instruments, and add sonic colors and musical counterpoints that would be difficult or impossible to pull off in live performance. The technique that makes this all possible is called *overdubbing.*

BASIC CONCEPTS

To understand overdubbing, you must first grasp the concept of a multitrack tape deck. Stereo tape decks use two *tracks* on the tape to record the right and left channels of a stereo audio signal. The multitrack deck extends this capability by dividing the tape into 4, 8, 16, 24, or more tracks.

Electric-guitar pioneer Les Paul developed the concept of multitracking about 40 years ago, visualizing a bunch of monaural (1-track) tape decks stacked on top of each other, with a single, wide piece of recording tape passing over all of them at once (see Fig. 1). Each of these "conceptual" mono tape recorders is equivalent to one track of a modern multitrack tape recorder.

For years, the "professional" standard has been 24 tracks on 2-inch-wide (open-reel) analog tape. However, there are also analog 1-inch open-reel tape formats for 16 and 24 tracks, as well as 4- and 8-track cassette recorders. The digital age has produced computer-controlled hard-disk recorders with almost unlimited tracks and 8-track digital tape machines that utilize S-VHS or 8 mm video formats.

During the overdubbing process, you can listen to one or more tracks of previously recorded material while recording a new part onto a fresh (unused) track. Obviously, the more tracks you have, the more musical parts you can overdub.

Let's say you record a stereo piano patch from your synthesizer onto two tracks of a multitrack deck. If you want to add a vocal, you can listen to your piano performance through headphones while singing into a microphone to record, or "overdub," the vocal on a separate track. The overdubbing process can be repeated to add as many musical parts as there are tracks to do so.

Overdubbing also lets you easily fix mistakes. If your band is recording a song and the bass player hits a wrong note, you don't have to make the whole band play the song again. If you record each instrument onto its own track (of the multitrack deck), the player can re-record the bass part at his or her leisure, without disturbing the other recorded performances. In essence, each track of the multitrack deck is a separate entity—just like Les Paul's conceptual stack of monaural tape recorders—and what is recorded or re-recorded on track 1

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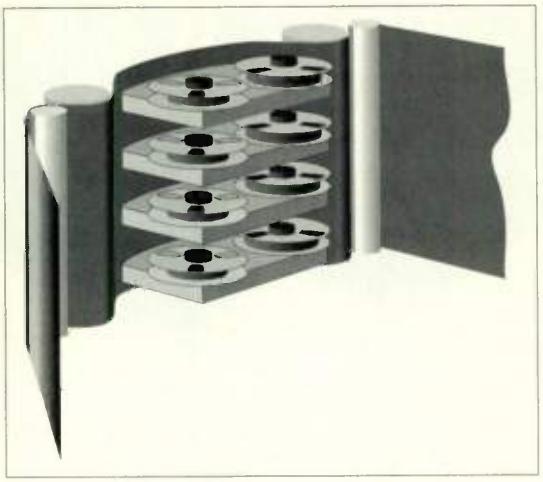

FIG. 1: Multitrack recording was born when legendary guitarist/producer/mad scientist Les Paul visualized a bunch of monaural tape decks stacked on top of each other, with a single piece of wide tape passing simultaneously over each.

of an 8-track deck does not affect tracks 2 through 8.

FIRST THINGS FIRST

Before you succumb to the common malady of "overdub madness," you must first record a basic foundation track from which to build your masterpiece. (For an overview on the basics of multitrack recording, see October 1992 "From the Top: Multitrack Recording.") There is no set rule regarding the order in which a musical project should be recorded. What works for some musicians doesn't always work for others. Typically, though, the rhythm section (drums, bass, rhythm guitar, and/or keyboard) or a click track is recorded first to provide a reference as you overdub other parts.

Once you have a rhythm track recorded, it's a good idea to overdub a *scratch vocal* (assuming your music has vocals). A scratch vocal is yet another reference for future overdubs, as it indicates the melody and (hopefully) where other instruments and vocals fit into the big picture.

After the scratch vocal is down, you can start filling in all the other instruments (strings, oboe, etc.) and background vocals. The final lead vocal is usually saved for the last overdub so the singer can listen to the entire arrangement, (unless, of course, the singer nailed the performance on the scratch track). Lead instruments, such as guitar and sax, are typically recorded during the final overdub stage for the same reasons.

HEARING THE PAST

Obviously, overdubbing requires listening to previously recorded tracks. In many situations, you can use headphones to hear (or *monitor*) what is already on tape. A major benefit of headphones is that they provide some sound isolation. For instance, if you monitored your tracks through your stereo speakers while recording a vocal, the instrumental track

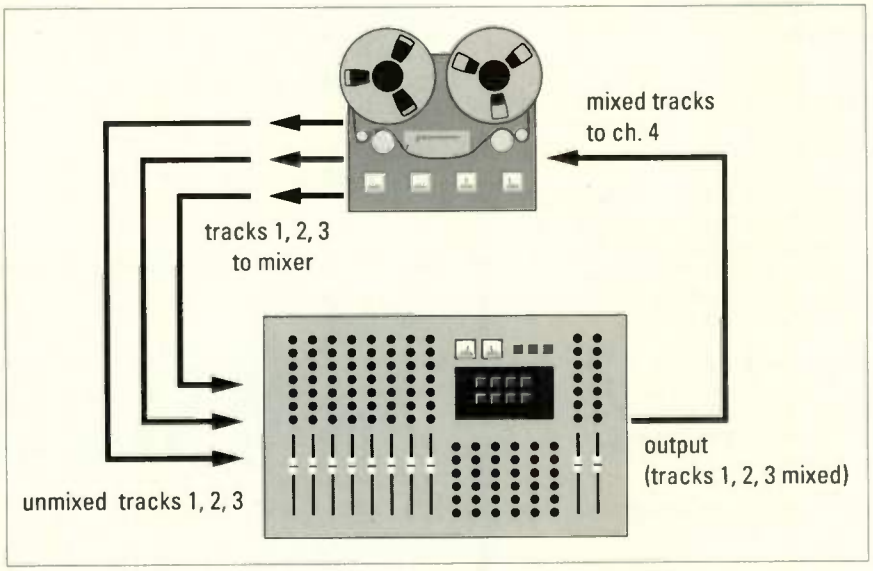

FIG. 2: In this example of track bouncing, three recorded tracks are mixed and re-recorded onto track 4, freeing the other three tracks for additional recording.

would be picked up by the microphone along with your voice. Not only can this "re-recording" cause an uncomfortable feedback loop, but it can ruin the clarity of your vocal track. (Some professionals record *without* isolation for artistic or performance-enhancing reasons, but they usually have the technical chops to minimize potential audio problems.) If you are overdubbing instruments that are not miked, such as synths or a bass plugged directly into the mixer, you can use speakers without fear.

Keep in mind that the relative volume level of each recorded track is changeable. Your mixer should allow each track to be played back at volumes

▼

Overdubbing lets you easily fix mistakes.

that may be louder or softer than the level set during actual recording. This balance of pre-recorded tracks is called a *monitor mix* and makes overdubbing more comfortable because desired reference instruments (or vocals) can be adjusted until they are dominant.

OUT OF TRACKS

Because most home studios are limited to four or eight tracks, you might think that you need to buy another multitrack deck to get all those wonderful ideas of yours on tape. Luckily, there are less-expensive ways to expand your tracking horizons.

Increasing the number of parts you can record involves a technique called *bouncing*. In this process, several recorded tracks are mixed together and re-recorded, or "bounced," onto one or two empty tracks. For example, suppose you've recorded drums on track 1, bass on track 2, and a rhythm guitar on track 3 of your 4-track deck. To free up more tracks for solos and vocals, you can take tracks 1, 2, and 3, mix them together, and record them all onto track 4 (see Fig. 2). This process frees up tracks 1, 2, and 3 for additional parts. (Keep in mind that you may lose some audio quality after the bouncing process if you're using analog tape.)

After bouncing these tracks, your rhythm track is now monaural. (Remember, you bounced three tracks to one.)

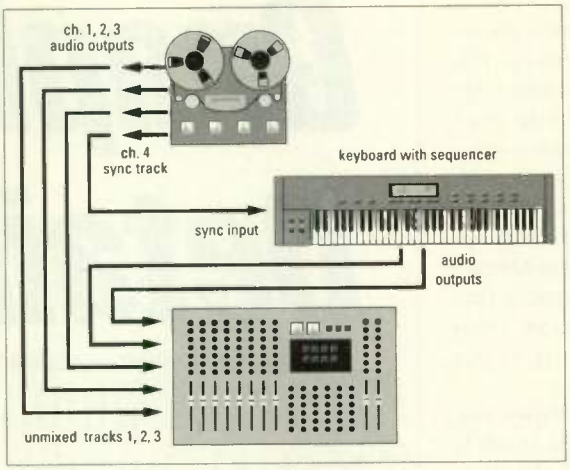

FIG. 3: When synchronizing a sequencer to a multitrack tape deck, the sync tone on the last track is sent to the sync input of the sequencer (in this case, within an electronic keyboard). The sequencer then starts and stops along with the tape.

Also, because you've committed your rhythm tracks to a *submix*, it is essential that you're happy with the balance of guitar, bass, and drums. Once you erase the three original tracks to make room for more parts, the balance of your mono rhythm track cannot be changed.

A less-destructive technique for saving tape tracks involves MIDI sequencing. In this process, a computer or a keyboard's built-in MIDI sequencer records all the parts played by electronic instruments. Typically, keyboard sequencers provide eight or sixteen tracks, while software sequencers often offer hundreds of tracks. Because these sequencer tracks are not recorded onto tape, they are often called *virtual tracks*.

Combining virtual tracks with tape-based tracks requires synchronizing the sequencer to the multitrack deck so they can play together (see Fig. 3). A link between the two formats is established by recording a *sync tone* on one track of the tape deck. Recording a sync tone reduces your available tape tracks by one, but because you can now access many virtual tracks, the trade off is worth it. (For more detail about sequencing and tape synchronization, see "From The Top: Sequencing Made Easy, Parts 1 and 2" in the March 1992 and April 1992 issues.)

OVERDUBBING TIPS

Keep several things in mind while overdubbing. First, record all tracks as "hot" as possible without causing audible distortion. The loudest musical passages should send your recording level meters just above the "0" mark. (This may not apply to digital multitracks, which tend to distort at any level above 0.) Maximum recording levels can minimize hiss and other non-musical noises on analog tape.

It's a good idea to avoid recording overdubs with effects such as reverb or delay, unless you're certain you want to live with the effect forever. (As with your rhythm-track submix, once the effect is recorded to tape, it's there to stay.) Decisions regarding effects are usually saved for the final mixdown, where several options can be auditioned without risking permanent commitment. Also, go easy on the equalization (EQ) while overdubbing. If you "over-EQ" during the recording process, then decide to re-EQ at the final mixdown, you're risking additional noise. Get in the habit of recording a good sound "flat" (without EQ) by concentrating on mic placement or synth programming.

In addition, keep your bass and drum tracks well separated from the sync-tone track. If a loud instrumental track is recorded next to the sync track, the sequencer might not be able to read the sync tone because the instrumental sounds can bleed over and interfere with the sync track. It's best if you can leave a blank *guard track* between the sync track and other instrumental tracks, but this is often impossible. If you can't afford a guard track, soft musical pads and other sustained parts are the best "neighbors" for your sync tone.

Though overdubbing is a great recording technique that adds flexibility to the recording process, it can also cause your music to sound sterile. It's important to look at the big picture, the overall sound of your music. Remember that the overdubbed parts should work together to create seamless music that has the feel of a live band.

Next month, we'll examine the process of mixdown. Until then, keep on making music!

Neal Brighton *is co-owner of Sound & Vision studios in San Francisco.* **Scott Wilkinson** *is technical editor of* **EM**.

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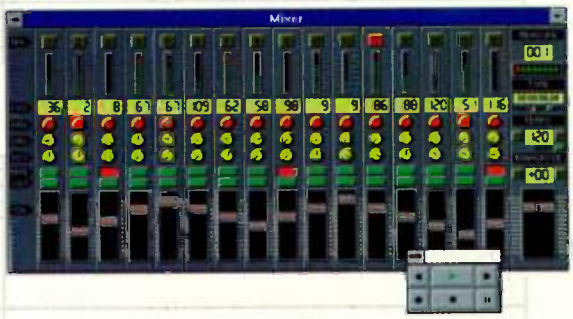

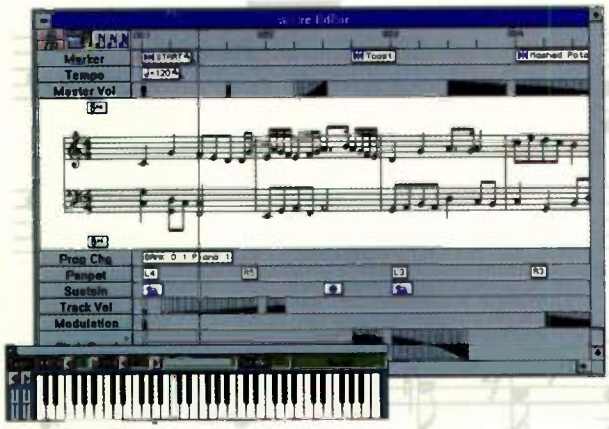

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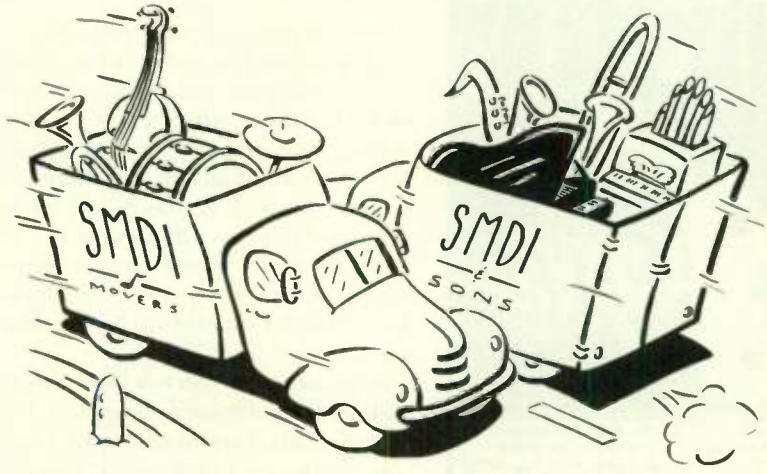
What is SMDI?

By Matt Isaacson

A standard method for transferring samples via SCSI is now available. Will it catch on?



I'm not one to create acronyms for the sake of acronyms, but when I tried to name a new data transfer method I developed, it made sense to link it to another well-known member of the electronic music lexicon. So yes, SMDI (pronounced "smi-dee"), an acronym for SCSI Musical Data Interchange, rhymes with MIDI. However, it is *not* SCSI-MIDI, it is *not* spelled SMIDI, and it is *not* pronounced "ess-MIDI." Those using these spellings or pronunciations are in error and should be politely corrected.

What exactly is SMDI? Simply put, SMDI is a method of using SCSI (the Small Computer Systems Interface) to transfer information between samplers and computers. SMDI has been characterized as "SCSI sample dump" because it is based loosely on the familiar MIDI Sample Dump Standard (SDS). The central aim of SMDI is to use the superior data-transfer ability of SCSI to serve the same purpose as SDS, that is, to send samples between any two devices in a nonproprietary, commonly recognized format.

LIFE BEFORE SMDI

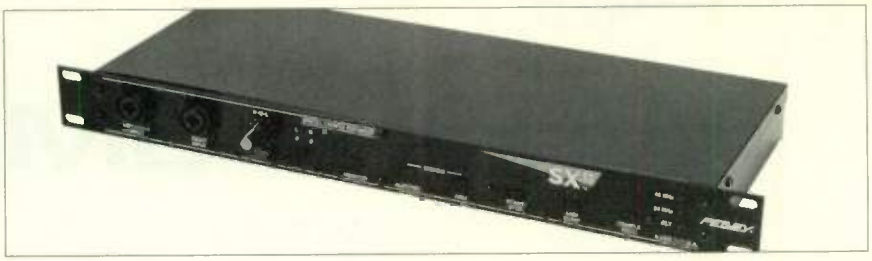
The story of SMDI starts with the state of music equipment in its absence. All previous methods of sample transfer have shortcomings that grow more problematic as the state of digital audio improves. For example, SDS has several flaws. It can't deal with stereo samples or samples longer than two megawords, and it conveys a bare minimum of information about a sample (names and pitch values not included) and none about the sampler (such as its sample-number range). SDS also offers no tools for remote management (e.g., a Delete command).

However, the greatest shortfall of SDS is that it uses MIDI and is therefore glacially slow. MIDI was never meant to move large quantities of data. It's a low-cost system for transmitting real-time event information, working at a speed that just barely lets it do a competent job. On the other hand, SCSI was born to move data. Even transfers over a low-cost SCSI interface can easily be 100 to 300 times faster than an equivalent MIDI transfer.

Thanks to its versatile design and wide acceptance as a standard by the computer industry, SCSI is the interface of choice for sampler hard-disk access. Its key advantages for the designer (and user) are standardization and device-independence. SCSI disks handle the messy details of cylinders, heads, buffers, and the like on the inside, and present a simple, standard "virtual" device to the SCSI bus. SCSI driver software then deals with this virtual device in a generic way. More importantly, a SCSI driver that sets up a sampler for use with the whole range of SCSI disks—even those not yet developed—must be created only once.

