Reviews: Tascam DA-88, Pro Tools 2.0, Roland JD-990

Electronic Musician

October 1993

Digital Tape Recorders

- Sonic Heaven or Hi-Tech Hype?
- Should You Buy One?
- Which is Best for You?

Sound Module Buyer's Guide

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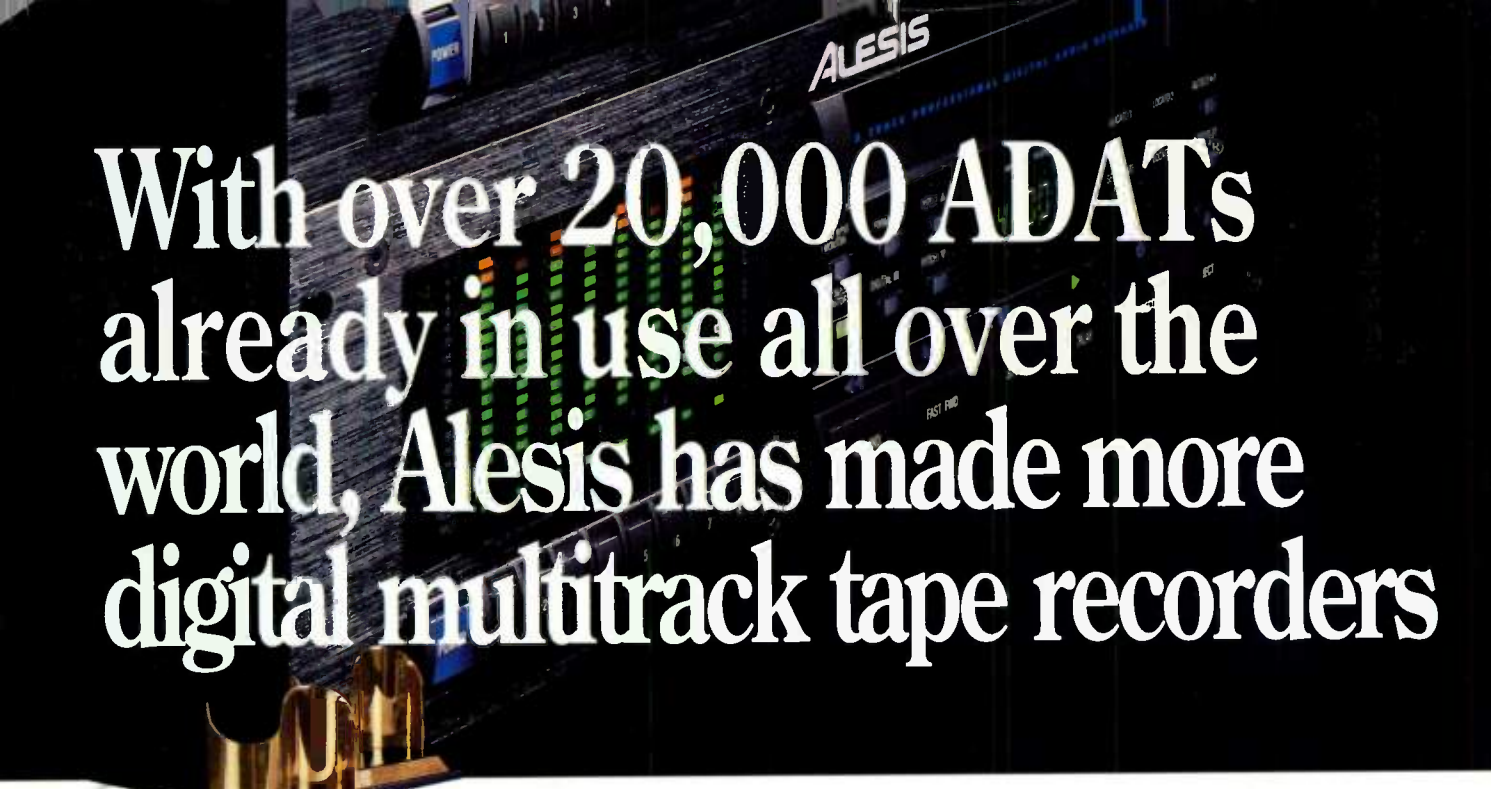

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Its revolutionary impact on the recording industry has made ADAT the de facto standard in digital multitrack. The enormous number of ADAT users worldwide, the fact that Fostex has licensed the ADAT format for their own digital recorder, and the growing list of leading companies focusing on industry compatibility by becoming members of The ADAT Group™, all mean that when you choose ADAT, you're compatible with a vast array of music and audio equipment, now and in the future. And, you're supported by a network of professionally trained Authorized ADAT Service Centers worldwide.

The adat Group™

The ADAT Format – made for multitrack

ADAT records eight tracks of 16-bit linear, 48 kHz sample rate audio, with no data compression "tricks" or channel sharing. We chose Super VHS® (S-VHS®) tape as a foundation, then designed ADAT's data structure and heads specifically for the rough-and-tumble, back-and-forth, punch-in-and-out environment of multitrack recording. To make sure that recording one track wouldn't disturb any other track, we divided each helical scan into eight separate data blocks. Some digital recorders combine data from two different channels into the same data block on tape, which means that each time you record a track, another track must be read into a buffer and actually re-recorded even though it is in "safe" mode.

An 8 track, 8mm recorder's helical scan: there are only four audio data blocks, forcing each track to share a block with another.

An ADAT's helical scan: ADAT tracks are safely separated into 8 discrete data blocks. (Both vertical dimensions enlarged for clarity)

The 8 track, 8mm helical scan format risks introducing errors into "safe" tracks each and every time you press record.

The ADAT format records each track discretely, as all professional multitrack recorders should.

Bigger is Safer

Microscopic contaminants in the studio aren't just probable, they're statistically inevitable. If the format can't overcome them, they'll cause mistracking, noise, distortion, even total muting of the audio. Formats smaller than S-VHS are more vulnerable to contaminants, dropout, and misalignment, especially when exchanging tapes between machines. One 8mm digital format attempts to squeeze the same amount of sound into one-tenth the tape area that ADAT does. ADAT's S-VHS tape offers more total surface area to meet the demands of digital recording, and its wider 100 micron tracks are five times less vulnerable to being derailed by dust. Because even though technology makes it possible to make formats smaller and smaller, dust stays the same size.

Comparison of tape areas for 1 second of audio: ADAT (1,211 mm²) and the 8 track, 8mm helical scan format (133 mm²).

Actual microscopic comparison of the ADAT tape format and the 8 track, 8mm helical scan format (enlarged approximately 100 times).

ADAT's wide 100-micron tracks offer an extra margin of safety for digital audio.

The 8mm's 20-micron tracks squeeze more data into the same area, with little room for error.

than any other company. More than Sony. More than Mitsubishi. More than Yamaha, Akai, and Tascam combined.

More than just a tape recorder– The ADAT System

ADAT, when combined with the BRC™ Master Remote Control, is a complete digital recording and digital editing system with features that no other recorder, analog or digital, can match. The BRC is a full-function autolocator and MIDI/SMPTE time code chase-lock synchronizer. Plus, it controls digital copying between ADATs, like a disk-based recorder, but much simpler to use.

The ADAT MultiChannel Optical Digital Interface digitally transmits up to eight ADAT channels at once over a single fiber optic cable to any track on any ADAT in the system without repatching, all in the digital domain. Now you can "fly in" that perfect vocal part to multiple locations in seconds, with absolutely no generation loss. And our new QuadraSynth™ keyboard has an ADAT digital interface so you can record it without ever leaving the digital domain.

A fiber optic cable for digital connection is included with every ADAT.

The BRC Master Remote Control, shown with optional RMB™ Remote Meter Bridge, supercharges your ADAT System by adding SMPTE and MIDI synchronization, storable autolocation points, copy and paste digital editing and more.

ADAT/BRC digitally stores important session notes

Unlike analog autolocators, the BRC can recall 400 points, storable on each ADAT tape for later recall, so you can keep your mind on the project instead of having to remember minutes, seconds and frames.

Instead of scribbling notes on cumbersome studio track sheets, the BRC lets you store 400 autolocation points, 20 Song start points, punch in and out points, MIDI tempo maps, SMPTE offsets, and more in the two-minute data header of the ADAT tape. The BRC's alphanumeric display lets you name each cue point and song. It even has a handy built-in list of 16 standard cue point names you can edit.

The ADAT Worldwide Network

Thousands of ADAT Worldwide Network™ multitrack recording group members are reaping the benefits of choosing The ADAT System. As WWN members, they are able to collaborate and exchange ADAT tapes with other talented musicians, producers, composers and engineers throughout the world. Alesis is proud that so many creative people worldwide are using this American-made product, making ADAT the most popular digital multitrack tape recorder in history. The recording professionals below don't endorse ADAT, they *use* it every day. Their credentials speak for themselves. Visit your Authorized ADAT dealer and see what the new standard in digital multitrack recording can do for you.

Dave Rouze
Technical engineer for Larry Carlton, currently using ADAT to record all Larry's live concerts. 2 ADAT's and a BRC.

Jay Graydon
Two time Grammy® Award winning (twelve nominations) producer, engineer, writer, and guitarist. 4 ADATs and a BRC.

Owen Bradley
Country Music Hall of Famer. Producer of many legendary country music artists. 9 ADATs and a BRC.

Francis Buckley
One of the top dance and pop engineers in Hollywood. 4 ADATs and a BRC.

Web Staunton
Grammy–nominated chief engineer and studio owner. 3 ADATs and a BRC.

Mick Guzauski
L.A.'s leading platinum mixdown engineer. 4 ADATs and a BRC.

Andy Hilton
Owner and Chairman of the largest pro-audio equipment-for-hire company in the U.K. and Europe. Plenty of ADATs.

Ray Benson
One of country music's hottest producer/arranger/writers. 3 ADATs and a BRC.

Tom Size
Has engineered and mixed a wide range of music from rock to legendary jazz. 3 ADATs and a BRC.

Russell Brower
Two Emmys (eight nominations). Sound designer and producer for film, television and major theme parks. 2 ADATs and a BRC.

Tim Wilson
Consultant and system designer for leading recording artists and songwriters. Has installed more ADATs than he remembers.

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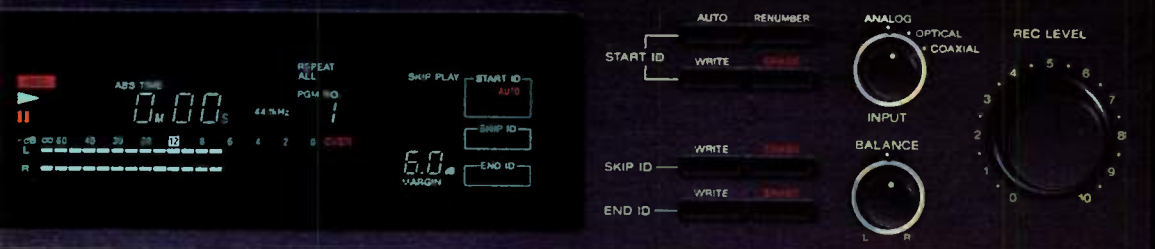

PRO STANDARD DIGITAL AUDIO SERIES

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REVIEWS

DEPARTMENTS

Cover: Photo by Robert Perry.
Special thanks to Alesis, Fostex, and Tascam.

The Digital Glacier

Digital recording systems are making their impact felt.

ANNIE HAMERSKY

Don't let anyone tell you otherwise: Slow-moving targets are tough to track. In fact, observing large-scale trends on a daily basis is like watching a glacier move; you know it's going to make a big impact when it finally gets there, but you don't hold your breath waiting for it. That's the way musicians and the industry view the shift toward digital recording over the last few years. Everyone knew it was going to change everything, but no one was quite sure when it would run over them.

Well, it appears the time has come, or at least it's moved closer. Affordable digital multitrack recorders, downright cheap DAT recorders, and more digital inputs and outputs than anyone ever thought possible are appearing everywhere, showering the aural landscape with buckets o' digital-audio bits. These developments aren't new—digital recording has been available for a while—but now the trend is reaching critical mass.

Making the transition to digital isn't as simple as it first appears. For one thing, you must consider basic connections. You can't just plug any digital audio output into any digital input; you've got to take into account different formats, different sample rates, and a whole new animal called *word clock* (see "The Digital Puzzle," in the May 1993 **EM**). The sometimes-too-pristine audio quality of digital recorders also glaringly reveals any deficiencies you may have in other parts of your system. That older synth, last year's signal processor, and your beloved Radio Shack mic may suddenly not sound as good as they used to. Once you move to digital, however, the new sonic and creative benefits will astound you.

Inevitably, there will be some bumps in the road as we crawl toward the all-digital age. Musicians will learn to work with digital gear, discovering the importance of such things as regular backups, and manufacturers will work to refine the technologies in their first-generation products.

This month's **EM**, which is being distributed at the annual Audio Engineering Society (AES) convention, pulls many of these issues together. The cover story, "Brave New World," on p. 54, delves into the exploding phenomenon of low-cost, multitrack, digital tape recorders, examining the benefits and pitfalls of these new machines, and exploring which machine is best suited for various applications.

Digital audio is significantly different than analog—it's more than just a change in format—and once audio is converted into the digital domain, you can do lots of interesting things with it. For example, you can shuttle it around in a computer network. "Sound All Around," on p. 70, explains the ins and outs of digital-audio networks, reveals how they're currently used in high-end professional environments, and offers a glimpse into the future of these networks in smaller studios.

The Reviews section includes in-depth evaluations of Tascam's eagerly awaited DA-88, the latest entry in the multitrack, digital tape recorder fray, and Sony's baby DAT, the TCD-D7. It also examines one of the primary alternatives to digital tape recorders, Digidesign's Pro Tools 2.0.

We've only begun our journey into the digital world. As we move forward, we expect to learn new techniques, uncover new products, and discover more creative uses for the powerful new tools we have—and will have—at our disposal. There's a lot of ground to explore over the next few years, and the trip promises to be a great one.

In the mean time, watch out, the new ice age is coming.

Bob O'Donnell

Electronic Musician

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Craig Anderton
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Alex

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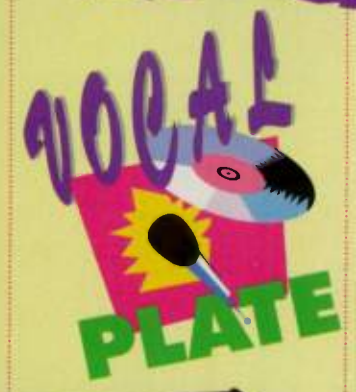

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LETTERS

MAC SPEED

In Bob O'Donnell's reply to John Ungaretti in the August 1993 "Letters," he stated that "all Mac sequencers will run fine on Mac Pluses," then qualified this as applying only to "the essential task of recording and playing back MIDI messages." However, because computer-based sequencers exist primarily for their editing advantages, this criteria is far too minimal. How quickly the software and hardware carry out editing functions can mean the difference between a productive and enjoyable session or a creativity-sapping exercise in frustration.

I'm currently running the latest version of a popular pro-level sequencer on my venerable SE. I do a lot of work slaved to SMPTE, and although my sequencer "will run" (even this is debatable—I have had playback lurch by opening an edit window during synchronized playback), the onscreen faders are so sluggish they are practically useless. Also, screen redraws are so slow that any sort of graphic editing on-the-fly is impractical. I do not fault the software developers; they give us the features we ask for, and I realize it is time for me to ante up for a newer Mac.

The sort of review Mr. Ungaretti requested—one that describes the performance of various pro-level sequencers on various Mac platforms in realistic pro-level situations—is a good idea. This would be useful to your many readers who use their Macs for more than simply "recording and playing back MIDI data."

James Steele
San Diego, CA

BINAURALLY SPEAKING

I spent 21 years as an engineer and voicing consultant with Hammond Organ Company, and I read the letter from Jeff Hadden and your response ("Letters," August 1993) with mixed emotions.

Music is seldom heard exactly as the composer wrote it, even by the musicians playing it. A listener seated front row, center of an audience is the only one who hears the music as the composer intended. The persons seated to the right and left will hear something different, due to the differing wavelengths of the various instruments playing different frequency notes.

Binaural reproduction through headphones sounds as it would to some single person, seated "someplace," ideally front and center. Stereo reproduction, on the other hand, sounds as it would to a person with perhaps ten or more ears spaced randomly, at distances up to twenty feet apart.

Binaural recording was the first multiple channel sound-delivery system available to the public. One reason early binaural recording did not catch on is that early records had two side-by-side tracks, and it took a special turntable with two pickup arms to play them.

I am glad that some people still have the sensitivity to appreciate binaural recordings. Stereo, while good, is a different animal.

Robert Mathias
Brookfield, IL

WHAT TO DO?

I currently own a Boss DS-330, having just up-dated from a Roland CM-32L, and enjoyed Andrew Schlesinger's article "Colors for Your Canvas" (July 1993).

I would like to know if I too can get my MT-32 sounds back from my DS-330, as I lost a lot of Tones when I updated. The button sequences in the article were for an SC-55.

Paul Bynum
Durango, CO

Paul—Unfortunately, the MT-32 sounds are only available in certain Sound Canvas products: the SC-55, SC-155, CM300, JW-50, JV-30, and SCC-1. The Boss DS-330, the Roland SC-33, SD-35, SC-7, and RAP-10 fully support General MIDI, but they do not include the original MT-32 Tones. Also, any MT-32 emulations in Sound Canvas products are only of the stock factory Tones; it is not a complete emulation. Any song or application (such as a computer game) that uses SysEx to customize MT-32 sounds cannot be accurately reproduced.—Bob O'D.

DIGITAL TIMBRE

I'd like to congratulate Larry "the O" Oppenheimer on his informative article, "The Digital Puzzle" (May 1993). I do, however, have an additional question that was not addressed in the article, nor have I seen it explained anywhere else.

How is the harmonic structure, or timbre, encoded in a 16-bit sample? In other words, how is the harmonic content of a sample transformed into digital bits, and where is this information located in the sample's bitstream?

Ken Meyer
New York, NY

Author Larry Oppenheimer responds: *It isn't. Digital audio is stored as a series of samples, each of which is a number representing the instantaneous level of an audio waveform at the moment of sampling. The digital sound's timbre is contained within the amplitude changes, just as with an analog waveform. The sampling process doesn't alter the waveform or its timbre (at least theoretically); it simply converts the sound into a different format.*

Spectral information (i.e., harmonic or non-harmonic content) can only be obtained through analysis methods, the most familiar being the Fast Fourier Transform (FFT). Many sample-editing programs include some facility for performing "reasonable-time" FFTs (not quite real-time, but taking only a few seconds or minutes to compute), and there are some excellent, though probably pricey, pieces of test equipment from the likes of Brüel and Kjær or Hewlett-

DAVID SMITH

Packard that perform FFTs in real time.

BIT BY BIT

In purchasing a new CD player, I came across a series of Kenwood players that advertised 1-bit D/A conversion. Sony just introduced a new line of DAT decks, the Pro/Standard series, which offers 1-bit A/D converters.

In regard to the number of bits, I was under the impression that bigger was better. The more bits, the more information expressed at one time, thus making the sound quality of a 16-bit digital audio system remarkably better than an 8-bit system. The way I understand it, it would be impossible for a 1-bit system to get anything across.

Please explain what a 1-bit conversion system is, and why manufacturers advertise it as a plus.

Jacob Winkler
Seattle, WA

Jacob—I remember thinking the same thing when I first heard about 1-bit DACs. Digital audio systems represent a waveform as a series of numbers derived by measuring the instantaneous level of the waveform many times per second. CDs use 16-bits, and the instantaneous level of the waveform is measured 44,100 times per second. In a Pulse Code Modulation digital circuit, the number of bits (called the resolution) determines the number of steps between the lowest level (all bits=0) and the highest level (all bits=1), affecting the accuracy and dynamic range of the system. This implies that the more bits, the better.

However, there is a tradeoff. As you increase the resolution, you also increase the accuracy and stability required of the circuitry. For example, a 16-bit system must be accurate to one part in 65,536; an 18-bit system demands an accuracy of one part in 262,544.

Another sampling technique, called Sigma-Delta Modulation, *transmits one bit at a higher rate. For example, consider a light switch: When it's on, the room is brightly lit; when it's off, the room is dark. If you turn the light on and off very quickly, any intensity can be achieved. Similarly, a stream of 1s represents a fully positive level, while a stream of 0s represents a fully negative level; a stream of evenly alternating 1s and 0s represents a zero level, and other variations produce intermediate levels. Altering the sequence of 0s and 1s can thus produce any waveform. This technique, called* time division, *is inherently more accurate than multibit representations of the waveform's amplitude.—Scott W.*

DIY FYI

Mr. Ryckebusch's reply to my letter, "Room For Improvement" in your August 1993 issue is incorrect. Where Mr. Ryckebusch is finding his "extra gain of two" is beyond me, but any opamp reference book will show the formula for the voltage gain of a differential amplifier circuit to be $E_{Out} = E_{Differential} \times R_{Out}/R_{In}$. Period. There is no factor of two in the formula. If Mr. Ryckebusch disagrees, I suggest he connect a floating source signal of a few millivolts at 500 Hz to the input of his amplifier and measure the output of the first stage.

Now, about those input capacitors. Mr. Ryckebush responded, "Typically,

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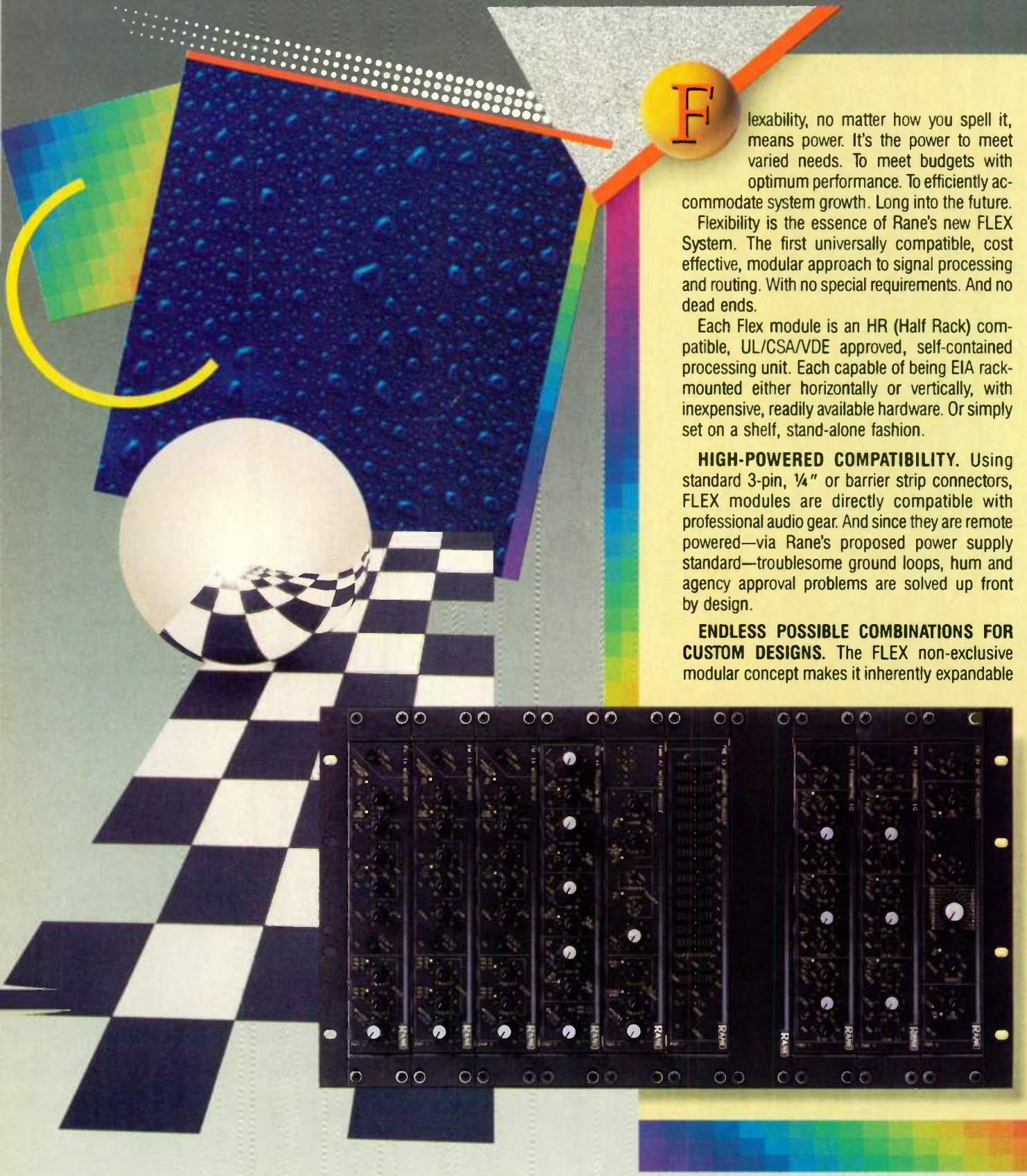


Flexability, no matter how you spell it, means power. It's the power to meet varied needs. To meet budgets with optimum performance. To efficiently accommodate system growth. Long into the future.

Flexibility is the essence of Rane's new FLEX System. The first universally compatible, cost effective, modular approach to signal processing and routing. With no special requirements. And no dead ends.

Each Flex module is an HR (Half Rack) compatible, UL/CSA/VDE approved, self-contained processing unit. Each capable of being EIA rack-mounted either horizontally or vertically, with inexpensive, readily available hardware. Or simply set on a shelf, stand-alone fashion.

HIGH-POWERED COMPATIBILITY. Using standard 3-pin, ¼" or barrier strip connectors, FLEX modules are directly compatible with professional audio gear. And since they are remote powered—via Rane's proposed power supply standard—troublesome ground loops, hum and agency approval problems are solved up front by design.

ENDLESS POSSIBLE COMBINATIONS FOR CUSTOM DESIGNS. The FLEX non-exclusive modular concept makes it inherently expandable

ARE STAGGERING!

and upgradeable. It boasts a large and growing number of functions and components to choose from. Mixers. Preamps. Splitters. Crossovers. Dynamic controllers. Equalizers. Amplifiers. Line drivers. And much more under development.

And thanks to Rane's efficient bus design, system wiring is greatly simplified in even complex mixing and splitting layouts.

COST EFFECTIVE CAPABILITIES. Modular flexibility. Uncompromising performance. All without a premium price. That's the FLEX System manifesto. There is no expensive mainframe to buy; you only pay for the functions you want, when you want them.

Say, for example, you only need a 3 channel mixer with one channel of crossover. The FLEX System delivers. And when your needs expand, just add more modules. No need to obsolete old equipment for a loss.

Whether you use two modules or twenty modules, the FLEX System remains cost effective. And supremely flexible. Year after year.

SUPERLATIVE PERFORMANCE, RANE RELIABILITY. The design and performance of each and every Flex module is, in a word, superlative. Every model carries top-grade studio specifications, utilizing the best components available. The result is unsurpassed performance and reliability.

Our HR compatible modules may be compact, but they're stuffed with more top-notch features than you would have thought possible. For example, the **FMI 14 Mixer Input module** measures only 1.75" × 10.5", yet it boasts a −128dB EIN mic stage, switchable phantom power, true 20dB pad, powerful 3-way EQ section, insert loop, two source-selectable Aux sends and balanced master channel outputs. A single DIN cable, supplied with each module, routes the Master and Aux buses from unit to unit for quick and clean hook-up.

The **FME 15 MicroGraphic Equalizer** brings Interpolating Constant-Q filter performance to the Flex line, pioneered by our full-sized GE 30 +15/−20dB boost/cut, 2-octave down to 1/30th-octave bandwidth range for notch capability, and a full 10Hz-20kHz frequency sweep range for unprecedented flexibility.

The **FMM 42 Master Module** not only provides Aux returns and mixing, but features extra mic and stereo line inputs with ducking capability for paging and other applications.

For even more mixing flexibility, the **FPM 44 Program Mixer** allows 4 separate mic or line inputs to be mixed to 4 output programs, with pre or post fade switch selection for the Aux sends. Both the direct balanced/unbalanced terminal strip and the DIN Flex bus inputs and outputs can be used simultaneously for easy expansion and integration into larger systems.

Carrying on a fine tradition of innovative equalizer technology, Rane sets yet more new standards with the Flex Series. The **FPE 13 Parametric Equalizer** provides 3 separate bands, each capable of model which has set new industry standards. Minimized filter interaction, smooth combined response and fully balanced three-pin and terminal strip input/ output are but a few of the features. Both the FME 15 and the FPE 13 also provide an exclusive Patch I/O jack which allows direct connection to an insert loop jack with a single ¼" TRS patch cable.

The **FAC 24 Active Crossover** is the next generation to follow in the respected footsteps of our AC 22 and AC 23 designs. In addition to the proven 24dB/octave Linkwitze-Riley performance, the FAC 24 features a true 24-position frequency selector switch to provide plug-in card accuracy and repeatability with the convenience of a knob. Add to this a built-in CD Horn EQ section, electronic phase alignment, summing LF input and three-pin high-current balanced outputs, and you've got a powerful, flexible new crossover standard.

This is but a sampling of the innovative Flex Modules to be released this year. We encourage you to obtain separate, detailed data sheets on the many FLEX System modules. Then compare these with the best standard equipment available. You'll discover that FLEX offers the best of all worlds: compact, cost effective, flexible, uncompromising performance.

FLEX

MODULAR SIGNAL PROCESSORS

series

RANE

10802-47th Ave. W.
Everett, WA 98204
(206) 355-6000

(Read this in a low voice with reverb)

FIRST WE INVENTED THE MUSIC WORKSTATION

The M1, the world's first "music workstation."

THEN WE MADE IT BIGGER

The T1, a more complete version of a powerful idea.

THEN WE MADE IT BETTER

The 01/Wfd, still the world's leading workstation.

AND NOW

The New X3
Power Music Workstation

Korg, the acknowledged leader in music workstations, is proud to introduce another breakthrough loaded with the highest quality Korg sounds and features at an unprecedented price — the X3 Power Music Workstation.

The X3 has 536 phenomenal sounds featuring a new acoustic piano plus new organs, guitars, drums and a collection of orchestral and ethnic instruments from all over the world.

It's equipped with a powerful 16 track, 32,000 event sequencer. And another breakthrough for its class — *a built-in disk drive.* Plus Korg's Dynamic Digital Multi-Effects System with 47 types of effects. It also has General MIDI with Standard MIDI File compatibility, too.

If you've been looking for the most music workstation for the money, go to your Korg dealer and experience the powerful new X3.

Discover how far you can take your music with a special CD of original sequences created with the X3 that also includes an X3 CD ROM Demo (Mac Compatible). Just send $2.95 for shipping and handling with your name and address to X3- CD, Korg U.S.A., 89 Frost St., Westbury, NY 11590.

Please send check or money order and allow four to eight weeks for delivery. Offer good in the U.S. only until February 28, 1994 or while supplies last.

KORG
X3
Power MUSIC WORKSTATION

electrolytic capacitor values run higher than rated specifications (+80%/-20%)." However, the parts list calls for tantalum caps, which usually have a 10% or 20% tolerance. And if he is that worried about leakage current, he should not be using 35-volt capacitors at 39 volts.

One last point. For the common mode rejection to be effective down to 60 Hz (that dreaded hum), the input capacitors in each channel must be matched to within at least 2% of each other.

Les Cooley
Director of Engineering
Eltec Instruments, Inc.
Daytona Beach, FL

Author Jules Ryckebusch responds: *Here is where my gain of two comes from: The input stage amp is a* differential *amplifier. There are actually two inputs that are added together (one in phase, one out of phase) before being multiplied by ten. Thus, a total gain of twenty. Les is right though: If I connected an* unbalanced signal *to one of the inputs, I would get a gain of ten. However, our microphone is actually sending two signals of equal amplitude (one 180° out of phase) to the microphone preamp, referenced to ground. About the input capacitors: Their DC leakage depends on the applied voltage and capacitance value. I do stand corrected on the tantalum vs. electrolytic. By the way, Panasonic makes some nice, low leakage electrolytics these days under the "HFQ" part number. Leakage is on the order of .003CV microamps. Thank you for your letter. It is nice to know fellow engineers are keeping me on my toes!*

CD-ROM BOOKS

Like many other folks, money's tight, and I regret I can't access the wealth of information from the *Mix Bookshelf*. Although the books are reasonably priced, I can't afford to purchase all I'd like. With the developments in multimedia and usage of the CD-ROM, have you considered offering disks with compilations of some of your popular titles? Since disk prices are often lower than published book prices, I could take advantage of such an opportunity.

Dana Negry
Olds, AB, Canada

Dana—According to Mix Bookshelf director Craig Wingate, the idea of a CD-ROM-based compilation of popular books is being considered as a future offering from Bookshelf. Keep your eyes peeled .—Bob O'D.

ERROR LOG

August 1993, "Modern Manuscripts," pp. 34-36: We accidentally omitted Softronics' *WinSong* ($79), a 64-track sequencer/notation package for *Windows*. Notation scrolls during playback, and dynamic marks (such as crescendos and diminuendos) are "live," i.e., they affect playback. A Juke Box feature plays Standard MIDI Files or *WinSong* files from a playlist, and a telecommunications module connects you with computer BBSs that offer SMFs. Softronics; tel. (800) 225-8590 or (719) 593-9540; fax (719) 548-1878.

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.*

WHAT'S NEW

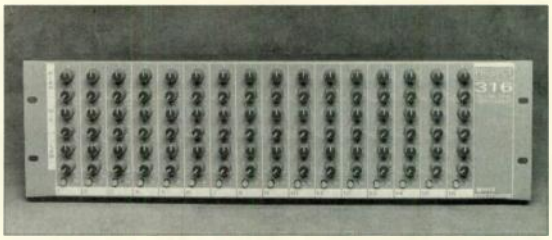
▲ MARANTZ CDR610

Marantz announced a new compact-disc recorder, the CDR610 ($4,000), and has lowered the price of the CDR600 ($3,500). The new model offers all major functions of the CDR600, including analog and digital I/O, Red and Orange Book compatibility, and automatic and manual track incrementing.

New CDR610 features include true AES/EBU digital I/O; Cascade connections for parallel operation of several units; balanced, +4 dBm or -10 dBu operation; and calibration pots for matching the digital meters to another reference. The recorder comes with a 16-key, wired remote control that also controls CD players, cassette decks, and DCC recorders. The remote has a parallel port to let external controllers and event-generators automate the recorder's major functions. A CDR600 can be upgraded to full CDR610 functionality for $400. Marantz also is offering 63-minute, blank media to CDR600 and CDR610 owners for $15 per disc. Marantz Professional Products; tel. (708) 820-4800; fax (708) 820-8103.

Circle #401 on Reader Service Card

▶ SPECK MODEL 316

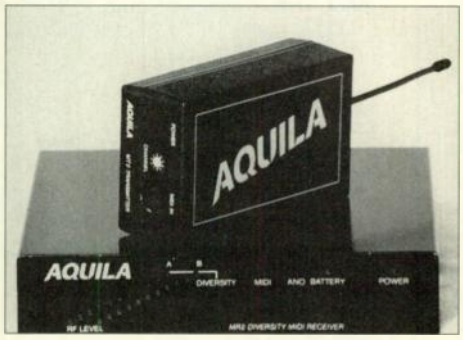


Speck Electronics is shipping the Model 316 ($698), a 3-rackspace, 16-channel, quasi-parametric equalizer designed to operate with synths, samplers, and 16-channel mixers. Each independent channel offers three bands of EQ with ±15 dB boost/cut controls. The low-band frequency is sweepable from 50 Hz to 500 Hz; the mid band ranges from 500 Hz to 5 kHz; and the high band extends from 5 to 15 kHz. All three bandwidths are fixed. Each channel has a hard-wired EQ bypass with status LED. All inputs and outputs use unbalanced, ¼-inch jacks. Frequency response is rated at 10 Hz to 110 kHz, residual noise at -89 dBu, and maximum input and output levels at +21 dBu. Speck Electronics; tel. (619) 723-4281; fax (619) 723-3294.

Circle #402 on Reader Service Card

▼ AQUILA MR2

Aquila Systems is offering the MR2 diversity wireless MIDI system ($1,699). The system uses Spread Spectrum technology and an omnidirectional, monopole antenna, which permits reliable operation up to 300 feet. You can select among eight RF channels between 902 and 928 MHz. The transmitter uses an external power supply, and the receiver can operate for up to an hour on 8.4V rechargeable NiCad batteries, three hours on 9V alkalines, and up to seven hours on 9V Ultralife lithium batteries. A low-battery indicator is included. The receiver can be rack-mounted with an optional kit. Aquila Systems; tel. and fax (215) 957-5450.



Circle #403 on Reader Service Card

▼ ZOOM 9050

Zoom's 9050 multi-effects processor ($799) is a direct descendant of the company's popular model 9030. The new, half-rackspace signal processor uses a chain of nine specialized effects groups. A comp/limiter precedes distortion (five types), noise reduction, configurable EQ (graphic, parametric, or enhancer), amp simulator, two conventional effects modules (pitch-shifting, phasing, chorusing, flanging, delay, etc.), a special-effects module, and delay/reverb.

The special-effects module produces combined effects such as Harmonized Pitch Shifter, Bend Chorus, Ducker, and Rotary Speaker. In Auto mode, the noise-reduction module tracks the input-signal level and active patch, and automatically adjusts accordingly. The 9050 has 55 preset patches in ROM and 198 in RAM, including all the 9030's presets. Samson Technologies (distributor); tel. (516) 932-3810; fax (516) 932-3815.

Circle #404 on Reader Service Card

▶ KORG I3

Korg released several new 32-voice polyphonic, 16-part multitimbral synthesizers. All use the same basic sound engine, which is almost identical to that in the 03R/W synth (They do not have the waveshaping feature of the 01/W.) All except the Audio Gallery include a digital multi-effects processor that offers real-time, dynamic parameter control.

The X3 Music Workstation ($1,949) includes a 61-key, unweighted, Velocity and Channel Aftertouch-sensitive keyboard; a 16-track, 32,000-note sequencer that can load and save Standard MIDI Files; a double-density, DOS-compatible floppy-disk drive; and two multi-effects processors. The 2U rack-mount X3R ($1,699) is identical to the X3, but without a keyboard.

The tone generator features 6 MB of ROM-based waveforms, comprising 340 multisounds and 164 drum sounds. The sounds include new piano, organ, and orchestral samples and a selection of guitars, basses, and ethnic instruments. The 136 ROM-based presets include 128 General MIDI presets and eight GM drum kits. The X3 has two banks of user program RAM, which can store up to 200 Programs and 200 Combinations. The digital filters are not resonant, but offer a Color feature that uses filter-regeneration, but without oscillation; a company representative described this as "pseudo-resonance."

The X3 offers a pair of slots for waveform cards and the optional SRC-512 program RAM card ($140), which adds two more user-program banks. The effects processors can produce 47 effects (including chorus, delay, and overdrive), four of which can be used simultaneously.

The 05R/W ($799) is a half-rack unit that offers the same sound engine, patches, and features as the rack-mount X3R, but without a sequencer and disk drive. In addition, it has an onboard MIDI interface for PC, Mac, and NEC PC-98 computers.

The AG-10 Audio Gallery ($499) is a tabletop General MIDI sound module that offers 4 MB of sample ROM, 128 ROM-based patches and one Multi set. Its effects processor offers reverb and chorus. The patches can be edited, but you must save your programs via SysEx, as there are no user program locations. There are two versions of the Audio Gallery: the AG-101 includes a PC-compatible MIDI interface, while the AG-102 has a Mac-compatible interface. Both come bundled with Passport's *Trax* sequencing/notation software.

Last, and certainly not least, Korg is shipping the 76-key i2 ($3,899) and 61-key i3 ($3,199) Interactive Music Workstations. The i series use the same sound engine and signal processor as the X3, but are distinguished by interactive accompaniment features that provide preprogrammed sequence patterns (Styles). These Styles are designed as a compositional aid; they quickly create background tracks, while you focus on the melody and song arrangement. Each Style contains four variations, two intros, two fills, and two endings. Each variation consists of six tracks, including drum, percussion, bass, and other parts. They can be edited, combined, or looped and stored as a new pattern or Style. Korg offers a library of Styles to fit a variety of musical genres.

The i2 and i3 have a 16-track, 40,000-note sequencer, with the same functions as the 01/W's sequencer. In Backing Sequence mode, the units can record six backing tracks associated with the Styles, plus the user's button pushes, the chord progression, and eight additional sequence tracks. The i2 and i3 also have over 10,000 tracks of prerecorded, ROM-based sequences. Finally, i-series instruments offer a program card slot and a disk drive that lets you save sequences, Styles, and patches. Korg USA; tel. (516) 333-9100; fax (516) 333-9108.

Circle #405 on Reader Service Card

▶ BLUE RIBBON PATCHMEISTER

The Blue Ribbon SoundWorks introduced *The PatchMeister* ($99), a universal editor/librarian for the Commodore Amiga. The program can store an unlimited number of Banks and Libraries and features setup "snapshots," setup files, and SysEx attachments. Patches can be auditioned using a MIDI controller or the computer keyboard, in addition to special auto-audition features.

The PatchMeister integrates with the company's *Bars&Pipes Professional* sequencer, and windows from both programs can be viewed simultaneously. Drivers are provided for a wide variety of gear by Alesis, E-mu, Ensoniq, Korg, Roland, Yamaha, and others, and you can create your own drivers. The Blue Ribbon SoundWorks; tel. (404) 315-0212; fax (404) 315-0213.

Circle #406 on Reader Service Card

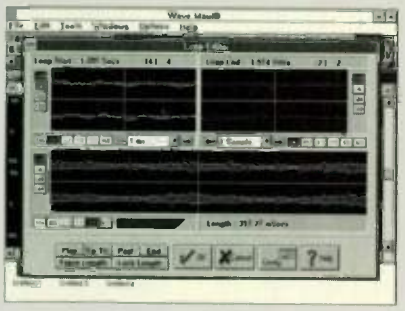
PC SOUND CARDS ▲ ▲ ▲ ▲ ▲

▼ TURTLE BEACH SYSTEMS

Turtle Beach Systems introduced two new card-based products for PCs. The Tahiti Digital Audio Card ($399) is similar to the company's MultiSound card, but without the synthesizer. A Creative Labs WaveBlaster-compatible header is provided so a synth can be added later. Designed for multimedia applications, it uses a Motorola 56001 DSP chip to provide two tracks of 16-bit, 44 kHz recording to hard-disk. The card is bundled with *Wave Lite* software.

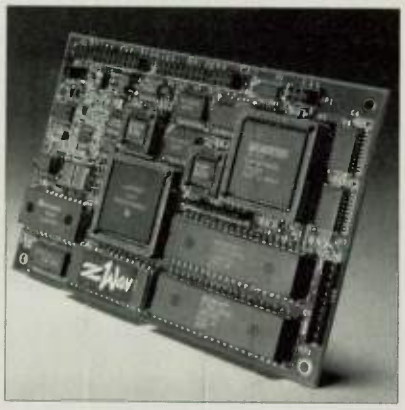
In addition, Turtle Beach is shipping Maui ($199), a 24-voice, 16-part multitimbral wavetable synth upgrade card. The Turtle Beach-made synthesizer is General MIDI-compatible and has 2 megabytes of ROM-based sounds and 256 KB of user sample RAM, expandable to 8 MB (for playback only). The *WaveMaui* software lets Maui load and play PC Wave files. Maui includes a Roland MPU-401-compatible MIDI interface. Turtle Beach Systems; tel. (717) 767-0200; fax (717) 767-6033.

Circle #407 on Reader Service Card



▼ ANTEX

Antex is offering Z.WAV ($295), a wavetable synthesizer on an add-on daughtercard for the Antex Series 3/Model Z1 digital audio adapter card. Z.WAV uses the Ensoniq OTTO synth engine to provide 4 MB of 16-bit, 44.1 kHz samples, programmed into 128 General MIDI-compatible instruments and a GM drum set of 47 percussion sounds. The 32-voice polyphonic, 16-part multitimbral synth is compatible with the Creative Labs SoundBlaster 16, providing an alternative to Creative's WaveBlaster synth. The sounds are not editable. Antex Electronics; tel. (800) 338-4231 or (310) 532-3092; fax (310) 532-8509.



Circle #408 on Reader Service Card

▲ MEDIA VISION

Media Vision announced the Pro AudioStudio 16XL ($499), a 16-bit sound card that features a 32-part polyphonic, 16-part multitimbral Korg synthesizer. The synth uses the same chip set as Korg's 03R/W and Audio Gallery wavetable synths and produces 128 GM-compatible sounds and four drum sets. In addition, it includes a signal processor that produces digital reverb and chorus. To top it off, Pro AudioStudio 16XL has an FM synthesizer, a game port, a SCSI CD-ROM controller interface, and a built-in MIDI interface. The card comes bundled with Dragon Systems' *ExecuVoice* voice-recognition software, *Monologue for Windows* text-to-speech synthesizer, Passport *Trax for Windows* sequencing/notation software, and Media Vision's *Pocket Tools* audio recording and editing package. Media Vision; tel. (800) 348-7116 or (510) 770-8600; fax (510) 623-5749.