Samplers use the speed of their SCSI ports to upload and download samples. However, the precise transfer methods for samplers are not standardized over SCSI. Each sampler's implementation is usable only through a coordinated effort by someone—usually a third-party software company—working from the other end of the SCSI cable. Unlike SCSI disk drivers, this effort must be duplicated for each sampler by each company seeking to support it. A company may decide that the cost of this effort isn't justified by the projected sales, or its programmers may be unable to do it right away (perhaps because of

ROBERT PRINCE



Peavey's DPM-SXII sampling module can transfer samples using SMDI in real time to the company's DPM-SP sample player.

other samplers that need support).

Clearly, this is a losing situation for almost everyone involved, but especially for users, who are resigned to seeing their sample libraries remain "ghettoized" for lack of a usable interchange method. It also puts a strain on manufacturers. Digidesign, one of the original heavyweights in third-party sampler support, now puts its energies into SampleCell and no longer supports samplers.

A few samplers can read the floppy-disk formats of some competitors, but this piecemeal approach to the problem involves a cumbersome transfer method that is especially taxing for manufacturers to implement. It certainly offers some utility, mainly as an "escape route" from one sampler to another, but it does nothing to address the real problem or facilitate new capabilities.

A STANDARD IS BORN

A standard SCSI sample-transfer method would clearly be a boon to all concerned. So why isn't there one? For starters, arriving at a standard protocol is no trivial undertaking. SCSI is a big topic. It covers a breadth of equipment in which musical instruments don't even rate a mention. In the cloistered world of MIDI, every other unit on the line is a MIDI device, but a SCSI cable normally plays host to devices that don't know a sampler from a samovar.

In addition to the thorny technical problems, there is the question of an appropriate forum in which to address the issue. It's far too narrow for the American National Standards Institute (ANSI), the stewards of SCSI. The focus of the MIDI Manufacturers Association (MMA) is MIDI; SCSI is technically not part of their charter. However, unless a standard emerges from an industry group charged with creating it, manufacturers may be skeptical of its merit, or may wait to see who else adopts it before committing themselves.

Meanwhile, those companies that have forged ahead with proprietary protocols are less inclined to feel that a standard would benefit them. Some may be downright hostile at the suggestion that they scrap their work to start over with a new method not of their own invention. In addition, the desire for a standard protocol isn't universally shared. Companies with large investments in sound libraries—and it is often the library that makes or breaks a sampler—have reason to be wary of a feature that helps users export samples *en masse* to other products.

The Kurzweil K2000 can use SMDI to transfer samples straight into Passport's *Alchemy* on the Mac, Turtle Beach's *SampleVision* on the PC, or dissidents' *MIDI Sample Wrench* on the Amiga.

How did SMDI evolve, then? Rather spontaneously, as it turns out. I took a stab at it while developing the system software for the Peavey DPM-SP. The SP is a low-cost sample-player without built-in sampling and, at the time of its introduction, a rather limited factory sound library. Clearly, in order

for the DPM-SP to have any chance of success, the issue of sample transfers had to be addressed. Users of other samplers would want to move their personal libraries over to it, as would commercial sound library suppliers. There

SMDIFIED

Following is a list of products currently using the SMDI protocol.

Turtle Beach *SampleVision* (PC sample editor)

Opcode *MAX* (Mac music-programming construction kit)

Passport *Alchemy* (Mac sample editor)

dissidents *MIDI Sample Wrench* (Amiga sample editor)

dissidents *disSX* (Amiga control program for Peavey SX)

Kurzweil K2000 and K2000R (keyboard and rack-mount sample player)

Peavey DPM-SP (rack-mount sample player)

Peavey DPM-SX/SXII (rack-mount sampling module)

wasn't time to crack three or four alien floppy formats while also developing the native one for the DPM-SP. It seemed that a well-supported SCSI transfer protocol was the best prospect.

Rather than designing a product-specific protocol, I wanted to create a generic one, hoping that this would make it easier to enlist the necessary third-party support early on. In addition, I thought it might help break the SCSI transfer logjam and trigger some other activity in this area. (No harm in trying, anyway.) The powers-that-be at Peavey understood the intent and gave the go-ahead to release SMDI into the public domain without fees or royalties. This would encourage other product developers facing the same problem to consider adopting the already-worked-out SMDI method.

Such an attempt to parlay a unilateral creation into a standard is far from unprecedented in industry. SCSI itself evolved from something called SASI, the Shugart Associates System Interface. It's too soon to say whether SMDI will become a universal standard, but among the companies that have chosen to use it is Kurzweil in their K2000 synth/sam-

pler. That's an important first step. (For a current list of products supporting SMDI, see the sidebar "SMDIfied.")

WHAT'S IN IT FOR ME?

When (and if) it comes to your gear, SMDI can spare you lots of waiting when shuttling your samples around; ditto for computer editing. In addition, you don't need a DSP board in the computer just to audition edits because you can zip an edited sample quickly back into the sampler.

If a new sampler were to join the SMDI club today, it would already be supported by *Alchemy*, *MAX*, and *SampleVision* and enjoy the ability to transfer samples directly to and from the K2000 and DPM-SP, with no updates to any of those products and nary a phone call to their manufacturers.

The adoption of a standard protocol might hasten the appearance of previously impractical applications. For example, a centrally fed sampler network could be designed in which all units receive their samples via SMDI downloads from a common sample database accessed by a sophisticated session manager. If you now use two or more different samplers and a computer, your sample library may exist in different formats on as many hard disks. If you're fortunate enough to have gigabytes of sounds, redundant disks add up to real money. Wouldn't it be nice if your samplers didn't need dedicated hard disks of their own?

SMDI also provides a method for transmission of MIDI messages. This means that program information for each sampler could be maintained on the same central disk as the sample database and sent along the same SCSI cable (as SMDI MIDI SysEx) at the same blazing speed. (Don't throw those MIDI cables away, though. Despite its data-moving prowess, SCSI is *not* a good real-time event-transmission interface, and SMDI won't be replacing MIDI anytime soon.)

The same idea applies to CD-ROM sound libraries. With sound files in the native format of the computer (e.g., AIFF), a single CD-ROM could furnish samples to any SMDI sampler and include device-specific files that organize these samples into sound banks for many different products, also transmittable via SMDI.

The bottom line is this: The more you move samples around, and the bigger they are, the more SMDI can help. As more manufacturers adopt SMDI, the more it *will* help. The applications in this article are possible right now, but they will become commonplace more quickly if SMDI (or something like it) becomes a *de facto* standard in the music industry. If you'd like to see that happen, make your voice heard. Manufacturers do listen, especially when many voices are talking. Drop a letter or make a call to your favorite sampler or software company and ask, "Where do *you* stand on the SMDI question?"

(To obtain a copy of the SMDI spec, contact Peavey Electronics Corporation at [601] 483-5365.)

Matt Isaacson *lives in San Francisco and has been a design and development engineer with Sequential Circuits, Yamaha, and Peavey over the last nine years.*

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Audio for Personal Digital Video

By Chris Meyer

Creating soundtracks for computer movies takes some unusual tools and tricks.

First, the good news: Whether your interest is adding music to your songs, or helping create corporate presentations, musicians are well-suited to the art of multimedia. We already have a sense of timing and dynamics that often is missing from these efforts.

Now, the bad news: You're going to have to learn some new tools, rules, and expectations. Forget multi-channel sequencing; multitrack, 16-bit, 48 kHz digital audio; and sample-accurate editing. Few multimedia programs allow even basic audio editing, let alone MIDI. It's even harder to find professional digital audio and MIDI sequencers and editors that make it easy for you to see the images you are scoring.

That doesn't mean all hope is lost; you merely have a different set of challenges. With a little patience and trickery, you can still use some of your favorite tools to create your final work. Here's how I crafted the soundtrack for a short *QuickTime* movie, called *asiacan*, that won the Best Use of Audio category at the *QuickTime* Movie Festival held during the January 1993 *Macworld* Expo. Although I work in *QuickTime* on the Macintosh, you should be able to apply these basic concepts to any platform and suite of programs.

THE GROUND RULES

Most *QuickTime* movies are played back on one user's computer, using the internal sound chip and the built-in speaker. This translates to 8-bit, monophonic, 22 kHz audio, reproduced by a tinny speaker that is in the same box as a noisy cooling fan. In addition, most internal speakers have no low end, so certain bass parts (kick drums included) might not be reproduced.

Even with these restrictions, don't neglect the issue of frequency response. Many multimedia authors opt to use the less memory-hungry 11 kHz sample rate, but it sounds bad for almost anything beyond speech. The lack of high frequencies and proper anti-aliasing filters in most PC sound systems results in the "steely" sound typical of many 11 kHz soundtracks.

Thankfully, the situation is changing. Some users—particularly those who buy good sound cards—use external speakers or headphones and have a better chance of appreciating stereo and higher fidelity. It should improve further with the proliferation of data compression, General MIDI synthesizers, and better overall sound-awareness. But for now, the extra storage and real-time playback requirements of anything better than mono 22 kHz sound are hard to justify.

Of course, you still need to satisfy listeners who have quality external speakers, and most multimedia presentations intended for an audience larger than one will be pumped through a larger sound system. You should monitor your work through both internal and external sound systems and work out an acceptable compromise.

Finally, the 8-bit linear format gives you only 48 dB of dynamic range. Also, most computers tend to be in noisy environments. Therefore, you will have to seriously consider compressing most of the audio you record, whether it is narration or the great song you just painstakingly sequenced. On the plus side, this format sounds so bad that clipping is less noticeable. Whereas clipping sounds harsh in a sanitary, 16-bit world, it makes an 8-bit signal sound only slightly more compressed, noisier, and less intelligible. For the sake of clarity, you don't want to clip speech, but you'll be surprised how much you

GIRAFFE SHOTS BY CARL PURCELL

can get away with, especially on percussive peaks.

With these limitations in mind, let's dive in.

THE PROJECT

Asiacan—a cross between Asian and African—is a short, impressionistic movie that combines images of wild animals with frantic, almost tribal, Balinese music and voices and some African percussion and ambiences. The main body is bracketed by a scene of waving pampas grass along with the opening title and closing credits.

To start with, I dug into my sample library and found an old sample of howling wind to accompany the waving grass. Rather than just fade it up slowly, I decided to ramp it up and back down quickly to give a "bump" that reinforced the way the opening titles flipped up on the screen (see Fig. 1). The original sample was recorded by an E-mu Emulator II at 27 kHz, rather than my target 22 kHz. Luckily, most computer video editing programs can handle multiple sample rates and mix them down to the target rate, so you don't have to worry about sample rate-converting all your sources before mixing them. On the other hand, the sample rate-conversion algorithm most multimedia programs use is pretty crude. I convert most of my material ahead of time in a program such as Passport's *Alchemy*.

▼

Whereas clipping sounds harsh in a sanitary, 16-bit world, it makes an 8-bit signal sound only slightly more compressed, noisier, and less intelligible.

As the waving clump of grass morphs

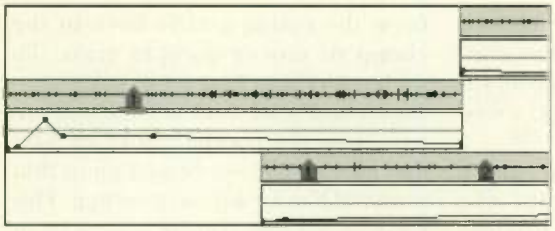

FIG. 1: Audio envelopes for the start of *asiacan*. The wind ambience that starts in track 2 gets an ADSR-like "bump" to emphasize the graphics. Another repetition of the wind loop is crossfaded in on track 1 and eventually faded out while an insect ambience is faded up on track 3.

into a still of a giraffe bending over to eat, I wanted to crossfade the wind into a more open ambience. I located a track of insects buzzing on the Sound Ideas *Ambience*-series audio CDs. Because my computer (a Mac IIcx) lacks an audio digitizer, and most digitizers that are less than professional-quality sound pretty bad by musician's standards, I recorded the track into a MIDI sampler and dumped it into my Mac, using *Alchemy* and the MIDI Sample Dump Standard. This is the biggest secret to better multimedia sound: Use the best audio digitizer you can up front; the difference is really noticeable.

To announce the transition from the titles and intro to the main body of the movie, I decided to rattle the viewer with a sudden percussive event. I ended up layering a sample of an eagle screeching and an African shaker. I wanted a deeper, slightly slower sound than the original shaker, so I transposed it downward, using the variable-speed option that is provided in many *QuickTime* programs. (Unfortunately, the effect is usually defined in percentage of the original speed, rather than duration or semitones and cents of transposition.)

After test-viewing the transition multiple times, I also decided to back-time the shaker sample so that the backstroke actually started before the transition, and the beads hitting on the forward stroke landed exactly at the visual peak. Most sound effects don't start at their peak, so you can't just blindly place their start on a downbeat or cut. Also, current *QuickTime* technology is such that there might be timing hiccups on playback, especially as the computer tries to decompress a sudden visual change in real time. The second secret of multimedia audio is to audition your work *numerous* times to make sure the visuals and soundtrack work together as you would expect the elements of a rhythm track to.

After this hit, the insect-ambience bed fades out, while a found Balinese recording, taken from the Aris Entertainment *Batik Designs* CD-ROM, fades in. The sound recordings on this disc were saved as *HyperCard* resources, because Aris' viewing program is written in *HyperCard*. Most *QuickTime* programs cannot open *HyperCard* resources directly, however, so I used *Alchemy* to convert the sounds from .SND format to the more-recognizable AIFF file format. The Balinese track starts with children yelling and frantic drumming that suddenly breaks into a hypnotic, percussive two-step. I timed the soundtrack and ended the fade-out right at this musical transition.

The original recording was not long enough for my purposes, so I found an 8-bar section of the two-step and measured it for looping. Most *QuickTime* editing programs do not have a looping feature, so I had to edit the soundfile down to the loop and copy it. However, I could not just place these segments end-to-end; in Adobe *Premiere*, all cuts must be on frame boundaries. At the program's highest timing resolution of 30 frames per second, this is a quantization of 33.33 milliseconds; hardly sample-accurate. If a soundfile is not exactly the same length as an integer number of frames (e.g., if it is a few samples too long or too short), you will hear a pop at the transition from one segment to the next.

To get around this in *asiacan*, I cut

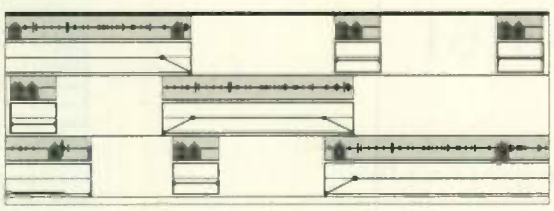

FIG. 2: A loop in the Balinese soundtrack is marked in track 1, crossfaded to just the looped portion on track 2, and crossfaded again to the loop and the rest of the music cue in track 3. The shorter samples checkerboarded in between are the shakers mentioned in the text.

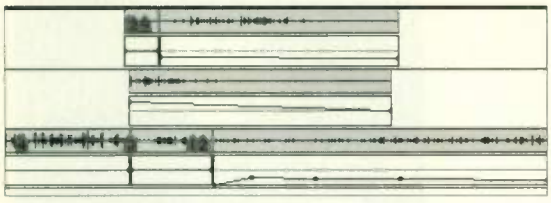

FIG. 3: After the Balinese soundtrack reaches a crescendo on track 3, a shaker on track 1, gong crash on track 2, and eagle scream on track 3 all hit together. A bowed gong is mixed underneath on track 1, as the wind ambience bed is faded back up on track 3.

the loop segments slightly long and bounced back and forth between them on adjacent audio tracks, using a 10-frame crossfade to smooth out the transition (see Fig. 2). (A similar technique was used to extend the howling-wind ambience.) Shakers, placed at the downbeats and increasing in level at each measure to build tension, helped mask the fades and enhanced the matching visual cuts.

Since I completed this movie, I've started using the time-scale feature in *Alchemy* to resize looped segments to exactly fit start and stop and video-frame boundaries. This way, I can place segments end-to-end and not use audio tracks just to pull off a simple loop.

After three loop repetitions, I played out the remainder of the original soundfile, which builds to a hectic frenzy, only to be suddenly and inartistically faded out by whoever edited the audio for the original CD-ROM. I decided to time the ending of the movie's main body with the last downbeat before this artificial fade, augmented by another eagle scream and a gong crash (this time, culled from a floppy-disk sample dumped into my Mac). I had steadily built tension throughout the body of the movie, and the gong was recorded cleanly, so I had a hard time making this crash seem loud enough. I ended up increasing its level to the point where it was clipping badly but was brash enough to cut through.

The movie ends with a reverse-morph from the eating giraffe back to the clump of waving pampas grass. To underscore this, I mixed in—at a near-subliminal level (but not *too* subliminal, given the restrictions of an 8-bit dynamic range)—a bowed gong that sounded like an animal growling. This emphasized how painful it must be to morph from an animal into, in essence, a very large weed. At the end, the original howling wind is faded back up, and final credits are presented. **Fig. 3** illustrates this mix.

Asiacan won awards at each of the two *QuickTime* Festivals in which I've entered it. For a relative video neophyte—this is the third movie I have ever created, in any format—it's been quite gratifying. As it turns out, I was presented the Audio award by Todd Rundgren, who is another fine example of what a musician can accomplish inside the realm of multimedia.

Chris Meyer *has often been accused of "seeing things." Desktop video gives him a chance to show everyone else what he's been seeing.*

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- There will only be two major shows per night, each without conflicting events in the same genre: one major rock showcase from 7:00 to 10:00 pm and one major dance showcase from 10:00 pm to 1:00 am. All club shows will begin at 10:00 pm.
- There will be a greater emphasis on rap, dance, metal, R&B, country, blues, and ethnic genres.
- Only twenty of New York's finest clubs are included in this year's program. This will make the festival more organized, with fewer conflicts between bands, and increase the percentage of industry professionals at every show. No more than four groups will perform at any club on any night. Many rooms have upgraded or installed new equipment to participate so every group can sound the best they can.
- No wrist bands will be sold to the general public! A limited supply of individual tickets will be available to the public for single shows only. This will make it easier for delegates to see more showcases with less crowding from non-NMS attendees.
- Scheduled highlights include Psycho Night II, a major Rave, and other special parties and events.

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NMS is proud to welcome Blue Man Group as one of this year's Opening Night Party performers. Here's what the *New York Post* has to say about Blue Man and their sold-out off-broadway show, *Tubes*:

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—*New York Post*

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European Rock Indies: Licensing Into and From the U.S.
Freedom Of The Press: Belongs to Those Who Own One
Imprints: The Pros and Cons of Label Subsidiaries
Indies For Sale: What Makes An Indie Independent?
Marketing: Majors In The '90s
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MC/DJ BATTLE FOR WORLD SUPREMACY

One event that epitomizes NMS's commitment to hip hop and kindred black beats, The Battle has garnered a reputation for being "the ultimate audition showcase for aspiring street music hopefuls." Most Battle finalists have been signed to recording contracts following their entry. This year, Supermen, Inc. and NMS brings you the latest battle, held in the Sheraton Ballroom in semi-final and final rounds. Champs win a Supermen, Inc. Jacket and Ring, a free registration to next year's NMS, and a foothold in the industry!

Mixing with Pitch Shifters

By Larry the O

The power to bend and shape pitch can turn tattered tracks into objets d' art.

Back in the 1970s, real-time pitch shifters were so exotic that the Eventide Harmonizer was the only reasonable choice. Unfortunately, these beauties weren't cheap, and their fidelity often left something to be desired. Since then, vigorous research and development has improved the capabilities and quality of pitch shifters, while concurrently lowering their cost. Now these tools are available to practically everyone.

Isn't it a shame, then, that the widespread conception of pitch shifting remains narrow and unclear? Pitch shifting may be harder to master than basic reverb applications, but it's not a dark secret. Anyone can become one of the *cognoscenti*, reveling in the magic spells required to convince friends and clients of your signal-processing genius, in just the few minutes it takes to read this article.

CORRECTNESS COUNTS

There are three general applications for pitch shifting: correction, enhancement, and special effects. Easy correction of off-pitch recordings became possible with the advent of context-sensitive, a.k.a. "intelligent," pitch shifters in the mid-1980s. Thanks to these devices, good (or even great) performances no longer need be ruined by a few bad notes. For example, you can copy a pitch-compromised vocal track onto a fresh track, run the original track through a pitch shifter adjusted to compensate for the bad notes, and punch in the "fixed" notes onto the copy track (see Fig. 1). When completed, the copy track becomes a composite of original and corrected performances. In other words, the composite track is now an assemblage of "pitch-perfect" takes.

Occasionally, a sound may be constantly off-pitch by a consistent amount, as if the tape deck were running off-speed when the track was recorded. This problem can be easily corrected by running the offending track through a pitch shifter tuned to the desired reference pitch. Obviously, only the corrected version should be audible during mixdown.

A bigger problem is a track with random pitch inaccuracies. The culprit may have been uneven tape speed in the original recorder (often the result of worn capstans or rollers), or a sloppy performance. Fortunately, context-sensitive pitch shifters can "pitch-quantize" an entire performance. Fixing wobbly pitches requires routing the track through a context-sensitive pitch shifter set to correct all notes within a defined range. The device automatically "auditions" every note and corrects the slackers.

This type of processing often salvages a wide variety of errors, but beware: The action of even the best pitch shifters can become audible when a majority of notes are corrected. Heavy-handed pitch correction usually works best on tracks that are not highlighted in the mix. However, if you must apply such high levels of correction to a featured track—such as a lead vocal—pitch-shifting artifacts probably are not your greatest worry.

Oddly, sometimes more can be less in pitch correction. A subtle approach to saving a track with pitch problems involves what I call *pitch concealment*. This application does not correct the pitch, but attempts to make the problem less obvious to the listener. Such tonal camouflage is accomplished by exploiting chorusing effects that fool the ear into averaging the pitch of multiple sources.

ROBERT PRINCE

In the 1970s, Eventide produced one of the first practical real-time pitch shifters. A recent update to the lineage, the H3500 Ultra-Harmonizer offers sampling in its multi-effects menu.

Electronic chorusing is largely based on small, variable amounts of pitch shifting. A good, thick chorus—preferably with more than two voices—can smear pitch perception enough to hide many intonation problems. The key tweaks are the depth of chorusing and the mix between the chorused and original signals (which usually need to be nearly equal for the technique to work).

Although chorus speed is also important, a more crucial consideration is the nature of the modulation creating the chorusing effect. Ideally, all voices should not be chorused identically. Examples of this effect are the random modulation found in the Lexicon 224X and LXP-1 chorus programs and the ability of devices such as the DigiTech IPS-33B and Eventide Ultra-Harmonizer to apply independent modulation to the pitch and/or delay time of their voices.

Another pitch-concealment application involves mixing enough of a pitch-corrected track with a pitch-compromised track to make the combined sound "feel" on pitch. This method helped me salvage a performance where the vocalist's intonation was slightly sharp throughout an entire song.

ENHANCING THE EXPERIENCE

The greatest value of pitch shifting often is signal-enhancement. Pitch shifters can be used to thicken a sound, spread it into stereo, add depth or brightness, or animate it.

The simplest method of thickening, or doubling, a vocal or other track—outside of having the singer replicate the performance on a separate track—is to use 15 to 30 milliseconds of delay to "clone" the signal onto an effects return (or an available input module). Modulating the delay improves the illusion, but shifting the pitch by a few cents improves it even more. If your processor offers more than one voice of pitch shifting, set the voices to complementary amounts (+5 cents and -5 cents, for example). This doubling technique also helps construct exceptionally fat bass tracks. Remember, enhancement usually requires subtlety, so go light on the amount of pitch shift, modulation, and wet/dry mix.

To spread a mono track into stereo, simply pan the pitch-shifted voice(s) away from the original. For lead vocals, I usually use complementary shifts (*sans* modulation), panned right and left, with the original source in the middle. Varying the degree of panning changes the apparent width of the image. It's also fun to add very short amounts of modulated delay (between 5 to 10 ms) to the

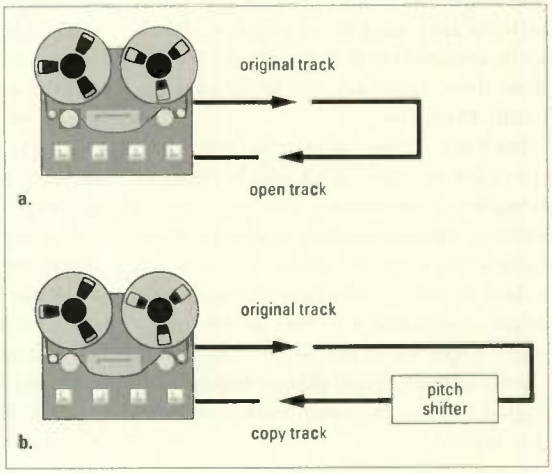

FIG. 1: Using a pitch shifter to correct bad notes in an otherwise good performance requires copying the pitch-compromised track to an open track (a). Then the original track is routed into a pitch shifter adjusted to correct the pitch problem (b), and the corrected note is punched into the copy track. Correct one note at a time, repeating the procedure as needed.

pitch-shifted sound to destabilize the stereo imaging. The source appears to float around the stereo field. I call this technique "animating" the source, and it is one of my favorite tricks.

Pitch shifting can also be used to add depth or brightness to drum tracks. I tune my snare drum very high, but for some rock mixes, it needs a little more "beef." In these cases, I shift the snare down (sometimes as much as a few semitones), roll off the high EQ, and carefully mix the pitch-shifted snare with the original. Now I have the snap of the original with the body of a deeper snare.

▼

Pitch shifting may be harder to master than basic reverb applications, but it's not a dark secret.

Conversely, a flat, "cereal-box" snare can sound snappier by mixing in an up-shifted copy. Be careful: The ear hears imperfections in higher components more clearly than in lower ones. Toms and kick drums also can benefit from judicious pitch-enhancement. However, keep in mind that any sound leaking into the drum mics will also be pitch-enhanced. I often employ a noise gate on the send to the pitch shifter. Carefully gating usually ensures that only the desired source sound is processed.

SHIFTING INTO OVERDRIVE

Producing special effects can be the most enjoyable application of pitch shifting. The most obvious trick is using radical pitch shifts on a voice to produce "helium" (up-shift) or "monster" (down-shift) effects. But even more wildness awaits the fearless. For example, context-sensitive shifters can generate harmonies within a specified

DigiTech's DHP-55, which replaced the popular IPS-33B, is a context-sensitive, "intelligent," pitch-shifting processor.

tonality; some even allow you to specify the amount of shift for each note of the scale. This function was used to transform a solo violin into a demented string section on a recent mix for my band, Stone Fiddle. Again, keep in mind that harmonies *above* the original are usually more detectable as "phonies" than harmonies below.

But wait, there's more! Adding substantial delay to the shifted voices produces great echo/arpeggiation effects. You can get even crazier by adding some regeneration (feedback). A pitch shift of a minor third, with a few hundred milliseconds of delay and some feedback, can take a single note and turn it into an upwardly spiraling, arpeggiated diminished chord. Now try one voice of upshift and one voice of downshift, both with feedback. Are we unintelligible yet?

Besides being fun, these tricks are often employed by film sound designers to wrench fantastic sound effects from commonplace objects: A match being struck becomes a supernova explosion; a sink full of water is transformed into a raging ocean; and a buzzsaw metamorphisizes into the 700-foot killer mosquito from Planet X.

SOME FINAL THOUGHTS

As with all digital processors, overloading a pitch shifter's input produces truly ugly sounds. Unfortunately (for reasons that remain unclear to me), some pitch shifters are unusually susceptible to overload. I often insert a compressor before the send to the pitch shifter to avoid nuking the input level. In the future, I'd love to see manufacturers include onboard analog limiting on the inputs to *all* digital processors. Keep in mind that the greater the pitch shift, the more audible the artifacts.

Also, don't forget that non-real-time pitch shifting, such as that found on samplers and many digital audio workstations, can be used for some of the applications I've discussed, as well as many others.

In my experience, pitch shifters broaden the sonic palette more than any other type of processing except reverb. They can be utilitarian one second and lunatic the next. As always, the real limitations are only your imagination and taste.

Larry the O *recently completed mixing projects for Stone Fiddle and Amazon Queen. Your order form will arrive soon.*

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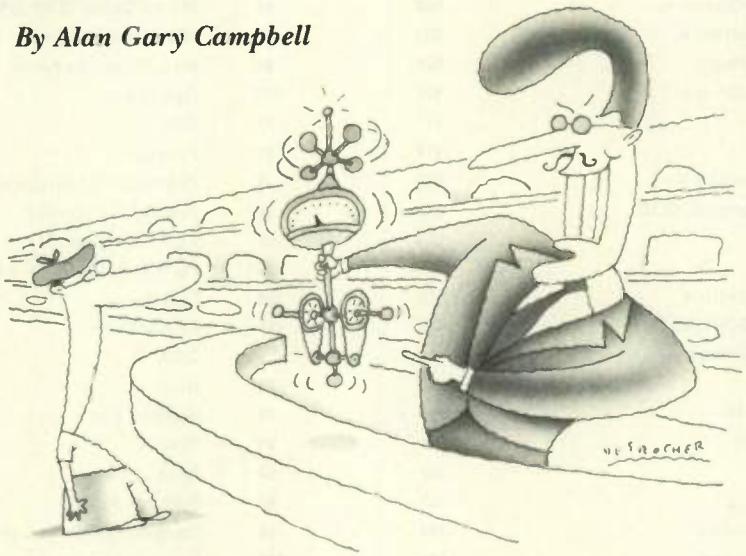
Questions & Answers

By Alan Gary Campbell

Our tech guru groks gizmos for safe AC power testing, muses about multimeters, and revives Memorymoogs.



Q. I want to purchase a digital meter of good quality. What should I look for, a DVM or DMM? What features are important, and what accuracy is really needed?

A. A digital volt meter (DVM) is a high-accuracy, laboratory device that measures voltage only. The test instrument you want is a digital multimeter (DMM), which is available in many sizes and configurations. DMMs measure (within design limits) AC and DC voltage, DC (and often AC) current, and resistance. More elaborate DMMs also measure true-RMS AC, continuity, conductance, dB, frequency, and diode and transistor parameters. Some provide high-voltage and high-current capability, relative measurements, logic functions, and signal-generation capability—a lot of functions for what is often a handheld device.

For professional service work, a 4½-digit, 0.05% DC-accuracy (or better), 100 µV resolution DMM is essential. An instrument with less accuracy and resolution is inadequate for measuring power-supply output voltages, reference voltages, voltage offsets, and DAC parameters in synthesizers and effects. The benchtop Fluke 8050A 4½-digit model (around $425) is often seen in music-technology service.

Nonetheless, a simple, 3½-digit, generic DMM is useful and can handle a large percentage of service work. Believe it or not, I use a Radio Shack pocket DMM (catalog number 22-171; around $25) for most general troubleshooting tasks, which saves wear and tear on my necessary, but temperamental, 8050A. Radio Shack puts this little jewel on sale once or twice a year, and it's a bargain. You can always purchase the big DMM later.

Note: Using a 3½-digit DMM to calibrate electronic parameters that require a 4½-digit instrument will result in complete miscalibration of the affected gear.

No matter what DMM you choose, some features are mandatory: auto-zero, auto-polarity, and audible continuity testing. Auto-ranging is handy, too. Depending on the application, other functions may be just bells and whistles.

Q. Recently, one of my amps blew up because of improperly wired AC power. It was scary; it could have been me that blew up. Is there a safe, accurate way to test AC power? Sticking meter leads in AC socket holes doesn't seem safe.

A. An outlet analyzer (see Fig. 1) is a safe, effective, inexpensive (around $6) device for testing AC power at a standard, 3-wire outlet. It indicates the status of the outlet via three LEDs, which show correct, reversed, or open wiring, and simply plugs into the socket like a standard AC plug. These devices are available at hardware and department stores and Radio Shack (catalog number 22-101). An outlet analyzer is an indispensable test instrument that can save your gear and help prevent serious injury. (For more on testing AC outlets, see "On Solid Ground, Part 1" in the September 1992 EM.)

It cannot, however, test for high or low outlet voltage, or more complex wiring problems. For such applications, Ecos Electronics Corporation manufactures the Accu-Test, a sophisticated, hand-held, AC-line test instrument. The Accu-Test is considerably more expensive ($149.95), but its value to those who work in venues with unknown AC-line characteristics can hardly be overestimated. The first accident avoided could pay for the Accu-Test

JACK DESROCHER

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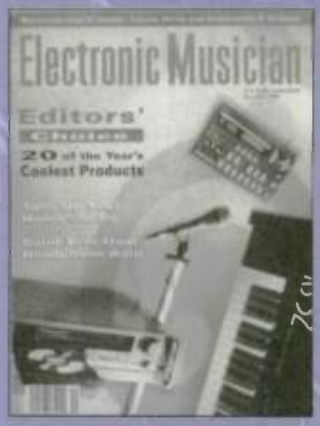

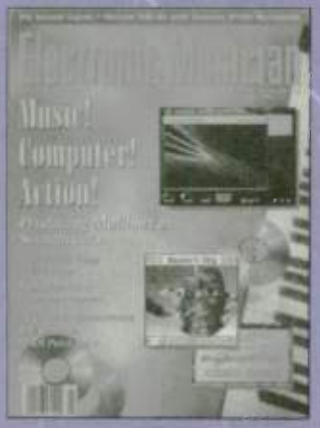

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many times over. The Accu-Test (catalog number 327TEO12) is available from Techni-Tool, 5 Apollo Rd., PO Box 368, Plymouth Meeting, PA 19462; tel. (215) 941-2400.

Continuous monitoring of line voltage from an outlet known to be correctly wired requires an AC line monitor, which is a dedicated analog or digital AC voltmeter housed in a freestanding enclosure. It plugs into your outlet strip just like any AC-powered accessory. AC line monitors are available from most electronics suppliers (though they are often special-order items) and range in price from $100 to $200. A mail-order source for the Viz Model WV-120C Analog Line Monitor ($119.95) and the Model WD-121A Digital Line Monitor ($180) is Fordham Radio, 150 Oser Ave., Hauppauge, NY 11788-5134; tel. (800) 695-4848; (516) 435-8080; fax (516) 435-8079.

Caution: It is unsafe to stick anything except a standard AC plug into an outlet.

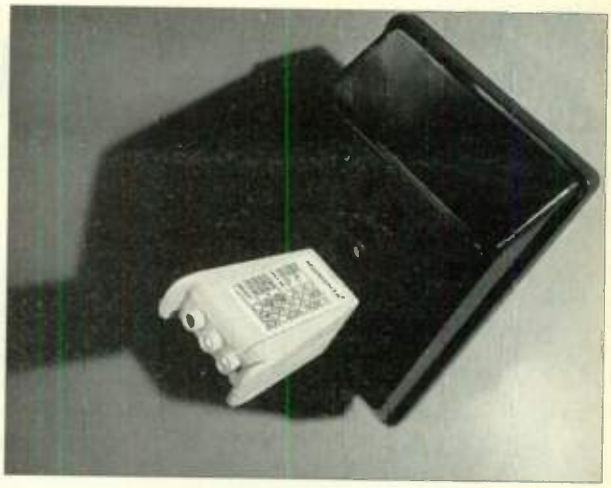

FIG. 1: Three-prong AC outlet analyzers, such as this Radio Shack model, show whether an outlet's hot, neutral, and if the ground terminals are disconnected, or if the hot terminal is reverse-wired with either neutral or ground.