Circle #409 on Reader Service Card

▶ OPTIMA DESKTAPE

Optima Technology Corp.'s *DeskTape* 1.6 ($495) is a system extension for the Macintosh that allows SCSI-2 tape devices (e.g., 4 mm data DAT and 8 mm tape drives) to mount as 2 GB hierarchical file structure (HFS) volumes on the Macintosh desktop. This lets you use tape media as if they were other removable media. (The throughput is between 180 and 500 Kb per second uncompressed.) You can write Finder copies via click-and-drag, directly open files (including large audio and multimedia files), view pictures and *QuickTime* movies, and print documents directly from tape. The software requires System 6.0.5 or later, and takes advantage of System 7.1 *WorldScript*, which allows it to operate in 32 languages. It is compatible with many popular DAT and 8 mm drives and is bundled with Optima tape subsystems. Optima Technology Corp.; tel. (714) 476-0515; fax (714) 476-0613

Circle #410 on Reader Service Card

(continued on p. 25)

PRESSURE SENSITIVITY:
LIKE ON THE $2,050.00 ROLAND JV-80.

+

32 VOICE POLYPHONY:
LIKE ON THE $1,495.00 E-MU PROTEUS MPS.

+

55 TEMPERAMENT VARIATIONS:
LIKE NOBODY ELSE. ROLAND'S $2,295.00 JW-50 HAS ONLY 16 TEMPERAMENTS AVAILABLE.

+

32 MULTITIMBRAL PARTS:
LIKE NOBODY ELSE. YAMAHA'S $2,195.00 SY-77 HAS ONLY 16 PARTS.

+

FULL EDITING AND STORAGE:
LIKE ON THE $2,399.00 KORG O1W.

+

MAC™ INTERFACE:
LIKE YOU'D PAY AN EXTRA $99.95 FOR THE MACMAN.

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2 MIDI INPUTS:
LIKE NOBODY ELSE. WELL, YOU COULD BUY TWO KEYBOARDS TO GET THIS.

+

18 BIT DAC, 512 DIFFERENT WAVEFORMS, GENERAL MIDI, 384 TONE BANKS, CD-LIKE AUDIO QUALITY,
21 DRUM KITS, MONSTROUS LAYERS AND MULTIPLE SPLITS,
SOUND QUALITY RICHER AND THICKER THAN A STACK OF BLUEBERRY PANCAKES DRIPPING MAPLE SYRUP.

=

THE ALL NEW KAWAI K ELEVEN DIGITAL SYNTHESIZER.

SO, LIKE, WHAT ARE YOU WAITING FOR?

KAWAI
Digital Magic.

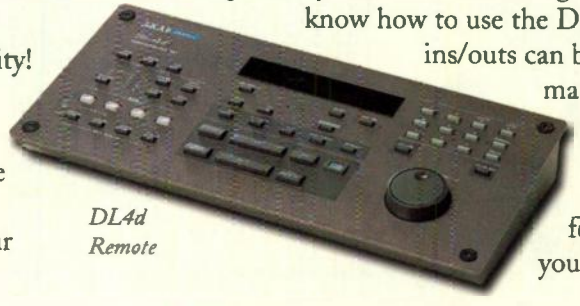
Ten Reasons Why You Should Cho

1. TAPELESS EDITING The DR4d can simultaneously record 4 tracks directly to standard SCSI-compatible hard disks, not tape. Tape recorders which use a cassette format (VHS, 8mm, etc.) have a huge problem: without at least two machines, you can't edit. But even a single DR4d allows random access editing that tape recorders just can't offer. Move, Copy, Insert, Copy + Insert, Move + Insert, Erase, and Delete with ease. Edit with complete confidence, because if you try an edit but change your mind, the Undo function will instantly restore the previous arrangement. It's a breeze to copy any part of a track and paste it anywhere on any track, even with a specified number of repeats. Or perhaps use the Insert commands to instantly slide track data in time against other tracks. This editing power encourages experimentation, and thus, your creativity! Imagine it. Do it.

2. NO WAITING Another problem with tape is the time required to physically move from one point on the tape to another. Concentrating on your music is what's important, not waiting for tape to shuttle back and forth. Never again waste such precious time: the DR4d allows you to instantly move to 108 different locations. Set up repeat sections, jam along with your tracks, then drop into record to capture it all while it's still immediate, fresh.

3. JOG/SHUTTLE Another cool DR4d advantage is the ability to offer scrubbing of audio, like "reel-rocking"on analog decks - only with much better quality. Our Jog/Shuttle wheel lets you scrub through the audio at various speeds, forwards or backwards. So finding precise editing points is only as complicated as using your ears.

4. FAMILIAR OPERATION One concept we *did* want to carry over from tape recorders is the user interface. Friendly, tape machine-style controls make the DR4d by far the easiest hard disk recorder to use. With dedicated buttons for Play, Stop, Rewind, Fast Forward, and so on, what could be simpler? If you've used an analog deck, then you know how to use the DR4d. Punch-ins/outs can be performed manually or automatically from the front panel, or via footswitch. Like you'd expect.



DL4d Remote

5. EXPANDABILITY Up to four DR4ds can be chained together to create a 16-track system, simply by plugging an optional cable between units! And the optional DL4d Remote makes it a snap to

ɔse the DR4*d* Hard Disk Recorder

control all of them. An optional, factory-installed 200 MB internal hard disk offers 32 track minutes of recording right out of the box. The DR4d can handle up to seven hard disks and supports seamless overflow recording across multiple disks. With enough disk storage space, you can actually record on all four tracks for an incredible 24 hours!

6. EXCELLENT CONNECTIONS Four balanced TRS 1/4" Input and Output jacks, easily switchable between -10 and +4 dBu levels, simplify interfacing with any type of console. The DR4d's pair of digital I/O ports allow communication with other digital devices in the form of both XLR and RCA connectors (AES/EBU or Type II selectable), as well as provide DAT backup. And then there's the supplied SCSI port for access to external hard disk drives. Just plug and play!

7. YOU'VE GOT OPTIONS And affordable ones, at that. For digital access to all four channels simultaneously, the IB110D provides the two additional AES/EBU ports. For SMPTE timecode applications (slave or master), the IB112T is installed in seconds. The IB113M interface gives you MIDI In, Out, and Thru, and the IB111S is a second SCSI port which will allow connection to computers for visual waveform editing and magneto optical drives for data backup.

8. DEDICATED DESIGN The DR4d is a dedicated digital audio product, rather than an add-in board for a computer. It's a tool designed for a single purpose: to record and edit audio precisely, effortlessly, and affordably. We think you'll agree that it succeeds on all counts beautifully.

9. SOUND QUALITY The DR4d contains Akai's own advanced digital technology, including super-clean 18-bit 64x oversampling A/Ds and advanced single-bit 8x oversampling D/A convertors with 18-bit resolution. Industry standard sample rates include 48, 44.1, and 32kHz. In short, the quality is superb and with a full 96dB dynamic range, you can rest assured of always sounding your best.

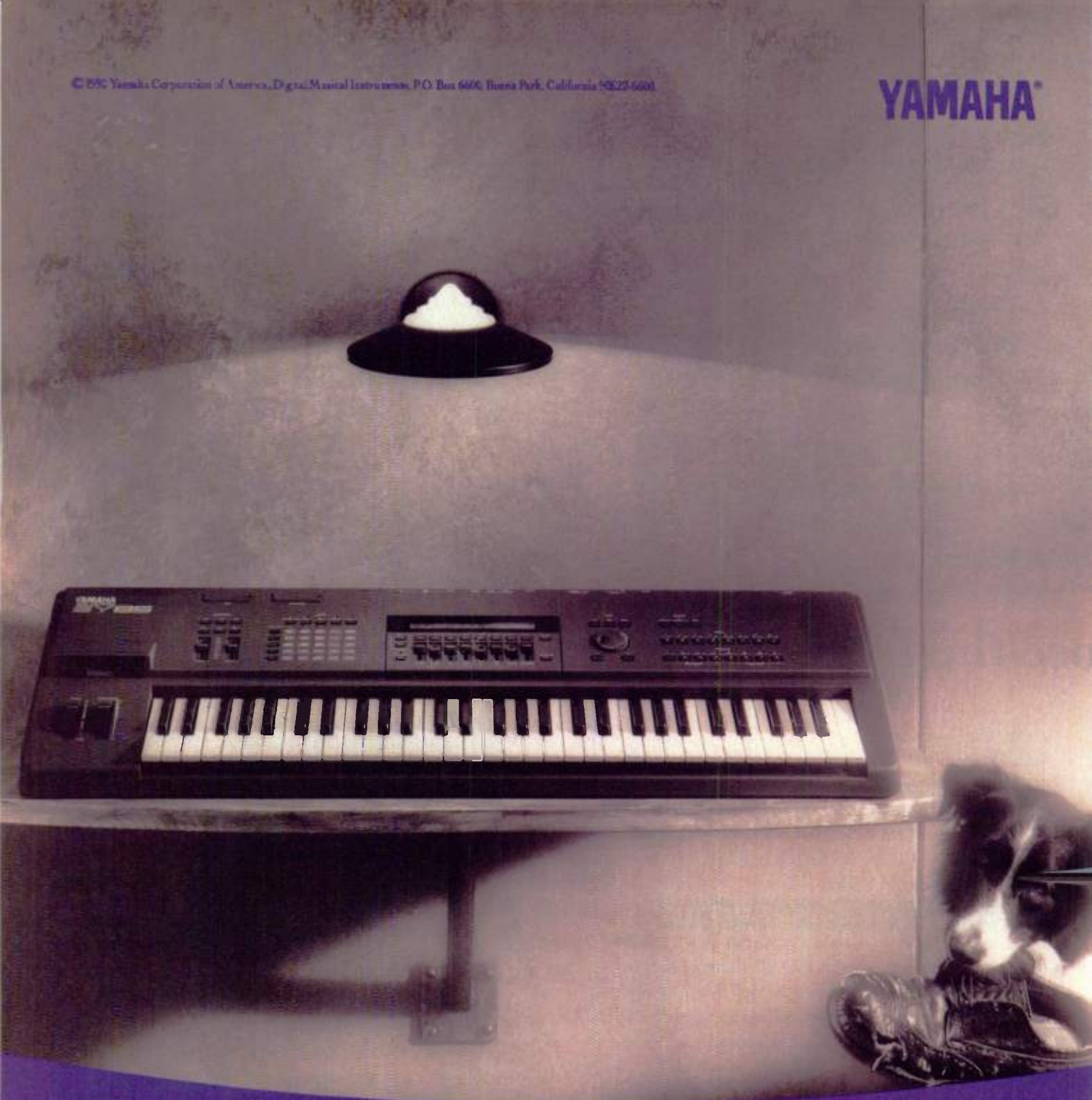
10. $1995.00 Simply put, the DR4d is the best value in digital recording today. For the first time, the nucleus of a professional quality 4-track hard disk recording system can be yours for only $1995.00! Just add internal or external hard disks, and you're ready to use our latest masterpiece for creating your next masterpiece.

DR4d

AKAI DIGITAL

P.O. Box 2344 Ft. Worth, TX 76102
(817) 336-5114 Fax 870-1271

YAMAHA



Sound will obey.

The dog will never be the intelligent, obedient and loyal servant you would like him to be. Your music, however, will do whatever you want. How come?

Quick Edit. It's a mode of programming in the SY85 AWM synthesizer. It allows you to, very simply, create any sound you can imagine. How simply?

You can layer, split, and cross fade up to four voices at once. Eight control sliders let you modify any parameter you like. It's easy and it's quick, hence the name.

You need more control? While playing live those same sliders can modify the effects, filters, attack, release, and balance, all in real-time. And the SY85 has SIMMs as well as battery-backed, expandable RAM, MIDI capability and, of course, our distinctly superior sound quality and playability. It is, after all, a Yamaha.

Would you like more information? Call us. Obediently, we'll send you our brochure.
1-800-932-0001, extension 100. **The SY85.**

▼ SPECTRAL SYNTHESIS AUDIOPRISMA

Spectral Synthesis is shipping AudioPrisma ($3,995), a PC-based, hard-disk recording system that records and mixes twelve channels of digital audio on 96 virtual tracks, using one ISA-bus card. Multiband parametric EQ is provided on all active channels. In addition, signals can be routed between tracks through 24-bit internal, real-time digital effects, and effects sends and returns let you send signals to external processors.

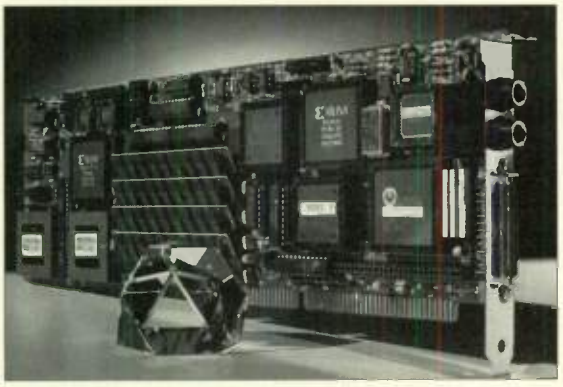
The system provides 8-channel digital I/O with the addition of the MAX 880 external box ($1,985), which converts the company's Spectral Multi I/O into four stereo pairs of S/PDIF. Analog I/O is available with the addition of the ADAX 8818 ($3,795) for eight channels, or the ADAX 4418 ($2,395) for four channels. The board itself, which includes 4 MB of RAM standard, supports stereo digital AES/EBU or S/PDIF I/O via isolated ¼-inch TRS jacks. (RCA adapters are included.)

Other noteworthy features are true chase-lock synched directly to SMPTE time code, MTC, and black burst; built-in SCSI control; and RAM-based (non-destructive) editing. A ½-rack-space breakout box for SMPTE, MIDI, and black-burst connections is included.

The *Prismatica* software (which evolved from Spectral's *StudioTracks* 2.0) runs under *Windows* 3.1 and integrates with *Windows*-based sequencing programs. In addition to its Multitrack Editor, Playlist Editor, and Tape-deck windows, the program offers automixing and supports real-time recording to removable media, including magneto-optical disk. The system can back up to MO, DDS 4 mm DataDAT, and Exabyte 8 mm digital tape. AudioPrisma is data- and media-compatible with Spectral's AudioEngine, and the two systems can be networked.

AudioPrisma requires at least a 25 MHz, 80386-based PC (33 MHz 80486 recommended), with 4 MB of RAM, *Windows* 3.1 or *Windows NT,* and an ISA bus slot. Spectral Synthesis; tel. (206) 487-2931; fax (206) 487-3431.

Circle #411 on Reader Service Card



▼ SOUND TRAX PC-CONNECTION

Sound Trax Studios announced *PC-Connection* ($695), a PC card with software that provides computer control of the Alesis ADAT. Designed for editing audio for film and video post-production, the system lets you edit sound effects and dialog with SMPTE lock, CMX list auto-assembly of audio, and auto-locate. It also offers machine control that lets the ADAT chase video and audio tape recorders. Sound Trax Studios; tel. (800) 959-9722 or (818) 842-6300; fax (818) 846-3757.

Circle #412 on Reader Service Card

▲ SAMSON Q5

Samson introduced the Q5 headphone amplifier ($169). The half-rack unit provides five independent, 500 mW (into 160Ω) headphone outputs with individual volume knobs. The unit also has a master input-level control and a mono/stereo switch. The rear-panel Stereo Link jack lets you daisy-chain multiple Q5's. Samson Technologies Corp.; tel. (516) 932-3810; fax (516) 932-3815.

Circle #413 on Reader Service Card

▶ SOUNDCRAFT SPIRIT FOLIO SI

Soundcraft introduced two new Spirit Folio-series mixers. The Spirit Folio Si ($725) is an 18 x 2 board designed for keyboard mixing, submixing, and A/V suites. Six stereo input channels provide 3-band, fixed EQ, and two stereo input channels have 2-band EQ. The remaining two input channels are monaural and include a mic preamp, 48V phantom power, a highpass filter, and 3-band EQ with swept midband.

All eighteen channels have 60 mm faders; two aux sends (one switchable pre/post-fader, the other post-fader); balanced XLR and ¼-inch inputs; and latching, PFL soloing. The aux master buses also have soloing. The tape returns can be routed to the mix and used as extra inputs. The L/R masters have insert points and 12-segment LED bar-graph meters. The Folio Si comes in 7U rack-mount and tabletop versions.

The Spirit Folio 4 tabletop mixer ($1,795) offers twenty inputs—twelve mono and four stereo channels—and four subgroups. The mono channels include 3-band EQ with sweepable mids; mic preamps; and balanced XLR and ¼-inch inputs. The stereo channels have 60 mm faders and 2-band shelving EQ. The EQ on all channels can be switched in and out.

The aux section provides four mono aux sends, two stereo sends (eight sends total), and four stereo returns. Aux sends 1 and 2 are prefader, Aux 3 is switchable pre/post, and Aux sends 4 through 8 are post-fader. A pair of bar-graph VU meters monitor the mix output and a pair of peak meters monitor either the mix, tape return, stereo return, stereo aux buses, or group outputs. PFL soloing is provided on all channels and AFL soloing on the aux masters. Each mono input fader has a peak LED. Soundcraft USA/JBL Professional; tel. (818) 893-8411; fax (818) 893-0358. ●

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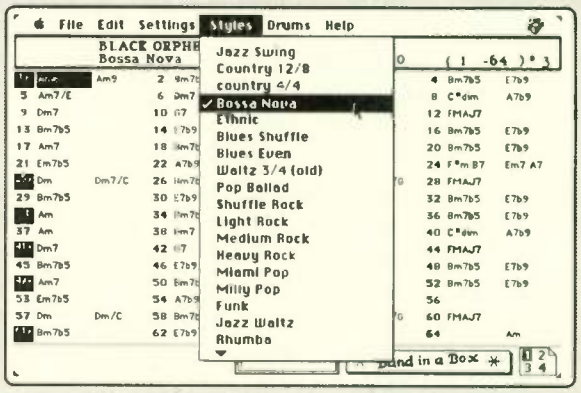

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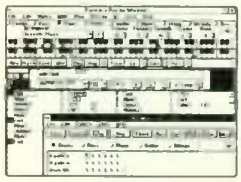
- *all files fully compatible with DOS, Mac & Atari versions!*



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PC MAGAZINE Jan. 15, 1991 – Technical Excellence Awards

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Band-in-a-Box Prices

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*Requirements: **Windows (IBM)** 2mb RAM memory, Windows 3.1, Soundcard (Roland, SoundBlaster, etc.) or MIDI system with piano sound, 3.5" or 5.25" high density Floppy Disk, 2mb hard drive space required. **Atari version coming soon!***

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YOU CAN ALSO USE THE PIECES IN YOUR OTHER MUSIC PROGRAMS OR FOR YOUR PRESENTATIONS
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USE YOUR EXISTING SOUND CARD OR MIDI SYNTHESIZER
Plays the music back through your existing MIDI synthesizer, digital piano, or sound module. Windows users can playback through your SoundCard (Roland, SoundBlaster, etc.)

***REQUIREMENTS:** MACINTOSH 2 MB memory, system 6 or 7, MIDI interface + synthesizer/module with guitar, bass, drums sound. 3.5" high density floppy disk, 2mb hard drive space required.*
Requirements: Windows (IBM) 2mb RAM memory, Windows 3.1, SoundCard (Roland, SoundBlaster, etc.) or MIDI system with guitar, bass, drums sound, 3.5" or 5.25" high density floppy disk, 2mb hard drive space required.
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Both of above Roland products come bundled with great software - PowerTracks MIDI sequencer for Windows and DOS, and SC-PRO Sound Canvas Editor/Librarian for Windows)

The Music/Brain Connection

A new wave of research probes how the brain perceives music.

By Daniel Levitin

The mystery of perception and cognition has long fascinated humans. The process by which we perceive, process, and interpret information is far more complex than any computer and is not easily studied. Many researchers believe the brain is composed of separate structures dedicated to performing certain tasks, all interwired and working in parallel. But what do we mean by "separate" structures, and how specific are they? Take reading, for example. Some believe the brain recognizes individual letters in a word using certain structures connected to other structures that recognize whole words, dynamically taking into account context, word frequency, syntax, etc.

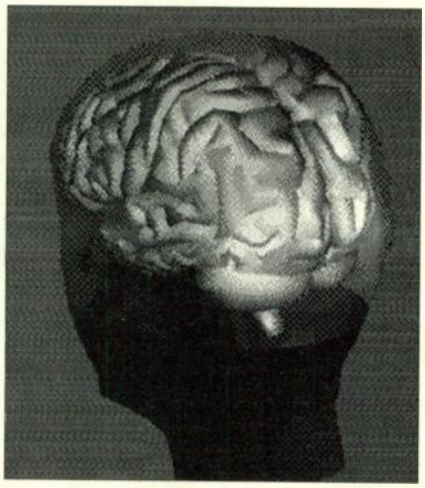
There may also be separate structures for different aspects of music perception. Petr Janata, a neurobiologist in the Brain Electrophysiology Laboratory at the University of Oregon, believes the brain probably contains many separate substructures for music perception: one for processing pitch and others for rhythm, timbre, and meter. These structures would be connected to other cognitive structures, such as those for memory, attention, and emotion.

One early structural finding was that the two hemispheres of our brain perform different functions. In a nutshell, the left brain's specialty is logical, analytical, and verbal thinking; the right brain is more artistic and intuitive and thinks in images. Tom Bever of the University of Rochester found that musicians tend to use their left brain for music processing, while non-musicians use their right brain. Linda Anderson of Harvard replicated these results and got musicians to use their right brain and non-musicians to use their left brain in certain tasks.

Anderson found that both musicians and non-musicians used the left brain when listening for *interval* changes. But when asked to listen only for changes in *contour* (the "shape" of a melody), both tended to use the right brain. Listening for interval changes may require specific analytic skills, whereas detecting changes in melodic contour may involve higher-level, or global, perceptual skills.

If musicians and non-musicians use different brain structures, it doesn't necessarily mean that musicians are born with different brains; their brains may develop differently through training. New evidence shows that the neural wiring of the brain continues to change well into adolescence. The music you listen to in early adolescence may actually become incorporated neurologically into the way you hear music the rest of your life. This may explain why parents often can't stand their children's favorite music.

A new method of learning about the structure of the brain uses *Event-Related Potentials* (ERPs). Fluctuations in the brain's electrical fields are detected by sensors placed on the head. ERP plots the course of various mental activities and can reveal the general areas of the brain used for a given mental activity.



The brain's electrical activity can be recorded with dense arrays of electrical scalp sensors. (Image by Eric Gorr, Matt Rubin, and Don Tucker.)

Previous ERP work revealed waveforms that are sensitive to context and surprise. Specifically, a positive voltage spike occurs in certain brain structures about 300 ms after a surprising event. Janata created musical cadences with either standard or unexpected resolutions. People who heard the unexpected resolutions showed the signature "surprise" voltage spike in a location that seems to be approximately above the right auditory cortex. In addition, different harmonic resolutions evoked different activity at the right frontal cortex, suggesting that multiple brain areas are required in processing musical harmony and context.

Additional support for the notion of separate musical processors comes from *amusiacs*, people who suffer from localized brain damage, most commonly from a stroke or head injury. Amusiacs may have normal mental functioning in every way except for music processing. One amusiac couldn't read or recognize any music, but could successfully sing certain songs; one previously accomplished pianist and violinist could play songs on the violin, but not the piano. Some amusiacs can't perceive music at all, complaining that it sounds like a bunch of noise. Maybe my parents suffered from amusia with regard to rock 'n' roll!

A former producer and engineer, **Daniel Levitin** *is a researcher at the Institute for Cognitive and Decision Sciences, University of Oregon.*

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By Steve Oppenheimer

MODULAR MUSIC MACHINES

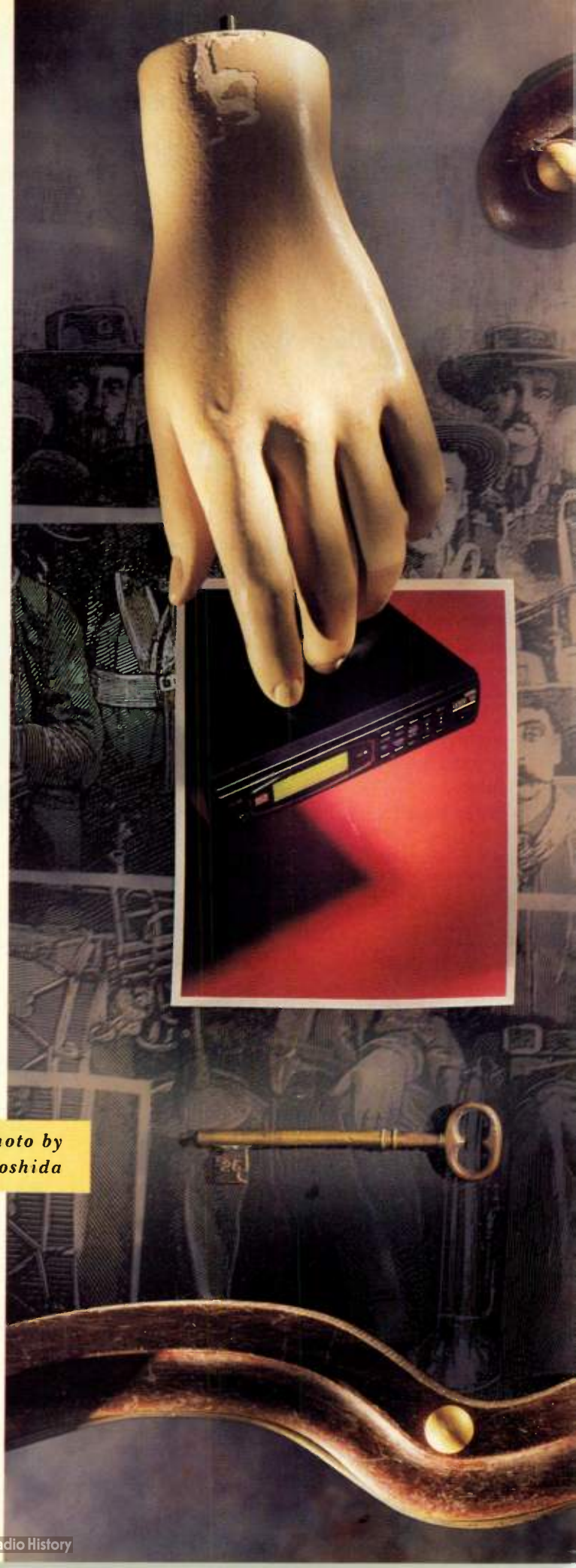

Photo by Tetsuji Yoshida

If variety is indeed spice, the sound-module stew is either more piquant, or a bit more bland than it was a few years back, depending on your point of view. The last time we took a look at sound modules the selections included analog synths, FM synths, L/A synths, and a host of wavetable (sample-based) synths. This time around, all that's left is sample-based instruments.

On the other hand, there are several new twists on the sample-playback scene. Since our previous buyer's guide ("EM Guide to Expander Modules," in the February 1991 issue), four completely RAM-based sample players have been introduced, one of which (Akai's CD3000) plays samples from a built-in CD-ROM drive. A few new synths offer both ROM-based samples and user RAM, several new modules offer especially powerful synthesis capabilities, and a few ROM-based synths incorporate unusual ethnic and electronically produced samples.

The EM guide to sound modules.

FXR!

The FXR's are the first dazzling results of A.R.T.'s 3 year superchip development program. Tucked inside the rugged steel enclosures is a new V.L.S.I. microchip with a stunning new level of power and precision. This provides for spaciousness and clarity that used to cost thousands of dollars.
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- Room reverbs
- Chamber reverbs
- Plate reverbs
- Delay
- Multi-tap delay
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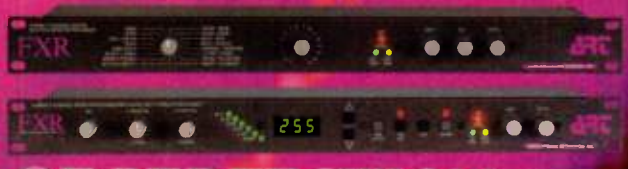
- Stereo flange
- Gated reverb
- Reverse reverb
- Stereo panning
- Separate input, output and mix controls and L.E.D.signal/clip indicators

The new A.R.T. ASIC shown in proportion to a penny. Three years and hundreds of thousands of dollars have yielded one of the most powerful audio chips ever.

Through a scanning electron microscope, you can see the gold plated connecting wires that are welded to the microchip.

At 100 times it size, you can see the immense number of micro-circuits on the A.R.T. superchip. Each handles an audio function.



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Sound Modules

To bring a sense of order to the plethora of available choices, we've limited the buyer's guide scope to rack-mount and tabletop synthesizers. As a result, we've excluded samplers and computer sound cards, which have different purchase considerations. We also eliminated drum-sound boxes with trigger inputs (which are intended primarily for electronic percussion kits) because they will be covered in an upcoming issue.

That still leaves an impressive list of sound modules. Some of them are keyboardless versions of products covered in "Keys to the Sonic Kingdom: The EM Guide to Keyboard Synthesizers" (April 1993 EM), but several instruments are available only as modules. And even though all current sound modules are sample-based, they certainly don't all sound alike, nor do they share all the same features or process samples in the same way. So if you're eager to taste the spice of electronic music life, take a look at the chart on pp. 34-35, and we'll start discussing the ingredients.

THE BASICS

Max Polyphony/Multitimbral Parts. The first chart category indicates the greatest number of notes the sound module can produce at a time. Most modules offer at least 16-note polyphony, but some can produce up to 32 notes or more. The vast majority of sound modules are multitimbral, which means they can simultaneously play several different sounds, with each sound on its own MIDI channel. Because there are sixteen MIDI channels, most instruments are 16-part multitimbral, meaning they can play sixteen distinct sounds at once.

Total Oscillators/Max # Oscillators per Voice. In some contemporary synths, each polyphonic voice requires just one oscillator; in these cases, Total Oscillators equals Maximum Polyphony. However, most synths use two oscillators per voice; in this case, a 24-voice module would have 48 oscillators.

In addition, most synths let you layer multiple oscillators for a denser, more complex sound. This is limited by the Maximum Number of Oscillators Per Voice. When you layer multiple oscillators per voice, you proportionately reduce the number of polyphonic voices; for instance, if there are 24 oscillators in a 24-voice module, and you layer four of them, the maximum polyphony is six notes.

Filters per Voice/Envelopes per Voice. If you just want to play the presets, detailed synthesis parameters may not be of interest to you. If you wish to create your own sounds, though, the number of filters and envelopes is of critical importance. You should probably find out about the number of low-frequency oscillators (LFOs), too.

Some sound module's filters offer resonance, which increases the waveform's amplitude at the filter's cutoff or center frequency. This adds a surprising amount of programming power, especially when you have two or three filters per voice.

Naturally, the more envelopes you have, the more parameter changes you can control over time. Ideally, you should be able to modulate the behavior of the envelopes—attack time, for instance—from other controllers, such as LFOs.

Audio Outs. If you have enough mixer channels to handle more than

SOUND MODULES IN REVIEW

Many of the sound modules in the chart on pp. 34-35 were reviewed in EM. In most cases, the keyboard versions were reviewed instead, but much of the review is equally applicable to the rack-mount or tabletop version. We've listed both and, where appropriate, put the module name in parentheses to indicate that the review covered the keyboard version. EM back issues are available from the Mix Bookshelf; tel. (800) 233-9604 or (510) 653-3307; fax (510) 653-5142.

Manufacturer	Product	Issue
E-mu	Emulator IIIxp	6/93
E-mu	ProCussion	8/91
E-mu	ProFormance	11/90
E-mu	Proteus/1	10/89
E-mu	Proteus/2	12/90
E-mu	Proteus/3	8/92
E-mu	Vintage Keys	5/93
Ensoniq	SQ-2 (SQ-R Plus)	10/90
Kawai	GMega	6/93
Korg	03R/W	7/92
Korg	O1/W (01/RW)	1/92
Korg	Wavestation A/D	11/91
Kurzweil	K2000 (K2000R)	3/92
Peavey	DPM 3 (DPM V3)	3/90
Peavey	DPM 2 (DPM V2)	12/91
Peavey	DPM SP	5/92
Roland	JD-990	10/93
Roland	JV-80 (JV-880)	5/92
Roland	R-8 (R-8M)	5/89
Roland	Sound Canvas	6/92
Roland	SP-700	8/93
Waldorf	MicroWave	4/90
Yamaha	TG100	2/93

Akai's unique CD3000 plays samples from its built-in CD-ROM drive.

Sound Modules Buyer's Guide

Manufacturer/Model	Max Poly./ Multitimbral Parts	Total Osc./Max Osc. per Voice	Filters per Voice/Env. per Voice	Audio Outs	Wave. ROM: Stand./Max	Wave. RAM: Stand./Max	ROM Multisamples/ Drum Samples	Single Presets ROM/RAM
Akai CD3000	32/16	32/4	1/2	10	0/0	8 MB/16 MB	0/0	0/254
E-mu Emulator IIIxp	32/16	32/2	1/2	8	0/0	8 MB/32 MB	0/0	0/0
E-mu ProCussion	32/16	32/8	0/2	6	4 MB/4 MB	0/0	0/220	64/64
E-mu ProFormance	16/1	32/2	0/1	4	2 MB/2 MB	0/0	na/0	15/0
E-mu ProFormance Plus	16/1	32/2	0/1	4	2 MB/2 MB	0/0	na/0	32/0
E-mu Proteus/1	32/16	32/8	0/2	6	4 MB/8 MB	0/0	125/33	128/64
E-mu Proteus/2	32/16	32/8	0/2	6	8 MB/8 MB	0/0	144/14	128/64
E-mu Proteus/3	32/16	32/8	0/2	6	4 MB/8 MB	0/0	144/44	128/64
E-mu SoundEngine	32/16	32/8	0/2	2	4 MB/4 MB	0/0	128/61	128/0
E-mu Systems Vintage Keys	32/16	32/8	1/2	6	8 MB/16 MB	0/0	164/32	256/256
Ensoniq SQ-R Plus 32 Voice	32/8	32/3	2/3	2	3 MB/3 MB	0/0	103/65	100/80
Kawai GMega	32/32	32/20	1/2	2	6 MB/6 MB	0/0	256/256	256/128
Korg 01R/W	32/16	32/2	1/3	4	6 MB/6 MB	0/0	255/119	0/200
Korg 03R/W	32/16	32/2	1/3	4	5 MB/5 MB	0/0	255/114	0/100
Korg 05R/W	32/16	32/2	1/3	2	6 MB/6 MB	0/0	340/164	136 /100
Korg AG-10 Audio Gallery	32/16	32/2	1/3	2	4 MB/4 MB	0/0	(not published)	128/0
Korg Wavestation A/D	32/16	32/32	1/2	4	4 MB/4 MB	0/0	518/13	50/150
Korg Wavestation SR	32/16	32/32	1/2	4	4 MB/4 MB	0/0	516/13	400 /150
Korg X3R	32/16	32/2	1/3	4	6 MB/6 MB	0/0	340/164	136/200
Kurzweil K2000R	24/16	96/4	3/3	10	8 MB/24 MB	2 MB/64 MB	89/41	200/100
Kurzweil Micro Piano	32/1	32/1	32/2	2	2 MB/2 MB	0/0	8/0	32/0
Peavey DPM SP	16/16	16/16	1/2	2	0/0	2 MB/32 MB	0/0	128
Peavey DPM V2	16/16	16/4	1/3	2	4 MB/4 MB	0/0	104/34	0/300
Peavey DPM V3	16/16	32/8	1/4	6	4 MB/4 MB	64 KB/1 MB	104/34	0/200
Peavey Spectrum Bass	8/4	8/4	1/3	2	1 MB/4 MB	0/0	52/0	200/0
Roland CM-300	24/16	24/2	1/1	2	(not published)	0/0	(not published)	317/16
Roland CM-500	56/16	56/4	4/4 (1/1 GS)	2	(not published)	0/0	(not published)	445/16
Roland JD-990	24/8	24/4	4/4	8	6 MB/16 MB	0/0	156/39	128/64
Roland JV-880	28/8	28/4	4/4	4	4 MB/14 MB	0/0	83/46	128/64
Roland P-55	28/3	56/2	(not published)	2	4MB/4MB	0/0	32/0	32/16
Roland R-8M	12/5	12/1	0/0	8	(not published)	0/0	0/68	n/a
Roland SC-155	24/16	24/2	1/1	2	(not published)	0/0	(not published)	317/16
Roland SC-33	28/16	28/2	1/1	2	(not published)	0/0	(not published)	226/128
Roland SC-55	24/16	24/2	1/1	2	(not published)	0/0	(not published)	317/16
Roland SC-7	28/16	28/2	1/1	2	(not published)	0/0	(not published)	128/0
Roland SP-700	24/16	24/4	4/4	8	0/0	8 MB/32 MB	0/0	0/256
Roland TD-7	14/4	14/2	0/0	4	(not published)	0/0	16/240	0/512
Roland/Boss DS-330	28/16	28/2	1/1	2	(not published)	0/0	(not published)	156/128
Voce Micro B	32/3	32/2	0/0	2	128 KB/128 KB	0/0	0/0	36/0
Waldorf MicroWave	8/8	16/2	1/4	6	(not published)	0/0	0/0	0/64
Yamaha TG100	28/16	28/2	0/1	2	2 MB/2 MB	0/0	192/100	102/64
Yamaha TG500	64/16	64/4	4/12	6	8 MB/8 MB	0/1 MB	294/54	256/128

Multi Presets ROM/RAM	Card Slots (Wave./Prog.)	Splits/ Layers	Microtuning Tables: Key./ Oct./User	# of Effects Algorithms/ Simul. Effects	General MIDI Compatibility (or GS)	Additional Features	List Price
0/254	0/0	128/32	0/5/1	4/1	no	built-in CD-ROM/CD Audio player, custom set-up feature, assignable program modulation	$3,995
0/0	0/0	88/4	(not published)	0/0	GM	floppy disk, SCSI, extensive sample editing, includes CD-ROM with 600 MB of sounds	$3,995
0/0	0/0	24/8	0/0/0	0/0	no	downloadable preset sounds available on 3.5 inch floppy	$795
1/0	0/0	0/0	1/1/0	0/0	no	true stereo samples	$399
1/0	0/0	7/0	1/1/0	0/0	no	true stereo samples	$499
0/0	0/0	2/3	5/0/1	0/0	no	downloadable preset sounds available on 3.5-inch floppy. XR version has 256 RAM presets	$795
0/0	0/0	2/8	5/0/1	0/0	no	downloadable preset sounds available on 3.5 inch floppy. XR version has 256 RAM presets	$995
0/0	0/0	2/8	5/0/1	0/0	no	downloadable preset sounds available on 3.5-inch floppy. XR version has 256 RAM presets	$795
0/0	0/0	2/8	5/0/1	10/2	GM	built-in MIDI interface, bundled Opcode Mac sequencing and editor/librarian software	$595
0/0	0/0	2/8	5/0/1	0/0	no	downloadable preset sounds available on 3.5-inch floppy	$1,095
0/100	0/1	8/8	0/0/0	13/3	no	dynamic effects, "smart transmit" takes incoming MIDI data from a single channel and retransmits on up to 8 channels with additional parameter changes	$995
0/64	0/0	32/32	55/6/0	6/1	GM	Mac serial interface, 2 MIDI In, 2 MIDI Out, MIDI monitor mode, separate temperament for each of 32 parts	$795
0/210	1/1	16/16	5/1/1	4/4	no	waveshaping, 16-track, 7,000-event sequencer	$2,299
0/101	1/1	8/8	5/1/1	47/4	GM		$1,299
0/100	0/0	8/8	11/1/1	47/4	GM	computer interface for Mac or IBM	$799
0/1	0/0	16/0	0/2/0	2/2	GM	headphones; built-in computer interface; *Trax* MIDI player and QuickTunes Song Library	$499
0/16	1/1	8/8	16/12/12	55/6	no	2 analog inputs	$2,499
0/32	1/1	8/8	16/12/12	55/6	no		$1,399
0/210	1/1	16/16	11/1/1	47/4	GM	disk drive; SMF; 16-track, 32,000-note sequencer	$1,699
100/100	0/0	3/3	0/17/160	26/4	GM*	disk drive, loads Akai, Roland, Ensoniq samples, SCSI ports (2), *requires 2-disk set	$2,895
0/0	0/0	1/1	0/2/0	(not published)/2	no	preset only, features pianos, strings, electric piano, FM piano, Hammond organ	$495
128	0/0	128/8	0/0/0	0/0	no	SCSI, HD disk drive	$999
0/300	0/1	4/4	0/3/2	39/2	no		$799
0/200	0/1	4/4	0/3/2	39/4	no		$999
200/0	0/0	4/4	0/0/0	0/0	no		$299
0/1	0/0	16/16	0/16/0	16/2	GS		$695
0/1	0/0	16/16	0/16/0	16/2	GS		$1,295
32/16	1/1	4/8	0/7/0	23/8	no	structures, ring modulation, oscillator sync; Frequency Cross Modulation; tap delay; takes SR-JV80 expansion boards, SLJD80 series; SO-PCM series; PNJV80 cards	$2,195
32/16	1/1	0/8	0/1/0	11/2	no	PCM cards and expansion boards also include patch information, Frequency Cross Modulation; poly portamento	$1,095
0/0	0/0	2/3	0/7/0	16/2	no	stacked functions, stretched tuning; audio inputs	$650
0/32	3/1	0/2	0/0/32	0/0	no		$995
0/1	0/0	16/16	0/16/9	16/2	GS	8 assignable sliders; automated mixing features; music minus one, 2 MIDI Ins; custom LED	$950
0/1	0/0	2/2	0/16/0	16/2	GS		$625
0/1	0/0	16/16	0/16/0	16/2	GS	custom LED; 2 MIDI In; music minus one	$825
0/1	0/0	0/0	0/16/0	9/2	GM	includes PG Music *Band in the Box* and Dynaware's *Ballade*, computer interface for IBM or Mac	$399
0/128	0/0	127/24	0/0/0	1/1	no	reads Akai S1000/S1100 libraries (complete sample and programs via SCSI); listen delete, load while play; includes SV-SF70-01 CD-ROM	$2,895
0/32	0/0	0/2	0/0/32	6/2	no	32 patches and 8 patch chains; built-in pattern sequencer	$795
0/1	0/0	2/2	0/16/0	9/2	GM		$550
0/0	0/0	1/0	0/0/0	4/2	no	single-trigger, B-3 type percussion, double-rotor rotating-speaker simulation	$499
0/64	1/1	8/8	4/4/4	0/0	no	24 dB analog filter; quick access macros; dynamic panning modulation	$1,699
90/64	0/0	64/64	0/0/0	8/1	GM	card library compatible with GM, Disk Orchestra Collection (Clavinova), and C/M64	$449
128/64	2/2	64/64	0/0/0	90/4	no	Performance Quick Edit	$1,495

SOUND MODULES

two audio outputs, you can route the sound from each of the module's outputs to its own channel EQ, outboard effects, and other processing. This is particularly important if you want to use only one or two modules for an entire mix.

STORAGE

Waveform ROM: Standard/Max. Most sound modules store their factory-created waveforms in Read Only Memory (ROM). These unerasable waveforms are the sound sources from which the factory presets are made. ROM sounds have distinct advantages over RAM-based waveforms: They are permanently loaded in memory, providing instant access, and cannot be erased by a simple power failure or user error.

Several sound modules are designed to accept supplemental ROM chips to increase the number of available waveforms. Max ROM indicates the total amount of ROM—original and supplemental—that can be installed in the module.

Waveform RAM: Standard/Max. If you want to use your own (or third-party) samples, you will need a sound module with Random-Access Memory (RAM). Some modules are preconfigured with a permanently set amount of RAM, in which case Standard and Max Waveform RAM are the same. Others start with a lesser amount and let you add RAM later. The addition of user-loaded waveform RAM is the most significant change in sound modules over the last three years.

ROM Multisamples/Drum Samples. The timbre of most acoustic and electric instruments changes over a large range of pitches, say, an octave or more apart. In addition, when you transpose samples by too much, they display ugly sounding garbage referred to as "artifacts." For this reason, most high-quality "samples" of multi-octave instruments actually are multisamples, i.e., they comprise several samples recorded at different pitches. If the factory multisamples are large, fewer will fit in a given amount of ROM, so the amount of waveform ROM is not necessarily proportional to the number of waveforms.

If you want to ascertain how much raw material is available for program creation, it's even more useful to know how many waveforms you have to work with than how much ROM the samples consume. The first part of this column lists the number of independent multisamples.

The GM-compatible Kawai GMega offers a Macintosh MIDI interface with two non-merging MIDI In ports for 32-part multitimbral operation.

Most manufacturers perform a balancing act between the high price of ROM, the number of samples they feel the market demands, and the sample size required for satisfactory sounds. Don't forget that, in some cases, you can compensate for short loops with careful ensemble arranging and a dose of signal processing.

Many synth modules have independent drum sections. In these boxes, the drum samples are handled separately from the other waveforms. By nature, percussion samples (except for cymbals) tend to be small and are not looped, so the number of samples is the main objective consideration.

Single Presets ROM/RAM. For most people, the most important feature in a sound module is the sound of the factory (ROM) presets. (The exceptions are the RAM-based sample-players, such as the Roland SP-700, E-mu E-IIIxp, Akai CD3000, and Peavey DPM SP, which depend entirely on your sample library.) A Single preset is a basic sound (which may contain several layers) that is triggered as one program on one MIDI channel. Of course, if you're a programmer, you can synthesize new sounds or modify the factory sounds and store them as user (RAM) presets.