Q. I have a Roland S-50 sampler that intermittently garbles the sound data in memory, but this just affects some of the sounds, or part of the keyboard. I had the unit open for service and noticed that when I pushed on the CPU board at a certain spot, the symptom recurred. I finally narrowed down the trouble to a capacitor near IC27; if I touched it, the unit glitched. I had the soldering iron on and the unit open, so I resoldered the capacitor connections. The unit has worked fine since.

Am I kidding myself, or did I actually fix something?

A. The bypass capacitors are vital for keeping noise off the data lines. If the capacitor's solder joints were cold, resoldering the connections could have solved the problem. It is possible, though, that the capacitor is internally defective, and the heat of resoldering temporarily "patched" it. If the problem recurs, try replacing the capacitor. (Take care when desoldering not to overheat and inadvertently lift the pads.) It is remotely possible that some other defect is the source of the trouble, and the result is a coincidence, but it seems likely you found the trouble the first time out. If this becomes a habit, send me your resumé.

Q. I have a Moog Memorymoog synth in which the oscillator 2 circuits are not functioning. I have checked the "C7" oscillator-tuning routines, as described in the manual; all oscillator 1 and 3 circuits are normal, but the oscillator 2 displays "DEAD OSC." This affects all the programs.

I've opened and reassembled the unit myself without difficulty, following the instructions in the service section of the manual. While it was open, I observed that most of the ICs are socketed. I'm not a technician, but I can work intelligently and carefully. Does this sound like something I could fix by swapping ICs, and where would I get the parts? Also, I have the service documentation that is included with the owner's manual and a big envelope that contains schematics and some photocopied update bulletins; is that all the documentation there is?

A. The key symptom is the fact that the oscillator 2 tuning routines for all six voices are affected similarly, and the problem is not patch-dependent. (A defective component in the Polymod section can cause similar symptoms when that section is enabled.) This symptom strongly suggests that one of the DMUX circuits that affects only the oscillator 2 circuits has a defective CMOS switch, or a defective output sample/hold op amp. Try replacing, on the DMUX board, the 4051 CMOS switch, U11, and LF353 dual op-amp U22 (associated with the oscillator 2 tuning output). Alternatively, replace the 4051, U14, and LF353 dual op-amp U35 (associated with the oscillator 2 octave output).

As you observed, these components are socketed, and, in the absence of available professional service, it seems reasonable to attempt to troubleshoot the unit by part-substitution. (Make sure the unit is unplugged from the AC line before opening the case or removing or replacing any components.) The proper procedure for removing socketing ICs was described in detail in the May 1993 "Service Clinic." The 4051 is a static-sensitive part; proper static safety procedures were described in the January 1993 "Service Clinic."

The 4051 CMOS switch and LF353 op amp are available from most electronics suppliers (though not from Radio Shack). A TLO72 can substitute for the LF353.

Your Memorymoog documentation appears to be complete, assuming all the schematics and update bulletins are included. Note that updates for the power supply, common analog board, panel switches, and R.S.C. board are all necessary for the proper operation of the Memorymoog.

Moog Music Memorymoog

EM *contributing editor* **Alan Gary Campbell** *is owner of Musitech, a consulting firm specializing in electronic music product design, service, and modification.*

Reviews

Audio Editing Software for Multimedia PCs

By Dennis Miller

Five low-cost audio-control programs for Windows.

As the importance of audio has increased in the world of mainstream desktop computing, numerous *Windows* programs have started offering varying degrees of audio support. One of the benefits to musicians is the appearance of inexpensive programs that access all the audio sources in a multimedia PC. These programs are intended to enhance the software bundled with *Windows* sound cards and, in most cases, add considerably to the features of those cards.

PROGRAM	LOAD TIME	COMMENTS
AudioView	1 min. 20 sec.	complete waveform displayed
MCS Stereo (Tape mode)	36 sec.	no waveform displayed
MCS Stereo (Wave Edit mode)	n/a	file too large to load
Sound Impression	15 sec.	complete waveform displayed
Sound Professional (Data mode)	7 min. 57 sec.	complete waveform displayed
Sound Professional (Formula mode)	instantaneous	waveform display disabled
Wave Tools	1 min. 10 sec.	complete waveform displayed

FIG. 1: The average time it took each program to load a 48 MB soundfile into a 33 MHz, 80486 PC with 4 MB of RAM. No other *Windows* programs were running, and Undo was turned off (if possible). Note that when using the default display showing only a few seconds of the sound, *Wave Tools'* load time dropped to near-instantaneous.

Among these new editing programs, Voyetra's *AudioView*, Animotion's *MCS Stereo*, Asystem's *Sound Impression*, Digital Soup's *Sound Professional*, and Turtle Beach's *Turtle Tools* provide features that should appeal to the business user, hobbyist, and professional musician alike. Similar programs are proliferating at an amazing rate, but I'll focus on these five, which typify the genre.

Most useful for the musician are the waveform-editing tools for stereo hard-disk recording, which range from fairly basic to extensive. Equally important are the "multitrack" mixers featured in two of these programs. There are also various levels of MIDI support, from a complete sequencer in *Turtle Tools* to simple Standard MIDI File (SMF) playback in most of the others. Although they handle audio, and MIDI in some cases, none of these programs provide the capabilities of an integrated program such as Opcode's *Studio Vision* for the Macintosh. But you can play a MIDI file while recording digital audio, and for $130 or less, there is something to please almost everyone.

Each of the five programs examined here contains two or more modules for controlling audio. All five include a waveform editor, and all can play audio CDs from a CD-ROM drive. After that, the similarities end. *Sound Impression*, *MCS Stereo*, and *Turtle Tools* play Standard MIDI Files, but only *Turtle Tools* offers MIDI data editing. *Sound Impression* has a unique digital-audio "sequencer," while *Stereo* has a database for tracking the numerous files multimedia projects can generate. *Sound Professional* and *AudioView* offer just waveform-editing and CD control, but their feature sets place them at or near the top of the pack for editing.

PLAYBACK FEATURES

Each of these programs lets you play two or more audio sources at the same time. It's a kick to have .WAV (Wave) files, MIDI, and CD audio humming along together, but one limitation hounds all the programs: Although you can build playlists in several of the programs, none let you mix different types of audio in a single list. As a result, in all programs except *Sound Impression*, you must trigger different sound sources individually to hear them all play at the same time. The new version

3.5 of *Sound Impression* includes a trigger dialog box that lets you trigger any combination of audio sources. This feature lets you sync MIDI and digital audio playback, something few, if any, other programs on the PC can do. Note that *Windows* does not supply a common clock, so once you trigger your various audio sources, you can only hope they stay in sync. If the CD player hiccups, it's out of sync for the duration.

In addition, only *Sound Impression* and *Stereo* provide mixers to manage the output levels of the various audio sources, and neither offers any type of automation. With the other three programs, you must use the mixer supplied with your sound card's software. That's not unreasonable, but a mixer is a basic feature and should be included in any program that aims to provide "integrated" audio control.

All of these programs can play Wave files, and again there's a wide range of capabilities. *Stereo* and *Sound Impression* have modules that resemble cassette players, complete with Fast Scan, Loop, and Pause buttons, as well as output-level meters. Both programs also provide waveform displays, which is the approach used by the other three programs for all Wave file functions.

Every program allows you to playback an entire file, or a selected range. *Turtle Tools' Wave Tools* application can also play just the range that appears in the current window. *AudioView* adds another nice touch: the ability to define a range during playback. Click on the Mark Range button while playing, and the highlighted area extends as the cursor moves across the screen.

RECORDING

Recording from an external source is fairly straightforward, assuming your hardware supports it. All five programs offer variable sample rates (specific rates depend on your sound card), and you can monitor the source with meters while recording in *Sound Impression, AudioView, Wave Tools,* and *MCS Stereo. Sound Professional* and *Stereo* have a handy option that lets you insert, mix, or overwrite a new recording into an existing file. *Wave Tools,* by default, inserts the new recording into the open file, while *Sound Impression* and *AudioView* simply replace the existing file. *AudioView* also lets you load an existing file directly into the clipboard and mix it into your new recording, which is handy.

▼ It's a kick to have Wave files, MIDI, and CD audio humming along together.

None of the programs provide a threshold option for recording, so you must start the Record function, then trigger your source. However, *Sound Professional* has a handy Record-Lock feature that starts an attached CD-ROM drive at the same instant you click on the Record button. (Note that the previously mentioned new trigger dialog box in *Sound Impression* 3.5 more than covers this territory.)

Keep in mind that all five programs support two tracks of digital audio, locked in a stereo pair. You can't have different Wave files on the left and right tracks (hence, you can't overdub Wave files), and you can't offset one track with respect to the other.

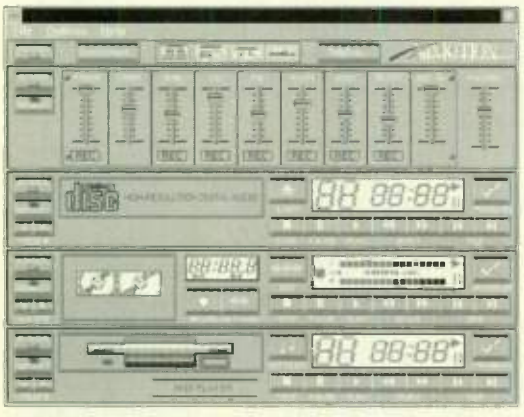

FIG. 2: *MCS Stereo's* main screen emulates a rack of stereo components, with modules for Wave file recording, editing, and playback; SMF playback; CD-ROM audio; and mixing.

EDITING

The key to all five programs is random-access editing of audio on disk. Unlike most high-end digital-audio editors, most of the edits are destructive, i.e., the soundfile is permanently altered. While various types of Undo options are available, only *Sound Professional* offers true non-destructive editing.

Each of the programs provide basic cut, copy, and paste waveform editing, as well as fade-ins and fade-outs. *Sound Professional* tops the list with the most extensive list of effects, including time-stretching (with or without pitch shift), delay, compression, EQ, and waveform-reverse. Unfortunately, some of these are difficult to use and can take quite a while to perform.

AudioView comes in second, with a well-rounded set of transforms, while *Stereo* and *Sound Impression* also offer numerous ways to process your soundfiles. Only the *Wave Tools* module in *Turtle Tools* falls short, offering just fade-in and fade-out. If you like *Turtle Tools'* other features and are serious about wave editing, you'll want to add Turtle Beach's excellent waveform editor, *Wave for Windows* (see sidebar "Wave for Windows 2.0").

When evaluating editing features, keep in mind that *Stereo* uses RAM-based editing, which means soundfiles are loaded into RAM for processing. As a result, your system RAM limits the size of the files you can work on, but editing is faster. Under *Windows'* Enhanced mode, you can get around this limitation by using virtual memory, so that free space on your hard disk holds the files you're working on. But even then, you don't have access to your entire disk. *Wave, AudioView, Sound Impression,* and *Sound Professional* use disk-based editing, letting you work with much larger files.

DOCUMENTATION

As music software moves into the mainstream market, the importance of help for the new user grows. All five programs follow the *Windows* convention of providing online help, but only *MCS Stereo* offers a full-blown, online tutorial. Each of the manuals are at least adequate, with *AudioView* and *Sound Impression* receiving a special nod for thoroughness and clarity. However, a "thumbs down" goes to *Turtle Tools* for not providing an index in its documentation. All but Digital Soup's *Sound Professional* have established a presence on CompuServe and offer direct BBS

support.

Another distinction involves an element of the user interface. Many new *Windows* programs let you view an icon's function by moving the mouse cursor over it, or by clicking on it with the right button. This feature is fully supported by *Stereo*, *Sound Professional*, and *Sound Impression*. *Wave Tools* has fewer icons, and they are self-explanatory for the most part, but *AudioView* could certainly benefit by adopting this convention.

SPEED

Digital audio recorded at high sampling rates consumes huge amounts of disk space, so I measured the time it took each program to load a 9-minute, mono, 16-bit .WAV file recorded at 44.1 kHz. The file was 48 MB, and I was running a 33 MHz, 80486 PC with 4 MB of RAM. I repeated the operation three times and took an average. All settings were identical: No other *Windows* programs were running, Undo was turned off (if possible), and I specified that a complete waveform be drawn. The results were striking (see **Fig. 1**).

Keep in mind that the initial amount of sample time displayed in *Wave Tools* is adjustable, and when using the default display of only a few seconds, the load time drops to near-instantaneous. Large files in *Sound Professional* are best managed in Formula mode, with the waveform display disabled.

ART MEETS COMMERCE

Another consideration is support for Object Linking and Embedding (OLE), a capability now provided by most top-of-the-line non-music *Windows* programs. With OLE, a Wave file can be represented with an icon in a non-music application such as a word processor. The Wave file plays back when the user clicks on the icon.

The term "server" is used to describe the program that created the Wave file, and "client" describes the non-music program. Currently, *AudioView*, *Sound Professional*, and *Sound Impression* are the only programs that can act as servers, but I predict all music programs will get into the act soon. The ability to serve up audio in a business program will greatly increase the business world's interest in audio software.

MCS STEREO

Working with *MCS Stereo* 1.02 is like having a rack of stereo components onscreen (see **Fig. 2**). Functional mod-

WAVE FOR WINDOWS 2.0

Picking the most powerful standalone waveform editor for *Windows* is not difficult: Turtle Beach's *Wave for Windows* wins hands down. Originally released in 1992, *Wave* will have received a major upgrade to version 2.0 ($149; upgrade $39) by the time you read this. Although it's hard to imagine, Turtle Beach has made it an even more powerful program. The new release includes an awesome set of processing tools that provide, in essence, racks full of effects to manipulate soundfiles. Numerous shortcuts and clever features make audio editing a simple proposition.

Wave 2.0 retains its large, graphic waveform display and overall lean appearance. Like the previous version, up to four files can be open at once, but several new soundfile formats, including Microsoft ADPCM and raw PCM, are now supported. However, the most significant enhancements are in the processing tools. New functions include Auto Stutter, Distortion, Flange, Digital Delay, Reverb, Speed Up/Down, and Normalize. Many of these options include preconfigured settings in addition to user-adjustable parameters. Better still, the user settings can be saved and named for later recall.

With new audio software developing dramatically and new processing chips just up ahead, it won't be long before we see software-based multi-effects programs, complete with real-time MIDI control. Judging by the lead Turtle Beach has on the competition, *Wave* will surely be the first in line on the PC. As it stands, *Wave* already equals many dedicated hardware effects units. Catch the *Wave* for the best *Windows* waveform editor around.

ules include Wave file recording, editing, and playback: Standard MIDI File playback; CD-ROM audio; and mixing. You'll also find a remote-control component that can quick-start any or all of the applications.

Stereo has two main working modes: Standard, in which you work with all or some of the modules at once, and Enhanced, in which they are used individually. While there are some differences between the features in each mode, it might have been easier to combine all the functions into one approach. *Stereo*'s graphics are clear and crisp, and the program is highly integrated and well-organized (with a few exceptions).

Playing MIDI files in *Stereo* is similar to using all other play modules: Launch the MIDI Player, open the Open File dialog box, select a file, and hit Play. As with the other components, you can build a playlist and save it to disk, but the list can only reference the type of file you're currently using. Both the Standard and Enhanced MIDI players use tape-deck-style controls to adjust volume and play, pause, stop, scan, or skip a selection. Enhanced mode adds more options, including the ability to repeat or randomize the selections in a playlist, and provides a souped-up display that can toggle between total and remaining playing time. Icons representing the other modules are displayed at the top of the screen, making it simple to jump between applications.

Stereo includes a fairly extensive toolkit for processing selected segments of audio files. Options include Amplify, Pan, Fade, Chorus, Flange, Echo, Mix, Insert, (sample) Rate, and Reverse. Nearly all the options have adjustable parameters. For example, the Chorus function provides Depth, Delay Time, and Sweep Rate. *Stereo*'s sliders and faders are large and efficient, making fine-tuning easy. *Stereo* also offers Block Save, which lets you highlight a segment and save it directly to disk. I found this feature quite useful.

You can easily mix in another file of the same sample rate and bit resolution, and you can adjust its volume. But inserting a file takes a little more effort: You must first insert a silent segment, then mix the new file into that space. (Alternatively, you could load both files and cut and paste.) More annoying is the fact that you can't record directly in the editor; you must move to the main

Product Summary

PRODUCT:
MCS Stereo 1.02
PRICE:
$79.95
MANUFACTURER:
Animotion Development Corp.
3720 Fourth Ave. South, Suite 205
Birmingham, AL 35222
tel. (205) 591-5715
fax (205) 591-5716

EM METERS	RATING PRODUCTS FROM 1 TO 5
EDIT FEATURES	●●●◖
EASE OF USE	●●●●
DOCUMENTATION	●●●◖
VALUE	●●●●◖

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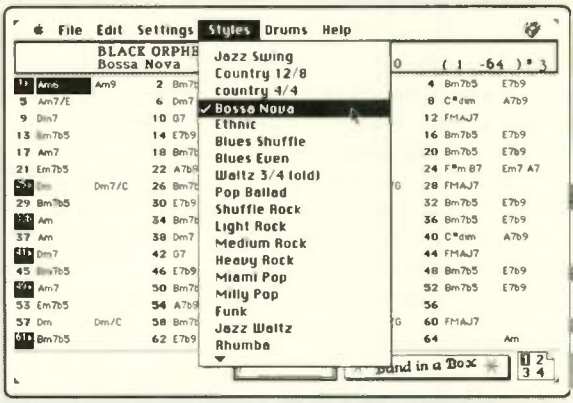

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PC Magazine Jan. 15, 1991
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Electronic Musician Magazine

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STart magazine

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Music Paper Magazine

"I am in awe. I didn't think that such an incredible program could even exist. This software is a dream come true."
PC Journal Sept. 1992

"Band-in-a-Box is an amazing program"
Keyboard Magazine Aug. 1992

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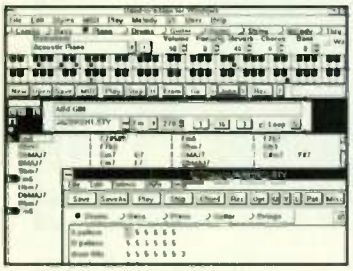

- *The "Wizard" (intelligent playalong features)*
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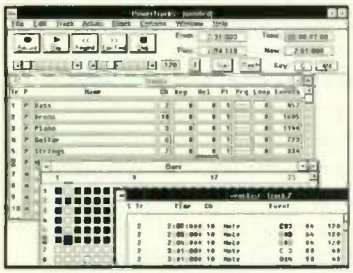

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Recorder module. However, playback and various file options are available from the editor.

The CD-ROM Player operates much like the other modules, with one nice twist: You can launch a CD-ROM-based application directly from your drive. *Stereo* also includes a built-in database that can catalog all your Wave or MIDI files, or build lists of your record, CD, or cassette collections. The database automatically saves any playlists you create with the various modules and has full search, sort, and print capabilities. It's not very customizable though; for example, it won't let you change the names of the different fields.

Stereo's Enhanced Mixing Console is easily the most powerful mixer in the group, providing a full set of features to support every device supported by your sound card. Large, easy-to-control faders and panpots are available for each audio source, and if your card can handle it, you can globally boost the treble and bass. There's also a VU-style level meter, complete with peak hold. Best of all, up to eight named preset configurations can be pre-loaded, while even more can be stored on disk. As always, context-sensitive help is readily available.

This program's only downside is a somewhat confusing user interface. Even after a month of use, I still found moving from certain areas to others fairly awkward. If the Standard mixer is displayed and you want to switch to the Enhanced version, you must first access the Remote Control screen, then launch the Enhanced mixer. It would be far easier to have a button right on the Standard component that moved you to its Enhanced counterpart. A little streamlining such as this would further improve an otherwise fine program.

AUDIOVIEW

AudioView 1.50V, from Voyetra Technologies, consists of a waveform editor, a CD-ROM player, and—for users of *Windows* 3.0 without *MME*—a mixer. Although it includes three applications, there's no real integration; you can't start one program from within another. However, *AudioView*'s editor is top-class, and offers much, if not all, of what you need for serious music production. It's also the only program to provide direct support for Sound Blaster's .VOC file format.

AudioView's Wave Editor screen displays a neat and concise arrangement of menu items, edit buttons, "tape transport" controls, and the waveform you're editing (see **Fig. 3**). The VU meter is aligned horizontally, rather than the traditional vertical arrangement, and windows display the range selection and indicate Play or Edit mode. Information about the file's sample rate and bit resolution appears along the bottom of the screen. Most of the major editing operations can be accessed from icons, but there are a few, such as echo and reverse, that you can only access from a drop-down menu. I can't think of a reason these shouldn't be represented as icons, too.

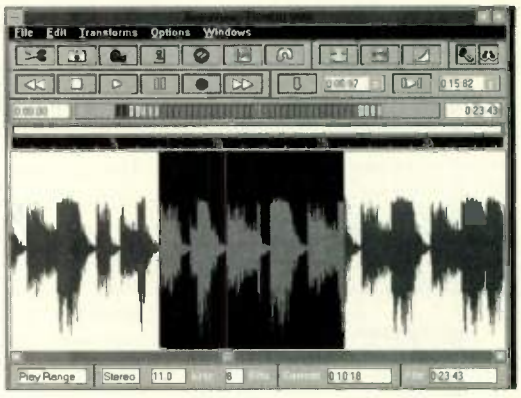


FIG. 3: *AudioView's* Wave Editor. Windows show the range selection and indicate Play or Edit mode. Information about the file's sampling rate and bit resolution appears along the bottom of the screen. Most—but not all—major editing operations can be accessed from icons. Note that the VU meter is aligned horizontally, rather than the traditional vertical arrangement.

Various aspects of the program can be user-configured. If you simply want a Wave file player with no display, you can choose the No Wave option, and the files will load instantaneously. Another set of options lets you customize various aspects of the screen, including waveform, background, and peak colors. Keyboard shortcuts are available for the transport controls and many edit commands. Zooming capabilities are accessible from icons and a drop-down menu.

AudioView's edit functions are called Transforms. They are easy to use and run as fast as, if not faster than, the other programs I examined. Many Transforms have adjustable parameters; for example, Echo lets you choose from several preset configurations, or manually adjust the Time and Depth settings. Other operations, such as Normalize, are "hard-wired" and don't need any additional user input.

The rest of the Transforms are Find Peak, Fade, Noise Gate, Invert Samples, Reverse, Crossfade, DC Offset, and Compress (which only works on .VOC files). Other options include converting a stereo file to mono and adjusting the sample rate. Overall, the program provides a well-balanced and thorough set of features.

While it's easy to cut-and-paste data from within the same file, you can't work on two files at once without launching a second copy of the program. Depending on how much RAM you have, you can actually launch several copies, although this setup would be more efficient if there were a way to automatically arrange the various screens and save the configuration. We're not talking about multitracking here; only one file plays back at a time. Still, the ability to load several files and cut-and-paste among them makes certain types of operations much easier. *AudioView*'s Clipboard window even displays information about a cut or copied segment and plays it back. In addition, the Clipboard segment can be saved to disk as a new file.

AudioView's CD Player is similar to the others, with the familiar "tape transport" controls. The Player has four Program buttons that are used individually, or in combination, to provide numerous playback options. The Play Range feature repeats a short section of a CD,

Product Summary

PRODUCT:
AudioView 1.50V
PRICE:
$129.95
MANUFACTURER:
Voyetra Technologies
333 Fifth Ave.
Pelham, NY 10803
tel. (800) 233-9377
or (914) 738-4500
fax (914) 738-6946

EM METERS	RATING PRODUCTS FROM 1 TO 5
EDIT FEATURES	● ● ● ●
EASE OF USE	● ● ● ● ◖
DOCUMENTATION	● ● ● ● ◖
VALUE	● ● ● ◖

which is handy when transcribing a tricky solo or catching the vocals on a tune. But there's no way to automatically loop the range, or save it to disk. Playlists can also be built and stored for later use.

Subjectively, *AudioView* feels more stable than the other four programs. While General Protection Faults occasionally still haunt many *Windows* programs, including those reviewed here, I didn't experience a single crash while using the *AudioView* editor or CD Player.

Some areas could be improved. For example, when playback of a Wave file ends, the cursor automatically "rewinds" to zero. I would rather have selectable auto-rewind, as in most sequencers. I'd also like to see tighter integration of the modules, such as an auto-start option that triggers CD audio playback when recording starts. But as Voyetra's first entry into the digital-audio world, the program has much to like, and it will undoubtedly evolve and become an even more robust program in the future.

SOUND IMPRESSION

Sound Impression 3.4b, from Asystem, offers a highly integrated set of components to manage MIDI, Wave files, and CD-ROM audio. Its most unusual feature is the Wave Composer, which is, in effect, a sequencer for digital audio. This lets you mix and playback up to sixteen files and save the resulting mix as a new file. These capabilities offer great potential for musicians, but the current implementation leaves a lot to be desired.

Like *MCS Stereo*, *Sound Impression* starts with a main screen that resembles a stereo rack. A menu line provides access to the File, Edit, Options, and Help commands, while a set of buttons lets you show or hide each individual component. Many aspects of the program can be configured, including the appearance of the screen and which modules load at startup. It's easy to move from any area to another using buttons or panels on almost every screen. The excellent online help includes numerous diagrams and text entries.

Sound Impression's Mixing panel provides sliders that control the levels of each playback module and input source, as well as master volume. The Mixer's left and right channels can be

controlled independently, or locked together, and a set of buttons toggles between the various inputs provided by your sound card.

Each of the three sound players is easy to use, but I was troubled by one aspect of the display: An icon is used to program playlists for the MIDI and CD players, but in the Wave Player, the same icon is used for a different function (to loop file playback). This will certainly be confusing for the first-time user. (According to Asystem, this icon has been replaced with a picture of a loop in version 3.5.) On the other hand, playing MIDI and CD-ROM audio is straightforward: Individual files, or user-created playlists, can easily be loaded from disk and triggered.

Sound Impression's main working mode for Wave files is called a "Session," which starts when you load a file into the Wave Player for playback, or into the Wave Editor for manipulation. You can load up to sixteen Sessions at once and move among them using the Session Manager. In addition, an icon on the Session Manager panel lets you stop playback of all sound devices at once. Unfortunately, there's no way to automatically arrange multiple windows, and the screen can quickly become cluttered.

Most of the editing and effects manipulation is done in the Waveform Editor. This screen displays a waveform along with icons for the program's various processing effects, record and playback features, and display options. Many of the effects have parameters you can alter by using handy scroll bars, but others, such as Echo, are less convenient: Tiny arrow keys must be

Product Summary

PRODUCT:
Sound Impression 3.4b
PRICE:
$79
MANUFACTURER:
Asystem
1178 West 11th St., #85
Tracy, CA 95376
tel. (510) 525-4311
fax (510) 525-2812

EM METERS	RATING PRODUCTS FROM 1 TO 5
EDIT FEATURES	● ● ●
EASE OF USE	● ● ● ◖
DOCUMENTATION	● ● ● ● ◖
VALUE	● ● ● ● ◖

FIG. 4: *Sound Impression's* Wave Composer is the heart of the program, a "sequencer" for scheduling and combining up to sixteen Wave files. The Wave Composer represents tracks vertically and time horizontally and uses small "segments" to represent Wave files. The display is fairly small and can't be maximized.

clicked and held by the mouse to increment or decrement values, and you cannot enter numbers directly into a parameter field. If you want to change the Echo delay time from 1 ms to the maximum 9,999 ms, you have a very long wait on your hands.

Sound Impression's other effects include Noise Filter, Gain Adjust, Waveform Reverse, Add or Remove Silence, and Fade In and Out. There also is a real-time pitch-scroll feature, which changes the sample rate of a file as it plays back. Another option merges data from any open Wave Session into the active window.

Once a Session is started, you can launch the Wave Composer. Here is the heart of the program, a "sequencer" for scheduling and combining up to sixteen Wave files (see Fig. 4). The process is not real time, which means you cannot overdub, but it is exceptionally handy and begins to duplicate features found only on systems costing thousands of dollars more.

The Wave Composer represents tracks vertically and time horizontally. Like a sequencer's piano-roll screen, it uses small "segments" to represent Wave files. The display is fairly small and can't be maximized (expanded to fit the full screen), but you can easily position files in the tracks by clicking on one of the sixteen Session buttons, then moving to the track area and placing the segment anywhere in a track. Files of different sample rates can be mixed, with no change in pitch, and individual tracks or an entire composition can be moved forward or backward in millisecond increments. When all the tracks are in place, click the Build Composition button, and a new, mixed file is created. The new file can be saved to disk, or loaded into a Session for additional editing.

The Wave Composer is hampered by some interface quirks. For example, the bars representing different files are not color-coded, and no time line is displayed across the bottom of the screen, so it's sometimes hard to tell where you are and what you're editing. In addition, when you select Show Title On Track, the filename text appears right on top of the bar representing the data. Yet despite minor problems, the program has tremendous potential and could turn out to be a gold mine.

TURTLE TOOLS

Turtle Tools version 1.0, from Turtle Beach Systems, provides a different mix of applications than the others. Included are *Session*, a complete MIDI sequencer with notation editing; *Sound Attach*, for adding sounds to various *Windows* events; *Key Player*, a keyboard-based MIDI note player; *Wave Tool*, a scaled down version of Turtle Beach's *Wave* waveform editor; and *MIDI Tune-Up*, a Standard MIDI File player. These modules appear as stand-alone programs and aren't integrated. yet the overall capabilities of the package, especially with respect to MIDI, are extensive. *Turtle Tools* also ships with *Sound Bank*, a CD-ROM with 300 short sound effects in Wave file and Red Book CD audio format.

KeyPlayer

KeyPlayer is a recreational program that turns your computer keyboard into a MIDI input device. Although it's clearly designed for the hobbyist, *KeyPlayer* could also serve as a handy scratch pad for the musician who spends a lot of time in front of a PC. With a built-in MIDI file player and 16-channel mixer, you can easily configure a sophisticated, multitimbral ensemble to accompany your improvisations.

The application lets you select from any of the twelve keys and nineteen common scales. Once a key and scale are chosen, only those notes are available. You can play chords up to the limit of your sound card's polyphonic voices, using the Shift or Caps Lock keys to sustain notes. There are two different ways to map your keyboard: Jagged, where successive scale steps are found on alternate rows; and Horizontal, where the scale steps progress continuously along each row of keys. While you're playing, a piano keyboard is displayed on the screen, so you can

see what notes you're hitting. The mouse can also be used to play the virtual piano directly.

KeyPlayer can record your performance and save it in a separate file, or in combination with a MIDI file accompaniment. There's no way to edit MIDI files directly, but other applications in the package provide that. A basic but functional CD player is also included with *KeyPlayer*, so you can jam with your favorite artists.

Midisoft Session

Turtle Tools' most powerful MIDI capabilities are found in Midisoft *Session*, a complete sequencer with music-notation editing. *Session*'s three main work areas include a Mixer screen, a graphic window used to record, edit, and play files; a MIDI event list for detailed, text-based editing; and a Score window, where approximately eight tracks can be displayed at once. (The maximum number of tracks is limited by system RAM.) All of these windows can be onscreen at once, but there's no automatic sizing or arrangement option.

▼

Turtle Tools' modules appear as stand-alone programs and aren't integrated, yet the overall capabilities of the package, especially for MIDI, are extensive.

Overall, the program is well-integrated; changes made in one area are immediately updated in the others. *Session* also provides a huge number of keyboard shortcuts, making nearly all commands available as one- or two-keystroke combinations.

The Mixer screen is a pleasure to use, with large, uncluttered displays and smooth, efficient controls (see **Fig. 5**). The Mixer provides individual volume, pan, and solo/mute options for each track, plus a master volume slider. Its transport controls use the familiar tape-recorder model. Program changes can be sent during playback, and chorus and reverb are available if your sound card supports them.

Session loads and displays files in the Score View very quickly and ships with an extensive collection of MIDI files in many musical styles to get you started. A graphic toolkit is used to step-enter notes and perform various cut-and-paste functions. I found step entry into an empty measure quick and easy, but trying to add music to an existing measure was unpredictable. Recording from a MIDI keyboard was fine, however, and a considerable number of editing tools are available to clean up your score.

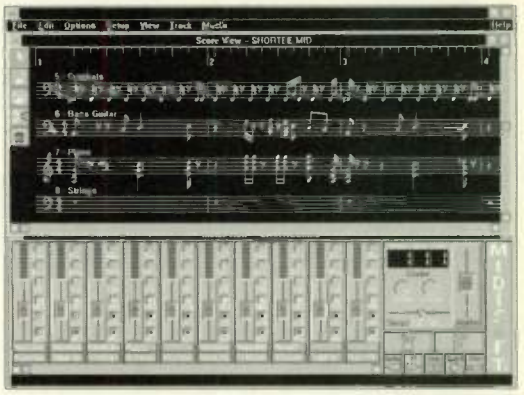


FIG. 5: *Turtle Tools* includes Midisoft *Session*, a powerful sequencer that features a Mixer screen with large, uncluttered displays and smooth, efficient controls.

The MIDI List View organizes MIDI data into editable rows and columns. Every individual event, including pitch, controller, and velocity information, is shown in chronological order. Using the left and right mouse buttons, you can change the values associated with any event, while Insert and Delete buttons are available to manipulate single or multiple entries. Unfortunately, the screen doesn't scroll during playback, unlike the Score View, which sometimes makes it difficult to locate a specific event.

Wave Tools

Turtle Tools provides Wave file recording, editing, and playback through its *Wave Tools* module. While the program offers only a tiny subset of *Wave for Windows*' processing capabilities, many of the basic cut, copy, and paste features are intact, and Turtle Beach's reputation for slick graphics and easy-to-use interfaces is upheld. *Wave Tools* uses *Windows*' Multiple Document Interface model to display four sound files onscreen at once, and you can copy-and-paste between all open windows, as long as the sound files are in the same format.

Wave Tools' main screen includes a menu bar, icons for several of the program's primary functions, a pair of sliders to adjust horizontal and vertical zoom levels, and a large, crisp display for Wave files. Nearly all of the features can be accessed by single- or double-keystroke combinations, and moving through files of any length is a breeze using any of the 256 named markers. (A Go To Marker menu item calls up a list of the first sixteen markers, which can be accessed randomly.)

The program's effects list includes only fade-in and fade-out. But an extensive range of editing functions, including Paste Insert, Paste Over, Paste Fill, Mix Paste, and more, gives you numerous options for creating unique sounds. *Wave Tools* also offers a customizable Frequency Analysis display for viewing the harmonic spectrum of a sound.