Multi Presets ROM/RAM. Multitimbral sound modules let you combine several Single presets, each on its own MIDI channel, and save them as multitimbral ("Multi" or "Combi") presets. Generally, factory Multis are stored in ROM and user presets in RAM, but some companies generously fill the user RAM with presets that you can back up via SysEx and overwrite.

Card Slots (Waveform/Program). Plug-in cards let you expand a synth's waveform or program memory. Waveform cards are an efficient way to add samples, though more easily misplaced and less convenient than adding a sample ROM chip. You can access new waveforms from cards a lot more quickly than you can load samples into user RAM, but unlike RAM samples, waveform cards limit you to manufacturer and third-party samples.

Program cards, which are often available in ROM and RAM formats, are a mixed bag. They offer a certain convenience for accessing new sounds, but they are expensive and easily misplaced.

Splits/Layers. Splits let you assign different sounds to different MIDI note ranges, or zones. This lets you, for in-

(continued on p. 41)

Korg's 01R/W boasts a Waveshaper waveform-modulation section between the oscillator and filter.

We've Always Talked Performance. Now Let's Talk Price.

266 Dual Compressor/Gate

$299

Uses the newly developed dbx AutoDynamic™ attack and release circuitry which delivers classic dbx compression for a wide range of applications—plus an advanced new gate circuit which overcomes the functional limitations of traditional "utility" gates. Both compression and gating provide superior versatility and sonic performance.

296 Dual Spectral Enhancer

$349

Cleans up and details instruments, vocals and mixed program material on stage or in the studio. Dynamic self-adjusting circuitry lets you dial in just the right amount of sparkle and sizzle you want. HF Detail and Hiss Reduction work together so you can actually cut hiss while adding High Frequency Detail. LF Detail solidifies the bottom while removing mid-bass mud.

274 Quad Expander/Gate

$449

Four independent channels of high-performance gating or downward expansion in any combination of stereo pairs or mono channels. Patented dbx VCA and RMS detection circuitry provides ultra-fast attack times to preserve the character of percussive sounds and an incredibly smooth release that won't chop off reverb tails or hanging guitar chords.

Now, with the dbx Project 1 series of signal processors, there's no need to settle for second-tier equipment to save money. Those ever-abundant budget brands have touted great pricing but have never matched dbx quality, reliability and experience.

dbx PROJECT 1

dbx Project 1 is ideal for both studio and sound reinforcement applications. Each unit delivers real dbx sound and reliability, plus innovative new performance enhancements—at the same price of other models with fewer features.

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So now that we've talked price, isn't it time you talked to your nearest dbx dealer and asked for a demo?

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The Seriou

The TASCAM DA-88 The Digital Multitrack Deck For Serious Production

It's true. The first machine designed specifically for low cost digital multitrack production is now available. And it comes to you from the world multitrack leader, TASCAM. It's simply the most advanced, well thought out and heavy duty digital 8-track deck you can buy. The best part is, it's incredibly affordable.

The DA-88 is built for production. The integrity of TASCAM's design is evident in every facet of the deck. From its look and feel — to its exceptional sound, unsurpassed features and expansion capability.

Goes Faster, Lasts Longer And Takes A Beating

While we admit that it's an elegant looking machine, it's tough to see its finest asset. The tape transport. Designed and manufactured by TASCAM specifically for the DA-88, it's fast, accurate and solid. And that's what counts in production — in personal studios, project studios or in those demanding high-end facilities.

You'll notice it uses superior Hi 8mm tape, giving you a full 108 minutes of record time. What's more, the transport is lightning fast and yet so quiet you'll barely hear it blaze through a tape.

We didn't stop there. Because production environments are notorious for constant, if not abusive, shuttling, punching, 24-hour operation — you get the idea — the transport was designed and built to take a beating.

Even more impressive is the transport's responsiveness. Take a look at the front panel. Notice the shuttle wheel? Turn it just a bit and the tape moves at one fourth the normal play speed. Turn it all the way and it flies at 8 times faster. Do it all night if you want. It's quick, smooth and it's precise. Need to get to a location quickly? Accurately? Shuttle a bit and you're there. The location is easily viewed on the DA-88's 8-digit absolute time display — in hours, minutes, seconds and frames. With the optional SY-88 sync card it displays timecode and offset, too.

Adding the optional SY-88 synchronizer card is as easy as changing a Nintendo® cartridge. With it you're SMPTE and MIDI compatible. And no matter how many DA-88s you have locked up, you need only one sync card. Other optional accessories include AES/EBU and SDIF2 digital interfaces allowing the digital audio signal to be converted for direct-digital interfacing with digital consoles, signal processors and recording equipment.

You Already Know How To Operate It

Unlike other digital multitrack decks, the DA-88 works logically and is simple to operate. Like your analog deck. All functions are familiar and easily operated from the front of the deck.

s Machine

Take punching-in and out, for example. You have three easy ways to do it. You can punch-in and out of single tracks on the fly. Just hit the track button at the punch-in point. Hit it again to punch-out. You can use the optional foot switch, if you like.

Or, for multiple tracks, simply select the track numbers you want to punch, push play, and when you're ready, hit record to punch-in, play to punch-out.

Finally, for those frame accurate punch-ins, you've got auto punch-in and out. In this mode you can rehearse your part prior to committing it to tape.

No matter which way you choose, your punch-in and out is seamless and glitch free due to TASCAM's sophisticated variable digital crossfade technology.

That's not all, you also can set your pitch (± 6%), sample rates (44.1 or 48K), as well as crossfade and track delay times. All from the front of the DA-88.

Complete Synchronicity

There's more. Add the optional SY-88 synchronizer card to just one of your DA-88s and you've got full SMPTE/EBU chase synchronization. The best part is, you can record time-code without sacrificing one of your audio tracks. You also get video sync input, an RS-422 port to allow control of the DA-88 from a video editor, and MIDI ports for MIDI machine control.

A Digital Recording System That Grows With You

The DA-88 is truly part of a digital recording system. Start with 8 tracks today — add more tomorrow.

Adding tracks is as simple as adding machines — up to16 for a total of 128 tracks. They interconnect with one simple cable, and no matter how many DA-88s you have, they'll all lock up in less than 2 seconds.

Controlling multiple machines is made simple with the optional RC-848 remote. With it you can auto locate and catch 99 cue points on the fly. It comes complete with shuttle wheel, jog dial, RS-422 and parallel ports, and it controls other digital and analog machines, too.

Listen To The Rest

Of course, the sound quality is stunning. With a flat frequency response from 20Hz to 20kHz and dynamic range greater than 92dB, it delivers the performance you expect in digital recording.

So get to your authorized TASCAM dealer now. Check it out. Touch it. And listen to it. Once you do you'll know why the TASCAM DA-88 is the serious machine for digital production. The TASCAM DA-88 is the choice of studios worldwide. And at only $4,499, it should be your choice.

TASCAM

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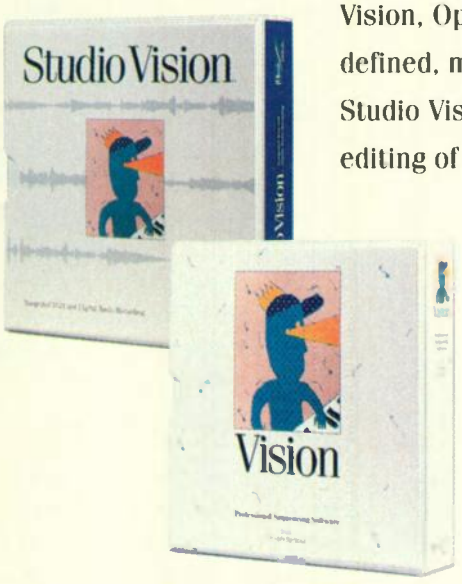
Get There Faster

Vision and Studio Vision have what you need to get your Macintosh music system up and running quickly



Vision, Opcode's professional MIDI sequencer for the Mac, offers better defined, more useful ways to make music than any other sequencer. Studio Vision® incorporates all the features in Vision with recording and editing of CD-quality audio on your hard disk using Digidesign hardware — we even offer a special bundle with the Audiomedia II™ card. And you can upgrade from Vision to Studio Vision.

"Brilliant" is what Electronic Musician magazine called Studio Vision, and recently added it's *"the leading program in the category."* Keyboard magazine said it's *"Marvelously liberating"* and MIX magazine has labeled Studio Vision *"A revolutionary step."*

To help you start making music faster we're including our 90 minute *"Looking Into Vision"* video with Vision and Studio Vision. The video shows you how to quickly make a song, set up a MIDI interface, edit your music, integrate Galaxy, record digital audio guitar tracks, and more. Plus you get Galaxy the universal librarian — the industry standard Mac software for storing and arranging patches for over 150 instruments.

Start making music faster, get yours today.

Vision Video & Galaxy

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With Vision or Studio Vision Purchase

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Sound Modules

Waldorf's 8-part multitimbral MicroWave. It uses a classic form of wavetable synthesis in which lookup tables containing small samples are sequentially read, or "swept," under the control of a modulator. The tables can be swept forward or backward, creating unique, complex waveforms.

(continued from p. 36)

tance, play a guitar lead in one zone, a bass patch in another, and guitar harmonics in a third. By stacking a series of single sounds, all of which are mapped to the same key zone and MIDI channel, into Layers, you can build a more complex, composite sound.

MISCELLANEOUS

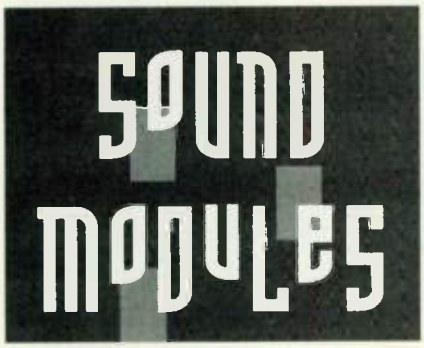
Microtuning Tables: Keyboard/Octave/User. If you want to tune the sound

▼

The addition of user-loaded waveform RAM is the most significant change in sound modules over the last three years.

source to temperaments other than the Western 12-tone scale, microtuning is an essential feature. Keyboard tuning tables let you create tunings regardless of octave, e.g., you could create a 20-note octave, or a tuning that has no octaves at all. Octave tables let you create alternative relationships within the standard octave, which is useful for creating traditional European temperaments such as just and mean tone. Some sound modules also support user-created tunings.

Number of Effects/Simultaneous Effects. Most synth modules available today offer a wide variety of signal processing effects onboard. This column



lists the number of different effects (i.e., reverb, delay, chorus, etc.) and the number of effects that can occur at once. Even these numbers don't tell the whole story, however. Some modules have two independent effects processors, so you can put unique effects on two different sounds at once. Others have one processor on an internal bus, so all sounds get the same processing, but with independent depth control. If you want to investigate this level of detail, check out the respective **EM** reviews.

General MIDI Compatibility. General MIDI (GM) is an addition to the MIDI specification that designates a common set of synth features, including 24-voice minimum polyphony and predetermined Program Change, controller, and drum-note assignments. For instance, in a GM bank, Violin is program 41, Trumpet is program 57, and Clarinet is program 72. Drums are always on channel 10. Acoustic Snare drum is mapped to MIDI note 38 and Low Tom to note 45. GM modules also must respond to Pitch Bend, Velocity, Mod Wheel, Aftertouch, Sustain, Expression Pedal, Volume, Pan, All Notes Off, and Reset All Controllers messages. Roland has developed a superset of General MIDI, known as the GS Standard, which adds more controllers and sounds. (For more on GM and GS, see "MIDI for the Masses," in the August 1991 **EM**, and "Generating General MIDI," in the September 1992 issue.)

Additional Features. Special features that are unique to a few modules and don't fit neatly into the chart categories are included here. Especially noteworthy are modules that include computer MIDI interfaces (a recent development) or extra MIDI ports for 32-channel control.

Price. The manufacturer's recommended U.S. list price.

SOUND MODULE MANUFACTURERS

Akai/IMC
1316 E. Lancaster St.
Fort Worth, TX 76113
tel. (800) 433-5627
or (817) 336-5114
fax (817) 870-1271

E-mu Systems
1600 Green Hills Rd.
Scotts Valley, CA 95066
tel. (408) 438-1921
fax (408) 438-8612

Ensoniq Corp.
155 Great Valley Pkwy.
Malvern, PA 19355
tel. (215) 647-3930
fax (215) 647-8908

Kawai America
2055 E. University Dr.
Compton, CA 90220
tel. (310) 631-1771
fax (310) 604-6913

Korg USA, Inc.
89 Frost St.
Westbury, NY 11590
tel. (516) 333-9100
fax (516) 333-9108

Kurzweil Music Systems
13336 Alondra Blvd.
Cerritos, CA 90701
tel. (310) 926-3200
fax (310) 404-0748

Peavey Electronics
711 A St.
Meridian, MS 39302
tel. (601) 483-5365
fax (601) 484-4278

Roland Corporation US
7200 Dominion Circle
Los Angeles, CA 90040
tel. (213) 685-5141
fax (213) 722-0911

Voce
111 10th St.
Wood-Ridge, NJ 07075
tel. (201) 939-0052
fax (201) 939-6914

Waldorf Electronics
(dist. by Steinberg/Jones)
17700 Raymer St., Suite 1001
Northridge, CA 91325
tel. (818) 993-4091
fax (818) 701-7452

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

IN YOUR EAR

The point of a buyer's guide is to help you narrow the field, not to provide a one-stop buying decision. Using the chart, you can eliminate sound modules that are out of your price range, lack features you want, or duplicate an instrument you already have. Your next step in the selection process is to read the reviews on the remaining candidates (see sidebar "Sound Modules in Review"), which should give you enough details (including an evaluation of the user interface) to reduce the possibilities considerably.

When you're down to the finalists, shopping for a sound module comes down to one question that only you can answer: Do you like its sound? Sure, product reviews include comments about the practical usefulness and realism of the factory presets. But only a fool or a manufacturer's marketing representative would honestly claim that, for instance, Roland's traditionally "bright" sound is better or worse than Korg's "rich" sound. When you get down to comparing quality instruments, one person's pick is another's poison.

It's time for a taste test at the music store. With knowledge of the products' features and limitations in hand, you can check out the user interface and evaluate the sound in the context of your individual needs.

EM *products editor* **Steve O** *is a synth and sampler junkie who will take two of these, three of those, and a few of that one over there, please.*

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PART II

THE ELECTRONIC ORCHESTRA

Last month, we advised you to throw out all of your MIDI gear and learn to play the oboe. Well, not really. But we did explain that if you want to simulate orchestral instruments and ensembles—perhaps because your clients are among the hordes who have taken up the cry for "real instruments"—then the more you know about writing for acoustic instruments, the more convincing your music will be. This month, we finish our look at the instruments of the orchestra and talk about specific

Bring the sound of the concert  hall into your home studio.

By Paul D. Lehrman

ILLUSTRATION: NICHOLAS VITACCO

MIDI and studio techniques for emulating orchestral sounds.

PERCUSSION AND TIMPANI

The percussion section of a symphony orchestra is quite different from a rock 'n' roll drum kit. An orchestral bass drum is big and boomy and is played with a relatively soft beater. It has a less-defined attack and far more decay than a rock kick. An orchestral snare is deeper-sounding, with less punch, more snare rattle, and a longer decay than a rock snare. A "military drum" is an even deeper snare. Tom-toms, as rock players know them, are almost never used in an orchestra.

Snare-drum rolls are common in orchestral music, and a true snare-roll sample is the best way to simulate it. The better ones allow real-time dynamic control using Aftertouch or some other controller. If you are stuck with single snare sounds and want to create a roll, don't step-time or quantize it because it will sound far too mechanical and "pistol shot"-like. If you must step-time, then randomize the attacks and Velocities slightly, after the fact. Even better, play the notes in by hand, at a slow speed if necessary, to get the requisite unevenness. Use a MIDI drum pad, or if you don't have one, play the roll on two adjacent black keys and transpose the roll so that all the notes are on the key for the snare drum. If you want to create a crescendo or diminuendo, try drawing in Velocity curves and slightly randomizing them.

Cymbals on a stand, known as "suspended cymbals," are sometimes used in orchestras, but the far more common variety are "clash" cymbals—two cymbals banged together—which are also called "piatti." For soft cymbal "dings," you can get away with using a ride cymbal, but for those big crashes, there's no substitute for the real thing. A rock crash cymbal sounds pathetic, and don't even think of using a hi-hat.

Orchestral cymbal crashes have duration. A percussionist chokes a cymbal crash by pressing the cymbals against his or her body. (The notation "l.v.," or "laissez vibrer," means "let 'em ring.") If your cymbal sample doesn't stop when you send it a Note-Off, you can get a cutoff by setting up the sound so that it is "monophonic," i.e., only one cymbal note can play at a time. Then, follow the initial crash with another note at an extremely low (but not zero) Velocity, right at the point where you want the sound to stop. Suspended cymbals *are* used for playing cymbal rolls, so you can use your drum machine's large crash cymbal for them. You can keep the Velocity on the low side and randomize, or lay in the notes by hand, as with snare rolls.

Orchestral tambourines have a head, or skin, not just the ring of "jangles" that Mick Jagger waves around. They are played either by hitting them on the head (sometimes with soft sticks), or by shaking them. This means the tambourine sound in your drum machine, which is undoubtedly a sample of a

The Top 500

Play the D4 with its onboard trigger inputs.

Alesis drum machines are famous for their sounds. The HR-16's natural acoustic drums are still the standard for transparent rhythm tracks. The punchy aggressive samples of the HR16:B redefine how to make rhythm tracks burn. The SR-16 is an instant hit with its sampled reverb and ambience techniques.

Now you can have all this and more with the new **Alesis D4 Drum Sound Module.** There's an incredible 500 sounds in all. Right at your fingertips.

The D4's sounds are unparalleled for their realism. For example, when you hit a D4 sound harder, the tone *and* pitch change just like a real drum, thanks to the D4's Enhanced Dynamic Articulation.™ Plus, stereo reverb and ambience are built into many of the samples so you can keep your mind on the beat.

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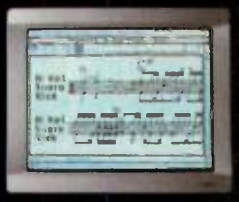
The D4's 21 user definable drum-sets are accessible via MIDI or through the 12 onboard audio trigger inputs. You can even replace a wimpy drum sound on tape. Which you'll want to do if it didn't come from a D4. No rocket science here. Just pure honest incredible sound. The only reason to buy a drum sound module.

Everybody wants a hit. The D4 has 500 of them right now. At your Alesis dealer.



Play the D4 with MIDI software or hardware.

12 audio trigger-to-MIDI inputs are built in for drum triggers, pads, or tape.

TEC 1992 WINNER

ALESIS THE TOP 500 DRUM SOUNDS

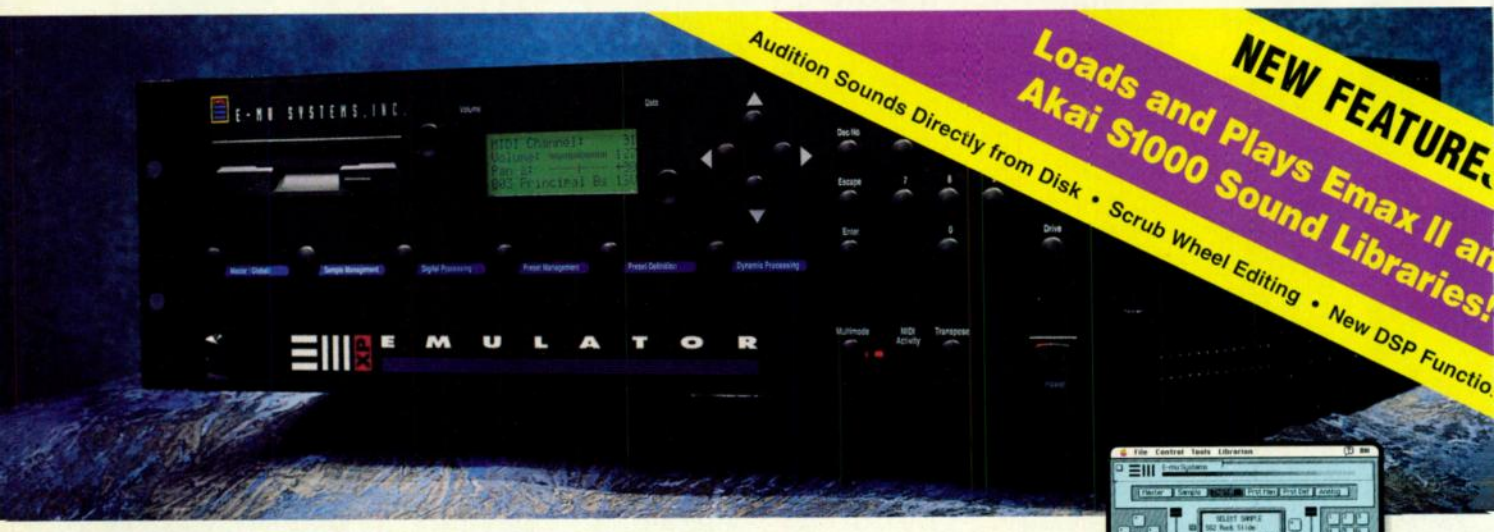
THIS WEEK	LAST WEEK	WKS. ON CHART	TITLE / ARTIST	DRUM PRODUCTION
1	2	208	HONEST SNARE / HR-16	ALL WOOD-BRASS RIM
2	NEW ▶		STUDIO TOM / BRAND NEW D4	16" MAPLE TOM w/VERB
3	NEW ▶		BIG "O" / BRAND NEW D4	DOUBLE HEAD KICK w/VERB
4	5	52	RIM SHOT ROOM / SR-16	BRASS PICCOLO w/VERB
5	10	156	BIG FOOT / HR-16:B	SINGLE HEAD 26" MAPLE
6	NEW ▶		SLAM / BRAND NEW D4	POWER TOM w/VERB
7	23	156	COMBO SNARE / HR-16:B	PICCOLO PLUS WOOD
8	NEW ▶		BIG BALLAD / BRAND NEW D4	WOOD SNARE w/BIG VERB
9	NEW ▶		FAT CITY / BRAND NEW D4	SUPER FAT SNARE
			[illegible]	ARTICULATED HI HAT

THIS WEEK	LAST WEEK	WKS. ON CHART	TITLE / ARTIST	
302	NEW ▶		RAW HIDE / BRAND NEW D4	CUSTOM SN.
303	450	52	HI ROOM TOM / SR-16	10" MAPLE
304	NEW ▶		WET HALF / BRAND NEW D4	HALF OPEN HAT
305	327	52	RIM 2 CENTER / SR-16	ARTICU
306	123	20[illegible]	DOUBLE HEAD	DOUBLE HEAD KIC
307	223	15[illegible]		
308	401	5[illegible]		
309	NEW ▶			
310	175	1[illegible]		
311	NEW ▶			
312	171	[illegible]		

ALESIS STUDIO ELECTRONICS

Alesis Corporation 3630 Holdrege Avenue
Los Angeles CA 90016

The Emulator IIIx Series of Professional Digital Samplers.



Its Power Is Only Surpassed By Its Simplicity.

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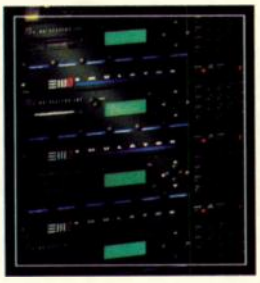
As you would expect from the company that pioneered digital sampling, the EIIIx series features true 16-bit resolution for the purest audio quality possible. Proprietary DSP technology gives you pitch transposition capabilities over an incredible 10 octave range without aliasing, imaging or clock noise.



But incredible sound is only half of the story. The EIIIx series offers an impressive complement of features beginning with 32-voice polyphony, 32 digital resonant lowpass filters and 8 MB of RAM standard (expandable to 32 MB). And with AES/EBU digital I/O and eight balanced polyphonic outputs, the EIIIx series is ready for any mix environment. Dual SCSI connectors make it easy to link multiple EIIIx modules and to access a variety of mass storage devices. Add a long list of sample processing functions and you've got both power and versatility at your fingertips—all accessible through the industry's clearest user interface.

Optional Remote Controller/Librarian software allows you to control all EIIIx functions from the screen of your Macintosh and easily catalog, search and retrieve sounds from your entire library in seconds. You can even configure and load custom sound banks into your EIIIx with a simple click of your mouse.

All EIIIx series samplers are compatible with the ever-expanding EIII sound library. Over 16 gigabytes in size, the EIII library includes virtually every instrument on earth as well as an enormous selection of sound effects—all brought to you by E-mu and the industry's leading third-party sound developers.

EIIIx series samplers are available in a variety of configurations. For sampling live, or from analog source material, the EIIIxs features two channels of 64x oversampling sigma/delta analog-to-digital conversion. Remove analog sampling and you've got the EIIIxp—ideal for sampling within the digital domain or as a voice and memory expander when linked to other EIIIx units. Both models are available as Turbo versions featuring 32 MB of RAM and an internal 120 MB hard drive.

But with all these features, the most impressive one may be price. EIIIx models start at $3,995. Visit your nearest E-mu dealer for a demo and consider your search for the perfect audio tool over.

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jangles-only tambourine being struck, isn't really appropriate for Bizet or Rimsky-Korsakov. If you don't have a real tambourine sample, try combining sounds. Use a bit of high, damped tom-tom underneath your drum machine's tambourine; the result will be much closer to the classical model. A shaken tambourine is trickier. One solution is to play your tambourine sample *twice* for each beat, with the two notes a few milliseconds (or ticks) apart and the first note at a lower Velocity than the second. For continuous shaking, try rolling the tambourine, using the same techniques as the snare rolls mentioned earlier.

An orchestral triangle is a unique but sonically simple beast. Don't try to simulate it with a ride cymbal bell; that sound is much too complex. At soft volumes, a triangle is almost a pure sine wave, while at higher dynamics, it has a very short, metallic clank, followed by a sine wave with some non-integral harmonics. Like cymbals, triangle notes often have defined durations, and the same cutoff technique can be used.

Two popular, wood-based percussion instruments are temple blocks and wood blocks. Temple blocks are more hollow-sounding and have a more definite pitch than wood blocks. Never use sidesticks in place of these; try to get the real thing. (They're easy to synthesize, if you can't get a sample.)

Marimba and xylophone, while they may look alike, sound quite different. The marimba is a soft instrument, played with soft mallets, that features lots of fundamental and low harmonics in the sound, thanks to the tube "resonators" underneath the tone bars. Especially at low pitches, it can have a fairly long decay. Soft rolls on low marimba notes, if executed properly, sound like one continuous note. The xylophone is made of much harder wood, has smaller resonators, and is played with very hard sticks. There's a lot more "crack" in a xylophone sound, and it decays quickly. A xylophone roll sounds like a series of discreet events. If you only have a xylophone sample and you need to create a marimba sound, try these techniques: Start the sample a little late to cut off some of the attack, slow the attack envelope slightly, add some decay, and filter out some of the high harmonics, while boosting the fundamental.

Timpani samples found in drum machines are generally of limited use. They don't transpose particularly well, so they have only a short usable pitch range, and you usually can't roll them because each note cuts off the previous one. Multisampled ROM or RAM timpani, or even synthesized ones, are far more flexible. Like cymbals, timpani notes often have durations, and they can be cut off with the same technique. However, if the timpani sound you're using *does* respond to Note-Offs, make sure before you cut it off that you're *supposed* to; it's not always obvious in the notation whether notes are supposed to ring or not.

Like snare rolls, timpani rolls should be randomized, or laid in by hand. But there's a big difference because of the variable duration of a timpani note. To make a convincing roll, the individual strokes need to overlap. If you are step-entering, you can accomplish this by setting the durations, after the fact, to 150 to 200% of their original values. If you are playing the roll, you can use the sustain pedal to keep the notes ringing. When using sustain, however, be careful that you don't use up all of your instrument's polyphony in the first 16 or 24 strokes. Use the pedal sparingly, or not until the very end of the roll. Another technique is to put the timpani sound through a limiter, so you can take advantage of the sound's wide dynamics without swamping the rest of the mix. (You'll need a dedicated output for the timp sound to achieve this.)

REAL-TIME CONTROL

As mentioned last issue, one of the best ways to improve the realism of a synthesized sound is to give it a vibrato that changes over time in both depth and rate. For example, Aftertouch can be used to change the rate while Mod Wheel controls the depth, or vice versa. Because the apparent "intensity" of a note is often related to its vibrato speed or depth, Aftertouch is a natural way to control it. Also try using footpedals, data sliders, or—if you're lucky enough to have one—a breath controller.

Timbre can also be altered in real time. Wind instruments tend to become brighter when they get loud, and string instruments become noisier, so having a controller mapped to a particular layer, operator, or filter that deals with those aspects of the sound can create realistic effects. They can be especially useful when you need to make a sound emerge through a thick texture, and you don't want to turn up the volume too much (see **Fig. 1**).

Ends of notes are important. Most patches give you a fairly realistic release envelope, but sometimes you need it longer or shorter, and sometimes you need a more complex envelope than just a simple volume fade provides. Often, before a note's level goes to zero, the timbre gets darker and the vibrato stops. This is particularly noticeable with soft wind sounds. (To create a really good pianissimo flute fade-out, lose the fundamental tone first, then fade out the breath noise, so the air lingers a bit.) Conversely, a loud note that crescendos and then stops abruptly can be made more dramatic by increasing the vibrato and brightness right up until the cutoff.

Remember always that MIDI Volume and MIDI Velocity are totally different animals. Velocity is only relevant when the note starts. Although Velocity may

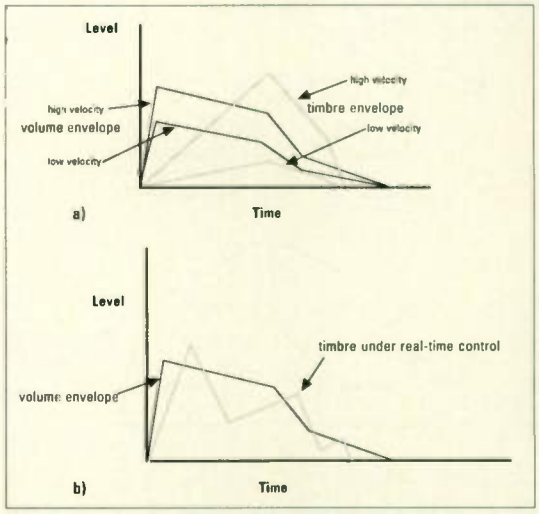
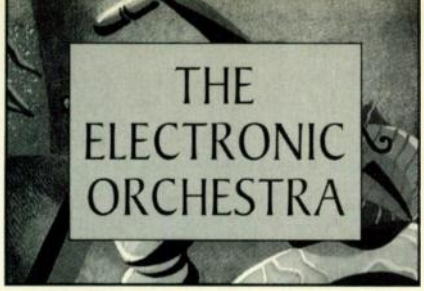


FIG. 1: With fixed timbre envelopes (a), timbral balance may change with velocity, but the progression of timbre over time stays the same. If a filter, layer, or operator is controlled with a real-time parameter (b), timbre envelopes can be totally different from one note to the next.



have some effect on what happens later—amplitude or filter envelope depth or timing can be modulated with Velocity—once the note is played, the die is cast until you turn it off. With Volume (MIDI Controller 7), however, you have continuous control over the shape of the note. Aftertouch also makes a good controller for level changes. Try designing a patch so that Aftertouch is mapped to level, but don't set it up so that the minimum level is zero, or your notes will never start on time. Alternatively, record the Aftertouch information and, using your sequencer's controller-altering functions, change it to MIDI Volume.

When creating crescendos and diminuendos on top of phrases, think about the effect you're aiming for. Do you want the instrument to sound like it's being blown or bowed harder and softer, or just to sound like it's moving closer or further away? If the former, use Velocity; if the latter, use MIDI Volume. If you're in Mono mode (which is not a bad idea for wind instruments), you can't use Velocity at all with legato phrases, so you *have* to rely on Volume. One cool effect is to generate a soft, bright tone by playing a note with a high Velocity and putting a low Volume value right where it starts. If you then fade up the note with more Volume commands, this can be very expressive.

You can also use Volume and other controllers to create a sforzando (hard attack, immediately softer, then growing in volume) effect. Plenty of preprogrammed sforzando brass patches are available for most every synth, but maybe you don't want your sforzando to be timed exactly the way the patch times it, or you want to use the effect on a clarinet or viola. Use a constant-level patch and add the appropriate controllers after a high-Velocity keystroke.

One thing to be careful of with MIDI Volume, however, is quantization, or "zipper," noise. Jumps in volume that are too large and too fast will sound unnatural. Therefore, you need to pack your Volume data relatively densely. On the other hand, data that is too dense can cause your MIDI line to choke up and induce timing delays, but that's a different article. Use as much Volume data as you need, but no more.

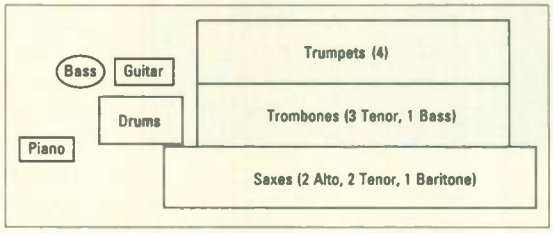


FIG. 3: The typical layout for a big band features saxes in front, then trombones, then trumpets. The rhythm section is usually placed off to the side, though you may want to pan their sounds closer to center.

MIXING YOUR ORCHESTRA

How you place the different instruments in the soundstage (left-right and near-far) goes a long way toward helping the sense of realism in an orchestral arrangement.

Because the strings are the largest instrumental group of the orchestra, they should be spread wide. Ideally, you should use separate MIDI channels or instruments for the different sections, in which case you should arrange them according to **Fig. 2a**. (If the individual sections are in stereo, use the same panning, but make the stereo spread on each section narrow.) It should be noted that some conductors and composers put the first and second violins on opposite sides, with the violas, cellos, and basses in the middle (see **Fig. 2b**). If your piece is highly contrapuntal, and the first and second violins have equally important parts, this is an effective arrangement.

If all of your strings are on a single MIDI channel, use a pitch-based stereo spread. In this case, the high notes should be on the left and the bass on the right. Add reverb to taste: Some synths don't need it, while others that start out more "in your face" can benefit greatly from it.

Woodwinds like to be more centered: maybe set at ten o'clock and two o'clock on the mixer. Individual instruments should be placed carefully, and stereo samples of flutes and clarinets are totally unnecessary in an orchestral context. Woodwinds can take a little more reverb than the strings; it puts them further away from the listener and helps them blend.

Brass can be spread out more, although French horns sound best right up the middle. Again, if you're using a single channel for the whole section, pan the high notes to the left and the low notes to the right. Lots of reverb on these instruments helps them blend and gives them more of a concert-hall ambience. Keep in mind that at lower frequencies, our ears' sense of direction is not as good, so putting basses, tuba, and timpani off to the side won't help the image much. In fact, it may lead to trouble down the road if your music is going to be broadcast (where mono compatibility is always an issue) or cut into (remember this?) vinyl.

Timpani and bass drum, like other low instruments, work best panned toward the center. The rest of the percussion family can be spread around, although not too far, lest they sound like they're being piped in from another planet. A cymbal climax is more effective if it doesn't come from—literally—left field.

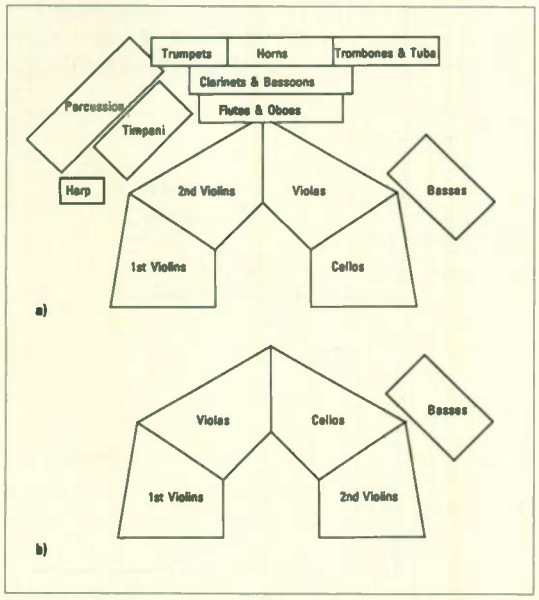


FIG. 2: The panning for most instruments should follow the real-world layout of an orchestra (a). The exceptions to this rule are low-frequency instruments, such as basses, tuba, and timpani, which should all be panned to the center. An alternative layout for strings (b) places the second violins opposite the first violins, instead of next to them.

Stereo pan positions can be set on the synths as part of each patch, or they can be determined at the beginning of the sequence by sending an appropriate Pan (Controller 10) message on each track, assuming your synths respond to that. Zero is left, 64 is center, and 127 is right. Some instruments use 0 or 127 for disabling or reversing external pan control, or setting up a random pan, so watch out for those. *Don't* change the pan position of things in the middle of a piece. Instruments of the orchestra do not get up and walk around (except in certain P.D.Q. Bach compositions), and neither should yours.

If you are using nothing but single-timbre synths, the process of panning and mixing instruments is relatively straightforward. With multitimbral units, however, you have to make decisions about output assignments before you start mixing. If the unit has only two outputs, then you must try to create a stereo spectrum as best you can and more or less forget about different delays, reverbs, or other processing on different voices. If the synth has multiple outputs, try to use them in stereo pairs: for example, the strings on one pair, the woodwinds on another, and the brass on a third. Percussion should be divided up into as many outputs as possible, because timpani and bass drum (as mentioned) might need limiting; the snare drum might benefit from a diffuse, dull reverb; and the wood blocks and tambourine might be happier with a bright, sharp reverb.

If you don't have enough outputs, you can combine sections. The strings and woodwinds can go on the same output pair, with the winds panned closer to the center. In a pinch, the brass can survive going out of a single output, but they will be helped greatly if you have a quality reverb that creates a good stereo image from mono.

A solo instrument, such as a concerto-style violin or piano, should be panned right up the middle. If there is more than one soloist, they can each be set off a little away from the center, but they should be balanced around it. Reverb on solo instruments should be used sparingly: Create the illusion that these instruments are up at the *front* of the orchestra, close to the listener. If you use too much reverb, they will sound like humongous beasts lurking behind the trombone section.

SMALL ORCHESTRAS AND BIG BANDS

The same principles apply to mixing acoustic instrumental ensembles other than symphony orchestras. Use level, panning, and reverb to re-create the way the group looks on a stage. Generally speaking, melody voices can be spread fairly wide left and right, as long as they balance each other, while bass and textural instruments ("rhythm," if you will) belong in the middle. Soft instruments should have less reverb so they sound "up front," while louder instruments can have more ambience around them.

A string quartet is arranged the same as a string orchestra: from left to right, first violin, second violin, viola, and cello. A wind quintet has the flute and oboe on one side, the horn in the middle, and the clarinet and bassoon on the other. A mixed chamber ensemble often has the strings on one side, with the highest-pitched in the front, and the winds on the other, again with the

highest in front. The horn, if there is one, sits at the back, in the middle. A larger ensemble, such as for a baroque concerto, has the strings in front, the winds behind them, and the harpsichord and bass in the back, off to the sides.

There's a lot of call these days for the sound of big-band jazz. Big bands usually are set up so that five saxes are in front, with four trombones behind them, and four trumpets in the back, on risers (see **Fig. 3**). Each section takes up the same amount of physical width, so in your MIDI big band, they can be spread about equally wide in the mix. Less reverb on the saxes gives better definition, while more on the trumpets makes them more dramatic. Bass should be in the middle, and piano and guitar can be off to the sides.

Big-band drums are an exception to the "hear-it-the-way-it-looks" rule. On stage, the drums are usually on one side, but that sounds strange on a recording, so you should put them in the middle. How much you spread them out depends largely on how much you want the drums to be featured. If you want to sound like Basie's band, they can be fairly narrow, but if you have delusions of being Buddy Rich, make them wide (and boomy, while you're at it).

BEYOND THE ORCHESTRA

Now that we've discussed at length how to construct a "real" orchestra, let's do a little *de*constructing. Today's MIDI equipment can go far in simulating an orchestra, but it can also go way beyond that role. In the rush to please your clients' professed desire for "realism," don't ignore the flexibility electronic instruments offer.

Those of us who have grown up with orchestral sounds in our ears will have certain predictable emotional reactions when we hear them. Putting those sounds into contexts we're not used to can have a striking effect. Composers such as Stravinsky, Messaien, and Varèse had to ask orchestral players to do unconventional things with their conventional instruments to create new sounds, but electronic musicians have available to them a palette of literally millions of unique and evocative sounds, each as accessible and easy to play as any realistic sound. The juxtaposition of familiar sounds with unfamiliar ones can induce a strong reaction in the listener.

Try mixing instruments that wouldn't normally be heard together, such as a harpsichord and a gong, or a low, loud flute and a high, soft trumpet. Use vocal samples mixed in with instrumental ones to give a "human" effect. (Gustav Holst, composer of *The Planets*, was one of several early twentieth-century composers who used vowel-singing vocalists as orchestral "instruments.") Double a natural sound, such as a sampled violin, with an unfamiliar one, perhaps a bell with a slow attack. Create a stereo image in which an oboe is immense (thanks to lots of delays and stereo spreading), while a tuba is tiny (no processing and low volume). Set up a harmonic pad using an exotic, shifting, evocative background and play melodies in front of it on ordinary instruments, such as piccolo or xylophone.

▼

This is the kind of stuff Stravinsky could only dream about.

Remember that orchestral music was at one time only produced by symphony orchestras, and hundreds of years of listening to them have influenced the Western ear tremendously. With MIDI gear, you can convincingly re-create an orchestra, if you pay attention to the details that make up the sound. Once you've learned how to do that, you can add in other sounds, giving your music a sense of dimension and context that you couldn't accomplish any other way. It's the kind of stuff Stravinsky could only dream about.

Paul D. Lehrman *studied composition, orchestration, electronic music, and bassoon (in that order) at Columbia University and the State University of New York at Purchase.*

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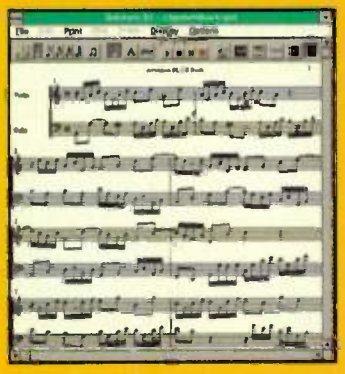

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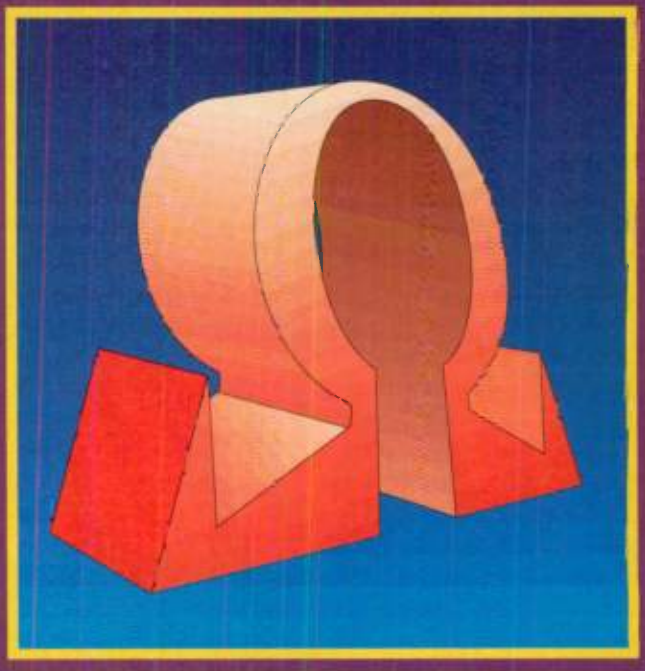

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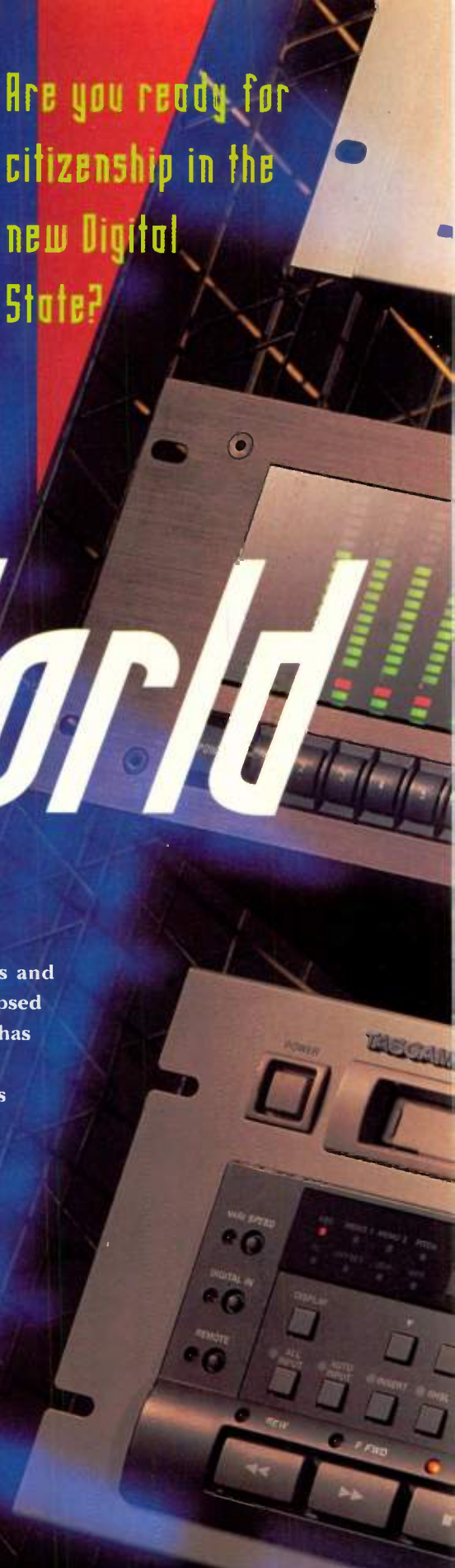
By Michael Molenda

Are you ready for citizenship in the new Digital State?