Other Tools

Turtle Tools' two remaining modules are geared primarily for playback and don't provide much in the way of music production. *Tune-Up*, a MIDI file player, resembles the main screen of many *Windows* sequencers. *Sound Attach* is a utility for attaching sounds to *Windows*

Product Summary

PRODUCT:
Turtle Tools 1.0
PRICE:
$89
MANUFACTURER:
Turtle Beach Systems
Cyber Center 33
1600 Pennsylvania Ave.
York, PA 17404
tel. (717) 843-6916
fax (717) 854-8319

EM METERS	RATING PRODUCTS FROM 1 TO 5
EDIT FEATURES	● ◖
EASE OF USE	● ● ● ◖
DOCUMENTATION	● ● ●
VALUE	● ● ● ● ◖

events. Both work as advertised and are useful add-ons to *Turtle Tools'* already extensive capabilities.

SOUND PROFESSIONAL

Sound Professional 1.0d, from Digital Soup Corporation, includes a powerful toolkit for processing Wave files and an integrated but troublesome utility for playing CD-ROM audio. The program stands alone in its ability to perform non-destructive, disk-based editing, and it provides a unique but complex approach to sound processing with its Formula Mode. *Sound Professional* can combine up to sixteen tracks of audio and effects, although its unfamiliar interface takes some getting used to. Extensive tutorials, due in a forthcoming release, should ease the pain somewhat.

Sound Professional's main screen includes a Track Editor, Tool Bar, transport controls, and status information (see **Fig. 6**). Like the other programs, many features can be configured; for example, the Tool Bar can be arranged to show only those functions you select. Although the multiple windows are movable, they cannot be maximized, making detailed work difficult. A "smart cursor," which displays the names of the Tool Bar icons as you pass over them, helps keep track of which options are available.

After recording a sound, the waveform display appears in the open tracks, and you can immediately play back from any point. However, moving the cursor to a specific point in the file is not so simple because long files can't be displayed in their entirety,

Product Summary

PRODUCT:
Sound Professional 1.0d
PRICE:
$99
MANUFACTURER:
Digital Soup
PO Box 1340
Brattleboro, VT 05302
tel. (800) 793-7356
or (802) 254-7356
fax (802) 254-6812

EM METERS	RATING PRODUCTS FROM 1 TO 5
EDIT FEATURES	● ● ● ●
EASE OF USE	● ◖
DOCUMENTATION	● ●
VALUE	● ● ● ◖

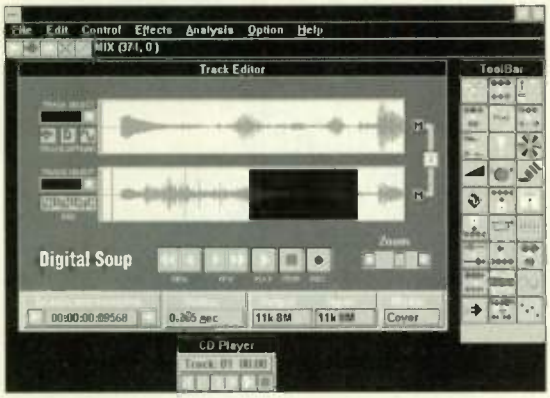


FIG. 6: *Sound Professional*'s main screen includes a Track Editor, Tool Bar, transport controls, and status information. Like the other programs, many features can be configured. Though the multiple windows are movable, they cannot be maximized, making detailed work difficult.

even at minimum zoom. Once you locate a point, you can set a marker, and moving between contiguous markers is easy.

Sound Professional lets you view only two tracks at a time; the Track Select buttons are used to move between tracks. You can record new material into as many as sixteen tracks, or import Wave files from disk. But tracks can also hold instructions about how audio data should be processed. This lets you create a massive "multi-effects" algorithm by storing up to fifteen layers of processing information for a single track of audio. Applying effects to audio tracks, individually or in combination, offers a bewildering number of options.

Like a formula in a spreadsheet, *Sound Professional*'s functions don't actually alter the audio on disk, but are applied when you play back. Depending on the complexity of the formulas, the additional processing time can be considerable. (A separate Data Mode plays edited files more quickly, but the changes to the file are permanent.) Formulas are entered by typing directly into the Formula Edit Box, which appears at the top of the main screen, or using the tool icons to specify the various effects parameters. For example, if you want to change the timing of a file using Formula mode, you must go through an elaborate, convoluted process that is far more trouble than it should be. But I love the concept.

While single-track editing and playback is fairly straightforward, multitrack processes give new meaning to the word "complex." Individual tracks must be routed to left and right Output Tracks, then enabled for inclusion in the mix, one at a time, all of which is done in a nonintuitive, non-graphic environment. *Sound Professional* desperately needs a multitrack worksheet on which tracks can be arranged over time and adjusted for volume and pan levels. Until then, the tremendous potential of Digital Soup's program lies buried beneath several needless layers of structure.

I also had intermittent problems using *Sound Professional*'s CD player. In many cases, I got a message saying my drive was not available when I tried to play. At other times, I could not get the track selector to increment tracks, i.e., the button would not move past Track 1. To get the drive working, I had to give it a jump start from the CD player in another program, after which *Sound Professional*'s icons worked properly.

SUMMARY

So which program should you buy? If your main interest is MIDI, and you don't have a sequencer already, *Turtle Tools* is the best bet. A superior choice for waveform editing is *AudioView* because it provides a more complete set of features and feels bulletproof. *MCS Stereo* and *Sound Impression* can control more types of audio than the others, and both have well-integrated mixers, making them ideal for small-scale multimedia productions. However, *Stereo*'s editing capabilities are limited by the fact that it is RAM-based. Parts of *Sound Impression*'s user interface need revamping; hopefully this has been addressed in the new version. *Sound Professional* shows great potential, but it is not yet ready for prime time.

It seems clear that the professional musician has much to gain from the current massive interest in desktop audio and multimedia. While none of these programs are perfect, their incredibly low prices and potential power leave me with great expectations for the near future. With a few enhancements, such as the ability to move Wave files to a sampler (via MIDI Sample Dump Standard or SMDI) and improved multitrack mixing and editing, I can imagine these and similar programs on the desktop of every computer musician. That should be a tremendous boon for music producers and will put random-access, digital-audio editing within everybody's reach.

Dennis Miller *is on the music faculty of Northeastern University in Boston. After a fifteen-year break, he's finally back on stage performing live signal-processing on 16-bit audio files. It's not going over too well with the wedding crowd, but he hopes they'll learn to like it.*

Kawai GMega Synthesizer

By Jim Pierson-Perry

Another advance in low-cost General MIDI synths.

At first glance, the Kawai GMega seems modeled after its fellow half-rack General MIDI synth modules, the Roland Sound Canvas and Yamaha TG100. It is roughly the size of a cigar box and would be equally at home onstage with a master keyboard, or supplying the instrumental sound of a multimedia computer system. Closer inspection, however, shows some significant design improvements over its competitors.

The GMega's front-panel controls are cleanly laid out, with welcome attention to ergonomics. Six buttons, nicely finger-sized, control the unit's operations, while parameter values are selected by dialing a large wheel. By using two fingers to push buttons, and a third on the dial, you can make all setup and editing changes without moving your hand.

The front panel also holds a green, backlit, 2-line × 16-character, LCD display; a master volume control; and a stereo, ¼-inch miniplug headphone jack. In Monitor mode, the display shows the channel numbers for incoming MIDI events, which is useful for diagnosing MIDI-system problems.

The back panel has a pair of RCA

audio-out jacks; an 8-pin, mini-DIN, serial MIDI interface for Macintosh computers; and a connector for the external power adapter (yes, another "wall-wart" plug). A serial interface for PC computers was considered, but not implemented. The presence of a mini-jack for headphones and RCAs for the main outs clearly indicates that Kawai designed the unit primarily for the consumer electronics market and only secondarily for the home recordist.

The Mac MIDI interface is surprisingly sophisticated for a simple General MIDI unit, offering two independent, non-merging MIDI In ports. Since each port supports sixteen channels, the GMega can respond to 32 MIDI channels, without additional hardware. One obvious use for this is to have a sequencer play back on MIDI In A, while you play along through port B. There are additional ports for Out/Thru A (software-switchable) and Thru B. You even can specify whether the GMega will respond to MIDI information arriving at the MIDI ports, the Macintosh serial port, or both. I had no troubles using the Mac interface to run a variety of MIDI software.

The GMega manual is well-suited for beginners, offering easy-to-follow instructions. More knowledgeable users may become frustrated trying to find specific information, due to an inadequate index (e.g., no listing for aftertouch or reverb).

FROM THE INSIDE

The GMega is a 32-part multitimbral synthesizer module that uses Kawai's new Digital Multi Spectrum tone generator, which combines sample-playback

Product Summary

PRODUCT:
GMega synthesizer module
PRICE
$795
MANUFACTURER:
Kawai America Corp.
2055 E. University Dr.
Compton, CA 90220
tel. (310) 631-1771
fax (310) 604-6913

EM METERS	RATING PRODUCTS FROM 1 TO 5
FEATURES	● ● ● ◖
EASE OF USE	● ● ● ● ◖
SOUND QUALITY	● ● ●
VALUE	● ● ● ●

and a form of amplitude-modulation (AM) that Kawai labels "ring modulation." (Editor's note: The so-called "ring modulation" in the Kawai K4 and GMega actually is 2-quadrant amplitude modulation. In true, balanced ring modulation, two signals are multiplied, producing audible sum and difference frequencies, but the two original signals are not passed. In 2-quadrant modulation, the original signals remain audible.—SO)

The unit's 6 MB of ROM holds 256 sample waveforms and 256 percussion sounds, but offers no provision for adding additional waveforms. While the GMega has 32-voice polyphony, roughly half of the preset sounds use two oscillators, which quickly eats up voices. There is no provision to reserve voices for parts; drum parts (on channel 10, per the GM spec) get the highest priority, followed by other MIDI channels in numerical order.

The GMega supplies three regular, 128-patch Banks, including ROM-based preset Banks for General MIDI and Roland MT-32 emulation and a RAM-based, programmable user Bank. You cannot directly edit the preset Banks, but can copy the patches into the user RAM Bank for tweaking. The MT-32 Bank, called "Sound Palette," reproduces all patches except five sound effects (presets 124 to 128). This feature is a boon to those with a library of pre-General MIDI, third-party sequences, which often were based on the MT-32.

In addition, the GMega contains seven drum kits: Standard, Room, Power, Electro, BOB (which sounds similar to the venerable Roland TR-808), Jazz, and Orchestral. Each kit contains 128 programmable sounds, most of which are modest variations on the Standard drum kit. All seven kits can be accessed from any of the three sound Banks, and you can edit them in the user Bank.

In a major change from most GM synth modules, the GMega offers 55 predefined tuning tables. You can use one of them for all multitimbral parts, or apply a different tuning to each part. The tunings include equal temperament (default) and families of Pythagorean, Werckmeister, mean tone, pure, Kimburger, and others. They are based on repeated 12-note scales and cannot be edited. The alternative tunings can add realism to acoustic-instrument patches, or serve as a starting point to explore microtonality. The GMega manual contains some helpful guidelines for their use.

The GMega fully implements the General MIDI specification. It responds to Note-On Velocity, Channel (but not Poly) Aftertouch, Pitch Bend, Mod Wheel, Data Entry, Volume, Pan, Expression Pedal, Sustain Pedal, Soft Pedal, Reset All Controllers, and All Sound Off. Controller 91 toggles the effect wet/dry mix between two pre-defined levels. The only thing notably missing was Portamento, a minor complaint.

Controller responses are smooth and dynamic. There is a significant limitation, however: Incoming controllers only serve one function each and cannot be remapped. For example, Aftertouch and Mod Wheel are "hard-wired" to the Vibrato effect, and Expression Pedal always modulates the output level of Sections.

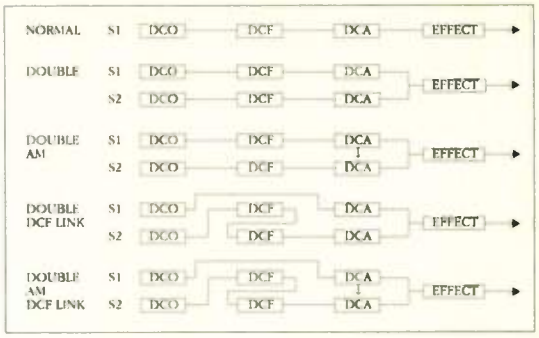


FIG. 1: A basic tone, or Single, can contain one or two waveforms. Singles containing two waveforms can route the oscillator outputs in any of four ways, including double-filtering (DCF Link) and 2-quadrant amplitude modulation (AM). (Courtesy Kawai America Corp.)

Virtually all front-panel operations are echoed as System Exclusive messages at the MIDI Out port so you can record them into a sequencer for automated setups. Even better, the GMega can send a full SysEx dump containing the setup parameters and the user Bank, which can be used to fully restore the unit's status.

SOUND ARCHITECTURE

As with Kawai's K-series synths, a basic patch on the GMega is called a Single. This can be a tad confusing, as Singles

Kawai's GMega offers programming and MIDI control features not found on most General MIDI modules.

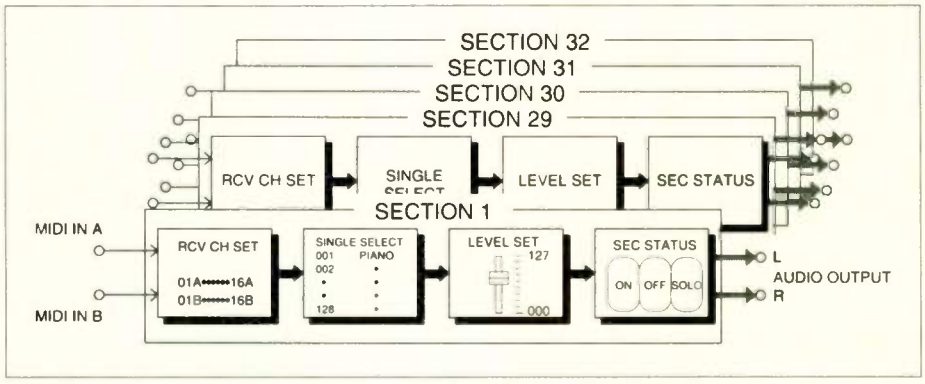


FIG. 2: Play mode signal flow in the Kawai GMega. Two independent MIDI inputs drive up to 32 Sections, each playing a specified sound, with control of pan, level, and note range. Sections may be on, off, or soloed in the final mix. (Courtesy Kawai America Corp.)

can comprise one or two waveforms. Singles containing one waveform are composed of an oscillator going into a digital filter and, in turn, to a digital amplifier. The GMega controls the filter and amplifier elements with modified ADSR envelopes in which the sustain stage can be flat, or can modulate between two levels.

Singles containing two waveforms can be created using any one of four formats: Parallel Play, Parallel with Ring Modulation, Parallel with Linked Filters, and a combination of the three (see Fig. 1). Oscillator-control parameters are Mute; Pitch Tuning; Attack Delay; and Vibrato Waveform, Speed, and Depth.

Although the GMega only supplies a lowpass and highpass filter, the two can be linked in certain dual-waveform formats to create a bandpass filter. Filters have an adjustable cutoff frequency, resonance, ADSR envelope, and velocity and note-number modulation. Amplifier-control parameters include amplitude modulation (with certain dual-waveform formats), Velocity and note-number modulation, and ADSR envelope. Overall, there are plenty of choices.

A step up from the Single is the Section (see Fig. 2), which corresponds to one of the multitimbral parts. A Section acts like an independent synth: You set it to respond to a desired MIDI channel, map it to a given note range, and assign it a specific Single sound. Additional Section controls let you specify pan position, transposition, tuning, effect wet/dry mix, mod wheel and aftertouch sensitivity, tuning-table selection, pitch-bend range, filter-cutoff frequency, and offsets for attack and release.

Section parameters are independent of, and supersede, Single parameters; if you set a note range for a plucked bass Single within a Section and later call up a flute, the Section will only play the bass note range. With creative use of note ranges and MIDI-channel assignments, you can build layered and zone effects with multiple Sections.

Editing drums is similar to editing Singles, except effects level and pan are set at the waveform level, rather than for the overall Section. Global commands let you exchange waveforms between two Singles, copy one Single, or copy an entire Bank. The GMega's editing operations are greatly simplified by

intuitive front-panel button operations and parameter-value wraparound (i.e., turning the rotary dial one step past the highest value takes you back to the lowest one).

EFFECTS

The GMega provides six reverb algorithms, with adjustable values for depth, predelay time, and level (mix). All parts must go through the same algorithm, and if you change algorithms, there is a 3-second delay during which the unit doesn't play. In an unusually restrictive move, you can only specify one of two wet/dry mix levels for each Section, rather than set each Section as desired. You can set these two mix levels to any desired values, but all Sections get one or the other.

The GMega is especially strong for string, brass, and woodwind sounds.

The effects section is the weakest point of the GMega. It provides spatial ambience, but with little differentiation between the reverb algorithms. The algorithms are not described in the manual, and a phone call to Kawai was equally fruitless. The reverb sound is not as clean and warm as I'd like, though this is less noticeable with ensembles than with solo instruments.

SOUNDS

The overall sound quality is clean and clear, which is not surprising, as the 16-bit samples were recorded at 44.1 kHz and play back through 18-bit DACs. The majority of the General MIDI and MT-32 sounds emulate acoustic instruments. As with the Roland Sound Canvas and Yamaha TG100, presets that sound a bit thin in solo use become much more realistic when played in ensemble. The demo song nicely shows off the GMega's wide variety of sounds across several styles.

The GMega is especially strong for

string, brass, and woodwind sounds. The pianos are good, but a bit too resonant for my taste. Rock Organ is built from a combination of distorted guitar and choir waveforms; it works for Pink Floyd licks, but is not a typical organ.