Brave New World



The flames of insurrection have abated. Zealots and rebels no longer run wild in the streets. Fear has lapsed into acceptance and denial into belief. The miracle has come: Digital multitrack belongs to the masses. *Vive la revolution!*

Affordable, taped-based digital multitracks have smashed the status quo of the recording industry. The heroes of the revolution—the Alesis ADAT, Tascam's DA-88, and the Fostex RD-8—have formed a new Digital State that promises sonic parity and eternal audio bliss for all recordists. The artist is no longer suppressed by expensive studios, the voracious data-storage needs of hard-disk recorders, or the semi-pro sound of affordable analog multitracks. Today, virtually anyone has the capability to produce aurally magnificent digital recordings.

Well, at least that's the party line of the Digital State's propaganda machine. It may be true. The impact of tape-based, modular digital multitracks (MDMs) *is* rocking both the analog recording establishment and the commercial studio community. Sales of 8-track, reel-to-reel analog decks are stagnant, and it's alleged that 16- and 24-track semi-pro machines aren't moving very briskly either.

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MDMs and MIDI systems have also allowed small project and personal studios to produce increasing shares of big-league audio (major-label record releases, advertising underscores, jingles, film and video soundtracks, etc.). The Digital State seems poised to deliver the David blow to the large studio Goliath.

HISTORICAL PERSPECTIVE

The digital revolution began on January 18, 1991, when Alesis announced the ADAT at the Winter NAMM Show. At first, industry skepticism was rampant. Here was a company that had never built a tape deck of any kind, claiming they could sell a functional 8-track digital recorder for under $4,000. After constant delays—which were gleefully reported as proof that Alesis was in over its head—the ADAT hit the streets in the summer of 1992. The list price was $3,995. And it worked.

Approximately one year after ADAT's debut, Tascam entered the uprising with its DA-88; a digital multitrack that offered expanded features and still sold for under $4,500. The DA-88 ignited a format battle by opting for a Hi-8 mm transport rather than the S-VHS system chosen by Alesis. And to confuse matters further, Fostex should be shipping their S-VHS-based, ADAT-compatible RD-8 by the time you read this (see sidebar "Fostex Joins the ADAT Alliance"). Designed primarily for audio post-production applications, the RD-8 is the result of an alliance between Fostex and Alesis to manufacture complementary ADAT machines.

Currently, this unquiet revolution has three battlefronts. The first is a cold war between analog loyalists and digital disciples. Many engineers and producers refute the eminence of digital and maintain that analog is still a viable—and vital—recording medium.

On the second battlefront is the ADAT's blitzkreig for control of the Digital State. Alesis is exploiting its massive user base to expand pacts with third-party developers and win the format war.

And on the third front, Tascam is betting that its manufacturing experience, reputation for product reliability, and industry perception as "the pro's choice" will rally serious recordists around the DA-88.

Unfortunately, without the intervention of prophecy, it may require years of field use to discover which digital format is best, or if analog is nearing extinction. However, EM has been lucky enough to work with these machines throughout their lifespan and to interact with audio professionals who use MDMs extensively. So while we can't predict the future, our observations "from the trenches" offer an illuminating status report on the current state of digital tape recording.

OFF WITH THEIR HEADS!

The digital revolution proved that some analog aristocrats were long overdue for the guillotine. MDMs offer innumerable benefits to recordists, many of which stem from the death of analog tape anomalies. For instance, few engineers will shed tears over never having to do a record alignment again. Here are some other common nuisances you won't miss when you work with an ADAT, DA-88, or RD-8.

Tape hiss. The noise floor of analog tape has haunted the medium since its inception. No matter how hot you record signals—or how carefully you ensure sonic sterilization—varying degrees of audible hiss appear once tracks stack up. Noise-reduction technology and high-output tape formulations have tamed the problem, but noise build-up is a by-product of analog multitrack recording. You can usually cut the medium some slack on dense musical programs (such as loud rock tracks), but the subtle beauty of quieter projects can be ruined by audible hiss.

Of course, the digital domain does not eliminate noise. Sloppy engineering, fractured gain staging, bad cables, and dirty signal processors threaten sonic clarity regardless of the recording medium. But if you take pains to sanctify your signals, digital's immunity to tape hiss passes the audio white-glove test every time.

Crosstalk. The tracks on an analog multitrack are not isolated little kingdoms; signals tend to sneak over the boundaries and end up where they're not wanted. For example, I once recorded a timbale track to spice up a song demo. When my senses returned during the mix session, I muted the obnoxious clatter. But I still heard a ghost image of those damn timbales! Unfortunately, the timbale track was adjacent to the vocal track, and signal crosstalk made it impossible to delete the percussion without muting the voice. Even after I had completely erased the timbale track, a minute taste of the dreaded percussion remained audible on the vocal track. Although there is a slight possibility of crosstalk on digital multitrack recorders (analog signals are still present within ADCs and DACs), digital tracks stay put: They don't bleed onto their neighbors.

Print-through. Magnetic particles can be devious little buggers. After a session, when you've put your multitrack tape safely to bed, these particles can travel through several layers of tape in both directions. On analog recorders, the magnetic invasions are manifest as pre- and post-echoes. There is no antidote for this anomaly; the sonic purity of your master tape is soiled forever. Preventative measures such as storing your masters tails out and using noise reduction only diminishes the problem. However, the playback on digital recorders is not compromised by print-through. The misplaced particles are simply not recognized as audio data.

Wow and flutter. Although BMW advertisements would have us believe otherwise, there is no such thing as a perfect machine. On tape decks, unavoidable (albeit slight) mechanical flaws make it impossible for the transport to maintain a consistent, exact speed. These tape-speed fluctuations can effect pitch, causing you to think you've lost your mind when tracks move ever-slightly in and out of tune. Slow speed deviations cause wow, while faster speed variations produce flutter. Digital transports aren't perfectly constant either, but speed variations don't

Alesis ADAT

matter: All audio data is fed into a RAM buffer, where it is clocked out with faultless precision (and uncompromised pitch).

Bad tracks. Analog recordists constantly fret about finding good homes for their audio signals. Edge (or outside) tracks are bad places for important parts because a tape curl—due to mishandling, bent reel flanges, or a brutal rewind—can cause dropouts. In addition, as your record and playback heads fall victim to wear and tear, certain tracks may diminish in sonic quality. Smart engineers always know the location of their best tracks and plot instrument (and vocal) assignments accordingly. But there is no such thing as a bad track on a MDM: Helical heads and error correction theoretically ensure sonic perfection.

Head feedback. The whims of inspiration can force recordists to paint themselves into corners. In other words, you always seem to need one more track to record an "essential" musical part. This situation usually occurs when the most viable tracks for a bounce (so you can free up an extra track or two) are side-by-side. Unfortunately, bouncing audio signals to neighboring tracks is not a good idea. The stationary record and playback heads of analog decks are stacked in close proximity, and the crosstalk that occurs while bouncing to adjacent tracks can produce shrieking feedback. However, digital multitracks don't handle audio in a linear fashion and therefore don't suffer from record crosstalk: You can bounce tracks anywhere you want without risking feedback.

Butchered punches. Tight punches on an analog deck are risky. First, your ears and fingers must be time-aligned to pinpoint and perform the ideal punch in. Then, the mechanical switches and relays of the recorder must rapidly execute your punch-in and punch-out commands. There's a lot of room for an "oops!"—which usually means you've erased part of a good track.

Digital multitracks offer almost tension-free punches because they seem-

lessly crossfade the new audio into—and out of—the previously recorded track. Digital crossfading has allowed me to punch-in complete drum performances without chopping up cymbal decays or room ambience. Such surgical precision is near-impossible with analog machines.

THE DIGITAL PROMISE

Okay, we've looked at some of the benefits that digital bestows upon recordists. The over-zealous propaganda of the Digital State promises much, and yet, does digital really sound all that wonderful? And what about mechanical reliability, customer service, and other practical concerns? Just how well do these things really work? Let's take a hard look at several aspects of the digital revolution.

BITS OF SOUND

Digital sound is a beautiful thing. It's clean, transparent, and innocent of audible tape hiss. It also reproduces a vast dynamic range and is practically impervious to signal degradation. But don't let anyone tell you it's perfect.

"Sixteen bits are not enough to do the job right," says an industry source. "We really need 20-bit resolution to accurately reproduce a full dynamic range. In many ways, analog is still a more realistic medium for reproducing audio. For instance, listen to some reverb decays recorded on a digital deck. The decays fade to a certain [volume] level and then cut right off. On an analog machine, those decays would fade smoothly into nothingness without the abrupt drop-off."

Many engineers and producers have also discovered a slight harshness in the high-frequency data produced by MDMs. Interestingly, the anomaly isn't really noticeable until you start building up tracks. Progressive distortion is usually most apparent once five or six tracks are recorded.

"I was engineering an album project on an ADAT for [folk singer and hit songwriter] Steve Seskin, and the producer, Robin Sylvester, kept saying that something sounded weird," recalls Sound & Vision co-owner Neal Brighton. "Robin was one of the original engineers at Trident Studios in London, so I trust his ears. Sure enough, as we added overdubs, the high-end definitely became kind of brash. Because this was an airy, acoustic folk production, the

edginess was pretty noticeable."

To soften things up, Brighton mixed the project with a dbx 563 single-ended noise-reduction unit inserted into the console stereo bus. Because these devices diminish hiss by muting "unused" high frequencies in the program material, the upper partial harmonics most affected by the harshness were deemphasized. "The result wasn't perfect," admits Brighton, "but the mixes sounded much smoother."

Although the ADAT and DA-88 (see review on p. 116) spec out beautifully, it's not a given that they can make beautiful *music*. (And we haven't even gotten into complaints about the sterility of digital sound yet!) The sonic quirks that have been discovered are slight, and yet they prove that right now, digital is not quite an aural paradise.

SONG SECURITY

"Digital is not a perfect storage medium," cautions noted San Francisco Bay Area studio technician Michael Gore. "It is not very difficult to get corrupted data. Anything from tape drop-outs to minute errors in head tracking can compromise audio."

Digital designers have expended massive quantities of brain cells to develop tenacious error correction, but catastrophic errors still occur. I almost lost the ADAT master for my band's premiere single release when the tape produced massive data drop-outs at the mixdown session. At that time, we only had one ADAT, so there was no tape back-up. But I was lucky. I brought my master tape to (*Mix* products editor) George Petersen's studio—which had two ADATs—and the tape played perfectly on his machines. A quick clone of the master was made, and I was mixing again within days.

The moral of this story is: Make back ups! If you don't have a safety copy of your work, you're risking tragedy. Not everyone can afford two ADATs or DA-88s, but you should find "back-up buddies" for the purpose of making copies. If you want to be extra careful, use tape formulations recommended by the manufacturers, "break" new tape (do a complete fast-forward and rewind cycle to ensure uniform packing), rewind masters completely after each use, and store tapes in a cool, dry place. Also, before you budget a session, be sure to double your tape costs to allow for safety copies.

TRANSPORTS AND HEADS

A lot of mud has been slung regarding the viability of S-VHS and Hi-8 mm formats. Tascam supporters claim that the clumsy VHS transport is a mechanical nightmare, while Alesis fans argue that 8 mm tape is too tiny to store multitrack data safely. The format issue isn't a bad place to pick a fight: Every MDM owner I interviewed was extremely concerned about the lifespan of their unit's transport and heads. Unfortunately, long-term data is not yet available. To get some perspective, I turned to the video industry.

"I've run my VHS decks for five years, and I've never had a breakdown," says Herb Ferrette, owner of First Generation, an off-line video facility. "Of course, I don't wait for them to wear out. I do preventative maintenance every 750 to 1,000 hours. Usually, I have to replace the belts once a year and the heads every two years."

Tascam DA-88

Hi-8 mm users and editing facilities gave similar accounts: No significant mechanical problems were reported. Obviously, digital audio applications are different from video editing operations. But video editors beat up their machines pretty good—an MTV "machine gun" cut style involves multiple

continued on p. 65

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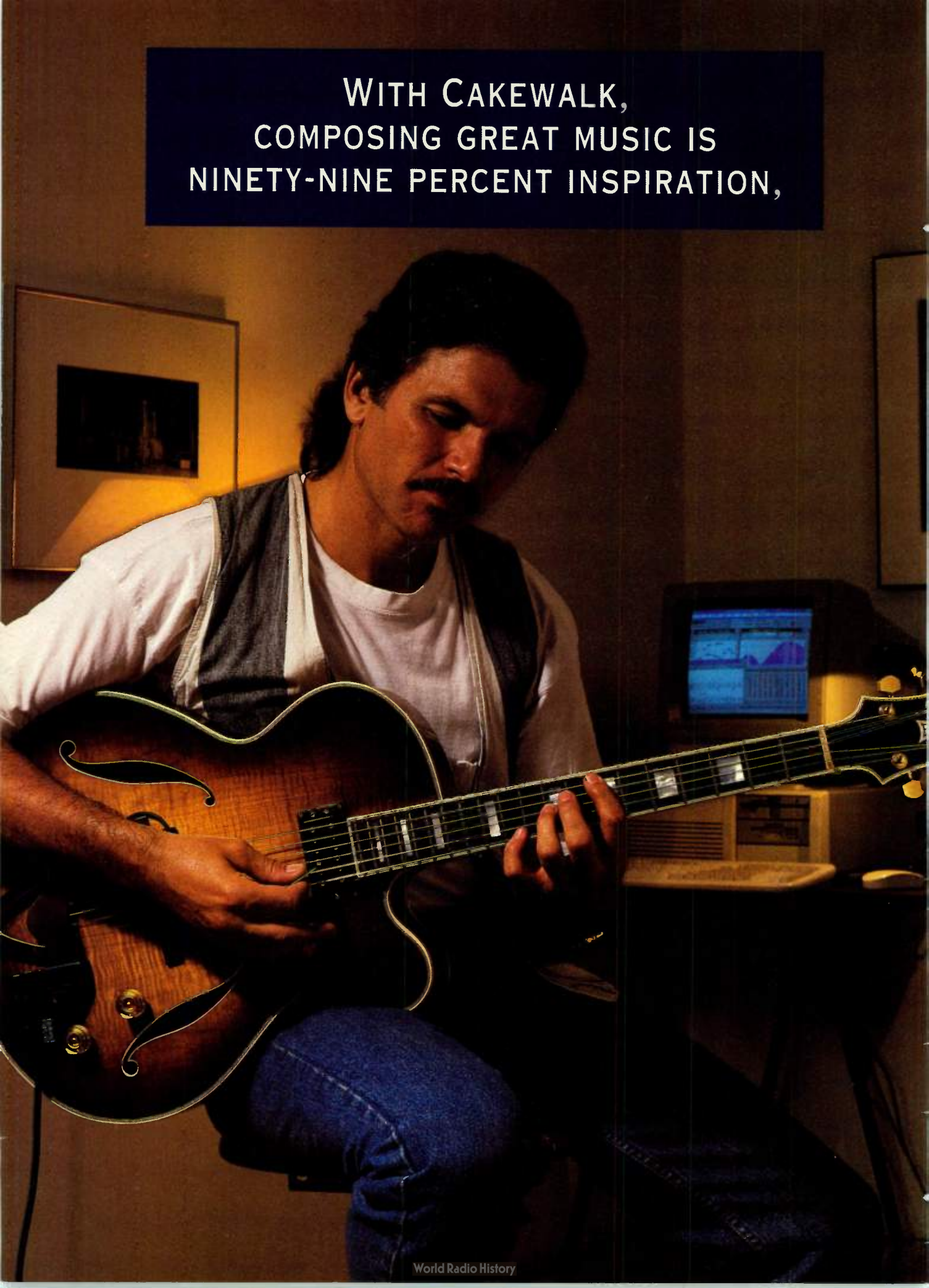

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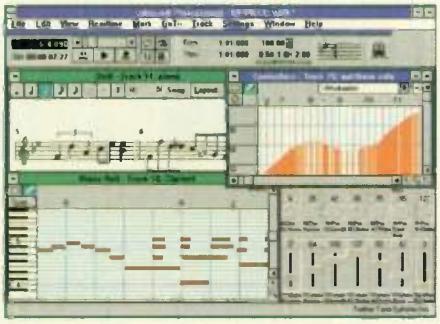

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(continued from p. 60)

images changing every few frames, which is certainly more intense than audio punch-ins marked in seconds—so I'm inclined to believe that both formats will be pretty robust. However, making back-up copies of your masters is definitive protection against the mangling of tapes by transport glitches.

Ensuring trouble-free operation requires periodic maintenance. The more wear-and-tear on your transport and heads, the more susceptible they are to failure. Home and personal project studios can probably get by with having a qualified tech tune-up their MDMs once a year. Busy pro and commercial facilities should maintain their decks every six months. Luckily, both formats are designed for easy repairs or part replacements.

MULTIMACHINE CHASE

I can't say that I'm ecstatic over the chase-lock lags when linking two or more MDMs together. On a 16-track ADAT system, it frequently takes the slave machine (tracks 9-16) seven seconds to chase lock to the master deck (tracks 1-8). Thankfully, the slave ADAT remains in mute mode until lock-up is achieved, but it's still disconcerting to wait for tracks 9 through 16 to appear. If you're used to hearing all tracks at all times (another one of those silly analog habits), this methodolgy can drive you batty. To avoid the "lock-up blues," most engineers submix rhythm tracks onto one or two tracks of a MDM and do their overdubs on a single machine. Full chase-lock operation is only initiated at the mixdown, where constant shuttling is usually unnecessary.

USER BASE

Alesis claims to have shipped more than 20,000 ADATs worldwide. Locally, I can attest that the ADAT has overrun the market. Will the DA-88 catch up? Well, Tascam is a solid company, and I wouldn't count them out of *any* race. But did the recording studios in my community gamble their profitability on the DA-88's chances of outdistancing the ADAT? No.

Even if you don't operate a commercial studio, a healthy user base is important. The more people that own "your" machine, the more opportunities for networking. For example, if your MDM bites the dust during a productive weekend, you may be able to borrow (or rent) a replacement from a sympathetic local user.

SERVICE

At press time, it was too soon to report on the service history of the DA-88 and RD-8. Fostex's RD-8 hadn't shipped yet and Tascam was still collecting field data regarding potential problems and repairs.

"Currently, the main Southern California service center is working on a three-day turnaround," says Tascam Service Manager Rich Whittell. "The DA-88 hasn't been in the field long enough to develop a service history yet, but the recorder's modular design is really built for quick repairs."

Whittell stressed the importance of communication if a professional facility has a service problem. "We'll try to accommodate tight schedules," he says, "but the studio has to let us know what we're up against and be realistic about shipping and repair times."

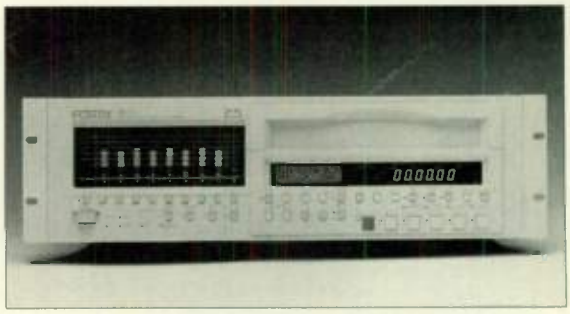
Alesis also claims a three-day turnaround for normal repairs. Early ADATs had power-supply problems and most were repaired quickly without further incident. However, some engineers reported that it took a couple of weeks to get their machines back. (Allegedly, users returning their ADATs for software updates this summer overloaded the service department.) Although there is no official policy for commercial facilities, sources at Alesis state that professional accommodations can be negotiated. As with Tascam, communication is the key.

THE ANALOG FRONT

Given all the benefits of digital, one can't help but wonder, "Is analog dead?" The Digital State would have us believe that analog casualties are necessary and pardonable because digital is a vastly superior recording medium.

Don't believe the hype! The digital revolution does *not* serve the needs of every musician. For all its faults, many engineers and producers still prefer the sound of analog. (And even digital disciples can't argue that the analog medium has produced legions of great-sounding records.) The funny thing is, analog loyalists are devoted to the medium because of something that digital is sworn to eradicate: distortion.

Distortion is an integral component of analog recording. The degree to which this distortion (or tape coloration) exists and changes a signal's timbre depends on a recorder's mechanical health and system alignment, the formulation of the tape being used, and the signal's input level. Technical babble aside, music sounds warm and fat on analog tape. The Digital State can spew incredible specs, but digital masters tend to sound cold and sterile. Of course, over-zealous recordists can "warm up" analog a little too much and produce truly ugly sounds. For the most part, however, you can push the limits of analog tape and still get great recordings. But if you "red-line" digital, all you get is unusable audio.



Fostex RD-8

The perception of fat sound is the analog loyalist's main weapon against the digital invasion, but it's not the only defense. Following are a few tricks that analog has hidden up its sleeve.

Universality. The infiltration of MDMs into the audio world was quick and decisive. But right now, more analog machines are in existence than digital. In addition, the Digital State has not yet scored a coup against the professional format for large studios: 24-tracks on 2-inch analog tape, running at 30 ips. If your project is recorded on the pro format, you can work in practically any major studio on the planet. But an ADAT or DA-88 master won't open every (studio) door.

Editing ease. Few engineers will argue that digital audio workstations (DAWs) allow unprecedented audio editing control. Unfortunately, these technical marvels cost thousands of dollars more than a simple razor blade. My point is this: Although taking a razor blade to a strip of analog tape is primitive, tape splicing is your sole option for editing audio if you can't afford a DAW (or the two MDMs and a controller needed to perform assembly edits). Hi-8 mm and S-VHS cassettes are not razor-friendly, so if you want to cut a few bars out of a guitar solo recorded on a single MDM, you're up a creek.

Reverse recording. I love flipping tape reels over and recording instruments and voices backwards. (Remember when records had trippy *nemac-zemnawree-zeeeebop* guitar solos and inverted Satanic chants?) Backwards effects wear thin real fast, but if used discreetly they can be tons of fun. And if you want to process a signal with true reverse reverb, turning the tape over and recording a "backward" decay is still the only way to get it. If you flip over an S-VHS or Hi-8 mm cassette and pop it into your MDM, all you'll get is a repair bill.

Slick service. "If I service an analog recorder at a client's facility, 90 percent of the time, the machine is running when I leave," says Gore. The scenario may not be the same for MDM owners. Most analog repairs involve relatively inexpensive components, but MDMs are constructed with costly circuit boards that prohibit most techs from stocking replacements. If a circuit board goes down, you may be forced to send the unit back to the factory. (An often-painful separation that can add a few "down" days to your recording schedule.)

Bargain hunting. Because MDMs have effectively torpedoed (or at least frozen) the analog recorder market, you can cut some great deals on used equipment. In the San Francisco area, 2-inch, 16-track decks in good condition are going for $5,000. Professional 2-inch, 24-track recorders are currently

FOSTEX JOINS THE ADAT ALLIANCE

At the 1992 Audio Engineering Society convention in San Francisco, Fostex announced its entry into the modular multitrack milieu with an ADAT-compatible digital recorder. The Fostex RD-8, uses the same S-VHS transport and record electronics as the Alesis ADAT, but adds sophisticated synchronization and control features.

The RD-8 can be used as either a master or slave deck (with the identical D-sub 9 sync connector as the ADAT), and up to sixteen RD-8s can be synched together for a maximum of 128 tracks. The fiber optic digital I/O ports are identical to those used on the Alesis, as are the BRC remote and meter bridge connections.

Preliminary features for this 3-rackspace deck include an onboard SMPTE chase-lock synchronizer/reader/generator (24, 25, 29.97, and 30 frames DF-NDF), RS-422 (Sony P2 9-pin) control for interfacing to video editors, video sync and word sync in/out (both with 75-ohm termination switches), pullup/pulldown (44.056 and 47.952 kHz sampling for 29.97 fps resync), XLR time-code in/out, and multimachine offset. The RD-8 also offers 44.1 and 48 kHz sampling and onboard 170 ms track delay. Analog inputs and outputs are -10 dBV (RCA) and +4 dBu (D25 sub multipin). MIDI is handled via In/Out ports with MIDI Machine Control.

The RD-8 has a 2-line-by-18-character LCD window that displays multiple pages of operational data (incoming/outgoing SMPTE rates, sync status, sampling and/or clock rates, etc.), as well as autodiagnostics and locator info. The LCD window can also display song titles, take numbers, and other helpful information. Initial deliveries for the RD-8 are scheduled to begin this fall, with pricing presumed to be under $5,000.—*George Petersen*

a steal at $10,000. By comparison, two ADATs—at street prices around $3,500 each—will set you back $7,000 for 16 tracks. (Two DA-88s or RD-8s will cost you a bit more.) Thanks to the digital revolution, analog decks may become the recording industry's best bargain.

PLEDGES OF ALLEGIANCE

The Digital State is currently a two-party system, with the ADAT and DA-88 formats vying for dominance. Also, a healthy analog underground is fighting to revitalize the medium. So, analog versus digital; S-VHS versus Hi-8 mm; which recorder is best for you?

If you're the nervous type, there's only one way to go: Stick with analog. It's been around for years, it's reliable, and it sounds quite good. (And with Dolby SR or S noise reduction, the noise figures for analog can match or exceed those for digital.) MDMs, on the other hand, are still developing. We don't know how dependable these digital formats will be over time. In addition, error correction is not always a sure thing and corrupted digital data often produces permanently mutilated audio.

Recordists who wish to embrace the Digital State have a tougher choice. Unlike analog recorders, neither the ADAT nor the DA-88 can boast a time-tested format. Either the overwrought exclamations of marketing pundits will come true, and each machine will fall victim to its reported fatal flaws, or both formats will prove to be just fine. So, let's forget about conjecture and make choices based on how each MDM looks *today*.

For project studios and mid-level commercial facilities, I'd recommend the ADAT because of its user base. ADATs are everywhere. If you're a personal user, you have a vast network of recordists with which to share applications, tips, and even tracks. Studio owners can dip into an expanded client base and offer track upgrades (home 8-track projects can become 16- or 24-track productions within the confines of your studio) and professional mixing capability. In addition, the ADAT has enough third-party support to ensure the continued health of the format.

The DA-88 seems more appropriate for professional audio post-production houses and film soundtrack composers. Its later entry into the marketplace hasn't allowed the DA-88 to establish a

wide user base, but reports indicate that sales are active. (A famous New York post-production studio allegedly ordered 30 units.)

The DA-88 also allows audio-post pros to do split edits, where multiple audio cues are punched in and out while video and sound sources are synched and running. Once you enter record mode, the ADAT does not allow you to access additional tracks for punch-ins. Unless you enjoy constantly rolling back (and having to chase-lock audio and video again) for sound-effect punch-ins, the Tascam DA-88 wins the audio-post mantle hands down. (The Fostex RD-8, which is also designed for audio post, has not been reviewed yet, so its viability cannot be assessed.)

DIGITAL CITIZENSHIP

I know my fate. In ten years, I'll be a surly old man penning beatific reminiscences of the analog era. The Digital State will be omnipotent, magnetic tape a museum oddity, and recording studios one big hard disk.

But until that day, the Digital State has some work to do. Software and hardware designers should get 20-bit machines on the drawing boards and develop filters that produce warmer, fatter timbres. Data safety must be paramount. No one I interviewed trusted the digital medium to honor recorded data with the same reverence as analog.

Of course, the propaganda ministries of the Digital State implore us to stop thinking with analog minds. Digital promises an audio paradise, they say, but new technology requires new methods. I fully support the Digital State and all it stands for—socialized sonics, pristine audio, and personal recording cabals—but I won't stop thinking with an analog mind until digital sounds warm and fat. Embracing the future shouldn't require purging what's good about the past.

EM *managing editor* **Michael Molenda** *is tormented by having a digital head and an analog heart.*

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Computer networks never sounded so good.

By Scott Wilkinson

SOUND

The engineer cues up the tape and punches the talkback button on the console. "You ready to try a take?" she asks the voice-over artist. "You bet," comes the reply over the control-room monitors. The engineer enables one tape track for recording and says, "Rolling! KNRD radio spot, take one." The intro music swells, then fades as the voice-over artist starts his spiel. The engineer looks at the producer, who nods approvingly; they might even make it out of the studio before midnight.

This little scene is nothing out of the ordinary—except that the engineer and producer are in L.A. and the voice-over artist is in New York. The talkback, voice-over, and tape-playback audio signals are sent back and forth between the two studios, in real time, over special phone lines. This amazing feat is made possible by relatively recent developments in data compression and digital-audio networking.

This technology is making an impact in less far-flung applications, as well. Post-production houses, live-concert venues, radio and television broadcast facilities, and single recording studios can all benefit greatly from digital-audio networks. In a few years, home and project studios will also benefit.

START BIT

Digital-audio networks are nothing more than specialized computer networks. In any computer network, two or more devices (called *nodes*) are connected together so they can share data, programs, and resources such as printers. Typically, there are several computers in a network, each of which can send and receive information, as well as control and monitor devices such as file servers, scanners, and printers. (If you're unfamiliar with the basic concepts of computer networks, see the sidebar, "Networks For Novices.")

However, digital-audio networks have some special requirements. For one thing, they demand a much higher bandwidth than most computer networks. "CD-quality audio" (16-bit linear at 44.1 kHz)consumes about 700 kilobits per

Illustration by Dave Ember

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second (kb/s) per channel; a stereo signal eats up 1.4 megabits per second (Mb/s). (To put this in perspective, MIDI's maximum bandwidth is 31.25 kb/s.) When you consider that many channels may be flying through the network, a total bandwidth on the order of 100 Mb/s is not unreasonable. By contrast, Ethernet operates at 10 Mb/s. Of course, it's possible to compress the audio data to reduce bandwidth requirements, but most audio engineers prefer to avoid this if possible. Data compression is essential when digital audio is sent over phone lines, however.

In addition, digital-audio networks must be *deterministic;* that is, they must deliver files to their destination in real time, without interruption, and with no more than a specified *latency*, or delay, from the time they were requested. If an audio network is not deterministic, you will hear dropouts when the audio file is interrupted for any reason. Multiple channels of simultaneous audio must also be synchronized to play together. This real-time capability is not very important in most computer networks; it's no big deal if a printer file is held up for a moment in mid-transmission.

Finally, digital-audio networks must be extremely *fault-tolerant.* If one node goes down, it should not compromise the operation of the entire network. Any device should also be able to gracefully recover from an error in the delivered data or instructions. Again, these issues are far more important in audio networks than they are in generic computer networks, which depend much less on real-time delivery.

IN CONTROL

In addition to data, all networks carry control and monitor information, which lets the computers in the system control other devices and monitor their performance. In fact, early audio networks were limited to control and monitor functions because they require relatively little bandwidth. Several proprietary schemes have been developed, including Crown's IQ and Crest Audio's NexSys, which let computers control the volume of their respective power amps and monitor such things as output level and temperature.

PA-422, a non-proprietary control and monitoring system introduced in 1988, became an AES standard in 1991. PA-422 is based on the RS-232/422 serial interface found on virtually all microcomputers, making it easy and cost-effective to develop computer-based control systems. Using a bus topology, in which devices are connected in a daisy-chain, the computer is the master in the system, while any connected devices such as power amps, equalizers, and other audio gear are called slaves. Slaves cannot initiate a conversation with the master (or each other), so the host must continually poll the devices for their status.

Up to 255 devices can be connected to a PA-422 port, and devices can be located up to 4,000 feet apart. The bandwidth is 19.2 kb/s, which is fine for configuring a sound system between relatively static events such as different functions in a hotel ballroom. However, PA-422 is not well-suited for dynamic, real-time control.

Lone Wolf (tel. [310] 379-2036; fax [310] 374-2496) has developed a multimedia network called MediaLink that it licenses to other manufacturers. At its current stage of development, dubbed "MediaLink 1," this system is used to control and monitor audio gear by a growing number of companies, including Rane, QSC, Carver, TOA, JBL, Altec-Lansing, and Klark-Teknik.

MediaLink 1 operates at 125 kb/s over just about any media, including fiber-optic, twisted-pair, coax, and/or twinax (balanced) cable, as well as RF wireless. Most current implementations use fiber-optic cable. Up to 253 devices can occupy a single network with up to 2.5 km between nodes (or repeaters) over fiber-optic cable, 2 km over coax or twinax, or 1 km over twisted pair. With the exception of fiber-optic cable, these maximum lengths will decrease somewhat in faster, future versions of MediaLink (more in a moment).

Separate networks can be linked together on a backbone (see **Fig. 1**); in this configuration, the networks are called *subnets.* Each network or subnet can use a bus or star topology. The star configuration is more fault-tolerant because the network can function perfectly well even if one or more devices go down. If a device goes down in a bus topology, two separate networks are created, each one capable of local operation but unable to communicate

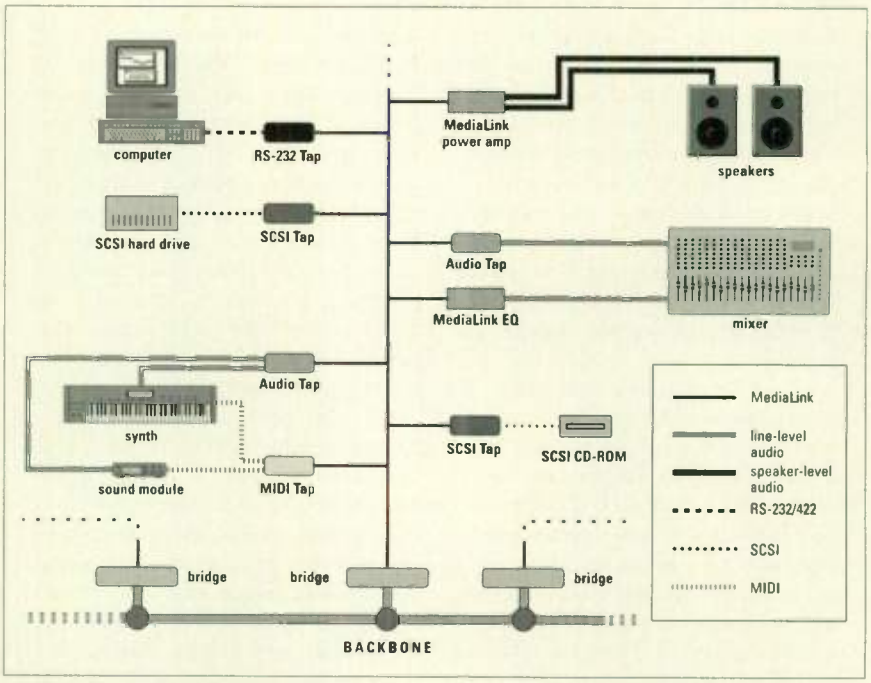


FIG. 1: Individual MediaLink networks can connect devices in a bus topology, where several subnets are linked together on a backbone. In this diagram, the MidiTap, MediaLink EQ, and MediaLink power amp are currently available; the other devices will be developed by third-party manufacturers or Lone Wolf in the future.

with the other one.

Lone Wolf has also created a control program called *VNOS* (*Visual Network Operating System*) for Macintosh and *Windows* (see **Fig. 2**). This program depicts the connections in the network and displays virtual control panels for each device. Unlike PA-422, the computer can be located anywhere in the network. In fact, any number of computers and other devices can transmit data simultaneously with surprisingly little drop in network performance.

AUDIO IN THE HOUSE

Although it currently is used only for control and monitoring, the potential of MediaLink is far greater. It is designed to carry any digital information with equal ease, including digital audio and video, MIDI, SCSI, RS-232/422, PA-422, etc. Some have described MediaLink as the Federal Express of digital media; give it a package containing any digital message, and it will deliver the package to the intended destination in a timely manner. Rather than replacing one or another digital standard, MediaLink supports all standards.

Of course, digital messages occur in different formats, which must be encapsulated into MediaLink packets before they can be sent out onto the network. Devices that include a MediaLink port perform this task internally, but any device can join the network through an intermediate device called a *tap* (see **Fig. 1**). For example, a MidiTap (Lone Wolf's first product) connects several MIDI devices to the network, translating between MIDI and MediaLink. Similar taps will no doubt be developed for digital audio, SCSI, RS-232/422, and other digital signals, allowing non-MediaLink devices to communicate on the network.

Lone Wolf recently was infused with a badly needed, multimillion dollar shot in the arm from Paul Allen, cofounder of Microsoft. Lone Wolf has entered a cross-licensing agreement that makes MediaLink available to Allen's other companies, including Asymetrix, a developer of multimedia software, and Interval Research, a think tank that is exploring the future of digital multimedia.

As a result of this investment, Lone Wolf intends to send digital audio through a MediaLink network at the October 1993 AES show in New York. This phase of development is called "MediaLink 1.5." It will operate at a bandwidth of 5 Mb/s and carry 60 channels of digital audio—twelve independent audio programs in 5-channel Dolby surround sound—compressed with Dolby's AC-3 data-compression scheme, which is aimed at the home-theater market.

Lone Wolf is working with VLSI Technologies to develop a single chip with the entire MediaLink protocol encoded onboard. This version, called "MediaLink 2," will operate at 20 Mb/s and carry up to 24 channels of uncompressed digital audio. "MediaLink 3" is intended to operate at 100 Mb/s. These plans reflect the ultimate goal of MediaLink: to become a low-cost OEM solution for connecting and integrating various digital media.

SONICNET

Although most of MediaLink's potential has yet to be realized, Sonic Solutions (tel. [415] 485-4800; fax [415] 485-4877) currently sells a full-blown

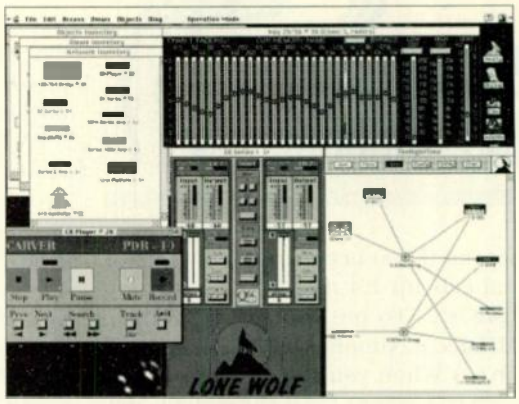


FIG. 2: Lone Wolf's *VNOS* displays a list of devices on the MediaLink network (upper left); shows front-panel controls for a Rane NEQ (upper right), Carver PDR-10 CD recorder (lower left), and QSC EX power amp (center); and graphically depicts the network's MIDI connections (lower right).

NETWORKS FOR NOVICES

Perhaps one of the most fundamental concepts in networking is bandwidth. In general terms, the bandwidth of a network is the amount of information it is capable of transmitting on a single cable. One simple analogy is a water hose; the larger the diameter, the more water can be pumped through it. The bandwidth of a hose, which is a measure of the maximum possible flow, is expressed in gallons per minute.

In a digital-audio network, bandwidth is measured in thousands or millions of bits per second (kilobits or megabits per second, abbreviated kb/s or Mb/s). The bandwidth can be filled with any combination of signals as long as the total capacity is not exceeded. However, some signals use more of the bandwidth than others. For example, audio signals take far more bandwidth than control and monitor signals.

Digital signals are carried from one device to another over a physical medium. One of the most common media for transmitting digital information is fiber-optic cable, in which pulses of light represent digital bits. Other types of cable conduct electrical pulses. These other cable types include twisted pair (two wires twisted around each other), coax (a central wire surrounded by a conductive shield), and twinax (two central wires and a shield). It is also possible to transmit digital data via RF (radio frequency) wireless signals.

Devices in a network are connected together in one of several patterns called topologies. A star topology connects each device to a central hub, which distributes messages to and from the devices. In a ring topology, devices are connected in a closed loop (see **Fig. 3**). In a bus topology, devices tap into a cable that doesn't close on itself as a ring does. Several busses can be connected to a backbone, forming the "branches" of a tree topology (see **Fig. 1**).

digital-audio network for high-end music and audio production. The company's SonicNet offers a bandwidth of 100 Mb/s, which can carry up to 80 simultaneous channels of uncompressed digital audio. The network is implemented on an FDDI (Fiber Distributed Data Interface) token-ring topology (see Fig. 3); each node can be separated by as much as 2 km, with up to 1,000 nodes and a total circumference of up to 200 km.

Each node is a NuBus card installed in a Macintosh or dedicated chassis. This card includes an FDDI transceiver; 68030 microprocessor; two high-speed SCSI ports, each capable of sustained transfers at more than 28 Mb/s; and 4, 16, or 64 MB of dynamic RAM. The card, called a SCSI Node, mediates network activity, allowing the host processor to concentrate on local tasks. It integrates seamlessly with any SonicSystem digital audio cards in the computer.

FDDI is a widely accepted ANSI (American National Standards Institute) and ISO (International Standards Organization) standard, which allows other FDDI devices to share the same network as any digital-audio equipment. In fact, SonicNet fully supports standard AppleTalk protocols, making it the fastest Macintosh network in the world.

Although SonicNet supports the standard Macintosh file system, Sonic Solutions has designed its own file system called Media Optimized File System (MOFS), which runs on the disks attached to the node's SCSI ports. This increases the efficiency of the system to nearly 100 percent, allowing it to use most of its bandwidth to carry audio channels with guaranteed delivery. In order to ensure compatibility, MOFS is presented on the network as a standard Mac HFS file system. Users see the familiar "drag and drop" desktop; everything just happens much faster than on conventional Mac networks.

Sound files on any hard disk or other storage medium are available to any workstation. You simply compile an EDL (edit decision list) of sound files, and the files are played over the network directly from the source, without having to copy them to your local hard disk. Multiple users can even access the same sound file simultaneously. Processing resources such as Sonic Solutions' NoNOISE sound restoration, TimeTwist time adjustment, sample-rate conversion, Turbo Bit Mapping, and CD printing are available to all users, regardless of where they reside in the network.

Because of significant interest from other manufacturers, Sonic Solutions designed a generalized version of the network called MediaNet, which will be available for any digital audio or video workstation. Sonic first showed MediaNet at the April 1993 NAB convention by linking an Avid workstation with two SonicStations, each in a

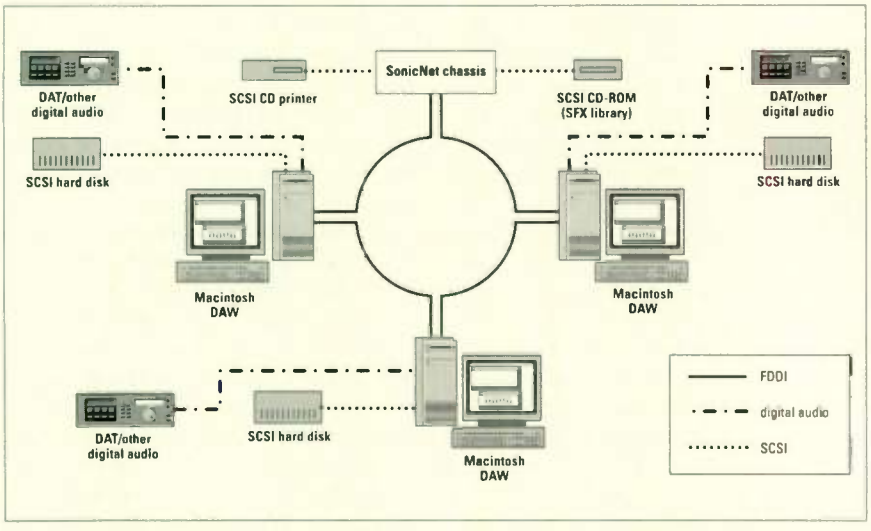


FIG. 3: SonicNet uses an FDDI token-ring topology, in which a special message called the *token* is passed from device to device, arbitrating the data flow in the network. This system configuration allows each individual workstation to access sound files and processing resources anywhere within the network.

different building, over a fiber-optic ring more than a mile in length. Sonic has also announced a MediaNet Partners program to facilitate the use of the network by other companies, and expects to announce a number of companies incorporating MediaNet into their product lines in the fall.

COME HERE, MR. WATSON

As examples of local-area networks (LANs), MediaLink and SonicNet are fine for sharing digital audio among workstations within a single facility or venue. But what about the scenario described earlier in which the engineer and producer are in one city and the talent is in another city? This requires a wide-area network (WAN). It's possible to buy satellite time to create a WAN, but this is extremely expensive and sometimes dicey due to weather conditions or priority usage by the authorities.

The phone companies offer special land-based lines designed to accommodate WANs. These lines come in two forms: PSDS (Public Switched Digital Service) and T1. PSDS lines work like regular phone lines; simply dial a destination and pay according to connect time (in addition to a monthly fee). There are two types of PSDS lines: Switched 56, which operates at 56 kb/s, and ISDN (Integrated Services Digital Network), which offers two or more channels at 64 kb/s each. It is possible, but cumbersome, to combine several Switched 56 lines to increase the total bandwidth. However, ISDN channels are automatically allocated as needed, with a commensurate increase in cost.

T1 lines are dedicated links that are leased by the month. These lines provide up to 24 channels at 64 kb/s each for a total maximum bandwidth of 1.54 Mb/s. T1 is more expensive than either PSDS option, but the higher bandwidth and constant connection may be worth it. In addition to audio, a T1 line can carry voice and data communications for intercom and e-mail applications.

Given the previous discussion regarding bandwidth requirements, it seems clear that all of these phone-line options are inadequate to accommodate digital-audio networks. However, careful application of data compression can reduce the required bandwidth by as much as a factor of twelve without significantly sacrificing audio quality. (Of course, if a signal is compressed and uncompressed several times, audible artifacts become apparent.)

Dolby is one of the leaders in the field of audio data compression. As mentioned earlier, their AC-3 compression scheme is aimed at the home-theater market. AC-2 is designed for the professional audio market, offering a compression ratio of 6:1, which translates to a bandwidth of 128 kb/s per channel. This process is used to send audio data, as well as all intraoffice communications, on a T1 phone line between George Lucas' Skywalker facilities in Marin County, California, and Los Angeles, about 400 miles apart (see **Fig. 4**).

The Skywalker connection is a part of the Entertainment Digital Network (EDNet), a company that has installed similar services in 60 audio and video facilities around the country. EDNet's goal is to help pave the digital information highway that is so often discussed these days, especially for the entertainment and media industries.

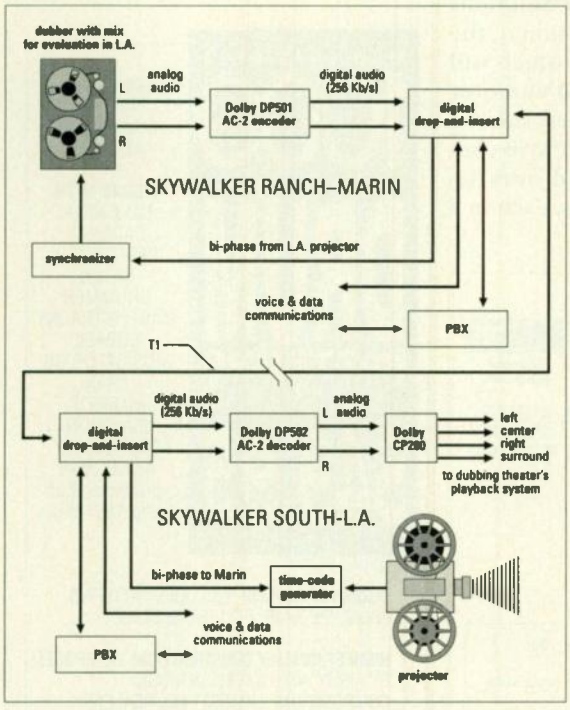


FIG. 4: A leased T1 phone line connects Skywalker Ranch in Marin to Skywalker South in L.A.; Dolby AC-2 encoders and decoders reduce the audio bandwidth. In this example, the soundtrack is on tape in Marin, while the film is in L.A. The sound is synchronized to film, and they are evaluated together in L.A. Voice and data communications are also carried on the T1 line.

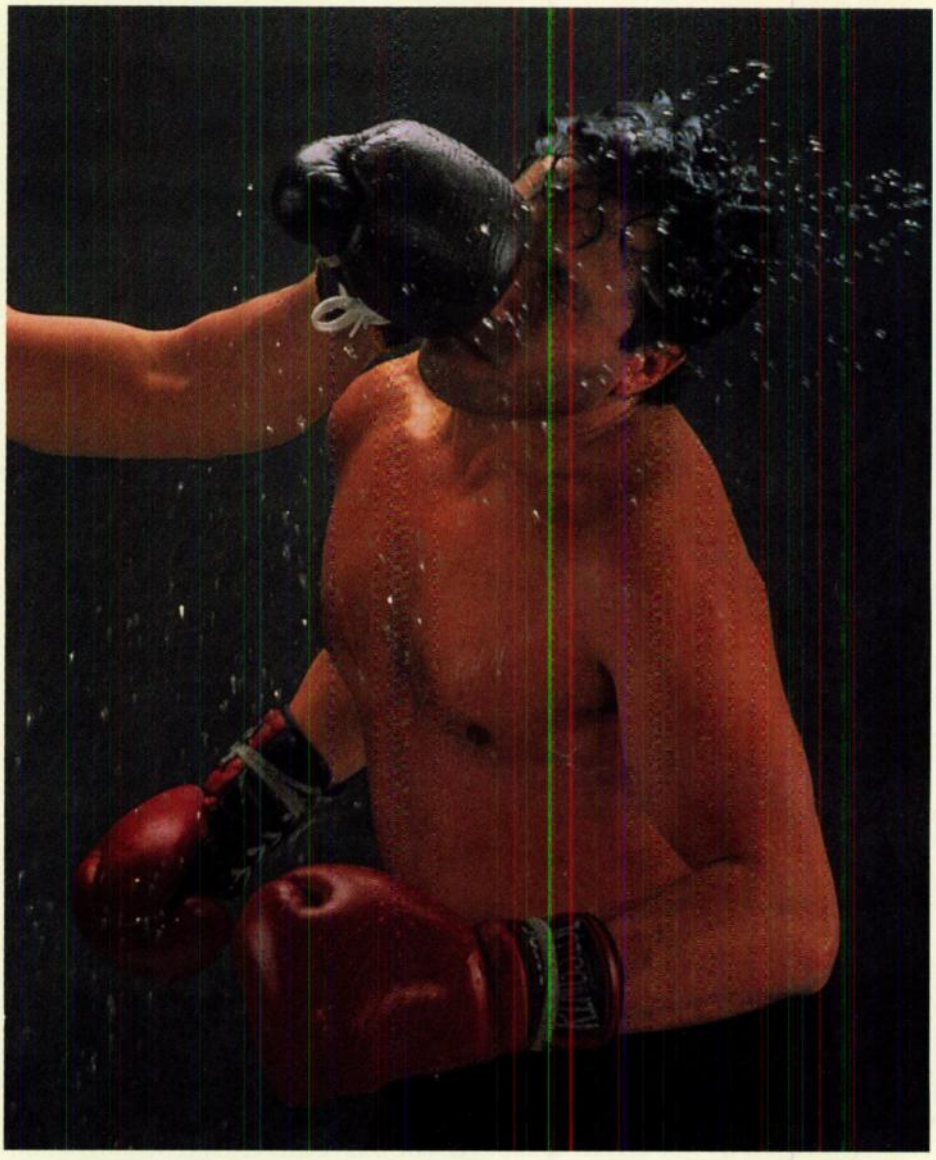
END BIT

Digital-audio networks provide recording studios, post-production houses, live-performance venues, and broadcast facilities with an important tool. By distributing the resources and control of a complex audio system among several workstations and storage devices, more people can get more work done with less downtime. Artists in remote locations can even phone in their parts!

It won't be long until home and project studio owners benefit from the control, ease of connection, and new capabilities that low-cost networks of audio, recording, and MIDI gear will provide. Imagine, for example, having only a single cable coming from each device in your studio plugged into a central patchbay under computer control. Audio, MIDI, and other data routing, as well as device control, such as editing EQ parameters, could all happen through a common interface.

As the 20th century comes to a close, we find ourselves in a transition similar to the one faced by Alexander Graham Bell and his contemporaries 100 years ago. The technology developed today is likely to have a profound influence on the entire world in the next century, and digital-audio (and video) networks will be an integral part of that world. We are witnessing no less than the beginning of a global transformation in which information will be carried to a multitude of workstations on beams of light. The end result is impossible to predict, but it ought to be one hell of a ride getting there.

EM *technical editor* **Scott Wilkinson** *looks forward to the future.*



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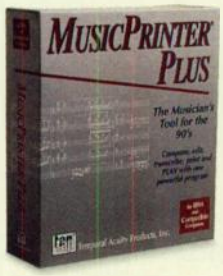

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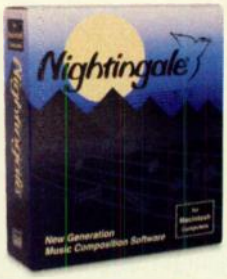

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DO ✦ IT YOURSELF

Build the EM Hiss Whacker

This downward expander provides two channels of single-ended noise reduction.

By Jules Ryckebush

Compressors and expanders are examples of *dynamic-range processors*. A compressor reduces the dynamic range of a signal (see "DIY: Build the EM Dual Compressor," in the October 1992 **EM**). When the input signal exceeds a predetermined threshold, the compressor automatically attenuates the signal to reduce the increase in signal level; it *compresses* the dynamic range of the input signal.

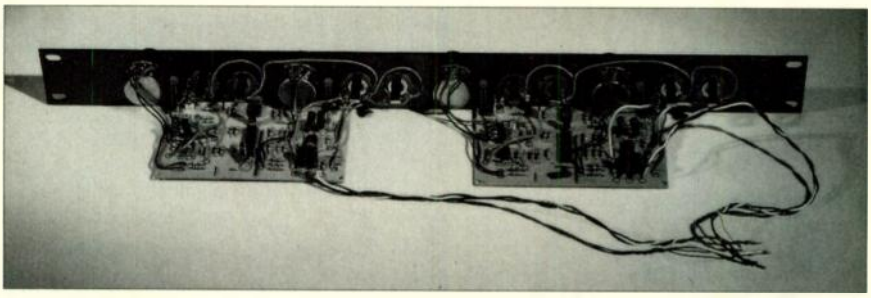
A downward expander performs the opposite function. When the input-signal level is above the threshold of the expander, it does nothing; the input signal comes out unchanged. When the signal drops below the threshold, the expander attenuates the signal, making it even lower.

For live sound, you can use a downward expander on stage microphones. When no one is singing or playing, the expander automatically reduces the signal level to the P.A., which is just background noise anyway. This reduces P.A. hiss and lets you run louder monitor levels without risking feedback.

In the studio, a downward expander can be used as a single-ended noise reducer; that is, it removes noise from an audio source without requiring a decoder during playback. Thus, single-ended systems are useful for different applications than encode/decode-type noise reduction (e.g., by Dolby and dbx). Let's say you want to record a snare drum on its own tape track. During recording, the snare mic also picks up the rest of the drum kit. However, if you use a downward expander during recording or mixdown, the threshold can be adjusted to let the snare through, while reducing the level of the extraneous sounds.

Several companies make commercial, single-ended, noise-reduction devices: Rocktron, dbx, Symetrix, and Roland are well-known sources. In addition to providing a downward expander, many of these devices include a *sliding dynamic filter*. When the program signal drops too low to mask high-frequency noise, the filter automatically attenuates the offending frequencies, just as if you had reached for a treble control. (For more on the principles, technology, and applications of noise reduction, see "The Last Noise Reduction Article, Parts 1 and 2" in the October and November 1991 **EM**.)

However, a sliding dynamic filter is not always necessary. If the program signal tends to remain at moderate to hot levels, a downward expander might be all you need. So why should you go out and buy fancier, more expensive



PHOTOS BY PETER DIGGS

The EM Hiss Whacker (above) provides four channels of downward expansion on two circuit boards (top).

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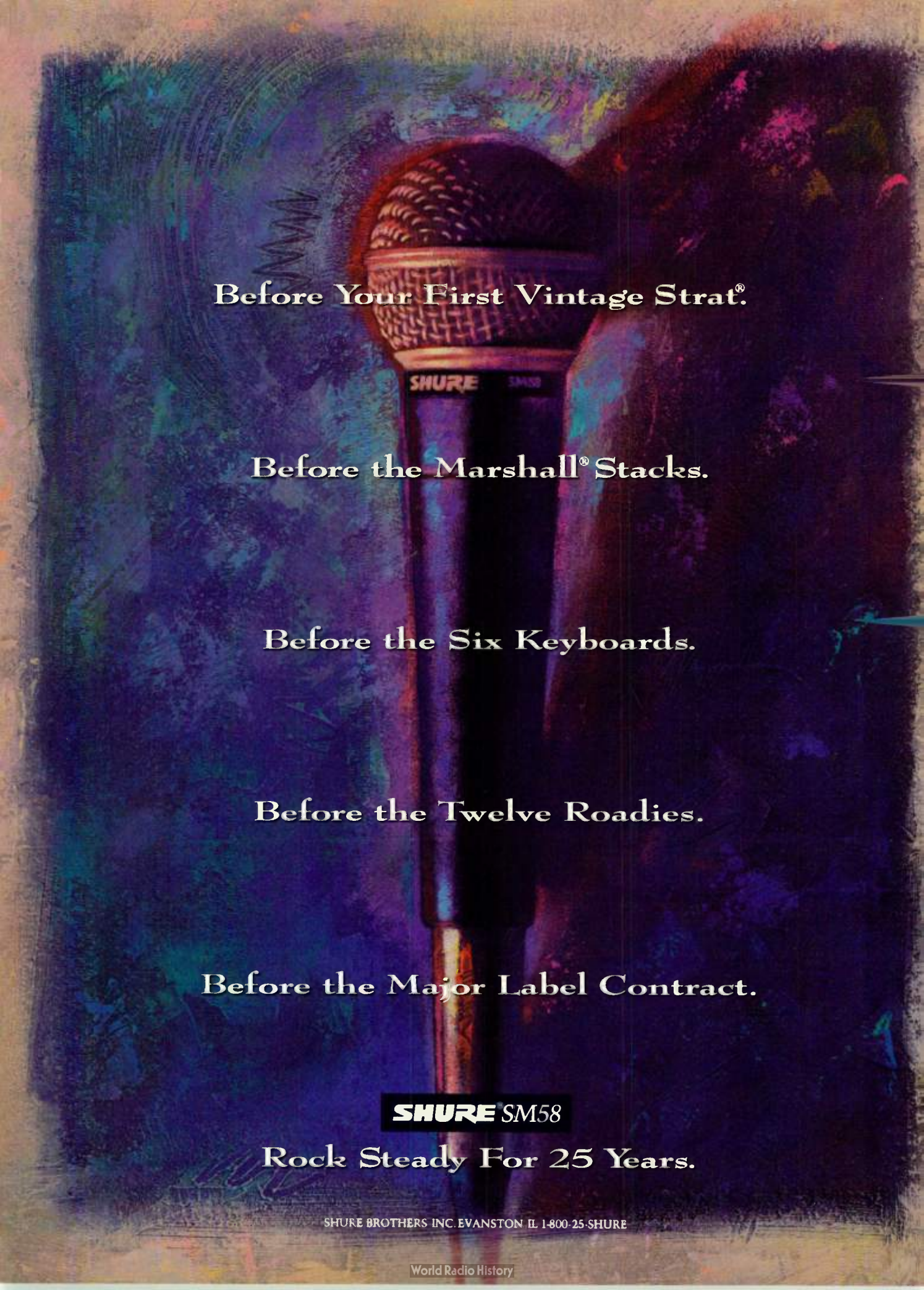


noise-reduction devices when you can build the EM Hiss Whacker? After glancing at its name, you might be tempted to trim your lawn with it, but the EM Hiss Whacker is a high-quality downward expander optimized for noise reduction.

ABOUT THE CIRCUIT

The circuit (see **Fig. 1**) is based on the same IC as the EM Dual Compressor, the SSM2120, which is a dual dynamic-range processor. It features two independent channels, a dynamic range of 100 dB, a THD of 0.01%, and a flat frequency response. The rest of the circuitry buffers the incoming audio, determines the threshold for expansion, sets the expansion ratio and attack/release times, and recovers the audio signal (more in a moment).

Each of the two input buffers consists of one-half of a 5532 dual operational amplifier (IC2:B, IC3:A). These are non-inverting buffers. The signal then splits. One copy goes to the internal VCA of the SSM2120, which controls the output level. The other copy of the signal goes to a precision level-detector and log-converter, which are conveniently contained within the SSM2120. The output of the level-detector is compared to the threshold setting determined by potentiometers R13 and R14.

The internal VCA has a nominal gain of zero; it normally passes the input signal straight through, unchanged. When the input level falls below the threshold, a negative control voltage is developed. This negative voltage is applied to the +VI1 or +VI2 pin of the SSM2120, reducing the gain of the appropriate VCA. Maximum gain-reduction is about 40 dB. The expansion ratio and attack/release times are optimized for single-ended noise reduction. (The expansion ratio for the two channels is controlled by R15/R16 and R28/R30; attack/release time is controlled by C4/R20 and C8/R40.)

The output of the VCA (SOUT1, SOUT2), which is actually a current-based signal, is sent to another op-amp (IC3:B, IC2:A). This is configured as a current-to-voltage converter that converts the output current of the VCA back to a voltage.

The threshold and control voltages from the level detector for each channel are sent to IC4 via 330 kΩ resistors (R22, R23, R19, R29). This is a comparator circuit that visually indicates when downward expansion occurs. It drives a bi-color LED, which changes from green to red during expansion.

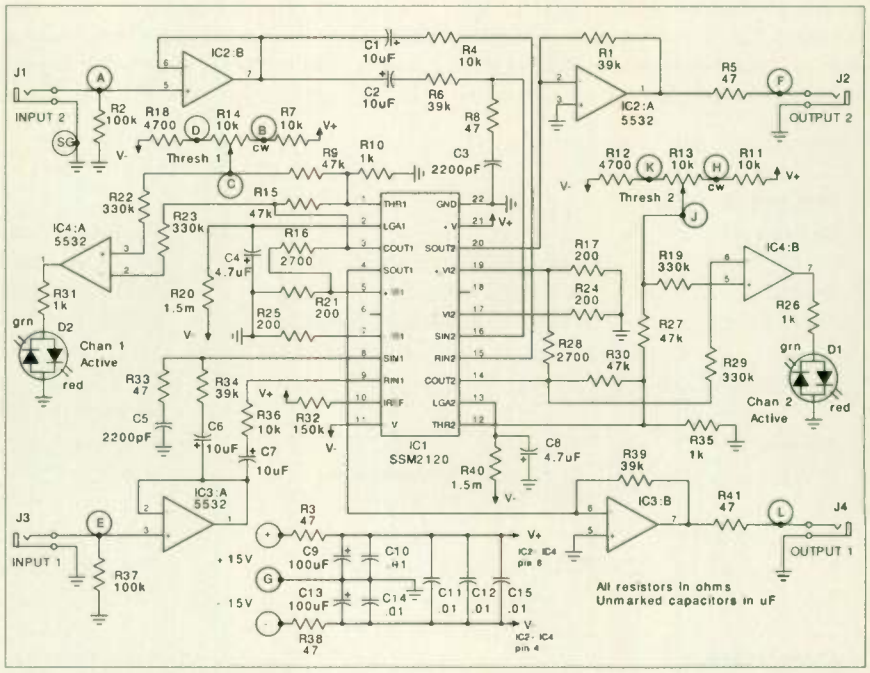


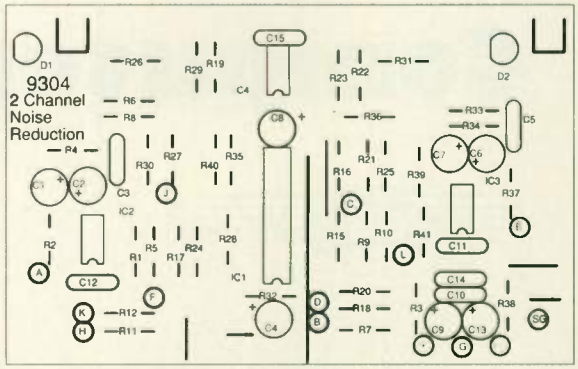
FIG. 1: The schematic of the EM Hiss Whacker.

The Hiss Whacker is designed to run with a ±15 VDC power supply. It can also be powered by two 9V batteries, but with reduced headroom.

CONSTRUCTION

Construction is not difficult. PAiA Electronics has put together a complete kit of all parts and a well-designed circuit board (see sidebar, "PAiA Kits"). I recommend using the circuit board to ensure the quietest possible operation; a lot of attention was paid to proper grounding and power-supply lines (see **Fig. 2**). The LED comparator has the potential to cause noise spikes when switching. If you build more than one circuit board, run separate wires to a common power supply; don't daisy chain them. PAiA also has a silk-screened, rack-mount panel that will accommodate two circuit boards, allowing four channels of noise reduction in one rack space.

As always, pay attention to detail during assembly. You should be able to



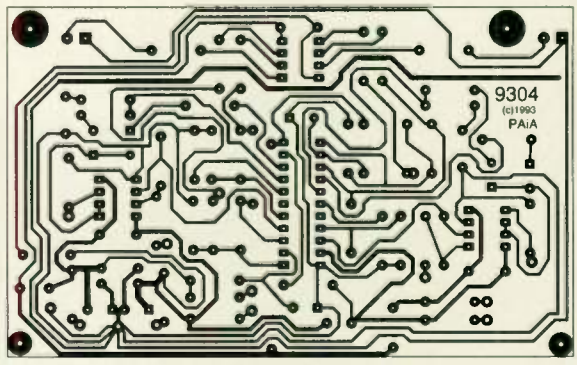


FIG. 2: The printed circuit board of the EM Hiss Whacker. The top view shows the location of the circuit elements. The bottom view reveals the conductive traces.

finish mounting all the parts in one evening. Use a low-wattage soldering iron and rosin-core solder. Check your work as you go; the results are worth the extra effort. When you have soldered in the last component, take a break. Then, check your work again. Before applying power, I like to use a meter and make sure I have no power-supply shorts. For some unknown reason, this is where most of my solder bridges are found.

PARTS LIST

Capacitors

C1, C2, C6, C7.....10 µF/6V electrolytic capacitor
C4, C8.....4.7 µF/6V electrolytic capacitor
C9, C13.....100 µF/16V electrolytic capacitor
C3, C5.....2200 pF polystyrene capacitor
C10, C11, C12, C14, C15.....0.01 µF ceramic disk capacitor

Diodes

D1, D2.....red/green bi-color LED

Semiconductors

IC1.....SSM2120 dynamic range processor
IC2, IC3, IC4.....5532 dual low-noise op-amp

Connectors

J1-J4.....open-circuit ¼-inch phone jacks

Potentiometers

R13, R14.....10 kΩ linear taper potentiometer

Resistors (5% ¼W)

R1, R6, R34, R39.....39 kΩ
R2, R37.....100 kΩ
R3, R5, R8, R33, R38, R41.....47Ω
R4, R7, R11, R36.....10 kΩ
R9, R15, R27, R30.....47 kΩ
R10, R26, R31, R35.....1 kΩ
R12, R18.....4700Ω
R16, R28.....2700Ω
R17, R21, R24, R25.....200Ω
R19, R22, R23, R29.....330 kΩ
R20, R40.....1.5 MΩ
R32.....150 kΩ

Other Components

Circuit board
Front panel
Knobs
Wire

Once you are satisfied with your construction, power up the board. The LEDs should light up red or green. Turn the threshold potentiometers fully counter-clockwise; the associated LEDs should be green. Slowly adjust the potentiometers clockwise. At some point (about halfway), the LEDs should turn red. If this happens, you are ready to connect audio. If you see the opposite colors, either the LED or the threshold potentiometer is wired backward. Once the wiring checks out, it's time to connect the audio.

PAIA KITS

Complete kits for this project are available from PAiA Electronics, Inc., 3200 Teakwood Ln., Edmond, OK 73013; tel. (405) 340-6300; fax (405) 340-6378.

Circuit board and all electronic components except panel and power supply (9304k): $48.35

Punched, anodized, and silk-screened rack panel for two circuit boards (four channels of noise reduction) (9304fp): $17.75

Drilled ciruit board only (9304pc): $16.25

Please add $4 per order for shipping.

I tested my prototype with a CD player and "Breakdown" by Alan Parsons Project. It starts with a bass and snare intro; the snare has a big, lush reverb tail. By adjusting the threshold, I could kill the reverb tail and just hear the snare alone. However you test it, you should hear no noise, grit, or hum.

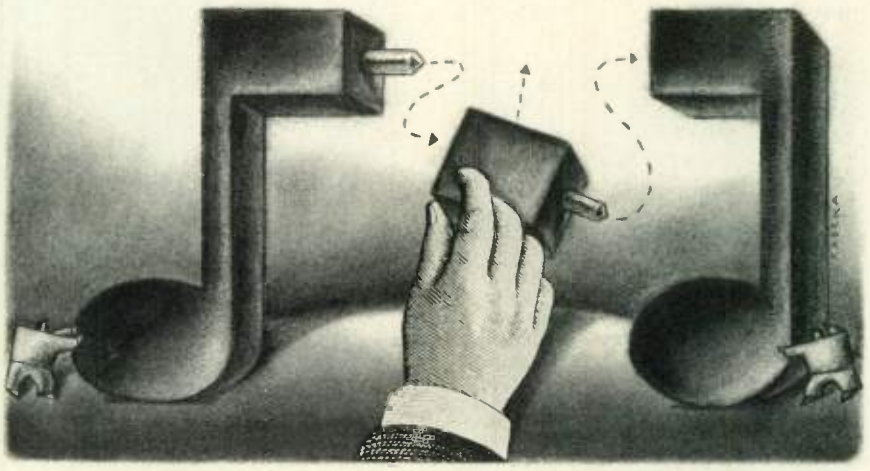
The coolest thing about downward expanders is that they are small and inexpensive. I have installed them as a retrofit inside mixing consoles and packed a bunch of them into a 1-rackspace box. For just over $100, you can have four channels of noise reduction in your home studio. So fire up that soldering iron and DIY!

Jules Ryckebusch *teaches nuclear science at the Naval Nuclear Power School. He freelances as an analog design engineer and sound engineer and occasionally wears dark glasses.*

Basic Audio Connections, Part 1

By Scott Wilkinson

Audio signals are nothing to fear, if you have the right connections.



If you've ever tried to hook up a P.A. system or recording studio, you know that the potential for problems is great. Plugging a microphone or guitar into the wrong place can result in a sea of noise, or even unexpected silence. Those who are lucky enough to have some professional equipment in addition to more modest semi-pro gear must also be careful; connecting a synthesizer output to the input on a professional mixer can reduce the synth's volume and add noise to its pristine timbres. What's an aspiring sound engineer to do?

Learning and understanding the fundamental theory of audio signals is an important step, but this information is easily found in many books; one example is the *Yamaha Sound Reinforcement Handbook*, by Gary Davis and Ralph Jones (available from Mix Bookshelf; tel. ([800] 233-9604 or [510] 653-3307). Of even more practical importance is knowledge about how to properly connect and route audio signals between various devices. With some helpful information, you can avoid problems that commonly crop up in home studios and live performances.

ON THE LEVEL

It seems obvious that all audio connections are made from the output of one device to the input of another. Unfortunately, you can't simply connect *any* output to *any* input. Different devices produce audio signals at different *levels*, or *amplitudes*, which are the electrical equivalent of acoustic sounds at different volumes.

All inputs and outputs are designed to handle signals in a certain range of levels, from silence to a maximum value. Many audio problems arise from mismatched levels between devices. If a high-level output is connected to a low-level input, the result can be a garbled and grungy sound that bears little resemblance to the original signal; this is called *distortion*. If a low-level output is connected to a high-level input, the resulting sound will generally be quite noisy and extremely low in volume.

Most audio devices fall into one of several categories: sound sources, mixers, signal processors, tape decks, amplifiers, and speakers. Each type of device produces and/or accepts signals at different levels. Among the most common sound sources in an electronic musician's setup are synthesizers. Most synths have at least two audio outputs, which are called *line-level* outputs. The outputs from a synth are usually easy to connect to a mixer's *line inputs* (see **Fig. 1**), which are designed to accept signals within the specified amplitude range.

Typically, line-level signals are carried over cables that include two electrical conductors; one of the conductors is a braided or solid metal *shield* that surrounds a central wire, which helps protect the signal from induced electrical noise. This noise usually manifests itself as a low-frequency hum or buzz. Sometimes, a nearby radio station or a passing trucker with a CB radio comes through loud and clear on your system as a result of poorly shielded cables.

At both ends of the cable is a 2-conductor, ¼-inch *phone* plug (see **Fig. 2**). This type of plug is sometimes called a *TS* (Tip-Sleeve) plug. Some low-end mixers accept line-level signals from cables with *phono* connectors (commonly called "RCA" connectors) like those found on consumer stereo gear (see **Fig. 3**). Simple adapters that change one type of connector to the other are available at your local Radio Shack.

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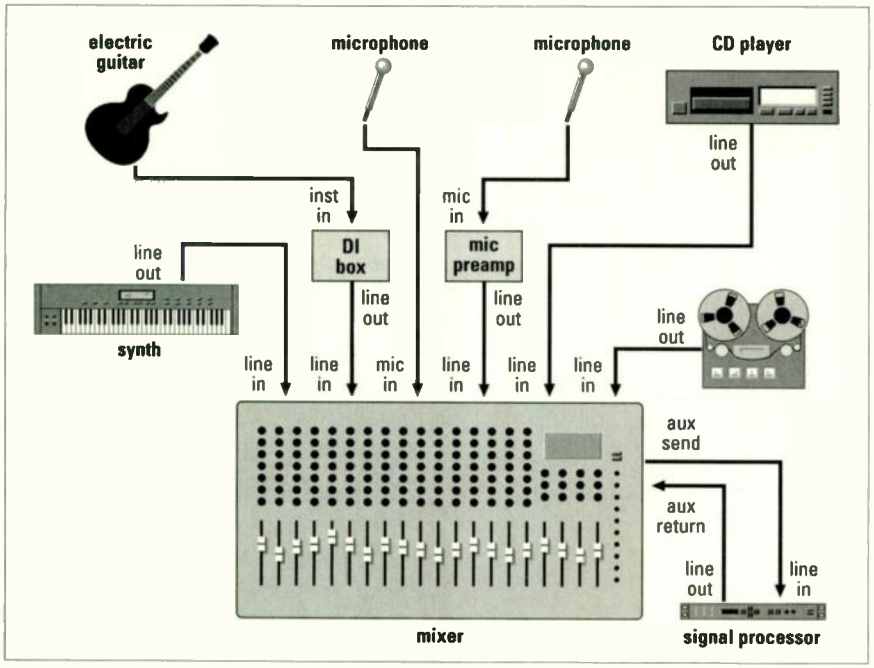

FIG. 1: The outputs of sound sources are connected to the inputs on a mixer. The effects loop sends the signal to a signal processor and returns it to the mixer.

Other line-level sound sources include CD-player and tape-deck outputs. In consumer and semi-pro gear, the outputs on these devices are usually phono connectors.

Unfortunately, "line level" means slightly different things in consumer or semi-pro equipment and professional gear. Semi-pro line level is called *-10 dBV*, or simply *-10*, which indicates the maximum amplitude that can be generated by the equipment. The most common connectors for -10 equipment are RCA and ¼-inch TS. Professional line level is called *+4 dBu*, or *+4*, which reflects the maximum amplitude for pro gear. This gear normally uses 3-conductor *XLR* connectors (see **Fig. 2**).

As you might deduce from these two numbers, professional gear operates at a higher maximum amplitude than semi-professional equipment. However, they don't use the same units of measurement. This leads to confusing mathematical machinations when trying to directly compare the two, but, for now, it's not important to understand any more than the basic differences. (See "The Decibel Demystified" in the April 1990 **EM**.)

If you connect a +4 line output (e.g., from a professional tape deck) to a -10 line input (e.g., to a semi-pro mixer), it should work with little or no problem. You might need to reduce the input on the mixer to avoid distortion. However, if you connect a -10 line output (e.g., from a synthesizer) to a +4 line input (e.g., on a professional mixer), you will probably experience lowered volume and increased internal noise. This internal noise is different from the induced noise described earlier; it sounds like hissing and appears as a result of the internal electronics of the device being connected.

Some manufacturers include both types of line connections on their gear, especially mixers, so be sure to use the appropriate connector for each piece of equipment. There are also several interface boxes that translate between the two types of line levels.

Electric guitars use the same kind of cables and ¼-inch TS connectors as synths and other -10 gear, so it should be possible to plug them directly into a mixer line input, right? Wrong. If you try this connection, the result will probably be increased internal noise, distortion, and very low volume. The signal from a guitar pickup is said to be at *instrument level*, which is somewhat lower than line level. The output from the guitar must first be connected to the input of a guitar amp with a line output, which can then be connected to a line input on a mixer. You can also connect the output from a guitar to the input of a *direct injection* (DI) box, a *preamp*, or a multi-effects processor that includes an instrument-level input. All of these devices convert the signal to line level before sending it to a mixer line input (see **Fig. 1**).

MICROPHONIA

Microphones are another common sound source. Some microphones have a ¼-inch TS plug at the end of their cable, so you might think you can simply plug them directly into a mixer line input. This is possible in a few isolated cases, but most such mics are of rather poor quality and not worth using in any but the most casual applications. Most mics use a 3-conductor *balanced* cable and XLR connectors (more on these in a moment), unlike ¼-inch TS and RCA connectors, which use only two conductors.

The output from a microphone is said to be at *mic level*, which is much lower than line level. Many mixers include both mic and line inputs to accommodate both types of signals. The mic input is usually an XLR receptacle. This input is accompanied by an internal *mic preamp*, sometimes called a

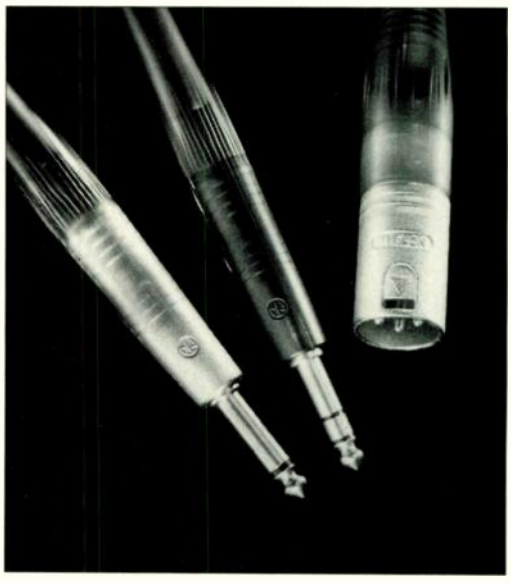

FIG. 2: A ¼-inch, TS phone plug, shown on left, has two conductors: tip and sleeve. It's used on -10 dBV unbalanced line-level and guitar cables. A ¼-inch TRS phone plug, center, has three conductors: tip, ring, and sleeve. It's used on balanced-line cables, stereo cables, and console send/return inserts. A 3-conductor XLR connector, shown on the right, is used on +4 dBu, balanced, line-level and mic cables.

"mic pre," which amplifies the mic-level signal up to line level so it can be mixed with other signals.

If you want to connect a microphone to a line input, you may need to use a separate, outboard mic preamp. These are usually of better quality than the internal mic preamps of most mixers, but they also can be expensive. (You can build your own outboard mic preamp for much less than the cost of a commercial device; see "DIY: Build the EM Phantom-Power Mic Preamp" in the April 1993 **EM**.) Make sure the line output of the preamp matches the mixer line input (-10 or +4).

Some low-end mixers and ministudios have ¼-inch mic inputs. You can use a mic with an appropriate plug, but it's better to use a mic with an XLR connector and a special adapter called a *matching transformer*. This adapter includes an XLR receptacle on one end and a ¼-inch phone plug on the other end.

BALANCING ACT

As mentioned earlier, microphones use *balanced* cables and connectors with three conductors, one of which forms a shield around the other two (see "On Solid Ground, Part 2" in the October 1992 **EM**). This provides even greater protection from induced electrical noise than unbalanced, shielded cable, especially over long cable runs.

Professional devices that operate at +4 line levels often use balanced-line inputs and outputs with XLR connectors. High-end semi-pro devices that operate at -10 levels sometimes use balanced-line inputs and outputs with 3-conductor, ¼-inch phone connectors. These plugs, which are used for stereo headphones, are known as *TRS* (Tip-Ring-Sleeve) plugs (see **Fig. 2**). Like a balanced mic cable, balanced-line cables include three conductors, one of which is a shield, which helps protect line-level signals from induced electrical noise.

Plugging an unbalanced-line output (e.g., from a synth) into a balanced-line input (e.g., on a pro mixer) is usually fine; the extra conductor at the input simply connects to the sleeve of the unbalanced TS plug, which causes no trouble.

Plugging a balanced-line output (e.g., from a pro tape deck) into an unbalanced-line input (e.g., on a semi-pro mixer) often results in a very *thin* sound. The problem is that the two main signal lines in a balanced cable carry two different versions of the signal (in phase and out of phase). When you make this type of balanced-to-unbalanced connection, the two signals combine and partially cancel each other out. The only way to avoid this is with a special cable wired for the situation.

As a rule, you should try to avoid running any audio lines, particularly unbalanced cables, near AC power cords, which can induce noise.

KNOCKED FOR A LOOP

A signal processor is another important type of component in the audio signal path. These devices are commonly used to add reverb, delay, and other effects to the signals coursing through the mixer. A signal processor's inputs and outputs are invariably line-level connections. As always, semi-pro units operate at -10, while pro devices operate at +4; some processors offer

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- Stereo mix ... mix stereo sound files together ... digitally.
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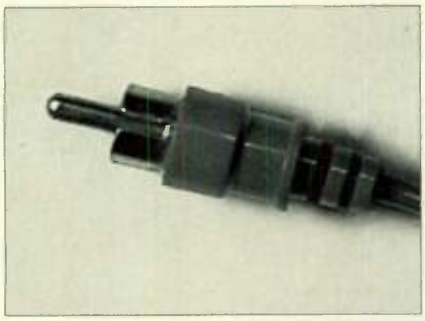


FIG. 3: A 2-conductor RCA connector is used on -10 dBV unbalanced, line-level cables.

switchable operation. The connections on most processors are unbalanced, although some high-end pro units are balanced to reduce noise as much as possible.

To get to the signal processor, the signal coming into each mixer input is split into two copies. One copy proceeds directly through the mixer to the output section (more next month). The other copy is sent to the signal processor via the mixer's *aux send* output, which is typically a ¼-inch unbalanced line (see Fig. 1). The aux send can combine and route signals from several mixer channels to a signal processor. Most mixers have at least one aux send; many have two, three, four, or more. With multiple aux sends, you can send the signal from one mixer input to several processors for multiple effects; you can also send the signals from different mixer inputs to different processors for independent effects.

The processed signals are brought back into the mixer via the *aux return* inputs, which are usually ¼-inch unbalanced connectors. Typically, there are two aux returns for every aux send; many signal processors accept a mono signal and return a stereo signal. The processed signal is then combined with the original signal in the output section of the mixer. Each set of aux sends and returns is called an *effects loop*, because the signal path forms a loop from the mixer, through the signal processor, and back to the mixer.

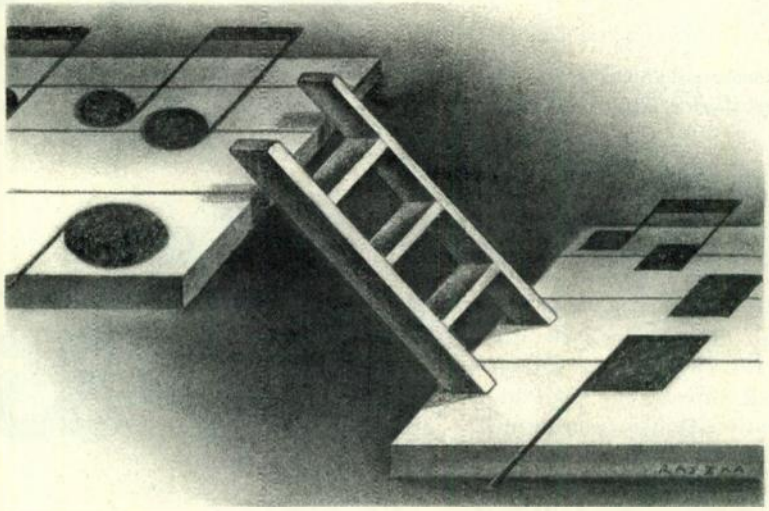
CONCLUSION

Next month, we'll learn how to connect tape decks, power amplifiers, and speakers to the mixer. Then you'll be well on your way to connecting the devices in your own studio setup for maximum performance and minimum hassle. ●

Crossing Platforms

By Bob Lindstrom

How to share music files with other computer users.



Since the late 1970s, when hearty PC pioneers assembled hand-soldered Altair kits and others purchased prefab Apples at their local Byte Shop, computer users have dreamed of standards. Wouldn't it be nice if a common technology let System A transparently share programs and data with System B? Some fifteen years later, the notion of computer independence is still only a pipe dream.

Despite the incredible sophistication of today's computers, users are often stymied when trying to get PC-compatible data from a home sequencer to a project studio's Mac sequencer. Or Amiga. Or Atari. The disk formats are different. The file formats are different. The programs are different. It's the Technology of Babel.

Things really aren't so bleak. The overwhelming success of PC-compatibles has turned that platform and its hardware/software formats into something of a *lingua franca* of microcomputer technology. Almost all computer brands now have utilities that permit some degree of data sharing using PC formats as a standard.

Electronic musicians have it fairly easy. The Standard MIDI File (SMF) format makes it possible to move sequences between different brands and types of computers. It requires only a little knowledge and a little preparation. Notation and digital audio files, however, are another story. Using these files across platforms and programs remains a frustrating challenge. Notation software users can use SMFs to transfer note data, but expression marks, most text, and layout information will be lost in the transfer. Similarly, small digital audio files (e.g., samples) can be somewhat easily transferred, but there's no way to get large chunks of audio across the computer-platform bridge.

SWAPPING MIDI DATA

The MIDI software industry solved file-format incompatibility by implementing Type 0 and Type 1 Standard MIDI Files. Generally, you should export MIDI files from your sequencer as Type 1 files, which maintain multiple, separate tracks. Type 0 files combine all data into a single track.

With your files in a standard format, you're ready to move them to another computer. Short of installing Ethernet in your home studio, the easiest way to move data is to swap floppy disks from one computer to another, the proverbial "SneakerNet." However, incompatible floppy-disk formats quickly raise their ugly heads. Luckily, the 3.5-inch 720 KB PC format has become a *de facto* standard. Even computers with incompatible disk drives usually can be made to read and write these disks.

The simplest transfer is from the Atari ST to the IBM PC-compatible. Atari wisely made the ST disk drive compatible with the 720 KB PC disk. There is a slight wrinkle: The PC can't mount ST-formatted floppies. As a result, you must format the floppy disk on the PC. Then you can pop the disk into the ST's floppy drive, copy the files, and shift the floppy back to the PC. The PC then can read the ST files and vice-versa.

PC and ST transfers to and from the Commodore Amiga become transparent with the addition of *CrossDOS*, a nifty utility from Consultron that is incorporated into the most recent version (2.1) of *AmigaDOS*. *CrossDOS* redefines your Amiga's floppy drives, under new device names, as PC-compatible drives, yet maintains their Amiga compatibility. Unlike the PC and Mac, an

BRIAN RAZSKA

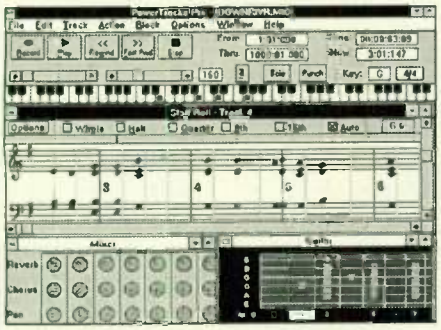
PG Music announces... PowerTracks Pro™ ...at the incredible price of $29

IBM SEQUENCER FOR WINDOWS & DOS

"Solid sequencing at an unbelievable price" *Electronic Musician Magazine - Sept. 93*

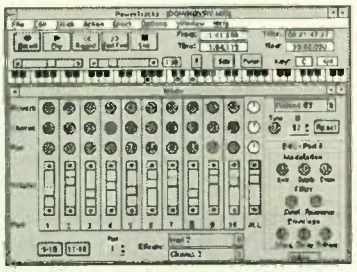
PowerTracks is a professional, fully featured MIDI sequencing program, and is so easy to use!
And we include versions for Windows 3.1 AND DOS so you'll be able to use PowerTracks on all of your machines!

PowerTracks Pro 2.0 for Windows



POWERTRACKS FOR DOS VERSION ALSO INCLUDED

Yes! You Get both the Windows & DOS version included in the same package! 48 Track recording, similar features and operation to PowerTracks for Windows version. DOS version supports MPU401/MIDIATOR/SoundBlaster FM sounds/SoundBlaster MIDI/TG100/Roland SC7 and more. Runs on XT/AT/386 or better. Monochrome or color 640K. Many features listed above are reduced or not available in DOS version.