Novelty synth sounds such as Echoes, Metal Pad, Sweep Pad, and Rain are okay, but lack the timbral dynamics of comparable Sound Canvas sounds. The Choir sounds are below average and lack definition. The drums are good, except for the closed high-hats and other cymbals, which take too long to decay.

BOTTOM LINE

In the rapidly swelling market for entry-level General MIDI synths, the GMega offers several features that distinguish it from its closest competitors, the Sound Canvas and TG100. It is easy to set up and program and offers alternate tunings and a battery-backed user patch Bank. (The Sound Canvas lets you save settings to battery-backed RAM, but not patches, and the TG100 has no battery-backed RAM.) It offers a good MIDI implementation, with 32-channel capability, and includes a built-in Macintosh interface.

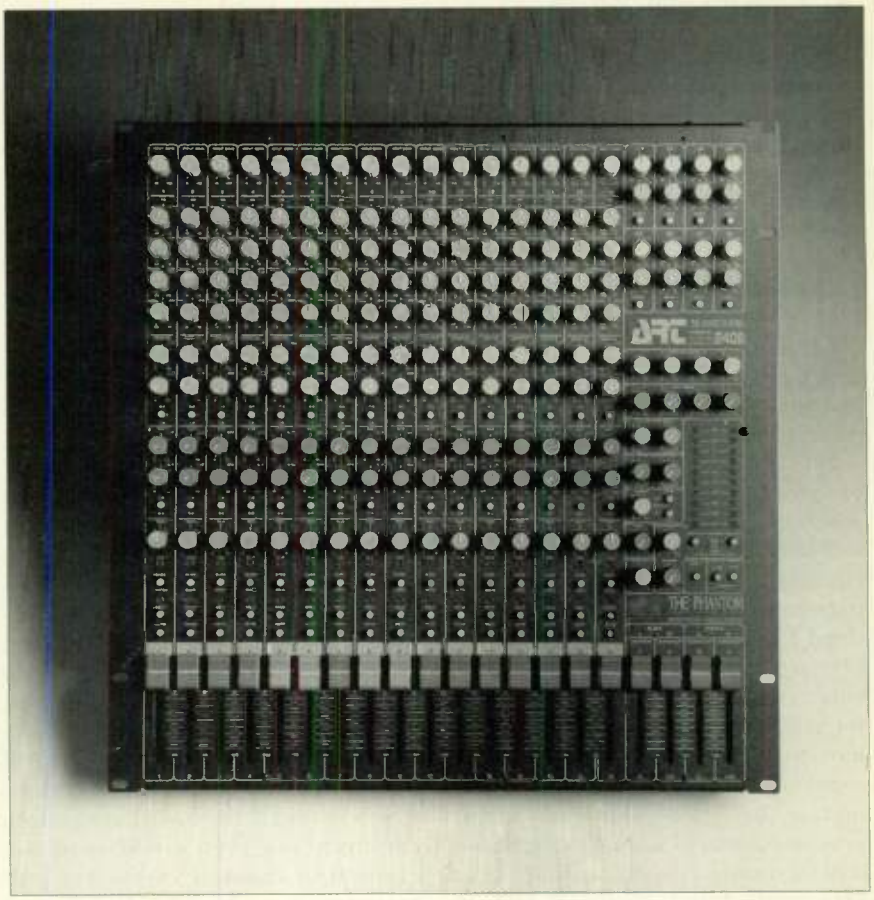
The Kawai synth functions equally well onstage, in the home demo studio, or as part of a multimedia computer system. If you are getting started with MIDI, or are looking for a General MIDI synth, the GMega is a good, cost-effective choice.

Jim Pierson-Perry *is a chemist by day, musician/author by night, and runs a non-profit desktop publishing business on the side. Fortunately, his children have inherited his wife's common sense.*

ART Phantom 2408 Mixer

By Neal Brighton

A powerful compact mixer for the new sonic frontier.



The ART Phantom mixer sounds good, is solidly built, and delivers an excellent selection of routing and processing options.

The arrival of affordable digital 8-track decks has forced many musicians to reevaluate their mixers. They have discovered that the small, rack-mountable submixers they bought a few years back don't quite have the audio quality or features to fully exploit new sonic frontiers. Fortunately, the development of high-quality, affordable, compact mixers has coincided with the development of affordable digital recording.

With this potent combination, the home-studio owner can produce recordings with an audio quality once reserved to the high-end pros. One of the new breed of mixers that facilitates this trend is ART's compact Phantom series, including the models 1608, 2408, and 3208. I reviewed the 24-channel 2408.

I hooked the 2408's control-room outputs to an AB power amp and monitored through Yamaha NS10M speakers. Using an 8-track Alesis ADAT digital tape recorder, I recorded and mixed a pop rock group and a jazz quartet. Everything went smoothly. The 2408 was sonically clean, and I was impressed that the mixer offered plenty of headroom in the input channels and stereo bus.

OVERVIEW

The 11-rackspace model 2408 can be configured as a 16 × 8 × 2 or a 27 × 2 mixer. The 24-channel configuration is delivered via sixteen full-featured input channels and eight subgroup/tape return inputs that only have level, pan, and solo controls. The full-featured channels offer balanced XLR mic inputs and balanced ¼-inch line inputs, while the eight tape-return channels provide ¼-inch, unbalanced inputs.

Each of the full-featured inputs has an unbalanced, pre-EQ channel insert with a ¼-inch, tip/ring/sleeve connector. This configuration allows you to use an insert as a half-normaled jack by putting the ¼-inch plug in half way. Input channels 1 through 8 offer phantom power, which can be switched on or off in banks of four.

The board's main outputs are balanced, male XLRs, and a talkback microphone can be connected via a female XLR jack. The remaining rear-panel connections (with the exception of the

stereo headphone jack) are handled by unbalanced, ¼-inch jacks. These include direct outputs on channels 1 through 8, subgroup outputs, aux and monitor sends, 2-track sends and returns, a mono output, and a left/right control room output.

THE ROAD MAP

The full-featured input channels start off (at the top, of course) with an input-gain pot that controls the line *and* microphone preamps. Signal gain is from +6 dB to + 48 dB.

The 2408's 4-band channel EQ is one of the smoothest I've heard in a compact mixer. It offers ±12 dB at fixed frequencies of 12 kHz, 2.5 kHz, 200 Hz, and 70 Hz. However, I missed having sweepable mid-range controls. The fixed frequencies of 200 Hz and 2.5 kHz are very useful, but I want to be able tweak the 5 kHz to 7 kHz range for acoustic guitars and vocals. For the most part, the fixed frequencies worked especially well on electronic instruments. The 70 Hz control also allows precise control of most electric basses and (acoustic) kick drums, and the 12 kHz control adds top end without introducing unacceptable audible hiss or distortion.

The two channel monitor sends are pre-fader, but can be made post-fader with an internal jumper. Although four master monitor sends are available, each channel can access only two simultaneously, selected with a switch. Two post-fader, channel aux sends and four dedicated aux send masters work in precisely the same manner as the monitor sends.

The channel strip is completed with a pan pot; a clip LED; a bus/mains switch that routes the input channel signal to either the main stereo bus, or the subgroups; a post-EQ solo switch; and a mute switch. The Phantom does not offer solo-in-place; the soloed signal remains mono no matter how the pan pot is positioned. Accessing the solo function automatically mutes the main control-room signal, but doesn't affect the other outputs.

The master section of the 2408 includes the eight tape-return inputs (labeled 17 through 24), four monitor and four aux send masters, and 2-track send and return level controls. Four user-assignable faders control the subgroups and/or the main outputs. The talkback-level control has switches that route the signal to the monitor bus, aux bus, or subgroups.

A mono level pot controls the summed output level of the four subgroups, which is useful for live mixing applications. (You even could send the mono feed through a crossover, roll off the highs, and send the results to a subwoofer.) The stereo, 10-step LED meter lets you monitor the main outputs, subgroups, monitor bus, aux bus, solo bus, and input channels.

ROUTING

The Phantom offers some unusual routing features. The tape-return channels can be fed into the main stereo bus, or summed and routed through stereo, ¼-inch output jacks. Essentially, this function gives you an independent 8 × 2 or 8 × 1 mixer. In "budget" live applications, you could run your main room and stage-monitor mixes from the same board. The tape-return channels can also be assigned to the main stereo bus.

Another good routing feature of the 2408 involves its eight direct outputs (via input channels one through eight). These outputs can be used to quickly and easily connect the mixer to an 8-track recorder. In addition, both the monitor and aux sends can be routed into the stereo bus. Because the monitor sends are pre-fader, you could use them to provide a stereo headphone mix by simply using sends 1 and 2 as your left/right mix controls. If you involve other players in your home-recording setup, the ability to provide everyone with a stereo headphone mix can make tracking much more comfortable.

The flexibility of the routing structure proved invaluable, and it consistently allowed me to find ways to get more out of the board. For example, I used the direct outputs off channels 1 through 8 as dedicated effects sends, saving the conventional aux and monitor sends for additional signal processing.

CRITIC'S CORNER

I have only a few complaints about the Phantom. My biggest gripe is the faders, which are somewhat difficult to move and have more play than I'd like. In addition, although they look great, I found the multi-toned gray knobs and switches a bit difficult to work with. Because the background panel *and* the switches are gray, it's really hard to tell which switches are in the down position and which ones are up. Also, in low lighting, the mixer controls blend together. (According to the manufacturer, the new mixers feature higher-contrast paint and colors that should be easier to read in dark environments.)

The review model had a pretty loud transformer hum from the power supply. ART notes that this problem was fixed in later production models by putting the transformer on isolation mounts.

CONCLUSIONS

The Phantom 2408 is a good mixer for the money. With a little more consideration for ergonomics, it could be a monster board. The mixer's electronic design is top-rate. It's solidly built—tough, metal panels surround the unit—and if you're a qualified technician, the mixer is a breeze to maintain, repair, and clean. Simply removing some Philips screws from the top panel provides access to the two polyethylene grids that hold all of the pots and switches in place. (Warning: Do not open the board up unless you feel confident that your technical, cleaning, and repair chops are good enough to survive voiding your warranty.)

The 2408 would be a welcome addition to the home studio or club mixing system. It sounds great, delivers an abundance of routing and processing

Product Summary

PRODUCT:
Phantom 2408 compact mixer
PRICE
$1,229
MANUFACTURER:
ART
215 Tremont St.
Rochester, NY 14608
tel. (716) 436-2720
fax (716) 436-3942

EM METERS	RATING PRODUCTS FROM 1 TO 5
FEATURES	● ● ● ●
EASE OF USE	● ● ● ◖
SOUND QUALITY	● ● ● ●
VALUE	● ● ● ●

options, and is tough enough to shrug off the rigors of the road.

E-mu Emulator IIIxs

By Peter Freeman

A new top of the line sampler with impeccable sonic quality.

E-mu Systems has long been established as a major player in the sampling world. From the original Emulator (introduced in 1981) to its successors, the Emulator II (1984) and Emulator III (1987), the company has captured a sizable chunk of the high-end sampler market. In addition, their Emax and Emax II became popular in the mid-level sampler market.

In recent years, the high-end competition has heated up substantially, with the introduction of Akai's S1100 and their new S2800/3000/3200 line, Roland's S-770, and Kurzweil's K2000S/K2000RS. Prospective sampler buyers have more and better options than ever. The 3U rack-mount Emulator IIIxs is E-mu's new flagship in this battle for sampling supremacy. (For those who don't need analog sampling inputs and want to save a few dollars, E-mu offers the E-IIIxp, which is otherwise identical to the xs.)

THE NEXT GENERATION

Owners of the original Emulator III will note many new features on the E-IIIxs. One of most obvious is the addition of a pair of XLR connectors for AES/EBU or S/PDIF digital I/O (hardware-switchable). The E-IIIxs also features 16-bit resolution with new 18-bit DACs and 16-bit, 64x oversampling Sigma Delta A/D converters.

The sampler comes with 8 megabytes of sample RAM, and unlike the older unit, it can be expanded to 32 MB. You can load more samples in memory and more Presets (keyboard setups) per Bank than with the Emulator III. E-mu's top-of-the-line instrument boasts 32-voice polyphony (sixteen voices for stereo samples), a major plus. Especially welcome are six individual, balanced, ¼-inch, polyphonic outputs in addition to ¼-inch L/R mix outs and XLR mix outs.

Another significant improvement is what the manufacturer refers to as "Constant Sampling Rate" technology, which virtually eliminates undesirable aliasing noise when samples are transposed across a wide range. To top it off, E-mu provided an improved, high-speed SCSI implementation, which I'll discuss shortly.

Some changes only become noticable if you pop the lid: The E-IIIxs' internal design has been cleaned up substantially. Gone are the jumpers and ribbon cables of the original E-III. In their place are the G and H chips the manufacturer first developed for its Proteus and Vintage Key synths. E-mu claims that because of the integration allowed by the advanced chips, the EIIxs is far more reliable than its predecessor.

The unit's rear panel is completed by the requisite MIDI In, Out, and Thru connectors; dual, 50-pin SCSI connectors; and an RS-422 connector that was included to facilitate computer control at some time in the future. This last feature may sound familiar to readers with experience in the world of samplers—remember the "computer" port on the Casio FZ-1?—and it will be interesting to see what E-mu or third-party developers do with the RS-422 port.

RAM, SCSI, AND OTHER STORIES

The E-IIIxs Turbo, which is the model I received for review, comes with the maximum 32 MB of sample RAM and an internal 105 MB Quantum hard drive. The factory-installed extra RAM and hard drive add a lot to the price, though, so you might want to buy your own and have your tech install them.

The advantage of getting the hard drive from E-mu is that it comes loaded with selected samples from the E-mu library, including many used in the

Proteus series. A 480 MB CD-ROM filled with samples also is included with every E-IIIx. E-mu has a comprehensive, 20-gigabyte sample library that is available on a variety of formats, including magneto-optical disk, SyQuest cartridge, and CD-ROM, so there's no shortage of readily-available E-III sounds.

Among the nicest sounds E-mu supplies on the hard drive is a collection of Indian instrument samples (Sitar, Tabla, and Tamboura), which really showcases the instrument's excellent audio quality. The Orchestral Comp Bank is an equally impressive array of orchestral-instrument multisamples. If you need special effects, you get sounds such as Soda Drinks (a Bank of soda fountain sounds); a Bank of audience applause and laughter; and Car Glass Smash, an assortment of what sounded like auto glass being smashed at a junkyard. Overall, you get a large variety of sounds.

A 105 MB hard-disk drive is not exactly bountiful these days. Fortunately, E-mu provides optional mounting brackets and internal SCSI cables that allow you to mount huge internal drives. In addition, the E-IIIxs' SCSI ports allow you to connect external hard drives, optical drives, SyQuest drives, or other SCSI storage devices, providing virtually unlimited sample storage.

One noteworthy feature of the E-IIIxs' SCSI implementation is its ability to function as master simultaneously with multiple E-IIIxs's on the same SCSI chain. They can also share a single hard disk. The unit's new high-speed SCSI driver loads and saves samples in a flash. In addition, the unit can send samples via SCSI to Passport's *Alchemy* and Digidesign's *Sound Designer II* sample-editors.

E-mu's Emulator IIIx series represents a major improvement over the original Emulator III, adding digital I/O, better converters, 32-voice polyphony, up to 32 MB of RAM, and a greatly improved SCSI implementation. The E-IIIxp shown here lacks analog sampling inputs but otherwise is identical to the E-IIIxs.

Product Summary

PRODUCT:
E-IIIx series
PRICE
E-IIIxs $4,495
E-IIIxs Turbo $6,995
E-IIIxp $3,995
E-IIIxp Turbo $6,495
MANUFACTURER:
E-mu Systems, Inc.
1600 Green Hills Rd..
P.O. Box 660015
Scotts Valley, CA 95067-0015
tel. (408) 438-1921
fax (408) 438-8612

EM METERS	RATING PRODUCTS FROM 1 TO 5
FEATURES	● ● ●
AUDIO QUALITY	● ● ● ● ◖
EASE OF USE	● ● ● ●
VALUE	● ● ●

USER INTERFACE

The E-IIIxs sports six main module-select keys (Sample Management, Master/Globals, Preset Management, Preset Definition, Digital Processing and Dynamic Processing, which offers real-time data manipulation), a 10-key pad, four cursor keys, an Audition key, and three disk-related keys (Load, Save, and Drive Select). There is a medium-sized, backlit LCD display, flanked by a pair of sliders for master volume and data entry. Also on the front panel are a floppy drive and the Transpose (for globally transposing the entire instrument) and Multi mode keys. Each of the Module keys accesses related software pages (submenus) that govern the sampler's functions.

Multi mode, a feature many synth and sampler owners have enjoyed for years, provides convenient multitimbral operation. Sixteen different Presets that have been loaded into RAM can be assigned to their own MIDI channels and played simultaneously, each with independent MIDI Volume and Panning. This was obviously designed to make the instrument sequencer-friendly, and it succeeds. Setting up Multi mode is intuitive, as the left and right cursor keys scroll through the sixteen MIDI channels and their respective Preset level and pan assignments.

One of the strongest aspects of the E-III line has always been its simple-to-use operating system, and the E-IIIxs is no exception. For example, the pages of each submodule in the six main areas of the instrument are numbered. They can be accessed by first pressing the proper module key (e.g., Preset Management) and then the desired page number on the keypad. Once you memorize the page numbers, you can get around the E-IIIxs in a flash. As with the original E-III, E-mu is developing Macintosh-based remote-control software for the E-IIIxs, which will further facilitate its ease-of-use and provide extensive librarian and database capabilities. The software is expected to be available by the time you read this.