FOR STARTERS... *PowerTracks has all the Pro features found in sequencers costing hundreds of $$ more.*

PRO RECORDING, PLAYBACK, SYNCH, EDIT & SYS-EX OPTIONS: 48 tracks, real/step/punch record, sound-on-sound, MIDI File support, sync (SMPTE, Midi Time Code, MIDI) edit (quantize/ cut/ copy/ paste/undo/ data filters/transpose), multi-port support, 480 ppq timebase, sys-ex-editor-librarian, patch names, banks & much more.

INPUT, VIEW & EDIT NOTES ON A MUSIC STAFF: See the notes displayed on a music staff, this is the easiest way to input,view or change the music!

DELUXE WINDOWS INTERFACE: Multiple Windows – Staff Roll, Event List, Tracks, Bars, Meter, Tempo, Piano, Guitar.

BUT POWERTRACKS GOES MUCH FURTHER... WITH EXCITING NEW FEATURES NOT FOUND IN OTHER SEQUENCERS!

THE FASTEST WAY TO ENTER NOTES ONTO A MUSIC STAFF! Using our intelligent AutoDuration™ feature, you can enter music onto a music staff using one mouse click per note - including the duration!!

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ON SCREEN PIANO, GUITAR & MUSIC STAFF SHOWS THE NOTES IN COLOR AS THEY ARE BEING PLAYED: You see the notes drawn on the piano keyboard, the guitar fretboard & highlighted in red on the music staff as the song is playing.

...AND POWERTRACKS COMES WITH PRO QUALITY MIDI FILES READY TO PLAY: We include MIDI files of pro musicians playing piano, guitar & combo tracks.

REQUIREMENTS: PowerTracks for Windows - Windows 3.1, IBM Compatible AT, 386 or higher, 2mb RAM, Supports any device compatible with Windows 3.1 including Roland MPU401, Music Quest MQX interfaces, Key Electronics MIDIATOR, SoundBlaster, AdLib, TurtleBeach, etc.

PowerTracks for DOS - DOS 3.3 or higher, 640K, XT/286/386 or better. MIDI interface (Roland MPU401, Music Quest MQX series, SoundBlaster MIDI and FM sounds, Mediator, Roland SC7, Yamaha TG100) or Adlib/SoundBlaster compatible sound card.

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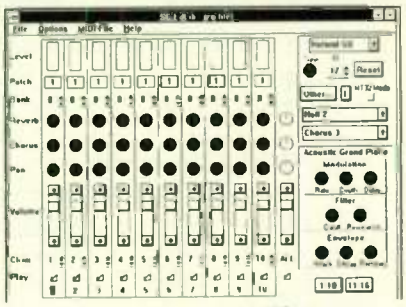
PG Music announces... New Windows programs & great deals on Roland hardware with software



Sound Canvas Pro Editor/Librarian for Windows $29

This program for Windows (SC-PRO) provides mixing/editing/storage of EVERY feature on the Sound Canvas and other Roland GS and GM modules. (Sound Canvas, SCC1, SC-55, SC-155, CM-300, JV-30, SC-88, E-70, etc.)

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Edit/design new sounds, new scales, tunings... YOU CAN EDIT EVERYTHING!!!
Also plays MIDI files so you can hear changes as you make them.

Multi-MPU401 Driver for Windows $19

- *allows 8 music programs to use the same MPU401 at the same time!*
- *this is a "must have" driver for all MPU401 Windows users (Roland, Music Quest, CMS, etc.)*
- *easy to use, installs as a driver in Windows to replace your current MPU401 driver*

The current MPU401 Driver that comes with Windows has some major drawbacks. For example, it only allows one music program to use the port at a time. You need to close down all music applications before running a new one. This new "Multi MPU401 Driver" overcomes this by allowing up to 8 programs to use the MPU401 at the same time. So you can use all of your music programs at the same time (eg. Band-in-a-Box, PowerTracks, Cake Walk, Finale all can be open and used at the same time)

Roland SCC1 card $389

- *includes PowerTracks Sequencer and SoundCanvas Pro Editor FREE!*

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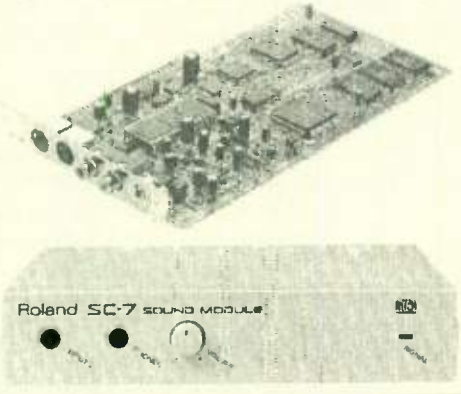

Roland SC-7 General MIDI module $389

- *built in MIDI interface connects to your PC or notebook!*
- *includes PowerTracks Sequencer and SoundCanvas Pro Editor FREE!*
- *also includes Windows Driver for SC-7*

Roland's newest product for IBM, MAC or ATARI computers. This external module has the 128 General MIDI sounds (same sound quality as the Sound Canvas/SCC1), and also a direct connection to the serial port of your PC or MAC. This means that you can use the SC-7 with your notebook/laptop and don't require a MIDI interface!

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Amiga running *CrossDOS* can read ST-formatted disks. Just pop in a PC or ST disk, copy the files to those PC-compatible device names (di0: and di1:), and you have instant PC-format compatibility.

There are several solutions for transferring "alien" files to the Macintosh platform. The oldest and crudest method is to run the *Apple File Exchange* application included in Apple's system software. When running *AFE*, Macs equipped with 1.4 MB SuperDrives can read and write PC-format and *CrossDOS*-format disks but only from within the application. Dayna Communications' *DOS Mounter* (see **Fig. 1**) and Apple's *PC Exchange* are more elegant solutions because they are system extensions and run transparently in the background. They allow SuperDrive-equipped Macs to read and write PC-format and *CrossDOS*-format Amiga disks (including high-density disks) just as if they were Mac disks.

A more thorough alternative is Insignia Solutions' *SoftPC*, a software-based PC emulator for the Mac that not only reads and writes PC disks but also allows the Mac to run many PC programs (though not MIDI programs), including *Windows* applications. Unfortunately, the *Windows* version requires a 68040-based Macintosh.

If you share PC-format disks across different platforms, try to stick with MS-DOS file-name conventions. In MS-DOS, file names have no more than eight characters, with a 3-character extender (usually .MID, .MMF, or .SMF for MIDI files). Also, when formatting PC-compatible disks, use the 720 KB double-density format and avoid the 1.44 MB high-density format. This eliminates potential conflicts with older drives on the ST and Amiga.

CREATOR CODES

PROGRAM	CREATOR CODE
AudioTrax	ATRX
Beyond	BYND
Composer's Mosaic	sqid
Cubase	stCU
Digital Performer	MOUP
Encore	ENCC
EZVision	MIDJ
Finale/Finale 3.0	FINL/FIN3
Master Tracks Pro	MTPS
MusicProse	MPRO
Musicshop	MIDJ
MusicTime	ENCC
Notator Logic	EMAG
Performer	MOUP
Professional Composer	MOTU
Studio Vision	MIDA
Trax	TRX!
Vision	MIDI

FIG. 2: A table listing the Creator codes for common Mac sequencing and notation programs.

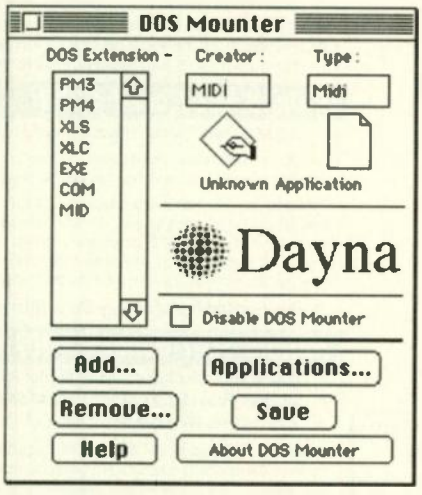

FIG. 1: To read MS-DOS formatted disks on a Mac, you need a utility such as Dayna's *DOS Mounter*.

MAC COMPLICATIONS

If your computer destination is a Macintosh, and the Mac lacks a SuperDrive, you need to create Mac-format disks. On the PC, Central Point Software's Deluxe Option Board is a good choice. It's a half-size card that allows PC disk drives to read and write in Macintosh format.

On the Amiga, you'll need a Macintosh-compatible disk drive and either Central Coast Software's *Mac2DOS*, or ReadySoft's *AMax II*. Both are hardware/software combinations that provide a Mac-compatible disk-drive port to accommodate a Mac drive. *AMax II* is also a software-based Mac emulator that allows the Amiga to run Macintosh software (when outfitted with Macintosh system ROMs, which must be purchased separately). On the ST, Gadgets by Small's Spectre GCR provides Mac-compatible hardware/software emulation with the addition of a Mac

disk drive and system ROMs.

REASON TO RESEDIT

Even after you've solved disk compatibility, getting a MIDI file into the Mac is not quite as simple as reading it from disk. The convenience (complexity?) of Apple's operating system adds an additional level of manipulation when trading MIDI and sample files.

Each Macintosh file contains information that identifies the file type and the program that created it. Because this file information doesn't exist in files on other platforms, you must add it when transferring "alien" files to the Mac. Conversely, you must strip this data when transferring a Mac file to another platform, or you'll get garbage at the beginning of the file.

Programs like *DOS Mounter* and *Macintosh/PC Exchange* support a feature called extension mapping that can automatically convert files with a particular DOS extension (like .MID) to the appropriate Mac file format. Another utility commonly used to create or alter file information is *ResEdit*, an Apple program available from many Macintosh bulletin boards and user groups. It allows you to access and alter the separate components (resources) of a Macintosh file. (You can also perform this minor surgery with the *Disk Editor* in *Norton Utilities* 2.0 for the Mac.) Because you potentially can render a file unusable with *ResEdit*, you should work on a copy of the file.

Start by saving the file on your computer in one of the two Standard MIDI File formats. Then, using one of the methods explained earlier, move the file to your Macintosh. Boot *ResEdit*, and when a file dialog box appears, load the MIDI file.

With the file loaded, go to the File menu and select "Get info for <filename>." In the dialog box that appears, you'll see a box called Type. Change the entry in the Type box to "Midi," observing the upper- and lower-case letters but omitting the quotes. Close the Info window and choose "Yes" when asked if you want to save the info for this file. The file is now a Mac-compatible MIDI file that can be imported to any SMF-compatible Mac sequencer.

You can go a step further and turn the MIDI files into double-clickable items with icons to match your sequencer by simply typing in the appropriate Creator code. See **Fig. 2** for a table of Creator

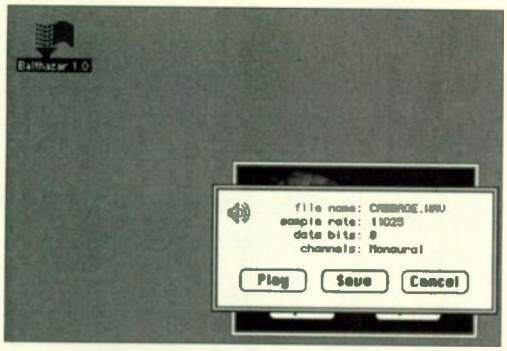

FIG. 3: One of the many shareware utilities for transferring digital audio files across platforms is *Balthazar*, which converts *Windows* Wave files into Mac format.

codes for popular Mac sequencers and notation programs.

Several shareware programs, including *MIDIFile Converter* and the *HyperCard*-based *FileType Changer*, can also do the dirty work for you.

SAMPLES

Moving samples and System Exclusive files between computer platforms is as easy as moving MIDI files. Getting them to work is the problem. Several public domain and shareware utilities are available for moving short samples from one system to another, although not all combinations are covered yet.

If you hope to move song-length digital audio files from one platform to another, forget it. One of the glaring shortcomings of computerized music-making is that a good solution does not exist for transferring large sample files between computers, even between similar programs running on different platforms. Fortunately, several sequencer manufacturers are discussing an expansion of the SMF format that would incorporate digital audio files. In order to create that protocol, they'll need to determine a way to transfer the digital audio segments, either separately, or embedded into the SMFs.

If you're moving small files, such as sampled instruments, it's generally best to set loop points and other internal flags on the destination machine, as transferring files between computers and applications often leaves loop points behind.

A reliable, but time-consuming, way to transfer files from one system to another is through MIDI, using the Sample Dump Standard. It's slow and clumsy, but it gets data from here to there with minimal surprises. You can also transfer sounds from a sample-editing program on one computer to a sampler, and then from the sampler to a sample-editing program on another computer.

Beyond that, moving brief samples is a matter of finding sound utilities. You can start by looking on local bulletin boards, user groups, or commercial online services, such as PAN and America Online. The following freeware and shareware utilities are available on various forums in CompuServe:

•*MASC* on the Amiga transfers Amiga IFF samples to AIFF on the Mac and vice-versa.

•*PlayMack* transfers Mac sound files to 8SVX format on the Amiga.

•*Balthazar* on the Mac (see **Fig. 3**) transfers 8-bit *Windows* Wave files to the Mac as self-playing files. You can import the sound resources from these files into a sample editor such as Passport Design's *Alchemy*. *WaveEdit* on the PC, a tool included with Microsoft's *Multimedia Viewer* and Multimedia Developers' Kit, will load AIFF files and convert them to Wave format.

•*WAVE.LZH* for the ST plays and converts Wave files from the PC.

•*SOX*, also for the Atari ST, converts files between the ST, PC, and Amiga.

•*SoundBuilder* 1.01 on the Mac reads Wave files and transfers them to its own format or exports them as resources.

All of these utilities, however, are only partial solutions, at best. What is needed desperately is a standard file format or a conversion program that can transfer samples between computers through the high-speed serial, parallel, or SCSI ports.

SYSEX

To transfer SysEx data you can either use the SysEx file-transfer utilities included with many sequencers, or you can sneak SysEx bulk dumps into Standard MIDI Files and use them to transfer SysEx across platforms. The MIDIEX SysEx format has enjoyed popularity on bulletin boards, and you'll often find MIDIEX-compatible files there. Some sequencers directly support MIDIEX format, including PG Music's capable (and incredibly affordable)

MANUFACTURERS

Apple Computer
tel. (800) 776-2333
or (408) 996-1010
fax (408) 974-9974

Central Coast Software
tel. (512) 328-6650
fax (512) 328-1925

Central Point Software
tel. (503) 690-8080

Consultron
tel. (313) 459-7271

Dayna Communications
tel. (801) 269-7200
fax (801) 269-7363

Gadgets by Small
tel. (303) 791-6098
fax (303) 791-0253

Insignia Solutions
tel. (415) 694-7600
fax (800) 876-3872

ReadySoft
tel. (416) 731-4175
fax (416) 764-8867

$29.95 PowerTracks. MIDIEX SysEx utilities for most systems, such as BSU.SEA for the Mac, are also widely available on many electronic bulletin-board services.

Overall, cross-platform compatibility is more of a reality today than it was in the days of computer kits and cassette tape drives. Combine the emergence of General MIDI, the dominance of the PC as a hardware/software paradigm, and the MIDI file standards, and you're a little closer to the dream of machine independence.

Still, the relative convenience of transferring MIDI file formats between systems points up the importance of creating standards for all music-associated files, particularly notation and digital audio. We've come a long way in the few years of personal computers and MIDI, but we still have a long way to go.

Bob Lindstrom *is a freelance writer, composer, and conductor with such weak buyer's resistance that he finds himself purchasing one of everything.*

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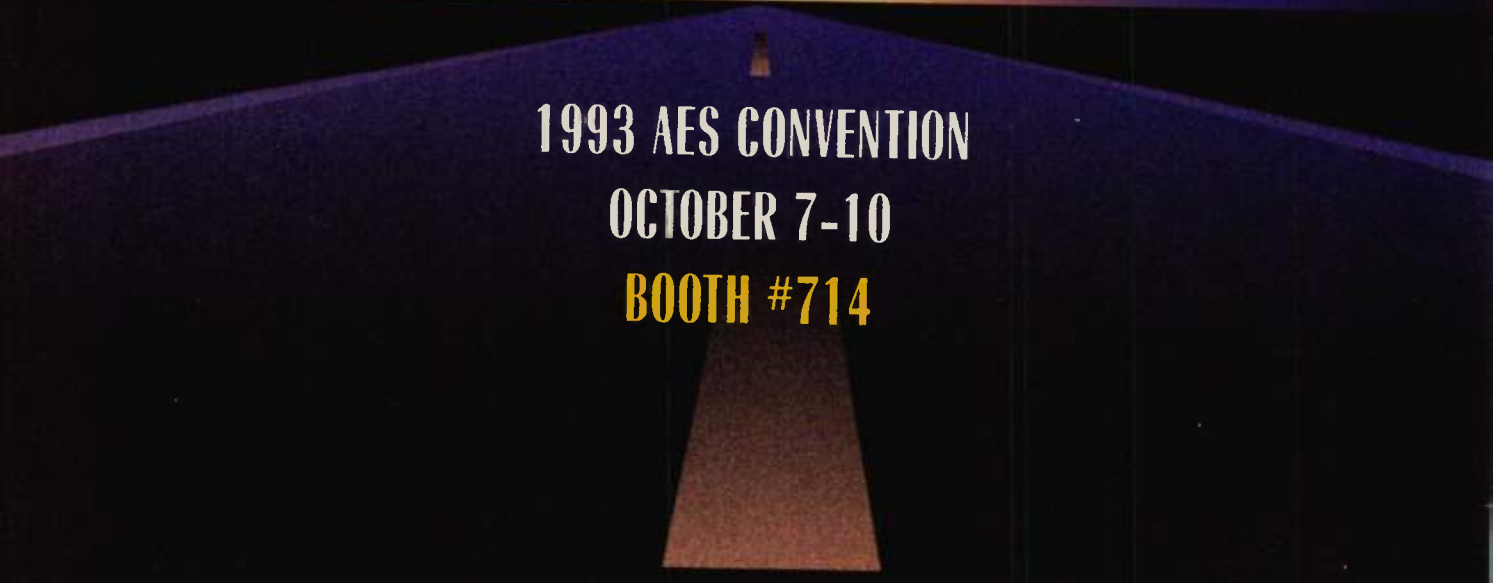

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Computer Audio Monitoring

By Daniel Kumin

You've already got a computer monitor. Do you need two more?

FIG. 1: The Altec Lansing ACS300 system incorporates two powered, clamshell satellites and a separate subwoofer.

At long last, your twenty-first century multimedia workstation is complete. You've got the warp-speed, 50 MHz CPU. You've got the 150-millisecond, Photo CD-compatible CD-ROM drive. You've got the dual-chip DSP board in your computer, a 16 zillion-color, accelerated video board, and a video monitor big enough to roll a pizza on. You're in business, ready to experience, or design and produce, multimedia in all its glory.

Or are you? Not if you're reproducing the sound elements through (heaven forbid!) the cheap, half-dollar-sized, mono speaker built into your CPU. Or, nearly as poor, that unbelievably cheesy pair of micro-monitors you bought with a Walkman portable back in the Reagan years.

Audio is an equal partner to visuals in the heady multimedia brew, yet the audio delivery system for many multimedia computer setups offers the sonic equivalent of an AM transistor radio sitting atop a 40-inch projection TV. Even some musicians forego the obvious advantage that good speakers bring to a multimedia computer. Clearly, this situation must be rectified.

FROM WHENCE IT COMES

Multimedia applications generate sound from three different sources. First, there's sound designed to be played through the computer's sound system. Second, higher-quality sound can be reproduced with plug-in sound cards, either as digital audio, or using the onboard synthesizer. Finally, some programs offer 16-bit Red Book audio that plays directly from the audio outputs of the CD-ROM drive.

To address the requirements of the latter two forms of audio, many companies now offer monitor speakers to place on either side of the computer monitor: small, powered, magnetically shielded speakers designed to reproduce computer and multimedia sound. But as an EM reader, you probably already own monitors in your home studio, a hi-fi in the living room, a car stereo in your Saturn, and a boom box or two. Must you run right out and buy yet *another* pair of loudspeakers?

There's nothing particularly magical about speakers designed (or at least labeled) for use in a multimedia setup. Nevertheless, ideal computer speakers should include a few specialized features. They should be magnetically shielded, like audio-for-video home-theater speakers, to prevent image distortion on the nearby video monitor (caused by the speaker drivers' magnetic influence). They must be small, so they can fit on the desk and form a reasonable near-field array (two to three feet apart). Finally, they should employ an active design with audio power amplification built in, so that an additional component isn't required.

That's the ideal, but the realities may differ. Many of the computer-audio monitors on the market are repackaged mini-monitors designed for semi-portable use, without much in the way of special "computer" features, save perhaps magnetic shielding. They range in quality from pretty good to quite poor, and the real cheapies (under $100/pair) aren't really up to snuff for anything but the most casual use. Even the higher-priced items are usually limited in bass response due to size and cost restrictions.

For those to whom audio is critically important, conventional monitor speakers from outside the computer/multimedia world are the best bet in terms of performance and value. This also applies to those involved in multimedia

production, where critical monitoring is as important as it is in any recording studio.

COMPUTER SPEAKER MANUFACTURERS

Acoustic Research
tel. (617) 821-2300
fax (617) 784-4102

Altec Lansing Multimedia
tel. (800) 258-3288
or (717) 296-2818
fax (717) 296-1222

Apple Computer
tel. (800) 776-2333
or (408) 996-1010
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Atlantic Technology
tel. (617) 762-6300
fax (617) 762-6868

Bose
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fax (508) 872-6541

Boston Acoustics
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fax (508) 429-3699

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Philips
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or (310) 217-1300
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CHOICES, CHOICES

A good pair of pro-style near-field monitors designed for console-top placement are an obvious solution, although usually an expensive and somewhat bulky one. However, several super-compact, consumer hi-fi speakers (such as those from Boston Acoustics, Cambridge SoundWorks, Celestion, and Rock Solid) can offer equal quality and are usually better values. Many models from both the pro and hi-fi genres are already magnetically shielded, thanks to the ubiquitous demand for A/V-ready gear. Even many unshielded compact speakers (those with 6-inch woofers and smaller) present no magnetic problem when located at least eighteen inches from the video monitor.

Several music-equipment companies, including Roland, JBL, and Yamaha, offer powered mini-monitors. A few hi-fi makers also offer powered, shielded mini-monitors that fit the bill unusually well. The Powered Partner line from Acoustic Research, with several models of increasing size, is one example; Koss offers a similar line.

Bose's RoomMate Computer Monitor ($339/pr.) is essentially a white version of its widely popular RoomMate II powered mini-speaker, offering another compact (6 × 6 × 9 inches), inexpensive, yet generally good performer. The sole control is a single volume knob on one speaker (which controls both speakers), and the system is packed with various adaptors for easy hookup. However, there's only a single, non-mixing input. Accessories for wall, table, or stand-mounting are inexpensive options.

To enhance the bass output, add a small, powered subwoofer to one of these systems. (The subwoofer could be passive if you have a surplus of amplifiers lying around.) Many of the previously mentioned companies offer a matching subwoofer that fits easily under a desk. Chosen carefully, the whole system should cost well under $750. As a side benefit, it can double as a surprisingly capable hi-fi system for rocking out during the occasional mono-media all-nighter required to clear away more mundane work.

COMPUTER CHOICES

In spite of my previous warnings, dedicated computer audio monitors from several well-known manufacturers are appearing in ever-greater numbers, with more options, higher performance, and better values. Even Peavey is getting into the act; they recently inked a deal with Dell Computer to provide speakers for Dell's upcoming multimedia PCs.

A few of the dedicated computer speakers distinguish themselves from the pack with specialized features. Altec Lansing Multimedia offers what is surely the most innovative computer audio monitor available. The ACS300 computer speaker system ($450; see **Fig. 1**) combines a miniature active subwoofer (two 4-inch, long-throw drivers) with two unusual, powered, shielded satellite speakers ($300/pair for the ACS200 satellites alone). These are 2-way speakers (4-inch woofers and ½-inch, dome tweeters) in a unique, clamshell arrangement in which the tweeter pod can fold up or down, creating arrays suitable for wall, tabletop, or monitor-side mounting.

The ACS300's controls are divided among the two satellites. The unique "DSP" knob adds synthesized stereo ambience, derived from onboard digital signal processing, to liven up dull, monaural sound from the computer or CD-ROM. Two mini-stereo inputs mix automatically, accepting simultaneous input from a computer or sound card and a CD-ROM (or any other) source; a mix control on the right speaker manages their relative levels.

The full-blown Altec setup sounds remarkably good. The low end is solid to about 50 Hz, and the arrangement plays surprisingly loud and clean, with a reasonably open and articulate balance. A junior system, the ACS100 ($180/pair; 3-inch 2-way) is a smaller, clamshell-design, powered satellite design. The ACS150 ($150) is a separate subwoofer usable with the ACS100s or any self-powered speaker system.

Apple Computer recently joined the audio monitor fray. The AppleDesign Powered Speakers are active minis optimized specifically for listeners seated up close. The effect is achieved with controlled dispersion and the principles of near-field acoustics, according to the company's literature. At $179/pair, they seem very much in step with Apple's new-found Grail of price-competitiveness.

The Apple speakers include a built-in noise-reduction scheme to enhance the clarity of potentially grungy computer

FIG. 2: Apple's new AudioVision 14 display puts high-quality speakers directly into the computer monitor.

sound, an active EQ, and a tuned-port enclosure for low-end extension and efficiency. (The AppleDesigns are said to be capable of 90 dB SPL at 90 Hz at a distance of half a meter.) The shielded, tabletop layout provides two mixing inputs for audio from both a Mac (or another computer, of course) and a CD-ROM drive, with volume and balance controls on the left speaker. There's also a thoughtful headphone jack that mutes the speakers when connected for private listening so you don't have to repatch your setup.

Apple's new AudioVision 14 display (see Fig. 2) takes the next logical step by incorporating high-quality stereo speakers into the computer monitor itself. The display also includes a built-in mic, volume controls, and stereo audio input and output jacks. Proton and Philips also offer displays for PCs with built-in speakers.

Many other companies market powered, shielded mini-monitors to the computer world; many are relabeled OEM jobs produced by large Asian firms, originally as Walkman portable and video add-on speakers. Sony, Panasonic, Toshiba, and a host of others also make models along these lines, many of which are quite suitable and affordable. And don't eliminate 3-piece, fully powered systems from the hi-fi sphere: Consider the Atlantic Technology Pattern and Bose Acoustimass systems, to name just two suitably shielded possibilities. In fact, the Atlantic Technology Pattern has three self-mixing stereo inputs, perfect for computer, CD-ROM, and MIDI-module audio outputs.

However you slice it, computer-based sound is finally seeing its day in the sun. And with CD-ROM-based educational and game programs increasingly using high-quality audio, it's about time. Don't neglect sound at your personal multimedia workstation; it's a big part of the multimedia equation.

Daniel Kumin *writes about musical instruments, audio, and video (and pretty much anything else, for a buck) for more than a dozen national magazines.*

Questions & Answers

By Alan Gary Campbell

The professor lectures about accelerating MIDI, correct soldering technique, and the color of noise.

Q. Is there a straightforward way to speed up MIDI by increasing the clock rate of the system? In other words, could you change a crystal, capacitor, or IC for a speed-up mod, as is done with PCs?

A. Unlike some PCs, microcomputer-based musical instruments and effects are generally designed to work at only one clock frequency. Changing the frequency would wreak havoc with system timing, propagation delays, etc., and probably greatly exceed the design limits of the system components. Excess RFI might also be generated.

Moreover, some instrument designs incorporate local MIDI clock sources that are independent of the system clock and would not be affected (except by incorrect operation). A local clock might be altered, but such modification is not trivial. Typical MIDI circuit components, as commonly implemented, are not capable of significantly higher baud rates. In addition, a faster MIDI baud rate would necessitate comparatively shorter cable runs and lower-capacitance, better-shielded (read: more expensive) cable. Even with upgraded cables, the radiated energy might be troublesome, especially at connectors.

Assuming that all these problems were solved, the problem of inter-equipment compatibility remains. Achieving higher MIDI rates via modifications is questionable at best. Fortunately, future MIDI implementations that incorporate faster speeds are likely to be downward-compatible.

Q. In school I was taught "heat the work, not the solder," but the senior tech at my job always adds solder before making a joint. Will this result in a cold joint? Should the tip have solder on it when idling?

A. Unfortunately, many soldering courses are unclear (or uninformed) on these fundamentals. Solder should remain on the tip, when the iron is idling, to prevent the accumulation of oxidation products and maximize tip life. The solder should be wiped away on the cleaning sponge prior to making a joint and a minute amount of fresh solder added to facilitate adequate heat-conduction from the tip to the work. It is not necessary to add so much solder that the quality of the joint is compromised by premature flux activation.

As soon as soldering temperature is reached, apply solder to the work smoothly and quickly, just enough to provide a satisfactory joint. For small joints (PC pads, etc.), the whole process, from initial tip-to-work contact to completion, should transpire in about the time it takes to say "solder."

When the joint, or series of joints, is finished (or when the tip shows signs of accumulated residue), the tip should be wiped on the sponge, coated with a quantity of fresh solder to aid in cleaning, and wiped again. Never return the iron to the holder with "joint junk" on the tip; always clean the tip and apply fresh solder. Note that the cleaning sponge should be damp, never wet.

Of course, the above discussion applies to soldering standard, not surface-mount, components. It can be argued that the procedure wastes solder, but it saves tips, joints, and customers.

Caution: Solder fumes are hazardous. Adequate ventilation should be maintained in the work area, and any technician who works with solder should wear an appropriate respirator (3M type 9970L or equivalent). Contact with mucous membranes—eyes, nose, or mouth—or injured skin should be

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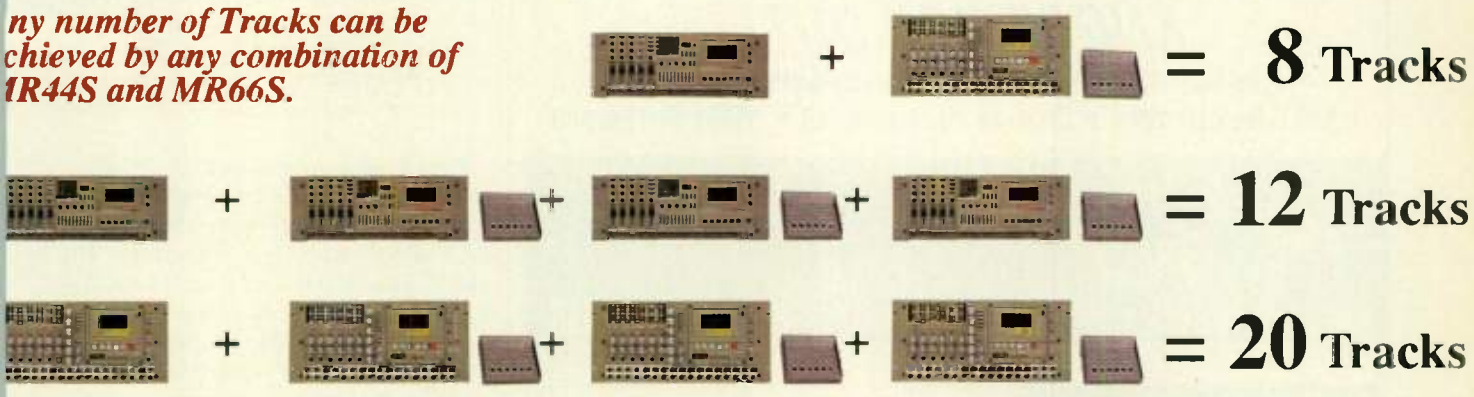

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2860 Cordelia Road, Suite 120
Fairfield, CA 94585
Tel: (707) 427-1920 Fax: (707) 427-2025

avoided. Hands should be washed thoroughly before eating and drinking. Food and drink should not be allowed near the soldering area.

Q. What is the difference between white noise and pink noise? How are they synthesized electronically?

A. In greatly simplified terms, white noise contains equal energy at all frequencies. Sonically, it resembles the static of an FM radio that is set between stations. Mathematically, white noise is a postulated random process where the power spectral density is assumed to be constant. In fact, this is not possible, but many noise sources approximate this behavior over a limited bandwidth. Thus, thermal noise (Johnson noise) and other random processes are often referred to casually as "white noise."

Pink noise contains equal energy in each octave band. (Pink noise energy is inversely related to frequency.) It contains the same energy from 20 to 40 Hz, 220 to 440 Hz, or 10 to 20 kHz. As a result, pink noise has a low-frequency emphasis that makes a characteristic, generally pleasant sound. It is often used for test signals because its spectral balance approximately compensates for the frequency-sensitivity of the human ear.

Analog noise sources generally use a reverse-biased semiconductor junction to generate an approximate white-noise output. Pink noise is derived from white noise via lowpass filtering. Useful, digitally synthesized noise is fairly difficult to obtain, as the distracting cycling thumps produced by the pseudo-random binary sequence (PRBS) generators of some synthesizers attest. (This

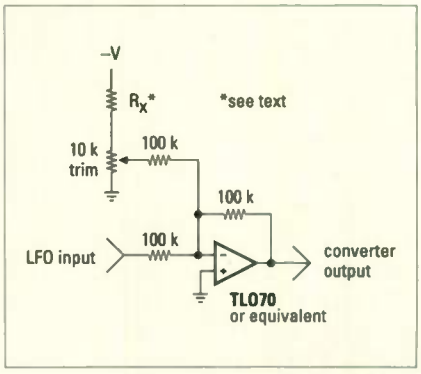

FIG. 1: . A simplified schematic for an LFO-to-CV-pedal input converter, designed for instructional purposes.

Moog Source

effect is clearly audible with the noise generators of many later Moog products, e.g., the Source, Rogue, and Memorymoog.) Wavetable synths circumvent this by simply looping sampled noise.

Q. Is it possible to use an external LFO with the pedal inputs on synthesizers?

A. You can connect an LFO to a pedal input designed to be used with a voltage pedal (not a resistive pedal), but it might not work as you expect.

Most pedal inputs are designed to accept a positive input voltage, commonly with either a 0 to 5V or 0 to 10V range, but most LFO outputs are bipolar. In order to achieve a true LFO effect, you have to add a positive bias voltage, equal to one-half the pedal-input voltage range, to the LFO output to "center" it. Otherwise, the negative-going portion of the LFO waveform would be chopped off. (This is harmless but would cause an odd effect.) Then you need to adjust the oscillator tuning (or filter cutoff, or oscillator pulse width, etc.) to compensate for the added offset.

In practice, the easiest way to do this is to add a negative voltage to the LFO output via a simple op-amp inverting summer, which achieves the same result (see **Fig. 1**). Note that this is a simplified schematic for instructional purposes, not a full-blown, do-it-yourself circuit. It is assumed that anyone who wants to experiment with this sort of thing is able to fill in the details. R1 should be 18 kΩ for a 5-volt pedal input, 4.7 kΩ for a 10-volt input. (This assumes a 15-volt supply.) Resistors should be metal oxide or film, and the trimpot should be cermet.

One significant limitation of this scheme is the reduced frequency response (or scan rate) of many voltage-pedal inputs: 25 Hz or lower.

Q. Why don't you print the names and addresses of readers who submit questions?

A. Names and addresses are omitted primarily to save space. In addition, they are sometimes difficult to credit properly: Some questions derive from phone calls, in-shop conversations, and miscellaneous comments. Some are composites from several inquiries, and some are highly edited adaptations. Also, some readers request that their name and address not be printed, and a few provide no return address.

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

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All combining is done at unity gain, so no level or headroom is lost and no additional noise is introduced. Matching 100mm Remote Fader ($75*) controls master level of all mixers plugged into the MixerMixer (existing master faders become submasters). Comes with its own 6-ft cable and can be bolted to the side of a CR-1604, handheld or attached to any surface. Not shown: The CordPack ($69*) all patch cords needed to combine 3 CR-1604s.

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Instead of cheap, integrated circuits, the CR-1604 has six totally discrete preamplifiers with conjugate pair, large-emitter transistors. The result is ultra-low noise (–129dBm E.I.N. @150 ohms), low distortion (0.005%), astonishing headroom and 300K bandwidth that contributes to the preamps' transparent accuracy. At any gain level, you can handle everything from a close-miked kick drum to a flute with exceptional sonic fidelity and freedom from overload. These preamps have made the CR-1604 legendary among pros who are used to $150,000+ mega consoles. But what if you need more than six mic inputs? Simply add ten more of the same with our XLR10 Mic Preamplifier Expander ($199*). It attaches in minutes to form an integrated, mechanical/electronic whole and includes its own +48V phantom power switch. Plus you can still use the line inputs on Chs. 7-16!

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ROTATE IT • $25

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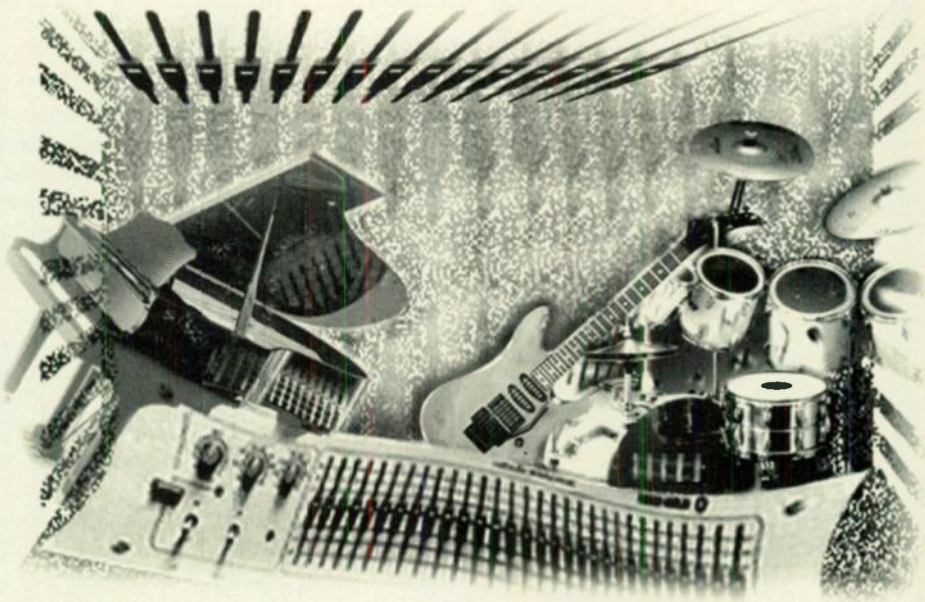
EQ Workshop

By Neal Brighton and Michael Molenda

An education in equalization techniques can help your demos graduate to masters.



DMITRY PANICH

Clarity of concept and crispness of sound are two essential features of professional music productions. Unfortunately, no recording device has a button, knob, or fader that can fine tune creative inspiration. You can, however, take control of a project's tonal clarity with informed and sensitive use of equalization.

Effective musical arranging and EQ manipulation can help kill the cliché that demo tapes are temples of butchered sonics. It doesn't have to be a foregone conclusion that semi-pro equipment delivers muddy bass and audible hiss. Equalization can spruce up demo tracks until they sound almost as sharp and punchy as anything broadcast on MTV or the radio. But the trick is knowing when and how to use EQ, and when to leave things alone.

TAKING TONAL CONTROL

Every time you touch an EQ knob, you add some degree of noise to the source signal. If you want clean, transparent sounds, judicious use of EQ is critical. This doesn't mean that EQ should be a sonic last resort, only that some forethought is required to make the most of your tonal tweaks.

Perhaps the most critical factor in optimum tonal processing is the quality of your mixer EQ. Here's a simple rule-of-thumb: If you don't like how it sounds, don't use it. Try switching microphone positions, or programming your keyboards to produce better source signals. If these aren't viable alternatives, you can avoid the sonic compromises of poor-sounding EQ by employing subtractive equalization. For example, when you want a brighter sound, don't crank up the highs. Often all you'll get is less-than-sterling high end and audible hiss. It's better to sharpen a signal by cutting (diminishing) low frequencies.

Another important step toward producing crystalline sonics is to never EQ a sound twice. Many engineers fuss over EQ settings during recording and then re-EQ the same sounds at the final mix. This double processing increases the chances of adding hiss, distortion, and other sonic anomalies to the source signal. It's also unnecessary. Proper instrument miking and programming should deliver good basic signals. (Sometimes it's necessary to cut low-end rumbles from vocal and ambient mics, but only extreme situations should require *boosting* frequencies.) Until you've recorded all the tracks for a project, you can't possibly be certain where specific instruments should reside in the overall sonic environment. You'll produce sharper mixes by recording instruments flat (*sans* EQ) and saving your tonal decisions for the final mixdown.

It also helps to know where instruments sit in the audio spectrum, so you're not processing frequencies that have a limited effect on the source signal (see **Fig. 1**). For example, most vocalists top out at 10 kHz, so boosting 15 kHz on a lead vocal will probably add more hiss than tonal highlights.

A final warning: Watch out for overdriven gain structures. Most mixer EQ is active, so tonal boosts add some degree of gain to a signal, and cutting frequencies can diminish signal levels. Usually, overdriven signals are clearly manifested by pops, crackles, and other strange noises. Lowering the input signal level often corrects the problem. This adjustment can be made via the instrument's volume control, or by turning down the mic/line level pot on the mixer's input channel.

Sometimes, however, EQ distortion

Mid-level, professional consoles often combine fixed-frequency controls with parametric EQ. (Parametric equalization allows you to select a center frequency, from which you can add or subtract gain.) For example, Soundcraft's Spirit Auto console offers four bands of EQ: two bands with fixed-frequencies and two bands with sweepable mids.

is more subtle. A slight harshness in the high-end may be the only evidence of an overdriven signal. Critical listening and comprehensive knowledge of your mixer's gain stages are the best defenses against these "hidden" EQ anomalies.

SPECIFIC TREATMENT

Guidelines for the tonal processing of specific instruments is dangerous because no instrument exists in a vacuum. I've watched engineers spend hours dialing in a "perfect" guitar tone, then collapse when the sound proved inappropriate for the overall mix. It's critical that mixers constantly reference EQ changes with the total audio spectrum. Also, reference your mix against stylistically similar commercial CDs at low and high volume levels before finalizing your EQ settings.

Use the following EQ parameters as starting points, and don't forget that you're making music, not frequency-range charts. We've structured these EQ ranges within the boundaries of home and personal project-studio equipment, so do not consider them comprehensive pro-level applications.

Kick drum. If you want a big boom, boost at 100 Hz. Avoid getting so boom-enraptured that you boost the bottom into an indistinct woof. Also, listen for signs of EQ distortion. (You're pushing a lot of air down there!) Accentuate the impact of the beater by boosting anywhere between 4 kHz to 7.5 kHz. You can achieve a modern rock snap by cutting 100 Hz and boosting midrange frequencies so that only the slap of the beater is prominent. Whatever you do, be sure to reference your kick tone with the bass. The tonalities should work together.

Snare. A biting attack can be produced by boosting between 3 kHz and 7.5 kHz. If you want a thinner sound, cut 100 Hz (or the low-mids if your mixer EQ permits), too. Cutting the low-mids *without* boosting between 3 kHz to 7.5 kHz often accentuates snare rattles for a classic rock sound. More robust snares can be produced by boosting in the 200 Hz to 1 kHz range. For more articulation, insert a noise gate into the input module during mixdown, then try to cut out every sound except the actual impact of drum stick to snare.

Toms. An overall boost between 100 and 500 Hz can fatten up tom tracks, but sometimes it's cooler to tweak each drum individually (especially if the drummer's kit is poorly tuned). High-pitched rack toms snap sharper if you cut low mids and boost slightly around 7 kHz. Mid-pitched rack toms should produce a bit more resonance, so try cutting the low mids and leaving the upper mids flat. Floor toms sound big and fat when boosted at 100 Hz, with 5 kHz to 7 kHz boosted slightly for articulation.

Room and overhead mics (drums). Drummers can't seem to get enough cymbals in the mix. Give them a ringing sizzle by boosting 10 kHz and cutting low mids *and* 100 Hz. If they want to hear more robust tones—such as when they're hitting the bell of the ride cymbal—boost between 5 kHz and 7.5 kHz. For room or ambient mics,

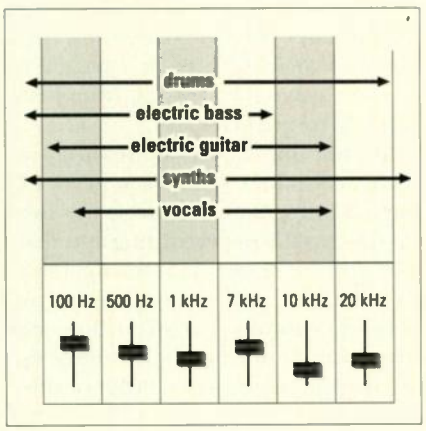


FIG. 1: The practical bandwidth of some common instruments within the audio spectrum.

it's a good idea to diminish possible muddiness (when the room sounds are mixed in with the close-miked sounds) by cutting 100 Hz.

Electric bass. First, think flat. Many basses produce great tone all by themselves, so don't immediately reach for the EQ. If you hear any hiss caused by cheap pickups, poor shielding, or shoddy output electronics, cut 10 kHz drastically. Most basses don't live up there, so a brutal tweak shouldn't compromise overall sound quality. If you want more punch, boost 100 Hz. The funky snap-and-pop usually occurs around 800 Hz to 5 kHz, so boost to taste. Keep in mind that midrange and high-frequency boosts may accentuate finger and fret noises.