SAMPLING

Sampling on the E-IIIxs is straightforward. In the Sample Management module, you choose the appropriate input source (analog or digital input) and set the sampling level (if the analog inputs are selected) and the length of the sample to be recorded. The unit defaults to stereo sampling, although either channel can be selectively disabled for mono. At this point, triggered sampling can be performed, using an adjustable threshold for the sampling trigger (i.e., when the input signal reaches the threshold, the unit begins sampling), or "force" sampling can be

executed by hitting one of the keys on the keypad.

After the sample is recorded, the E-IIIxs indicates if any clipping took place during the recording and returns to the submodule menu. If you choose Auto Truncate or Auto Normalize from the Sample menu, the E-IIIxs analyzes the sample level and digitally adjusts gain for maximum level without clipping and automatically trims dead air from the end of the sample. The sample is then ready to assign to a Zone, or key-range assignment. The Place Sample command allows a root key and high and low key limits to be defined. A Zone can contain two different samples, Primary and Secondary, which can respond to different Velocity ranges and have different dynamic processing. A Preset includes the sample(s) with Zone, Velocity range, and processing assignments. Up to 256 Presets can exist in a Bank.

Once a sample is set up inside a Preset, you can perform various digital processing operations on it. On the real-time side, these include applying an amplitude envelope (VCA) to control the sample's volume; a standard, 4-pole, lowpass, resonant filter; envelope control (VCF); and LFO modulation. Some degree of real-time control is available: two wheels, Pressure, external footpedals, LFOs, Velocity, and two arbitrary MIDI controllers can be routed to destinations such as pitch, envelope attack time, crossfade, panning, VCF cutoff frequency, and VCA amplitude. There also is an Auxiliary envelope that can be sent to the same parameters, and you can modulate the LFO Depth.

The digital-processing functions include the ability to cut, copy, and paste all or part of a sample, as well as truncation, gain change, and normal or crossfade looping. A Taper function allows artificial attack and/or decay slopes to be imposed on samples, using one of three exponential curves or a linear curve. This is useful for quickly reshaping samples to remove unwanted noise at their start or end, or to achieve a special effect. Finally, there is a handy Undo feature, which reverses the last digital processing operation, restoring the sample to its former state. If the Backup Sample option is selected beforehand, the processed version is placed on the E-IIIxs' clipboard (temporary RAM area).

OTHER FEATURES

Two other noteworthy aspects of the E-IIIxs are Stack mode and the unit's sophisticated Arpeggiator. Stack mode allows multiple Presets to be placed on each key of the keyboard by "linking" them in an extended chain.

The Arpeggiator offers six different Modes (Up, Down, Up/Down, Forward Assign, Backward Assign, and Random). It provides adjustable note-echo, harmony-note generation, and can automatically fit the number of notes being held into the specified arpeggiation note value (e.g., if you specify a 4-note arpeggio at a given tempo and hold down five notes, it fits five notes into the space of four). It can also synchronize to an external MIDI Clock. The Arpeggiator's settings can be stored independently with each Preset.

One of the strongest aspects of the E-III line has always been its simple-to-use operating system.

COMPLAINTS

Although I was immediately impressed with the E-IIIxs' sound, after using the instrument for a few days, I wanted more bang for the buck. The E-IIIxs allows relatively little manipulation or processing of samples after they are recorded or loaded into RAM. On an instrument in this price category, I hoped to see a multimode filter and more extensive modulation capabilities.

I was particularly dismayed at the absence of graphic envelope and waveform display and editing; the E-IIIxs is the only instrument in its price range that lacks graphic sample-editing. This might not have been an issue five years ago, when there were few high-quality samplers available in the less-than-megabuck category. But in today's climate, I expected more. In the "wouldn't it be nice" category, I'd like the option to connect an external monitor and mouse for easier sample manipulation.

Fortunately, E-mu has announced a forthcoming set of enhancements for the E-IIIx series, called "Advanced DSP," which will allow such processes as time-variant tuning of samples, 20-band graphic EQ, sample-rate conversion, digital compression of samples, and three types of filtering (notch, linear phase, and time-varying lowpass). But in order to take advantage of these functions, E-IIIx-Series owners must purchase an additional floating-point co-processor chip, which also accelerates DSP functions. I would feel much better about the sampler's cost-effectiveness if these were standard features.

Also, there is no way to save a single raw sample to disk. Only entire Banks can be saved, which means that if you already have the instrument's memory nearly filled with samples, and you record a new sample that you wish to save by itself, all other samples currently in RAM must be deleted, and the new sample must be saved by itself as a Bank. This process is unnecessarily complex. Similarly, there is no way to save a single Preset, with or without its related samples; even the old Akai S900 can do this. Instead, a Preset must be saved as a Bank before it can be loaded individually into another Bank.

CONCLUSIONS

The E-IIIxs sounds excellent. I found no detectable noise in the samples created using the analog and digital inputs, and the samples transpose remarkably smoothly and noiselessly up and down the keyboard. Sounds came out of the E-IIIxs exactly as they went in; I could hear no audible changes or artifacts of any kind. I have absolutely no complaints in this department; E-mu promises pristine sound with the instrument and delivers it.

Is it the ideal sampler for your needs? That depends largely on what kind of work you do, and your working methods. If your work involves extensive sample-manipulation, or you are simply interested in experimenting with in-depth sample-mangling through onboard DSP and synthesis functions, the E-IIIxs probably is not your best choice.

On the other hand, E-mu emphasizes the E-IIIxs' loading speed (which they claim outpaces any other sampler), and many musicians will appreciate this time-saver. Film, TV, and commercial

composers and others who need to get large amounts of samples recorded, set up, and saved to and loaded from disk all day could find the E-IIIxs's high-speed loading and simple operation ideal. My only reservation here regards the extra steps required to save a raw sample as a finished Bank. In addition, if your work relies heavily on pre-existing sample libraries, the instrument will give you access to E-mu's substantial treasure trove of sounds. The E-IIIxs seems to have been designed with a clear emphasis on these applications.

As with any product, I strongly suggest some serious comparison shopping before plunking down your hard-earned cash. But if your work is based on straight-ahead, no-frills sampling, and you need blazing speed, easy operation, and unquestioned audio quality, the E-IIIxs is a serious contender

Peter Freeman *is a freelance bassist/synthesist and composer living in New York City. He has worked with such artists as John Cale, Jon Hassell, Chris Spedding, L. Shankar, Sussan Deihim, and Richard Horowitz.*

Peavey PRM 26i Reference Monitors

By Neal Brighton

Close-field monitors with a dual personality.

In studios where the physical size of the control room may be as small as your bathroom, close-field monitor speakers play a key roll in contouring a clear and distinct sound. The demand for such speakers is high, and it seems everybody in the world is manufacturing them. Peavey, who makes at least one of almost everything musical, has added several new monitors to its PRM series, including the 2-way PRM 26i. Capable of handling 100 watts of program material at a nominal impedance of 4 ohms, the speakers cross over at about 3 kHz and have a frequency response of 68 Hz to 20 kHz (+1/-3 dB).

Product Summary

PRODUCT:
PRM 26i reference monitors
PRICE:
$460/pair
MANUFACTURER:
Peavey Electronics
711 A St.
Meridian, MS 39302-2898
tel. (601) 483-5365
fax (601) 484-4278

EM METERS	RATING PRODUCTS FROM 1 TO 5
AUDIO QUALITY	● ● ◖
VALUE	● ● ●

CONSTRUCTION

The PRM 26i's are constructed with medium-density particle board, nailed to a plywood frame. The particle board—including the front face, which has no speaker grill—is covered with a granite-like formica. (Frankly, I think the fake-granite look works better on a kitchen counter top.) All components are of good quality and are solidly mounted to the speaker case. I especially liked the gold-plated wire connectors because they accept either banana plugs, or stripped wire.

In general, the speakers are quite well-built. The only major flaw I found in the construction of the review unit was the incredibly sharp edges of the formica; I received a "paper cut" on my finger from the speaker cabinet when I took it out of the box. Peavey's representative assured me that the edges have been smoothed on all currently shipping PRM cabinets.

TALE OF TWO SETTINGS

Peavey gave these monitors an interesting twist, providing two operating modes. In Reference mode, the speakers have a relatively flat response. Alternatively, you can monitor using an equalized curve meant to help you hear some of the mids (the 500 Hz to 3 kHz area) better when tracking or mixing. A black rocker switch on the front of the speaker toggles between the two modes.

I had a few problems with this design. First, it was hard to see the position of the switch when room lighting was less than optimal. (Black would not have been my first color choice.) More important, I don't think it's a good idea to change the sonic characteristics of a speaker at different stages of the recording process. Whether tracking, overdubbing, or mixing, most engineers look for consistency in the sound of their speakers. The last thing you need is a speaker that has a different response when you track an instrument than when you mix it. If you listen to these speakers in a store and like the overall sound, I recommend you pick one sound and live with it. Your results will be more consistent.

THE BOTTOM LINE

Obviously, monitor speakers live or die by their sound quality. The PRM 26i's highs and lows were accurate and well-defined (especially the highs), as was the left-right stereo imaging, but I had some trouble with the overall clarity of the mids. I referenced rock, rap, and even harp music on these speakers, and both the Reference and EQ settings exhibited a dullness that made me uncomfortable when mixing.

Peavey's 2-way PRM 26i monitors are well-built and handle high frequencies well, but midrange frequencies are disappointingly dull. You can switch in a peculiar EQ setting that applies an equalization curve to the mids.

On the positive side, after a few hours of mixing, my ears had much less fatigue than when using other speakers. But this comfort factor was somewhat compromised by the fact that the PRM 26i's "soft" midrange necessitated my taking longer than usual to produce an acceptable mix. ●

(continued from p. 65)

useful in extending the range of a sample beyond that of the original instrument (e.g., making a piccolo out of a flute).

When I've finished creating the samples for a particular instrument, I stop and save the looping for later. It's much better to begin the looping process with fresh ears.

In truth, the loop points of most instruments will not be readily detectable in multitrack compositions, but you'll feel better if the sample sounds good when played by itself. Most brass and reed instruments, harps, guitars, and tuned percussive instruments such as marimbas and xylophones are easy to loop. Back when we were using 8-bit instruments, single-cycle loops of these instruments were acceptable. Today, short crossfade loops tend to sound the best. In the case of brass and reeds recorded without vibrato, I've found that a quarter-second sample (or even less) is plenty long. You want to loop the sound as soon as the initial attack transient has changed over to a fairly consistent waveform, but before there is time for much evolution of the harmonic structure. Harps, marimbas, and xylophones quickly turn into sine waves, which are easy to loop. Acoustic guitars (and some electrics) generally loop well about two or three seconds into the sound and sound pretty good with a fairly short crossfade loop.

Instruments sampled with vibrato, such as violins or flutes, tend to be a bit tougher to loop because the amplitude and harmonic structure of each vibrato cycle is likely to be slightly different. Still, with just a touch of crossfading, just about any instrument sampled with vibrato can be looped by placing the start and end points on the peaks or dips of each cycle, about a second and a half into the sample. This should be the point where the player is producing the most consistent vibrato. If your sampler has graphic editing, it is easy to see the best spots to place your loop points.

Much bigger problems present themselves with pianos, pipe organs, distorted guitars, and ensembles. The changing harmonic structures of these sounds do not allow short loops, so you are forced to take a bigger section of the sound and crossfade it. With pianos, a half-second crossfade loop, about two or three seconds into the sample, works well. (See the first half of "Sound Bytes," in the June 1992 **EM**, for more on looping pianos.) The same is true for distorted guitars. Ensembles and pipe organs require grabbing a much bigger chunk of the total sample and doing some liberal crossfading. By the way, of the two crossfade types, *linear* works best with shorter loops in sounds that are decaying while *equal power* works best with long loops in sounds that have a lot of harmonic motion.

For those who have struggled through the looping process for several years, I should mention that help is on the way in the form of a ground-breaking, System 7-dependent Mac program called *Infinity* from Jupiter Systems ($495; tel. [800] 446-2356 or [916] 878-2770). *Infinity* does the impossible and loops samples perfectly. (Yes, it's true.)

▼

To realistically play sampled instruments, you must think like the appropriate instrumentalist.

One final word about digitizing samples. Though it's nice to have all your samples at a high sample rate, such as 44.1 or 48 kHz, consider using a lower rate to save space. You'd be surprised how few sounds have a lot of high-frequency energy above 10 or 12 kHz. I've had surprisingly good results from sampling rates as low as 29 kHz for instruments such as electric guitars, basses, percussion, and certain ethnic instruments. Give it a try and then trust your ears.

SPECIAL CONSIDERATIONS

Throughout your sampling efforts, it's important to remember that real acoustic instruments (and some electrics) are nothing like synthesizers. Synths can produce a totally uniform sound across the keyboard. Real instruments rarely produce the same tone all the way up and down the full range of the instrument. Guitarists know that playing an open low A string sounds quite different from playing the same A on the E string at the fifth fret. Similarly, different fingerings on bowed instruments produce dramatically different timbres. When sampling real instruments and building your keyboard maps, you need to take this into consideration. There are times when you will have to accept that your samples just won't match up perfectly.

Keyboard players are used to hearing a note immediately upon pressing down a key. For some instruments, notably double reeds, breathy saxes, and the lower ranges of most flutes, there is no such thing as an instantaneous attack. For these instruments, the player begins to articulate the note a bit early so that the minute delay will not be noticeable in the performance. To realistically play sampled instruments, you must *think* like the appropriate instrumentalist. Violinists have told me that part of their training involves eliminating the bow scrape from their tone, so they're usually surprised when I ask them to include it in a recording. Musicians playing sampled violins tend to like to hear the bow scrape, believing that this increases the realism of the sample and allows the note to "speak" more rapidly. In the real world, unless they are playing fast 32nd-note runs, violinists tend to play a tiny bit ahead of the note to decrease the scrape and increase the purity of the tone.

Obviously, no article can possibly cover every aspect of sampling. Trial and error is usually life's best lesson. Even if you fail to produce what you expected, you learn many positive things along the way. Producing a great set of samples requires an enormous amount of patience and determination. Those who are quick to criticize anyone's samples only reveal how little they know about the time, effort, and energy that goes into producing them. Stick with it; your best efforts lie ahead.

Jim Miller *is co-owner of Stratus Sounds and senior sound designer for InVision Interactive.*

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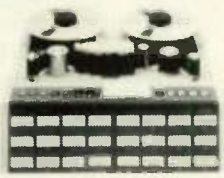

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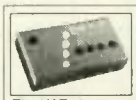

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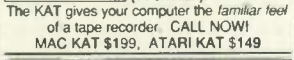

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PRO FILE

Big Bottom

Primus squeezes Pork Soda *from the low end.*

By Jeff Forlenza

Les Claypool's lanky, rubbery figure ricochets off Tim "Herb" Alexander's extensive drum arsenal, his face an encyclopedia of goofy grimaces as he pops, slaps, and strums ungodly notes from his bass. Meanwhile Larry "Ler" Lalonde's pyrotechnic guitar fizzles into the frantic freakout of bass and drums. The band is Primus, and they suck. At least that's what their devoted fans say.

Pork Soda, the new album from this wacky San Francisco Bay Area band, is chock full of porcine goodness and in-your-face bass. Weaned on cartoons and progressive rock, bass monster Claypool writes surreal, funky epics inspired by gonzo journalist Hunter S. Thompson and the art of angling. Go figure.

Claypool's musical influences, however, are easily identified by his playing style and include Geddy Lee, Tony Levin, Stanley Clarke, and Larry Graham. It seems appropriate that his bass heroes defined the sound of their respective bands, just as Primus' "bass-ic" impact is due to Claypool's hyperactive technique and collection of basses.

"Lately, I've been playing some custom basses made for me by Carl Thompson," says Claypool. "These instruments have a lot of character, so I haven't needed much [signal] processing besides EQ. I've been getting pretty fat tones just running straight into the board."

However, there is much more to the story of Primus' big bottom. While the bass sound is predominantly free of signal processing, signal *manipulation* was a major ingredient of the band's "pork soda."

"We ended up with three separate tracks for Les' bass," explains Derek Featherstone, one of the engineers on *Pork Soda*. "Each track gave us different sounds to work with. The main bass tone was derived from an ADA MP-1 preamp and a SanSamp was used for an effects track. The third track was a 'sub' track for recording real subwoofer-type lows. For this track, we took a direct line from the bass and cut everything above 150 Hz. The sub track was a boon, because it could be worked into the overall bass sound to add bottom without making the tone real muddy."

Although the 3-track system was used to construct bass tones on much of *Pork Soda*, one song added "dynamic tension" to the treatment.

"The growling and snorting bass sounds on the song 'Mr. Krinkle' were produced by bowing a homemade upright bass," reveals Featherstone. "Unfortunately, the bass didn't survive the session. It couldn't handle the neck tension and just blew up on us one afternoon. It was a miracle that we finished the track before the bass exploded, because the song required about seven different bass tracks."

Ron Rigler, who co-engineered *Pork Soda* and single-handedly engineered the last two Primus' albums, sums up Claypool's bass sound: "Les is just a monster on the bass. He takes up a lot of room. There's a little bit of treatment [to his bass], but so much of it comes from him and the way he plays."

Mix *assistant editor* **Jeff Forlenza** *first caught Les Claypool's big bass at the University of California-Berkeley's Barrington Hall, the notorious residence chronicled in the Primus song "Frizzle Fry."*

Primus: Tim Alexander, Larry Lalonde, and Les Claypool.

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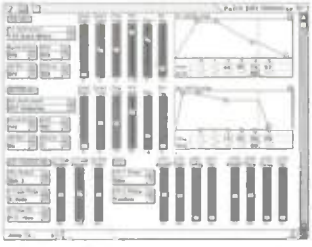

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