Acoustic bass. Good miking (or a fine contact pickup) should give you all the sound you need, but some acoustic basses can produce flabby low end. Tighten it up by cutting 100 Hz slightly. If the performer plays a lot of melodic runs or fast scales, you can improve

▼

A preliminary rough mix can help you determine how much tonal processing is warranted.

articulation by boosting between 800 Hz and 7 kHz.

Electric guitar. Be extremely careful when tweaking electric guitars. Many guitarists use stacks and racks of effects to produce an individual (and hopefully unique) sound, and if you mess with their sonic ideal, you'll be chopped up into doggy dinners. On a practical level, the combination of mixer EQ *and* guitar processor EQ may be too much of a good thing. If you want to risk it, more attack can be produced by boosting between 3 kHz and 7.5 kHz. Also, you don't have to boost frequencies to get ripping tones. Try cutting the low mids to produce sharper attacks. Warmer sounds can be achieved with a slight boost in the 100 Hz to 500 Hz range.

Acoustic guitar. Sometimes an acoustic guitar's wonderful, ringing harmonics can produce muddy tone. A slight cut at 100 Hz often clarifies the sound without compromising the guitar's warmth. REM-inspired jangles can be accentuated by boosting between 4 kHz and 7.5 kHz, and shimmering tones can be achieved by boosting 10 kHz.

Electronic keyboards. If a synthesizer tone is dull, try a different program before boosting the EQ. For example, many synths have multiple versions of the same instrument, so it may be easier—and cleaner—to find a string patch that is brighter than the one currently on tap. If you must resort to EQ, stay away from high-frequencies that add hiss. Usually, cutting the low mids to improve articulation is better than boosting 7 kHz and higher. For stacked and layered synth sounds, muddiness can be avoided by cutting 100 Hz.

Acoustic piano. Solo piano tracks often sound better when left flat. However, if you need to diminish boomy bass caused by imprecise microphone positioning, cut between 100 Hz and 500 Hz. If you want to make a piano pop out of a dense rock mix, cut 100 Hz and boost in the 4 kHz to 7.5 kHz range.

Brass. A saxophone at full wail can be a frightening thing. You can sweeten up individual brass instruments and horn sections by cutting the 1 kHz to 7 kHz range. Not bright enough for you? Add some sizzle by boosting anywhere between 5 kHz and 10 kHz. If you want some warmth, boost the 100 Hz to 400 Hz range. However, when boosting lows and low mids, be careful not to highlight breaths, finger clacks, and bizarre harmonics.

Lead vocal. In a perfect world, the singer and the microphone alone would deliver the goods. But it's not a perfect world, is it? If you need to increase vocal presence, boost the 4 kHz to 7.5 kHz range. Sometimes a minute boost at 10 kHz adds a nice sizzle. To maintain articulation without producing annoying sibilance, route a de-esser through your input send and return. If you compress the vocal—an often-recommended approach—be sure to tweak EQ settings *after* you've finalized the compression parameters. (Compression changes the timbre of the voice.) Diminish boominess by cutting 100 Hz.

Background vocals. Typically, background vocals support the lead vocal, so make sure that the EQ ranges of the tracks don't interfere. When you start tweaking the background vocals, reference the sound constantly with the final lead vocal tone. Often, cutting 100 Hz to diminish room noises and low-end mud is all you have to do. If more articulation is needed, take the opposite approach from the lead vocal treatment. For example, if the lead vocal is boosted at 7.5 kHz, leave that frequency alone and cut the low mids instead.

The EQ of some cassette ministudios—such as Fostex's X-28H—is limited to two fixed-frequency shelving controls: high (often 10 kHz) and low (often 100 Hz). Basically, this type of EQ allows you to boost or cut a predetermined or "fixed" frequency range.

FINAL TWEAK

State-of-the-art gear doesn't ensure sterling audio productions. Hotshot pros working in expensive facilities often churn out records that sound terrible, while savvy artists can produce brilliant work with basic equipment. It all comes down to ears and inspiration. And it's pretty much the same with equalization; no conjurer's tricks or high-tech tools can promise optimum tonal processing. You just have to listen critically to your tracks and make sure that every sound is clear and distinct. Effective use of EQ will not only help you achieve sonic clarity, it will make your demo tracks sound like polished masters.

Neal Brighton *is currently co-producing (with Jerry Stucker) San Francisco's white soul ramble rouster Patrick Maier for Sound & Vision Productions.*

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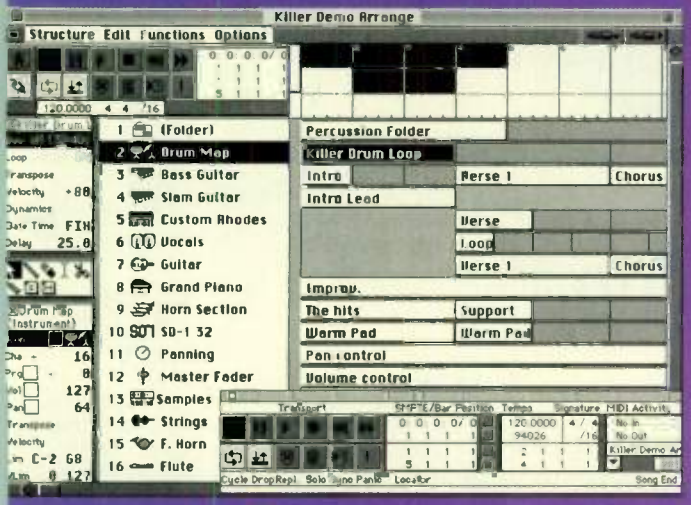

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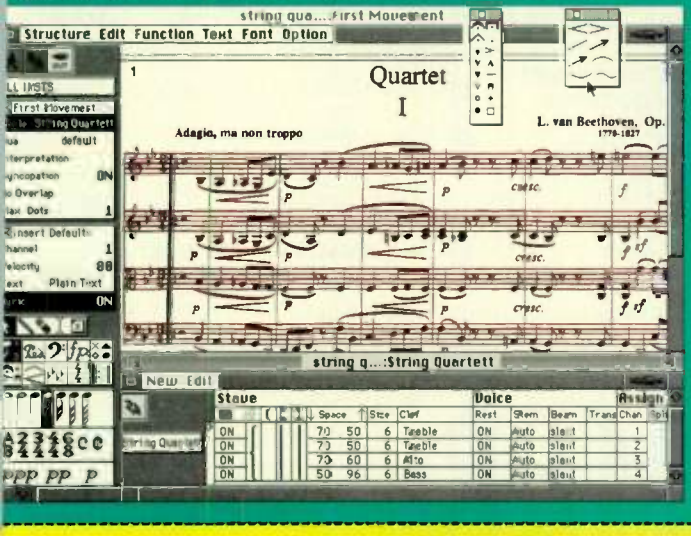

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Collaboration Without Combat

By Michael Molenda

Ever try writing songs in a boxing ring?

The early Who had a double dose of trouble. Drummer Keith Moon was a certified lunatic, and guitarist Pete Townshend and vocalist Roger Daltrey constantly fought—often physically—over musical direction.

He was going to kill me. If it wasn't more interesting to watch a bandmate shotput a guitar across the studio, I'm sure my life would have flashed before my eyes. I tensed for the attack. Fortunately, the martyred ax sated my guitarist's blood lust, and I sustained only a brief salvo of expletives as he stalked out of the building. But the recording session was over.

My big mistake—after watching the studio clock tick away our meager recording budget—was suggesting he stop trying (over and over) to play a solo that was beyond his technical reach. I was tactful and sympathetic, but I was still pinning failure on a man who possessed a fragile ego. The resulting explosion was a prime example of ineffective collaboration.

DYSFUNCTIONAL ALLIANCES

Here's a conundrum for you: You need people to initiate collaboration, but people often make collaboration impossible. The inability to work toward a common goal is especially virulent in artistic communities, where many creative minds suffer from a lack of democratic neurons. Artists can be exquisitely self-centered and unwilling to have their brilliant ideas tainted by collaborative input. (I chuckled when the mob boss in the movie *Reservoir Dogs* growled "It's my way or the highway," because he reminded me of every band leader I've known.)

But the filling of power vacuums is not the only thing threatening creative collaboration. The frail human mind often throws a few psychological wrenches into the works. Creation can be a brutal muse, and some people can't handle the price tag for inspiration. Compound all of this with the fact that collaboration often requires sharing your deepest passions with a committee, and you've got a recipe for mayhem.

The mental pressure of "full creative disclosure" can intensify psychological dysfunctions and can even produce behavioral anomalies. (I've known people who were absolute sweethearts outside of band practice, but once they touched an instrument they became living versions of the *Nightmare on Elm Street* slasher, Freddy Krueger.)

Although I'm not a psychologist, I've played in enough bands to notice that certain personalities *always* spell trouble. The first step toward constructive collaboration is recognizing any qualities in your creative partners that may endanger the project. Whether the talent of a dysfunctional collaborator is transcendent enough to merit tolerance is a personal choice. In any case, forewarned is forearmed. What follows is my personal rogues gallery of dangerous personalities.

The "I am the world" complex. An individual doesn't have to be an established superstar to tote around an ego larger than a brachiosaurus. Legions of ordinary people are often incredibly impressed with themselves, despite the fact they have accomplished absolutely nothing of significance. Go figure. Egotists are frustrating collaborators because they require constant attention, and they seldom listen unless you're praising them. Such one-sided communication inhibits a free-flowing exchange of ideas.

Eggheads. Some people are literal thinkers. This type of mindset can be problematic when dealing with music because creativity doesn't always follow a straight path from A to B. Those who can't deal with the wild ride of conceptual whimsy often subvert creative

collaboration by focusing on structural elements that they *can* understand.

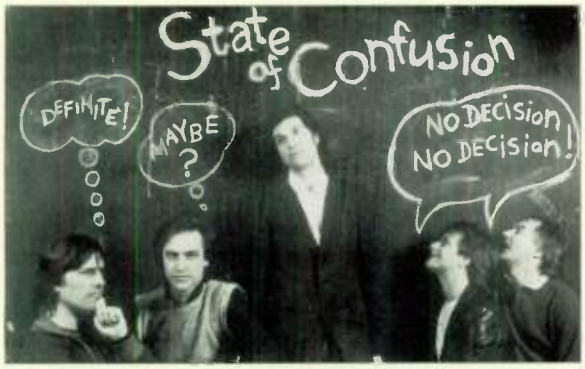
For example, notation is music's universal language. However, music is not merely a collection of notes, chords, and rhythms on a staff; it requires "unnotated" elements such as passion and sensitivity to bring it to life. This is why an old Pablo Casals recording might move you to tears, but the identical piece performed by a younger, more technically adept cellist may not affect you at all. Now, if you handed a literal thinker a score with instructions to play the piece "with an almost unbearable sorrow," he or she would obsess over the rudiments of the song and disregard the work's emotional subtext. For many styles of music, such an approach is tantamount to murder.

Flakes. I've never met a flake who wasn't a nice person. They sincerely apologize when they forget rehearsals. They are sufficiently repentant when their tardiness causes a waiting producer to go ballistic. They're even truly embarrassed when they can't remember songs, lyrics, and chord changes. And when their foibles cause a project to self-destruct, they are usually very, very sorry.

Control Freaks and Musical Popes. Collaboration is a process of give and take. Unfortunately, control freaks don't give up much. In a fierce effort to dominate a creative partnership, the control freak destroys the very essence of collaboration. But don't confuse the control freak with a strong leader. A sensitive creative director always seeks out the best idea because the quality of the work is all that matters. Control freaks, however, often champion the weaker idea simply because it is theirs.

Musical popes don't bother forcing their agendas on others because they practice creative infallibility. However, this pious attitude can be equally frustrating and detrimental to collaborative efforts. If the pope performs a piece in a musically or emotionally inappropriate manner, you're stuck. He or she will never change their part because the musical problem simply cannot be *their* fault.

12-Step Poster Children. Despite the mythology surrounding tortured artists, severe addictions to drugs and/or alcohol seldom open the mind's eye to creative brilliance. The majority of addicts are simply befuddled wrecks. And disregarding your



The Davies brothers (Dave, second from left; Ray, center) have battled throughout the entire history of the Kinks. Ray's perception of the feud inspired the song "Hatred (A Duet)" on the band's recent album, *Phobia*.

personal feelings about chemically controlled lifestyles, let's just deal with logistics. The addict/partner will rarely be where you need them when you need them, or in shape to do what you need them for. You can't collaborate with a ghost.

Love Bugs. If someone in your band is dating (or is married to) someone else in your band, you're courting disaster. I'm sorry, but that's the way it is. It's incredibly difficult to be creatively and personally intimate with the same person. Some people pull it off, and I salute them. Personally, I'd rather not gamble with the two most important things in my life: music and *amour*.

PRODUCTIVITY INSURANCE

Okay, I've identified some potentially dangerous personalities. Now what? I don't recommend the ostrich approach of sticking your head in the sand and hoping the problem goes away. It won't. And, obviously, I *can't* propose the "supreme being" solution, where you simply point your finger and the offending personality traits are vanquished. (And believe me, only the will of the gods can enforce a personality adjustment.) The only viable option is to plan for the inevitable.

Combat-free collaboration is only possible when sticky issues are resolved early in the partnership. Collaborators should acknowledge their goals and needs, cop to their personal quirks, and specify responsibilities and rewards. Put everything on the table. If you can't deal comfortably with business issues, you'll probably experience difficulty collaborating on creative projects. Follow your guts. My rule of thumb is: If you're feel uneasy about something, bail out. My intuition might have cost me some lucrative (music) business prospects, but I also don't have any ulcers. However, if you're loathe to trust premonitions, here are some practical tips for avoiding creative conflicts.

Embrace your dysfunctions. Just admit it. We all possess traits that can sabotage collaboration. (The first part of this column wasn't written so that you could laugh at everyone *else*.) Artists who understand the less-productive aspects of their psyches can compensate for behavioral land mines. Conceding that you're as bonkers as your creative partners increases tolerance levels. The more collaborators

understand each other, the better the chance for success.

Define the project. I don't know why it's so hard for artists to define what they're doing and why. The amount of serious projects that begin without a game plan is staggering. Vague alliances can be big trouble when collaborators discover they're in a project for different reasons.

You can avoid future tensions by having the creative partners approve a simple statement of purpose. Write down the partnership's goals "we're collaborating on a song to be shopped to music publishers"; "we're forming a band to play local clubs"; "we're forming a commercial pop band for the express purpose of seeking a major-label record deal," etc.—and have everyone involved sign the document. This agreement is not a legal contract, just a reality check. A declaration of purpose ensures that everyone knows what is going on from day one. Consider it your first collaboration.

Clarify responsibilities. As equally important as defining a project is deciding who does what. Every project generates tons of practical questions that must be answered to ensure smooth operation. Is there a band leader? Who contacts the music industry? Who books the clubs? Who keeps the books? The list of administrative chores is endless. It's essential that all partners understand what is expected of them. Otherwise, you'll be fighting over who forgot to mail the demo tape to the big-name producer who needed your song for an album project. Believe me, the joy of blaming someone else for screwing up will not ease the pain of a blown opportunity.

Determine the rewards. Sometimes the music industry seems like one big arena full of artists fighting over profit participation. You know the drill: Two people write a song or produce a record, and the project rockets up the charts. The royalties start gushing and suddenly someone isn't getting what they consider a fair share. Shazzam! Say hello to months or years of legal trench warfare. No wonder many musicians and songwriters are petrified of collaboration; they're afraid of being ripped off.

Such fear should be unwarranted. Before you begin your collaboration, write up a simple agreement between the partners tentatively dividing the profit percentages of the work in question. Then, agree that some percent-

The line-up of (left to right) Lindsey Buckingham, Stevie Nicks, Mick Fleetwood, Christine McVie, and John McVie reaped huge commercial rewards for Fleetwood Mac. Unfortunately, an emotional circus of intra-band relationships ultimately poisoned the creative partnership.

Jim Morrison (foreground) was a psychedelic Faust, and alcohol was his Mephistopheles. The charismatic singer, allegedly tormented by his preeminence as a teeny-bopper sex god, drank himself into a bloated travesty of a rock star.

and other business and legal documents. Also, don't forget to determine who owns the store—the master tape, composition copyright, band name, etc.—before signing any pertinent legal agreements.

Count to ten. A veteran record producer once told me that if you lose your temper, you also lose the argument. Basically, he meant that you can't critically assess a situation if you're out of control. In addition, an aggressive posture can make collaborators defensive, and soon everyone is too busy screaming to do any listening.

No matter how much I've wanted to incinerate a pompous ass or garden-variety dumb-dumb, I've learned (the hard way) that a calm demeanor is infinitely more productive than a temper tantrum. Channeling for inspiration—or devising brilliant solutions to creative problems—is difficult when all you want to do is tear someone's head off.

SURVIVOR'S CLUB

Oh, could I tell you some stories! Collaboration tends to bring out the best *and* worst in people. But despite the risks, I truly enjoy working with partners. A wonderful dynamic occurs when the right bunch of people pour their creative juices into a melting pot. Although negotiating the ebb and flow of multiple creative energies can be fatiguing, the results are usually worth the struggle. I'm constantly amazed at how others interpret and enliven my songs far beyond my personal vision.

To me, it's certainly a fair exchange if a few arguments and misunderstandings occur along the way to a brilliant collective effort. Devotion to the project at hand is paramount, and this allegiance is also the final safeguard for effective collaboration. If anyone—or anything—threatens the artistic health of a project, terminate the troublemaker with extreme prejudice. And that's the *only* combat tactic sensible collaborators should initiate.

ages may be amended to more accurately reflect contributions to the final product. This two-step process may seem like one step too many, but it's essential to deal with revenue issues early in the creative process.

When the project is completed, review the agreement and make sure all collaborators confirm and accept their "shares" before filing copyright forms

Reviews

Tascam DA-88 Digital Recorder

By Michael Molenda

A veteran manufacturer puts eight digital tracks on Hi-8.

One hears a lot of sniping in this business. For the most part, it's healthy, competitive bravado on the level of "We have more buttons than you do." But the rumor mill is uncharacteristically vicious regarding Tascam's recently shipped DA-88 and the Alesis ADAT modular digital multitracks. A verbal war zone has erupted where overzealous pros, consumers, and company representatives have savaged both manufacturers' choice of tape format, long-term system viability, error correction, and the right to call their units "professional" quality.

Can we stop now? Both of these machines are brilliant *and* flawed (see "Brave New World" on p. 54). And when I say "flawed," I'm not delivering a backhanded slap to the manufacturers. The DA-88 and the ADAT are the first generation of affordable digital multitrack recorders, an evolving medium that is still in its infancy. Years of field use is required before the industry can accurately assess the viability and reliability of these revolutionary devices. Today, the only sure bet is that Tascam's DA-88 provides tape-based digital recordists the only viable alternative to the Alesis and Fostex versions of the ADAT.

The front panel of the DA-88 is clearly laid out for easy operation, and the rugged transport controls can handle even the most barbaric punch-ins.

THE BASICS

Right off the bat, the DA-88 marches to a different drummer. Tascam chose the compact, Hi-8 mm tape format as the data engine for its modular 8-track recorder. The rotary, 4-head, helical scan transport runs at 16 mm per second (ten percent faster than an 8 mm camcorder) and records 108 minutes of digital audio onto a 120-minute tape. And the DA-88 is extremely picky about what is inserted into its tape loader. It ejects any tape that isn't Hi-8 or is longer than 120 minutes. Even old Hi-8 camcorder tapes are snubbed; once video data is recorded onto a tape, the tape cannot be formatted to record digital audio.

The DA-88 offers two sample rates—44.1 kHz and 48 kHz—and one frequency must be selected before formatting a tape. Once you've selected a sample rate and initiated formatting, you're committed; the rate cannot be changed unless you stop the procedure, rewind the tape, and start over. I recommend tracking at the increased resolution of 48 kHz, because you can always mix to DAT at 44.1 kHz for CD production.

A positively righteous trick the DA-88 allows is the ability to delay playback of individual tracks. In addition to the obvious phase-alignment applications, this means you can move snare hits a little behind the beat, or even "fix" vocal doubles to more precisely match the original lead track. A maximum delay of 7,200 samples is possible, which translates to a delay of 163 milliseconds at 44.1 kHz and 150

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"I can now hear and identify tones and the key in which a song is played just by hearing it. My sight reading has improved. I can also recall and sing individual tones at will. My music teacher and classmates are amazed at my advancement!

"Perfect Pitch is like learning a foreign language. Before, things don't make sense, and then things become more and more clear as you progress. It's not just the memorization of a pitch. The pitch colors of the tones have a subtle feeling; every pitch is distinct and has its own 'personality.'

"When I hear music now it has much more definition, form and substance. I don't just passively listen to music anymore, but actively listen to detail. With Perfect Pitch I can make up my own mind about what and how I feel when I hear music, and also know why I feel that way." *M.U., bass*

"I wish I could have had this 30 years ago!" *R.B., voice*

"It feels like I'm singing and playing 'my' notes instead of 'somebody else's' notes—like music is more 'my own.' Improved delivery because of being able to make more natural music." *L.H., voice/guitar*

"In three short weeks I've noticed a vast difference in my listening skills." *T.E., guitar*

"Someone played a D major chord and I recognized it straight away.

"I enjoy listening and playing more and I get new musical ideas as a result." *S.C., bass*

"After just a few minutes of your instructions, I could locate an F♯ by ear—even when it was hidden in a group of several tones!" *G.B., synthesizer*

"You can imagine my joy when I listened to your tapes for the first time, went to the piano, and make the startling discovery of Perfect Pitch! I started crying and laughing all at the same time." *J.S., educator*

"I never before thought it was possible to obtain Perfect Pitch, but now I know it is." *T.S., piano*

"The information I received was worth more to me than most of the instruction I had received up to that point. Everyone who plays must know about this." *J.T., guitar*

"Wow! What an amazing thing! It really worked. I couldn't be happier. I started last Halloween and can now distinguish all the notes on my piano.

Mr. Burge, I am grateful for what you have given me—I feel like a new musician. Since I am a drummer, I am very proud that I could achieve something of this caliber. I feel as if I have a leg up on those who I will be competing with in college." *J.M., percussion*

"It's like hearing in a whole new dimension." *L.S., guitar*

"I'm able to play things I hear in my head a lot faster than ever before. Before I started the course, I could barely do it." *J.W., keyboards*

"It's so simple it's ridiculous. *M.P., guitar*

"I can listen to a song and still hear it hours later in my mind." *D.O., guitar*

"Mr. Burge has given me the key to what I once considered a closed door." *D.H., Ph.D., voice/piano professor*

"I believe! It works just because it's so simple." *S.P., sax*

"Perfect Pitch is an invaluable asset in my musical career. I feel if every musician could hear as I do, they would realize how useful it is and how delightful." *H.M., voice*

"It brings mu root of their *R.C., piano*

"When I heard the first tape I could hear the pitch color differences Mr. Burge described. At first I thought it might be my synthesizer, so I tried other synthesizers. I could still hear the differences.

"Now I listen more carefully to the sounds of the notes and how they blend together. While working on a piece I was writing, all of a sudden I heard the pitch color of each note. I revised the piece immediately. I'm much happier with it now." *W.H.P., synthesizer*

"It's hard to describe. It's like hearing more of the piece or the different feelings evoked because of the key it's played in.

"I can listen to myself better and hear what I'm doing, allowing me to express myself better.

"It's amazing how easy and simple Perfect Pitch is. After understanding it, it was like the pitches were at the 'tip of my ear.'" *C.L., piano*

"All music listening is improved quite markedly on the level of happiness, as you pointed out on one of the tapes." *S.H., jazz guitar*

"Never again will I listen to music as before. My playing has improved and I am able to easily transcribe note-for-note many Eric Clapton songs I had wanted to for so long." *H.K. guitar*

"The life and breath of feeling part of what we play can be more fully experienced through this knowledge of Perfect Pitch." *D.S., piano*

"I hear a song on the radio and I know what they're doing without my bass guitar.

"My improvisations have improved. I feel more in control of what I'm doing." *I.F.B., Costa Rica*

"It all boils down to taking the time to listen." *M.B. piano*

"This is absolutely what I have been searching for." *D.F., piano*

"Mr. Burge—you have changed my life!" *T.B. guitar*

"I am convinced that a finely tuned ear is the greatest gift that I could ever give my students." *J.F., music teacher*

"This course could replace, or at the very least, cut in half the time lavished on seemingly obsolete ear-training courses currently taught." *M.S., music teacher*

"It's strange how some things that seem so hard are so simple." *D.W., flute*

I used to sleep in instead of practicing in the morning, but since starting your course I haven't skipped one day. My improvisations have improved." *M.S., piano/synthesizer*

"Perfect Pitch for a musician is more valuable than gold." *E.V. guitar*

"Although I was at first skeptical, I am now awed." *R.H., sax*

"I can't understand why it's remained a secret for so long." *B.T., music student*

"A few days after starting the course the music did seem more colorful and vibrant." *J.P., Australia*

have already acquired abilities I never eamed of having 2 years ago, as well as an erall zest for music. You've really made a fference in my life." *M.G., piano, Germany*

"Last Tuesday night in rehearsal I was listening to the soloist play and I recognized F♯. I was so excited that I nearly jumped up and down. The

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milliseconds at 48 kHz. The DA-88 displays the delay time in samples only—a specification that is practically useless to math idiots such as myself—but the optional RC-848 remote controller ($1,499) allows you to choose between sample and millisecond designations.

As with the ADAT, sixteen DA-88's can be synched together for a total of 128 tracks. One Tascam PW-88S sync cable ($85) between each machine is all it takes for sample-accurate synchronization (see Fig. 1). *Warning:* Although this cable has a conventional, 15-pin D-sub connector, using a standard computer cable can damage the machine. Play it safe and buy the optional Tascam cable. (However, *Mix* magazine bad boy and technical whiz George Petersen discovered that you can buy a less-expensive, generic cable and simply remove pins 12 and 13.)

Analog-to-digital conversion is handled by a high-quality, 16-bit, 64× oversampling Crystal 5339. The digital-to-analog converter is an equally classy, 18-bit, 16× oversampling Analog Devices DA-1865N. If the sound isn't to your liking, the DA-88 employs an open, modular architecture that may entice third-party manufacturers to develop customized ADC and DAC cards.

UP FRONT

The front panel of the DA-88 is laid out for quick and easy operation. The transport controls are big enough to accommodate stubby fingers and clumsy engineers and tough enough to withstand whiplash punch-ins. However, I am somewhat concerned that you only have to hit the Record button (during play) to start recording. A typical safety feature of most recorders—including other Tascam decks—requires the user to push Record and Play simultaneously to enter Record mode. To avoid tragedy, I recommend that you leave the record functions unarmed until you're ready to track. All it takes is one tired engineer bumping against the Record button to undo a hard night's work.

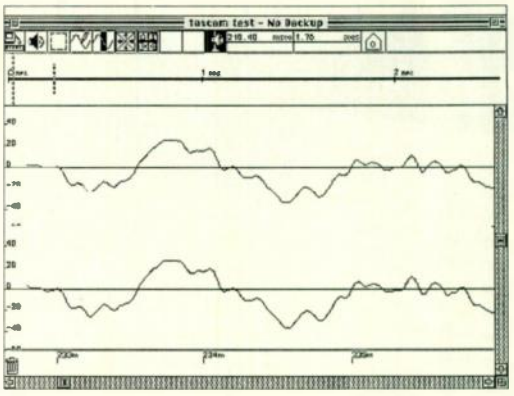


FIG. 1: To test multimachine synchronization, a mono signal was recorded simultaneously onto two DA-88s. The audio burst was then analyzed through a Digidesign Sound Tools system, which confirmed that playback sync is sample-accurate.

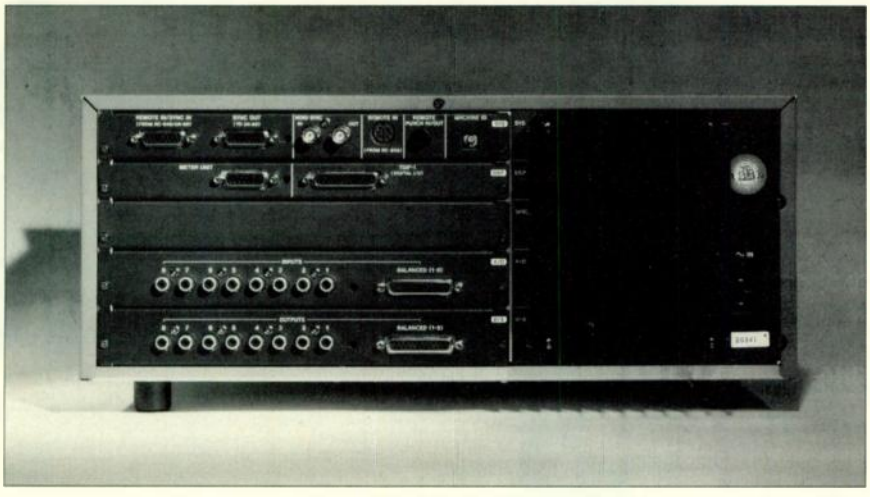
The remaining function switches are small, but they are clearly labeled, and enough space is provided between them to ward off "misfires." (Oops, I meant to hit the Loc 1 key, not Memo 1!) Two memory locations are offered for autolocate functions, a number that some users decry as miserly. Now, multiple locate points are certainly handy, but I don't think two cue points is an abomination. Typical overdub sessions tend to concentrate on one song section until the overdub is mastered. Few musicians can blow through, say, six choruses worth of background vocals in rapid succession, so it's often necessary to store only the start of the song and the current overdub location. When you move to another song section, what's the big deal about overwriting the previous memory location? Tascam makes location updating easy with the touch of a Memo button.

Besides, let's get real here. Remember how much this digital marvel costs? If Tascam shaved a few bucks off the memory features to make a price point, or shored up the ADC, DAC, and transport, then I say "no foul." If you crave abundant locate points, the RC-848 stores up to 99 cues.

Other functions include a display switch, increment and decrement keys, input monitor switches, and punch-in controls such as Rehearsal, Auto In/Out, Repeat, and Clear. There are also front-panel switches for power; tape eject; sample-rate selection; formatting; chase lock (which locks together multiple machines); clock sync (which selects the clock source); timecode generate and record (which require the optional SY-88 sync card); varispeed (±6%); digital/analog input selection; and remote enable. Signal-level status is reported via eight 15-segment, LED peak meters.

One of the DA-88's hipper functions is its shuttle knob, which allows precise cueing of audio material. (The jog/shuttle feature on professional VCRs allows editors to pinpoint video frames.) Unfortunately, the audio is smeared in Shuttle mode, making it difficult to hear a kick drum or snare hit amidst the garble of the track. It's practically impossible to shuttle for surgical insert edits, as you can with an analog reel-to-reel deck.

However, the shuttle does allow accurate cueing to the beginning of songs, a substantial help when mixing. I was able to shuttle past pre-song garbage, such as count-ins, and start the tape



PETER DIGGS

All rear-panel connections are accessible and labeled to make faulty connections nearly impossible. The DA-88's modular construction awaits installation of Tascam's optional SY-88 sync board and could accommodate third-party cards.

right on the music. Such cueing accuracy is difficult with conventional DAT transports. (Usually only luck provides you with a clean, "on the money" starting point.)

OUT BACK

The DA-88's rear panel is cleanly arranged and clearly labeled. For example, the 15-pin, D-sub sync connections are marked "Remote In/Sync In (From RC-848/DA-88)" and "Sync Out (To DA-88)." If you manage to improperly connect cables with such specific instructions, you'll be banished to the House of Shame.

Additional rear-panel features include Word Sync In and Out; an 8-pin DIN, Remote In jack for the optional RC-808 basic transport controller ($175); a ¼-inch, remote punch-in jack (the footswitch is optional); a machine ID selector (the identification of master and slave decks in a multiple unit system must be done manually); and the connection for the optional MU-8824 24-track meter bridge (price unavailable at press time).

Digital I/O is offered via a proprietary Tascam digital interface (TDIF-1) that utilizes a bidirectional, 25-pin D-sub port. For analog I/O, unbalanced RCA jacks handle -10 dBV levels, while balanced, +4 dBm levels are routed through a 25-pin, D-sub connector.

A blank card space is available for Tascam's optional SY-88 plug-in SMPTE card ($799). This synchronization board—which was still being beta tested at press time—chase-locks to video and adds the capability to support MIDI Machine Control.

Product Summary

PRODUCT:
DA-88 modular digital multitrack recorder

PRICE:
$4,499

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

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

INNER PEACE

Tascam is no slouch when it comes to durability, and the DA-88 is built like a tank. There's enough copper shielding to start your own penny mint, and I don't know if an RF wave exists that could break through the heavy sheets protecting the unit's motherboard, sides, and bottom. The massive transformer and heat sinks look as if they could power your entire studio, if not your whole house. Unfortunately, the cooling fan is positioned so it can suck dust right across the unsealed transport and head assembly. (I watched it happen.) It's a good thing the transport is top-mounted for easy cleaning and maintenance.

The only other places that the characteristic Tascam ruggedness is compromised are the RCA connections and, oddly enough, the power switch. The boards connected to the RCA input and output jacks are configured in reverse order to the rear-panel jacks, so the internal wiring is criss-crossed to route the signals to their proper destinations. I doubt this bizarre wiring

scheme compromises sonic quality, but I'm a bit of a neat freak regarding system designs.

I also discovered that the actual power switch is placed at the rear of the unit. A long, plastic extension rod connects the front-panel power button to the "real" on/off switch. My Roland SDE-3000 digital-delay processor employed this design, and I've accidentally broken that rod more times than I like to admit. Be gentle when powering the DA-88 up and down.

SOUND QUALITY

Tascam's DA-30 DAT machine is one of my favorite digital mixdown decks, so I was confident the DA-88 would deliver great sound. It did. Everything I recorded—from commercial CDs to rock bands to *a capella* vocal groups—was reproduced with pristine and transparent clarity. Using the +4 dBm inputs and outputs produced more robust signals than the -10 dBV I/O, but the difference in discernable audio quality was slight.

I also did multiple submixes through a Trident Model 65 analog mixing console and reached submix number 7 before I heard even minimal audio degradation. It's conceivable that a DA-88 linked to a digital mixer could accept submixes into the double digits without risking sonic quality.

If you're dying to know whether the DA-88 sounds better (or worse) than the ADAT, I'm going to disappoint you: It's too close to call. Both machines produce amazing sonic quality. I can say, however, that the DA-88 seems to

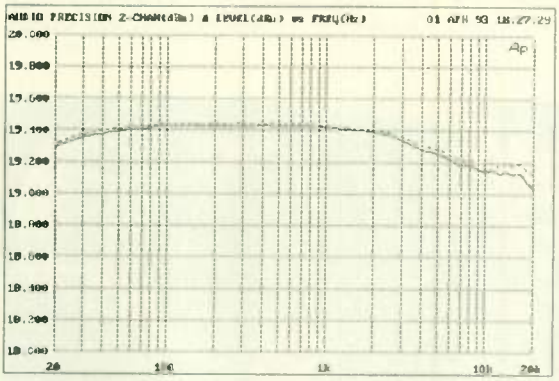


FIG. 2: A frequency-response test found the DA-88 to be flat within ±2 dB across a 20 Hz to 20 kHz audio range.

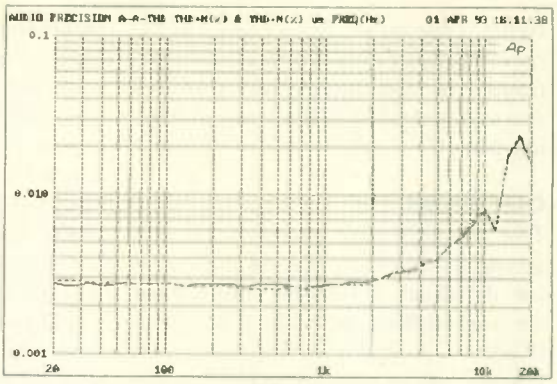


FIG. 3: The DA-88 posted a total harmonic distortion rating of 0.003 percent at 1 kHz.

produce less of the minute high-frequency distortions that often haunt affordable digital multitracks. (These anomalies are explained in greater depth in the "Brave New World" feature referenced earlier.)

To satisfy the tech-spec disciples, the DA-88 was also subjected to a performance test on an Audio Precision System One. (Digital adapters were unavailable, so the test was conducted in the analog realm.) In all cases, the DA-88 exceeded the manufacturer's published specs. Frequency response (**Fig. 2**) was measured flat to ±0.2 dB across a 20 Hz to 20 kHz range. Tascam claimed only a ±0.5 dB spec. Total harmonic distortion (**Fig. 3**) at 1 kHz was far better than the manufacturer's rating of 0.007 percent, posting 0.003 percent on our test equipment.

ERROR CORRECTION

The DA-88 handles the demands of digital multitrack recording by sharing two tracks of data on a single bitstream. Basically, this means that whenever you record on track 2, track 1 is being read into a RAM buffer, and written over onto track 1. Ideally, the re-recorded track 1 should be an uncompromised clone of itself, with any possible signal damage repaired by the DA-88's error-correction facilities.

However, a simple "power out" test by George Petersen, *Mix* associate editor Paul Potyen, and myself produced predictable and repeatable glitches in record-disabled tracks.

We recorded a 10-minute, 5 kHz sine wave at 0 dB onto track 7 of the DA-88 and pulled the plug while recording some music from a popular CD onto track 8. Obviously, track 8 was toast when power was restored and the tape replayed. However, track 7 produced a noticeable "blip" at the exact point where the power was interrupted.

Now, in the real world of music production, you (hopefully) don't stack up sine waves to construct a song, or kick out the power plug in the middle of a take. And depending upon how picky your ears are, the slight glitches we encountered might be inaudible against the fury of a dense music track. However, I believe this crude test speaks to a larger issue than the ramifications of an improbable power blackout: That is, whether the DA-88's error correction can guarantee the safety of all tracks at all times.

CONCLUSION

There is no doubt that the Tascam DA-88 is a rugged, professional-quality unit. I've used Tascam products for years, because the company has always supported the personal recording scene with dependable and affordable equipment.

However, I am very uncomfortable that the DA-88 is track sharing. I want my "safe" tracks to be safe. Years of field use may prove my fears to be unfounded, but until then, I recommend that you protect any irreplaceable performances by backing up data *immediately* after the session. (Of course, regular data backup is wise with any digital medium.)

Does this mean I wouldn't buy a DA-88? Not at all. The DA-88 sounds amazing, is built to last, and offers features (shuttle control, the ability to punch-in tracks "on the fly" with the Rec Function buttons, and so on) that make it a clear choice for professional post-production work.

(Many thanks to George Petersen and Paul Potyen of *Mix* magazine, Neal

Brighton and Buddy Saleman of Sound & Vision, Gary Hall of Sonic Solutions, and Jeff Mock.)

Circle #437 on Reader Service Card

Roland JD-990 Synthesizer Module

By Peter Freeman

A new superhero arrives in Metropolis.

The introduction of Roland's JD-800 synthesizer, with its 57 front-panel sliders, signaled the return of immediate, easy sonic control, a characteristic conspicuously absent from the synths of the mid and late 1980s. Although the unit didn't exactly take over the marketplace, it evidently was successful enough for Roland to produce its successor, the JD-990.

The JD-990 Super JD is a 2U rackmount synth module that has, at its core, the same 24-voice polyphonic sound engine as the JD-800; in fact, you can load JD-800 patches directly into the JD-990.

However, Roland has added features (including some from the company's JV-80 synth, reviewed in the May 1992 **EM**) that were lamentably absent in the JD-800, such as expandable waveform ROM, enhanced multitimbral capabilities (for a start, the JD-990 8-part multitimbral), oscillator sync, panning for each Tone, polyphonic portamento, onboard percussion samples, four more audio outputs, and many convenience features. Because much of the basic architecture was covered in the review of the JD-800 (September 1991 **EM**), I'll focus mostly on the new features.

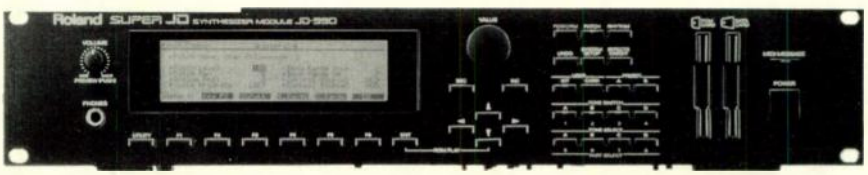
SUPER JD

To my ears, the Super JD sounds even cleaner and more hi-fi than the JD-800; my JD-800 patches somehow sound nicer in the JD-990. As with the JV-80, its factory patches have a decidedly commercial slant, and although many of the acoustic instrument patches aren't precise emulations, they give a fair impression of the sampled instrument. Emulation isn't the point of the JD synths, anyway; their architecture makes them capable of a wide range of creative sounds, from pristine, transparent tones to distorted, noisy washes. The Super JD seems suitable for just about any musical situation.

The JD-990 contains 195 waveforms in 6 MB of ROM, including all 108 JD-800 waveforms. The 87 additional waveforms (many from the JV-80) range from acoustic- and electric-piano samples to abstract loops composed of small fragments of various sounds, endlessly repeating in rhythm.

In addition, the waveform ROM can be expanded by installing any one of the four JV-80 waveform-expansion boards (orchestral, piano, pop, and synth sounds). These boards are easily installed by the user, and each one adds 8 MB of waveforms. The SR-JV80-01 Pop Expansion board, which I had in the review unit, adds another 224 waveforms (for a total of 14 MB) and 145 Patches to the instrument's arsenal. The Pop expansion board provides a large variety of sampled waveforms from sources as diverse as Roland's old GR-300 guitar synth; orchestral string, brass, and wind instruments; turntable scratches; and an array of percussion. As with most such products, the quality of the board's waveforms ranges from mediocre to very good; when viewed as more raw material for synthesis, the extra waveforms are useful indeed.

JD-800/JV-80 waveform and program-data cards can also be used, further increasing the unit's sound



The Roland JD-990 uses an enhanced version of the JD-800 sound engine. Although it can produce mainstream sounds, the JD-990 really earns its sobriquet "Super JD" when used to create unique synth timbres.

storage and access. Roland has located the card slots on the front panel for easy access. Because the JV-80 employs a different architecture, its sounds are automatically translated from the card.

I was a bit disappointed that the JD-990 lacks sample RAM and the ability to receive samples via MIDI Sample Dump Standard (or any other method), making it impossible to include user waveforms in Patches. Along with all the other features included in the instrument, this would have completely justified the "Super" moniker.

SOUND CREATION

Although the JD-990 uses the same basic synth engine as the JD-800, Roland added some nice enhancements. As with the earlier instrument, the basic sound-creation unit is the Tone, which uses one oscillator. Up to four Tones, with independent key ranges, can be combined in a Patch (see **Fig. 1**). But if you use all four Tones, you have only 6-voice polyphony.

Each Tone has a multimode (highpass, lowpass, and bandpass), 24 dB/octave, resonant, time-variant filter (TVF) and a time-variant amplifier (TVA). Dedicated envelope generators and two LFOs modulate the oscillator, TVF, and TVA. The LFOs offer Rate and Delay parameters, plus a Fade parameter that fades the LFO depth in or out over time. The JD-990 also offers oscillator-sync capability (a rare commodity nowadays) and ring modulation. There's a lot more power here than in earlier Roland digital synths; for instance, the filter can be placed before or after the ring modulator, and you can have two filters in series.

Also, you can control which Patch is sounded by notes held during Patch changes. Held notes can either change to the new Patch, or remain on the previous Patch until they are released.

There are other nifty features in the JD-990. Inherited from the JV-80, Analog Feel introduces subtle pitch instability into the selected waveform. Although this effect is subtle, it is an especially welcome addition on a completely digital instrument, making many sounds less tiring on the ears.

A particularly valuable new feature is FXM, which includes Color and Depth parameters. This feature is the closest digital equivalent to the venerable cross-modulation capabilities found on older analog machines, such as the Oberheim OB-X and Sequential Prophet-5. It gives JD-990 waveforms character and potential and really helped me get more sonic mileage out of the instrument.

PERFORMANCE ART

The JD-990 uses a programmable multi-effects processor that has been enhanced since the JD-800. For instance, delay time has been extended from 650 ms to three seconds, and delay can sync to MIDI Clock or tap tempo. The effects can also be controlled in real time via MIDI, a first for Roland synths.

As with the keyboard synth, there are two effects sections. Effects Group A contains a phase shifter; distortion unit; enhancer; and 6-band, fixed-frequency (250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, and 8 kHz), graphic EQ. Group B provides chorus, delay, and reverb. The effects can be routed in different orders, but Group A always feeds Group

B. The effects sound very good, especially the reverb, although the distortion algorithms are a bit thin and metallic for my taste.

An important area in which the JD-990 represents an improvement over the JD-800 is the way effects are handled in its multitimbral Performance mode. The multitimbral capabilities of the JD-800 are limited to six parts, and only one of the unit's two Effects groups (Group B) is accessible during multitimbral operation. This is a major drawback, as Patches that rely on Group A Effects for their sound are pretty much useless in this mode. Furthermore, there are only four outputs (two dry and two wet) on the JD-800, which makes the practical utility of this mode even more limited.

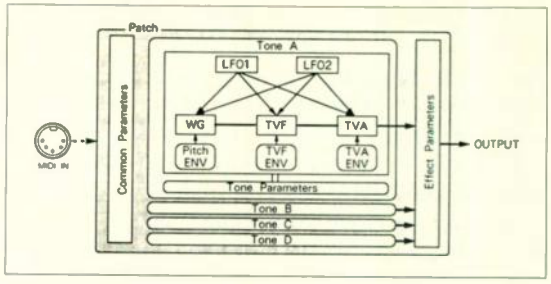


FIG. 1: A Patch comprises four sounds, called "Tones," which contain a 1-oscillator Wave Generator; a resonant, multimode, time-variant filter (TVF), and a time-variant amplifier (TVA). These are modulated by dedicated envelope generators and two LFOs. (Courtesy Roland Corporation US.)

On the JD-990, Performances can contain up to seven Parts, plus one Rhythm set (a set of the unit's onboard drum/percussion sounds, assigned across the keyboard, that uses just one Tone per key). Each Part can have a specific minimum number of voices reserved for it, which is handy for live performance situations; you're unlikely to run out of voices when playing an intricate piano part with your right hand and bass lines with your left. Group A and B Effects can be applied to one Part per Performance (called a Super Synth Part on the JD-990), while the other Parts are processed with Group B Effects (chorus, delay, and reverb) only.

Finally, you can route each Part to the six Direct (dry) outputs and a stereo pair of Mix (wet) outputs. The Mix outputs are processed by a 3-band, master EQ section.

LIFE'S CONVENIENCES

Several new user-interface features make programming the instrument easier and less tedious than previous Roland synths. Although the JD-990 lacks dedicated sliders, its LCD display is large and shows a lot of information at a time. Directly beneath the display are six "soft" function keys (F1 through F6) that correspond to function labels displayed on the LCD, in a manner reminiscent of Roland's S-770 and S-750 samplers. Although they don't provide the same convenience as hardware sliders, these features make the JD-990 quick and simple to use.

Roland took advantage of the Super JD's added LCD real estate to provide a graphic display of the current EQ curve, specified by the settings of the six bands. There are also graphic TVF and TVA envelope displays, which make editing filter and amplifier parameters a lot more intuitive. The waveforms of the LFOs also are displayed graphically, which is convenient.

The Effects On/Off control is implemented in a novel way. Pressing the Effects On/Off button brings up the status of the currently selected group of effects on the LCD (displayed from left to right, in the order they are currently routed), portrayed as a very easy-to-read, graphic "switch." The function keys directly below the LCD act as effects on/off buttons. Very useful.

The JD-800 has a Layer/Active button that determines which of the Tones in a Part will sound and which are editable by the sliders. In the JD-990, this function is served by four Tone (on/off) switches and four Tone Select (edit) switches. This is a vast improvement over the Layer/Active method; the status of all Tones is visible at a glance and can be changed quickly.

Also new on the user-interface front is an Undo button that restores the value of the current parameter to its previous value. This is particularly useful on an instrument of the JD-990's complexity, as the setting of a given parameter can be critical to achieving a particular sonic result. (Have you ever destroyed a near-perfect sound because you just couldn't leave it alone?) All synths and samplers should have this.

Other convenience features include

Preview (a button in the unit's volume control), which triggers predetermined notes on the JD-990, allowing you to audition sounds without a MIDI keyboard. The addition of Increment/Decrement buttons, a Value knob for parameter changes (which scrolls faster if you push it in), and four directional cursor keys for navigating around the LCD fields further facilitate speedy work. An excellent feature lets you edit all four Tones at once, or just one Tone at a time. If you edit all four Tones together, you have the option of maintaining the relative relationships between them. Even the power-up state of the instrument (last settings or default) can be programmed.

MIDI IMPLEMENTATION

The JD-990's comprehensive MIDI implementation includes System Exclusive parameter change via MIDI and Patch load/dump. Three MIDI Registered Parameters are implemented (Pitch Bend Sensitivity, Coarse Tune, and Fine Tune), in addition to Pan, Portamento, Expression, and Bank Select. Five General Purpose controllers are supported: The first four controllers turn Tones on or off in a Patch, while External Effects Depth controls the effects-send level of each Part in Performance mode.

The best news is that if you have a JD-800, you can use its sliders to remotely edit the JD-990's parameters. It would be nice if Roland manufactured a separate programmer for the

Product Summary

PRODUCT:
JD-990 Super JD Synthesizer Module

PRICE:
$2,195

MANUFACTURER:
Roland Corporation US
7200 Dominion Circle
Los Angeles, CA 90040-3696
tel. (213) 685-5141
fax (213) 722-0911

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

JD-990, as they have done in the past with other synths. Of course, you can always edit the synth in an editor/librarian program.

A MIDI monitor screen graphically displays MIDI messages as they are received. The monitor is great for quickly determining what kinds of MIDI data are being received on which channels, a time-saver when troubleshooting. The status of a single MIDI message type can be displayed for each Part in a Performance, using individual bar-graph meters. The messages that can be displayed are Volume, Voice Activity (the number of polyphonic voices currently being used by each Part), Program Change, Pan, Expression, Pitch Bend, Modulation, Aftertouch, Breath Control, and Hold 1.

CONCLUSIONS

The JD-990 is definitely a happening synth. The only problem I encountered was that it occasionally froze on power-up; when I turned it off and on again, it worked fine. Once cooking, it proved user-friendly, versatile, clean, and well-behaved.

▼

The JD-990 seems suitable for any musical situation.

If you liked the JD-800, you'll find more of the same (and then some) in the JD-990; both instruments' real power lies in their programming flexibility. If you're strictly after high-quality acoustic instrument simulations, get a straight-up sample player or sampler. But if you are in the market for a powerful and versatile programmer's synth, the JD-990 may be the answer. Its well-thought-out design and large waveform capacity, coupled with its powerful architecture, make it an instrument to be reckoned with.

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.*

Digidesign Pro Tools 2.0 (Mac)

By Joel Fox

Multitrack hard-disk recording on the Mac matures.

Pro Tools has finally arrived. Although the multichannel, digital-audio recording and editing system for the Macintosh has been available for nearly two years, the software front end was sadly lacking until now. Pro Tools 2.0 is an absolute pleasure, with solid, glitch-free performance and a trunkload of powerful tools for music and audio producers.

The original Pro Tools software was hampered by an interface that forced you to constantly switch between two programs, *Pro Deck* and *Pro Edit*. With Pro Tools 2, everything is controlled from a single application. The result is a remarkable difference in speed and performance. The new version is a fast, convenient tool for any audio recording, editing, or mixing job.

In addition to recording digital audio, Pro Tools supports basic MIDI input and editing. Digital audio and MIDI data can be recorded, graphically displayed, and edited onscreen, with up to 64 virtual audio tracks and 32 MIDI tracks. Even if you only have a 4-channel system (that is, four channels of audio hardware), you can record as many virtual channels as your hard disk can fit and mix them down to the number of audio outputs your system supports. You can also record multiple takes for each track and either keep the best take and archive the rest, or create the ultimate performance by editing the best bits together.

HARDWARE

The Pro Tools hardware consists of one NuBus audio card and one rack-mount Audio Interface for each four channels of audio. The system can be expanded up to sixteen channels with the addition of more Audio Interfaces and audio cards. Digidesign's System Accelerator, a 68020-based, NuBus SCSI card, is also required for anything above four tracks.

The Audio Interface features bal-

anced XLR connectors for four analog inputs and four outputs; AES/EBU digital I/O, with XLR connectors; and S/PDIF digital I/O, with RCA jacks. Under software control, you can route any input to any track, or any track to any output. For example, you could mix four (or more) audio tracks to outputs 1 and 2, while using inputs/outputs 3 and 4 as effect sends/returns. You could also send your final mix to a DAT machine via your digital protocol of choice.

Calibration of each analog I/O channel is accomplished with adjustment screws, which are recessed in the front panel. *Calibration Tool*, a new software application included with 2.0, simplifies the setup procedure. Unlike earlier Digidesign interfaces, there are no other physical controls on the Audio Interface; all setups are controlled from the computer. Front-panel lights indicate output signal level and display the current sample rate and sync source.

A separate, rear-panel BNC connector is available for receiving Digidesign's Superclock, which is necessary for keeping multiple interfaces synchronized to a stable sync source. Another BNC connector passes the clock output so multiple interfaces can be daisy-chained together. The sonic quality of the hardware is excellent.

As with all hard-disk recording systems, you will need the fastest, highest-capacity hard drive you can afford. In addition, you should budget for some type of archival backup system.

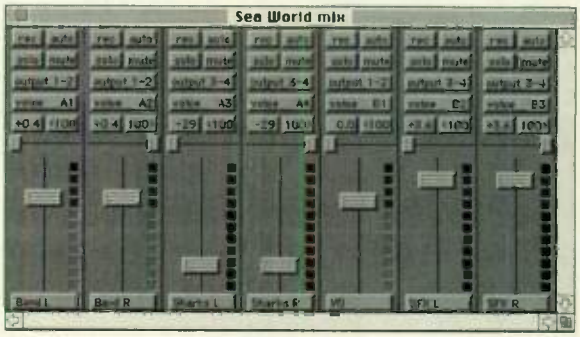


FIG. 1: Digidesign's Pro Tools 2.0 features an integrated recording and editing environment. The Mix window lets you set levels, panning, EQ, and more for each track in a Session.

SOFTWARE

The Pro Tools 2.0 software features three main windows: the Mix window, the Edit window, and the Transport window. The Mix window (see **Fig. 1**) contains a virtual input module for every track you create. Here, you can name and enable recording on the track; view and assign input and output channels; and set levels, panning, and voice assignment (the physical hardware channel through which the track is routed). Next to the fader in every module is a 3-color, simulated LED VU meter that displays the post-fader signal with remarkable animation. Each fader is adjustable with a mouse or outboard controller and can be automated. Mute and solo buttons also appear here, as well as in the Edit window, saving miles of wear and tear on the mouse or trackball.

The Mix window also offers access to the new equalizer built into 2.0. Each track has two EQ modules with five

selectable curves: highpass, high shelf, peak/notch, lowpass, or low shelf. The controls work in real time during playback, and the sound is excellent. Other digital effects available in earlier versions of Pro Tools were dropped in favor of this much-improved EQ section. If you haven't heard good digital equalization, you will be amazed at how much better it can sound than traditional analog EQ.

The Edit window (see Fig. 2) is where your audio production takes shape. The waveform for each audio region and piano roll for each MIDI region are displayed in a scalable time line. You can cut, copy, and paste individual tracks, or groups of tracks (including combinations of MIDI and audio), and drag regions around with the Grabber tool. You can assemble a project quickly, even over multiple tracks, by grabbing predefined regions from the scroll box on the right side of the window.

Four edit modes are available: Shuffle, Slip, Spot, and Grid. In Shuffle mode, the start of each region snaps to the end of the previous one, while in Slip mode, regions can be moved freely. In Spot mode, selecting a region causes a dialog box to appear, allowing you to enter a specific SMPTE time for that region. In Grid mode, regions are automatically aligned to a timing grid, which is user-definable in either musical beat subdivisions, or real time.

After regions are placed, crossfades are easily created between two adjacent regions, or you can use the fantastic new automation feature that appears as volume graph over the grayed-out waveform display (see Fig. 2). You add control points to this line display simply by clicking. These control points can then be positioned for unbelievably precise control of the track's output. Also, you can easily create long, contoured fades, or short, several millisecond-long, steep level dips to keep a transient from being too obtrusive.

This feature is particularly helpful when working with singing or speaking. Instead of, or in addition to, using a compressor/limiter, you can see where the peaks and valleys in the waveform are and "draw" a volume contour over the track that increases clarity without obliterating the nuances of the voice. A similarly functioning pan graph is also available that can be used to create elaborately tailored panning

effects. Most important, this editing is non-destructive. The original recording remains intact on your hard drive unless you deliberately alter it.

The floating Transport window (see **Fig. 3**) functions identically to the controls of a tape recorder. You can use the mouse to operate the onscreen buttons, or use an external unit such as the JLCooper CS-10 for hands-on control. Ten autolocate buttons store and recall cue points that can be dropped in and named during playback or while stopped. (According to Digidesign, the next update will support 100 autolocate points.) You can also edit punch-in/punch-out points here.

PUT TO USE

The software makes this incarnation of Pro Tools a pleasure to use. Previous users of *Sound Designer* will feel at home

▼

The sonic quality of the hardware is excellent.

immediately, and even new users who are familiar with tape recorders, mixing boards, and other traditional gear should find the system fairly intuitive. Simply create a new Session, add an audio track, set the input, select the Record Enable button in either the Track or Edit window, then click Record and Play in the Transport window.

Pro Tools 2.0 supports both destructive and non-destructive recording. In destructive recording, the original pass is erased when a second pass is recorded, much like a tape recorder. In non-destructive mode, the first pass is retained on the hard drive; the second pass replaces playback of the first in the re-recorded area. If you change your mind about the first take, the original track can still be used.

During recording, a vertical line scrolls across the time line, coloring the area of each track that is being recorded. As recording is completed, the waveform (or representation of MIDI data) for each track is displayed on the screen. The speed of the waveform display is dramatically improved from earlier Pro Tools software because it is calculated while recording. You

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RATE THE ARTICLES IN THIS ISSUE! OCTOBER 1993

We want to know what you think of the articles in *Electronic Musician*! Now you can use your reader service card to give us feedback about *EM*'s editorial coverage. We have assigned a rating number to each of the main articles in this issue. Please select a rating for each article and circle the appropriate number on your reader service card:

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can start editing and mixing, or you can continue to build your session by recording further tracks or importing audio or MIDI data from other files.

Each track added in the Mix window can be manipulated in a number of ways. By zooming in on the display with either the Zoomer ("magnifying glass") tool, or the Scale arrows, it's possible to select precise edit points for defining regions. The Trimmer tool allows you to tweak edit points by shrinking or expanding the region's "window" over the underlying waveform or MIDI data. Editing regions in this way causes the program to automatically name and add the new region to the region list on the right of the window. The naming convention adds a bullet symbol (•) to a shortened version of a region, or a plus sign (+) to an extended region. Using either the Nudge command, or the Grabber tool, lets you quickly and accurately position regions in time.

This combination of positioning and trimming material visually is extremely powerful, yet intuitive. Even if you are an old hand at Sound Tools playlist editing, you will probably find graphic assembly much faster (and a lot more fun) in Pro Tools 2.0.

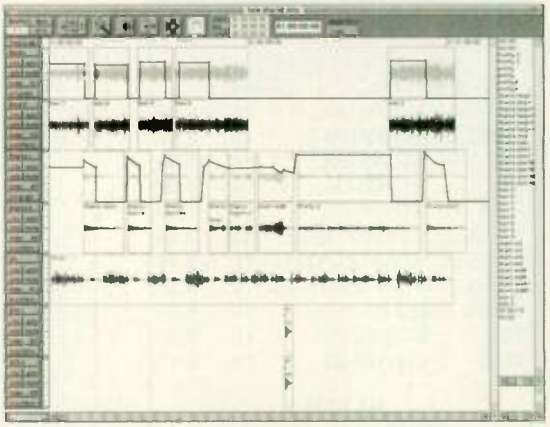

FIG. 2: The heart of Pro Tools 2.0 is the new Edit window, which provides a graphical display of individual tracks and regions. The program's new amplitude envelope feature gives you precise, non-destructive control over each track's level.

MIDI AND SYNC

The MIDI implementation in Pro Tools is satisfactory. It's possible to record, import, edit, and play MIDI data, but editing is limited to simple quantization, transposition, and piano-roll note-editing. Most Pro Tools users will probably prefer to record and edit MIDI in a professional sequencing program, export a Standard MIDI File, and import the SMF into Pro Tools. This lets you edit your audio to the bars and beats, or real time, instead of SMPTE time code.

One of the most important improvements in Pro Tool 2.0 is its synchronization to the rest of the studio. The original Pro Tools suffered from a very slow lockup time (often twenty seconds or more) when used in conjunction with audio and video tape machines. The amount of pre-roll required to get a track to punch into Record at the right time was not acceptable. Now, the situation is much improved: Lockup occurs within a reasonable five to ten seconds, so much less pre-roll is needed before recording.

Most users who are synchronizing Pro Tools to audio and/or video transports will want to consider using either a Digidesign SMPTE Slave Driver or Video Slave Driver, or a TimeLine Micro Lynx synchronizer. Because Pro Tools synchronization no longer chases or "continuously resyncs" to incoming time code (which was never terribly desirable in the first place), it needs a timing reference that will prevent sync from drifting during longer programs. Depending on the user's studio configuration, any of these devices can be used to assure accurate sync, although through different means.

Pro Tools 2.0 now has full support for all flavors of time code, including

DINR IS SERVED

Digidesign Intelligent Noise Reduction (*DINR*) is a new software plug-in module for use with *Sound Designer II* software in Sound Tools II, ProMaster 20, and Pro Tools systems. After a simple installation procedure, two new items appear in the DSP menu: Broadband Noise Reduction and Hum Removal. *DINR* is designed to remove these noises without adversely affecting the content of a recording.

To use *DINR*, you open a sound file in *Sound Designer II* and select a small section (0.1 to 0.5 seconds) of the undesired noise. Next, choose Broadband Noise Reduction and click the Learn button to allow the computer to create a model of the noise, which it will use to separate noise from signal. Click the Fit button to create a Contour Line, which is an envelope with movable breakpoints that allows the user to fine-tune the noise reduction.

Other user parameters are noise-reduction amount (from 0.1 dB to infinite), response and release times, smoothing, and high-shelf EQ. Smoothing helps to reduce the artifacts that can be created by the modeling process, and high shelf either boosts or cuts high frequencies in the signal without boosting the noise.

DINR removes hum in a similar fashion, by first "learning" the noise. It then uses harmonic and/or notch filters that are automatically set to suppress the pitch or pitches present in the noise. The audio processing for both of these functions can take place and be adjusted in real time on playback, or by permanently altering the sound file.

After performing a variety of tests on files that suffered from varying degrees of hiss and hum, we found it's possible to use *DINR* with great success. It's also possible to wreak substantial havoc on the musical content of your recording. Using too much noise reduction can alter the timbre of voices and instruments, or create artifacts that sound like distant wind chimes ringing in the breeze. Warning: Intentional and deliberate misuse of this software can create bizarre and wonderful vocoding effects unlike anything you've ever heard. In general, single instruments can be processed more easily and effectively than full mixes.

Depending on your applications, this software may be worth the investment. At a list price of $1,000 it is clearly not for occasional or casual use. But for those who often encounter noisy recordings and need a repair tool, *DINR* might be the meal, er, tool you need.

29.97 drop or non-drop. No time code is recorded on the hard disk, so synchronization is performed by calculation. If one of the variables is wrong (somebody told you that a tape was 30 fps code, and you believed them), the calculated sync point will be wrong, and synchronization will get progressively worse over time.

FIG. 3: The Transport window allows you to control the system's operation.

Another great new feature in 2.0 is the time-stamping of audio files with their original time-code location whenever a recording is made online. This gives you the opportunity to move a region back to its original location at any time.

Another new feature is improved importing and exporting of sound files and regions from other sessions and files. If you import a stereo *Sound Designer II* file into a Pro Tools session, the program automatically copies it to a pair of mono files for Pro Tools use. For destructive edits not available in Pro Tools, there is a menu selection for opening a selected region in *Sound Designer II*. If *SDII* is on your hard drive, the program launches, the edit can be made, and the changes are reflected on returning to Pro Tools.

Also, hardware setup is now available as a menu item, instead of having to switch to the old *Pro Tools Setup* application. A new application, *Digidesign Audio Engine* (*DAE*), now runs in the background. *DAE* controls the low-level recording and playback hardware. It also allows third-party programs access to Pro Tools' underlying audio technology. *DAE* also paves the way for Digidesign's TDM 256-channel digital audio bus architecture and provides support for plug-in modules such as *DINR* (see sidebar "DINR Is Served").

CONCLUSIONS

I use the system at a busy Chicago music-production company, where we create, record, and mix music, dialog, and effects for TV and radio advertising. As long-time Sound Tools users, we initially purchased an 8-channel Pro Tools system (version 1.12 software) with high expectations. Unfortunately, we were not happy with its performance. Two days after we installed version 2.0 software, however, we used it to produce a radio spot that would have been difficult and tedious, if not impossible, without Pro Tools 2.0.

As happy as I am with the system, however, there are a few omissions that can be aggravating. First, there is no Revert command, and Undo is not available in all situations. If you change a number of things and regret it, you must close the session without saving changes, then reopen it. Second, I'd like to see a shortcut for adding tracks and for setting up a whole group of tracks at once, instead of having to repeatedly select "Add New Track" from the menu.

Also, since the upgrade to version 2.0, launching the program causes the Audio Interfaces to default to a sampling rate of 44.1 kHz, even if they were left at 48 kHz. This is easy to overlook if you're not aware of it, because it didn't happen before, and you gener-

Product Summary

PRODUCT:
Pro Tools 2.02

PRICE:
Basic system $5,995
System Accelerator $2,000
4-channel expansion $4,000

SYSTEM REQUIREMENTS:
NuBus-equipped Mac, 8 MB RAM, System 7.0 or 7.0.1

MANUFACTURER:
Digidesign
1360 Willow Rd.
Menlo Park, CA 94025
tel. (415) 688-0600
fax (415) 327-0777

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

ally don't expect that sort of parameter to change by itself. (How would you like it if your tape recorder changed speeds on you between sessions?)

On the positive side, getting up and running with Pro Tools 2.0 is simplified by an Installer program that places all of the Pro Tools software and system extensions in the appropriate folders. A helpful instructional video is included with the package; I highly recommend it to anyone installing a new system.

Although it took a little longer than we would have liked, Digidesign finally has delivered the product we expected from them, and more. With digital tie-ins to products such as the Lexicon NuVerb board, via the forthcoming TDM bus, we can look forward to the continued evolution of creative tools from Digidesign.

Joel Fox *is a creative member of the production staff at Libman Music in Chicago, purveyors of leading-edge music for radio, television, and film.*

Circle #439 on Reader Service Card

Soundcraft Spirit Folio

By Neal Brighton

This well-appointed mixer gets a grip on live sound.

Spirit Folio, the new compact mixer from Soundcraft, renewed my faith in the truism, "Good things come in small packages." Designed for quick-and-easy live-sound setups, the featherweight (13.2 lbs.) Folio offers simple, accessible I/O and controls and literally can be carried to a gig like a briefcase, with its handy tote handle.

The Folio is constructed with sturdy sheet-metal top and bottom panels, surrounded by a high-impact plastic frame. (The handle, positioned at the top of the mixer, is also made of high-impact plastic.) All of the connectors are solidly mounted on the main surface. The Folio's pots and switches are fairly robust, but the faders exhibited some play.

The external power supply utilizes a well-built transformer with more-than-sufficient output. The connector seems uncharacteristically flimsy, though; I had to keep my eye out for clumsy musicians or other humanoids that might ungracefully remove the power supply from its connection.

A pleasing battleship gray is the main color of the Folio, splashed with subtle reds, yellows, pale blues, blacks, whites, and fuchsias from the color-coded faders, switches, and knobs. The controls are well laid-out, easy to see, and easy to use. If the owner's manual disappeared, you could suss out this board in mere seconds.

I admit that when I first saw it, I thought the handle was goofy. However, the handle proved to be extremely useful both for transporting the mixer and for positioning controls at a convenient angle when the board was placed on a flat surface.

● SPIRIT FOLIO

FOLIO FEATURES

The 10 × 2 tabletop model I reviewed (12 × 2 tabletop and rack-mount versions also are available) uses standard XLR microphone connections and ¼-inch tip/ring/sleeve connectors that can be used as balanced or unbalanced line inputs. Channels 1 through 6 are full-featured inputs, while channels 7/8 and 9/10 are shared stereo modules with limited EQ and no XLR connections. The remaining connections (stereo inserts, mix and monitor outputs, etc.) are ¼-inch.

On the six full-featured channels, a single knob does double-duty as the mic/line preamp level control. The EQ section begins with a switchable (on or off), 100 Hz, highpass filter. This filter can be used to reduce low-end rumble, and it's a real treat on an inexpensive mixer. The highpass filter is followed by three bands of EQ—12 kHz (fixed), sweepable mids from 250 Hz to 6 kHz, and 60 Hz (fixed)—each with a boost/cut range of 15 dB. It's an impressive amount of EQ for such a small board.

The Spirit Folio provides two aux sends, one of which can be configured as either pre-fader, or post-fader, with the push of a button. Each input channel and the aux send has a PFL feature. (This "solo" function is *not* solo-in-place; the solo signal will be mono, no matter where the instrument is panned.) You also can change the Folio's line level to be either +4 dBu or -10 dBV, another feature you rarely find on small boards. Global phantom power can be switched on or off.

Product Summary

PRODUCT:
Spirit Folio
PRICE:
10 × 2 $495
12 × 2 $625
MANUFACTURER:
Soundcraft/JBL
8500 Balboa Blvd.
Northridge, CA 91329
tel. (818) 893-4351
fax (818) 893-0358

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

THE GIG TEST

My production partner immediately commandeered the Folio to supplement the 4,000,000-year-old Acoustic P.A. system at his rehearsal studio. We simply plugged the mics into the Folio and routed the mixer's outputs into two channels of the P.A. head, effectively relegating the Acoustic to power-amp service. Everything was set up within minutes, and the sound was absolutely crisp and clear. (It was the first rehearsal in which anybody could hear the vocals, but that's another story.)

Impressed with the Folio's live chops,

The Soundcraft Spirit Folio is a featherweight marvel, stocking many useful features into a compact frame.

I used the board to mix some digital location recordings. I remained extremely impressed. The Folio is clean and punchy, with plenty of headroom. For an inexpensive mixer, the EQ delivered good sound and excellent tone-shaping capability. The 100 Hz roll-off, in particular, was handy when cleaning up muddy signals. I also appreciated the Folio's built-in 1 kHz tone generator. This is yet another uncommon feature for an inexpensive, compact mixer, and it made checking and calibrating recorder playback levels a breeze.

My only complaint—and it's an unrealistic request for a mixer in this price range—is the lack of channel inserts, although there are inserts on the main L/R outputs. Channel inserts would have made live recording even easier by allowing insertion of dynamics processors (typically, compressors and noise gates) to the signal chain. I became so accustomed to the Folio's simplicity and sound quality that I kept wanting the board to do *more*.

CARRY OUT

Grabbing the Folio and flinging it into

a car quickly became an in-house joke. ("Yep, that's my mixing console on the passenger seat.") The Folio is so eminently toss-able—you just toss it in the car, toss it onto a table at the gig or rehearsal, and toss it into a corner at the end of the night—that it's easy to consider it a toy. It's not. The Folio's sound quality and features make it a viable choice for a house or monitor mixer in a small house and as a live or studio keyboard submixer. While it certainly is a conversation piece, the Folio also delivers serious sound.

Circle #440 on Reader Service Card

Sony TCD-D7 Portable DAT

By Daniel Kumin

The one DAT to buy when you're buying more than one.

By now, DAT is far from a novelty. It has become a fundamental tool of virtually all electronic music studios, from hobbyist to pro. It's also pretty much the *de facto* standard for mastering, referencing, and demo-ing recordings.

Sony's TCD-D7 is a simple, compact, full-performance, mini DAT recorder that makes an ideal multipurpose second DAT or, in a pinch, a useful main mastering/archiving deck. The D7 is almost exactly the size of an analog cassette Walkman from a few years back: It's roughly 5 × 4 × 1½ inches and weighs just over a pound, yet it offers full digital-audio performance and the most important DAT features.

LAY OF THE LAND

The main control surface is on the top, with full transport controls and a compact LCD display. The front edge offers volume up/down buttons (pots are too bulky for the intensely miniaturized D7) and switches for the various modes. The right end supplies mic and line mini-phone input jacks, a line/headphone output jack, a record-level knob, and a mic-sensitivity switch. All the inputs and outputs are stereo, and the mic jack supplies non-standard phantom power for compatible Sony mini mics. The opposite end holds a specialized, 7-pin mini-jack for an optional, optical, digital input/output connecting cable ($79.95). Alternatively, a coaxial, digital input-only cable ($59.95) uses the same port. You'll probably need one or the other, as the D7 includes no standard digital I/O ports.

The Sony TCD-D7 portable DAT packs impressive audio quality into a tiny, inexpensive package.

In fact, Sony's principle method of cost-saving in the D7 design is just this sort of accessorizing. The unit runs on four AA batteries loaded into a removable holder on the back; an AC adapter ($34.95) is optional. (A multivoltage AC pack is a whopping $119.95.) There's also a 12-volt adapter for automotive use ($39.95). Sony claims the D7 has about 3.5 hours of battery life in playback with alkaline cells, and up to four hours in Record if you don't monitor over headphones. I found these numbers only slightly optimistic: With fresh alkaline AA batteries I got nearly three hours of playback, including a typical amount of track-seeking and rewinding.

Another important option is the RM-D3K ($169.95), which provides wireless remote facilities, standard coax digital I/O, and a control for unattended recording and/or playback. The RM-TD7 ($79.95), which offers wired-remote, transport-mode LEDs, volume, and 2-speed cue controls, is ideal for studio use. Importantly, both permit rewriting and erasing of Start-ID codes and adding them during playback. Out of the box, the D7 lets you write IDs manually in record (automatically while dubbing), but you cannot delete, add, or renumber IDs.

The D7 is easy enough to use, though its controls are small and somewhat cramped. The deck sets no records in fast-winding—a DAT-90 tape took a minute end-to-end—but the transport keys work positively and relatively quickly. ID seeking was fast and sure, and there's a 2-speed audible cue/review. The display is fussy and small, but well laid-out. It includes a 2-channel, 11-segment, 50 dB-scale, input-level meter; 4-segment battery meter; and several numerics and indicators. The window is tough to read in dim light, but you can use its blue backlight. This feature makes a large difference in legibility, but cuts battery life significantly. Interestingly, the D7 never shuts off; there's no power switch. Instead, after a few minutes in unattended Pause or Stop, the tape automatically unwraps, and the backlight, if on, turns off.

JAPANESE AUDIO KNIFE

The D7's multifunction nature is borne out by its several record modes. In addition to normal DAT record/playback it also offers the little-known DAT LP mode: 32 kHz, adaptive PCM, with doubled record time (four hours on standard 120 minute tapes) and surprising fidelity. It's perfect for recording meetings, interviews (there's an automatic recording time/date-stamping routine for these), or for archiving those old Buddy Holly LPs. I challenge anyone to tell the difference on such material. The unit features defeatable automatic mic gain, with two modes (Music and Speech) for idiot-proof recording.

Product Summary

PRODUCT:
TCD-D7 DAT Walkman
PRICE:
$629.95
MANUFACTURER:
Sony Corporation
1 Sony Dr.
Park Ridge, NJ 07056
tel. (201) 930-1000

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

Both modes work reasonably well. There's also an automatic level-limiting function for headphone volume, which presumably extends battery life somewhat.

In its normal SP mode, the D7 records at DAT-standard 48 kHz when sampling from its analog inputs. With the digital input, it automatically clones the sampling frequency of the source (48, 44.1, or 32 kHz). It includes the SCMS copy-inhibit scheme, so only first-generation, digital-to-digital copies are possible.

Sonically, the D7, which uses 1-bit A/D and D/A converters, stands up amazingly when measured against full-sized decks, supporting its fine specs (a frequency response of 20 Hz to 22 kHz, ±1 dB; >90 dB dynamic range; and .008% THD at 1 kHz). I made several reference recordings, including CD dubs and multitrack mixes, on the D7 and my full-sized, JVC studio DAT and was impressed by the lack of distinguishing audio artifacts between the two machines. The D7's analog input tracks were just a hair noisier than my studio DAT's and seemed slightly restricted spatially, front-to-back, but that was pretty much it. There's nothing that would discourage me from mastering a high-end demo or a serious reference on the little Sony.

With $200 worth of accessories, the D7 can make a functional, if ergonomically delicate, primary DAT for a small studio, one that can also slip into a vest pocket for trips to another studio, sample-acquisition, recreational travel, or what have you. (The D7's alloy-resin chassis and simple leather case seem roadworthy enough, though not like using a hardshell case.)

As a second deck for tape-dubbing and portable use, it's a steal. At a street price of well under $600 for the deck and little more than $700 for a fully functional package, it's an attractive mini and will fit in my Christmas stocking, no problem.

Composer/writer **Daniel Kumin** *covers consumer and pro audio and video for numerous magazines.*

Circle #441 on Reader Service Card

Hughes & Kettner Tubeman Preamp

By Peter McConnell

Ultra-clean, multipurpose, tube distortion.

If the name Tubeman suggests an inexpensive, compact guitar box that allows you to carry your sound in your pocket, you're partially right. At $299, Hughes & Kettner Tubeman is reasonably priced, and it produces great tube sounds, with virtually no noise, in a small, portable package. But you will get the most out of this technically immaculate little preamp if you bear in mind that it is not a jack-of-all-trades, but a tube-distortion specialist.

The Tubeman preamp looks like a slightly oversized stomp box, with gain and master volume controls; a voicing

control that switches between Rock, Blues, Funk, and Jazz circuits; and Bass, Mid, and Treble post-gain tone controls. A Mid Boost switch gives you a beefier tone by boosting a large band above 300 Hz and rolling off above 2 kHz. A stomp switch puts the Tubeman in true hardware bypass. The unit is powered by an external power supply.

MORE OUTPUT

All this seems pretty normal until you look at the back of the unit and find an instrument input and not one, but three separate outputs for a power amp, guitar amp, and mixer. This variety of outputs makes the Tubeman not merely a stomp box, but a multipurpose tool for adding tube distortion in a variety of different situations.

Most people will use the Guitar Amp output first, putting the Tubeman between instrument and amp to add an extra level of distortion during solos. The Guitar Amp output is quite bright, but slightly rolled off at the high end to provide the type of input signal most guitar amps are designed to accept. The unit's tone controls won't diminish the sound's brightness as much as you might think, though. The idea here seems to be that it gives you all the rip and crunch you will ever need and lets you roll it off in your guitar amp, if necessary.

The Mixer output mimics the sound of a closed-back, 4 × 12, Celestion-loaded speaker cabinet for recording directly into a console. As you might expect, the Mixer output has a mellower sound than the Guitar Amp out. Keep in mind, however, that the Bypass switch only passes the dry instrument signal through to the Guitar Amp output; using the Mixer or Power Amp output means always having the Tubeman active in the circuit.

I found the Power Amp output the least useful because it is *extremely* bright. It's meant for power amps driving cabinets with 12-inch woofers and no tweeters, or to go to an existing amp head with a line input or effects return. If you have a full-range speaker system, the sound is too harsh.

Hughes & Kettner's Tubeman preamp produces ultra-clean tube sounds, with separate outputs for a power amp, guitar amp, and mixer. The versatile stompbox lets you select between Rock, Blues, Funk, and Jazz circuits and apply bass, mid, and treble EQ.

IMMACULATE DISTORTION

The Tubeman really shines when you use it with the Mixer output in a recording situation. Every sound it delivers, from Funk and Jazz to the most distorted Rock setting, is done with *absolutely no noise*. It is so clean I was able to use it as a vocal effect for recording, mixing in just a little of the slightly distorted Jazz sound to give vocals an Exciter-like sizzle.

The Rock setting has a powerfully ripping distortion that ranges between modern metal and classic Marshall-style sounds. The Blues sound is punchy and warmer, and the Jazz and Funk settings are incredibly clean. There are large level differences between the different tube voicings, though, and the Rock setting is particularly loud. As a result, the Tubeman is a set-it-and-leave-it box. It is simply not practical to switch often between voicings during a performance—not even between songs, for that matter—because you will have to reset your gain and master controls from scratch.

My one complaint is that it is difficult to get extremely warm and bassy sounds without top end. But as I noted earlier, Hughes & Kettner's Tubeman is a specialist. What it does, it does very well, with quality unmatched by anything near its price.

Peter McConnell *is a music-a-holic who lives in Berkeley, California. When he isn't composing and designing music software for LucasArts Games, he sings and plays electric violin and guitar in the Bay Area band Lotus Eaters.*

Circle #442 on Reader Service Card

Product Summary

PRODUCT:
Tubeman Guitar Preamplifier
PRICE:
$299
MANUFACTURER:
Hughes & Kettner, Inc.
35 Summit Ave.
Chadds Ford, PA 19317
tel. (215) 558-0345
fax (215) 558-0342

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

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PRO FILE

The Heart of Mann

Sensitive miking showcases an emotional chanteuse.

By Daniel Levitin

Regular readers of **EM** know that these pages are filled with tips and tricks for enhancing average, and below-average, recording efforts. But what's the best way to record a great performer?

The simple answer is: Stay out of the way. The type of microphones you use, or where you place them, is not nearly as important as the quality of the sound emanating from the source. For example, the vocal timbre on Aimee Mann's new solo release *Whatever* is a testament to minimalist engineering. The former 'Til Tuesday vocalist didn't need massive signal processing to produce the kind of evocative vocal tone that stands out over dense musical arrangements.

"The quality of Aimee's voice is such that, if you stand right in front of it, it sounds amazing, " explains Jon Brion, Mann's songwriting partner and one of the producers on *Whatever*. "Some people just have 'mic friendly' voices. The more I hear her voice, the more impressed I am by it. I think it has to do with the fact that she has so many vocal nuances to capture."

Mann's voice projects a great deal of melodic intricacy and spans the gamut of emotions. Capturing those nuances on tape required extremely subtle recording techniques. "I sang very soft, and we used lots of tube compression," says Mann. "Also, we instructed [mixer] Bob Clearmountain to mix everything really, really dry to maintain an intimate quality."

The combination of a quiet, controlled vocal performance, maximum compression (to ensure that soft passages are audible), and a dry mix brings intimacy and power to a track. It almost seems like the singer is whispering the song right into your ear. This technique has been exploited most famously by the Beatles, Elvis Costello, and the Pretenders.

The result is that on the loudest cuts, such as "I Should've Known," Mann's voice rides effortlessly above the brash electric track; none of the subtleties of her vocal performance are covered up by the band. In the softer and more sensitive moments on the album, such as in "Jacob Marley's Chain" and the baroque "Mr. Harris," the unprocessed warmth and richness of her voice is each track's tonal center.

For most of the vocal tracks, a tube mic was routed through Focusrite or Hardy preamps, into a Pultec EQ, and then to a modified UREI LA 3A compressor.

"At Bearsville studios, [engineer] Rhett Davies used their Neumann M49. It's an unbelieveable mic for my vocals," Mann recalls. "At other studios we used either a Neumann U49 or U67. Except on 'I Could Hurt You Now' I used an AKG C24; it's a stereo version of their C12, and I really preferred its sound for that particular song."

Even if you're fortunate enough to have an arsenal of pro gear at your disposal, it won't do you much good if you can't discern when *not* to use it. The art of recording a great vocal perfomance lies in allowing the heart of the singer to reach the listener's ears with the least interference.

A former producer and engineer, **Daniel Levitin** *is a researcher at the Institute for Cognitive and Decision Sciences at the University of Oregon.*

Aimee Mann

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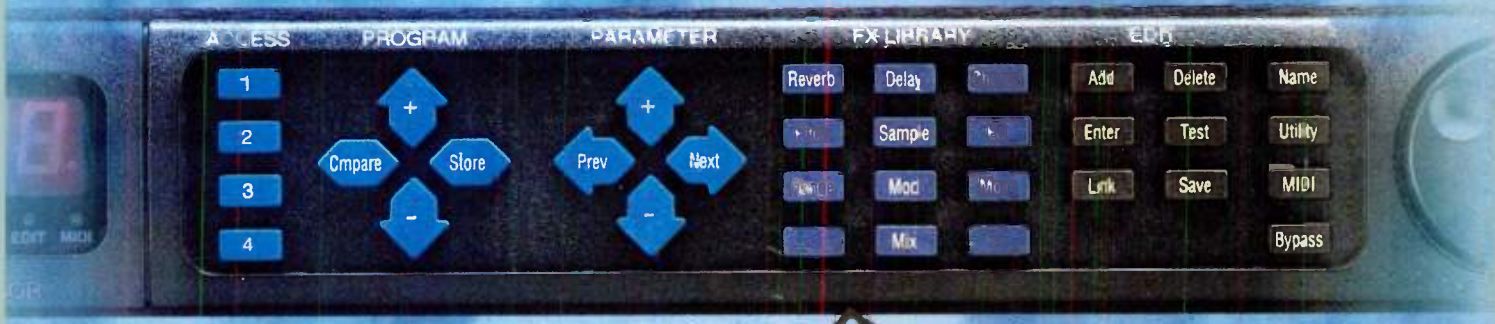

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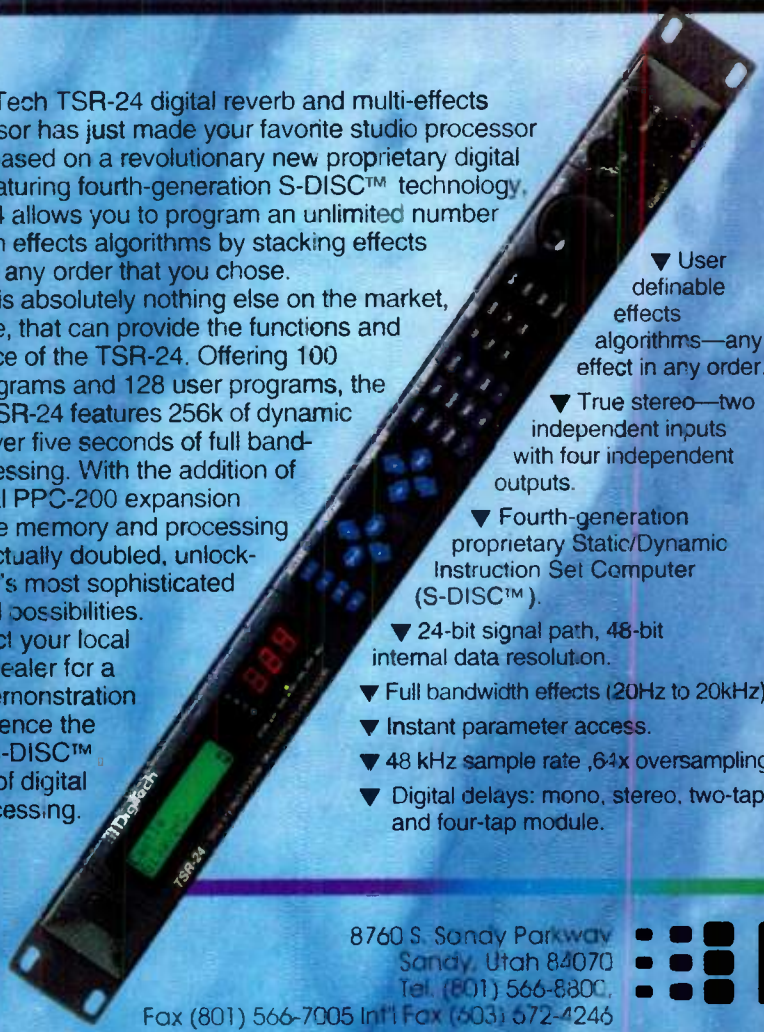

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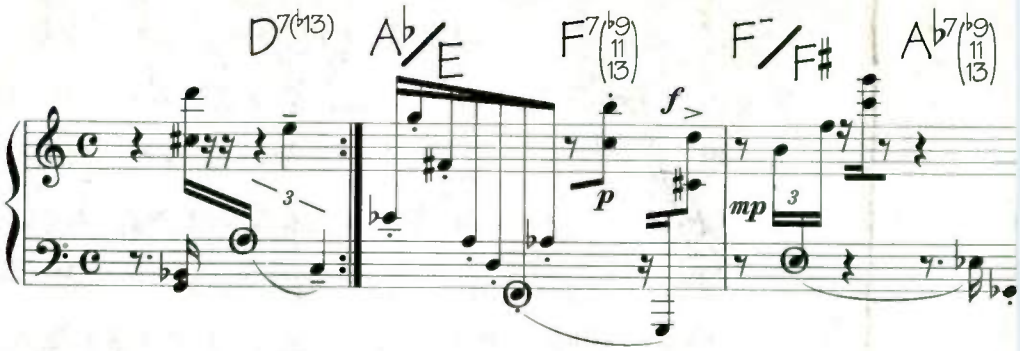

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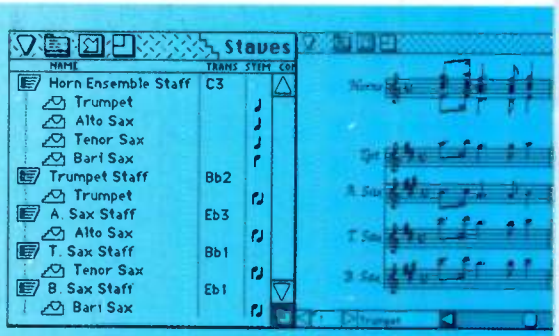

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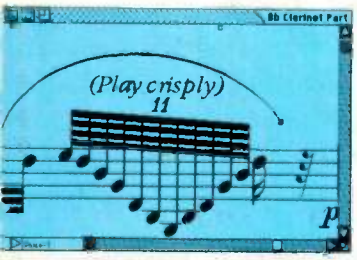

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